SYSTEM DESCRIPTION

General information

4H-STUB Version: 6/2008-2q

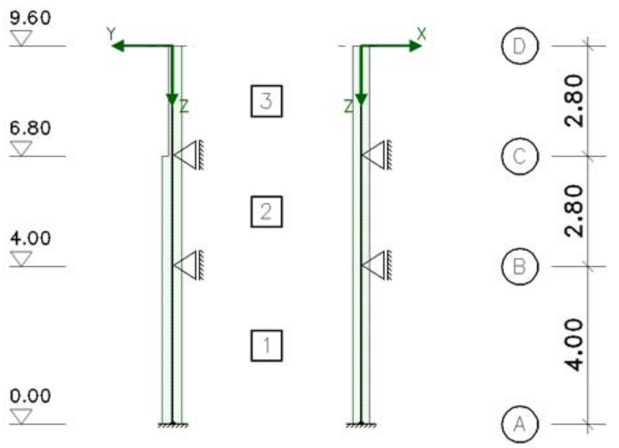
The enlargement of the columns longitudinal axis is orientated on the global Z-axis.
The global origin is located in the column head, the global Z-axis points to the bottom.
The lokal beam axis x runs from the bottom to the top contrary to the global Z-axis.
Dead loads act in global Z-direction.
The deformations of the load spectra don't include the imperfections.

At non linear calculation iteration runs through maximal 50 steps per load spectrum.
Convergence criterion: The iteration is stopped if the result differences of two following steps do not exceed at no point the tolerances listed below.

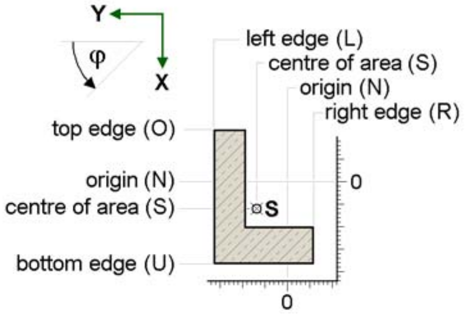
criterion	tolerance
displacements	0.00010 mm
rotations	0.00010 ‰
internal forces	0.00010 kN
intern. moments	0.00010 kNm

System sketch

Information: torsional supports are not represented graphically!



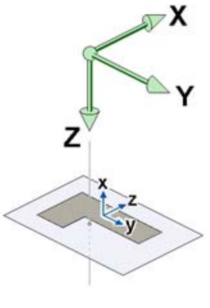
List of sections



The penetration point of the global Z-axis through the plane of the cross-section is defined using the alongside shown horizontal and vertical alignment points.

The alignment points are also used to describe the points of action of flexible point or line supports.

Following the alignment the cross-section is rotated through φ about the global Z-axis and then shifted locally with Δy and Δz.



section	from xu	to xo	l	alignment at the start		alignment at the end		φ
-	m	m	m	Δy [cm]	Δz [cm]	Δy [cm]	Δz [cm]	°
1	0.00	4.00	4.00	(S) + 0.00	(S) + 0.00	(S) + 0.00	(S) + 0.00	0.00
2	4.00	6.80	2.80	(S) + 0.00	(S) + 0.00	(S) + 0.00	(S) + 0.00	0.00
3	6.80	9.60	2.80	(S) - 7.50	(S) + 0.00	(S) - 7.50	(S) + 0.00	0.00

Point supports at the ends of sections

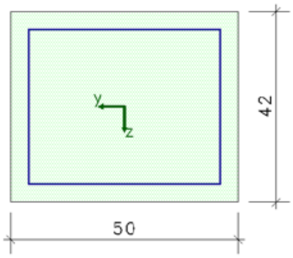
The support is relocated from the Z-axis with ΔX and ΔY and distorted with the angle φ. Numeric values indicate spring constants.
CPX, CPY and CPZ describe supports for forces in the indexed direction.
CMX, CMY and CMZ describe fixity about the indexed axis.

supp.	at x	CPX	CPY	CPZ	CMX	CMY	CMZ	ΔX	ΔY	φ
-	m	kN/m	kN/m	kN/m	kNm/-	kNm/-	kNm/-	cm	cm	°
A	0.00	fix	fix	fix	fix	fix	fix	0.00	0.00	0.00
B	4.00	fix	fix	----	----	----	----	0.00	0.00	0.00
C	6.80	fix	fix	----	----	----	----	0.00	0.00	0.00

Cross-sections

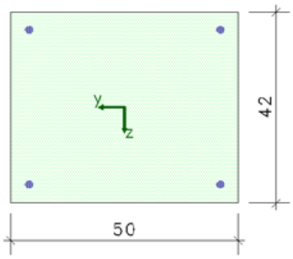
section	type	haunched	b_y	b_z	detailing of reinforcement
			cm	cm	
1	rectangle	no	50.00	42.00	circumference reinf.
2	rectangle	no	50.00	42.00	corner reinforcement
3	rectangle	no	35.00	42.00	corner reinforcement

SECTION 1:



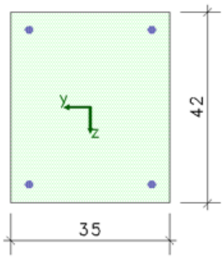
longit. reinf.	d_s	type	numb.	constant	select.	$A_{s,sel}$	l	$a_{s,sel}$
	cm		-			cm^2	cm	cm^2/m
perimeter	4.0	line	4	no	12 Ø 12	13.57	152.0	8.93

SECTION 2:



longit. reinf.	d_s	type	numb.	constant	selected	$A_{s,sel}$
	cm		-			cm^2
corners	4.0	point	4	no	4 Ø 12 2er bun.	9.05

SECTION 3:



longit. reinf.	d_s	type	numb.	constant	selected	$A_{s,sel}$
	cm		-			cm^2
corners	4.0	point	4	no	4 Ø 12 2er bun.	9.05

Material properties of bars for verifications acc. to EC 2

Explanations: ρ_c: maximum density of concrete; BSt_l: steel quality of longitudinal reinforcement
Material properties of concrete: f_{ck}: compression strength; α_c: reduction factor (Gl. 3.15); ε_{c2}, ε_{c2u}: strains;
n_c: exponent to describe the stress-strain-diagram (Gl. 3.17); E_{cm}: mean elastic modulus (secant modulus)
f_{ctm}: mean value of centric tensile strength; calculation of deformations: final creep coeff. $\varphi_{\infty,t0}$; final shrinkage strain $\varepsilon_{cs,\infty}$
Calculation second-order theory in condition 2 with effective creep coefficient $\varphi_{eff} = f_{eff} \cdot \varphi_{\infty,t0}$
Material properties of reinforcement: f_{yk}: yield strength; f_{tk}: tensile strength; ε_{su}: ult. compr. strain; E_s: modulus of elasticity
Exposure classes for reinforcement corrosion XC, concrete attack XF, concrete corrosion (moisture class AKR) W

bar	concr.	ρ_c kg/m³	f_{ck} MN/m²	α_c	ε_{c2} ‰	ε_{c2u} ‰	n_c	E_{cm} MN/m²	f_{ctm} MN/m²	f_{eff}	$\varphi_{\infty,t0}$	ε_{cs} ‰
1	C35/45	2200	35.0	s.NAD	-2.0	-3.5	2.00	34077.1	3.21	---	---	
2	C35/45	2200	35.0	s.NAD	-2.0	-3.5	2.00	34077.1	3.21	---	---	
3	C35/45	2200	35.0	s.NAD	-2.0	-3.5	2.00	34077.1	3.21	---	---	

bar	BSt_l	f_{yk} MN/m²	f_{tk} MN/m²	ε_{su} ‰	E_s MN/m²	XC	XF	W
1	500	500.0	525.0	25.0	200000.0			
2	500	500.0	525.0	25.0	200000.0			
3	500	500.0	525.0	25.0	200000.0			

Design calculation options for verification 1: EC 2 design calculation

Explanations: BSt_l, BSt_q: quality of longitudinal, shear reinforcement
column **(M_T)**, **(M_S)**: minimum reinforcement of beams and/or columns; column **(S)**: shear design calculation
Θ: angle of compr. strut (0 = minimal); column **(W)**: efficiency factor of stirrups in circular cross-sections
t_{eff}: torsion, effect. wall thickness (0 = acc. to design code); a_{sw0}: initial stirrup reinf., $\varnothing_{w0}$,s_{w0}: diameter and spacing of stirrups
Material description see 'material properties of beams'

bar	concr.	BSt_l	(M_T)	(M_S)	(S)	BSt_q	Θ °	(W) -	t_{eff} cm	a_{sw0} cm²/m	$\varnothing_{w0}$/s_{w0} mm/cm
1	C35/45	500	no	yes	yes	500	0	--	0.0	0.00	
2	C35/45	500	no	yes	yes	500	0	--	0.0	0.00	
3	C35/45	500	no	yes	yes	500	0	--	0.0	0.00	

Design calculation options for verification 2: EC 2 crack limitation

Explanations: first cracking of flexual or centric restraint (tensile restraint) of directly (intrinsically) or indirectly (extrinsically) imposed deformation.
Recording the time being considered with k_{zt} (if cracks due to restraint and load: k_{zt} for the part of restraint only)
Consider minimum tensile stress, if $k_{zt} \geq 1$
concrete, steel quality of longitudinal reinforcement see: 'design calculation/material properties of bars'
Influences of creeps and shrinks are taken into account about a modification of the stress-strain-diagram of concrete with $\varphi_{\infty,t0}$ and $\varepsilon_{cs,\infty}$.
Abbreviation of reinforcement positions: ol = top left, or = top right, ul = bottom left, ur = bottom right; circle (annulus): ol = extern

bar	ultimate Ø of reinf. in mm				bond property	crack width w_k in mm	cracks due to loads	time factor k_{zt}	first cracking of	minimum tensile strength	slowly hardening concrete
	ol	or	ul	ur							
1	12	12	12	12	good	0.30	yes	1.00	flex.rest.(direct)	no	no
2	12	12	12	12	good	0.30	yes	1.00	flex.rest.(direct)	no	no
3	12	12	12	12	good	0.30	yes	1.00	flex.rest.(direct)	no	no

Design calculation options for verification 3: EC 2 buckling safety Z2

Concrete, steel quality of longitudinal reinforcement see 'material properties of bars'
Influences of creeps and shrinks are taken into account about a modification of the stress-strain-diagram of concrete with φ_{eff} and $\varepsilon_{cs,\infty}$.

