Investitor:	LUČKA UPRAVA SPLIT 21000 Split, Gat Sv. Duje OIB: 06992092556
Naziv građevine:	REKONSTRUKCIJA I DOGRADNJA GATA SV.PETRA
Lokacija građevine:	Gradska luka Split k.č.br. dio 9544/2, k.o. SPLIT
Zajednička oznaka projekta:	GSP
Broj projekta:	VAK-04/23
Redni broj mape:	5
Razina razrade:	IZVEDBENI PROJEKT
Strukovna odrednica:	GRAĐEVINSKI PROJEKT
Projektirani dio građevine:	PROJEKT ČELIČNIH KONSTRUKCIJA
Datum izrade projekta:	travanj, 2024.
Glavni projektant:	Dalibor Crnac, dipl.ing.građ., Ovlašteni inženjer građevinarstva, G 4292 Hrvatska komora inženjera građevinarstva Digitalno potpisao Dalibor Crnac SN: C=HR; O=HKIG; OID.2.5.4.97=VATHR-65080653676; OU=Signature; SN=Crnac; G=Dalibor; SERIALNUMBER=PNOHR-55623509704; CN=Dalibor Crnac Datum: 28.05.2024_08:13:14_+02'00'
Projektant:	Stjepan Medić, dipl.ing.građ. Ovlašteni inženjer građevinarstva, G 2275 HRVATSKA KOMORA INŽENJERA GRAĐEVINARSTVA Stjepan Medić dipl. ing. građ. Ovlašteni inženjer građevinarstva G 2275 Digitally signed by Stjepan Medić DN: cn=Stjepan Medić, c=HR, o=HKIG, ou=Signature Date: 23.05.2024. 14:02:17
Direktor:	Matija Vaniček, dipl.ing.arh. vaniček arhitekti Digitally signed by MATIJA VANIČEK DN: cn=MATIJA VANIČEK, c=HR, o=HRIDCA, ou=Identification Date: 23.05.2024. 14:05:33

SADRŽAJ:

A. OPĆI DIO

B. TEHNIČKI DIO

B.1 TEKSTUALNI DIO

TEHNIČKI OPIS

Tri stupa nadstrešnice su na starom doku, a ostali na novom. Kako su dokovi međusobno dilatirani, potrebno je konstrukciju nadstrešnice rastaviti. Na starom doku biti će tri nadstrešnice šestorokutnog oblika sa stupom u središtu. Razmak ta tri šesterokuta od ostalog dijela nadstrešnice, prema projektu gata, treba biti minimalno 7,5cm, kako bi se omogućio pomak 5cm uzdužno i 5cm okomito na dilataciju. Kod postavljanja obšava, treba osigurati iste pomake u suprotnom smjeru.

Odvajanje nadstrešnica zahtijeva nešto jače poprečne presjeke, vijke i čvorne ploče nastavaka. Svi nastavci izrađuju se prema osnovnom projektu, ali korigiranih dimenzija prema proračunu u prilogu. U grafičkom dijelu prikazani su detalji izvornog projekta, koji treba poslužiti kao neku vrst upute za izradu. Međutim vijke i dimenzije treba korigirati prema proračunima koji su prilog tekstualnog dijela projekta.

Na novom doku nadstrešnica se slaže od 5 pojedinačnih nadstrešnica šestorokunog oblika, bez razmaka ali međusobno povezanih vijcima, te na taj način postižemo jednu konstrukciju. Sve dimenzije i nastavci odgovaraju odvojenim nadstrešnicama uz dodatak vijčanih spojeva za međusobno povezivanje. Povezivanje postižemo ugradnjom po 3 vijka M16-8.8 uzduž osi priljubljenih bridova od UNP180 profila. Dva vijka su maksimalno 300mm udaljena od kraja štepa s obje strane te jedan u sredini. Vijci su odabrani zbog robusnosti i trajnosti, proračunski bi mogli biti M12.

Alternativno moguće je nadstrešnicu izraditi kao jednu cjelinu, zamjenjujući dodirne bridove (2xUNP180) jednim INP180.

U oba slučaja izvođač konstrukcije odabire mjesta nastavaka vijcima UNP180 i INP180, na način prikazan detaljima.

Oba slučaja zadovoljavaju važeće propise u pogledu mehaničke otpornosti i stabilnosti.

PREDVIĐENI MATERIJALI

Beton

Za izvedbu nosive a-b konstrukcije rabiti slijedeće razrede betona:

- **temelji : C 35/45**

  zaštitni sloj c_{nom}= 50 mm; (razred izloženosti: XS2, XS3)

  aditiv za vodonepropusnost VDP2

Armatura

Za izvedbu temelja koristimo slijedeću armaturu:

- **šipkasta armatura - rebrasta: B500B; mrežasta armatura - rebrasta: B500B**

Konstrukcijski čelik

Za izvedbu čelične konstrukcije predviđeni su čelici:

- S355JR.
- Za montažne spojeve visokovrijedni vijci prema proračunu, minimalno 8.8.

Staklo za fasadu

Predviđeno je SIGURNOSNO lamelirano staklo od ploča debljine 6mm.

Predviđa se polukaljeno staklo prema TPZSK

POPIS PRIMIJENJENIH ZAKONA, PRAVILNIKA I TEHNIČKIH PROPISA

Primijenjeni su važeći zakoni, pravilnici i tehnički propisi, te pripadajuće norme na koje se isti pozivaju, u pogledu mehaničke otpornosti i stabilnosti predmetne građevine.

Popis primijenjenih zakona, pravilnika i propisa:

1. Zakon o gradnji (NN 153/13, 20/17,39/19,125/19) i prateći posebni propisi
2. Zakon o prostornom uređenju (NN RH 153/13, 65/17, 114/18, 39/19 ,98/19)
3. Tehnički propis za građevinske konstrukcije (NN 17/17, 75/20, 7/22)
4. Tehnički propis o građevnim proizvodima (NN. 35/18,104/19)
5. Zakon o zaštiti na radu (NN 71/14, 118/14, 94/18, 96/18)
6. Uredba o izmjeni Zakona zaštite na radu (154/14)
7. Zakon o zaštiti od požara (NN 92/10)
8. Zakon o građevnim proizvodima (NN 76/13, 30/14, 130/17,39/19, 118/20)
9. HRN EN 1990
10. HRN EN 1991, niz normi
11. HRN EN 1992, niz normi
12. HRN EN 1993, niz normi
13. HRN EN 1998, niz normi
14. HRN EN 1090-2 s pripadajućim nacionalnim dodatkom

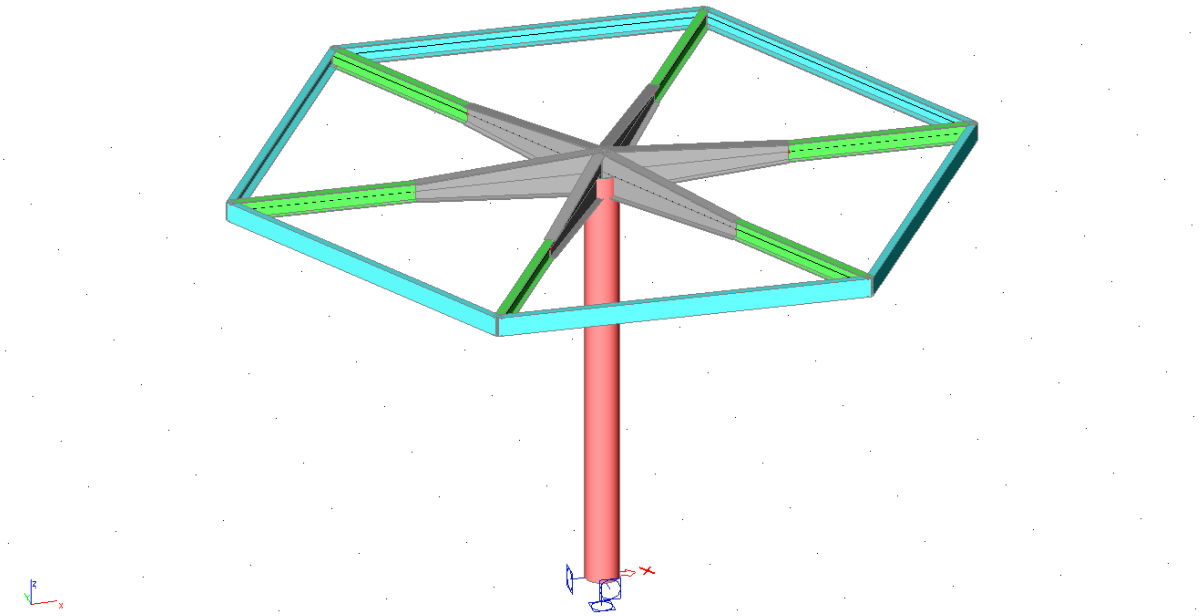
B.2 PRORAČUN KONSTRUKCIJE

Poz N1

PRORAČUNSKI MODEL NADSTEŠNICE NA JEDNOM STUPU OPTEREĆENJA NA KOSTRUKCIJI

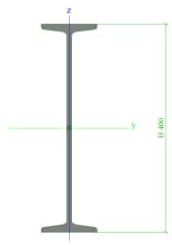
Opterećenja su preuzeta iz izvornog projekta konstrukcije.

MODEL KONSTRUKCIJE



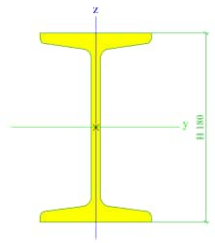
Cross-sections

Name	CS1
Type	I var
Detailed	INP240; 400
Item material	S 235
Fabrication	welded
Flexural buckling y-y	b
Flexural buckling z-z	c
Lateral torsional buckling	Default
Use 2D FEM analysis	×

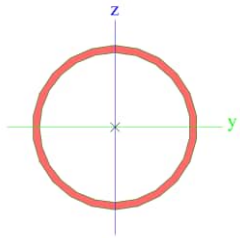


Name	CS2
Type	I var
Detailed	INP240; 180
Item material	S 235

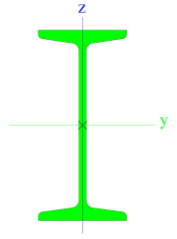
Fabrication	welded
Flexural buckling y-y	b
Flexural buckling z-z	c
Lateral torsional buckling	Default
Use 2D FEM analysis	×



Name	CS3
Type	RO323.9X14.2
Source description	Stahl im Hochbau / 14.Auflage Band I / Teil 1
Item material	S 235
Fabrication	rolled
Flexural buckling y-y	a
Flexural buckling z-z	a
Lateral torsional buckling	Default
Use 2D FEM analysis	×

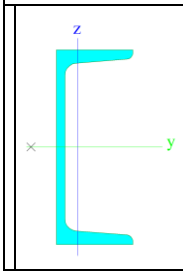


Name	CS4
Type	IPN180
Source description	ArcelorMittal / Sales Programme / Version 2012-1
Item material	S 235
Fabrication	rolled
Flexural buckling y-y	a
Flexural buckling z-z	b
Lateral torsional buckling	Default
Use 2D FEM analysis	×



Name	CS5
Type	UNP180
Source description	Stahlbau Zentrum Schweiz / Konstruktionstabellen / 9.Ausgabe 2005
Item material	S 235
Fabrication	rolled
Flexural buckling y-y	c

Flexural buckling z-z	c
Lateral torsional buckling	Default
Use 2D FEM analysis	×



REAKCIJE

Reactions

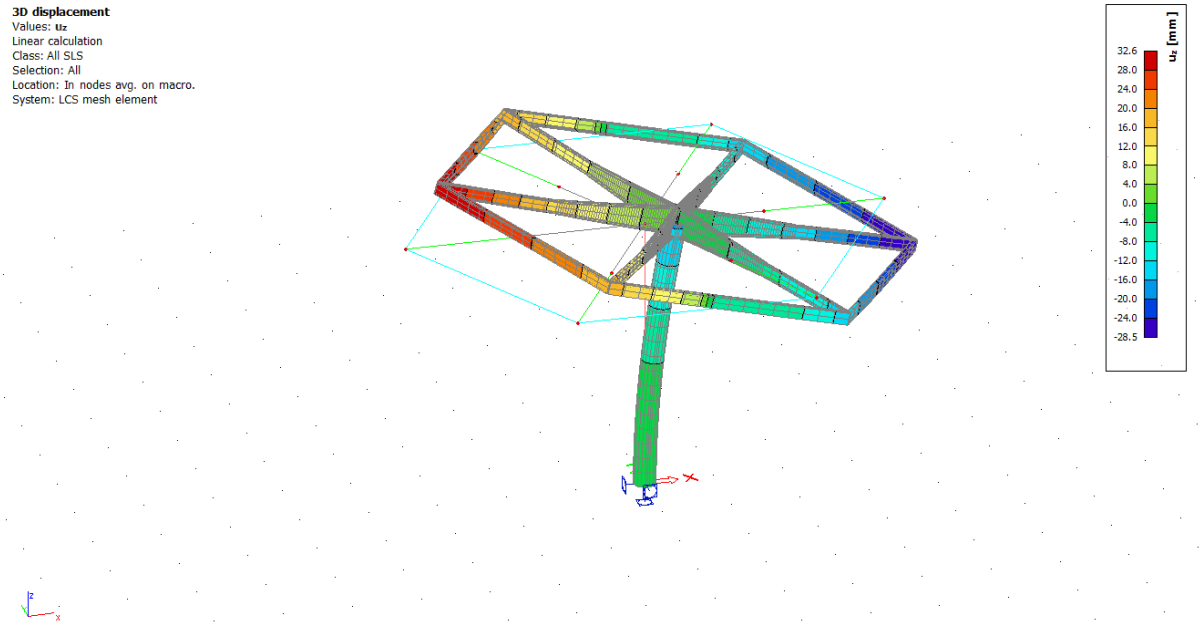
Linear calculation
Class: All ULS
System: Global
Extreme: Global
Selection: All

Nodal reactions

Name	Case	R_x [kN]	R_y [kN]	R_z [kN]	M_x [kNm]	M_y [kNm]	M_z [kNm]
Sn1/N1	KGS 4/1	0.00	0.00	-88.67	0.02	-0.03	0.00
Sn1/N1	KGS 3/2	0.00	0.00	86.51	-0.02	0.03	0.00
Sn1/N1	KGS 1/3	0.00	0.00	53.45	0.00	55.50	0.00
Sn1/N1	KGS 2/4	-12.16	0.00	-36.78	0.00	-123.58	0.00

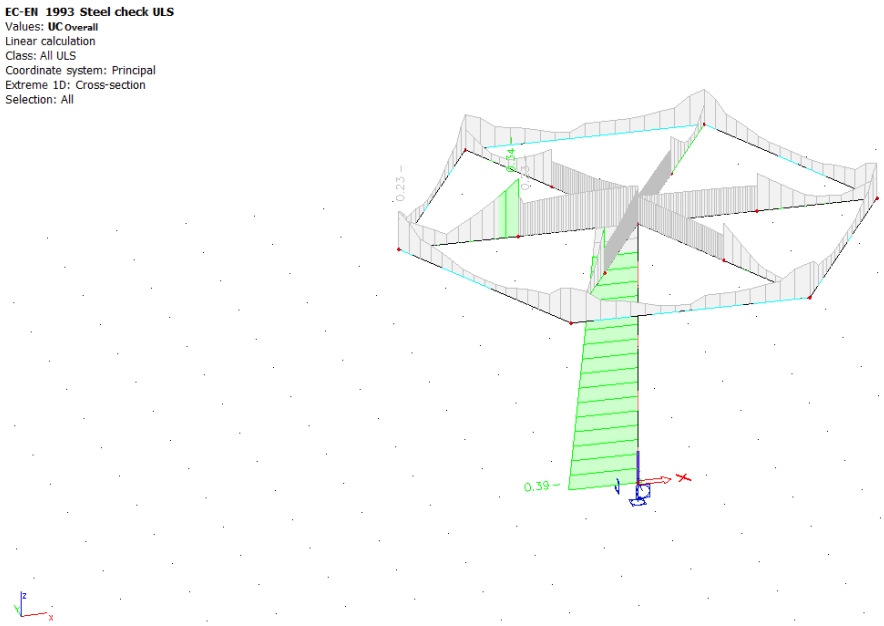
Name	Combination key
KGS 4/1	LC1 + LC2 + 1.50*LC7
KGS 3/2	1.35*LC1 + 1.35*LC2 + 0.90*LC3 + 1.50*LC6
KGS 1/3	1.35*LC1 + 1.35*LC2 + 0.90*LC3 + 1.50*LC4
KGS 2/4	LC1 + LC2 + 1.50*LC5

PROGIBI GREDA



-UVJET ZA STAKLO : za konzole: L/100= 35mm > 32.6 mm (progib nastao od rot. stupa ne utječe na stalko)

DIMENZIONIRANJE ELEMENATA



EC-EN 1993 Steel check ULS

Values: $UC_{Overall}$
Linear calculation
Class: All ULS
Coordinate system: Principal
Extreme 1D: Cross-section
Selection: All

EN 1993-1-1 Code Check
National annex: Standard EN

Member B1	0.000 / 4.000 m	RO323.9X14.2	Rolled	S 235	All ULS	0.39 -

Combination key
All ULS / LC1 + LC2 + 1.50*LC5

Partial safety factors		
Resistance of cross-sections	γ_{M0}	1.00
Resistance to instability	γ_{M1}	1.10
Resistance of net sections	γ_{M2}	1.25

Material			
Yield strength	f_y	235.0	MPa
Ultimate strength	f_u	360.0	MPa

...::SECTION CHECK::...

The critical check is on position 0.000 m

Internal forces		Calculated	Unit
Normal force	N_{Ed}	36.89	kN
Shear force	$V_{y,Ed}$	0.00	kN
Shear force	$V_{z,Ed}$	12.16	kN
Torsion	T_{Ed}	0.00	kNm
Bending moment	$M_{y,Ed}$	-123.58	kNm
Bending moment	$M_{z,Ed}$	0.00	kNm

Classification for cross-section design
Classification according to EN 1993-1-1 article 5.5.2
Classification of Tubular sections according to EN 1993-1-1 Table 5.2 Sheet 3

d [mm]	t [mm]	d / t [-]	Class 1 Limit [-]	Class 2 Limit [-]	Class 3 Limit [-]	Class
324	14	22.8	50.0	70.0	90.0	1

The cross-section is classified as Class 1

Tension check
According to EN 1993-1-1 article 6.2.3 and formula (6.5)

Cross-section area	A	1.3800e-02	m^2
Plastic tension resistance	$N_{pl,Rd}$	3243.00	kN
Ultimate tension resistance	$N_{u,Rd}$	3576.96	kN
Tension resistance	$N_{t,Rd}$	3243.00	kN
Unity check		0.01	-

Bending moment check for M_y
According to EN 1993-1-1 article 6.2.5 and formula (6.12),(6.13)

Plastic section modulus	$W_{pl,y}$	1.3620e-03	m^3
Plastic bending moment	$M_{pl,y,Rd}$	320.07	kNm
Unity check		0.39	-

Shear check for V_z
According to EN 1993-1-1 article 6.2.6 and formula (6.17)

Shear correction factor	η	1.20	
Shear area	A_v	8.7854e-03	m^2
Plastic shear resistance for V_z	$V_{pl,z,Rd}$	1191.97	kN
Unity check		0.01	-

Torsion check
According to EN 1993-1-1 article 6.2.7 and formula (6.23)

Index of fibre	Fibre	1	
Total torsional moment	τ_{Ed}	0.0	MPa
Elastic shear resistance	τ_{Rd}	135.7	MPa
Unity check		0.00	-

Note: The unity check for torsion is lower than the limit value of 0.05. Therefore torsion is considered as insignificant and is ignored in the combined checks.

