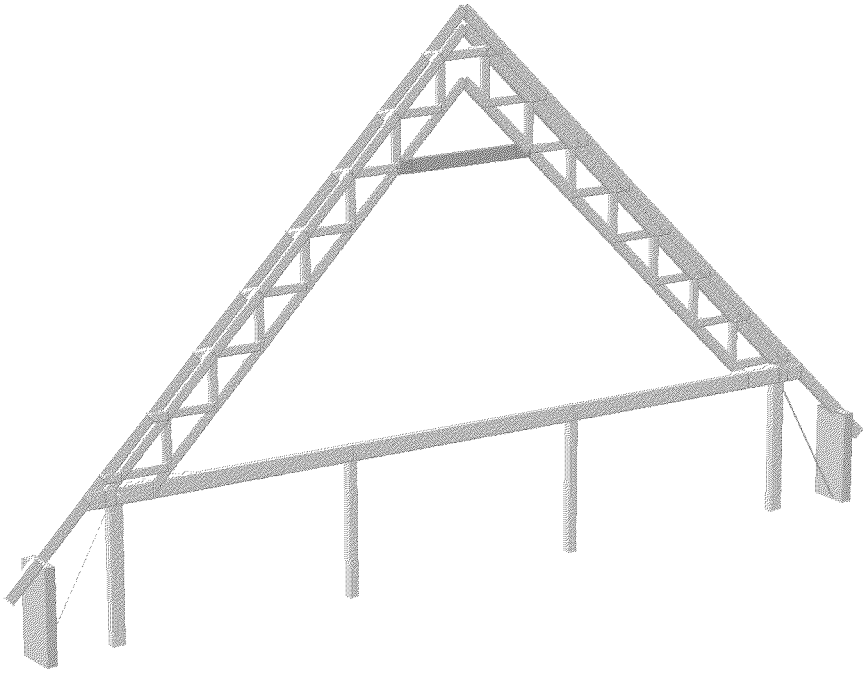
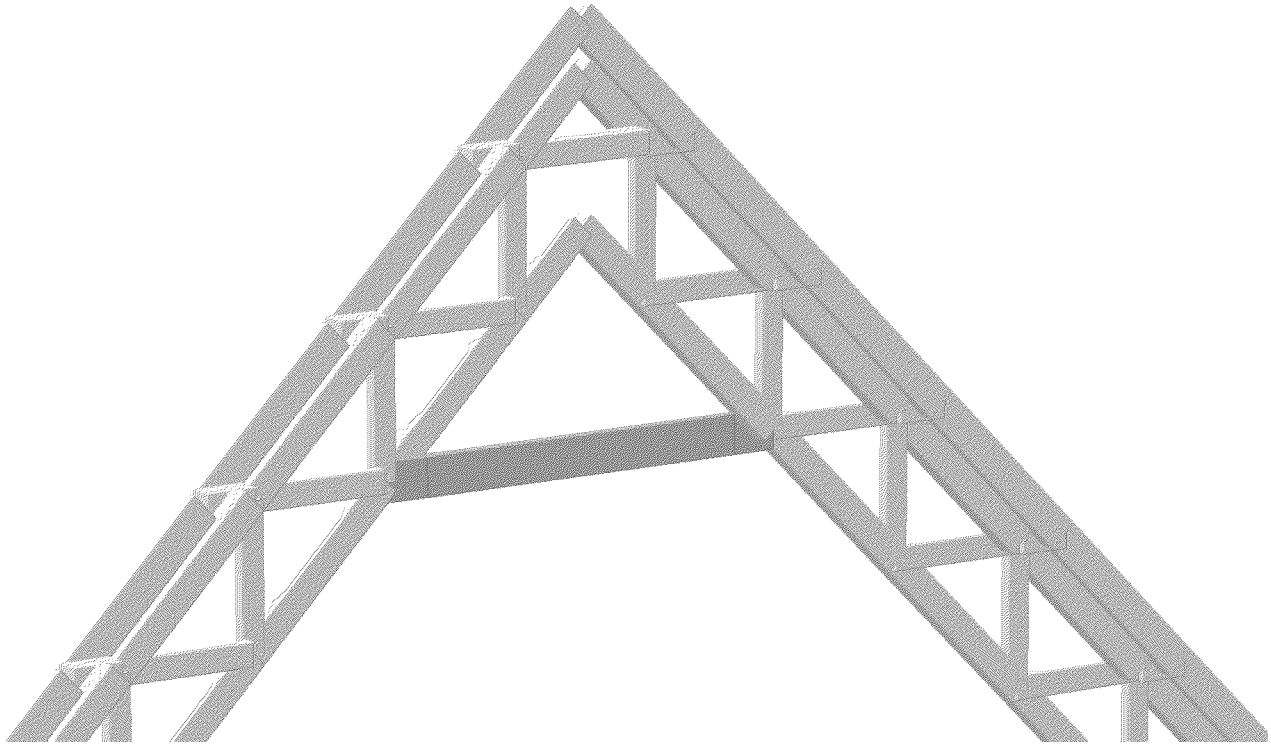
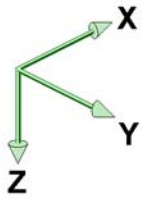
DETAILS, VIEWS





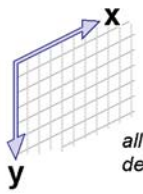
Static calculation of a 2D-frame

Coordinate systems



Stationary global 3D-coordinate system

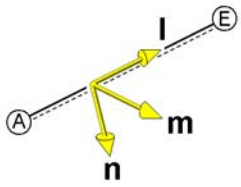
X and Y spread out a horizontal area. Z points to the centre of the earth.



Stationary plane coordinate system

(x = X, y = Z)

all nodes and bars are defined in this plane

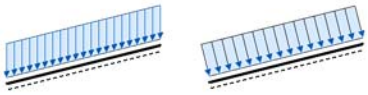


Coordinate system applied to bars

I points from the initial node to the end node. n points in the direction of the dashed zone.

