Architecture Construction Engineering

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PROJEKTO PAVADINIMAS:	**Administracinės paskirties pastatas, Kelmės g. 7A, Tytuvėnai, Kelmės r. sav. statybos projektas**
ADRESAS:	**Kelmės g. 7A, Tytuvėnai, Kelmės r. sav.**
SKLYPO KADASTRINIS NR.:	**5472/0001:14**
UŽSAKOVAS:	**Kelmės rajono savivaldybės administracija**
STATINIO KATEGORIJA:	**Ypatingasis statinys**
STATYBOS RŪŠIS:	**Nauja statyba**
STATINIO NAUDOJIMO PASKIRTIS:	**Administracinės paskirties**
PROJEKTAVIMO DARBŲ STADIJA:	**Techninis darbo projektas**
PROJEKTO DALIS	**Konstrukcijų. Sprendinių detalieji skaičiavimai**
LAIDA	**0**
BYLA:	**IN2502-01-TDP-SK-S**

Direktorius		Marius Matuliukštis
AV.	Parašas	
PV		Jolanta Stefanovič KA Nr. 2232
	Parašas	
PDV.		Margarita Čekalina KA Nr. 40628
	Parašas	

2025 m.

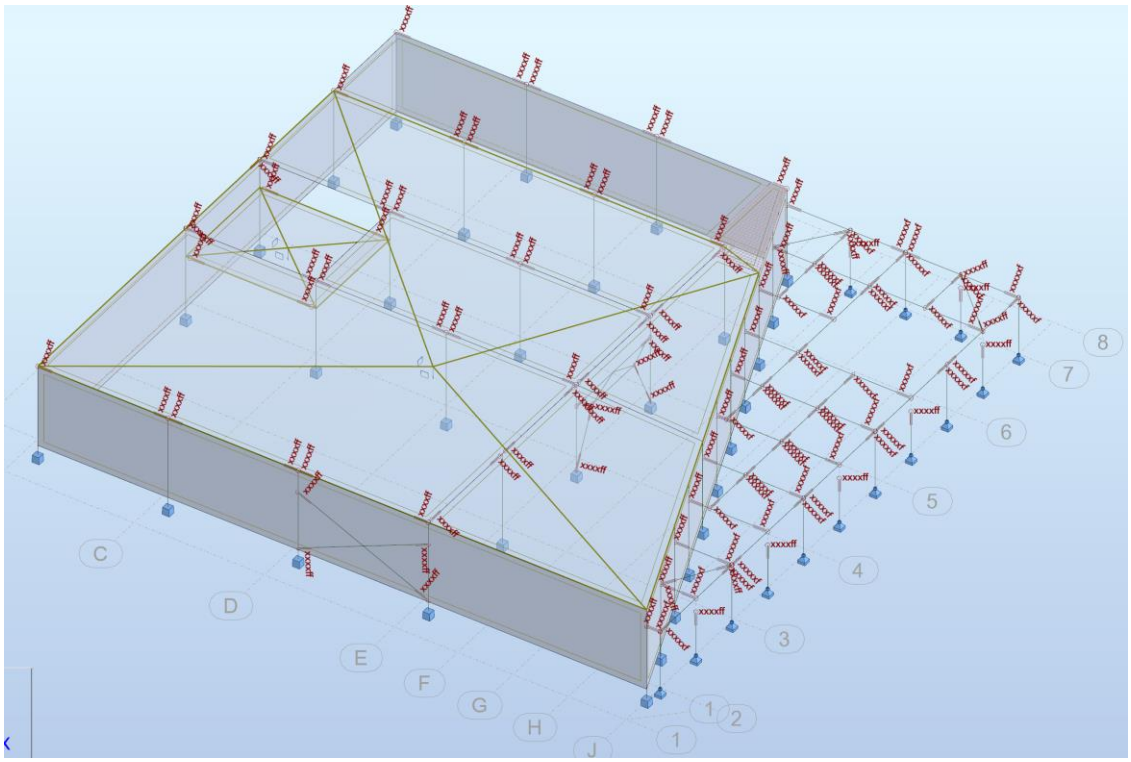
PROJEKTO SUDĖTIES ŽINIARAŠTIS		
Eil. Nr.	**Projekto dalies pavadinimas**	**Raidinis ž…**
1.	Bendroji	BD
2.	Sklypo sutvarkymo (sklypo planas)	SP
3.	Architektūros (statinio architektūra)	SA
4.	Konstrukcijų (statinio konstrukcijos)	SK
5.	Vandentiekio ir nuotekų šalinimo	VN
6.	Šildymo, vėdinimo ir oro kondicionavimo	ŠVOK
7.	Elektrotechnikos (lauko ir vidaus)	E
8.	Elektroninių ryšių (telekomunikacijos) (lauko ir vidaus)	ER
9.	Apsauginės signalizacijos	AS
10.	Gaisrinės signalizacijos	GSS
11.	Procesų valdymo ir automatizacijos	PVA
12.	Šilumos gamybos ir tiekimo	ŠTG
13.	Gaisrinės saugos	GS
14.	Pasirengimo statybai ir statybos darbų organizavimo	SO
15.	Statybos skaičiuojamosios kainos nustatymo	KS

PROJEKTO DALIES BYLŲ (SEGTUVŲ) SUDĖTIES ŽINIARAŠTIS				
Eil. Nr.	Bylos (segtuvo) žymuo	Laida	Pavadinimas	Pastabos
1.	IN2502-01-TDP-SK	0	Konstrukcijų (statinio konstrukcijos)	
3.	**IN2502-01-TDP-SK-S**	**0**	**Konstrukcijų. Sprendinių detalieji skaičiavimai**	

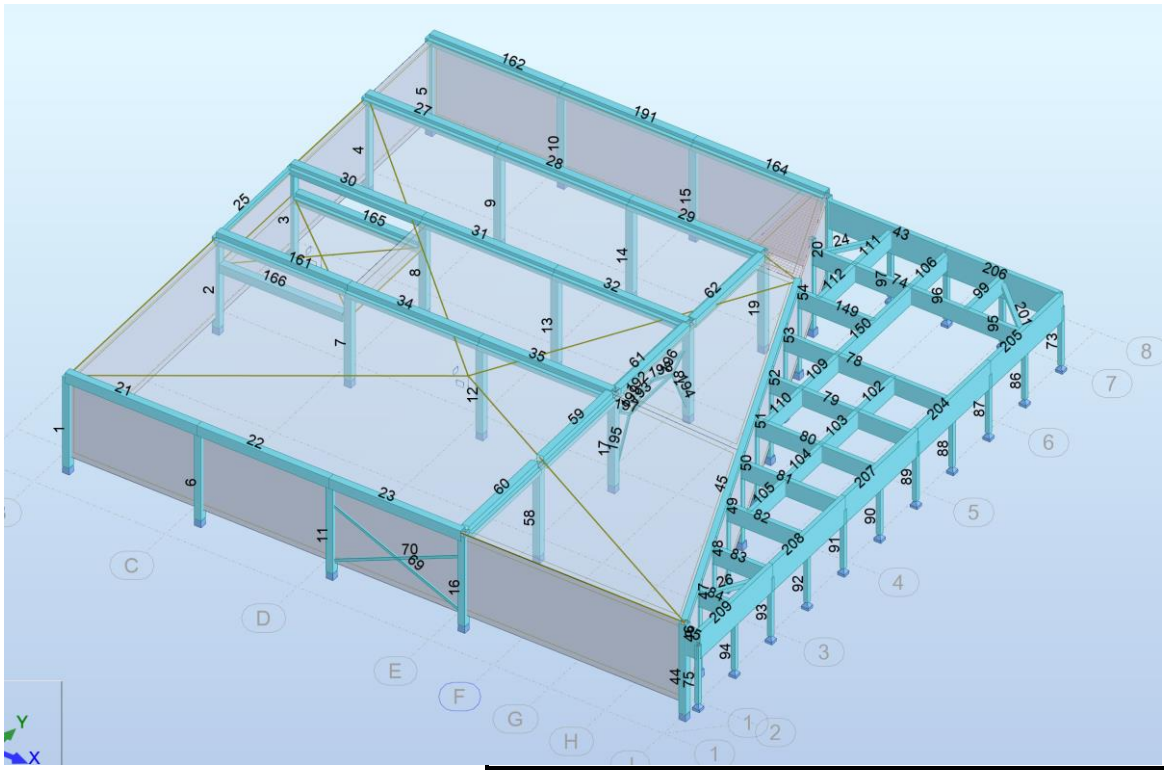
2. KONSTRUKCIJŲ SKAIČIAVIMAS

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

Pastato diskretinis modelis:

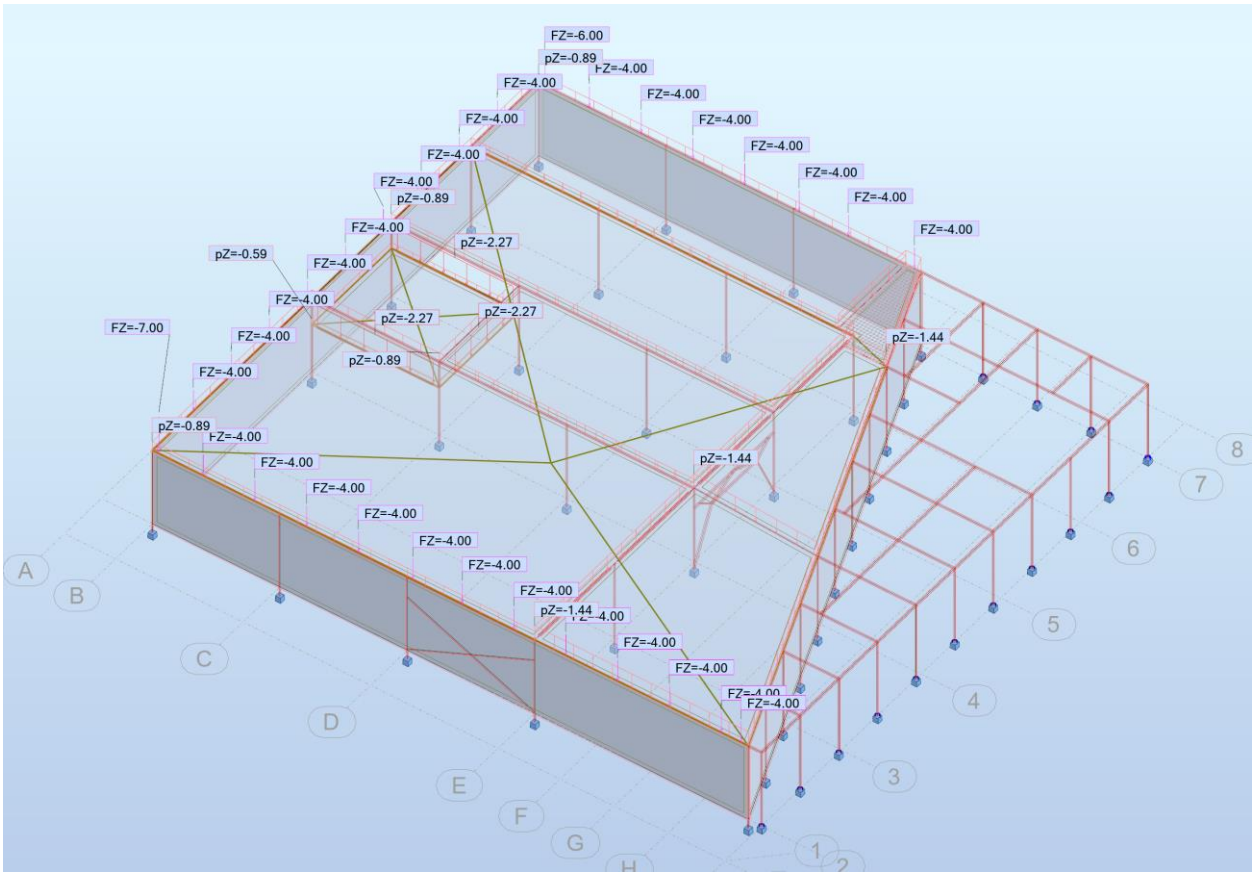


Elementų numeracija skaičiuojamojoje schemoje:

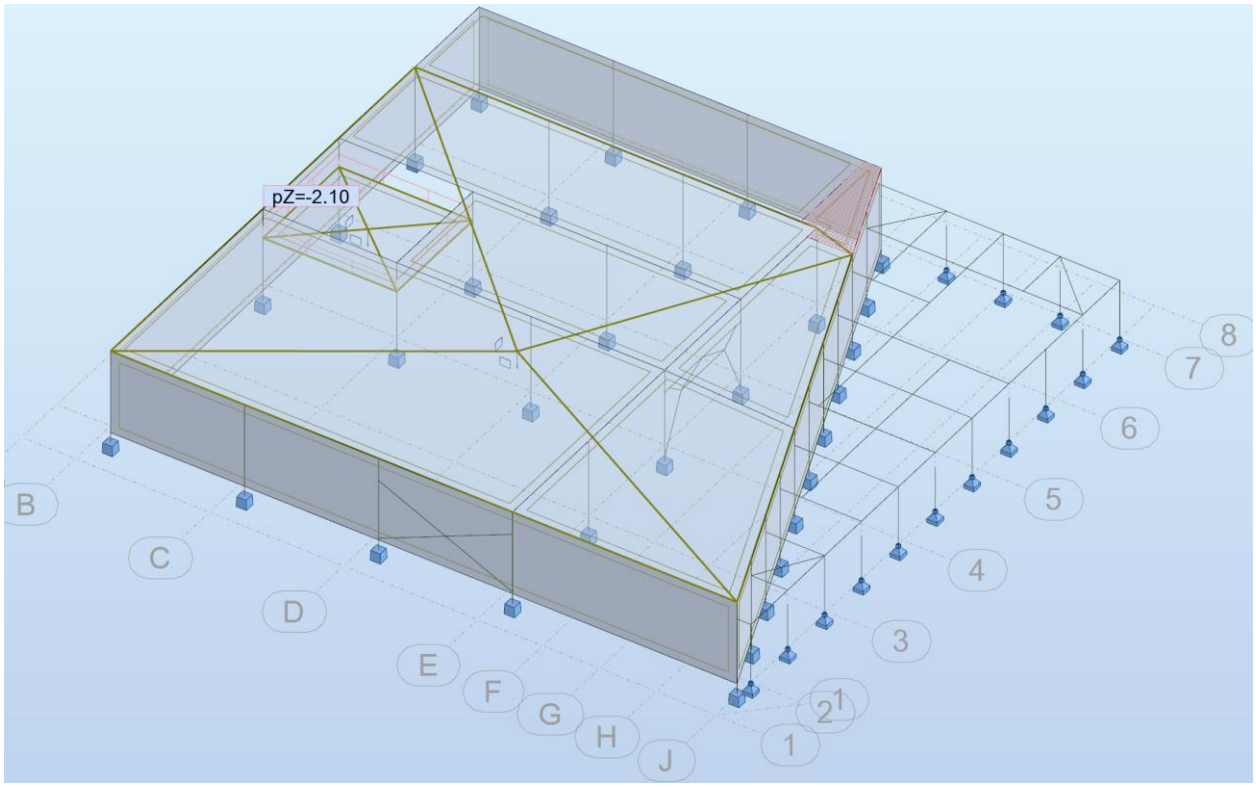


Veikiančios apkrovos.

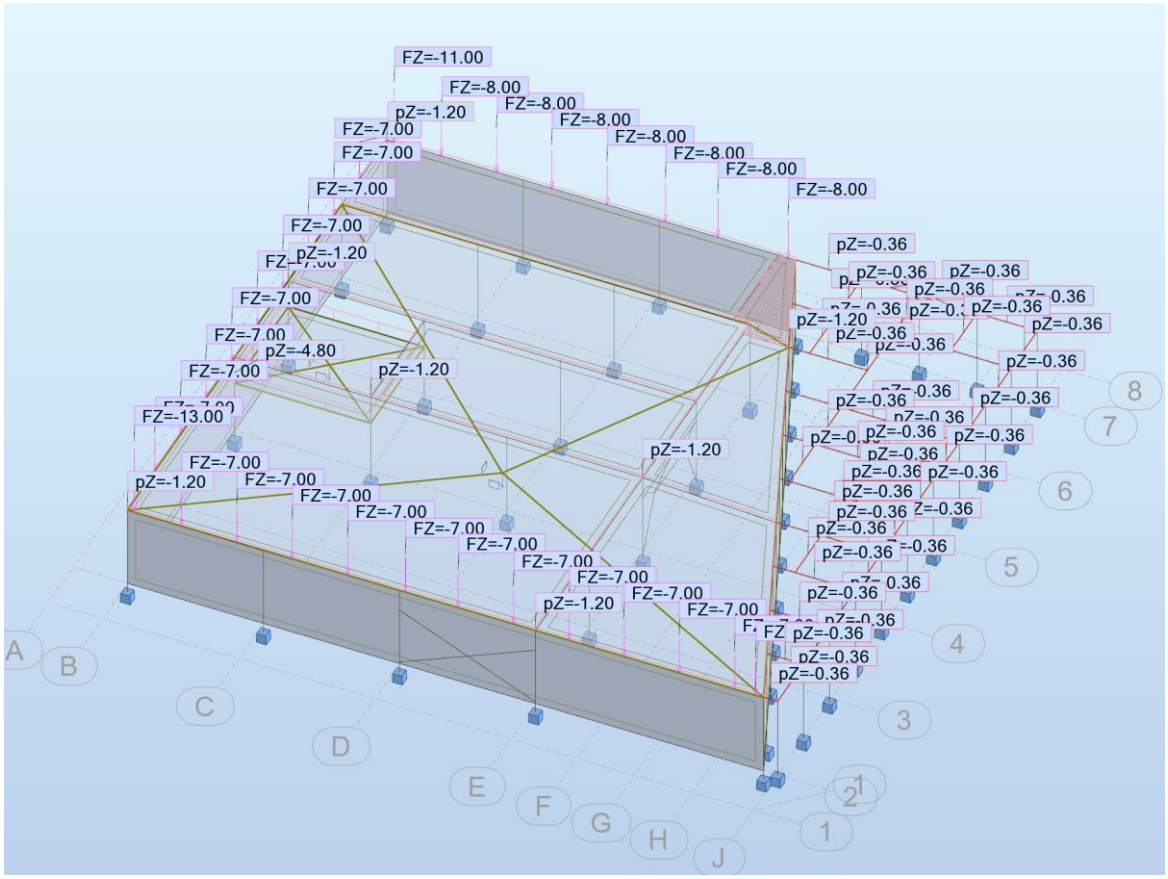
Nuolatinės apkrovos:



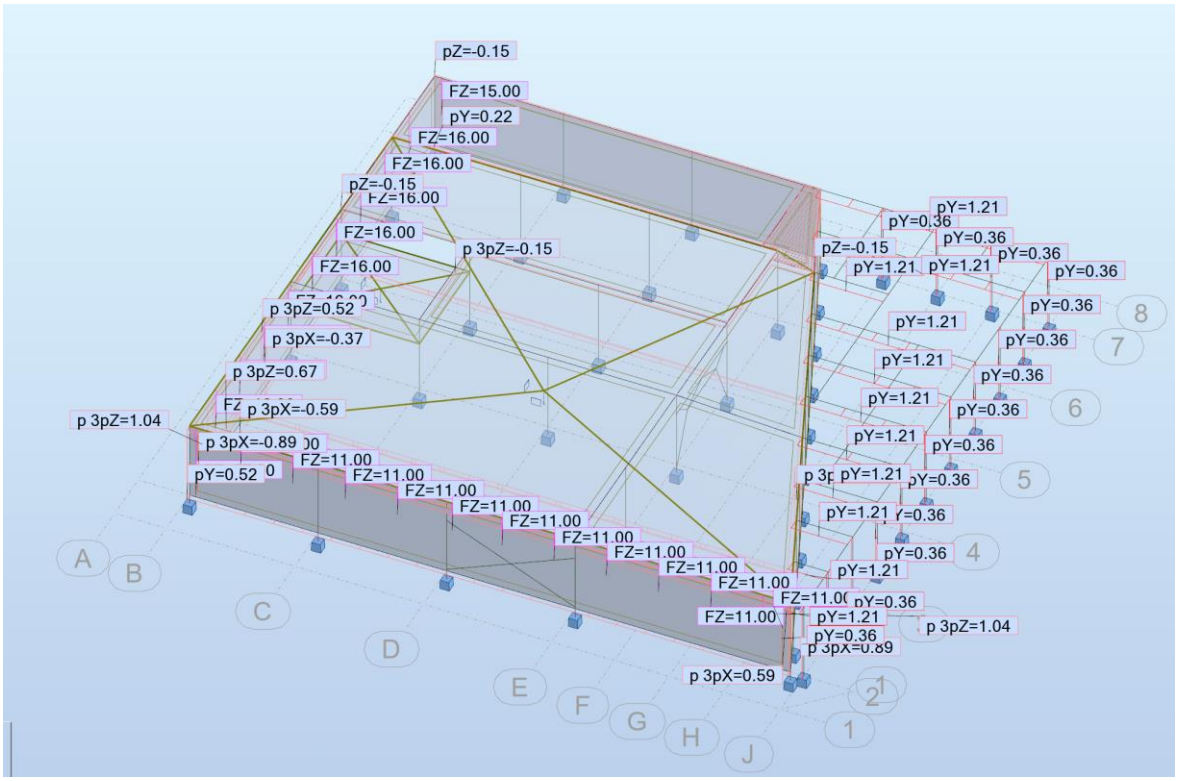
Naudojimo apkrovos nuo įrangos:



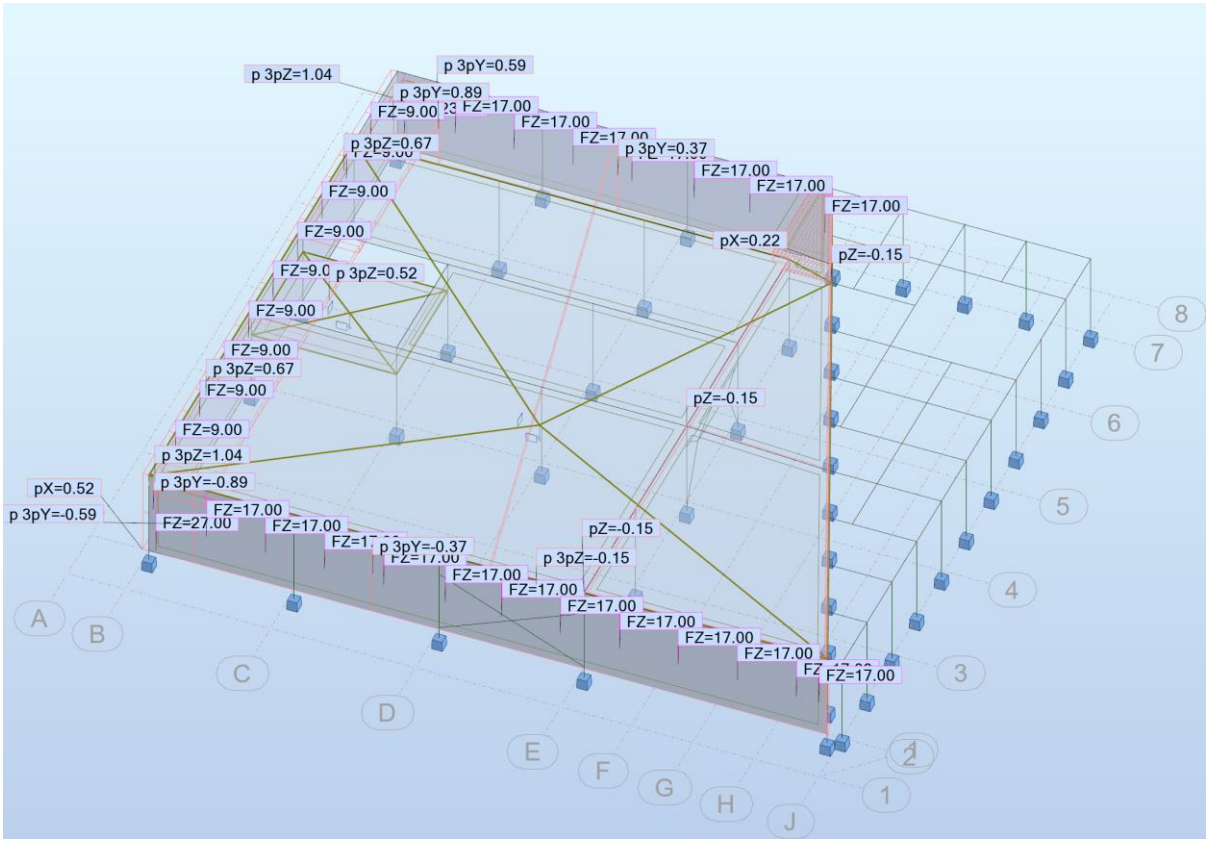
Sniego apkrovos:



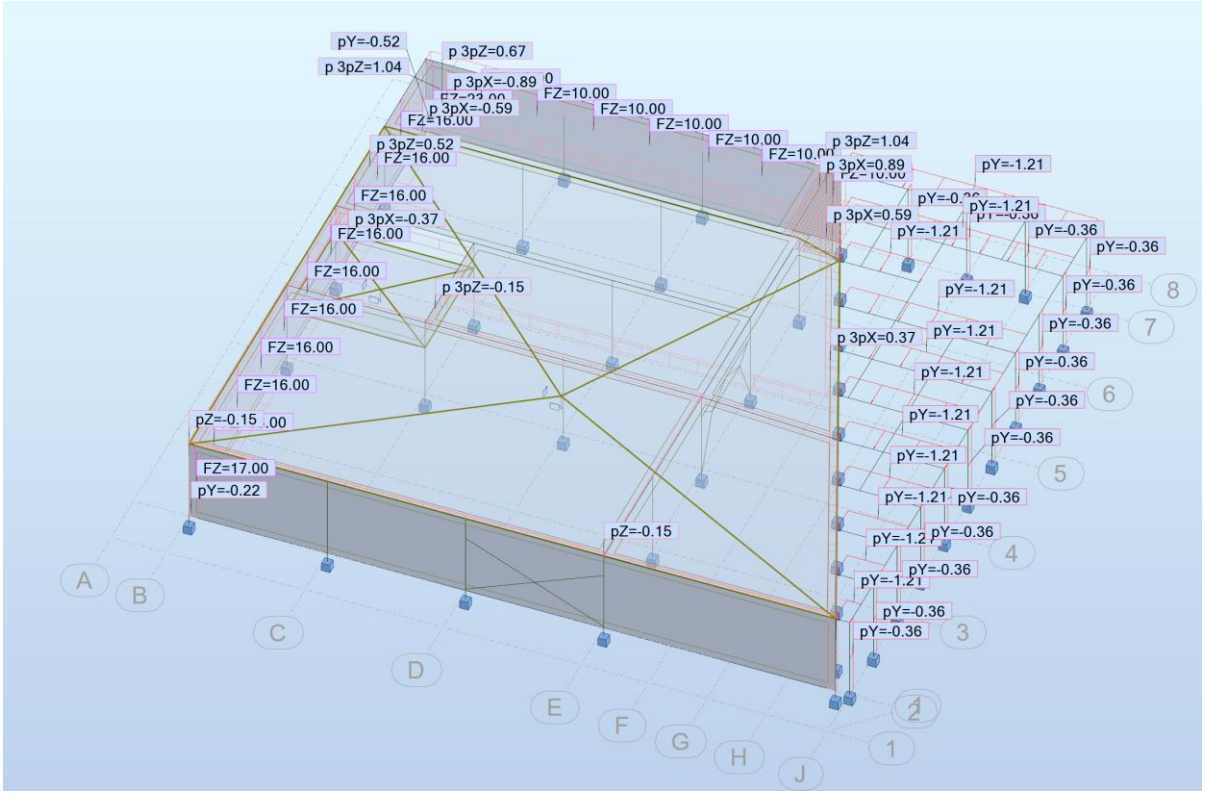
Wind 1 apkrovos:



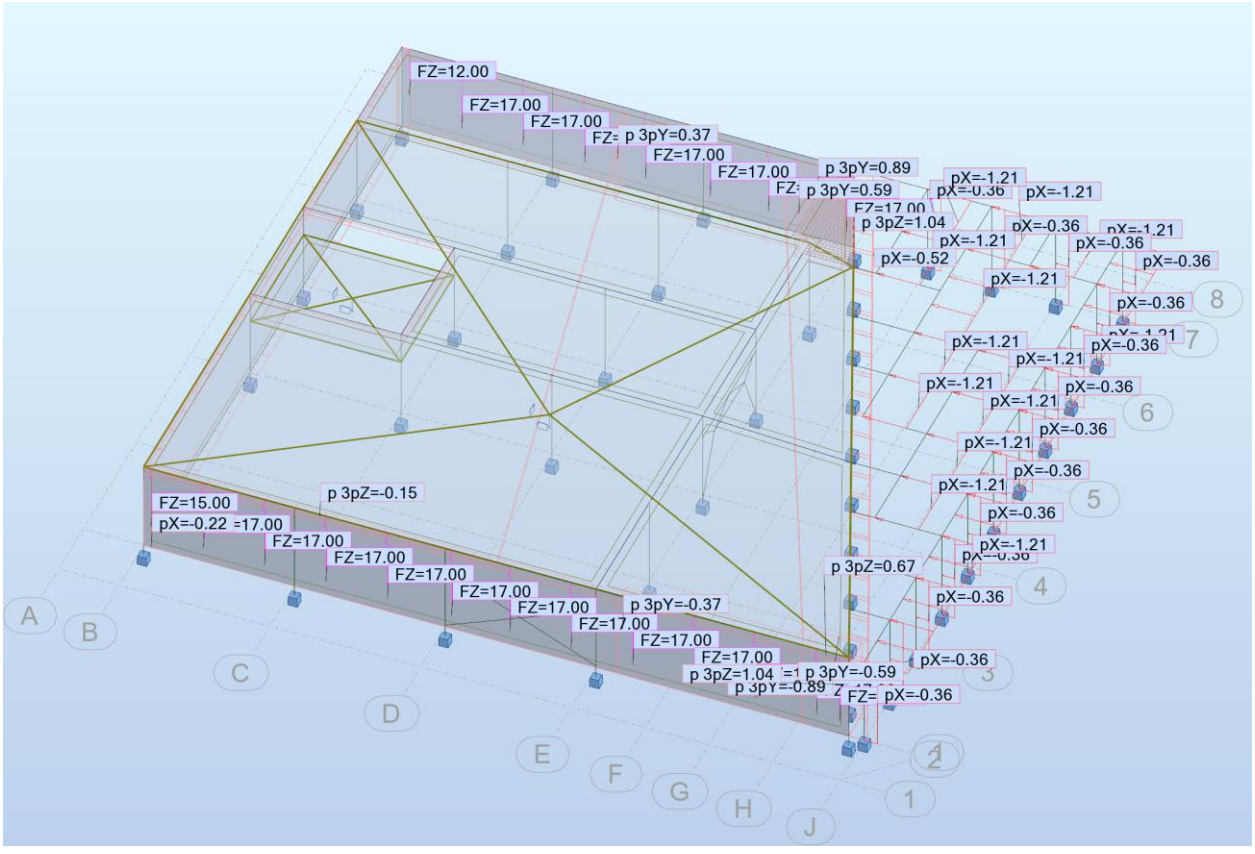
Wind 2 apkrovos:



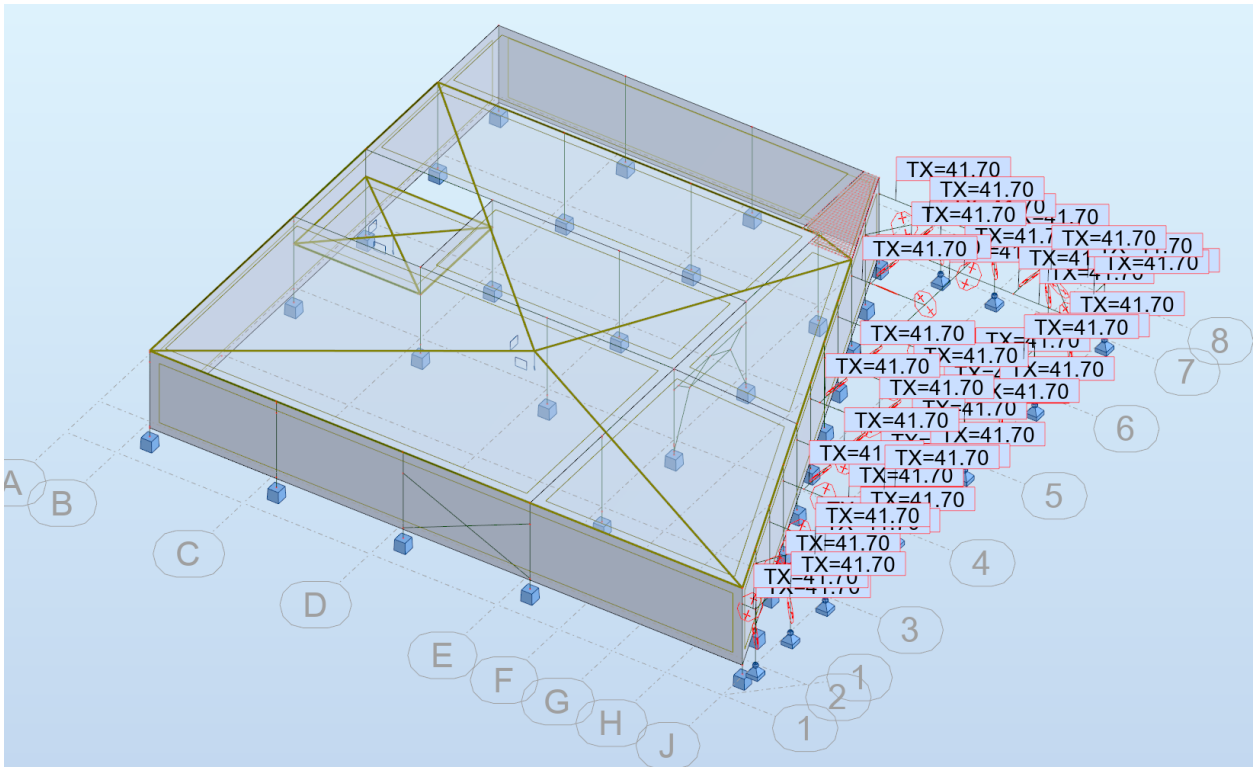
Wind 3 apkrovos:



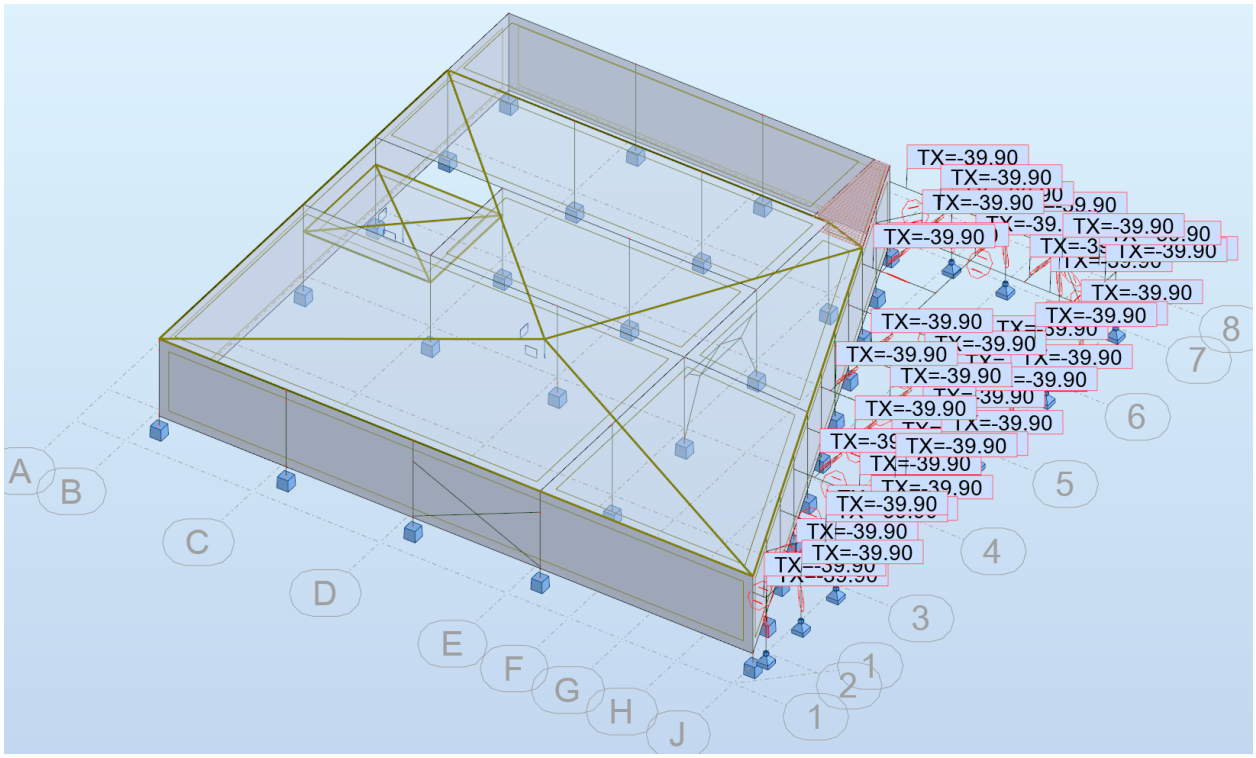
Wind 4 apkrovos:



Temeratūrinės apkrovos vasarą:



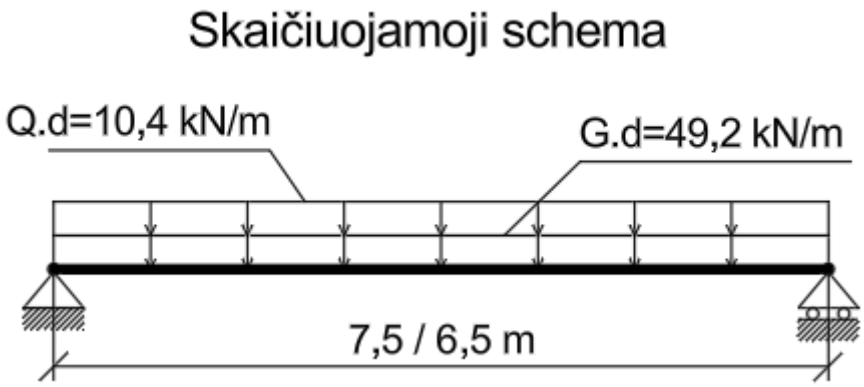
Temeratūrinės apkrovos žiemą:

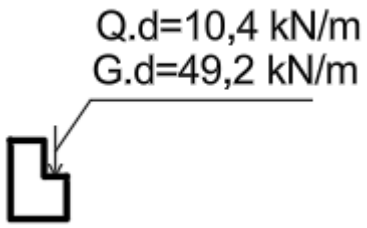


2.1. Rygelių projektavimas

Projektuojami surenkami g/b rygeliai. Rygelių geometrija parenkama pagal gamintojų katalogus. Rygelių tikslius skaičiavimus pateikia gamintojas. Maksimalus plyšių atsivėrimo plotis 0,3mm.

RL Rygelių ant 2 ir E ašies skaičiuojamoji schema:

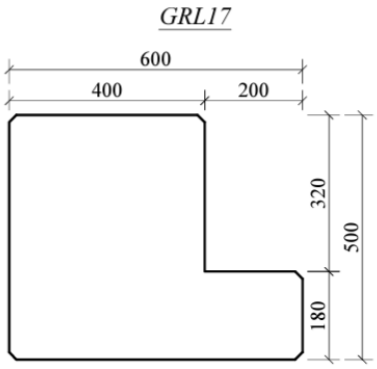




Pagal gkg3 RL rygelių laikomosios galios lentelę veikiant skaičiuojamosioms apkrovoms 600x500 rygelio skerspjūvis gali būti iki 8,17m ilgio.

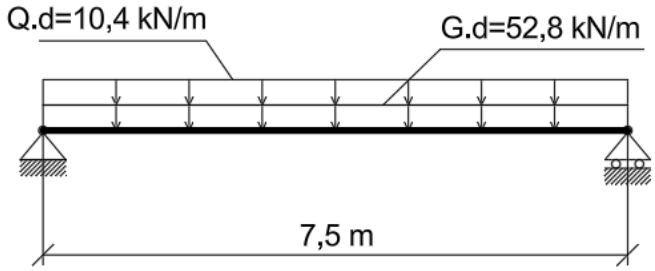
Sija	$b_{pl} \times h(h_{pl})$	Skaičiuoti							
		30	40	50	60	70	80	90	1
		Didžiau							
GRL01	500x400(220)	7.80	6.97	6.34	5.95	5.64	5.37	-	-
GRL2	500x500(220)	9.32	8.38	7.80	7.34	6.96	6.64	6.26	5
GRL3	500x500(265)	9.40	8.40	7.81	7.35	6.97	6.64	6.29	5
GRL4	500x500(320)	9.54	8.44	7.84	7.37	6.98	6.65	6.30	5
GRL5	500x600(220)	11.07	9.93	9.27	8.73	8.28	7.91	7.50	7.
GRL6	500x600(265)	11.11	9.96	9.28	8.74	8.29	7.92	7.50	7.
GRL7	500x600(320)	11.22	9.98	9.30	8.76	8.31	7.93	7.55	7.
GRL8	500x700(220)	13.37	11.96	10.92	10.12	9.57	9.15	8.78	8.
GRL9	500x700(265)	13.38	11.97	10.92	10.11	9.58	9.15	8.79	8.
GRL10	500x700(320)	13.46	12.02	10.97	10.15	9.59	9.17	8.80	8
GRL11	500x800(220)	14.61	13.12	12.02	11.32	10.79	10.33	9.94	9.
GRL12	500x800(265)	14.60	13.11	12.00	11.34	10.80	10.34	9.94	9.
GRL13	500x800(320)	14.64	13.13	12.01	11.35	10.82	10.36	9.96	9.
GRL14	600x400(220)	9.00	7.97	7.23	6.67	6.24	5.97	5.72	5
GRL15	600x500(220)	10.84	9.66	8.79	8.13	7.67	7.32	7.02	6
GRL16	600x500(265)	10.84	9.66	8.79	8.13	7.67	7.32	7.02	6
GRL17	600x500(320)	10.92	9.72	8.85	8.17	7.67	7.33	7.03	6
GRL18	600x600(220)	13.08	11.71	10.70	9.92	9.28	8.79	8.47	8.
GRL19	600x600(265)	13.13	11.75	10.73	9.94	9.30	8.79	8.48	8.
GRL20	600x600(320)	13.16	11.84	10.81	10.00	9.36	8.84	8.49	8.
GRL21	600x700(220)	14.98	13.48	12.35	11.47	10.75	10.16	9.73	9.
GRL22	600x700(265)	15.00	13.49	12.36	11.48	10.76	10.16	9.74	9.
GRL23	600x700(320)	15.00	13.56	12.41	11.52	10.79	10.19	9.75	9.
GRL24	600x800(220)	16.91	15.33	14.09	13.12	12.32	11.65	11.07	10.
GRL25	600x800(265)	16.85	15.33	14.09	13.10	12.30	11.63	11.06	10.

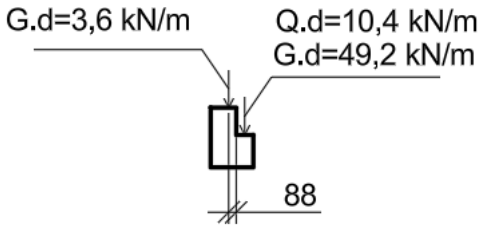
Pasirinkto rygelio geometrija:



Išvada: 500mm aukščio rygelio laikomoji galia pakankama

RL Rygelio ant 4 ašies tarp C-B skaičiuojamoji schema:

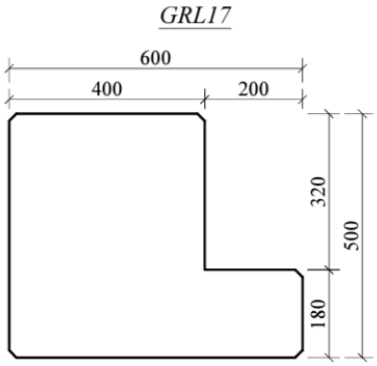




Pagal gkg3 RL rygelių laikomosios galios lentelę veikiant skaičiuojamosioms apkrovoms 600x500 rygelio skerspjūvis gali būti iki 8,17m ilgio.

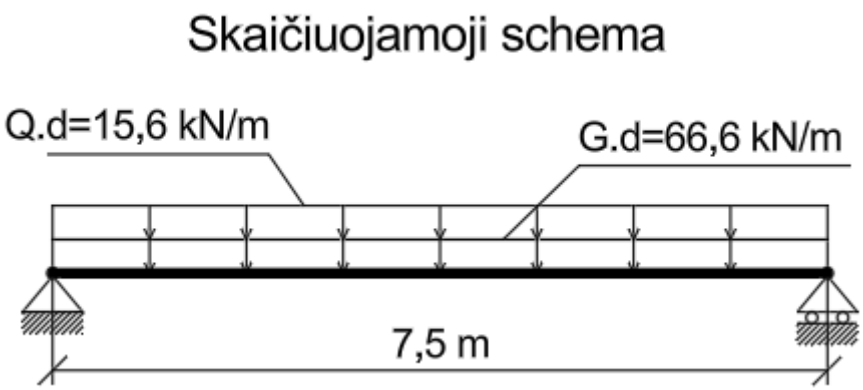
Sija	b_{fl} x $h(h_{pl})$	S					
		30	40	50	60	70	80
GRL01	500x400(220)	7.80	6.97	6.34	5.95	5.64	5.37
GRL2	500x500(220)	9.32	8.38	7.80	7.34	6.96	6.64
GRL3	500x500(265)	9.40	8.40	7.81	7.35	6.97	6.64
GRL4	500x500(320)	9.54	8.44	7.84	7.37	6.98	6.65
GRL5	500x600(220)	11.07	9.93	9.27	8.73	8.28	7.91
GRL6	500x600(265)	11.11	9.96	9.28	8.74	8.29	7.92
GRL7	500x600(320)	11.22	9.98	9.30	8.76	8.31	7.93
GRL8	500x700(220)	13.37	11.96	10.92	10.12	9.57	9.15
GRL9	500x700(265)	13.38	11.97	10.92	10.11	9.58	9.15
GRL10	500x700(320)	13.46	12.02	10.97	10.15	9.59	9.17
GRL11	500x800(220)	14.61	13.12	12.02	11.32	10.79	10.33
GRL12	500x800(265)	14.60	13.11	12.00	11.34	10.80	10.34
GRL13	500x800(320)	14.64	13.13	12.01	11.35	10.82	10.36
GRL14	600x400(220)	9.00	7.97	7.23	6.67	6.24	5.97
GRL15	600x500(220)	10.84	9.66	8.79	8.13	7.67	7.32
GRL16	600x500(265)	10.84	9.66	8.79	8.13	7.67	7.32
GRL17	600x500(320)	10.92	9.72	8.85	8.17	7.67	7.33
GRL18	600x600(220)	13.08	11.71	10.70	9.92	9.28	8.79
GRL19	600x600(265)	13.13	11.75	10.73	9.94	9.30	8.79

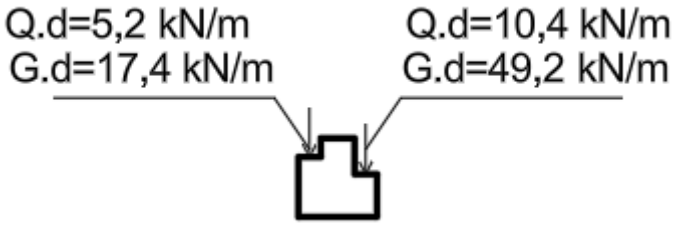
Pasirinkto rygelio geometrija:



Išvada: 500mm aukščio rygelio laikomoji galia pakankama

RT Rygelių ant 4 ašies skaičiuojamoji schema:



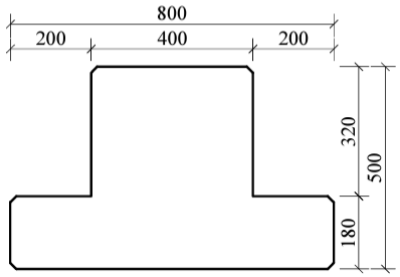


Pagal gkg3 RT rygelių laikomosios galios lentelę veikiant skaičiuojamosioms apkrovoms 800x500 rygelio skerspjūvis gali būti iki 7,70m ilgio.

Sija	$b_{ji} x\ h(h_{pi})$	Skaičiuotinė								
		30	40	50	60	70	80	90	100	1.
		Didžiausia								
GRT1	700x400(220)	7.70	6.80	6.30	5.90	5.50	4.88	-	-	-
GRT2	700x500(220)	9.20	8.30	7.80	7.25	6.65	6.30	6.05	5.70	5.
GRT3	700x500(265)	9.40	8.40	7.80	7.20	6.70	6.40	6.10	5.80	5.
GRT4	700x500(320)	9.35	8.40	7.80	7.20	6.75	6.45	6.10	5.80	5.
GRT5	700x600(220)	10.90	9.90	9.20	8.70	8.19	7.73	7.30	6.90	6.
GRT6	700x600(265)	11.36	10.17	9.30	8.70	8.20	7.70	7.30	7.00	6.
GRT7	700x600(320)	11.15	10.00	9.34	8.61	8.27	7.80	7.40	7.00	6.
GRT8	700x700(220)	13.46	12.10	11.10	10.30	9.70	9.30	8.90	8.40	7.
GRT9	700x700(265)	13.47	12.10	11.10	10.30	9.70	9.30	8.90	8.45	7.
GRT10	700x700(320)	13.36	12.00	10.80	10.20	9.64	9.20	8.85	8.35	7.
GRT11	700x800(220)	14.56	13.17	12.16	11.49	10.97	10.50	10.06	9.60	9.
GRT12	700x800(265)	14.56	13.17	12.16	11.50	10.97	10.50	10.06	9.60	9.
GRT13	700x800(320)	14.60	13.20	12.20	11.56	11.00	10.56	10.14	9.70	9.
GRT14	800x400(220)	9.00	8.00	7.30	6.70	6.30	6.10	5.80	5.50	-
GRT15	800x500(220)	10.90	9.70	8.90	8.20	7.80	7.40	7.10	6.80	6.
GRT16	800x500(265)	11.30	10.24	9.34	8.65	8.09	7.62	7.30	7.00	6.
GRT17	800x500(320)	11.30	10.30	9.40	8.70	8.10	7.70	7.30	7.00	6.
GRT18	800x600(220)	13.00	11.70	10.80	10.00	9.40	8.90	8.50	8.20	7.
GRT19	800x600(265)	13.40	12.32	11.29	10.48	9.80	9.28	8.80	8.50	8.
GRT20	800x600(320)	13.40	12.40	11.30	10.50	9.80	9.30	8.80	8.50	8.
GRT21	800x700(220)	15.20	13.85	12.76	11.88	11.10	10.50	10.00	9.70	9.
GRT22	800x700(265)	15.20	13.85	12.76	11.88	11.10	10.50	10.00	9.70	9.
GRT23	800x700(320)	15.20	13.90	12.80	11.90	11.10	10.50	10.00	9.70	9.
GRT24	800x800(220)	16.90	15.40	14.24	13.30	12.50	11.87	11.30	10.88	10.
GRT25	800x800(265)	16.90	15.40	14.24	13.30	12.50	11.87	11.30	10.90	10.
GRT26	800x800(320)	16.90	15.45	14.26	13.30	12.50	11.87	11.30	10.90	10.
GRT27	900x400(220)	9.80	8.90	8.20	7.50	7.00	6.60	6.30	6.00	5.
GRT28	900x500(220)	12.00	11.00	10.10	9.40	8.80	8.30	7.90	7.55	7.
GRT29	900x500(265)	12.00	11.17	10.26	9.50	8.90	8.40	7.98	7.60	7.

Pasirinkto rygelio iš laikomosios galios lentelės geometrija:

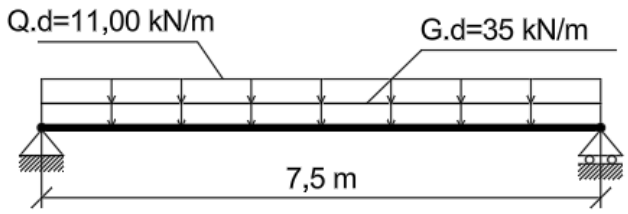
GRT17

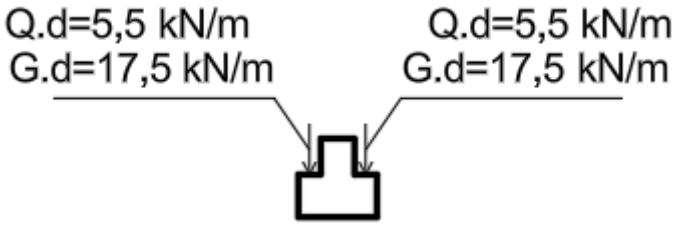


Išvada: 500mm aukščio rygelio laikomoji galia pakankama

RT Rygelių ant 5 ir 6 ašies skaičiuojamoji schema:

Skaičiuojamoji schema



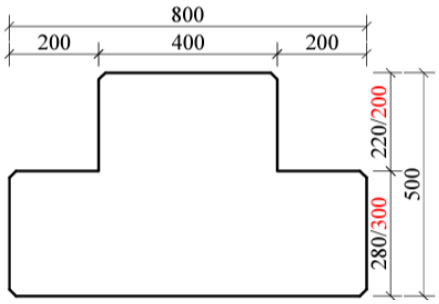


Pagal gkg3 RT rygelių laikomosios galios lentelę veikiant skaičiuojamosioms apkrovoms 800x500 rygelio skerspjūvis gali būti iki 8,90m ilgio.

Sija	b_{fl} x $h(h_{pl})$	Skaiči							
		30	*40*	*50*	*60*	*70*	*80*	*90*	*1*
									Did
GRT1	700x400(220)	7.70	6.80	6.30	5.90	5.50	4.88	-	-
GRT2	700x500(220)	9.20	8.30	7.80	7.25	6.65	6.30	6.05	5.
GRT3	700x500(265)	9.40	8.40	7.80	7.20	6.70	6.40	6.10	5.
GRT4	700x500(320)	9.35	8.40	7.80	7.20	6.75	6.45	6.10	5.
GRT5	700x600(220)	10.90	9.90	9.20	8.70	8.19	7.73	7.30	6.
GRT6	700x600(265)	11.36	10.17	9.30	8.70	8.20	7.70	7.30	7.
GRT7	700x600(320)	11.15	10.00	9.34	8.61	8.27	7.80	7.40	7.
GRT8	700x700(220)	13.46	12.10	11.10	10.30	9.70	9.30	8.90	8.
GRT9	700x700(265)	13.47	12.10	11.10	10.30	9.70	9.30	8.90	8.
GRT10	700x700(320)	13.36	12.00	10.80	10.20	9.64	9.20	8.85	8.
GRT11	700x800(220)	14.56	13.17	12.16	11.49	10.97	10.50	10.06	9.
GRT12	700x800(265)	14.56	13.17	12.16	11.50	10.97	10.50	10.06	9.
GRT13	700x800(320)	14.60	13.20	12.20	11.56	11.00	10.56	10.14	9.
GRT14	800x400(220)	9.00	8.00	7.30	6.70	6.30	6.10	5.80	5.
GRT15	800x500(220)	10.90	9.70	8.90	8.20	7.80	7.40	7.10	6.
GRT16	800x500(265)	11.30	10.24	9.34	8.65	8.09	7.62	7.30	7.
GRT17	800x500(320)	11.30	10.30	9.40	8.70	8.10	7.70	7.30	7.
GRT18	800x600(220)	13.00	11.70	10.80	10.00	9.40	8.90	8.50	8.
GRT19	800x600(265)	13.40	12.32	11.29	10.48	9.80	9.28	8.80	8.
GRT20	800x600(320)	13.40	12.40	11.30	10.50	9.80	9.30	8.80	8.
GRT21	800x700(220)	15.20	13.85	12.76	11.88	11.10	10.50	10.00	9.
GRT22	800x700(265)	15.20	13.85	12.76	11.88	11.10	10.50	10.00	9.
GRT23	800x700(320)	15.20	13.90	12.80	11.90	11.10	10.50	10.00	9.
GRT24	800x800(220)	16.90	15.40	14.24	13.30	12.50	11.87	11.30	10.

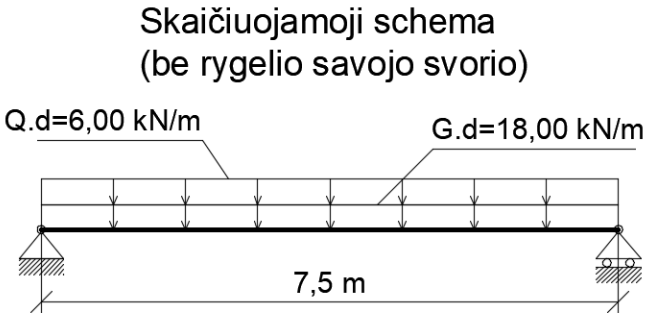
Pasirinkto rygelio iš laikomosios galios lentelės geometrija:

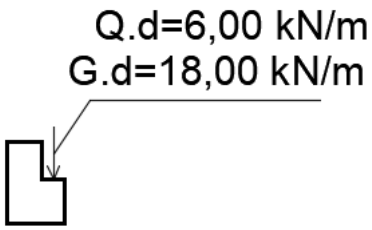
GRT15



Išvada: 500mm aukščio rygelio laikomoji galia pakankama

RL Rygelių ant 7 ašies skaičiuojamoji schema:



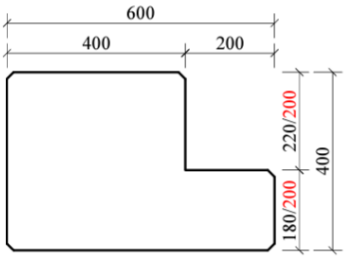


Pagal gkg3 RL rygelių laikomosios galios lentelę veikiant skaičiuojamosioms apkrovoms 600x400 rygelio skerspjūvis gali būti iki 9,0m ilgio.

Sija	b_{fl} x $h(h_{pl})$	Sk						
		30	40	50	60	70	80	
GRL01	500x400(220)	7.80	6.97	6.34	5.95	5.64	5.37	-
GRL2	500x500(220)	9.32	8.38	7.80	7.34	6.96	6.64	6
GRL3	500x500(265)	9.40	8.40	7.81	7.35	6.97	6.64	6
GRL4	500x500(320)	9.54	8.44	7.84	7.37	6.98	6.65	6
GRL5	500x600(220)	11.07	9.93	9.27	8.73	8.28	7.91	7
GRL6	500x600(265)	11.11	9.96	9.28	8.74	8.29	7.92	7
GRL7	500x600(320)	11.22	9.98	9.30	8.76	8.31	7.93	7
GRL8	500x700(220)	13.37	11.96	10.92	10.12	9.57	9.15	8
GRL9	500x700(265)	13.38	11.97	10.92	10.11	9.58	9.15	8
GRL10	500x700(320)	13.46	12.02	10.97	10.15	9.59	9.17	8
GRL11	500x800(220)	14.61	13.12	12.02	11.32	10.79	10.33	9
GRL12	500x800(265)	14.60	13.11	12.00	11.34	10.80	10.34	9
GRL13	500x800(320)	14.64	13.13	12.01	11.35	10.82	10.36	9
GRL14	600x400(220)	9.00	7.97	7.23	6.67	6.24	5.97	5
GRL15	600x500(220)	10.84	9.66	8.79	8.13	7.67	7.32	7
GRL16	600x500(265)	10.84	9.66	8.79	8.13	7.67	7.32	7
GRL17	600x500(320)	10.92	9.72	8.85	8.17	7.67	7.33	7
GRL18	600x600(220)	13.08	11.71	10.70	9.92	9.28	8.79	8
GRL19	600x600(265)	13.13	11.75	10.73	9.94	9.30	8.79	8
GRL20	600x600(320)	13.16	11.84	10.81	10.00	9.36	8.84	8
GRL21	600x700(220)	14.98	13.48	12.35	11.47	10.75	10.16	9
GRL22	600x700(265)	15.00	13.49	12.36	11.48	10.76	10.16	9
GRL23	600x700(320)	15.00	13.56	12.41	11.52	10.79	10.19	9

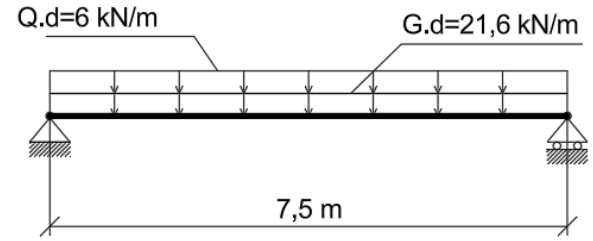
Pasirinkto rygelio iš laikomosios galios lentelės geometrija:

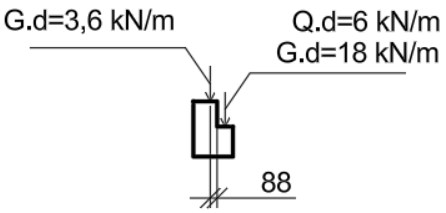
GRL14



Išvada: 400mm aukščio rygelio laikomoji galia pakankama

RL Rygelio ant 5 ašies tarp B-C skaičiuojamoji schema:



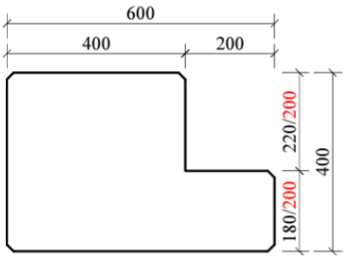


Pagal gkg3 RL rygelių laikomosios galios lentelę veikiant skaičiuojamosioms apkrovoms 600x400 rygelio skerspjūvis gali būti iki 9,0m ilgio.

Sija	b_{fl} x $h(h_{pl})$	Sk						
		30	*40*	*50*	*60*	*70*	*80*	
GRL01	500x400(220)	7.80	6.97	6.34	5.95	5.64	5.37	-
GRL2	500x500(220)	9.32	8.38	7.80	7.34	6.96	6.64	6
GRL3	500x500(265)	9.40	8.40	7.81	7.35	6.97	6.64	6
GRL4	500x500(320)	9.54	8.44	7.84	7.37	6.98	6.65	6
GRL5	500x600(220)	11.07	9.93	9.27	8.73	8.28	7.91	7
GRL6	500x600(265)	11.11	9.96	9.28	8.74	8.29	7.92	7
GRL7	500x600(320)	11.22	9.98	9.30	8.76	8.31	7.93	7
GRL8	500x700(220)	13.37	11.96	10.92	10.12	9.57	9.15	8
GRL9	500x700(265)	13.38	11.97	10.92	10.11	9.58	9.15	8
GRL10	500x700(320)	13.46	12.02	10.97	10.15	9.59	9.17	8
GRL11	500x800(220)	14.61	13.12	12.02	11.32	10.79	10.33	9
GRL12	500x800(265)	14.60	13.11	12.00	11.34	10.80	10.34	9
GRL13	500x800(320)	14.64	13.13	12.01	11.35	10.82	10.36	9
GRL14	600x400(220)	9.00	7.97	7.23	6.67	6.24	5.97	5
GRL15	600x500(220)	10.84	9.66	8.79	8.13	7.67	7.32	7
GRL16	600x500(265)	10.84	9.66	8.79	8.13	7.67	7.32	7
GRL17	600x500(320)	10.92	9.72	8.85	8.17	7.67	7.33	7
GRL18	600x600(220)	13.08	11.71	10.70	9.92	9.28	8.79	8
GRL19	600x600(265)	13.13	11.75	10.73	9.94	9.30	8.79	8
GRL20	600x600(320)	13.16	11.84	10.81	10.00	9.36	8.84	8
GRL21	600x700(220)	14.98	13.48	12.35	11.47	10.75	10.16	9
GRL22	600x700(265)	15.00	13.49	12.36	11.48	10.76	10.16	9
GRL23	600x700(320)	15.00	13.56	12.41	11.52	10.79	10.19	9

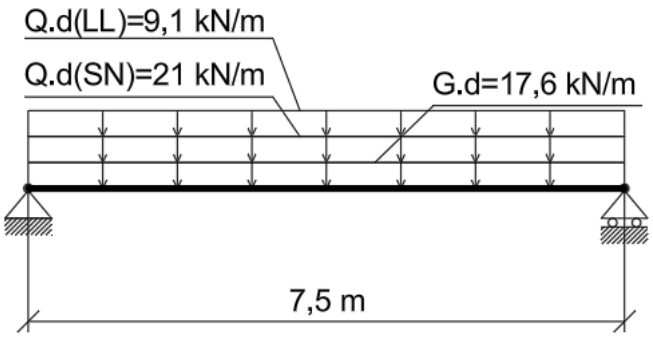
Pasirinkto rygelio iš laikomosios galios lentelės geometrija:

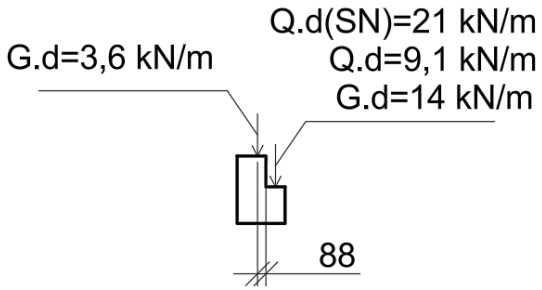
GRL14



Išvada: 400mm aukščio rygelio laikomoji galia pakankama

RL Rygelių ant 4 ir 5 ašies su ŠVOK įrangos apkrova skaičiuojamoji schema:

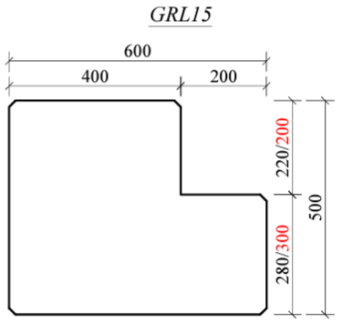




Pagal gkg3 RL rygelių laikomosios galios lentelę veikiant skaičiuojamosioms apkrovoms 600x500 rygelio skerspjūvis gali būti iki 8,79m ilgio.

Sija	b_{fl} x $h(h_{pl})$	*30*	*40*	*50*	*60*	*70*	*80*	Sk
GRL01	500x400(220)	7.80	6.97	6.34	5.95	5.64	5.37	-
GRL2	500x500(220)	9.32	8.38	7.80	7.34	6.96	6.64	6
GRL3	500x500(265)	9.40	8.40	7.81	7.35	6.97	6.64	6
GRL4	500x500(320)	9.54	8.44	7.84	7.37	6.98	6.65	6
GRL5	500x600(220)	11.07	9.93	9.27	8.73	8.28	7.91	7
GRL6	500x600(265)	11.11	9.96	9.28	8.74	8.29	7.92	7
GRL7	500x600(320)	11.22	9.98	9.30	8.76	8.31	7.93	7
GRL8	500x700(220)	13.37	11.96	10.92	10.12	9.57	9.15	8
GRL9	500x700(265)	13.38	11.97	10.92	10.11	9.58	9.15	8
GRL10	500x700(320)	13.46	12.02	10.97	10.15	9.59	9.17	8
GRL11	500x800(220)	14.61	13.12	12.02	11.32	10.79	10.33	9
GRL12	500x800(265)	14.60	13.11	12.00	11.34	10.80	10.34	9
GRL13	500x800(320)	14.64	13.13	12.01	11.35	10.82	10.36	9
GRL14	600x400(220)	9.00	7.97	7.23	6.67	6.24	5.97	5
GRL15	600x500(220)	10.84	9.66	8.79	8.13	7.67	7.32	7
GRL16	600x500(265)	10.84	9.66	8.79	8.13	7.67	7.32	7
GRL17	600x500(320)	10.92	9.72	8.85	8.17	7.67	7.33	7
GRL18	600x600(220)	13.08	11.71	10.70	9.92	9.28	8.79	8
GRL19	600x600(265)	13.13	11.75	10.73	9.94	9.30	8.79	8
GRL20	600x600(320)	13.16	11.84	10.81	10.00	9.36	8.84	8
GRL21	600x700(220)	14.98	13.48	12.35	11.47	10.75	10.16	9
GRL22	600x700(265)	15.00	13.49	12.36	11.48	10.76	10.16	9
GRL23	600x700(320)	15.00	13.56	12.41	11.52	10.79	10.19	9

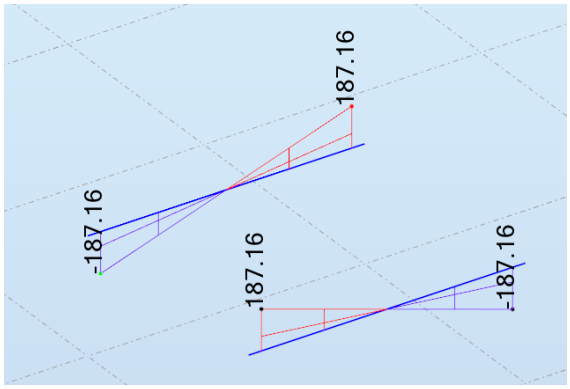
Pasirinkto rygelio iš laikomosios galios lentelės geometrija:



Išvada: 500mm aukščio rygelio laikomoji galia pakankama

Rygelis tvirtinamas prie kolonos su paslėptos gembės įdėtine detale.

Rygeliuose veikiančios skersinės jėgos:



Momentai, veikiantys paslėptų gembių įdėtinėse detalėse montavimo metu nuo perdangos savojo svorio:

$M = N \cdot e \cdot L/2 = 11{,}1 \cdot 0{,}3 \cdot 7{,}5/2 = 12{,}5\ kN \cdot m.$

Pagal PEIKKO apkrovų lentelę parenkama gembė pagal veikiančias apkrovas:

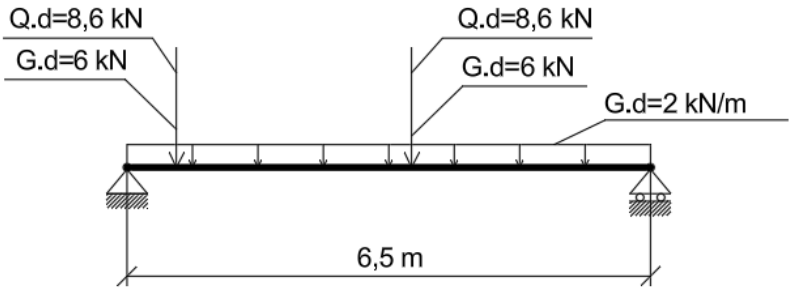
Load		Units	PCs 2	PCs 3	PCs 5	PCs 7	PCs 10	PCs 15
Vertical load	V_{Rd}	kN	230	355	575	785	1010	1500
Horizontal load	H_{Ed}	kN	0	0	0	0	0	0
Torsional moment	T_{Rd}	kNm	7	15	25	50	75	170

Išvada: Ved=187,16 kN<Vrd=355kN; Med=12,5kN*m<Mrd=15kN*m. Parenkama gembė PCs3

R-1 sijos ant B ašies skaičiuojamoji schema:

Sijos armavimą pagal Projekto brėžiniuose pateiktas atrėmimo ir apkrovų schemas konstruoja gamintojas.

Skaičiuojamoji schema:

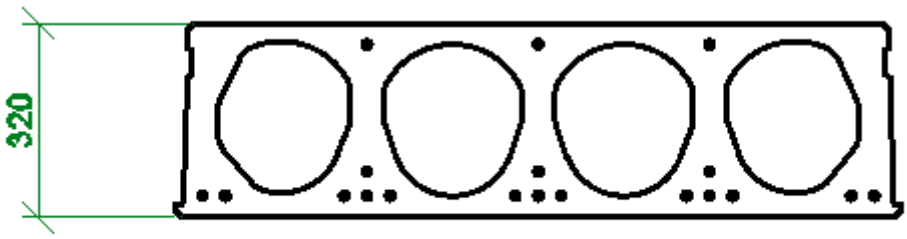


2.2. Perdangos plokščių projektavimas

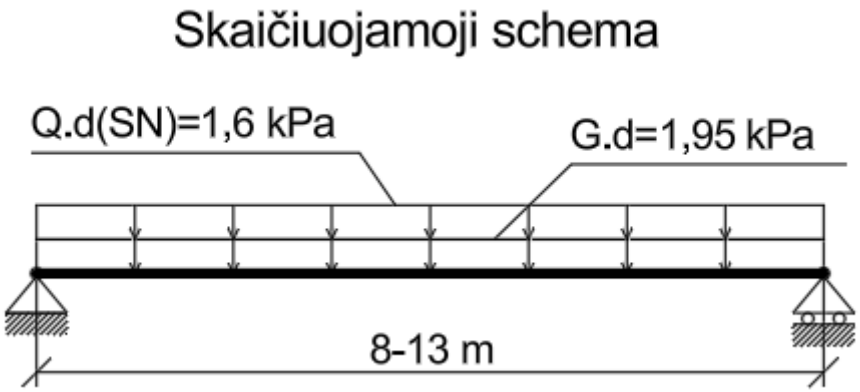
Projektuojamos standartinės įtempto gelžbetonio kiaurymėtos perdangos plokštės.

Perdangų armavimą pagal Projekto brėžiniuose pateiktas atrėmimo ir apkrovų schemas konstruoja gamintojas.

Perdangos tarp ašių 2-4 ir E-J ilgesni už 8m ilgio:



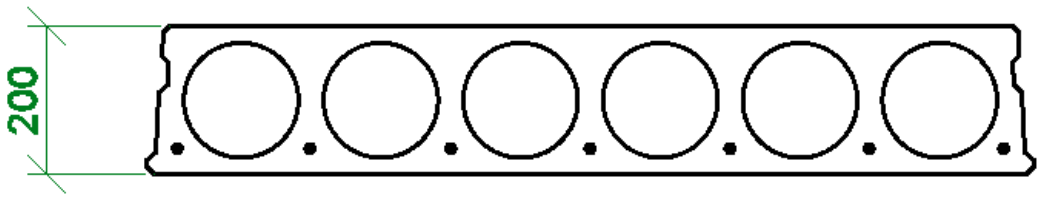
Skaičiuojamoji schema:



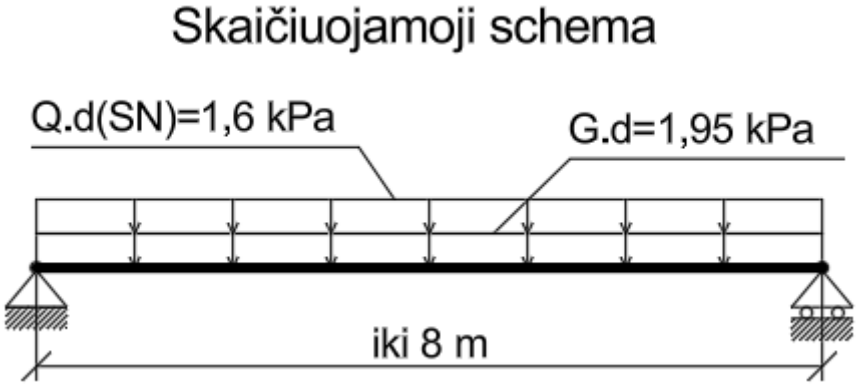
Perdangos plokščių aukštis nustatomas pagal gamintojų apkrovų lenteles.

Pagal pateiktą apkrovimo schemą perdangos armavimo skaičiavimus atlieka gamintojas.

Perdangos tarp ašių 4-7 ir E-J trumpesni už 8m ilgio:



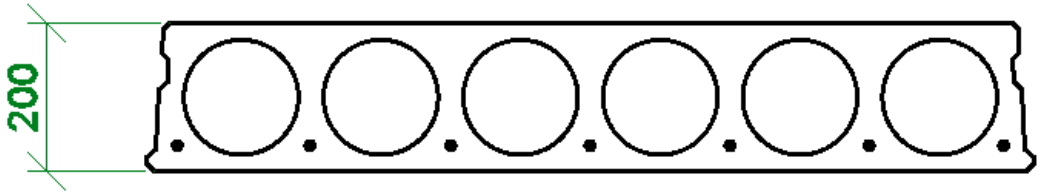
Skaičiuojamoji schema:



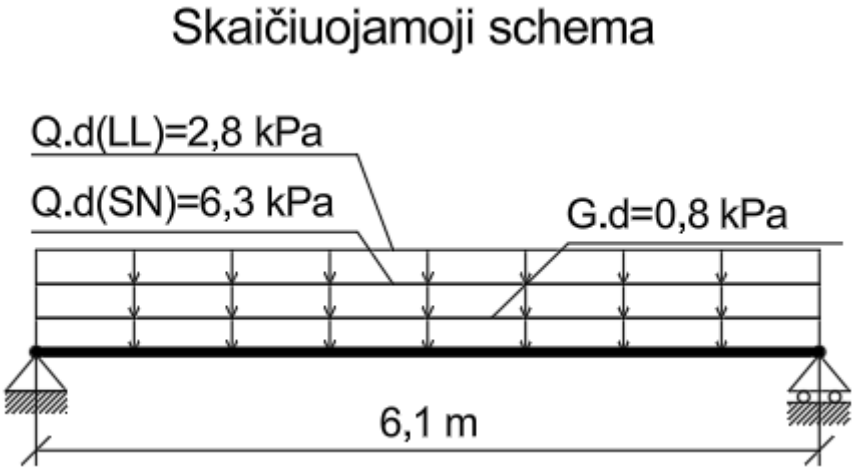
Perdangos plokščių aukštis nustatomas pagal gamintojų apkrovų lenteles.

Pagal pateiktą apkrovimo schemą perdangos armavimo skaičiavimus atlieka gamintojas.

Perdangos tarp ašių 4-5 ir B-C su apkrova nuo ŠVOK įrangos



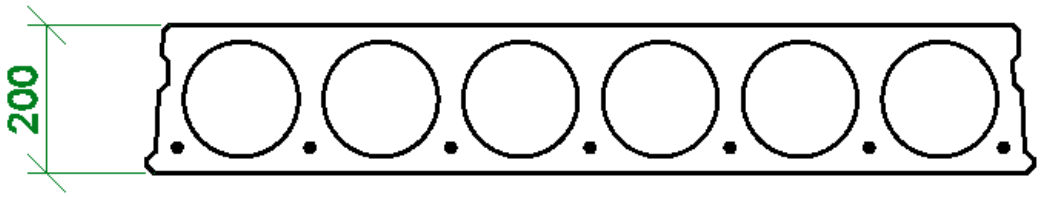
Skaičiuojamoji schema:



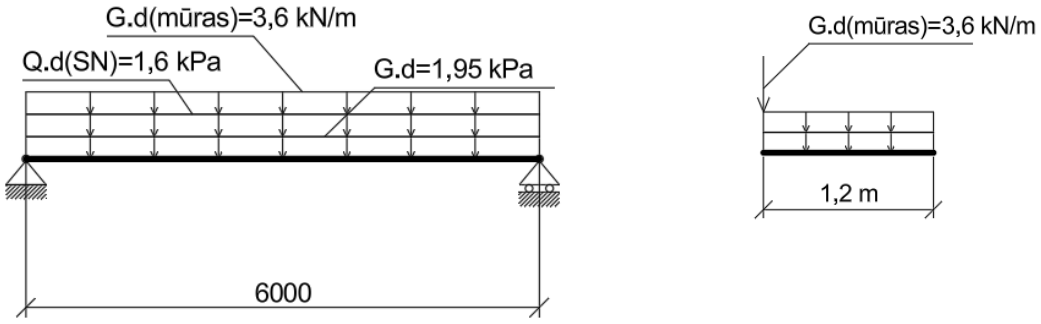
Perdangos plokščių aukštis nustatomas pagal gamintojų apkrovų lenteles.

Pagal pateiktą apkrovimo schemą perdangos armavimo skaičiavimus atlieka gamintojas.

Perdanga tarp ašių 4-5 prie C ašies su apkrova nuo mūro:



Skaičiuojamoji schema:



Perdangos plokščių aukštis nustatomas pagal gamintojų apkrovų lenteles.

Pagal pateiktą apkrovimo schemą perdangos armavimo skaičiavimus atlieka gamintojas.

2.3. Kolonų projektavimas

Betonas: C30/37;

Aplinkos klasė XC2;

Kolonos su pamatu jungiamos standžiai.

Apsauginis betono sluoksnis: ne mažiau kaip armatūros skersmuo ir ne mažiau nei 30 mm iki pagrindinės armatūros krašto.

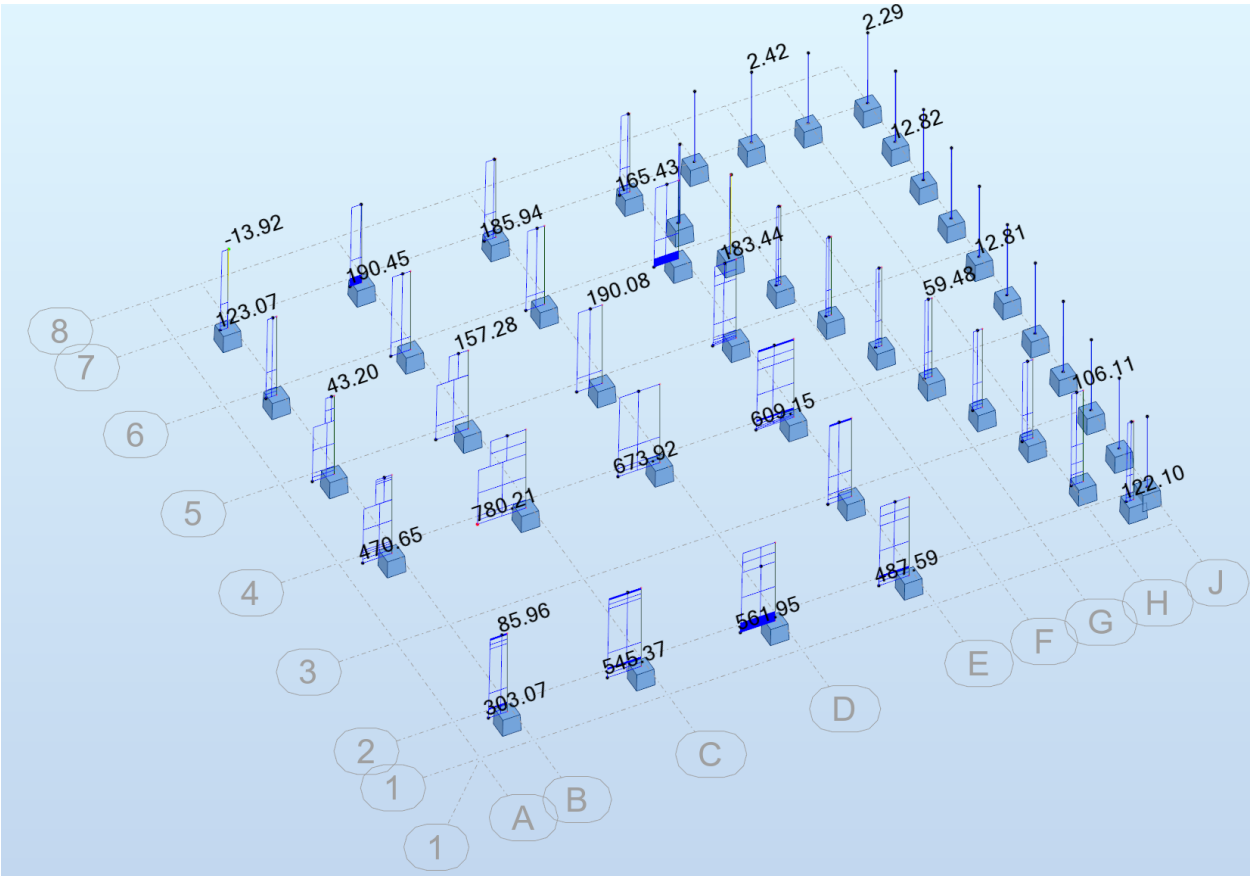
Projektuojamos dviejų skerspjūvio tipų kolonos: 400x400mm, 250x250mm.

Kolonos projektuojamos montavimo ir eksploatavimo stadijoje. Kolonų atsparumą transportavimo ir kėlimo metu turi įvertinti Gamintojas. Kolonų GB gembes tikrina gamintojas.

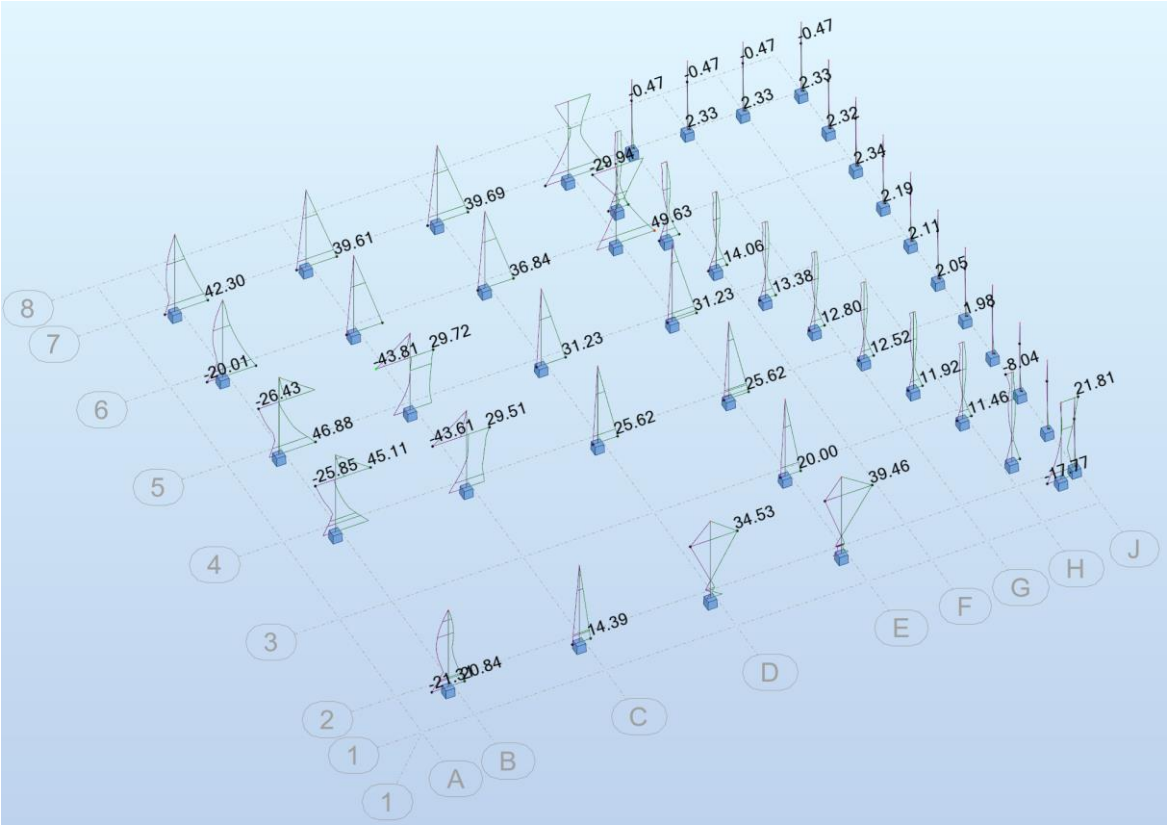
Išilginės armatūros kiekis negali būti mažesnis nei nurodyta skaičiavimuose.

Veikiančios įrąžos.

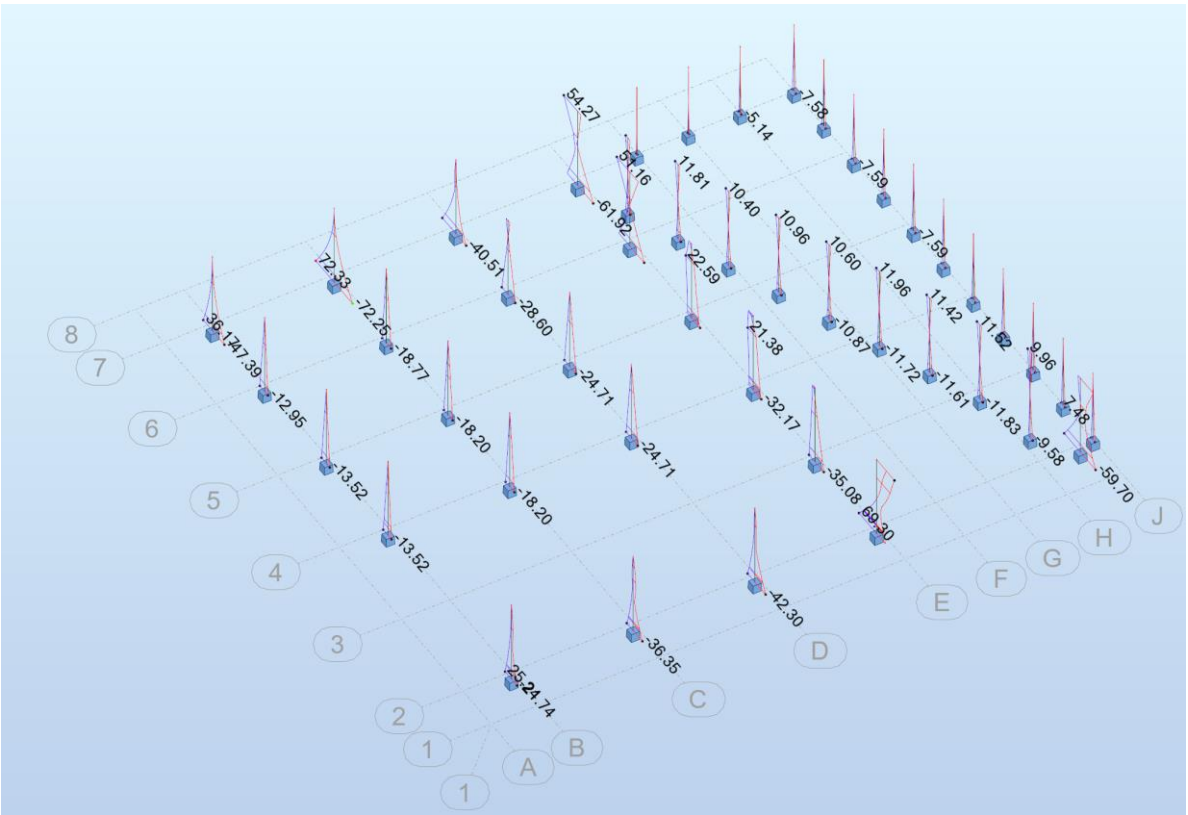
Ašinės jėgos:



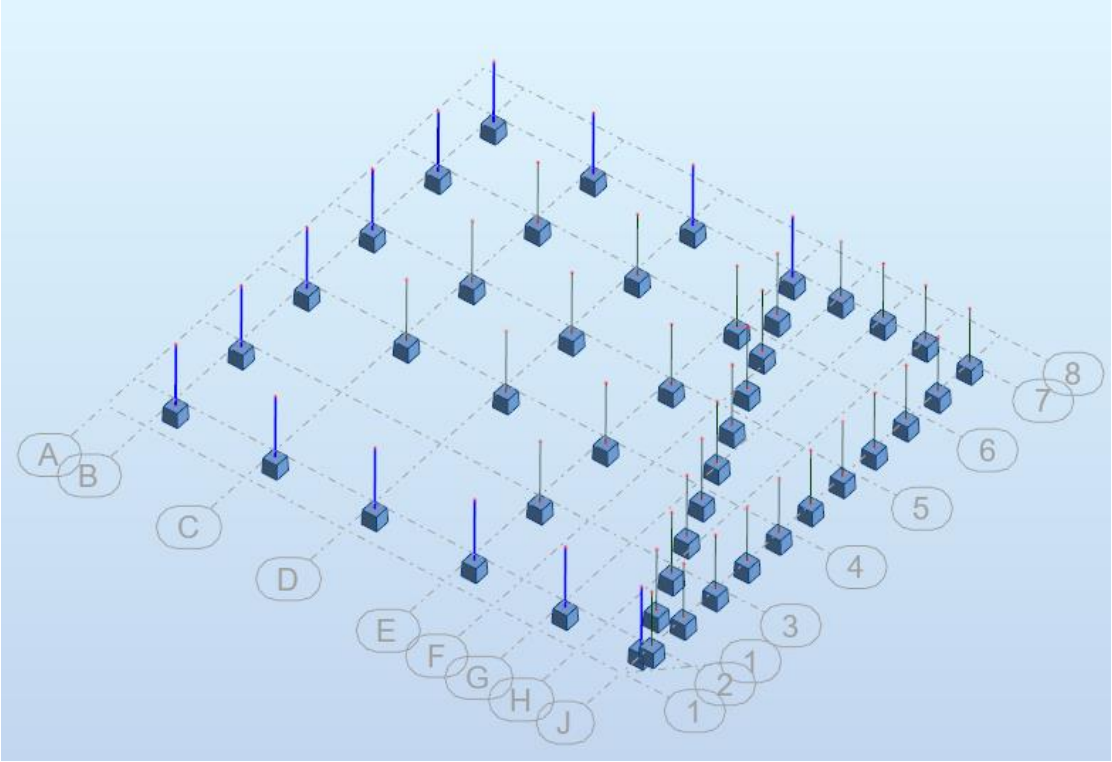
Lenkimo momentai Y kryptimi:



Lenkimo momentai Z kryptimi:

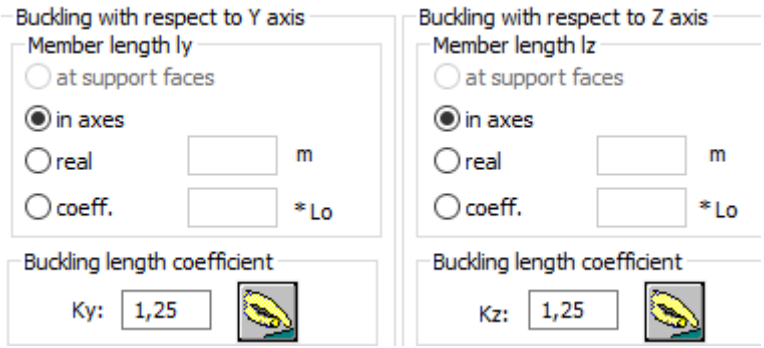


Perimetro kolonų išdėstymas:

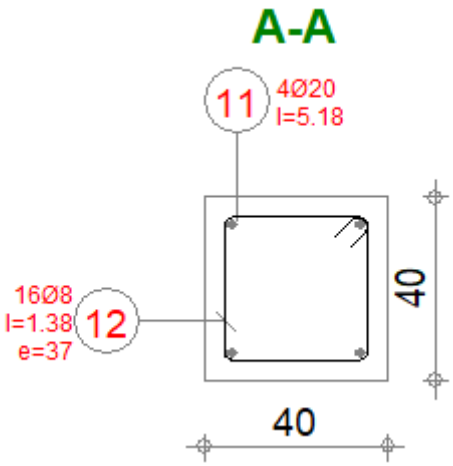


Kolonos geometrinis ilgis: 5,37 m.

Skaičiuojamieji ilgiai:



Reikalingas armavimas:



1 Level:

- Name :
- Reference level : -0.55 (m)
- Concrete creep coefficient : φ_p = 2.47
- Cement class : N
- Environment class : XC1
- Structure class : S4

2 Column: Column5..20

Number of identical elements: 4

2.1 Material properties:

- Concrete : C30/37 f_{ck} = 30.00 (MPa)
  Unit weight : 2501.36 (kG/m3)
  Aggregate size : 20.0 (mm)
- Longitudinal reinforcement: : B500B f_{yk} = 500.00 (MPa)
  Ductility class : B
- Transversal reinforcement: : B500B f_{yk} = 500.00 (MPa)
- Modified partial coefficients:
  α_{cc} = 0.9 1992-1-1 3.1.6 (1)P

2.2 Geometry:

2.2.1	Rectangular	40.0 x 40.0 (cm)
2.2.2	Height: L	= 5.37 (m)
2.2.3	Slab thickness	= 0.00 (m)
2.2.4	Beam height	= 0.00 (m)
2.2.5	Cover	= 4.0 (cm)

2.3 Calculation options:

- Calculations according to : EN 1992-1-1:2004/A1:2014
- Seismic dispositions : No requirements
- Precast column : yes
- Pre-design : no

- Slenderness taken into account : yes
- Compression : with bending
- Ties : to slab
- Fire resistance class : No requirements

2.4 Calculation results:

Safety factors Rd/Ed = 1.29 > 1.0

2.4.1 ULS/ALS Analysis

Design combination: ULS/50=1*1.00 + 5*1.30 (B)
Combination type: ULS
Internal forces:
Nsd = 30.39 (kN) Msdy = 6.34 (kN*m) Msdz = 72.25 (kN*m)
Design forces:
Lower node
N = 30.39 (kN) N*etotz = 6.34 (kN*m) N*etoty= 72.69 (kN*m)

Eccentricity:		ez (My/N) (cm)	ey (Mz/N) (cm)
Initial	e0:	20.9	237.7
Imperfection	ei:	0.0	1.4
I order (e0 + ei)	e0Ed:	20.9	239.2
Minimal	eEdmin:	2.0	2.0
Total	eEd:	20.9	239.2

2.4.1.1. Detailed analysis-Direction Y:

2.4.1.1.1 Slenderness analysis

Non-sway structure

L (m)	Lo (m)	λ	λlim	
5.37	6.71	58.13	107.11	Short column

2.4.1.1.2 Buckling analysis

MA = 0.00 (kN*m) MB = 6.34 (kN*m)
Case: Cross-section at the column end (Lower node), Slenderness not taken into account
M0 = 6.34 (kN*m)
ei = 0.0 (cm)
Ma = N*ei = 0.00 (kN*m)
MEdmin = 0.61 (kN*m)
M0Ed = max(MEdmin,M0 + Ma) = 6.34 (kN*m)

2.4.1.2. Detailed analysis-Direction Z:

2.4.1.2.1 Slenderness analysis

Non-sway structure

L (m)	Lo (m)	λ	λlim	
5.37	6.71	58.13	107.11	Short column

2.4.1.2.2 Buckling analysis

MA = 0.00 (kN*m) MB = 72.25 (kN*m)
Case: Cross-section at the column end (Lower node), Slenderness not taken into account
M0 = 72.25 (kN*m)
ei = $\theta 1$* lo/2 = 1.4 (cm)

$\theta 1 = \theta o * \alpha h * \alpha m = 0.00$
$\theta o = 0.01$
$\alpha h = 0.86$
$\alpha m = (0,5(1+1/m))^{0.5} = 1.00$
$m = 1.00$
Ma = N*ei = 0.44 (kN*m)
MEdmin = 0.61 (kN*m)
M0Ed = max(MEdmin,M0 + Ma) = 72.69 (kN*m)

2.4.2 Reinforcement:

Real (provided) area	Asr = 12.57 (cm2)
Ratio:	ρ = 0.79 %

2.5 Reinforcement:

Main bars (B500B):
- 4 ϕ20 l = 5.33 (m)

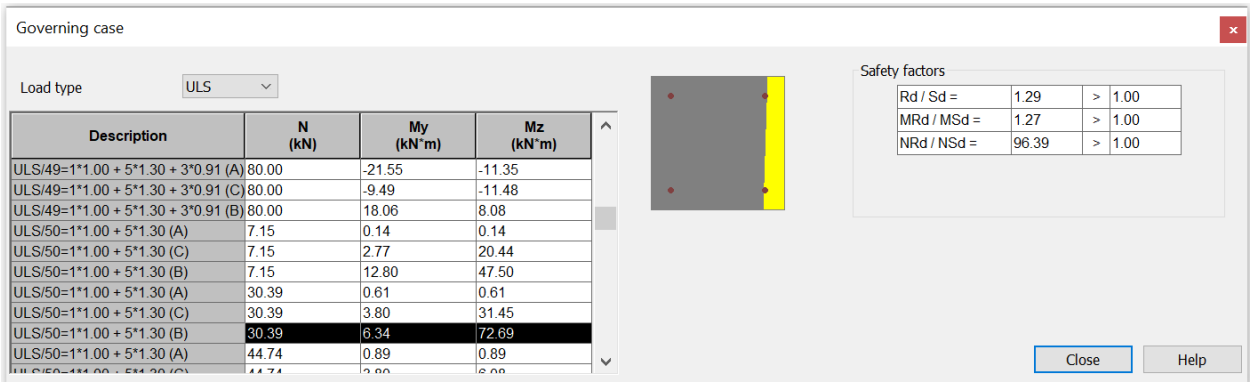
Transversal reinforcement: (B500B):
stirrups: 16 ϕ8 l = 1.38 (m)

3 Material survey:

- Concrete volume = 3.44 (m3)
- Formwork = 34.37 (m2)

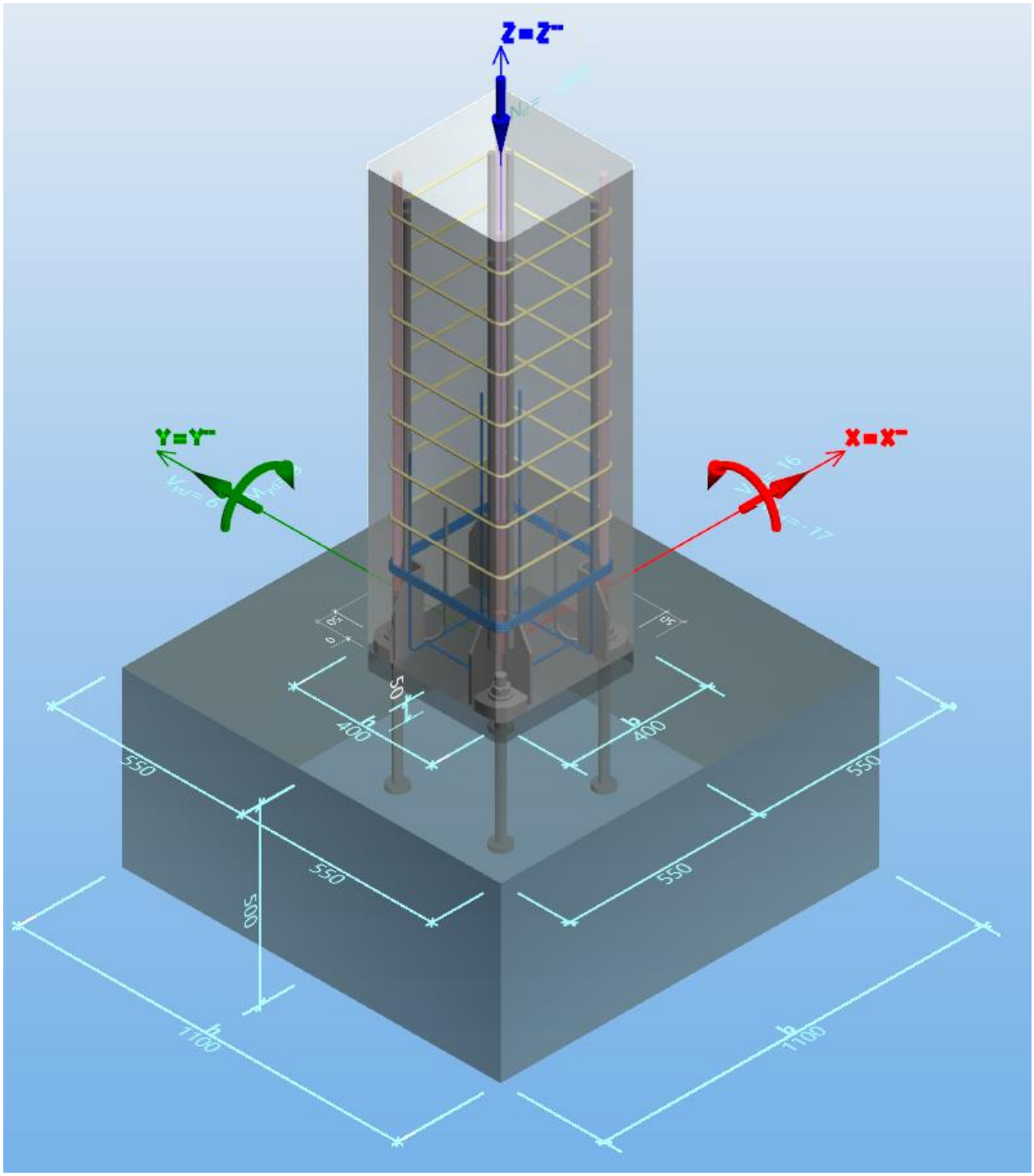
- Steel B500B
  - Total weight = 245.16 (kG)
  - Density = 71.33 (kG/m3)
  - Average diameter = 13.9 (mm)
  - Reinforcement survey:

Diameter	Length (m)	Weight (kG)	Number (No.)	Total weight (kG)
8	1.38	0.54	64	34.77
20	5.33	13.15	16	210.39



Išvada : sąlyga tenkinama

Perimetro kolonos bazės inkariniai varžtai pagal atramines reakcijas pamate parenkami „Peikko Designer“ programa. Perimetro kolonų bazės 4xHPKM24 ir inkariniai varžtai HPM24L.



Summary

Name	Stage	#	Load Case	Page No.	Max Utilization	Status
Kolona 1	Final	1	N max	5	26%	OK
	Final	2	M max	6	98%	OK
	Final	3	V max	7	38%	OK

Kolona 1

Note:

Number of Columns: 1

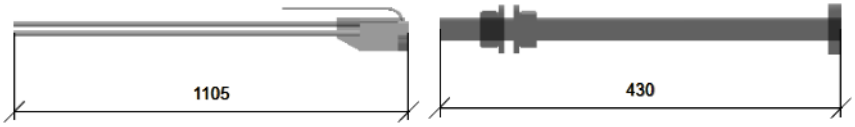
Peikko Products

Column Shoes: 4 x HPKM24

Bolts: 4 x HPM24L

Totals

Product	Amount
HPKM24	4
HPM24L	4



Minimum required torque value of nuts : T_{min} = 200 Nm
Maximum allowed torque value of nuts : T_{max} = 380 Nm

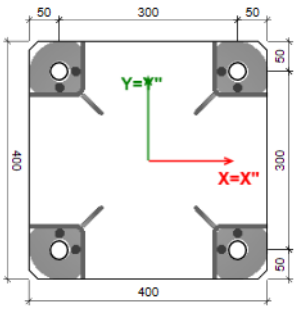
Bolt installation template: PPL24-4 300x300

Materials and Geometry

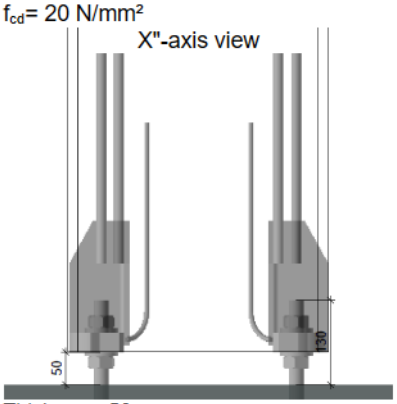
Column: 400x400

Concrete: C30/37
f_{cd}= 20 N/mm²

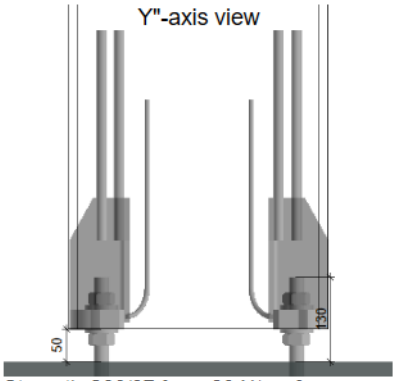
Plane View



X"-axis view



Y"-axis view



Grouting:

Thickness: 50 mm

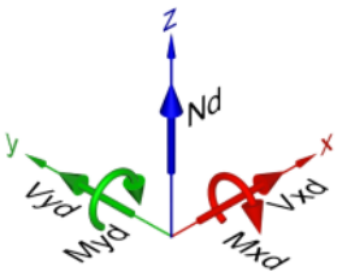
Strength C30/37 f_{cd} = 20 N/mm²

X; Y = local coordinate system of profile
X"; Y" = local coordinate system of anchors

Load Cases

NOTE: Loads are defined in the local coordinate system of the profile.

(Design loads)



Final Stage

#	Name	N_d [kN]	M_{xd} [kNm]	M_{yd} [kNm]	V_{xd} [kN]	V_{yd} [kN]
1	N max	-562.0	-17.0	9.0	16.0	6.0
2	M max	-104.0	73.0	-4.0	-1.0	-26.0
3	V max	-399.0	-54.0	8.0	23.0	37.0

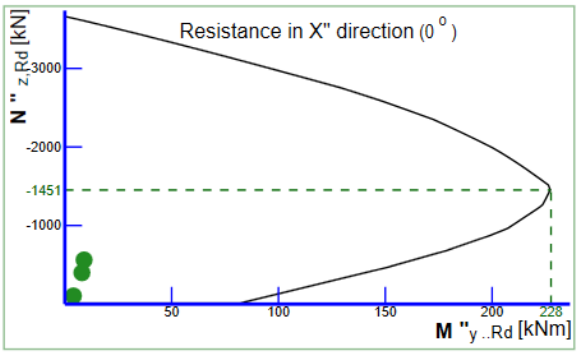
Erection stage

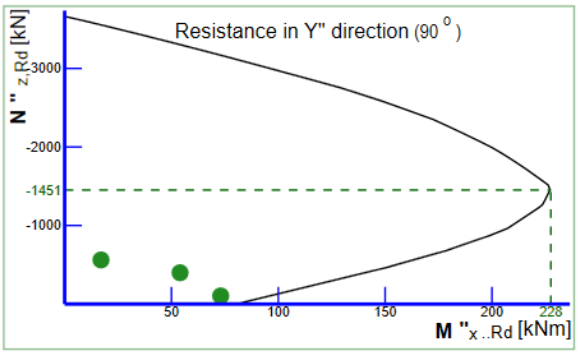
No load case for this stage defined

Fire Situation Loads

No load case for this stage defined

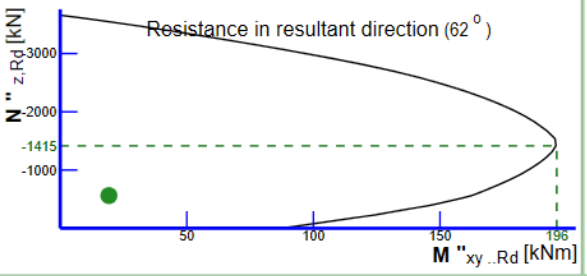
Resistance Diagrams



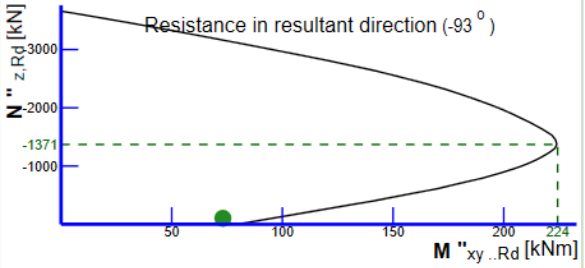


Resultant Diagrams per Load

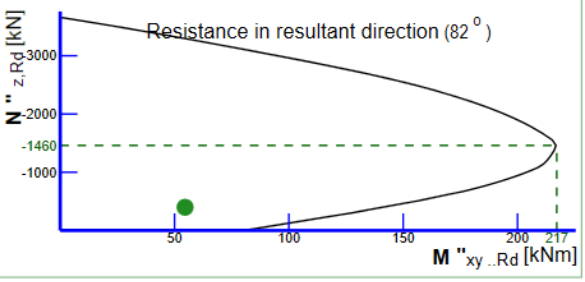
N max : Nd=-562.0, Mxd=-17.0, Myd=9.0, Vxd=16.0, Vyd=6.0
(loads in coordinate system of profile)
N max : N"d=-562.0, M"xd=-17.0, M"yd=9.0, V"xd=16.0, V"yd=
(loads in coordinate system of anchors)



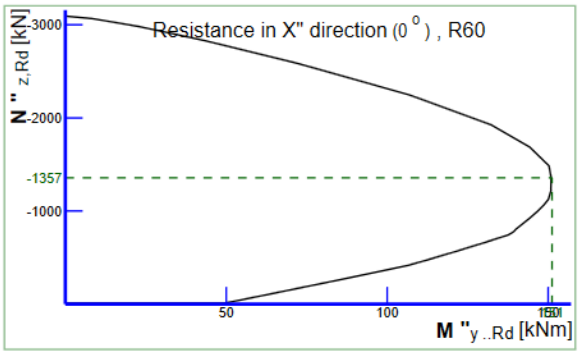
M max : Nd=-104.0, Mxd=73.0, Myd=-4.0, Vxd=-1.0, Vyd=-26.0
(loads in coordinate system of profile)
M max : N"d=-104.0, M"xd=73.0, M"yd=-4.0, V"xd=-1.0, V"yd=
(loads in coordinate system of anchors)

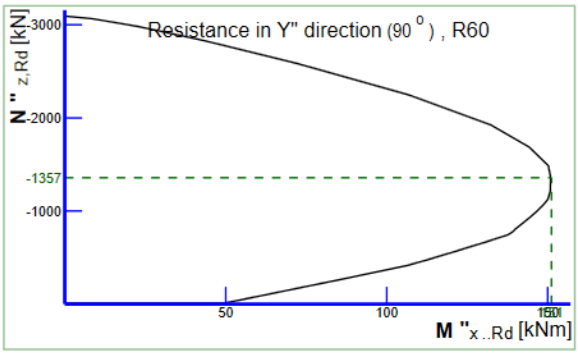


V max : Nd=-399.0, Mxd=-54.0, Myd=8.0, Vxd=23.0, Vyd=37.0
(loads in coordinate system of profile)
V max : N"d=-399.0, M"xd=-54.0, M"yd=8.0, V"xd=23.0, V"yd=
(loads in coordinate system of anchors)



Fire Situation Resistances Diagrams





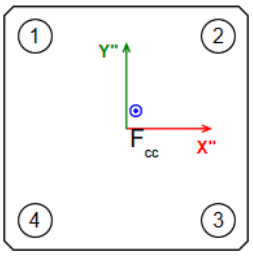
Load Case #1 : N max : Nd=-562.0, Mxd=-17.0, Myd=9.0, Vxd=16.0, Vyd=6.0

Steel Failure: Sufficient capacity **Concrete failure: Sufficient capacity**

Steel failure verification

Design value of normal compressive force in the column	$N_{c,Ed}$	-562	kN
Friction coefficient (between base plate and grout layer)	C_{fd}	0.2	
Joint friction resistance	$F_{f,Rd}$	112.4	kN
Resultant shear force	V_{sd}	17.09	kN
Resultant shear force taking account friction contribution	$V_{sd,f}$	0	kN

Resultant compression force (concrete) in (X"/Y") = F_{cc}(15.1/28.6)



Bolt Pos.	Acting axial force [kN]	Design tension resistance [kN]	Axial capacity usage [%]	Acting shear force [kN]	Design shear resistance [kN]	Shear capacity usage [%]	Interaction [%]
1	-14.0	127.1	11.0	0.0	45.0	0.0	n/r
2	-18.3	127.1	14.4	0.0	45.0	0.0	n/r
3	-10.1	127.1	8.0	0.0	45.0	0.0	n/r
4	-5.78	127.1	4.5	0.0	45.0	0.0	n/r

Concrete failure verifications

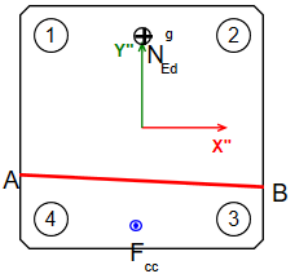
Proof	Load [kN]	Capacity [kN]	Utilization [%]	Status
Pull-Out Failure	0.0	0.0	0.0	Ok
Cone failure				Ok
Concrete decisive:				
1) Foundation (Plain Concrete)	0.0	0.0	n/r	
2) Assigned Hanger Reinforcement	0.0	0.0	n/r	
3) Requirement of Strut and Tie Model	0.0	0.0	n/r	
Splitting Failure				Ok
Concrete decisive:				
1) Foundation (Plain Concrete)	0.0	0.0	n/r	
2)Assigned Splitting Reinforcement || X	0.0	0.0	-	
3)Assigned Splitting Reinforcement || Y	0.0	0.0	-	
Blow-Out Failure	0.0	0.0	n/r	Ok
Pry-out failure	0.0	0.0	n/r	Ok
Edge failure				Ok
Concrete decisive:				
1) -X (Left) Edge (Plain Concrete)	0.0	0.0	n/r	
2) +X (Right) Edge (Plain Concrete)	0.0	0.0	n/r	
3) +Y (Top) Edge (Plain Concrete)	0.0	0.0	n/r	
4) -Y (Bottom) Edge (Plain Concrete)	0.0	0.0	n/r	
5)Assigned Edge Reinforcement (-X)	0.0	0.0	n/r	
6)Assigned Edge Reinforcement (+X)	0.0	0.0	n/r	
7)Assigned Edge Reinforcement (+Y)	0.0	0.0	n/r	
8)Assigned Edge Reinforcement (-Y)	0.0	0.0	n/r	
Combined Resistance	$\beta_N \leq 1$		0.0	Ok

Load Case #2 : M max : Nd=-104.0, Mxd=73.0, Myd=-4.0, Vxd=-1.0, Vyd=-26.0

Steel Failure: Sufficient capacity **Concrete failure: Sufficient capacity**

Steel failure verification

Design value of normal compressive force in the column	$N_{c,Ed}$	-104	kN
Friction coefficient (between base plate and grout layer)	C_{fd}	0.2	
Joint friction resistance	$F_{f,Rd}$	20.8	kN
Resultant shear force	V_{sd}	26.02	kN
Resultant shear force taking account friction contribution	$V_{sd,f}$	5.22	kN



Neutral axis in (X"/Y") = A(-200.0 / -78.2); B(200.0 / -95.8)
Resultant tension force in (X"/Y") = N $^{g}_{Ed}$(4.2/150.0)
Resultant compression force (concrete) in (X"/Y") = F $_{cc}$(-10.5/-160.2)

Bolt Pos.	Acting axial force [kN]	Design tension resistance [kN]	Axial capacity usage [%]	Acting shear force [kN]	Design shear resistance [kN]	Shear capacity usage [%]	Interaction [%]
1	89.1	127.1	70.1	1.74	45.0	3.9	53.9
2	94.2	127.1	74.1	0.0	45.0	0.0	n/r
3	-21.8	127.1	17.2	1.74	45.0	3.9	n/r
4	-26.9	127.1	21.2	1.74	45.0	3.9	n/r

Concrete failure verifications

Proof	Load [kN]	Capacity [kN]	Utilization [%]	Status
Pull-Out Failure	94.2	279.0	33.8	Ok
Cone failure				Ok
Concrete decisive:				
1) Foundation (Plain Concrete)	183.3	204.2	89.7	
2) Assigned Hanger Reinforcement	0.0	0.0	n/r	
3) Requirement of Strut and Tie Model	0.0	0.0	n/r	
Splitting Failure				Ok
Concrete decisive:				
1) Foundation (Plain Concrete)	183.3	186.4	98.3	
2)Assigned Splitting Reinforcement || X	0.0	0.0	-	
3)Assigned Splitting Reinforcement || Y	0.0	0.0	-	
Blow-Out Failure	0.0	0.0	n/r	Ok
Pry-out failure	5.2	549.3	1.0	Ok
Edge failure				Ok
Concrete decisive:				
1) -X (Left) Edge (Plain Concrete)	5.2	156.3	3.3	
2) +X (Right) Edge (Plain Concrete)	5.2	179.6	2.9	
3) +Y (Top) Edge (Plain Concrete)	0.2	179.6	0.1	
4) -Y (Bottom) Edge (Plain Concrete)	5.2	62.8	8.3	
5)Assigned Edge Reinforcement (-X)	1.7	0.0	n/r	
6)Assigned Edge Reinforcement (+X)	1.7	0.0	n/r	
7)Assigned Edge Reinforcement (+Y)	0.1	0.0	n/r	
8)Assigned Edge Reinforcement (-Y)	4.3	0.0	n/r	
Combined Resistance	$\beta_N+\beta_V \le 1.2$ or $\beta_N^{1.5}+\beta_V^{1.5} \le 1$		88.9	Ok

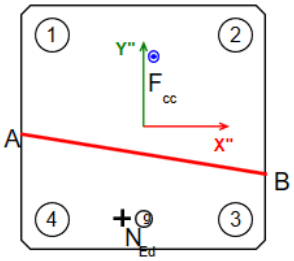
Load Case #3 : V max : Nd=-399.0, Mxd=-54.0, Myd=8.0, Vxd=23.0, Vyd=37.0

Steel Failure: Sufficient capacity **Concrete failure: Sufficient capacity**

Steel failure verification

Design value of normal compressive force in the column	$N_{c,Ed}$	-399	kN
Friction coefficient (between base plate and grout layer)	C_{fd}	0.2	
Joint friction resistance	$F_{f,Rd}$	79.8	kN
Resultant shear force	V_{sd}	43.57	kN
Resultant shear force taking account friction contribution	$V_{sd,f}$	0	kN

Neutral axis in (X"/Y") = A(-200.0 / -12.6); B(200.0 / -77.0)
Resultant tension force in (X"/Y") = N_{Ed}(-34.4/-150.0)
Resultant compression force (concrete) in (X"/Y") = F_{cc}(16.6/115.0)



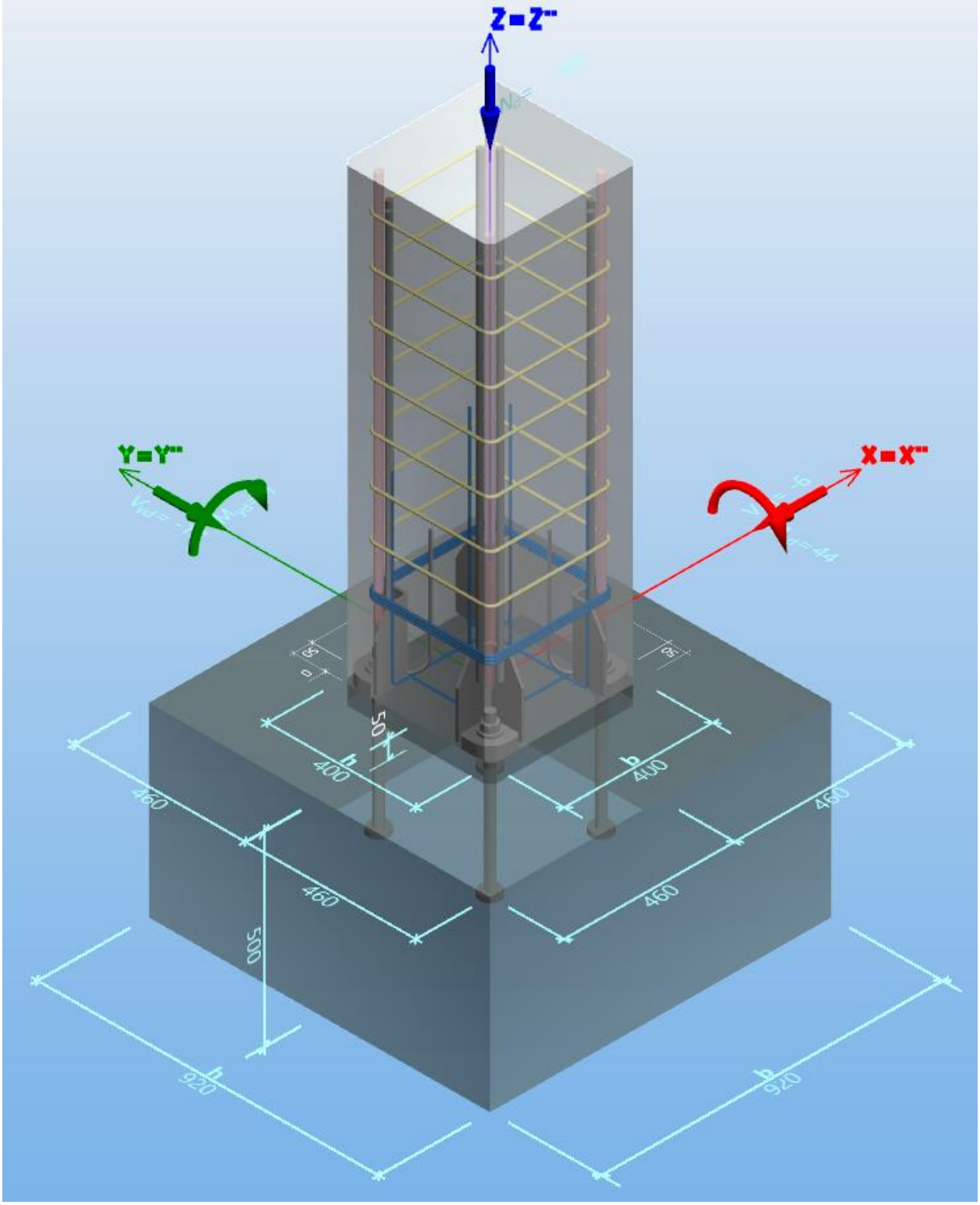
Bolt Pos.	Acting axial force [kN]	Design tension resistance [kN]	Axial capacity usage [%]	Acting shear force [kN]	Design shear resistance [kN]	Shear capacity usage [%]	Interaction [%]
1	-20.6	127.1	16.2	0.0	45.0	0.0	n/r
2	-26.5	127.1	20.8	0.0	45.0	0.0	n/r
3	9.81	127.1	7.7	0.0	45.0	0.0	n/r
4	15.7	127.1	12.3	0.0	45.0	0.0	n/r

Concrete failure verifications

Proof	Load [kN]	Capacity [kN]	Utilization [%]	Status
Pull-Out Failure	15.7	279.0	5.6	Ok
Cone failure				Ok
Concrete decisive:				
1) Foundation (Plain Concrete)	25.5	190.0	13.4	
2) Assigned Hanger Reinforcement	0.0	0.0	n/r	
3) Requirement of Strut and Tie Model	0.0	0.0	n/r	
Splitting Failure				Ok
Concrete decisive:				
1) Foundation (Plain Concrete)	25.5	174.3	14.6	
2)Assigned Splitting Reinforcement || X	0.0	0.0	-	
3)Assigned Splitting Reinforcement || Y	0.0	0.0	-	
Blow-Out Failure	0.0	0.0	n/r	Ok
Pry-out failure	0.0	0.0	n/r	Ok
Edge failure				Ok
Concrete decisive:				
1) -X (Left) Edge (Plain Concrete)	0.0	0.0	n/r	
2) +X (Right) Edge (Plain Concrete)	0.0	0.0	n/r	
3) +Y (Top) Edge (Plain Concrete)	0.0	0.0	n/r	
4) -Y (Bottom) Edge (Plain Concrete)	0.0	0.0	n/r	
5)Assigned Edge Reinforcement (-X)	0.0	0.0	n/r	
6)Assigned Edge Reinforcement (+X)	0.0	0.0	n/r	
7)Assigned Edge Reinforcement (+Y)	0.0	0.0	n/r	
8)Assigned Edge Reinforcement (-Y)	0.0	0.0	n/r	
Combined Resistance	$\beta_N \le 1$		14.6	Ok

IŠVADA: kolonų laikomoji galia užtikrinta.

Perimetro kampinės kolonos bazės ant ašių 7-E inkariniai varžtai pagal atramines reakcijas pamate parenkami „Peikko Designer“ programa. Perimetro kolonų bazės 4xHPKM24 ir inkariniai varžtai HPM24L.



Summary

Name	Stage	#	Load Case	Page No.	Max Utilization	Status
Kolona 1	Final	1	N max	5	48%	OK
	Final	2	M max	6	92%	OK

Kolona 1

Note:

Number of Columns: 1

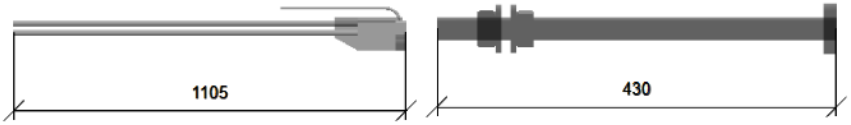
Peikko Products

Column Shoes: 4 x HPKM24

Bolts: 4 x HPM24L

Totals

Product	Amount
HPKM24	4
HPM24L	4



Minimum required torque value of nuts : T_{min} = 200 Nm
Maximum allowed torque value of nuts : T_{max} = 380 Nm

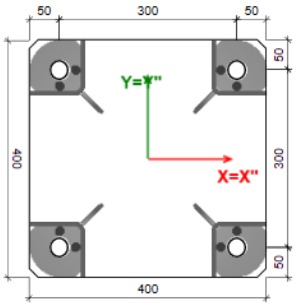
Bolt installation template: PPL24-4 300x300

Materials and Geometry

Column: 400x400

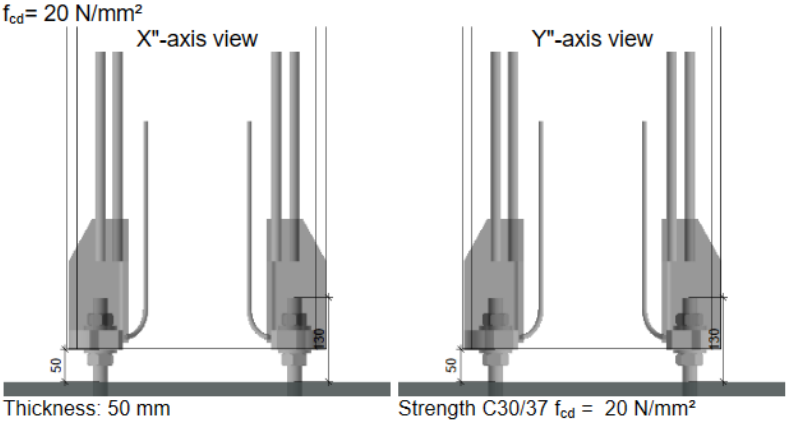
Concrete: C30/37
f_{cd}= 20 N/mm²

Plane View



X"-axis view

Y"-axis view



Grouting:

Thickness: 50 mm

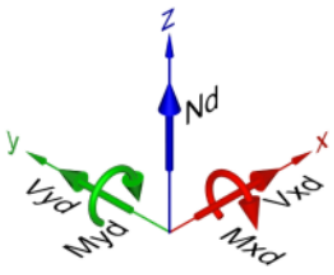
Strength C30/37 f_{cd} = 20 N/mm²

X; Y = local coordinate system of profile
X"; Y" = local coordinate system of anchors

Load Cases

NOTE: Loads are defined in the local coordinate system of the profile.

(Design loads)



Final Stage

#	Name	N_d [kN]	M_{xd} [kNm]	M_{yd} [kNm]	V_{xd} [kN]	V_{yd} [kN]
1	N max	-165.0	44.0	1.0	-6.0	-18.0
2	M max	-160.0	62.0	7.0	-4.0	-24.0

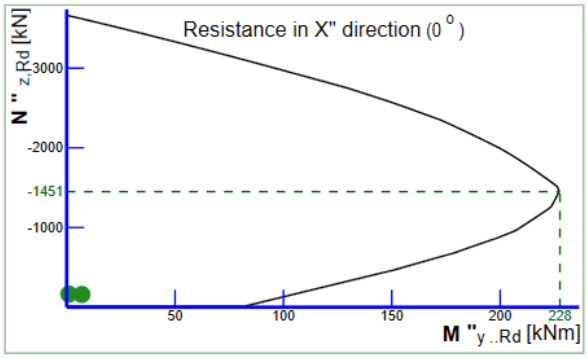
Erection stage

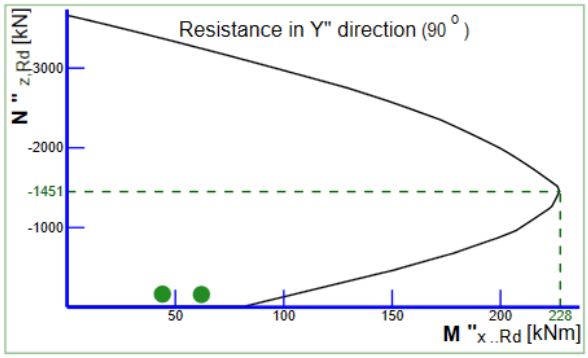
No load case for this stage defined

Fire Situation Loads

No load case for this stage defined

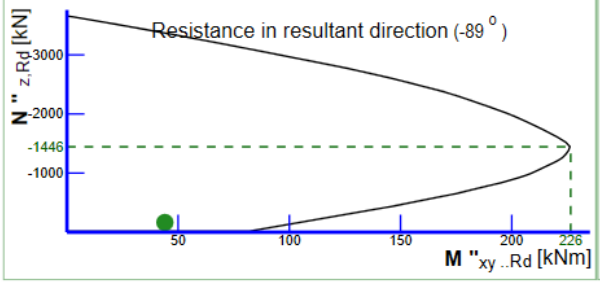
Resistance Diagrams



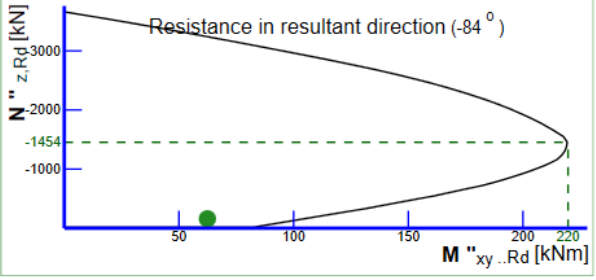


Resultant Diagrams per Load

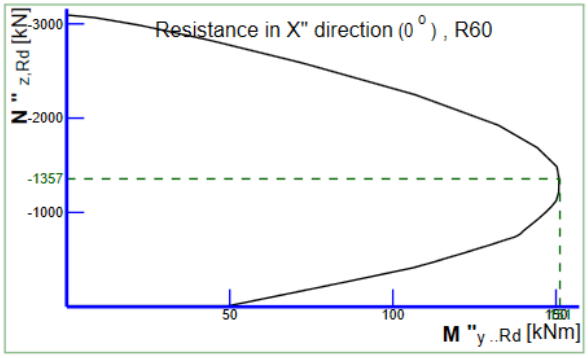
N max : Nd=-165.0, Mxd=44.0, Myd=1.0, Vxd=-6.0, Vyd=-18.0
(loads in coordinate system of profile)
N max : N"d=-165.0, M"xd=44.0, M"yd=1.0, V"xd=-6.0, V"yd=-1
(loads in coordinate system of anchors)

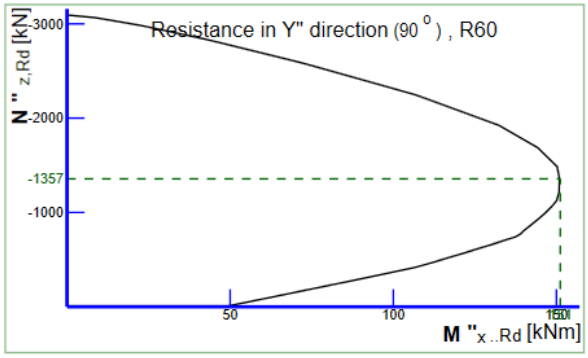


M max : Nd=-160.0, Mxd=62.0, Myd=7.0, Vxd=-4.0, Vyd=-24.0
(loads in coordinate system of profile)
M max : N"d=-160.0, M"xd=62.0, M"yd=7.0, V"xd=-4.0, V"yd=-2
(loads in coordinate system of anchors)



Fire Situation Resistances Diagrams





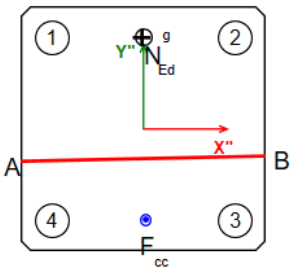
Load Case #1 : N max : Nd=-165.0, Mxd=44.0, Myd=1.0, Vxd=-6.0, Vyd=-18.0

Steel Failure: Sufficient capacity **Concrete failure: Sufficient capacity**

Steel failure verification

Design value of normal compressive force in the column	$N_{c,Ed}$	-165	kN
Friction coefficient (between base plate and grout layer)	C_{fd}	0.2	
Joint friction resistance	$F_{f,Rd}$	33	kN
Resultant shear force	V_{sd}	18.97	kN
Resultant shear force taking account friction contribution	$V_{sd,f}$	0	kN

Neutral axis in (X"/Y") = A(-200.0 / -52.5); B(200.0 / -43.4)
Resultant tension force in (X"/Y") = N $^{g}_{Ed}$(-2.6/150.0)
Resultant compression force (concrete) in (X"/Y") = F $_{cc}$(3.4/-148.1)



Bolt Pos.	Acting axial force [kN]	Design tension resistance [kN]	Axial capacity usage [%]	Acting shear force [kN]	Design shear resistance [kN]	Shear capacity usage [%]	Interaction [%]
1	33.4	127.1	26.3	0.0	45.0	0.0	n/r
2	32.3	127.1	25.4	0.0	45.0	0.0	n/r
3	-17.5	127.1	13.8	0.0	45.0	0.0	n/r
4	-16.4	127.1	12.9	0.0	45.0	0.0	n/r

Concrete failure verifications

Proof	Load [kN]	Capacity [kN]	Utilization [%]	Status
Pull-Out Failure	33.4	279.0	12.0	Ok
Cone failure				Ok
Concrete decisive:				
1) Foundation (Plain Concrete)	65.7	150.7	43.6	
2) Assigned Hanger Reinforcement	0.0	0.0	n/r	
3) Requirement of Strut and Tie Model	0.0	0.0	n/r	
Splitting Failure				Ok
Concrete decisive:				
1) Foundation (Plain Concrete)	65.7	137.8	47.7	
2)Assigned Splitting Reinforcement || X	0.0	0.0	-	
3)Assigned Splitting Reinforcement || Y	0.0	0.0	-	
Blow-Out Failure	0.0	0.0	n/r	Ok
Pry-out failure	0.0	0.0	n/r	Ok
Edge failure				Ok
Concrete decisive:				
1) -X (Left) Edge (Plain Concrete)	0.0	0.0	n/r	
2) +X (Right) Edge (Plain Concrete)	0.0	0.0	n/r	
3) +Y (Top) Edge (Plain Concrete)	0.0	0.0	n/r	
4) -Y (Bottom) Edge (Plain Concrete)	0.0	0.0	n/r	
5)Assigned Edge Reinforcement (-X)	0.0	0.0	n/r	
6)Assigned Edge Reinforcement (+X)	0.0	0.0	n/r	
7)Assigned Edge Reinforcement (+Y)	0.0	0.0	n/r	
8)Assigned Edge Reinforcement (-Y)	0.0	0.0	n/r	
Combined Resistance	$\beta_N \leq 1$		47.7	Ok

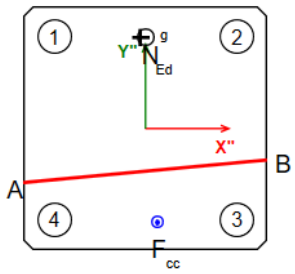
Load Case #2 : M max : Nd=-160.0, Mxd=62.0, Myd=7.0, Vxd=-4.0, Vyd=-24.0

Steel Failure: Sufficient capacity **Concrete failure: Sufficient capacity**

Steel failure verification

Design value of normal compressive force in the column	$N_{c,Ed}$	-160	kN
Friction coefficient (between base plate and grout layer)	C_{fd}	0.2	
Joint friction resistance	$F_{f,Rd}$	32	kN
Resultant shear force	V_{sd}	24.33	kN
Resultant shear force taking account friction contribution	$V_{sd,f}$	0	kN

Neutral axis in (X"/Y") = A(-200.0 / -89.5); B(200.0 / -51.1)
Resultant tension force in (X"/Y") = N^{g}_{Ed}(-9.8/150.0)
Resultant compression force (concrete) in (X"/Y") = F_{cc}(19.2/-153.3)



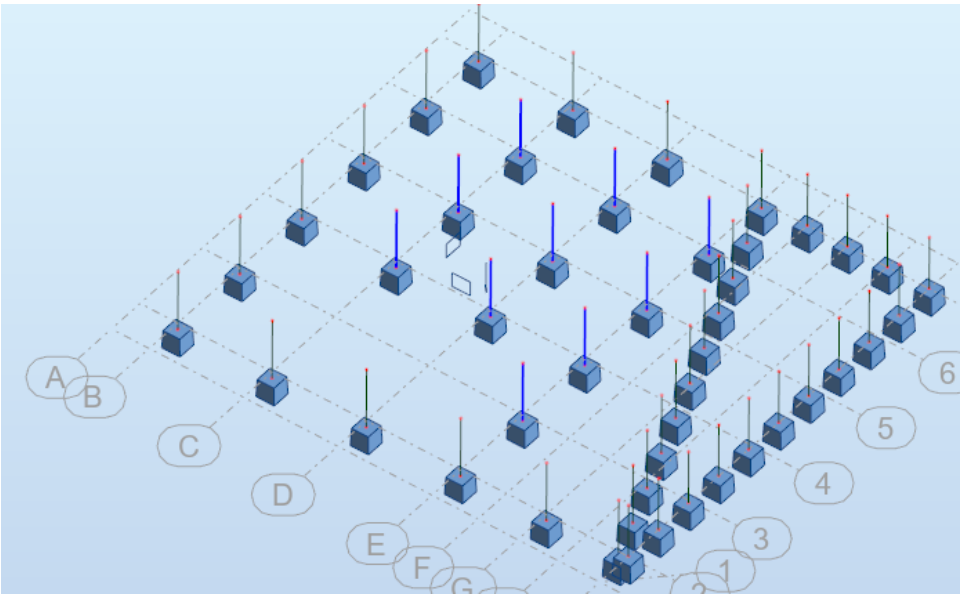
Bolt Pos.	Acting axial force [kN]	Design tension resistance [kN]	Axial capacity usage [%]	Acting shear force [kN]	Design shear resistance [kN]	Shear capacity usage [%]	Interaction [%]
1	66.2	127.1	52.1	0.0	45.0	0.0	n/r
2	58.1	127.1	45.7	0.0	45.0	0.0	n/r
3	-26.5	127.1	20.9	0.0	45.0	0.0	n/r
4	-18.4	127.1	14.5	0.0	45.0	0.0	n/r

Concrete failure verifications

Proof	Load [kN]	Capacity [kN]	Utilization [%]	Status
Pull-Out Failure	66.2	279.0	23.7	Ok
Cone failure				Ok
Concrete decisive:				
1) Foundation (Plain Concrete)	124.2	147.3	84.3	
2) Assigned Hanger Reinforcement	0.0	0.0	n/r	
3) Requirement of Strut and Tie Model	0.0	0.0	n/r	
Splitting Failure				Ok
Concrete decisive:				
1) Foundation (Plain Concrete)	124.2	135.5	91.7	
2)Assigned Splitting Reinforcement || X	0.0	0.0	-	
3)Assigned Splitting Reinforcement || Y	0.0	0.0	-	
Blow-Out Failure	0.0	0.0	n/r	Ok
Pry-out failure	0.0	0.0	n/r	Ok
Edge failure				Ok
Concrete decisive:				
1) -X (Left) Edge (Plain Concrete)	0.0	0.0	n/r	
2) +X (Right) Edge (Plain Concrete)	0.0	0.0	n/r	
3) +Y (Top) Edge (Plain Concrete)	0.0	0.0	n/r	
4) -Y (Bottom) Edge (Plain Concrete)	0.0	0.0	n/r	
5)Assigned Edge Reinforcement (-X)	0.0	0.0	n/r	
6)Assigned Edge Reinforcement (+X)	0.0	0.0	n/r	
7)Assigned Edge Reinforcement (+Y)	0.0	0.0	n/r	
8)Assigned Edge Reinforcement (-Y)	0.0	0.0	n/r	
Combined Resistance	$\beta_N \le 1$		91.7	Ok

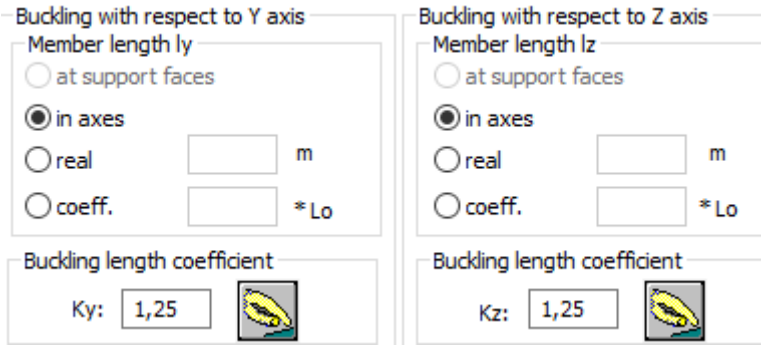
IŠVADA: kolonų laikomoji galia užtikrinta.

