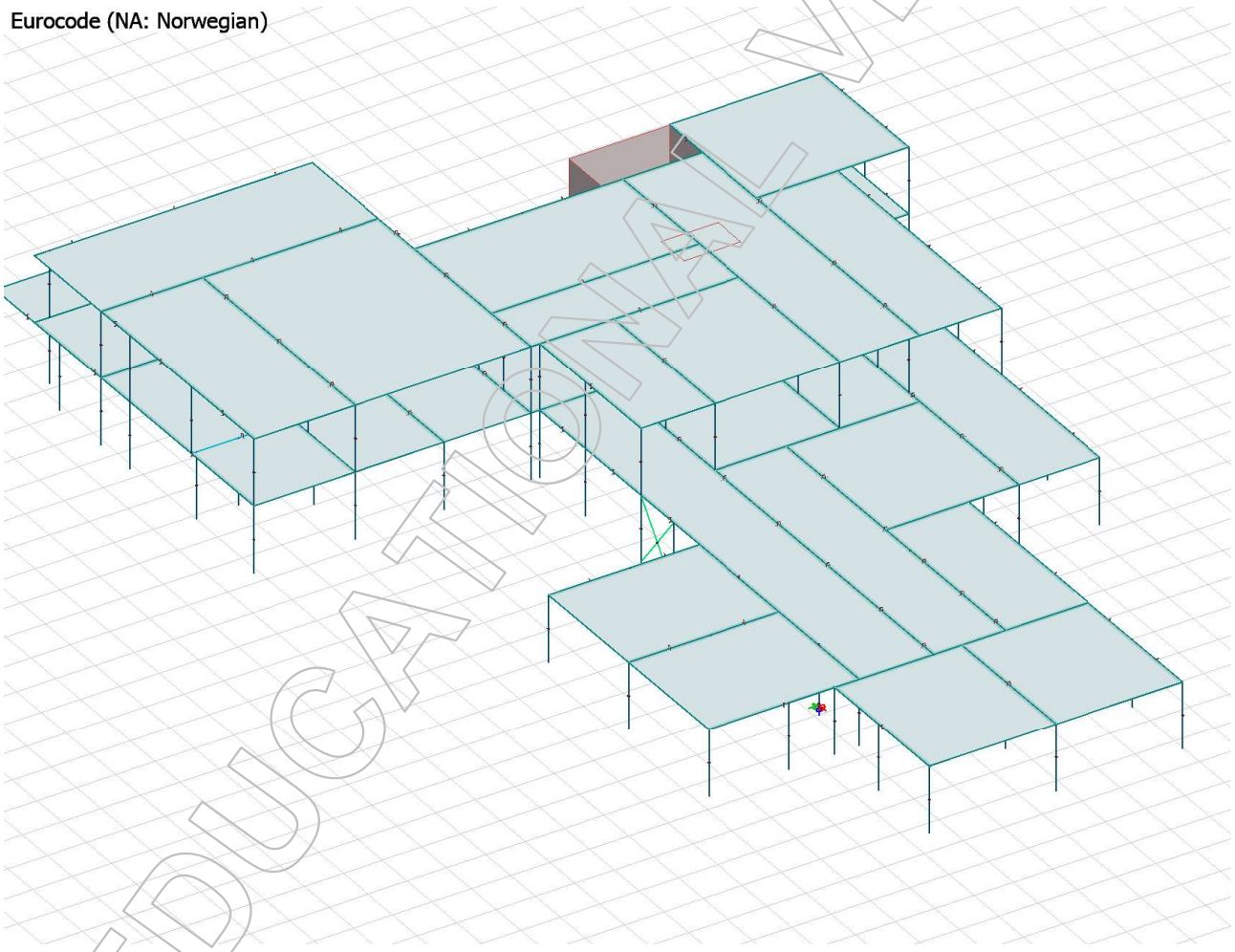
Vedlegg nr: 5
Fem-Design
Rapport

Eurocode (NA: Norwegian)



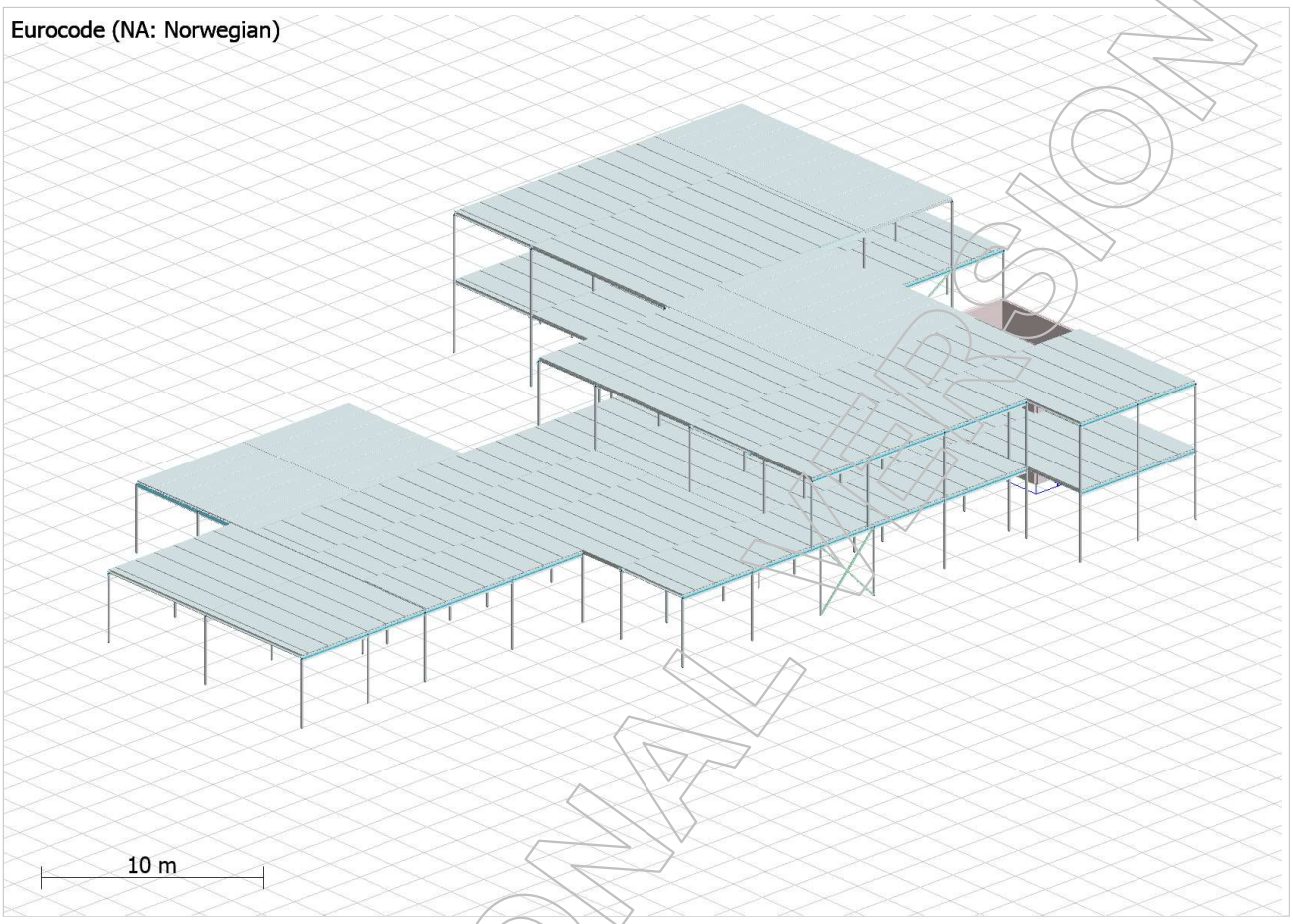
Project: Brisningsstubben Bo og Aktivitetssenter	Customer: Consto Midt-Norge/NTNU
Description: Bachelor oppgave	FEM-Design © StruSoft
Designed: Peder Brønstad Parnas, Emil Tangerud Viken, Per Hammer	Date: 02.05.2022 / Page: 1 / 63

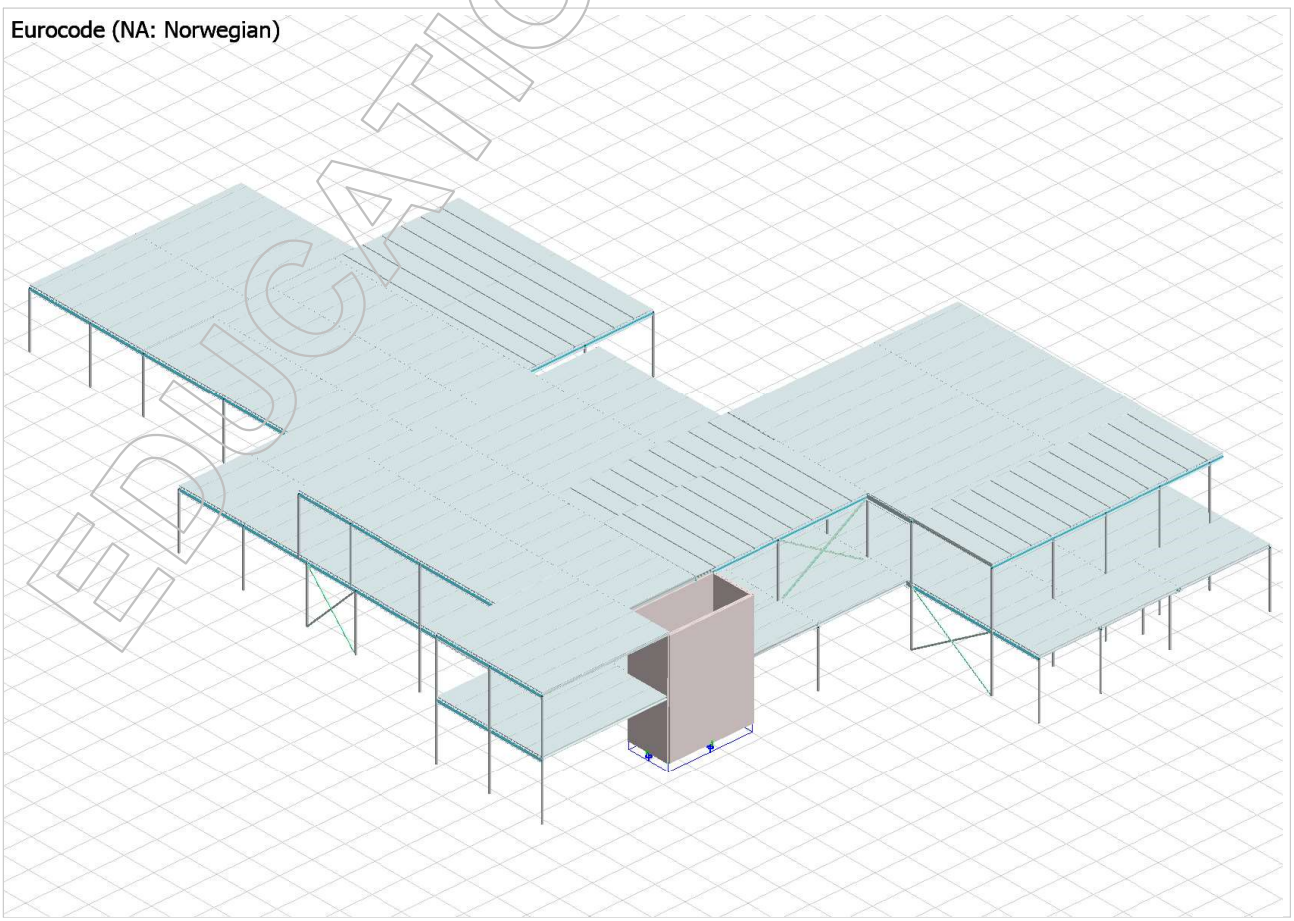
Innholdsfortegnelse

Documentation — Contents

1 Design

1.1 3D View





1.2 Materialer

1.2.1 Betong

Concrete materials

No.	Name	Fck	Fck,cube	Fctm	Fctk	Ecm	Yield strain	Ultimate strain	Gamma c
[-]	[-]	[N/mm2]	[N/mm2]	[N/mm2]	[N/mm2]	[N/mm2]	[-]	[-]	[-]
1	C35/45	35.000	45.000	3.200	2.200	34000.000	0.00175	0.00350	1.50

Gamma c, Acc	Gamma cE	Gamma s	Gamma s, Acc	Gamma c,fi	Gamma s,fi	Alfa cc	Alfa ct	Density	Therm. coeff.
[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[t/m3]	[1/°C]
1.20	1.20	1.15	1.00	1.00	1.00	0.85	0.85	2.548	0.000010

Poisson's ratio	Creep c.(U,Ua,Us)	Creep c.(Sq)	Creep c.(Sf)	Creep c.(Sc)	Shrinkage	Dyna r.	Stab r.
[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]
0.200	0.00	0.00	0.00	0.00	0.000	1.000	1.000

Profiled panels

ID	Material	Profile
[-]	[-]	[-]
PP.1.1	C35...	HD-F 120-20
PP.2.1	C35...	HD-F 120-20
PP.3.1	C35...	HD-F 120-20
PP.4.1	C35...	HD-F 120-20
PP.5.1	C35...	HD-F 120-20
PP.6.1	C35...	HD-F 120-20
PP.7.1	C35...	HD-F 120-20
PP.8.1	C35...	HD-F 120-20
PP.9.1	C35...	HD-F 120-20
PP.10.1	C35...	HD-F 120-20
PP.11.1	C35...	HD-F 120-20
PP.12.1	C35...	HD-F 120-20
PP.13.1	C35...	HD-F 120-20

ID	Material	Profile
[-]	[-]	[-]
PP.14.1	C35...	HD-F 120-20
PP.15.1	C35...	HD-F 120-20
PP.16.1	C35...	HD-F 120-20
PP.17.1	C35...	HD-F 120-20
PP.18.1	C35...	HD-F 120-20
PP.19.1	C35...	HD-F 120-20
PP.20.1	C35...	HD-F 120-20
PP.21.1	C35...	HD-F 120-20
PP.22.1	C35...	HD-F 120-20
PP.23.1	C35...	HD-F 120-20
PP.24.1	C35...	HD-F 120-20
PP.25.1	C35...	HD-F 120-20
PP.26.1	C35...	HD-F 120-20

ID	Material	Profile
[-]	[-]	[-]
PP.27.1	C35...	HD-F 120-20
PP.28.1	C35...	HD-F 120-20
PP.29.1	C35...	HD-F 120-20
PP.30.1	C35...	HD-F 120-20
PP.31.1	C35...	HD-F 120-20
PP.32.1	C35...	HD-F 120-20
PP.33.1	C35...	HD-F 120-20
PP.34.1	C35...	HD-F 120-20
PP.35.1	C35...	HD-F 120-20
PP.36.1	C35...	HD-F 120-20
PP.37.1	C35...	HD-F 120-20

1.2.2 Stål

Steel materials

No.	Name	fyk(t<16)	fyk(16<=t<=40)	fyk(40<t<=63)	fyk(63<t<=80)	fyk(80<t<=100)	fyk(100<t<=150)
[-]	[-]	[N/mm2]	[N/mm2]	[N/mm2]	[N/mm2]	[N/mm2]	[N/mm2]
1	S 355	355.000	355.000	335.000	335.000	335.000	335.000
2	S 355	355.000	355.000	335.000	335.000	335.000	335.000

fyk(150<t<=200)	fyk(200<t<=250)	fyk(250<t<=400)	fuk(t<3)	fuk(3<=t<=40)	fuk(40<t<=100)
[N/mm2]	[N/mm2]	[N/mm2]	[N/mm2]	[N/mm2]	[N/mm2]
335.000	335.000	335.000	510.000	510.000	470.000
335.000	335.000	335.000	510.000	510.000	470.000

fuk(100<t<=150)	fuk(150<t<=250)	fuk(250<t<=400)	Gamma M0	Gamma M0, Acc	Gamma M1	Gamma M1, Acc
[N/mm2]	[N/mm2]	[N/mm2]	[-]	[-]	[-]	[-]
470.000	470.000	470.000	1.050	1.000	1.050	1.000
470.000	470.000	470.000	1.050	1.000	1.050	1.000

Gamma M2	Gamma M2, Acc	Gamma M5	Gamma M5, Acc	Gamma Mfi	Ek	Poisson's ratio	G
[-]	[-]	[-]	[-]	[-]	[N/mm2]	[-]	[N/mm2]
1.250	1.000	1.000	1.000	1.000	210000.000	0.300	80769.000
1.250	1.000	1.000	1.000	1.000	210000.000	0.300	80769.000

Therm. coeff.	Density
[1/°C]	[t/m3]
1.2000e-05	7.850000
1.2000e-05	7.850000

1.3 Dimensjon Bjelker

Beams

ID	Material	Section, start	Section, end	Ecc. mode.	Ecc. crack.
[-]	[-]	[-]	[-]	[-]	[-]
B.1.1	S 355	IPE 240	IPE 240	Release at END	No
B.2.1	S 355	IPE 240	IPE 240	Release at END	No
B.3.1	S 355	D 20-200	D 20-200	Release at END	No
B.4.1	S 355	D 20-200	D 20-200	Release at END	No
B.5.1	S 355	D 20-200	D 20-200	Release at END	No
B.6.1	S 355	IPE 240	IPE 240	Release at END	No
B.7.1	S 355	D 20-200	D 20-200	Release at END	No
B.8.1	S 355	IPE 240	IPE 240	Release at END	No
B.9.1	S 355	D 20-200	D 20-200	Release at END	No
B.10.1	S 355	D 20-200	D 20-200	Release at END	No
B.11.1	S 355	D 20-200	D 20-200	Release at END	No
B.12.1	S 355	D 20-200	D 20-200	Release at END	No
B.13.1	S 355	D 20-200	D 20-200	Release at END	No
B.14.1	S 355	D 20-200	D 20-200	Release at END	No
B.15.1	S 355	D 20-200	D 20-200	Release at END	No
B.16.1	S 355	D 20-200	D 20-200	Release at END	No
B.17.1	S 355	IPE 240	IPE 240	Release at END	No
B.18.1	S 355	IPE 240	IPE 240	Release at END	No
B.19.1	S 355	IPE 240	IPE 240	Release at END	No
B.20.1	S 355	IPE 240	IPE 240	Release at END	No
B.21.1	S 355	IPE 240	IPE 240	Release at END	No
B.22.1	S 355	IPE 240	IPE 240	Release at END	No
B.23.1	S 355	D 20-200	D 20-200	Release at END	No
B.24.1	S 355	D 20-200	D 20-200	Release at END	No
B.25.1	S 355	D 20-200	D 20-200	Release at END	No
B.26.1	S 355	D 20-200	D 20-200	Release at END	No
B.27.1	S 355	D 20-200	D 20-200	Release at END	No
B.28.1	S 355	D 20-200	D 20-200	Release at END	No
B.29.1	S 355	D 20-200	D 20-200	Release at END	No
B.30.1	S 355	D 20-200	D 20-200	Release at END	No
B.31.1	S 355	D 20-200	D 20-200	Release at END	No
B.32.1	S 355	D 20-200	D 20-200	Release at END	No
B.33.1	S 355	D 20-200	D 20-200	Release at END	No
B.34.1	S 355	D 20-200	D 20-200	Release at END	No
B.35.1	S 355	IPE 240	IPE 240	Release at END	No
B.36.1	S 355	IPE 240	IPE 240	Release at END	No
B.37.1	S 355	IPE 240	IPE 240	Release at END	No
B.38.1	S 355	IPE 240	IPE 240	Release at END	No
B.39.1	S 355	D 20-200	D 20-200	Release at END	No
B.40.1	S 355	D 20-200	D 20-200	Release at END	No
B.41.1	S 355	D 20-200	D 20-200	Release at END	No
B.42.1	S 355	D 20-200	D 20-200	Release at END	No
B.43.1	S 355	D 20-200	D 20-200	Release at END	No
B.44.1	S 355	D 20-200	D 20-200	Release at END	No
B.45.1	S 355	D 20-200	D 20-200	Release at END	No
B.46.1	S 355	D 20-200	D 20-200	Release at END	No
B.47.1	S 355	D 20-200	D 20-200	Release at END	No
B.48.1	S 355	D 20-200	D 20-200	Release at END	No
B.49.1	S 355	D 20-200	D 20-200	Release at END	No
B.50.1	S 355	D 20-200	D 20-200	Release at END	No

ID	Material	Section, start	Section, end	Ecc. mode.	Ecc. crack.
[-]	[-]	[-]	[-]	[-]	[-]
B.51.1	S 355	IPE 240	IPE 240	Release at END	No
B.52.1	S 355	IPE 240	IPE 240	Release at END	No
B.53.1	S 355	IPE 240	IPE 240	Release at END	No
B.54.1	S 355	IPE 240	IPE 240	Release at END	No
B.55.1	S 355	IPE 240	IPE 240	Release at END	No
B.56.1	S 355	D 20-200	D 20-200	Release at END	No
B.57.1	S 355	D 20-200	D 20-200	Release at END	No
B.58.1	S 355	D 20-200	D 20-200	Release at END	No
B.59.1	S 355	D 20-200	D 20-200	Release at END	No
B.60.1	S 355	D 20-200	D 20-200	Release at END	No
B.61.1	S 355	D 20-200	D 20-200	Release at END	No
B.62.1	S 355	D 20-200	D 20-200	Release at END	No
B.63.1	S 355	D 20-200	D 20-200	Release at END	No
B.64.1	S 355	D 20-200	D 20-200	Release at END	No
B.65.1	S 355	IPE 240	IPE 240	Release at END	No
B.66.1	S 355	IPE 240	IPE 240	Release at END	No
B.67.1	S 355	IPE 240	IPE 240	Release at END	No
B.68.1	S 355	IPE 240	IPE 240	Release at END	No
B.69.1	S 355	IPE 240	IPE 240	Release at END	No
B.70.1	S 355	IPE 240	IPE 240	Release at END	No
B.71.1	S 355	IPE 240	IPE 240	Release at END	No
B.72.1	S 355	IPE 240	IPE 240	Release at END	No
B.73.1	S 355	IPE 240	IPE 240	Release at END	No
B.74.1	S 355	IPE 240	IPE 240	Release at END	No
B.75.1	S 355	IPE 240	IPE 240	Release at END	No
B.76.1	S 355	IPE 240	IPE 240	Release at END	No
B.77.1	S 355	IPE 240	IPE 240	Release at END	No
B.78.1	S 355	D 20-200	D 20-200	Release at END	No
B.79.1	S 355	D 20-200	D 20-200	Release at END	No
B.80.1	S 355	D 20-200	D 20-200	Release at END	No
B.81.1	S 355	IPE 240	IPE 240	Release at END	No
B.82.1	S 355	IPE 240	IPE 240	Release at END	No
B.83.1	S 355	IPE 240	IPE 240	Release at END	No
B.84.1	S 355	IPE 240	IPE 240	Release at END	No
B.85.1	S 355	IPE 240	IPE 240	Release at END	No
B.86.1	S 355	IPE 240	IPE 240	Release at END	No
B.87.1	S 355	IPE 240	IPE 240	Release at END	No
B.88.1	S 355	D 20-200	D 20-200	Release at END	No
B.89.1	S 355	D 20-200	D 20-200	Release at END	No
B.90.1	S 355	D 20-200	D 20-200	Release at END	No
B.91.1	S 355	D 20-200	D 20-200	Release at END	No
B.92.1	S 355	D 20-200	D 20-200	Release at END	No
B.93.1	S 355	D 20-200	D 20-200	Release at END	No
B.94.1	S 355	IPE 240	IPE 240	Release at END	No
B.95.1	S 355	IPE 240	IPE 240	Release at END	No

1.4 Dimensjon Søyler

Columns

ID	Material	Section, start	Section, end	Ecc. mode.	Ecc. crack.
[-]	[-]	[-]	[-]	[-]	[-]
C.1.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.2.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.3.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.4.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.5.1	S 355	KKR 120x120x6	KKR 120x120x6	Release at END	No
C.6.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.7.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.8.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.9.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.10.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.11.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.12.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.13.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.14.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.15.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.16.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.17.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.18.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.19.1	S 355	KKR 120x120x6	KKR 120x120x6	Release at END	No
C.20.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.21.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.22.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.23.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.24.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.25.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.26.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.27.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.28.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.29.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.30.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.31.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.32.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.33.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.34.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.35.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.36.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.37.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.38.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.39.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.40.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.41.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.42.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.43.1	S 355	KKR 120x120x6	KKR 120x120x6	Release at END	No
C.44.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.45.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.46.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.47.1	S 355	KKR 100x100x8	KKR 100x100x8	Release at END	No
C.48.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.49.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.50.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No

ID	Material	Section, start	Section, end	Ecc. mode.	Ecc. crack.
[-]	[-]	[-]	[-]	[-]	[-]
C.51.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.52.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.53.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.54.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.55.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.56.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.57.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.58.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.59.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.60.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.61.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.62.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.63.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.64.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.65.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.66.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.67.1	S 355	KKR 120x120x6	KKR 120x120x6	Release at END	No
C.68.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.69.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.70.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.71.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.72.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.73.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.74.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.75.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.76.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.77.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.78.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.79.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.80.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.81.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.82.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.83.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.84.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.85.1	S 355	KKR 120x120x6	KKR 120x120x6	Release at END	No
C.86.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.87.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.88.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.89.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.90.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.91.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.92.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.93.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.94.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.95.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.96.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.97.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.98.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.99.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.100.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.101.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.102.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No

ID	Material	Section, start	Section, end	Ecc. mode.	Ecc. crack.
[-]	[-]	[-]	[-]	[-]	[-]
C.103.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.104.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.105.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.106.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.107.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.108.1	S 355	KKR 100x100x8	KKR 100x100x8	Release at END	No
C.109.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.110.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.111.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.112.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.113.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.114.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.115.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.116.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.117.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.118.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.119.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.120.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.121.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.122.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.123.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.124.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.125.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.126.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.127.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.128.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.129.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.130.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.131.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.132.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.133.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.134.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.135.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.136.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.137.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.138.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No
C.139.1	S 355	KKR 100x100x6	KKR 100x100x6	Release at END	No

1.5 Dimensjon Hulldekker

Profiled panels

ID	Material	Profile	E2 / E1
[-]	[-]	[-]	[-]
PP.1.1	C35/45	HD-F 120-20	1.000
PP.2.1	C35/45	HD-F 120-20	1.000
PP.3.1	C35/45	HD-F 120-20	1.000
PP.4.1	C35/45	HD-F 120-20	1.000
PP.5.1	C35/45	HD-F 120-20	1.000
PP.6.1	C35/45	HD-F 120-20	1.000
PP.7.1	C35/45	HD-F 120-20	1.000
PP.8.1	C35/45	HD-F 120-20	1.000
PP.9.1	C35/45	HD-F 120-20	1.000
PP.10.1	C35/45	HD-F 120-20	1.000
PP.11.1	C35/45	HD-F 120-20	1.000
PP.12.1	C35/45	HD-F 120-20	1.000
PP.13.1	C35/45	HD-F 120-20	1.000
PP.14.1	C35/45	HD-F 120-20	1.000
PP.15.1	C35/45	HD-F 120-20	1.000
PP.16.1	C35/45	HD-F 120-20	1.000
PP.17.1	C35/45	HD-F 120-20	1.000
PP.18.1	C35/45	HD-F 120-20	1.000
PP.19.1	C35/45	HD-F 120-20	1.000
PP.20.1	C35/45	HD-F 120-20	1.000
PP.21.1	C35/45	HD-F 120-20	1.000
PP.22.1	C35/45	HD-F 120-20	1.000
PP.23.1	C35/45	HD-F 120-20	1.000
PP.24.1	C35/45	HD-F 120-20	1.000
PP.25.1	C35/45	HD-F 120-20	1.000
PP.26.1	C35/45	HD-F 120-20	1.000
PP.27.1	C35/45	HD-F 120-20	1.000
PP.28.1	C35/45	HD-F 120-20	1.000
PP.29.1	C35/45	HD-F 120-20	1.000
PP.30.1	C35/45	HD-F 120-20	1.000
PP.31.1	C35/45	HD-F 120-20	1.000
PP.32.1	C35/45	HD-F 120-20	1.000
PP.33.1	C35/45	HD-F 120-20	1.000
PP.34.1	C35/45	HD-F 120-20	1.000
PP.35.1	C35/45	HD-F 120-20	1.000
PP.36.1	C35/45	HD-F 120-20	1.000
PP.37.1	C35/45	HD-F 120-20	1.000

2 Laster

2.1 Lastilfeller

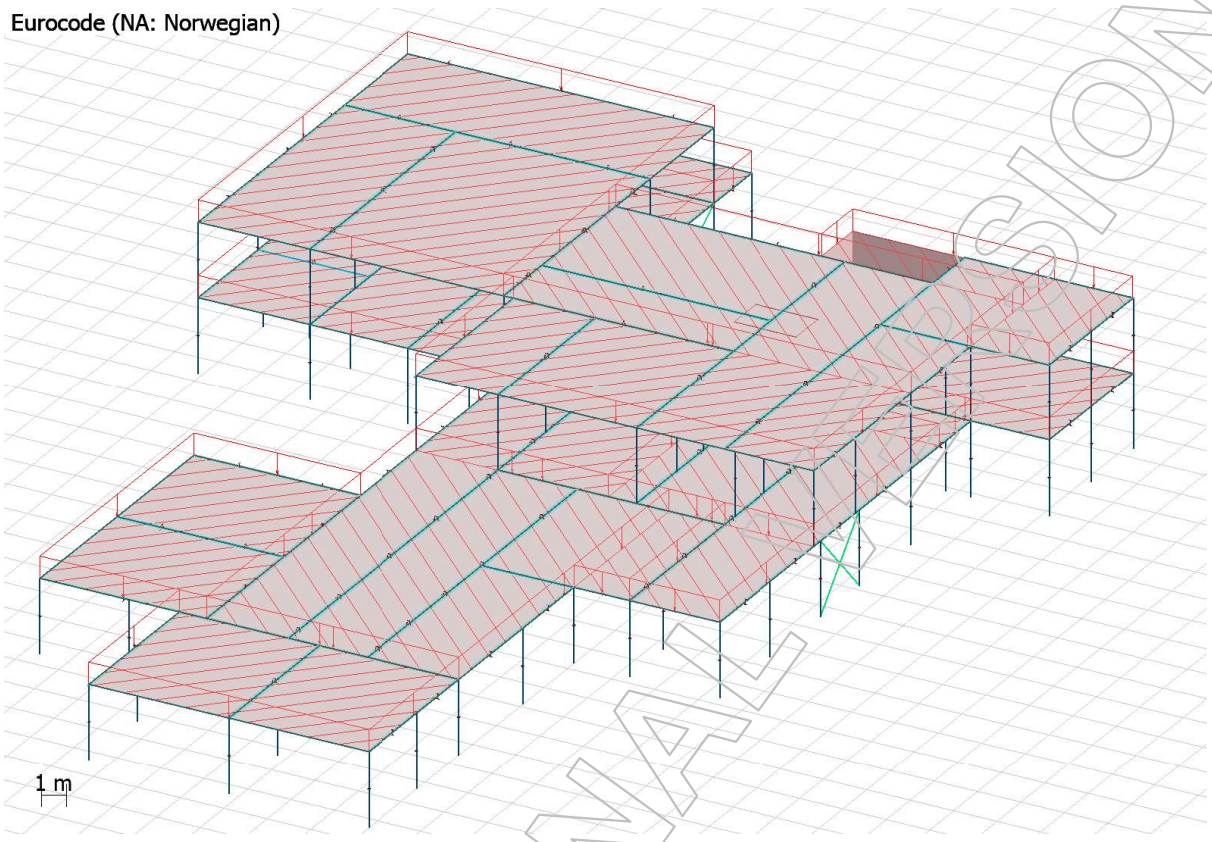
Load cases

No.	Name	Type	Duration class
1	Egenlast	+Struc. dead load	Permanent
2	Vest (X+)	Ordinary	Short-term
3	Øst (X-)	Ordinary	Short-term
4	Sør (Y+)	Ordinary	Short-term
5	Nord (Y-)	Ordinary	Short-term
6	Egenlast påført	Ordinary	Permanent
7	Egenlast solceller	Ordinary	Permanent
8	Nyttelast	Ordinary	Medium-term
9	Snølast	Ordinary	Medium-term