Combined bending, axial force and shear force check
According to EN 1993-1-1 article 6.2.9.1 and formula (6.31)

Resultant bending moment	$M_{resultant}$	123.58	kNm
Resultant shear force	$V_{resultant}$	12.16	kN
Design plastic moment resistance reduced due to N_{Ed}	$M_{N,Rd}$	319.91	kNm
Unity check		0.39	-

Note: The resultant internal forces are used for CHS sections.
Note: Since the shear forces are less than half the plastic shear resistances their effect on the moment resistances is neglected.

The member satisfies the section check.

...::STABILITY CHECK::...

Classification for member buckling design
Decisive position for stability classification: 0.000 m
Decisive utilisation factor η: 0.39
Classification according to EN 1993-1-1 article 5.5.2
Classification of Tubular sections according to EN 1993-1-1 Table 5.2 Sheet 3

d [mm]	t [mm]	d/t [-]	Class 1 Limit [-]	Class 2 Limit [-]	Class 3 Limit [-]	Class
324	14	22.8	50.0	70.0	90.0	1

The cross-section is classified as Class 1
Note: The decisive position for the stability classification is based on the utilisation factor η according to Semi-Comp+.

Lateral Torsional Buckling check
According to EN 1993-1-1 article 6.3.2.1
Note: The cross-section concerns a CHS section which is not susceptible to Lateral Torsional Buckling.

The member satisfies the stability check.

EN 1993-1-1 Code Check
National annex: Standard EN

Member B5	1.730 / 1.730 m	I var (INP240; 180)	Welded	S 235	All ULS	0.23 -

Combination key
All ULS / LC1 + LC2 + 1.50*LC5

Partial safety factors		
Resistance of cross-sections	γ_{M0}	1.00
Resistance to instability	γ_{M1}	1.10
Resistance of net sections	γ_{M2}	1.25

Material			
Yield strength	f_y	235.0	MPa
Ultimate strength	f_u	360.0	MPa

...::SECTION CHECK::...

The critical check is on position 1.730 m

Internal forces		Calculated	Unit
Normal force	N_{Ed}	-2.54	kN
Shear force	$V_{y,Ed}$	0.00	kN
Shear force	$V_{z,Ed}$	-12.31	kN
Torsion	T_{Ed}	0.00	kNm
Bending moment	$M_{y,Ed}$	10.00	kNm
Bending moment	$M_{z,Ed}$	0.00	kNm

Classification for cross-section design
Classification according to EN 1993-1-1 article 5.5.2
Classification of Internal and Outstand parts according to EN 1993-1-1 Table 5.2 Sheet 1 & 2

Id	Type	c [mm]	t [mm]	σ_1 [kN/m^2]	σ_2 [kN/m^2]	ψ [-]	k_σ [-]	α [-]	c/t [-]	Class 1 Limit [-]	Class 2 Limit [-]	Class 3 Limit [-]	Class
1	SO	40	13	-36673.695	-36676.022								
3	SO	40	13	-36672.175	-36669.849								
4	I	136	9	-29860.204	31074.653	-1.0		0.5	15.7	71.0	81.9	118.9	1
5	SO	40	13	37888.145	37890.471	1.0	0.4	1.0	3.0	9.0	10.0	13.8	1
7	SO	40	13	37886.624	37884.298	1.0	0.4	1.0	3.0	9.0	10.0	13.8	1

Note: The Classification limits have been set according to Semi-Comp+.
The cross-section is classified as Class 1

Section properties			
A	4.0867e-03 m^2		
A_y/A	0.71	A_z/A	0.39
I_y	2.1744e-05 m^4	I_z	2.1959e-06 m^4
I_{yz}	6.7763e-21 m^4	I_t	2.1447e-07 m^4
I_w	1.8109e-08 m^6		
$W_{el,y}$	2.4160e-04 m^3	$W_{el,z}$	4.1433e-05 m^3
$W_{pl,y}$	2.8033e-04 m^3	$W_{pl,z}$	6.8834e-05 m^3
c_y	53 mm	c_z	90 mm
d_y	0 mm	d_z	0 mm

Compression check
According to EN 1993-1-1 article 6.2.4 and formula (6.9)

Cross-section area	A	4.0867e-03	m^2
Compression resistance	$N_{c,Rd}$	960.37	kN
Unity check		0.00	-

Bending moment check for M_y
According to EN 1993-1-1 article 6.2.5 and formula (6.12),(6.13)

Plastic section modulus	$W_{pl,y}$	2.8033e-04	m^3
Plastic bending moment	$M_{pl,y,Rd}$	65.88	kNm
Unity check		0.15	-

Bending moment check for M_z
According to EN 1993-1-1 article 6.2.5 and formula (6.12),(6.13)

Plastic section modulus	$W_{pl,z}$	6.8834e-05	m^3
Plastic bending moment	$M_{pl,z,Rd}$	16.18	kNm
Unity check		0.00	-

Shear check for V_z
According to EN 1993-1-1 article 6.2.6 and formula (6.17)

Shear correction factor	η	1.20	
Shear area	A_v	1.6057e-03	m^2
Plastic shear resistance for V_z	$V_{pl,z,Rd}$	217.85	kN
Unity check		0.06	-

Combined bending, axial force and shear force check
According to EN 1993-1-1 article 6.2.9.1 and formula (6.41)

Plastic bending moment	$M_{pl,y,Rd}$	65.88	kNm
Exponent of bending ratio y	α	2.00	
Plastic bending moment	$M_{pl,z,Rd}$	16.18	kNm
Exponent of bending ratio z	β	1.00	

Unity check (6.41) = 0.02 + 0.00 = 0.02 -

Note: Since the shear forces are less than half the plastic shear resistances their effect on the moment resistances is neglected.
Note: Since the axial force satisfies both criteria (6.33) and (6.34) of EN 1993-1-1 article 6.2.9.1(4) its effect on the moment resistance about the y-y axis is neglected.
Note: Since the axial force satisfies criteria (6.35) of EN 1993-1-1 article 6.2.9.1(4) its effect on the moment resistance about the z-z axis is neglected.

The member satisfies the section check.

...::STABILITY CHECK::...

Classification for member buckling design
Note: For this section the classification for cross-section design is also used for member buckling design.
=> Section classified as Class 1 for member buckling design

Flexural Buckling check
According to EN 1993-1-1 article 6.3.1.1 and formula (6.46)

Buckling parameters		yy	zz	
Sway type		sway	non-sway	
System length	L	3.464	3.464	m
Buckling factor	k	8.02	0.78	
Buckling length	l_{cr}	27.777	2.715	m
Critical Euler load	N_{cr}	58.41	617.45	kN
Slenderness	λ	380.81	117.12	
Relative slenderness	λ_{rel}	4.05	1.25	
Limit slenderness	$\lambda_{rel,0}$	0.20	0.20	
Buckling curve		b	c	
Imperfection	α	0.34	0.49	
Reduction factor	χ	0.06	0.41	
Buckling resistance	$N_{b,Rd}$	48.96	359.60	kN

Flexural Buckling verification			
Cross-section area	A	4.0867e-03	m^2
Buckling resistance	$N_{b,Rd}$	48.96	kN
Unity check		0.05	-

Torsional(-Flexural) Buckling check
According to EN 1993-1-1 article 6.3.1.1 and formula (6.46)
Note: For this I-section the Torsional(-Flexural) buckling resistance is higher than the resistance for Flexural buckling. Therefore Torsional(-Flexural) buckling is not printed on the output.

Lateral Torsional Buckling check
According to EN 1993-1-1 article 6.3.2.1 & 6.3.2.3 and formula (6.54)

LTB parameters			
Method for LTB curve		Alternative case	
Plastic section modulus	$W_{pl,y}$	2.8033e-04	m^3
Elastic critical moment	M_{cr}	212.93	kNm
Relative slenderness	$\lambda_{rel,LT}$	0.56	
Limit slenderness	$\lambda_{rel,LT,0}$	0.40	

Note: The slenderness or bending moment is such that Lateral Torsional Buckling effects may be ignored according to EN 1993-1-1 article 6.3.2.2(4).

M_{cr} parameters			
LTB length	l_{LT}	3.464	m
Influence of load position		no influence	
Correction factor	k	1.00	
Correction factor	k_w	1.00	
LTB moment factor	C_1	2.42	
LTB moment factor	C_2	0.13	
LTB moment factor	C_3	1.00	
Shear centre distance	d_z	0	mm
Distance of load application	z_g	0	mm
Mono-symmetry constant	β_y	0	mm
Mono-symmetry constant	z_j	0	mm

Note: C parameters are determined according to ECCS 119 2006 / Galea 2002.

Bending and axial compression check
According to EN 1993-1-1 article 6.3.3 and formula (6.61),(6.62)

Bending and axial compression check parameters			
Interaction method		alternative method 1	
Cross-section area	A	4.0867e-03	m^2
Plastic section modulus	$W_{pl,y}$	2.8033e-04	m^3
Plastic section modulus	$W_{pl,z}$	6.8834e-05	m^3
Design compression force	N_{Ed}	2.54	kN
Design bending moment	$M_{y,Ed}$	10.00	kNm
Design bending moment	$M_{z,Ed}$	0.00	kNm
Characteristic compression resistance	N_{Rk}	960.37	kN
Characteristic moment resistance	$M_{y,Rk}$	65.88	kNm
Characteristic moment resistance	$M_{z,Rk}$	16.18	kNm
Reduction factor	χ_y	0.06	
Reduction factor	χ_z	0.41	
Modified reduction factor	$\chi_{LT,mod}$	1.00	
Interaction factor	k_{yy}	1.07	
Interaction factor	k_{yz}	0.52	
Interaction factor	k_{zy}	0.61	
Interaction factor	k_{zz}	0.73	

Note: Since this member is non-prismatic the actual moments in the section are being used instead of the maximal moments.
For $C_{my,0}$ the maximum moment $M_{y,Ed}$ is derived from beam B5 position 0.000 m.

Interaction method 1 parameters			
Critical Euler load	$N_{cr,y}$	58.41	kN
Critical Euler load	$N_{cr,z}$	617.45	kN
Elastic critical load	$N_{cr,T}$	3490.99	kN
Plastic section modulus	$W_{pl,y}$	2.8033e-04	m^3
Elastic section modulus	$W_{el,y}$	2.4160e-04	m^3
Plastic section modulus	$W_{pl,z}$	6.8834e-05	m^3
Elastic section modulus	$W_{el,z}$	4.1433e-05	m^3
Second moment of area	I_y	2.1744e-05	m^4
Second moment of area	I_z	2.1959e-06	m^4
Torsional constant	I_t	2.1447e-07	m^4
Method for equivalent moment factor $C_{my,0}$		Table A.2 Line 2 (General)	
Design bending moment (maximum)	$M_{y,Ed}$	36.88	kNm
Maximum relative deflection	δ_z	49.1	mm
Equivalent moment factor	$C_{my,0}$	1.17	
Method for equivalent moment factor $C_{mz,0}$		Table A.2 Line 1 (Linear)	
Ratio of end moments	ψ_z	-0.34	
Equivalent moment factor	$C_{mz,0}$	0.72	
Factor	μ_y	0.96	
Factor	μ_z	1.00	
Factor	ε_y	66.63	
Factor	a_{LT}	0.99	
Critical moment for uniform bending	$M_{cr,0}$	88.07	kNm
Relative slenderness	$\lambda_{rel,0}$	0.86	
Limit relative slenderness	$\lambda_{rel,0,lim}$	0.31	
Equivalent moment factor	C_{my}	1.02	
Equivalent moment factor	C_{mz}	0.72	
Equivalent moment factor	C_{mLT}	1.03	
Factor	b_{LT}	0.00	
Factor	c_{LT}	0.15	
Factor	d_{LT}	0.00	
Factor	e_{LT}	0.09	
Factor	w_y	1.16	
Factor	w_z	1.50	
Factor	n_{pl}	0.00	
Maximum relative slenderness	$\lambda_{rel,max}$	4.05	
Factor	C_{yy}	0.99	
Factor	C_{yz}	0.91	

Interaction method 1 parameters			
Factor	C_{zy}	0.95	
Factor	C_{zz}	0.99	

Unity check (6.61) = 0.05 + 0.18 + 0.00 = 0.23 -
Unity check (6.62) = 0.01 + 0.10 + 0.00 = 0.11 -

Shear Buckling check
According to EN 1993-1-5 article 5 & 7.1 and formula (5.10) & (7.1)

Shear Buckling parameters			
Buckling field length	a	1.730	m
Web		unstiffened	
Web height	h_w	154	mm
Web thickness	t	9	mm
Material coefficient	ε	1.00	
Shear correction factor	η	1.20	

Shear Buckling verification		
Web slenderness	h_w/t	17.68
Web slenderness limit		60.00

Note: The web slenderness is such that Shear Buckling effects may be ignored according to EN 1993-1-5 article 5.1(2).

The member satisfies the stability check.

EN 1993-1-1 Code Check
National annex: Standard EN

Member B10	0.000 / 1.734 m	IPN180	Rolled	S 235	All ULS	0.34 -

Combination key
All ULS / LC1 + LC2 + 1.50*LC5

Partial safety factors		
Resistance of cross-sections	γ_{M0}	1.00
Resistance to instability	γ_{M1}	1.10
Resistance of net sections	γ_{M2}	1.25

Material			
Yield strength	f_y	235.0	MPa
Ultimate strength	f_u	360.0	MPa

...::SECTION CHECK::...

The critical check is on position 0.000 m

Internal forces		Calculated	Unit
Normal force	N_{Ed}	-2.54	kN
Shear force	$V_{y,Ed}$	0.00	kN
Shear force	$V_{z,Ed}$	-12.31	kN
Torsion	T_{Ed}	0.00	kNm
Bending moment	$M_{y,Ed}$	10.00	kNm
Bending moment	$M_{z,Ed}$	0.00	kNm

Classification for cross-section design
Classification according to EN 1993-1-1 article 5.5.2
Classification of Internal and Outstand parts according to EN 1993-1-1 Table 5.2 Sheet 1 & 2

Id	Type	c [mm]	t [mm]	σ_1 [kN/m^2]	σ_2 [kN/m^2]	Ψ [-]	k_σ [-]	α [-]	c/t [-]	Class 1 Limit [-]	Class 2 Limit [-]	Class 3 Limit [-]	Class
1	SO	31	10	-56210.568	-56215.418								
3	SO	31	10	-56207.292	-56202.442								
4	I	145	7	-48061.241	49845.705	-1.0		0.5	21.1	70.8	81.7	119.3	1
5	SO	31	10	57995.032	57999.882	1.0	0.4	1.0	2.9	9.0	10.0	13.8	1
7	SO	31	10	57991.756	57986.906	1.0	0.4	1.0	2.9	9.0	10.0	13.8	1

Note: The Classification limits have been set according to Semi-Comp+.
The cross-section is classified as Class 1

Compression check
According to EN 1993-1-1 article 6.2.4 and formula (6.9)

Cross-section area	A	2.7900e-03	m^2
Compression resistance	$N_{c,Rd}$	655.65	kN
Unity check		0.00	-

Bending moment check for M_y
According to EN 1993-1-1 article 6.2.5 and formula (6.12),(6.13)

Plastic section modulus	$W_{pl,y}$	1.8700e-04	m^3
Plastic bending moment	$M_{pl,y,Rd}$	43.95	kNm
Unity check		0.23	-

Bending moment check for M_z
According to EN 1993-1-1 article 6.2.5 and formula (6.12),(6.13)

Plastic section modulus	$W_{pl,z}$	3.3200e-05	m^3
Plastic bending moment	$M_{pl,z,Rd}$	7.80	kNm
Unity check		0.00	-

Shear check for V_z
According to EN 1993-1-1 article 6.2.6 and formula (6.17)

Shear correction factor	η	1.20	
Shear area	A_v	1.3182e-03	m^2
Plastic shear resistance for V_z	$V_{pl,z,Rd}$	178.85	kN
Unity check		0.07	-

Combined bending, axial force and shear force check
According to EN 1993-1-1 article 6.2.9.1 and formula (6.41)

Plastic bending moment	$M_{pl,y,Rd}$	43.95	kNm
Exponent of bending ratio y	α	2.00	
Plastic bending moment	$M_{pl,z,Rd}$	7.80	kNm
Exponent of bending ratio z	β	1.00	

Unity check (6.41) = 0.05 + 0.00 = 0.05 -

Note: Since the shear forces are less than half the plastic shear resistances their effect on the moment resistances is neglected.
Note: Since the axial force satisfies both criteria (6.33) and (6.34) of EN 1993-1-1 article 6.2.9.1(4) its effect on the moment resistance about the y-y axis is neglected.
Note: Since the axial force satisfies criteria (6.35) of EN 1993-1-1 article 6.2.9.1(4) its effect on the moment resistance about the z-z axis is neglected.

The member satisfies the section check.

...::STABILITY CHECK::...

Classification for member buckling design
Decisive position for stability classification: 0.000 m
Decisive utilisation factor η: 0.23
Classification according to EN 1993-1-1 article 5.5.2
Classification of Internal and Outstand parts according to EN 1993-1-1 Table 5.2 Sheet 1 & 2

Id	Type	c [mm]	t [mm]	σ_1 [kN/m^2]	σ_2 [kN/m^2]	Ψ [-]	k_σ [-]	α [-]	c/t [-]	Class 1 Limit [-]	Class 2 Limit [-]	Class 3 Limit [-]	Class
1	SO	31	10	-56210.568	-56215.418								
3	SO	31	10	-56207.292	-56202.442								
4	I	145	7	-48061.241	49845.705	-1.0		0.5	21.1	70.8	81.7	119.3	1
5	SO	31	10	57995.032	57999.882	1.0	0.4	1.0	2.9	9.0	10.0	13.8	1
7	SO	31	10	57991.756	57986.906	1.0	0.4	1.0	2.9	9.0	10.0	13.8	1

Note: The Classification limits have been set according to Semi-Comp+.
The cross-section is classified as Class 1
Note: The decisive position for the stability classification is based on the utilisation factor η according to Semi-Comp+.

Flexural Buckling check
According to EN 1993-1-1 article 6.3.1.1 and formula (6.46)

Buckling parameters		yy	zz	
Sway type		sway	non-sway	
System length	L	3.464	3.464	m
Buckling factor	k	8.02	0.78	
Buckling length	l_{cr}	27.777	2.715	m
Critical Euler load	N_{cr}	38.95	228.60	kN
Slenderness	λ	385.31	159.05	
Relative slenderness	λ_{rel}	4.10	1.69	
Limit slenderness	$\lambda_{rel,0}$	0.20	0.20	
Buckling curve		a	b	
Imperfection	α	0.21	0.34	
Reduction factor	χ	0.06	0.28	
Buckling resistance	$N_{b,Rd}$	33.67	166.81	kN

Flexural Buckling verification			
Cross-section area	A	2.7900e-03	m^2
Buckling resistance	$N_{b,Rd}$	33.67	kN
Unity check		0.08	-

Torsional(-Flexural) Buckling check
According to EN 1993-1-1 article 6.3.1.1 and formula (6.46)
Note: For this I-section the Torsional(-Flexural) buckling resistance is higher than the resistance for Flexural buckling. Therefore Torsional(-Flexural) buckling is not printed on the output.

Lateral Torsional Buckling check
According to EN 1993-1-1 article 6.3.2.1 & 6.3.2.3 and formula (6.54)

LTB parameters			
Method for LTB curve		Alternative case	
Plastic section modulus	$W_{pl,y}$	1.8700e-04	m^3
Elastic critical moment	M_{cr}	85.59	kNm
Relative slenderness	$\lambda_{rel,LT}$	0.72	
Limit slenderness	$\lambda_{rel,LT,0}$	0.40	

Note: The slenderness or bending moment is such that Lateral Torsional Buckling effects may be ignored according to EN 1993-1-1 article 6.3.2.2(4).

