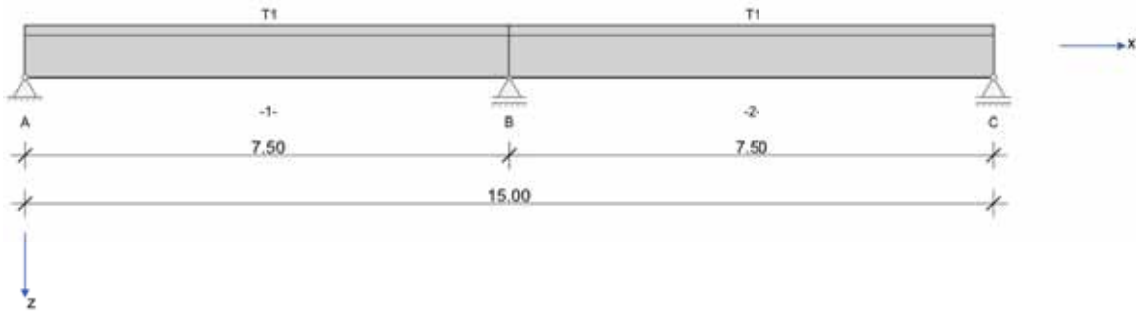
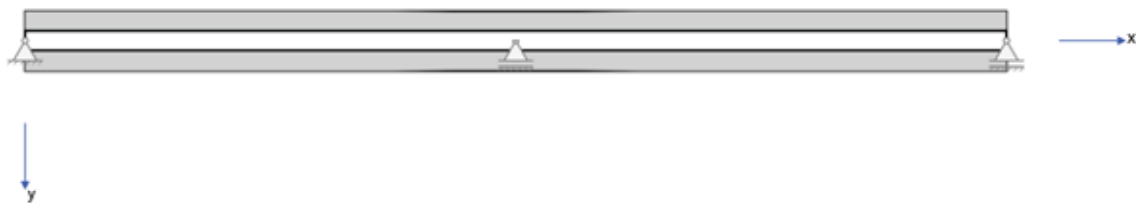


RIB Software SE	BALKEN V18.0 Build-No. 19102018	Type: Reinforced concrete
File: Bauen im Bestand.Balx		

System information



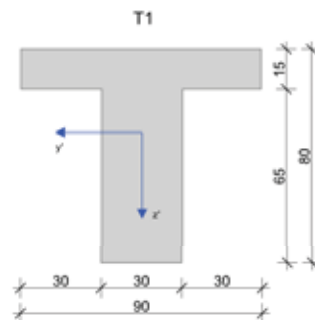
Effective slab width



Standards:	DIN 1045-1:2008		Refurbishment	
Calculation:	effective widths are being considered		Moment redistribution:	limited < 15.00 %
Building type:	General building construction		Prestressing:	none
Design situation:	permanent			
Exposure class:	top:XC1	bottom:XC1		
Fire resistance class:	R60		Flame application:	3-sided

Continuous beam geometry

Type	Cross-section type	b_t	Top flange width
b_w	Web width	d_t	Top flange thickness
h_w	Web height	b_b	Bottom flange width
z_s	Distance of the centroid measured from the TE	d_b	Bottom flange thickness

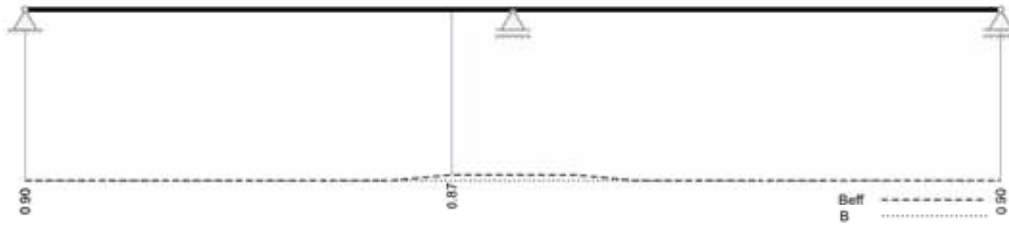


Cross-section	Type	b_w [cm]	h_w [cm]	b_t [cm]	d_t [cm]	b_b [cm]	d_b [cm]	A_c [cm ²]	I_y [cm ⁴]	z_s [cm]
T1	T	30.0	65.0	90.0	15.0			3300.0	1988239	31.1

Span	Length [m]	Cross-section
1	7.50	T1
2	7.50	T1

Effective slab widths

Effective slab width [m]



Support

Support	Type	C _x [kN/m]	C _z [kN/m]	C _{φx} [kNm]	C _{φy} [kNm]	Width [cm]	Notch	
							ba [cm]	h [cm]
A	Concrete, direct	rigid	rigid	rigid		20.0	0.0	0.0
B	Concrete, direct		rigid			20.0		
C	Concrete, direct		rigid			20.0	0.0	0.0

Material

Concrete	f _{ck} [N/mm ²]	E _{cm} [N/mm ²]	γ _c	α _{cc}	f _{cd} [N/mm ²]	f _{ctm} [N/mm ²]	γ [kN/m ³]
C20/25 (Bn250)	20.0	24900	1.50	0.85	11.3	2.2	25.00

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

Reinforcement	Application	f _{yk} [N/mm ²]	E _s [N/mm ²]	γ _s	f _{yd} [N/mm ²]	Ductility	Δσ _{RSK(N*)}
St-A-III	Longitudinal & Lateral	420.00	200000	1.15	365.2	B (high)	175.00
B420S	Shear joint	420.00	200000	1.15	365.2	B (high)	175.00

Reinforcement specification

Longitudinal reinforcement

d ₁	Reinforcement axis distance to the edge	∅ _s	Bar diameter in the web or flange
----------------	---	----------------	-----------------------------------

Span No.	Section [m]		As top [cm ²]			As bottom [cm ²]			∅ _s -top [mm]		∅ _s -bottom [mm]	
	a	b	d ₁ [cm]	Web	Flange	d ₁ [cm]	Web	Flange	Web	Flange	Web	Flange
1	0.000	5.000	4.0	3∅20	2∅14	4.0	4∅25	0.00	20	14	25	14
1	5.000	15.000	4.0	3∅20	2∅14	4.0	4∅25	0.00	20	14	25	14
1	15.000	15.000	4.0	3∅20	2∅14	4.0	4∅25	0.00	20	14	25	14

Shear reinforcement

d _{1w}	Edge axis distance of the stirrups	A _{sf} OG	Σ Flange connecting reinforcement - top flange
A _{sw}	Stirrups	A _{sf} UG	Σ Flange connecting reinforcement - bottom flange

relat. span	Section [m]		Web (double shear stirrups)		Flange connection	
No.	a	b	d _{1w} [cm]	A _{sw} [cm ² /m]	A _{sf} OG [cm ² /m]	A _{sf} UG [cm ² /m]
1	0.000	15.000	3.0	2.51	2.00	0.00

Loading

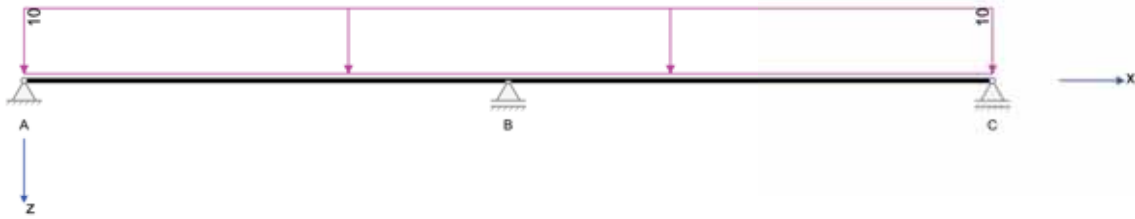
Reinforced concrete - all load values in the load cases are characteristic

