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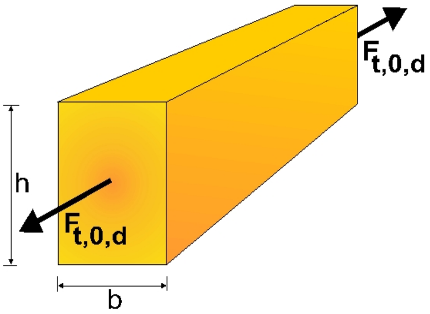
Example of ULS

1. SECT.-001

ULTIMATE LIMIT STATE, Tension
(EC5 EN1995-1-1:2009, §6.1.2)



1.1. Structural design (EC5 EN1995-1-1:2009, §6)

Material properties (EC5 EN1995-1-1:2009, §3)
Timber class : GL24h
Service classes : Class 1, moisture content<=12% (§2.3.1.
Material factor γM=1.25 (EC5 Table 2.3)
Load duration classes : Permanent (Table 2.1)

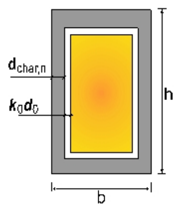
Cross section properties (EC5 EN1995-1-1:2009, §2.4.2)
Rectangular cross section, b=50 mm, h=150 mm, A= 7 500 mm^2
Timber cross section reduction 0.00%, dA=0 mm^2
Effective timber cross section Anetto= 7 500 mm^2

Characteristic material properties for timber (EC5 EN1995-1-1:2009, §2, §3)
Modification factor Kmod=0.60 (EC5 Table 3.1)
Material factor γM=1.25 (EC5 Table 2.3)
ft0k=16.50 N/mm^2, ft0d=Kmod·ft0k/γM=0.60x16.50/1.25=7.92N/mm^2 (EC5 Eq.2.14)

Cross section loads
Ft0d=10.000 kN

Tension parallel to the grain (EC5 EN1995-1-1:2009, §6.1.2)
σt0d=Ft0d/Anetto=1000x10.000/7500=1.33N/mm^2 < 7.92N/mm^2=ft0d (EC5 Eq.6.1)
The check is satisfied
Percent of cross section used =17%

1.2. Structural Fire design (EC5 EN1995-1-2:2004)



Exposure to a standard fire for 10 minutes.
Glulam GL24h with a characteristic density 380kg/m^3
The notional charring rate is βn=0.80 mm/min (EN1995-1-2, Table 3.1)
Charring depth dchar,n=βn·t=0.80x10=8 mm (EN1995-1-2, Eq.3.2)

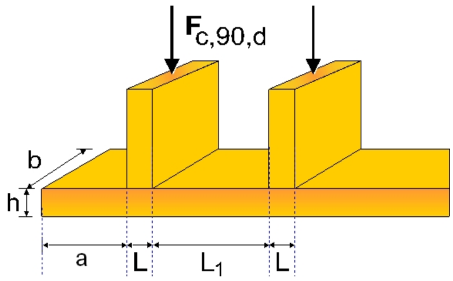
Design based on reduced cross-section method (EC5 EN1995-1-2:2004, §4.2.2)
Effective charring depth def=dchar,n+ko·do, do=7mm (EN1995-1-2, Eq.4.1)
For unprotected surfaces and t<20 min, ko=t/20=10/20=0.50, (EN1995-1-2, Table 4.1)
def=8+0.50x7=12 mm, reduced cross section BfxHf=26x126 mm

Strength check of reduced cross-section (EC5 EN1995-1-2:2004, §2.3)
Kmod,fi=1.00, (EN1995-1-2, §4.2.2 (5)), γM,fi=1.00 (§2.3 N. 2)
Coefficient for the 20% fractile of strength kfi=1.15 (EN1995-1-2, Table 2.1)