M_{cr} parameters			
LTB length	l_{LT}	3.464	m
Influence of load position		no influence	
Correction factor	k	1.00	
Correction factor	k_w	1.00	
LTB moment factor	C_1	2.42	

M_{cr} parameters			
LTB moment factor	C_2	0.13	
LTB moment factor	C_3	1.00	
Shear centre distance	d_z	0	mm
Distance of load application	z_g	0	mm
Mono-symmetry constant	β_y	0	mm
Mono-symmetry constant	z_j	0	mm

Note: C parameters are determined according to ECCS 119 2006 / Galea 2002.

Bending and axial compression check
According to EN 1993-1-1 article 6.3.3 and formula (6.61),(6.62)

Bending and axial compression check parameters			
Interaction method		alternative method 1	
Cross-section area	A	2.7900e-03	m^2
Plastic section modulus	$W_{pl,y}$	1.8700e-04	m^3
Plastic section modulus	$W_{pl,z}$	3.3200e-05	m^3
Design compression force	N_{Ed}	2.54	kN
Design bending moment	$M_{y,Ed}$	10.00	kNm
Design bending moment	$M_{z,Ed}$	0.00	kNm
Characteristic compression resistance	N_{Rk}	655.65	kN
Characteristic moment resistance	$M_{y,Rk}$	43.95	kNm
Characteristic moment resistance	$M_{z,Rk}$	7.80	kNm
Reduction factor	χ_y	0.06	
Reduction factor	χ_z	0.28	
Modified reduction factor	$\chi_{LT,mod}$	1.00	
Interaction factor	k_{yy}	1.07	
Interaction factor	k_{yz}	0.54	
Interaction factor	k_{zy}	0.64	
Interaction factor	k_{zz}	0.73	

Note: Since this member is non-prismatic the actual moments in the section are being used instead of the maximal moments.
For $C_{my,0}$ the maximum moment $M_{y,Ed}$ is derived from beam B5 position 0.000 m.

Interaction method 1 parameters			
Critical Euler load	$N_{cr,y}$	38.95	kN
Critical Euler load	$N_{cr,z}$	228.60	kN
Elastic critical load	$N_{cr,T}$	1626.06	kN
Plastic section modulus	$W_{pl,y}$	1.8700e-04	m^3
Elastic section modulus	$W_{el,y}$	1.6100e-04	m^3
Plastic section modulus	$W_{pl,z}$	3.3200e-05	m^3
Elastic section modulus	$W_{el,z}$	1.9800e-05	m^3
Second moment of area	I_y	1.4500e-05	m^4
Second moment of area	I_z	8.1300e-07	m^4
Torsional constant	I_t	9.5800e-08	m^4
Method for equivalent moment factor $C_{my,0}$		Table A.2 Line 2 (General)	
Design bending moment (maximum)	$M_{y,Ed}$	36.88	kNm
Maximum relative deflection	δ_z	49.1	mm
Equivalent moment factor	$C_{my,0}$	1.15	
Method for equivalent moment factor $C_{mz,0}$		Table A.2 Line 1 (Linear)	
Ratio of end moments	ψ_z	-0.34	
Equivalent moment factor	$C_{mz,0}$	0.72	
Factor	μ_y	0.94	
Factor	μ_z	0.99	
Factor	ε_y	68.26	
Factor	a_{LT}	0.99	
Critical moment for uniform bending	$M_{cr,0}$	35.40	kNm
Relative slenderness	$\lambda_{rel,0}$	1.11	
Limit relative slenderness	$\lambda_{rel,0,lim}$	0.31	
Equivalent moment factor	C_{my}	1.02	
Equivalent moment factor	C_{mz}	0.72	

Interaction method 1 parameters			
Equivalent moment factor	C_{mLT}	1.03	
Factor	b_{LT}	0.00	
Factor	c_{LT}	0.21	
Factor	d_{LT}	0.00	
Factor	e_{LT}	0.05	
Factor	w_y	1.16	
Factor	w_z	1.50	
Factor	n_{pl}	0.00	
Maximum relative slenderness	$\lambda_{rel,max}$	4.10	
Factor	C_{yy}	0.98	
Factor	C_{yz}	0.87	
Factor	C_{zy}	0.92	
Factor	C_{zz}	0.98	

Unity check (6.61) = 0.08 + 0.27 + 0.00 = 0.34 -
Unity check (6.62) = 0.02 + 0.16 + 0.00 = 0.17 -

Shear Buckling check
According to EN 1993-1-5 article 5 & 7.1 and formula (5.10) & (7.1)

Shear Buckling parameters			
Buckling field length	a	1.734	m
Web		unstiffened	
Web height	h_w	159	mm
Web thickness	t	7	mm
Material coefficient	ε	1.00	
Shear correction factor	η	1.20	

Shear Buckling verification		
Web slenderness	h_w/t	23.07
Web slenderness limit		60.00

Note: The web slenderness is such that Shear Buckling effects may be ignored according to EN 1993-1-5 article 5.1(2).

The member satisfies the stability check.

EN 1993-1-1 Code Check
National annex: Standard EN

Member B17	3.464 / 3.464 m	UNP180	Rolled	S 235	All ULS	0.23 -

Combination key
All ULS / 1.35*LC1 + 1.35*LC2 + 0.90*LC3 + 1.50*LC4

Partial safety factors		
Resistance of cross-sections	γ_{M0}	1.00
Resistance to instability	γ_{M1}	1.10
Resistance of net sections	γ_{M2}	1.25

Material			
Yield strength	f_y	235.0	MPa
Ultimate strength	f_u	360.0	MPa

...::SECTION CHECK::...

The critical check is on position 3.464 m

Internal forces		Calculated	Unit
Normal force	N_{Ed}	0.00	kN
Shear force	$V_{y,Ed}$	0.00	kN
Shear force	$V_{z,Ed}$	-4.12	kN
Torsion	T_{Ed}	-0.15	kNm
Bending moment	$M_{y,Ed}$	-5.78	kNm
Bending moment	$M_{z,Ed}$	0.00	kNm

Classification for cross-section design
Classification according to EN 1993-1-1 article 5.5.2
Classification of Internal and Outstand parts according to EN 1993-1-1 Table 5.2 Sheet 1 & 2

Id	Type	c [mm]	t [mm]	σ_1 [kN/m^2]	σ_2 [kN/m^2]	Ψ [-]	k_σ [-]	α [-]	c/t [-]	Class 1 Limit [-]	Class 2 Limit [-]	Class 3 Limit [-]	Class
1	UO	51	11	34991.178	34991.178	1.0	0.4	1.0	4.6	9.0	10.0	14.0	1
3	I	136	8	28158.581	-28158.581	-1.0		0.5	17.0	72.0	83.0	124.0	1
5	UO	51	11	-34991.178	-34991.178								

Note: The Classification limits have been set according to Semi-Comp+.
The cross-section is classified as Class 1

Bending moment check for M_y
According to EN 1993-1-1 article 6.2.5 and formula (6.12),(6.13)

Plastic section modulus	$W_{pl,y}$	1.7920e-04	m^3
Plastic bending moment	$M_{pl,y,Rd}$	42.11	kNm
Unity check		0.14	-

Shear check for V_z
According to EN 1993-1-1 article 6.2.6 and formula (6.17)

Shear correction factor	η	1.20	
Shear area	A_v	1.4690e-03	m^2
Plastic shear resistance for V_z	$V_{pl,z,Rd}$	199.31	kN
Unity check		0.02	-

Torsion check
According to EN 1993-1-1 article 6.2.7 and formula (6.23)

Index of fibre	Fibre	3	
Total torsional moment	τ_{Ed}	17.4	MPa
Elastic shear resistance	τ_{Rd}	135.7	MPa
Unity check		0.13	-

Combined Shear and Torsion check for V_z and $\tau_{t,Ed}$
According to EN 1993-1-1 article 6.2.6 & 6.2.7 and formula (6.25),(6.27)

Plastic shear resistance for V_z and T_{Ed}	$V_{pl,T,z,Rd}$	188.81	kN
Unity check		0.02	-

The member satisfies the section check.

...::STABILITY CHECK::...

Classification for member buckling design
Decisive position for stability classification: 3.464 m
Decisive utilisation factor η: 0.14
Classification according to EN 1993-1-1 article 5.5.2
Classification of Internal and Outstand parts according to EN 1993-1-1 Table 5.2 Sheet 1 & 2

Id	Type	c [mm]	t [mm]	σ_1 [kN/m^2]	σ_2 [kN/m^2]	Ψ [-]	k_σ [-]	α [-]	c/t [-]	Class 1 Limit [-]	Class 2 Limit [-]	Class 3 Limit [-]	Class
1	UO	51	11	34991.178	34991.178	1.0	0.4	1.0	4.6	9.0	10.0	14.0	1
3	I	136	8	28158.581	-28158.581	-1.0		0.5	17.0	72.0	83.0	124.0	1
5	UO	51	11	-34991.178	-34991.178								

Note: The Classification limits have been set according to Semi-Comp+.
The cross-section is classified as Class 1
Note: The decisive position for the stability classification is based on the utilisation factor η according to Semi-Comp+.

Lateral Torsional Buckling check
According to EN 1993-1-1 article 6.3.2.1 & 6.3.2.2 and formula (6.54)

LTB parameters			
Method for LTB curve		General case	
Plastic section modulus	$W_{pl,y}$	1.7920e-04	m^3
Elastic critical moment	M_{cr}	132.82	kNm
Relative slenderness	$\lambda_{rel,LT}$	0.56	
Relative slenderness	$\lambda_{rel,T}$	0.44	
Relative slenderness	$\lambda_{rel,EXTRA}$	1.00	
Limit slenderness	$\lambda_{rel,LT,0}$	0.20	
LTB curve		a	
Imperfection	α_{LT}	0.21	
Reduction factor	χ_{LT}	0.67	
Design buckling resistance	$M_{b,Rd}$	25.48	kNm
Unity check		0.23	-

Note: $\lambda_{rel,EXTRA}$ is determined according to "Design rule for lateral torsional buckling of channel sections, 2007".

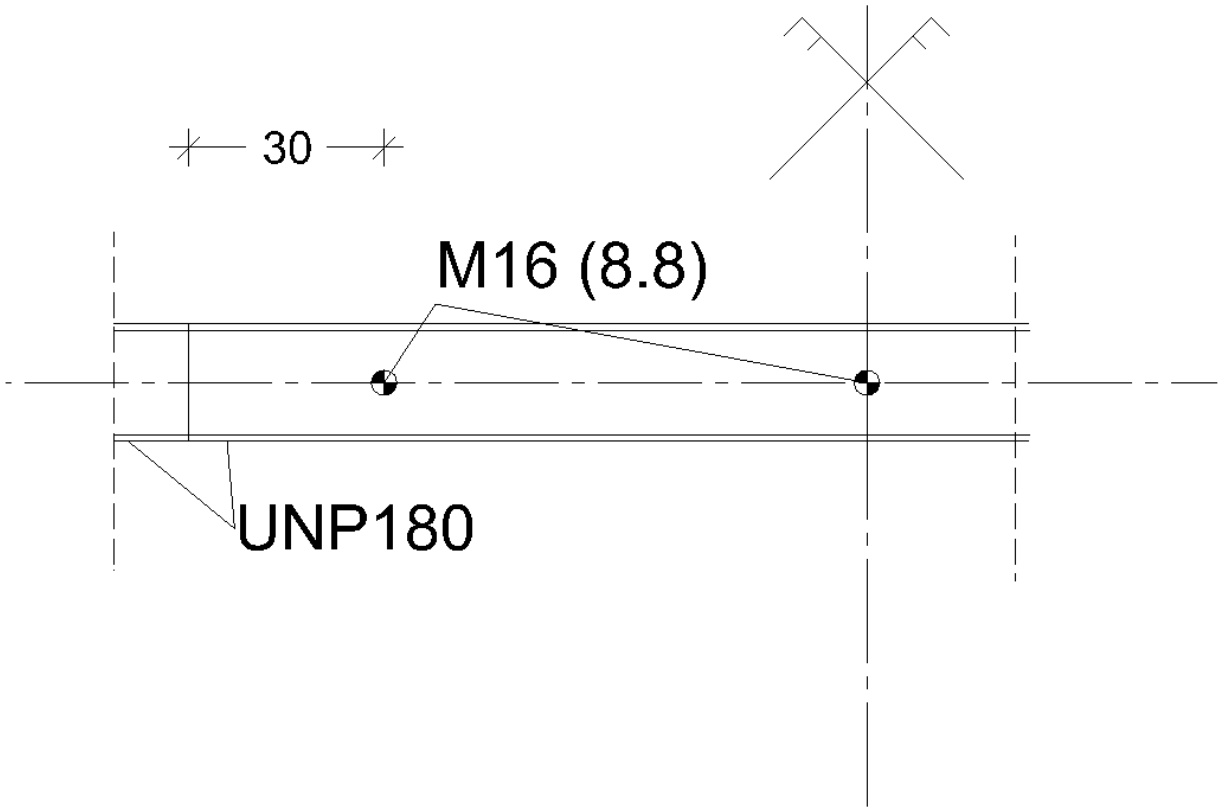
M_{cr} parameters			
LTB length	l_{LT}	3.464	m
Influence of load position		no influence	
Correction factor	k	1.00	
Correction factor	k_w	1.00	
LTB moment factor	C_1	3.19	
LTB moment factor	C_2	0.74	
LTB moment factor	C_3	1.00	
Shear centre distance	d_z	0	mm
Distance of load application	z_g	0	mm
Mono-symmetry constant	β_y	0	mm
Mono-symmetry constant	z_j	0	mm

Note: C parameters are determined according to ECCS 119 2006 / Galea 2002.

The member satisfies the stability check.

Poz N2

Sve isto kao N1, ali su međusobno povezane po dodirnim bridovima vijcima 3xM16(8.8) po jednom bridu. Dva vijka što bliže čvorovima (krajevima) štapova i jedan u sredini. Maksimalna udaljenost dva vijka je 30cm od čvora:



PRORAČUN PRIKLJUČAKA

SPOJ GREDA NA STUP

Material

Steel S 235

Analysis Stress, strain/ loads in equilibrium

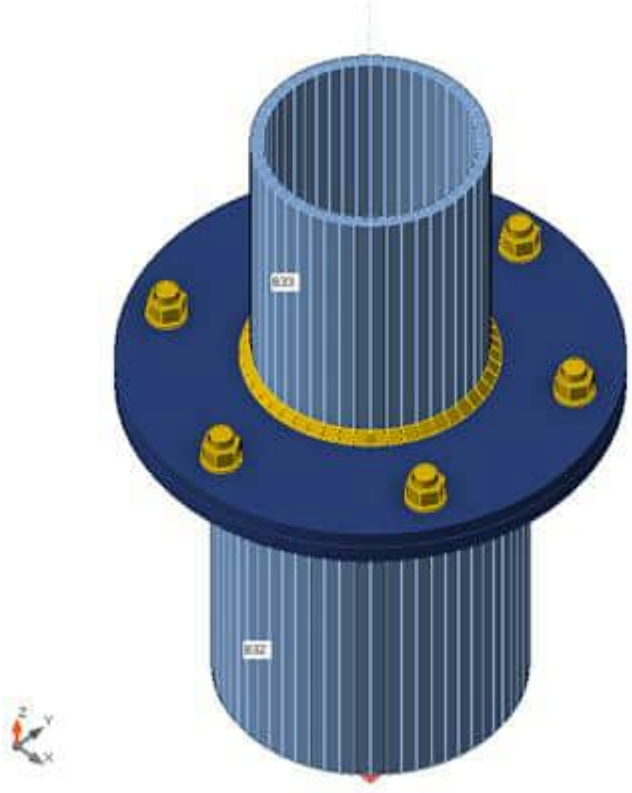
Members

Geometry

Name	Cross-section	β – Direction [°]	γ - Pitch [°]	α - Rotation [°]	Offset ex [mm]	Offset ey [mm]	Offset ez [mm]
B32	1 - RO323.9X14.2	0.0	90.0	0.0	0	0	0
B33	2 - CHS244.5/12.5	0.0	90.0	0.0	0	0	0

Supports and forces

Name	Support	Forces in	X [mm]
B32 / end	N-Vy-Vz-Mx-My-Mz	Position	0
B33 / end		Position	0



Cross-sections

Name	Material
1 - RO323.9X14.2	S 235
2 - CHS244.5/12.5	S 235

Bolts

Name	Bolt assembly	Diameter [mm]	f_u [MPa]	Gross area [mm^2]
M24 8.8	M24 8.8	24	800.0	452

Load effects (forces in equilibrium)

Name	Member	N [kN]	Vy [kN]	Vz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
KGS(1)	B32 / Begin	-93.0	0.0	0.0	0.0	0.0	0.0
	B33 / End	93.0	0.0	0.0	0.0	0.0	0.0
KGS(2)	B32 / Begin	80.7	0.0	0.0	0.0	0.0	0.0
	B33 / End	-80.7	0.0	0.0	0.0	0.0	0.0
KGS(4)	B32 / Begin	-41.1	0.0	12.2	0.0	-75.6	0.0
	B33 / End	41.1	0.0	-12.2	0.0	75.6	0.0
KGS(5)	B32 / Begin	47.6	0.0	0.0	0.0	55.5	0.0
	B33 / End	-47.6	0.0	0.0	0.0	-55.5	0.0

Unbalanced forces

Name	X [kN]	Y [kN]	Z [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
KGS(1)	0.0	0.0	0.0	0.0	0.0	0.0
KGS(2)	0.0	0.0	0.0	0.0	0.0	0.0
KGS(4)	0.0	0.0	0.0	0.0	0.0	0.0
KGS(5)	0.0	0.0	0.0	0.0	0.0	0.0

Check

Summary

Name	Value	Check status
Analysis	100.0%	OK
Plates	0.9 < 5.0%	OK
Loc. deformation	0.1 < 3%	OK
Bolts	84.0 < 100%	OK
Welds	98.6 < 100%	OK
Buckling	Not calculated	
GMNA	Calculated	

Plates

Name	t_p [mm]	Loads	σ_{Ed} [MPa]	ε_{Pl} [%]	$\sigma_{c,Ed}$ [MPa]	Status
B32	14.2	KGS(4)	121.1	0.0	0.0	OK
B33	12.5	KGS(4)	235.5	0.2	0.0	OK
PP1a	20.0	KGS(4)	235.4	0.2	86.2	OK

PP1b	20.0	KGS(4)	236.9	0.9	86.3	OK

Design data

Material	f_y [MPa]	ε_{lim} [%]
S 235	235.0	5.0

Symbol explanation

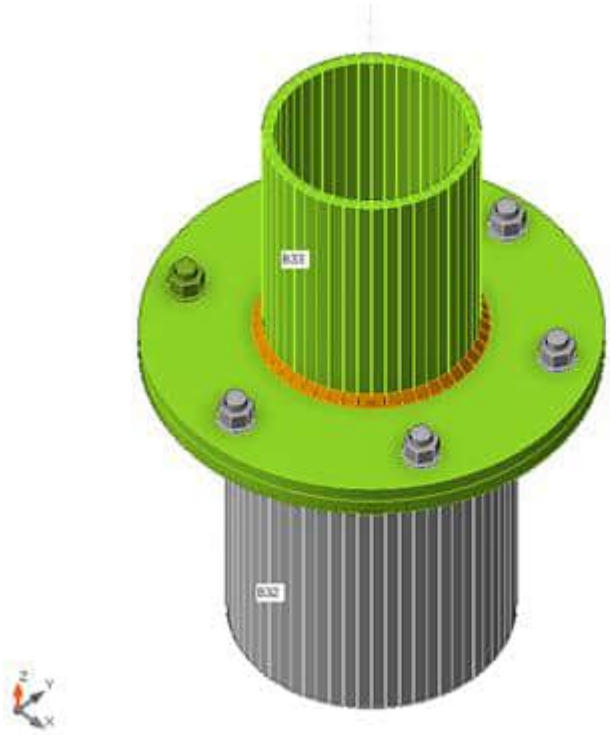
t_p Plate thickness
σ_{Ed} Equivalent stress
ε_{Pl} Plastic strain
$\sigma_{c,Ed}$ Contact stress
f_y Yield strength
ε_{lim} Limit of plastic strain