Load cases

LC	Type of action	γ _{sup}	γ _{inf}	ψ ₀	ψ ₁	ψ ₂	Name
1	Permanent load	1.35	1.00	1.00	1.00	1.00	
2	Storage rooms (Live Load E)	1.50	0.00	1.00	0.90	0.80	Verkehr Feld 1
3	Storage rooms (Live Load E)	1.50	0.00	1.00	0.90	0.80	Verkehr Feld 2

Load case 1:

Loads in z-direction

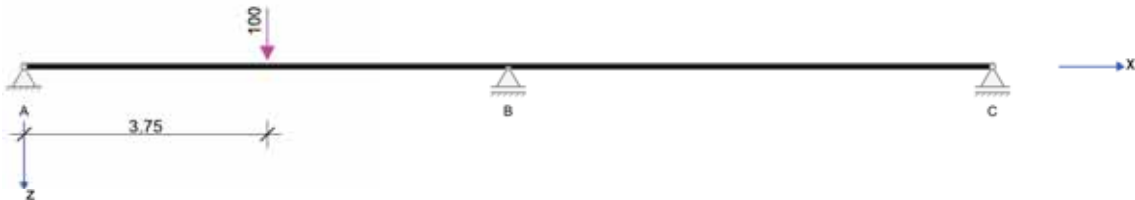


Loading in XZ plane

T	Type	Relation	LR	a to the origin [m]	qL/mL [kN,kNm]	qR/mR [kN,kNm]	ey [cm]	ez [cm]	Length [m]	bL [m]	bR [m]
	Line load	Support A	z	0.000	10.00	10.00		0.0	15.000		

Load case 2:

Loads in z-direction

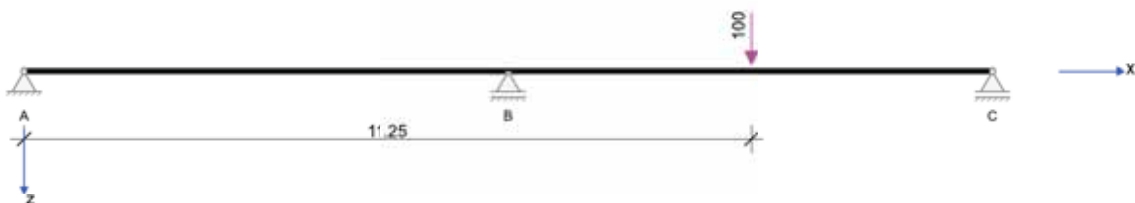


Loading in XZ plane

T	Type	Relation	LR	a to the origin [m]	P [kN]	M [kNm]	ey [cm]	ez [cm]	n	Δx [m]
	Single load	Support A	z	3.750	100.00				0	0.000

Load case 3:

Loads in z-direction



Loading in XZ plane

T	Type	Relation	LR	a to the origin [m]	P [kN]	M [kNm]	ey [cm]	ez [cm]	n	Δx [m]
	Single load	Support B	z	3.750	100.00				0	0.000

Combination coefficients

Type of action	γ_{sup}	γ_{inf}	ψ_0	ψ_1	ψ_2
Permanent load	1.35	1.00	1.00	1.00	1.00
Storage rooms (Live load E)	1.50	0.00	1.00	0.90	0.80

Results

Support forces

LC 1,2, ...	Original LC	EXTR	Leading parameter
Q	Live loads, characteristic	EQU	Safety against displacement

A	Accidental action effect	GK	Basic combination
ΣG	Permanent action effects	AK	Accidental combination
ΣP _∞	Prestressing t _∞	CoA	Earthquake combination

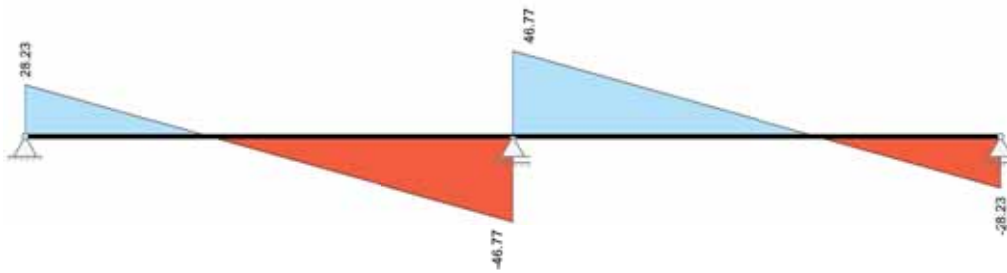
Support	Load case	EXTR	A _x [kN]	A _z [kN]	M _x [kNm]	M _y [kNm]
A	1		0.00	28.23	0.00	0.00
A	2		0.00	40.74	0.00	0.00
A	3		0.00	-9.26	0.00	0.00
A	Sum G		0.00	28.23	0.00	0.00
A	Q (NLE)	max Az	0.00	40.74	0.00	0.00
A	Q (NLE)	mi n Az	0.00	-9.26	0.00	0.00
A	EQU	mi n Az	0.00	11.52	0.00	0.00
A	GK	max Az	0.00	99.22	0.00	0.00
A	GK	mi n Az	0.00	14.34	0.00	0.00
B	1		0.00	93.53	0.00	0.00
B	2		0.00	68.52	0.00	0.00
B	3		0.00	68.52	0.00	0.00
B	Sum G		0.00	93.53	0.00	0.00
B	Q (NLE)	max Az	0.00	137.05	0.00	0.00
B	Q (NLE)	mi n Az	0.00	0.00	0.00	0.00
B	EQU	mi n Az	0.00	84.18	0.00	0.00
B	GK	max Az	0.00	331.84	0.00	0.00
B	GK	mi n Az	0.00	93.53	0.00	0.00
C	1		0.00	28.23	0.00	0.00
C	2		0.00	-9.26	0.00	0.00
C	3		0.00	40.74	0.00	0.00
C	Sum G		0.00	28.23	0.00	0.00
C	Q (NLE)	max Az	0.00	40.74	0.00	0.00
C	Q (NLE)	mi n Az	0.00	-9.26	0.00	0.00
C	EQU	mi n Az	0.00	11.52	0.00	0.00
C	GK	max Az	0.00	99.22	0.00	0.00
C	GK	mi n Az	0.00	14.34	0.00	0.00

Stress resultants

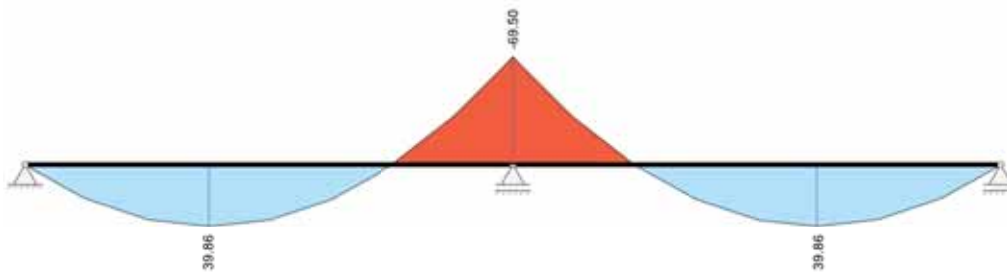
Load case 1:

