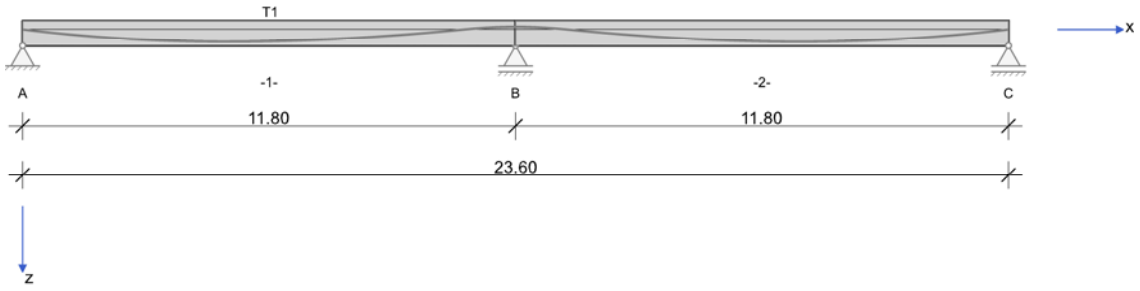
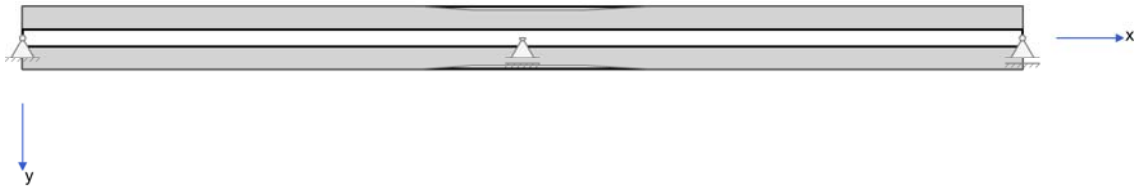
RIB Software SE	BALKEN V18.0 Build-No. 29112018	Type: Reinforced concrete
File: Vorspannung.Balx		

System information

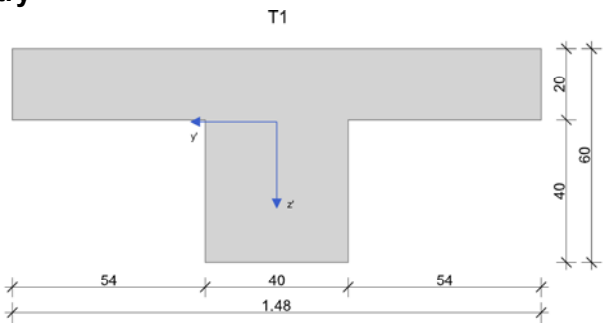


Effective slab width



Standards:	DIN EN 1992-1-1		Design	
Calculation:	effective widths are being considered		Moment redistribution:	limited < 15.00 %
Building type:	General building construction		Prestressing:	posttensioning
Design situation:	permanent			
Exposure class:	top:XC3	bottom:XC3		
Fire protection:	no fire protection analysis			

Continuous beam geometry

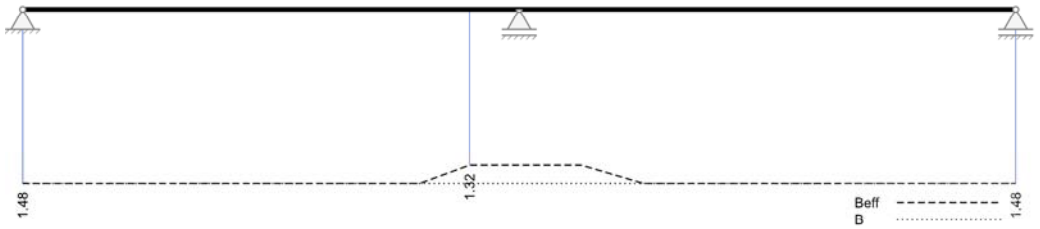


Cross-section	Type	b_w [cm]	h_w [cm]	b_t [cm]	d_t [cm]	b_b [cm]	d_b [cm]	A_c [cm²]	I_y [cm⁴]	z_s [cm]
T1	T	40.0	40.0	148.0	20.0			4560.0	1246737	20.5