Vidurinių kolonų išdėstymas:

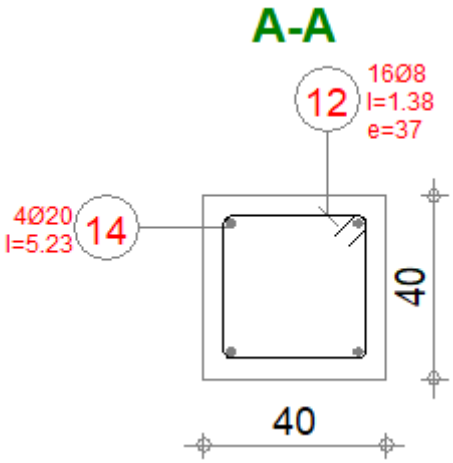


Kolonos geometrinis ilgis: 5,37 m.

Skaičiuojamieji ilgiai:



Reikalingas armavimas:



1 Level:

- Name :

- Reference level : -0.55 (m)
- Concrete creep coefficient : φ_p = 2.47
- Cement class : N
- Environment class : XC1
- Structure class : S4

2 Column: Column7

Number of identical elements: 1

2.1 Material properties:

- Concrete : C30/37 f_{ck} = 30.00 (MPa)
  Unit weight : 2501.36 (kG/m3)
  Aggregate size : 20.0 (mm)
- Longitudinal reinforcement: : B500B f_{yk} = 500.00 (MPa)
  Ductility class : B
- Transversal reinforcement: : B500B f_{yk} = 500.00 (MPa)
- Modified partial coefficients:
  α_{cc} = 0.9 1992-1-1 3.1.6 (1)P

2.2 Geometry:

2.2.1	Rectangular	40.0 x 40.0 (cm)
2.2.2	Height: L	= 5.37 (m)
2.2.3	Slab thickness	= 0.00 (m)
2.2.4	Beam height	= 0.00 (m)
2.2.5	Cover	= 4.0 (cm)

2.3 Calculation options:

- Calculations according to : EN 1992-1-1:2004/A1:2014
- Seismic dispositions : No requirements
- Precast column : yes
- Pre-design : no
- Slenderness taken into account : yes
- Compression : with bending
- Ties : to slab
- Fire resistance class : No requirements

2.4 Calculation results:

Safety factors Rd/Ed = 1.54 > 1.0

2.4.1 ULS/ALS Analysis

Design combination: ULS/59=1*1.35 + 2*0.91 + 7*0.78 + 3*1.30 (C)
Combination type: ULS
Internal forces:
Nsd = 780.21 (kN) Msdy = -27.70 (kN*m) Msdz = -5.40 (kN*m)
Design forces:
Cross-section in the middle of the column
N = 780.21 (kN) N*etotz = -82.10 (kN*m) N*etoty= -15.60 (kN*m)

Eccentricity:		ez (My/N) (cm)	ey (Mz/N) (cm)
Initial	e0:	-3.6	-0.7
Imperfection	ei:	1.4	0.0
I order (e0 + ei)	e0Ed:	-2.1	-0.7
Minimal	eEdmin:	2.0	2.0
Total	eEd:	-10.5	-2.0

2.4.1.1. Detailed analysis-Direction Y:

2.4.1.1.1 Slenderness analysis

Non-sway structure

L (m)	Lo (m)	λ	λlim	
5.37	6.71	58.13	21.14	Slender column

2.4.1.1.2 Buckling analysis

MA = 0.00 (kN*m) MB = -5.90 (kN*m) MC = -27.70 (kN*m)
Case: Cross-section in the middle of the column, Slenderness taken into account
M0 = -27.70 (kN*m)
ei = θ1* lo/2 = 1.4 (cm)
θ1 = θo ∗ αh * αm = 0.00
θo = 0.01
αh = 0.86
αm = (0,5(1+1/m))^0.5 = 1.00
m = 1.00
Method based on nominal stiffness

$$\left[1+\frac{\beta}{(N_B/N)-1}\right] = 2.11$$

β = 1.00
Nb = (π^2 * EJ)/ lo^2 = 1486.20 (kN)
EJ = Kc*Ecd*Jc+Ks*Es*Js = 6784.96 (kN*m2)
φef = 2.47
Jc = 213333.3 (cm4)
Js = 2463.0 (cm4)
Kc = 0.03 ()
Ks = 1.00 ()
MEdmin = 15.60 (kN*m)

$$M_{Ed} = \max\left\{M_{Ed\min};\left[1+\frac{\beta}{(N_B/N)-1}\right]M_{0Ed}\right\} = -82.10 \text{ (kN*m)}$$

2.4.1.2. Detailed analysis-Direction Z:

2.4.1.2.1 Slenderness analysis

Non-sway structure

L (m)	Lo (m)	λ	λlim	
5.37	6.71	58.13	21.14	Slender column

2.4.1.2.2 Buckling analysis

MA = 0.00 (kN*m) MB = -8.20 (kN*m) MC = -5.40 (kN*m)
Case: Cross-section in the middle of the column, Slenderness taken into account
M0 = -5.40 (kN*m)
ei = 0.0 (cm)
Method based on nominal stiffness

$$\left[1+\frac{\beta}{(N_B/N)-1}\right] = 2.11$$

β = 1.00
Nb = (π^2 * EJ)/ lo^2 = 1486.20 (kN)
EJ = Kc*Ecd*Jc+Ks*Es*Js = 6784.96 (kN*m2)
φef = 2.47
Jc = 213333.3 (cm4)
Js = 2463.0 (cm4)
Kc = 0.03 ()
Ks = 1.00 ()
MEdmin = 15.60 (kN*m)

$$M_{Ed} = \max\left\{M_{Ed\min};\left[1+\frac{\beta}{(N_B/N)-1}\right]M_{0Ed}\right\} = -15.60 \text{ (kN*m)}$$

2.4.2 Reinforcement:

Real (provided) area	Asr = 12.57 (cm2)
Ratio:	ρ = 0.79 %

2.5 Reinforcement:

Main bars (B500B):
- 4 ϕ20 l = 5.33 (m)

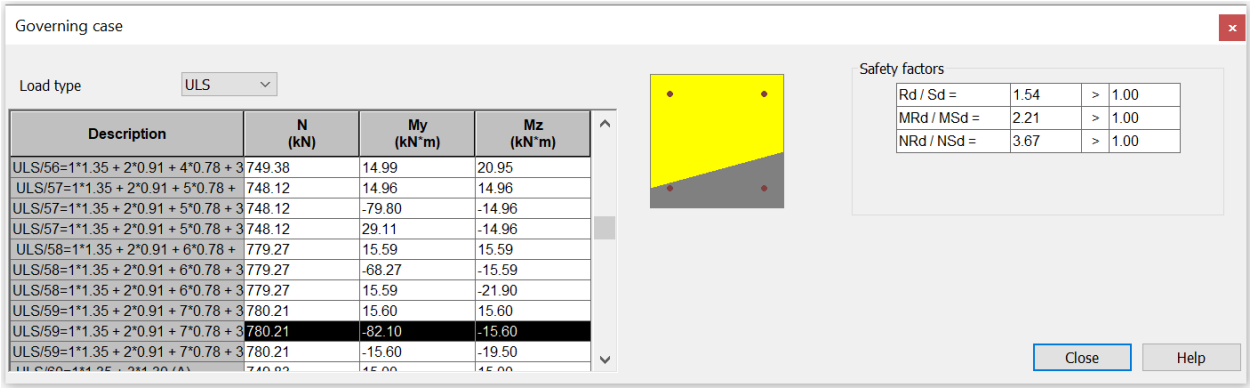
Transversal reinforcement: (B500B):
stirrups: 16 ϕ8 l = 1.38 (m)

3 Material survey:

- Concrete volume = 0.86 (m3)
- Formwork = 8.59 (m2)

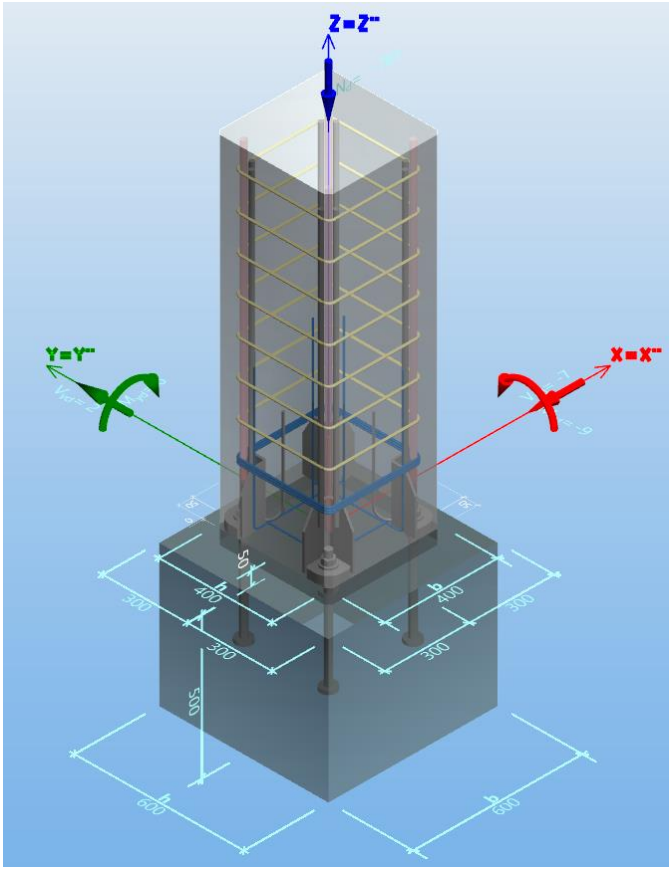
- Steel B500B
  - Total weight = 61.29 (kG)
  - Density = 71.33 (kG/m3)
  - Average diameter = 13.9 (mm)
  - Reinforcement survey:

Diameter	Length (m)	Weight (kG)	Number (No.)	Total weight (kG)
8	1.38	0.54	16	8.69
20	5.33	13.15	4	52.60



Išvada: sąlyga tenkinama

Vidinės Kolonos bazės inkariniai varžtai pagal atramines reakcijas pamate parenkami „Peikko Designer“ programa. Vidinių kolonų bazės 4xHPKM24 ir inkariniai varžtai HPM24L.



Summary

Name	Stage	#	Load Case	Page No.	Max Utilization	Status
Kolona 1	Final	1	N max	5	28%	OK
	Final	2	M max	6	69%	OK

Kolona 1

Note:

Number of Columns: 1

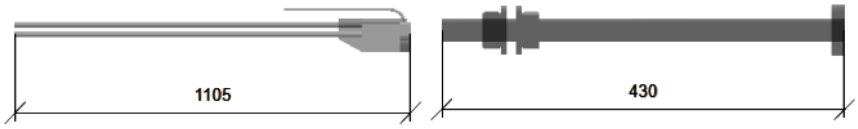
Peikko Products

Column Shoes: 4 x HPKM24

Bolts: 4 x HPM24L

Totals

Product	Amount
HPKM24	4
HPM24L	4



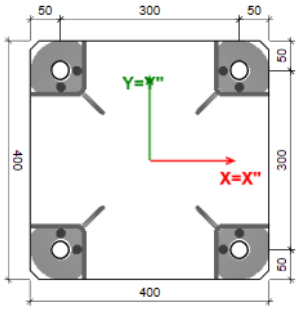
Minimum required torque value of nuts : T_{min} = 200 Nm
Maximum allowed torque value of nuts : T_{max} = 380 Nm
Bolt installation template: PPL24-4 300x300

Materials and Geometry

Column: 400x400

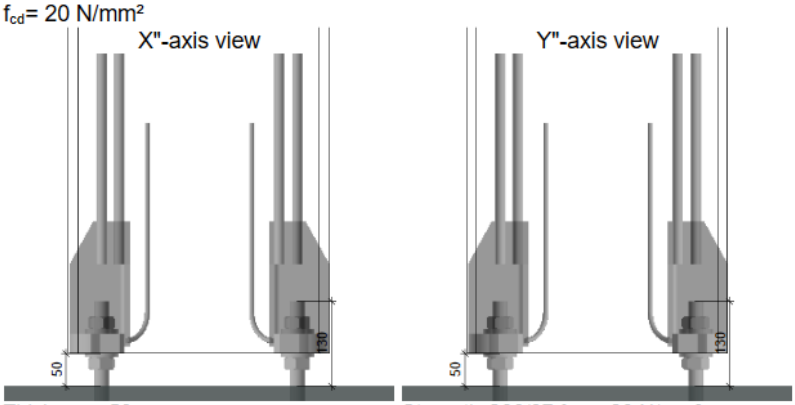
Concrete: C30/37
f_{cd}= 20 N/mm²

Plane View



X"-axis view

Y"-axis view



Grouting:

Thickness: 50 mm

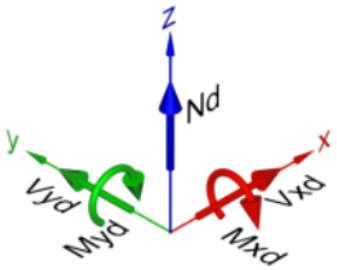
Strength C30/37 f_{cd} = 20 N/mm²

X; Y = local coordinate system of profile
X"; Y" = local coordinate system of anchors

Load Cases

NOTE: Loads are defined in the local coordinate system of the profile.

(Design loads)



Final Stage

#	Name	N_d [kN]	M_{xd} [kNm]	M_{yd} [kNm]	V_{xd} [kN]	V_{yd} [kN]
1	N max	-781.0	-9.0	6.0	-7.0	2.0
2	M max	-379.0	57.0	9.0	-1.0	-20.0

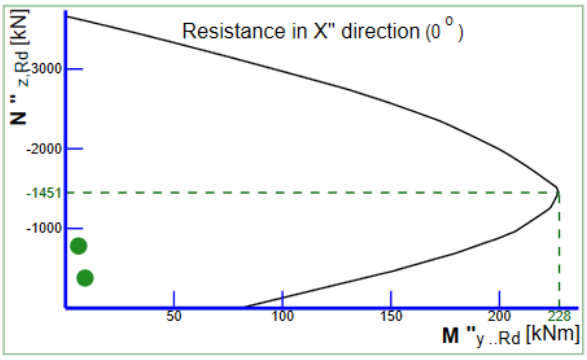
Erection stage

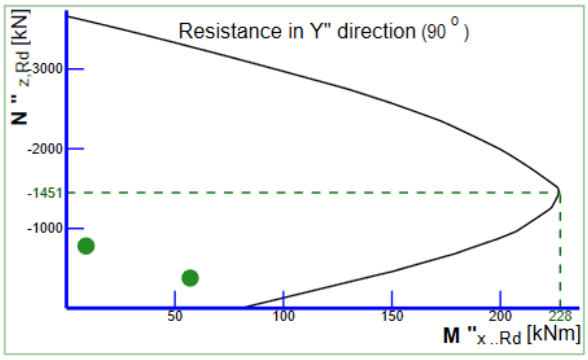
No load case for this stage defined

Fire Situation Loads

No load case for this stage defined

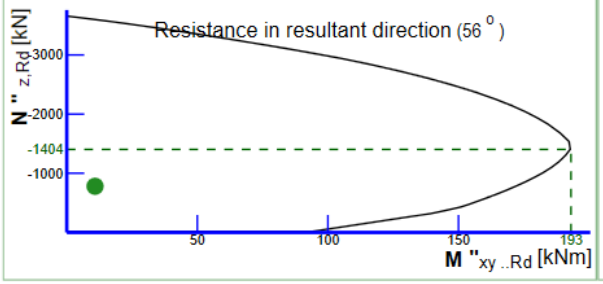
Resistance Diagrams



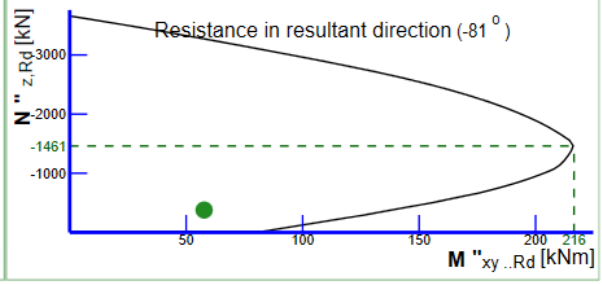


Resultant Diagrams per Load

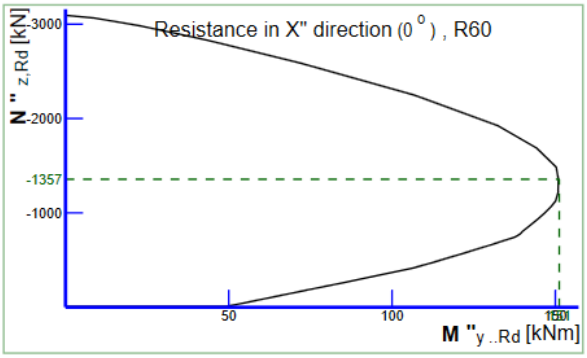
N max : Nd=-781.0, Mxd=-9.0, Myd=6.0, Vxd=-7.0, Vyd=2.0
(loads in coordinate system of profile)
N max : N"d=-781.0, M"xd=-9.0, M"yd=6.0, V"xd=-7.0, V"yd=2.
(loads in coordinate system of anchors)

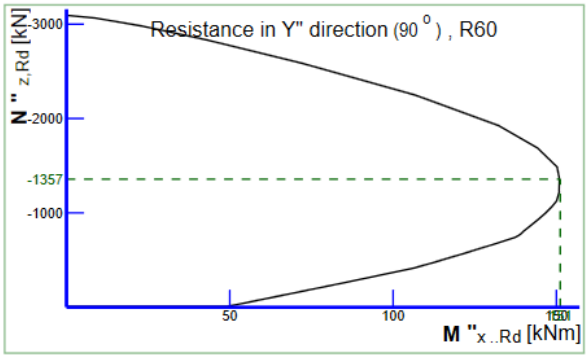


M max : Nd=-379.0, Mxd=57.0, Myd=9.0, Vxd=-1.0, Vyd=-20.0
(loads in coordinate system of profile)
M max : N"d=-379.0, M"xd=57.0, M"yd=9.0, V"xd=-1.0, V"yd=-
(loads in coordinate system of anchors)



Fire Situation Resistances Diagrams





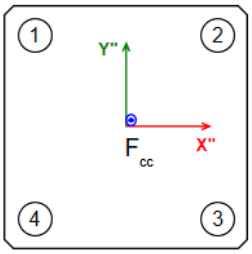
Load Case #1 : N max : Nd=-781.0, Mxd=-9.0, Myd=6.0, Vxd=-7.0, Vyd=2.0

Steel Failure: Sufficient capacity **Concrete failure: Sufficient capacity**

Steel failure verification

Design value of normal compressive force in the column	$N_{c,Ed}$	-781	kN
Friction coefficient (between base plate and grout layer)	C_{fd}	0.2	
Joint friction resistance	$F_{f,Rd}$	156.2	kN
Resultant shear force	V_{sd}	7.28	kN
Resultant shear force taking account friction contribution	$V_{sd,f}$	0	kN

Resultant compression force (concrete) in (X"/Y") = F_{cc}(7.2/10.9)



Bolt Pos.	Acting axial force [kN]	Design tension resistance [kN]	Axial capacity usage [%]	Acting shear force [kN]	Design shear resistance [kN]	Shear capacity usage [%]	Interaction [%]
1	-17.7	127.1	13.9	0.0	45.0	0.0	n/r
2	-20.7	127.1	16.3	0.0	45.0	0.0	n/r
3	-16.2	127.1	12.8	0.0	45.0	0.0	n/r
4	-13.2	127.1	10.4	0.0	45.0	0.0	n/r

Concrete failure verifications

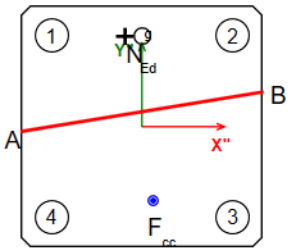
Proof	Load [kN]	Capacity [kN]	Utilization [%]	Status
Pull-Out Failure	0.0	0.0	0.0	Ok
Cone failure				Ok
Concrete decisive:				
1) Foundation (Plain Concrete)	0.0	0.0	n/r	
2) Assigned Hanger Reinforcement	0.0	0.0	n/r	
3) Requirement of Strut and Tie Model	0.0	0.0	n/r	
Splitting Failure				Ok
Concrete decisive:				
1) Foundation (Plain Concrete)	0.0	0.0	n/r	
2)Assigned Splitting Reinforcement || X	0.0	0.0	-	
3)Assigned Splitting Reinforcement || Y	0.0	0.0	-	
Blow-Out Failure	0.0	0.0	n/r	Ok
Pry-out failure	0.0	0.0	n/r	Ok
Edge failure				Ok
Concrete decisive:				
1) -X (Left) Edge (Plain Concrete)	0.0	0.0	n/r	
2) +X (Right) Edge (Plain Concrete)	0.0	0.0	n/r	
3) +Y (Top) Edge (Plain Concrete)	0.0	0.0	n/r	
4) -Y (Bottom) Edge (Plain Concrete)	0.0	0.0	n/r	
5)Assigned Edge Reinforcement (-X)	0.0	0.0	n/r	
6)Assigned Edge Reinforcement (+X)	0.0	0.0	n/r	
7)Assigned Edge Reinforcement (+Y)	0.0	0.0	n/r	
8)Assigned Edge Reinforcement (-Y)	0.0	0.0	n/r	
Combined Resistance	$\beta_N \leq 1$		0.0	Ok

Load Case #2 : M max : Nd=-379.0, Mxd=57.0, Myd=9.0, Vxd=-1.0, Vyd=-20.0

Steel Failure: Sufficient capacity **Concrete failure: Sufficient capacity**

Steel failure verification

Design value of normal compressive force in the column	$N_{c,Ed}$	-379	kN
Friction coefficient (between base plate and grout layer)	C_{fd}	0.2	
Joint friction resistance	$F_{f,Rd}$	75.8	kN
Resultant shear force	V_{sd}	20.02	kN
Resultant shear force taking account friction contribution	$V_{sd,f}$	0	kN



Neutral axis in (X"/Y") = A(-200.0 / -9.5); B(200.0 / 57.5)
Resultant tension force in (X"/Y") = N^{g}_{Ed}(-29.9/150.0)
Resultant compression force (concrete) in (X"/Y") = F_{cc}(18.9/-121.9)

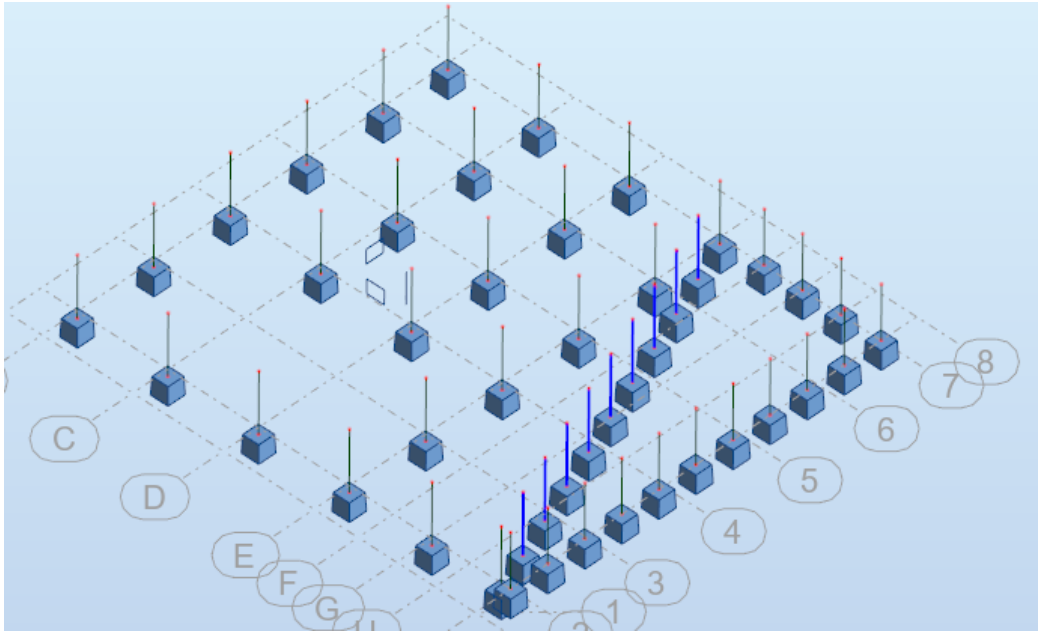
Bolt Pos.	Acting axial force [kN]	Design tension resistance [kN]	Axial capacity usage [%]	Acting shear force [kN]	Design shear resistance [kN]	Shear capacity usage [%]	Interaction [%]
1	21.3	127.1	16.8	0.0	45.0	0.0	n/r
2	14.2	127.1	11.2	0.0	45.0	0.0	n/r
3	-28.1	127.1	22.1	0.0	45.0	0.0	n/r
4	-21.0	127.1	16.5	0.0	45.0	0.0	n/r

Concrete failure verifications

Proof	Load [kN]	Capacity [kN]	Utilization [%]	Status
Pull-Out Failure	21.3	226.2	9.4	Ok
Cone failure				Ok
Concrete decisive:				
1) Foundation (Plain Concrete)	35.5	51.8	68.6	
2) Assigned Hanger Reinforcement	0.0	0.0	n/r	
3) Requirement of Strut and Tie Model	0.0	0.0	n/r	
Splitting Failure				Ok
Concrete decisive:				
1) Foundation (Plain Concrete)	35.5	52.9	67.1	
2)Assigned Splitting Reinforcement || X	0.0	0.0	-	
3)Assigned Splitting Reinforcement || Y	0.0	0.0	-	
Blow-Out Failure	0.0	0.0	n/r	Ok
Pry-out failure	0.0	0.0	n/r	Ok
Edge failure				Ok
Concrete decisive:				
1) -X (Left) Edge (Plain Concrete)	0.0	0.0	n/r	
2) +X (Right) Edge (Plain Concrete)	0.0	0.0	n/r	
3) +Y (Top) Edge (Plain Concrete)	0.0	0.0	n/r	
4) -Y (Bottom) Edge (Plain Concrete)	0.0	0.0	n/r	
5)Assigned Edge Reinforcement (-X)	0.0	0.0	n/r	
6)Assigned Edge Reinforcement (+X)	0.0	0.0	n/r	
7)Assigned Edge Reinforcement (+Y)	0.0	0.0	n/r	
8)Assigned Edge Reinforcement (-Y)	0.0	0.0	n/r	
Combined Resistance	$\beta_N \le 1$		68.6	Ok

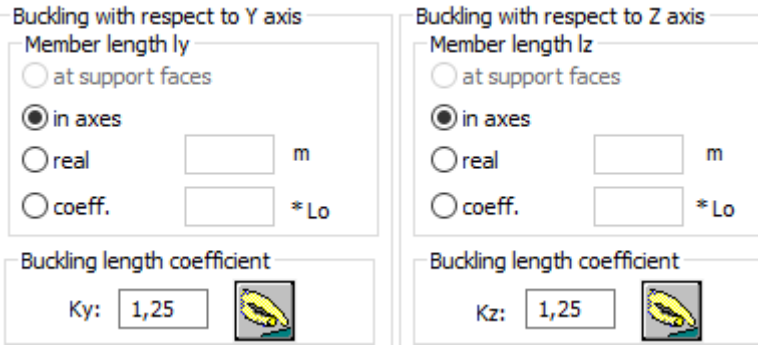
IŠVADA: kolonų laikomoji galia užtikrinta.

Kolonos ant E1 ašies:

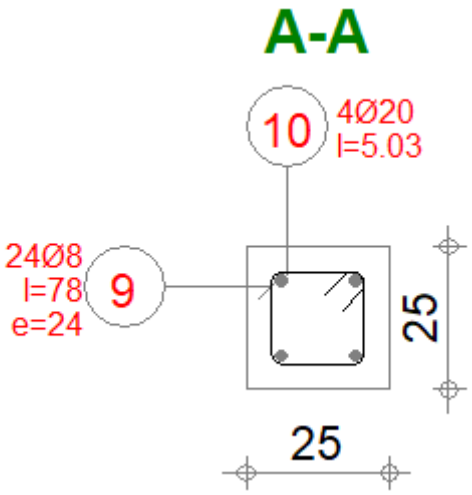


Kolonos geometrinis ilgis: 5,37 m.

Skaičiuojamieji ilgiai:



Reikalingas armavimas:



1 Level:

- Name :
- Reference level : -0.55 (m)
- Concrete creep coefficient : φ_p = 2.67
- Cement class : N
- Environment class : XC1
- Structure class : S4

2 Column: Column46

Number of identical elements: 1

2.1 Material properties:

- Concrete : C30/37 f_{ck} = 30.00 (MPa)
  Unit weight : 2501.36 (kG/m3)
  Aggregate size : 20.0 (mm)
- Longitudinal reinforcement: : B500B f_{yk} = 500.00 (MPa)
  Ductility class : B
- Transversal reinforcement: : B500B f_{yk} = 500.00 (MPa)
- Modified partial coefficients:
  α_{cc} = 0.9 1992-1-1 3.1.6 (1)P

2.2 Geometry:

2.2.1	Rectangular	25.0 x 25.0 (cm)
2.2.2	Height: L	= 5.37 (m)
2.2.3	Slab thickness	= 0.00 (m)
2.2.4	Beam height	= 0.00 (m)
2.2.5	Cover	= 4.0 (cm)

2.3 Calculation options:

- Calculations according to : EN 1992-1-1:2004/A1:2014
- Seismic dispositions : No requirements
- Precast column : yes
- Pre-design : no
- Slenderness taken into account : yes
- Compression : with bending
- Ties : to slab
- Fire resistance class : No requirements

2.4 Calculation results:

Safety factors Rd/Ed = 1.39 > 1.0

2.4.1 ULS/ALS Analysis

Design combination: ULS/29=1*1.35 + 2*0.91 + 7*1.30 + 3*0.91 (C)
Combination type: ULS
Internal forces:
Nsd = 183.73 (kN) Msdy = 3.86 (kN*m) Msdz = -1.78 (kN*m)
Design forces:

Cross-section in the middle of the column
N = 183.73 (kN) N*etotz = 17.87 (kN*m) N*etoty= -5.61 (kN*m)

Eccentricity:		ez (My/N) (cm)	ey (Mz/N) (cm)
Initial	e0:	2.1	-1.0
Imperfection	ei:	1.4	0.0
I order (e0 + ei)	e0Ed:	3.5	-1.0
Minimal	eEdmin:	2.0	2.0
Total	eEd:	9.7	-3.1

2.4.1.1. Detailed analysis-Direction Y:

2.4.1.1.1 Slenderness analysis

Non-sway structure

L (m)	Lo (m)	λ	λlim	
5.37	6.71	93.01	31.71	Slender column

2.4.1.1.2 Buckling analysis

MA = 0.29 (kN*m) MB = -10.69 (kN*m) MC = 3.86 (kN*m)
Case: Cross-section in the middle of the column, Slenderness taken into account
M0 = 3.86 (kN*m)
ei = θ1* lo/2 = 1.4 (cm)
θ1 = θo ∗ αh * αm = 0.00
θo = 0.01
αh = 0.86
αm = (0,5(1+1/m))^0.5 = 1.00
m = 1.00
Method based on nominal stiffness

$$\left[1+\frac{\beta}{(N_B/N)-1}\right] = 2.74$$

β = 1.00
Nb = (π^2 * EJ)/ lo^2 = 289.30 (kN)
EJ = Kc*Ecd*Jc+Ks*Es*Js = 1320.75 (kN*m2)
φef = 2.67
Jc = 32552.1 (cm4)
Js = 530.9 (cm4)
Kc = 0.03 ()
Ks = 1.00 ()
MEdmin = 3.67 (kN*m)

$$M_{Ed} = \max\left\{M_{Ed\min};\left[1+\frac{\beta}{(N_B/N)-1}\right]M_{0Ed}\right\} = 17.87 \text{ (kN*m)}$$

2.4.1.2. Detailed analysis-Direction Z:

2.4.1.2.1 Slenderness analysis

Non-sway structure

L (m)	Lo (m)	λ	λlim	
5.37	6.71	93.01	65.59	Slender column

2.4.1.2.2 Buckling analysis

MA = -4.46 (kN*m) MB = 3.74 (kN*m) MC = -1.78 (kN*m)
Case: Cross-section in the middle of the column, Slenderness taken into account
M0 = max(|M0e|, |M0emin|) = -1.78 (kN*m)
M0e = 0.6*M02+0.4*M01 = -1.18 (kN*m)
M0emin = 0.4*M02 = -1.78 (kN*m)

M01 = min(|MA|; |MB|)
M02 = max(|MA|; |MB|)
| MA | > | MB | ⇒ M01 = MB, M02 = MA

ei = 0.0 (cm)
Method based on nominal stiffness

$$\left[1+\frac{\beta}{(N_B/N)-1}\right] = 3.15$$

β = 1.23
Nb = (π^2 * EJ)/ lo^2 = 289.30 (kN)
EJ = Kc*Ecd*Jc+Ks*Es*Js = 1320.75 (kN*m2)
φef = 2.67
Jc = 32552.1 (cm4)
Js = 530.9 (cm4)
Kc = 0.03 ()
Ks = 1.00 ()
MEdmin = 3.67 (kN*m)

$$M_{Ed} = \max\left\{M_{Ed\min};\left[1+\frac{\beta}{(N_B/N)-1}\right]M_{0Ed}\right\} = -5.61 \text{ (kN*m)}$$

2.4.2 Reinforcement:

Real (provided) area	Asr = 12.57 (cm2)
Ratio:	ρ = 2.01 %

2.5 Reinforcement:

Main bars (B500B):
- 4 ϕ20 l = 5.33 (m)

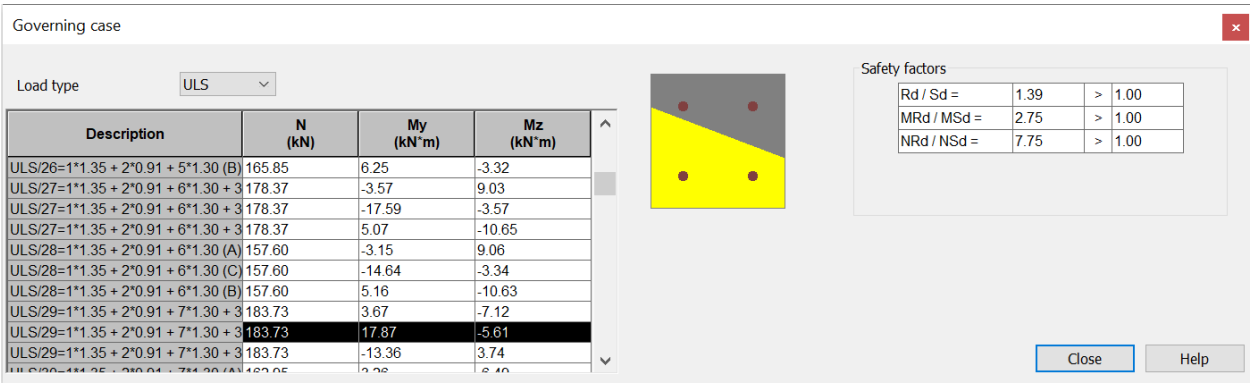
Transversal reinforcement: (B500B):
stirrups: 24 ϕ8 l = 0.78 (m)

3 Material survey:

- Concrete volume = 0.34 (m3)
- Formwork = 5.37 (m2)

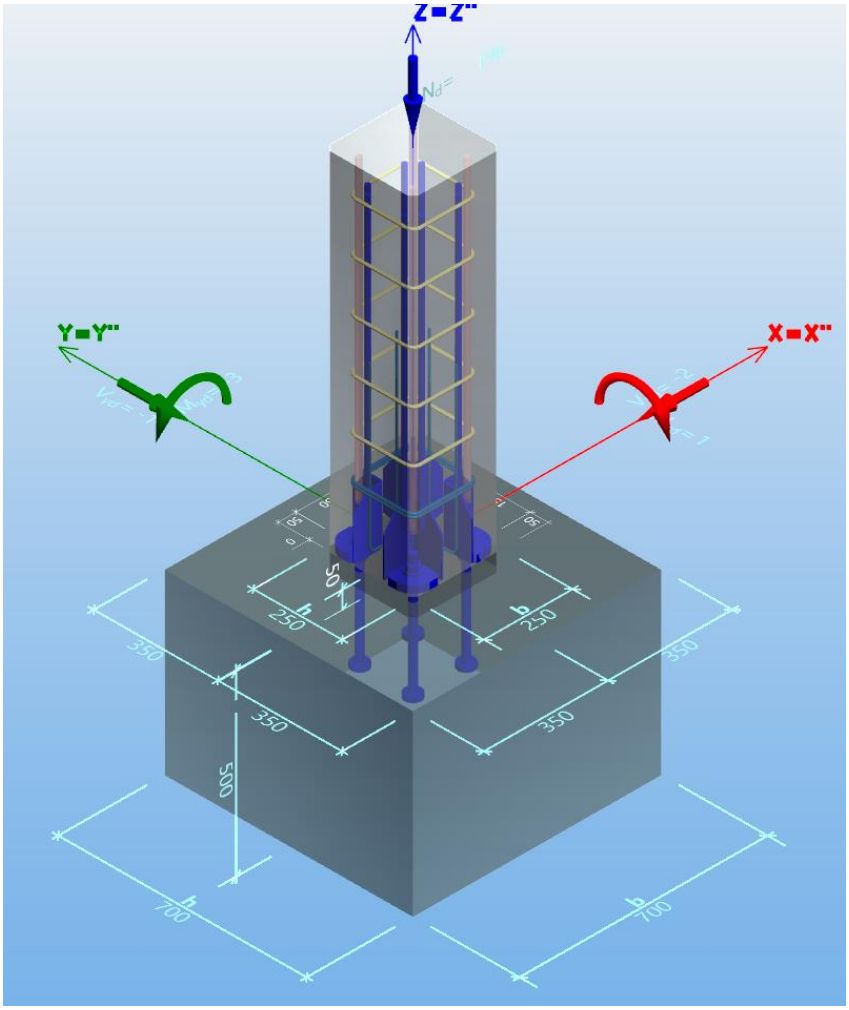
- Steel B500B
  - Total weight = 59.95 (kG)
  - Density = 178.63 (kG/m3)
  - Average diameter = 14.4 (mm)
  - Reinforcement survey:

Diameter	Length (m)	Weight (kG)	Number (No.)	Total weight (kG)
8	0.78	0.31	24	7.36
20	5.33	13.15	4	52.60



Išvada: sąlyga tenkinama

Kolonos ant E-1 ašies bazės inkariniai varžtai pagal atramines reakcijas pamate parenkami „Peikko Designer“ programa. Kolonų ant E-1 ašies bazės 4xHPKM20 ir inkariniai varžtai HPM20L.



Summary

Name	Stage	#	Load Case	Page No.	Max Utilization	Status
Kolona 1	Final	1	N max	5	20%	OK
	Final	2	M max	6	94%	OK
	Final	3	-N max	7	94%	OK

Kolona 1

Note:

Number of Columns: 1

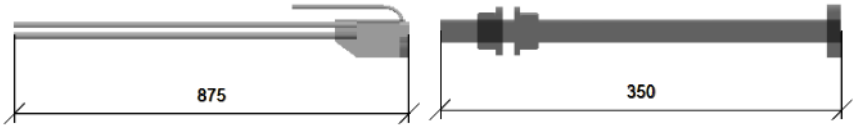
Peikko Products

Column Shoes: 4 x HPKM20

Bolts: 4 x HPM20L

Totals

Product	Amount
HPKM20	4
HPM20L	4



Minimum required torque value of nuts : T_{min} = 150 Nm
Maximum allowed torque value of nuts : T_{max} = 250 Nm

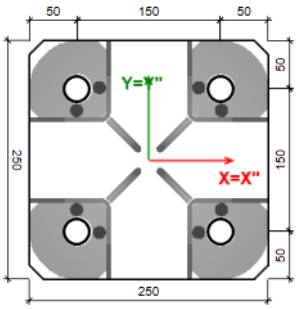
Bolt installation template: PPL20-4 150x150

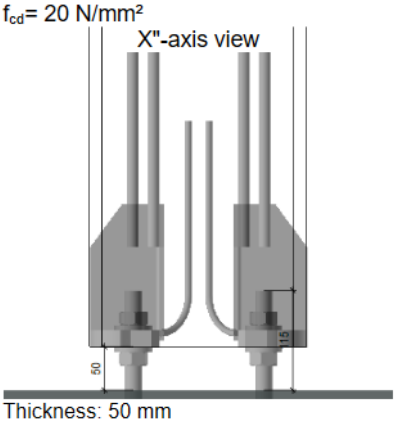
Materials and Geometry

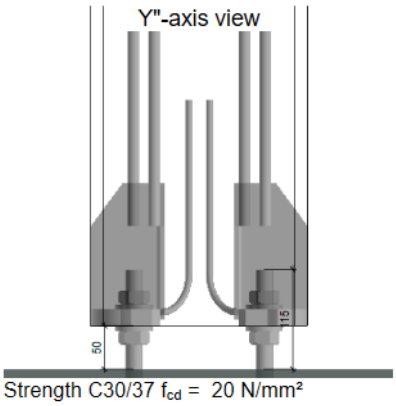
Column: 250x250

Concrete: C30/37
f_{cd}= 20 N/mm²

Plane View







Grouting:

Thickness: 50 mm

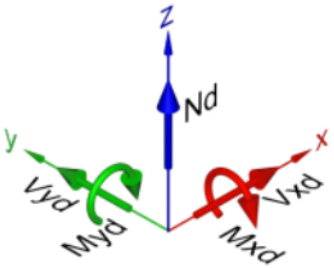
Strength C30/37 f_{cd} = 20 N/mm²

X; Y = local coordinate system of profile
X"; Y" = local coordinate system of anchors

Load Cases

NOTE: Loads are defined in the local coordinate system of the profile.

(Design loads)



Final Stage

#	Name	N_d [kN]	M_{xd} [kNm]	M_{yd} [kNm]	V_{xd} [kN]	V_{yd} [kN]
1	N max	-196.0	1.0	-3.0	-2.0	-1.0
2	M max	2.0	3.0	16.0	9.0	-2.0
3	-N max	6.0	2.0	16.0	9.0	-1.0

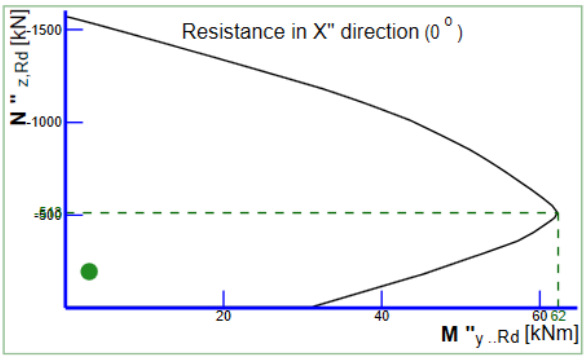
Erection stage

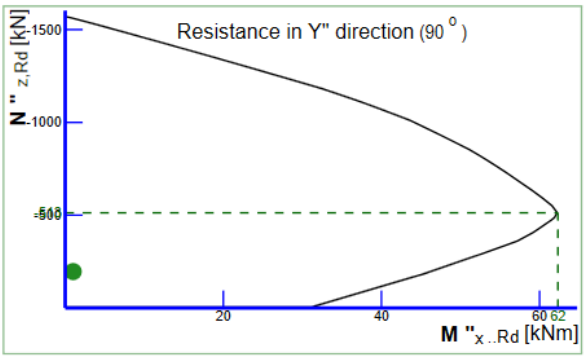
No load case for this stage defined

Fire Situation Loads

No load case for this stage defined

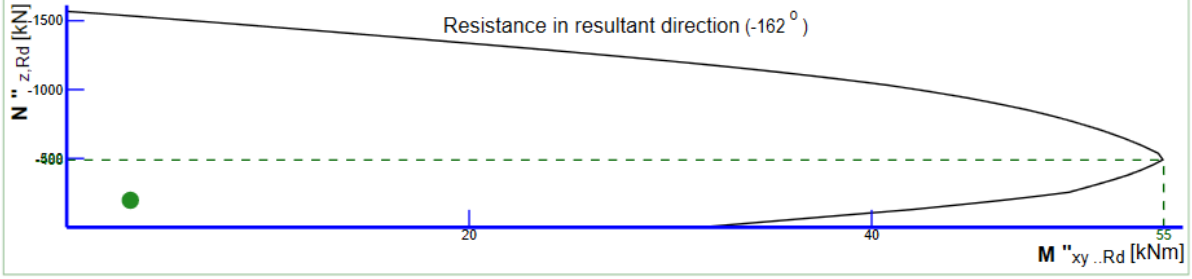
Resistance Diagrams



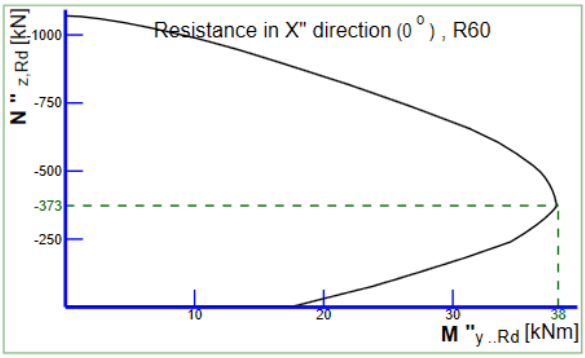


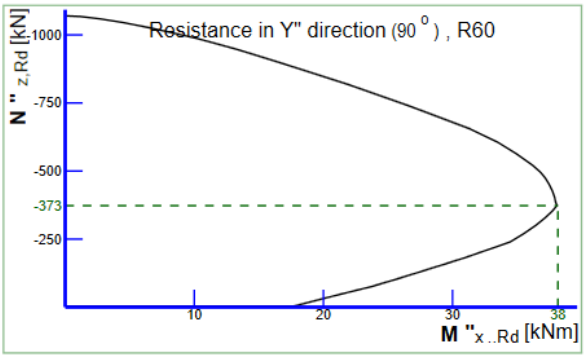
Resultant Diagrams per Load

N max : Nd=-196.0, Mxd=1.0, Myd=-3.0, Vxd=-2.0, Vyd=-1.0
(loads in coordinate system of profile)
N max : N"d=-196.0, M"xd=1.0, M"yd=-3.0, V"xd=-2.0, V"yd=-1.0
(loads in coordinate system of anchors)



Fire Situation Resistances Diagrams





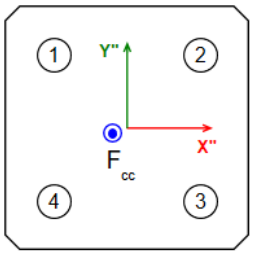
Load Case #1 : N max : Nd=-196.0, Mxd=1.0, Myd=-3.0, Vxd=-2.0, Vyd=-1.0

Steel Failure: Sufficient capacity **Concrete failure: Sufficient capacity**

Steel failure verification

Design value of normal compressive force in the column	$N_{c,Ed}$	-196	kN
Friction coefficient (between base plate and grout layer)	C_{fd}	0.2	
Joint friction resistance	$F_{f,Rd}$	39.2	kN
Resultant shear force	V_{sd}	2.24	kN
Resultant shear force taking account friction contribution	$V_{sd,f}$	0	kN

Resultant compression force (concrete) in (X"/Y") = F_{cc}(-15.2/-5.1)



Bolt Pos.	Acting axial force [kN]	Design tension resistance [kN]	Axial capacity usage [%]	Acting shear force [kN]	Design shear resistance [kN]	Shear capacity usage [%]	Interaction [%]
1	-8.07	88.2	9.2	0.0	31.3	0.0	n/r
2	-4.86	88.2	5.5	0.0	31.3	0.0	n/r
3	-5.93	88.2	6.7	0.0	31.3	0.0	n/r
4	-9.15	88.2	10.4	0.0	31.3	0.0	n/r

Concrete failure verifications

Proof	Load [kN]	Capacity [kN]	Utilization [%]	Status
Pull-Out Failure	0.0	0.0	0.0	Ok
Cone failure				Ok
Concrete decisive:				
1) Foundation (Plain Concrete)	0.0	0.0	n/r	
2) Assigned Hanger Reinforcement	0.0	0.0	n/r	
3) Requirement of Strut and Tie Model	0.0	0.0	n/r	
Splitting Failure				Ok
Concrete decisive:				
1) Foundation (Plain Concrete)	0.0	0.0	n/r	
2)Assigned Splitting Reinforcement || X	0.0	0.0	-	
3)Assigned Splitting Reinforcement || Y	0.0	0.0	-	
Blow-Out Failure	0.0	0.0	n/r	Ok
Pry-out failure	0.0	0.0	n/r	Ok
Edge failure				Ok
Concrete decisive:				
1) -X (Left) Edge (Plain Concrete)	0.0	0.0	n/r	
2) +X (Right) Edge (Plain Concrete)	0.0	0.0	n/r	
3) +Y (Top) Edge (Plain Concrete)	0.0	0.0	n/r	
4) -Y (Bottom) Edge (Plain Concrete)	0.0	0.0	n/r	
5)Assigned Edge Reinforcement (-X)	0.0	0.0	n/r	
6)Assigned Edge Reinforcement (+X)	0.0	0.0	n/r	
7)Assigned Edge Reinforcement (+Y)	0.0	0.0	n/r	
8)Assigned Edge Reinforcement (-Y)	0.0	0.0	n/r	
Combined Resistance	$\beta_N \leq 1$		0.0	Ok

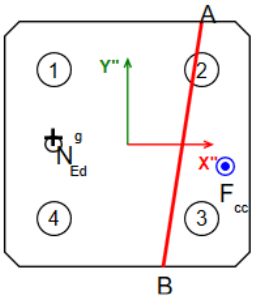
Load Case #2 : M max : Nd=2.0, Mxd=3.0, Myd=16.0, Vxd=9.0, Vyd=-2.0

Steel Failure: Sufficient capacity **Concrete failure: Sufficient capacity**

Steel failure verification

Design value of normal compressive force in the column	$N_{c,Ed}$	0	kN
Friction coefficient (between base plate and grout layer)	C_{fd}	0.2	
Joint friction resistance	$F_{f,Rd}$	0	kN
Resultant shear force	V_{sd}	9.22	kN
Resultant shear force taking account friction contribution	$V_{sd,f}$	9.22	kN

Neutral axis in (X"/Y") = A(75.6 / 125.0); B(36.0 / -125.0)
Resultant tension force in (X"/Y") = N^{g}_{Ed}(-75.0/6.8)
Resultant compression force (concrete) in (X"/Y") = F_{cc}(98.9/-22.1)



Bolt Pos.	Acting axial force [kN]	Design tension resistance [kN]	Axial capacity usage [%]	Acting shear force [kN]	Design shear resistance [kN]	Shear capacity usage [%]	Interaction [%]
1	51.9	88.2	58.8	0.0	31.3	0.0	n/r
2	-2.66	88.2	3.0	3.07	31.3	9.8	n/r
3	-11.3	88.2	12.8	3.07	31.3	9.8	n/r
4	43.2	88.2	49.0	3.07	31.3	9.8	44.8

Concrete failure verifications

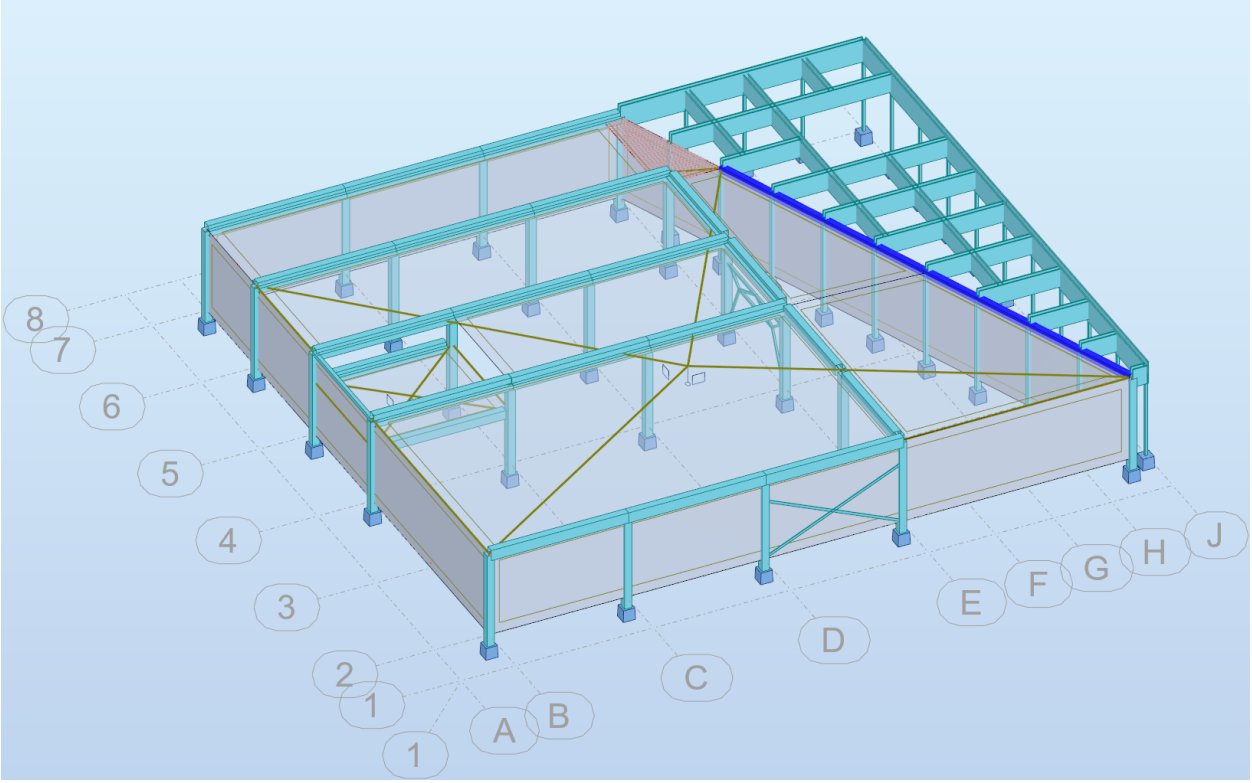
Proof	Load [kN]	Capacity [kN]	Utilization [%]	Status
Pull-Out Failure	51.9	199.5	26.0	Ok
Cone failure				Ok
Concrete decisive:				
1) Foundation (Plain Concrete)	95.1	106.3	89.5	
2) Assigned Hanger Reinforcement	0.0	0.0	n/r	
3) Requirement of Strut and Tie Model	0.0	0.0	n/r	
Splitting Failure				Ok
Concrete decisive:				
1) Foundation (Plain Concrete)	95.1	115.2	82.6	
2)Assigned Splitting Reinforcement || X	0.0	0.0	-	
3)Assigned Splitting Reinforcement || Y	0.0	0.0	-	
Blow-Out Failure	0.0	0.0	n/r	Ok
Pry-out failure	9.2	281.4	3.3	Ok
Edge failure				Ok
Concrete decisive:				
1) -X (Left) Edge (Plain Concrete)	2.0	98.2	2.0	
2) +X (Right) Edge (Plain Concrete)	9.2	40.1	23.0	
3) +Y (Top) Edge (Plain Concrete)	9.0	98.2	9.2	
4) -Y (Bottom) Edge (Plain Concrete)	9.2	88.0	10.5	
5)Assigned Edge Reinforcement (-X)	0.7	0.0	n/r	
6)Assigned Edge Reinforcement (+X)	7.4	0.0	n/r	
7)Assigned Edge Reinforcement (+Y)	2.9	0.0	n/r	
8)Assigned Edge Reinforcement (-Y)	3.4	0.0	n/r	
Combined Resistance	$\beta_N+\beta_V\leq 1.2$ or $\beta_N^{1.5}+\beta_V^{1.5}\leq 1$		93.8	Ok

IŠVADA: kolonų laikomoji galia užtikrinta.

2.4.Monolitinės sijos projektavimas

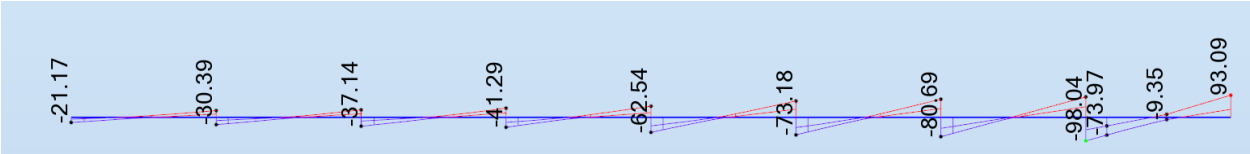
Projektuojama nekarpyta monolitinė sija ant E1 ašies 325x350mm skerspjūvio. Naudojamas betonas C30/37 XC1, armatūra S500. Apsauginis sluoksnis 30mm.

Sijos išdėstymas:

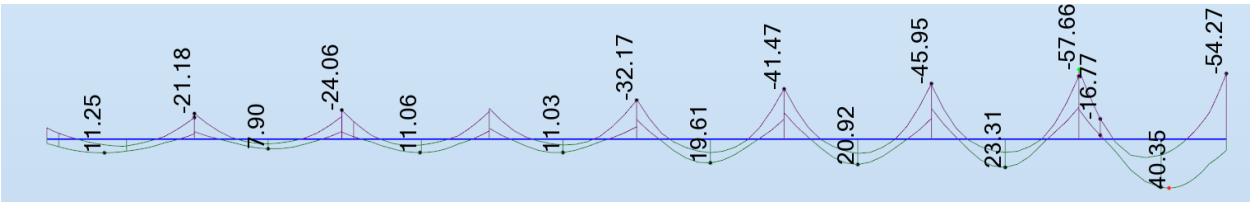


Veikiančios įrąžos:

Skersinės jėgos:

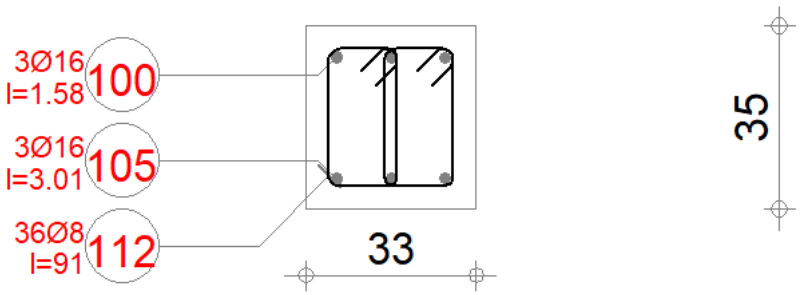


Lenkimo momentai:



Reikalingas armavimas:

A-A



1 Level:

- Name :
- Reference level : ---
- Maximum cracking : 0.30 (mm)
- Exposure : XC1
- Concrete creep coefficient : φ_{π} = 1.74
- Cement class : N
- Concrete age (loading moment) : 28 (days)
- Concrete age : 50 (years)
- Concrete age after erecting a structure : 365 (years)
- Structure class : S4
- Fire resistance class : no requirements
- FFB Recommendations 7.4.3(7) : 0.00

2 Beam: Beam45 Number of identical elements: 1

2.1 Material properties:

- Concrete : C30/37 f_{ck} = 30.00 (MPa)
  Rectangular stress distribution [3.1.7(3)]
  Density : 2501.36 (kG/m3)
  Aggregate size : 20.0 (mm)
- Longitudinal reinforcement: : B500B f_{yk} = 500.00 (MPa)
  Horizontal branch of the stress-strain diagram
  Ductility class : B
- Transversal reinforcement: : B500B f_{yk} = 500.00 (MPa)
  Horizontal branch of the stress-strain diagram
  Ductility class : B
- Additional reinforcement: : f_{yk} = 0.00 (MPa)
  Horizontal branch of the stress-strain diagram
- Modified partial coefficients:
  α_{cc} = 0.9 1992-1-1 3.1.6 (1)P

2.2 Geometry:

2.2.1

Span	Position	L.supp. (m)	L (m)	R.supp. (m)
P1	**Span 0.25**	**3.14**	**0.25**	

Span length: L_o = 3.39 (m)
Section from 0.00 to 3.14 (m)
32.5 x 35.0 (cm)
without left slab
without right slab

2.2.2

Span	Position	L.supp. (m)	L (m)	R.supp. (m)
P2	**Span 0.25**	**3.14**	**0.25**	

Span length: L_o = 3.39 (m)
Section from 0.00 to 3.14 (m)
32.5 x 35.0 (cm)
without left slab
without right slab

2.2.3

Span	Position	L.supp. (m)	L (m)	R.supp. (m)
P3	**Span 0.25**	**3.14**	**0.25**	

Span length: L_o = 3.39 (m)
Section from 0.00 to 3.14 (m)
32.5 x 35.0 (cm)
without left slab
without right slab

2.2.4

Span	Position	L.supp. (m)	L (m)	R.supp. (m)
P4	**Span 0.25**	**3.14**	**0.25**	

Span length: L_o = 3.39 (m)
Section from 0.00 to 3.14 (m)
32.5 x 35.0 (cm)
without left slab
without right slab

2.2.5

Span	Position	L.supp. (m)	L (m)	R.supp. (m)
P5	**Span 0.25**	**3.14**	**0.25**	

Span length: L_o = 3.39 (m)
Section from 0.00 to 3.14 (m)
32.5 x 35.0 (cm)
without left slab
without right slab

2.2.6

Span	Position	L.supp. (m)	L (m)	R.supp. (m)
P6	**Span 0.25**	**3.14**	**0.25**	

Span length: L_o = 3.39 (m)
Section from 0.00 to 3.14 (m)
32.5 x 35.0 (cm)
without left slab
without right slab

2.2.7	Span	Position	L.supp. (m)	L (m)	R.supp. (m)
	P7	**Span 0.25**	**3.14**	**0.25**	

Span length: L_o = 3.39 (m)
Section from 0.00 to 3.14 (m)
32.5 x 35.0 (cm)
without left slab
without right slab

2.2.8	Span	Position	L.supp. (m)	L (m)	R.supp. (m)
	P8	**Span 0.25**	**3.07**	**0.40**	

Span length: L_o = 3.39 (m)
Section from 0.00 to 3.07 (m)
32.5 x 35.0 (cm)
without left slab
without right slab

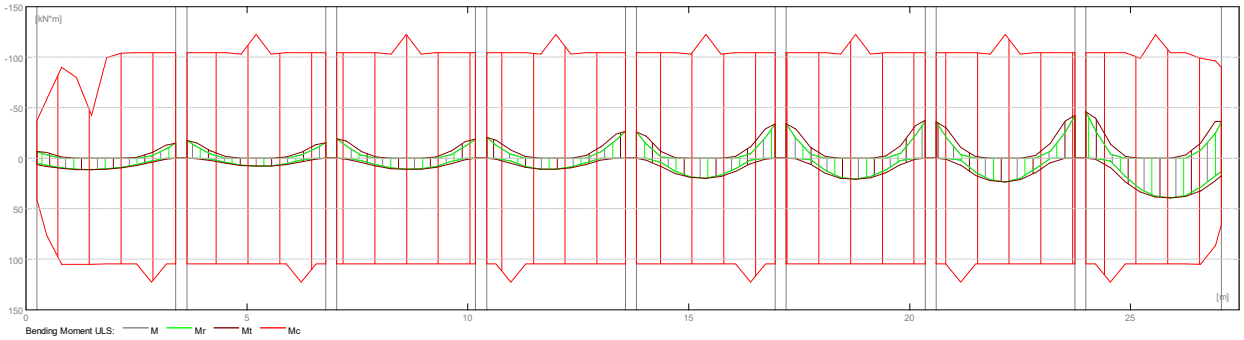
2.3 Calculation options:

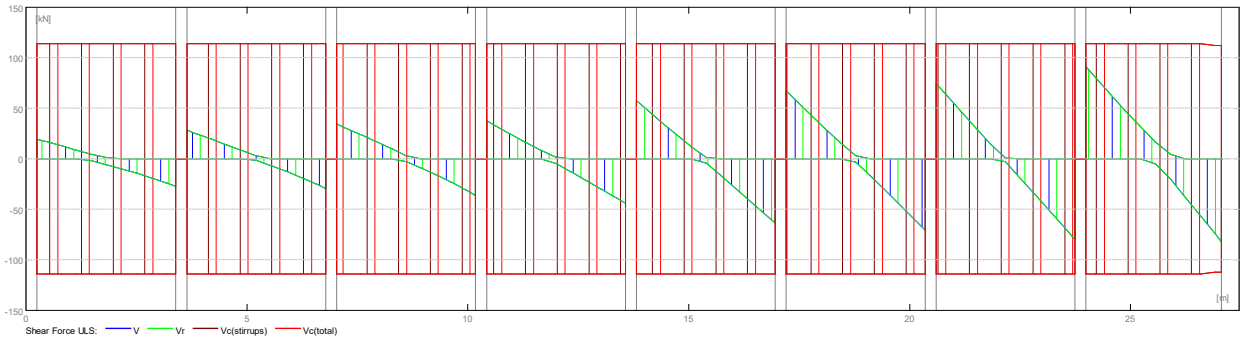
- Regulation of combinations : EN 1990:2002
- Calculations according to : EN 1992-1-1:2004/A1:2014
- Seismic dispositions : No requirements
- Precast beam : no
- Cover : bottom c = 4.0 (cm)
  : side c1= 4.0 (cm)
  : top c2= 4.0 (cm)
- Cover deviations : Cdev = 1.0(cm), Cdur = 0.0(cm)
- Coefficient β_2 =0.50 : long-term or cyclic load
- Method of shear calculations : strut inclination

2.4 Calculation results:

2.4.1 Internal forces in ULS

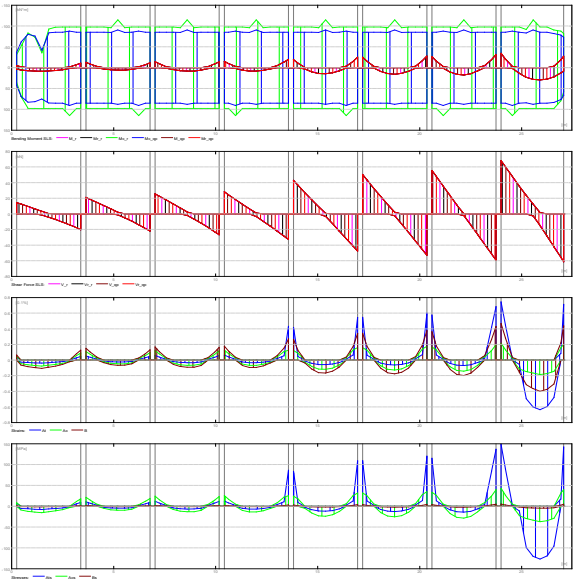
Span	Mt max. (kN*m)	Mt min. (kN*m)	Ml (kN*m)	Mr (kN*m)	Ql (kN)	Qr (kN)
P1	11.30	-0.99	-6.89	-14.68	19.38	-26.97
P2	7.86	-1.68	-17.45	-15.44	28.28	-29.15
P3	10.97	-1.48	-19.46	-18.91	34.49	-35.86
P4	11.03	-2.73	-20.67	-26.78	38.05	-43.77
P5	19.61	-1.87	-26.01	-33.80	57.68	-63.71
P6	20.91	-2.11	-34.02	-37.34	67.63	-70.71
P7	23.29	-2.81	-35.90	-42.56	74.54	-79.53
P8	39.27	-3.22	-46.17	-36.47	91.41	-81.93





2.4.2 Internal forces in SLS

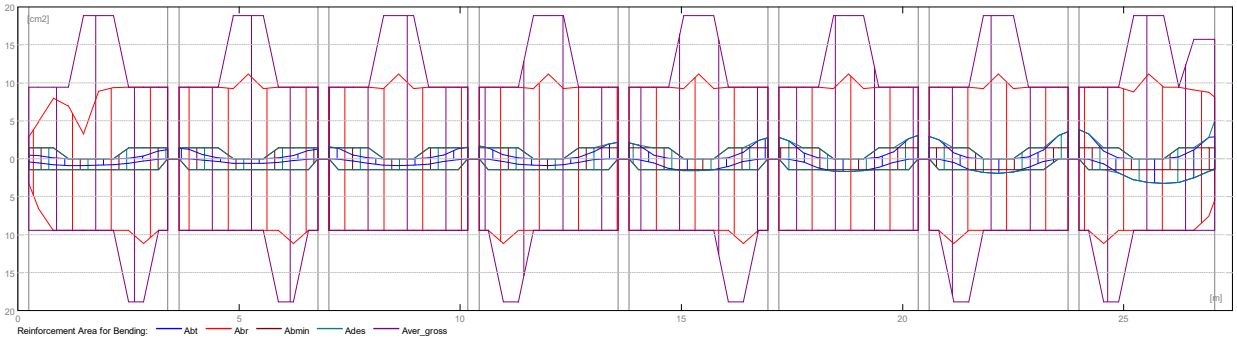
Span	Mt max. (kN*m)	Mt min. (kN*m)	Ml (kN*m)	Mr (kN*m)	Ql (kN)	Qr (kN)
P1	8.44	0.00	-5.10	-10.99	14.52	-20.13
P2	5.87	0.00	-13.10	-11.55	21.14	-21.76
P3	8.19	0.00	-14.62	-14.16	25.79	-26.77
P4	8.25	0.00	-15.49	-20.03	28.41	-32.70
P5	14.62	0.00	-19.44	-25.24	42.99	-47.52
P6	15.59	0.00	-25.40	-27.91	50.42	-52.75
P7	17.39	0.00	-26.78	-31.74	55.57	-59.30
P8	29.38	0.00	-34.50	-27.69	68.16	-61.24

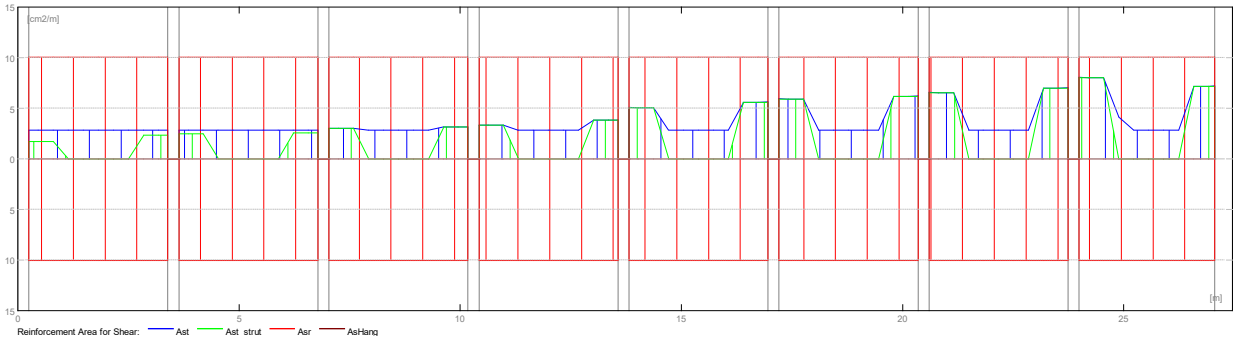


2.4.3 Required reinforcement area

Span	Span (cm2)		Left support (cm2)		Right support (cm2)	
	bottom	top	bottom	top	bottom	top
P1	0.91	0.00	0.42	0.47	0.00	1.18
P2	0.63	0.00	0.00	1.41	0.00	1.24

P3	0.88	0.00	0.00	1.58	0.00	1.53
P4	0.88	0.00	0.00	1.68	0.00	2.19
P5	1.59	0.00	0.00	2.12	0.00	2.78
P6	1.70	0.00	0.00	2.80	0.00	3.08
P7	1.89	0.00	0.00	2.96	0.00	3.54
P8	3.25	0.00	0.00	3.85	1.32	2.85





2.4.4 Deflection and cracking

wt(QP) Total due to quasi-permanent combination
wt(QP)dop Allowable due to quasi-permanent combination
Dwt(QP) Deflection increment from the quasi-permanent load combination after erecting a structure.
Dwt(QP)dop Admissible deflection increment from the quasi-permanent load combination after erecting a structure.

wk - width of perpendicular cracks

Span	wt(QP) (cm)	wt(QP)dop (cm)	Dwt(QP) (cm)	Dwt(QP)dop (cm)	wk (mm)
P1	0.0	1.4	0.0	0.0	0.0
P2	0.0	1.4	0.0	0.0	0.0
P3	0.0	1.4	0.0	0.0	0.0
P4	0.0	1.4	0.0	0.0	0.1
P5	0.1	1.4	0.0	0.0	0.1
P6	0.1	1.4	0.0	0.0	0.1
P7	0.1	1.4	0.0	0.0	0.1
P8	0.3	1.4	0.1	0.0	0.1

2.5 Theoretical results - detailed results:

2.5.1 P1 : Span from 0.25 to 3.39 (m)

	ULS		SLS			
Abscissa (m)	M max. (kN*m)	M min. (kN*m)	M max. (kN*m)	M min. (kN*m)	A bottom (cm2)	A top (cm2)
0.25	6.15	-6.89	3.42	-5.10	0.42	0.47
0.46	7.97	-5.78	5.21	-2.35	0.56	0.41
0.80	10.09	-1.51	7.15	0.00	0.79	0.12
1.14	11.06	-0.00	8.15	0.00	0.89	0.00

1.48	11.30	-0.00	8.44	0.00	0.91	0.00
1.82	10.85	-0.00	7.85	0.00	0.87	0.00
2.16	9.54	-0.00	6.60	0.00	0.76	0.00
2.50	7.41	-0.99	4.80	0.00	0.58	0.08
2.84	4.20	-5.29	1.95	-1.82	0.29	0.36
3.18	1.10	-12.87	0.00	-7.00	0.09	1.02
3.39	0.00	-14.68	0.00	-10.99	0.00	1.18

Abscissa (m)	ULS V max. (kN)	SLS V max. (kN)	afp (mm)
0.25	19.38	14.52	0.0
0.46	16.92	12.69	0.0
0.80	12.90	9.69	0.0
1.14	8.75	6.61	0.0
1.48	4.48	3.42	0.0
1.82	-5.68	-4.29	0.0
2.16	-9.78	-7.32	0.0
2.50	-14.04	-10.49	0.0
2.84	-18.75	-13.99	0.0
3.18	-23.66	-17.65	0.0
3.39	-26.97	-20.13	0.0

2.5.2 P2 : Span from 3.64 to 6.78 (m)

	ULS		SLS			
Abscissa (m)	M max. (kN*m)	M min. (kN*m)	M max. (kN*m)	M min. (kN*m)	A bottom (cm2)	A top (cm2)
3.64	0.00	-17.45	0.00	-13.10	0.00	1.41
3.86	0.32	-15.46	0.00	-8.70	0.03	1.24
4.19	2.13	-7.17	0.37	-3.06	0.16	0.54
4.53	5.17	-1.68	3.02	0.00	0.39	0.13
4.87	7.22	-0.00	5.04	0.00	0.58	0.00
5.21	7.86	-0.00	5.87	0.00	0.63	0.00
5.55	7.70	-0.00	5.67	0.00	0.62	0.00
5.89	6.44	-1.23	4.23	0.00	0.50	0.10
6.23	3.52	-5.80	1.39	-2.25	0.25	0.41
6.57	0.84	-13.53	0.00	-7.32	0.07	1.08
6.78	0.00	-15.44	0.00	-11.55	0.00	1.24

Abscissa (m)	ULS V max. (kN)	SLS V max. (kN)	afp (mm)
3.64	28.28	21.14	0.0
3.86	24.89	18.61	0.0
4.19	19.60	14.67	0.0
4.53	14.18	10.63	0.0
4.87	8.63	6.50	0.0
5.21	2.96	2.27	0.0
5.55	-6.62	-4.96	0.0
5.89	-12.24	-9.14	0.0
6.23	-18.51	-13.82	0.0
6.57	-24.98	-18.65	0.0
6.78	-29.15	-21.76	0.0

2.5.3 P3 : Span from 7.03 to 10.17 (m)

	ULS		SLS			
Abscissa (m)	M max. (kN*m)	M min. (kN*m)	M max. (kN*m)	M min. (kN*m)	A bottom (cm2)	A top (cm2)
7.03	0.00	-19.46	0.00	-14.62	0.00	1.58
7.25	0.86	-17.04	0.00	-9.26	0.07	1.37
7.59	3.84	-6.97	1.56	-2.41	0.28	0.50
7.93	7.69	-1.31	4.72	0.00	0.60	0.10
8.26	10.18	-0.00	7.17	0.00	0.82	0.00
8.60	10.97	-0.00	8.19	0.00	0.88	0.00
8.94	10.72	-0.00	7.89	0.00	0.86	0.00
9.28	9.07	-1.48	6.04	0.00	0.71	0.11
9.62	5.29	-7.09	2.47	-2.70	0.37	0.50
9.96	1.39	-16.59	0.00	-9.04	0.11	1.32
10.17	0.00	-18.91	0.00	-14.16	0.00	1.53

Abscissa (m)	ULS V max. (kN)	SLS V max. (kN)	afp (mm)
7.03	34.49	25.79	0.0
7.25	30.25	22.62	0.0
7.59	23.69	17.73	0.0
7.93	16.99	12.74	0.0
8.26	10.17	7.66	0.0
8.60	3.27	2.51	0.0
8.94	-8.85	-6.64	0.0
9.28	-15.60	-11.66	0.0
9.62	-23.01	-17.19	0.0
9.96	-30.83	-23.02	0.0
10.17	-35.86	-26.77	0.0

2.5.4 P4 : Span from 10.42 to 13.57 (m)

Abscissa (m)	ULS M max. (kN*m)	ULS M min. (kN*m)	SLS M max. (kN*m)	SLS M min. (kN*m)	A bottom (cm2)	A top (cm2)
10.42	0.00	-20.67	0.00	-15.49	0.00	1.68
10.64	1.07	-18.16	0.00	-9.97	0.08	1.46
10.98	4.83	-7.89	1.91	-3.09	0.34	0.57
11.32	9.12	-1.69	5.99	0.00	0.71	0.13
11.66	10.86	-0.00	8.03	0.00	0.87	0.00
11.99	11.03	-0.00	8.25	0.00	0.88	0.00
12.33	9.60	-0.00	6.40	0.00	0.77	0.00
12.67	6.18	-2.73	3.37	0.00	0.46	0.20
13.01	1.88	-11.26	0.00	-4.90	0.15	0.88
13.35	0.01	-23.76	0.00	-13.37	0.00	1.93
13.57	0.00	-26.78	0.00	-20.03	0.00	2.19

Abscissa (m)	ULS V max. (kN)	SLS V max. (kN)	afp (mm)
10.42	38.05	28.41	0.0
10.64	32.62	24.36	0.0
10.98	24.45	18.27	0.0
11.32	16.28	12.18	0.0
11.66	8.69	6.54	0.0
11.99	-4.40	-3.33	0.0
12.33	-12.68	-9.51	0.0
12.67	-20.97	-15.68	0.0
13.01	-29.57	-22.10	0.0
13.35	-38.27	-28.60	0.0
13.57	-43.77	-32.70	0.1

2.5.5 P5 : Span from 13.82 to 16.96 (m)

Abscissa (m)	ULS M max. (kN*m)	ULS M min. (kN*m)	SLS M max. (kN*m)	SLS M min. (kN*m)	A bottom (cm2)	A top (cm2)
13.82	0.00	-26.01	0.00	-19.44	0.00	2.12
14.03	1.73	-22.12	0.00	-10.86	0.14	1.77
14.37	7.96	-6.80	3.12	-0.62	0.55	0.47
14.71	15.50	-0.53	9.91	0.00	1.25	0.04
15.05	19.01	-0.00	13.86	0.00	1.54	0.00
15.39	19.61	-0.00	14.62	0.00	1.59	0.00
15.73	17.82	-0.00	12.32	0.00	1.44	0.00
16.06	12.85	-1.87	7.62	0.00	1.01	0.15
16.40	5.22	-11.28	0.89	-3.38	0.38	0.84
16.74	0.68	-29.39	0.00	-15.52	0.05	2.40
16.96	0.00	-33.80	0.00	-25.24	0.00	2.78

Abscissa (m)	ULS V max. (kN)	SLS V max. (kN)	afp (mm)
13.82	57.68	42.99	0.1
14.03	49.46	36.87	0.0
14.37	36.51	27.22	0.0
14.71	24.18	18.04	0.0
15.05	12.13	9.08	0.0

15.39	-4.22	-3.19	0.0
15.73	-16.73	-12.50	0.0
16.06	-29.49	-22.01	0.0
16.40	-42.50	-31.70	0.0
16.74	-55.50	-41.40	0.0
16.96	-63.71	-47.52	0.1

2.5.6 P6 : Span from 17.21 to 20.35 (m)

	ULS		SLS			
Abscissa (m)	M max. (kN*m)	M min. (kN*m)	M max. (kN*m)	M min. (kN*m)	A bottom (cm2)	A top (cm2)
17.21	0.00	-34.02	0.00	-25.40	0.00	2.80
17.42	0.62	-29.44	0.00	-15.30	0.05	2.40
17.76	5.97	-10.96	0.99	-3.16	0.43	0.80
18.10	15.03	-1.73	9.13	0.00	1.19	0.13
18.44	19.77	-0.00	14.14	0.00	1.60	0.00
18.78	20.91	-0.00	15.59	0.00	1.70	0.00
19.12	19.26	-0.00	13.47	0.00	1.56	0.00
19.46	14.33	-2.11	8.71	0.00	1.12	0.16
19.79	6.25	-12.54	1.50	-3.82	0.46	0.93
20.13	0.99	-32.48	0.00	-17.19	0.08	2.66
20.35	0.00	-37.34	0.00	-27.91	0.00	3.08

	ULS	SLS	
Abscissa (m)	V max. (kN)	V max. (kN)	afp (mm)
17.21	67.63	50.42	0.1
17.42	58.28	43.44	0.0
17.76	43.53	32.45	0.0
18.10	29.50	22.00	0.0
18.44	15.77	11.80	0.0
18.78	-3.06	-2.34	0.0
19.12	-17.29	-12.94	0.0
19.46	-31.73	-23.69	0.0
19.79	-46.54	-34.74	0.0
20.13	-61.36	-45.78	0.0
20.35	-70.71	-52.75	0.1

2.5.7 P7 : Span from 20.60 to 23.74 (m)

	ULS		SLS			
Abscissa (m)	M max. (kN*m)	M min. (kN*m)	M max. (kN*m)	M min. (kN*m)	A bottom (cm2)	A top (cm2)
20.60	0.00	-35.90	0.00	-26.78	0.00	2.96
20.81	0.71	-30.86	0.00	-15.68	0.06	2.52
21.15	6.87	-10.98	1.21	-2.91	0.49	0.79
21.49	17.12	-1.59	10.53	0.00	1.36	0.12
21.83	22.16	-0.00	15.94	0.00	1.80	0.00
22.17	23.29	-0.00	17.39	0.00	1.89	0.00
22.51	21.14	-0.00	14.63	0.00	1.71	0.00
22.85	14.28	-2.81	7.82	0.00	1.11	0.22
23.19	4.37	-14.90	0.00	-5.05	0.33	1.15
23.53	0.00	-37.05	0.00	-19.59	0.00	3.06
23.74	0.00	-42.56	0.00	-31.74	0.00	3.54

	ULS	SLS	
Abscissa (m)	V max. (kN)	V max. (kN)	afp (mm)
20.60	74.54	55.57	0.1
20.81	64.05	47.75	0.0
21.15	47.44	35.36	0.0
21.49	30.82	22.98	0.0
21.83	14.72	10.98	0.0
22.17	-2.82	-2.11	0.0
22.51	-19.19	-14.32	0.0
22.85	-35.81	-26.70	0.0
23.19	-52.42	-39.09	0.0
23.53	-69.04	-51.48	0.1
23.74	-79.53	-59.30	0.1

2.5.8 P8 : Span from 23.99 to 27.06 (m)

	ULS		SLS			
Abscissa (m)	M max. (kN*m)	M min. (kN*m)	M max. (kN*m)	M min. (kN*m)	A bottom (cm2)	A top (cm2)
23.99	0.00	-46.17	0.00	-34.50	0.00	3.85
24.20	1.09	-39.91	0.00	-20.70	0.09	3.29
24.54	9.12	-13.81	2.00	-2.96	0.65	1.00
24.88	23.45	-1.62	13.58	0.00	1.89	0.13
25.22	33.49	-0.00	22.94	0.00	2.75	0.00
25.56	38.13	-0.00	27.87	0.00	3.15	0.00
25.90	39.27	-0.00	29.38	0.00	3.25	0.00
26.24	37.86	-3.22	27.69	0.00	3.10	0.25
26.58	32.30	-14.86	21.98	-3.81	2.50	1.13
26.92	22.14	-36.47	12.54	-19.00	1.69	2.83
27.06	17.29	-36.47	7.83	-27.69	1.32	2.85

	ULS	SLS	
Abscissa (m)	V max. (kN)	V max. (kN)	afp (mm)
23.99	91.41	68.16	0.1
24.20	80.66	60.16	0.1
24.54	63.91	47.69	0.0
24.88	47.12	35.21	0.0
25.22	31.76	23.82	0.1
25.56	16.46	12.48	0.1
25.90	-19.97	-15.11	0.1
26.24	-38.14	-28.63	0.1
26.58	-56.31	-42.16	0.1
26.92	-74.48	-55.69	0.0
27.06	-81.93	-61.24	0.1

2.6 Reinforcement:

2.6.1 P1 : Span from 0.25 to 3.39 (m)

Longitudinal reinforcement:

- bottom (B500B)
  3 ϕ20 l = 3.09 from 0.04 to 3.13
- assembling (top) (B500B)
  3 ϕ8 l = 1.85 from 0.73 to 2.57
- support (B500B)
  3 ϕ20 l = 1.87 from 0.04 to 1.78
  3 ϕ20 l = 0.82 from 1.52 to 2.34
  3 ϕ20 l = 4.43 from 1.30 to 5.73

Transversal reinforcement:

- main (B500B)
  stirrups 32 ϕ8 l = 0.92
  e = 1*0.07 + 15*0.20 (m)

2.6.2 P2 : Span from 3.64 to 6.78 (m)

Longitudinal reinforcement:

- bottom (B500B)
  3 ϕ20 l = 4.12 from 2.40 to 6.52
- support (B500B)
  3 ϕ20 l = 4.43 from 4.69 to 9.12

Transversal reinforcement:

- main (B500B)
  stirrups 32 ϕ8 l = 0.92
  e = 1*0.07 + 15*0.20 (m)

2.6.3 P3 : Span from 7.03 to 10.17 (m)

Longitudinal reinforcement:

- bottom (B500B)
  3 ϕ20 l = 5.62 from 5.79 to 11.41
- support (B500B)
  3 ϕ20 l = 4.43 from 8.09 to 12.51

Transversal reinforcement:

- main (B500B)
  stirrups 32 ϕ8 l = 0.92
  e = 1*0.07 + 15*0.20 (m)

2.6.4 P4 : Span from 10.42 to 13.57 (m)

Longitudinal reinforcement:

- bottom (B500B)
  3 ϕ20 l = 6.00 from 10.69 to 16.69
- support (B500B)
  3 ϕ20 l = 4.43 from 11.48 to 15.90

Transversal reinforcement:

- main (B500B)
  stirrups 32 ϕ8 l = 0.92
  e = 1*0.07 + 15*0.20 (m)

2.6.5 P5 : Span from 13.82 to 16.96 (m)

Longitudinal reinforcement:

- support (B500B)
  3 ϕ20 l = 4.43 from 14.87 to 19.30

Transversal reinforcement:

- main (B500B)
  stirrups 32 ϕ8 l = 0.92
  e = 1*0.07 + 15*0.20 (m)

2.6.6 P6 : Span from 17.21 to 20.35 (m)

Longitudinal reinforcement:

- bottom (B500B)
  3 ϕ20 l = 5.62 from 15.97 to 21.59
- support (B500B)
  3 ϕ20 l = 4.43 from 18.26 to 22.69

Transversal reinforcement:

- main (B500B)
  stirrups 32 ϕ8 l = 0.92
  e = 1*0.07 + 15*0.20 (m)

2.6.7 P7 : Span from 20.60 to 23.74 (m)

Longitudinal reinforcement:

- bottom (B500B)
  3 ϕ20 l = 4.10 from 20.86 to 24.97
- support (B500B)
  3 ϕ20 l = 4.39 from 21.65 to 26.04

Transversal reinforcement:

- main (B500B)
  stirrups 32 ϕ8 l = 0.92
  e = 1*0.07 + 15*0.20 (m)

2.6.8 P8 : Span from 23.99 to 27.06 (m)

Longitudinal reinforcement:

- bottom (B500B)

3 ϕ20 l = 3.17 from 24.24 to 27.41

- support (B500B)
  3 ϕ20 l = 2.41 from 25.01 to 27.42
  1 ϕ20 l = 2.28 from 27.40 to 27.40

Transversal reinforcement:

- main (B500B)
  stirrups 32 ϕ8 l = 0.92
  e = 1*0.03 + 15*0.20 (m)

3 Material survey:

- Concrete volume = 3.12 (m3)
- Formwork = 27.59 (m2)

- Steel B500B
  - Total weight = 601.99 (kG)
  - Density = 192.76 (kG/m3)
  - Average diameter = 13.5 (mm)
  - Survey according to diameters:

Diameter (mm)	Length (m)	Weight (kG)	Number (No.)	Total weight (kG)
8	0.92	0.36	256	92.71
8	1.85	0.73	3	2.19
20	0.82	2.01	3	6.04
20	1.87	4.61	3	13.82
20	2.28	5.63	1	5.63
20	2.41	5.95	3	17.84
20	3.09	7.61	3	22.84
20	3.17	7.81	3	23.44
20	4.10	10.12	3	30.35
20	4.12	10.15	3	30.46
20	4.39	10.83	3	32.48
20	4.43	10.92	18	196.56
20	5.62	13.87	6	83.22
20	6.00	14.80	3	44.41

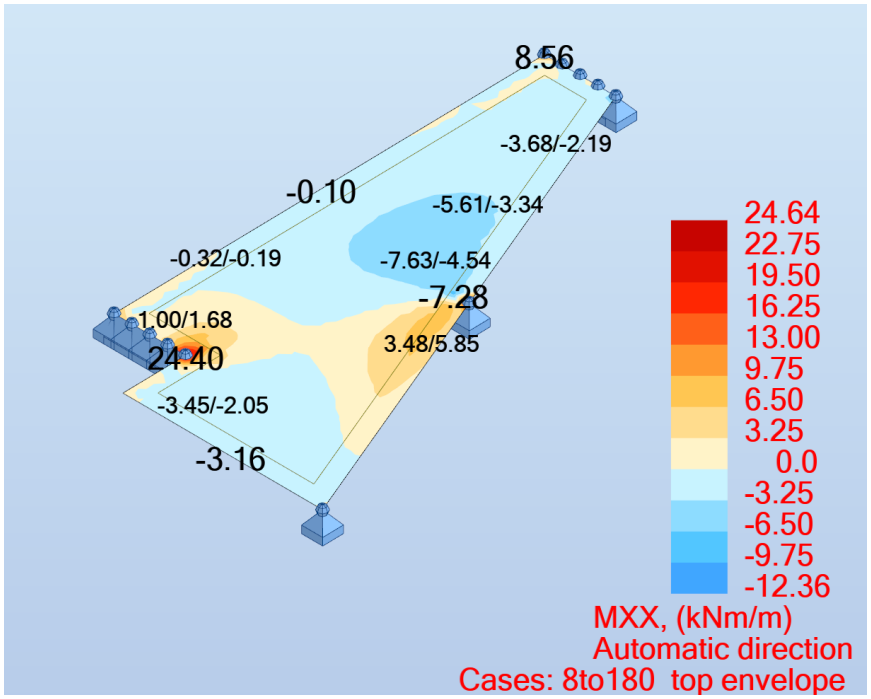
Išvada: sąlyga tenkinama

2.5.Monolitinės perdangos projektavimas

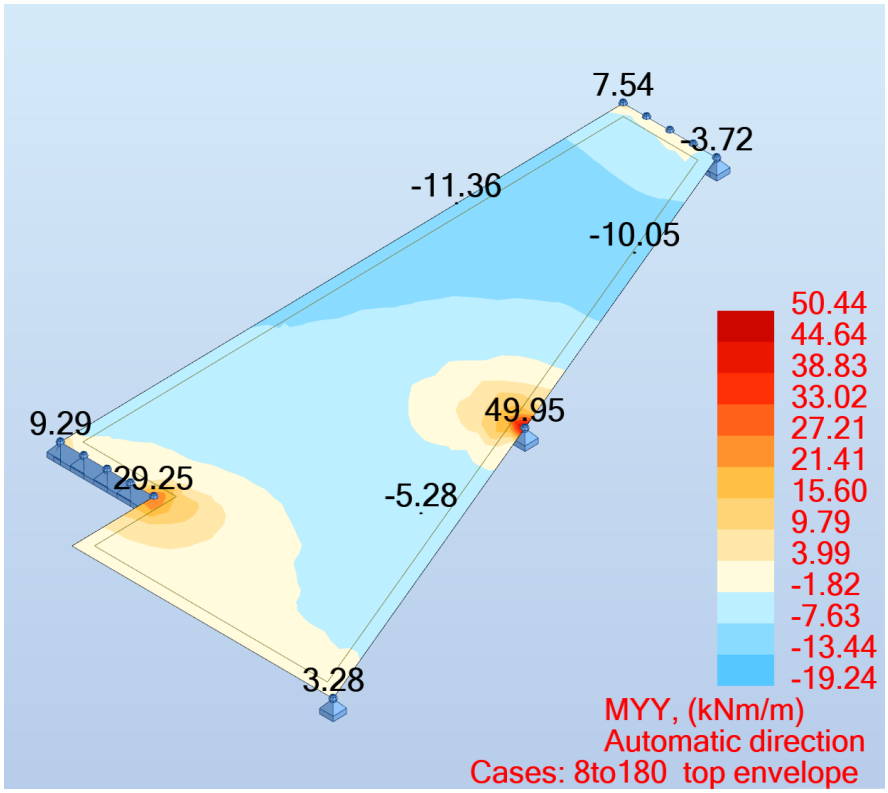
Projektuojama trikampio formos monolitinė perdanga 200mm storio. Naudojamas betonas C20/25, armatūra S500. Tinklo apsauginis sluoksnis 30mm.

Veikiančios įrąžos.

Momentai X kryptimi:

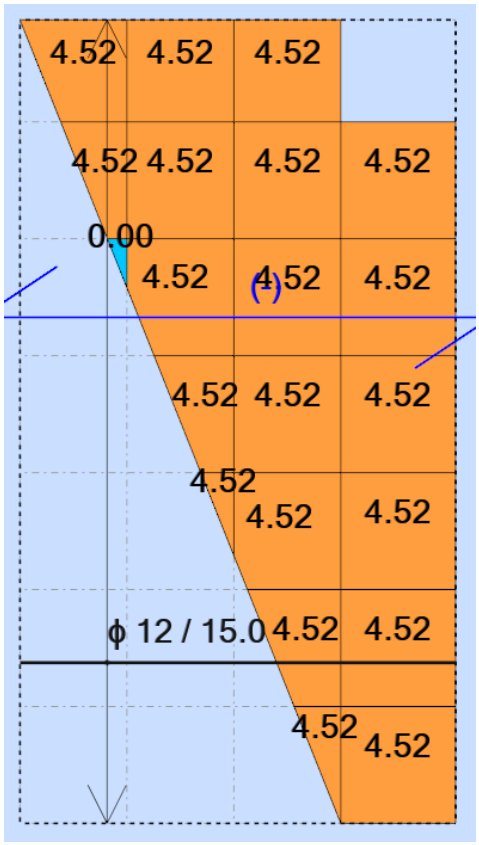


Momentai Y kryptimi:

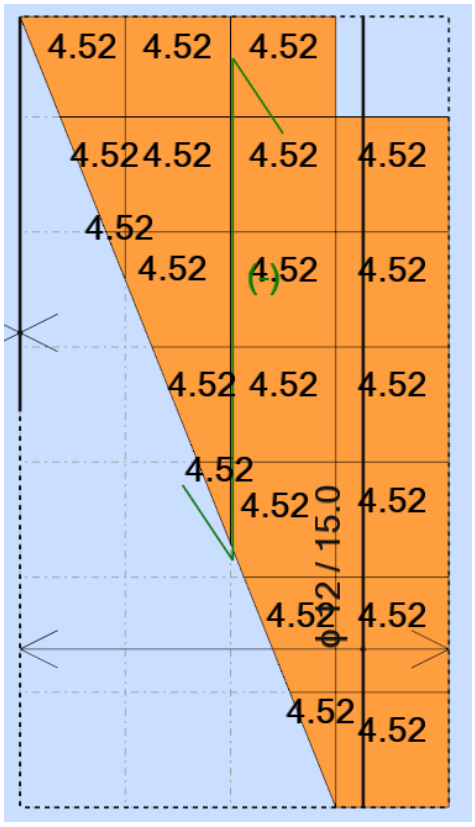


Reikalingas armavimas:

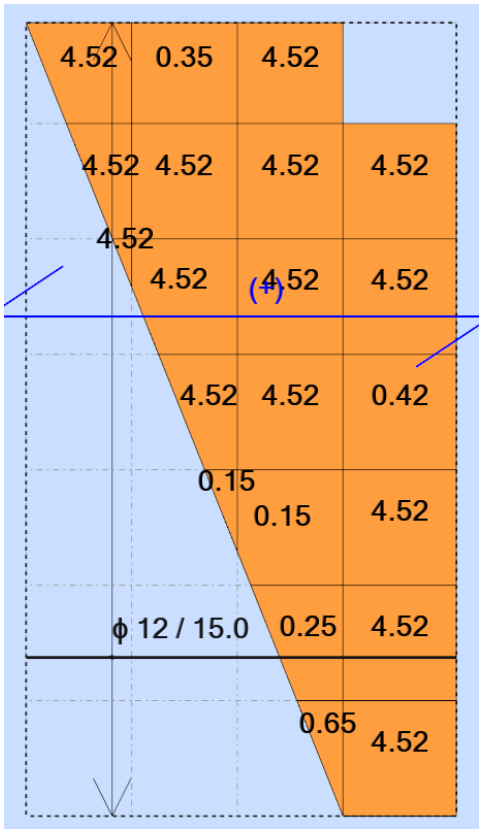
Apatinis armavimas X kryptimi:



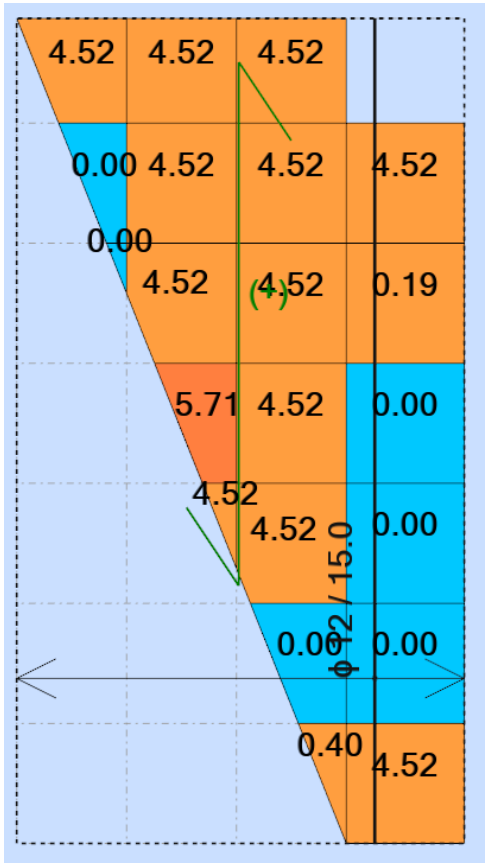
Apatinis armavimas Y kryptimi:



Viršutinis armavimas X kryptimi:



Viršutinis armavimas Y kryptimi:



1. Slab: Slab154 - Panel no. 154

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 = 3.0 (cm)
  top c2 = 3.0 (cm)
- Cover deviations Cdev = 1.0(cm), Cdur = 0.0(cm)

1.2. Concrete

Class : Characteristic strength = 24.10 MPa
Rectangular stress distribution [3.1.7(3)]

- Density : 2407.24 (kG/m3)
- Concrete creep coefficient : 1.50
- 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 : 3.00 (cm)
- Verification of punching : yes
- Exposure
  - upper layer : XC1
  - lower layer : XC1
- 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 0.300 (m)

Contour:

edge	beginning		end		length
	x1	y1	x2	y2	(m)
1	0.000	0.000	2.513	0.000	2.513
2	2.513	0.000	2.513	-0.800	0.800
3	2.513	-0.800	3.413	-0.800	0.900
4	3.413	-0.800	3.413	-6.300	5.500
5	3.413	-6.300	2.513	-6.300	0.900
6	2.513	-6.300	0.000	0.000	6.783

Support:

n°	Name	dimensions (m)	coordinates x	y	edge
8	point	0.250 / 0.250	0.000	0.000	□
9	point	0.250 / 0.250	1.257	-3.150	□

* - head present

1.5. Calculation results:

1.5.1. Maximum moments + reinforcement for bending

	Ax(+)	Ax(-)	Ay(+)	Ay(-)
Provided reinforcement (cm2/m):	7.54	7.54	7.54	7.54
Modified required reinforcement (cm2/m):	4.52	4.52	4.52	4.52
Original required reinforcement (cm2/m):	4.52	4.52	4.52	4.52
Coordinates (m):	2.963;-0.800	2.513;-6.300	3.188;-0.800	2.513;-6.300

1.5.2. Maximum moments + reinforcement for bending

	Ax(+)	Ax(-)	Ay(+)	Ay(-)
Symbol: required area/provided area				
Ax(+) (cm2/m)	**4.52/7.54**	0.58/7.54	4.52/7.54	0.58/7.54
Ax(-) (cm2/m)	4.52/7.54	**4.52/7.54**	4.52/7.54	4.52/7.54
Ay(+) (cm2/m)	4.52/7.54	0.40/7.54	**4.52/7.54**	0.40/7.54
Ay(-) (cm2/m)	4.52/7.54	4.52/7.54	4.52/7.54	**4.52/7.54**
SLS				
Mxx (kN*m/m)	0.07	-5.88	1.25	-5.88
Myy (kN*m/m)	-1.29	-4.62	0.03	-4.62
Mxy (kN*m/m)	-3.70	4.73	-5.39	4.73
Nxx (kN/m)	0.00	0.00	0.00	0.00
Nyy (kN/m)	0.00	0.00	0.00	0.00
Nxy (kN/m)	0.00	0.00	0.00	0.00
ULS				
Mxx (kN*m/m)	0.09	-7.89	1.68	-7.89
Myy (kN*m/m)	-1.74	-6.21	0.04	-6.21
Mxy (kN*m/m)	-4.97	6.35	-7.24	6.35
Nxx (kN/m)	0.00	0.00	0.00	0.00
Nyy (kN/m)	0.00	0.00	0.00	0.00
Nxy (kN/m)	0.00	0.00	0.00	0.00
Coordinates (m)	2.963;-0.800	2.513;-6.300	3.188;-0.800	2.513;-6.300
Coordinates* (m)	23.794;26.650;10.190 23.569;26.650;10.190		24.244;32.150;10.190 24.244;32.150;10.190	

* - Coordinates in the structure global coordinate system

1.5.3. Punching

Support no. / Point	Location (m) x	y	Geometry: (m) a	b	d	h

S1 (55)	0.000	0.000	Column	0.250	0.250	-
	-					
S2 (56)	1.257	-3.150	Column	0.250	0.250	-
	-					

Support no. / Point	Loads: (kN)		Critical perimeter (m)	
	Q	Qadm	u	Qadm / Q
S1 (55)	4.54	208.18	1.821	45.88 > 1
S2 (56)	70.05	116.94	1.023	1.67 > 1

Support no. / Point: S1 (55)

uo = 0.275
u1 = 1.821
ρLx = 0.00
ρLy = 0.00
heff = 25.8 (cm)
Ax = 7.54 (cm2)
Ay = 7.54 (cm2)
α = 1.57
ν = 0.54 ()
γc = 1.50 ()
fcd = 16.07 (MPa)
vRdmax = 3.48 (MPa)
V = 4.54 (kN)
Mx = 0.00 (kN*m)
My = 0.00 (kN*m)
A = 0.209 (m2)
Kx = 0.67
Ky = 0.48
Wx = 0.034
Wy = 0.022

vRdc = 0.43
νmin = 0.44
vEds = 0.06
cRdc= 0.12
k = 1.88
ρL = 0.00 ()
vlim = 0.44 (MPa)
v = 0.01 (MPa)
A = 0.470 (m2)

Support no. / Point: S2 (56)

uo = 0.425
u1 = 1.023
ρLx = 0.00
ρLy = 0.00
heff = 25.8 (cm)
Ax = 7.54 (cm2)
Ay = 7.54 (cm2)
α = 1.57
ν = 0.54 ()
γc = 1.50 ()
fcd = 16.07 (MPa)
vRdmax = 3.48 (MPa)
V = 70.05 (kN)
Mx = 0.00 (kN*m)
My = 0.00 (kN*m)
A = 0.547 (m2)

Kx = 0.64
Ky = 0.51
Wx = 0.221
Wy = 0.116

vRdc = 0.43
νmin = 0.44
vEds = 0.64
cRdc= 0.12
k = 1.88
ρL = 0.00 ()
vlim = 0.44 (MPa)
v = 0.27 (MPa)
A = 0.264 (m2)

1.5.4. Deflection
|f(+)| = 0.02 (cm) <= f_{dop}(+) = 3.00 (cm)
|f(-)| = 0.13 (cm) <= f_{dop}(-) = 3.00 (cm)

1.5.5. Cracking
upper layer
ax = 0.00 (mm) <= a_{dop} = 0.30 (mm)
ay = 0.00 (mm) <= a_{dop} = 0.30 (mm)
lower layer
ax = 0.00 (mm) <= a_{dop} = 0.30 (mm)
ay = 0.00 (mm) <= a_{dop} = 0.30 (mm)

3. Results - detailing

List of solutions:
Reinforcement: bars

Solution no.	Reinforcement range Diameter / Weight	Total weight (kG)
1	-	304.71

Results for the solution no. 1
Reinforcement zones

Bottom reinforcement

Name	coordinates x1	y1	x2	y2	Provided reinforcement ϕ (mm) / (cm)	At Ar (cm2/m)
1/3- Ay Perpendicular	0.000	-6.300	3.413	0.000	12.0 / 15.0	4.52 < 7.54
1/4- Ax Main	0.000	-6.300	3.413	0.000	12.0 / 15.0	4.52 < 7.54

Top reinforcement

Name	coordinates x1	y1	x2	y2	Provided reinforcement ϕ (mm) / (cm)	At Ar (cm2/m)
1/1+ Ay Perpendicular	0.000	-6.300	3.413	0.000	12.0 / 15.0	4.52 < 7.54

1/2+ Ax Main	0.000	-6.300	3.413	0.000	12.0 / 15.0	4.52 < 7.54

4. Material survey

- Concrete volume = 3.860 (m3)
- Formwork = 12.866 (m2)
- Slab circumference = 17.396 (m)
- Area of openings = 0.000 (m2)

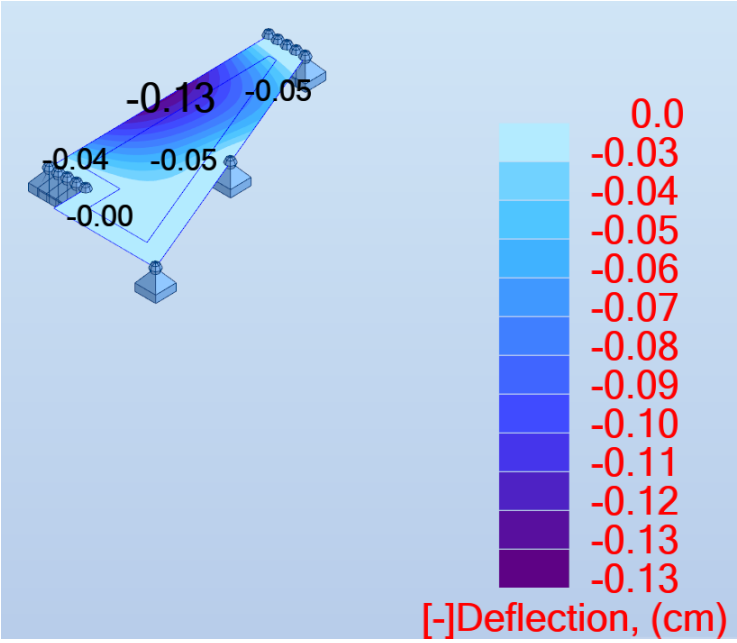
- Steel B500B
- Total weight = 299.94 (kG)
- Density = 77.71 (kG/m3)
- Average diameter = 12.0 (mm)
- Survey according to diameters:

Diameter	Length (m)	Number of identical elements:
12	0.466	2
12	0.843	2
12	0.872	2
12	0.932	2
12	0.992	2
12	1.051	2
12	1.111	2
12	1.171	2
12	1.219	2
12	1.231	2
12	1.291	2
12	1.351	2
12	1.410	2
12	1.470	2
12	1.530	2
12	1.590	4
12	1.650	2
12	1.710	2
12	1.769	2
12	1.829	2
12	1.889	2
12	1.949	2
12	1.971	2
12	2.009	2
12	2.069	2
12	2.128	2
12	2.186	4
12	2.246	4
12	2.305	4
12	2.347	2
12	2.365	4
12	2.425	4
12	2.487	2
12	2.547	2
12	2.607	2
12	2.667	2
12	2.727	4
12	2.787	2

12	2.846	2
12	2.906	2
12	2.966	2
12	3.026	2
12	3.099	2
12	3.475	2
12	3.851	2
12	4.227	2
12	4.603	2
12	4.979	2
12	5.355	2
12	5.440	12
12	5.731	2
12	6.107	2

Išvada: laikomoji galia pakankama

Tinkamumo ribinis būvis:



0,13cm<L/200=6,5/200=3,2cm

Išvada: sąlyga tenkinama

2.6. Medinių konstrukcijų projektavimas

Projektuojamos lauko medinės konstrukcijos iš klijuotos medienos GL24h. Modelyje priimama sijų standi jungtis sijos plokštumoje (dėl aukšto sijos skerspjūvio) ir lanksti jungtis iš sijos plokštumos. Tarpinė kolona prie sijos tvirtinama lanksčiai. Medinių kolonų bazė lanksti. Sistemos stabilumą užtikrina horizontalūs ryšiai kampuose.

2.6.1. Medinių konstrukcijų elementų projektavimas

Perimetro sija susilpnintoje skerpsjūvio vietoje

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

CODE GROUP:
MEMBER: 43 **POINT:** 3 **COORDINATE:** x = 0.50 L = 3.1800 m

LOADS:
Governing Load Case: 143 ULS/134=1*1.35 + 6*1.30 + 3*0.91 + 9*0.78 1*1.35+6*1.30+3*0.91+9*0.78

MATERIAL GL24h

gM = 1.25	f m,0,k = 24.00 MPa	f t,0,k = 19.20 MPa	f c,0,k = 24.00 MPa
f v,k = 3.50 MPa	f t,90,k = 0.50 MPa	f c,90,k = 2.50 MPa	E 0,moyen = 11500.00 MPa
E 0,05 = 9600.00 MPa	G moyen = 650.00 MPa	Service class: 3	Beta c = 0.10



SECTION PARAMETERS: 120x1640

ht=1640 mm			
bf=120 mm	Ay=1312.00 cm2	Az=1312.00 cm2	Ax=1968.00 cm2
tw=60 mm	Iy=4410944.00 cm4	Iz=23616.00 cm4	Ix=90109 cm4
tf=60 mm	Wy=53792.00 cm3	Wz=3936.00 cm3	

STRESSES

Sig_c,0,d = N/Ax = 9.79/1968.00 = 0.05 MPa
Sig_m,y,d = MY/Wy= 7.93/53792.00 = 0.15 MPa
Sig_m,z,d = MZ/Wz= 14.11/3936.00 = 3.58 MPa
Tau y,d = 1.5*8.53/1968.00 = 0.07 MPa
Tau z,d = 1.5*-6.80/1968.00 = -0.05 MPa
Tau tory,d = 0.04 MPa, Tau torz,d = 0.05 MPa

ALLOWABLE STRESSES

f c,0,d = 13.44 MPa
f m,y,d = 13.44 MPa
f m,z,d = 14.78 MPa
f v,d = 1.96 MPa

Factors and additional parameters

km = 0.70 kh = 1.10 kmod = 0.70 Ksys = 1.00 kcr = 0.67



LATERAL BUCKLING PARAMETERS:

lef = 4.8770 m	Lambda_rel m = 1.33
Sig_cr = 13.48 MPa	k crit = 0.56

BUCKLING PARAMETERS:



About Y axis:

LY = 3.2000 m	Lambda Y = 6.76	LZ = 3.2000 m	Lambda Z = 92.38
Lambda_rel Y = 0.11	ky = 0.50	Lambda_rel Z = 1.47	kz = 1.64
LFY = 3.2000 m	kcy = 1.00	LFZ = 3.2000 m	kcz = 0.42



About Z axis:

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 = 0.26 < 1.00 (6.24)
Sig_m,y,d/(kcrit*f m,y,d) = 0.15/(0.56*13.44) = 0.02 < 1.00 (6.33)
(Tau y,d/kcr+Tau tory,d/kshape)/f v,d = 0.06 < 1.00 (Tau z,d/kcr+Tau torz,d/kshape)/f v,d = 0.06 < 1.00 (6.13-4)

LIMIT DISPLACEMENTS



Deflections (LOCAL SYSTEM):

u fin,y = 1.0 cm < u fin,max,y = L/200.00 = 3.2 cm Verified

Governing load case: (1+2)*1 + (0.7+0*2)*3 + (1+0*2)*6 + (0.6+0*2)*9

u fin,z = 0.0 cm < u fin,max,z = L/200.00 = 3.2 cm Verified
Governing load case: (1+2)*1 + (0.7+0.3*2)*2 + (0.6+0*2)*7 + (1+0*2)*9

Displacements (GLOBAL SYSTEM):

Section OK !!!
Išvada: laikomoji galia pakankama

Kitos sijos

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

CODE GROUP:
MEMBER: 80 Sija pagrindine_80 **POINT:** 1 **COORDINATE:** x = 0.00 L = 0.0000 m

---

LOADS:
Governing Load Case: 140 ULS/131=1*1.35 + 6*1.30 + 3*0.91 + 8*0.78 + 9*0.78
1*1.35+6*1.30+3*0.91+(8+9)*0.78

MATERIAL GL24h

gM = 1.25	f m,0,k = 24.00 MPa	f t,0,k = 19.20 MPa	f c,0,k = 24.00 MPa
f v,k = 3.50 MPa	f t,90,k = 0.50 MPa	f c,90,k = 2.50 MPa	E 0,moyen = 11500.00 MPa
E 0,05 = 9600.00 MPa	G moyen = 650.00 MPa	Service class: 3	Beta c = 0.10

SECTION PARAMETERS: 240x1000

ht=1000 mm			
bf=240 mm	Ay=1600.00 cm2	Az=1600.00 cm2	Ax=2400.00 cm2
tw=120 mm	Iy=2000000.00 cm4	Iz=115200.00 cm4	Ix=391102 cm4
tf=120 mm	Wy=40000.00 cm3	Wz=9600.00 cm3	

STRESSES
Sig_t,0,d = N/Ax = -0.22/2400.00 = -0.00 MPa
Tau y,d = 1.5*-28.53/2400.00 = -0.18 MPa
Tau z,d = 1.5*-8.72/2400.00 = -0.05 MPa
Tau tory,d = 0.04 MPa, Tau torz,d = 0.06 MPa

ALLOWABLE STRESSES
f t,0,d = 11.78 MPa
f v,d = 1.96 MPa

Factors and additional parameters
kh = 1.10 kmod = 0.70 Ksys = 1.00 kcr = 0.67

LATERAL BUCKLING PARAMETERS:

BUCKLING PARAMETERS:
About Y axis: About Z axis:

VERIFICATION FORMULAS:
Sig_t,0,d/f t,0,d = 0.00/11.78 = 0.00 < 1.00 (6.1)
(Tau y,d/kcr+Tau tory,d/kshape)/f v,d = 0.15 < 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 = 0.2 cm < u fin,max,y = L/200.00 = 3.5 cm Verified

Governing load case: (1+2)*1 + (0.7+0.3*2)*2 + (0.7+0*2)*3 + (1+0*2)*6 + (0.6+0*2)*9

u fin,z = 0.1 cm < u fin,max,z = L/200.00 = 3.5 cm Verified

Governing load case: (1+2)*1 + (0.7+0.3*2)*2 + (1+0*2)*3 + (0.6+0*2)*4 + (0.6+0*2)*9



Displacements (GLOBAL SYSTEM):

Section OK !!!

Išvada: laikomoji galia pakankama

Horizontalūs ryšiai

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

ANALYSIS TYPE: Member Verification

CODE GROUP:

MEMBER: 26 Mediniai ryšiai_26 **POINT:** 2 **COORDINATE:** x = 0.50 L = 1.8741 m

---

LOADS:

Governing Load Case: 127 ULS/118=1*1.35 + 4*1.30 + 3*0.91 + 9*0.78 1*1.35+4*1.30+3*0.91+9*0.78

MATERIAL GL24h

gM = 1.25	f m,0,k = 24.00 MPa	f t,0,k = 19.20 MPa	f c,0,k = 24.00 MPa
f v,k = 3.50 MPa	f t,90,k = 0.50 MPa	f c,90,k = 2.50 MPa	E 0,moyen = 11500.00 MPa
E 0,05 = 9600.00 MPa	G moyen = 650.00 MPa	Service class: 3	Beta c = 0.10



SECTION PARAMETERS: 240x240

ht=240 mm			
bf=240 mm	Ay=384.00 cm2	Az=384.00 cm2	Ax=576.00 cm2
tw=120 mm	Iy=27648.00 cm4	Iz=27648.00 cm4	Ix=46642 cm4
tf=120 mm	Wy=2304.00 cm3	Wz=2304.00 cm3	

STRESSES

Sig_t,0,d = N/Ax = -57.61/576.00 = -1.00 MPa

Sig_m,y,d = MY/Wy= -0.98/2304.00 = -0.42 MPa

Tau tory,d = 0.01 MPa, Tau torz,d = 0.01 MPa

ALLOWABLE STRESSES

f t,0,d = 11.78 MPa

f m,y,d = 14.73 MPa

Factors and additional parameters

kh = 1.10 kh_y = 1.10 kmod = 0.70 Ksys = 1.00

LATERAL BUCKLING PARAMETERS:

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 = 1.00/11.78 + 0.42/14.73 = 0.11 < 1.00 (6.17)

(Tau y,d+Tau tory,d/kshape)/f v,d = 0.01 < 1.00 (Tau z,d+Tau torz,d/kshape)/f v,d = 0.01 < 1.00 (6.13-4)

LIMIT DISPLACEMENTS



Deflections (LOCAL SYSTEM):

u fin,y = 0.0 cm < u fin,max,y = L/200.00 = 1.9 cm Verified
Governing load case: (1+2)*1 + (0.7+0.3*2)*2 + (1+0*2)*4 + (0.6+0*2)*8
u fin,z = 0.1 cm < u fin,max,z = L/200.00 = 1.9 cm Verified
Governing load case: (1+2)*1 + (1+0*2)*3 + (0.6+0*2)*7 + (0.6+0*2)*9



Displacements (GLOBAL SYSTEM):

Section OK !!!

Išvada: laikomoji galia pakankama

Medinė kolona

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

CODE GROUP:
MEMBER: 73 Column_73 **POINT:** 3 **COORDINATE:** x = 1.00 L = 3.4900 m

---

LOADS:
Governing Load Case: 334 ULS/325=1*1.35 + 8*1.30 1*1.35+8*1.30

MATERIAL GL24h

gM = 1.25	f m,0,k = 24.00 MPa	f t,0,k = 19.20 MPa	f c,0,k = 24.00 MPa
f v,k = 3.50 MPa	f t,90,k = 0.50 MPa	f c,90,k = 2.50 MPa	E 0,moyen = 11500.00 MPa
E 0,05 = 9600.00 MPa	G moyen = 650.00 MPa	Service class: 3	Beta c = 0.10



SECTION PARAMETERS: 240x240

ht=240 mm

bf=240 mm	Ay=384.00 cm2	Az=384.00 cm2	Ax=576.00 cm2
tw=120 mm	Iy=27648.00 cm4	Iz=27648.00 cm4	Ix=46642 cm4
tf=120 mm	Wy=2304.00 cm3	Wz=2304.00 cm3	

STRESSES
Sig_c,0,d = N/Ax = 21.15/576.00 = 0.37 MPa
Sig_m,y,d = MY/Wy= 2.58/2304.00 = 1.12 MPa
Sig_m,z,d = MZ/Wz= 5.87/2304.00 = 2.55 MPa
Tau y,d = 1.5*-1.68/576.00 = -0.04 MPa
Tau z,d = 1.5*0.74/576.00 = 0.02 MPa

ALLOWABLE STRESSES
f c,0,d = 9.60 MPa
f m,y,d = 10.52 MPa
f m,z,d = 10.52 MPa
f v,d = 1.40 MPa

Factors and additional parameters
km = 0.70 kh = 1.10 kmod = 0.50 Ksys = 1.00 kcr = 0.67



LATERAL BUCKLING PARAMETERS:

BUCKLING PARAMETERS:

About Y axis:		About Z axis:	
LY = 3.4900 m	Lambda Y = 110.82	LZ = 3.4900 m	Lambda Z = 110.82
Lambda_rel Y = 1.76	ky = 2.13	Lambda_rel Z = 1.76	kz = 2.13
LFY = 7.6780 m	kcy = 0.30	LFZ = 7.6780 m	kcz = 0.30

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 = 0.44 < 1.00 (6.24)

(Tau y,d/kcr)/f v,d = (0.04/0.67)/1.40 = 0.05 < 1.00 (Tau z,d/kcr)/f v,d = (0.02/0.67)/1.40 = 0.02 < 1.00 (6.13)

LIMIT DISPLACEMENTS

Deflections (LOCAL SYSTEM):

Displacements (GLOBAL SYSTEM):

v x = 0.5 cm < v max,x = L/150.00 = 2.3 cm Verified

Governing load case: SLS:CHR/69=1*1.00 + 2*0.70 + 7*1.00 + 3*0.70 + 9*0.60 (1+7)*1.00+(2+3)*0.70+9*0.60

v y = 0.9 cm < v max,y = L/150.00 = 2.3 cm Verified

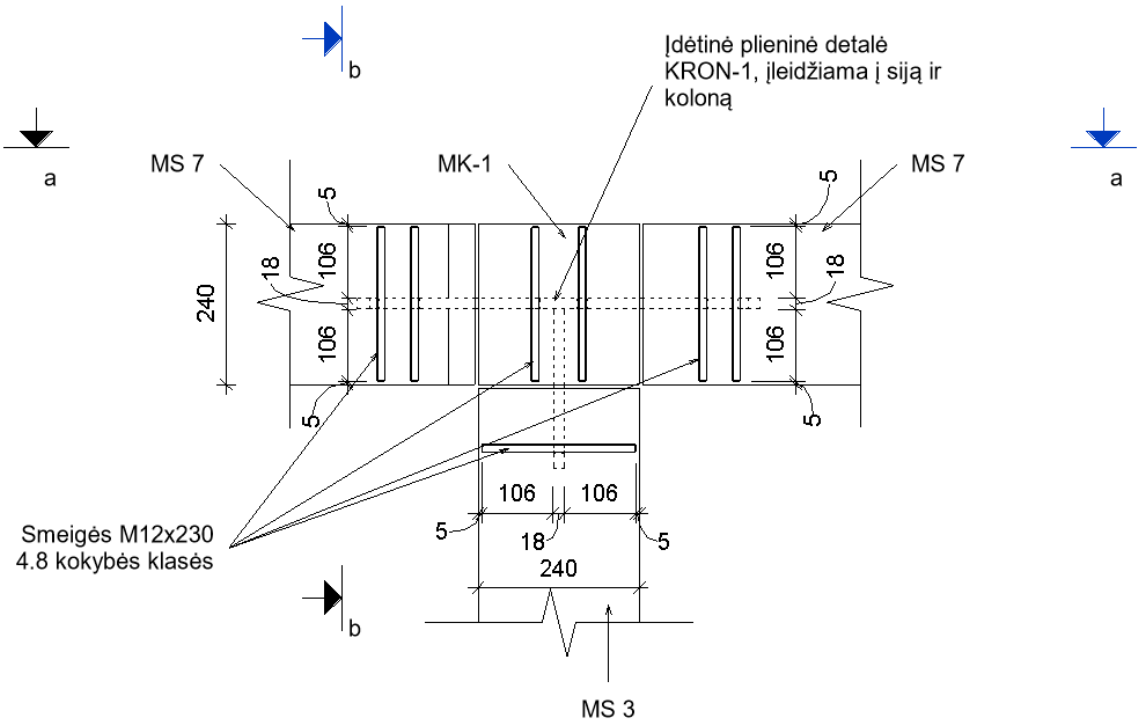
Governing load case: SLS:CHR/44=1*1.00 + 2*0.70 + 4*1.00 + 3*0.70 + 8*0.60 (1+4)*1.00+(2+3)*0.70+8*0.60

Section OK !!!

Išvada: laikomoji galia pakankama

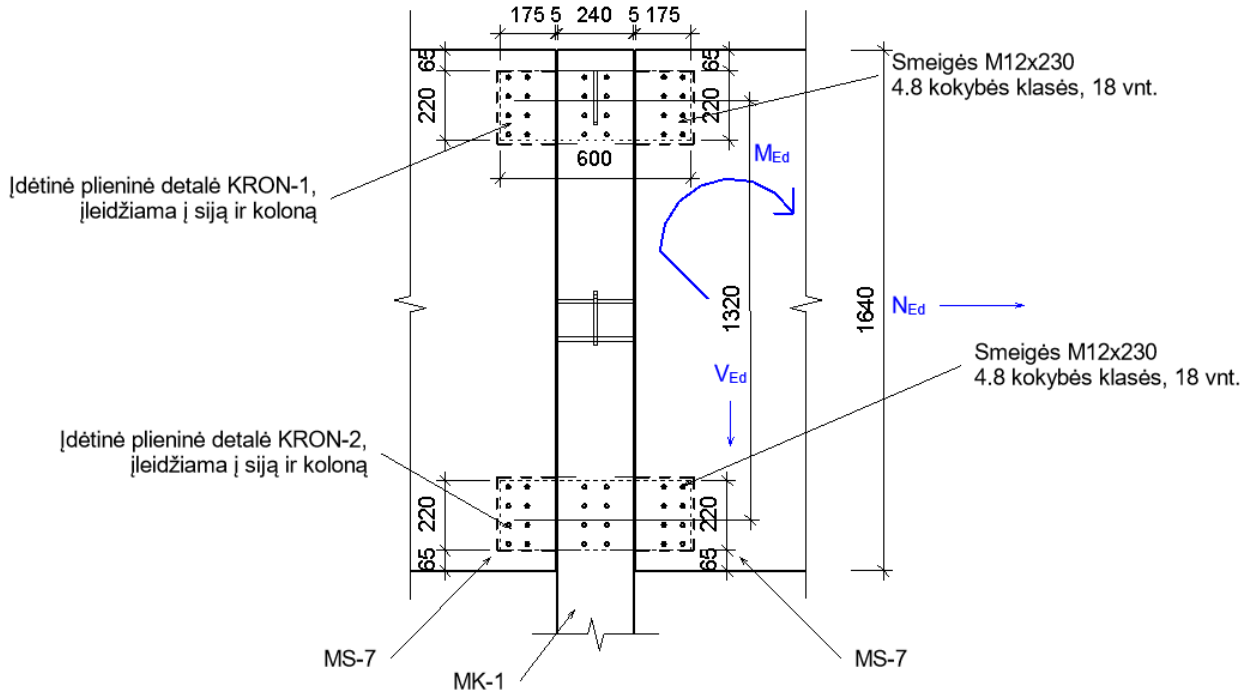
2.6.2. Medinių konstrukcijų mazgų projektavimas

2.6.2.1. Sijų ir kolonos jungtis TM-1



Sijų MS 7 ir kolonos MK-1 jungtis.

a-a (MS 7 ir MK-1 jungtis)



Jungties duomenys:

Medienos klasė GL24h, charakteristinis tankis: $\rho_k = 420\ kg/m^3$;

Kaiščių charakteristinis tempiamasis stiptis: $f_{u,k} = 800$ MPa;

Smeigių diametras: $d = 12$ mm;

Smeigių įsmigimas vienoje šlyties plokštumoje: $t_1 = 106$ mm;

Smeigių atstumas išilgai pluošto: $a_1 = 60$ mm;

Didžiausia veikianti ašinė jėga N_{Ed} = 43 kN (tempimas), 195 apkrovų derinys, elementas Nr. 208.

Didžiausia veikianti skersinė jėga V_{Ed} = 13,01 kN, 319 apkrovų derinys, elementas Nr. 209.

Didžiausias veikianti lenkiamasis momentas M_{Ed} = 33,19 kNm, 311 apkrovų derinys, elementas Nr. 43.

<u>Tikrinamas lenkiamasis momentas:</u>

Lenkiamojo momento sukeliama jėgų atsojamoji skerspjūvio viršuje:

$$V_{M,Ed} = \frac{33,19}{1,32 - \frac{1,32}{3}} = 37,72\ kN.$$

Tikrinama dvipusės šlyties veikiama plieno – medžio jungtis pagal LST EN 1995-1-1. Plieninė įleidžiama plokštelė t = 15 mm, smeigės M12 8 vnt.

Kampas tarp jėgos ir medienos pluošto krypties:

$$\alpha_1 = 90°.$$

Charakteristiniai vietiniai medienos stipriai kolonos atžvilgiu:

$$f_{h,0,k} = 0,082 \cdot (1 - 0,01 \cdot d) \cdot \rho_k = 30,31\ N/mm^2;$$

$$k_{90} = 1,35 + 0,015 \cdot d = 1,53.$$

$$f_{h,1,k} = \frac{f_{h,0,k}}{k_{90} \cdot sin^2(\alpha) + cos^2(\alpha)} = 19,81\ N/mm^2;$$

Charakteristinis varžto takumo momentas:

$$M_{y,Rk} = 0,3 \cdot f_{u,k} \cdot d^{2,6} = 1,5349 \cdot 10^5\ N \cdot mm.$$

Kaiščio vienos šlyties plokštumo charakteristinė laikomoji galia (LST EN 1995-1-1 8.11 išraiška):

$$t_1 = 106\ mm;$$

$$F_{v,Rk(f)} = f_{h,1,k} \cdot t_1 \cdot d = 25,2\ kN;$$

$$F_{v,Rk(g)} = f_{h,1,k} \cdot t_1 \cdot d \cdot \left[\sqrt{2 + \frac{4 \cdot M_{y,Rk}}{f_{h,1,k} \cdot {t_1}^2 \cdot d}} - 1\right] + \frac{F_{ax,Rk}}{4} = \mathbf{12,43\ kN};$$

$$F_{v,Rk(h)} = 2,3 \cdot \sqrt{M_{y,Rk} \cdot f_{h,1,k} \cdot d} + \frac{F_{ax,Rk}}{4} = 13,89\ kN.$$

Kaiščio vienos šlyties plokštumos skaičiuotinė laikomoji galia:

$$F_{v,Rd} = k_{mod} \cdot \frac{F_{v,Rk}}{\gamma_M} = 0,6 \cdot \frac{12,43}{1,25} = 5,97\ kN.$$

Bendra jungties skaičiuotinė laikomoji galia:

$$F_{Rd} = F_{v,Rd} \cdot n_{ef} \cdot n_{sl} \cdot n_{eil} = 5,97\ \cdot 1,47 \cdot 2 \cdot 4 = 70,2\ kN.$$

Jungties išnaudojimas:

$$\frac{V_{M,Ed}}{F_{Rd}} = \frac{37,72}{70,2} = 0,54.$$

Tikrinama skersinė jėga:

$V_{Ed} = 13,01\ kN$

Tikrinama dvipusės šlyties veikiama plieno – medžio jungtis pagal LST EN 1995-1-1. Plieninė įleidžiama plokštelė t = 15 mm 2 vnt., varžtai M12 8 vnt.

Kampas tarp jėgos ir medienos pluošto krypties:

$$\alpha_1 = 90°.$$

Charakteristiniai vietiniai medienos stipriai sijos atžvilgiu:

$$f_{h,0,k} = 0,082 \cdot (1 - 0,01 \cdot d) \cdot \rho_k = 30,31\ N/mm^2;$$

$$k_{90} = 1,35 + 0,015 \cdot d = 1,53;$$

$$f_{h,1,k} = \frac{f_{h,0,k}}{k_{90} \cdot sin^2(\alpha) + cos^2(\alpha)} = 19,81\ N/mm^2.$$

Charakteristinis varžto takumo momentas:

$$M_{y,Rk} = 0,3 \cdot f_{u,k} \cdot d^{2,6} = 1,5349 \cdot 10^5\ N \cdot mm.$$

Kaiščio vienos šlyties plokštumo charakteristinė laikomoji galia (LST EN 1995-1-1 8.11 išraiška):

$$t_1 = 106\ mm;$$

$$F_{v,Rk(f)} = f_{h,1,k} \cdot t_1 \cdot d = 25,19\ kN;$$

$$F_{v,Rk(g)} = f_{h,1,k} \cdot t_1 \cdot d \cdot \left[\sqrt{2 + \frac{4 \cdot M_{y,Rk}}{f_{h,1,k} \cdot {t_1}^2 \cdot d}} - 1\right] + \frac{F_{ax,Rk}}{4} = \mathbf{12,43\ kN};$$

$$F_{v,Rk(h)} = 2,3 \cdot \sqrt{M_{y,Rk} \cdot f_{h,1,k} \cdot d} + \frac{F_{ax,Rk}}{4} = 13,89\ kN;$$

Kaiščio vienos šlyties plokštumos skaičiuotinė laikomoji galia:

$$F_{v,Rd} = k_{mod} \cdot \frac{F_{v,Rk}}{\gamma_M} = 0,6 \cdot \frac{12,43}{1,25} = 5,97\ kN.$$

Bendra jungties skaičiuotinė laikomoji galia:

$$F_{Rd} = F_{v,Rd} \cdot n_{ef} \cdot n_{sl} \cdot n_{eil} \cdot n_j = 5{,}97 \cdot 2{,}62 \cdot 2 \cdot 2 = 62{,}6\ kN.$$

Jungties išnaudojimas:

$$\frac{V_{Ed}}{F_{Rd}} = \frac{13{,}01}{62{,}6} = 0{,}21.$$

Tikrinama ašinė jėga:

$N_{Ed} = 43\ kN$

Tikrinama dvipusės šlyties veikiama plieno – medžio jungtis pagal LST EN 1995-1-1. Plieninė įleidžiama plokštelė t = 15 mm 2 vnt., smeigės M12 8 vnt.

Kampas tarp jėgos ir medienos pluošto krypties:

$$\alpha_1 = 90°.$$

Charakteristiniai vietiniai medienos stipriai kolonos atžvilgiu:

$$f_{h,0,k} = 0{,}082 \cdot (1 - 0{,}01 \cdot d) \cdot \rho_k = 30{,}31\ N/mm^2;$$

$$k_{90} = 1{,}35 + 0{,}015 \cdot d = 1{,}53;$$

$$f_{h,1,k} = \frac{f_{h,0,k}}{k_{90} \cdot sin^2(\alpha) + cos^2(\alpha)} = 19{,}81\ N/mm^2.$$

Charakteristinis varžto takumo momentas:

$$M_{y,Rk} = 0{,}3 \cdot f_{u,k} \cdot d^{2,6} = 1{,}5349 \cdot 10^5\ N \cdot mm.$$

Kaiščio vienos šlyties plokštumo charakteristinė laikomoji galia (LST EN 1995-1-1 8.11 išraiška):

$$t_1 = 106\ mm;$$

$$F_{v,Rk(f)} = f_{h,1,k} \cdot t_1 \cdot d = 25{,}19\ kN;$$

$$F_{v,Rk(g)} = f_{h,1,k} \cdot t_1 \cdot d \cdot \left[\sqrt{2 + \frac{4 \cdot M_{y,Rk}}{f_{h,1,k} \cdot {t_1}^2 \cdot d}} - 1\right] + \frac{F_{ax,Rk}}{4} = \mathbf{12{,}43\ kN};$$

$$F_{v,Rk(h)} = 2{,}3 \cdot \sqrt{M_{y,Rk} \cdot f_{h,1,k} \cdot d} + \frac{F_{ax,Rk}}{4} = 13{,}89\ kN.$$

Kaiščio vienos šlyties plokštumos skaičiuotinė laikomoji galia:

$$F_{v,Rd} = k_{mod} \cdot \frac{F_{v,Rk}}{\gamma_M} = 0{,}6 \cdot \frac{12{,}43}{1{,}25} = 5{,}97\ kN.$$

Bendra jungties skaičiuotinė laikomoji galia:

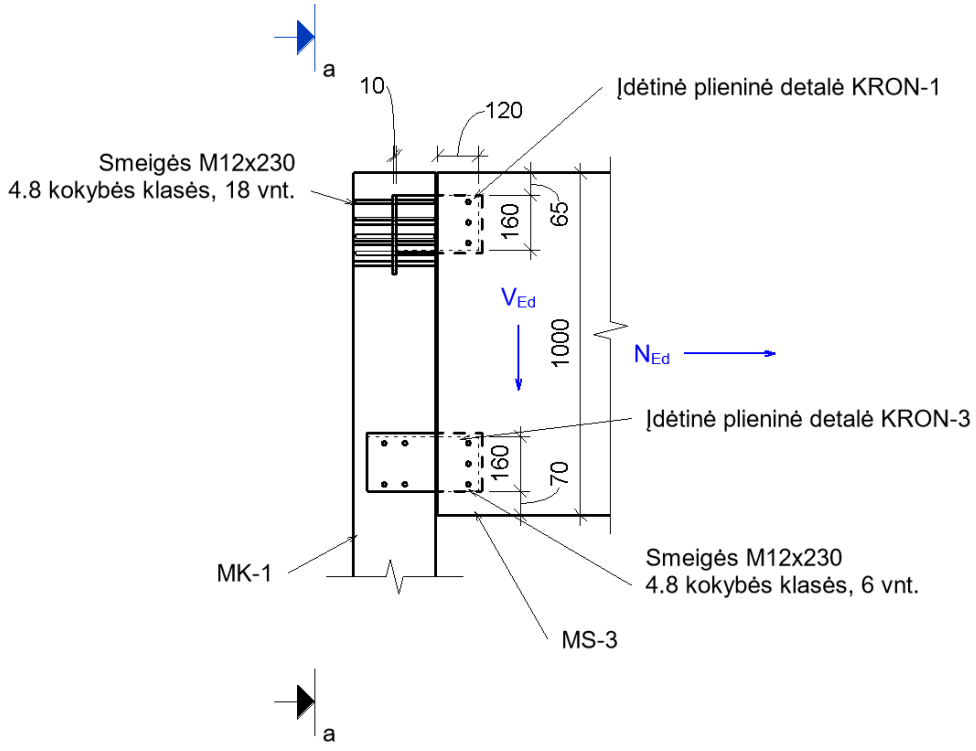
$$F_{Rd} = F_{v,Rd} \cdot n_{ef} \cdot n_{sl} \cdot n_{eil} \cdot n_j = 5{,}97\ \cdot 1{,}47 \cdot 2 \cdot 4 \cdot 2 = 140{,}4\ kN.$$

Jungties išnaudojimas:

$$\frac{N_{Ed}}{F_{Rd}} = \frac{43}{140{,}4} = 0{,}31.$$

Sijų MS 3 ir kolonos MK-1 jungtis.

b-b (MS 3 ir MK-1 jungtis)



Jungties duomenys:

Medienos klasė GL24h, charakteristinis tankis: $\rho_k = 420\ kg/m^3$;

Kaiščių charakteristinis tempiamasis stiptis: $f_{u,k} = 800$ MPa;

Smeigių diametras: $d = 12$ mm;

Smeigių įsmigimas vienoje šlyties plokštumoje: $t_1 = 109$ mm;

Smeigių atstumas išilgai pluošto: $a_1 = 60$ mm;

Didžiausia veikianti ašinė jėga N_{Ed} = 28,38 kN (gniuždymas), 195 apkrovų derinys, elementas Nr. 83.

Didžiausia veikianti skersinė jėga V_{Ed} = 11,53 kN, 94 apkrovų derinys, elementas Nr. 106.

Tikrinama skersinė jėga:

$V_{Ed} = 11{,}53\ kN$

Tikrinama dvipusės šlyties veikiama plieno – medžio jungtis pagal LST EN 1995-1-1. Plieninė įleidžiama plokštelė t = 15 mm 2 vnt., smeigės M12 3 vnt.