Span No.	x [m]	L/R	M _y [kNm]	V _z [kN]	M _t [kNm]	N _x [kN]
1	0.000	R	0.00	28.23	0.00	0.00
1	0.100		2.77	27.23	0.00	0.00
1	0.860		20.58	19.63	0.00	0.00
1	0.938		22.07	18.86	0.00	0.00
1	1.875		35.36	9.48	0.00	0.00
1	2.813		39.86	0.11	0.00	0.00
1	3.750		35.56	-9.27	0.00	0.00
1	4.688		22.48	-18.64	0.00	0.00
1	5.625		0.61	-28.02	0.00	0.00
1	6.563		-30.05	-37.39	0.00	0.00
1	6.640		-32.98	-38.17	0.00	0.00
1	7.400		-64.87	-45.77	0.00	0.00
1	7.500	L	-69.50	-46.77	0.00	0.00
2	0.000	R	-69.50	46.77	0.00	0.00
2	0.100		-64.87	45.77	0.00	0.00
2	0.860		-32.98	38.17	0.00	0.00
2	0.938		-30.05	37.39	0.00	0.00
2	1.875		0.61	28.02	0.00	0.00
2	2.813		22.48	18.64	0.00	0.00
2	3.750		35.56	9.27	0.00	0.00
2	4.688		39.86	-0.11	0.00	0.00
2	5.625		35.36	-9.48	0.00	0.00
2	6.563		22.07	-18.86	0.00	0.00
2	6.640		20.58	-19.63	0.00	0.00
2	7.400		2.77	-27.23	0.00	0.00
2	7.500	L	0.00	-28.23	0.00	0.00

Shear forces V_z [kN]



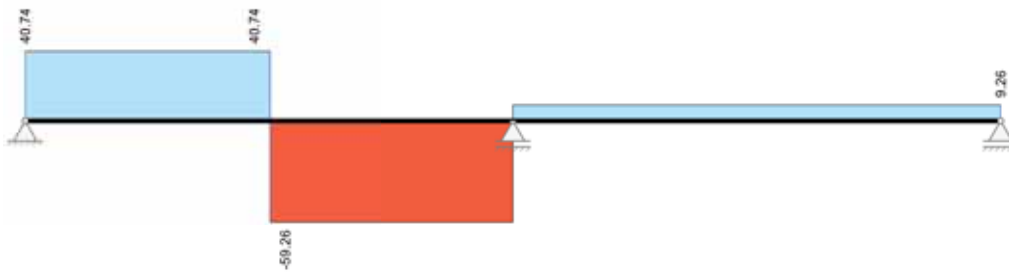
Moments M_y [kNm]



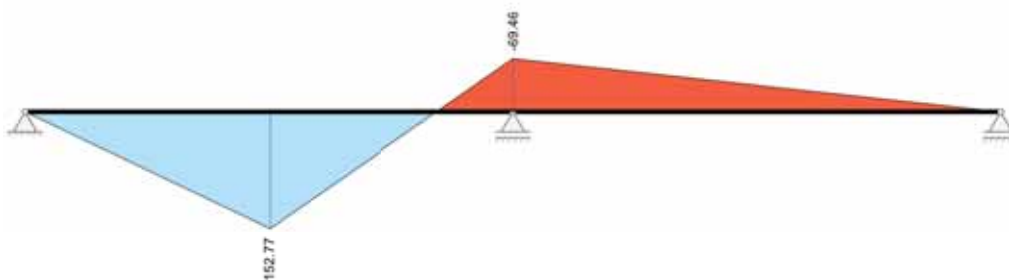
Load case 2: Verkehr Feld 1

Span No.	x [m]	L/R	M_y [kNm]	V_z [kN]	M_t [kNm]	N_x [kN]
1	0.000	R	0.00	40.74	0.00	0.00
1	0.100		4.07	40.74	0.00	0.00
1	0.860		35.03	40.74	0.00	0.00
1	0.938		38.19	40.74	0.00	0.00
1	1.875		76.38	40.74	0.00	0.00
1	2.813		114.58	40.74	0.00	0.00
1	3.750	L	152.77	40.74	0.00	0.00
1	3.750	R	152.77	-59.26	0.00	0.00
1	4.688		97.21	-59.26	0.00	0.00
1	5.625		41.65	-59.26	0.00	0.00
1	6.563		-13.90	-59.26	0.00	0.00
1	6.640		-18.50	-59.26	0.00	0.00
1	7.400		-63.54	-59.26	0.00	0.00
1	7.500	L	-69.46	-59.26	0.00	0.00
2	0.000	R	-69.46	9.26	0.00	0.00
2	0.100		-68.54	9.26	0.00	0.00
2	0.860		-61.50	9.26	0.00	0.00
2	0.938		-60.78	9.26	0.00	0.00
2	1.875		-52.10	9.26	0.00	0.00
2	2.813		-43.41	9.26	0.00	0.00
2	3.750		-34.73	9.26	0.00	0.00
2	4.688		-26.05	9.26	0.00	0.00
2	5.625		-17.37	9.26	0.00	0.00
2	6.563		-8.68	9.26	0.00	0.00
2	6.640		-7.96	9.26	0.00	0.00
2	7.400		-0.93	9.26	0.00	0.00
2	7.500	L	0.00	9.26	0.00	0.00

Shear forces V_z [kN]



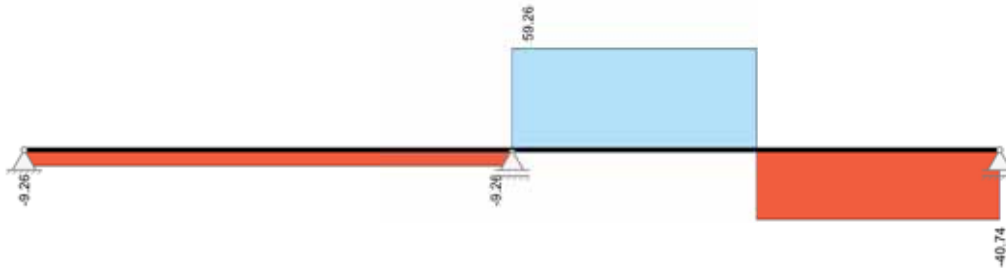
Moments M_y [kNm]



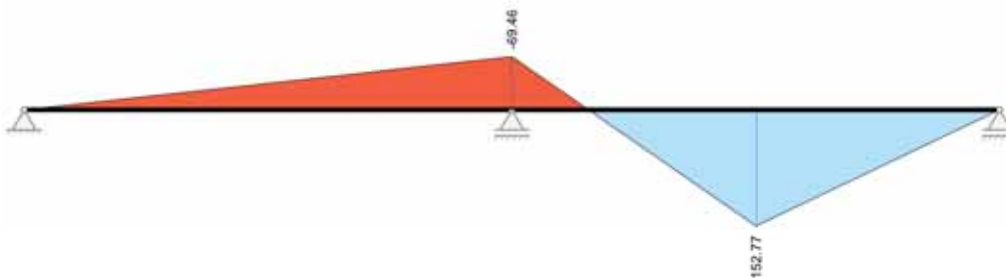
Load case 3: Verkehr Feld 2

Span No.	x [m]	L/R	M_y [kNm]	V_z [kN]	M_t [kNm]	N_x [kN]
1	0.000	R	0.00	-9.26	0.00	0.00
1	0.100		-0.93	-9.26	0.00	0.00
1	0.860		-7.96	-9.26	0.00	0.00
1	0.938		-8.68	-9.26	0.00	0.00
1	1.875		-17.37	-9.26	0.00	0.00
1	2.813		-26.05	-9.26	0.00	0.00
1	3.750		-34.73	-9.26	0.00	0.00
1	4.688		-43.41	-9.26	0.00	0.00
1	5.625		-52.10	-9.26	0.00	0.00
1	6.563		-60.78	-9.26	0.00	0.00
1	6.640		-61.50	-9.26	0.00	0.00
1	7.400		-68.54	-9.26	0.00	0.00
1	7.500	L	-69.46	-9.26	0.00	0.00
2	0.000	R	-69.46	59.26	0.00	0.00
2	0.100		-63.54	59.26	0.00	0.00
2	0.860		-18.50	59.26	0.00	0.00
2	0.938		-13.90	59.26	0.00	0.00
2	1.875		41.65	59.26	0.00	0.00
2	2.813		97.21	59.26	0.00	0.00
2	3.750	L	152.77	59.26	0.00	0.00
2	3.750	R	152.77	-40.74	0.00	0.00
2	4.688		114.58	-40.74	0.00	0.00
2	5.625		76.38	-40.74	0.00	0.00
2	6.563		38.19	-40.74	0.00	0.00
2	6.640		35.03	-40.74	0.00	0.00
2	7.400		4.07	-40.74	0.00	0.00
2	7.500	L	0.00	-40.74	0.00	0.00