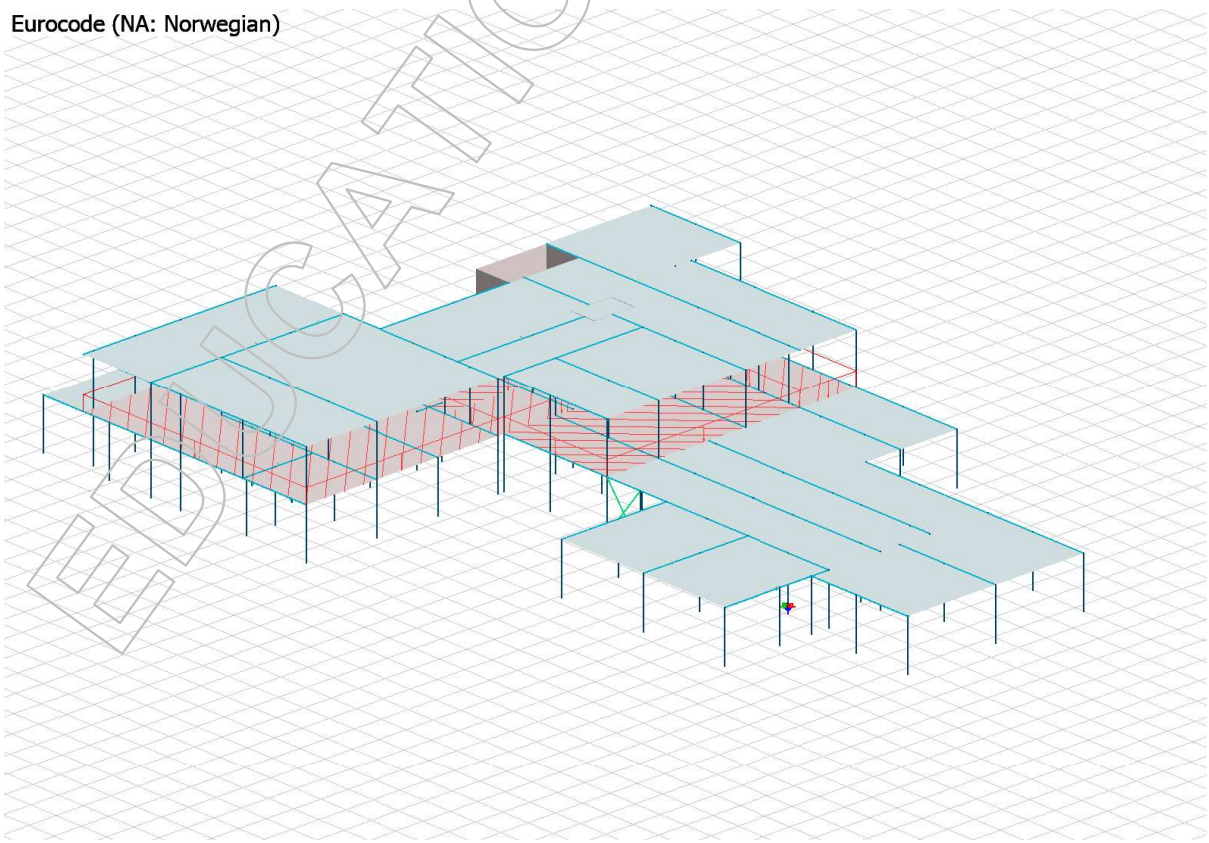
2.2 Påførte laster

2.2.1 Påført Egenlast

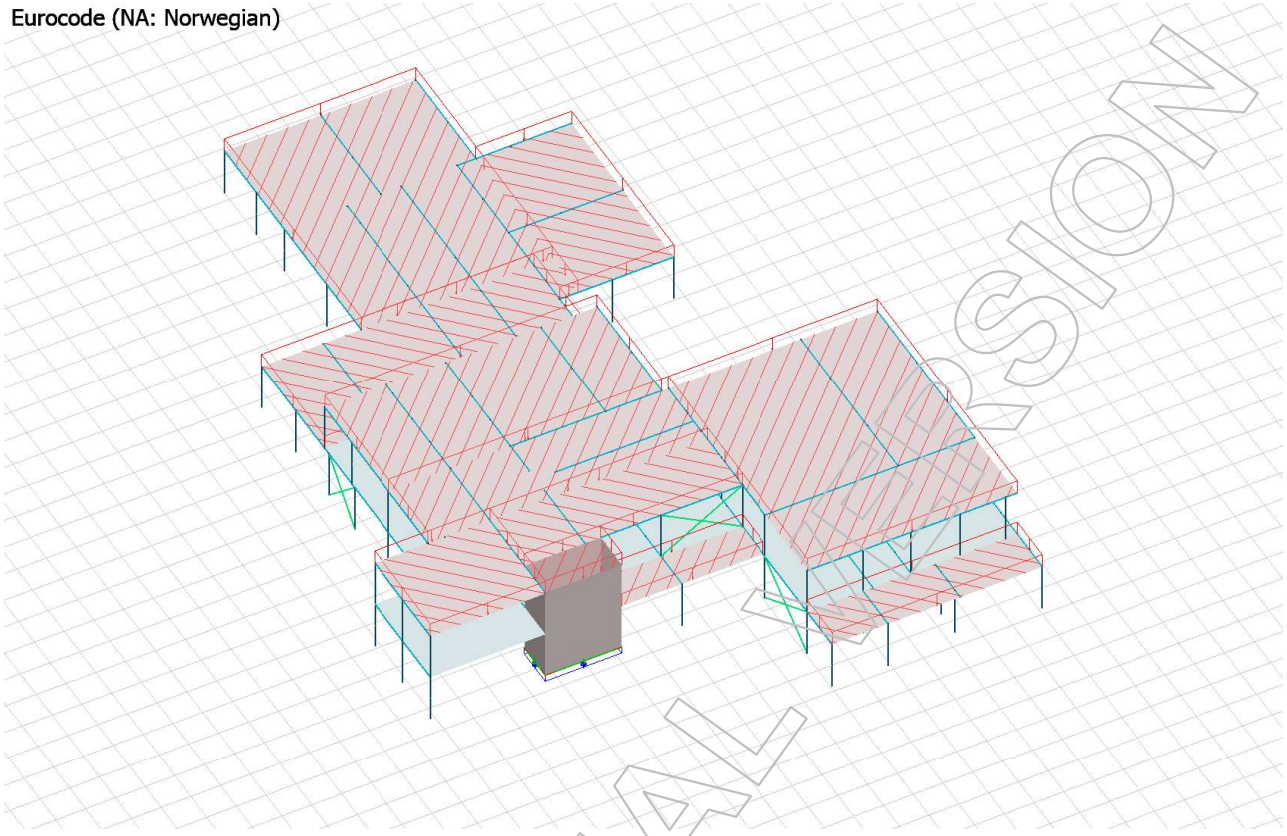
Egenlast påført



2.2.2 Nyttelast

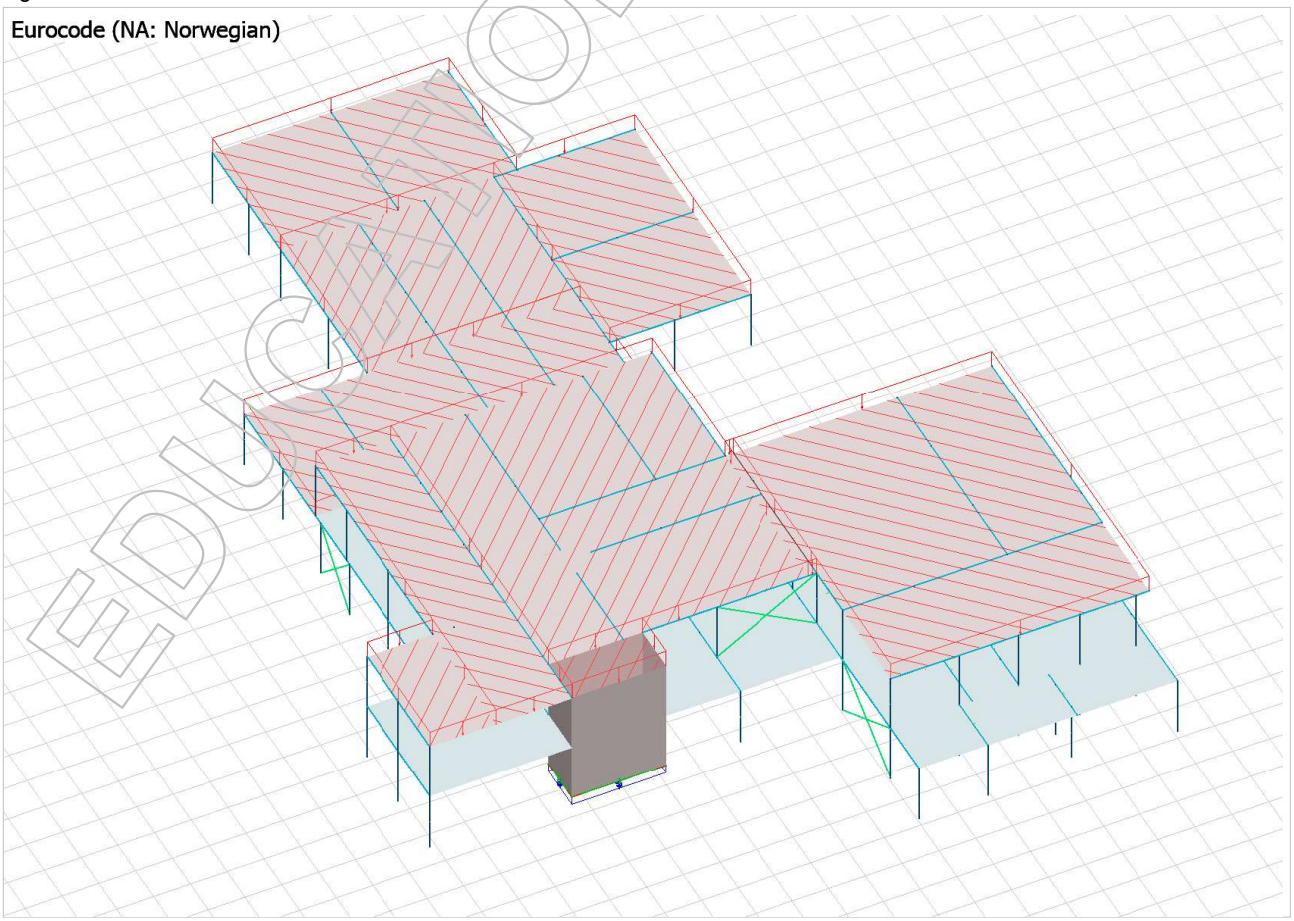


2.2.3 Snølast



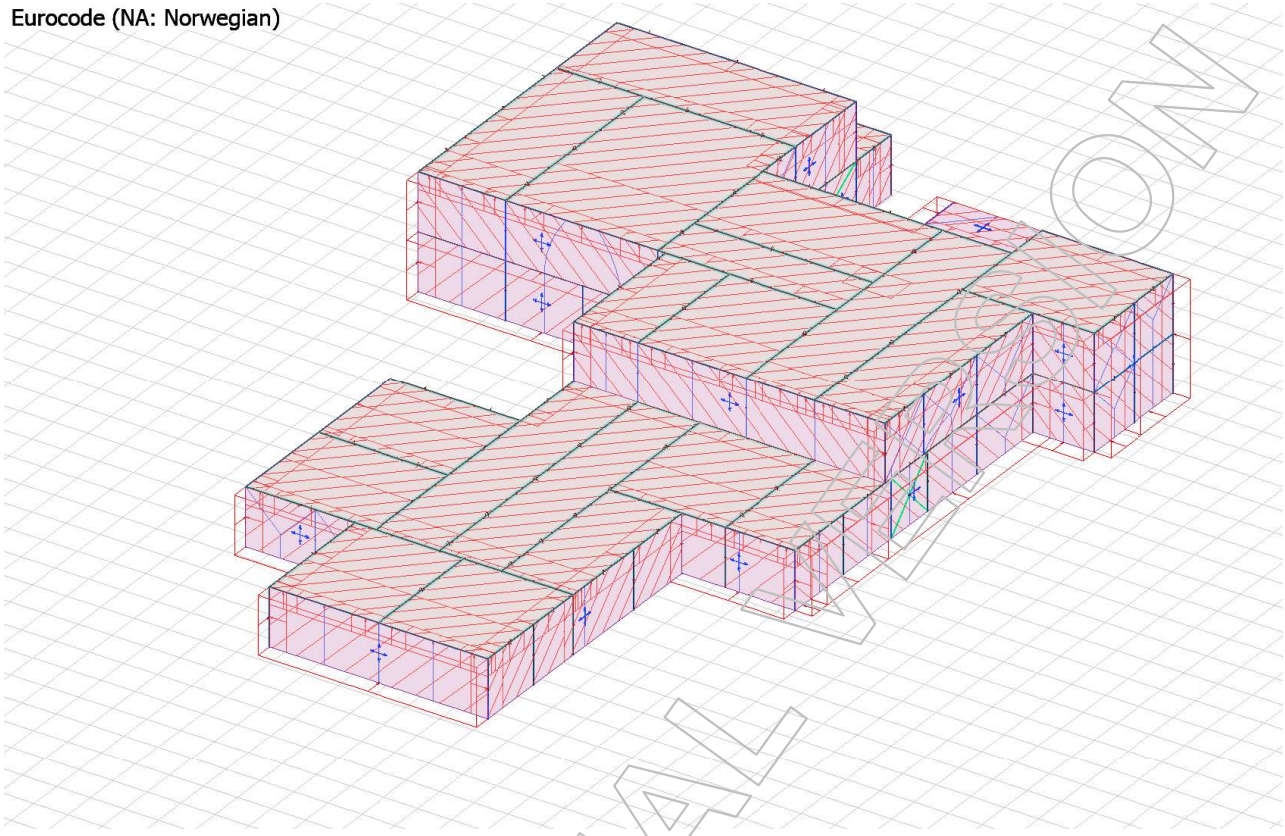
2.2.4 Egenlast solceller

Egenlast solceller



2.2.5 Vindlast Sør

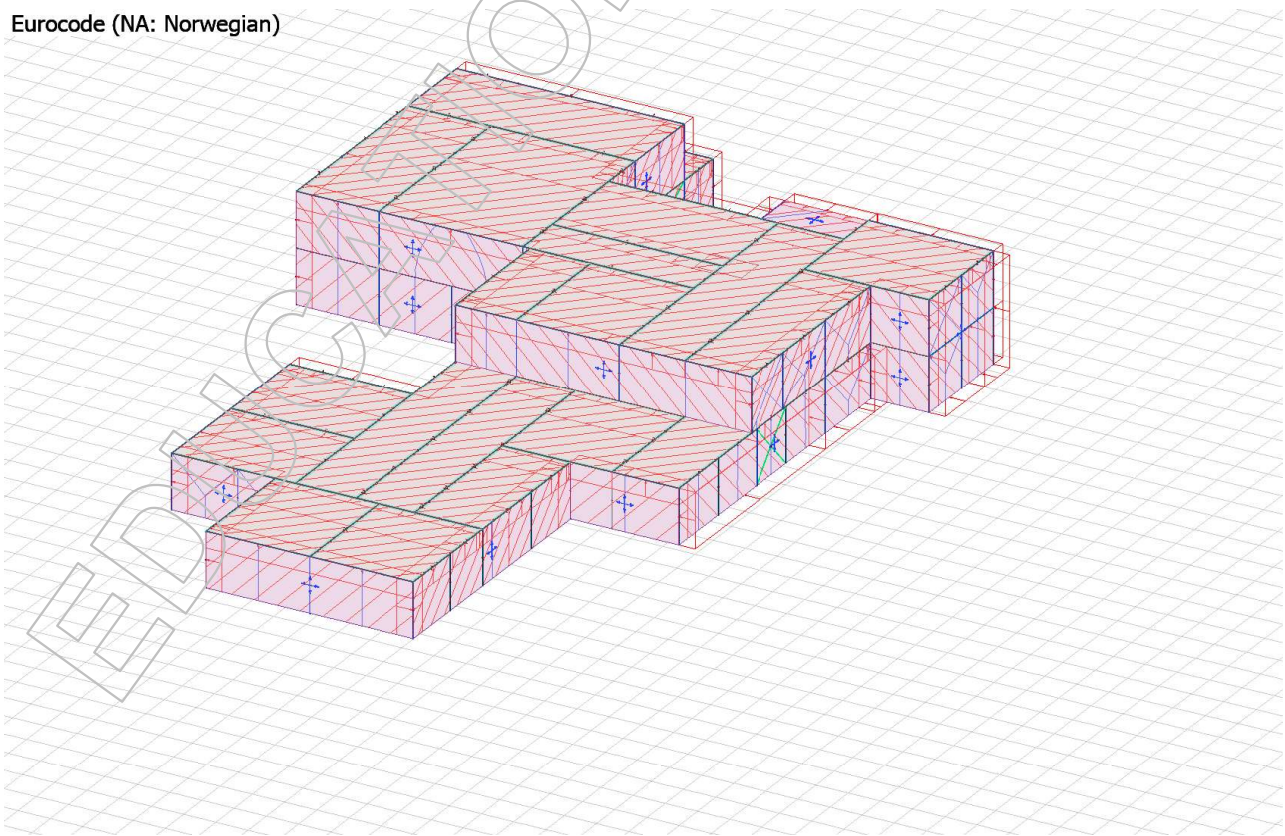
Eurocode (NA: Norwegian)



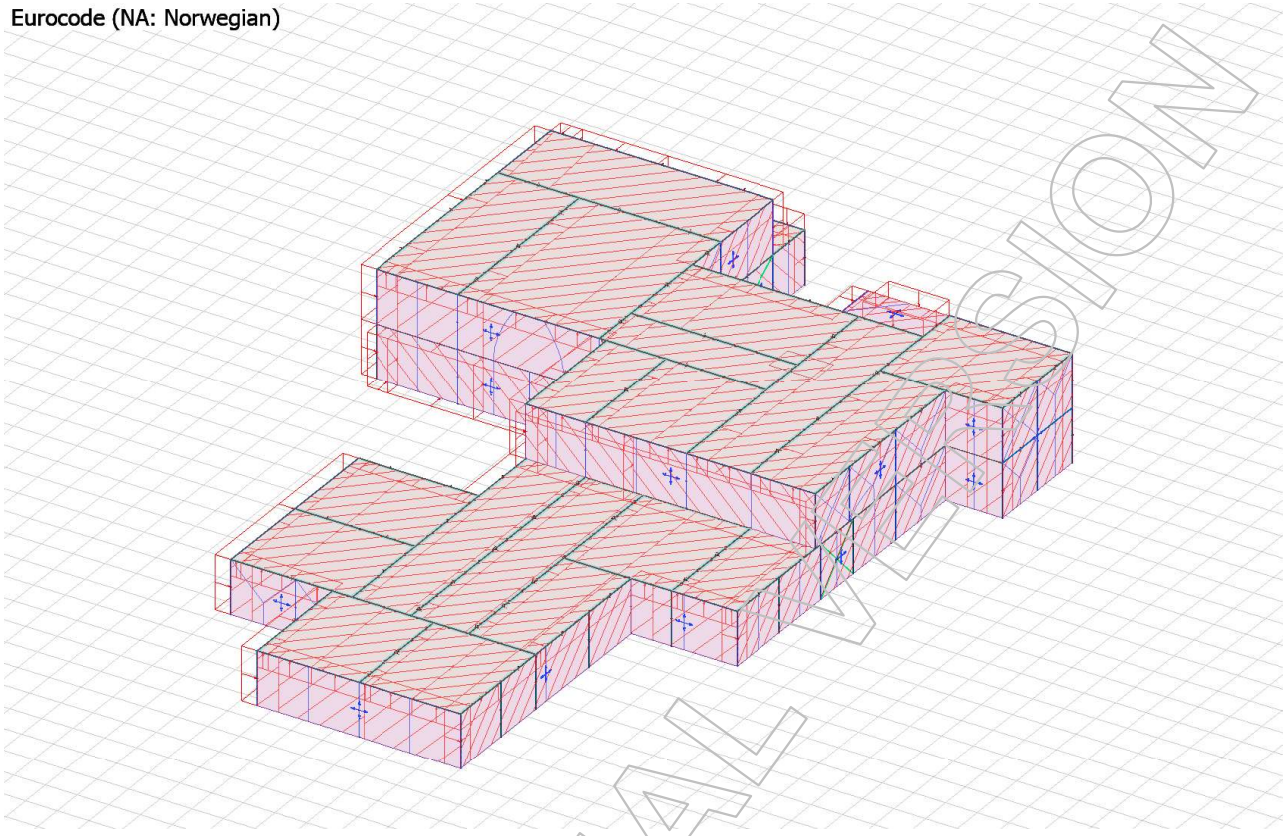
2.2.6 Vindlast Nord

Nord (Y-)

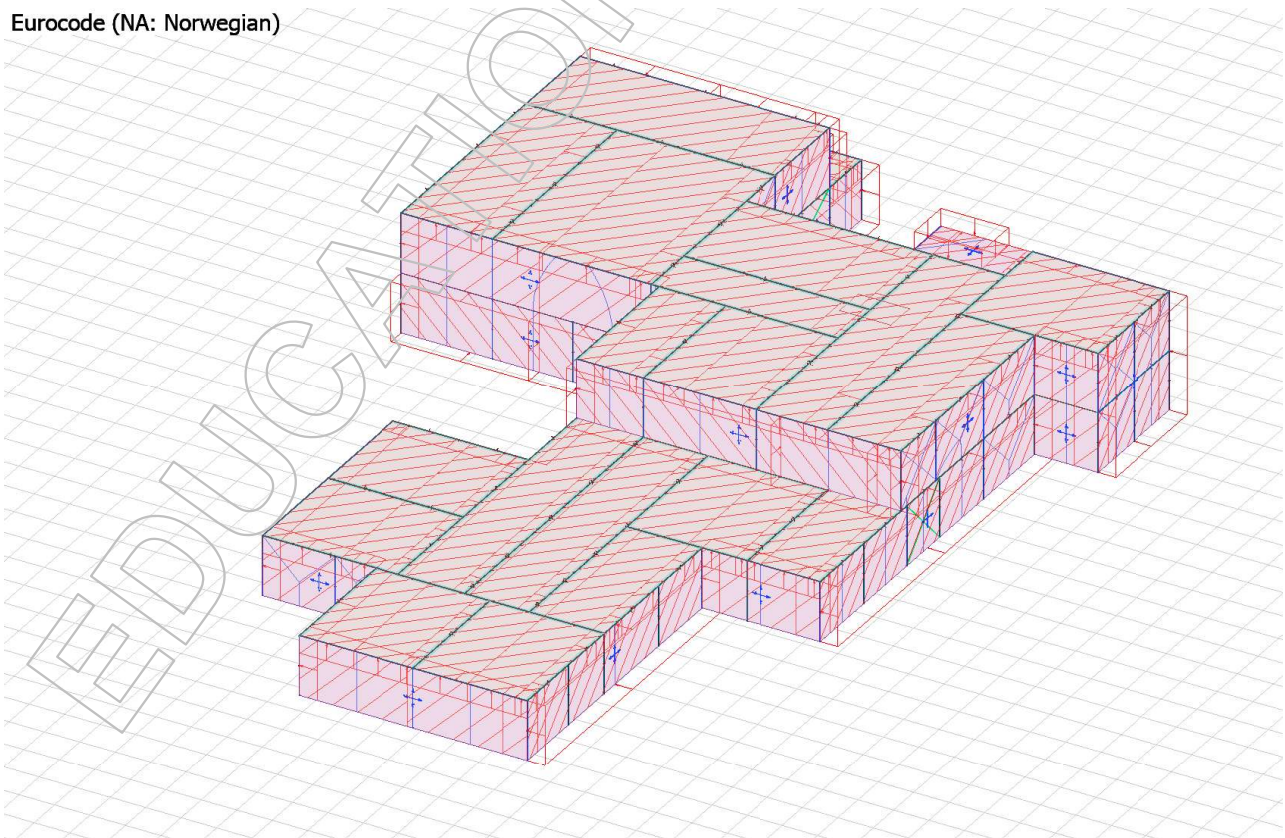
Eurocode (NA: Norwegian)



2.2.7 Vindlast Vest



2.2.8 Vindlast Øst



2.3 Lastkombinasjoner

Load combinations

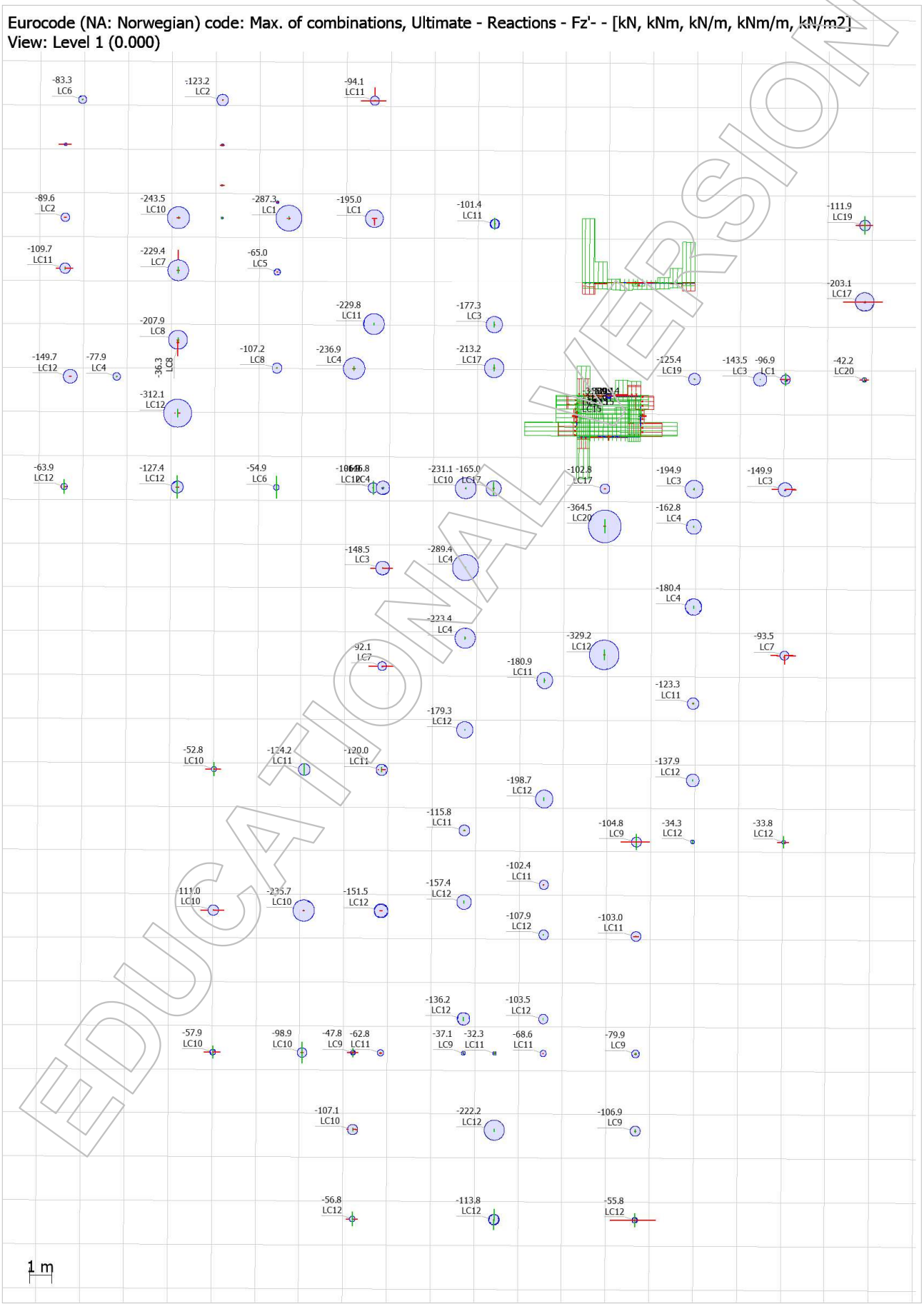
No.	Name	Type	Factor	Load cases
1	B1 Dominerende Snølast, Vindlast fra Vest	Ultimate	1.350	Egenlast (+Struc. dead load)
			1.350	Egenlast påført
			1.350	Egenlast solceller
			0.900	Vest (X+)
			1.050	Nyttelast
			1.050	Snølast
2	B1 Dominerende Snølast, Vindlast fra Øst	Ultimate	1.350	Egenlast (+Struc. dead load)
			1.350	Egenlast påført
			1.350	Egenlast solceller
			0.900	Øst (X-)
			1.050	Nyttelast
			1.050	Snølast
3	B1 Dominerende Snølast, Vindlast fra Sør	Ultimate	1.350	Egenlast (+Struc. dead load)
			1.350	Egenlast påført
			1.350	Egenlast solceller
			0.900	Sør (Y+)
			1.050	Nyttelast
			1.050	Snølast
4	B1 Dominerende Snølast, Vindlast fra Nord	Ultimate	1.350	Egenlast (+Struc. dead load)
			1.350	Egenlast påført
			1.350	Egenlast solceller
			0.900	Nord (Y-)
			1.050	Nyttelast
			1.050	Snølast
5	B1 Dominerende Vindlast, Vindlast fra Vest	Ultimate	1.350	Egenlast (+Struc. dead load)
			1.350	Egenlast påført
			1.350	Egenlast solceller
			1.050	Vest (X+)
			1.050	Nyttelast
			1.050	Snølast
6	B1 Dominerende Vindlast, Vindlast fra Øst	Ultimate	1.350	Egenlast (+Struc. dead load)
			1.350	Egenlast påført
			1.350	Egenlast solceller
			1.050	Øst (X-)
			1.050	Nyttelast
			1.050	Snølast
7	B1 Dominerende Vindlast, Vindlast fra Sør	Ultimate	1.350	Egenlast (+Struc. dead load)
			1.350	Egenlast påført
			1.350	Egenlast solceller
			1.050	Sør (Y+)
			1.050	Nyttelast
			1.050	Snølast
8	B1 Dominerende Vindlast, Vindlast fra Nord	Ultimate	1.350	Egenlast (+Struc. dead load)
			1.350	Egenlast påført
			1.350	Egenlast solceller
			1.050	Nord (Y-)
			1.050	Nyttelast
			1.050	Snølast
9	B2 Dominerende Snølast, Vindlast fra Vest	Ultimate	1.200	Egenlast (+Struc. dead load)
			1.200	Egenlast påført
			1.200	Egenlast solceller

No.	Name	Type	Factor	Load cases
			0.900	Vest (X+)
			1.050	Nyttelast
			1.500	Snølast
10	B2 Dominerende Snølast, Vindlast fra Øst	Ultimate	1.200	Egenlast (+Struc. dead load)
			1.200	Egenlast påført
			1.200	Egenlast solceller
			0.900	Øst (X-)
			1.050	Nyttelast
			1.500	Snølast
11	B2 Dominerende Snølast, Vindlast fra Sør	Ultimate	1.200	Egenlast (+Struc. dead load)
			1.200	Egenlast påført
			1.200	Egenlast solceller
			0.900	Sør (Y+)
			1.050	Nyttelast
			1.500	Snølast
12	B2 Dominerende Snølast, Vindlast fra Nord	Ultimate	1.200	Egenlast (+Struc. dead load)
			1.200	Egenlast påført
			1.200	Egenlast solceller
			0.900	Nord (Y-)
			1.050	Nyttelast
			1.500	Snølast
13	B2 Dominerende Vindlast, Vindlast fra Vest	Ultimate	1.200	Egenlast (+Struc. dead load)
			1.200	Egenlast påført
			1.200	Egenlast solceller
			1.500	Vest (X+)
			1.050	Nyttelast
			1.050	Snølast
14	B2 Dominerende Vindlast, Vindlast fra Øst	Ultimate	1.200	Egenlast (+Struc. dead load)
			1.200	Egenlast påført
			1.200	Egenlast solceller
			1.500	Øst (X-)
			1.050	Nyttelast
			1.050	Snølast
15	B2 Dominerende Vindlast, Vindlast fra Sør	Ultimate	1.200	Egenlast (+Struc. dead load)
			1.200	Egenlast påført
			1.200	Egenlast solceller
			1.500	Sør (Y+)
			1.050	Nyttelast
			1.050	Snølast
16	B2 Dominerende Vindlast, Vindlast fra Nord	Ultimate	1.200	Egenlast (+Struc. dead load)
			1.200	Egenlast påført
			1.200	Egenlast solceller
			1.500	Nord (Y-)
			1.050	Nyttelast
			1.050	Snølast
17	B2 Dominerende Nyttelast, Vindlast fra Vest	Ultimate	1.200	Egenlast (+Struc. dead load)
			1.200	Egenlast påført
			1.200	Egenlast solceller
			0.900	Vest (X+)
			1.500	Nyttelast
			1.050	Snølast
18	B2 Dominerende Nyttelast, Vindlast fra Øst	Ultimate	1.200	Egenlast (+Struc. dead load)
			1.200	Egenlast påført