Design calculation options for verification 5: EC 2 fire prot.- buckling safety Z2

Explanations: fire front side o=top, u=bottom, l=left, r=right
zone method with number of zones / isotherms method with a critical temperature
If there is no other settlement in the National Annex, thermal conductivity is used as follows:
The form of the $\sigma\varepsilon$-line is either adequate to the one of the 'cold' or to the one of the 'hot' design.
Concrete, steel quality of longitudinal reinforcement see 'material properties of bars'

bar	temperature profile	fire durat. min	zone/ crit.T. -/°C	fire side	concr. moist. %	desity conc. kg/m³	thermal conduc. limit	concr. temperatures °C	steel temperatures °C	ineff. section cm	$\sigma\varepsilon$-line	aggregate concrete	production method steel
1	yes	90	10/500	o u l r	1.5	2400	lower	---	---	---	'hot'	quartz	hot rolled
2	yes	90	10/500	o u l r	1.5	2400	lower	---	---	---	'hot'	quartz	hot rolled
3	yes	90	10/500	o u l r	1.5	2400	lower	---	---	---	'hot'	quartz	hot rolled

LOADING STRUCTURE

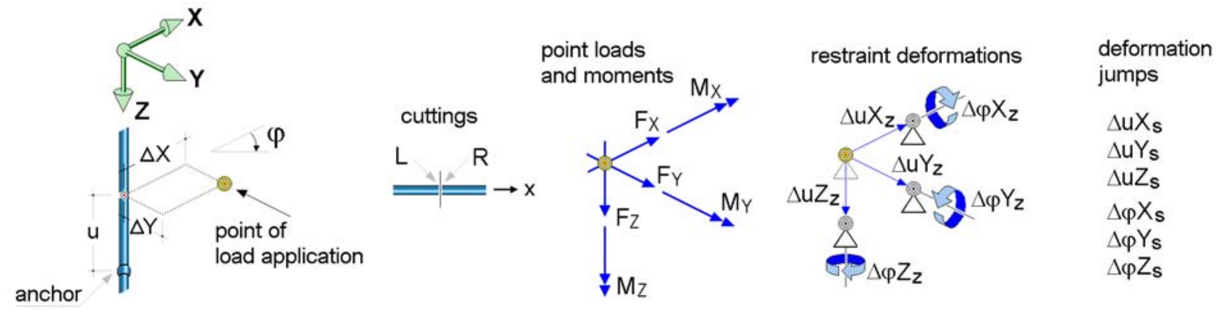
On the left-hand side, the relationship between the actions effects, load case file and load cases are shown in a tree structure. The right-hand side shows the characteristics of the superposition to the associated objects on the left-hand. In terms of the superposition, a load case file is equivalent to an extreme rule of the defined objects therein and can be additive or alternatively superpositioned.

used symbols: action effect | load case file | load case | imperfection cases

1: permanent loads	**permanent loads**
1: dead load	additive
2: live loads	**transient live loads in housing areas, offices**
2: live loads (1/1)	additive
3: live loads (1/2)	additive
3: wind loads	**transient wind loads**
wind loads file	additive
4: wind load left	generally alternative
5: wind load right	generally alternative
imperfection cases	
1: imperfection X-axis	
2: imperfection Y-axis	

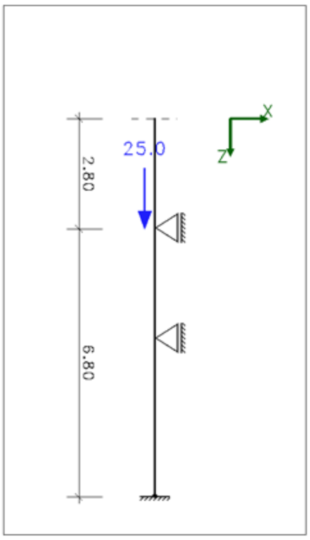
DESCRIPTION OF THE LOAD PICTURES

List of point loads

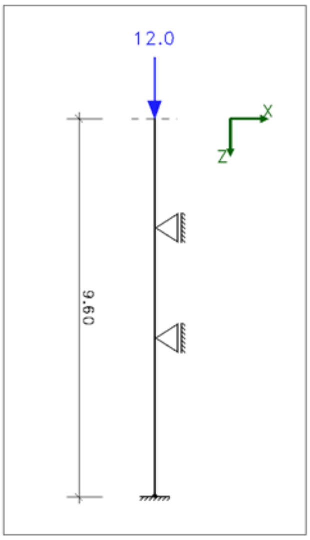


load c.	anchor	u	ΔX	ΔY	edge	load type and ordinates	φ
-	-	m	cm	cm	-		°
2	C	0.000	-25.000	0.000	L	Fz = 25.000 kN Mz = 0.000 kNm	0.00
3	D	0.000	0.000	0.000	L	Fz = 12.000 kN Mz = 0.000 kNm	0.00

load case 2 (picture 1)

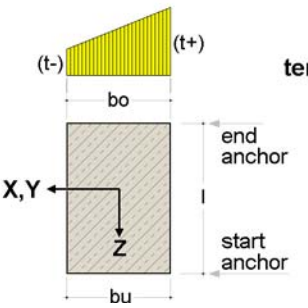


load case 3 (picture 2)



Load pictures of torsion and restraint deformations are not represented graphically.

List of dead loads and temperature loads



temperature load

$$tm = \frac{(t+) + (t-)}{2}$$

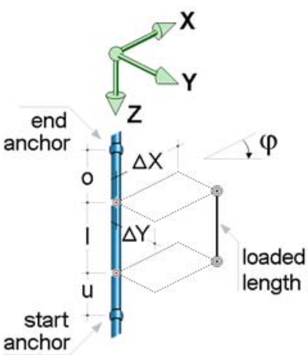
$$\Delta t = (t+) - (t-)$$

load types

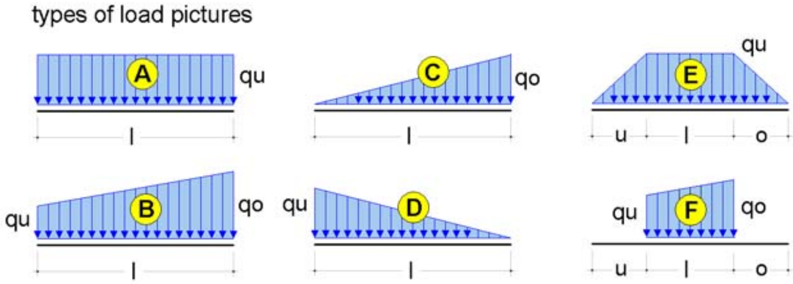
EG dead load
TX temperature (variable in X-direction)
TY temperature (variable in Y-direction)

load c.	start anchor	l	end anch.	type	γ	tm	Δt	bu	bo
-	-	m	-	-	kN/m³	°C	°C	cm	cm
1	A	9.600	D	EG	25.000	--	--	--	--

List of line loads



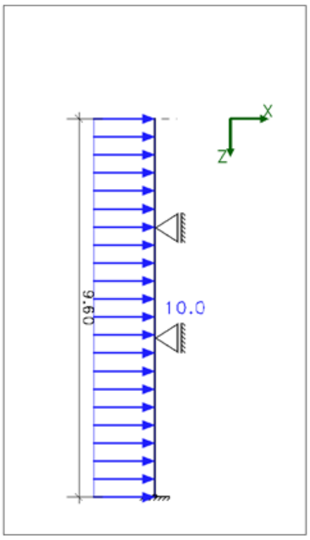
types of load pictures



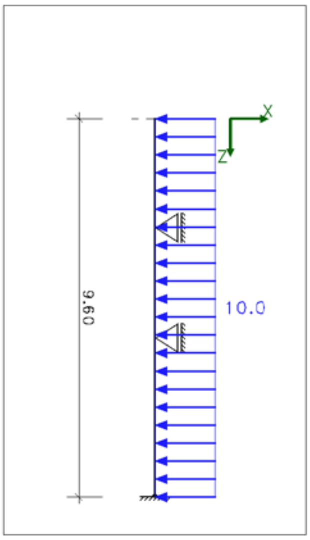
In the column "type" the type of the displayed load picture and (separated with "/") the direction of the line load are indicated.
"X", "Y" and "Z" mark normal line loads in kNm. "D" describes a torsional moment about the longitudinal axis of the section of the line in kNm/m.

loadcase	start anchor	line sections u	l	o	end anch.	eccentricities ΔX	ΔY	type	qu	qo	φ
-	-	m	m	m	-	cm	cm	-	kN, m	kN, m	°
4	A	0.000	9.600	0.000	D	0.000	0.000	A/X	10.000	---	0.00
5	A	0.000	9.600	0.000	D	0.000	0.000	A/X	-10.000	---	0.00

load case 4 (picture 1)

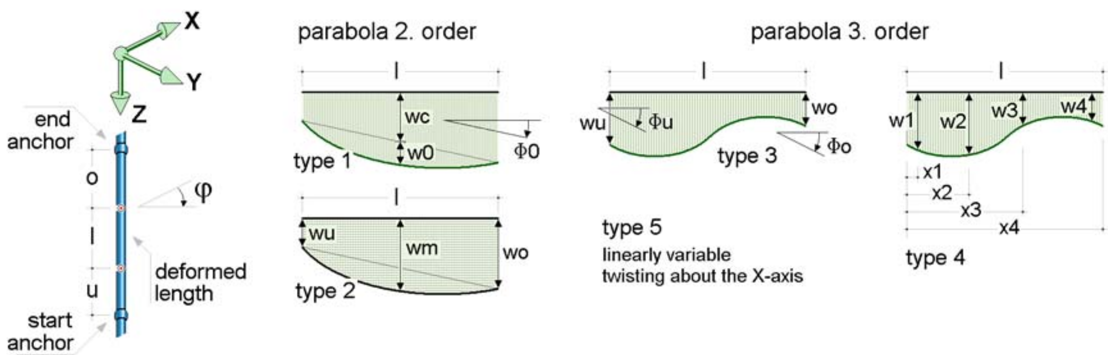


load case 5 (picture 2)



List of predeformations

Explanation of the types of description for imperfections



Imperfections: type of description 1

Imperf. case	start anchor	u	line sections l	o	end anch.	direc-tion	φ	wc	w0	Φ0
-	-	m	m	m	-	-	°	mm	mm	%
1	A	0.000	9.600	0.000	D	X	0.00	1/620	0.000	1/310
2	A	0.000	9.600	0.000	D	Y	0.00	1/620	0.000	1/310

DESCRIPTION OF THE DEMANDED VERIFICATIONS

The following means:

Ψ_{dom} at rule of superposition DIN 1055-100: combination coefficient of a leading traffic load action
Ψ_{sub} at rule of superposition DIN 1055-100: combination coefficient of a non-leading traffic load action
γ_{sup} partial safety factor for unfavourable load positions
γ_{inf} partial safety factor for favourable load positions

rules of superposition Eurocode are comparable with DIN 1055-100
in non-linear analysis, rules of extremization will not be considered

Verification 1: EC 2 design calculation

EC 2 design calculation: design resistance acc. to Eurocode 2 (6.1, 6.2, 6.3)

Design options to verification 1:

bending design calculation

- [x] Shear design calculation
  - [ ] z = 0.9 d (per direction)
  - [x] z = 0.9 d (per direction)
  - [ ] formulation acc. to P.Mark
  - [ ] NO limitation of min VRdct
- [x] with minimum reinforcement (bending)

1: standard extreme rule

rules of extremization for verification 1,type: standard, rule of superposition: Eurocode
material safety factors: γ_C = 1.50, γ_S = 1.15

Action	Ψ_{dom}	Ψ_{sub}	γ_{sup}	γ_{inf}
1	1.00	1.00	1.35	1.00
2	1.00	0.70	1.50	0.00
3	1.00	0.60	1.50	0.00

Verification 2: EC 2 crack limitation

EC 2 crack limitation: serviceability acc. to Eurocode 2 (7.3)

Design options to verification 2:

- [ ] acc. to design code (without direct analysis)
- [x] acc. to design code (direct analysis)
- [ ] acc. to Schießl
- [ ] acc. to Noakowski
- [x] check of initial reinforcement
- [x] minimum reinforcement (by restraint)
- [x] crack control (by loads)

stress-strain-diagram of concrete

- [ ] acc. to 3.1.7 (parabola rectangle)
- [x] acc. to 3.1.5 (realistic)
- [ ] linear with α = Es/Ecm

1: standard extreme rule

rules of extremization for verification 2,type: standard, rule of superposition: Eurocode

Action	Ψ_{dom}	Ψ_{sub}	γ_{sup}	γ_{inf}
1	1.00	1.00	1.00	1.00
2	0.30	0.30	1.00	0.00

Verification 3: EC 2 buckling safety Z2

EC 2 buckling safety Z2: buckling safety acc. to Eurocode 2

Design options to verification 3:

stress-strain-diagram of concrete
to calculate the effective stiffnesses

- [ ] acc. to 3.1.7 (parabola rectangle)
- [x] acc. to 3.1.5 (realistic)
- [ ] linear with α = Es/Ecm

- [ ] WITHOUT creep and shrinkage

1: standard load spectra

generation code for verification 3,type: standard, rule of superposition: Eurocode

load spectra of generation code 1 of verification 3

Factorization of load cases. Negative numbers of load cases refer to imperfections