Span	Length [m]	Cross-section
1	11.80	T1
2	11.80	T1

Effective slab widths

Effective slab width [m]



Support

Support	Type	c_x [kN/m]	c_z [kN/m]	$c_{\varphi x}$ [kNm]	$c_{\varphi y}$ [kNm]	Width [cm]	Notch	
							ba [cm]	h [cm]
A	Concrete, direct	rigid	rigid	rigid		30.0	0.0	0.0
B	Concrete, direct		rigid	rigid		30.0		
C	Concrete, direct		rigid	rigid		30.0	0.0	0.0

Material

Concrete	f_{ck} [N/mm²]	E_{cm} [N/mm²]	γ_c	α_{cc}	f_{cd} [N/mm²]	f_{ctm} [N/mm²]	γ [kN/m³]
C35/45	35.0	34100	1.50	0.85	19.8	3.2	25.00

The rising branch of the stress-strain curve is considered according to 3.2.7 (2)a.

Reinforcement	Application	f_{yk} [N/mm²]	E_s [N/mm²]	γ_s	f_{yd} [N/mm²]	Ductility	$\Delta\sigma_{RSK(N^*)}$
B500S	Longitudinal & lateral	500.00	200000	1.15	434.8	B (high)	175.00
B500S	Shear joint	500.00	200000	1.15	434.8	B (high)	175.00

Prestressing steel	Sort/type Composite	$f_{p01,k}$ $f_{p01,d}$	f_{pk} f_{pd}	E_p $\Delta\sigma_{RSK}$ (N*)	γ_{inf} γ_{sup}	γ_p l_{pt} [m]	$\varnothing_{int}$ $\varnothing_{out}$	k [°/m] μ	s [mm] R_{min} [m]	σ_{po}/f_{pk}		
										60%	70%	80%
ST1570/1770	Strand post-tensioned	1500 1304	1770 1539	195000 150	0.90 1.10	1.15 0.00	58 63	0.30 0.14	6.0 4.8	1.0	2.5	4.5

Reinforcement specification

Longitudinal reinforcement

Span No.	Section [m]		As top [cm²]			As bottom [cm²]			$\varnothing_s$-top [mm]		$\varnothing_s$-bottom [mm]	
	a	b	d_1 [cm]	Web	Flange	d_1 [cm]	Web	Flange	Web	Flange	Web	Flange
1	0.000	10.620	5.0	0.00	0.00	5.0	0.00	0.00	20	14	25	14
1	10.620	12.980	5.0	0.00	0.00	5.0	0.00	0.00	20	14	25	14
1	12.980	23.600	5.0	0.00	0.00	5.0	0.00	0.00	20	14	25	14

Prestressing reinforcement

post-tensioning / unbonded

Position	Type	n_p	A_p [cm²]	ΣA_p [cm²]	$\varnothing_p$ [mm]	ζ	e [cm]	Beginning of tendon [kN]			End of tendon [kN]		
								Prest.	Discharge	Post-ten.	Prest.	Discharge	Post-ten.
a	ST1570/1770	1	10.50	10.50	0.0	0.60	15.5	1342.7	0.0	0.0	0.0	0.0	0.0
b	ST1570/1770	1	10.50	10.50	0.0	0.60	15.5	0.0	0.0	0.0	1262.2	0.0	0.0

Loading

Load cases

LC	Type of action	γ_{sup}	γ_{inf}	ψ_0	ψ_1	ψ_2	Name
1	Dead load	1.35	1.00	1.00	1.00	1.00	Eigengewicht des Trägers
2	Permanent load	1.35	1.00	1.00	1.00	1.00	Ausbaulast
3	Vorspannung 1	1.00	1.00	1.00	1.00	1.00	Vorspannung 1
4	Snow	1.50	0.00	0.50	0.20	0.00	Schneelast max.
5	Snow	1.50	0.00	0.50	0.20	0.00	Schneelast min.
6	Moving load < 160 kN (Live	1.50	0.00	0.70	0.50	0.30	

	load G)						
7	Moving load < 160 kN (Live load G)	1.50	0.00	0.70	0.50	0.30	

Load case 1:

