Project

Job name : Pragu building
Part : Part D
Author : John Smith
Date : 29.01.2018

Standard

Standard **EN 1993-1-2/Czech Rep.**.

Reliability of steel in fire : $\gamma_{M,fi}$ = 1,000

1 Beam 1

1.1 Input data

Length: 8,000 m

1.1.1 Geometry

x [m]	Point kind	A/L [m]	I/L [m³]
0,000	hinged	-	-
6,000	hinged	-	-
8,000	free	-	-

Cross-section

Sector no.	Start [m]	End [m]	Section	Rotation [°]
1	0,000	8,000	HE 140 B	0,0

Material

Name: EN 10210-1 : S 235

Fire detail

Unprotected cross-section, exposed to fire on three sides

Temperature curve

Standard temperature curve

1.1.2 Load

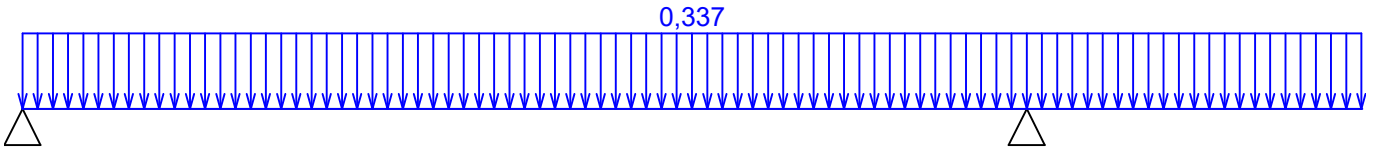
Load cases

no.	Name	Code	Type	γ_f ($\gamma_{f,inf}$)*	Factors for combinations				
					ξ	Categ.**	ψ_0	ψ_1	ψ_2
1	G1 Self-weight	Self weight	Permanent	1,35(0,90)	0,85	-	-	-	-
2	G2 Permanent	Force	Permanent	1,35(0,90)	0,85	-	-	-	-
3	Q3 Variable (Category A) 01	Force	Variable	1,50	-	A	0,70	0,50	0,30
4	Q4 Variable (Category A) 02	Force	Variable	1,50	-	A	0,70	0,50	0,30
5	Q5 Variable (Category A) 03	Force	Variable	1,50	-	A	0,70	0,50	0,30

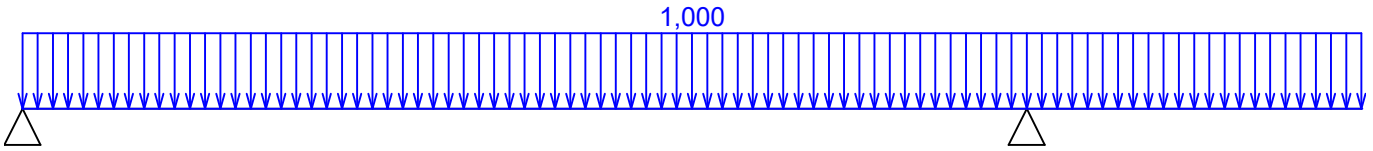
* $\gamma_{f,inf}$ for favourable dead loads

** Category of live loads according to table A1.1 in EN 1990

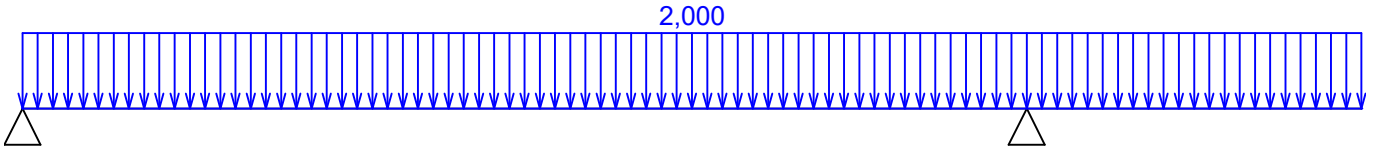
G1 Self-weight - load				
Type	**Coor.x [m]**	**Length [m]**	**Size1**	**Size2**
uniform	0,000	8,000	0,337kN/m	-