Loc. deformation

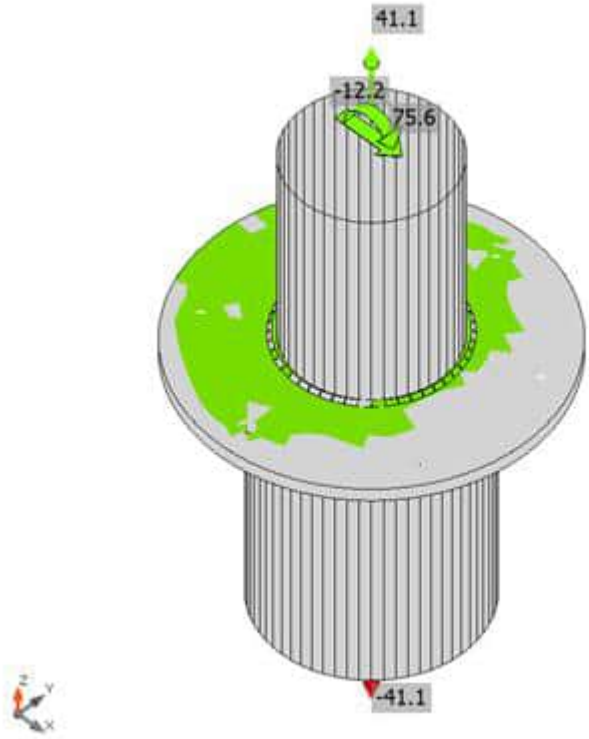
Name	d_0 [mm]	Loads	δ [mm]	δ_{lim} [mm]	δ/d_0 [%]	Check status
B32	324	KGS(4)	0	10	0.0	OK
B33	245	KGS(4)	0	7	0.1	OK

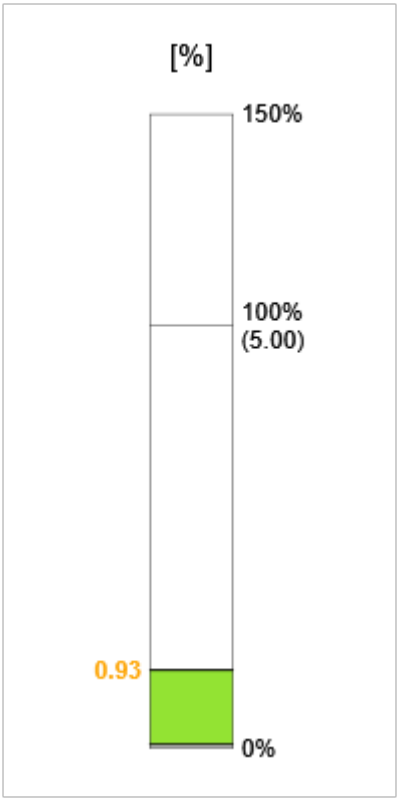
Symbol explanation

d_0 Cross-section size
δ Local cross-section deformation
δ_{lim} Allowed deformation

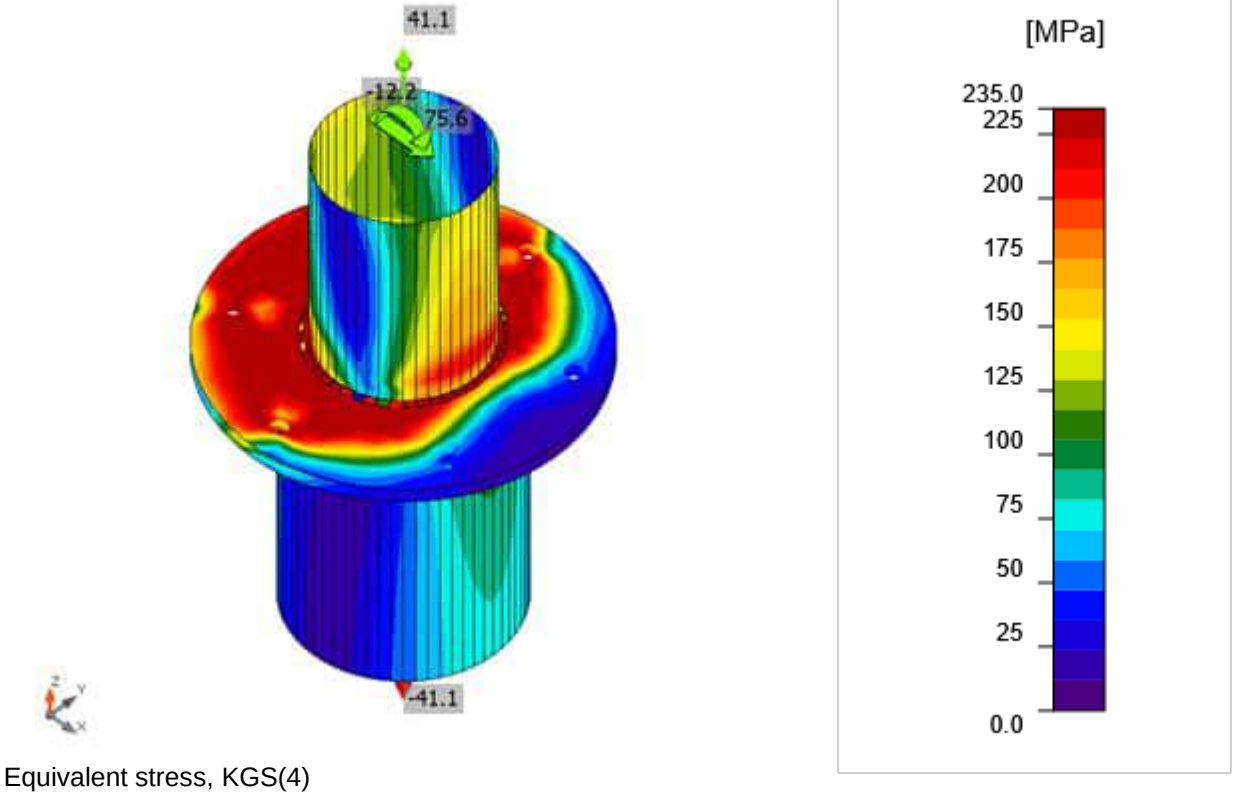


Overall check, KGS(4)



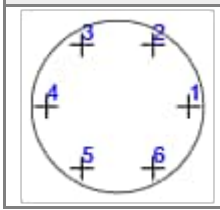


Strain check, KGS(4)



Equivalent stress, KGS(4)

Bolts

Shape	Item	Grade	Loads	$F_{t,Ed}$ [kN]	$F_{v,Ed}$ [kN]	$F_{b,Rd}$ [kN]	Ut_t [%]	Ut_s [%]	Ut_{ts} [%]	Detailing	Status
	B1	M24 8.8 - 1	KGS(4)	117.8	5.3	201.6	57.9	3.9	45.3	OK	OK
	B2	M24 8.8 - 1	KGS(4)	170.7	7.8	199.2	84.0	5.7	65.7	OK	OK
	B3	M24 8.8 - 1	KGS(4)	170.8	7.8	199.2	84.0	5.7	65.7	OK	OK
	B4	M24 8.8 - 1	KGS(4)	119.1	5.3	201.2	58.6	3.9	45.7	OK	OK
	B5	M24 8.8 - 1	KGS(5)	127.3	1.5	222.8	62.6	1.1	45.8	OK	OK
	B6	M24 8.8 - 1	KGS(5)	126.4	1.5	223.5	62.2	1.1	45.5	OK	OK

Design data

Grade	$F_{t,Rd}$ [kN]	$B_{p,Rd}$ [kN]	$F_{v,Rd}$ [kN]
M24 8.8 - 1	203.3	412.5	135.6

Symbol explanation

$F_{t,Ed}$	Tension force
$F_{v,Ed}$	Resultant of bolt shear forces Vy and Vz in shear planes
$F_{b,Rd}$	Plate bearing resistance EN 1993-1-8 – Tab. 3.4
Ut_t	Utilization in tension
Ut_s	Utilization in shear
Ut_{ts}	Interaction of tension and shear EN 1993-1-8 – Tab. 3.4
$F_{t,Rd}$	Bolt tension resistance EN 1993-1-8 – Tab. 3.4
$B_{p,Rd}$	Punching shear resistance EN 1993-1-8 – Tab. 3.4

$F_{v,Rd}$ Bolt shear resistance EN 1993-1-8 – Tab. 3.4

Welds

Item	Edge	T_w [mm]	L [mm]	Loads	$\sigma_{w,Ed}$ [MPa]	ε_{Pl} [%]	$\sigma_\perp$ [MPa]	$\tau_\perp$ [MPa]	$\tau_\parallel$ [MPa]	Ut [%]	Ut_c [%]	Detailing	Status
PP1a	B32	◢ 8.0	973	KGS(4)	257.2	0.0	-122.6	130.2	-8.6	71.4	39.8	OK	OK
PP1b	B33	◢ 8.0	728	KGS(4)	355.0	1.6	-205.9	167.0	2.5	98.6	72.0	OK	OK

Design data

Material	f_u [MPa]	β_w [-]	$\sigma_{w,Rd}$ [MPa]	0.9 σ [MPa]
S 235	360.0	0.80	360.0	259.2

Symbol explanation

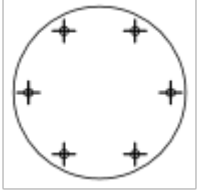
T_w	Throat thickness a
L	Length
$\sigma_{w,Ed}$	Equivalent stress
ε_{Pl}	Strain
$\sigma_\perp$	Perpendicular stress
$\tau_\perp$	Shear stress perpendicular to weld axis
$\tau_\parallel$	Shear stress parallel to weld axis
Ut	Utilization
Ut_c	Weld capacity estimation
◢	Fillet weld
f_u	Ultimate strength of weld
β_w	Correlation factor EN 1993-1-8 – Tab. 4.1
$\sigma_{w,Rd}$	Equivalent stress resistance
0.9 σ	Perpendicular stress resistance: 0.9*fu/γM2

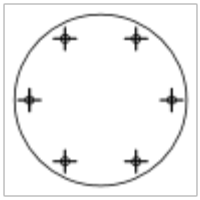
Buckling

Buckling analysis was not calculated.

Bill of material

Manufacturing operations

Name	Plates [mm]	Shape	Nr.	Welds [mm]	Length [mm]	Bolts	Nr.
PP1	P20.0x520.0-0.0 (S 235)		1	Fillet: a = 8.0	1700.9	M24 8.8	6

	P20.0x520.0-0.0 (S 235)		1				

Welds

Type	Material	Throat thickness [mm]	Leg size [mm]	Length [mm]
Fillet	S 235	8.0	11.3	1700.9

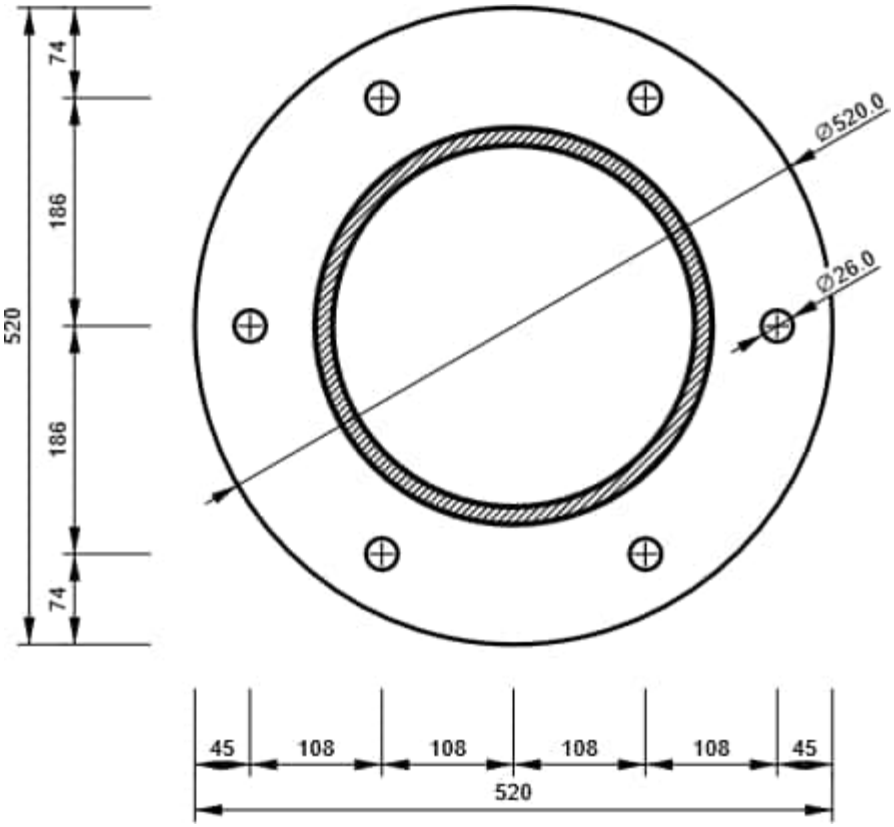
Bolts

Name	Grip length [mm]	Count
M24 8.8	40	6

Drawing

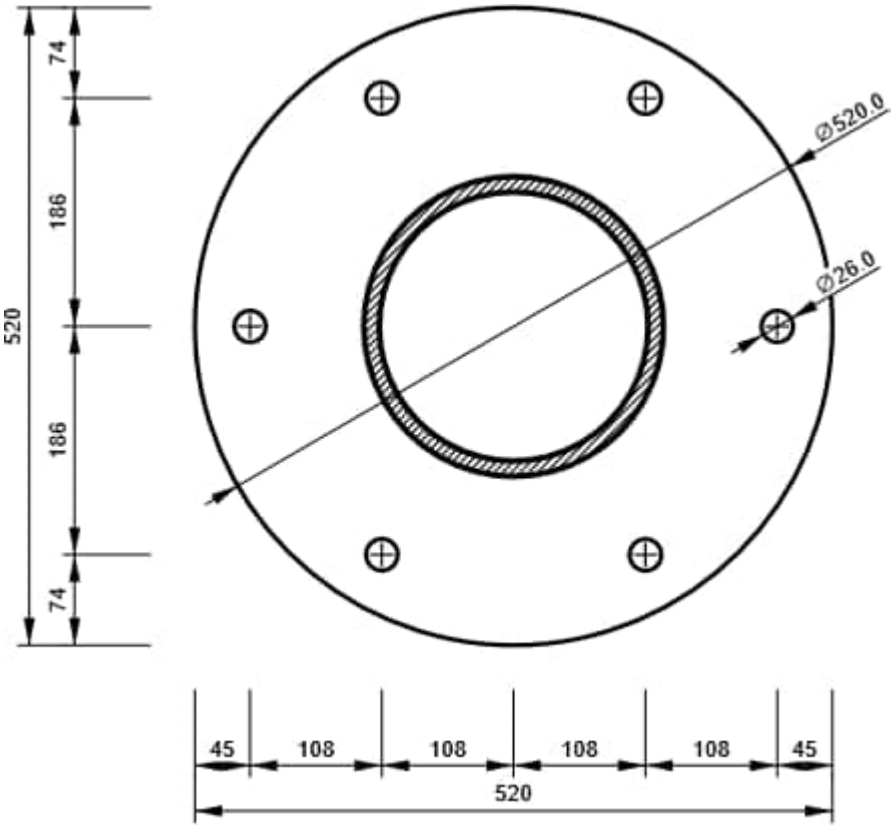
PP1 - PP1a

P20.0x520-520 (S 235)



PP1 - PP1b

P20.0x520-520 (S 235)



Code settings

Item	Value	Unit	Reference
Safety factor γ_{M0}	1.00	-	EN 1993-1-1: 6.1
Safety factor γ_{M1}	1.00	-	EN 1993-1-1: 6.1
Safety factor γ_{M2}	1.25	-	EN 1993-1-1: 6.1
Safety factor γ_{M3}	1.25	-	EN 1993-1-8: 2.2
Safety factor γ_C	1.50	-	EN 1992-1-1: 2.4.2.4
Safety factor γ_{Inst}	1.20	-	EN 1992-4: Table 4.1
Joint coefficient βj	0.67	-	EN 1993-1-8: 6.2.5
Effective area - influence of mesh size	0.10	-	
Friction coefficient - concrete	0.25	-	EN 1993-1-8
Friction coefficient in slip-resistance	0.30	-	EN 1993-1-8 tab 3.7
Limit plastic strain	0.05	-	EN 1993-1-5
Detailing	Yes		
Distance between bolts [d]	2.20	-	EN 1993-1-8: tab 3.3
Distance between bolts and edge [d]	1.20	-	EN 1993-1-8: tab 3.3
Concrete breakout resistance check	Both		EN 1992-4: 7.2.1.4 and 7.2.2.5
Use calculated αb in bearing check.	Yes		EN 1993-1-8: tab 3.4
Cracked concrete	Yes		EN 1992-4
Local deformation check	Yes		CIDECT DG 1, 3 - 1.1
Local deformation limit	0.03	-	CIDECT DG 1, 3 - 1.1
Geometrical nonlinearity (GMNA)	Yes		Analysis with large deformations for hollow section joints
Braced system	No		EN 1993-1-8: 5.2.2.5

NASTAVCI INP180

Material

Steel S 235

Analysis Stress, strain/ loads in equilibrium

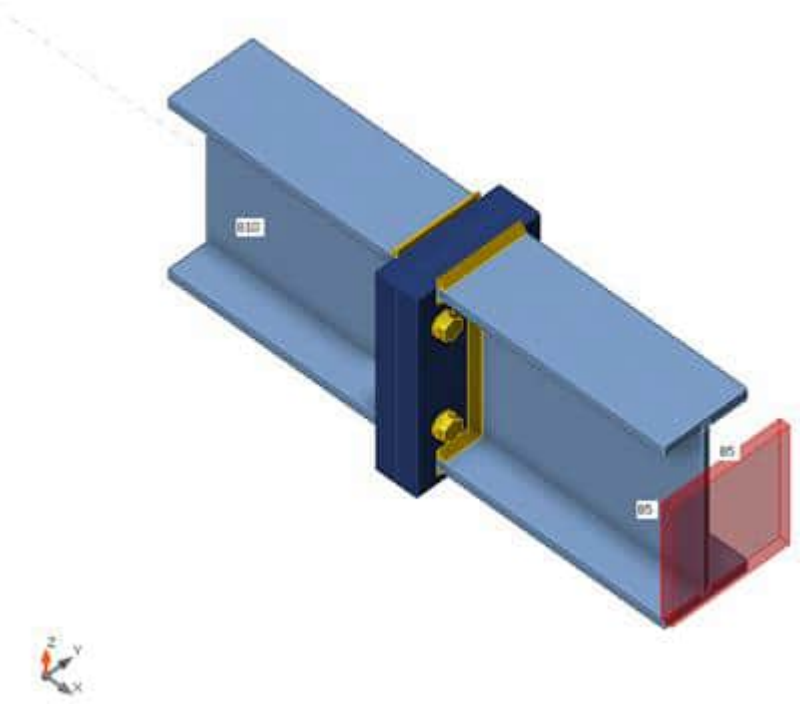
Members

Geometry

Name	Cross-section	β – Direction [°]	γ - Pitch [°]	α - Rotation [°]	Offset ex [mm]	Offset ey [mm]	Offset ez [mm]
B5	2 - IPN180	180.0	0.0	0.0	0	0	0
B10	2 - IPN180	-180.0	0.0	0.0	0	0	0

Supports and forces

Name	Support	Forces in	X [mm]
B5 / begin	N-Vy-Vz-Mx-My-Mz	Position	0
B10 / end		Position	0