Tension parallel to the grain (EC5 EN1995-1-1:2009, §6.1.2)
Rectangular cross section, bf=26 mm, hf=126 mm, A=1.00x26x126= 3 276 mm^2
ft0k=16.50N/mm^2, ft0d,fi=Kmod,fi.Kfi.ft0k/γM,fi=1.00x1.15x16.50/1.00=18.98N/mm^2 (EN1995-1-2, Eq.2.1
σt0d=Ft0d/Anetto=1000x10.000/3276=3.05N/mm^2 < 18.98N/mm^2=ft0d,fi (EC5 Eq.6.1)
The structural fire design check is satisfied

2. SECT.-002

ULTIMATE LIMIT STATE, Compression perpendicular to the gra
(EC5 EN1995-1-1:2009, §6.1.5)



Material properties (EC5 EN1995-1-1:2009, §3)
Timber class : C24
Service classes : Class 1, moisture content<=12% (§2.3.1.
Material factor γM=1.30 (EC5 Table 2.3)
Load duration classes : Permanent (Table 2.1)

Cross section properties (EC5 EN1995-1-1:2009, §2.4.2)
Rectangular loaded area, b=200 mm, L=100 mm, A= 20 000 mm²
Reduction of loaded area 0.00%, dA=0 mm²
Effective loaded area Anetto= 20 000 mm²

Characteristic material properties for timber (EC5 EN1995-1-1:2009, §2, §3)
Modification factor Kmod=0.60 (EC5 Table 3.1)
Material factor γM=1.30 (EC5 Table 2.3)
fc90k=2.50 N/mm², fc90d=Kmod·fc90k/γM=0.60x2.50/1.30=1.15N/mm² (EC5 Eq.2.14)

Cross section loads
Fc90d=-8.000 kN

Compression perpendicular to the grain (EC5 EN1995-1-1:2009, §6.1.5)
h=100<=2.50b=500, L=100mm, L1=150mm, a=50mm, Leff=158mm, (EC5 §6.1.5.(5)Fig. 6.3)
Kc90=(2.38-L/250)√(Lef/L) = 2.49 (EN1995-1-1 §6.1.5.(4), Eq.6.6)
σc90d=Fc90d/Anetto=1000x8.000/20000=0.40N/mm²<2.87N/mm²=2.49x1.15=Kc90xfc90d (EN1995-1-1, Eq.6.3)
The check is satisfied

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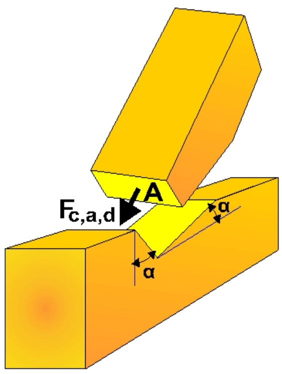
3. SECT.-003



ULTIMATE LIMIT STATE, Compression at an angle to the grain
(EC5 EN1995-1-1:2009, §6.2.2)

3.1. Structural design (EC5 EN1995-1-1:2009, §6)

Material properties (EC5 EN1995-1-1:2009, §3)
Timber class : C30
Service classes : Class 1, moisture content<=12% (§2.3.1.
Material factor γM=1.30 (EC5 Table 2.3)
Load duration classes : Permanent (Table 2.1)

Cross section properties (EC5 EN1995-1-1:2009, §2.4.2)
Rectangular loaded area, b=63 mm, h=100 mm, A= 6 300 mm²
Reduction of loaded area 0.00%, dA=0 mm²
Effective loaded area Anetto= 6 300 mm²

Characteristic material properties for timber (EC5 EN1995-1-1:2009, §2, §3)
Modification factor Kmod=0.60 (EC5 Table 3.1)
Material factor γM=1.30 (EC5 Table 2.3)
fc0k=23.00 N/mm², fc0d=Kmod·fc0k/γM=0.60x23.00/1.30=10.62N/mm² (EC5 Eq.2.14)
fc90k=2.70 N/mm², fc90d=Kmod·fc90k/γM=0.60x2.70/1.30=1.25N/mm²

Cross section loads

Fcαd=-9.000 kN, at angle α=20.00° with the grain

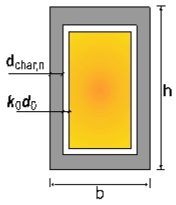
Compression at an angle to the grain (EC5 EN1995-1-1:2009, §6.2.2)