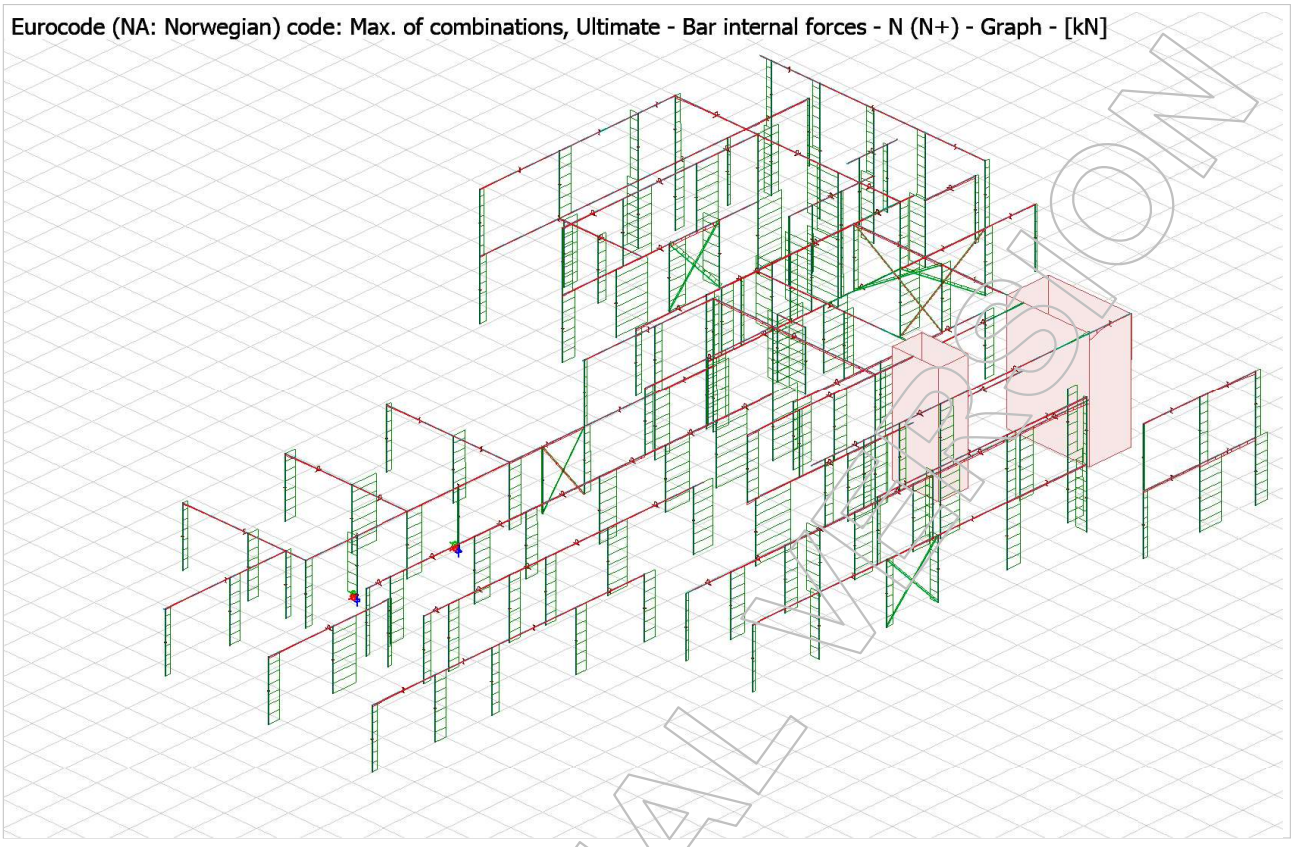
No.	Name	Type	Factor	Load cases
			1.200	Egenlast solceller
			0.900	Øst (X-)
			1.500	Nyttelast
			1.050	Snølast
19	B2 Dominerende Nyttelast, Vindlast fra Sør	Ultimate	1.200	Egenlast (+Struc. dead load)
			1.200	Egenlast påført
			1.200	Egenlast solceller
			0.900	Sør (Y+)
			1.500	Nyttelast
			1.050	Snølast
20	B2 Dominerende Nyttelast, Vindlast fra Nord	Ultimate	1.200	Egenlast (+Struc. dead load)
			1.200	Egenlast påført
			1.200	Egenlast solceller
			0.900	Nord (Y-)
			1.500	Nyttelast
			1.050	Snølast
21	Bruddgrense, Vindlast fra Vest	Quasi-permanent	1.000	Egenlast (+Struc. dead load)
			1.000	Egenlast påført
			1.000	Egenlast solceller
			0.600	Vest (X+)
			0.600	Nyttelast
			0.600	Snølast
22	Bruddgrense, Vindlast fra Øst	Quasi-permanent	1.000	Egenlast (+Struc. dead load)
			1.000	Egenlast påført
			1.000	Egenlast solceller
			0.600	Øst (X-)
			0.600	Nyttelast
			0.600	Snølast
23	Bruddgrense, Vindlast fra Sør	Quasi-permanent	1.000	Egenlast (+Struc. dead load)
			1.000	Egenlast påført
			1.000	Egenlast solceller
			0.600	Sør (Y+)
			0.600	Nyttelast
			0.600	Snølast
24	Bruddgrense, Vindlast fra Nord	Quasi-permanent	1.000	Egenlast (+Struc. dead load)
			1.000	Egenlast påført
			1.000	Egenlast solceller
			0.600	Nord (Y-)
			0.600	Nyttelast
			0.600	Snølast

3 Resultater

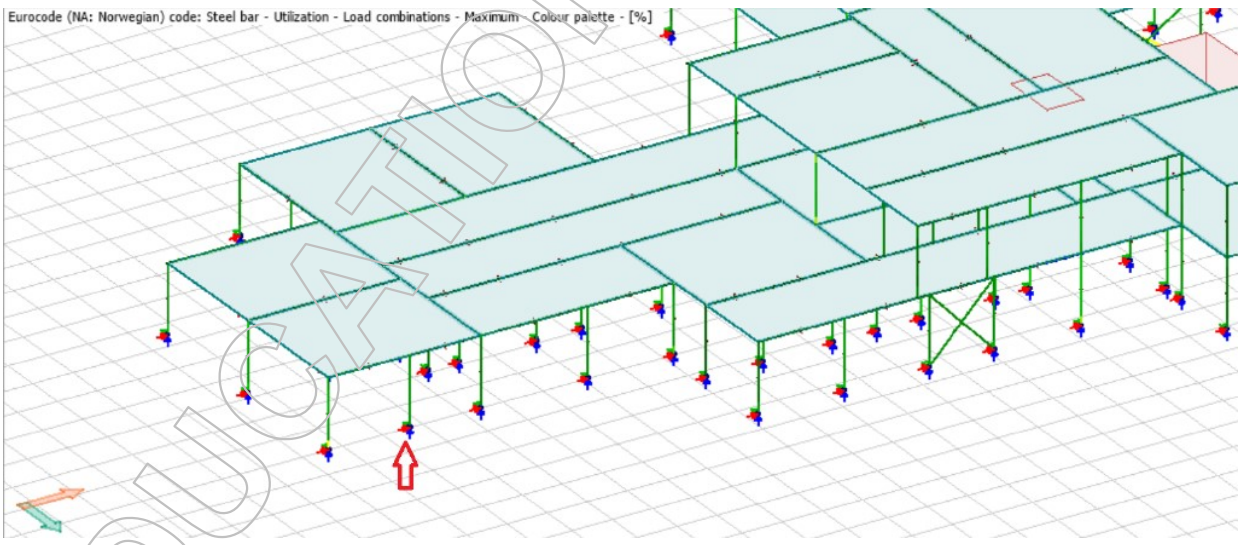
3.1 Krefter Punktfundament



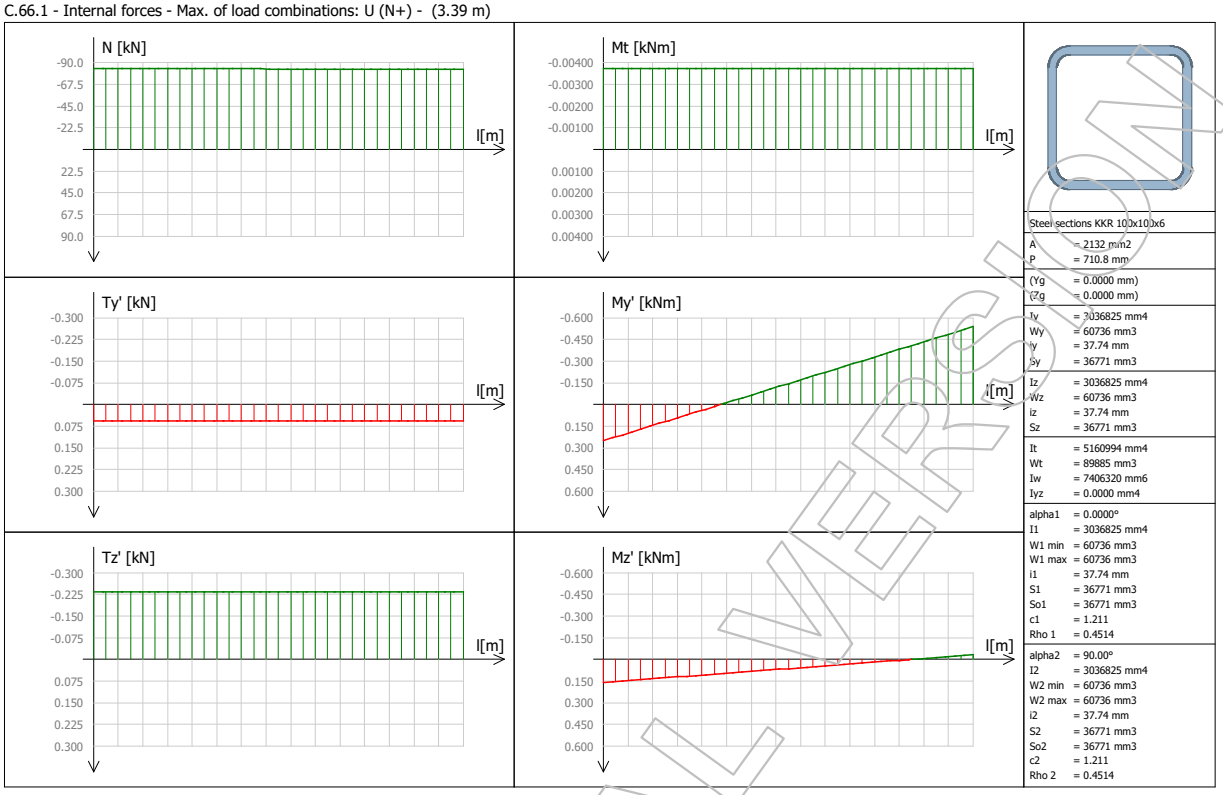
3.2 Søyler



3.2.1 Søyle C.66.1



C.66.1 - Internal forces - Max. of load combinations: U (N+) - (3.39 m)



Steel sections KKR 100x100x6	
A	= 2132 mm2
P	= 710.8 mm
(Yg	= 0.0000 mm)
(Zg	= 0.0000 mm)
Iy	= 3036825 mm4
Wy	= 60736 mm3
iy	= 37.74 mm
Sy	= 36771 mm3
Iz	= 3036825 mm4
Wz	= 60736 mm3
iz	= 37.74 mm
Sz	= 36771 mm3
It	= 5160994 mm4
Wt	= 89885 mm3
Iw	= 7406320 mm6
Iyz	= 0.0000 mm4
alpha1	= 0.0000°
I1	= 3036825 mm4
W1 min	= 60736 mm3
W1 max	= 60736 mm3
i1	= 37.74 mm
S1	= 36771 mm3
So1	= 36771 mm3
c1	= 1.211
Rho 1	= 0.4514
alpha2	= 90.00°
I2	= 3036825 mm4
W2 min	= 60736 mm3
W2 max	= 60736 mm3
i2	= 37.74 mm
S2	= 36771 mm3
So2	= 36771 mm3
c2	= 1.211
Rho 2	= 0.4514

C.66.1
Maximum of load combinations

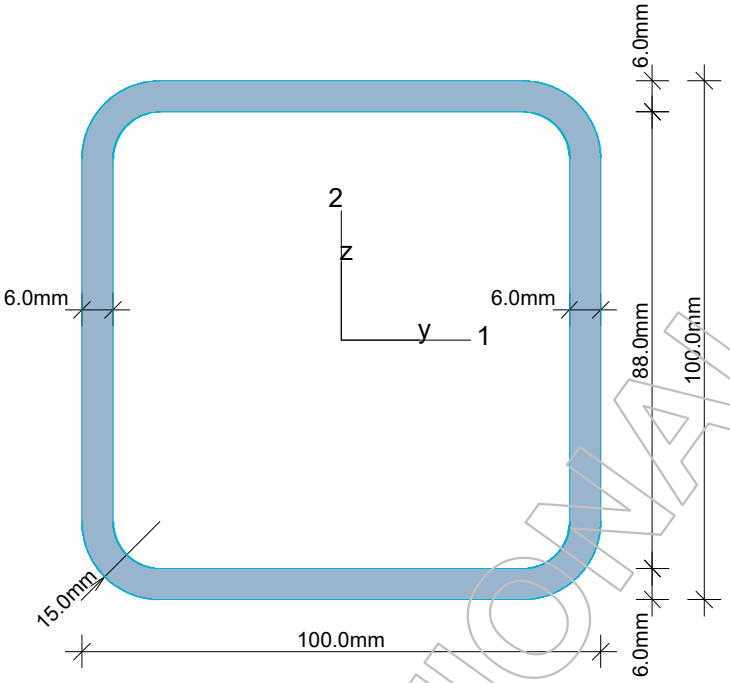
S 355

$E = 210000\ N/mm^2$

$G = 80769\ N/mm^2$

$\gamma_{M0,ult}$	= 1.05	$\gamma_{M0,acc/seis}$	= 1.00
$\gamma_{M1,ult}$	= 1.05	$\gamma_{M1,acc/seis}$	= 1.00
$\gamma_{M2,ult}$	= 1.25	$\gamma_{M2,acc/seis}$	= 1.00

KKR 100x100x6



P	=	374 mm	f_y	=	355 N/mm^2
A	=	2132 mm^2	ε	=	0.81
I_y	=	3.037e+06 mm^4	λ_1	=	76.40
I_z	=	3.037e+06 mm^4			
I_1	=	3.037e+06 mm^4			
I_2	=	3.037e+06 mm^4			
$W_{pl,1}$	=	7.354e+04 mm^3			
$W_{pl,2}$	=	7.354e+04 mm^3			
$W_{el,min,1}$	=	6.074e+04 mm^3			
$W_{el,min,2}$	=	6.074e+04 mm^3			
i_1	=	38 mm			
i_2	=	38 mm			
I_t	=	5.161e+06 mm^4			
I_w	=	7.406e+06 mm^6			

Shear resistance, 1-1 - Part 1-1: 6.2.6, 6.2.8

LC: 'B2 Dominerende Vindlast, Vindlast fra Vest', x = 2906 mm

$Class_N = 1$, $Class_{M1} = 1$, $Class_{M2} = 1$

$$V_{1,pl,Rd} = \frac{A_{1,v} \cdot f_y}{\sqrt{3} \cdot \gamma_{M0}} = \frac{1066 \cdot 355}{\sqrt{3} \cdot 1.05} = 208.12\ kN \quad (6.18)$$

$$V_{1,pl,T,Rd} = 1 - \frac{\tau_{t,Ed}}{(f_y / \sqrt{3}) / \gamma_{M0}} \cdot V_{1,pl,Rd} = 1 - \frac{0.07}{(355 / \sqrt{3}) / 1.05} \cdot 208.12 = 208.04\ kN \quad (6.28)$$

$$\frac{V_{1,Ed}}{V_{1,pl,T,Rd}} = \frac{0.09}{208.04} = 0.00 \le 1.00 \quad (6.25) - OK$$

Shear resistance, 2-2 - Part 1-1: 6.2.6, 6.2.8

LC: 'B2 Dominerende Snølast, Vindlast fra Vest', x = 2906 mm

$Class_N = 1$, $Class_{M1} = 1$, $Class_{M2} = 1$

$$V_{2,pl,Rd} = \frac{A_{2,v} \cdot f_y}{\sqrt{3} \cdot \gamma_{M0}} = \frac{1066 \cdot 355}{\sqrt{3} \cdot 1.05} = 208.12\ kN \quad (6.18)$$

$$V_{2,pl,T,Rd} = 1 - \frac{\tau_{t,Ed}}{(f_y / \sqrt{3}) / \gamma_{M0}} \cdot V_{2,pl,Rd} = 1 - \frac{0.04}{(355 / \sqrt{3}) / 1.05} \cdot 208.12 = 208.07\ kN \quad (6.28)$$

$$\frac{V_{2,Ed}}{V_{2,pl,T,Rd}} = \frac{0.31}{208.07} = 0.00 \le 1.00 \quad (6.25) - OK$$

Torsional resistance - Part 1-1: 6.2.7
LC: 'B2 Dominerende Vindlast, Vindlast fra Vest', x = 2906 mm

$Class_N = 1$, $Class_{M1} = 1$, $Class_{M2} = 1$

$\tau_{max,unit} = 11.13 \frac{N/mm^2}{kNm}$ is calculated by FEM analysis.

$$T_{Rd} = \frac{f_y}{\sqrt{3} \cdot \tau_{max,unit} \cdot \gamma_{M0}} = \frac{355}{\sqrt{3} \cdot 11.13 \cdot 1.05} = 17.55 \text{ kNm}$$

$$\frac{T_{Ed}}{T_{Rd}} = \frac{0.01}{17.55} = 0.00 \leq 1.00 \quad (6.23) \text{ - OK}$$

Shear stress - Part 1-1: 6.2.6
Not relevant

Normal stress - Part 1-1: 6.2.1
Not relevant

Pure normal resistance - Part 1-1: 6.2.3, 6.2.4
Not relevant

Normal capacity - Part 1-1: 6.2
LC: 'B2 Dominerende Snølast, Vindlast fra Vest', x = 3390 mm

$Class_N = 1$, $Class_{M1} = 1$, $Class_{M2} = 1$

$V_{1,Ed} = 0.06 \text{ kN} \leq 0.5 \cdot V_{1,pl,T,Rd} = 0.5 \cdot 208.07 = 104.04 \text{ kN} \rightarrow \rho_1 = 0.00$

$V_{2,Ed} = 0.31 \text{ kN} \leq 0.5 \cdot V_{2,pl,T,Rd} = 0.5 \cdot 208.07 = 104.04 \text{ kN} \rightarrow \rho_2 = 0.00$

$$\frac{N_{Ed}}{N_{Rd}} + \frac{M_{1,Ed}}{M_{1,Rd}} + \frac{M_{2,Ed}}{M_{2,Rd}} = \frac{106.20}{720.95} + \frac{0.70}{24.86} + \frac{0.01}{24.86} = 0.18 \leq 1.00 \quad (6.2) \text{ - OK}$$

Flexural buckling, 1-1 - Part 1-1: 6.3.1
LC: 'B2 Dominerende Snølast, Vindlast fra Vest', x = 0 mm

$Class_N = 1$, $Class_{M1} = 1$, $Class_{M2} = 1$

$$\bar{\lambda}_1 = \frac{L_{cr,1}}{i_1 \cdot \lambda_1} = \frac{3390}{38 \cdot 76.40} = 1.18 \quad (6.50)$$

$\alpha_1 = 0.49$ (Buckling curve: c)

$$\varphi_1 = 0.5 \left[1 + \alpha_1 \cdot (\bar{\lambda}_1 - 0.2) + \bar{\lambda}_1^2\right] = 0.5 \left[1 + 0.49 \cdot (1.18 - 0.2) + 1.18^2\right] = 1.43$$

$$\chi_1 = \min\left(\frac{1}{\varphi_1 + \sqrt{\varphi_1^2 - \bar{\lambda}_1^2}}, 1.0\right) = \min\left(\frac{1}{1.43 + \sqrt{1.43^2 - 1.18^2}}, 1.0\right) = 0.45 \quad (6.49)$$

$$N_{b,Rd,1} = \frac{\chi_1 \cdot A \cdot f_y}{\gamma_{M1}} = \frac{0.45 \cdot 2132 \cdot 355}{1.05} = 321.14 \text{ kN} \quad (6.47)$$

$$\frac{N_{Ed}}{N_{b,Rd,1}} = \frac{106.86}{321.14} = 0.33 \leq 1.00 \quad (6.46) \text{ - OK}$$

Flexural buckling, 2-2 - Part 1-1: 6.3.1
LC: 'B2 Dominerende Snølast, Vindlast fra Vest', x = 0 mm

$Class_N = 1$, $Class_{M1} = 1$, $Class_{M2} = 1$

$$\bar{\lambda}_2 = \frac{L_{cr,2}}{i_2 \cdot \lambda_1} = \frac{3390}{38 \cdot 76.40} = 1.18 \quad (6.50)$$

$\alpha_2 = 0.49$ (Buckling curve: c)

$$\varphi_2 = 0.5 \left[1 + \alpha_2 \cdot \left(\bar{\lambda}_2 - 0.2\right) + \bar{\lambda}_2^{\,2}\right] = 0.5 \left[1 + 0.49 \cdot (1.18 - 0.2) + 1.18^2\right] = 1.43$$

$$\chi_2 = \min\left(\frac{1}{\varphi_2 + \sqrt{\varphi_2^{\,2} - \bar{\lambda}_2^{\,2}}}, 1.0\right) = \min\left(\frac{1}{1.43 + \sqrt{1.43^2 - 1.18^2}}, 1.0\right) = 0.45 \quad (6.49)$$

$$N_{b,Rd,2} = \frac{\chi_2 \cdot A \cdot f_y}{\gamma_{M1}} = \frac{0.45 \cdot 2132 \cdot 355}{1.05} = 321.14 \text{ kN} \quad (6.47)$$

$$\frac{N_{Ed}}{N_{b,Rd,2}} = \frac{106.86}{321.14} = 0.33 \leq 1.00 \quad (6.46) \text{ - OK}$$

Torsional-flexural buckling - Part 1-1: 6.3.1
LC: 'B2 Dominerende Snølast, Vindlast fra Vest', x = 0 mm

$Class_N = 1$, $Class_{M1} = 1$, $Class_{M2} = 1$

$$i_0 = \sqrt{i_1^{\,2} + i_2^{\,2} + y_0^{\,2} + z_0^{\,2}} = \sqrt{38^2 + 38^2 + 0^2 + 0^2} = 53 \text{ mm}$$

$$N_{cr,1} = \frac{\pi^2 \cdot E \cdot I_1}{L_{cr,1}^{\,2}} = \frac{\pi^2 \cdot 210000 \cdot 3036825}{3390^2} = 547.63 \text{ kN}$$

$$N_{cr,2} = \frac{\pi^2 \cdot E \cdot I_2}{L_{cr,2}^{\,2}} = \frac{\pi^2 \cdot 210000 \cdot 3036825}{3390^2} = 547.63 \text{ kN}$$

$$N_{cr,T} = \frac{1}{i_0^{\,2}}\left(G \cdot I_t + \frac{\pi^2 \cdot E \cdot I_w}{L_t^{\,2}}\right) =$$

$$= \frac{1}{53^2}\left(80769 \cdot 5.161e{+}06 + \frac{\pi^2 \cdot 210000 \cdot 7.406e{+}06}{3390^2}\right) = 146351.61 \text{ kN}$$

$$i_0^{\,2} (N - N_{cr,1}) (N - N_{cr,2}) (N - N_{cr,T}) - N^2 y_0^{\,2} (N - N_{cr,2}) - N^2 z_0^{\,2} (N - N_{cr,1}) =$$

$$= 53^2 (N - 547.63) (N - 547.63) (N - 146351.61) - N^2 0^2 (N - 547.63) - N^2 0^2 (N - 547.63) = 0$$

Smallest root of the above equation related to the torsional-flexural buckling:

$N_{cr,TF} = 146351.61$ kN

$N_{cr} = \min(N_{cr,T}, N_{cr,TF}) = \min(146351.61, 146351.61) = 146351.61$ kN

$$\bar{\lambda}_T = \sqrt{\frac{A \cdot f_y}{N_{cr}}} = \sqrt{\frac{2132 \cdot 355}{146351.61}} = 0.07 \quad (6.53)$$

$\alpha_T = 0.49$ (Buckling curve: c)

$$\varphi_T = 0.5 \left[1 + \alpha_T \cdot \left(\bar{\lambda}_T - 0.2\right) + \bar{\lambda}_T^{\,2}\right] = 0.5 \left[1 + 0.49 \cdot (0.07 - 0.2) + 0.07^2\right] = 0.47$$

$$\chi_T = \min\left(\frac{1}{\varphi_T + \sqrt{\varphi_T^{\,2} - \bar{\lambda}_T^{\,2}}}, 1.0\right) = \min\left(\frac{1}{0.47 + \sqrt{0.47^2 - 0.07^2}}, 1.0\right) = 1.00 \quad (6.49)$$

$$N_{b,Rd,T} = \frac{\chi_T \cdot A \cdot f_y}{\gamma_{M1}} = \frac{1.00 \cdot 2132 \cdot 355}{1.05} = 720.95 \text{ kN} \quad (6.47)$$

$$\frac{N_{Ed}}{N_{b,Rd,T}} = \frac{106.86}{720.95} = 0.15 \leq 1.00 \text{ - OK}$$

Lateral torsional buckling, top flange - Part 1-1: 6.3.2.2
LC: 'B2 Dominerende Snølast, Vindlast fra Vest', x = 0 mm

$Class_N = 1$, $Class_{M1} = 1$, $Class_{M2} = 1$

$$N_{cr,LT} = \frac{\pi^2 \cdot E \cdot I_z}{(k_z \cdot L_{cr})^2} = \frac{\pi^2 \cdot 2.100e+05 \cdot 3.037e+06}{(1.00 \cdot 3390)^2} = 547.63 \text{ kN}$$

Loaded on top edge.

$$Z = (C_2 \cdot z_g - C_3 \cdot z_j) = (0.00 \cdot 50 - 0.67 \cdot 0) = 0.00 \text{ mm}$$

$$M_{cr} = C_1 \cdot N_{cr,LT} \cdot \left\{ \left[\left(\frac{k_z}{k_w} \right)^2 \cdot \frac{I_w}{I_z} + \frac{G \cdot I_t}{N_{cr,LT}} + Z^2 \right]^{0.5} - Z \right\} =$$

$$= 2.34 \cdot 5.476e+05 \cdot \left\{ \left[\left(\frac{1.00}{1.00} \right)^2 \cdot \frac{7.406e+06}{3.037e+06} + \frac{8.077e+04 \cdot 5.161e+06}{5.476e+05} + 0.00^2 \right]^{0.5} - 0.00 \right\} =$$

$$= 1118.07 \text{ kNm}$$

$$\bar{\lambda}_{LT} = \sqrt{\frac{W_y \cdot f_y}{M_{cr}}} = \sqrt{\frac{73542 \cdot 355}{1.118e+09}} = 0.15$$

$\alpha_{LT} = 0.76$ (Buckling curve: d)

$$\varphi_{LT} = 0.5 \left[1 + \alpha_{LT} \cdot (\bar{\lambda}_{LT} - 0.2) + \bar{\lambda}_{LT}^2 \right] =$$

$$= 0.5 \left[1 + 0.76 \cdot (0.15 - 0.2) + 0.15^2 \right] = 0.49$$

$$\chi_{LT} = \min\left(\frac{1}{\varphi_{LT} + \sqrt{\varphi_{LT}^2 - \bar{\lambda}_{LT}^2}}, 1.0 \right) = \min\left(\frac{1}{0.49 + \sqrt{0.49^2 - 0.15^2}}, 1.0 \right) = 1.00 \quad (6.56)$$

$$M_{y,b,Rd} = \frac{\chi_{LT} \cdot W_y \cdot f_y}{\gamma_{M1}} = \frac{1.00 \cdot 73542 \cdot 355}{1.05} = 24.86 \text{ kNm} \quad (6.55)$$

$$\frac{M_{1,Ed}}{M_{y,b,Rd}} = \frac{0.36}{24.86} = 0.01 \leq 1.00 \quad (6.54) \text{ - OK}$$

Lateral torsional buckling, bottom flange - Part 1-1: 6.3.2.2

LC: 'B2 Dominerende Snølast, Vindlast fra Vest', x = 3390 mm

$Class_N = 1$, $Class_{M1} = 1$, $Class_{M2} = 1$

$$N_{cr,LT} = \frac{\pi^2 \cdot E \cdot I_z}{(k_z \cdot L_{cr})^2} = \frac{\pi^2 \cdot 2.100e+05 \cdot 3.037e+06}{(1.00 \cdot 3390)^2} = 547.63 \text{ kN}$$

Loaded on top edge.

$$Z = (C_2 \cdot z_g - C_3 \cdot z_j) = (0.00 \cdot 50 - 0.67 \cdot 0) = 0.00 \text{ mm}$$

$$M_{cr} = C_1 \cdot N_{cr,LT} \cdot \left\{ \left[\left(\frac{k_z}{k_w} \right)^2 \cdot \frac{I_w}{I_z} + \frac{G \cdot I_t}{N_{cr,LT}} + Z^2 \right]^{0.5} - Z \right\} =$$

$$= 2.34 \cdot 5.476e+05 \cdot \left\{ \left[\left(\frac{1.00}{1.00} \right)^2 \cdot \frac{7.406e+06}{3.037e+06} + \frac{8.077e+04 \cdot 5.161e+06}{5.476e+05} + 0.00^2 \right]^{0.5} - 0.00 \right\} =$$

$$= 1118.07 \text{ kNm}$$

$$\bar{\lambda}_{LT} = \sqrt{\frac{W_y \cdot f_y}{M_{cr}}} = \sqrt{\frac{73542 \cdot 355}{1.118e+09}} = 0.15$$

$\alpha_{LT} = 0.76$ (Buckling curve: d)

$$\varphi_{LT} = 0.5 \left[1 + \alpha_{LT} \cdot (\bar{\lambda}_{LT} - 0.2) + \bar{\lambda}_{LT}^2 \right] =$$

$$= 0.5 \left[1 + 0.76 \cdot (0.15 - 0.2) + 0.15^2 \right] = 0.49$$

$$\chi_{LT} = \min\left(\frac{1}{\varphi_{LT} + \sqrt{\varphi_{LT}^2 - \bar{\lambda}_{LT}^2}}, 1.0 \right) = \min\left(\frac{1}{0.49 + \sqrt{0.49^2 - 0.15^2}}, 1.0 \right) = 1.00 \quad (6.56)$$

$$M_{y,b,Rd} = \frac{\chi_{LT} \cdot W_y \cdot f_y}{\gamma_{M1}} = \frac{1.00 \cdot 73542 \cdot 355}{1.05} = 24.86 \text{ kNm} \quad (6.55)$$

$$\frac{M_{1,Ed}}{M_{y,b,Rd}} = \frac{0.70}{24.86} = 0.03 \leq 1.00 \quad (6.54) \text{ - OK}$$

