

1. Options for Calculations

calculation DIN EN 1995:2010, Germany

service class 1

coefficients of thermal expansion: timber $\alpha_t = 0.500 \cdot 10^{-5}/^{\circ}\text{K}$, steel $\alpha_t = 1.200 \cdot 10^{-5}/^{\circ}\text{K}$

2. Structural system



reinforcement left side

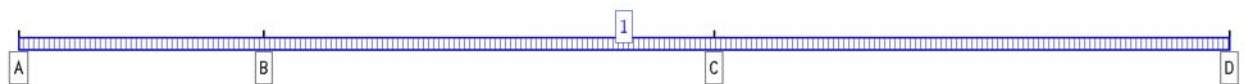


main beam

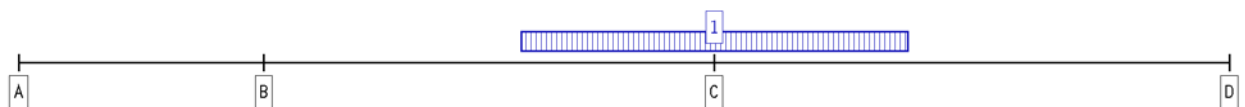


reinforcement right side

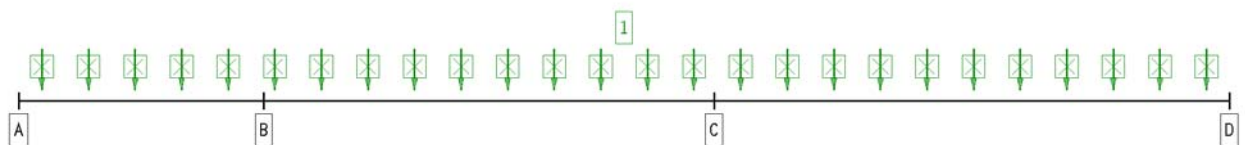
3. Loading



action effect 1: permanent loads (permanent, 1 load cases)



D



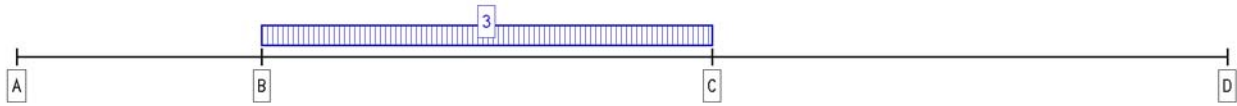
D



D



action effect 2: live loads (transient, 3 load cases)



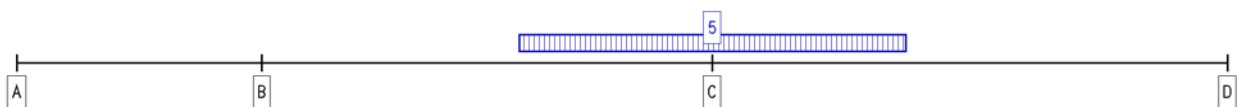
D



D



D



action effect 3: snow (transient, 1 load cases)



D

4. material parameters

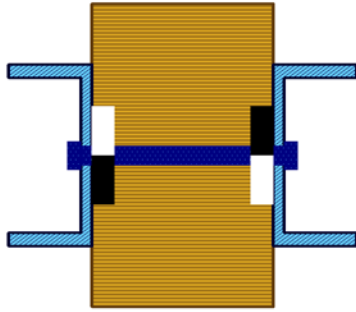
timber grade main beam	solid coniferous timber, C24 (S10)
service class	1
beam width	$b = 120 \text{ mm}$
coeff. therm.expan. timber:	$0.500 \cdot 10^{-5} / ^\circ\text{K}$
coeff. thermal expan. steel:	$1.200 \cdot 10^{-5} / ^\circ\text{K}$
char. bend. strength $f_{m,k}$	24.0 N/mm^2
char. shear strength $f_{v,k}$	4.0 N/mm^2
modulus of elast. $E_{0,mean}$	11000 N/mm^2
k_{cr}	$0.50 \text{ mm}^2/\text{N}$

definition of internal forces and moments:

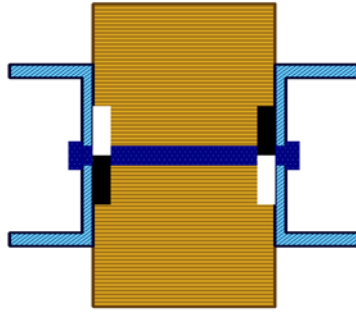


5. Beam sections

section beam section 1, scale 1: 5



section beam section 2, scale 1: 5



main beam sections

section	x_A m	x_E m	l m	l_{ef} m	k_m -	l_v m	cantil.	$h_{main\ beam}$ mm
1	0.00	1.90	1.90	2.00	1.0000	1.90	x	200
2	1.90	5.40	3.50	3.50	1.0000	3.50	-	200
3	5.40	9.40	4.00	4.00	1.0000	4.00	-	200

sections with reinforcements

section	reinforcement left side	reinforcement right side
1	steel plate S235 U120	steel plate S235 U120
2	steel plate S235 U120	steel plate S235 U120
3	-	-

6. Fastener data

section 1 from $x_A = 0.00$ m to $x_E = 1.90$

shear plate connector B1 $d_c = 65$ mm, FK 4.6

bolt M 12, FK 4.6

1 - row

$K_{ser} = 27300$ N/mm, $\gamma_M = 1.30$, $R_k = 14780.8$ N, all values per shear plane

coordinates of connectors section 1

Nr.	x_{Abs} m	x_D m	Nr.	x_{Abs} m	x_D m
1	0.200	0.200	4	1.400	1.400
2	0.600	0.600	5	1.800	1.800
3	1.000	1.000			

section 2 from $x_A = 1.90$ m to $x_E = 5.40$

shear plate connector B1 $d_c = 65$ mm, FK 4.6

bolt M 12, FK 4.6

1 - row

$K_{ser} = 27300$ N/mm, $\gamma_M = 1.30$, $R_k = 14780.8$ N, all values per shear plane

coordinates of connectors section 2

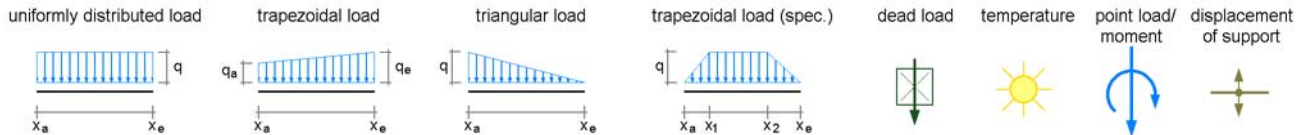
Nr.	x_{Abs} m	x_D m	Nr.	x_{Abs} m	x_D m
1	0.200	2.100	4	2.500	4.400
2	0.600	2.500	5	2.900	4.800
3	1.000	2.900	6	3.300	5.200

7. Supports

coordinates of supports

supp.name	x m	c_F kN/m	c_M kNm/-	left reinf. (F) (M)		main beam (F) (M)		right reinf. (F) (M)	
B	1.90	fix	----	-	-	X	-	-	-
C	5.40	fix	----	-	-	X	-	-	-
D	9.40	fix	----	-	-	X	-	-	-

8. Action effects



Lastfaktoren (Hochbau) des nationalen annexs Germany

Teilsicherheitsfaktoren für action effects der permanenten and transienten design situation

action effectsart	γ_{Fsup}	γ_{Finf}
permanent loads	1.35	1.00
transiente Lasten	1.50	0.00
Flüssigkeitsdruck/Maschinenlasten	1.35	0.00
Zwang	1.00	0.00
Vorspannung	1.00	1.00

Teilsicherheitsfaktoren für action effects der accidental en design situation

action effectsart	γ_{Fsup}	γ_{Finf}
permanent loads	1.00	1.00
transiente Lasten	1.00	0.00
Flüssigkeitsdruck/Maschinenlasten	1.00	0.00
Zwang	1.00	0.00
Vorspannung	1.00	1.00
accidental e action effectsen	1.00	1.00

Teilsicherheitsfaktoren für action effects der Erdbebenbemessungssituation

action effectsart	γ_{Fsup}	γ_{Finf}
permanent loads	1.00	1.00
transiente Lasten	1.00	0.00
Flüssigkeitsdruck/Maschinenlasten	1.00	0.00
Zwang	1.00	0.00
Vorspannung	1.00	1.00
Erdbeben	1.00	1.00

Teilsicherheitsfaktoren für action effects der Gebrauchstauglichkeits- und Ermüdungsnachweise

action effectsart	γ_{Fsup}	γ_{Finf}
permanent loads	1.00	1.00
transiente Lasten	1.00	0.00
Flüssigkeitsdruck/Maschinenlasten	1.00	0.00
Zwang	1.00	0.00
Vorspannung	1.00	1.00

Kombinationsbeiwerte

Die valuee in der Ψ_{2E} -Spalte sind die Ψ_2 -valuee für die Erdbebenbemessungssituation

action effect	Kategorie	Ψ_0	Ψ_1	Ψ_2	Ψ_{2E}
Wohn-, Büroräume	A, B	0.70	0.50	0.30	0.30
Versamlungs-, Verkaufsräume	C, D	0.70	0.70	0.60	0.60
supporträume	E	1.00	0.90	0.80	0.80
Fahrzeuge to 30 kN	F	0.70	0.70	0.60	0.60
Fahrzeuge to 160 kN	G	0.70	0.50	0.30	0.30
Dächer	H	0.00	0.00	0.00	0.00
snow/Eis to 1000 m ü.NN		0.50	0.20	0.00	0.50
snow/Eis über 1000 m ü.NN		0.70	0.50	0.20	0.50
wind		0.60	0.20	0.00	0.00
temperature		0.60	0.50	0.00	0.00
Baugrundsetzungen		1.00	1.00	1.00	1.00
otherige action effectsen		0.80	0.70	0.50	0.50

Anmerkung: Flüssigkeitsdruck/Maschinenlasten, Zwang sowie Baugrundsetzungen, otherige action effectsen sind nicht Teil der EN 1990 (Eurocode).

