

PRILOGA B: IZPIS IZ PROGRAMA SCIA ENGINEER 14

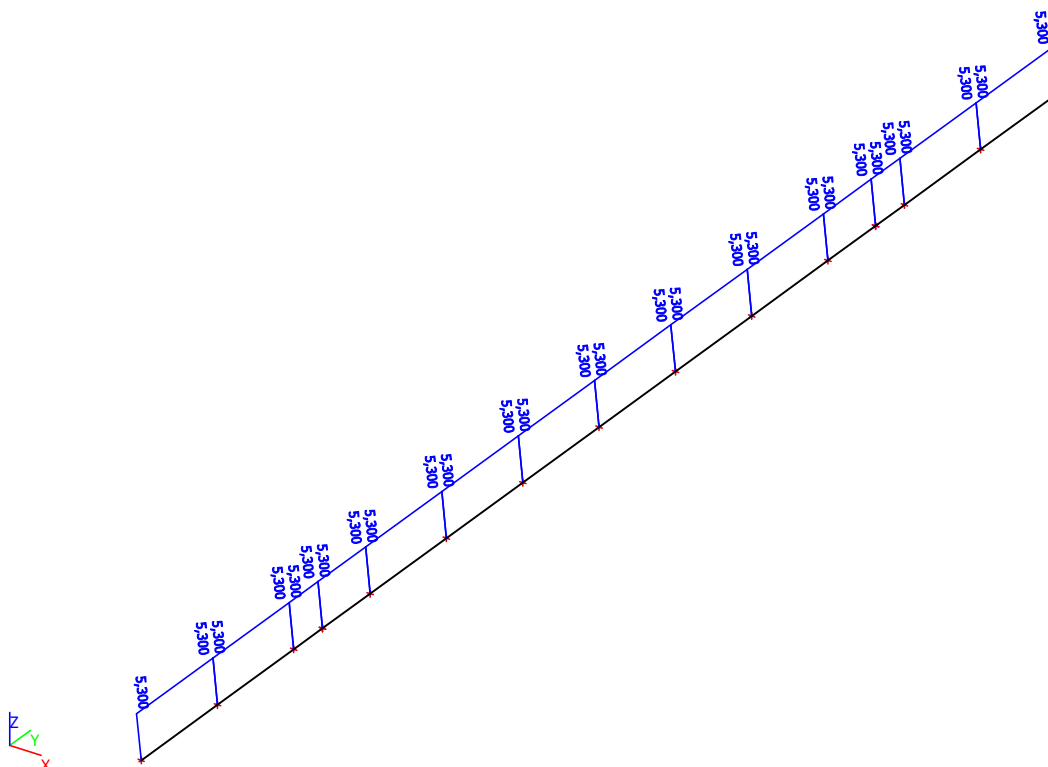
Kontrola nosilnosti in stabilnosti strešne lege - MSN