LS	1	2	3	4	5	-1	-2	
1	1.00	1.50	-	-	-	1.00	-	load spectrum auto #1
2	1.35	1.50	-	-	-	1.00	-	load spectrum auto #2
3	1.00	-	1.50	-	-	1.00	-	load spectrum auto #3
4	1.35	-	1.50	-	-	1.00	-	load spectrum auto #4
5	1.00	1.50	1.50	-	-	1.00	-	load spectrum auto #5
6	1.35	1.50	1.50	-	-	1.00	-	load spectrum auto #6
7	1.00	1.50	-	0.90	-	1.00	-	load spectrum auto #7
8	1.35	1.50	-	0.90	-	1.00	-	load spectrum auto #8
9	1.00	-	1.50	0.90	-	1.00	-	load spectrum auto #9
10	1.35	-	1.50	0.90	-	1.00	-	load spectrum auto #10
11	1.00	1.50	1.50	0.90	-	1.00	-	load spectrum auto #11
12	1.35	1.50	1.50	0.90	-	1.00	-	load spectrum auto #12
13	1.00	1.50	-	-	0.90	1.00	-	load spectrum auto #13
14	1.35	1.50	-	-	0.90	1.00	-	load spectrum auto #14
15	1.00	-	1.50	-	0.90	1.00	-	load spectrum auto #15
16	1.35	-	1.50	-	0.90	1.00	-	load spectrum auto #16
17	1.00	1.50	1.50	-	0.90	1.00	-	load spectrum auto #17
18	1.35	1.50	1.50	-	0.90	1.00	-	load spectrum auto #18
19	1.00	1.50	-	-	-	-1.00	-	load spectrum auto #19
20	1.35	1.50	-	-	-	-1.00	-	load spectrum auto #20
21	1.00	-	1.50	-	-	-1.00	-	load spectrum auto #21
22	1.35	-	1.50	-	-	-1.00	-	load spectrum auto #22
23	1.00	1.50	1.50	-	-	-1.00	-	load spectrum auto #23
24	1.35	1.50	1.50	-	-	-1.00	-	load spectrum auto #24
25	1.00	1.50	-	0.90	-	-1.00	-	load spectrum auto #25
26	1.35	1.50	-	0.90	-	-1.00	-	load spectrum auto #26
27	1.00	-	1.50	0.90	-	-1.00	-	load spectrum auto #27
28	1.35	-	1.50	0.90	-	-1.00	-	load spectrum auto #28
29	1.00	1.50	1.50	0.90	-	-1.00	-	load spectrum auto #29
30	1.35	1.50	1.50	0.90	-	-1.00	-	load spectrum auto #30
31	1.00	1.50	-	-	0.90	-1.00	-	load spectrum auto #31
32	1.35	1.50	-	-	0.90	-1.00	-	load spectrum auto #32
33	1.00	-	1.50	-	0.90	-1.00	-	load spectrum auto #33
34	1.35	-	1.50	-	0.90	-1.00	-	load spectrum auto #34
35	1.00	1.50	1.50	-	0.90	-1.00	-	load spectrum auto #35
36	1.35	1.50	1.50	-	0.90	-1.00	-	load spectrum auto #36
37	1.00	1.50	-	-	-	-	1.00	load spectrum auto #37
38	1.35	1.50	-	-	-	-	1.00	load spectrum auto #38
39	1.00	-	1.50	-	-	-	1.00	load spectrum auto #39
40	1.35	-	1.50	-	-	-	1.00	load spectrum auto #40
41	1.00	1.50	1.50	-	-	-	1.00	load spectrum auto #41
42	1.35	1.50	1.50	-	-	-	1.00	load spectrum auto #42
43	1.00	1.50	-	0.90	-	-	1.00	load spectrum auto #43
44	1.35	1.50	-	0.90	-	-	1.00	load spectrum auto #44
45	1.00	-	1.50	0.90	-	-	1.00	load spectrum auto #45
46	1.35	-	1.50	0.90	-	-	1.00	load spectrum auto #46
47	1.00	1.50	1.50	0.90	-	-	1.00	load spectrum auto #47
48	1.35	1.50	1.50	0.90	-	-	1.00	load spectrum auto #48
49	1.00	1.50	-	-	0.90	-	1.00	load spectrum auto #49
50	1.35	1.50	-	-	0.90	-	1.00	load spectrum auto #50

load spectra of generation code 1 of verification 3
Factorization of load cases. Negative numbers of load cases refer to imperfections

LS	1	2	3	4	5	-1	-2	
243	1.00	1.05	-	1.50	-	1.00	-1.00	load spectrum auto #243
244	1.35	1.05	-	1.50	-	1.00	-1.00	load spectrum auto #244
245	1.00	-	1.05	1.50	-	1.00	-1.00	load spectrum auto #245
246	1.35	-	1.05	1.50	-	1.00	-1.00	load spectrum auto #246
247	1.00	1.05	1.05	1.50	-	1.00	-1.00	load spectrum auto #247
248	1.35	1.05	1.05	1.50	-	1.00	-1.00	load spectrum auto #248
249	1.00	-	-	-	1.50	1.00	-1.00	load spectrum auto #249
250	1.35	-	-	-	1.50	1.00	-1.00	load spectrum auto #250
251	1.00	1.05	-	-	1.50	1.00	-1.00	load spectrum auto #251
252	1.35	1.05	-	-	1.50	1.00	-1.00	load spectrum auto #252
253	1.00	-	1.05	-	1.50	1.00	-1.00	load spectrum auto #253
254	1.35	-	1.05	-	1.50	1.00	-1.00	load spectrum auto #254
255	1.00	1.05	1.05	-	1.50	1.00	-1.00	load spectrum auto #255
256	1.35	1.05	1.05	-	1.50	1.00	-1.00	load spectrum auto #256
257	1.00	-	-	1.50	-	-1.00	-1.00	load spectrum auto #257
258	1.35	-	-	1.50	-	-1.00	-1.00	load spectrum auto #258
259	1.00	1.05	-	1.50	-	-1.00	-1.00	load spectrum auto #259
260	1.35	1.05	-	1.50	-	-1.00	-1.00	load spectrum auto #260
261	1.00	-	1.05	1.50	-	-1.00	-1.00	load spectrum auto #261
262	1.35	-	1.05	1.50	-	-1.00	-1.00	load spectrum auto #262
263	1.00	1.05	1.05	1.50	-	-1.00	-1.00	load spectrum auto #263
264	1.35	1.05	1.05	1.50	-	-1.00	-1.00	load spectrum auto #264
265	1.00	-	-	-	1.50	-1.00	-1.00	load spectrum auto #265
266	1.35	-	-	-	1.50	-1.00	-1.00	load spectrum auto #266
267	1.00	1.05	-	-	1.50	-1.00	-1.00	load spectrum auto #267
268	1.35	1.05	-	-	1.50	-1.00	-1.00	load spectrum auto #268
269	1.00	-	1.05	-	1.50	-1.00	-1.00	load spectrum auto #269
270	1.35	-	1.05	-	1.50	-1.00	-1.00	load spectrum auto #270
271	1.00	1.05	1.05	-	1.50	-1.00	-1.00	load spectrum auto #271
272	1.35	1.05	1.05	-	1.50	-1.00	-1.00	load spectrum auto #272

Verification 5: EC 2 fire prot.- buckling safety Z2

EC 2 fire prot.- buckling safety Z2: buckling safety acc. to Eurocode 2

Design options to verification 5:

- [x] Eurocode 2
- [ ] EC 2 (prestandard, 5.97)
- [ ] zone method
- [ ] isotherms method
- [ ] zone method acc. to Cyllok/Achenbach
- [x] zone method acc. to Zilch/Müller/Reitmayer
- [ ] WITHOUT thermically induced predeformations

1: standard generation code
generation code for verification 5,type: standard, rule of superposition: Eurocode

load spectra of generation code 1 of verification 5
Factorization of load cases. Negative numbers of load cases refer to imperfections

LS	1	2	3	4	5	-1	-2	
1	1.00	0.30	-	-	-	1.00	-	load spectrum auto #1
2	1.00	-	0.30	-	-	1.00	-	load spectrum auto #2
3	1.00	0.30	0.30	-	-	1.00	-	load spectrum auto #3
4	1.00	0.30	-	-	-	-1.00	-	load spectrum auto #4
5	1.00	-	0.30	-	-	-1.00	-	load spectrum auto #5
6	1.00	0.30	0.30	-	-	-1.00	-	load spectrum auto #6
7	1.00	0.30	-	-	-	-	1.00	load spectrum auto #7
8	1.00	-	0.30	-	-	-	1.00	load spectrum auto #8
9	1.00	0.30	0.30	-	-	-	1.00	load spectrum auto #9

load spectra of generation code 1 of verification 5
Factorization of load cases. Negative numbers of load cases refer to imperfections

LS	1	2	3	4	5	-1	-2	
10	1.00	0.30	-	-	-	-	-1.00	load spectrum auto #10
11	1.00	-	0.30	-	-	-	-1.00	load spectrum auto #11
12	1.00	0.30	0.30	-	-	-	-1.00	load spectrum auto #12
13	1.00	0.30	-	-	-	1.00	1.00	load spectrum auto #13
14	1.00	-	0.30	-	-	1.00	1.00	load spectrum auto #14
15	1.00	0.30	0.30	-	-	1.00	1.00	load spectrum auto #15
16	1.00	0.30	-	-	-	-1.00	1.00	load spectrum auto #16
17	1.00	-	0.30	-	-	-1.00	1.00	load spectrum auto #17
18	1.00	0.30	0.30	-	-	-1.00	1.00	load spectrum auto #18
19	1.00	0.30	-	-	-	1.00	-1.00	load spectrum auto #19
20	1.00	-	0.30	-	-	1.00	-1.00	load spectrum auto #20
21	1.00	0.30	0.30	-	-	1.00	-1.00	load spectrum auto #21
22	1.00	0.30	-	-	-	-1.00	-1.00	load spectrum auto #22
23	1.00	-	0.30	-	-	-1.00	-1.00	load spectrum auto #23
24	1.00	0.30	0.30	-	-	-1.00	-1.00	load spectrum auto #24
25	1.00	-	-	-	-	1.00	-	load spectrum auto #25
26	1.00	-	-	-	-	-1.00	-	load spectrum auto #26
27	1.00	-	-	-	-	-	1.00	load spectrum auto #27
28	1.00	-	-	-	-	-	-1.00	load spectrum auto #28
29	1.00	-	-	-	-	1.00	1.00	load spectrum auto #29
30	1.00	-	-	-	-	-1.00	1.00	load spectrum auto #30
31	1.00	-	-	-	-	1.00	-1.00	load spectrum auto #31
32	1.00	-	-	-	-	-1.00	-1.00	load spectrum auto #32

NATIONAL APPENDIX OF EUROCODES

Load factors of the national appendix
Germany

DIN EN 1990 (EC 0)

Partial safety factors for actions
of permanent and transient design situation

Type of action effect	γ_{Fsup}	γ_{Finf}
permanent loads	1.35	1.00
transient loads	1.50	0.00
fluid pressure/engine loads	1.35	0.00
restraint	1.00	0.00
prestressing	1.00	1.00

Partial safety factors for actions
of accidental design situation

Type of action effect	γ_{Fsup}	γ_{Finf}
permanent loads	1.00	1.00
transient loads	1.00	0.00
fluid pressure/engine loads	1.00	0.00
restraint	1.00	0.00
prestressing	1.00	1.00
accidental action effects	1.00	1.00

Partial safety factors for actions
of earthquake situation

Type of action effect	γ_{Fsup}	γ_{Finf}
permanent loads	1.00	1.00
transient loads	1.00	0.00
fluid pressure/engine loads	1.00	0.00
restraint	1.00	0.00
prestressing	1.00	1.00
earthquake	1.00	1.00

Partial safety factors for actions
of design of serviceability and fatigue

Type of action effect	γ_{Fsup}	γ_{Finf}
permanent loads	1.00	1.00
transient loads	1.00	0.00
fluid pressure/engine loads	1.00	0.00
restraint	1.00	0.00
prestressing	1.00	1.00

Combination coefficients

Action effect	Category	Ψ_0	Ψ_1	Ψ_2
housing, office rooms	A, B	0.70	0.50	0.30
Assembly, salesrooms	C, D	0.70	0.70	0.60
storage rooms	E	1.00	0.90	0.80
vehicles up to 30 kN	F	0.70	0.70	0.60
vehicles up to 160 kN	G	0.70	0.50	0.30
roofs	H	0.00	0.00	0.00
snow/ice up to 1000 m alt.		0.50	0.20	0.00
snow/ice above 1000 m alt.		0.70	0.50	0.20
wind		0.60	0.20	0.00
temperature		0.60	0.50	0.00
soil settlements		1.00	1.00	1.00
other action effects		0.80	0.70	0.50

Note: Fluid pressure/engine loads, restraint or soil settlements, other action effects take no part to EN 1990 (Eurocode).