Applied verification parameters of the National Annex Germany

DIN EN 1995-1-1 and DIN EN 1995-1-2 (EC5)

material safety factors

design situation	species	value
permanent and transient	solid wood	1.30
	glue lam. timber	1.30
accidental	all types	1.00
fire protection	all types	1.00

modification coefficients

KLED	service class		
	1	2	3
permanent	0.60	0.60	0.50
long-term	0.70	0.70	0.55
med.-term	0.80	0.80	0.65
sh.-term	0.90	0.90	0.70
instantan.	1.10	1.10	0.90

Ermittlung der Netto-Enddurchbiegung nach EC5 (7.2)

$W_{net,fin} = W_{inst} + W_{creep} - W_c$ with W_{inst} aus quasicontinuouser Kombination acc. to NAD Germany Änderung A1, (NA.A1)

Ermittlung der bezogenen Kippschlankheit atm verifika Faktor acc. to NCI Zu 6.3.3(2) = 1.40

Chapter	Value	Meaning
2.3.1.2(2)P	use table NA.1	Association of a
2.4.1 Tab. 2.3	$\gamma_M = 1.30$ $\gamma_M = 1.30$ $\gamma_M = 1.30$ $\gamma_M = 1.30$ $\gamma_M = 1.30$ $\gamma_M = 1.30$ $\gamma_M = 1.30$ $\gamma_M = 1.30$ $\gamma_M = 1.30$ $\gamma_M = 1.25$ $\gamma_M = 1.30$ $\gamma_M = 1.30$	Partial safety f solid wood glue lam. timber Cross Laminated LVL, plywood, OS particleboards hard fibreboards medium fibreboar MDF-fibreboards soft fibreboards connections metal plate fast steel in connect gypsum board, et
3.1.3	use table NA.4	modification coe
8.3.2	use table NA.15	f_{ax} , f_{head} for p
8.3.1.2	use NA.11	penetration dept
8.5.3 (2)	threaded rods acc. to NAD	allow threaded r
6.3.3 (7)	lat. tors. buckl. acc.to NAD	verification of
8.2.4 (1)	simplified method acc.to NAD	fastener
9.2.4.2 (NA.20)	reduction der Tragf.	at hor. Stoß and s
9.2.4.2 (NA.21)	Erhöhung der char. Tragf.	at Schwellenpres
6.1 (NA.8.1.6)	Abm. der tensile strength	at sym. ausge
8.6 (NA.7)	drill hole diameter at	steelteilen um 1m

crack factor

crack factor k_{Cr} for determination of effective cross-section width
for the calculation of shear stresses from shear force

$k_{Cr} = 2.0/f_{v,k}$ for coniferous timber
 $k_{Cr} = 0.67$ for hardwood
 $k_{Cr} = 2.5/f_{v,k}$ for glue laminated timber
 $k_{Cr} = 1.0$ other

Permanent action effect: permanent loads

1. additive load case: dead load (1)
 - ⇒ unif.distr.load (main beam): $q = 1.00 \text{ kN/m}$ fr
 - ⇒ point load (main beam): $F = 3.00 \text{ kN}$ at $x = 0$
 - ⇒ unif.distr.load (main beam): $q = 1.50 \text{ kN/m}$ fr
 - ⇒ dead load (main beam): $\gamma = 6.00 \text{ kN/m}^3$ from x

2. Transient action effect: live loads

2. additive load case: span 1
 - ⇒ unif.distr.load (main beam): $q = 1.20 \text{ kN/m}$ fr
 - ⇒ point load (main beam): $F = 2.00 \text{ kN}$ at $x = 0$
3. additive load case: span 2
 - ⇒ unif.distr.load (main beam): $q = 1.20 \text{ kN/m}$ fr
4. additive load case: span3
 - ⇒ unif.distr.load (main beam): $q = 1.20 \text{ kN/m}$ fr

3. Transient action effect: snow

5. additive load case: snow
 - ⇒ unif.distr.load (main beam): $q = 1.00 \text{ kN/m}$ fr
 - ⇒ point load (main beam): $F = 1.50 \text{ kN}$ at $x = 0$

9. verifications

1: EC 5 load-carrying capacity

safety against overturning will be executed
Extreme rule 1

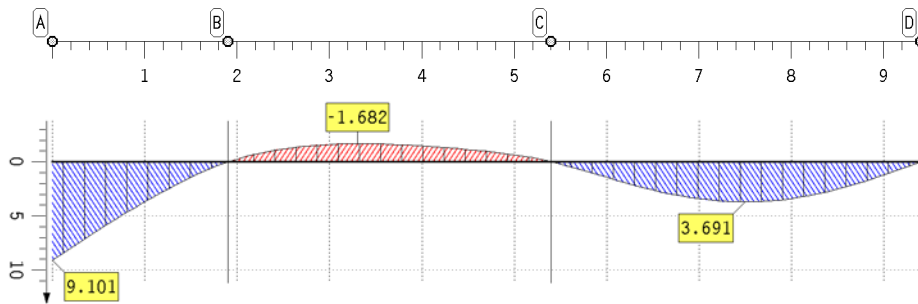
2: EC 5 deformations

Grenzwerte für deformations acc. to DIN EN 1995-1-1, Tab. 7.2!
Extreme rule 1

10. Results of load cases

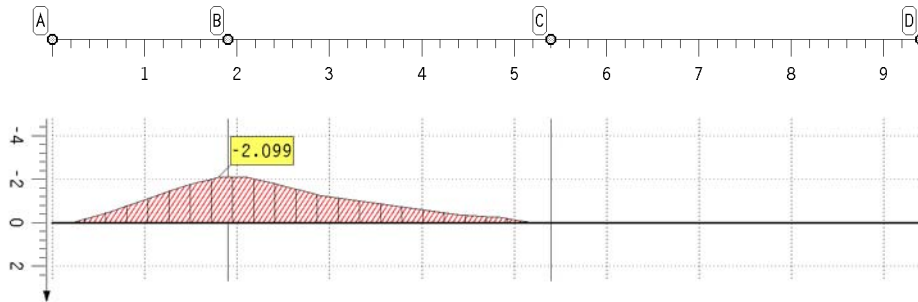
10.1. Action effect 1: load case 1: dead load (1)

deflections of main beam (characteristic)

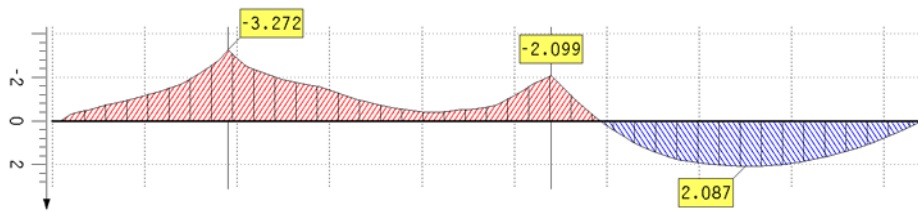


deflection
main beam
characteristic
w in mm
Min: -1.68
Max: 9.10

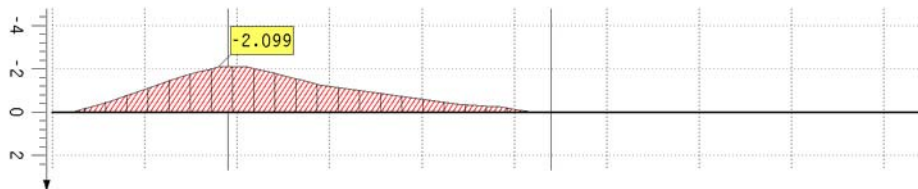
internal forces and moments



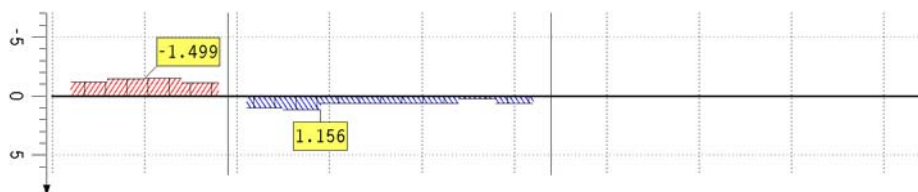
flexural moment
reinf. left
 M_l in kNm
Min: -2.10
Max: 0.00



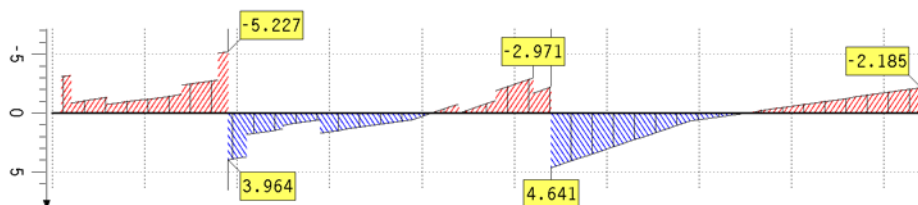
flexural moment
main beam
M in kNm
Min: -3.27
Max: 2.09