Loading

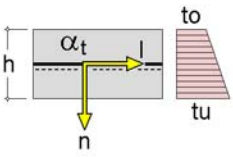
Line loads



Line loads of types G and S always point in y=Z-direction

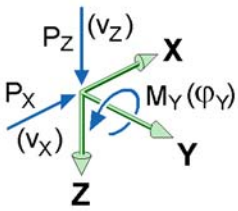
Line loads of type W always point in n-direction

Temperature loads



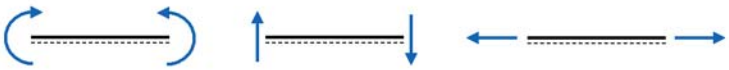
positive on heating

Point loads



within brackets: imposed deformations

Internal forces and moments

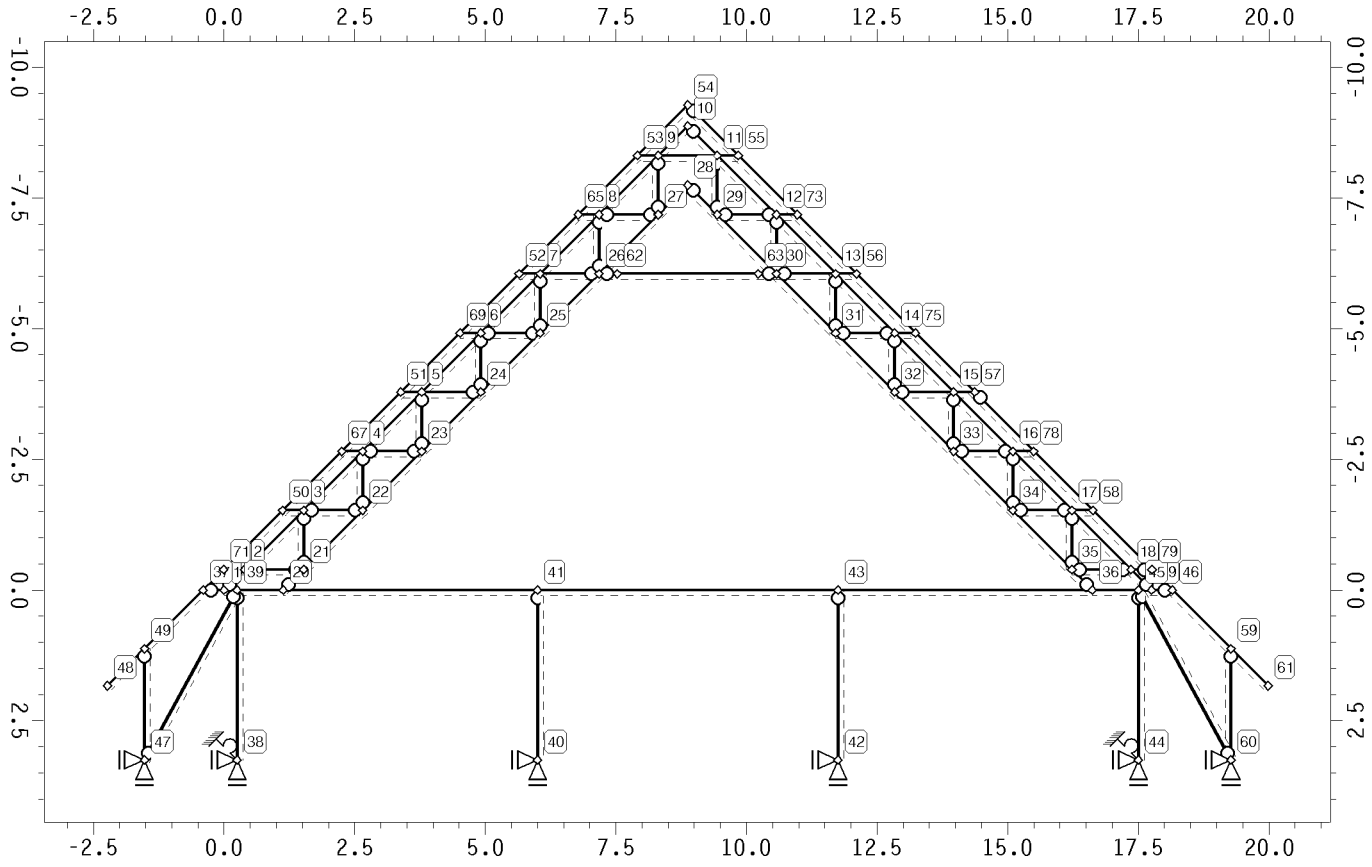


positive moments cause tension at the dashed zone

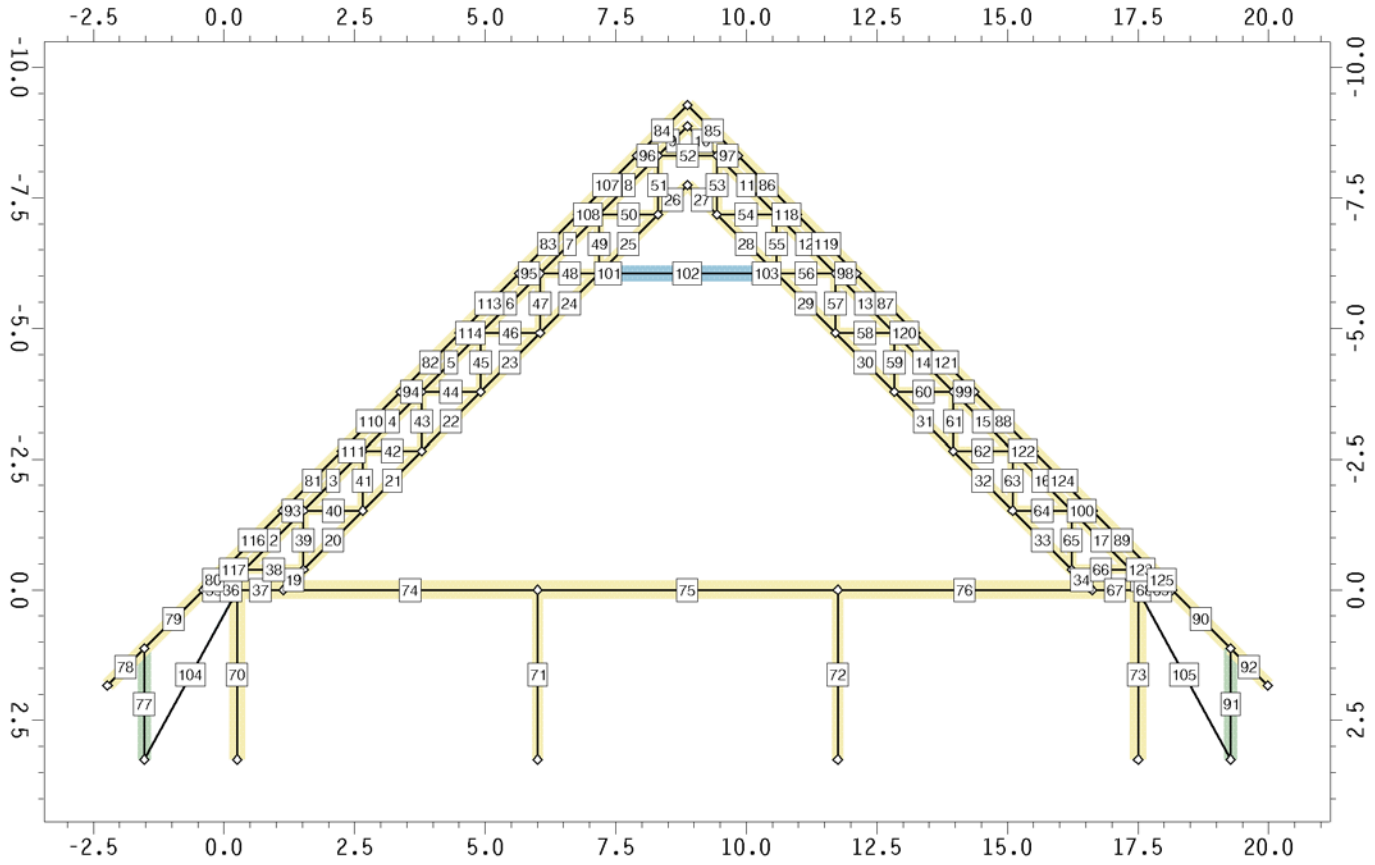
shear forces

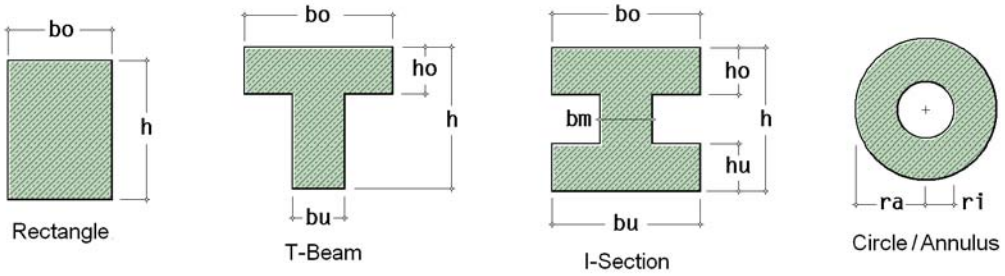
positive normal forces cause tension stresses

node numbers, bearing information, hinges and orientation of bars



Bar numbers and thicknesses



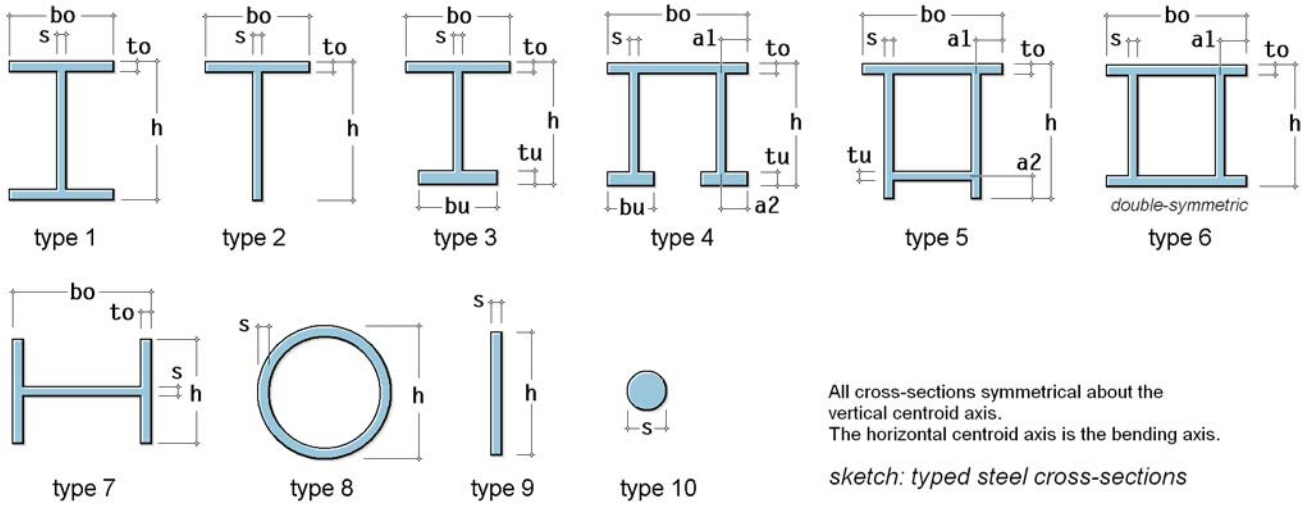


sketch: typed concrete cross-sections

Concrete bars with typed cross-section

For haunched cross-sectionen line (A) shows values at the start and line (E) values at the end of the bar.
For meanings of abbreviations see sketch above.