Cross-sections

Name	Material
2 - IPN180	S 235

Bolts

Name	Bolt assembly	Diameter [mm]	f_u [MPa]	Gross area [mm²]
M12 8.8	M12 8.8	12	800.0	113

Load effects (forces in equilibrium)

Name	Member	N [kN]	Vy [kN]	Vz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
KGS(2)	B5 / Begin	2.5	12.3	0.0	0.0	0.0	10.0
	B10 / End	-2.5	0.0	12.3	0.0	-10.0	0.0
KGS(3)	B5 / Begin	0.0	-12.0	0.0	0.0	0.0	-11.6
	B10 / End	0.0	0.0	-12.0	0.0	11.6	0.0
KGS(4)	B5 / Begin	0.0	10.9	0.0	0.0	0.0	8.0
	B10 / End	0.0	0.0	10.9	0.0	-8.0	0.0
KGS(5)	B5 / Begin	0.0	-10.8	0.0	0.0	0.0	-9.9
	B10 / End	0.0	0.0	-10.8	0.0	9.9	0.0

Unbalanced forces

Name	X [kN]	Y [kN]	Z [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
KGS(2)	0.0	-12.3	12.3	0.0	10.0	10.0
KGS(3)	0.0	12.0	-12.0	0.0	-11.6	-11.6
KGS(4)	0.0	-10.9	10.9	0.0	8.0	8.0
KGS(5)	0.0	10.8	-10.8	0.0	-9.9	-9.9

Check

Summary

Name	Value	Check status
Analysis	100.0%	OK
Plates	0.0 < 5.0%	OK
Bolts	82.6 < 100%	OK
Welds	54.6 < 100%	OK
Buckling	Not calculated	

Plates

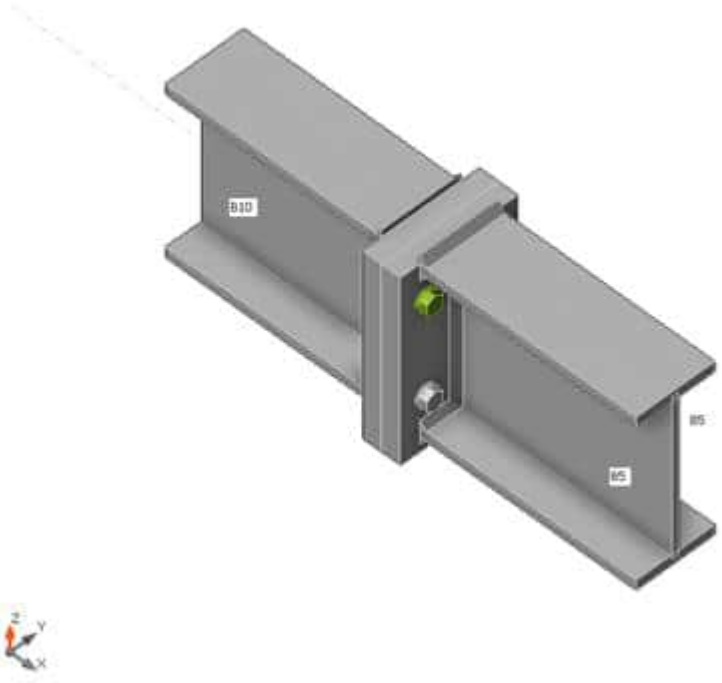
Name	t_p [mm]	Loads	σ_{Ed} [MPa]	ε_{Pl} [%]	$\sigma_{c,Ed}$ [MPa]	Status
B5-bfl 1	10.4	KGS(3)	154.3	0.0	0.0	OK
B5-tfl 1	10.4	KGS(3)	140.4	0.0	0.0	OK
B5-w 1	6.9	KGS(3)	128.4	0.0	0.0	OK
B10-bfl 1	10.4	KGS(3)	160.0	0.0	0.0	OK
B10-tfl 1	10.4	KGS(3)	125.5	0.0	0.0	OK
B10-w 1	6.9	KGS(3)	114.3	0.0	0.0	OK
PP1a	20.0	KGS(3)	167.9	0.0	39.9	OK
PP1b	20.0	KGS(3)	174.1	0.0	39.9	OK

Design data

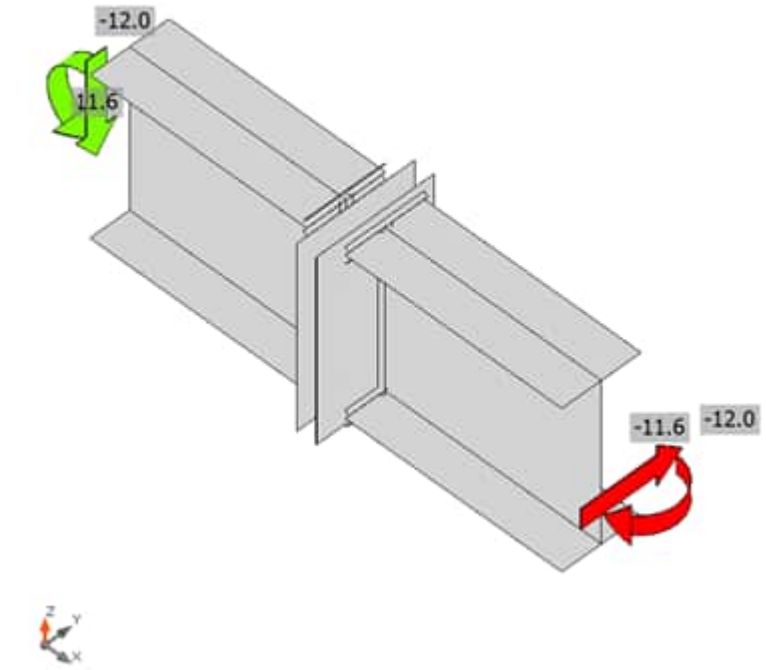
Material	f_y [MPa]	ε_{lim} [%]
S 235	235.0	5.0

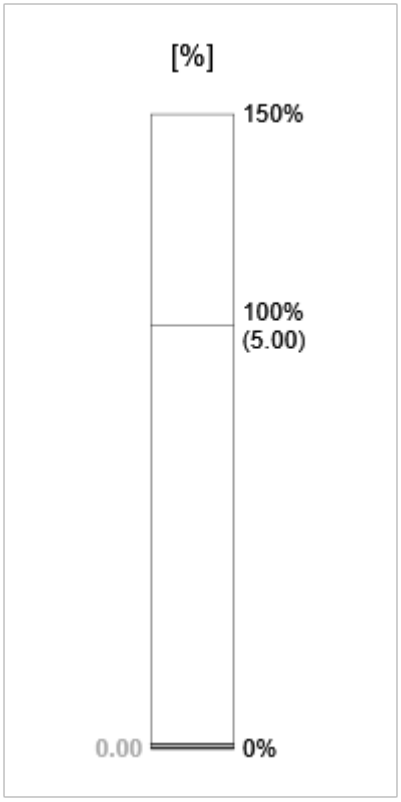
Symbol explanation

t_p	Plate thickness
σ_{Ed}	Equivalent stress
ε_{Pl}	Plastic strain
$\sigma_{c,Ed}$	Contact stress
f_y	Yield strength
ε_{lim}	Limit of plastic strain

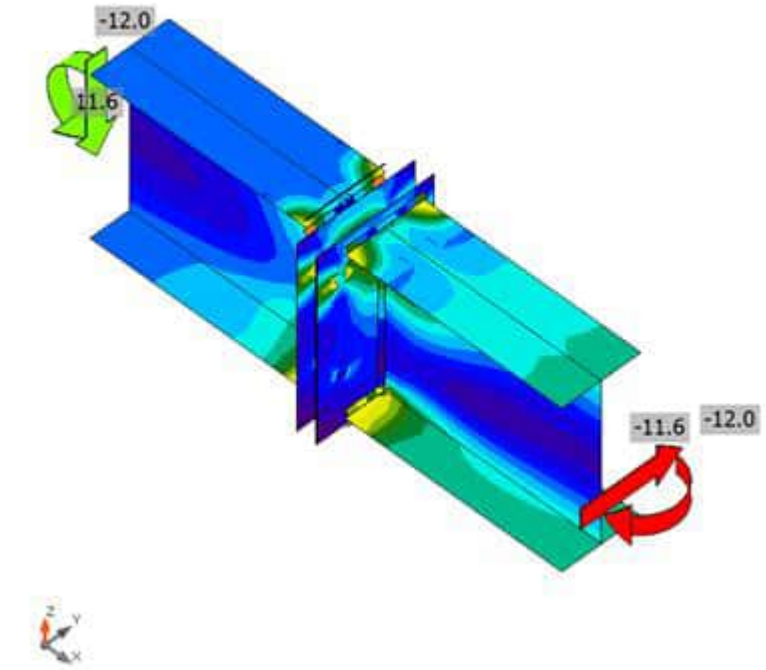


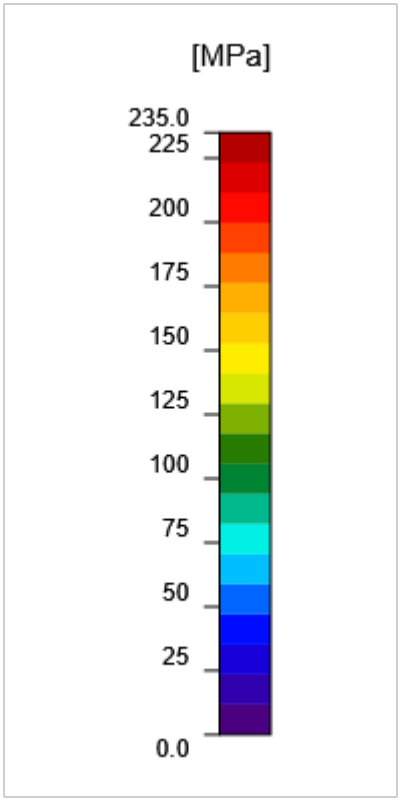
Overall check, KGS(3)





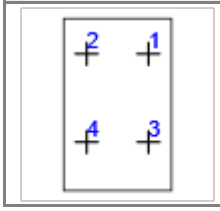
Strain check, KGS(3)





Equivalent stress, KGS(3)

Bolts

Shape	Item	Grade	Loads	$F_{t,Ed}$ [kN]	$F_{v,Ed}$ [kN]	$F_{b,Rd}$ [kN]	Ut_t [%]	Ut_s [%]	Ut_{ts} [%]	Detailing	Status
	B1	M12 8.8 - 1	KGS(3)	40.1	2.7	172.8	82.6	8.2	67.2	OK	OK
	B2	M12 8.8 - 1	KGS(3)	40.1	2.7	172.8	82.6	8.2	67.2	OK	OK
	B3	M12 8.8 - 1	KGS(2)	36.7	3.1	172.8	75.5	9.5	63.4	OK	OK
	B4	M12 8.8 - 1	KGS(2)	36.6	3.1	172.8	75.4	9.5	63.4	OK	OK

Design data

Grade	$F_{t,Rd}$ [kN]	$B_{p,Rd}$ [kN]	$F_{v,Rd}$ [kN]
M12 8.8 - 1	48.6	206.5	32.4

Symbol explanation

$F_{t,Ed}$	Tension force
$F_{v,Ed}$	Resultant of bolt shear forces Vy and Vz in shear planes
$F_{b,Rd}$	Plate bearing resistance EN 1993-1-8 – Tab. 3.4
Ut_t	Utilization in tension
Ut_s	Utilization in shear
Ut_{ts}	Interaction of tension and shear EN 1993-1-8 – Tab. 3.4
$F_{t,Rd}$	Bolt tension resistance EN 1993-1-8 – Tab. 3.4
$B_{p,Rd}$	Punching shear resistance EN 1993-1-8 – Tab. 3.4
$F_{v,Rd}$	Bolt shear resistance EN 1993-1-8 – Tab. 3.4

Welds

Item	Edge	T_w [mm]	L [mm]	Loads	$\sigma_{w,Ed}$ [MPa]	ε_{Pl} [%]	$\sigma_{\perp}$ [MPa]	$\tau_{\perp}$ [MPa]	$\tau_{\parallel}$ [MPa]	Ut [%]	Ut_c [%]	Detailing	Status
PP1a	B5-bfl 1	◢ 5.0 ◣	82	KGS(2)	181.0	0.0	83.9	61.0	69.6	50.3	46.1	OK	OK
		◢ 5.0 ◣	81	KGS(3)	173.3	0.0	-84.4	73.5	47.3	48.1	48.1	OK	OK
PP1a	B5-tfl 1	◢ 5.0 ◣	82	KGS(2)	138.1	0.0	-66.9	-58.4	-38.1	38.4	37.3	OK	OK
		◢ 5.0 ◣	82	KGS(3)	196.5	0.0	95.9	-62.9	76.4	54.6	49.8	OK	OK
PP1a	B5-w 1	◢ 5.0 ◣	168	KGS(3)	125.2	0.0	57.1	57.9	-28.0	34.8	21.6	OK	OK
		◢ 5.0 ◣	168	KGS(3)	124.4	0.0	58.0	-57.3	27.4	34.6	21.6	OK	OK
PP1b	B10-bfl 1	◢ 5.0 ◣	82	KGS(2)	166.8	0.0	77.2	55.6	64.8	46.3	42.7	OK	OK
		◢ 5.0 ◣	81	KGS(3)	175.7	0.0	-102.7	80.9	14.9	48.8	48.3	OK	OK
PP1b	B10-tfl 1	◢ 5.0 ◣	82	KGS(2)	135.5	0.0	-67.1	-55.8	-38.7	37.6	36.7	OK	OK
		◢ 5.0 ◣	82	KGS(3)	184.0	0.0	88.6	-58.1	-72.7	51.1	46.6	OK	OK
PP1b	B10-w 1	◢ 5.0 ◣	168	KGS(3)	121.7	0.0	-43.2	-43.8	-49.0	33.8	27.2	OK	OK

		◢ 5.0 ◣	168	KGS(3)	120.5	0.0	-43.7	43.1	48.5	33.5	26.9	OK	OK

Design data

Material	f_u [MPa]	β_w [-]	$\sigma_{w,Rd}$ [MPa]	0.9 σ [MPa]
S 235	360.0	0.80	360.0	259.2

Symbol explanation

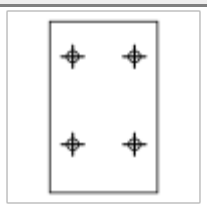
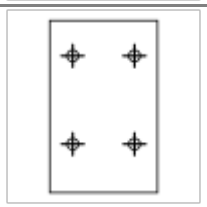
T_w	Throat thickness a
L	Length
$\sigma_{w,Ed}$	Equivalent stress
ε_{Pl}	Strain
$\sigma_{\perp}$	Perpendicular stress
$\tau_{\perp}$	Shear stress perpendicular to weld axis
$\tau_{\parallel}$	Shear stress parallel to weld axis
Ut	Utilization
Ut_c	Weld capacity estimation
◢	Fillet weld
f_u	Ultimate strength of weld
β_w	Correlation factor EN 1993-1-8 – Tab. 4.1
$\sigma_{w,Rd}$	Equivalent stress resistance
0.9 σ	Perpendicular stress resistance: 0.9*fu/γM2

Buckling

Buckling analysis was not calculated.

Bill of material

Manufacturing operations

Name	Plates [mm]	Shape	Nr.	Welds [mm]	Length [mm]	Bolts	Nr.
PP1	P20.0x122.0-195.0 (S 235)		1	Double fillet: a = 5.0	667.2	M12 8.8	4
	P20.0x122.0-195.0 (S 235)		1				

Welds

Type	Material	Throat thickness [mm]	Leg size [mm]	Length [mm]
Double fillet	S 235	5.0	7.1	667.2

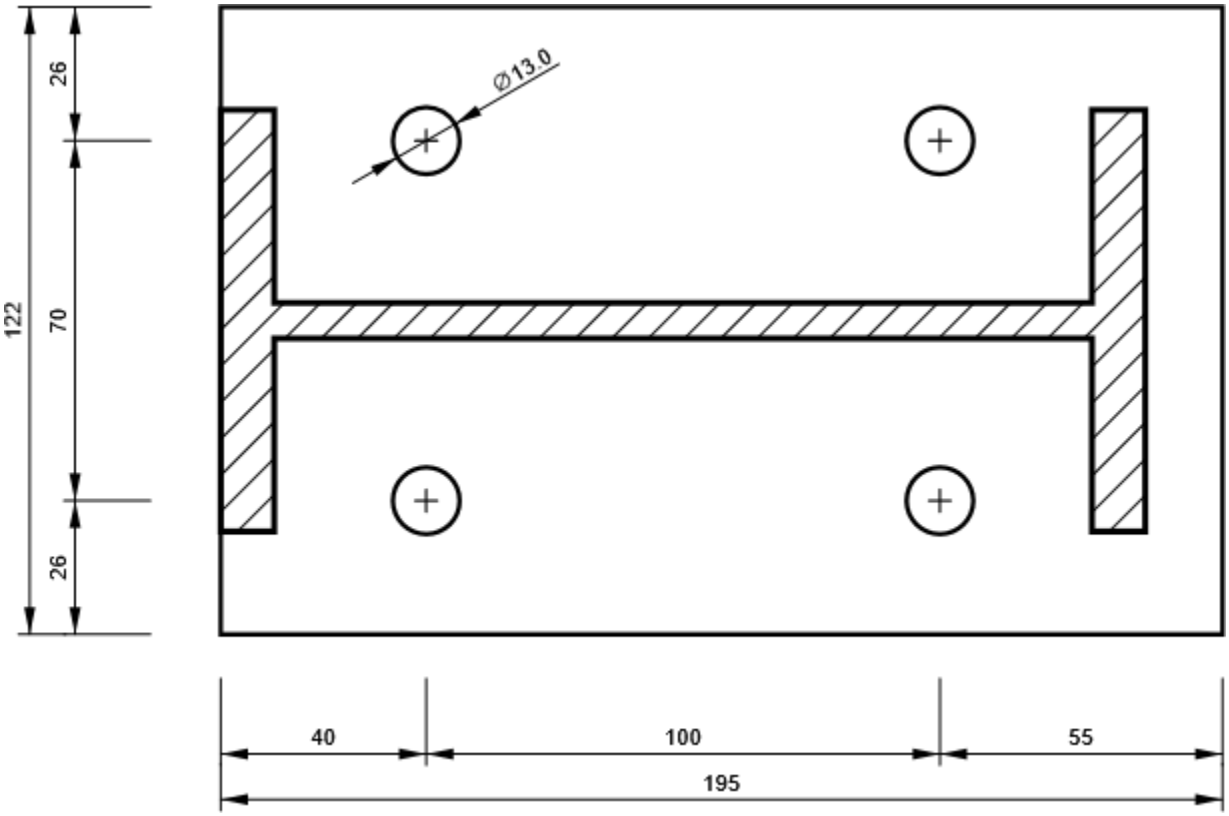
Bolts

Name	Grip length [mm]	Count
M12 8.8	40	4

Drawing

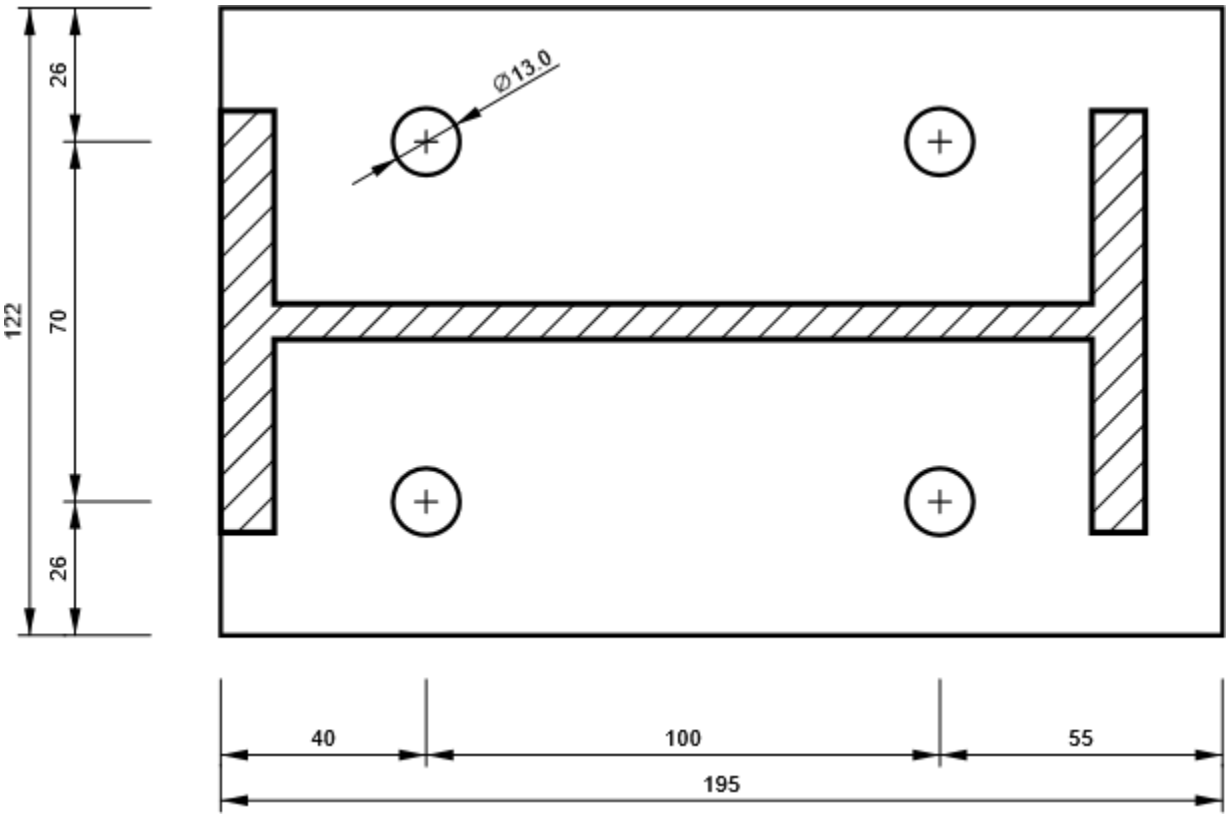
PP1 - PP1a

P20.0x195-122 (S 235)