Interaction between normal force and bending 1. - Part 1-1: 6.3.3

LC: 'B2 Dominerende Snølast, Vindlast fra Vest', x = 3390 mm

$Class_N = 1$, $Class_{M1} = 1$, $Class_{M2} = 1$

k_{ij} factors are calculated according to Method 1

C_{my}	= 0.62	C_{yy}	= 1.02
C_{mz}	= 0.75	C_{yz}	= 0.93
C_{mLT}	= 1.00	C_{zy}	= 0.97
		C_{zz}	= 1.00

$$M_{2,Rk} = f_y \cdot W_{pl,2} = 355 \cdot 73542 = 26.11 \text{ kNm}$$

$$\frac{N_{Ed}^{comp}}{N_{b,Rd,1}} + k_{11} \cdot \frac{M_{1,Ed}}{M_{y,b,Rd}} + k_{12} \cdot \frac{M_{2,Ed}}{\frac{M_{2,Rk}}{\gamma_{M1}}} =$$

$$= \frac{106.20}{321.14} + 0.67 \cdot \frac{0.70}{24.86} + 0.53 \cdot \frac{0.01}{\frac{26.11}{1.05}} = 0.35 \leq 1.00 \quad (6.61) \text{ - OK}$$

Interaction between normal force and bending 2. - Part 1-1: 6.3.3

LC: 'B2 Dominerende Snølast, Vindlast fra Vest', x = 0 mm

$Class_N = 1$, $Class_{M1} = 1$, $Class_{M2} = 1$

k_{ij} factors are calculated according to Method 1

C_{my}	= 0.62	C_{yy}	= 1.02
C_{mz}	= 0.75	C_{yz}	= 0.93
C_{mLT}	= 1.00	C_{zy}	= 0.97
		C_{zz}	= 1.00

$M_{2,Rk} = f_y \cdot W_{pl,2} = 355 \cdot 73542 = 26.11$ kNm

$$\frac{N_{Ed}^{comp}}{N_{b,Rd,2}} + k_{21} \cdot \frac{M_{1,Ed}}{M_{y,b,Rd}} + k_{22} \cdot \frac{M_{2,Ed}}{\frac{M_{2,Rk}}{\gamma_{M1}}} =$$

$$= \frac{106.86}{321.14} + 0.42 \cdot \frac{0.36}{24.86} + 0.82 \cdot \frac{0.18}{\frac{26.11}{1.05}} = 0.34 \leq 1.00 \quad (6.62) - \text{OK}$$

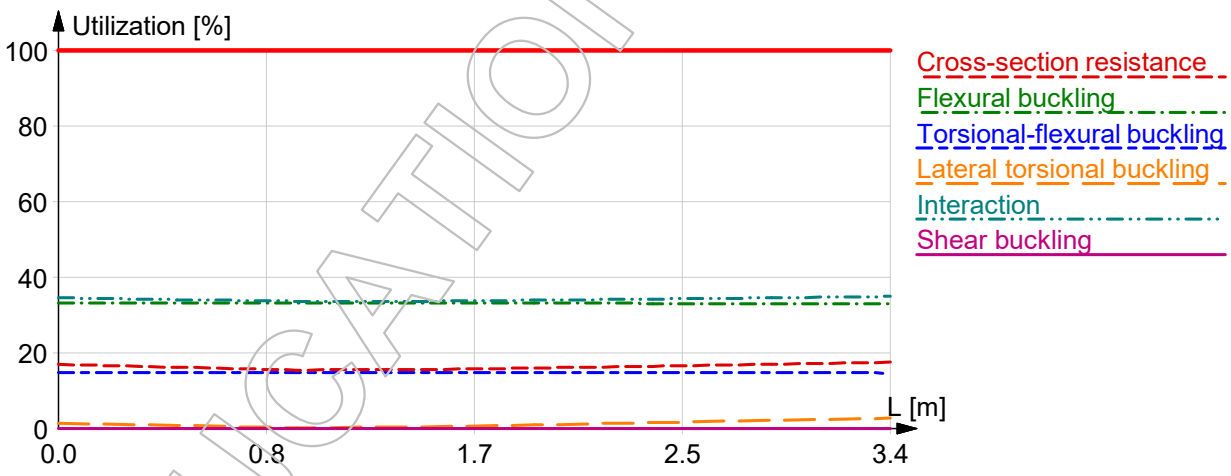
Interaction between normal force and bending, 2nd order - Part 1-1: 6.3.3

Not relevant

Shear buckling - Part 1-5: 5

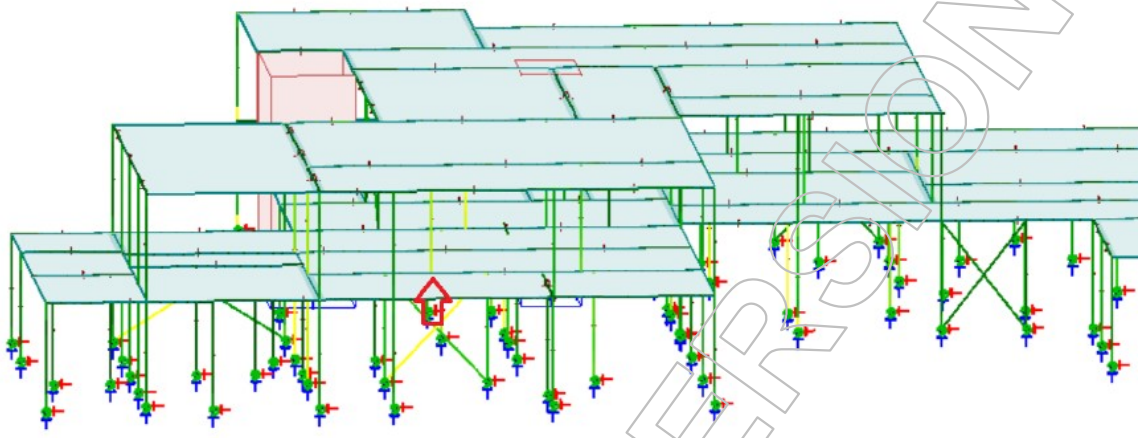
$$\frac{h_w}{t} = \frac{88}{6} = 14.7 \leq \frac{72}{\eta} \cdot \varepsilon = \frac{72}{1.20} \cdot 0.81 = 48.8 \rightarrow \quad \text{Not relevant}$$

Summary

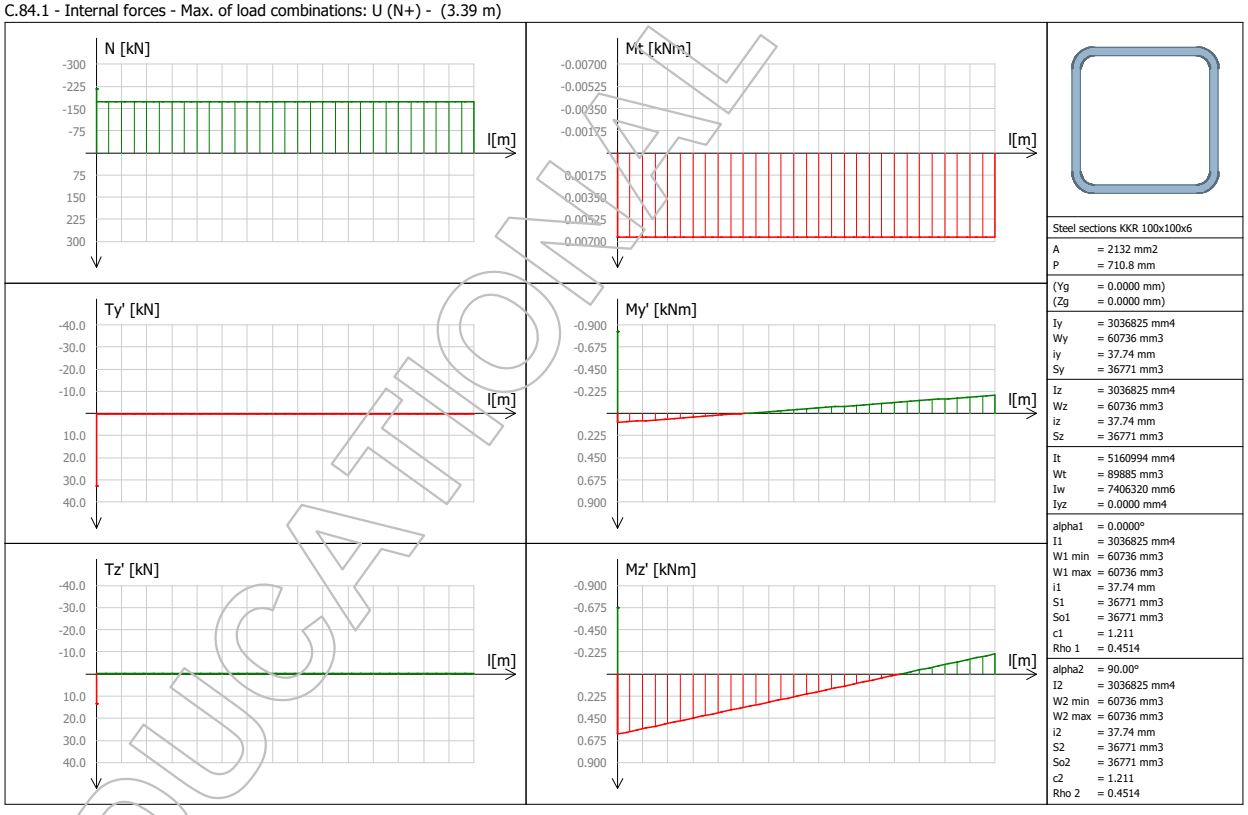


3.2.2 Søyle C.84.1

Eurocode (NA: Norwegian) code: Steel bar - Utilization - Load combinations - Maximum - Colour palette - [%]



C.84.1 - Internal forces - Max. of load combinations: U (N+) - (3.39 m)



Steel sections KKR 100x100x6	
A	= 2132 mm2
P	= 710.8 mm
(Yg	= 0.0000 mm)
(Zg	= 0.0000 mm)
Iy	= 3036825 mm4
Wy	= 60736 mm3
iy	= 37.74 mm
Sy	= 36771 mm3
Iz	= 3036825 mm4
Wz	= 60736 mm3
iz	= 37.74 mm
Sz	= 36771 mm3
It	= 5160994 mm4
Wt	= 89885 mm3
Iw	= 7406320 mm6
Iyz	= 0.0000 mm4
alpha1	= 0.0000°
I1	= 3036825 mm4
W1 min	= 60736 mm3
W1 max	= 60736 mm3
i1	= 37.74 mm
S1	= 36771 mm3
So1	= 36771 mm3
c1	= 1.211
Rho 1	= 0.4514
alpha2	= 90.00°
I2	= 3036825 mm4
W2 min	= 60736 mm3
W2 max	= 60736 mm3
i2	= 37.74 mm
S2	= 36771 mm3
So2	= 36771 mm3
c2	= 1.211
Rho 2	= 0.4514

C.84.1
Maximum of load combinations

S 355

$E = 210000\ N/mm^2$

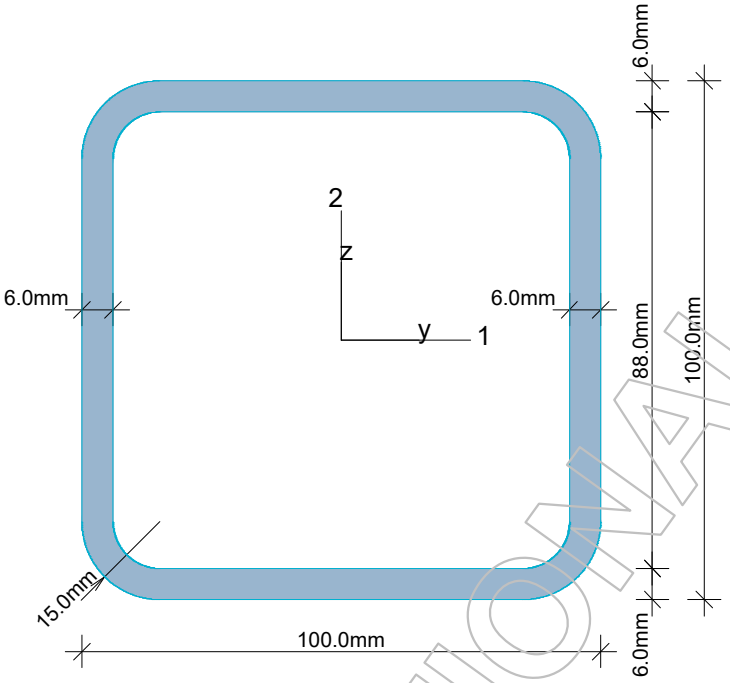
$G = 80769\ N/mm^2$

$\gamma_{M0,ult} = 1.05$ $\gamma_{M0,acc/seis} = 1.00$

$\gamma_{M1,ult} = 1.05$ $\gamma_{M1,acc/seis} = 1.00$

$\gamma_{M2,ult} = 1.25$ $\gamma_{M2,acc/seis} = 1.00$

KKR 100x100x6



P	=	374 mm	f_y	=	355 N/mm²
A	=	2132 mm²	ε	=	0.81
I_y	=	3.037e+06 mm⁴	λ_1	=	76.40
I_z	=	3.037e+06 mm⁴			
I_1	=	3.037e+06 mm⁴			
I_2	=	3.037e+06 mm⁴			
$W_{pl,1}$	=	7.354e+04 mm³			
$W_{pl,2}$	=	7.354e+04 mm³			
$W_{el,min,1}$	=	6.074e+04 mm³			
$W_{el,min,2}$	=	6.074e+04 mm³			
i_1	=	38 mm			
i_2	=	38 mm			
I_t	=	5.161e+06 mm⁴			
I_w	=	7.406e+06 mm⁶			

Shear resistance, 1-1 - Part 1-1: 6.2.6, 6.2.8

LC: 'B2 Dominerende Vindlast, Vindlast fra Vest', x = 0 mm

$Class_N = 1$, $Class_{M1} = 1$, $Class_{M2} = 1$

$$V_{1,pl,Rd} = \frac{A_{1,v} \cdot f_y}{\sqrt{3} \cdot \gamma_{M0}} = \frac{1066 \cdot 355}{\sqrt{3} \cdot 1.05} = 208.12\ kN \quad (6.18)$$

$$V_{1,pl,T,Rd} = 1 - \frac{\tau_{t,Ed}}{(f_y / \sqrt{3}) / \gamma_{M0}} \cdot V_{1,pl,Rd} = 1 - \frac{0.07}{(355 / \sqrt{3}) / 1.05} \cdot 208.12 = 208.04\ kN \quad (6.28)$$

$$\frac{V_{1,Ed}}{V_{1,pl,T,Rd}} = \frac{32.80}{208.04} = 0.16 \leq 1.00 \quad (6.25) - OK$$

Shear resistance, 2-2 - Part 1-1: 6.2.6, 6.2.8

LC: 'B2 Dominerende Vindlast, Vindlast fra Vest', x = 0 mm

$Class_N = 1$, $Class_{M1} = 1$, $Class_{M2} = 1$

$$V_{2,pl,Rd} = \frac{A_{2,v} \cdot f_y}{\sqrt{3} \cdot \gamma_{M0}} = \frac{1066 \cdot 355}{\sqrt{3} \cdot 1.05} = 208.12\ kN \quad (6.18)$$

$$V_{2,pl,T,Rd} = 1 - \frac{\tau_{t,Ed}}{(f_y / \sqrt{3}) / \gamma_{M0}} \cdot V_{2,pl,Rd} = 1 - \frac{0.07}{(355 / \sqrt{3}) / 1.05} \cdot 208.12 = 208.04\ kN \quad (6.28)$$

$$\frac{V_{2,Ed}}{V_{2,pl,T,Rd}} = \frac{13.44}{208.04} = 0.06 \leq 1.00 \quad (6.25) - OK$$

Torsional resistance - Part 1-1: 6.2.7
LC: 'B2 Dominerende Vindlast, Vindlast fra Vest', x = 2906 mm

$Class_N = 1$, $Class_{M1} = 1$, $Class_{M2} = 1$

$\tau_{max,unit} = 11.13 \frac{N/mm^2}{kNm}$ is calculated by FEM analysis.

$$T_{Rd} = \frac{f_y}{\sqrt{3} \cdot \tau_{max,unit} \cdot \gamma_{M0}} = \frac{355}{\sqrt{3} \cdot 11.13 \cdot 1.05} = 17.55 \text{ kNm}$$

$$\frac{T_{Ed}}{T_{Rd}} = \frac{0.01}{17.55} = 0.00 \leq 1.00 \quad (6.23) \text{ - OK}$$

Shear stress - Part 1-1: 6.2.6
Not relevant

Normal stress - Part 1-1: 6.2.1
Not relevant

Pure normal resistance - Part 1-1: 6.2.3, 6.2.4
Not relevant

Normal capacity - Part 1-1: 6.2
LC: 'B1 Dominerende Snølast, Vindlast fra Sør', x = 0 mm

$Class_N = 1$, $Class_{M1} = 1$, $Class_{M2} = 1$

$V_{1,Ed} = 9.80 \text{ kN} \leq 0.5 \cdot V_{1,pl,T,Rd} = 0.5 \cdot 208.08 = 104.04 \text{ kN} \rightarrow \rho_1 = 0.00$

$V_{2,Ed} = 0.14 \text{ kN} \leq 0.5 \cdot V_{2,pl,T,Rd} = 0.5 \cdot 208.08 = 104.04 \text{ kN} \rightarrow \rho_2 = 0.00$

$$\frac{N_{Ed}}{N_{Rd}} + \frac{M_{1,Ed}}{M_{1,Rd}} + \frac{M_{2,Ed}}{M_{2,Rd}} = \frac{268.88}{720.95} + \frac{1.12}{24.86} + \frac{0.51}{24.86} = 0.44 \leq 1.00 \quad (6.2) \text{ - OK}$$

Flexural buckling, 1-1 - Part 1-1: 6.3.1
LC: 'B2 Dominerende Snølast, Vindlast fra Sør', x = 0 mm

$Class_N = 1$, $Class_{M1} = 1$, $Class_{M2} = 1$

$$\bar{\lambda}_1 = \frac{L_{cr,1}}{i_1 \cdot \lambda_1} = \frac{3390}{38 \cdot 76.40} = 1.18 \quad (6.50)$$

$\alpha_1 = 0.49$ (Buckling curve: c)

$$\varphi_1 = 0.5 \left[1 + \alpha_1 \cdot (\bar{\lambda}_1 - 0.2) + \bar{\lambda}_1^2\right] = 0.5 \left[1 + 0.49 \cdot (1.18 - 0.2) + 1.18^2\right] = 1.43$$

$$\chi_1 = \min\left(\frac{1}{\varphi_1 + \sqrt{\varphi_1^2 - \bar{\lambda}_1^2}}, 1.0\right) = \min\left(\frac{1}{1.43 + \sqrt{1.43^2 - 1.18^2}}, 1.0\right) = 0.45 \quad (6.49)$$

$$N_{b,Rd,1} = \frac{\chi_1 \cdot A \cdot f_y}{\gamma_{M1}} = \frac{0.45 \cdot 2132 \cdot 355}{1.05} = 321.19 \text{ kN} \quad (6.47)$$

$$\frac{N_{Ed}}{N_{b,Rd,1}} = \frac{232.20}{321.19} = 0.72 \leq 1.00 \quad (6.46) \text{ - OK}$$

Flexural buckling, 2-2 - Part 1-1: 6.3.1

LC: 'B2 Dominerende Snølast, Vindlast fra Sør', x = 0 mm

$Class_N = 1$, $Class_{M1} = 1$, $Class_{M2} = 1$

$$\bar{\lambda}_2 = \frac{L_{cr,2}}{i_2 \cdot \lambda_1} = \frac{3390}{38 \cdot 76.40} = 1.18 \quad (6.50)$$

$\alpha_2 = 0.49$ (Buckling curve: c)

$$\varphi_2 = 0.5 \left[1 + \alpha_2 \cdot \left(\bar{\lambda}_2 - 0.2\right) + \bar{\lambda}_2^2\right] = 0.5 \left[1 + 0.49 \cdot (1.18 - 0.2) + 1.18^2\right] = 1.43$$

$$\chi_2 = \min\left(\frac{1}{\varphi_2 + \sqrt{\varphi_2^2 - \bar{\lambda}_2^2}}, 1.0\right) = \min\left(\frac{1}{1.43 + \sqrt{1.43^2 - 1.18^2}}, 1.0\right) = 0.45 \quad (6.49)$$

$$N_{b,Rd,2} = \frac{\chi_2 \cdot A \cdot f_y}{\gamma_{M1}} = \frac{0.45 \cdot 2132 \cdot 355}{1.05} = 321.19 \text{ kN} \quad (6.47)$$

$$\frac{N_{Ed}}{N_{b,Rd,2}} = \frac{232.20}{321.19} = 0.72 \leq 1.00 \quad (6.46) \text{ - OK}$$

Torsional-flexural buckling - Part 1-1: 6.3.1

LC: 'B2 Dominerende Snølast, Vindlast fra Sør', x = 0 mm

$Class_N = 1$, $Class_{M1} = 1$, $Class_{M2} = 1$

$$i_0 = \sqrt{i_1^2 + i_2^2 + y_0^2 + z_0^2} = \sqrt{38^2 + 38^2 + 0^2 + 0^2} = 53 \text{ mm}$$

$$N_{cr,1} = \frac{\pi^2 \cdot E \cdot I_1}{L_{cr,1}^2} = \frac{\pi^2 \cdot 210000 \cdot 3036825}{0^2} = 176532630546.46 \text{ kN}$$

$$N_{cr,2} = \frac{\pi^2 \cdot E \cdot I_2}{L_{cr,2}^2} = \frac{\pi^2 \cdot 210000 \cdot 3036825}{0^2} = 176532630546.46 \text{ kN}$$

$$N_{cr,T} = \frac{1}{i_0^2}\left(G \cdot I_t + \frac{\pi^2 \cdot E \cdot I_w}{L_t^2}\right) =$$

$$= \frac{1}{53^2}\left(80769 \cdot 5.161e{+}06 + \frac{\pi^2 \cdot 210000 \cdot 7.406e{+}06}{0^2}\right) = 151302028.64 \text{ kN}$$

$$i_0^2 (N - N_{cr,1})(N - N_{cr,2})(N - N_{cr,T}) - N^2 y_0^2 (N - N_{cr,2}) - N^2 z_0^2 (N - N_{cr,1}) =$$

$$= 53^2 (N - 176532630546.46)(N - 176532630546.46)(N - 151302028.64) - N^2 0^2 (N - 176532630546.46) - N^2 0^2 (N$$

$$= 0$$

Smallest root of the above equation related to the torsional-flexural buckling:

$N_{cr,TF} = 151302028.64$ kN

$N_{cr} = \min(N_{cr,T}, N_{cr,TF}) = \min(151302028.64, 151302028.64) = 151302028.64$ kN

$$\bar{\lambda}_T = \sqrt{\frac{A \cdot f_y}{N_{cr}}} = \sqrt{\frac{2132 \cdot 355}{151302028.64}} = 0.00 \quad (6.53)$$

$\alpha_T = 0.49$ (Buckling curve: c)

$$\varphi_T = 0.5 \left[1 + \alpha_T \cdot \left(\bar{\lambda}_T - 0.2\right) + \bar{\lambda}_T^2\right] = 0.5 \left[1 + 0.49 \cdot (0.00 - 0.2) + 0.00^2\right] = 0.45$$

$$\chi_T = \min\left(\frac{1}{\varphi_T + \sqrt{\varphi_T^2 - \bar{\lambda}_T^2}}, 1.0\right) = \min\left(\frac{1}{0.45 + \sqrt{0.45^2 - 0.00^2}}, 1.0\right) = 1.00 \quad (6.49)$$

$$N_{b,Rd,T} = \frac{\chi_T \cdot A \cdot f_y}{\gamma_{M1}} = \frac{1.00 \cdot 2132 \cdot 355}{1.05} = 720.95 \text{ kN} \quad (6.47)$$

$$\frac{N_{Ed}}{N_{b,Rd,T}} = \frac{273.39}{720.95} = 0.38 \leq 1.00 \text{ - OK}$$

Lateral torsional buckling, top flange - Part 1-1: 6.3.2.2
LC: 'B2 Dominerende Vindlast, Vindlast fra Sør', x = 0 mm

$Class_N = 1$, $Class_{M1} = 1$, $Class_{M2} = 1$

$$N_{cr,LT} = \frac{\pi^2 \cdot E \cdot I_z}{(k_z \cdot L_{cr})^2} = \frac{\pi^2 \cdot 2.100e+05 \cdot 3.037e+06}{(1.00 \cdot 3390)^2} = 547.76 \text{ kN}$$

Loaded on top edge.

$$Z = (C_2 \cdot z_g - C_3 \cdot z_j) = (1.83 \cdot 50 - 2.64 \cdot 0) = 91.43 \text{ mm}$$

$$M_{cr} = C_1 \cdot N_{cr,LT} \cdot \left\{ \left[\left(\frac{k_z}{k_w} \right)^2 \cdot \frac{I_w}{I_z} + \frac{G \cdot I_t}{N_{cr,LT}} + Z^2 \right]^{0.5} - Z \right\} =$$

$$= 2.42 \cdot 5.478e+05 \cdot \left\{ \left[\left(\frac{1.00}{1.00} \right)^2 \cdot \frac{7.406e+06}{3.037e+06} + \frac{8.077e+04 \cdot 5.161e+06}{5.478e+05} + 91.43^2 \right]^{0.5} - 91.43 \right\} =$$

$$= 1041.46 \text{ kNm}$$

$$\bar{\lambda}_{LT} = \sqrt{\frac{W_y \cdot f_y}{M_{cr}}} = \sqrt{\frac{73542 \cdot 355}{1.041e+09}} = 0.16$$

$\alpha_{LT} = 0.76$ (Buckling curve: d)

$$\varphi_{LT} = 0.5 \left[1 + \alpha_{LT} \cdot (\bar{\lambda}_{LT} - 0.2) + \bar{\lambda}_{LT}^2 \right] =$$

$$= 0.5 \left[1 + 0.76 \cdot (0.16 - 0.2) + 0.16^2 \right] = 0.50$$

$$\chi_{LT} = \min\left(\frac{1}{\varphi_{LT} + \sqrt{\varphi_{LT}^2 - \bar{\lambda}_{LT}^2}}, 1.0 \right) = \min\left(\frac{1}{0.50 + \sqrt{0.50^2 - 0.16^2}}, 1.0 \right) = 1.00 \quad (6.56)$$

$$M_{y,b,Rd} = \frac{\chi_{LT} \cdot W_y \cdot f_y}{\gamma_{M1}} = \frac{1.00 \cdot 73542 \cdot 355}{1.05} = 24.86 \text{ kNm} \quad (6.55)$$

$$\frac{M_{1,Ed}}{M_{y,b,Rd}} = \frac{0.61}{24.86} = 0.02 \leq 1.00 \quad (6.54) \text{ - OK}$$

Lateral torsional buckling, bottom flange - Part 1-1: 6.3.2.2

LC: 'B1 Dominerende Vindlast, Vindlast fra Sør', x = 0 mm

$Class_N = 1$, $Class_{M1} = 1$, $Class_{M2} = 1$

$$N_{cr,LT} = \frac{\pi^2 \cdot E \cdot I_z}{(k_z \cdot L_{cr})^2} = \frac{\pi^2 \cdot 2.100e+05 \cdot 3.037e+06}{(1.00 \cdot 0)^2} = 176532630546.46 \text{ kN}$$

Loaded on top edge.

$$Z = (C_2 \cdot z_g - C_3 \cdot z_j) = (1.82 \cdot 50 - 2.64 \cdot 0) = 91.05 \text{ mm}$$

$$M_{cr} = C_1 \cdot N_{cr,LT} \cdot \left\{ \left[\left(\frac{k_z}{k_w} \right)^2 \cdot \frac{I_w}{I_z} + \frac{G \cdot I_t}{N_{cr,LT}} + Z^2 \right]^{0.5} - Z \right\} =$$

$$= 2.46 \cdot 1.765e+14 \cdot \left\{ \left[\left(\frac{1.00}{1.00} \right)^2 \cdot \frac{7.406e+06}{3.037e+06} + \frac{8.077e+04 \cdot 5.161e+06}{1.765e+14} + 91.05^2 \right]^{0.5} - 91.05 \right\} =$$

$$= 5824467.54 \text{ kNm}$$

$$\bar{\lambda}_{LT} = \sqrt{\frac{W_y \cdot f_y}{M_{cr}}} = \sqrt{\frac{73542 \cdot 355}{5.824e+12}} = 0.00$$

$\alpha_{LT} = 0.76$ (Buckling curve: d)

$$\varphi_{LT} = 0.5 \left[1 + \alpha_{LT} \cdot (\bar{\lambda}_{LT} - 0.2) + \bar{\lambda}_{LT}^2 \right] =$$

$$= 0.5 \left[1 + 0.76 \cdot (0.00 - 0.2) + 0.00^2 \right] = 0.42$$

$$\chi_{LT} = \min\left(\frac{1}{\varphi_{LT} + \sqrt{\varphi_{LT}^2 - \bar{\lambda}_{LT}^2}}, 1.0 \right) = \min\left(\frac{1}{0.42 + \sqrt{0.42^2 - 0.00^2}}, 1.0 \right) = 1.00 \quad (6.56)$$

$$M_{y,b,Rd} = \frac{\chi_{LT} \cdot W_y \cdot f_y}{\gamma_{M1}} = \frac{1.00 \cdot 73542 \cdot 355}{1.05} = 24.86 \text{ kNm} \quad (6.55)$$

$$\frac{M_{1,Ed}}{M_{y,b,Rd}} = \frac{1.14}{24.86} = 0.05 \leq 1.00 \quad (6.54) \text{ - OK}$$

Interaction between normal force and bending 1. - Part 1-1: 6.3.3

LC: 'B2 Dominerende Snølast, Vindlast fra Sør', x = 0 mm

$Class_N = 1$, $Class_{M1} = 1$, $Class_{M2} = 1$

k_{ij} factors are calculated according to Method 1

C_{my}	= 0.74	C_{yy}	= 1.01
C_{mz}	= 0.83	C_{yz}	= 0.79
C_{mLT}	= 1.00	C_{zy}	= 0.86
		C_{zz}	= 0.98

$$M_{2,Rk} = f_y \cdot W_{pl,2} = 355 \cdot 73542 = 26.11 \text{ kNm}$$

$$\frac{N_{Ed}^{comp}}{N_{b,Rd,1}} + k_{11} \cdot \frac{M_{1,Ed}}{M_{y,b,Rd}} + k_{12} \cdot \frac{M_{2,Ed}}{\frac{M_{2,Rk}}{\gamma_{M1}}} =$$

$$= \frac{232.20}{321.19} + 0.91 \cdot \frac{0.58}{24.86} + 0.79 \cdot \frac{0.38}{\frac{26.11}{1.05}} = 0.76 \leq 1.00 \quad (6.61) \text{ - OK}$$

Interaction between normal force and bending 2. - Part 1-1: 6.3.3

LC: 'B2 Dominerende Snølast, Vindlast fra Sør', x = 0 mm

$Class_N = 1$, $Class_{M1} = 1$, $Class_{M2} = 1$

k_{ij} factors are calculated according to Method 1

C_{my}	= 0.74	C_{yy}	= 1.01
C_{mz}	= 0.83	C_{yz}	= 0.79
C_{mLT}	= 1.00	C_{zy}	= 0.86
		C_{zz}	= 0.98

$M_{2,Rk} = f_y \cdot W_{pl,2} = 355 \cdot 73542 = 26.11$ kNm

$$\frac{N_{Ed}^{comp}}{N_{b,Rd,2}} + k_{21} \cdot \frac{M_{1,Ed}}{M_{y,b,Rd}} + k_{22} \cdot \frac{M_{2,Ed}}{\frac{M_{2,Rk}}{\gamma_{M1}}} =$$

$$= \frac{232.20}{321.19} + 0.64 \cdot \frac{0.58}{24.86} + 1.05 \cdot \frac{0.38}{\frac{26.11}{1.05}} = 0.75 \leq 1.00 \quad (6.62) \text{ - OK}$$