T	Type	Relation	LR	a to the origin [m]	q_L/m_L [kN,kNm]	q_R/m_R [kN,kNm]	e_y [cm]	e_z [cm]	Length [m]	b_L [m]	b_R [m]
	Line load	Support A	z	0.000	21.70	21.70		0.0	23.600		

Load case 2:

T	Type	Relation	LR	a to the origin [m]	q_L/m_L [kN,kNm]	q_R/m_R [kN,kNm]	e_y [cm]	e_z [cm]	Length [m]	b_L [m]	b_R [m]
	Line load	Support A	z	0.000	14.70	14.70		0.0	23.600		

Load case 4:

T	Type	Relation	LR	a to the origin [m]	q_L/m_L [kN,kNm]	q_R/m_R [kN,kNm]	e_y [cm]	e_z [cm]	Length [m]	b_L [m]	b_R [m]
	Line load	Girder	z	0.000	3.10	3.10		0.0	23.600		

Load case 5:

T	Type	Relation	LR	a to the origin [m]	q_L/m_L [kN,kNm]	q_R/m_R [kN,kNm]	e_y [cm]	e_z [cm]	Length [m]	b_L [m]	b_R [m]
	Line load	Span 1	z	0.000	3.00	3.00		0.0	11.800		
	Line load	Span 2	z	11.800	1.50	1.50		0.0	11.800		

Load case 6:

T	Type	Relation	LR	a to the origin [m]	q_L/m_L [kN,kNm]	q_R/m_R [kN,kNm]	e_y [cm]	e_z [cm]	Length [m]	b_L [m]	b_R [m]
	Line load	Span 1	z	0.000	9.60	9.60		0.0	11.800		

Load case 7:

T	Type	Relation	LR	a to the origin [m]	q_L/m_L [kN,kNm]	q_R/m_R [kN,kNm]	e_y [cm]	e_z [cm]	Length [m]	b_L [m]	b_R [m]
	Line load	Span 2	z	11.800	9.60	9.60		0.0	11.800		

Combination coefficients

Type of action	γ_{sup}	γ_{inf}	ψ_0	ψ_1	ψ_2
Dead load	1.35	1.00	1.00	1.00	1.00
Permanent load	1.35	1.00	1.00	1.00	1.00
Vorspannung 1	1.00	1.00	1.00	1.00	1.00
Snow	1.50	0.00	0.50	0.20	0.00
Moving load < 160 kN (Live load G)	1.50	0.00	0.70	0.50	0.30

