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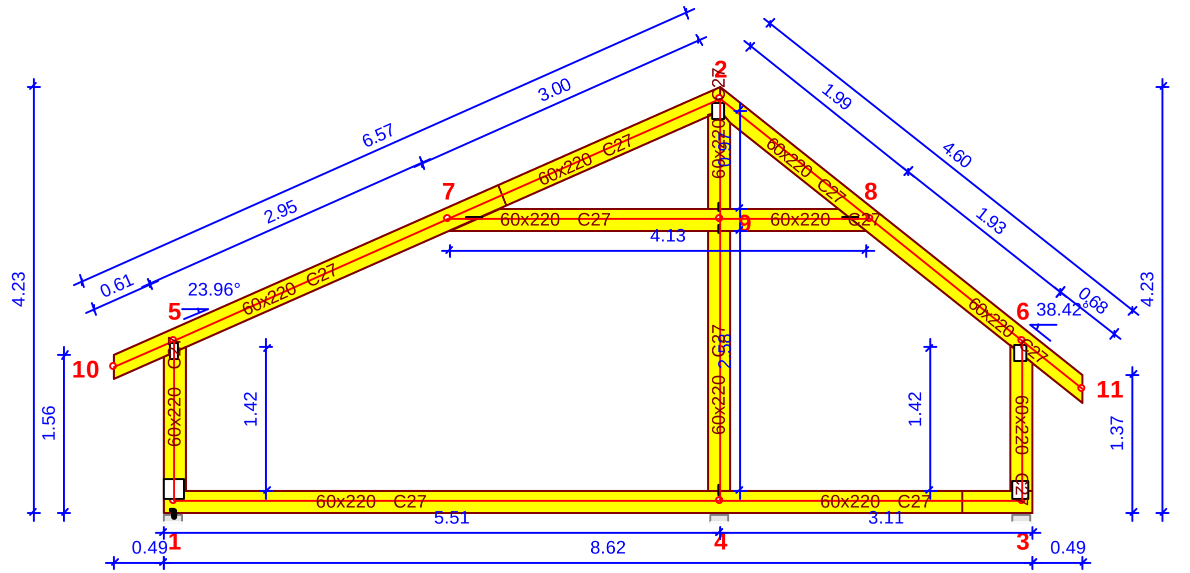

General information

Timber class for trusses C27

Truss spacing C/C 0.60 m

Purlins C27, 50x50 mm, at C/C 0.30 m

Service classes (EN1995-1-1, §2.3.1.3): Class 2

Material factor: 1.30 (EC5 EN1995-1-1:2009, Table 2.3)

Truss volume =0.409 m³

Design codes

EN1990-1-1:2002 Basis of structural design

EN1991-1-1:2003 Actions on structures

EN1991-1-3:2003 Snow loads

EN1991-1-4:2005 Wind actions

EN1995-1-1:2009 Design of timber structures

Distributed roof loads

Permanent load of roof covering	0.100 kN/m²
Purlins, finishing, insulation	0.100 kN/m²
Load of ceiling under the roof	0.300 kN/m²
Snow load on the ground	1.600 kN/m²
Wind pressure on vertical surface	0.500 kN/m²
Permanent load of attic floor finishing	0.500 kN/m²
Live load on attic floor	2.000 kN/m²

Truss elements

elem	size	class	length(L)	(Lmax)
El 2-5 :	60x220	C27	L2-5 =5.91 m	Lmax =6.57 m
El 2-6 :	60x220	C27	L2-6 =3.84 m	Lmax =4.60 m
El 1-3 :	60x220	C27	L1-3 =8.40 m	Lmax =8.62 m
El 1-5 :	60x220	C27	L1-5 =1.60 m	Lmax =1.42 m
El 3-6 :	60x220	C27	L3-6 =1.60 m	Lmax =1.44 m
El 7-8 :	60x220	C27	L7-8 =4.20 m	Lmax =4.13 m
El 2-4 :	60x220	C27	L2-4 =4.00 m	Lmax =2.58 m
El 2-9 :	60x220	C27	L2-9 =1.20 m	Lmax =0.97 m

Connection plates

node	type	size (BxL)mm	bolts
Nd 2 :	Steel plate 2.0mm	2x130x180mm	4.0mm :20 [8+4+8]
Nd 7 :	Steel plate 2.0mm	2x180x45mm	4.0mm :8 [4+4]
Nd 8 :	Steel plate 2.0mm	2x180x45mm	4.0mm :8 [4+4]
Nd 5 :	Steel plate 2.0mm	2x110x180mm	4.0mm :32 [16+16]
Nd 6 :	Steel plate 2.0mm	2x135x180mm	4.0mm :40 [20+20]
Nd 1 :	Steel plate 2.0mm	2x205x225mm	4.0mm :72 [36+36]
Nd 3 :	Steel plate 2.0mm	2x175x195mm	4.0mm :60 [30+30]
Nd 4 :	Steel plate 2.0mm	2x45x125mm	4.0mm :8 [4+4]
Nd 9 :	Steel plate 2.0mm	2x45x100mm	4.0mm :8 [4+4]
Nd 9 :	Steel plate 2.0mm	2x45x100mm	4.0mm :8 [4+4]

Project: Example of Attic Truss

Scale : 1:75 **Date:** 09/09/2011

Designer: **Draw.No.:**

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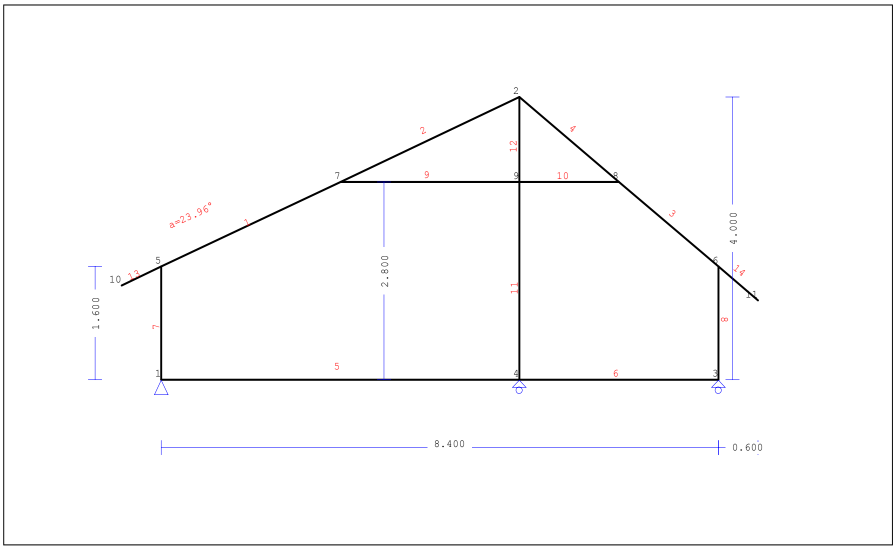
Example of Attic truss

1. ROOF -001

Attic truss



1.1. General description, assumptions, materials, loads

1.1.1. Construction type

Timber roof, from trusses with timber C27. The truss type as sketch above.
Span 8.400m, height 4.000m, roof pitch 23.96°, 38.66°, truss spacing 0.600m
Purlins from timber C27, with dimensions 50x50 mm, in spacing 0.300 m
Truss element cross sections BxH [mm]
Elements 1, 2, 3, 4, cross section 60x220 [mm]
Elements 5, 6, cross section 60x220 [mm]
Elements 7, 8, cross section 60x220 [mm]
Elements 9, 10, cross section 60x220 [mm]
Elements 11,12, cross section 60x220 [mm]
Truss volume =0.409 m³, truss weight =1.484 kN

1.1.2. Design codes

EN1990-1-1:2002, Eurocode 0 Part 1-1, Basis of structural design
EN1991-1-1:2003, Eurocode 1 Part 1-1, Actions on structures
EN1991-1-3:2003, Eurocode 1 Part 1-3, Snow loads
EN1991-1-4:2005, Eurocode 1 Part 1-4, Wind actions
EN1995-1-1:2009, Eurocode 5 Part 1-1, Design of timber structures

1.1.3. Design methodology

The internal forces of the roof trusses are computed with finite element analysis. The truss is considered as a two dimensional frame. The stiffness of the connections is adjusted according to the selected degree of stiffness. In order to compute the design values for internal forces in various loading conditions, the internal forces are first computed in unit loading, and then from their combination the internal forces in various loading conditions are obtained.
All the load combinations according to Eurocode 1 and Eurocode 5 are taken into account, and the checks are performed in the most unfavourable loading conditions, for combined action, in ultimate limit state, according to EC5 EN1995-1-1:2009, §6. The connections are designed as bolted connections with metal plates according to EC5 EN1995-1-1:2009, §8.
The deflections are checked in serviceability limit condition, according to EC5 EN1995-1-1:2009, §7.

1.1.4. Material properties (truss, purlins) (EC5 EN1995-1-1:2009, §3)

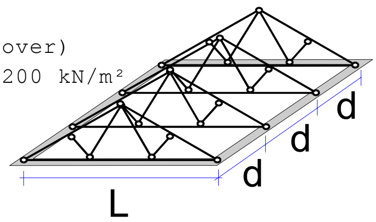
Timber class : C27
Service classes : Class 1, moisture content<=12% (EC5 §2.3.1.3)
Material factor γM=1.30 (EC5 Table 2.3)

Characteristic material properties for timber

fmk = 27.0 MPa, ft0k = 16.0 MPa, ft90k= 0.4 MPa
fc0k= 22.0 MPa, fc90k= 2.6 MPa, fvk = 4.0 MPa
E0m =11500 MPa, E005 = 7700 MPa, E90m = 380 MPa
Gm = 720 MPa, ρk = 370 Kg/m^3

1.1.5. Distributed roof loads

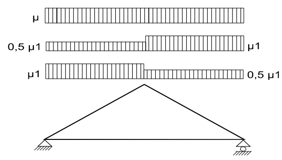
Permanent load of roof covering Ge= 0.100 kN/m^2 (Thatch cover)
Purlins, finishing, insulation Gt= 0.100 kN/m^2 Ge+Gt= 0.200 kN/m^2
Load of ceiling under the roof Gc= 0.300 kN/m^2
Snow load on the ground Sk= 1.600 kN/m^2
Wind pressure on vertical surface Qw= 0.500 kN/m^2
Permanent load of attic floor finishing Gf= 0.500 kN/m^2
Live load on attic floor Qf= 2.000 kN/m^2
Imposed load (category H) Qi= 0.400 kN/m^2



1.2. Snow load (EC1 EN1991-1-3:2003, §5)

Characteristic value of snow load on the ground: sk=1.600 kN/m^2

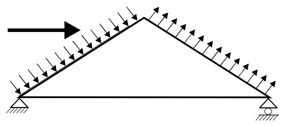
Snow load on the roof (EC1 EN1991-1-3:2003, §5)
Angle of pitch of roof : α1=23.962°
Angle of pitch of roof : α2=38.660°
Exposure coefficient : Ce=1.000
Thermal coefficient : Ct=1.000
Shape factors, α1=23.96°, α2=38.66°, μ1(α1)=0.800, μ1(α2)=0.569
S(α1)=μ1(α1)·Ce·Ct·Sk=0.800x1.00x1.00x1.600=1.280kN/m^2 (§5.2)
S(α2)=μ1(α2)·Ce·Ct·Sk=0.569x1.00x1.00x1.600=0.911kN/m^2



Snow load (EC1 EN1991-1-3:2003, §5.3.3)
Load case (I), S(Left)=S(α1) =1.280 kN/m^2, S(Right)=S(α2)= 0.911 kN/m^2
Load case (II), S(Left)=0.5xS(α1)=0.640 kN/m^2, S(Right)=S(α2)= 0.911 kN/m^2
Load case (III), S(Left)=S(α1)= 1.280 kN/m^2, S(Right)=0.5xS(α2)=0.455 kN/m^2

1.3. Wind loading (EC1 EN1991-1-4:2005 §5)

Pick velocity pressure Q(z)=Qref·Ce(z), Qref=Vref^2/1.6 (EC1 EN1991-1-4:2005 §4.5)
Wind pressure on vertical surface Qref.Ce(z)= 0.500 kN/m^2



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Wind pressure on roof we=Qref·Ce(z).Cpe (EC1 EN1991-1-4:2005, §5.2)
External pressure coefficients (EC1 EN1991-1-4:2005 Table 7.3)
For pitch angle α=23.96°, Cpe(+)=0.41, Cpe(-)=-0.44
Wind pressure we(Left  )=  0.205 kN/m²
Wind pressure we(Right )= -0.221 kN/m²
For pitch angle α=38.66°, Cpe(+)=0.61, Cpe(-)=-0.54
Wind pressure we(Left  )= -0.270 kN/m²
Wind pressure we(Right )=  0.304 kN/m²
```

1.4. Design of purlins

Structural system for purlins

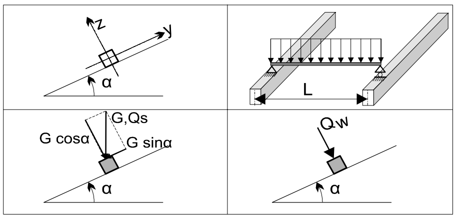
The purlins are designed as simply supported beams with span length L=0.600m the distance between the trusses. They are loaded with a surface load of width L1=0.300m (purlin spacing). The purlin axis has inclination a=23.96° with the vertical. The vertical loads (self weight, snow, concentrated load) are decomposed in two components in the directions z-z P.cosa, and y-y P.sina, the wind load acts in the z-z direction.

Dimensions of purlins

Timber of purlins: C27, Class 1, moisture content<=12%, cross section of purlins BxH:50x50mm
Spacing of purlins L1=0.300m, roof pitch α=23.96°, spacing of trusses L=0.600m.

Uniform loading of purlins kN/m²

Roof covering	Ge= 0.100 kN/m²
Finishing+self weight	G1= 0.100 kN/m²
Snow load	Qs= 1.280 kN/m²
Wind load	Qw= 0.205 kN/m²
Concentrated load	Qp= 1.000 kN



Line loading of purlins (kN/m) in z-z and y-y

Roof covering+self weight	Gk = 0.060 kN/m,	Gkz = 0.055 kN/m,	Gkez= 0.024 kN/m
Snow load	Qks= 0.384 kN/m,	Qksz= 0.351 kN/m,	Qksz= 0.156 kN/m
Wind load	Qkw= 0.061 kN/m,	Qkwz= 0.061 kN/m,	Qkwy= 0.000 kN/m
Concentrated load	Qkp= 1.000 kN,	Qkpz= 0.914 kN,	Qkpz= 0.406 kN

Internal forces of purlins (span L=0.600 m, BxH: 50x50 mm)

Loading			action	γg	γq	ψo	Qz[kN]	Qy[kN]	My[kNm]	Mz[kNm]
(Gk)	Permanent	Gk =0.060[kN/m]	Permanent	1.35	0.00	1.00	0.016	0.007	0.002	0.001
(Qk1)	Snow	Qks=0.384[kN/m]	Short-term	0.00	1.50	0.60	0.105	0.047	0.016	0.007
(Qk2)	Wind	Qkw=0.061[kN/m]	Short-term	0.00	1.50	0.50	0.018	0.000	0.003	0.000
(Qk3)	Concentr.	Qkp=1.000[kN]	Instantaneous	0.00	1.00	0.00	0.457	0.203	0.137	0.061

1.4.1. Serviceability limit state (EC5 EN1995-1-1:2009, §2.2.3, §7)

Control of deflection (EC5 §7.2)

Loading [kN/m]			u[mm]	action	ψ0	ψ1	ψ2	Kdef
(Gk)	Permanent	Gk =0.055[kN/m]	0.006	Permanent	1.00	1.00	1.00	0.60
(Qk1)	Snow	Qks=0.351[kN/m]	0.041	Short-term	0.60	0.20	0.00	0.60
(Qk2)	Wind	Qkw=0.061[kN/m]	0.007	Short-term	0.50	0.20	0.00	0.60

Load combination	w.inst	w.fin [mm]
1 Gk	0.006	0.010
2 Gk + Qk1	0.047	0.051
3 Gk + Qk2	0.014	0.017
4 Gk + Qk1 + ψo.Qk2	0.051	0.055
5 Gk + Qk2 + ψo.Qk1	0.038	0.042

w.fin,g=w.inst,g(1+kdef), w.fin,q=w.inst,q(1+ψ2·kdef)(EC5 §2.2.3, Eq.2.3, Eq.2.4)

Maximum deflection values

w.inst = 0.051 mm, w.fin = 0.055 mm

Check according to EC5 EN1995-1-1:2009 §7.2, Tab.7.2

Final deflections

w.inst = 0.051 mm < L/300=600/300= 2.000 mm
w.net,fin = 0.055 mm < L/250=600/250= 2.400 mm
w.fin = 0.055 mm < L/150=600/150= 4.000 mm
The check is satisfied

1.4.2. Check of purlins, Ultimate limit state of design (EC5 EN1995-1-1:2009, §6)

L.C.	Load combination	duration class	kmod	Qz/Kmod	Qy/Kmod	My/Kmod	Mz/Kmod
1	γg.Gk	Permanent	0.60	0.037	0.016	0.006	0.002
2	γg.Gk + γq.Qk1	Short-term	0.90	0.200	0.089	0.030	0.013
3	γg.Gk + γq.Qk2	Short-term	0.90	0.055	0.011	0.008	0.002
4	γg.Gk + γq.Qk3	Instantaneous	1.10	0.436	0.194	0.128	0.057
5	γg.Gk + γq.Qk1 + γq.ψo.Qk2 + γq.	Short-term	0.90	0.215	0.089	0.032	0.013
6	γg.Gk + γq.Qk2 + γq.ψo.Qk1 + γq.	Short-term	0.90	0.161	0.058	0.024	0.009
	Maximum values			0.436	0.194	0.128	0.057

Purlin, load combination No 4

Shear, Fv=0.479 kN (EC5 §6.1.7)
Rectangular cross section, bef=0.67x50=34 mm, h=50 mm, A= 1 700 mm²
Modification factor Kmod=1.10 (Table 3.1), material factor γM=1.30 (Table 2.3)
fvk=4.00 N/mm², fvd=Kmod·fvk/γM=1.10x4.00/1.30=3.38N/mm² (EC5 Eq.2.14)
Fv=0.479 kN, τv0d=1.50Fv0d/Anetto=1000x1.50x0.479/1700=0.42N/mm² < 3.38N/mm²=fv0d (Eq.6.13)
The check is satisfied

Purlin, load combination No 4

Shear, Fv=0.213 kN (EC5 §6.1.7)
Rectangular cross section, bef=0.67x50=34 mm, h=50 mm, A= 1 700 mm²
Modification factor Kmod=1.10 (Table 3.1), material factor γM=1.30 (Table 2.3)
fvk=4.00 N/mm², fvd=Kmod·fvk/γM=1.10x4.00/1.30=3.38N/mm² (EC5 Eq.2.14)
Fv=0.213 kN, τv0d=1.50Fv0d/Anetto=1000x1.50x0.213/1700=0.19N/mm² < 3.38N/mm²=fv0d (Eq.6.13)
The check is satisfied

Purlin, load combination No 4

Bending, Myd=0.140 kNm, Mzd=0.062 kNm (EC5 §6.1.6)
Rectangular cross section, b=50mm, h=50mm, A=2.500E+003mm², Wy=2.083E+004mm³, Wz=2.083E+004mm³
Modification factor Kmod=1.10 (Table 3.1), material factor γM=1.30 (Table 2.3)
fmyk=27.00 N/mm², fmyd=Kmod·fmyk/γM=1.10x27.00/1.30=22.85N/mm²
fmzk=27.00 N/mm², fmzd=Kmod·fmzk/γM=1.10x27.00/1.30=22.85N/mm²

Rectangular cross section Km=0.70 (EC5 §6.1.6.(2))
σmyd=Myd/Wmy,netto=1E+06x0.140/2.083E+004= 6.74 N/mm²
σmzd=Mzd/Wmz,netto=1E+06x0.062/2.083E+004= 3.00 N/mm²

σmyd/fmyd+Km.σmzd/fmzd=0.295+0.092= 0.39 < 1 (EC5 Eq.6.11)
Km.σmyd/fmyd+σmzd/fmzd=0.206+0.131= 0.34 < 1 (EC5 Eq.6.12)
The check is satisfied

Purlin, load combination No 4

Lateral torsional stability of beams, Myd=0.140 kNm, Mzd=0.062 kNm (EC5 §6.3.3)
Rectangular cross section, b=50mm, h=50mm, A=2.500E+003mm², Wy=2.083E+004mm³, Wz=2.083E+004mm³
Modification factor Kmod=1.10 (Table 3.1), material factor γM=1.30 (Table 2.3)
fc0k=22.00 N/mm², fc0d=Kmod·fc0k/γM=1.10x22.00/1.30=18.62N/mm²
fmyk=27.00 N/mm², fmyd=Kmod·fmyk/γM=1.10x27.00/1.30=22.85N/mm²
fmzk=27.00 N/mm², fmzd=Kmod·fmzk/γM=1.10x27.00/1.30=22.85N/mm²

```
Rectangular cross section Km=0.70 (EC5  §6.1.6.(2))
σmyd=Myd/Wmy,netto=1E+06x0.140/2.083E+004= 6.74 N/mm²
σmzd=Mzd/Wmz,netto=1E+06x0.062/2.083E+004= 3.00 N/mm²


Buckling length Sk
Sky= 1.00x0.600=0.600 m=  600 mm
Skz= 1.00x0.600=0.600 m=  600 mm


Slenderness
iy=√(Iy/A)=0.289x  50= 14 mm, λy=  600/ 14= 42.86
iz=√(Iz/A)=0.289x  50= 14 mm, λz=  600/ 14= 42.86


σm,crit=0.78.b²·E005/(h·Lef)=0.78x50²x 7700/(50x600)= 500.50N/mm² (EC5 Eq.6.32)
σm,crit=0.78.b²·E005/(h·Lef)=0.78x50²x 7700/(50x600)= 500.50N/mm² (EC5 Eq.6.32)
Critical stresses
σm,crity=  500.50 N/mm², λrel,my=√(fmyk/σm,crity)=  0.23 (EC5 Eq.6.30)
σm,critz=  500.50 N/mm², λrel,mz=√(fmzk/σm,critz)=  0.23 (EC5 Eq.6.30)


λrel,my=0.23, (λrel<=0.75), Kcrity=1.00 (EC5 Eq.6.34)
λrel,mz=0.23, (λrel<=0.75), Kcritz=1.00 (EC5 Eq.6.34)


σmyd/(Kcrity·fmyd)+Km.σmzd/(Kcritz·fmzd)=0.295+0.092= 0.39 < 1 (EC5 Eq.6.33)
Km.σmyd/(Kcrity·fmyd)+σmzd/(Kcritz·fmzd)=0.206+0.131= 0.34 < 1 (EC5 Eq.6.33)
The check is satisfied
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1.5. Truss design

Truss geometric characteristics

Length L=8.400 m, height H=4.000 m, truss spacing d=0.600 m
Pitch =44.44%, angle α=23.96 °, tanα=0.444, sinα=0.406, cosα=0.914
Pitch =80.00%, angle α=38.66 °, tanα=0.800, sinα=0.625, cosα=0.781
Number of nodes = 11, number of elements =14, supports 3

Nodal coordinates

Node	x[m]	y[m]	Sup.
1	0.000	0.000	11
2	5.400	4.000	
3	8.400	0.000	01
4	5.400	0.000	01
5	0.000	1.600	
6	8.400	1.600	
7	2.700	2.800	
8	6.900	2.800	
9	5.400	2.800	
10	-0.600	1.333	
11	9.000	1.120	

Truss element properties

Element	K1	K2	bxh[mm]	L[m]	A[mm²]	Iy[mm4]	Wy[mm³]
1	5	7	60x220	2.955	1.320E+004	5.324E+007	4.840E+005
2	7	2	60x220	2.955	1.320E+004	5.324E+007	4.840E+005
3	8	6	60x220	1.921	1.320E+004	5.324E+007	4.840E+005
4	2	8	60x220	1.921	1.320E+004	5.324E+007	4.840E+005
5	1	4	60x220	5.400	1.320E+004	5.324E+007	4.840E+005
6	4	3	60x220	3.000	1.320E+004	5.324E+007	4.840E+005
7	1	5	60x220	1.600	1.320E+004	5.324E+007	4.840E+005
8	6	3	60x220	1.600	1.320E+004	5.324E+007	4.840E+005
9	7	9	60x220	2.700	1.320E+004	5.324E+007	4.840E+005
10	9	8	60x220	1.500	1.320E+004	5.324E+007	4.840E+005
11	4	9	60x220	2.800	1.320E+004	5.324E+007	4.840E+005
12	9	2	60x220	1.200	1.320E+004	5.324E+007	4.840E+005
13	10	5	60x220	0.657	1.320E+004	5.324E+007	4.840E+005
14	6	11	60x220	0.768	1.320E+004	5.324E+007	4.840E+005

Line loads per truss
Timber density =370.00 kg/m³, truss self weight =1.484 kN
Truss spacing d=0.60 m, weight of truss connections =0.148 kN

Permanent line loads (kN/m) on truss
Roof covering+self weight Gk1= 0.314 kN/m
Ceiling under roof Gk2= 0.180 kN/m
Permanent load of attic floor Gkf= 0.300 kN/m

Variable line loads of medium term (kN/m) on truss
Live load of attic floor Qkf= 1.200 kN/m
Variable line loads of short term action (kN/m) on truss
Imposed Qki= 0.40x0.600= 0.240 kN/m
Snow (Left) Qk1l= 0.768 kN/m (Right) Qk1r= 0.546 kN/m
Snow (Left) Qk2l= 0.384 kN/m (Right) Qk2r= 0.546 kN/m
Snow (Left) Qk3l= 0.768 kN/m (Right) Qk3r= 0.273 kN/m
Wind (Left) Qk4l= 0.123 kN/m (Right) Qk4r=-0.133 kN/m
Wind (Left) Qk5l=-0.162 kN/m (Right) Qk5r= 0.182 kN/m

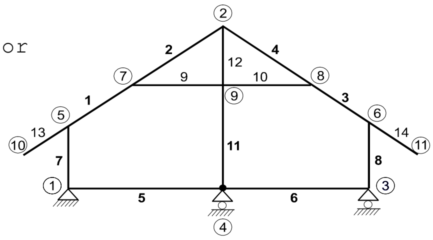
Design load combinations

(γg=1.35, γq=1.50, ψo(live Qf)=0.70, ψo(snow Q1,Q2,Q3)=0.60, ψo(wind Q4,Q5)=0.50)

L.C.	Actions Permanent-Variable	Duration classes
1	γg.G	Permanent
2	γg.G+γq.Q1	Short-term
3	γg.G+γq.Q2	Short-term
4	γg.G+γq.Q3	Short-term
5	γg.G+γq.Q4	Short-term
6	γg.G+γq.Q5	Short-term
7	γg.G+γq.Qf	Medium-term
8	γg.G+γq.Qi	Short-term
9	γg.G+γq.Q1+γq.ψo.Q4+γq.ψo.Qf	Short-term
10	γg.G+γq.Q1+γq.ψo.Q5+γq.ψo.Qf	Short-term
11	γg.G+γq.Q2+γq.ψo.Q4+γq.ψo.Qf	Short-term
12	γg.G+γq.Q2+γq.ψo.Q5+γq.ψo.Qf	Short-term
13	γg.G+γq.Q3+γq.ψo.Q4+γq.ψo.Qf	Short-term
14	γg.G+γq.Q3+γq.ψo.Q5+γq.ψo.Qf	Short-term
15	γg.G+γq.Q4+γq.ψo.Q1+γq.ψo.Qf	Short-term
16	γg.G+γq.Q4+γq.ψo.Q2+γq.ψo.Qf	Short-term
17	γg.G+γq.Q4+γq.ψo.Q3+γq.ψo.Qf	Short-term
18	γg.G+γq.Q5+γq.ψo.Q1+γq.ψo.Qf	Short-term
19	γg.G+γq.Q5+γq.ψo.Q2+γq.ψo.Qf	Short-term
20	γg.G+γq.Q5+γq.ψo.Q3+γq.ψo.Qf	Short-term
21	γg.G+γq.Qf+γq.ψo.Q1+γq.ψo.Q4	Short-term
22	γg.G+γq.Qf+γq.ψo.Q1+γq.ψo.Q5	Short-term
23	γg.G+γq.Qf+γq.ψo.Q2+γq.ψo.Q4	Short-term
24	γg.G+γq.Qf+γq.ψo.Q2+γq.ψo.Q5	Short-term
25	γg.G+γq.Qf+γq.ψo.Q3+γq.ψo.Q4	Short-term
26	γg.G+γq.Qf+γq.ψo.Q3+γq.ψo.Q5	Short-term
27	γg.G+γq.Qi+γq.ψo.Q1+γq.ψo.Q4+γq.ψo.Qf	Short-term
28	γg.G+γq.Qi+γq.ψo.Q1+γq.ψo.Q5+γq.ψo.Qf	Short-term
29	γg.G+γq.Qi+γq.ψo.Q2+γq.ψo.Q4+γq.ψo.Qf	Short-term
30	γg.G+γq.Qi+γq.ψo.Q2+γq.ψo.Q5+γq.ψo.Qf	Short-term
31	γg.G+γq.Qi+γq.ψo.Q3+γq.ψo.Q4+γq.ψo.Qf	Short-term
32	γg.G+γq.Qi+γq.ψo.Q3+γq.ψo.Q5+γq.ψo.Qf	Short-term

1.6. Truss static analysis

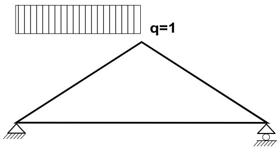
Design for connections with reduced stiffness (factor 0.40)
The truss is designed as frame structure (EN1995-1-1 §5.4.1)
with reduced connection stiffness according to the above factor
The rafter and the tie are considered as continuous elements.
The truss is first solved for various unit load conditions,
and from them are computed the internal forces
for the various loading conditions and load combinations.
Number of nodes = 11, number of elements =14, supports 3



1.6.1. Static solutions for unit loads

Internal forces for unit loading (1 kN/m left rafter downwards)

elem.	node-1	node-2	N1[kN]	V1[kN]	M1[kNm]	N2[kN]	V2[kN]	M2[kNm]
1	5	7	-1.14	1.87	-1.04	-0.04	-0.60	0.83
2	7	2	3.47	0.97	0.81	4.56	-1.50	0.02
3	8	6	0.70	1.30	-2.12	0.70	1.30	0.37
4	2	8	3.71	-1.08	-0.02	3.71	-1.08	-2.10
5	1	4	0.28	-0.08	0.41	0.28	-0.08	0.00
6	4	3	0.26	-0.27	0.02	0.26	-0.27	-0.79
7	1	5	-2.77	-0.28	-0.41	-2.77	-0.28	-0.86
8	6	3	1.45	0.26	0.37	1.45	0.26	0.79
9	7	9	-3.84	-0.01	0.02	-3.84	-0.01	-0.01
10	9	8	-3.84	-0.02	0.01	-3.84	-0.02	-0.03
11	4	9	-4.68	0.02	-0.02	-4.68	0.02	0.02
12	9	2	-4.70	0.01	0.01	-4.70	0.01	0.03
13	10	5	0.00	0.00	0.00	0.24	-0.55	-0.18
14	6	11	0.00	0.00	0.00	0.00	0.00	0.00



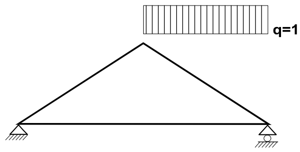
Element end forces for unit loading (1 kN/m left rafter downwards)

elem.	node-1	node-2	F1x[kN]	F1y[kN]	M1[kNm]	F2x[kN]	F2y[kN]	M2[kNm]
1	5	7	0.28	2.17	-1.04	-0.28	0.53	-0.83
2	7	2	-3.56	-0.52	0.81	3.56	3.22	-0.02
3	8	6	0.26	1.45	-2.12	-0.26	-1.45	-0.37
4	2	8	-3.57	1.47	-0.02	3.57	-1.47	2.10
5	1	4	-0.28	-0.08	0.41	0.28	0.08	0.00
6	4	3	-0.26	-0.27	0.02	0.26	0.27	0.79
7	1	5	0.28	2.77	-0.41	-0.28	-2.77	0.86
8	6	3	0.26	1.45	0.37	-0.26	-1.45	-0.79
9	7	9	3.84	-0.01	0.02	-3.84	0.01	0.01
10	9	8	3.84	-0.02	0.01	-3.84	0.02	0.03
11	4	9	-0.02	4.68	-0.02	0.02	-4.68	-0.02
12	9	2	-0.01	4.70	0.01	0.01	-4.70	-0.03
13	10	5	0.00	0.00	0.00	0.00	0.60	0.18
14	6	11	0.00	0.00	0.00	0.00	0.00	0.00

(element end forces in global coordinate system x-y)

Internal forces for unit loading (1 kN/m right rafter downwards)

elem.	node-1	node-2	N1[kN]	V1[kN]	M1[kNm]	N2[kN]	V2[kN]	M2[kNm]
1	5	7	0.05	-0.18	0.11	0.05	-0.18	-0.41
2	7	2	0.76	0.14	-0.40	0.76	0.14	0.00
3	8	6	0.08	0.14	0.46	-0.86	-1.03	-0.40
4	2	8	1.61	0.82	0.01	0.67	-0.35	0.45
5	1	4	0.02	0.03	-0.15	0.02	0.03	0.02
6	4	3	0.03	0.05	0.01	0.03	0.05	0.17
7	1	5	0.18	-0.02	0.15	0.18	-0.02	0.11
8	6	3	-1.95	0.03	-0.22	-1.95	0.03	-0.17
9	7	9	-0.77	0.00	0.00	-0.77	0.00	0.00
10	9	8	-0.77	0.01	0.00	-0.77	0.01	0.01
11	4	9	-1.84	0.00	0.01	-1.84	0.00	-0.01
12	9	2	-1.83	0.00	0.00	-1.83	0.00	-0.01
13	10	5	0.00	0.00	0.00	0.00	0.00	0.00
14	6	11	0.37	0.47	-0.18	0.00	0.00	0.00



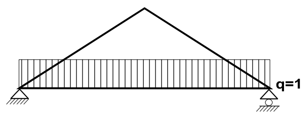
Element end forces for unit loading (1 kN/m right rafter downwards)

elem.	node-1	node-2	F1x[kN]	F1y[kN]	M1[kNm]	F2x[kN]	F2y[kN]	M2[kNm]
1	5	7	0.02	-0.18	0.11	-0.02	0.18	0.41
2	7	2	-0.75	-0.19	-0.40	0.75	0.19	0.00
3	8	6	0.03	0.15	0.46	-0.03	1.35	0.40
4	2	8	-0.75	1.65	0.01	0.75	-0.15	-0.45
5	1	4	-0.02	0.03	-0.15	0.02	-0.03	-0.02
6	4	3	-0.03	0.05	0.01	0.03	-0.05	-0.17
7	1	5	0.02	-0.18	0.15	-0.02	0.18	-0.11
8	6	3	0.03	-1.95	-0.22	-0.03	1.95	0.17
9	7	9	0.77	0.00	0.00	-0.77	0.00	0.00
10	9	8	0.77	0.01	0.00	-0.77	-0.01	-0.01
11	4	9	0.00	1.84	0.01	0.00	-1.84	0.01
12	9	2	0.00	1.83	0.00	0.00	-1.83	0.01
13	10	5	0.00	0.00	0.00	0.00	0.00	0.00
14	6	11	0.00	0.60	-0.18	0.00	0.00	0.00

(element end forces in global coordinate system x-y)

Internal forces for unit loading (1 kN/m tie downwards)

elem.	node-1	node-2	N1[kN]	V1[kN]	M1[kNm]	N2[kN]	V2[kN]	M2[kNm]
1	5	7	-0.95	0.00	0.17	-0.95	0.00	0.17
2	7	2	-1.08	-0.06	0.17	-1.08	-0.06	0.00
3	8	6	-1.27	-0.21	-0.23	-1.27	-0.21	-0.64
4	2	8	-1.39	-0.12	0.00	-1.39	-0.12	-0.22
5	1	4	0.87	2.60	-1.56	0.87	-2.80	-2.12
6	4	3	0.86	1.95	-2.10	0.86	-1.05	-0.74
7	1	5	-0.39	-0.87	1.56	-0.39	-0.87	0.17
8	6	3	-0.96	0.86	-0.64	-0.96	0.86	0.74
9	7	9	0.14	0.00	0.00	0.14	0.00	0.00
10	9	8	0.15	0.00	0.00	0.15	0.00	0.00
11	4	9	1.35	0.01	-0.02	1.35	0.01	0.01
12	9	2	1.35	0.00	0.00	1.35	0.00	0.00
13	10	5	0.00	0.00	0.00	0.00	0.00	0.00
14	6	11	0.00	0.00	0.00	0.00	0.00	0.00

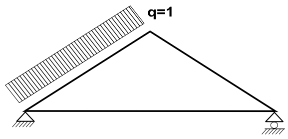


Element end forces for unit loading (1 kN/m tie downwards)

elem.	node-1	node-2	F1x[kN]	F1y[kN]	M1[kNm]	F2x[kN]	F2y[kN]	M2[kNm]
1	5	7	0.87	0.39	0.17	-0.87	-0.39	-0.17
2	7	2	1.01	0.39	0.17	-1.01	-0.39	0.00
3	8	6	0.86	-0.96	-0.23	-0.86	0.96	0.64
4	2	8	1.01	-0.96	0.00	-1.01	0.96	0.22
5	1	4	-0.87	2.60	-1.56	0.87	2.80	2.12
6	4	3	-0.86	1.95	-2.10	0.86	1.05	0.74
7	1	5	0.87	0.39	1.56	-0.87	-0.39	-0.17
8	6	3	0.86	-0.96	-0.64	-0.86	0.96	-0.74
9	7	9	-0.14	0.00	0.00	0.14	0.00	0.00
10	9	8	-0.15	0.00	0.00	0.15	0.00	0.00
11	4	9	-0.01	-1.35	-0.02	0.01	1.35	-0.01
12	9	2	0.00	-1.35	0.00	0.00	1.35	0.00
13	10	5	0.00	0.00	0.00	0.00	0.00	0.00
14	6	11	0.00	0.00	0.00	0.00	0.00	0.00

(element end forces in global coordinate system x-y)

Internal forces for unit loading (1 kN/m left rafter pressure)

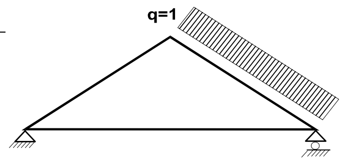


elem.	node-1	node-2	N1[kN]	V1[kN]	M1[kNm]	N2[kN]	V2[kN]	M2[kNm]
1	5	7	-0.80	2.01	-0.15	-0.80	-0.95	1.42
2	7	2	3.57	1.01	1.40	3.57	-1.94	0.03
3	8	6	-1.94	1.23	-3.36	-1.94	1.23	-0.99
4	2	8	1.81	-1.71	-0.02	1.81	-1.71	-3.32
5	1	4	2.32	-0.35	1.77	2.32	-0.35	-0.11
6	4	3	2.28	-0.87	-0.06	2.28	-0.87	-2.66
7	1	5	-2.76	1.95	-1.77	-2.76	0.35	0.07
8	6	3	-0.25	2.28	-0.99	-0.25	2.28	2.66
9	7	9	-4.79	-0.01	0.03	-4.79	-0.01	-0.01
10	9	8	-4.77	-0.04	0.02	-4.77	-0.04	-0.04
11	4	9	-2.99	0.04	-0.05	-2.99	0.04	0.05
12	9	2	-3.02	0.01	0.02	-3.02	0.01	0.04
13	10	5	0.00	0.00	0.00	0.00	-0.66	-0.22
14	6	11	0.00	0.00	0.00	0.00	0.00	0.00

Element end forces for unit loading (1 kN/m left rafter pressure)

elem.	node-1	node-2	F1x[kN]	F1y[kN]	M1[kNm]	F2x[kN]	F2y[kN]	M2[kNm]
1	5	7	-0.08	2.16	-0.15	-1.12	0.54	-1.42
2	7	2	-3.67	-0.52	1.40	2.47	3.22	-0.03
3	8	6	2.28	-0.25	-3.36	-2.28	0.25	0.99
4	2	8	-2.49	-0.21	-0.02	2.49	0.21	3.32
5	1	4	-2.32	-0.35	1.77	2.32	0.35	0.11
6	4	3	-2.28	-0.87	-0.06	2.28	0.87	2.66
7	1	5	-1.95	2.76	-1.77	0.35	-2.76	-0.07
8	6	3	2.28	-0.25	-0.99	-2.28	0.25	-2.66
9	7	9	4.79	-0.01	0.03	-4.79	0.01	0.01
10	9	8	4.77	-0.04	0.02	-4.77	0.04	0.04
11	4	9	-0.04	2.99	-0.05	0.04	-2.99	-0.05
12	9	2	-0.01	3.02	0.02	0.01	-3.02	-0.04
13	10	5	0.00	0.00	0.00	-0.27	0.60	0.22
14	6	11	0.00	0.00	0.00	0.00	0.00	0.00

(element end forces in global coordinate system x-y)



Internal forces for unit loading (1 kN/m right rafter pressure)

elem.	node-1	node-2	N1[kN]	V1[kN]	M1[kNm]	N2[kN]	V2[kN]	M2[kNm]
1	5	7	-1.61	-0.08	-0.96	-1.61	-0.08	-1.19
2	7	2	-0.52	0.40	-1.18	-0.52	0.40	-0.01
3	8	6	0.06	0.61	1.56	0.06	-1.31	0.88
4	2	8	0.99	1.75	0.02	0.99	-0.17	1.53
5	1	4	-2.97	0.28	-1.45	-2.97	0.28	0.08
6	4	3	-2.95	0.74	0.04	-2.95	0.74	2.26
7	1	5	-0.58	-1.51	1.45	-0.58	-1.51	-0.96
8	6	3	-1.59	-1.35	1.18	-1.59	-2.95	-2.26
9	7	9	-1.19	0.01	-0.01	-1.19	0.01	0.01
10	9	8	-1.21	0.03	-0.01	-1.21	0.03	0.03
11	4	9	-1.43	-0.03	0.04	-1.43	-0.03	-0.03
12	9	2	-1.41	0.00	-0.02	-1.41	0.00	-0.02
13	10	5	0.00	0.00	0.00	0.00	0.00	0.00
14	6	11	0.00	0.77	-0.30	0.00	0.00	0.00

Element end forces for unit loading (1 kN/m right rafter pressure)

elem.	node-1	node-2	F1x[kN]	F1y[kN]	M1[kNm]	F2x[kN]	F2y[kN]	M2[kNm]
1	5	7	1.51	0.58	-0.96	-1.51	-0.58	1.19
2	7	2	0.32	0.57	-1.18	-0.32	-0.57	0.01
3	8	6	0.33	0.51	1.56	0.87	0.99	-0.88
4	2	8	0.32	1.98	0.02	0.88	-0.48	-1.53
5	1	4	2.97	0.28	-1.45	-2.97	-0.28	-0.08
6	4	3	2.95	0.74	0.04	-2.95	-0.74	-2.26
7	1	5	1.51	0.58	1.45	-1.51	-0.58	0.96
8	6	3	-1.35	-1.59	1.18	2.95	1.59	2.26
9	7	9	1.19	0.01	-0.01	-1.19	-0.01	-0.01
10	9	8	1.21	0.03	-0.01	-1.21	-0.03	-0.03
11	4	9	0.03	1.43	0.04	-0.03	-1.43	0.03
12	9	2	0.00	1.41	-0.02	0.00	-1.41	0.02
13	10	5	0.00	0.00	0.00	0.00	0.00	0.00
14	6	11	0.48	0.60	-0.30	0.00	0.00	0.00

(element end forces in global coordinate system x-y)

1.6.2. Internal forces for applied loads

Internal forces, Loading: (G) Dead Gk1 = 0.314, Gk2 = 0.180, Gkf=0.300 [kN/m]

elem.	node-1	node-2	N1[kN]	V1[kN]	M1[kNm]	N2[kN]	V2[kN]	M2[kNm]	Nm[kN]	Vm[kN]	Mm[kNm]
1	5	7	-0.83	0.57	-0.23	-0.45	-0.28	0.20	-0.57	0.00	0.34
2	7	2	0.98	0.36	0.20	1.36	-0.49	0.01	1.14	0.00	0.42
3	8	6	-0.34	0.40	-0.65	-0.72	-0.07	-0.34	-0.66	0.00	-0.33
4	2	8	1.26	-0.10	0.00	0.88	-0.57	-0.65	1.22	-0.15	-0.03
5	1	4	0.52	1.23	-0.67	0.52	-1.36	-1.01	0.52	0.00	0.91
6	4	3	0.52	0.87	-0.99	0.52	-0.57	-0.56	0.52	0.00	-0.21
7	1	5	-1.06	-0.52	0.67	-1.06	-0.52	-0.17	-1.06	-0.52	0.25
8	6	3	-0.75	0.52	-0.27	-0.75	0.52	0.56	-0.75	0.52	0.15
9	7	9	-1.56	0.00	0.01	-1.56	0.00	0.00	-1.56	-0.25	-0.16
10	9	8	-1.56	-0.01	0.00	-1.56	-0.01	-0.01	-1.56	-0.14	-0.05
11	4	9	-1.70	0.01	-0.01	-1.70	0.01	0.01	-1.70	0.01	0.00
12	9	2	-1.71	0.00	0.00	-1.71	0.00	0.01	-1.71	0.00	0.01
13	10	5	0.00	0.00	0.00	0.08	-0.19	-0.06	0.00	0.00	0.00
14	6	11	0.15	0.19	-0.07	0.00	0.00	0.00	0.00	0.00	0.00

(m point of maximum span moment for permanent load, or element middle point)

Internal forces, Loading: (Q1) Snow QksL= 0.768, QksR= 0.546 [kN/m]

elem.	node-1	node-2	N1[kN]	V1[kN]	M1[kNm]	N2[kN]	V2[kN]	M2[kNm]	Nm[kN]	Vm[kN]	Mm[kNm]
1	5	7	-0.84	1.34	-0.74	0.00	-0.56	0.41	-0.28	0.06	0.65
2	7	2	3.08	0.82	0.40	3.92	-1.08	0.01	3.44	0.01	0.92
3	8	6	0.58	1.07	-1.38	0.07	0.43	0.07	0.15	0.53	-0.08
4	2	8	3.73	-0.38	-0.01	3.22	-1.02	-1.36	3.68	-0.45	-0.09
5	1	4	0.23	-0.04	0.24	0.23	-0.04	0.01	0.23	-0.04	0.13
6	4	3	0.22	-0.18	0.02	0.22	-0.18	-0.51	0.22	-0.18	-0.30
7	1	5	-2.02	-0.23	-0.24	-2.02	-0.23	-0.60	-2.02	-0.23	-0.42
8	6	3	0.05	0.22	0.17	0.05	0.22	0.51	0.05	0.22	0.34
9	7	9	-3.37	-0.01	0.01	-3.37	-0.01	0.00	-3.37	-0.01	0.00
10	9	8	-3.37	-0.01	0.00	-3.37	-0.01	-0.02	-3.37	-0.01	-0.01
11	4	9	-4.60	0.01	-0.01	-4.60	0.01	0.02	-4.60	0.01	0.00
12	9	2	-4.61	0.01	0.01	-4.61	0.01	0.02	-4.61	0.01	0.01
13	10	5	0.00	0.00	0.00	0.19	-0.42	-0.14	0.00	0.00	0.00
14	6	11	0.20	0.26	-0.10	0.00	0.00	0.00	0.00	0.00	0.00

(m point of maximum span moment for permanent load, or element middle point)

Internal forces, Loading: (Q2) Snow QksL= 0.384, QksR= 0.546 [kN/m]

elem.	node-1	node-2	N1[kN]	V1[kN]	M1[kNm]	N2[kN]	V2[kN]	M2[kNm]	Nm[kN]	Vm[kN]	Mm[kNm]
1	5	7	-0.41	0.62	-0.34	0.01	-0.33	0.09	-0.12	-0.02	0.26
2	7	2	1.75	0.45	0.09	2.17	-0.50	0.01	1.93	0.04	0.40
3	8	6	0.31	0.57	-0.56	-0.20	-0.07	-0.08	-0.12	0.03	-0.07
4	2	8	2.31	0.03	0.00	1.79	-0.61	-0.56	2.25	-0.04	0.00
5	1	4	0.12	-0.01	0.08	0.12	-0.01	0.01	0.12	-0.01	0.05
6	4	3	0.12	-0.07	0.02	0.12	-0.07	-0.21	0.12	-0.07	-0.12
7	1	5	-0.96	-0.12	-0.08	-0.96	-0.12	-0.27	-0.96	-0.12	-0.17
8	6	3	-0.51	0.12	0.02	-0.51	0.12	0.21	-0.51	0.12	0.12
9	7	9	-1.90	0.00	0.01	-1.90	0.00	0.00	-1.90	0.00	0.00
10	9	8	-1.90	0.00	0.00	-1.90	0.00	-0.01	-1.90	0.00	0.00
11	4	9	-2.80	0.00	0.00	-2.80	0.00	0.01	-2.80	0.00	0.00
12	9	2	-2.80	0.00	0.00	-2.80	0.00	0.01	-2.80	0.00	0.00
13	10	5	0.00	0.00	0.00	0.09	-0.21	-0.07	0.00	0.00	0.00
14	6	11	0.20	0.26	-0.10	0.00	0.00	0.00	0.00	0.00	0.00

Internal forces, Loading: (Q3) Snow QksL= 0.768, QksR= 0.273 [kN/m]

elem.	node-1	node-2	N1[kN]	V1[kN]	M1[kNm]	N2[kN]	V2[kN]	M2[kNm]	Nm[kN]	Vm[kN]	Mm[kNm]
1	5	7	-0.86	1.38	-0.77	-0.01	-0.51	0.52	-0.29	0.11	0.72
2	7	2	2.87	0.78	0.51	3.71	-1.12	0.01	3.23	-0.02	0.98
3	8	6	0.56	1.03	-1.50	0.30	0.71	0.18	0.34	0.76	-0.04
4	2	8	3.29	-0.61	-0.01	3.03	-0.93	-1.49	3.26	-0.64	-0.14
5	1	4	0.22	-0.05	0.28	0.22	-0.05	0.01	0.22	-0.05	0.15
6	4	3	0.21	-0.19	0.02	0.21	-0.19	-0.56	0.21	-0.19	-0.33
7	1	5	-2.07	-0.22	-0.28	-2.07	-0.22	-0.63	-2.07	-0.22	-0.45
8	6	3	0.58	0.21	0.22	0.58	0.21	0.56	0.58	0.21	0.39
9	7	9	-3.16	-0.01	0.01	-3.16	-0.01	0.00	-3.16	-0.01	0.00
10	9	8	-3.16	-0.02	0.01	-3.16	-0.02	-0.02	-3.16	-0.02	-0.01
11	4	9	-4.10	0.01	-0.01	-4.10	0.01	0.02	-4.10	0.01	0.00
12	9	2	-4.11	0.01	0.01	-4.11	0.01	0.02	-4.11	0.01	0.01
13	10	5	0.00	0.00	0.00	0.19	-0.42	-0.14	0.00	0.00	0.00
14	6	11	0.10	0.13	-0.05	0.00	0.00	0.00	0.00	0.00	0.00

Internal forces, Loading: (Q4) Wind QkwL= 0.123, QkwR=-0.133 [kN/m]

elem.	node-1	node-2	N1[kN]	V1[kN]	M1[kNm]	N2[kN]	V2[kN]	M2[kNm]	Nm[kN]	Vm[kN]	Mm[kNm]
1	5	7	0.12	0.26	0.11	0.12	-0.11	0.33	0.12	0.01	0.38
2	7	2	0.51	0.07	0.33	0.51	-0.29	0.00	0.51	-0.08	0.32
3	8	6	-0.25	0.07	-0.62	-0.25	0.33	-0.24	-0.25	0.29	-0.33
4	2	8	0.09	-0.44	-0.01	0.09	-0.19	-0.61	0.09	-0.42	-0.09
5	1	4	0.68	-0.08	0.41	0.68	-0.08	-0.02	0.68	-0.08	0.20
6	4	3	0.67	-0.20	-0.01	0.67	-0.20	-0.63	0.67	-0.20	-0.38
7	1	5	-0.26	0.44	-0.41	-0.26	0.24	0.14	-0.26	0.44	-0.06
8	6	3	0.18	0.46	-0.28	0.18	0.67	0.63	0.18	0.46	0.09
9	7	9	-0.43	0.00	0.01	-0.43	0.00	0.00	-0.43	0.00	0.00
10	9	8	-0.42	-0.01	0.00	-0.42	-0.01	-0.01	-0.42	-0.01	0.00
11	4	9	-0.18	0.01	-0.01	-0.18	0.01	0.01	-0.18	0.01	0.00
12	9	2	-0.18	0.00	0.00	-0.18	0.00	0.01	-0.18	0.00	0.01
13	10	5	0.00	0.00	0.00	0.00	-0.08	-0.03	0.00	0.00	0.00
14	6	11	0.00	-0.10	0.04	0.00	0.00	0.00	0.00	0.00	0.00

(m point of maximum span moment for permanent load, or element middle point)