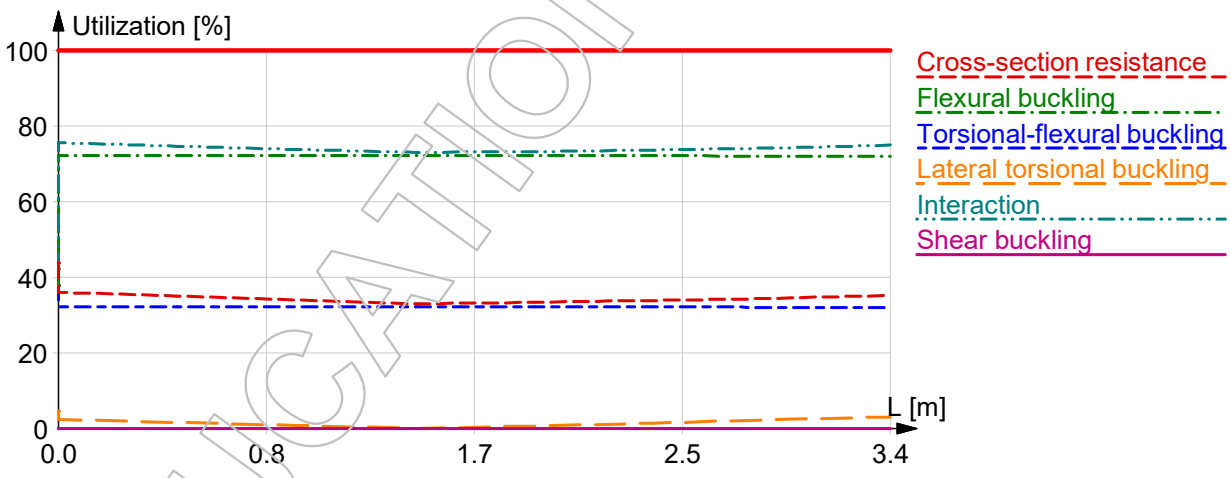
Interaction between normal force and bending, 2nd order - Part 1-1: 6.3.3

Not relevant

Shear buckling - Part 1-5: 5

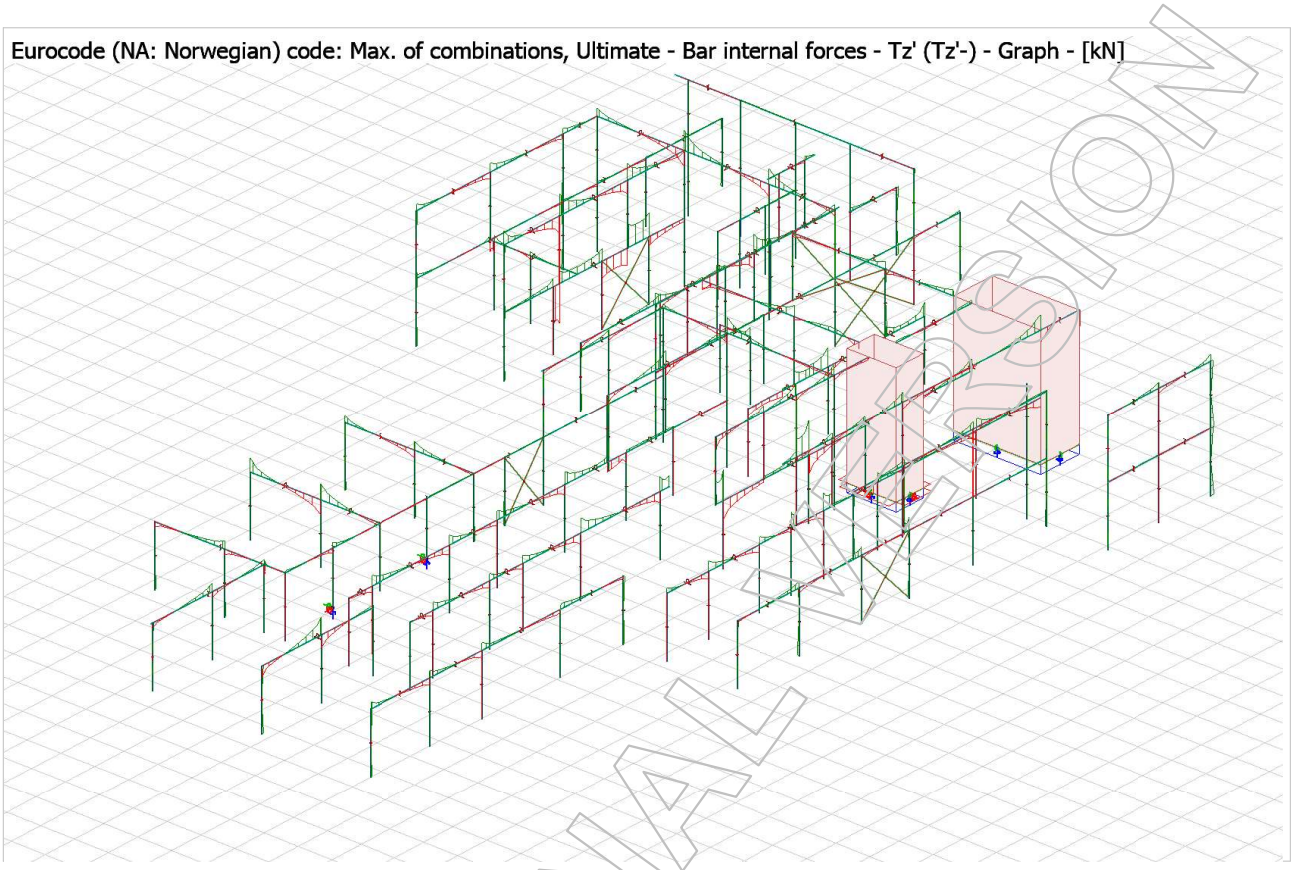
$$\frac{h_w}{t} = \frac{88}{6} = 14.7 \leq \frac{72}{\eta} \cdot \varepsilon = \frac{72}{1.20} \cdot 0.81 = 48.8 \rightarrow \quad \text{Not relevant}$$

Summary

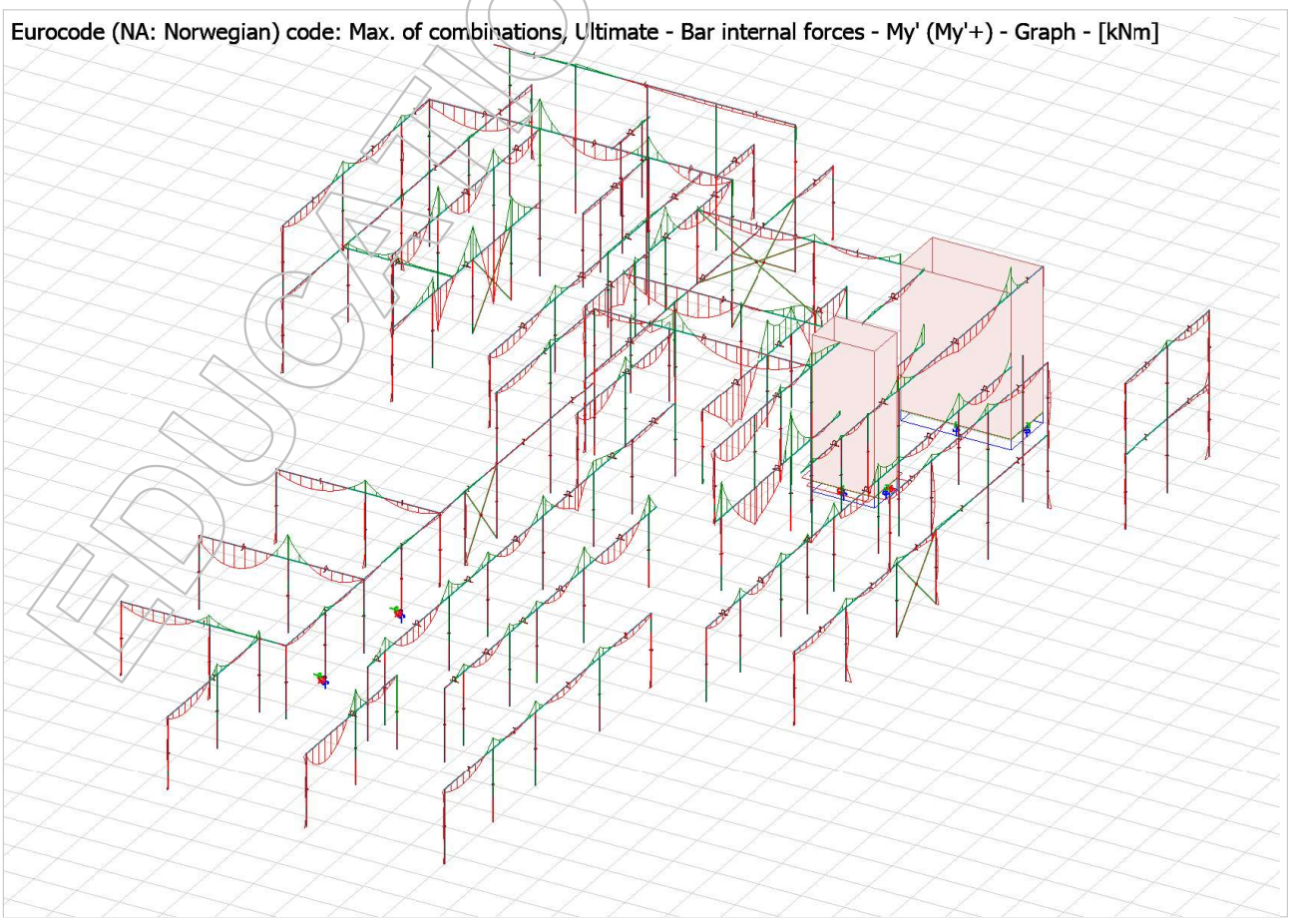


3.3 Bjelker

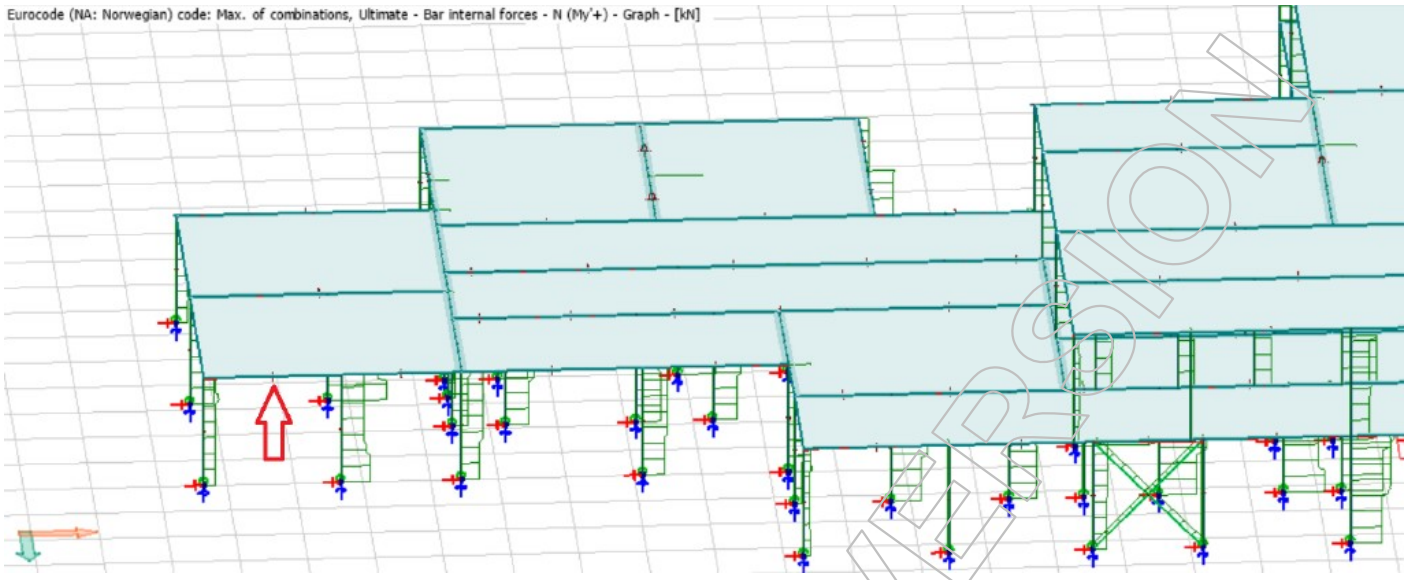
3.3.1 Maks skjærkraft Bjelker



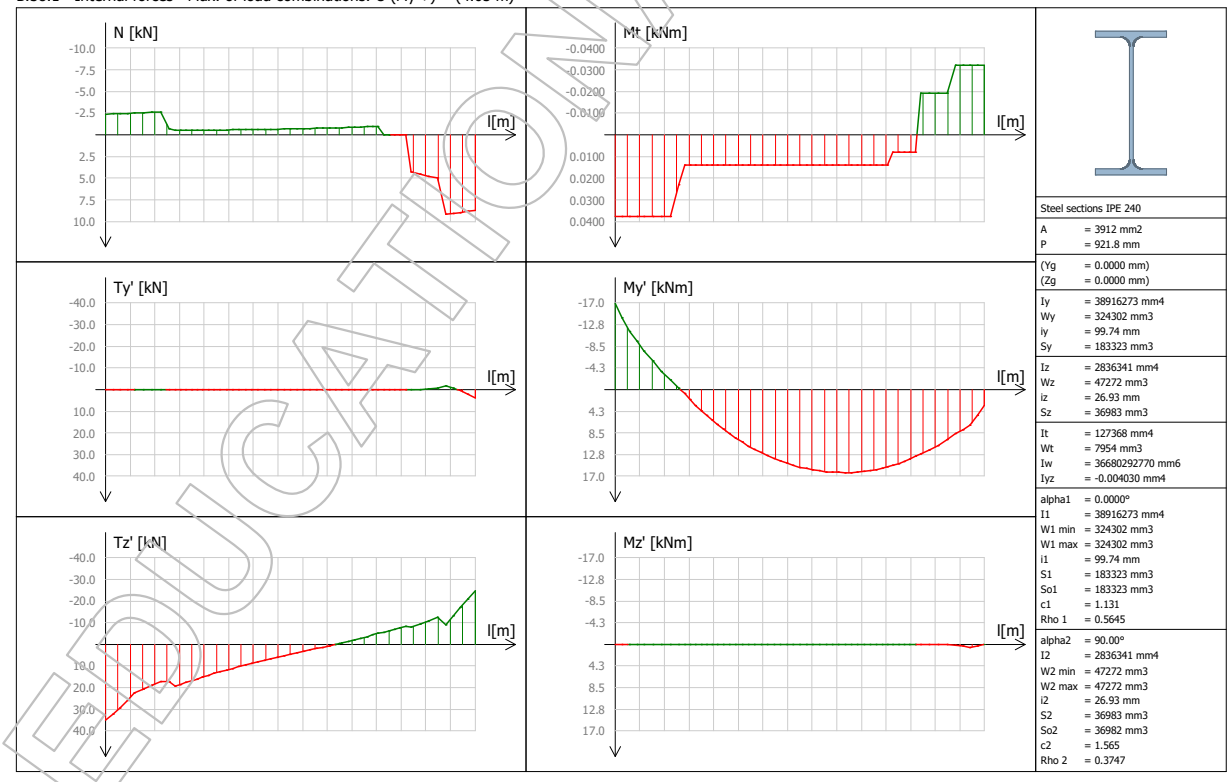
3.3.2 Maks moment Bjelker



3.3.3 Bjelke B.38.1



B.38.1 - Internal forces - Max. of load combinations: U (My'+) - (4.05 m)



Steel sections IPE 240	
A	= 3912 mm2
P	= 921.8 mm
(Yg	= 0.0000 mm)
(Zg	= 0.0000 mm)
Iy	= 38916273 mm4
Wy	= 324302 mm3
iy	= 99.74 mm
Sy	= 183323 mm3
Iz	= 2836341 mm4
Wz	= 47272 mm3
iz	= 26.93 mm
Sz	= 36983 mm3
It	= 127368 mm4
Wt	= 7954 mm3
Iw	= 36680292770 mm6
Iyz	= -0.004030 mm4
alpha1	= 0.0000°
I1	= 38916273 mm4
W1 min	= 324302 mm3
W1 max	= 324302 mm3
i1	= 99.74 mm
S1	= 183323 mm3
So1	= 183323 mm3
c1	= 1.131
Rho 1	= 0.5645
alpha2	= 90.00°
I2	= 2836341 mm4
W2 min	= 47272 mm3
W2 max	= 47272 mm3
i2	= 26.93 mm
S2	= 36983 mm3
So2	= 36982 mm3
c2	= 1.565
Rho 2	= 0.3747

B.38.1
Maximum of load combinations

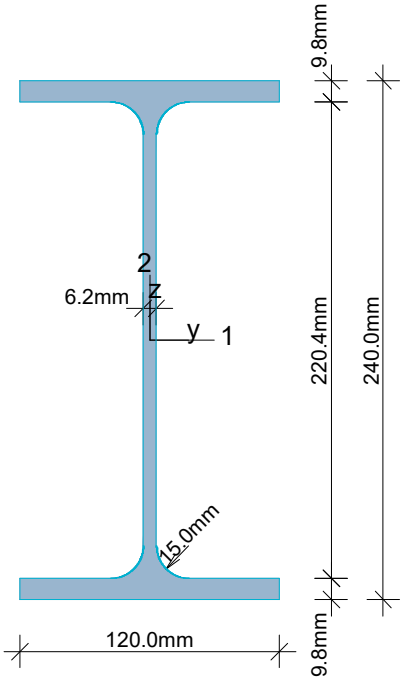
S 355

$E = 210000\ N/mm^2$

$G = 80769\ N/mm^2$

$\gamma_{M0,ult}$	= 1.05	$\gamma_{M0,acc/seis}$	= 1.00
$\gamma_{M1,ult}$	= 1.05	$\gamma_{M1,acc/seis}$	= 1.00
$\gamma_{M2,ult}$	= 1.25	$\gamma_{M2,acc/seis}$	= 1.00

IPE 240



P	=	922 mm	f_y	=	355 N/mm^2
A	=	3912 mm^2	ε	=	0.81
I_y	=	3.892e+07 mm^4	λ_1	=	76.40
I_z	=	2.836e+06 mm^4			
I_1	=	3.892e+07 mm^4			
I_2	=	2.836e+06 mm^4			
$W_{pl,1}$	=	3.666e+05 mm^3			
$W_{pl,2}$	=	7.396e+04 mm^3			
$W_{el,min,1}$	=	3.243e+05 mm^3			
$W_{el,min,2}$	=	4.727e+04 mm^3			
i_1	=	100 mm			
i_2	=	27 mm			
I_t	=	1.274e+05 mm^4			
I_w	=	3.668e+10 mm^6			

Shear resistance, 1-1 - Part 1-1: 6.2.6, 6.2.8

LC: 'B2 Dominerende Vindlast, Vindlast fra Sør', x = 4052 mm

$Class_N = 2$, $Class_{M1} = 1$, $Class_{M2} = 1$

$$V_{1,pl,Rd} = \frac{A_{1,v} \cdot f_y}{\sqrt{3} \cdot \gamma_{M0}} = \frac{2545 \cdot 355}{\sqrt{3} \cdot 1.05} = 496.81\ kN \quad (6.18)$$

$$V_{1,pl,T,Rd} = \sqrt{1 - \frac{\tau_{t,Ed}}{1.25\ (f_y / \sqrt{3}) / \gamma_{M0}}} \cdot V_{1,pl,Rd} =$$

$$= \sqrt{1 - \frac{4.73}{1.25\ (355 / \sqrt{3}) / 1.05}} \cdot 496.81 = 491.97\ kN \quad (6.26)$$

$$\frac{V_{1,Ed}}{V_{1,pl,T,Rd}} = \frac{4.42}{491.97} = 0.01 \leq 1.00 \quad (6.25) - OK$$

Shear resistance, 2-2 - Part 1-1: 6.2.6, 6.2.8
LC: 'B2 Dominerende Snølast, Vindlast fra Vest', x = 0 mm

$Class_N = 2$, $Class_{M1} = 1$, $Class_{M2} = 1$

$$V_{2,pl,Rd} = \frac{A_{2,v} \cdot f_y}{\sqrt{3} \cdot \gamma_{M0}} = \frac{1914 \cdot 355}{\sqrt{3} \cdot 1.05} = 373.69 \text{ kN} \quad (6.18)$$

$$V_{2,pl,T,Rd} = \sqrt{1 - \frac{\tau_{t,Ed}}{1.25 \left(f_y / \sqrt{3}\right) / \gamma_{M0}}} \cdot V_{2,pl,Rd} =$$

$$= \sqrt{1 - \frac{1.03}{1.25 \left(355 / \sqrt{3}\right) / 1.05}} \cdot 373.69 = 372.90 \text{ kN} \quad (6.26)$$

$$\frac{V_{2,Ed}}{V_{2,pl,T,Rd}} = \frac{43.92}{372.90} = 0.12 \leq 1.00 \quad (6.25) \text{ - OK}$$

Torsional resistance - Part 1-1: 6.2.7
LC: 'B2 Dominerende Vindlast, Vindlast fra Sør', x = 4052 mm

$Class_N = 2$, $Class_{M1} = 1$, $Class_{M2} = 1$

$\tau_{max,unit} = 125.73 \frac{N/mm^2}{kNm}$ is calculated by FEM analysis.

$$T_{Rd} = \frac{f_y}{\sqrt{3} \cdot \tau_{max,unit} \cdot \gamma_{M0}} = \frac{355}{\sqrt{3} \cdot 125.73 \cdot 1.05} = 1.55 \text{ kNm}$$

$$\frac{T_{Ed}}{T_{Rd}} = \frac{0.04}{1.55} = 0.02 \leq 1.00 \quad (6.23) \text{ - OK}$$

Shear stress - Part 1-1: 6.2.6
Not relevant

Normal stress - Part 1-1: 6.2.1
Not relevant

Pure normal resistance - Part 1-1: 6.2.3, 6.2.4
Not relevant

Normal capacity - Part 1-1: 6.2
LC: 'B2 Dominerende Snølast, Vindlast fra Vest', x = 0 mm

$Class_N = 2$, $Class_{M1} = 1$, $Class_{M2} = 1$

$V_{1,Ed} = 0.02 \text{ kN} \leq 0.5 \cdot V_{1,pl,T,Rd} = 0.5 \cdot 495.76 = 247.88 \text{ kN} \rightarrow \rho_1 = 0.00$

$V_{2,Ed} = 43.92 \text{ kN} \leq 0.5 \cdot V_{2,pl,T,Rd} = 0.5 \cdot 372.90 = 186.45 \text{ kN} \rightarrow \rho_2 = 0.00$

$$\frac{N_{Ed}}{N_{Rd}} + \frac{M_{1,Ed}}{M_{1,Rd}} + \frac{M_{2,Ed}}{M_{2,Rd}} = \frac{0.24}{1322.50} + \frac{21.50}{123.96} + \frac{0.00}{25.01} = 0.17 \leq 1.00 \quad (6.2) \text{ - OK}$$

Flexural buckling, 1-1 - Part 1-1: 6.3.1
LC: 'B2 Dominerende Vindlast, Vindlast fra Sør', x = 3602 mm

$Class_N = 2$, $Class_{M1} = 1$, $Class_{M2} = 1$

$$\bar{\lambda}_1 = \frac{L_{cr,1}}{i_1 \cdot \lambda_1} = \frac{4052}{100 \cdot 76.40} = 0.53 \quad (6.50)$$

$\alpha_1 = 0.21$ (Buckling curve: a)

$$\varphi_1 = 0.5 \left[1 + \alpha_1 \cdot \left(\bar{\lambda}_1 - 0.2\right) + \bar{\lambda}_1^2\right] = 0.5 \left[1 + 0.21 \cdot (0.53 - 0.2) + 0.53^2\right] = 0.68$$

$$\chi_1 = \min\left(\frac{1}{\varphi_1 + \sqrt{\varphi_1^2 - \bar{\lambda}_1^2}}, 1.0\right) = \min\left(\frac{1}{0.68 + \sqrt{0.68^2 - 0.53^2}}, 1.0\right) = 0.91 \quad (6.49)$$

$$N_{b,Rd,1} = \frac{\chi_1 \cdot A \cdot f_y}{\gamma_{M1}} = \frac{0.91 \cdot 3912 \cdot 355}{1.05} = 1208.90 \text{ kN} \quad (6.47)$$

$$\frac{N_{Ed}}{N_{b,Rd,1}} = \frac{8.47}{1208.90} = 0.01 \leq 1.00 \quad (6.46) \text{ - OK}$$

Flexural buckling, 2-2 - Part 1-1: 6.3.1
LC: 'B2 Dominerende Vindlast, Vindlast fra Sør', x = 3602 mm

$Class_N = 2$, $Class_{M1} = 1$, $Class_{M2} = 1$

$$\bar{\lambda}_2 = \frac{L_{cr,2}}{i_2 \cdot \lambda_1} = \frac{4052}{27 \cdot 76.40} = 1.97 \quad (6.50)$$

$\alpha_2 = 0.34$ (Buckling curve: b)

$$\varphi_2 = 0.5 \left[1 + \alpha_2 \cdot \left(\bar{\lambda}_2 - 0.2\right) + \bar{\lambda}_2^2\right] = 0.5 \left[1 + 0.34 \cdot (1.97 - 0.2) + 1.97^2\right] = 2.74$$

$$\chi_2 = \min\left(\frac{1}{\varphi_2 + \sqrt{\varphi_2^2 - \bar{\lambda}_2^2}}, 1.0\right) = \min\left(\frac{1}{2.74 + \sqrt{2.74^2 - 1.97^2}}, 1.0\right) = 0.22 \quad (6.49)$$

$$N_{b,Rd,2} = \frac{\chi_2 \cdot A \cdot f_y}{\gamma_{M1}} = \frac{0.22 \cdot 3912 \cdot 355}{1.05} = 284.59 \text{ kN} \quad (6.47)$$

$$\frac{N_{Ed}}{N_{b,Rd,2}} = \frac{8.47}{284.59} = 0.03 \leq 1.00 \quad (6.46) \text{ - OK}$$

Torsional-flexural buckling - Part 1-1: 6.3.1

LC: 'B2 Dominerende Vindlast, Vindlast fra Sør', x = 3602 mm

$Class_N = 2$, $Class_{M1} = 1$, $Class_{M2} = 1$

$$i_0 = \sqrt{i_1^2 + i_2^2 + y_0^2 + z_0^2} = \sqrt{100^2 + 27^2 + 0^2 + 0^2} = 103 \text{ mm}$$

$$N_{cr,1} = \frac{\pi^2 \cdot E \cdot I_1}{L_{cr,1}^2} = \frac{\pi^2 \cdot 210000 \cdot 38916273}{4052^2} = 4911.46 \text{ kN}$$

$$N_{cr,2} = \frac{\pi^2 \cdot E \cdot I_2}{L_{cr,2}^2} = \frac{\pi^2 \cdot 210000 \cdot 2836341}{4052^2} = 357.96 \text{ kN}$$

$$N_{cr,T} = \frac{1}{i_0^2}\left(G \cdot I_t + \frac{\pi^2 \cdot E \cdot I_w}{L_t^2}\right) =$$

$$= \frac{1}{103^2}\left(80769 \cdot 1.274e{+}05 + \frac{\pi^2 \cdot 210000 \cdot 3.668e{+}10}{4052^2}\right) = 1397.48 \text{ kN}$$

$$i_0^2 (N - N_{cr,1})(N - N_{cr,2})(N - N_{cr,T}) - N^2 y_0^2 (N - N_{cr,2}) - N^2 z_0^2 (N - N_{cr,1}) =$$

$$= 103^2 (N - 4911.46)(N - 357.96)(N - 1397.48) - N^2 0^2 (N - 357.96) - N^2 0^2 (N - 4911.46) = 0$$

Smallest root of the above equation related to the torsional-flexural buckling:

$N_{cr,TF} = 1397.48$ kN

$N_{cr} = \min(N_{cr,T}, N_{cr,TF}) = \min(1397.48, 1397.48) = 1397.48$ kN

$$\bar{\lambda}_T = \sqrt{\frac{A \cdot f_y}{N_{cr}}} = \sqrt{\frac{3912 \cdot 355}{1397.48}} = 1.00 \quad (6.53)$$

$\alpha_T = 0.34$ (Buckling curve: b)

$$\varphi_T = 0.5\left[1 + \alpha_T \cdot (\bar{\lambda}_T - 0.2) + \bar{\lambda}_T^2\right] = 0.5\left[1 + 0.34 \cdot (1.00 - 0.2) + 1.00^2\right] = 1.13$$

$$\chi_T = \min\left(\frac{1}{\varphi_T + \sqrt{\varphi_T^2 - \bar{\lambda}_T^2}}, 1.0\right) = \min\left(\frac{1}{1.13 + \sqrt{1.13^2 - 1.00^2}}, 1.0\right) = 0.60 \quad (6.49)$$

$$N_{b,Rd,T} = \frac{\chi_T \cdot A \cdot f_y}{\gamma_{M1}} = \frac{0.60 \cdot 3912 \cdot 355}{1.05} = 792.23 \text{ kN} \quad (6.47)$$

$$\frac{N_{Ed}}{N_{b,Rd,T}} = \frac{8.47}{792.23} = 0.01 \leq 1.00 \text{ - OK}$$

Lateral torsional buckling, top flange - Part 1-1: 6.3.2.2
LC: 'B2 Dominerende Snølast, Vindlast fra Nord', x = 2702 mm

$Class_N = 2$, $Class_{M1} = 1$, $Class_{M2} = 1$

$$N_{cr,LT} = \frac{\pi^2 \cdot E \cdot I_z}{(k_z \cdot L_{cr})^2} = \frac{\pi^2 \cdot 2.100e+05 \cdot 2.836e+06}{(1.00 \cdot 4052)^2} = 357.96 \text{ kN}$$

Loaded on top edge.

$$Z = (C_2 \cdot z_g - C_3 \cdot z_j) = (0.80 \cdot 120 - 0.75 \cdot 0) = 95.73 \text{ mm}$$

$$M_{cr} = C_1 \cdot N_{cr,LT} \cdot \left\{ \left[\left(\frac{k_z}{k_w} \right)^2 \cdot \frac{I_w}{I_z} + \frac{G \cdot I_t}{N_{cr,LT}} + Z^2 \right]^{0.5} - Z \right\} =$$

$$= 1.64 \cdot 3.580e+05 \cdot \left\{ \left[\left(\frac{1.00}{1.00} \right)^2 \cdot \frac{3.668e+10}{2.836e+06} + \frac{8.077e+04 \cdot 1.274e+05}{3.580e+05} + 95.73^2 \right]^{0.5} - 95.73 \right\} =$$

$$= 76.38 \text{ kNm}$$

$$\bar{\lambda}_{LT} = \sqrt{\frac{W_y \cdot f_y}{M_{cr}}} = \sqrt{\frac{366645 \cdot 355}{7.638e+07}} = 1.31$$

$\alpha_{LT} = 0.21$ (Buckling curve: a)

$$\varphi_{LT} = 0.5 \left[1 + \alpha_{LT} \cdot (\bar{\lambda}_{LT} - 0.2) + \bar{\lambda}_{LT}^2 \right] =$$

$$= 0.5 \left[1 + 0.21 \cdot (1.31 - 0.2) + 1.31^2 \right] = 1.47$$

$$\chi_{LT} = \min\left(\frac{1}{\varphi_{LT} + \sqrt{\varphi_{LT}^2 - \bar{\lambda}_{LT}^2}}, 1.0 \right) = \min\left(\frac{1}{1.47 + \sqrt{1.47^2 - 1.31^2}}, 1.0 \right) = 0.47 \quad (6.56)$$

$$M_{y,b,Rd} = \frac{\chi_{LT} \cdot W_y \cdot f_y}{\gamma_{M1}} = \frac{0.47 \cdot 366645 \cdot 355}{1.05} = 57.93 \text{ kNm} \quad (6.55)$$

$$\frac{M_{1,Ed}}{M_{y,b,Rd}} = \frac{16.11}{57.93} = 0.28 \leq 1.00 \quad (6.54) \text{ - OK}$$