$K_{c\alpha}=1/((f_{c0d}/f_{c90d})\sin^2\alpha+\cos^2\alpha)$ = 0.53 (EC5 Eq.6.16)

$\sigma_{c\alpha d}=F_{c\alpha d}/A_{netto}=1000\text{x}9.000/6300=1.43\text{N/mm}^2 < 5.65\text{N/mm}^2=0.53\text{x}10.62=K_{c\alpha}\text{x}f_{c0d}$

The check is satisfied

3.2. Structural Fire design (EC5 EN1995-1-2:2004)



Exposure to a standard fire for 10 minutes.

Solid timber C30 with a characteristic density 380kg/m^3

The notional charring rate is βn=0.80 mm/min (EN1995-1-2, Table 3.1)

Charring depth dchar,n=βn·t=0.80x10=8 mm (EN1995-1-2, Eq.3.2)

Design based on reduced cross-section method (EC5 EN1995-1-2:2004, §4.2.2)

Effective charring depth def=dchar,n+ko·do, do=7mm (EN1995-1-2, Eq.4.1)

For unprotected surfaces and t<20 min, ko=t/20=10/20=0.50, (EN1995-1-2, Table 4.1)

def=8+0.50x7=12 mm, reduced cross section BfxHf=39x76 mm

Strength check of reduced cross-section (EC5 EN1995-1-2:2004, §2.3)

Kmod,fi=1.00, (EN1995-1-2, §4.2.2 (5)), γM,fi=1.00 (§2.3 N. 2)

Coefficient for the 20% fractile of strength kfi=1.25 (EN1995-1-2, Table 2.1)

Compression at an angle to the grain (EC5 EN1995-1-1:2009, §6.2.2)

Rectangular cross section, bf=39 mm, hf=76 mm, A=1.00x39x76= 2 964 mm^2

fc0k=23.00N/mm^2, fc0d,fi=Kmod,fi.Kfi.fc0k/γM,fi=1.00x1.25x23.00/1.00=28.75N/mm^2 (EN1995-1-2, Eq.2.1

$\sigma_{c\alpha d}=F_{c\alpha d}/A_{netto}=1000\text{x}9.000/2964=3.04\text{N/mm}^2 < 15.30\text{N/mm}^2=0.53\text{x}28.75=K_{c\alpha}\text{x}f_{c0d,fi}$

The structural fire design check is satisfied

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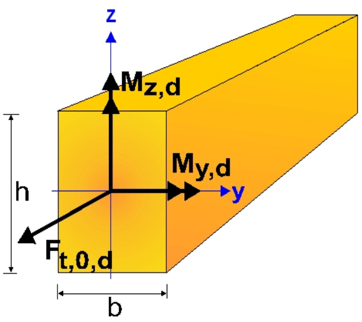
4. SECT.-004



ULTIMATE LIMIT STATE, Bending and tension

(EC5 EN1995-1-1:2009, §6.2.3)

4.1. Structural design (EC5 EN1995-1-1:2009, §6)

Material properties (EC5 EN1995-1-1:2009, §3)

Timber class : D40

Service classes : Class 2, moisture content<=20% (§2.3.1.

Material factor γM=1.30 (EC5 Table 2.3)

Load duration classes : Permanent (Table 2.1)

Cross section properties

Rectangular cross section, b=100mm, h=100mm, A=1.000E+004mm^2, Wy=1.667E+005mm^3, Wz=1.667E+005mm^3

Timber cross section reduction 0.00%, dA=0.000E+000mm^2, dWy=0.000E+000mm^3, dWz=0.000E+000mm^3

Effective cross section Anetto=1.000E+004mm^2, Wy,netto=1.667E+005mm^3, Wz,netto=1.667E+005mm^3

Characteristic material properties for timber

Modification factor Kmod=0.60 (EC5 Table 3.1)