Shear forces Vz [kN]



Moments My [kNm]



Span stress resultants, summary

Span No.	max MyEd [kNm]	min MyEd [kNm]	max VzEd [kN]	max MtEd [kNm]	max NxEd [kN]	min NxEd [kN]
1	292.02	-256.88	159.88	0.00	0.00	0.00
2	292.02	-256.88	159.88	0.00	0.00	0.00

Support stress resultants, summary

Support	max MyEd [kNm]	min MyEd [kNm]	max VzEd-Li max VzEd-Re [kN]	max MtEd-Li max MtEd-Re [kNm]	max NxEd [kN]	min NxEd [kN]
A	0.00	0.00	0.00 103.18	0.00 0.00	0.00	0.00
B	-59.07	-256.88	-159.88 159.88	0.00 0.00	0.00	0.00
C	0.00	0.00	-103.18 0.00	0.00 0.00	0.00	0.00

Design

Design combinations according to EN 1990

Analyses	decisive CoA for exposure classXC1
Ductility behavior	rare
Load bearing capacity	Basic combination STR/GEO
Safety against displacement	Basic combination EQU
Decompression	quasi-permanent
Crack width limitation	
Concrete stress	rare quasi-permanent
Reinforcing steel stresses	rare
Tendon stress	quasi-permanent
Fatigue	frequent
Deformation	quasi-permanent rare
Fire protection	accidental

Combination stress resultants

Combination stress resultants do not contain prestressing. (With limited moment redistribution <= 15.00 %)

Span No.	x [m]	Basic combination STR/GEO				rare CoA		frequent CoA		quasi-permanent CoA	
		max Myd [kNm]	min Myd [kNm]	max Vzd [kN]	max Mt [kNm]	max Myd [kNm]	min Myd [kNm]	max Myd [kNm]	min Myd [kNm]	max Myd [kNm]	min Myd [kNm]
1	0.000	0.00	0.00	103.18	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1	0.100	10.25	1.73	101.83	0.00	6.85	1.85	6.44	1.94	6.03	2.03
1	0.860	83.75	11.62	91.57	0.00	55.62	12.62	52.11	13.41	48.61	14.21
1	0.938	90.80	12.31	90.53	0.00	60.27	13.39	56.45	14.26	52.63	15.13
1	1.875	169.74	15.83	77.87	0.00	111.74	17.99	104.11	19.73	96.47	21.47
1	2.813	236.81	10.55	65.21	0.00	154.43	13.81	142.98	16.41	131.52	19.02

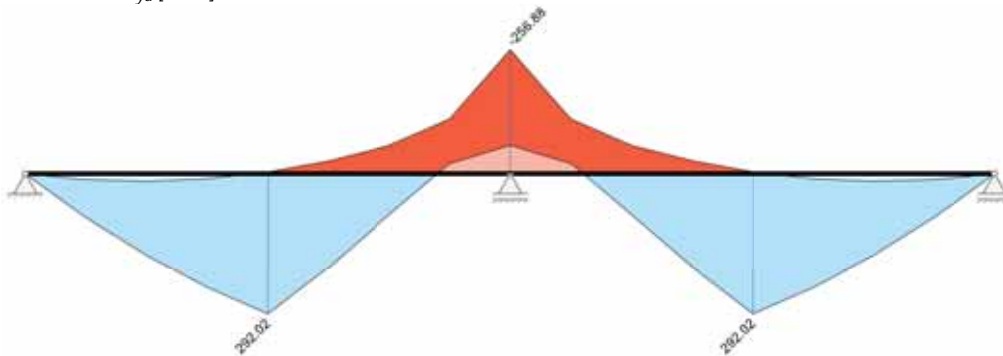
Auftrag: Bauen im Bestand

Position: A11

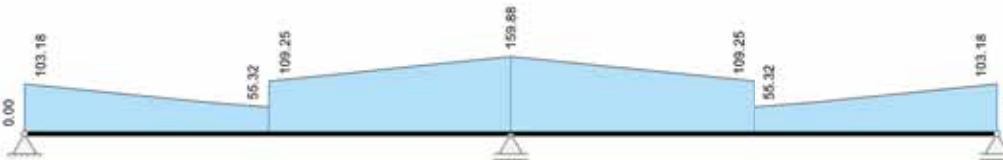
Bauteil: Firstpfette

1	3.750	292.02	-3.51	55.32	0.00	188.33	0.83	173.06	4.31	157.78	7.78
1	3.750	292.02	-3.51	109.25	0.00	188.33	0.83	173.06	4.31	157.78	7.78
1	4.688	194.73	-26.35	121.91	0.00	119.69	-20.93	109.97	-16.59	100.25	-12.25
1	5.625	85.58	-57.99	134.56	0.00	42.27	-51.48	38.10	-46.28	33.93	-41.07
1	6.563	-20.93	-112.93	147.22	0.00	-30.05	-104.73	-30.05	-97.26	-30.05	-89.79
1	6.640	-23.75	-124.38	148.27	0.00	-32.98	-112.97	-32.98	-104.97	-32.98	-96.97
1	7.400	-54.58	-240.96	158.53	0.00	-64.87	-196.94	-64.87	-183.73	-64.87	-170.53
1	7.500	-59.07	-256.88	159.88	0.00	-69.50	-208.42	-69.50	-194.53	-69.50	-180.64
2	0.100	-54.58	-240.96	158.53	0.00	-64.87	-196.94	-64.87	-183.73	-64.87	-170.53
2	0.860	-23.75	-124.38	148.27	0.00	-32.98	-112.97	-32.98	-104.97	-32.98	-96.97
2	0.938	-20.93	-112.93	147.22	0.00	-30.05	-104.73	-30.05	-97.26	-30.05	-89.79
2	1.875	85.58	-57.99	134.56	0.00	42.27	-51.48	38.10	-46.28	33.93	-41.07
2	2.813	194.73	-26.35	121.91	0.00	119.69	-20.93	109.97	-16.59	100.25	-12.25
2	3.750	292.02	-3.51	109.25	0.00	188.33	0.83	173.06	4.31	157.78	7.78
2	3.750	292.02	-3.51	55.32	0.00	188.33	0.83	173.06	4.31	157.78	7.78
2	4.688	236.81	10.55	65.21	0.00	154.43	13.81	142.98	16.41	131.52	19.02
2	5.625	169.74	15.83	77.87	0.00	111.74	17.99	104.11	19.73	96.47	21.47
2	6.563	90.80	12.31	90.53	0.00	60.27	13.39	56.45	14.26	52.63	15.13
2	6.640	83.75	11.62	91.57	0.00	55.62	12.62	52.11	13.41	48.61	14.21
2	7.400	10.25	1.73	101.83	0.00	6.85	1.85	6.44	1.94	6.03	2.03
2	7.500	0.00	0.00	103.18	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Basic combination M_{yd} [kNm]



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



Moment zero-points

Area of negative design moments in the ULS				
Span No.	Compression underside [m]		Tension - top side [m]	
	from the origin	from the end	from the origin	from the end
1		1.24	2.69	3.98
2	1.24		3.98	2.69