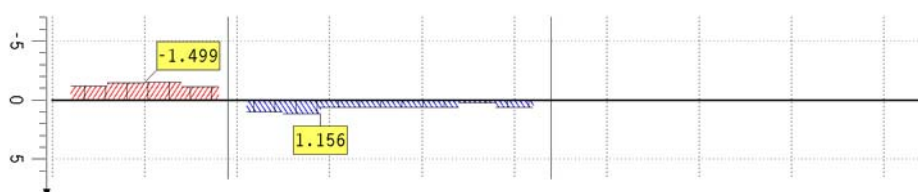
flexural moment
reinf. right
 M_r in kNm
Min: -2.10
Max: 0.00



shear force
reinf. left
 V_l in kN
Min: -1.50
Max: 1.16



shear force
main beam
V in kN
Min: -5.23
Max: 4.64



shear force
reinf. right
 V_r in kN
Min: -1.50
Max: 1.16

support forces

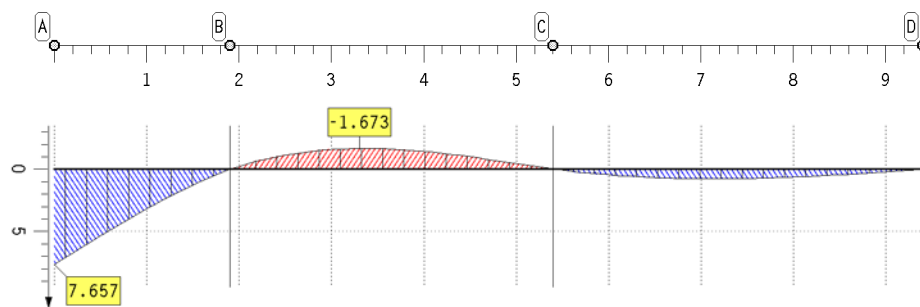
point	x m	AP kN	AP _l kN	AP _r kN	ΣAP kN
B	1.900	-9.19	0.00	0.00	-9.19
C	5.400	-6.88	-0.00	0.00	-6.88
D	9.400	-2.19	-----	-----	-2.19

connector reactions

x m	CP _l kN	CM _l kNm	CP _r kN	CM _r kNm	x m	CP _l kN	CM _l kNm	CP _r kN	CM _r kNm
0.200	1.17	0.00	1.17	0.00	2.500	-0.16	0.00	-0.16	0.00
0.600	0.30	0.00	0.30	0.00	2.900	0.56	0.00	0.56	0.00
1.000	0.03	0.00	0.03	0.00	4.400	0.38	0.00	0.38	0.00
1.400	-0.39	0.00	-0.39	0.00	4.800	-0.42	0.00	-0.42	0.00
1.800	-1.14	0.00	-1.14	0.00	5.200	0.63	0.00	0.63	0.00
2.100	-0.97	0.00	-0.97	0.00					

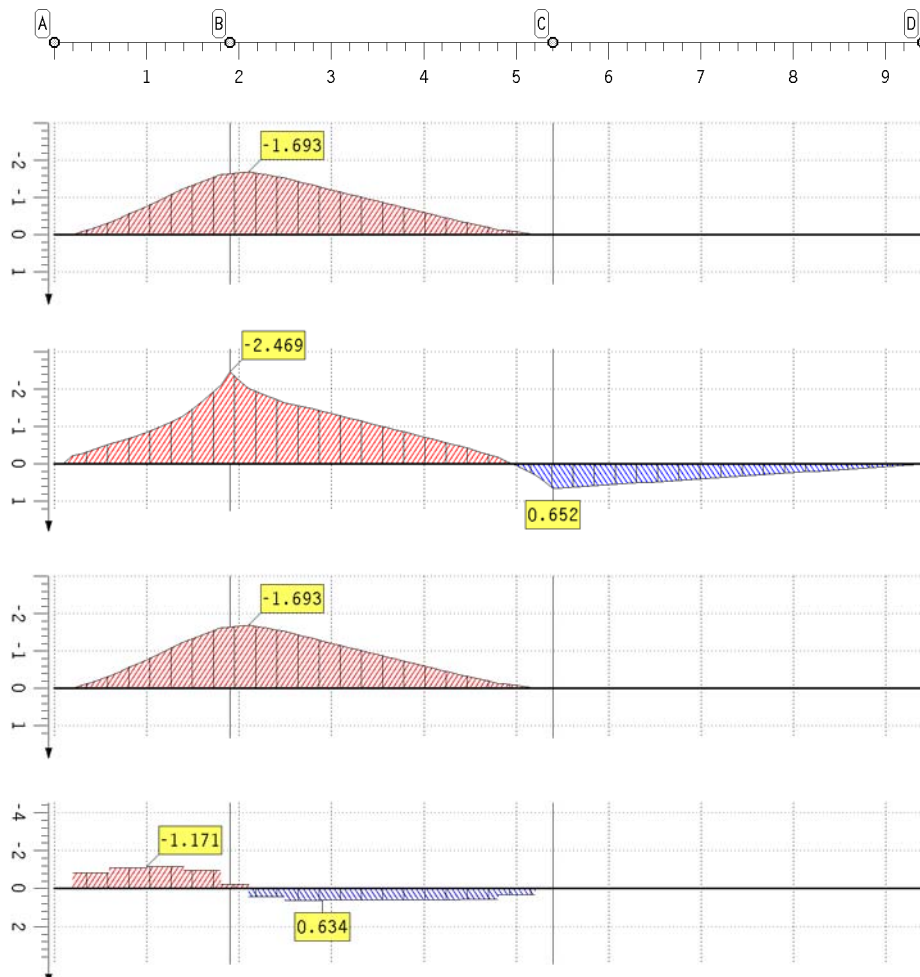
10.2. Action effect 2: load case 2: span 1

deflections of main beam (characteristic)



deflection
main beam
characteristic
w in mm
Min: -1.67
Max: 7.66

internal forces and moments



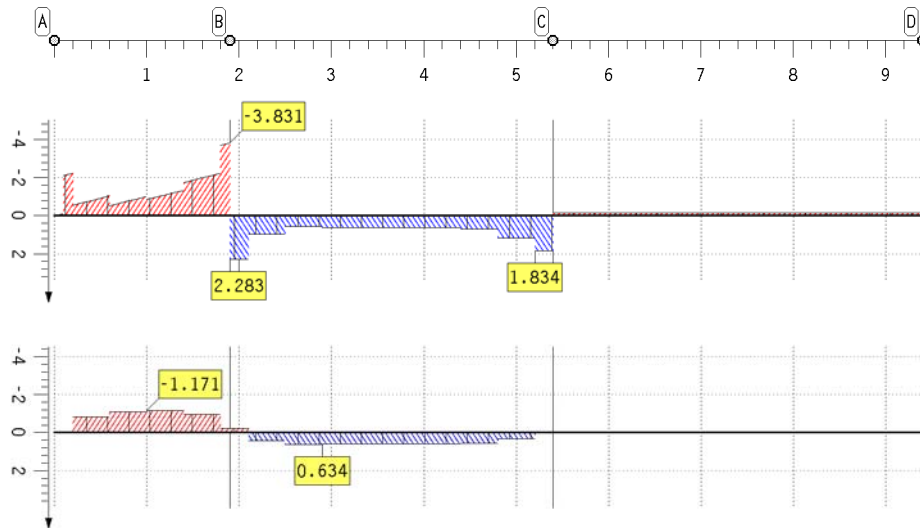
flexural moment
reinf. left
M_l in kNm
Min: -1.69
Max: 0.00

flexural moment
main beam
M in kNm
Min: -2.47
Max: 0.65

flexural moment
reinf. right
M_r in kNm
Min: -1.69
Max: 0.00

shear force
reinf. left
V_l in kN
Min: -1.17
Max: 0.63

internal forces and moments



support forces

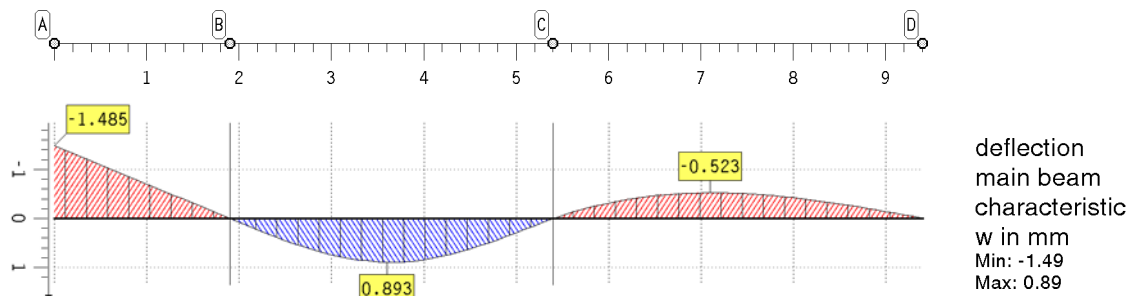
point	x m	AP kN	AP _l kN	AP _r kN	ΣAP kN
B	1.900	-6.11	-0.00	0.00	-6.11
C	5.400	2.00	0.00	-0.00	2.00
D	9.400	-0.16	-----	-----	-0.16

connector reactions

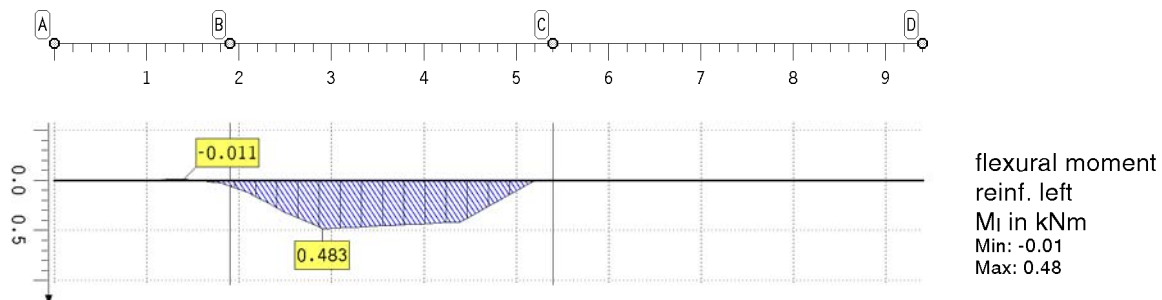
x m	CP _l kN	CM _l kNm	CP _r kN	CM _r kNm	x m	CP _l kN	CM _l kNm	CP _r kN	CM _r kNm
0.200	0.84	0.00	0.84	0.00	2.500	-0.19	0.00	-0.19	0.00
0.600	0.26	0.00	0.26	0.00	2.900	0.03	0.00	0.03	0.00
1.000	0.08	0.00	0.08	0.00	4.400	0.04	0.00	0.04	0.00
1.400	-0.21	0.00	-0.21	0.00	4.800	0.23	0.00	0.23	0.00
1.800	-0.74	0.00	-0.74	0.00	5.200	0.34	0.00	0.34	0.00
2.100	-0.66	0.00	-0.66	0.00					