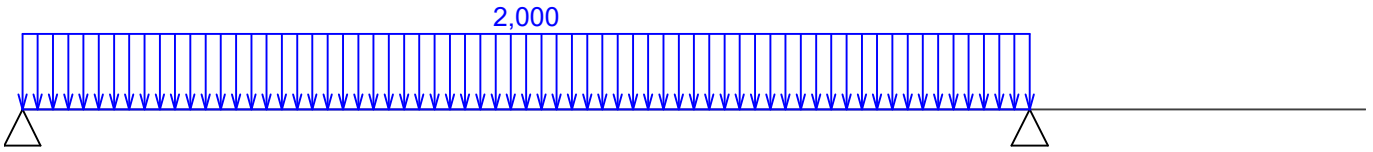
G2 Permanent - load				
Type	**Coor.x [m]**	**Length [m]**	**Size1**	**Size2**
uniform	0,000	8,000	1,000kN/m	-



Q3 Variable (Category A) 01 - load				
Type	**Coor.x [m]**	**Length [m]**	**Size1**	**Size2**
uniform	0,000	8,000	2,000kN/m	-



Q4 Variable (Category A) 02 - load				
Type	**Coor.x [m]**	**Length [m]**	**Size1**	**Size2**
uniform	0,000	6,000	2,000kN/m	-



Q5 Variable (Category A) 03 - load				
Type	**Coor.x [m]**	**Length [m]**	**Size1**	**Size2**
uniform	6,000	2,000	2,000kN/m	-

1.1.3 Combinations

Combinations

1.1.4 Combinations for 1st order calculation

Combination for check of ultimate limit state (ULS), 1st order

Number	Comb. name and type Composition
1	G1+G2; accidental combination
	G1 + G2
2	Q5:G1+G2; accidental combination
	G1 + G2 + $\psi_{1,5}$*Q5
3	Q4:G1+G2; accidental combination
	G1 + G2 + $\psi_{1,4}$*Q4
4	Q3:G1+G2; accidental combination
	G1 + G2 + $\psi_{1,3}$*Q3

Internal forces

Total number of loads: 4

G1+G2:

	V_3[kN]	M_2[kNm]	R_z[kN]	RO_x[kNm]
Max. value	4,457	4,745	7,132	-
Min. value	-3,566	-2,674	3,566	-

Q5:G1+G2:

	V_3[kN]	M_2[kNm]	R_z[kN]	RO_x[kNm]
Max. value	4,791	3,888	9,465	-
Min. value	-4,674	-4,674	3,233	-

Q4:G1+G2:

	V_3[kN]	M_2[kNm]	R_z[kN]	RO_x[kNm]
Max. value	7,457	9,180	10,132	-
Min. value	-6,566	-2,674	6,566	-

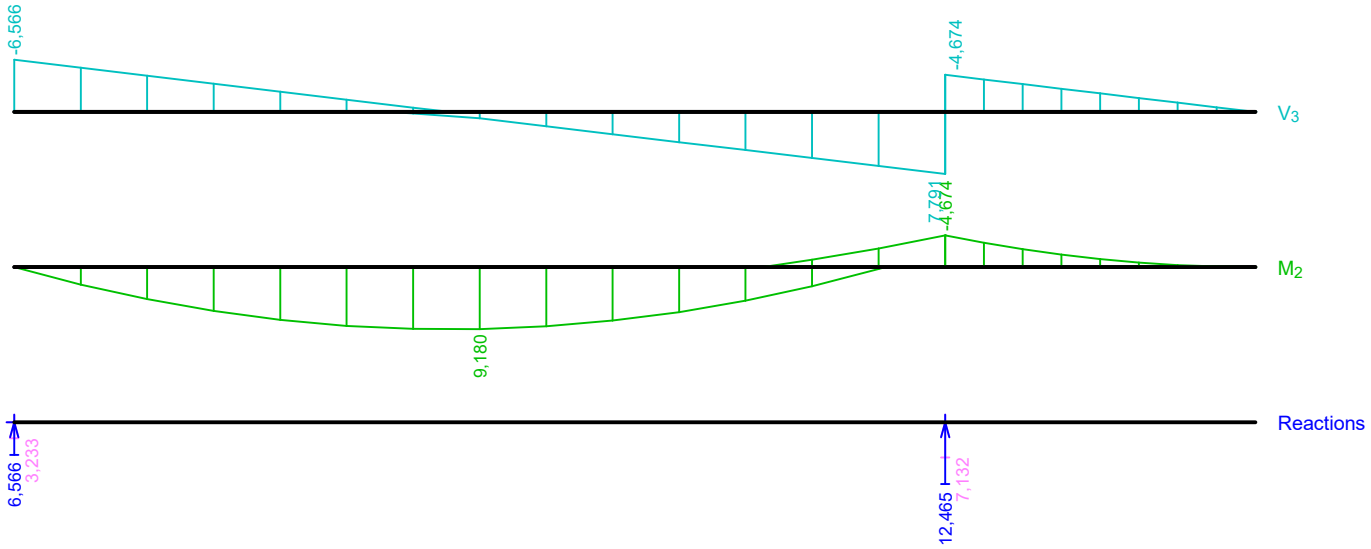
Q3:G1+G2:

	V_3[kN]	M_2[kNm]	R_z[kN]	RO_x[kNm]
Max. value	7,791	8,294	12,465	-
Min. value	-6,233	-4,674	6,233	-

Envelopes

Envelope accidental design (ULS)								
x [m]	Max M_2 [kNm]	Min M_2 [kNm]	Max V_3 [kN]	Min V_3 [kN]	Max R_z [kN]	Min R_z [kN]	Max RO_x [kNm]	Min RO_x [kNm]
0,000	0,000	0,000	-3,233	-6,566	6,566	3,233	-	-
0,429	2,596	1,260	-2,659	-5,563	-	-	-	-
0,857	4,759	2,274	-2,087	-4,563	-	-	-	-
1,286	6,500	3,045	-1,513	-3,560	-	-	-	-
1,714	7,809	3,570	-0,941	-2,560	-	-	-	-
2,143	8,695	3,851	-0,367	-1,557	-	-	-	-
2,571	9,151	3,888	0,205	-0,557	-	-	-	-
3,000	9,180	3,680	0,779	0,446	-	-	-	-
3,429	8,768	3,220	1,782	1,019	-	-	-	-
3,857	7,931	2,516	2,782	1,592	-	-	-	-

Envelope accidental design (ULS)								
x [m]	Max M_2 [kNm]	Min M_2 [kNm]	Max V_3 [kN]	Min V_3 [kN]	Max R_z [kN]	Min R_z [kN]	Max RO_x [kNm]	Min RO_x [kNm]
4,286	6,663	1,566	3,785	2,165	-	-	-	-
4,714	4,972	0,374	4,785	2,738	-	-	-	-
5,143	2,849	-1,065	5,788	3,311	-	-	-	-
5,571	0,304	-2,746	6,788	3,884	-	-	-	-
6,000	-2,674L	-4,674L	7,791L	4,457L	12,465	7,132	-	-
6,000	-2,674R	-4,674R	-2,674R	-4,674R	-	-	-	-
6,250	-2,048	-3,580	-2,340	-4,090	-	-	-	-
6,500	-1,505	-2,631	-2,006	-3,506	-	-	-	-
6,750	-1,045	-1,827	-1,672	-2,922	-	-	-	-
7,000	-0,669	-1,169	-1,337	-2,337	-	-	-	-
7,250	-0,377	-0,658	-1,003	-1,753	-	-	-	-
7,500	-0,168	-0,293	-0,669	-1,169	-	-	-	-
7,750	-0,042	-0,074	-0,334	-0,584	-	-	-	-
8,000	0,000	0,000	0,000	0,000	-	-	-	-



Reactions extremes

Reactions extremes accidental design (ULS)	
x [m]	Reaction
0,000	Max R_z = 6,566kN - Q4:G1+G2
0,000	Min R_z = 3,233kN - Q5:G1+G2
6,000	Max R_z = 12,465kN - Q3:G1+G2
6,000	Min R_z = 7,132kN - G1+G2