Applied design parameters of the national appendix
Germany

DIN EN 1992-1-1 (EC 2)

Chapter	Value	Meaning
2.4.2.4(1)		Partial safety factors for concrete and reinforcement
	γ_c = 1.50 γ_s = 1.15	Permanent and transient design situation
	γ_c = 1.50 γ_s = 1.15	Fatigue design situation
	γ_c = 1.50 γ_s = 1.15	Earthquake design situation
	γ_c = 1.30 γ_s = 1.00	Accidental design situation
3.1.6(1)P	α_{cc} = 0.85	Coeff. to consider the long-term influence of compression strength of concrete and the unfavourable effect due to the kind of action effect
3.1.6(2)P	α_{ct} = 1.00	Coeff. of tensile strength of concrete to calculate the bond strength
6.2.2(1)	$C_{Rd,c}$ = 0.15 / γ_c	Coeff. to calculate the resistance of shear force
	v_{min} = 0.0525/γ_c $k^{3/2}$ $f_{ck}^{1/2}$	
	k_1 = 0.12	
6.2.2(6)	v_V = 0.675	Reduction factor of strength of shear force
6.3.2(4)	v_T = 0.525	Reduction factor of strength of torsion
6.2.3(2)	min cot Θ = 1.00	lower bound of strut gradient
	max cot Θ = 3.00	upper bound of strut gradient
6.2.3(3)	α_{cw} = 1.00	Coeff. to consider the state of stress in the compress. boom
	v_1 = 0.750	Coeff. to calculate the max. design resistance of shear force
6.2.4(4)	cot Θ_{fz} = 1.00	Connections: strut gradient of tension booms
	cot Θ_{fd} = 1.20	Connections: strut gradient of compression booms
6.2.4(6)	k = 0.00	Connections: Coeff. of resisting tensile stress without through-reinforcement
6.2.5(1)	intended : v = 0.700	Joints: Reduction factor of strength depending on subsurface condition
	rough : v = 0.500	
	smooth : v = 0.200	
	very smooth: v = 0.000	
6.8.4(1)	$\gamma_{F,fat}$ = 1.00	Fatigue: Safety factor of action effects
6.8.7(1)	k_1 = 1.00	Fatigue: Coeff. to calculate the design strength of concrete
7.3.4(3)	k_3 = 0.00	Cracks: Coeff. to calculate the maximum crack distance if fracture pattern is completed
	k_4 = 0.278	Cracks: Coeff. to calculate the maximum crack distance if fracture pattern is completed
9.2.1.1(1)	$A_{s,min}$ s. NA-DE	Minimum reinforcement of beams [cm²]
9.2.2(5)	$\rho_{w,min}$ s. NA-DE	Minimum ratio of shear reinforcement
9.5.2(2)	$A_{s,min}$ = 0.150 N_{Ed} / f_{yd}	
	≥ 0.000 A_c	minimum reinforcement for columns [cm²]
9.6.2(1)	$A_{s,vmin}$ s. NA-DE	vertical minimum reinforcement for walls [cm²]
11.3.5(1)	α_{lcc} = 0.75	Lightw.conc.: Reduction factor of compression strength of concrete
11.3.5(2)	α_{lct} = 1.00	Lightw.conc.: Reduction factor of tensile strength of concrete

Chapter	Value	Meaning
11.6.1(1)	$C_{lRd,c} = 0.15 / \gamma_c$ $v_{l,min} = 0.0525\ k^{3/2}\ f_{lck}^{1/2}$ $k_{l1} = 0.12$	Lightw.conc.: Coeff. to calculate the resistance of shear force
11.6.1(2)	$v_l = 0.675\ \eta_1$ $v_l = 0.525\ \eta_1$	Lightw.conc.: Reduction factor of strength of shear force Lightw.conc.: Reduction factor of strength of torsion
11.6.2(1)	$v_{l1} = 0.750\ \eta_1$	Lightw.conc.: Coeff. to calculate the maximum design res. of shear f.

DIN EN 1992-1-2 (EC 2, fire)

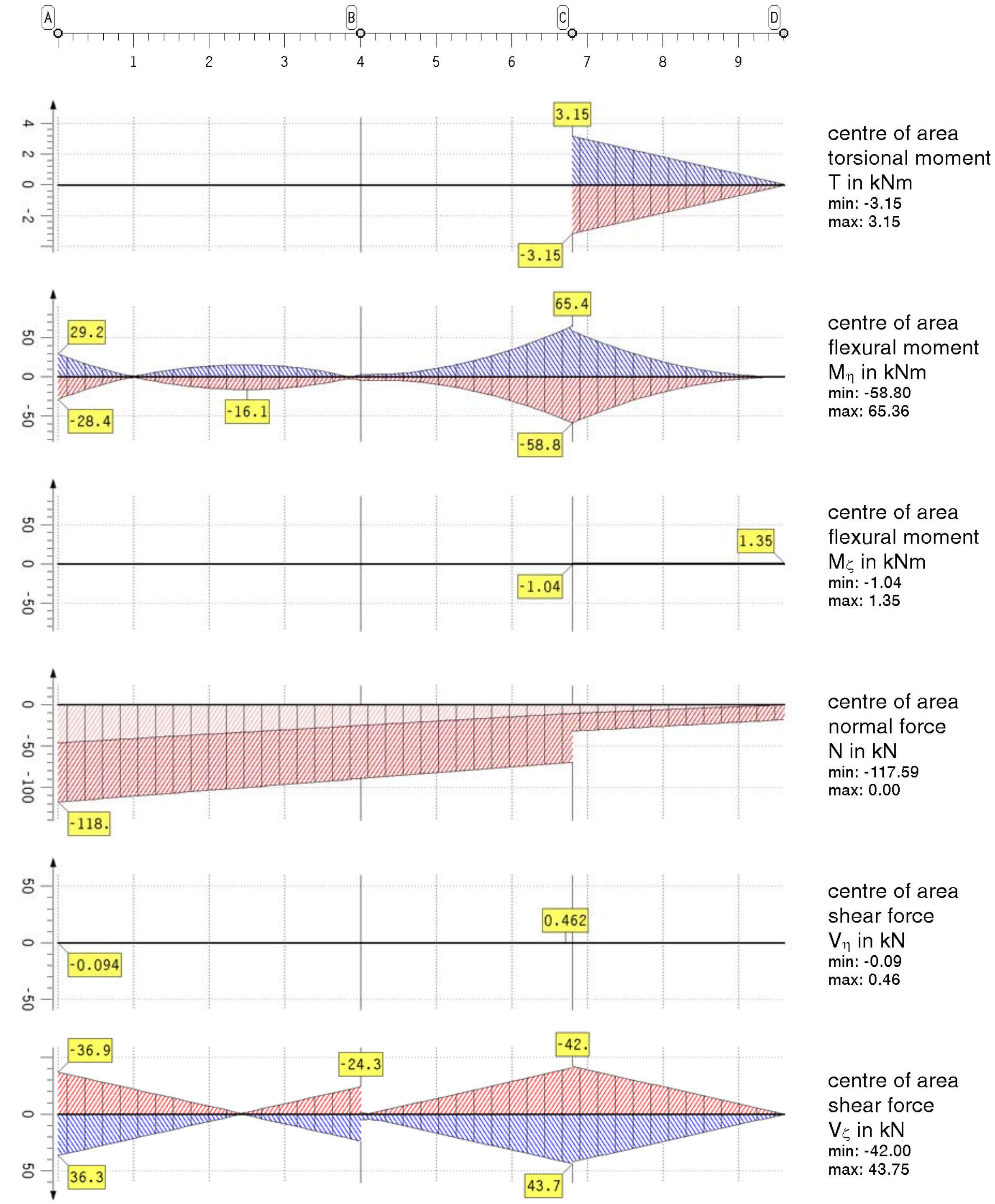
Chapter	Value	Meaning
3.2.3(5)	Class N (table 3.2a)	reinforcement-class to describe stress-strain-relation relation at increased temperatures
3.3.3(1)	$\lambda_c = \lambda_{co}$ oder λ_{cu} see design calc. options	thermal conductivity of concrete λ_{co} upper limit, λ_{cu} lower limit acc. to 3.3.3(2)
6.1(5)	Class 1 (table 6.1N)	high strength concrete: concrete-class to describe the reduction of strength
6.4.2.1(3)	k = 1.000	hgih strength concrete: coeff. for reduction of cross-section

SUMMARY VERIFICATION 1: EC 2 DESIGN CALCULATION

extremal deformations in column axis

point	x	type	u_X	u_Y	u_Z	φ_X	φ_Y	φ_Z
-	m		mm	mm	mm	‰	‰	‰
A	0.000	min	0.00	0.00	0.00	0.00	0.00	0.00
		max	0.00	0.00	0.00	0.00	0.00	0.00
	0.600	min	-0.04	-0.00	0.00	-0.00	-0.11	-0.00
		max	0.04	-0.00	0.01	-0.00	0.11	0.00
	1.300	min	-0.12	-0.00	0.01	-0.00	-0.11	-0.00
		max	0.12	-0.00	0.02	-0.00	0.12	0.00
	2.300	min	-0.19	-0.00	0.01	-0.00	-0.00	-0.00
		max	0.18	-0.00	0.04	-0.00	0.01	0.00
	2.600	min	-0.18	-0.00	0.01	-0.00	-0.05	-0.00
		max	0.17	-0.00	0.04	-0.00	0.05	0.00
	3.900	min	-0.02	-0.00	0.02	0.00	-0.17	-0.00
		max	0.02	-0.00	0.06	0.00	0.16	0.00
B	4.000	min	0.00	0.00	0.02	0.00	-0.17	-0.00
		max	0.00	0.00	0.06	0.00	0.16	0.00
B	4.000	min	0.00	0.00	0.02	0.00	-0.17	-0.00
		max	0.00	0.00	0.06	0.00	0.16	0.00
	4.560	min	-0.08	0.00	0.02	0.00	-0.16	-0.00
		max	0.09	0.00	0.06	0.00	0.14	0.00
	5.680	min	-0.19	0.00	0.02	0.00	-0.01	-0.00
		max	0.21	0.00	0.08	0.00	0.01	0.00
	6.240	min	-0.15	0.00	0.03	-0.00	-0.15	-0.00
		max	0.17	0.00	0.08	-0.00	0.17	0.00
C	6.800	min	0.00	0.00	0.03	-0.01	-0.41	-0.00
		max	0.00	0.00	0.09	-0.00	0.46	0.00
C	6.800	min	0.00	0.00	0.03	-0.01	-0.41	-0.00
		max	0.00	0.00	0.09	-0.00	0.46	0.00
	8.107	min	-1.10	-0.01	0.03	-0.01	-1.04	-0.07
		max	1.03	0.02	0.10	0.03	1.09	0.07
	9.413	min	-2.63	-0.01	0.03	-0.01	-1.15	-0.10
		max	2.49	0.08	0.11	0.06	1.20	0.10
D	9.600	min	-2.85	-0.02	0.03	-0.01	-1.15	-0.10
		max	2.71	0.09	0.11	0.07	1.20	0.10
minimum			**-2.85**	**-0.02**	**0.00**	**-0.01**	**-1.15**	**-0.10**
maximum			**2.71**	**0.09**	**0.11**	**0.07**	**1.20**	**0.10**

extremal internal forces and moments in system of principal axis



extremal internal forces and moments in system of principal axis

The shear forces V_η, V_ζ, the normal force N and the flexural moments M_η, M_ζ refer to the centre of area.

