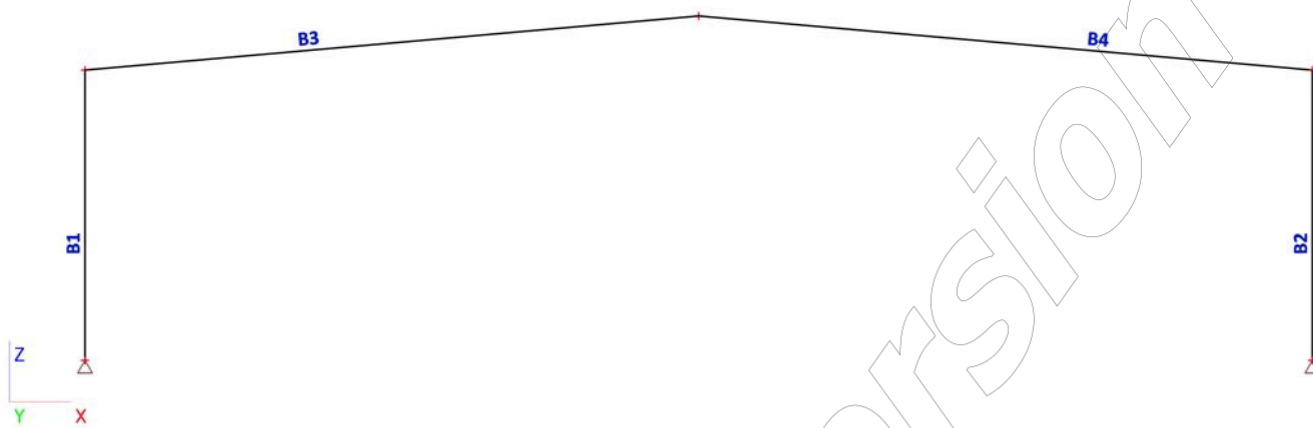


1. Priloga A1: Izpisi statičnih izračunov za portalni okvir

2. Oznake elementov okvirja



3. Kontrola in dimenzioniranje prečnih prerezov

Nonlinear calculation, Extreme : Member
Selection : B2, B4
Class : MSN_NC

EN 1993-1-1 Code Check

National annex: Slovenian SIST-EN NA

Member B2	5,900 m	I var	S 235	MSN_NC4	0,97
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Partial safety factors

Student version *Student version* *Student version* *Student version* *Student	
Gamma M0 for resistance of cross-sections	1,00
Gamma M1 for resistance to instability	1,00
Gamma M2 for resistance of net sections	1,25

Material

Student version *Student version* *Student version* *Student		
Yield strength f_y	235,0	MPa
Ultimate strength f_u	360,0	MPa
Fabrication	Welded	

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

The critical check is on position 5.900 m

Internal forces	Calculated	Unit
Student version *Student version* *Student version* *Student		
N,Ed	-267,24	kN
Vy,Ed	0,00	kN
Vz,Ed	170,26	kN
T,Ed	0,00	kNm
My,Ed	971,20	kNm
Mz,Ed	0,00	kNm

Classification for cross-section design

According to EN 1993-1-1 article 5.5.2

Classification of Internal Compression parts

According to EN 1993-1-1 Table 5.2 Sheet 1

Maximum width-to-thickness ratio	56,83
Class 1 Limit	61,08
Class 2 Limit	70,33
Class 3 Limit	107,64

=> Internal Compression parts Class 1

Classification of Outstand Flanges

According to EN 1993-1-1 Table 5.2 Sheet 2

Maximum width-to-thickness ratio	5,58
Class 1 Limit	9,00
Class 2 Limit	10,00
Class 3 Limit	13,77

=> Outstand Flanges Class 1

=> Section classified as Class 1 for cross-section design

Section properties

A	2.137479e+004 mm ²	Az/A	0.410
Ay/A	0.571	Iz	9.469619e+007 mm ⁴
Iy	2.089271e+009 mm ⁴	It	2.594527e+006 mm ⁴
Iyz	-2.168404e-007 mm ⁴		
Iw	1.254152e+013 mm ⁶		
Wely	5.574363e+006 mm ³	Welz	6.313079e+005 mm ³
Wply	6.251306e+006 mm ³	Wplz	9.759481e+005 mm ³
cy	374.80 mm	cz	150.00 mm
dy	0.00 mm	dz	0.00 mm