Lateral-torsional buckling

Lat. tors. buckling due to b. moment M_y:

Sector no.	Start [m]	End [m]	l_{z1} [m]	Moment area shape	Load position
1	0,000	8,000	8,000	Simple supported beam, distributed load	1,000

Lat. tors. buckling due to b. moment M_z:

Sector no.	Start [m]	End [m]	l_{y1} [m]	Moment area shape	Load position
1	0,000	8,000	No input	No input	-

1.2 Results

Intermediate results

G1+G2:
Fire check:
Factors of member action during fire:
κ_1 = 0,700 κ_2 = 1,000
Critical temperature: 759,3°C
Member temperature development:
Bulk density of steel ρ = 7,850E+03 kg/m^3
Configuration factor φ = 1,000
Surface emissivity ε_m = 0,700
Emissivity of the fire ε_f = 1,000
Section factor A/V = 154,888 m^{-1}
Convection coefficient α_c = 25,000 W/(m^2.K)
Specific heat of steel changes
from 439,8 J/kg/K at 20,0°C
to 1196,7 J/kg/K at 759,3°C
Fire resistance period: 25,1 min > 15,0 min
Fire resistance is sufficient

Cross-section check at steel temperature 651,2°C
Reduction factors of material properties :
k_y = 0,347
k_E = 0,218
Cross-section classification:
ε = 0,850 × √(235,0 / f_y) = 0,850 × √(235,0 / 235,0) = 0,850
Web classification:
c = 92,0 mm
t = 7,0 mm
c/t = 13,1; 13,1 ≤ 28,0; Class 1
Top flange left part classification:
c = 54,5 mm
t = 12,0 mm
c/t = 4,5; 4,5 ≤ 7,6; Class 1
Top flange right part classification:
c = 54,5 mm
t = 12,0 mm
c/t = 4,5; 4,5 ≤ 7,6; Class 1
Bottom flange left part classification:
c = 54,5 mm
t = 12,0 mm
c/t = 4,5; 4,5 ≤ 7,6; Class 1
Bottom flange right part classification:
c = 54,5 mm
t = 12,0 mm
c/t = 4,5; 4,5 ≤ 7,6; Class 1
Cross-section class 1

Calculation of shear res. in z-axis direction
Shear area $A_{v,z}$ = 1,308E03 mm^2
Cross-section shear resistance $V_{pl,Rd,z}$ = 61,605 kN

Shear buckling resistance:
d/t_w = 13,1 < 69,0
Web buckling has not to be checked
Shear buckling resistance $V_{ba,Rd,z}$ = 61,605 kN
Design shear resistance $V_{Rd,z}$ = 61,605 kN

Calculation of shear res. in y-axis direction
Shear area $A_{v,y}$ = 2,988E03 mm^2
Cross-section shear resistance $V_{pl,Rd,y}$ = 140,730 kN

B. moment M_y resistance calculation
$V_z \leq 0.5 * 61,605$ kN $\Rightarrow$ "inconsiderable shear" for z axis
$V_y \leq 0.5 * 140,730$ kN $\Rightarrow$ "inconsiderable shear" for y axis
Plastic section modulus $W_{pl,y}$ = 2,454E05 mm^3
Cross-section b. moment resistance $M_{c,Rd,y}$ = 28,599 kNm
Design b. moment resistance $M_{c,Rd,y}$ = 28,599 kNm
Buckling effect calculation:
Laterally restrained point spacing L_{z1} = 8,000 m
Cross-section load position z_P = 140,0 mm
Buckling length factors: k = 1,000; k_w = 1,000
z_g = 70,0 mm
z_j = 0,0 mm
Dimensionless torsion parameter: κ_{wt} = 0,212
Dimensionless parameter of load application point with respect to shear centre : ζ_g = 0,232
Dimensionless cross-section asymmetry parameter: ζ_j = 0,000
Cross-section asymmetry parameter: ψ_f = 0,000
Load & support condition factors:
C_1 = 1,130; C_2 = 0,460; C_3 = 0,530
Dimensionless critical bending moment: μ_{cr} = 1,041
El. crit. bending moment M_{cr} = 55,980 kNm
Rel. slenderness $\lambda_{bar,LT}$ = 1,281
Imperfection factor α = 0,650
φ = 1,737
Transverse and torsion stability factor $\chi_{LT,y}$ = 0,344
Buckling b. moment resistance $M_{b,Rd,y}$ = 9,827 kNm