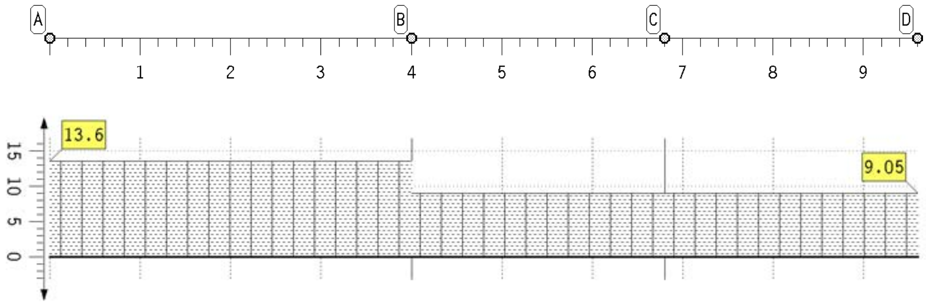
point	x	type	N	V_η	V_ζ	T	M_η	M_ζ
-	m		kN	kN	kN	kNm	kNm	kNm
A	0.000	min	-117.6	-0.09	-36.88	-0.00	-28.4	-0.1
		max	-46.0	-0.07	36.28	0.00	29.2	-0.1
	1.000	min	-110.5	-0.09	-21.88	-0.00	-0.4	-0.0
		max	-40.7	-0.07	21.28	0.00	0.6	-0.0
	2.400	min	-100.6	-0.09	-1.02	-0.00	-16.1	0.1
		max	-33.4	-0.07	0.28	0.00	15.5	0.1
B	4.000	min	-89.2	-0.09	-24.31	-0.00	-4.8	0.2
		max	-25.0	-0.07	23.72	0.00	3.2	0.3
B	4.000	min	-89.2	0.34	-1.16	-0.00	-4.8	0.2

extremal internal forces and moments in system of principal axis

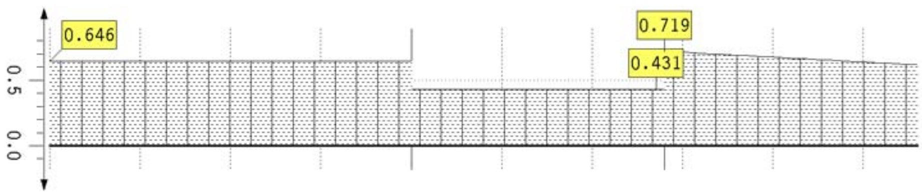
The shear forces V_η, V_ζ, the normal force N and the flexural moments M_η, M_ζ refer to the centre of area.

point	x	type	N	V_η	V_ζ	T	M_η	M_ζ
-	m		kN	kN	kN	kNm	kNm	kNm
		max	-25.0	0.46	4.85	0.00	3.2	0.3
	5.400	min	-79.3	0.34	-19.84	-0.00	-16.3	-0.4
		max	-17.6	0.46	22.75	0.00	18.8	-0.3
C	6.800	min	-69.4	0.34	-40.84	-0.00	-58.8	-1.0
		max	-10.3	0.46	43.75	0.00	65.4	-0.8
C	6.800	min	-31.9	-0.00	-42.00	-3.15	-58.8	-0.0
		max	-10.3	0.00	42.00	3.15	58.8	1.4
	8.200	min	-24.9	-0.00	-21.00	-1.58	-14.7	-0.0
		max	-5.1	0.00	21.00	1.58	14.7	1.4
D	9.600	min	-18.0	-0.00	-0.00	-0.00	-0.0	0.0
		max	0.0	-0.00	0.00	0.00	0.0	1.4
minimum			**-117.6**	**-0.09**	**-42.00**	**-3.15**	**-58.8**	**-1.0**
maximum			**0.0**	**0.46**	**43.75**	**3.15**	**65.4**	**1.4**

general design results of reinforced concrete

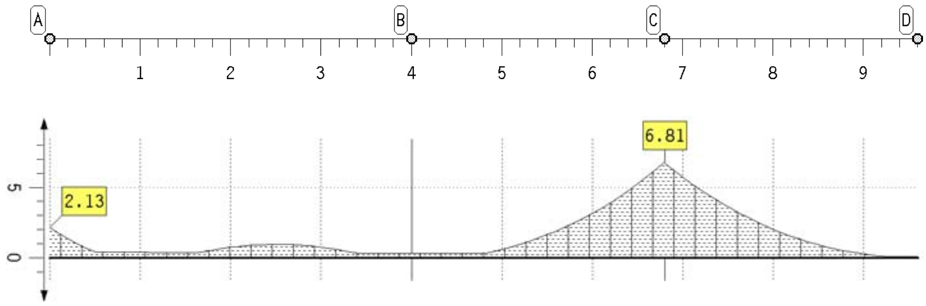


reinf.
As_l in cm^2
max: 13.57

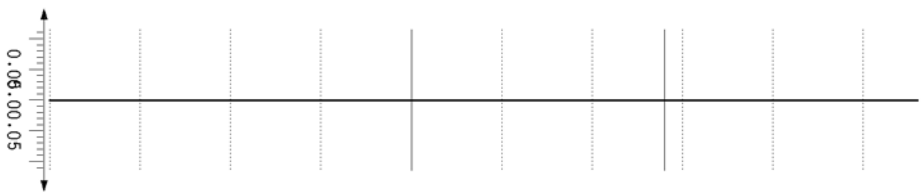


reinforcement ratio
μ_s in %
max: 0.72

results of reinforced concrete design

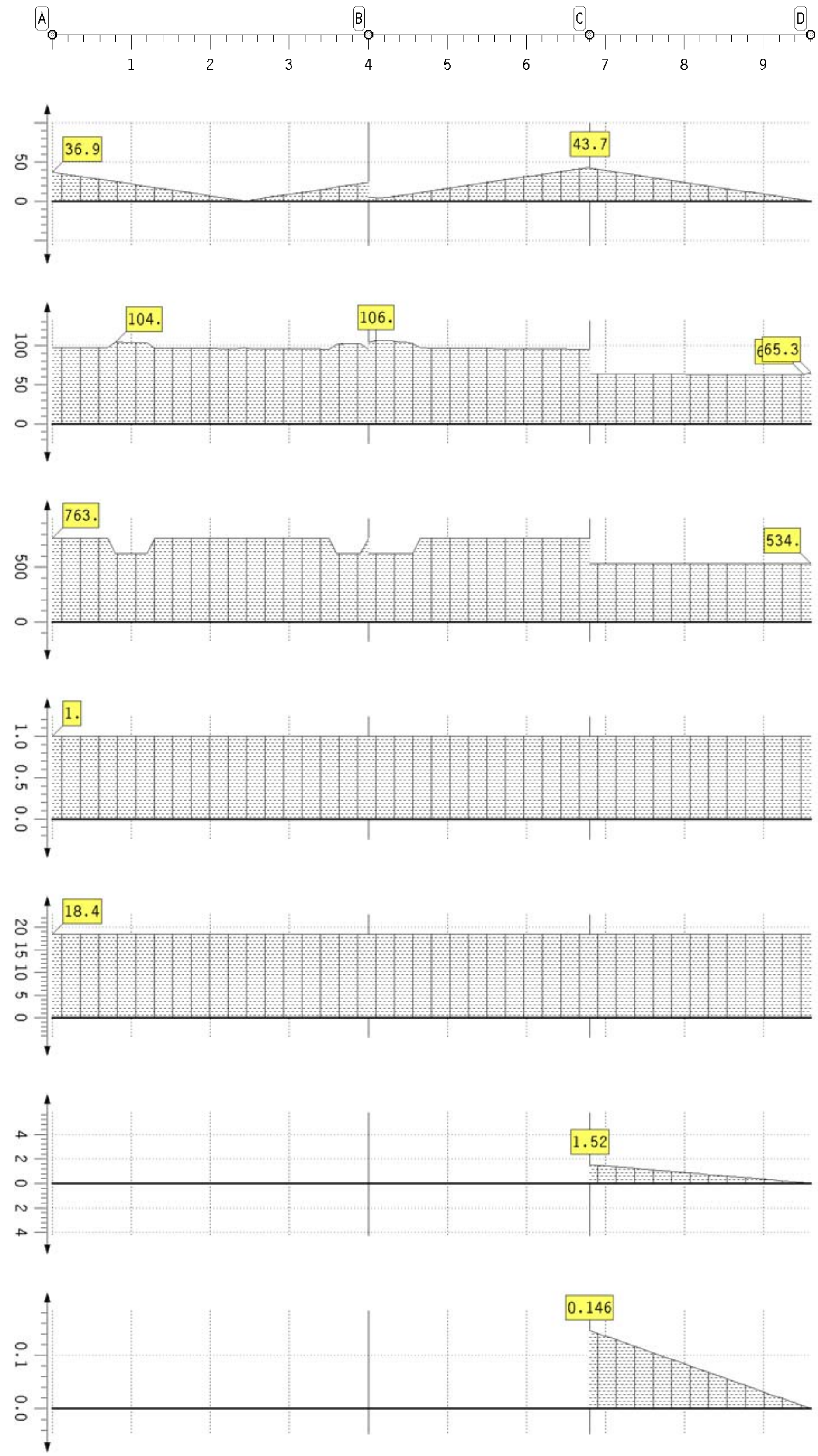


min. reinf.
As_{bl} in cm^2
max: 6.81



stirrup reinforcement
due to shear force
(total)
as_w in cm^2/m
max: 0.00

results of reinforced concrete design



design shear force
V_{Ed} in kN
max V_{Ed} : 43.75

design res. of shear f.
V_{Rdct} in kN
min V_{Rdct}: 62.46

design calc. value max.
design res. of shear f.
V_{Rdmax} in kN
min: 534.16
max: 763.09

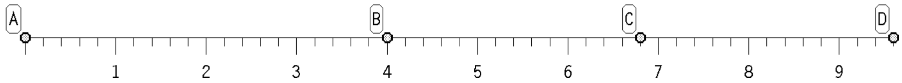
range of utilization AB
min: 1
max: 1

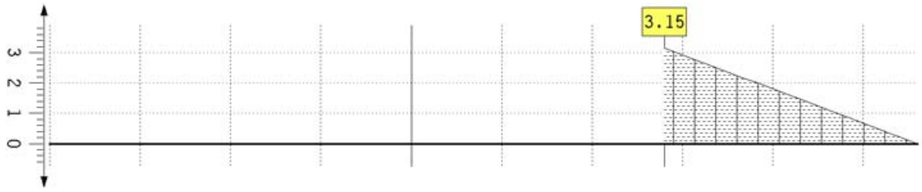
minimal
angle of compr. strut
min θ in °
min: 18

longitudinal reinforcement
due to torsion
As_T in cm^2
max: 1.52

stirrup reinforcement
due to torsion
(per side)
as_{wT} in cm^2/m
max: 0.15

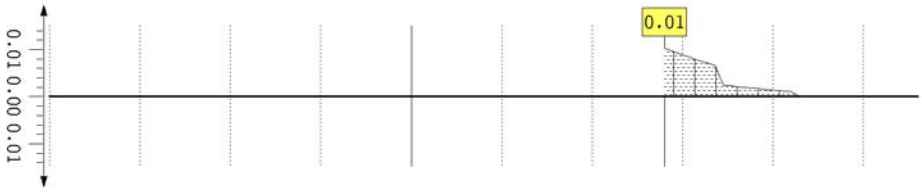
results of reinforced concrete design





design calc. value
torsional moment
ass T_{Ed} in kNm
min: 0.00
max: 3.15

design calc. value max.
design res. of torsion
ass T_{Rdmax} in kNm
min: 0.00
max: 49.27



utilization of
shear force with Torsion
U_{V+T}
max: 0.01

reactions in support points (incl. γ_F)

point	x	type	AP_X	AP_Y	AP_Z	AM_X	AM_Y	AM_Z
-	m		kN	kN	kN	kNm	kNm	kNm
A	0.000	min	-36.28	0.07	-117.59	0.09	-29.17	-0.00
		max	36.88	0.09	-45.99	0.13	28.38	0.00
B	4.000	min	-28.38	-0.56	-0.00	0.00	-0.00	-0.00
		max	24.88	-0.41	-0.00	0.00	0.00	0.00
C	6.800	min	-82.84	0.34	-0.00	-0.00	-0.00	-0.00
		max	85.75	0.46	-0.00	0.00	0.00	0.00
D	9.600	min	-0.00	-0.00	-0.00	0.00	-0.00	-0.00
		max	0.00	-0.00	-0.00	0.00	0.00	0.00