Bending design - bearing capacity

EXTR leading value for the design combination

Span No.	x [m]	EXTR	NEd,max M NEd,min M [kN]	MyEd,max M MyEd,min M [kNm]	Cross-section [cm]		Reinforcement				Utilization (As top) (As bottom)
					Height	d10 d1u	As top [cm²]		As bottom [cm²]		
							Flange	Web	Flange	Web	
1	0.000	max M min M	0.00 0.00	0.00 -69.29	80.0	4.0 4.0	0.63	1.94	0.00	0.00	0.21 0.00
1	0.100	max M min M	0.00 0.00	10.25 -69.29	80.0	4.0 4.0	0.63	1.94	0.00	0.37	0.21 0.02
1	0.860	max M min M	0.00 0.00	83.75 -69.29	80.0	4.0 4.0	0.63	1.94	0.00	3.07	0.21 0.16
1	0.938	max M min M	0.00 0.00	90.80 -69.29	80.0	4.0 4.0	0.63	1.94	0.00	3.33	0.21 0.17
1	1.875	max M min M	0.00 0.00	169.74 -69.29	80.0	4.0 4.0	0.63	1.94	0.00	6.29	0.21 0.33
1	2.813	max M min M	0.00 0.00	236.81 10.55	80.0	4.0 4.0	0.00	0.00	0.00	8.84	0.00 0.46
1	3.750	max M min M	0.00 0.00	292.02 -3.51	80.0	4.0 4.0	0.03	0.09	0.00	10.96	0.01 0.56

1	4.688	max M min M	0.00 0.00	194.73 -26.35	80.0	4.0 4.0	0.24	0.73	0.00	7.23	0.08 0.38
1	5.625	max M min M	0.00 0.00	85.58 -57.99	80.0	4.0 4.0	0.53	1.62	0.00	3.13	0.17 0.17
1	6.563	max M min M	0.00 0.00	-20.93 -112.93	80.0	4.0 4.0	1.05	3.21	0.00	0.00	0.34 0.00
1	6.640	max M min M	0.00 0.00	-23.75 -124.38	80.0	4.0 4.0	1.16	3.55	0.00	0.00	0.38 0.00
1	7.400	max M min M	0.00 0.00	-54.58 -240.96	80.0	4.0 4.0	2.31	7.08	0.00	0.00	0.73 0.00
1	7.500	max M min M	0.00 0.00	-54.58 -240.96	80.0	4.0 4.0	2.31	7.08	0.00	0.00	0.73 0.00
2	0.000	max M min M	0.00 0.00	-54.58 -240.96	80.0	4.0 4.0	2.31	7.08	0.00	0.00	0.73 0.00
2	0.100	max M min M	0.00 0.00	-54.58 -240.96	80.0	4.0 4.0	2.31	7.08	0.00	0.00	0.73 0.00
2	0.860	max M min M	0.00 0.00	-23.75 -124.38	80.0	4.0 4.0	1.16	3.55	0.00	0.00	0.38 0.00
2	0.938	max M min M	0.00 0.00	-20.93 -112.93	80.0	4.0 4.0	1.05	3.21	0.00	0.00	0.34 0.00
2	1.875	max M min M	0.00 0.00	85.58 -57.99	80.0	4.0 4.0	0.53	1.62	0.00	3.13	0.17 0.17
2	2.813	max M min M	0.00 0.00	194.73 -26.35	80.0	4.0 4.0	0.24	0.73	0.00	7.23	0.08 0.38
2	3.750	max M min M	0.00 0.00	292.02 -3.51	80.0	4.0 4.0	0.03	0.09	0.00	10.96	0.01 0.56
2	4.688	max M min M	0.00 0.00	236.81 10.55	80.0	4.0 4.0	0.00	0.00	0.00	8.84	0.00 0.46
2	5.625	max M min M	0.00 0.00	169.74 -69.29	80.0	4.0 4.0	0.63	1.94	0.00	6.29	0.21 0.33
2	6.563	max M min M	0.00 0.00	90.80 -69.29	80.0	4.0 4.0	0.63	1.94	0.00	3.33	0.21 0.17
2	6.640	max M min M	0.00 0.00	83.75 -69.29	80.0	4.0 4.0	0.63	1.94	0.00	3.07	0.21 0.16
2	7.400	max M min M	0.00 0.00	10.25 -69.29	80.0	4.0 4.0	0.63	1.94	0.00	0.37	0.21 0.02
2	7.500	max M min M	0.00 0.00	0.00 -69.29	80.0	4.0 4.0	0.63	1.94	0.00	0.00	0.21 0.00

Bending design

With limited moment redistribution <= 15.00 %

E	E={a,e,u,i} action	B	B={m,v,A,D,g} reinforcement
a	M _{yEd} from moment round-off	m	Minimum longitudinal reinforcement
e	M _{yEd} from minimum restraint	v	Anchorage reinforcement
u	M _{yEd} from moment redistribution	A	Recess reinforcement
i	M _{yEd} section moment	D	Ductility reinforcement
EXTR	leading value for the design combination	g	Reinforcement specification

Span No.	x [m]	EXTR	N _{Ed,max} N _{Ed,min} M [kN]	My _{Ed,max} My _{Ed,min} M [kNm]	E	Cross-section [cm]		Reinforcement						Utilization (As top) (As bottom)
						Height Redistribution [%]	d10 d1u	As top [cm²]			As bottom [cm²]			
								Flange	Web	B	Flange	Web	B	
1	0.000	max M min M	0.00 0.00	0.00 -69.29	e	80.0	4.0 4.0	3.08	9.43	g	0.00	19.64	g	0.21 0.00
1	0.100	max M min M	0.00 0.00	10.25 -69.29	e	80.0	4.0 4.0	3.08	9.43	g	0.00	19.64	g	0.21 0.02
1	0.860	max M min M	0.00 0.00	83.75 -69.29	e	80.0	4.0 4.0	3.08	9.43	g	0.00	19.64	g	0.21 0.16
1	0.938	max M min M	0.00 0.00	90.80 -69.29	e	80.0	4.0 4.0	3.08	9.43	g	0.00	19.64	g	0.21 0.18
1	1.875	max M min M	0.00 0.00	169.74 -69.29	e	80.0	4.0 4.0	3.08	9.43	g	0.00	19.64	g	0.21 0.33
1	2.813	max M min M	0.00 0.00	236.81 10.55	u	80.0	4.0 4.0	3.08	9.43	g	0.00	19.64	g	0.02 0.46
1	3.750	max M min M	0.00 0.00	292.02 -3.51	u	80.0	4.0 4.0	3.08	9.43	g	0.00	19.64	g	0.01 0.56
1	4.688	max M min M	0.00 0.00	194.73 -26.35	u	80.0	4.0 4.0	3.08	9.43	g	0.00	19.64	g	0.08 0.38
1	5.625	max M min M	0.00 0.00	85.58 -57.99	u	80.0	4.0 4.0	3.08	9.43	g	0.00	19.64	g	0.18 0.16
1	6.563	max M min M	0.00 0.00	-20.93 -112.93	u	80.0	4.0 4.0	3.08	9.43	g	0.00	19.64	g	0.34 0.06
1	6.640	max M min M	0.00 0.00	-23.75 -124.38	u	80.0	4.0 4.0	3.08	9.43	g	0.00	19.64	g	0.38 0.07
1	7.400	max M min M	0.00 0.00	-54.58 -240.96	u	80.0	4.0 4.0	3.08	9.43	g	0.00	19.64	g	0.73 0.16
1	7.500	max M min M	0.00 0.00	-54.58 -240.96	u	80.0	4.0 15.0	3.08	9.43	g	0.00	19.64	g	0.73 0.16
2	0.000	max M min M	0.00 0.00	-54.58 -240.96	u	80.0	4.0 15.0	3.08	9.43	g	0.00	19.64	g	0.73 0.16
2	0.100	max M min M	0.00 0.00	-54.58 -240.96	u	80.0	4.0 4.0	3.08	9.43	g	0.00	19.64	g	0.73 0.16
2	0.860	max M min M	0.00 0.00	-23.75 -124.38	u	80.0	4.0 4.0	3.08	9.43	g	0.00	19.64	g	0.38 0.07
2	0.938	max M min M	0.00 0.00	-20.93 -112.93	u	80.0	4.0 4.0	3.08	9.43	g	0.00	19.64	g	0.34 0.06
2	1.875	max M min M	0.00 0.00	85.58 -57.99	u	80.0	4.0 4.0	3.08	9.43	g	0.00	19.64	g	0.18 0.16