1. Priloga B

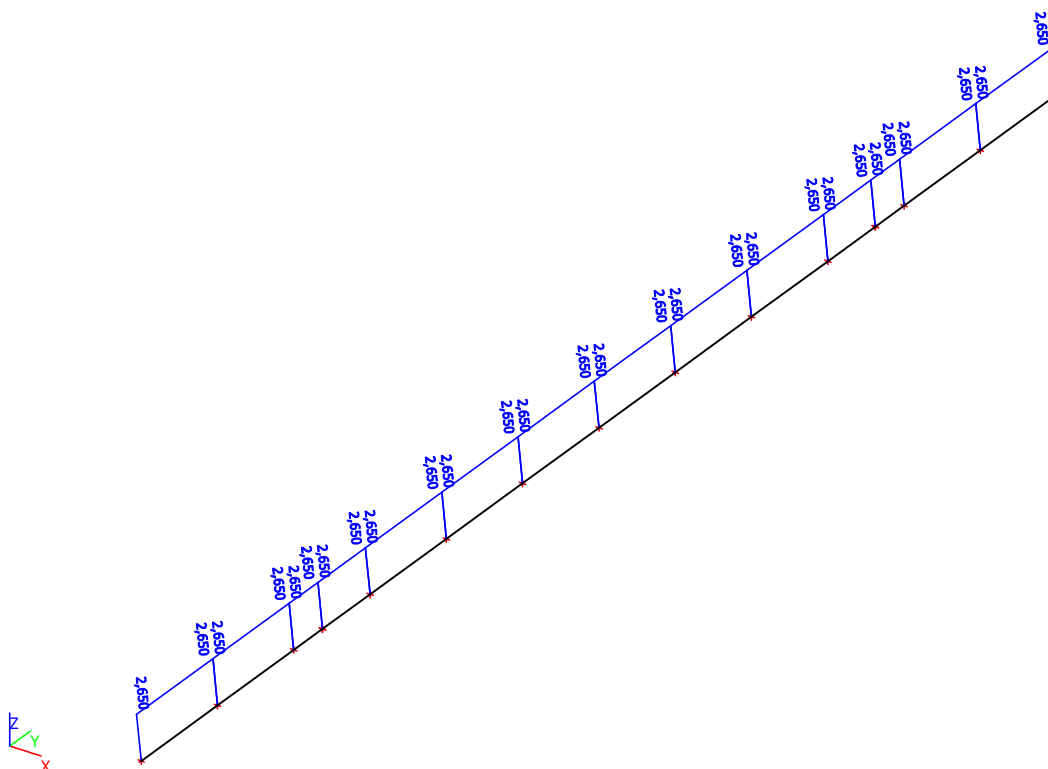
Linear calculation

Member	CS Name	Part	Sway y	Ly [m]	ky [-]	ly [m]	Lam y [-]	lyz [m]	I LTB [m]
			Sway z	Lz [m]	kz [-]	lz [m]	Lam z [-]		
B1	CS2	1	Yes	5,300	1,00	5,300	64,19	2,650	2,650
			No	2,650	1,00	2,650	118,72		
B2	CS2	1	Yes	5,300	1,00	5,300	64,19	2,650	2,650
			No	2,650	1,00	2,650	118,72		
B3	CS2	1	Yes	5,300	1,00	5,300	64,19	2,650	2,650
			No	2,650	1,00	2,650	118,72		
B4	CS1	1	Yes	5,300	1,00	5,300	71,40	2,650	2,650
			No	2,650	1,00	2,650	128,91		
B5	CS1	1	Yes	5,300	1,00	5,300	71,40	2,650	2,650
			No	2,650	1,00	2,650	128,91		
B6	CS1	1	Yes	5,300	1,00	5,300	71,40	2,650	2,650
			No	2,650	1,00	2,650	128,91		
B7	CS1	1	Yes	5,300	1,00	5,300	71,40	2,650	2,650
			No	2,650	1,00	2,650	128,91		
B8	CS1	1	Yes	5,300	1,00	5,300	71,40	2,650	2,650
			No	2,650	1,00	2,650	128,91		
B9	CS1	1	Yes	5,300	1,00	5,300	71,40	2,650	2,650
			No	2,650	1,00	2,650	128,91		
B10	CS1	1	Yes	5,300	1,00	5,300	71,40	2,650	2,650
			No	2,650	1,00	2,650	128,91		
B11	CS2	1	Yes	5,300	1,00	5,300	64,19	2,650	2,650
			No	2,650	1,00	2,650	118,72		
B12	CS2	1	Yes	5,300	1,00	5,300	64,19	2,650	2,650
			No	2,650	1,00	2,650	118,72		
B13	CS1	1	Yes	5,300	1,00	5,300	71,40	2,650	2,650
			No	2,650	1,00	2,650	128,91		
B14	CS2	1	Yes	5,300	1,00	5,300	64,19	2,650	2,650
			No	2,650	1,00	2,650	118,72		