SUMMARY VERIFICATION 2: EC 2 CRACK LIMITATION

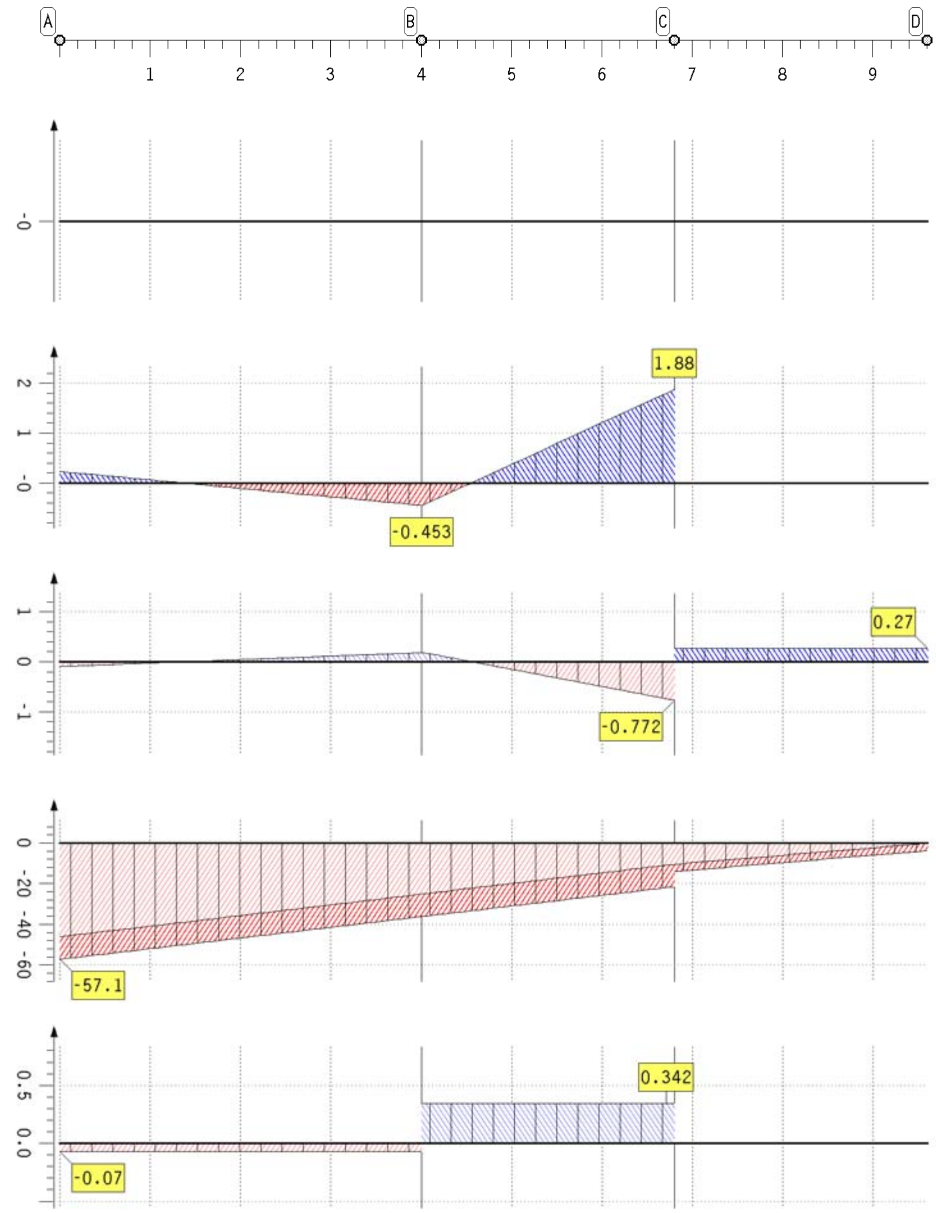
extremal deformations in column axis

point	x	type	u_X	u_Y	u_Z	φ_X	φ_Y	φ_Z
-	m		mm	mm	mm	‰	‰	‰
A	0.000	min	0.00	0.00	0.00	0.00	0.00	0.00
		max	0.00	0.00	0.00	0.00	0.00	0.00
	1.300	min	-0.00	-0.00	0.01	-0.00	0.00	0.00
		max	0.00	-0.00	0.01	-0.00	0.00	0.00
	2.600	min	-0.00	-0.00	0.01	-0.00	0.00	0.00
		max	0.00	-0.00	0.02	-0.00	0.00	0.00
	2.700	min	-0.00	-0.00	0.01	0.00	-0.00	0.00
		max	0.00	-0.00	0.02	0.00	0.00	0.00
B	4.000	min	0.00	0.00	0.02	0.00	-0.00	0.00
		max	0.00	0.00	0.03	0.00	0.00	0.00
B	4.000	min	0.00	0.00	0.02	0.00	-0.00	0.00
		max	0.00	0.00	0.03	0.00	0.00	0.00
	4.560	min	0.00	0.00	0.02	0.00	-0.01	0.00

extremal deformations in column axis

point	x	type	uX	uY	uZ	φX	φY	φZ
-	m		mm	mm	mm	‰	‰	‰
		max	0.00	0.00	0.03	0.00	0.00	0.00
	5.680	min	0.00	0.00	0.02	0.00	-0.00	0.00
		max	0.01	0.00	0.03	0.00	0.00	0.00
	6.240	min	0.00	0.00	0.03	-0.00	0.00	0.00
		max	0.01	0.00	0.04	-0.00	0.01	0.00
C	6.800	min	0.00	0.00	0.03	-0.00	0.00	0.00
		max	0.00	0.00	0.04	-0.00	0.01	0.00
C	6.800	min	0.00	0.00	0.03	-0.00	0.00	0.00
		max	0.00	0.00	0.04	-0.00	0.01	0.00
	8.200	min	-0.02	-0.01	0.03	-0.00	0.00	0.00
		max	0.00	-0.00	0.04	0.00	0.01	0.00
D	9.600	min	-0.04	-0.01	0.03	-0.00	0.00	0.00
		max	0.00	0.01	0.04	0.01	0.01	0.00
minimum			**-0.04**	**-0.01**	**0.00**	**-0.00**	**-0.01**	**0.00**
maximum			**0.01**	**0.01**	**0.04**	**0.01**	**0.01**	**0.00**

extremal internal forces and moments in system of principal axis



centre of area
torsional moment
T in kNm
min: -0.00
max: 0.00

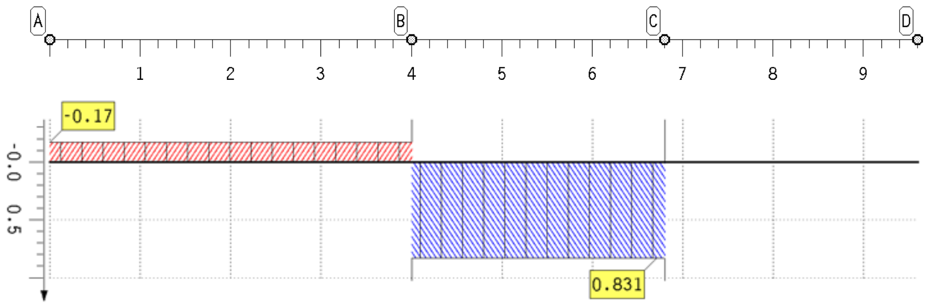
centre of area
flexural moment
M_η in kNm
min: -0.45
max: 1.88

centre of area
flexural moment
M_ζ in kNm
min: -0.77
max: 0.27

centre of area
normal force
N in kN
min: -57.09
max: 0.00

centre of area
shear force
V_η in kN
min: -0.07
max: 0.34

extremal internal forces and moments in system of principal axis



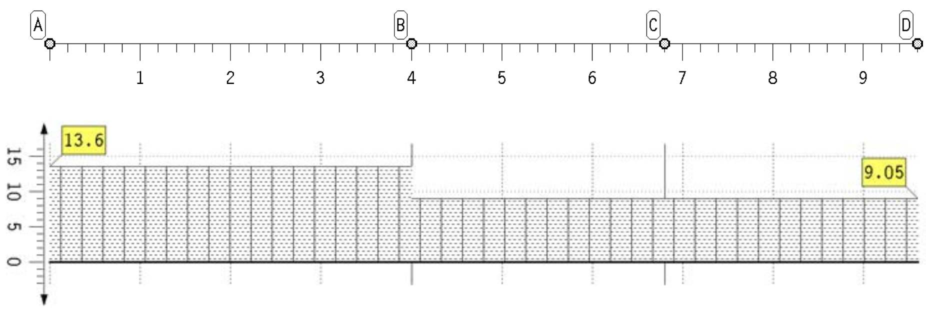
centre of area
shear force
V_ζ in kN
min: -0.17
max: 0.83

extremal internal forces and moments in system of principal axis

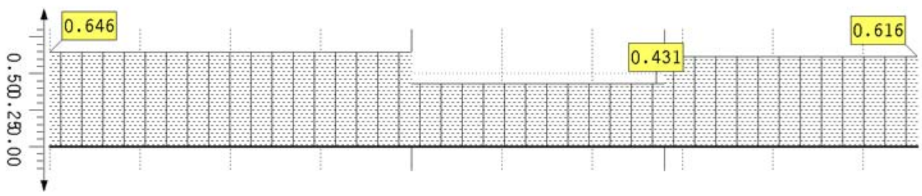
The shear forces V_η, V_ζ, the normal force N and the flexural moments M_η, M_ζ refer to the centre of area.

point	x	type	N	V_η	V_ζ	T	M_η	M_ζ
-	m		kN	kN	kN	kNm	kNm	kNm
A	0.000	min	-57.1	-0.07	-0.17	-0.00	0.0	-0.1
		max	-46.0	-0.07	0.00	0.00	0.2	-0.1
	1.300	min	-50.3	-0.07	-0.17	-0.00	0.0	-0.0
		max	-39.2	-0.07	0.00	0.00	0.0	-0.0
B	4.000	min	-36.1	-0.07	-0.17	-0.00	-0.5	0.2
		max	-25.0	-0.07	0.00	0.00	0.0	0.2
B	4.000	min	-36.1	0.34	0.00	-0.00	-0.5	0.2
		max	-25.0	0.34	0.83	0.00	0.0	0.2
	4.560	min	-33.2	0.34	0.00	-0.00	0.0	-0.0
		max	-22.0	0.34	0.83	0.00	0.0	-0.0
C	6.800	min	-21.4	0.34	0.00	-0.00	0.0	-0.8
		max	-10.3	0.34	0.83	0.00	1.9	-0.8
C	6.800	min	-13.9	-0.00	-0.00	-0.00	0.0	-0.0
		max	-10.3	-0.00	0.00	0.00	0.0	0.3
D	9.600	min	-3.6	-0.00	-0.00	-0.00	-0.0	0.0
		max	0.0	-0.00	0.00	0.00	0.0	0.3
minimum			**-57.1**	**-0.07**	**-0.17**	**-0.00**	**-0.5**	**-0.8**
maximum			**0.0**	**0.34**	**0.83**	**0.00**	**1.9**	**0.3**