Lateral torsional buckling, bottom flange - Part 1-1: 6.3.2.2

LC: 'B2 Dominerende Snølast, Vindlast fra Nord', x = 0 mm

$Class_N = 2$, $Class_{M1} = 1$, $Class_{M2} = 1$

$$N_{cr,LT} = \frac{\pi^2 \cdot E \cdot I_z}{(k_z \cdot L_{cr})^2} = \frac{\pi^2 \cdot 2.100e{+}05 \cdot 2.836e{+}06}{(1.00 \cdot 4052)^2} = 357.96 \text{ kN}$$

Loaded on top edge.

$$Z = (C_2 \cdot z_g - C_3 \cdot z_j) = (0.80 \cdot 120 - 0.75 \cdot 0) = 95.73 \text{ mm}$$

$$M_{cr} = C_1 \cdot N_{cr,LT} \cdot \left\{ \left[\left(\frac{k_z}{k_w} \right)^2 \cdot \frac{I_w}{I_z} + \frac{G \cdot I_t}{N_{cr,LT}} + Z^2 \right]^{0.5} - Z \right\} =$$

$$= 1.64 \cdot 3.580e{+}05 \cdot \left\{ \left[\left(\frac{1.00}{1.00} \right)^2 \cdot \frac{3.668e{+}10}{2.836e{+}06} + \frac{8.077e{+}04 \cdot 1.274e{+}05}{3.580e{+}05} + 95.73^2 \right]^{0.5} - 95.73 \right\} =$$

$$= 76.38 \text{ kNm}$$

$$\bar{\lambda}_{LT} = \sqrt{\frac{W_y \cdot f_y}{M_{cr}}} = \sqrt{\frac{366645 \cdot 355}{7.638e{+}07}} = 1.31$$

$\alpha_{LT} = 0.21$ (Buckling curve: a)

$$\varphi_{LT} = 0.5 \left[1 + \alpha_{LT} \cdot (\bar{\lambda}_{LT} - 0.2) + \bar{\lambda}_{LT}^2 \right] =$$

$$= 0.5 \left[1 + 0.21 \cdot (1.31 - 0.2) + 1.31^2 \right] = 1.47$$

$$\chi_{LT} = \min\left(\frac{1}{\varphi_{LT} + \sqrt{\varphi_{LT}^2 - \bar{\lambda}_{LT}^2}}, 1.0 \right) = \min\left(\frac{1}{1.47 + \sqrt{1.47^2 - 1.31^2}}, 1.0 \right) = 0.47 \quad (6.56)$$

$$M_{y,b,Rd} = \frac{\chi_{LT} \cdot W_y \cdot f_y}{\gamma_{M1}} = \frac{0.47 \cdot 366645 \cdot 355}{1.05} = 57.93 \text{ kNm} \quad (6.55)$$

$$\frac{M_{1,Ed}}{M_{y,b,Rd}} = \frac{21.30}{57.93} = 0.37 \leq 1.00 \quad (6.54) \text{ - OK}$$

Interaction between normal force and bending 1. - Part 1-1: 6.3.3

LC: 'B2 Dominerende Snølast, Vindlast fra Nord', x = 0 mm

$Class_N = 2$, $Class_{M1} = 1$, $Class_{M2} = 1$

k_{ij} factors are calculated according to Method 1

C_{my}	= 1.00	C_{yy}	= 1.00
C_{mz}	= 1.00	C_{yz}	= 0.84
C_{mLT}	= 1.00	C_{zy}	= 1.00
		C_{zz}	= 0.97

$$M_{2,Rk} = f_y \cdot W_{pl,2} = 355 \cdot 73964 = 26.26 \text{ kNm}$$

$$\frac{N_{Ed}^{comp}}{N_{b,Rd,1}} + k_{11} \cdot \frac{M_{1,Ed}}{M_{y,b,Rd}} + k_{12} \cdot \frac{M_{2,Ed}}{\frac{M_{2,Rk}}{\gamma_{M1}}} =$$

$$= \frac{0.51}{1208.90} + 1.00 \cdot \frac{21.30}{57.93} + 0.83 \cdot \frac{0.00}{\frac{26.26}{1.05}} = 0.37 \leq 1.00 \quad (6.61) \text{ - OK}$$

Interaction between normal force and bending 2. - Part 1-1: 6.3.3

LC: 'B2 Dominerende Snølast, Vindlast fra Nord', x = 0 mm

$Class_N = 2$, $Class_{M1} = 1$, $Class_{M2} = 1$

k_{ij} factors are calculated according to Method 1

C_{my}	= 1.00	C_{yy}	= 1.00
C_{mz}	= 1.00	C_{yz}	= 0.84
C_{mLT}	= 1.00	C_{zy}	= 1.00
		C_{zz}	= 0.97

$M_{2,Rk} = f_y \cdot W_{pl,2} = 355 \cdot 73964 = 26.26$ kNm

$$\frac{N_{Ed}^{comp}}{N_{b,Rd,2}} + k_{21} \cdot \frac{M_{1,Ed}}{M_{y,b,Rd}} + k_{22} \cdot \frac{M_{2,Ed}}{\frac{M_{2,Rk}}{\gamma_{M1}}} =$$

$$= \frac{0.51}{284.59} + 0.52 \cdot \frac{21.30}{57.93} + 1.03 \cdot \frac{0.00}{\frac{26.26}{1.05}} = 0.19 \leq 1.00 \quad (6.62) \text{ - OK}$$

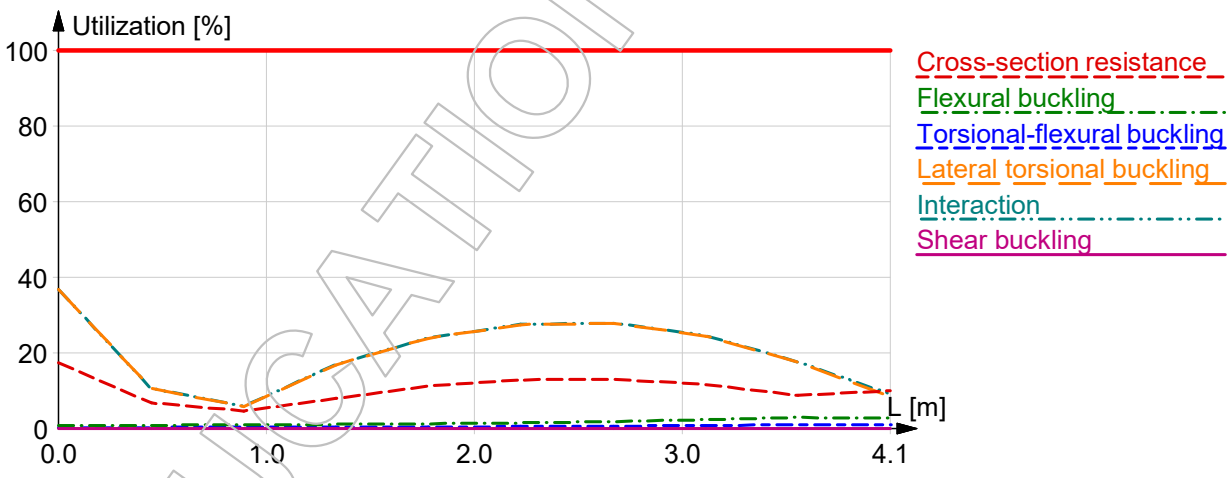
Interaction between normal force and bending, 2nd order - Part 1-1: 6.3.3

Not relevant

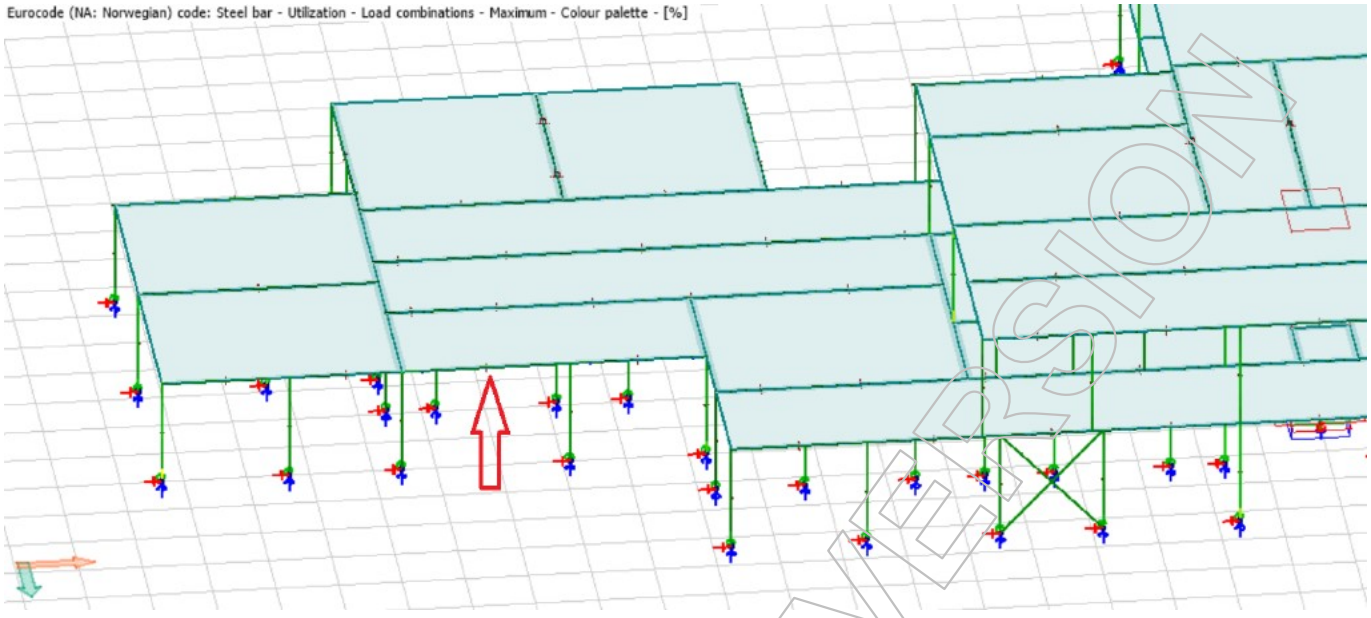
Shear buckling - Part 1-5: 5

$$\frac{h_w}{t} = \frac{220}{6} = 35.5 \leq \frac{72}{\eta} \cdot \varepsilon = \frac{72}{1.20} \cdot 0.81 = 48.8 \rightarrow \quad \text{Not relevant}$$

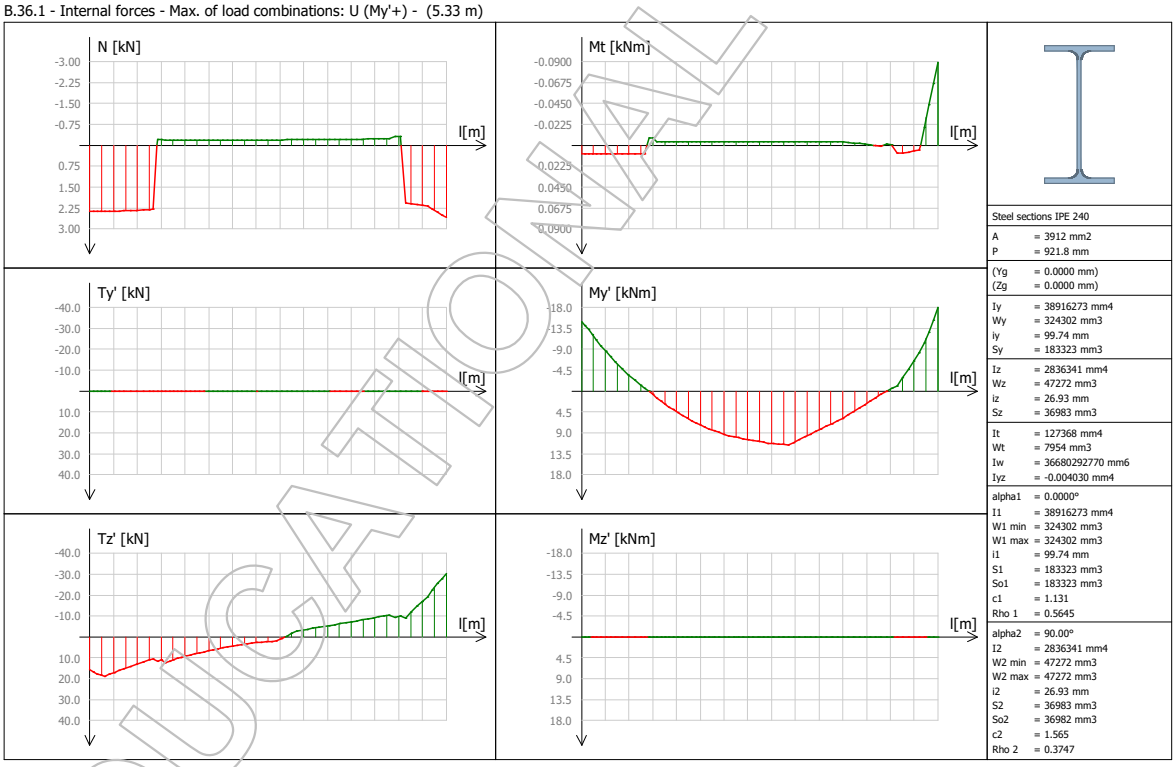
Summary



3.3.4 Bjelke B.36.1



B.36.1 - Internal forces - Max. of load combinations: U (My'+) - (5.33 m)



B.36.1
Maximum of load combinations

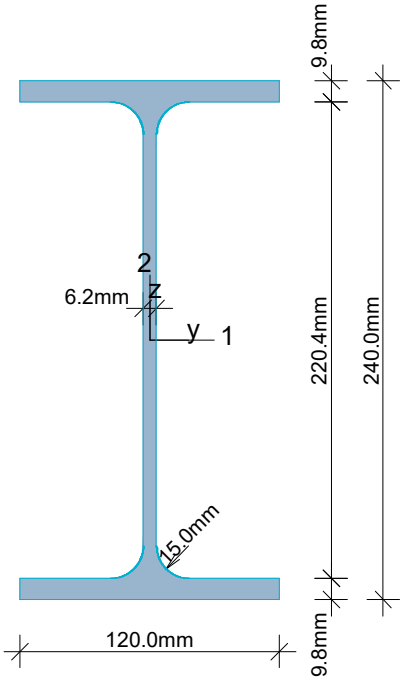
S 355

$E = 210000\ N/mm^2$

$G = 80769\ N/mm^2$

$\gamma_{M0,ult}$	= 1.05	$\gamma_{M0,acc/seis}$	= 1.00
$\gamma_{M1,ult}$	= 1.05	$\gamma_{M1,acc/seis}$	= 1.00
$\gamma_{M2,ult}$	= 1.25	$\gamma_{M2,acc/seis}$	= 1.00

IPE 240



P	=	922 mm	f_y	=	355 N/mm²
A	=	3912 mm²	ε	=	0.81
I_y	=	3.892e+07 mm⁴	λ_1	=	76.40
I_z	=	2.836e+06 mm⁴			
I_1	=	3.892e+07 mm⁴			
I_2	=	2.836e+06 mm⁴			
$W_{pl,1}$	=	3.666e+05 mm³			
$W_{pl,2}$	=	7.396e+04 mm³			
$W_{el,min,1}$	=	3.243e+05 mm³			
$W_{el,min,2}$	=	4.727e+04 mm³			
i_1	=	100 mm			
i_2	=	27 mm			
I_t	=	1.274e+05 mm⁴			
I_w	=	3.668e+10 mm⁶			

Shear resistance, 1-1 - Part 1-1: 6.2.6, 6.2.8

LC: 'B2 Dominerende Snølast, Vindlast fra Vest', x = 0 mm

$Class_N = 2$, $Class_{M1} = 1$, $Class_{M2} = 1$

$$V_{1,pl,Rd} = \frac{A_{1,v} \cdot f_y}{\sqrt{3} \cdot \gamma_{M0}} = \frac{2545 \cdot 355}{\sqrt{3} \cdot 1.05} = 496.81\ kN \quad (6.18)$$

$$V_{1,pl,T,Rd} = \sqrt{1 - \frac{\tau_{t,Ed}}{1.25\ (f_y / \sqrt{3}) / \gamma_{M0}}} \cdot V_{1,pl,Rd} =$$

$$= \sqrt{1 - \frac{0.01}{1.25\ (355 / \sqrt{3}) / 1.05}} \cdot 496.81 = 496.80\ kN \quad (6.26)$$

$$\frac{V_{1,Ed}}{V_{1,pl,T,Rd}} = \frac{0.06}{496.80} = 0.00 \leq 1.00 \quad (6.25) - OK$$

Shear resistance, 2-2 - Part 1-1: 6.2.6, 6.2.8
LC: 'B2 Dominerende Snølast, Vindlast fra Vest', x = 5331 mm

$Class_N = 2$, $Class_{M1} = 1$, $Class_{M2} = 1$

$$V_{2,pl,Rd} = \frac{A_{2,v} \cdot f_y}{\sqrt{3} \cdot \gamma_{M0}} = \frac{1914 \cdot 355}{\sqrt{3} \cdot 1.05} = 373.69 \text{ kN} \quad (6.18)$$

$$V_{2,pl,T,Rd} = \sqrt{1 - \frac{\tau_{t,Ed}}{1.25 \left(f_y / \sqrt{3}\right) / \gamma_{M0}}} \cdot V_{2,pl,Rd} =$$

$$= \sqrt{1 - \frac{21.14}{1.25 \left(355 / \sqrt{3}\right) / 1.05}} \cdot 373.69 = 357.13 \text{ kN} \quad (6.26)$$

$$\frac{V_{2,Ed}}{V_{2,pl,T,Rd}} = \frac{40.50}{357.13} = 0.11 \leq 1.00 \quad (6.25) \text{ - OK}$$

Torsional resistance - Part 1-1: 6.2.7
LC: 'B2 Dominerende Snølast, Vindlast fra Vest', x = 5331 mm

$Class_N = 2$, $Class_{M1} = 1$, $Class_{M2} = 1$

$\tau_{max,unit} = 125.73 \frac{N/mm^2}{kNm}$ is calculated by FEM analysis.

$$T_{Rd} = \frac{f_y}{\sqrt{3} \cdot \tau_{max,unit} \cdot \gamma_{M0}} = \frac{355}{\sqrt{3} \cdot 125.73 \cdot 1.05} = 1.55 \text{ kNm}$$

$$\frac{T_{Ed}}{T_{Rd}} = \frac{0.17}{1.55} = 0.11 \leq 1.00 \quad (6.23) \text{ - OK}$$

Shear stress - Part 1-1: 6.2.6
Not relevant

Normal stress - Part 1-1: 6.2.1
Not relevant

Pure normal resistance - Part 1-1: 6.2.3, 6.2.4
Not relevant

Normal capacity - Part 1-1: 6.2
LC: 'B2 Dominerende Snølast, Vindlast fra Sør', x = 5331 mm

$Class_N = 2$, $Class_{M1} = 1$, $Class_{M2} = 1$

$V_{1,Ed} = 0.01 \text{ kN} \leq 0.5 \cdot V_{1,pl,T,Rd} = 0.5 \cdot 482.48 = 241.24 \text{ kN} \rightarrow \rho_1 = 0.00$

$V_{2,Ed} = 40.22 \text{ kN} \leq 0.5 \cdot V_{2,pl,T,Rd} = 0.5 \cdot 362.91 = 181.45 \text{ kN} \rightarrow \rho_2 = 0.00$

$$\frac{N_{Ed}}{N_{Rd}} + \frac{M_{1,Ed}}{M_{1,Rd}} + \frac{M_{2,Ed}}{M_{2,Rd}} = \frac{1.28}{1322.50} + \frac{23.98}{123.96} + \frac{0.00}{25.01} = 0.19 \leq 1.00 \quad (6.2) \text{ - OK}$$

Flexural buckling, 1-1 - Part 1-1: 6.3.1
LC: 'B2 Dominerende Vindlast, Vindlast fra Sør', x = 5331 mm

$Class_N = 2$, $Class_{M1} = 1$, $Class_{M2} = 1$

$$\bar{\lambda}_1 = \frac{L_{cr,1}}{i_1 \cdot \lambda_1} = \frac{5331}{100 \cdot 76.40} = 0.70 \quad (6.50)$$

$\alpha_1 = 0.21$ (Buckling curve: a)

$$\varphi_1 = 0.5 \left[1 + \alpha_1 \cdot \left(\bar{\lambda}_1 - 0.2\right) + \bar{\lambda}_1^2\right] = 0.5 \left[1 + 0.21 \cdot (0.70 - 0.2) + 0.70^2\right] = 0.80$$

$$\chi_1 = \min\left(\frac{1}{\varphi_1 + \sqrt{\varphi_1^2 - \bar{\lambda}_1^2}}, 1.0\right) = \min\left(\frac{1}{0.80 + \sqrt{0.80^2 - 0.70^2}}, 1.0\right) = 0.85 \quad (6.49)$$

$$N_{b,Rd,1} = \frac{\chi_1 \cdot A \cdot f_y}{\gamma_{M1}} = \frac{0.85 \cdot 3912 \cdot 355}{1.05} = 1121.41 \text{ kN} \quad (6.47)$$

$$\frac{N_{Ed}}{N_{b,Rd,1}} = \frac{1.95}{1121.41} = 0.00 \leq 1.00 \quad (6.46) \text{ - OK}$$

Flexural buckling, 2-2 - Part 1-1: 6.3.1
LC: 'B2 Dominerende Vindlast, Vindlast fra Sør', x = 5331 mm

$Class_N = 2$, $Class_{M1} = 1$, $Class_{M2} = 1$

$$\bar{\lambda}_2 = \frac{L_{cr,2}}{i_2 \cdot \lambda_1} = \frac{5331}{27 \cdot 76.40} = 2.59 \quad (6.50)$$

$\alpha_2 = 0.34$ (Buckling curve: b)

$$\varphi_2 = 0.5 \left[1 + \alpha_2 \cdot \left(\bar{\lambda}_2 - 0.2\right) + \bar{\lambda}_2^2\right] = 0.5 \left[1 + 0.34 \cdot (2.59 - 0.2) + 2.59^2\right] = 4.26$$

$$\chi_2 = \min\left(\frac{1}{\varphi_2 + \sqrt{\varphi_2^2 - \bar{\lambda}_2^2}}, 1.0\right) = \min\left(\frac{1}{4.26 + \sqrt{4.26^2 - 2.59^2}}, 1.0\right) = 0.13 \quad (6.49)$$

$$N_{b,Rd,2} = \frac{\chi_2 \cdot A \cdot f_y}{\gamma_{M1}} = \frac{0.13 \cdot 3912 \cdot 355}{1.05} = 172.88 \text{ kN} \quad (6.47)$$

$$\frac{N_{Ed}}{N_{b,Rd,2}} = \frac{1.95}{172.88} = 0.01 \leq 1.00 \quad (6.46) \text{ - OK}$$

Torsional-flexural buckling - Part 1-1: 6.3.1

LC: 'B2 Dominerende Vindlast, Vindlast fra Sør', x = 5331 mm

$Class_N = 2$, $Class_{M1} = 1$, $Class_{M2} = 1$

$$i_0 = \sqrt{i_1^2 + i_2^2 + y_0^2 + z_0^2} = \sqrt{100^2 + 27^2 + 0^2 + 0^2} = 103 \text{ mm}$$

$$N_{cr,1} = \frac{\pi^2 \cdot E \cdot I_1}{L_{cr,1}^2} = \frac{\pi^2 \cdot 210000 \cdot 38916273}{5331^2} = 2838.32 \text{ kN}$$

$$N_{cr,2} = \frac{\pi^2 \cdot E \cdot I_2}{L_{cr,2}^2} = \frac{\pi^2 \cdot 210000 \cdot 2836341}{5331^2} = 206.87 \text{ kN}$$

$$N_{cr,T} = \frac{1}{i_0^2}\left(G \cdot I_t + \frac{\pi^2 \cdot E \cdot I_w}{L_t^2}\right) =$$

$$= \frac{1}{103^2}\left(80769 \cdot 1.274e{+}05 + \frac{\pi^2 \cdot 210000 \cdot 3.668e{+}10}{5331^2}\right) = 1214.41 \text{ kN}$$

$$i_0^2 (N - N_{cr,1})(N - N_{cr,2})(N - N_{cr,T}) - N^2 y_0^2 (N - N_{cr,2}) - N^2 z_0^2 (N - N_{cr,1}) =$$

$$= 103^2 (N - 2838.32)(N - 206.87)(N - 1214.41) - N^2 0^2 (N - 206.87) - N^2 0^2 (N - 2838.32) = 0$$

Smallest root of the above equation related to the torsional-flexural buckling:

$N_{cr,TF} = 1214.41$ kN

$N_{cr} = \min(N_{cr,T}, N_{cr,TF}) = \min(1214.41, 1214.41) = 1214.41$ kN

$$\bar{\lambda}_T = \sqrt{\frac{A \cdot f_y}{N_{cr}}} = \sqrt{\frac{3912 \cdot 355}{1214.41}} = 1.07 \quad (6.53)$$

$\alpha_T = 0.34$ (Buckling curve: b)

$$\varphi_T = 0.5\left[1 + \alpha_T \cdot (\bar{\lambda}_T - 0.2) + \bar{\lambda}_T^2\right] = 0.5\left[1 + 0.34 \cdot (1.07 - 0.2) + 1.07^2\right] = 1.22$$

$$\chi_T = \min\left(\frac{1}{\varphi_T + \sqrt{\varphi_T^2 - \bar{\lambda}_T^2}}, 1.0\right) = \min\left(\frac{1}{1.22 + \sqrt{1.22^2 - 1.07^2}}, 1.0\right) = 0.55 \quad (6.49)$$

$$N_{b,Rd,T} = \frac{\chi_T \cdot A \cdot f_y}{\gamma_{M1}} = \frac{0.55 \cdot 3912 \cdot 355}{1.05} = 732.35 \text{ kN} \quad (6.47)$$

$$\frac{N_{Ed}}{N_{b,Rd,T}} = \frac{1.95}{732.35} = 0.00 \le 1.00 \text{ - OK}$$

Lateral torsional buckling, top flange - Part 1-1: 6.3.2.2
LC: 'B2 Dominerende Snølast, Vindlast fra Nord', x = 2908 mm

$Class_N = 2$, $Class_{M1} = 1$, $Class_{M2} = 1$

$$N_{cr,LT} = \frac{\pi^2 \cdot E \cdot I_z}{(k_z \cdot L_{cr})^2} = \frac{\pi^2 \cdot 2.100e+05 \cdot 2.836e+06}{(1.00 \cdot 5331)^2} = 206.87 \text{ kN}$$

Loaded on top edge.

$$Z = (C_2 \cdot z_g - C_3 \cdot z_j) = (1.51 \cdot 120 - 0.75 \cdot 0) = 181.42 \text{ mm}$$

$$M_{cr} = C_1 \cdot N_{cr,LT} \cdot \left\{ \left[\left(\frac{k_z}{k_w} \right)^2 \cdot \frac{I_w}{I_z} + \frac{G \cdot I_t}{N_{cr,LT}} + Z^2 \right]^{0.5} - Z \right\} =$$

$$= 2.67 \cdot 2.069e+05 \cdot \left\{ \left[\left(\frac{1.00}{1.00} \right)^2 \cdot \frac{3.668e+10}{2.836e+06} + \frac{8.077e+04 \cdot 1.274e+05}{2.069e+05} + 181.42^2 \right]^{0.5} - 181.42 \right\} =$$

$$= 70.63 \text{ kNm}$$

$$\bar{\lambda}_{LT} = \sqrt{\frac{W_y \cdot f_y}{M_{cr}}} = \sqrt{\frac{366645 \cdot 355}{7.063e+07}} = 1.36$$

$\alpha_{LT} = 0.21$ (Buckling curve: a)

$$\varphi_{LT} = 0.5 \left[1 + \alpha_{LT} \cdot (\bar{\lambda}_{LT} - 0.2) + \bar{\lambda}_{LT}^2 \right] =$$

$$= 0.5 \left[1 + 0.21 \cdot (1.36 - 0.2) + 1.36^2 \right] = 1.54$$

$$\chi_{LT} = \min\left(\frac{1}{\varphi_{LT} + \sqrt{\varphi_{LT}^2 - \bar{\lambda}_{LT}^2}}, 1.0 \right) = \min\left(\frac{1}{1.54 + \sqrt{1.54^2 - 1.36^2}}, 1.0 \right) = 0.44 \quad (6.56)$$

$$M_{y,b,Rd} = \frac{\chi_{LT} \cdot W_y \cdot f_y}{\gamma_{M1}} = \frac{0.44 \cdot 366645 \cdot 355}{1.05} = 54.45 \text{ kNm} \quad (6.55)$$

$$\frac{M_{1,Ed}}{M_{y,b,Rd}} = \frac{11.36}{54.45} = 0.21 \leq 1.00 \quad (6.54) \text{ - OK}$$

Lateral torsional buckling, bottom flange - Part 1-1: 6.3.2.2

LC: 'B2 Dominerende Snølast, Vindlast fra Nord', x = 5331 mm

$Class_N = 2$, $Class_{M1} = 1$, $Class_{M2} = 1$

$$N_{cr,LT} = \frac{\pi^2 \cdot E \cdot I_z}{(k_z \cdot L_{cr})^2} = \frac{\pi^2 \cdot 2.100e{+}05 \cdot 2.836e{+}06}{(1.00 \cdot 5331)^2} = 206.87 \text{ kN}$$

Loaded on top edge.

$$Z = (C_2 \cdot z_g - C_3 \cdot z_j) = (1.51 \cdot 120 - 0.75 \cdot 0) = 181.42 \text{ mm}$$

$$M_{cr} = C_1 \cdot N_{cr,LT} \cdot \left\{ \left[\left(\frac{k_z}{k_w} \right)^2 \cdot \frac{I_w}{I_z} + \frac{G \cdot I_t}{N_{cr,LT}} + Z^2 \right]^{0.5} - Z \right\} =$$

$$= 2.67 \cdot 2.069e{+}05 \cdot \left\{ \left[\left(\frac{1.00}{1.00} \right)^2 \cdot \frac{3.668e{+}10}{2.836e{+}06} + \frac{8.077e{+}04 \cdot 1.274e{+}05}{2.069e{+}05} + 181.42^2 \right]^{0.5} - 181.42 \right\} =$$

$$= 70.63 \text{ kNm}$$

$$\bar{\lambda}_{LT} = \sqrt{\frac{W_y \cdot f_y}{M_{cr}}} = \sqrt{\frac{366645 \cdot 355}{7.063e{+}07}} = 1.36$$

$\alpha_{LT} = 0.21$ (Buckling curve: a)

$$\varphi_{LT} = 0.5 \left[1 + \alpha_{LT} \cdot (\bar{\lambda}_{LT} - 0.2) + \bar{\lambda}_{LT}^2 \right] =$$

$$= 0.5 \left[1 + 0.21 \cdot (1.36 - 0.2) + 1.36^2 \right] = 1.54$$

$$\chi_{LT} = \min\left(\frac{1}{\varphi_{LT} + \sqrt{\varphi_{LT}^2 - \bar{\lambda}_{LT}^2}}, 1.0 \right) = \min\left(\frac{1}{1.54 + \sqrt{1.54^2 - 1.36^2}}, 1.0 \right) = 0.44 \quad (6.56)$$

$$M_{y,b,Rd} = \frac{\chi_{LT} \cdot W_y \cdot f_y}{\gamma_{M1}} = \frac{0.44 \cdot 366645 \cdot 355}{1.05} = 54.45 \text{ kNm} \quad (6.55)$$

$$\frac{M_{1,Ed}}{M_{y,b,Rd}} = \frac{23.98}{54.45} = 0.44 \leq 1.00 \quad (6.54) \text{ - OK}$$