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4. Result classes

4.1. Result classes - All MSNnelin

Name	List
All MSNnelin	MSN1nelin MSN2nelin

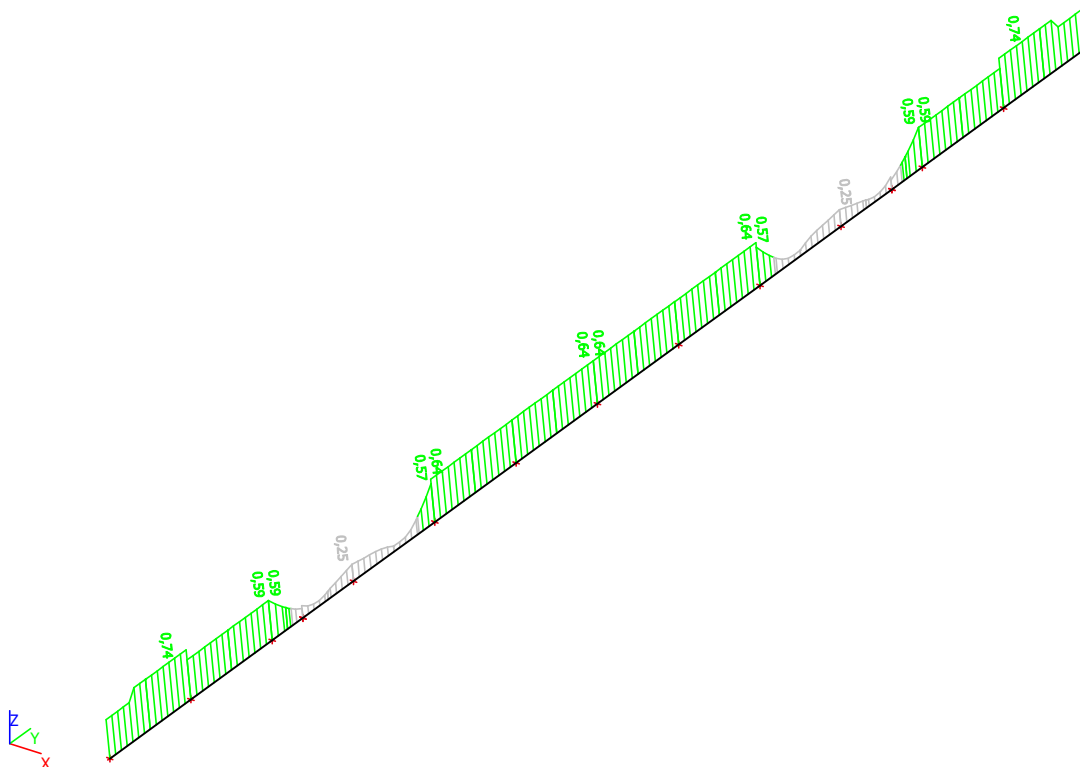
4.1.1. Check of steel

Nonlinear calculation, Extreme : Member

Selection : All

Class : All MSNnelin

Member	css	mat	Case	dx [m]	un.check [-]	sec.check [-]	stab.check [-]
B1	CS2 - IPE200	S 235	MSN1nelin	2,082	0,74	0,37	0,74
B2	CS2 - IPE200	S 235	MSN1nelin	2,650	0,59	0,52	0,59
B3	CS2 - IPE200	S 235	MSN1nelin	0,000	0,59	0,52	0,59
B4	CS1 - IPE180	S 235	MSN1nelin	2,650	0,57	0,49	0,57
B5	CS1 - IPE180	S 235	MSN1nelin	0,000	0,64	0,49	0,64
B6	CS1 - IPE180	S 235	MSN1nelin	2,650	0,64	0,56	0,64
B7	CS1 - IPE180	S 235	MSN1nelin	0,000	0,64	0,56	0,64
B8	CS1 - IPE180	S 235	MSN1nelin	2,650	0,64	0,49	0,64
B9	CS1 - IPE180	S 235	MSN1nelin	0,000	0,57	0,49	0,57
B10	CS1 - IPE180	S 235	MSN1nelin	0,000	0,25	0,21	0,25
B11	CS2 - IPE200	S 235	MSN1nelin	0,000	0,59	0,52	0,59
B12	CS2 - IPE200	S 235	MSN1nelin	0,568	0,74	0,37	0,74
B13	CS1 - IPE180	S 235	MSN1nelin	1,650	0,25	0,21	0,25
B14	CS2 - IPE200	S 235	MSN1nelin	1,000	0,59	0,52	0,59



Nonlinear calculation, Extreme : Cross-section
 Selection : All
 Class : All MSNnelin

Member B12	2,650 m	IPE200	S 235	MSN1nelin	0,74 -
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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 fy	23,5	kN/cm ²
Ultimate strength fu	36,0	kN/cm ²
Fabrication	Rolled	

....SECTION CHECK:....