Kampas tarp jėgos ir medienos pluošto krypties:

$$\alpha_1 = 90°.$$

Charakteristiniai vietiniai medienos stipriai kolonos ašies atžvilgiu:

$$f_{h,0,k} = 0{,}082 \cdot (1 - 0{,}01 \cdot d) \cdot \rho_k = 30{,}31\ N/mm^2;$$

$$k_{90} = 1{,}35 + 0{,}015 \cdot d = 1{,}53;$$

$$f_{h,1,k} = \frac{f_{h,0,k}}{k_{90} \cdot sin^2(\alpha) + cos^2(\alpha)} = 19{,}81\ N/mm^2.$$

Charakteristinis varžto takumo momentas:

$$M_{y,Rk} = 0{,}3 \cdot f_{u,k} \cdot d^{2,6} = 1{,}5349 \cdot 10^5\ N \cdot mm.$$

Kaiščio vienos šlyties plokštumo charakteristinė laikomoji galia (LST EN 1995-1-1 8.11 išraiška):

$$t_1 = 109\ mm;$$

$$F_{v,Rk(f)} = f_{h,1,k} \cdot t_1 \cdot d = 25{,}91\ kN;$$

$$F_{v,Rk(g)} = f_{h,1,k} \cdot t_1 \cdot d \cdot \left[\sqrt{2 + \frac{4 \cdot M_{y,Rk}}{f_{h,1,k} \cdot {t_1}^2 \cdot d}} - 1\right] + \frac{F_{ax,Rk}}{4} = \mathbf{12{,}67\ kN};$$

$$F_{v,Rk(h)} = 2{,}3 \cdot \sqrt{M_{y,Rk} \cdot f_{h,1,k} \cdot d} + \frac{F_{ax,Rk}}{4} = 13{,}89\ kN;$$

Kaiščio vienos šlyties plokštumos skaičiuotinė laikomoji galia:

$$F_{v,Rd} = k_{mod} \cdot \frac{F_{v,Rk}}{\gamma_M} = 0{,}6 \cdot \frac{12{,}67}{1{,}25} = 6{,}08\ kN.$$

Bendra jungties skaičiuotinė laikomoji galia:

$$F_{Rd} = F_{v,Rd} \cdot n_{ef} \cdot n_{sl} \cdot n_j = 6{,}08 \cdot 2{,}02 \cdot 2 \cdot 2 = 49{,}12\ kN.$$

Jungties išnaudojimas:

$$\frac{V_{Ed}}{F_{Rd}} = \frac{11{,}53}{49{,}12} = 0{,}23.$$

Tikrinama ašinė jėga:

$N_{Ed} = 28{,}38\ kN$

Tikrinama dvipusės šlyties veikiama plieno – medžio jungtis pagal LST EN 1995-1-1. Plieninė įleidžiama plokštelė t = 15 mm 2 vnt., smeigės M12 3 vnt.

Kampas tarp jėgos ir medienos pluošto krypties:

$$\alpha_1 = 0°.$$

Charakteristiniai vietiniai medienos stipriai kolonos atžvilgiu:

$$f_{h,0,k} = 0{,}082 \cdot (1 - 0{,}01 \cdot d) \cdot \rho_k = 30{,}31\ N/mm^2;$$

$$k_{90} = 1{,}35 + 0{,}015 \cdot d = 1{,}53.$$

$$f_{h,1,k} = \frac{f_{h,0,k}}{k_{90} \cdot sin^2(\alpha) + cos^2(\alpha)} = 30{,}31\ N/mm^2;$$

Charakteristinis varžto takumo momentas:

$$M_{y,Rk} = 0{,}3 \cdot f_{u,k} \cdot d^{2,6} = 1{,}5349 \cdot 10^5\ N \cdot mm.$$

Kaiščio vienos šlyties plokštumo charakteristinė laikomoji galia (LST EN 1995-1-1 8.11 išraiška):

$$t_1 = 109\ mm;$$

$$F_{v,Rk(f)} = f_{h,1,k} \cdot t_1 \cdot d = 39{,}64\ kN;$$

$$F_{v,Rk(g)} = f_{h,1,k} \cdot t_1 \cdot d \cdot \left[\sqrt{2 + \frac{4 \cdot M_{y,Rk}}{f_{h,1,k} \cdot {t_1}^2 \cdot d}} - 1\right] + \frac{F_{ax,Rk}}{4} = 18{,}37\ kN;$$

$$F_{v,Rk(h)} = 2{,}3 \cdot \sqrt{M_{y,Rk} \cdot f_{h,1,k} \cdot d} + \frac{F_{ax,Rk}}{4} = \mathbf{17{,}18\ kN}.$$

Kaiščio vienos šlyties plokštumos skaičiuotinė laikomoji galia:

$$F_{v,Rd} = k_{mod} \cdot \frac{F_{v,Rk}}{\gamma_M} = 0{,}6 \cdot \frac{17{,}18}{1{,}25} = 8{,}24\ kN.$$

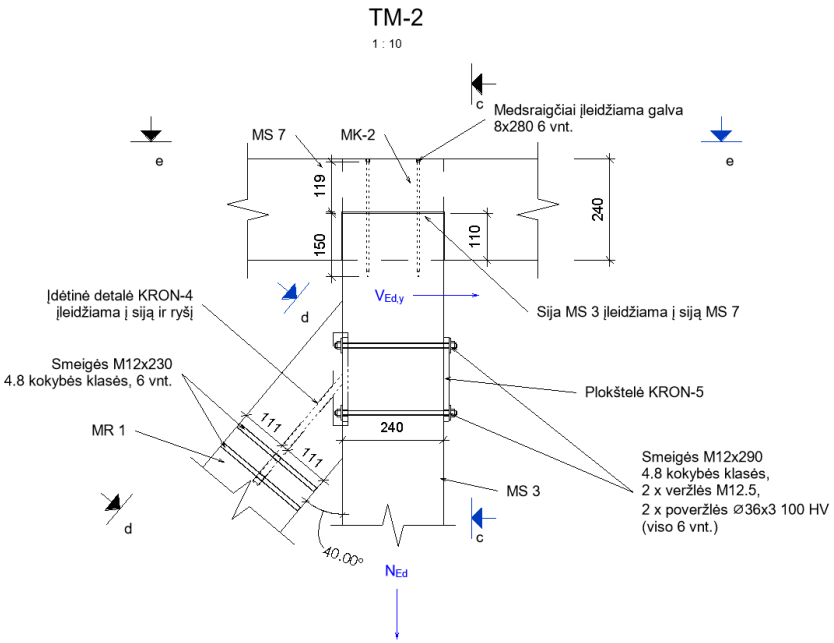
Bendra jungties skaičiuotinė laikomoji galia:

$$F_{Rd} = F_{v,Rd} \cdot n \cdot n_{sl} \cdot n_j = 8{,}24\ \cdot 3 \cdot 2 \cdot 3 = 148{,}32\ kN.$$

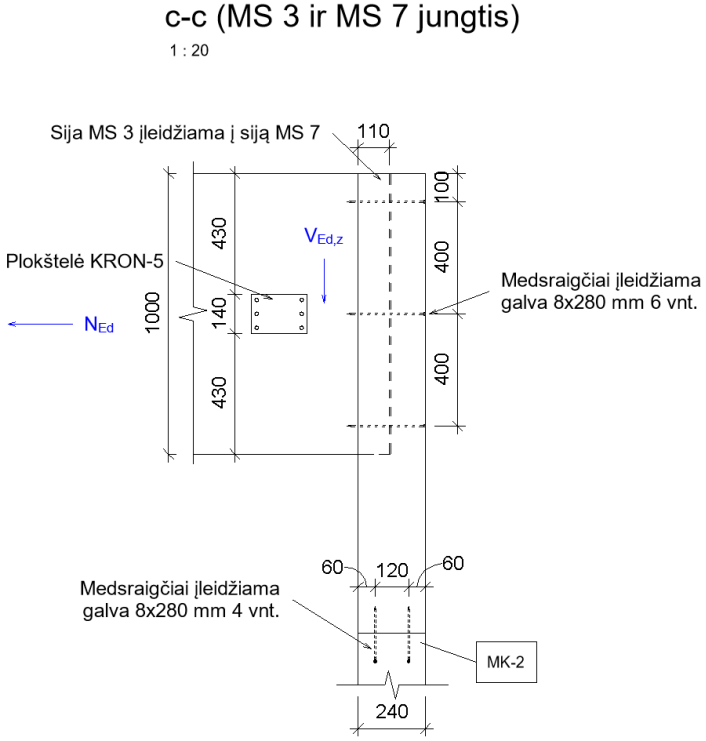
Jungties išnaudojimas:

$$\frac{N_{Ed}}{F_{Rd}} = \frac{28{,}38}{148{,}32} = 0{,}19.$$

2.6.2.2. Sijų, ryšių ir kolonos jungtis TM-2



Sijų MS 3 ir MS-7 jungtis.



Jungties duomenys:

Didžiausia veikianti ašinė jėga N_{Ed} = 14,97 kN (tempimas), 350 apkrovų derinys, elementas Nr. 111.

Didžiausia veikianti skersinė jėga $V_{Ed,z}$ = 18,60 kN, 226 apkrovų derinys, elementas Nr. 74.

Didžiausia veikianti skersinė jėga $V_{Ed,y}$ = 57,93 kN, 195 apkrovų derinys, elementas Nr. 82.

<u>Tikrinama skersinė jėga vertikalia kryptimi:</u>

$V_{Ed,z} = 18{,}60\ kN$

Tikrinama statmeno pluoštui gniuždymo veikiama sija. Gniuždymo įraža perduodama sijų sąlyčio vietoje. Sija MS 3 atsiremia ant sijos MS 7 110x240 mm plotu.

Skaičiuojamas veikiantis įtempis statmenai pluošto:

$$\sigma_{c,90,d} = \frac{V_{Ed,z}}{A} = \frac{18,6}{0,11 \cdot 0,24} = 0,70\ MPa.$$

Skaičiuojamas skaičiuotinis stipris statmenai pluošto:

$$f_{c,90,d} = k_{mod} \cdot \frac{f_{c,90,k}}{\gamma_M} = \frac{0,6 \cdot 2,5}{1,25} = 1,2\ MPa.$$

Jungties išnaudojimas:

$$\frac{\sigma_{c,90,d}}{f_{c,90,d} \cdot k_{c,90}} = \frac{0,70}{1,2 \cdot 1,0} = 0,58.$$

Tikrinama skersinė jėga horizontalia kryptimi:

$V_{Ed,y} = 57,93\ kN$

Tikrinama statmeno pluoštui gniuždymo veikiama sija. Gniuždymo įraža perduodama sijų sąlyčio vietoje. Sija MS 3 remiasi į siją MS 7 110x1000 mm plotu.

Skaičiuojamas veikiantis įtempis statmenai pluošto:

$$\sigma_{c,90,d} = \frac{V_{Ed,y}}{A} = \frac{57,93}{0,11 \cdot 1,0} = 0,53\ MPa.$$

Skaičiuojamas skaičiuotinis stipris statmenai pluošto:

$$f_{c,90,d} = k_{mod} \cdot \frac{f_{c,90,k}}{\gamma_M} = \frac{0,6 \cdot 2,5}{1,25} = 1,2\ MPa.$$

Jungties išnaudojimas:

$$\frac{\sigma_{c,90,d}}{f_{c,90,d} \cdot k_{c,90}} = \frac{0,53}{1,2 \cdot 1,0} = 0,44.$$

Tikrinama ašinė jėga

$N_{Ed} = 14,97\ kN$

Tikrinama tempimo veikiama medžio – medžio jungtis pagal LST EN 1995-1-1. Medsraigčiai įleidžiama galva 8x280 mm, 6 vnt.

Kampas tarp jėgos ir medienos pluošto krypties:

$$\alpha = 0\ °.$$

Charakteristiniai vietiniai medienos stipriai kolonos ašies atžvilgiu:

$$f_{ax,k} = 0{,}52 \cdot d^{-0{,}5} \cdot {l_{ef}}^{-0{,}1} \cdot {\rho_k}^{0{,}8} = 14{,}31\ N/mm^2;$$

$$k_d = \min\begin{cases}\frac{d}{8} = 1\\ 1\end{cases};$$

$$n_{ef} = n^{0{,}9} = 5{,}01;$$

$$F_{ax,k,Rk} = \frac{n_{ef} \cdot f_{ax,k} \cdot d \cdot l_{ef} \cdot k_d}{1{,}2 \cdot cos^2(\alpha) + sin^2(\alpha)} = 56{,}92\ kN.$$

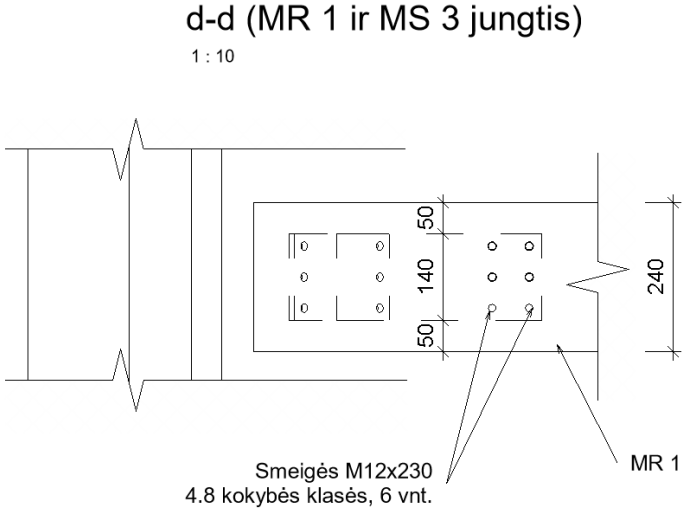
Skaičiuotinė laikomoji galia:

$$F_{ax,k,Rd} = k_{mod} \cdot \frac{F_{ax,k,Rk}}{\gamma_M} = 0{,}6 \cdot \frac{56{,}92}{1{,}25} = 27{,}32\ kN.$$

Jungties išnaudojimas:

$$\frac{N_{Ed}}{F_{ax,k,Rd}} = \frac{14{,}97}{27{,}32} = 0{,}55.$$

Ryšių MR-1 ir MS-7 jungtis.



Jungties duomenys:

Medienos klasė GL24h, charakteristinis tankis: $\rho_k = 420\ kg/m^3$;

Kaiščių charakteristinis tempiamasis stiptis: $f_{u,k} = 800$ MPa;

Smeigių diametras: $d = 12$ mm;

Didžiausia veikianti ašinė jėga N_{Ed} = 54,77 kN (tempimas), 195 apkrovų derinys, elementas Nr. 26.

Tikrinama ašinė jėga:

Tikrinama dvipusės šlyties veikiama plieno – medžio jungtis pagal LST EN 1995-1-1. Plieninė įleidžiama plokštelė t = 15 mm, smeigės M12 6 vnt.

Kampas tarp jėgos ir medienos pluošto krypties:

$$\alpha_1 = 0°.$$

Charakteristiniai vietiniai medienos stipriai kolonos atžvilgiu:

$$f_{h,0,k} = 0{,}082 \cdot (1 - 0{,}01 \cdot d) \cdot \rho_k = 30{,}31\ N/mm^2;$$

$$k_{90} = 1{,}35 + 0{,}015 \cdot d = 1{,}53.$$

$$f_{h,1,k} = \frac{f_{h,0,k}}{k_{90} \cdot sin^2(\alpha) + cos^2(\alpha)} = 30{,}31\ \ N/mm^2;$$

Charakteristinis varžto takumo momentas:

$$M_{y,Rk} = 0{,}3 \cdot f_{u,k} \cdot d^{2{,}6} = 1{,}5349 \cdot 10^5\ N \cdot mm.$$

Kaiščio vienos šlyties plokštumo charakteristinė laikomoji galia (LST EN 1995-1-1 8.11 išraiška):

$$t_1 = 111\ mm;$$

$$F_{v,Rk(f)} = f_{h,1,k} \cdot t_1 \cdot d = 38{,}55\ kN;$$

$$F_{v,Rk(g)} = f_{h,1,k} \cdot t_1 \cdot d \cdot \left[\sqrt{2 + \frac{4 \cdot M_{y,Rk}}{f_{h,1,k} \cdot {t_1}^2 \cdot d}} - 1\right] + \frac{F_{ax,Rk}}{4} = 17{,}98\ kN;$$

$$F_{v,Rk(h)} = 2{,}3 \cdot \sqrt{M_{y,Rk} \cdot f_{h,1,k} \cdot d} + \frac{F_{ax,Rk}}{4} = \mathbf{17{,}18\ kN}.$$

Kaiščio vienos šlyties plokštumos skaičiuotinė laikomoji galia:

$$F_{v,Rd} = k_{mod} \cdot \frac{F_{v,Rk}}{\gamma_M} = 0{,}6 \cdot \frac{17{,}18}{1{,}25} = 8{,}25\ kN.$$

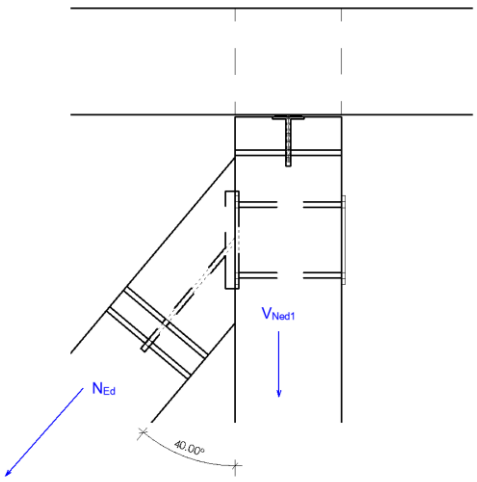
Bendra jungties skaičiuotinė laikomoji galia:

$$F_{Rd} = F_{v,Rd} \cdot n_{ef} \cdot n_{sl} \cdot n_{eil} = 8{,}25\ \cdot 1{,}47 \cdot 2 \cdot 3 = 72{,}73\ kN.$$

Jungties išnaudojimas:

$$\frac{N_{Ed}}{F_{Rd}} = \frac{54,77}{72,73} = 0,75.$$

Tikrinama jungties dalis ties MS 3.



Skersinė jėga kylanti sijoje MS 3 nuo ryšio MR 1 ašinės jėgos:

$$V_{Ned1} = \cos(40) \cdot N_{Ed} = 41,96\ kN.$$

Tikrinama vienpusės šlyties veikiama plieno – medžio jungtis pagal LST EN 1995-1-1. Išorinės plieninės plokštelės t=15 mm, 1 vnt., smeigės M12 8 vnt.

Kampas tarp jėgos ir medienos pluošto krypties:

$$\alpha_1 = 0°.$$

Charakteristiniai vietiniai medienos stipriai kolonos atžvilgiu:

$$f_{h,0,k} = 0,082 \cdot (1 - 0,01 \cdot d) \cdot \rho_k = 30,31\ N/mm^2;$$

$$k_{90} = 1,35 + 0,015 \cdot d = 1,53.$$

$$f_{h,1,k} = \frac{f_{h,0,k}}{k_{90} \cdot sin^2(\alpha) + cos^2(\alpha)} = 30,31\ \ N/mm^2;$$

Charakteristinis varžto takumo momentas:

$$M_{y,Rk} = 0,3 \cdot f_{u,k} \cdot d^{2,6} = 1,5349 \cdot 10^5\ N \cdot mm.$$

Kaiščio vienos šlyties plokštumo charakteristinė laikomoji galia (LST EN 1995-1-1 8.11 išraiška):

$$t_2 = 232\ mm;$$

$$F_{v,Rk(a)} = 0{,}4 \cdot f_{h,k} \cdot t_1 \cdot d = 30{,}55\ kN;$$

$$F_{v,Rk(b)} = 1{,}15 \cdot \sqrt{2 \cdot M_{y,Rk} \cdot f_{h,2,k} \cdot d} + \frac{F_{ax,Rk}}{4} = \mathbf{12{,}15\ kN};$$

Kaiščio vienos šlyties plokštumos skaičiuotinė laikomoji galia:

$$F_{v,Rd} = k_{mod} \cdot \frac{F_{v,Rk}}{\gamma_M} = 0{,}6 \cdot \frac{12{,}15}{1{,}25} = 5{,}83\ kN.$$

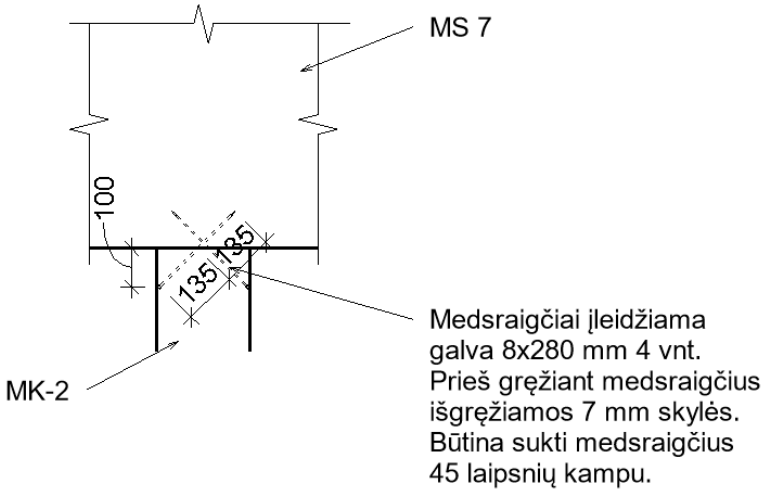
Bendra jungties skaičiuotinė laikomoji galia:

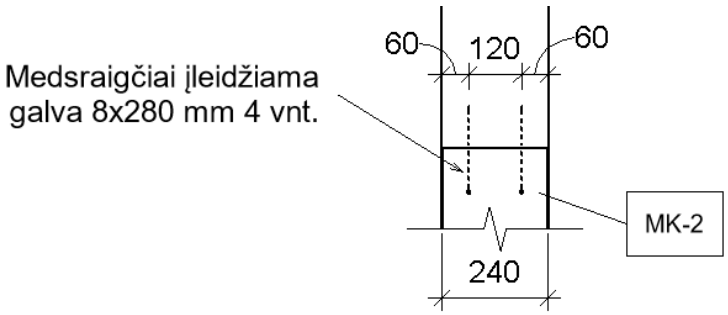
$$F_{Rd} = F_{v,Rd} \cdot n_{ef} \cdot n_{eil} = 5{,}83\ \cdot 1{,}88 \cdot 4 = 43{,}84\ kN.$$

Jungties išnaudojimas:

$$\frac{V_{Ned1}}{F_{Rd}} = \frac{41{,}96}{43{,}84} = 0{,}96.$$

Sijų MS-7 ir tarpinių kolonų MK-2 jungtis





Jungties duomenys:

Medienos klasė GL24h, charakteristinis tankis: $\rho_k = 420\ kg/m^3$;

Kaiščių charakteristinis tempiamasis stiptis: $f_{u,k} = 800$ MPa;

Medvaržčių diametras: $d = 8$ mm;

Medvaržčio įsmigimo gylis: $l_{ef} = 130$ mm;

Didžiausia veikianti ašinė jėga N_{Ed} = 16,13 kN (tempimas), 412 apkrovų derinys, elementas Nr. 95.

Tikrinama ašinė jėga:

Tikrinama tempimo veikiama medžio – medžio jungtis pagal LST EN 1995-1-1. Medsraigčiai įleidžiama galva 8x280 mm, 4 vnt.

Kampas tarp jėgos ir medienos pluošto krypties:

$$\alpha = 45\ °.$$

Charakteristiniai vietiniai medienos stipriai kolonos ašies atžvilgiu:

$$f_{ax,k} = 0{,}52 \cdot d^{-0{,}5} \cdot {l_{ef}}^{-0{,}1} \cdot {\rho_k}^{0{,}8} = 16{,}37\ N/mm^2;$$

$$k_d = \min\begin{cases}\frac{d}{8} = 1\\ 1\end{cases};$$

$$n_{ef} = n^{0{,}9} = 3{,}48;$$

$$F_{ax,k,Rk} = \frac{n_{ef} \cdot f_{ax,k} \cdot d \cdot l_{ef} \cdot k_d}{1{,}2 \cdot cos^2(\alpha) + sin^2(\alpha)} = 46{,}68\ kN.$$

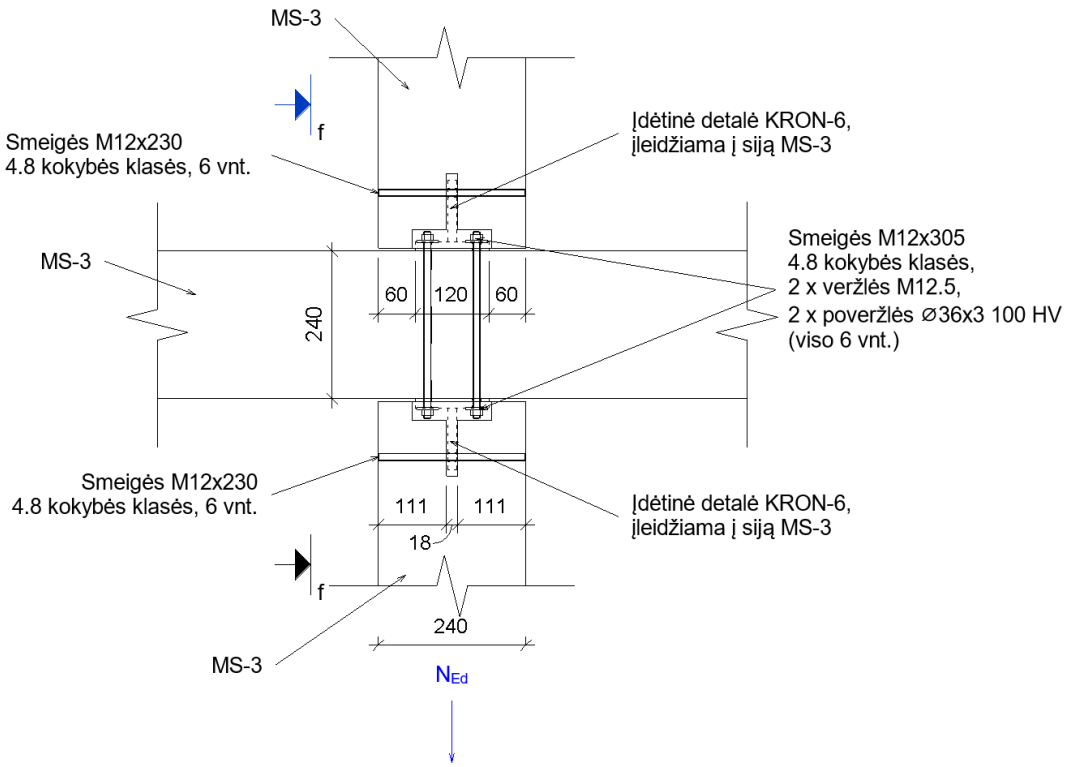
Skaičiuotinė laikomoji galia:

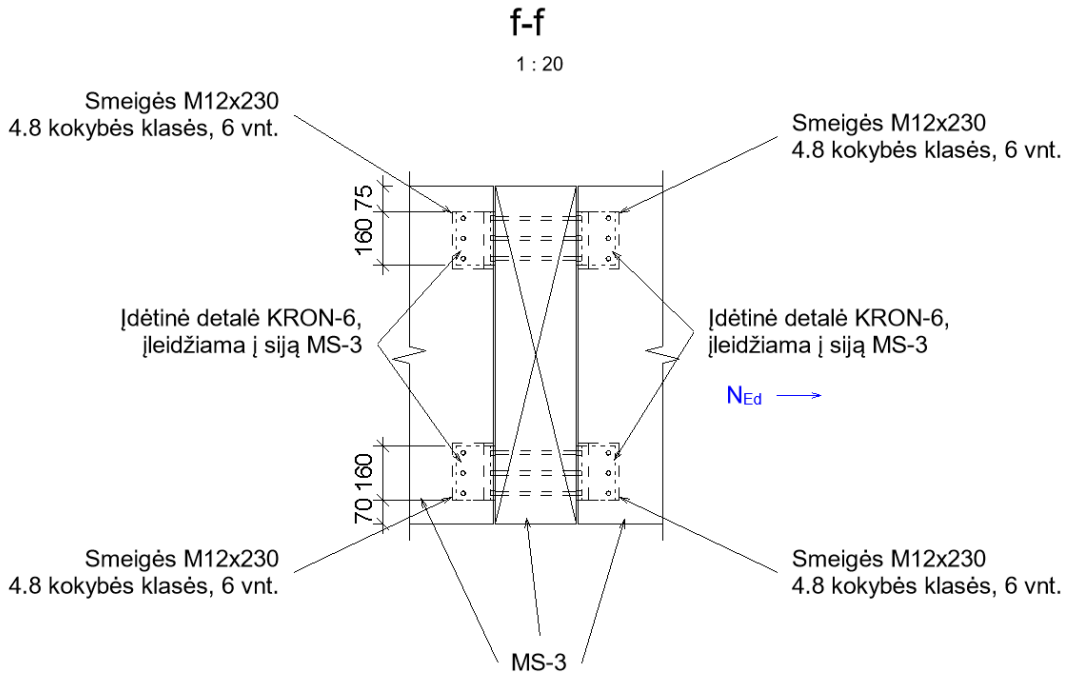
$$F_{ax,k,Rd} = k_{mod} \cdot \frac{F_{ax,k,Rk}}{\gamma_M} = 0{,}6 \cdot \frac{46{,}68}{1{,}25} = 22{,}41\ kN.$$

Jungties išnaudojimas:

$$\frac{N_{Ed}}{F_{ax,k,Rd}} = \frac{16{,}13}{22{,}41} = 0{,}72.$$

2.6.2.3. Sijų jungtis TM-3





Jungties duomenys:

Medienos klasė GL24h, charakteristinis tankis: $\rho_k = 420\ kg/m^3$;

Kaiščių charakteristinis tempiamasis stiptis: $f_{u,k} = 800$ MPa;

Smeigių diametras: $d = 12$ mm;

Didžiausia veikianti ašinė jėga N_{Ed} = 40,28 kN (tempimas), 126 apkrovų derinys, elementas Nr. 110.

Tikrinama ašinė jėga:

Tikrinama dvipusės šlyties veikiama plieno – medžio jungtis pagal LST EN 1995-1-1. Plieninė įleidžiama plokštelė t = 15 mm, smeigės M12 6 vnt.

Kampas tarp jėgos ir medienos pluošto krypties:

$$\alpha_1 = 0°.$$

Charakteristiniai vietiniai medienos stipriai kolonos atžvilgiu:

$$f_{h,0,k} = 0{,}082 \cdot (1 - 0{,}01 \cdot d) \cdot \rho_k = 30{,}31\ N/mm^2;$$

$$k_{90} = 1{,}35 + 0{,}015 \cdot d = 1{,}53.$$

$$f_{h,1,k} = \frac{f_{h,0,k}}{k_{90} \cdot sin^2(\alpha) + cos^2(\alpha)} = 30{,}31\ \ N/mm^2;$$

Charakteristinis varžto takumo momentas:

$$M_{y,Rk} = 0{,}3 \cdot f_{u,k} \cdot d^{2,6} = 1{,}5349 \cdot 10^5\ N \cdot mm.$$

Kaiščio vienos šlyties plokštumo charakteristinė laikomoji galia (LST EN 1995-1-1 8.11 išraiška):

$$t_1 = 115\ mm;$$

$$F_{v,Rk(f)} = f_{h,1,k} \cdot t_1 \cdot d = 41{,}82\ kN;$$

$$F_{v,Rk(g)} = f_{h,1,k} \cdot t_1 \cdot d \cdot \left[\sqrt{2 + \frac{4 \cdot M_{y,Rk}}{f_{h,1,k} \cdot {t_1}^2 \cdot d}} - 1\right] + \frac{F_{ax,Rk}}{4} = 19{,}18\ kN;$$

$$F_{v,Rk(h)} = 2{,}3 \cdot \sqrt{M_{y,Rk} \cdot f_{h,1,k} \cdot d} + \frac{F_{ax,Rk}}{4} = \mathbf{17{,}18\ kN}.$$

Kaiščio vienos šlyties plokštumos skaičiuotinė laikomoji galia:

$$F_{v,Rd} = k_{mod} \cdot \frac{F_{v,Rk}}{\gamma_M} = 0{,}6 \cdot \frac{17{,}18}{1{,}25} = 8{,}25\ kN.$$

Bendra jungties skaičiuotinė laikomoji galia:

$$F_{Rd} = F_{v,Rd} \cdot n_{ef} \cdot n_{sl} \cdot n_{eil} = 8{,}25\ \cdot 1{,}47 \cdot 2 \cdot 3 = 72{,}73\ kN.$$

Jungties išnaudojimas:

$$\frac{N_{Ed}}{F_{Rd}} = \frac{40{,}28}{72{,}73} = 0{,}75.$$

<u>Tikrinamas gniuždymas statmenai pluošto</u>

Tikrinama statmeno pluoštui gniuždymo veikiama sija. Gniuždymo įraža perduodama per dvi įdėtines detales KRON-6. Vienos plokštelės matmenys sąlyčio vietoje 120x160(h) mm.

Skaičiuojamas veikiantis įtempis statmenai pluošto:

$$\sigma_{c,90,d} = \frac{\mathrm{N}_{Ed}}{A} = \frac{40{,}28}{2 \cdot 0{,}12 \cdot 0{,}16} = 1{,}05\ MPa.$$

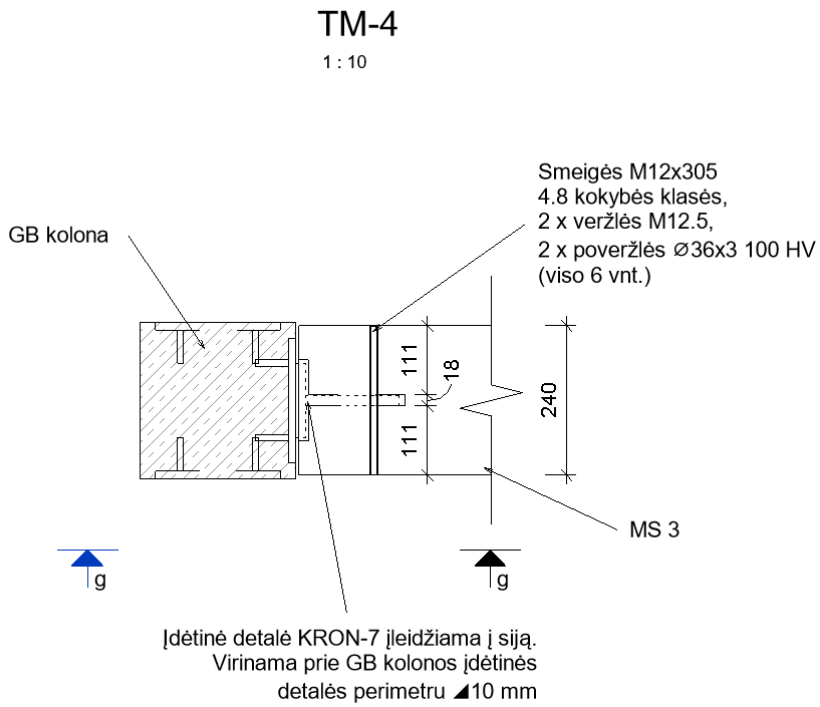
Skaičiuojamas skaičiuotinis stipris statmenai pluošto:

$$f_{c,90,d} = k_{mod} \cdot \frac{f_{c,90,k}}{\gamma_M} = \frac{0,6 \cdot 2,5}{1,25} = 1,2\ MPa.$$

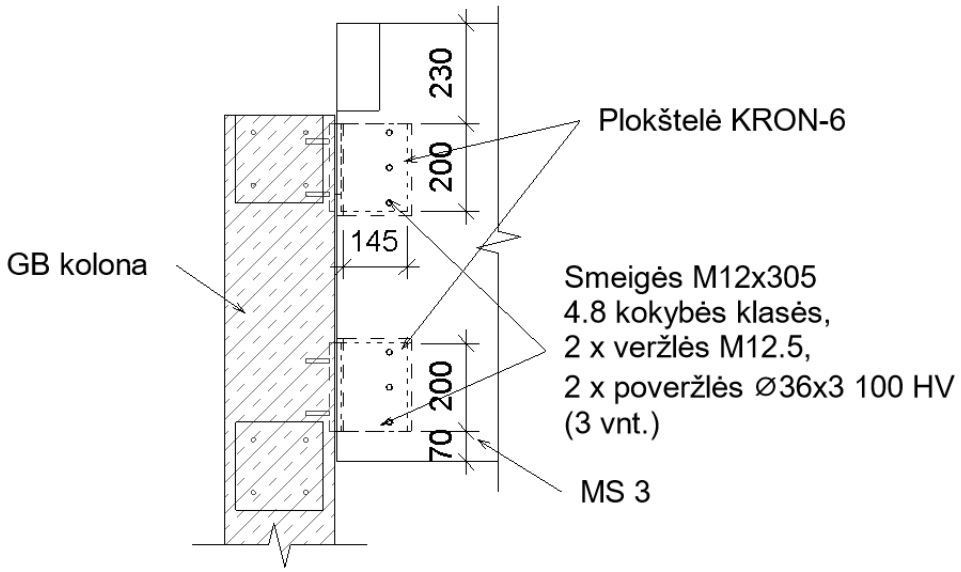
Jungties išnaudojimas:

$$\frac{\sigma_{c,90,d}}{f_{c,90,d} \cdot k_{c,90}} = \frac{1,05}{1,2 \cdot 1,0} = 0,88.$$

2.6.2.4. Sijų MS 3 ir GB kolonų jungtis TM-4



g-g
1 : 20



Jungties duomenys:

Medienos klasė GL24h, charakteristinis tankis: $\rho_k = 420\ kg/m^3$;

Kaiščių charakteristinis tempiamasis stiptis: $f_{u,k} = 800$ MPa;

Smeigių diametras: $d = 12$ mm;

Didžiausia veikianti ašinė jėga N_{Ed} = 30,5 kN (tempimas), 195 apkrovų derinys, elementas Nr. 83.

Didžiausia veikianti skersinė jėga $V_{Ed,z}$ = 21,33 kN, 226 apkrovų derinys, elementas Nr. 74.

Didžiausia veikianti skersinė jėga $V_{Ed,y}$ = 62,72 kN, 195 apkrovų derinys, elementas Nr. 82.

Tikrinama skersinė jėga:

$V_{Ed,z} = 21{,}33\ kN$

Tikrinama dvipusės šlyties veikiama plieno – medžio jungtis pagal LST EN 1995-1-1. Plieninė įleidžiama plokštelė t = 15 mm 2 vnt., smeigės M12 3 vnt.

Kampas tarp jėgos ir medienos pluošto krypties:

$$\alpha_1 = 90°.$$

Charakteristiniai vietiniai medienos stipriai kolonos ašies atžvilgiu:

$$f_{h,0,k} = 0{,}082 \cdot (1 - 0{,}01 \cdot d) \cdot \rho_k = 30{,}31\ N/mm^2;$$

$$k_{90} = 1{,}35 + 0{,}015 \cdot d = 1{,}53;$$

$$f_{h,1,k} = \frac{f_{h,0,k}}{k_{90} \cdot sin^2(\alpha) + cos^2(\alpha)} = 19{,}81\ N/mm^2.$$

Charakteristinis varžto takumo momentas:

$$M_{y,Rk} = 0{,}3 \cdot f_{u,k} \cdot d^{2,6} = 1{,}5349 \cdot 10^5\ N \cdot mm.$$

Kaiščio vienos šlyties plokštumo charakteristinė laikomoji galia (LST EN 1995-1-1 8.11 išraiška):

$$t_1 = 109\ mm;$$

$$F_{v,Rk(f)} = f_{h,1,k} \cdot t_1 \cdot d = 25{,}91\ kN;$$

$$F_{v,Rk(g)} = f_{h,1,k} \cdot t_1 \cdot d \cdot \left[\sqrt{2 + \frac{4 \cdot M_{y,Rk}}{f_{h,1,k} \cdot {t_1}^2 \cdot d}} - 1\right] + \frac{F_{ax,Rk}}{4} = \mathbf{12{,}67\ kN};$$

$$F_{v,Rk(h)} = 2{,}3 \cdot \sqrt{M_{y,Rk} \cdot f_{h,1,k} \cdot d} + \frac{F_{ax,Rk}}{4} = 13{,}89\ kN;$$

Kaiščio vienos šlyties plokštumos skaičiuotinė laikomoji galia:

$$F_{v,Rd} = k_{mod} \cdot \frac{F_{v,Rk}}{\gamma_M} = 0{,}6 \cdot \frac{12{,}67}{1{,}25} = 6{,}08\ kN.$$

Bendra jungties skaičiuotinė laikomoji galia:

$$F_{Rd} = F_{v,Rd} \cdot n_{ef} \cdot n_{sl} \cdot n_j = 6{,}08 \cdot 2{,}02 \cdot 2 \cdot 2 = 49{,}12\ kN.$$

Jungties išnaudojimas:

$$\frac{V_{Ed,z}}{F_{Rd}} = \frac{21{,}33}{49{,}12} = 0{,}43.$$

<u>Tikrinama ašinė jėga:</u>

Tikrinama dvipusės šlyties veikiama plieno – medžio jungtis pagal LST EN 1995-1-1. Plieninė įleidžiama plokštelė t = 15 mm, smeigės M12 6 vnt.

Kampas tarp jėgos ir medienos pluošto krypties:

$$\alpha_1 = 0°.$$

Charakteristiniai vietiniai medienos stipriai kolonos atžvilgiu:

$$f_{h,0,k} = 0{,}082 \cdot (1 - 0{,}01 \cdot d) \cdot \rho_k = 30{,}31\ N/mm^2;$$

$$k_{90} = 1{,}35 + 0{,}015 \cdot d = 1{,}53.$$

$$f_{h,1,k} = \frac{f_{h,0,k}}{k_{90} \cdot sin^2(\alpha) + cos^2(\alpha)} = 30{,}31\ \ N/mm^2;$$

Charakteristinis varžto takumo momentas:

$$M_{y,Rk} = 0{,}3 \cdot f_{u,k} \cdot d^{2,6} = 1{,}5349 \cdot 10^5\ N \cdot mm.$$

Kaiščio vienos šlyties plokštumo charakteristinė laikomoji galia (LST EN 1995-1-1 8.11 išraiška):

$$t_1 = 111\ mm;$$

$$F_{v,Rk(f)} = f_{h,1,k} \cdot t_1 \cdot d = 41{,}82\ kN;$$

$$F_{v,Rk(g)} = f_{h,1,k} \cdot t_1 \cdot d \cdot \left[\sqrt{2 + \frac{4 \cdot M_{y,Rk}}{f_{h,1,k} \cdot {t_1}^2 \cdot d}} - 1\right] + \frac{F_{ax,Rk}}{4} = 19{,}18\ kN;$$

$$F_{v,Rk(h)} = 2{,}3 \cdot \sqrt{M_{y,Rk} \cdot f_{h,1,k} \cdot d} + \frac{F_{ax,Rk}}{4} = \mathbf{17{,}18\ kN}.$$

Kaiščio vienos šlyties plokštumos skaičiuotinė laikomoji galia:

$$F_{v,Rd} = k_{mod} \cdot \frac{F_{v,Rk}}{\gamma_M} = 0{,}6 \cdot \frac{17{,}18}{1{,}25} = 8{,}25\ kN.$$

Bendra jungties skaičiuotinė laikomoji galia:

$$F_{Rd} = F_{v,Rd} \cdot n_{ef} \cdot n_{sl} \cdot n_{eil} = 8{,}25\ \cdot 1{,}47 \cdot 2 \cdot 3 = 72{,}73\ kN.$$

Jungties išnaudojimas:

$$\frac{N_{Ed}}{F_{Rd}} = \frac{30{,}5}{72{,}73} = 0{,}42.$$

<u>Tikrinamas gniuždymas statmenai pluošto</u>

Tikrinama statmeno pluoštui gniuždymo veikiama sija. Gniuždymo įraža perduodama per dvi įdėtines detales KRON-7. Vienos plokštelės matmenys sąlyčio vietoje 145x200(h) mm.

Skaičiuojamas veikiantis įtempis statmenai pluošto:

$$\sigma_{c,90,d} = \frac{V_{Ed,y}}{A} = \frac{62,72}{2 \cdot 0,145 \cdot 0,20} = 1,08\ MPa.$$

Skaičiuojamas skaičiuotinis stipris statmenai pluošto:

$$f_{c,90,d} = k_{mod} \cdot \frac{f_{c,90,k}}{\gamma_M} = \frac{0,6 \cdot 2,5}{1,25} = 1,2\ MPa.$$

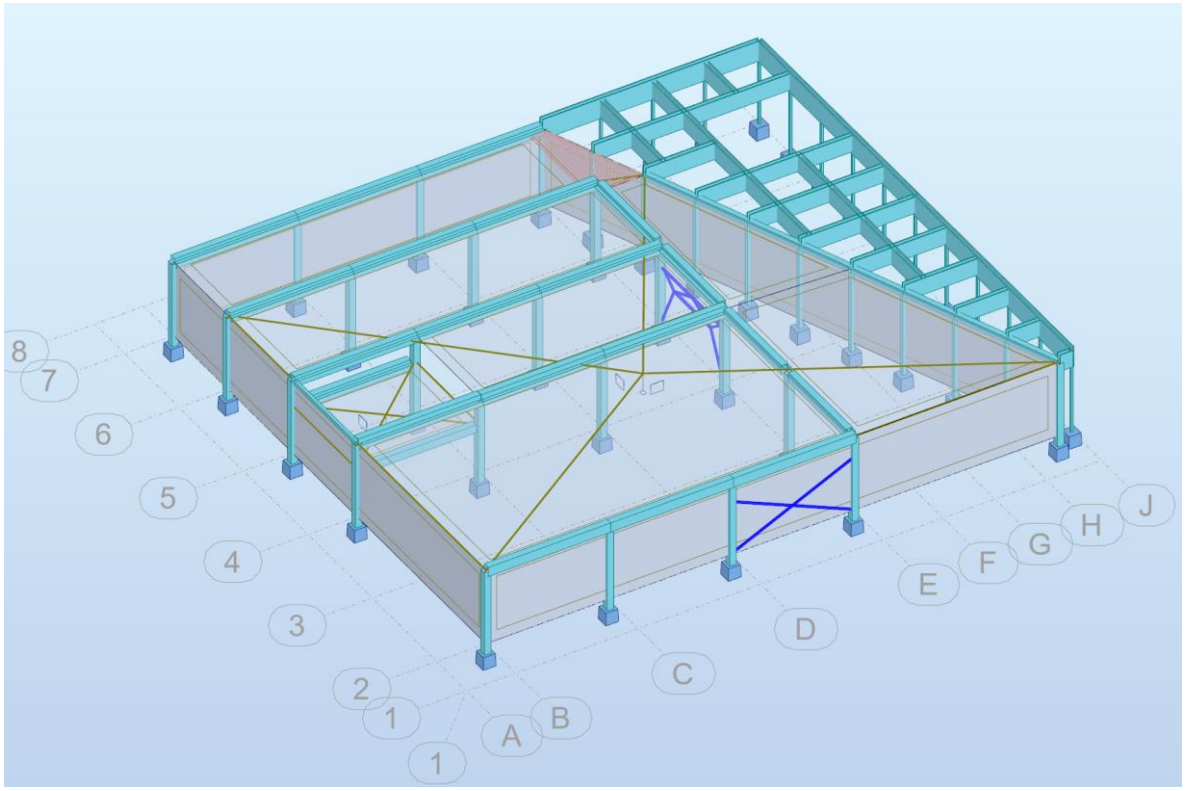
Jungties išnaudojimas:

$$\frac{\sigma_{c,90,d}}{f_{c,90,d} \cdot k_{c,90}} = \frac{1,08}{1,2 \cdot 1,0} = 0,9.$$

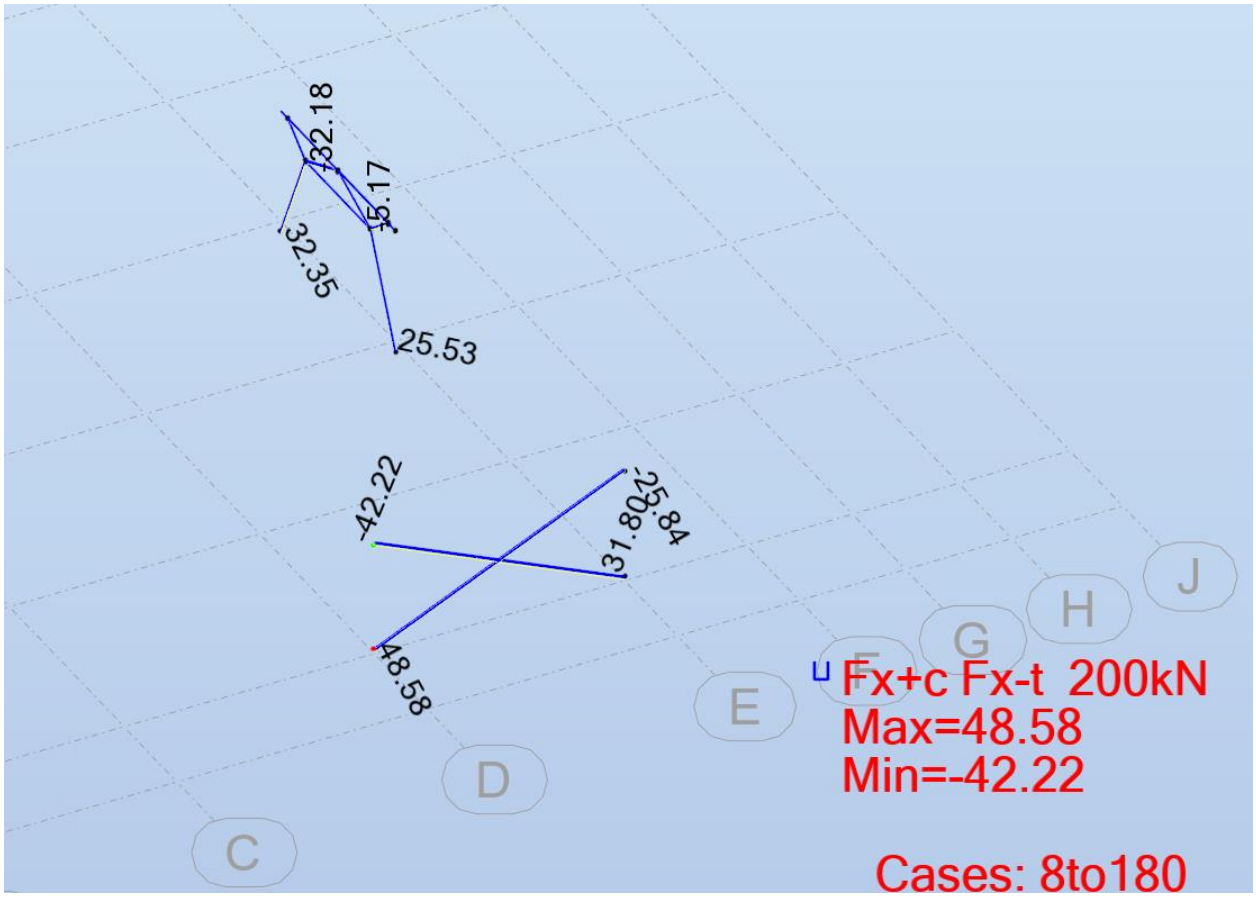
2.7.Metalinių konstrukcijų projektavimas

2.7.1. Vertikalių ryšių projektavimas

Projektuojamų vertikalių ryšių plieno klasė S355J2. Vertikalių ryšių išdėstymas:



Veikiančios ašinės jėgos:



Vertikalus ryšys

CODE: *EN 1993-1:2005/A1:2014, Eurocode 3: Design of steel structures.*
ANALYSIS TYPE: Member Verification

CODE GROUP:
MEMBER: 70 VR_70 **POINT:** 2 **COORDINATE:** x = 0.50 L = 4.12 m

---

LOADS:
Governing Load Case: 44 ULS/37=1*1.35 + 7*1.30 + 3*0.91 1*1.35+7*1.30+3*0.91

MATERIAL:
S 355 (S 355) fy = 355.00 MPa

SECTION PARAMETERS: SQUA 150x150x5

h=15.0 cm	gM0=1.10	gM1=1.10	
b=15.0 cm	Ay=14.18 cm2	Az=14.18 cm2	Ax=28.36 cm2
tw=0.5 cm	Iy=982.12 cm4	Iz=982.12 cm4	Ix=1526.73 cm4
tf=0.5 cm	Wply=152.98 cm3	Wplz=152.98 cm3	

INTERNAL FORCES AND CAPACITIES:

N,Ed = 48.08 kN	My,Ed = 2.28 kN*m
Nc,Rd = 915.13 kN	My,Ed,max = 2.28 kN*m
Nb,Rd = 208.35 kN	My,c,Rd = 49.37 kN*m
	MN,y,Rd = 49.37 kN*m

Mb,Rd = 49.37 kN*m

Class of section = 1

LATERAL BUCKLING PARAMETERS:

z = 0.00	Mcr = 1143.24 kN*m	Curve,LT - d	XLT = 1.00
Lcr,upp=8.24 m	Lam_LT = 0.22	fi,LT = 0.45	XLT,mod = 1.00

BUCKLING PARAMETERS:

About y axis:

Ly = 8.24 m	Lam_y = 1.83	Lz = 8.24 m	Lam_z = 1.83
Lcr,y = 8.24 m	Xy = 0.23	Lcr,z = 8.24 m	Xz = 0.23
Lamy = 139.99	kyy = 1.09	Lamz = 139.99	kzy = 0.76

About z axis:

VERIFICATION FORMULAS:

Section strength check:

N,Ed/Nc,Rd = 0.05 < 1.00 (6.2.4.(1))

My,Ed/My,c,Rd = 0.05 < 1.00 (6.2.5.(1))

Global stability check of member:

Lambda,y = 139.99 < Lambda,max = 150.00 Lambda,z = 139.99 < Lambda,max = 150.00 STABLE

My,Ed,max/Mb,Rd = 0.05 < 1.00 (6.3.2.1.(1))

N,Ed/(Xy*N,Rk/gM1) + kyy*My,Ed,max/(XLT*My,Rk/gM1) = 0.28 < 1.00 (6.3.3.(4))

N,Ed/(Xz*N,Rk/gM1) + kzy*My,Ed,max/(XLT*My,Rk/gM1) = 0.27 < 1.00 (6.3.3.(4))

LIMIT DISPLACEMENTS

Deflections (LOCAL SYSTEM):

uy = 0.0 cm < uy max = L/200.00 = 4.1 cm Verified

Governing Load Case: 97 SLS:CHR/16=1*1.00 + 2*0.70 + 6*1.00 + 3*0.70 (1+6)*1.00+(2+3)*0.70

uz = 0.6 cm < uz max = L/200.00 = 4.1 cm Verified

Governing Load Case: 99 SLS:CHR/18=1*1.00 + 2*0.70 + 7*1.00 + 3*0.70 (1+7)*1.00+(2+3)*0.70

Displacements (GLOBAL SYSTEM): *Not analyzed*

Section OK !!!

Išvada: sąlyga tenkinama

Vertikalus ryšys

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

ANALYSIS TYPE: Member Verification

CODE GROUP:

MEMBER: 192 VR1_192 **POINT:** 3 **COORDINATE:** x = 0.50 L = 3.25 m

---

LOADS:

Governing Load Case: 30 ULS/23=1*1.35 + 2*0.91 + 4*1.30 + 3*0.91 1*1.35+(2+3)*0.91+4*1.30

MATERIAL:

S 355 (S 355) fy = 355.00 MPa



SECTION PARAMETERS: SQUA 120x120x5

h=12.0 cm	gM0=1.10	gM1=1.10	
b=12.0 cm	Ay=11.18 cm2	Az=11.18 cm2	Ax=22.36 cm2
tw=0.5 cm	Iy=485.47 cm4	Iz=485.47 cm4	Ix=762.35 cm4
tf=0.5 cm	Wply=95.45 cm3	Wplz=95.45 cm3	

INTERNAL FORCES AND CAPACITIES:

N,Ed = 29.06 kN	My,Ed = -0.49 kN*m	
Nc,Rd = 721.50 kN	My,Ed,max = -2.63 kN*m	
Nb,Rd = 165.27 kN	My,c,Rd = 30.80 kN*m	Vz,Ed = -1.10 kN
	MN,y,Rd = 30.80 kN*m	Vz,c,Rd = 208.28 kN
	Mb,Rd = 30.80 kN*m	
		Class of section = 1



LATERAL BUCKLING PARAMETERS:

z = 0.00	Mcr = 719.93 kN*m	Curve,LT - d	XLT = 1.00
Lcr,low=6.50 m	Lam_LT = 0.22	fi,LT = 0.45	XLT,mod = 1.00

BUCKLING PARAMETERS:



About y axis:



About z axis:

Ly = 6.50 m	Lam_y = 1.83	Lz = 6.50 m	Lam_z = 1.83
Lcr,y = 6.50 m	Xy = 0.23	Lcr,z = 6.50 m	Xz = 0.23
Lamy = 139.49	kyy = 1.07	Lamz = 139.49	kzy = 0.72

VERIFICATION FORMULAS:

Section strength check:

N,Ed/Nc,Rd = 0.04 < 1.00 (6.2.4.(1))
My,Ed/My,c,Rd = 0.02 < 1.00 (6.2.5.(1))
Vz,Ed/Vz,c,Rd = 0.01 < 1.00 (6.2.6.(1))

Global stability check of member:

Lambda,y = 139.49 < Lambda,max = 150.00 Lambda,z = 139.49 < Lambda,max = 150.00 STABLE
My,Ed,max/Mb,Rd = 0.09 < 1.00 (6.3.2.1.(1))
N,Ed/(Xy*N,Rk/gM1) + kyy*My,Ed,max/(XLT*My,Rk/gM1) = 0.27 < 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 = 0.0 cm < uy max = L/200.00 = 3.3 cm Verified
Governing Load Case: 99 SLS:CHR/18=1*1.00 + 2*0.70 + 7*1.00 + 3*0.70 (1+7)*1.00+(2+3)*0.70
uz = 0.1 cm < uz max = L/200.00 = 3.3 cm Verified
Governing Load Case: 93 SLS:CHR/12=1*1.00 + 2*0.70 + 4*1.00 + 3*0.70 (1+4)*1.00+(2+3)*0.70



Displacements (GLOBAL SYSTEM): *Not analyzed*

Section OK !!!

Išvada: sąlyga tenkinama

Įdėtinės detalės vertikaliems ryšiams skaičiavimas

Įdėtinių detalių skaičiavimas vertikaliems ryšiams

Betonas

$f_{ck} := 30$ MPa $f_{ctk005} := 1.8$ MPa

$\gamma_c := 1.5$ $\alpha ct := 1$ $\gamma_{m2} := 1.25$

$$f_{cd} := \frac{f_{ck}}{\gamma_c} \cdot 0.9 = 18 \text{ MPa}$$

$$fctd := \alpha ct \cdot \frac{f_{ctk005}}{\gamma_c} = 1.2 \text{ MPa}$$

$\beta := 1$ sunkiajam betonui

Plienas S500

$$f_{yd} := \frac{500}{1.15} = 434.783 \text{ MPa}$$

$$f_{yw} := \frac{f_{yd}}{\gamma_{m2}} = 347.826 \text{ MPa}$$

Veikiančios įrąžos

$N_{full} := 49$ kN

Jėgos pasukimo kampas

$\varphi := 19$ laipsniai

Ašinės jėgos atstojamosios

$$N_{ed} := \sin\left(\varphi \cdot \frac{\pi}{180}\right) \cdot N_{full} = 15.953 \text{ kN}$$

$$V_{ed} := \cos\left(\varphi \cdot \frac{\pi}{180}\right) \cdot N_{full} = 46.33 \text{ kN}$$

Įrąžos vienai išoriniai inkarų eilei

$$N_{an} := \frac{2N_{ed}}{n_{an}} \cdot 10^3 = 1.595 \times 10^4 \text{ N}$$

$$V_{an} := 2\,\frac{V_{ed} \cdot 10^3 - 0.3 \cdot N_{an}}{n_{an}} = 4.154 \times 10^4 \text{ N}$$

Suminis apkrautos eilės skerspjūvio plotas

$$\omega := 0.6 \cdot \frac{N_{an}}{V_{an}} = 0.23 \quad \text{(be prispaudimo)}$$

$$\delta := \text{if}\left(\frac{1}{\sqrt{1+\omega}} < 0.15, 0.15, \frac{1}{\sqrt{1+\omega}}\right) = 0.902$$

Įdėtinės detalės geometrija

atstumas tarp inkarinių strypų

$s := 0.12$ m

$b_1 := 0.2$ m

$h := 0.22$ m

Atstumas tarp kraštinių inkarinių strypų

$z := 0.12$ m

Inkarinių strypų eilių skaičius šlyties jėgos veikimo kryptimi

$n_{an} := 2$

Inkarų skersmuo

$d := 1.6$ cm

Inkaro skerspjūvio plotas

$$A_{an1} := \frac{\pi \cdot d^2}{4} = 2.011 \text{ cm2}$$

Inkarų skaičius vienoje eilėje

$n := 2$

$$\lambda := \text{if}\left[\frac{4.75\cdot\sqrt[3]{f_{cd}}}{\left(1+0.15\cdot A_{an1}\right)\cdot\sqrt{f_{yd}}}\cdot\beta > 0.7, 0.7, \frac{4.75\cdot\sqrt[3]{f_{cd}}}{\left(1+0.15\cdot A_{an1}\right)\cdot\sqrt{f_{yd}}}\cdot\beta\right] = 0.459$$

Tikrinamas reikalingas inkarų eilės skersjūvio plotas ir lyginamas su parinktu

$$A_{an} := \frac{1.1\cdot\sqrt{N_{an}^{\ 2}+\left(\frac{V_{an}}{\lambda\cdot\delta}\right)^2}}{f_{yd}}\cdot 10^{-2} = 2.574$$

Inkarinių strypų išnaudojimas

$$p := \frac{A_{an}}{A_{an1}\cdot n} = 0.64$$

Reikalingas plokštelės storis

$$t_1 := 0.25\cdot d\cdot\frac{f_{yd}}{f_{yw}} = 0.5 \quad \text{cm}$$

$$t_2 := 0.7\cdot d = 1.12 \quad \text{cm}$$

Išvada: įdėtinės detalės laikomoji galia pakankama. Įdėtinės detalės plokštelės storis 15mm, plokštelės matmenys 220x200mm. Inkarinių strypų skersmuo 16mm, strypų skaičius 4 vnt. Atstumas tarp inkarinių strypų 120mm.

2.7.2. Omega ilginių metalinio stogelio apačioje projektavimas

Omega ilginiai skaičiuojami su RUUKKI PurCalc skaičiavimo programa.

Omega ilginių parinkimas didžiausiame tarpatramyje tarp ašių 7-8 D-E1.

Structural part: Part

Updated: 2025-09-03 12:37 (GMT) **Version:** 1.1.50 (2025-08-27)

Created: 2025-08-27 09:12 (GMT)

Reliability class: RC2

Structure type: Roof purlin

Roof slope: 34 °

Deflection limit: L/175 (custom)

SLS combination: Characteristic

Profile type: H-profile

Purlin direction: Longitudinal

Purlin orientation: Wide flange top

Bottom flange deflection restricted: No

Design according to testing: No

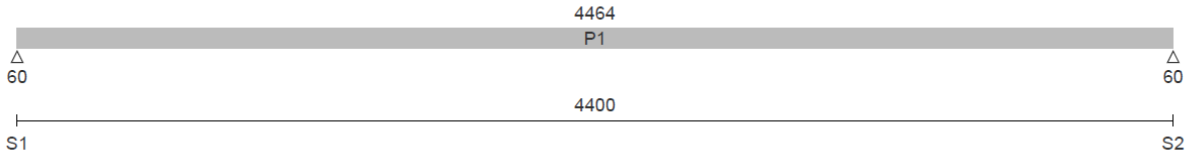
Chosen purlins fulfill design criteria. Maximum utilization rate: 89.0 %

Chosen fasteners fulfill design criteria. Maximum utilization rate: 1.5 %

Structural model

Left end: Distance to end of purlin: 32 mm

Right end: Distance to end of purlin: 32 mm



Selected purlin: LP-H150

Purlin interval: 500 mm

Total weight of the purlins: 9.5 kg/m^2

Global warming potential, GWP (A1...A3): 24.8 kg CO_2 eq. / m^2 Zinc-coated

Span	Thickness	Length
	[mm]	[mm]
P1	1.2	4464

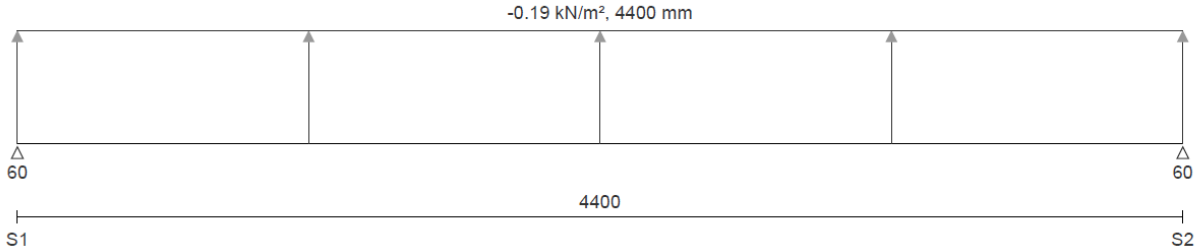
Supports and joints

Support	Support piece	Axial support	Joint type
S1	No	Yes	End support
S2	No	Yes	End support

Dead load

Structure weight without purlins and sheeting: 0 kN/m^2

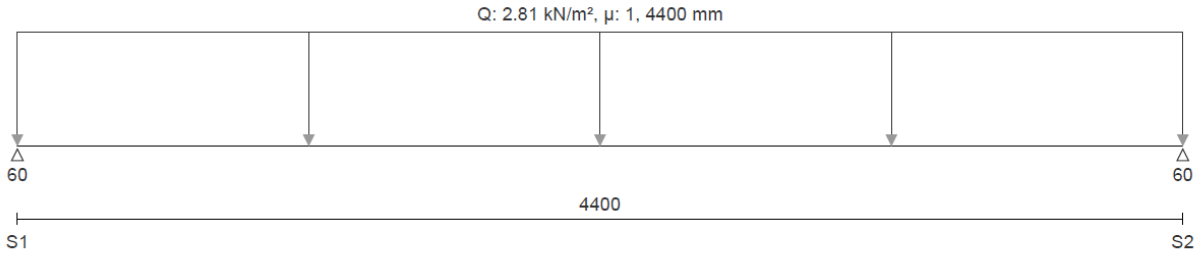
Total weight of the sheeting: 0 kN/m^2



Wind load

Basic wind load: 2.81 kN/m^2

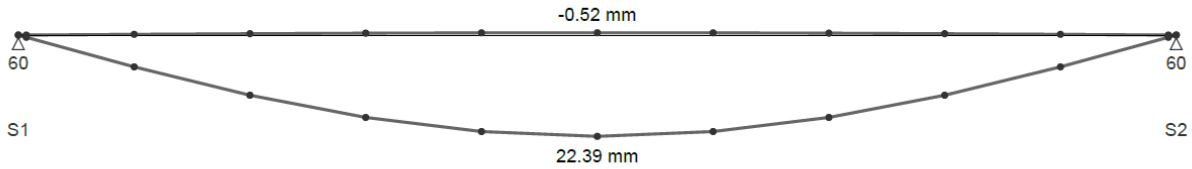
Case 1



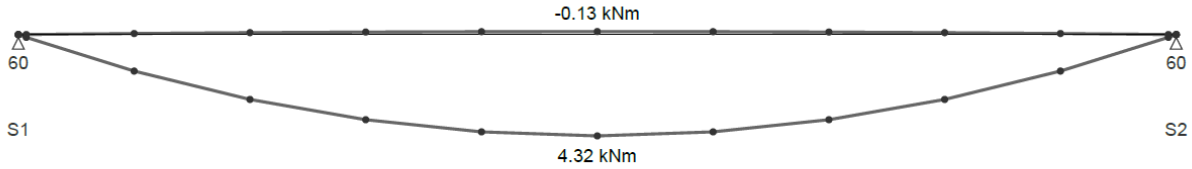
Utilization rates

Purlin	M [kNm]	R [kN]	M/R	N [kN]	V [kN]	N/V/M	σ [MPa]	D [mm]
P1	4.3 / 5.5 79.0 %	3.9 / 6.9 56.7 %	45.4 %	0.0 / 100.0 0.0 %	3.9 / 24.7 15.7 %	79.0 %	-276.4 / 350.0 79.0 %	22.4 / 25.1 89.0 %

Deflection



Bending moment



Shear force



Support reactions

ULS

	Transverse direction		Axial direction	
Support	**Min**	**Max**	**Min**	**Max**
	[kN/purlin]	[kN/purlin]	[kN]	[kN]
S1	-0.12	3.93	0.0	0.0
S2	-0.12	3.93	0.0	0.0

Fasteners

Support wall thickness: 4 mm

Steel grade of the supporting beams: S355J2 (355/490)

Bottom flange fastener: SD6-H15-5.5

Upper flange support from load bearing sheet

Positioning of sheeting: Wide flange of the sheet fixed to purlin

Continuity of the sheet: Single-span structure

Number of top flange screws: 1

Sheet fastener distance in upper flange: 50 %

Fixing interval: Through every through

Load bearing sheet name: T45-30-905

Nominal sheet thickness: 0.6 mm

	Support fasteners		
Support	**pcs / support**	**Utilization rate**	**Design criterion**
		[%]	
S1	2	1.5	Pull-through
S2	2	1.5	Pull-through

Amount of fasteners

Total amount: 4 pcs / purlin row

Išvada: laikomoji galia pakankama. Naudojant kito gamintojo skerspjūvius, juos privalo perskaičiuoti gamintojas.

Omega ilginių parinkimas kituose tarpatramiuose

Structural part: kiti ilginiai apacioje

Updated: 2025-09-03 13:07 (GMT) **Version:** 1.1.50 (2025-08-27)

Created: 2025-08-22 12:27 (GMT)

Reliability class: RC2

Structure type: Roof purlin

Roof slope: 34 °

Deflection limit: L/175 (custom)

SLS combination: Characteristic

Profile type: H-profile

Purlin direction: Longitudinal

Purlin orientation: Wide flange top

Bottom flange deflection restricted: No

Design according to testing: No

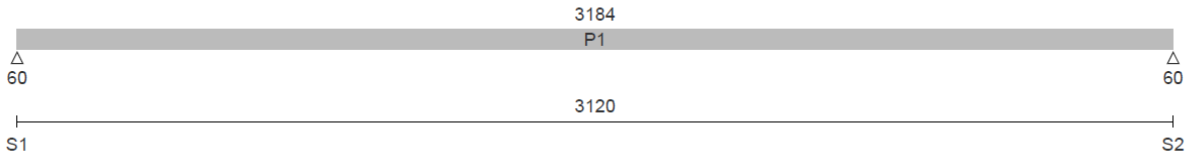
Chosen purlins fulfill design criteria. Maximum utilization rate: 79.5 %

Chosen fasteners fulfill design criteria. Maximum utilization rate: 3.2 %

Structural model

Left end: Distance to end of purlin: 32 mm

Right end: Distance to end of purlin: 32 mm



Selected purlin: LP-H150

Purlin interval: 1000 mm

Total weight of the purlins: 4.8 kg/m^2

Global warming potential, GWP (A1...A3): 12.4 kg CO_2 eq. / m^2 Zinc-coated

Span	Thickness	Length
	[mm]	[mm]
P1	1.2	3184

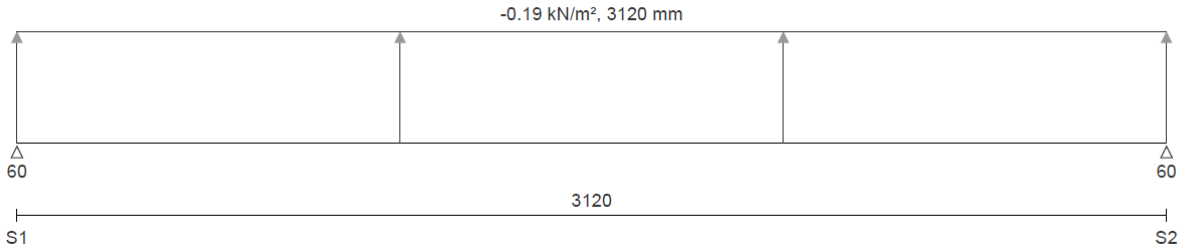
Supports and joints

Support	Support piece	Axial support	Joint type
S1	No	Yes	End support
S2	No	Yes	End support

Dead load

Structure weight without purlins and sheeting: 0 kN/m^2

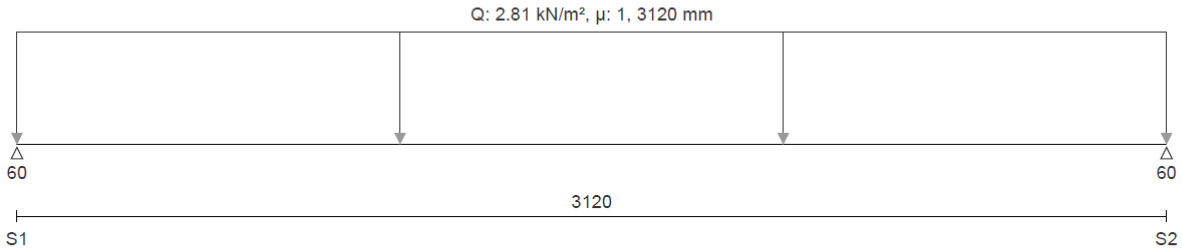
Total weight of the sheeting: 0 kN/m^2



Wind load

Basic wind load: 2.81 kN/m^2

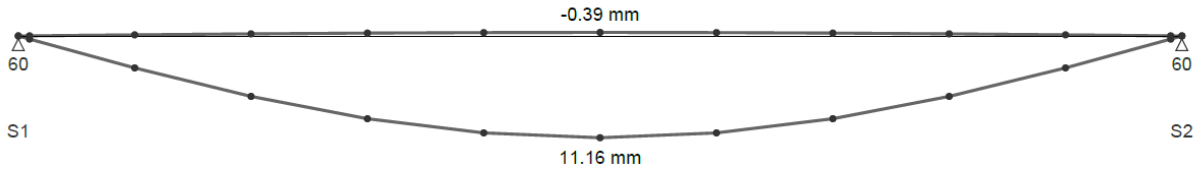
Case 1



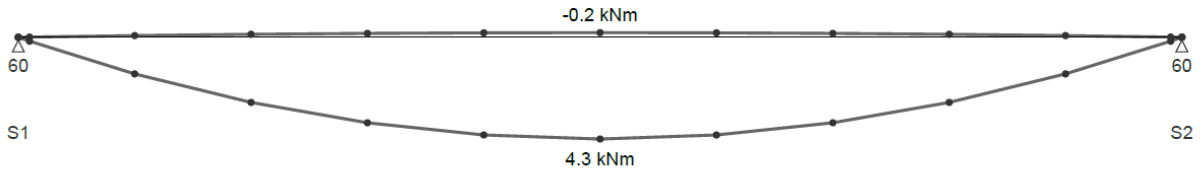
Utilization rates

Purlin	M	R	M/R	N	V	N/V/M	σ	D
	[kNm]	[kN]		[kN]	[kN]		[MPa]	[mm]
P1	4.3 / 5.5 78.6 %	5.5 / 6.9 79.5 %	63.6 %	0.0 / 100.0 0.0 %	5.4 / 24.7 21.9 %	78.6 %	-274.9 / 350.0 78.5 %	11.2 / 17.8 62.6 %

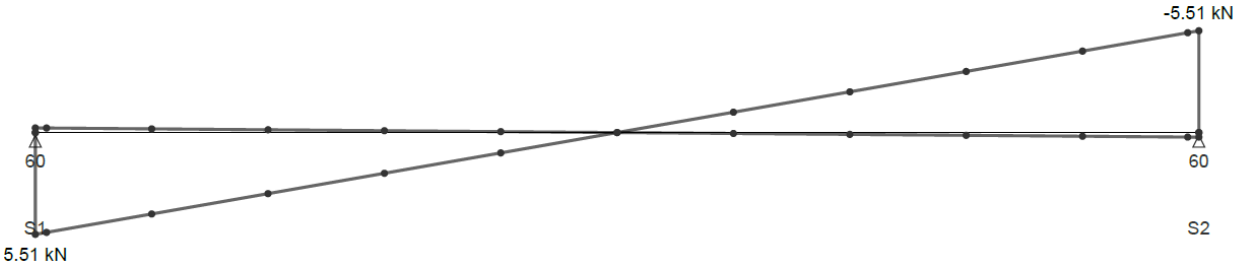
Deflection



Bending moment



Shear force



Support reactions

ULS

Support	Transverse direction Min	Transverse direction Max	Axial direction Min	Axial direction Max
	[kN/purlin]	[kN/purlin]	[kN]	[kN]
S1	-0.25	5.51	0.0	0.0
S2	-0.25	5.51	0.0	0.0

Fasteners

Support wall thickness: 4 mm

Steel grade of the supporting beams: S355J2 (355/490)

Bottom flange fastener: SD6-H15-5.5

Upper flange support from load bearing sheet

Positioning of sheeting: Wide flange of the sheet fixed to purlin

Continuity of the sheet: Single-span structure

Number of top flange screws: 1

Sheet fastener distance in upper flange: 50 %

Fixing interval: Through every through

Load bearing sheet name: T45-30-905

Nominal sheet thickness: 0.6 mm

Support	Support fasteners pcs / support	Utilization rate [%]	Design criterion
S1	2	3.2	Pull-through
S2	2	3.2	Pull-through

Amount of fasteners

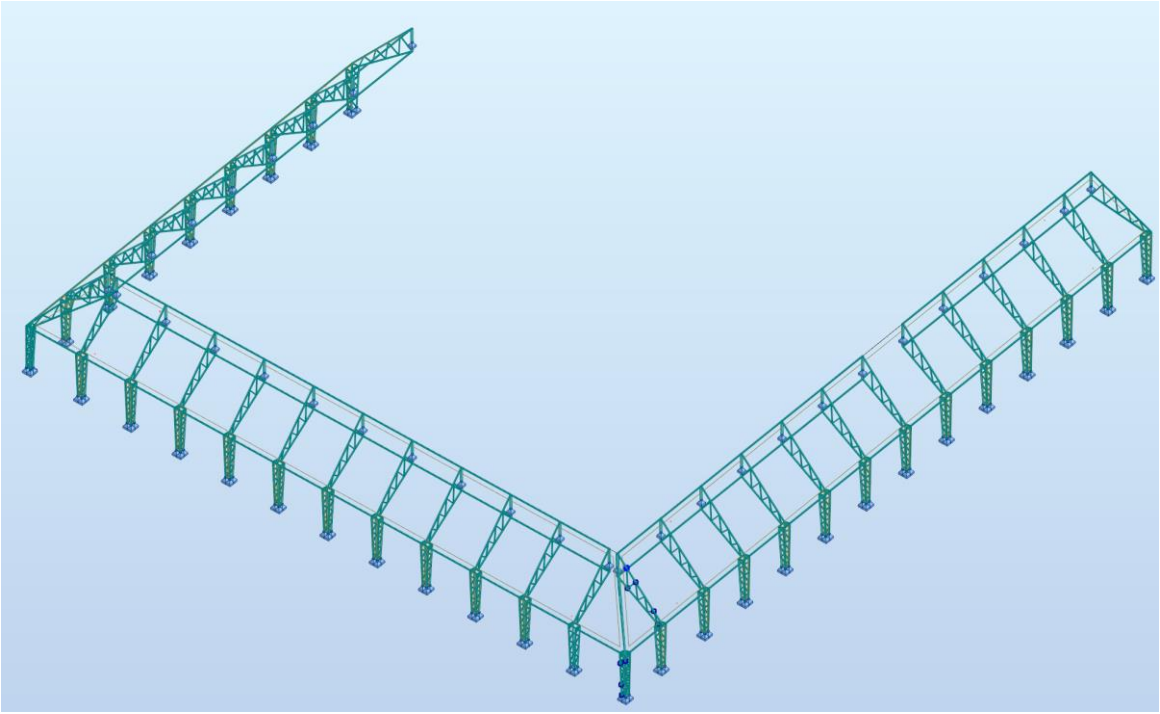
Total amount: 4 pcs / purlin row

Išvada: laikomoji galia pakankama. Naudojant kito gamintojo skerspjūvius, juos privalo perskaičiuoti gamintojas.

2.7.3. Spragoto skerspjūvio rėmų projektavimas

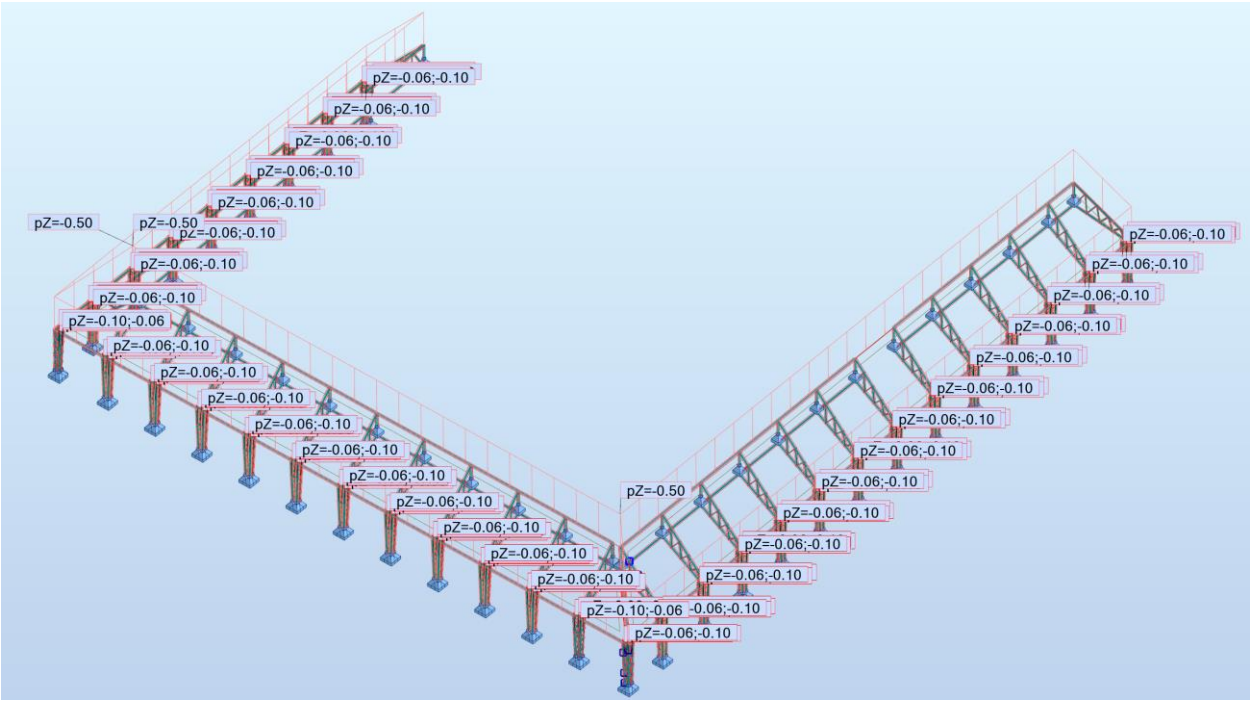
Projektuojami spragoto skerspjūvio rėmai, plieno klasė S355J2H. Rėmo kolona bazėje tvirtinama standžiai, sija prie kolonos ir denginio perdangos tvirtinama lanksčiai.

Skaičiuojamoji schema:

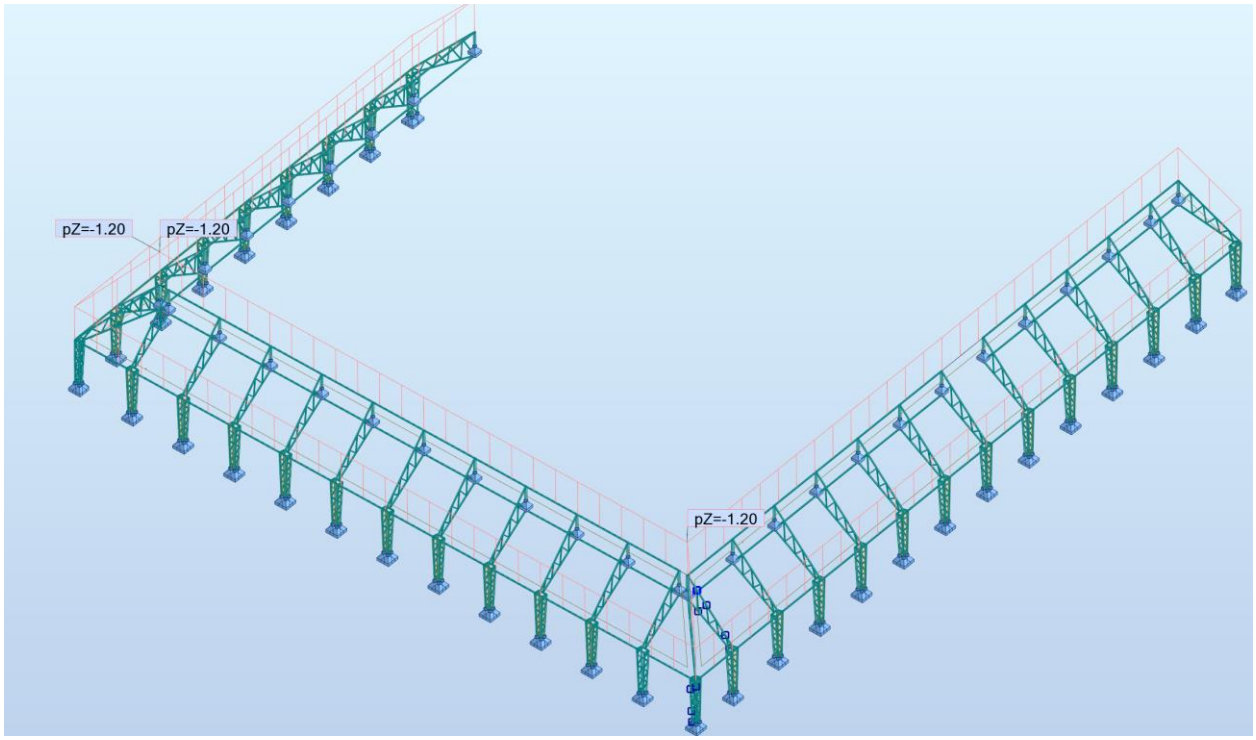


Veikiančios apkrovos:

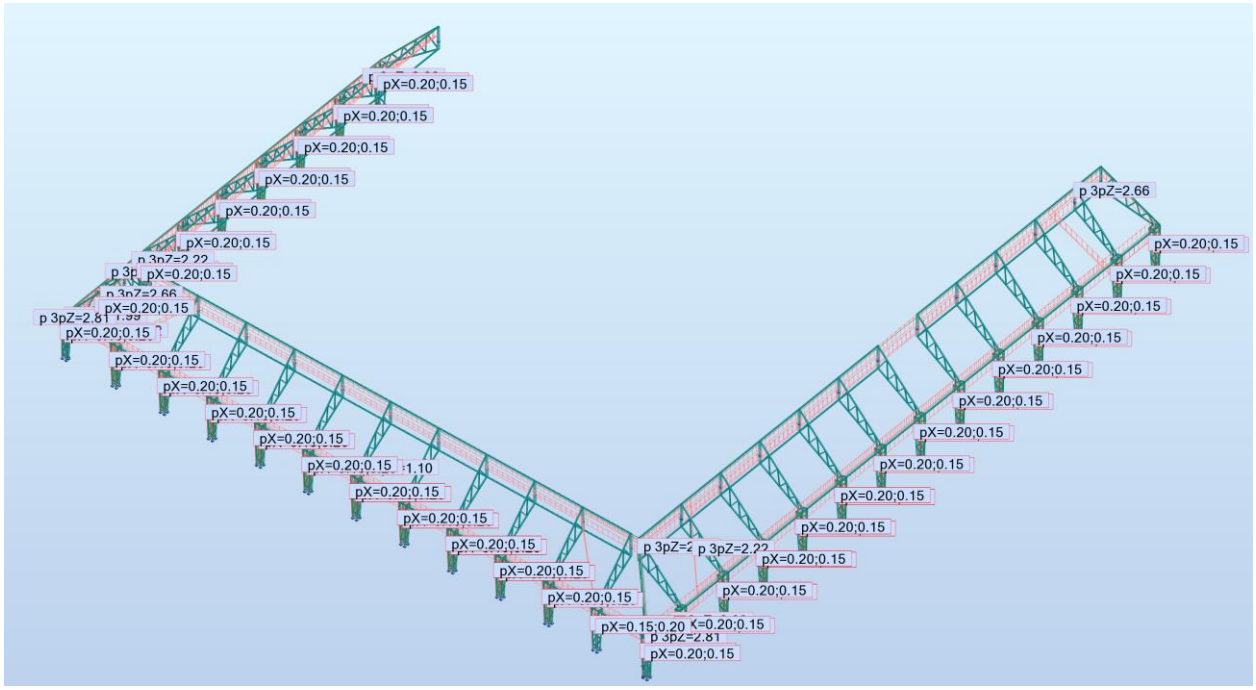
Nuolatinės apkrovos:



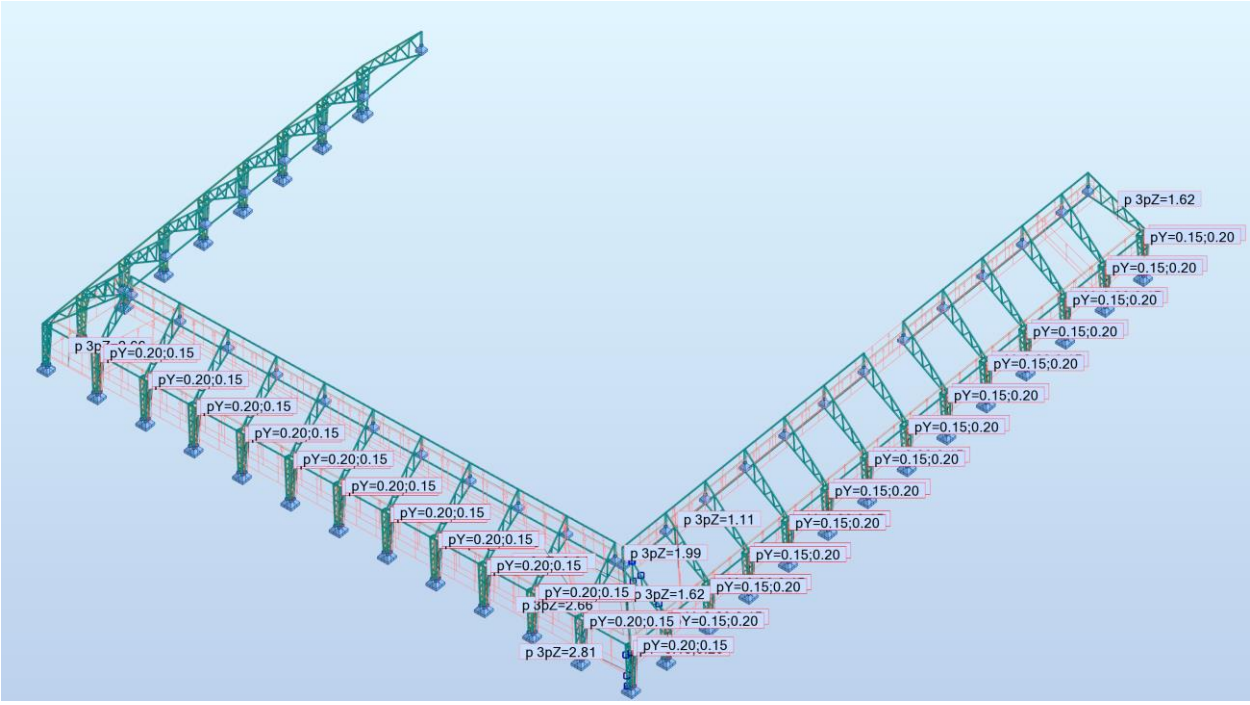
Sniego apkrovos:



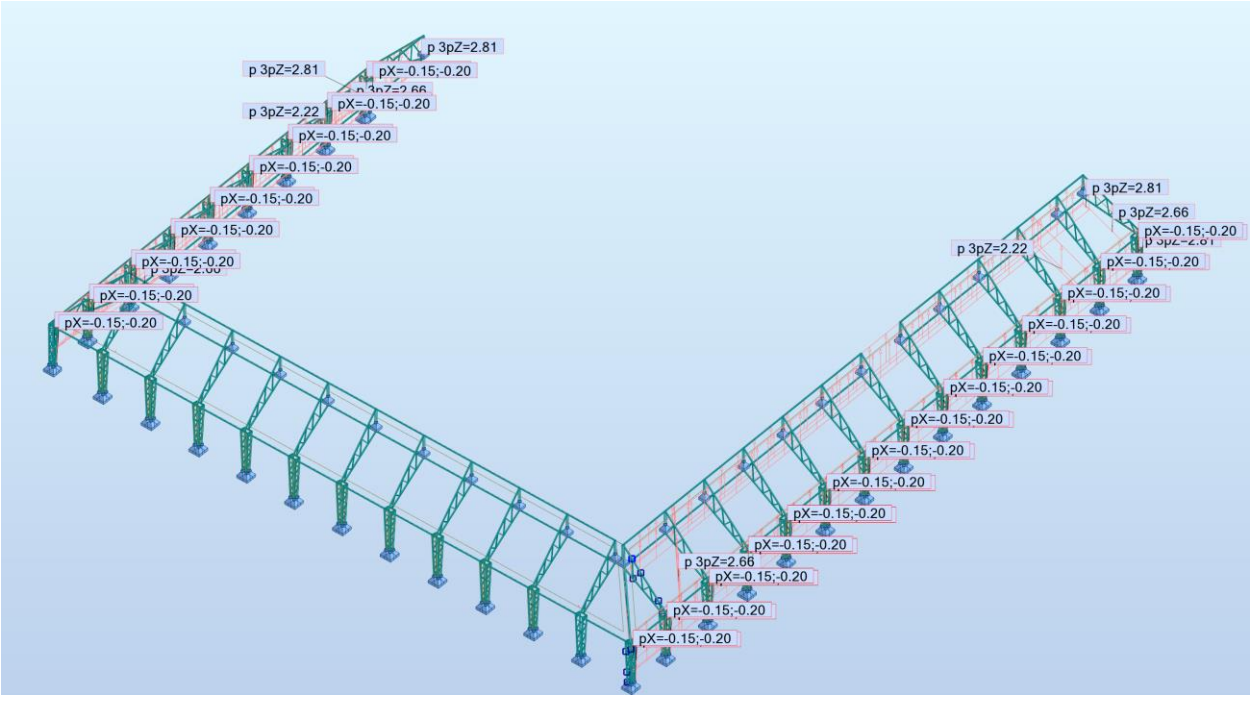
Vėjo apkrovos 1:



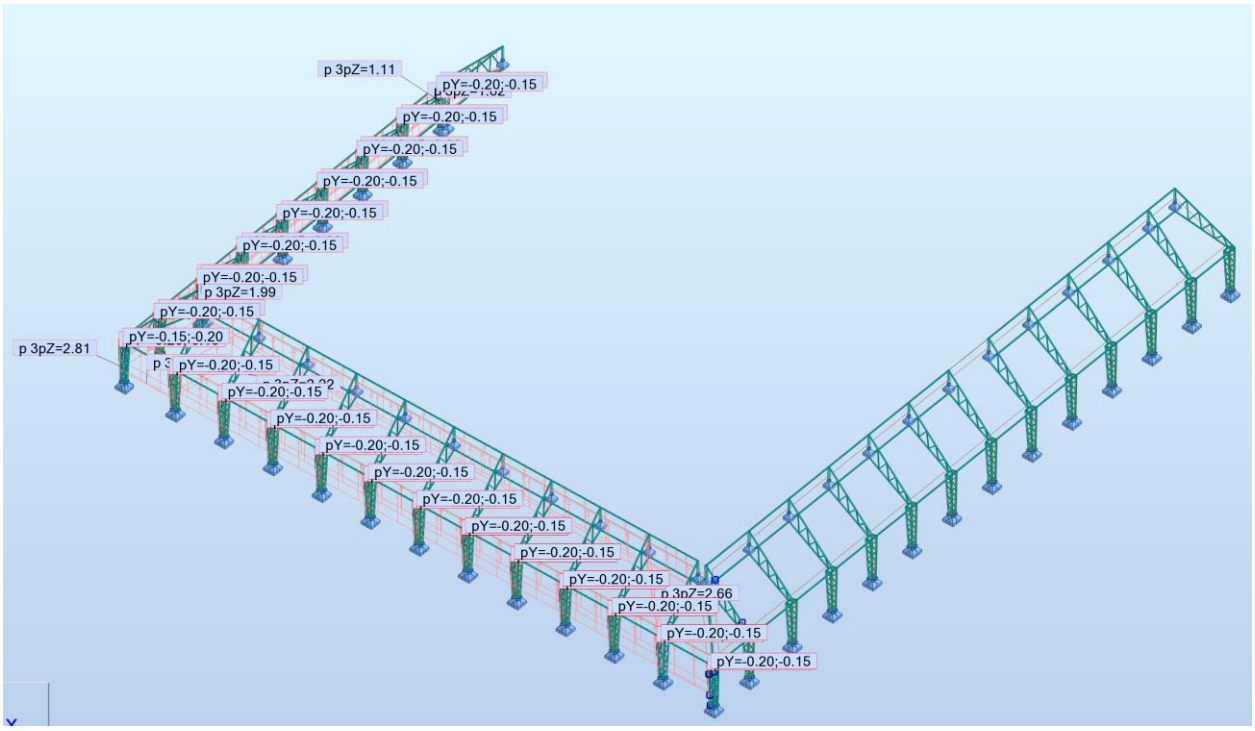
Vėjo apkrovos 2:



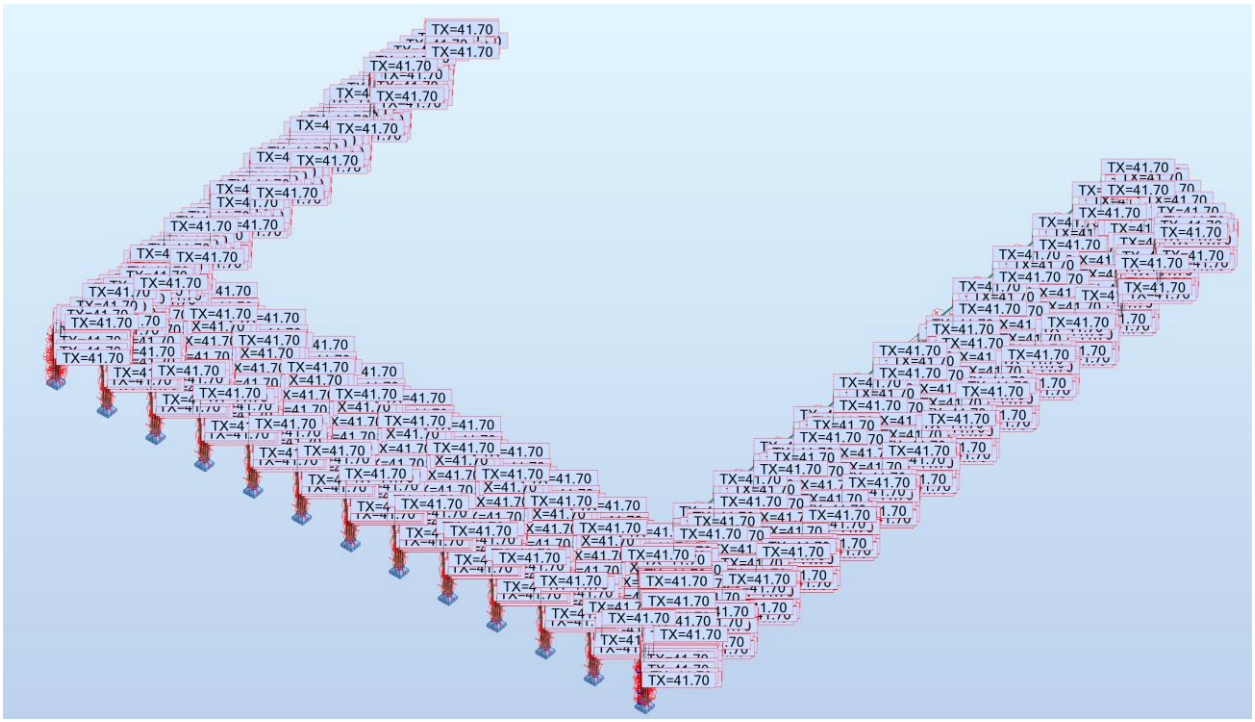
Vėjo apkrovos 3:



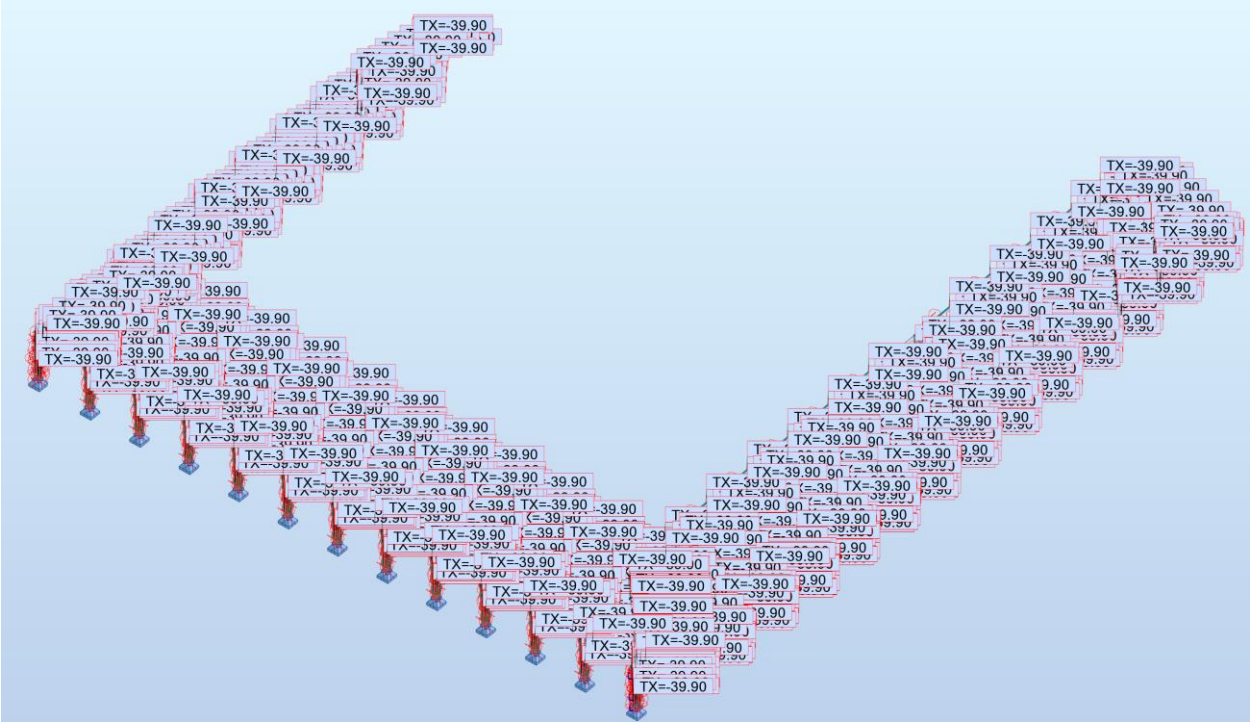
Vėjo apkrovos 4:



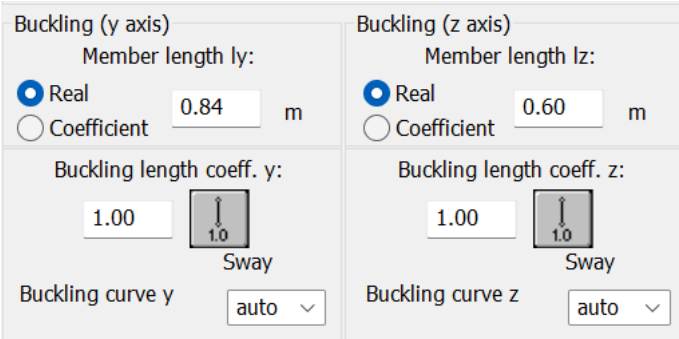
Temperatūrinės apkrovos vasarą:



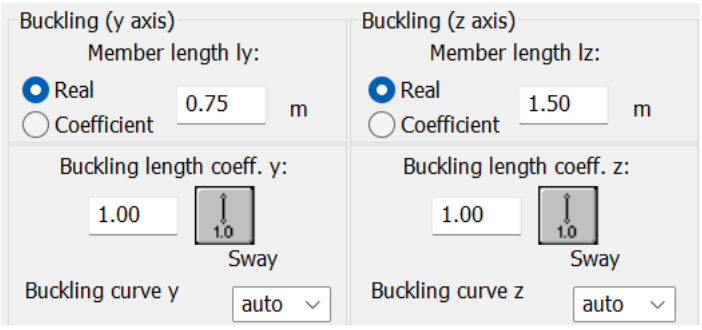
Temperatūrinės apkrovos žiemą:



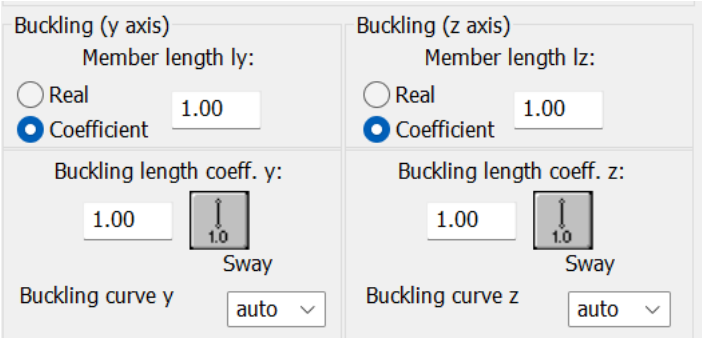
Sijos viršutinės juostos skaičiuojamieji ilgiai:



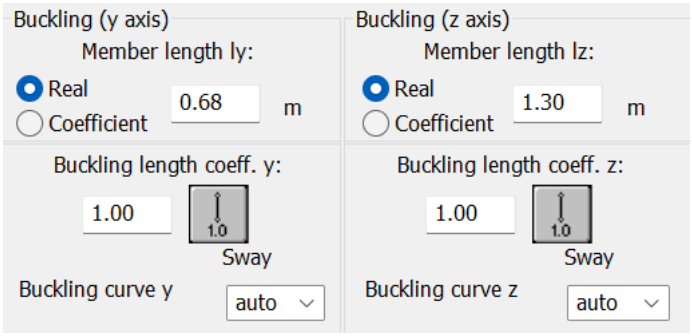
Sijos apatinės juostos skaičiuojamieji ilgiai:



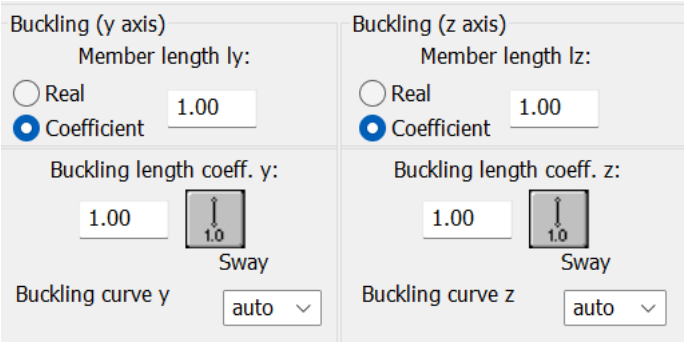
Sijos spyrių skaičiuojamieji ilgiai:



Kolonos juostų skaičiuojamieji ilgiai:



Kolonos spyrių skaičiuojamieji ilgiai:



2.7.3.1. Spragoto skerspjūvio rėmų elementų projektavimas

Santvaros viršutinė juosta

CODE: *EN 1993-1:2005/A1:2014, Eurocode 3: Design of steel structures.*
ANALYSIS TYPE: Member Verification

CODE GROUP:
MEMBER: 3359 sijos viršutinė juosta_3359 **POINT:** 3 **COORDINATE:** x = 0.20 L = 0.86617088 m

---

LOADS:
Governing Load Case: 116 ULS/108=1*1.00 + 3*0.78 + 8*1.30 1*1.00+3*0.78+8*1.30

MATERIAL:
S 355 (S 355) fy = 355.00 MPa



SECTION PARAMETERS: SQUA 60x60x4

h=6.0 cm	gM0=1.10	gM1=1.10	
b=6.0 cm	Ay=4.27 cm2	Az=4.27 cm2	Ax=8.55 cm2
tw=0.4 cm	Iy=43.55 cm4	Iz=43.55 cm4	Ix=70.72 cm4
tf=0.4 cm	Wply=17.64 cm3	Wplz=17.64 cm3	

INTERNAL FORCES AND CAPACITIES:

N,Ed = 18.21 kN	My,Ed = 0.13 kN*m	Mz,Ed = -0.45 kN*m	Vy,Ed = 0.16 kN
Nc,Rd = 275.87 kN	My,Ed,max = 1.72 kN*m	Mz,Ed,max = 0.70 kN*m	Vy,T,Rd = 79.17 kN
Nb,Rd = 256.07 kN	My,c,Rd = 5.69 kN*m	Mz,c,Rd = 5.69 kN*m	Vz,Ed = 0.73 kN
	MN,y,Rd = 5.69 kN*m	MN,z,Rd = 5.69 kN*m	Vz,T,Rd = 79.17 kN
	Mb,Rd = 5.69 kN*m		Tt,Ed = -0.03 kN*m
			Class of section = 1



LATERAL BUCKLING PARAMETERS:

z = 1.00	Mcr = 391.11 kN*m	Curve,LT - d	XLT = 1.00
Lcr,upp=0.60000000 m	Lam_LT = 0.13	fi,LT = 0.40	XLT,mod = 1.00

BUCKLING PARAMETERS:



About y axis:

Ly = 0.84000000 m	Lam_y = 0.49	Lz = 0.60000000 m	Lam_z = 0.35
Lcr,y = 0.84000000 m	Xy = 0.93	Lcr,z = 0.60000000 m	Xz = 0.97
Lamy = 37.21	kyy = 1.00	Lamz = 26.58	kyz = 0.60

VERIFICATION FORMULAS:

Section strength check:

N,Ed/Nc,Rd = 0.07 < 1.00 (6.2.4.(1))
My,Ed/MN,y,Rd = 0.02 < 1.00 (6.2.9.1.(2))
Mz,Ed/MN,z,Rd = 0.08 < 1.00 (6.2.9.1.(2))
(My,Ed/MN,y,Rd)^ 1.67 + (Mz,Ed/MN,z,Rd)^1.67 = 0.02 < 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 = 0.01 < 1.00 (6.2.6-7)
Tau,ty,Ed/(fy/(sqrt(3)*gM0)) = 0.01 < 1.00 (6.2.6)
Tau,tz,Ed/(fy/(sqrt(3)*gM0)) = 0.01 < 1.00 (6.2.6)

Global stability check of member:

Lambda,y = 37.21 < Lambda,max = 120.00 Lambda,z = 26.58 < Lambda,max = 120.00 STABLE
My,Ed,max/Mb,Rd = 0.30 < 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):

uy = 0.4 cm < uy max = L/150.00 = 2.9 cm Verified
Governing Load Case: 169 SLS:CHR/41=1*1.00 + 2*0.70 + 7*1.00 (1+7)*1.00+2*0.70
uz = 0.1 cm < uz max = L/150.00 = 2.9 cm Verified
Governing Load Case: 175 SLS:CHR/47=1*1.00 + 3*0.60 + 7*1.00 (1+7)*1.00+3*0.60



Displacements (GLOBAL SYSTEM): *Not analyzed*

Section OK !!!

Išvada: sąlyga tenkinama

Kampinės santvaros viršutinė juosta

CODE: *EN 1993-1:2005/A1:2014, Eurocode 3: Design of steel structures.*
ANALYSIS TYPE: Member Verification

CODE GROUP:
MEMBER: 3450 sijos viršutinė juosta_3450 **POINT:** 3 **COORDINATE:** x = 0.20 L = 1.00881515 m

---

LOADS:
Governing Load Case: 94 ULS/86=1*1.35 + 3*0.78 + 2*0.91 + 8*1.30 1*1.35+3*0.78+2*0.91+8*1.30

MATERIAL:
S 355 (S 355) fy = 355.00 MPa



SECTION PARAMETERS: RK 60x60x5

h=6.0 cm	gM0=1.10	gM1=1.10	
b=6.0 cm	Ay=5.35 cm2	Az=5.35 cm2	Ax=10.70 cm2
tw=0.5 cm	Iy=53.30 cm4	Iz=53.30 cm4	Ix=84.10 cm4
tf=0.5 cm	Wply=20.88 cm3	Wplz=20.88 cm3	

INTERNAL FORCES AND CAPACITIES:

N,Ed = 74.62 kN	My,Ed = 0.00 kN*m	Mz,Ed = 0.02 kN*m	Vy,Ed = -0.01 kN
Nc,Rd = 345.32 kN	My,Ed,max = -1.95 kN*m	Mz,Ed,max = 0.22 kN*m	Vy,T,Rd = 99.51 kN
Nb,Rd = 319.96 kN	My,c,Rd = 6.74 kN*m	Mz,c,Rd = 6.74 kN*m	Vz,Ed = -0.64 kN
	MN,y,Rd = 6.74 kN*m	MN,z,Rd = 6.74 kN*m	Vz,T,Rd = 99.51 kN
			Tt,Ed = 0.01 kN*m
			Class of section = 1

LATERAL BUCKLING PARAMETERS:

BUCKLING PARAMETERS:



About y axis:

Ly = 0.84000000 m	Lam_y = 0.49	Lz = 0.60000000 m	Lam_z = 0.35
Lcr,y = 0.84000000 m	Xy = 0.93	Lcr,z = 0.60000000 m	Xz = 0.97
Lamy = 37.64	kyy = 1.01	Lamz = 26.88	kyz = 0.60

VERIFICATION FORMULAS:

Section strength check:
N,Ed/Nc,Rd = 0.22 < 1.00 (6.2.4.(1))
My,Ed/MN,y,Rd = 0.00 < 1.00 (6.2.9.1.(2))
Mz,Ed/MN,z,Rd = 0.00 < 1.00 (6.2.9.1.(2))
(My,Ed/MN,y,Rd)^ 1.75 + (Mz,Ed/MN,z,Rd)^1.75 = 0.00 < 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 = 0.01 < 1.00 (6.2.6-7)
Tau,ty,Ed/(fy/(sqrt(3)*gM0)) = 0.00 < 1.00 (6.2.6)
Tau,tz,Ed/(fy/(sqrt(3)*gM0)) = 0.00 < 1.00 (6.2.6)
Global stability check of member:
Lambda,y = 37.64 < Lambda,max = 120.00 Lambda,z = 26.88 < Lambda,max = 120.00 STABLE

N,Ed/(Xy*N,Rk/gM1) + kyy*My,Ed,max/(XLT*My,Rk/gM1) + kyz*Mz,Ed,max/(Mz,Rk/gM1) = 0.54 < 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) = 0.43 < 1.00 (6.3.3.(4))

LIMIT DISPLACEMENTS



Deflections (LOCAL SYSTEM):

uy = 0.1 cm < uy max = L/150.00 = 3.4 cm Verified
Governing Load Case: 175 SLS:CHR/47=1*1.00 + 3*0.60 + 7*1.00 (1+7)*1.00+3*0.60
uz = 0.1 cm < uz max = L/150.00 = 3.4 cm Verified
Governing Load Case: 170 SLS:CHR/42=1*1.00 + 2*0.70 + 8*1.00 (1+8)*1.00+2*0.70



Displacements (GLOBAL SYSTEM): *Not analyzed*

Section OK !!!

Išvada: sąlyga tenkinama

Santvaros apatinė juosta

CODE: *EN 1993-1:2005/A1:2014, Eurocode 3: Design of steel structures.*
ANALYSIS TYPE: Member Verification

CODE GROUP:
MEMBER: 3358 sijos apatinė juosta_3358 **POINT:** 3 **COORDINATE:** x = 0.25 L = 0.79468252 m

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LOADS:
Governing Load Case: 127 ULS/119=1*1.00 + 6*0.78 + 7*1.30 1*1.00+6*0.78+7*1.30

MATERIAL:
S 355 (S 355) fy = 355.00 MPa



SECTION PARAMETERS: SQUA 60x60x4

h=6.0 cm	gM0=1.10	gM1=1.10	
b=6.0 cm	Ay=4.27 cm2	Az=4.27 cm2	Ax=8.55 cm2
tw=0.4 cm	Iy=43.55 cm4	Iz=43.55 cm4	Ix=70.72 cm4
tf=0.4 cm	Wply=17.64 cm3	Wplz=17.64 cm3	

INTERNAL FORCES AND CAPACITIES:

N,Ed = 23.17 kN	My,Ed = 0.01 kN*m	Mz,Ed = 0.46 kN*m	Vy,Ed = 0.19 kN
Nc,Rd = 275.87 kN	My,Ed,max = 1.84 kN*m	Mz,Ed,max = 0.61 kN*m	Vy,T,Rd = 77.89 kN
Nb,Rd = 207.88 kN	My,c,Rd = 5.69 kN*m	Mz,c,Rd = 5.69 kN*m	Vz,Ed = 0.20 kN
	MN,y,Rd = 5.69 kN*m	MN,z,Rd = 5.69 kN*m	Vz,T,Rd = 77.89 kN
	Mb,Rd = 5.69 kN*m		Tt,Ed = -0.10 kN*m
			Class of section = 1



LATERAL BUCKLING PARAMETERS:

z = 1.00	Mcr = 165.23 kN*m	Curve,LT - d	XLT = 1.00
Lcr,upp=1.50000000 m	Lam_LT = 0.19	fi,LT = 0.44	XLT,mod = 1.00

BUCKLING PARAMETERS:

About y axis:

Ly = 0.75000000 m Lam_y = 0.43
Lcr,y = 0.75000000 m Xy = 0.94
Lamy = 33.23 kyy = 1.02

About z axis:

Lz = 1.50000000 m Lam_z = 0.87
Lcr,z = 1.50000000 m Xz = 0.75
Lamz = 66.45 kyz = 0.66

VERIFICATION FORMULAS:

Section strength check:

N,Ed/Nc,Rd = 0.08 < 1.00 (6.2.4.(1))
My,Ed/MN,y,Rd = 0.00 < 1.00 (6.2.9.1.(2))
Mz,Ed/MN,z,Rd = 0.08 < 1.00 (6.2.9.1.(2))
(My,Ed/MN,y,Rd)^ 1.67 + (Mz,Ed/MN,z,Rd)^1.67 = 0.01 < 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 = 0.00 < 1.00 (6.2.6-7)
Tau,ty,Ed/(fy/(sqrt(3)*gM0)) = 0.02 < 1.00 (6.2.6)
Tau,tz,Ed/(fy/(sqrt(3)*gM0)) = 0.02 < 1.00 (6.2.6)

Global stability check of member:

Lambda,y = 33.23 < Lambda,max = 120.00 Lambda,z = 66.45 < Lambda,max = 120.00 STABLE
My,Ed,max/Mb,Rd = 0.32 < 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) = 0.49 < 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) = 0.42 < 1.00 (6.3.3.(4))

LIMIT DISPLACEMENTS

Deflections (LOCAL SYSTEM):

uy = 0.4 cm < uy max = L/150.00 = 2.1 cm Verified
Governing Load Case: 177 SLS:CHR/49=1*1.00 + 4*0.60 + 2*0.70 + 7*1.00 (1+7)*1.00+4*0.60+2*0.70
uz = 0.1 cm < uz max = L/150.00 = 2.1 cm Verified
Governing Load Case: 177 SLS:CHR/49=1*1.00 + 4*0.60 + 2*0.70 + 7*1.00 (1+7)*1.00+4*0.60+2*0.70

Displacements (GLOBAL SYSTEM): *Not analyzed*

Section OK !!!

Išvada: sąlyga tenkinama

Santvaros tinklelis

CODE: *EN 1993-1:2005/A1:2014, Eurocode 3: Design of steel structures.*
ANALYSIS TYPE: Member Verification

CODE GROUP:
MEMBER: 3458 sijos spyris_3458 **POINT:** 3 **COORDINATE:** x = 1.00 L = 0.84123946 m

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LOADS:
Governing Load Case: 89 ULS/81=1*1.35 + 2*0.91 + 7*1.30 1*1.35+2*0.91+7*1.30

MATERIAL:
S 355 (S 355) fy = 355.00 MPa

SECTION PARAMETERS: SHS 40x4
h=4.0 cm gM0=1.10 gM1=1.10

b=4.0 cm	Ay=2.84 cm2	Az=2.84 cm2	Ax=5.68 cm2
tw=0.4 cm	Iy=12.10 cm4	Iz=12.10 cm4	Ix=18.97 cm4
tf=0.4 cm	Wply=7.61 cm3	Wplz=7.61 cm3	

INTERNAL FORCES AND CAPACITIES:

N,Ed = 39.32 kN	My,Ed = -0.56 kN*m	Mz,Ed = 0.00 kN*m	Vy,Ed = -0.01 kN
Nc,Rd = 183.31 kN	My,Ed,max = -0.56 kN*m	Mz,Ed,max = 0.00 kN*m	Vy,T,Rd = 52.80 kN
Nb,Rd = 150.45 kN	My,c,Rd = 2.46 kN*m	Mz,c,Rd = 2.46 kN*m	Vz,Ed = -0.99 kN
	MN,y,Rd = 2.46 kN*m	MN,z,Rd = 2.46 kN*m	Vz,T,Rd = 52.80 kN
			Tt,Ed = -0.00 kN*m
			Class of section = 1

LATERAL BUCKLING PARAMETERS:

BUCKLING PARAMETERS:

About y axis: About z axis:

Ly = 0.84123946 m	Lam_y = 0.75	Lz = 0.84123946 m	Lam_z = 0.75
Lcr,y = 0.84123946 m	Xy = 0.82	Lcr,z = 0.84123946 m	Xz = 0.82
Lamy = 57.64	kyy = 1.09	Lamz = 57.64	kyz = 0.68

VERIFICATION FORMULAS:

Section strength check:

N,Ed/Nc,Rd = 0.21 < 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 = 0.00 < 1.00 (6.2.9.1.(2))
(My,Ed/MN,y,Rd)^ 1.75 + (Mz,Ed/MN,z,Rd)^1.75 = 0.08 < 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 = 0.02 < 1.00 (6.2.6-7)
Tau,ty,Ed/(fy/(sqrt(3)*gM0)) = 0.00 < 1.00 (6.2.6)
Tau,tz,Ed/(fy/(sqrt(3)*gM0)) = 0.00 < 1.00 (6.2.6)

Global stability check of member:

Lambda,y = 57.64 < Lambda,max = 150.00 Lambda,z = 57.64 < Lambda,max = 150.00 STABLE
N,Ed/(Xy*N,Rk/gM1) + kyy*My,Ed,max/(XLT*My,Rk/gM1) + kyz*Mz,Ed,max/(Mz,Rk/gM1) = 0.51 < 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) = 0.42 < 1.00 (6.3.3.(4))

LIMIT DISPLACEMENTS

Deflections (LOCAL SYSTEM):

uy = 0.0 cm < uy max = L/150.00 = 0.6 cm Verified
Governing Load Case: 134 SLS:CHR/6=1*1.00 + 3*1.00 + 7*0.60 (1+3)*1.00+7*0.60
uz = 0.0 cm < uz max = L/150.00 = 0.6 cm Verified
Governing Load Case: 169 SLS:CHR/41=1*1.00 + 2*0.70 + 7*1.00 (1+7)*1.00+2*0.70

Displacements (GLOBAL SYSTEM): *Not analyzed*

Section OK !!!

Išvada: sąlyga tenkinama

Atraminis santvaros spyris

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

ANALYSIS TYPE: Member Verification

CODE GROUP:
MEMBER: 3360 sijos spyris1_3360 **POINT:** 1 **COORDINATE:** x = 0.59 L = 0.88000000 m

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LOADS:
Governing Load Case: 115 ULS/107=1*1.00 + 3*0.78 + 7*1.30 1*1.00+3*0.78+7*1.30

MATERIAL:
S 355 (S 355) fy = 355.00 MPa



SECTION PARAMETERS: SQUA 100x100x6

h=10.0 cm	gM0=1.10	gM1=1.10	
b=10.0 cm	Ay=10.82 cm2	Az=10.82 cm2	Ax=21.63 cm2
tw=0.6 cm	Iy=311.47 cm4	Iz=311.47 cm4	Ix=501.06 cm4
tf=0.6 cm	Wply=75.10 cm3	Wplz=75.10 cm3	

INTERNAL FORCES AND CAPACITIES:

N,Ed = 13.90 kN	My,Ed = 1.46 kN*m	Mz,Ed = -21.13 kN*m	Vy,Ed = -38.08 kN
Nc,Rd = 698.15 kN	My,Ed,max = 1.46 kN*m	Mz,Ed,max = -21.13 kN*m	Vy,T,Rd = 199.45 kN
Nb,Rd = 642.99 kN	My,c,Rd = 24.24 kN*m	Mz,c,Rd = 24.24 kN*m	Vz,Ed = -5.42 kN
	MN,y,Rd = 24.24 kN*m	MN,z,Rd = 24.24 kN*m	Vz,T,Rd = 199.45 kN
	Mb,Rd = 24.24 kN*m		Tt,Ed = 0.20 kN*m
			Class of section = 1



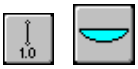
LATERAL BUCKLING PARAMETERS:

z = 1.00	Mcr = 1162.10 kN*m	Curve,LT - d	XLT = 1.00
Lcr,upp=1.48000000 m	Lam_LT = 0.15	fi,LT = 0.41	XLT,mod = 1.00

BUCKLING PARAMETERS:



About y axis:



About z axis:

Ly = 1.48000000 m	Lam_y = 0.51	Lz = 1.48000000 m	Lam_z = 0.51
Lcr,y = 1.48000000 m	Xy = 0.92	Lcr,z = 1.48000000 m	Xz = 0.92
Lamy = 39.00	kzy = 0.60	Lamz = 39.00	kzz = 1.00

VERIFICATION FORMULAS:

Section strength check:

N,Ed/Nc,Rd = 0.02 < 1.00 (6.2.4.(1))
My,Ed/MN,y,Rd = 0.06 < 1.00 (6.2.9.1.(2))
Mz,Ed/MN,z,Rd = 0.87 < 1.00 (6.2.9.1.(2))
(My,Ed/MN,y,Rd)^ 1.66 + (Mz,Ed/MN,z,Rd)^1.66 = 0.81 < 1.00 (6.2.9.1.(6))
Vy,Ed/Vy,T,Rd = 0.19 < 1.00 (6.2.6-7)
Vz,Ed/Vz,T,Rd = 0.03 < 1.00 (6.2.6-7)
Tau,ty,Ed/(fy/(sqrt(3)*gM0)) = 0.01 < 1.00 (6.2.6)
Tau,tz,Ed/(fy/(sqrt(3)*gM0)) = 0.01 < 1.00 (6.2.6)

Global stability check of member:

Lambda,y = 39.00 < Lambda,max = 150.00 Lambda,z = 39.00 < Lambda,max = 150.00 STABLE
My,Ed,max/Mb,Rd = 0.06 < 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) = 0.61 < 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) = 0.93 < 1.00 (6.3.3.(4))

LIMIT DISPLACEMENTS



Deflections (LOCAL SYSTEM):

uy = 0.4 cm < uy max = L/150.00 = 1.0 cm Verified

Governing Load Case: 175 SLS:CHR/47=1*1.00 + 3*0.60 + 7*1.00 (1+7)*1.00+3*0.60

uz = 0.0 cm < uz max = L/150.00 = 1.0 cm Verified

Governing Load Case: 185 SLS:CHR/57=1*1.00 + 6*0.60 + 2*0.70 + 7*1.00 (1+7)*1.00+6*0.60+2*0.70



Displacements (GLOBAL SYSTEM): *Not analyzed*

Section OK !!!

Išvada: sąlyga tenkinama

Kolonos juosta

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

ANALYSIS TYPE: Member Verification

CODE GROUP:

MEMBER: 3416 kolonos juosta_3416 **POINT:** 1 **COORDINATE:** x = 0.00 L = 0.00000000 m

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LOADS:

Governing Load Case: 101 ULS/93=1*1.35 + 5*0.78 + 2*0.91 + 7*1.30 1*1.35+5*0.78+2*0.91+7*1.30

MATERIAL:

S 355 (S 355) fy = 355.00 MPa



SECTION PARAMETERS: RK 60x60x6

h=6.0 cm	gM0=1.10	gM1=1.10	
b=6.0 cm	Ay=6.30 cm2	Az=6.30 cm2	Ax=12.60 cm2
tw=0.6 cm	Iy=59.90 cm4	Iz=59.90 cm4	Ix=96.03 cm4
tf=0.6 cm	Wply=23.68 cm3	Wplz=23.68 cm3	

INTERNAL FORCES AND CAPACITIES:

N,Ed = 148.91 kN	My,Ed = 1.72 kN*m	Mz,Ed = 1.80 kN*m	Vy,Ed = 6.86 kN
Nc,Rd = 406.64 kN	My,Ed,max = 1.72 kN*m	Mz,Ed,max = 1.80 kN*m	Vy,T,Rd = 117.27 kN
Nb,Rd = 328.06 kN	My,c,Rd = 7.64 kN*m	Mz,c,Rd = 7.64 kN*m	Vz,Ed = -6.81 kN
	MN,y,Rd = 6.16 kN*m	MN,z,Rd = 6.16 kN*m	Vz,T,Rd = 117.27 kN
	Mb,Rd = 7.64 kN*m		Tt,Ed = 0.01 kN*m
			Class of section = 1



LATERAL BUCKLING PARAMETERS:

z = 1.00	Mcr = 259.01 kN*m	Curve,LT - d	XLT = 1.00
Lcr,upp=1.30000000 m	Lam_LT = 0.18	fi,LT = 0.43	XLT,mod = 1.00

BUCKLING PARAMETERS:



About y axis:

Ly = 0.68000000 m	Lam_y = 0.41	Lz = 1.30000000 m	Lam_z = 0.78
Lcr,y = 0.68000000 m	Xy = 0.95	Lcr,z = 1.30000000 m	Xz = 0.81
Lamy = 31.19	kzy = 0.68	Lamz = 59.62	kzz = 1.19

VERIFICATION FORMULAS:

Section strength check:

N,Ed/Nc,Rd = 0.37 < 1.00 (6.2.4.(1))
My,Ed/MN,y,Rd = 0.28 < 1.00 (6.2.9.1.(2))
Mz,Ed/MN,z,Rd = 0.29 < 1.00 (6.2.9.1.(2))
(My,Ed/MN,y,Rd)^ 1.96 + (Mz,Ed/MN,z,Rd)^1.96 = 0.17 < 1.00 (6.2.9.1.(6))
Vy,Ed/Vy,T,Rd = 0.06 < 1.00 (6.2.6-7)
Vz,Ed/Vz,T,Rd = 0.06 < 1.00 (6.2.6-7)
Tau,ty,Ed/(fy/(sqrt(3)*gM0)) = 0.00 < 1.00 (6.2.6)
Tau,tz,Ed/(fy/(sqrt(3)*gM0)) = 0.00 < 1.00 (6.2.6)

Global stability check of member:

Lambda,y = 31.19 < Lambda,max = 120.00 Lambda,z = 59.62 < Lambda,max = 120.00 STABLE
My,Ed,max/Mb,Rd = 0.23 < 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) = 0.82 < 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) = 0.89 < 1.00 (6.3.3.(4))

LIMIT DISPLACEMENTS



Deflections (LOCAL SYSTEM):

uy = 0.0 cm < uy max = L/150.00 = 1.8 cm Verified
Governing Load Case: 175 SLS:CHR/47=1*1.00 + 3*0.60 + 7*1.00 (1+7)*1.00+3*0.60
uz = 0.0 cm < uz max = L/150.00 = 1.8 cm Verified
Governing Load Case: 183 SLS:CHR/55=1*1.00 + 5*0.60 + 7*1.00 (1+7)*1.00+5*0.60



Displacements (GLOBAL SYSTEM): *Not analyzed*

Section OK !!!

Išvada: sąlyga tenkinama

Kolonos spyrio projektavimas

CODE: *EN 1993-1:2005/A1:2014, Eurocode 3: Design of steel structures.*
ANALYSIS TYPE: Member Verification

CODE GROUP:
MEMBER: 3463 kolonos spyris_3463 **POINT:** 3 **COORDINATE:** x = 1.00 L = 0.12840511 m

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LOADS:
Governing Load Case: 128 ULS/120=1*1.00 + 6*0.78 + 8*1.30 1*1.00+6*0.78+8*1.30

MATERIAL:
S 355 (S 355) fy = 355.00 MPa



SECTION PARAMETERS: SHS 40x4

h=4.0 cm	gM0=1.10	gM1=1.10	
b=4.0 cm	Ay=2.84 cm2	Az=2.84 cm2	Ax=5.68 cm2
tw=0.4 cm	Iy=12.10 cm4	Iz=12.10 cm4	Ix=18.97 cm4
tf=0.4 cm	Wply=7.61 cm3	Wplz=7.61 cm3	

INTERNAL FORCES AND CAPACITIES:

N,Ed = 5.32 kN My,Ed = -1.08 kN*m Mz,Ed = 0.83 kN*m Vy,Ed = -8.52 kN

Nc,Rd = 183.31 kN	My,Ed,max = -1.08 kN*m	Mz,Ed,max = 0.83 kN*m	Vy,T,Rd = 52.71 kN
Nb,Rd = 183.31 kN	My,c,Rd = 2.46 kN*m	Mz,c,Rd = 2.46 kN*m	Vz,Ed = -14.46 kN
	MN,y,Rd = 2.46 kN*m	MN,z,Rd = 2.46 kN*m	Vz,T,Rd = 52.71 kN
			Tt,Ed = -0.01 kN*m
			Class of section = 1

LATERAL BUCKLING PARAMETERS:

BUCKLING PARAMETERS:

About y axis:

Ly = 0.12840511 m	Lam_y = 0.12
Lcr,y = 0.12840511 m	Xy = 1.00
Lamy = 8.80	kyy = 0.99

About z axis:

Lz = 0.12840511 m	Lam_z = 0.12
Lcr,z = 0.12840511 m	Xz = 1.00
Lamz = 8.80	kyz = 0.59

VERIFICATION FORMULAS:

Section strength check:

N,Ed/Nc,Rd = 0.03 < 1.00 (6.2.4.(1))
My,Ed/MN,y,Rd = 0.44 < 1.00 (6.2.9.1.(2))
Mz,Ed/MN,z,Rd = 0.34 < 1.00 (6.2.9.1.(2))
(My,Ed/MN,y,Rd)^ 1.66 + (Mz,Ed/MN,z,Rd)^1.66 = 0.42 < 1.00 (6.2.9.1.(6))
Vy,Ed/Vy,T,Rd = 0.16 < 1.00 (6.2.6-7)
Vz,Ed/Vz,T,Rd = 0.27 < 1.00 (6.2.6-7)
Tau,ty,Ed/(fy/(sqrt(3)*gM0)) = 0.00 < 1.00 (6.2.6)
Tau,tz,Ed/(fy/(sqrt(3)*gM0)) = 0.00 < 1.00 (6.2.6)

Global stability check of member:

Lambda,y = 8.80 < Lambda,max = 150.00 Lambda,z = 8.80 < Lambda,max = 150.00 STABLE
N,Ed/(Xy*N,Rk/gM1) + kyy*My,Ed,max/(XLT*My,Rk/gM1) + kyz*Mz,Ed,max/(Mz,Rk/gM1) = 0.66 < 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) = 0.62 < 1.00 (6.3.3.(4))

LIMIT DISPLACEMENTS

Deflections (LOCAL SYSTEM):

uy = 0.0 cm < uy max = L/150.00 = 0.1 cm Verified
Governing Load Case: 187 SLS:CHR/59=1*1.00 + 6*0.60 + 7*1.00 (1+7)*1.00+6*0.60
uz = 0.0 cm < uz max = L/150.00 = 0.1 cm Verified
Governing Load Case: 169 SLS:CHR/41=1*1.00 + 2*0.70 + 7*1.00 (1+7)*1.00+2*0.70

Displacements (GLOBAL SYSTEM): *Not analyzed*

Section OK !!!

Išvada: sąlyga tenkinama

Viršutinis kolonos tinklelis

CODE: *EN 1993-1:2005/A1:2014, Eurocode 3: Design of steel structures.*
ANALYSIS TYPE: Member Verification

CODE GROUP:
MEMBER: 2113 kolonos rysys_2113 **POINT:** 1 **COORDINATE:** x = 0.50 L = 0.22500000 m

---

LOADS:
Governing Load Case: 89 ULS/81=1*1.35 + 2*0.91 + 7*1.30 1*1.35+2*0.91+7*1.30

MATERIAL:

S 355 (S 355) fy = 355.00 MPa



SECTION PARAMETERS: RP 90x50x5

h=9.0 cm	gM0=1.10	gM1=1.10	
b=5.0 cm	Ay=4.54 cm2	Az=8.16 cm2	Ax=12.70 cm2
tw=0.5 cm	Iy=127.00 cm4	Iz=49.20 cm4	Ix=113.63 cm4
tf=0.5 cm	Wply=34.41 cm3	Wplz=22.70 cm3	

INTERNAL FORCES AND CAPACITIES:

N,Ed = 1.79 kN	My,Ed = 3.24 kN*m	Mz,Ed = 1.89 kN*m	Vy,Ed = 11.28 kN
Nc,Rd = 409.86 kN	My,Ed,max = 3.24 kN*m	Mz,Ed,max = 1.89 kN*m	Vy,T,Rd = 79.29 kN
Nb,Rd = 400.71 kN	My,c,Rd = 11.11 kN*m	Mz,c,Rd = 7.33 kN*m	Vz,Ed = -17.34 kN
	MN,y,Rd = 11.11 kN*m	MN,z,Rd = 7.33 kN*m	Vz,T,Rd = 142.72 kN
	Mb,Rd = 11.11 kN*m		Tt,Ed = 0.44 kN*m
			Class of section = 1



LATERAL BUCKLING PARAMETERS:

z = 1.00	Mcr = 662.36 kN*m	Curve,LT - d	XLT = 1.00
Lcr,upp=0.45000000 m	Lam_LT = 0.14	fi,LT = 0.41	XLT,mod = 1.00

BUCKLING PARAMETERS:



About y axis:

Ly = 0.45000000 m	Lam_y = 0.19	Lz = 0.45000000 m	Lam_z = 0.30
Lcr,y = 0.45000000 m	Xy = 1.00	Lcr,z = 0.45000000 m	Xz = 0.98
Lamy = 14.23	kyy = 1.00	Lamz = 22.86	kyz = 0.58

VERIFICATION FORMULAS:

Section strength check:

N,Ed/Nc,Rd = 0.00 < 1.00 (6.2.4.(1))
My,Ed/MN,y,Rd = 0.29 < 1.00 (6.2.9.1.(2))
Mz,Ed/MN,z,Rd = 0.26 < 1.00 (6.2.9.1.(2))
(My,Ed/MN,y,Rd)^ 1.66 + (Mz,Ed/MN,z,Rd)^1.66 = 0.23 < 1.00 (6.2.9.1.(6))
Vy,Ed/Vy,T,Rd = 0.14 < 1.00 (6.2.6-7)
Vz,Ed/Vz,T,Rd = 0.12 < 1.00 (6.2.6-7)
Tau,ty,Ed/(fy/(sqrt(3)*gM0)) = 0.06 < 1.00 (6.2.6)
Tau,tz,Ed/(fy/(sqrt(3)*gM0)) = 0.06 < 1.00 (6.2.6)

Global stability check of member:

Lambda,y = 14.23 < Lambda,max = 150.00 Lambda,z = 22.86 < Lambda,max = 150.00 STABLE
My,Ed,max/Mb,Rd = 0.29 < 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) = 0.44 < 1.00 (6.3.3.(4))

LIMIT DISPLACEMENTS



Deflections (LOCAL SYSTEM):

uy = 0.0 cm < uy max = L/150.00 = 0.3 cm Verified
Governing Load Case: 179 SLS:CHR/51=1*1.00 + 4*0.60 + 7*1.00 (1+7)*1.00+4*0.60
uz = 0.0 cm < uz max = L/150.00 = 0.3 cm Verified
Governing Load Case: 169 SLS:CHR/41=1*1.00 + 2*0.70 + 7*1.00 (1+7)*1.00+2*0.70



Displacements (GLOBAL SYSTEM): *Not analyzed*

Section OK !!!

Išvada: sąlyga tenkinama

Ryšio tarp kolonų ir santvarų projektavimas

CODE: *EN 1993-1:2005/A1:2014, Eurocode 3: Design of steel structures.*
ANALYSIS TYPE: Member Verification

CODE GROUP:
MEMBER: 159 rysys_159 **POINT:** 2 **COORDINATE:** x = 0.50 L = 2.22000000 m

---

LOADS:
Governing Load Case: 95 ULS/87=1*1.35 + 3*0.78 + 7*1.30 1*1.35+3*0.78+7*1.30

MATERIAL:
S 355 (S 355) fy = 355.00 MPa



SECTION PARAMETERS: SQUA 60x60x4

h=6.0 cm	gM0=1.10	gM1=1.10	
b=6.0 cm	Ay=4.27 cm2	Az=4.27 cm2	Ax=8.55 cm2
tw=0.4 cm	Iy=43.55 cm4	Iz=43.55 cm4	Ix=70.72 cm4
tf=0.4 cm	Wply=17.64 cm3	Wplz=17.64 cm3	

INTERNAL FORCES AND CAPACITIES:

N,Ed = 35.66 kN	My,Ed = 0.22 kN*m	
Nc,Rd = 275.87 kN	My,Ed,max = 0.22 kN*m	
Nb,Rd = 38.28 kN	My,c,Rd = 5.69 kN*m	
	MN,y,Rd = 5.69 kN*m	
	Mb,Rd = 5.69 kN*m	
		Class of section = 1



LATERAL BUCKLING PARAMETERS:

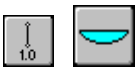
z = 1.00	Mcr = 57.18 kN*m	Curve,LT - d	XLT = 1.00
Lcr,upp=4.44000000 m	Lam_LT = 0.33	fi,LT = 0.51	XLT,mod = 1.00

BUCKLING PARAMETERS:



About y axis:

Ly = 4.44000000 m	Lam_y = 2.57	Lz = 4.44000000 m	Lam_z = 2.57
Lcr,y = 4.44000000 m	Xy = 0.14	Lcr,z = 4.44000000 m	Xz = 0.14
Lamy = 196.71	kyy = 1.39	Lamz = 196.71	kzy = 1.39



About z axis:

VERIFICATION FORMULAS:
Section strength check:
N,Ed/Nc,Rd = 0.13 < 1.00 (6.2.4.(1))
My,Ed/My,c,Rd = 0.04 < 1.00 (6.2.5.(1))
My,Ed/MN,y,Rd = 0.04 < 1.00 (6.2.9.1.(2))
Global stability check of member:
Lambda,y = 196.71 < Lambda,max = 200.00 Lambda,z = 196.71 < Lambda,max = 200.00 STABLE
My,Ed,max/Mb,Rd = 0.04 < 1.00 (6.3.2.1.(1))

N,Ed/(Xy*N,Rk/gM1) + kyy*My,Ed,max/(XLT*My,Rk/gM1) = 0.99 < 1.00 (6.3.3.(4))
N,Ed/(Xz*N,Rk/gM1) + kzy*My,Ed,max/(XLT*My,Rk/gM1) = 0.99 < 1.00 (6.3.3.(4))

LIMIT DISPLACEMENTS

Deflections (LOCAL SYSTEM):
uy = 0.0 cm < uy max = L/150.00 = 3.0 cm Verified
Governing Load Case: 177 SLS:CHR/49=1*1.00 + 4*0.60 + 2*0.70 + 7*1.00 (1+7)*1.00+4*0.60+2*0.70
uz = 0.4 cm < uz max = L/150.00 = 3.0 cm Verified
Governing Load Case: 167 SLS:CHR/39=1*1.00 + 6*0.60 + 2*1.00 + 7*0.60 (1+2)*1.00+(6+7)*0.60

Displacements (GLOBAL SYSTEM): *Not analyzed*

Section OK !!!