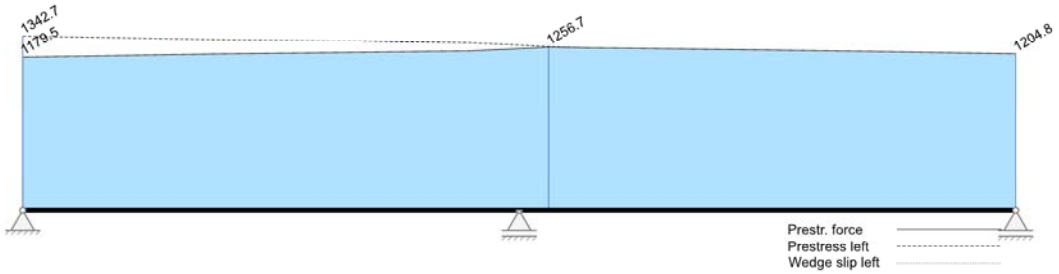
Results

Prestressing

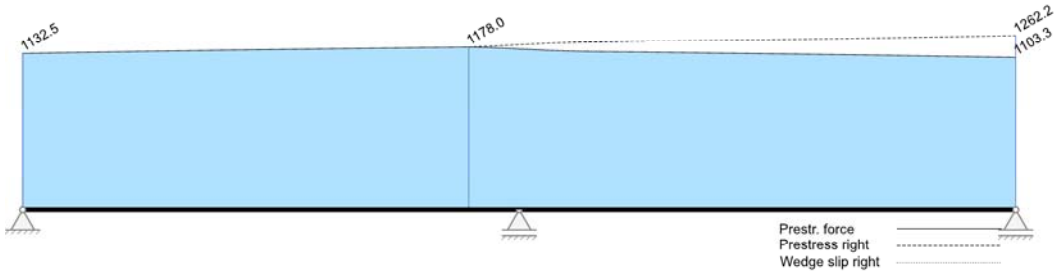
Time line

Time line t(d)	t_0 7	t_1 28	t_∞ ∞	
zul σ_p [N/mm²]	1278.8	1275.0	1150.5	
zul σ_p [N/mm²]	1278.8	1275.0	1150.5	

Prestr. force [kN]

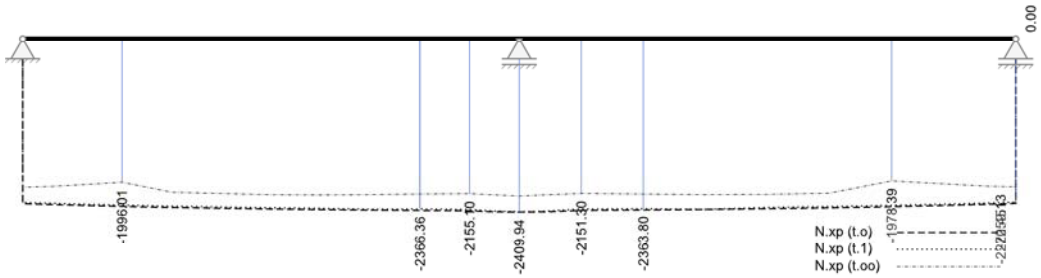


Prestr. force [kN]

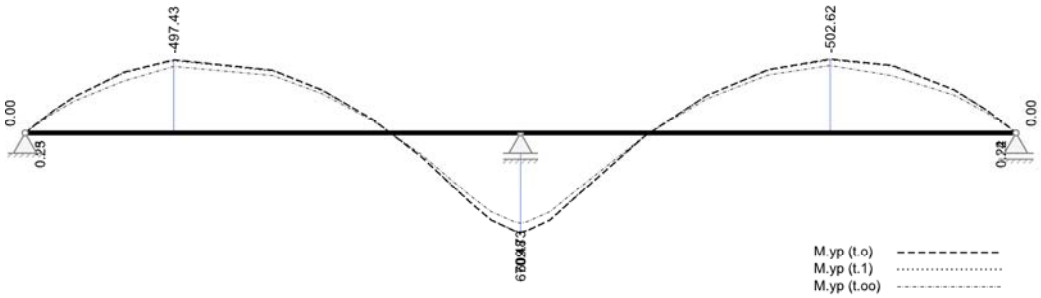


Prestressing stress resultants

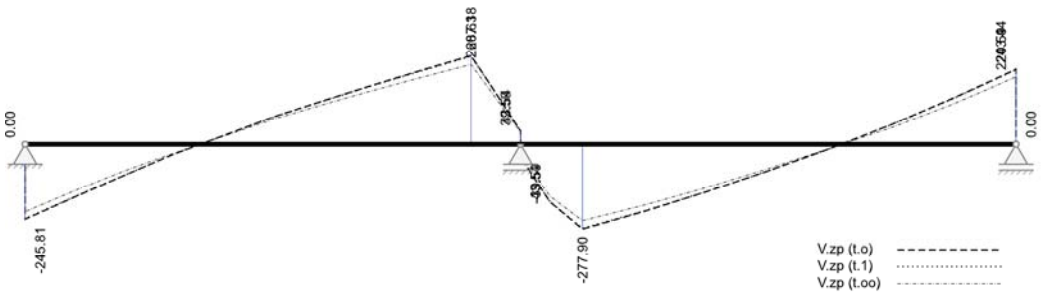
Normal forces Nx [kN]



Bending moments My [kNm]



Shear forces Vz [kN]