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	28,39
Class 1 Limit	71,36
Class 2 Limit	82,17
Class 3 Limit	121,87

=> 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	4,14
Class 1 Limit	9,00
Class 2 Limit	10,00
Class 3 Limit	13,83

=> Outstand Flanges Class 1

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

The critical check is on position 0.568 m

Internal forces	Calculated	Unit
N _{Ed}	-1,59	kN
V _{y,Ed}	-0,82	kN
V _{z,Ed}	-0,04	kN
T _{Ed}	0,00	kNm
M _{y,Ed}	19,35	kNm
M _{z,Ed}	-0,16	kNm

Compression check

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

A	28,5000	cm ²
N _{c,Rd}	669,75	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)

W _{pl,y}	221,0000	cm ³
M _{pl,y,Rd}	51,94	kNm
Unity check	0,37	-

Bending moment check for M_z

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

W _{pl,z}	44,6000	cm ³
M _{pl,z,Rd}	10,48	kNm
Unity check	0,02	-

Shear check for V_y

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

Eta	1,20	
A _v	17,9856	cm ²
V _{pl,y,Rd}	244,02	kN
Unity check	0,00	-

Shear check for V_z

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

Eta	1,20	
A _v	14,0160	cm ²
V _{pl,z,Rd}	190,17	kN
Unity check	0,00	-

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}	51,94	kNm
Alpha	2,00	
M _{pl,z,Rd}	10,48	kNm
Beta	1,00	

Unity check (6.41) = 0,14 + 0,02 = 0,15 -

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	28,39
Class 1 Limit	71,36
Class 2 Limit	82,17
Class 3 Limit	121,75

=> 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	4,14
Class 1 Limit	9,00
Class 2 Limit	10,00
Class 3 Limit	13,93

=> 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	5,300	2,650	m
Buckling factor k	1,00	1,00	

Buckling parameters	yy	zz	
Buckling length Lcr	5,300	2,650	m
Critical Euler load Ncr	1433,64	419,10	kN
Slenderness Lambda	64,19	118,72	
Relative slenderness Lambda,rel	0,68	1,26	
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).

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	221.0000	cm ³
Elastic critical moment Mcr	74.26	kNm
Relative slenderness Lambda,LT	0.84	
Limit slenderness Lambda,LT,0	0.40	
LTB curve	a	
Imperfection Alpha,LT	0.21	
Reduction factor Chi,LT	0.77	
Buckling resistance Mb,Rd	40.21	kNm
Unity check	0.48	-

Mcr Parameters		
LTB length	2.650	m
k	1.00	
kw	1.00	
C1	1.18	
C2	0.18	
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 1

Table of values		
kyy	1.004	
kyz	1.095	
kzy	0.527	
kzz	1.005	
Delta My	0.00	kNm
Delta Mz	0.00	kNm
A	28.5000	cm ²
Wy	221.0000	cm ³
Wz	44.6000	cm ³
NRk	669.75	kN
My,Rk	51.94	kNm
Mz,Rk	10.48	kNm
My,Ed	-27.20	kNm
Mz,Ed	-0.55	kNm
Interaction Method 1		
Mcr0	63.01	kNm
reduced slenderness 0	0.91	
Psi y	0.000	
Psi z	0.000	
Cmy,0	1.000	
Cmz,0	1.000	
Cmy	1.000	
Cmz	1.000	
CmLT	1.000	
muy	1.000	
muz	1.000	
wy	1.139	
wz	1.500	
npl	0.002	
aLT	0.996	
bLT	0.015	
cLT	0.735	
dLT	0.024	
eLT	0.392	
Cyy	0.997	
Cyz	0.631	
Czy	0.993	

Table of values		
Czz	0.998	

Unity check (6.61) = $0.00 + 0.68 + 0.06 = 0.74$

Unity check (6.62) = $0.00 + 0.36 + 0.05 = 0.41$

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	
hw/t	32.679

The web slenderness is such that the Shear Buckling Check is not required.