Material factor γM=1.30 (EC5 Table 2.3)

ft0k=24.00 N/mm^2, ft0d=Kmod·ft0k/γM=0.60x24.00/1.30=11.08N/mm^2 (EN1995-1-1, Eq.2.14)

fmyk=40.00 N/mm^2, fmyd=Kmod·fmyk/γM=0.60x40.00/1.30=18.46N/mm^2

fmzk=40.00 N/mm^2, fmzd=Kmod·fmzk/γM=0.60x40.00/1.30=18.46N/mm^2

Cross section loads

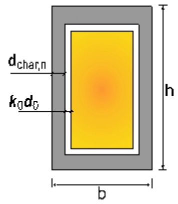
Ft0d=4.000kN, Myd=1.000kNm, Mzd=1.000kNm

Combined bending and axial tension (EN1995-1-1, §6.2.3)

Rectangular cross section Km=0.70 (EC5 EN1995-1-1:2009 §6.1.6.(2))
σt0d=Ft0d/Anetto=1000x4.000/10000= 0.40 N/mm²
σmyd=Myd/Wmy,netto=1E+06x1.000/1.667E+005= 6.00 N/mm²
σmzd=Mzd/Wmz,netto=1E+06x1.000/1.667E+005= 6.00 N/mm²

σt0d/ft0d+σmyd/fmyd+Km.σmzd/fmzd=0.036+0.325+0.227= 0.59 < 1 (EN1995-1-1, Eq.6.17)
σt0d/ft0d+Km.σmyd/fmyd+σmzd/fmzd=0.036+0.227+0.325= 0.59 < 1 (EN1995-1-1, Eq.6.18)
The check is satisfied
Percent of cross section used =59%

4.2. Structural Fire design (EC5 EN1995-1-2:2004)



Exposure to a standard fire for 10 minutes.
Solid Hardwood D40 with a characteristic density 550kg/m³
The notional charring rate is βn=0.80 mm/min (EN1995-1-2, Table 3.1)
Charring depth dchar,n=βn·t=0.80x10=8 mm (EN1995-1-2, Eq.3.2)

Design based on reduced cross-section method (EC5 EN1995-1-2:2004, §4.2.2)

Effective charring depth def=dchar,n+ko·do, do=7mm (EN1995-1-2, Eq.4.1)
For unprotected surfaces and t<20 min, ko=t/20=10/20=0.50, (EN1995-1-2, Table 4.1)
def=8+0.50x7=12 mm, reduced cross section BfxHf=76x76 mm

Strength check of reduced cross-section (EC5 EN1995-1-2:2004, §2.3)

Kmod,fi=1.00, (EN1995-1-2, §4.2.2 (5)), γM,fi=1.00 (§2.3 N. 2)
Coefficient for the 20% fractile of strength kfi=1.25 (EN1995-1-2, Table 2.1)

Compression perpendicular to the grain (EC5 EN1995-1-1:2009, §6.1.5)

Rectangular cross section, bf=76mm, hf=76mm, A=5.776E+003mm², Wy=7.316E+004mm³, Wz=7.316E+004mm³
ft0k=24.00N/mm², ft0d,fi=Kmod,fi.Kfi.ft0k/γM,fi=1.00x1.25x24.00/1.00=30.00N/mm² (EN1995-1-2, Eq.2.1
fmyk=40.00N/mm², fmyd,fi=Kmod,fi.Kfi.fmyk/γM,fi=1.00x1.25x40.00/1.00=50.00N/mm² (EN1995-1-2, Eq.2.1
fmzk=40.00N/mm², fmzd,fi=Kmod,fi.Kfi.fmzk/γM,fi=1.00x1.25x40.00/1.00=50.00N/mm²

σt0d=Ft0d/Anetto=1000x4.000/5776= 0.69 N/mm²
σmyd=Myd/Wmy,netto=1E+06x1.000/7.316E+004=13.67 N/mm²
σmzd=Mzd/Wmz,netto=1E+06x1.000/7.316E+004=13.67 N/mm²