Internal forces, Loading: (Q5) Wind QkwL=-0.162, QkwR= 0.182 [kN/m]

elem.	node-1	node-2	N1[kN]	V1[kN]	M1[kNm]	N2[kN]	V2[kN]	M2[kNm]	Nm[kN]	Vm[kN]	Mm[kNm]
1	5	7	-0.16	-0.34	-0.15	-0.16	0.14	-0.45	-0.16	-0.02	-0.51
2	7	2	-0.67	-0.09	-0.44	-0.67	0.39	-0.01	-0.67	0.11	-0.43
3	8	6	0.32	-0.09	0.83	0.32	-0.44	0.32	0.32	-0.39	0.44
4	2	8	-0.11	0.60	0.01	-0.11	0.25	0.82	-0.11	0.56	0.12
5	1	4	-0.92	0.11	-0.55	-0.92	0.11	0.03	-0.92	0.11	-0.27
6	4	3	-0.91	0.28	0.02	-0.91	0.28	0.84	-0.91	0.28	0.51
7	1	5	0.34	-0.59	0.55	0.34	-0.33	-0.19	0.34	-0.59	0.08
8	6	3	-0.25	-0.62	0.38	-0.25	-0.91	-0.84	-0.25	-0.62	-0.12
9	7	9	0.56	0.00	-0.01	0.56	0.00	0.00	0.56	0.00	0.00
10	9	8	0.55	0.01	-0.01	0.55	0.01	0.01	0.55	0.01	0.00
11	4	9	0.22	-0.01	0.02	0.22	-0.01	-0.01	0.22	-0.01	0.00
12	9	2	0.23	0.00	-0.01	0.23	0.00	-0.01	0.23	0.00	-0.01
13	10	5	0.00	0.00	0.00	0.00	0.11	0.03	0.00	0.00	0.00
14	6	11	0.00	0.14	-0.05	0.00	0.00	0.00	0.00	0.00	0.00

Internal forces, Loading: (Qf) Live Qkf = 1.200 [kN/m]

elem.	node-1	node-2	N1[kN]	V1[kN]	M1[kNm]	N2[kN]	V2[kN]	M2[kNm]	Nm[kN]	Vm[kN]	Mm[kNm]
1	5	7	-1.15	0.00	0.20	-1.15	0.00	0.20	-1.15	0.00	0.20
2	7	2	-1.30	-0.07	0.20	-1.30	-0.07	0.00	-1.30	-0.07	0.12
3	8	6	-1.53	-0.26	-0.27	-1.53	-0.26	-0.77	-1.53	-0.26	-0.69
4	2	8	-1.67	-0.14	0.00	-1.67	-0.14	-0.27	-1.67	-0.14	-0.03
5	1	4	1.05	3.12	-1.88	1.05	-3.36	-2.54	1.05	0.03	2.17
6	4	3	1.03	2.34	-2.52	1.03	-1.26	-0.89	1.03	0.18	-0.24
7	1	5	-0.46	-1.05	1.88	-0.46	-1.05	0.20	-0.46	-1.05	1.04
8	6	3	-1.16	1.03	-0.77	-1.16	1.03	0.89	-1.16	1.03	0.06
9	7	9	0.17	0.00	0.00	0.17	0.00	0.00	0.17	0.00	0.00
10	9	8	0.18	-0.01	0.00	0.18	-0.01	0.00	0.18	-0.01	0.00
11	4	9	1.62	0.01	-0.03	1.62	0.01	0.01	1.62	0.01	-0.01
12	9	2	1.62	0.00	0.00	1.62	0.00	0.00	1.62	0.00	0.00
13	10	5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14	6	11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

(m point of maximum span moment for permanent load, or element middle point)

Internal forces, Loading: (Qi) Imposed (H) Qi = 0.240 [kN/m]

elem.	node-1	node-2	N1[kN]	V1[kN]	M1[kNm]	N2[kN]	V2[kN]	M2[kNm]	Nm[kN]	Vm[kN]	Mm[kNm]
1	5	7	-0.26	0.41	-0.22	0.00	-0.19	0.10	-0.08	0.01	0.19
2	7	2	1.01	0.26	0.10	1.28	-0.33	0.00	1.13	0.01	0.27
3	8	6	0.19	0.34	-0.40	-0.04	0.06	-0.01	0.00	0.11	-0.03
4	2	8	1.28	-0.06	0.00	1.05	-0.34	-0.39	1.25	-0.09	-0.02
5	1	4	0.07	-0.01	0.06	0.07	-0.01	0.00	0.07	-0.01	0.04
6	4	3	0.07	-0.05	0.01	0.07	-0.05	-0.15	0.07	-0.05	-0.09
7	1	5	-0.62	-0.07	-0.06	-0.62	-0.07	-0.18	-0.62	-0.07	-0.12
8	6	3	-0.12	0.07	0.04	-0.12	0.07	0.15	-0.12	0.07	0.09
9	7	9	-1.11	0.00	0.00	-1.11	0.00	0.00	-1.11	0.00	0.00
10	9	8	-1.11	0.00	0.00	-1.11	0.00	0.00	-1.11	0.00	0.00
11	4	9	-1.57	0.00	0.00	-1.57	0.00	0.00	-1.57	0.00	0.00
12	9	2	-1.57	0.00	0.00	-1.57	0.00	0.00	-1.57	0.00	0.00
13	10	5	0.00	0.00	0.00	0.06	-0.13	-0.04	0.00	0.00	0.00
14	6	11	0.09	0.11	-0.04	0.00	0.00	0.00	0.00	0.00	0.00

(m point of maximum span moment for permanent load, or element middle point)

1.6.3. Element end forces for applied loads

Element end forces, Loading: (G) Dead Gk1 = 0.314, Gk2 = 0.180, Gkf=0.300 [kN/m]

elem.	node-1	node-2	F1x[kN]	F1y[kN]	M1[kNm]	F2x[kN]	F2y[kN]	M2[kNm]
1	5	7	0.52	0.86	-0.23	-0.52	0.07	-0.20
2	7	2	-1.04	-0.07	0.20	1.04	1.00	-0.01
3	8	6	0.52	0.10	-0.65	-0.52	0.51	0.34
4	2	8	-1.04	0.71	0.00	1.04	-0.11	0.65
5	1	4	-0.52	1.23	-0.67	0.52	1.36	1.01
6	4	3	-0.52	0.87	-0.99	0.52	0.57	0.56
7	1	5	0.52	1.06	0.67	-0.52	-1.06	0.17
8	6	3	0.52	-0.75	-0.27	-0.52	0.75	-0.56
9	7	9	1.56	0.00	0.01	-1.56	0.00	0.00
10	9	8	1.56	-0.01	0.00	-1.56	0.01	0.01
11	4	9	-0.01	1.70	-0.01	0.01	-1.70	-0.01
12	9	2	0.00	1.71	0.00	0.00	-1.71	-0.01
13	10	5	0.00	0.00	0.00	0.00	0.21	0.06
14	6	11	0.00	0.24	-0.07	0.00	0.00	0.00

(element end forces in global coordinate system x-y)

Element end forces, Loading: (Q1) Snow QksL= 0.768, QksR= 0.546 [kN/m]

elem.	node-1	node-2	F1x[kN]	F1y[kN]	M1[kNm]	F2x[kN]	F2y[kN]	M2[kNm]
1	5	7	0.23	1.56	-0.74	-0.23	0.51	-0.41
2	7	2	-3.14	-0.50	0.40	3.14	2.58	-0.01
3	8	6	0.22	1.20	-1.38	-0.22	-0.38	-0.07
4	2	8	-3.15	2.03	-0.01	3.15	-1.21	1.36
5	1	4	-0.23	-0.04	0.24	0.23	0.04	-0.01
6	4	3	-0.22	-0.18	0.02	0.22	0.18	0.51
7	1	5	0.23	2.02	-0.24	-0.23	-2.02	0.60
8	6	3	0.22	0.05	0.17	-0.22	-0.05	-0.51
9	7	9	3.37	-0.01	0.01	-3.37	0.01	0.00
10	9	8	3.37	-0.01	0.00	-3.37	0.01	0.02
11	4	9	-0.01	4.60	-0.01	0.01	-4.60	-0.02
12	9	2	-0.01	4.61	0.01	0.01	-4.61	-0.02
13	10	5	0.00	0.00	0.00	0.00	0.46	0.14
14	6	11	0.00	0.33	-0.10	0.00	0.00	0.00

(element end forces in global coordinate system x-y)

Element end forces, Loading: (Q2) Snow QksL= 0.384, QksR= 0.546 [kN/m]

elem.	node-1	node-2	F1x[kN]	F1y[kN]	M1[kNm]	F2x[kN]	F2y[kN]	M2[kNm]
1	5	7	0.12	0.73	-0.34	-0.12	0.31	-0.09
2	7	2	-1.78	-0.30	0.09	1.78	1.34	-0.01
3	8	6	0.12	0.64	-0.56	-0.12	0.18	0.08
4	2	8	-1.78	1.46	0.00	1.78	-0.65	0.56
5	1	4	-0.12	-0.01	0.08	0.12	0.01	-0.01
6	4	3	-0.12	-0.07	0.02	0.12	0.07	0.21
7	1	5	0.12	0.96	-0.08	-0.12	-0.96	0.27
8	6	3	0.12	-0.51	0.02	-0.12	0.51	-0.21
9	7	9	1.90	0.00	0.01	-1.90	0.00	0.00
10	9	8	1.90	0.00	0.00	-1.90	0.00	0.01
11	4	9	0.00	2.80	0.00	0.00	-2.80	-0.01
12	9	2	0.00	2.80	0.00	0.00	-2.80	-0.01
13	10	5	0.00	0.00	0.00	0.00	0.23	0.07
14	6	11	0.00	0.33	-0.10	0.00	0.00	0.00

(element end forces in global coordinate system x-y)

Element end forces, Loading: (Q3) Snow QksL= 0.768, QksR= 0.273 [kN/m]

elem.	node-1	node-2	F1x[kN]	F1y[kN]	M1[kNm]	F2x[kN]	F2y[kN]	M2[kNm]
1	5	7	0.22	1.61	-0.77	-0.22	0.46	-0.52
2	7	2	-2.94	-0.45	0.51	2.94	2.53	-0.01
3	8	6	0.21	1.16	-1.50	-0.21	-0.75	-0.18
4	2	8	-2.95	1.58	-0.01	2.95	-1.17	1.49
5	1	4	-0.22	-0.05	0.28	0.22	0.05	-0.01
6	4	3	-0.21	-0.19	0.02	0.21	0.19	0.56
7	1	5	0.22	2.07	-0.28	-0.22	-2.07	0.63
8	6	3	0.21	0.58	0.22	-0.21	-0.58	-0.56
9	7	9	3.16	-0.01	0.01	-3.16	0.01	0.00
10	9	8	3.16	-0.02	0.01	-3.16	0.02	0.02
11	4	9	-0.01	4.10	-0.01	0.01	-4.10	-0.02
12	9	2	-0.01	4.11	0.01	0.01	-4.11	-0.02
13	10	5	0.00	0.00	0.00	0.00	0.46	0.14
14	6	11	0.00	0.16	-0.05	0.00	0.00	0.00

(element end forces in global coordinate system x-y)

Element end forces, Loading: (Q4) Wind QkwL= 0.123, QkwR=-0.133 [kN/m]

elem.	node-1	node-2	F1x[kN]	F1y[kN]	M1[kNm]	F2x[kN]	F2y[kN]	M2[kNm]
1	5	7	-0.21	0.19	0.11	0.06	0.14	-0.33
2	7	2	-0.49	-0.14	0.33	0.35	0.47	0.00
3	8	6	0.24	-0.10	-0.62	-0.40	-0.10	0.24
4	2	8	-0.35	-0.29	-0.01	0.19	0.09	0.61
5	1	4	-0.68	-0.08	0.41	0.68	0.08	0.02
6	4	3	-0.67	-0.20	-0.01	0.67	0.20	0.63
7	1	5	-0.44	0.26	-0.41	0.24	-0.26	-0.14
8	6	3	0.46	0.18	-0.28	-0.67	-0.18	-0.63
9	7	9	0.43	0.00	0.01	-0.43	0.00	0.00
10	9	8	0.42	-0.01	0.00	-0.42	0.01	0.01
11	4	9	-0.01	0.18	-0.01	0.01	-0.18	-0.01
12	9	2	0.00	0.18	0.00	0.00	-0.18	-0.01
13	10	5	0.00	0.00	0.00	-0.03	0.07	0.03
14	6	11	-0.06	-0.08	0.04	0.00	0.00	0.00

(element end forces in global coordinate system x-y)

Element end forces, Loading: (Q5) Wind QkwL=-0.162, QkwR= 0.182 [kN/m]

elem.	node-1	node-2	F1x[kN]	F1y[kN]	M1[kNm]	F2x[kN]	F2y[kN]	M2[kNm]
1	5	7	0.29	-0.24	-0.15	-0.09	-0.19	0.45
2	7	2	0.65	0.19	-0.44	-0.46	-0.63	0.01
3	8	6	-0.31	0.13	0.83	0.53	0.14	-0.32
4	2	8	0.46	0.40	0.01	-0.24	-0.12	-0.82
5	1	4	0.92	0.11	-0.55	-0.92	-0.11	-0.03
6	4	3	0.91	0.28	0.02	-0.91	-0.28	-0.84
7	1	5	0.59	-0.34	0.55	-0.33	0.34	0.19
8	6	3	-0.62	-0.25	0.38	0.91	0.25	0.84
9	7	9	-0.56	0.00	-0.01	0.56	0.00	0.00
10	9	8	-0.55	0.01	-0.01	0.55	-0.01	-0.01
11	4	9	0.01	-0.22	0.02	-0.01	0.22	0.01
12	9	2	0.00	-0.23	-0.01	0.00	0.23	0.01
13	10	5	0.00	0.00	0.00	0.04	-0.10	-0.03
14	6	11	0.09	0.11	-0.05	0.00	0.00	0.00

(element end forces in global coordinate system x-y)

Element end forces, Loading: (Qf) Live Qkf = 1.200 [kN/m]

elem.	node-1	node-2	F1x[kN]	F1y[kN]	M1[kNm]	F2x[kN]	F2y[kN]	M2[kNm]
1	5	7	1.05	0.46	0.20	-1.05	-0.46	-0.20
2	7	2	1.22	0.47	0.20	-1.22	-0.47	0.00
3	8	6	1.03	-1.16	-0.27	-1.03	1.16	0.77
4	2	8	1.22	-1.15	0.00	-1.22	1.15	0.27
5	1	4	-1.05	3.12	-1.88	1.05	3.36	2.54
6	4	3	-1.03	2.34	-2.52	1.03	1.26	0.89
7	1	5	1.05	0.46	1.88	-1.05	-0.46	-0.20
8	6	3	1.03	-1.16	-0.77	-1.03	1.16	-0.89
9	7	9	-0.17	0.00	0.00	0.17	0.00	0.00
10	9	8	-0.18	-0.01	0.00	0.18	0.01	0.00
11	4	9	-0.01	-1.62	-0.03	0.01	1.62	-0.01
12	9	2	0.00	-1.62	0.00	0.00	1.62	0.00
13	10	5	0.00	0.00	0.00	0.00	0.00	0.00
14	6	11	0.00	0.00	0.00	0.00	0.00	0.00

(element end forces in global coordinate system x-y)

Element end forces, Loading: (Qi) Imposed (H) Qi = 0.240 [kN/m]

elem.	node-1	node-2	F1x[kN]	F1y[kN]	M1[kNm]	F2x[kN]	F2y[kN]	M2[kNm]
1	5	7	0.07	0.48	-0.22	-0.07	0.17	-0.10
2	7	2	-1.03	-0.17	0.10	1.03	0.82	0.00
3	8	6	0.07	0.39	-0.40	-0.07	-0.03	0.01
4	2	8	-1.04	0.75	0.00	1.04	-0.39	0.39
5	1	4	-0.07	-0.01	0.06	0.07	0.01	0.00
6	4	3	-0.07	-0.05	0.01	0.07	0.05	0.15
7	1	5	0.07	0.62	-0.06	-0.07	-0.62	0.18
8	6	3	0.07	-0.12	0.04	-0.07	0.12	-0.15
9	7	9	1.11	0.00	0.00	-1.11	0.00	0.00
10	9	8	1.11	0.00	0.00	-1.11	0.00	0.00
11	4	9	0.00	1.57	0.00	0.00	-1.57	0.00
12	9	2	0.00	1.57	0.00	0.00	-1.57	0.00
13	10	5	0.00	0.00	0.00	0.00	0.14	0.04
14	6	11	0.00	0.14	-0.04	0.00	0.00	0.00

(element end forces in global coordinate system x-y)

1.6.4. Vertical nodal displacements (in mm)

node	Gk	Qk1	Qk2	Qk3	Qk4	Qk5	Qkf	Qki
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	-0.05	-0.12	-0.08	-0.11	0.00	0.01	0.04	-0.05
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	-0.01	-0.02	-0.01	-0.02	0.00	0.00	0.00	-0.01
6	-0.01	0.00	-0.01	0.01	0.00	0.00	-0.01	0.00
7	-2.03	-4.15	-1.63	-4.59	-2.16	2.90	-1.08	-1.97
8	0.95	1.83	0.62	2.12	1.16	-1.56	0.75	0.90
9	-0.03	-0.09	-0.05	-0.08	0.00	0.00	0.03	-0.03
10	0.60	1.04	0.39	1.16	0.87	-1.17	0.53	0.50
11	-0.75	-1.04	-0.40	-1.16	-0.84	1.13	-0.89	-0.50

1.6.5. Support reactions (kN)

node	react.	Gk	Qk1	Qk2	Qk3	Qk4	Qk5	Qkf	Qki
1	Fx	0.00	0.00	0.00	0.00	-1.12	1.51	0.00	0.00
1	Fy	2.30	1.98	0.95	2.02	0.18	-0.23	3.58	0.61
3	Fx	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	Fy	1.32	0.13	0.58	-0.39	0.02	-0.03	2.41	0.17
4	Fx	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	Fy	3.93	4.46	2.74	3.96	0.05	-0.06	4.08	1.52

1.7. Support reactions for load combinations (kN)

Loading [kN/m]	action	γg	γq	ψo
(Gk) Dead Gk1 = 0.314, Gk2 = 0.180, Gkf=0.300	Permanent	1.35	0.00	1.00
(Qk1) Snow QksL= 0.768, QksR= 0.546	Short-term	0.00	1.50	0.60
(Qk2) Snow QksL= 0.384, QksR= 0.546	Short-term	0.00	1.50	0.60
(Qk3) Snow QksL= 0.768, QksR= 0.273	Short-term	0.00	1.50	0.60
(Qk4) Wind QkwL= 0.123, QkwR=-0.133	Short-term	0.00	1.50	0.50
(Qk5) Wind QkwL=-0.162, QkwR= 0.182	Short-term	0.00	1.50	0.50
(Qkf) Live Qkf = 1.200	Medium-term	0.00	1.50	0.70
(Qki) Imposed (H) Qi = 0.240	Short-term	0.00	1.50	0.00

1.7.1. Reactions at node : 1 (kN)

L.C.	Load combination	duration class	kmod	Fx	Fy	Fx/Kmod	Fy/Kmod
1	γg.G	Permanent	0.60	0.000	3.101	0.000	5.168
2	γg.G+γq.Q1	Short-term	0.90	0.000	6.075	0.000	6.750
3	γg.G+γq.Q2	Short-term	0.90	0.000	4.525	0.000	5.028
4	γg.G+γq.Q3	Short-term	0.90	0.000	6.137	0.000	6.819
5	γg.G+γq.Q4	Short-term	0.90	-1.677	3.373	-1.863	3.748
6	γg.G+γq.Q5	Short-term	0.90	2.262	2.750	2.514	3.056
7	γg.G+γq.Qf	Medium-term	0.80	0.000	8.473	0.000	10.592
8	γg.G+γq.Qi	Short-term	0.90	0.000	4.014	0.000	4.460
9	γg.G+γq.Q1+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-0.839	9.972	-0.932	11.080
10	γg.G+γq.Q1+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	1.131	9.661	1.257	10.734
11	γg.G+γq.Q2+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-0.839	8.422	-0.932	9.358
12	γg.G+γq.Q2+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	1.131	8.111	1.257	9.012
13	γg.G+γq.Q3+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-0.839	10.034	-0.932	11.149
14	γg.G+γq.Q3+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	1.131	9.723	1.257	10.803
15	γg.G+γq.Q4+γq.ψo.Q1+γq.ψo.Qf	Short-term	0.90	-1.677	8.918	-1.863	9.909
16	γg.G+γq.Q4+γq.ψo.Q2+γq.ψo.Qf	Short-term	0.90	-1.677	7.989	-1.863	8.876
17	γg.G+γq.Q4+γq.ψo.Q3+γq.ψo.Qf	Short-term	0.90	-1.677	8.956	-1.863	9.951
18	γg.G+γq.Q5+γq.ψo.Q1+γq.ψo.Qf	Short-term	0.90	2.262	8.296	2.514	9.218
19	γg.G+γq.Q5+γq.ψo.Q2+γq.ψo.Qf	Short-term	0.90	2.262	7.366	2.514	8.185
20	γg.G+γq.Q5+γq.ψo.Q3+γq.ψo.Qf	Short-term	0.90	2.262	8.333	2.514	9.259
21	γg.G+γq.Qf+γq.ψo.Q1+γq.ψo.Q4	Short-term	0.90	-0.839	10.394	-0.932	11.549
22	γg.G+γq.Qf+γq.ψo.Q1+γq.ψo.Q5	Short-term	0.90	1.131	10.083	1.257	11.203
23	γg.G+γq.Qf+γq.ψo.Q2+γq.ψo.Q4	Short-term	0.90	-0.839	9.464	-0.932	10.516
24	γg.G+γq.Qf+γq.ψo.Q2+γq.ψo.Q5	Short-term	0.90	1.131	9.153	1.257	10.170
25	γg.G+γq.Qf+γq.ψo.Q3+γq.ψo.Q4	Short-term	0.90	-0.839	10.432	-0.932	11.591
26	γg.G+γq.Qf+γq.ψo.Q3+γq.ψo.Q5	Short-term	0.90	1.131	10.120	1.257	11.245
27	γg.G+γq.Qi+γq.ψo.Q1+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-0.839	9.696	-0.932	10.773
28	γg.G+γq.Qi+γq.ψo.Q1+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	1.131	9.385	1.257	10.427
29	γg.G+γq.Qi+γq.ψo.Q2+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-0.839	8.766	-0.932	9.740
30	γg.G+γq.Qi+γq.ψo.Q2+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	1.131	8.455	1.257	9.394
31	γg.G+γq.Qi+γq.ψo.Q3+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-0.839	9.733	-0.932	10.815
32	γg.G+γq.Qi+γq.ψo.Q3+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	1.131	9.422	1.257	10.469
	Maximum values			2.262	10.432	2.514	11.591
33	γg.G+γq.Q4=0.9G+1.5Q4, (EQU)	Short-term	0.90	-1.677	2.339	-1.863	2.599
34	γg.G+γq.Q5=0.9G+1.5Q5, (EQU)	Short-term	0.90	2.262	1.717	2.514	1.908

1.7.2. Reactions at node : 4 (kN)

L.C.	Load combination	duration class	kmod	Fx	Fy	Fx/Kmod	Fy/Kmod
1	γg.G	Permanent	0.60	0.000	5.301	0.000	8.834
2	γg.G+γq.Q1	Short-term	0.90	0.000	11.996	0.000	13.329
3	γg.G+γq.Q2	Short-term	0.90	0.000	9.410	0.000	10.456
4	γg.G+γq.Q3	Short-term	0.90	0.000	11.234	0.000	12.482
5	γg.G+γq.Q4	Short-term	0.90	0.000	5.380	0.000	5.977
6	γg.G+γq.Q5	Short-term	0.90	0.000	5.216	0.000	5.796
7	γg.G+γq.Qf	Medium-term	0.80	0.000	11.426	0.000	14.282
8	γg.G+γq.Qi	Short-term	0.90	0.000	7.586	0.000	8.429
9	γg.G+γq.Q1+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	0.000	16.323	0.000	18.137
10	γg.G+γq.Q1+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	0.000	16.241	0.000	18.046
11	γg.G+γq.Q2+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	0.000	13.738	0.000	15.264
12	γg.G+γq.Q2+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	0.000	13.656	0.000	15.173
13	γg.G+γq.Q3+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	0.000	15.561	0.000	17.290
14	γg.G+γq.Q3+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	0.000	15.479	0.000	17.199
15	γg.G+γq.Q4+γq.ψo.Q1+γq.ψo.Qf	Short-term	0.90	0.000	13.684	0.000	15.205
16	γg.G+γq.Q4+γq.ψo.Q2+γq.ψo.Qf	Short-term	0.90	0.000	12.133	0.000	13.481
17	γg.G+γq.Q4+γq.ψo.Q3+γq.ψo.Qf	Short-term	0.90	0.000	13.227	0.000	14.697
18	γg.G+γq.Q5+γq.ψo.Q1+γq.ψo.Qf	Short-term	0.90	0.000	13.521	0.000	15.024
19	γg.G+γq.Q5+γq.ψo.Q2+γq.ψo.Qf	Short-term	0.90	0.000	11.970	0.000	13.300
20	γg.G+γq.Q5+γq.ψo.Q3+γq.ψo.Qf	Short-term	0.90	0.000	13.064	0.000	14.515
21	γg.G+γq.Qf+γq.ψo.Q1+γq.ψo.Q4	Short-term	0.90	0.000	15.482	0.000	17.203
22	γg.G+γq.Qf+γq.ψo.Q1+γq.ψo.Q5	Short-term	0.90	0.000	15.401	0.000	17.112
23	γg.G+γq.Qf+γq.ψo.Q2+γq.ψo.Q4	Short-term	0.90	0.000	13.931	0.000	15.479
24	γg.G+γq.Qf+γq.ψo.Q2+γq.ψo.Q5	Short-term	0.90	0.000	13.850	0.000	15.388
25	γg.G+γq.Qf+γq.ψo.Q3+γq.ψo.Q4	Short-term	0.90	0.000	15.025	0.000	16.695
26	γg.G+γq.Qf+γq.ψo.Q3+γq.ψo.Q5	Short-term	0.90	0.000	14.943	0.000	16.604
27	γg.G+γq.Qi+γq.ψo.Q1+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	0.000	15.930	0.000	17.700
28	γg.G+γq.Qi+γq.ψo.Q1+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	0.000	15.849	0.000	17.610
29	γg.G+γq.Qi+γq.ψo.Q2+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	0.000	14.379	0.000	15.977
30	γg.G+γq.Qi+γq.ψo.Q2+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	0.000	14.298	0.000	15.886
31	γg.G+γq.Qi+γq.ψo.Q3+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	0.000	15.473	0.000	17.192
32	γg.G+γq.Qi+γq.ψo.Q3+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	0.000	15.391	0.000	17.102
	Maximum values			0.000	16.323	0.000	18.137
33	γg.G+γq.Q4=0.9G+1.5Q4, (EQU)	Short-term	0.90	0.000	3.613	0.000	4.014
34	γg.G+γq.Q5=0.9G+1.5Q5, (EQU)	Short-term	0.90	0.000	3.450	0.000	3.833

1.7.3. Reactions at node : 3 (kN)

L.C.	Load combination	duration class	kmod	Fx	Fy	Fx/Kmod	Fy/Kmod
1	γg.G	Permanent	0.60	0.000	1.784	0.000	2.974
2	γg.G+γq.Q1	Short-term	0.90	0.000	1.976	0.000	2.196
3	γg.G+γq.Q2	Short-term	0.90	0.000	2.655	0.000	2.950
4	γg.G+γq.Q3	Short-term	0.90	0.000	1.201	0.000	1.334
5	γg.G+γq.Q4	Short-term	0.90	0.000	1.820	0.000	2.022
6	γg.G+γq.Q5	Short-term	0.90	0.000	1.746	0.000	1.940
7	γg.G+γq.Qf	Medium-term	0.80	0.000	5.405	0.000	6.756
8	γg.G+γq.Qi	Short-term	0.90	0.000	2.041	0.000	2.268
9	γg.G+γq.Q1+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	0.000	4.529	0.000	5.032
10	γg.G+γq.Q1+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	0.000	4.491	0.000	4.990
11	γg.G+γq.Q2+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	0.000	5.208	0.000	5.787
12	γg.G+γq.Q2+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	0.000	5.171	0.000	5.745
13	γg.G+γq.Q3+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	0.000	3.753	0.000	4.170
14	γg.G+γq.Q3+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	0.000	3.716	0.000	4.129
15	γg.G+γq.Q4+γq.ψo.Q1+γq.ψo.Qf	Short-term	0.90	0.000	4.470	0.000	4.967
16	γg.G+γq.Q4+γq.ψo.Q2+γq.ψo.Qf	Short-term	0.90	0.000	4.878	0.000	5.420
17	γg.G+γq.Q4+γq.ψo.Q3+γq.ψo.Qf	Short-term	0.90	0.000	4.005	0.000	4.450
18	γg.G+γq.Q5+γq.ψo.Q1+γq.ψo.Qf	Short-term	0.90	0.000	4.395	0.000	4.884
19	γg.G+γq.Q5+γq.ψo.Q2+γq.ψo.Qf	Short-term	0.90	0.000	4.803	0.000	5.337
20	γg.G+γq.Q5+γq.ψo.Q3+γq.ψo.Qf	Short-term	0.90	0.000	3.930	0.000	4.367
21	γg.G+γq.Qf+γq.ψo.Q1+γq.ψo.Q4	Short-term	0.90	0.000	5.538	0.000	6.154
22	γg.G+γq.Qf+γq.ψo.Q1+γq.ψo.Q5	Short-term	0.90	0.000	5.501	0.000	6.112
23	γg.G+γq.Qf+γq.ψo.Q2+γq.ψo.Q4	Short-term	0.90	0.000	5.946	0.000	6.607
24	γg.G+γq.Qf+γq.ψo.Q2+γq.ψo.Q5	Short-term	0.90	0.000	5.909	0.000	6.565
25	γg.G+γq.Qf+γq.ψo.Q3+γq.ψo.Q4	Short-term	0.90	0.000	5.073	0.000	5.637
26	γg.G+γq.Qf+γq.ψo.Q3+γq.ψo.Q5	Short-term	0.90	0.000	5.036	0.000	5.595
27	γg.G+γq.Qi+γq.ψo.Q1+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	0.000	4.709	0.000	5.232
28	γg.G+γq.Qi+γq.ψo.Q1+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	0.000	4.671	0.000	5.190
29	γg.G+γq.Qi+γq.ψo.Q2+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	0.000	5.116	0.000	5.685
30	γg.G+γq.Qi+γq.ψo.Q2+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	0.000	5.079	0.000	5.643
31	γg.G+γq.Qi+γq.ψo.Q3+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	0.000	4.243	0.000	4.715
32	γg.G+γq.Qi+γq.ψo.Q3+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	0.000	4.206	0.000	4.673
	Maximum values			0.000	5.405	0.000	6.756
33	γg.G+γq.Q4=0.9G+1.5Q4, (EQU)	Short-term	0.90	0.000	1.225	0.000	1.362
34	γg.G+γq.Q5=0.9G+1.5Q5, (EQU)	Short-term	0.90	0.000	1.151	0.000	1.279

1.8. Serviceability limit state

1.8.1. Serviceability limit state (EC5 EN1995-1-1:2009, §2.2.3, §7)

Control of deflection at node 7 (EC5 §7.2)

Loading [kN/m]	u[mm]	action	ψ0	ψ1	ψ2	Kdef
(Gk) Dead Gk1 = 0.314, Gk2 = 0.180, Gkf=0.300	-2.032	Permanent	1.00	1.00	1.00	0.60
(Qk1) Snow QksL= 0.768, QksR= 0.546	-4.146	Short-term	0.60	0.20	0.00	0.60
(Qk2) Snow QksL= 0.384, QksR= 0.546	-1.626	Short-term	0.60	0.20	0.00	0.60
(Qk3) Snow QksL= 0.768, QksR= 0.273	-4.594	Short-term	0.60	0.20	0.00	0.60
(Qk4) Wind QkwL= 0.123, QkwR=-0.133	-2.163	Short-term	0.50	0.20	0.00	0.60
(Qk5) Wind QkwL=-0.162, QkwR= 0.182	2.901	Short-term	0.50	0.20	0.00	0.60
(Qkf) Live Qkf = 1.200	-1.085	Medium-term	0.70	0.50	0.30	0.60

Load combination	w.inst	w.fin [mm]
1 Gk	2.032	3.252
2 Gk + Qk1	6.178	7.398
3 Gk + Qk2	3.658	4.877
4 Gk + Qk3	6.626	7.845
5 Gk + Qk4	4.195	5.415
6 Gk + Qk5	2.032	3.252
7 Gk + Qkf	3.117	4.531
8 Gk + Qk1 + ψo.Qk4 + ψo.Qkf	8.019	9.434
9 Gk + Qk1 + ψo.Qk5 + ψo.Qkf	6.938	8.352
10 Gk + Qk2 + ψo.Qk4 + ψo.Qkf	5.499	6.913
11 Gk + Qk2 + ψo.Qk5 + ψo.Qkf	4.417	5.832
12 Gk + Qk3 + ψo.Qk4 + ψo.Qkf	8.467	9.881
13 Gk + Qk3 + ψo.Qk5 + ψo.Qkf	7.385	8.800
14 Gk + Qk4 + ψo.Qk1 + ψo.Qkf	7.442	8.857
15 Gk + Qk4 + ψo.Qk2 + ψo.Qkf	5.930	7.345
16 Gk + Qk4 + ψo.Qk3 + ψo.Qkf	7.711	9.125
17 Gk + Qk5 + ψo.Qk1 + ψo.Qkf	5.279	6.694
18 Gk + Qk5 + ψo.Qk2 + ψo.Qkf	3.767	5.181
19 Gk + Qk5 + ψo.Qk3 + ψo.Qkf	5.548	6.962
20 Gk + Qkf + ψo.Qk1 + ψo.Qk4	6.686	8.101
21 Gk + Qkf + ψo.Qk1 + ψo.Qk5	5.605	7.019
22 Gk + Qkf + ψo.Qk2 + ψo.Qk4	5.174	6.588
23 Gk + Qkf + ψo.Qk2 + ψo.Qk5	4.092	5.507
24 Gk + Qkf + ψo.Qk3 + ψo.Qk4	6.955	8.369
25 Gk + Qkf + ψo.Qk3 + ψo.Qk5	5.873	7.288

w.fin,g=w.inst,g(1+kdef), w.fin,q=w.inst,q(1+ψ2·kdef)(EC5 §2.2.3, Eq.2.3, Eq.2.4)

Maximum deflection values at node 7

w.inst = 8.467 mm, w.fin = 9.881 mm

Check according to EC5 EN1995-1-1:2009 §7.2, Tab.7.2

Final deflections at node 7

w.inst = 8.467 mm < L/300=8400/300= 28.000 mm
w.net,fin = 9.881 mm < L/250=8400/250= 33.600 mm
w.fin = 9.881 mm < L/150=8400/150= 56.000 mm
The check is satisfied

1.8.2. Serviceability limit state (EC5 EN1995-1-1:2009, §2.2.3, §7)
Control of deflection at node 10 (EC5 §7.2)

Loading [kN/m]	u[mm]	action	ψ0	ψ1	ψ2	Kdef
(Gk) Dead Gk1 = 0.314, Gk2 = 0.180, Gkf=0.300	0.603	Permanent	1.00	1.00	1.00	0.60
(Qk1) Snow QksL= 0.768, QksR= 0.546	1.035	Short-term	0.60	0.20	0.00	0.60
(Qk2) Snow QksL= 0.384, QksR= 0.546	0.395	Short-term	0.60	0.20	0.00	0.60
(Qk3) Snow QksL= 0.768, QksR= 0.273	1.158	Short-term	0.60	0.20	0.00	0.60
(Qk4) Wind QkwL= 0.123, QkwR=-0.133	0.868	Short-term	0.50	0.20	0.00	0.60
(Qk5) Wind QkwL=-0.162, QkwR= 0.182	-1.167	Short-term	0.50	0.20	0.00	0.60
(Qkf) Live Qkf = 1.200	0.527	Medium-term	0.70	0.50	0.30	0.60

Load combination	w.inst	w.fin [mm]
1 Gk	0.603	0.965
2 Gk + Qk1	1.639	2.001
3 Gk + Qk2	0.998	1.360
4 Gk + Qk3	1.762	2.124
5 Gk + Qk4	1.472	1.834
6 Gk + Qk5	0.603	0.965
7 Gk + Qkf	1.130	1.587
8 Gk + Qk1 + ψo.Qk4 + ψo.Qkf	2.442	2.899
9 Gk + Qk1 + ψo.Qk5 + ψo.Qkf	2.008	2.464
10 Gk + Qk2 + ψo.Qk4 + ψo.Qkf	1.801	2.258
11 Gk + Qk2 + ψo.Qk5 + ψo.Qkf	1.367	1.824
12 Gk + Qk3 + ψo.Qk4 + ψo.Qkf	2.565	3.022
13 Gk + Qk3 + ψo.Qk5 + ψo.Qkf	2.131	2.587
14 Gk + Qk4 + ψo.Qk1 + ψo.Qkf	2.462	2.919
15 Gk + Qk4 + ψo.Qk2 + ψo.Qkf	2.077	2.534
16 Gk + Qk4 + ψo.Qk3 + ψo.Qkf	2.536	2.992
17 Gk + Qk5 + ψo.Qk1 + ψo.Qkf	1.593	2.050
18 Gk + Qk5 + ψo.Qk2 + ψo.Qkf	1.209	1.666
19 Gk + Qk5 + ψo.Qk3 + ψo.Qkf	1.667	2.124
20 Gk + Qkf + ψo.Qk1 + ψo.Qk4	2.186	2.642
21 Gk + Qkf + ψo.Qk1 + ψo.Qk5	1.751	2.208
22 Gk + Qkf + ψo.Qk2 + ψo.Qk4	1.801	2.258
23 Gk + Qkf + ψo.Qk2 + ψo.Qk5	1.367	1.824
24 Gk + Qkf + ψo.Qk3 + ψo.Qk4	2.259	2.716
25 Gk + Qkf + ψo.Qk3 + ψo.Qk5	1.825	2.282

w.fin,g=w.inst,g(1+kdef), w.fin,q=w.inst,q(1+ψ2·kdef)(EC5 §2.2.3, Eq.2.3, Eq.2.4)

Maximum deflection values at node 10
w.inst = 2.565 mm, w.fin = 3.022 mm

Check according to EC5 EN1995-1-1:2009 §7.2, Tab.7.2
Final deflections at node 10
w.inst = 2.565 mm < L/150=600/150= 4.000 mm
w.net,fin = 3.022 mm < L/125=600/125= 4.800 mm
w.fin = 3.022 mm < L/75=600/75= 8.000 mm
The check is satisfied

1.8.3. Serviceability limit state (EC5 EN1995-1-1:2009, §2.2.3, §7)
Control of deflection in middle of element 2 (EC5 §7.2)

Loading [kN/m]	u[mm]	action	ψ0	ψ1	ψ2	Kdef
(Gk) Dead Gk1 = 0.314, Gk2 = 0.180, Gkf=0.300	0.194	Permanent	1.00	1.00	1.00	0.60
(Qk1) Snow QksL= 0.768, QksR= 0.546	0.473	Short-term	0.60	0.20	0.00	0.60
(Qk2) Snow QksL= 0.384, QksR= 0.546	0.237	Short-term	0.60	0.20	0.00	0.60
(Qk3) Snow QksL= 0.768, QksR= 0.273	0.473	Short-term	0.60	0.20	0.00	0.60
(Qk4) Wind QkwL= 0.123, QkwR=-0.133	0.083	Short-term	0.50	0.20	0.00	0.60
(Qk5) Wind QkwL=-0.162, QkwR= 0.182	-0.109	Short-term	0.50	0.20	0.00	0.60
(Qkf) Live Qkf = 1.200	0.000	Medium-term	0.70	0.50	0.30	0.60

Load combination	w.inst	w.fin [mm]
1 Gk	0.194	0.310
2 Gk + Qk1	0.667	0.783
3 Gk + Qk2	0.430	0.547
4 Gk + Qk3	0.667	0.783
5 Gk + Qk4	0.276	0.393
6 Gk + Qk5	0.194	0.310
7 Gk + Qkf	0.194	0.310
8 Gk + Qk1 + ψo.Qk4 + ψo.Qkf	0.708	0.825
9 Gk + Qk1 + ψo.Qk5 + ψo.Qkf	0.667	0.783
10 Gk + Qk2 + ψo.Qk4 + ψo.Qkf	0.472	0.588
11 Gk + Qk2 + ψo.Qk5 + ψo.Qkf	0.430	0.547
12 Gk + Qk3 + ψo.Qk4 + ψo.Qkf	0.708	0.825
13 Gk + Qk3 + ψo.Qk5 + ψo.Qkf	0.667	0.783
14 Gk + Qk4 + ψo.Qk1 + ψo.Qkf	0.560	0.677
15 Gk + Qk4 + ψo.Qk2 + ψo.Qkf	0.418	0.535
16 Gk + Qk4 + ψo.Qk3 + ψo.Qkf	0.560	0.677
17 Gk + Qk5 + ψo.Qk1 + ψo.Qkf	0.478	0.594
18 Gk + Qk5 + ψo.Qk2 + ψo.Qkf	0.336	0.452
19 Gk + Qk5 + ψo.Qk3 + ψo.Qkf	0.478	0.594
20 Gk + Qkf + ψo.Qk1 + ψo.Qk4	0.519	0.635
21 Gk + Qkf + ψo.Qk1 + ψo.Qk5	0.478	0.594
22 Gk + Qkf + ψo.Qk2 + ψo.Qk4	0.377	0.493
23 Gk + Qkf + ψo.Qk2 + ψo.Qk5	0.336	0.452
24 Gk + Qkf + ψo.Qk3 + ψo.Qk4	0.519	0.635
25 Gk + Qkf + ψo.Qk3 + ψo.Qk5	0.478	0.594

w.fin,g=w.inst,g(1+kdef), w.fin,q=w.inst,q(1+ψ2·kdef)(EC5 §2.2.3, Eq.2.3, Eq.2.4)

Maximum deflection values in middle of element 2
w.inst = 0.708 mm, w.fin = 0.825 mm

Check according to EC5 EN1995-1-1:2009 §7.2, Tab.7.2
Final deflections in middle of element 2
w.inst = 0.708 mm < L/300=2955/300= 9.849 mm
w.net,fin = 0.825 mm < L/250=2955/250= 11.819 mm
w.fin = 0.825 mm < L/150=2955/150= 19.698 mm
The check is satisfied

1.9. Characteristic structural natural frequencies (self weight + permanent loads)

After a dynamic analysis the basic natural frequencies of the structure are computed. For the computation of natural frequencies, we consider mass corresponding to the self weight and the permanent loads.

No.	Frequency[Hz]	Period[sec]
1	6.52223	0.15332
2	13.27990	0.07530
3	18.55571	0.05389
4	34.48668	0.02900
5	41.35096	0.02418
6	44.93245	0.02226
7	50.49334	0.01980
8	69.15631	0.01446
9	75.40775	0.01326

1.10. Ultimate limit state

1.10.1. Ultimate limit state (EC5 EN1995-1-1:2009, §6)

Rafter, elements: 1

Loading [kN/m]	action	γg	γq	ψo
(Gk) Dead Gk1 = 0.314, Gk2 = 0.180, Gkf=0.300	Permanent	1.35	0.00	1.00
(Qk1) Snow QksL= 0.768, QksR= 0.546	Short-term	0.00	1.50	0.60
(Qk2) Snow QksL= 0.384, QksR= 0.546	Short-term	0.00	1.50	0.60
(Qk3) Snow QksL= 0.768, QksR= 0.273	Short-term	0.00	1.50	0.60
(Qk4) Wind QkwL= 0.123, QkwR=-0.133	Short-term	0.00	1.50	0.50
(Qk5) Wind QkwL=-0.162, QkwR= 0.182	Short-term	0.00	1.50	0.50
(Qkf) Live Qkf = 1.200	Medium-term	0.00	1.50	0.70
(Qki) Imposed (H) Qi = 0.240	Short-term	0.00	1.50	0.00

L.C.	Load combination	duration class	kmod	-N/Kmod	+N/Kmod	V/Kmod	M/Kmod
1	γg.G	Permanent	0.60	-1.860	0.000	1.284	0.755
2	γg.G+γq.Q1	Short-term	0.90	-2.644	0.000	3.083	1.591
3	γg.G+γq.Q2	Short-term	0.90	-1.918	0.000	1.889	0.939
4	γg.G+γq.Q3	Short-term	0.90	-2.669	0.000	3.164	1.700
5	γg.G+γq.Q4	Short-term	0.90	-1.048	0.000	1.285	1.133
6	γg.G+γq.Q5	Short-term	0.90	-1.240	0.000	0.856	0.504
7	γg.G+γq.Qf	Medium-term	0.80	-3.542	0.000	0.963	0.947
8	γg.G+γq.Qi	Short-term	0.90	-1.673	0.000	1.532	0.816
9	γg.G+γq.Q1+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-3.884	0.000	3.297	2.142
10	γg.G+γq.Q1+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-3.980	0.000	3.083	1.828
11	γg.G+γq.Q2+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-3.158	0.000	2.103	1.490
12	γg.G+γq.Q2+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-3.254	0.000	1.889	1.175
13	γg.G+γq.Q3+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-3.909	0.000	3.378	2.251
14	γg.G+γq.Q3+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-4.005	0.000	3.164	1.936
15	γg.G+γq.Q4+γq.ψo.Q1+γq.ψo.Qf	Short-term	0.90	-3.226	0.000	2.621	2.022
16	γg.G+γq.Q4+γq.ψo.Q2+γq.ψo.Qf	Short-term	0.90	-2.791	0.000	1.904	1.631
17	γg.G+γq.Q4+γq.ψo.Q3+γq.ψo.Qf	Short-term	0.90	-3.241	0.000	2.669	2.087
18	γg.G+γq.Q5+γq.ψo.Q1+γq.ψo.Qf	Short-term	0.90	-3.419	0.000	2.192	1.393
19	γg.G+γq.Q5+γq.ψo.Q2+γq.ψo.Qf	Short-term	0.90	-2.983	0.000	1.476	1.001
20	γg.G+γq.Q5+γq.ψo.Q3+γq.ψo.Qf	Short-term	0.90	-3.433	0.000	2.240	1.458
21	γg.G+γq.Qf+γq.ψo.Q1+γq.ψo.Q4	Short-term	0.90	-3.895	0.000	2.406	1.809
22	γg.G+γq.Qf+γq.ψo.Q1+γq.ψo.Q5	Short-term	0.90	-3.991	0.000	2.192	1.494
23	γg.G+γq.Qf+γq.ψo.Q2+γq.ψo.Q4	Short-term	0.90	-3.459	0.000	1.690	1.417
24	γg.G+γq.Qf+γq.ψo.Q2+γq.ψo.Q5	Short-term	0.90	-3.555	0.000	1.476	1.103
25	γg.G+γq.Qf+γq.ψo.Q3+γq.ψo.Q4	Short-term	0.90	-3.910	0.000	2.455	1.874
26	γg.G+γq.Qf+γq.ψo.Q3+γq.ψo.Q5	Short-term	0.90	-4.006	0.000	2.240	1.559
27	γg.G+γq.Qi+γq.ψo.Q1+γq.ψo.Q4+γq.ψo.Q	Short-term	0.90	-3.755	0.000	3.082	2.020
28	γg.G+γq.Qi+γq.ψo.Q1+γq.ψo.Q5+γq.ψo.Q	Short-term	0.90	-3.851	0.000	2.868	1.705
29	γg.G+γq.Qi+γq.ψo.Q2+γq.ψo.Q4+γq.ψo.Q	Short-term	0.90	-3.319	0.000	2.366	1.628
30	γg.G+γq.Qi+γq.ψo.Q2+γq.ψo.Q5+γq.ψo.Q	Short-term	0.90	-3.415	0.000	2.151	1.314
31	γg.G+γq.Qi+γq.ψo.Q3+γq.ψo.Q4+γq.ψo.Q	Short-term	0.90	-3.770	0.000	3.130	2.085
32	γg.G+γq.Qi+γq.ψo.Q3+γq.ψo.Q5+γq.ψo.Q	Short-term	0.90	-3.866	0.000	2.916	1.770
	Maximum values			-4.006	0.000	3.378	2.251

1.10.2. Check of cross section Rafter, elements: 1

Rafter, elements: 1 , load combination No 26

Compression parallel to the grain, Fc0d=-3.605 kN (EC5 §6.1.4)

Rectangular cross section, b=60 mm, h=220 mm, A= 13 200 mm²

Modification factor Kmod=0.90 (Table 3.1), material factor γM=1.30 (Table 2.3)

fc0k=22.00 N/mm², fc0d=Kmod·fc0k/γM=0.90x22.00/1.30=15.23N/mm² (EC5 Eq.2.14)

Fc0d=-3.605 kN, σc0d=Fc0d/Anetto=1000x3.605/13200=0.27N/mm² < 15.23N/mm²=fc0d (Eq.6.2)

The check is satisfied

Rafter, elements: 1 , load combination No 13
Shear, Fv=3.040 kN (EC5 §6.1.7)
Rectangular cross section, bef=0.67x60=40 mm, h=220 mm, A= 8 800 mm²
Modification factor Kmod=0.90 (Table 3.1), material factor γM=1.30 (Table 2.3)
fvk=4.00 N/mm², fvd=Kmod·fvk/γM=0.90x4.00/1.30=2.77N/mm² (EC5 Eq.2.14)
Fv=3.040 kN, τv0d=1.50Fv0d/Anetto=1000x1.50x3.040/8800=0.52N/mm² < 2.77N/mm²=fv0d (Eq.6.13)
The check is satisfied

Rafter, elements: 1 , load combination No 13
Bending, Myd=2.026 kNm, Mzd=0.000 kNm (EC5 §6.1.6)
Rectangular cross section, b=60mm, h=220mm, A=1.320E+004mm², Wy=4.840E+005mm³, Wz=1.320E+005mm³
Modification factor Kmod=0.90 (Table 3.1), material factor γM=1.30 (Table 2.3)
fmyk=27.00 N/mm², fmyd=Kmod·fmyk/γM=0.90x27.00/1.30=18.69N/mm²
fmzk=27.00 N/mm², fmzd=Kmod·fmzk/γM=0.90x27.00/1.30=18.69N/mm²

Rectangular cross section Km=0.70 (EC5 §6.1.6.(2))
σmyd=Myd/Wmy,netto=1E+06x2.026/4.840E+005= 4.19 N/mm²
σmzd=Mzd/Wmz,netto=1E+06x0.000/1.320E+005= 0.00 N/mm²

σmyd/fmyd+Km.σmzd/fmzd=0.224+0.000= 0.22 < 1 (EC5 Eq.6.11)
Km.σmyd/fmyd+σmzd/fmzd=0.157+0.000= 0.16 < 1 (EC5 Eq.6.12)
The check is satisfied

Rafter, elements: 1 , load combination No 26
Combined bending and axial compression, Fc0d=-3.605kN, Myd=1.403kNm, Mzd=0.000kNm (EC5 §6.2.4)
Rectangular cross section, b=60mm, h=220mm, A=1.320E+004mm², Wy=4.840E+005mm³, Wz=1.320E+005mm³
Modification factor Kmod=0.90 (Table 3.1), material factor γM=1.30 (Table 2.3)
fc0k=22.00 N/mm², fc0d=Kmod·fc0k/γM=0.90x22.00/1.30=15.23N/mm²
fmyk=27.00 N/mm², fmyd=Kmod·fmyk/γM=0.90x27.00/1.30=18.69N/mm²
fmzk=27.00 N/mm², fmzd=Kmod·fmzk/γM=0.90x27.00/1.30=18.69N/mm²

Rectangular cross section Km=0.70 (EC5 §6.1.6.(2))
σc0d=Fc0d/Anetto=1000x3.605/13200= 0.27 N/mm²
σmyd=Myd/Wmy,netto=1E+06x1.403/4.840E+005= 2.90 N/mm²
σmzd=Mzd/Wmz,netto=1E+06x0.000/1.320E+005= 0.00 N/mm²

(σc0d/fc0d)²+σmyd/fmyd+Km.σmzd/fmzd=0.000+0.155+0.000= 0.16 < 1 (EC5 Eq.6.19)
(σc0d/fc0d)²+Km.σmyd/fmyd+σmzd/fmzd=0.000+0.109+0.000= 0.11 < 1 (EC5 Eq.6.20)
The check is satisfied

Rafter, elements: 1 , load combination No 13
Combined bending and axial compression, Fc0d=-3.518kN, Myd=2.026kNm, Mzd=0.000kNm (EC5 §6.2.4)
Rectangular cross section, b=60mm, h=220mm, A=1.320E+004mm², Wy=4.840E+005mm³, Wz=1.320E+005mm³
Modification factor Kmod=0.90 (Table 3.1), material factor γM=1.30 (Table 2.3)
fc0k=22.00 N/mm², fc0d=Kmod·fc0k/γM=0.90x22.00/1.30=15.23N/mm²
fmyk=27.00 N/mm², fmyd=Kmod·fmyk/γM=0.90x27.00/1.30=18.69N/mm²
fmzk=27.00 N/mm², fmzd=Kmod·fmzk/γM=0.90x27.00/1.30=18.69N/mm²

Rectangular cross section Km=0.70 (EC5 §6.1.6.(2))
σc0d=Fc0d/Anetto=1000x3.518/13200= 0.27 N/mm²
σmyd=Myd/Wmy,netto=1E+06x2.026/4.840E+005= 4.19 N/mm²
σmzd=Mzd/Wmz,netto=1E+06x0.000/1.320E+005= 0.00 N/mm²

(σc0d/fc0d)²+σmyd/fmyd+Km.σmzd/fmzd=0.000+0.224+0.000= 0.22 < 1 (EC5 Eq.6.19)
(σc0d/fc0d)²+Km.σmyd/fmyd+σmzd/fmzd=0.000+0.157+0.000= 0.16 < 1 (EC5 Eq.6.20)
The check is satisfied