bar	material	typ	h	bo	ho	bu	hu,ra	bm,ri
-	-	-	cm	cm	cm	cm	cm	cm
77	B25	rectang.	24.00	100.00	--	--	--	--
91	B25	rectang.	24.00	100.00	--	--	--	--



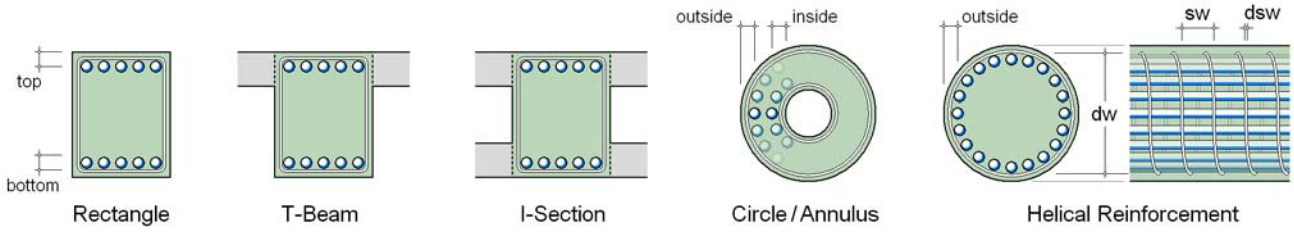
sketch: typed steel cross-sections

Steel bars with typed cross-section

For haunched cross-sectionen line (A) shows values at the start and line (E) values at the end of the bar.
For meanings of abbreviations see sketch above.

bar	material	type	h	bo	s	to	bu	tu	a1	a2
-	-	-	cm	cm	cm	cm	cm	cm	cm	cm
104	S235 (St37)	10	--	--	1.00	--	--	--	--	--
105	S235 (St37)	10	--	--	1.00	--	--	--	--	--

Explanation of design properties



Design properties of bars

Explanations: column **(S)** = symmetry condition for detailing of reinforcement: Z = tension reinforcement, S = symmetrical (top = bottom)
max μ = maximum (rated) reinforcement ratio

bar	edge dist. top	edge dist. bott.	initial reinf. top	initial reinf. bott.	S	max ρ
	cm	cm	cm^2	cm^2	-	%
77	3.0	3.0	0.00	0.00	Z	9.0
91	3.0	3.0	0.00	0.00	Z	9.0