Išvada: sąlyga tenkinama

Įstrižo rysio tarp santvarų projektavimas

CODE: *EN 1993-1:2005/A1:2014, Eurocode 3: Design of steel structures.*
ANALYSIS TYPE: Member Verification

CODE GROUP:
MEMBER: 3576 istryzas rysys_3576 **POINT:** 2 **COORDINATE:** x = 0.50 L = 2.22707768 m

---

LOADS:
Governing Load Case: 104 ULS/96=1*1.35 + 5*0.78 + 8*1.30 1*1.35+5*0.78+8*1.30

MATERIAL:
S 355 (S 355) fy = 355.00 MPa

SECTION PARAMETERS: SQUA 80x80x4

h=8.0 cm	gM0=1.10	gM1=1.10	
b=8.0 cm	Ay=5.87 cm2	Az=5.87 cm2	Ax=11.75 cm2
tw=0.4 cm	Iy=111.04 cm4	Iz=111.04 cm4	Ix=176.24 cm4
tf=0.4 cm	Wply=33.07 cm3	Wplz=33.07 cm3	

INTERNAL FORCES AND CAPACITIES:

N,Ed = 21.26 kN	My,Ed = 0.28 kN*m	
Nc,Rd = 379.14 kN	My,Ed,max = 0.28 kN*m	
Nb,Rd = 93.21 kN	My,c,Rd = 10.67 kN*m	
	MN,y,Rd = 10.67 kN*m	
	Mb,Rd = 10.67 kN*m	
		Class of section = 1

LATERAL BUCKLING PARAMETERS:

z = 1.00	Mcr = 143.07 kN*m	Curve,LT - d	XLT = 1.00
Lcr,upp=4.45415536 m	Lam_LT = 0.29	fi,LT = 0.49	XLT,mod = 1.00

BUCKLING PARAMETERS:

About y axis: About z axis:

Ly = 4.45415536 m	Lam_y = 1.90	Lz = 4.45415536 m	Lam_z = 1.90
Lcr,y = 4.45415536 m	Xy = 0.25	Lcr,z = 4.45415536 m	Xz = 0.25
Lamy = 144.88	kyy = 1.12	Lamz = 144.88	kzy = 0.80

VERIFICATION FORMULAS:

Section strength check:

N,Ed/Nc,Rd = 0.06 < 1.00 (6.2.4.(1))

My,Ed/My,c,Rd = 0.03 < 1.00 (6.2.5.(1))

Global stability check of member:

Lambda,y = 144.88 < Lambda,max = 200.00 Lambda,z = 144.88 < Lambda,max = 200.00 STABLE

My,Ed,max/Mb,Rd = 0.03 < 1.00 (6.3.2.1.(1))

N,Ed/(Xy*N,Rk/gM1) + kyy*My,Ed,max/(XLT*My,Rk/gM1) = 0.26 < 1.00 (6.3.3.(4))

N,Ed/(Xz*N,Rk/gM1) + kzy*My,Ed,max/(XLT*My,Rk/gM1) = 0.25 < 1.00 (6.3.3.(4))

LIMIT DISPLACEMENTS

Deflections (LOCAL SYSTEM):

uy = 0.0 cm < uy max = L/150.00 = 3.0 cm Verified

Governing Load Case: 180 SLS:CHR/52=1*1.00 + 4*0.60 + 8*1.00 (1+8)*1.00+4*0.60

uz = 0.2 cm < uz max = L/150.00 = 3.0 cm Verified

Governing Load Case: 129 SLS:CHR/1=1*1.00 1*1.00

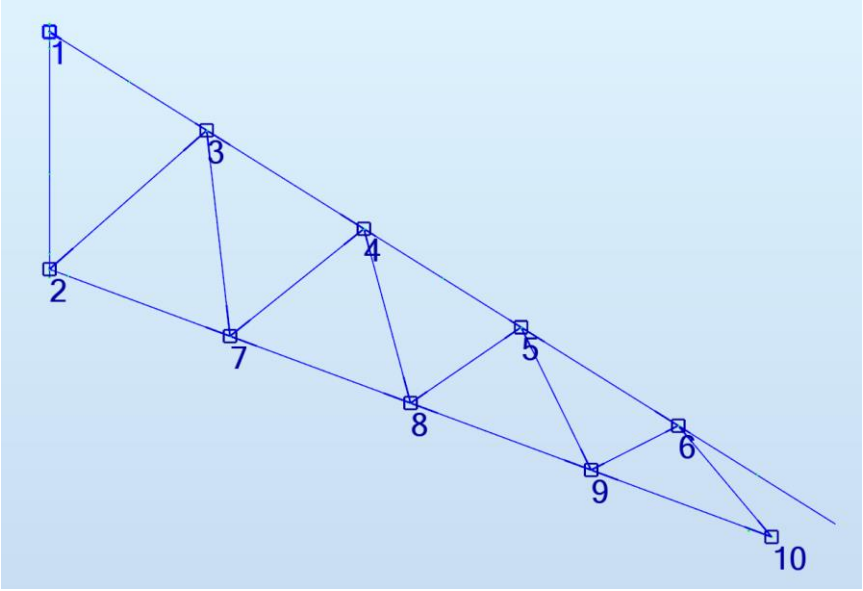
Displacements (GLOBAL SYSTEM): *Not analyzed*

Section OK !!!

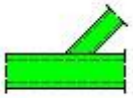
Išvada: sąlyga tenkinama

2.7.3.2.Spragoto skerspjūvio rėmų kampinių santvarų mazgų projektavimas

Mazgų numeriai:



Mazgas Nr. 1



Robot Structural Analysis Professional 2023

Design of truss node connection

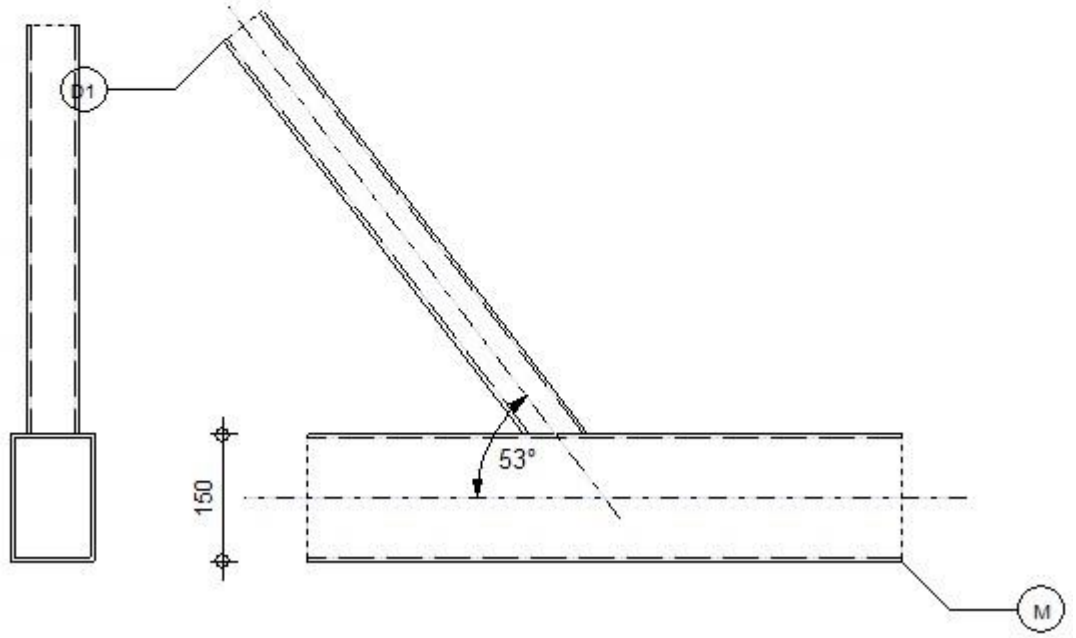
EN 1993-1-8:2005/AC:2009

OK

Ratio
0.89

D1 - RK 60x60x5

M - RECT 150x100x5



GENERAL

Connection no.: 1
Connection name: Tube
Structure node: 5784
Structure members: 2893, 3450

GEOMETRY

MEMBERS

		Chord	Diagonal 1	Diagonal 2	Post	
Member no.:		2893	3450			
Section:		RECT 150x100x5	RK 60x60x5			
	h	150	60			mm
	b_f	100	60			mm
	t_w	5	5			mm
	t_f	5	5			mm
	r	5	5			mm

		Chord	Diagonal 1	Diagonal 2	Post	
Material:		S 355	S 355			
	f_y	355.00	355.00			MPa
	f_u	470.00	470.00			MPa
Angle	θ	0.0	52.5			Deg
Length	l	1580	5044			mm

WELDS

a_d = 4 [mm] Thickness of welds of diagonals and posts

LOADS

Case: 90: ULS/82=1*1.35 + 2*0.91 + 8*1.30 1*1.35+2*0.91+8*1.30

CHORD

$N_{01,Ed}$ = -0.01 [kN] Axial force
$M_{01,Ed}$ = 0.00 [kN*m] Bending moment
$N_{02,Ed}$ = 0.53 [kN] Axial force
$M_{02,Ed}$ = 2.15 [kN*m] Bending moment

DIAGONAL 1

N_1 = -9.39 [kN] Axial force
M_1 = 1.97 [kN*m] Bending moment

Shear forces were not included in the connection verification. The connection was designed as a truss node.

RESULTS

CAPACITY VERIFICATION EUROCODE 3: EN 1993-1-8:2005

γ_{M5} = 1.00 Partial safety factor [Table 2.1]

FAILURE MODES FOR JOINTS (RHS CHORD MEMBERS) [Table 7.11] for $N_{i,Rd}$ and [Table 7.14] for $M_{i,Rd}$

GEOMETRICAL PARAMETERS

β = 0.60	Coefficient taking account of geometry of connection members	$\beta = b_1/b_0$ [1.5 (6)]
γ = 10.00	Coefficient taking account of geometry of the chord	$\gamma = b_0/(2*t_0)$ [1.5 (6)]
n = 0.07	Coefficient taking account of stresses in the chord	$n_0 = \sigma_{0,Ed}/f_{y0}$
k_n = 1.00	Coefficient taking account of stresses in the chord	$k_n = 1.0$

TUBE CHORD FACE FAILURE

DIAGONAL 1

η = 0.60 Coefficient taking account of geometry of connection members $\eta = h_1/b_0$

$N_{1,Rd}$ = 113.03 [kN] Compression capacity $N_{1,Rd} = [(k_n*f_{y0}*t_0^2)/(1-\beta)*\sin(\theta_1)]*[2*\eta/\sin(\theta_1) + 4*\sqrt{(1-\beta)}] / \gamma_{M5}$

$\lvert N_1\rvert \le N_{1,Rd}$	|-9.39| < 113.03	verified	(0.08)
$M_{1,Rd}$ = 2.93 [kN*m] Bending resistance	$M_{1,Rd} = k_n*f_{y0}*t_0^2*h_1*[1/(2*\eta) + 2/\sqrt{[1-\beta]} + \eta/(1-\beta)] / \gamma_{M5}$		
$\lvert M_1\rvert \le M_{1,Rd}$	|1.97| < 2.93	verified	(0.67)
$N_1/N_{1,Rd} + M_1/M_{1,Rd} \le 1$	0.76 < 1.00	verified	(0.76)

CHORD SHEAR

DIAGONAL 1

A_v =	15.00	[cm^2]	Shear area of the chord		$A_v = 2*h_0*t_0$
$N_{1,Rd}$ =	387.47	[kN]	Compression capacity		$N_{1,Rd} = f_{y0}*A_v/[\sqrt{3}*\sin(\theta_1)] / \gamma_{M5}$
$\|N_1\| \le N_{1,Rd}$			$\|-9.39\| < 387.47$	verified	(0.02)

CHORD RESISTANCE

$N_{0,Rd}$ =	829.28	[kN]	Tension capacity		$N_{0,Rd} = (A_0*f_{y0})/\gamma_{M5}$
$\|N_{02}\| \le N_{0,Rd}$			$\|0.53\| < 829.28$	verified	(0.00)

VERIFICATION OF WELDS

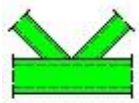
DIAGONAL 1

β_w =	0.88		Correlation coefficient		[Table 4.1]
γ_{M2} =	1.25		Partial safety factor		[Table 2.1]
Longitudinal weld					
$\sigma_\perp$ =	-191.11	[MPa]	Normal stress in a weld		
$\tau_\perp$ =	-191.11	[MPa]	Perpendicular tangent stress		
τ_{II} =	-9.45	[MPa]	Tangent stress		
$\|\sigma_\perp\| \le 0.9*f_u/\gamma_{M2}$			$\|-191.11\| < 338.40$	verified	(0.56)
$\sqrt{[\sigma_\perp^2 + 3*(\tau_\perp^2+\tau_{II}^2)]} \le f_u/(\beta_w*\gamma_{M2})$			$382.56 < 429.71$	verified	(0.89)

Connection conforms to the code Ratio 0.89

Išvada: laikomoji galia pakankama

Mazgas Nr. 2



Robot Structural Analysis Professional 2023

Design of truss node connection

EN 1993-1-8:2005/AC:2009

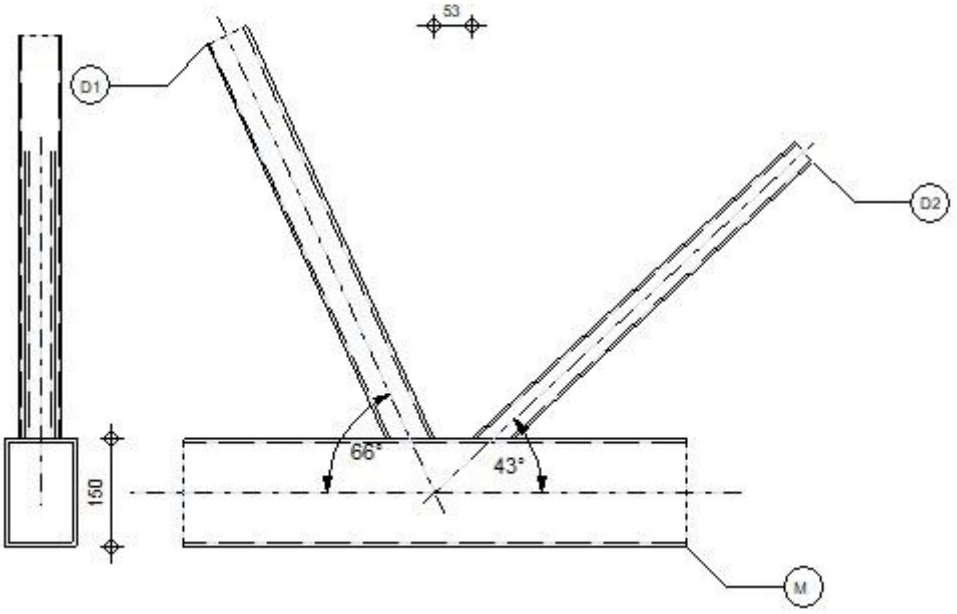
OK

Ratio **0.96**

D1 - SQUA 60x60x4

D2 - SHS 40x4

M - RECT 150x100x5



GENERAL

Connection no.: 2
Connection name: Tube
Structure node: 6073
Structure members: 2893, 3451, 3449

GEOMETRY

MEMBERS

		Chord	Diagonal 1	Diagonal 2	Post	
Member no.:		2893	3449	3451		
Section:		RECT 150x100x5	SQUA 60x60x4	SHS 40x4		
	h	150	60	40		mm
	b_f	100	60	40		mm
	t_w	5	4	4		mm
	t_f	5	4	4		mm
	r	5	4	0		mm
Material:		S 355	S 355	S 355		
	f_y	355.00	355.00	355.00		MPa
	f_u	470.00	470.00	470.00		MPa
Angle	θ	0.0	65.6	42.7		Deg
Length	l	1580	4039	1179		mm

OFFSET

e_0 = 0 [mm] Offset

SPACINGS

g_2 = 53 [mm] Spacing of 2nd diagonal

WELDS

a_d = 3 [mm] Thickness of welds of diagonals and posts

LOADS

Case: 101: ULS/93=1*1.35 + 5*0.78 + 2*0.91 + 7*1.30 1*1.35+5*0.78+2*0.91+7*1.30

CHORD

$N_{01,Ed}$ = 3.08 [kN] Axial force
$M_{01,Ed}$ = -2.63 [kN*m] Bending moment
$N_{02,Ed}$ = 0.01 [kN] Axial force
$M_{02,Ed}$ = 0.00 [kN*m] Bending moment

DIAGONAL 1

N_1 = 34.69 [kN] Axial force
M_1 = 1.83 [kN*m] Bending moment

DIAGONAL 2

N_2 = 1.72 [kN] Axial force
M_2 = 0.55 [kN*m] Bending moment

Shear forces were not included in the connection verification. The connection was designed as a truss node.

RESULTS

CAPACITY VERIFICATION EUROCODE 3: EN 1993-1-8:2005

γ_{M5} = 1.00 Partial safety factor [Table 2.1]

FAILURE MODES FOR JOINTS (RHS CHORD MEMBERS) [Table 7.12] for $N_{i,Rd}$ and [Table 7.14] for $M_{i,Rd}$

GEOMETRICAL PARAMETERS

β = 0.50 Coefficient taking account of geometry of connection members $\beta = (b_2+h_2+b_1+h_1)/(4*b_0)$ [1.5 (6)]
γ = 10.00 Coefficient taking account of geometry of the chord $\gamma = b_0/(2*t_0)$ [1.5 (6)]
k_n = 1.00 Coefficient taking account of stresses in the chord $k_n = 1.0$

TUBE CHORD FACE FAILURE

DIAGONAL 2

$N_{2,Rd}$ = 184.00 [kN] Tension capacity $N_{2,Rd} = 8.9*k_n*f_{y0}*t_0^2*\sqrt{\gamma}/\sin(\theta_2) * \beta / \gamma_{M5}$
$|N_2| \le N_{2,Rd}$ |1.72| < 184.00 verified (0.01)

$M_{2,Rd}$ = 1.73 [kN*m] Bending resistance $M_{2,Rd} = k_n*f_{y0}*t_0^2*h_2*[1/(2*\eta) + 2/\sqrt{[1-\beta]} + \eta/(1-\beta)] / \gamma_{M5}$
$|M_2| \le M_{2,Rd}$ |0.55| < 1.73 verified (0.32)

$N_2/N_{2,Rd} + M_2/M_{2,Rd} \le 1$	0.33 < 1.00	verified	(0.33)

DIAGONAL 1

$N_{1,Rd}$ = 137.17 [kN] Tension capacity $N_{1,Rd} = 8.9*k_n*f_{y0}*t_0^2*\sqrt{\gamma}/\sin(\theta_1) * \beta / \gamma_{M5}$

$\lvert N_1\rvert \le N_{1,Rd}$	|34.69| < 137.17	verified	(0.25)

$M_{1,Rd}$ = 2.59 [kN*m] Bending resistance $M_{1,Rd} = k_n*f_{y0}*t_0^2*h_1*[1/(2*\eta) + 2/\sqrt{[1-\beta]} + \eta/(1-\beta)] / \gamma_{M5}$

$\lvert M_1\rvert \le M_{1,Rd}$	|1.83| < 2.59	verified	(0.71)
$N_1/N_{1,Rd} + M_1/M_{1,Rd} \le 1$	0.96 < 1.00	verified	(0.96)

CHORD PUNCHING

DIAGONAL 2

$b_{e,p}$ = 20 [mm] Effective width for punching shear $b_{e,p} = (10*b_2)/(b_0/t_0)$

$N_{2,Rd}$ = 268.53 [kN] Tension capacity $N_{2,Rd} = f_{y0}*t_0/(\sqrt{3}*\sin(\theta_2))*[2*h_2/\sin(\theta_2)+b_2+b_{e,p}]/\gamma_{M5}$

$\lvert N_2\rvert \le N_{2,Rd}$	|1.72| < 268.53	verified	(0.01)

DIAGONAL 1

$b_{e,p}$ = 30 [mm] Effective width for punching shear $b_{e,p} = (10*b_1)/(b_0/t_0)$

$N_{1,Rd}$ = 249.64 [kN] Tension capacity $N_{1,Rd} = f_{y0}*t_0/(\sqrt{3}*\sin(\theta_1))*[2*h_1/\sin(\theta_1)+b_1+b_{e,p}]/\gamma_{M5}$

$\lvert N_1\rvert \le N_{1,Rd}$	|34.69| < 249.64	verified	(0.14)

TUBE BRACE FAILURE

DIAGONAL 2

b_{eff} = 25 [mm] Effective width in the connection of the diagonal to the chord $b_{eff} = [10/(b_0/t_0)] * [(f_{y0}*t_0)/(f_{y2}*t_2)] * b_2$

$N_{2,Rd}$ = 183.18 [kN] Tension capacity $N_{2,Rd} = f_{y2}*t_2*(2*h_2-4*t_2 + b_2 + b_{eff})/\gamma_{M5}$

$\lvert N_2\rvert \le N_{2,Rd}$	|1.72| < 183.18	verified	(0.01)

DIAGONAL 1

b_{eff} = 38 [mm] Effective width in the connection of the diagonal to the chord $b_{eff} = [10/(b_0/t_0)] * [(f_{y0}*t_0)/(f_{y1}*t_1)] * b_1$

$N_{1,Rd}$ = 286.13 [kN] Tension capacity $N_{1,Rd} = f_{y1}*t_1*(2*h_1-4*t_1 + b_1 + b_{eff})/\gamma_{M5}$

$\lvert N_1\rvert \le N_{1,Rd}$	|34.69| < 286.13	verified	(0.12)

CHORD SHEAR

DIAGONAL 2

A_v = 15.41 [cm^2] Shear area of the chord $A_v = (2*h_0 + \alpha*b_0)*t_0$

$N_{2,Rd}$ = 465.28 [kN] Tension capacity $N_{2,Rd} = f_{y0}*A_v/[\sqrt{3}*\sin(\theta_2)] / \gamma_{M5}$

$\lvert N_2\rvert \le N_{2,Rd}$	|1.72| < 465.28	verified	(0.00)

DIAGONAL 1

A_v = 15.41 [cm^2] Shear area of the chord $A_v = (2*h_0 + \alpha*b_0)*t_0$

$N_{1,Rd}$ = 346.86 [kN] Tension capacity $N_{1,Rd} = f_{y0}*A_v/[\sqrt{3}*\sin(\theta_1)] / \gamma_{M5}$

$\lvert N_1\rvert \le N_{1,Rd}$	|34.69| < 346.86	verified	(0.10)

CHORD RESISTANCE

$V_{pl,Rd}$ = 287.11 [kN] Plastic resistance for shear $V_{pl,Rd} = (A_v*f_{y0})/(\sqrt{3}*\gamma_{M0})$

$\lvert V_{Ed}\rvert \le V_{pl,Rd}$	|31.59| < 287.11	verified	(0.11)

$N_{0,Rd}$ = 825.96 [kN] Tension capacity $N_{0,Rd} = [\ (A_0-A_v)*f_{y0} + A_v*f_{y0}*\sqrt{[1-(V_{Ed}/V_{pl,Rd})^2]}\ ]/\gamma_{M5}$

$\|N_{01}\| \le N_{0,Rd}$	|3.08| < 825.96	verified	(0.00)

VERIFICATION OF WELDS

DIAGONAL 2

β_w =	0.88	Correlation coefficient	[Table 4.1]
γ_{M2} =	1.25	Partial safety factor	[Table 2.1]

Longitudinal weld

$\sigma_\perp$ =	1.39 [MPa]	Normal stress in a weld	
$\tau_\perp$ =	1.39 [MPa]	Perpendicular tangent stress	
τ_{II} =	2.13 [MPa]	Tangent stress	

$\|\sigma_\perp\| \le 0.9*f_u/\gamma_{M2}$	|1.39| < 338.40	verified	(0.00)
$\sqrt{[\sigma_\perp^2 + 3*(\tau_\perp^2+\tau_{II}^2)]} \le f_u/(\beta_w*\gamma_{M2})$	4.63 < 429.71	verified	(0.01)

Transverse inner weld

$\sigma_\perp$ =	21.34 [MPa]	Normal stress in a weld	
$\tau_\perp$ =	48.68 [MPa]	Perpendicular tangent stress	
τ_{II} =	0.00 [MPa]	Tangent stress	

$\|\sigma_\perp\| \le 0.9*f_u/\gamma_{M2}$	|21.34| < 338.40	verified	(0.06)
$\sqrt{[\sigma_\perp^2 + 3*(\tau_\perp^2+\tau_{II}^2)]} \le f_u/(\beta_w*\gamma_{M2})$	86.97 < 429.71	verified	(0.20)

Transverse outer weld

$\sigma_\perp$ =	-46.56 [MPa]	Normal stress in a weld	
$\tau_\perp$ =	-15.93 [MPa]	Perpendicular tangent stress	
τ_{II} =	0.00 [MPa]	Tangent stress	

$\|\sigma_\perp\| \le 0.9*f_u/\gamma_{M2}$	|-46.56| < 338.40	verified	(0.14)
$\sqrt{[\sigma_\perp^2 + 3*(\tau_\perp^2+\tau_{II}^2)]} \le f_u/(\beta_w*\gamma_{M2})$	54.12 < 429.71	verified	(0.13)

DIAGONAL 1

β_w =	0.88	Correlation coefficient	[Table 4.1]
γ_{M2} =	1.25	Partial safety factor	[Table 2.1]

Longitudinal weld

$\sigma_\perp$ =	38.02 [MPa]	Normal stress in a weld	
$\tau_\perp$ =	38.02 [MPa]	Perpendicular tangent stress	
τ_{II} =	24.93 [MPa]	Tangent stress	

$\|\sigma_\perp\| \le 0.9*f_u/\gamma_{M2}$	|38.02| < 338.40	verified	(0.11)
$\sqrt{[\sigma_\perp^2 + 3*(\tau_\perp^2+\tau_{II}^2)]} \le f_u/(\beta_w*\gamma_{M2})$	87.44 < 429.71	verified	(0.20)

Transverse inner weld

$\sigma_\perp$ =	148.06 [MPa]	Normal stress in a weld	
$\tau_\perp$ =	183.81 [MPa]	Perpendicular tangent stress	
τ_{II} =	0.00 [MPa]	Tangent stress	

$\|\sigma_\perp\| \le 0.9*f_u/\gamma_{M2}$	|148.06| < 338.40	verified	(0.44)
$\sqrt{[\sigma_\perp^2 + 3*(\tau_\perp^2+\tau_{II}^2)]} \le f_u/(\beta_w*\gamma_{M2})$	351.12 < 429.71	verified	(0.82)

Connection conforms to the code Ratio 0.96

Išvada: laikomoji galia pakankama

Mazgas Nr. 3

Robot Structural Analysis Professional 2023

Design of truss node connection

EN 1993-1-8:2005/AC:2009

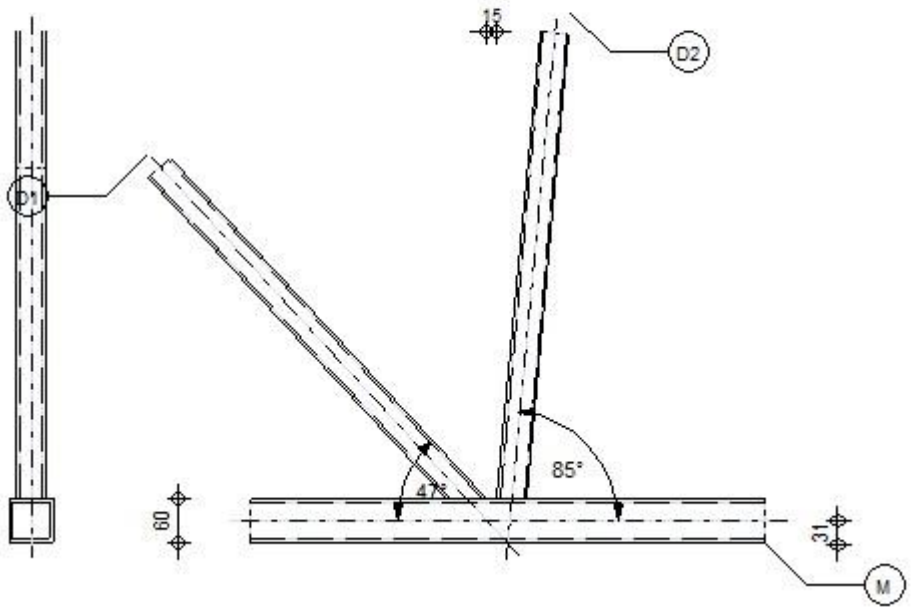
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Ratio
0.25

D1 - SHS 40x4

D2 - SHS 40x4

M - RK 60x60x5



GENERAL

Connection no.: 3
Connection name: Tube
Structure node: 6101
Structure members: 3450, 3451, 3452

GEOMETRY

MEMBERS

		Chord	Diagonal 1	Diagonal 2	Post	
Member no.:		3450	3452	3451		
Section:		RK 60x60x5	SHS 40x4	SHS 40x4		
	h	60	40	40		mm
	b_f	60	40	40		mm
	t_w	5	4	4		mm
	t_f	5	4	4		mm
	r	5	0	0		mm

		Chord	Diagonal 1	Diagonal 2	Post	
Material:		S 355	S 355	S 355		
	f_y	355.00	355.00	355.00		MPa
	f_u	470.00	470.00	470.00		MPa
Angle	θ	0.0	47.2	84.7		Deg
Length	l	5044	1289	1179		mm

OFFSET

e_0 = 31 [mm] Offset

SPACINGS

g_2 = 15 [mm] Spacing of 2nd diagonal

WELDS

a_d = 3 [mm] Thickness of welds of diagonals and posts

LOADS

Case: 90: ULS/82=1*1.35 + 2*0.91 + 8*1.30 1*1.35+2*0.91+8*1.30

CHORD

$N_{01,Ed}$ = -9.94 [kN] Axial force
$M_{01,Ed}$ = -0.57 [kN*m] Bending moment
$N_{02,Ed}$ = -21.00 [kN] Axial force
$M_{02,Ed}$ = -0.19 [kN*m] Bending moment

DIAGONAL 1

N_1 = 14.04 [kN] Axial force
M_1 = -0.03 [kN*m] Bending moment

DIAGONAL 2

N_2 = -8.54 [kN] Axial force
M_2 = 0.34 [kN*m] Bending moment

Shear forces were not included in the connection verification. The connection was designed as a truss node.

RESULTS

CONSIDER NON-AXIAL CONNECTION OF MEMBERS IN THE NODE

M_0 = 0.35 [kN*m] Additional moment from eccentric connection of members $M_0 = (N_{02}-N_{01}) * e_0$
$\Sigma E_i J_i / L_i$ = 130021.94 [kN*m] Overall connection stiffness
ΔM_{01} = 0.12 [kN*m] Additional moment in the chord
ΔM_{02} = 0.12 [kN*m] Additional moment in the chord
ΔM_2 = 0.06 [kN*m] Additional moment in the diagonal
ΔM_1 = 0.05 [kN*m] Additional moment in the diagonal

CAPACITY VERIFICATION EUROCODE 3: EN 1993-1-8:2005

γ_{M5} = 1.00 Partial safety factor [Table 2.1]

FAILURE MODES FOR JOINTS (RHS CHORD MEMBERS) [Table 7.10] for $N_{i,Rd}$ and [Table 7.14] for $M_{i,Rd}$

GEOMETRICAL PARAMETERS

β = 0.67	Coefficient taking account of geometry of connection members	$\beta = (b_2+b_1)/(2*b_0)$ [1.5 (6)]
γ = 6.00	Coefficient taking account of geometry of the chord	$\gamma = b_0/(2*t_0)$ [1.5 (6)]
n = 0.13	Coefficient taking account of stresses in the chord	$n_0 = \sigma_{0,Ed}/f_{y0}$
k_n = 1.00	Coefficient taking account of stresses in the chord	$k_n = 1.0$

TUBE CHORD FACE FAILURE

DIAGONAL 2

$N_{2,Rd}$ = 129.53 [kN]	Compression capacity			$N_{2,Rd} = 8.9*k_n*f_{y0}*t_0^2*\sqrt{\gamma}/\sin(\theta_2) * \beta$
$\|N_2\| \le N_{2,Rd}$		$\|-8.54\| < 129.53$	verified	(0.07)
$M_{2,Rd}$ = 2.21 [kN*m]	Bending resistance			$M_{2,Rd} = k_n*f_{y0}*t_0^2*h_2*[1/(2*\eta) + 2/\sqrt{[1-\beta] + \eta/(1-\beta)}] / \gamma_{M5}$
$\|M_2+\Delta M_2\| \le M_{2,Rd}$		$\|0.40\| < 2.21$	verified	(0.18)
$N_2/N_{2,Rd} + (M_2+\Delta M_2)/M_{2,Rd} \le 1$		$0.25 < 1.00$	verified	(0.25)

DIAGONAL 1

$N_{1,Rd}$ = 175.74 [kN]	Tension capacity			$N_{1,Rd} = 8.9*k_n*f_{y0}*t_0^2*\sqrt{\gamma}/\sin(\theta_1) * \beta$
$\|N_1\| \le N_{1,Rd}$		$\|14.04\| < 175.74$	verified	(0.08)
$M_{1,Rd}$ = 2.21 [kN*m]	Bending resistance			$M_{1,Rd} = k_n*f_{y0}*t_0^2*h_1*[1/(2*\eta) + 2/\sqrt{[1-\beta] + \eta/(1-\beta)}] / \gamma_{M5}$
$\|M_1+\Delta M_1\| \le M_{1,Rd}$		$\|0.02\| < 2.21$	verified	(0.01)
$N_1/N_{1,Rd} + (M_1+\Delta M_1)/M_{1,Rd} \le 1$		$0.09 < 1.00$	verified	(0.09)

CHORD PUNCHING

DIAGONAL 2

$b_{e,p}$ = 33 [mm]	Effective width for punching shear			$b_{e,p} = (10*b_2)/(b_0/t_0)$
$N_{2,Rd}$ = 158.15 [kN]	Compression capacity			$N_{2,Rd} = f_{y0}*t_0/(\sqrt{3}*\sin(\theta_2))*[2*h_2/\sin(\theta_2)+b_2+b_{e,p}]/\gamma_{M5}$
$\|N_2\| \le N_{2,Rd}$		$\|-8.54\| < 158.15$	verified	(0.05)

DIAGONAL 1

$b_{e,p}$ = 33 [mm]	Effective width for punching shear			$b_{e,p} = (10*b_1)/(b_0/t_0)$
$N_{1,Rd}$ = 254.59 [kN]	Tension capacity			$N_{1,Rd} = f_{y0}*t_0/(\sqrt{3}*\sin(\theta_1))*[2*h_1/\sin(\theta_1)+b_1+b_{e,p}]/\gamma_{M5}$
$\|N_1\| \le N_{1,Rd}$		$\|14.04\| < 254.59$	verified	(0.06)

CHORD SHEAR

DIAGONAL 2

A_v = 6.83 [cm^2]	Shear area of the chord			$A_v = (2*h_0 + \alpha*b_0)*t_0$
$N_{2,Rd}$ = 140.62 [kN]	Compression capacity			$N_{2,Rd} = f_{y0}*A_v/[\sqrt{3}*\sin(\theta_2)] / \gamma_{M5}$
$\|N_2\| \le N_{2,Rd}$		$\|-8.54\| < 140.62$	verified	(0.06)

DIAGONAL 1

A_v = 6.83 [cm^2]	Shear area of the chord			$A_v = (2*h_0 + \alpha*b_0)*t_0$
$N_{1,Rd}$ = 190.79 [kN]	Tension capacity			$N_{1,Rd} = f_{y0}*A_v/[\sqrt{3}*\sin(\theta_1)] / \gamma_{M5}$
$\|N_1\| \le N_{1,Rd}$		$\|14.04\| < 190.79$	verified	(0.07)

CHORD RESISTANCE

$V_{pl,Rd}$ = 127.30 [kN]	Plastic resistance for shear		$V_{pl,Rd} = (A_v*f_{y0})/(\sqrt{3}*\gamma_{M0})$

$\|V_{Ed}\| \le V_{pl,Rd}$	$\|10.30\| < 127.30$	verified	(0.08)	
$N_{0,Rd}$ = 379.05 [kN]	Compression capacity	$N_{0,Rd} = [(A_0-A_v)*f_{y0} + A_v*f_{y0}*\sqrt{[1-(V_{Ed}/V_{pl,Rd})^2]}]/\gamma_{M5}$		
$\|N_{02}\| \le N_{0,Rd}$	$\|-21.00\| < 379.05$	verified	(0.06)	

VERIFICATION OF WELDS

DIAGONAL 2

β_w = 0.88	Correlation coefficient		[Table 4.1]
γ_{M2} = 1.25	Partial safety factor		[Table 2.1]
Longitudinal weld			
$\sigma_\perp$ = -16.03 [MPa]	Normal stress in a weld		
$\tau_\perp$ = -16.03 [MPa]	Perpendicular tangent stress		
τ_{II} = -2.17 [MPa]	Tangent stress		
$\|\sigma_\perp\| \le 0.9*f_u/\gamma_{M2}$	$\|-16.03\| < 338.40$	verified	(0.05)
$\sqrt{[\sigma_\perp^2 + 3*(\tau_\perp^2+\tau_{II}^2)]} \le f_u/(\beta_w*\gamma_{M2})$	$32.28 < 429.71$	verified	(0.08)
Transverse inner weld			
$\sigma_\perp$ = 20.15 [MPa]	Normal stress in a weld		
$\tau_\perp$ = 25.30 [MPa]	Perpendicular tangent stress		
τ_{II} = 0.00 [MPa]	Tangent stress		
$\|\sigma_\perp\| \le 0.9*f_u/\gamma_{M2}$	$\|20.15\| < 338.40$	verified	(0.06)
$\sqrt{[\sigma_\perp^2 + 3*(\tau_\perp^2+\tau_{II}^2)]} \le f_u/(\beta_w*\gamma_{M2})$	$48.23 < 429.71$	verified	(0.11)

DIAGONAL 1

β_w = 0.88	Correlation coefficient		[Table 4.1]
γ_{M2} = 1.25	Partial safety factor		[Table 2.1]
Longitudinal weld			
$\sigma_\perp$ = 12.85 [MPa]	Normal stress in a weld		
$\tau_\perp$ = 12.85 [MPa]	Perpendicular tangent stress		
τ_{II} = 16.82 [MPa]	Tangent stress		
$\|\sigma_\perp\| \le 0.9*f_u/\gamma_{M2}$	$\|12.85\| < 338.40$	verified	(0.04)
$\sqrt{[\sigma_\perp^2 + 3*(\tau_\perp^2+\tau_{II}^2)]} \le f_u/(\beta_w*\gamma_{M2})$	$38.85 < 429.71$	verified	(0.09)
Transverse inner weld			
$\sigma_\perp$ = 21.40 [MPa]	Normal stress in a weld		
$\tau_\perp$ = 6.97 [MPa]	Perpendicular tangent stress		
τ_{II} = 0.00 [MPa]	Tangent stress		
$\|\sigma_\perp\| \le 0.9*f_u/\gamma_{M2}$	$\|21.40\| < 338.40$	verified	(0.06)
$\sqrt{[\sigma_\perp^2 + 3*(\tau_\perp^2+\tau_{II}^2)]} \le f_u/(\beta_w*\gamma_{M2})$	$24.57 < 429.71$	verified	(0.06)
Transverse outer weld			
$\sigma_\perp$ = 12.86 [MPa]	Normal stress in a weld		
$\tau_\perp$ = 23.97 [MPa]	Perpendicular tangent stress		
τ_{II} = 0.00 [MPa]	Tangent stress		
$\|\sigma_\perp\| \le 0.9*f_u/\gamma_{M2}$	$\|12.86\| < 338.40$	verified	(0.04)
$\sqrt{[\sigma_\perp^2 + 3*(\tau_\perp^2+\tau_{II}^2)]} \le f_u/(\beta_w*\gamma_{M2})$	$43.47 < 429.71$	verified	(0.10)

REMARKS

Eccentricity is too large. 31 [mm] > 15 [mm]

Connection conforms to the code Ratio 0.25

Išvada: laikomoji galia pakankama

Mazgas Nr. 4

Robot Structural Analysis Professional 2023

Design of truss node connection

EN 1993-1-8:2005/AC:2009

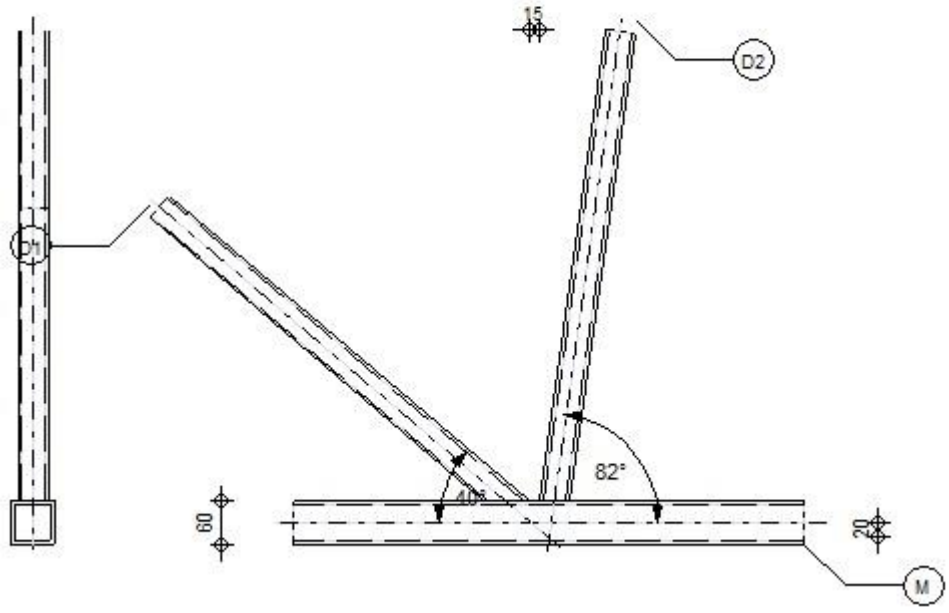
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Ratio **0.15**

D1 - SHS 40x4

D2 - SHS 40x4

M - RK 60x60x5



GENERAL

Connection no.: 4
Connection name: Tube
Structure node: 6102
Structure members: 3450, 3453, 3454

GEOMETRY

MEMBERS

		Chord	Diagonal 1	Diagonal 2	Post	
Member no.:		3450	3454	3453		
Section:		RK 60x60x5	SHS 40x4	SHS 40x4		
	h	60	40	40		mm
	b_f	60	40	40		mm
	t_w	5	4	4		mm
	t_f	5	4	4		mm
	r	5	0	0		mm
Material:		S 355	S 355	S 355		
	f_y	355.00	355.00	355.00		MPa
	f_u	470.00	470.00	470.00		MPa
Angle	θ	0.0	40.2	82.0		Deg
Length	l	5044	1113	955		mm

OFFSET

e_0 = 20 [mm] Offset

SPACINGS

g_2 = 15 [mm] Spacing of 2nd diagonal

WELDS

a_d = 3 [mm] Thickness of welds of diagonals and posts

LOADS

Case: 90: ULS/82=1*1.35 + 2*0.91 + 8*1.30 1*1.35+2*0.91+8*1.30

CHORD

$N_{01,Ed}$ = -22.04 [kN] Axial force
$M_{01,Ed}$ = 0.22 [kN*m] Bending moment
$N_{02,Ed}$ = -32.02 [kN] Axial force
$M_{02,Ed}$ = 0.21 [kN*m] Bending moment

DIAGONAL 1

N_1 = 11.40 [kN] Axial force
M_1 = -0.01 [kN*m] Bending moment

DIAGONAL 2

N_2 = -9.63 [kN] Axial force
M_2 = -0.02 [kN*m] Bending moment

Shear forces were not included in the connection verification. The connection was designed as a truss node.

RESULTS

CONSIDER NON-AXIAL CONNECTION OF MEMBERS IN THE NODE

M_0 = 0.20 [kN*m] Additional moment from eccentric connection of members $M_0 = (N_{02}-N_{01}) * e_0$
$\Sigma E_i J_i / L_i$ = 138194.31 [kN*m] Overall connection stiffness
ΔM_{01} = 0.06 [kN*m] Additional moment in the chord
ΔM_{02} = 0.06 [kN*m] Additional moment in the chord
ΔM_2 = 0.04 [kN*m] Additional moment in the diagonal

M_0 = 0.20 [kN*m] Additional moment from eccentric connection of members $M_0 = (N_{02}-N_{01}) * e_0$

ΔM_1 = 0.03 [kN*m] Additional moment in the diagonal

CAPACITY VERIFICATION EUROCODE 3: EN 1993-1-8:2005

γ_{M5} = 1.00 Partial safety factor [Table 2.1]

FAILURE MODES FOR JOINTS (RHS CHORD MEMBERS) [Table 7.10] for $N_{i,Rd}$ and [Table 7.14] for $M_{i,Rd}$

GEOMETRICAL PARAMETERS

β = 0.67	Coefficient taking account of geometry of connection members	$\beta = (b_2+b_1)/(2*b_0)$ [1.5 (6)]
γ = 6.00	Coefficient taking account of geometry of the chord	$\gamma = b_0/(2*t_0)$ [1.5 (6)]
n = 0.13	Coefficient taking account of stresses in the chord	$n_0 = \sigma_{0,Ed}/f_{y0}$
k_n = 1.00	Coefficient taking account of stresses in the chord	$k_n = 1.0$

TUBE CHORD FACE FAILURE

DIAGONAL 2

$N_{2,Rd}$ = 130.26 [kN] Compression capacity $N_{2,Rd} = 8.9*k_n*f_{y0}*t_0^2*\sqrt{\gamma}/\sin(\theta_2) * \beta$

$\lvert N_2\rvert \le N_{2,Rd}$	|-9.63| < 130.26	verified	(0.07)

$M_{2,Rd}$ = 2.21 [kN*m] Bending resistance $M_{2,Rd} = k_n*f_{y0}*t_0^2*h_2*[1/(2*\eta) + 2/\sqrt{[1-\beta] + \eta/(1-\beta)}] / \gamma_{M5}$

$\lvert M_2+\Delta M_2\rvert \le M_{2,Rd}$	|0.02| < 2.21	verified	(0.01)
$N_2/N_{2,Rd} + (M_2+\Delta M_2)/M_{2,Rd} \le 1$	0.08 < 1.00	verified	(0.08)

DIAGONAL 1

$N_{1,Rd}$ = 199.95 [kN] Tension capacity $N_{1,Rd} = 8.9*k_n*f_{y0}*t_0^2*\sqrt{\gamma}/\sin(\theta_1) * \beta$

$\lvert N_1\rvert \le N_{1,Rd}$	|11.40| < 199.95	verified	(0.06)

$M_{1,Rd}$ = 2.21 [kN*m] Bending resistance $M_{1,Rd} = k_n*f_{y0}*t_0^2*h_1*[1/(2*\eta) + 2/\sqrt{[1-\beta] + \eta/(1-\beta)}] / \gamma_{M5}$

$\lvert M_1+\Delta M_1\rvert \le M_{1,Rd}$	|0.02| < 2.21	verified	(0.01)
$N_1/N_{1,Rd} + (M_1+\Delta M_1)/M_{1,Rd} \le 1$	0.07 < 1.00	verified	(0.07)

CHORD PUNCHING

DIAGONAL 2

$b_{e,p}$ = 33 [mm] Effective width for punching shear $b_{e,p} = (10*b_2)/(b_0/t_0)$

$N_{2,Rd}$ = 159.51 [kN] Compression capacity $N_{2,Rd} = f_{y0}*t_0/(\sqrt{3}*\sin(\theta_2))*[2*h_2/\sin(\theta_2)+b_2+b_{e,p}]/\gamma_{M5}$

$\lvert N_2\rvert \le N_{2,Rd}$	|-9.63| < 159.51	verified	(0.06)

DIAGONAL 1

$b_{e,p}$ = 33 [mm] Effective width for punching shear $b_{e,p} = (10*b_1)/(b_0/t_0)$

$N_{1,Rd}$ = 313.50 [kN] Tension capacity $N_{1,Rd} = f_{y0}*t_0/(\sqrt{3}*\sin(\theta_1))*[2*h_1/\sin(\theta_1)+b_1+b_{e,p}]/\gamma_{M5}$

$\lvert N_1\rvert \le N_{1,Rd}$	|11.40| < 313.50	verified	(0.04)

CHORD SHEAR

DIAGONAL 2

A_v = 6.83 [cm^2] Shear area of the chord $A_v = (2*h_0 + \alpha*b_0)*t_0$

$N_{2,Rd}$ = 141.41 [kN] Compression capacity $N_{2,Rd} = f_{y0}*A_v/[\sqrt{3}*\sin(\theta_2)] / \gamma_{M5}$

$\lvert N_2\rvert \le N_{2,Rd}$	|-9.63| < 141.41	verified	(0.07)

DIAGONAL 1

A_v =	6.83	[cm^2]	Shear area of the chord		$A_v = (2*h_0 + \alpha*b_0)*t_0$
$N_{1,Rd}$ =	217.07	[kN]	Tension capacity		$N_{1,Rd} = f_{y0}*A_v/[\sqrt{3}*\sin(\theta_1)] / \gamma_{M5}$
$\lvert N_1 \rvert \le N_{1,Rd}$			$\lvert 11.40 \rvert < 217.07$	verified	(0.05)

CHORD RESISTANCE

$V_{pl,Rd}$ =	127.30	[kN]	Plastic resistance for shear		$V_{pl,Rd} = (A_v*f_{y0})/(\sqrt{3}*\gamma_{M0})$
$\lvert V_{Ed} \rvert \le V_{pl,Rd}$			$\lvert 9.53 \rvert < 127.30$	verified	(0.07)
$N_{0,Rd}$ =	379.17	[kN]	Compression capacity		$N_{0,Rd} = [\ (A_0-A_v)*f_{y0} + A_v*f_{y0}*\sqrt{[1-(V_{Ed}/V_{pl,Rd})^2]}\ ]/\gamma_{M5}$
$\lvert N_{02} \rvert \le N_{0,Rd}$			$\lvert -32.02 \rvert < 379.17$	verified	(0.08)

VERIFICATION OF WELDS

DIAGONAL 2

β_w =	0.88		Correlation coefficient		[Table 4.1]
γ_{M2} =	1.25		Partial safety factor		[Table 2.1]
Longitudinal weld					
$\sigma_\perp$ =	-17.92	[MPa]	Normal stress in a weld		
$\tau_\perp$ =	-17.92	[MPa]	Perpendicular tangent stress		
τ_{II} =	-3.71	[MPa]	Tangent stress		
$\lvert \sigma_\perp \rvert \le 0.9*f_u/\gamma_{M2}$			$\lvert -17.92 \rvert < 338.40$	verified	(0.05)
$\sqrt{[\sigma_\perp^2 + 3*(\tau_\perp^2+\tau_{II}^2)]} \le f_u/(\beta_w*\gamma_{M2})$			$36.40 < 429.71$	verified	(0.08)
Transverse inner weld					
$\sigma_\perp$ =	-33.18	[MPa]	Normal stress in a weld		
$\tau_\perp$ =	-32.54	[MPa]	Perpendicular tangent stress		
τ_{II} =	0.00	[MPa]	Tangent stress		
$\lvert \sigma_\perp \rvert \le 0.9*f_u/\gamma_{M2}$			$\lvert -33.18 \rvert < 338.40$	verified	(0.10)
$\sqrt{[\sigma_\perp^2 + 3*(\tau_\perp^2+\tau_{II}^2)]} \le f_u/(\beta_w*\gamma_{M2})$			$65.40 < 429.71$	verified	(0.15)

DIAGONAL 1

β_w =	0.88		Correlation coefficient		[Table 4.1]
γ_{M2} =	1.25		Partial safety factor		[Table 2.1]
Longitudinal weld					
$\sigma_\perp$ =	8.50	[MPa]	Normal stress in a weld		
$\tau_\perp$ =	8.50	[MPa]	Perpendicular tangent stress		
τ_{II} =	14.23	[MPa]	Tangent stress		
$\lvert \sigma_\perp \rvert \le 0.9*f_u/\gamma_{M2}$			$\lvert 8.50 \rvert < 338.40$	verified	(0.03)
$\sqrt{[\sigma_\perp^2 + 3*(\tau_\perp^2+\tau_{II}^2)]} \le f_u/(\beta_w*\gamma_{M2})$			$29.95 < 429.71$	verified	(0.07)
Transverse inner weld					
$\sigma_\perp$ =	17.20	[MPa]	Normal stress in a weld		
$\tau_\perp$ =	5.60	[MPa]	Perpendicular tangent stress		
τ_{II} =	0.00	[MPa]	Tangent stress		
$\lvert \sigma_\perp \rvert \le 0.9*f_u/\gamma_{M2}$			$\lvert 17.20 \rvert < 338.40$	verified	(0.05)
$\sqrt{[\sigma_\perp^2 + 3*(\tau_\perp^2+\tau_{II}^2)]} \le f_u/(\beta_w*\gamma_{M2})$			$19.75 < 429.71$	verified	(0.05)
Transverse outer weld					
$\sigma_\perp$ =	7.20	[MPa]	Normal stress in a weld		
$\tau_\perp$ =	17.79	[MPa]	Perpendicular tangent stress		
τ_{II} =	0.00	[MPa]	Tangent stress		
$\lvert \sigma_\perp \rvert \le 0.9*f_u/\gamma_{M2}$			$\lvert 7.20 \rvert < 338.40$	verified	(0.02)
$\sqrt{[\sigma_\perp^2 + 3*(\tau_\perp^2+\tau_{II}^2)]} \le f_u/(\beta_w*\gamma_{M2})$			$31.64 < 429.71$	verified	(0.07)

REMARKS

Eccentricity is too large. 20 [mm] > 15 [mm]

Connection conforms to the code Ratio 0.15

Išvada: laikomoji galia pakankama

Mazgas Nr. 5

Robot Structural Analysis Professional 2023

Design of truss node connection

EN 1993-1-8:2005/AC:2009

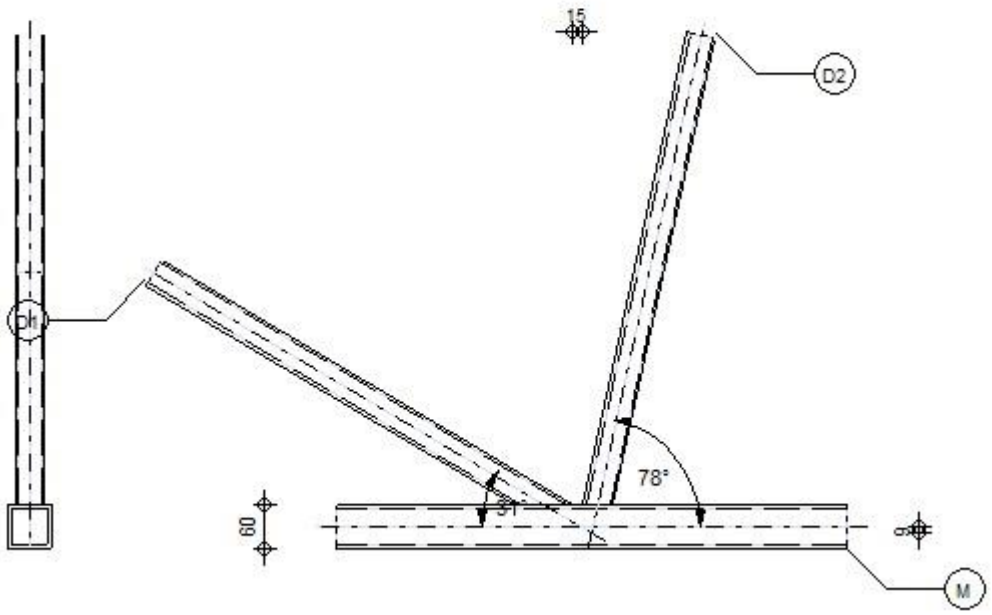
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Ratio **0.13**

D1 - SHS 40x4

D2 - SHS 40x4

M - RK 60x60x5



GENERAL

Connection no.: 5
Connection name: Tube

Connection no.: 5
Structure node: 6128
Structure members: 3450, 3455, 3456

GEOMETRY

MEMBERS

		Chord	Diagonal 1	Diagonal 2	Post	
Member no.:		3450	3456	3455		
Section:		RK 60x60x5	SHS 40x4	SHS 40x4		
	h	60	40	40		mm
	b_f	60	40	40		mm
	t_w	5	4	4		mm
	t_f	5	4	4		mm
	r	5	0	0		mm
Material:		S 355	S 355	S 355		
	f_y	355.00	355.00	355.00		MPa
	f_u	470.00	470.00	470.00		MPa
Angle	θ	0.0	30.7	77.5		Deg
Length	l	5044	959	735		mm

OFFSET

e_0 = 9 [mm] Offset

SPACINGS

g_2 = 15 [mm] Spacing of 2nd diagonal

WELDS

a_d = 3 [mm] Thickness of welds of diagonals and posts

LOADS

Case: 90: ULS/82=1*1.35 + 2*0.91 + 8*1.30 1*1.35+2*0.91+8*1.30

CHORD

$N_{01,Ed}$ = -33.56 [kN] Axial force
$M_{01,Ed}$ = 0.11 [kN*m] Bending moment
$N_{02,Ed}$ = -49.38 [kN] Axial force
$M_{02,Ed}$ = 0.20 [kN*m] Bending moment

DIAGONAL 1

N_1 = 15.51 [kN] Axial force
M_1 = -0.02 [kN*m] Bending moment

DIAGONAL 2

N_2 = -10.40 [kN] Axial force
M_2 = 0.07 [kN*m] Bending moment

Shear forces were not included in the connection verification. The connection was designed as a truss node.

RESULTS

CONSIDER NON-AXIAL CONNECTION OF MEMBERS IN THE NODE

M_0 =	0.15	[kN*m]	Additional moment from eccentric connection of members	$M_0 = (N_{02}-N_{01}) * e_0$
$\Sigma E_i J_i/L_i$ =	149817.56	[kN*m]	Overall connection stiffness	
ΔM_{01} =	0.04	[kN*m]	Additional moment in the chord	
ΔM_{02} =	0.04	[kN*m]	Additional moment in the chord	
ΔM_2 =	0.03	[kN*m]	Additional moment in the diagonal	
ΔM_1 =	0.03	[kN*m]	Additional moment in the diagonal	

CAPACITY VERIFICATION EUROCODE 3: EN 1993-1-8:2005

γ_{M5} = 1.00 Partial safety factor [Table 2.1]

FAILURE MODES FOR JOINTS (RHS CHORD MEMBERS) [Table 7.10] for $N_{i,Rd}$ and [Table 7.14] for $M_{i,Rd}$

GEOMETRICAL PARAMETERS

β =	0.67	Coefficient taking account of geometry of connection members	$\beta = (b_2+b_1)/(2*b_0)$ [1.5 (6)]
γ =	6.00	Coefficient taking account of geometry of the chord	$\gamma = b_0/(2*t_0)$ [1.5 (6)]
n =	0.18	Coefficient taking account of stresses in the chord	$n_0 = \sigma_{0,Ed}/f_{y0}$
k_n =	1.00	Coefficient taking account of stresses in the chord	$k_n = 1.0$

TUBE CHORD FACE FAILURE

DIAGONAL 2

$N_{2,Rd}$ =	132.10 [kN]	Compression capacity		$N_{2,Rd} = 8.9*k_n*f_{y0}*t_0^{2*}\sqrt{\gamma}/\sin(\theta_2) * \beta$
$\lvert N_2\rvert \le N_{2,Rd}$		$\lvert -10.40\rvert < 132.10$	verified	(0.08)
$M_{2,Rd}$ =	2.21 [kN*m]	Bending resistance		$M_{2,Rd} = k_n*f_{y0}*t_0^2*h_2*[1/(2*\eta) + 2/\sqrt{[1-\beta]} + \eta/(1-\beta)] / \gamma_{M5}$
$\lvert M_2+\Delta M_2\rvert \le M_{2,Rd}$		$\lvert 0.10\rvert < 2.21$	verified	(0.05)
$N_2/N_{2,Rd} + (M_2+\Delta M_2)/M_{2,Rd} \le 1$		$0.12 < 1.00$	verified	(0.12)

DIAGONAL 1

$N_{1,Rd}$ =	252.75 [kN]	Tension capacity		$N_{1,Rd} = 8.9*k_n*f_{y0}*t_0^{2*}\sqrt{\gamma}/\sin(\theta_1) * \beta$
$\lvert N_1\rvert \le N_{1,Rd}$		$\lvert 15.51\rvert < 252.75$	verified	(0.06)
$M_{1,Rd}$ =	2.21 [kN*m]	Bending resistance		$M_{1,Rd} = k_n*f_{y0}*t_0^2*h_1*[1/(2*\eta) + 2/\sqrt{[1-\beta]} + \eta/(1-\beta)] / \gamma_{M5}$
$\lvert M_1+\Delta M_1\rvert \le M_{1,Rd}$		$\lvert 0.00\rvert < 2.21$	verified	(0.00)
$N_1/N_{1,Rd} + (M_1+\Delta M_1)/M_{1,Rd} \le 1$		$0.06 < 1.00$	verified	(0.06)

CHORD PUNCHING

DIAGONAL 2

$b_{e,p}$ =	33 [mm]	Effective width for punching shear		$b_{e,p} = (10*b_2)/(b_0/t_0)$
$N_{2,Rd}$ =	162.95 [kN]	Compression capacity		$N_{2,Rd} = f_{y0}*t_0/(\sqrt{3}*\sin(\theta_2))*[2*h_2/\sin(\theta_2)+b_2+b_{e,p}]/\gamma_{M5}$
$\lvert N_2\rvert \le N_{2,Rd}$		$\lvert -10.40\rvert < 162.95$	verified	(0.06)

DIAGONAL 1

$b_{e,p}$ =	33 [mm]	Effective width for punching shear		$b_{e,p} = (10*b_1)/(b_0/t_0)$
$N_{1,Rd}$ =	462.04 [kN]	Tension capacity		$N_{1,Rd} = f_{y0}*t_0/(\sqrt{3}*\sin(\theta_1))*[2*h_1/\sin(\theta_1)+b_1+b_{e,p}]/\gamma_{M5}$
$\lvert N_1\rvert \le N_{1,Rd}$		$\lvert 15.51\rvert < 462.04$	verified	(0.03)

CHORD SHEAR

DIAGONAL 2

A_v =	6.83	[cm^2]	Shear area of the chord		$A_v = (2*h_0 + \alpha*b_0)*t_0$
$N_{2,Rd}$ =	143.41	[kN]	Compression capacity		$N_{2,Rd} = f_{y0}*A_v/[\sqrt{3}*\sin(\theta_2)] / \gamma_{M5}$
$\lvert N_2\rvert \le N_{2,Rd}$			$\lvert -10.40\rvert < 143.41$	verified	(0.07)

DIAGONAL 1

A_v =	6.83	[cm^2]	Shear area of the chord		$A_v = (2*h_0 + \alpha*b_0)*t_0$
$N_{1,Rd}$ =	274.38	[kN]	Tension capacity		$N_{1,Rd} = f_{y0}*A_v/[\sqrt{3}*\sin(\theta_1)] / \gamma_{M5}$
$\lvert N_1\rvert \le N_{1,Rd}$			$\lvert 15.51\rvert < 274.38$	verified	(0.06)

CHORD RESISTANCE

$V_{pl,Rd}$ =	127.30	[kN]	Plastic resistance for shear		$V_{pl,Rd} = (A_v*f_{y0})/(\sqrt{3}*\gamma_{M0})$
$\lvert V_{Ed}\rvert \le V_{pl,Rd}$			$\lvert 10.15\rvert < 127.30$	verified	(0.08)
$N_{0,Rd}$ =	379.08	[kN]	Compression capacity		$N_{0,Rd} = [\ (A_0-A_v)*f_{y0} + A_v*f_{y0}*\sqrt{[1-(V_{Ed}/V_{pl,Rd})^2]}\ ]/\gamma_{M5}$
$\lvert N_{02}\rvert \le N_{0,Rd}$			$\lvert -49.38\rvert < 379.08$	verified	(0.13)

VERIFICATION OF WELDS

DIAGONAL 2

β_w =	0.88		Correlation coefficient		[Table 4.1]
γ_{M2} =	1.25		Partial safety factor		[Table 2.1]
Longitudinal weld					
$\sigma_\perp$ =	-18.93	[MPa]	Normal stress in a weld		
$\tau_\perp$ =	-18.93	[MPa]	Perpendicular tangent stress		
τ_{II} =	-6.13	[MPa]	Tangent stress		
$\lvert\sigma_\perp\rvert \le 0.9*f_u/\gamma_{M2}$			$\lvert -18.93\rvert < 338.40$	verified	(0.06)
$\sqrt{[\sigma_\perp^2 + 3*(\tau_\perp^2+\tau_{II}^2)]} \le f_u/(\beta_w*\gamma_{M2})$			$39.31 < 429.71$	verified	(0.09)
Transverse inner weld					
$\sigma_\perp$ =	-24.15	[MPa]	Normal stress in a weld		
$\tau_\perp$ =	-20.27	[MPa]	Perpendicular tangent stress		
τ_{II} =	0.00	[MPa]	Tangent stress		
$\lvert\sigma_\perp\rvert \le 0.9*f_u/\gamma_{M2}$			$\lvert -24.15\rvert < 338.40$	verified	(0.07)
$\sqrt{[\sigma_\perp^2 + 3*(\tau_\perp^2+\tau_{II}^2)]} \le f_u/(\beta_w*\gamma_{M2})$			$42.61 < 429.71$	verified	(0.10)

DIAGONAL 1

β_w =	0.88		Correlation coefficient		[Table 4.1]
γ_{M2} =	1.25		Partial safety factor		[Table 2.1]
Longitudinal weld					
$\sigma_\perp$ =	7.88	[MPa]	Normal stress in a weld		
$\tau_\perp$ =	7.88	[MPa]	Perpendicular tangent stress		
τ_{II} =	18.78	[MPa]	Tangent stress		
$\lvert\sigma_\perp\rvert \le 0.9*f_u/\gamma_{M2}$			$\lvert 7.88\rvert < 338.40$	verified	(0.02)
$\sqrt{[\sigma_\perp^2 + 3*(\tau_\perp^2+\tau_{II}^2)]} \le f_u/(\beta_w*\gamma_{M2})$			$36.15 < 429.71$	verified	(0.08)
Transverse inner weld					
$\sigma_\perp$ =	20.69	[MPa]	Normal stress in a weld		
$\tau_\perp$ =	4.43	[MPa]	Perpendicular tangent stress		
τ_{II} =	0.00	[MPa]	Tangent stress		
$\lvert\sigma_\perp\rvert \le 0.9*f_u/\gamma_{M2}$			$\lvert 20.69\rvert < 338.40$	verified	(0.06)

$\sigma_\perp$ =	20.69	[MPa]	Normal stress in a weld	
$\sqrt{[\sigma_\perp^2 + 3*(\tau_\perp^2+\tau_{II}^2)]} \le f_u/(\beta_w*\gamma_{M2})$	22.07 < 429.71		verified	(0.05)
Transverse outer weld				
$\sigma_\perp$ =	7.13	[MPa]	Normal stress in a weld	
$\tau_\perp$ =	21.43	[MPa]	Perpendicular tangent stress	
τ_{II} =	0.00	[MPa]	Tangent stress	
$\lvert\sigma_\perp\rvert \le 0.9*f_u/\gamma_{M2}$	|7.13| < 338.40		verified	(0.02)
$\sqrt{[\sigma_\perp^2 + 3*(\tau_\perp^2+\tau_{II}^2)]} \le f_u/(\beta_w*\gamma_{M2})$	37.80 < 429.71		verified	(0.09)

Connection conforms to the code Ratio 0.13

Išvada: laikomoji galia pakankama

Mazgas Nr. 6

Robot Structural Analysis Professional 2023

Design of truss node connection

EN 1993-1-8:2005/AC:2009

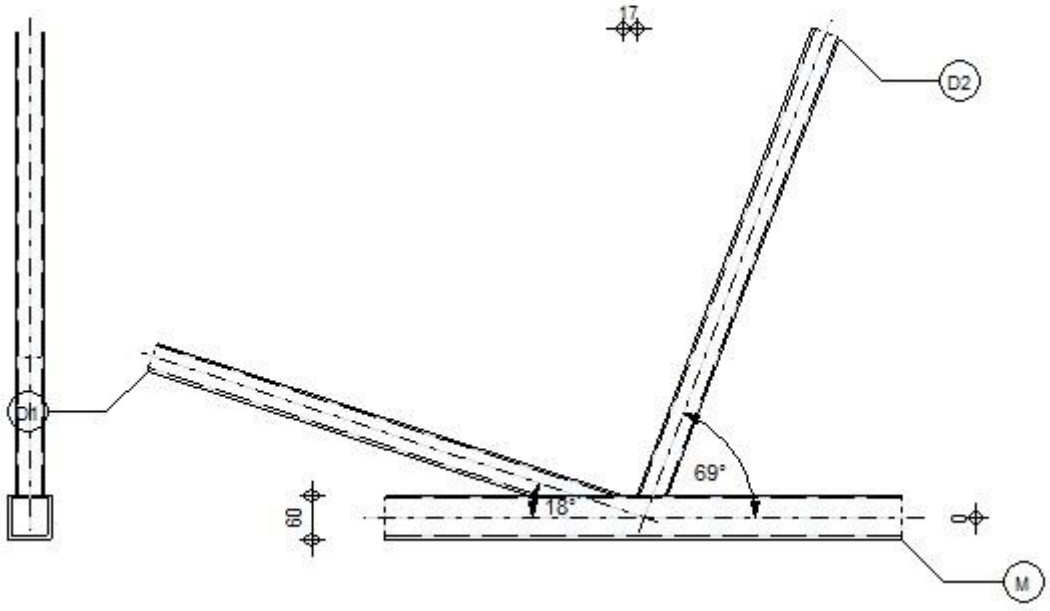
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Ratio **0.23**

D1 - SHS 40x4

D2 - SHS 40x4

M - RK 60x60x5



GENERAL

Connection no.: 6
Connection name: Tube
Structure node: 6282
Structure members: 3450, 3457, 3458

GEOMETRY

MEMBERS

		Chord	Diagonal 1	Diagonal 2	Post	
Member no.:		3450	3458	3457		
Section:		RK 60x60x5	SHS 40x4	SHS 40x4		
	h	60	40	40		mm
	b_f	60	40	40		mm
	t_w	5	4	4		mm
	t_f	5	4	4		mm
	r	5	0	0		mm
Material:		S 355	S 355	S 355		
	f_y	355.00	355.00	355.00		MPa
	f_u	470.00	470.00	470.00		MPa
Angle	θ	0.0	18.1	69.4		Deg
Length	l	5044	841	523		mm

OFFSET

e_0 = -0 [mm] Offset

SPACINGS

g_2 = 17 [mm] Spacing of 2nd diagonal

WELDS

a_d = 3 [mm] Thickness of welds of diagonals and posts

LOADS

Case: 89: ULS/81=1*1.35 + 2*0.91 + 7*1.30 1*1.35+2*0.91+7*1.30

CHORD

$N_{01,Ed}$ = 30.55 [kN] Axial force
$M_{01,Ed}$ = 0.14 [kN*m] Bending moment
$N_{02,Ed}$ = 76.13 [kN] Axial force
$M_{02,Ed}$ = 0.11 [kN*m] Bending moment

DIAGONAL 1

N_1 = -42.14 [kN] Axial force
M_1 = -0.25 [kN*m] Bending moment

DIAGONAL 2

N_2 = 13.47 [kN] Axial force
M_2 = -0.29 [kN*m] Bending moment
Shear forces were not included in the connection verification. The connection was designed as a truss node.

RESULTS

CONSIDER NON-AXIAL CONNECTION OF MEMBERS IN THE NODE

M_0 = 0.00 [kN*m] Additional moment from eccentric connection of members $M_0 = (N_{02}-N_{01}) * e_0$
$\Sigma E_iJ_i/L_i$ = 167557.75 [kN*m] Overall connection stiffness
ΔM_{01} = 0.00 [kN*m] Additional moment in the chord
ΔM_{02} = 0.00 [kN*m] Additional moment in the chord
ΔM_2 = 0.00 [kN*m] Additional moment in the diagonal
ΔM_1 = 0.00 [kN*m] Additional moment in the diagonal

CAPACITY VERIFICATION EUROCODE 3: EN 1993-1-8:2005

γ_{M5} = 1.00 Partial safety factor [Table 2.1]

FAILURE MODES FOR JOINTS (RHS CHORD MEMBERS) [Table 7.10] for $N_{i,Rd}$ and [Table 7.14] for $M_{i,Rd}$

GEOMETRICAL PARAMETERS

β = 0.67 Coefficient taking account of geometry of connection members $\beta = (b_2+b_1)/(2*b_0)$ [1.5 (6)]
γ = 6.00 Coefficient taking account of geometry of the chord $\gamma = b_0/(2*t_0)$ [1.5 (6)]
k_n = 1.00 Coefficient taking account of stresses in the chord $k_n = 1.0$

TUBE CHORD FACE FAILURE

DIAGONAL 2

$N_{2,Rd}$ = 137.79 [kN] Tension capacity $N_{2,Rd} = 8.9*k_n*f_{y0}*t_0^2*\sqrt{\gamma}/\sin(\theta_2) * \beta$

$\lvert N_2\rvert \le N_{2,Rd}$	|13.47| < 137.79	verified	(0.10)
$M_{2,Rd}$ = 2.21 [kN*m] Bending resistance	$M_{2,Rd} = k_n*f_{y0}*t_0^2*h_2*[1/(2*\eta) + 2/\sqrt{[1-\beta]} + \eta/(1-\beta)] / \gamma_{M5}$		
$\lvert M_2+\Delta M_2\rvert \le M_{2,Rd}$	|-0.28| < 2.21	verified	(0.13)
$N_2/N_{2,Rd} + (M_2+\Delta M_2)/M_{2,Rd} \le 1$	0.23 < 1.00	verified	(0.23)

DIAGONAL 1

$N_{1,Rd}$ = 415.29 [kN] Compression capacity $N_{1,Rd} = 8.9*k_n*f_{y0}*t_0^2*\sqrt{\gamma}/\sin(\theta_1) * \beta$

$\lvert N_1\rvert \le N_{1,Rd}$	|-42.14| < 415.29	verified	(0.10)
$M_{1,Rd}$ = 2.21 [kN*m] Bending resistance	$M_{1,Rd} = k_n*f_{y0}*t_0^2*h_1*[1/(2*\eta) + 2/\sqrt{[1-\beta]} + \eta/(1-\beta)] / \gamma_{M5}$		
$\lvert M_1+\Delta M_1\rvert \le M_{1,Rd}$	|-0.25| < 2.21	verified	(0.11)
$N_1/N_{1,Rd} + (M_1+\Delta M_1)/M_{1,Rd} \le 1$	0.22 < 1.00	verified	(0.22)

CHORD PUNCHING

DIAGONAL 2

$b_{e,p}$ = 33 [mm] Effective width for punching shear $b_{e,p} = (10*b_2)/(b_0/t_0)$
$N_{2,Rd}$ = 173.83 [kN] Tension capacity $N_{2,Rd} = f_{y0}*t_0/(\sqrt{3}*\sin(\theta_2))*[2*h_2/\sin(\theta_2)+b_2+b_{e,p}]/\gamma_{M5}$

$\lvert N_2\rvert \le N_{2,Rd}$	|13.47| < 173.83	verified	(0.08)

DIAGONAL 1

$b_{e,p}$ = 33	[mm]	Effective width for punching shear		$b_{e,p} = (10*b_1)/(b_0/t_0)$
$N_{1,Rd}$ = 1091.82	[kN]	Compression capacity		$N_{1,Rd} = f_{y0}*t_0/(\sqrt{3}*\sin(\theta_1))*[2*h_1/\sin(\theta_1)+b_1+b_{e,p}]/\gamma_{M5}$
$\lvert N_1\rvert \le N_{1,Rd}$		$\lvert -42.14\rvert < 1091.82$	verified	(0.04)

CHORD SHEAR

DIAGONAL 2

A_v = 6.74	[cm^2]	Shear area of the chord		$A_v = (2*h_0 + \alpha*b_0)*t_0$
$N_{2,Rd}$ = 147.58	[kN]	Tension capacity		$N_{2,Rd} = f_{y0}*A_v/[\sqrt{3}*\sin(\theta_2)] / \gamma_{M5}$
$\lvert N_2\rvert \le N_{2,Rd}$		$\lvert 13.47\rvert < 147.58$	verified	(0.09)

DIAGONAL 1

A_v = 6.74	[cm^2]	Shear area of the chord		$A_v = (2*h_0 + \alpha*b_0)*t_0$
$N_{1,Rd}$ = 444.80	[kN]	Compression capacity		$N_{1,Rd} = f_{y0}*A_v/[\sqrt{3}*\sin(\theta_1)] / \gamma_{M5}$
$\lvert N_1\rvert \le N_{1,Rd}$		$\lvert -42.14\rvert < 444.80$	verified	(0.09)

CHORD RESISTANCE

$V_{pl,Rd}$ = 125.59	[kN]	Plastic resistance for shear		$V_{pl,Rd} = (A_v*f_{y0})/(\sqrt{3}*\gamma_{M0})$
$\lvert V_{Ed}\rvert \le V_{pl,Rd}$		$\lvert 13.09\rvert < 125.59$	verified	(0.10)
$N_{0,Rd}$ = 378.55	[kN]	Tension capacity		$N_{0,Rd} = [\ (A_0-A_v)*f_{y0} + A_v*f_{y0}*\sqrt{[1-(V_{Ed}/V_{pl,Rd})^2]}\ ]/\gamma_{M5}$
$\lvert N_{02}\rvert \le N_{0,Rd}$		$\lvert 76.13\rvert < 378.55$	verified	(0.20)

VERIFICATION OF WELDS

DIAGONAL 2

β_w = 0.88		Correlation coefficient		[Table 4.1]
γ_{M2} = 1.25		Partial safety factor		[Table 2.1]
Longitudinal weld				
$\sigma_\perp$ = 22.92	[MPa]	Normal stress in a weld		
$\tau_\perp$ = 22.92	[MPa]	Perpendicular tangent stress		
τ_{II} = 12.59	[MPa]	Tangent stress		
$\lvert\sigma_\perp\rvert \le 0.9*f_u/\gamma_{M2}$		$\lvert 22.92\rvert < 338.40$	verified	(0.07)
$\sqrt{[\sigma_\perp^2 + 3*(\tau_\perp^2+\tau_{II}^2)]} \le f_u/(\beta_w*\gamma_{M2})$		$50.75 < 429.71$	verified	(0.12)
Transverse inner weld				
$\sigma_\perp$ = 9.76	[MPa]	Normal stress in a weld		
$\tau_\perp$ = -8.02	[MPa]	Perpendicular tangent stress		
τ_{II} = 0.00	[MPa]	Tangent stress		
$\lvert\sigma_\perp\rvert \le 0.9*f_u/\gamma_{M2}$		$\lvert 9.76\rvert < 338.40$	verified	(0.03)
$\sqrt{[\sigma_\perp^2 + 3*(\tau_\perp^2+\tau_{II}^2)]} \le f_u/(\beta_w*\gamma_{M2})$		$16.98 < 429.71$	verified	(0.04)

DIAGONAL 1

β_w = 0.88		Correlation coefficient		[Table 4.1]
γ_{M2} = 1.25		Partial safety factor		[Table 2.1]
Longitudinal weld				
$\sigma_\perp$ = -9.14	[MPa]	Normal stress in a weld		
$\tau_\perp$ = -9.14	[MPa]	Perpendicular tangent stress		
τ_{II} = -39.56	[MPa]	Tangent stress		
$\lvert\sigma_\perp\rvert \le 0.9*f_u/\gamma_{M2}$		$\lvert -9.14\rvert < 338.40$	verified	(0.03)
$\sqrt{[\sigma_\perp^2 + 3*(\tau_\perp^2+\tau_{II}^2)]} \le f_u/(\beta_w*\gamma_{M2})$		$70.91 < 429.71$	verified	(0.17)
Transverse inner weld				

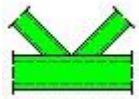
$\sigma_\perp$ =	-42.35	[MPa]	Normal stress in a weld		
$\tau_\perp$ =	-14.38	[MPa]	Perpendicular tangent stress		
τ_{II} =	0.00	[MPa]	Tangent stress		
$\lvert\sigma_\perp\rvert \le 0.9 f_u/\gamma_{M2}$			|-42.35| < 338.40	verified	(0.13)
$\sqrt{[\sigma_\perp^2 + 3(\tau_\perp^2+\tau_{II}^2)]} \le f_u/(\beta_w \gamma_{M2})$			49.13 < 429.71	verified	(0.11)
Transverse outer weld					
$\sigma_\perp$ =	1.30	[MPa]	Normal stress in a weld		
$\tau_\perp$ =	-39.85	[MPa]	Perpendicular tangent stress		
τ_{II} =	0.00	[MPa]	Tangent stress		
$\lvert\sigma_\perp\rvert \le 0.9 f_u/\gamma_{M2}$			|1.30| < 338.40	verified	(0.00)
$\sqrt{[\sigma_\perp^2 + 3(\tau_\perp^2+\tau_{II}^2)]} \le f_u/(\beta_w \gamma_{M2})$			69.03 < 429.71	verified	(0.16)

REMARKS

Diagonal angle is too small. 18.1 [Deg] < 30.0 [Deg]

Connection conforms to the code Ratio 0.23

Išvada: laikomoji galia pakankama
Mazgas Nr. 7



Robot Structural Analysis Professional 2023

Design of truss node connection

EN 1993-1-8:2005/AC:2009

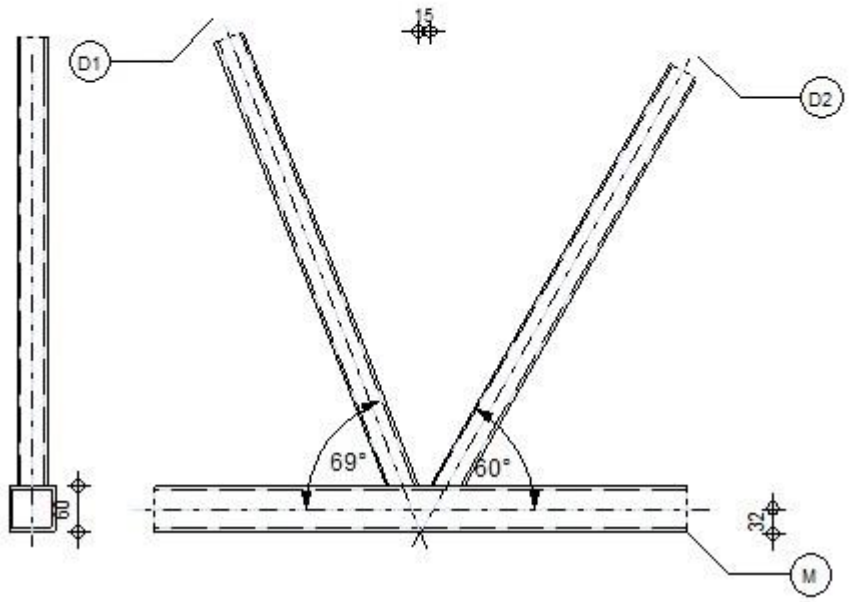
OK

Ratio **0.20**

D1 - SHS 40x4

D2 - SHS 40x4

M - SQUA 60x60x4



GENERAL

Connection no.: 7
Connection name: Tube
Structure node: 6100
Structure members: 3449, 3452, 3453

GEOMETRY

MEMBERS

		Chord	Diagonal 1	Diagonal 2	Post	
Member no.:		3449	3453	3452		
Section:		SQUA 60x60x4	SHS 40x4	SHS 40x4		
	h	60	40	40		mm
	b_f	60	40	40		mm
	t_w	4	4	4		mm
	t_f	4	4	4		mm
	r	4	0	0		mm
Material:		S 355	S 355	S 355		
	f_y	355.00	355.00	355.00		MPa
	f_u	470.00	470.00	470.00		MPa
Angle	θ	0.0	68.9	60.3		Deg
Length	l	4039	955	1289		mm

OFFSET

e_0 = 32 [mm] Offset

SPACINGS

g_2 = 15 [mm] Spacing of 2nd diagonal

WELDS

a_d = 3 [mm] Thickness of welds of diagonals and posts

LOADS

Case: 90: ULS/82=1*1.35 + 2*0.91 + 8*1.30 1*1.35+2*0.91+8*1.30

CHORD

$N_{01,Ed}$ = -28.19 [kN] Axial force
$M_{01,Ed}$ = 0.54 [kN*m] Bending moment
$N_{02,Ed}$ = -17.91 [kN] Axial force
$M_{02,Ed}$ = 0.42 [kN*m] Bending moment

DIAGONAL 1

N_1 = -9.67 [kN] Axial force
M_1 = 0.08 [kN*m] Bending moment

DIAGONAL 2

N_2 = 13.96 [kN] Axial force
M_2 = -0.04 [kN*m] Bending moment

Shear forces were not included in the connection verification. The connection was designed as a truss node.

RESULTS

CONSIDER NON-AXIAL CONNECTION OF MEMBERS IN THE NODE

M_0 = -0.33 [kN*m] Additional moment from eccentric connection of members $M_0 = (N_{02}-N_{01}) * e_0$
$\Sigma E_i J_i/L_i$ = 136890.85 [kN*m] Overall connection stiffness
ΔM_{01} = -0.11 [kN*m] Additional moment in the chord
ΔM_{02} = -0.11 [kN*m] Additional moment in the chord
ΔM_2 = -0.05 [kN*m] Additional moment in the diagonal
ΔM_1 = -0.06 [kN*m] Additional moment in the diagonal

CAPACITY VERIFICATION EUROCODE 3: EN 1993-1-8:2005

γ_{M5} = 1.00 Partial safety factor [Table 2.1]

FAILURE MODES FOR JOINTS (RHS CHORD MEMBERS) [Table 7.10] for $N_{i,Rd}$ and [Table 7.14] for $M_{i,Rd}$

GEOMETRICAL PARAMETERS

β = 0.67 Coefficient taking account of geometry of connection members $\beta = (b_2+b_1)/(2*b_0)$ [1.5 (6)]
γ = 7.50 Coefficient taking account of geometry of the chord $\gamma = b_0/(2*t_0)$ [1.5 (6)]
n = 0.22 Coefficient taking account of stresses in the chord $n_0 = \sigma_{0,Ed}/f_{y0}$
k_n = 1.00 Coefficient taking account of stresses in the chord $k_n = 1.0$

β = 0.67 Coefficient taking account of geometry of connection members $\beta = (b_2+b_1)/(2*b_0)$ [1.5 (6)]

TUBE CHORD FACE FAILURE

DIAGONAL 2

$N_{2,Rd}$ = 106.27 [kN] Tension capacity			$N_{2,Rd} = 8.9*k_n*f_{y0}*t_0^2*\sqrt{\gamma}/\sin(\theta_2) * \beta$
$\lvert N_2 \rvert \le N_{2,Rd}$	$\lvert 13.96 \rvert < 106.27$	verified	(0.13)
$M_{2,Rd}$ = 1.41 [kN*m] Bending resistance			$M_{2,Rd} = k_n*f_{y0}*t_0^2*h_2*[1/(2*\eta) + 2/\sqrt{[1-\beta]} + \eta/(1-\beta)] / \gamma_{M5}$
$\lvert M_2+\Delta M_2 \rvert \le M_{2,Rd}$	$\lvert -0.09 \rvert < 1.41$	verified	(0.07)
$N_2/N_{2,Rd} + (M_2+\Delta M_2)/M_{2,Rd} \le 1$	$0.20 < 1.00$	verified	(0.20)

DIAGONAL 1

$N_{1,Rd}$ = 98.92 [kN] Compression capacity			$N_{1,Rd} = 8.9*k_n*f_{y0}*t_0^2*\sqrt{\gamma}/\sin(\theta_1) * \beta$
$\lvert N_1 \rvert \le N_{1,Rd}$	$\lvert -9.67 \rvert < 98.92$	verified	(0.10)
$M_{1,Rd}$ = 1.41 [kN*m] Bending resistance			$M_{1,Rd} = k_n*f_{y0}*t_0^2*h_1*[1/(2*\eta) + 2/\sqrt{[1-\beta]} + \eta/(1-\beta)] / \gamma_{M5}$
$\lvert M_1+\Delta M_1 \rvert \le M_{1,Rd}$	$\lvert 0.02 \rvert < 1.41$	verified	(0.01)
$N_1/N_{1,Rd} + (M_1+\Delta M_1)/M_{1,Rd} \le 1$	$0.11 < 1.00$	verified	(0.11)

CHORD PUNCHING

DIAGONAL 2

$b_{e,p}$ = 27 [mm] Effective width for punching shear			$b_{e,p} = (10*b_2)/(b_0/t_0)$
$N_{2,Rd}$ = 149.88 [kN] Tension capacity			$N_{2,Rd} = f_{y0}*t_0/(\sqrt{3}*\sin(\theta_2))*[2*h_2/\sin(\theta_2)+b_2+b_{e,p}]/\gamma_{M5}$
$\lvert N_2 \rvert \le N_{2,Rd}$	$\lvert 13.96 \rvert < 149.88$	verified	(0.09)

DIAGONAL 1

$b_{e,p}$ = 27 [mm] Effective width for punching shear			$b_{e,p} = (10*b_1)/(b_0/t_0)$
$N_{1,Rd}$ = 133.92 [kN] Compression capacity			$N_{1,Rd} = f_{y0}*t_0/(\sqrt{3}*\sin(\theta_1))*[2*h_1/\sin(\theta_1)+b_1+b_{e,p}]/\gamma_{M5}$
$\lvert N_1 \rvert \le N_{1,Rd}$	$\lvert -9.67 \rvert < 133.92$	verified	(0.07)

CHORD SHEAR

DIAGONAL 2

A_v = 5.34 [cm^2] Shear area of the chord			$A_v = (2*h_0 + \alpha*b_0)*t_0$
$N_{2,Rd}$ = 126.02 [kN] Tension capacity			$N_{2,Rd} = f_{y0}*A_v/[\sqrt{3}*\sin(\theta_2)] / \gamma_{M5}$
$\lvert N_2 \rvert \le N_{2,Rd}$	$\lvert 13.96 \rvert < 126.02$	verified	(0.11)

DIAGONAL 1

A_v = 5.34 [cm^2] Shear area of the chord			$A_v = (2*h_0 + \alpha*b_0)*t_0$
$N_{1,Rd}$ = 117.30 [kN] Compression capacity			$N_{1,Rd} = f_{y0}*A_v/[\sqrt{3}*\sin(\theta_1)] / \gamma_{M5}$
$\lvert N_1 \rvert \le N_{1,Rd}$	$\lvert -9.67 \rvert < 117.30$	verified	(0.08)

CHORD RESISTANCE

$V_{pl,Rd}$ = 99.50 [kN] Plastic resistance for shear			$V_{pl,Rd} = (A_v*f_{y0})/(\sqrt{3}*\gamma_{M0})$
$\lvert V_{Ed} \rvert \le V_{pl,Rd}$	$\lvert 12.13 \rvert < 99.50$	verified	(0.12)
$N_{0,Rd}$ = 302.04 [kN] Compression capacity			$N_{0,Rd} = [\,(A_0-A_v)*f_{y0} + A_v*f_{y0}*\sqrt{[1-(V_{Ed}/V_{pl,Rd})^2]}\,]/\gamma_{M5}$
$\lvert N_{01} \rvert \le N_{0,Rd}$	$\lvert -28.19 \rvert < 302.04$	verified	(0.09)

VERIFICATION OF WELDS

DIAGONAL 2

β_w =	0.88		Correlation coefficient		[Table 4.1]
γ_{M2} =	1.25		Partial safety factor		[Table 2.1]
Longitudinal weld					
$\sigma_\perp$ =	21.02	[MPa]	Normal stress in a weld		
$\tau_\perp$ =	21.02	[MPa]	Perpendicular tangent stress		
τ_{II} =	17.46	[MPa]	Tangent stress		
$\lvert\sigma_\perp\rvert \le 0.9*f_u/\gamma_{M2}$			$\lvert 21.02\rvert < 338.40$	verified	(0.06)
$\sqrt{[\sigma_\perp^2 + 3*(\tau_\perp^2+\tau_{II}^2)]} \le f_u/(\beta_w*\gamma_{M2})$			$51.80 < 429.71$	verified	(0.12)
Transverse inner weld					
$\sigma_\perp$ =	35.43	[MPa]	Normal stress in a weld		
$\tau_\perp$ =	26.23	[MPa]	Perpendicular tangent stress		
τ_{II} =	0.00	[MPa]	Tangent stress		
$\lvert\sigma_\perp\rvert \le 0.9*f_u/\gamma_{M2}$			$\lvert 35.43\rvert < 338.40$	verified	(0.10)
$\sqrt{[\sigma_\perp^2 + 3*(\tau_\perp^2+\tau_{II}^2)]} \le f_u/(\beta_w*\gamma_{M2})$			$57.61 < 429.71$	verified	(0.13)

DIAGONAL 1

β_w =	0.88		Correlation coefficient		[Table 4.1]
γ_{M2} =	1.25		Partial safety factor		[Table 2.1]
Longitudinal weld					
$\sigma_\perp$ =	-16.35	[MPa]	Normal stress in a weld		
$\tau_\perp$ =	-16.35	[MPa]	Perpendicular tangent stress		
τ_{II} =	-9.22	[MPa]	Tangent stress		
$\lvert\sigma_\perp\rvert \le 0.9*f_u/\gamma_{M2}$			$\lvert -16.35\rvert < 338.40$	verified	(0.05)
$\sqrt{[\sigma_\perp^2 + 3*(\tau_\perp^2+\tau_{II}^2)]} \le f_u/(\beta_w*\gamma_{M2})$			$36.39 < 429.71$	verified	(0.08)
Transverse inner weld					
$\sigma_\perp$ =	-20.43	[MPa]	Normal stress in a weld		
$\tau_\perp$ =	-13.48	[MPa]	Perpendicular tangent stress		
τ_{II} =	0.00	[MPa]	Tangent stress		
$\lvert\sigma_\perp\rvert \le 0.9*f_u/\gamma_{M2}$			$\lvert -20.43\rvert < 338.40$	verified	(0.06)
$\sqrt{[\sigma_\perp^2 + 3*(\tau_\perp^2+\tau_{II}^2)]} \le f_u/(\beta_w*\gamma_{M2})$			$31.02 < 429.71$	verified	(0.07)

REMARKS

Eccentricity is too large. 32 [mm] > 15 [mm]

Connection conforms to the code Ratio 0.20

Išvada: laikomoji galia pakankama

Mazgas Nr. 8

Robot Structural Analysis Professional 2023

Design of truss node connection

EN 1993-1-8:2005/AC:2009

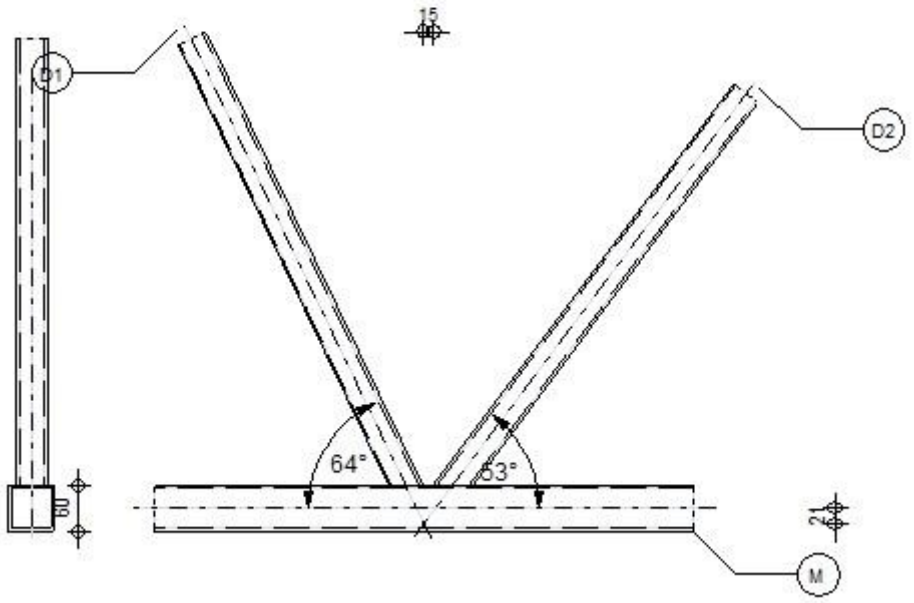
OK

Ratio
0.20

D1 - SHS 40x4

D2 - SHS 40x4

M - SQUA 60x60x4



GENERAL

Connection no.: 8
Connection name: Tube
Structure node: 6099
Structure members: 3449, 3454, 3455

GEOMETRY

MEMBERS

		Chord	Diagonal 1	Diagonal 2	Post	
Member no.:		3449	3455	3454		
Section:		SQUA 60x60x4	SHS 40x4	SHS 40x4		
	h	60	40	40		mm
	b_f	60	40	40		mm
	t_w	4	4	4		mm
	t_f	4	4	4		mm
	r	4	0	0		mm

		Chord	Diagonal 1	Diagonal 2	Post	
Material:		S 355	S 355	S 355		
	f_y	355.00	355.00	355.00		MPa
	f_u	470.00	470.00	470.00		MPa
Angle	θ	0.0	64.5	53.2		Deg
Length	l	4039	735	1113		mm

OFFSET

e_0 = 21 [mm] Offset

SPACINGS

g_2 = 15 [mm] Spacing of 2nd diagonal

WELDS

a_d = 3 [mm] Thickness of welds of diagonals and posts

LOADS

Case: 90: ULS/82=1*1.35 + 2*0.91 + 8*1.30 1*1.35+2*0.91+8*1.30

CHORD

$N_{01,Ed}$ = -18.09 [kN] Axial force
$M_{01,Ed}$ = -0.15 [kN*m] Bending moment
$N_{02,Ed}$ = -6.63 [kN] Axial force
$M_{02,Ed}$ = -0.05 [kN*m] Bending moment

DIAGONAL 1

N_1 = -10.43 [kN] Axial force
M_1 = -0.08 [kN*m] Bending moment

DIAGONAL 2

N_2 = 11.34 [kN] Axial force
M_2 = 0.02 [kN*m] Bending moment

Shear forces were not included in the connection verification. The connection was designed as a truss node.

RESULTS

CONSIDER NON-AXIAL CONNECTION OF MEMBERS IN THE NODE

M_0 = -0.24 [kN*m] Additional moment from eccentric connection of members $M_0 = (N_{02}-N_{01}) * e_0$
$\Sigma E_i J_i/L_i$ = 147984.37 [kN*m] Overall connection stiffness
ΔM_{01} = -0.07 [kN*m] Additional moment in the chord
ΔM_{02} = -0.07 [kN*m] Additional moment in the chord
ΔM_2 = -0.04 [kN*m] Additional moment in the diagonal
ΔM_1 = -0.06 [kN*m] Additional moment in the diagonal

CAPACITY VERIFICATION EUROCODE 3: EN 1993-1-8:2005

γ_{M5} = 1.00 Partial safety factor [Table 2.1]

FAILURE MODES FOR JOINTS (RHS CHORD MEMBERS) [Table 7.10] for $N_{i,Rd}$ and [Table 7.14] for $M_{i,Rd}$

GEOMETRICAL PARAMETERS

β = 0.67	Coefficient taking account of geometry of connection members	$\beta = (b_2+b_1)/(2*b_0)$ [1.5 (6)]
γ = 7.50	Coefficient taking account of geometry of the chord	$\gamma = b_0/(2*t_0)$ [1.5 (6)]
n = 0.10	Coefficient taking account of stresses in the chord	$n_0 = \sigma_{0,Ed}/f_{y0}$
k_n = 1.00	Coefficient taking account of stresses in the chord	$k_n = 1.0$

TUBE CHORD FACE FAILURE

DIAGONAL 2

$N_{2,Rd}$ = 115.20 [kN]	Tension capacity			$N_{2,Rd} = 8.9*k_n*f_{y0}*t_0^2*\sqrt{\gamma}/\sin(\theta_2) * \beta$
$\lvert N_2 \rvert \le N_{2,Rd}$		$\lvert 11.34 \rvert < 115.20$	verified	(0.10)
$M_{2,Rd}$ = 1.41 [kN*m]	Bending resistance			$M_{2,Rd} = k_n*f_{y0}*t_0^2*h_2*[1/(2*\eta) + 2/\sqrt{[1-\beta]} + \eta/(1-\beta)] / \gamma_{M5}$
$\lvert M_2+\Delta M_2 \rvert \le M_{2,Rd}$		$\lvert -0.02 \rvert < 1.41$	verified	(0.01)
$N_2/N_{2,Rd} + (M_2+\Delta M_2)/M_{2,Rd} \le 1$		0.11 < 1.00	verified	(0.11)

DIAGONAL 1

$N_{1,Rd}$ = 102.28 [kN]	Compression capacity			$N_{1,Rd} = 8.9*k_n*f_{y0}*t_0^2*\sqrt{\gamma}/\sin(\theta_1) * \beta$
$\lvert N_1 \rvert \le N_{1,Rd}$		$\lvert -10.43 \rvert < 102.28$	verified	(0.10)
$M_{1,Rd}$ = 1.41 [kN*m]	Bending resistance			$M_{1,Rd} = k_n*f_{y0}*t_0^2*h_1*[1/(2*\eta) + 2/\sqrt{[1-\beta]} + \eta/(1-\beta)] / \gamma_{M5}$
$\lvert M_1+\Delta M_1 \rvert \le M_{1,Rd}$		$\lvert -0.13 \rvert < 1.41$	verified	(0.09)
$N_1/N_{1,Rd} + (M_1+\Delta M_1)/M_{1,Rd} \le 1$		0.20 < 1.00	verified	(0.20)

CHORD PUNCHING

DIAGONAL 2

$b_{e,p}$ = 27 [mm]	Effective width for punching shear			$b_{e,p} = (10*b_2)/(b_0/t_0)$
$N_{2,Rd}$ = 170.41 [kN]	Tension capacity			$N_{2,Rd} = f_{y0}*t_0/(\sqrt{3}*\sin(\theta_2))*[2*h_2/\sin(\theta_2)+b_2+b_{e,p}]/\gamma_{M5}$
$\lvert N_2 \rvert \le N_{2,Rd}$		$\lvert 11.34 \rvert < 170.41$	verified	(0.07)

DIAGONAL 1

$b_{e,p}$ = 27 [mm]	Effective width for punching shear			$b_{e,p} = (10*b_1)/(b_0/t_0)$
$N_{1,Rd}$ = 141.11 [kN]	Compression capacity			$N_{1,Rd} = f_{y0}*t_0/(\sqrt{3}*\sin(\theta_1))*[2*h_1/\sin(\theta_1)+b_1+b_{e,p}]/\gamma_{M5}$
$\lvert N_1 \rvert \le N_{1,Rd}$		$\lvert -10.43 \rvert < 141.11$	verified	(0.07)

CHORD SHEAR

DIAGONAL 2

A_v = 5.34 [cm^2]	Shear area of the chord			$A_v = (2*h_0 + \alpha*b_0)*t_0$
$N_{2,Rd}$ = 136.62 [kN]	Tension capacity			$N_{2,Rd} = f_{y0}*A_v/[\sqrt{3}*\sin(\theta_2)] / \gamma_{M5}$
$\lvert N_2 \rvert \le N_{2,Rd}$		$\lvert 11.34 \rvert < 136.62$	verified	(0.08)

DIAGONAL 1

A_v = 5.34 [cm^2]	Shear area of the chord			$A_v = (2*h_0 + \alpha*b_0)*t_0$
$N_{1,Rd}$ = 121.29 [kN]	Compression capacity			$N_{1,Rd} = f_{y0}*A_v/[\sqrt{3}*\sin(\theta_1)] / \gamma_{M5}$
$\lvert N_1 \rvert \le N_{1,Rd}$		$\lvert -10.43 \rvert < 121.29$	verified	(0.09)

CHORD RESISTANCE

$V_{pl,Rd}$ = 99.50 [kN]	Plastic resistance for shear		$V_{pl,Rd} = (A_v*f_{y0})/(\sqrt{3}*\gamma_{M0})$

$\|V_{Ed}\| \le V_{pl,Rd}$	$\|9.41\| < 99.50$	verified	(0.09)	
$N_{0,Rd}$ = 302.60 [kN]	Compression capacity	$N_{0,Rd} = [(A_0-A_v)*f_{y0} + A_v*f_{y0}*\sqrt{[1-(V_{Ed}/V_{pl,Rd})^2]}]/\gamma_{M5}$		
$\|N_{01}\| \le N_{0,Rd}$	$\|-18.09\| < 302.60$	verified	(0.06)	

VERIFICATION OF WELDS

DIAGONAL 2

β_w = 0.88	Correlation coefficient		[Table 4.1]
γ_{M2} = 1.25	Partial safety factor		[Table 2.1]
Longitudinal weld			
$\sigma_\perp$ = 12.31 [MPa]	Normal stress in a weld		
$\tau_\perp$ = 12.31 [MPa]	Perpendicular tangent stress		
τ_{II} = 13.55 [MPa]	Tangent stress		
$\|\sigma_\perp\| \le 0.9*f_u/\gamma_{M2}$	$\|12.31\| < 338.40$	verified	(0.04)
$\sqrt{[\sigma_\perp^2 + 3*(\tau_\perp^2+\tau_{II}^2)]} \le f_u/(\beta_w*\gamma_{M2})$	$34.02 < 429.71$	verified	(0.08)
Transverse inner weld			
$\sigma_\perp$ = 22.67 [MPa]	Normal stress in a weld		
$\tau_\perp$ = 14.98 [MPa]	Perpendicular tangent stress		
τ_{II} = 0.00 [MPa]	Tangent stress		
$\|\sigma_\perp\| \le 0.9*f_u/\gamma_{M2}$	$\|22.67\| < 338.40$	verified	(0.07)
$\sqrt{[\sigma_\perp^2 + 3*(\tau_\perp^2+\tau_{II}^2)]} \le f_u/(\beta_w*\gamma_{M2})$	$34.45 < 429.71$	verified	(0.08)
Transverse outer weld			
$\sigma_\perp$ = 6.61 [MPa]	Normal stress in a weld		
$\tau_\perp$ = 18.47 [MPa]	Perpendicular tangent stress		
τ_{II} = 0.00 [MPa]	Tangent stress		
$\|\sigma_\perp\| \le 0.9*f_u/\gamma_{M2}$	$\|6.61\| < 338.40$	verified	(0.02)
$\sqrt{[\sigma_\perp^2 + 3*(\tau_\perp^2+\tau_{II}^2)]} \le f_u/(\beta_w*\gamma_{M2})$	$32.67 < 429.71$	verified	(0.08)

DIAGONAL 1

β_w = 0.88	Correlation coefficient		[Table 4.1]
γ_{M2} = 1.25	Partial safety factor		[Table 2.1]
Longitudinal weld			
$\sigma_\perp$ = -16.71 [MPa]	Normal stress in a weld		
$\tau_\perp$ = -16.71 [MPa]	Perpendicular tangent stress		
τ_{II} = -11.64 [MPa]	Tangent stress		
$\|\sigma_\perp\| \le 0.9*f_u/\gamma_{M2}$	$\|-16.71\| < 338.40$	verified	(0.05)
$\sqrt{[\sigma_\perp^2 + 3*(\tau_\perp^2+\tau_{II}^2)]} \le f_u/(\beta_w*\gamma_{M2})$	$39.03 < 429.71$	verified	(0.09)
Transverse inner weld			
$\sigma_\perp$ = -37.86 [MPa]	Normal stress in a weld		
$\tau_\perp$ = -38.22 [MPa]	Perpendicular tangent stress		
τ_{II} = 0.00 [MPa]	Tangent stress		
$\|\sigma_\perp\| \le 0.9*f_u/\gamma_{M2}$	$\|-37.86\| < 338.40$	verified	(0.11)
$\sqrt{[\sigma_\perp^2 + 3*(\tau_\perp^2+\tau_{II}^2)]} \le f_u/(\beta_w*\gamma_{M2})$	$76.26 < 429.71$	verified	(0.18)

REMARKS

Eccentricity is too large. 21 [mm] > 15 [mm]

Connection conforms to the code Ratio 0.20

Išvada: laikomoji galia pakankama

Mazgas Nr. 9

Robot Structural Analysis Professional 2023

Design of truss node connection

EN 1993-1-8:2005/AC:2009

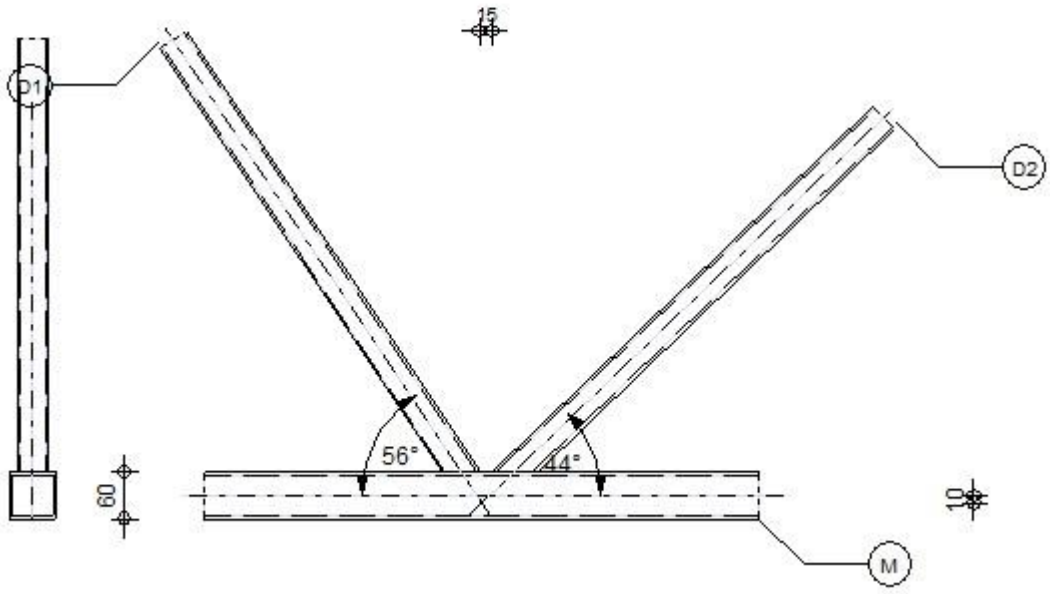
OK

Ratio **0.40**

D1 - SHS 40x4

D2 - SHS 40x4

M - SQUA 60x60x4



GENERAL

Connection no.: 9
Connection name: Tube
Structure node: 5709
Structure members: 3449, 3456, 3457

GEOMETRY

MEMBERS

		Chord	Diagonal 1	Diagonal 2	Post	
Member no.:		3449	3457	3456		

		Chord	Diagonal 1	Diagonal 2	Post	
Section:		SQUA 60x60x4	SHS 40x4	SHS 40x4		
	h	60	40	40		mm
	b_f	60	40	40		mm
	t_w	4	4	4		mm
	t_f	4	4	4		mm
	r	4	0	0		mm
Material:		S 355	S 355	S 355		
	f_y	355.00	355.00	355.00		MPa
	f_u	470.00	470.00	470.00		MPa
Angle	θ	0.0	56.3	43.8		Deg
Length	l	4039	523	959		mm

OFFSET

e_0 = 10 [mm] Offset

SPACINGS

g_2 = 15 [mm] Spacing of 2nd diagonal

WELDS

a_d = 3 [mm] Thickness of welds of diagonals and posts

LOADS

Case: 89: ULS/81=1*1.35 + 2*0.91 + 7*1.30 1*1.35+2*0.91+7*1.30

CHORD

$N_{01,Ed}$ = 25.27 [kN] Axial force
$M_{01,Ed}$ = -0.19 [kN*m] Bending moment
$N_{02,Ed}$ = 3.65 [kN] Axial force
$M_{02,Ed}$ = -0.59 [kN*m] Bending moment

DIAGONAL 1

N_1 = 13.46 [kN] Axial force
M_1 = 0.33 [kN*m] Bending moment

DIAGONAL 2

N_2 = -18.17 [kN] Axial force
M_2 = -0.07 [kN*m] Bending moment

Shear forces were not included in the connection verification. The connection was designed as a truss node.

RESULTS

CONSIDER NON-AXIAL CONNECTION OF MEMBERS IN THE NODE

M_0 = 0.21 [kN*m] Additional moment from eccentric connection of members $M_0 = (N_{02}-N_{01}) * e_0$
$\Sigma E_i J_i / L_i$ = 165662.02 [kN*m] Overall connection stiffness
ΔM_{01} = 0.06 [kN*m] Additional moment in the chord
ΔM_{02} = 0.06 [kN*m] Additional moment in the chord
ΔM_2 = 0.03 [kN*m] Additional moment in the diagonal
ΔM_1 = 0.06 [kN*m] Additional moment in the diagonal

CAPACITY VERIFICATION EUROCODE 3: EN 1993-1-8:2005

γ_{M5} = 1.00 Partial safety factor [Table 2.1]

FAILURE MODES FOR JOINTS (RHS CHORD MEMBERS) [Table 7.10] for $N_{i,Rd}$ and [Table 7.14] for $M_{i,Rd}$

GEOMETRICAL PARAMETERS

β = 0.67	Coefficient taking account of geometry of connection members	$\beta = (b_2+b_1)/(2*b_0)$	[1.5 (6)]
γ = 7.50	Coefficient taking account of geometry of the chord	$\gamma = b_0/(2*t_0)$	[1.5 (6)]
k_n = 1.00	Coefficient taking account of stresses in the chord	k_n = 1.0	

TUBE CHORD FACE FAILURE

DIAGONAL 2

$N_{2,Rd}$ = 133.46 [kN]	Compression capacity		$N_{2,Rd} = 8.9*k_n*f_{y0}*t_0^2*\sqrt{\gamma}/\sin(\theta_2) * \beta$	
$\lvert N_2\rvert \le N_{2,Rd}$	$\lvert -18.17\rvert < 133.46$	verified		(0.14)
$M_{2,Rd}$ = 1.41 [kN*m]	Bending resistance		$M_{2,Rd} = k_n*f_{y0}*t_0^2*h_2*[1/(2*\eta) + 2/\sqrt{[1-\beta]} + \eta/(1-\beta)] / \gamma_{M5}$	
$\lvert M_2+\Delta M_2\rvert \le M_{2,Rd}$	$\lvert -0.03\rvert < 1.41$	verified		(0.02)
$N_2/N_{2,Rd} + (M_2+\Delta M_2)/M_{2,Rd} \le 1$	$0.16 < 1.00$	verified		(0.16)

DIAGONAL 1

$N_{1,Rd}$ = 110.88 [kN]	Tension capacity		$N_{1,Rd} = 8.9*k_n*f_{y0}*t_0^2*\sqrt{\gamma}/\sin(\theta_1) * \beta$	
$\lvert N_1\rvert \le N_{1,Rd}$	$\lvert 13.46\rvert < 110.88$	verified		(0.12)
$M_{1,Rd}$ = 1.41 [kN*m]	Bending resistance		$M_{1,Rd} = k_n*f_{y0}*t_0^2*h_1*[1/(2*\eta) + 2/\sqrt{[1-\beta]} + \eta/(1-\beta)] / \gamma_{M5}$	
$\lvert M_1+\Delta M_1\rvert \le M_{1,Rd}$	$\lvert 0.39\rvert < 1.41$	verified		(0.27)
$N_1/N_{1,Rd} + (M_1+\Delta M_1)/M_{1,Rd} \le 1$	$0.40 < 1.00$	verified		(0.40)

CHORD PUNCHING

DIAGONAL 2

$b_{e,p}$ = 27 [mm]	Effective width for punching shear		$b_{e,p} = (10*b_2)/(b_0/t_0)$	
$N_{2,Rd}$ = 216.18 [kN]	Compression capacity		$N_{2,Rd} = f_{y0}*t_0/(\sqrt{3}*\sin(\theta_2))*[2*h_2/\sin(\theta_2)+b_2+b_{e,p}]/\gamma_{M5}$	
$\lvert N_2\rvert \le N_{2,Rd}$	$\lvert -18.17\rvert < 216.18$	verified		(0.08)

DIAGONAL 1

$b_{e,p}$ = 27 [mm]	Effective width for punching shear		$b_{e,p} = (10*b_1)/(b_0/t_0)$	
$N_{1,Rd}$ = 160.32 [kN]	Tension capacity		$N_{1,Rd} = f_{y0}*t_0/(\sqrt{3}*\sin(\theta_1))*[2*h_1/\sin(\theta_1)+b_1+b_{e,p}]/\gamma_{M5}$	
$\lvert N_1\rvert \le N_{1,Rd}$	$\lvert 13.46\rvert < 160.32$	verified		(0.08)

CHORD SHEAR

DIAGONAL 2

A_v = 5.34 [cm^2]	Shear area of the chord		$A_v = (2*h_0 + \alpha*b_0)*t_0$	
$N_{2,Rd}$ = 158.27 [kN]	Compression capacity		$N_{2,Rd} = f_{y0}*A_v/[\sqrt{3}*\sin(\theta_2)] / \gamma_{M5}$	
$\lvert N_2\rvert \le N_{2,Rd}$	$\lvert -18.17\rvert < 158.27$	verified		(0.11)

DIAGONAL 1

A_v = 5.34 [cm^2]	Shear area of the chord		$A_v = (2*h_0 + \alpha*b_0)*t_0$	

$N_{1,Rd}$ = 131.49	[kN]	Tension capacity		$N_{1,Rd} = f_{y0}*A_v/[\sqrt{3}*\sin(\theta_1)] / \gamma_{M5}$
$\|N_1\| \le N_{1,Rd}$		|13.46| < 131.49	verified	(0.10)

CHORD RESISTANCE

$V_{pl,Rd}$ = 99.50	[kN]	Plastic resistance for shear		$V_{pl,Rd} = (A_v*f_{y0})/(\sqrt{3}*\gamma_{M0})$
$\|V_{Ed}\| \le V_{pl,Rd}$		|12.56| < 99.50	verified	(0.13)
$N_{0,Rd}$ = 301.94	[kN]	Tension capacity		$N_{0,Rd} = [(A_0-A_v)*f_{y0} + A_v*f_{y0}*\sqrt{[1-(V_{Ed}/V_{pl,Rd})^2]}]/\gamma_{M5}$
$\|N_{01}\| \le N_{0,Rd}$		|25.27| < 301.94	verified	(0.08)

VERIFICATION OF WELDS

DIAGONAL 2

β_w = 0.88		Correlation coefficient		[Table 4.1]
γ_{M2} = 1.25		Partial safety factor		[Table 2.1]
Longitudinal weld				
$\sigma_\perp$ = -15.13	[MPa]	Normal stress in a weld		
$\tau_\perp$ = -15.13	[MPa]	Perpendicular tangent stress		
τ_{II} = -22.36	[MPa]	Tangent stress		
$\|\sigma_\perp\| \le 0.9*f_u/\gamma_{M2}$		|-15.13| < 338.40	verified	(0.04)
$\sqrt{[\sigma_\perp^2 + 3*(\tau_\perp^2+\tau_{II}^2)]} \le f_u/(\beta_w*\gamma_{M2})$		49.15 < 429.71	verified	(0.11)
Transverse inner weld				
$\sigma_\perp$ = -31.09	[MPa]	Normal stress in a weld		
$\tau_\perp$ = -17.43	[MPa]	Perpendicular tangent stress		
τ_{II} = 0.00	[MPa]	Tangent stress		
$\|\sigma_\perp\| \le 0.9*f_u/\gamma_{M2}$		|-31.09| < 338.40	verified	(0.09)
$\sqrt{[\sigma_\perp^2 + 3*(\tau_\perp^2+\tau_{II}^2)]} \le f_u/(\beta_w*\gamma_{M2})$		43.33 < 429.71	verified	(0.10)
Transverse outer weld				
$\sigma_\perp$ = -5.64	[MPa]	Normal stress in a weld		
$\tau_\perp$ = -26.35	[MPa]	Perpendicular tangent stress		
τ_{II} = 0.00	[MPa]	Tangent stress		
$\|\sigma_\perp\| \le 0.9*f_u/\gamma_{M2}$		|-5.64| < 338.40	verified	(0.02)
$\sqrt{[\sigma_\perp^2 + 3*(\tau_\perp^2+\tau_{II}^2)]} \le f_u/(\beta_w*\gamma_{M2})$		45.99 < 429.71	verified	(0.11)

DIAGONAL 1

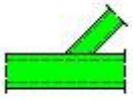
β_w = 0.88		Correlation coefficient		[Table 4.1]
γ_{M2} = 1.25		Partial safety factor		[Table 2.1]
Longitudinal weld				
$\sigma_\perp$ = 16.89	[MPa]	Normal stress in a weld		
$\tau_\perp$ = 16.89	[MPa]	Perpendicular tangent stress		
τ_{II} = 16.49	[MPa]	Tangent stress		
$\|\sigma_\perp\| \le 0.9*f_u/\gamma_{M2}$		|16.89| < 338.40	verified	(0.05)
$\sqrt{[\sigma_\perp^2 + 3*(\tau_\perp^2+\tau_{II}^2)]} \le f_u/(\beta_w*\gamma_{M2})$		44.24 < 429.71	verified	(0.10)
Transverse inner weld				
$\sigma_\perp$ = 51.33	[MPa]	Normal stress in a weld		
$\tau_\perp$ = 60.92	[MPa]	Perpendicular tangent stress		
τ_{II} = 0.00	[MPa]	Tangent stress		
$\|\sigma_\perp\| \le 0.9*f_u/\gamma_{M2}$		|51.33| < 338.40	verified	(0.15)
$\sqrt{[\sigma_\perp^2 + 3*(\tau_\perp^2+\tau_{II}^2)]} \le f_u/(\beta_w*\gamma_{M2})$		117.34 < 429.71	verified	(0.27)
Transverse outer weld				
$\sigma_\perp$ = -48.52	[MPa]	Normal stress in a weld		
$\tau_\perp$ = -7.28	[MPa]	Perpendicular tangent stress		
τ_{II} = 0.00	[MPa]	Tangent stress		

$\|\sigma_\perp\| \le 0.9*f_u/\gamma_{M2}$	|-48.52| < 338.40	verified	(0.14)
$\sqrt{[\sigma_\perp^2 + 3*(\tau_\perp^2+\tau_{II}^2)]} \le f_u/(\beta_w*\gamma_{M2})$	50.13 < 429.71	verified	(0.12)

Connection conforms to the code Ratio 0.40

Išvada: laikomoji galia pakankama

Mazgas Nr. 10



Robot Structural Analysis Professional 2023

Design of truss node connection

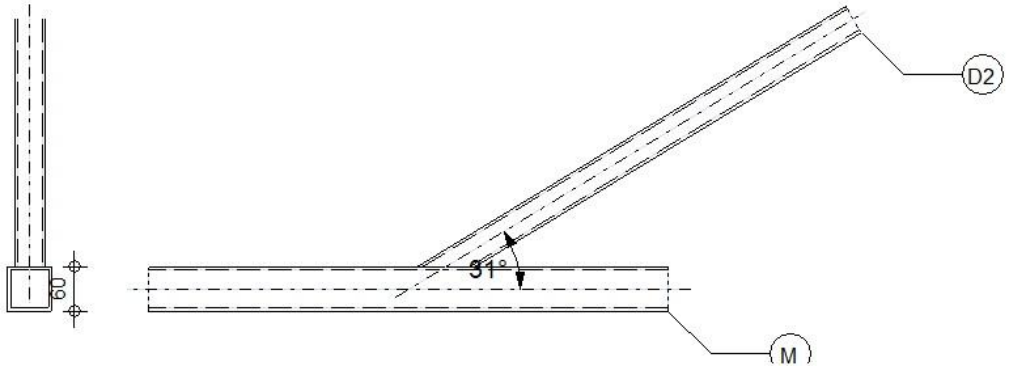
EN 1993-1-8:2005/AC:2009

OK

Ratio **0.66**

D2 - SHS 40x4

M - SQUA 60x60x4



GENERAL

Connection no.: 10
Connection name: Tube
Structure node: 6308
Structure members: 3449, 3458

GEOMETRY

MEMBERS

		Chord	Diagonal 1	Diagonal 2	Post	
Member no.:		3449		3458		
Section:		SQUA 60x60x4		SHS 40x4		
	h	60		40		mm

		Chord	Diagonal 1	Diagonal 2	Post	
	b_f	60		40		mm
	t_w	4		4		mm
	t_f	4		4		mm
	r	4		0		mm
Material:		S 355		S 355		
	f_y	355.00		355.00		MPa
	f_u	470.00		470.00		MPa
Angle	θ	0.0		31.2		Deg
Length	l	4039		841		mm

WELDS

a_d = 3 [mm] Thickness of welds of diagonals and posts

LOADS

Case: 89: ULS/81=1*1.35 + 2*0.91 + 7*1.30 1*1.35+2*0.91+7*1.30

CHORD

$N_{01,Ed}$ = 0.00 [kN] Axial force
$M_{01,Ed}$ = 0.00 [kN*m] Bending moment
$N_{02,Ed}$ = 3.31 [kN] Axial force
$M_{02,Ed}$ = 1.71 [kN*m] Bending moment

DIAGONAL 2

N_2 = -42.18 [kN] Axial force
M_2 = 0.57 [kN*m] Bending moment

Shear forces were not included in the connection verification. The connection was designed as a truss node.

RESULTS

CAPACITY VERIFICATION EUROCODE 3: EN 1993-1-8:2005

γ_{M5} = 1.00 Partial safety factor [Table 2.1]

FAILURE MODES FOR JOINTS (RHS CHORD MEMBERS) [Table 7.10] for $N_{i,Rd}$ and [Table 7.14] for $M_{i,Rd}$

GEOMETRICAL PARAMETERS

β =	0.67	Coefficient taking account of geometry of connection members	$\beta = b_2/b_0$ [1.5 (6)]
γ =	7.50	Coefficient taking account of geometry of the chord	$\gamma = b_0/(2*t_0)$ [1.5 (6)]
n =	0.35	Coefficient taking account of stresses in the chord	$n_0 = \sigma_{0,Ed}/f_{y0}$
k_n =	1.00	Coefficient taking account of stresses in the chord	$k_n = 1.0$

TUBE CHORD FACE FAILURE

DIAGONAL 2

$N_{2,Rd}$ = 160.91 [kN] Compression capacity $N_{2,Rd} = [(k_n*f_{y0}*t_0^2)/(1-\beta)*\sin(\theta_2)]*[2*\beta/\sin(\theta_2) + 4*\sqrt{(1-\beta)}] / \gamma_{M5}$

$\lvert N_2\rvert \le N_{2,Rd}$	|-42.18| < 160.91	verified	(0.26)
$M_{2,Rd}$ = 1.41 [kN*m] Bending resistance		$M_{2,Rd} = k_n*f_{y0}*t_0^2*h_2*[1/(2*\eta) + 2/\sqrt{[1-\beta]} + \eta/(1-\beta)] / \gamma_{M5}$	
$\lvert M_2\rvert \le M_{2,Rd}$	|0.57| < 1.41	verified	(0.40)
$N_2/N_{2,Rd} + M_2/M_{2,Rd} \le 1$	0.66 < 1.00	verified	(0.66)

CHORD SHEAR

DIAGONAL 2

A_v =	4.80	[cm^2]	Shear area of the chord		$A_v = 2*h_0*t_0$
$N_{2,Rd}$ =	190.13	[kN]	Compression capacity		$N_{2,Rd} = f_{y0}*A_v/[\sqrt{3}*\sin(\theta_2)] / \gamma_{M5}$
$\|N_2\| \le N_{2,Rd}$			$\|-42.18\| < 190.13$	verified	(0.22)

CHORD RESISTANCE

$N_{0,Rd}$ =	303.45	[kN]	Tension capacity		$N_{0,Rd} = (A_0*f_{y0})/\gamma_{M5}$
$\|N_{02}\| \le N_{0,Rd}$			$\|3.31\| < 303.45$	verified	(0.01)

VERIFICATION OF WELDS

DIAGONAL 2

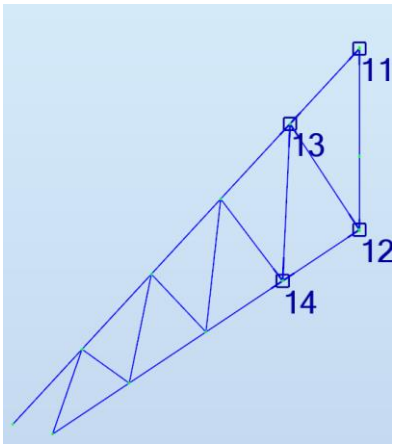
β_w =	0.88		Correlation coefficient		[Table 4.1]
γ_{M2} =	1.25		Partial safety factor		[Table 2.1]
Longitudinal weld					
$\sigma_\perp$ =	-100.55	[MPa]	Normal stress in a weld		
$\tau_\perp$ =	-100.55	[MPa]	Perpendicular tangent stress		
τ_{II} =	-77.83	[MPa]	Tangent stress		
$\|\sigma_\perp\| \le 0.9*f_u/\gamma_{M2}$			$\|-100.55\| < 338.40$	verified	(0.30)
$\sqrt{[\sigma_\perp^2 + 3*(\tau_\perp^2+\tau_{II}^2)]} \le f_u/(\beta_w*\gamma_{M2})$			$242.10 < 429.71$	verified	(0.56)

Connection conforms to the code Ratio 0.66

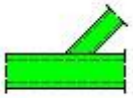
Išvada: laikomoji galia pakankama

2.7.3.3.Spragoto skerspjūvio rėmų kitų santvarų mazgų projektavimas

Mazgų numeriai:



Mazgas nr. 11



Robot Structural Analysis Professional 2023

Design of truss node connection

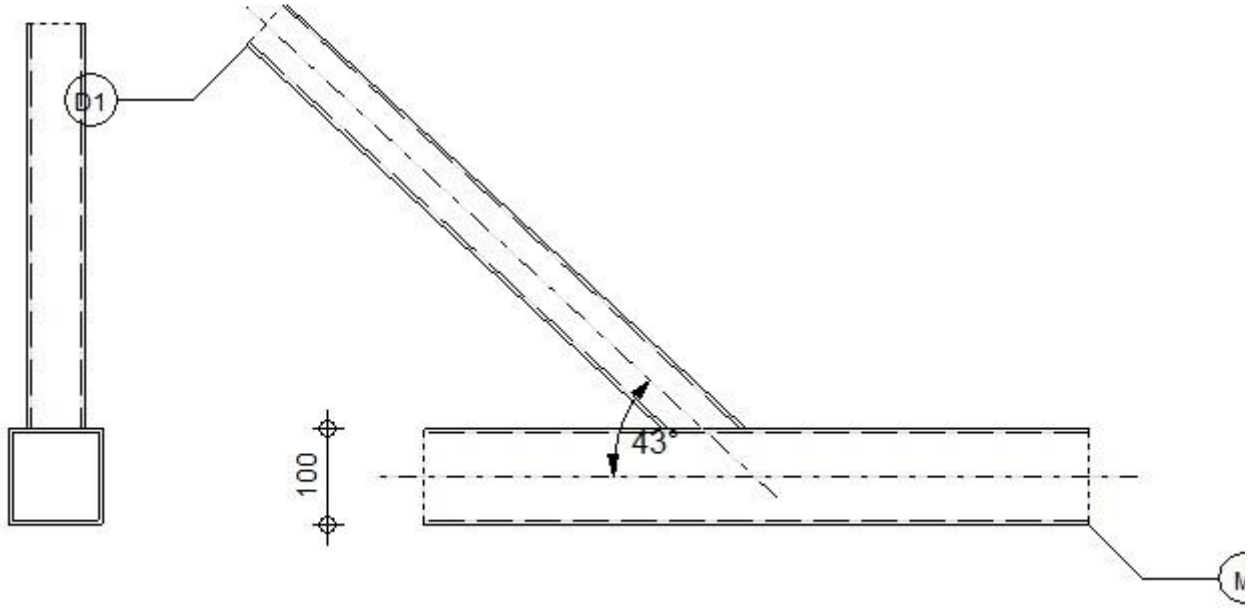
EN 1993-1-8:2005/AC:2009

OK

Ratio
0.28

D1 - SQUA 60x60x

M - SQUA 100x10



GENERAL

Connection no.: 11
Connection name: Tube
Structure node: 6457
Structure members: 3071, 3070

GEOMETRY

MEMBERS

		Chord	Diagonal 1	Diagonal 2	Post	
Member no.:		3071	3070			
Section:		SQUA 100x100x4	SQUA 60x60x4			
	h	100	60			mm
	b_f	100	60			mm
	t_w	4	4			mm
	t_f	4	4			mm
	r	4	4			mm

		Chord	Diagonal 1	Diagonal 2	Post	
Material:		S 355	S 355			
	f_y	355.00	355.00			MPa
	f_u	470.00	470.00			MPa
Angle	θ	0.0	42.7			Deg
Length	l	1500	4175			mm

WELDS

a_d = 3 [mm] Thickness of welds of diagonals and posts

LOADS

Case: 40: ULS/32=1*1.00 + 3*1.30 + 8*0.78 1*1.00+3*1.30+8*0.78

CHORD

$N_{01,Ed}$ = 2.23 [kN] Axial force
$M_{01,Ed}$ = -0.52 [kN*m] Bending moment
$N_{02,Ed}$ = -0.00 [kN] Axial force
$M_{02,Ed}$ = 0.00 [kN*m] Bending moment

DIAGONAL 1

N_1 = -0.65 [kN] Axial force
M_1 = -0.52 [kN*m] Bending moment

Shear forces were not included in the connection verification. The connection was designed as a truss node.

RESULTS

CAPACITY VERIFICATION EUROCODE 3: EN 1993-1-8:2005

γ_{M5} = 1.00 Partial safety factor [Table 2.1]

FAILURE MODES FOR JOINTS (RHS CHORD MEMBERS) [Table 7.10] for $N_{i,Rd}$ and [Table 7.14] for $M_{i,Rd}$

GEOMETRICAL PARAMETERS

β = 0.60	Coefficient taking account of geometry of connection members	$\beta = b_1/b_0$ [1.5 (6)]
γ = 12.50	Coefficient taking account of geometry of the chord	$\gamma = b_0/(2*t_0)$ [1.5 (6)]
k_n = 1.00	Coefficient taking account of stresses in the chord	$k_n = 1.0$

TUBE CHORD FACE FAILURE

DIAGONAL 1

$N_{1,Rd}$ = 90.09 [kN] Compression capacity			$N_{1,Rd} = [(k_n*f_{y0}*t_0^2)/(1-\beta)*\sin(\theta_1)]*[2*\beta/\sin(\theta_1) + 4*\sqrt{(1-\beta)}] / \gamma_{M5}$
$\lvert N_1\rvert \le N_{1,Rd}$	$\lvert -0.65\rvert < 90.09$	verified	(0.01)
$M_{1,Rd}$ = 1.87 [kN*m] Bending resistance			$M_{1,Rd} = k_n*f_{y0}*t_0^2*h_1*[1/(2*\eta) + 2/\sqrt{[1-\beta]} + \eta/(1-\beta)] / \gamma_{M5}$
$\lvert M_1\rvert \le M_{1,Rd}$	$\lvert -0.52\rvert < 1.87$	verified	(0.28)
$N_1/N_{1,Rd} + M_1/M_{1,Rd} \le 1$	$0.28 < 1.00$	verified	(0.28)

CHORD SHEAR

DIAGONAL 1

A_v =	8.00	[cm²]	Shear area of the chord		$A_v = 2*h_0*t_0$
$N_{1,Rd}$ =	241.92	[kN]	Compression capacity		$N_{1,Rd} = f_{y0}*A_v/[\sqrt{3}*\sin(\theta_1)] / \gamma_{M5}$
$\|N_1\| \le N_{1,Rd}$			|-0.65| < 241.92	verified	(0.00)

CHORD RESISTANCE

$N_{0,Rd}$ =	530.65	[kN]	Tension capacity		$N_{0,Rd} = (A_0*f_{y0})/\gamma_{M5}$
$\|N_{01}\| \le N_{0,Rd}$			|2.23| < 530.65	verified	(0.00)

VERIFICATION OF WELDS

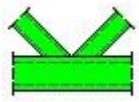
DIAGONAL 1

β_w =	0.88		Correlation coefficient		[Table 4.1]
γ_{M2} =	1.25		Partial safety factor		[Table 2.1]
Longitudinal weld					
$\sigma_\perp$ =	46.05	[MPa]	Normal stress in a weld		
$\tau_\perp$ =	46.05	[MPa]	Perpendicular tangent stress		
τ_{II} =	-0.90	[MPa]	Tangent stress		
$\|\sigma_\perp\| \le 0.9*f_u/\gamma_{M2}$			|46.05| < 338.40	verified	(0.14)
$\sqrt{[\sigma_\perp^2 + 3*(\tau_\perp^2+\tau_{II}^2)]} \le f_u/(\beta_w*\gamma_{M2})$			92.11 < 429.71	verified	(0.21)

Connection conforms to the code Ratio 0.28

Išvada: laikomoji galia pakankama

Mazgas nr. 12



Robot Structural Analysis Professional 2023

Design of truss node connection

EN 1993-1-8:2005/AC:2009

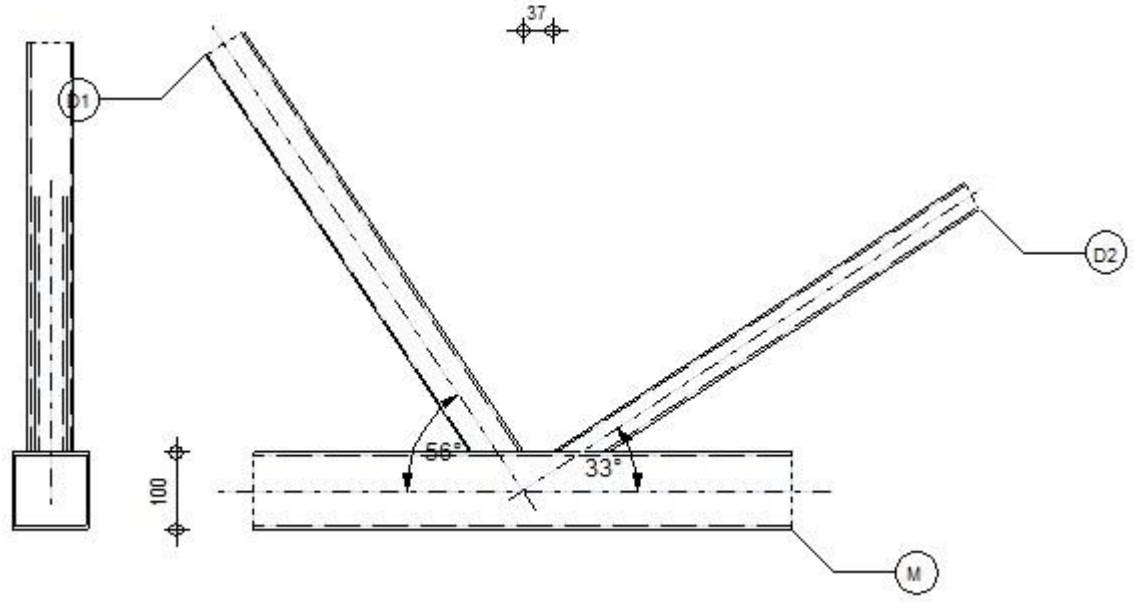
OK

Ratio **0.28**

D1 - SQUA 60x60x4

D2 - SHS 40x4

M - SQUA 100x100x4



GENERAL

Connection no.: 12
Connection name: Tube
Structure node: 6543
Structure members: 3071, 3072, 3069

GEOMETRY

MEMBERS

		Chord	Diagonal 1	Diagonal 2	Post	
Member no.:		3071	3069	3072		
Section:		SQUA 100x100x4	SQUA 60x60x4	SHS 40x4		
	h	100	60	40		mm
	b_f	100	60	40		mm
	t_w	4	4	4		mm
	t_f	4	4	4		mm
	r	4	4	0		mm
Material:		S 355	S 355	S 355		
	f_y	355.00	355.00	355.00		MPa
	f_u	470.00	470.00	470.00		MPa
Angle	θ	0.0	56.3	33.2		Deg
Length	l	1500	3011	1035		mm

OFFSET

e_0 = 0 [mm] Offset

SPACINGS

g_2 = 37 [mm] Spacing of 2nd diagonal

WELDS

a_d = 3 [mm] Thickness of welds of diagonals and posts

LOADS

Case: 98: ULS/90=1*1.35 + 4*0.78 + 2*0.91 + 8*1.30 1*1.35+4*0.78+2*0.91+8*1.30

CHORD

$N_{01,Ed}$ = 0.00 [kN] Axial force
$M_{01,Ed}$ = -0.00 [kN*m] Bending moment
$N_{02,Ed}$ = 15.03 [kN] Axial force
$M_{02,Ed}$ = -0.34 [kN*m] Bending moment

DIAGONAL 1

N_1 = 9.36 [kN] Axial force
M_1 = 0.31 [kN*m] Bending moment

DIAGONAL 2

N_2 = -10.57 [kN] Axial force
M_2 = 0.03 [kN*m] Bending moment

Shear forces were not included in the connection verification. The connection was designed as a truss node.