Rafter, elements: 1 , load combination No 26
Column stability with bending, Fc0d=-3.605kN, Myd=1.403kNm, Mzd=0.000kNm (EC5 §6.3.2)
Rectangular cross section, b=60mm, h=220mm, A=1.320E+004mm^2, Wy=4.840E+005mm^3, Wz=1.320E+005mm^3
Modification factor Kmod=0.90 (Table 3.1), material factor γM=1.30 (Table 2.3, E005=7700N/mm^2
fc0k=22.00 N/mm^2, fc0d=Kmod·fc0k/γM=0.90x22.00/1.30=15.23N/mm^2
fmyk=27.00 N/mm^2, fmyd=Kmod·fmyk/γM=0.90x27.00/1.30=18.69N/mm^2
fmzk=27.00 N/mm^2, fmzd=Kmod·fmzk/γM=0.90x27.00/1.30=18.69N/mm^2

Rectangular cross section Km=0.70 (EC5 §6.1.6.(2))
σc0d=Fc0d/Anetto=1000x3.605/13200= 0.27 N/mm^2
σmyd=Myd/Wmy,netto=1E+06x1.403/4.840E+005= 2.90 N/mm^2
σmzd=Mzd/Wmz,netto=1E+06x0.000/1.320E+005= 0.00 N/mm^2

Buckling length Sk
Sky= 1.00x2.955=2.955 m= 2955 mm (most unfavourable)
Skz= 0.10x2.955=0.300 m= 300 mm (effective length/total length=0.30/2.95=0.10)

Slenderness
iy=√(Iy/A)=0.289x 220= 64 mm, λy= 2955/ 64= 46.17
iz=√(Iz/A)=0.289x 60= 17 mm, λz= 300/ 17= 17.65

Critical stresses
σc,crity=π^{2}E005/λy^2= 35.65 N/mm^2, λrel,y=√(fc0k/σc,crity)= 0.79 (EC5 Eq.6.21)
σc,critz=π^{2}E005/λz^2= 243.95 N/mm^2, λrel,z=√(fc0k/σc,critz)= 0.30 (EC5 Eq.6.22)

βc=0.20 (solid timber)
ky=0.5[1+βc(λrely-0.3)+λrely^2]= 0.86, Kcy=1/(ky+√(ky^2-λrely^2))=0.833 (Eq.6.27 6.25)
kz=0.5[1+βc(λrelz-0.3)+λrelz^2]= 0.55, Kcz=1/(kz+√(kz^2-λrelz^2))=1.000 (Eq.6.28 6.26)

σc0d/(Kcy·fc0d)+σmyd/fmyd+Km.σmzd/fmzd=0.022+0.155+0.000= 0.18 < 1 (EC5 Eq.6.23)
σc0d/(Kcz·fc0d)+Km.σmyd/fmyd+σmzd/fmzd=0.018+0.109+0.000= 0.13 < 1 (EC5 Eq.6.24)
The check is satisfied

Rafter, elements: 1 , load combination No 13
Column stability with bending, Fc0d=-3.518kN, Myd=2.026kNm, Mzd=0.000kNm (EC5 §6.3.2)
Rectangular cross section, b=60mm, h=220mm, A=1.320E+004mm^2, Wy=4.840E+005mm^3, Wz=1.320E+005mm^3
Modification factor Kmod=0.90 (Table 3.1), material factor γM=1.30 (Table 2.3, E005=7700N/mm^2
fc0k=22.00 N/mm^2, fc0d=Kmod·fc0k/γM=0.90x22.00/1.30=15.23N/mm^2
fmyk=27.00 N/mm^2, fmyd=Kmod·fmyk/γM=0.90x27.00/1.30=18.69N/mm^2
fmzk=27.00 N/mm^2, fmzd=Kmod·fmzk/γM=0.90x27.00/1.30=18.69N/mm^2

Rectangular cross section Km=0.70 (EC5 §6.1.6.(2))
σc0d=Fc0d/Anetto=1000x3.518/13200= 0.27 N/mm^2
σmyd=Myd/Wmy,netto=1E+06x2.026/4.840E+005= 4.19 N/mm^2
σmzd=Mzd/Wmz,netto=1E+06x0.000/1.320E+005= 0.00 N/mm^2

Buckling length Sk
Sky= 1.00x2.955=2.955 m= 2955 mm (most unfavourable)
Skz= 0.10x2.955=0.300 m= 300 mm (effective length/total length=0.30/2.95=0.10)

Slenderness
iy=√(Iy/A)=0.289x 220= 64 mm, λy= 2955/ 64= 46.17
iz=√(Iz/A)=0.289x 60= 17 mm, λz= 300/ 17= 17.65

Critical stresses
σc,crity=π^{2}E005/λy^2= 35.65 N/mm^2, λrel,y=√(fc0k/σc,crity)= 0.79 (EC5 Eq.6.21)
σc,critz=π^{2}E005/λz^2= 243.95 N/mm^2, λrel,z=√(fc0k/σc,critz)= 0.30 (EC5 Eq.6.22)

βc=0.20 (solid timber)
ky=0.5[1+βc(λrely-0.3)+λrely^2]= 0.86, Kcy=1/(ky+√(ky^2-λrely^2))=0.833 (Eq.6.27 6.25)
kz=0.5[1+βc(λrelz-0.3)+λrelz^2]= 0.55, Kcz=1/(kz+√(kz^2-λrelz^2))=1.000 (Eq.6.28 6.26)

σc0d/(Kcy·fc0d)+σmyd/fmyd+Km.σmzd/fmzd=0.021+0.224+0.000= 0.24 < 1 (EC5 Eq.6.23)
σc0d/(Kcz·fc0d)+Km.σmyd/fmyd+σmzd/fmzd=0.017+0.157+0.000= 0.17 < 1 (EC5 Eq.6.24)
The check is satisfied

Rafter, elements: 1 , load combination No 13
Lateral torsional stability of beams, Myd=2.026 kNm, Mzd=0.000 kNm (EC5 §6.3.3)
Rectangular cross section, b=60mm, h=220mm, A=1.320E+004mm^2, Wy=4.840E+005mm^3, Wz=1.320E+005mm^3
Modification factor Kmod=0.90 (Table 3.1), material factor γM=1.30 (Table 2.3)
fc0k=22.00 N/mm^2, fc0d=Kmod·fc0k/γM=0.90x22.00/1.30=15.23N/mm^2
fmyk=27.00 N/mm^2, fmyd=Kmod·fmyk/γM=0.90x27.00/1.30=18.69N/mm^2
fmzk=27.00 N/mm^2, fmzd=Kmod·fmzk/γM=0.90x27.00/1.30=18.69N/mm^2

Rectangular cross section Km=0.70 (EC5 §6.1.6.(2))
σmyd=Myd/Wmy,netto=1E+06x2.026/4.840E+005= 4.19 N/mm^2
σmzd=Mzd/Wmz,netto=1E+06x0.000/1.320E+005= 0.00 N/mm^2

Buckling length Sk
Sky= 1.00x2.955=2.955 m= 2955 mm (most unfavourable)
Skz= 0.10x2.955=0.300 m= 300 mm (effective length/total length=0.30/2.95=0.10)

Slenderness
iy=√(Iy/A)=0.289x 220= 64 mm, λy= 2955/ 64= 46.17
iz=√(Iz/A)=0.289x 60= 17 mm, λz= 300/ 17= 17.65

σm,crit=0.78.b^2·E005/(h·Lef)=0.78x60^{2}x 7700/(220x2659)= 36.96N/mm^2 (EC5 Eq.6.32)
σm,crit=0.78.b^2·E005/(h·Lef)=0.78x220^{2}x 7700/(60x300)=16149.47N/mm^2 (EC5 Eq.6.32)
Critical stresses
σm,crity= 36.96 N/mm^2, λrel,my=√(fmyk/σm,crity)= 0.85 (EC5 Eq.6.30)
σm,critz=16149.47 N/mm^2, λrel,mz=√(fmzk/σm,critz)= 0.04 (EC5 Eq.6.30)

λrel,my=0.85, (0.75<λrel<=1.40, Kcrit=1.56-0.75λrelm), Kcrity=0.92 (EC5 Eq.6.34)
λrel,mz=0.04, (λrel<=0.75), Kcritz=1.00 (EC5 Eq.6.34)

σmyd/(Kcrity·fmyd)+Km.σmzd/(Kcritz·fmzd)=0.244+0.000= 0.24 < 1 (EC5 Eq.6.33)
Km.σmyd/(Kcrity·fmyd)+σmzd/(Kcritz·fmzd)=0.171+0.000= 0.17 < 1 (EC5 Eq.6.33)
The check is satisfied

1.10.3. Ultimate limit state (EC5 EN1995-1-1:2009, §6)

Rafter, elements: 3

Loading [kN/m]	action	γg	γq	ψo
(Gk) Dead Gk1 = 0.314, Gk2 = 0.180, Gkf=0.300	Permanent	1.35	0.00	1.00
(Qk1) Snow QksL= 0.768, QksR= 0.546	Short-term	0.00	1.50	0.60
(Qk2) Snow QksL= 0.384, QksR= 0.546	Short-term	0.00	1.50	0.60
(Qk3) Snow QksL= 0.768, QksR= 0.273	Short-term	0.00	1.50	0.60
(Qk4) Wind QkwL= 0.123, QkwR=-0.133	Short-term	0.00	1.50	0.50
(Qk5) Wind QkwL=-0.162, QkwR= 0.182	Short-term	0.00	1.50	0.50
(Qkf) Live Qkf = 1.200	Medium-term	0.00	1.50	0.70
(Qki) Imposed (H) Qi = 0.240	Short-term	0.00	1.50	0.00

L.C.	Load combination	duration class	kmod	-N/Kmod	+N/Kmod	V/Kmod	M/Kmod
1	γg.G	Permanent	0.60	-1.616	0.000	0.897	1.468
2	γg.G+γq.Q1	Short-term	0.90	-0.966	0.453	2.384	3.274
3	γg.G+γq.Q2	Short-term	0.90	-1.414	0.005	1.553	1.915
4	γg.G+γq.Q3	Short-term	0.90	-0.573	0.419	2.322	3.485
5	γg.G+γq.Q4	Short-term	0.90	-1.486	0.000	0.716	2.012
6	γg.G+γq.Q5	Short-term	0.90	-1.077	0.000	0.598	0.979
7	γg.G+γq.Qf	Medium-term	0.80	-4.080	0.000	0.605	2.010
8	γg.G+γq.Qi	Short-term	0.90	-1.142	0.000	1.172	1.642
9	γg.G+γq.Q1+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-2.955	0.000	2.143	4.108
10	γg.G+γq.Q1+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-2.750	0.000	2.084	3.591
11	γg.G+γq.Q2+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-3.403	0.000	1.312	2.749
12	γg.G+γq.Q2+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-3.198	0.000	1.253	2.233
13	γg.G+γq.Q3+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-2.563	0.000	2.080	4.319
14	γg.G+γq.Q3+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-2.358	0.000	2.021	3.802
15	γg.G+γq.Q4+γq.ψo.Q1+γq.ψo.Qf	Short-term	0.90	-3.204	0.000	1.488	3.706
16	γg.G+γq.Q4+γq.ψo.Q2+γq.ψo.Qf	Short-term	0.90	-3.473	0.000	0.989	2.891
17	γg.G+γq.Q4+γq.ψo.Q3+γq.ψo.Qf	Short-term	0.90	-2.969	0.000	1.450	3.833
18	γg.G+γq.Q5+γq.ψo.Q1+γq.ψo.Qf	Short-term	0.90	-2.795	0.000	1.369	2.673
19	γg.G+γq.Q5+γq.ψo.Q2+γq.ψo.Qf	Short-term	0.90	-3.064	0.000	0.871	1.858
20	γg.G+γq.Q5+γq.ψo.Q3+γq.ψo.Qf	Short-term	0.90	-2.559	0.000	1.332	2.800
21	γg.G+γq.Qf+γq.ψo.Q1+γq.ψo.Q4	Short-term	0.90	-3.764	0.000	1.300	3.326
22	γg.G+γq.Qf+γq.ψo.Q1+γq.ψo.Q5	Short-term	0.90	-3.560	0.000	1.241	2.809
23	γg.G+γq.Qf+γq.ψo.Q2+γq.ψo.Q4	Short-term	0.90	-4.033	0.000	0.801	2.510
24	γg.G+γq.Qf+γq.ψo.Q2+γq.ψo.Q5	Short-term	0.90	-3.828	0.000	0.742	1.994
25	γg.G+γq.Qf+γq.ψo.Q3+γq.ψo.Q4	Short-term	0.90	-3.529	0.000	1.262	3.452
26	γg.G+γq.Qf+γq.ψo.Q3+γq.ψo.Q5	Short-term	0.90	-3.324	0.000	1.203	2.936
27	γg.G+γq.Qi+γq.ψo.Q1+γq.ψo.Q4+γq.ψo.Q	Short-term	0.90	-3.064	0.000	2.002	3.853
28	γg.G+γq.Qi+γq.ψo.Q1+γq.ψo.Q5+γq.ψo.Q	Short-term	0.90	-2.860	0.000	1.943	3.337
29	γg.G+γq.Qi+γq.ψo.Q2+γq.ψo.Q4+γq.ψo.Q	Short-term	0.90	-3.333	0.000	1.504	3.038
30	γg.G+γq.Qi+γq.ψo.Q2+γq.ψo.Q5+γq.ψo.Q	Short-term	0.90	-3.128	0.000	1.445	2.522
31	γg.G+γq.Qi+γq.ψo.Q3+γq.ψo.Q4+γq.ψo.Q	Short-term	0.90	-2.829	0.000	1.965	3.980
32	γg.G+γq.Qi+γq.ψo.Q3+γq.ψo.Q5+γq.ψo.Q	Short-term	0.90	-2.624	0.000	1.906	3.463
	Maximum values			-4.080	0.453	2.384	4.319

1.10.4. Check of cross section Rafter, elements: 3

Rafter, elements: 3 , load combination No 2

Tension parallel to the grain, Ft0d=0.408 kN (EC5 §6.1.2)

Rectangular cross section, b=60 mm, h=220 mm, A= 13 200 mm²

Modification factor Kmod=0.90 (Table 3.1), material factor γM=1.30 (Table 2.3)

ft0k=16.00 N/mm², ft0d=Kmod·ft0k/γM=0.90x16.00/1.30=11.08N/mm² (EC5 Eq.2.14)

Ft0d=0.408 kN, σt0d=Ft0d/Anetto=1000x0.408/13200=0.03N/mm² < 11.08N/mm²=ft0d (Eq.6.1)

The check is satisfied

Rafter, elements: 3 , load combination No 7
Compression parallel to the grain, Fc0d=-3.264 kN (EC5 §6.1.4)
Rectangular cross section, b=60 mm, h=220 mm, A= 13 200 mm^2
Modification factor Kmod=0.80 (Table 3.1), material factor γM=1.30 (Table 2.3)
fc0k=22.00 N/mm^2, fc0d=Kmod·fc0k/γM=0.80x22.00/1.30=13.54N/mm^2 (EC5 Eq.2.14)
Fc0d=-3.264 kN, σc0d=Fc0d/Anetto=1000x3.264/13200=0.25N/mm^2 < 13.54N/mm^2=fc0d (Eq.6.2)
The check is satisfied

Rafter, elements: 3 , load combination No 2
Shear, Fv=2.146 kN (EC5 §6.1.7)
Rectangular cross section, bef=0.67x60=40 mm, h=220 mm, A= 8 800 mm^2
Modification factor Kmod=0.90 (Table 3.1), material factor γM=1.30 (Table 2.3)
fvk=4.00 N/mm^2, fvd=Kmod·fvk/γM=0.90x4.00/1.30=2.77N/mm^2 (EC5 Eq.2.14)
Fv=2.146 kN, τv0d=1.50Fv0d/Anetto=1000x1.50x2.146/8800=0.37N/mm^2 < 2.77N/mm^2=fv0d (Eq.6.13)
The check is satisfied

Rafter, elements: 3 , load combination No 13
Bending, Myd=3.887 kNm, Mzd=0.000 kNm (EC5 §6.1.6)
Rectangular cross section, b=60mm, h=220mm, A=1.320E+004mm^2, Wy=4.840E+005mm^3, Wz=1.320E+005mm^3
Modification factor Kmod=0.90 (Table 3.1), material factor γM=1.30 (Table 2.3)
fmyk=27.00 N/mm^2, fmyd=Kmod·fmyk/γM=0.90x27.00/1.30=18.69N/mm^2
fmzk=27.00 N/mm^2, fmzd=Kmod·fmzk/γM=0.90x27.00/1.30=18.69N/mm^2

Rectangular cross section Km=0.70 (EC5 §6.1.6.(2))
σmyd=Myd/Wmy,netto=1E+06x3.887/4.840E+005= 8.03 N/mm^2
σmzd=Mzd/Wmz,netto=1E+06x0.000/1.320E+005= 0.00 N/mm^2

σmyd/fmyd+Km.σmzd/fmzd=0.430+0.000= 0.43 < 1 (EC5 Eq.6.11)
Km.σmyd/fmyd+σmzd/fmzd=0.301+0.000= 0.30 < 1 (EC5 Eq.6.12)
The check is satisfied

Rafter, elements: 3 , load combination No 7
Combined bending and axial compression, Fc0d=-3.264kN, Myd=1.608kNm, Mzd=0.000kNm (EC5 §6.2.4)
Rectangular cross section, b=60mm, h=220mm, A=1.320E+004mm^2, Wy=4.840E+005mm^3, Wz=1.320E+005mm^3
Modification factor Kmod=0.80 (Table 3.1), material factor γM=1.30 (Table 2.3)
fc0k=22.00 N/mm^2, fc0d=Kmod·fc0k/γM=0.80x22.00/1.30=13.54N/mm^2
fmyk=27.00 N/mm^2, fmyd=Kmod·fmyk/γM=0.80x27.00/1.30=16.62N/mm^2
fmzk=27.00 N/mm^2, fmzd=Kmod·fmzk/γM=0.80x27.00/1.30=16.62N/mm^2

Rectangular cross section Km=0.70 (EC5 §6.1.6.(2))
σc0d=Fc0d/Anetto=1000x3.264/13200= 0.25 N/mm^2
σmyd=Myd/Wmy,netto=1E+06x1.608/4.840E+005= 3.32 N/mm^2
σmzd=Mzd/Wmz,netto=1E+06x0.000/1.320E+005= 0.00 N/mm^2

(σc0d/fc0d)^2+σmyd/fmyd+Km.σmzd/fmzd=0.000+0.200+0.000= 0.20 < 1 (EC5 Eq.6.19)
(σc0d/fc0d)^2+Km.σmyd/fmyd+σmzd/fmzd=0.000+0.140+0.000= 0.14 < 1 (EC5 Eq.6.20)
The check is satisfied

Rafter, elements: 3 , load combination No 13
Combined bending and axial compression, Fc0d=-2.306kN, Myd=3.887kNm, Mzd=0.000kNm (EC5 §6.2.4)
Rectangular cross section, b=60mm, h=220mm, A=1.320E+004mm^2, Wy=4.840E+005mm^3, Wz=1.320E+005mm^3
Modification factor Kmod=0.90 (Table 3.1), material factor γM=1.30 (Table 2.3)
fc0k=22.00 N/mm^2, fc0d=Kmod·fc0k/γM=0.90x22.00/1.30=15.23N/mm^2
fmyk=27.00 N/mm^2, fmyd=Kmod·fmyk/γM=0.90x27.00/1.30=18.69N/mm^2
fmzk=27.00 N/mm^2, fmzd=Kmod·fmzk/γM=0.90x27.00/1.30=18.69N/mm^2

Rectangular cross section Km=0.70 (EC5 §6.1.6.(2))
σc0d=Fc0d/Anetto=1000x2.306/13200= 0.17 N/mm^2
σmyd=Myd/Wmy,netto=1E+06x3.887/4.840E+005= 8.03 N/mm^2
σmzd=Mzd/Wmz,netto=1E+06x0.000/1.320E+005= 0.00 N/mm^2

(σc0d/fc0d)^2+σmyd/fmyd+Km.σmzd/fmzd=0.000+0.430+0.000= 0.43 < 1 (EC5 Eq.6.19)
(σc0d/fc0d)^2+Km.σmyd/fmyd+σmzd/fmzd=0.000+0.301+0.000= 0.30 < 1 (EC5 Eq.6.20)
The check is satisfied

Rafter, elements: 3 , load combination No 7
Column stability with bending, Fc0d=-3.264kN, Myd=1.608kNm, Mzd=0.000kNm (EC5 §6.3.2)
Rectangular cross section, b=60mm, h=220mm, A=1.320E+004mm^2, Wy=4.840E+005mm^3, Wz=1.320E+005mm^3
Modification factor Kmod=0.80 (Table 3.1), material factor γM=1.30 (Table 2.3, E005=7700N/mm^2
fc0k=22.00 N/mm^2, fc0d=Kmod·fc0k/γM=0.80x22.00/1.30=13.54N/mm^2
fmyk=27.00 N/mm^2, fmyd=Kmod·fmyk/γM=0.80x27.00/1.30=16.62N/mm^2
fmzk=27.00 N/mm^2, fmzd=Kmod·fmzk/γM=0.80x27.00/1.30=16.62N/mm^2

Rectangular cross section Km=0.70 (EC5 §6.1.6.(2))
σc0d=Fc0d/Anetto=1000x3.264/13200= 0.25 N/mm^2
σmyd=Myd/Wmy,netto=1E+06x1.608/4.840E+005= 3.32 N/mm^2
σmzd=Mzd/Wmz,netto=1E+06x0.000/1.320E+005= 0.00 N/mm^2

Buckling length Sk
Sky= 1.00x1.921=1.921 m= 1921 mm (most unfavourable)
Skz= 0.16x1.921=0.300 m= 300 mm (effective length/total length=0.30/1.92=0.16)

Slenderness
iy=√(Iy/A)=0.289x 220= 64 mm, λy= 1921/ 64= 30.01
iz=√(Iz/A)=0.289x 60= 17 mm, λz= 300/ 17= 17.65

Critical stresses
σc,crity=π^{2}E005/λy^2= 84.38 N/mm^2, λrel,y=√(fc0k/σc,crity)= 0.51 (EC5 Eq.6.21)
σc,critz=π^{2}E005/λz^2= 243.95 N/mm^2, λrel,z=√(fc0k/σc,critz)= 0.30 (EC5 Eq.6.22)

βc=0.20 (solid timber)
ky=0.5[1+βc(λrely-0.3)+λrely^2]= 0.65, Kcy=1/(ky+√(ky^2-λrely^2))=0.947 (Eq.6.27 6.25)
kz=0.5[1+βc(λrelz-0.3)+λrelz^2]= 0.55, Kcz=1/(kz+√(kz^2-λrelz^2))=1.000 (Eq.6.28 6.26)

σc0d/(Kcy·fc0d)+σmyd/fmyd+Km.σmzd/fmzd=0.019+0.200+0.000= 0.22 < 1 (EC5 Eq.6.23)
σc0d/(Kcz·fc0d)+Km.σmyd/fmyd+σmzd/fmzd=0.018+0.140+0.000= 0.16 < 1 (EC5 Eq.6.24)
The check is satisfied

Rafter, elements: 3 , load combination No 13
Column stability with bending, Fc0d=-2.306kN, Myd=3.887kNm, Mzd=0.000kNm (EC5 §6.3.2)
Rectangular cross section, b=60mm, h=220mm, A=1.320E+004mm^2, Wy=4.840E+005mm^3, Wz=1.320E+005mm^3
Modification factor Kmod=0.90 (Table 3.1), material factor γM=1.30 (Table 2.3, E005=7700N/mm^2
fc0k=22.00 N/mm^2, fc0d=Kmod·fc0k/γM=0.90x22.00/1.30=15.23N/mm^2
fmyk=27.00 N/mm^2, fmyd=Kmod·fmyk/γM=0.90x27.00/1.30=18.69N/mm^2
fmzk=27.00 N/mm^2, fmzd=Kmod·fmzk/γM=0.90x27.00/1.30=18.69N/mm^2

Rectangular cross section Km=0.70 (EC5 §6.1.6.(2))
σc0d=Fc0d/Anetto=1000x2.306/13200= 0.17 N/mm^2
σmyd=Myd/Wmy,netto=1E+06x3.887/4.840E+005= 8.03 N/mm^2
σmzd=Mzd/Wmz,netto=1E+06x0.000/1.320E+005= 0.00 N/mm^2

Buckling length Sk
Sky= 1.00x1.921=1.921 m= 1921 mm (most unfavourable)
Skz= 0.16x1.921=0.300 m= 300 mm (effective length/total length=0.30/1.92=0.16)

Slenderness
$i_y=\sqrt{(I_y/A)}=0.289\times 220= 64$ mm, $\lambda_y= 1921/ 64= 30.01$
$i_z=\sqrt{(I_z/A)}=0.289\times 60= 17$ mm, $\lambda_z= 300/ 17= 17.65$

Critical stresses
$\sigma_{c,crity}=\pi^2 E005/\lambda_y^2= 84.38$ N/mm², $\lambda_{rel,y}=\sqrt{(f_{c0k}/\sigma_{c,crity})}= 0.51$ (EC5 Eq.6.21)
$\sigma_{c,critz}=\pi^2 E005/\lambda_z^2= 243.95$ N/mm², $\lambda_{rel,z}=\sqrt{(f_{c0k}/\sigma_{c,critz})}= 0.30$ (EC5 Eq.6.22)

$\beta_c=0.20$ (solid timber)
$k_y=0.5[1+\beta_c(\lambda_{rely}-0.3)+\lambda_{rely}^2]= 0.65$, $K_{cy}=1/(k_y+\sqrt{(k_y^2-\lambda_{rely}^2)})=0.947$ (Eq.6.27 6.25)
$k_z=0.5[1+\beta_c(\lambda_{relz}-0.3)+\lambda_{relz}^2]= 0.55$, $K_{cz}=1/(k_z+\sqrt{(k_z^2-\lambda_{relz}^2)})=1.000$ (Eq.6.28 6.26)

$\sigma_{c0d}/(K_{cy}\cdot f_{c0d})+\sigma_{myd}/f_{myd}+K_m.\sigma_{mzd}/f_{mzd}=0.012+0.430+0.000= 0.44 < 1$ (EC5 Eq.6.23)
$\sigma_{c0d}/(K_{cz}\cdot f_{c0d})+K_m.\sigma_{myd}/f_{myd}+\sigma_{mzd}/f_{mzd}=0.011+0.301+0.000= 0.31 < 1$ (EC5 Eq.6.24)
The check is satisfied

Rafter, elements: 3 , load combination No 13
Lateral torsional stability of beams, Myd=3.887 kNm, Mzd=0.000 kNm (EC5 §6.3.3)
Rectangular cross section, b=60mm, h=220mm, A=1.320E+004mm², Wy=4.840E+005mm³, Wz=1.320E+005mm³
Modification factor Kmod=0.90 (Table 3.1), material factor $\gamma_M=1.30$ (Table 2.3)
$f_{c0k}=22.00$ N/mm², $f_{c0d}=K_{mod}\cdot f_{c0k}/\gamma_M=0.90\times 22.00/1.30=15.23$ N/mm²
$f_{myk}=27.00$ N/mm², $f_{myd}=K_{mod}\cdot f_{myk}/\gamma_M=0.90\times 27.00/1.30=18.69$ N/mm²
$f_{mzk}=27.00$ N/mm², $f_{mzd}=K_{mod}\cdot f_{mzk}/\gamma_M=0.90\times 27.00/1.30=18.69$ N/mm²

Rectangular cross section Km=0.70 (EC5 §6.1.6.(2))
$\sigma_{myd}=M_{yd}/W_{my,netto}=1E+06\times 3.887/4.840E+005= 8.03$ N/mm²
$\sigma_{mzd}=M_{zd}/W_{mz,netto}=1E+06\times 0.000/1.320E+005= 0.00$ N/mm²

Buckling length Sk
Sky= 1.00x1.921=1.921 m= 1921 mm (most unfavourable)
Skz= 0.16x1.921=0.300 m= 300 mm (effective length/total length=0.30/1.92=0.16)

Slenderness
$i_y=\sqrt{(I_y/A)}=0.289\times 220= 64$ mm, $\lambda_y= 1921/ 64= 30.01$
$i_z=\sqrt{(I_z/A)}=0.289\times 60= 17$ mm, $\lambda_z= 300/ 17= 17.65$

$\sigma_{m,crit}=0.78.b^2\cdot E005/(h\cdot L_{ef})=0.78\times 60^2\times 7700/(220\times 1729)= 56.85$ N/mm² (EC5 Eq.6.32)
$\sigma_{m,crit}=0.78.b^2\cdot E005/(h\cdot L_{ef})=0.78\times 220^2\times 7700/(60\times 300)=16149.47$ N/mm² (EC5 Eq.6.32)
Critical stresses
$\sigma_{m,crity}= 56.85$ N/mm², $\lambda_{rel,my}=\sqrt{(f_{myk}/\sigma_{m,crity})}= 0.69$ (EC5 Eq.6.30)
$\sigma_{m,critz}=16149.47$ N/mm², $\lambda_{rel,mz}=\sqrt{(f_{mzk}/\sigma_{m,critz})}= 0.04$ (EC5 Eq.6.30)

$\lambda_{rel,my}=0.69$, $(\lambda_{rel}<=0.75)$, $K_{crity}=1.00$ (EC5 Eq.6.34)
$\lambda_{rel,mz}=0.04$, $(\lambda_{rel}<=0.75)$, $K_{critz}=1.00$ (EC5 Eq.6.34)

$\sigma_{myd}/(K_{crity}\cdot f_{myd})+K_m.\sigma_{mzd}/(K_{critz}\cdot f_{mzd})=0.430+0.000= 0.43 < 1$ (EC5 Eq.6.33)
$K_m.\sigma_{myd}/(K_{crity}\cdot f_{myd})+\sigma_{mzd}/(K_{critz}\cdot f_{mzd})=0.301+0.000= 0.30 < 1$ (EC5 Eq.6.33)
The check is satisfied

Negligible tensile stress, combined bending-tension check is omitted (EC5 §6.2.3)

1.10.5. Ultimate limit state (EC5 EN1995-1-1:2009, §6)

Rafter, elements: 2

Loading [kN/m]	action	γg	γq	ψo
(Gk) Dead Gk1 = 0.314, Gk2 = 0.180, Gkf=0.300	Permanent	1.35	0.00	1.00
(Qk1) Snow QksL= 0.768, QksR= 0.546	Short-term	0.00	1.50	0.60
(Qk2) Snow QksL= 0.384, QksR= 0.546	Short-term	0.00	1.50	0.60
(Qk3) Snow QksL= 0.768, QksR= 0.273	Short-term	0.00	1.50	0.60
(Qk4) Wind QkwL= 0.123, QkwR=-0.133	Short-term	0.00	1.50	0.50
(Qk5) Wind QkwL=-0.162, QkwR= 0.182	Short-term	0.00	1.50	0.50
(Qkf) Live Qkf = 1.200	Medium-term	0.00	1.50	0.70
(Qki) Imposed (H) Qi = 0.240	Short-term	0.00	1.50	0.00

L.C.	Load combination	duration class	kmod	-N/Kmod	+N/Kmod	V/Kmod	M/Kmod
1	γg.G	Permanent	0.60	0.000	3.052	1.099	0.947
2	γg.G+γq.Q1	Short-term	0.90	0.000	8.569	2.530	2.163
3	γg.G+γq.Q2	Short-term	0.90	0.000	5.649	1.570	1.291
4	γg.G+γq.Q3	Short-term	0.90	0.000	8.221	2.592	2.270
5	γg.G+γq.Q4	Short-term	0.90	0.000	2.880	1.217	1.167
6	γg.G+γq.Q5	Short-term	0.90	0.000	2.035	0.733	0.631
7	γg.G+γq.Qf	Medium-term	0.80	-0.785	0.000	0.951	0.927
8	γg.G+γq.Qi	Short-term	0.90	0.000	4.165	1.279	1.083
9	γg.G+γq.Q1+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	0.000	7.475	2.851	2.566
10	γg.G+γq.Q1+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	0.000	7.052	2.609	2.298
11	γg.G+γq.Q2+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	0.000	4.555	1.891	1.693
12	γg.G+γq.Q2+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	0.000	4.132	1.648	1.426
13	γg.G+γq.Q3+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	0.000	7.128	2.913	2.673
14	γg.G+γq.Q3+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	0.000	6.705	2.671	2.405
15	γg.G+γq.Q4+γq.ψo.Q1+γq.ψo.Qf	Short-term	0.90	0.000	5.284	2.374	2.221
16	γg.G+γq.Q4+γq.ψo.Q2+γq.ψo.Qf	Short-term	0.90	0.000	3.532	1.798	1.697
17	γg.G+γq.Q4+γq.ψo.Q3+γq.ψo.Qf	Short-term	0.90	0.000	5.076	2.412	2.285
18	γg.G+γq.Q5+γq.ψo.Q1+γq.ψo.Qf	Short-term	0.90	0.000	4.438	1.890	1.686
19	γg.G+γq.Q5+γq.ψo.Q2+γq.ψo.Qf	Short-term	0.90	0.000	2.687	1.314	1.162
20	γg.G+γq.Q5+γq.ψo.Q3+γq.ψo.Qf	Short-term	0.90	0.000	4.230	1.927	1.750
21	γg.G+γq.Qf+γq.ψo.Q1+γq.ψo.Q4	Short-term	0.90	0.000	4.211	2.166	2.011
22	γg.G+γq.Qf+γq.ψo.Q1+γq.ψo.Q5	Short-term	0.90	0.000	3.788	1.924	1.743
23	γg.G+γq.Qf+γq.ψo.Q2+γq.ψo.Q4	Short-term	0.90	0.000	2.459	1.590	1.488
24	γg.G+γq.Qf+γq.ψo.Q2+γq.ψo.Q5	Short-term	0.90	0.000	2.037	1.347	1.220
25	γg.G+γq.Qf+γq.ψo.Q3+γq.ψo.Q4	Short-term	0.90	0.000	4.003	2.203	2.075
26	γg.G+γq.Qf+γq.ψo.Q3+γq.ψo.Q5	Short-term	0.90	0.000	3.580	1.961	1.808
27	γg.G+γq.Qi+γq.ψo.Q1+γq.ψo.Q4+γq.ψo.Q	Short-term	0.90	0.000	6.991	2.678	2.405
28	γg.G+γq.Qi+γq.ψo.Q1+γq.ψo.Q5+γq.ψo.Q	Short-term	0.90	0.000	6.568	2.436	2.137
29	γg.G+γq.Qi+γq.ψo.Q2+γq.ψo.Q4+γq.ψo.Q	Short-term	0.90	0.000	5.239	2.102	1.881
30	γg.G+γq.Qi+γq.ψo.Q2+γq.ψo.Q5+γq.ψo.Q	Short-term	0.90	0.000	4.816	1.859	1.614
31	γg.G+γq.Qi+γq.ψo.Q3+γq.ψo.Q4+γq.ψo.Q	Short-term	0.90	0.000	6.783	2.715	2.469
32	γg.G+γq.Qi+γq.ψo.Q3+γq.ψo.Q5+γq.ψo.Q	Short-term	0.90	0.000	6.360	2.473	2.201
	Maximum values			-0.785	8.569	2.913	2.673

1.10.6. Check of cross section Rafter, elements: 2

Rafter, elements: 2 , load combination No 2

Tension parallel to the grain, Ft0d=7.712 kN (EC5 §6.1.2)

Rectangular cross section, b=60 mm, h=220 mm, A= 13 200 mm²

Modification factor Kmod=0.90 (Table 3.1), material factor γM=1.30 (Table 2.3)

ft0k=16.00 N/mm², ft0d=Kmod·ft0k/γM=0.90x16.00/1.30=11.08N/mm² (EC5 Eq.2.14)

Ft0d=7.712 kN, σt0d=Ft0d/Anetto=1000x7.712/13200=0.58N/mm² < 11.08N/mm²=ft0d (Eq.6.1)

The check is satisfied

Rafter, elements: 2 , load combination No 7
Compression parallel to the grain, Fc0d=-0.628 kN (EC5 §6.1.4)
Rectangular cross section, b=60 mm, h=220 mm, A= 13 200 mm^2
Modification factor Kmod=0.80 (Table 3.1), material factor γM=1.30 (Table 2.3)
fc0k=22.00 N/mm^2, fc0d=Kmod·fc0k/γM=0.80x22.00/1.30=13.54N/mm^2 (EC5 Eq.2.14)
Fc0d=-0.628 kN, σc0d=Fc0d/Anetto=1000x0.628/13200=0.05N/mm^2 < 13.54N/mm^2=fc0d (Eq.6.2)
The check is satisfied

Rafter, elements: 2 , load combination No 13
Shear, Fv=2.622 kN (EC5 §6.1.7)
Rectangular cross section, bef=0.67x60=40 mm, h=220 mm, A= 8 800 mm^2
Modification factor Kmod=0.90 (Table 3.1), material factor γM=1.30 (Table 2.3)
fvk=4.00 N/mm^2, fvd=Kmod·fvk/γM=0.90x4.00/1.30=2.77N/mm^2 (EC5 Eq.2.14)
Fv=2.622 kN, τv0d=1.50Fv0d/Anetto=1000x1.50x2.622/8800=0.45N/mm^2 < 2.77N/mm^2=fv0d (Eq.6.13)
The check is satisfied

Rafter, elements: 2 , load combination No 13
Bending, Myd=2.406 kNm, Mzd=0.000 kNm (EC5 §6.1.6)
Rectangular cross section, b=60mm, h=220mm, A=1.320E+004mm^2, Wy=4.840E+005mm^3, Wz=1.320E+005mm^3
Modification factor Kmod=0.90 (Table 3.1), material factor γM=1.30 (Table 2.3)
fmyk=27.00 N/mm^2, fmyd=Kmod·fmyk/γM=0.90x27.00/1.30=18.69N/mm^2
fmzk=27.00 N/mm^2, fmzd=Kmod·fmzk/γM=0.90x27.00/1.30=18.69N/mm^2

Rectangular cross section Km=0.70 (EC5 §6.1.6.(2))
σmyd=Myd/Wmy,netto=1E+06x2.406/4.840E+005= 4.97 N/mm^2
σmzd=Mzd/Wmz,netto=1E+06x0.000/1.320E+005= 0.00 N/mm^2

σmyd/fmyd+Km.σmzd/fmzd=0.266+0.000= 0.27 < 1 (EC5 Eq.6.11)
Km.σmyd/fmyd+σmzd/fmzd=0.186+0.000= 0.19 < 1 (EC5 Eq.6.12)
The check is satisfied

Negligible compressive stress, combined bending-compression check is omitted (EC5 §6.2.4)

Rafter, elements: 2 , load combination No 7
Column stability with bending, Fc0d=-0.628kN, Myd=0.742kNm, Mzd=0.000kNm (EC5 §6.3.2)
Rectangular cross section, b=60mm, h=220mm, A=1.320E+004mm^2, Wy=4.840E+005mm^3, Wz=1.320E+005mm^3
Modification factor Kmod=0.80 (Table 3.1), material factor γM=1.30 (Table 2.3, E005=7700N/mm^2
fc0k=22.00 N/mm^2, fc0d=Kmod·fc0k/γM=0.80x22.00/1.30=13.54N/mm^2
fmyk=27.00 N/mm^2, fmyd=Kmod·fmyk/γM=0.80x27.00/1.30=16.62N/mm^2
fmzk=27.00 N/mm^2, fmzd=Kmod·fmzk/γM=0.80x27.00/1.30=16.62N/mm^2

Rectangular cross section Km=0.70 (EC5 §6.1.6.(2))
σc0d=Fc0d/Anetto=1000x0.628/13200= 0.05 N/mm^2
σmyd=Myd/Wmy,netto=1E+06x0.742/4.840E+005= 1.53 N/mm^2
σmzd=Mzd/Wmz,netto=1E+06x0.000/1.320E+005= 0.00 N/mm^2

Buckling length Sk
Sky= 1.00x2.955=2.955 m= 2955 mm (most unfavourable)
Skz= 0.10x2.955=0.300 m= 300 mm (effective length/total length=0.30/2.95=0.10)

Slenderness
iy=√(Iy/A)=0.289x 220= 64 mm, λy= 2955/ 64= 46.17
iz=√(Iz/A)=0.289x 60= 17 mm, λz= 300/ 17= 17.65

Critical stresses
σc,crity=π^{2}E005/λy^2= 35.65 N/mm^2, λrel,y=√(fc0k/σc,crity)= 0.79 (EC5 Eq.6.21)
σc,critz=π^{2}E005/λz^2= 243.95 N/mm^2, λrel,z=√(fc0k/σc,critz)= 0.30 (EC5 Eq.6.22)

βc=0.20 (solid timber)
ky=0.5[1+βc(λrely-0.3)+λrely^2]= 0.86, Kcy=1/(ky+√(ky^2-λrely^2))=0.833 (Eq.6.27 6.25)
kz=0.5[1+βc(λrelz-0.3)+λrelz^2]= 0.55, Kcz=1/(kz+√(kz^2-λrelz^2))=1.000 (Eq.6.28 6.26)

σc0d/(Kcy·fc0d)+σmyd/fmyd+Km.σmzd/fmzd=0.004+0.092+0.000= 0.10 < 1 (EC5 Eq.6.23)
σc0d/(Kcz·fc0d)+Km.σmyd/fmyd+σmzd/fmzd=0.004+0.065+0.000= 0.07 < 1 (EC5 Eq.6.24)
The check is satisfied

Rafter, elements: 2 , load combination No 13
Lateral torsional stability of beams, Myd=2.406 kNm, Mzd=0.000 kNm (EC5 §6.3.3)
Rectangular cross section, b=60mm, h=220mm, A=1.320E+004mm^2, Wy=4.840E+005mm^3, Wz=1.320E+005mm^3
Modification factor Kmod=0.90 (Table 3.1), material factor γM=1.30 (Table 2.3)
fc0k=22.00 N/mm^2, fc0d=Kmod·fc0k/γM=0.90x22.00/1.30=15.23N/mm^2
fmyk=27.00 N/mm^2, fmyd=Kmod·fmyk/γM=0.90x27.00/1.30=18.69N/mm^2
fmzk=27.00 N/mm^2, fmzd=Kmod·fmzk/γM=0.90x27.00/1.30=18.69N/mm^2

Rectangular cross section Km=0.70 (EC5 §6.1.6.(2))
σmyd=Myd/Wmy,netto=1E+06x2.406/4.840E+005= 4.97 N/mm^2
σmzd=Mzd/Wmz,netto=1E+06x0.000/1.320E+005= 0.00 N/mm^2

Buckling length Sk
Sky= 1.00x2.955=2.955 m= 2955 mm (most unfavourable)
Skz= 0.10x2.955=0.300 m= 300 mm (effective length/total length=0.30/2.95=0.10)

Slenderness
iy=√(Iy/A)=0.289x 220= 64 mm, λy= 2955/ 64= 46.17
iz=√(Iz/A)=0.289x 60= 17 mm, λz= 300/ 17= 17.65

σm,crit=0.78.b^2·E005/(h·Lef)=0.78x60^{2}x 7700/(220x2659)= 36.96N/mm^2 (EC5 Eq.6.32)
σm,crit=0.78.b^2·E005/(h·Lef)=0.78x220^{2}x 7700/(60x300)=16149.47N/mm^2 (EC5 Eq.6.32)
Critical stresses
σm,crity= 36.96 N/mm^2, λrel,my=√(fmyk/σm,crity)= 0.85 (EC5 Eq.6.30)
σm,critz=16149.47 N/mm^2, λrel,mz=√(fmzk/σm,critz)= 0.04 (EC5 Eq.6.30)

λrel,my=0.85, (0.75 < λrel <=1.40, Kcrit=1.56-0.75λrelm), Kcrity=0.92 (EC5 Eq.6.34)
λrel,mz=0.04, (λrel<=0.75), Kcritz=1.00 (EC5 Eq.6.34)

σmyd/(Kcrity·fmyd)+Km.σmzd/(Kcritz·fmzd)=0.289+0.000= 0.29 < 1 (EC5 Eq.6.33)
Km.σmyd/(Kcrity·fmyd)+σmzd/(Kcritz·fmzd)=0.203+0.000= 0.20 < 1 (EC5 Eq.6.33)
The check is satisfied

Rafter, elements: 2 , load combination No 2
Combined bending and axial tension, Ft0d=7.712kN, Myd=1.947kNm, Mzd=0.000kNm (EC5 §6.2.3)
Rectangular cross section, b=60mm, h=220mm, A=1.320E+004mm^2, Wy=4.840E+005mm^3, Wz=1.320E+005mm^3
Modification factor Kmod=0.90 (Table 3.1), material factor γM=1.30 (Table 2.3)
ft0k=16.00 N/mm^2, ft0d=Kmod·ft0k/γM=0.90x16.00/1.30=11.08N/mm^2
fmyk=27.00 N/mm^2, fmyd=Kmod·fmyk/γM=0.90x27.00/1.30=18.69N/mm^2
fmzk=27.00 N/mm^2, fmzd=Kmod·fmzk/γM=0.90x27.00/1.30=18.69N/mm^2

Rectangular cross section Km=0.70 (EC5 §6.1.6.(2))
σt0d=Ft0d/Anetto=1000x7.712/13200= 0.58 N/mm^2
σmyd=Myd/Wmy,netto=1E+06x1.947/4.840E+005= 4.02 N/mm^2
σmzd=Mzd/Wmz,netto=1E+06x0.000/1.320E+005= 0.00 N/mm^2

σt0d/ft0d+σmyd/fmyd+Km.σmzd/fmzd=0.053+0.215+0.000= 0.27 < 1 (EC5 Eq.6.17)
σt0d/ft0d+Km.σmyd/fmyd+σmzd/fmzd=0.053+0.151+0.000= 0.20 < 1 (EC5 Eq.6.18)
The check is satisfied

Rafter, elements: 2 , load combination No 13

Combined bending and axial tension, Ft0d=6.415kN, Myd=2.406kNm, Mzd=0.000kNm (EC5 §6.2.3)

Rectangular cross section, b=60mm, h=220mm, A=1.320E+004mm², Wy=4.840E+005mm³, Wz=1.320E+005mm³

Modification factor Kmod=0.90 (Table 3.1), material factor γM=1.30 (Table 2.3)

ft0k=16.00 N/mm², ft0d=Kmod·ft0k/γM=0.90x16.00/1.30=11.08N/mm²

fmyk=27.00 N/mm², fmyd=Kmod·fmyk/γM=0.90x27.00/1.30=18.69N/mm²

fmzk=27.00 N/mm², fmzd=Kmod·fmzk/γM=0.90x27.00/1.30=18.69N/mm²

Rectangular cross section Km=0.70 (EC5 §6.1.6.(2))

σt0d=Ft0d/Anetto=1000x6.415/13200= 0.49 N/mm²

σmyd=Myd/Wmy,netto=1E+06x2.406/4.840E+005= 4.97 N/mm²

σmzd=Mzd/Wmz,netto=1E+06x0.000/1.320E+005= 0.00 N/mm²

σt0d/ft0d+σmyd/fmyd+Km.σmzd/fmzd=0.044+0.266+0.000= 0.31 < 1 (EC5 Eq.6.17)

σt0d/ft0d+Km.σmyd/fmyd+σmzd/fmzd=0.044+0.186+0.000= 0.23 < 1 (EC5 Eq.6.18)

The check is satisfied

1.10.7. Ultimate limit state (EC5 EN1995-1-1:2009, §6)

Rafter, elements: 4

Loading [kN/m]	action	γg	γq	ψo
(Gk) Dead Gk1 = 0.314, Gk2 = 0.180, Gkf=0.300	Permanent	1.35	0.00	1.00
(Qk1) Snow QksL= 0.768, QksR= 0.546	Short-term	0.00	1.50	0.60
(Qk2) Snow QksL= 0.384, QksR= 0.546	Short-term	0.00	1.50	0.60
(Qk3) Snow QksL= 0.768, QksR= 0.273	Short-term	0.00	1.50	0.60
(Qk4) Wind QkwL= 0.123, QkwR=-0.133	Short-term	0.00	1.50	0.50
(Qk5) Wind QkwL=-0.162, QkwR= 0.182	Short-term	0.00	1.50	0.50
(Qkf) Live Qkf = 1.200	Medium-term	0.00	1.50	0.70
(Qki) Imposed (H) Qi = 0.240	Short-term	0.00	1.50	0.00

L.C.	Load combination	duration class	kmod	-N/Kmod	+N/Kmod	V/Kmod	M/Kmod
1	γg.G	Permanent	0.60	0.000	2.830	1.282	1.452
2	γg.G+γq.Q1	Short-term	0.90	0.000	8.105	2.561	3.237
3	γg.G+γq.Q2	Short-term	0.90	0.000	5.729	1.869	1.896
4	γg.G+γq.Q3	Short-term	0.90	0.000	7.371	2.400	3.443
5	γg.G+γq.Q4	Short-term	0.90	0.000	2.039	1.168	1.986
6	γg.G+γq.Q5	Short-term	0.90	0.000	1.887	0.855	0.968
7	γg.G+γq.Qf	Medium-term	0.80	-1.644	0.000	1.222	1.592
8	γg.G+γq.Qi	Short-term	0.90	0.000	4.016	1.429	1.625
9	γg.G+γq.Q1+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	0.000	6.233	2.880	4.059
10	γg.G+γq.Q1+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	0.000	6.157	2.723	3.550
11	γg.G+γq.Q2+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	0.000	3.858	2.188	2.718
12	γg.G+γq.Q2+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	0.000	3.782	2.031	2.209
13	γg.G+γq.Q3+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	0.000	5.500	2.719	4.265
14	γg.G+γq.Q3+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	0.000	5.424	2.562	3.756
15	γg.G+γq.Q4+γq.ψo.Q1+γq.ψo.Qf	Short-term	0.90	0.000	3.822	2.354	3.660
16	γg.G+γq.Q4+γq.ψo.Q2+γq.ψo.Qf	Short-term	0.90	0.000	2.397	1.938	2.856
17	γg.G+γq.Q4+γq.ψo.Q3+γq.ψo.Qf	Short-term	0.90	0.000	3.382	2.257	3.784
18	γg.G+γq.Q5+γq.ψo.Q1+γq.ψo.Qf	Short-term	0.90	0.000	3.670	2.041	2.642
19	γg.G+γq.Q5+γq.ψo.Q2+γq.ψo.Qf	Short-term	0.90	0.000	2.245	1.625	1.838
20	γg.G+γq.Q5+γq.ψo.Q3+γq.ψo.Qf	Short-term	0.90	0.000	3.230	1.944	2.766
21	γg.G+γq.Qf+γq.ψo.Q1+γq.ψo.Q4	Short-term	0.90	0.000	2.911	2.267	3.285
22	γg.G+γq.Qf+γq.ψo.Q1+γq.ψo.Q5	Short-term	0.90	0.000	2.835	2.110	2.776
23	γg.G+γq.Qf+γq.ψo.Q2+γq.ψo.Q4	Short-term	0.90	0.000	1.486	1.851	2.481
24	γg.G+γq.Qf+γq.ψo.Q2+γq.ψo.Q5	Short-term	0.90	0.000	1.410	1.695	1.972
25	γg.G+γq.Qf+γq.ψo.Q3+γq.ψo.Q4	Short-term	0.90	0.000	2.471	2.170	3.409
26	γg.G+γq.Qf+γq.ψo.Q3+γq.ψo.Q5	Short-term	0.90	0.000	2.395	2.014	2.900
27	γg.G+γq.Qi+γq.ψo.Q1+γq.ψo.Q4+γq.ψo.Q	Short-term	0.90	0.000	5.875	2.771	3.808
28	γg.G+γq.Qi+γq.ψo.Q1+γq.ψo.Q5+γq.ψo.Q	Short-term	0.90	0.000	5.799	2.615	3.299
29	γg.G+γq.Qi+γq.ψo.Q2+γq.ψo.Q4+γq.ψo.Q	Short-term	0.90	0.000	4.450	2.356	3.003
30	γg.G+γq.Qi+γq.ψo.Q2+γq.ψo.Q5+γq.ψo.Q	Short-term	0.90	0.000	4.374	2.199	2.494
31	γg.G+γq.Qi+γq.ψo.Q3+γq.ψo.Q4+γq.ψo.Q	Short-term	0.90	0.000	5.435	2.675	3.932
32	γg.G+γq.Qi+γq.ψo.Q3+γq.ψo.Q5+γq.ψo.Q	Short-term	0.90	0.000	5.359	2.518	3.423
	Maximum values			-1.644	8.105	2.880	4.265

1.10.8. Check of cross section Rafter, elements: 4

Rafter, elements: 4 , load combination No 2

Tension parallel to the grain, Ft0d=7.294 kN (EC5 §6.1.2)

Rectangular cross section, b=60 mm, h=220 mm, A= 13 200 mm²

Modification factor Kmod=0.90 (Table 3.1), material factor γM=1.30 (Table 2.3)

ft0k=16.00 N/mm², ft0d=Kmod·ft0k/γM=0.90x16.00/1.30=11.08N/mm² (EC5 Eq.2.14)

Ft0d=7.294 kN, σt0d=Ft0d/Anetto=1000x7.294/13200=0.55N/mm² < 11.08N/mm²=ft0d (Eq.6.1)