Dimensions			
Student version	*Student version*	*Student version*	*Student version*
Height	749.60 mm	Width	300.00 mm
Thickness of flange	21.00 mm	Thickness of web	11.50 mm
Radius	27.00 mm		

Compression check

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

A	2,1375e-02	m ²
Nc,Rd	5023,08	kN
Unity check	0,05	-

Bending moment check for My

According to EN 1993-1-1 article 6.2.5 and formula (6.12),(6.13)

Wpl,y	6,2513e-03	m ³
Mpl,y,Rd	1469,06	kNm
Unity check	0,66	-

Shear check for Vz

According to EN 1993-1-1 article 6.2.6 and formula (6.17)

Eta	1,20	
Av	9,7649e-03	m ²
Vpl,z,Rd	1324,87	kN
Unity check	0,13	-

Combined bending, axial force and shear force check

According to EN 1993-1-1 article 6.2.9.1 and formula (6.31)

Mpl,y,Rd	1469,06	kNm
Unity check	0,66	-

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.

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	
Student version	*Student version*	*Student version*	*Student version*
Sway type	non-sway	non-sway	
System length L	5,900	5,900	m
Buckling factor k		1,00	
Buckling length Lcr	5,900	5,900	m
Critical Euler load Ncr	297317,95	5638,29	kN
Slenderness Lambda	12,21	88,64	
Relative slenderness Lambda,rel	0,13	0,94	
Limit slenderness Lambda,rel,0	0,20	0,20	
Buckling curve	b	c	
Imperfection Alpha	0,34	0,49	
Reduction factor Chi	1,00	0,57	

Student version *Student version* *Student version* *Student version* *Student version* *Student version*

Buckling parameters	yy	zz	
Student version *Student version* *Student version* *Student version* *Student version* *Student version			
Buckling resistance Nb,Rd	5023,08	2878,92	kN

Tapered member data	
Student version *Student version* *Student version* *Student version	
Beam stiffness at begin Ri'	100,00
Beam stiffness at end Rj'	100,00
Factor Ksi	1,67
Imperfection Alpha	8,09

Flexural Buckling verification		
Student version *Student version* *Student version* *Student version* *Student version		
Cross-section area A	2,1375e-02	m ²
Buckling resistance Nb,Rd	2878,92	kN
Unity check	0,09	-

Lateral Torsional Buckling Check

According to article EN 1993-1-1 : 6.3.2.1. and formula (6.54)

LTB Parameters		
Student version *Student version* *Student version* *Student version* *Student version		
Method for LTB curve	Art. 6.3.2.2.	
Wy	6,2513e-03	m ³
Elastic critical moment M _{cr}	4086,38	kNm
Relative slenderness Lambda _{LT}	0,60	
Limit slenderness Lambda _{LT,0}	0,40	
LTB curve	d	
Imperfection Alpha _{LT}	0,76	
Reduction factor Chi _{LT}	0,71	
Buckling resistance Mb,Rd	1043,49	kNm
Unity check	0,93	-

Mcr Parameters		
Student version *Student version* *Student version*		
LTB length	5,900	m
k	1,00	
kw	1,00	
C1	1,76	
C2	0,00	
C3	1,00	

Note: C Parameters according to ECCS 119 2006 / Galea 2002 load in center of gravity

Compression and bending check

According to article EN 1993-1-1 : 6.3.3. and formula (6.61), (6.62)
Interaction Method 2

Table of values		
Student version *Student version* *Student version* *Student version		
k _{yy}	0.399	
k _{yz}	0.672	
k _{zy}	0.942	
k _{zz}	1.120	
Delta My	0.00	kNm
Delta Mz	0.00	kNm
A	2.1375e-02	m ²
Wy	6.2513e-03	m ³
Wz	9.7595e-04	m ³
NRk	5023.08	kN
My,Rk	1469.06	kNm
Mz,Rk	229.35	kNm
My,Ed	971.20	kNm
Mz,Ed	0.00	kNm
Interaction Method 2		
Psi y	-0.005	
Psi z	1.000	
C _{my}	0.400	
C _{mz}	1.000	
C _{mLT}	0.400	