σt0d/ft0d+σmyd/fmyd,fi+Km.σmzd/fmzd,fi=0.023+0.273+0.191= 0.49 < 1
σt0d/ft0d+Km.σmyd/fmyd,fi+σmzd/fmzd,fi=0.023+0.191+0.273= 0.49 < 1
The structural fire design check is satisfied

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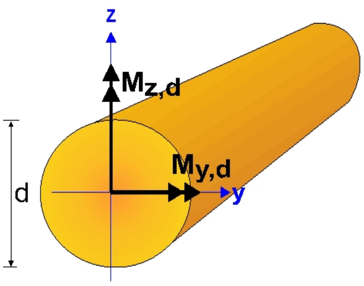
5. SECT.-005



ULTIMATE LIMIT STATE, Lateral stability
(EC5 EN1995-1-1:2009, §6.3.3)

5.1. Structural design (EC5 EN1995-1-1:2009, §6)

Material properties (EC5 EN1995-1-1:2009, §3)

Timber class : C24
Service classes : Class 1, moisture content<=12% (§2.3.1.
Material factor γM=1.30 (EC5 Table 2.3)
Load duration classes : Medium-term (Table 2.1)

Cross section properties

Round cross section, diameter d=150mm, A=1.767E+004mm^2, Wy=3.313E+005mm^3, Wz=3.313E+005mm^3
Timber cross section reduction 0.00%, dA=0.000E+000mm^2, dWy=0.000E+000mm^3, dWz=0.000E+000mm^3
Effective cross section Anetto=1.767E+004mm^2, Wy,netto=3.313E+005mm^3, Wz,netto=3.313E+005mm^3

Characteristic material properties for timber

Modification factor Kmod=0.80 (EC5 Table 3.1)
Material factor γM=1.30 (EC5 Table 2.3)
fc0k=21.00 N/mm^2, fc0d=Kmod·fc0k/γM=0.80x21.00/1.30=12.92N/mm^2 (EN1995-1-1, Eq.2.14)
fmyk=24.00 N/mm^2, fmyd=Kmod·fmyk/γM=0.80x24.00/1.30=14.77N/mm^2
fmzk=24.00 N/mm^2, fmzd=Kmod·fmzk/γM=0.80x24.00/1.30=14.77N/mm^2

Cross section loads

Myd=0.500 kNm, Mzd=0.500 kNm

Lateral torsional stability of beams (EC5 EN1995-1-1:2009, §6.3.3)

Non rectangular cross section Km=1.00 (EC5 EN1995-1-1:2009 §6.1.6.(2))
σmyd=Myd/Wmy,netto=1E+06x0.500/3.313E+005= 1.51 N/mm^2
σmzd=Mzd/Wmz,netto=1E+06x0.500/3.313E+005= 1.51 N/mm^2

Buckling length Sk

Sky= 1.00x3.000=3.000 m= 3000 mm
Skz= 1.00x3.000=3.000 m= 3000 mm

Slenderness

iy= √(Iy/A)=0.250x 150= 38 mm, λy= 3000/ 38= 78.95
iz= √(Iz/A)=0.250x 150= 38 mm, λz= 3000/ 38= 78.95

σm,crit=Mycrit/Wy=π √(E005·Iz·G005·Itor)/(Lef.Wy)= 145.30N/mm^2 (EN1995-1-1, Eq.6.31)
σm,crit=Mycrit/Wy=π √(E005·Iz·G005·Itor)/(Lef.Wy)= 145.30N/mm^2 (EN1995-1-1, Eq.6.31)

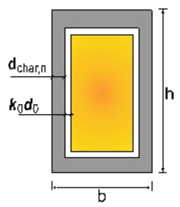
Critical stresses

σm,crity= 145.30 N/mm^2, λrel,my= √(fmyk/σm,crity)= 0.41 (EN1995-1-1, Eq.6.30)
σm,critz= 145.30 N/mm^2, λrel,mz= √(fmzk/σm,critz)= 0.41 (EN1995-1-1, Eq.6.30)