The check is satisfied

Rafter, elements: 4 , load combination No 7
Compression parallel to the grain, Fc0d=-1.315 kN (EC5 §6.1.4)
Rectangular cross section, b=60 mm, h=220 mm, A= 13 200 mm^2
Modification factor Kmod=0.80 (Table 3.1), material factor γM=1.30 (Table 2.3)
fc0k=22.00 N/mm^2, fc0d=Kmod·fc0k/γM=0.80x22.00/1.30=13.54N/mm^2 (EC5 Eq.2.14)
Fc0d=-1.315 kN, σc0d=Fc0d/Anetto=1000x1.315/13200=0.10N/mm^2 < 13.54N/mm^2=fc0d (Eq.6.2)
The check is satisfied

Rafter, elements: 4 , load combination No 9
Shear, Fv=2.592 kN (EC5 §6.1.7)
Rectangular cross section, bef=0.67x60=40 mm, h=220 mm, A= 8 800 mm^2
Modification factor Kmod=0.90 (Table 3.1), material factor γM=1.30 (Table 2.3)
fvk=4.00 N/mm^2, fvd=Kmod·fvk/γM=0.90x4.00/1.30=2.77N/mm^2 (EC5 Eq.2.14)
Fv=2.592 kN, τv0d=1.50Fv0d/Anetto=1000x1.50x2.592/8800=0.44N/mm^2 < 2.77N/mm^2=fv0d (Eq.6.13)
The check is satisfied

Rafter, elements: 4 , load combination No 13
Bending, Myd=3.839 kNm, Mzd=0.000 kNm (EC5 §6.1.6)
Rectangular cross section, b=60mm, h=220mm, A=1.320E+004mm^2, Wy=4.840E+005mm^3, Wz=1.320E+005mm^3
Modification factor Kmod=0.90 (Table 3.1), material factor γM=1.30 (Table 2.3)
fmyk=27.00 N/mm^2, fmyd=Kmod·fmyk/γM=0.90x27.00/1.30=18.69N/mm^2
fmzk=27.00 N/mm^2, fmzd=Kmod·fmzk/γM=0.90x27.00/1.30=18.69N/mm^2

Rectangular cross section Km=0.70 (EC5 §6.1.6.(2))
σmyd=Myd/Wmy,netto=1E+06x3.839/4.840E+005= 7.93 N/mm^2
σmzd=Mzd/Wmz,netto=1E+06x0.000/1.320E+005= 0.00 N/mm^2

σmyd/fmyd+Km.σmzd/fmzd=0.424+0.000= 0.42 < 1 (EC5 Eq.6.11)
Km.σmyd/fmyd+σmzd/fmzd=0.297+0.000= 0.30 < 1 (EC5 Eq.6.12)
The check is satisfied

Negligible compressive stress, combined bending-compression check is omitted (EC5 §6.2.4)

Rafter, elements: 4 , load combination No 7
Column stability with bending, Fc0d=-1.315kN, Myd=1.273kNm, Mzd=0.000kNm (EC5 §6.3.2)
Rectangular cross section, b=60mm, h=220mm, A=1.320E+004mm^2, Wy=4.840E+005mm^3, Wz=1.320E+005mm^3
Modification factor Kmod=0.80 (Table 3.1), material factor γM=1.30 (Table 2.3, E005=7700N/mm^2
fc0k=22.00 N/mm^2, fc0d=Kmod·fc0k/γM=0.80x22.00/1.30=13.54N/mm^2
fmyk=27.00 N/mm^2, fmyd=Kmod·fmyk/γM=0.80x27.00/1.30=16.62N/mm^2
fmzk=27.00 N/mm^2, fmzd=Kmod·fmzk/γM=0.80x27.00/1.30=16.62N/mm^2

Rectangular cross section Km=0.70 (EC5 §6.1.6.(2))
σc0d=Fc0d/Anetto=1000x1.315/13200= 0.10 N/mm^2
σmyd=Myd/Wmy,netto=1E+06x1.273/4.840E+005= 2.63 N/mm^2
σmzd=Mzd/Wmz,netto=1E+06x0.000/1.320E+005= 0.00 N/mm^2

Buckling length Sk
Sky= 1.00x1.921=1.921 m= 1921 mm (most unfavourable)
Skz= 0.16x1.921=0.300 m= 300 mm (effective length/total length=0.30/1.92=0.16)

Slenderness
iy=√(Iy/A)=0.289x 220= 64 mm, λy= 1921/ 64= 30.01
iz=√(Iz/A)=0.289x 60= 17 mm, λz= 300/ 17= 17.65

Critical stresses
σc,crity=π^{2}E005/λy^2= 84.38 N/mm^2, λrel,y=√(fc0k/σc,crity)= 0.51 (EC5 Eq.6.21)
σc,critz=π^{2}E005/λz^2= 243.95 N/mm^2, λrel,z=√(fc0k/σc,critz)= 0.30 (EC5 Eq.6.22)

βc=0.20 (solid timber)
ky=0.5[1+βc(λrely-0.3)+λrely^2]= 0.65, Kcy=1/(ky+√(ky^2-λrely^2))=0.947 (Eq.6.27 6.25)
kz=0.5[1+βc(λrelz-0.3)+λrelz^2]= 0.55, Kcz=1/(kz+√(kz^2-λrelz^2))=1.000 (Eq.6.28 6.26)

σc0d/(Kcy·fc0d)+σmyd/fmyd+Km.σmzd/fmzd=0.008+0.158+0.000= 0.17 < 1 (EC5 Eq.6.23)
σc0d/(Kcz·fc0d)+Km.σmyd/fmyd+σmzd/fmzd=0.007+0.111+0.000= 0.12 < 1 (EC5 Eq.6.24)
The check is satisfied

Rafter, elements: 4 , load combination No 13
Lateral torsional stability of beams, Myd=3.839 kNm, Mzd=0.000 kNm (EC5 §6.3.3)
Rectangular cross section, b=60mm, h=220mm, A=1.320E+004mm^2, Wy=4.840E+005mm^3, Wz=1.320E+005mm^3
Modification factor Kmod=0.90 (Table 3.1), material factor γM=1.30 (Table 2.3)
fc0k=22.00 N/mm^2, fc0d=Kmod·fc0k/γM=0.90x22.00/1.30=15.23N/mm^2
fmyk=27.00 N/mm^2, fmyd=Kmod·fmyk/γM=0.90x27.00/1.30=18.69N/mm^2
fmzk=27.00 N/mm^2, fmzd=Kmod·fmzk/γM=0.90x27.00/1.30=18.69N/mm^2

Rectangular cross section Km=0.70 (EC5 §6.1.6.(2))
σmyd=Myd/Wmy,netto=1E+06x3.839/4.840E+005= 7.93 N/mm^2
σmzd=Mzd/Wmz,netto=1E+06x0.000/1.320E+005= 0.00 N/mm^2

Buckling length Sk
Sky= 1.00x1.921=1.921 m= 1921 mm (most unfavourable)
Skz= 0.16x1.921=0.300 m= 300 mm (effective length/total length=0.30/1.92=0.16)

Slenderness
iy=√(Iy/A)=0.289x 220= 64 mm, λy= 1921/ 64= 30.01
iz=√(Iz/A)=0.289x 60= 17 mm, λz= 300/ 17= 17.65

σm,crit=0.78.b^2·E005/(h·Lef)=0.78x60^{2}x 7700/(220x1729)= 56.85N/mm^2 (EC5 Eq.6.32)
σm,crit=0.78.b^2·E005/(h·Lef)=0.78x220^{2}x 7700/(60x300)=16149.47N/mm^2 (EC5 Eq.6.32)
Critical stresses
σm,crity= 56.85 N/mm^2, λrel,my=√(fmyk/σm,crity)= 0.69 (EC5 Eq.6.30)
σm,critz=16149.47 N/mm^2, λrel,mz=√(fmzk/σm,critz)= 0.04 (EC5 Eq.6.30)

λrel,my=0.69, (λrel<=0.75), Kcrity=1.00 (EC5 Eq.6.34)
λrel,mz=0.04, (λrel<=0.75), Kcritz=1.00 (EC5 Eq.6.34)

σmyd/(Kcrity·fmyd)+Km.σmzd/(Kcritz·fmzd)=0.424+0.000= 0.42 < 1 (EC5 Eq.6.33)
Km.σmyd/(Kcrity·fmyd)+σmzd/(Kcritz·fmzd)=0.297+0.000= 0.30 < 1 (EC5 Eq.6.33)
The check is satisfied

Rafter, elements: 4 , load combination No 2
Combined bending and axial tension, Ft0d=7.294kN, Myd=2.913kNm, Mzd=0.000kNm (EC5 §6.2.3)
Rectangular cross section, b=60mm, h=220mm, A=1.320E+004mm^2, Wy=4.840E+005mm^3, Wz=1.320E+005mm^3
Modification factor Kmod=0.90 (Table 3.1), material factor γM=1.30 (Table 2.3)
ft0k=16.00 N/mm^2, ft0d=Kmod·ft0k/γM=0.90x16.00/1.30=11.08N/mm^2
fmyk=27.00 N/mm^2, fmyd=Kmod·fmyk/γM=0.90x27.00/1.30=18.69N/mm^2
fmzk=27.00 N/mm^2, fmzd=Kmod·fmzk/γM=0.90x27.00/1.30=18.69N/mm^2

Rectangular cross section Km=0.70 (EC5 §6.1.6.(2))
σt0d=Ft0d/Anetto=1000x7.294/13200= 0.55 N/mm^2
σmyd=Myd/Wmy,netto=1E+06x2.913/4.840E+005= 6.02 N/mm^2
σmzd=Mzd/Wmz,netto=1E+06x0.000/1.320E+005= 0.00 N/mm^2

σt0d/ft0d+σmyd/fmyd+Km.σmzd/fmzd=0.050+0.322+0.000= 0.37 < 1 (EC5 Eq.6.17)
σt0d/ft0d+Km.σmyd/fmyd+σmzd/fmzd=0.050+0.225+0.000= 0.28 < 1 (EC5 Eq.6.18)
The check is satisfied

Rafter, elements: 4 , load combination No 13

Combined bending and axial tension, Ft0d=4.950kN, Myd=3.839kNm, Mzd=0.000kNm (EC5 §6.2.3)

Rectangular cross section, b=60mm, h=220mm, A=1.320E+004mm², Wy=4.840E+005mm³, Wz=1.320E+005mm³

Modification factor Kmod=0.90 (Table 3.1), material factor γM=1.30 (Table 2.3)

ft0k=16.00 N/mm², ft0d=Kmod·ft0k/γM=0.90x16.00/1.30=11.08N/mm²

fmyk=27.00 N/mm², fmyd=Kmod·fmyk/γM=0.90x27.00/1.30=18.69N/mm²

fmzk=27.00 N/mm², fmzd=Kmod·fmzk/γM=0.90x27.00/1.30=18.69N/mm²

Rectangular cross section Km=0.70 (EC5 §6.1.6.(2))

σt0d=Ft0d/Anetto=1000x4.950/13200= 0.37 N/mm²

σmyd=Myd/Wmy,netto=1E+06x3.839/4.840E+005= 7.93 N/mm²

σmzd=Mzd/Wmz,netto=1E+06x0.000/1.320E+005= 0.00 N/mm²

σt0d/ft0d+σmyd/fmyd+Km.σmzd/fmzd=0.034+0.424+0.000= 0.46 < 1 (EC5 Eq.6.17)

σt0d/ft0d+Km.σmyd/fmyd+σmzd/fmzd=0.034+0.297+0.000= 0.33 < 1 (EC5 Eq.6.18)

The check is satisfied

1.10.9. Ultimate limit state (EC5 EN1995-1-1:2009, §6)
Rafter, elements: 13, 14

Loading [kN/m]	action	γg	γq	ψo
(Gk) Dead Gk1 = 0.314, Gk2 = 0.180, Gkf=0.300	Permanent	1.35	0.00	1.00
(Qk1) Snow QksL= 0.768, QksR= 0.546	Short-term	0.00	1.50	0.60
(Qk2) Snow QksL= 0.384, QksR= 0.546	Short-term	0.00	1.50	0.60
(Qk3) Snow QksL= 0.768, QksR= 0.273	Short-term	0.00	1.50	0.60
(Qk4) Wind QkwL= 0.123, QkwR=-0.133	Short-term	0.00	1.50	0.50
(Qk5) Wind QkwL=-0.162, QkwR= 0.182	Short-term	0.00	1.50	0.50
(Qkf) Live Qkf = 1.200	Medium-term	0.00	1.50	0.70
(Qki) Imposed (H) Qi = 0.240	Short-term	0.00	1.50	0.00

L.C.	Load combination	duration class	kmod	-N/Kmod	+N/Kmod	V/Kmod	M/Kmod
1	γg.G	Permanent	0.60	0.000	0.340	0.424	0.163
2	γg.G+γq.Q1	Short-term	0.90	0.000	0.568	0.985	0.323
3	γg.G+γq.Q2	Short-term	0.90	0.000	0.568	0.710	0.273
4	γg.G+γq.Q3	Short-term	0.90	0.000	0.438	0.985	0.323
5	γg.G+γq.Q4	Short-term	0.90	0.000	0.226	0.283	0.093
6	γg.G+γq.Q5	Short-term	0.90	0.000	0.226	0.283	0.109
7	γg.G+γq.Qf	Medium-term	0.80	0.000	0.255	0.318	0.122
8	γg.G+γq.Qi	Short-term	0.90	0.000	0.376	0.502	0.181
9	γg.G+γq.Q1+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	0.000	0.568	0.985	0.323
10	γg.G+γq.Q1+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	0.000	0.568	0.896	0.294
11	γg.G+γq.Q2+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	0.000	0.568	0.634	0.240
12	γg.G+γq.Q2+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	0.000	0.568	0.710	0.273
13	γg.G+γq.Q3+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	0.000	0.438	0.985	0.323
14	γg.G+γq.Q3+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	0.000	0.438	0.896	0.294
15	γg.G+γq.Q4+γq.ψo.Q1+γq.ψo.Qf	Short-term	0.90	0.000	0.431	0.704	0.231
16	γg.G+γq.Q4+γq.ψo.Q2+γq.ψo.Qf	Short-term	0.90	0.000	0.431	0.493	0.162
17	γg.G+γq.Q4+γq.ψo.Q3+γq.ψo.Qf	Short-term	0.90	0.000	0.329	0.704	0.231
18	γg.G+γq.Q5+γq.ψo.Q1+γq.ψo.Qf	Short-term	0.90	0.000	0.431	0.539	0.207
19	γg.G+γq.Q5+γq.ψo.Q2+γq.ψo.Qf	Short-term	0.90	0.000	0.431	0.539	0.207
20	γg.G+γq.Q5+γq.ψo.Q3+γq.ψo.Qf	Short-term	0.90	0.000	0.329	0.527	0.173
21	γg.G+γq.Qf+γq.ψo.Q1+γq.ψo.Q4	Short-term	0.90	0.000	0.431	0.771	0.253
22	γg.G+γq.Qf+γq.ψo.Q1+γq.ψo.Q5	Short-term	0.90	0.000	0.431	0.704	0.231
23	γg.G+γq.Qf+γq.ψo.Q2+γq.ψo.Q4	Short-term	0.90	0.000	0.431	0.561	0.184
24	γg.G+γq.Qf+γq.ψo.Q2+γq.ψo.Q5	Short-term	0.90	0.000	0.431	0.539	0.207
25	γg.G+γq.Qf+γq.ψo.Q3+γq.ψo.Q4	Short-term	0.90	0.000	0.329	0.771	0.253
26	γg.G+γq.Qf+γq.ψo.Q3+γq.ψo.Q5	Short-term	0.90	0.000	0.329	0.704	0.231
27	γg.G+γq.Qi+γq.ψo.Q1+γq.ψo.Q4+γq.ψo.Q	Short-term	0.90	0.000	0.581	0.923	0.303
28	γg.G+γq.Qi+γq.ψo.Q1+γq.ψo.Q5+γq.ψo.Q	Short-term	0.90	0.000	0.581	0.835	0.279
29	γg.G+γq.Qi+γq.ψo.Q2+γq.ψo.Q4+γq.ψo.Q	Short-term	0.90	0.000	0.581	0.713	0.246
30	γg.G+γq.Qi+γq.ψo.Q2+γq.ψo.Q5+γq.ψo.Q	Short-term	0.90	0.000	0.581	0.726	0.279
31	γg.G+γq.Qi+γq.ψo.Q3+γq.ψo.Q4+γq.ψo.Q	Short-term	0.90	0.000	0.479	0.923	0.303
32	γg.G+γq.Qi+γq.ψo.Q3+γq.ψo.Q5+γq.ψo.Q	Short-term	0.90	0.000	0.479	0.835	0.274
	Maximum values			0.000	0.581	0.985	0.323

1.10.10. Check of cross section Rafter, elements: 13, 14

Rafter, elements: 13, 14 , load combination No 28
Tension parallel to the grain, Ft0d=0.523 kN (EC5 §6.1.2)
Rectangular cross section, b=60 mm, h=220 mm, A= 13 200 mm²
Modification factor Kmod=0.90 (Table 3.1), material factor γM=1.30 (Table 2.3)
ft0k=16.00 N/mm², ft0d=Kmod·ft0k/γM=0.90x16.00/1.30=11.08N/mm² (EC5 Eq.2.14)
Ft0d=0.523 kN, σt0d=Ft0d/Anetto=1000x0.523/13200=0.04N/mm² < 11.08N/mm²=ft0d (Eq.6.1)
The check is satisfied

Rafter, elements: 13, 14 , load combination No 9
Shear, Fv=0.886 kN (EC5 §6.1.7)
Rectangular cross section, bef=0.67x60=40 mm, h=220 mm, A= 8 800 mm²
Modification factor Kmod=0.90 (Table 3.1), material factor γM=1.30 (Table 2.3)
fvk=4.00 N/mm², fvd=Kmod·fvk/γM=0.90x4.00/1.30=2.77N/mm² (EC5 Eq.2.14)
Fv=0.886 kN, τv0d=1.50Fv0d/Anetto=1000x1.50x0.886/8800=0.15N/mm² < 2.77N/mm²=fv0d (Eq.6.13)
The check is satisfied

Rafter, elements: 13, 14 , load combination No 13
Bending, Myd=0.291 kNm, Mzd=0.000 kNm (EC5 §6.1.6)
Rectangular cross section, b=60mm, h=220mm, A=1.320E+004mm², Wy=4.840E+005mm³, Wz=1.320E+005mm³
Modification factor Kmod=0.90 (Table 3.1), material factor γM=1.30 (Table 2.3)
fmyk=27.00 N/mm², fmyd=Kmod·fmyk/γM=0.90x27.00/1.30=18.69N/mm²
fmzk=27.00 N/mm², fmzd=Kmod·fmzk/γM=0.90x27.00/1.30=18.69N/mm²

Rectangular cross section Km=0.70 (EC5 §6.1.6.(2))
σmyd=Myd/Wmy,netto=1E+06x0.291/4.840E+005= 0.60 N/mm²
σmzd=Mzd/Wmz,netto=1E+06x0.000/1.320E+005= 0.00 N/mm²

σmyd/fmyd+Km.σmzd/fmzd=0.032+0.000= 0.03 < 1 (EC5 Eq.6.11)
Km.σmyd/fmyd+σmzd/fmzd=0.023+0.000= 0.02 < 1 (EC5 Eq.6.12)
The check is satisfied

Rafter, elements: 13, 14 , load combination No 13
Lateral torsional stability of beams, Myd=0.291 kNm, Mzd=0.000 kNm (EC5 §6.3.3)
Rectangular cross section, b=60mm, h=220mm, A=1.320E+004mm², Wy=4.840E+005mm³, Wz=1.320E+005mm³
Modification factor Kmod=0.90 (Table 3.1), material factor γM=1.30 (Table 2.3)
fc0k=22.00 N/mm², fc0d=Kmod·fc0k/γM=0.90x22.00/1.30=15.23N/mm²
fmyk=27.00 N/mm², fmyd=Kmod·fmyk/γM=0.90x27.00/1.30=18.69N/mm²
fmzk=27.00 N/mm², fmzd=Kmod·fmzk/γM=0.90x27.00/1.30=18.69N/mm²

Rectangular cross section Km=0.70 (EC5 §6.1.6.(2))
σmyd=Myd/Wmy,netto=1E+06x0.291/4.840E+005= 0.60 N/mm²
σmzd=Mzd/Wmz,netto=1E+06x0.000/1.320E+005= 0.00 N/mm²

Buckling length Sk
Sky= 1.00x1.313=1.313 m= 1313 mm (most unfavourable)
Skz= 0.23x1.313=0.300 m= 300 mm (effective length/total length=0.30/1.31=0.23)

Slenderness
iy=√(Iy/A)=0.289x 220= 64 mm, λy= 1313/ 64= 20.52
iz=√(Iz/A)=0.289x 60= 17 mm, λz= 300/ 17= 17.65

σm,crit=0.78.b²·E005/(h·Lef)=0.78x60²x 7700/(220x1182)= 83.16N/mm² (EC5 Eq.6.32)
σm,crit=0.78.b²·E005/(h·Lef)=0.78x220²x 7700/(60x300)=16149.47N/mm² (EC5 Eq.6.32)
Critical stresses
σm,crity= 83.16 N/mm², λrel,my=√(fmyk/σm,crity)= 0.57 (EC5 Eq.6.30)
σm,critz=16149.47 N/mm², λrel,mz=√(fmzk/σm,critz)= 0.04 (EC5 Eq.6.30)

λrel,my=0.57, (λrel<=0.75), Kcrity=1.00 (EC5 Eq.6.34)
λrel,mz=0.04, (λrel<=0.75), Kcritz=1.00 (EC5 Eq.6.34)

σmyd/(Kcrity·fmyd)+Km.σmzd/(Kcritz·fmzd)=0.032+0.000= 0.03 < 1 (EC5 Eq.6.33)
Km.σmyd/(Kcrity·fmyd)+σmzd/(Kcritz·fmzd)=0.023+0.000= 0.02 < 1 (EC5 Eq.6.33)
The check is satisfied

Negligible tensile stress, combined bending-tension check is omitted (EC5 §6.2.3)

1.10.11. Ultimate limit state (EC5 EN1995-1-1:2009, §6)

Tie, elements: 5

Loading [kN/m]	action	γg	γq	ψo
(Gk) Dead Gk1 = 0.314, Gk2 = 0.180, Gkf=0.300	Permanent	1.35	0.00	1.00
(Qk1) Snow QksL= 0.768, QksR= 0.546	Short-term	0.00	1.50	0.60
(Qk2) Snow QksL= 0.384, QksR= 0.546	Short-term	0.00	1.50	0.60
(Qk3) Snow QksL= 0.768, QksR= 0.273	Short-term	0.00	1.50	0.60
(Qk4) Wind QkwL= 0.123, QkwR=-0.133	Short-term	0.00	1.50	0.50
(Qk5) Wind QkwL=-0.162, QkwR= 0.182	Short-term	0.00	1.50	0.50
(Qkf) Live Qkf = 1.200	Medium-term	0.00	1.50	0.70
(Qki) Imposed (H) Qi = 0.240	Short-term	0.00	1.50	0.00

L.C.	Load combination	duration class	kmod	-N/Kmod	+N/Kmod	V/Kmod	M/Kmod
1	γg.G	Permanent	0.60	0.000	1.179	3.057	2.269
2	γg.G+γq.Q1	Short-term	0.90	0.000	1.164	2.107	1.587
3	γg.G+γq.Q2	Short-term	0.90	0.000	0.985	2.059	1.494
4	γg.G+γq.Q3	Short-term	0.90	0.000	1.154	2.121	1.619
5	γg.G+γq.Q4	Short-term	0.90	0.000	1.918	2.172	1.711
6	γg.G+γq.Q5	Short-term	0.90	0.000	0.786	2.038	1.513
7	γg.G+γq.Qf	Medium-term	0.80	0.000	2.846	8.599	6.467
8	γg.G+γq.Qi	Short-term	0.90	0.000	0.907	2.056	1.504
9	γg.G+γq.Q1+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	0.000	2.951	6.098	4.478
10	γg.G+γq.Q1+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	0.000	2.385	6.031	4.458
11	γg.G+γq.Q2+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	0.000	2.772	6.049	4.479
12	γg.G+γq.Q2+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	0.000	2.206	5.982	4.459
13	γg.G+γq.Q3+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	0.000	2.941	6.112	4.487
14	γg.G+γq.Q3+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	0.000	2.375	6.045	4.467
15	γg.G+γq.Q4+γq.ψo.Q1+γq.ψo.Qf	Short-term	0.90	0.000	3.366	6.137	4.506
16	γg.G+γq.Q4+γq.ψo.Q2+γq.ψo.Qf	Short-term	0.90	0.000	3.258	6.108	4.507
17	γg.G+γq.Q4+γq.ψo.Q3+γq.ψo.Qf	Short-term	0.90	0.000	3.359	6.146	4.511
18	γg.G+γq.Q5+γq.ψo.Q1+γq.ψo.Qf	Short-term	0.90	0.000	2.234	6.003	4.466
19	γg.G+γq.Q5+γq.ψo.Q2+γq.ψo.Qf	Short-term	0.90	0.000	2.126	5.974	4.467
20	γg.G+γq.Q5+γq.ψo.Q3+γq.ψo.Qf	Short-term	0.90	0.000	2.227	6.012	4.471
21	γg.G+γq.Qf+γq.ψo.Q1+γq.ψo.Q4	Short-term	0.90	0.000	3.323	7.752	5.757
22	γg.G+γq.Qf+γq.ψo.Q1+γq.ψo.Q5	Short-term	0.90	0.000	2.757	7.685	5.737
23	γg.G+γq.Qf+γq.ψo.Q2+γq.ψo.Q4	Short-term	0.90	0.000	3.215	7.722	5.758
24	γg.G+γq.Qf+γq.ψo.Q2+γq.ψo.Q5	Short-term	0.90	0.000	2.649	7.656	5.738
25	γg.G+γq.Qf+γq.ψo.Q3+γq.ψo.Q4	Short-term	0.90	0.000	3.317	7.760	5.762
26	γg.G+γq.Qf+γq.ψo.Q3+γq.ψo.Q5	Short-term	0.90	0.000	2.751	7.693	5.742
27	γg.G+γq.Qi+γq.ψo.Q1+γq.ψo.Q4+γq.ψo.Q	Short-term	0.90	0.000	2.920	6.088	4.478
28	γg.G+γq.Qi+γq.ψo.Q1+γq.ψo.Q5+γq.ψo.Q	Short-term	0.90	0.000	2.354	6.021	4.458
29	γg.G+γq.Qi+γq.ψo.Q2+γq.ψo.Q4+γq.ψo.Q	Short-term	0.90	0.000	2.813	6.059	4.478
30	γg.G+γq.Qi+γq.ψo.Q2+γq.ψo.Q5+γq.ψo.Q	Short-term	0.90	0.000	2.247	5.992	4.458
31	γg.G+γq.Qi+γq.ψo.Q3+γq.ψo.Q4+γq.ψo.Q	Short-term	0.90	0.000	2.914	6.097	4.483
32	γg.G+γq.Qi+γq.ψo.Q3+γq.ψo.Q5+γq.ψo.Q	Short-term	0.90	0.000	2.348	6.030	4.463
	Maximum values			0.000	3.366	8.599	6.467

1.10.12. Check of cross section Tie, elements: 5

Tie, elements: 5 , load combination No 15

Tension parallel to the grain, Ft0d=3.029 kN (EC5 §6.1.2)

Rectangular cross section, b=60 mm, h=220 mm, A= 13 200 mm²

Modification factor Kmod=0.90 (Table 3.1), material factor γM=1.30 (Table 2.3)

ft0k=16.00 N/mm², ft0d=Kmod·ft0k/γM=0.90x16.00/1.30=11.08N/mm² (EC5 Eq.2.14)

Ft0d=3.029 kN, σt0d=Ft0d/Anetto=1000x3.029/13200=0.23N/mm² < 11.08N/mm²=ft0d (Eq.6.1)

The check is satisfied

Tie, elements: 5 , load combination No 7

Shear, Fv=6.879 kN (EC5 §6.1.7)
Rectangular cross section, bef=0.67x60=40 mm, h=220 mm, A= 8 800 mm^2
Modification factor Kmod=0.80 (Table 3.1), material factor γM=1.30 (Table 2.3)
fvk=4.00 N/mm^2, fvd=Kmod·fvk/γM=0.80x4.00/1.30=2.46N/mm^2 (EC5 Eq.2.14)
Fv=6.879 kN, τv0d=1.50Fv0d/Anetto=1000x1.50x6.879/8800=1.17N/mm^2 < 2.46N/mm^2=fv0d (Eq.6.13)
The check is satisfied

Tie, elements: 5 , load combination No 7

Bending, Myd=5.174 kNm, Mzd=0.000 kNm (EC5 §6.1.6)
Rectangular cross section, b=60mm, h=220mm, A=1.320E+004mm^2, Wy=4.840E+005mm^3, Wz=1.320E+005mm^3
Modification factor Kmod=0.80 (Table 3.1), material factor γM=1.30 (Table 2.3)
fmyk=27.00 N/mm^2, fmyd=Kmod·fmyk/γM=0.80x27.00/1.30=16.62N/mm^2
fmzk=27.00 N/mm^2, fmzd=Kmod·fmzk/γM=0.80x27.00/1.30=16.62N/mm^2

Rectangular cross section Km=0.70 (EC5 §6.1.6.(2))
σmyd=Myd/Wmy,netto=1E+06x5.174/4.840E+005=10.69 N/mm^2
σmzd=Mzd/Wmz,netto=1E+06x0.000/1.320E+005= 0.00 N/mm^2

σmyd/fmyd+Km.σmzd/fmzd=0.643+0.000= 0.64 < 1 (EC5 Eq.6.11)
Km.σmyd/fmyd+σmzd/fmzd=0.450+0.000= 0.45 < 1 (EC5 Eq.6.12)
The check is satisfied

Tie, elements: 5 , load combination No 15

Combined bending and axial tension, Ft0d=3.029kN, Myd=4.055kNm, Mzd=0.000kNm (EC5 §6.2.3)
Rectangular cross section, b=60mm, h=220mm, A=1.320E+004mm^2, Wy=4.840E+005mm^3, Wz=1.320E+005mm^3
Modification factor Kmod=0.90 (Table 3.1), material factor γM=1.30 (Table 2.3)
ft0k=16.00 N/mm^2, ft0d=Kmod·ft0k/γM=0.90x16.00/1.30=11.08N/mm^2
fmyk=27.00 N/mm^2, fmyd=Kmod·fmyk/γM=0.90x27.00/1.30=18.69N/mm^2
fmzk=27.00 N/mm^2, fmzd=Kmod·fmzk/γM=0.90x27.00/1.30=18.69N/mm^2

Rectangular cross section Km=0.70 (EC5 §6.1.6.(2))
σt0d=Ft0d/Anetto=1000x3.029/13200= 0.23 N/mm^2
σmyd=Myd/Wmy,netto=1E+06x4.055/4.840E+005= 8.38 N/mm^2
σmzd=Mzd/Wmz,netto=1E+06x0.000/1.320E+005= 0.00 N/mm^2

σt0d/ft0d+σmyd/fmyd+Km.σmzd/fmzd=0.021+0.448+0.000= 0.47 < 1 (EC5 Eq.6.17)
σt0d/ft0d+Km.σmyd/fmyd+σmzd/fmzd=0.021+0.314+0.000= 0.33 < 1 (EC5 Eq.6.18)
The check is satisfied

Tie, elements: 5 , load combination No 7

Combined bending and axial tension, Ft0d=2.277kN, Myd=5.174kNm, Mzd=0.000kNm (EC5 §6.2.3)
Rectangular cross section, b=60mm, h=220mm, A=1.320E+004mm^2, Wy=4.840E+005mm^3, Wz=1.320E+005mm^3
Modification factor Kmod=0.80 (Table 3.1), material factor γM=1.30 (Table 2.3)
ft0k=16.00 N/mm^2, ft0d=Kmod·ft0k/γM=0.80x16.00/1.30=9.85N/mm^2
fmyk=27.00 N/mm^2, fmyd=Kmod·fmyk/γM=0.80x27.00/1.30=16.62N/mm^2
fmzk=27.00 N/mm^2, fmzd=Kmod·fmzk/γM=0.80x27.00/1.30=16.62N/mm^2

Rectangular cross section Km=0.70 (EC5 §6.1.6.(2))
σt0d=Ft0d/Anetto=1000x2.277/13200= 0.17 N/mm^2
σmyd=Myd/Wmy,netto=1E+06x5.174/4.840E+005=10.69 N/mm^2
σmzd=Mzd/Wmz,netto=1E+06x0.000/1.320E+005= 0.00 N/mm^2

σt0d/ft0d+σmyd/fmyd+Km.σmzd/fmzd=0.018+0.643+0.000= 0.66 < 1 (EC5 Eq.6.17)
σt0d/ft0d+Km.σmyd/fmyd+σmzd/fmzd=0.018+0.450+0.000= 0.47 < 1 (EC5 Eq.6.18)
The check is satisfied

1.10.13. Ultimate limit state (EC5 EN1995-1-1:2009, §6)

Tie, elements: 6

Loading [kN/m]	action	γg	γq	ψo
(Gk) Dead Gk1 = 0.314, Gk2 = 0.180, Gkf=0.300	Permanent	1.35	0.00	1.00
(Qk1) Snow QksL= 0.768, QksR= 0.546	Short-term	0.00	1.50	0.60
(Qk2) Snow QksL= 0.384, QksR= 0.546	Short-term	0.00	1.50	0.60
(Qk3) Snow QksL= 0.768, QksR= 0.273	Short-term	0.00	1.50	0.60
(Qk4) Wind QkwL= 0.123, QkwR=-0.133	Short-term	0.00	1.50	0.50
(Qk5) Wind QkwL=-0.162, QkwR= 0.182	Short-term	0.00	1.50	0.50
(Qkf) Live Qkf = 1.200	Medium-term	0.00	1.50	0.70
(Qki) Imposed (H) Qi = 0.240	Short-term	0.00	1.50	0.00

L.C.	Load combination	duration class	kmod	-N/Kmod	+N/Kmod	V/Kmod	M/Kmod
1	γg.G	Permanent	0.60	0.000	1.159	1.947	2.235
2	γg.G+γq.Q1	Short-term	0.90	0.000	1.135	1.160	1.691
3	γg.G+γq.Q2	Short-term	0.90	0.000	0.966	1.173	1.464
4	γg.G+γq.Q3	Short-term	0.90	0.000	1.123	1.185	1.771
5	γg.G+γq.Q4	Short-term	0.90	0.000	1.891	1.203	1.879
6	γg.G+γq.Q5	Short-term	0.90	0.000	0.773	1.298	1.490
7	γg.G+γq.Qf	Medium-term	0.80	0.000	2.807	5.852	6.392
8	γg.G+γq.Qi	Short-term	0.90	0.000	0.889	1.211	1.476
9	γg.G+γq.Q1+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	0.000	2.901	3.562	4.395
10	γg.G+γq.Q1+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	0.000	2.341	3.733	4.385
11	γg.G+γq.Q2+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	0.000	2.732	3.736	4.409
12	γg.G+γq.Q2+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	0.000	2.172	3.906	4.399
13	γg.G+γq.Q3+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	0.000	2.888	3.538	4.401
14	γg.G+γq.Q3+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	0.000	2.329	3.708	4.391
15	γg.G+γq.Q4+γq.ψo.Q1+γq.ψo.Qf	Short-term	0.90	0.000	3.315	3.511	4.421
16	γg.G+γq.Q4+γq.ψo.Q2+γq.ψo.Qf	Short-term	0.90	0.000	3.214	3.615	4.430
17	γg.G+γq.Q4+γq.ψo.Q3+γq.ψo.Qf	Short-term	0.90	0.000	3.308	3.496	4.425
18	γg.G+γq.Q5+γq.ψo.Q1+γq.ψo.Qf	Short-term	0.90	0.000	2.196	3.852	4.401
19	γg.G+γq.Q5+γq.ψo.Q2+γq.ψo.Qf	Short-term	0.90	0.000	2.095	3.956	4.409
20	γg.G+γq.Q5+γq.ψo.Q3+γq.ψo.Qf	Short-term	0.90	0.000	2.189	3.837	4.404
21	γg.G+γq.Qf+γq.ψo.Q1+γq.ψo.Q4	Short-term	0.90	0.000	3.272	4.853	5.669
22	γg.G+γq.Qf+γq.ψo.Q1+γq.ψo.Q5	Short-term	0.90	0.000	2.713	5.023	5.658
23	γg.G+γq.Qf+γq.ψo.Q2+γq.ψo.Q4	Short-term	0.90	0.000	3.171	4.957	5.677
24	γg.G+γq.Qf+γq.ψo.Q2+γq.ψo.Q5	Short-term	0.90	0.000	2.612	5.127	5.666
25	γg.G+γq.Qf+γq.ψo.Q3+γq.ψo.Q4	Short-term	0.90	0.000	3.265	4.838	5.672
26	γg.G+γq.Qf+γq.ψo.Q3+γq.ψo.Q5	Short-term	0.90	0.000	2.706	5.009	5.662
27	γg.G+γq.Qi+γq.ψo.Q1+γq.ψo.Q4+γq.ψo.Q	Short-term	0.90	0.000	2.872	3.595	4.397
28	γg.G+γq.Qi+γq.ψo.Q1+γq.ψo.Q5+γq.ψo.Q	Short-term	0.90	0.000	2.313	3.765	4.387
29	γg.G+γq.Qi+γq.ψo.Q2+γq.ψo.Q4+γq.ψo.Q	Short-term	0.90	0.000	2.771	3.699	4.405
30	γg.G+γq.Qi+γq.ψo.Q2+γq.ψo.Q5+γq.ψo.Q	Short-term	0.90	0.000	2.211	3.869	4.395
31	γg.G+γq.Qi+γq.ψo.Q3+γq.ψo.Q4+γq.ψo.Q	Short-term	0.90	0.000	2.865	3.580	4.401
32	γg.G+γq.Qi+γq.ψo.Q3+γq.ψo.Q5+γq.ψo.Q	Short-term	0.90	0.000	2.305	3.750	4.391
	Maximum values			0.000	3.315	5.852	6.392

1.10.14. Check of cross section Tie, elements: 6

Tie, elements: 6 , load combination No 15

Tension parallel to the grain, Ft0d=2.983 kN (EC5 §6.1.2)

Rectangular cross section, b=60 mm, h=220 mm, A= 13 200 mm²

Modification factor Kmod=0.90 (Table 3.1), material factor γM=1.30 (Table 2.3)

ft0k=16.00 N/mm², ft0d=Kmod·ft0k/γM=0.90x16.00/1.30=11.08N/mm² (EC5 Eq.2.14)

Ft0d=2.983 kN, σt0d=Ft0d/Anetto=1000x2.983/13200=0.23N/mm² < 11.08N/mm²=ft0d (Eq.6.1)

The check is satisfied

Tie, elements: 6 , load combination No 7
Shear, Fv=4.682 kN (EC5 §6.1.7)
Rectangular cross section, bef=0.67x60=40 mm, h=220 mm, A= 8 800 mm²
Modification factor Kmod=0.80 (Table 3.1), material factor γM=1.30 (Table 2.3)
fvk=4.00 N/mm², fvd=Kmod·fvk/γM=0.80x4.00/1.30=2.46N/mm² (EC5 Eq.2.14)
Fv=4.682 kN, τv0d=1.50Fv0d/Anetto=1000x1.50x4.682/8800=0.80N/mm² < 2.46N/mm²=fv0d (Eq.6.13)
The check is satisfied

Tie, elements: 6 , load combination No 7
Bending, Myd=5.114 kNm, Mzd=0.000 kNm (EC5 §6.1.6)
Rectangular cross section, b=60mm, h=220mm, A=1.320E+004mm², Wy=4.840E+005mm³, Wz=1.320E+005mm³
Modification factor Kmod=0.80 (Table 3.1), material factor γM=1.30 (Table 2.3)
fmyk=27.00 N/mm², fmyd=Kmod·fmyk/γM=0.80x27.00/1.30=16.62N/mm²
fmzk=27.00 N/mm², fmzd=Kmod·fmzk/γM=0.80x27.00/1.30=16.62N/mm²

Rectangular cross section Km=0.70 (EC5 §6.1.6.(2))
σmyd=Myd/Wmy,netto=1E+06x5.114/4.840E+005=10.57 N/mm²
σmzd=Mzd/Wmz,netto=1E+06x0.000/1.320E+005= 0.00 N/mm²

σmyd/fmyd+Km.σmzd/fmzd=0.636+0.000= 0.64 < 1 (EC5 Eq.6.11)
Km.σmyd/fmyd+σmzd/fmzd=0.445+0.000= 0.45 < 1 (EC5 Eq.6.12)
The check is satisfied

Tie, elements: 6 , load combination No 15
Combined bending and axial tension, Ft0d=2.983kN, Myd=3.979kNm, Mzd=0.000kNm (EC5 §6.2.3)
Rectangular cross section, b=60mm, h=220mm, A=1.320E+004mm², Wy=4.840E+005mm³, Wz=1.320E+005mm³
Modification factor Kmod=0.90 (Table 3.1), material factor γM=1.30 (Table 2.3)
ft0k=16.00 N/mm², ft0d=Kmod·ft0k/γM=0.90x16.00/1.30=11.08N/mm²
fmyk=27.00 N/mm², fmyd=Kmod·fmyk/γM=0.90x27.00/1.30=18.69N/mm²
fmzk=27.00 N/mm², fmzd=Kmod·fmzk/γM=0.90x27.00/1.30=18.69N/mm²

Rectangular cross section Km=0.70 (EC5 §6.1.6.(2))
σt0d=Ft0d/Anetto=1000x2.983/13200= 0.23 N/mm²
σmyd=Myd/Wmy,netto=1E+06x3.979/4.840E+005= 8.22 N/mm²
σmzd=Mzd/Wmz,netto=1E+06x0.000/1.320E+005= 0.00 N/mm²

σt0d/ft0d+σmyd/fmyd+Km.σmzd/fmzd=0.020+0.440+0.000= 0.46 < 1 (EC5 Eq.6.17)
σt0d/ft0d+Km.σmyd/fmyd+σmzd/fmzd=0.020+0.308+0.000= 0.33 < 1 (EC5 Eq.6.18)
The check is satisfied

Tie, elements: 6 , load combination No 7
Combined bending and axial tension, Ft0d=2.246kN, Myd=5.114kNm, Mzd=0.000kNm (EC5 §6.2.3)
Rectangular cross section, b=60mm, h=220mm, A=1.320E+004mm², Wy=4.840E+005mm³, Wz=1.320E+005mm³
Modification factor Kmod=0.80 (Table 3.1), material factor γM=1.30 (Table 2.3)
ft0k=16.00 N/mm², ft0d=Kmod·ft0k/γM=0.80x16.00/1.30=9.85N/mm²
fmyk=27.00 N/mm², fmyd=Kmod·fmyk/γM=0.80x27.00/1.30=16.62N/mm²
fmzk=27.00 N/mm², fmzd=Kmod·fmzk/γM=0.80x27.00/1.30=16.62N/mm²

Rectangular cross section Km=0.70 (EC5 §6.1.6.(2))
σt0d=Ft0d/Anetto=1000x2.246/13200= 0.17 N/mm²
σmyd=Myd/Wmy,netto=1E+06x5.114/4.840E+005=10.57 N/mm²
σmzd=Mzd/Wmz,netto=1E+06x0.000/1.320E+005= 0.00 N/mm²

σt0d/ft0d+σmyd/fmyd+Km.σmzd/fmzd=0.017+0.636+0.000= 0.65 < 1 (EC5 Eq.6.17)
σt0d/ft0d+Km.σmyd/fmyd+σmzd/fmzd=0.017+0.445+0.000= 0.46 < 1 (EC5 Eq.6.18)
The check is satisfied

1.10.15. Ultimate limit state (EC5 EN1995-1-1:2009, §6)

Elements: 7

Loading [kN/m]	action	γg	γq	ψo
(Gk) Dead Gk1 = 0.314, Gk2 = 0.180, Gkf=0.300	Permanent	1.35	0.00	1.00
(Qk1) Snow QksL= 0.768, QksR= 0.546	Short-term	0.00	1.50	0.60
(Qk2) Snow QksL= 0.384, QksR= 0.546	Short-term	0.00	1.50	0.60
(Qk3) Snow QksL= 0.768, QksR= 0.273	Short-term	0.00	1.50	0.60
(Qk4) Wind QkwL= 0.123, QkwR=-0.133	Short-term	0.00	1.50	0.50
(Qk5) Wind QkwL=-0.162, QkwR= 0.182	Short-term	0.00	1.50	0.50
(Qkf) Live Qkf = 1.200	Medium-term	0.00	1.50	0.70
(Qki) Imposed (H) Qi = 0.240	Short-term	0.00	1.50	0.00

L.C.	Load combination	duration class	kmod	-N/Kmod	+N/Kmod	V/Kmod	M/Kmod
1	γg.G	Permanent	0.60	-2.393	0.000	1.179	1.505
2	γg.G+γq.Q1	Short-term	0.90	-4.969	0.000	1.164	1.251
3	γg.G+γq.Q2	Short-term	0.90	-3.199	0.000	0.985	0.875
4	γg.G+γq.Q3	Short-term	0.90	-5.053	0.000	1.154	1.303
5	γg.G+γq.Q4	Short-term	0.90	-1.595	0.000	0.786	1.004
6	γg.G+γq.Q5	Short-term	0.90	-1.026	0.000	1.769	1.922
7	γg.G+γq.Qf	Medium-term	0.80	-2.667	0.000	2.846	4.649
8	γg.G+γq.Qi	Short-term	0.90	-2.629	0.000	0.907	0.898
9	γg.G+γq.Q1+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-5.730	0.000	2.183	2.460
10	γg.G+γq.Q1+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-5.511	0.000	2.385	2.802
11	γg.G+γq.Q2+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-3.741	0.000	2.206	3.066
12	γg.G+γq.Q2+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-3.456	0.000	2.698	3.525
13	γg.G+γq.Q3+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-5.813	0.000	2.173	2.392
14	γg.G+γq.Q3+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-5.595	0.000	2.375	2.734
15	γg.G+γq.Q4+γq.ψo.Q1+γq.ψo.Qf	Short-term	0.90	-4.162	0.000	2.234	2.958
16	γg.G+γq.Q4+γq.ψo.Q2+γq.ψo.Qf	Short-term	0.90	-3.100	0.000	2.126	3.117
17	γg.G+γq.Q4+γq.ψo.Q3+γq.ψo.Qf	Short-term	0.90	-4.212	0.000	2.227	2.918
18	γg.G+γq.Q5+γq.ψo.Q1+γq.ψo.Qf	Short-term	0.90	-3.593	0.000	3.217	3.877
19	γg.G+γq.Q5+γq.ψo.Q2+γq.ψo.Qf	Short-term	0.90	-2.530	0.000	3.110	4.036
20	γg.G+γq.Q5+γq.ψo.Q3+γq.ψo.Qf	Short-term	0.90	-3.643	0.000	3.211	3.837
21	γg.G+γq.Qf+γq.ψo.Q1+γq.ψo.Q4	Short-term	0.90	-4.394	0.000	2.757	3.897
22	γg.G+γq.Qf+γq.ψo.Q1+γq.ψo.Q5	Short-term	0.90	-4.110	0.000	3.249	4.356
23	γg.G+γq.Qf+γq.ψo.Q2+γq.ψo.Q4	Short-term	0.90	-3.332	0.000	2.649	4.055
24	γg.G+γq.Qf+γq.ψo.Q2+γq.ψo.Q5	Short-term	0.90	-3.048	0.000	3.141	4.515
25	γg.G+γq.Qf+γq.ψo.Q3+γq.ψo.Q4	Short-term	0.90	-4.445	0.000	2.751	3.856
26	γg.G+γq.Qf+γq.ψo.Q3+γq.ψo.Q5	Short-term	0.90	-4.160	0.000	3.242	4.316
27	γg.G+γq.Qi+γq.ψo.Q1+γq.ψo.Q4+γq.ψo.Q	Short-term	0.90	-5.413	0.000	2.152	2.512
28	γg.G+γq.Qi+γq.ψo.Q1+γq.ψo.Q5+γq.ψo.Q	Short-term	0.90	-5.195	0.000	2.354	2.853
29	γg.G+γq.Qi+γq.ψo.Q2+γq.ψo.Q4+γq.ψo.Q	Short-term	0.90	-4.133	0.000	2.247	3.012
30	γg.G+γq.Qi+γq.ψo.Q2+γq.ψo.Q5+γq.ψo.Q	Short-term	0.90	-3.848	0.000	2.739	3.471
31	γg.G+γq.Qi+γq.ψo.Q3+γq.ψo.Q4+γq.ψo.Q	Short-term	0.90	-5.463	0.000	2.146	2.471
32	γg.G+γq.Qi+γq.ψo.Q3+γq.ψo.Q5+γq.ψo.Q	Short-term	0.90	-5.245	0.000	2.348	2.812
	Maximum values			-5.813	0.000	3.249	4.649

1.10.16. Check of cross section Elements: 7

Elements: 7 , load combination No 13

Compression parallel to the grain, Fc0d=-5.232 kN (EC5 §6.1.4)

Rectangular cross section, b=60 mm, h=220 mm, A= 13 200 mm²

Modification factor Kmod=0.90 (Table 3.1), material factor γM=1.30 (Table 2.3)

fc0k=22.00 N/mm², fc0d=Kmod·fc0k/γM=0.90x22.00/1.30=15.23N/mm² (EC5 Eq.2.14)

Fc0d=-5.232 kN, σc0d=Fc0d/Anetto=1000x5.232/13200=0.40N/mm² < 15.23N/mm²=fc0d (Eq.6.2)

The check is satisfied

Elements: 7 , load combination No 22
Shear, Fv=2.924 kN (EC5 §6.1.7)
Rectangular cross section, bef=0.67x60=40 mm, h=220 mm, A= 8 800 mm^2
Modification factor Kmod=0.90 (Table 3.1), material factor γM=1.30 (Table 2.3)
fvk=4.00 N/mm^2, fvd=Kmod·fvk/γM=0.90x4.00/1.30=2.77N/mm^2 (EC5 Eq.2.14)
Fv=2.924 kN, τv0d=1.50Fv0d/Anetto=1000x1.50x2.924/8800=0.50N/mm^2 < 2.77N/mm^2=fv0d (Eq.6.13)
The check is satisfied

Elements: 7 , load combination No 7
Bending, Myd=3.719 kNm, Mzd=0.000 kNm (EC5 §6.1.6)
Rectangular cross section, b=60mm, h=220mm, A=1.320E+004mm^2, Wy=4.840E+005mm^3, Wz=1.320E+005mm^3
Modification factor Kmod=0.80 (Table 3.1), material factor γM=1.30 (Table 2.3)
fmyk=27.00 N/mm^2, fmyd=Kmod·fmyk/γM=0.80x27.00/1.30=16.62N/mm^2
fmzk=27.00 N/mm^2, fmzd=Kmod·fmzk/γM=0.80x27.00/1.30=16.62N/mm^2

Rectangular cross section Km=0.70 (EC5 §6.1.6.(2))
σmyd=Myd/Wmy,netto=1E+06x3.719/4.840E+005= 7.68 N/mm^2
σmzd=Mzd/Wmz,netto=1E+06x0.000/1.320E+005= 0.00 N/mm^2

σmyd/fmyd+Km.σmzd/fmzd=0.462+0.000= 0.46 < 1 (EC5 Eq.6.11)
Km.σmyd/fmyd+σmzd/fmzd=0.324+0.000= 0.32 < 1 (EC5 Eq.6.12)
The check is satisfied

Elements: 7 , load combination No 13
Combined bending and axial compression, Fc0d=-5.232kN, Myd=2.153kNm, Mzd=0.000kNm (EC5 §6.2.4)
Rectangular cross section, b=60mm, h=220mm, A=1.320E+004mm^2, Wy=4.840E+005mm^3, Wz=1.320E+005mm^3
Modification factor Kmod=0.90 (Table 3.1), material factor γM=1.30 (Table 2.3)
fc0k=22.00 N/mm^2, fc0d=Kmod·fc0k/γM=0.90x22.00/1.30=15.23N/mm^2
fmyk=27.00 N/mm^2, fmyd=Kmod·fmyk/γM=0.90x27.00/1.30=18.69N/mm^2
fmzk=27.00 N/mm^2, fmzd=Kmod·fmzk/γM=0.90x27.00/1.30=18.69N/mm^2

Rectangular cross section Km=0.70 (EC5 §6.1.6.(2))
σc0d=Fc0d/Anetto=1000x5.232/13200= 0.40 N/mm^2
σmyd=Myd/Wmy,netto=1E+06x2.153/4.840E+005= 4.45 N/mm^2
σmzd=Mzd/Wmz,netto=1E+06x0.000/1.320E+005= 0.00 N/mm^2

(σc0d/fc0d)^2+σmyd/fmyd+Km.σmzd/fmzd=0.001+0.238+0.000= 0.24 < 1 (EC5 Eq.6.19)
(σc0d/fc0d)^2+Km.σmyd/fmyd+σmzd/fmzd=0.001+0.167+0.000= 0.17 < 1 (EC5 Eq.6.20)
The check is satisfied

Elements: 7 , load combination No 7
Combined bending and axial compression, Fc0d=-2.133kN, Myd=3.719kNm, Mzd=0.000kNm (EC5 §6.2.4)
Rectangular cross section, b=60mm, h=220mm, A=1.320E+004mm^2, Wy=4.840E+005mm^3, Wz=1.320E+005mm^3
Modification factor Kmod=0.80 (Table 3.1), material factor γM=1.30 (Table 2.3)
fc0k=22.00 N/mm^2, fc0d=Kmod·fc0k/γM=0.80x22.00/1.30=13.54N/mm^2
fmyk=27.00 N/mm^2, fmyd=Kmod·fmyk/γM=0.80x27.00/1.30=16.62N/mm^2
fmzk=27.00 N/mm^2, fmzd=Kmod·fmzk/γM=0.80x27.00/1.30=16.62N/mm^2