B. moment M_z resistance calculation
$V_z \leq 0.5 * 61,605$ kN $\Rightarrow$ "inconsiderable shear" for z axis
$V_y \leq 0.5 * 140,730$ kN $\Rightarrow$ "inconsiderable shear" for y axis
Plastic section modulus $W_{pl,z}$ = 1,198E05 mm^3
Cross-section b. moment resistance $M_{c,Rd,z}$ = 13,961 kNm
Design b. moment resistance $M_{c,Rd,z}$ = 13,961 kNm

Shear capacity check

Magnitude	Loading	Resistance	Utilization	
V_z	0,446 kN	61,605 kN	0,7 %	Pass

Bending moment check
0,476 < 1 $\Rightarrow$ Pass

Q5:G1+G2:
Fire check:

Factors of member action during fire:
κ_1 = 0,700 κ_2 = 1,000
Critical temperature: 799,0°C
Member temperature development:
Bulk density of steel ρ = 7,850E+03 kg/m^3
Configuration factor φ = 1,000
Surface emissivity ε_m = 0,700
Emissivity of the fire ε_f = 1,000
Section factor A/V = 154,888 m^{-1}
Convection coefficient α_c = 25,000 W/(m^2.K)
Specific heat of steel changes
from 439,8 J/kg/K at 20,0°C
to 809,6 J/kg/K at 799,3°C
Fire resistance period: 28,2 min > 15,0 min
Fire resistance is sufficient

Cross-section check at steel temperature 651,2°C
Reduction factors of material properties :
k_y = 0,347
k_E = 0,218
Cross-section classification:
ε = 0,850 × √(235,0 / f_y) = 0,850 × √(235,0 / 235,0) = 0,850
Web classification:
c = 92,0 mm
t = 7,0 mm
c/t = 13,1; 13,1 ≤ 28,0; Class 1
Top flange left part classification:
c = 54,5 mm
t = 12,0 mm
c/t = 4,5; 4,5 ≤ 7,6; Class 1
Top flange right part classification:
c = 54,5 mm
t = 12,0 mm
c/t = 4,5; 4,5 ≤ 7,6; Class 1
Bottom flange left part classification:
c = 54,5 mm
t = 12,0 mm
c/t = 4,5; 4,5 ≤ 7,6; Class 1
Bottom flange right part classification:
c = 54,5 mm
t = 12,0 mm
c/t = 4,5; 4,5 ≤ 7,6; Class 1
Cross-section class 1

Calculation of shear res. in z-axis direction
Shear area $A_{v,z}$ = 1,308E03 mm^2
Cross-section shear resistance $V_{pl,Rd,z}$ = 61,605 kN
Shear buckling resistance:
d/t_w = 13,1 < 69,0
Web buckling has not to be checked
Shear buckling resistance $V_{ba,Rd,z}$ = 61,605 kN
Design shear resistance $V_{Rd,z}$ = 61,605 kN

Calculation of shear res. in y-axis direction
Shear area $A_{v,y}$ = 2,988E03 mm^2
Cross-section shear resistance $V_{pl,Rd,y}$ = 140,730 kN