10.3. Action effect 2: load case 3: span 2

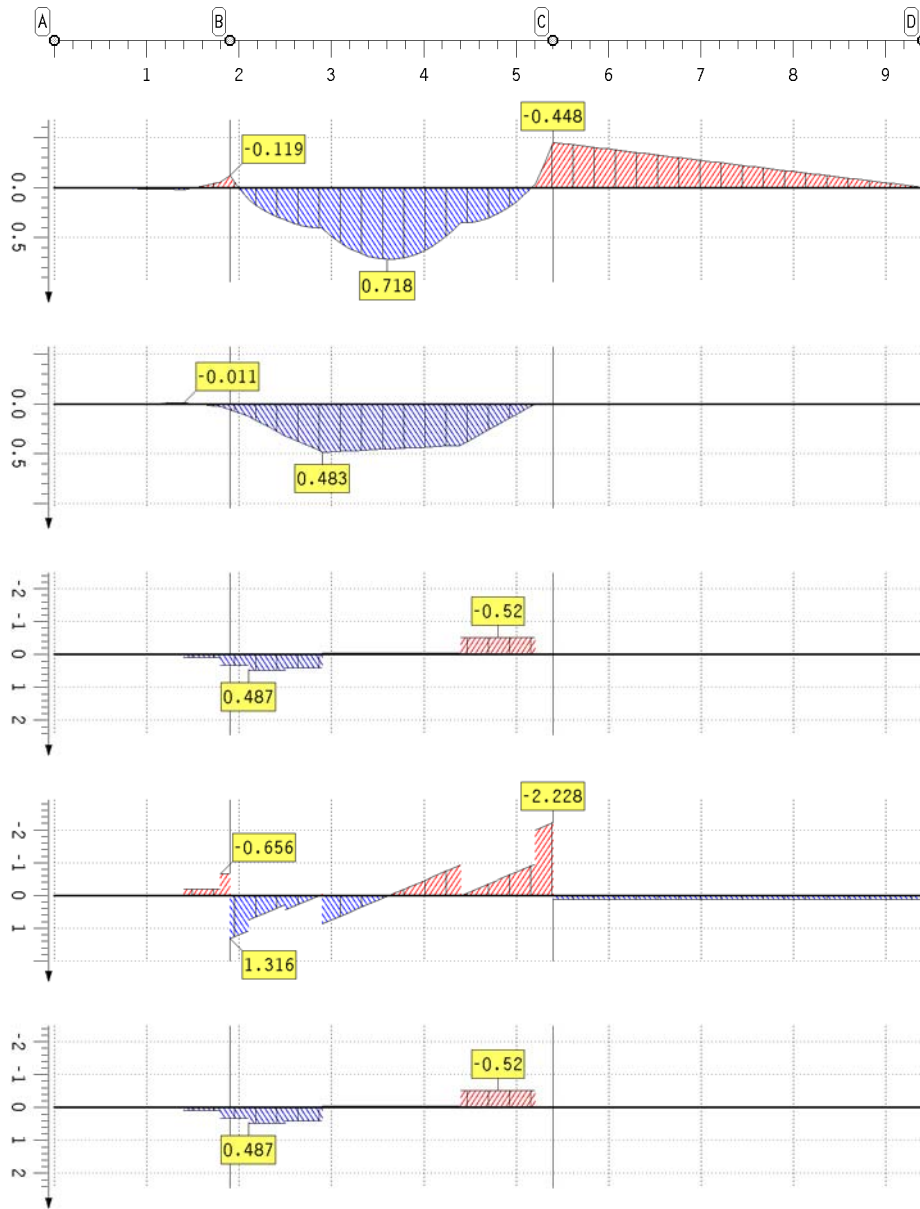
deflections of main beam (characteristic)



internal forces and moments



internal forces and moments



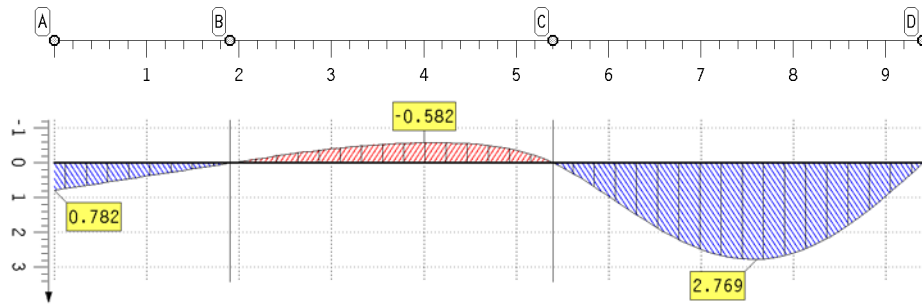
support forces

point	x m	AP kN	AP _l kN	AP _r kN	ΣAP kN
B	1.900	-1.97	0.00	-0.00	-1.97
C	5.400	-2.34	-0.00	-0.00	-2.34
D	9.400	0.11	-----	-----	0.11

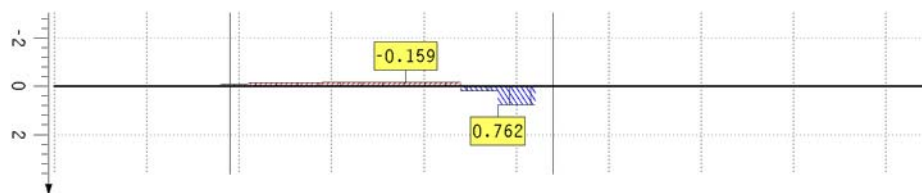
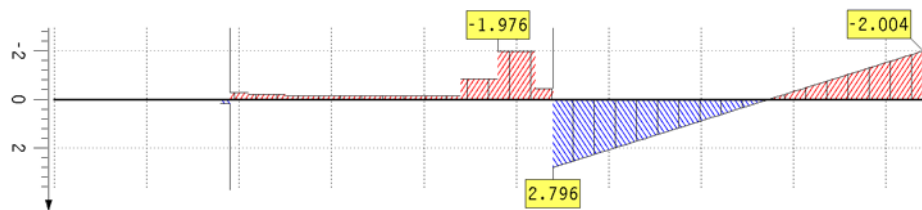
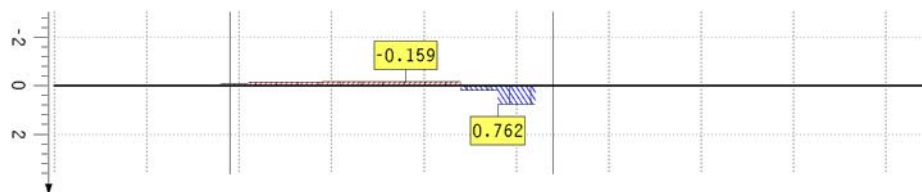
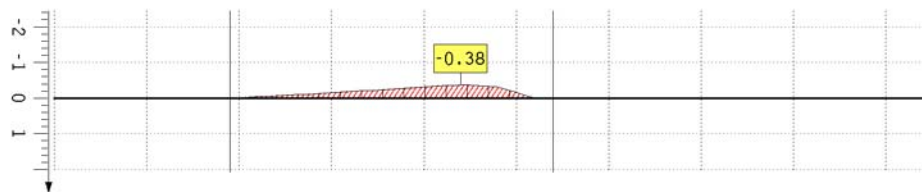
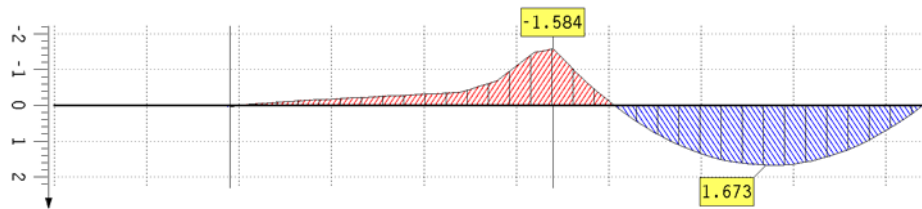
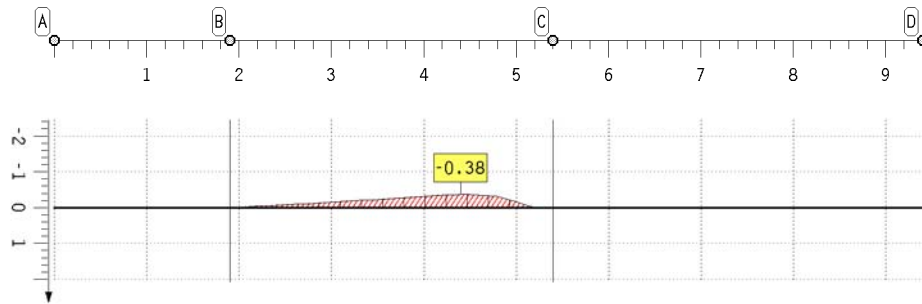
connector reactions

x m	CP _l kN	CM _l kNm	CP _r kN	CM _r kNm	x m	CP _l kN	CM _l kNm	CP _r kN	CM _r kNm
0.200	0.00	0.00	0.00	0.00	2.500	0.08	0.00	0.08	0.00
0.600	0.01	0.00	0.01	0.00	2.900	0.45	0.00	0.45	0.00
1.000	-0.01	0.00	-0.01	0.00	4.400	0.47	0.00	0.47	0.00
1.400	-0.10	0.00	-0.10	0.00	4.800	-0.01	0.00	-0.01	0.00
1.800	-0.24	0.00	-0.24	0.00	5.200	-0.51	0.00	-0.51	0.00
2.100	-0.16	0.00	-0.16	0.00					