Rectangular cross section Km=0.70 (EC5 §6.1.6.(2))
σc0d=Fc0d/Anetto=1000x2.133/13200= 0.16 N/mm^2
σmyd=Myd/Wmy,netto=1E+06x3.719/4.840E+005= 7.68 N/mm^2
σmzd=Mzd/Wmz,netto=1E+06x0.000/1.320E+005= 0.00 N/mm^2

(σc0d/fc0d)^2+σmyd/fmyd+Km.σmzd/fmzd=0.000+0.462+0.000= 0.46 < 1 (EC5 Eq.6.19)
(σc0d/fc0d)^2+Km.σmyd/fmyd+σmzd/fmzd=0.000+0.324+0.000= 0.32 < 1 (EC5 Eq.6.20)
The check is satisfied

Elements: 7 , load combination No 13

Column stability with bending, Fc0d=-5.232kN, Myd=2.153kNm, Mzd=0.000kNm (EC5 §6.3.2)
Rectangular cross section, b=60mm, h=220mm, A=1.320E+004mm², Wy=4.840E+005mm³, Wz=1.320E+005mm³
Modification factor Kmod=0.90 (Table 3.1), material factor γM=1.30 (Table 2.3, E005=7700N/mm²
fc0k=22.00 N/mm², fc0d=Kmod·fc0k/γM=0.90x22.00/1.30=15.23N/mm²
fmyk=27.00 N/mm², fmyd=Kmod·fmyk/γM=0.90x27.00/1.30=18.69N/mm²
fmzk=27.00 N/mm², fmzd=Kmod·fmzk/γM=0.90x27.00/1.30=18.69N/mm²

Rectangular cross section Km=0.70 (EC5 §6.1.6.(2))
σc0d=Fc0d/Anetto=1000x5.232/13200= 0.40 N/mm²
σmyd=Myd/Wmy,netto=1E+06x2.153/4.840E+005= 4.45 N/mm²
σmzd=Mzd/Wmz,netto=1E+06x0.000/1.320E+005= 0.00 N/mm²

Buckling length Sk
Sky= 1.00x1.600=1.600 m= 1600 mm (most unfavourable)
Skz= 1.00x1.600=1.600 m= 1600 mm (most unfavourable)

Slenderness
iy=√(Iy/A)=0.289x 220= 64 mm, λy= 1600/ 64= 25.00
iz=√(Iz/A)=0.289x 60= 17 mm, λz= 1600/ 17= 94.12

Critical stresses
σc,crity=π²E005/λy²= 121.59 N/mm², λrel,y=√(fc0k/σc,crity)= 0.43 (EC5 Eq.6.21)
σc,critz=π²E005/λz²= 8.58 N/mm², λrel,z=√(fc0k/σc,critz)= 1.60 (EC5 Eq.6.22)

βc=0.20 (solid timber)
ky=0.5[1+βc(λrely-0.3)+λrely²]= 0.60, Kcy=1/(ky+√(ky²-λrely²))=0.970 (Eq.6.27 6.25)
kz=0.5[1+βc(λrelz-0.3)+λrelz²]= 1.91, Kcz=1/(kz+√(kz²-λrelz²))=0.338 (Eq.6.28 6.26)

σc0d/(Kcy·fc0d)+σmyd/fmyd+Km.σmzd/fmzd=0.027+0.238+0.000= 0.26 < 1 (EC5 Eq.6.23)
σc0d/(Kcz·fc0d)+Km.σmyd/fmyd+σmzd/fmzd=0.077+0.167+0.000= 0.24 < 1 (EC5 Eq.6.24)
The check is satisfied

Elements: 7 , load combination No 7

Column stability with bending, Fc0d=-2.133kN, Myd=3.719kNm, Mzd=0.000kNm (EC5 §6.3.2)
Rectangular cross section, b=60mm, h=220mm, A=1.320E+004mm², Wy=4.840E+005mm³, Wz=1.320E+005mm³
Modification factor Kmod=0.80 (Table 3.1), material factor γM=1.30 (Table 2.3, E005=7700N/mm²
fc0k=22.00 N/mm², fc0d=Kmod·fc0k/γM=0.80x22.00/1.30=13.54N/mm²
fmyk=27.00 N/mm², fmyd=Kmod·fmyk/γM=0.80x27.00/1.30=16.62N/mm²
fmzk=27.00 N/mm², fmzd=Kmod·fmzk/γM=0.80x27.00/1.30=16.62N/mm²

Rectangular cross section Km=0.70 (EC5 §6.1.6.(2))
σc0d=Fc0d/Anetto=1000x2.133/13200= 0.16 N/mm²
σmyd=Myd/Wmy,netto=1E+06x3.719/4.840E+005= 7.68 N/mm²
σmzd=Mzd/Wmz,netto=1E+06x0.000/1.320E+005= 0.00 N/mm²

Buckling length Sk
Sky= 1.00x1.600=1.600 m= 1600 mm (most unfavourable)
Skz= 1.00x1.600=1.600 m= 1600 mm (most unfavourable)

Slenderness
iy=√(Iy/A)=0.289x 220= 64 mm, λy= 1600/ 64= 25.00
iz=√(Iz/A)=0.289x 60= 17 mm, λz= 1600/ 17= 94.12

Critical stresses
σc,crity=π²E005/λy²= 121.59 N/mm², λrel,y=√(fc0k/σc,crity)= 0.43 (EC5 Eq.6.21)
σc,critz=π²E005/λz²= 8.58 N/mm², λrel,z=√(fc0k/σc,critz)= 1.60 (EC5 Eq.6.22)

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βc=0.20 (solid timber)
ky=0.5[1+βc(λrely-0.3)+λrely²]= 0.60, Kcy=1/(ky+√(ky²-λrely²))=0.970 (Eq.6.27 6.25)
kz=0.5[1+βc(λrelz-0.3)+λrelz²]= 1.91, Kcz=1/(kz+√(kz²-λrelz²))=0.338 (Eq.6.28 6.26)

σc0d/(Kcy·fc0d)+σmyd/fmyd+Km.σmzd/fmzd=0.012+0.462+0.000= 0.47 < 1 (EC5 Eq.6.23)
σc0d/(Kcz·fc0d)+Km.σmyd/fmyd+σmzd/fmzd=0.035+0.324+0.000= 0.36 < 1 (EC5 Eq.6.24)
The check is satisfied
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1.10.17. Ultimate limit state (EC5 EN1995-1-1:2009, §6)
Elements: 8

Loading [kN/m]	action	γg	γq	ψo
(Gk) Dead Gk1 = 0.314, Gk2 = 0.180, Gkf=0.300	Permanent	1.35	0.00	1.00
(Qk1) Snow QksL= 0.768, QksR= 0.546	Short-term	0.00	1.50	0.60
(Qk2) Snow QksL= 0.384, QksR= 0.546	Short-term	0.00	1.50	0.60
(Qk3) Snow QksL= 0.768, QksR= 0.273	Short-term	0.00	1.50	0.60
(Qk4) Wind QkwL= 0.123, QkwR=-0.133	Short-term	0.00	1.50	0.50
(Qk5) Wind QkwL=-0.162, QkwR= 0.182	Short-term	0.00	1.50	0.50
(Qkf) Live Qkf = 1.200	Medium-term	0.00	1.50	0.70
(Qki) Imposed (H) Qi = 0.240	Short-term	0.00	1.50	0.00

L.C.	Load combination	duration class	kmod	-N/Kmod	+N/Kmod	V/Kmod	M/Kmod
1	γg.G	Permanent	0.60	-1.681	0.000	1.159	1.254
2	γg.G+γq.Q1	Short-term	0.90	-1.035	0.000	1.135	1.691
3	γg.G+γq.Q2	Short-term	0.90	-1.964	0.000	0.966	1.184
4	γg.G+γq.Q3	Short-term	0.90	-0.149	0.000	1.123	1.771
5	γg.G+γq.Q4	Short-term	0.90	-0.820	0.000	1.891	1.879
6	γg.G+γq.Q5	Short-term	0.90	-1.120	0.000	0.773	0.836
7	γg.G+γq.Qf	Medium-term	0.80	-3.429	0.000	2.807	2.604
8	γg.G+γq.Qi	Short-term	0.90	-1.319	0.000	0.889	1.083
9	γg.G+γq.Q1+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-2.234	0.000	2.901	3.248
10	γg.G+γq.Q1+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-2.385	0.000	2.341	2.727
11	γg.G+γq.Q2+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-3.163	0.000	2.732	2.741
12	γg.G+γq.Q2+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-3.313	0.000	2.172	2.219
13	γg.G+γq.Q3+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-1.348	0.000	2.888	3.328
14	γg.G+γq.Q3+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-1.499	0.000	2.329	2.806
15	γg.G+γq.Q4+γq.ψo.Q1+γq.ψo.Qf	Short-term	0.90	-2.118	0.000	3.315	3.428
16	γg.G+γq.Q4+γq.ψo.Q2+γq.ψo.Qf	Short-term	0.90	-2.675	0.000	3.214	3.124
17	γg.G+γq.Q4+γq.ψo.Q3+γq.ψo.Qf	Short-term	0.90	-1.586	0.000	3.308	3.476
18	γg.G+γq.Q5+γq.ψo.Q1+γq.ψo.Qf	Short-term	0.90	-2.419	0.000	2.196	2.385
19	γg.G+γq.Q5+γq.ψo.Q2+γq.ψo.Qf	Short-term	0.90	-2.976	0.000	2.095	2.080
20	γg.G+γq.Q5+γq.ψo.Q3+γq.ψo.Qf	Short-term	0.90	-1.887	0.000	2.189	2.432
21	γg.G+γq.Qf+γq.ψo.Q1+γq.ψo.Q4	Short-term	0.90	-2.846	0.000	3.272	3.350
22	γg.G+γq.Qf+γq.ψo.Q1+γq.ψo.Q5	Short-term	0.90	-2.997	0.000	2.713	2.828
23	γg.G+γq.Qf+γq.ψo.Q2+γq.ψo.Q4	Short-term	0.90	-3.404	0.000	3.171	3.046
24	γg.G+γq.Qf+γq.ψo.Q2+γq.ψo.Q5	Short-term	0.90	-3.554	0.000	2.612	2.524
25	γg.G+γq.Qf+γq.ψo.Q3+γq.ψo.Q4	Short-term	0.90	-2.315	0.000	3.265	3.398
26	γg.G+γq.Qf+γq.ψo.Q3+γq.ψo.Q5	Short-term	0.90	-2.465	0.000	2.706	2.876
27	γg.G+γq.Qi+γq.ψo.Q1+γq.ψo.Q4+γq.ψo.Q	Short-term	0.90	-2.466	0.000	2.872	3.153
28	γg.G+γq.Qi+γq.ψo.Q1+γq.ψo.Q5+γq.ψo.Q	Short-term	0.90	-2.617	0.000	2.313	2.632
29	γg.G+γq.Qi+γq.ψo.Q2+γq.ψo.Q4+γq.ψo.Q	Short-term	0.90	-3.023	0.000	2.771	2.849
30	γg.G+γq.Qi+γq.ψo.Q2+γq.ψo.Q5+γq.ψo.Q	Short-term	0.90	-3.174	0.000	2.211	2.327
31	γg.G+γq.Qi+γq.ψo.Q3+γq.ψo.Q4+γq.ψo.Q	Short-term	0.90	-1.935	0.000	2.865	3.201
32	γg.G+γq.Qi+γq.ψo.Q3+γq.ψo.Q5+γq.ψo.Q	Short-term	0.90	-2.085	0.000	2.305	2.679
	Maximum values			-3.554	0.000	3.315	3.476

1.10.18. Check of cross section Elements: 8

Elements: 8 , load combination No 24
Compression parallel to the grain, Fc0d=-3.199 kN (EC5 §6.1.4)
Rectangular cross section, b=60 mm, h=220 mm, A= 13 200 mm²
Modification factor Kmod=0.90 (Table 3.1), material factor γM=1.30 (Table 2.3)
fc0k=22.00 N/mm², fc0d=Kmod·fc0k/γM=0.90x22.00/1.30=15.23N/mm² (EC5 Eq.2.14)
Fc0d=-3.199 kN, σc0d=Fc0d/Anetto=1000x3.199/13200=0.24N/mm² < 15.23N/mm²=fc0d (Eq.6.2)
The check is satisfied

Elements: 8 , load combination No 15
Shear, Fv=2.983 kN (EC5 §6.1.7)
Rectangular cross section, bef=0.67x60=40 mm, h=220 mm, A= 8 800 mm²
Modification factor Kmod=0.90 (Table 3.1), material factor γM=1.30 (Table 2.3)
fvk=4.00 N/mm², fvd=Kmod·fvk/γM=0.90x4.00/1.30=2.77N/mm² (EC5 Eq.2.14)
Fv=2.983 kN, τv0d=1.50Fv0d/Anetto=1000x1.50x2.983/8800=0.51N/mm² < 2.77N/mm²=fv0d (Eq.6.13)
The check is satisfied

Elements: 8 , load combination No 17
Bending, Myd=3.128 kNm, Mzd=0.000 kNm (EC5 §6.1.6)
Rectangular cross section, b=60mm, h=220mm, A=1.320E+004mm², Wy=4.840E+005mm³, Wz=1.320E+005mm³
Modification factor Kmod=0.90 (Table 3.1), material factor γM=1.30 (Table 2.3)
fmyk=27.00 N/mm², fmyd=Kmod·fmyk/γM=0.90x27.00/1.30=18.69N/mm²
fmzk=27.00 N/mm², fmzd=Kmod·fmzk/γM=0.90x27.00/1.30=18.69N/mm²

Rectangular cross section Km=0.70 (EC5 §6.1.6.(2))
σmyd=Myd/Wmy,netto=1E+06x3.128/4.840E+005= 6.46 N/mm²
σmzd=Mzd/Wmz,netto=1E+06x0.000/1.320E+005= 0.00 N/mm²

σmyd/fmyd+Km.σmzd/fmzd=0.346+0.000= 0.35 < 1 (EC5 Eq.6.11)
Km.σmyd/fmyd+σmzd/fmzd=0.242+0.000= 0.24 < 1 (EC5 Eq.6.12)
The check is satisfied

Elements: 8 , load combination No 24
Combined bending and axial compression, Fc0d=-3.199kN, Myd=2.272kNm, Mzd=0.000kNm (EC5 §6.2.4)
Rectangular cross section, b=60mm, h=220mm, A=1.320E+004mm², Wy=4.840E+005mm³, Wz=1.320E+005mm³
Modification factor Kmod=0.90 (Table 3.1), material factor γM=1.30 (Table 2.3)
fc0k=22.00 N/mm², fc0d=Kmod·fc0k/γM=0.90x22.00/1.30=15.23N/mm²
fmyk=27.00 N/mm², fmyd=Kmod·fmyk/γM=0.90x27.00/1.30=18.69N/mm²
fmzk=27.00 N/mm², fmzd=Kmod·fmzk/γM=0.90x27.00/1.30=18.69N/mm²

Rectangular cross section Km=0.70 (EC5 §6.1.6.(2))
σc0d=Fc0d/Anetto=1000x3.199/13200= 0.24 N/mm²
σmyd=Myd/Wmy,netto=1E+06x2.272/4.840E+005= 4.69 N/mm²
σmzd=Mzd/Wmz,netto=1E+06x0.000/1.320E+005= 0.00 N/mm²

(σc0d/fc0d)²+σmyd/fmyd+Km.σmzd/fmzd=0.000+0.251+0.000= 0.25 < 1 (EC5 Eq.6.19)
(σc0d/fc0d)²+Km.σmyd/fmyd+σmzd/fmzd=0.000+0.176+0.000= 0.18 < 1 (EC5 Eq.6.20)
The check is satisfied

Elements: 8 , load combination No 17
Combined bending and axial compression, Fc0d=-1.428kN, Myd=3.128kNm, Mzd=0.000kNm (EC5 §6.2.4)
Rectangular cross section, b=60mm, h=220mm, A=1.320E+004mm², Wy=4.840E+005mm³, Wz=1.320E+005mm³
Modification factor Kmod=0.90 (Table 3.1), material factor γM=1.30 (Table 2.3)
fc0k=22.00 N/mm², fc0d=Kmod·fc0k/γM=0.90x22.00/1.30=15.23N/mm²
fmyk=27.00 N/mm², fmyd=Kmod·fmyk/γM=0.90x27.00/1.30=18.69N/mm²
fmzk=27.00 N/mm², fmzd=Kmod·fmzk/γM=0.90x27.00/1.30=18.69N/mm²

Rectangular cross section Km=0.70 (EC5 §6.1.6.(2))
σc0d=Fc0d/Anetto=1000x1.428/13200= 0.11 N/mm²
σmyd=Myd/Wmy,netto=1E+06x3.128/4.840E+005= 6.46 N/mm²
σmzd=Mzd/Wmz,netto=1E+06x0.000/1.320E+005= 0.00 N/mm²

(σc0d/fc0d)²+σmyd/fmyd+Km.σmzd/fmzd=0.000+0.346+0.000= 0.35 < 1 (EC5 Eq.6.19)
(σc0d/fc0d)²+Km.σmyd/fmyd+σmzd/fmzd=0.000+0.242+0.000= 0.24 < 1 (EC5 Eq.6.20)
The check is satisfied

Elements: 8 , load combination No 24

Column stability with bending, Fc0d=-3.199kN, Myd=2.272kNm, Mzd=0.000kNm (EC5 §6.3.2)

Rectangular cross section, b=60mm, h=220mm, A=1.320E+004mm², Wy=4.840E+005mm³, Wz=1.320E+005mm³

Modification factor Kmod=0.90 (Table 3.1), material factor γM=1.30 (Table 2.3, E005=7700N/mm²

fc0k=22.00 N/mm², fc0d=Kmod·fc0k/γM=0.90x22.00/1.30=15.23N/mm²

fmyk=27.00 N/mm², fmyd=Kmod·fmyk/γM=0.90x27.00/1.30=18.69N/mm²

fmzk=27.00 N/mm², fmzd=Kmod·fmzk/γM=0.90x27.00/1.30=18.69N/mm²

Rectangular cross section Km=0.70 (EC5 §6.1.6.(2))

σc0d=Fc0d/Anetto=1000x3.199/13200= 0.24 N/mm²

σmyd=Myd/Wmy,netto=1E+06x2.272/4.840E+005= 4.69 N/mm²

σmzd=Mzd/Wmz,netto=1E+06x0.000/1.320E+005= 0.00 N/mm²

Buckling length Sk

Sky= 1.00x1.600=1.600 m= 1600 mm (most unfavourable)

Skz= 1.00x1.600=1.600 m= 1600 mm (most unfavourable)

Slenderness

iy=√(Iy/A)=0.289x 220= 64 mm, λy= 1600/ 64= 25.00

iz=√(Iz/A)=0.289x 60= 17 mm, λz= 1600/ 17= 94.12

Critical stresses

σc,crity=π²E005/λy²= 121.59 N/mm², λrel,y=√(fc0k/σc,crity)= 0.43 (EC5 Eq.6.21)

σc,critz=π²E005/λz²= 8.58 N/mm², λrel,z=√(fc0k/σc,critz)= 1.60 (EC5 Eq.6.22)

βc=0.20 (solid timber)

ky=0.5[1+βc(λrely-0.3)+λrely²]= 0.60, Kcy=1/(ky+√(ky²-λrely²))=0.970 (Eq.6.27 6.25)

kz=0.5[1+βc(λrelz-0.3)+λrelz²]= 1.91, Kcz=1/(kz+√(kz²-λrelz²))=0.338 (Eq.6.28 6.26)

σc0d/(Kcy·fc0d)+σmyd/fmyd+Km.σmzd/fmzd=0.016+0.251+0.000= 0.27 < 1 (EC5 Eq.6.23)

σc0d/(Kcz·fc0d)+Km.σmyd/fmyd+σmzd/fmzd=0.047+0.176+0.000= 0.22 < 1 (EC5 Eq.6.24)

The check is satisfied

1.10.19. Ultimate limit state (EC5 EN1995-1-1:2009, §6)
Elements: 9

Loading [kN/m]	action	γg	γq	ψo
(Gk) Dead Gk1 = 0.314, Gk2 = 0.180, Gkf=0.300	Permanent	1.35	0.00	1.00
(Qk1) Snow QksL= 0.768, QksR= 0.546	Short-term	0.00	1.50	0.60
(Qk2) Snow QksL= 0.384, QksR= 0.546	Short-term	0.00	1.50	0.60
(Qk3) Snow QksL= 0.768, QksR= 0.273	Short-term	0.00	1.50	0.60
(Qk4) Wind QkwL= 0.123, QkwR=-0.133	Short-term	0.00	1.50	0.50
(Qk5) Wind QkwL=-0.162, QkwR= 0.182	Short-term	0.00	1.50	0.50
(Qkf) Live Qkf = 1.200	Medium-term	0.00	1.50	0.70
(Qki) Imposed (H) Qi = 0.240	Short-term	0.00	1.50	0.00

L.C.	Load combination	duration class	kmod	-N/Kmod	+N/Kmod	V/Kmod	M/Kmod
1	γg.G	Permanent	0.60	-3.521	0.000	0.554	0.365
2	γg.G+γq.Q1	Short-term	0.90	-7.967	0.000	0.379	0.236
3	γg.G+γq.Q2	Short-term	0.90	-5.510	0.000	0.373	0.240
4	γg.G+γq.Q3	Short-term	0.90	-7.614	0.000	0.380	0.235
5	γg.G+γq.Q4	Short-term	0.90	-2.347	0.000	0.369	0.243
6	γg.G+γq.Q5	Short-term	0.90	-1.414	0.000	0.363	0.247
7	γg.G+γq.Qf	Medium-term	0.80	-2.324	0.000	0.418	0.273
8	γg.G+γq.Qi	Short-term	0.90	-4.193	0.000	0.372	0.241
9	γg.G+γq.Q1+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-7.770	0.000	0.381	0.236
10	γg.G+γq.Q1+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-7.303	0.000	0.378	0.237
11	γg.G+γq.Q2+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-5.313	0.000	0.375	0.240
12	γg.G+γq.Q2+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-4.846	0.000	0.372	0.242
13	γg.G+γq.Q3+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-7.417	0.000	0.382	0.235
14	γg.G+γq.Q3+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-6.951	0.000	0.379	0.237
15	γg.G+γq.Q4+γq.ψo.Q1+γq.ψo.Qf	Short-term	0.90	-5.522	0.000	0.377	0.239
16	γg.G+γq.Q4+γq.ψo.Q2+γq.ψo.Qf	Short-term	0.90	-4.048	0.000	0.373	0.241
17	γg.G+γq.Q4+γq.ψo.Q3+γq.ψo.Qf	Short-term	0.90	-5.310	0.000	0.378	0.238
18	γg.G+γq.Q5+γq.ψo.Q1+γq.ψo.Qf	Short-term	0.90	-4.589	0.000	0.371	0.242
19	γg.G+γq.Q5+γq.ψo.Q2+γq.ψo.Qf	Short-term	0.90	-3.115	0.000	0.367	0.245
20	γg.G+γq.Q5+γq.ψo.Q3+γq.ψo.Qf	Short-term	0.90	-4.377	0.000	0.371	0.241
21	γg.G+γq.Qf+γq.ψo.Q1+γq.ψo.Q4	Short-term	0.90	-5.438	0.000	0.378	0.238
22	γg.G+γq.Qf+γq.ψo.Q1+γq.ψo.Q5	Short-term	0.90	-4.971	0.000	0.375	0.240
23	γg.G+γq.Qf+γq.ψo.Q2+γq.ψo.Q4	Short-term	0.90	-3.963	0.000	0.374	0.241
24	γg.G+γq.Qf+γq.ψo.Q2+γq.ψo.Q5	Short-term	0.90	-3.497	0.000	0.371	0.243
25	γg.G+γq.Qf+γq.ψo.Q3+γq.ψo.Q4	Short-term	0.90	-5.226	0.000	0.378	0.238
26	γg.G+γq.Qf+γq.ψo.Q3+γq.ψo.Q5	Short-term	0.90	-4.759	0.000	0.375	0.240
27	γg.G+γq.Qi+γq.ψo.Q1+γq.ψo.Q4+γq.ψo.Q	Short-term	0.90	-7.367	0.000	0.380	0.236
28	γg.G+γq.Qi+γq.ψo.Q1+γq.ψo.Q5+γq.ψo.Q	Short-term	0.90	-6.901	0.000	0.377	0.238
29	γg.G+γq.Qi+γq.ψo.Q2+γq.ψo.Q4+γq.ψo.Q	Short-term	0.90	-5.893	0.000	0.376	0.239
30	γg.G+γq.Qi+γq.ψo.Q2+γq.ψo.Q5+γq.ψo.Q	Short-term	0.90	-5.427	0.000	0.373	0.241
31	γg.G+γq.Qi+γq.ψo.Q3+γq.ψo.Q4+γq.ψo.Q	Short-term	0.90	-7.156	0.000	0.381	0.236
32	γg.G+γq.Qi+γq.ψo.Q3+γq.ψo.Q5+γq.ψo.Q	Short-term	0.90	-6.689	0.000	0.377	0.238
	Maximum values			-7.967	0.000	0.554	0.365

1.10.20. Check of cross section Elements: 9

Elements: 9 , load combination No 2
Compression parallel to the grain, Fc0d=-7.170 kN (EC5 §6.1.4)
Rectangular cross section, b=60 mm, h=220 mm, A= 13 200 mm²
Modification factor Kmod=0.90 (Table 3.1), material factor γM=1.30 (Table 2.3)
fc0k=22.00 N/mm², fc0d=Kmod·fc0k/γM=0.90x22.00/1.30=15.23N/mm² (EC5 Eq.2.14)
Fc0d=-7.170 kN, σc0d=Fc0d/Anetto=1000x7.170/13200=0.54N/mm² < 15.23N/mm²=fc0d (Eq.6.2)
The check is satisfied

Negligible shear stress, shear check is omitted (EC5 §6.1.7)

Elements: 9 , load combination No 1
Bending, Myd=0.219 kNm, Mzd=0.000 kNm (EC5 §6.1.6)
Rectangular cross section, b=60mm, h=220mm, A=1.320E+004mm^2, Wy=4.840E+005mm^3, Wz=1.320E+005mm^3
Modification factor Kmod=0.60 (Table 3.1), material factor γM=1.30 (Table 2.3)
fmyk=27.00 N/mm^2, fmyd=Kmod·fmyk/γM=0.60x27.00/1.30=12.46N/mm^2
fmzk=27.00 N/mm^2, fmzd=Kmod·fmzk/γM=0.60x27.00/1.30=12.46N/mm^2

Rectangular cross section Km=0.70 (EC5 §6.1.6.(2))
σmyd=Myd/Wmy,netto=1E+06x0.219/4.840E+005= 0.45 N/mm^2
σmzd=Mzd/Wmz,netto=1E+06x0.000/1.320E+005= 0.00 N/mm^2

σmyd/fmyd+Km.σmzd/fmzd=0.036+0.000= 0.04 < 1 (EC5 Eq.6.11)
Km.σmyd/fmyd+σmzd/fmzd=0.025+0.000= 0.03 < 1 (EC5 Eq.6.12)
The check is satisfied

Elements: 9 , load combination No 2
Combined bending and axial compression, Fc0d=-7.170kN, Myd=0.212kNm, Mzd=0.000kNm (EC5 §6.2.4)
Rectangular cross section, b=60mm, h=220mm, A=1.320E+004mm^2, Wy=4.840E+005mm^3, Wz=1.320E+005mm^3
Modification factor Kmod=0.90 (Table 3.1), material factor γM=1.30 (Table 2.3)
fc0k=22.00 N/mm^2, fc0d=Kmod·fc0k/γM=0.90x22.00/1.30=15.23N/mm^2
fmyk=27.00 N/mm^2, fmyd=Kmod·fmyk/γM=0.90x27.00/1.30=18.69N/mm^2
fmzk=27.00 N/mm^2, fmzd=Kmod·fmzk/γM=0.90x27.00/1.30=18.69N/mm^2

Rectangular cross section Km=0.70 (EC5 §6.1.6.(2))
σc0d=Fc0d/Anetto=1000x7.170/13200= 0.54 N/mm^2
σmyd=Myd/Wmy,netto=1E+06x0.212/4.840E+005= 0.44 N/mm^2
σmzd=Mzd/Wmz,netto=1E+06x0.000/1.320E+005= 0.00 N/mm^2

(σc0d/fc0d)^2+σmyd/fmyd+Km.σmzd/fmzd=0.001+0.023+0.000= 0.02 < 1 (EC5 Eq.6.19)
(σc0d/fc0d)^2+Km.σmyd/fmyd+σmzd/fmzd=0.001+0.016+0.000= 0.02 < 1 (EC5 Eq.6.20)
The check is satisfied

Elements: 9 , load combination No 1
Combined bending and axial compression, Fc0d=-2.113kN, Myd=0.219kNm, Mzd=0.000kNm (EC5 §6.2.4)
Rectangular cross section, b=60mm, h=220mm, A=1.320E+004mm^2, Wy=4.840E+005mm^3, Wz=1.320E+005mm^3
Modification factor Kmod=0.60 (Table 3.1), material factor γM=1.30 (Table 2.3)
fc0k=22.00 N/mm^2, fc0d=Kmod·fc0k/γM=0.60x22.00/1.30=10.15N/mm^2
fmyk=27.00 N/mm^2, fmyd=Kmod·fmyk/γM=0.60x27.00/1.30=12.46N/mm^2
fmzk=27.00 N/mm^2, fmzd=Kmod·fmzk/γM=0.60x27.00/1.30=12.46N/mm^2

Rectangular cross section Km=0.70 (EC5 §6.1.6.(2))
σc0d=Fc0d/Anetto=1000x2.113/13200= 0.16 N/mm^2
σmyd=Myd/Wmy,netto=1E+06x0.219/4.840E+005= 0.45 N/mm^2
σmzd=Mzd/Wmz,netto=1E+06x0.000/1.320E+005= 0.00 N/mm^2

(σc0d/fc0d)^2+σmyd/fmyd+Km.σmzd/fmzd=0.000+0.036+0.000= 0.04 < 1 (EC5 Eq.6.19)
(σc0d/fc0d)^2+Km.σmyd/fmyd+σmzd/fmzd=0.000+0.025+0.000= 0.03 < 1 (EC5 Eq.6.20)
The check is satisfied

Elements: 9 , load combination No 2
Column stability with bending, Fc0d=-7.170kN, Myd=0.212kNm, Mzd=0.000kNm (EC5 §6.3.2)
Rectangular cross section, b=60mm, h=220mm, A=1.320E+004mm^2, Wy=4.840E+005mm^3, Wz=1.320E+005mm^3
Modification factor Kmod=0.90 (Table 3.1), material factor γM=1.30 (Table 2.3, E005=7700N/mm^2
fc0k=22.00 N/mm^2, fc0d=Kmod·fc0k/γM=0.90x22.00/1.30=15.23N/mm^2
fmyk=27.00 N/mm^2, fmyd=Kmod·fmyk/γM=0.90x27.00/1.30=18.69N/mm^2
fmzk=27.00 N/mm^2, fmzd=Kmod·fmzk/γM=0.90x27.00/1.30=18.69N/mm^2

```
Rectangular cross section Km=0.70 (EC5  §6.1.6.(2))
σc0d=Fc0d/Anetto=1000x7.170/13200= 0.54 N/mm²
σmyd=Myd/Wmy,netto=1E+06x0.212/4.840E+005= 0.44 N/mm²
σmzd=Mzd/Wmz,netto=1E+06x0.000/1.320E+005= 0.00 N/mm²


Buckling length Sk
Sky= 1.00x2.700=2.700 m= 2700 mm (most unfavourable)
Skz= 0.11x2.700=0.300 m=  300 mm (effective length/total length=0.30/2.70=0.11)


Slenderness
iy=√(Iy/A)=0.289x 220= 64 mm, λy= 2700/ 64= 42.19
iz=√(Iz/A)=0.289x  60= 17 mm, λz=  300/ 17= 17.65


Critical stresses
σc,crity=π²E005/λy²=   42.69 N/mm², λrel,y=√(fc0k/σc,crity)=  0.72 (EC5 Eq.6.21)
σc,critz=π²E005/λz²=  243.95 N/mm², λrel,z=√(fc0k/σc,critz)=  0.30 (EC5 Eq.6.22)


βc=0.20 (solid timber)
ky=0.5[1+βc(λrely-0.3)+λrely²]= 0.80, Kcy=1/(ky+√(ky²-λrely²))=0.869 (Eq.6.27 6.25)
kz=0.5[1+βc(λrelz-0.3)+λrelz²]= 0.55, Kcz=1/(kz+√(kz²-λrelz²))=1.000 (Eq.6.28 6.26)


σc0d/(Kcy·fc0d)+σmyd/fmyd+Km.σmzd/fmzd=0.041+0.023+0.000= 0.06 < 1 (EC5 Eq.6.23)
σc0d/(Kcz·fc0d)+Km.σmyd/fmyd+σmzd/fmzd=0.036+0.016+0.000= 0.05 < 1 (EC5 Eq.6.24)
The check is satisfied
```