B. moment M_y resistance calculation

$V_z \leq 0.5 * 61,605$ kN $\Rightarrow$ "inconsiderable shear" for z axis
$V_y \leq 0.5 * 140,730$ kN $\Rightarrow$ "inconsiderable shear" for y axis
Plastic section modulus $W_{pl,y} = 2,454E05$ mm^3
Cross-section b. moment resistance $M_{c,Rd,y} = 28,599$ kNm
Design b. moment resistance $M_{c,Rd,y} = 28,599$ kNm
Buckling effect calculation:
Laterally restrained point spacing $L_{z1} = 8,000$ m
Cross-section load position $z_P = 140,0$ mm
Buckling length factors: $k = 1,000$; $k_w = 1,000$
$z_g = 70,0$ mm
$z_j = 0,0$ mm
Dimensionless torsion parameter: $\kappa_{wt} = 0,212$
Dimensionless parameter of load application point with respect to shear centre : $\zeta_g = 0,232$
Dimensionless cross-section asymmetry parameter: $\zeta_j = 0,000$
Cross-section asymmetry parameter: $\psi_f = 0,000$
Load & support condition factors:
$C_1 = 1,130$; $C_2 = 0,460$; $C_3 = 0,530$
Dimensionless critical bending moment: $\mu_{cr} = 1,041$
El. crit. bending moment $M_{cr} = 55,980$ kNm
Rel. slenderness $\lambda_{bar,LT} = 1,281$
Imperfection factor $\alpha = 0,650$
$\varphi = 1,737$
Transverse and torsion stability factor $\chi_{LT,y} = 0,344$
Buckling b. moment resistance $M_{b,Rd,y} = 9,827$ kNm

B. moment M_z resistance calculation

$V_z \leq 0.5 * 61,605$ kN $\Rightarrow$ "inconsiderable shear" for z axis
$V_y \leq 0.5 * 140,730$ kN $\Rightarrow$ "inconsiderable shear" for y axis
Plastic section modulus $W_{pl,z} = 1,198E05$ mm^3
Cross-section b. moment resistance $M_{c,Rd,z} = 13,961$ kNm
Design b. moment resistance $M_{c,Rd,z} = 13,961$ kNm

Shear capacity check

Magnitude	Loading	Resistance	Utilization	
V_z	0,779 kN	61,605 kN	1,3 %	Pass

Bending moment check
0,375 < 1 $\Rightarrow$ Pass

Q4:G1+G2:
Fire check:
Factors of member action during fire:
$\kappa_1 = 0,700$ $\kappa_2 = 1,000$
Critical temperature: 659,7°C
Member temperature development:
Bulk density of steel $\rho = 7,850E+03$ kg/m^3
Configuration factor $\varphi = 1,000$
Surface emissivity $\varepsilon_m = 0,700$
Emissivity of the fire $\varepsilon_f = 1,000$
Section factor A/V = 154,888 m^{-1}
Convection coefficient $\alpha_c = 25,000$ W/(m^2.K)

Specific heat of steel changes
from 439,8 J/kg/K at 20,0°C
to 829,1 J/kg/K at 660,0°C
Fire resistance period: 15,4 min > 15,0 min
Fire resistance is sufficient

Cross-section check at steel temperature 651,2°C
Reduction factors of material properties :
k_y = 0,347
k_E = 0,218
Cross-section classification:
ε = 0,850 × √(235,0 / f_y) = 0,850 × √(235,0 / 235,0) = 0,850
Web classification:
c = 92,0 mm
t = 7,0 mm
c/t = 13,1; 13,1 ≤ 28,0; Class 1
Top flange left part classification:
c = 54,5 mm
t = 12,0 mm
c/t = 4,5; 4,5 ≤ 7,6; Class 1
Top flange right part classification:
c = 54,5 mm
t = 12,0 mm
c/t = 4,5; 4,5 ≤ 7,6; Class 1
Bottom flange left part classification:
c = 54,5 mm
t = 12,0 mm
c/t = 4,5; 4,5 ≤ 7,6; Class 1
Bottom flange right part classification:
c = 54,5 mm
t = 12,0 mm
c/t = 4,5; 4,5 ≤ 7,6; Class 1
Cross-section class 1

Calculation of shear res. in z-axis direction
Shear area $A_{v,z}$ = 1,308E03 mm^2
Cross-section shear resistance $V_{pl,Rd,z}$ = 61,605 kN
Shear buckling resistance:
d/t_w = 13,1 < 69,0
Web buckling has not to be checked
Shear buckling resistance $V_{ba,Rd,z}$ = 61,605 kN
Design shear resistance $V_{Rd,z}$ = 61,605 kN