Unity check (6.61) = 0.05 + 0.37 + 0.00 = 0.42
Unity check (6.62) = 0.09 + 0.88 + 0.00 = 0.97

Shear buckling check
in buckling field 1

According to article EN 1993-1-5 : 5. & 7.1. and formula (5.10) & (7.1)

Table of values		
Student version *Student version* *Student version* *Student version*		
a	5.900	m
hw	708	mm
t	12	mm
fyw	235.0	MPa
Eta	1.20	
k tau	5.34	
Sigma E	50.1	MPa
tau cr	267.7	MPa
Chi w	1.17	
bf	300	mm
tf	21	mm
a	1.692	m
Mf,Rd	981.34	kNm
Chi f	0.00	
Chi V	1.17	
Vb,Rd	1287.33	kN
Eta 3	0.13	
Eta 1	0.71	
Mpl,Rd	1469.06	kNm

Unity check 0.13 (5.10)

The member satisfies the stability check.

EN 1993-1-1 Code Check

National annex: Slovenian SIST-EN NA

Member B4	12,548 m	I var	S 235	MSN_NC4	0,84 -
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Partial safety factors	
Student version *Student version* *Student version* *Student version*	
Gamma M0 for resistance of cross-sections	1,00
Gamma M1 for resistance to instability	1,00
Gamma M2 for resistance of net sections	1,25

Material	
Student version *Student version* *Student version* *Student version*	
Yield strength fy	235,0 MPa
Ultimate strength fu	360,0 MPa
Fabrication	Welded

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

The critical check is on position 0.000 m

Internal forces	Calculated	Unit
Student version *Student version* *Student version* *Student version*		
N,Ed	-192,33	kN
Vy,Ed	0,00	kN
Vz,Ed	251,82	kN
T,Ed	0,00	kNm
My,Ed	-995,07	kNm
Mz,Ed	0,00	kNm

Classification for cross-section design

According to EN 1993-1-1 article 5.5.2

Classification of Internal Compression parts

According to EN 1993-1-1 Table 5.2 Sheet 1

Maximum width-to-thickness ratio	57,83
Class 1 Limit	64,51
Class 2 Limit	74,28
Class 3 Limit	112,56

=> Internal Compression parts Class 1

Classification of Outstand Flanges

According to EN 1993-1-1 Table 5.2 Sheet 2

Maximum width-to-thickness ratio	4,21
Class 1 Limit	9,00
Class 2 Limit	10,00
Class 3 Limit	13,77

=> Outstand Flanges Class 1

=> Section classified as Class 1 for cross-section design

Section properties

A	1.776762e+004 mm ²	Az/A	0.522
Ay/A	0.489	Iz	3.390183e+007 mm ⁴
Iy	1.686450e+009 mm ⁴	It	1.757847e+006 mm ⁴
Iyz	-9.757820e-007 mm ⁴		
Iw	4.881797e+012 mm ⁶		
Wely	4.324231e+006 mm ³	Welz	3.081985e+005 mm ³
Wply	5.016783e+006 mm ³	Wplz	4.922645e+005 mm ³
cy	390.00 mm	cz	110.00 mm
dy	0.00 mm	dz	-0.00 mm

Compression check

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

A	1,7768e-02	m ²
Nc,Rd	4175,39	kN
Unity check	0,05	-

Bending moment check for My

According to EN 1993-1-1 article 6.2.5 and formula (6.12),(6.13)

Wpl,y	5,0168e-03	m ³
Mpl,y,Rd	1178,94	kNm
Unity check	0,84	-

Shear check for Vz

According to EN 1993-1-1 article 6.2.6 and formula (6.17)

Eta	1,20	
Av	1,0685e-02	m ²
Vpl,z,Rd	1449,68	kN
Unity check	0,17	-

Combined bending, axial force and shear force check

According to EN 1993-1-1 article 6.2.9.1 and formula (6.31)

Mpl,y,Rd	1178,94	kNm
Unity check	0,84	-

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.