Elements: 9 , load combination No 1

Column stability with bending, Fc0d=-2.113kN, Myd=0.219kNm, Mzd=0.000kNm (EC5 §6.3.2)

```
Rectangular cross section, b=60mm, h=220mm, A=1.320E+004mm², Wy=4.840E+005mm³, Wz=1.320E+005mm³
Modification factor Kmod=0.60 (Table 3.1), material factor γM=1.30 (Table 2.3, E005=7700N/mm²
fc0k=22.00 N/mm², fc0d=Kmod·fc0k/γM=0.60x22.00/1.30=10.15N/mm²
fmyk=27.00 N/mm², fmyd=Kmod·fmyk/γM=0.60x27.00/1.30=12.46N/mm²
fmzk=27.00 N/mm², fmzd=Kmod·fmzk/γM=0.60x27.00/1.30=12.46N/mm²


Rectangular cross section Km=0.70 (EC5  §6.1.6.(2))
σc0d=Fc0d/Anetto=1000x2.113/13200= 0.16 N/mm²
σmyd=Myd/Wmy,netto=1E+06x0.219/4.840E+005= 0.45 N/mm²
σmzd=Mzd/Wmz,netto=1E+06x0.000/1.320E+005= 0.00 N/mm²


Buckling length Sk
Sky= 1.00x2.700=2.700 m= 2700 mm (most unfavourable)
Skz= 0.11x2.700=0.300 m=  300 mm (effective length/total length=0.30/2.70=0.11)


Slenderness
iy=√(Iy/A)=0.289x 220= 64 mm, λy= 2700/ 64= 42.19
iz=√(Iz/A)=0.289x  60= 17 mm, λz=  300/ 17= 17.65


Critical stresses
σc,crity=π²E005/λy²=   42.69 N/mm², λrel,y=√(fc0k/σc,crity)=  0.72 (EC5 Eq.6.21)
σc,critz=π²E005/λz²=  243.95 N/mm², λrel,z=√(fc0k/σc,critz)=  0.30 (EC5 Eq.6.22)


βc=0.20 (solid timber)
ky=0.5[1+βc(λrely-0.3)+λrely²]= 0.80, Kcy=1/(ky+√(ky²-λrely²))=0.869 (Eq.6.27 6.25)
kz=0.5[1+βc(λrelz-0.3)+λrelz²]= 0.55, Kcz=1/(kz+√(kz²-λrelz²))=1.000 (Eq.6.28 6.26)


σc0d/(Kcy·fc0d)+σmyd/fmyd+Km.σmzd/fmzd=0.018+0.036+0.000= 0.05 < 1 (EC5 Eq.6.23)
σc0d/(Kcz·fc0d)+Km.σmyd/fmyd+σmzd/fmzd=0.016+0.025+0.000= 0.04 < 1 (EC5 Eq.6.24)
The check is satisfied
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1.10.21. Ultimate limit state (EC5 EN1995-1-1:2009, §6)

Elements: 10

Loading [kN/m]	action	γg	γq	ψo
(Gk) Dead Gk1 = 0.314, Gk2 = 0.180, Gkf=0.300	Permanent	1.35	0.00	1.00
(Qk1) Snow QksL= 0.768, QksR= 0.546	Short-term	0.00	1.50	0.60
(Qk2) Snow QksL= 0.384, QksR= 0.546	Short-term	0.00	1.50	0.60
(Qk3) Snow QksL= 0.768, QksR= 0.273	Short-term	0.00	1.50	0.60
(Qk4) Wind QkwL= 0.123, QkwR=-0.133	Short-term	0.00	1.50	0.50
(Qk5) Wind QkwL=-0.162, QkwR= 0.182	Short-term	0.00	1.50	0.50
(Qkf) Live Qkf = 1.200	Medium-term	0.00	1.50	0.70
(Qki) Imposed (H) Qi = 0.240	Short-term	0.00	1.50	0.00

L.C.	Load combination	duration class	kmod	-N/Kmod	+N/Kmod	V/Kmod	M/Kmod
1	γg.G	Permanent	0.60	-3.507	0.000	0.319	0.118
2	γg.G+γq.Q1	Short-term	0.90	-7.956	0.000	0.235	0.088
3	γg.G+γq.Q2	Short-term	0.90	-5.500	0.000	0.220	0.082
4	γg.G+γq.Q3	Short-term	0.90	-7.603	0.000	0.239	0.090
5	γg.G+γq.Q4	Short-term	0.90	-3.046	0.000	0.227	0.083
6	γg.G+γq.Q5	Short-term	0.90	-2.338	0.000	0.212	0.079
7	γg.G+γq.Qf	Medium-term	0.80	-2.287	0.000	0.249	0.089
8	γg.G+γq.Qi	Short-term	0.90	-4.183	0.000	0.218	0.081
9	γg.G+γq.Q1+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-8.096	0.000	0.248	0.090
10	γg.G+γq.Q1+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-7.742	0.000	0.240	0.088
11	γg.G+γq.Q2+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-5.640	0.000	0.233	0.084
12	γg.G+γq.Q2+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-5.286	0.000	0.225	0.082
13	γg.G+γq.Q3+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-7.744	0.000	0.252	0.092
14	γg.G+γq.Q3+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-7.390	0.000	0.244	0.090
15	γg.G+γq.Q4+γq.ψo.Q1+γq.ψo.Qf	Short-term	0.90	-6.203	0.000	0.246	0.089
16	γg.G+γq.Q4+γq.ψo.Q2+γq.ψo.Qf	Short-term	0.90	-4.729	0.000	0.237	0.085
17	γg.G+γq.Q4+γq.ψo.Q3+γq.ψo.Qf	Short-term	0.90	-5.991	0.000	0.248	0.090
18	γg.G+γq.Q5+γq.ψo.Q1+γq.ψo.Qf	Short-term	0.90	-5.495	0.000	0.232	0.085
19	γg.G+γq.Q5+γq.ψo.Q2+γq.ψo.Qf	Short-term	0.90	-4.021	0.000	0.223	0.081
20	γg.G+γq.Q5+γq.ψo.Q3+γq.ψo.Qf	Short-term	0.90	-5.284	0.000	0.234	0.086
21	γg.G+γq.Qf+γq.ψo.Q1+γq.ψo.Q4	Short-term	0.90	-5.758	0.000	0.241	0.087
22	γg.G+γq.Qf+γq.ψo.Q1+γq.ψo.Q5	Short-term	0.90	-5.404	0.000	0.234	0.085
23	γg.G+γq.Qf+γq.ψo.Q2+γq.ψo.Q4	Short-term	0.90	-4.284	0.000	0.232	0.083
24	γg.G+γq.Qf+γq.ψo.Q2+γq.ψo.Q5	Short-term	0.90	-3.930	0.000	0.225	0.081
25	γg.G+γq.Qf+γq.ψo.Q3+γq.ψo.Q4	Short-term	0.90	-5.546	0.000	0.244	0.088
26	γg.G+γq.Qf+γq.ψo.Q3+γq.ψo.Q5	Short-term	0.90	-5.192	0.000	0.237	0.085
27	γg.G+γq.Qi+γq.ψo.Q1+γq.ψo.Q4+γq.ψo.Q	Short-term	0.90	-7.694	0.000	0.245	0.089
28	γg.G+γq.Qi+γq.ψo.Q1+γq.ψo.Q5+γq.ψo.Q	Short-term	0.90	-7.340	0.000	0.238	0.087
29	γg.G+γq.Qi+γq.ψo.Q2+γq.ψo.Q4+γq.ψo.Q	Short-term	0.90	-6.220	0.000	0.236	0.085
30	γg.G+γq.Qi+γq.ψo.Q2+γq.ψo.Q5+γq.ψo.Q	Short-term	0.90	-5.866	0.000	0.229	0.083
31	γg.G+γq.Qi+γq.ψo.Q3+γq.ψo.Q4+γq.ψo.Q	Short-term	0.90	-7.483	0.000	0.247	0.090
32	γg.G+γq.Qi+γq.ψo.Q3+γq.ψo.Q5+γq.ψo.Q	Short-term	0.90	-7.129	0.000	0.240	0.088
	Maximum values			-8.096	0.000	0.319	0.118

1.10.22. Check of cross section Elements: 10

Elements: 10 , load combination No 9

Compression parallel to the grain, Fc0d=-7.287 kN (EC5 §6.1.4)

Rectangular cross section, b=60 mm, h=220 mm, A= 13 200 mm²

Modification factor Kmod=0.90 (Table 3.1), material factor γM=1.30 (Table 2.3)

fc0k=22.00 N/mm², fc0d=Kmod·fc0k/γM=0.90x22.00/1.30=15.23N/mm² (EC5 Eq.2.14)

Fc0d=-7.287 kN, σc0d=Fc0d/Anetto=1000x7.287/13200=0.55N/mm² < 15.23N/mm²=fc0d (Eq.6.2)

The check is satisfied

Negligible shear stress, shear check is omitted (EC5 §6.1.7)

Elements: 10 , load combination No 1
Bending, Myd=0.071 kNm, Mzd=0.000 kNm (EC5 §6.1.6)
Rectangular cross section, b=60mm, h=220mm, A=1.320E+004mm^2, Wy=4.840E+005mm^3, Wz=1.320E+005mm^3
Modification factor Kmod=0.60 (Table 3.1), material factor γM=1.30 (Table 2.3)
fmyk=27.00 N/mm^2, fmyd=Kmod·fmyk/γM=0.60x27.00/1.30=12.46N/mm^2
fmzk=27.00 N/mm^2, fmzd=Kmod·fmzk/γM=0.60x27.00/1.30=12.46N/mm^2

Rectangular cross section Km=0.70 (EC5 §6.1.6.(2))
σmyd=Myd/Wmy,netto=1E+06x0.071/4.840E+005= 0.15 N/mm^2
σmzd=Mzd/Wmz,netto=1E+06x0.000/1.320E+005= 0.00 N/mm^2

σmyd/fmyd+Km.σmzd/fmzd=0.012+0.000= 0.01 < 1 (EC5 Eq.6.11)
Km.σmyd/fmyd+σmzd/fmzd=0.008+0.000= 0.01 < 1 (EC5 Eq.6.12)
The check is satisfied

Elements: 10 , load combination No 9
Combined bending and axial compression, Fc0d=-7.287kN, Myd=0.081kNm, Mzd=0.000kNm (EC5 §6.2.4)
Rectangular cross section, b=60mm, h=220mm, A=1.320E+004mm^2, Wy=4.840E+005mm^3, Wz=1.320E+005mm^3
Modification factor Kmod=0.90 (Table 3.1), material factor γM=1.30 (Table 2.3)
fc0k=22.00 N/mm^2, fc0d=Kmod·fc0k/γM=0.90x22.00/1.30=15.23N/mm^2
fmyk=27.00 N/mm^2, fmyd=Kmod·fmyk/γM=0.90x27.00/1.30=18.69N/mm^2
fmzk=27.00 N/mm^2, fmzd=Kmod·fmzk/γM=0.90x27.00/1.30=18.69N/mm^2

Rectangular cross section Km=0.70 (EC5 §6.1.6.(2))
σc0d=Fc0d/Anetto=1000x7.287/13200= 0.55 N/mm^2
σmyd=Myd/Wmy,netto=1E+06x0.081/4.840E+005= 0.17 N/mm^2
σmzd=Mzd/Wmz,netto=1E+06x0.000/1.320E+005= 0.00 N/mm^2

(σc0d/fc0d)^2+σmyd/fmyd+Km.σmzd/fmzd=0.001+0.009+0.000= 0.01 < 1 (EC5 Eq.6.19)
(σc0d/fc0d)^2+Km.σmyd/fmyd+σmzd/fmzd=0.001+0.006+0.000= 0.01 < 1 (EC5 Eq.6.20)
The check is satisfied

Elements: 10 , load combination No 1
Combined bending and axial compression, Fc0d=-2.104kN, Myd=0.071kNm, Mzd=0.000kNm (EC5 §6.2.4)
Rectangular cross section, b=60mm, h=220mm, A=1.320E+004mm^2, Wy=4.840E+005mm^3, Wz=1.320E+005mm^3
Modification factor Kmod=0.60 (Table 3.1), material factor γM=1.30 (Table 2.3)
fc0k=22.00 N/mm^2, fc0d=Kmod·fc0k/γM=0.60x22.00/1.30=10.15N/mm^2
fmyk=27.00 N/mm^2, fmyd=Kmod·fmyk/γM=0.60x27.00/1.30=12.46N/mm^2
fmzk=27.00 N/mm^2, fmzd=Kmod·fmzk/γM=0.60x27.00/1.30=12.46N/mm^2

Rectangular cross section Km=0.70 (EC5 §6.1.6.(2))
σc0d=Fc0d/Anetto=1000x2.104/13200= 0.16 N/mm^2
σmyd=Myd/Wmy,netto=1E+06x0.071/4.840E+005= 0.15 N/mm^2
σmzd=Mzd/Wmz,netto=1E+06x0.000/1.320E+005= 0.00 N/mm^2

(σc0d/fc0d)^2+σmyd/fmyd+Km.σmzd/fmzd=0.000+0.012+0.000= 0.01 < 1 (EC5 Eq.6.19)
(σc0d/fc0d)^2+Km.σmyd/fmyd+σmzd/fmzd=0.000+0.008+0.000= 0.01 < 1 (EC5 Eq.6.20)
The check is satisfied

Elements: 10 , load combination No 9
Column stability with bending, Fc0d=-7.287kN, Myd=0.081kNm, Mzd=0.000kNm (EC5 §6.3.2)
Rectangular cross section, b=60mm, h=220mm, A=1.320E+004mm^2, Wy=4.840E+005mm^3, Wz=1.320E+005mm^3
Modification factor Kmod=0.90 (Table 3.1), material factor γM=1.30 (Table 2.3, E005=7700N/mm^2
fc0k=22.00 N/mm^2, fc0d=Kmod·fc0k/γM=0.90x22.00/1.30=15.23N/mm^2
fmyk=27.00 N/mm^2, fmyd=Kmod·fmyk/γM=0.90x27.00/1.30=18.69N/mm^2
fmzk=27.00 N/mm^2, fmzd=Kmod·fmzk/γM=0.90x27.00/1.30=18.69N/mm^2

Rectangular cross section Km=0.70 (EC5 §6.1.6.(2))
σc0d=Fc0d/Anetto=1000x7.287/13200= 0.55 N/mm^2
σmyd=Myd/Wmy,netto=1E+06x0.081/4.840E+005= 0.17 N/mm^2
σmzd=Mzd/Wmz,netto=1E+06x0.000/1.320E+005= 0.00 N/mm^2

Buckling length Sk
Sky= 1.00x1.500=1.500 m= 1500 mm (most unfavourable)
Skz= 0.20x1.500=0.300 m= 300 mm (effective length/total length=0.30/1.50=0.20)

Slenderness
iy=√(Iy/A)=0.289x 220= 64 mm, λy= 1500/ 64= 23.44
iz=√(Iz/A)=0.289x 60= 17 mm, λz= 300/ 17= 17.65

Critical stresses
σc,crity=π^{2}E005/λy^2= 138.32 N/mm^2, λrel,y=√(fc0k/σc,crity)= 0.40 (EC5 Eq.6.21)
σc,critz=π^{2}E005/λz^2= 243.95 N/mm^2, λrel,z=√(fc0k/σc,critz)= 0.30 (EC5 Eq.6.22)

βc=0.20 (solid timber)
ky=0.5[1+βc(λrely-0.3)+λrely^2]= 0.59, Kcy=1/(ky+√(ky^2-λrely^2))=0.977 (Eq.6.27 6.25)
kz=0.5[1+βc(λrelz-0.3)+λrelz^2]= 0.55, Kcz=1/(kz+√(kz^2-λrelz^2))=1.000 (Eq.6.28 6.26)

σc0d/(Kcy·fc0d)+σmyd/fmyd+Km.σmzd/fmzd=0.037+0.009+0.000= 0.05 < 1 (EC5 Eq.6.23)
σc0d/(Kcz·fc0d)+Km.σmyd/fmyd+σmzd/fmzd=0.036+0.006+0.000= 0.04 < 1 (EC5 Eq.6.24)
The check is satisfied

Elements: 10 , load combination No 1
Column stability with bending, Fc0d=-2.104kN, Myd=0.071kNm, Mzd=0.000kNm (EC5 §6.3.2)
Rectangular cross section, b=60mm, h=220mm, A=1.320E+004mm^2, Wy=4.840E+005mm^3, Wz=1.320E+005mm^3
Modification factor Kmod=0.60 (Table 3.1), material factor γM=1.30 (Table 2.3, E005=7700N/mm^2
fc0k=22.00 N/mm^2, fc0d=Kmod·fc0k/γM=0.60x22.00/1.30=10.15N/mm^2
fmyk=27.00 N/mm^2, fmyd=Kmod·fmyk/γM=0.60x27.00/1.30=12.46N/mm^2
fmzk=27.00 N/mm^2, fmzd=Kmod·fmzk/γM=0.60x27.00/1.30=12.46N/mm^2

Rectangular cross section Km=0.70 (EC5 §6.1.6.(2))
σc0d=Fc0d/Anetto=1000x2.104/13200= 0.16 N/mm^2
σmyd=Myd/Wmy,netto=1E+06x0.071/4.840E+005= 0.15 N/mm^2
σmzd=Mzd/Wmz,netto=1E+06x0.000/1.320E+005= 0.00 N/mm^2

Buckling length Sk
Sky= 1.00x1.500=1.500 m= 1500 mm (most unfavourable)
Skz= 0.20x1.500=0.300 m= 300 mm (effective length/total length=0.30/1.50=0.20)

Slenderness
iy=√(Iy/A)=0.289x 220= 64 mm, λy= 1500/ 64= 23.44
iz=√(Iz/A)=0.289x 60= 17 mm, λz= 300/ 17= 17.65

Critical stresses
σc,crity=π^{2}E005/λy^2= 138.32 N/mm^2, λrel,y=√(fc0k/σc,crity)= 0.40 (EC5 Eq.6.21)
σc,critz=π^{2}E005/λz^2= 243.95 N/mm^2, λrel,z=√(fc0k/σc,critz)= 0.30 (EC5 Eq.6.22)

βc=0.20 (solid timber)
ky=0.5[1+βc(λrely-0.3)+λrely^2]= 0.59, Kcy=1/(ky+√(ky^2-λrely^2))=0.977 (Eq.6.27 6.25)
kz=0.5[1+βc(λrelz-0.3)+λrelz^2]= 0.55, Kcz=1/(kz+√(kz^2-λrelz^2))=1.000 (Eq.6.28 6.26)

σc0d/(Kcy·fc0d)+σmyd/fmyd+Km.σmzd/fmzd=0.016+0.012+0.000= 0.03 < 1 (EC5 Eq.6.23)
σc0d/(Kcz·fc0d)+Km.σmyd/fmyd+σmzd/fmzd=0.016+0.008+0.000= 0.02 < 1 (EC5 Eq.6.24)
The check is satisfied

1.10.23. Ultimate limit state (EC5 EN1995-1-1:2009, §6)
Elements: 11

Loading [kN/m]	action	γg	γq	ψo
(Gk) Dead Gk1 = 0.314, Gk2 = 0.180, Gkf=0.300	Permanent	1.35	0.00	1.00
(Qk1) Snow QksL= 0.768, QksR= 0.546	Short-term	0.00	1.50	0.60
(Qk2) Snow QksL= 0.384, QksR= 0.546	Short-term	0.00	1.50	0.60
(Qk3) Snow QksL= 0.768, QksR= 0.273	Short-term	0.00	1.50	0.60
(Qk4) Wind QkwL= 0.123, QkwR=-0.133	Short-term	0.00	1.50	0.50
(Qk5) Wind QkwL=-0.162, QkwR= 0.182	Short-term	0.00	1.50	0.50
(Qkf) Live Qkf = 1.200	Medium-term	0.00	1.50	0.70
(Qki) Imposed (H) Qi = 0.240	Short-term	0.00	1.50	0.00

L.C.	Load combination	duration class	kmod	-N/Kmod	+N/Kmod	V/Kmod	M/Kmod
1	γg.G	Permanent	0.60	-3.830	0.000	0.019	0.033
2	γg.G+γq.Q1	Short-term	0.90	-10.222	0.000	0.029	0.041
3	γg.G+γq.Q2	Short-term	0.90	-7.224	0.000	0.019	0.029
4	γg.G+γq.Q3	Short-term	0.90	-9.385	0.000	0.031	0.044
5	γg.G+γq.Q4	Short-term	0.90	-2.848	0.000	0.026	0.041
6	γg.G+γq.Q5	Short-term	0.90	-2.553	0.000	0.013	0.022
7	γg.G+γq.Qf	Medium-term	0.80	0.000	0.169	0.039	0.074
8	γg.G+γq.Qi	Short-term	0.90	-5.162	0.000	0.017	0.028
9	γg.G+γq.Q1+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-8.477	0.000	0.050	0.081
10	γg.G+γq.Q1+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-8.329	0.000	0.044	0.072
11	γg.G+γq.Q2+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-5.479	0.000	0.040	0.069
12	γg.G+γq.Q2+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-5.332	0.000	0.034	0.060
13	γg.G+γq.Q3+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-7.640	0.000	0.052	0.084
14	γg.G+γq.Q3+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-7.493	0.000	0.046	0.074
15	γg.G+γq.Q4+γq.ψo.Q1+γq.ψo.Qf	Short-term	0.90	-5.557	0.000	0.051	0.083
16	γg.G+γq.Q4+γq.ψo.Q2+γq.ψo.Qf	Short-term	0.90	-3.758	0.000	0.045	0.076
17	γg.G+γq.Q4+γq.ψo.Q3+γq.ψo.Qf	Short-term	0.90	-5.055	0.000	0.052	0.085
18	γg.G+γq.Q5+γq.ψo.Q1+γq.ψo.Qf	Short-term	0.90	-5.262	0.000	0.037	0.064
19	γg.G+γq.Q5+γq.ψo.Q2+γq.ψo.Qf	Short-term	0.90	-3.463	0.000	0.031	0.057
20	γg.G+γq.Q5+γq.ψo.Q3+γq.ψo.Qf	Short-term	0.90	-4.760	0.000	0.039	0.066
21	γg.G+γq.Qf+γq.ψo.Q1+γq.ψo.Q4	Short-term	0.90	-4.598	0.000	0.050	0.087
22	γg.G+γq.Qf+γq.ψo.Q1+γq.ψo.Q5	Short-term	0.90	-4.451	0.000	0.044	0.077
23	γg.G+γq.Qf+γq.ψo.Q2+γq.ψo.Q4	Short-term	0.90	-2.800	0.000	0.044	0.080
24	γg.G+γq.Qf+γq.ψo.Q2+γq.ψo.Q5	Short-term	0.90	-2.652	0.000	0.038	0.070
25	γg.G+γq.Qf+γq.ψo.Q3+γq.ψo.Q4	Short-term	0.90	-4.096	0.000	0.052	0.088
26	γg.G+γq.Qf+γq.ψo.Q3+γq.ψo.Q5	Short-term	0.90	-3.949	0.000	0.045	0.079
27	γg.G+γq.Qi+γq.ψo.Q1+γq.ψo.Q4+γq.ψo.Q	Short-term	0.90	-8.018	0.000	0.048	0.079
28	γg.G+γq.Qi+γq.ψo.Q1+γq.ψo.Q5+γq.ψo.Q	Short-term	0.90	-7.870	0.000	0.042	0.070
29	γg.G+γq.Qi+γq.ψo.Q2+γq.ψo.Q4+γq.ψo.Q	Short-term	0.90	-6.219	0.000	0.042	0.072
30	γg.G+γq.Qi+γq.ψo.Q2+γq.ψo.Q5+γq.ψo.Q	Short-term	0.90	-6.072	0.000	0.036	0.062
31	γg.G+γq.Qi+γq.ψo.Q3+γq.ψo.Q4+γq.ψo.Q	Short-term	0.90	-7.516	0.000	0.050	0.080
32	γg.G+γq.Qi+γq.ψo.Q3+γq.ψo.Q5+γq.ψo.Q	Short-term	0.90	-7.368	0.000	0.043	0.071
	Maximum values			-10.222	0.169	0.052	0.088

1.10.24. Check of cross section Elements: 11

Elements: 11 , load combination No 7
Tension parallel to the grain, Ft0d=0.135 kN (EC5 §6.1.2)
Rectangular cross section, b=60 mm, h=220 mm, A= 13 200 mm²
Modification factor Kmod=0.80 (Table 3.1), material factor γM=1.30 (Table 2.3)
ft0k=16.00 N/mm², ft0d=Kmod·ft0k/γM=0.80x16.00/1.30=9.85N/mm² (EC5 Eq.2.14)
Ft0d=0.135 kN, σt0d=Ft0d/Anetto=1000x0.135/13200=0.01N/mm² < 9.85N/mm²=ft0d (Eq.6.1)
The check is satisfied

Elements: 11 , load combination No 2
Compression parallel to the grain, Fc0d=-9.199 kN (EC5 §6.1.4)
Rectangular cross section, b=60 mm, h=220 mm, A= 13 200 mm²
Modification factor Kmod=0.90 (Table 3.1), material factor γM=1.30 (Table 2.3)
fc0k=22.00 N/mm², fc0d=Kmod·fc0k/γM=0.90x22.00/1.30=15.23N/mm² (EC5 Eq.2.14)
Fc0d=-9.199 kN, σc0d=Fc0d/Anetto=1000x9.199/13200=0.70N/mm² < 15.23N/mm²=fc0d (Eq.6.2)
The check is satisfied

Negligible shear stress, shear check is omitted (EC5 §6.1.7)

Elements: 11 , load combination No 25
Bending, Myd=0.079 kNm, Mzd=0.000 kNm (EC5 §6.1.6)
Rectangular cross section, b=60mm, h=220mm, A=1.320E+004mm², Wy=4.840E+005mm³, Wz=1.320E+005mm³
Modification factor Kmod=0.90 (Table 3.1), material factor γM=1.30 (Table 2.3)
fmyk=27.00 N/mm², fmyd=Kmod·fmyk/γM=0.90x27.00/1.30=18.69N/mm²
fmzk=27.00 N/mm², fmzd=Kmod·fmzk/γM=0.90x27.00/1.30=18.69N/mm²

Rectangular cross section Km=0.70 (EC5 §6.1.6.(2))
σmyd=Myd/Wmy,netto=1E+06x0.079/4.840E+005= 0.16 N/mm²
σmzd=Mzd/Wmz,netto=1E+06x0.000/1.320E+005= 0.00 N/mm²

σmyd/fmyd+Km.σmzd/fmzd=0.009+0.000= 0.01 < 1 (EC5 Eq.6.11)
Km.σmyd/fmyd+σmzd/fmzd=0.006+0.000= 0.01 < 1 (EC5 Eq.6.12)
The check is satisfied

Elements: 11 , load combination No 2
Combined bending and axial compression, Fc0d=-9.199kN, Myd=0.037kNm, Mzd=0.000kNm (EC5 §6.2.4)
Rectangular cross section, b=60mm, h=220mm, A=1.320E+004mm², Wy=4.840E+005mm³, Wz=1.320E+005mm³
Modification factor Kmod=0.90 (Table 3.1), material factor γM=1.30 (Table 2.3)
fc0k=22.00 N/mm², fc0d=Kmod·fc0k/γM=0.90x22.00/1.30=15.23N/mm²
fmyk=27.00 N/mm², fmyd=Kmod·fmyk/γM=0.90x27.00/1.30=18.69N/mm²
fmzk=27.00 N/mm², fmzd=Kmod·fmzk/γM=0.90x27.00/1.30=18.69N/mm²

Rectangular cross section Km=0.70 (EC5 §6.1.6.(2))
σc0d=Fc0d/Anetto=1000x9.199/13200= 0.70 N/mm²
σmyd=Myd/Wmy,netto=1E+06x0.037/4.840E+005= 0.08 N/mm²
σmzd=Mzd/Wmz,netto=1E+06x0.000/1.320E+005= 0.00 N/mm²

(σc0d/fc0d)²+σmyd/fmyd+Km.σmzd/fmzd=0.002+0.004+0.000= 0.01 < 1 (EC5 Eq.6.19)
(σc0d/fc0d)²+Km.σmyd/fmyd+σmzd/fmzd=0.002+0.003+0.000= 0.00 < 1 (EC5 Eq.6.20)
The check is satisfied

Elements: 11 , load combination No 25
Combined bending and axial compression, Fc0d=-3.687kN, Myd=0.079kNm, Mzd=0.000kNm (EC5 §6.2.4)
Rectangular cross section, b=60mm, h=220mm, A=1.320E+004mm², Wy=4.840E+005mm³, Wz=1.320E+005mm³
Modification factor Kmod=0.90 (Table 3.1), material factor γM=1.30 (Table 2.3)
fc0k=22.00 N/mm², fc0d=Kmod·fc0k/γM=0.90x22.00/1.30=15.23N/mm²
fmyk=27.00 N/mm², fmyd=Kmod·fmyk/γM=0.90x27.00/1.30=18.69N/mm²
fmzk=27.00 N/mm², fmzd=Kmod·fmzk/γM=0.90x27.00/1.30=18.69N/mm²

Rectangular cross section Km=0.70 (EC5 §6.1.6.(2))
σc0d=Fc0d/Anetto=1000x3.687/13200= 0.28 N/mm²
σmyd=Myd/Wmy,netto=1E+06x0.079/4.840E+005= 0.16 N/mm²
σmzd=Mzd/Wmz,netto=1E+06x0.000/1.320E+005= 0.00 N/mm²

(σc0d/fc0d)²+σmyd/fmyd+Km.σmzd/fmzd=0.000+0.009+0.000= 0.01 < 1 (EC5 Eq.6.19)
(σc0d/fc0d)²+Km.σmyd/fmyd+σmzd/fmzd=0.000+0.006+0.000= 0.01 < 1 (EC5 Eq.6.20)
The check is satisfied

Elements: 11 , load combination No 2

Column stability with bending, Fc0d=-9.199kN, Myd=0.037kNm, Mzd=0.000kNm (EC5 §6.3.2)
Rectangular cross section, b=60mm, h=220mm, A=1.320E+004mm², Wy=4.840E+005mm³, Wz=1.320E+005mm³
Modification factor Kmod=0.90 (Table 3.1), material factor γM=1.30 (Table 2.3, E005=7700N/mm²
fc0k=22.00 N/mm², fc0d=Kmod·fc0k/γM=0.90x22.00/1.30=15.23N/mm²
fmyk=27.00 N/mm², fmyd=Kmod·fmyk/γM=0.90x27.00/1.30=18.69N/mm²
fmzk=27.00 N/mm², fmzd=Kmod·fmzk/γM=0.90x27.00/1.30=18.69N/mm²

Rectangular cross section Km=0.70 (EC5 §6.1.6.(2))
σc0d=Fc0d/Anetto=1000x9.199/13200= 0.70 N/mm²
σmyd=Myd/Wmy,netto=1E+06x0.037/4.840E+005= 0.08 N/mm²
σmzd=Mzd/Wmz,netto=1E+06x0.000/1.320E+005= 0.00 N/mm²

Buckling length Sk
Sky= 1.00x2.800=2.800 m= 2800 mm (most unfavourable)
Skz= 1.00x2.800=2.800 m= 2800 mm (most unfavourable)

Slenderness
iy=√(Iy/A)=0.289x 220= 64 mm, λy= 2800/ 64= 43.75
iz=√(Iz/A)=0.289x 60= 17 mm, λz= 2800/ 17=164.71

Critical stresses
σc,crity=π²E005/λy²= 39.70 N/mm², λrel,y=√(fc0k/σc,crity)= 0.74 (EC5 Eq.6.21)
σc,critz=π²E005/λz²= 2.80 N/mm², λrel,z=√(fc0k/σc,critz)= 2.80 (EC5 Eq.6.22)

βc=0.20 (solid timber)
ky=0.5[1+βc(λrely-0.3)+λrely²]= 0.82, Kcy=1/(ky+√(ky²-λrely²))=0.855 (Eq.6.27 6.25)
kz=0.5[1+βc(λrelz-0.3)+λrelz²]= 4.68, Kcz=1/(kz+√(kz²-λrelz²))=0.119 (Eq.6.28 6.26)

σc0d/(Kcy·fc0d)+σmyd/fmyd+Km.σmzd/fmzd=0.054+0.004+0.000= 0.06 < 1 (EC5 Eq.6.23)
σc0d/(Kcz·fc0d)+Km.σmyd/fmyd+σmzd/fmzd=0.385+0.003+0.000= 0.39 < 1 (EC5 Eq.6.24)
The check is satisfied

Elements: 11 , load combination No 25

Column stability with bending, Fc0d=-3.687kN, Myd=0.079kNm, Mzd=0.000kNm (EC5 §6.3.2)
Rectangular cross section, b=60mm, h=220mm, A=1.320E+004mm², Wy=4.840E+005mm³, Wz=1.320E+005mm³
Modification factor Kmod=0.90 (Table 3.1), material factor γM=1.30 (Table 2.3, E005=7700N/mm²
fc0k=22.00 N/mm², fc0d=Kmod·fc0k/γM=0.90x22.00/1.30=15.23N/mm²
fmyk=27.00 N/mm², fmyd=Kmod·fmyk/γM=0.90x27.00/1.30=18.69N/mm²
fmzk=27.00 N/mm², fmzd=Kmod·fmzk/γM=0.90x27.00/1.30=18.69N/mm²

Rectangular cross section Km=0.70 (EC5 §6.1.6.(2))
σc0d=Fc0d/Anetto=1000x3.687/13200= 0.28 N/mm²
σmyd=Myd/Wmy,netto=1E+06x0.079/4.840E+005= 0.16 N/mm²
σmzd=Mzd/Wmz,netto=1E+06x0.000/1.320E+005= 0.00 N/mm²

Buckling length Sk
Sky= 1.00x2.800=2.800 m= 2800 mm (most unfavourable)
Skz= 1.00x2.800=2.800 m= 2800 mm (most unfavourable)

Slenderness
iy=√(Iy/A)=0.289x 220= 64 mm, λy= 2800/ 64= 43.75
iz=√(Iz/A)=0.289x 60= 17 mm, λz= 2800/ 17=164.71

Critical stresses
σc,crity=π²E005/λy²= 39.70 N/mm², λrel,y=√(fc0k/σc,crity)= 0.74 (EC5 Eq.6.21)
σc,critz=π²E005/λz²= 2.80 N/mm², λrel,z=√(fc0k/σc,critz)= 2.80 (EC5 Eq.6.22)

$\beta c=0.20$ (solid timber)
$ky=0.5[1+\beta c(\lambda rely-0.3)+\lambda rely^2]= 0.82$, $Kcy=1/(ky+\sqrt{(ky^2-\lambda rely^2)})=0.855$ (Eq.6.27 6.25)
$kz=0.5[1+\beta c(\lambda relz-0.3)+\lambda relz^2]= 4.68$, $Kcz=1/(kz+\sqrt{(kz^2-\lambda relz^2)})=0.119$ (Eq.6.28 6.26)

$\sigma c0d/(Kcy\cdot fc0d)+\sigma myd/fmyd+Km.\sigma mzd/fmzd=0.021+0.009+0.000= 0.03 < 1$ (EC5 Eq.6.23)
$\sigma c0d/(Kcz\cdot fc0d)+Km.\sigma myd/fmyd+\sigma mzd/fmzd=0.154+0.006+0.000= 0.16 < 1$ (EC5 Eq.6.24)
The check is satisfied

Negligible tensile stress, combined bending-tension check is omitted (EC5 §6.2.3)

1.10.25. Ultimate limit state (EC5 EN1995-1-1:2009, §6)

Elements: 12

Loading [kN/m]	action	γg	γq	ψo
(Gk) Dead Gk1 = 0.314, Gk2 = 0.180, Gkf=0.300	Permanent	1.35	0.00	1.00
(Qk1) Snow QksL= 0.768, QksR= 0.546	Short-term	0.00	1.50	0.60
(Qk2) Snow QksL= 0.384, QksR= 0.546	Short-term	0.00	1.50	0.60
(Qk3) Snow QksL= 0.768, QksR= 0.273	Short-term	0.00	1.50	0.60
(Qk4) Wind QkwL= 0.123, QkwR=-0.133	Short-term	0.00	1.50	0.50
(Qk5) Wind QkwL=-0.162, QkwR= 0.182	Short-term	0.00	1.50	0.50
(Qkf) Live Qkf = 1.200	Medium-term	0.00	1.50	0.70
(Qki) Imposed (H) Qi = 0.240	Short-term	0.00	1.50	0.00

L.C.	Load combination	duration class	kmod	-N/Kmod	+N/Kmod	V/Kmod	M/Kmod
1	γg.G	Permanent	0.60	-3.838	0.000	0.006	0.016
2	γg.G+γq.Q1	Short-term	0.90	-10.239	0.000	0.018	0.039
3	γg.G+γq.Q2	Short-term	0.90	-7.232	0.000	0.009	0.021
4	γg.G+γq.Q3	Short-term	0.90	-9.405	0.000	0.020	0.043
5	γg.G+γq.Q4	Short-term	0.90	-2.863	0.000	0.008	0.024
6	γg.G+γq.Q5	Short-term	0.90	-2.559	0.000	0.004	0.011
7	γg.G+γq.Qf	Medium-term	0.80	0.000	0.156	0.001	0.017
8	γg.G+γq.Qi	Short-term	0.90	-5.170	0.000	0.008	0.019
9	γg.G+γq.Q1+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-8.503	0.000	0.018	0.049
10	γg.G+γq.Q1+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-8.351	0.000	0.016	0.042
11	γg.G+γq.Q2+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-5.496	0.000	0.009	0.030
12	γg.G+γq.Q2+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-5.344	0.000	0.007	0.024
13	γg.G+γq.Q3+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-7.669	0.000	0.020	0.052
14	γg.G+γq.Q3+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-7.517	0.000	0.018	0.046
15	γg.G+γq.Q4+γq.ψo.Q1+γq.ψo.Qf	Short-term	0.90	-5.583	0.000	0.015	0.044
16	γg.G+γq.Q4+γq.ψo.Q2+γq.ψo.Qf	Short-term	0.90	-3.779	0.000	0.009	0.033
17	γg.G+γq.Q4+γq.ψo.Q3+γq.ψo.Qf	Short-term	0.90	-5.083	0.000	0.016	0.046
18	γg.G+γq.Q5+γq.ψo.Q1+γq.ψo.Qf	Short-term	0.90	-5.278	0.000	0.011	0.031
19	γg.G+γq.Q5+γq.ψo.Q2+γq.ψo.Qf	Short-term	0.90	-3.475	0.000	0.005	0.020
20	γg.G+γq.Q5+γq.ψo.Q3+γq.ψo.Qf	Short-term	0.90	-4.778	0.000	0.012	0.033
21	γg.G+γq.Qf+γq.ψo.Q1+γq.ψo.Q4	Short-term	0.90	-4.622	0.000	0.012	0.038
22	γg.G+γq.Qf+γq.ψo.Q1+γq.ψo.Q5	Short-term	0.90	-4.469	0.000	0.010	0.032
23	γg.G+γq.Qf+γq.ψo.Q2+γq.ψo.Q4	Short-term	0.90	-2.818	0.000	0.006	0.027
24	γg.G+γq.Qf+γq.ψo.Q2+γq.ψo.Q5	Short-term	0.90	-2.665	0.000	0.004	0.021
25	γg.G+γq.Qf+γq.ψo.Q3+γq.ψo.Q4	Short-term	0.90	-4.121	0.000	0.013	0.041
26	γg.G+γq.Qf+γq.ψo.Q3+γq.ψo.Q5	Short-term	0.90	-3.969	0.000	0.011	0.034
27	γg.G+γq.Qi+γq.ψo.Q1+γq.ψo.Q4+γq.ψo.Q	Short-term	0.90	-8.042	0.000	0.017	0.045
28	γg.G+γq.Qi+γq.ψo.Q1+γq.ψo.Q5+γq.ψo.Q	Short-term	0.90	-7.890	0.000	0.015	0.039
29	γg.G+γq.Qi+γq.ψo.Q2+γq.ψo.Q4+γq.ψo.Q	Short-term	0.90	-6.238	0.000	0.011	0.034
30	γg.G+γq.Qi+γq.ψo.Q2+γq.ψo.Q5+γq.ψo.Q	Short-term	0.90	-6.086	0.000	0.009	0.028
31	γg.G+γq.Qi+γq.ψo.Q3+γq.ψo.Q4+γq.ψo.Q	Short-term	0.90	-7.542	0.000	0.018	0.047
32	γg.G+γq.Qi+γq.ψo.Q3+γq.ψo.Q5+γq.ψo.Q	Short-term	0.90	-7.390	0.000	0.016	0.041
	Maximum values			-10.239	0.156	0.020	0.052

1.10.26. Check of cross section Elements: 12

Elements: 12 , load combination No 7

Tension parallel to the grain, Ft0d=0.125 kN (EC5 §6.1.2)

Rectangular cross section, b=60 mm, h=220 mm, A= 13 200 mm²

Modification factor Kmod=0.80 (Table 3.1), material factor γM=1.30 (Table 2.3)

ft0k=16.00 N/mm², ft0d=Kmod·ft0k/γM=0.80x16.00/1.30=9.85N/mm² (EC5 Eq.2.14)

Ft0d=0.125 kN, σt0d=Ft0d/Anetto=1000x0.125/13200=0.01N/mm² < 9.85N/mm²=ft0d (Eq.6.1)

The check is satisfied

Elements: 12 , load combination No 2
Compression parallel to the grain, Fc0d=-9.215 kN (EC5 §6.1.4)
Rectangular cross section, b=60 mm, h=220 mm, A= 13 200 mm^2
Modification factor Kmod=0.90 (Table 3.1), material factor γM=1.30 (Table 2.3)
fc0k=22.00 N/mm^2, fc0d=Kmod·fc0k/γM=0.90x22.00/1.30=15.23N/mm^2 (EC5 Eq.2.14)
Fc0d=-9.215 kN, σc0d=Fc0d/Anetto=1000x9.215/13200=0.70N/mm^2 < 15.23N/mm^2=fc0d (Eq.6.2)
The check is satisfied

Negligible shear stress, shear check is omitted (EC5 §6.1.7)

Elements: 12 , load combination No 13
Bending, Myd=0.047 kNm, Mzd=0.000 kNm (EC5 §6.1.6)
Rectangular cross section, b=60mm, h=220mm, A=1.320E+004mm^2, Wy=4.840E+005mm^3, Wz=1.320E+005mm^3
Modification factor Kmod=0.90 (Table 3.1), material factor γM=1.30 (Table 2.3)
fmyk=27.00 N/mm^2, fmyd=Kmod·fmyk/γM=0.90x27.00/1.30=18.69N/mm^2
fmzk=27.00 N/mm^2, fmzd=Kmod·fmzk/γM=0.90x27.00/1.30=18.69N/mm^2

Rectangular cross section Km=0.70 (EC5 §6.1.6.(2))
σmyd=Myd/Wmy,netto=1E+06x0.047/4.840E+005= 0.10 N/mm^2
σmzd=Mzd/Wmz,netto=1E+06x0.000/1.320E+005= 0.00 N/mm^2

σmyd/fmyd+Km.σmzd/fmzd=0.005+0.000= 0.01 < 1 (EC5 Eq.6.11)
Km.σmyd/fmyd+σmzd/fmzd=0.004+0.000= 0.00 < 1 (EC5 Eq.6.12)
The check is satisfied

Elements: 12 , load combination No 13
Combined bending and axial compression, Fc0d=-6.902kN, Myd=0.047kNm, Mzd=0.000kNm (EC5 §6.2.4)
Rectangular cross section, b=60mm, h=220mm, A=1.320E+004mm^2, Wy=4.840E+005mm^3, Wz=1.320E+005mm^3
Modification factor Kmod=0.90 (Table 3.1), material factor γM=1.30 (Table 2.3)
fc0k=22.00 N/mm^2, fc0d=Kmod·fc0k/γM=0.90x22.00/1.30=15.23N/mm^2
fmyk=27.00 N/mm^2, fmyd=Kmod·fmyk/γM=0.90x27.00/1.30=18.69N/mm^2
fmzk=27.00 N/mm^2, fmzd=Kmod·fmzk/γM=0.90x27.00/1.30=18.69N/mm^2

Rectangular cross section Km=0.70 (EC5 §6.1.6.(2))
σc0d=Fc0d/Anetto=1000x6.902/13200= 0.52 N/mm^2
σmyd=Myd/Wmy,netto=1E+06x0.047/4.840E+005= 0.10 N/mm^2
σmzd=Mzd/Wmz,netto=1E+06x0.000/1.320E+005= 0.00 N/mm^2

(σc0d/fc0d)^2+σmyd/fmyd+Km.σmzd/fmzd=0.001+0.005+0.000= 0.01 < 1 (EC5 Eq.6.19)
(σc0d/fc0d)^2+Km.σmyd/fmyd+σmzd/fmzd=0.001+0.004+0.000= 0.00 < 1 (EC5 Eq.6.20)
The check is satisfied

Elements: 12 , load combination No 2
Column stability with bending, Fc0d=-9.215kN, Myd=0.035kNm, Mzd=0.000kNm (EC5 §6.3.2)
Rectangular cross section, b=60mm, h=220mm, A=1.320E+004mm^2, Wy=4.840E+005mm^3, Wz=1.320E+005mm^3
Modification factor Kmod=0.90 (Table 3.1), material factor γM=1.30 (Table 2.3, E005=7700N/mm^2
fc0k=22.00 N/mm^2, fc0d=Kmod·fc0k/γM=0.90x22.00/1.30=15.23N/mm^2
fmyk=27.00 N/mm^2, fmyd=Kmod·fmyk/γM=0.90x27.00/1.30=18.69N/mm^2
fmzk=27.00 N/mm^2, fmzd=Kmod·fmzk/γM=0.90x27.00/1.30=18.69N/mm^2

Rectangular cross section Km=0.70 (EC5 §6.1.6.(2))
σc0d=Fc0d/Anetto=1000x9.215/13200= 0.70 N/mm^2
σmyd=Myd/Wmy,netto=1E+06x0.035/4.840E+005= 0.07 N/mm^2
σmzd=Mzd/Wmz,netto=1E+06x0.000/1.320E+005= 0.00 N/mm^2

Buckling length Sk
Sky= 1.00x1.200=1.200 m= 1200 mm (most unfavourable)
Skz= 1.00x1.200=1.200 m= 1200 mm (most unfavourable)

Slenderness
iy=√(Iy/A)=0.289x 220= 64 mm, λy= 1200/ 64= 18.75
iz=√(Iz/A)=0.289x 60= 17 mm, λz= 1200/ 17= 70.59

Critical stresses
σc,crity=π^{2}E005/λy^2= 216.17 N/mm^2, λrel,y=√(fc0k/σc,crity)= 0.32 (EC5 Eq.6.21)
σc,critz=π^{2}E005/λz^2= 15.25 N/mm^2, λrel,z=√(fc0k/σc,critz)= 1.20 (EC5 Eq.6.22)

βc=0.20 (solid timber)
ky=0.5[1+βc(λrely-0.3)+λrely^2]= 0.55, Kcy=1/(ky+√(ky^2-λrely^2))=0.996 (Eq.6.27 6.25)
kz=0.5[1+βc(λrelz-0.3)+λrelz^2]= 1.31, Kcz=1/(kz+√(kz^2-λrelz^2))=0.544 (Eq.6.28 6.26)

σc0d/(Kcy·fc0d)+σmyd/fmyd+Km.σmzd/fmzd=0.046+0.004+0.000= 0.05 < 1 (EC5 Eq.6.23)
σc0d/(Kcz·fc0d)+Km.σmyd/fmyd+σmzd/fmzd=0.084+0.003+0.000= 0.09 < 1 (EC5 Eq.6.24)
The check is satisfied

Elements: 12 , load combination No 13
Column stability with bending, Fc0d=-6.902kN, Myd=0.047kNm, Mzd=0.000kNm (EC5 §6.3.2)
Rectangular cross section, b=60mm, h=220mm, A=1.320E+004mm^2, Wy=4.840E+005mm^3, Wz=1.320E+005mm^3
Modification factor Kmod=0.90 (Table 3.1), material factor γM=1.30 (Table 2.3, E005=7700N/mm^2
fc0k=22.00 N/mm^2, fc0d=Kmod·fc0k/γM=0.90x22.00/1.30=15.23N/mm^2
fmyk=27.00 N/mm^2, fmyd=Kmod·fmyk/γM=0.90x27.00/1.30=18.69N/mm^2
fmzk=27.00 N/mm^2, fmzd=Kmod·fmzk/γM=0.90x27.00/1.30=18.69N/mm^2

Rectangular cross section Km=0.70 (EC5 §6.1.6.(2))
σc0d=Fc0d/Anetto=1000x6.902/13200= 0.52 N/mm^2
σmyd=Myd/Wmy,netto=1E+06x0.047/4.840E+005= 0.10 N/mm^2
σmzd=Mzd/Wmz,netto=1E+06x0.000/1.320E+005= 0.00 N/mm^2

Buckling length Sk
Sky= 1.00x1.200=1.200 m= 1200 mm (most unfavourable)
Skz= 1.00x1.200=1.200 m= 1200 mm (most unfavourable)

Slenderness
iy=√(Iy/A)=0.289x 220= 64 mm, λy= 1200/ 64= 18.75
iz=√(Iz/A)=0.289x 60= 17 mm, λz= 1200/ 17= 70.59

Critical stresses
σc,crity=π^{2}E005/λy^2= 216.17 N/mm^2, λrel,y=√(fc0k/σc,crity)= 0.32 (EC5 Eq.6.21)
σc,critz=π^{2}E005/λz^2= 15.25 N/mm^2, λrel,z=√(fc0k/σc,critz)= 1.20 (EC5 Eq.6.22)

βc=0.20 (solid timber)
ky=0.5[1+βc(λrely-0.3)+λrely^2]= 0.55, Kcy=1/(ky+√(ky^2-λrely^2))=0.996 (Eq.6.27 6.25)
kz=0.5[1+βc(λrelz-0.3)+λrelz^2]= 1.31, Kcz=1/(kz+√(kz^2-λrelz^2))=0.544 (Eq.6.28 6.26)

σc0d/(Kcy·fc0d)+σmyd/fmyd+Km.σmzd/fmzd=0.034+0.005+0.000= 0.04 < 1 (EC5 Eq.6.23)
σc0d/(Kcz·fc0d)+Km.σmyd/fmyd+σmzd/fmzd=0.063+0.004+0.000= 0.07 < 1 (EC5 Eq.6.24)
The check is satisfied

Negligible tensile stress, combined bending-tension check is omitted (EC5 §6.2.3)

1.11. Truss connections

1.11.1. Lateral Load-carrying capacity of connections (EC5 EN1995-1-1:2009, §8)

Connection bolts and connection plates
Selected bolts of diameter d=4.0 mm. Metal plates of thickness t=2.0 mm.
Yield strength for plate steel fy=240 N/mm². Net plate area (minus holes) Anet=(0.75)·b·t

Cross section properties
Thickness of timber d=60.0 mm, thickness of steel plate t=2.0 mm
Bolt properties (EC5 §8.5.1)
Bolt diameter d=4.0mm, washer with diameter >= 12.0mm and thickness >=1.2mm.
Distance between bolts (EC5 Table 8.4)
as most unfavourable is chosen a1=7d=7x4.0=28 mm, a2=4d=16 mm

Characteristic value for yield moment (EC5 §8.5.1.1)
Myrk=0.30fuk·d^2.6=0.30x400x4.0^2.6=4411 Nmm (fuk=400N/mm²) (EN1995-1-1 Eq.8.30)

Characteristic value of embedment strength (EC5 §8.3.1.1)
fhk=0.082(1-0.01d)ρk=29.13N/mm², (ρk=370kg/m³,d=4.0mm) (EN1995-1-1 Eq.8.32)

Permanent action
Capacity of laterally loaded bolts -Double shear connection (EC5 §8.2.3)
t2=60.0 mm, thickness of steel plate t=2.0<=0.5d=0.5x4.0=2.0 mm
Fvrk=the minimum of the values (EC5 EN1995-1-1:2009 Eq.8.12(j), 8.12(k))
0.50fhk·t2·d=3.496 kN
1.15√[2Myrk·fhk·d]=1.166 kN
Lateral load-carrying capacity of bolt Rd=2Kmod·Fvrk/γM=2x0.60x1.166/1.30=1.076 kN

Medium-term action
Capacity of laterally loaded bolts -Double shear connection (EC5 §8.2.3)
t2=60.0 mm, thickness of steel plate t=2.0<=0.5d=0.5x4.0=2.0 mm
Fvrk=the minimum of the values (EC5 EN1995-1-1:2009 Eq.8.12(j), 8.12(k))
0.50fhk·t2·d=3.496 kN
1.15√[2Myrk·fhk·d]=1.166 kN
Lateral load-carrying capacity of bolt Rd=2Kmod·Fvrk/γM=2x0.80x1.166/1.30=1.435 kN

Short-term action
Capacity of laterally loaded bolts -Double shear connection (EC5 §8.2.3)
t2=60.0 mm, thickness of steel plate t=2.0<=0.5d=0.5x4.0=2.0 mm
Fvrk=the minimum of the values (EC5 EN1995-1-1:2009 Eq.8.12(j), 8.12(k))
0.50fhk·t2·d=3.496 kN
1.15√[2Myrk·fhk·d]=1.166 kN
Lateral load-carrying capacity of bolt Rd=2Kmod·Fvrk/γM=2x0.90x1.166/1.30=1.614 kN

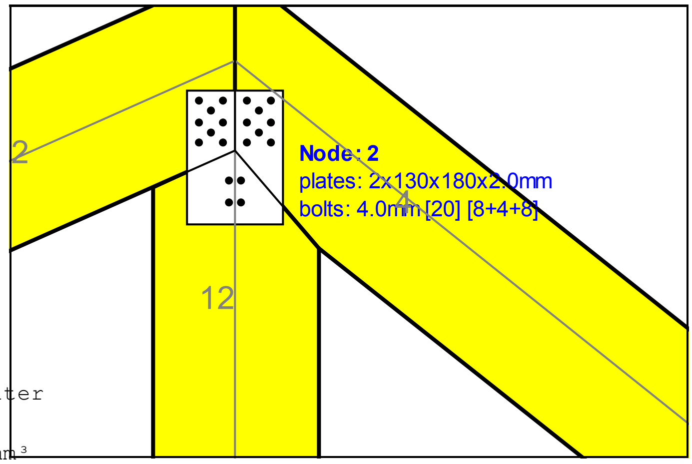
Assumptions for the design of bolted connections
The design of connections is based on plastic analysis. The forces at the bolts are all reaching the same limit value. The metal plate capacity is based on plastic section modulus. The compressive design force is reduced to 0.50xFd

1.11.2. Ultimate limit state

Design of bolted connection at node : 2 (EC5 EN1995-1-1:2009, §8.5)
Connection with double (2) metal plates on the two faces of the truss.

Connection check of element 2, with elements 4 and 12, at node 2

Fastener characteristics:
Two(2) metal 2.0 mm plates with dimensions
BxH=130mmx180mm, and thickness 2.0mm
Bolts with diameter d=4.0mm,
8 bolts on each of the connected elements
Distance between bolts a1=28 mm, a2=16 mm
Yield strength for plate steel fy=240 N/mm²
Net plate area (minus holes) Anet=(0.75)·b·t
Fa= force at the center of the connection
Ma= moment at the center of the connection
Maximum force at corner bolt Fn=Fa/n+Ma/Wp
n: number of bolts, a: bolt section area
A=nxa: total area of bolts
r: distance of corner bolt from connection center
Wp: section modulus of connection
n= 8, (nef=1.30n), A=101mm², r=37mm, Wp =3407mm³
σ and σd plate normal and bearing stress N/mm²



Forces at node 2 ,from elements 4, 12, at the center of the joint F(force) M(moment)

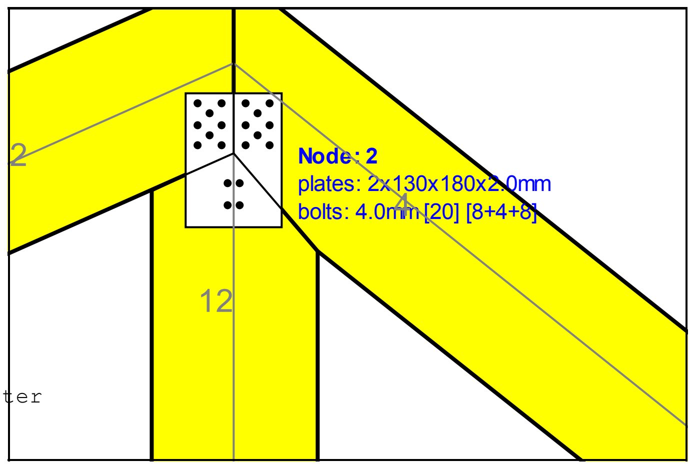
Check capacity of connection

L.C.	Load combination	duration class	kmod	Fa(kN)	Ma(kNm)	Fn(kN)		Rd(kN)
1	γg.G	Permanent	0.60	1.946	-0.029	0.348	<	1.076
2	γg.G+γq.Q1	Short-term	0.90	8.041	-0.110	1.406	<	1.614
3	γg.G+γq.Q2	Short-term	0.90	5.277	-0.069	0.912	<	1.614
4	γg.G+γq.Q3	Short-term	0.90	7.758	-0.110	1.370	<	1.614
5	γg.G+γq.Q4	Short-term	0.90	2.814	-0.047	0.519	<	1.614
6	γg.G+γq.Q5	Short-term	0.90	1.946	-0.029	0.348	<	1.614
7	γg.G+γq.Qf	Medium-term	0.80	-0.770	-0.019	0.062	<	1.435
8	γg.G+γq.Qi	Short-term	0.90	3.921	-0.054	0.687	<	1.614
9	γg.G+γq.Q1+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	7.200	-0.112	1.303	<	1.614
10	γg.G+γq.Q1+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	6.767	-0.103	1.218	<	1.614
11	γg.G+γq.Q2+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	4.439	-0.071	0.810	<	1.614
12	γg.G+γq.Q2+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	4.004	-0.063	0.725	<	1.614
