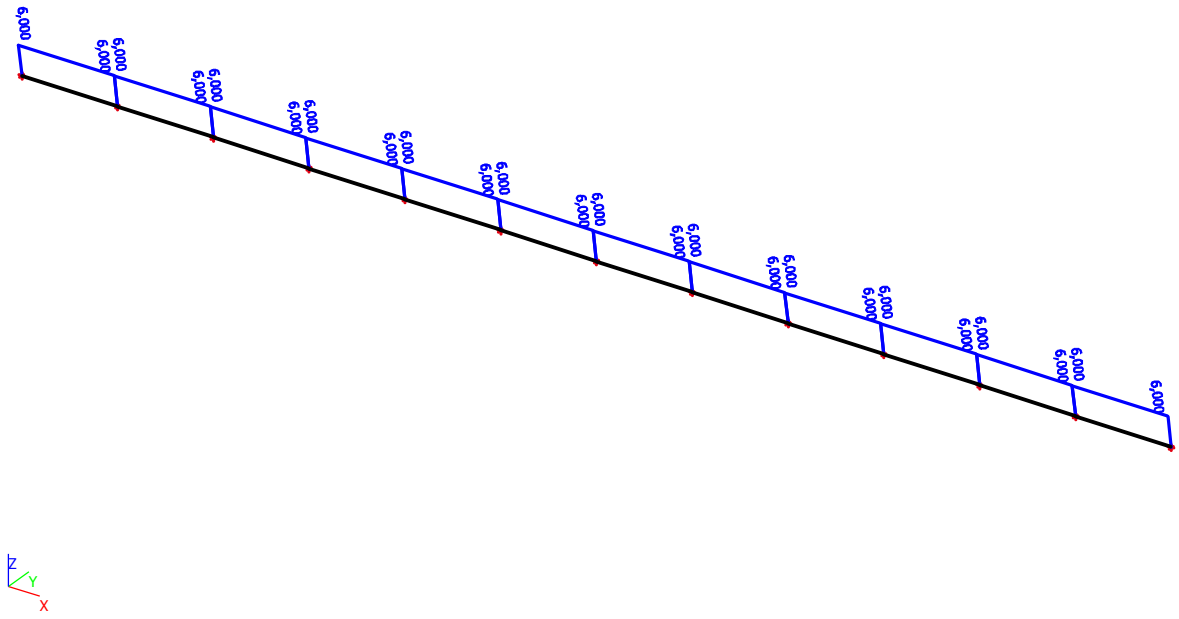
PRILOGA B: Kontrola nosilnosti in stabilnosti strešne lege