RESULTS

CAPACITY VERIFICATION EUROCODE 3: EN 1993-1-8:2005

γ_{M5} = 1.00 Partial safety factor [Table 2.1]

FAILURE MODES FOR JOINTS (RHS CHORD MEMBERS) [Table 7.10] for $N_{i,Rd}$ and [Table 7.14] for $M_{i,Rd}$

GEOMETRICAL PARAMETERS

β = 0.50	Coefficient taking account of geometry of connection members	$\beta = (b_2+b_1)/(2*b_0)$ [1.5 (6)]
γ = 12.50	Coefficient taking account of geometry of the chord	$\gamma = b_0/(2*t_0)$ [1.5 (6)]
k_n = 1.00	Coefficient taking account of stresses in the chord	$k_n = 1.0$

TUBE CHORD FACE FAILURE

DIAGONAL 2

$N_{2,Rd}$ = 163.34 [kN]	Compression capacity		$N_{2,Rd} = 8.9*k_n*f_{y0}*t_0^2*\sqrt{\gamma}/\sin(\theta_2) * \beta$
$\lvert N_2\rvert \le N_{2,Rd}$	$\lvert -10.57\rvert < 163.34$	verified	(0.06)
$M_{2,Rd}$ = 1.11 [kN*m]	Bending resistance		$M_{2,Rd} = k_n*f_{y0}*t_0^2*h_2*[1/(2*\eta) + 2/\sqrt{[1-\beta]} + \eta/(1-\beta)] / \gamma_{M5}$
$\lvert M_2\rvert \le M_{2,Rd}$	$\lvert 0.03\rvert < 1.11$	verified	(0.02)
$N_2/N_{2,Rd} + M_2/M_{2,Rd} \le 1$	$0.09 < 1.00$	verified	(0.09)

DIAGONAL 1

$N_{1,Rd}$ = 107.40	[kN]	Tension capacity		$N_{1,Rd} = 8.9*k_n*f_{y0}*t_0^2*\sqrt{\gamma}/\sin(\theta_1) * \beta$
$\|N_1\| \le N_{1,Rd}$		$\|9.36\| < 107.40$	verified	(0.09)
$M_{1,Rd}$ = 1.66	[kN*m]	Bending resistance		$M_{1,Rd} = k_n*f_{y0}*t_0^2*h_1*[1/(2*\eta) + 2/\sqrt{[1-\beta]} + \eta/(1-\beta)] / \gamma_{M5}$
$\|M_1\| \le M_{1,Rd}$		$\|0.31\| < 1.66$	verified	(0.19)
$N_1/N_{1,Rd} + M_1/M_{1,Rd} \le 1$		$0.28 < 1.00$	verified	(0.28)

CHORD PUNCHING

DIAGONAL 2

$b_{e,p}$ = 16	[mm]	Effective width for punching shear		$b_{e,p} = (10*b_2)/(b_0/t_0)$
$N_{2,Rd}$ = 303.04	[kN]	Compression capacity		$N_{2,Rd} = f_{y0}*t_0/(\sqrt{3}*\sin(\theta_2))*[2*h_2/\sin(\theta_2)+b_2+b_{e,p}]/\gamma_{M5}$
$\|N_2\| \le N_{2,Rd}$		$\|-10.57\| < 303.04$	verified	(0.03)

DIAGONAL 1

$b_{e,p}$ = 24	[mm]	Effective width for punching shear		$b_{e,p} = (10*b_1)/(b_0/t_0)$
$N_{1,Rd}$ = 224.87	[kN]	Tension capacity		$N_{1,Rd} = f_{y0}*t_0/(\sqrt{3}*\sin(\theta_1))*[2*h_1/\sin(\theta_1)+b_1+b_{e,p}]/\gamma_{M5}$
$\|N_1\| \le N_{1,Rd}$		$\|9.36\| < 224.87$	verified	(0.04)

CHORD SHEAR

DIAGONAL 2

A_v = 8.37	[cm^2]	Shear area of the chord		$A_v = (2*h_0 + \alpha*b_0)*t_0$
$N_{2,Rd}$ = 313.59	[kN]	Compression capacity		$N_{2,Rd} = f_{y0}*A_v/[\sqrt{3}*\sin(\theta_2)] / \gamma_{M5}$
$\|N_2\| \le N_{2,Rd}$		$\|-10.57\| < 313.59$	verified	(0.03)

DIAGONAL 1

A_v = 8.37	[cm^2]	Shear area of the chord		$A_v = (2*h_0 + \alpha*b_0)*t_0$
$N_{1,Rd}$ = 206.19	[kN]	Tension capacity		$N_{1,Rd} = f_{y0}*A_v/[\sqrt{3}*\sin(\theta_1)] / \gamma_{M5}$
$\|N_1\| \le N_{1,Rd}$		$\|9.36\| < 206.19$	verified	(0.05)

CHORD RESISTANCE

$V_{pl,Rd}$ = 155.97	[kN]	Plastic resistance for shear		$V_{pl,Rd} = (A_v*f_{y0})/(\sqrt{3}*\gamma_{M0})$
$\|V_{Ed}\| \le V_{pl,Rd}$		$\|7.79\| < 155.97$	verified	(0.05)
$N_{0,Rd}$ = 530.28	[kN]	Tension capacity		$N_{0,Rd} = [\ (A_0-A_v)*f_{y0} + A_v*f_{y0}*\sqrt{[1-(V_{Ed}/V_{pl,Rd})^2]}\ ]/\gamma_{M5}$
$\|N_{02}\| \le N_{0,Rd}$		$\|15.03\| < 530.28$	verified	(0.03)

VERIFICATION OF WELDS

DIAGONAL 2

β_w = 0.88		Correlation coefficient		[Table 4.1]
γ_{M2} = 1.25		Partial safety factor		[Table 2.1]
Longitudinal weld				
$\sigma_\perp$ = -6.02	[MPa]	Normal stress in a weld		
$\tau_\perp$ = -6.02	[MPa]	Perpendicular tangent stress		
τ_{II} = -13.03	[MPa]	Tangent stress		
$\|\sigma_\perp\| \le 0.9*f_u/\gamma_{M2}$		$\|-6.02\| < 338.40$	verified	(0.02)
$\sqrt{[\sigma_\perp^2 + 3*(\tau_\perp^2+\tau_{II}^2)]} \le f_u/(\beta_w*\gamma_{M2})$		$25.59 < 429.71$	verified	(0.06)

Transverse inner weld

$\sigma_\perp$ =	-14.40	[MPa]	Normal stress in a weld		
$\tau_\perp$ =	-2.68	[MPa]	Perpendicular tangent stress		
τ_{II} =	0.00	[MPa]	Tangent stress		
$\lvert\sigma_\perp\rvert \le 0.9 f_u/\gamma_{M2}$			|-14.40| < 338.40	verified	(0.04)
$\sqrt{[\sigma_\perp^2 + 3(\tau_\perp^2+\tau_{II}^2)]} \le f_u/(\beta_w \gamma_{M2})$			15.13 < 429.71	verified	(0.04)

Transverse outer weld

$\sigma_\perp$ =	-6.20	[MPa]	Normal stress in a weld		
$\tau_\perp$ =	-15.45	[MPa]	Perpendicular tangent stress		
τ_{II} =	0.00	[MPa]	Tangent stress		
$\lvert\sigma_\perp\rvert \le 0.9 f_u/\gamma_{M2}$			|-6.20| < 338.40	verified	(0.02)
$\sqrt{[\sigma_\perp^2 + 3(\tau_\perp^2+\tau_{II}^2)]} \le f_u/(\beta_w \gamma_{M2})$			27.47 < 429.71	verified	(0.06)

DIAGONAL 1

β_w =	0.88	Correlation coefficient	[Table 4.1]
γ_{M2} =	1.25	Partial safety factor	[Table 2.1]

Longitudinal weld

$\sigma_\perp$ =	7.92	[MPa]	Normal stress in a weld		
$\tau_\perp$ =	7.92	[MPa]	Perpendicular tangent stress		
τ_{II} =	7.65	[MPa]	Tangent stress		
$\lvert\sigma_\perp\rvert \le 0.9 f_u/\gamma_{M2}$			|7.92| < 338.40	verified	(0.02)
$\sqrt{[\sigma_\perp^2 + 3(\tau_\perp^2+\tau_{II}^2)]} \le f_u/(\beta_w \gamma_{M2})$			20.64 < 429.71	verified	(0.05)

Transverse inner weld

$\sigma_\perp$ =	22.88	[MPa]	Normal stress in a weld		
$\tau_\perp$ =	26.55	[MPa]	Perpendicular tangent stress		
τ_{II} =	0.00	[MPa]	Tangent stress		
$\lvert\sigma_\perp\rvert \le 0.9 f_u/\gamma_{M2}$			|22.88| < 338.40	verified	(0.07)
$\sqrt{[\sigma_\perp^2 + 3(\tau_\perp^2+\tau_{II}^2)]} \le f_u/(\beta_w \gamma_{M2})$			51.37 < 429.71	verified	(0.12)

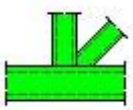
Transverse outer weld

$\sigma_\perp$ =	-20.59	[MPa]	Normal stress in a weld		
$\tau_\perp$ =	-2.34	[MPa]	Perpendicular tangent stress		
τ_{II} =	0.00	[MPa]	Tangent stress		
$\lvert\sigma_\perp\rvert \le 0.9 f_u/\gamma_{M2}$			|-20.59| < 338.40	verified	(0.06)
$\sqrt{[\sigma_\perp^2 + 3(\tau_\perp^2+\tau_{II}^2)]} \le f_u/(\beta_w \gamma_{M2})$			20.98 < 429.71	verified	(0.05)

Connection conforms to the code Ratio 0.28

Išvada: laikomoji galia pakankama

Mazgas nr. 13



Robot Structural Analysis Professional 2023

Design of truss node connection

EN 1993-1-8:2005/AC:2009

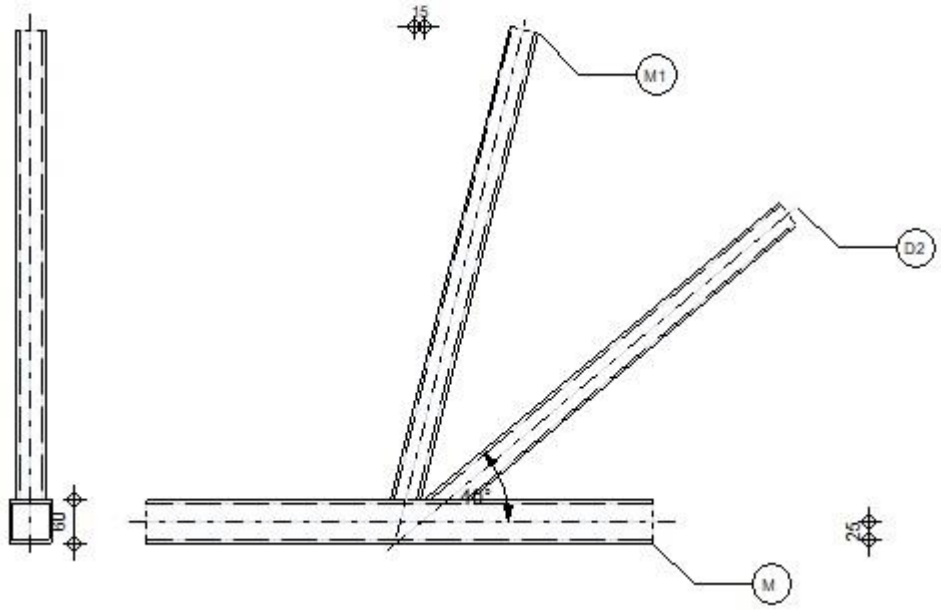
OK

Ratio **0.15**

M1 - SHS 40x4

D2 - SHS 40x4

M - SQUA 60x60x4



GENERAL

Connection no.: 13
Connection name: Tube
Structure node: 6545
Structure members: 3070, 3073, 3072

GEOMETRY

MEMBERS

		Chord	Diagonal 1	Diagonal 2	Post	
Member no.:		3070		3073	3072	
Section:		SQUA 60x60x4		SHS 40x4	SHS 40x4	
	h	60		40	40	mm
	b_f	60		40	40	mm
	t_w	4		4	4	mm
	t_f	4		4	4	mm
	r	4		0	0	mm
Material:		S 355		S 355	S 355	
	f_y	355.00		355.00	355.00	MPa
	f_u	470.00		470.00	470.00	MPa
Angle	θ	0.0		40.0	75.8	Deg
Length	l	4175		1285	1035	mm

OFFSET

e_0 = 25 [mm] Offset

SPACINGS

g_2 = 15 [mm] Spacing of 2nd diagonal

WELDS

a_d = 3 [mm] Thickness of welds of diagonals and posts

LOADS

Case: 51: ULS/43=1*1.00 + 5*1.30 + 7*0.78 1*1.00+5*1.30+7*0.78

CHORD

$N_{01,Ed}$ = 5.60 [kN] Axial force
$M_{01,Ed}$ = -0.37 [kN*m] Bending moment
$N_{02,Ed}$ = 2.02 [kN] Axial force
$M_{02,Ed}$ = -0.37 [kN*m] Bending moment

DIAGONAL 2

N_2 = -7.95 [kN] Axial force
M_2 = 0.01 [kN*m] Bending moment

POST

N_3 = 10.11 [kN] Axial force
M_3 = 0.01 [kN*m] Bending moment

Shear forces were not included in the connection verification. The connection was designed as a truss node.

RESULTS

CONSIDER NON-AXIAL CONNECTION OF MEMBERS IN THE NODE

M_0 = 0.09 [kN*m] Additional moment from eccentric connection of members $M_0 = (N_{02}-N_{01}) * e_0$
$\Sigma E_i J_i/L_i$ = 131952.64 [kN*m] Overall connection stiffness
ΔM_{01} = 0.03 [kN*m] Additional moment in the chord
ΔM_{02} = 0.03 [kN*m] Additional moment in the chord
ΔM_2 = 0.01 [kN*m] Additional moment in the diagonal
ΔM_3 = 0.02 [kN*m] Additional moment in the diagonal

CAPACITY VERIFICATION EUROCODE 3: EN 1993-1-8:2005

γ_{M5} = 1.00 Partial safety factor [Table 2.1]

FAILURE MODES FOR JOINTS (RHS CHORD MEMBERS) [Table 7.10] for $N_{i,Rd}$ and [Table 7.14] for $M_{i,Rd}$

GEOMETRICAL PARAMETERS

β = 0.67 Coefficient taking account of geometry of connection members $\beta = (b_2+b_3)/(2*b_0)$ [1.5 (6)]
γ = 7.50 Coefficient taking account of geometry of the chord $\gamma = b_0/(2*t_0)$ [1.5 (6)]
k_n = 1.00 Coefficient taking account of stresses in the chord $k_n = 1.0$

TUBE CHORD FACE FAILURE

DIAGONAL 2

$N_{2,Rd}$ = 143.64 [kN] Compression capacity $N_{2,Rd} = 8.9*k_n*f_{y0}*t_0^2*\sqrt{\gamma}/\sin(\theta_2) * \beta$

$|N_2| \le N_{2,Rd}$ |-7.95| < 143.64 verified (0.06)

$M_{2,Rd}$ = 1.41 [kN*m] Bending resistance $M_{2,Rd} = k_n*f_{y0}*t_0^2*h_2*[1/(2*\eta) + 2/\sqrt{[1-\beta]} + \eta/(1-\beta)] / \gamma_{M5}$

$|M_2+\Delta M_2| \le M_{2,Rd}$ |0.02| < 1.41 verified (0.02)

$N_2/N_{2,Rd} + (M_2+\Delta M_2)/M_{2,Rd} \le 1$ 0.07 < 1.00 verified (0.07)

POST

$N_{3,Rd}$ = 95.19 [kN] Tension capacity $N_{3,Rd} = 8.9*k_n*f_{y0}*t_0^2*\sqrt{\gamma}/\sin(\theta_3) * \beta$

$|N_3| \le N_{3,Rd}$ |10.11| < 95.19 verified (0.11)

$M_{3,Rd}$ = 1.41 [kN*m] Bending resistance $M_{3,Rd} = k_n*f_{y0}*t_0^2*h_3*[1/(2*\eta) + 2/\sqrt{[1-\beta]} + \eta/(1-\beta)] / \gamma_{M5}$

$|M_3+\Delta M_3| \le M_{3,Rd}$ |0.03| < 1.41 verified (0.02)

$N_3/N_{3,Rd} + (M_3+\Delta M_3)/M_{3,Rd} \le 1$ 0.13 < 1.00 verified (0.13)

CHORD PUNCHING

DIAGONAL 2

$b_{e,p}$ = 27 [mm] Effective width for punching shear $b_{e,p} = (10*b_2)/(b_0/t_0)$

$N_{2,Rd}$ = 243.91 [kN] Compression capacity $N_{2,Rd} = f_{y0}*t_0/(\sqrt{3}*\sin(\theta_2))*[2*h_2/\sin(\theta_2)+b_2+b_{e,p}]/\gamma_{M5}$

$|N_2| \le N_{2,Rd}$ |-7.95| < 243.91 verified (0.03)

POST

$b_{e,p}$ = 27 [mm] Effective width for punching shear $b_{e,p} = (10*b_3)/(b_0/t_0)$

$N_{3,Rd}$ = 126.13 [kN] Tension capacity $N_{3,Rd} = f_{y0}*t_0/(\sqrt{3}*\sin(\theta_3))*[2*h_3/\sin(\theta_3)+b_3+b_{e,p}]/\gamma_{M5}$

$|N_3| \le N_{3,Rd}$ |10.11| < 126.13 verified (0.08)

CHORD SHEAR

DIAGONAL 2

A_v = 5.34 [cm^2] Shear area of the chord $A_v = (2*h_0 + \alpha*b_0)*t_0$

$N_{2,Rd}$ = 170.33 [kN] Compression capacity $N_{2,Rd} = f_{y0}*A_v/[\sqrt{3}*\sin(\theta_2)] / \gamma_{M5}$

$|N_2| \le N_{2,Rd}$ |-7.95| < 170.33 verified (0.05)

POST

A_v = 5.34 [cm^2] Shear area of the chord $A_v = (2*h_0 + \alpha*b_0)*t_0$

$N_{3,Rd}$ = 112.88 [kN] Tension capacity $N_{3,Rd} = f_{y0}*A_v/[\sqrt{3}*\sin(\theta_3)] / \gamma_{M5}$

$|N_3| \le N_{3,Rd}$ |10.11| < 112.88 verified (0.09)

CHORD RESISTANCE

$V_{pl,Rd}$ = 99.50 [kN] Plastic resistance for shear $V_{pl,Rd} = (A_v*f_{y0})/(\sqrt{3}*\gamma_{M0})$

$|V_{Ed}| \le V_{pl,Rd}$ |9.80| < 99.50 verified (0.10)

$N_{0,Rd}$ = 302.53 [kN] Tension capacity $N_{0,Rd} = [\ (A_0-A_v)*f_{y0} + A_v*f_{y0}*\sqrt{[1-(V_{Ed}/V_{pl,Rd})^2]}\ ]/\gamma_{M5}$

$|N_{01}| \le N_{0,Rd}$ |5.60| < 302.53 verified (0.02)

VERIFICATION OF WELDS

DIAGONAL 2

β_w =	0.88		Correlation coefficient		[Table 4.1]
γ_{M2} =	1.25		Partial safety factor		[Table 2.1]
Longitudinal weld					
$\sigma_\perp$ =	-5.89	[MPa]	Normal stress in a weld		
$\tau_\perp$ =	-5.89	[MPa]	Perpendicular tangent stress		
τ_{II} =	-9.93	[MPa]	Tangent stress		
$\lvert\sigma_\perp\rvert \le 0.9*f_u/\gamma_{M2}$			$\lvert-5.89\rvert < 338.40$	verified	(0.02)
$\sqrt{[\sigma_\perp^2 + 3*(\tau_\perp^2+\tau_{II}^2)]} \le f_u/(\beta_w*\gamma_{M2})$			$20.85 < 429.71$	verified	(0.05)
Transverse inner weld					
$\sigma_\perp$ =	-11.87	[MPa]	Normal stress in a weld		
$\tau_\perp$ =	-3.59	[MPa]	Perpendicular tangent stress		
τ_{II} =	0.00	[MPa]	Tangent stress		
$\lvert\sigma_\perp\rvert \le 0.9*f_u/\gamma_{M2}$			$\lvert-11.87\rvert < 338.40$	verified	(0.04)
$\sqrt{[\sigma_\perp^2 + 3*(\tau_\perp^2+\tau_{II}^2)]} \le f_u/(\beta_w*\gamma_{M2})$			$13.40 < 429.71$	verified	(0.03)
Transverse outer weld					
$\sigma_\perp$ =	-5.28	[MPa]	Normal stress in a weld		
$\tau_\perp$ =	-12.49	[MPa]	Perpendicular tangent stress		
τ_{II} =	0.00	[MPa]	Tangent stress		
$\lvert\sigma_\perp\rvert \le 0.9*f_u/\gamma_{M2}$			$\lvert-5.28\rvert < 338.40$	verified	(0.02)
$\sqrt{[\sigma_\perp^2 + 3*(\tau_\perp^2+\tau_{II}^2)]} \le f_u/(\beta_w*\gamma_{M2})$			$22.27 < 429.71$	verified	(0.05)

POST

β_w =	0.88		Correlation coefficient		[Table 4.1]
γ_{M2} =	1.25		Partial safety factor		[Table 2.1]
Longitudinal weld					
$\sigma_\perp$ =	18.20	[MPa]	Normal stress in a weld		
$\tau_\perp$ =	18.20	[MPa]	Perpendicular tangent stress		
τ_{II} =	6.73	[MPa]	Tangent stress		
$\lvert\sigma_\perp\rvert \le 0.9*f_u/\gamma_{M2}$			$\lvert18.20\rvert < 338.40$	verified	(0.05)
$\sqrt{[\sigma_\perp^2 + 3*(\tau_\perp^2+\tau_{II}^2)]} \le f_u/(\beta_w*\gamma_{M2})$			$38.22 < 429.71$	verified	(0.09)
Transverse inner weld					
$\sigma_\perp$ =	33.35	[MPa]	Normal stress in a weld		
$\tau_\perp$ =	31.86	[MPa]	Perpendicular tangent stress		
τ_{II} =	0.00	[MPa]	Tangent stress		
$\lvert\sigma_\perp\rvert \le 0.9*f_u/\gamma_{M2}$			$\lvert33.35\rvert < 338.40$	verified	(0.10)
$\sqrt{[\sigma_\perp^2 + 3*(\tau_\perp^2+\tau_{II}^2)]} \le f_u/(\beta_w*\gamma_{M2})$			$64.48 < 429.71$	verified	(0.15)

REMARKS

Eccentricity is too large. 25 [mm] > 15 [mm]

Connection conforms to the code Ratio 0.15

Išvada: laikomoji galia pakankama

Mazgas nr. 14

Robot Structural Analysis Professional 2023

Design of truss node connection

EN 1993-1-8:2005/AC:2009

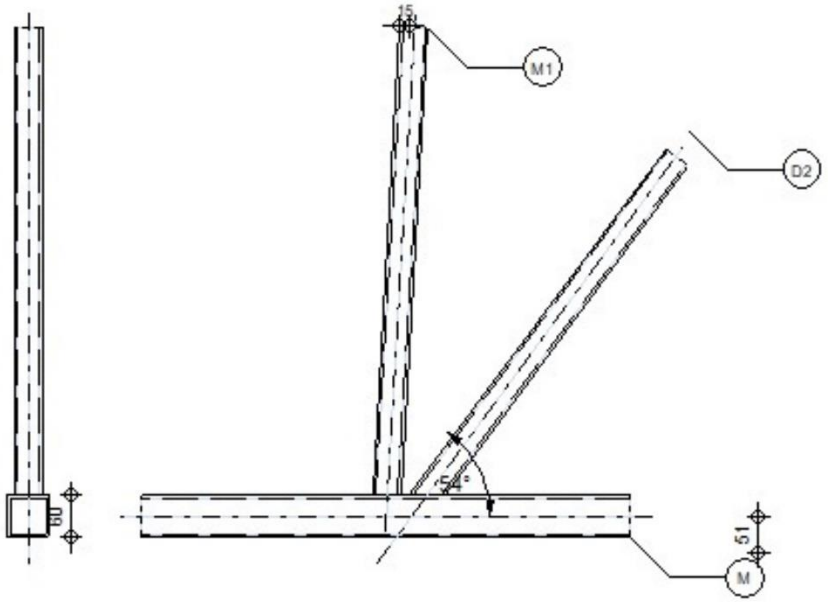
OK

Ratio
0.16

M1 - SHS 40x4

D2 - SHS 40x4

M - SQUA 60x60x4



GENERAL

Connection no.: 14
Connection name: Tube
Structure node: 6546
Structure members: 3069, 3073, 3074

GEOMETRY

MEMBERS

		Chord	Diagonal 1	Diagonal 2	Post	
Member no.:		3069		3073	3074	
Section:		SQUA 60x60x4		SHS 40x4	SHS 40x4	
	h	60		40	40	mm
	b_f	60		40	40	mm
	t_w	4		4	4	mm
	t_f	4		4	4	mm
	r	4		0	0	mm
Material:		S 355		S 355	S 355	

		Chord	Diagonal 1	Diagonal 2	Post	
	f_y	355.00		355.00	355.00	MPa
	f_u	470.00		470.00	470.00	MPa
Angle	θ	0.0		53.6	86.6	Deg
Length	l	3011		1285	839	mm

OFFSET

e_0 = 51 [mm] Offset

SPACINGS

g_2 = 15 [mm] Spacing of 2nd diagonal

WELDS

a_d = 3 [mm] Thickness of welds of diagonals and posts

LOADS

Case: 98: ULS/90=1*1.35 + 4*0.78 + 2*0.91 + 8*1.30 1*1.35+4*0.78+2*0.91+8*1.30

CHORD

$N_{01,Ed}$ = 15.85 [kN] Axial force
$M_{01,Ed}$ = -0.03 [kN*m] Bending moment
$N_{02,Ed}$ = 9.00 [kN] Axial force
$M_{02,Ed}$ = -0.11 [kN*m] Bending moment

DIAGONAL 2

N_2 = 10.48 [kN] Axial force
M_2 = 0.02 [kN*m] Bending moment

POST

N_3 = -8.44 [kN] Axial force
M_3 = -0.06 [kN*m] Bending moment

Shear forces were not included in the connection verification. The connection was designed as a truss node.

RESULTS

CONSIDER NON-AXIAL CONNECTION OF MEMBERS IN THE NODE

M_0 = 0.35 [kN*m] Additional moment from eccentric connection of members $M_0 = (N_{02}-N_{01}) * e_0$
$\Sigma E_i J_i / L_i$ = 171572.03 [kN*m] Overall connection stiffness
ΔM_{01} = 0.12 [kN*m] Additional moment in the chord
ΔM_{02} = 0.12 [kN*m] Additional moment in the chord
ΔM_2 = 0.04 [kN*m] Additional moment in the diagonal
ΔM_3 = 0.06 [kN*m] Additional moment in the diagonal

CAPACITY VERIFICATION EUROCODE 3: EN 1993-1-8:2005

γ_{M5} = 1.00 Partial safety factor [Table 2.1]

FAILURE MODES FOR JOINTS (RHS CHORD MEMBERS) [Table 7.10] for $N_{i,Rd}$ and [Table 7.14] for $M_{i,Rd}$

GEOMETRICAL PARAMETERS

β = 0.67	Coefficient taking account of geometry of connection members	$\beta = (b_2+b_3)/(2*b_0)$ [1.5 (6)]
γ = 7.50	Coefficient taking account of geometry of the chord	$\gamma = b_0/(2*t_0)$ [1.5 (6)]
k_n = 1.00	Coefficient taking account of stresses in the chord	$k_n = 1.0$

TUBE CHORD FACE FAILURE

DIAGONAL 2

$N_{2,Rd}$ = 114.63 [kN]	Tension capacity		$N_{2,Rd} = 8.9*k_n*f_{y0}*t_0^2*\sqrt{\gamma}/\sin(\theta_2) * \beta$
$\lvert N_2 \rvert \le N_{2,Rd}$	$\lvert 10.48 \rvert < 114.63$	verified	(0.09)
$M_{2,Rd}$ = 1.41 [kN*m]	Bending resistance		$M_{2,Rd} = k_n*f_{y0}*t_0^2*h_2*[1/(2*\eta) + 2/\sqrt{[1-\beta]} + \eta/(1-\beta)] / \gamma_{M5}$
$\lvert M_2+\Delta M_2 \rvert \le M_{2,Rd}$	$\lvert 0.06 \rvert < 1.41$	verified	(0.04)
$N_2/N_{2,Rd} + (M_2+\Delta M_2)/M_{2,Rd} \le 1$	$0.14 < 1.00$	verified	(0.14)

POST

$N_{3,Rd}$ = 92.46 [kN]	Compression capacity		$N_{3,Rd} = 8.9*k_n*f_{y0}*t_0^2*\sqrt{\gamma}/\sin(\theta_3) * \beta$
$\lvert N_3 \rvert \le N_{3,Rd}$	$\lvert -8.44 \rvert < 92.46$	verified	(0.09)
$M_{3,Rd}$ = 1.41 [kN*m]	Bending resistance		$M_{3,Rd} = k_n*f_{y0}*t_0^2*h_3*[1/(2*\eta) + 2/\sqrt{[1-\beta]} + \eta/(1-\beta)] / \gamma_{M5}$
$\lvert M_3+\Delta M_3 \rvert \le M_{3,Rd}$	$\lvert 0.00 \rvert < 1.41$	verified	(0.00)
$N_3/N_{3,Rd} + (M_3+\Delta M_3)/M_{3,Rd} \le 1$	$0.09 < 1.00$	verified	(0.09)

CHORD PUNCHING

DIAGONAL 2

$b_{e,p}$ = 27 [mm]	Effective width for punching shear		$b_{e,p} = (10*b_2)/(b_0/t_0)$
$N_{2,Rd}$ = 169.06 [kN]	Tension capacity		$N_{2,Rd} = f_{y0}*t_0/(\sqrt{3}*\sin(\theta_2))*[2*h_2/\sin(\theta_2)+b_2+b_{e,p}]/\gamma_{M5}$
$\lvert N_2 \rvert \le N_{2,Rd}$	$\lvert 10.48 \rvert < 169.06$	verified	(0.06)

POST

$b_{e,p}$ = 27 [mm]	Effective width for punching shear		$b_{e,p} = (10*b_3)/(b_0/t_0)$
$N_{3,Rd}$ = 120.57 [kN]	Compression capacity		$N_{3,Rd} = f_{y0}*t_0/(\sqrt{3}*\sin(\theta_3))*[2*h_3/\sin(\theta_3)+b_3+b_{e,p}]/\gamma_{M5}$
$\lvert N_3 \rvert \le N_{3,Rd}$	$\lvert -8.44 \rvert < 120.57$	verified	(0.07)

CHORD SHEAR

DIAGONAL 2

A_v = 5.34 [cm^2]	Shear area of the chord		$A_v = (2*h_0 + \alpha*b_0)*t_0$
$N_{2,Rd}$ = 135.94 [kN]	Tension capacity		$N_{2,Rd} = f_{y0}*A_v/[\sqrt{3}*\sin(\theta_2)] / \gamma_{M5}$
$\lvert N_2 \rvert \le N_{2,Rd}$	$\lvert 10.48 \rvert < 135.94$	verified	(0.08)

POST

A_v = 5.34 [cm^2]	Shear area of the chord		$A_v = (2*h_0 + \alpha*b_0)*t_0$
$N_{3,Rd}$ = 109.64 [kN]	Compression capacity		$N_{3,Rd} = f_{y0}*A_v/[\sqrt{3}*\sin(\theta_3)] / \gamma_{M5}$
$\lvert N_3 \rvert \le N_{3,Rd}$	$\lvert -8.44 \rvert < 109.64$	verified	(0.08)

CHORD RESISTANCE

$V_{pl,Rd}$ = 99.50 [kN]	Plastic resistance for shear		$V_{pl,Rd} = (A_v*f_{y0})/(\sqrt{3}*\gamma_{M0})$
$\lvert V_{Ed} \rvert \le V_{pl,Rd}$	$\lvert 8.44 \rvert < 99.50$	verified	(0.08)

$N_{0,Rd}$ = 302.77 [kN] Tension capacity			$N_{0,Rd} = [(A_0-A_v)*f_{y0} + A_v*f_{y0}*\sqrt{[1-(V_{Ed}/V_{pl,Rd})^2]}]/\gamma_{M5}$	
$\lvert N_{01} \rvert \le N_{0,Rd}$		$\lvert 15.85 \rvert < 302.77$	verified	(0.05)

VERIFICATION OF WELDS

DIAGONAL 2

β_w = 0.88		Correlation coefficient		[Table 4.1]
γ_{M2} = 1.25		Partial safety factor		[Table 2.1]
Longitudinal weld				
$\sigma_\perp$ = 11.58	[MPa]	Normal stress in a weld		
$\tau_\perp$ = 11.58	[MPa]	Perpendicular tangent stress		
τ_{II} = 12.56	[MPa]	Tangent stress		
$\lvert\sigma_\perp\rvert \le 0.9*f_u/\gamma_{M2}$		$\lvert 11.58 \rvert < 338.40$	verified	(0.03)
$\sqrt{[\sigma_\perp^2 + 3*(\tau_\perp^2+\tau_{II}^2)]} \le f_u/(\beta_w*\gamma_{M2})$		$31.78 < 429.71$	verified	(0.07)
Transverse inner weld				
$\sigma_\perp$ = 21.71	[MPa]	Normal stress in a weld		
$\tau_\perp$ = 15.11	[MPa]	Perpendicular tangent stress		
τ_{II} = 0.00	[MPa]	Tangent stress		
$\lvert\sigma_\perp\rvert \le 0.9*f_u/\gamma_{M2}$		$\lvert 21.71 \rvert < 338.40$	verified	(0.06)
$\sqrt{[\sigma_\perp^2 + 3*(\tau_\perp^2+\tau_{II}^2)]} \le f_u/(\beta_w*\gamma_{M2})$		$34.00 < 429.71$	verified	(0.08)
Transverse outer weld				
$\sigma_\perp$ = 4.94	[MPa]	Normal stress in a weld		
$\tau_\perp$ = 16.58	[MPa]	Perpendicular tangent stress		
τ_{II} = 0.00	[MPa]	Tangent stress		
$\lvert\sigma_\perp\rvert \le 0.9*f_u/\gamma_{M2}$		$\lvert 4.94 \rvert < 338.40$	verified	(0.01)
$\sqrt{[\sigma_\perp^2 + 3*(\tau_\perp^2+\tau_{II}^2)]} \le f_u/(\beta_w*\gamma_{M2})$		$29.13 < 429.71$	verified	(0.07)

POST

β_w = 0.88		Correlation coefficient		[Table 4.1]
γ_{M2} = 1.25		Partial safety factor		[Table 2.1]
Longitudinal weld				
$\sigma_\perp$ = -15.92	[MPa]	Normal stress in a weld		
$\tau_\perp$ = -15.92	[MPa]	Perpendicular tangent stress		
τ_{II} = -1.38	[MPa]	Tangent stress		
$\lvert\sigma_\perp\rvert \le 0.9*f_u/\gamma_{M2}$		$\lvert -15.92 \rvert < 338.40$	verified	(0.05)
$\sqrt{[\sigma_\perp^2 + 3*(\tau_\perp^2+\tau_{II}^2)]} \le f_u/(\beta_w*\gamma_{M2})$		$31.93 < 429.71$	verified	(0.07)
Transverse inner weld				
$\sigma_\perp$ = -35.29	[MPa]	Normal stress in a weld		
$\tau_\perp$ = -35.42	[MPa]	Perpendicular tangent stress		
τ_{II} = 0.00	[MPa]	Tangent stress		
$\lvert\sigma_\perp\rvert \le 0.9*f_u/\gamma_{M2}$		$\lvert -35.29 \rvert < 338.40$	verified	(0.10)
$\sqrt{[\sigma_\perp^2 + 3*(\tau_\perp^2+\tau_{II}^2)]} \le f_u/(\beta_w*\gamma_{M2})$		$70.78 < 429.71$	verified	(0.16)

REMARKS

Eccentricity is too large. 51 [mm] > 15 [mm]

Connection conforms to the code Ratio 0.16

Išvada: laikomoji galia pakankama

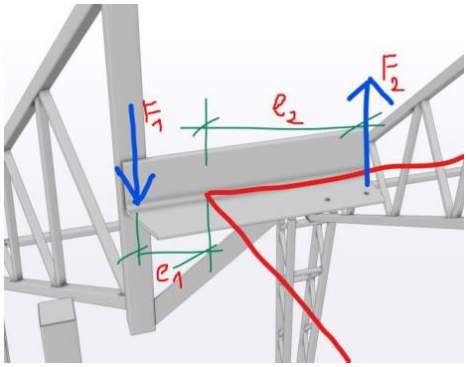
2.7.3.4.Santvarų tvirtinimo prie rygelių ir perdangų pavojingiausio gembinio mazgo projektavimas

Skaičiuojamas inkarinio varžto kirpimas ir ištraukimas iš betono.

Mazgą veikiančios didžiausios apkrovos:

	FX (kN)	FY (kN)	FZ (kN)	MX (kNm)	MY (kNm)	MZ (kNm)
MAX	61.09	8.82	17.96	0.00	0.00	0.00
Node	5635	5635	5635	6075	5635	5635
Case	124 (C)	97 (C)	90 (C)	124 (C)	105 (C)	120 (C)
MIN	-63.59	-8.35	-18.72	-0.00	-0.00	-0.00
Node	5635	5635	5635	6075	5635	5635
Case	97 (C)	116 (C)	51 (C)	93 (C)	120 (C)	101 (C)

Varžtą veikiantis tempimas I atvejis (vertinama, kad tempimą perima vienas varžtas):



$F_{1.1} = 18\ kN$;

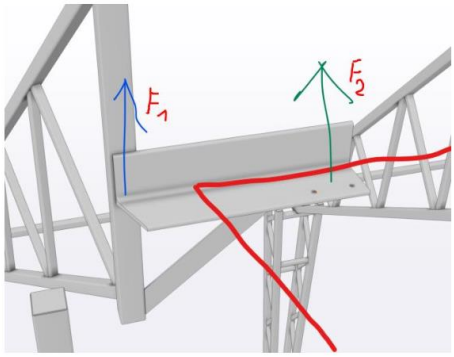
$e_1 = 380mm$;

$e_2 = 445mm$.

$M = F_{1.1} \cdot e_1 = 18 \cdot 0{,}38 = 6{,}84\ kNm.$

$F_{2.1} = \frac{M}{e_2} = \frac{6{,}84}{0{,}445} = 15{,}4\ kN.$

Varžtą veikiantis tempimas II atvejis (vertinama, kad tempimą perima vienas varžtas):



$F_{1.2} = F_{2.2} = 19\ kN.$

Varžtą veikiantis kerpimas (vertinama, kad abu varžtai perima kirpimą vienodai):

$$F_3 = \frac{\max(F_x; F_y)}{2} = \frac{64}{2} = 32\ kN.$$

Tvirtinimui naudojami HILTI HAS-U M20 8.8 varžtai su ankerine mase HILTI HIT HY 170.

Varžtų laikomoji galia tempimui:

Anchor size				M8	M10	M12	M16	M20	M24
Cracked concrete									
Tension	HAS-U 5.8 HAS 5.8	N_{Rec}	[kN]	-	7,8	11,4	17,3	31,5	46,7
	HAS-U 8.8 HAS 8.8			-	7,8	11,4	17,3	31,5	46,7
	HAS-U A4 HAS A4			-	7,8	11,4	17,3	31,5	46,7
	HAS-U HCR			-	7,8	11,4	17,3	31,5	46,7

Varžtų laikomoji galia kirpimui:

Anchor size				M8	M10	M12	M16	M20	M24
Shear	HAS-U 5.8 HAS 5.8	V_{Rec}	[kN]	-	9,9	14,5	26,9	42,0	60,5
	HAS-U 8.8 HAS 8.8			-	13,3	19,3	34,7	56,0	80,7
	HAS-U A4 HAS A4			-	9,3	13,5	25,2	39,3	56,6
	HAS-U HCR			-	13,3	19,3	34,7	56,0	50,4

Išvada: 19 kN<31,5 kN laikomoji galia tempimui pakankama;

32 kN<56 kN laikomoji galia kirpimui pakankama.

2.7.3.5. Kitų tipinių santvarų tvirtinimo prie rygelių ir perdangų mazgų skaičiavimas

Skaičiuojamas inkarinio varžto kirpimas ir ištraukimas iš betono. Skaičiuojant atsparumą tempimui ir kirpimui vertinama, kad vienas varžtas perima visą tempimo reakciją.

Mazgą veikiančios didžiausios apkrovos:

	FX (kN)	FY (kN)	FZ (kN)	MX (kNm)	MY (kNm)	MZ (kNm)
MAX	40.06	33.45	29.80	0.00	0.00	0.00
Node	6159	5308	6176	5378	5673	6666
Case	124 (C)	105 (C)	90 (C)	106 (C)	115 (C)	90 (C)
MIN	-41.82	-32.00	-25.01	-0.00	-0.00	-0.00
Node	6159	5308	6176	5268	6146	6670
Case	93 (C)	120 (C)	115 (C)	97 (C)	102 (C)	119 (C)

Tvirtinimui naudojami HILTI HAS-U M20 8.8 varžtai su ankerine mase HILTI HIT HY 170.

Varžtų laikomoji galia tempimui:

Anchor size				M8	M10	M12	M16	M20	M24
Cracked concrete									
Tension	HAS-U 5.8 HAS 5.8	N_{Rec}	[kN]	-	7,8	11,4	17,3	31,5	46,7
	HAS-U 8.8 HAS 8.8			-	7,8	11,4	17,3	31,5	46,7
	HAS-U A4 HAS A4			-	7,8	11,4	17,3	31,5	46,7
	HAS-U HCR			-	7,8	11,4	17,3	31,5	46,7

Varžtų laikomoji galia kirpimui:

Anchor size				M8	M10	M12	M16	M20	M24
Shear	HAS-U 5.8 HAS 5.8	V_{Rec}	[kN]	-	9,9	14,5	26,9	42,0	60,5
	HAS-U 8.8 HAS 8.8			-	13,3	19,3	34,7	56,0	80,7
	HAS-U A4 HAS A4			-	9,3	13,5	25,2	39,3	56,6
	HAS-U HCR			-	13,3	19,3	34,7	56,0	50,4

Išvada: 30 kN<31,5 kN laikomoji galia tempimui pakankama;

42 kN<56 kN laikomoji galia kirpimui pakankama.

2.7.3.6. Kampinių santvarų tvirtinimo prie rygelių ir perdangų mazgų skaičiavimas

Skaičiuojamas inkarinio varžto kirpimas ir ištraukimas iš betono. Skaičiuojant atsparumą tempimui vertinama, kad vienas varžtas perima visą tempimo reakciją. Skaičiuojant atsparumą kirpimui vertinama, kad kirpimo reakciją perimtų vienu varžtu mažiau, negu yra mazge.

Mazgą su trimis varžtais veikiančios didžiausios apkrovos:

	FX (kN)	FY (kN)	FZ (kN)	MX (kNm)	MY (kNm)	MZ (kNm)
MAX	97.40	15.47	16.99	0.00	0.00	0.00
Node	6759	5129	5129	6759	5129	6759
Case	123 (C)	123 (C)	60 (C)	106 (C)	94 (C)	122 (C)
MIN	-93.23	-14.79	-18.39	-0.00	-0.00	-0.00
Node	6759	5129	5129	5129	5129	6759
Case	94 (C)	98 (C)	40 (C)	104 (C)	119 (C)	95 (C)

Mazgą su dviem varžtais veikiančios didžiausios apkrovos:

	FX (kN)	FY (kN)	FZ (kN)	MX (kNm)	MY (kNm)	MZ (kNm)
MAX	10.04	31.79	19.91	0.00	0.00	0.00
Node	5234	5671	5234	5671	5234	5234
Case	120 (C)	106 (C)	90 (C)	126 (C)	98 (C)	89 (C)
MIN	-10.63	-33.21	-20.13	-0.00	-0.00	-0.00
Node	5234	5671	5234	5234	5234	5234
Case	101 (C)	119 (C)	57 (C)	97 (C)	115 (C)	114 (C)

Tvirtinimui naudojami HILTI HAS-U M20 8.8 varžtai su ankerine mase HILTI HIT HY 170.

Varžtų laikomoji galia tempimui:

Anchor size				M8	M10	M12	M16	M20	M24
Cracked concrete									
Tension	HAS-U 5.8 HAS 5.8	N_{Rec}	[kN]	-	7,8	11,4	17,3	31,5	46,7
	HAS-U 8.8 HAS 8.8			-	7,8	11,4	17,3	31,5	46,7
	HAS-U A4 HAS A4			-	7,8	11,4	17,3	31,5	46,7
	HAS-U HCR			-	7,8	11,4	17,3	31,5	46,7

Varžtų laikomoji galia kirpimui:

Anchor size				M8	M10	M12	M16	M20	M24
Shear	HAS-U 5.8 HAS 5.8	V_{Rec}	[kN]	-	9,9	14,5	26,9	42,0	60,5
	HAS-U 8.8 HAS 8.8			-	13,3	19,3	34,7	56,0	80,7
	HAS-U A4 HAS A4			-	9,3	13,5	25,2	39,3	56,6
	HAS-U HCR			-	13,3	19,3	34,7	56,0	50,4

Išvada: 21 kN<31,5 kN laikomoji galia tempimui pakankama;

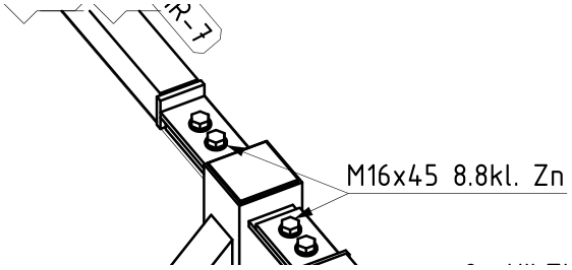
98/2=49 kN<56 kN mazgo su trimi varžtais laikomoji galia kirpimui pakankama.

34 kN<56 kN mazgo su dviem varžtais laikomoji galia kirpimui pakankama.

2.7.3.7. Ryšių plokštelių jungimo prie kolonų ir santvarų mazgų projektavimas

Elemento praspaudimas su horizontalia ryšio plokštele

Tikrinamas horizontalių ryšių jungimas prie santvarų juostos, plokštelė jungiama horizontaliai (juostos pločio linkme):



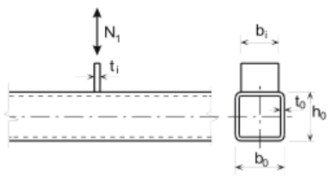
$t_1 := 0.01$ m
$b_1 := 0.07$ m
$t_0 := 0.006$ m
$b_0 := 0.10$ m

$f_y := 355000$ kPa

$\gamma_{M5} := 1$

$N := 68$ kN

Mazgo tipas



$$b_{eff} := \frac{10}{\frac{b_0}{t_0}} \cdot \frac{f_y \cdot t_0}{f_y \cdot t_1} \cdot b_1 = 0.025 \text{ m}$$

$$b_{ep} := \frac{10}{\frac{b_0}{t_0}} \cdot b_1 = 0.042 \text{ m}$$

Skaiciuotinė laikomoji galia

$$N_{rd1} := \frac{f_y \cdot t_1 \cdot b_{eff}}{\gamma_{M5}} = 89.46 \text{ kN}$$

Juostos irtis

$$N_{rd2} := \text{if}\left[(b_0 - 2t_0) \geq b_1, \frac{\left[f_y \cdot t_0 \cdot (2 \cdot t_1 + 10t_0)\right]}{\gamma_{M5}}, \frac{\frac{f_y \cdot t_0}{\sqrt{3}} \cdot (2 \cdot t_1 + 2 \cdot b_{ep})}{\gamma_{M5}}\right] = 170.4 \text{ kN}$$

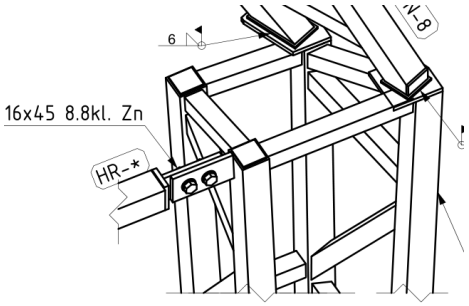
Juostos išnaudojimas

$$\frac{N}{N_{rd1}} = 0.76$$

Išvada: laikomoji galia be papildomos plokštelės pakankama

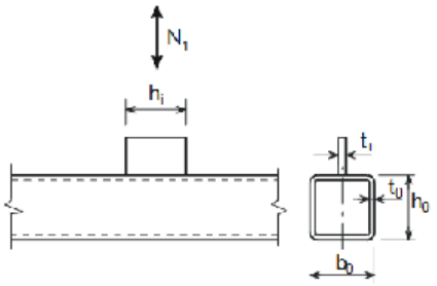
Elemento praspaudimas su vertikalia ryšio plokštele

Tikrinamas horizontalių ryšių jungimas prie spragotų kolonų juostos, plokštelė jungiama vertikaliai (išilgai juostos):



Kai veikia tempimas:

$t_1 := 0.01$ m
$h_1 := 0.07$ m
$t_0 := 0.006$ m
$b_0 := 0.06$ m
$f_y := 355000$ kPa
$\gamma_{M5} := 1$
$N_1 := 49$ kN



$t_1 / b_0 \le 0,2$

Kai tempimas

$k_{m1} := 1$

Skaiciuotinė laikomoji galia

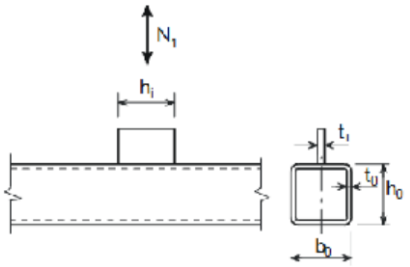
$$N_{rd} := \frac{k_{m1} \cdot f_y \cdot t_0^2}{1 - \frac{t_1}{b_0}} \cdot \frac{\left(\frac{2 \cdot h_1}{b_0} + 4 \cdot \sqrt{1 - \frac{t_1}{b_0}}\right)}{\gamma_{M5}} = 91.783 \quad \text{kN}$$

Juostos išnaudojimas

$$\frac{N_1}{N_{rd}} = 0.534$$

Kai veikia gniuždymas:

$t_1 := 0.01$ m
$h_1 := 0.07$ m
$t_0 := 0.006$ m
$b_0 := 0.06$ m
$f_y := 355000$ kPa
$\gamma_{M5} := 1$
$N_2 := 52$ kN



$t_1 / b_0 \le 0,2$

Mazgo jusotos gniuždomasis įtempis:

$\sigma_{0Ed} := 199 \cdot 10^3 = 1.99 \times 10^5$ kPa

Įtempių koeficientas:

$$n := \frac{\frac{\sigma_{0Ed}}{f_y}}{\gamma_{M5}} = 0.561$$

Kai gniuždymas

$k_{m2} := \text{if}[1.3 \cdot (1 - n) < 1, 1.3 \cdot (1 - n), 1] = 0.571$

Skaiciuotinė laikomoji galia

$$N_{rd} := \frac{k_{m2} \cdot f_y \cdot t_0^2}{1 - \frac{t_1}{b_0}} \cdot \frac{\left(\frac{2 \cdot h_1}{b_0} + 4 \cdot \sqrt{1 - \frac{t_1}{b_0}}\right)}{\gamma_{M5}} = 52.433 \quad \text{kN}$$

Juostos išnaudojimas

$$\frac{N_2}{N_{rd}} = 0.992$$

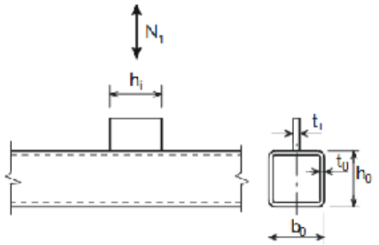
Išvada: laikomoji galia be papildomos plokštelės pakankama

Elemento praspaudimas su vertikalia ryšio plokštele

Tikrinamas horizontalių įstryžų ryšių jungimas prie santvaros viršutinės juostos, plokštelė jungiama vertikaliai (išilgai juostos):

Kai veikia tempimas:

$t_1 := 0.01$ m
$h_1 := 0.07$ m
$t_0 := 0.004$ m
$b_0 := 0.06$ m
$f_y := 355000$ kPa
$\gamma_{M5} := 1$
$N_1 := 35$ kN



$t_1 / b_0 \le 0,2$

Kai tempimas

$k_{m1} := 1$

Skaiciuotinė laikomoji galia

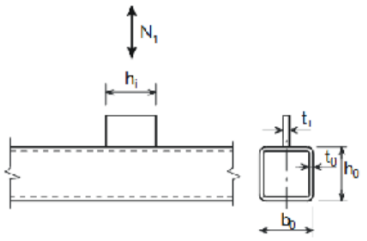
$$N_{rd1} := \frac{k_{m1} \cdot f_y \cdot t_0^2}{1 - \frac{t_1}{b_0}} \cdot \frac{\left(\frac{2 \cdot h_1}{b_0} + 4 \cdot \sqrt{1 - \frac{t_1}{b_0}}\right)}{\gamma_{M5}} = 40.793 \text{ kN}$$

Juostos išnaudojimas

$$\frac{N_1}{N_{rd1}} = 0.858$$

Kai veikia gniuždymas:

$t_1 := 0.01$ m
$h_1 := 0.07$ m
$t_0 := 0.004$ m
$b_0 := 0.06$ m
$f_y := 355000$ kPa
$\gamma_{M5} := 1$
$N_2 := 35$ kN



$t_1 / b_0 \le 0,2$

Mazgo jusotos gniuždomasis įtempis:

$\sigma_{0Ed} := 117 \cdot 10^3 = 1.17 \times 10^5$ kPa

Įtempių koeficientas:

$$n := \frac{\frac{\sigma_{0Ed}}{f_y}}{\gamma_{M5}} = 0.33$$

Kai gniuždymas

$k_{m2} := \text{if}[1.3 \cdot (1 - n) < 1, 1.3 \cdot (1 - n), 1] = 0.872$

Skaiciuotinė laikomoji galia

$$N_{rd2} := \frac{k_{m2} \cdot f_y \cdot t_0^2}{1 - \frac{t_1}{b_0}} \cdot \frac{\left(\frac{2 \cdot h_1}{b_0} + 4 \cdot \sqrt{1 - \frac{t_1}{b_0}}\right)}{\gamma_{M5}} = 35.553 \text{ kN}$$

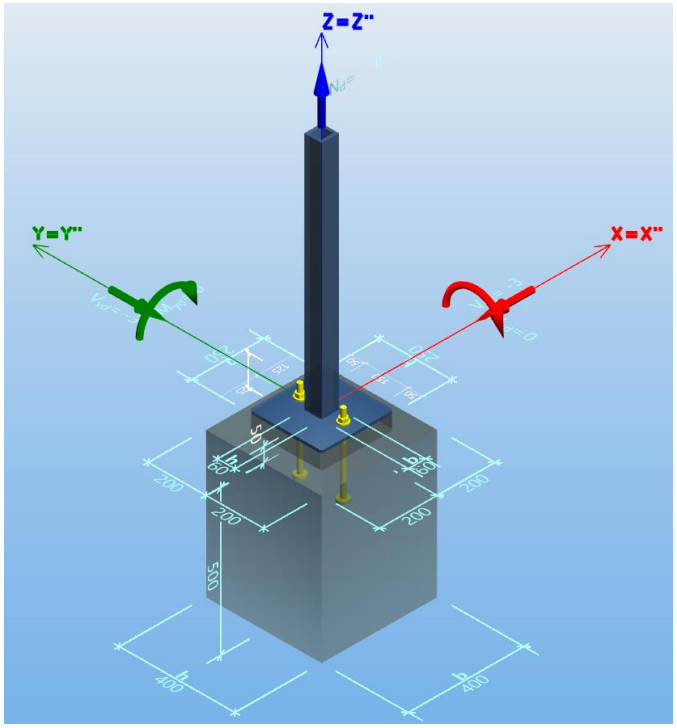
Juostos išnaudojimas

$$\frac{N_2}{N_{rd2}} = 0.984$$

Išvada: laikomoji galia be papildomos plokštelės pakankama

2.7.3.8. Metalinio santvarinio stogelio kolonos bazės varžtų skaičiavimas

Metalinės kolonos bazės inkariniai varžtai pagal atramines reakcijas pamate parenkami „Peikko Designer“ programa. Metalinių kolonų inkariniai varžtai HPM16L.



Summary

Name	Stage	#	Load Case	Page No.	Max Utilization	Status
Column 1	Final	1	+N max	4	69%	OK
	Final	2	-N max	5	2%	OK

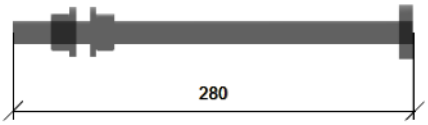
Column 1

Note:

Number of Columns: 1

Peikko Products

Bolts: 2 x HPM16L



Totals

Product	Amount
HPM16L	2

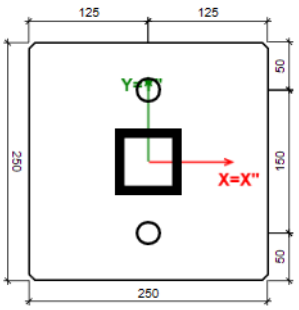
Minimum required torque value of nuts : T_{min} = 120 Nm
Maximum allowed torque value of nuts : T_{max} = 170 Nm
Bolt installation template: PPL16-2 150

Materials and Geometry

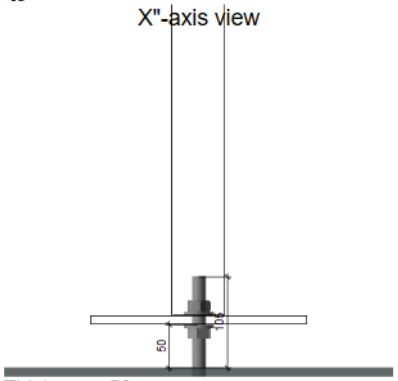
Column: 60x60

f_{cd}= 20 N/mm²

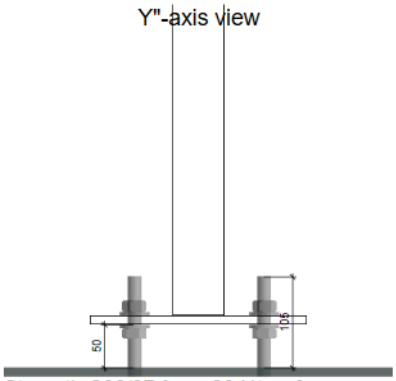
Plane View



X"-axis view



Y"-axis view



Grouting:

Thickness: 50 mm

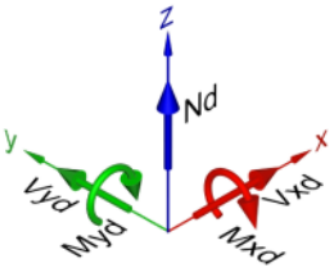
Strength C30/37 f_{cd} = 20 N/mm²

X; Y = local coordinate system of profile
X"; Y" = local coordinate system of anchors

Load Cases

NOTE: Loads are defined in the local coordinate system of the profile.

(Design loads)



Final Stage

#	Name	N_d [kN]	M_{xd} [kNm]	M_{yd} [kNm]	V_{xd} [kN]	V_{yd} [kN]
1	+N max	28.0	0.0	0.0	-3.0	-3.0
2	-N max	-25.0	0.0	0.0	-1.0	-3.0

Erection stage

No load case for this stage defined

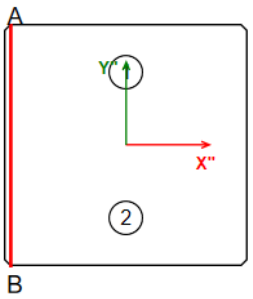
Load Case #1 : +N max : Nd=28.0, Mxd=0.0, Myd=0.0, Vxd=-3.0, Vyd=-3.0

Steel Failure: Sufficient capacity **Concrete failure: Sufficient capacity**

Steel failure verification

Design value of normal compressive force in the column	$N_{c,Ed}$	0	kN
Friction coefficient (between base plate and grout layer)	C_{fd}	0.2	
Joint friction resistance	$F_{f,Rd}$	0	kN
Resultant shear force	V_{sd}	4.24	kN
Resultant shear force taking account friction contribution	$V_{sd,f}$	4.24	kN

Neutral axis in (X"/Y") = A(-117.5 / 125.0); B(-117.9 / -125.0)
Resultant tension force in (X"/Y") = N_{Ed}(0.0/0.0)



Bolt Pos.	Acting axial force [kN]	Design tension resistance [kN]	Axial capacity usage [%]	Acting shear force [kN]	Design shear resistance [kN]	Shear capacity usage [%]	Interaction [%]
1	14.0	56.5	24.7	2.12	20.0	10.6	28.3
2	14.0	56.5	24.8	2.12	20.0	10.6	28.3

Concrete failure verifications

Proof	Load [kN]	Capacity [kN]	Utilization [%]	Status
Pull-Out Failure	14.0	116.6	12.0	Ok
Cone failure				Ok
Concrete decisive:				
1) Foundation (Plain Concrete)	28.0	40.5	69.0	
2) Assigned Hanger Reinforcement	0.0	0.0	n/r	
3) Requirement of Strut and Tie Model	0.0	0.0	n/r	
Splitting Failure				Ok
Concrete decisive:				
1) Foundation (Plain Concrete)	28.0	49.7	56.4	
2)Assigned Splitting Reinforcement || X	0.0	0.0	-	
3)Assigned Splitting Reinforcement || Y	0.0	0.0	-	
Blow-Out Failure	0.0	0.0	n/r	Ok
Pry-out failure	4.2	81.1	5.2	Ok
Edge failure				Ok
Concrete decisive:				
1) -X (Left) Edge (Plain Concrete)	4.2	19.5	21.7	
2) +X (Right) Edge (Plain Concrete)	3.0	30.9	9.7	
3) +Y (Top) Edge (Plain Concrete)	3.0	35.1	8.6	
4) -Y (Bottom) Edge (Plain Concrete)	4.2	22.2	19.1	
5)Assigned Edge Reinforcement (-X)	2.2	0.0	n/r	
6)Assigned Edge Reinforcement (+X)	1.0	0.0	n/r	
7)Assigned Edge Reinforcement (+Y)	2.1	0.0	n/r	
8)Assigned Edge Reinforcement (-Y)	4.7	0.0	n/r	
Combined Resistance	$\beta_N+\beta_V \le 1.2$ or $\beta_N^{1.5}+\beta_V^{1.5} \le 1$		67.5	Ok

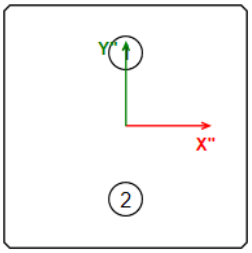
Load Case #2 : -N max : Nd=-25.0, Mxd=0.0, Myd=0.0, Vxd=-1.0, Vyd=-3.0

Steel Failure: Sufficient capacity **Concrete failure: Sufficient capacity**

Steel failure verification

Design value of normal compressive force in the column	$N_{c,Ed}$	-25	kN
Friction coefficient (between base plate and grout layer)	C_{fd}	0.2	
Joint friction resistance	$F_{f,Rd}$	5	kN
Resultant shear force	V_{sd}	3.16	kN
Resultant shear force taking account friction contribution	$V_{sd,f}$	0	kN

Resultant compression force (concrete) in (X"/Y") = F_{cc}(0.1/0.1)



Bolt Pos.	Acting axial force [kN]	Design tension resistance [kN]	Axial capacity usage [%]	Acting shear force [kN]	Design shear resistance [kN]	Shear capacity usage [%]	Interaction [%]
1	-0.605	56.5	1.1	0.0	20.0	0.0	n/r
2	-0.604	56.5	1.1	0.0	20.0	0.0	n/r

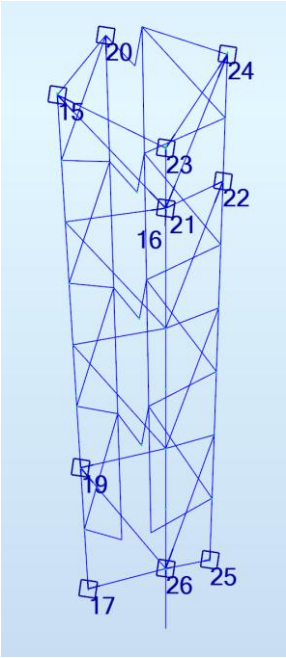
Concrete failure verifications

Proof	Load [kN]	Capacity [kN]	Utilization [%]	Status
Pull-Out Failure	0.0	0.0	0.0	Ok
Cone failure				Ok
Concrete decisive:				
1) Foundation (Plain Concrete)	0.0	0.0	n/r	
2) Assigned Hanger Reinforcement	0.0	0.0	n/r	
3) Requirement of Strut and Tie Model	0.0	0.0	n/r	
Splitting Failure				Ok
Concrete decisive:				
1) Foundation (Plain Concrete)	0.0	0.0	n/r	
2)Assigned Splitting Reinforcement || X	0.0	0.0	-	
3)Assigned Splitting Reinforcement || Y	0.0	0.0	-	
Blow-Out Failure	0.0	0.0	n/r	Ok
Pry-out failure	0.0	0.0	n/r	Ok
Edge failure				Ok
Concrete decisive:				
1) -X (Left) Edge (Plain Concrete)	0.0	0.0	n/r	
2) +X (Right) Edge (Plain Concrete)	0.0	0.0	n/r	
3) +Y (Top) Edge (Plain Concrete)	0.0	0.0	n/r	
4) -Y (Bottom) Edge (Plain Concrete)	0.0	0.0	n/r	
5)Assigned Edge Reinforcement (-X)	0.0	0.0	n/r	
6)Assigned Edge Reinforcement (+X)	0.0	0.0	n/r	
7)Assigned Edge Reinforcement (+Y)	0.0	0.0	n/r	
8)Assigned Edge Reinforcement (-Y)	0.0	0.0	n/r	
Combined Resistance	$\beta_N \leq 1$		0.0	Ok

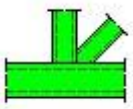
Išvada: kolonų bazės laikomoji galia užtikrinta.

2.7.3.9. Spragoto skerspjūvio rėmų kampinių kolonų mazgų projektavimas

Mazgų numeriai:



Mazgas nr. 15



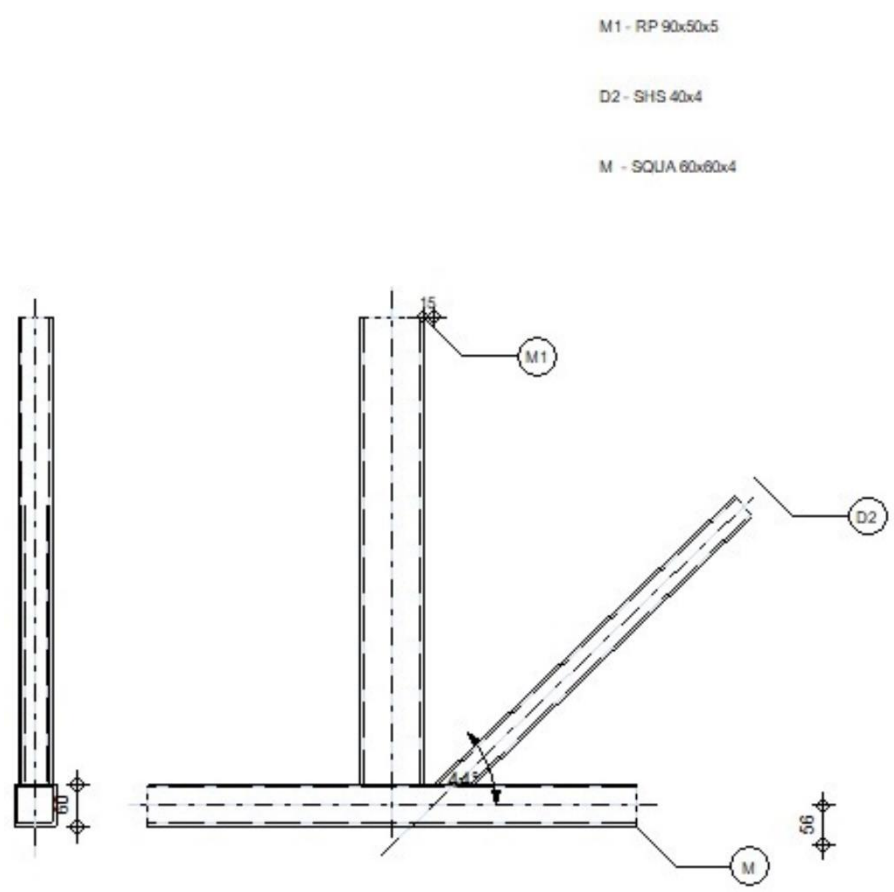
Robot Structural Analysis Professional 2023

Design of truss node connection

EN 1993-1-8:2005/AC:2009

OK

Ratio
0.42



GENERAL

Connection no.: 15
Connection name: Tube
Structure node: 6095
Structure members: 2471, 3433, 3445

GEOMETRY

MEMBERS

		Chord	Diagonal 1	Diagonal 2	Post	
Member no.:		2471		3433	3445	
Section:		SQUA 60x60x4		SHS 40x4	RP 90x50x5	
	h	60		40	90	mm
	b_f	60		40	50	mm
	t_w	4		4	5	mm
	t_f	4		4	5	mm
	r	4		0	5	mm
Material:		S 355		S 355	S 355	
	f_y	355.00		355.00	355.00	MPa
	f_u	470.00		470.00	470.00	MPa
Angle	θ	0.0		43.9	90.0	Deg
Length	l	2712		486	350	mm

OFFSET

e_0 = 56 [mm] Offset

SPACINGS

g_2 = 15 [mm] Spacing of 2nd diagonal

WELDS

a_d = 3 [mm] Thickness of welds of diagonals and posts

LOADS

Case: 105: ULS/97=1*1.35 + 6*0.78 + 2*0.91 + 7*1.30 1*1.35+6*0.78+2*0.91+7*1.30

CHORD

$N_{01,Ed}$ = 8.83 [kN] Axial force
$M_{01,Ed}$ = 0.17 [kN*m] Bending moment
$N_{02,Ed}$ = -0.00 [kN] Axial force
$M_{02,Ed}$ = -0.00 [kN*m] Bending moment

DIAGONAL 2

N_2 = -12.92 [kN] Axial force
M_2 = 0.01 [kN*m] Bending moment

POST

N_3 = -41.40 [kN] Axial force
M_3 = -0.43 [kN*m] Bending moment

Shear forces were not included in the connection verification. The connection was designed as a truss node.

RESULTS

CONSIDER NON-AXIAL CONNECTION OF MEMBERS IN THE NODE

M_0 = 0.49 [kN*m] Additional moment from eccentric connection of members $M_0 = (N_{02}-N_{01}) * e_0$
$\Sigma E_i J_i/L_i$ = 949577.05 [kN*m] Overall connection stiffness
ΔM_{01} = 0.03 [kN*m] Additional moment in the chord
ΔM_{02} = 0.03 [kN*m] Additional moment in the chord
ΔM_2 = 0.03 [kN*m] Additional moment in the diagonal
ΔM_3 = 0.39 [kN*m] Additional moment in the diagonal

CAPACITY VERIFICATION EUROCODE 3: EN 1993-1-8:2005

γ_{M5} = 1.00 Partial safety factor [Table 2.1]

FAILURE MODES FOR JOINTS (RHS CHORD MEMBERS) [Table 7.12] for $N_{i,Rd}$ and [Table 7.14] for $M_{i,Rd}$

GEOMETRICAL PARAMETERS

β = 0.92 Coefficient taking account of geometry of connection members $\beta = (b_2+h_2+b_3+h_3)/(4*b_0)$ [1.5 (6)]
γ = 7.50 Coefficient taking account of geometry of the chord $\gamma = b_0/(2*t_0)$ [1.5 (6)]
n = 0.00 Coefficient taking account of stresses in the chord $n_0 = \sigma_{0,Ed}/f_{y0}$
k_n = 1.00 Coefficient taking account of stresses in the chord $k_n = 1.0$

TUBE CHORD FACE FAILURE

DIAGONAL 2

$N_{2,Rd}$ = 182.99 [kN] Compression capacity $N_{2,Rd} = 8.9*k_n*f_{y0}*t_0^2*\sqrt{\gamma}/\sin(\theta_2) * \beta / \gamma_{M5}$
$|N_2| \le N_{2,Rd}$ |-12.92| < 182.99 verified (0.07)

POST

$N_{3,Rd}$ = 126.91 [kN] Compression capacity $N_{3,Rd} = 8.9*k_n*f_{y0}*t_0^2*\sqrt{\gamma}/\sin(\theta_3) * \beta / \gamma_{M5}$
$|N_3| \le N_{3,Rd}$ |-41.40| < 126.91 verified (0.33)

TUBE BRACE FAILURE

DIAGONAL 2

b_{eff} = 27 [mm] Effective width in the connection of the diagonal to the chord $b_{eff} = [10/(b_0/t_0)] * [(f_{y0}*t_0)/(f_{y2}*t_2)] * b_2$
$N_{2,Rd}$ = 185.55 [kN] Compression capacity $N_{2,Rd} = f_{y2}*t_2*(2*h_2-4*t_2 + b_2 + b_{eff})/\gamma_{M5}$
$|N_2| \le N_{2,Rd}$ |-12.92| < 185.55 verified (0.07)

POST

b_{eff} = 27 [mm] Effective width in the connection of the post to the chord $b_{eff} = [10/(b_0/t_0)] * [(f_{y0}*t_0)/(f_{y3}*t_3)] * b_3$
$N_{3,Rd}$ = 420.08 [kN] Compression capacity $N_{3,Rd} = f_{y3}*t_3*(2*h_3-4*t_3 + b_3 + b_{eff})/\gamma_{M5}$
$|N_3| \le N_{3,Rd}$ |-41.40| < 420.08 verified (0.10)

CHORD SHEAR

DIAGONAL 2

A_v = 5.34 [cm^2] Shear area of the chord $A_v = (2*h_0 + \alpha*b_0)*t_0$
$N_{2,Rd}$ = 157.82 [kN] Compression capacity $N_{2,Rd} = f_{y0}*A_v/[\sqrt{3}*\sin(\theta_2)] / \gamma_{M5}$
$|N_2| \le N_{2,Rd}$ |-12.92| < 157.82 verified (0.08)

POST

A_v = 5.34 [cm^2] Shear area of the chord $A_v = (2*h_0 + \alpha*b_0)*t_0$
$N_{3,Rd}$ = 109.45 [kN] Compression capacity $N_{3,Rd} = f_{y0}*A_v/[\sqrt{3}*\sin(\theta_3)] / \gamma_{M5}$
$|N_3| \le N_{3,Rd}$ |-41.40| < 109.45 verified (0.38)

CHORD RESISTANCE

$V_{pl,Rd}$ = 99.50 [kN] Plastic resistance for shear $V_{pl,Rd} = (A_v*f_{y0})/(\sqrt{3}*\gamma_{M0})$
$|V_{Ed}| \le V_{pl,Rd}$ |41.40| < 99.50 verified (0.42)
$N_{0,Rd}$ = 286.26 [kN] Tension capacity $N_{0,Rd} = [(A_0-A_v)*f_{y0} + A_v*f_{y0}*\sqrt{[1-(V_{Ed}/V_{pl,Rd})^2]}]/\gamma_{M5}$
$|N_{01}| \le N_{0,Rd}$ |8.83| < 286.26 verified (0.03)

CHORD SIDE WALL CRUSHING

DIAGONAL 2

$M_{2,Rd}$ = 2.56 [kN*m] Bending resistance $M_{2,Rd} = 0.5*f_{y0}*t_0*(h_2+5*t_0)^2/ \gamma_{M5}$
$|M_2+\Delta M_2| \le M_{2,Rd}$ |0.04| < 2.56 verified (0.01)

POST

$M_{3,Rd}$ = 8.59 [kN*m] Bending resistance $M_{3,Rd} = 0.5*f_{y0}*t_0*(h_3+5*t_0)^2/ \gamma_{M5}$
$|M_3+\Delta M_3| \le M_{3,Rd}$ |-0.04| < 8.59 verified (0.00)

VERIFICATION OF WELDS

DIAGONAL 2

β_w =	0.88		Correlation coefficient		[Table 4.1]
γ_{M2} =	1.25		Partial safety factor		[Table 2.1]
Longitudinal weld					
$\sigma_\perp$ =	-10.81	[MPa]	Normal stress in a weld		
$\tau_\perp$ =	-10.81	[MPa]	Perpendicular tangent stress		
τ_{II} =	-15.89	[MPa]	Tangent stress		
$\lvert\sigma_\perp\rvert \le 0.9 f_u/\gamma_{M2}$			$\lvert-10.81\rvert < 338.40$	verified	(0.03)
$\sqrt{[\sigma_\perp^2 + 3(\tau_\perp^2+\tau_{II}^2)]} \le f_u/(\beta_w\gamma_{M2})$			$35.00 < 429.71$	verified	(0.08)
Transverse inner weld					
$\sigma_\perp$ =	-20.09	[MPa]	Normal stress in a weld		
$\tau_\perp$ =	-7.34	[MPa]	Perpendicular tangent stress		
τ_{II} =	0.00	[MPa]	Tangent stress		
$\lvert\sigma_\perp\rvert \le 0.9 f_u/\gamma_{M2}$			$\lvert-20.09\rvert < 338.40$	verified	(0.06)
$\sqrt{[\sigma_\perp^2 + 3(\tau_\perp^2+\tau_{II}^2)]} \le f_u/(\beta_w\gamma_{M2})$			$23.77 < 429.71$	verified	(0.06)
Transverse outer weld					
$\sigma_\perp$ =	-9.15	[MPa]	Normal stress in a weld		
$\tau_\perp$ =	-20.82	[MPa]	Perpendicular tangent stress		
τ_{II} =	0.00	[MPa]	Tangent stress		
$\lvert\sigma_\perp\rvert \le 0.9 f_u/\gamma_{M2}$			$\lvert-9.15\rvert < 338.40$	verified	(0.03)
$\sqrt{[\sigma_\perp^2 + 3(\tau_\perp^2+\tau_{II}^2)]} \le f_u/(\beta_w\gamma_{M2})$			$37.20 < 429.71$	verified	(0.09)

POST

β_w =	0.88		Correlation coefficient		[Table 4.1]
γ_{M2} =	1.25		Partial safety factor		[Table 2.1]
Longitudinal weld					
$\sigma_\perp$ =	-42.04	[MPa]	Normal stress in a weld		
$\tau_\perp$ =	-42.04	[MPa]	Perpendicular tangent stress		
τ_{II} =	-0.00	[MPa]	Tangent stress		
$\lvert\sigma_\perp\rvert \le 0.9 f_u/\gamma_{M2}$			$\lvert-42.04\rvert < 338.40$	verified	(0.12)
$\sqrt{[\sigma_\perp^2 + 3(\tau_\perp^2+\tau_{II}^2)]} \le f_u/(\beta_w\gamma_{M2})$			$84.07 < 429.71$	verified	(0.20)
Transverse inner weld					
$\sigma_\perp$ =	-79.33	[MPa]	Normal stress in a weld		
$\tau_\perp$ =	-79.33	[MPa]	Perpendicular tangent stress		
τ_{II} =	0.00	[MPa]	Tangent stress		
$\lvert\sigma_\perp\rvert \le 0.9 f_u/\gamma_{M2}$			$\lvert-79.33\rvert < 338.40$	verified	(0.23)
$\sqrt{[\sigma_\perp^2 + 3(\tau_\perp^2+\tau_{II}^2)]} \le f_u/(\beta_w\gamma_{M2})$			$158.67 < 429.71$	verified	(0.37)

REMARKS

Eccentricity is too large. 56 [mm] > 15 [mm]

Connection conforms to the code Ratio 0.42

Išvada: laikomoji galia pakankama

Mazgas nr. 16

Robot Structural Analysis Professional 2023

Design of truss node connection

EN 1993-1-8:2005/AC:2009

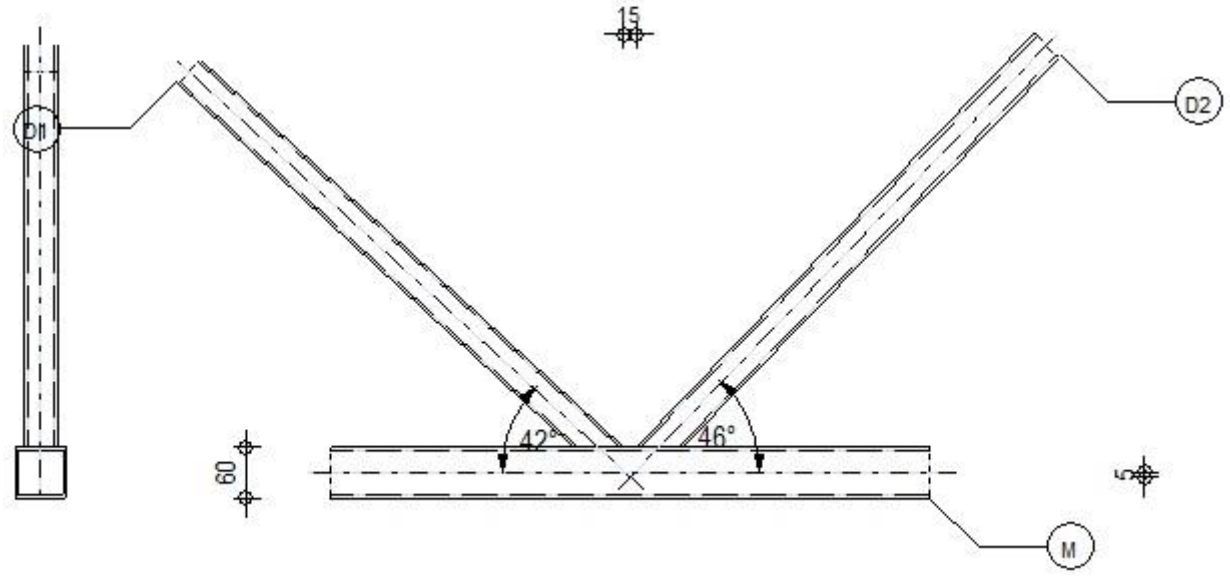
OK

Ratio **0.15**

D1 - SHS 40x4

D2 - SHS 40x4

M - SQUA 60x60x4



GENERAL

Connection no.: 16
Connection name: Tube
Structure node: 6280
Structure members: 3416, 3433, 3434

GEOMETRY

MEMBERS

		Chord	Diagonal 1	Diagonal 2	Post	
Member no.:		3416	3434	3433		
Section:		SQUA 60x60x4	SHS 40x4	SHS 40x4		

		Chord	Diagonal 1	Diagonal 2	Post	
	h	60	40	40		mm
	b_f	60	40	40		mm
	t_w	4	4	4		mm
	t_f	4	4	4		mm
	r	4	0	0		mm
Material:		S 355	S 355	S 355		
	f_y	355.00	355.00	355.00		MPa
	f_u	470.00	470.00	470.00		MPa
Angle	θ	0.0	42.5	46.0		Deg
Length	l	2700	480	486		mm

OFFSET

e_0 = 5 [mm] Offset

SPACINGS

g_2 = 15 [mm] Spacing of 2nd diagonal

WELDS

a_d = 3 [mm] Thickness of welds of diagonals and posts

LOADS

Case: 127: ULS/119=1*1.00 + 6*0.78 + 7*1.30 1*1.00+6*0.78+7*1.30

CHORD

$N_{01,Ed}$ = 11.53 [kN] Axial force
$M_{01,Ed}$ = 0.03 [kN*m] Bending moment
$N_{02,Ed}$ = 46.33 [kN] Axial force
$M_{02,Ed}$ = 0.02 [kN*m] Bending moment

DIAGONAL 1

N_1 = 16.01 [kN] Axial force
M_1 = 0.05 [kN*m] Bending moment

DIAGONAL 2

N_2 = -13.07 [kN] Axial force
M_2 = 0.01 [kN*m] Bending moment

Shear forces were not included in the connection verification. The connection was designed as a truss node.

RESULTS

CONSIDER NON-AXIAL CONNECTION OF MEMBERS IN THE NODE

M_0 = -0.18 [kN*m] Additional moment from eccentric connection of members $M_0 = (N_{02}-N_{01}) * e_0$
$\Sigma E_i J_i/L_i$ = 240708.50 [kN*m] Overall connection stiffness
ΔM_{01} = -0.05 [kN*m] Additional moment in the chord
ΔM_{02} = -0.05 [kN*m] Additional moment in the chord
ΔM_2 = -0.04 [kN*m] Additional moment in the diagonal
ΔM_1 = -0.04 [kN*m] Additional moment in the diagonal

CAPACITY VERIFICATION EUROCODE 3: EN 1993-1-8:2005

γ_{M5} = 1.00 Partial safety factor [Table 2.1]

FAILURE MODES FOR JOINTS (RHS CHORD MEMBERS) [Table 7.10] for $N_{i,Rd}$ and [Table 7.14] for $M_{i,Rd}$

GEOMETRICAL PARAMETERS

β = 0.67	Coefficient taking account of geometry of connection members	$\beta = (b_2+b_1)/(2*b_0)$	[1.5 (6)]
γ = 7.50	Coefficient taking account of geometry of the chord	$\gamma = b_0/(2*t_0)$	[1.5 (6)]
k_n = 1.00	Coefficient taking account of stresses in the chord	k_n = 1.0	

TUBE CHORD FACE FAILURE

DIAGONAL 2

$N_{2,Rd}$ = 128.25 [kN] Compression capacity $N_{2,Rd} = 8.9*k_n*f_{y0}*t_0^2*\sqrt{\gamma}/\sin(\theta_2) * \beta$

$\lvert N_2\rvert \le N_{2,Rd}$	|-13.07| < 128.25	verified	(0.10)

$M_{2,Rd}$ = 1.41 [kN*m] Bending resistance $M_{2,Rd} = k_n*f_{y0}*t_0^2*h_2*[1/(2*\eta) + 2/\sqrt{[1-\beta] + \eta/(1-\beta)}] / \gamma_{M5}$

$\lvert M_2+\Delta M_2\rvert \le M_{2,Rd}$	|-0.03| < 1.41	verified	(0.02)
$N_2/N_{2,Rd} + (M_2+\Delta M_2)/M_{2,Rd} \le 1$	0.12 < 1.00	verified	(0.12)

DIAGONAL 1

$N_{1,Rd}$ = 136.62 [kN] Tension capacity $N_{1,Rd} = 8.9*k_n*f_{y0}*t_0^2*\sqrt{\gamma}/\sin(\theta_1) * \beta$

$\lvert N_1\rvert \le N_{1,Rd}$	|16.01| < 136.62	verified	(0.12)

$M_{1,Rd}$ = 1.41 [kN*m] Bending resistance $M_{1,Rd} = k_n*f_{y0}*t_0^2*h_1*[1/(2*\eta) + 2/\sqrt{[1-\beta] + \eta/(1-\beta)}] / \gamma_{M5}$

$\lvert M_1+\Delta M_1\rvert \le M_{1,Rd}$	|0.01| < 1.41	verified	(0.01)
$N_1/N_{1,Rd} + (M_1+\Delta M_1)/M_{1,Rd} \le 1$	0.12 < 1.00	verified	(0.12)

CHORD PUNCHING

DIAGONAL 2

$b_{e,p}$ = 27 [mm] Effective width for punching shear $b_{e,p} = (10*b_2)/(b_0/t_0)$

$N_{2,Rd}$ = 202.58 [kN] Compression capacity $N_{2,Rd} = f_{y0}*t_0/(\sqrt{3}*\sin(\theta_2))*[2*h_2/\sin(\theta_2)+b_2+b_{e,p}]/\gamma_{M5}$

$\lvert N_2\rvert \le N_{2,Rd}$	|-13.07| < 202.58	verified	(0.06)

DIAGONAL 1

$b_{e,p}$ = 27 [mm] Effective width for punching shear $b_{e,p} = (10*b_1)/(b_0/t_0)$

$N_{1,Rd}$ = 224.60 [kN] Tension capacity $N_{1,Rd} = f_{y0}*t_0/(\sqrt{3}*\sin(\theta_1))*[2*h_1/\sin(\theta_1)+b_1+b_{e,p}]/\gamma_{M5}$

$\lvert N_1\rvert \le N_{1,Rd}$	|16.01| < 224.60	verified	(0.07)

CHORD SHEAR

DIAGONAL 2

A_v = 5.34 [cm^2] Shear area of the chord $A_v = (2*h_0 + \alpha*b_0)*t_0$

$N_{2,Rd}$ = 152.08 [kN] Compression capacity $N_{2,Rd} = f_{y0}*A_v/[\sqrt{3}*\sin(\theta_2)] / \gamma_{M5}$

$\lvert N_2\rvert \le N_{2,Rd}$	|-13.07| < 152.08	verified	(0.09)

DIAGONAL 1

A_v = 5.34 [cm^2] Shear area of the chord $A_v = (2*h_0 + \alpha*b_0)*t_0$

$N_{1,Rd}$ =	162.01	[kN]	Tension capacity		$N_{1,Rd} = f_{y0}*A_v/[\sqrt{3}*\sin(\theta_1)] / \gamma_{M5}$
$\|N_1\| \le N_{1,Rd}$			|16.01| < 162.01	verified	(0.10)

CHORD RESISTANCE

$V_{pl,Rd}$ =	99.50	[kN]	Plastic resistance for shear		$V_{pl,Rd} = (A_v*f_{y0})/(\sqrt{3}*\gamma_{M0})$
$\|V_{Ed}\| \le V_{pl,Rd}$			|10.82| < 99.50	verified	(0.11)
$N_{0,Rd}$ =	302.33	[kN]	Tension capacity		$N_{0,Rd} = [(A_0-A_v)*f_{y0} + A_v*f_{y0}*\sqrt{[1-(V_{Ed}/V_{pl,Rd})^2]}]/\gamma_{M5}$
$\|N_{02}\| \le N_{0,Rd}$			|46.33| < 302.33	verified	(0.15)

VERIFICATION OF WELDS

DIAGONAL 2

β_w =	0.88		Correlation coefficient		[Table 4.1]
γ_{M2} =	1.25		Partial safety factor		[Table 2.1]
Longitudinal weld					
$\sigma_\perp$ =	-11.60	[MPa]	Normal stress in a weld		
$\tau_\perp$ =	-11.60	[MPa]	Perpendicular tangent stress		
τ_{II} =	-15.83	[MPa]	Tangent stress		
$\|\sigma_\perp\| \le 0.9*f_u/\gamma_{M2}$			|-11.60| < 338.40	verified	(0.03)
$\sqrt{[\sigma_\perp^2 + 3*(\tau_\perp^2+\tau_{II}^2)]} \le f_u/(\beta_w*\gamma_{M2})$			35.92 < 429.71	verified	(0.08)
Transverse inner weld					
$\sigma_\perp$ =	-20.49	[MPa]	Normal stress in a weld		
$\tau_\perp$ =	-7.74	[MPa]	Perpendicular tangent stress		
τ_{II} =	0.00	[MPa]	Tangent stress		
$\|\sigma_\perp\| \le 0.9*f_u/\gamma_{M2}$			|-20.49| < 338.40	verified	(0.06)
$\sqrt{[\sigma_\perp^2 + 3*(\tau_\perp^2+\tau_{II}^2)]} \le f_u/(\beta_w*\gamma_{M2})$			24.49 < 429.71	verified	(0.06)
Transverse outer weld					
$\sigma_\perp$ =	-10.08	[MPa]	Normal stress in a weld		
$\tau_\perp$ =	-21.48	[MPa]	Perpendicular tangent stress		
τ_{II} =	0.00	[MPa]	Tangent stress		
$\|\sigma_\perp\| \le 0.9*f_u/\gamma_{M2}$			|-10.08| < 338.40	verified	(0.03)
$\sqrt{[\sigma_\perp^2 + 3*(\tau_\perp^2+\tau_{II}^2)]} \le f_u/(\beta_w*\gamma_{M2})$			38.55 < 429.71	verified	(0.09)

DIAGONAL 1

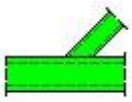
β_w =	0.88		Correlation coefficient		[Table 4.1]
γ_{M2} =	1.25		Partial safety factor		[Table 2.1]
Longitudinal weld					
$\sigma_\perp$ =	12.85	[MPa]	Normal stress in a weld		
$\tau_\perp$ =	12.85	[MPa]	Perpendicular tangent stress		
τ_{II} =	19.83	[MPa]	Tangent stress		
$\|\sigma_\perp\| \le 0.9*f_u/\gamma_{M2}$			|12.85| < 338.40	verified	(0.04)
$\sqrt{[\sigma_\perp^2 + 3*(\tau_\perp^2+\tau_{II}^2)]} \le f_u/(\beta_w*\gamma_{M2})$			42.90 < 429.71	verified	(0.10)
Transverse inner weld					
$\sigma_\perp$ =	26.72	[MPa]	Normal stress in a weld		
$\tau_\perp$ =	13.98	[MPa]	Perpendicular tangent stress		
τ_{II} =	0.00	[MPa]	Tangent stress		
$\|\sigma_\perp\| \le 0.9*f_u/\gamma_{M2}$			|26.72| < 338.40	verified	(0.08)
$\sqrt{[\sigma_\perp^2 + 3*(\tau_\perp^2+\tau_{II}^2)]} \le f_u/(\beta_w*\gamma_{M2})$			36.06 < 429.71	verified	(0.08)
Transverse outer weld					
$\sigma_\perp$ =	5.52	[MPa]	Normal stress in a weld		
$\tau_\perp$ =	23.43	[MPa]	Perpendicular tangent stress		
τ_{II} =	0.00	[MPa]	Tangent stress		

$\sigma_\perp$ = 5.52 [MPa] Normal stress in a weld			
$\lvert\sigma_\perp\rvert \le 0.9*f_u/\gamma_{M2}$	|5.52| < 338.40	verified	(0.02)
$\sqrt{[\sigma_\perp^2 + 3*(\tau_\perp^2+\tau_{II}^2)]} \le f_u/(\beta_w*\gamma_{M2})$	40.95 < 429.71	verified	(0.10)

Connection conforms to the code Ratio 0.15

Išvada: laikomoji galia pakankama

Mazgas nr. 17



Robot Structural Analysis Professional 2023

Design of truss node connection

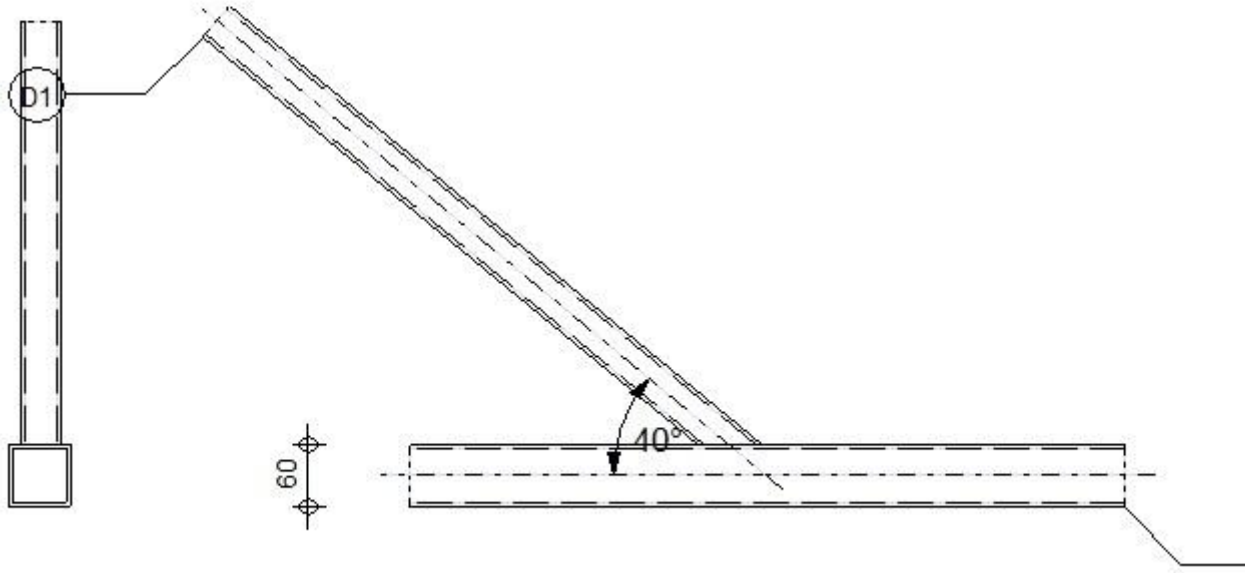
EN 1993-1-8:2005/AC:2009

OK

Ratio **0.17**

D1 - SHS 40x4

M - SQUA 60x



GENERAL

Connection no.: 17
Connection name: Tube
Structure node: 6771
Structure members: 2471, 3440

GEOMETRY

MEMBERS

		Chord	Diagonal 1	Diagonal 2	Post	
Member no.:		2471	3440			
Section:		SQUA 60x60x4	SHS 40x4			
	h	60	40			mm
	b_f	60	40			mm
	t_w	4	4			mm
	t_f	4	4			mm
	r	4	0			mm
Material:		S 355	S 355			
	f_y	355.00	355.00			MPa
	f_u	470.00	470.00			MPa
Angle	θ	0.0	39.5			Deg
Length	l	2712	412			mm

WELDS

a_d = 3 [mm] Thickness of welds of diagonals and posts

LOADS

Case: 105: ULS/97=1*1.35 + 6*0.78 + 2*0.91 + 7*1.30 1*1.35+6*0.78+2*0.91+7*1.30

CHORD

$N_{01,Ed}$ = 3.36 [kN] Axial force
$M_{01,Ed}$ = -0.55 [kN*m] Bending moment
$N_{02,Ed}$ = -4.24 [kN] Axial force
$M_{02,Ed}$ = -0.44 [kN*m] Bending moment

DIAGONAL 1

N_1 = 9.88 [kN] Axial force
M_1 = 0.11 [kN*m] Bending moment

Shear forces were not included in the connection verification. The connection was designed as a truss node.

RESULTS

CAPACITY VERIFICATION EUROCODE 3: EN 1993-1-8:2005

γ_{M5} = 1.00 Partial safety factor [Table 2.1]

FAILURE MODES FOR JOINTS (RHS CHORD MEMBERS) [Table 7.10] for $N_{i,Rd}$ and [Table 7.14] for $M_{i,Rd}$

GEOMETRICAL PARAMETERS

β = 0.67	Coefficient taking account of geometry of connection members	$\beta = b_1/b_0$ [1.5 (6)]
γ = 7.50	Coefficient taking account of geometry of the chord	$\gamma = b_0/(2*t_0)$ [1.5 (6)]
n = 0.11	Coefficient taking account of stresses in the chord	$n_0 = \sigma_{0,Ed}/f_{y0}$
k_n = 1.00	Coefficient taking account of stresses in the chord	$k_n = 1.0$

TUBE CHORD FACE FAILURE

DIAGONAL 1

$N_{1,Rd}$ = 117.97 [kN] Tension capacity			$N_{1,Rd} = [(k_n*f_{y0}*t_0^2)/(1-\beta)*\sin(\theta_1)]*[2*\beta/\sin(\theta_1) + 4*\sqrt{(1-\beta)}] /\gamma_{M5}$
$\lvert N_1\rvert \le N_{1,Rd}$	|9.88| < 117.97	verified	(0.08)
$M_{1,Rd}$ = 1.41 [kN*m] Bending resistance			$M_{1,Rd} = k_n*f_{y0}*t_0^2*h_1*[1/(2*\eta) + 2/\sqrt{[1-\beta] + \eta/(1-\beta)}] / \gamma_{M5}$
$\lvert M_1\rvert \le M_{1,Rd}$	|0.11| < 1.41	verified	(0.08)
$N_1/N_{1,Rd} + M_1/M_{1,Rd} \le 1$	0.16 < 1.00	verified	(0.16)

CHORD SHEAR

DIAGONAL 1

A_v = 4.80	[cm^2]	Shear area of the chord		$A_v = 2*h_0*t_0$
$N_{1,Rd}$ = 154.62	[kN]	Tension capacity		$N_{1,Rd} = f_{y0}*A_v/[\sqrt{3}*\sin(\theta_1)] / \gamma_{M5}$
$\lvert N_1\rvert \le N_{1,Rd}$		|9.88| < 154.62	verified	(0.06)

CHORD RESISTANCE

$N_{0,Rd}$ = 303.45	[kN]	Compression capacity		$N_{0,Rd} = (A_0*f_{y0})/\gamma_{M5}$
$\lvert N_{02}\rvert \le N_{0,Rd}$		|-4.24| < 303.45	verified	(0.01)

VERIFICATION OF WELDS

DIAGONAL 1

β_w = 0.88		Correlation coefficient		[Table 4.1]
γ_{M2} = 1.25		Partial safety factor		[Table 2.1]
Longitudinal weld				
$\sigma_\perp$ = 32.10	[MPa]	Normal stress in a weld		
$\tau_\perp$ = 32.10	[MPa]	Perpendicular tangent stress		
τ_{II} = 20.20	[MPa]	Tangent stress		
$\lvert\sigma_\perp\rvert \le 0.9*f_u/\gamma_{M2}$		|32.10| < 338.40	verified	(0.09)
$\sqrt{[\sigma_\perp^2 + 3*(\tau_\perp^2+\tau_{II}^2)]} \le f_u/(\beta_w*\gamma_{M2})$		73.13 < 429.71	verified	(0.17)

Connection conforms to the code Ratio 0.17

Išvada: laikomoji galia pakankama

Mazgas nr. 19

Robot Structural Analysis Professional 2023

Design of truss node connection

EN 1993-1-8:2005/AC:2009

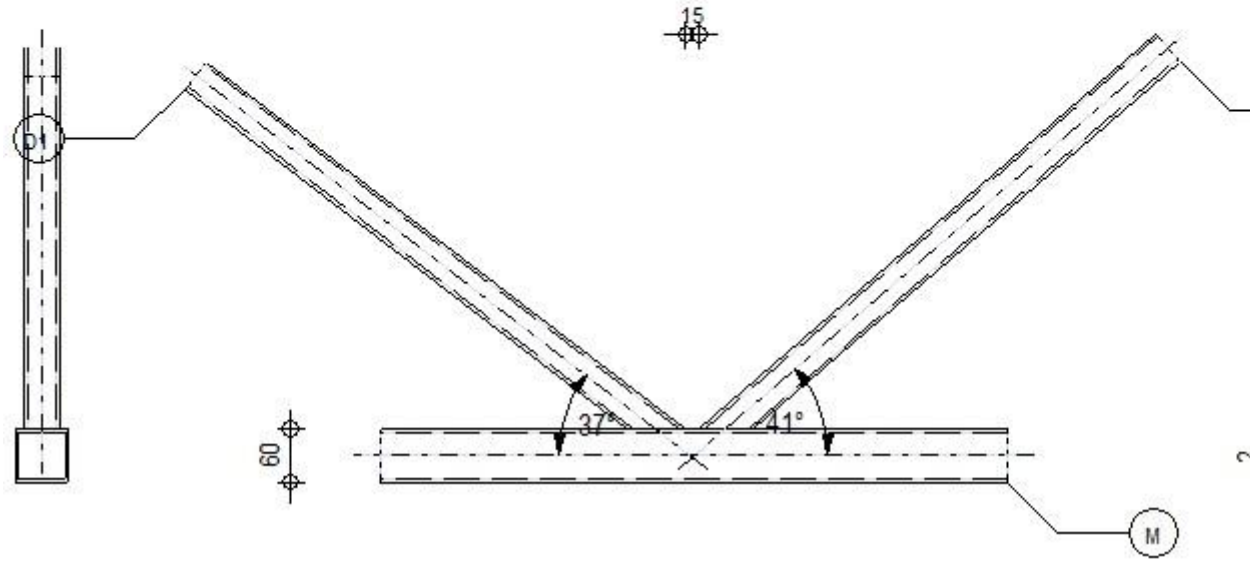
OK

Ratio
0.29

D1 - SHS 40x4

D2 - SHS 40x4

M - SQUA 60x60x4



GENERAL

Connection no.: 19
Connection name: Tube
Structure node: 6306
Structure members: 2471, 3438, 3439

GEOMETRY

MEMBERS

		Chord	Diagonal 1	Diagonal 2	Post	
Member no.:		2471	3439	3438		
Section:		SQUA 60x60x4	SHS 40x4	SHS 40x4		
	h	60	40	40		mm
	b_f	60	40	40		mm
	t_w	4	4	4		mm
	t_f	4	4	4		mm
	r	4	0	0		mm

		Chord	Diagonal 1	Diagonal 2	Post	
Material:		S 355	S 355	S 355		
	f_y	355.00	355.00	355.00		MPa
	f_u	470.00	470.00	470.00		MPa
Angle	θ	0.0	37.5	40.8		Deg
Length	l	2712	431	439		mm

OFFSET

e_0 = 2 [mm] Offset

SPACINGS

g_2 = 15 [mm] Spacing of 2nd diagonal

WELDS

a_d = 3 [mm] Thickness of welds of diagonals and posts

LOADS

Case: 105: ULS/97=1*1.35 + 6*0.78 + 2*0.91 + 7*1.30 1*1.35+6*0.78+2*0.91+7*1.30

CHORD

$N_{01,Ed}$ = 23.98 [kN] Axial force
$M_{01,Ed}$ = -0.06 [kN*m] Bending moment
$N_{02,Ed}$ = -7.90 [kN] Axial force
$M_{02,Ed}$ = -0.21 [kN*m] Bending moment

DIAGONAL 1

N_1 = -21.59 [kN] Axial force
M_1 = -0.22 [kN*m] Bending moment

DIAGONAL 2

N_2 = 18.90 [kN] Axial force
M_2 = 0.08 [kN*m] Bending moment

Shear forces were not included in the connection verification. The connection was designed as a truss node.

RESULTS

CONSIDER NON-AXIAL CONNECTION OF MEMBERS IN THE NODE

M_0 = 0.06 [kN*m] Additional moment from eccentric connection of members $M_0 = (N_{02}-N_{01}) * e_0$
$\Sigma E_i J_i / L_i$ = 251682.72 [kN*m] Overall connection stiffness
ΔM_{01} = 0.02 [kN*m] Additional moment in the chord
ΔM_{02} = 0.02 [kN*m] Additional moment in the chord
ΔM_2 = 0.01 [kN*m] Additional moment in the diagonal
ΔM_1 = 0.01 [kN*m] Additional moment in the diagonal

CAPACITY VERIFICATION EUROCODE 3: EN 1993-1-8:2005

γ_{M5} = 1.00 Partial safety factor [Table 2.1]

FAILURE MODES FOR JOINTS (RHS CHORD MEMBERS) [Table 7.10] for $N_{i,Rd}$ and [Table 7.14] for $M_{i,Rd}$

GEOMETRICAL PARAMETERS

β = 0.67	Coefficient taking account of geometry of connection members	$\beta = (b_2+b_1)/(2*b_0)$ [1.5 (6)]
γ = 7.50	Coefficient taking account of geometry of the chord	$\gamma = b_0/(2*t_0)$ [1.5 (6)]
n = 0.07	Coefficient taking account of stresses in the chord	$n_0 = \sigma_{0,Ed}/f_{y0}$
k_n = 1.00	Coefficient taking account of stresses in the chord	$k_n = 1.0$

TUBE CHORD FACE FAILURE

DIAGONAL 2

$N_{2,Rd}$ = 141.20 [kN]	Tension capacity			$N_{2,Rd} = 8.9*k_n*f_{y0}*t_0^2*\sqrt{\gamma}/\sin(\theta_2) * \beta$
$\lvert N_2 \rvert \le N_{2,Rd}$		18.90 < 141.20	verified	(0.13)
$M_{2,Rd}$ = 1.41 [kN*m]	Bending resistance			$M_{2,Rd} = k_n*f_{y0}*t_0^2*h_2*[1/(2*\eta) + 2/\sqrt{[1-\beta]} + \eta/(1-\beta)] / \gamma_{M5}$
$\lvert M_2+\Delta M_2 \rvert \le M_{2,Rd}$		0.09 < 1.41	verified	(0.07)
$N_2/N_{2,Rd} + (M_2+\Delta M_2)/M_{2,Rd} \le 1$		0.20 < 1.00	verified	(0.20)

DIAGONAL 1

$N_{1,Rd}$ = 151.65 [kN]	Compression capacity			$N_{1,Rd} = 8.9*k_n*f_{y0}*t_0^2*\sqrt{\gamma}/\sin(\theta_1) * \beta$
$\lvert N_1 \rvert \le N_{1,Rd}$		|-21.59| < 151.65	verified	(0.14)
$M_{1,Rd}$ = 1.41 [kN*m]	Bending resistance			$M_{1,Rd} = k_n*f_{y0}*t_0^2*h_1*[1/(2*\eta) + 2/\sqrt{[1-\beta]} + \eta/(1-\beta)] / \gamma_{M5}$
$\lvert M_1+\Delta M_1 \rvert \le M_{1,Rd}$		|-0.21| < 1.41	verified	(0.15)
$N_1/N_{1,Rd} + (M_1+\Delta M_1)/M_{1,Rd} \le 1$		0.29 < 1.00	verified	(0.29)

CHORD PUNCHING

DIAGONAL 2

$b_{e,p}$ = 27 [mm]	Effective width for punching shear			$b_{e,p} = (10*b_2)/(b_0/t_0)$
$N_{2,Rd}$ = 237.13 [kN]	Tension capacity			$N_{2,Rd} = f_{y0}*t_0/(\sqrt{3}*\sin(\theta_2))*[2*h_2/\sin(\theta_2)+b_2+b_{e,p}]/\gamma_{M5}$
$\lvert N_2 \rvert \le N_{2,Rd}$		18.90 < 237.13	verified	(0.08)

DIAGONAL 1

$b_{e,p}$ = 27 [mm]	Effective width for punching shear			$b_{e,p} = (10*b_1)/(b_0/t_0)$
$N_{1,Rd}$ = 266.87 [kN]	Compression capacity			$N_{1,Rd} = f_{y0}*t_0/(\sqrt{3}*\sin(\theta_1))*[2*h_1/\sin(\theta_1)+b_1+b_{e,p}]/\gamma_{M5}$
$\lvert N_1 \rvert \le N_{1,Rd}$		|-21.59| < 266.87	verified	(0.08)

CHORD SHEAR

DIAGONAL 2

A_v = 5.34 [cm^2]	Shear area of the chord			$A_v = (2*h_0 + \alpha*b_0)*t_0$
$N_{2,Rd}$ = 167.45 [kN]	Tension capacity			$N_{2,Rd} = f_{y0}*A_v/[\sqrt{3}*\sin(\theta_2)] / \gamma_{M5}$
$\lvert N_2 \rvert \le N_{2,Rd}$		18.90 < 167.45	verified	(0.11)

DIAGONAL 1

A_v = 5.34 [cm^2]	Shear area of the chord			$A_v = (2*h_0 + \alpha*b_0)*t_0$
$N_{1,Rd}$ = 179.83 [kN]	Compression capacity			$N_{1,Rd} = f_{y0}*A_v/[\sqrt{3}*\sin(\theta_1)] / \gamma_{M5}$
$\lvert N_1 \rvert \le N_{1,Rd}$		|-21.59| < 179.83	verified	(0.12)

CHORD RESISTANCE

$V_{pl,Rd}$ = 99.50 [kN]	Plastic resistance for shear		$V_{pl,Rd} = (A_v*f_{y0})/(\sqrt{3}*\gamma_{M0})$

$\|V_{Ed}\| \le V_{pl,Rd}$	$\|13.14\| < 99.50$	verified	(0.13)	
$N_{0,Rd}$ = 301.79 [kN] Tension capacity	$N_{0,Rd} = [(A_0-A_v)*f_{y0} + A_v*f_{y0}*\sqrt{[1-(V_{Ed}/V_{pl,Rd})^2]}]/\gamma_{M5}$			
$\|N_{01}\| \le N_{0,Rd}$	$\|23.98\| < 301.79$	verified	(0.08)	

VERIFICATION OF WELDS

DIAGONAL 2

β_w = 0.88	Correlation coefficient		[Table 4.1]
γ_{M2} = 1.25	Partial safety factor		[Table 2.1]
Longitudinal weld			
$\sigma_\perp$ = 14.39 [MPa]	Normal stress in a weld		
$\tau_\perp$ = 14.39 [MPa]	Perpendicular tangent stress		
τ_{II} = 23.56 [MPa]	Tangent stress		
$\|\sigma_\perp\| \le 0.9*f_u/\gamma_{M2}$	$\|14.39\| < 338.40$	verified	(0.04)
$\sqrt{[\sigma_\perp^2 + 3*(\tau_\perp^2+\tau_{II}^2)]} \le f_u/(\beta_w*\gamma_{M2})$	$49.92 < 429.71$	verified	(0.12)
Transverse inner weld			
$\sigma_\perp$ = 31.58 [MPa]	Normal stress in a weld		
$\tau_\perp$ = 17.34 [MPa]	Perpendicular tangent stress		
τ_{II} = 0.00 [MPa]	Tangent stress		
$\|\sigma_\perp\| \le 0.9*f_u/\gamma_{M2}$	$\|31.58\| < 338.40$	verified	(0.09)
$\sqrt{[\sigma_\perp^2 + 3*(\tau_\perp^2+\tau_{II}^2)]} \le f_u/(\beta_w*\gamma_{M2})$	$43.58 < 429.71$	verified	(0.10)
Transverse outer weld			
$\sigma_\perp$ = 4.37 [MPa]	Normal stress in a weld		
$\tau_\perp$ = 26.76 [MPa]	Perpendicular tangent stress		
τ_{II} = 0.00 [MPa]	Tangent stress		
$\|\sigma_\perp\| \le 0.9*f_u/\gamma_{M2}$	$\|4.37\| < 338.40$	verified	(0.01)
$\sqrt{[\sigma_\perp^2 + 3*(\tau_\perp^2+\tau_{II}^2)]} \le f_u/(\beta_w*\gamma_{M2})$	$46.55 < 429.71$	verified	(0.11)

DIAGONAL 1

β_w = 0.88	Correlation coefficient		[Table 4.1]
γ_{M2} = 1.25	Partial safety factor		[Table 2.1]
Longitudinal weld			
$\sigma_\perp$ = -14.65 [MPa]	Normal stress in a weld		
$\tau_\perp$ = -14.65 [MPa]	Perpendicular tangent stress		
τ_{II} = -27.01 [MPa]	Tangent stress		
$\|\sigma_\perp\| \le 0.9*f_u/\gamma_{M2}$	$\|-14.65\| < 338.40$	verified	(0.04)
$\sqrt{[\sigma_\perp^2 + 3*(\tau_\perp^2+\tau_{II}^2)]} \le f_u/(\beta_w*\gamma_{M2})$	$55.20 < 429.71$	verified	(0.13)
Transverse inner weld			
$\sigma_\perp$ = -38.05 [MPa]	Normal stress in a weld		
$\tau_\perp$ = -28.07 [MPa]	Perpendicular tangent stress		
τ_{II} = 0.00 [MPa]	Tangent stress		
$\|\sigma_\perp\| \le 0.9*f_u/\gamma_{M2}$	$\|-38.05\| < 338.40$	verified	(0.11)
$\sqrt{[\sigma_\perp^2 + 3*(\tau_\perp^2+\tau_{II}^2)]} \le f_u/(\beta_w*\gamma_{M2})$	$61.73 < 429.71$	verified	(0.14)
Transverse outer weld			
$\sigma_\perp$ = 6.19 [MPa]	Normal stress in a weld		
$\tau_\perp$ = -26.42 [MPa]	Perpendicular tangent stress		
τ_{II} = 0.00 [MPa]	Tangent stress		
$\|\sigma_\perp\| \le 0.9*f_u/\gamma_{M2}$	$\|6.19\| < 338.40$	verified	(0.02)
$\sqrt{[\sigma_\perp^2 + 3*(\tau_\perp^2+\tau_{II}^2)]} \le f_u/(\beta_w*\gamma_{M2})$	$46.18 < 429.71$	verified	(0.11)

Connection conforms to the code Ratio 0.29

Išvada: laikomoji galia pakankama

Mazgas nr. 20

Robot Structural Analysis Professional 2023

Design of truss node connection

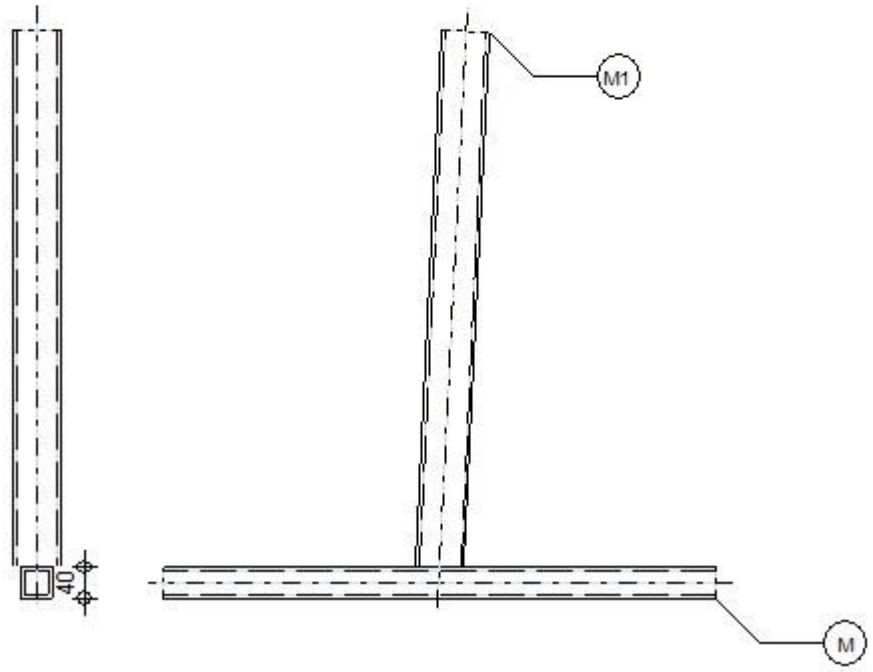
EN 1993-1-8:2005/AC:2009

OK

Ratio **0.28**

M1 - SQUA 60x60x4

M - SHS 40x4



GENERAL

Connection no.: 20
Connection name: Tube
Structure node: 6111
Structure members: 3399, 2482

GEOMETRY

MEMBERS

		Chord	Diagonal 1	Diagonal 2	Post	
Member no.:		3399			2482	
Section:		SHS 40x4			SQUA 60x60x4	
	h	40			60	mm
	b_f	40			60	mm
	t_w	4			4	mm
	t_f	4			4	mm
	r	0			4	mm
Material:		S 355			S 355	
	f_y	355.00			355.00	MPa
	f_u	470.00			470.00	MPa
Angle	θ	0.0			87.3	Deg
Length	l	128			2623	mm

WELDS

a_d = 3 [mm] Thickness of welds of diagonals and posts

LOADS

Case: 116: ULS/108=1*1.00 + 3*0.78 + 8*1.30 1*1.00+3*0.78+8*1.30

CHORD

$N_{01,Ed}$ = -5.75 [kN] Axial force
$M_{01,Ed}$ = -0.87 [kN*m] Bending moment
$N_{02,Ed}$ = 0.00 [kN] Axial force
$M_{02,Ed}$ = 0.00 [kN*m] Bending moment

POST

N_3 = 7.81 [kN] Axial force
M_3 = 0.23 [kN*m] Bending moment

Shear forces were not included in the connection verification. The connection was designed as a truss node.

RESULTS

CAPACITY VERIFICATION EUROCODE 3: EN 1993-1-8:2005

γ_{M5} = 1.00 Partial safety factor [Table 2.1]

The connection geometry does not comply with the table. [7.9]

FAILURE MODES FOR JOINTS (RHS CHORD MEMBERS) [Table 7.11] for $N_{i,Rd}$

GEOMETRICAL PARAMETERS

β = 1.50 Coefficient taking account of geometry of connection members $\beta = b_3/b_0$ [1.5 (6)]
γ = 5.00 Coefficient taking account of geometry of the chord $\gamma = b_0/(2*t_0)$ [1.5 (6)]

TUBE BRACE FAILURE

POST

b_{eff} =	60	[mm]	Effective width in the connection of the post to the chord	$b_{eff} = [10/(b_0/t_0)] * [(f_{y0}*t_0)/(f_{y3}*t_3)] * b_3$	
$N_{3,Rd}$ =	318.08	[kN]	Tension capacity	$N_{3,Rd} = f_{y3}*t_3*(2*h_3-4*t_3 + 2*b_{eff})/\gamma_{M5}$	
$\|N_3\| \le N_{3,Rd}$			$\|7.81\| < 318.08$	verified	(0.02)

CHORD SIDE WALL BUCKLING

POST

f_b =	325.54	[MPa]	Buckling strength of the chord side wall	$f_b = \chi*f_{y0}$	
$N_{3,Rd}$ =	208.75	[kN]	Tension capacity	$N_{3,Rd} = [(k_n*f_b*t_0)/\sin(\theta_3)]*[(2*h_3)/\sin(\theta_3) + 10*t_0] /\gamma_{M5}$	
$\|N_3\| \le N_{3,Rd}$			$\|7.81\| < 208.75$	verified	(0.04)

CHORD SHEAR

POST

A_v =	3.20	[cm^2]	Shear area of the chord	$A_v = 2*h_0*t_0$	
$N_{3,Rd}$ =	65.66	[kN]	Tension capacity	$N_{3,Rd} = f_{y0}*A_v/[\sqrt{3}*\sin(\theta_3)] / \gamma_{M5}$	
$\|N_3\| \le N_{3,Rd}$			$\|7.81\| < 65.66$	verified	(0.12)

CHORD RESISTANCE

$N_{0,Rd}$ =	201.64	[kN]	Compression capacity	$N_{0,Rd} = (A_0*f_{y0})/\gamma_{M5}$	
$\|N_{01}\| \le N_{0,Rd}$			$\|-5.75\| < 201.64$	verified	(0.03)

VERIFICATION OF WELDS

POST

β_w =	0.88		Correlation coefficient		[Table 4.1]
γ_{M2} =	1.25		Partial safety factor		[Table 2.1]
Longitudinal weld					
$\sigma_\perp$ =	61.06	[MPa]	Normal stress in a weld		
$\tau_\perp$ =	61.06	[MPa]	Perpendicular tangent stress		
τ_{II} =	1.02	[MPa]	Tangent stress		
$\|\sigma_\perp\| \le 0.9*f_u/\gamma_{M2}$			$\|61.06\| < 338.40$	verified	(0.18)
$\sqrt{[\sigma_\perp^2 + 3*(\tau_\perp^2+\tau_{II}^2)]} \le f_u/(\beta_w*\gamma_{M2})$			$122.13 < 429.71$	verified	(0.28)

REMARKS

Ratio of the post width to the chord width is too large 1.50 > 0.85

Connection conforms to the code Ratio 0.28

Išvada: laikomoji galia pakankama

Mazgas nr. 21

Robot Structural Analysis Professional 2023

Design of truss node connection

EN 1993-1-8:2005/AC:2009

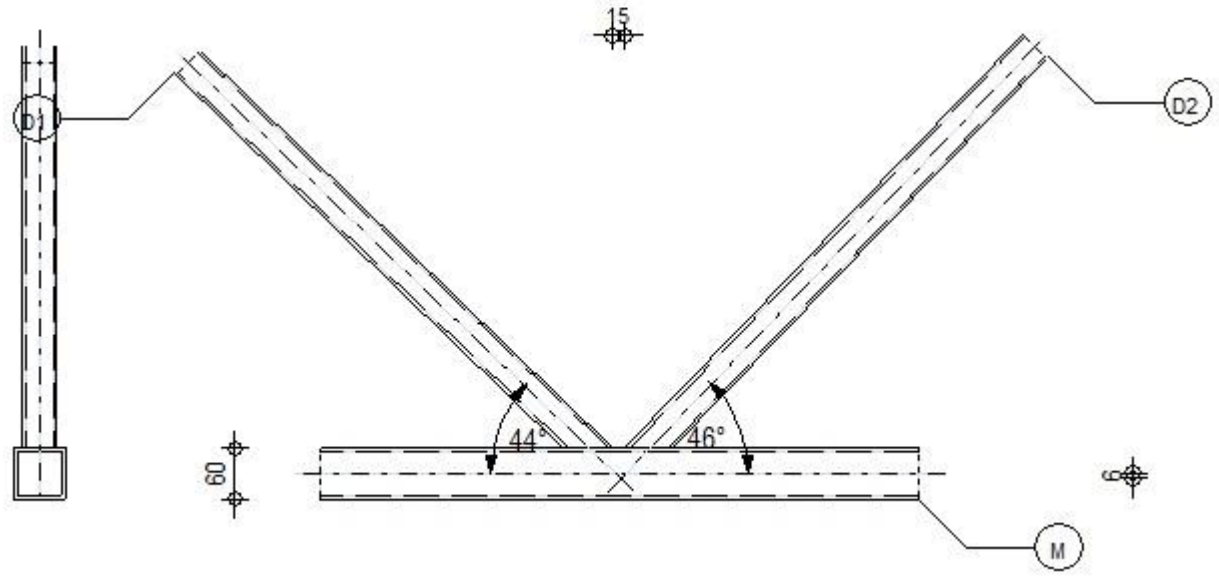
OK

Ratio **0.15**

D1 - SHS 40x4

D2 - SHS 40x4

M - SQUA 60x60x4



GENERAL

Connection no.: 21
Connection name: Tube
Structure node: 6280
Structure members: 3416, 3414, 3428

GEOMETRY

MEMBERS

		Chord	Diagonal 1	Diagonal 2	Post	
Member no.:		3416	3428	3414		
Section:		SQUA 60x60x4	SHS 40x4	SHS 40x4		
	h	60	40	40		mm
	b_f	60	40	40		mm
	t_w	4	4	4		mm
	t_f	4	4	4		mm
	r	4	0	0		mm

		Chord	Diagonal 1	Diagonal 2	Post	
Material:		S 355	S 355	S 355		
	f_y	355.00	355.00	355.00		MPa
	f_u	470.00	470.00	470.00		MPa
Angle	θ	0.0	43.9	46.0		Deg
Length	l	2700	469	486		mm

OFFSET

e_0 = 6 [mm] Offset

SPACINGS

g_2 = 15 [mm] Spacing of 2nd diagonal

WELDS

a_d = 3 [mm] Thickness of welds of diagonals and posts

LOADS

Case: 127: ULS/119=1*1.00 + 6*0.78 + 7*1.30 1*1.00+6*0.78+7*1.30

CHORD

$N_{01,Ed}$ = 11.53 [kN] Axial force
$M_{01,Ed}$ = 0.03 [kN*m] Bending moment
$N_{02,Ed}$ = 46.33 [kN] Axial force
$M_{02,Ed}$ = 0.02 [kN*m] Bending moment

DIAGONAL 1

N_1 = 10.62 [kN] Axial force
M_1 = 0.03 [kN*m] Bending moment

DIAGONAL 2

N_2 = -8.66 [kN] Axial force
M_2 = 0.01 [kN*m] Bending moment

Shear forces were not included in the connection verification. The connection was designed as a truss node.

RESULTS

CONSIDER NON-AXIAL CONNECTION OF MEMBERS IN THE NODE

M_0 = -0.20 [kN*m] Additional moment from eccentric connection of members $M_0 = (N_{02}-N_{01}) * e_0$
$\Sigma E_i J_i / L_i$ = 241985.12 [kN*m] Overall connection stiffness
ΔM_{01} = -0.06 [kN*m] Additional moment in the chord
ΔM_{02} = -0.06 [kN*m] Additional moment in the chord
ΔM_2 = -0.04 [kN*m] Additional moment in the diagonal
ΔM_1 = -0.04 [kN*m] Additional moment in the diagonal

CAPACITY VERIFICATION EUROCODE 3: EN 1993-1-8:2005

γ_{M5} = 1.00 Partial safety factor [Table 2.1]

FAILURE MODES FOR JOINTS (RHS CHORD MEMBERS) [Table 7.10] for $N_{i,Rd}$ and [Table 7.14] for $M_{i,Rd}$

GEOMETRICAL PARAMETERS

β = 0.67	Coefficient taking account of geometry of connection members	$\beta = (b_2+b_1)/(2*b_0)$ [1.5 (6)]
γ = 7.50	Coefficient taking account of geometry of the chord	$\gamma = b_0/(2*t_0)$ [1.5 (6)]
k_n = 1.00	Coefficient taking account of stresses in the chord	$k_n = 1.0$

TUBE CHORD FACE FAILURE

DIAGONAL 2

$N_{2,Rd}$ = 128.22 [kN]	Compression capacity			$N_{2,Rd} = 8.9*k_n*f_{y0}*t_0^2*\sqrt{\gamma}/\sin(\theta_2) * \beta$
$\lvert N_2 \rvert \le N_{2,Rd}$		$\lvert -8.66 \rvert < 128.22$	verified	(0.07)
$M_{2,Rd}$ = 1.41 [kN*m]	Bending resistance			$M_{2,Rd} = k_n*f_{y0}*t_0^2*h_2*[1/(2*\eta) + 2/\sqrt{[1-\beta]} + \eta/(1-\beta)] / \gamma_{M5}$
$\lvert M_2+\Delta M_2 \rvert \le M_{2,Rd}$		$\lvert -0.03 \rvert < 1.41$	verified	(0.02)
$N_2/N_{2,Rd} + (M_2+\Delta M_2)/M_{2,Rd} \le 1$		$0.09 < 1.00$	verified	(0.09)

DIAGONAL 1

$N_{1,Rd}$ = 133.06 [kN]	Tension capacity			$N_{1,Rd} = 8.9*k_n*f_{y0}*t_0^2*\sqrt{\gamma}/\sin(\theta_1) * \beta$
$\lvert N_1 \rvert \le N_{1,Rd}$		$\lvert 10.62 \rvert < 133.06$	verified	(0.08)
$M_{1,Rd}$ = 1.41 [kN*m]	Bending resistance			$M_{1,Rd} = k_n*f_{y0}*t_0^2*h_1*[1/(2*\eta) + 2/\sqrt{[1-\beta]} + \eta/(1-\beta)] / \gamma_{M5}$
$\lvert M_1+\Delta M_1 \rvert \le M_{1,Rd}$		$\lvert -0.01 \rvert < 1.41$	verified	(0.01)
$N_1/N_{1,Rd} + (M_1+\Delta M_1)/M_{1,Rd} \le 1$		$0.09 < 1.00$	verified	(0.09)

CHORD PUNCHING

DIAGONAL 2

$b_{e,p}$ = 27 [mm]	Effective width for punching shear			$b_{e,p} = (10*b_2)/(b_0/t_0)$
$N_{2,Rd}$ = 202.50 [kN]	Compression capacity			$N_{2,Rd} = f_{y0}*t_0/(\sqrt{3}*\sin(\theta_2))*[2*h_2/\sin(\theta_2)+b_2+b_{e,p}]/\gamma_{M5}$
$\lvert N_2 \rvert \le N_{2,Rd}$		$\lvert -8.66 \rvert < 202.50$	verified	(0.04)

DIAGONAL 1

$b_{e,p}$ = 27 [mm]	Effective width for punching shear			$b_{e,p} = (10*b_1)/(b_0/t_0)$
$N_{1,Rd}$ = 215.11 [kN]	Tension capacity			$N_{1,Rd} = f_{y0}*t_0/(\sqrt{3}*\sin(\theta_1))*[2*h_1/\sin(\theta_1)+b_1+b_{e,p}]/\gamma_{M5}$
$\lvert N_1 \rvert \le N_{1,Rd}$		$\lvert 10.62 \rvert < 215.11$	verified	(0.05)

CHORD SHEAR

DIAGONAL 2

A_v = 5.34 [cm^2]	Shear area of the chord			$A_v = (2*h_0 + \alpha*b_0)*t_0$
$N_{2,Rd}$ = 152.05 [kN]	Compression capacity			$N_{2,Rd} = f_{y0}*A_v/[\sqrt{3}*\sin(\theta_2)] / \gamma_{M5}$
$\lvert N_2 \rvert \le N_{2,Rd}$		$\lvert -8.66 \rvert < 152.05$	verified	(0.06)

DIAGONAL 1

A_v = 5.34 [cm^2]	Shear area of the chord			$A_v = (2*h_0 + \alpha*b_0)*t_0$
$N_{1,Rd}$ = 157.79 [kN]	Tension capacity			$N_{1,Rd} = f_{y0}*A_v/[\sqrt{3}*\sin(\theta_1)] / \gamma_{M5}$
$\lvert N_1 \rvert \le N_{1,Rd}$		$\lvert 10.62 \rvert < 157.79$	verified	(0.07)

CHORD RESISTANCE

$V_{pl,Rd}$ = 99.50 [kN]	Plastic resistance for shear			$V_{pl,Rd} = (A_v*f_{y0})/(\sqrt{3}*\gamma_{M0})$
$\lvert V_{Ed} \rvert \le V_{pl,Rd}$		$\lvert 7.37 \rvert < 99.50$	verified	(0.07)

$N_{0,Rd}$ = 302.93 [kN] Tension capacity			$N_{0,Rd} = [(A_0-A_v)*f_{y0} + A_v*f_{y0}*\sqrt{[1-(V_{Ed}/V_{pl,Rd})^2]}]/\gamma_{M5}$	
$\lvert N_{02}\rvert \le N_{0,Rd}$		$\lvert 46.33\rvert < 302.93$	verified	(0.15)

VERIFICATION OF WELDS

DIAGONAL 2

β_w = 0.88		Correlation coefficient		[Table 4.1]
γ_{M2} = 1.25		Partial safety factor		[Table 2.1]
Longitudinal weld				
$\sigma_\perp$ = -7.69	[MPa]	Normal stress in a weld		
$\tau_\perp$ = -7.69	[MPa]	Perpendicular tangent stress		
τ_{II} = -10.49	[MPa]	Tangent stress		
$\lvert\sigma_\perp\rvert \le 0.9*f_u/\gamma_{M2}$		$\lvert -7.69\rvert < 338.40$	verified	(0.02)
$\sqrt{[\sigma_\perp^2 + 3*(\tau_\perp^2+\tau_{II}^2)]} \le f_u/(\beta_w*\gamma_{M2})$		$23.80 < 429.71$	verified	(0.06)
Transverse inner weld				
$\sigma_\perp$ = -13.58	[MPa]	Normal stress in a weld		
$\tau_\perp$ = -5.13	[MPa]	Perpendicular tangent stress		
τ_{II} = 0.00	[MPa]	Tangent stress		
$\lvert\sigma_\perp\rvert \le 0.9*f_u/\gamma_{M2}$		$\lvert -13.58\rvert < 338.40$	verified	(0.04)
$\sqrt{[\sigma_\perp^2 + 3*(\tau_\perp^2+\tau_{II}^2)]} \le f_u/(\beta_w*\gamma_{M2})$		$16.23 < 429.71$	verified	(0.04)
Transverse outer weld				
$\sigma_\perp$ = -6.68	[MPa]	Normal stress in a weld		
$\tau_\perp$ = -14.24	[MPa]	Perpendicular tangent stress		
τ_{II} = 0.00	[MPa]	Tangent stress		
$\lvert\sigma_\perp\rvert \le 0.9*f_u/\gamma_{M2}$		$\lvert -6.68\rvert < 338.40$	verified	(0.02)
$\sqrt{[\sigma_\perp^2 + 3*(\tau_\perp^2+\tau_{II}^2)]} \le f_u/(\beta_w*\gamma_{M2})$		$25.55 < 429.71$	verified	(0.06)

DIAGONAL 1

β_w = 0.88		Correlation coefficient		[Table 4.1]
γ_{M2} = 1.25		Partial safety factor		[Table 2.1]
Longitudinal weld				
$\sigma_\perp$ = 8.89	[MPa]	Normal stress in a weld		
$\tau_\perp$ = 8.89	[MPa]	Perpendicular tangent stress		
τ_{II} = 13.06	[MPa]	Tangent stress		
$\lvert\sigma_\perp\rvert \le 0.9*f_u/\gamma_{M2}$		$\lvert 8.89\rvert < 338.40$	verified	(0.03)
$\sqrt{[\sigma_\perp^2 + 3*(\tau_\perp^2+\tau_{II}^2)]} \le f_u/(\beta_w*\gamma_{M2})$		$28.78 < 429.71$	verified	(0.07)
Transverse inner weld				
$\sigma_\perp$ = 18.02	[MPa]	Normal stress in a weld		
$\tau_\perp$ = 9.77	[MPa]	Perpendicular tangent stress		
τ_{II} = 0.00	[MPa]	Tangent stress		
$\lvert\sigma_\perp\rvert \le 0.9*f_u/\gamma_{M2}$		$\lvert 18.02\rvert < 338.40$	verified	(0.05)
$\sqrt{[\sigma_\perp^2 + 3*(\tau_\perp^2+\tau_{II}^2)]} \le f_u/(\beta_w*\gamma_{M2})$		$24.72 < 429.71$	verified	(0.06)
Transverse outer weld				
$\sigma_\perp$ = 3.79	[MPa]	Normal stress in a weld		
$\tau_\perp$ = 15.61	[MPa]	Perpendicular tangent stress		
τ_{II} = 0.00	[MPa]	Tangent stress		
$\lvert\sigma_\perp\rvert \le 0.9*f_u/\gamma_{M2}$		$\lvert 3.79\rvert < 338.40$	verified	(0.01)
$\sqrt{[\sigma_\perp^2 + 3*(\tau_\perp^2+\tau_{II}^2)]} \le f_u/(\beta_w*\gamma_{M2})$		$27.30 < 429.71$	verified	(0.06)

Connection conforms to the code Ratio 0.15

Išvada: laikomoji galia pakankama

Mazgas nr. 22

Robot Structural Analysis Professional 2023

Design of truss node connection

EN 1993-1-8:2005/AC:2009

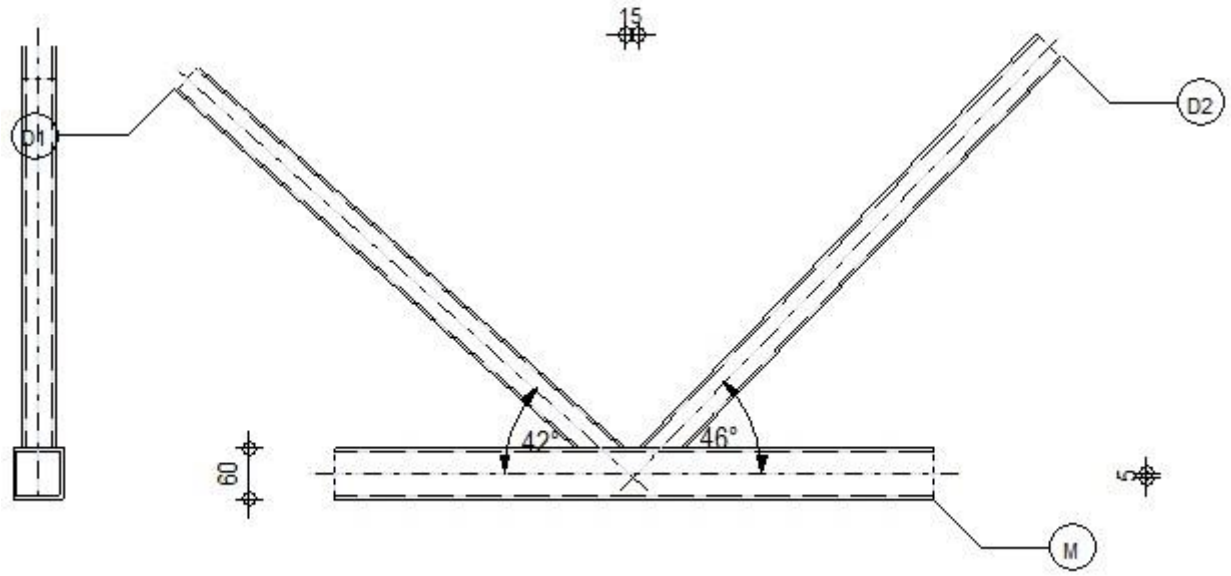
OK

Ratio **0.10**

D1 - SHS 40x4

D2 - SHS 40x4

M - SQUA 60x60x4



GENERAL

Connection no.: 22
Connection name: Tube
Structure node: 6288
Structure members: 3417, 3428, 3415

GEOMETRY

MEMBERS

		Chord	Diagonal 1	Diagonal 2	Post	
Member no.:		3417	3415	3428		
Section:		SQUA 60x60x4	SHS 40x4	SHS 40x4		
	h	60	40	40		mm
	b_f	60	40	40		mm
	t_w	4	4	4		mm
	t_f	4	4	4		mm
	r	4	0	0		mm
Material:		S 355	S 355	S 355		
	f_y	355.00	355.00	355.00		MPa
	f_u	470.00	470.00	470.00		MPa
Angle	θ	0.0	41.8	46.0		Deg
Length	l	2702	469	469		mm

OFFSET

e_0 = 5 [mm] Offset

SPACINGS

g_2 = 15 [mm] Spacing of 2nd diagonal

WELDS

a_d = 3 [mm] Thickness of welds of diagonals and posts

LOADS

Case: 119: ULS/111=1*1.00 + 4*0.78 + 7*1.30 1*1.00+4*0.78+7*1.30

CHORD

$N_{01,Ed}$ = 6.75 [kN] Axial force
$M_{01,Ed}$ = 0.09 [kN*m] Bending moment
$N_{02,Ed}$ = -9.29 [kN] Axial force
$M_{02,Ed}$ = 0.03 [kN*m] Bending moment

DIAGONAL 1

N_1 = -11.08 [kN] Axial force
M_1 = -0.01 [kN*m] Bending moment

DIAGONAL 2

N_2 = 10.99 [kN] Axial force
M_2 = -0.04 [kN*m] Bending moment

Shear forces were not included in the connection verification. The connection was designed as a truss node.