λrel,my=0.41, (λrel<=0.75), Kcrity=1.00 (EN1995-1-1, Eq.6.34)
λrel,mz=0.41, (λrel<=0.75), Kcritz=1.00 (EN1995-1-1, Eq.6.34)

σmyd/(Kcrity·fmyd)+Km.σmzd/(Kcritz·fmzd)=0.102+0.102= 0.20 < 1 (EN1995-1-1, Eq.6.33)
Km.σmyd/(Kcrity·fmyd)+σmzd/(Kcritz·fmzd)=0.102+0.102= 0.20 < 1 (EN1995-1-1, Eq.6.33)
The check is satisfied
Percent of cross section used =20%

5.2. Structural Fire design (EC5 EN1995-1-2:2004)



Exposure to a standard fire for 10 minutes.
Solid timber C24 with a characteristic density 350kg/m^3
The notional charring rate is βn=0.80 mm/min (EN1995-1-2, Table 3.1)
Charring depth dchar,n=βn·t=0.80x10=8 mm (EN1995-1-2, Eq.3.2)

Design based on reduced cross-section method (EC5 EN1995-1-2:2004, §4.2.2)

Effective charring depth def=dchar,n+ko·do, do=7mm (EN1995-1-2, Eq.4.1)
For unprotected surfaces and t<20 min, ko=t/20=10/20=0.50, (EN1995-1-2, Table 4.1)
def=8+0.50x7=12 mm, reduced cross section df=126 mm

Strength check of reduced cross-section (EC5 EN1995-1-2:2004, §2.3)

Kmod,fi=1.00, (EN1995-1-2, §4.2.2 (5)), γM,fi=1.00 (§2.3 N. 2)
Coefficient for the 20% fractile of strength kfi=1.25 (EN1995-1-2, Table 2.1)

Lateral torsional stability of beams (EC5 EN1995-1-1:2009, §6.3.3)
Round cross section, diameter df=126mm, A=1.247E+004mm², Wy=1.964E+005mm³, Wz=1.964E+005mm³
fc0k=21.00N/mm², fc0d,fi=Kmod,fi.Kfi.fc0k/γM,fi=1.00x1.25x21.00/1.00=26.25N/mm² (EN1995-1-2, Eq.2.1
fmyk=24.00N/mm², fmyd,fi=Kmod,fi.Kfi.fmyk/γM,fi=1.00x1.25x24.00/1.00=30.00N/mm² (EN1995-1-2, Eq.2.1
fmzk=24.00N/mm², fmzd,fi=Kmod,fi.Kfi.fmzk/γM,fi=1.00x1.25x24.00/1.00=30.00N/mm²
E005= 7400N/mm², E005,fi=Kmod,fi.Kfi.E005/γM,fi=1.00x1.25x 7400/1.00= 9250N/mm² (EN1995-1-2, Eq.2.2

σmyd=Myd/Wmy,netto=1E+06x0.500/1.964E+005= 2.55 N/mm²
σmzd=Mzd/Wmz,netto=1E+06x0.500/1.964E+005= 2.55 N/mm²
Buckling length Sk
Sky= 1.00x3.000=3.000 m= 3000 mm, Skz= 1.00x3.000=3.000 m= 3000 mm

Slenderness
iy= √(Iy/A)=0.250x 126= 32 mm, λy= 3000/ 32= 93.75
iz= √(Iz/A)=0.250x 126= 32 mm, λz= 3000/ 32= 93.75

Critical stresses
σm,crity= 152.56 N/mm², λrel,my= √(fmyk/σm,crity)= 0.44
σm,critz= 152.56 N/mm², λrel,mz= √(fmzk/σm,critz)= 0.44

λrel,my=0.44, (λrel<=0.75), Kcrity=1.00
λrel,mz=0.44, (λrel<=0.75), Kcritz=1.00

σmyd/(Kcrity·fmyd,fi)+Km.σmzd/(Kcritz·fmzd,fi)=0.085+0.085= 0.17 < 1 (EN1995-1-1, Eq.6.33)
Km.σmyd/(Kcrity·fmyd,fi)+σmzd/(Kcritz·fmzd,fi)=0.085+0.085= 0.17 < 1 (EN1995-1-1, Eq.6.33)
The check is satisfied