The member satisfies the stability check.

Member B6	2,650 m	IPE180	S 235	MSN1nelin	0,64 -
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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 fy	23,5	kN/cm ²
Ultimate strength fu	36,0	kN/cm ²
Fabrication	Rolled	

....SECTION CHECK:....

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	71,26
Class 2 Limit	82,06
Class 3 Limit	122,22

=> 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	13,96

=> Outstand Flanges Class 1

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

The critical check is on position 2.650 m

Internal forces	Calculated	Unit
N,Ed	-1,59	kN
Vy,Ed	1,24	kN
Vz,Ed	-24,01	kN
T,Ed	0,00	kNm
My,Ed	-21,67	kNm
Mz,Ed	0,64	kNm

Compression check

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

A	23,9000	cm ²
Nc,Rd	561,65	kN
Unity check	0,00	-

Bending moment check for My

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

Wpl,y	166,0000	cm ³
Mpl,y,Rd	39,01	kNm
Unity check	0,56	-

Bending moment check for Mz

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

Wpl,z	34,6000	cm ³
Mpl,z,Rd	8,13	kNm
Unity check	0,08	-

Shear check for Vy

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

Eta	1,20	
Av	15,3179	cm ²
Vpl,y,Rd	207,83	kN
Unity check	0,01	-

Shear check for Vz

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

Eta	1,20	
Av	11,2040	cm ²
Vpl,z,Rd	152,01	kN
Unity check	0,16	-

Combined bending, axial force and shear force check

According to EN 1993-1-1 article 6.2.9.1 and formula (6.41)

Mpl,y,Rd	39,01	kNm
Alpha	2,00	
Mpl,z,Rd	8,13	kNm
Beta	1,00	

Unity check (6.41) = 0,31 + 0,08 = 0,39 -

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	71,26
Class 2 Limit	82,06
Class 3 Limit	120,98

=> 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	13,99

=> 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	5,300	2,650	m
Buckling factor k	1,00	1,00	
Buckling length Lcr	5,300	2,650	m
Critical Euler load Ncr	971,75	298,09	kN
Slenderness Lambda	71,40	128,91	
Relative slenderness Lambda,rel	0,76	1,37	
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).

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	166.0000	cm ³
Elastic critical moment Mcr	136.22	kNm
Relative slenderness Lambda,LT	0.54	
Limit slenderness Lambda,LT,0	0.40	

Mcr Parameters		
LTB length	2.650	m
k	1.00	
kw	1.00	
C1	3.20	
C2	0.41	
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		
kyy	1.005	
kyz	0.984	
kzy	0.527	
kzz	1.004	
Delta My	0.00	kNm
Delta Mz	0.00	kNm
A	23.9000	cm ²
Wy	166.0000	cm ³
Wz	34.6000	cm ³
NRk	561.65	kN
My,Rk	39.01	kNm
Mz,Rk	8.13	kNm
My,Ed	-21.67	kNm
Mz,Ed	0.64	kNm
Interaction Method 1		
Mcr0	42.51	kNm
reduced slenderness 0	0.96	
Psi y	0.885	
Psi z	0.568	
Cmy,0	0.999	
Cmz,0	0.996	
Cmy	1.000	
Cmz	0.996	
CmLT	1.000	
muy	1.000	
muz	1.000	
wy	1.137	
wz	1.500	
npl	0.003	
aLT	0.996	
bLT	0.020	
cLT	0.594	
dLT	0.023	
eLT	0.247	
Cyy	0.996	
Cyz	0.701	
Czy	0.992	
Czz	0.998	

Unity check (6.61) = 0.00 + 0.56 + 0.08 = 0.64

Unity check (6.62) = 0.00 + 0.29 + 0.08 = 0.37

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	
hw/t	30.943

The web slenderness is such that the Shear Buckling Check is not required.

The member satisfies the stability check.