1. Steel slenderness

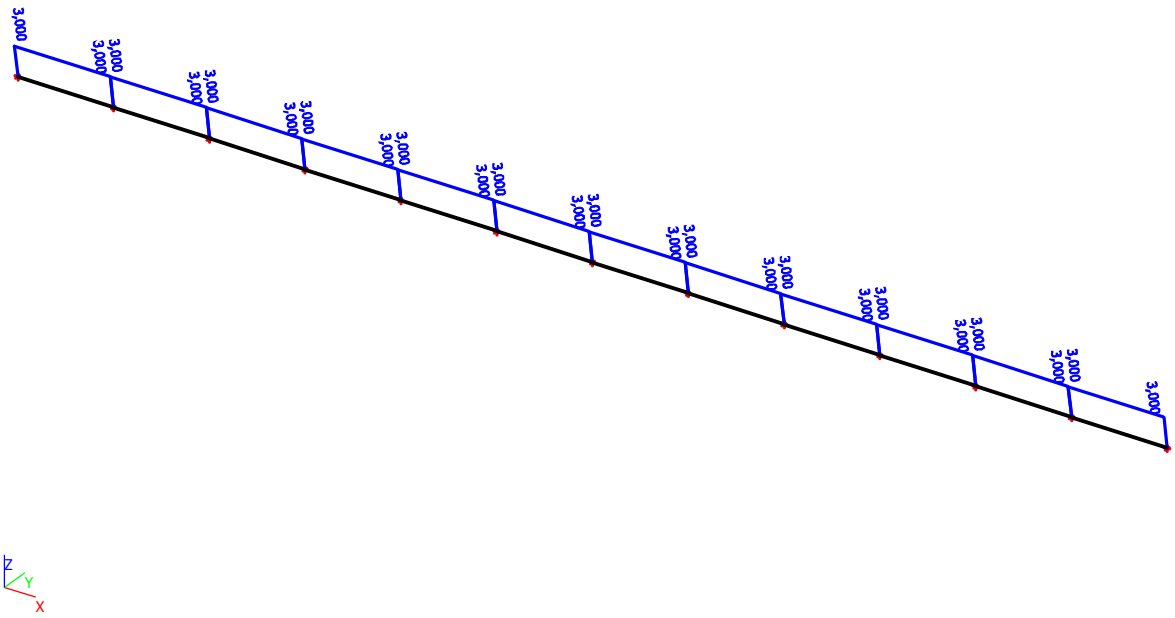
Linear calculation

Member	CS Name	Part	Sway y Sway z	Ly [m] Lz [m]	ky [-] kz [-]	Iy [m] Iz [m]	Lam y [-] Lam z [-]	Iyz [m]	l LTB [m]
B1	CS1	1	Yes	6,000	1,00	6,000	80,83	3,000	3,000
			No	3,000	1,00	3,000	145,94		
B2	CS1	1	Yes	6,000	1,00	6,000	80,83	3,000	3,000
			No	3,000	1,00	3,000	145,94		
B3	CS1	1	Yes	6,000	1,00	6,000	80,83	3,000	3,000
			No	3,000	1,00	3,000	145,94		
B4	CS1	1	Yes	6,000	1,00	6,000	80,83	3,000	3,000
			No	3,000	1,00	3,000	145,94		
B5	CS1	1	Yes	6,000	1,00	6,000	80,83	3,000	3,000
			No	3,000	1,00	3,000	145,94		
B6	CS1	1	Yes	6,000	1,00	6,000	80,83	3,000	3,000
			No	3,000	1,00	3,000	145,94		
B7	CS1	1	Yes	6,000	1,00	6,000	80,83	3,000	3,000
			No	3,000	1,00	3,000	145,94		
B8	CS1	1	Yes	6,000	1,00	6,000	80,83	3,000	3,000
			No	3,000	1,00	3,000	145,94		
B9	CS1	1	Yes	6,000	1,00	6,000	80,83	3,000	3,000
			No	3,000	1,00	3,000	145,94		
B10	CS1	1	Yes	6,000	1,00	6,000	80,83	3,000	3,000
			No	3,000	1,00	3,000	145,94		
B11	CS1	1	Yes	6,000	1,00	6,000	80,83	3,000	3,000
			No	3,000	1,00	3,000	145,94		
B12	CS1	1	Yes	6,000	1,00	6,000	80,83	3,000	3,000
			No	3,000	1,00	3,000	145,94		