Calculation of shear res. in y-axis direction
Shear area $A_{v,y}$ = 2,988E03 mm^2
Cross-section shear resistance $V_{pl,Rd,y}$ = 140,730 kN

B. moment M_y resistance calculation
$V_z \leq 0.5 * 61,605$ kN ⇒ "inconsiderable shear" for z axis
$V_y \leq 0.5 * 140,730$ kN ⇒ "inconsiderable shear" for y axis
Plastic section modulus $W_{pl,y}$ = 2,454E05 mm^3
Cross-section b. moment resistance $M_{c,Rd,y}$ = 28,599 kNm
Design b. moment resistance $M_{c,Rd,y}$ = 28,599 kNm
Buckling effect calculation:
Laterally restrained point spacing L_{z1} = 8,000 m
Cross-section load position z_P = 140,0 mm
Buckling length factors: k = 1,000; k_w = 1,000

z_g = 70,0 mm
z_j = 0,0 mm
Dimensionless torsion parameter: κ_{wt} = 0,212
Dimensionless parameter of load application point with respect to shear centre : ζ_g = 0,232
Dimensionless cross-section asymmetry parameter: ζ_j = 0,000
Cross-section asymmetry parameter: ψ_f = 0,000
Load & support condition factors:
C_1 = 1,130; C_2 = 0,460; C_3 = 0,530
Dimensionless critical bending moment: μ_{cr} = 1,041
El. crit. bending moment M_{cr} = 55,980 kNm
Rel. slenderness $\lambda_{bar,LT}$ = 1,281
Imperfection factor α = 0,650
φ = 1,737
Transverse and torsion stability factor $\chi_{LT,y}$ = 0,344
Buckling b. moment resistance $M_{b,Rd,y}$ = 9,827 kNm

B. moment M_z resistance calculation
$V_z \leq 0.5 * 61,605$ kN $\Rightarrow$ "inconsiderable shear" for z axis
$V_y \leq 0.5 * 140,730$ kN $\Rightarrow$ "inconsiderable shear" for y axis
Plastic section modulus $W_{pl,z}$ = 1,198E05 mm^3
Cross-section b. moment resistance $M_{c,Rd,z}$ = 13,961 kNm
Design b. moment resistance $M_{c,Rd,z}$ = 13,961 kNm

Shear capacity check

Magnitude	Loading	Resistance	Utilization	
V_z	0,446 kN	61,605 kN	0,7 %	Pass

Bending moment check
0,934 < 1 $\Rightarrow$ Pass

Q3:G1+G2:
Fire check:
Factors of member action during fire:
κ_1 = 0,700 κ_2 = 1,000
Critical temperature: 672,7°C
Member temperature development:
Bulk density of steel ρ = 7,850E+03 kg/m^3
Configuration factor φ = 1,000
Surface emissivity ε_m = 0,700
Emissivity of the fire ε_f = 1,000
Section factor A/V = 154,888 m^{-1}
Convection coefficient α_c = 25,000 $W/(m^2.K)$
Specific heat of steel changes
from 439,8 J/kg/K at 20,0°C
to 861,5 J/kg/K at 673,1°C
Fire resistance period: 16,1 min > 15,0 min
Fire resistance is sufficient

Cross-section check at steel temperature 651,2°C
Reduction factors of material properties :
k_y = 0,347
k_E = 0,218
Cross-section classification:

$\varepsilon = 0{,}850 \times \sqrt{(235{,}0 / f_y)} = 0{,}850 \times \sqrt{(235{,}0 / 235{,}0)} = 0{,}850$
Web classification:
c = 92,0 mm
t = 7,0 mm
c/t = 13,1; 13,1 ≤ 28,0; Class 1
Top flange left part classification:
c = 54,5 mm
t = 12,0 mm
c/t = 4,5; 4,5 ≤ 7,6; Class 1
Top flange right part classification:
c = 54,5 mm
t = 12,0 mm
c/t = 4,5; 4,5 ≤ 7,6; Class 1
Bottom flange left part classification:
c = 54,5 mm
t = 12,0 mm
c/t = 4,5; 4,5 ≤ 7,6; Class 1
Bottom flange right part classification:
c = 54,5 mm
t = 12,0 mm
c/t = 4,5; 4,5 ≤ 7,6; Class 1
Cross-section class 1