10.4. Action effect 2: load case 4: span3 deflections of main beam (characteristic)



internal forces and moments



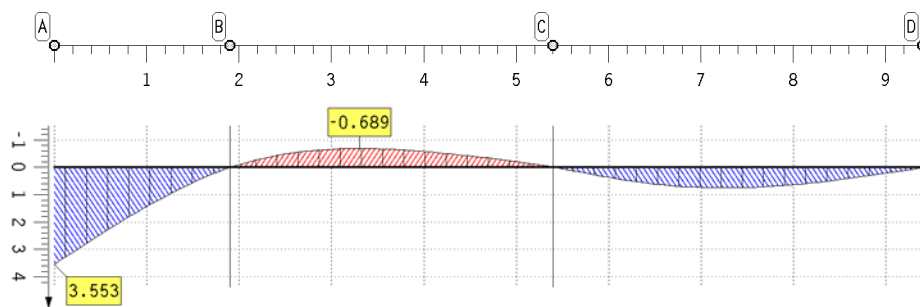
support forces

point	x m	AP kN	AP _l kN	AP _r kN	ΣAP kN
B	1.900	0.45	0.00	-0.00	0.45
C	5.400	-3.25	-0.00	0.00	-3.25
D	9.400	-2.00	-----	-----	-2.00

connector reactions

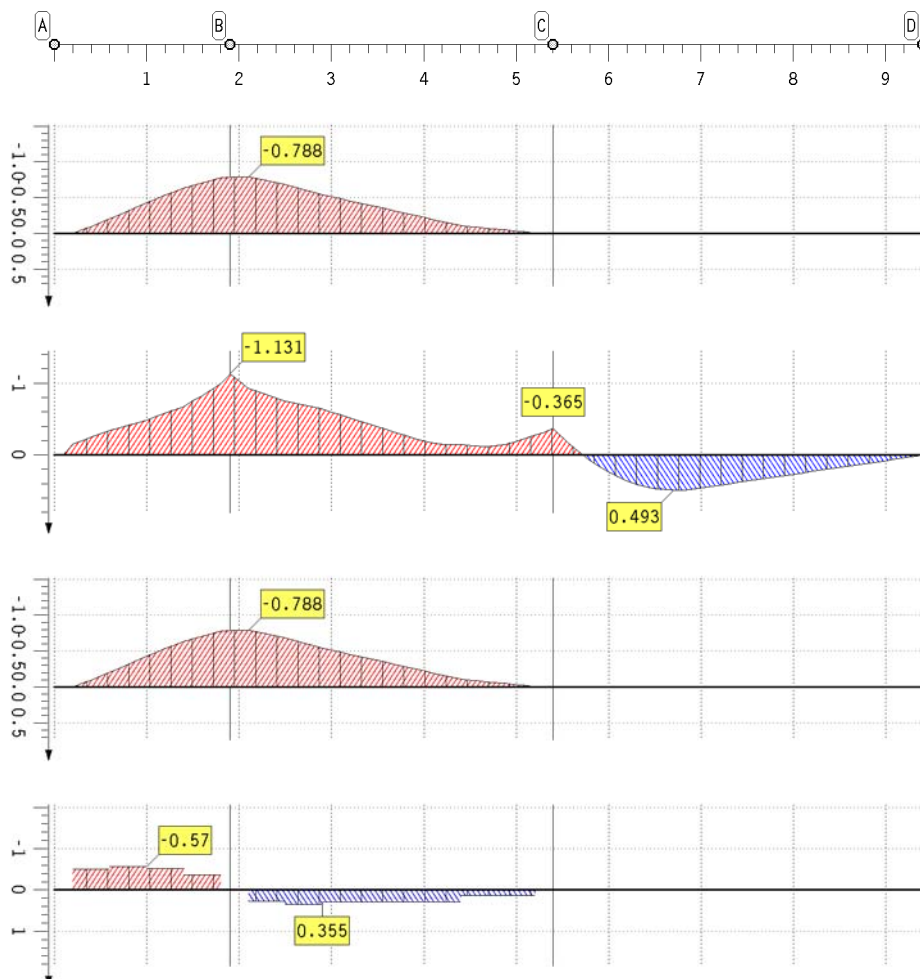
x m	CP _l kN	CM _l kNm	CP _r kN	CM _r kNm	x m	CP _l kN	CM _l kNm	CP _r kN	CM _r kNm
0.200	-0.00	0.00	-0.00	0.00	2.500	0.02	0.00	0.02	0.00
0.600	-0.00	0.00	-0.00	0.00	2.900	0.01	0.00	0.01	0.00
1.000	0.00	0.00	0.00	0.00	4.400	-0.35	0.00	-0.35	0.00
1.400	0.02	0.00	0.02	0.00	4.800	-0.57	0.00	-0.57	0.00
1.800	0.06	0.00	0.06	0.00	5.200	0.76	0.00	0.76	0.00
2.100	0.05	0.00	0.05	0.00					

10.5. Action effect 3: load case 5: snow deflections of main beam (characteristic)



deflection
main beam
characteristic
w in mm
Min: -0.69
Max: 3.55

internal forces and moments



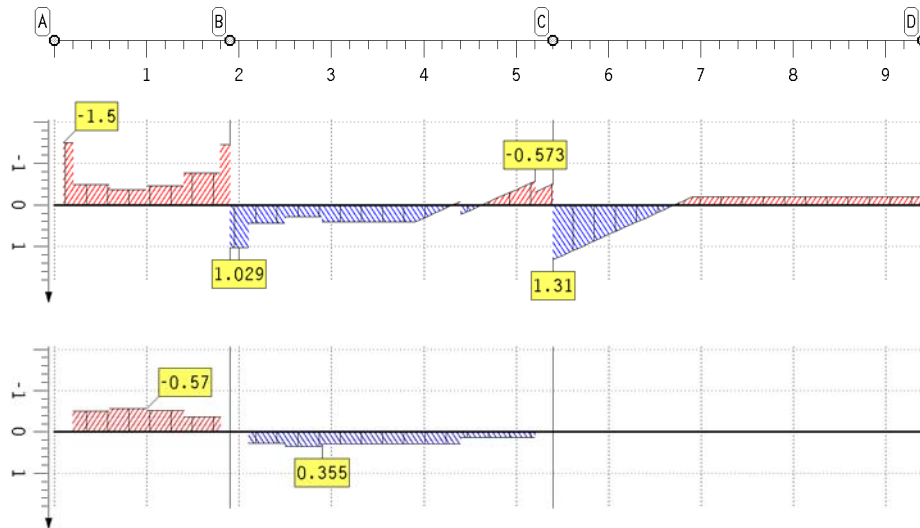
flexural moment
reinf. left
M_l in kNm
Min: -0.79
Max: 0.00

flexural moment
main beam
M in kNm
Min: -1.13
Max: 0.49

flexural moment
reinf. right
M_r in kNm
Min: -0.79
Max: 0.00

shear force
reinf. left
V_l in kN
Min: -0.57
Max: 0.36

internal forces and moments



shear force
main beam
V in kN
Min: -1.50
Max: 1.31

shear force
reinf. right
V_r in kN
Min: -0.57
Max: 0.36

support forces

point	x m	AP kN	AP _l kN	AP _r kN	ΣAP kN
B	1.900	-2.49	0.00	0.00	-2.49
C	5.400	-1.82	0.00	0.00	-1.82
D	9.400	-0.19	-----	-----	-0.19

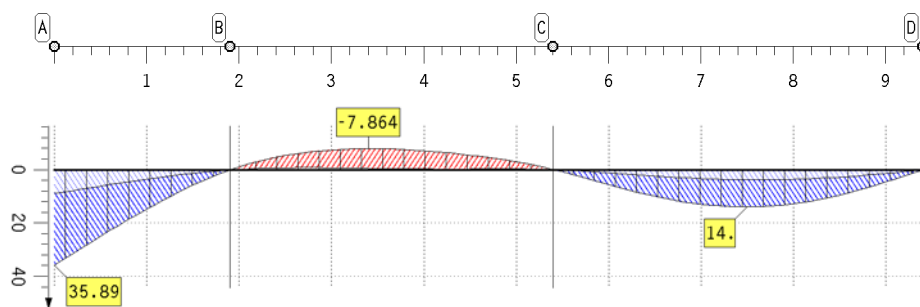
connector reactions

x m	CP _l kN	CM _l kNm	CP _r kN	CM _r kNm	x m	CP _l kN	CM _l kNm	CP _r kN	CM _r kNm
0.200	0.51	0.00	0.51	0.00	2.500	-0.08	0.00	-0.08	0.00
0.600	0.06	0.00	0.06	0.00	2.900	0.07	0.00	0.07	0.00
1.000	-0.05	0.00	-0.05	0.00	4.400	0.16	0.00	0.16	0.00
1.400	-0.15	0.00	-0.15	0.00	4.800	0.00	0.00	0.00	0.00
1.800	-0.34	0.00	-0.34	0.00	5.200	0.13	0.00	0.13	0.00
2.100	-0.29	0.00	-0.29	0.00					