Support forces

Support	Load case	EXTR	A_x [kN]	A_z [kN]	M_x [kNm]	M_y [kNm]
A	1		0.00	96.42	0.00	0.00
A	2		0.00	65.32	0.00	0.00
A	3		0.00	43.42	0.00	0.00
A	4		0.00	13.77	0.00	0.00
A	5		0.00	14.42	0.00	0.00
A	6		0.00	49.66	0.00	0.00
A	7		0.00	-7.00	0.00	0.00
A	Snow	max Az	0.00	28.20	0.00	0.00
A	Snow	min Az	0.00	0.00	0.00	0.00

B	1		0.00	319.28	0.00	0.00
B	2		0.00	216.28	0.00	0.00
B	3		0.00	-86.85	0.00	0.00
B	4		0.00	45.61	0.00	0.00
B	5		0.00	33.10	0.00	0.00
B	6		0.00	70.61	0.00	0.00
B	7		0.00	70.64	0.00	0.00
B	Snow	max Az	0.00	78.71	0.00	0.00
B	Snow	min Az	0.00	0.00	0.00	0.00
C	1		0.00	96.42	0.00	0.00
C	2		0.00	65.32	0.00	0.00
C	3		0.00	43.42	0.00	0.00
C	4		0.00	13.77	0.00	0.00
C	5		0.00	5.57	0.00	0.00
C	6		0.00	-6.98	0.00	0.00
C	7		0.00	49.64	0.00	0.00
C	Snow	max Az	0.00	19.35	0.00	0.00
C	Snow	min Az	0.00	0.00	0.00	0.00

Stress resultants

Span stress resultants, summary

Span No.	max M_{yEd} [kNm]	min M_{yEd} [kNm]	max V_{zEd} [kN]	max M_{tEd} [kNm]	max N_{xEd} [kN]	min N_{xEd} [kN]
1	723.24	-1069.25	493.98	0.00	0.00	0.00
2	704.04	-1069.25	483.16	0.00	0.00	0.00

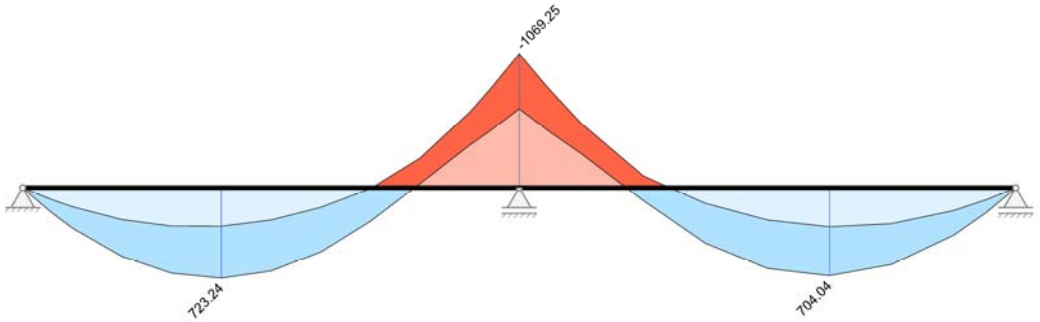
Support stress resultants, summary

Support	max M_{yEd} [kNm]	min M_{yEd} [kNm]	max V_{zEd-Li} max V_{zEd-Re} [kN]	max M_{tEd-Li} max M_{tEd-Re} [kNm]	max N_{xEd} [kN]	min N_{xEd} [kN]
A	0.00	0.00	0.00 313.98	0.00 0.00	0.00	0.00
B	-625.65	-1069.25	-493.98 483.16	0.00 0.00	0.00	0.00
C	0.00	0.00	-307.32 0.00	0.00 0.00	0.00	0.00

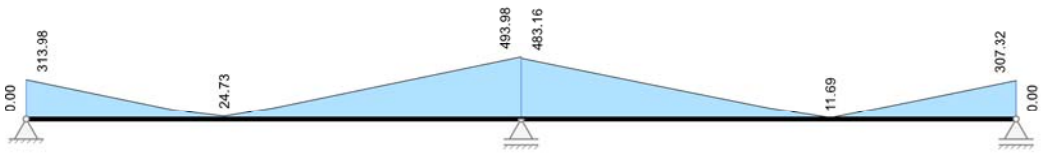
Design

Combination stress resultants

Basic combination M_{yd} [kNm]