general design results of reinforced concrete

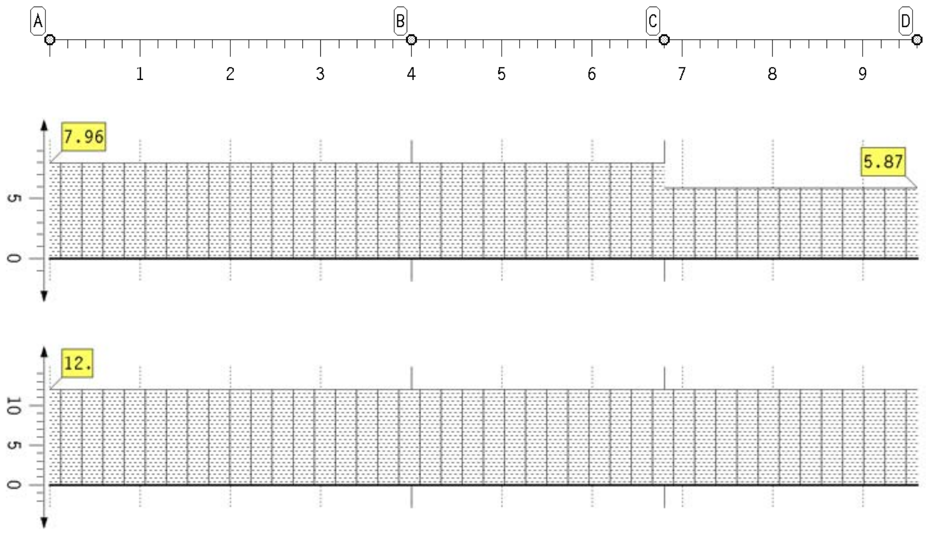


reinf.
As_l in cm^2
max: 13.57



reinforcement ratio
μ_s in %
max: 0.65

results of crack limitation



minimum reinforcement
$As_{l,min}$ in cm^2
max: 7.96

maximum
maximum bar diameter
max dsR in mm
min: 12.00

reactions in support points (incl. γF)

point	x	type	APx	APy	APz	AMx	AMy	AMz
-	m		kN	kN	kN	kNm	kNm	kNm
A	0.000	min	0.00	0.07	-57.09	0.09	-0.23	-0.00
		max	0.17	0.07	-45.99	0.09	0.00	0.00
B	4.000	min	-1.00	-0.41	-0.00	0.00	-0.00	0.00
		max	0.00	-0.41	-0.00	0.00	0.00	0.00
C	6.800	min	0.00	0.34	-0.00	0.00	0.00	-0.00
		max	0.83	0.34	-0.00	0.00	0.00	0.00
D	9.600	min	-0.00	-0.00	-0.00	0.00	-0.00	-0.00
		max	0.00	-0.00	-0.00	0.00	0.00	0.00

SUMMARY VERIFICATION 3: EC 2 BUCKLING SAFETY Z2

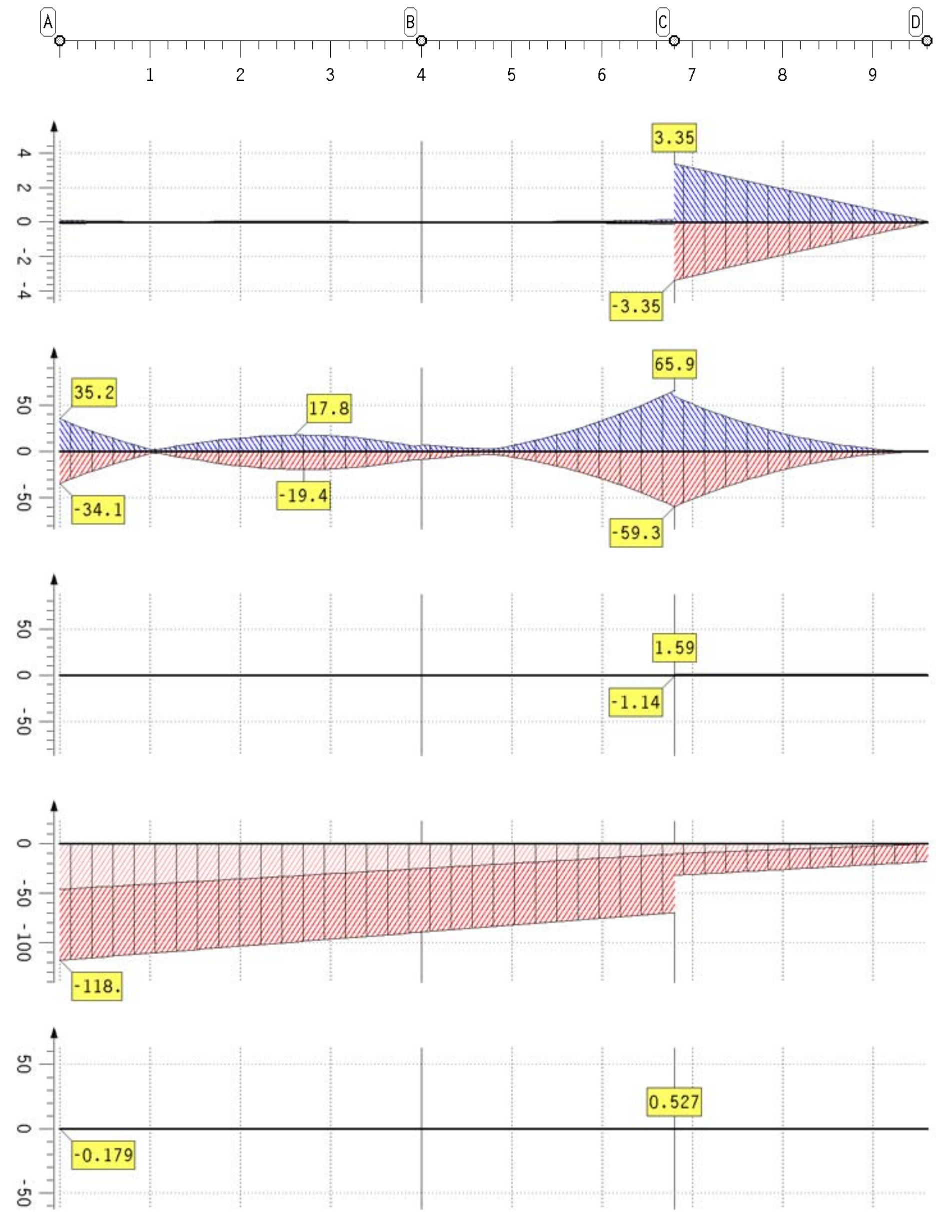
extremal deformations in column axis

point	x	type	uX	uY	uZ	φX	φY	φZ
-	m		mm	mm	mm	‰	‰	‰
A	0.000	min	-0.00	-0.00	0.00	-0.00	-0.00	-0.00
		max	0.00	0.00	0.00	-0.00	0.00	0.00
	1.300	min	-0.59	-0.00	-0.04	-0.00	-0.61	-0.00
		max	0.59	-0.00	0.03	-0.00	0.61	0.00
	2.400	min	-1.05	-0.01	-0.08	-0.00	-0.05	-0.00
		max	1.05	-0.00	0.05	-0.00	0.05	0.00
	2.600	min	-1.04	-0.01	-0.10	-0.00	-0.18	-0.00
		max	1.04	-0.00	0.06	0.00	0.18	0.00
	3.400	min	-0.59	-0.00	-0.17	0.00	-0.84	-0.00
		max	0.59	-0.00	0.07	0.00	0.84	0.00
B	4.000	min	-0.00	-0.00	-0.20	0.00	-1.10	-0.00
		max	0.00	0.00	0.08	0.01	1.10	0.00
B	4.000	min	-0.00	-0.00	-0.20	0.00	-1.10	-0.00
		max	0.00	0.00	0.08	0.01	1.10	0.00
	4.653	min	-0.72	0.00	-0.20	0.00	-1.11	-0.00
		max	0.72	0.01	0.09	0.01	1.11	0.00
	5.307	min	-1.38	0.00	-0.25	0.00	-0.73	-0.00
		max	1.38	0.01	0.11	0.01	0.73	0.00
	5.773	min	-1.59	0.00	-0.30	-0.00	-0.39	-0.00
		max	1.59	0.02	0.11	0.00	0.32	0.00
	5.867	min	-1.60	0.00	-0.31	-0.00	-0.31	-0.00

extremal deformations in column axis

point	x	type	u_X	u_Y	u_Z	φ_X	φ_Y	φ_Z
-	m		mm	mm	mm	‰	‰	‰
		max	1.60	0.02	0.11	0.00	0.27	0.00
	6.333	min	-1.23	0.00	-0.60	-0.02	-1.67	-0.00
		max	1.23	0.01	0.12	-0.00	1.67	0.00
C	6.800	min	-0.00	-0.00	-0.90	-0.03	-3.63	-0.00
		max	0.00	0.00	0.13	-0.00	3.63	0.00
C	6.800	min	-0.00	-0.00	-0.90	-0.03	-3.63	-0.00
		max	0.00	0.00	0.13	-0.00	3.63	0.00
	8.107	min	-8.28	-0.05	-1.61	-0.03	-8.22	-0.07
		max	8.28	0.11	0.14	0.17	8.22	0.07
D	9.600	min	-21.58	-0.10	-1.80	-0.03	-9.12	-0.11
		max	21.58	0.48	0.16	0.29	9.12	0.11
minimum			**-21.58**	**-0.10**	**-1.80**	**-0.03**	**-9.12**	**-0.11**
maximum			**21.58**	**0.48**	**0.16**	**0.29**	**9.12**	**0.11**

extremal internal forces and moments in system of principal axis



centre of area
torsional moment
T in kNm
min: -3.35
max: 3.35

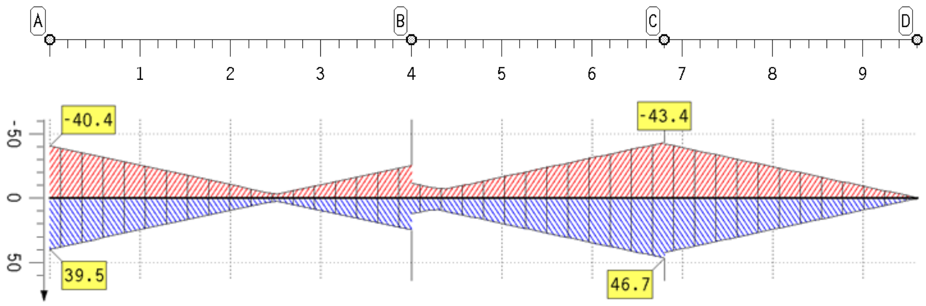
centre of area
flexural moment
M_η in kNm
min: -59.35
max: 65.91

centre of area
flexural moment
M_ζ in kNm
min: -1.14
max: 1.59

centre of area
normal force
N in kN
min: -117.67
max: 0.00

centre of area
shear force
V_η in kN
min: -0.18
max: 0.53

extremal internal forces and moments in system of principal axis



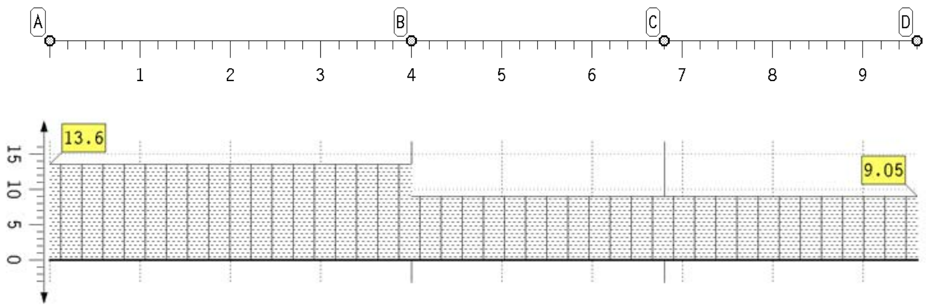
centre of area
shear force
V_ζ in kN
min: -43.44
max: 46.68

extremal internal forces and moments in system of principal axis

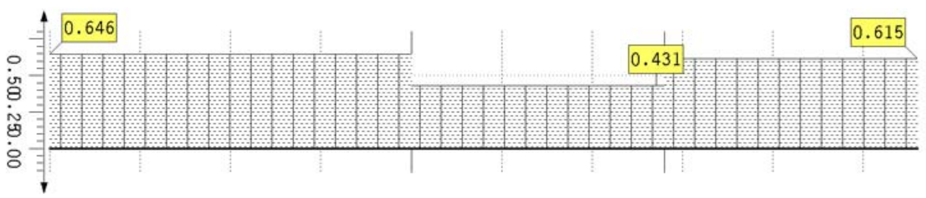
The shear forces V_η, V_ζ, the normal force N and the flexural moments M_η, M_ζ refer to the centre of area.