11. Results of verification of ultimate limit state

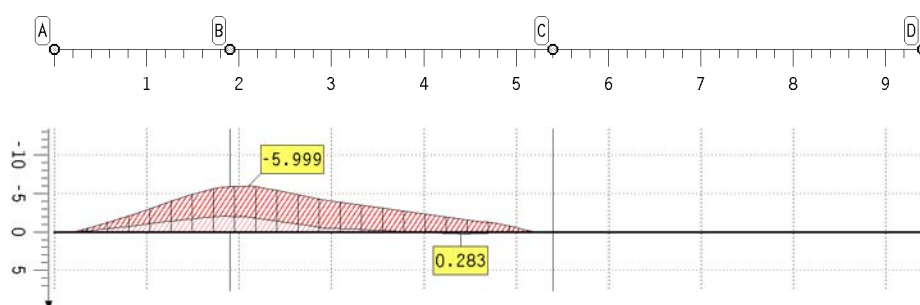
11.1. Verification of ultimate limit state

extremal deflections of main beam (incl. γ_F)



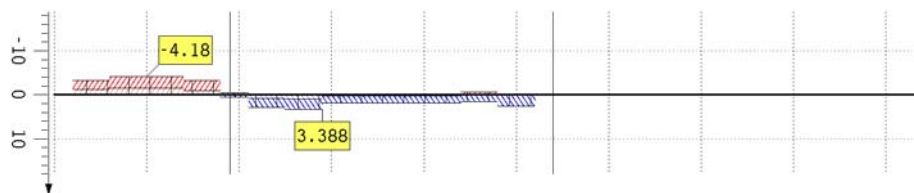
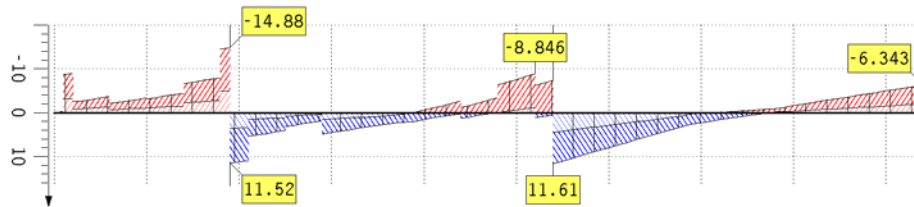
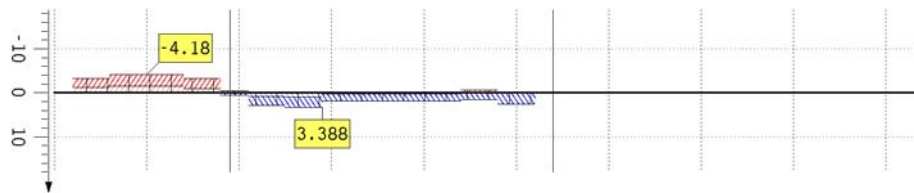
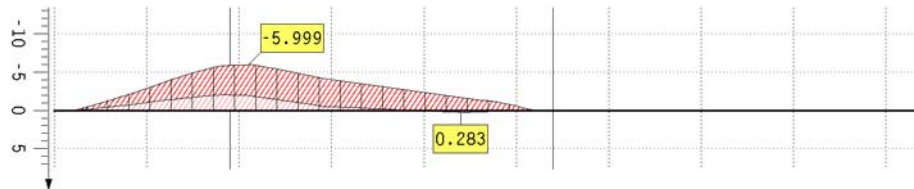
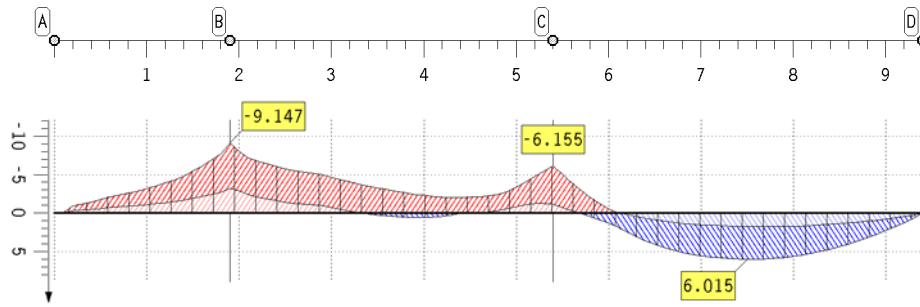
deflection
main beam
γ_F-fach
w in mm
Min: -7.86
Max: 35.89

extremal internal forces

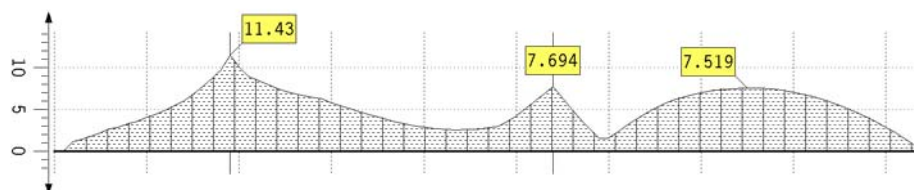
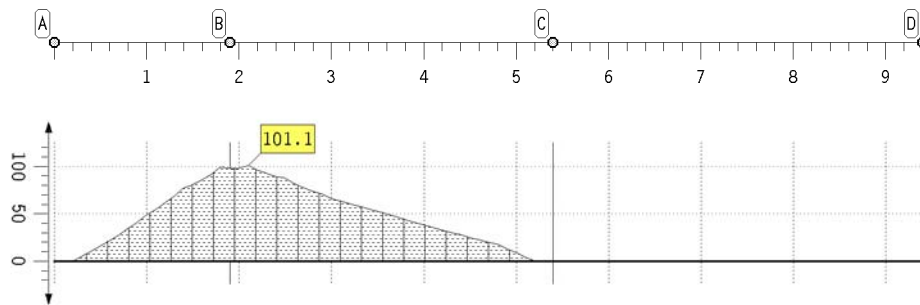