13	γg.G+γq.Q3+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	6.930	-0.112	1.269	<	1.614
14	γg.G+γq.Q3+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	6.495	-0.103	1.183	<	1.614
15	γg.G+γq.Q4+γq.ψo.Q1+γq.ψo.Qf	Short-term	0.90	5.214	-0.088	0.967	<	1.614
16	γg.G+γq.Q4+γq.ψo.Q2+γq.ψo.Qf	Short-term	0.90	3.567	-0.064	0.672	<	1.614
17	γg.G+γq.Q4+γq.ψo.Q3+γq.ψo.Qf	Short-term	0.90	5.058	-0.089	0.946	<	1.614
18	γg.G+γq.Q5+γq.ψo.Q1+γq.ψo.Qf	Short-term	0.90	4.342	-0.071	0.796	<	1.614
19	γg.G+γq.Q5+γq.ψo.Q2+γq.ψo.Qf	Short-term	0.90	2.691	-0.046	0.501	<	1.614
20	γg.G+γq.Q5+γq.ψo.Q3+γq.ψo.Qf	Short-term	0.90	4.183	-0.071	0.775	<	1.614
21	γg.G+γq.Qf+γq.ψo.Q1+γq.ψo.Q4	Short-term	0.90	4.262	-0.077	0.803	<	1.614
22	γg.G+γq.Qf+γq.ψo.Q1+γq.ψo.Q5	Short-term	0.90	3.824	-0.068	0.717	<	1.614
23	γg.G+γq.Qf+γq.ψo.Q2+γq.ψo.Q4	Short-term	0.90	2.636	-0.052	0.509	<	1.614
24	γg.G+γq.Qf+γq.ψo.Q2+γq.ψo.Q5	Short-term	0.90	2.198	-0.044	0.424	<	1.614
25	γg.G+γq.Qf+γq.ψo.Q3+γq.ψo.Q4	Short-term	0.90	4.112	-0.077	0.783	<	1.614
26	γg.G+γq.Qf+γq.ψo.Q3+γq.ψo.Q5	Short-term	0.90	3.674	-0.068	0.697	<	1.614
27	γg.G+γq.Qi+γq.ψo.Q1+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	6.738	-0.105	1.220	<	1.614
28	γg.G+γq.Qi+γq.ψo.Q1+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	6.305	-0.096	1.135	<	1.614
29	γg.G+γq.Qi+γq.ψo.Q2+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	5.081	-0.080	0.924	<	1.614
30	γg.G+γq.Qi+γq.ψo.Q2+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	4.647	-0.072	0.839	<	1.614
31	γg.G+γq.Qi+γq.ψo.Q3+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	6.575	-0.105	1.199	<	1.614
32	γg.G+γq.Qi+γq.ψo.Q3+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	6.141	-0.096	1.114	<	1.614

Check capacity of connection plate

L.C.	Load combination	duration class	kmod	Fa(kN)	Ma(kNm)	σ		σd(N/mm²)
1	γg.G	Permanent	0.60	1.946	-0.029	5	<	131
2	γg.G+γq.Q1	Short-term	0.90	8.041	-0.110	19	<	196
3	γg.G+γq.Q2	Short-term	0.90	5.277	-0.069	13	<	196
4	γg.G+γq.Q3	Short-term	0.90	7.758	-0.110	19	<	196
5	γg.G+γq.Q4	Short-term	0.90	2.814	-0.047	7	<	196
6	γg.G+γq.Q5	Short-term	0.90	1.946	-0.029	5	<	196
7	γg.G+γq.Qf	Medium-term	0.80	-0.770	-0.019	1	<	175
8	γg.G+γq.Qi	Short-term	0.90	3.921	-0.054	9	<	196
9	γg.G+γq.Q1+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	7.200	-0.112	18	<	196
10	γg.G+γq.Q1+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	6.767	-0.103	17	<	196
11	γg.G+γq.Q2+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	4.439	-0.071	11	<	196
12	γg.G+γq.Q2+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	4.004	-0.063	10	<	196
13	γg.G+γq.Q3+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	6.930	-0.112	17	<	196
14	γg.G+γq.Q3+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	6.495	-0.103	16	<	196
15	γg.G+γq.Q4+γq.ψo.Q1+γq.ψo.Qf	Short-term	0.90	5.214	-0.088	13	<	196
16	γg.G+γq.Q4+γq.ψo.Q2+γq.ψo.Qf	Short-term	0.90	3.567	-0.064	9	<	196
17	γg.G+γq.Q4+γq.ψo.Q3+γq.ψo.Qf	Short-term	0.90	5.058	-0.089	13	<	196
18	γg.G+γq.Q5+γq.ψo.Q1+γq.ψo.Qf	Short-term	0.90	4.342	-0.071	11	<	196
19	γg.G+γq.Q5+γq.ψo.Q2+γq.ψo.Qf	Short-term	0.90	2.691	-0.046	7	<	196
20	γg.G+γq.Q5+γq.ψo.Q3+γq.ψo.Qf	Short-term	0.90	4.183	-0.071	11	<	196
21	γg.G+γq.Qf+γq.ψo.Q1+γq.ψo.Q4	Short-term	0.90	4.262	-0.077	11	<	196
22	γg.G+γq.Qf+γq.ψo.Q1+γq.ψo.Q5	Short-term	0.90	3.824	-0.068	10	<	196
23	γg.G+γq.Qf+γq.ψo.Q2+γq.ψo.Q4	Short-term	0.90	2.636	-0.052	7	<	196
24	γg.G+γq.Qf+γq.ψo.Q2+γq.ψo.Q5	Short-term	0.90	2.198	-0.044	6	<	196
25	γg.G+γq.Qf+γq.ψo.Q3+γq.ψo.Q4	Short-term	0.90	4.112	-0.077	11	<	196
26	γg.G+γq.Qf+γq.ψo.Q3+γq.ψo.Q5	Short-term	0.90	3.674	-0.068	10	<	196
27	γg.G+γq.Qi+γq.ψo.Q1+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	6.738	-0.105	17	<	196
28	γg.G+γq.Qi+γq.ψo.Q1+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	6.305	-0.096	16	<	196
29	γg.G+γq.Qi+γq.ψo.Q2+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	5.081	-0.080	13	<	196
30	γg.G+γq.Qi+γq.ψo.Q2+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	4.647	-0.072	12	<	196
31	γg.G+γq.Qi+γq.ψo.Q3+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	6.575	-0.105	16	<	196
32	γg.G+γq.Qi+γq.ψo.Q3+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	6.141	-0.096	15	<	196

Connection check of element 12, with elements 2 and 4, at node 2



Fastener characteristics:
Two(2) metal 2.0 mm plates with dimensions
BxH=130mmx180mm, and thickness 2.0mm
Bolts with diameter d=4.0mm,
4 bolts on each of the connected elements
Distance between bolts a1=28 mm, a2=16 mm
Yield strength for plate steel fy=240 N/mm²
Net plate area (minus holes) Anet=(0.75)·b·t
Fa= force at the center of the connection
Ma= moment at the center of the connection
Maximum force at corner bolt Fn=Fa/n+Ma/Wp
n: number of bolts, a: bolt section area
A=nxa: total area of bolts
r: distance of corner bolt from connection center
Wp: section modulus of connection
n= 4, (nef=1.00n), A=50mm², r=18mm, Wp =811mm³
σ and σd plate normal and bearing stress N/mm²

Forces at node 2 ,from element 12, at the center of the joint F(force) M(moment)

Check capacity of connection

L.C.	Load combination	duration class	kmod	Fa(kN)	Ma(kNm)	Fn(kN)		Rd(kN)
1	γg.G	Permanent	0.60	-2.303	-0.010	0.355	<	1.076
2	γg.G+γq.Q1	Short-term	0.90	-9.215	-0.035	1.394	<	1.614
3	γg.G+γq.Q2	Short-term	0.90	-6.509	-0.019	0.944	<	1.614
4	γg.G+γq.Q3	Short-term	0.90	-8.465	-0.038	1.325	<	1.614
5	γg.G+γq.Q4	Short-term	0.90	-2.577	-0.021	0.471	<	1.614
6	γg.G+γq.Q5	Short-term	0.90	-2.303	-0.010	0.355	<	1.614
7	γg.G+γq.Qf	Medium-term	0.80	0.125	-0.013	0.235	<	1.435
8	γg.G+γq.Qi	Short-term	0.90	-4.653	-0.017	0.697	<	1.614
9	γg.G+γq.Q1+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-7.653	-0.043	1.259	<	1.614
10	γg.G+γq.Q1+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-7.515	-0.038	1.201	<	1.614
11	γg.G+γq.Q2+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-4.947	-0.027	0.808	<	1.614
12	γg.G+γq.Q2+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-4.810	-0.021	0.750	<	1.614
13	γg.G+γq.Q3+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-6.902	-0.047	1.191	<	1.614
14	γg.G+γq.Q3+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-6.765	-0.041	1.133	<	1.614
15	γg.G+γq.Q4+γq.ψo.Q1+γq.ψo.Qf	Short-term	0.90	-5.025	-0.039	0.902	<	1.614
16	γg.G+γq.Q4+γq.ψo.Q2+γq.ψo.Qf	Short-term	0.90	-3.401	-0.029	0.632	<	1.614
17	γg.G+γq.Q4+γq.ψo.Q3+γq.ψo.Qf	Short-term	0.90	-4.575	-0.041	0.862	<	1.614
18	γg.G+γq.Q5+γq.ψo.Q1+γq.ψo.Qf	Short-term	0.90	-4.751	-0.027	0.786	<	1.614
19	γg.G+γq.Q5+γq.ψo.Q2+γq.ψo.Qf	Short-term	0.90	-3.127	-0.018	0.515	<	1.614
20	γg.G+γq.Q5+γq.ψo.Q3+γq.ψo.Qf	Short-term	0.90	-4.301	-0.030	0.745	<	1.614
21	γg.G+γq.Qf+γq.ψo.Q1+γq.ψo.Q4	Short-term	0.90	-4.159	-0.034	0.762	<	1.614
22	γg.G+γq.Qf+γq.ψo.Q1+γq.ψo.Q5	Short-term	0.90	-4.022	-0.029	0.703	<	1.614
23	γg.G+γq.Qf+γq.ψo.Q2+γq.ψo.Q4	Short-term	0.90	-2.536	-0.025	0.492	<	1.614
24	γg.G+γq.Qf+γq.ψo.Q2+γq.ψo.Q5	Short-term	0.90	-2.399	-0.019	0.433	<	1.614
25	γg.G+γq.Qf+γq.ψo.Q3+γq.ψo.Q4	Short-term	0.90	-3.709	-0.036	0.722	<	1.614
26	γg.G+γq.Qf+γq.ψo.Q3+γq.ψo.Q5	Short-term	0.90	-3.572	-0.031	0.663	<	1.614
27	γg.G+γq.Qi+γq.ψo.Q1+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-7.238	-0.040	1.185	<	1.614
28	γg.G+γq.Qi+γq.ψo.Q1+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-7.101	-0.034	1.127	<	1.614
29	γg.G+γq.Qi+γq.ψo.Q2+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-5.614	-0.031	0.915	<	1.614
30	γg.G+γq.Qi+γq.ψo.Q2+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-5.477	-0.025	0.857	<	1.614
31	γg.G+γq.Qi+γq.ψo.Q3+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-6.788	-0.042	1.144	<	1.614
32	γg.G+γq.Qi+γq.ψo.Q3+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-6.651	-0.037	1.086	<	1.614

Check capacity of connection plate

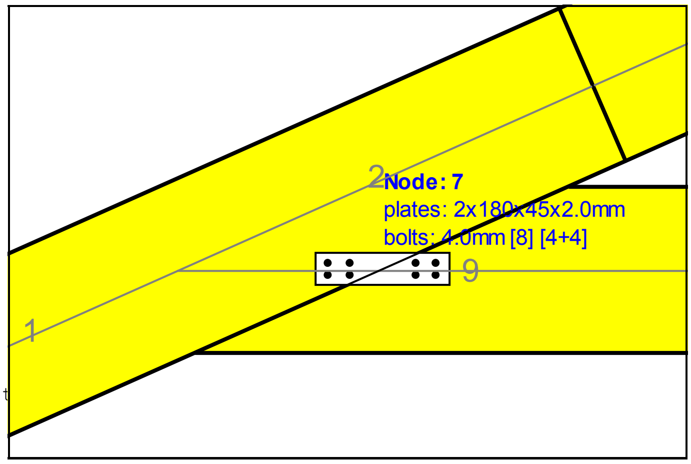
L.C.	Load combination	duration class	kmod	Fa(kN)	Ma(kNm)	σ		σd(N/mm²)
1	γg.G	Permanent	0.60	-2.303	-0.010	3	<	131
2	γg.G+γq.Q1	Short-term	0.90	-9.215	-0.035	13	<	196
3	γg.G+γq.Q2	Short-term	0.90	-6.509	-0.019	9	<	196
4	γg.G+γq.Q3	Short-term	0.90	-8.465	-0.038	12	<	196
5	γg.G+γq.Q4	Short-term	0.90	-2.577	-0.021	4	<	196
6	γg.G+γq.Q5	Short-term	0.90	-2.303	-0.010	3	<	196
7	γg.G+γq.Qf	Medium-term	0.80	0.125	-0.013	1	<	175
8	γg.G+γq.Qi	Short-term	0.90	-4.653	-0.017	7	<	196
9	γg.G+γq.Q1+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-7.653	-0.043	12	<	196
10	γg.G+γq.Q1+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-7.515	-0.038	11	<	196
11	γg.G+γq.Q2+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-4.947	-0.027	7	<	196
12	γg.G+γq.Q2+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-4.810	-0.021	7	<	196
13	γg.G+γq.Q3+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-6.902	-0.047	11	<	196
14	γg.G+γq.Q3+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-6.765	-0.041	10	<	196
15	γg.G+γq.Q4+γq.ψo.Q1+γq.ψo.Qf	Short-term	0.90	-5.025	-0.039	8	<	196
16	γg.G+γq.Q4+γq.ψo.Q2+γq.ψo.Qf	Short-term	0.90	-3.401	-0.029	6	<	196
17	γg.G+γq.Q4+γq.ψo.Q3+γq.ψo.Qf	Short-term	0.90	-4.575	-0.041	7	<	196
18	γg.G+γq.Q5+γq.ψo.Q1+γq.ψo.Qf	Short-term	0.90	-4.751	-0.027	7	<	196
19	γg.G+γq.Q5+γq.ψo.Q2+γq.ψo.Qf	Short-term	0.90	-3.127	-0.018	5	<	196
20	γg.G+γq.Q5+γq.ψo.Q3+γq.ψo.Qf	Short-term	0.90	-4.301	-0.030	7	<	196
21	γg.G+γq.Qf+γq.ψo.Q1+γq.ψo.Q4	Short-term	0.90	-4.159	-0.034	7	<	196
22	γg.G+γq.Qf+γq.ψo.Q1+γq.ψo.Q5	Short-term	0.90	-4.022	-0.029	6	<	196
23	γg.G+γq.Qf+γq.ψo.Q2+γq.ψo.Q4	Short-term	0.90	-2.536	-0.025	4	<	196
24	γg.G+γq.Qf+γq.ψo.Q2+γq.ψo.Q5	Short-term	0.90	-2.399	-0.019	4	<	196
25	γg.G+γq.Qf+γq.ψo.Q3+γq.ψo.Q4	Short-term	0.90	-3.709	-0.036	6	<	196
26	γg.G+γq.Qf+γq.ψo.Q3+γq.ψo.Q5	Short-term	0.90	-3.572	-0.031	6	<	196
27	γg.G+γq.Qi+γq.ψo.Q1+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-7.238	-0.040	11	<	196
28	γg.G+γq.Qi+γq.ψo.Q1+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-7.101	-0.034	10	<	196
29	γg.G+γq.Qi+γq.ψo.Q2+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-5.614	-0.031	8	<	196
30	γg.G+γq.Qi+γq.ψo.Q2+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-5.477	-0.025	8	<	196
31	γg.G+γq.Qi+γq.ψo.Q3+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-6.788	-0.042	10	<	196
32	γg.G+γq.Qi+γq.ψo.Q3+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-6.651	-0.037	10	<	196

1.11.3. Ultimate limit state

Design of bolted connection at node : 7 (EC5 EN1995-1-1:2009, §8.5)
Connection with double (2) metal plates on the two faces of the truss.

Connection check of element 9, with elements 1 and 2, at node 7

Fastener characteristics:
Two(2) metal 2.0 mm plates with dimensions
BxH=180mmx45mm, and thickness 2.0mm
Bolts with diameter d=4.0mm,
4 bolts on each of the connected elements
Distance between bolts a1=28 mm, a2=16 mm
Yield strength for plate steel fy=240 N/mm²
Net plate area (minus holes) Anet=(0.75)·b·t
Fa= force at the center of the connection
Ma= moment at the center of the connection
Maximum force at corner bolt Fn=Fa/n+Ma/Wp
n: number of bolts, a: bolt section area
A=nxa: total area of bolts
r: distance of corner bolt from connection cent
Wp: section modulus of connection
n= 4, (nef=1.00n), A=50mm², r=18mm, Wp =811mm³
σ and σd plate normal and bearing stress N/mm²



Forces at node 7 ,from element 9, at the center of the joint F(force) M(moment)

Check capacity of connection

L.C.	Load combination	duration class	kmod	Fa(kN)	Ma(kNm)	Fn(kN)		Rd(kN)
1	γg.G	Permanent	0.60	-2.113	0.008	0.319	<	1.076
2	γg.G+γq.Q1	Short-term	0.90	-7.170	0.027	1.082	<	1.614
3	γg.G+γq.Q2	Short-term	0.90	-4.959	0.016	0.727	<	1.614
4	γg.G+γq.Q3	Short-term	0.90	-6.853	0.029	1.056	<	1.614
5	γg.G+γq.Q4	Short-term	0.90	-2.113	0.008	0.319	<	1.614
6	γg.G+γq.Q5	Short-term	0.90	-1.273	-0.003	0.177	<	1.614
7	γg.G+γq.Qf	Medium-term	0.80	-1.859	0.011	0.311	<	1.435
8	γg.G+γq.Qi	Short-term	0.90	-3.774	0.013	0.564	<	1.614
9	γg.G+γq.Q1+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-6.993	0.029	1.076	<	1.614
10	γg.G+γq.Q1+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-6.573	0.024	0.987	<	1.614
11	γg.G+γq.Q2+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-4.781	0.018	0.721	<	1.614
12	γg.G+γq.Q2+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-4.362	0.013	0.632	<	1.614
13	γg.G+γq.Q3+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-6.675	0.031	1.050	<	1.614
14	γg.G+γq.Q3+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-6.255	0.026	0.961	<	1.614
15	γg.G+γq.Q4+γq.ψo.Q1+γq.ψo.Qf	Short-term	0.90	-4.970	0.022	0.771	<	1.614
16	γg.G+γq.Q4+γq.ψo.Q2+γq.ψo.Qf	Short-term	0.90	-3.643	0.015	0.558	<	1.614
17	γg.G+γq.Q4+γq.ψo.Q3+γq.ψo.Qf	Short-term	0.90	-4.779	0.023	0.755	<	1.614
18	γg.G+γq.Q5+γq.ψo.Q1+γq.ψo.Qf	Short-term	0.90	-4.130	0.011	0.592	<	1.614
19	γg.G+γq.Q5+γq.ψo.Q2+γq.ψo.Qf	Short-term	0.90	-2.803	0.004	0.379	<	1.614
20	γg.G+γq.Q5+γq.ψo.Q3+γq.ψo.Qf	Short-term	0.90	-3.940	0.012	0.576	<	1.614
21	γg.G+γq.Qf+γq.ψo.Q1+γq.ψo.Q4	Short-term	0.90	-4.894	0.023	0.769	<	1.614
22	γg.G+γq.Qf+γq.ψo.Q1+γq.ψo.Q5	Short-term	0.90	-4.474	0.017	0.679	<	1.614
23	γg.G+γq.Qf+γq.ψo.Q2+γq.ψo.Q4	Short-term	0.90	-3.567	0.016	0.555	<	1.614
24	γg.G+γq.Qf+γq.ψo.Q2+γq.ψo.Q5	Short-term	0.90	-3.147	0.011	0.466	<	1.614
25	γg.G+γq.Qf+γq.ψo.Q3+γq.ψo.Q4	Short-term	0.90	-4.703	0.024	0.753	<	1.614
26	γg.G+γq.Qf+γq.ψo.Q3+γq.ψo.Q5	Short-term	0.90	-4.284	0.018	0.663	<	1.614
27	γg.G+γq.Qi+γq.ψo.Q1+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-6.631	0.027	1.016	<	1.614
28	γg.G+γq.Qi+γq.ψo.Q1+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-6.211	0.022	0.927	<	1.614
29	γg.G+γq.Qi+γq.ψo.Q2+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-5.304	0.020	0.803	<	1.614
30	γg.G+γq.Qi+γq.ψo.Q2+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-4.884	0.015	0.714	<	1.614
31	γg.G+γq.Qi+γq.ψo.Q3+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-6.440	0.028	1.001	<	1.614
32	γg.G+γq.Qi+γq.ψo.Q3+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-6.020	0.023	0.911	<	1.614

Check capacity of connection plate

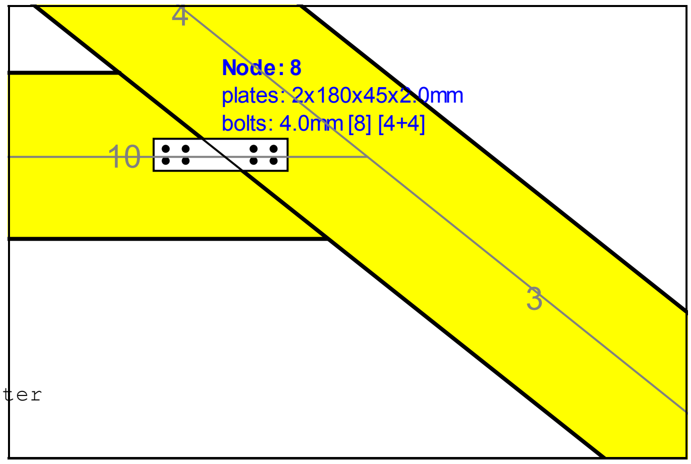
L.C.	Load combination	duration class	kmod	Fa(kN)	Ma(kNm)	σ	σd(N/mm²)
1	γg.G	Permanent	0.60	-2.113	0.008	10 <	131
2	γg.G+γq.Q1	Short-term	0.90	-7.170	0.027	35 <	196
3	γg.G+γq.Q2	Short-term	0.90	-4.959	0.016	23 <	196
4	γg.G+γq.Q3	Short-term	0.90	-6.853	0.029	35 <	196
5	γg.G+γq.Q4	Short-term	0.90	-2.113	0.008	10 <	196
6	γg.G+γq.Q5	Short-term	0.90	-1.273	-0.003	6 <	196
7	γg.G+γq.Qf	Medium-term	0.80	-1.859	0.011	11 <	175
8	γg.G+γq.Qi	Short-term	0.90	-3.774	0.013	18 <	196
9	γg.G+γq.Q1+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-6.993	0.029	36 <	196
10	γg.G+γq.Q1+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-6.573	0.024	32 <	196
11	γg.G+γq.Q2+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-4.781	0.018	24 <	196
12	γg.G+γq.Q2+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-4.362	0.013	20 <	196
13	γg.G+γq.Q3+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-6.675	0.031	35 <	196
14	γg.G+γq.Q3+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-6.255	0.026	32 <	196
15	γg.G+γq.Q4+γq.ψo.Q1+γq.ψo.Qf	Short-term	0.90	-4.970	0.022	26 <	196
16	γg.G+γq.Q4+γq.ψo.Q2+γq.ψo.Qf	Short-term	0.90	-3.643	0.015	18 <	196
17	γg.G+γq.Q4+γq.ψo.Q3+γq.ψo.Qf	Short-term	0.90	-4.779	0.023	25 <	196
18	γg.G+γq.Q5+γq.ψo.Q1+γq.ψo.Qf	Short-term	0.90	-4.130	0.011	19 <	196
19	γg.G+γq.Q5+γq.ψo.Q2+γq.ψo.Qf	Short-term	0.90	-2.803	0.004	12 <	196
20	γg.G+γq.Q5+γq.ψo.Q3+γq.ψo.Qf	Short-term	0.90	-3.940	0.012	19 <	196
21	γg.G+γq.Qf+γq.ψo.Q1+γq.ψo.Q4	Short-term	0.90	-4.894	0.023	26 <	196
22	γg.G+γq.Qf+γq.ψo.Q1+γq.ψo.Q5	Short-term	0.90	-4.474	0.017	22 <	196
23	γg.G+γq.Qf+γq.ψo.Q2+γq.ψo.Q4	Short-term	0.90	-3.567	0.016	18 <	196
24	γg.G+γq.Qf+γq.ψo.Q2+γq.ψo.Q5	Short-term	0.90	-3.147	0.011	15 <	196
25	γg.G+γq.Qf+γq.ψo.Q3+γq.ψo.Q4	Short-term	0.90	-4.703	0.024	25 <	196
26	γg.G+γq.Qf+γq.ψo.Q3+γq.ψo.Q5	Short-term	0.90	-4.284	0.018	22 <	196
27	γg.G+γq.Qi+γq.ψo.Q1+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-6.631	0.027	33 <	196
28	γg.G+γq.Qi+γq.ψo.Q1+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-6.211	0.022	30 <	196
29	γg.G+γq.Qi+γq.ψo.Q2+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-5.304	0.020	26 <	196
30	γg.G+γq.Qi+γq.ψo.Q2+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-4.884	0.015	23 <	196
31	γg.G+γq.Qi+γq.ψo.Q3+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-6.440	0.028	33 <	196
32	γg.G+γq.Qi+γq.ψo.Q3+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-6.020	0.023	30 <	196

1.11.4. Ultimate limit state

Design of bolted connection at node : 8 (EC5 EN1995-1-1:2009, §8.5)
Connection with double (2) metal plates on the two faces of the truss.

Connection check of element 10, with elements 3 and 4, at node 8

Fastener characteristics:
Two(2) metal 2.0 mm plates with dimensions
BxH=180mmx45mm, and thickness 2.0mm
Bolts with diameter d=4.0mm,
4 bolts on each of the connected elements
Distance between bolts a1=28 mm, a2=16 mm
Yield strength for plate steel fy=240 N/mm²
Net plate area (minus holes) Anet=(0.75)·b·t
Fa= force at the center of the connection
Ma= moment at the center of the connection
Maximum force at corner bolt Fn=Fa/n+Ma/Wp
n: number of bolts, a: bolt section area
A=nxa: total area of bolts
r: distance of corner bolt from connection center
Wp: section modulus of connection
n= 4, (nef=1.00n), A=50mm², r=18mm, Wp =811mm³
σ and σd plate normal and bearing stress N/mm²



Forces at node 8 ,from element 10, at the center of the joint F(force) M(moment)

Check capacity of connection

L.C.	Load combination	duration class	kmod	Fa(kN)	Ma(kNm)	Fn(kN)		Rd(kN)
1	γg.G	Permanent	0.60	-2.104	-0.009	0.327	<	1.076
2	γg.G+γq.Q1	Short-term	0.90	-7.160	-0.032	1.119	<	1.614
3	γg.G+γq.Q2	Short-term	0.90	-4.950	-0.017	0.733	<	1.614
4	γg.G+γq.Q3	Short-term	0.90	-6.843	-0.036	1.108	<	1.614
5	γg.G+γq.Q4	Short-term	0.90	-2.742	-0.022	0.501	<	1.614
6	γg.G+γq.Q5	Short-term	0.90	-2.104	-0.009	0.327	<	1.614
7	γg.G+γq.Qf	Medium-term	0.80	-1.830	-0.015	0.333	<	1.435
8	γg.G+γq.Qi	Short-term	0.90	-3.765	-0.015	0.577	<	1.614
9	γg.G+γq.Q1+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-7.287	-0.043	1.209	<	1.614
10	γg.G+γq.Q1+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-6.968	-0.036	1.123	<	1.614
11	γg.G+γq.Q2+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-5.076	-0.027	0.824	<	1.614
12	γg.G+γq.Q2+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-4.757	-0.020	0.737	<	1.614
13	γg.G+γq.Q3+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-6.969	-0.047	1.200	<	1.614
14	γg.G+γq.Q3+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-6.651	-0.040	1.112	<	1.614
15	γg.G+γq.Q4+γq.ψo.Q1+γq.ψo.Qf	Short-term	0.90	-5.583	-0.040	0.980	<	1.614
16	γg.G+γq.Q4+γq.ψo.Q2+γq.ψo.Qf	Short-term	0.90	-4.256	-0.031	0.748	<	1.614
17	γg.G+γq.Q4+γq.ψo.Q3+γq.ψo.Qf	Short-term	0.90	-5.392	-0.042	0.974	<	1.614
18	γg.G+γq.Q5+γq.ψo.Q1+γq.ψo.Qf	Short-term	0.90	-4.946	-0.027	0.806	<	1.614
19	γg.G+γq.Q5+γq.ψo.Q2+γq.ψo.Qf	Short-term	0.90	-3.619	-0.017	0.574	<	1.614
20	γg.G+γq.Q5+γq.ψo.Q3+γq.ψo.Qf	Short-term	0.90	-4.755	-0.029	0.800	<	1.614
21	γg.G+γq.Qf+γq.ψo.Q1+γq.ψo.Q4	Short-term	0.90	-5.182	-0.035	0.895	<	1.614
22	γg.G+γq.Qf+γq.ψo.Q1+γq.ψo.Q5	Short-term	0.90	-4.863	-0.028	0.808	<	1.614
23	γg.G+γq.Qf+γq.ψo.Q2+γq.ψo.Q4	Short-term	0.90	-3.855	-0.026	0.663	<	1.614
24	γg.G+γq.Qf+γq.ψo.Q2+γq.ψo.Q5	Short-term	0.90	-3.537	-0.019	0.576	<	1.614
25	γg.G+γq.Qf+γq.ψo.Q3+γq.ψo.Q4	Short-term	0.90	-4.991	-0.037	0.889	<	1.614
26	γg.G+γq.Qf+γq.ψo.Q3+γq.ψo.Q5	Short-term	0.90	-4.673	-0.031	0.802	<	1.614
27	γg.G+γq.Qi+γq.ψo.Q1+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-6.925	-0.040	1.143	<	1.614
28	γg.G+γq.Qi+γq.ψo.Q1+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-6.606	-0.033	1.056	<	1.614
29	γg.G+γq.Qi+γq.ψo.Q2+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-5.598	-0.030	0.911	<	1.614
30	γg.G+γq.Qi+γq.ψo.Q2+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-5.280	-0.024	0.824	<	1.614
31	γg.G+γq.Qi+γq.ψo.Q3+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-6.734	-0.042	1.137	<	1.614
32	γg.G+γq.Qi+γq.ψo.Q3+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-6.416	-0.035	1.050	<	1.614

Check capacity of connection plate

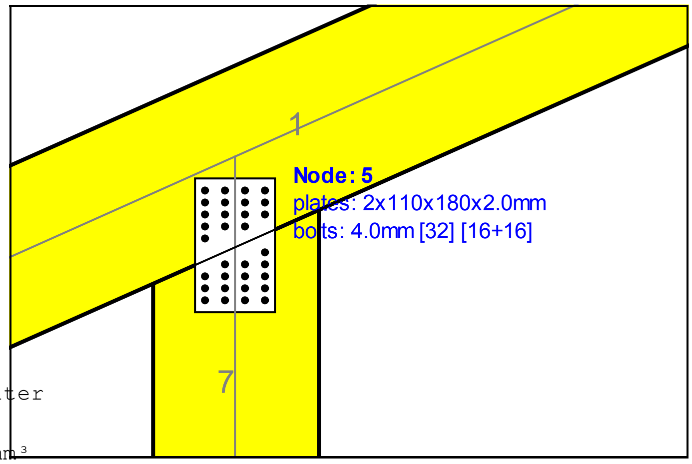
L.C.	Load combination	duration class	kmod	Fa(kN)	Ma(kNm)	σ		σd(N/mm²)
1	γg.G	Permanent	0.60	-2.104	-0.009	11	<	131
2	γg.G+γq.Q1	Short-term	0.90	-7.160	-0.032	37	<	196
3	γg.G+γq.Q2	Short-term	0.90	-4.950	-0.017	24	<	196
4	γg.G+γq.Q3	Short-term	0.90	-6.843	-0.036	37	<	196
5	γg.G+γq.Q4	Short-term	0.90	-2.742	-0.022	18	<	196
6	γg.G+γq.Q5	Short-term	0.90	-2.104	-0.009	11	<	196
7	γg.G+γq.Qf	Medium-term	0.80	-1.830	-0.015	12	<	175
8	γg.G+γq.Qi	Short-term	0.90	-3.765	-0.015	19	<	196
9	γg.G+γq.Q1+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-7.287	-0.043	41	<	196
10	γg.G+γq.Q1+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-6.968	-0.036	38	<	196
11	γg.G+γq.Q2+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-5.076	-0.027	28	<	196
12	γg.G+γq.Q2+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-4.757	-0.020	24	<	196
13	γg.G+γq.Q3+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-6.969	-0.047	41	<	196
14	γg.G+γq.Q3+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-6.651	-0.040	38	<	196
15	γg.G+γq.Q4+γq.ψo.Q1+γq.ψo.Qf	Short-term	0.90	-5.583	-0.040	34	<	196
16	γg.G+γq.Q4+γq.ψo.Q2+γq.ψo.Qf	Short-term	0.90	-4.256	-0.031	26	<	196
17	γg.G+γq.Q4+γq.ψo.Q3+γq.ψo.Qf	Short-term	0.90	-5.392	-0.042	34	<	196
18	γg.G+γq.Q5+γq.ψo.Q1+γq.ψo.Qf	Short-term	0.90	-4.946	-0.027	27	<	196
19	γg.G+γq.Q5+γq.ψo.Q2+γq.ψo.Qf	Short-term	0.90	-3.619	-0.017	19	<	196
20	γg.G+γq.Q5+γq.ψo.Q3+γq.ψo.Qf	Short-term	0.90	-4.755	-0.029	27	<	196
21	γg.G+γq.Qf+γq.ψo.Q1+γq.ψo.Q4	Short-term	0.90	-5.182	-0.035	31	<	196
22	γg.G+γq.Qf+γq.ψo.Q1+γq.ψo.Q5	Short-term	0.90	-4.863	-0.028	27	<	196
23	γg.G+γq.Qf+γq.ψo.Q2+γq.ψo.Q4	Short-term	0.90	-3.855	-0.026	23	<	196
24	γg.G+γq.Qf+γq.ψo.Q2+γq.ψo.Q5	Short-term	0.90	-3.537	-0.019	19	<	196
25	γg.G+γq.Qf+γq.ψo.Q3+γq.ψo.Q4	Short-term	0.90	-4.991	-0.037	31	<	196
26	γg.G+γq.Qf+γq.ψo.Q3+γq.ψo.Q5	Short-term	0.90	-4.673	-0.031	27	<	196
27	γg.G+γq.Qi+γq.ψo.Q1+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-6.925	-0.040	39	<	196
28	γg.G+γq.Qi+γq.ψo.Q1+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-6.606	-0.033	35	<	196
29	γg.G+γq.Qi+γq.ψo.Q2+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-5.598	-0.030	31	<	196
30	γg.G+γq.Qi+γq.ψo.Q2+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-5.280	-0.024	27	<	196
31	γg.G+γq.Qi+γq.ψo.Q3+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-6.734	-0.042	39	<	196
32	γg.G+γq.Qi+γq.ψo.Q3+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-6.416	-0.035	35	<	196

1.11.5. Ultimate limit state

Design of bolted connection at node : 5 (EC5 EN1995-1-1:2009, §8.5)
Connection with double (2) metal plates on the two faces of the truss.

Connection check between elements 7 and 1, at node 5

Fastener characteristics:
Two(2) metal 2.0 mm plates with dimensions
BxH=180mmx110mm, and thickness 2.0mm
Bolts with diameter d=4.0mm,
16 bolts on each of the connected elements
Distance between bolts a1=28 mm, a2=16 mm
Yield strength for plate steel fy=240 N/mm²
Net plate area (minus holes) Anet=(0.75)·b·t
Fa= force at the center of the connection
Ma= moment at the center of the connection
Maximum force at corner bolt Fn=Fa/n+Ma/Wp
n: number of bolts, a: bolt section area
A=nxa: total area of bolts
r: distance of corner bolt from connection center
Wp: section modulus of connection
n=16, (nef=1.34n), A=201mm², r=43mm, Wp =5283mm³
σ and σd plate normal and bearing stress N/mm²



Forces at node 5 ,from element 7, at the center of the joint F(force) M(moment)

Check capacity of connection

L.C.	Load combination	duration class	kmod	Fa(kN)	Ma(kNm)	Fn(kN)		Rd(kN)
1	γg.G	Permanent	0.60	-1.601	0.211	0.298	<	1.076
2	γg.G+γq.Q1	Short-term	0.90	-4.593	1.101	1.427	<	1.614
3	γg.G+γq.Q2	Short-term	0.90	-3.012	0.610	0.806	<	1.614
4	γg.G+γq.Q3	Short-term	0.90	-4.664	1.147	1.484	<	1.614
5	γg.G+γq.Q4	Short-term	0.90	-1.601	0.211	0.298	<	1.614
6	γg.G+γq.Q5	Short-term	0.90	-1.517	0.478	0.616	<	1.614
7	γg.G+γq.Qf	Medium-term	0.80	-3.120	-0.131	0.253	<	1.435
8	γg.G+γq.Qi	Short-term	0.90	-2.502	0.478	0.636	<	1.614
9	γg.G+γq.Q1+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-5.518	0.764	1.063	<	1.614
10	γg.G+γq.Q1+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-5.405	0.861	1.178	<	1.614
11	γg.G+γq.Q2+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-3.909	0.370	0.557	<	1.614
12	γg.G+γq.Q2+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-3.830	0.503	0.715	<	1.614
13	γg.G+γq.Q3+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-5.585	0.811	1.120	<	1.614
14	γg.G+γq.Q3+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-5.470	0.908	1.235	<	1.614
15	γg.G+γq.Q4+γq.ψo.Q1+γq.ψo.Qf	Short-term	0.90	-4.251	0.506	0.726	<	1.614
16	γg.G+γq.Q4+γq.ψo.Q2+γq.ψo.Qf	Short-term	0.90	-3.383	0.211	0.354	<	1.614
17	γg.G+γq.Q4+γq.ψo.Q3+γq.ψo.Qf	Short-term	0.90	-4.288	0.533	0.760	<	1.614
18	γg.G+γq.Q5+γq.ψo.Q1+γq.ψo.Qf	Short-term	0.90	-4.091	0.772	1.044	<	1.614
19	γg.G+γq.Q5+γq.ψo.Q2+γq.ψo.Qf	Short-term	0.90	-3.316	0.477	0.671	<	1.614
20	γg.G+γq.Q5+γq.ψo.Q3+γq.ψo.Qf	Short-term	0.90	-4.124	0.800	1.078	<	1.614
21	γg.G+γq.Qf+γq.ψo.Q1+γq.ψo.Q4	Short-term	0.90	-4.669	0.403	0.620	<	1.614
22	γg.G+γq.Qf+γq.ψo.Q1+γq.ψo.Q5	Short-term	0.90	-4.597	0.536	0.778	<	1.614
23	γg.G+γq.Qf+γq.ψo.Q2+γq.ψo.Q4	Short-term	0.90	-3.831	0.108	0.247	<	1.614
24	γg.G+γq.Qf+γq.ψo.Q2+γq.ψo.Q5	Short-term	0.90	-3.802	0.241	0.405	<	1.614
25	γg.G+γq.Qf+γq.ψo.Q3+γq.ψo.Q4	Short-term	0.90	-4.704	0.431	0.654	<	1.614
26	γg.G+γq.Qf+γq.ψo.Q3+γq.ψo.Q5	Short-term	0.90	-4.630	0.564	0.812	<	1.614
27	γg.G+γq.Qi+γq.ψo.Q1+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-5.243	0.675	0.950	<	1.614
28	γg.G+γq.Qi+γq.ψo.Q1+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-5.133	0.772	1.065	<	1.614
29	γg.G+γq.Qi+γq.ψo.Q2+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-4.234	0.477	0.692	<	1.614
30	γg.G+γq.Qi+γq.ψo.Q2+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-4.141	0.610	0.851	<	1.614
31	γg.G+γq.Qi+γq.ψo.Q3+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-5.283	0.702	0.984	<	1.614
32	γg.G+γq.Qi+γq.ψo.Q3+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-5.172	0.800	1.099	<	1.614

Check capacity of connection plate

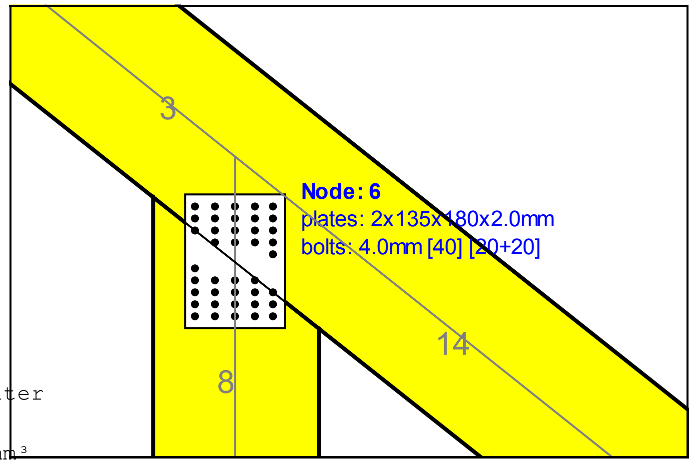
L.C.	Load combination	duration class	kmod	Fa(kN)	Ma(kNm)	σ		σd(N/mm²)
1	γg.G	Permanent	0.60	-1.601	0.211	14	<	131
2	γg.G+γq.Q1	Short-term	0.90	-4.593	1.101	68	<	196
3	γg.G+γq.Q2	Short-term	0.90	-3.012	0.610	38	<	196
4	γg.G+γq.Q3	Short-term	0.90	-4.664	1.147	70	<	196
5	γg.G+γq.Q4	Short-term	0.90	-1.601	0.211	14	<	196
6	γg.G+γq.Q5	Short-term	0.90	-1.517	0.478	29	<	196
7	γg.G+γq.Qf	Medium-term	0.80	-3.120	-0.131	12	<	175
8	γg.G+γq.Qi	Short-term	0.90	-2.502	0.478	30	<	196
9	γg.G+γq.Q1+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-5.518	0.764	50	<	196
10	γg.G+γq.Q1+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-5.405	0.861	56	<	196
11	γg.G+γq.Q2+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-3.909	0.370	26	<	196
12	γg.G+γq.Q2+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-3.830	0.503	34	<	196
13	γg.G+γq.Q3+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-5.585	0.811	53	<	196
14	γg.G+γq.Q3+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-5.470	0.908	58	<	196
15	γg.G+γq.Q4+γq.ψo.Q1+γq.ψo.Qf	Short-term	0.90	-4.251	0.506	34	<	196
16	γg.G+γq.Q4+γq.ψo.Q2+γq.ψo.Qf	Short-term	0.90	-3.383	0.211	17	<	196
17	γg.G+γq.Q4+γq.ψo.Q3+γq.ψo.Qf	Short-term	0.90	-4.288	0.533	36	<	196
18	γg.G+γq.Q5+γq.ψo.Q1+γq.ψo.Qf	Short-term	0.90	-4.091	0.772	49	<	196
19	γg.G+γq.Q5+γq.ψo.Q2+γq.ψo.Qf	Short-term	0.90	-3.316	0.477	31	<	196
20	γg.G+γq.Q5+γq.ψo.Q3+γq.ψo.Qf	Short-term	0.90	-4.124	0.800	50	<	196
21	γg.G+γq.Qf+γq.ψo.Q1+γq.ψo.Q4	Short-term	0.90	-4.669	0.403	29	<	196
22	γg.G+γq.Qf+γq.ψo.Q1+γq.ψo.Q5	Short-term	0.90	-4.597	0.536	37	<	196
23	γg.G+γq.Qf+γq.ψo.Q2+γq.ψo.Q4	Short-term	0.90	-3.831	0.108	12	<	196
24	γg.G+γq.Qf+γq.ψo.Q2+γq.ψo.Q5	Short-term	0.90	-3.802	0.241	19	<	196
25	γg.G+γq.Qf+γq.ψo.Q3+γq.ψo.Q4	Short-term	0.90	-4.704	0.431	31	<	196
26	γg.G+γq.Qf+γq.ψo.Q3+γq.ψo.Q5	Short-term	0.90	-4.630	0.564	38	<	196
27	γg.G+γq.Qi+γq.ψo.Q1+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-5.243	0.675	45	<	196
28	γg.G+γq.Qi+γq.ψo.Q1+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-5.133	0.772	50	<	196
29	γg.G+γq.Qi+γq.ψo.Q2+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-4.234	0.477	33	<	196
30	γg.G+γq.Qi+γq.ψo.Q2+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-4.141	0.610	40	<	196
31	γg.G+γq.Qi+γq.ψo.Q3+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-5.283	0.702	47	<	196
32	γg.G+γq.Qi+γq.ψo.Q3+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-5.172	0.800	52	<	196

1.11.6. Ultimate limit state

Design of bolted connection at node : 6 (EC5 EN1995-1-1:2009, §8.5)
Connection with double (2) metal plates on the two faces of the truss.

Connection check between elements 8 and 3, at node 6

Fastener characteristics:
Two(2) metal 2.0 mm plates with dimensions
BxH=180mmx135mm, and thickness 2.0mm
Bolts with diameter d=4.0mm,
20 bolts on each of the connected elements
Distance between bolts a1=28 mm, a2=16 mm
Yield strength for plate steel fy=240 N/mm²
Net plate area (minus holes) Anet=(0.75)·b·t
Fa= force at the center of the connection
Ma= moment at the center of the connection
Maximum force at corner bolt Fn=Fa/n+Ma/Wp
n: number of bolts, a: bolt section area
A=nxa: total area of bolts
r: distance of corner bolt from connection center
Wp: section modulus of connection
n=20, (nef=1.37n), A=251mm², r=51mm, Wp =8395mm³
σ and σd plate normal and bearing stress N/mm²



Forces at node 6 ,from element 8, at the center of the joint F(force) M(moment)

Check capacity of connection

L.C.	Load combination	duration class	kmod	Fa(kN)	Ma(kNm)	Fn(kN)		Rd(kN)
1	γg.G	Permanent	0.60	-1.225	0.344	0.286	<	1.076
2	γg.G+γq.Q1	Short-term	0.90	-1.383	0.088	0.100	<	1.614
3	γg.G+γq.Q2	Short-term	0.90	-1.970	0.305	0.272	<	1.614
4	γg.G+γq.Q3	Short-term	0.90	-1.020	-0.001	0.026	<	1.614
5	γg.G+γq.Q4	Short-term	0.90	-1.568	0.744	0.596	<	1.614
6	γg.G+γq.Q5	Short-term	0.90	-1.225	0.344	0.286	<	1.614
7	γg.G+γq.Qf	Medium-term	0.80	-3.545	1.456	1.174	<	1.435
8	γg.G+γq.Qi	Short-term	0.90	-1.431	0.287	0.248	<	1.614
9	γg.G+γq.Q1+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-3.171	1.067	0.877	<	1.614
10	γg.G+γq.Q1+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-3.008	0.867	0.722	<	1.614
11	γg.G+γq.Q2+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-3.659	1.284	1.048	<	1.614
12	γg.G+γq.Q2+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-3.566	1.084	0.893	<	1.614
13	γg.G+γq.Q3+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-2.725	0.978	0.800	<	1.614
14	γg.G+γq.Q3+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-2.493	0.778	0.644	<	1.614
15	γg.G+γq.Q4+γq.ψo.Q1+γq.ψo.Qf	Short-term	0.90	-3.276	1.370	1.107	<	1.614
16	γg.G+γq.Q4+γq.ψo.Q2+γq.ψo.Qf	Short-term	0.90	-3.524	1.500	1.209	<	1.614
17	γg.G+γq.Q4+γq.ψo.Q3+γq.ψo.Qf	Short-term	0.90	-3.017	1.316	1.060	<	1.614
18	γg.G+γq.Q5+γq.ψo.Q1+γq.ψo.Qf	Short-term	0.90	-2.940	0.969	0.796	<	1.614
19	γg.G+γq.Q5+γq.ψo.Q2+γq.ψo.Qf	Short-term	0.90	-3.275	1.099	0.899	<	1.614
20	γg.G+γq.Q5+γq.ψo.Q3+γq.ψo.Qf	Short-term	0.90	-2.601	0.916	0.750	<	1.614
21	γg.G+γq.Qf+γq.ψo.Q1+γq.ψo.Q4	Short-term	0.90	-3.785	1.503	1.218	<	1.614
22	γg.G+γq.Qf+γq.ψo.Q1+γq.ψo.Q5	Short-term	0.90	-3.638	1.303	1.063	<	1.614
23	γg.G+γq.Qf+γq.ψo.Q2+γq.ψo.Q4	Short-term	0.90	-4.080	1.633	1.321	<	1.614
24	γg.G+γq.Qf+γq.ψo.Q2+γq.ψo.Q5	Short-term	0.90	-3.969	1.433	1.165	<	1.614
25	γg.G+γq.Qf+γq.ψo.Q3+γq.ψo.Q4	Short-term	0.90	-3.473	1.450	1.172	<	1.614
26	γg.G+γq.Qf+γq.ψo.Q3+γq.ψo.Q5	Short-term	0.90	-3.294	1.249	1.016	<	1.614
27	γg.G+γq.Qi+γq.ψo.Q1+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-3.288	1.112	0.913	<	1.614
28	γg.G+γq.Qi+γq.ψo.Q1+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-3.143	0.912	0.758	<	1.614
29	γg.G+γq.Qi+γq.ψo.Q2+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-3.585	1.242	1.016	<	1.614
30	γg.G+γq.Qi+γq.ψo.Q2+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-3.481	1.042	0.861	<	1.614
31	γg.G+γq.Qi+γq.ψo.Q3+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-2.981	1.059	0.867	<	1.614
32	γg.G+γq.Qi+γq.ψo.Q3+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-2.798	0.858	0.712	<	1.614

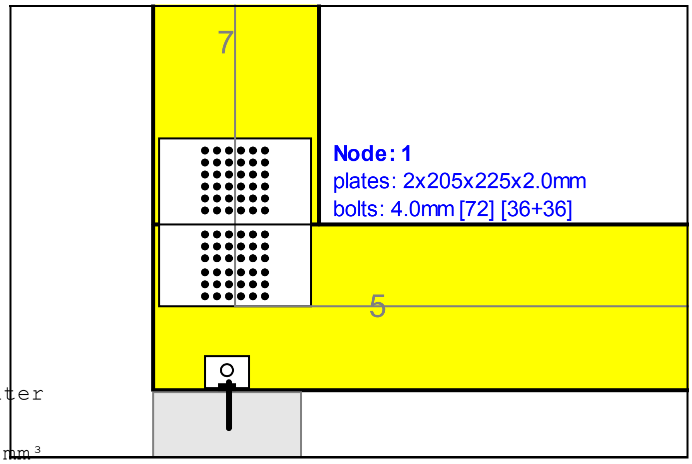
Check capacity of connection plate

L.C.	Load combination	duration class	kmod	Fa(kN)	Ma(kNm)	σ		σd(N/mm²)
1	γg.G	Permanent	0.60	-1.225	0.344	14	<	131
2	γg.G+γq.Q1	Short-term	0.90	-1.383	0.088	5	<	196
3	γg.G+γq.Q2	Short-term	0.90	-1.970	0.305	14	<	196
4	γg.G+γq.Q3	Short-term	0.90	-1.020	-0.001	1	<	196
5	γg.G+γq.Q4	Short-term	0.90	-1.568	0.744	29	<	196
6	γg.G+γq.Q5	Short-term	0.90	-1.225	0.344	14	<	196
7	γg.G+γq.Qf	Medium-term	0.80	-3.545	1.456	58	<	175
8	γg.G+γq.Qi	Short-term	0.90	-1.431	0.287	12	<	196
9	γg.G+γq.Q1+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-3.171	1.067	43	<	196
10	γg.G+γq.Q1+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-3.008	0.867	35	<	196
11	γg.G+γq.Q2+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-3.659	1.284	51	<	196
12	γg.G+γq.Q2+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-3.566	1.084	44	<	196
13	γg.G+γq.Q3+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-2.725	0.978	39	<	196
14	γg.G+γq.Q3+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-2.493	0.778	32	<	196
15	γg.G+γq.Q4+γq.ψo.Q1+γq.ψo.Qf	Short-term	0.90	-3.276	1.370	54	<	196
16	γg.G+γq.Q4+γq.ψo.Q2+γq.ψo.Qf	Short-term	0.90	-3.524	1.500	59	<	196