RESULTS

CONSIDER NON-AXIAL CONNECTION OF MEMBERS IN THE NODE

M_0 = 0.08 [kN*m] Additional moment from eccentric connection of members $M_0 = (N_{02}-N_{01}) * e_0$
$\Sigma E_i J_i / L_i$ = 243863.69 [kN*m] Overall connection stiffness
ΔM_{01} = 0.02 [kN*m] Additional moment in the chord

M_0 =	0.08	[kN*m]	Additional moment from eccentric connection of members	$M_0 = (N_{02}-N_{01}) * e_0$
ΔM_{02} =	0.02	[kN*m]	Additional moment in the chord	
ΔM_2 =	0.02	[kN*m]	Additional moment in the diagonal	
ΔM_1 =	0.02	[kN*m]	Additional moment in the diagonal	

CAPACITY VERIFICATION EUROCODE 3: EN 1993-1-8:2005

γ_{M5} = 1.00 Partial safety factor [Table 2.1]

FAILURE MODES FOR JOINTS (RHS CHORD MEMBERS) [Table 7.10] for $N_{i,Rd}$ and [Table 7.14] for $M_{i,Rd}$

GEOMETRICAL PARAMETERS

β = 0.67	Coefficient taking account of geometry of connection members	$\beta = (b_2+b_1)/(2*b_0)$ [1.5 (6)]	
γ = 7.50	Coefficient taking account of geometry of the chord	$\gamma = b_0/(2*t_0)$ [1.5 (6)]	
n = 0.04	Coefficient taking account of stresses in the chord	$n_0 = \sigma_{0,Ed}/f_{y0}$	
k_n = 1.00	Coefficient taking account of stresses in the chord	$k_n = 1.0$	

TUBE CHORD FACE FAILURE

DIAGONAL 2

$N_{2,Rd}$ = 128.22 [kN] Tension capacity			$N_{2,Rd} = 8.9*k_n*f_{y0}*t_0^2*\sqrt{\gamma}/\sin(\theta_2) * \beta$
$\lvert N_2 \rvert \le N_{2,Rd}$	$\lvert 10.99 \rvert < 128.22$	verified	(0.09)
$M_{2,Rd}$ = 1.41 [kN*m] Bending resistance			$M_{2,Rd} = k_n*f_{y0}*t_0^2*h_2*[1/(2*\eta) + 2/\sqrt{[1-\beta]} + \eta/(1-\beta)] / \gamma_{M5}$
$\lvert M_2+\Delta M_2 \rvert \le M_{2,Rd}$	$\lvert -0.03 \rvert < 1.41$	verified	(0.02)
$N_2/N_{2,Rd} + (M_2+\Delta M_2)/M_{2,Rd} \le 1$	$0.10 < 1.00$	verified	(0.10)

DIAGONAL 1

$N_{1,Rd}$ = 138.48 [kN] Compression capacity			$N_{1,Rd} = 8.9*k_n*f_{y0}*t_0^2*\sqrt{\gamma}/\sin(\theta_1) * \beta$
$\lvert N_1 \rvert \le N_{1,Rd}$	$\lvert -11.08 \rvert < 138.48$	verified	(0.08)
$M_{1,Rd}$ = 1.41 [kN*m] Bending resistance			$M_{1,Rd} = k_n*f_{y0}*t_0^2*h_1*[1/(2*\eta) + 2/\sqrt{[1-\beta]} + \eta/(1-\beta)] / \gamma_{M5}$
$\lvert M_1+\Delta M_1 \rvert \le M_{1,Rd}$	$\lvert 0.00 \rvert < 1.41$	verified	(0.00)
$N_1/N_{1,Rd} + (M_1+\Delta M_1)/M_{1,Rd} \le 1$	$0.08 < 1.00$	verified	(0.08)

CHORD PUNCHING

DIAGONAL 2

$b_{e,p}$ = 27 [mm] Effective width for punching shear			$b_{e,p} = (10*b_2)/(b_0/t_0)$
$N_{2,Rd}$ = 202.51 [kN] Tension capacity			$N_{2,Rd} = f_{y0}*t_0/(\sqrt{3}*\sin(\theta_2))*[2*h_2/\sin(\theta_2)+b_2+b_{e,p}]/\gamma_{M5}$
$\lvert N_2 \rvert \le N_{2,Rd}$	$\lvert 10.99 \rvert < 202.51$	verified	(0.05)

DIAGONAL 1

$b_{e,p}$ = 27 [mm] Effective width for punching shear			$b_{e,p} = (10*b_1)/(b_0/t_0)$
$N_{1,Rd}$ = 229.65 [kN] Compression capacity			$N_{1,Rd} = f_{y0}*t_0/(\sqrt{3}*\sin(\theta_1))*[2*h_1/\sin(\theta_1)+b_1+b_{e,p}]/\gamma_{M5}$
$\lvert N_1 \rvert \le N_{1,Rd}$	$\lvert -11.08 \rvert < 229.65$	verified	(0.05)

CHORD SHEAR

DIAGONAL 2

A_v =	5.34	[cm^2]	Shear area of the chord	$A_v = (2*h_0 + \alpha*b_0)*t_0$
$N_{2,Rd}$ =	152.05	[kN]	Tension capacity	$N_{2,Rd} = f_{y0}*A_v/[\sqrt{3}*\sin(\theta_2)] / \gamma_{M5}$

$\|N_2\| \le N_{2,Rd}$	$\|10.99\| < 152.05$	verified	(0.07)

DIAGONAL 1

A_v = 5.34 [cm²]	Shear area of the chord		$A_v = (2*h_0 + \alpha*b_0)*t_0$
$N_{1,Rd}$ = 164.21 [kN]	Compression capacity		$N_{1,Rd} = f_{y0}*A_v/[\sqrt{3}*\sin(\theta_1)] / \gamma_{M5}$
$\|N_1\| \le N_{1,Rd}$	$\|-11.08\| < 164.21$	verified	(0.07)

CHORD RESISTANCE

$V_{pl,Rd}$ = 99.50 [kN]	Plastic resistance for shear		$V_{pl,Rd} = (A_v*f_{y0})/(\sqrt{3}*\gamma_{M0})$
$\|V_{Ed}\| \le V_{pl,Rd}$	$\|7.91\| < 99.50$	verified	(0.08)
$N_{0,Rd}$ = 302.85 [kN]	Compression capacity		$N_{0,Rd} = [(A_0-A_v)*f_{y0} + A_v*f_{y0}*\sqrt{[1-(V_{Ed}/V_{pl,Rd})^2]}]/\gamma_{M5}$
$\|N_{02}\| \le N_{0,Rd}$	$\|-9.29\| < 302.85$	verified	(0.03)

VERIFICATION OF WELDS

DIAGONAL 2

β_w = 0.88	Correlation coefficient		[Table 4.1]
γ_{M2} = 1.25	Partial safety factor		[Table 2.1]
Longitudinal weld			
$\sigma_\perp$ = 9.76 [MPa]	Normal stress in a weld		
$\tau_\perp$ = 9.76 [MPa]	Perpendicular tangent stress		
τ_{II} = 13.31 [MPa]	Tangent stress		
$\|\sigma_\perp\| \le 0.9*f_u/\gamma_{M2}$	$\|9.76\| < 338.40$	verified	(0.03)
$\sqrt{[\sigma_\perp^2 + 3*(\tau_\perp^2+\tau_{II}^2)]} \le f_u/(\beta_w*\gamma_{M2})$	$30.20 < 429.71$	verified	(0.07)
Transverse inner weld			
$\sigma_\perp$ = 15.91 [MPa]	Normal stress in a weld		
$\tau_\perp$ = 3.41 [MPa]	Perpendicular tangent stress		
τ_{II} = 0.00 [MPa]	Tangent stress		
$\|\sigma_\perp\| \le 0.9*f_u/\gamma_{M2}$	$\|15.91\| < 338.40$	verified	(0.05)
$\sqrt{[\sigma_\perp^2 + 3*(\tau_\perp^2+\tau_{II}^2)]} \le f_u/(\beta_w*\gamma_{M2})$	$16.97 < 429.71$	verified	(0.04)
Transverse outer weld			
$\sigma_\perp$ = 11.58 [MPa]	Normal stress in a weld		
$\tau_\perp$ = 19.38 [MPa]	Perpendicular tangent stress		
τ_{II} = 0.00 [MPa]	Tangent stress		
$\|\sigma_\perp\| \le 0.9*f_u/\gamma_{M2}$	$\|11.58\| < 338.40$	verified	(0.03)
$\sqrt{[\sigma_\perp^2 + 3*(\tau_\perp^2+\tau_{II}^2)]} \le f_u/(\beta_w*\gamma_{M2})$	$35.51 < 429.71$	verified	(0.08)

DIAGONAL 1

β_w = 0.88	Correlation coefficient		[Table 4.1]
γ_{M2} = 1.25	Partial safety factor		[Table 2.1]
Longitudinal weld			
$\sigma_\perp$ = -8.70 [MPa]	Normal stress in a weld		
$\tau_\perp$ = -8.70 [MPa]	Perpendicular tangent stress		
τ_{II} = -13.77 [MPa]	Tangent stress		
$\|\sigma_\perp\| \le 0.9*f_u/\gamma_{M2}$	$\|-8.70\| < 338.40$	verified	(0.03)
$\sqrt{[\sigma_\perp^2 + 3*(\tau_\perp^2+\tau_{II}^2)]} \le f_u/(\beta_w*\gamma_{M2})$	$29.52 < 429.71$	verified	(0.07)
Transverse inner weld			
$\sigma_\perp$ = -17.70 [MPa]	Normal stress in a weld		
$\tau_\perp$ = -7.76 [MPa]	Perpendicular tangent stress		
τ_{II} = 0.00 [MPa]	Tangent stress		
$\|\sigma_\perp\| \le 0.9*f_u/\gamma_{M2}$	$\|-17.70\| < 338.40$	verified	(0.05)
$\sqrt{[\sigma_\perp^2 + 3*(\tau_\perp^2+\tau_{II}^2)]} \le f_u/(\beta_w*\gamma_{M2})$	$22.22 < 429.71$	verified	(0.05)

Transverse outer weld

$\sigma_\perp$ =	-5.42	[MPa]	Normal stress in a weld
$\tau_\perp$ =	-16.80	[MPa]	Perpendicular tangent stress
τ_{II} =	0.00	[MPa]	Tangent stress

$\lvert\sigma_\perp\rvert \le 0.9 f_u/\gamma_{M2}$	$\lvert -5.42\rvert < 338.40$	verified	(0.02)
$\sqrt{[\sigma_\perp^2 + 3(\tau_\perp^2+\tau_{II}^2)]} \le f_u/(\beta_w \gamma_{M2})$	$29.60 < 429.71$	verified	(0.07)

Connection conforms to the code Ratio 0.10

Išvada: laikomoji galia pakankama

Mazgas nr. 23

Robot Structural Analysis Professional 2023

Design of truss node connection

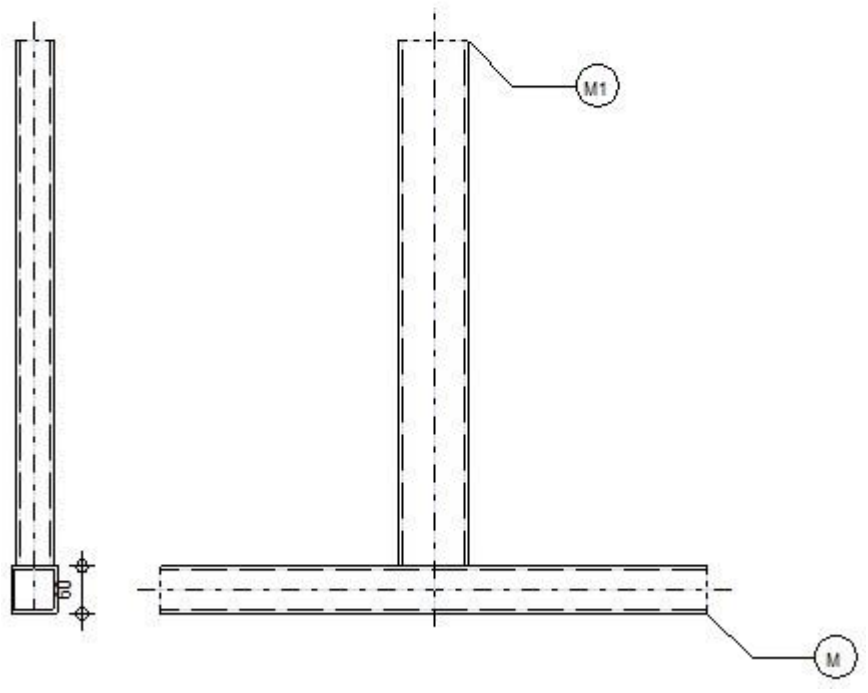
EN 1993-1-8:2005/AC:2009

OK

Ratio **0.42**

M1 - RP 90x50x5

M - SQUA 60x60x4



GENERAL

Connection no.: 23
Connection name: Tube
Structure node: 6279
Structure members: 3416, 3446

GEOMETRY

MEMBERS

		Chord	Diagonal 1	Diagonal 2	Post	
Member no.:		3416			3446	
Section:		SQUA 60x60x4			RP 90x50x5	
	h	60			90	mm
	b_f	60			50	mm
	t_w	4			5	mm
	t_f	4			5	mm
	r	4			5	mm
Material:		S 355			S 355	
	f_y	355.00			355.00	MPa
	f_u	470.00			470.00	MPa
Angle	θ	0.0			90.0	Deg
Length	l	2710			350	mm

WELDS

a_d = 3 [mm] Thickness of welds of diagonals and posts

LOADS

Case: 105: ULS/97=1*1.35 + 6*0.78 + 2*0.91 + 7*1.30 1*1.35+6*0.78+2*0.91+7*1.30

CHORD

$N_{01,Ed}$ = 45.00 [kN] Axial force
$M_{01,Ed}$ = 0.32 [kN*m] Bending moment
$N_{02,Ed}$ = -0.00 [kN] Axial force
$M_{02,Ed}$ = 0.00 [kN*m] Bending moment

POST

N_3 = -41.17 [kN] Axial force
M_3 = -0.20 [kN*m] Bending moment

Shear forces were not included in the connection verification. The connection was designed as a truss node.

RESULTS

CAPACITY VERIFICATION EUROCODE 3: EN 1993-1-8:2005

γ_{M5} = 1.00 Partial safety factor [Table 2.1]

FAILURE MODES FOR JOINTS (RHS CHORD MEMBERS) [Table 7.11] for $N_{i,Rd}$ and [Table 7.14] for $M_{i,Rd}$

GEOMETRICAL PARAMETERS

β = 0.83	Coefficient taking account of geometry of connection members		$\beta = b_3/b_0$ [1.5 (6)]
γ = 7.50	Coefficient taking account of geometry of the chord		$\gamma = b_0/(2*t_0)$ [1.5 (6)]
k_n = 1.00	Coefficient taking account of stresses in the chord		$k_n = 1.0$

TUBE CHORD FACE FAILURE

POST

η = 1.50	Coefficient taking account of geometry of connection members			$\eta = h_3/b_0$
$N_{3,Rd}$ = 157.89 [kN]	Compression capacity			$N_{3,Rd} = [(k_n*f_{y0}*t_0^2)/(1-\beta)*\sin(\theta_3)]*[2*\eta/\sin(\theta_3) + 4*\sqrt{(1-\beta)}] / \gamma_{M5}$
$\lvert N_3 \rvert \le N_{3,Rd}$		$\lvert -41.17 \rvert < 157.89$	verified	(0.26)
$M_{3,Rd}$ = 7.28 [kN*m]	Bending resistance			$M_{3,Rd} = k_n*f_{y0}*t_0^2*h_3*[1/(2*\eta) + 2/\sqrt{[1-\beta]} + \eta/(1-\beta)] / \gamma_{M5}$
$\lvert M_3 \rvert \le M_{3,Rd}$		$\lvert -0.20 \rvert < 7.28$	verified	(0.03)
$N_3/N_{3,Rd} + M_3/M_{3,Rd} \le 1$		$0.29 < 1.00$	verified	(0.29)

CHORD SHEAR

POST

A_v =	4.80	[cm^2]	Shear area of the chord		$A_v = 2*h_0*t_0$
$N_{3,Rd}$ =	98.38	[kN]	Compression capacity		$N_{3,Rd} = f_{y0}*A_v/[\sqrt{3}*\sin(\theta_3)] / \gamma_{M5}$
$\lvert N_3 \rvert \le N_{3,Rd}$			$\lvert -41.17 \rvert < 98.38$	verified	(0.42)

CHORD RESISTANCE

$N_{0,Rd}$ =	303.45	[kN]	Tension capacity		$N_{0,Rd} = (A_0*f_{y0})/\gamma_{M5}$
$\lvert N_{01} \rvert \le N_{0,Rd}$			$\lvert 45.00 \rvert < 303.45$	verified	(0.15)

VERIFICATION OF WELDS

POST

β_w =	0.88		Correlation coefficient		[Table 4.1]
γ_{M2} =	1.25		Partial safety factor		[Table 2.1]
Longitudinal weld					
$\sigma_\perp$ =	-36.88	[MPa]	Normal stress in a weld		
$\tau_\perp$ =	-36.88	[MPa]	Perpendicular tangent stress		
τ_{II} =	-0.00	[MPa]	Tangent stress		
$\lvert \sigma_\perp \rvert \le 0.9*f_u/\gamma_{M2}$			$\lvert -36.88 \rvert < 338.40$	verified	(0.11)
$\sqrt{[\sigma_\perp^2 + 3*(\tau_\perp^2+\tau_{II}^2)]} \le f_u/(\beta_w*\gamma_{M2})$			$73.75 < 429.71$	verified	(0.17)

Connection conforms to the code Ratio 0.42

Išvada: laikomoji galia pakankama

Mazgas nr. 24

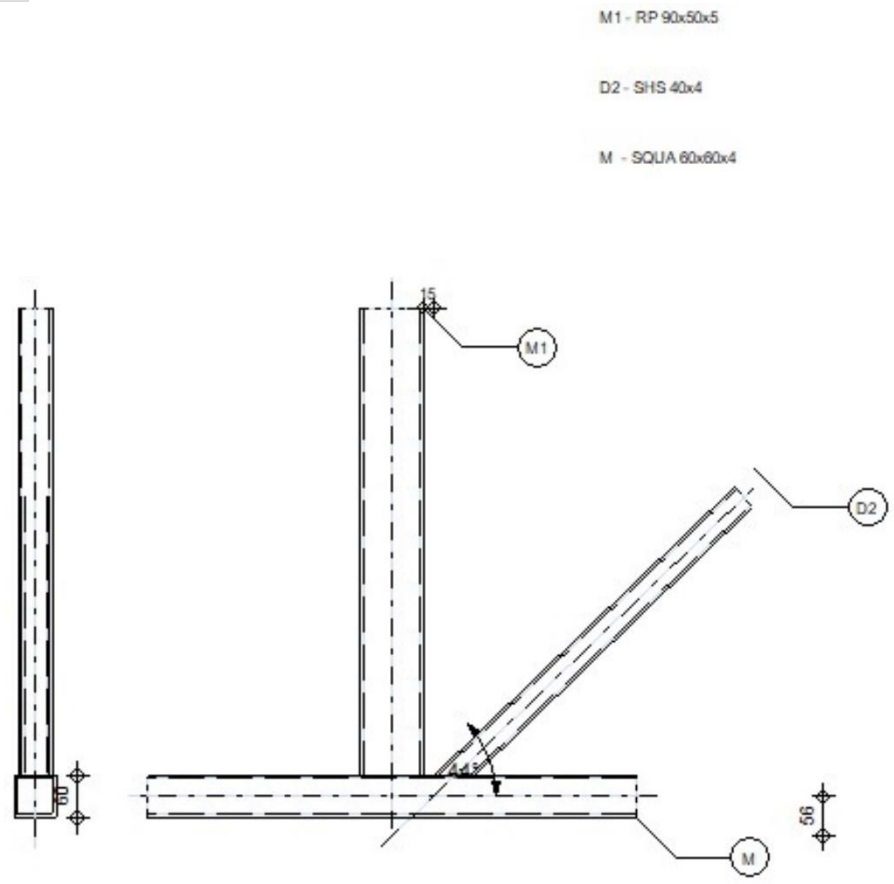
Robot Structural Analysis Professional 2023

Design of truss node connection

EN 1993-1-8:2005/AC:2009

OK

Ratio **0.41**



GENERAL

Connection no.: 24
Connection name: Tube
Structure node: 6138
Structure members: 3417, 3414, 3446

GEOMETRY

MEMBERS

		Chord	Diagonal 1	Diagonal 2	Post	
Member no.:		3417		3414	3446	
Section:		SQUA 60x60x4		SHS 40x4	RP 90x50x5	
	h	60		40	90	mm
	b_f	60		40	50	mm
	t_w	4		4	5	mm
	t_f	4		4	5	mm
	r	4		0	5	mm
Material:		S 355		S 355	S 355	

		Chord	Diagonal 1	Diagonal 2	Post	
	f_y	355.00		355.00	355.00	MPa
	f_u	470.00		470.00	470.00	MPa
Angle	θ	0.0		43.9	90.0	Deg
Length	l	2712		486	350	mm

OFFSET

e_0 = 56 [mm] Offset

SPACINGS

g_2 = 15 [mm] Spacing of 2nd diagonal

WELDS

a_d = 3 [mm] Thickness of welds of diagonals and posts

LOADS

Case: 105: ULS/97=1*1.35 + 6*0.78 + 2*0.91 + 7*1.30 1*1.35+6*0.78+2*0.91+7*1.30

CHORD

$N_{01,Ed}$ = 5.67 [kN] Axial force
$M_{01,Ed}$ = 0.14 [kN*m] Bending moment
$N_{02,Ed}$ = -0.00 [kN] Axial force
$M_{02,Ed}$ = 0.00 [kN*m] Bending moment

DIAGONAL 2

N_2 = -8.51 [kN] Axial force
M_2 = 0.01 [kN*m] Bending moment

POST

N_3 = -41.17 [kN] Axial force
M_3 = -0.41 [kN*m] Bending moment

Shear forces were not included in the connection verification. The connection was designed as a truss node.

RESULTS

CONSIDER NON-AXIAL CONNECTION OF MEMBERS IN THE NODE

M_0 = 0.32 [kN*m] Additional moment from eccentric connection of members $M_0 = (N_{02}-N_{01}) * e_0$
$\Sigma E_i J_i / L_i$ = 949160.54 [kN*m] Overall connection stiffness
ΔM_{01} = 0.02 [kN*m] Additional moment in the chord
ΔM_{02} = 0.02 [kN*m] Additional moment in the chord
ΔM_2 = 0.02 [kN*m] Additional moment in the diagonal
ΔM_3 = 0.25 [kN*m] Additional moment in the diagonal

CAPACITY VERIFICATION EUROCODE 3: EN 1993-1-8:2005

γ_{M5} = 1.00 Partial safety factor [Table 2.1]

FAILURE MODES FOR JOINTS (RHS CHORD MEMBERS) [Table 7.12] for $N_{i,Rd}$ and [Table 7.14] for $M_{i,Rd}$

GEOMETRICAL PARAMETERS

β = 0.92	Coefficient taking account of geometry of connection members	$\beta = (b_2+h_2+b_3+h_3)/(4*b_0)$ [1.5 (6)]
γ = 7.50	Coefficient taking account of geometry of the chord	$\gamma = b_0/(2*t_0)$ [1.5 (6)]
n = 0.01	Coefficient taking account of stresses in the chord	$n_0 = \sigma_{0,Ed}/f_{y0}$
k_n = 1.00	Coefficient taking account of stresses in the chord	$k_n = 1.0$

TUBE CHORD FACE FAILURE

DIAGONAL 2

$N_{2,Rd}$ = 182.95	[kN]	Compression capacity		$N_{2,Rd} = 8.9*k_n*f_{y0}*t_0^2*\sqrt{\gamma}/\sin(\theta_2) * \beta / \gamma_{M5}$
$\lvert N_2 \rvert \le N_{2,Rd}$		$\lvert -8.51 \rvert < 182.95$	verified	(0.05)

POST

$N_{3,Rd}$ = 126.91	[kN]	Compression capacity		$N_{3,Rd} = 8.9*k_n*f_{y0}*t_0^2*\sqrt{\gamma}/\sin(\theta_3) * \beta / \gamma_{M5}$
$\lvert N_3 \rvert \le N_{3,Rd}$		$\lvert -41.17 \rvert < 126.91$	verified	(0.32)

TUBE BRACE FAILURE

DIAGONAL 2

b_{eff} = 27 [mm] Effective width in the connection of the diagonal to the chord $b_{eff} = [10/(b_0/t_0)] * [(f_{y0}*t_0)/(f_{y2}*t_2)] * b_2$

$N_{2,Rd}$ = 185.55	[kN]	Compression capacity		$N_{2,Rd} = f_{y2}*t_2*(2*h_2-4*t_2 + b_2 + b_{eff})/\gamma_{M5}$
$\lvert N_2 \rvert \le N_{2,Rd}$		$\lvert -8.51 \rvert < 185.55$	verified	(0.05)

POST

b_{eff} = 27 [mm] Effective width in the connection of the post to the chord $b_{eff} = [10/(b_0/t_0)] * [(f_{y0}*t_0)/(f_{y3}*t_3)] * b_3$

$N_{3,Rd}$ = 420.08	[kN]	Compression capacity		$N_{3,Rd} = f_{y3}*t_3*(2*h_3-4*t_3 + b_3 + b_{eff})/\gamma_{M5}$
$\lvert N_3 \rvert \le N_{3,Rd}$		$\lvert -41.17 \rvert < 420.08$	verified	(0.10)

CHORD SHEAR

DIAGONAL 2

A_v = 5.34	[cm^2]	Shear area of the chord		$A_v = (2*h_0 + \alpha*b_0)*t_0$
$N_{2,Rd}$ = 157.79	[kN]	Compression capacity		$N_{2,Rd} = f_{y0}*A_v/[\sqrt{3}*\sin(\theta_2)] / \gamma_{M5}$
$\lvert N_2 \rvert \le N_{2,Rd}$		$\lvert -8.51 \rvert < 157.79$	verified	(0.05)

POST

A_v = 5.34	[cm^2]	Shear area of the chord		$A_v = (2*h_0 + \alpha*b_0)*t_0$
$N_{3,Rd}$ = 109.45	[kN]	Compression capacity		$N_{3,Rd} = f_{y0}*A_v/[\sqrt{3}*\sin(\theta_3)] / \gamma_{M5}$
$\lvert N_3 \rvert \le N_{3,Rd}$		$\lvert -41.17 \rvert < 109.45$	verified	(0.38)

CHORD RESISTANCE

$V_{pl,Rd}$ = 99.50	[kN]	Plastic resistance for shear		$V_{pl,Rd} = (A_v*f_{y0})/(\sqrt{3}*\gamma_{M0})$
$\lvert V_{Ed} \rvert \le V_{pl,Rd}$		$\lvert 41.17 \rvert < 99.50$	verified	(0.41)
$N_{0,Rd}$ = 286.47	[kN]	Tension capacity		$N_{0,Rd} = [(A_0-A_v)*f_{y0} + A_v*f_{y0}*\sqrt{[1-(V_{Ed}/V_{pl,Rd})^2]}]/\gamma_{M5}$
$\lvert N_{01} \rvert \le N_{0,Rd}$		$\lvert 5.67 \rvert < 286.47$	verified	(0.02)

CHORD SIDE WALL CRUSHING

DIAGONAL 2

$M_{2,Rd}$ =	2.56	[kN*m]	Bending resistance		$M_{2,Rd} = 0.5*f_{y0}*t_0*(h_2+5*t_0)^2/\gamma_{M5}$
$\|M_2+\Delta M_2\| \le M_{2,Rd}$			|0.02| < 2.56	verified	(0.01)

POST

$M_{3,Rd}$ =	8.59	[kN*m]	Bending resistance		$M_{3,Rd} = 0.5*f_{y0}*t_0*(h_3+5*t_0)^2/\gamma_{M5}$
$\|M_3+\Delta M_3\| \le M_{3,Rd}$			|-0.15| < 8.59	verified	(0.02)

VERIFICATION OF WELDS

DIAGONAL 2

β_w =	0.88		Correlation coefficient		[Table 4.1]
γ_{M2} =	1.25		Partial safety factor		[Table 2.1]
Longitudinal weld					
$\sigma_\perp$ =	-7.12	[MPa]	Normal stress in a weld		
$\tau_\perp$ =	-7.12	[MPa]	Perpendicular tangent stress		
τ_{II} =	-10.46	[MPa]	Tangent stress		
$\|\sigma_\perp\| \le 0.9*f_u/\gamma_{M2}$			|-7.12| < 338.40	verified	(0.02)
$\sqrt{[\sigma_\perp^2 + 3*(\tau_\perp^2+\tau_{II}^2)]} \le f_u/(\beta_w*\gamma_{M2})$			23.05 < 429.71	verified	(0.05)
Transverse inner weld					
$\sigma_\perp$ =	-13.23	[MPa]	Normal stress in a weld		
$\tau_\perp$ =	-4.82	[MPa]	Perpendicular tangent stress		
τ_{II} =	0.00	[MPa]	Tangent stress		
$\|\sigma_\perp\| \le 0.9*f_u/\gamma_{M2}$			|-13.23| < 338.40	verified	(0.04)
$\sqrt{[\sigma_\perp^2 + 3*(\tau_\perp^2+\tau_{II}^2)]} \le f_u/(\beta_w*\gamma_{M2})$			15.64 < 429.71	verified	(0.04)
Transverse outer weld					
$\sigma_\perp$ =	-6.04	[MPa]	Normal stress in a weld		
$\tau_\perp$ =	-13.72	[MPa]	Perpendicular tangent stress		
τ_{II} =	0.00	[MPa]	Tangent stress		
$\|\sigma_\perp\| \le 0.9*f_u/\gamma_{M2}$			|-6.04| < 338.40	verified	(0.02)
$\sqrt{[\sigma_\perp^2 + 3*(\tau_\perp^2+\tau_{II}^2)]} \le f_u/(\beta_w*\gamma_{M2})$			24.52 < 429.71	verified	(0.06)

POST

β_w =	0.88		Correlation coefficient		[Table 4.1]
γ_{M2} =	1.25		Partial safety factor		[Table 2.1]
Longitudinal weld					
$\sigma_\perp$ =	-41.80	[MPa]	Normal stress in a weld		
$\tau_\perp$ =	-41.80	[MPa]	Perpendicular tangent stress		
τ_{II} =	-0.00	[MPa]	Tangent stress		
$\|\sigma_\perp\| \le 0.9*f_u/\gamma_{M2}$			|-41.80| < 338.40	verified	(0.12)
$\sqrt{[\sigma_\perp^2 + 3*(\tau_\perp^2+\tau_{II}^2)]} \le f_u/(\beta_w*\gamma_{M2})$			83.59 < 429.71	verified	(0.19)
Transverse inner weld					
$\sigma_\perp$ =	-77.83	[MPa]	Normal stress in a weld		
$\tau_\perp$ =	-77.83	[MPa]	Perpendicular tangent stress		
τ_{II} =	0.00	[MPa]	Tangent stress		
$\|\sigma_\perp\| \le 0.9*f_u/\gamma_{M2}$			|-77.83| < 338.40	verified	(0.23)
$\sqrt{[\sigma_\perp^2 + 3*(\tau_\perp^2+\tau_{II}^2)]} \le f_u/(\beta_w*\gamma_{M2})$			155.66 < 429.71	verified	(0.36)

REMARKS

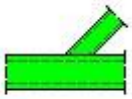
Eccentricity is too large. 56 [mm] > 15 [mm]

Connection conforms to the code

Ratio 0.41

Išvada: laikomoji galia pakankama

Mazgas nr. 25



Robot Structural Analysis Professional 2023

Design of truss node connection

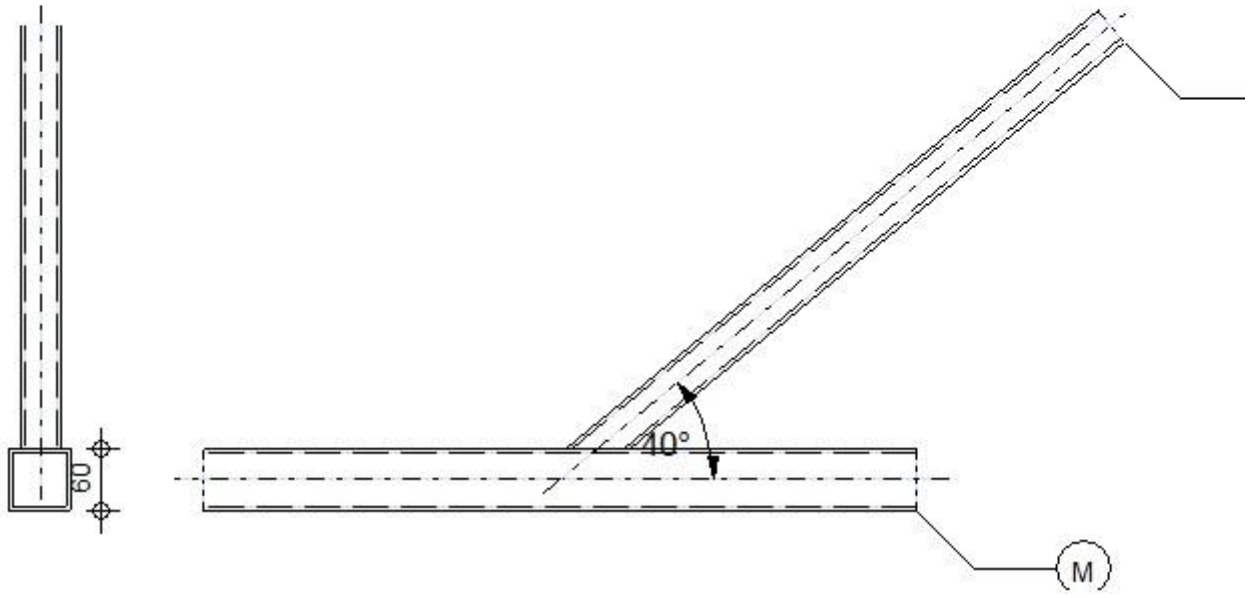
EN 1993-1-8:2005/AC:2009

OK

Ratio **0.12**

D2 - SHS 40x4

M - SQUA 60x60x4



GENERAL

Connection no.: 25
Connection name: Tube
Structure node: 10
Structure members: 3417, 3432

GEOMETRY

MEMBERS

		Chord	Diagonal 1	Diagonal 2	Post	
Member no.:		3417		3432		
Section:		SQUA 60x60x4		SHS 40x4		
	h	60		40		mm
	b_f	60		40		mm
	t_w	4		4		mm
	t_f	4		4		mm
	r	4		0		mm
Material:		S 355		S 355		
	f_y	355.00		355.00		MPa
	f_u	470.00		470.00		MPa
Angle	θ	0.0		39.5		Deg
Length	l	2712		412		mm

WELDS

a_d = 3 [mm] Thickness of welds of diagonals and posts

LOADS

Case: 101: ULS/93=1*1.35 + 5*0.78 + 2*0.91 + 7*1.30 1*1.35+5*0.78+2*0.91+7*1.30

CHORD

$N_{01,Ed}$ = -24.89 [kN] Axial force
$M_{01,Ed}$ = -0.44 [kN*m] Bending moment
$N_{02,Ed}$ = -27.23 [kN] Axial force
$M_{02,Ed}$ = -0.32 [kN*m] Bending moment

DIAGONAL 2

N_2 = 3.14 [kN] Axial force
M_2 = 0.12 [kN*m] Bending moment

Shear forces were not included in the connection verification. The connection was designed as a truss node.

RESULTS

CAPACITY VERIFICATION EUROCODE 3: EN 1993-1-8:2005

γ_{M5} = 1.00 Partial safety factor [Table 2.1]

FAILURE MODES FOR JOINTS (RHS CHORD MEMBERS) [Table 7.10] for $N_{i,Rd}$ and [Table 7.14] for $M_{i,Rd}$

GEOMETRICAL PARAMETERS

β =	0.67	Coefficient taking account of geometry of connection members	$\beta = b_2/b_0$ [1.5 (6)]
γ =	7.50	Coefficient taking account of geometry of the chord	$\gamma = b_0/(2*t_0)$ [1.5 (6)]
n =	0.18	Coefficient taking account of stresses in the chord	$n_0 = \sigma_{0,Ed}/f_{y0}$
k_n =	1.00	Coefficient taking account of stresses in the chord	$k_n = 1.0$

TUBE CHORD FACE FAILURE

DIAGONAL 2

$N_{2,Rd}$ = 117.96 [kN] Tension capacity				$N_{2,Rd} = [(k_n*f_{y0}*t_0^2)/(1-\beta)*\sin(\theta_2)]*[2*\beta/\sin(\theta_2) + 4*\sqrt{(1-\beta)}] / \gamma_{M5}$
$\|N_2\| \le N_{2,Rd}$	|3.14| < 117.96	verified	(0.03)	
$M_{2,Rd}$ = 1.41 [kN*m] Bending resistance				$M_{2,Rd} = k_n*f_{y0}*t_0^2*h_2*[1/(2*\eta) + 2/\sqrt{[1-\beta]} + \eta/(1-\beta)] / \gamma_{M5}$
$\|M_2\| \le M_{2,Rd}$	|0.12| < 1.41	verified	(0.08)	
$N_2/N_{2,Rd} + M_2/M_{2,Rd} \le 1$	0.11 < 1.00	verified	(0.11)	

CHORD SHEAR

DIAGONAL 2

A_v = 4.80 [cm^2] Shear area of the chord				$A_v = 2*h_0*t_0$
$N_{2,Rd}$ = 154.61 [kN] Tension capacity				$N_{2,Rd} = f_{y0}*A_v/[\sqrt{3}*\sin(\theta_2)] / \gamma_{M5}$
$\|N_2\| \le N_{2,Rd}$	|3.14| < 154.61	verified	(0.02)	

CHORD RESISTANCE

$N_{0,Rd}$ = 303.45 [kN] Compression capacity				$N_{0,Rd} = (A_0*f_{y0})/\gamma_{M5}$
$\|N_{02}\| \le N_{0,Rd}$	|-27.23| < 303.45	verified	(0.09)	

VERIFICATION OF WELDS

DIAGONAL 2

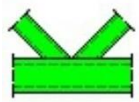
β_w = 0.88	Correlation coefficient		[Table 4.1]
γ_{M2} = 1.25	Partial safety factor		[Table 2.1]
Longitudinal weld			
$\sigma_\perp$ = 25.12 [MPa]	Normal stress in a weld		
$\tau_\perp$ = 25.12 [MPa]	Perpendicular tangent stress		
τ_{II} = 6.43 [MPa]	Tangent stress		

$\|\sigma_\perp\| \le 0.9*f_u/\gamma_{M2}$	|25.12| < 338.40	verified	(0.07)
$\sqrt{[\sigma_\perp^2 + 3*(\tau_\perp^2+\tau_{II}^2)]} \le f_u/(\beta_w*\gamma_{M2})$	51.46 < 429.71	verified	(0.12)

Connection conforms to the code Ratio 0.12

Išvada: laikomoji galia pakankama

Mazgas nr. 26



Robot Structural Analysis Professional 2023

Design of truss node connection

EN 1993-1-8:2005/AC:2009

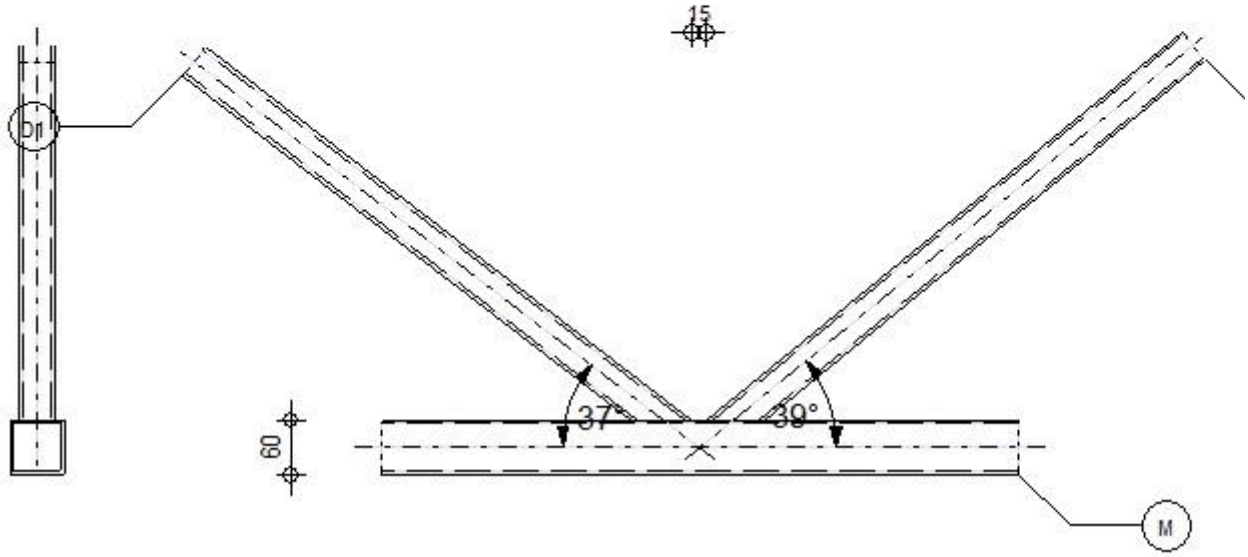
OK

Ratio **0.38**

D1 - SHS 40x4

D2 - SHS 40x4

M - SQUA 60x60x4



GENERAL

Connection no.: 26
Connection name: Tube
Structure node: 11
Structure members: 3416, 3431, 3432

GEOMETRY

MEMBERS

		Chord	Diagonal 1	Diagonal 2	Post	
Member no.:		3416	3432	3431		
Section:		SQUA 60x60x4	SHS 40x4	SHS 40x4		
	h	60	40	40		mm
	b_f	60	40	40		mm
	t_w	4	4	4		mm
	t_f	4	4	4		mm
	r	4	0	0		mm
Material:		S 355	S 355	S 355		
	f_y	355.00	355.00	355.00		MPa
	f_u	470.00	470.00	470.00		MPa
Angle	θ	0.0	37.4	39.2		Deg
Length	l	2710	412	435		mm

OFFSET

e_0 = 1 [mm] Offset

SPACINGS

g_2 = 15 [mm] Spacing of 2nd diagonal

WELDS

a_d = 3 [mm] Thickness of welds of diagonals and posts

LOADS

Case: 101: ULS/93=1*1.35 + 5*0.78 + 2*0.91 + 7*1.30 1*1.35+5*0.78+2*0.91+7*1.30

CHORD

$N_{01,Ed}$ = -113.82 [kN] Axial force
$M_{01,Ed}$ = 0.50 [kN*m] Bending moment
$N_{02,Ed}$ = -75.06 [kN] Axial force
$M_{02,Ed}$ = 0.15 [kN*m] Bending moment

DIAGONAL 1

N_1 = 3.16 [kN] Axial force
M_1 = 0.07 [kN*m] Bending moment

DIAGONAL 2

N_2 = -16.17 [kN] Axial force
M_2 = 0.24 [kN*m] Bending moment

Shear forces were not included in the connection verification. The connection was designed as a truss node.

RESULTS

CONSIDER NON-AXIAL CONNECTION OF MEMBERS IN THE NODE

M_0 = -0.05 [kN*m] Additional moment from eccentric connection of members $M_0 = (N_{02}-N_{01}) * e_0$
$\Sigma E_i J_i/L_i$ = 254997.02 [kN*m] Overall connection stiffness
ΔM_{01} = -0.01 [kN*m] Additional moment in the chord
ΔM_{02} = -0.01 [kN*m] Additional moment in the chord
ΔM_2 = -0.01 [kN*m] Additional moment in the diagonal
ΔM_1 = -0.01 [kN*m] Additional moment in the diagonal

CAPACITY VERIFICATION EUROCODE 3: EN 1993-1-8:2005

γ_{M5} = 1.00 Partial safety factor [Table 2.1]

FAILURE MODES FOR JOINTS (RHS CHORD MEMBERS) [Table 7.10] for $N_{i,Rd}$ and [Table 7.14] for $M_{i,Rd}$

GEOMETRICAL PARAMETERS

β = 0.67 Coefficient taking account of geometry of connection members $\beta = (b_2+b_1)/(2*b_0)$ [1.5 (6)]
γ = 7.50 Coefficient taking account of geometry of the chord $\gamma = b_0/(2*t_0)$ [1.5 (6)]
n = 0.52 Coefficient taking account of stresses in the chord $n_0 = \sigma_{0,Ed}/f_{y0}$
k_n = 0.99 Coefficient taking account of stresses in the chord $k_n = 1.3 - 0.4*n_0/\beta$

TUBE CHORD FACE FAILURE

DIAGONAL 2

$N_{2,Rd}$ = 144.39 [kN] Compression capacity $N_{2,Rd} = 8.9*k_n*f_{y0}*t_0^2*\sqrt{\gamma}/\sin(\theta_2) * \beta$

$|N_2| \le N_{2,Rd}$ |-16.17| < 144.39 verified (0.11)

$M_{2,Rd}$ = 1.40 [kN*m] Bending resistance $M_{2,Rd} = k_n*f_{y0}*t_0^2*h_2*[1/(2*\eta) + 2/\sqrt{[1-\beta]} + \eta/(1-\beta)] / \gamma_{M5}$

$|M_2+\Delta M_2| \le M_{2,Rd}$ |0.23| < 1.40 verified (0.17)

$N_2/N_{2,Rd} + (M_2+\Delta M_2)/M_{2,Rd} \le 1$ 0.28 < 1.00 verified (0.28)

DIAGONAL 1

$N_{1,Rd}$ = 150.17 [kN] Tension capacity $N_{1,Rd} = 8.9*k_n*f_{y0}*t_0^2*\sqrt{\gamma}/\sin(\theta_1) * \beta$

$|N_1| \le N_{1,Rd}$ |3.16| < 150.17 verified (0.02)

$M_{1,Rd}$ = 1.40 [kN*m] Bending resistance $M_{1,Rd} = k_n*f_{y0}*t_0^2*h_1*[1/(2*\eta) + 2/\sqrt{[1-\beta]} + \eta/(1-\beta)] / \gamma_{M5}$

$|M_1+\Delta M_1| \le M_{1,Rd}$ |0.06| < 1.40 verified (0.04)

$N_1/N_{1,Rd} + (M_1+\Delta M_1)/M_{1,Rd} \le 1$ 0.06 < 1.00 verified (0.06)

CHORD PUNCHING

DIAGONAL 2

$b_{e,p}$ = 27 [mm] Effective width for punching shear $b_{e,p} = (10*b_2)/(b_0/t_0)$

$N_{2,Rd}$ = 250.90 [kN] Compression capacity $N_{2,Rd} = f_{y0}*t_0/(\sqrt{3}*\sin(\theta_2))*[2*h_2/\sin(\theta_2)+b_2+b_{e,p}]/\gamma_{M5}$

$|N_2| \le N_{2,Rd}$ |-16.17| < 250.90 verified (0.06)

DIAGONAL 1

$b_{e,p}$ = 27 [mm] Effective width for punching shear $b_{e,p} = (10*b_1)/(b_0/t_0)$

$N_{1,Rd}$ = 267.81 [kN] Tension capacity $N_{1,Rd} = f_{y0}*t_0/(\sqrt{3}*\sin(\theta_1))*[2*h_1/\sin(\theta_1)+b_1+b_{e,p}]/\gamma_{M5}$

$|N_1| \le N_{1,Rd}$ |3.16| < 267.81 verified (0.01)

CHORD SHEAR

DIAGONAL 2

A_v = 5.34 [cm^2] Shear area of the chord $A_v = (2*h_0 + \alpha*b_0)*t_0$

$N_{2,Rd}$ = 173.27 [kN] Compression capacity $N_{2,Rd} = f_{y0}*A_v/[\sqrt{3}*\sin(\theta_2)] / \gamma_{M5}$

$|N_2| \le N_{2,Rd}$ |-16.17| < 173.27 verified (0.09)

DIAGONAL 1

A_v = 5.34 [cm^2] Shear area of the chord $A_v = (2*h_0 + \alpha*b_0)*t_0$

$N_{1,Rd}$ = 180.21 [kN] Tension capacity $N_{1,Rd} = f_{y0}*A_v/[\sqrt{3}*\sin(\theta_1)] / \gamma_{M5}$

$|N_1| \le N_{1,Rd}$ |3.16| < 180.21 verified (0.02)

CHORD RESISTANCE

$V_{pl,Rd}$ = 99.50 [kN] Plastic resistance for shear $V_{pl,Rd} = (A_v*f_{y0})/(\sqrt{3}*\gamma_{M0})$

$|V_{Ed}| \le V_{pl,Rd}$ |10.22| < 99.50 verified (0.10)

$N_{0,Rd}$ = 302.45 [kN] Compression capacity $N_{0,Rd} = [\,(A_0-A_v)*f_{y0} + A_v*f_{y0}*\sqrt{[1-(V_{Ed}/V_{pl,Rd})^2]}\,]/\gamma_{M5}$

$|N_{01}| \le N_{0,Rd}$ |-113.82| < 302.45 verified (0.38)

VERIFICATION OF WELDS

DIAGONAL 2

β_w =	0.88		Correlation coefficient		[Table 4.1]
γ_{M2} =	1.25		Partial safety factor		[Table 2.1]
Longitudinal weld					
$\sigma_\perp$ =	-11.65	[MPa]	Normal stress in a weld		
$\tau_\perp$ =	-11.65	[MPa]	Perpendicular tangent stress		
τ_{II} =	-20.23	[MPa]	Tangent stress		
$\lvert\sigma_\perp\rvert \le 0.9*f_u/\gamma_{M2}$			$\lvert-11.65\rvert < 338.40$	verified	(0.03)
$\sqrt{[\sigma_\perp^2 + 3*(\tau_\perp^2+\tau_{II}^2)]} \le f_u/(\beta_w*\gamma_{M2})$			$42.08 < 429.71$	verified	(0.10)
Transverse inner weld					
$\sigma_\perp$ =	-17.64	[MPa]	Normal stress in a weld		
$\tau_\perp$ =	10.75	[MPa]	Perpendicular tangent stress		
τ_{II} =	0.00	[MPa]	Tangent stress		
$\lvert\sigma_\perp\rvert \le 0.9*f_u/\gamma_{M2}$			$\lvert-17.64\rvert < 338.40$	verified	(0.05)
$\sqrt{[\sigma_\perp^2 + 3*(\tau_\perp^2+\tau_{II}^2)]} \le f_u/(\beta_w*\gamma_{M2})$			$25.65 < 429.71$	verified	(0.06)
Transverse outer weld					
$\sigma_\perp$ =	-28.24	[MPa]	Normal stress in a weld		
$\tau_\perp$ =	-31.52	[MPa]	Perpendicular tangent stress		
τ_{II} =	0.00	[MPa]	Tangent stress		
$\lvert\sigma_\perp\rvert \le 0.9*f_u/\gamma_{M2}$			$\lvert-28.24\rvert < 338.40$	verified	(0.08)
$\sqrt{[\sigma_\perp^2 + 3*(\tau_\perp^2+\tau_{II}^2)]} \le f_u/(\beta_w*\gamma_{M2})$			$61.46 < 429.71$	verified	(0.14)

DIAGONAL 1

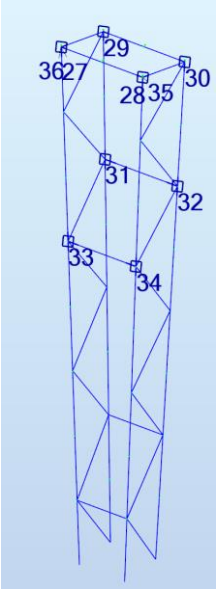
β_w =	0.88		Correlation coefficient		[Table 4.1]
γ_{M2} =	1.25		Partial safety factor		[Table 2.1]
Longitudinal weld					
$\sigma_\perp$ =	2.14	[MPa]	Normal stress in a weld		
$\tau_\perp$ =	2.14	[MPa]	Perpendicular tangent stress		
τ_{II} =	3.95	[MPa]	Tangent stress		
$\lvert\sigma_\perp\rvert \le 0.9*f_u/\gamma_{M2}$			$\lvert2.14\rvert < 338.40$	verified	(0.01)
$\sqrt{[\sigma_\perp^2 + 3*(\tau_\perp^2+\tau_{II}^2)]} \le f_u/(\beta_w*\gamma_{M2})$			$8.07 < 429.71$	verified	(0.02)
Transverse inner weld					
$\sigma_\perp$ =	6.48	[MPa]	Normal stress in a weld		
$\tau_\perp$ =	6.81	[MPa]	Perpendicular tangent stress		
τ_{II} =	0.00	[MPa]	Tangent stress		
$\lvert\sigma_\perp\rvert \le 0.9*f_u/\gamma_{M2}$			$\lvert6.48\rvert < 338.40$	verified	(0.02)
$\sqrt{[\sigma_\perp^2 + 3*(\tau_\perp^2+\tau_{II}^2)]} \le f_u/(\beta_w*\gamma_{M2})$			$13.46 < 429.71$	verified	(0.03)
Transverse outer weld					
$\sigma_\perp$ =	-3.62	[MPa]	Normal stress in a weld		
$\tau_\perp$ =	2.95	[MPa]	Perpendicular tangent stress		
τ_{II} =	0.00	[MPa]	Tangent stress		
$\lvert\sigma_\perp\rvert \le 0.9*f_u/\gamma_{M2}$			$\lvert-3.62\rvert < 338.40$	verified	(0.01)
$\sqrt{[\sigma_\perp^2 + 3*(\tau_\perp^2+\tau_{II}^2)]} \le f_u/(\beta_w*\gamma_{M2})$			$6.26 < 429.71$	verified	(0.01)

Connection conforms to the code Ratio 0.38

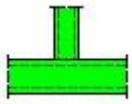
Išvada: laikomoji galia pakankama

2.7.3.10. Spragoto skerspjūvio rėmų kitų kolonų mazgų projektavimas

Mazgų numeriai:



Mazgas nr. 27



Robot Structural Analysis Professional 2023

Design of truss node connection

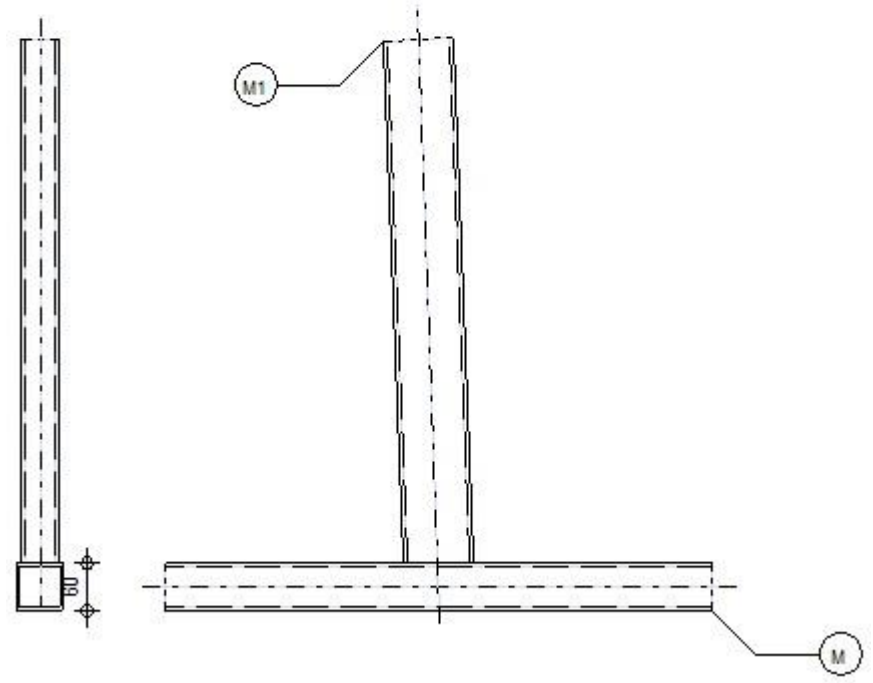
EN 1993-1-8:2005/AC:2009

OK

Ratio
0.50

M1 - RP 90x50x5

M - RK 60x60x4



GENERAL

Connection no.: 27
Connection name: Tube
Structure node: 5275
Structure members: 2091, 2105

GEOMETRY

MEMBERS

		Chord	Diagonal 1	Diagonal 2	Post	
Member no.:		2091			2105	
Section:		RK 60x60x4			RP 90x50x5	
	h	60			90	mm
	b_f	60			50	mm
	t_w	4			5	mm
	t_f	4			5	mm
	r	4			5	mm
Material:		S 355			S 355	
	f_y	355.00			355.00	MPa
	f_u	470.00			470.00	MPa
Angle	θ	0.0			92.1	Deg
Length	l	2712			450	mm

WELDS

a_d = 3 [mm] Thickness of welds of diagonals and posts

LOADS

Case: 90: ULS/82=1*1.35 + 2*0.91 + 8*1.30 1*1.35+2*0.91+8*1.30

CHORD

$N_{01,Ed}$ = -11.07 [kN] Axial force
$M_{01,Ed}$ = -0.49 [kN*m] Bending moment
$N_{02,Ed}$ = -0.00 [kN] Axial force
$M_{02,Ed}$ = 0.00 [kN*m] Bending moment

POST

N_3 = 46.30 [kN] Axial force
M_3 = 0.54 [kN*m] Bending moment

Shear forces were not included in the connection verification. The connection was designed as a truss node.

RESULTS

CAPACITY VERIFICATION EUROCODE 3: EN 1993-1-8:2005

γ_{M5} = 1.00 Partial safety factor [Table 2.1]

FAILURE MODES FOR JOINTS (RHS CHORD MEMBERS) [Table 7.11] for $N_{i,Rd}$ and [Table 7.14] for $M_{i,Rd}$

GEOMETRICAL PARAMETERS

β = 0.83	Coefficient taking account of geometry of connection members	$\beta = b_3/b_0$ [1.5 (6)]	
γ = 7.50	Coefficient taking account of geometry of the chord	$\gamma = b_0/(2*t_0)$ [1.5 (6)]	
n = 0.14	Coefficient taking account of stresses in the chord	$n_0 = \sigma_{0,Ed}/f_{y0}$	
k_n = 1.00	Coefficient taking account of stresses in the chord	$k_n = 1.0$	

TUBE CHORD FACE FAILURE

POST

η = 1.50 Coefficient taking account of geometry of connection members $\eta = h_3/b_0$

$N_{3,Rd}$ = 158.07 [kN] Tension capacity $N_{3,Rd} = [(k_n*f_{y0}*t_0^2)/(1-\beta)*\sin(\theta_3)]*[2*\eta/\sin(\theta_3) + 4*\sqrt{(1-\beta)}] / \gamma_{M5}$

$\lvert N_3\rvert \le N_{3,Rd}$	|46.30| < 158.07	verified	(0.29)

$M_{3,Rd}$ = 7.28 [kN*m] Bending resistance $M_{3,Rd} = k_n*f_{y0}*t_0^2*h_3*[1/(2*\eta) + 2/\sqrt{[1-\beta]} + \eta/(1-\beta)] / \gamma_{M5}$

$\lvert M_3\rvert \le M_{3,Rd}$	|0.54| < 7.28	verified	(0.07)
$N_3/N_{3,Rd} + M_3/M_{3,Rd} \le 1$	0.37 < 1.00	verified	(0.37)

CHORD SHEAR

POST

A_v = 4.80 [cm^2] Shear area of the chord $A_v = 2*h_0*t_0$

$N_{3,Rd}$ = 98.45 [kN] Tension capacity $N_{3,Rd} = f_{y0}*A_v/[\sqrt{3}*\sin(\theta_3)] / \gamma_{M5}$

$\lvert N_3\rvert \le N_{3,Rd}$	|46.30| < 98.45	verified	(0.47)

CHORD RESISTANCE

$N_{0,Rd}$ =	312.05	[kN]	Compression capacity		$N_{0,Rd} = (A_0 * f_{y0})/\gamma_{M5}$
$\|N_{01}\| \le N_{0,Rd}$			|-11.07| < 312.05	verified	(0.04)

VERIFICATION OF WELDS

POST

β_w =	0.88		Correlation coefficient		[Table 4.1]
γ_{M2} =	1.25		Partial safety factor		[Table 2.1]
Longitudinal weld					
$\sigma_\perp$ =	107.82	[MPa]	Normal stress in a weld		
$\tau_\perp$ =	107.82	[MPa]	Perpendicular tangent stress		
τ_{II} =	-3.17	[MPa]	Tangent stress		
$\|\sigma_\perp\| \le 0.9 * f_u/\gamma_{M2}$			|107.82| < 338.40	verified	(0.32)
$\sqrt{[\sigma_\perp^2 + 3*(\tau_\perp^2+\tau_{II}^2)]} \le f_u/(\beta_w*\gamma_{M2})$			215.71 < 429.71	verified	(0.50)

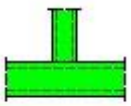
REMARKS

Diagonal angle is too large. 92.1 [Deg] > 90.0 [Deg]

Connection conforms to the code Ratio 0.50

Išvada: laikomoji galia pakankama

Mazgas nr. 28



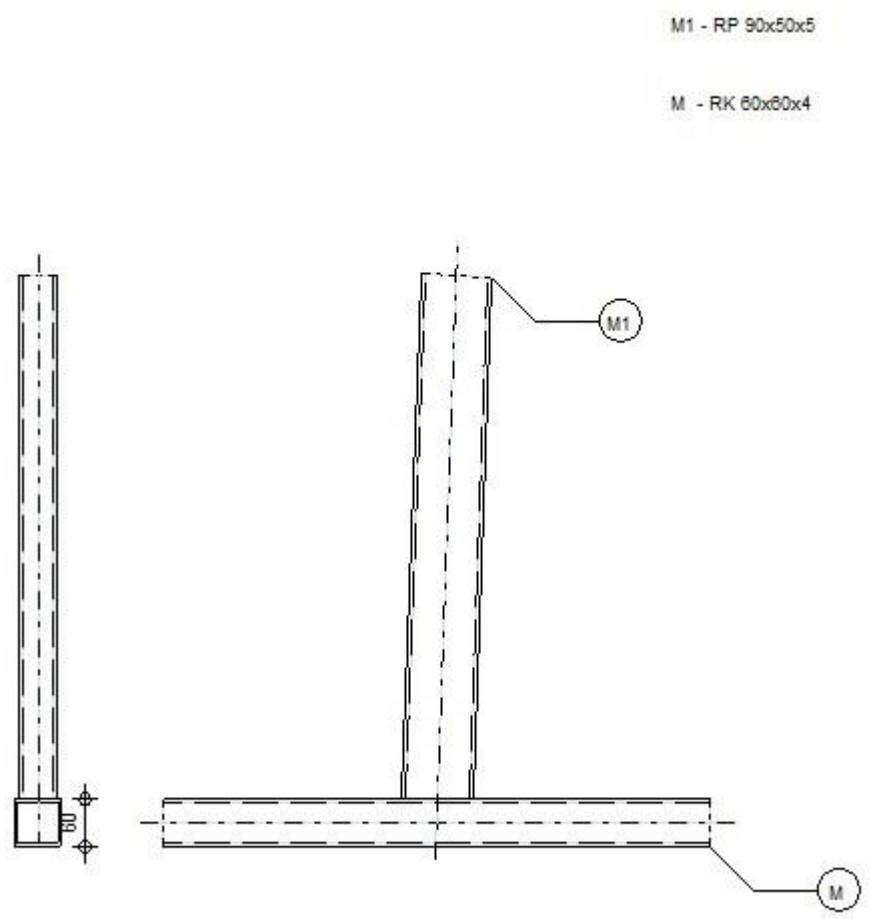
Robot Structural Analysis Professional 2023

Design of truss node connection

EN 1993-1-8:2005/AC:2009

OK

Ratio **0.51**



GENERAL

Connection no.: 28
Connection name: Tube
Structure node: 5253
Structure members: 2069, 2105

GEOMETRY

MEMBERS

		Chord	Diagonal 1	Diagonal 2	Post	
Member no.:		2069			2105	
Section:		RK 60x60x4			RP 90x50x5	
	h	60			90	mm
	b_f	60			50	mm
	t_w	4			5	mm
	t_f	4			5	mm
	r	4			5	mm
Material:		S 355			S 355	
	f_y	355.00			355.00	MPa
	f_u	470.00			470.00	MPa
Angle	θ	0.0			87.9	Deg
Length	l	2712			450	mm

WELDS

a_d = 3 [mm] Thickness of welds of diagonals and posts

LOADS

Case: 101: ULS/93=1*1.35 + 5*0.78 + 2*0.91 + 7*1.30 1*1.35+5*0.78+2*0.91+7*1.30

CHORD

$N_{01,Ed}$ = 5.39 [kN] Axial force
$M_{01,Ed}$ = 0.06 [kN*m] Bending moment
$N_{02,Ed}$ = -0.00 [kN] Axial force
$M_{02,Ed}$ = 0.00 [kN*m] Bending moment

POST

N_3 = -50.24 [kN] Axial force
M_3 = -0.11 [kN*m] Bending moment

Shear forces were not included in the connection verification. The connection was designed as a truss node.

RESULTS

CAPACITY VERIFICATION EUROCODE 3: EN 1993-1-8:2005

γ_{M5} = 1.00 Partial safety factor [Table 2.1]

FAILURE MODES FOR JOINTS (RHS CHORD MEMBERS) [Table 7.11] for $N_{i,Rd}$ and [Table 7.14] for $M_{i,Rd}$

GEOMETRICAL PARAMETERS

β = 0.83	Coefficient taking account of geometry of connection members	$\beta = b_3/b_0$ [1.5 (6)]
γ = 7.50	Coefficient taking account of geometry of the chord	$\gamma = b_0/(2*t_0)$ [1.5 (6)]
k_n = 1.00	Coefficient taking account of stresses in the chord	$k_n = 1.0$

TUBE CHORD FACE FAILURE

POST

η = 1.50 Coefficient taking account of geometry of connection members $\eta = h_3/b_0$

$N_{3,Rd}$ = 158.07 [kN] Compression capacity $N_{3,Rd} = [(k_n*f_{y0}*t_0^2)/(1-\beta)*\sin(\theta_3)]*[2*\eta/\sin(\theta_3) + 4*\sqrt{(1-\beta)}] / \gamma_{M5}$

$\lvert N_3\rvert \le N_{3,Rd}$	|-50.24| < 158.07	verified	(0.32)

$M_{3,Rd}$ = 7.28 [kN*m] Bending resistance $M_{3,Rd} = k_n*f_{y0}*t_0^2*h_3*[1/(2*\eta) + 2/\sqrt{[1-\beta]} + \eta/(1-\beta)] / \gamma_{M5}$

$\lvert M_3\rvert \le M_{3,Rd}$	|-0.11| < 7.28	verified	(0.02)
$N_3/N_{3,Rd} + M_3/M_{3,Rd} \le 1$	0.33 < 1.00	verified	(0.33)

CHORD SHEAR

POST

A_v = 4.80 [cm^2] Shear area of the chord $A_v = 2*h_0*t_0$

$N_{3,Rd}$ = 98.45 [kN] Compression capacity $N_{3,Rd} = f_{y0}*A_v/[\sqrt{3}*\sin(\theta_3)] / \gamma_{M5}$

$\lvert N_3\rvert \le N_{3,Rd}$	|-50.24| < 98.45	verified	(0.51)

CHORD RESISTANCE

$N_{0,Rd}$ =	312.05	[kN]	Tension capacity		$N_{0,Rd} = (A_0 * f_{y0})/\gamma_{M5}$
$\|N_{01}\| \le N_{0,Rd}$			|5.39| < 312.05	verified	(0.02)

VERIFICATION OF WELDS

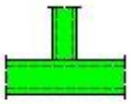
POST

β_w =	0.88		Correlation coefficient		[Table 4.1]
γ_{M2} =	1.25		Partial safety factor		[Table 2.1]
Longitudinal weld					
$\sigma_\perp$ =	-55.91	[MPa]	Normal stress in a weld		
$\tau_\perp$ =	-55.91	[MPa]	Perpendicular tangent stress		
τ_{II} =	-3.44	[MPa]	Tangent stress		
$\|\sigma_\perp\| \le 0.9 * f_u/\gamma_{M2}$			|-55.91| < 338.40	verified	(0.17)
$\sqrt{[\sigma_\perp^2 + 3*(\tau_\perp^2+\tau_{II}^2)]} \le f_u/(\beta_w*\gamma_{M2})$			111.98 < 429.71	verified	(0.26)

Connection conforms to the code Ratio 0.51

Išvada: laikomoji galia pakankama

Mazgas nr. 29



Robot Structural Analysis Professional 2023

Design of truss node connection

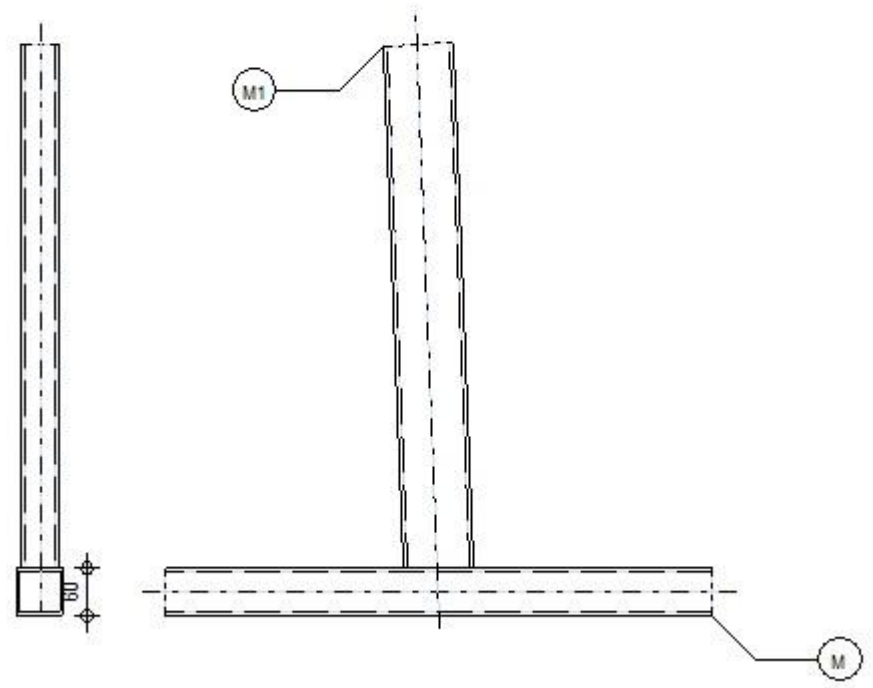
EN 1993-1-8:2005/AC:2009

OK

Ratio **0.28**

M1 - RP 90x50x5

M - RK 60x60x4



GENERAL

Connection no.: 29
Connection name: Tube
Structure node: 5277
Structure members: 2092, 2113

GEOMETRY

MEMBERS

		Chord	Diagonal 1	Diagonal 2	Post	
Member no.:		2092			2113	
Section:		RK 60x60x4			RP 90x50x5	
	h	60			90	mm
	b_f	60			50	mm
	t_w	4			5	mm
	t_f	4			5	mm
	r	4			5	mm
Material:		S 355			S 355	
	f_y	355.00			355.00	MPa
	f_u	470.00			470.00	MPa
Angle	θ	0.0			92.2	Deg
Length	l	2633			450	mm

WELDS

a_d = 3 [mm] Thickness of welds of diagonals and posts

LOADS

Case: 101: ULS/93=1*1.35 + 5*0.78 + 2*0.91 + 7*1.30 1*1.35+5*0.78+2*0.91+7*1.30

CHORD

$N_{01,Ed}$ = -0.00 [kN] Axial force
$M_{01,Ed}$ = 0.00 [kN*m] Bending moment
$N_{02,Ed}$ = -16.31 [kN] Axial force
$M_{02,Ed}$ = -0.45 [kN*m] Bending moment

POST

N_3 = -1.79 [kN] Axial force
M_3 = 0.67 [kN*m] Bending moment

Shear forces were not included in the connection verification. The connection was designed as a truss node.

RESULTS

CAPACITY VERIFICATION EUROCODE 3: EN 1993-1-8:2005

γ_{M5} = 1.00 Partial safety factor [Table 2.1]

FAILURE MODES FOR JOINTS (RHS CHORD MEMBERS) [Table 7.11] for $N_{i,Rd}$ and [Table 7.14] for $M_{i,Rd}$

GEOMETRICAL PARAMETERS

β = 0.83	Coefficient taking account of geometry of connection members	$\beta = b_3/b_0$ [1.5 (6)]
γ = 7.50	Coefficient taking account of geometry of the chord	$\gamma = b_0/(2*t_0)$ [1.5 (6)]
n = 0.15	Coefficient taking account of stresses in the chord	$n_0 = \sigma_{0,Ed}/f_{y0}$
k_n = 1.00	Coefficient taking account of stresses in the chord	k_n = 1.0

TUBE CHORD FACE FAILURE

POST

η = 1.50 Coefficient taking account of geometry of connection members $\eta = h_3/b_0$

$N_{3,Rd}$ = 158.08 [kN] Compression capacity $N_{3,Rd} = [(k_n*f_{y0}*t_0^2)/(1-\beta)*\sin(\theta_3)]*[2*\eta/\sin(\theta_3) + 4*\sqrt{(1-\beta)}] / \gamma_{M5}$

$|N_3| \le N_{3,Rd}$ |-1.79| < 158.08 verified (0.01)

$M_{3,Rd}$ = 7.28 [kN*m] Bending resistance $M_{3,Rd} = k_n*f_{y0}*t_0^2*h_3*[1/(2*\eta) + 2/\sqrt{[1-\beta]} + \eta/(1-\beta)] / \gamma_{M5}$

$|M_3| \le M_{3,Rd}$ |0.67| < 7.28 verified (0.09)

$N_3/N_{3,Rd} + M_3/M_{3,Rd} \le 1$ 0.10 < 1.00 verified (0.10)

CHORD SHEAR

POST

A_v = 4.80 [cm^2] Shear area of the chord $A_v = 2*h_0*t_0$

$N_{3,Rd}$ = 98.45 [kN] Compression capacity $N_{3,Rd} = f_{y0}*A_v/[\sqrt{3}*\sin(\theta_3)] / \gamma_{M5}$

$|N_3| \le N_{3,Rd}$ |-1.79| < 98.45 verified (0.02)

CHORD RESISTANCE

$N_{0,Rd}$ =	312.05	[kN]	Compression capacity		$N_{0,Rd} = (A_0 * f_{y0})/\gamma_{M5}$
$\lvert N_{02}\rvert \le N_{0,Rd}$			|-16.31| < 312.05	verified	(0.05)

VERIFICATION OF WELDS

POST

β_w =	0.88		Correlation coefficient		[Table 4.1]
γ_{M2} =	1.25		Partial safety factor		[Table 2.1]
Longitudinal weld					
$\sigma_\perp$ =	-60.64	[MPa]	Normal stress in a weld		
$\tau_\perp$ =	-60.64	[MPa]	Perpendicular tangent stress		
τ_{II} =	0.13	[MPa]	Tangent stress		
$\lvert\sigma_\perp\rvert \le 0.9 * f_u/\gamma_{M2}$			|-60.64| < 338.40	verified	(0.18)
$\sqrt{[\sigma_\perp^2 + 3*(\tau_\perp^2+\tau_{II}^2)]} \le f_u/(\beta_w*\gamma_{M2})$			121.29 < 429.71	verified	(0.28)

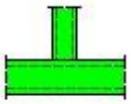
REMARKS

Diagonal angle is too large. 92.2 [Deg] > 90.0 [Deg]

Connection conforms to the code Ratio 0.28

Išvada: laikomoji galia pakankama

Mazgas nr. 30



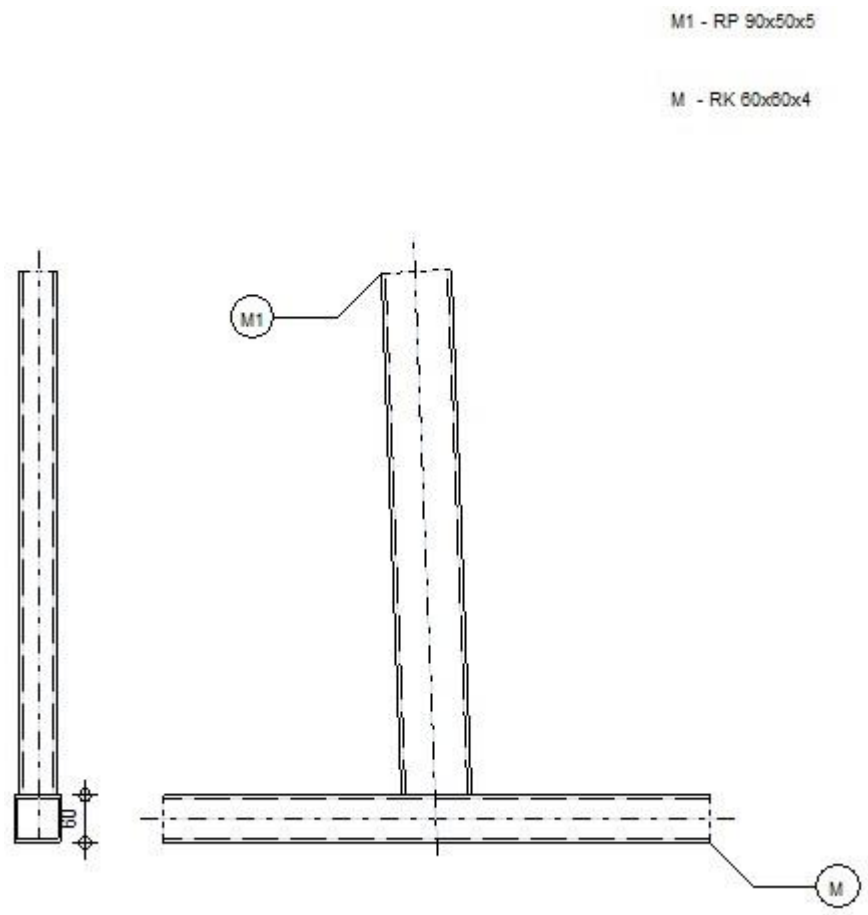
Robot Structural Analysis Professional 2023

Design of truss node connection

EN 1993-1-8:2005/AC:2009

OK

Ratio **0.37**



GENERAL

Connection no.: 30
Connection name: Tube
Structure node: 5255
Structure members: 2070, 2113

GEOMETRY

MEMBERS

		Chord	Diagonal 1	Diagonal 2	Post	
Member no.:		2070			2113	
Section:		RK 60x60x4			RP 90x50x5	
	h	60			90	mm
	b_f	60			50	mm
	t_w	4			5	mm
	t_f	4			5	mm
	r	4			5	mm
Material:		S 355			S 355	
	f_y	355.00			355.00	MPa
	f_u	470.00			470.00	MPa
Angle	θ	0.0			92.2	Deg
Length	l	2633			450	mm

WELDS

a_d = 3 [mm] Thickness of welds of diagonals and posts

LOADS

Case: 89: ULS/81=1*1.35 + 2*0.91 + 7*1.30 1*1.35+2*0.91+7*1.30

CHORD

$N_{01,Ed}$ = -0.00 [kN] Axial force
$M_{01,Ed}$ = 0.00 [kN*m] Bending moment
$N_{02,Ed}$ = -17.45 [kN] Axial force
$M_{02,Ed}$ = 0.26 [kN*m] Bending moment

POST

N_3 = -1.69 [kN] Axial force
M_3 = 0.89 [kN*m] Bending moment

Shear forces were not included in the connection verification. The connection was designed as a truss node.

RESULTS

CAPACITY VERIFICATION EUROCODE 3: EN 1993-1-8:2005

γ_{M5} = 1.00 Partial safety factor [Table 2.1]

FAILURE MODES FOR JOINTS (RHS CHORD MEMBERS) [Table 7.11] for $N_{i,Rd}$ and [Table 7.14] for $M_{i,Rd}$

GEOMETRICAL PARAMETERS

β = 0.83	Coefficient taking account of geometry of connection members	$\beta = b_3/b_0$ [1.5 (6)]
γ = 7.50	Coefficient taking account of geometry of the chord	$\gamma = b_0/(2*t_0)$ [1.5 (6)]
n = 0.11	Coefficient taking account of stresses in the chord	$n_0 = \sigma_{0,Ed}/f_{y0}$
k_n = 1.00	Coefficient taking account of stresses in the chord	k_n = 1.0

TUBE CHORD FACE FAILURE

POST

η = 1.50 Coefficient taking account of geometry of connection members $\eta = h_3/b_0$

$N_{3,Rd}$ = 158.08 [kN] Compression capacity			$N_{3,Rd} = [(k_n*f_{y0}*t_0^2)/(1-\beta)*\sin(\theta_3)]*[2*\eta/\sin(\theta_3) + 4*\sqrt{(1-\beta)}] / \gamma_{M5}$
$\lvert N_3\rvert \le N_{3,Rd}$	$\lvert -1.69\rvert < 158.08$	verified	(0.01)
$M_{3,Rd}$ = 7.28 [kN*m] Bending resistance			$M_{3,Rd} = k_n*f_{y0}*t_0^2*h_3*[1/(2*\eta) + 2/\sqrt{[1-\beta]} + \eta/(1-\beta)] / \gamma_{M5}$
$\lvert M_3\rvert \le M_{3,Rd}$	$\lvert 0.89\rvert < 7.28$	verified	(0.12)
$N_3/N_{3,Rd} + M_3/M_{3,Rd} \le 1$	$0.13 < 1.00$	verified	(0.13)

CHORD SHEAR

POST

A_v = 4.80	[cm^2]	Shear area of the chord		$A_v = 2*h_0*t_0$
$N_{3,Rd}$ = 98.45	[kN]	Compression capacity		$N_{3,Rd} = f_{y0}*A_v/[\sqrt{3}*\sin(\theta_3)] / \gamma_{M5}$
$\lvert N_3\rvert \le N_{3,Rd}$		$\lvert -1.69\rvert < 98.45$	verified	(0.02)

CHORD RESISTANCE

$N_{0,Rd}$ =	312.05	[kN]	Compression capacity		$N_{0,Rd} = (A_0 * f_{y0})/\gamma_{M5}$
$\lvert N_{02}\rvert \le N_{0,Rd}$			|-17.45| < 312.05	verified	(0.06)

VERIFICATION OF WELDS

POST

β_w =	0.88		Correlation coefficient		[Table 4.1]
γ_{M2} =	1.25		Partial safety factor		[Table 2.1]
Longitudinal weld					
$\sigma_\perp$ =	-80.20	[MPa]	Normal stress in a weld		
$\tau_\perp$ =	-80.20	[MPa]	Perpendicular tangent stress		
τ_{II} =	0.12	[MPa]	Tangent stress		
$\lvert\sigma_\perp\rvert \le 0.9 * f_u/\gamma_{M2}$			|-80.20| < 338.40	verified	(0.24)
$\sqrt{[\sigma_\perp^2 + 3*(\tau_\perp^2+\tau_{II}^2)]} \le f_u/(\beta_w*\gamma_{M2})$			160.40 < 429.71	verified	(0.37)

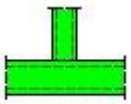
REMARKS

Diagonal angle is too large. 92.2 [Deg] > 90.0 [Deg]

Connection conforms to the code Ratio 0.37

Išvada: laikomoji galia pakankama

Mazgas nr. 31



Robot Structural Analysis Professional 2023

Design of truss node connection

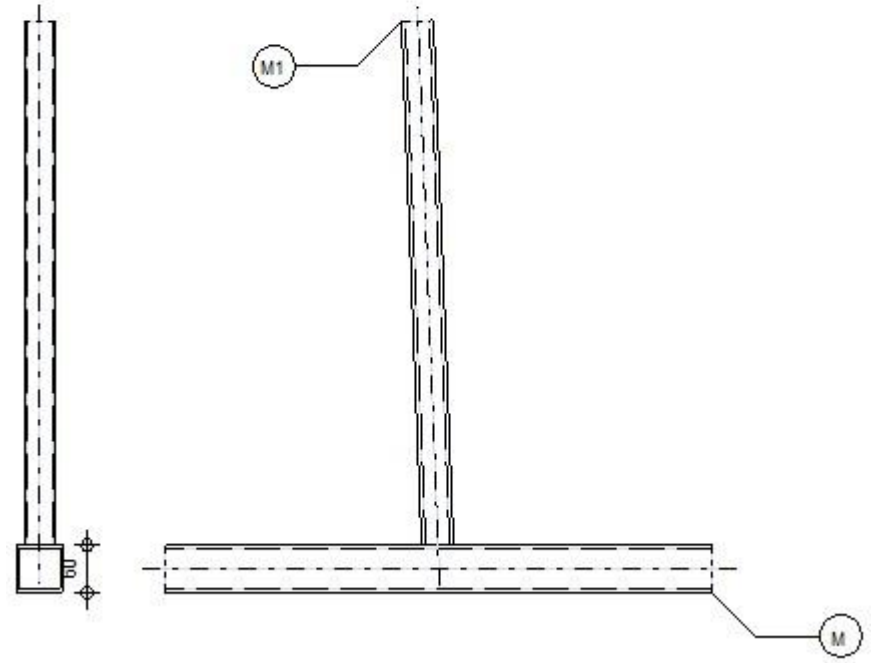
EN 1993-1-8:2005/AC:2009

OK

Ratio **0.27**

M1 - SHS 40x4

M - RK 60x60x4



GENERAL

Connection no.: 31
Connection name: Tube
Structure node: 5279
Structure members: 2092, 2120

GEOMETRY

MEMBERS

		Chord	Diagonal 1	Diagonal 2	Post	
Member no.:		2092			2120	
Section:		RK 60x60x4			SHS 40x4	
	h	60			40	mm
	b_f	60			40	mm
	t_w	4			4	mm
	t_f	4			4	mm
	r	4			0	mm
Material:		S 355			S 355	
	f_y	355.00			355.00	MPa
	f_u	470.00			470.00	MPa
Angle	θ	0.0			92.2	Deg
Length	l	2633			400	mm

WELDS

a_d = 3 [mm] Thickness of welds of diagonals and posts

LOADS

Case: 102: ULS/94=1*1.35 + 5*0.78 + 2*0.91 + 8*1.30 1*1.35+5*0.78+2*0.91+8*1.30

CHORD

$N_{01,Ed}$ = 4.41 [kN] Axial force
$M_{01,Ed}$ = -0.04 [kN*m] Bending moment
$N_{02,Ed}$ = -6.25 [kN] Axial force
$M_{02,Ed}$ = -0.13 [kN*m] Bending moment

POST

N_3 = -0.41 [kN] Axial force
M_3 = 0.13 [kN*m] Bending moment

Shear forces were not included in the connection verification. The connection was designed as a truss node.

RESULTS

CAPACITY VERIFICATION EUROCODE 3: EN 1993-1-8:2005

γ_{M5} = 1.00 Partial safety factor [Table 2.1]

FAILURE MODES FOR JOINTS (RHS CHORD MEMBERS) [Table 7.10] for $N_{i,Rd}$ and [Table 7.14] for $M_{i,Rd}$

GEOMETRICAL PARAMETERS

β = 0.67	Coefficient taking account of geometry of connection members		$\beta = b_3/b_0$ [1.5 (6)]
γ = 7.50	Coefficient taking account of geometry of the chord		$\gamma = b_0/(2*t_0)$ [1.5 (6)]
n = 0.05	Coefficient taking account of stresses in the chord		$n_0 = \sigma_{0,Ed}/f_{y0}$
k_n = 1.00	Coefficient taking account of stresses in the chord		k_n = 1.0

TUBE CHORD FACE FAILURE

POST

$N_{3,Rd}$ = 62.13 [kN]	Compression capacity		$N_{3,Rd} = [(k_n*f_{y0}*t_0^2)/(1-\beta)*\sin(\theta_3)]*[2*\beta/\sin(\theta_3) + 4*\sqrt{(1-\beta)}] /\gamma_{M5}$
$\lvert N_3\rvert \le N_{3,Rd}$	$\lvert -0.41\rvert < 62.13$	verified	(0.01)
$M_{3,Rd}$ = 1.41 [kN*m]	Bending resistance		$M_{3,Rd} = k_n*f_{y0}*t_0^2*h_3*[1/(2*\eta) + 2/\sqrt{[1-\beta]} + \eta/(1-\beta)] / \gamma_{M5}$
$\lvert M_3\rvert \le M_{3,Rd}$	$\lvert 0.13\rvert < 1.41$	verified	(0.09)
$N_3/N_{3,Rd} + M_3/M_{3,Rd} \le 1$	$0.10 < 1.00$	verified	(0.10)

CHORD SHEAR

POST

A_v = 4.80 [cm^2]	Shear area of the chord			$A_v = 2*h_0*t_0$
$N_{3,Rd}$ = 98.45 [kN]	Compression capacity			$N_{3,Rd} = f_{y0}*A_v/[\sqrt{3}*\sin(\theta_3)] / \gamma_{M5}$
$\lvert N_3\rvert \le N_{3,Rd}$		$\lvert -0.41\rvert < 98.45$	verified	(0.00)

CHORD RESISTANCE

$N_{0,Rd}$ = 312.05	[kN]	Compression capacity		$N_{0,Rd} = (A_0 * f_{y0})/\gamma_{M5}$
$\|N_{02}\| \le N_{0,Rd}$		|-6.25| < 312.05	verified	(0.02)

VERIFICATION OF WELDS

POST

β_w = 0.88		Correlation coefficient		[Table 4.1]
γ_{M2} = 1.25		Partial safety factor		[Table 2.1]
Longitudinal weld				
$\sigma_\perp$ = -58.77	[MPa]	Normal stress in a weld		
$\tau_\perp$ = -58.77	[MPa]	Perpendicular tangent stress		
τ_{II} = 0.07	[MPa]	Tangent stress		
$\|\sigma_\perp\| \le 0.9 * f_u/\gamma_{M2}$		|-58.77| < 338.40	verified	(0.17)
$\sqrt{[\sigma_\perp^2 + 3*(\tau_\perp^2+\tau_{II}^2)]} \le f_u/(\beta_w*\gamma_{M2})$		117.53 < 429.71	verified	(0.27)

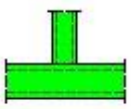
REMARKS

Diagonal angle is too large. 92.2 [Deg] > 90.0 [Deg]

Connection conforms to the code Ratio 0.27

Išvada: laikomoji galia pakankama

Mazgas nr. 32



Robot Structural Analysis Professional 2023

Design of truss node connection

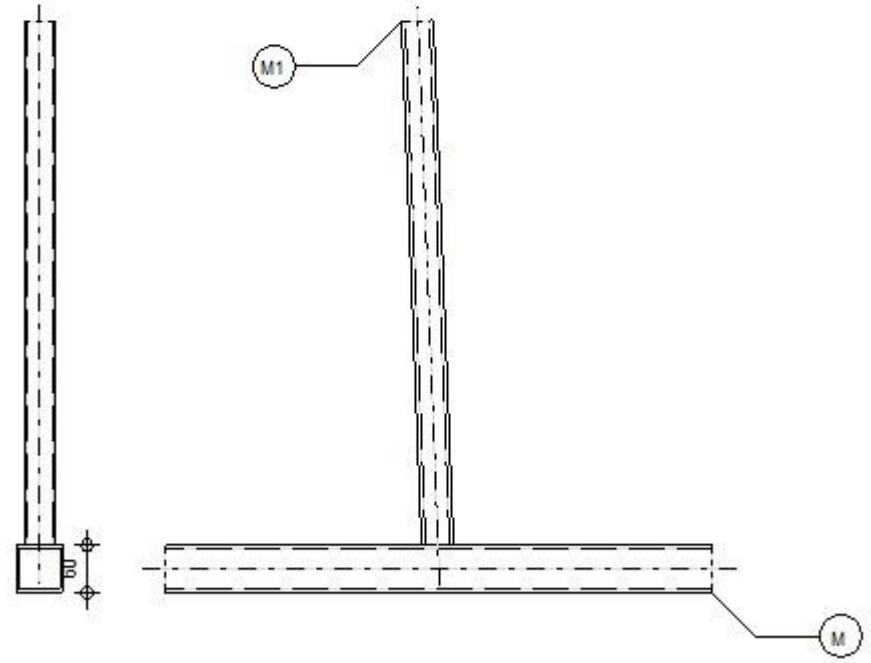
EN 1993-1-8:2005/AC:2009

OK

Ratio **0.38**

M1 - SHS 40x4

M - RK 60x60x4



GENERAL

Connection no.: 32
Connection name: Tube
Structure node: 5257
Structure members: 2070, 2120

GEOMETRY

MEMBERS

		Chord	Diagonal 1	Diagonal 2	Post	
Member no.:		2070			2120	
Section:		RK 60x60x4			SHS 40x4	
	h	60			40	mm
	b_f	60			40	mm
	t_w	4			4	mm
	t_f	4			4	mm
	r	4			0	mm
Material:		S 355			S 355	
	f_y	355.00			355.00	MPa
	f_u	470.00			470.00	MPa
Angle	θ	0.0			92.2	Deg
Length	l	2633			400	mm

WELDS

a_d = 3 [mm] Thickness of welds of diagonals and posts

LOADS

Case: 89: ULS/81=1*1.35 + 2*0.91 + 7*1.30 1*1.35+2*0.91+7*1.30

CHORD

$N_{01,Ed}$ = -17.57 [kN] Axial force
$M_{01,Ed}$ = -0.06 [kN*m] Bending moment
$N_{02,Ed}$ = -8.53 [kN] Axial force
$M_{02,Ed}$ = -0.00 [kN*m] Bending moment

POST

N_3 = 1.31 [kN] Axial force
M_3 = 0.18 [kN*m] Bending moment

Shear forces were not included in the connection verification. The connection was designed as a truss node.

RESULTS

CAPACITY VERIFICATION EUROCODE 3: EN 1993-1-8:2005

γ_{M5} = 1.00 Partial safety factor [Table 2.1]

FAILURE MODES FOR JOINTS (RHS CHORD MEMBERS) [Table 7.10] for $N_{i,Rd}$ and [Table 7.14] for $M_{i,Rd}$

GEOMETRICAL PARAMETERS

β = 0.67	Coefficient taking account of geometry of connection members	$\beta = b_3/b_0$ [1.5 (6)]
γ = 7.50	Coefficient taking account of geometry of the chord	$\gamma = b_0/(2*t_0)$ [1.5 (6)]
n = 0.07	Coefficient taking account of stresses in the chord	$n_0 = \sigma_{0,Ed}/f_{y0}$
k_n = 1.00	Coefficient taking account of stresses in the chord	k_n = 1.0

TUBE CHORD FACE FAILURE

POST

$N_{3,Rd}$ = 62.13 [kN] Tension capacity $N_{3,Rd} = [(k_n*f_{y0}*t_0^2)/(1-\beta)*\sin(\theta_3)]*[2*\beta/\sin(\theta_3) + 4*\sqrt{(1-\beta)}] /\gamma_{M5}$

$\lvert N_3\rvert \le N_{3,Rd}$	$\lvert 1.31\rvert < 62.13$	verified	(0.02)

$M_{3,Rd}$ = 1.41 [kN*m] Bending resistance $M_{3,Rd} = k_n*f_{y0}*t_0^2*h_3*[1/(2*\eta) + 2/\sqrt{[1-\beta]} + \eta/(1-\beta)] / \gamma_{M5}$

$\lvert M_3\rvert \le M_{3,Rd}$	$\lvert 0.18\rvert < 1.41$	verified	(0.12)
$N_3/N_{3,Rd} + M_3/M_{3,Rd} \le 1$	$0.15 < 1.00$	verified	(0.15)

CHORD SHEAR

POST

A_v = 4.80 [cm^2] Shear area of the chord $A_v = 2*h_0*t_0$
$N_{3,Rd}$ = 98.45 [kN] Tension capacity $N_{3,Rd} = f_{y0}*A_v/[\sqrt{3}*\sin(\theta_3)] / \gamma_{M5}$

$\lvert N_3\rvert \le N_{3,Rd}$	$\lvert 1.31\rvert < 98.45$	verified	(0.01)

CHORD RESISTANCE

$N_{0,Rd}$ = 312.05	[kN]	Compression capacity		$N_{0,Rd} = (A_0 * f_{y0})/\gamma_{M5}$
$\|N_{01}\| \le N_{0,Rd}$		|-17.57| < 312.05	verified	(0.06)

VERIFICATION OF WELDS

POST

β_w = 0.88		Correlation coefficient		[Table 4.1]
γ_{M2} = 1.25		Partial safety factor		[Table 2.1]
Longitudinal weld				
$\sigma_\perp$ = 81.27	[MPa]	Normal stress in a weld		
$\tau_\perp$ = 81.27	[MPa]	Perpendicular tangent stress		
τ_{II} = -0.21	[MPa]	Tangent stress		
$\|\sigma_\perp\| \le 0.9 * f_u/\gamma_{M2}$		|81.27| < 338.40	verified	(0.24)
$\sqrt{[\sigma_\perp^2 + 3*(\tau_\perp^2+\tau_{II}^2)]} \le f_u/(\beta_w*\gamma_{M2})$		162.54 < 429.71	verified	(0.38)

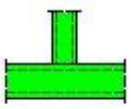
REMARKS

Diagonal angle is too large. 92.2 [Deg] > 90.0 [Deg]

Connection conforms to the code Ratio 0.38

Išvada: laikomoji galia pakankama

Mazgas nr. 33



Robot Structural Analysis Professional 2023

Design of truss node connection

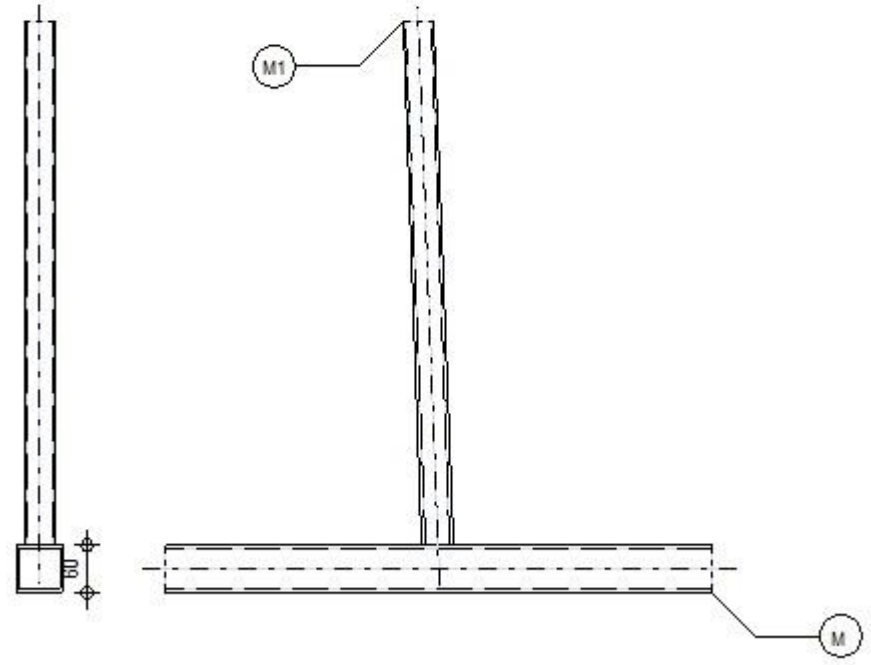
EN 1993-1-8:2005/AC:2009

OK

Ratio **0.58**

M1 - SHS 40x4

M - RK 60x60x4



GENERAL

Connection no.: 33
Connection name: Tube
Structure node: 5280
Structure members: 2091, 2117

GEOMETRY

MEMBERS

		Chord	Diagonal 1	Diagonal 2	Post	
Member no.:		2091			2117	
Section:		RK 60x60x4			SHS 40x4	
	h	60			40	mm
	b_f	60			40	mm
	t_w	4			4	mm
	t_f	4			4	mm
	r	4			0	mm
Material:		S 355			S 355	
	f_y	355.00			355.00	MPa
	f_u	470.00			470.00	MPa
Angle	θ	0.0			92.1	Deg
Length	l	2712			375	mm

WELDS

a_d = 3 [mm] Thickness of welds of diagonals and posts

LOADS

Case: 127: ULS/119=1*1.00 + 6*0.78 + 7*1.30 1*1.00+6*0.78+7*1.30

CHORD

$N_{01,Ed}$ = -8.74 [kN] Axial force
$M_{01,Ed}$ = 0.16 [kN*m] Bending moment
$N_{02,Ed}$ = 1.27 [kN] Axial force
$M_{02,Ed}$ = -0.11 [kN*m] Bending moment

POST

N_3 = -0.23 [kN] Axial force
M_3 = -0.28 [kN*m] Bending moment

Shear forces were not included in the connection verification. The connection was designed as a truss node.

RESULTS

CAPACITY VERIFICATION EUROCODE 3: EN 1993-1-8:2005

γ_{M5} = 1.00 Partial safety factor [Table 2.1]

FAILURE MODES FOR JOINTS (RHS CHORD MEMBERS) [Table 7.10] for $N_{i,Rd}$ and [Table 7.14] for $M_{i,Rd}$

GEOMETRICAL PARAMETERS

β = 0.67	Coefficient taking account of geometry of connection members	$\beta = b_3/b_0$ [1.5 (6)]
γ = 7.50	Coefficient taking account of geometry of the chord	$\gamma = b_0/(2*t_0)$ [1.5 (6)]
n = 0.06	Coefficient taking account of stresses in the chord	$n_0 = \sigma_{0,Ed}/f_{y0}$
k_n = 1.00	Coefficient taking account of stresses in the chord	k_n = 1.0

TUBE CHORD FACE FAILURE

POST

$N_{3,Rd}$ = 62.13 [kN] Compression capacity $N_{3,Rd} = [(k_n*f_{y0}*t_0^2)/(1-\beta)*\sin(\theta_3)]*[2*\beta/\sin(\theta_3) + 4*\sqrt{(1-\beta)}] /\gamma_{M5}$

$\lvert N_3\rvert \le N_{3,Rd}$	|-0.23| < 62.13	verified	(0.00)

$M_{3,Rd}$ = 1.41 [kN*m] Bending resistance $M_{3,Rd} = k_n*f_{y0}*t_0^2*h_3*[1/(2*\eta) + 2/\sqrt{[1-\beta]} + \eta/(1-\beta)] / \gamma_{M5}$

$\lvert M_3\rvert \le M_{3,Rd}$	|-0.28| < 1.41	verified	(0.20)
$N_3/N_{3,Rd} + M_3/M_{3,Rd} \le 1$	0.20 < 1.00	verified	(0.20)

CHORD SHEAR

POST

A_v = 4.80 [cm^2] Shear area of the chord $A_v = 2*h_0*t_0$
$N_{3,Rd}$ = 98.45 [kN] Compression capacity $N_{3,Rd} = f_{y0}*A_v/[\sqrt{3}*\sin(\theta_3)] / \gamma_{M5}$

$\lvert N_3\rvert \le N_{3,Rd}$	|-0.23| < 98.45	verified	(0.00)

CHORD RESISTANCE

$N_{0,Rd}$ =	312.05	[kN]	Compression capacity		$N_{0,Rd} = (A_0 * f_{y0})/\gamma_{M5}$
$\|N_{01}\| \le N_{0,Rd}$			|-8.74| < 312.05	verified	(0.03)

VERIFICATION OF WELDS

POST

β_w =	0.88		Correlation coefficient		[Table 4.1]
γ_{M2} =	1.25		Partial safety factor		[Table 2.1]
Longitudinal weld					
$\sigma_\perp$ =	124.15	[MPa]	Normal stress in a weld		
$\tau_\perp$ =	124.15	[MPa]	Perpendicular tangent stress		
τ_{II} =	0.03	[MPa]	Tangent stress		
$\|\sigma_\perp\| \le 0.9 * f_u/\gamma_{M2}$			|124.15| < 338.40	verified	(0.37)
$\sqrt{[\sigma_\perp^2 + 3*(\tau_\perp^2+\tau_{II}^2)]} \le f_u/(\beta_w*\gamma_{M2})$			248.30 < 429.71	verified	(0.58)

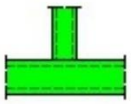
REMARKS

Diagonal angle is too large. 92.1 [Deg] > 90.0 [Deg]

Connection conforms to the code Ratio 0.58

Išvada: laikomoji galia pakankama

Mazgas nr. 34



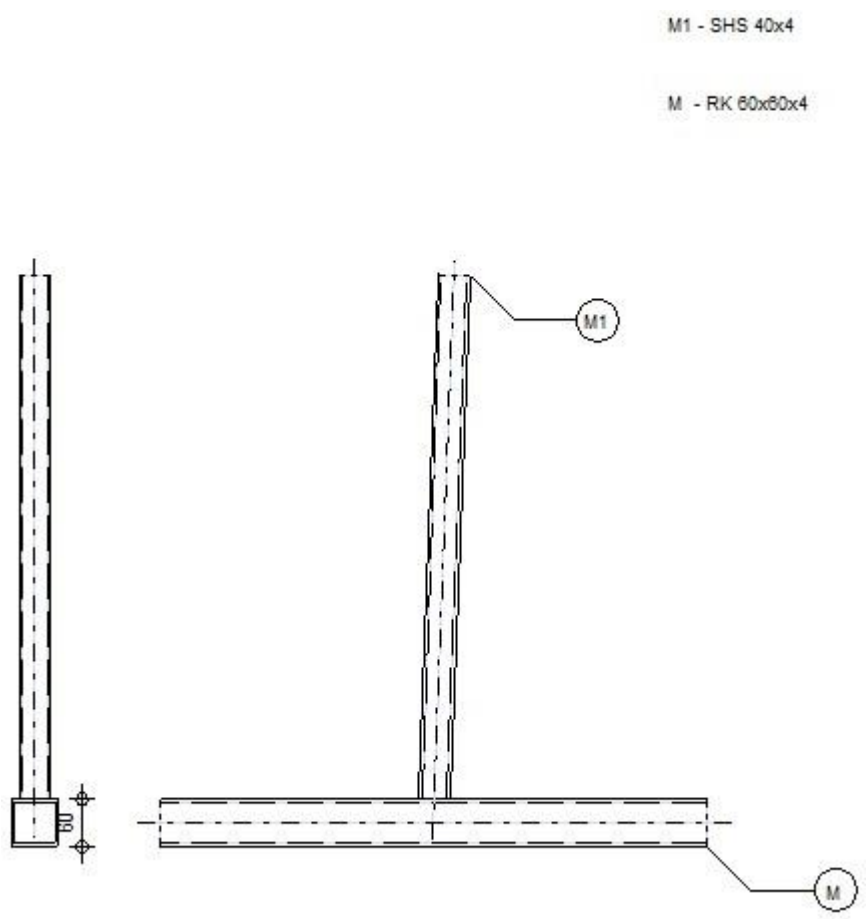
Robot Structural Analysis Professional 2023

Design of truss node connection

EN 1993-1-8:2005/AC:2009

OK

Ratio **0.55**



GENERAL

Connection no.: 34
Connection name: Tube
Structure node: 5258
Structure members: 2069, 2117

GEOMETRY

MEMBERS

		Chord	Diagonal 1	Diagonal 2	Post	
Member no.:		2069			2117	
Section:		RK 60x60x4			SHS 40x4	
	h	60			40	mm
	b_f	60			40	mm
	t_w	4			4	mm
	t_f	4			4	mm
	r	4			0	mm
Material:		S 355			S 355	
	f_y	355.00			355.00	MPa
	f_u	470.00			470.00	MPa
Angle	θ	0.0			87.9	Deg
Length	l	2712			375	mm

WELDS

a_d = 3 [mm] Thickness of welds of diagonals and posts

LOADS

Case: 105: ULS/97=1*1.35 + 6*0.78 + 2*0.91 + 7*1.30 1*1.35+6*0.78+2*0.91+7*1.30

CHORD

$N_{01,Ed}$ = -12.91 [kN] Axial force
$M_{01,Ed}$ = -0.16 [kN*m] Bending moment
$N_{02,Ed}$ = -0.89 [kN] Axial force
$M_{02,Ed}$ = 0.03 [kN*m] Bending moment

POST

N_3 = -0.19 [kN] Axial force
M_3 = 0.27 [kN*m] Bending moment

Shear forces were not included in the connection verification. The connection was designed as a truss node.

RESULTS

CAPACITY VERIFICATION EUROCODE 3: EN 1993-1-8:2005

γ_{M5} = 1.00 Partial safety factor [Table 2.1]

FAILURE MODES FOR JOINTS (RHS CHORD MEMBERS) [Table 7.10] for $N_{i,Rd}$ and [Table 7.14] for $M_{i,Rd}$

GEOMETRICAL PARAMETERS

β =	0.67	Coefficient taking account of geometry of connection members	$\beta = b_3/b_0$ [1.5 (6)]
γ =	7.50	Coefficient taking account of geometry of the chord	$\gamma = b_0/(2*t_0)$ [1.5 (6)]
n =	0.08	Coefficient taking account of stresses in the chord	$n_0 = \sigma_{0,Ed}/f_{y0}$
k_n =	1.00	Coefficient taking account of stresses in the chord	k_n = 1.0

TUBE CHORD FACE FAILURE

POST

$N_{3,Rd}$ = 62.13 [kN] Compression capacity $N_{3,Rd} = [(k_n*f_{y0}*t_0^2)/(1-\beta)*\sin(\theta_3)]*[2*\beta/\sin(\theta_3) + 4*\sqrt{(1-\beta)}] /\gamma_{M5}$

$\lvert N_3\rvert \le N_{3,Rd}$	|-0.19| < 62.13	verified	(0.00)

$M_{3,Rd}$ = 1.41 [kN*m] Bending resistance $M_{3,Rd} = k_n*f_{y0}*t_0^2*h_3*[1/(2*\eta) + 2/\sqrt{[1-\beta]} + \eta/(1-\beta)] / \gamma_{M5}$

$\lvert M_3\rvert \le M_{3,Rd}$	|0.27| < 1.41	verified	(0.19)
$N_3/N_{3,Rd} + M_3/M_{3,Rd} \le 1$	0.19 < 1.00	verified	(0.19)

CHORD SHEAR

POST

A_v = 4.80 [cm^2] Shear area of the chord $A_v = 2*h_0*t_0$

$N_{3,Rd}$ = 98.45 [kN] Compression capacity $N_{3,Rd} = f_{y0}*A_v/[\sqrt{3}*\sin(\theta_3)] / \gamma_{M5}$

$\lvert N_3\rvert \le N_{3,Rd}$	|-0.19| < 98.45	verified	(0.00)

CHORD RESISTANCE

$N_{0,Rd}$ = 312.05	[kN]	Compression capacity		$N_{0,Rd} = (A_0 * f_{y0})/\gamma_{M5}$
$\|N_{01}\| \le N_{0,Rd}$		|-12.91| < 312.05	verified	(0.04)

VERIFICATION OF WELDS

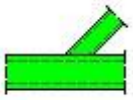
POST

β_w = 0.88		Correlation coefficient		[Table 4.1]
γ_{M2} = 1.25		Partial safety factor		[Table 2.1]
Longitudinal weld				
$\sigma_\perp$ = -118.41	[MPa]	Normal stress in a weld		
$\tau_\perp$ = -118.41	[MPa]	Perpendicular tangent stress		
τ_{II} = -0.03	[MPa]	Tangent stress		
$\|\sigma_\perp\| \le 0.9 * f_u/\gamma_{M2}$		|-118.41| < 338.40	verified	(0.35)
$\sqrt{[\sigma_\perp^2 + 3*(\tau_\perp^2+\tau_{II}^2)]} \le f_u/(\beta_w*\gamma_{M2})$		236.83 < 429.71	verified	(0.55)

Connection conforms to the code Ratio 0.55

Išvada: laikomoji galia pakankama

Mazgas nr. 35



Robot Structural Analysis Professional 2023

Design of truss node connection

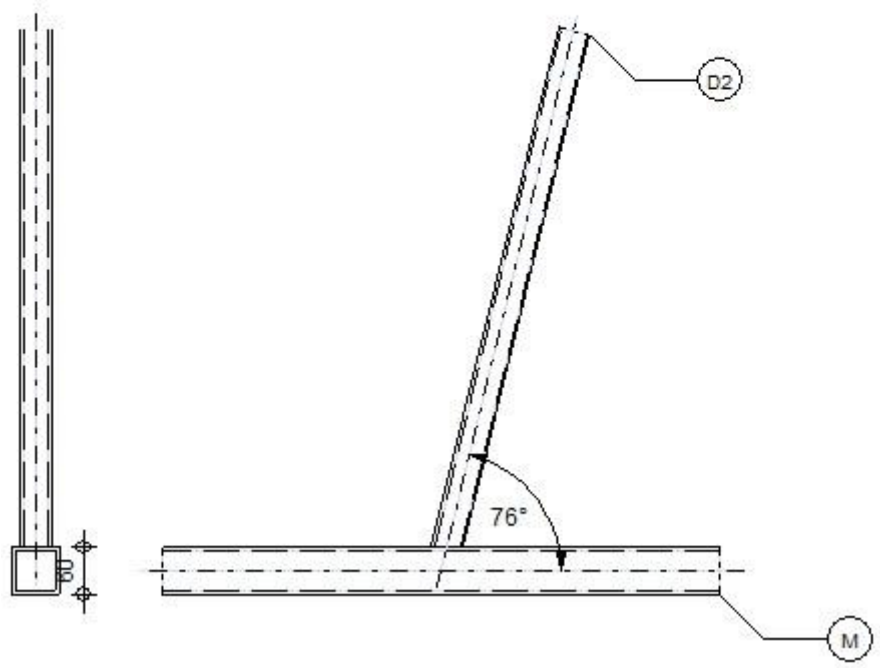
EN 1993-1-8:2005/AC:2009

OK

Ratio **0.23**

D2 - SHS 40x4

M - RK 60x60x4



GENERAL

Connection no.: 35
Connection name: Tube
Structure node: 5253
Structure members: 2069, 2071

GEOMETRY

MEMBERS

		Chord	Diagonal 1	Diagonal 2	Post	
Member no.:		2069		2071		
Section:		RK 60x60x4		SHS 40x4		
	h	60		40		mm
	b_f	60		40		mm
	t_w	4		4		mm
	t_f	4		4		mm
	r	4		0		mm
Material:		S 355		S 355		
	f_y	355.00		355.00		MPa
	f_u	470.00		470.00		MPa
Angle	θ	0.0		76.2		Deg
Length	l	2712		335		mm

WELDS

a_d = 3 [mm] Thickness of welds of diagonals and posts

LOADS

Case: 120: ULS/112=1*1.00 + 4*0.78 + 8*1.30 1*1.00+4*0.78+8*1.30

CHORD

$N_{01,Ed}$ = -0.00 [kN] Axial force
$M_{01,Ed}$ = -0.00 [kN*m] Bending moment
$N_{02,Ed}$ = -6.17 [kN] Axial force
$M_{02,Ed}$ = -0.09 [kN*m] Bending moment

DIAGONAL 2

N_2 = 6.18 [kN] Axial force
M_2 = 0.07 [kN*m] Bending moment

Shear forces were not included in the connection verification. The connection was designed as a truss node.

RESULTS

CAPACITY VERIFICATION EUROCODE 3: EN 1993-1-8:2005

γ_{M5} = 1.00 Partial safety factor [Table 2.1]

FAILURE MODES FOR JOINTS (RHS CHORD MEMBERS) [Table 7.10] for $N_{i,Rd}$ and [Table 7.14] for $M_{i,Rd}$

GEOMETRICAL PARAMETERS

β = 0.67	Coefficient taking account of geometry of connection members	$\beta = b_2/b_0$ [1.5 (6)]
γ = 7.50	Coefficient taking account of geometry of the chord	$\gamma = b_0/(2*t_0)$ [1.5 (6)]
n = 0.04	Coefficient taking account of stresses in the chord	$n_0 = \sigma_{0,Ed}/f_{y0}$
k_n = 1.00	Coefficient taking account of stresses in the chord	k_n = 1.0

TUBE CHORD FACE FAILURE

DIAGONAL 2

$N_{2,Rd}$ = 64.62 [kN] Tension capacity $N_{2,Rd} = [(k_n*f_{y0}*t_0^2)/(1-\beta)*\sin(\theta_2)]*[2*\beta/\sin(\theta_2) + 4*\sqrt{(1-\beta)}] / \gamma_{M5}$

$\lvert N_2 \rvert \le N_{2,Rd}$	|6.18| < 64.62	verified	(0.10)

$M_{2,Rd}$ = 1.41 [kN*m] Bending resistance $M_{2,Rd} = k_n*f_{y0}*t_0^2*h_2*[1/(2*\eta) + 2/\sqrt{[1-\beta]} + \eta/(1-\beta)] / \gamma_{M5}$

$\lvert M_2 \rvert \le M_{2,Rd}$	|0.07| < 1.41	verified	(0.05)
$N_2/N_{2,Rd} + M_2/M_{2,Rd} \le 1$	0.15 < 1.00	verified	(0.15)

CHORD SHEAR

DIAGONAL 2

A_v = 4.80 [cm^2] Shear area of the chord $A_v = 2*h_0*t_0$
$N_{2,Rd}$ = 101.31 [kN] Tension capacity $N_{2,Rd} = f_{y0}*A_v/[\sqrt{3}*\sin(\theta_2)] / \gamma_{M5}$

$\lvert N_2 \rvert \le N_{2,Rd}$	|6.18| < 101.31	verified	(0.06)

CHORD RESISTANCE

$N_{0,Rd}$ =	312.05	[kN]	Compression capacity		$N_{0,Rd} = (A_0 * f_{y0})/\gamma_{M5}$
$\lvert N_{02} \rvert \le N_{0,Rd}$			|-6.17| < 312.05	verified	(0.02)

VERIFICATION OF WELDS

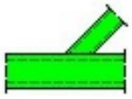
DIAGONAL 2

β_w =	0.88		Correlation coefficient		[Table 4.1]
γ_{M2} =	1.25		Partial safety factor		[Table 2.1]
Longitudinal weld					
$\sigma_\perp$ =	48.13	[MPa]	Normal stress in a weld		
$\tau_\perp$ =	48.13	[MPa]	Perpendicular tangent stress		
τ_{II} =	5.97	[MPa]	Tangent stress		
$\lvert \sigma_\perp \rvert \le 0.9 * f_u/\gamma_{M2}$			|48.13| < 338.40	verified	(0.14)
$\sqrt{[\sigma_\perp^2 + 3*(\tau_\perp^2+\tau_{II}^2)]} \le f_u/(\beta_w*\gamma_{M2})$			96.82 < 429.71	verified	(0.23)

Connection conforms to the code Ratio 0.23

Išvada: laikomoji galia pakankama

Mazgas nr. 36



Robot Structural Analysis Professional 2023

Design of truss node connection

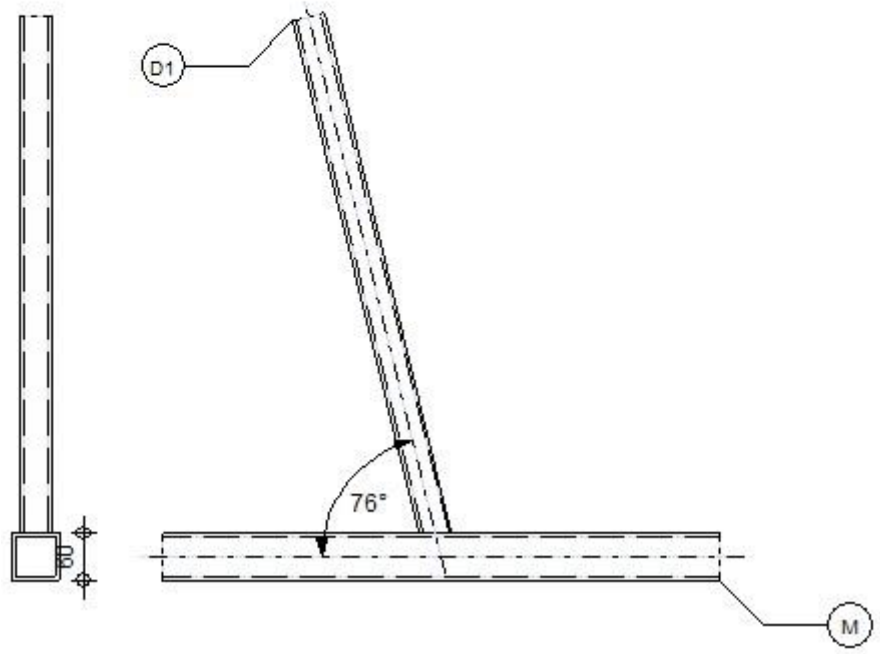
EN 1993-1-8:2005/AC:2009

OK

Ratio **0.24**

D1 - SHS 40x4

M - RK 60x60x4



GENERAL

Connection no.: 36
Connection name: Tube
Structure node: 5275
Structure members: 2091, 2093

GEOMETRY

MEMBERS

		Chord	Diagonal 1	Diagonal 2	Post	
Member no.:		2091	2093			
Section:		RK 60x60x4	SHS 40x4			
	h	60	40			mm
	b_f	60	40			mm
	t_w	4	4			mm
	t_f	4	4			mm
	r	4	0			mm
Material:		S 355	S 355			
	f_y	355.00	355.00			MPa
	f_u	470.00	470.00			MPa
Angle	θ	0.0	103.8			Deg
Length	l	2712	335			mm

WELDS

a_d = 3 [mm] Thickness of welds of diagonals and posts

LOADS

Case: 128: ULS/120=1*1.00 + 6*0.78 + 8*1.30 1*1.00+6*0.78+8*1.30

CHORD

$N_{01,Ed}$ = -0.00 [kN] Axial force
$M_{01,Ed}$ = -0.00 [kN*m] Bending moment
$N_{02,Ed}$ = -7.96 [kN] Axial force
$M_{02,Ed}$ = -0.44 [kN*m] Bending moment

DIAGONAL 1

N_1 = 6.25 [kN] Axial force
M_1 = 0.08 [kN*m] Bending moment

Shear forces were not included in the connection verification. The connection was designed as a truss node.

RESULTS

CAPACITY VERIFICATION EUROCODE 3: EN 1993-1-8:2005

γ_{M5} = 1.00 Partial safety factor [Table 2.1]

FAILURE MODES FOR JOINTS (RHS CHORD MEMBERS) [Table 7.10] for $N_{i,Rd}$ and [Table 7.14] for $M_{i,Rd}$

GEOMETRICAL PARAMETERS

β = 0.67	Coefficient taking account of geometry of connection members	$\beta = b_1/b_0$ [1.5 (6)]
γ = 7.50	Coefficient taking account of geometry of the chord	$\gamma = b_0/(2*t_0)$ [1.5 (6)]
n = 0.12	Coefficient taking account of stresses in the chord	$n_0 = \sigma_{0,Ed}/f_{y0}$
k_n = 1.00	Coefficient taking account of stresses in the chord	k_n = 1.0

TUBE CHORD FACE FAILURE

DIAGONAL 1

$N_{1,Rd}$ = 64.62 [kN] Tension capacity $N_{1,Rd} = [(k_n*f_{y0}*t_0^2)/(1-\beta)*\sin(\theta_1)]*[2*\beta/\sin(\theta_1) + 4*\sqrt{(1-\beta)}] /\gamma_{M5}$

$\lvert N_1\rvert \le N_{1,Rd}$	$\lvert 6.25\rvert < 64.62$	verified	(0.10)

$M_{1,Rd}$ = 1.41 [kN*m] Bending resistance $M_{1,Rd} = k_n*f_{y0}*t_0^2*h_1*[1/(2*\eta) + 2/\sqrt{[1-\beta]} + \eta/(1-\beta)] / \gamma_{M5}$

$\lvert M_1\rvert \le M_{1,Rd}$	$\lvert 0.08\rvert < 1.41$	verified	(0.06)
$N_1/N_{1,Rd} + M_1/M_{1,Rd} \le 1$	0.16 < 1.00	verified	(0.16)

CHORD SHEAR

DIAGONAL 1

A_v = 4.80 [cm^2] Shear area of the chord $A_v = 2*h_0*t_0$
$N_{1,Rd}$ = 101.31 [kN] Tension capacity $N_{1,Rd} = f_{y0}*A_v/[\sqrt{3}*\sin(\theta_1)] / \gamma_{M5}$

$\lvert N_1\rvert \le N_{1,Rd}$	$\lvert 6.25\rvert < 101.31$	verified	(0.06)

CHORD RESISTANCE

$N_{0,Rd}$ = 312.05	[kN]	Compression capacity		$N_{0,Rd} = (A_0 * f_{y0})/\gamma_{M5}$
$\lvert N_{02} \rvert \le N_{0,Rd}$		|-7.96| < 312.05	verified	(0.03)

VERIFICATION OF WELDS

DIAGONAL 1

β_w = 0.88		Correlation coefficient		[Table 4.1]
γ_{M2} = 1.25		Partial safety factor		[Table 2.1]
Longitudinal weld				
$\sigma_\perp$ = 52.07	[MPa]	Normal stress in a weld		
$\tau_\perp$ = 52.07	[MPa]	Perpendicular tangent stress		
τ_{II} = -6.04	[MPa]	Tangent stress		
$\lvert \sigma_\perp \rvert \le 0.9 * f_u/\gamma_{M2}$		|52.07| < 338.40	verified	(0.15)
$\sqrt{[\sigma_\perp^2 + 3*(\tau_\perp^2+\tau_{II}^2)]} \le f_u/(\beta_w*\gamma_{M2})$		104.66 < 429.71	verified	(0.24)

REMARKS

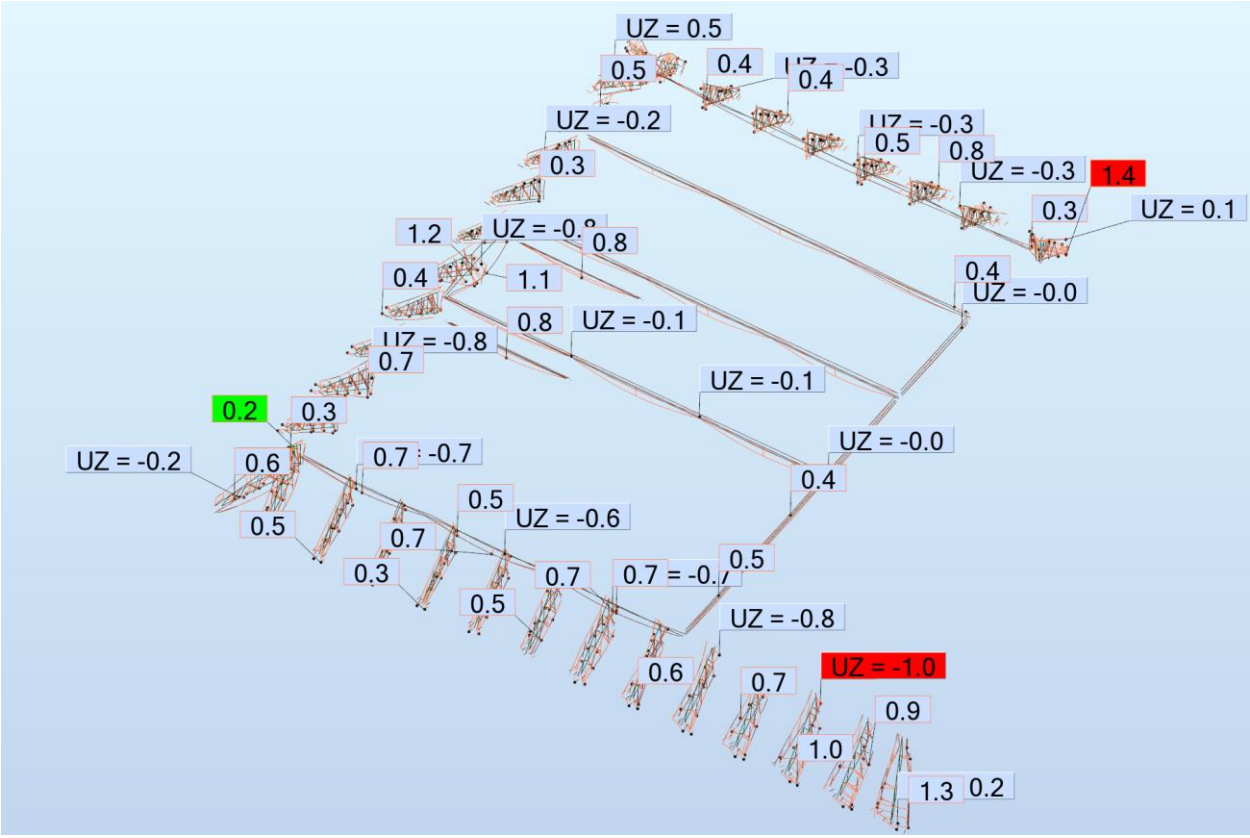
Diagonal angle is too large. 103.8 [Deg] > 90.0 [Deg]

Connection conforms to the code Ratio 0.24

Išvada: laikomoji galia pakankama

2.8. Statinio tinkamumo ribinis būvis

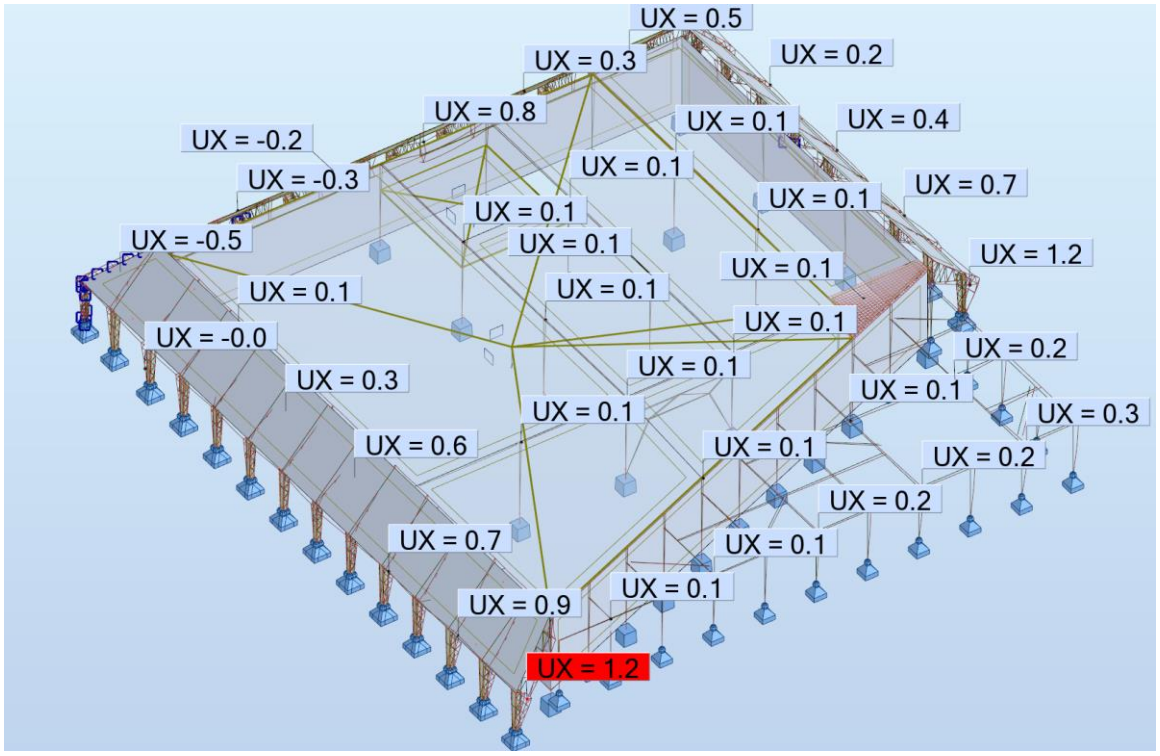
Rygelių deformuota schema:

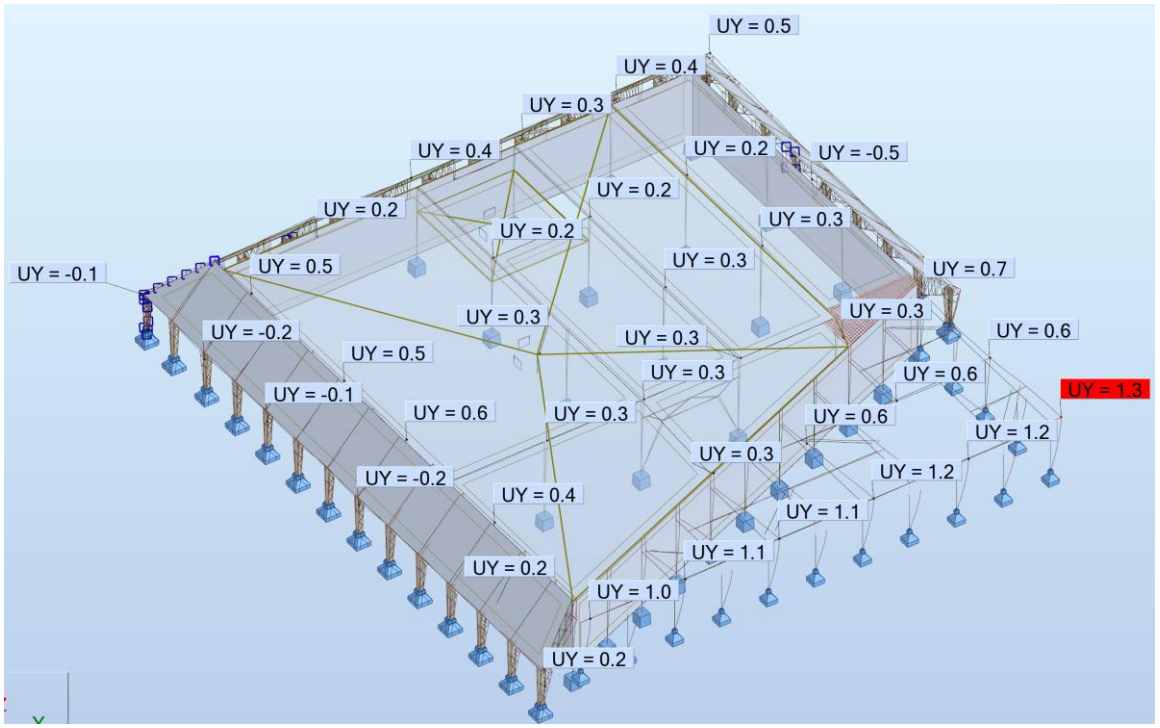


Rygelių maksimalus įlinkis 1,1cm<L/200=7,5/250=3,0cm

Sijų vertikalus poslinkis 1,4cm<L/200=4,17/200=2,1cm

Kolonų horizontalieji poslinkiai veikiant pavojingiausiam tinkamumo ribinio būvio apkrovų deriniui:





Medinių lauko kolonų horizontlaus poslinkis $U_{Y\ max}$=1,3 cm≤hs/150=3,49/150=2,3 cm.

Santvarinio stogelio kolonų horizontalus poslinkis $U_{X\ max}$=1,2cm<h/150=2,70/150=1,8cm

Pastato kontūro horizontalieji poslinkiai U_{max}+Δs=0,5+0,14=0,64 cm≤hs/150=5,37/150=3,6 cm;

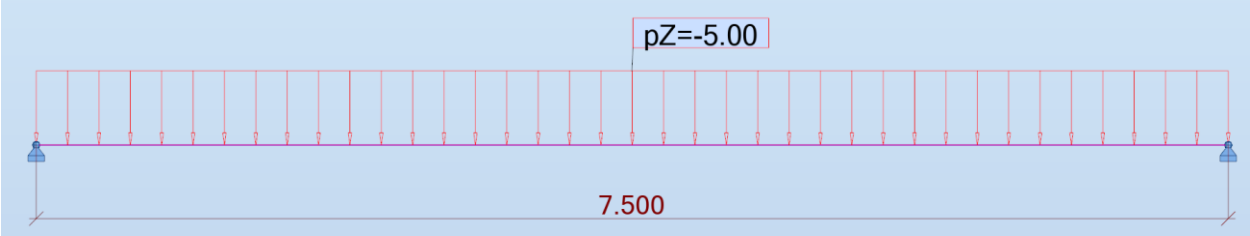
IŠVADA: Pastato deformacijos neviršija ribinių.

2.9.Rostverkų projektavimas

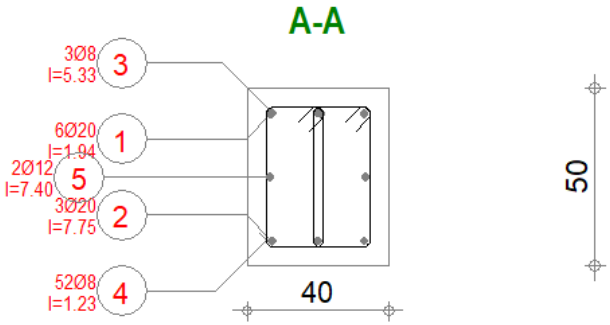
Rostverkų betonas C30/37, W8, XC2, F100. Armatūra S500. Rostverkus veikia apkrova nuo aliuminio stiklo vitrinos.