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	
Student version *Student version* *Student version* *Student version* *Student version* *Student v			
Sway type	non-sway	non-sway	
System length L	12,548	12,548	m
Buckling factor k	2,00	0,20	
Buckling length Lcr	25,096	2,510	m
Critical Euler load Ncr	5549,88	11156,09	kN
Slenderness Lambda	81,46	57,45	
Relative slenderness Lambda,rel	0,87	0,61	
Limit slenderness Lambda,rel,0	0,20	0,20	

Note: The slenderness or compression force is such that Flexural Buckling effects may be ignored according to EN 1993-1-1 article 6.3.1.2(4).

Torsional (-Flexural) Buckling check

According to article EN 1993-1-1 : 6.3.1.1. and formula (6.46)

Table of values		
Student version *Student version* *Student version* *Student version* *Student ve		
Torsional Buckling length	12,548	m
Ncr,T	2129,97	kN
Ncr,TF	5549,88	kN
Relative slenderness Lambda,T	1,40	
Limit slenderness Lambda,0	0,20	
Buckling curve	c	
Imperfection Alpha	0,49	
A	1,7768e-02	m ²

Student version *Student version* *Student version* *Student version* *Student ve

Table of values		
Student version *Student version* *Student version* *Student version* *Student version*		
Reduction factor Chi	0.35	
Buckling resistance Nb,Rd	1457.96	kN
Unity check	0.13	-

Lateral Torsional Buckling Check

According to article EN 1993-1-1 : 6.3.2.1. and formula (6.54)

LTB Parameters		
Student version *Student version* *Student version* *Student version* *Student version*		
Method for LTB curve	Art. 6.3.2.2.	
Wy	5.0168e-03	m^3
Elastic critical moment Mcr	14061.53	kNm
Relative slenderness Lambda,LT	0.29	
Limit slenderness Lambda,LT,0	0.40	

Mcr Parameters		
Student version *Student version* *Student version*		
LTB length	2.510	m
k	1.00	
kw	1.00	
C1	3.18	
C2	0.49	
C3	1.00	

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)

Compression and bending check

According to article EN 1993-1-1 : 6.3.3. and formula (6.61), (6.62)

Interaction Method 2

Table of values		
Student version *Student version* *Student version* *Student version*		
kyy	0.412	
kyz	0.617	
kzy	0.247	
kzz	1.029	
Delta My	0.00	kNm
Delta Mz	0.00	kNm
A	1.7768e-02	m^2
Wy	5.0168e-03	m^3
Wz	4.9226e-04	m^3
NRk	4175.39	kN
My,Rk	1178.94	kNm
Mz,Rk	115.68	kNm
My,Ed	-995.07	kNm
Mz,Ed	0.00	kNm
Interaction Method 2		
Psi y	-0.482	
Psi z	1.000	
Cmy	0.400	
Cmz	1.000	
CmLT	0.400	

$$\text{Unity check (6.61)} = 0.05 + 0.35 + 0.00 = 0.39$$

$$\text{Unity check (6.62)} = 0.13 + 0.21 + 0.00 = 0.34$$

Shear buckling check

in buckling field 1

According to article EN 1993-1-5 : 5. & 7.1. and formula (5.10) & (7.1)

Table of values		
Student version *Student version* *Student version* *Student version*		
a	12.548	m
hw	742	mm
t	12	mm
fyw	235.0	MPa
Eta	1.20	
k tau	5.34	
Sigma E	49.6	MPa
tau cr	265.1	MPa
Chi w	1.16	
bf	220	mm
tf	19	mm
a	3.378	m
Mf,Rd	674.35	kNm
Chi f	0.00	

Table of values		
Chi V	1.16	
Vb,Rd	1401.29	kN
Eta 3	0.18	
Eta 1	0.89	
Mpl,Rd	1178.94	kNm

Unity check 0.18 (5.10)
The member satisfies the stability check.

Student version