2	2.813	max M min M	0.00 0.00	194.73 -26.35	u	80.0	4.0 4.0	3.08	9.43	g	0.00	19.64	g	0.08 0.38
2	3.750	max M min M	0.00 0.00	292.02 -3.51	u	80.0	4.0 4.0	3.08	9.43	g	0.00	19.64	g	0.01 0.56
2	4.688	max M min M	0.00 0.00	236.81 10.55	u	80.0	4.0 4.0	3.08	9.43	g	0.00	19.64	g	0.02 0.46
2	5.625	max M min M	0.00 0.00	169.74 -69.29	e	80.0	4.0 4.0	3.08	9.43	g	0.00	19.64	g	0.21 0.33
2	6.563	max M min M	0.00 0.00	90.80 -69.29	e	80.0	4.0 4.0	3.08	9.43	g	0.00	19.64	g	0.21 0.18
2	6.640	max M min M	0.00 0.00	83.75 -69.29	e	80.0	4.0 4.0	3.08	9.43	g	0.00	19.64	g	0.21 0.16
2	7.400	max M min M	0.00 0.00	10.25 -69.29	e	80.0	4.0 4.0	3.08	9.43	g	0.00	19.64	g	0.21 0.02
2	7.500	max M min M	0.00 0.00	0.00 -69.29	e	80.0	4.0 4.0	3.08	9.43	g	0.00	19.64	g	0.21 0.00

Maximum utilization: 0.73 at span / pos. = 1 / 7.400 m Analysis fulfilled.

Shear design

With limited moment redistribution <= 15.00 %

A	Support axis	Ar	Support edge
Ar±d	Distance d from support edge	r	red. shear force from sinlge loads close to a support
m	Minimum shear force reinforcement	j	Design of the shear joint decisive
a _{sw}	Stirrup reinforcement (shear force + torsion) double shear	A _{sTL}	Longitudinal torsion reinforcement distributed over the circumference

Span No.	x [m]	Attr	VEd [kN]	MTd [kNm]	VRde [kN]	θ [cm]	Zi [cm]	VRdmax [kN]	TRdmax [kNm]	VEd / VTRd	asmin [cm²/m]	asw [cm²/m]	AsTL [cm²]
1	0.000	A	103.2	0.0	89.1	18.4	71.0	543.1	69.9	0.00	2.51	2.51	m 0.00
1	0.100	Ar	101.8	0.0	89.1	18.4	71.0	543.1	69.9	0.00	2.51	2.51	m 0.00
1	0.860	Ar+d	91.6	0.0	89.1	18.4	71.0	543.1	69.9	0.00	2.51	2.51	m 0.00
1	0.938		90.5	0.0	89.1	18.4	71.0	543.1	69.9	0.00	2.51	2.51	m 0.00
1	1.875		77.9	0.0	89.1	18.4	71.0	543.1	69.9	0.00	2.51	2.51	m 0.00
1	2.813		65.2	0.0	89.1	18.4	71.0	543.1	69.9	0.00	2.51	2.51	m 0.00
1	3.750		55.3	0.0	89.1	18.4	71.0	543.1	69.9	0.00	2.51	2.51	m 0.00
1	4.688		121.9	0.0	89.1	18.4	71.0	543.1	69.9	0.00	2.51	2.51	m 0.00
1	5.625		134.6	0.0	89.1	18.4	71.0	543.1	69.9	0.00	2.51	2.51	m 0.00
1	6.563		147.2	0.0	76.6	18.4	71.0	543.1	69.9	0.00	2.51	2.51	m 0.00
1	6.640	Ar-d	148.3	0.0	76.6	18.4	71.0	543.1	69.9	0.00	2.51	2.51	m 0.00
1	7.400	Ar	158.5	0.0	76.6	18.4	71.0	543.1	69.9	0.00	2.51	2.51	m 0.00
1	7.500	A	159.9	0.0	76.6	18.4	71.0	543.1	69.9	0.00	2.51	2.51	m 0.00
2	0.000	A	159.9	0.0	76.6	18.4	71.0	543.1	69.9	0.00	2.51	2.51	m 0.00
2	0.100	Ar	158.5	0.0	76.6	18.4	71.0	543.1	69.9	0.00	2.51	2.51	m 0.00
2	0.860	Ar+d	148.3	0.0	76.6	18.4	71.0	543.1	69.9	0.00	2.51	2.51	m 0.00
2	0.938		147.2	0.0	76.6	18.4	71.0	543.1	69.9	0.00	2.51	2.51	m 0.00
2	1.875		134.6	0.0	89.1	18.4	71.0	543.1	69.9	0.00	2.51	2.51	m 0.00
2	2.813		121.9	0.0	89.1	18.4	71.0	543.1	69.9	0.00	2.51	2.51	m 0.00
2	3.750		109.3	0.0	89.1	18.4	71.0	543.1	69.9	0.00	2.51	2.51	m 0.00
2	4.688		65.2	0.0	89.1	18.4	71.0	543.1	69.9	0.00	2.51	2.51	m 0.00
2	5.625		77.9	0.0	89.1	18.4	71.0	543.1	69.9	0.00	2.51	2.51	m 0.00
2	6.563		90.5	0.0	89.1	18.4	71.0	543.1	69.9	0.00	2.51	2.51	m 0.00
2	6.640	Ar-d	91.6	0.0	89.1	18.4	71.0	543.1	69.9	0.00	2.51	2.51	m 0.00
2	7.400	Ar	101.8	0.0	89.1	18.4	71.0	543.1	69.9	0.00	2.51	2.51	m 0.00
2	7.500	A	103.2	0.0	89.1	18.4	71.0	543.1	69.9	0.00	2.51	2.51	m 0.00

Maximum utilization: 0.76 at span / pos. = 1 / 7.500 m Analysis fulfilled.

Flange connecting reinforcement

A _c	effective flange area	h _f	Flange thickness at the connection
b _f /b	Flange width/Slab width	V _{Ed}	Longitudinal shear stress at the connection (ΔF _d / (h _f Δx))
ΔF _d	Longitudinal force margin in the flange over the length of Δx	V _{Rdmax}	adm. strut stress
Δx	Half distance moment zero point / maximum	z	Tension flange in condition I

Span No.	x [m]	Pos.	A _c [m²]	h _f [cm]	b _f /b [-]	V _{Ed} [kN/m²]	V _{Rdmax} [kN/m²]	asf [cm²/m]
1	0.000	TF-le	0.0450	15.0	0.333	277.5	4180.3	0.95
		TF-ri	0.0450	15.0	0.333	277.5	4180.3	0.95
1	0.100	TF-le	0.0450	15.0	0.333	277.5	4180.3	0.95
		TF-ri	0.0450	15.0	0.333	277.5	4180.3	0.95
1	0.860	TF-le	0.0450	15.0	0.333	277.5	4180.3	0.95
		TF-ri	0.0450	15.0	0.333	277.5	4180.3	0.95
1	0.938	TF-le	0.0450	15.0	0.333	277.5	4180.3	0.95
		TF-ri	0.0450	15.0	0.333	277.5	4180.3	0.95
1	1.875	TF-le	0.0450	15.0	0.333	224.7	4180.3	0.77
		TF-ri	0.0450	15.0	0.333	224.7	4180.3	0.77
1	2.813	TF-le	0.0450	15.0	0.333	224.7	4180.3	0.77
		TF-ri	0.0450	15.0	0.333	224.7	4180.3	0.77