Basic combination $|V_{zd}|$ [kN]



Limitation of the crack widths

Crack widths [mm]

Limitation of the stresses

Span / Column	Time [days]	$\sigma_{s,rare}$ [N/mm²]	$\sigma_{p,qperm}$ [N/mm²]	$\sigma_{c,rare}$ [N/mm²]	$\sigma_{c,qperm}$ [N/mm²]	IAB [-]
A	28		1087.00	-8.99	-7.58	0.94
1	28	29.00	1148.00	-22.35	-18.97	1.00
B	28		1150.00	-8.53	-7.24	1.00
2	28	43.00	1157.00	-24.02	-20.36	1.01
C	28		1111.00	-8.88	-7.58	0.97

Fatigue analysis - reinforcing and prestressing steel

Maximum utilization: 0.41 at span / pos. = 1 / 5.900 m Analysis fulfilled.

Fatigue analysis - shear force

Maximum utilization: 1.00 at span / pos. = 1 / 0.000 m Analysis fulfilled.

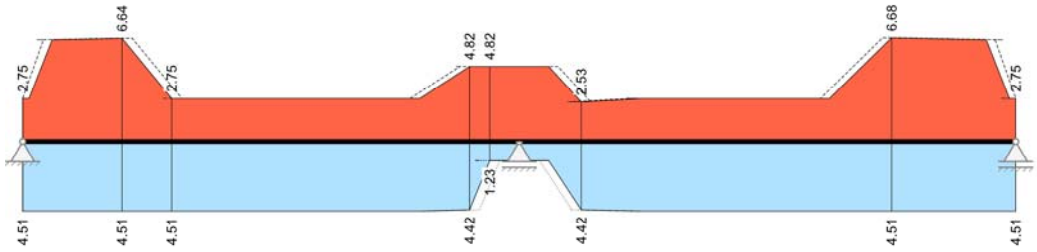
Summary

Analysis summary

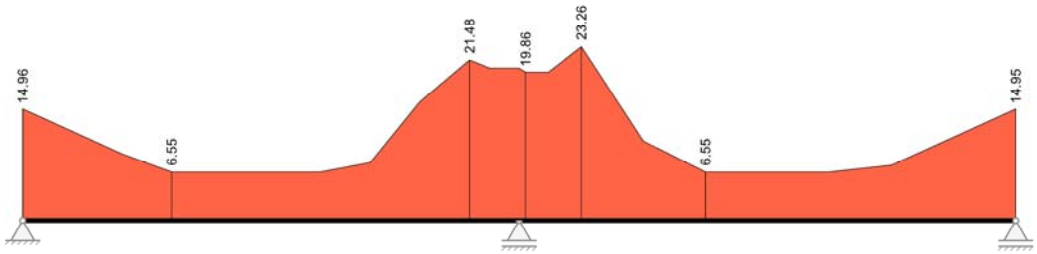
Structural analysis of continuous beam with linear eleastic stress resultant calculation and limited moment redistribution <= 15.00 %					
Design according to DIN EN 1992-1-1		General building construction		Design is carried out normative	
ULS	Analysis	SLS	Analysis	FLS	Analysis
Announcement behavior	yes	Decompression	fulfilled	Fatigue - bending	fulfilled
Bending bearing capacity	fulfilled	Limitation of the crack width	fulfilled	Fatigue - shear force	fulfilled
Shear loading capacity	fulfilled	Limitation of the stresses	not fulfilled		
Shear joint loading capacity	w/o ana.	Limitation of the deformations	w/o ana.		
Structural fire protection	w/o ana.				
Notches	w/o ana.				

Required reinforcement

Required longitudinal reinforcement [cm²]



Required stirrups - web [cm²/m]



Required flange connecting reinforcement [cm²/m]