PP1 - PP1b

P20.0x195-122 (S 235)



Code settings

Item	Value	Unit	Reference
Safety factor γ_{M0}	1.00	-	EN 1993-1-1: 6.1
Safety factor γ_{M1}	1.00	-	EN 1993-1-1: 6.1
Safety factor γ_{M2}	1.25	-	EN 1993-1-1: 6.1
Safety factor γ_{M3}	1.25	-	EN 1993-1-8: 2.2
Safety factor γ_{C}	1.50	-	EN 1992-1-1: 2.4.2.4
Safety factor γ_{Inst}	1.20	-	EN 1992-4: Table 4.1
Joint coefficient βj	0.67	-	EN 1993-1-8: 6.2.5
Effective area - influence of mesh size	0.10	-	
Friction coefficient - concrete	0.25	-	EN 1993-1-8
Friction coefficient in slip-resistance	0.30	-	EN 1993-1-8 tab 3.7
Limit plastic strain	0.05	-	EN 1993-1-5
Detailing	Yes		
Distance between bolts [d]	2.20	-	EN 1993-1-8: tab 3.3
Distance between bolts and edge [d]	1.20	-	EN 1993-1-8: tab 3.3
Concrete breakout resistance check	Both		EN 1992-4: 7.2.1.4 and 7.2.2.5
Use calculated αb in bearing check.	Yes		EN 1993-1-8: tab 3.4
Cracked concrete	Yes		EN 1992-4
Local deformation check	Yes		CIDECT DG 1, 3 - 1.1
Local deformation limit	0.03	-	CIDECT DG 1, 3 - 1.1
Geometrical nonlinearity (GMNA)	Yes		Analysis with large deformations for hollow section joints
Braced system	No		EN 1993-1-8: 5.2.2.5

NASTAVCI UNP180

Material

Steel S 235

Analysis Stress, strain/ loads in equilibrium

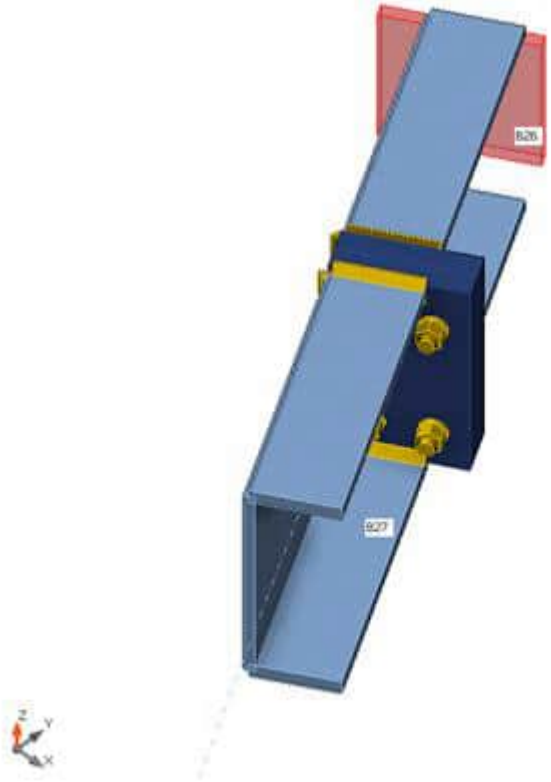
Members

Geometry

Name	Cross-section	β – Direction [°]	γ - Pitch [°]	α - Rotation [°]	Offset ex [mm]	Offset ey [mm]	Offset ez [mm]
B26	1 - UNP180	-60.0	0.0	0.0	0	0	0
B27	1 - UNP180	-60.0	0.0	0.0	0	0	0

Supports and forces

Name	Support	Forces in	X [mm]
B26 / begin	N-Vy-Vz-Mx-My-Mz	Position	0
B27 / end		Position	0



Cross-sections

Name	Material
1 - UNP180	S 235

Bolts

Name	Bolt assembly	Diameter [mm]	f_u [MPa]	Gross area [mm^2]
M12 8.8	M12 8.8	12	800.0	113

Load effects (forces in equilibrium)

Name	Member	N [kN]	Vy [kN]	Vz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
KGS(1)	B26 / Begin	-1.1	-0.1	-0.7	0.0	0.6	0.2
	B27 / End	1.1	0.1	0.7	0.0	-0.6	-0.2
KGS(3)	B26 / Begin	0.0	0.0	0.6	0.0	-0.9	0.0
	B27 / End	0.0	0.0	-0.6	0.0	0.9	0.0
KGS(4)	B26 / Begin	0.0	0.0	0.0	0.0	-1.6	0.0
	B27 / End	0.0	0.0	0.0	0.0	1.6	0.0
KGS(5)	B26 / Begin	0.0	0.0	0.0	0.0	1.3	0.0
	B27 / End	0.0	0.0	0.0	0.0	-1.3	0.0

Unbalanced forces

Name	X [kN]	Y [kN]	Z [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
KGS(1)	0.0	0.0	0.0	0.0	0.0	0.0
KGS(3)	0.0	0.0	0.0	0.0	0.0	0.0
KGS(4)	0.0	0.0	0.0	0.0	0.0	0.0
KGS(5)	0.0	0.0	0.0	0.0	0.0	0.0

Check

Summary

Name	Value	Check status
Analysis	100.0%	OK
Plates	0.0 < 5.0%	OK
Bolts	21.4 < 100%	OK
Welds	9.8 < 100%	OK
Buckling	Not calculated	

Plates

Name	t_p [mm]	Loads	σ_{Ed} [MPa]	ε_{Pl} [%]	$\sigma_{c,Ed}$ [MPa]	Status
B26-bfl 1	11.0	KGS(1)	31.7	0.0	0.0	OK
B26-tfl 1	11.0	KGS(4)	21.9	0.0	0.0	OK
B26-w 1	8.0	KGS(4)	25.6	0.0	0.0	OK
B27-bfl 1	11.0	KGS(5)	22.2	0.0	0.0	OK
B27-tfl 1	11.0	KGS(4)	21.9	0.0	0.0	OK
B27-w 1	8.0	KGS(4)	25.6	0.0	0.0	OK

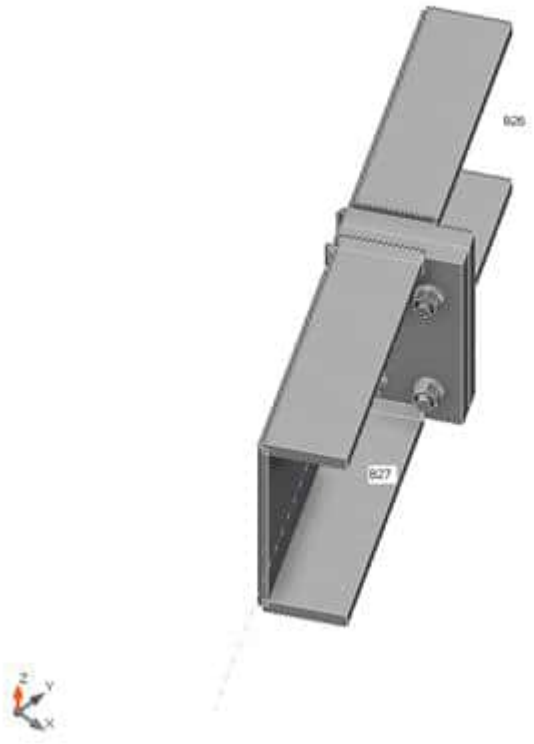
PP1a	18.0	KGS(4)	46.4	0.0	23.5	OK
PP1b	18.0	KGS(4)	46.4	0.0	23.5	OK

Design data

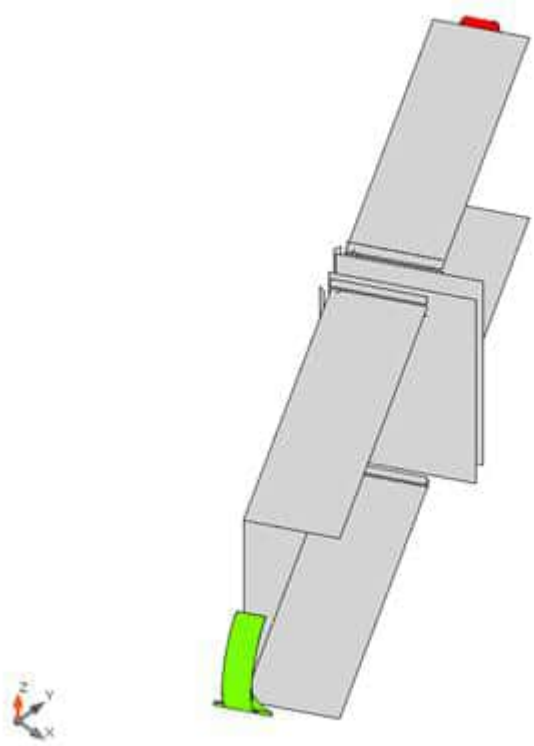
Material	f_y [MPa]	ε_{lim} [%]
S 235	235.0	5.0

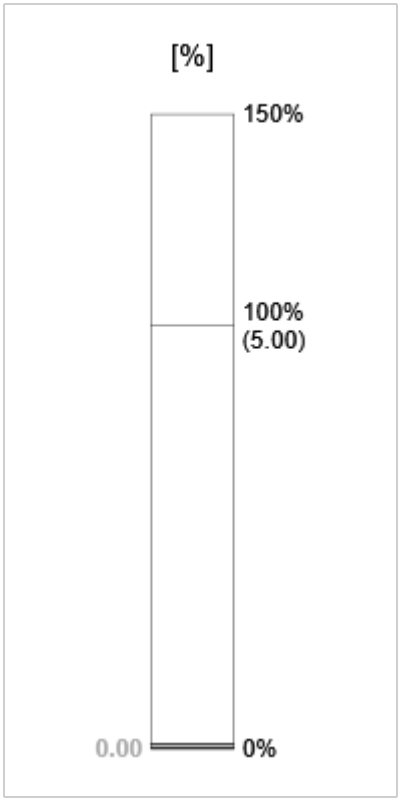
Symbol explanation

t_p	Plate thickness
σ_{Ed}	Equivalent stress
ε_{Pl}	Plastic strain
$\sigma_{c,Ed}$	Contact stress
f_y	Yield strength
ε_{lim}	Limit of plastic strain

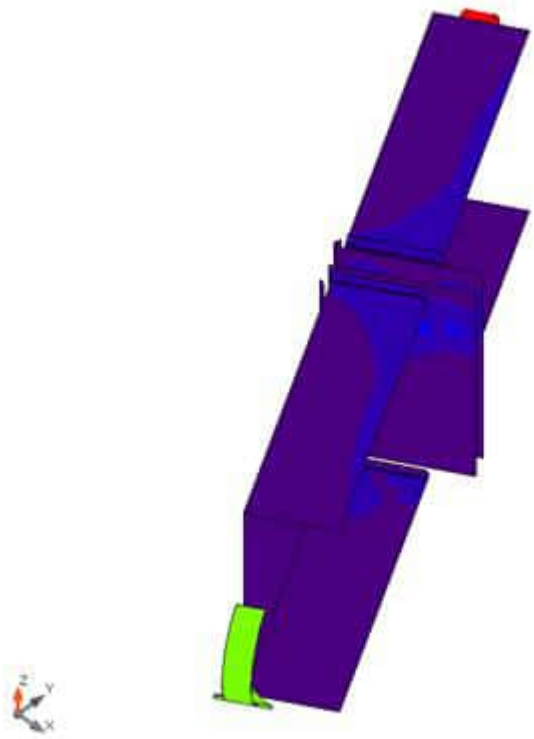


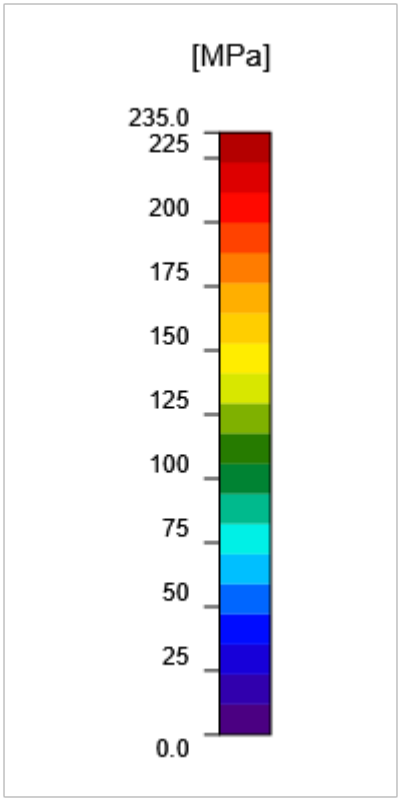
Overall check, KGS(4)





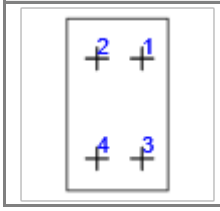
Strain check, KGS(4)





Equivalent stress, KGS(4)

Bolts

Shape	Item	Grade	Loads	$F_{t,Ed}$ [kN]	$F_{v,Ed}$ [kN]	$F_{b,Rd}$ [kN]	Ut_t [%]	Ut_s [%]	Ut_{ts} [%]	Detailing	Status
	B1	M12 8.8 - 1	KGS(4)	3.2	0.0	103.7	6.6	0.0	4.7	OK	OK
	B2	M12 8.8 - 1	KGS(4)	10.4	0.0	119.6	21.4	0.0	15.3	OK	OK
	B3	M12 8.8 - 1	KGS(5)	2.7	0.0	105.2	5.6	0.0	4.0	OK	OK
	B4	M12 8.8 - 1	KGS(5)	8.6	0.0	119.6	17.7	0.0	12.7	OK	OK

Design data

Grade	$F_{t,Rd}$ [kN]	$B_{p,Rd}$ [kN]	$F_{v,Rd}$ [kN]
M12 8.8 - 1	48.6	185.8	32.4

Symbol explanation

$F_{t,Ed}$ Tension force
$F_{v,Ed}$ Resultant of bolt shear forces Vy and Vz in shear planes
$F_{b,Rd}$ Plate bearing resistance EN 1993-1-8 – Tab. 3.4
Ut_t Utilization in tension
Ut_s Utilization in shear
Ut_{ts} Interaction of tension and shear EN 1993-1-8 – Tab. 3.4
$F_{t,Rd}$ Bolt tension resistance EN 1993-1-8 – Tab. 3.4
$B_{p,Rd}$ Punching shear resistance EN 1993-1-8 – Tab. 3.4
$F_{v,Rd}$ Bolt shear resistance EN 1993-1-8 – Tab. 3.4

Welds

Item	Edge	T_w [mm]	L [mm]	Loads	$\sigma_{w,Ed}$ [MPa]	ε_{Pl} [%]	$\sigma_\perp$ [MPa]	$\tau_\perp$ [MPa]	$\tau_\parallel$ [MPa]	Ut [%]	Ut_c [%]	Detailing	Status
PP1a	B26-bfl 1	◢ 5.0 ◣	66	KGS(1)	26.2	0.0	13.0	8.6	-9.9	7.3	7.3	OK	OK
		◢ 5.0 ◣	66	KGS(4)	35.3	0.0	-22.1	-13.1	-9.0	9.8	9.8	OK	OK
PP1a	B26-tfl 1	◢ 5.0 ◣	65	KGS(5)	22.0	0.0	-11.6	-10.5	2.4	6.1	6.1	OK	OK
		◢ 5.0 ◣	65	KGS(4)	24.9	0.0	8.4	-11.6	7.1	6.9	6.9	OK	OK
PP1a	B26-w 1	◢ 5.0 ◣	166	KGS(4)	28.7	0.0	-15.1	-14.1	0.2	8.0	8.0	OK	OK
		◢ 5.0 ◣	166	KGS(4)	16.9	0.0	-7.5	8.5	1.8	4.7	4.7	OK	OK
PP1b	B27-bfl 1	◢ 5.0 ◣	65	KGS(5)	14.9	0.0	1.3	7.5	4.2	4.1	4.1	OK	OK
		◢ 5.0 ◣	66	KGS(4)	35.3	0.0	-22.1	-13.1	9.0	9.8	9.8	OK	OK
PP1b	B27-tfl 1	◢ 5.0 ◣	65	KGS(5)	22.1	0.0	-11.6	-10.6	-2.4	6.1	6.1	OK	OK
		◢ 5.0 ◣	65	KGS(4)	25.0	0.0	8.4	-11.6	-7.1	6.9	6.9	OK	OK
PP1b	B27-w 1	◢ 5.0 ◣	166	KGS(4)	28.8	0.0	-15.1	-14.1	-0.2	8.0	8.0	OK	OK

		◢ 5.0 ◣	166	KGS(4)	16.8	0.0	-7.5	8.5	-1.8	4.7	4.7	OK	OK

Design data

Material	f_u [MPa]	β_w [-]	$\sigma_{w,Rd}$ [MPa]	0.9 σ [MPa]
S 235	360.0	0.80	360.0	259.2

Symbol explanation

T_w	Throat thickness a
L	Length
$\sigma_{w,Ed}$	Equivalent stress
ε_{Pl}	Strain
$\sigma_\perp$	Perpendicular stress
$\tau_\perp$	Shear stress perpendicular to weld axis
$\tau_\parallel$	Shear stress parallel to weld axis
Ut	Utilization
Ut_c	Weld capacity estimation
◢	Fillet weld
f_u	Ultimate strength of weld
β_w	Correlation factor EN 1993-1-8 – Tab. 4.1
$\sigma_{w,Rd}$	Equivalent stress resistance
0.9 σ	Perpendicular stress resistance: 0.9*fu/γM2

Buckling

Buckling analysis was not calculated.