2.9.1. Trumpųjų rostverkų ant ašių 2, B ir 7 projektavimas

Rostverko skaičiuojamoji schema su veikiančiomis apkrovomis:



Reikalingas armavimas:



1 Level:

- Name :
- Reference level : ---
- Maximum cracking : 0.30 (mm)
- Exposure : XC2
- Concrete creep coefficient : φ_{π} = 2.31
- Cement class : N
- Concrete age (loading moment) : 28 (days)
- Concrete age : 50 (years)
- Concrete age after erecting a structure : 365 (years)
- Structure class : S4
- Fire resistance class : no requirements
- FFB Recommendations 7.4.3(7) : 0.00

2 Beam: Beam1 Number of identical elements: 1

2.1 Material properties:

- Concrete : C30/37 f_{ck} = 30.00 (MPa)
  Rectangular stress distribution [3.1.7(3)]
  Density : 2501.36 (kG/m3)

Aggregate size : 20.0 (mm)

- Longitudinal reinforcement: : B500B f_{yk} = 500.00 (MPa)
  Horizontal branch of the stress-strain diagram
  Ductility class : B
- Transversal reinforcement: : B500B f_{yk} = 500.00 (MPa)
  Horizontal branch of the stress-strain diagram
  Ductility class : B
- Additional reinforcement: : B500B f_{yk} = 500.00 (MPa)
  Horizontal branch of the stress-strain diagram

- Modified partial coefficients:
  α_{cc} = 0.9 1992-1-1 3.1.6 (1)P

2.2 Geometry:

2.2.1

Span	Position	L.supp. (m)	L (m)	R.supp. (m)
P1	**Span 0.350**	**7.150**	**0.350**	

Span length: L_o = 7.500 (m)
Section from 0.000 to 7.150 (m)
40.0 x 50.0 (cm)
without left slab
without right slab

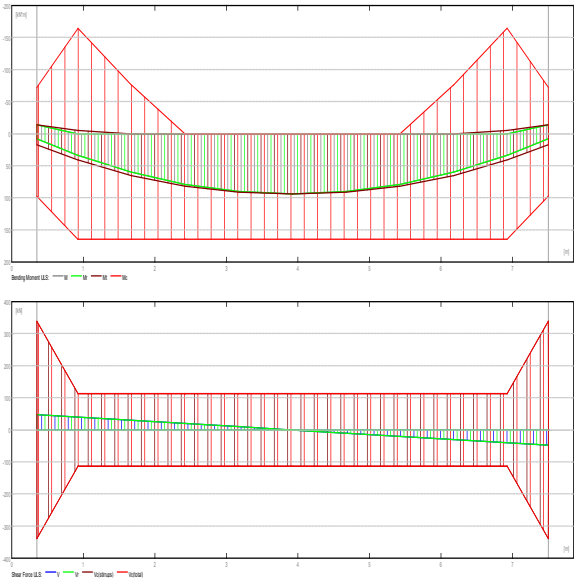
2.3 Calculation options:

- Regulation of combinations : EN 1990:2002
- Calculations according to : EN 1992-1-1:2004/A1:2014
- Seismic dispositions : No requirements
- Precast beam : no
- Cover : bottom c = 5.0 (cm)
  : side c1= 5.0 (cm)
  : top c2= 5.0 (cm)
- Cover deviations : Cdev = 1.0(cm), Cdur = 0.0(cm)
- Coefficient β_2 =0.50 : long-term or cyclic load
- Method of shear calculations : strut inclination

2.4 Calculation results:

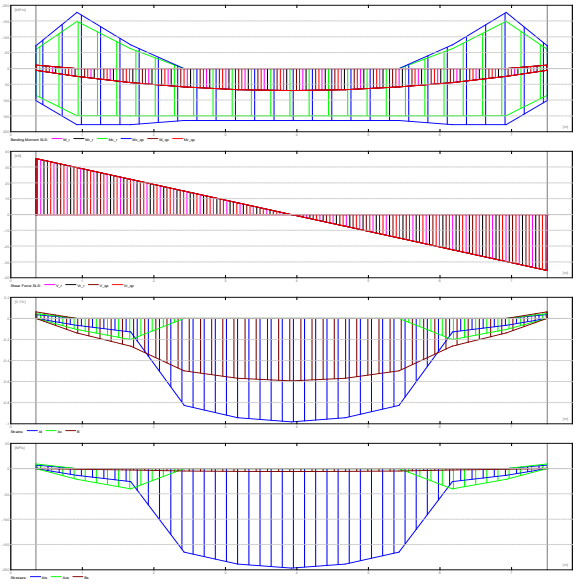
2.4.1 Internal forces in ULS

Span	Mt max. (kN*m)	Mt min. (kN*m)	Ml (kN*m)	Mr (kN*m)	Ql (kN)	Qr (kN)
P1	94.03	-0.00	17.04	17.04	47.81	-47.81



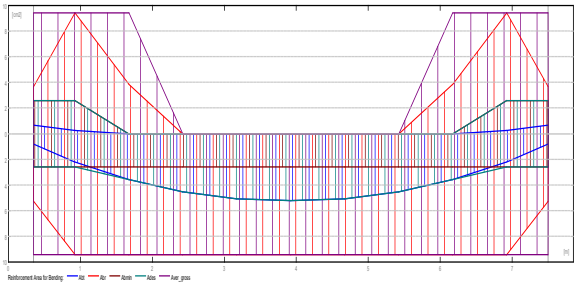
2.4.2 Internal forces in SLS

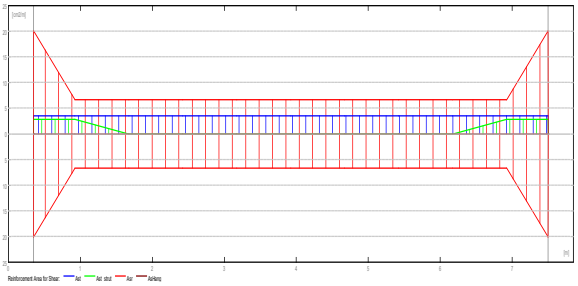
Span	Mt max. (kN*m)	Mt min. (kN*m)	Ml (kN*m)	Mr (kN*m)	Ql (kN)	Qr (kN)
P1	69.65	0.00	-10.45	-10.45	35.41	-35.41



2.4.3 Required reinforcement area

Span	Span (cm2)		Left support (cm2)		Right support (cm2)	
	bottom	top	bottom	top	bottom	top
P1	5.22	0.00	0.82	0.68	0.82	0.68





2.4.4 Deflection and cracking

wt(QP) Total due to quasi-permanent combination
wt(QP)dop Allowable due to quasi-permanent combination
Dwt(QP) Deflection increment from the quasi-permanent load combination after erecting a structure.
Dwt(QP)dop Admissible deflection increment from the quasi-permanent load combination after erecting a structure.

wk - width of perpendicular cracks

Span	wt(QP) (cm)	wt(QP)dop (cm)	Dwt(QP) (cm)	Dwt(QP)dop (cm)	wk (mm)
P1	1.84	3.00	0.12	1.50	0.2

2.5 Theoretical results - detailed results:

2.5.1 P1 : Span from 0.350 to 7.500 (m)

	ULS		SLS			
Abscissa (m)	M max. (kN*m)	M min. (kN*m)	M max. (kN*m)	M min. (kN*m)	A bottom (cm2)	A top (cm2)
0.350	17.04	-14.10	5.85	-10.45	0.82	0.68
0.925	40.96	-4.97	25.07	0.00	2.19	0.26
1.675	65.26	-0.00	44.58	0.00	3.58	0.00
2.425	82.03	-0.00	58.51	0.00	4.53	0.00
3.175	91.28	-0.00	66.87	0.00	5.06	0.00
3.925	94.03	0.00	69.65	0.00	5.22	0.00
4.675	91.28	-0.00	66.87	0.00	5.06	0.00
5.425	82.03	-0.00	58.51	0.00	4.53	0.00
6.175	65.26	-0.00	44.58	0.00	3.58	0.00
6.925	40.96	-4.97	25.07	0.00	2.19	0.26
7.500	17.04	-14.10	5.85	-10.45	0.82	0.68

	ULS	SLS	
Abscissa (m)	V max. (kN)	V max. (kN)	afp (mm)
0.350	47.81	35.41	0.0
0.925	40.12	29.72	0.0
1.675	30.09	22.29	0.0
2.425	20.06	14.86	0.2
3.175	10.03	7.43	0.2
3.925	0.00	0.00	0.2

4.675	-10.03	-7.43	0.2
5.425	-20.06	-14.86	0.2
6.175	-30.09	-22.29	0.0
6.925	-40.12	-29.72	0.0
7.500	-47.81	-35.41	0.0

2.6 Reinforcement:

2.6.1 P1 : Span from 0.350 to 7.500 (m)

Longitudinal reinforcement:

- bottom (B500B)
  3 ϕ20 l = 7.750 from 0.050 to 7.800
- assembling (top) (B500B)
  3 ϕ8 l = 5.328 from 1.261 to 6.589
- support (B500B)
  3 ϕ20 l = 1.936 from 0.050 to 1.986
  3 ϕ20 l = 1.936 from 5.864 to 7.800

Surface reinforcement (B500B):

2 ϕ12 l = 7.400 from 0.225 to 7.625
pins 1 ∅8 l = 0.458
e = 1*3.575 (m)

Transversal reinforcement:

- main (B500B)
  stirrups 52 ϕ8 l = 1.232
  e = 1*0.025 + 1*0.100 + 23*0.300 + 1*0.100 (m)
  2 ϕ12 l = 7.400
  e = 1*-0.125 (m)

  pins 2 ϕ12 l = 7.400
  e = 1*-0.125 (m)

3 Material survey:

- Concrete volume = 1.570 (m3)
- Formwork = 11.110 (m2)

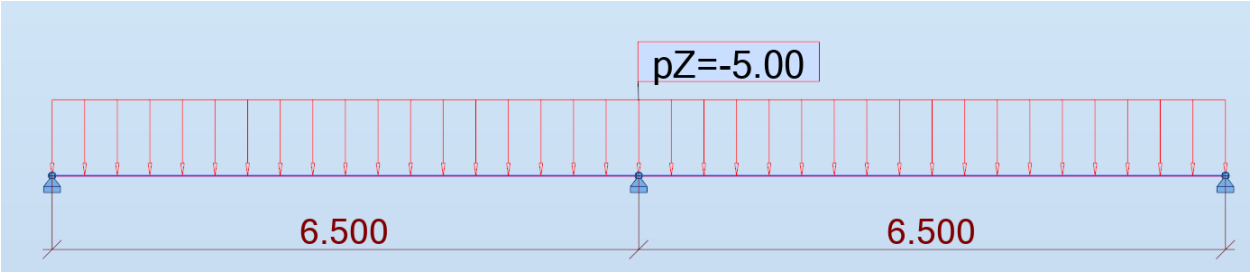
- Steel B500B
  - Total weight = 130.94 (kG)
  - Density = 83.40 (kG/m3)
  - Average diameter = 11.7 (mm)
  - Survey according to diameters:

Diameter	Length (m)	Weight (kG)
8	80.532	31.79
12	14.800	13.14
20	34.863	86.01

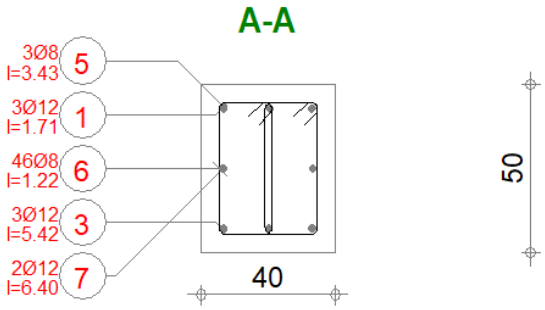
Išvada: laikomoji galia pakankama

2.9.2. Ilgųjų rostverkų ant ašių 2, B projektavimas

Rostverko skaičiuojamoji schema su veikiančiomis apkrovomis:



Reikalingas armavimas:



1 Level:

- Name :
- Reference level : ---
- Maximum cracking : 0.30 (mm)
- Exposure : XC2
- Concrete creep coefficient : φ_{π} = 2.31
- Cement class : N
- Concrete age (loading moment) : 28 (days)
- Concrete age : 50 (years)
- Concrete age after erecting a structure : 365 (years)
- Structure class : S4
- Fire resistance class : no requirements
- FFB Recommendations 7.4.3(7) : 0.00

2 Beam: Beam1 Number of identical elements: 1

2.1 Material properties:

- Concrete : C30/37 f_{ck} = 30.00 (MPa)
  Rectangular stress distribution [3.1.7(3)]
  Density : 2501.36 (kG/m3)
  Aggregate size : 20.0 (mm)
- Longitudinal reinforcement: : B500B f_{yk} = 500.00 (MPa)
  Horizontal branch of the stress-strain diagram
  Ductility class : B
- Transversal reinforcement: : B500B f_{yk} = 500.00 (MPa)
  Horizontal branch of the stress-strain diagram

- Additional reinforcement: : Ductility class : B
  B500B f_{yk} = 500.00 (MPa)
  Horizontal branch of the stress-strain diagram

- Modified partial coefficients:
  α_{cc} = 0.9 1992-1-1 3.1.6 (1)P

2.2 Geometry:

2.2.1

Span	Position	L.supp. (m)	L (m)	R.supp. (m)
P1	**Span 0.350**	**6.125**	**0.400**	

Span length: L_o = 6.500 (m)
Section from 0.000 to 6.125 (m)
40.0 x 50.0 (cm)
without left slab
without right slab

2.2.2

Span	Position	L.supp. (m)	L (m)	R.supp. (m)
P2	**Span 0.400**	**6.125**	**0.350**	

Span length: L_o = 6.500 (m)
Section from 0.000 to 6.125 (m)
40.0 x 50.0 (cm)
without left slab
without right slab

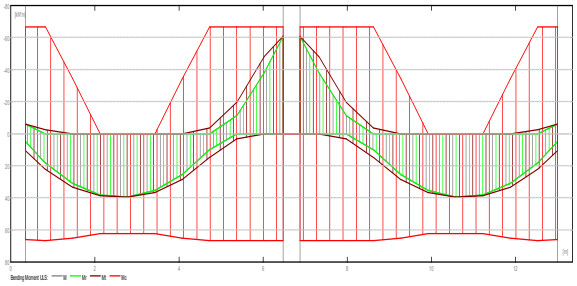
2.3 Calculation options:

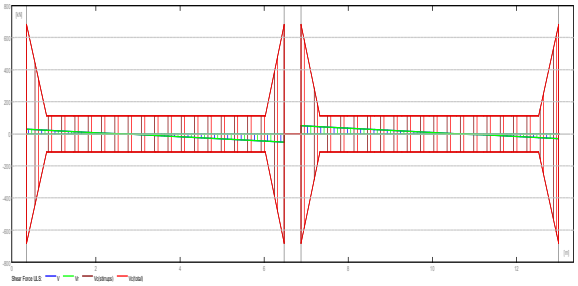
- Regulation of combinations : EN 1990:2002
- Calculations according to : EN 1992-1-1:2004/A1:2014
- Seismic dispositions : No requirements
- Precast beam : no
- Cover : bottom c = 5.0 (cm)
  : side c1= 5.0 (cm)
  : top c2= 5.0 (cm)
- Cover deviations : Cdev = 1.0(cm), Cdur = 0.0(cm)
- Coefficient β_2 =0.50 : long-term or cyclic load
- Method of shear calculations : strut inclination

2.4 Calculation results:

2.4.1 Internal forces in ULS

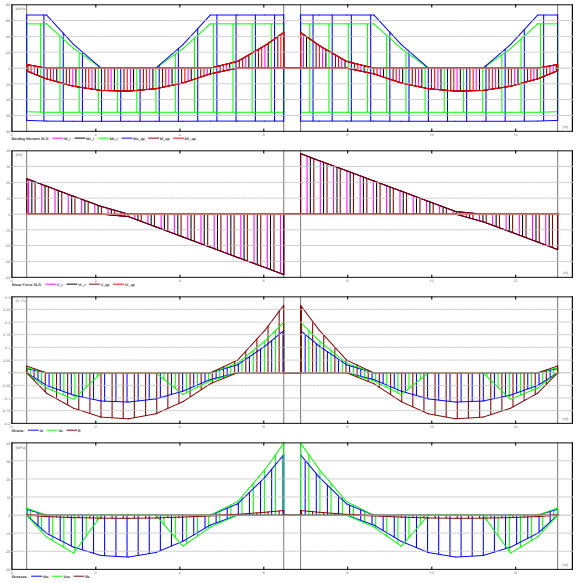
Span	Mt max. (kN*m)	Mt min. (kN*m)	Ml (kN*m)	Mr (kN*m)	Ql (kN)	Qr (kN)
P1	39.55	-3.52	10.66	-60.63	30.26	-51.65
P2	39.55	-3.52	-60.63	10.66	51.65	-30.26





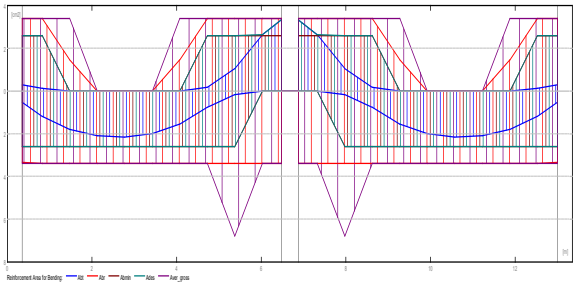
2.4.2 Internal forces in SLS

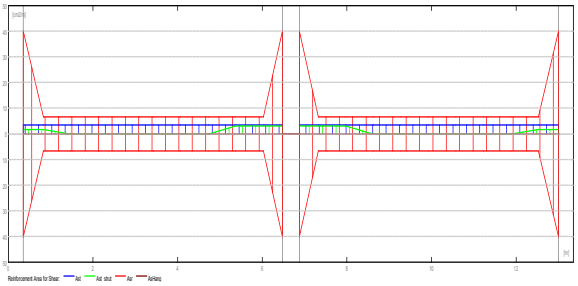
Span	Mt max. (kN*m)	Mt min. (kN*m)	Ml (kN*m)	Mr (kN*m)	Ql (kN)	Qr (kN)
P1	29.30	0.00	-4.39	-44.91	22.41	-38.26
P2	29.30	0.00	-44.91	-4.39	38.26	-22.41



2.4.3 Required reinforcement area

Span	Span (cm2)		Left support (cm2)		Right support (cm2)	
	bottom	top	bottom	top	bottom	top
P1	2.15	0.00	0.53	0.29	0.00	3.32
P2	2.15	0.00	0.00	3.32	0.53	0.29





2.4.4 Deflection and cracking

wt(QP) Total due to quasi-permanent combination
wt(QP)dop Allowable due to quasi-permanent combination
Dwt(QP) Deflection increment from the quasi-permanent load combination after erecting a structure.
Dwt(QP)dop Admissible deflection increment from the quasi-permanent load combination after erecting a structure.

wk - width of perpendicular cracks

Span	wt(QP) (cm)	wt(QP)dop (cm)	Dwt(QP) (cm)	Dwt(QP)dop (cm)	wk (mm)
P1	0.23	2.60	0.04	1.30	0.0
P2	0.23	2.60	0.04	1.30	0.0

2.5 Theoretical results - detailed results:

2.5.1 P1 : Span from 0.350 to 6.475 (m)

	ULS		SLS			
Abscissa (m)	M max. (kN*m)	M min. (kN*m)	M max. (kN*m)	M min. (kN*m)	A bottom (cm2)	A top (cm2)
0.350	10.66	-5.93	3.66	-4.39	0.53	0.29
0.825	22.32	-2.53	13.60	0.00	1.19	0.13
1.475	33.28	-0.00	23.02	0.00	1.80	0.00
2.125	38.58	-0.00	28.25	0.00	2.09	0.00
2.775	39.55	-0.00	29.30	0.00	2.15	0.00
3.425	36.63	-0.00	26.16	0.00	1.99	0.00
4.075	28.51	-0.00	18.83	0.00	1.54	0.00
4.725	14.73	-3.52	7.32	0.00	0.77	0.18
5.375	3.08	-19.66	0.00	-8.37	0.16	1.04
6.025	0.00	-48.26	0.00	-28.25	0.00	2.63
6.475	0.00	-60.63	0.00	-44.91	0.00	3.32

	ULS	SLS	
Abscissa (m)	V max. (kN)	V max. (kN)	afp (mm)
0.350	30.26	22.41	0.0
0.825	23.90	17.71	0.0
1.475	15.21	11.27	0.0
2.125	6.52	4.83	0.0
2.775	-2.17	-1.61	0.0

3.425	-10.87	-8.05	0.0
4.075	-19.56	-14.49	0.0
4.725	-28.25	-20.93	0.0
5.375	-36.94	-27.37	0.0
6.025	-45.64	-33.80	0.0
6.475	-51.65	-38.26	0.0

2.5.2 P2 : Span from 6.875 to 13.000 (m)

	ULS		SLS			
Abscissa (m)	M max. (kN*m)	M min. (kN*m)	M max. (kN*m)	M min. (kN*m)	A bottom (cm2)	A top (cm2)
6.875	0.00	-60.63	0.00	-44.91	0.00	3.32
7.325	0.00	-48.26	0.00	-28.25	0.00	2.63
7.975	3.08	-19.66	0.00	-8.37	0.16	1.04
8.625	14.73	-3.52	7.32	0.00	0.77	0.18
9.275	28.51	-0.00	18.83	0.00	1.54	0.00
9.925	36.63	-0.00	26.16	0.00	1.99	0.00
10.575	39.55	-0.00	29.30	0.00	2.15	0.00
11.225	38.58	-0.00	28.25	0.00	2.09	0.00
11.875	33.28	-0.00	23.02	0.00	1.80	0.00
12.525	22.32	-2.53	13.60	0.00	1.19	0.13
13.000	10.66	-5.93	3.66	-4.39	0.53	0.29

Abscissa (m)	ULS V max. (kN)	SLS V max. (kN)	afp (mm)
6.875	51.65	38.26	0.0
7.325	45.64	33.80	0.0
7.975	36.94	27.37	0.0
8.625	28.25	20.93	0.0
9.275	19.56	14.49	0.0
9.925	10.87	8.05	0.0
10.575	2.17	1.61	0.0
11.225	-6.52	-4.83	0.0
11.875	-15.21	-11.27	0.0
12.525	-23.90	-17.71	0.0
13.000	-30.26	-22.41	0.0

2.6 Reinforcement:

2.6.1 P1 : Span from 0.350 to 6.475 (m)

Longitudinal reinforcement:

- bottom (B500B)
  3 ϕ12 l = 5.417 from 0.050 to 5.467
  3 ϕ12 l = 3.285 from 5.033 to 8.317
- assembling (top) (B500B)
  3 ϕ8 l = 3.428 from 1.061 to 4.489
- support (B500B)
  3 ϕ12 l = 1.706 from 0.050 to 1.661
  3 ϕ12 l = 5.573 from 3.889 to 9.461

Surface reinforcement (B500B):

2 ϕ12 l = 6.400 from 0.225 to 6.625
pins 1 ∅8 l = 0.458
e = 1*3.075 (m)

Transversal reinforcement:

- main (B500B)
  stirrups 46 ϕ8 l = 1.224
  e = 1*0.013 + 1*0.050 + 20*0.300 + 1*0.050 (m)
  2 ϕ12 l = 6.400
  e = 1*-0.125 (m)

  pins 2 ϕ12 l = 6.400
  e = 1*-0.125 (m)

2.6.2 P2 : Span from 6.875 to 13.000 (m)

Longitudinal reinforcement:

- bottom (B500B)
  3 ϕ12 l = 5.417 from 7.883 to 13.300
- assembling (top) (B500B)
  3 ϕ8 l = 3.428 from 8.861 to 12.289
- support (B500B)
  3 ϕ12 l = 1.706 from 11.689 to 13.300

Surface reinforcement (B500B):

2 ϕ12 l = 6.400 from 6.725 to 13.125
pins 1 ∅8 l = 0.458
e = 1*3.050 (m)

Transversal reinforcement:

- main (B500B)
  stirrups 46 ϕ8 l = 1.224
  e = 1*0.013 + 1*0.050 + 20*0.300 + 1*0.050 (m)
  2 ϕ12 l = 6.400
  e = 1*-0.150 (m)

  pins 2 ϕ12 l = 6.400
  e = 1*-0.150 (m)

3 Material survey:

- Concrete volume = 2.670 (m3)
- Formwork = 18.650 (m2)

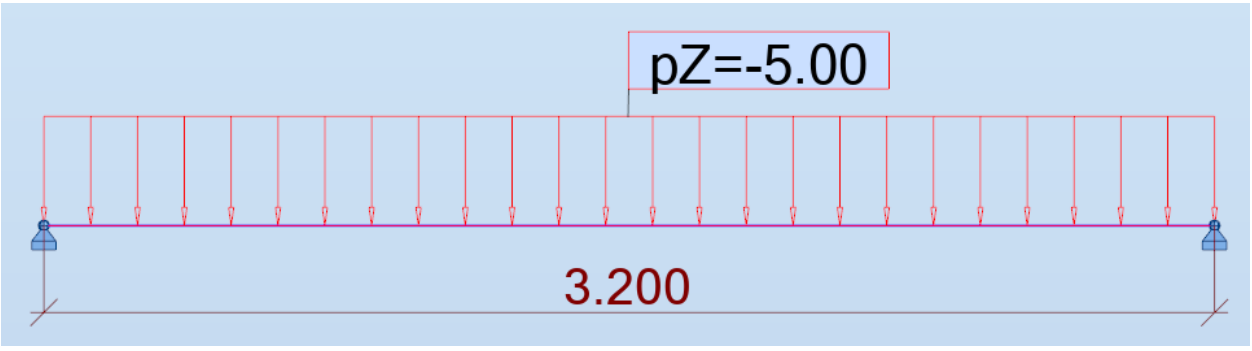
- Steel B500B
  - Total weight = 137.24 (kG)
  - Density = 51.40 (kG/m3)
  - Average diameter = 9.7 (mm)
  - Survey according to diameters:

Diameter	Length (m)	Weight (kG)
8	134.138	52.95
12	94.913	84.29

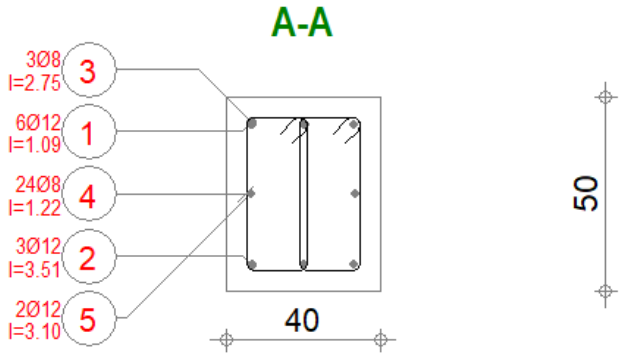
Išvada: laikomoji galia pakankama

2.9.3. Rostverkų ant E1 ašies projektavimas

Rostverko skaičiuojamoji schema su veikiančiomis apkrovomis:



Reikalingas armavimas:



1 Level:

- Name :
- Reference level : ---
- Maximum cracking : 0.30 (mm)
- Exposure : XC2
- Concrete creep coefficient : φ_{π} = 2.31
- Cement class : N
- Concrete age (loading moment) : 28 (days)
- Concrete age : 50 (years)
- Concrete age after erecting a structure : 365 (years)
- Structure class : S4
- Fire resistance class : no requirements
- FFB Recommendations 7.4.3(7) : 0.00

2 Beam: Beam1 Number of identical elements: 1

2.1 Material properties:

- Concrete : C30/37 f_{ck} = 30.00 (MPa)
  Rectangular stress distribution [3.1.7(3)]
  Density : 2501.36 (kG/m3)
  Aggregate size : 20.0 (mm)
- Longitudinal reinforcement: : B500B f_{yk} = 500.00 (MPa)
  Horizontal branch of the stress-strain diagram
  Ductility class : B
- Transversal reinforcement: : B500B f_{yk} = 500.00 (MPa)
  Horizontal branch of the stress-strain diagram
  Ductility class : B
- Additional reinforcement: : B500B f_{yk} = 500.00 (MPa)
  Horizontal branch of the stress-strain diagram
- Modified partial coefficients:
  α_{cc} = 0.9 1992-1-1 3.1.6 (1)P

2.2 Geometry:

2.2.1

Span	Position	L.supp. (m)	L (m)	R.supp. (m)
P1	**Span**	**0.220**	**2.980**	**0.220**

Span length: L_o = 3.200 (m)
Section from 0.000 to 2.980 (m)
40.0 x 50.0 (cm)
without left slab
without right slab

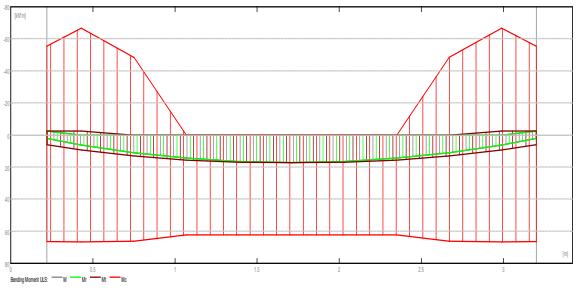
2.3 Calculation options:

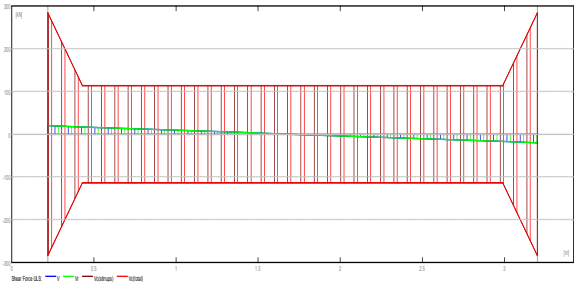
- Regulation of combinations : EN 1990:2002
- Calculations according to : EN 1992-1-1:2004/A1:2014
- Seismic dispositions : No requirements
- Precast beam : no
- Cover : bottom c = 5.0 (cm)
  : side c1= 5.0 (cm)
  : top c2= 5.0 (cm)
- Cover deviations : Cdev = 1.0(cm), Cdur = 0.0(cm)
- Coefficient β_2 =0.50 : long-term or cyclic load
- Method of shear calculations : strut inclination

2.4 Calculation results:

2.4.1 Internal forces in ULS

Span	Mt max. (kN*m)	Mt min. (kN*m)	Ml (kN*m)	Mr (kN*m)	Ql (kN)	Qr (kN)
P1	17.12	-0.00	6.02	6.02	19.93	-19.93

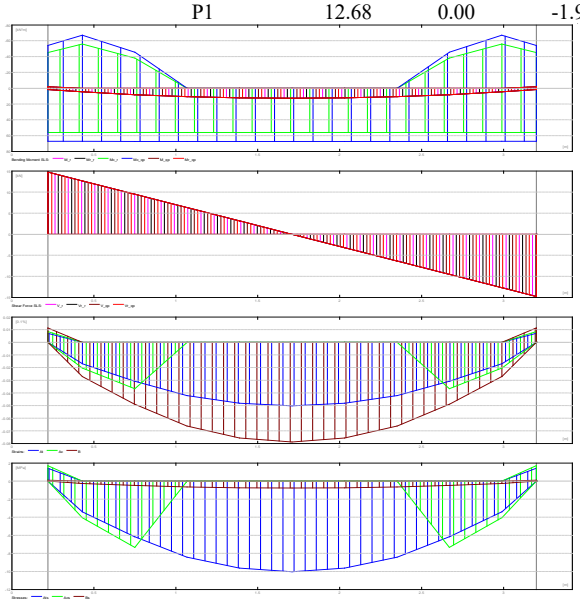




2.4.2 Internal forces in SLS

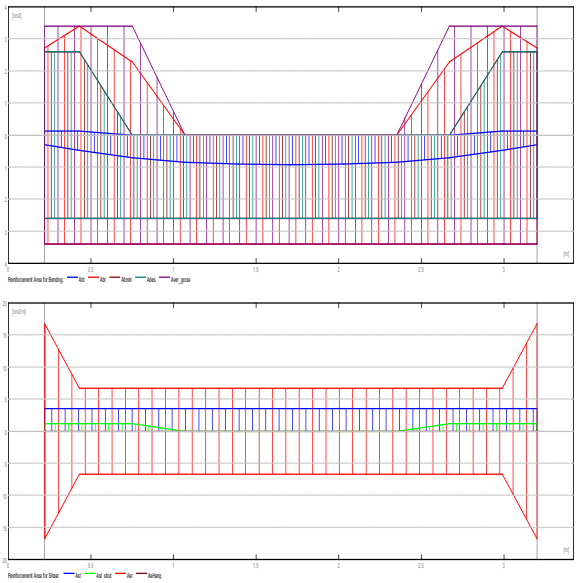
Span	Mt max. (kN*m)	Mt min. (kN*m)	Ml (kN*m)	Mr (kN*m)	Ql (kN)	Qr (kN)

P1	12.68	0.00	-1.90	-1.90	14.76	-14.76



2.4.3 Required reinforcement area

Span	Span (cm2)		Left support (cm2)		Right support (cm2)	
	bottom	top	bottom	top	bottom	top
P1	0.92	0.00	0.30	0.13	0.30	0.13



2.4.4 Deflection and cracking

wt(QP) Total due to quasi-permanent combination
wt(QP)dop Allowable due to quasi-permanent combination
Dwt(QP) Deflection increment from the quasi-permanent load combination after erecting a structure.
Dwt(QP)dop Admissible deflection increment from the quasi-permanent load combination after erecting a structure.

wk - width of perpendicular cracks

Span	wt(QP) (cm)	wt(QP)dop (cm)	Dwt(QP) (cm)	Dwt(QP)dop (cm)	wk (mm)
P1	0.03	1.28	0.01	0.64	0.0

2.5 Theoretical results - detailed results:

2.5.1 P1 : Span from 0.220 to 3.200 (m)

	ULS		SLS			
Abscissa (m)	M max. (kN*m)	M min. (kN*m)	M max. (kN*m)	M min. (kN*m)	A bottom (cm2)	A top (cm2)
0.220	6.02	-2.57	1.57	-1.90	0.30	0.13
0.430	9.20	-2.48	4.56	0.00	0.48	0.13
0.750	13.12	-0.00	8.11	0.00	0.71	0.00
1.070	15.68	-0.00	10.65	0.00	0.84	0.00
1.390	16.87	-0.00	12.17	0.00	0.91	0.00
1.710	17.12	0.00	12.68	0.00	0.92	0.00
2.030	16.87	-0.00	12.17	0.00	0.91	0.00
2.350	15.68	-0.00	10.65	0.00	0.84	0.00
2.670	13.12	-0.00	8.11	0.00	0.71	0.00
2.990	9.20	-2.48	4.56	0.00	0.48	0.13
3.200	6.02	-2.57	1.57	-1.90	0.30	0.13

	ULS	SLS	
Abscissa (m)	V max. (kN)	V max. (kN)	afp (mm)
0.220	19.93	14.76	0.0
0.430	17.12	12.68	0.0
0.750	12.84	9.51	0.0
1.070	8.56	6.34	0.0
1.390	4.28	3.17	0.0
1.710	0.00	0.00	0.0
2.030	-4.28	-3.17	0.0
2.350	-8.56	-6.34	0.0
2.670	-12.84	-9.51	0.0
2.990	-17.12	-12.68	0.0
3.200	-19.93	-14.76	0.0

2.6 Reinforcement:

2.6.1 P1 : Span from 0.220 to 3.200 (m)

Longitudinal reinforcement:

- bottom (B500B)
  3 ϕ12 l = 3.509 from 0.050 to 3.370
- assembling (top) (B500B)
  3 ϕ8 l = 2.748 from 0.336 to 3.084
- support (B500B)
  3 ϕ12 l = 1.087 from 0.050 to 1.042
  3 ϕ12 l = 1.087 from 2.378 to 3.370

Surface reinforcement (B500B):

2 ϕ12 l = 3.100 from 0.160 to 3.260
pins 1 ∅8 l = 0.458
e = 1*1.490 (m)

Transversal reinforcement:

- main (B500B)
  stirrups 24 ϕ8 l = 1.224
  e = 1*0.020 + 1*0.120 + 9*0.300 + 1*0.120 (m)
  2 ϕ12 l = 3.100
  e = 1*-0.060 (m)

  pins 2 ϕ12 l = 3.100
  e = 1*-0.060 (m)

3 Material survey:

- Concrete volume = 0.684 (m3)
- Formwork = 5.012 (m2)

- Steel B500B
  - Total weight = 35.68 (kG)
  - Density = 52.17 (kG/m3)
  - Average diameter = 9.5 (mm)
  - Survey according to diameters:

Diameter	Length (m)	Weight (kG)
8	38.090	15.03
12	23.250	20.65

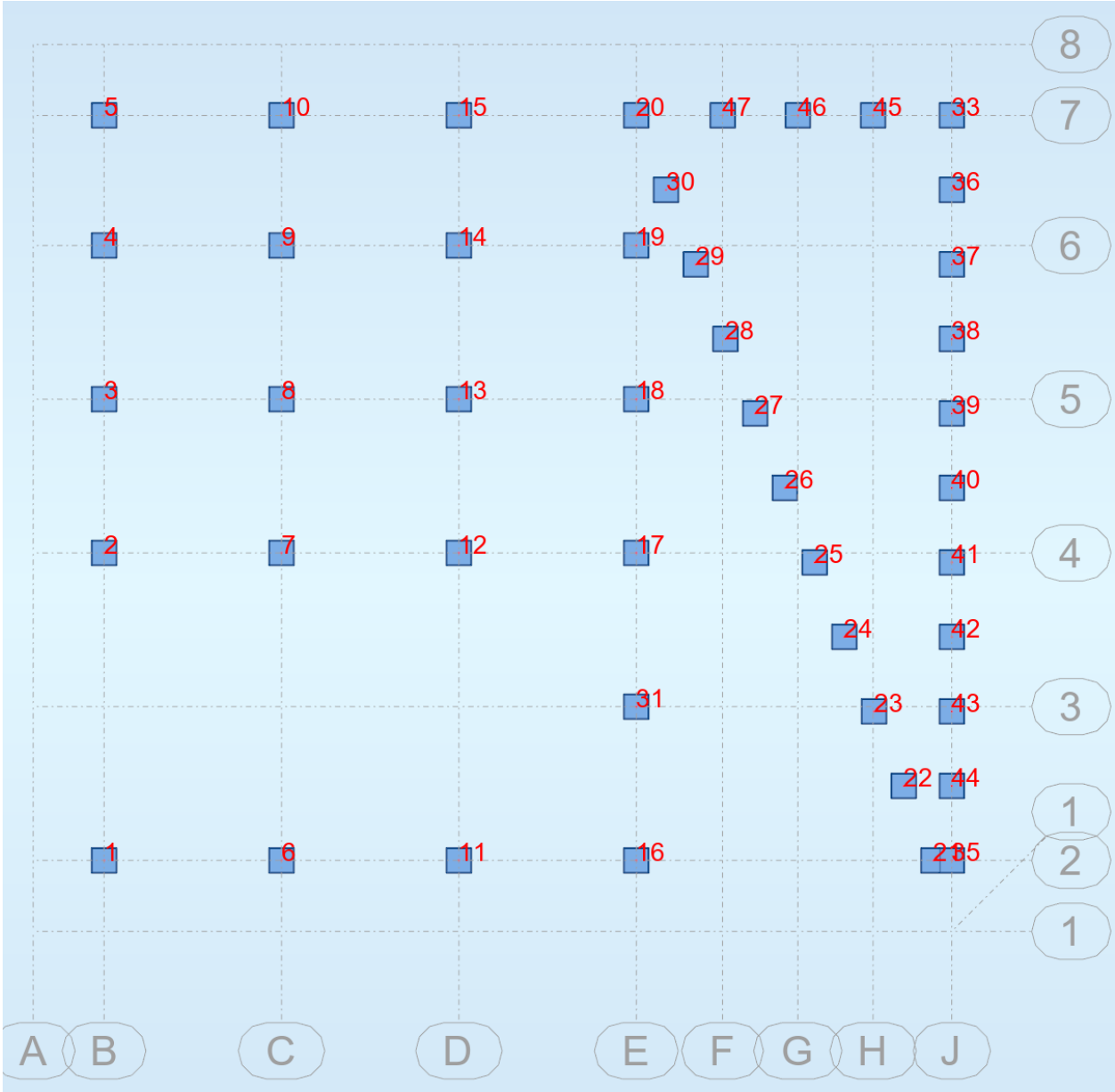
Išvada: laikomoji galia pakankama

2.10. Pamatų projektavimas

Pamatų betonas ne žemesnės klasės nei C25/30, W8, XC2, F100. Armatūra S500. Pamatų atramines reakcijas žiūrėti kartu su atraminių reakcijų planu.

Pamatų reakcijos

Atraminių taškų numeracijos schema ir reakcijų kryptys pagal globalias koordinačių ašis:



Pagal LST EN 1990:2004 STR ir GEO ribiniam būviui apkrovų deriniai sudaromi pagal 6.4 formulę:

$$\sum_{j\geq 1}\gamma_{G,j}G_{k,j}\text{"+"}\gamma_{p}P\text{"+"}\gamma_{Q,1}Q_{k,1}\text{"+"}\sum_{i>1}\gamma_{Q,i}\psi_{0,i}Q_{k,i};$$

Čia "+" reiškia derinimas su; $G_{k,j}$ ir $Q_{k,j}$ yra nuolatinių ir kintamų apkrovų charakteristinės reikšmės, γG ir γQ yra daliniai nuolatinių ir kintamųjų poveikių koeficientai, kurie atsižvelgia į įrąžų skaičiavimo modelių neapibrėžtumus, skaičiuojamosios schemos neapibrėžtumus, galimas perkrovas ir t.t.; $\Psi_{0,i}$ – kintamojo poveikio derintinės reikšmės koeficientas.

Daliniai koeficientai poveikiams (γ_F) ir jų efektams (γ_E):

Poveikis	Žymuo	Apkrovimo grupė

			A1	*A2*
Nuolatinis	Nepalankus	γ_G	1,35	1,0
	Palankus		1,0	1,0
Kintamasis	Nepalankus	γ_Q	1,3	1,3
	Palankus		0	0

Pamatų reakcijos A1 apkrovų atvejui

Taškas/ kombinacija	FX (kN)	FY (kN)	FZ (kN)	MX (kNm)	MY (kNm)	MZ (kNm)
1/ 38 (C)	14.74>>	-9.33	219.5	20.64	11.33	-1.06
1/ 49 (C)	-13.47<<	11.24	107.03	-16.85	-21.27	-0.01
1/ 32 (C)	-13.46	11.45>>	212.63	-17.95	-21.22	-0.11
1/ 55 (C)	14.74	-9.53<<	113.9	21.74	11.28	-0.96
1/ 62 (C)	0.02	0.54	303.07>>	-2.9	0.12	-0.28
1/ 49 (C)	-13.47	11.24	107.03<<	-16.85	-21.27	-0.01
1/ 55 (C)	14.74	-9.53	113.9	21.74>>	11.28	-0.96
1/ 36 (C)	7.89	8.59	253.31	-25.34<<	20.76	-1.08
1/ 44 (C)	7.89	8.59	253.31	-25.34	20.76>>	-1.08
1/ 49 (C)	-13.47	11.24	107.03	-16.85	-21.27<<	-0.01
1/ 59 (C)	10.27	5.05	162.87	-14.65	19.09	0.84>>
1/ 36 (C)	7.89	8.59	253.31	-25.34	20.76	-1.08<<
2/ 30 (C)	20.34>>	-2.54	401.17	12.41	24.75	-0.79
2/ 57 (C)	-11.02<<	1.1	212.8	-4.53	-16.07	-0.06
2/ 44 (C)	18.11	3.46>>	413.19	-18.98	40.96	-0.84
2/ 47 (C)	15.99	-2.75<<	232.94	13.51	18.57	-0.71
2/ 66 (C)	16.71	2.32	470.65>>	-12.7	32.74	-0.6
2/ 55 (C)	14.71	-2.75	209.65<<	13.51	17.02	-0.71
2/ 47 (C)	15.99	-2.75	232.94	13.51>>	18.57	-0.71
2/ 44 (C)	18.11	3.46	413.19	-18.98<<	40.96	-0.84
2/ 36 (C)	19.38	3.46	436.48	-18.98	42.51>>	-0.84
2/ 57 (C)	-11.02	1.1	212.8	-4.53	-16.07<<	-0.06
2/ 51 (C)	14.5	1.87	254.17	-10.65	16.15	0.69>>
2/ 44 (C)	18.11	3.46	413.19	-18.98	40.96	-0.84<<
3/ 36 (C)	18.92>>	3.46	323.51	-18.98	46.73	-0.84
3/ 57 (C)	-7.28<<	1.1	139.87	-4.53	-12.48	-0.06
3/ 44 (C)	17.65	3.46>>	300.22	-18.98	45.17	-0.84
3/ 47 (C)	13.01	-2.75<<	163.24	13.51	19.86	-0.71
3/ 66 (C)	16.56	2.32	354.69>>	-12.7	35.92	-0.6
3/ 59 (C)	11.04	1.87	129.33<<	-10.65	8.9	0.69
3/ 47 (C)	13.01	-2.75	163.24	13.51>>	19.86	-0.71
3/ 44 (C)	17.65	3.46	300.22	-18.98<<	45.17	-0.84
3/ 36 (C)	18.92	3.46	323.51	-18.98	46.73>>	-0.84

3/ 57 (C)	-7.28	1.1	139.87	-4.53	-12.48<<	-0.06
3/ 51 (C)	12.31	1.87	152.62	-10.65	10.46	0.69>>
3/ 44 (C)	17.65	3.46	300.22	-18.98	45.17	-0.84<<
4/ 36 (C)	11.65>>	3.57	164.95	-19.15	42.62	-1.08
4/ 57 (C)	-12.50<<	0.73	82.74	-3.92	-19.98	-0.01
4/ 36 (C)	11.65	3.57>>	164.95	-19.15	42.62	-1.08
4/ 55 (C)	9.83	-2.41<<	105.12	12.95	20.55	-0.96
4/ 63 (C)	6.62	-1.08	173.72>>	5.81	16.21	-0.76
4/ 49 (C)	-12.5	0.73	82.74<<	-3.92	-19.98	-0.01
4/ 55 (C)	9.83	-2.41	105.12	12.95>>	20.55	-0.96
4/ 36 (C)	11.65	3.57	164.95	-19.15<<	42.62	-1.08
4/ 36 (C)	11.65	3.57	164.95	-19.15	42.62>>	-1.08
4/ 57 (C)	-12.5	0.73	82.74	-3.92	-19.98<<	-0.01
4/ 59 (C)	10.77	2.03	85.33	-10.93	6.42	0.84>>
4/ 36 (C)	11.65	3.57	164.95	-19.15	42.62	-1.08<<
5/ 36 (C)	9.55>>	-7.97	81.27	22.65	42.12	0
5/ 57 (C)	-6.40<<	-16.68	7.15	47.39	-12.78	0
5/ 34 (C)	6.41	12.22>>	62.19	-36.17	0.83	0
5/ 32 (C)	-5.91	-16.68<<	55.78	47.39	-10.13	0
5/ 62 (C)	1.33	0	123.07>>	0	7.12	0
5/ 49 (C)	-6.4	-16.68	7.15<<	47.39	-12.78	0
5/ 32 (C)	-5.91	-16.68	55.78	47.39>>	-10.13	0
5/ 34 (C)	6.41	12.22	62.19	-36.17<<	0.83	0
5/ 36 (C)	9.55	-7.97	81.27	22.65	42.12>>	0
5/ 57 (C)	-6.4	-16.68	7.15	47.39	-12.78<<	0
5/ 8 (C)	1.22	0	111.68	0	6.57	0.0>>
5/ 8 (C)	1.22	0	111.68	0	6.57	0.0<<
6/ 44 (C)	2.67>>	12.42	466.85	-25.07	14.31	-1.08
6/ 47 (C)	-1.65<<	-17.72	254.14	36.25	-8.88	-0.96
6/ 32 (C)	-1.11	16.84>>	422.47	-24.09	-5.98	-0.11
6/ 55 (C)	-1.65	-17.72<<	254.14	36.25	-8.88	-0.96
6/ 65 (C)	0.95	5.55	545.37>>	-14.88	5.11	0.32
6/ 49 (C)	-1.12	16.75	238.96<<	-23.6	-6.03	-0.01
6/ 55 (C)	-1.65	-17.72	254.14	36.25>>	-8.88	-0.96
6/ 36 (C)	2.67	12.42	466.85	-25.07<<	14.31	-1.08
6/ 44 (C)	2.67	12.42	466.85	-25.07	14.31>>	-1.08
6/ 47 (C)	-1.65	-17.72	254.14	36.25	-8.88<<	-0.96
6/ 59 (C)	1.56	8.99	335.65	-23.35	8.37	0.84>>
6/ 36 (C)	2.67	12.42	466.85	-25.07	14.31	-1.08<<
7/ 61 (C)	2.71>>	2.39	440.51	-12.4	22.9	-0.76
7/ 32 (C)	-14.04<<	0.44	680.12	-3.76	-22.78	-0.14
7/ 34 (C)	-5.76	3.21>>	732.03	-16.67	-5.04	0.61
7/ 55 (C)	-0.15	-3.14<<	389.12	18.1	2.04	-0.71
7/ 66 (C)	-6.1	1.59	780.21>>	-8.29	5.82	-0.6
7/ 57 (C)	-8.82	0.36	387.02<<	-3.27	-17.24	-0.06

7/ 55 (C)	-0.15	-3.14	389.12	18.10>>	2.04	-0.71
7/ 34 (C)	-5.76	3.21	732.03	-16.67<<	-5.04	0.61
7/ 61 (C)	2.71	2.39	440.51	-12.4	22.90>>	-0.76
7/ 32 (C)	-14.04	0.44	680.12	-3.76	-22.78<<	-0.14
7/ 51 (C)	-1.81	3.13	462.22	-16.18	-1.06	0.69>>
7/ 44 (C)	-1.24	2.47	710.32	-12.88	18.92	-0.84<<
8/ 61 (C)	3.46>>	2.39	274.99	-12.4	27.64	-0.76
8/ 32 (C)	-13.29<<	0.44	454.49	-3.76	-21.15	-0.14
8/ 34 (C)	-6.74	3.21>>	453.71	-16.67	-9.29	0.61
8/ 55 (C)	0.19	-3.14<<	275.26	18.1	6.02	-0.71
8/ 63 (C)	-7.42	-1.73	522.63>>	10.01	-3.34	-0.57
8/ 59 (C)	-1.62	3.13	243.41<<	-16.18	-4.29	0.69
8/ 55 (C)	0.19	-3.14	275.26	18.10>>	6.02	-0.71
8/ 34 (C)	-6.74	3.21	453.71	-16.67<<	-9.29	0.61
8/ 61 (C)	3.46	2.39	274.99	-12.4	27.64>>	-0.76
8/ 32 (C)	-13.29	0.44	454.49	-3.76	-21.15<<	-0.14
8/ 51 (C)	-2.9	3.13	266.7	-16.18	-5.85	0.69>>
8/ 44 (C)	-0.39	2.47	462	-12.88	24.2	-0.84<<
9/ 36 (C)	6.83>>	2.37	300.83	-12.71	36.67	-1.08
9/ 59 (C)	-1.66<<	2.96	149.82	-15.91	-8.9	0.84
9/ 34 (C)	-1.26	3.05>>	262.1	-16.4	-6.75	0.73
9/ 55 (C)	2.04	-3.48<<	189.16	18.67	10.94	-0.96
9/ 63 (C)	1.94	-1.92	318.99>>	10.33	10.44	-0.76
9/ 51 (C)	-1.66	2.96	149.82<<	-15.91	-8.9	0.84
9/ 55 (C)	2.04	-3.48	189.16	18.67>>	10.94	-0.96
9/ 34 (C)	-1.26	3.05	262.1	-16.40<<	-6.75	0.73
9/ 36 (C)	6.83	2.37	300.83	-12.71	36.67>>	-1.08
9/ 59 (C)	-1.66	2.96	149.82	-15.91	-8.90<<	0.84
9/ 59 (C)	-1.66	2.96	149.82	-15.91	-8.9	0.84>>
9/ 36 (C)	6.83	2.37	300.83	-12.71	36.67	-1.08<<
10/ 36 (C)	7.34>>	-16.26	121.69	46.21	39.43	0
10/ 59 (C)	-2.21<<	24.44	46.51	-72.33	-11.88	0
10/ 34 (C)	-1.72	24.44>>	120.8	-72.33	-9.22	0
10/ 32 (C)	-0.68	-25.43<<	104.68	72.25	-3.66	0
10/ 63 (C)	2.61	-6.2	190.45>>	18.36	14.02	0
10/ 49 (C)	-1.18	-25.43	30.39<<	72.25	-6.32	0
10/ 32 (C)	-0.68	-25.43	104.68	72.25>>	-3.66	0
10/ 34 (C)	-1.72	24.44	120.8	-72.33<<	-9.22	0
10/ 36 (C)	7.34	-16.26	121.69	46.21	39.43>>	0
10/ 59 (C)	-2.21	24.44	46.51	-72.33	-11.88<<	0
10/ 8 (C)	1.23	0	171.36	0	6.58	0.0>>
10/ 8 (C)	1.23	0	171.36	0	6.58	0.0<<
11/ 44 (C)	32.34>>	11.2	501.62	-18.6	15.19	-1.08
11/ 47 (C)	-14.63<<	-18.78	233.26	41.97	-4.63	-0.96
11/ 53 (C)	30.51	11.22>>	317.12	-18.71	13.56	-0.98

11/ 38 (C)	-12.79	-18.80<<	417.76	42.08	-3	-1.06
11/ 70 (C)	15.15	5.91	561.97>>	-16.77	8.72	0.32
11/ 47 (C)	-14.63	-18.78	233.26<<	41.97	-4.63	-0.96
11/ 38 (C)	-12.79	-18.8	417.76	42.08>>	-3	-1.06
11/ 51 (C)	19.51	9.92	360.13	-28.33<<	9.44	0.84
11/ 44 (C)	32.34	11.2	501.62	-18.6	15.19>>	-1.08
11/ 47 (C)	-14.63	-18.78	233.26	41.97	-4.63<<	-0.96
11/ 59 (C)	19.51	9.92	360.13	-28.33	9.44	0.84>>
11/ 36 (C)	32.34	11.2	501.62	-18.6	15.19	-1.08<<
12/ 44 (C)	4.75>>	1.17	640.74	-6.26	25.49	-1.08
12/ 49 (C)	-1.11<<	0.72	390.09	-3.85	-5.97	-0.01
12/ 51 (C)	-0.05	3.89>>	420.81	-20.89	-0.27	0.84
12/ 38 (C)	0.4	-4.56<<	586.94	24.5	2.13	-1.06
12/ 65 (C)	0.34	2.29	673.92>>	-12.31	1.82	0.32
12/ 47 (C)	0.19	-4.54	363.65<<	24.38	1.03	-0.96
12/ 38 (C)	0.4	-4.56	586.94	24.50>>	2.13	-1.06
12/ 51 (C)	-0.05	3.89	420.81	-20.89<<	-0.27	0.84
12/ 44 (C)	4.75	1.17	640.74	-6.26	25.49>>	-1.08
12/ 49 (C)	-1.11	0.72	390.09	-3.85	-5.97<<	-0.01
12/ 59 (C)	-0.05	3.89	420.81	-20.89	-0.27	0.84>>
12/ 36 (C)	4.75	1.17	640.74	-6.26	25.49	-1.08<<
13/ 36 (C)	5.79>>	1.17	386.09	-6.26	31.08	-1.08
13/ 57 (C)	-1.11<<	0.72	238.95	-3.85	-5.94	-0.01
13/ 51 (C)	-0.85	3.89>>	211.16	-20.89	-4.58	0.84
13/ 38 (C)	1.42	-4.56<<	392.29	24.5	7.61	-1.06
13/ 63 (C)	1.21	-2.77	411.30>>	14.86	6.52	-0.76
13/ 51 (C)	-0.85	3.89	211.16<<	-20.89	-4.58	0.84
13/ 38 (C)	1.42	-4.56	392.29	24.50>>	7.61	-1.06
13/ 51 (C)	-0.85	3.89	211.16	-20.89<<	-4.58	0.84
13/ 36 (C)	5.79	1.17	386.09	-6.26	31.08>>	-1.08
13/ 57 (C)	-1.11	0.72	238.95	-3.85	-5.94<<	-0.01
13/ 59 (C)	-0.85	3.89	211.16	-20.89	-4.58	0.84>>
13/ 36 (C)	5.79	1.17	386.09	-6.26	31.08	-1.08<<
14/ 36 (C)	6.83>>	1.89	279.61	-7.55	36.67	-1.08
14/ 59 (C)	-1.66<<	5.89	141.3	-24.47	-8.9	0.84
14/ 34 (C)	-1.26	5.91>>	247.04	-24.43	-6.75	0.73
14/ 55 (C)	2.04	-6.73<<	179.25	28.3	10.94	-0.96
14/ 63 (C)	1.94	-4.01	301.27>>	17.07	10.44	-0.76
14/ 59 (C)	-1.66	5.89	141.30<<	-24.47	-8.9	0.84
14/ 38 (C)	2.44	-6.71	284.99	28.35>>	13.09	-1.06
14/ 51 (C)	-1.66	5.89	141.3	-24.47<<	-8.9	0.84
14/ 36 (C)	6.83	1.89	279.61	-7.55	36.67>>	-1.08
14/ 59 (C)	-1.66	5.89	141.3	-24.47	-8.90<<	0.84
14/ 59 (C)	-1.66	5.89	141.3	-24.47	-8.9	0.84>>
14/ 36 (C)	6.83	1.89	279.61	-7.55	36.67	-1.08<<

15/ 36 (C)	7.36>>	-19.49	117.92	40.38	39.51	0
15/ 59 (C)	-2.22<<	20.88	46.82	-53.23	-11.94	0
15/ 50 (C)	-1.98	20.89>>	85.2	-53.27	-10.65	0
15/ 45 (C)	7.12	-19.50<<	79.55	40.42	38.22	0
15/ 63 (C)	2.62	-6.24	185.93>>	18.53	14.05	0
15/ 57 (C)	-1.17	-12.24	44.74<<	24.63	-6.31	0
15/ 45 (C)	7.12	-19.5	79.55	40.42>>	38.22	0
15/ 50 (C)	-1.98	20.89	85.2	-53.27<<	-10.65	0
15/ 36 (C)	7.36	-19.49	117.92	40.38	39.51>>	0
15/ 59 (C)	-2.22	20.88	46.82	-53.23	-11.94<<	0
15/ 8 (C)	1.23	-0.02	166.6	0.13	6.59	0.0>>
15/ 8 (C)	1.23	-0.02	166.6	0.13	6.59	0.0<<
16/ 61 (C)	24.74>>	29.98	236.82	-44.16	8.58	-0.98
16/ 30 (C)	-21.70<<	-7.67	433.64	23.69	-10.68	-1.06
16/ 44 (C)	22.91	36.18>>	398.32	-54.78	7.06	-1.08
16/ 47 (C)	-19.87	-13.87<<	272.14	34.31	-9.15	-0.96
16/ 62 (C)	-5.42	19.13	487.55>>	-32.9	-4.55	-0.28
16/ 61 (C)	24.74	29.98	236.82<<	-44.16	8.58	-0.98
16/ 47 (C)	-19.87	-13.87	272.14	34.31>>	-9.15	-0.96
16/ 42 (C)	10.88	31.74	450.77	-69.11<<	2.05	0.73
16/ 61 (C)	24.74	29.98	236.82	-44.16	8.58>>	-0.98
16/ 30 (C)	-21.7	-7.67	433.64	23.69	-10.68<<	-1.06
16/ 59 (C)	12.71	25.54	289.26	-58.49	3.58	0.84>>
16/ 36 (C)	22.91	36.18	398.32	-54.78	7.06	-1.08<<
17/ 44 (C)	4.75>>	-2	569.92	6.26	25.49	-1.08
17/ 49 (C)	-1.11<<	0.36	386.36	0.84	-5.97	-0.01
17/ 59 (C)	-0.05	9.42>>	391.49	-17.88	-0.27	0.84
17/ 30 (C)	0.4	-14.41<<	520.61	31.9	2.13	-1.06
17/ 70 (C)	0.34	3.91	609.12>>	-5.84	1.82	0.32
17/ 47 (C)	0.19	-13.48	323.88<<	29.36	1.03	-0.96
17/ 30 (C)	0.4	-14.41	520.61	31.90>>	2.13	-1.06
17/ 59 (C)	-0.05	9.42	391.49	-17.88<<	-0.27	0.84
17/ 44 (C)	4.75	-2	569.92	6.26	25.49>>	-1.08
17/ 49 (C)	-1.11	0.36	386.36	0.84	-5.97<<	-0.01
17/ 59 (C)	-0.05	9.42	391.49	-17.88	-0.27	0.84>>
17/ 36 (C)	4.75	-2	569.92	6.26	25.49	-1.08<<
18/ 36 (C)	5.79>>	-6.74	347.35	7.87	31.08	-1.08
18/ 57 (C)	-1.11<<	-2.93	234.54	1.83	-5.94	-0.01
18/ 59 (C)	-0.85	6.28>>	195.9	-17.16	-4.58	0.84
18/ 30 (C)	1.42	-19.07<<	365.21	33.59	7.61	-1.06
18/ 63 (C)	1.21	-14.68	377.96>>	24.26	6.52	-0.76
18/ 59 (C)	-0.85	6.28	195.90<<	-17.16	-4.58	0.84
18/ 30 (C)	1.42	-19.07	365.21	33.59>>	7.61	-1.06
18/ 59 (C)	-0.85	6.28	195.9	-17.16<<	-4.58	0.84
18/ 36 (C)	5.79	-6.74	347.35	7.87	31.08>>	-1.08

18/ 57 (C)	-1.11	-2.93	234.54	1.83	-5.94<<	-0.01
18/ 59 (C)	-0.85	6.28	195.9	-17.16	-4.58	0.84>>
18/ 36 (C)	5.79	-6.74	347.35	7.87	31.08	-1.08<<
19/ 53 (C)	14.73>>	-1.13	243.88	1.66	49.38	-0.98
19/ 42 (C)	-11.05<<	13.33	341.83	-40.63	-24.28	0.73
19/ 59 (C)	-9.08	14.08>>	209.34	-42.45	-22.2	0.84
19/ 30 (C)	-0.31	-19.89<<	378.09	56.16	8.17	-1.06
19/ 63 (C)	-2.56	-13.03	396.06>>	36.24	2.38	-0.76
19/ 59 (C)	-9.08	14.08	209.34<<	-42.45	-22.2	0.84
19/ 30 (C)	-0.31	-19.89	378.09	56.16>>	8.17	-1.06
19/ 59 (C)	-9.08	14.08	209.34	-42.45<<	-22.2	0.84
19/ 53 (C)	14.73	-1.13	243.88	1.66	49.38>>	-0.98
19/ 42 (C)	-11.05	13.33	341.83	-40.63	-24.28<<	0.73
19/ 59 (C)	-9.08	14.08	209.34	-42.45	-22.2	0.84>>
19/ 36 (C)	12.76	-1.87	376.37	3.48	47.29	-1.08<<
20/ 53 (C)	14.83>>	-12.63	45.97	16.49	49.4	0.48
20/ 42 (C)	-14.44<<	12.66	103.65	-35.43	-29.12	-0.02
20/ 59 (C)	-11.82	15.20>>	46.58	-40.45	-26.2	0.03
20/ 30 (C)	-3.83	-23.80<<	159.74	61.42	6.47	-0.62
20/ 63 (C)	-5.28	-17.53	165.34>>	43.25	0.68	-0.44
20/ 61 (C)	14.83	-12.63	45.97<<	16.49	49.4	0.48
20/ 30 (C)	-3.83	-23.8	159.74	61.42>>	6.47	-0.62
20/ 59 (C)	-11.82	15.2	46.58	-40.45<<	-26.2	0.03
20/ 53 (C)	14.83	-12.63	45.97	16.49	49.40>>	0.48
20/ 42 (C)	-14.44	12.66	103.65	-35.43	-29.12<<	-0.02
20/ 61 (C)	14.83	-12.63	45.97	16.49	49.4	0.48>>
20/ 30 (C)	-3.83	-23.8	159.74	61.42	6.47	-0.62<<
21/ 61 (C)	6.00>>	14.5	63.85	-11.17	18.45	-0.98
21/ 30 (C)	-7.80<<	-19.86	90.62	56.53	-16.89	-1.06
21/ 42 (C)	-6.59	25.04>>	121.92	-63.67	-4.96	0.73
21/ 47 (C)	-6.79	-22.02<<	55	59.25	-15.13	-0.96
21/ 42 (C)	-6.59	25.04	121.92>>	-63.67	-4.96	0.73
21/ 47 (C)	-6.79	-22.02	55.00<<	59.25	-15.13	-0.96
21/ 47 (C)	-6.79	-22.02	55	59.25>>	-15.13	-0.96
21/ 42 (C)	-6.59	25.04	121.92	-63.67<<	-4.96	0.73
21/ 61 (C)	6	14.5	63.85	-11.17	18.45>>	-0.98
21/ 30 (C)	-7.8	-19.86	90.62	56.53	-16.89<<	-1.06
21/ 59 (C)	-5.59	22.87	86.3	-60.95	-3.2	0.84>>
21/ 36 (C)	4.99	16.66	99.47	-13.89	16.69	-1.08<<
22/ 36 (C)	7.01>>	-1.53	183.73	3.74	10.69	-0.17
22/ 55 (C)	-6.01<<	-4.37	115.37	11.77	-7.14	-0.15
22/ 59 (C)	-4.68	2.97>>	115.12	-8.72	-5.28	0.13
22/ 30 (C)	-5.91	-4.64<<	178.63	12.41	-6.93	-0.16
22/ 64 (C)	-1.45	-0.33	194.73>>	0.67	-2.01	-0.03
22/ 59 (C)	-4.68	2.97	115.12<<	-8.72	-5.28	0.13

22/ 30 (C)	-5.91	-4.64	178.63	12.41>>	-6.93	-0.16
22/ 59 (C)	-4.68	2.97	115.12	-8.72<<	-5.28	0.13
22/ 44 (C)	7.01	-1.53	183.73	3.74	10.69>>	-0.17
22/ 47 (C)	-6.01	-4.37	115.37	11.77	-7.14<<	-0.15
22/ 59 (C)	-4.68	2.97	115.12	-8.72	-5.28	0.13>>
22/ 36 (C)	7.01	-1.53	183.73	3.74	10.69	-0.17<<
23/ 36 (C)	7.15>>	-1	150.9	2.68	11.23	-0.17
23/ 55 (C)	-5.75<<	-4.05	92.5	11.08	-6.79	-0.15
23/ 59 (C)	-4.86	2.68>>	109.87	-8.11	-5.81	0.13
23/ 30 (C)	-5.68	-4.23<<	146.78	11.57	-6.6	-0.16
23/ 70 (C)	-2.78	1.27	169.63>>	-3.97	-3.15	0.05
23/ 47 (C)	-5.75	-4.05	92.50<<	11.08	-6.79	-0.15
23/ 30 (C)	-5.68	-4.23	146.78	11.57>>	-6.6	-0.16
23/ 59 (C)	-4.86	2.68	109.87	-8.11<<	-5.81	0.13
23/ 44 (C)	7.15	-1	150.9	2.68	11.23>>	-0.17
23/ 47 (C)	-5.75	-4.05	92.5	11.08	-6.79<<	-0.15
23/ 59 (C)	-4.86	2.68	109.87	-8.11	-5.81	0.13>>
23/ 36 (C)	7.15	-1	150.9	2.68	11.23	-0.17<<
24/ 36 (C)	7.33>>	-0.97	140.13	2.53	11.82	-0.17
24/ 55 (C)	-5.41<<	-4.04	87.98	10.98	-6.1	-0.15
24/ 59 (C)	-5.02	2.69>>	99.07	-8.04	-6.31	0.13
24/ 30 (C)	-5.33	-4.23<<	138.18	11.46	-5.87	-0.16
24/ 64 (C)	-1.61	-0.16	155.62>>	0.33	-2.2	-0.03
24/ 55 (C)	-5.41	-4.04	87.98<<	10.98	-6.1	-0.15
24/ 30 (C)	-5.33	-4.23	138.18	11.46>>	-5.87	-0.16
24/ 59 (C)	-5.02	2.69	99.07	-8.04<<	-6.31	0.13
24/ 44 (C)	7.33	-0.97	140.13	2.53	11.82>>	-0.17
24/ 51 (C)	-5.02	2.69	99.07	-8.04	-6.31<<	0.13
24/ 59 (C)	-5.02	2.69	99.07	-8.04	-6.31	0.13>>
24/ 36 (C)	7.33	-0.97	140.13	2.53	11.82	-0.17<<
25/ 36 (C)	7.53>>	-1.14	109.45	2.73	12.46	-0.17
25/ 59 (C)	-5.04<<	2.49	78.85	-7.59	-6.57	0.13
25/ 59 (C)	-5.04	2.49>>	78.85	-7.59	-6.57	0.13
25/ 30 (C)	-3.16	-4.36<<	108.69	11.59	-3.02	-0.16
25/ 70 (C)	-2.81	1.03	124.88>>	-3.48	-3.36	0.05
25/ 47 (C)	-3.28	-4.12	67.70<<	11.01	-3.33	-0.15
25/ 30 (C)	-3.16	-4.36	108.69	11.59>>	-3.02	-0.16
25/ 59 (C)	-5.04	2.49	78.85	-7.59<<	-6.57	0.13
25/ 36 (C)	7.53	-1.14	109.45	2.73	12.46>>	-0.17
25/ 59 (C)	-5.04	2.49	78.85	-7.59	-6.57<<	0.13
25/ 59 (C)	-5.04	2.49	78.85	-7.59	-6.57	0.13>>
25/ 36 (C)	7.53	-1.14	109.45	2.73	12.46	-0.17<<
26/ 36 (C)	7.54>>	-0.83	83.83	2.05	12.75	-0.17
26/ 59 (C)	-5.17<<	2.59	56.04	-7.68	-7.02	0.13
26/ 59 (C)	-5.17	2.59>>	56.04	-7.68	-7.02	0.13

26/ 30 (C)	-3.13	-3.95<<	89.22	10.75	-2.69	-0.16
26/ 64 (C)	-1.61	-0.11	98.29>>	0.2	-2.1	-0.03
26/ 61 (C)	7.44	-0.66	50.54<<	1.63	12.45	-0.15
26/ 30 (C)	-3.13	-3.95	89.22	10.75>>	-2.69	-0.16
26/ 59 (C)	-5.17	2.59	56.04	-7.68<<	-7.02	0.13
26/ 36 (C)	7.54	-0.83	83.83	2.05	12.75>>	-0.17
26/ 59 (C)	-5.17	2.59	56.04	-7.68	-7.02<<	0.13
26/ 59 (C)	-5.17	2.59	56.04	-7.68	-7.02	0.13>>
26/ 36 (C)	7.54	-0.83	83.83	2.05	12.75	-0.17<<
27/ 36 (C)	7.71>>	-0.82	73.75	1.92	13.34	-0.17
27/ 59 (C)	-5.29<<	2.57	45.59	-7.58	-7.43	0.13
27/ 59 (C)	-5.29	2.57>>	45.59	-7.58	-7.43	0.13
27/ 30 (C)	-2.92	-4.03<<	82.8	10.77	-2.04	-0.16
27/ 63 (C)	-1.61	-2.64	86.62>>	7	-0.79	-0.12
27/ 61 (C)	7.6	-0.64	44.73<<	1.49	12.97	-0.15
27/ 30 (C)	-2.92	-4.03	82.8	10.77>>	-2.04	-0.16
27/ 59 (C)	-5.29	2.57	45.59	-7.58<<	-7.43	0.13
27/ 36 (C)	7.71	-0.82	73.75	1.92	13.34>>	-0.17
27/ 59 (C)	-5.29	2.57	45.59	-7.58	-7.43<<	0.13
27/ 59 (C)	-5.29	2.57	45.59	-7.58	-7.43	0.13>>
27/ 36 (C)	7.71	-0.82	73.75	1.92	13.34	-0.17<<
28/ 36 (C)	7.94>>	-0.6	68.98	1.42	14.02	-0.17
28/ 59 (C)	-7.27<<	2.61	43.87	-7.56	-9.89	0.13
28/ 59 (C)	-7.27	2.61>>	43.87	-7.56	-9.89	0.13
28/ 30 (C)	-2.73	-3.84<<	73.96	10.33	-1.43	-0.16
28/ 69 (C)	-1.57	-0.03	78.78>>	0.01	-1.94	-0.03
28/ 53 (C)	7.81	-0.46	42.48<<	1.08	13.61	-0.15
28/ 30 (C)	-2.73	-3.84	73.96	10.33>>	-1.43	-0.16
28/ 59 (C)	-7.27	2.61	43.87	-7.56<<	-9.89	0.13
28/ 36 (C)	7.94	-0.6	68.98	1.42	14.02>>	-0.17
28/ 59 (C)	-7.27	2.61	43.87	-7.56	-9.89<<	0.13
28/ 59 (C)	-7.27	2.61	43.87	-7.56	-9.89	0.13>>
28/ 36 (C)	7.94	-0.6	68.98	1.42	14.02	-0.17<<
29/ 36 (C)	8.84>>	-1.08	-1.64	2.18	15.9	-0.17
29/ 59 (C)	-7.11<<	2.2	14.43	-6.74	-9.66	0.13
29/ 59 (C)	-7.11	2.20>>	14.43	-6.74	-9.66	0.13
29/ 30 (C)	-2.03	-4.21<<	9.21	10.88	0.08	-0.16
29/ 41 (C)	-2.69	-0.29	18.13>>	0.18	-3.79	-0.01
29/ 52 (C)	8.71	-0.87	-5.33<<	1.75	15.56	-0.16
29/ 30 (C)	-2.03	-4.21	9.21	10.88>>	0.08	-0.16
29/ 59 (C)	-7.11	2.2	14.43	-6.74<<	-9.66	0.13
29/ 36 (C)	8.84	-1.08	-1.64	2.18	15.90>>	-0.17
29/ 59 (C)	-7.11	2.2	14.43	-6.74	-9.66<<	0.13
29/ 59 (C)	-7.11	2.2	14.43	-6.74	-9.66	0.13>>
29/ 36 (C)	8.84	-1.08	-1.64	2.18	15.9	-0.17<<

30/ 53 (C)	7.79>>	0.16	13.83	-0.25	14.05	-0.12
30/ 42 (C)	-8.30<<	2.87	30.53	-7.76	-11.4	0.07
30/ 59 (C)	-7.95	2.91>>	23.49	-7.92	-11.01	0.09
30/ 30 (C)	-3.66	-3.27<<	25.14	9.09	-2.56	-0.12
30/ 41 (C)	-3.92	0.49	33.91>>	-1.22	-5.99	-0.01
30/ 52 (C)	7.66	0.13	13.52<<	-0.17	13.94	-0.13
30/ 30 (C)	-3.66	-3.27	25.14	9.09>>	-2.56	-0.12
30/ 59 (C)	-7.95	2.91	23.49	-7.92<<	-11.01	0.09
30/ 53 (C)	7.79	0.16	13.83	-0.25	14.05>>	-0.12
30/ 42 (C)	-8.3	2.87	30.53	-7.76	-11.40<<	0.07
30/ 59 (C)	-7.95	2.91	23.49	-7.92	-11.01	0.09>>
30/ 36 (C)	7.44	0.11	20.88	-0.08	13.66	-0.14<<
31/ 44 (C)	3.71>>	-2.5	360.68	4.61	19.9	-1.08
31/ 49 (C)	-1.12<<	-0.94	247.37	-0.87	-6	-0.01
31/ 59 (C)	0.75	3.17>>	247.37	-22.92	4.05	0.84
31/ 30 (C)	-0.62	-7.94<<	338.11	34.75	-3.35	-1.06
31/ 64 (C)	-0.48	-2.46	379.57>>	3.75	-2.56	-0.19
31/ 47 (C)	-0.73	-6.93	218.50<<	32.47	-3.93	-0.96
31/ 30 (C)	-0.62	-7.94	338.11	34.75>>	-3.35	-1.06
31/ 59 (C)	0.75	3.17	247.37	-22.92<<	4.05	0.84
31/ 44 (C)	3.71	-2.5	360.68	4.61	19.90>>	-1.08
31/ 49 (C)	-1.12	-0.94	247.37	-0.87	-6.00<<	-0.01
31/ 59 (C)	0.75	3.17	247.37	-22.92	4.05	0.84>>
31/ 36 (C)	3.71	-2.5	360.68	4.61	19.9	-1.08<<
33/ 36 (C)	1.61>>	-0.04	5.52	0.18	2.33	0
33/ 59 (C)	-0.06<<	2.67	3.08	-7.43	-0.31	0
33/ 59 (C)	-0.06	2.67>>	3.08	-7.43	-0.31	0
33/ 30 (C)	0.09	-2.70<<	5.54	7.57	0.46	0
33/ 63 (C)	0.07	-1.63	6.12>>	4.58	0.35	0
33/ 61 (C)	1.6	-0.03	3.08<<	0.15	2.26	0
33/ 30 (C)	0.09	-2.7	5.54	7.57>>	0.46	0
33/ 59 (C)	-0.06	2.67	3.08	-7.43<<	-0.31	0
33/ 36 (C)	1.61	-0.04	5.52	0.18	2.33>>	0
33/ 59 (C)	-0.06	2.67	3.08	-7.43	-0.31<<	0
33/ 8 (C)	0.03	-0.02	5.54	0.08	0.16	0.0>>
33/ 8 (C)	0.03	-0.02	5.54	0.08	0.16	0.0<<
35/ 44 (C)	1.49>>	-0.04	3.08	0.18	1.71	0
35/ 47 (C)	-0.04<<	-2.7	1.83	7.58	-0.21	0
35/ 59 (C)	0.04	2.68>>	1.83	-7.47	0.2	0
35/ 30 (C)	-0.04	-2.70<<	3.08	7.61	-0.21	0
35/ 63 (C)	-0.03	-1.63	3.33>>	4.6	-0.13	0
35/ 53 (C)	1.49	-0.03	1.83<<	0.15	1.71	0
35/ 30 (C)	-0.04	-2.7	3.08	7.61>>	-0.21	0
35/ 59 (C)	0.04	2.68	1.83	-7.47<<	0.2	0
35/ 44 (C)	1.49	-0.04	3.08	0.18	1.71>>	0

35/ 47 (C)	-0.04	-2.7	1.83	7.58	-0.21<<	0
35/ 8 (C)	0	-0.02	3.08	0.08	0	0.0>>
35/ 8 (C)	0	-0.02	3.08	0.08	0	0.0<<
36/ 36 (C)	1.61>>	-0.04	11.4	0.18	2.31	0
36/ 59 (C)	-0.04<<	2.67	5.99	-7.44	-0.22	0
36/ 59 (C)	-0.04	2.67>>	5.99	-7.44	-0.22	0
36/ 30 (C)	0.07	-2.70<<	11.4	7.57	0.33	0
36/ 63 (C)	0.05	-1.63	12.82>>	4.58	0.27	0
36/ 61 (C)	1.6	-0.03	5.99<<	0.15	2.26	0
36/ 30 (C)	0.07	-2.7	11.4	7.57>>	0.33	0
36/ 59 (C)	-0.04	2.67	5.99	-7.44<<	-0.22	0
36/ 36 (C)	1.61	-0.04	11.4	0.18	2.31>>	0
36/ 59 (C)	-0.04	2.67	5.99	-7.44	-0.22<<	0
36/ 8 (C)	0.03	-0.02	11.4	0.08	0.14	0.0>>
36/ 8 (C)	0.03	-0.02	11.4	0.08	0.14	0.0<<
37/ 36 (C)	1.62>>	-0.04	8.48	0.18	2.34	0
37/ 59 (C)	-0.06<<	2.67	4.55	-7.44	-0.28	0
37/ 59 (C)	-0.06	2.67>>	4.55	-7.44	-0.28	0
37/ 30 (C)	0.08	-2.70<<	8.48	7.58	0.37	0
37/ 71 (C)	0.98	-0.03	9.48>>	0.15	1.46	0
37/ 47 (C)	0.07	-2.69	4.55<<	7.55	0.32	0
37/ 30 (C)	0.08	-2.7	8.48	7.58>>	0.37	0
37/ 59 (C)	-0.06	2.67	4.55	-7.44<<	-0.28	0
37/ 36 (C)	1.62	-0.04	8.48	0.18	2.34>>	0
37/ 59 (C)	-0.06	2.67	4.55	-7.44	-0.28<<	0
37/ 8 (C)	0.03	-0.02	8.48	0.08	0.12	0.0>>
37/ 8 (C)	0.03	-0.02	8.48	0.08	0.12	0.0<<
38/ 36 (C)	1.58>>	-0.04	10.51	0.18	2.18	0
38/ 59 (C)	-0.03<<	2.67	5.54	-7.44	-0.15	0
38/ 59 (C)	-0.03	2.67>>	5.54	-7.44	-0.15	0
38/ 30 (C)	0.05	-2.70<<	10.51	7.58	0.24	0
38/ 71 (C)	0.96	-0.03	11.80>>	0.15	1.36	0
38/ 47 (C)	0.04	-2.69	5.54<<	7.55	0.19	0
38/ 30 (C)	0.05	-2.7	10.51	7.58>>	0.24	0
38/ 59 (C)	-0.03	2.67	5.54	-7.44<<	-0.15	0
38/ 36 (C)	1.58	-0.04	10.51	0.18	2.18>>	0
38/ 59 (C)	-0.03	2.67	5.54	-7.44	-0.15<<	0
38/ 8 (C)	0.02	-0.02	10.51	0.08	0.11	0.0>>
38/ 8 (C)	0.02	-0.02	10.51	0.08	0.11	0.0<<
39/ 36 (C)	1.57>>	-0.04	11.39	0.18	2.11	0
39/ 57 (C)	-0.03<<	0.01	5.98	-0.07	-0.14	0
39/ 59 (C)	-0.02	2.67>>	5.98	-7.45	-0.1	0
39/ 30 (C)	0.03	-2.70<<	11.39	7.59	0.17	0
39/ 63 (C)	0.03	-1.63	12.81>>	4.59	0.15	0
39/ 53 (C)	1.56	-0.03	5.98<<	0.15	2.07	0

39/ 30 (C)	0.03	-2.7	11.39	7.59>>	0.17	0
39/ 59 (C)	-0.02	2.67	5.98	-7.45<<	-0.1	0
39/ 36 (C)	1.57	-0.04	11.39	0.18	2.11>>	0
39/ 57 (C)	-0.03	0.01	5.98	-0.07	-0.14<<	0
39/ 8 (C)	0.02	-0.02	11.39	0.08	0.09	0.0>>
39/ 8 (C)	0.02	-0.02	11.39	0.08	0.09	0.0<<
40/ 36 (C)	1.55>>	-0.04	9.44	0.18	2.04	0
40/ 57 (C)	-0.03<<	0.01	5	-0.07	-0.14	0
40/ 59 (C)	-0.01	2.67>>	5	-7.45	-0.05	0
40/ 30 (C)	0.02	-2.70<<	9.44	7.59	0.11	0
40/ 63 (C)	0.02	-1.63	10.59>>	4.59	0.1	0
40/ 53 (C)	1.55	-0.03	5.00<<	0.15	2.01	0
40/ 30 (C)	0.02	-2.7	9.44	7.59>>	0.11	0
40/ 59 (C)	-0.01	2.67	5	-7.45<<	-0.05	0
40/ 36 (C)	1.55	-0.04	9.44	0.18	2.04>>	0
40/ 57 (C)	-0.03	0.01	5	-0.07	-0.14<<	0
40/ 8 (C)	0.02	-0.02	9.44	0.08	0.08	0.0>>
40/ 8 (C)	0.02	-0.02	9.44	0.08	0.08	0.0<<
41/ 44 (C)	1.54>>	-0.04	8.84	0.18	1.98	0
41/ 49 (C)	-0.03<<	0.01	4.73	-0.07	-0.14	0
41/ 59 (C)	0	2.67>>	4.73	-7.46	0	0
41/ 30 (C)	0.01	-2.70<<	8.84	7.6	0.04	0
41/ 63 (C)	0.01	-1.63	9.89>>	4.6	0.06	0
41/ 53 (C)	1.54	-0.03	4.73<<	0.15	1.95	0
41/ 30 (C)	0.01	-2.7	8.84	7.60>>	0.04	0
41/ 59 (C)	0	2.67	4.73	-7.46<<	0	0
41/ 44 (C)	1.54	-0.04	8.84	0.18	1.98>>	0
41/ 49 (C)	-0.03	0.01	4.73	-0.07	-0.14<<	0
41/ 8 (C)	0.01	-0.02	8.84	0.08	0.06	0.0>>
41/ 8 (C)	0.01	-0.02	8.84	0.08	0.06	0.0<<
42/ 44 (C)	1.53>>	-0.04	7.37	0.18	1.91	0
42/ 49 (C)	-0.03<<	0.01	4.01	-0.07	-0.14	0
42/ 59 (C)	0.01	2.68>>	4.01	-7.47	0.05	0
42/ 30 (C)	0	-2.70<<	7.37	7.61	-0.02	0
42/ 66 (C)	0.92	-0.03	8.21>>	0.15	1.17	0
42/ 47 (C)	-0.01	-2.7	4.01<<	7.57	-0.04	0
42/ 30 (C)	0	-2.7	7.37	7.61>>	-0.02	0
42/ 59 (C)	0.01	2.68	4.01	-7.47<<	0.05	0
42/ 44 (C)	1.53	-0.04	7.37	0.18	1.91>>	0
42/ 49 (C)	-0.03	0.01	4.01	-0.07	-0.14<<	0
42/ 8 (C)	0.01	-0.02	7.37	0.08	0.05	0.0>>
42/ 8 (C)	0.01	-0.02	7.37	0.08	0.05	0.0<<
43/ 44 (C)	1.51>>	-0.04	6.38	0.18	1.84	0
43/ 49 (C)	-0.03<<	0.01	3.52	-0.07	-0.14	0
43/ 59 (C)	0.02	2.68>>	3.52	-7.47	0.1	0

43/ 30 (C)	-0.02	-2.70<<	6.38	7.61	-0.08	0
43/ 66 (C)	0.91	-0.03	7.07>>	0.15	1.12	0
43/ 47 (C)	-0.02	-2.7	3.52<<	7.58	-0.1	0
43/ 30 (C)	-0.02	-2.7	6.38	7.61>>	-0.08	0
43/ 59 (C)	0.02	2.68	3.52	-7.47<<	0.1	0
43/ 44 (C)	1.51	-0.04	6.38	0.18	1.84>>	0
43/ 49 (C)	-0.03	0.01	3.52	-0.07	-0.14<<	0
43/ 8 (C)	0.01	-0.02	6.38	0.08	0.03	0.0>>
43/ 8 (C)	0.01	-0.02	6.38	0.08	0.03	0.0<<
44/ 44 (C)	1.50>>	-0.04	5.54	0.18	1.78	0
44/ 47 (C)	-0.03<<	-2.7	3.11	7.58	-0.16	0
44/ 59 (C)	0.03	2.68>>	3.11	-7.47	0.15	0
44/ 30 (C)	-0.03	-2.70<<	5.54	7.61	-0.15	0
44/ 63 (C)	-0.02	-1.63	6.12>>	4.6	-0.08	0
44/ 53 (C)	1.5	-0.03	3.11<<	0.15	1.77	0
44/ 30 (C)	-0.03	-2.7	5.54	7.61>>	-0.15	0
44/ 59 (C)	0.03	2.68	3.11	-7.47<<	0.15	0
44/ 44 (C)	1.5	-0.04	5.54	0.18	1.78>>	0
44/ 47 (C)	-0.03	-2.7	3.11	7.58	-0.16<<	0
44/ 8 (C)	0	-0.02	5.54	0.08	0.02	0.0>>
44/ 8 (C)	0	-0.02	5.54	0.08	0.02	0.0<<
45/ 36 (C)	1.61>>	-0.03	6.36	0.17	2.33	0
45/ 59 (C)	-0.06<<	2.16	3.53	-4.99	-0.31	0
45/ 59 (C)	-0.06	2.16>>	3.53	-4.99	-0.31	0
45/ 30 (C)	0.09	-2.19<<	6.27	5.13	0.45	0
45/ 71 (C)	0.98	-0.03	7.02>>	0.14	1.47	0
45/ 47 (C)	0.08	-2.19	3.45<<	5.1	0.39	0
45/ 30 (C)	0.09	-2.19	6.27	5.13>>	0.45	0
45/ 59 (C)	-0.06	2.16	3.53	-4.99<<	-0.31	0
45/ 36 (C)	1.61	-0.03	6.36	0.17	2.33>>	0
45/ 59 (C)	-0.06	2.16	3.53	-4.99	-0.31<<	0
45/ 8 (C)	0.03	-0.02	6.3	0.08	0.16	0.0>>
45/ 8 (C)	0.03	-0.02	6.3	0.08	0.16	0.0<<
46/ 36 (C)	1.61>>	-0.03	6.17	0.14	2.33	0
46/ 59 (C)	-0.06<<	1.68	3.47	-2.64	-0.3	0
46/ 59 (C)	-0.06	1.68>>	3.47	-2.64	-0.3	0
46/ 30 (C)	0.09	-1.71<<	5.92	2.79	0.45	0
46/ 71 (C)	0.98	-0.02	6.76>>	0.12	1.47	0
46/ 47 (C)	0.08	-1.7	3.22<<	2.76	0.38	0
46/ 30 (C)	0.09	-1.71	5.92	2.79>>	0.45	0
46/ 59 (C)	-0.06	1.68	3.47	-2.64<<	-0.3	0
46/ 36 (C)	1.61	-0.03	6.17	0.14	2.33>>	0
46/ 59 (C)	-0.06	1.68	3.47	-2.64	-0.30<<	0
46/ 8 (C)	0.03	-0.02	5.98	0.08	0.16	0.0>>
46/ 8 (C)	0.03	-0.02	5.98	0.08	0.16	0.0<<

47/ 36 (C)	1.61>>	-0.02	7.03	0.08	2.32	0
47/ 59 (C)	-0.06<<	1.57	3.74	-2.11	-0.29	0
47/ 59 (C)	-0.06	1.57>>	3.74	-2.11	-0.29	0
47/ 30 (C)	0.09	-1.60<<	7.67	2.24	0.44	0
47/ 63 (C)	0.07	-0.96	8.39>>	1.37	0.34	0
47/ 61 (C)	1.6	-0.01	3.73<<	0.06	2.26	0
47/ 30 (C)	0.09	-1.6	7.67	2.24>>	0.44	0
47/ 59 (C)	-0.06	1.57	3.74	-2.11<<	-0.29	0
47/ 36 (C)	1.61	-0.02	7.03	0.08	2.32>>	0
47/ 59 (C)	-0.06	1.57	3.74	-2.11	-0.29<<	0
47/ 8 (C)	0.03	-0.01	7.51	0.06	0.16	0.0>>
47/ 8 (C)	0.03	-0.01	7.51	0.06	0.16	0.0<<

Pamatų reakcijos A2 apkrovų atvejui

Taškas/ kombinacija	FX (kN)	FY (kN)	FZ (kN)	MX (kNm)	MY (kNm)	MZ (kNm)
1/ 142 (C)	14.74>>	-9.43	156.82	21.19	11.31	-1.01
1/ 137 (C)	-13.47<<	11.24	107.03	-16.85	-21.27	-0.01
1/ 136 (C)	-13.46	11.35>>	149.95	-17.4	-21.24	-0.05
1/ 143 (C)	14.74	-9.53<<	113.9	21.74	11.28	-0.96
1/ 150 (C)	0.02	0.44	240.40>>	-2.35	0.1	-0.22
1/ 137 (C)	-13.47	11.24	107.03<<	-16.85	-21.27	-0.01
1/ 143 (C)	14.74	-9.53	113.9	21.74>>	11.28	-0.96
1/ 140 (C)	7.88	8.49	190.64	-24.79<<	20.74	-1.03
1/ 148 (C)	7.88	8.49	190.64	-24.79	20.74>>	-1.03
1/ 137 (C)	-13.47	11.24	107.03	-16.85	-21.27<<	-0.01
1/ 147 (C)	10.27	5.05	162.87	-14.65	19.09	0.84>>
1/ 140 (C)	7.88	8.49	190.64	-24.79	20.74	-1.03<<
2/ 134 (C)	18.99>>	-2.64	317.1	12.96	22.66	-0.75
2/ 145 (C)	-11.02<<	1.1	212.8	-4.53	-16.07	-0.06
2/ 148 (C)	16.76	3.36>>	329.12	-18.43	38.87	-0.8
2/ 135 (C)	15.99	-2.75<<	232.94	13.51	18.57	-0.71
2/ 154 (C)	15.36	2.22	386.58>>	-12.15	30.65	-0.56
2/ 143 (C)	14.71	-2.75	209.65<<	13.51	17.02	-0.71
2/ 135 (C)	15.99	-2.75	232.94	13.51>>	18.57	-0.71
2/ 148 (C)	16.76	3.36	329.12	-18.43<<	38.87	-0.8
2/ 140 (C)	18.03	3.36	352.41	-18.43	40.42>>	-0.8
2/ 145 (C)	-11.02	1.1	212.8	-4.53	-16.07<<	-0.06
2/ 139 (C)	14.5	1.87	254.17	-10.65	16.15	0.69>>
2/ 148 (C)	16.76	3.36	329.12	-18.43	38.87	-0.80<<
3/ 140 (C)	17.52>>	3.36	265.73	-18.43	44.36	-0.8
3/ 145 (C)	-7.28<<	1.1	139.87	-4.53	-12.48	-0.06
3/ 148 (C)	16.24	3.36>>	242.44	-18.43	42.8	-0.8
3/ 135 (C)	13.01	-2.75<<	163.24	13.51	19.86	-0.71

3/ 154 (C)	15.15	2.22	296.91>>	-12.15	33.55	-0.56
3/ 147 (C)	11.04	1.87	129.33<<	-10.65	8.9	0.69
3/ 135 (C)	13.01	-2.75	163.24	13.51>>	19.86	-0.71
3/ 148 (C)	16.24	3.36	242.44	-18.43<<	42.8	-0.8
3/ 140 (C)	17.52	3.36	265.73	-18.43	44.36>>	-0.8
3/ 145 (C)	-7.28	1.1	139.87	-4.53	-12.48<<	-0.06
3/ 139 (C)	12.31	1.87	152.62	-10.65	10.46	0.69>>
3/ 148 (C)	16.24	3.36	242.44	-18.43	42.8	-0.80<<
4/ 140 (C)	11.44>>	3.47	129.69	-18.61	41.49	-1.03
4/ 145 (C)	-12.50<<	0.73	82.74	-3.92	-19.98	-0.01
4/ 140 (C)	11.44	3.47>>	129.69	-18.61	41.49	-1.03
4/ 143 (C)	9.83	-2.41<<	105.12	12.95	20.55	-0.96
4/ 151 (C)	6.41	-1.18	138.46>>	6.35	15.08	-0.71
4/ 137 (C)	-12.5	0.73	82.74<<	-3.92	-19.98	-0.01
4/ 143 (C)	9.83	-2.41	105.12	12.95>>	20.55	-0.96
4/ 140 (C)	11.44	3.47	129.69	-18.61<<	41.49	-1.03
4/ 140 (C)	11.44	3.47	129.69	-18.61	41.49>>	-1.03
4/ 145 (C)	-12.5	0.73	82.74	-3.92	-19.98<<	-0.01
4/ 147 (C)	10.77	2.03	85.33	-10.93	6.42	0.84>>
4/ 140 (C)	11.44	3.47	129.69	-18.61	41.49	-1.03<<
5/ 140 (C)	9.29>>	-7.97	59.21	22.65	40.75	0
5/ 145 (C)	-6.40<<	-16.68	7.15	47.39	-12.78	0
5/ 138 (C)	6.15	12.22>>	40.12	-36.17	-0.54	0
5/ 136 (C)	-6.16	-16.68<<	33.71	47.39	-11.5	0
5/ 150 (C)	1.07	0	101.00>>	0	5.75	0
5/ 137 (C)	-6.4	-16.68	7.15<<	47.39	-12.78	0
5/ 136 (C)	-6.16	-16.68	33.71	47.39>>	-11.5	0
5/ 138 (C)	6.15	12.22	40.12	-36.17<<	-0.54	0
5/ 140 (C)	9.29	-7.97	59.21	22.65	40.75>>	0
5/ 145 (C)	-6.4	-16.68	7.15	47.39	-12.78<<	0
5/ 123 (C)	0.97	0	89.61	0	5.2	0.0>>
5/ 123 (C)	0.97	0	89.61	0	5.2	0.0<<
6/ 148 (C)	2.66>>	12.37	352.3	-24.84	14.29	-1.03
6/ 135 (C)	-1.65<<	-17.72	254.14	36.25	-8.88	-0.96
6/ 136 (C)	-1.12	16.80>>	307.92	-23.87	-6	-0.05
6/ 143 (C)	-1.65	-17.72<<	254.14	36.25	-8.88	-0.96
6/ 153 (C)	0.95	5.51	430.82>>	-14.65	5.09	0.37
6/ 137 (C)	-1.12	16.75	238.96<<	-23.6	-6.03	-0.01
6/ 143 (C)	-1.65	-17.72	254.14	36.25>>	-8.88	-0.96
6/ 140 (C)	2.66	12.37	352.3	-24.84<<	14.29	-1.03
6/ 148 (C)	2.66	12.37	352.3	-24.84	14.29>>	-1.03
6/ 135 (C)	-1.65	-17.72	254.14	36.25	-8.88<<	-0.96
6/ 147 (C)	1.56	8.99	335.65	-23.35	8.37	0.84>>
6/ 140 (C)	2.66	12.37	352.3	-24.84	14.29	-1.03<<
7/ 149 (C)	2.71>>	2.39	440.51	-12.4	22.9	-0.76

7/ 136 (C)	-12.90<<	0.4	530.08	-3.53	-21.82	-0.1
7/ 138 (C)	-4.62	3.17>>	582	-16.44	-4.09	0.65
7/ 143 (C)	-0.15	-3.14<<	389.12	18.1	2.04	-0.71
7/ 154 (C)	-4.97	1.54	630.18>>	-8.07	6.77	-0.56
7/ 145 (C)	-8.82	0.36	387.02<<	-3.27	-17.24	-0.06
7/ 143 (C)	-0.15	-3.14	389.12	18.10>>	2.04	-0.71
7/ 138 (C)	-4.62	3.17	582	-16.44<<	-4.09	0.65
7/ 149 (C)	2.71	2.39	440.51	-12.4	22.90>>	-0.76
7/ 136 (C)	-12.9	0.4	530.08	-3.53	-21.82<<	-0.1
7/ 139 (C)	-1.81	3.13	462.22	-16.18	-1.06	0.69>>
7/ 148 (C)	-0.1	2.43	560.28	-12.66	19.87	-0.80<<
8/ 149 (C)	3.46>>	2.39	274.99	-12.4	27.64	-0.76
8/ 136 (C)	-12.21<<	0.4	360.65	-3.53	-20.48	-0.1
8/ 138 (C)	-5.66	3.17>>	359.86	-16.44	-8.62	0.65
8/ 143 (C)	0.19	-3.14<<	275.26	18.1	6.02	-0.71
8/ 151 (C)	-6.34	-1.77	428.78>>	10.23	-2.67	-0.53
8/ 147 (C)	-1.62	3.13	243.41<<	-16.18	-4.29	0.69
8/ 143 (C)	0.19	-3.14	275.26	18.10>>	6.02	-0.71
8/ 138 (C)	-5.66	3.17	359.86	-16.44<<	-8.62	0.65
8/ 149 (C)	3.46	2.39	274.99	-12.4	27.64>>	-0.76
8/ 136 (C)	-12.21	0.4	360.65	-3.53	-20.48<<	-0.1
8/ 139 (C)	-2.9	3.13	266.7	-16.18	-5.85	0.69>>
8/ 148 (C)	0.7	2.43	368.15	-12.66	24.87	-0.80<<
9/ 140 (C)	6.62>>	2.32	237.69	-12.48	35.54	-1.03
9/ 147 (C)	-1.66<<	2.96	149.82	-15.91	-8.9	0.84
9/ 138 (C)	-1.47	3.01>>	198.96	-16.17	-7.87	0.79
9/ 143 (C)	2.04	-3.48<<	189.16	18.67	10.94	-0.96
9/ 151 (C)	1.74	-1.97	255.85>>	10.56	9.32	-0.71
9/ 139 (C)	-1.66	2.96	149.82<<	-15.91	-8.9	0.84
9/ 143 (C)	2.04	-3.48	189.16	18.67>>	10.94	-0.96
9/ 138 (C)	-1.47	3.01	198.96	-16.17<<	-7.87	0.79
9/ 140 (C)	6.62	2.32	237.69	-12.48	35.54>>	-1.03
9/ 147 (C)	-1.66	2.96	149.82	-15.91	-8.90<<	0.84
9/ 147 (C)	-1.66	2.96	149.82	-15.91	-8.9	0.84>>
9/ 140 (C)	6.62	2.32	237.69	-12.48	35.54	-1.03<<
10/ 140 (C)	7.09>>	-16.26	87.71	46.21	38.05	0
10/ 147 (C)	-2.21<<	24.44	46.51	-72.33	-11.88	0
10/ 138 (C)	-1.97	24.44>>	86.83	-72.33	-10.6	0
10/ 136 (C)	-0.94	-25.43<<	70.71	72.25	-5.03	0
10/ 151 (C)	2.36	-6.2	156.47>>	18.36	12.65	0
10/ 137 (C)	-1.18	-25.43	30.39<<	72.25	-6.32	0
10/ 136 (C)	-0.94	-25.43	70.71	72.25>>	-5.03	0
10/ 138 (C)	-1.97	24.44	86.83	-72.33<<	-10.6	0
10/ 140 (C)	7.09	-16.26	87.71	46.21	38.05>>	0
10/ 147 (C)	-2.21	24.44	46.51	-72.33	-11.88<<	0

10/ 123 (C)	0.97	0	137.38	0	5.21	0.0>>
10/ 123 (C)	0.97	0	137.38	0	5.21	0.0<<
11/ 148 (C)	31.18>>	11.22	386.38	-18.69	14.17	-1.03
11/ 135 (C)	-14.63<<	-18.78	233.26	41.97	-4.63	-0.96
11/ 141 (C)	30.51	11.22>>	317.12	-18.71	13.56	-0.98
11/ 142 (C)	-13.95	-18.79<<	302.51	41.99	-4.01	-1.01
11/ 158 (C)	14	5.92	446.72>>	-16.86	7.7	0.37
11/ 135 (C)	-14.63	-18.78	233.26<<	41.97	-4.63	-0.96
11/ 142 (C)	-13.95	-18.79	302.51	41.99>>	-4.01	-1.01
11/ 139 (C)	19.51	9.92	360.13	-28.33<<	9.44	0.84
11/ 148 (C)	31.18	11.22	386.38	-18.69	14.17>>	-1.03
11/ 135 (C)	-14.63	-18.78	233.26	41.97	-4.63<<	-0.96
11/ 147 (C)	19.51	9.92	360.13	-28.33	9.44	0.84>>
11/ 140 (C)	31.18	11.22	386.38	-18.69	14.17	-1.03<<
12/ 148 (C)	4.64>>	1.18	497.3	-6.35	24.92	-1.03
12/ 137 (C)	-1.11<<	0.72	390.09	-3.85	-5.97	-0.01
12/ 139 (C)	-0.05	3.89>>	420.81	-20.89	-0.27	0.84
12/ 142 (C)	0.29	-4.54<<	443.5	24.41	1.56	-1.01
12/ 153 (C)	0.23	2.31	530.49>>	-12.4	1.25	0.37
12/ 135 (C)	0.19	-4.54	363.65<<	24.38	1.03	-0.96
12/ 142 (C)	0.29	-4.54	443.5	24.41>>	1.56	-1.01
12/ 139 (C)	-0.05	3.89	420.81	-20.89<<	-0.27	0.84
12/ 148 (C)	4.64	1.18	497.3	-6.35	24.92>>	-1.03
12/ 137 (C)	-1.11	0.72	390.09	-3.85	-5.97<<	-0.01
12/ 147 (C)	-0.05	3.89	420.81	-20.89	-0.27	0.84>>
12/ 140 (C)	4.64	1.18	497.3	-6.35	24.92	-1.03<<
13/ 140 (C)	5.63>>	1.18	300.65	-6.35	30.23	-1.03
13/ 145 (C)	-1.11<<	0.72	238.95	-3.85	-5.94	-0.01
13/ 139 (C)	-0.85	3.89>>	211.16	-20.89	-4.58	0.84
13/ 142 (C)	1.26	-4.54<<	306.85	24.41	6.76	-1.01
13/ 151 (C)	1.06	-2.75	325.86>>	14.77	5.67	-0.71
13/ 139 (C)	-0.85	3.89	211.16<<	-20.89	-4.58	0.84
13/ 142 (C)	1.26	-4.54	306.85	24.41>>	6.76	-1.01
13/ 139 (C)	-0.85	3.89	211.16	-20.89<<	-4.58	0.84
13/ 140 (C)	5.63	1.18	300.65	-6.35	30.23>>	-1.03
13/ 145 (C)	-1.11	0.72	238.95	-3.85	-5.94<<	-0.01
13/ 147 (C)	-0.85	3.89	211.16	-20.89	-4.58	0.84>>
13/ 140 (C)	5.63	1.18	300.65	-6.35	30.23	-1.03<<
14/ 140 (C)	6.62>>	1.88	219.89	-7.59	35.54	-1.03
14/ 147 (C)	-1.66<<	5.89	141.3	-24.47	-8.9	0.84
14/ 138 (C)	-1.47	5.90>>	187.32	-24.46	-7.87	0.79
14/ 143 (C)	2.04	-6.73<<	179.25	28.3	10.94	-0.96
14/ 151 (C)	1.74	-4.02	241.55>>	17.04	9.32	-0.71
14/ 147 (C)	-1.66	5.89	141.30<<	-24.47	-8.9	0.84
14/ 142 (C)	2.23	-6.72	225.27	28.31>>	11.97	-1.01

14/ 139 (C)	-1.66	5.89	141.3	-24.47<<	-8.9	0.84
14/ 140 (C)	6.62	1.88	219.89	-7.59	35.54>>	-1.03
14/ 147 (C)	-1.66	5.89	141.3	-24.47	-8.90<<	0.84
14/ 147 (C)	-1.66	5.89	141.3	-24.47	-8.9	0.84>>
14/ 140 (C)	6.62	1.88	219.89	-7.59	35.54	-1.03<<
15/ 140 (C)	7.10>>	-19.48	84.68	40.33	38.13	0
15/ 147 (C)	-2.22<<	20.88	46.82	-53.23	-11.94	0
15/ 138 (C)	-1.98	20.89>>	85.2	-53.27	-10.65	0
15/ 149 (C)	6.86	-19.49<<	46.31	40.37	36.85	0
15/ 151 (C)	2.36	-6.23	152.69>>	18.49	12.67	0
15/ 145 (C)	-1.17	-12.24	44.74<<	24.63	-6.31	0
15/ 149 (C)	6.86	-19.49	46.31	40.37>>	36.85	0
15/ 138 (C)	-1.98	20.89	85.2	-53.27<<	-10.65	0
15/ 140 (C)	7.1	-19.48	84.68	40.33	38.13>>	0
15/ 147 (C)	-2.22	20.88	46.82	-53.23	-11.94<<	0
15/ 123 (C)	0.97	-0.02	133.35	0.08	5.22	0.0>>
15/ 123 (C)	0.97	-0.02	133.35	0.08	5.22	0.0<<
16/ 149 (C)	24.74>>	29.98	236.82	-44.16	8.58	-0.98
16/ 134 (C)	-20.55<<	-11.9	327.89	30.99	-9.7	-1.01
16/ 148 (C)	24.06	31.95>>	292.57	-47.48	8.03	-1.03
16/ 135 (C)	-19.87	-13.87<<	272.14	34.31	-9.15	-0.96
16/ 150 (C)	-4.27	14.9	381.79>>	-25.6	-3.57	-0.22
16/ 149 (C)	24.74	29.98	236.82<<	-44.16	8.58	-0.98
16/ 135 (C)	-19.87	-13.87	272.14	34.31>>	-9.15	-0.96
16/ 146 (C)	12.04	27.51	345.01	-61.81<<	3.03	0.79
16/ 149 (C)	24.74	29.98	236.82	-44.16	8.58>>	-0.98
16/ 134 (C)	-20.55	-11.9	327.89	30.99	-9.70<<	-1.01
16/ 147 (C)	12.71	25.54	289.26	-58.49	3.58	0.84>>
16/ 140 (C)	24.06	31.95	292.57	-47.48	8.03	-1.03<<
17/ 148 (C)	4.64>>	-1.42	439.47	4.49	24.92	-1.03
17/ 137 (C)	-1.11<<	0.36	386.36	0.84	-5.97	-0.01
17/ 147 (C)	-0.05	9.42>>	391.49	-17.88	-0.27	0.84
17/ 134 (C)	0.29	-13.82<<	390.16	30.13	1.56	-1.01
17/ 158 (C)	0.23	4.5	478.66>>	-7.6	1.25	0.37
17/ 135 (C)	0.19	-13.48	323.88<<	29.36	1.03	-0.96
17/ 134 (C)	0.29	-13.82	390.16	30.13>>	1.56	-1.01
17/ 147 (C)	-0.05	9.42	391.49	-17.88<<	-0.27	0.84
17/ 148 (C)	4.64	-1.42	439.47	4.49	24.92>>	-1.03
17/ 137 (C)	-1.11	0.36	386.36	0.84	-5.97<<	-0.01
17/ 147 (C)	-0.05	9.42	391.49	-17.88	-0.27	0.84>>
17/ 140 (C)	4.64	-1.42	439.47	4.49	24.92	-1.03<<
18/ 140 (C)	5.63>>	-5.02	267.48	5.77	30.23	-1.03
18/ 145 (C)	-1.11<<	-2.93	234.54	1.83	-5.94	-0.01
18/ 147 (C)	-0.85	6.28>>	195.9	-17.16	-4.58	0.84
18/ 134 (C)	1.26	-17.35<<	285.35	31.49	6.76	-1.01

18/ 151 (C)	1.06	-12.96	298.09>>	22.16	5.67	-0.71
18/ 147 (C)	-0.85	6.28	195.90<<	-17.16	-4.58	0.84
18/ 134 (C)	1.26	-17.35	285.35	31.49>>	6.76	-1.01
18/ 147 (C)	-0.85	6.28	195.9	-17.16<<	-4.58	0.84
18/ 140 (C)	5.63	-5.02	267.48	5.77	30.23>>	-1.03
18/ 145 (C)	-1.11	-2.93	234.54	1.83	-5.94<<	-0.01
18/ 147 (C)	-0.85	6.28	195.9	-17.16	-4.58	0.84>>
18/ 140 (C)	5.63	-5.02	267.48	5.77	30.23	-1.03<<
19/ 141 (C)	14.73>>	-1.13	243.88	1.66	49.38	-0.98
19/ 146 (C)	-10.01<<	13.99	258.63	-42.09	-23.16	0.79
19/ 147 (C)	-9.08	14.08>>	209.34	-42.45	-22.2	0.84
19/ 134 (C)	0.73	-19.23<<	294.89	54.7	9.28	-1.01
19/ 151 (C)	-1.52	-12.37	312.86>>	34.78	3.49	-0.71
19/ 147 (C)	-9.08	14.08	209.34<<	-42.45	-22.2	0.84
19/ 134 (C)	0.73	-19.23	294.89	54.70>>	9.28	-1.01
19/ 147 (C)	-9.08	14.08	209.34	-42.45<<	-22.2	0.84
19/ 141 (C)	14.73	-1.13	243.88	1.66	49.38>>	-0.98
19/ 146 (C)	-10.01	13.99	258.63	-42.09	-23.16<<	0.79
19/ 147 (C)	-9.08	14.08	209.34	-42.45	-22.2	0.84>>
19/ 140 (C)	13.81	-1.21	293.17	2.02	48.41	-1.03<<
20/ 141 (C)	14.83>>	-12.63	45.97	16.49	49.4	0.48
20/ 146 (C)	-13.30<<	14.27	72.58	-38.57	-28.01	0
20/ 147 (C)	-11.82	15.20>>	46.58	-40.45	-26.2	0.03
20/ 134 (C)	-2.69	-22.20<<	128.67	58.29	7.58	-0.6
20/ 151 (C)	-4.14	-15.93	134.26>>	40.11	1.79	-0.41
20/ 149 (C)	14.83	-12.63	45.97<<	16.49	49.4	0.48
20/ 134 (C)	-2.69	-22.2	128.67	58.29>>	7.58	-0.6
20/ 147 (C)	-11.82	15.2	46.58	-40.45<<	-26.2	0.03
20/ 141 (C)	14.83	-12.63	45.97	16.49	49.40>>	0.48
20/ 146 (C)	-13.3	14.27	72.58	-38.57	-28.01<<	0
20/ 149 (C)	14.83	-12.63	45.97	16.49	49.4	0.48>>
20/ 134 (C)	-2.69	-22.2	128.67	58.29	7.58	-0.60<<
21/ 149 (C)	6.00>>	14.5	63.85	-11.17	18.45	-0.98
21/ 134 (C)	-7.12<<	-21.36	64.65	58.6	-15.69	-1.01
21/ 146 (C)	-5.92	23.53>>	95.95	-61.6	-3.76	0.79
21/ 135 (C)	-6.79	-22.02<<	55	59.25	-15.13	-0.96
21/ 146 (C)	-5.92	23.53	95.95>>	-61.6	-3.76	0.79
21/ 135 (C)	-6.79	-22.02	55.00<<	59.25	-15.13	-0.96
21/ 135 (C)	-6.79	-22.02	55	59.25>>	-15.13	-0.96
21/ 146 (C)	-5.92	23.53	95.95	-61.60<<	-3.76	0.79
21/ 149 (C)	6	14.5	63.85	-11.17	18.45>>	-0.98
21/ 134 (C)	-7.12	-21.36	64.65	58.6	-15.69<<	-1.01
21/ 147 (C)	-5.59	22.87	86.3	-60.95	-3.2	0.84>>
21/ 140 (C)	5.67	15.16	73.51	-11.82	17.89	-1.03<<
22/ 140 (C)	6.95>>	-1.37	141.25	3.38	10.58	-0.16

22/ 143 (C)	-6.01<<	-4.37	115.37	11.77	-7.14	-0.15
22/ 147 (C)	-4.68	2.97>>	115.12	-8.72	-5.28	0.13
22/ 134 (C)	-5.96	-4.49<<	136.15	12.05	-7.05	-0.15
22/ 152 (C)	-1.51	-0.18	152.25>>	0.3	-2.12	-0.02
22/ 147 (C)	-4.68	2.97	115.12<<	-8.72	-5.28	0.13
22/ 134 (C)	-5.96	-4.49	136.15	12.05>>	-7.05	-0.15
22/ 147 (C)	-4.68	2.97	115.12	-8.72<<	-5.28	0.13
22/ 148 (C)	6.95	-1.37	141.25	3.38	10.58>>	-0.16
22/ 135 (C)	-6.01	-4.37	115.37	11.77	-7.14<<	-0.15
22/ 147 (C)	-4.68	2.97	115.12	-8.72	-5.28	0.13>>
22/ 140 (C)	6.95	-1.37	141.25	3.38	10.58	-0.16<<
23/ 140 (C)	7.11>>	-0.89	114.27	2.41	11.12	-0.16
23/ 143 (C)	-5.75<<	-4.05	92.5	11.08	-6.79	-0.15
23/ 147 (C)	-4.86	2.68>>	109.87	-8.11	-5.81	0.13
23/ 134 (C)	-5.72	-4.13<<	110.15	11.3	-6.71	-0.15
23/ 158 (C)	-2.82	1.37	133.00>>	-4.24	-3.25	0.06
23/ 135 (C)	-5.75	-4.05	92.50<<	11.08	-6.79	-0.15
23/ 134 (C)	-5.72	-4.13	110.15	11.30>>	-6.71	-0.15
23/ 147 (C)	-4.86	2.68	109.87	-8.11<<	-5.81	0.13
23/ 148 (C)	7.11	-0.89	114.27	2.41	11.12>>	-0.16
23/ 135 (C)	-5.75	-4.05	92.5	11.08	-6.79<<	-0.15
23/ 147 (C)	-4.86	2.68	109.87	-8.11	-5.81	0.13>>
23/ 140 (C)	7.11	-0.89	114.27	2.41	11.12	-0.16<<
24/ 140 (C)	7.28>>	-0.87	106.23	2.27	11.7	-0.16
24/ 143 (C)	-5.41<<	-4.04	87.98	10.98	-6.1	-0.15
24/ 147 (C)	-5.02	2.69>>	99.07	-8.04	-6.31	0.13
24/ 134 (C)	-5.37	-4.13<<	104.28	11.2	-5.99	-0.15
24/ 152 (C)	-1.66	-0.06	121.72>>	0.07	-2.32	-0.02
24/ 143 (C)	-5.41	-4.04	87.98<<	10.98	-6.1	-0.15
24/ 134 (C)	-5.37	-4.13	104.28	11.20>>	-5.99	-0.15
24/ 147 (C)	-5.02	2.69	99.07	-8.04<<	-6.31	0.13
24/ 148 (C)	7.28	-0.87	106.23	2.27	11.70>>	-0.16
24/ 139 (C)	-5.02	2.69	99.07	-8.04	-6.31<<	0.13
24/ 147 (C)	-5.02	2.69	99.07	-8.04	-6.31	0.13>>
24/ 140 (C)	7.28	-0.87	106.23	2.27	11.7	-0.16<<
25/ 140 (C)	7.46>>	-0.99	82.83	2.37	12.28	-0.16
25/ 147 (C)	-5.04<<	2.49	78.85	-7.59	-6.57	0.13
25/ 147 (C)	-5.04	2.49>>	78.85	-7.59	-6.57	0.13
25/ 134 (C)	-3.23	-4.20<<	82.07	11.23	-3.2	-0.15
25/ 158 (C)	-2.88	1.19	98.26>>	-3.84	-3.54	0.06
25/ 135 (C)	-3.28	-4.12	67.70<<	11.01	-3.33	-0.15
25/ 134 (C)	-3.23	-4.2	82.07	11.23>>	-3.2	-0.15
25/ 147 (C)	-5.04	2.49	78.85	-7.59<<	-6.57	0.13
25/ 140 (C)	7.46	-0.99	82.83	2.37	12.28>>	-0.16
25/ 147 (C)	-5.04	2.49	78.85	-7.59	-6.57<<	0.13

25/ 147 (C)	-5.04	2.49	78.85	-7.59	-6.57	0.13>>
25/ 140 (C)	7.46	-0.99	82.83	2.37	12.28	-0.16<<
26/ 140 (C)	7.49>>	-0.74	63.42	1.83	12.6	-0.16
26/ 147 (C)	-5.17<<	2.59	56.04	-7.68	-7.02	0.13
26/ 147 (C)	-5.17	2.59>>	56.04	-7.68	-7.02	0.13
26/ 134 (C)	-3.17	-3.87<<	68.81	10.53	-2.84	-0.15
26/ 152 (C)	-1.66	-0.02	77.88>>	-0.03	-2.26	-0.02
26/ 149 (C)	7.44	-0.66	50.54<<	1.63	12.45	-0.15
26/ 134 (C)	-3.17	-3.87	68.81	10.53>>	-2.84	-0.15
26/ 147 (C)	-5.17	2.59	56.04	-7.68<<	-7.02	0.13
26/ 140 (C)	7.49	-0.74	63.42	1.83	12.60>>	-0.16
26/ 147 (C)	-5.17	2.59	56.04	-7.68	-7.02<<	0.13
26/ 147 (C)	-5.17	2.59	56.04	-7.68	-7.02	0.13>>
26/ 140 (C)	7.49	-0.74	63.42	1.83	12.6	-0.16<<
27/ 140 (C)	7.65>>	-0.72	55.7	1.68	13.15	-0.16
27/ 147 (C)	-5.29<<	2.57	45.59	-7.58	-7.43	0.13
27/ 147 (C)	-5.29	2.57>>	45.59	-7.58	-7.43	0.13
27/ 134 (C)	-2.98	-3.93<<	64.74	10.53	-2.23	-0.15
27/ 151 (C)	-1.67	-2.54	68.57>>	6.76	-0.98	-0.11
27/ 149 (C)	7.6	-0.64	44.73<<	1.49	12.97	-0.15
27/ 134 (C)	-2.98	-3.93	64.74	10.53>>	-2.23	-0.15
27/ 147 (C)	-5.29	2.57	45.59	-7.58<<	-7.43	0.13
27/ 140 (C)	7.65	-0.72	55.7	1.68	13.15>>	-0.16
27/ 147 (C)	-5.29	2.57	45.59	-7.58	-7.43<<	0.13
27/ 147 (C)	-5.29	2.57	45.59	-7.58	-7.43	0.13>>
27/ 140 (C)	7.65	-0.72	55.7	1.68	13.15	-0.16<<
28/ 140 (C)	7.88>>	-0.52	52.43	1.23	13.82	-0.16
28/ 147 (C)	-7.27<<	2.61	43.87	-7.56	-9.89	0.13
28/ 147 (C)	-7.27	2.61>>	43.87	-7.56	-9.89	0.13
28/ 134 (C)	-2.78	-3.77<<	57.42	10.15	-1.63	-0.15
28/ 157 (C)	-1.63	0.04	62.23>>	-0.18	-2.14	-0.02
28/ 141 (C)	7.81	-0.46	42.48<<	1.08	13.61	-0.15
28/ 134 (C)	-2.78	-3.77	57.42	10.15>>	-1.63	-0.15
28/ 147 (C)	-7.27	2.61	43.87	-7.56<<	-9.89	0.13
28/ 140 (C)	7.88	-0.52	52.43	1.23	13.82>>	-0.16
28/ 147 (C)	-7.27	2.61	43.87	-7.56	-9.89<<	0.13
28/ 147 (C)	-7.27	2.61	43.87	-7.56	-9.89	0.13>>
28/ 140 (C)	7.88	-0.52	52.43	1.23	13.82	-0.16<<
29/ 140 (C)	8.71>>	-0.87	-5.33	1.75	15.56	-0.16
29/ 147 (C)	-7.11<<	2.2	14.43	-6.74	-9.66	0.13
29/ 147 (C)	-7.11	2.20>>	14.43	-6.74	-9.66	0.13
29/ 134 (C)	-2.16	-4.00<<	5.52	10.45	-0.27	-0.15
29/ 145 (C)	-2.82	-0.07	14.43>>	-0.26	-4.14	0
29/ 140 (C)	8.71	-0.87	-5.33<<	1.75	15.56	-0.16
29/ 134 (C)	-2.16	-4	5.52	10.45>>	-0.27	-0.15

29/ 147 (C)	-7.11	2.2	14.43	-6.74<<	-9.66	0.13
29/ 140 (C)	8.71	-0.87	-5.33	1.75	15.56>>	-0.16
29/ 147 (C)	-7.11	2.2	14.43	-6.74	-9.66<<	0.13
29/ 147 (C)	-7.11	2.2	14.43	-6.74	-9.66	0.13>>
29/ 140 (C)	8.71	-0.87	-5.33	1.75	15.56	-0.16<<
30/ 141 (C)	7.79>>	0.16	13.83	-0.25	14.05	-0.12
30/ 146 (C)	-8.08<<	2.89	23.17	-7.84	-11.12	0.08
30/ 147 (C)	-7.95	2.91>>	23.49	-7.92	-11.01	0.09
30/ 134 (C)	-3.43	-3.25<<	17.79	9.01	-2.28	-0.11
30/ 145 (C)	-3.7	0.51	26.55>>	-1.31	-5.71	0
30/ 140 (C)	7.66	0.13	13.52<<	-0.17	13.94	-0.13
30/ 134 (C)	-3.43	-3.25	17.79	9.01>>	-2.28	-0.11
30/ 147 (C)	-7.95	2.91	23.49	-7.92<<	-11.01	0.09
30/ 141 (C)	7.79	0.16	13.83	-0.25	14.05>>	-0.12
30/ 146 (C)	-8.08	2.89	23.17	-7.84	-11.12<<	0.08
30/ 147 (C)	-7.95	2.91	23.49	-7.92	-11.01	0.09>>
30/ 140 (C)	7.66	0.13	13.52	-0.17	13.94	-0.13<<
31/ 148 (C)	3.65>>	-1.87	276.3	3.2	19.6	-1.03
31/ 137 (C)	-1.12<<	-0.94	247.37	-0.87	-6	-0.01
31/ 147 (C)	0.75	3.17>>	247.37	-22.92	4.05	0.84
31/ 134 (C)	-0.68	-7.30<<	253.74	33.35	-3.65	-1.01
31/ 152 (C)	-0.53	-1.82	295.20>>	2.34	-2.86	-0.13
31/ 135 (C)	-0.73	-6.93	218.50<<	32.47	-3.93	-0.96
31/ 134 (C)	-0.68	-7.3	253.74	33.35>>	-3.65	-1.01
31/ 147 (C)	0.75	3.17	247.37	-22.92<<	4.05	0.84
31/ 148 (C)	3.65	-1.87	276.3	3.2	19.60>>	-1.03
31/ 137 (C)	-1.12	-0.94	247.37	-0.87	-6.00<<	-0.01
31/ 147 (C)	0.75	3.17	247.37	-22.92	4.05	0.84>>
31/ 140 (C)	3.65	-1.87	276.3	3.2	19.6	-1.03<<
33/ 140 (C)	1.61>>	-0.03	4.44	0.16	2.29	0
33/ 147 (C)	-0.06<<	2.67	3.08	-7.43	-0.31	0
33/ 147 (C)	-0.06	2.67>>	3.08	-7.43	-0.31	0
33/ 134 (C)	0.09	-2.69<<	4.46	7.55	0.43	0
33/ 151 (C)	0.07	-1.62	5.04>>	4.56	0.32	0
33/ 149 (C)	1.6	-0.03	3.08<<	0.15	2.26	0
33/ 134 (C)	0.09	-2.69	4.46	7.55>>	0.43	0
33/ 147 (C)	-0.06	2.67	3.08	-7.43<<	-0.31	0
33/ 140 (C)	1.61	-0.03	4.44	0.16	2.29>>	0
33/ 147 (C)	-0.06	2.67	3.08	-7.43	-0.31<<	0
33/ 123 (C)	0.03	-0.01	4.45	0.06	0.13	0.0>>
33/ 123 (C)	0.03	-0.01	4.45	0.06	0.13	0.0<<
35/ 148 (C)	1.49>>	-0.03	2.43	0.16	1.71	0
35/ 135 (C)	-0.04<<	-2.7	1.83	7.58	-0.21	0
35/ 147 (C)	0.04	2.68>>	1.83	-7.47	0.2	0
35/ 134 (C)	-0.04	-2.70<<	2.43	7.59	-0.21	0

35/ 151 (C)	-0.03	-1.63	2.69>>	4.59	-0.13	0
35/ 141 (C)	1.49	-0.03	1.83<<	0.15	1.71	0
35/ 134 (C)	-0.04	-2.7	2.43	7.59>>	-0.21	0
35/ 147 (C)	0.04	2.68	1.83	-7.47<<	0.2	0
35/ 148 (C)	1.49	-0.03	2.43	0.16	1.71>>	0
35/ 135 (C)	-0.04	-2.7	1.83	7.58	-0.21<<	0
35/ 123 (C)	0	-0.01	2.43	0.06	0	0.0>>
35/ 123 (C)	0	-0.01	2.43	0.06	0	0.0<<
36/ 140 (C)	1.60>>	-0.03	9.3	0.16	2.29	0
36/ 147 (C)	-0.04<<	2.67	5.99	-7.44	-0.22	0
36/ 147 (C)	-0.04	2.67>>	5.99	-7.44	-0.22	0
36/ 134 (C)	0.06	-2.69<<	9.3	7.56	0.3	0
36/ 151 (C)	0.05	-1.62	10.72>>	4.57	0.24	0
36/ 149 (C)	1.6	-0.03	5.99<<	0.15	2.26	0
36/ 134 (C)	0.06	-2.69	9.3	7.56>>	0.3	0
36/ 147 (C)	-0.04	2.67	5.99	-7.44<<	-0.22	0
36/ 140 (C)	1.6	-0.03	9.3	0.16	2.29>>	0
36/ 147 (C)	-0.04	2.67	5.99	-7.44	-0.22<<	0
36/ 123 (C)	0.02	-0.01	9.3	0.06	0.11	0.0>>
36/ 123 (C)	0.02	-0.01	9.3	0.06	0.11	0.0<<
37/ 140 (C)	1.61>>	-0.03	6.89	0.16	2.31	0
37/ 147 (C)	-0.06<<	2.67	4.55	-7.44	-0.28	0
37/ 147 (C)	-0.06	2.67>>	4.55	-7.44	-0.28	0
37/ 134 (C)	0.07	-2.69<<	6.88	7.56	0.35	0
37/ 159 (C)	0.98	-0.03	7.89>>	0.13	1.44	0
37/ 135 (C)	0.07	-2.69	4.55<<	7.55	0.32	0
37/ 134 (C)	0.07	-2.69	6.88	7.56>>	0.35	0
37/ 147 (C)	-0.06	2.67	4.55	-7.44<<	-0.28	0
37/ 140 (C)	1.61	-0.03	6.89	0.16	2.31>>	0
37/ 147 (C)	-0.06	2.67	4.55	-7.44	-0.28<<	0
37/ 123 (C)	0.02	-0.01	6.88	0.06	0.1	0.0>>
37/ 123 (C)	0.02	-0.01	6.88	0.06	0.1	0.0<<
38/ 140 (C)	1.58>>	-0.03	8.57	0.16	2.16	0
38/ 147 (C)	-0.03<<	2.67	5.54	-7.44	-0.15	0
38/ 147 (C)	-0.03	2.67>>	5.54	-7.44	-0.15	0
38/ 134 (C)	0.04	-2.70<<	8.56	7.56	0.21	0
38/ 159 (C)	0.96	-0.03	9.86>>	0.13	1.34	0
38/ 135 (C)	0.04	-2.69	5.54<<	7.55	0.19	0
38/ 134 (C)	0.04	-2.7	8.56	7.56>>	0.21	0
38/ 147 (C)	-0.03	2.67	5.54	-7.44<<	-0.15	0
38/ 140 (C)	1.58	-0.03	8.57	0.16	2.16>>	0
38/ 147 (C)	-0.03	2.67	5.54	-7.44	-0.15<<	0
38/ 123 (C)	0.02	-0.01	8.56	0.06	0.09	0.0>>
38/ 123 (C)	0.02	-0.01	8.56	0.06	0.09	0.0<<
39/ 140 (C)	1.56>>	-0.03	9.29	0.16	2.09	0

39/ 145 (C)	-0.03<<	0.01	5.98	-0.07	-0.14	0
39/ 147 (C)	-0.02	2.67>>	5.98	-7.45	-0.1	0
39/ 134 (C)	0.03	-2.70<<	9.29	7.57	0.15	0
39/ 151 (C)	0.03	-1.62	10.71>>	4.57	0.13	0
39/ 141 (C)	1.56	-0.03	5.98<<	0.15	2.07	0
39/ 134 (C)	0.03	-2.7	9.29	7.57>>	0.15	0
39/ 147 (C)	-0.02	2.67	5.98	-7.45<<	-0.1	0
39/ 140 (C)	1.56	-0.03	9.29	0.16	2.09>>	0
39/ 145 (C)	-0.03	0.01	5.98	-0.07	-0.14<<	0
39/ 123 (C)	0.02	-0.01	9.29	0.06	0.07	0.0>>
39/ 123 (C)	0.02	-0.01	9.29	0.06	0.07	0.0<<
40/ 140 (C)	1.55>>	-0.03	7.69	0.16	2.03	0
40/ 145 (C)	-0.03<<	0.01	5	-0.07	-0.14	0
40/ 147 (C)	-0.01	2.67>>	5	-7.45	-0.05	0
40/ 134 (C)	0.02	-2.70<<	7.69	7.57	0.09	0
40/ 151 (C)	0.02	-1.63	8.84>>	4.58	0.09	0
40/ 141 (C)	1.55	-0.03	5.00<<	0.15	2.01	0
40/ 134 (C)	0.02	-2.7	7.69	7.57>>	0.09	0
40/ 147 (C)	-0.01	2.67	5	-7.45<<	-0.05	0
40/ 140 (C)	1.55	-0.03	7.69	0.16	2.03>>	0
40/ 145 (C)	-0.03	0.01	5	-0.07	-0.14<<	0
40/ 123 (C)	0.01	-0.01	7.69	0.06	0.06	0.0>>
40/ 123 (C)	0.01	-0.01	7.69	0.06	0.06	0.0<<
41/ 148 (C)	1.54>>	-0.03	7.18	0.16	1.96	0
41/ 137 (C)	-0.03<<	0.01	4.73	-0.07	-0.14	0
41/ 147 (C)	0	2.67>>	4.73	-7.46	0	0
41/ 134 (C)	0.01	-2.70<<	7.18	7.58	0.03	0
41/ 151 (C)	0.01	-1.63	8.23>>	4.58	0.04	0
41/ 141 (C)	1.54	-0.03	4.73<<	0.15	1.95	0
41/ 134 (C)	0.01	-2.7	7.18	7.58>>	0.03	0
41/ 147 (C)	0	2.67	4.73	-7.46<<	0	0
41/ 148 (C)	1.54	-0.03	7.18	0.16	1.96>>	0
41/ 137 (C)	-0.03	0.01	4.73	-0.07	-0.14<<	0
41/ 123 (C)	0.01	-0.01	7.18	0.06	0.05	0.0>>
41/ 123 (C)	0.01	-0.01	7.18	0.06	0.05	0.0<<
42/ 148 (C)	1.53>>	-0.03	5.97	0.16	1.9	0
42/ 137 (C)	-0.03<<	0.01	4.01	-0.07	-0.14	0
42/ 147 (C)	0.01	2.68>>	4.01	-7.47	0.05	0
42/ 134 (C)	-0.01	-2.70<<	5.97	7.59	-0.03	0
42/ 154 (C)	0.92	-0.03	6.81>>	0.13	1.16	0
42/ 135 (C)	-0.01	-2.7	4.01<<	7.57	-0.04	0
42/ 134 (C)	-0.01	-2.7	5.97	7.59>>	-0.03	0
42/ 147 (C)	0.01	2.68	4.01	-7.47<<	0.05	0
42/ 148 (C)	1.53	-0.03	5.97	0.16	1.90>>	0
42/ 137 (C)	-0.03	0.01	4.01	-0.07	-0.14<<	0

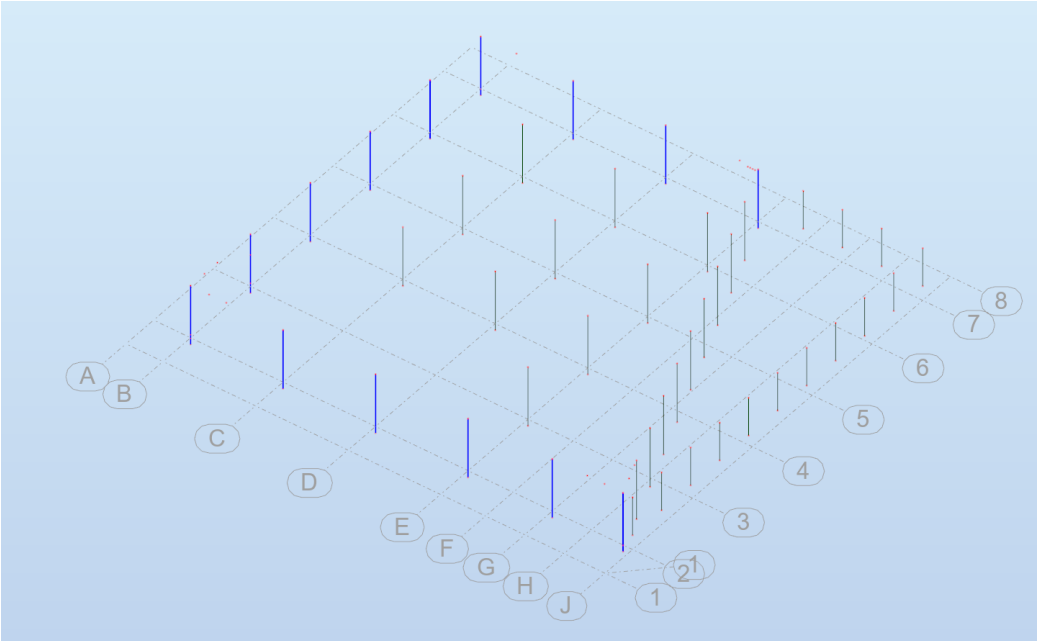
42/ 123 (C)	0.01	-0.01	5.97	0.06	0.04	0.0>>
42/ 123 (C)	0.01	-0.01	5.97	0.06	0.04	0.0<<
43/ 148 (C)	1.51>>	-0.03	5.14	0.16	1.84	0
43/ 137 (C)	-0.03<<	0.01	3.52	-0.07	-0.14	0
43/ 147 (C)	0.02	2.68>>	3.52	-7.47	0.1	0
43/ 134 (C)	-0.02	-2.70<<	5.14	7.59	-0.09	0
43/ 154 (C)	0.91	-0.03	5.84>>	0.13	1.12	0
43/ 135 (C)	-0.02	-2.7	3.52<<	7.58	-0.1	0
43/ 134 (C)	-0.02	-2.7	5.14	7.59>>	-0.09	0
43/ 147 (C)	0.02	2.68	3.52	-7.47<<	0.1	0
43/ 148 (C)	1.51	-0.03	5.14	0.16	1.84>>	0
43/ 137 (C)	-0.03	0.01	3.52	-0.07	-0.14<<	0
43/ 123 (C)	0.01	-0.01	5.14	0.06	0.03	0.0>>
43/ 123 (C)	0.01	-0.01	5.14	0.06	0.03	0.0<<
44/ 148 (C)	1.50>>	-0.03	4.46	0.16	1.78	0
44/ 135 (C)	-0.03<<	-2.7	3.11	7.58	-0.16	0
44/ 147 (C)	0.03	2.68>>	3.11	-7.47	0.15	0
44/ 134 (C)	-0.03	-2.70<<	4.46	7.59	-0.15	0
44/ 151 (C)	-0.02	-1.63	5.03>>	4.59	-0.08	0
44/ 141 (C)	1.5	-0.03	3.11<<	0.15	1.77	0
44/ 134 (C)	-0.03	-2.7	4.46	7.59>>	-0.15	0
44/ 147 (C)	0.03	2.68	3.11	-7.47<<	0.15	0
44/ 148 (C)	1.5	-0.03	4.46	0.16	1.78>>	0
44/ 135 (C)	-0.03	-2.7	3.11	7.58	-0.16<<	0
44/ 123 (C)	0	-0.01	4.46	0.06	0.01	0.0>>
44/ 123 (C)	0	-0.01	4.46	0.06	0.01	0.0<<
45/ 140 (C)	1.61>>	-0.03	5.15	0.15	2.29	0
45/ 147 (C)	-0.06<<	2.16	3.53	-4.99	-0.31	0
45/ 147 (C)	-0.06	2.16>>	3.53	-4.99	-0.31	0
45/ 134 (C)	0.09	-2.19<<	5.06	5.11	0.42	0
45/ 159 (C)	0.98	-0.03	5.81>>	0.12	1.44	0
45/ 135 (C)	0.08	-2.19	3.45<<	5.1	0.39	0
45/ 134 (C)	0.09	-2.19	5.06	5.11>>	0.42	0
45/ 147 (C)	-0.06	2.16	3.53	-4.99<<	-0.31	0
45/ 140 (C)	1.61	-0.03	5.15	0.15	2.29>>	0
45/ 147 (C)	-0.06	2.16	3.53	-4.99	-0.31<<	0
45/ 123 (C)	0.03	-0.01	5.08	0.06	0.13	0.0>>
45/ 123 (C)	0.03	-0.01	5.08	0.06	0.13	0.0<<
46/ 140 (C)	1.61>>	-0.03	5.02	0.12	2.29	0
46/ 147 (C)	-0.06<<	1.68	3.47	-2.64	-0.3	0
46/ 147 (C)	-0.06	1.68>>	3.47	-2.64	-0.3	0
46/ 134 (C)	0.09	-1.71<<	4.77	2.77	0.41	0
46/ 159 (C)	0.98	-0.02	5.61>>	0.1	1.44	0
46/ 135 (C)	0.08	-1.7	3.22<<	2.76	0.38	0
46/ 134 (C)	0.09	-1.71	4.77	2.77>>	0.41	0

46/ 147 (C)	-0.06	1.68	3.47	-2.64<<	-0.3	0
46/ 140 (C)	1.61	-0.03	5.02	0.12	2.29>>	0
46/ 147 (C)	-0.06	1.68	3.47	-2.64	-0.30<<	0
46/ 123 (C)	0.03	-0.01	4.83	0.06	0.13	0.0>>
46/ 123 (C)	0.03	-0.01	4.83	0.06	0.13	0.0<<
47/ 140 (C)	1.61>>	-0.01	5.55	0.07	2.29	0
47/ 147 (C)	-0.06<<	1.57	3.74	-2.11	-0.29	0
47/ 147 (C)	-0.06	1.57>>	3.74	-2.11	-0.29	0
47/ 134 (C)	0.08	-1.59<<	6.19	2.23	0.41	0
47/ 151 (C)	0.06	-0.96	6.91>>	1.36	0.31	0
47/ 149 (C)	1.6	-0.01	3.73<<	0.06	2.26	0
47/ 134 (C)	0.08	-1.59	6.19	2.23>>	0.41	0
47/ 147 (C)	-0.06	1.57	3.74	-2.11<<	-0.29	0
47/ 140 (C)	1.61	-0.01	5.55	0.07	2.29>>	0
47/ 147 (C)	-0.06	1.57	3.74	-2.11	-0.29<<	0
47/ 123 (C)	0.03	-0.01	6.04	0.05	0.13	0.0>>
47/ 123 (C)	0.03	-0.01	6.04	0.05	0.13	0.0<<

2.11. Pamatų geometrijos parinkimas

2.11.1. Pastato perimetro polių projektavimas

Skaičiuojami poliai po perimetro kolonomis. Perimetro kolonų išdėstymas:



Silpniausias sluoksnis, į kurį remiami pastato perimetro poliai moreninis smėlingas molis, kurio qc=8,5 kPa. Trinties stipriai imami pagal 1 gręžinio sluoksnių duomenis su vidutinėmis reikšmėmis. Polis su galvena 1100x1100x500mm. Poliaus geometrinis ilgis 7,00m, skersmuo 600mm. Poliaus skaičiuojamasis ilgis 4,77m. Polis remiamas į IGS 6lst (abs. alt. 117.70). Šoninė

trintis vertinama pagal 1 gręžinį. Šoninė trintis vertinama nuo gręžinio 3 sluoksnio. 1 gręžinyje ir 2 gręžinyje aptiktas labai silpnas stipriai suspaudžiamas grunto tarpsluoksnis IGS3s 4,2m-5,1m gylyje. Jeigu pamato nuosėdžiai didesni daugiau, negu pusė ribinių nuosėdžių, reikia vertinti neigiamą trintį polyje. Durpės ir gruntas su organinėmis priemaišomis iškasamas ir piltinis gruntas polių skaičiavime nevertinamas.

Nuosėdžių skaičiavimas

Skaičiuojami pavienio polio nuosėdžiai sumavimo metodu.

Polių eilių skičias B kryptimi mB	1	vnt
Polių eilių skičias L kryptimi mL	1	vnt
Atstumas tarp polių ašių B kryptimi aB	0	m
Atstumas tarp polių ašių L kryptimi aL	0	m
Polio skersmuo	0.6	m
Grunto vidinis trinties kampas	0	
Polių skaičius n	1	vnt
Poliaus ilgis	7	m
Rostverko aukštis	0.5	m
Rostverko viršaus altittudė	0.6	m

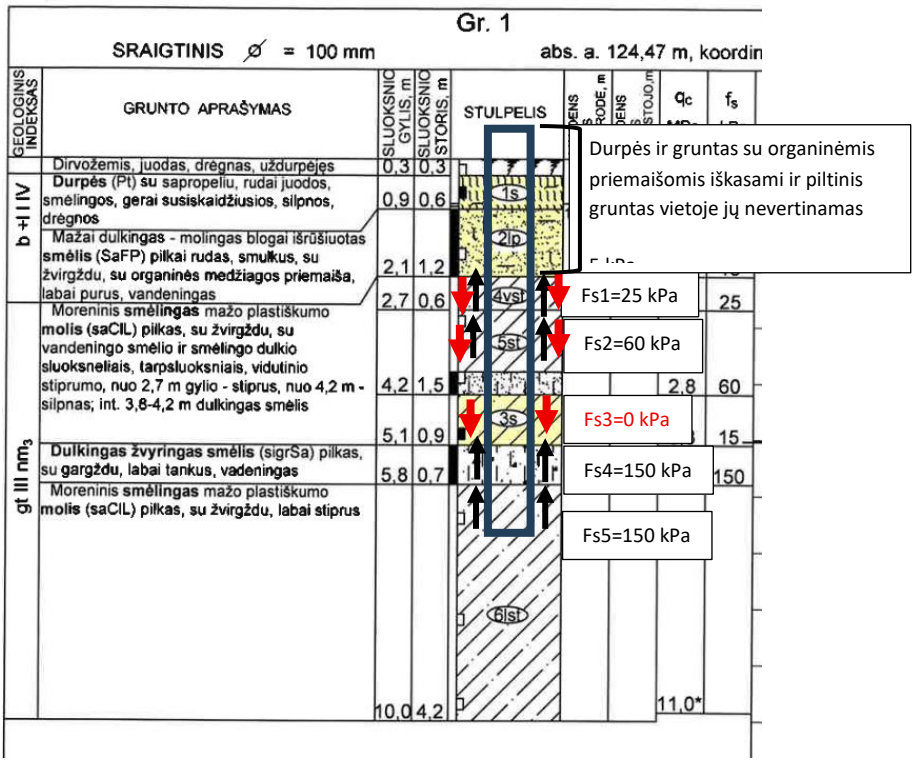
Eil. Nr.	d,m	γ, kN/m^3	σ_{zg}, kPa	$0,2\sigma_{zg}$, kPa	z,m	ξ=2z/b	η=l/b	K	σ_{zp}, kPa	$\sigma_{zp,vid}$, kPa	H_i, m	E, Mpa	S_i, m
1	8.1	22	178.2	35.64	0	0	1	1	1095.23		0.12		
2	8.34	22	183.5	36.7	0.24	0.8	1	0.756	827.99	961.6	0.24	83.8	0.0028
3	8.58	22	188.8	37.75	0.48	1.6	1	0.39	427.14	627.6	0.24	83.8	0.0018
4	8.82	22	194	38.81	0.72	2.4	1	0.214	234.38	330.8	0.24	83.8	0.0009
5	9.06	22	199.3	39.86	0.96	3.2	1	0.13	142.38	188.4	0.24	83.8	0.0005
6	9.3	22	204.6	40.92	1.2	4	1	0.087	95.28	118.8	0.24	83.8	0.0003
7	9.54	22	209.9	41.98	1.44	4.8	1	0.067	73.38	84.33	0.24	83.8	0.0002
8	9.78	22	215.2	43.03	1.68	5.6	1	0.046	50.38	61.88	0.24	83.8	0.0002
8	10.02	22	220.4	44.09	1.92	6.4	1	0.036	39.43	44.9	0.24	83.8	0.0001
9	10.26	23	226	45.19	2.16	7.2	1	0.028	30.67	35.05	0.24	118	7E-05
												Σs_i=	0.007

Ned	394	kN
B	0.6	m
L	0.6	m
A	0.36	m2
L1	0.3	m
B1	0.3	m

0,2 σzg>σzp

Išvada: 0,7cm<0,03*0,6=1,8cm. Kadangi nuosėdžiai yra mažesni negu pusė ribinių nuosėdžių, galima nevertinti neigiamos trinties virš silpno grunto sluoksnio ir grunto prie polio šonų trinties ribinį stiprumą priimti teigiamą, nors polio aplinkoje yra durpių tarpsluoksnių. Fs3 silpno grunto tarpsluoksnio šoninė trintis skaičiavimuose priimta lygi 0 kPa.