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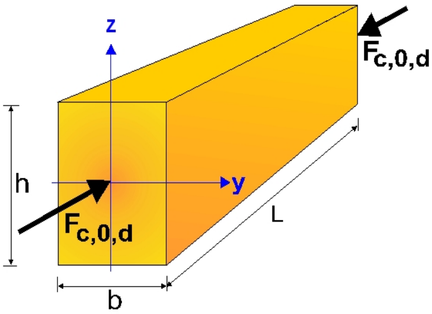
6. SECT.-006



ULTIMATE LIMIT STATE, Stability
(EC5 EN1995-1-1:2009, §6.3.2)

6.1. Structural design (EC5 EN1995-1-1:2009, §6)

Material properties (EC5 EN1995-1-1:2009, §3)
Timber class : C30
Service classes : Class 1, moisture content<=12% (§2.3.1.
Material factor γM=1.30 (EC5 Table 2.3)
Load duration classes : Permanent (Table 2.1)

Cross section properties
Rectangular cross section, b=100mm, h=100mm, A=1.000E+004mm², Wy=1.667E+005mm³, Wz=1.667E+005mm³
Timber cross section reduction 0.00%, dA=0.000E+000mm², dWy=0.000E+000mm³, dWz=0.000E+000mm³
Effective cross section Anetto=1.000E+004mm², Wy,netto=1.667E+005mm³, Wz,netto=1.667E+005mm³

Characteristic material properties for timber
Modification factor Kmod=0.60 (EC5 Table 3.1)
Material factor γM=1.30 (EC5 Table 2.3)
E005=8000N/mm²
fc0k=23.00 N/mm², fc0d=Kmod·fc0k/γM=0.60x23.00/1.30=10.62N/mm² (EN1995-1-1, Eq.2.14)
fmyk=30.00 N/mm², fmyd=Kmod·fmyk/γM=0.60x30.00/1.30=13.85N/mm²
fmzk=30.00 N/mm², fmzd=Kmod·fmzk/γM=0.60x30.00/1.30=13.85N/mm²

Cross section loads
Fc0d=-5.000 kN

Column stability (EC5 EN1995-1-1:2009, §6.3.2)
Rectangular cross section Km=0.70 (EC5 EN1995-1-1:2009 §6.1.6.(2))
σc0d=Fc0d/Anetto=1000x5.000/10000= 0.50 N/mm^2

Buckling length Sk
Sky= 2.00x3.600=7.200 m= 7200 mm
Skz= 2.00x3.600=7.200 m= 7200 mm

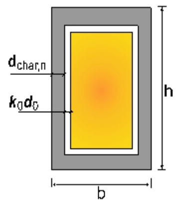
Slenderness
iy=√(Iy/A)=0.289x 100= 29 mm, λy= 7200/ 29=248.28
iz=√(Iz/A)=0.289x 100= 29 mm, λz= 7200/ 29=248.28

Critical stresses
σc,crity=π^{2}E005/λy^2= 1.28 N/mm^2, λrel,y= √(fc0k/σc,crity)= 4.24 (EN1995-1-1, Eq.6.21)
σc,critz=π^{2}E005/λz^2= 1.28 N/mm^2, λrel,z= √(fc0k/σc,critz)= 4.24 (EN1995-1-1, Eq.6.22)

βc=0.20 (solid timber)
ky=0.5[1+βc(λrely-0.3)+λrely^2]= 9.87, Kcy=1/(ky+ √(ky^2-λrely^2))=0.053 (Eq.6.27 6.25)
kz=0.5[1+βc(λrelz-0.3)+λrelz^2]= 9.87, Kcz=1/(kz+ √(kz^2-λrelz^2))=0.053 (Eq.6.28 6.26)