Calculation of shear res. in z-axis direction
Shear area $A_{v,z} = 1{,}308E03$ mm^2
Cross-section shear resistance $V_{pl,Rd,z} = 61{,}605$ kN
Shear buckling resistance:
$d/t_w = 13{,}1 < 69{,}0$
Web buckling has not to be checked
Shear buckling resistance $V_{ba,Rd,z} = 61{,}605$ kN
Design shear resistance $V_{Rd,z} = 61{,}605$ kN

Calculation of shear res. in y-axis direction
Shear area $A_{v,y} = 2{,}988E03$ mm^2
Cross-section shear resistance $V_{pl,Rd,y} = 140{,}730$ kN

B. moment M_y resistance calculation
$V_z \leq 0.5 * 61{,}605$ kN $\Rightarrow$ "inconsiderable shear" for z axis
$V_y \leq 0.5 * 140{,}730$ kN $\Rightarrow$ "inconsiderable shear" for y axis
Plastic section modulus $W_{pl,y} = 2{,}454E05$ mm^3
Cross-section b. moment resistance $M_{c,Rd,y} = 28{,}599$ kNm
Design b. moment resistance $M_{c,Rd,y} = 28{,}599$ kNm
Buckling effect calculation:
Laterally restrained point spacing $L_{z1} = 8{,}000$ m
Cross-section load position $z_P = 140{,}0$ mm
Buckling length factors: $k = 1{,}000$; $k_w = 1{,}000$
$z_g = 70{,}0$ mm
$z_j = 0{,}0$ mm
Dimensionless torsion parameter: $\kappa_{wt} = 0{,}212$
Dimensionless parameter of load application point with respect to shear centre : $\zeta_g = 0{,}232$
Dimensionless cross-section asymmetry parameter: $\zeta_j = 0{,}000$
Cross-section asymmetry parameter: $\psi_f = 0{,}000$
Load & support condition factors:
$C_1 = 1{,}130$; $C_2 = 0{,}460$; $C_3 = 0{,}530$
Dimensionless critical bending moment: $\mu_{cr} = 1{,}041$
El. crit. bending moment $M_{cr} = 55{,}980$ kNm

Rel. slenderness $\lambda_{bar,LT}$ = 1,281
Imperfection factor α = 0,650
φ = 1,737
Transverse and torsion stability factor $\chi_{LT,y}$ = 0,344
Buckling b. moment resistance $M_{b,Rd,y}$ = 9,827 kNm

B. moment M_z resistance calculation

$V_z \leq 0.5 * 61,605$ kN $\Rightarrow$ "inconsiderable shear" for z axis
$V_y \leq 0.5 * 140,730$ kN $\Rightarrow$ "inconsiderable shear" for y axis
Plastic section modulus $W_{pl,z}$ = 1,198E05 mm^3
Cross-section b. moment resistance $M_{c,Rd,z}$ = 13,961 kNm
Design b. moment resistance $M_{c,Rd,z}$ = 13,961 kNm

Shear capacity check

Magnitude	Loading	Resistance	Utilization	
V_z	0,779 kN	61,605 kN	1,3 %	Pass

Bending moment check
0,832 < 1 $\Rightarrow$ Pass

Overall check

Decisive load: Q4:G1+G2; **Cross-section class:** 1
Critical temperature: 659,7°C **Fire resistance period:** 15,4 min $\geq$ 15,0 min **Pass**
Check at time t = 15,0 min:
Gas temperature: 738,6°C Steel temperature: 651,2°C
Shear check due to shear force V_z:
0,446 kN < 61,605 kN **Pass**
Bending moment: M_y = 9,180 kNm

Bending moment check:
Resistance: $M_{y,R}$ = 9,827 kNm
| 0,934 | < 1 **Pass**
Section ok