flexural moment
reinf. left
M_l in kNm
Min: -6.00
Max: 0.28

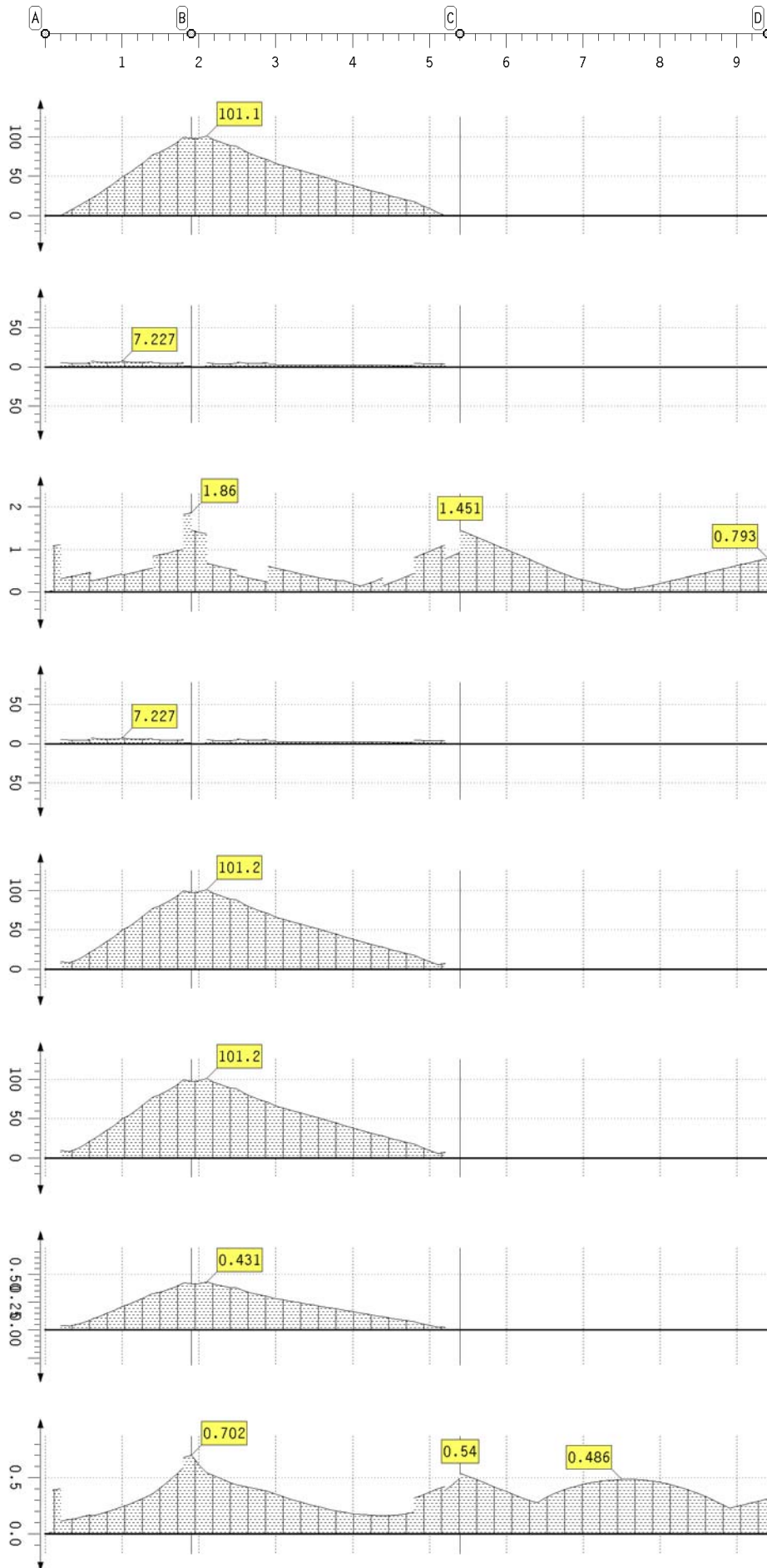
extremal internal forces



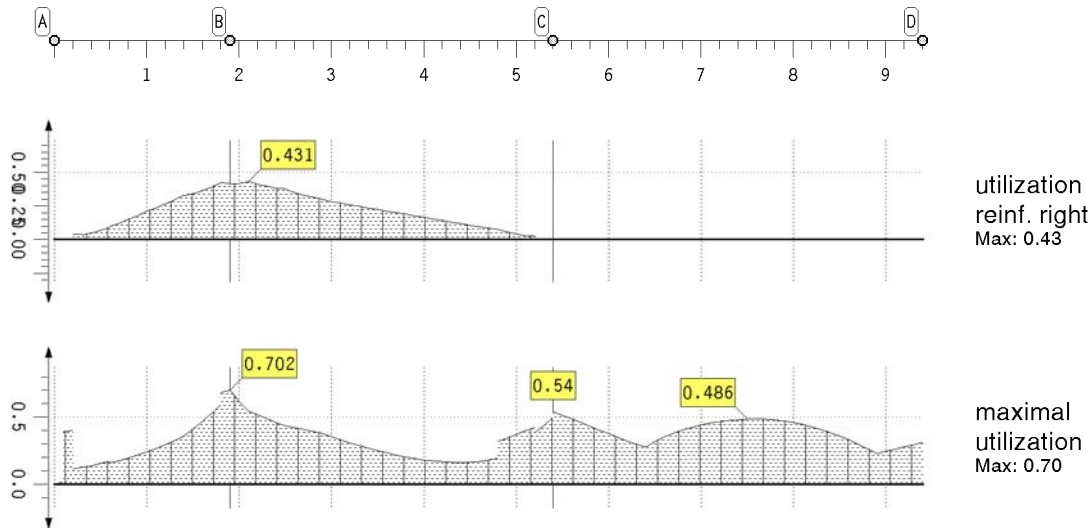
results of verification of ultimate limit state



results of verification of ultimate limit state



results of verification of ultimate limit state



verification of ultimate limit state of left-sided steel reinforcement

point	x	σ_1	τ_1	$\sigma_{v,1}$	U_1	point	x	σ_1	τ_1	$\sigma_{v,1}$	U_1
-	m	MN/m ²	MN/m ²	MN/m ²	-	-	m	MN/m ²	MN/m ²	MN/m ²	-
A	0.000	0.00	0.00	0.00	0.000		2.400	88.94	4.19	89.03	0.379
	0.200	0.00	0.00	0.00	0.000		2.500	87.57	5.08	87.67	0.373
	0.200	0.00	5.57	9.65	0.041		2.500	87.57	5.86	87.70	0.373
	0.500	15.94	4.60	16.53	0.070		2.600	81.41	4.84	81.54	0.347
	0.600	21.74	5.57	22.21	0.095		2.800	72.99	4.84	73.13	0.311
	0.600	21.74	7.04	22.49	0.096		2.900	70.34	5.86	70.50	0.300
	0.700	27.96	5.81	28.50	0.121		2.900	70.34	3.33	70.39	0.300
	0.900	41.38	5.81	41.75	0.178		3.000	65.99	2.75	66.04	0.281
	1.000	49.19	7.23	49.54	0.211		4.400	27.67	3.33	27.80	0.118
	1.100	54.98	5.97	55.28	0.235		4.400	27.67	2.61	27.75	0.118
	1.300	68.77	5.97	69.00	0.294		4.500	24.57	2.15	24.65	0.105
	1.400	77.38	7.23	77.60	0.330		4.700	19.60	2.15	19.71	0.084
	1.400	77.38	5.61	77.51	0.330		4.800	17.51	2.61	17.64	0.075
	1.500	80.72	4.63	80.84	0.344		4.800	17.51	4.49	17.89	0.076
	1.800	98.92	5.61	99.02	0.421		4.900	12.84	3.71	13.31	0.057
	1.800	98.92	0.91	98.92	0.421		5.200	0.00	4.49	7.78	0.033
B	1.900	97.44	0.75	97.44	0.415		5.200	0.00	0.00	0.00	0.000
B	1.900	97.44	0.75	97.44	0.415	C	5.400	0.00	0.00	0.00	0.000
	2.100	101.13	0.91	101.13	0.430	minimum		0.00	0.00	0.00	0.000
	2.100	101.13	5.08	101.21	0.431	maximum		101.13	7.23	101.21	0.431
	2.200	95.57	4.19	95.65	0.407						

verification of ultimate limit state of main beam

point	x	$k_{mod,h}$	σ_h	τ_h	U_h	point	x	$k_{mod,h}$	σ_h	τ_h	U_h
-	m	-	MN/m ²	MN/m ²	-	-	m	-	MN/m ²	MN/m ²	-
A	0.000	0.600	0.00	0.00	0.000		2.900	0.800	6.18	0.60	0.378
	0.100	0.800	0.02	0.04	0.017		4.100	0.800	2.66	0.14	0.170
	0.100	0.900	0.02	1.09	0.392		4.300	0.800	2.54	0.27	0.163
	0.200	0.900	1.12	1.12	0.404		4.400	0.800	2.56	0.34	0.164
	0.200	0.900	1.12	0.32	0.114		4.400	0.800	2.56	0.16	0.164
	0.400	0.900	1.82	0.39	0.139		4.800	0.800	3.01	0.44	0.195
	0.500	0.800	2.22	0.43	0.155		4.800	0.800	3.01	0.80	0.318
	0.600	0.800	2.66	0.47	0.172		5.200	0.800	5.99	1.11	0.427
	0.600	0.900	2.66	0.27	0.160		5.200	0.800	5.99	0.78	0.388
	1.200	0.900	4.91	0.48	0.295	C	5.400	0.800	7.69	0.93	0.498
	1.300	0.800	5.41	0.52	0.327	C	5.400	0.800	7.69	1.45	0.540
	1.400	0.800	5.96	0.57	0.361		5.900	0.800	1.55	1.07	0.403
	1.400	0.800	5.96	0.84	0.361		6.400	0.800	4.54	0.69	0.279
	1.800	0.800	9.60	1.01	0.587		6.900	0.800	6.76	0.32	0.427
	1.800	0.800	9.60	1.82	0.683		7.500	0.800	7.52	0.07	0.486
	1.900	0.800	11.43	1.86	0.702		8.200	0.800	6.50	0.29	0.426
B	1.900	0.800	11.43	1.44	0.702		8.900	0.800	3.44	0.58	0.230
	2.100	0.800	8.92	1.36	0.545	D	9.400	0.800	0.00	0.79	0.315
	2.100	0.800	8.92	0.67	0.545	minimum		0.600	0.00	0.00	0.000
	2.500	0.800	7.12	0.39	0.435	maximum		0.900	11.43	1.86	0.702
	2.900	0.800	6.18	0.23	0.378						

verification of ultimate limit state of right-sided steel reinforcement

point	x	σ_r	τ_r	$\sigma_{v,r}$	U_r	point	x	σ_r	τ_r	$\sigma_{v,r}$	U_r
-	m	MN/m ²	MN/m ²	MN/m ²	-	-	m	MN/m ²	MN/m ²	MN/m ²	-
A	0.000	0.00	0.00	0.00	0.000		2.400	88.94	4.19	89.03	0.379
	0.200	0.00	0.00	0.00	0.000		2.500	87.57	5.08	87.67	0.373
	0.200	0.00	5.57	9.65	0.041		2.500	87.57	5.86	87.70	0.373
	0.500	15.94	4.60	16.53	0.070		2.600	81.41	4.84	81.54	0.347
	0.600	21.74	5.57	22.21	0.095		2.800	72.99	4.84	73.13	0.311
	0.600	21.74	7.04	22.49	0.096		2.900	70.34	5.86	70.50	0.300
	0.700	27.96	5.81	28.50	0.121		2.900	70.34	3.33	70.39	0.300
	0.900	41.38	5.81	41.75	0.178		3.000	65.99	2.75	66.04	0.281
	1.000	49.19	7.23	49.54	0.211		4.400	27.67	3.33	27.80	0.118
	1.100	54.98	5.97	55.28	0.235		4.400	27.67	2.61	27.75	0.118
	1.300	68.77	5.97	69.00	0.294		4.500	24.57	2.15	24.65	0.105
	1.400	77.38	7.23	77.60	0.330		4.700	19.60	2.15	19.71	0.084
	1.400	77.38	5.61	77.51	0.330		4.800	17.51	2.61	17.64	0.075
	1.500	80.72	4.63	80.84	0.344		4.800	17.51	4.49	17.89	0.076
	1.800	98.92	5.61	99.02	0.421		4.900	12.84	3.71	13.31	0.057
	1.800	98.92	0.91	98.92	0.421		5.200	0.00	4.49	7.78	0.033
	1.900	97.44	0.75	97.44	0.415		5.200	0.00	0.00	0.00	0.000
B	1.900	97.44	0.75	97.44	0.415	C	5.400	0.00	0.00	0.00	0.000
B	2.100	101.13	0.91	101.13	0.430	minimum		0.00	0.00	0.00	0.000
	2.100	101.13	5.08	101.21	0.431	maximum		101.13	7.23	101.21	0.431
	2.200	95.57	4.19	95.65	0.407						