σc0d/(Kcy·fc0d)= 0.89 < 1 (EN1995-1-1, Eq.6.23)
σc0d/(Kcz·fc0d)= 0.89 < 1 (EN1995-1-1, Eq.6.24)
The check is satisfied
Percent of cross section used =89%

6.2. Structural Fire design (EC5 EN1995-1-2:2004)



Exposure to a standard fire for 10 minutes.
Solid timber C30 with a characteristic density 380kg/m^3
The notional charring rate is βn=0.80 mm/min (EN1995-1-2, Table 3.1)
Charring depth dchar,n=βn·t=0.80x10=8 mm (EN1995-1-2, Eq.3.2)

Design based on reduced cross-section method (EC5 EN1995-1-2:2004, §4.2.2)
Effective charring depth def=dchar,n+ko·do, do=7mm (EN1995-1-2, Eq.4.1)
For unprotected surfaces and t<20 min, ko=t/20=10/20=0.50, (EN1995-1-2, Table 4.1)
def=8+0.50x7=12 mm, reduced cross section BfxHf=76x76 mm

Strength check of reduced cross-section (EC5 EN1995-1-2:2004, §2.3)
Kmod,fi=1.00, (EN1995-1-2, §4.2.2 (5)), γM,fi=1.00 (§2.3 N. 2)
Coefficient for the 20% fractile of strength kfi=1.25 (EN1995-1-2, Table 2.1)

Column stability (EC5 EN1995-1-1:2009, §6.3.2)
Rectangular cross section, bf=76mm, hf=76mm, A=5.776E+003mm^2, Wy=7.316E+004mm^3, Wz=7.316E+004mm^3
fc0k=23.00N/mm^2, fc0d,fi=Kmod,fi.Kfi.fc0k/γM,fi=1.00x1.25x23.00/1.00=28.75N/mm^2 (EN1995-1-2, Eq.2.1
fmyk=30.00N/mm^2, fmyd,fi=Kmod,fi.Kfi.fmyk/γM,fi=1.00x1.25x30.00/1.00=37.50N/mm^2 (EN1995-1-2, Eq.2.1
fmzk=30.00N/mm^2, fmzd,fi=Kmod,fi.Kfi.fmzk/γM,fi=1.00x1.25x30.00/1.00=37.50N/mm^2
E005= 8000N/mm^2, E005,fi=Kmod,fi.Kfi.E005/γM,fi=1.00x1.25x 8000/1.00=10000N/mm^2 (EN1995-1-2, Eq.2.2

σc0d=Fc0d/Anetto=1000x5.000/5776= 0.87 N/mm^2
Buckling length Sk
Sky= 2.00x3.600=7.200 m= 7200 mm, Skz= 2.00x3.600=7.200 m= 7200 mm

Slenderness
iy=√(Iy/A)=0.289x 76= 22 mm, λy= 7200/ 22=327.27
iz=√(Iz/A)=0.289x 76= 22 mm, λz= 7200/ 22=327.27

Critical stresses

$\sigma c,crity=\pi^2 E005/\lambda y^2=$ 0.92 N/mm², $\lambda rel,y=\sqrt{(fc0d,fi/\sigma c,crity)}=$ 5.00

$\sigma c,critz=\pi^2 E005/\lambda z^2=$ 0.92 N/mm², $\lambda rel,z=\sqrt{(fc0d,fi/\sigma c,critz)}=$ 5.00

$\beta c=0.20$ (solid timber)

$ky=0.5[1+\beta c(\lambda rely-0.3)+\lambda rely^2]=13.45$, $Kcy=1/(ky+\sqrt{(ky^2-\lambda rely^2)})=0.039$

$kz=0.5[1+\beta c(\lambda relz-0.3)+\lambda relz^2]=13.45$, $Kcz=1/(kz+\sqrt{(kz^2-\lambda relz^2)})=0.039$

$\sigma c0d/(Kcy\cdot fc0d,fi)=0.77 < 1$ (EN1995-1-1, Eq.6.23)

$\sigma c0d/(Kcz\cdot fc0d,fi)=0.77 < 1$ (EN1995-1-1, Eq.6.24)

The check is satisfied