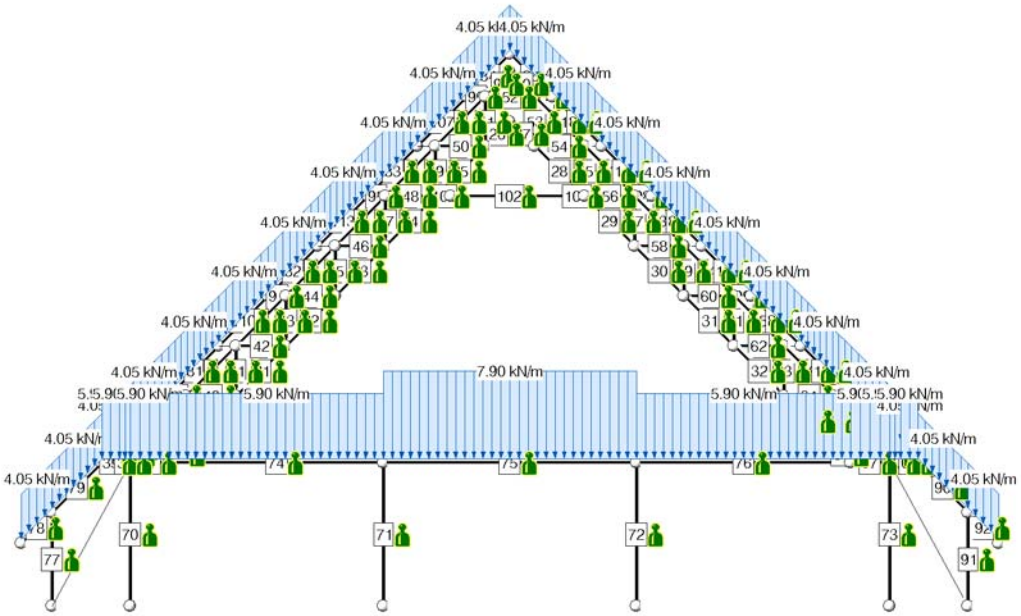
Material properties of bars for verifications according to EC 2

Explanations: ρ_C: maximum density of concrete; BSt: steel quality of longitudinal reinforcement
Material properties of concrete: f_{ck}: compressive strength of cylinder; α_C: reduction factor (eqn. 3.15); ε_{c2}, ε_{c2u}: strains;
n_C: exponent to describe the stress-strain-diagram (eqn. 3.17); E_{cm}: mean elastic modulus (secant modulus)
f_{ctm}: mean value of centric tensile strength; calculation of deformations: final creep coefficient $\varphi_{\infty,t0}$; final shrinkage strain $\varepsilon_{cs,\infty}$
Exposition classes for reinforcement corrosion XC, concrete attack XF, concrete corrosion (moisture class AKR) W
Material properties of reinforcement: f_{yk}: yield strength; f_{tk}: tensile strength; ε_{su}: elongation at failure; E_s: elastic modulus

bar	concrete	ρ_C	BSt	f_{ck}	α_C	ε_{c2}	ε_{c2u}	n_C	E_{cm}	f_{ctm}	$\varphi_{\infty,t0}$	ε_{cs}	f_{yk}	f_{tk}	ε_{su}	E_s	XC	XF	W
		kg/m3		MN/m2		‰	‰		MN/m2	MN/m2		‰	MN/m2	MN/m2	‰	MN/m2			
77	B25	2200	500	20.0	s.NAD	-2.0	-3.5	2.00	30000.0	2.21	---	---	500.0	525.0	25.0	200000.0			
91	B25	2200	500	20.0	s.NAD	-2.0	-3.5	2.00	30000.0	2.21	---	---	500.0	525.0	25.0	200000.0			

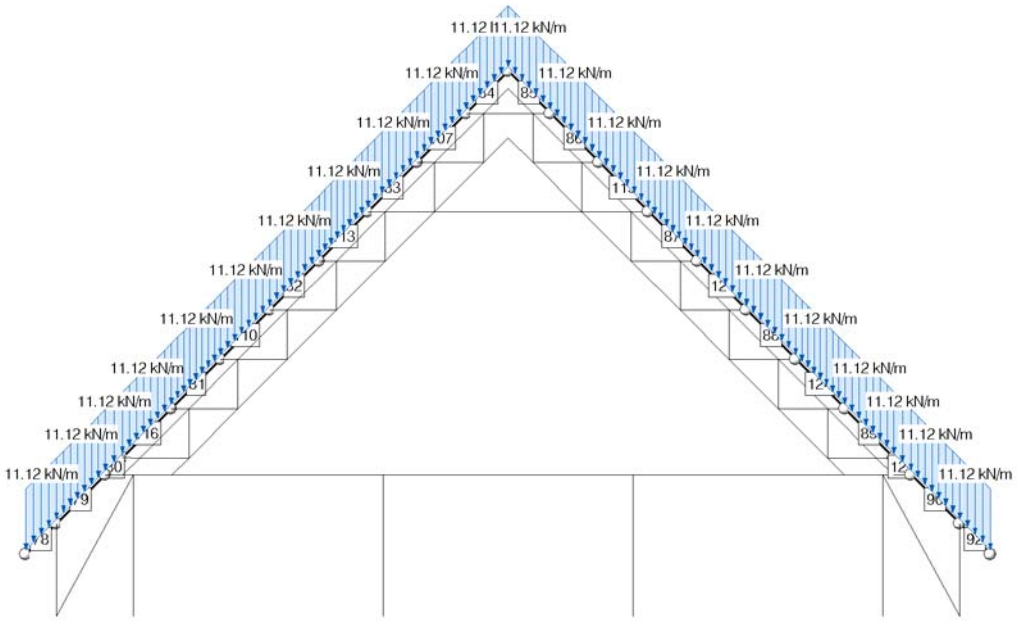
LOAD PICTURES IN LOAD CASE 1: DEAD LOADS