Interaction between normal force and bending 1. - Part 1-1: 6.3.3

LC: 'B2 Dominerende Snølast, Vindlast fra Nord', x = 5331 mm

$Class_N = 2$, $Class_{M1} = 1$, $Class_{M2} = 1$

k_{ij} factors are calculated according to Method 1

C_{my}	= 1.00	C_{yy}	= 1.00
C_{mz}	= 1.00	C_{yz}	= 0.89
C_{mLT}	= 1.00	C_{zy}	= 1.00
		C_{zz}	= 0.99

$$M_{2,Rk} = f_y \cdot W_{pl,2} = 355 \cdot 73964 = 26.26 \text{ kNm}$$

$$\frac{N_{Ed}^{comp}}{N_{b,Rd,1}} + k_{11} \cdot \frac{M_{1,Ed}}{M_{y,b,Rd}} + k_{12} \cdot \frac{M_{2,Ed}}{\frac{M_{2,Rk}}{\gamma_{M1}}} =$$

$$= \frac{0.44}{1121.41} + 1.00 \cdot \frac{23.98}{54.45} + 0.78 \cdot \frac{0.00}{\frac{26.26}{1.05}} = 0.44 \leq 1.00 \quad (6.61) \text{ - OK}$$

Interaction between normal force and bending 2. - Part 1-1: 6.3.3

LC: 'B2 Dominerende Snølast, Vindlast fra Sør', x = 5331 mm

$Class_N = 2$, $Class_{M1} = 1$, $Class_{M2} = 1$

k_{ij} factors are calculated according to Method 1

C_{my}	= 1.00	C_{yy}	= 1.00
C_{mz}	= 1.00	C_{yz}	= 0.89
C_{mLT}	= 1.00	C_{zy}	= 0.99
		C_{zz}	= 0.98

$M_{2,Rk} = f_y \cdot W_{pl,2} = 355 \cdot 73964 = 26.26$ kNm

$$\frac{N_{Ed}^{comp}}{N_{b,Rd,2}} + k_{21} \cdot \frac{M_{1,Ed}}{M_{y,b,Rd}} + k_{22} \cdot \frac{M_{2,Ed}}{\frac{M_{2,Rk}}{\gamma_{M1}}} =$$

$$= \frac{1.28}{172.88} + 0.52 \cdot \frac{23.98}{55.22} + 1.02 \cdot \frac{0.00}{\frac{26.26}{1.05}} = 0.23 \leq 1.00 \quad (6.62) \text{ - OK}$$

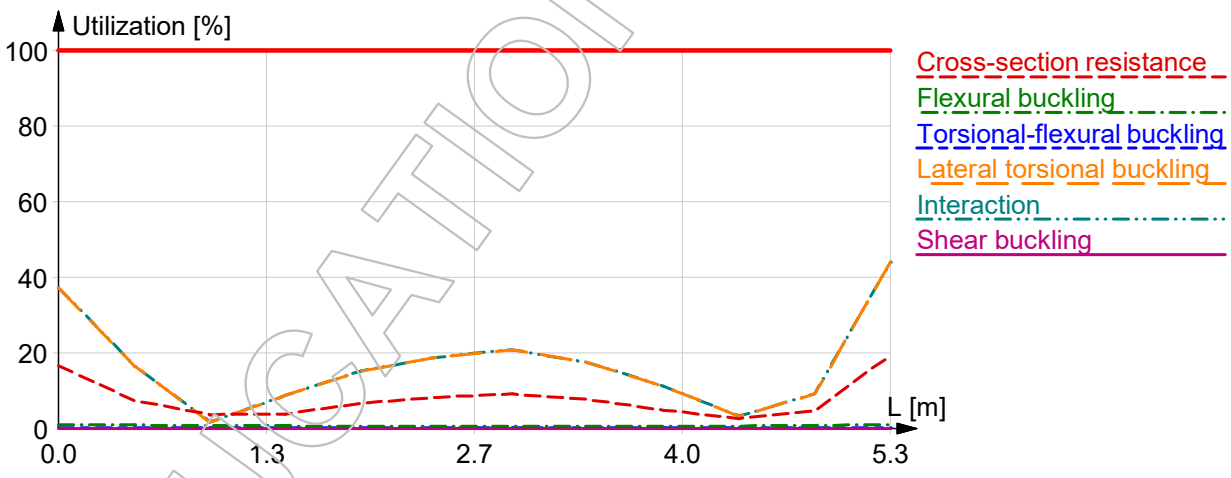
Interaction between normal force and bending, 2nd order - Part 1-1: 6.3.3

Not relevant

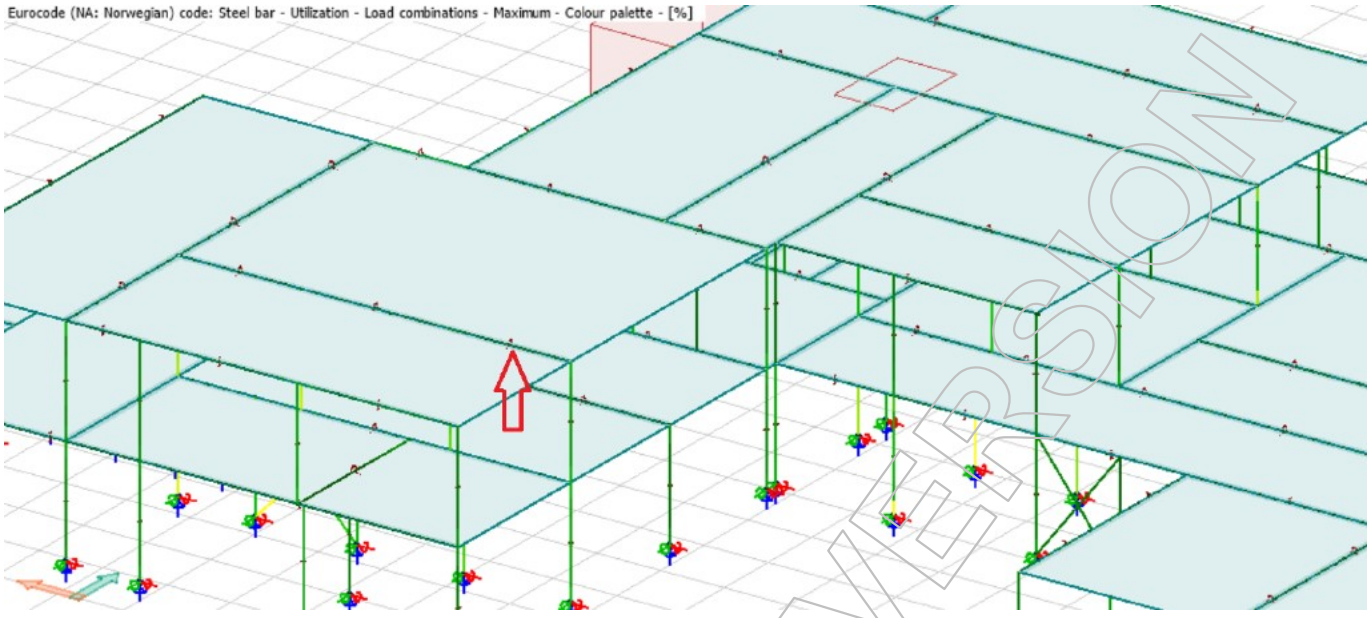
Shear buckling - Part 1-5: 5

$$\frac{h_w}{t} = \frac{220}{6} = 35.5 \leq \frac{72}{\eta} \cdot \varepsilon = \frac{72}{1.20} \cdot 0.81 = 48.8 \rightarrow \quad \text{Not relevant}$$

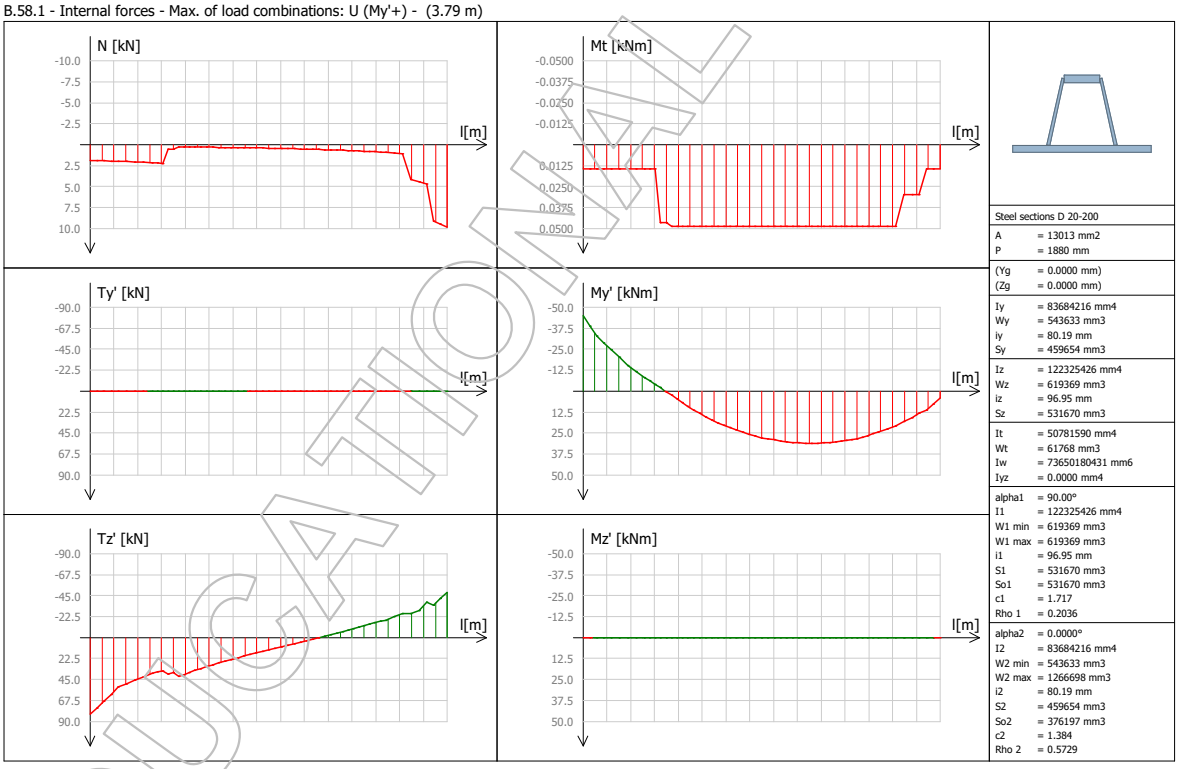
Summary



3.3.5 Bjelke B.58.1



B.58.1 - Internal forces - Max. of load combinations: U (My'+) - (3.79 m)



Steel sections D 20-200

A	= 13013 mm2
P	= 1880 mm
(Yg	= 0.0000 mm)
(Zg	= 0.0000 mm)
Iy	= 83684216 mm4
Wy	= 543633 mm3
iy	= 80.19 mm
Sy	= 459654 mm3
Iz	= 122325426 mm4
Wz	= 619369 mm3
iz	= 96.95 mm
Sz	= 531670 mm3
It	= 50781590 mm4
Wt	= 61768 mm3
Iw	= 7365018043 1 mm6
Iyz	= 0.0000 mm4
alpha1	= 90.00°
I1	= 122325426 mm4
W1 min	= 619369 mm3
W1 max	= 619369 mm3
i1	= 96.95 mm
S1	= 531670 mm3
So1	= 531670 mm3
c1	= 1.717
Rho 1	= 0.2036
alpha2	= 0.0000°
I2	= 83684216 mm4
W2 min	= 543633 mm3
W2 max	= 1266698 mm3
i2	= 80.19 mm
S2	= 459654 mm3
So2	= 376197 mm3
c2	= 1.384
Rho 2	= 0.5729

B.58.1
Maximum of load combinations

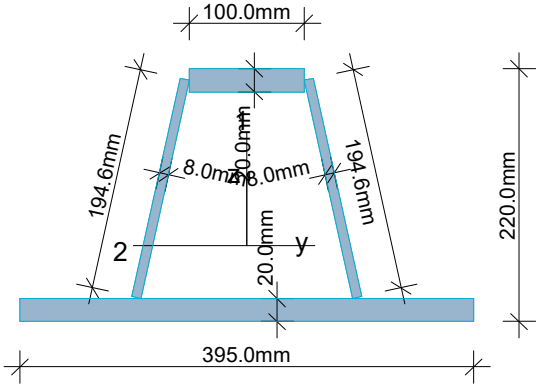
S 355

$E = 210000\ N/mm^2$

$G = 80769\ N/mm^2$

$\gamma_{M0,ult}$	= 1.05	$\gamma_{M0,acc/seis}$	= 1.00
$\gamma_{M1,ult}$	= 1.05	$\gamma_{M1,acc/seis}$	= 1.00
$\gamma_{M2,ult}$	= 1.25	$\gamma_{M2,acc/seis}$	= 1.00

D 20-200



P	=	1880 mm	f_y	=	355 N/mm^2
A	=	13013 mm^2	ε	=	0.81
I_y	=	8.368e+07 mm^4	λ_1	=	76.40
I_z	=	1.223e+08 mm^4			
I_1	=	1.223e+08 mm^4			
I_2	=	8.368e+07 mm^4			
$W_{pl,1}$	=	1.063e+06 mm^3			
$W_{pl,2}$	=	7.524e+05 mm^3			
$W_{el,min,1}$	=	6.194e+05 mm^3			
$W_{el,min,2}$	=	5.436e+05 mm^3			
i_1	=	97 mm			
i_2	=	80 mm			
I_t	=	5.078e+07 mm^4			
I_w	=	7.365e+10 mm^6			

Shear resistance, 1-1 - Part 1-1: 6.2.6, 6.2.8

LC: 'B2 Dominerende Snølast, Vindlast fra Nord', x = 0 mm

$Class_N = 1$, $Class_{M1} = 1$, $Class_{M2} = 1$

$$V_{1,pl,Rd} = \frac{A_{1,v} \cdot f_y}{\sqrt{3} \cdot \gamma_{M0}} = \frac{10064 \cdot 355}{\sqrt{3} \cdot 1.05} = 1964.46\ kN \quad (6.18)$$

$$V_{1,pl,T,Rd} = 1 - \frac{\tau_{t,Ed}}{(f_y / \sqrt{3}) / \gamma_{M0}} \cdot V_{1,pl,Rd} = 1 - \frac{0.79}{(355 / \sqrt{3}) / 1.05} \cdot 1964.46 = 1956.49\ kN \quad (6.28)$$

$$\frac{V_{1,Ed}}{V_{1,pl,T,Rd}} = \frac{110.11}{1956.49} = 0.06 \le 1.00 \quad (6.25) - OK$$

Shear resistance, 2-2 - Part 1-1: 6.2.6, 6.2.8

LC: 'B1 Dominerende Vindlast, Vindlast fra Sør', x = 0 mm

$Class_N = 1$, $Class_{M1} = 1$, $Class_{M2} = 1$

$$V_{2,pl,Rd} = \frac{A_{2,v} \cdot f_y}{\sqrt{3} \cdot \gamma_{M0}} = \frac{3277 \cdot 355}{\sqrt{3} \cdot 1.05} = 639.72\ kN \quad (6.18)$$

$$V_{2,pl,T,Rd} = 1 - \frac{\tau_{t,Ed}}{(f_y / \sqrt{3}) / \gamma_{M0}} \cdot V_{2,pl,Rd} = 1 - \frac{1.28}{(355 / \sqrt{3}) / 1.05} \cdot 639.72 = 635.53\ kN \quad (6.28)$$

$$\frac{V_{2,Ed}}{V_{2,pl,T,Rd}} = \frac{0.19}{635.53} = 0.00 \le 1.00 \quad (6.25) - OK$$

Torsional resistance - Part 1-1: 6.2.7
LC: 'B2 Dominerende Vindlast, Vindlast fra Sør', x = 3794 mm

$Class_N = 1$, $Class_{M1} = 1$, $Class_{M2} = 1$

$\tau_{max,unit} = 16.19 \frac{N/mm^2}{kNm}$ is calculated by FEM analysis.

$$T_{Rd} = \frac{f_y}{\sqrt{3} \cdot \tau_{max,unit} \cdot \gamma_{M0}} = \frac{355}{\sqrt{3} \cdot 16.19 \cdot 1.05} = 12.06 \text{ kNm}$$

$$\frac{T_{Ed}}{T_{Rd}} = \frac{0.08}{12.06} = 0.01 \leq 1.00 \quad (6.23) \text{ - OK}$$

Shear stress - Part 1-1: 6.2.6
Not relevant

Normal stress - Part 1-1: 6.2.1
Not relevant

Pure normal resistance - Part 1-1: 6.2.3, 6.2.4
Not relevant

Normal capacity - Part 1-1: 6.2
LC: 'B2 Dominerende Snølast, Vindlast fra Nord', x = 0 mm

$Class_N = 1$, $Class_{M1} = 1$, $Class_{M2} = 1$

$V_{1,Ed} = 110.11 \text{ kN} \leq 0.5 \cdot V_{1,pl,T,Rd} = 0.5 \cdot 1956.49 = 978.24 \text{ kN} \rightarrow \rho_1 = 0.00$

$V_{2,Ed} = 0.16 \text{ kN} \leq 0.5 \cdot V_{2,pl,T,Rd} = 0.5 \cdot 637.12 = 318.56 \text{ kN} \rightarrow \rho_2 = 0.00$

$$\frac{N_{Ed}}{N_{Rd}} + \frac{M_{1,Ed}}{M_{1,Rd}} + \frac{M_{2,Ed}}{M_{2,Rd}} = \frac{0.37}{4399.76} + \frac{0.03}{359.51} + \frac{59.95}{254.38} = 0.24 \leq 1.00 \quad (6.2) \text{ - OK}$$

Flexural buckling, 1-1 - Part 1-1: 6.3.1
LC: 'B2 Dominerende Vindlast, Vindlast fra Sør', x = 3794 mm

$Class_N = 1$, $Class_{M1} = 1$, $Class_{M2} = 1$

$$\bar{\lambda}_1 = \frac{L_{cr,1}}{i_1 \cdot \lambda_1} = \frac{3794}{97 \cdot 76.40} = 0.51 \quad (6.50)$$

$\alpha_1 = 0.49$ (Buckling curve: c)

$$\varphi_1 = 0.5 \left[1 + \alpha_1 \cdot (\bar{\lambda}_1 - 0.2) + \bar{\lambda}_1^2\right] = 0.5 \left[1 + 0.49 \cdot (0.51 - 0.2) + 0.51^2\right] = 0.71$$

$$\chi_1 = \min\left(\frac{1}{\varphi_1 + \sqrt{\varphi_1^2 - \bar{\lambda}_1^2}}, 1.0\right) = \min\left(\frac{1}{0.71 + \sqrt{0.71^2 - 0.51^2}}, 1.0\right) = 0.84 \quad (6.49)$$

$$N_{b,Rd,1} = \frac{\chi_1 \cdot A \cdot f_y}{\gamma_{M1}} = \frac{0.84 \cdot 13013 \cdot 355}{1.05} = 3678.82 \text{ kN} \quad (6.47)$$

$$\frac{N_{Ed}}{N_{b,Rd,1}} = \frac{10.89}{3678.82} = 0.00 \leq 1.00 \quad (6.46) \text{ - OK}$$

Flexural buckling, 2-2 - Part 1-1: 6.3.1

LC: 'B2 Dominerende Vindlast, Vindlast fra Sør', x = 3794 mm

$Class_N = 1$, $Class_{M1} = 1$, $Class_{M2} = 1$

$$\bar{\lambda}_2 = \frac{L_{cr,2}}{i_2 \cdot \lambda_1} = \frac{3794}{80 \cdot 76.40} = 0.62 \quad (6.50)$$

$\alpha_2 = 0.49$ (Buckling curve: c)

$$\varphi_2 = 0.5 \left[1 + \alpha_2 \cdot \left(\bar{\lambda}_2 - 0.2\right) + \bar{\lambda}_2^{\,2}\right] = 0.5 \left[1 + 0.49 \cdot (0.62 - 0.2) + 0.62^2\right] = 0.79$$

$$\chi_2 = \min\left(\frac{1}{\varphi_2 + \sqrt{\varphi_2^{\,2} - \bar{\lambda}_2^{\,2}}}, 1.0\right) = \min\left(\frac{1}{0.79 + \sqrt{0.79^2 - 0.62^2}}, 1.0\right) = 0.77 \quad (6.49)$$

$$N_{b,Rd,2} = \frac{\chi_2 \cdot A \cdot f_y}{\gamma_{M1}} = \frac{0.77 \cdot 13013 \cdot 355}{1.05} = 3404.99 \text{ kN} \quad (6.47)$$

$$\frac{N_{Ed}}{N_{b,Rd,2}} = \frac{10.89}{3404.99} = 0.00 \le 1.00 \quad (6.46) \text{ - OK}$$

Torsional-flexural buckling - Part 1-1: 6.3.1

LC: 'B2 Dominerende Vindlast, Vindlast fra Sør', x = 3794 mm

$Class_N = 1$, $Class_{M1} = 1$, $Class_{M2} = 1$

$$i_0 = \sqrt{i_1^{\,2} + i_2^{\,2} + y_0^{\,2} + z_0^{\,2}} = \sqrt{97^2 + 80^2 + 21^2 + 0^2} = 128 \text{ mm}$$

$$N_{cr,1} = \frac{\pi^2 \cdot E \cdot I_1}{L_{cr,1}^{\,2}} = \frac{\pi^2 \cdot 210000 \cdot 122325426}{3794^2} = 17613.50 \text{ kN}$$

$$N_{cr,2} = \frac{\pi^2 \cdot E \cdot I_2}{L_{cr,2}^{\,2}} = \frac{\pi^2 \cdot 210000 \cdot 83684216}{3794^2} = 12049.60 \text{ kN}$$

$$N_{cr,T} = \frac{1}{i_0^{\,2}}\left(G \cdot I_t + \frac{\pi^2 \cdot E \cdot I_w}{L_t^{\,2}}\right) =$$

$$= \frac{1}{128^2}\left(80769 \cdot 5.078e{+}07 + \frac{\pi^2 \cdot 210000 \cdot 7.365e{+}10}{3794^2}\right) = 252812.38 \text{ kN}$$

$$i_0^{\,2} (N - N_{cr,1}) (N - N_{cr,2}) (N - N_{cr,T}) - N^2 y_0^{\,2} (N - N_{cr,2}) - N^2 z_0^{\,2} (N - N_{cr,1}) =$$

$$= 128^2 (N - 17613.50) (N - 12049.60) (N - 252812.38) - N^2 21^2 (N - 12049.60) - N^2 0^2 (N - 17613.50) =$$

$$= 0$$

Smallest root of the above equation related to the torsional-flexural buckling:

$N_{cr,TF} = 12049.60$ kN

$N_{cr} = \min(N_{cr,T}, N_{cr,TF}) = \min(252812.38, 12049.60) = 12049.60$ kN

$$\bar{\lambda}_T = \sqrt{\frac{A \cdot f_y}{N_{cr}}} = \sqrt{\frac{13013 \cdot 355}{12049.60}} = 0.62 \quad (6.53)$$

$\alpha_T = 0.49$ (Buckling curve: c)

$$\varphi_T = 0.5 \left[1 + \alpha_T \cdot \left(\bar{\lambda}_T - 0.2\right) + \bar{\lambda}_T^{\,2}\right] = 0.5 \left[1 + 0.49 \cdot (0.62 - 0.2) + 0.62^2\right] = 0.79$$

$$\chi_T = \min\left(\frac{1}{\varphi_T + \sqrt{\varphi_T^{\,2} - \bar{\lambda}_T^{\,2}}}, 1.0\right) = \min\left(\frac{1}{0.79 + \sqrt{0.79^2 - 0.62^2}}, 1.0\right) = 0.77 \quad (6.49)$$

$$N_{b,Rd,T} = \frac{\chi_T \cdot A \cdot f_y}{\gamma_{M1}} = \frac{0.77 \cdot 13013 \cdot 355}{1.05} = 3405.21 \text{ kN} \quad (6.47)$$

$$\frac{N_{Ed}}{N_{b,Rd,T}} = \frac{10.89}{3405.21} = 0.00 \le 1.00 \text{ - OK}$$

Lateral torsional buckling, top flange - Part 1-1: 6.3.2.4

LC: 'B2 Dominerende Vindlast, Vindlast fra Sør', x = 0 mm

$Class_N = 1$, $Class_{M1} = 1$, $Class_{M2} = 1$

$$\bar{\lambda}_{f,y} = \frac{k_c \cdot L_{cr}}{i_{f,z} \cdot \lambda_1} = \frac{0.82 \cdot 3794}{56 \cdot 76.40} = 0.73 \quad (6.59)$$

$\alpha_y = 0.76$ (Buckling curve: d)

$$\varphi_y = 0.5 \left[1 + \alpha_y \cdot \left(\bar{\lambda}_{f,y} - 0.2\right) + \bar{\lambda}_{f,y}^{\,2}\right] =$$

$$= 0.5 \left[1 + 0.76 \cdot (0.73 - 0.2) + 0.73^2\right] = 0.96$$

$$\chi_y = \min\left(\frac{1}{\varphi_y + \sqrt{\varphi_y^{\,2} - \bar{\lambda}_{f,y}^{\,2}}}, 1.0\right) = \min\left(\frac{1}{0.96 + \sqrt{0.96^2 - 0.73^2}}, 1.0\right) = 0.63 \quad (6.49)$$

$$M_{y,c,Rd} = W_y \frac{f_y}{\gamma_{M1}} = 1063340 \frac{355}{1.05} = 359.51 \text{ kNm}$$

$$M_{y,b,Rd} = \min(k_{fl} \cdot \chi_y \cdot M_{y,c,Rd}, M_{y,c,Rd}) = \min(1.10 \cdot 0.63 \cdot 359.51, 359.51) = 247.58 \text{ kNm} \quad (6.60)$$

$$\frac{M_{1,Ed}}{M_{y,b,Rd}} = \frac{0.05}{247.58} = 0.00 \le 1.00 \quad (6.54) \text{ - OK}$$

Lateral torsional buckling, bottom flange - Part 1-1: 6.3.2.4

LC: 'B2 Dominerende Vindlast, Vindlast fra Øst', x = 3320 mm

$Class_N = 1$, $Class_{M1} = 1$, $Class_{M2} = 1$

$$\bar{\lambda}_{f,y} = \frac{k_c \cdot L_{cr}}{i_{f,z} \cdot \lambda_1} = \frac{0.91 \cdot 3794}{56 \cdot 76.40} = 0.81 \quad (6.59)$$

$\alpha_y = 0.76$ (Buckling curve: d)

$$\varphi_y = 0.5 \left[1 + \alpha_y \cdot \left(\bar{\lambda}_{f,y} - 0.2\right) + \bar{\lambda}_{f,y}^{\,2}\right] =$$

$$= 0.5 \left[1 + 0.76 \cdot (0.81 - 0.2) + 0.81^2\right] = 1.06$$

$$\chi_y = \min\left(\frac{1}{\varphi_y + \sqrt{\varphi_y^{\,2} - \bar{\lambda}_{f,y}^{\,2}}}, 1.0\right) = \min\left(\frac{1}{1.06 + \sqrt{1.06^2 - 0.81^2}}, 1.0\right) = 0.58 \quad (6.49)$$

$$M_{y,c,Rd} = W_y \frac{f_y}{\gamma_{M1}} = 1063340 \frac{355}{1.05} = 359.51 \text{ kNm}$$

$$M_{y,b,Rd} = \min(k_{fl} \cdot \chi_y \cdot M_{y,c,Rd}, M_{y,c,Rd}) = \min(1.10 \cdot 0.58 \cdot 359.51, 359.51) = 227.79 \text{ kNm} \quad (6.60)$$

$$\frac{M_{1,Ed}}{M_{y,b,Rd}} = \frac{0.03}{227.79} = 0.00 \le 1.00 \quad (6.54) \text{ - OK}$$

Interaction between normal force and bending 1. - Part 1-1: 6.3.3

LC: 'B2 Dominerende Snølast, Vindlast fra Nord', x = 0 mm

$Class_N = 1$, $Class_{M1} = 1$, $Class_{M2} = 1$

k_{ij} factors are calculated according to Method 2

α_{my}	= -0.21	ψ_{my}	= -0.04	C_{my}	= 0.40
α_{mz}	= -0.46	ψ_{mz}	= 0.01	C_{mz}	= 0.47
α_{mLT}	= -0.21	ψ_{mLT}	= -0.04	C_{mLT}	= 0.40

$M_{2,Rk} = f_y \cdot W_{pl,2} = 355 \cdot 752394 = 267.10$ kNm

$$\frac{N_{Ed}^{comp}}{N_{b,Rd,1}} + k_{11} \cdot \frac{M_{1,Ed}}{M_{y,b,Rd}} + k_{12} \cdot \frac{M_{2,Ed}}{\frac{M_{2,Rk}}{\gamma_{M1}}} =$$

$$= \frac{0.00}{3678.82} + 0.40 \cdot \frac{0.03}{227.79} + 0.28 \cdot \frac{59.95}{\frac{267.10}{1.05}} = 0.07 \leq 1.00 \quad (6.61) \text{ - OK}$$

Interaction between normal force and bending 2. - Part 1-1: 6.3.3

LC: 'B2 Dominerende Snølast, Vindlast fra Nord', x = 0 mm

$Class_N = 1$, $Class_{M1} = 1$, $Class_{M2} = 1$

k_{ij} factors are calculated according to Method 2

α_{my}	= -0.21	ψ_{my}	= -0.04	C_{my}	= 0.40
α_{mz}	= -0.46	ψ_{mz}	= 0.01	C_{mz}	= 0.47
α_{mLT}	= -0.21	ψ_{mLT}	= -0.04	C_{mLT}	= 0.40

$M_{2,Rk} = f_y \cdot W_{pl,2} = 355 \cdot 752394 = 267.10$ kNm

$$\frac{N_{Ed}^{comp}}{N_{b,Rd,2}} + k_{21} \cdot \frac{M_{1,Ed}}{M_{y,b,Rd}} + k_{22} \cdot \frac{M_{2,Ed}}{\frac{M_{2,Rk}}{\gamma_{M1}}} =$$

$$= \frac{0.00}{3404.99} + 1.00 \cdot \frac{0.03}{227.79} + 0.47 \cdot \frac{59.95}{\frac{267.10}{1.05}} = 0.11 \leq 1.00 \quad (6.62) \text{ - OK}$$

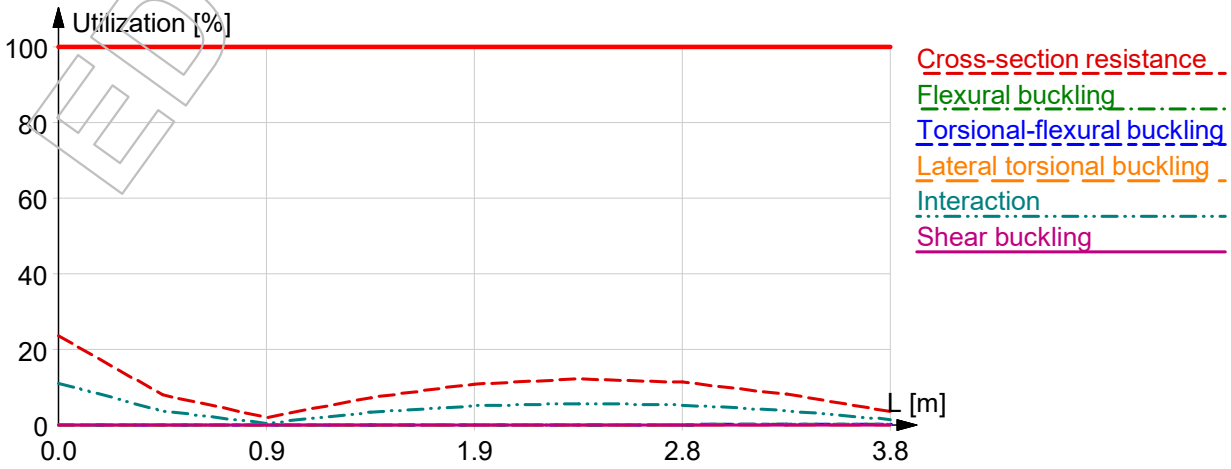
Interaction between normal force and bending, 2nd order - Part 1-1: 6.3.3

Not relevant

Shear buckling - Part 1-5: 5

Shear buckling check is not implemented for this section.