Šoninės trinties grafinis paaiškinimas (juoda rodykle pažymėta vertinama teigiama šoninė trintis, raudona rodykle pažymėta dėl mažų nuosėdžių nevertinama neigiama trintis):



Gniuždomo poliaus laikomosios galios skaičiavimas:

Veikiančios įrąžos:

$N_{Ed.1} := 562 \cdot 10^{-3} = 0.562$ MN

$N_{Ed.2} := 447 \cdot 10^{-3} = 0.447$ MN

Daliniai koeficientai:

Daliniai medžiagų patikimumo koef. atvejui M1:

$\gamma_{t\varphi.1} := 1$

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

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

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

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

Daliniai medžiagų patikimumo koef. atvejui M2:

$\gamma_{t\varphi.2} := 1.25$

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

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

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

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

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 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	$\gamma_{st1} := 1.25$	$\gamma_{st2} := 1.15$	$\gamma_{st3} := 1.1$	$\gamma_{st4} := 1.60$

$\alpha_b := 0.5$

$\xi_3 := 1.29$

Grunto rodikliai:

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

$q_c := 6.0$ MPa

$f_{s1} := 0.025$ MPa $f_{s2} := 0.06$ MPa $f_{s3} := 0.0$ MPa $f_{s4} := 0.15$ MPa $f_{s5} := 0.15$ MPa $f_{s6} := 0.0$ MPa $f_{s7} := 0.0$ MPa

Geometriniai rodikliai:

$f_{s8} := 0.0$ MPa

$h_1 := 0.6$ m $h_2 := 1.5$ m $h_3 := 0.9$ m $h_4 := 0.7$ m $h_5 := 1.07$ m $h_6 := 0$ m $h_7 := 0.0$ m $h_8 := 0.0$ m

$d := 0.60 \cdot 0.95 = 0.57$ m

$A_p := \frac{\pi \cdot d^2}{4} = 0.255$ m^2

$A_{š1} := \pi \cdot d \cdot h_1 = 1.074$ m^2 $A_{š2} := \pi \cdot d \cdot h_2 = 2.686$ m^2 $A_{š3} := \pi \cdot d \cdot h_3 = 1.612$ m^2

$A_{š4} := \pi \cdot d \cdot h_4 = 1.253$ m^2 $A_{š5} := \pi \cdot d \cdot h_5 = 1.916$ m^2 $A_{š6} := \pi \cdot d \cdot h_6 = 0$ m^2

$A_{š7} := \pi \cdot d \cdot h_7 = 0$ m^2 $A_{š8} := \pi \cdot d \cdot h_8 = 0$ m^2

Pirmas projektavimo atvejis:
A1+M1+R1

$q_b := \alpha_b \cdot q_c = 3$ MPa

$R_b := q_b \cdot A_p = 0.766$ MN

$R_s := f_{s1} \cdot A_{š1} + f_{s2} \cdot A_{š2} + f_{s3} \cdot A_{š3} + f_{s4} \cdot A_{š4} + f_{s5} \cdot A_{š5} + f_{s6} \cdot A_{š6} + f_{s7} \cdot A_{š7} + f_{s8} \cdot A_{š8} = 0.663$

$R_{c.cal1} := \frac{R_b}{\gamma_{b1}} + \frac{R_s}{\gamma_{s1}} = 1.359$ MN

$R_{c.k1} := \frac{R_{c.cal1}}{\xi_3} = 1.054$ MN

$R_{c.d1} := \frac{R_{c.k1}}{\gamma_{t1}} = 0.958$ MN

$\frac{N_{Ed.1}}{R_{c.d1}} = 0.587$

Antras projektavimo atvejis:
A2+M1+R4

$R_{c.cal2} := \frac{R_b}{\gamma_{b4}} + \frac{R_s}{\gamma_{s4}} = 1.038$ MN

$R_{c.k2} := \frac{R_{c.cal2}}{\xi_3} = 0.805$ MN

$R_{c.d2} := \frac{R_{c.k2}}{\gamma_{t4}} = 0.575$ MN

$\frac{N_{Ed.2}}{R_{c.d2}} = 0.778$

Išvada: gniuždymo laikomoji galia pakankama

Poliaus sukamosios laikomosios galios skaičiavimas:

$q_c := 6000$ kPa $f_{si1} := 25$ kPa $f_{si2} := 60$ $f_{si3} := 0$ $f_{si4} := 150$ $f_{si5} := 150$ $f_{si6} := 0$ $f_{si7} := 0$ $f_{si8} := 0$

$N := 71$ kN $h_1 := 0.6$ $h_2 := 1.5$ $h_3 := 0.9$ $h_4 := 0.7$ $h_5 := 1.0$ $h_6 := 0.0$ $h_7 := 0.0$ $h_8 := 0.0$

$M_d := 73$ kNm

$Q_d := 26$ kN Nevertinamo sluoksnio gylis:

$d := 0.6 \cdot 0.95 = 0.57$ m $h_s := 2.1$ m

Poliaus geometrinis ilgis:

$h := 7.1$ m

Pagrindo stiprumas po pamato padu: iš 6.22, 6.23 grafikų

$R_{s2} := 0.12 \cdot q_c \cdot 10^{-3} + 0.24 = 0.96$ MPa

$$A_b := 3.14 \cdot \frac{(d^2)}{4} = 0.255$$

Trinties jėga prie pamato šonų:

$$F_f := 3.14 \cdot d \cdot \left(h_1 \cdot \frac{f_{si1}}{3} + h_2 \cdot \frac{f_{si2}}{3} + h_3 \cdot \frac{f_{si3}}{3} + h_4 \cdot \frac{f_{si4}}{3} + h_5 \cdot \frac{f_{si5}}{3} + h_6 \cdot \frac{f_{si6}}{3} + h_7 \cdot \frac{f_{si7}}{3} + h_8 \cdot \frac{f_{si8}}{3} \right) = 214.776 \text{ kN}$$

Slėgis po pamato padu:

$$p := \frac{(N - F_f)}{A_b} = -563.725 \text{ kPa}$$ ne daugiau nei Rs2

Pasisukimas ir pasislinkimas

Skaičiuojamasis pamato gylis:

$d_d := h_1 + h_2 + h_3 + h_4 + h_5 + h_6 + h_7 + h_8 = 4.7$ m

Horiozntalios jėgos nuo momento aukštis virš pamato

$$h_m := \frac{M_d}{Q_d} = 2.808$$

Horizontalios jėgos pridėties taško skaičiuojamasis aukštis:

$h_d := h - d_d + h_m = 5.208$ m

$$\eta := \frac{(1.5 \cdot h_d + 0.5 \cdot d_d)}{1.5 \cdot h_d + d_d} = 0.812$$ $\mu := 0.35$ (nuo gruntotipo)

Kai Ff>N

$$F_Q := \frac{\left(10 + 1.5 \cdot F_f \cdot \frac{d}{\pi}\right)}{2 \cdot (1.5 \cdot h_d + d_d)} = 2.736 \text{ kN}$$

$\text{pamatas} := \text{if}\left[F_Q \geq 0.5 \cdot (\eta + 1) \cdot Q_d, \text{"nepasisuka"}, \text{"pasisuka"}\right] = \text{"pasisuka"}$

Pamato posukio centro gylis nuo skaičiuojamojo pagrindo paviršiaus z0:

$$z_0 := \frac{d_d}{1 + \frac{(Q_d \cdot \eta - F_Q)}{Q_d - F_Q}} = 2.626 \quad m$$

kadangi := if$(z_0 < d_d, \text{"u formule tinka"}, \text{"netinka"}) = \text{"u formule tinka"}$

$R_{s0.5} := 0.04 q_c \cdot 10^{-3} + 0.1 = 0.34$

Horizontalus pagrindo standumo modulis:

$$C_h := \frac{R_{s0.5} \cdot 10^3}{0.005 \cdot d} = 1.193 \times 10^5$$

$u_u := 0.01 \cdot d = 5.7 \times 10^{-3}$ m

$i_u := 0.005$ m

$$u := \left[4Q_d \cdot \frac{(1.5h_d + d_d)}{C_h \cdot d \cdot {d_d}^2}\right] \cdot \left[1 + \frac{(h - d_d)}{z_0}\right] \cdot \left(1 - \frac{F_Q}{Q_d}\right) = 1.484 \times 10^{-3} \quad m$$

poslinkis := if$(u < u_u, \text{"poslinkis leistinas"}, \text{"poslinkis neleistinas"}) = \text{"poslinkis leistinas"}$

$$i := \frac{u}{(z_0 + h - d_d)} = 2.952 \times 10^{-4} \quad m$$

pasisukimas := if$(i < i_u, \text{"pasisukimas leistinas"}, \text{"pasisukimas neleistinas"}) = \text{"pasisukimas leistinas"}$

Gylis kuriame veikia didžiausias lenkimo momentas

Grunto prie pamato šoninio paviršiaus vidutinis stipris:

$$R_f := \frac{F_f}{\pi \cdot d \cdot d_d} = 25.519 \quad kN$$

Gylis, kuriame veikia didžiausias lenkimo momentas:

$$z_m := z_0 - \sqrt{{z_0}^2 - \frac{\left(1 - \frac{d^2 \cdot R_f}{2 \cdot Q_d}\right) \cdot {d_d}^2 \cdot z_0}{2 \cdot (1.5 \cdot h_d + d_d)}} = 0.402 \quad m$$

Didžiausias polių veikiantis lenkimo momentas:

$$M := Q_d \cdot (h_d + z_m) - \frac{2 \cdot Q_d}{3 \cdot {d_d}^2 \cdot z_0} \cdot (1.5 \cdot h_d + d_d)(3 \cdot z_0 - z_m) \cdot {z_m}^2 - \frac{d^2}{2} \cdot R_f \cdot z_m = 139.66$$ kNm

Išvada: Poliaus sukamoji laikomoji galia pakankama

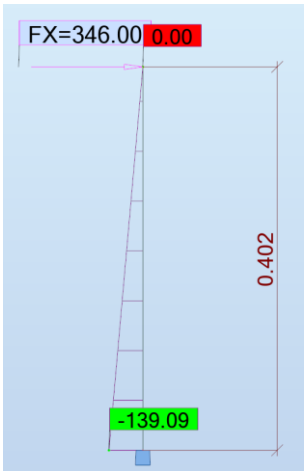
Reikalingas poliaus armavimas.

Reikalingas minimalus armavimas:

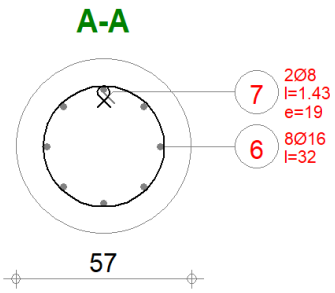
Polius					
d=	600	mm	Ac=	0.2826	m2
Armatūra					
d=	18	mm	As=	15.26	cm2
n=	6	vnt			
			Reikalingas armatūros plotas		
			Asreik=0,005*Ac=	14.13	cm2

Reikalingas armavimas veikiant didžiausiam lenkimo momentui M z_m poliaus gylyje.
Skaičiuojant poliaus armavimas priimamas poliaus ilgis lygus z_m gyliui ir parenkama horizontali apkrova, veikiant kuriai susidaro M momentas.

Poliaus skaičiuojamoji schema ir veikiantis momentas nuo uždėtos horizontalios apkrovos:



Reikalingas armavimas:



1 Level:

- Name :
- Reference level : -0.494 (m)
- Concrete creep coefficient : φ_p = 1.86
- Cement class : N
- Environment class : XC1
- Structure class : S4

2 Column: Column1

Number of identical elements: 1

2.1 Material properties:

- Concrete : C25/30 f_{ck} = 25.00 (MPa)
  Unit weight : 2501.36 (kG/m3)
  Aggregate size : 20.0 (mm)
- Longitudinal reinforcement: : B500B f_{yk} = 500.00 (MPa)
  Ductility class : B

- Transversal reinforcement: : B500B f_{yk} = 500.00 (MPa)
- Modified partial coefficients:
  α_{cc} = 0.9 1992-1-1 3.1.6 (1)P

2.2 Geometry:

2.2.1	C	
	Diameter	= 57.0 (cm)
2.2.2	Height: L	= 0.402 (m)
2.2.3	Slab thickness	= 0.000 (m)
2.2.4	Beam height	= 0.000 (m)
2.2.5	Cover	= 8.5 (cm)

2.3 Calculation options:

- Calculations according to : EN 1992-1-1:2004/A1:2014
- Seismic dispositions : No requirements
- Precast column : yes
- Pre-design : no
- Slenderness taken into account : yes
- Compression : with bending
- Ties : to slab
- Fire resistance class : No requirements

2.4 Calculation results:

Safety factors Rd/Ed = 1.02 > 1.0

2.4.1 ULS/ALS Analysis

Design combination: COMB1 (B)
Combination type: ULS
Internal forces:
Nsd = 3.40 (kN) Msdy = 139.09 (kN*m) Msdz = 0.00 (kN*m)
Design forces:
Lower node
N = 3.40 (kN) N*etotz = 139.10 (kN*m) N*etoty= 0.07 (kN*m)

Eccentricity:		ez (My/N) (cm)	ey (Mz/N) (cm)
Initial	e0:	4094.5	0.0
Imperfection	ei:	0.2	0.0
I order (e0 + ei)	e0Ed:	4094.7	0.0
Minimal	eEdmin:	2.0	2.0
Total	eEd:	4094.7	2.0

2.4.1.1. Detailed analysis-Direction Y:

2.4.1.1.1 Slenderness analysis

Non-sway structure

L (m)	Lo (m)	λ	λlim	
0.402	0.804	5.64	549.13	Short column

2.4.1.1.2 Buckling analysis

MA = 0.00 (kN*m) MB = 139.09 (kN*m)
Case: Cross-section at the column end (Lower node), Slenderness not taken into account
M0 = 139.09 (kN*m)
ei = θ1*lo/2 = 0.2 (cm)
θ1 = θo * αη * αm = 0.01
θo = 0.01
αh = 1.00
αm = (0,5(1+1/m))^0.5 = 1.00
m = 1.00
Ma = N*ei = 0.01 (kN*m)
MEdmin = 0.07 (kN*m)
M0Ed = max(MEdmin,M0 + Ma) = 139.10 (kN*m)

2.4.1.2. Detailed analysis-Direction Z:

2.4.1.2.1 Slenderness analysis

Non-sway structure

L (m)	Lo (m)	λ	λlim	
0.402	0.804	5.64	549.13	Short column

2.4.1.2.2 Buckling analysis

MA = 0.00 (kN*m) MB = 0.00 (kN*m)
Case: Cross-section at the column end (Lower node), Slenderness not taken into account
M0 = 0.00 (kN*m)
ei = 0.0 (cm)
Ma = N*ei = 0.00 (kN*m)
MEdmin = 0.07 (kN*m)
M0Ed = max(MEdmin,M0 + Ma) = 0.07 (kN*m)

2.4.2 Reinforcement:

Real (provided) area	Asr = 16.08 (cm2)
Ratio:	ρ = 0.63 %

2.5 Reinforcement:

Main bars (B500B):
- 8 ϕ16 l = 0.317 (m)

Transversal reinforcement: (B500B):
stirrups: 2 ϕ8 l = 1.426 (m)

3 Material survey:

- Concrete volume = 0.103 (m3)
- Formwork = 0.720 (m2)

- Steel B500B
  - Total weight = 5.13 (kG)
  - Density = 50.01 (kG/m3)
  - Average diameter = 11.8 (mm)
  - Reinforcement survey:

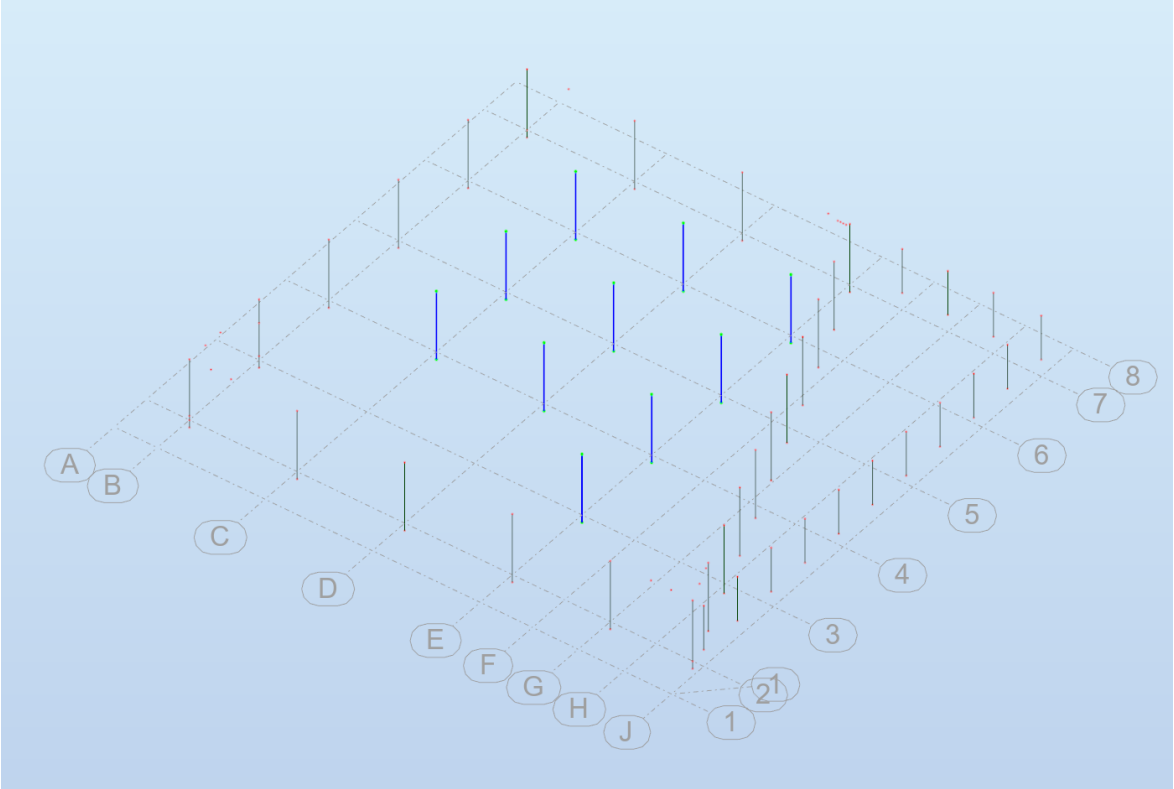
Diameter	Length (m)	Weight (kG)	Number (No.)	Total weight (kG)

8	1.426	0.56	2	1.13
16	0.317	0.50	8	4.00

Išvada: laikomoji galia pakankama. Polis armuojamas 8xd16 išilginiais strypais. Skersinė armatūra išdėstoma pagal konstrukcinius reikalavimus.

2.11.2. Pastato vidinių polių projektavimas

Skaičiuojami poliai po vidinėmis kolonomis. Vidinių kolonų išdėstymas:



Silpniausias sluoksnis, į kurį remiami pastato vidiniai poliai moreninis smėlingas molis, kurio qc=8,5 kPa. Trinties stipriai imami pagal 1 gręžinio sluoksnių duomenis su vidutinėmis reikšmėmis. Polius su galvena 600x600x500mm. Poliaus geometrinis ilgis 7,00m, skersmuo 700mm. Poliaus skaičiuojamasis ilgis 4,77m. Polis remiamas į IGS 6lst (abs. alt. 117.70). Šoninė trintis verinama pagal 1 gręžinį. Šoninė trintis vertinama nuo gręžinio 3 sluoksnio. 1 gręžinyje ir 2 gręžinyje aptiktas labai silpnas stipriai suspaudžiamas grunto tarpsluoksnis IGS3s 4,2m-5,1m gylyje. Jeigu pamato nuosėdžiai didesni daugiau, negu pusė ribinių nuosėdžių, reikia vertinti neigiamą trintį polyje. Durpės ir gruntas su organinėmis priemaišomis iškasamas ir piltinis gruntas polių skaičiavime nevertinamas.

Nuosėdžių skaičiavimas

Skaičiuojami pavienio polio nuosėžiai sumavimo metodu.

Polių eilių skičias B kryptimi mB	1	vnt
Polių eilių skičias L kryptimi mL	1	vnt
Atstumas tarp polių ašių B kryptimi aB	0	m
Atstumas tarp polių ašių L kryptimi aL	0	m
Polio skersmuo	0.7	m
Grunto vidinis trinties kampas	0	
Polių skaičius n	1	vnt
Poliaus ilgis	7.5	m
Rostverko aukštis	0	m
Rostverko viršaus altittudė	0.6	m

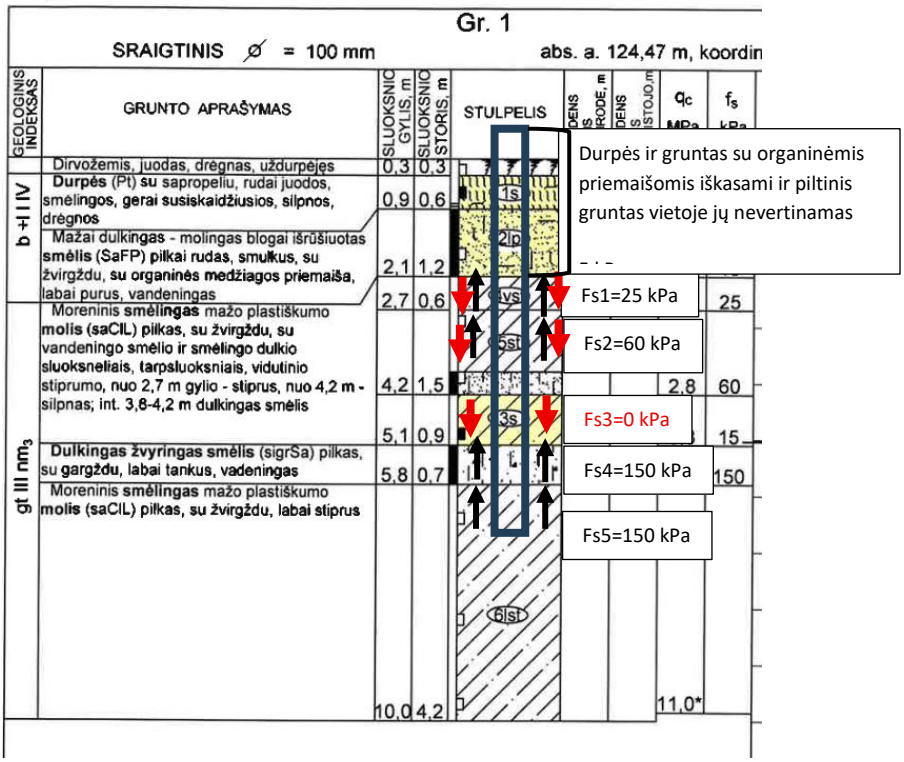
Eil. Nr.	d,m	γ, kN/m^3	$\sigma_{zg,}$ kPa	$0{,}2\sigma_{zg,}$ kPa	z,m	ξ=2z/b	η=l/b	K	$\sigma_{zp,}$ kPa	$\sigma_{zp,vid,}$ kPa	$H_{i,}$ m	E, Mpa	$S_{i,}$ m
1	8.1	22	178.2	35.64	0	0	1	1	1210.99		0.14		
2	8.38	22	184.4	36.87	0.28	0.8	1	0.756	915.51	1063	0.28	83.8	0.0036
3	8.66	22	190.5	38.1	0.56	1.6	1	0.39	472.29	693.9	0.28	83.8	0.0023
4	8.94	22	196.7	39.34	0.84	2.4	1	0.214	259.15	365.7	0.28	83.8	0.0012
5	9.22	22	202.8	40.57	1.12	3.2	1	0.13	157.43	208.3	0.28	83.8	0.0007
6	9.5	22	209	41.8	1.4	4	1	0.087	105.36	131.4	0.28	83.8	0.0004
7	9.78	22	215.2	43.03	1.68	4.8	1	0.067	81.14	93.25	0.28	83.8	0.0003
8	10.06	22	221.3	44.26	1.96	5.6	1	0.046	55.71	68.42	0.28	83.8	0.0002
8	10.34	22	227.5	45.5	2.24	6.4	1	0.036	43.60	49.65	0.28	83.8	0.0002
												Σs_i=	0.0089

Ned	593	kN
B	0.7	m
L	0.7	m
A	0.49	m2
L1	0.35	m
B1	0.35	m

0,2 σzg>σzp

Išvada: 0,89cm<0,03*0,7=2,1cm. Kadangi nuosėdžiai yra mažesni negu pusė ribinių nuosėdžių, galima nevertinti neigiamos trinties virš silpno grunto sluoksnio ir grunto prie polio šonų trinties ribinį stiprumą priimti teigiamą, nors polio aplinkoje yra durpių tarpsluoksnių. Fs3 silpno grunto tarpsluoksnio šoninė trintis skaičiavimuose priimta lygi 0 kPa.

Šoninės trinties grafinis paaiškinimas (juoda rodykle pažymėta vertinama teigiama šoninė trintis, raudona rodykle pažymėta dėl mažų nuosėdžių nevertinama neigiama trintis):



Gniuždomo poliaus laikomosios galios skaičiavimas:

Veikiančios įrąžos:

$N_{Ed.1} := 781 \cdot 10^{-3} = 0.781$ MN

$N_{Ed.2} := 631 \cdot 10^{-3} = 0.631$ 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 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	$\gamma_{st1} := 1.25$	$\gamma_{st2} := 1.15$	$\gamma_{st3} := 1.1$	$\gamma_{st4} := 1.60$

$\alpha_b := 0.5$

$\xi_3 := 1.29$

Grunto rodikliai:

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

$q_c := 6.0$ MPa

$f_{s1} := 0.025$ MPa $f_{s2} := 0.06$ MPa $f_{s3} := 0.015$ MPa $f_{s4} := 0.15$ MPa $f_{s5} := 0.15$ MPa $f_{s6} := 0.0$ MPa $f_{s7} := 0.0$ MPa

$f_{s8} := 0.0$ MPa

Geometriniai rodikliai:

$h_1 := 0.6$ m $h_2 := 1.5$ m $h_3 := 0.0$ m $h_4 := 0.7$ m $h_5 := 1.07$ m $h_6 := 0$ m $h_7 := 0.0$ m $h_8 := 0.0$ m

$d := 0.7 \cdot 0.95 = 0.665$ m

$A_p := \frac{\pi \cdot d^2}{4} = 0.347$ m^2

$A_{š1} := \pi \cdot d \cdot h_1 = 1.253$ m^2 $A_{š2} := \pi \cdot d \cdot h_2 = 3.134$ m^2 $A_{š3} := \pi \cdot d \cdot h_3 = 0$ m^2

$A_{š4} := \pi \cdot d \cdot h_4 = 1.462$ m^2 $A_{š5} := \pi \cdot d \cdot h_5 = 2.235$ m^2 $A_{š6} := \pi \cdot d \cdot h_6 = 0$ m^2

$A_{š7} := \pi \cdot d \cdot h_7 = 0$ m^2 $A_{š8} := \pi \cdot d \cdot h_8 = 0$ m^2

Pirmas projektavimo atvejis:
A1+M1+R1

$q_b := \alpha_b \cdot q_c = 3$ MPa

$R_b := q_b \cdot A_p = 1.042$ MN

$R_s := f_{s1} \cdot A_{š1} + f_{s2} \cdot A_{š2} + f_{s3} \cdot A_{š3} + f_{s4} \cdot A_{š4} + f_{s5} \cdot A_{š5} + f_{s6} \cdot A_{š6} + f_{s7} \cdot A_{š7} + f_{s8} \cdot A_{š8} = 0.774$

$$R_{c.cal1} := \frac{R_b}{\gamma_{b1}} + \frac{R_s}{\gamma_{s1}} = 1.721 \quad \text{MN}$$

$$R_{c.k1} := \frac{R_{c.cal1}}{\xi_3} = 1.334 \quad \text{MN}$$

$$R_{c.d1} := \frac{R_{c.k1}}{\gamma_{t1}} = 1.213 \quad \text{MN}$$

$$\frac{N_{Ed.1}}{R_{c.d1}} = 0.644$$

Antras projektavimo atvejis:
A2+M1+R4

$$R_{c.cal2} := \frac{R_b}{\gamma_{b4}} + \frac{R_s}{\gamma_{s4}} = 1.314 \quad \text{MN}$$

$$R_{c.k2} := \frac{R_{c.cal2}}{\xi_3} = 1.019 \quad \text{MN}$$

$$R_{c.d2} := \frac{R_{c.k2}}{\gamma_{t4}} = 0.728 \quad \text{MN}$$

$$\frac{N_{Ed.2}}{R_{c.d2}} = 0.867$$

Išvada: gniuždymo laikomoji galia pakankama

Poliaus sukamosios laikomosios galios skaičiavimas:

$q_c := 6000$ kPa $f_{si1} := 25$ kPa $f_{si2} := 60$ $f_{si3} := 15$ $f_{si4} := 150$ $f_{si5} := 150$ $f_{si6} := 0$ $f_{si7} := 0$ $f_{si8} := 0$

$N := 294$ kN $h_1 := 0.6$ $h_2 := 1.5$ $h_3 := 0.9$ $h_4 := 0.7$ $h_5 := 1.07$ $h_6 := 0.0$ $h_7 := 0.0$ $h_8 := 0.0$

$M_d := 55$ kNm

$Q_d := 20$ kN Nevertinamo sluoksnio gylis:

$d := 0.7 \cdot 0.95 = 0.665$ m $h_s := 2.1$ m

Poliaus geometrinis ilgis:

$h := 7$ m

Pagrindo stiprumas po pamato padu: iš 6.22, 6.23 grafikų

$R_{s2} := 0.12 \cdot q_c \cdot 10^{-3} + 0.24 = 0.96$ MPa

$A_b := 3.14 \cdot \frac{(d^2)}{4} = 0.347$

Trinties jėga prie pamato šonų:

$F_f := 3.14 \cdot d \cdot \left(h_1 \cdot \frac{f_{si1}}{3} + h_2 \cdot \frac{f_{si2}}{3} + h_3 \cdot \frac{f_{si3}}{3} + h_4 \cdot \frac{f_{si4}}{3} + h_5 \cdot \frac{f_{si5}}{3} + h_6 \cdot \frac{f_{si6}}{3} + h_7 \cdot \frac{f_{si7}}{3} + h_8 \cdot \frac{f_{si8}}{3} \right) = 267.277$ kN

Slėgis po pamato padu:

$p := \frac{(N - F_f)}{A_b} = 76.98$ kPa ne daugiau nei Rs2

Pasisukimas ir pasislinkimas

Skaičiuojamasis pamato gylis:

$d_d := h_1 + h_2 + h_3 + h_4 + h_5 + h_6 + h_7 + h_8 = 4.77$ m

Horiozntalios jėgos nuo momento aukštis virš pamato

$h_m := \frac{M_d}{Q_d} = 2.75$

Horizontalios jėgos pridėties taško skaičiuojamasis aukštis:

$h_d := h - d_d + h_m = 4.98$ m

$\eta := \frac{(1.5 \cdot h_d + 0.5 \cdot d_d)}{1.5 \cdot h_d + d_d} = 0.805$ $\mu := 0.5$

kai Ff<N:

Pamato posūkiui besipriešinančių jėgų atstojamoji:

$F_Q := \frac{\left[(N - F_f) \cdot \mu \cdot d_d + 1.5 \cdot F_f \cdot \frac{d}{\pi} \right]}{2 \cdot (1.5 \cdot h_d + d_d)} = 6.07$ kN

$\text{pamatas} := \text{if}\left[F_Q \geq 0.5 \cdot (\eta + 1) \cdot Q_d, \text{"nepasisuka"}, \text{"pasisuka"} \right] = \text{"pasisuka"}$

Pamato posukio centro gylis nuo skaičiuojamojopagrindo paviršiaus z0:

$$z_0 := \frac{d_d}{1 + \frac{(Q_d \cdot \eta - F_Q)}{Q_d - F_Q}} = 2.773 \quad m$$

kadangi := if$(z_0 < d_d, "u formule tinka", "netinka") = "u formule tinka"$

$R_{s0.5} := 0.04 q_c \cdot 10^{-3} + 0.1 = 0.34$

Horizontalus pagrindo standumo modulis:

$u_u := 0.01 \cdot d = 6.65 \times 10^{-3}$ m

$i_u := 0.005$ m

$$C_h := \frac{R_{s0.5} \cdot 10^3}{0.005 d} = 1.023 \times 10^5$$

$$u := \left[4 Q_d \cdot \frac{(1.5 h_d + d_d)}{C_h \cdot d \cdot {d_d}^2}\right] \cdot \left[1 + \frac{(h - d_d)}{z_0}\right] \cdot \left(1 - \frac{F_Q}{Q_d}\right) = 7.953 \times 10^{-4} \quad m$$

poslinkis:= if$(u < u_u, "poslinkis leistinas", "poslinkis neleistinas") = "poslinkis leistinas"$

$$i := \frac{u}{(z_0 + h - d_d)} = 1.59 \times 10^{-4} \quad m$$

pasisukimas := if$(i < i_u, "pasisukimas leistinas", "pasisukimas neleistinas") = "pasisukimas leistinas"$

Gylis kuriame veikia didžiausias lenkimo momentas

Grunto prie pamato šoninio paviršiaus vidutinis stipris:

$$R_f := \frac{F_f}{\pi \cdot d \cdot d_d} = 26.821 \quad kN$$

Gylis, kuriame veikia didžiausias lenkimo momentas:

$$z_m := z_0 - \sqrt{{z_0}^2 - \frac{\left(1 - \frac{d^2 \cdot R_f}{2 \cdot Q_d}\right) \cdot {d_d}^2 \cdot z_0}{2 \cdot (1.5 \cdot h_d + d_d)}} = 0.349 \quad m$$

Didžiausias polių veikiantis lenkimo momentas:

$$M := Q_d \cdot (h_d + z_m) - \frac{2 \cdot Q_d}{3 \cdot {d_d}^2 \cdot z_0} \cdot (1.5 \cdot h_d + d_d)(3 \cdot z_0 - z_m) \cdot {z_m}^2 - \frac{d^2}{2} \cdot R_f \cdot z_m = 101.995 \text{ kNm}$$

Išvada: Poliaus sukamoji laikomoji galia pakankama

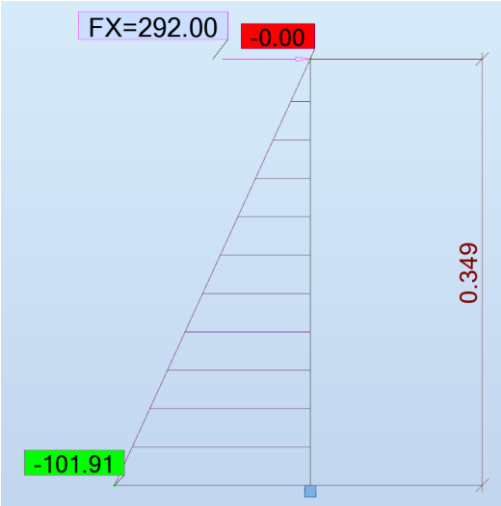
Reikalingas poliaus armavimas.

Reikalingas minimalus armavimas:

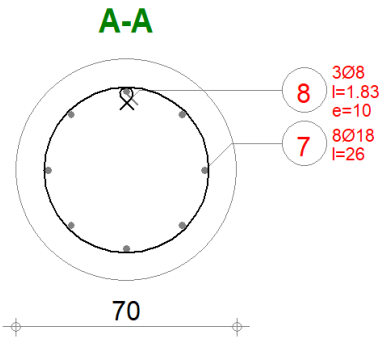
Polius				
d=	700	mm	Ac=	0.3847 m2
Armatūra				
d=	18	mm	As=	20.347 cm2
n=	8	vnt		
			Reikalingas armatūros plotas	
			Asreik=0,005*Ac=	19.233 cm2

Reikalingas armavimas veikiant didžiausiam lenkimo momentui M z_m poliaus gylyje. Skaičiuojant poliaus armavimas priimamas poliaus ilgis lygus z_m gyliui ir parenkama horizontali apkrova, veikiant kuriai susidaro M momentas.

Poliaus skaičiuojamoji schema ir veikiantis momentas nuo uždėtos horizontalios apkrovos:



Reikalingas armavimas:



1 Level:

- Name :
- Reference level : -0.494 (m)
- Concrete creep coefficient : φ_p = 1.84
- Cement class : N
- Environment class : XC2
- Structure class : S4

2 Column: Column1

Number of identical elements: 1

2.1 Material properties:

- Concrete : C25/30 f_{ck} = 25.00 (MPa)
  Unit weight : 2501.36 (kG/m3)
  Aggregate size : 20.0 (mm)
- Longitudinal reinforcement: : B500B f_{yk} = 500.00 (MPa)
  Ductility class : B
- Transversal reinforcement: : B500B f_{yk} = 500.00 (MPa)
- Modified partial coefficients:
  α_{cc} = 0.9 1992-1-1 3.1.6 (1)P

2.2 Geometry:

2.2.1	C	
	Diameter	= 66.5 (cm)
2.2.2	Height: L	= 0.349 (m)
2.2.3	Slab thickness	= 0.000 (m)
2.2.4	Beam height	= 0.000 (m)
2.2.5	Cover	= 8.5 (cm)

2.3 Calculation options:

- Calculations according to : EN 1992-1-1:2004/A1:2014
- Seismic dispositions : No requirements
- Precast column : yes
- Pre-design : no
- Slenderness taken into account : yes
- Compression : with bending
- Ties : to slab
- Fire resistance class : No requirements

2.4 Calculation results:

Safety factors Rd/Ed = 2.12 > 1.0

2.4.1 ULS/ALS Analysis

Design combination: COMB1 (B)
Combination type: ULS
Internal forces:
Nsd = 4.01 (kN) Msdy = 101.91 (kN*m) Msdz = 0.00 (kN*m)
Design forces:
Lower node
N = 4.01 (kN) N*etotz = 101.92 (kN*m) N*etoty= 0.09 (kN*m)

Eccentricity:		ez (My/N) (cm)	ey (Mz/N) (cm)
Initial	e0:	2538.7	0.0
Imperfection	ei:	0.2	0.0
I order (e0 + ei)	e0Ed:	2538.9	0.0

Minimal	eEdmin:	2.2	2.2	
Total	eEd:	2538.9		2.2

2.4.1.1. Detailed analysis-Direction Y:

2.4.1.1.1 Slenderness analysis

Non-sway structure

L (m)	Lo (m)	λ	λlim	
0.349	0.698	4.20	583.80	Short column

2.4.1.1.2 Buckling analysis

MA = 0.00 (kN*m) MB = 101.91 (kN*m)
Case: Cross-section at the column end (Lower node), Slenderness not taken into account
M0 = 101.91 (kN*m)
ei = θ1*lo/2 = 0.2 (cm)
θ1 = θo ∗ αη ∗ αm = 0.01
θo = 0.01
αh = 1.00
αm = (0,5(1+1/m))^0.5 = 1.00
m = 1.00
Ma = N*ei = 0.01 (kN*m)
MEdmin = 0.09 (kN*m)
M0Ed = max(MEdmin,M0 + Ma) = 101.92 (kN*m)

2.4.1.2. Detailed analysis-Direction Z:

2.4.1.2.1 Slenderness analysis

Non-sway structure

L (m)	Lo (m)	λ	λlim	
0.349	0.698	4.20	583.80	Short column

2.4.1.2.2 Buckling analysis

MA = 0.00 (kN*m) MB = 0.00 (kN*m)
Case: Cross-section at the column end (Lower node), Slenderness not taken into account
M0 = 0.00 (kN*m)
ei = 0.0 (cm)
Ma = N*ei = 0.00 (kN*m)
MEdmin = 0.09 (kN*m)
M0Ed = max(MEdmin,M0 + Ma) = 0.09 (kN*m)

2.4.2 Reinforcement:

Real (provided) area	Asr = 20.36 (cm2)
Ratio:	ρ = 0.59 %

2.5 Reinforcement:

Main bars (B500B):
- 8 ϕ18 l = 0.264 (m)

Transversal reinforcement: (B500B):
stirrups: 3 ϕ8 l = 1.724 (m)

3 Material survey:

- Concrete volume = 0.121 (m3)
- Formwork = 0.729 (m2)

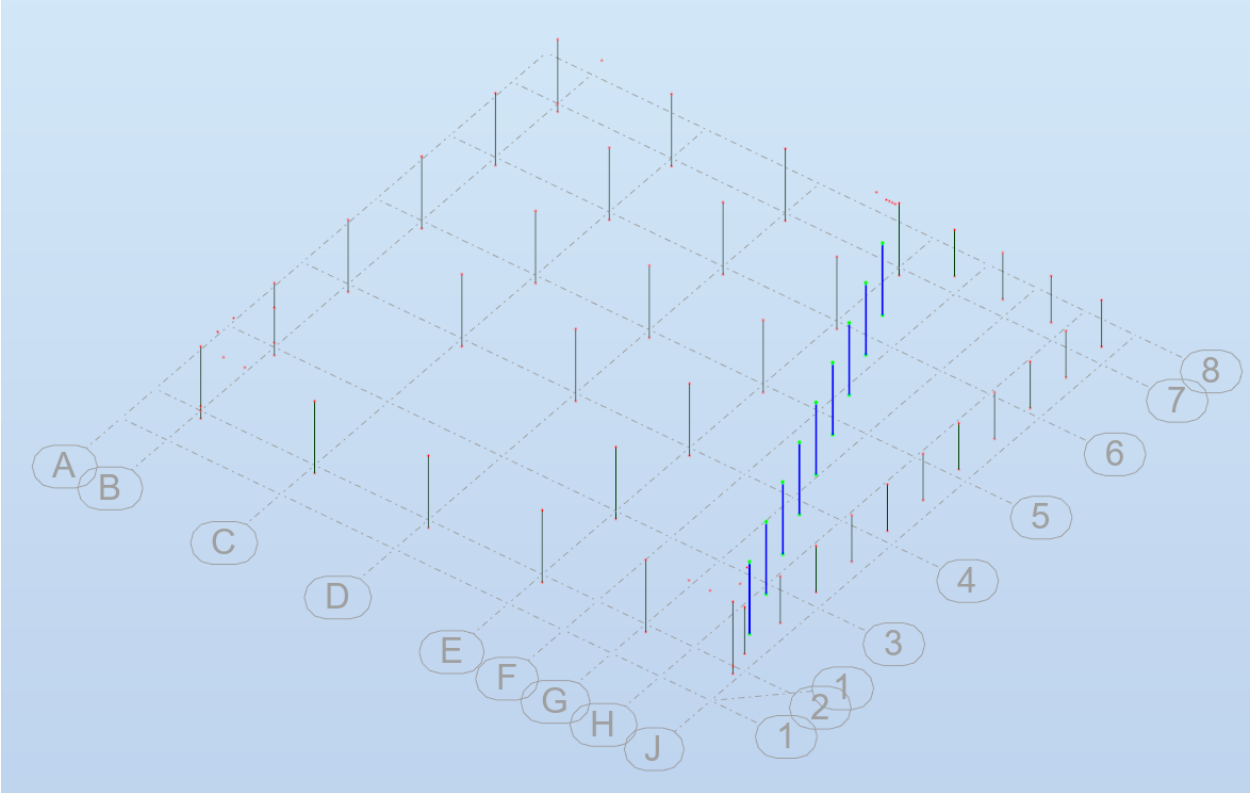
- Steel B500B
  - Total weight = 6.26 (kG)
  - Density = 51.66 (kG/m3)
  - Average diameter = 10.9 (mm)
  - Reinforcement survey:

Diameter	Length (m)	Weight (kG)	Number (No.)	Total weight (kG)
8	1.724	0.68	3	2.04
18	0.264	0.53	8	4.22

Išvada: laikomoji galia pakankama. Polis armuojamas pagla mnimaliu kosntrukcinius reiklavimus 8xd18 išilginiais strypais. Skersinė armatūra išdėstoma pagal konstrukcinius reikalavimus.

2.11.3. Pastato polių ant E1 ašies projektavimas

Skaičiuojami poliai po kolonomis ant E1 ašies. Kolonų išdėstymas:



Silpniausias sluoksnis, į kurį remiami pastato poliai ant E1 ašies smėlingas mažo plastiškumo molis, kurio qc=3,5 kPa. Trinties stipriai imami pagal 4 gręžinio sluoksnių duomenis su vidutinėmis reikšmėmis. Polius su galvena 700x700x500mm. Poliaus geometrinis ilgis 4,60 m, skersmuo 400mm. Poliaus skaičiuojamasis ilgis 2,33m. Polis remiamas į IGS 5lst

(abs. alt. 120.10). Šoninė trintis verinama pagal 4 gręžinį. Šoninė trintis vertinama nuo gręžinio 3 sluoksnio. Durpės ir gruntas su organinėmis priemaišomis iškasamas ir piltinis gruntas polių skaičiavime nevertinamas.

Nuosėdžių skaičiavimas

Skaičiuojami pavienio polio nuosėžiai sumavimo metodu.

Polių eilių skičias B kryptimi mB	1	vnt
Polių eilių skičias L kryptimi mL	1	vnt
Atstumas tarp polių ašių B kryptimi aB	0	m
Atstumas tarp polių ašių L kryptimi aL	0	m
Polio skersmuo	0.4	m
Grunto vidinis trinties kampas	0	
Polių skaičius n	1	vnt
Poliaus ilgis	7	m
Rostverko aukštis	0.5	m
Rostverko viršaus altittudė	0.6	m

Eil. Nr.	d,m	γ, kN/m^3	$\sigma_{zg,}$ kPa	$0{,}2\sigma_{zg,}$ kPa	z,m	ξ=2z/b	η=l/b	K	$\sigma_{zp,}$ kPa	$\sigma_{zp,vid,}$ kPa	$H_{i,}$ m	E, Mpa	$S_{i,}$ m
1	8.1	22	178.2	35.64	0	0	1	1	919.54		0.08		
2	8.26	22	181.7	36.34	0.16	0.8	1	0.756	695.17	807.4	0.16	39.9	0.0032
3	8.42	22	185.2	37.05	0.32	1.6	1	0.39	358.62	526.9	0.16	39.9	0.0021
4	8.58	22	188.8	37.75	0.48	2.4	1	0.214	196.78	277.7	0.16	39.9	0.0011
5	8.74	22	192.3	38.46	0.64	3.2	1	0.13	119.54	158.2	0.16	39.9	0.0006
6	8.9	22	195.8	39.16	0.8	4	1	0.087	80.00	99.77	0.16	39.9	0.0004
7	9.06	22	199.3	39.86	0.96	4.8	1	0.067	61.61	70.8	0.16	39.9	0.0003
8	9.22	22	202.8	40.57	1.12	5.6	1	0.046	42.30	51.95	0.16	39.9	0.0002
8	9.38	22	206.4	41.27	1.28	6.4	1	0.036	33.10	37.7	0.16	39.9	0.0002
9	9.54	23	210	42.01	1.44	7.2	1	0.028	25.75	29.43	0.16	39.9	0.0001
10	9.7	24	213.9	42.78	1.6	8	1	0.022	20.23	22.99	0.16	39.9	9E-05
												Σs_i=	0.0084

Ned	147	kN
B	0.4	m
L	0.4	m
A	0.16	m2
L1	0.2	m
B1	0.2	m

0,2 σzg>σzp

Išvada: 0,84cm<0,03*0,4=1,2cm. Sąlyga tenkinama.

Gniuždomo poliaus laikomosios galios skaičiavimas:

Veikiančios įrąžos:

$N_{Ed.1} := 195 \cdot 10^{-3} = 0.195$ MN

$N_{Ed.2} := 153 \cdot 10^{-3} = 0.153$ 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 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	$\gamma_{st1} := 1.25$	$\gamma_{st2} := 1.15$	$\gamma_{st3} := 1.1$	$\gamma_{st4} := 1.60$

$\alpha_b := 0.5$

$\xi_3 := 1.29$

Grunto rodikliai:

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

$q_c := 3.5$ MPa

$f_{s1} := 0.040$ MPa $f_{s2} := 0.110$ MPa $f_{s3} := 0.25$ MPa $f_{s4} := 0.0$ MPa $f_{s5} := 0.$ MPa $f_{s6} := 0.0$ MPa $f_{s7} := 0.0$ MPa

Geometriniai rodikliai:

$f_{s8} := 0.0$ MPa

$h_1 := 0.6$ m $h_2 := 1.73$ m $h_3 := 0$ m $h_4 := 0$ m $h_5 := 0.0$ m $h_6 := 0$ m $h_7 := 0.0$ m $h_8 := 0.0$ m

$d := 0.4 \cdot 0.95 = 0.38$ m

$A_p := \frac{\pi \cdot d^2}{4} = 0.113$ m^2

$A_{š1} := \pi \cdot d \cdot h_1 = 0.716$ m^2 $A_{š2} := \pi \cdot d \cdot h_2 = 2.065$ m^2 $A_{š3} := \pi \cdot d \cdot h_3 = 0$ m^2

$A_{š4} := \pi \cdot d \cdot h_4 = 0$ m^2 $A_{š5} := \pi \cdot d \cdot h_5 = 0$ m^2 $A_{š6} := \pi \cdot d \cdot h_6 = 0$ m^2

$A_{š7} := \pi \cdot d \cdot h_7 = 0$ m^2 $A_{š8} := \pi \cdot d \cdot h_8 = 0$ m^2

Pirmas projektavimo atvejis:
A1+M1+R1

$q_b := \alpha_b \cdot q_c = 1.75$ MPa

$R_b := q_b \cdot A_p = 0.198$ MN

$R_s := f_{s1} \cdot A_{s1} + f_{s2} \cdot A_{s2} + f_{s3} \cdot A_{s3} + f_{s4} \cdot A_{s4} + f_{s5} \cdot A_{s5} + f_{s6} \cdot A_{s6} + f_{s7} \cdot A_{s7} + f_{s8} \cdot A_{s8} = 0.256$

$$R_{c.cal1} := \frac{R_b}{\gamma_{b1}} + \frac{R_s}{\gamma_{s1}} = 0.436 \quad \text{MN}$$

$$R_{c.k1} := \frac{R_{c.cal1}}{\xi_3} = 0.338 \quad \text{MN}$$

$$R_{c.d1} := \frac{R_{c.k1}}{\gamma_{t1}} = 0.307 \quad \text{MN}$$

$$\frac{N_{Ed.1}}{R_{c.d1}} = 0.634$$

Antras projektavimo atvejis:
A2+M1+R4

$$R_{c.cal2} := \frac{R_b}{\gamma_{b4}} + \frac{R_s}{\gamma_{s4}} = 0.334 \quad \text{MN}$$

$$R_{c.k2} := \frac{R_{c.cal2}}{\xi_3} = 0.259 \quad \text{MN}$$

$$R_{c.d2} := \frac{R_{c.k2}}{\gamma_{t4}} = 0.185 \quad \text{MN}$$

$$\frac{N_{Ed.2}}{R_{c.d2}} = 0.828$$

Išvada: gniuždymo laikomoji galia pakankama

Poliaus sukamosios laikomosios galios skaičiavimas:

$q_c := 3500$ kPa $f_{si1} := 04$ kPa $f_{si2} := 110$ $f_{si3} := 250$ $f_{si4} := 0$ $f_{si5} := 0$ $f_{si6} := 0$ $f_{si7} := 0$ $f_{si8} := 0$

$N := 2$ kN $h_1 := 0.6$ $h_2 := 1.7$ $h_3 := 0.0$ $h_4 := 0.0$ $h_5 := 0.0$ $h_6 := 0.0$ $h_7 := 0.0$ $h_8 := 0.0$

$M_d := 18$ kNm

$Q_d := 10$ kN Nevertinamo sluoksnio gylis:

$d := 0.4 \cdot 0.95 = 0.38$ m $h_s := 2.1$ m

Poliaus geometrinis ilgis:

$h := 4.6$ m

Pagrindo stiprumas po pamato padu: iš 6.22, 6.23 grafikų

$R_{s2} := 0.2 \cdot q_c \cdot 10^{-3} + 0.24 = 0.94$ MPa

$$A_b := 3.14 \cdot \frac{\left(d^2\right)}{4} = 0.113$$

Trinties jėga prie pamato šonų:

$$F_f := 3.14 \cdot d \cdot \left(h_1 \cdot \frac{f_{si1}}{3} + h_2 \cdot \frac{f_{si2}}{3} + h_3 \cdot \frac{f_{si3}}{3} + h_4 \cdot \frac{f_{si4}}{3} + h_5 \cdot \frac{f_{si5}}{3} + h_6 \cdot \frac{f_{si6}}{3} + h_7 \cdot \frac{f_{si7}}{3} + h_8 \cdot \frac{f_{si8}}{3} \right) = 76.643 \text{ kN}$$

Slėgis po pamato padu:

$$p := \frac{\left(N - F_f\right)}{A_b} = -658.497 \text{ kPa}$$ ne daugiau nei Rs2

Pasisukimas ir pasislinkimas

Skaičiuojamasis pamato gylis:

$d_d := h_1 + h_2 + h_3 + h_4 + h_5 + h_6 + h_7 + h_8 = 2.33$ m

Horiozntalios jėgos nuo momento aukštis virš pamato

$$h_m := \frac{M_d}{Q_d} = 1.8$$

Horizontalios jėgos pridėties taško skaičiuojamasis aukštis:

$h_d := h - d_d + h_m = 4.07$ m

$$\eta := \frac{\left(1.5 \cdot h_d + 0.5 \cdot d_d\right)}{1.5 \cdot h_d + d_d} = 0.862$$ $\mu := 0.5$

Kai Ff>N

$$F_Q := \frac{\left(10 + 1.5 \cdot F_f \cdot \frac{d}{\pi}\right)}{2 \cdot \left(1.5 \cdot h_d + d_d\right)} = 1.417 \text{ kN}$$

$pamatas := if\left[F_Q \geq 0.5 \cdot (\eta + 1) \cdot Q_d, "nepasisuka", "pasisuka"\right] = "pasisuka"$

$$R_{s0.5} := 0.04 q_c \cdot 10^{-3} + 0.1 = 0.24$$

Horizontalus pagrindo standumo modulis:

$$C_h := \frac{R_{s0.5} \cdot 10^3}{0.005 \cdot d} = 1.263 \times 10^5$$

Pamato posukio centro gylis nuo skaičiuojamojo pagrindo paviršiaus z0:

$$z_0 := \frac{d_d}{1 + \frac{(Q_d \cdot \eta - F_Q)}{Q_d - F_Q}} = 1.267 \quad m$$

$$u_u := 0.01 \cdot d = 3.8 \times 10^{-3} \quad m$$

$$i_u := 0.005 \ m$$

$$u := if\left[z_0 < d_d, \left[4 Q_d \cdot \frac{(1.5 h_d + d_d)}{C_h \cdot d \cdot d_d^{\,2}}\right] \cdot \left[1 + \frac{(h - d_d)}{z_0}\right] \cdot \left(1 - \frac{F_Q}{Q_d}\right), \frac{\left[3 \cdot Q_d \cdot (h_d + d_d) - 1.5 \cdot F_f \cdot \frac{d}{\pi}\right] \cdot h}{C_h \cdot d_d^{\,2}}\right] = 3.102 \times 10^{-3} \quad m$$

$$poslinkis := if(u < u_u, "poslinkis leistinas", "poslinkis neleistinas") = "poslinkis leistinas"$$

$$i := \frac{u}{(z_0 + h - d_d)} = 8.771 \times 10^{-4} \quad m$$

$$pasisukimas := if(i < i_u, "pasisukimas leistinas", "pasisukimas neleistinas") = "pasisukimas leistinas"$$

Gylis kuriame veikia didžiausias lenkimo momentas

Grunto prie pamato šoninio paviršiaus vidutinis stipris:

$$R_f := \frac{F_f}{\pi \cdot d \cdot d_d} = 27.554 \quad kN$$

Gylis, kuriame veikia didžiausias lenkimo momentas:

$$z_m := z_0 - \sqrt{z_0^{\,2} - \frac{\left(1 - \frac{d^2 \cdot R_f}{2 \cdot Q_d}\right) \cdot d_d^{\,2} \cdot z_0}{2 \cdot (1.5 \cdot h_d + d_d)}} = 0.136 \quad m$$

Didžiausias polių veikiantis lenkimo momentas:

$$M := Q_d \cdot (h_d + z_m) - \frac{2 \cdot Q_d}{3 \cdot d_d^{\,2} \cdot z_0} \cdot (1.5 \cdot h_d + d_d)(3 \cdot z_0 - z_m) \cdot z_m^{\,2} - \frac{d^2}{2} \cdot R_f \cdot z_m = 41.235 \ kNm$$

Išvada: sukamoji laikomoji galia pakankama

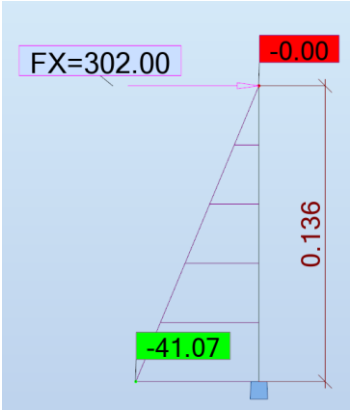
Reikalingas poliaus armavimas.

Reikalingas minimalus armavimas:

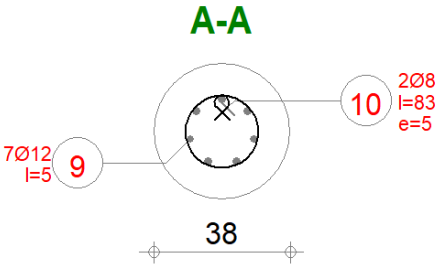
Polius					
d=	400	mm	Ac=	0.1256	m2
Armatūra					
d=	12	mm	As=	6.7824	cm2
n=	6	vnt			
			Reikalingas armatūros plotas		
			Asreik=0,005*Ac=	6.28	cm2

Reikalingas armavimas veikiant didžiausiam lenkimo momentui M z_m poliaus gylyje. Skaičiuojant poliaus armavimas priimamas poliaus ilgis lygus z_m gyliui ir parenkama horizontali apkrova, veikiant kuriai susidaro M momentas.

Poliaus skaičiuojamoji schema ir veikiantis momentas nuo uždėtos horizontalios apkrovos:



Reikalingas armavimas:



1 Level:

- Name :
- Reference level : -0.494 (m)
- Concrete creep coefficient : φ_p = 1.93
- Cement class : N
- Environment class : XC2
- Structure class : S4

2 Column: Column1

Number of identical elements: 1

2.1 Material properties:

- Concrete : C25/30 f_{ck} = 25.00 (MPa)
  Unit weight : 2501.36 (kG/m3)
  Aggregate size : 20.0 (mm)
- Longitudinal reinforcement: : B500B f_{yk} = 500.00 (MPa)
  Ductility class : B
- Transversal reinforcement: : B500B f_{yk} = 500.00 (MPa)
- Modified partial coefficients:
  α_{cc} = 0.9 1992-1-1 3.1.6 (1)P

2.2 Geometry:

2.2.1	C	
	Diameter	= 38.0 (cm)
2.2.2	Height: L	= 0.136 (m)
2.2.3	Slab thickness	= 0.000 (m)
2.2.4	Beam height	= 0.000 (m)
2.2.5	Cover	= 8.5 (cm)

2.3 Calculation options:

- Calculations according to : EN 1992-1-1:2004/A1:2014
- Seismic dispositions : No requirements
- Precast column : no
- Pre-design : no
- Slenderness taken into account : yes
- Compression : with bending
- Ties : to slab
- Fire resistance class : No requirements

2.4 Calculation results:

Safety factors Rd/Ed = 1.07 > 1.0

2.4.1 ULS/ALS Analysis

Design combination: COMB1 (B)
Combination type: ULS
Internal forces:
Nsd = 0.51 (kN) Msdy = 41.07 (kN*m) Msdz = 0.00 (kN*m)
Design forces:
Lower node
N = 0.51 (kN) N*etotz = 41.07 (kN*m) N*etoty= 0.01 (kN*m)

Eccentricity:		ez (My/N) (cm)	ey (Mz/N) (cm)
Initial	e0:	8041.2	0.0
Imperfection	ei:	0.1	0.0
I order (e0 + ei)	e0Ed:	8041.2	0.0
Minimal	eEdmin:	2.0	2.0
Total	eEd:	8041.2	2.0

2.4.1.1. Detailed analysis-Direction Y:

2.4.1.1.1 Slenderness analysis

Non-sway structure

L (m)	Lo (m)	λ	λlim	
0.136	0.272	2.86	957.58	Short column

2.4.1.1.2 Buckling analysis

MA = 0.00 (kN*m) MB = 41.07 (kN*m)
Case: Cross-section at the column end (Lower node), Slenderness not taken into account
M0 = 41.07 (kN*m)
ei = θ1*lo/2 = 0.1 (cm)
θ1 = θo * αη * αm = 0.01
θo = 0.01
αh = 1.00
αm = (0,5(1+1/m))^0.5 = 1.00
m = 1.00
Ma = N*ei = 0.00 (kN*m)
MEdmin = 0.01 (kN*m)
M0Ed = max(MEdmin,M0 + Ma) = 41.07 (kN*m)

2.4.1.2. Detailed analysis-Direction Z:

2.4.1.2.1 Slenderness analysis

Non-sway structure

L (m)	Lo (m)	λ	λlim	
0.136	0.272	2.86	957.58	Short column

2.4.1.2.2 Buckling analysis

MA = 0.00 (kN*m) MB = 0.00 (kN*m)
Case: Cross-section at the column end (Lower node), Slenderness not taken into account
M0 = 0.00 (kN*m)
ei = 0.0 (cm)
Ma = N*ei = 0.00 (kN*m)
MEdmin = 0.01 (kN*m)
M0Ed = max(MEdmin,M0 + Ma) = 0.01 (kN*m)

2.4.2 Reinforcement:

Real (provided) area Asr = 7.92 (cm2)
Ratio: ρ = 0.70 %

2.5 Reinforcement:

Main bars (B500B):
- 7 ϕ12 l = 0.051 (m)

Transversal reinforcement: (B500B):
stirrups: 2 ϕ8 l = 0.829 (m)

3 Material survey:

- Concrete volume = 0.015 (m3)
- Formwork = 0.162 (m2)

- Steel B500B
  - Total weight = 0.97 (kG)

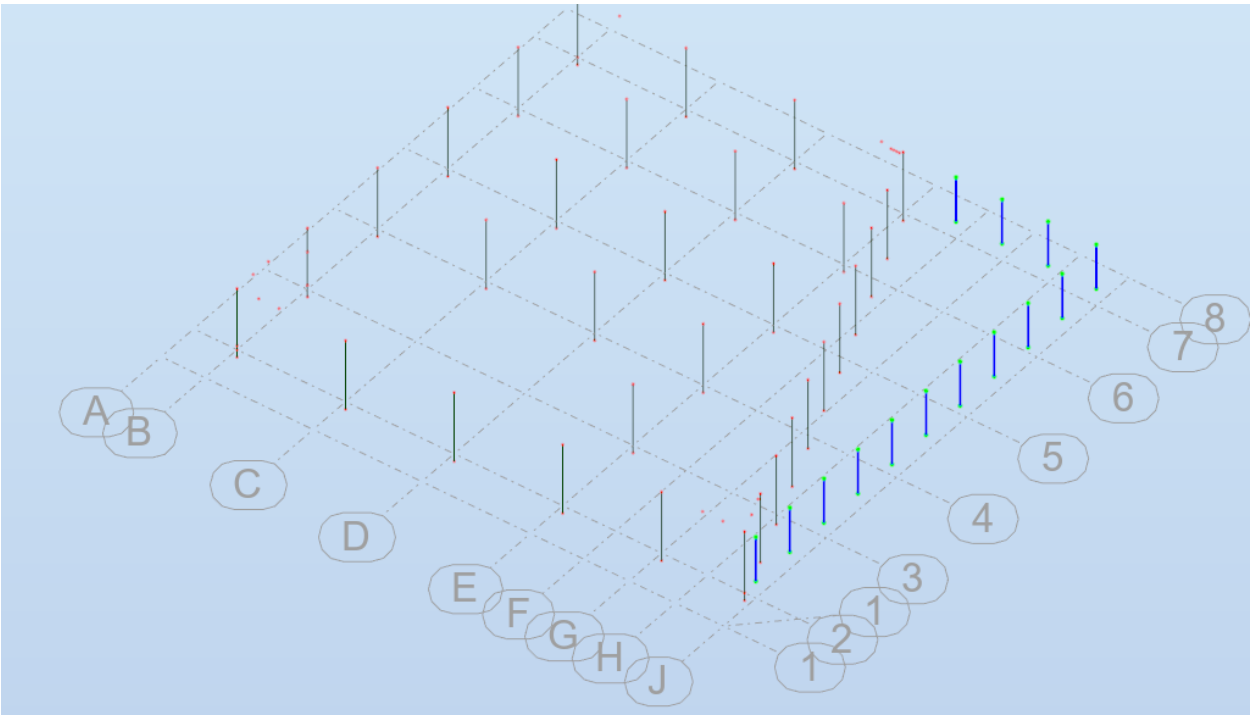
- Density = 62.98 (kG/m3)
- Average diameter = 8.7 (mm)
- Reinforcement survey:

Diameter	Length (m)	Weight (kG)	Number (No.)	Total weight (kG)
8	0.829	0.33	2	0.65
12	0.051	0.05	7	0.32

Išvada: laikomoji galia pakankama. Polis armuojamas 7xd12 išilginiais strypais. Skersinė armatūra išdėstoma pagal konstrukcinius reikalavimus.

2.11.4. Pastato polių po lauko kolonomis projektavimas

Skaičiuojami poliai po lauko kolonomis. Kolonų išdėstymas:



Silpniausias sluoksnis, į kurį remiami pastato poliai po lauko kolonomis smėlingas mažo plastiškumo molis, kurio qc=3,5 kPa. Trinties stipriai imami pagal 4 gręžinio sluoksnių duomenis su vidutinėmis reikšmėmis. Poliai ant ašių J ir 7 su galvena 450x450x500mm. Poliaus geometrinis ilgis 5,15m, skersmuo 300mm. Poliaus skaičiuojamasis ilgis 2,33m. Polis remiamas į IGS 5lst (abs. alt. 120.12). Šoninė trintis verinama pagal 4 gręžinį. Šoninė trintis vertinama nuo gręžinio 3 sluoksnio. Durpės ir gruntas su organinėmis priemaišomis iškasamas ir piltinis gruntas polių skaičiavime nevertinamas.

Nuosėdžių skaičiavimas

Skaičiuojami pavienio polio nuosėžiai sumavimo metodu.

Polių eilių skičias B kryptimi mB	1	vnt
Polių eilių skičias L kryptimi mL	1	vnt
Atstumas tarp polių ašių B kryptimi aB	0	m
Atstumas tarp polių ašių L kryptimi aL	0	m
Polio skersmuo	0.3	m
Grunto vidinis trinties kampas	0	
Polių skaičius n	1	vnt
Poliaus ilgis	4.6	m
Rostverko aukštis	0.5	m
Rostverko viršaus altittudė	0.6	m

Eil. Nr.	d,m	γ, kN/m^3	σ_{zg}, kPa	$0{,}2\sigma_{zg}$, kPa	z,m	ξ=2z/b	η=l/b	K	σ_{zp}, kPa	$\sigma_{zp,vid}$, kPa	H_i, m	E, Mpa	S_i, m
1	5.7	22	125.4	25.08	0	0	1	1	300.79		0.06		
2	5.82	22	128	25.61	0.12	0.8	1	0.756	227.39	264.1	0.12	39.9	0.0008
3	5.94	22	130.7	26.14	0.24	1.6	1	0.39	117.31	172.3	0.12	39.9	0.0005
4	6.06	22	133.3	26.66	0.36	2.4	1	0.214	64.37	90.84	0.12	39.9	0.0003
5	6.18	22	136	27.19	0.48	3.2	1	0.13	39.10	51.74	0.12	39.9	0.0002
6	6.3	22	138.6	27.72	0.6	4	1	0.087	26.17	32.64	0.12	39.9	1E-04
7	6.42	22	141.2	28.25	0.72	4.8	1	0.067	20.15	23.16	0.12	39.9	7E-05
8	6.54	22	143.9	28.78	0.84	5.6	1	0.046	13.84	16.99	0.12	39.9	5E-05
8	6.66	22	146.5	29.3	0.96	6.4	1	0.036	10.83	12.33	0.12	39.9	4E-05
9	6.78	23	149.3	29.86	1.08	7.2	1	0.028	8.42	9.625	0.12	39.9	3E-05
10	6.9	24	152.2	30.43	1.2	8	1	0.022	6.62	7.52	0.12	39.9	2E-05
												Σs_i=	0.002

Ned	27	kN
B	0.3	m
L	0.3	m
A	0.09	m2
L1	0.15	m
B1	0.15	m

0,2 σzg>σzp

Išvada: 0,2cm<0,03*0,3=0,9cm. Sąlyga tenkinama.

Tempiamo poliaus laikomosios galios skaičiavimas:

Veikiančios įrąžos:

$N_{Ed.1} := 12 \cdot 10^{-3} = 0.012$ MN

$N_{Ed.2} := 14 \cdot 10^{-3} = 0.014$ 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 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	$\gamma_{st1} := 1.25$	$\gamma_{st2} := 1.15$	$\gamma_{st3} := 1.1$	$\gamma_{st4} := 1.60$

$\alpha_b := 0.5$

$\xi_3 := 1.29$

Grunto rodikliai:

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

$q_c := 0$ MPa

$f_{s1} := 0.04$ MPa $f_{s2} := 0.11$ MPa $f_{s3} := 0.25$ MPa $f_{s4} := 0.0$ MPa $f_{s5} := 0.0$ MPa $f_{s6} := 0.0$ MPa $f_{s7} := 0.0$ MPa

Geometriniai rodikliai:

$f_{s8} := 0.0$ MPa

$h_1 := 0.6$ m $h_2 := 1.98$ m $h_3 := 0.0$ m $h_4 := 0.0$ m $h_5 := 0.$ m $h_6 := 0.$ m $h_7 := 0.0$ m $h_8 := 0.0$ m

$d := 0.3 - 0.02 = 0.28$ m

$A_p := \frac{\pi \cdot d^2}{4} = 0.062$ m^2

$A_{š1} := \pi \cdot d \cdot h_1 = 0.528$ m^2 $A_{š2} := \pi \cdot d \cdot h_2 = 1.742$ m^2 $A_{š3} := \pi \cdot d \cdot h_3 = 0$ m^2

$A_{š4} := \pi \cdot d \cdot h_4 = 0$ m^2 $A_{š5} := \pi \cdot d \cdot h_5 = 0$ m^2 $A_{š6} := \pi \cdot d \cdot h_6 = 0$ m^2

$A_{š7} := \pi \cdot d \cdot h_7 = 0$ m^2 $A_{š8} := \pi \cdot d \cdot h_8 = 0$ m^2

Pirmas projektavimo atvejis:
A1+M1+R1

$q_b := \alpha_b \cdot q_c = 0$ MPa

$R_b := q_b \cdot A_p = 0$ MN

$R_s := f_{s1} \cdot A_{š1} + f_{s2} \cdot A_{š2} + f_{s3} \cdot A_{š3} + f_{s4} \cdot A_{š4} + f_{s5} \cdot A_{š5} + f_{s6} \cdot A_{š6} + f_{s7} \cdot A_{š7} + f_{s8} \cdot A_{š8} = 0.213$

$R_{c.cal1} := \frac{R_b}{\gamma_{b1}} + \frac{R_s}{\gamma_{s1}} = 0.213$ MN

$R_{c.k1} := \frac{R_{c.cal1}}{\xi_3} = 0.165$ MN

$R_{c.d1} := \frac{R_{c.k1}}{\gamma_{st1}} = 0.132$ MN

$\frac{N_{Ed.1}}{R_{c.d1}} = 0.091$

Antras projektavimo atvejis:
A2+M1+R4

$R_{c.cal2} := \frac{R_b}{\gamma_{b4}} + \frac{R_s}{\gamma_{s4}} = 0.164$ MN

$R_{c.k2} := \frac{R_{c.cal2}}{\xi_3} = 0.127$ MN

$R_{c.d2} := \frac{R_{c.k2}}{\gamma_{st4}} = 0.079$ MN

$\frac{N_{Ed.2}}{R_{c.d2}} = 0.177$

Išvada: tempimo laikomoji galia pakankama

Gniuždomo poliaus laikomosios galios skaičiavimas:

Veikiančios įrąžos:

$N_{Ed.1} := 35 \cdot 10^{-3} = 0.035$ MN

$N_{Ed.2} := 31 \cdot 10^{-3} = 0.031$ 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 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	$\gamma_{st1} := 1.25$	$\gamma_{st2} := 1.15$	$\gamma_{st3} := 1.1$	$\gamma_{st4} := 1.60$

$\alpha_b := 0.5$

$\xi_3 := 1.29$

Grunto rodikliai:

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

$q_c := 3.5$ MPa

$f_{s1} := 0.04$ MPa $f_{s2} := 0.011$ MPa $f_{s3} := 0.25$ MPa $f_{s4} := 0.0$ MPa $f_{s5} := 0.0$ MPa $f_{s6} := 0.0$ MPa $f_{s7} := 0.0$ MPa

$f_{s8} := 0.0$ MPa

Geometriniai rodikliai:

$h_1 := 0.6$ m $h_2 := 1.98$ m $h_3 := 0.0$ m $h_4 := 0.0$ m $h_5 := 0.0$ m $h_6 := 0$ m $h_7 := 0.0$ m $h_8 := 0.0$ m

$d := 0.3 - 0.02 = 0.28$ m

$A_p := \frac{\pi \cdot d^2}{4} = 0.062$ m^2

$A_{š1} := \pi \cdot d \cdot h_1 = 0.528$ m^2 $A_{š2} := \pi \cdot d \cdot h_2 = 1.742$ m^2 $A_{š3} := \pi \cdot d \cdot h_3 = 0$ m^2

$A_{š4} := \pi \cdot d \cdot h_4 = 0$ m^2 $A_{š5} := \pi \cdot d \cdot h_5 = 0$ m^2 $A_{š6} := \pi \cdot d \cdot h_6 = 0$ m^2

$A_{š7} := \pi \cdot d \cdot h_7 = 0$ m^2 $A_{š8} := \pi \cdot d \cdot h_8 = 0$ m^2

Pirmas projektavimo atvejis:
A1+M1+R1

$q_b := \alpha_b \cdot q_c = 1.75$ MPa

$R_b := q_b \cdot A_p = 0.108$ MN

$R_s := f_{s1} \cdot A_{š1} + f_{s2} \cdot A_{š2} + f_{s3} \cdot A_{š3} + f_{s4} \cdot A_{š4} + f_{s5} \cdot A_{š5} + f_{s6} \cdot A_{š6} + f_{s7} \cdot A_{š7} + f_{s8} \cdot A_{š8} = 0.04$

$R_{c.cal1} := \frac{R_b}{\gamma_{b1}} + \frac{R_s}{\gamma_{s1}} = 0.138$ MN

$R_{c.k1} := \frac{R_{c.cal1}}{\xi_3} = 0.107$ MN

$R_{c.d1} := \frac{R_{c.k1}}{\gamma_{t1}} = 0.097$ MN

$\frac{N_{Ed.1}}{R_{c.d1}} = 0.359$

Antras projektavimo atvejis:
A2+M1+R4

$R_{c.cal2} := \frac{R_b}{\gamma_{b4}} + \frac{R_s}{\gamma_{s4}} = 0.105$ MN

$R_{c.k2} := \frac{R_{c.cal2}}{\xi_3} = 0.082$ MN

$R_{c.d2} := \frac{R_{c.k2}}{\gamma_{t4}} = 0.058$ MN

$\frac{N_{Ed.2}}{R_{c.d2}} = 0.532$

Išvada: gniuždymo laikomoji galia pakankama

Poliaus sukimo skaičiavimas:

$q_c := 3500$ kPa $f_{si1} := 40$ kPa $f_{si2} := 110$ $f_{si3} := 250$ $f_{si4} := 0$ $f_{si5} := 0$ $f_{si6} := 0$ $f_{si7} := 0$ $f_{si8} := 0$

$N := 17$ kN $h_1 := 0.6$ $h_2 := 1.9$ $h_3 := 0.0$ $h_4 := 0.0$ $h_5 := 0$ $h_6 := 0.0$ $h_7 := 0.0$ $h_8 := 0.0$

$M_d := 0.1$ kNm

$Q_d := 4$ kN Nevertinamo sluoksnio gylis:

$d := 0.3 - 0.02 = 0.28$ m $h_s := 2.57$ m

Poliaus geometrinis ilgis:

$h := 4.90$ m

Pagrindo stiprumas po pamato padu: iš 6.22, 6.23 grafikų

$R_{s2} := 0.12 \cdot q_c \cdot 10^{-3} + 0.24 = 0.66$ MPa

$$A_b := 3.14 \cdot \frac{\left(d^2\right)}{4} = 0.062$$

Trinties jėga prie pamato šonų:

$$F_f := 3.14 \cdot d \cdot \left(h_1 \cdot \frac{f_{si1}}{3} + h_2 \cdot \frac{f_{si2}}{3} + h_3 \cdot \frac{f_{si3}}{3} + h_4 \cdot \frac{f_{si4}}{3} + h_5 \cdot \frac{f_{si5}}{3} + h_6 \cdot \frac{f_{si6}}{3} + h_7 \cdot \frac{f_{si7}}{3} + h_8 \cdot \frac{f_{si8}}{3} \right) = 70.864 \text{ kN}$$

Slėgis po pamato padu:

$$p := \frac{(N - F_f)}{A_b} = -875.203 \text{ kPa}$$ ne daugiau nei Rs2

Pasisukimas ir pasislinkimas

Skaičiuojamasis pamato gylis:

$d_d := h_1 + h_2 + h_3 + h_4 + h_5 + h_6 + h_7 + h_8 = 2.58$ m

Horiozntalios jėgos nuo momento aukštis virš pamato

$$h_m := \frac{M_d}{Q_d} = 0.025$$

Horizontalios jėgos pridėties taško skaičiuojamasis aukštis:

$h_d := h - d_d + h_m = 2.345$ m

$$\eta := \frac{\left(1.5 \cdot h_d + 0.5 \cdot d_d\right)}{1.5 \cdot h_d + d_d} = 0.788$$ $\mu := 0.5$

kai Ff<N:

Pamato posūkiui besipriešinančių jėgų atstojamoji:

$$F_Q := \frac{\left[\left(N - F_f\right) \cdot \mu \cdot d_d + 1.5 \cdot F_f \cdot \frac{d}{\pi} \right]}{2 \cdot \left(1.5 \cdot h_d + d_d\right)} = -4.921 \text{ kN}$$

$\text{pamatas} := \text{if}\left[F_Q \geq 0.5 \cdot (\eta + 1) \cdot Q_d, \text{"nepasisuka"}, \text{"pasisuka"} \right] = \text{"pasisuka"}$

Pamato posukio centro gylis nuo skaičiuojamojo pagrindo paviršiaus z0:

$$z_0 := \frac{d_d}{1 + \frac{(Q_d \cdot \eta - F_Q)}{Q_d - F_Q}} = 1.354 \quad m$$

kadangi := if$(z_0 < d_d, \text{"u formule tinka"}, \text{"netinka"}) = \text{"u formule tinka"}$

$$R_{s0.5} := 0.04 q_c \cdot 10^{-3} + 0.1 = 0.24$$

Horizontalus pagrindo standumo modulis:

$$C_h := \frac{R_{s0.5} \cdot 10^3}{0.005 \cdot d} = 1.714 \times 10^5$$

$$u_u := 0.01 \cdot d = 2.8 \times 10^{-3} \quad m$$

$$i_u := 0.005 \quad m$$

$$u := \left[4 Q_d \cdot \frac{(1.5 h_d + d_d)}{C_h \cdot d \cdot d_d^{\,2}}\right] \cdot \left[1 + \frac{(h - d_d)}{z_0}\right] \cdot \left(1 - \frac{F_Q}{Q_d}\right) = 1.848 \times 10^{-3} \quad m$$

poslinkis:= if$(u < u_u, \text{"poslinkis leistinas"}, \text{"poslinkis neleistinas"}) = \text{"poslinkis leistinas"}$

$$i := \frac{u}{(z_0 + h - d_d)} = 5.029 \times 10^{-4} \quad m$$

pasisukimas:= if$(i < i_u, \text{"pasisukimas leistinas"}, \text{"pasisukimas neleistinas"}) = \text{"pasisukimas leistinas"}$

Gylis kuriame veikia didžiausias lenkimo momentas

Grunto prie pamato šoninio paviršiaus vidutinis stipris:

$$R_f := \frac{F_f}{\pi \cdot d \cdot d_d} = 31.224 \quad kN$$

Gylis, kuriame veikia didžiausias lenkimo momentas:

$$z_m := z_0 - \sqrt{z_0^{\,2} - \frac{\left(1 - \frac{d^2 \cdot R_f}{2 \cdot Q_d}\right) \cdot d_d^{\,2} \cdot z_0}{2 \cdot (1.5 \cdot h_d + d_d)}} = 0.205 \quad m$$

Didžiausias polių veikiantis lenkimo momentas:

$$M := Q_d \cdot (h_d + z_m) - \frac{2 \cdot Q_d}{3 \cdot d_d^{\,2} \cdot z_0} \cdot (1.5 \cdot h_d + d_d)(3 \cdot z_0 - z_m) \cdot z_m^{\,2} - \frac{d^2}{2} \cdot R_f \cdot z_m = 9.657 \quad kNm$$

Išvada: sukamoji laikomoji galia pakankama

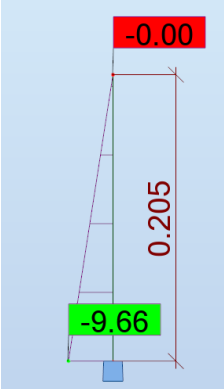
Reikalingas poliaus armavimas.

Reikalingas minimalus armavimas:

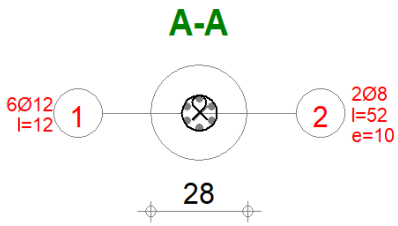
Polius					
d=	300	mm	Ac=	0.0707	m2
Armatūra					
d=	12	mm	As=	6.7824	cm2
n=	6	vnt			
			Reikalingas armatūros plotas		
			Asreik=0,005*Ac=	3.5325	cm2

Reikalingas armavimas veikiant didžiausiam lenkimo momentui M z_m poliaus gylyje.
Skaičiuojant poliaus armavimas priimamas poliaus ilgis lygus z_m gyliui ir parenkama horizontali apkrova, veikiant kuriai susidaro M momentas.

Poliaus skaičiuojamoji schema ir veikiantis momentas nuo uždėtos horizontalios apkrovos:



Reikalingas armavimas:



1 Level:

- Name :
- Reference level : 0.000 (m)
- Concrete creep coefficient : φ_p = 1.98
- Cement class : N
- Environment class : XC2
- Structure class : S4

2 Column: Column1

Number of identical elements: 1

2.1 Material properties:

- Concrete : C25/30 f_{ck} = 25.00 (MPa)
  Unit weight : 2501.36 (kG/m3)
  Aggregate size : 20.0 (mm)
- Longitudinal reinforcement: : B500B f_{yk} = 500.00 (MPa)
  Ductility class : B
- Transversal reinforcement: : B500B f_{yk} = 500.00 (MPa)
- Modified partial coefficients:
  α_{cc} = 0.9 1992-1-1 3.1.6 (1)P

2.2 Geometry:

2.2.1	C	
	Diameter	= 28.0 (cm)
2.2.2	Height: L	= 0.205 (m)
2.2.3	Slab thickness	= 0.000 (m)
2.2.4	Beam height	= 0.000 (m)
2.2.5	Cover	= 8.5 (cm)

2.3 Calculation options:

- Calculations according to : EN 1992-1-1:2004/A1:2014
- Seismic dispositions : No requirements
- Precast column : yes
- Pre-design : no
- Slenderness taken into account : yes
- Compression : with bending
- Ties : to slab
- Fire resistance class : No requirements

2.4 Calculation results:

Safety factors Rd/Ed = 2.26 > 1.0

2.4.1 ULS/ALS Analysis

Design combination: COMB1 (B)
Combination type: ULS
Internal forces:
Nsd = 0.42 (kN) Msdy = 9.66 (kN*m) Msdz = 0.00 (kN*m)
Design forces:
Lower node
N = 0.42 (kN) N*etotz = 9.66 (kN*m) N*etoty= 0.01 (kN*m)

Eccentricity:		ez (My/N) (cm)	ey (Mz/N) (cm)
Initial	e0:	2309.8	0.0
Imperfection	ei:	0.1	0.0
I order (e0 + ei)	e0Ed:	2310.0	0.0
Minimal	eEdmin:	2.0	2.0
Total	eEd:	2310.0	2.0

2.4.1.1. Detailed analysis-Direction Y:

2.4.1.1.1 Slenderness analysis

Non-sway structure

L (m)	Lo (m)	λ	λlim	
0.205	0.410	5.86	842.47	Short column

2.4.1.1.2 Buckling analysis

MA = 0.00 (kN*m) MB = 9.66 (kN*m)
Case: Cross-section at the column end (Lower node), Slenderness not taken into account
M0 = 9.66 (kN*m)
ei = θ1*lo/2 = 0.1 (cm)

$\theta 1 = \theta o * \alpha \eta * \alpha m = 0.01$
$\theta o = 0.01$
$\alpha h = 1.00$
$\alpha m = (0,5(1+1/m))^{0.5} = 1.00$
$m = 1.00$
Ma = N*ei = 0.00 (kN*m)
MEdmin = 0.01 (kN*m)
M0Ed = max(MEdmin,M0 + Ma) = 9.66 (kN*m)

2.4.1.2. Detailed analysis-Direction Z:

2.4.1.2.1 Slenderness analysis

Non-sway structure

L (m)	Lo (m)	λ	λlim	
0.205	0.410	5.86	842.47	Short column

2.4.1.2.2 Buckling analysis

MA = 0.00 (kN*m) MB = 0.00 (kN*m)
Case: Cross-section at the column end (Lower node), Slenderness not taken into account
M0 = 0.00 (kN*m)
ei = 0.0 (cm)
Ma = N*ei = 0.00 (kN*m)
MEdmin = 0.01 (kN*m)
M0Ed = max(MEdmin,M0 + Ma) = 0.01 (kN*m)

2.4.2 Reinforcement:

Real (provided) area	Asr = 6.79 (cm2)
Ratio:	ρ = 1.10 %

2.5 Reinforcement:

Main bars (B500B):
- 6 ϕ12 l = 0.120 (m)

Transversal reinforcement: (B500B):
stirrups: 2 ϕ8 l = 0.515 (m)

3 Material survey:

- Concrete volume = 0.013 (m3)
- Formwork = 0.180 (m2)

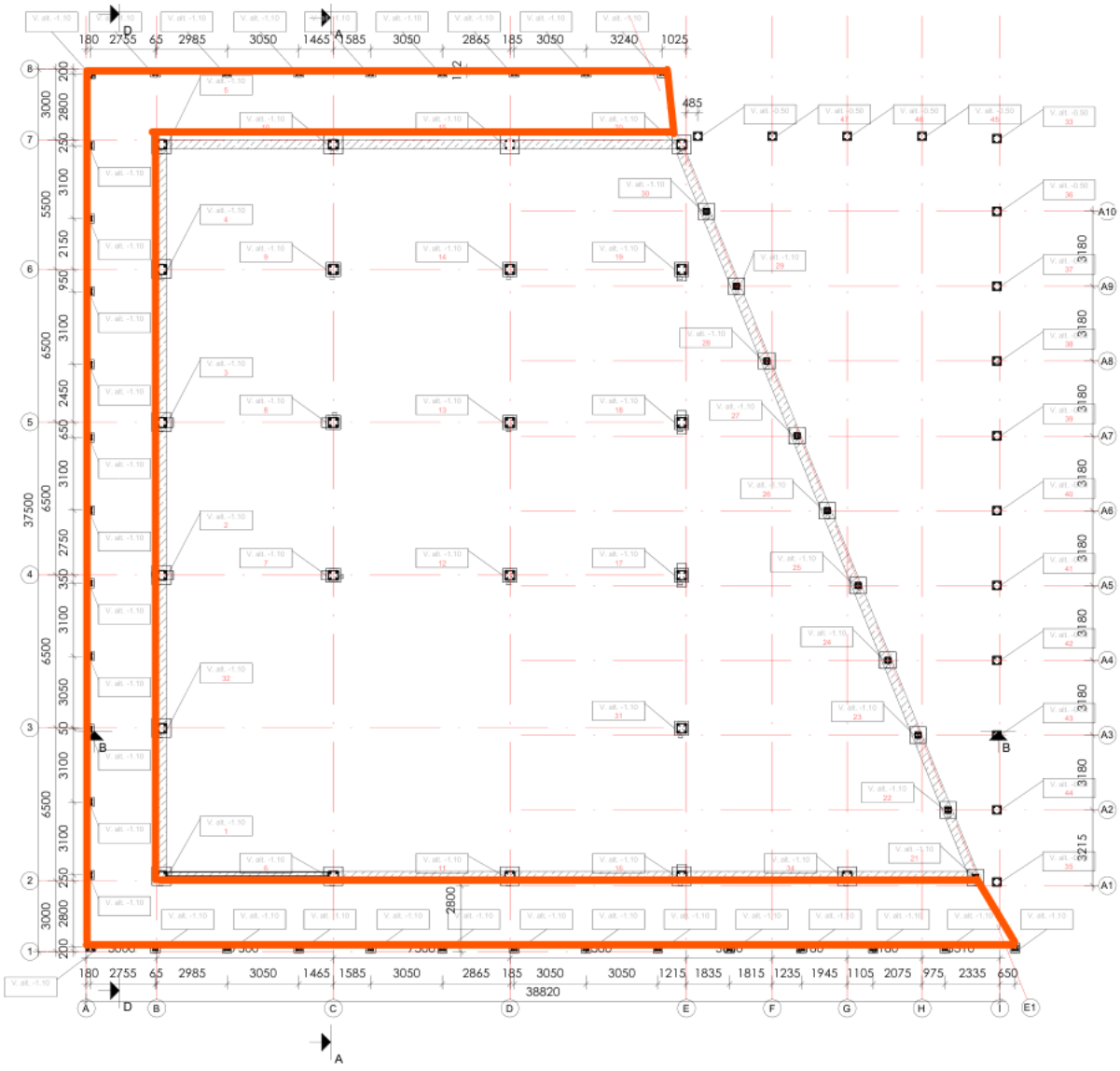
- Steel B500B
  - Total weight = 1.05 (kG)
  - Density = 82.85 (kG/m3)
  - Average diameter = 9.6 (mm)
  - Reinforcement survey:

Diameter	Length (m)	Weight (kG)	Number (No.)	Total weight (kG)
8	0.515	0.20	2	0.41
12	0.120	0.11	6	0.64

Išvada: laikomoji galia pakankama. Polis armuojamas pagal minimalius konstrukcinius reikalavimus 6xd12 išilginiais strypais. Skersinė armatūra išdėstoma pagal konstrukcinius reikalavimus.

2.11.5. Santvarinio stogelio polių projektavimas

Skaičiuojami poliai po santvarinio stogelio kolonomis. Stogelio vieta plane:



Silpniausias sluoksnis, į kurį remiami pastato poliai po lauko kolonomis moreninis smėlingas molis, kurio qc=11 kPa. Trinties stipriai imami pagal 1 gręžinio sluoksnių duomenis su mažiausiomis reikšmėmis. Poliai ant ašių 1, A, 8 su galvena 400x400x500mm. Poliaus geometrinis ilgis 6,20m, skersmuo 300mm. Poliaus skaičiuojamasis ilgis 2,6m. Polis remiamas į

IGS 5lst (abs. alt. 118.83). Šoninė trintis verinama pagal 1 gręžinį. Šoninė trintis vertinama nuo gręžinio 3 sluoksnio. 1 gręžinyje ir 2 gręžinyje aptiktas labai silpnas stipriai suspaudžiamas grunto tarpsluoksnis IGS3s 4,2m-5,1m gylyje. Jeigu pamato nuosėdžiai didesni daugiau, negu pusė ribinių nuosėdžių, reikia vertinti neigiamą trintį polyje. Durpės ir gruntas su organinėmis priemaišomis iškasamas ir piltinis gruntas polių skaičiavime nevertinamas.

Nuosėdžių skaičiavimas

Skaičiuojami pavienio polio nuosėžiai sumavimo metodu.

Polių eilių skičias B kryptimi mB	1	vnt
Polių eilių skičias L kryptimi mL	1	vnt
Atstumas tarp polių ašių B kryptimi aB	0	m
Atstumas tarp polių ašių L kryptimi aL	0	m
Polio skersmuo	0.3	m
Grunto vidinis trinties kampas	0	
Polių skaičius n	1	vnt
Poliaus ilgis	4.6	m
Rostverko aukštis	0.5	m
Rostverko viršaus altittudė	0.6	m

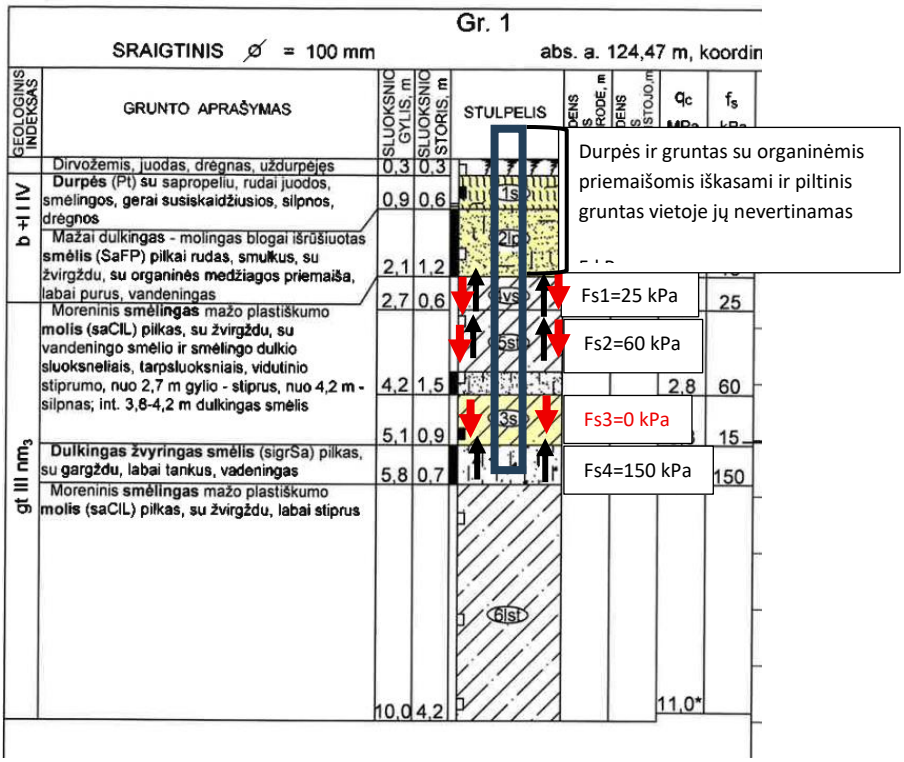
Eil. Nr.	d,m	γ, kN/m^3	σ_{zg}, kPa	$0{,}2\sigma_{zg}$, kPa	z,m	ξ=2z/b	η=l/b	K	σ_{zp}, kPa	$\sigma_{zp,vid}$, kPa	H_i, m	E, Mpa	S_i, m
1	5.7	22	125.4	25.08	0	0	1	1	211.90		0.06		
2	5.82	22	128	25.61	0.12	0.8	1	0.756	160.19	186	0.12	74.3	0.0003
3	5.94	22	130.7	26.14	0.24	1.6	1	0.39	82.64	121.4	0.12	74.3	0.0002
4	6.06	22	133.3	26.66	0.36	2.4	1	0.214	45.35	63.99	0.12	74.3	0.0001
5	6.18	22	136	27.19	0.48	3.2	1	0.13	27.55	36.45	0.12	74.3	6E-05
6	6.3	22	138.6	27.72	0.6	4	1	0.087	18.43	22.99	0.12	74.3	4E-05
												Σs_i=	0.0007

Ned	19	kN
B	0.3	m
L	0.3	m
A	0.09	m2
L1	0.15	m
B1	0.15	m

0,2 σzg>σzp

Išvada: 0,07cm<0,03*0,3=0,9cm. Kadangi nuosėdžiai yra mažesni negu pusė ribinių nuosėdžių, galima nevertinti neigiamos trinties virš silpno grunto sluoksnio ir grunto prie polio šonų trinties ribinį stiprumą priimti teigiamą, nors polio aplinkoje yra durpių tarpsluoksnių. Fs3 silpno grunto tarpsluoksnio šoninė trintis skaičiavimuose priimta lygi 0 kPa.

Šoninės trinties grafinis paaiškinimas (juoda rodykle pažymėta vertinama teigiama šoninė trintis, raudona rodykle pažymėta dėl mažų nuosėdžių nevertinama neigiama trintis):



Tempiamo poliaus laikomosios galios skaičiavimas:

Veikiančios įrąžos:

$N_{Ed.1} := 2 \cdot 10^{-3} = 2 \times 10^{-3}$ MN

$N_{Ed.2} := 2 \cdot 10^{-3} = 2 \times 10^{-3}$ 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 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	$\gamma_{st1} := 1.25$	$\gamma_{st2} := 1.15$	$\gamma_{st3} := 1.1$	$\gamma_{st4} := 1.60$

$\alpha_b := 0.5$

$\xi_3 := 1.29$

Grunto rodikliai:

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

$q_c := 0$ MPa

$f_{s1} := 0.025$ MPa $f_{s2} := 0.06$ MPa $f_{s3} := 0.0$ MPa $f_{s4} := 0.15$ MPa $f_{s5} := 0.0$ MPa $f_{s6} := 0.0$ MPa $f_{s7} := 0.0$ MPa

Geometriniai rodikliai:

$f_{s8} := 0.0$ MPa

$h_1 := 0.6$ m $h_2 := 1.5$ m $h_3 := 0.9$ m $h_4 := 0.64$ m $h_5 := 0.$ m $h_6 := 0.$ m $h_7 := 0.0$ m $h_8 := 0.0$ m

$d := 0.3 - 0.02 = 0.28$ m

$A_p := \frac{\pi \cdot d^2}{4} = 0.062$ m^2

$A_{š1} := \pi \cdot d \cdot h_1 = 0.528$ m^2 $A_{š2} := \pi \cdot d \cdot h_2 = 1.319$ m^2 $A_{š3} := \pi \cdot d \cdot h_3 = 0.792$ m^2

$A_{š4} := \pi \cdot d \cdot h_4 = 0.563$ m^2 $A_{š5} := \pi \cdot d \cdot h_5 = 0$ m^2 $A_{š6} := \pi \cdot d \cdot h_6 = 0$ m^2

$A_{š7} := \pi \cdot d \cdot h_7 = 0$ m^2 $A_{š8} := \pi \cdot d \cdot h_8 = 0$ m^2

Pirmas projektavimo atvejis:
A1+M1+R1

$q_b := \alpha_b \cdot q_c = 0$ MPa

$R_b := q_b \cdot A_p = 0$ MN

$R_s := f_{s1} \cdot A_{š1} + f_{s2} \cdot A_{š2} + f_{s3} \cdot A_{š3} + f_{s4} \cdot A_{š4} + f_{s5} \cdot A_{š5} + f_{s6} \cdot A_{š6} + f_{s7} \cdot A_{š7} + f_{s8} \cdot A_{š8} = 0.177$

$R_{c.cal1} := \frac{R_b}{\gamma_{b1}} + \frac{R_s}{\gamma_{s1}} = 0.177$ MN

$R_{c.k1} := \frac{R_{c.cal1}}{\xi_3} = 0.137$ MN

$R_{c.d1} := \frac{R_{c.k1}}{\gamma_{st1}} = 0.11$ MN

$\frac{N_{Ed.1}}{R_{c.d1}} = 0.018$

Antras projektavimo atvejis:
A2+M1+R4

$R_{c.cal2} := \frac{R_b}{\gamma_{b4}} + \frac{R_s}{\gamma_{s4}} = 0.136$ MN

$R_{c.k2} := \frac{R_{c.cal2}}{\xi_3} = 0.105$ MN

$R_{c.d2} := \frac{R_{c.k2}}{\gamma_{st4}} = 0.066$ MN

$\frac{N_{Ed.2}}{R_{c.d2}} = 0.03$

Išvada: laikomoji galia pakankama

Gniuždomo poliaus laikomosios galios skaičiavimas:

Veikiančios įrąžos:

$N_{Ed.1} := 24 \cdot 10^{-3} = 0.024$ MN

$N_{Ed.2} := 22 \cdot 10^{-3} = 0.022$ 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 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	$\gamma_{st1} := 1.25$	$\gamma_{st2} := 1.15$	$\gamma_{st3} := 1.1$	$\gamma_{st4} := 1.60$

$\alpha_b := 0.5$

$\xi_3 := 1.29$

Grunto rodikliai:

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

$q_c := 11$ MPa

$f_{s1} := 0.025$ MPa $f_{s2} := 0.06$ MPa $f_{s3} := 0.0$ MPa $f_{s4} := 0.15$ MPa $f_{s5} := 0.0$ MPa $f_{s6} := 0.0$ MPa $f_{s7} := 0.0$ MPa

Geometriniai rodikliai:

$f_{s8} := 0.0$ MPa

$h_1 := 0.6$ m $h_2 := 1.5$ m $h_3 := 0.9$ m $h_4 := 0.64$ m $h_5 := 0.0$ m $h_6 := 0$ m $h_7 := 0.0$ m $h_8 := 0.0$ m

$d := 0.3 - 0.02 = 0.28$ m

$A_p := \frac{\pi \cdot d^2}{4} = 0.062$ m^2

$A_{š1} := \pi \cdot d \cdot h_1 = 0.528$ m^2 $A_{š2} := \pi \cdot d \cdot h_2 = 1.319$ m^2 $A_{š3} := \pi \cdot d \cdot h_3 = 0.792$ m^2

$A_{š4} := \pi \cdot d \cdot h_4 = 0.563$ m^2 $A_{š5} := \pi \cdot d \cdot h_5 = 0$ m^2 $A_{š6} := \pi \cdot d \cdot h_6 = 0$ m^2

$A_{š7} := \pi \cdot d \cdot h_7 = 0$ m^2 $A_{š8} := \pi \cdot d \cdot h_8 = 0$ m^2

Pirmas projektavimo atvejis:
A1+M1+R1

$q_b := \alpha_b \cdot q_c = 5.5$ MPa

$R_b := q_b \cdot A_p = 0.339$ MN

$R_s := f_{s1} \cdot A_{š1} + f_{s2} \cdot A_{š2} + f_{s3} \cdot A_{š3} + f_{s4} \cdot A_{š4} + f_{s5} \cdot A_{š5} + f_{s6} \cdot A_{š6} + f_{s7} \cdot A_{š7} + f_{s8} \cdot A_{š8} = 0.177$

$R_{c.cal1} := \frac{R_b}{\gamma_{b1}} + \frac{R_s}{\gamma_{s1}} = 0.485$ MN

$R_{c.k1} := \frac{R_{c.cal1}}{\xi_3} = 0.376$ MN

$R_{c.d1} := \frac{R_{c.k1}}{\gamma_{t1}} = 0.342$ MN

$\frac{N_{Ed.1}}{R_{c.d1}} = 0.07$

Antras projektavimo atvejis:
A2+M1+R4

$R_{c.cal2} := \frac{R_b}{\gamma_{b4}} + \frac{R_s}{\gamma_{s4}} = 0.37$ MN

$R_{c.k2} := \frac{R_{c.cal2}}{\xi_3} = 0.286$ MN

$R_{c.d2} := \frac{R_{c.k2}}{\gamma_{t4}} = 0.205$ MN

$\frac{N_{Ed.2}}{R_{c.d2}} = 0.108$

Išvada: laikomoji galia pakankama

Sukamosios laikomosios galios skaičiavimas:

$q_c := 11000$ kPa $f_{si1} := 25$ kPa $f_{si2} := 60$ $f_{si3} := 0$ $f_{si4} := 150$ $f_{si5} := 150$ $f_{si6} := 0$ $f_{si7} := 0$ $f_{si8} := 0$

$N := 19$ kN $h_1 := 0.6$ $h_2 := 1.5$ $h_3 := 0.9$ $h_4 := 0.64$ $h_5 := 0.0$ $h_6 := 0.0$ $h_7 := 0.0$ $h_8 := 0.0$

$M_d := 0.1$ kNm

$Q_d := 3$ kN Nevertinamo sluoksnio gylis:

$d := 0.3 - 0.02 = 0.28$ m $h_s := 3.6$ m

Poliaus geometrinis ilgis:

$h := 6.2$ m

Pagrindo stiprumas po pamato padu: iš 6.22, 6.23 grafikų

$R_{s2} := 0.12 \cdot q_c \cdot 10^{-3} + 0.24 = 1.56$ MPa

$A_b := 3.14 \cdot \frac{(d^2)}{4} = 0.062$

Trinties jėga prie pamato šonų:

$F_f := 3.14 \cdot d \cdot \left(h_1 \cdot \frac{f_{si1}}{3} + h_2 \cdot \frac{f_{si2}}{3} + h_3 \cdot \frac{f_{si3}}{3} + h_4 \cdot \frac{f_{si4}}{3} + h_5 \cdot \frac{f_{si5}}{3} + h_6 \cdot \frac{f_{si6}}{3} + h_7 \cdot \frac{f_{si7}}{3} + h_8 \cdot \frac{f_{si8}}{3} \right) = 58.906$ kN

Slėgis po pamato padu:

$p := \frac{(N - F_f)}{A_b} = -648.421$ kPa ne daugiau nei Rs2

Pasisukimas ir pasislinkimas

Skaičiuojamasis pamato gylis:

$d_d := h_1 + h_2 + h_3 + h_4 + h_5 + h_6 + h_7 + h_8 = 3.64$ m

Horiozntalios jėgos nuo momento aukštis virš pamato

$h_m := \frac{M_d}{Q_d} = 0.033$

Horizontalios jėgos pridėties taško skaičiuojamasis aukštis:

$h_d := h - d_d + h_m = 2.593$ m

$\eta := \frac{(1.5 \cdot h_d + 0.5 \cdot d_d)}{1.5 \cdot h_d + d_d} = 0.758$ $\mu := 0.35$ (nuo grunto tipo)

Kai Ff>N

$F_Q := \frac{\left(10 + 1.5 \cdot F_f \cdot \frac{d}{\pi}\right)}{2 \cdot (1.5 \cdot h_d + d_d)} = 1.187$ kN

$\text{pamatas} := \text{if}\left[F_Q \geq 0.5 \cdot (\eta + 1) \cdot Q_d, \text{"nepasisuka"}, \text{"pasisuka"}\right] = \text{"pasisuka"}$

Pamato posukio centro gylis nuo skaičiuojamojo pagrindo paviršiaus z0:

$$z_0 := \frac{d_d}{1 + \frac{(Q_d \cdot \eta - F_Q)}{Q_d - F_Q}} = 2.275 \quad m$$

kadangi := if$(z_0 < d_d, \text{"u formule tinka"}, \text{"netinka"}) = \text{"u formule tinka"}$

$R_{s0.5} := 0.04 q_c \cdot 10^{-3} + 0.1 = 0.54$

Horizontalus pagrindo standumo modulis:

$$C_h := \frac{R_{s0.5} \cdot 10^3}{0.005 \cdot d} = 3.857 \times 10^5$$

$u_u := 0.01 \cdot d = 2.8 \times 10^{-3}$ m

$i_u := 0.005$ m

$$:= \left[4 Q_d \cdot \frac{(1.5 h_d + d_d)}{C_h \cdot d \cdot d_d^2}\right] \cdot \left[1 + \frac{(h - d_d)}{z_0}\right] \cdot \left(1 - \frac{F_Q}{Q_d}\right) = 8.111 \times 10^{-5} \quad m$$

poslinkis:= if$(u < u_u, \text{"poslinkis leistinas"}, \text{"poslinkis neleistinas"}) = \text{"poslinkis leistinas"}$

$$:= \frac{u}{(z_0 + h - d_d)} = 1.678 \times 10^{-5} \quad m$$

pasisukimas:= if$(i < i_u, \text{"pasisukimas leistinas"}, \text{"pasisukimas neleistinas"}) = \text{"pasisukimas leistinas"}$

Gylis kuriame veikia didžiausias lenkimo momentas

Grunto prie pamato šoninio paviršiaus vidutinis stipris:

$$R_f := \frac{F_f}{\pi \cdot d \cdot d_d} = 18.397 \quad kN$$

Gylis, kuriame veikia didžiausias lenkimo momentas:

$$z_m := z_0 - \sqrt{z_0^2 - \frac{\left(1 - \frac{d^2 \cdot R_f}{2 \cdot Q_d}\right) \cdot d_d^2 \cdot z_0}{2 \cdot (1.5 \cdot h_d + d_d)}} = 0.363 \quad m$$

Didžiausias polių veikiantis lenkimo momentas:

$$M := Q_d \cdot (h_d + z_m) - \frac{2 \cdot Q_d}{3 \cdot d_d^2 \cdot z_0} \cdot (1.5 \cdot h_d + d_d)(3 \cdot z_0 - z_m) \cdot z_m^2 - \frac{d^2}{2} \cdot R_f \cdot z_m = 8.182 \quad kNm$$

Išvada: sukamoji laikomoji galia pakankama

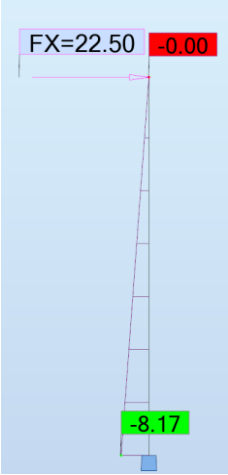
Reikalingas poliaus armavimas.

Reikalingas minimalus armavimas:

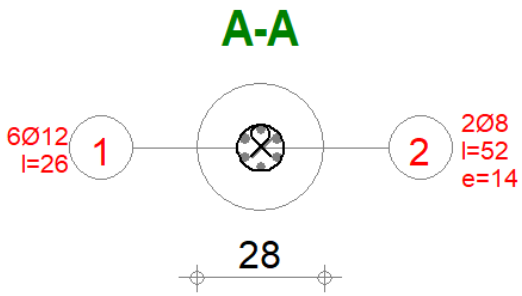
Polius					
d=	300	mm	Ac=	0.0707	m2
Armatūra					
d=	12	mm	As=	6.7824	cm2
n=	6	vnt			
			Reikalingas armatūros plotas		
			Asreik=0,005*Ac=	3.5325	cm2

Reikalingas armavimas veikiant didžiausiam lenkimo momentui M z_m poliaus gylyje.
Skaičiuojant poliaus armavimas priimamas poliaus ilgis lygus z_m gyliui ir parenkama horizontali apkrova, veikiant kuriai susidaro M momentas.

Poliaus skaičiuojamoji schema ir veikiantis momentas nuo uždėtos horizontalios apkrovos:



Reikalingas armavimas:



1 Level:

- Name :
- Reference level : 0.000 (m)
- Concrete creep coefficient : φ_p = 1.98
- Cement class : N
- Environment class : XC2
- Structure class : S4

2 Column: Column1

Number of identical elements: 1

2.1 Material properties:

- Concrete : C25/30 f_{ck} = 25.00 (MPa)
  Unit weight : 2501.36 (kG/m3)
  Aggregate size : 20.0 (mm)
- Longitudinal reinforcement: : B500B f_{yk} = 500.00 (MPa)
  Ductility class : B
- Transversal reinforcement: : B500B f_{yk} = 500.00 (MPa)

- Modified partial coefficients:
  α_{cc} = 0.9 1992-1-1 3.1.6 (1)P

2.2 Geometry:

2.2.1	C	
	Diameter	= 28.0 (cm)
2.2.2	Height: L	= 0.363 (m)
2.2.3	Slab thickness	= 0.000 (m)
2.2.4	Beam height	= 0.000 (m)
2.2.5	Cover	= 8.5 (cm)

2.3 Calculation options:

- Calculations according to : EN 1992-1-1:2004/A1:2014
- Seismic dispositions : No requirements
- Precast column : yes
- Pre-design : no
- Slenderness taken into account : yes
- Compression : with bending
- Ties : to slab
- Fire resistance class : No requirements

2.4 Calculation results:

Safety factors Rd/Ed = 2.67 > 1.0

2.4.1 ULS/ALS Analysis

Design combination: COMB1 (B)
Combination type: ULS
Internal forces:
Nsd = 0.74 (kN) Msdy = 8.17 (kN*m) Msdz = 0.00 (kN*m)
Design forces:
Lower node
N = 0.74 (kN) N*etotz = 8.17 (kN*m) N*etoty= 0.01 (kN*m)

Eccentricity:		ez (My/N) (cm)	ey (Mz/N) (cm)
Initial	e0:	1103.4	0.0
Imperfection	ei:	0.2	0.0
I order (e0 + ei)	e0Ed:	1103.6	0.0
Minimal	eEdmin:	2.0	2.0
Total	eEd:	1103.6	2.0

2.4.1.1. Detailed analysis-Direction Y:

2.4.1.1.1 Slenderness analysis

Non-sway structure

L (m)	Lo (m)	λ	λlim	
0.363	0.726	10.37	633.11	Short column

2.4.1.1.2 Buckling analysis

MA = 0.00 (kN*m) MB = 8.17 (kN*m)
Case: Cross-section at the column end (Lower node), Slenderness not taken into account
M0 = 8.17 (kN*m)
ei = θ1*lo/2 = 0.2 (cm)
θ1 = θo ∗ αη ∗ αm = 0.01
θo = 0.01
αh = 1.00
αm = (0,5(1+1/m))^0.5 = 1.00
m = 1.00
Ma = N*ei = 0.00 (kN*m)
MEdmin = 0.01 (kN*m)
M0Ed = max(MEdmin,M0 + Ma) = 8.17 (kN*m)

2.4.1.2. Detailed analysis-Direction Z:

2.4.1.2.1 Slenderness analysis

Non-sway structure

L (m)	Lo (m)	λ	λlim	
0.363	0.726	10.37	633.11	Short column

2.4.1.2.2 Buckling analysis

MA = 0.00 (kN*m) MB = 0.00 (kN*m)
Case: Cross-section at the column end (Lower node), Slenderness not taken into account
M0 = 0.00 (kN*m)
ei = 0.0 (cm)
Ma = N*ei = 0.00 (kN*m)
MEdmin = 0.01 (kN*m)
M0Ed = max(MEdmin,M0 + Ma) = 0.01 (kN*m)

2.4.2 Reinforcement:

Real (provided) area	Asr = 6.79 (cm2)
Ratio:	ρ = 1.10 %

2.5 Reinforcement:

Main bars (B500B):
- 6 ϕ12 l = 0.278 (m)

Transversal reinforcement: (B500B):
stirrups: 2 ϕ8 l = 0.515 (m)

3 Material survey:

- Concrete volume = 0.022 (m3)
- Formwork = 0.319 (m2)

- Steel B500B
  - Total weight = 1.89 (kG)
  - Density = 84.45 (kG/m3)
  - Average diameter = 10.5 (mm)
  - Reinforcement survey:

Diameter	Length (m)	Weight (kG)	Number (No.)	Total weight (kG)
8	0.515	0.20	2	0.41

12	0.278	0.25	6	1.48

Išvada: laikomoji galia pakankama. Polis armuojamas minimalius konstrukcinius reikalavimus 6xd12 išilginiais strypais. Skersinė armatūra išdėstoma pagal konstrukcinius reikalavimus

2.11.6. Pamatų santykinių nuosėdžių skaičiavimas

Tikrinami P-1 ir P-2 pamatų santykiniai nuosėdžiai:

$$\Delta s = s_2 - s_1 = 0,89 - 0,7 = 0,19\ cm;$$

$$\Delta s_L = \frac{\Delta s}{L_{min}} = \frac{0,19}{530} = 0,0004 < 0,0020.\ \textbf{Sąlyga tenkinama.}$$

Tikrinami P-2 ir P-3 pamatų santykiniai nuosėdžiai:

$$\Delta s = s_2 - s_3 = 0,89 - 0,84 = 0,05\ cm;$$

$$\Delta s_L = \frac{\Delta s}{L_{min}} = \frac{0,05}{245} = 0,0002 < 0,0020.\ \textbf{Sąlyga tenkinama.}$$

Tikrinami P-1 ir P-3 pamatų santykiniai nuosėdžiai:

$$\Delta s = s_3 - s_1 = 0,84 - 0,7 = 0,14\ cm;$$

$$\Delta s_L = \frac{\Delta s}{L_{min}} = \frac{0,14}{730} = 0,0002 < 0,0020.\ \textbf{Sąlyga tenkinama.}$$

Tikrinami P-3 ir P-4 pamatų santykiniai nuosėdžiai:

$$\Delta s = s_3 - s_4 = 0,84 - 0,07 = 0,77\ cm;$$

$$\Delta s_L = \frac{\Delta s}{L_{min}} = \frac{0,77}{323} = 0,002 < 0,0020.\ \textbf{Sąlyga tenkinama.}$$

Tikrinami P-3 ir P-5 pamatų santykiniai nuosėdžiai:

$$\Delta s = s_3 - s_5 = 0,84 - 0,2 = 0,64\ cm;$$

$$\Delta s_L = \frac{\Delta s}{L_{min}} = \frac{0,64}{335} = 0,002 < 0,0020.\ \textbf{Sąlyga tenkinama.}$$

Tikrinami P-1 ir P-4 pamatų santykiniai nuosėdžiai:

$$\Delta s = s_1 - s_4 = 0,7 - 0,07 = 0,63\ cm;$$

$$\Delta s_L = \frac{\Delta s}{L_{min}} = \frac{0,63}{320} = 0,002 < 0,0020.$$ **Sąlyga tenkinama.**

2.12. Grindų plokštės skaičiavimas

Grindų plokštė yra pjaunam į deformacinius blokus ne didesnius kaip 6x6m. Skaičiuojamas vienas deformacinis blokas ant tampraus pagrindo. Grindų plokštės storis 80mm. Grindų plokštės betonas C20/25 XC1. Grindų plokštė armuojama plienine fibra, kurią parenka plieninės fibros gamintojas.

Grunto elastinio koeficiento nustatymas:

Soil elastic coefficient

Soil layers

Layer	Name	Level (m)	Thickness (m)	IL/ID	Consolidation symbol	Moisture type
1	Medium gravel	0.000	0.200	0.40	---	---
2	Gravel	-0.200	0.350	0.40	---	---
3	Coarse sand	-0.550	0.200	0.40	---	---
4	Fine sand	-0.750	2.330	0.80	---	---
5	Clay	-3.080	0.600	0.00	---	---
6	Clay	-3.680	1.500	0.00	---	---
7	Clayey silt	-5.180	0.900	0.00	---	---
8	Coarse sand	-6.080	0.700	0.40	---	---
9	Clay	-6.780	---	0.00	---	---

Other soil parameters:

Layer	Name	Cohesion (MPa)	Friction angle (Deg)	Unit weight (kG/m3)	Mo (MPa)	M (MPa)
1	Medium gravel	0.00	38.0	1937.46	133.33	133.33
2	Gravel	0.00	38.0	1937.46	133.33	133.33
3	Coarse sand	0.00	32.0	1886.47	84.00	84.00
4	Fine sand	0.00	30.0	1886.47	144.00	144.00
5	Clay	0.06	25.0	2243.38	78.00	78.00
6	Clay	0.06	25.0	2243.38	78.00	78.00
7	Clayey silt	0.06	25.0	2039.43	78.00	78.00
8	Coarse sand	0.00	32.0	1886.47	84.00	84.00
9	Clay	0.06	25.0	2243.38	78.00	78.00

Average elastic coefficient for layered soil

K = 52813.00 (kN/m3)

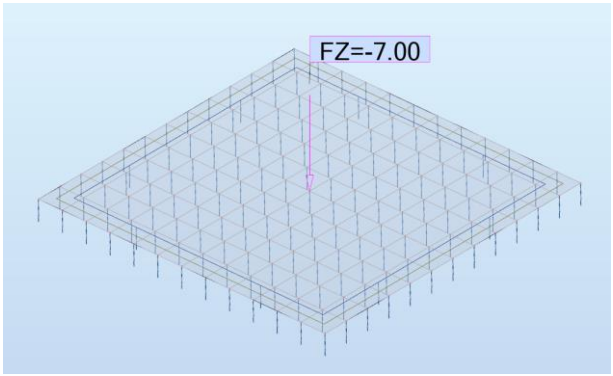
Equivalent elastic coefficient

For raft foundation which dimensions are 6 * 6 (m)
with estimated foundation load: 5 (kPa)
KZ = 52813.00 (kN/m3)

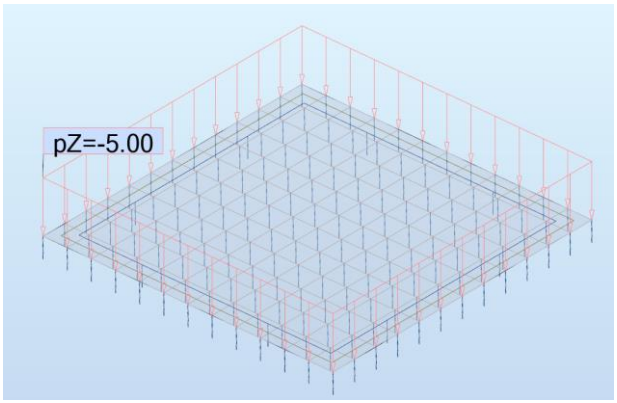
	Name	Level (m)	Thickness (m)	Color	Unit weight (kG/m3)	Friction angle (Deg)	Cohesion (MPa)	ν	Eo (MPa)
1	Medium gravel	0.000	0.200		1937.46	38.0	0.00	0.20	150.00
2	Gravel	-0.200	0.350		1937.46	38.0	0.00	0.20	120.00
3	Coarse sand	-0.550	0.200		1886.47	32.0	0.00	0.25	80.00
4	Fine sand	-0.750	2.330		1886.47	30.0	0.00	0.25	25.00
5	Clay	-3.080	0.600		2243.38	25.0	0.06	0.25	16.00
6	Clay	-3.680	1.500		2243.38	25.0	0.06	0.25	39.90
7	Clayey silt	-5.180	0.900		2039.43	25.0	0.06	0.25	39.90
8	Coarse sand	-6.080	0.700		1886.47	32.0	0.00	0.25	8.00
9	Clay	-6.780			2243.38	25.0	0.06	0.25	118.00

Vertinami du variantai plokštės apkrovimo:

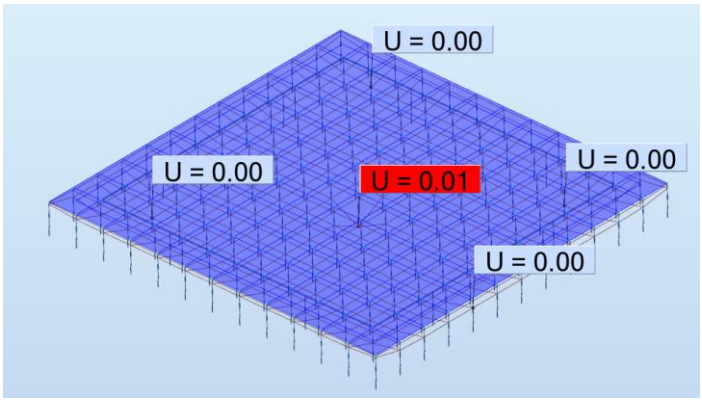
1 variantas – koncentruota naudojimo apkrova:



2 variantas – išskirstyta naudojimo apkrova:



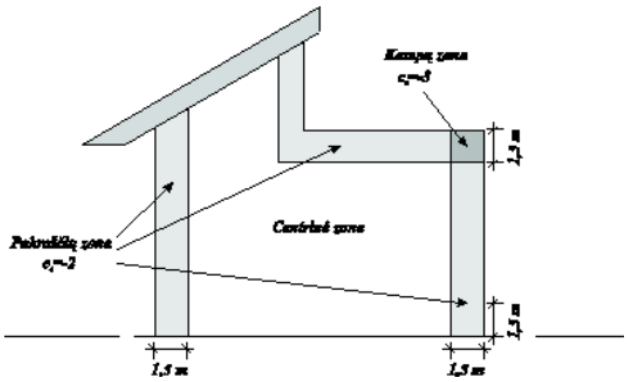
Plokštės deformacijos nuo tinkamumo ribinio būvio derinių:



Išvada: perdangos deformacijos 0,01cm<0,7cm (mažiausias pamato po kolona nuosėdis). Sąlyga tenkinama

2.13. Vėdinamos sistemos tvirtinimo elemento prie pagrindo ištraukimo iš pagrindo arba nutraukimo jėgos skaičiavimas

Sienų zonavimo schema pagal STR2.04.01:2018:



1.2 paveikslas. Pastato sienų aerodinaminių koeficientų nustatymo schema. Pagal išorinį sienų kontūrą išilgai paviršiaus 1,5 m plotyje esančiose vietose aerodinaminis koeficientas c_e= -2; 1,5 m nuo pastato kampo aerodinaminis koeficientas c_e= -3.

Vėdinamos sistemos inkarų projektinis atplėšimo stipris R_{mt}:

$R_{mt} = \frac{N_{rt} \cdot n}{g_{mt}}$.

Čia:

N_{rt} – tvirtinimo prie pagrindo elemento ištraukimo jėga iš pagrindo, kurią pateikia gamintojas (kN); Priimama 2 kN;

n – bendras tvirtinimo elementų kiekis pagal gamintojo tvirtinimo elementų išdėstymo schemą (vnt/m^2); Kronšteinų žingsnis 0,6 m.

g_{mt} – atsargos koeficintas mechaniškai tvirtinamai vėdinamai sistemai. Jeigu vėdinama sistema suprojektuota iš CE ženklu ženklintų statybos produktų ir suminis vėdinamos sistemos karkaso ir apdailos elementų svoris ne didesnis kaip 30 kg/m^2, $g_{mt} = 2$.

Kampų zonos:

Aukštis h [m]	Vietovės tipas	Atvira sienos dalis mažesnė nei 5 %	Vėjo stiprumas $v_{ref,0}$ [m/s]	Skaičiuojama vieta
5.75	B	Taip	24	Kampas

c(z)	c_i	c_e
0.5225	0.2	-3

Vėdinamos sistemos atplėšimo nuo pagrindo stipris R_{vent} (kPa) turi būti ne mažesnis užprojektinę vėjo apkrovą s_{ds} (kPa): $R_{vent} \geq s_{ds}$

kur:

projektinė vėjo apkrova: $s_{ds} = 0{,}001 \cdot |w_{sum}| \cdot \gamma_Q =$ -0.85 [kPa];

suminis vėjo slėgis į atitvaros paviršių: $w_{sum} = w_{me} - w_i =$ -651.04 [Pa];

vėjo slėgis į išorinį (priešvėjinį) atitvaros paviršių: $w_{me} = q_{ref} \cdot c(z) \cdot c_e =$ -610.35 [Pa];

vėjo slėgis į vidinį (pavėjinį) atitvaros paviršių: $w_{me} = q_{ref} \cdot c(z) \cdot c_i =$ 40.69 [Pa];

atskaitinis vėjo slėgis: $q_{ref} = \frac{\rho}{2} \cdot v_{ref}^2 =$ 389.38 [Pa];

atskaitinis vėjo greitis: $v_{ref} = c_{DIR} \cdot c_{TEM} \cdot c_{ALT} \cdot v_{ref,0} \cdot 1{,}04 =$ 24.96 [m/s];

čia: $\rho = 1{,}25 kg/m^3$; $c_{DIR} = 1{,}0$; $c_{TEM} = 1{,}0$; $c_{ALT} = 1{,}0$; $\gamma_Q = 1{,}3$.

Vėdinamos sistemos tvirtinimo elemento prie pagrindo ištraukimo iš pagrindo jėga arba nutraukimo jėga skaičiuojama pagal:

$$s_{ds} = \frac{N_{(Rt;tv)} \cdot n_{vent}}{\gamma_{vent}} \rightarrow N_{(Rt;tv)} = \frac{s_{ds} \cdot \gamma_{vent}}{n_{vent}} =$$ -0.60453 [kN];

čia:

vėdinamos sistemos tvirtinimo prie pagrindo elementų kiekis: $n_{vent} =$ 2.8 $[vnt./m^2]$;

atsargos koeficientas vėdinamai sistemai: $\gamma_{vent} =$ 2 .

Išvada: $N_{rt} = 2\ kN > N_{(rt,tv)} = 0,60\ kN.$, inkarų ištaukimo laikomoji galia pakankama. Inkarų žingsnis 0,6 m.

Pakraščių zonos:

Aukštis h [m]	Vietovės tipas	Atvira sienos dalis mažesnė nei 5 %	Vėjo stiprumas $v_{ref,0}$ [m/s]	Skaičiuojama vieta
5.75	B	Taip	24	Pakraštys

c(z)	c_i	c_e
0.5225	0.2	-2

Vėdinamos sistemos atplėšimo nuo pagrindo stipris R_{vent} (kPa) turi būti ne mažesnis užprojektinę vėjo apkrovą s_{ds} (kPa): $R_{vent} \geq s_{ds}$

kur:

projektinė vėjo apkrova: $s_{ds} = 0{,}001 \cdot |w_{sum}| \cdot \gamma_Q =$ -0.58 [kPa];

suminis vėjo slėgis į atitvaros paviršių: $w_{sum} = w_{me} - w_i =$ -447.59 [Pa];

vėjo slėgis į išorinį (priešvėjinį) atitvaros paviršių: $w_{me} = q_{ref} \cdot c(z) \cdot c_e =$ -406.90 [Pa];

vėjo slėgis į vidinį (pavėjinį) atitvaros paviršių: $w_{me} = q_{ref} \cdot c(z) \cdot c_i =$ 40.69 [Pa];

atskaitinis vėjo slėgis: $q_{ref} = \frac{\rho}{2} \cdot v_{ref}^2 =$ 389.38 [Pa];

atskaitinis vėjo greitis: $v_{ref} = c_{DIR} \cdot c_{TEM} \cdot c_{ALT} \cdot v_{ref,0} \cdot 1{,}04 =$ 24.96 [m/s];

čia: $\rho = 1{,}25 kg/m^3$; $c_{DIR} = 1{,}0$; $c_{TEM} = 1{,}0$; $c_{ALT} = 1{,}0$; $\gamma_Q = 1{,}3$.

Vėdinamos sistemos tvirtinimo elemento prie pagrindo ištraukimo iš pagrindo jėga arba nutraukimo jėga skaičiuojama pagal:

$$s_{ds} = \frac{N_{(Rt;tv)} \cdot n_{vent}}{\gamma_{vent}} \rightarrow N_{(Rt;tv)} = \frac{s_{ds} \cdot \gamma_{vent}}{n_{vent}} =$$ -0.41562 [kN];

čia:

vėdinamos sistemos tvirtinimo prie pagrindo elementų kiekis: $n_{vent} =$ 2.8 $[vnt./m^2]$;

atsargos koeficientas vėdinamai sistemai: $\gamma_{vent} =$ 2 .

Išvada: $N_{rt} = 2\ kN > N_{(rt,tv)} = 0,42\ kN.$, inkarų ištaukimo laikomoji galia pakankama.

Inkarų žingsnis 0,6 m.

Centrinė zona:

Aukštis h [m]	Vietovės tipas	Atvira sienos dalis mažesnė nei 5 %	Vėjo stiprumas $v_{ref,0}$ [m/s]	Skaičiuojama vieta
5.75	B	Taip	24	Centras

c(z)	c_i	c_e
0.5225	0.2	-0.8

Vėdinamos sistemos atplėšimo nuo pagrindo stipris R_{vent} (kPa) turi būti ne mažesnis užprojektinę vėjo apkrovą s_{ds} (kPa): $R_{vent} \geq s_{ds}$

kur:

projektinė vėjo apkrova: $s_{ds} = 0{,}001 \cdot |w_{sum}| \cdot \gamma_Q =$ -0.26 [kPa];

suminis vėjo slėgis į atitvaros paviršių: $w_{sum} = w_{me} - w_i =$ -203.45 [Pa];

vėjo slėgis į išorinį (priešvėjinį) atitvaros paviršių: $w_{me} = q_{ref} \cdot c(z) \cdot c_e =$ -162.76 [Pa];

vėjo slėgis į vidinį (pavėjinį) atitvaros paviršių: $w_{me} = q_{ref} \cdot c(z) \cdot c_i =$ 40.69 [Pa];

atskaitinis vėjo slėgis: $q_{ref} = \frac{\rho}{2} \cdot v_{ref}^2 =$ 389.38 [Pa];

atskaitinis vėjo greitis: $v_{ref} = c_{DIR} \cdot c_{TEM} \cdot c_{ALT} \cdot v_{ref,0} \cdot 1{,}04 =$ 24.96 [m/s];

čia: $\rho = 1{,}25 kg/m^3$; $c_{DIR} = 1{,}0$; $c_{TEM} = 1{,}0$; $c_{ALT} = 1{,}0$; $\gamma_Q = 1{,}3$.

Vėdinamos sistemos tvirtinimo elemento prie pagrindo ištraukimo iš pagrindo jėga arba nutraukimo jėga skaičiuojama pagal:

$$s_{ds} = \frac{N_{(Rt;tv)} \cdot n_{vent}}{\gamma_{vent}} \rightarrow N_{(Rt;tv)} = \frac{s_{ds} \cdot \gamma_{vent}}{n_{vent}} =$$ -0.18892 [kN];

čia:

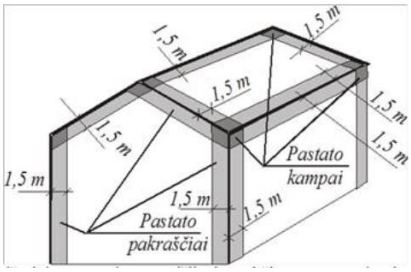
vėdinamos sistemos tvirtinimo prie pagrindo elementų kiekis: $n_{vent} =$ 2.8 $[vnt./m^2]$;

atsargos koeficientas vėdinamai sistemai: $\gamma_{vent} =$ 2 .

Išvada: $N_{rt} = 2\ kN > N_{(rt,tv)} = 0,19\ kN.$, inkarų ištaukimo laikomoji galia pakankama. Inkarų žingsnis 0,6 m.

2.14. Smeigių kiekio stogui skaičiavimas

Stogo zonavimo schema pagal STR2.04.01:2018:



Stogo izoliacijos tvirtinimui naudojamų smeigių kiekis apskaičiuojamas pagal STR 2.04.01:2018 3 priedo 1.1 p. formulę:

$$n_f = \frac{w_{sum}}{W_f} \cdot \gamma_Q; \tag{3.1}$$

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 = 0,4 kN;

γ_Q – vėjo poveikio dalinio patikimumo koeficientas (γ_Q = 1,3).

Kampų zonos:

Aukštis h [m]	Vietovės tipas	Atvira sienos dalis mažesnė nei 5 %	Vėjo stiprumas $v_{ref,0}$ [m/s]	Skaičiuojama vieta
5.75	B	Taip	24	Kampas

c(z)	c_i	c_e
0.5225	0.2	-3

Vėdinamos sistemos atplėšimo nuo pagrindo stipris R_{vent} (kPa) turi būti ne mažesnis užprojektinę vėjo apkrovą s_{ds} (kPa): $R_{vent} \geq s_{ds}$

kur:

projektinė vėjo apkrova:	$s_{ds} = 0{,}001 \cdot \lvert w_{sum} \rvert \cdot \gamma_Q =$	-0.85	[kPa];
suminis vėjo slėgis į atitvaros paviršių:	$w_{sum} = w_{me} - w_i =$	-651.04	[Pa];
vėjo slėgis į išorinį (priešvėjinį) atitvaros paviršių:	$w_{me} = q_{ref} \cdot c(z) \cdot c_e =$	-610.35	[Pa];
vėjo slėgis į vidinį (pavėjinį) atitvaros paviršių:	$w_{me} = q_{ref} \cdot c(z) \cdot c_i =$	40.69	[Pa];
atskaitinis vėjo slėgis:	$q_{ref} = \frac{\rho}{2} \cdot v_{ref}^2 =$	389.38	[Pa];
atskaitinis vėjo greitis:	$v_{ref} = c_{DIR} \cdot c_{TEM} \cdot c_{ALT} \cdot v_{ref,0} \cdot 1{,}04 =$	24.96	[m/s];

čia: $\rho = 1{,}25 kg/m^3$; $c_{DIR} = 1{,}0$; $c_{TEM} = 1{,}0$; $c_{ALT} = 1{,}0$; $\gamma_Q = 1{,}3$.

$$n_{f1} = \frac{w_{sum1}}{W_f} \cdot \gamma_Q = \frac{0{,}651}{0{,}4} \cdot 1{,}3 = 2{,}1 \rightarrow priimamas\ smeigių\ skaičius: 3\ vnt./m^2.$$

Pakraščių zonos:

Aukštis h [m]	Vietovės tipas	Atvira sienos dalis mažesnė nei 5 %	Vėjo stiprumas $v_{ref,0}$ [m/s]	Skaičiuojama vieta
5.75	B	Taip	24	Pakraštys

c(z)	Ci	Ce
0.5225	0.2	-2

Vėdinamos sistemos atplėšimo nuo pagrindo stipris R_{vent} (kPa) turi būti ne mažesnis užprojektinę vėjo apkrovą s_{ds} (kPa): $R_{vent} \geq s_{ds}$

kur:

projektinė vėjo apkrova:	$s_{ds} = 0{,}001 \cdot \lvert w_{sum} \rvert \cdot \gamma_Q =$	-0.58	[kPa];
suminis vėjo slėgis į atitvaros paviršių:	$w_{sum} = w_{me} - w_i =$	-447.59	[Pa];
vėjo slėgis į išorinį (priešvėjinį) atitvaros paviršių:	$w_{me} = q_{ref} \cdot c(z) \cdot c_e =$	-406.90	[Pa];
vėjo slėgis į vidinį (pavėjinį) atitvaros paviršių:	$w_{me} = q_{ref} \cdot c(z) \cdot c_i =$	40.69	[Pa];
atskaitinis vėjo slėgis:	$q_{ref} = \frac{\rho}{2} \cdot v_{ref}^2 =$	389.38	[Pa];
atskaitinis vėjo greitis:	$v_{ref} = c_{DIR} \cdot c_{TEM} \cdot c_{ALT} \cdot v_{ref,0} \cdot 1{,}04 =$	24.96	[m/s];

čia: $\rho = 1{,}25 kg/m^3$; $c_{DIR} = 1{,}0$; $c_{TEM} = 1{,}0$; $c_{ALT} = 1{,}0$; $\gamma_Q = 1{,}3$.

$$n_{f2} = \frac{w_{sum2}}{W_f} \cdot \gamma_Q = \frac{0{,}447}{0{,}4} \cdot 1{,}3 = 1{,}45 \rightarrow priimamas\ smeigių\ skaičius: 2\ vnt./m^2.$$

Centrinė zona:

Aukštis h [m]	Vietovės tipas	Atvira sienos dalis mažesnė nei 5 %	Vėjo stiprumas $v_{ref,0}$ [m/s]	Skaičiuojama vieta
5.75	B	Taip	24	Centras

c(z)	c_i	c_e
0.5225	0.2	-0.8

Vėdinamos sistemos atplėšimo nuo pagrindo stipris R_{vent} (kPa) turi būti ne mažesnis užprojektinę vėjo apkrovą s_{ds} (kPa): $R_{vent} \geq s_{ds}$

kur:

projektinė vėjo apkrova: $s_{ds} = 0{,}001 \cdot |w_{sum}| \cdot \gamma_Q =$ -0.26 [kPa];

suminis vėjo slėgis į atitvaros paviršių: $w_{sum} = w_{me} - w_i =$ -203.45 [Pa];

vėjo slėgis į išorinį (priešvėjinį) atitvaros paviršių: $w_{me} = q_{ref} \cdot c(z) \cdot c_e =$ -162.76 [Pa];

vėjo slėgis į vidinį (pavėjinį) atitvaros paviršių: $w_{me} = q_{ref} \cdot c(z) \cdot c_i =$ 40.69 [Pa];

atskaitinis vėjo slėgis: $q_{ref} = \frac{\rho}{2} \cdot v_{ref}^2 =$ 389.38 [Pa];

atskaitinis vėjo greitis: $v_{ref} = c_{DIR} \cdot c_{TEM} \cdot c_{ALT} \cdot v_{ref,0} \cdot 1{,}04 =$ 24.96 [m/s];

čia: $\rho = 1{,}25 kg/m^3$; $c_{DIR} = 1{,}0$; $c_{TEM} = 1{,}0$; $c_{ALT} = 1{,}0$; $\gamma_Q = 1{,}3$.

$$n_{f3} = \frac{w_{sum3}}{W_f} \cdot \gamma_Q = \frac{0{,}203}{0{,}4} \cdot 1{,}3 = 0{,}66 \rightarrow priimamas\ smeigių\ skaičius: 1\ vnt./m^2.$$

2.15. Medienos ir kitų organinių medžiagų iš atsinaujinančių gamtos išteklių pagrindu pagamintų statybos produktų kiekio pastatuose apskaičiavimas

Visuomeninės paskirties pastatuose turi būti panaudota bent 50 procentų medienos ir kitų organinių medžiagų iš atsinaujinančių gamtos išteklių pagrindu pagamintų statybos produktų, taikant aplinkos ministro patvirtintą Medienos ir kitų organinių medžiagų iš atsinaujinančių gamtos išteklių pagrindu pagamintų statybos produktų pastatuose apskaičiavimo metodiką.

NEĮTRAUKIAMI Į SKAIČIAVIMUS ELEMENTAI	
1.	Pastato požeminė dalis, įskaitant perdangą su grindimis virš požeminės dalies
2.	Evakuacinės ir avarinės laiptinės ir jų sudėtiniai elementai
3.	Ugniasienės ir priešgaisrinės atitvaros
4.	Sanitarinės patalpos
5.	Konstrukcijos, kuriose organinių statybos produktų būtų neįmanoma panaudoti techniškai ar dėl apsauginių priemonių ir (ar) didelių priežiūros kaštų, ir (ar) dėl visuomenės sveikatos saugos reglamentų (higienos normų) reikalavimų, ir (ar) dėl taikomų su įslaptinta informacija susijusių apsaugos reikalavimų
6.	Priedangų ir slėptuvių konstrukcijos
7.	Statinio sąramos, kai jos įtrauktos į bendrą mūro tūrį
8.	Lauko konstrukcijos (lauko laiptai ir kitos statinio lauko konstrukcijos)
9.	Statinio konstrukcijų jungtys ir tvirtinimo elementai
10.	Statinio konstrukcijų tuštumos ir (ar) ertmės

CO_2 kiekis (kg/m^3)		
	užkonservuotas	išskiriamas
P_{CO2}	770.0	
PG_{CO2}		300.0
PP_{CO2}		14500.0
PB_{CO2}		300.0
PEB_{CO2}		150.0
PS_{CO2}		250.0

Papildomi koef.	
k_{ilg} =	1.0
$k_{G,ilg}$ =	0.4
$k_{P,ilg}$ =	1.0
D_{PL} =	7.85
k_f =	0.7
s =	0.275
Fasadas:	**Vėdinamas**

MEDŽIAGŲ KIEKIAI				
Medinės konstrukcijos				
V_{KVM}	**0.00**	m^3	-	Vidaus medžio kolonos, statramsčiai
V_{KIM}	**3.06**	m^3	-	Išorės medžio kolonos
V_{PM}	**70.99**	m^3	-	Medžio perdangos (plokštės, sijos)
V_{DM}	**0.00**	m^3	-	Medžio denginys (stogas)
V_{ISM}	**0.00**	m^3	-	Išorės medžio sienos
V_{VSM}	**0.00**	m^3	-	Vidaus medžio sienos
Papildomi mediniai elementai				
V_{FM}	**57.71**	m^3	-	Fasadinė medžio danga
V_{AM}	**19.04**	m^3	-	Vidaus medžio apdaila
V_{GM}	**0.00**	m^3	-	Grindų medžio danga
V_{LDM}	**0.00**	m^3	-	Mediniai durų segmentai, langų rėmai
V_{IZM}	**0.00**	m^3	-	Medžio ir (ar) kitos atsinaujinančios organinės izoliacinės medžiagos

Gelžbetoninės ir betoninės konstrukcijos				
V_{KVG}	**19.26**	m^3	-	Vidaus gelžbetonio kolonos
V_{KIG}	**0.00**	m^3	-	Išorės gelžbetonio kolonos
V_{PG}	**43.45**	m^3	-	Gelžbetonio plokštės, sijos
V_{DG}	**112.32**	m^3	-	Gelžbetonio denginys (stogas)
V_{ISG}	**0.00**	m^3	-	Išorės gelžbetonio sienos
V_{VSG}	**0.00**	m^3	-	Vidaus gelžbetonio sienos
Mūrinės konstrukcijos				
V_{KVB}	**0.00**	m^3	-	Vidaus mūro kolonos
V_{KIB}	**0.00**	m^3	-	Išorės mūro kolonos
V_{PB}	**0.00**	m^3	-	Perdangų blokeliai
V_{DB}	**0.00**	m^3	-	Denginio blokeliai
V_{ISB}	**0.00**	m^3	-	Išorės mūro sienos
V_{VSB}	**63.00**	m^3	-	Vidaus mūro sienos
Plieninės konstrukcijos (ir armatūra)				
M_{KVP}	**2.89**	t	-	Vidaus kolonos
M_{KIP}	**10.33**	t	-	Išorės kolonos
M_{PP}	**8.49**	t	-	Plokštės, sijos
M_{DP}	**7.55**	t	-	Denginys (stogas)
M_{ISP}	**0.00**	t	-	Išorės sienos
M_{VSP}	**0.00**	t	-	Vidaus sienos
Gelžbetoninės ir betoninės konstrukcijos (ekologiškas betonas, kurio CO_2 emisija yra <= 200 kg/m^3)				
V_{KEVB}	**0.00**	m^3	-	Vidaus kolonos
V_{KEIB}	**0.00**	m^3	-	Išorės kolonos
V_{PEB}	**0.00**	m^3	-	Plokštės, sijos
V_{DEB}	**0.00**	m^3	-	Denginys (stogas)
V_{ISEB}	**0.00**	m^3	-	Išorės sienos
V_{VSEB}	**0.00**	m^3	-	Vidaus sienos
Stiklinis fasadas				
A_{SF}	**368.66**	m^2	-	Fasado plotas įvertinus arba neįvertinus langų apšviestumo ploto

Pagrindinių konstrukcijų organinių medžiagų užkonservuojamas CO_2 kiekis (kg):	
$PM(CO_2)$ =	57016.96
Ekvivalentinis tūris (m^3):	
V_{ML} =	74.05

Papildomų elementų organinių medžiagų užkonservuojamas CO_2 kiekis (kg):	
$PNM(CO_2)$ =	59094.42
Ekvivalentinis papildomų medinių elementų tūris (m^3):	
V_{NML} =	76.75

Nemedinių pagrindinių konstrukcijų išskiriamas į aplinką CO_2 kiekis (kg):	
$PN(CO_2)$ =	169052.21
Gelžbetoninių ir betoninių konstrukcijų įprasto betono suminis tūris (m^3):	
V_{GL} =	175.03
Plieninių konstrukcijų suminė masė (t):	
M_{PL} =	26.16
Mūrinių konstrukcijų suminis tūris (m^3):	
V_{BL} =	63.00
Ekologiško betono ir gelžbetonio konstrukcijų iš ekologiško betono suminis tūris (m^3):	
V_{EBL} =	0.00

Medienos ir kitų organinių statybos produktų kiekio pastate procentinė dalis:		
NAUDOJAMA 2.2 FORMULĖ!		
P_{med} =	54.41	%

Išvada: 54,41%>50%, medienos ir kitų organinių medžiagų kiekis yra pakankamas.