Code settings

Item	Value	Unit	Reference
Safety factor γ_{M0}	1.00	-	EN 1993-1-1: 6.1
Safety factor γ_{M1}	1.00	-	EN 1993-1-1: 6.1
Safety factor γ_{M2}	1.25	-	EN 1993-1-1: 6.1
Safety factor γ_{M3}	1.25	-	EN 1993-1-8: 2.2
Safety factor γ_{C}	1.50	-	EN 1992-1-1: 2.4.2.4
Safety factor γ_{Inst}	1.20	-	EN 1992-4: Table 4.1
Joint coefficient βj	0.67	-	EN 1993-1-8: 6.2.5
Effective area - influence of mesh size	0.10	-	
Friction coefficient - concrete	0.25	-	EN 1993-1-8
Friction coefficient in slip-resistance	0.30	-	EN 1993-1-8 tab 3.7
Limit plastic strain	0.05	-	EN 1993-1-5
Detailing	Yes		
Distance between bolts [d]	2.20	-	EN 1993-1-8: tab 3.3
Distance between bolts and edge [d]	1.20	-	EN 1993-1-8: tab 3.3
Concrete breakout resistance check	Both		EN 1992-4: 7.2.1.4 and 7.2.2.5
Use calculated αb in bearing check.	Yes		EN 1993-1-8: tab 3.4
Cracked concrete	Yes		EN 1992-4
Local deformation check	Yes		CIDECT DG 1, 3 - 1.1
Local deformation limit	0.03	-	CIDECT DG 1, 3 - 1.1
Geometrical nonlinearity (GMNA)	Yes		Analysis with large deformations for hollow section joints
Braced system	No		EN 1993-1-8: 5.2.2.5

SPOJ STUPA NA TEMELJ

Material

Steel	S 235
Concrete	C30/37

Analysis Stress, strain/ loads in equilibrium

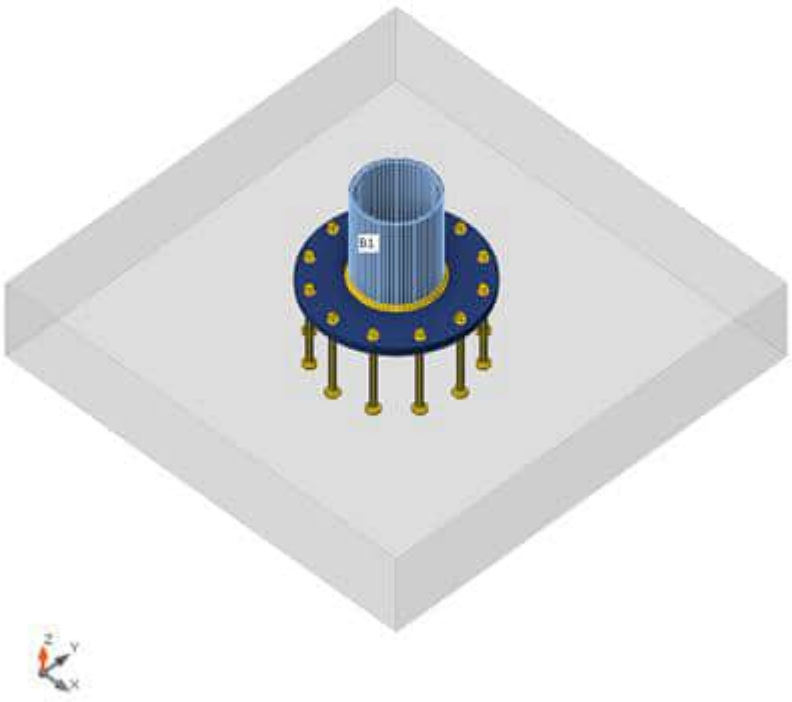
Members

Geometry

Name	Cross-section	β – Direction [°]	γ - Pitch [°]	α - Rotation [°]	Offset ex [mm]	Offset ey [mm]	Offset ez [mm]
B1	1 - RO323.9X14.2	0.0	90.0	0.0	0	0	0

Supports and forces

Name	Support	Forces in	X [mm]
B1 / end		Position	0



Cross-sections

Name	Material
1 - RO323.9X14.2	S 235

Anchors

Name	Bolt assembly	Diameter [mm]	f_u [MPa]	Gross area [mm^2]
M20 5.6	M20 5.6	20	500.0	314

Load effects (forces in equilibrium)

Name	Member	N [kN]	Vy [kN]	Vz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
KGS(1)	B1 / End	88.8	0.0	0.0	0.0	0.0	0.0
KGS(2)	B1 / End	-86.4	0.0	0.0	0.0	0.0	0.0
KGS(4)	B1 / End	36.9	0.0	-12.2	0.0	123.6	0.0
KGS(5)	B1 / End	-53.3	0.0	0.0	0.0	-55.5	0.0

Unbalanced forces

Name	X [kN]	Y [kN]	Z [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
KGS(1)	0.0	0.0	88.8	0.0	0.0	0.0
KGS(2)	0.0	0.0	-86.4	0.0	0.0	0.0
KGS(4)	12.2	0.0	36.9	0.0	123.6	0.0
KGS(5)	0.0	0.0	-53.3	0.0	-55.5	0.0

Foundation block

Item	Value	Unit
CB 1		
Dimensions	1900 x 1900	mm
Depth	350	mm
Anchor	M20 5.6	
Anchoring length	300	mm
Shear force transfer	Friction	

Check

Summary

Name	Value	Check status
Analysis	100.0%	OK
Plates	0.0 < 5.0%	OK
Loc. deformation	0.0 < 3%	OK
Anchors	97.6 < 100%	OK
Welds	91.4 < 100%	OK
Concrete block	99.9 < 100%	OK
Shear	16.5 < 100%	OK
Buckling	Not calculated	

Plates

Name	t_p [mm]	Loads	σ_{Ed} [MPa]	ε_{Pl} [%]	$\sigma_{c,Ed}$ [MPa]	Status
B1	14.2	KGS(4)	195.0	0.0	0.0	OK
BP1	40.0	KGS(4)	235.0	0.0	0.0	OK

Design data

Material	f_y [MPa]	ε_{lim} [%]
S 235	235.0	5.0

Symbol explanation

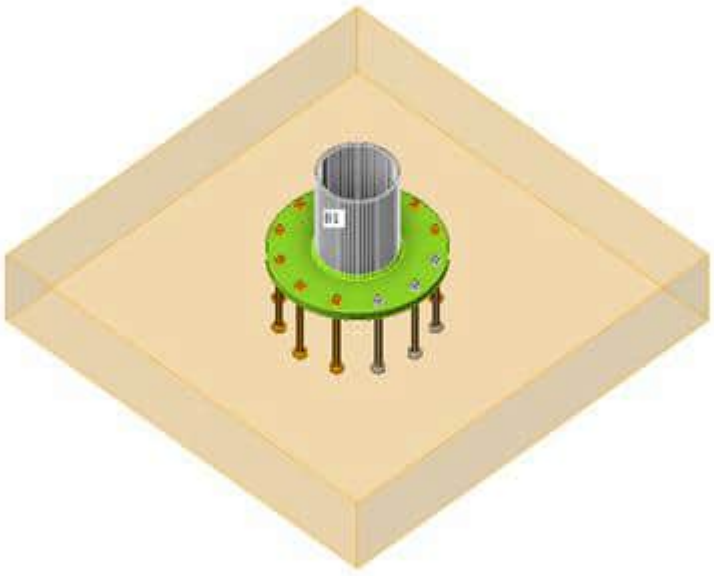
t_p	Plate thickness
σ_{Ed}	Equivalent stress
ε_{Pl}	Plastic strain
$\sigma_{c,Ed}$	Contact stress
f_y	Yield strength
ε_{lim}	Limit of plastic strain

Loc. deformation

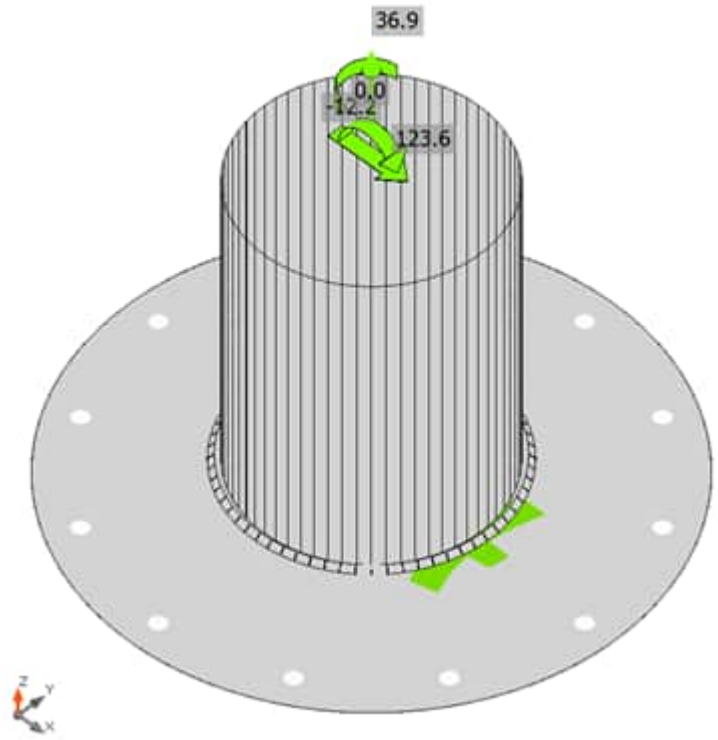
Name	d_0 [mm]	Loads	δ [mm]	δ_{lim} [mm]	δ/d_0 [%]	Check status
B1	324	KGS(4)	0	10	0.0	OK

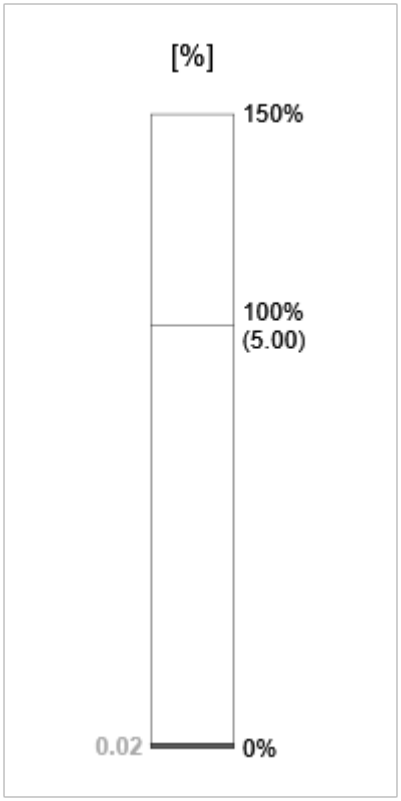
Symbol explanation

d_0	Cross-section size
δ	Local cross-section deformation
δ_{lim}	Allowed deformation

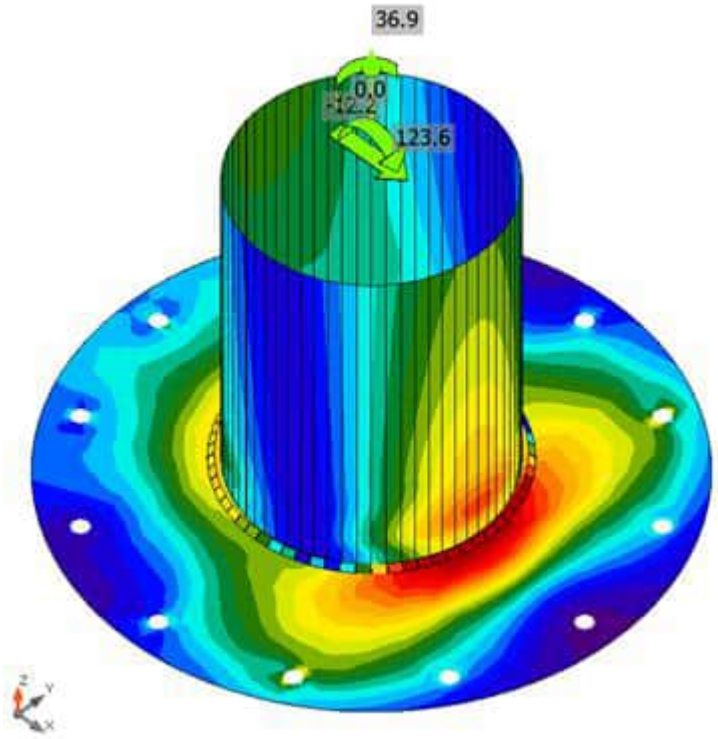


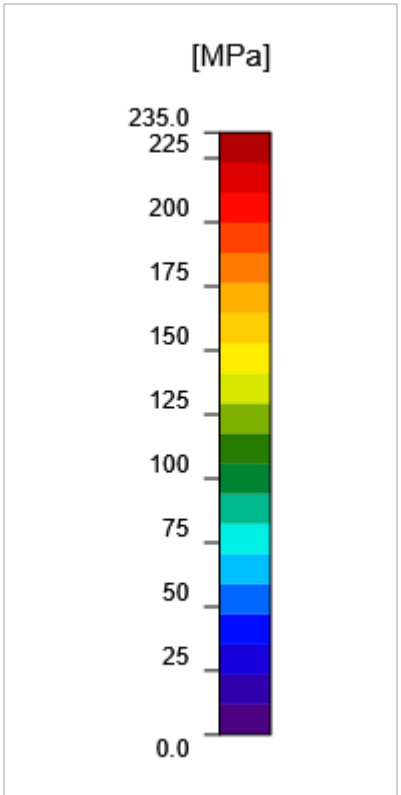
Overall check, KGS(4)





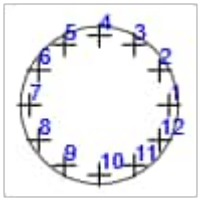
Strain check, KGS(4)





Equivalent stress, KGS(4)

Anchors

Shape	Item	Loads	N_{Ed} [kN]	V_{Ed} [kN]	$N_{Rd,c}$ [kN]	$N_{Rd,p}$ [kN]	$N_{Rd,cb}$ [kN]	$V_{Rd,cp}$ [kN]	Ut_t [%]	Ut_s [%]	Ut_{ts} [%]	Detailing	Status
	A1	KGS(4)	34.8	0.0	334.1	206.2	-	901.8	97.6	0.0	96.4	OK	OK
	A2	KGS(4)	41.0	0.0	334.1	206.2	-	901.8	97.6	0.0	96.4	OK	OK
	A3	KGS(4)	46.4	0.0	334.1	206.2	-	901.8	97.6	0.0	96.4	OK	OK
	A4	KGS(4)	48.5	0.0	334.1	206.2	-	901.8	97.6	0.0	96.4	OK	OK
	A5	KGS(4)	46.4	0.0	334.1	206.2	-	901.8	97.6	0.0	96.4	OK	OK
	A6	KGS(4)	40.9	0.0	334.1	206.2	-	901.8	97.6	0.0	96.4	OK	OK
	A7	KGS(4)	34.8	0.0	334.1	206.2	-	901.8	97.6	0.0	96.4	OK	OK
	A8	KGS(4)	16.7	0.0	334.1	206.2	-	901.8	97.6	0.0	96.4	OK	OK
	A9	KGS(5)	23.2	0.0	282.1	206.2	-	901.8	44.6	0.0	24.3	OK	OK
	A10	KGS(5)	26.5	0.0	282.1	206.2	-	901.8	50.8	0.0	25.8	OK	OK
	A11	KGS(5)	23.2	0.0	282.1	206.2	-	901.8	44.6	0.0	24.3	OK	OK
	A12	KGS(4)	16.7	0.0	334.1	206.2	-	901.8	97.6	0.0	96.4	OK	OK

Design data

Grade	$N_{Rd,s}$ [kN]	$V_{Rd,s}$ [kN]
M20 5.6 - 1	52.1	36.8

Symbol explanation

N_{Ed}	Tension force
V_{Ed}	Resultant of bolt shear forces Vy and Vz in shear planes
$N_{Rd,c}$	Design resistance in case of concrete cone failure under tension load - EN 1992-4 – 7.2.1.4
$N_{Rd,p}$	Design resistance in case of pull-out failure - EN 1992-4 – 7.2.1.5
$N_{Rd,cb}$	Design resistance in case of concrete blow-out failure - EN 1992-4 – 7.2.1.8
$V_{Rd,cp}$	Design resistance in case of concrete pryout failure - EN 1992-4 – 7.2.2.4
Ut_t	Utilization in tension
Ut_s	Utilization in shear
Ut_{ts}	Utilization in tension and shear
$N_{Rd,s}$	Design tensile resistance of a fastener in case of steel failure - EN 1992-4 – 7.2.1.3
$V_{Rd,s}$	Design shear resistance of a fastener in case of steel failure - EN 1992-4 – 7.2.2.3.1

Welds

Item	Edge	T_w [mm]	L [mm]	Loads	$\sigma_{w,Ed}$ [MPa]	ε_{Pl} [%]	$\sigma_{\perp}$ [MPa]	$\tau_{\perp}$ [MPa]	$\tau_{\parallel}$ [MPa]	Ut [%]	Ut_c [%]	Detailing	Status
BP1	B1	◢ 10.0	973	KGS(4)	329.0	0.0	-186.5	152.9	-33.2	91.4	39.8	OK	OK

Design data

Material	f_u [MPa]	β_w [-]	$\sigma_{w,Rd}$ [MPa]	0.9 σ [MPa]
S 235	360.0	0.80	360.0	259.2

Symbol explanation

T_w	Throat thickness a
L	Length
$\sigma_{w,Ed}$	Equivalent stress

ε_{Pl} Strain
$\sigma_{\perp}$ Perpendicular stress
$\tau_{\perp}$ Shear stress perpendicular to weld axis
$\tau_{||}$ Shear stress parallel to weld axis
Ut Utilization
Ut_c Weld capacity estimation
◢ Fillet weld
f_u Ultimate strength of weld
β_w Correlation factor EN 1993-1-8 – Tab. 4.1
$\sigma_{w,Rd}$ Equivalent stress resistance
0.9 σ Perpendicular stress resistance: 0.9*fu/γM2

Concrete block

Item	Loads	c [mm]	A_{eff} [mm²]	σ [MPa]	k_j [-]	f_{jd} [MPa]	Ut [%]	Status
CB 1	KGS(4)	56	7360	40.2	3.00	40.2	99.9	OK

Symbol explanation

c Bearing width
A_{eff} Effective area
σ Average stress in concrete
k_j Concentration factor
f_{jd} The ultimate bearing strength of the concrete block
Ut Utilization

Shear in contact plane

Name	Loads	V_y [kN]	V_z [kN]	$V_{Rd,y}$ [kN]	$V_{Rd,z}$ [kN]	U_t [%]	Status
BP1	KGS(4)	0.0	-12.2	73.9	73.9	16.5	OK

Symbol explanation

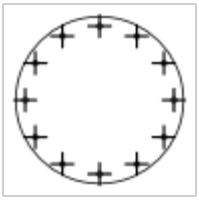
V_y Shear force in base plate Vy
V_z Shear force in base plate Vz
$V_{Rd,y}$ Shear resistance
$V_{Rd,z}$ Shear resistance
U_t Utilization

Buckling

Buckling analysis was not calculated.