Summary



3.4 Utnyttelse av Bjelker, Søyler og vindkryss

Max. of load combinations, Bar, Utilization

Member	Section	Maximum	Combination	RCS	FB	TFB	LTB,t	LTB,b	IA
[-]	[-]	[%]	[-]	[%]	[%]	[%]	[%]	[%]	[%]
B.1.1	IPE 240	39	B2 Dominerende Snølast, Vindlast fra Nord	19	2	1	30	38	39
B.2.1	IPE 240	39	B2 Dominerende Snølast, Vindlast fra Øst	16	2	1	33	39	39
B.3.1	D 20-200	33	B1 Dominerende Snølast, Vindlast fra Nord	33	0	0	0	0	33
B.4.1	D 20-200	39	B2 Dominerende Snølast, Vindlast fra Sør	39	1	1	1	1	25
B.5.1	D 20-200	2	B1 Dominerende Vindlast, Vindlast fra Sør	2	0	0	0	0	2
B.6.1	IPE 240	13	B2 Dominerende Snølast, Vindlast fra Nord	13	0	0	11	10	11
B.7.1	D 20-200	15	B2 Dominerende Nyttelast, Vindlast fra Nord	15	0	0	1	0	7
B.8.1	IPE 240	28	B2 Dominerende Snølast, Vindlast fra Nord	13	3	1	18	28	28
B.9.1	D 20-200	31	B2 Dominerende Snølast, Vindlast fra Sør	31	0	0	0	0	5
B.10.1	D 20-200	14	B2 Dominerende Snølast, Vindlast fra Nord	14	0	0	0	0	9
B.11.1	D 20-200	18	B2 Dominerende Snølast, Vindlast fra Vest	18	0	0	0	0	15
B.12.1	D 20-200	4	B2 Dominerende Snølast, Vindlast fra Sør	4	0	0	0	0	3
B.13.1	D 20-200	15	B2 Dominerende Snølast, Vindlast fra Øst	15	1	1	0	0	15
B.14.1	D 20-200	18	B2 Dominerende Snølast, Vindlast fra Øst	18	0	0	0	0	8
B.15.1	D 20-200	17	B2 Dominerende Snølast, Vindlast fra Nord	17	0	0	0	0	12
B.16.1	D 20-200	24	B2 Dominerende Snølast, Vindlast fra Øst	24	0	0	0	0	9
B.17.1	IPE 240	15	B2 Dominerende Snølast, Vindlast fra Sør	14	0	0	3	15	15
B.18.1	IPE 240	42	B2 Dominerende Snølast, Vindlast fra Sør	23	0	0	15	42	42
B.19.1	IPE 240	50	B2 Dominerende Snølast, Vindlast fra Nord	24	3	1	28	50	50
B.20.1	IPE 240	11	B2 Dominerende Vindlast, Vindlast fra Nord	11	1	1	7	4	11
B.21.1	IPE 240	8	B1 Dominerende Vindlast, Vindlast fra Nord	6	0	0	4	7	8
B.22.1	IPE 240	14	B2 Dominerende Vindlast, Vindlast fra Vest	8	4	1	10	14	14
B.23.1	D 20-200	52	B2 Dominerende Snølast, Vindlast fra Øst	52	0	0	0	1	10
B.24.1	D 20-200	10	B1 Dominerende Vindlast, Vindlast fra Nord	10	1	1	0	0	5
B.25.1	D 20-200	10	B1 Dominerende Vindlast, Vindlast fra Nord	10	0	0	0	0	4
B.26.1	D 20-200	5	B1 Dominerende Vindlast, Vindlast fra Sør	5	0	0	0	0	2
B.27.1	D 20-200	4	B2 Dominerende Vindlast, Vindlast fra Øst	4	0	0	0	0	2
B.28.1	D 20-200	6	B2 Dominerende Vindlast, Vindlast fra Nord	6	1	1	0	0	1
B.29.1	D 20-200	14	B2 Dominerende Nyttelast, Vindlast fra Nord	14	1	1	0	0	6
B.30.1	D 20-200	14	B2 Dominerende Nyttelast, Vindlast fra Nord	14	0	0	0	0	8
B.31.1	D 20-200	12	B1 Dominerende Snølast, Vindlast fra Nord	12	0	0	0	0	7
B.32.1	D 20-200	12	B1 Dominerende Snølast, Vindlast fra Nord	12	0	0	0	0	5
B.33.1	D 20-200	8	B2 Dominerende Snølast, Vindlast fra Nord	8	0	0	0	0	4
B.34.1	D 20-200	8	B2 Dominerende Snølast, Vindlast fra Nord	8	0	0	0	0	4
B.35.1	IPE 240	28	B2 Dominerende Snølast, Vindlast fra Sør	17	4	1	13	28	28
B.36.1	IPE 240	44	B2 Dominerende Snølast, Vindlast fra Nord	19	1	0	21	44	44
B.37.1	IPE 240	27	B2 Dominerende Snølast, Vindlast fra Sør	19	1	0	4	27	27
B.38.1	IPE 240	37	B2 Dominerende Snølast, Vindlast fra Nord	17	3	1	28	37	37
B.39.1	D 20-200	2	B2 Dominerende Snølast, Vindlast fra Sør	2	0	0	0	0	2
B.40.1	D 20-200	9	B2 Dominerende Snølast, Vindlast fra Nord	9	0	0	0	0	5
B.41.1	D 20-200	16	B2 Dominerende Snølast, Vindlast fra Nord	16	0	0	0	0	14
B.42.1	D 20-200	16	B2 Dominerende Snølast, Vindlast fra Nord	16	0	0	0	0	6
B.43.1	D 20-200	13	B2 Dominerende Snølast, Vindlast fra Nord	13	0	0	0	0	5
B.44.1	D 20-200	13	B2 Dominerende Snølast, Vindlast fra Sør	13	0	0	0	0	7
B.45.1	D 20-200	11	B2 Dominerende Snølast, Vindlast fra Nord	11	0	0	0	0	5
B.46.1	D 20-200	18	B2 Dominerende Snølast, Vindlast fra Sør	18	0	0	0	0	8
B.47.1	D 20-200	17	B2 Dominerende Snølast, Vindlast fra Sør	17	0	0	0	0	7
B.48.1	D 20-200	7	B2 Dominerende Snølast, Vindlast fra Nord	7	0	0	0	0	3
B.49.1	D 20-200	7	B2 Dominerende Snølast, Vindlast fra Nord	7	0	0	0	0	4
B.50.1	D 20-200	6	B2 Dominerende Snølast, Vindlast fra Sør	6	0	0	0	0	3

Member	Section	Maximum	Combination	RCS	FB	TFB	LTB,t	LTB,b	IA
[-]	[-]	[%]	[-]	[%]	[%]	[%]	[%]	[%]	[%]
B.51.1	IPE 240	14	B2 Dominerende Vindlast, Vindlast fra Nord	13	2	1	1	1	14
B.52.1	IPE 240	14	B2 Dominerende Vindlast, Vindlast fra Sør	13	2	1	2	2	14
B.53.1	IPE 240	9	B2 Dominerende Vindlast, Vindlast fra Vest	9	1	1	4	4	9
B.54.1	IPE 240	5	B2 Dominerende Snølast, Vindlast fra Øst	4	0	0	5	5	5
B.55.1	IPE 240	15	B2 Dominerende Snølast, Vindlast fra Nord	10	0	0	7	15	15
B.56.1	D 20-200	16	B2 Dominerende Snølast, Vindlast fra Sør	16	0	0	0	0	7
B.57.1	D 20-200	24	B2 Dominerende Snølast, Vindlast fra Nord	24	0	0	0	0	10
B.58.1	D 20-200	24	B2 Dominerende Snølast, Vindlast fra Nord	24	0	0	0	0	11
B.59.1	D 20-200	26	B2 Dominerende Snølast, Vindlast fra Øst	26	0	0	0	0	24
B.60.1	D 20-200	25	B1 Dominerende Snølast, Vindlast fra Vest	25	0	0	0	0	17
B.61.1	D 20-200	28	B2 Dominerende Snølast, Vindlast fra Øst	28	0	0	0	0	24
B.62.1	D 20-200	5	B2 Dominerende Snølast, Vindlast fra Nord	5	0	0	0	0	2
B.63.1	D 20-200	13	B2 Dominerende Snølast, Vindlast fra Nord	13	0	0	0	-	5
B.64.1	D 20-200	25	B2 Dominerende Snølast, Vindlast fra Sør	25	2	2	0	3	14
B.65.1	IPE 240	34	B2 Dominerende Snølast, Vindlast fra Sør	32	0	0	0	32	34
B.66.1	IPE 240	19	B2 Dominerende Snølast, Vindlast fra Nord	13	3	1	9	19	19
B.67.1	IPE 240	31	B2 Dominerende Snølast, Vindlast fra Sør	18	1	0	11	31	31
B.68.1	IPE 240	36	B2 Dominerende Snølast, Vindlast fra Sør	18	3	1	17	36	36
B.69.1	IPE 240	19	B2 Dominerende Snølast, Vindlast fra Vest	14	1	0	8	19	19
B.70.1	IPE 240	28	B2 Dominerende Snølast, Vindlast fra Vest	14	4	2	24	27	28
B.71.1	IPE 240	19	B2 Dominerende Vindlast, Vindlast fra Sør	19	0	0	0	1	19
B.72.1	IPE 240	10	B2 Dominerende Vindlast, Vindlast fra Sør	10	3	1	8	0	8
B.73.1	IPE 240	29	B2 Dominerende Snølast, Vindlast fra Nord	16	2	1	16	29	29
B.74.1	IPE 240	22	B2 Dominerende Snølast, Vindlast fra Nord	16	1	1	8	22	22
B.75.1	IPE 240	18	B2 Dominerende Snølast, Vindlast fra Nord	18	0	0	10	15	15
B.76.1	IPE 240	12	B2 Dominerende Vindlast, Vindlast fra Nord	12	2	1	1	6	9
B.77.1	IPE 240	19	B2 Dominerende Vindlast, Vindlast fra Vest	18	3	1	3	2	19
B.78.1	D 20-200	2	B1 Dominerende Vindlast, Vindlast fra Vest	2	0	0	0	0	1
B.79.1	D 20-200	11	B1 Dominerende Snølast, Vindlast fra Øst	11	0	0	0	0	4
B.80.1	D 20-200	3	B1 Dominerende Snølast, Vindlast fra Øst	3	0	0	0	0	1
B.81.1	IPE 240	8	B1 Dominerende Vindlast, Vindlast fra Nord	4	0	0	8	-	8
B.82.1	IPE 240	3	B1 Dominerende Vindlast, Vindlast fra Nord	2	0	0	1	3	3
B.83.1	IPE 240	10	B1 Dominerende Vindlast, Vindlast fra Nord	5	0	0	9	10	10
B.84.1	IPE 240	6	B2 Dominerende Snølast, Vindlast fra Sør	4	-	-	1	6	6
B.85.1	IPE 240	10	B2 Dominerende Snølast, Vindlast fra Vest	5	1	1	10	8	10
B.86.1	IPE 240	28	B2 Dominerende Snølast, Vindlast fra Sør	21	1	0	10	28	28
B.87.1	IPE 240	40	B2 Dominerende Snølast, Vindlast fra Øst	21	2	1	24	39	40
B.88.1	D 20-200	18	B2 Dominerende Snølast, Vindlast fra Øst	18	0	0	0	0	7
B.89.1	D 20-200	19	B2 Dominerende Snølast, Vindlast fra Øst	19	0	0	0	0	9
B.90.1	D 20-200	22	B2 Dominerende Snølast, Vindlast fra Øst	22	0	0	1	0	9
B.91.1	D 20-200	29	B2 Dominerende Snølast, Vindlast fra Øst	29	0	0	0	0	16
B.92.1	D 20-200	17	B2 Dominerende Snølast, Vindlast fra Vest	17	0	0	0	0	7
B.93.1	D 20-200	24	B2 Dominerende Snølast, Vindlast fra Øst	24	0	0	0	0	10
B.94.1	IPE 240	48	B2 Dominerende Snølast, Vindlast fra Øst	16	6	1	39	47	48
B.95.1	IPE 240	38	B2 Dominerende Snølast, Vindlast fra Sør	27	12	4	8	28	38
C.1.1	KKR 100x100x6	28	B2 Dominerende Snølast, Vindlast fra Nord	14	27	12	2	2	28
C.2.1	KKR 100x100x6	32	B2 Dominerende Vindlast, Vindlast fra Øst	29	8	3	26	18	32
C.3.1	KKR 100x100x6	42	B2 Dominerende Vindlast, Vindlast fra Sør	30	24	11	2	1	42
C.4.1	KKR 100x100x6	80	B2 Dominerende Vindlast, Vindlast fra Nord	58	46	21	1	1	80
C.5.1	KKR 120x120x6	72	B1 Dominerende Snølast, Vindlast fra Nord	46	67	37	9	4	72
C.6.1	KKR 100x100x6	89	B2 Dominerende Vindlast, Vindlast fra Øst	89	17	8	20	25	87
C.7.1	KKR 100x100x6	60	B2 Dominerende Vindlast, Vindlast fra Vest	47	35	16	35	32	60

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[-]	[-]	[%]	[-]	[%]	[%]	[%]	[%]	[%]	[%]
C.8.1	KKR 100x100x6	46	B2 Dominerende Vindlast, Vindlast fra Vest	43	18	8	19	25	46
C.9.1	KKR 100x100x6	27	B2 Dominerende Vindlast, Vindlast fra Vest	22	15	7	5	10	27
C.10.1	KKR 100x100x6	21	B2 Dominerende Snølast, Vindlast fra Sør	12	20	9	3	2	21
C.11.1	KKR 100x100x6	12	B2 Dominerende Snølast, Vindlast fra Sør	8	10	4	2	3	12
C.12.1	KKR 100x100x6	22	B2 Dominerende Snølast, Vindlast fra Sør	10	21	10	1	0	22
C.13.1	KKR 100x100x6	26	B2 Dominerende Snølast, Vindlast fra Vest	14	25	11	3	1	26
C.14.1	KKR 100x100x6	48	B2 Dominerende Vindlast, Vindlast fra Sør	44	18	8	11	18	48
C.15.1	KKR 100x100x6	61	B2 Dominerende Vindlast, Vindlast fra Sør	46	35	15	1	1	61
C.16.1	KKR 100x100x6	45	B2 Dominerende Vindlast, Vindlast fra Nord	44	16	7	21	14	45
C.17.1	KKR 100x100x6	45	B2 Dominerende Snølast, Vindlast fra Vest	28	37	17	14	8	45
C.18.1	KKR 100x100x6	49	B2 Dominerende Snølast, Vindlast fra Vest	25	47	21	1	1	49
C.19.1	KKR 120x120x6	65	B2 Dominerende Vindlast, Vindlast fra Nord	59	21	12	13	17	65
C.20.1	KKR 100x100x6	12	B2 Dominerende Snølast, Vindlast fra Nord	7	11	5	3	1	12
C.21.1	KKR 100x100x6	40	B2 Dominerende Vindlast, Vindlast fra Sør	40	11	5	19	24	40
C.22.1	KKR 100x100x6	42	B2 Dominerende Vindlast, Vindlast fra Vest	33	23	10	1	1	42
C.23.1	KKR 100x100x6	73	B2 Dominerende Vindlast, Vindlast fra Nord	51	47	21	1	1	73
C.24.1	KKR 100x100x6	62	B1 Dominerende Snølast, Vindlast fra Sør	29	61	27	2	1	62
C.25.1	KKR 100x100x6	47	B1 Dominerende Snølast, Vindlast fra Øst	22	46	20	2	1	47
C.26.1	KKR 100x100x6	27	B2 Dominerende Vindlast, Vindlast fra Sør	25	13	6	9	14	27
C.27.1	KKR 100x100x6	91	B2 Dominerende Vindlast, Vindlast fra Vest	89	35	16	49	38	91
C.28.1	KKR 100x100x6	38	B2 Dominerende Vindlast, Vindlast fra Vest	34	20	9	18	13	38
C.29.1	KKR 100x100x6	58	B2 Dominerende Vindlast, Vindlast fra Nord	41	40	18	23	23	58
C.30.1	KKR 100x100x6	41	B2 Dominerende Vindlast, Vindlast fra Øst	33	17	8	26	23	41
C.31.1	KKR 100x100x6	44	B2 Dominerende Vindlast, Vindlast fra Øst	29	33	15	16	12	44
C.32.1	KKR 100x100x6	57	B2 Dominerende Vindlast, Vindlast fra Sør	40	39	18	2	2	57
C.33.1	KKR 100x100x6	45	B2 Dominerende Vindlast, Vindlast fra Nord	34	28	12	2	2	45
C.34.1	KKR 100x100x6	78	B2 Dominerende Snølast, Vindlast fra Øst	38	76	34	2	1	78
C.35.1	KKR 100x100x6	6	B1 Dominerende Vindlast, Vindlast fra Nord	5	5	2	2	2	6
C.36.1	KKR 100x100x6	67	B1 Dominerende Vindlast, Vindlast fra Sør	42	58	26	1	1	67
C.37.1	KKR 100x100x6	31	B2 Dominerende Vindlast, Vindlast fra Nord	28	8	3	2	2	31
C.38.1	KKR 100x100x6	44	B2 Dominerende Vindlast, Vindlast fra Øst	40	12	5	34	32	44
C.39.1	KKR 100x100x6	28	B2 Dominerende Vindlast, Vindlast fra Nord	28	6	3	15	9	27
C.40.1	KKR 100x100x6	34	B1 Dominerende Vindlast, Vindlast fra Sør	17	33	15	2	2	34
C.41.1	KKR 100x100x6	21	B1 Dominerende Vindlast, Vindlast fra Sør	12	20	9	2	2	21
C.42.1	KKR 100x100x6	8	B1 Dominerende Vindlast, Vindlast fra Vest	6	7	3	1	1	8
C.43.1	KKR 120x120x6	68	B2 Dominerende Snølast, Vindlast fra Nord	45	63	35	6	3	68
C.44.1	KKR 100x100x6	56	B2 Dominerende Snølast, Vindlast fra Nord	30	53	24	4	2	56
C.45.1	KKR 100x100x6	6	B1 Dominerende Vindlast, Vindlast fra Sør	6	3	1	1	1	6
C.46.1	KKR 100x100x6	9	B1 Dominerende Vindlast, Vindlast fra Vest	8	6	3	1	1	9
C.47.1	KKR 100x100x8	63	B1 Dominerende Snølast, Vindlast fra Nord	32	60	26	2	4	63
C.48.1	KKR 100x100x6	73	B2 Dominerende Snølast, Vindlast fra Sør	33	72	32	1	2	73
C.49.1	KKR 100x100x6	71	B2 Dominerende Snølast, Vindlast fra Nord	34	69	31	2	3	71
C.50.1	KKR 100x100x6	48	B2 Dominerende Vindlast, Vindlast fra Øst	36	31	14	19	21	48
C.51.1	KKR 100x100x6	75	B2 Dominerende Snølast, Vindlast fra Øst	35	73	33	1	1	75
C.52.1	KKR 100x100x6	12	B2 Dominerende Snølast, Vindlast fra Vest	7	12	5	1	1	12
C.53.1	KKR 100x100x6	45	B2 Dominerende Snølast, Vindlast fra Nord	23	42	19	4	2	45
C.54.1	KKR 100x100x6	51	B2 Dominerende Snølast, Vindlast fra Sør	25	49	22	2	3	51
C.55.1	KKR 100x100x6	37	B2 Dominerende Snølast, Vindlast fra Nord	18	36	16	2	1	37
C.56.1	KKR 100x100x6	56	B2 Dominerende Snølast, Vindlast fra Nord	26	56	25	1	1	56
C.57.1	KKR 100x100x6	71	B1 Dominerende Snølast, Vindlast fra Nord	34	70	31	2	3	71
C.58.1	KKR 100x100x6	91	B1 Dominerende Snølast, Vindlast fra Nord	42	90	41	1	1	91
C.59.1	KKR 100x100x6	73	B2 Dominerende Snølast, Vindlast fra Øst	34	72	32	1	2	73

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[-]	[-]	[%]	[-]	[%]	[%]	[%]	[%]	[%]	[%]
C.60.1	KKR 100x100x6	33	B2 Dominerende Snølast, Vindlast fra Nord	16	32	14	2	1	33
C.61.1	KKR 100x100x6	34	B2 Dominerende Snølast, Vindlast fra Sør	16	34	15	1	1	34
C.62.1	KKR 100x100x6	32	B2 Dominerende Snølast, Vindlast fra Nord	15	32	14	1	1	32
C.63.1	KKR 100x100x6	63	B2 Dominerende Snølast, Vindlast fra Nord	30	62	28	3	1	63
C.64.1	KKR 100x100x6	59	B2 Dominerende Snølast, Vindlast fra Sør	30	56	25	2	4	59
C.65.1	KKR 100x100x6	37	B2 Dominerende Snølast, Vindlast fra Nord	22	32	14	0	1	37
C.66.1	KKR 100x100x6	35	B2 Dominerende Snølast, Vindlast fra Vest	18	33	15	1	3	35
C.67.1	KKR 120x120x6	81	B2 Dominerende Nyttelast, Vindlast fra Nord	53	74	41	6	11	81
C.68.1	KKR 100x100x6	33	B2 Dominerende Nyttelast, Vindlast fra Vest	16	32	14	0	1	33
C.69.1	KKR 100x100x6	43	B2 Dominerende Snølast, Vindlast fra Nord	20	43	19	1	1	43
C.70.1	KKR 100x100x6	39	B2 Dominerende Snølast, Vindlast fra Sør	18	38	17	1	1	39
C.71.1	KKR 100x100x6	57	B1 Dominerende Snølast, Vindlast fra Nord	27	56	25	2	1	57
C.72.1	KKR 100x100x6	52	B1 Dominerende Snølast, Vindlast fra Sør	25	51	23	1	2	52
C.73.1	KKR 100x100x6	39	B2 Dominerende Nyttelast, Vindlast fra Sør	18	39	17	0	0	39
C.74.1	KKR 100x100x6	91	B2 Dominerende Nyttelast, Vindlast fra Sør	64	63	28	1	1	91
C.75.1	KKR 100x100x6	41	B2 Dominerende Snølast, Vindlast fra Sør	28	32	14	7	13	41
C.76.1	KKR 100x100x6	60	B1 Dominerende Snølast, Vindlast fra Sør	32	55	25	7	3	60
C.77.1	KKR 100x100x6	72	B2 Dominerende Nyttelast, Vindlast fra Vest	39	66	30	4	8	72
C.78.1	KKR 100x100x6	62	B2 Dominerende Nyttelast, Vindlast fra Vest	39	51	23	15	8	62
C.79.1	KKR 100x100x6	62	B2 Dominerende Vindlast, Vindlast fra Øst	45	39	17	30	26	62
C.80.1	KKR 100x100x6	0	B1 Dominerende Snølast, Vindlast fra Vest	0	0	0	0	0	-
C.81.1	KKR 100x100x6	44	B2 Dominerende Vindlast, Vindlast fra Sør	33	23	10	2	1	44
C.82.1	KKR 100x100x6	43	B2 Dominerende Vindlast, Vindlast fra Vest	40	13	6	27	18	43
C.83.1	KKR 100x100x6	18	B2 Dominerende Snølast, Vindlast fra Vest	16	11	5	4	0	18
C.84.1	KKR 100x100x6	76	B2 Dominerende Snølast, Vindlast fra Sør	44	72	38	2	5	76
C.85.1	KKR 120x120x6	67	B2 Dominerende Snølast, Vindlast fra Nord	57	60	39	5	11	67
C.86.1	KKR 100x100x6	25	B1 Dominerende Snølast, Vindlast fra Nord	12	24	11	1	1	25
C.87.1	KKR 100x100x6	48	B2 Dominerende Snølast, Vindlast fra Nord	24	47	21	2	2	48
C.88.1	KKR 100x100x6	59	B2 Dominerende Vindlast, Vindlast fra Øst	46	28	13	34	34	59
C.89.1	KKR 100x100x6	44	B2 Dominerende Snølast, Vindlast fra Øst	28	35	16	5	2	44
C.90.1	KKR 100x100x6	73	B2 Dominerende Vindlast, Vindlast fra Nord	57	35	16	43	43	73
C.91.1	KKR 100x100x6	49	B2 Dominerende Vindlast, Vindlast fra Vest	39	26	12	30	24	49
C.92.1	KKR 100x100x6	39	B2 Dominerende Snølast, Vindlast fra Sør	27	31	14	3	5	39
C.93.1	KKR 100x100x6	49	B2 Dominerende Snølast, Vindlast fra Sør	35	39	17	16	13	49
C.94.1	KKR 100x100x6	19	B2 Dominerende Snølast, Vindlast fra Nord	10	17	8	0	2	19
C.95.1	KKR 100x100x6	26	B2 Dominerende Snølast, Vindlast fra Nord	14	24	11	2	3	26
C.96.1	KKR 100x100x6	23	B2 Dominerende Snølast, Vindlast fra Sør	12	21	9	3	2	23
C.97.1	KKR 100x100x6	44	B2 Dominerende Snølast, Vindlast fra Nord	22	43	19	3	3	44
C.98.1	KKR 100x100x6	45	B1 Dominerende Snølast, Vindlast fra Sør	20	45	20	0	0	45
C.99.1	KKR 100x100x6	53	B2 Dominerende Vindlast, Vindlast fra Sør	39	33	15	2	3	53
C.100.1	KKR 100x100x6	62	B2 Dominerende Snølast, Vindlast fra Nord	29	60	27	0	1	62
C.101.1	KKR 100x100x6	51	B2 Dominerende Vindlast, Vindlast fra Nord	38	30	13	22	11	51
C.102.1	KKR 100x100x6	50	B2 Dominerende Vindlast, Vindlast fra Vest	37	28	12	19	25	50
C.103.1	KKR 100x100x6	57	B2 Dominerende Vindlast, Vindlast fra Sør	44	28	12	33	29	57
C.104.1	KKR 100x100x6	23	B2 Dominerende Vindlast, Vindlast fra Vest	21	8	4	18	15	23
C.105.1	KKR 100x100x6	61	B1 Dominerende Vindlast, Vindlast fra Sør	34	57	25	1	3	61
C.106.1	KKR 100x100x6	47	B2 Dominerende Vindlast, Vindlast fra Nord	31	34	15	18	15	47
C.107.1	KKR 100x100x6	41	B2 Dominerende Vindlast, Vindlast fra Sør	28	25	11	19	16	41
C.108.1	KKR 100x100x8	89	B1 Dominerende Snølast, Vindlast fra Nord	41	87	37	1	1	89
C.109.1	KKR 100x100x6	40	B2 Dominerende Snølast, Vindlast fra Nord	19	40	18	1	1	40
C.110.1	KKR 100x100x6	66	B2 Dominerende Nyttelast, Vindlast fra Nord	66	29	28	4	2	60
C.111.1	KKR 100x100x6	90	B2 Dominerende Vindlast, Vindlast fra Nord	90	16	15	54	39	83

Member	Section	Maximum	Combination	RCS	FB	TFB	LTB,t	LTB,b	IA
[-]	[-]	[%]	[-]	[%]	[%]	[%]	[%]	[%]	[%]
C.112.1	KKR 100x100x6	25	B2 Dominerende Vindlast, Vindlast fra Sør	25	6	6	11	16	21
C.113.1	KKR 100x100x6	47	B2 Dominerende Vindlast, Vindlast fra Sør	47	26	25	5	10	44
C.114.1	KKR 100x100x6	38	B2 Dominerende Vindlast, Vindlast fra Øst	38	13	11	14	20	38
C.115.1	KKR 100x100x6	54	B2 Dominerende Vindlast, Vindlast fra Vest	53	33	17	35	28	54
C.116.1	KKR 100x100x6	22	B1 Dominerende Snølast, Vindlast fra Sør	22	20	20	3	3	22
C.117.1	KKR 100x100x6	50	B1 Dominerende Vindlast, Vindlast fra Øst	40	32	14	26	23	50
C.118.1	KKR 100x100x6	54	B2 Dominerende Vindlast, Vindlast fra Vest	46	20	9	2	2	54
C.119.1	KKR 100x100x6	38	B2 Dominerende Vindlast, Vindlast fra Sør	26	27	12	14	15	38
C.120.1	KKR 100x100x6	39	B2 Dominerende Vindlast, Vindlast fra Vest	36	15	7	19	23	39
C.121.1	KKR 100x100x6	75	B2 Dominerende Snølast, Vindlast fra Sør	75	70	35	3	36	75
C.122.1	KKR 100x100x6	44	B2 Dominerende Vindlast, Vindlast fra Nord	43	25	20	1	1	44
C.123.1	KKR 100x100x6	31	B2 Dominerende Vindlast, Vindlast fra Nord	31	12	12	18	12	27
C.124.1	KKR 100x100x6	58	B2 Dominerende Snølast, Vindlast fra Sør	37	53	31	4	7	58
C.125.1	KKR 100x100x6	49	B2 Dominerende Vindlast, Vindlast fra Nord	33	31	21	1	1	49
C.126.1	KKR 100x100x6	31	B2 Dominerende Snølast, Vindlast fra Nord	20	31	20	0	0	31
C.127.1	KKR 100x100x6	29	B2 Dominerende Vindlast, Vindlast fra Vest	29	13	13	15	7	27
C.128.1	KKR 100x100x6	27	B1 Dominerende Vindlast, Vindlast fra Øst	13	26	12	1	1	27
C.129.1	KKR 100x100x6	60	B2 Dominerende Snølast, Vindlast fra Øst	34	50	22	0	8	60
C.130.1	KKR 100x100x6	83	B2 Dominerende Snølast, Vindlast fra Øst	40	77	34	0	6	83
C.131.1	KKR 100x100x6	44	B2 Dominerende Vindlast, Vindlast fra Nord	44	7	3	17	11	39
C.132.1	KKR 100x100x6	38	B1 Dominerende Vindlast, Vindlast fra Sør	38	17	10	3	3	36
C.133.1	KKR 100x100x6	16	B1 Dominerende Snølast, Vindlast fra Øst	9	16	7	0	0	16
C.134.1	KKR 100x100x6	56	B1 Dominerende Vindlast, Vindlast fra Øst	56	38	17	1	9	51
C.135.1	KKR 100x100x6	52	B1 Dominerende Snølast, Vindlast fra Vest	37	49	22	4	1	52
C.136.1	KKR 100x100x6	57	B1 Dominerende Snølast, Vindlast fra Sør	57	39	17	2	11	54
C.137.1	KKR 100x100x6	94	B1 Dominerende Snølast, Vindlast fra Vest	46	89	40	3	4	94
C.138.1	KKR 100x100x6	3	B2 Dominerende Vindlast, Vindlast fra Sør	3	2	1	1	1	3
C.139.1	KKR 100x100x6	27	B2 Dominerende Snølast, Vindlast fra Sør	15	26	13	1	1	27
T.1.1	VKR 80x80x3.6	41	B2 Dominerende Vindlast, Vindlast fra Vest	5	41	5	-	-	-
T.2.1	VKR 80x80x3.6	81	B2 Dominerende Vindlast, Vindlast fra Sør	10	81	10	-	-	-
T.3.1	VKR 80x80x3.6	30	B2 Dominerende Vindlast, Vindlast fra Vest	7	30	7	-	-	-
T.4.1	VKR 80x80x3.6	34	B1 Dominerende Vindlast, Vindlast fra Sør	8	34	8	-	-	-
T.5.1	VKR 80x80x3.6	29	B2 Dominerende Vindlast, Vindlast fra Vest	8	29	8	-	-	-
T.6.1	VKR 80x80x3.6	23	B2 Dominerende Vindlast, Vindlast fra Sør	6	23	6	-	-	-
T.7.1	VKR 80x80x3.6	62	B1 Dominerende Vindlast, Vindlast fra Vest	14	62	14	-	-	-
T.8.1	VKR 80x80x3.6	82	B2 Dominerende Vindlast, Vindlast fra Sør	19	82	19	-	-	-
T.9.1	VKR 80x80x3.6	11	B2 Dominerende Vindlast, Vindlast fra Sør	2	11	1	-	-	-
T.10.1	VKR 80x80x3.6	43	B2 Dominerende Snølast, Vindlast fra Vest	5	43	5	-	-	-