17	γg.G+γq.Q4+γq.ψo.Q3+γq.ψo.Qf	Short-term	0.90	-3.017	1.316	52	<	196
18	γg.G+γq.Q5+γq.ψo.Q1+γq.ψo.Qf	Short-term	0.90	-2.940	0.969	39	<	196
19	γg.G+γq.Q5+γq.ψo.Q2+γq.ψo.Qf	Short-term	0.90	-3.275	1.099	44	<	196
20	γg.G+γq.Q5+γq.ψo.Q3+γq.ψo.Qf	Short-term	0.90	-2.601	0.916	37	<	196
21	γg.G+γq.Qf+γq.ψo.Q1+γq.ψo.Q4	Short-term	0.90	-3.785	1.503	60	<	196
22	γg.G+γq.Qf+γq.ψo.Q1+γq.ψo.Q5	Short-term	0.90	-3.638	1.303	52	<	196
23	γg.G+γq.Qf+γq.ψo.Q2+γq.ψo.Q4	Short-term	0.90	-4.080	1.633	65	<	196
24	γg.G+γq.Qf+γq.ψo.Q2+γq.ψo.Q5	Short-term	0.90	-3.969	1.433	57	<	196
25	γg.G+γq.Qf+γq.ψo.Q3+γq.ψo.Q4	Short-term	0.90	-3.473	1.450	57	<	196
26	γg.G+γq.Qf+γq.ψo.Q3+γq.ψo.Q5	Short-term	0.90	-3.294	1.249	50	<	196
27	γg.G+γq.Qi+γq.ψo.Q1+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-3.288	1.112	45	<	196
28	γg.G+γq.Qi+γq.ψo.Q1+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-3.143	0.912	37	<	196
29	γg.G+γq.Qi+γq.ψo.Q2+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-3.585	1.242	50	<	196
30	γg.G+γq.Qi+γq.ψo.Q2+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-3.481	1.042	42	<	196
31	γg.G+γq.Qi+γq.ψo.Q3+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-2.981	1.059	42	<	196
32	γg.G+γq.Qi+γq.ψo.Q3+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-2.798	0.858	35	<	196

1.11.7. Ultimate limit state

Design of bolted connection at node : 1 (EC5 EN1995-1-1:2009, §8.5)
Connection with double (2) metal plates on the two faces of the truss.

Connection check between elements 7 and 5, at node 1



Fastener characteristics:
Two(2) metal 2.0 mm plates with dimensions
BxH=225mmx205mm, and thickness 2.0mm
Bolts with diameter d=4.0mm,
36 bolts on each of the connected elements
Distance between bolts a1=28 mm, a2=16 mm
Yield strength for plate steel fy=240 N/mm²
Net plate area (minus holes) Anet=(0.75)·b·t
Fa= force at the center of the connection
Ma= moment at the center of the connection
Maximum force at corner bolt Fn=Fa/n+Ma/Wp
n: number of bolts, a: bolt section area
A=nxa: total area of bolts
r: distance of corner bolt from connection center
Wp: section modulus of connection
n=36, (nef=1.40n), A=452mm², r=65mm, Wp =16452mm³
σ and σd plate normal and bearing stress N/mm²

Forces at node 1 ,from element 7, at the center of the joint F(force) M(moment)

Check capacity of connection

L.C.	Load combination	duration class	kmod	Fa(kN)	Ma(kNm)	Fn(kN)		Rd(kN)
1	γg.G	Permanent	0.60	-1.601	0.886	0.360	<	1.076
2	γg.G+γq.Q1	Short-term	0.90	-4.593	0.525	0.257	<	1.614
3	γg.G+γq.Q2	Short-term	0.90	-3.012	0.767	0.330	<	1.614
4	γg.G+γq.Q3	Short-term	0.90	-4.664	0.464	0.235	<	1.614
5	γg.G+γq.Q4	Short-term	0.90	-1.601	0.886	0.360	<	1.614
6	γg.G+γq.Q5	Short-term	0.90	-1.841	1.692	0.671	<	1.614
7	γg.G+γq.Qf	Medium-term	0.80	-3.120	3.664	1.443	<=	1.435
8	γg.G+γq.Qi	Short-term	0.90	-2.502	0.789	0.333	<	1.614
9	γg.G+γq.Q1+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-5.468	2.171	0.898	<	1.614
10	γg.G+γq.Q1+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-5.405	2.470	1.013	<	1.614
11	γg.G+γq.Q2+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-3.909	2.711	1.088	<	1.614
12	γg.G+γq.Q2+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-3.946	3.114	1.244	<	1.614
13	γg.G+γq.Q3+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-5.535	2.110	0.875	<	1.614
14	γg.G+γq.Q3+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-5.470	2.409	0.991	<	1.614
15	γg.G+γq.Q4+γq.ψo.Q1+γq.ψo.Qf	Short-term	0.90	-4.251	2.614	1.055	<	1.614
16	γg.G+γq.Q4+γq.ψo.Q2+γq.ψo.Qf	Short-term	0.90	-3.383	2.759	1.100	<	1.614
17	γg.G+γq.Q4+γq.ψo.Q3+γq.ψo.Qf	Short-term	0.90	-4.288	2.578	1.042	<	1.614
18	γg.G+γq.Q5+γq.ψo.Q1+γq.ψo.Qf	Short-term	0.90	-4.340	3.420	1.366	<	1.614
19	γg.G+γq.Q5+γq.ψo.Q2+γq.ψo.Qf	Short-term	0.90	-3.608	3.565	1.411	<	1.614
20	γg.G+γq.Q5+γq.ψo.Q3+γq.ψo.Qf	Short-term	0.90	-4.370	3.384	1.353	<	1.614
21	γg.G+γq.Qf+γq.ψo.Q1+γq.ψo.Q4	Short-term	0.90	-4.669	3.448	1.380	<	1.614
22	γg.G+γq.Qf+γq.ψo.Q1+γq.ψo.Q5	Short-term	0.90	-4.715	3.851	1.536	<	1.614
23	γg.G+γq.Qf+γq.ψo.Q2+γq.ψo.Q4	Short-term	0.90	-3.831	3.593	1.425	<	1.614
24	γg.G+γq.Qf+γq.ψo.Q2+γq.ψo.Q5	Short-term	0.90	-3.939	3.996	1.581	<	1.614
25	γg.G+γq.Qf+γq.ψo.Q3+γq.ψo.Q4	Short-term	0.90	-4.704	3.411	1.366	<	1.614
26	γg.G+γq.Qf+γq.ψo.Q3+γq.ψo.Q5	Short-term	0.90	-4.747	3.814	1.522	<	1.614
27	γg.G+γq.Qi+γq.ψo.Q1+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-5.190	2.218	0.913	<	1.614
28	γg.G+γq.Qi+γq.ψo.Q1+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-5.133	2.517	1.028	<	1.614
29	γg.G+γq.Qi+γq.ψo.Q2+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-4.234	2.662	1.073	<	1.614
30	γg.G+γq.Qi+γq.ψo.Q2+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-4.251	3.065	1.229	<	1.614
31	γg.G+γq.Qi+γq.ψo.Q3+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-5.231	2.181	0.899	<	1.614
32	γg.G+γq.Qi+γq.ψo.Q3+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-5.172	2.480	1.015	<	1.614

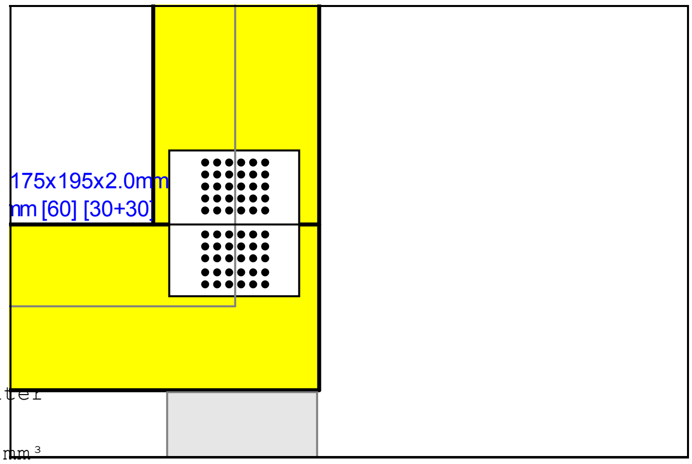
Check capacity of connection plate

L.C.	Load combination	duration class	kmod	Fa(kN)	Ma(kNm)	σ	σd(N/mm²)
1	γg.G	Permanent	0.60	-1.601	0.886	15 <	131
2	γg.G+γq.Q1	Short-term	0.90	-4.593	0.525	12 <	196
3	γg.G+γq.Q2	Short-term	0.90	-3.012	0.767	15 <	196
4	γg.G+γq.Q3	Short-term	0.90	-4.664	0.464	11 <	196
5	γg.G+γq.Q4	Short-term	0.90	-1.601	0.886	15 <	196
6	γg.G+γq.Q5	Short-term	0.90	-1.841	1.692	28 <	196
7	γg.G+γq.Qf	Medium-term	0.80	-3.120	3.664	61 <	175
8	γg.G+γq.Qi	Short-term	0.90	-2.502	0.789	15 <	196
9	γg.G+γq.Q1+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-5.468	2.171	39 <	196
10	γg.G+γq.Q1+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-5.405	2.470	44 <	196
11	γg.G+γq.Q2+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-3.909	2.711	46 <	196
12	γg.G+γq.Q2+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-3.946	3.114	53 <	196
13	γg.G+γq.Q3+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-5.535	2.110	38 <	196
14	γg.G+γq.Q3+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-5.470	2.409	43 <	196
15	γg.G+γq.Q4+γq.ψo.Q1+γq.ψo.Qf	Short-term	0.90	-4.251	2.614	45 <	196
16	γg.G+γq.Q4+γq.ψo.Q2+γq.ψo.Qf	Short-term	0.90	-3.383	2.759	47 <	196
17	γg.G+γq.Q4+γq.ψo.Q3+γq.ψo.Qf	Short-term	0.90	-4.288	2.578	44 <	196
18	γg.G+γq.Q5+γq.ψo.Q1+γq.ψo.Qf	Short-term	0.90	-4.340	3.420	58 <	196
19	γg.G+γq.Q5+γq.ψo.Q2+γq.ψo.Qf	Short-term	0.90	-3.608	3.565	59 <	196
20	γg.G+γq.Q5+γq.ψo.Q3+γq.ψo.Qf	Short-term	0.90	-4.370	3.384	57 <	196
21	γg.G+γq.Qf+γq.ψo.Q1+γq.ψo.Q4	Short-term	0.90	-4.669	3.448	58 <	196
22	γg.G+γq.Qf+γq.ψo.Q1+γq.ψo.Q5	Short-term	0.90	-4.715	3.851	65 <	196
23	γg.G+γq.Qf+γq.ψo.Q2+γq.ψo.Q4	Short-term	0.90	-3.831	3.593	60 <	196
24	γg.G+γq.Qf+γq.ψo.Q2+γq.ψo.Q5	Short-term	0.90	-3.939	3.996	67 <	196
25	γg.G+γq.Qf+γq.ψo.Q3+γq.ψo.Q4	Short-term	0.90	-4.704	3.411	58 <	196
26	γg.G+γq.Qf+γq.ψo.Q3+γq.ψo.Q5	Short-term	0.90	-4.747	3.814	64 <	196
27	γg.G+γq.Qi+γq.ψo.Q1+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-5.190	2.218	39 <	196
28	γg.G+γq.Qi+γq.ψo.Q1+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-5.133	2.517	44 <	196
29	γg.G+γq.Qi+γq.ψo.Q2+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-4.234	2.662	46 <	196
30	γg.G+γq.Qi+γq.ψo.Q2+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-4.251	3.065	52 <	196
31	γg.G+γq.Qi+γq.ψo.Q3+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-5.231	2.181	39 <	196
32	γg.G+γq.Qi+γq.ψo.Q3+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-5.172	2.480	44 <	196

1.11.8. Ultimate limit state

Design of bolted connection at node : 3 (EC5 EN1995-1-1:2009, §8.5)
Connection with double (2) metal plates on the two faces of the truss.

Connection check between elements 8 and 6, at node 3



Fastener characteristics:
Two(2) metal 2.0 mm plates with dimensions
BxH=195mmx175mm, and thickness 2.0mm
Bolts with diameter d=4.0mm,
30 bolts on each of the connected elements
Distance between bolts a1=28 mm, a2=16 mm
Yield strength for plate steel fy=240 N/mm^2
Net plate area (minus holes) Anet=(0.75)·b·t
Fa= force at the center of the connection
Ma= moment at the center of the connection
Maximum force at corner bolt Fn=Fa/n+Ma/Wp
n: number of bolts, a: bolt section area
A=nxa: total area of bolts
r: distance of corner bolt from connection center
Wp: section modulus of connection
n=30, (nef=1.40n), A=377mm^2, r=59mm, Wp =14377mm^3
σ and σd plate normal and bearing stress N/mm^2

Forces at node 3 ,from element 8, at the center of the joint F(force) M(moment)

Check capacity of connection

L.C.	Load combination	duration class	kmod	Fa(kN)	Ma(kNm)	Fn(kN)		Rd(kN)
1	γg.G	Permanent	0.60	-1.225	0.736	0.341	<	1.076
2	γg.G+γq.Q1	Short-term	0.90	-1.383	1.498	0.678	<	1.614
3	γg.G+γq.Q2	Short-term	0.90	-1.970	1.045	0.486	<	1.614
4	γg.G+γq.Q3	Short-term	0.90	-1.020	1.570	0.701	<	1.614
5	γg.G+γq.Q4	Short-term	0.90	-1.855	1.651	0.751	<	1.614
6	γg.G+γq.Q5	Short-term	0.90	-1.225	0.736	0.341	<	1.614
7	γg.G+γq.Qf	Medium-term	0.80	-3.545	2.030	0.945	<	1.435
8	γg.G+γq.Qi	Short-term	0.90	-1.431	0.956	0.440	<	1.614
9	γg.G+γq.Q1+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-3.295	2.861	1.305	<	1.614
10	γg.G+γq.Q1+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-3.008	2.403	1.100	<	1.614
11	γg.G+γq.Q2+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-3.761	2.408	1.114	<	1.614
12	γg.G+γq.Q2+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-3.566	1.951	0.909	<	1.614
13	γg.G+γq.Q3+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-2.869	2.933	1.328	<	1.614
14	γg.G+γq.Q3+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-2.493	2.475	1.123	<	1.614
15	γg.G+γq.Q4+γq.ψo.Q1+γq.ψo.Qf	Short-term	0.90	-3.540	3.014	1.376	<	1.614
16	γg.G+γq.Q4+γq.ψo.Q2+γq.ψo.Qf	Short-term	0.90	-3.763	2.742	1.261	<	1.614
17	γg.G+γq.Q4+γq.ψo.Q3+γq.ψo.Qf	Short-term	0.90	-3.301	3.057	1.390	<	1.614
18	γg.G+γq.Q5+γq.ψo.Q1+γq.ψo.Qf	Short-term	0.90	-2.940	2.099	0.966	<	1.614
19	γg.G+γq.Q5+γq.ψo.Q2+γq.ψo.Qf	Short-term	0.90	-3.275	1.827	0.851	<	1.614
20	γg.G+γq.Q5+γq.ψo.Q3+γq.ψo.Qf	Short-term	0.90	-2.601	2.142	0.979	<	1.614
21	γg.G+γq.Qf+γq.ψo.Q1+γq.ψo.Q4	Short-term	0.90	-3.903	2.944	1.352	<	1.614
22	γg.G+γq.Qf+γq.ψo.Q1+γq.ψo.Q5	Short-term	0.90	-3.638	2.487	1.147	<	1.614
23	γg.G+γq.Qf+γq.ψo.Q2+γq.ψo.Q4	Short-term	0.90	-4.187	2.673	1.237	<	1.614
24	γg.G+γq.Qf+γq.ψo.Q2+γq.ψo.Q5	Short-term	0.90	-3.969	2.215	1.032	<	1.614
25	γg.G+γq.Qf+γq.ψo.Q3+γq.ψo.Q4	Short-term	0.90	-3.602	2.988	1.366	<	1.614
26	γg.G+γq.Qf+γq.ψo.Q3+γq.ψo.Q5	Short-term	0.90	-3.294	2.530	1.160	<	1.614
27	γg.G+γq.Qi+γq.ψo.Q1+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-3.407	2.776	1.270	<	1.614
28	γg.G+γq.Qi+γq.ψo.Q1+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-3.143	2.319	1.065	<	1.614
29	γg.G+γq.Qi+γq.ψo.Q2+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-3.691	2.504	1.155	<	1.614
30	γg.G+γq.Qi+γq.ψo.Q2+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-3.481	2.047	0.950	<	1.614
31	γg.G+γq.Qi+γq.ψo.Q3+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-3.111	2.819	1.284	<	1.614
32	γg.G+γq.Qi+γq.ψo.Q3+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-2.798	2.362	1.079	<	1.614

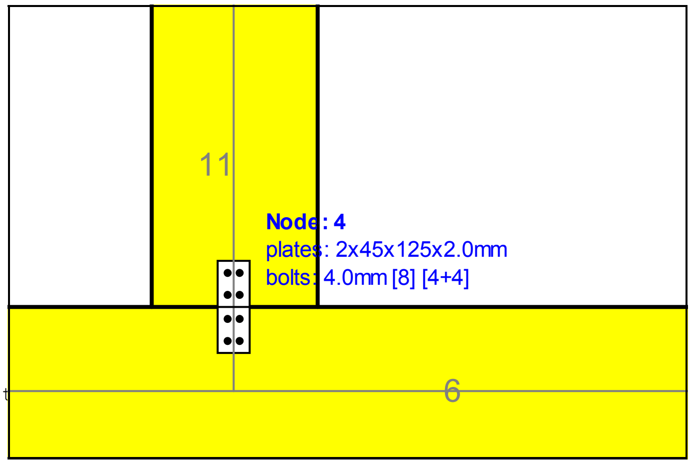
Check capacity of connection plate

L.C.	Load combination	duration class	kmod	Fa(kN)	Ma(kNm)	σ		σd(N/mm²)
1	γg.G	Permanent	0.60	-1.225	0.736	17	<	131
2	γg.G+γq.Q1	Short-term	0.90	-1.383	1.498	34	<	196
3	γg.G+γq.Q2	Short-term	0.90	-1.970	1.045	25	<	196
4	γg.G+γq.Q3	Short-term	0.90	-1.020	1.570	35	<	196
5	γg.G+γq.Q4	Short-term	0.90	-1.855	1.651	38	<	196
6	γg.G+γq.Q5	Short-term	0.90	-1.225	0.736	17	<	196
7	γg.G+γq.Qf	Medium-term	0.80	-3.545	2.030	48	<	175
8	γg.G+γq.Qi	Short-term	0.90	-1.431	0.956	22	<	196
9	γg.G+γq.Q1+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-3.295	2.861	65	<	196
10	γg.G+γq.Q1+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-3.008	2.403	55	<	196
11	γg.G+γq.Q2+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-3.761	2.408	56	<	196
12	γg.G+γq.Q2+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-3.566	1.951	46	<	196
13	γg.G+γq.Q3+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-2.869	2.933	67	<	196
14	γg.G+γq.Q3+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-2.493	2.475	56	<	196
15	γg.G+γq.Q4+γq.ψo.Q1+γq.ψo.Qf	Short-term	0.90	-3.540	3.014	69	<	196
16	γg.G+γq.Q4+γq.ψo.Q2+γq.ψo.Qf	Short-term	0.90	-3.763	2.742	63	<	196
17	γg.G+γq.Q4+γq.ψo.Q3+γq.ψo.Qf	Short-term	0.90	-3.301	3.057	70	<	196
18	γg.G+γq.Q5+γq.ψo.Q1+γq.ψo.Qf	Short-term	0.90	-2.940	2.099	48	<	196
19	γg.G+γq.Q5+γq.ψo.Q2+γq.ψo.Qf	Short-term	0.90	-3.275	1.827	43	<	196
20	γg.G+γq.Q5+γq.ψo.Q3+γq.ψo.Qf	Short-term	0.90	-2.601	2.142	49	<	196
21	γg.G+γq.Qf+γq.ψo.Q1+γq.ψo.Q4	Short-term	0.90	-3.903	2.944	68	<	196
22	γg.G+γq.Qf+γq.ψo.Q1+γq.ψo.Q5	Short-term	0.90	-3.638	2.487	58	<	196
23	γg.G+γq.Qf+γq.ψo.Q2+γq.ψo.Q4	Short-term	0.90	-4.187	2.673	62	<	196
24	γg.G+γq.Qf+γq.ψo.Q2+γq.ψo.Q5	Short-term	0.90	-3.969	2.215	52	<	196
25	γg.G+γq.Qf+γq.ψo.Q3+γq.ψo.Q4	Short-term	0.90	-3.602	2.988	68	<	196
26	γg.G+γq.Qf+γq.ψo.Q3+γq.ψo.Q5	Short-term	0.90	-3.294	2.530	58	<	196
27	γg.G+γq.Qi+γq.ψo.Q1+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-3.407	2.776	64	<	196
28	γg.G+γq.Qi+γq.ψo.Q1+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-3.143	2.319	53	<	196
29	γg.G+γq.Qi+γq.ψo.Q2+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-3.691	2.504	58	<	196
30	γg.G+γq.Qi+γq.ψo.Q2+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-3.481	2.047	48	<	196
31	γg.G+γq.Qi+γq.ψo.Q3+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-3.111	2.819	64	<	196
32	γg.G+γq.Qi+γq.ψo.Q3+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-2.798	2.362	54	<	196

1.11.9. Ultimate limit state

Design of bolted connection at node : 4 (EC5 EN1995-1-1:2009, §8.5)
Connection with double (2) metal plates on the two faces of the truss.

Connection check of element 11, with elements 5 and 6, at node 4



Fastener characteristics:
Two(2) metal 2.0 mm plates with dimensions BxH=45mmx125mm, and thickness 2.0mm
Bolts with diameter d=4.0mm,
4 bolts on each of the connected elements
Distance between bolts a1=28 mm, a2=16 mm
Yield strength for plate steel fy=240 N/mm²
Net plate area (minus holes) Anet=(0.75)·b·t
Fa= force at the center of the connection
Ma= moment at the center of the connection
Maximum force at corner bolt Fn=Fa/n+Ma/Wp
n: number of bolts, a: bolt section area
A=nxa: total area of bolts
r: distance of corner bolt from connection cent
Wp: section modulus of connection
n= 4, (nef=1.00n), A=50mm², r=18mm, Wp =811mm³
σ and σd plate normal and bearing stress N/mm²

Forces at node 4 ,from element 11, at the center of the joint F(force) M(moment)

Check capacity of connection

L.C.	Load combination	duration class	kmod	Fa(kN)	Ma(kNm)	Fn(kN)		Rd(kN)
1	γg.G	Permanent	0.60	-2.298	-0.020	0.426	<	1.076
2	γg.G+γq.Q1	Short-term	0.90	-9.199	-0.036	1.402	<	1.614
3	γg.G+γq.Q2	Short-term	0.90	-6.502	-0.026	0.992	<	1.614
4	γg.G+γq.Q3	Short-term	0.90	-8.447	-0.039	1.323	<	1.614
5	γg.G+γq.Q4	Short-term	0.90	-2.563	-0.037	0.583	<	1.614
6	γg.G+γq.Q5	Short-term	0.90	-2.298	-0.020	0.426	<	1.614
7	γg.G+γq.Qf	Medium-term	0.80	0.139	-0.059	0.942	<	1.435
8	γg.G+γq.Qi	Short-term	0.90	-4.646	-0.024	0.750	<	1.614
9	γg.G+γq.Q1+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-7.629	-0.072	1.464	<	1.614
10	γg.G+γq.Q1+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-7.496	-0.064	1.386	<	1.614
11	γg.G+γq.Q2+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-4.931	-0.062	1.057	<	1.614
12	γg.G+γq.Q2+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-4.798	-0.053	0.979	<	1.614
13	γg.G+γq.Q3+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-6.876	-0.074	1.387	<	1.614
14	γg.G+γq.Q3+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-6.743	-0.066	1.309	<	1.614
15	γg.G+γq.Q4+γq.ψo.Q1+γq.ψo.Qf	Short-term	0.90	-5.001	-0.074	1.156	<	1.614
16	γg.G+γq.Q4+γq.ψo.Q2+γq.ψo.Qf	Short-term	0.90	-3.383	-0.068	0.913	<	1.614
17	γg.G+γq.Q4+γq.ψo.Q3+γq.ψo.Qf	Short-term	0.90	-4.550	-0.075	1.110	<	1.614
18	γg.G+γq.Q5+γq.ψo.Q1+γq.ψo.Qf	Short-term	0.90	-4.736	-0.057	0.999	<	1.614
19	γg.G+γq.Q5+γq.ψo.Q2+γq.ψo.Qf	Short-term	0.90	-3.117	-0.051	0.755	<	1.614
20	γg.G+γq.Q5+γq.ψo.Q3+γq.ψo.Qf	Short-term	0.90	-4.284	-0.058	0.953	<	1.614
21	γg.G+γq.Qf+γq.ψo.Q1+γq.ψo.Q4	Short-term	0.90	-4.139	-0.077	1.076	<	1.614
22	γg.G+γq.Qf+γq.ψo.Q1+γq.ψo.Q5	Short-term	0.90	-4.006	-0.069	0.997	<	1.614
23	γg.G+γq.Qf+γq.ψo.Q2+γq.ψo.Q4	Short-term	0.90	-2.520	-0.071	0.835	<	1.614
24	γg.G+γq.Qf+γq.ψo.Q2+γq.ψo.Q5	Short-term	0.90	-2.387	-0.062	0.756	<	1.614
25	γg.G+γq.Qf+γq.ψo.Q3+γq.ψo.Q4	Short-term	0.90	-3.687	-0.078	1.031	<	1.614
26	γg.G+γq.Qf+γq.ψo.Q3+γq.ψo.Q5	Short-term	0.90	-3.554	-0.070	0.952	<	1.614
27	γg.G+γq.Qi+γq.ψo.Q1+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-7.216	-0.070	1.399	<	1.614
28	γg.G+γq.Qi+γq.ψo.Q1+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-7.083	-0.062	1.321	<	1.614
29	γg.G+γq.Qi+γq.ψo.Q2+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-5.597	-0.064	1.154	<	1.614
30	γg.G+γq.Qi+γq.ψo.Q2+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-5.465	-0.055	1.076	<	1.614
31	γg.G+γq.Qi+γq.ψo.Q3+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-6.764	-0.071	1.353	<	1.614
32	γg.G+γq.Qi+γq.ψo.Q3+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-6.632	-0.063	1.275	<	1.614

Check capacity of connection plate

L.C.	Load combination	duration class	kmod	Fa(kN)	Ma(kNm)	σ		$\sigma d (N/mm^2)$
1	γg.G	Permanent	0.60	-2.298	-0.020	15	<	131
2	γg.G+γq.Q1	Short-term	0.90	-9.199	-0.036	46	<	196
3	γg.G+γq.Q2	Short-term	0.90	-6.502	-0.026	33	<	196
4	γg.G+γq.Q3	Short-term	0.90	-8.447	-0.039	44	<	196
5	γg.G+γq.Q4	Short-term	0.90	-2.563	-0.037	22	<	196
6	γg.G+γq.Q5	Short-term	0.90	-2.298	-0.020	15	<	196
7	γg.G+γq.Qf	Medium-term	0.80	0.139	-0.059	40	<	175
8	γg.G+γq.Qi	Short-term	0.90	-4.646	-0.024	25	<	196
9	γg.G+γq.Q1+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-7.629	-0.072	52	<	196
10	γg.G+γq.Q1+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-7.496	-0.064	49	<	196
11	γg.G+γq.Q2+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-4.931	-0.062	39	<	196
12	γg.G+γq.Q2+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-4.798	-0.053	35	<	196
13	γg.G+γq.Q3+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-6.876	-0.074	50	<	196
14	γg.G+γq.Q3+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-6.743	-0.066	47	<	196
15	γg.G+γq.Q4+γq.ψo.Q1+γq.ψo.Qf	Short-term	0.90	-5.001	-0.074	43	<	196
16	γg.G+γq.Q4+γq.ψo.Q2+γq.ψo.Qf	Short-term	0.90	-3.383	-0.068	35	<	196
17	γg.G+γq.Q4+γq.ψo.Q3+γq.ψo.Qf	Short-term	0.90	-4.550	-0.075	42	<	196
18	γg.G+γq.Q5+γq.ψo.Q1+γq.ψo.Qf	Short-term	0.90	-4.736	-0.057	36	<	196
19	γg.G+γq.Q5+γq.ψo.Q2+γq.ψo.Qf	Short-term	0.90	-3.117	-0.051	28	<	196
20	γg.G+γq.Q5+γq.ψo.Q3+γq.ψo.Qf	Short-term	0.90	-4.284	-0.058	35	<	196
21	γg.G+γq.Qf+γq.ψo.Q1+γq.ψo.Q4	Short-term	0.90	-4.139	-0.077	41	<	196
22	γg.G+γq.Qf+γq.ψo.Q1+γq.ψo.Q5	Short-term	0.90	-4.006	-0.069	37	<	196
23	γg.G+γq.Qf+γq.ψo.Q2+γq.ψo.Q4	Short-term	0.90	-2.520	-0.071	33	<	196
24	γg.G+γq.Qf+γq.ψo.Q2+γq.ψo.Q5	Short-term	0.90	-2.387	-0.062	29	<	196
25	γg.G+γq.Qf+γq.ψo.Q3+γq.ψo.Q4	Short-term	0.90	-3.687	-0.078	39	<	196
26	γg.G+γq.Qf+γq.ψo.Q3+γq.ψo.Q5	Short-term	0.90	-3.554	-0.070	36	<	196
27	γg.G+γq.Qi+γq.ψo.Q1+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-7.216	-0.070	50	<	196
28	γg.G+γq.Qi+γq.ψo.Q1+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-7.083	-0.062	47	<	196
29	γg.G+γq.Qi+γq.ψo.Q2+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-5.597	-0.064	42	<	196
30	γg.G+γq.Qi+γq.ψo.Q2+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-5.465	-0.055	38	<	196
31	γg.G+γq.Qi+γq.ψo.Q3+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-6.764	-0.071	49	<	196
32	γg.G+γq.Qi+γq.ψo.Q3+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-6.632	-0.063	45	<	196

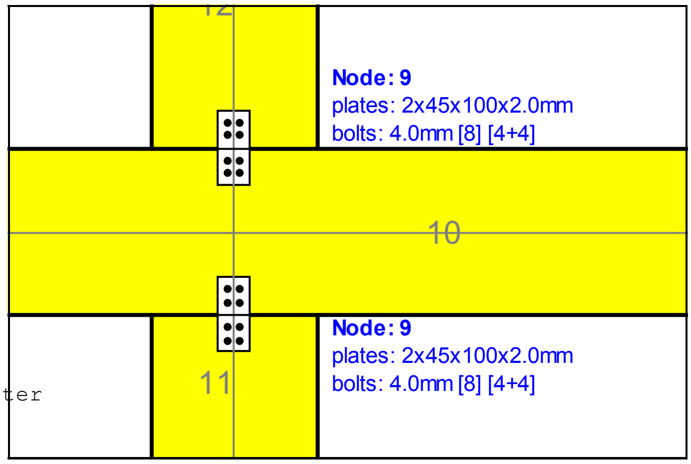
1.11.10. Ultimate limit state

Design of bolted connection at node : 9 (EC5 EN1995-1-1:2009, §8.5)

Connection with double (2) metal plates on the two faces of the truss.

Connection check of element 12, with elements 9 and 10, at node 9

Fastener characteristics:
Two(2) metal 2.0 mm plates with dimensions
BxH=100mmx45mm, and thickness 2.0mm
Bolts with diameter d=4.0mm,
4 bolts on each of the connected elements
Distance between bolts a1=28 mm, a2=16 mm
Yield strength for plate steel fy=240 N/mm^2
Net plate area (minus holes) Anet=(0.75)·b·t
Fa= force at the center of the connection
Ma= moment at the center of the connection
Maximum force at corner bolt Fn=Fa/n+Ma/Wp
n: number of bolts, a: bolt section area
A=nxa: total area of bolts
r: distance of corner bolt from connection center
Wp: section modulus of connection
n= 4, (nef=1.00n), A=50mm^2, r=18mm, Wp =811mm^3
σ and σd plate normal and bearing stress N/mm^2



Forces at node 9 ,from element 12, at the center of the joint F(force) M(moment)

Check capacity of connection

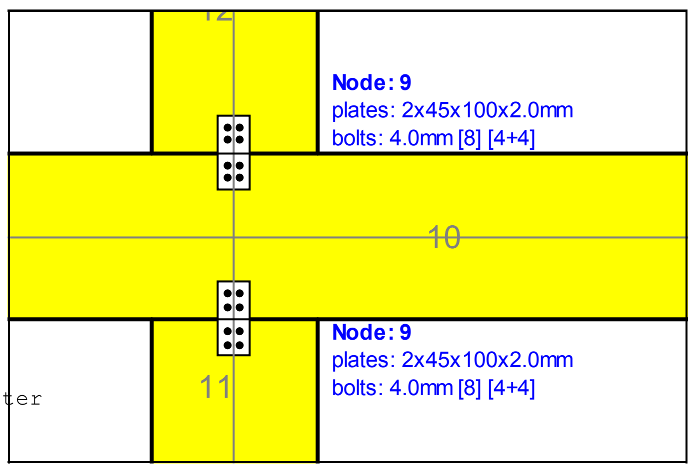
L.C.	Load combination	duration class	kmod	Fa(kN)	Ma(kNm)	Fn(kN)		Rd(kN)
1	γg.G	Permanent	0.60	-2.303	0.006	0.328	<	1.076
2	γg.G+γq.Q1	Short-term	0.90	-9.215	0.016	1.263	<	1.614
3	γg.G+γq.Q2	Short-term	0.90	-6.509	0.010	0.880	<	1.614
4	γg.G+γq.Q3	Short-term	0.90	-8.465	0.018	1.178	<	1.614
5	γg.G+γq.Q4	Short-term	0.90	-2.577	0.013	0.414	<	1.614
6	γg.G+γq.Q5	Short-term	0.90	-2.303	0.006	0.328	<	1.614
7	γg.G+γq.Qf	Medium-term	0.80	0.125	0.012	0.215	<	1.435
8	γg.G+γq.Qi	Short-term	0.90	-4.653	0.009	0.641	<	1.614
9	γg.G+γq.Q1+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-7.653	0.024	1.124	<	1.614
10	γg.G+γq.Q1+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-7.515	0.021	1.081	<	1.614
11	γg.G+γq.Q2+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-4.947	0.018	0.741	<	1.614
12	γg.G+γq.Q2+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-4.810	0.014	0.699	<	1.614
13	γg.G+γq.Q3+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-6.902	0.026	1.040	<	1.614
14	γg.G+γq.Q3+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-6.765	0.022	0.997	<	1.614
15	γg.G+γq.Q4+γq.ψo.Q1+γq.ψo.Qf	Short-term	0.90	-5.025	0.024	0.793	<	1.614
16	γg.G+γq.Q4+γq.ψo.Q2+γq.ψo.Qf	Short-term	0.90	-3.401	0.020	0.564	<	1.614
17	γg.G+γq.Q4+γq.ψo.Q3+γq.ψo.Qf	Short-term	0.90	-4.575	0.025	0.743	<	1.614
18	γg.G+γq.Q5+γq.ψo.Q1+γq.ψo.Qf	Short-term	0.90	-4.751	0.016	0.708	<	1.614
19	γg.G+γq.Q5+γq.ψo.Q2+γq.ψo.Qf	Short-term	0.90	-3.127	0.013	0.478	<	1.614
20	γg.G+γq.Q5+γq.ψo.Q3+γq.ψo.Qf	Short-term	0.90	-4.301	0.017	0.657	<	1.614
21	γg.G+γq.Qf+γq.ψo.Q1+γq.ψo.Q4	Short-term	0.90	-4.159	0.022	0.673	<	1.614
22	γg.G+γq.Qf+γq.ψo.Q1+γq.ψo.Q5	Short-term	0.90	-4.022	0.018	0.630	<	1.614
23	γg.G+γq.Qf+γq.ψo.Q2+γq.ψo.Q4	Short-term	0.90	-2.536	0.018	0.444	<	1.614
24	γg.G+γq.Qf+γq.ψo.Q2+γq.ψo.Q5	Short-term	0.90	-2.399	0.014	0.401	<	1.614
25	γg.G+γq.Qf+γq.ψo.Q3+γq.ψo.Q4	Short-term	0.90	-3.709	0.023	0.623	<	1.614
26	γg.G+γq.Qf+γq.ψo.Q3+γq.ψo.Q5	Short-term	0.90	-3.572	0.019	0.580	<	1.614
27	γg.G+γq.Qi+γq.ψo.Q1+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-7.238	0.023	1.064	<	1.614
28	γg.G+γq.Qi+γq.ψo.Q1+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-7.101	0.019	1.021	<	1.614
29	γg.G+γq.Qi+γq.ψo.Q2+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-5.614	0.019	0.834	<	1.614
30	γg.G+γq.Qi+γq.ψo.Q2+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-5.477	0.016	0.791	<	1.614
31	γg.G+γq.Qi+γq.ψo.Q3+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-6.788	0.024	1.013	<	1.614
32	γg.G+γq.Qi+γq.ψo.Q3+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-6.651	0.020	0.970	<	1.614

Check capacity of connection plate

L.C.	Load combination	duration class	kmod	Fa(kN)	Ma(kNm)	σ		σd(N/mm²)
1	γg.G	Permanent	0.60	-2.303	0.006	10	<	131
2	γg.G+γq.Q1	Short-term	0.90	-9.215	0.016	39	<	196
3	γg.G+γq.Q2	Short-term	0.90	-6.509	0.010	27	<	196
4	γg.G+γq.Q3	Short-term	0.90	-8.465	0.018	37	<	196
5	γg.G+γq.Q4	Short-term	0.90	-2.577	0.013	14	<	196
6	γg.G+γq.Q5	Short-term	0.90	-2.303	0.006	10	<	196
7	γg.G+γq.Qf	Medium-term	0.80	0.125	0.012	9	<	175
8	γg.G+γq.Qi	Short-term	0.90	-4.653	0.009	20	<	196
9	γg.G+γq.Q1+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-7.653	0.024	36	<	196
10	γg.G+γq.Q1+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-7.515	0.021	35	<	196
11	γg.G+γq.Q2+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-4.947	0.018	24	<	196
12	γg.G+γq.Q2+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-4.810	0.014	22	<	196
13	γg.G+γq.Q3+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-6.902	0.026	34	<	196
14	γg.G+γq.Q3+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-6.765	0.022	32	<	196
15	γg.G+γq.Q4+γq.ψo.Q1+γq.ψo.Qf	Short-term	0.90	-5.025	0.024	26	<	196
16	γg.G+γq.Q4+γq.ψo.Q2+γq.ψo.Qf	Short-term	0.90	-3.401	0.020	19	<	196
17	γg.G+γq.Q4+γq.ψo.Q3+γq.ψo.Qf	Short-term	0.90	-4.575	0.025	25	<	196
18	γg.G+γq.Q5+γq.ψo.Q1+γq.ψo.Qf	Short-term	0.90	-4.751	0.016	23	<	196
19	γg.G+γq.Q5+γq.ψo.Q2+γq.ψo.Qf	Short-term	0.90	-3.127	0.013	16	<	196
20	γg.G+γq.Q5+γq.ψo.Q3+γq.ψo.Qf	Short-term	0.90	-4.301	0.017	22	<	196
21	γg.G+γq.Qf+γq.ψo.Q1+γq.ψo.Q4	Short-term	0.90	-4.159	0.022	23	<	196
22	γg.G+γq.Qf+γq.ψo.Q1+γq.ψo.Q5	Short-term	0.90	-4.022	0.018	21	<	196
23	γg.G+γq.Qf+γq.ψo.Q2+γq.ψo.Q4	Short-term	0.90	-2.536	0.018	15	<	196
24	γg.G+γq.Qf+γq.ψo.Q2+γq.ψo.Q5	Short-term	0.90	-2.399	0.014	14	<	196
25	γg.G+γq.Qf+γq.ψo.Q3+γq.ψo.Q4	Short-term	0.90	-3.709	0.023	21	<	196
26	γg.G+γq.Qf+γq.ψo.Q3+γq.ψo.Q5	Short-term	0.90	-3.572	0.019	20	<	196
27	γg.G+γq.Qi+γq.ψo.Q1+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-7.238	0.023	34	<	196
28	γg.G+γq.Qi+γq.ψo.Q1+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-7.101	0.019	33	<	196
29	γg.G+γq.Qi+γq.ψo.Q2+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-5.614	0.019	27	<	196
30	γg.G+γq.Qi+γq.ψo.Q2+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-5.477	0.016	25	<	196
31	γg.G+γq.Qi+γq.ψo.Q3+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-6.788	0.024	33	<	196
32	γg.G+γq.Qi+γq.ψo.Q3+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-6.651	0.020	31	<	196

Connection check of element 11, with elements 9 and 10, at node 9

Fastener characteristics:
Two(2) metal 2.0 mm plates with dimensions
BxH=100mmx45mm, and thickness 2.0mm
Bolts with diameter d=4.0mm,
4 bolts on each of the connected elements
Distance between bolts a1=28 mm, a2=16 mm
Yield strength for plate steel fy=240 N/mm²
Net plate area (minus holes) Anet=(0.75)·b·t
Fa= force at the center of the connection
Ma= moment at the center of the connection
Maximum force at corner bolt Fn=Fa/n+Ma/Wp
n: number of bolts, a: bolt section area
A=nxa: total area of bolts
r: distance of corner bolt from connection center
Wp: section modulus of connection
n= 4, (nef=1.00n), A=50mm², r=18mm, Wp =811mm³
σ and σd plate normal and bearing stress N/mm²



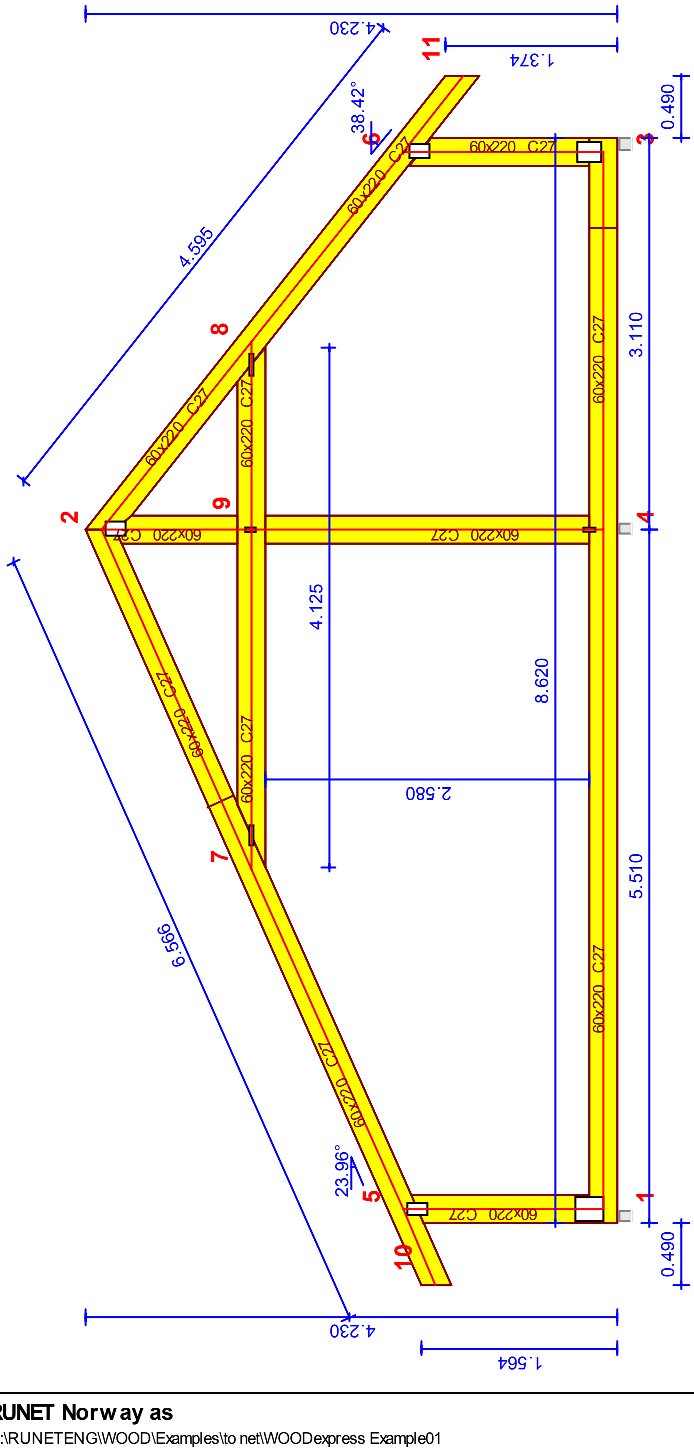
Forces at node 9 ,from element 11, at the center of the joint F(force) M(moment)

Check capacity of connection

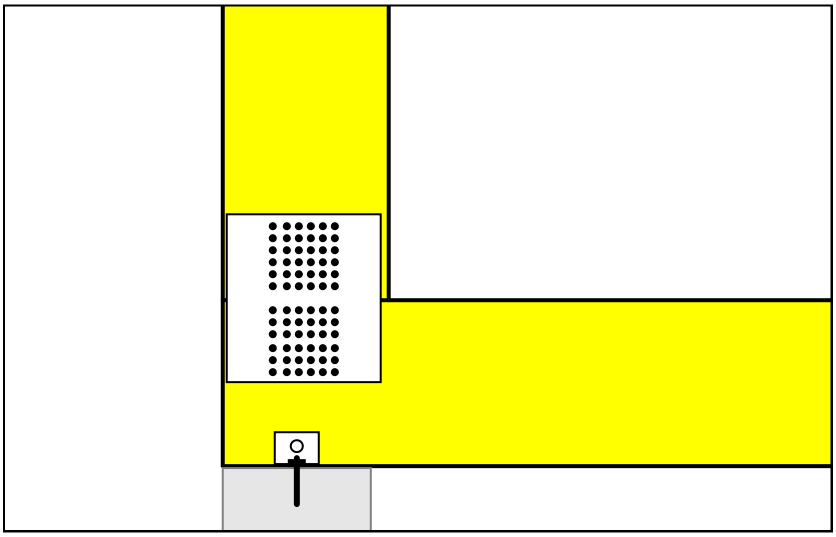
L.C.	Load combination	duration class	kmod	Fa(kN)	Ma(kNm)	Fn(kN)		Rd(kN)
1	γg.G	Permanent	0.60	-2.298	-0.012	0.374	<	1.076
2	γg.G+γq.Q1	Short-term	0.90	-9.199	-0.035	1.390	<	1.614
3	γg.G+γq.Q2	Short-term	0.90	-6.502	-0.021	0.955	<	1.614
4	γg.G+γq.Q3	Short-term	0.90	-8.447	-0.038	1.316	<	1.614
5	γg.G+γq.Q4	Short-term	0.90	-2.563	-0.029	0.524	<	1.614
6	γg.G+γq.Q5	Short-term	0.90	-2.298	-0.012	0.374	<	1.614
7	γg.G+γq.Qf	Medium-term	0.80	0.139	-0.026	0.441	<	1.435
8	γg.G+γq.Qi	Short-term	0.90	-4.646	-0.019	0.710	<	1.614
9	γg.G+γq.Q1+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-7.629	-0.052	1.321	<	1.614
10	γg.G+γq.Q1+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-7.496	-0.044	1.247	<	1.614
11	γg.G+γq.Q2+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-4.931	-0.038	0.887	<	1.614
12	γg.G+γq.Q2+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-4.798	-0.030	0.812	<	1.614
13	γg.G+γq.Q3+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-6.876	-0.055	1.249	<	1.614
14	γg.G+γq.Q3+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-6.743	-0.047	1.174	<	1.614
15	γg.G+γq.Q4+γq.ψo.Q1+γq.ψo.Qf	Short-term	0.90	-5.001	-0.052	0.991	<	1.614
16	γg.G+γq.Q4+γq.ψo.Q2+γq.ψo.Qf	Short-term	0.90	-3.383	-0.043	0.732	<	1.614
17	γg.G+γq.Q4+γq.ψo.Q3+γq.ψo.Qf	Short-term	0.90	-4.550	-0.053	0.949	<	1.614
18	γg.G+γq.Q5+γq.ψo.Q1+γq.ψo.Qf	Short-term	0.90	-4.736	-0.035	0.841	<	1.614
19	γg.G+γq.Q5+γq.ψo.Q2+γq.ψo.Qf	Short-term	0.90	-3.117	-0.027	0.581	<	1.614
20	γg.G+γq.Q5+γq.ψo.Q3+γq.ψo.Qf	Short-term	0.90	-4.284	-0.037	0.798	<	1.614
21	γg.G+γq.Qf+γq.ψo.Q1+γq.ψo.Q4	Short-term	0.90	-4.139	-0.048	0.857	<	1.614
22	γg.G+γq.Qf+γq.ψo.Q1+γq.ψo.Q5	Short-term	0.90	-4.006	-0.040	0.781	<	1.614
23	γg.G+γq.Qf+γq.ψo.Q2+γq.ψo.Q4	Short-term	0.90	-2.520	-0.039	0.598	<	1.614
24	γg.G+γq.Qf+γq.ψo.Q2+γq.ψo.Q5	Short-term	0.90	-2.387	-0.031	0.521	<	1.614
25	γg.G+γq.Qf+γq.ψo.Q3+γq.ψo.Q4	Short-term	0.90	-3.687	-0.049	0.814	<	1.614
26	γg.G+γq.Qf+γq.ψo.Q3+γq.ψo.Q5	Short-term	0.90	-3.554	-0.041	0.739	<	1.614
27	γg.G+γq.Qi+γq.ψo.Q1+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-7.216	-0.050	1.251	<	1.614
28	γg.G+γq.Qi+γq.ψo.Q1+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-7.083	-0.042	1.176	<	1.614
29	γg.G+γq.Qi+γq.ψo.Q2+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-5.597	-0.041	0.990	<	1.614
30	γg.G+γq.Qi+γq.ψo.Q2+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-5.465	-0.033	0.916	<	1.614
31	γg.G+γq.Qi+γq.ψo.Q3+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-6.764	-0.051	1.208	<	1.614
32	γg.G+γq.Qi+γq.ψo.Q3+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-6.632	-0.043	1.133	<	1.614

Check capacity of connection plate

L.C.	Load combination	duration class	kmod	Fa(kN)	Ma(kNm)	σ		σd(N/mm²)
1	γg.G	Permanent	0.60	-2.298	-0.012	13	<	131
2	γg.G+γq.Q1	Short-term	0.90	-9.199	-0.035	45	<	196
3	γg.G+γq.Q2	Short-term	0.90	-6.502	-0.021	31	<	196
4	γg.G+γq.Q3	Short-term	0.90	-8.447	-0.038	44	<	196
5	γg.G+γq.Q4	Short-term	0.90	-2.563	-0.029	19	<	196
6	γg.G+γq.Q5	Short-term	0.90	-2.298	-0.012	13	<	196
7	γg.G+γq.Qf	Medium-term	0.80	0.139	-0.026	18	<	175
8	γg.G+γq.Qi	Short-term	0.90	-4.646	-0.019	23	<	196
9	γg.G+γq.Q1+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-7.629	-0.052	46	<	196
10	γg.G+γq.Q1+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-7.496	-0.044	42	<	196
11	γg.G+γq.Q2+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-4.931	-0.038	31	<	196
12	γg.G+γq.Q2+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-4.798	-0.030	28	<	196
13	γg.G+γq.Q3+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-6.876	-0.055	44	<	196
14	γg.G+γq.Q3+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-6.743	-0.047	41	<	196
15	γg.G+γq.Q4+γq.ψo.Q1+γq.ψo.Qf	Short-term	0.90	-5.001	-0.052	36	<	196
16	γg.G+γq.Q4+γq.ψo.Q2+γq.ψo.Qf	Short-term	0.90	-3.383	-0.043	27	<	196
17	γg.G+γq.Q4+γq.ψo.Q3+γq.ψo.Qf	Short-term	0.90	-4.550	-0.053	34	<	196
18	γg.G+γq.Q5+γq.ψo.Q1+γq.ψo.Qf	Short-term	0.90	-4.736	-0.035	29	<	196
19	γg.G+γq.Q5+γq.ψo.Q2+γq.ψo.Qf	Short-term	0.90	-3.117	-0.027	20	<	196
20	γg.G+γq.Q5+γq.ψo.Q3+γq.ψo.Qf	Short-term	0.90	-4.284	-0.037	28	<	196
21	γg.G+γq.Qf+γq.ψo.Q1+γq.ψo.Q4	Short-term	0.90	-4.139	-0.048	31	<	196
22	γg.G+γq.Qf+γq.ψo.Q1+γq.ψo.Q5	Short-term	0.90	-4.006	-0.040	28	<	196
23	γg.G+γq.Qf+γq.ψo.Q2+γq.ψo.Q4	Short-term	0.90	-2.520	-0.039	22	<	196
24	γg.G+γq.Qf+γq.ψo.Q2+γq.ψo.Q5	Short-term	0.90	-2.387	-0.031	19	<	196
25	γg.G+γq.Qf+γq.ψo.Q3+γq.ψo.Q4	Short-term	0.90	-3.687	-0.049	30	<	196
26	γg.G+γq.Qf+γq.ψo.Q3+γq.ψo.Q5	Short-term	0.90	-3.554	-0.041	27	<	196
27	γg.G+γq.Qi+γq.ψo.Q1+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-7.216	-0.050	43	<	196
28	γg.G+γq.Qi+γq.ψo.Q1+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-7.083	-0.042	40	<	196
29	γg.G+γq.Qi+γq.ψo.Q2+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-5.597	-0.041	34	<	196
30	γg.G+γq.Qi+γq.ψo.Q2+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-5.465	-0.033	31	<	196
31	γg.G+γq.Qi+γq.ψo.Q3+γq.ψo.Q4+γq.ψo.Qf	Short-term	0.90	-6.764	-0.051	42	<	196
32	γg.G+γq.Qi+γq.ψo.Q3+γq.ψo.Q5+γq.ψo.Qf	Short-term	0.90	-6.632	-0.043	39	<	196


4.230
1.374
0.490
38.42°
4.595
60x220 C27
3.110
4.125
8.620
2.580
6.566
5.510
23.96°
1.564
1
2
3
4
5
6
7
8
9
10
11

Scale 1:60

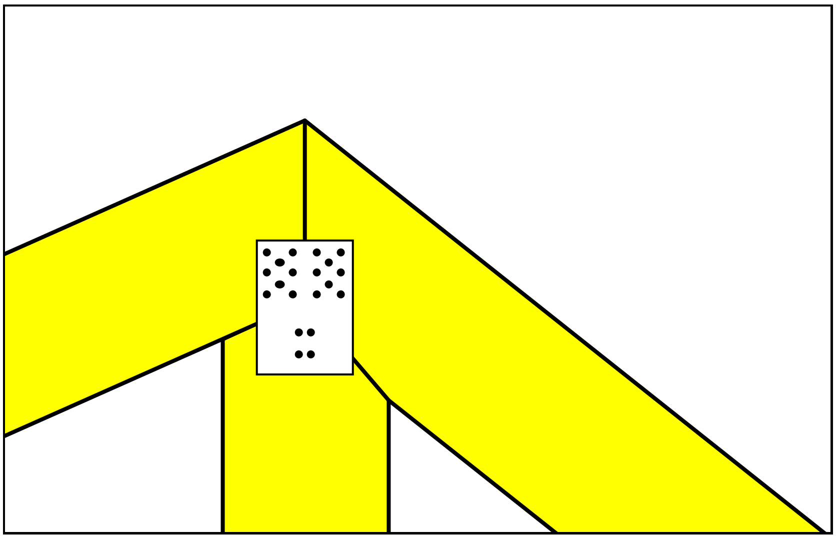


Connection at node 1

(node at x=0.000 m, y=0.000 m)

plates: 2x205x225x2.0mm

bolts: 4.0mm [72] [36+36]

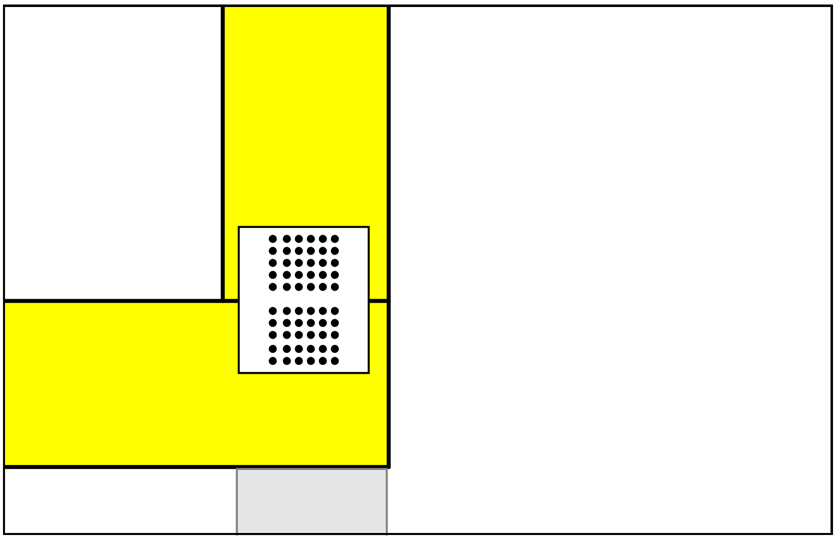


Connection at node 2

(node at x=5.400 m, y=3.873 m)

plates: 2x130x180x2.0mm

bolts: 4.0mm [20] [8+4+8]

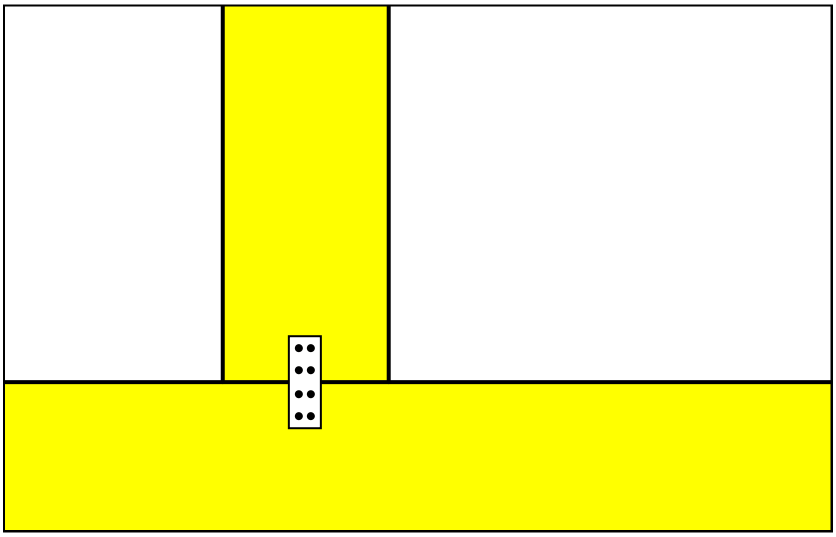


Connection at node 3

(node at x=8.400 m, y=0.000 m)

plates: 2x175x195x2.0mm

bolts: 4.0mm [60] [30+30]

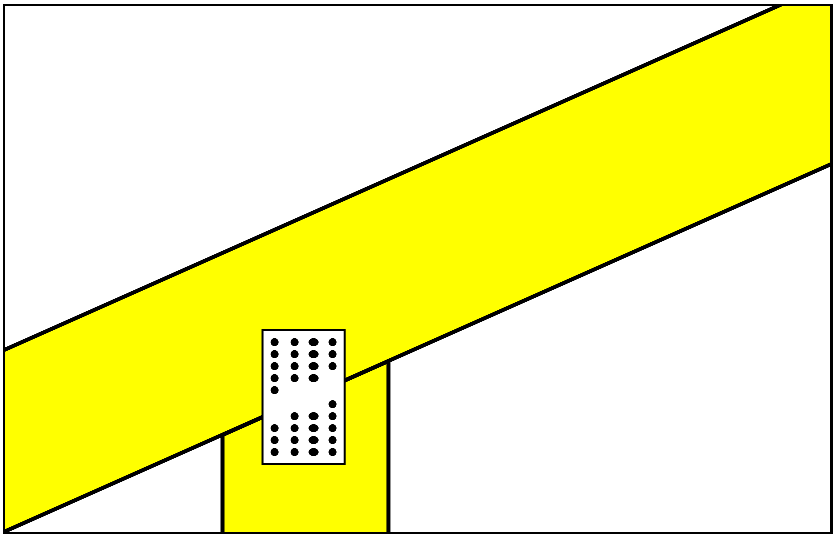


Connection at node 4

(node at x=5.400 m, y=0.110 m)

plates: 2x45x125x2.0mm

bolts: 4.0mm [8] [4+4]

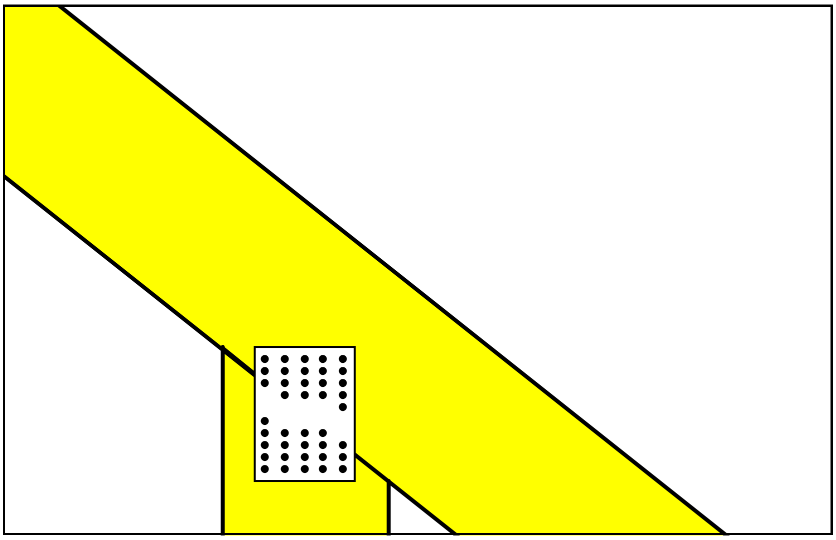


Connection at node 5

(node at x=0.000 m, y=1.600 m)

plates: 2x110x180x2.0mm

bolts: 4.0mm [32] [16+16]

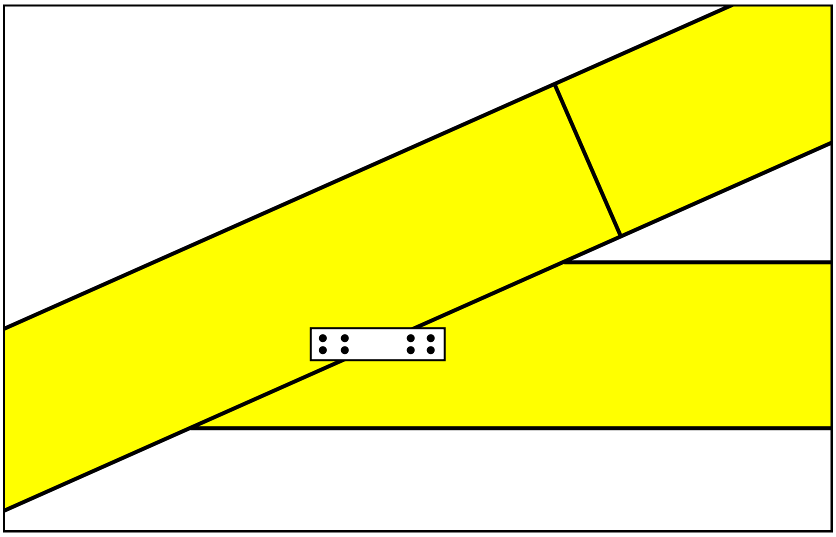


Connection at node 6

(node at x=8.400 m, y=1.600 m)

plates: 2x135x180x2.0mm

bolts: 4.0mm [40] [20+20]

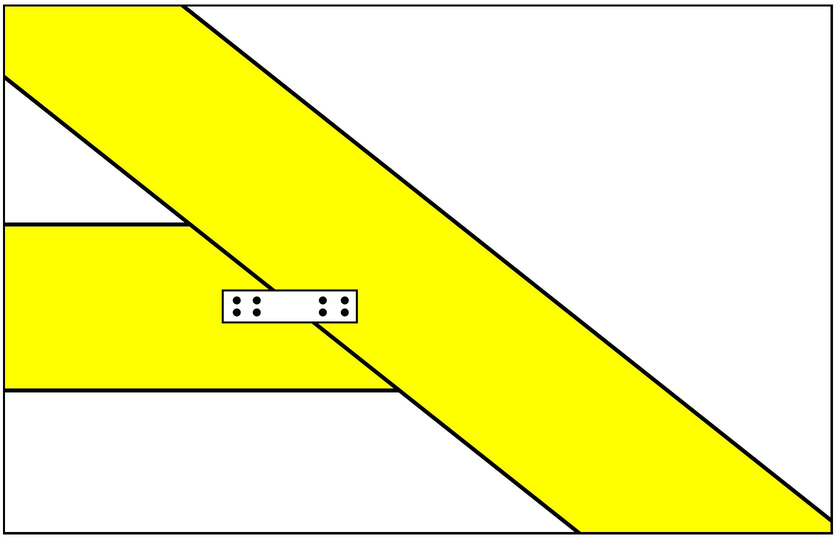


Connection at node 7

(node at x=2.524 m, y=2.800 m)

plates: 2x180x45x2.0mm

bolts: 4.0mm [8] [4+4]

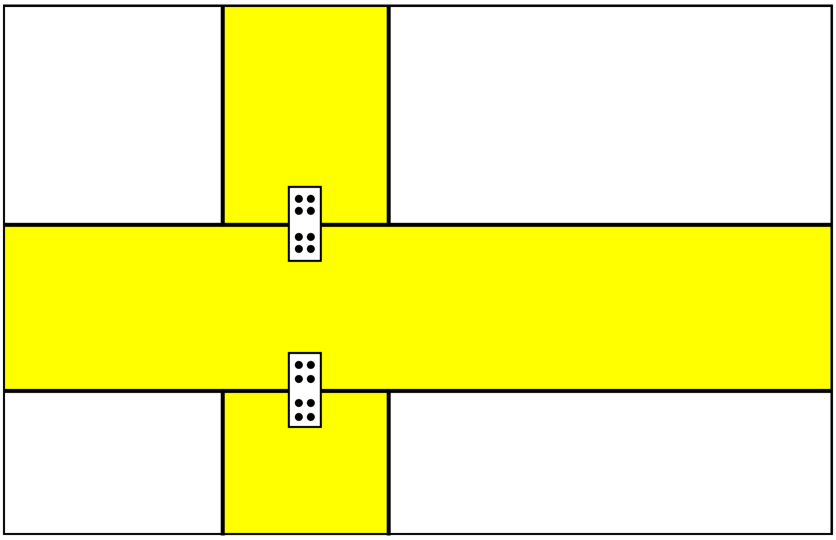


Connection at node 8

(node at x=6.724 m, y=2.800 m)

plates: 2x180x45x2.0mm

bolts: 4.0mm [8] [4+4]

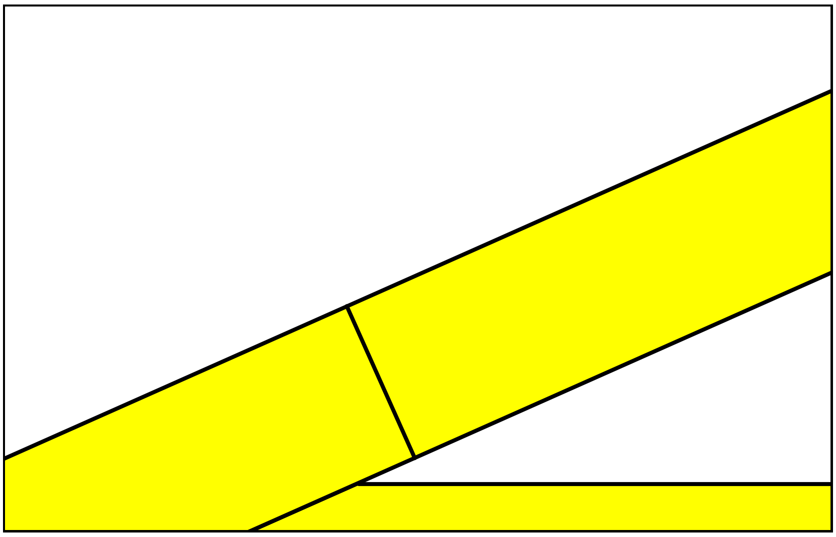


Connection at node 9

(node at x=5.400 m, y=2.800 m)

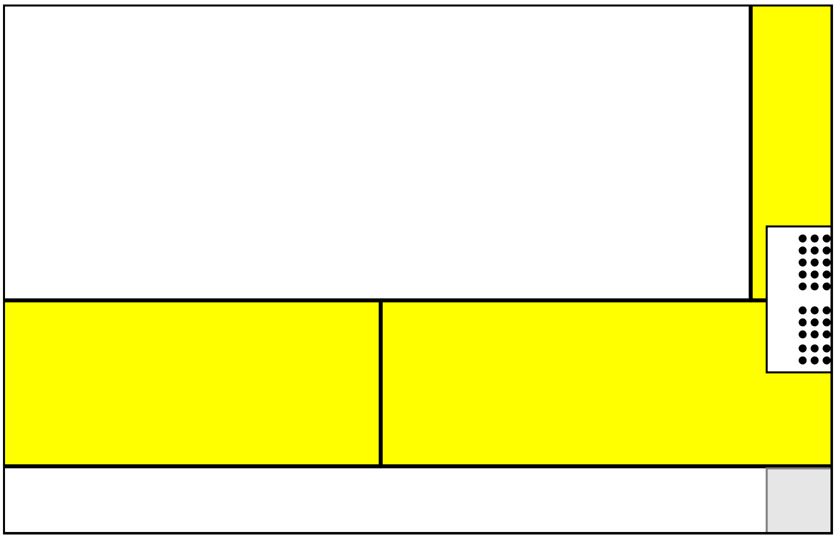
plates: 2x45x100x2.0mm

bolts: 4.0mm [8] [4+4]



Element splice

(at x=3.248 m, y=3.044 m)



Element splice

(at x=7.800 m, y=0.000 m)