loaded objects in load case 1



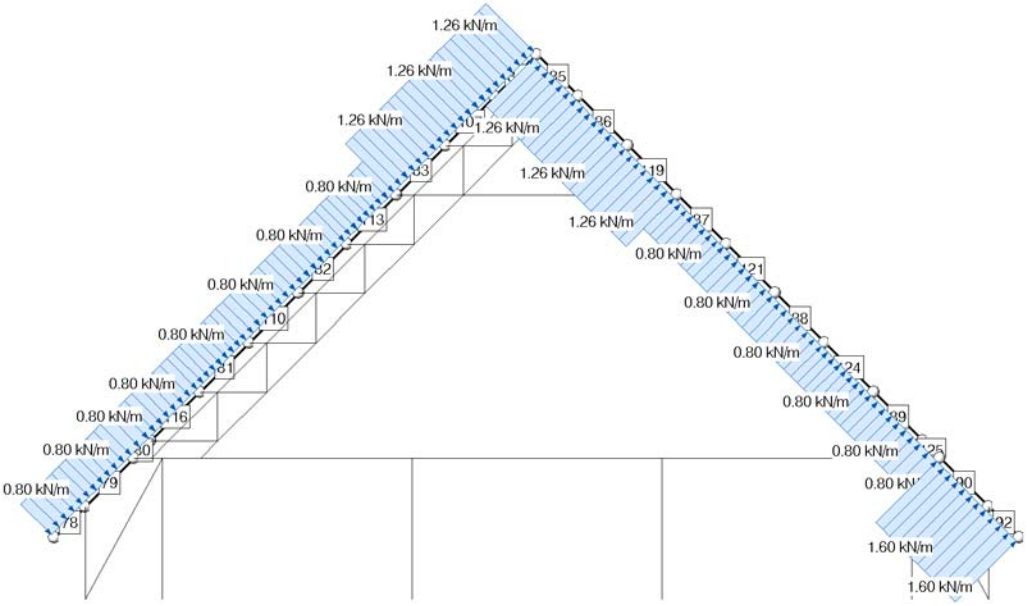
LOAD PICTURES IN LOAD CASE 2: SNOW LOAD

loaded objects in load case 2



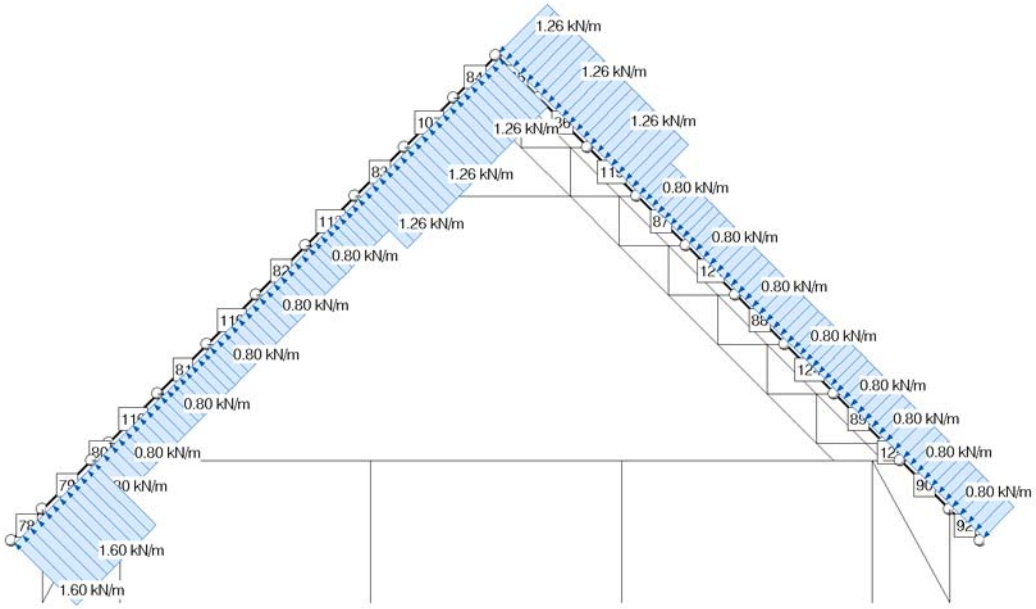
LOAD PICTURES IN LOAD CASE 3: WIND FR. LEFT SIDE

loaded objects in load case 3



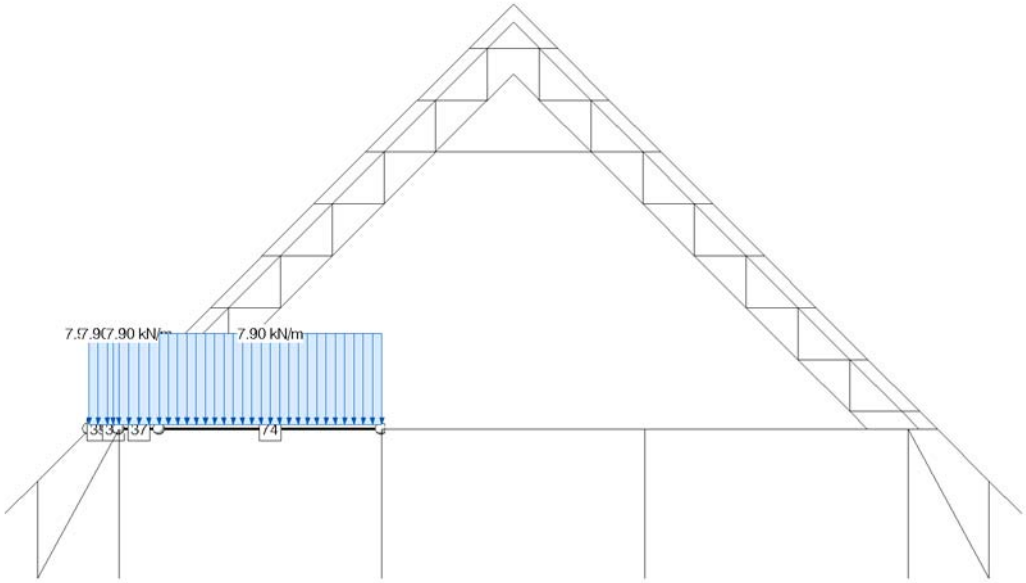
LOAD PICTURES IN LOAD CASE 4: WIND FR. RIGHT SIDE

loaded objects in load case 4



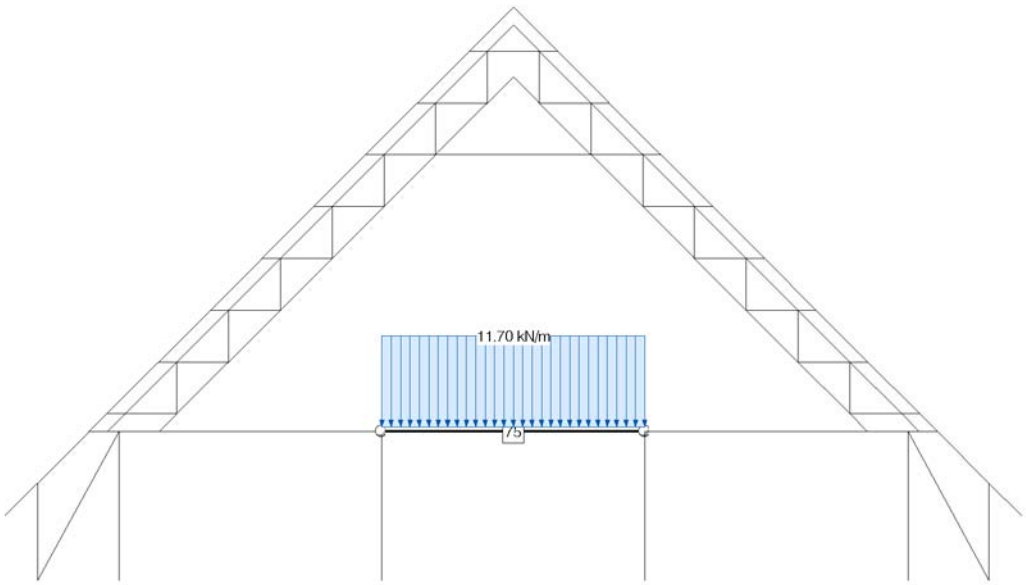
LOAD PICTURES IN LOAD CASE 5: TRAFFIC SPAN 1

loaded objects in load case 5



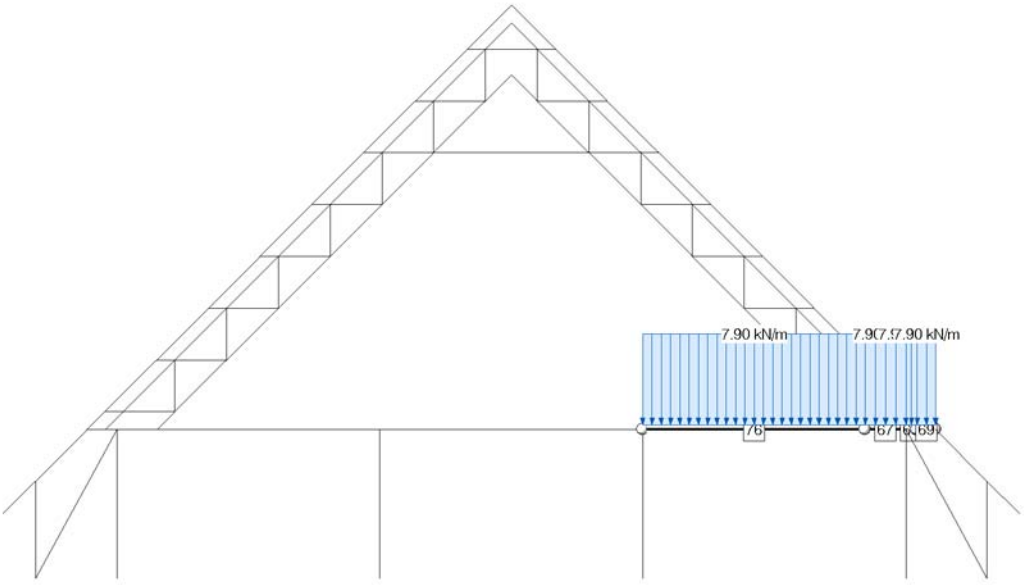
LOAD PICTURES IN LOAD CASE 6: TRAFFIC SPAN 2

loaded objects in load case 6



LOAD PICTURES IN LOAD CASE 7: TRAFFIC SPAN 3

loaded objects in load case 7



DESCRIPTION OF DEMANDED VERIFICATIONS

If using the rules of superposition according to Eurocode, it means:

Ψ_{dom}	Combination coefficient of a	leading	traffic load action	(dominant action)
Ψ_{sub}	Combination coefficient of a	non-leading	traffic load action	(accompanying action)
γ_{sup}	Partial safety factor for	unfavourable	load positions	
γ_{inf}	Partial safety factor for	favourable	load positions	

If using the rules of superposition according to DIN 18800, it means:

Ψ_{dom}	Combination coefficient of a main combination
Ψ_{sub}	Combination coefficient of a minor combination

Rules of superposition FB101 and DIN 1055-100 are comparable with Eurocode.
In non-linear analysis, rules of extremization will not be considered

If subsequently verifications acc. to Eurocode are listed, it means:
National Annex "Deutschland" is considered.

Verification 1: EC 2 Design calculation

EC 2 Design calculation: Design resistance according to Eurocode 2 (6.1, 6.2, 6.3)

Design options of verification 1:

Bending design calculation
- [x] Shear design calculation (limitation of z only for NA-DE)
  - [x] z from bending design calculation
  - [ ] z = 0.9 d ≤ d - 2 cv
  - [ ] z from bending design ≤ d - 2 cv
  - [ ] VRdct NOT to limit
- [x] Minimum reinforcement (bending, shear)

1: Standard combination

Rules of extremization of verification 1, type: standard, rule of superposition: Eurocode

action	Ψ_{dom}	Ψ_{sub}	γ_{sup}	γ_{inf}
1	1.00	1.00	1.35	1.00
2	1.00	0.80	1.50	0.00
3	1.00	0.80	1.50	0.00

Verification 2: EC 3 Design resistance (th. I. ord.)

EC 3 Design resistance (th. I. ord.): Design resistance according to DIN EN 1993

Design options of verification 2:

- [ ] Safety factors like stability

1: Standard combination

Rules of extremization of verification 2, type: standard, rule of superposition: Eurocode

action	Ψ_{dom}	Ψ_{sub}	γ_{sup}	γ_{inf}
1	1.00	1.00	1.35	1.00
2	1.00	0.80	1.50	0.00
3	1.00	0.80	1.50	0.00

Verification 3: EC 5 Design resistance (th. I ord.)

EC 5 Design resistance (th. I ord.): Design resistance according to DIN EN 1995

1: Standard combination

Rules of extremization of verification 3, type: standard, rule of superposition: Eurocode

action	Ψ_{dom}	Ψ_{sub}	γ_{sup}	γ_{inf}
group 1: kmod = 0.60				
1	1.00	1.00	1.35	1.00
group 2: kmod = 0.80				

action	Ψ_{dom}	Ψ_{sub}	γ_{sup}	γ_{inf}
1	1.00	1.00	1.35	1.00
2	1.00	0.80	1.50	0.00
3	1.00	0.80	1.50	0.00

REGULATIONS

DIN EN 1990, Eurocode 0: Grundlagen der Tragwerksplanung;
Deutsche Fassung EN 1990:2002 + A1:2005 + A1:2005/AC:2010, Ausgabe Dezember 2010
DIN EN 1990/NA, Nationaler Anhang zur DIN EN 1990, Ausgabe Dezember 2010

DIN EN 1992-1-1, Eurocode 2: Bemessung und Konstruktion von Stahlbeton- und Spannbetonbauteilen -
Teil 1-1: Allgemeine Bemessungsregeln und Regeln für den Hochbau;
Deutsche Fassung EN 1992-1-1:2004 + AC:2010, Ausgabe Januar 2011
DIN EN 1992-1-1/NA, Nationaler Anhang zur DIN EN 1992-1-1, Ausgabe Januar 2011

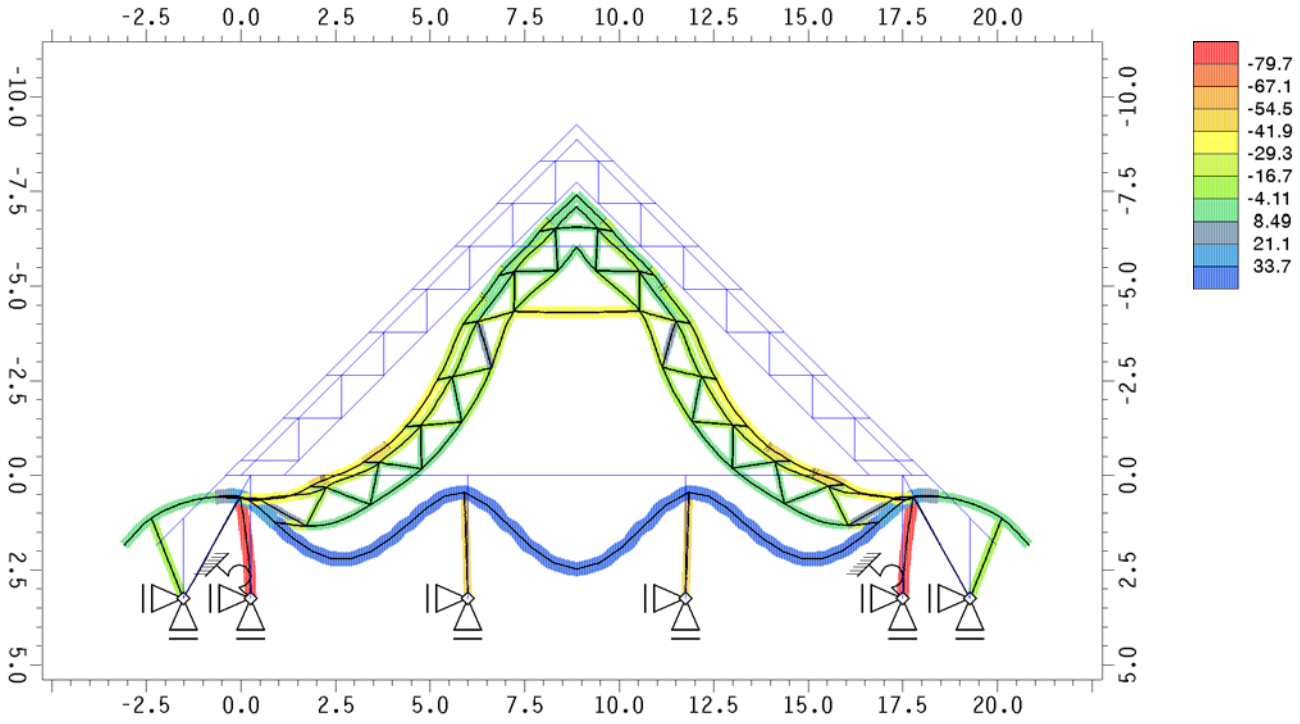
DIN EN 1993-1-1, Eurocode 3: Bemessung und Konstruktion von Stahlbauten -
  Teil 1-1: Allgemeine Bemessungsregeln und Regeln für den Hochbau;
  Deutsche Fassung EN 1993-1-1:2005 + AC:2009, Ausgabe Dezember 2010
DIN EN 1993-1-1/NA, Nationaler Anhang zur DIN EN 1993-1-1, Ausgabe Dezember 2010

DIN EN 1995-1-1, Eurocode 5: Bemessung und Konstruktion von Holzbauten -
  Teil 1-1: Allgemeines - Allgemeine Regeln und Regeln für den Hochbau;
  Deutsche Fassung EN 1995-1-1:2004 + AC:2006 + A1:2008, Ausgabe Dezember 2010
DIN EN 1995-1-1/NA, Nationaler Anhang zur DIN EN 1995-1-1, Ausgabe Dezember 2010
DIN 1052-10: Herstellung und Ausführung von Holzbauwerken -
  Teil 10: Ergänzende Bestimmungen, Ausgabe Mai 2012

SELECTED GRAPHICS/TABLES

Deformed system / Contours N

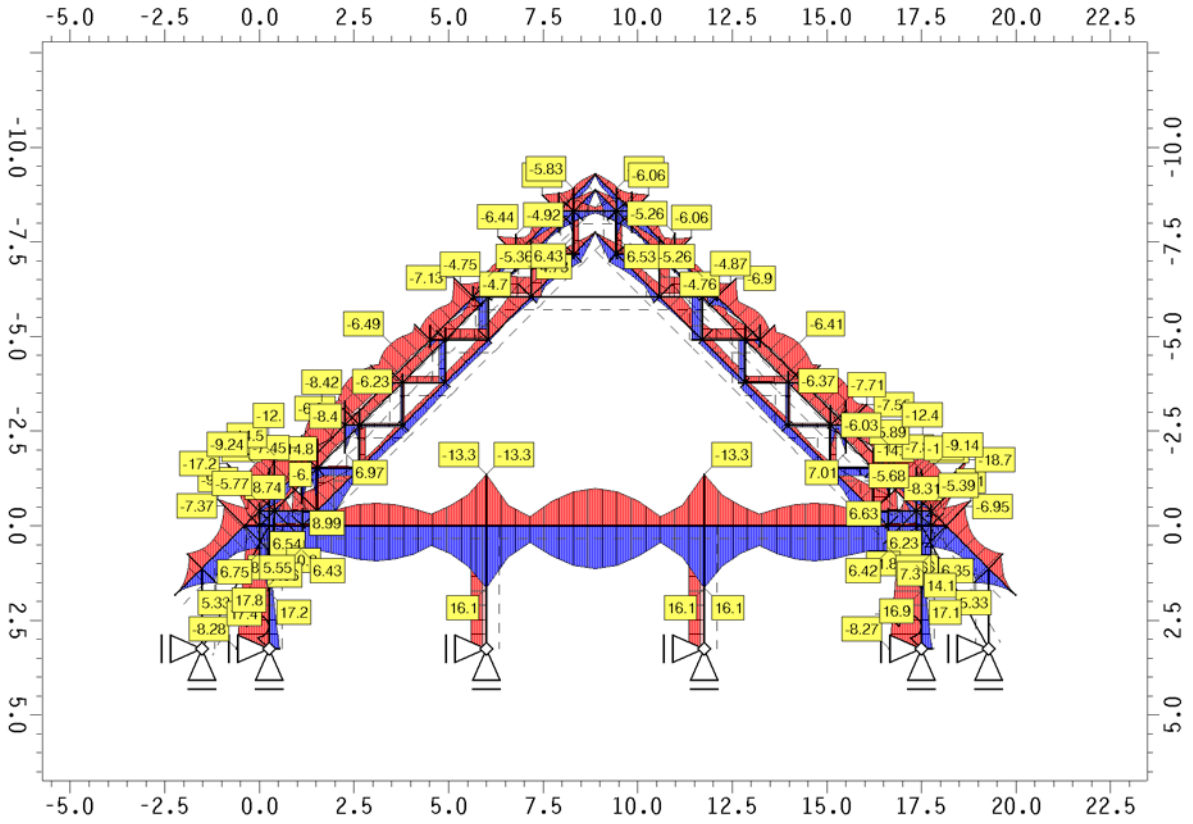
Load case 1: dead loads



Scale 1:200
Deformations: factor: 300.
  Min/Max: ux: -1.37/ 1.37 mm, uz: -3.33/2.E-2 mm
Contours N, Normal force
  Min/Max: N: -85.979/ 39.978 kN

Boundary lines ext σ

Verification 3: Extreme rule 1: Standard combination



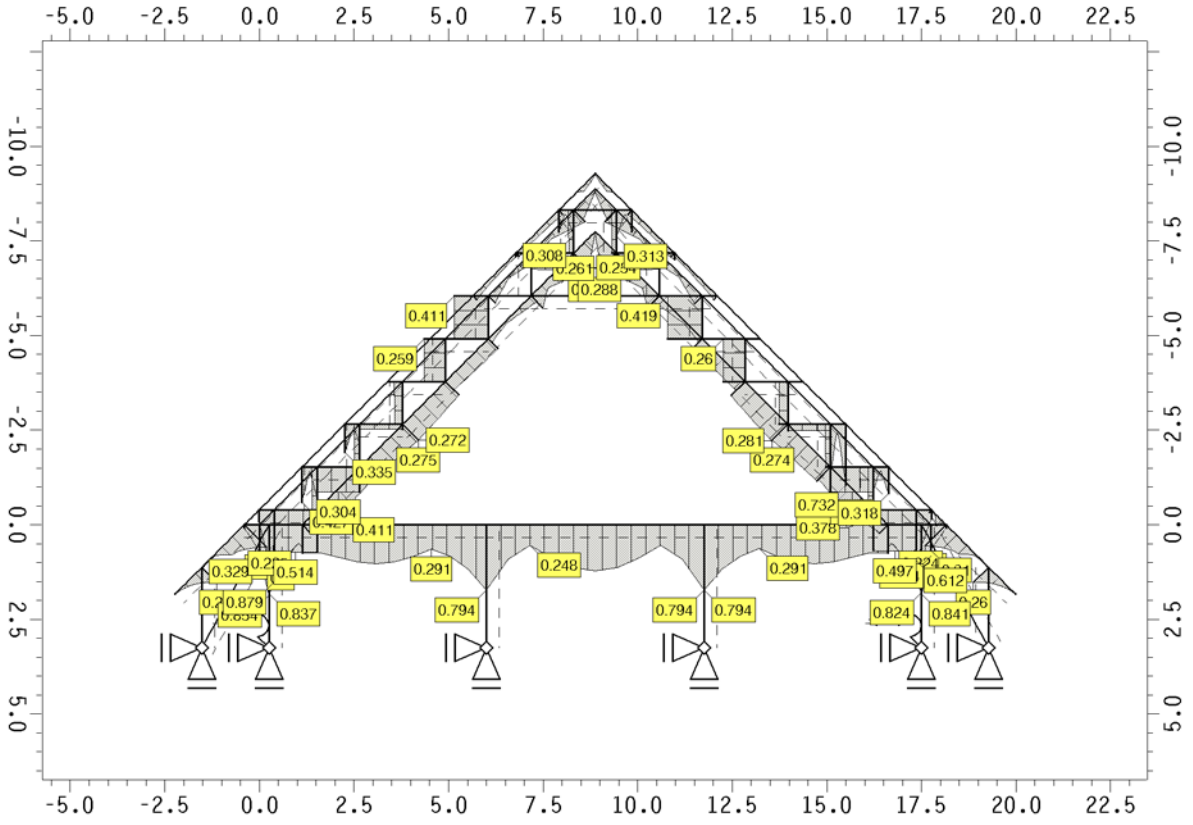
Scale 1:200

Boundary lines ext σ, extr. normal stresses: factor: 0.102

Min/Max: ext σ: -18.69/17.79 MN/m2

Boundary lines Uσ,t

Verification 3: Summary



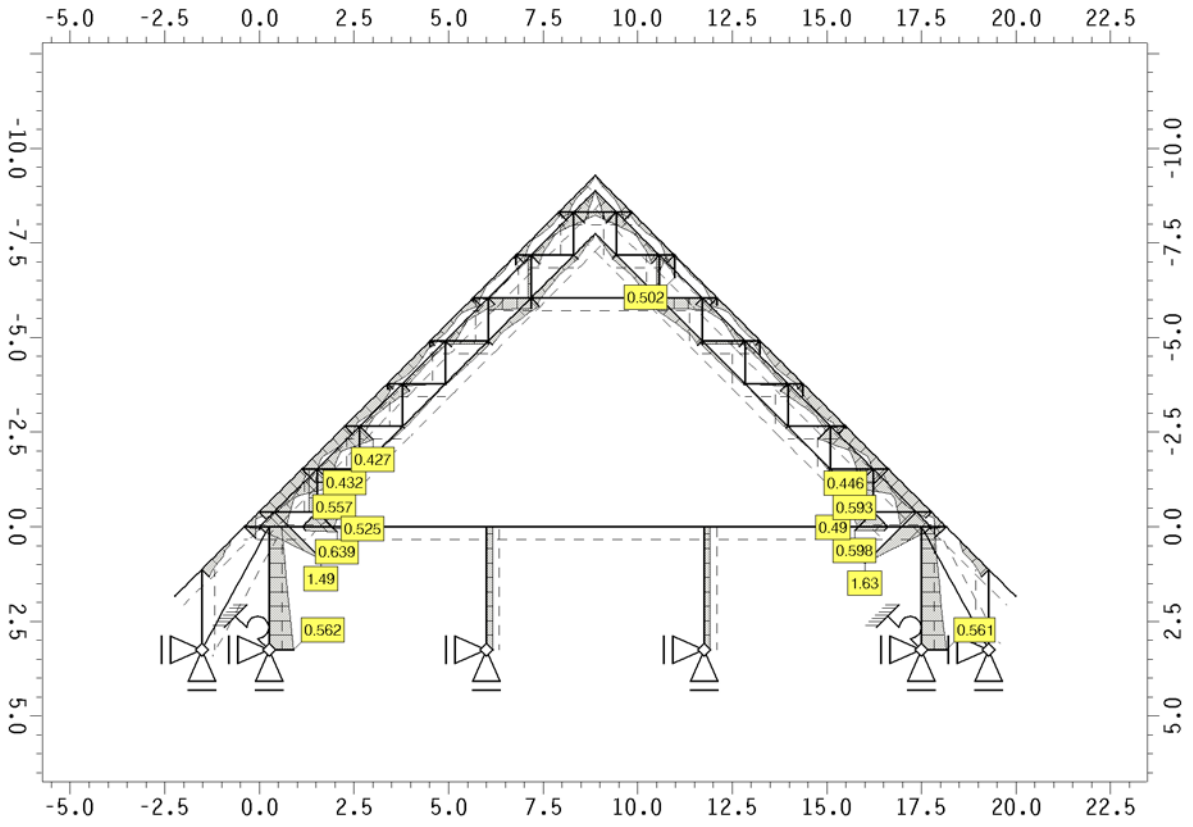
Scale 1:200

Boundary lines Uσ,t, Utilization due to bending and tension: factor: 2.18

Max: Uσ,t: 0.879

Boundary lines Uσ,c

Verification 3: Summary



Scale 1:200

Boundary lines Uσ,c, Utilization due to bending and compression: factor: 1.17

Max: Uσ,c: 1.63