maximal utilization

point	x	U	point	x	U	point	x	U	point	x	U
-	m	-	-	m	-	-	m	-	-	m	-
A	0.000	0.000		1.400	0.361		4.800	0.195		7.600	0.486
	0.100	0.017	B	1.900	0.702		4.800	0.318		8.200	0.426
	0.100	0.392	B	1.900	0.702	C	5.400	0.498		8.900	0.230
	0.200	0.404		2.100	0.545	C	5.400	0.540	D	9.400	0.315
	0.200	0.114		2.500	0.435		6.400	0.279	minimum		0.000
	0.700	0.177		4.300	0.163		6.900	0.427	maximum		0.702

extremal connector reactions

x	min CP _l	max CP _l	min CM _l	max CM _l	min CP _r	max CP _r	min CM _r	max CM _r
m	kN	kN	kNm	kNm	kN	kN	kNm	kNm
0.200	1.17	3.22	0.00	0.00	1.17	3.22	0.00	0.00
0.600	0.29	0.85	0.00	0.00	0.29	0.85	0.00	0.00
1.000	-0.06	0.16	0.00	0.00	-0.06	0.16	0.00	0.00
1.400	-1.11	-0.35	0.00	0.00	-1.11	-0.35	0.00	0.00
1.800	-3.25	-1.05	0.00	0.00	-3.25	-1.05	0.00	0.00
2.100	-2.76	-0.89	0.00	0.00	-2.76	-0.89	0.00	0.00
2.500	-0.57	-0.02	0.00	0.00	-0.57	-0.02	0.00	0.00
2.900	0.56	1.55	0.00	0.00	0.56	1.55	0.00	0.00
4.400	-0.14	1.41	0.00	0.00	-0.14	1.41	0.00	0.00
4.800	-1.44	-0.08	0.00	0.00	-1.44	-0.08	0.00	0.00
5.200	-0.14	2.60	0.00	0.00	-0.14	2.60	0.00	0.00

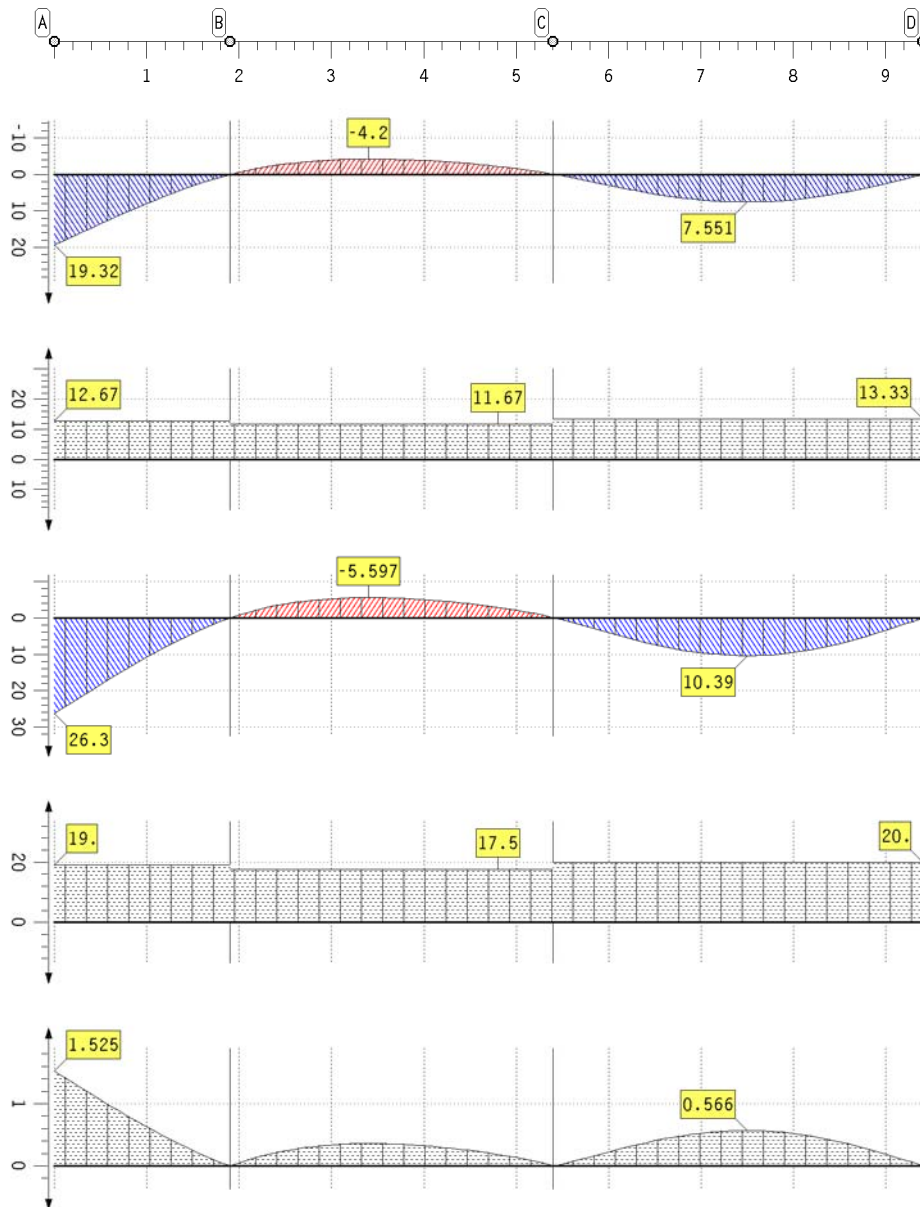
verification of ultimate limit state for connectors

x	k _{mod,l}	U _l	k _{mod,r}	U _r	x	k _{mod,l}	U _l	k _{mod,r}	U _r
m	-	-	-	-	m	-	-	-	-
0.200	0.900	0.315	0.900	0.315	2.500	0.800	0.056	0.800	0.056
0.600	0.800	0.088	0.800	0.088	2.900	0.800	0.165	0.800	0.165
1.000	0.800	0.018	0.800	0.018	4.400	0.800	0.142	0.800	0.142
1.400	0.800	0.109	0.800	0.109	4.800	0.800	0.158	0.800	0.158
1.800	0.800	0.329	0.800	0.329	5.200	0.800	0.275	0.800	0.275
2.100	0.800	0.280	0.800	0.280					

12. Results of verification of deflections

12.1. Verification of deflections

results of verification of deflections



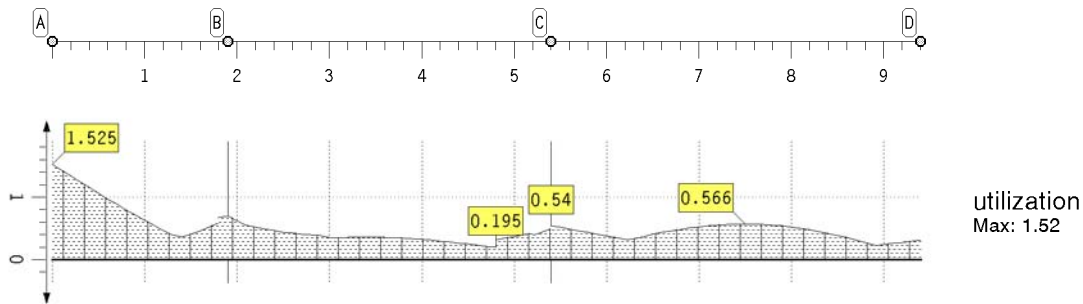
verification of deflections

point	x m	min/max/req w _{inst}			min/max/req w _{fin}			min/max/req w _{net, fin}			U
		mm	mm	mm	mm	mm	mm	mm	mm	mm	
A	0.000	0.00	19.32	12.67	0.00	26.30	19.00	----	----	----	1.525
B	1.900	0.00	0.00	12.67	0.00	0.00	19.00	----	----	----	0.000
B	1.900	0.00	0.00	11.67	0.00	0.00	17.50	----	----	----	0.000
	2.600	-3.19	0.00	11.67	-4.28	0.00	17.50	----	----	----	0.273
	3.400	-4.20	0.00	11.67	-5.60	0.00	17.50	----	----	----	0.360
	4.400	-3.05	0.00	11.67	-4.06	0.00	17.50	----	----	----	0.261
C	5.400	-0.00	0.00	11.67	-0.00	0.00	17.50	----	----	----	0.000
C	5.400	0.00	0.00	13.33	0.00	0.00	20.00	----	----	----	0.000
	6.700	0.00	6.20	13.33	0.00	8.52	20.00	----	----	----	0.465
	7.500	0.00	7.55	13.33	0.00	10.39	20.00	----	----	----	0.566
	8.300	0.00	5.92	13.33	0.00	8.16	20.00	----	----	----	0.444
D	9.400	-0.00	0.00	13.33	-0.00	0.00	20.00	----	----	----	0.000
minimum		-4.20	0.00	11.67	-5.60	0.00	17.50	0.00	0.00	0.00	0.000
maximum		0.00	19.32	13.33	0.00	26.30	20.00	0.00	0.00	0.00	1.525

13. Summary

13.1. Summary of all verifications

maximal utilization



maximal connector utilization

x m	U -	x m	U -	x m	U -
0.200	0.32	1.800	0.33	4.400	0.14
0.600	0.09	2.100	0.28	4.800	0.16
1.000	0.02	2.500	0.06	5.200	0.27
1.400	0.11	2.900	0.16		

14. Utilizations of all verifications

verification der deformations ($u = 1.525$) does not meet the requirements!