Bill of material

Manufacturing operations

Name	Plates [mm]	Shape	Nr.	Welds [mm]	Length [mm]	Bolts	Nr.
BP1	P40.0x700.0-0.0 (S 235)		1	Fillet: a = 10.0	972.6	M20 5.6	12

Welds

Type	Material	Throat thickness [mm]	Leg size [mm]	Length [mm]
Fillet	S 235	10.0	14.1	972.6

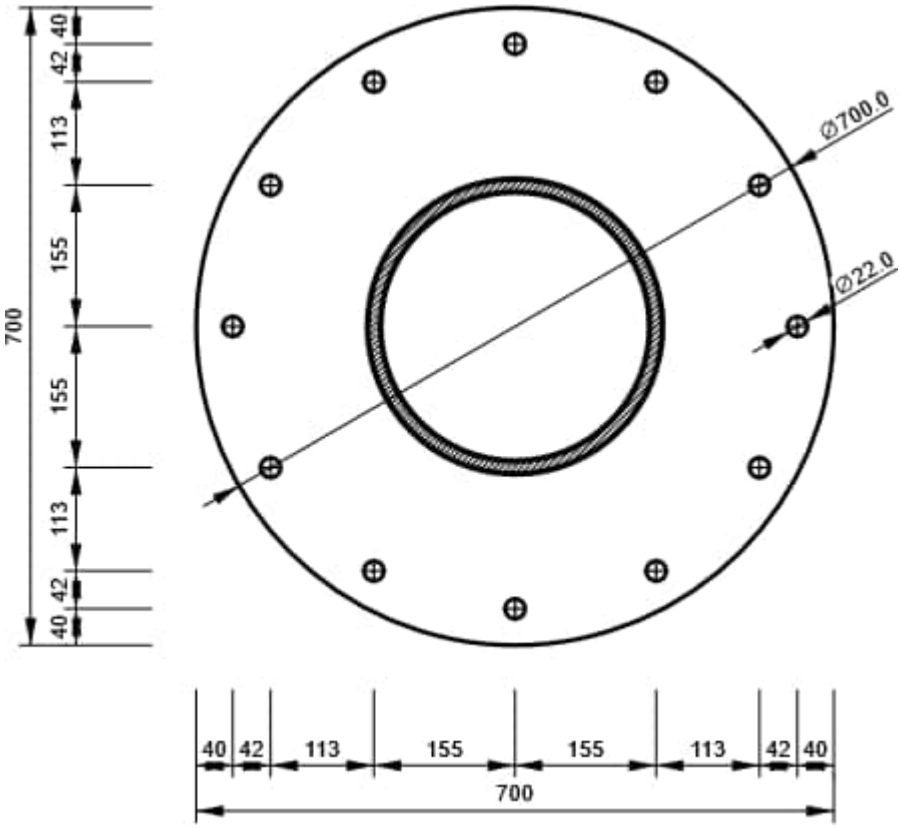
Anchors

Name	Length [mm]	Drill length [mm]	Count
M20 5.6	340	300	12

Drawing

BP1

P40.0x700-700 (S 235)



Code settings

Item	Value	Unit	Reference
Safety factor γ_{M0}	1.00	-	EN 1993-1-1: 6.1
Safety factor γ_{M1}	1.00	-	EN 1993-1-1: 6.1
Safety factor γ_{M2}	1.25	-	EN 1993-1-1: 6.1
Safety factor γ_{M3}	1.25	-	EN 1993-1-8: 2.2
Safety factor γ_{C}	1.50	-	EN 1992-1-1: 2.4.2.4
Safety factor γ_{Inst}	1.20	-	EN 1992-4: Table 4.1
Joint coefficient βj	0.67	-	EN 1993-1-8: 6.2.5
Effective area - influence of mesh size	0.10	-	
Friction coefficient - concrete	0.25	-	EN 1993-1-8
Friction coefficient in slip-resistance	0.30	-	EN 1993-1-8 tab 3.7
Limit plastic strain	0.05	-	EN 1993-1-5
Detailing	Yes		
Distance between bolts [d]	2.20	-	EN 1993-1-8: tab 3.3
Distance between bolts and edge [d]	1.20	-	EN 1993-1-8: tab 3.3
Concrete breakout resistance check	Both		EN 1992-4: 7.2.1.4 and 7.2.2.5
Use calculated αb in bearing check.	Yes		EN 1993-1-8: tab 3.4
Cracked concrete	Yes		EN 1992-4
Local deformation check	Yes		CIDECT DG 1, 3 - 1.1
Local deformation limit	0.03	-	CIDECT DG 1, 3 - 1.1
Geometrical nonlinearity (GMNA)	Yes		Analysis with large deformations for hollow section joints
Braced system	No		EN 1993-1-8: 5.2.2.5

SPECIFIKACIJA KONSTRUKCIJE

količina materijala nadstrešnica na jednom stupu

Summary

Material	Mass [kg]	Surface [m²]	Volume [m³]
Steel	1526.53	33.232	1.9446e-01
Total	1526.53	33.232	1.9446e-01

Note: Value 'Surface' represents for 1D members the total exposed surface area, while for 2D members it corresponds only to the surface area of the centroidal plane.

Steel (1D)

Cross-section	Material	Length [m]	Unit mass [kg/m]	Mass [kg]	Surface [m²]	Volume [m³]
CS1 - I var (INP240; 400) -> CS2 - I var (INP240; 180)	S 235	10.380	0.00	408.49	9.803	5.2037e-02
CS3 - RO323.9X14.2	S 235	4.000	108.33	433.32	4.060	5.5200e-02
CS4 - IPN180	S 235	10.405	21.90	227.88	6.669	2.9029e-02
CS5 - UNP180	S 235	20.785	21.98	456.85	12.699	5.8197e-02
Total		45.569		1526.53	33.232	1.9446e-01

masa materijala za 3 stupa: 3*1527=4 581. kg=
10% dodatak za priključke: 458kg

masa materijala za 8 stupa: 8*1527=12216. kg=
10% dodatak za priključke: 1222kg

Ukupno za 11 stupova: 16797. kg
10% dodatak za priključke: 1680. kg

Varijanta: količina materijala nadstrešnice na 8 stupova kao jedna cjelina:

Summary

Material	Mass [kg]	Surface [m^2]	Volume [m^3]
Steel	11372,0	242,976	1,4487e+00
Total	11372,0	242,976	1,4487e+00

Note: Value 'Surface' represents for 1D members the total exposed surface area,
while for 2D members it corresponds only to the surface area of the centroidal plane.

Steel (1D)

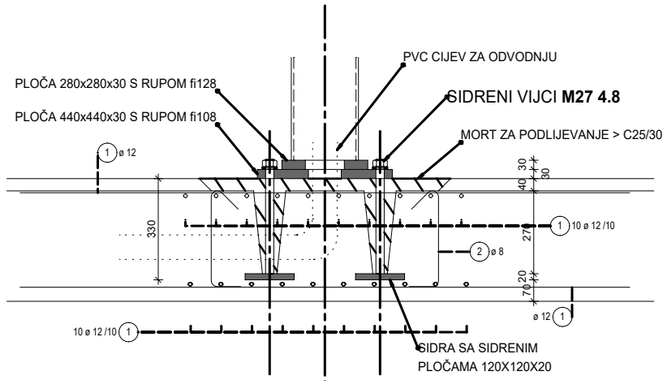
Cross-section	Material	Length [m]	Unit mass [kg/m]	Mass [kg]	Surface [m^2]	Volume [m^3]
CS1 - RO323.9X14.2	S 235	32,000	108,3	3466,6	32,483	4,4160e-01
CS2 - INP180	S 235	124,708	21,9	2731,3	79,813	3,4793e-01
CS3 - UPN180	S 235	86,553	22,0	1902,4	52,163	2,4235e-01
CS5 - I var (INP240; 180) -> CS6 - I var (INP240; 400)	S 235	83,138	0,0	3271,8	78,518	4,1679e-01
Total		326,399		11372,0	242,976	1,4487e+00

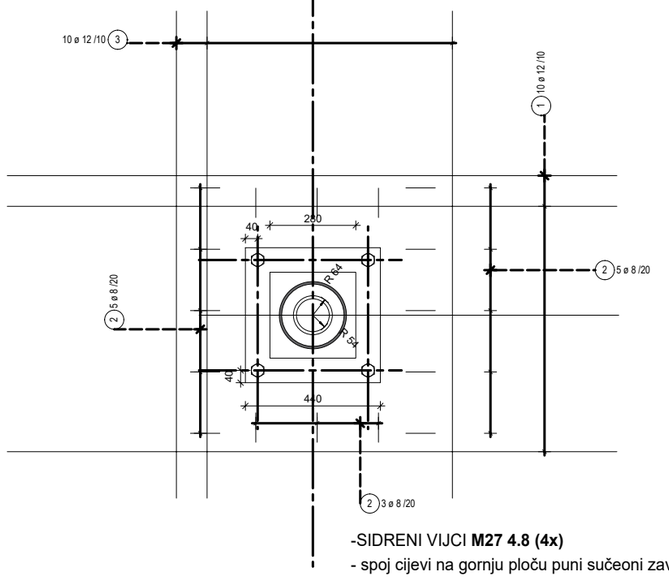
Ukupna masa cijele konstrukcije, varijanta 11372+4581=15953. kg

10% dodatak za priključke: 1595. kg

B.3 GRAFIČKI PRILOZI

SIDRENJE STUPOVA





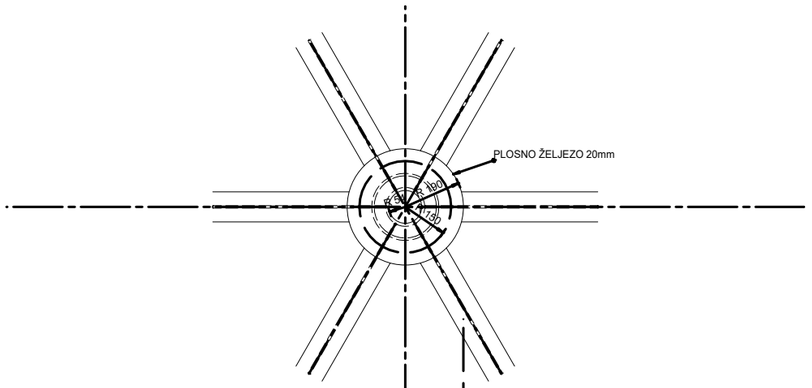
-SIDRENI VIJCI **M27 4.8 (4x)**
- spoj cijevi na gornju ploču puni sučeoni zavar
- spoj gornje na donju ploču kutnim zavarom 5mm u krug
- mort za podlijevanje > C25/30

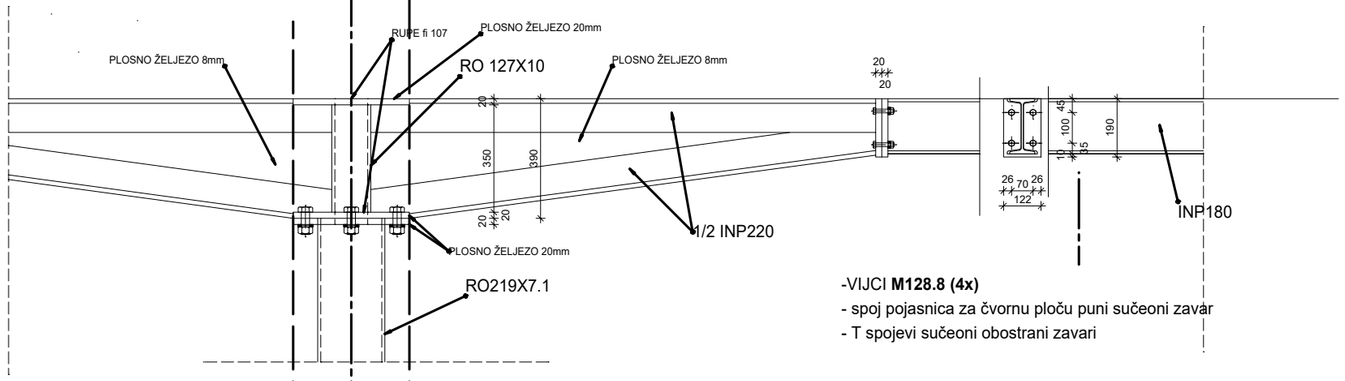
Lista šipki sa savijanjem

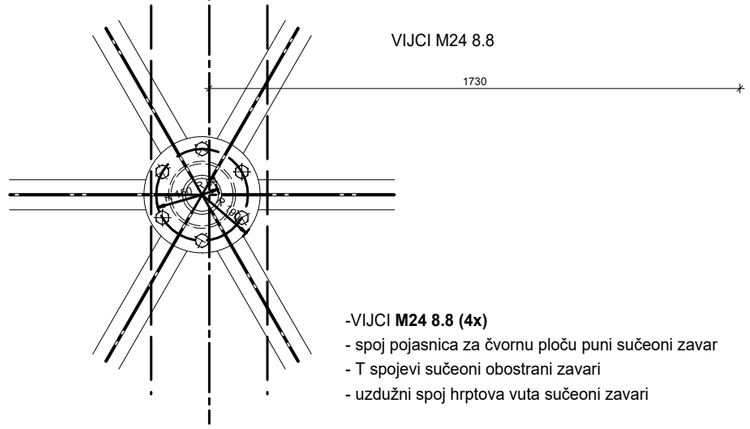
Poz.	Kom	ø [mm]	Jedinična dužina [m]	Mjere savijanja (van mjerila)	Ukupna dužina [m]	Težina [kg]
1	40	12	2.00	200	80.00	71.04
2	32	8	0.53	32	16.96	6.70
				Ukupna težina [kg] :		77.74

Detalji su dimenzionirani prema izvornom projektu te potrebno vijke i dimenzije čvornih ploča uskladiti s novim proračunom u ovom projektu!!!

DETALJ PRIKLJUČKA VUTA NA STUPOVIMA

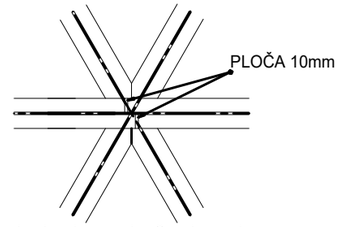






-VIJCI **M24 8.8 (4x)**
- spoj pojasnica za čvornu ploču puni sučeoni zavar
- T spojevi sučeoni obostrani zavari
- uzdužni spoj hrptova vuta sučeoni zavari

DETALJ PRIKLJUČKA 6 INP180

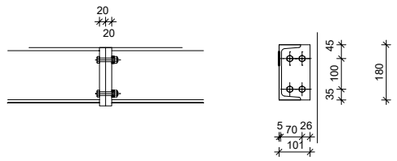


- spoj pojasnica puni sučeoni zavari
- T spojevi sučeoni obostrani zavari

DETALJ PRIKLJUČKA VUTA S INP180

-VIJCI **M128.8 (4x)**
- spoj pojasnica za čvornu ploču puni sučeoni zavar
- T spojevi sučeoni obostrani zavari

DETALJ PREKIDA UNP180



-VIJCI **M128.8 (4x)**
- spoj pojasnica za čvornu ploču puni sučeoni zavar
- T spojevi sučeoni obostrani zavari

vaniček arhitekti
d.o.o. za projektiranje | Lipa 2 | 10434 Strmec
Ulica lipa 2, Strmec Samoborski
OIB 06839878943 +385 91 561 62 77
matija.vaniček@gmail.com

Naručitelj: LUČKA UPRAVA SPLIT, Gat sv.Duje 1 21000 Split, OIB: 06992092556

Građevina: REKONSTRUKCIJA I DOGRADNJA GATA sv.PETRA

Projektant: STJEPAN MEDIĆ, d.i.g.

Razina razrade: IZVEDBENI PROJEKT

Strukovna odrednica: GRAĐEVINSKI PROJEKT

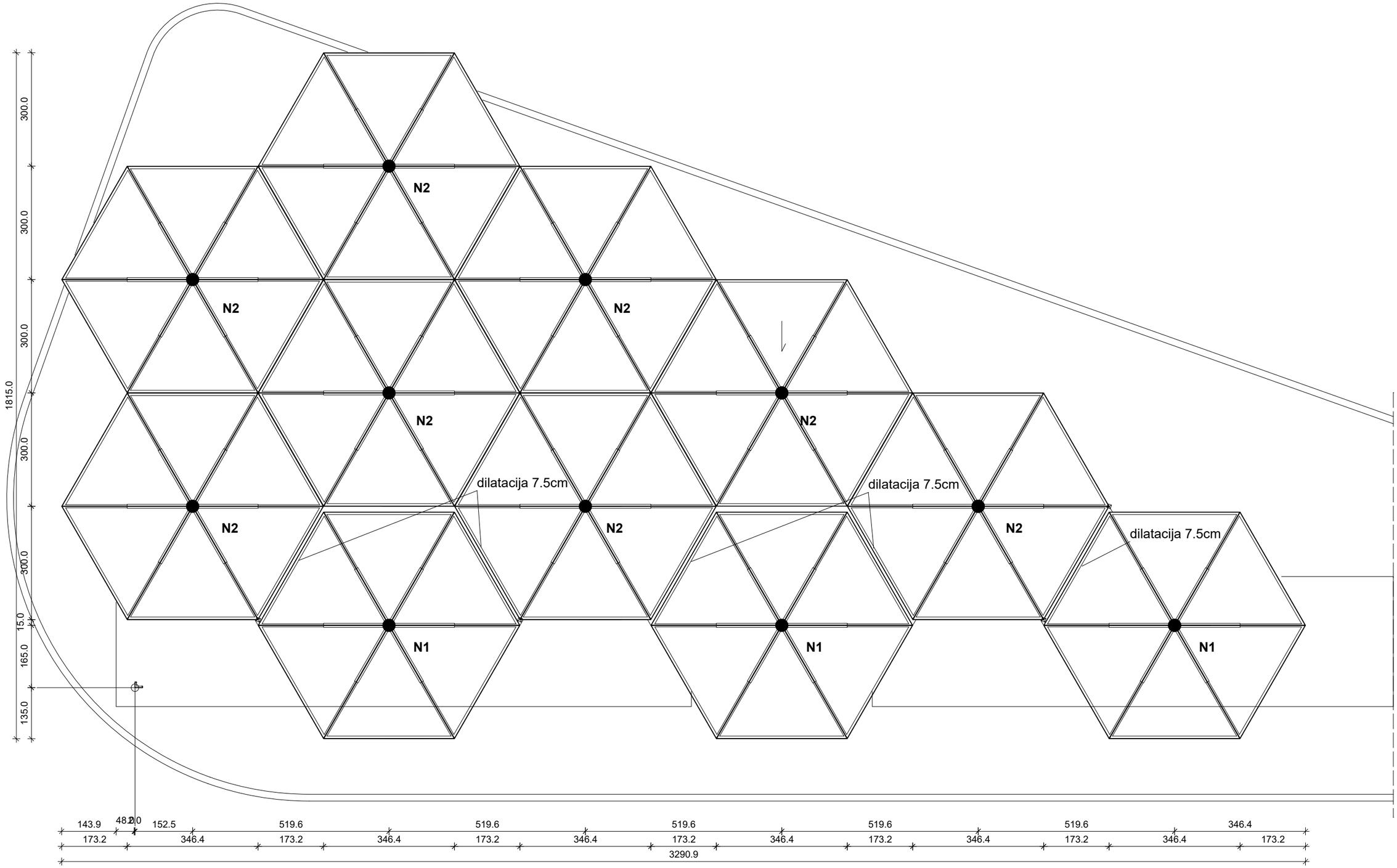
Projektirani dio građevine: PROJEKT ČELIČNIH KONSTRUKCIJA

Projektant suradnik:

Sadržaj: DETALJI IZVEDBE SPOJEVA

BP: VAK-04/23 ZOP: GSP Mjerilo: 1:20

Mapa: 5 Datum: travanj 2024. Revizija:



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Ulica lipa 2, Strmec Samoborski
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Projektirani dio građevine: PROJEKT ČELIČNIH KONSTRUKCIJA

Projektant suradnik:

Sadržaj: SHEMA POZICIJA

BP: VAK-04/23 ZOP: GSP Mjerilo: 1:100

Mapa: 5 Datum: travanj 2024. Revizija: