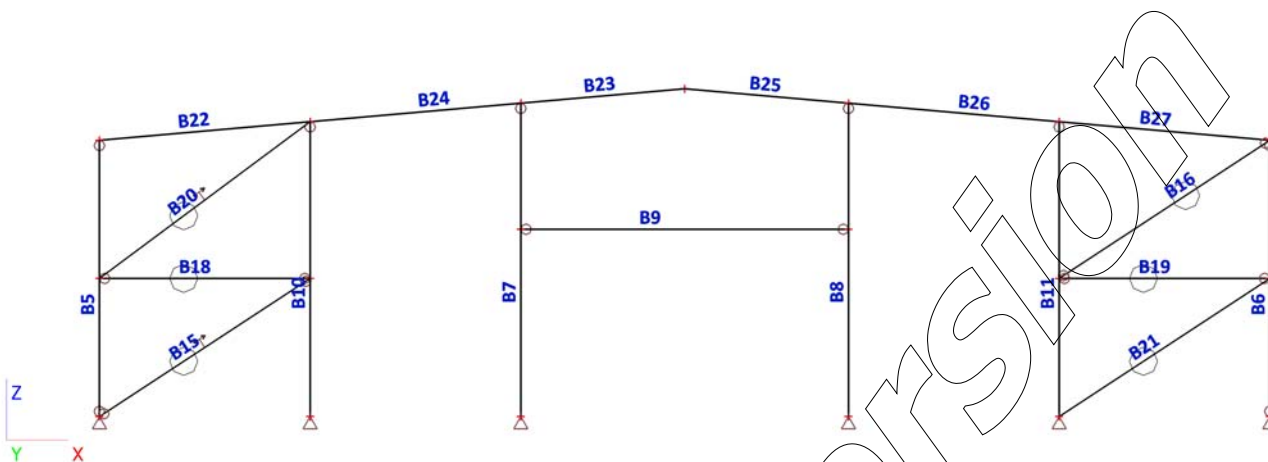


1. Priloga A2: Izpisi statičnih izračunov za čelni okvir

2. Oznake elementov okvirja



3. Kontrola in dimenzioniranje prečnih prerezov

Nonlinear calculation, Extreme : Member
Selection : B7, B18, B20, B22, B23, B24
Class : MSN_NC

EN 1993-1-1 Code Check

National annex: Slovenian SIST-EN NA

Member B7	6,692 m	HEA120	S 235	MSN_NC4	0,87 -
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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	Rolled

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

The critical check is on position 0.000 m

Internal forces	Calculated	Unit
Student version *Student version* *Student version* *Student		
N,Ed	-74,23	kN
Vy,Ed	0,00	kN
Vz,Ed	0,17	kN
T,Ed	0,00	kNm
My,Ed	0,00	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	14,80
Class 1 Limit	33,00
Class 2 Limit	38,00
Class 3 Limit	42,00

=> 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	5,69
Class 1 Limit	9,00
Class 2 Limit	10,00
Class 3 Limit	14,00

=> Outstand Flanges Class 1

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

Compression check

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

A	2,5300e-03	m ²
N _{c,Rd}	594,55	kN
Unity check	0,12	-

Shear check for V_z

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

Eta	1,20	
A _v	8,4200e-04	m ²
V _{pl,z,Rd}	114,24	kN
Unity check	0,00	-

The member satisfies the section check.

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

Classification for member buckling design

Decisive position for stability classification: 0,000 m

Classification of Internal Compression parts

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

Maximum width-to-thickness ratio	14,80
Class 1 Limit	33,00
Class 2 Limit	38,00
Class 3 Limit	42,00

=> 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	5,69
Class 1 Limit	9,00
Class 2 Limit	10,00
Class 3 Limit	14,00

=> Outstand Flanges Class 1

=> 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	6,692	6,692	m
Buckling factor k	1,00	1,00	
Buckling length L _{cr}	6,692	6,692	m
Critical Euler load N _{cr}	280,47	106,91	kN
Slenderness Lambda	136,74	221,47	
Relative slenderness Lambda _{rel}	1,46	2,36	
Limit slenderness Lambda _{rel,0}	0,20	0,20	
Buckling curve	b	c	
Imperfection Alpha	0,34	0,49	
Reduction factor Chi	0,36	0,15	
Buckling resistance N _{b,Rd}	213,41	87,42	kN

Warning: Slenderness 221,47 is larger than the limit value of 200,00.

Flexural Buckling verification

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

Cross-section area A	2,5300e-03	m ²
Buckling resistance N _{b,Rd}	87,42	kN
Unity check	0,85	-

Compression and bending check

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

Interaction Method 1

Table of values

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

k _{yy}	2.067	
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Student version *Student version* *Student version* *Student version*

Table of values		
Student version *Student version* *Student version* *Student version*		
kyz	4.735	
kzy	0.866	
kzz	1.984	
Delta My	0.00	kNm
Delta Mz	0.00	kNm
A	2.5300e-03	m^2
Wy	1.1958e-04	m^3
Wz	5.8750e-05	m^3
NRk	594.55	kN
My,Rk	28.10	kNm
Mz,Rk	13.81	kNm
My,Ed	0.59	kNm
Mz,Ed	0.00	kNm
Interaction Method 1		
Mcr0	23.44	kNm
reduced slenderness 0	1.10	
Psi y	1.000	
Psi z	1.000	
Cmy,0	0.952	
Cmz,0	1.167	
Cmy	0.967	
Cmz	1.167	
CmLT	1.715	
muy	0.813	
muz	0.340	
wy	1.128	
wz	1.500	
npl	0.125	
aLT	0.990	
bLT	0.000	
cLT	0.007	
dLT	0.000	
eLT	0.001	
Cyy	0.886	
Cyz	0.453	
Czy	0.461	
Czz	0.655	

Unity check (6.61) = 0.35 + 0.04 + 0.00 = 0.39
 Unity check (6.62) = 0.85 + 0.02 + 0.00 = 0.87

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*	
hw/t	19.600

The web slenderness is such that the Shear Buckling Check is not required.
 The member satisfies the stability check.

EN 1993-1-1 Code Check

National annex: Slovenian SIST-EN NA

Member B18	4,500 m	L70X7	S 235	MSN/NC3	0,82 -
Partial safety factors					
Student version *Student version* *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* *Student version* *Student version*		
Yield strength fy	235,0	MPa
Ultimate strength fu	360,0	MPa
Fabrication	Rolled	

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

The critical check is on position 0.000 m

Axis definition :

- principal y- axis in this code check is referring to the principal z axis in Scia Engineer
- principal z- axis in this code check is referring to the principal y axis in Scia Engineer

Internal forces	Calculated	Unit
N,Ed	-29,93	kN
Vy,Ed	0,00	kN
Vz,Ed	0,00	kN
T,Ed	0,00	kNm
My,Ed	0,00	kNm
Mz,Ed	0,00	kNm

Classification for cross-section design

According to EN 1993-1-1 article 5.5.2

Classification for Angles

According to EN 1993-1-1 Table 5.2 Sheet 3 & 2

Ratio c/t	7,71
Class 1 Limit	9,00
Class 2 Limit	10,00
Class 3 Limit	14,00

According to EN 1993-1-1 Table 5.2 Sheet 3

Ratio h/t	10,00
Class 3 Limit (1)	15,00
Ratio (b+h)/2t	10,00
Class 3 Limit (2)	11,50

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

Compression check

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

A	9,4000e-04	m ²
Nc,Rd	220,90	kN
Unity check	0,14	-

The member satisfies the section check.

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

Classification for member buckling design

Decisive position for stability classification: 0,000 m

Classification for Angles

According to EN 1993-1-1 Table 5.2 Sheet 3 & 2

Ratio c/t	7,71
Class 1 Limit	9,00
Class 2 Limit	10,00
Class 3 Limit	14,00

According to EN 1993-1-1 Table 5.2 Sheet 3

Ratio h/t	10,00
Class 3 Limit (1)	15,00
Ratio (b+h)/2t	10,00
Class 3 Limit (2)	11,50

=> 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	non-sway	sway	
System length L	4,500	4,500	m
Buckling factor k	1,00	1,00	
Buckling length Lcr	4,500	4,500	m
Critical Euler load Ncr	43,27	43,27	kN
Slenderness Lambda	212,18	212,18	
Relative slenderness Lambda,rel	2,26	2,26	
Limit slenderness Lambda,rel,0	0,20	0,20	
Buckling curve	b	b	
Imperfection Alpha	0,34	0,34	
Reduction factor Chi	0,17	0,17	
Buckling resistance Nb,Rd	37,15	37,15	kN

Warning: Slenderness 212,18 is larger than the limit value of 200,00.

Flexural Buckling verification		
Cross-section area A	9,4000e-04	m ²
Buckling resistance Nb,Rd	37,15	kN

Flexural Buckling verification		
Student version *Student version* *Student version* *Student version* *Student version*		
Unity check	0,81	-

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 version*		
Torsional Buckling length	4.500	m
Ncr,T	889.80	kN
Ncr,TF	42.46	kN
Relative slenderness Lambda,T	2.28	
Limit slenderness Lambda,0	0.20	
Buckling curve	b	
Imperfection Alpha	0.34	
A	9.4000e-04	m^2
Reduction factor Chi	0.17	
Buckling resistance Nb,Rd	36.51	kN
Unity check	0.82	-

The member satisfies the stability check.

EN 1993-1-1 Code Check

National annex: Slovenian SIST-EN NA

Member B20	5,608 m	L35X4	S 235	MSN_NC3	0,59 -
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Partial safety factors	
Student version *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* *Student version*		
Yield strength fy	235,0	MPa
Ultimate strength fu	360,0	MPa
Fabrication	Rolled	

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

The critical check is on position 5.608 m

Axis definition :

- principal y- axis in this code check is referring to the principal z axis in Scia Engineer
- principal z- axis in this code check is referring to the principal y axis in Scia Engineer

Internal forces	Calculated	Unit
Student version *Student version* *Student version* *Student version* *Student version*		
N,Ed	37,22	kN
Vy,Ed	0,00	kN
Vz,Ed	0,00	kN
T,Ed	0,00	kNm
My,Ed	0,00	kNm
Mz,Ed	0,00	kNm

Tension check

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

A	2,6700e-04	m^2
Npl,Rd	62,74	kN
Nu,Rd	69,21	kN
Nt,Rd	62,74	kN
Unity check	0,59	-

The member satisfies the section check.

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

The member satisfies the stability check.

EN 1993-1-1 Code Check

National annex: Slovenian SIST-EN NA

Member B22	4,517 m	IPE180	S 235	MSN_NC3	1,54 -
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Partial safety factors

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

Yield strength f_y	235,0	MPa
Ultimate strength f_u	360,0	MPa
Fabrication	Rolled	

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

The critical check is on position 0.000 m

Internal forces	Calculated	Unit
-----------------	------------	------

N,Ed	-57,95	kN
Vy,Ed	0,00	kN
Vz,Ed	2,43	kN
T,Ed	0,00	kNm
My,Ed	0,00	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	27,55
Class 1 Limit	33,00
Class 2 Limit	38,00
Class 3 Limit	42,00

=> 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	4,23
Class 1 Limit	9,00
Class 2 Limit	10,00
Class 3 Limit	14,00

=> Outstand Flanges Class 1

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

Compression check

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

A	2,3900e-03	m ²
Nc,Rd	561,65	kN
Unity check	0,10	-

Shear check for Vz

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

Eta	1,20	
Av	1,1204e-03	m ²
Vpl,z,Rd	152,01	kN
Unity check	0,02	-

The member satisfies the section check

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

Classification for member buckling design

Decisive position for stability classification: 0,000 m

Classification of Internal Compression parts

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

Maximum width-to-thickness ratio	27,55
Class 1 Limit	33,00
Class 2 Limit	38,00
Class 3 Limit	42,00

=> 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	4,23
Class 1 Limit	9,00

Student version *Student version* *Student version* *Student ver

Class 2 Limit	10,00
Class 3 Limit	14,00

=> Outstand Flanges Class 1
=> 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	non-sway	non-sway	
System length L	4,517	4,517	m
Buckling factor k	5,56	0,55	
Buckling length Lcr	25,100	2,500	m
Critical Euler load Ncr	43,33	334,93	kN
Slenderness Lambda	338,13	121,61	
Relative slenderness Lambda,rel	3,60	1,29	
Limit slenderness Lambda,rel,0	0,20	0,20	
Buckling curve	a	b	
Imperfection Alpha	0,21	0,34	
Reduction factor Chi	0,07	0,43	
Buckling resistance Nb,Rd	40,90	241,13	kN

Warning: Slenderness 338,13 is larger than the limit value of 200,00.

Flexural Buckling verification		
Cross-section area A	2,3900e-03	m ²
Buckling resistance Nb,Rd	40,90	kN
Unity check	1,42	-

Torsional (-Flexural) Buckling check

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

Table of values		
Torsional Buckling length	4,517	m
Ncr,T	779,27	kN
Ncr,TF	43,33	kN
Relative slenderness Lambda,T	3,60	
Limit slenderness Lambda,0	0,20	
Buckling curve	b	
Imperfection Alpha	0,34	
A	2,3900e-03	m ²
Reduction factor Chi	0,07	
Buckling resistance Nb,Rd	39,53	kN
Unity check	1,47	-

Compression and bending check

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

Table of values		
kyy	1.000	
kyz	1.963	
kzy	1.000	
kzz	1.754	
Delta My	0,00	kNm
Delta Mz	0,00	kNm
A	2,3900e-03	m ²
Wy	1,6600e-04	m ³
Wz	3,4600e-05	m ³
NRk	561,65	kN
My,Rk	39,01	kNm
Mz,Rk	8,13	kNm
My,Ed	-2,93	kNm
Mz,Ed	0,00	kNm
Interaction Method 1		
Mcr0	241,46	kNm
reduced slenderness 0	0,40	
Psi y	0,000	
Psi z	1,000	
Cmy,0	0,495	
Cmz,0	1,042	
Cmy	0,735	

Table of values		
Student version *Student version* *Student version* *Student version*		
Cmz	1.042	
CmLT	1.000	
muy	1.000	
muz	0.893	
wy	1.137	
wz	1.500	
npl	0.103	
aLT	0.996	
bLT	0.000	
cLT	0.021	
dLT	0.000	
eLT	0.024	
Cyy	0.880	
Cyz	0.442	
Czy	0.459	
Czz	0.642	

Unity check (6.61) = 1.42 + 0.08 + 0.00 = 1.49
 Unity check (6.62) = 1.47 + 0.08 + 0.00 = 1.54

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*	
hw/t	30.943

The web slenderness is such that the Shear Buckling Check is not required.
 The member does NOT satisfy the stability check!

EN 1993-1-1 Code Check

National annex: Slovenian SIST-EN NA

Member B23	3,514 m	IPE180	S 235	MSN NC4	1,15 -
Partial safety factors					
Student version *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	Rolled	

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

The critical check is on position 3.514 m

Internal forces	Calculated	Unit
Student version *Student version* *Student version* *Student version*		
N,Ed	-10,47	kN
Vy,Ed	0,00	kN
Vz,Ed	-0,91	kN
T,Ed	0,00	kNm
My,Ed	26,33	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	27,55
Class 1 Limit	67,41
Class 2 Limit	77,62
Class 3 Limit	116,91

=> 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	4,23
Class 1 Limit	9,00

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

Class 2 Limit	10,00
Class 3 Limit	13,77

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

Compression check

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

A	2,3900e-03	m ²
N _{c,Rd}	561,65	kN
Unity check	0,02	-

Bending moment check for M_y

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

W _{pl,y}	1,6600e-04	m ³
M _{pl,y,Rd}	39,01	kNm
Unity check	0,67	-

Shear check for V_z

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

Eta	1,20	
A _v	1,1204e-03	m ²
V _{pl,z,Rd}	152,01	kN
Unity check	0,01	-

Combined bending, axial force and shear force check

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

M _{pl,y,Rd}	39,01	kNm
Unity check	0,67	-

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

Decisive position for stability classification: 0,000 m

Classification of Internal Compression parts

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

Maximum width-to-thickness ratio	27,55
Class 1 Limit	67,51
Class 2 Limit	77,73
Class 3 Limit	118,30

=> 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	4,23
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 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	non-sway	non-sway	
System length L	3,514	3,514	m
Buckling factor k	7,14	0,71	
Buckling length L _{cr}	25,100	2,500	m
Critical Euler load N _{cr}	43,33	334,93	kN
Slenderness Lambda	338,13	121,61	
Relative slenderness Lambda _{rel}	3,60	1,29	
Limit slenderness Lambda _{rel,0}	0,20	0,20	
Buckling curve	a	b	
Imperfection Alpha	0,21	0,34	
Reduction factor Chi	0,07	0,43	
Buckling resistance N _{b,Rd}	40,90	241,13	kN

Warning: Slenderness 338,13 is larger than the limit value of 200,00.

Flexural Buckling verification		
Cross-section area A	2,3900e-03	m ²
Buckling resistance Nb,Rd	40,90	kN
Unity check	0,26	-

Torsional (-Flexural) Buckling check

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

Table of values		
Torsional Buckling length	3.514	m
Ncr,T	862.32	kN
Ncr,TF	43.33	kN
Relative slenderness Lambda,T	3.60	
Limit slenderness Lambda,0	0.20	
Buckling curve	b	
Imperfection Alpha	0.34	
A	2.3900e-03	m ²
Reduction factor Chi	0.07	
Buckling resistance Nb,Rd	39.53	kN
Unity check	0.26	-

Lateral Torsional Buckling Check

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

LTB Parameters		
Method for LTB curve	Art. 6.3.2.2.	
Wy	1.6600e-04	m ³
Elastic critical moment Mcr	783.80	kNm
Relative slenderness Lambda,LT	0.22	
Limit slenderness Lambda,LT,0	0.40	

Mcr Parameters		
LTB length	0.703	m
k	1.00	
kw	1.00	
C1	2.03	
C2	0.34	
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 1

Table of values		
ky	1.055	
kyz	0.751	
kzy	0.864	
kzz	1.202	
Delta My	0.00	kNm
Delta Mz	0.00	kNm
A	2,3900e-03	m ²
Wy	1.6600e-04	m ³
Wz	3.4600e-05	m ³
NRk	561.65	kN
My,Rk	39,01	kNm
Mz,Rk	8.13	kNm
My,Ed	-33.15	kNm
Mz,Ed	0.00	kNm
Interaction Method 1		
Mcr0	385.50	kNm
reduced slenderness 0	0.32	
Psi y	-0.794	
Psi z	1.000	
Cmy,0	0.857	
Cmz,0	1.008	
Cmy	0.982	
Cmz	1.008	
CmLT	1.000	

Table of values		
<i>*Student version* *Student version* *Student version* *Student version*</i>		
muy	0.772	
muz	0.982	
wy	1.137	
wz	1.500	
npl	0.019	
aLT	0.996	
bLT	0.000	
cLT	0.112	
dLT	0.000	
eLT	0.160	
Cyy	0.948	
Cyz	0.737	
Czy	0.770	
Czz	0.850	

Unity check (6.61) = 0.26 + 0.90 + 0.00 = 1.15
 Unity check (6.62) = 0.26 + 0.73 + 0.00 = 1.00

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	
<i>*Student version* *Student version* *Student version* *Student version*</i>	
hw/t	30.943

The web slenderness is such that the Shear Buckling Check is not required.
 The member does NOT satisfy the stability check!

EN 1993-1-1 Code Check

National annex: Slovenian SIST-EN NA

Member B24	4,517 m	IPE180	S 235	MSN_NC4	1,01 -
Partial safety factors					
<i>*Student version* *Student version* *Student version* *Student version* *Student version*</i>					
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		
<i>*Student version* *Student version* *Student version* *Student version*</i>		
Yield strength fy	235,0	MPa
Ultimate strength fu	360,0	MPa
Fabrication	Rolled	

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

The critical check is on position 0.000 m

Internal forces	Calculated	Unit
<i>*Student version* *Student version* *Student version* *Student version*</i>		
N,Ed	-5,49	kN
Vy,Ed	0,00	kN
Vz,Ed	26,23	kN
T,Ed	0,00	kNm
My,Ed	-33,15	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	27,55
Class 1 Limit	69,52
Class 2 Limit	80,05
Class 3 Limit	120,64

=> 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	4,23
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

Compression check

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

A	2,3900e-03	m ²
N _{c,Rd}	561,65	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)

W _{pl,y}	1,6600e-04	m ³
M _{pl,y,Rd}	39,01	kNm
Unity check	0,85	-

Shear check for V_z

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

E _t	1,20	
A _v	1,1204e-03	m ²
V _{pl,z,Rd}	152,01	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 (6.41)

M _{pl,y,Rd}	39,01	kNm
Alpha	2,00	
M _{pl,z,Rd}	8,13	kNm
Beta	1,00	

Unity check (6.41) = 0,72 + 0,00 = 0,72 -

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

Classification of Internal Compression parts

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

Maximum width-to-thickness ratio	27,55
Class 1 Limit	69,52
Class 2 Limit	80,05
Class 3 Limit	120,64

=> 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	4,23
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 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	non-sway	non-sway	
System length L	4,517	4,517	m
Buckling factor k	5,56	0,55	
Buckling length L _{cr}	25,100	2,500	m
Critical Euler load N _{cr}	43,33	334,93	kN
Slenderness Lambda	338,13	121,61	
Relative slenderness Lambda _{rel}	3,60	1,29	
Limit slenderness Lambda _{rel,0}	0,20	0,20	
Buckling curve	a	b	
Imperfection Alpha	0,21	0,34	
Reduction factor Chi	0,07	0,43	

Student version *Student version* *Student version* *Student version* *Student version* *Student v

Buckling parameters	yy	zz	
Student version *Student version* *Student version* *Student version* *Student version* *Student v			
Buckling resistance Nb,Rd	40,90	241,13	kN

Warning: Slenderness 338,13 is larger than the limit value of 200,00.

Flexural Buckling verification		
Student version *Student version* *Student version* *Student version* *Student v		
Cross-section area A	2,3900e-03	m ²
Buckling resistance Nb,Rd	40,90	kN
Unity check	0,13	-

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 v		
Torsional Buckling length	4.517	m
Ncr,T	779.27	kN
Ncr,TF	43.33	kN
Relative slenderness Lambda,T	3.60	
Limit slenderness Lambda,0	0.20	
Buckling curve	b	
Imperfection Alpha	0.34	
A	2.3900e-03	m ²
Reduction factor Chi	0.07	
Buckling resistance Nb,Rd	39.53	kN
Unity check	0.14	-

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 v		
Method for LTB curve	Art. 6.3.2.2.	
Wy	1.6600e-04	m ³
Elastic critical moment Mcr	991.47	kNm
Relative slenderness Lambda,LT	0.20	
Limit slenderness Lambda,LT,0	0.40	

Mcr Parameters		
Student version *Student version* *Student version*		
LTB length	0.903	m
k	1.00	
kw	1.00	
C1	4.11	
C2	1.02	
C3	0.41	

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 1

Table of values		
Student version *Student version* *Student version* *Student version*		
kyy	1.028	
kyz	0.771	
kzy	0.669	
kzz	1.097	
Delta My	0.00	kNm
Delta Mz	0.00	kNm
A	2.3900e-03	m ²
Wy	1.6600e-04	m ³
Wz	3.4600e-05	m ³
NRk	561.65	kN
My,Rk	39.01	kNm
Mz,Rk	8.13	kNm
My,Ed	-33.15	kNm
Mz,Ed	0.00	kNm
Interaction Method 1		
Mcr0	241.46	kNm
reduced slenderness 0	0.40	
Psi y	0.526	
Psi z	1.000	
Cmy,0	0.894	

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

Table of values		
<i>*Student version* *Student version* *Student version* *Student version*</i>		
Cmz,0	1.004	
Cmy	0.990	
Cmz	1.004	
CmLT	1.000	
muy	0.881	
muz	0.991	
wy	1.137	
wz	1.500	
npl	0.010	
aLT	0.996	
bLT	0.000	
cLT	0.177	
dLT	0.000	
eLT	0.201	
Cyy	0.972	
Cyz	0.804	
Czy	0.877	
Czz	0.922	

Unity check (6.61) $= 0.13 + 0.87 + 0.00 = 1.01$
 Unity check (6.62) $= 0.14 + 0.57 + 0.00 = 0.71$

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	
<i>*Student version* *Student version* *Student version*</i>	
hw/t	30.943

The web slenderness is such that the Shear Buckling Check is not required.
 The member does NOT satisfy the stability check!