2. Iy



3. Iz

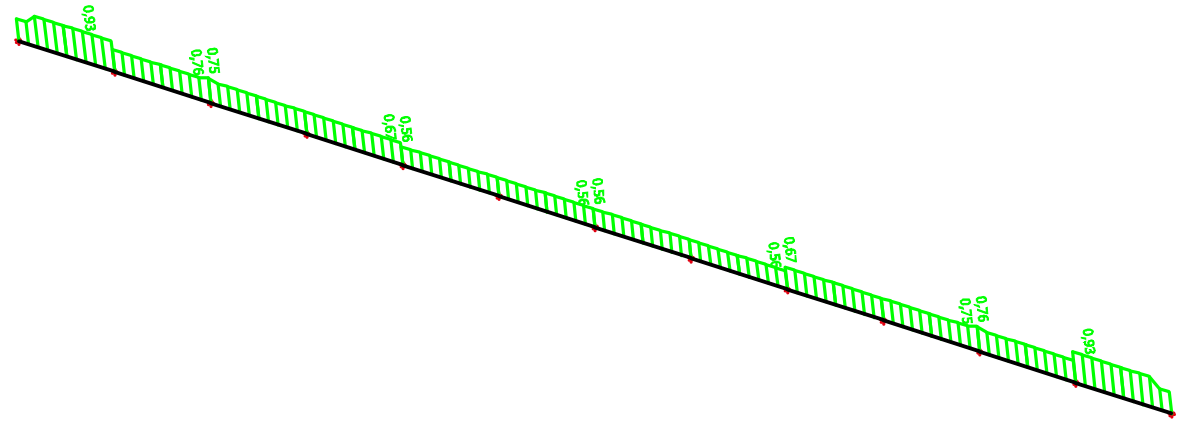


Name	List
RC1	MSN1
	MSN2

Check of steel

Nonlinear calculation, Extreme : Member
Selection : All
Class : RC1

Member	css	mat	Case	dx [m]	un.check [-]	sec.check [-]	stab.check [-]
B1	CS1 - IPE180	S 235	MSN1	2,400	0,93	0,42	0,93
B2	CS1 - IPE180	S 235	MSN1	3,000	0,76	**0,56**	0,76
B3	CS1 - IPE180	S 235	MSN1	0,000	0,75	0,56	0,75
B4	CS1 - IPE180	S 235	MSN1	3,000	0,67	**0,41**	0,67
B5	CS1 - IPE180	S 235	MSN1	0,000	**0,56**	0,41	**0,56**
B6	CS1 - IPE180	S 235	MSN1	3,000	0,56	0,46	0,56
B7	CS1 - IPE180	S 235	MSN1	0,000	0,56	0,46	0,56
B8	CS1 - IPE180	S 235	MSN1	3,000	0,56	0,41	0,56
B9	CS1 - IPE180	S 235	MSN1	0,000	0,67	0,41	0,67
B10	CS1 - IPE180	S 235	MSN1	3,000	0,75	0,56	0,75
B11	CS1 - IPE180	S 235	MSN1	0,000	0,76	0,56	0,76
B12	CS1 - IPE180	S 235	MSN1	0,600	**0,93**	0,42	**0,93**



Nonlinear calculation, Extreme : Cross-section
Selection : All
Class : RC1

Member B12	**3,000 m**	**IPE180**	**S 235**	**MSN1**	**0,93 -**

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	235,0	MPa
Ultimate strength fu	360,0	MPa
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	70,48
Class 2 Limit	81,16
Class 3 Limit	119,99

=> 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	13,84

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

The critical check is on position 0.600 m

Internal forces	Calculated	Unit
N,Ed	-3,32	kN
Vy,Ed	0,94	kN
Vz,Ed	0,04	kN

Internal forces	Calculated	Unit
T,Ed	0,00	kNm
My,Ed	16,25	kNm
Mz,Ed	0,17	kNm

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	0,01	-

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

Wpl,y	1,6600e-04	m^3
Mpl,y,Rd	39,01	kNm
Unity check	0,42	-

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

Wpl,z	3,4600e-05	m^3
Mpl,z,Rd	8,13	kNm
Unity check	0,02	-

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

Eta	1,20	
Av	1,5318e-03	m^2
Vpl,y,Rd	207,83	kN
Unity check	0,00	-

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	0,00	-

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) = 0,17 + 0,02 = 0,19 -

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	70,48
Class 2 Limit	81,16
Class 3 Limit	119,76

=> 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 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	6,000	3,000	m
Buckling factor k	1,00	1,00	
Buckling length Lcr	6,000	3,000	m
Critical Euler load Ncr	758,23	232,59	kN
Slenderness Lambda	80,83	145,94	
Relative slenderness Lambda,rel	0,86	1,55	
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	1.6600e-04	m^3
Elastic critical moment Mcr	42.63	kNm
Relative slenderness Lambda,LT	0.96	
Limit slenderness Lambda,LT,0	0.40	
LTB curve	a	
Imperfection Alpha,LT	0.21	
Reduction factor Chi,LT	0.70	
Buckling resistance Mb.Rd	27.14	kNm
Unity check	0.60	-

Mcr Parameters		
LTB length	3.000	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	1.017	
kyz	1.184	
kzy	0.536	
kzz	1.021	
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	-21.95	kNm
Mz,Ed	0.69	kNm
Interaction Method 1		
Mcr0	36.03	kNm
reduced slenderness 0	1.04	
Psi y	0.000	
Psi z	0.000	
Cmy,0	0.998	
Cmz,0	0.999	
Cmy	1.000	
Cmz	0.999	
CmLT	1.005	
muy	1.000	
muz	1.000	

Table of values		
wy	1.137	
wz	1.500	
npl	0.006	
aLT	0.996	
bLT	0.037	
cLT	0.806	
dLT	0.024	
eLT	0.240	
Cyy	0.992	
Cyz	0.590	
Czy	0.984	
Czz	0.993	

Unity check (6.61) = 0.01 + 0.82 + 0.10 = 0.93
Unity check (6.62) = 0.01 + 0.43 + 0.09 = 0.53

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.