1	3.750	TF-le	0.0450	15.0	0.333	267.5	4180.3	0.92	
		TF-ri	0.0450	15.0	0.333	267.5	4180.3	0.92	
1	4.688	TF-le	0.0450	15.0	0.333	321.0	4180.3	1.10	
		TF-ri	0.0450	15.0	0.333	321.0	4180.3	1.10	
1	5.625	TF-le	0.0450	15.0	0.333	321.0	4180.3	1.10	
		TF-ri	0.0450	15.0	0.333	321.0	4180.3	1.10	
1	6.563	TF-le	0.0428	15.0	0.123	169.9	4250.0	0.70	z
		TF-ri	0.0428	15.0	0.123	169.9	4250.0	0.70	z
1	6.640	TF-le	0.0428	15.0	0.123	184.5	4250.0	0.76	z
		TF-ri	0.0428	15.0	0.123	184.5	4250.0	0.76	z
1	7.400	TF-le	0.0428	15.0	0.123	184.5	4250.0	0.76	z
		TF-ri	0.0428	15.0	0.123	184.5	4250.0	0.76	z
1	7.500	TF-le	0.0428	15.0	0.123	184.5	4250.0	0.76	z
		TF-ri	0.0428	15.0	0.123	184.5	4250.0	0.76	z
2	0.000	TF-le	0.0428	15.0	0.123	184.5	4250.0	0.76	z
		TF-ri	0.0428	15.0	0.123	184.5	4250.0	0.76	z
2	0.100	TF-le	0.0428	15.0	0.123	184.5	4250.0	0.76	z
		TF-ri	0.0428	15.0	0.123	184.5	4250.0	0.76	z
2	0.860	TF-le	0.0428	15.0	0.123	184.5	4250.0	0.76	z
		TF-ri	0.0428	15.0	0.123	184.5	4250.0	0.76	z
2	0.938	TF-le	0.0428	15.0	0.123	169.9	4250.0	0.70	z
		TF-ri	0.0428	15.0	0.123	169.9	4250.0	0.70	z
2	1.875	TF-le	0.0450	15.0	0.333	321.0	4180.3	1.10	
		TF-ri	0.0450	15.0	0.333	321.0	4180.3	1.10	
2	2.813	TF-le	0.0450	15.0	0.333	321.0	4180.3	1.10	
		TF-ri	0.0450	15.0	0.333	321.0	4180.3	1.10	
2	3.750	TF-le	0.0450	15.0	0.333	267.5	4180.3	0.92	
		TF-ri	0.0450	15.0	0.333	267.5	4180.3	0.92	
2	4.688	TF-le	0.0450	15.0	0.333	224.7	4180.3	0.77	
		TF-ri	0.0450	15.0	0.333	224.7	4180.3	0.77	
2	5.625	TF-le	0.0450	15.0	0.333	224.7	4180.3	0.77	
		TF-ri	0.0450	15.0	0.333	224.7	4180.3	0.77	
2	6.563	TF-le	0.0450	15.0	0.333	277.5	4180.3	0.95	
		TF-ri	0.0450	15.0	0.333	277.5	4180.3	0.95	
2	6.640	TF-le	0.0450	15.0	0.333	277.5	4180.3	0.95	
		TF-ri	0.0450	15.0	0.333	277.5	4180.3	0.95	
2	7.400	TF-le	0.0450	15.0	0.333	277.5	4180.3	0.95	
		TF-ri	0.0450	15.0	0.333	277.5	4180.3	0.95	
2	7.500	TF-le	0.0450	15.0	0.333	277.5	4180.3	0.95	
		TF-ri	0.0450	15.0	0.333	277.5	4180.3	0.95	

Maximum utilization: 0.55 at span / pos. = 1 / 5.625 m Analysis fulfilled.

Tabular fire protection

Analysis for beams predominantly under bending according to table 5.5/5.6 or 5.7 as well as uniaxially strained slabs according to table 5.8			
System	static indeterminate	T _{crit}	critical reinforcing steel temperature
Fire resistance class	R60	b _w	min beam width - neutral axis cross-section
Flame application	trilateral	h _{w,min}	min beam height
As,prov / As,req	1.10	b _{min}	min beam width - neutral axis reinforcement
Web class	WC	a _{min}	min axis distance of neutral axis to tension reinforcement
μ _{fi}	M _{Ed,fi} /M _{Ed}	a _{sd}	min lateral axis distance with single-layer reinforcement

Span / Column	μ _{fi}	T _{crit} [°]	b _w [cm]		h _{w,min} [cm]		b _{min} [cm]		a _{min} [cm]		a _{sd} [cm]	Utilization
			exis.	req	exis.	req	exis.	req	exis.	req		
A	0.59	532.05	30.00	9.00	80.00	12.00	30.00	14.00	4.00	1.00	1.68	0.47
1	0.59	532.05	30.00	9.00	80.00	12.00	30.00	14.00	4.00	1.00	1.68	0.47
B	0.71	505.59	30.00	9.00	80.00	12.00	30.00	14.00	4.00	1.00	1.94	0.47
2	0.71	505.59	30.00	9.00	80.00	12.00	30.00	14.00	4.00	1.00	1.94	0.47
C	0.59	532.05	30.00	9.00	80.00	12.00	30.00	14.00	4.00	1.00	1.68	0.47

Maximum utilization: 0.47 in span 1 Analysis fulfilled.

Limitation of the deflection

Method	Deformations condition II according to Krüger-Mertzsch		
Point in time	t ₁ = 28 d	t _∞ = 36500 d	E _{cm} = 24900 N/mm ²
Creep coefficient	φ = 1.13	φ = 3.74	f _{ctm} = 2.20 N/mm ²
Shrinkage value	ε _{CS} = -9.5e-05	ε _{CS} = -66.8e-05	
Calculation of the sagging / deflection is carried for quasi-permanent CoA and required As-values			
l _{eff} /248	admissible deflection - span		
l _{eff} /500	admissible deflection - span (t _∞ - t ₁)		
l _{eff} /100	admissible deflection - lever arm		

Span	l _{eff}	x	Time	min w _I	max w _I	min w _{II}	max w _{II}	l _{eff} /W	l _{eff} /500	IAB
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Auftrag: Bauen im Bestand

Position: A11

Bauteil: Firstpfette

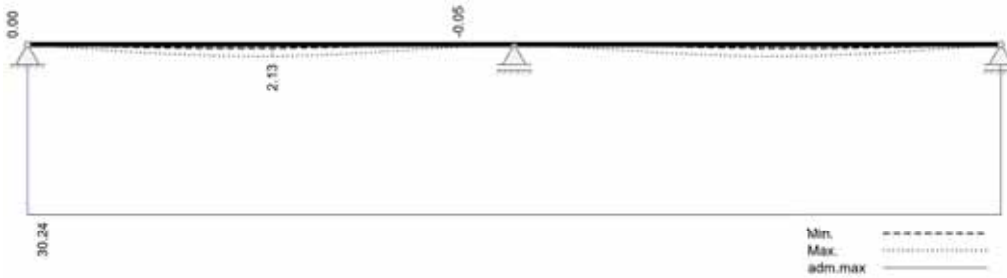
No.	[m]	[m]		[mm]	[mm]	[mm]	[mm]	[-]	[mm]	[-]
1	7.500	3.750	t_1	0.0	1.4	-0.1	4.1	1849		0.13
		3.750	t_∞	0.7	2.1	-0.6	7.3	1029		0.24
		3.750	$t_\infty - t_1$		2.2		7.4	1012	15.0	0.49
2	7.500	3.750	t_1	0.0	1.4	-0.1	4.1	1849		0.13
		3.750	t_∞	0.7	2.1	-0.6	7.3	1029		0.24
		3.750	$t_\infty - t_1$		2.2		7.4	1012	15.0	0.49

Maximum utilization: 0.49 at span / pos. = 1 / 3.750 m Analysis fulfilled.

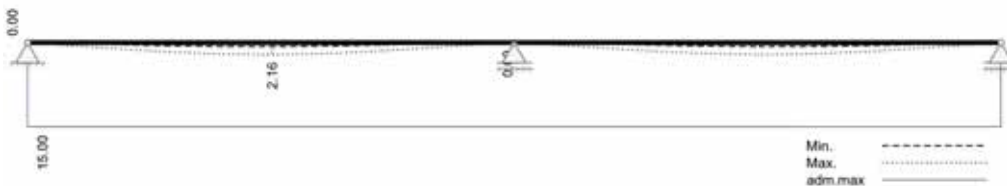
Deflection t_1 in condition I [mm]



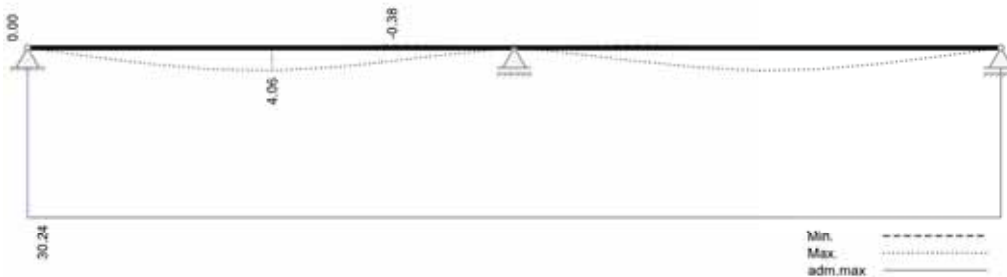
Deflection t_∞ in condition I [mm]



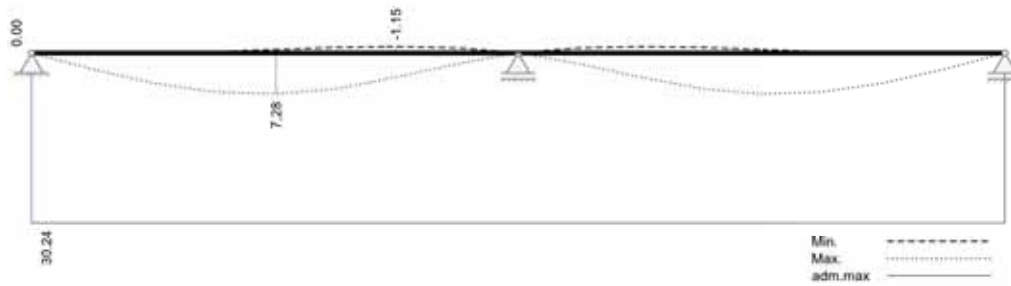
Deflection Δt in condition I [mm]



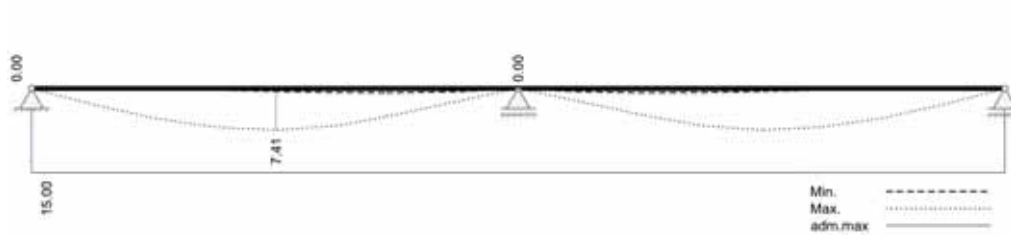
Deflection t_1 in condition II [mm]



Deflection t^{∞} in condition II [mm]



Deflection Δt in condition II [mm]



Summary

Analysis summary

Structural analysis of continuous beam with linear elastic stress resultant calculation and limited moment redistribution $\leq 15.00\%$

Design according to DIN 1045-1:2008		General building construction		Refurbishment	
ULS	Analysis	SLS	Analysis	FLS	Analysis
Announcement behavior	yes	Decompression	w/o ana.	Fatigue - bending	w/o ana.
Bending bearing capacity	fulfilled	Limitation of the crack width	w/o ana.	Fatigue - shear force	w/o ana.
Shear loading capacity	fulfilled	Limitation of the stresses	w/o ana.		
Shear joint loading capacity	w/o ana.	Limitation of the deformations	fulfilled		
Structural fire protection	fulfilled				
Notches	fulfilled				

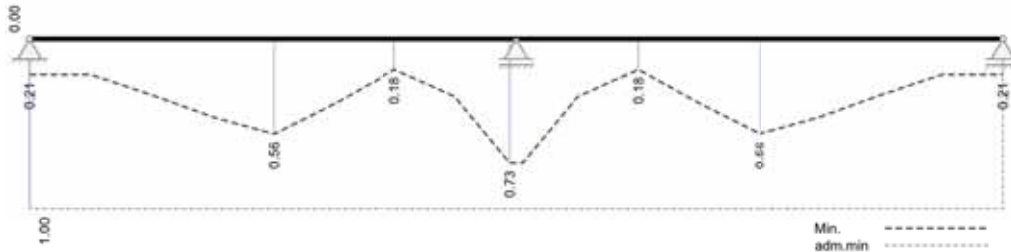
Utilization levels

(B)	Bending bearing capacity	(D)	Strut bearing capacity
(F)	Structural fire protection	(Z)	Load bearing capacity of the diagonal tie

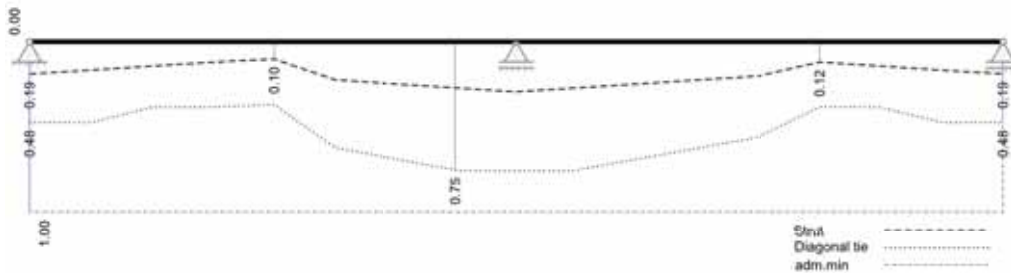
Span no.	x [m]	(B)	(D)	(Z)	(F)
1	0.000	0.21	0.19	0.47	0.47
1	0.100	0.21	0.19	0.47	0.47
1	0.860	0.21	0.17	0.47	0.47
1	0.938	0.21	0.17	0.47	0.47
1	1.875	0.33	0.14	0.38	0.47
1	2.813	0.46	0.12	0.38	0.47
1	3.750	0.56	0.10	0.37	0.47
1	4.688	0.38	0.22	0.62	0.47
1	5.625	0.18	0.25	0.69	0.47
1	6.563	0.34	0.27	0.75	0.47
1	6.640	0.38	0.27	0.76	0.47
1	7.400	0.73	0.29	0.76	0.47
1	7.500	0.73	0.29	0.76	0.47
2	0.000	0.73	0.29	0.76	0.47
2	0.100	0.73	0.29	0.76	0.47
2	0.860	0.38	0.27	0.76	0.47
2	0.938	0.34	0.27	0.75	0.47
2	1.875	0.18	0.25	0.69	0.47
2	2.813	0.38	0.22	0.62	0.47

2	3.750	0.56	0.20	0.56	0.47
2	4.688	0.46	0.12	0.38	0.47
2	5.625	0.33	0.14	0.38	0.47
2	6.563	0.21	0.17	0.47	0.47
2	6.640	0.21	0.17	0.47	0.47
2	7.400	0.21	0.19	0.47	0.47
2	7.500	0.21	0.19	0.47	0.47
maximum		(B)	(D)	(Z)	(F)
Utilization		0.73	0.29	0.76	0.47

Utilization - bending



Utilization - shear



Material consumption

Material		Volume [m³]	Weight [kg]
Concrete	C20/25_(Bn250)	4.950	12375
Reinforcing steel	St-A-III	0.055	431
Prestressing steel			

Theoretical material consumption of the design results without structural reinforcement, additions and lap lengths.