point	x	type	N	V_η	V_ζ	T	M_η	M_ζ
-	m		kN	kN	kN	kNm	kNm	kNm
A	0.000	min	-117.7	-0.18	-40.37	-0.10	-34.1	-0.2
		max	-45.9	-0.01	39.48	0.10	35.2	-0.0
	1.000	min	-110.6	-0.16	-25.39	-0.01	-2.2	-0.1
		max	-40.6	-0.03	24.49	0.01	2.3	-0.0
	2.500	min	-99.9	-0.15	-2.99	-0.05	-19.1	0.0
		max	-32.9	-0.05	2.41	0.05	17.7	0.2
	3.600	min	-92.1	-0.15	-19.41	-0.02	-13.1	0.1
		max	-27.0	-0.04	18.94	0.01	10.7	0.3
B	4.000	min	-89.3	-0.15	-25.41	-0.03	-8.1	0.1
		max	-24.9	-0.04	24.94	0.03	7.2	0.4
B	4.000	min	-89.3	0.24	-11.58	-0.03	-8.1	0.1
		max	-25.0	0.52	12.05	0.03	7.2	0.4
	4.933	min	-82.7	0.22	-15.52	-0.02	-5.0	-0.2
		max	-20.0	0.52	18.86	0.02	5.3	-0.0
C	6.800	min	-69.6	0.19	-43.44	-0.14	-59.3	-1.1
		max	-10.2	0.53	46.68	0.13	65.9	-0.4
C	6.800	min	-32.0	-0.10	-42.17	-3.35	-59.3	-0.1
		max	-10.0	0.10	42.17	3.35	59.3	1.6
	8.200	min	-25.0	-0.08	-21.21	-1.64	-15.0	-0.0
		max	-4.9	0.09	21.21	1.64	15.0	1.5
D	9.600	min	-18.0	-0.06	-0.15	-0.02	-0.0	-0.0
		max	0.0	0.06	0.15	0.02	0.0	1.4
minimum			**-117.7**	**-0.18**	**-43.44**	**-3.35**	**-59.3**	**-1.1**
maximum			**0.0**	**0.53**	**46.68**	**3.35**	**65.9**	**1.6**

general design results of reinforced concrete

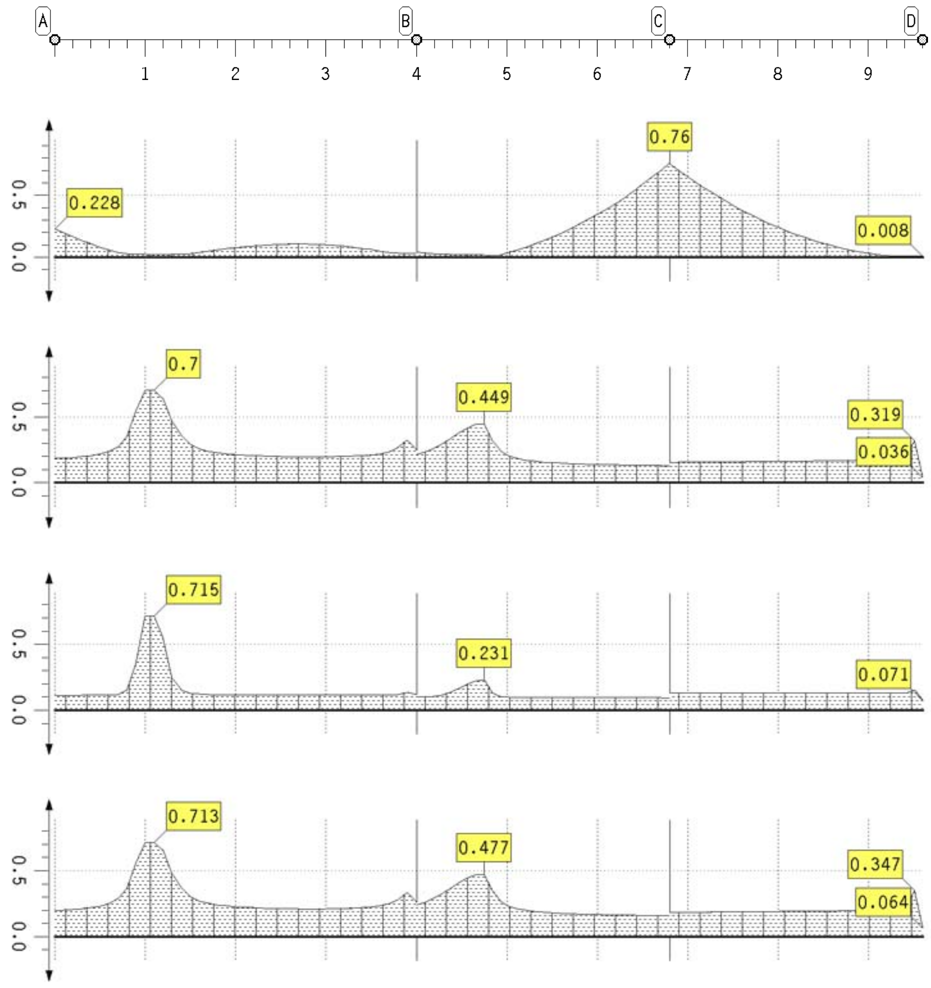


reinf.
As_l in cm^2
max: 13.57



reinforcement ratio
μ_s in %
max: 0.65

Results of calculation in state 2



utilization of cross-section design res.
max: 0.76

minimal effective cross-section area
A_{eff}/A_c
min: 0.04

minimal eff. sec. mom. of area about the η-axis
$I_{\eta,eff}/I_{\eta,c}$
min: 0.07

minimal eff. sec. mom. of area about the ζ-axis
$I_{\zeta,eff}/I_{\zeta,c}$
min: 0.06

reactions in support points (incl. γ_F)

point	x	type	AP_X	AP_Y	AP_Z	AM_X	AM_Y	AM_Z
-	m		kN	kN	kN	kNm	kNm	kNm
A	0.000	min	-39.58	-0.23	-117.59	0.04	-35.15	-0.01
		max	40.56	0.42	-45.99	0.21	34.12	0.01
B	4.000	min	-37.46	-0.66	-0.00	-0.00	-0.00	-0.00
		max	36.39	-0.30	0.00	0.00	0.00	0.00
C	6.800	min	-85.61	-0.02	-0.00	-0.00	-25.66	-0.03
		max	89.02	0.75	0.00	0.33	25.29	0.03
D	9.600	min	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
		max	0.00	0.00	0.00	0.00	0.00	0.00

SUMMARY VERIFICATION 5: EC 2 FIRE PROT.- BUCKLING SAFETY Z2

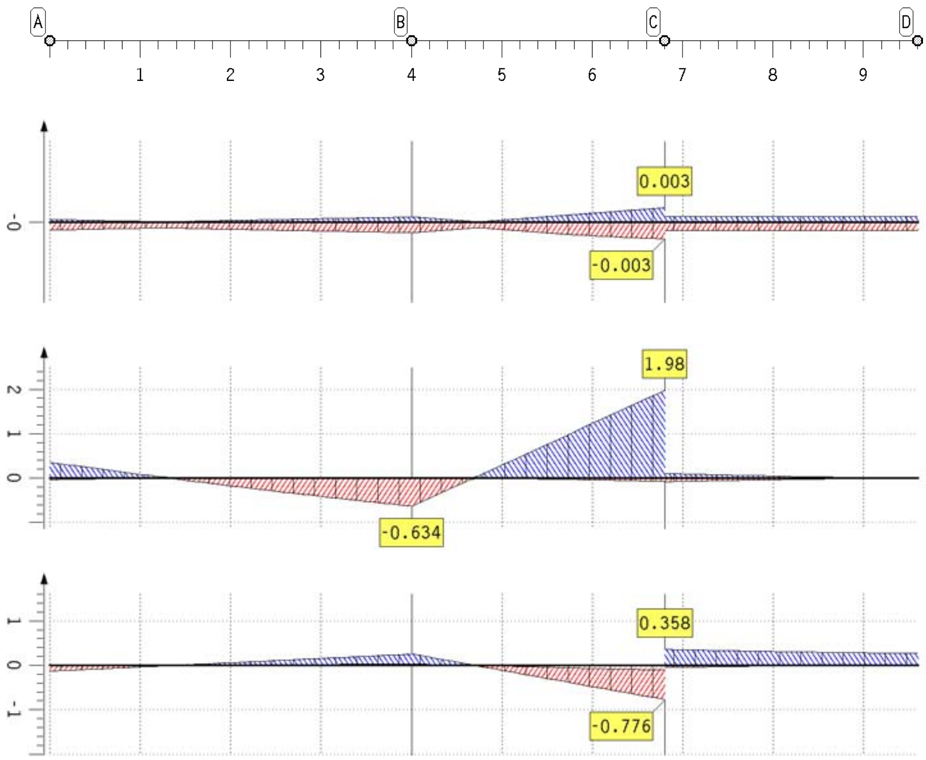
extremal deformations in column axis

point	x	type	u_X	u_Y	u_Z	φ_X	φ_Y	φ_Z
-	m		mm	mm	mm	‰	‰	‰
A	0.000	min	-0.00	-0.00	0.00	-0.00	-0.00	-0.00
		max	0.00	0.00	0.00	0.00	0.00	0.00
	0.700	min	-0.02	-0.01	-3.71	-0.01	-0.01	-0.00
		max	0.00	0.00	-3.66	0.00	0.06	0.00
	1.300	min	-0.07	-0.02	-6.90	-0.02	-0.01	-0.00

extremal deformations in column axis

point	x	type	uX	uY	uZ	φX	φY	φZ
-	m		mm	mm	mm	‰	‰	‰
		max	0.01	-0.00	-6.81	-0.00	0.08	0.00
	2.300	min	-0.13	-0.03	-12.24	-0.01	-0.00	-0.00
		max	0.01	-0.00	-12.08	-0.00	0.03	0.00
	2.600	min	-0.13	-0.03	-13.85	-0.00	-0.00	-0.00
		max	0.01	-0.00	-13.67	0.00	0.01	0.00
	3.300	min	-0.11	-0.03	-17.61	0.00	-0.09	-0.00
		max	0.01	-0.00	-17.39	0.02	0.01	0.00
B	4.000	min	-0.00	-0.00	-21.38	0.01	-0.22	-0.00
		max	0.00	0.00	-21.11	0.06	0.01	0.00
B	4.000	min	-0.00	-0.00	-21.38	0.01	-0.22	-0.00
		max	0.00	0.00	-21.11	0.06	0.01	0.00
	4.653	min	-0.01	0.01	-26.73	0.01	-0.36	-0.00
		max	0.20	0.05	-26.32	0.09	0.01	0.00
	5.680	min	-0.02	0.02	-35.20	0.00	-0.05	-0.00
		max	0.47	0.12	-34.57	0.01	0.00	0.00
	5.773	min	-0.02	0.02	-35.97	-0.00	-0.00	-0.00
		max	0.48	0.12	-35.32	0.00	0.01	0.00
	6.333	min	-0.01	0.01	-40.65	-0.12	-0.02	-0.00
		max	0.35	0.09	-39.87	-0.02	0.48	0.00
C	6.800	min	-0.00	-0.00	-44.56	-0.27	-0.04	-0.00
		max	0.00	0.00	-43.67	-0.04	1.03	0.00
C	6.800	min	-0.00	-0.00	-44.56	-0.27	-0.04	-0.00
		max	0.00	0.00	-43.67	-0.04	1.03	0.00
	8.200	min	-1.50	-0.37	-56.42	-0.27	-0.09	-0.00
		max	0.09	0.29	-55.39	0.45	1.10	0.00
D	9.600	min	-3.05	-0.75	-68.39	-0.27	-0.10	-0.00
		max	0.23	1.22	-67.24	0.87	1.11	0.00
minimum			**-3.05**	**-0.75**	**-68.39**	**-0.27**	**-0.36**	**-0.00**
maximum			**0.48**	**1.22**	**0.00**	**0.87**	**1.11**	**0.00**

extremal internal forces and moments in system of principal axis

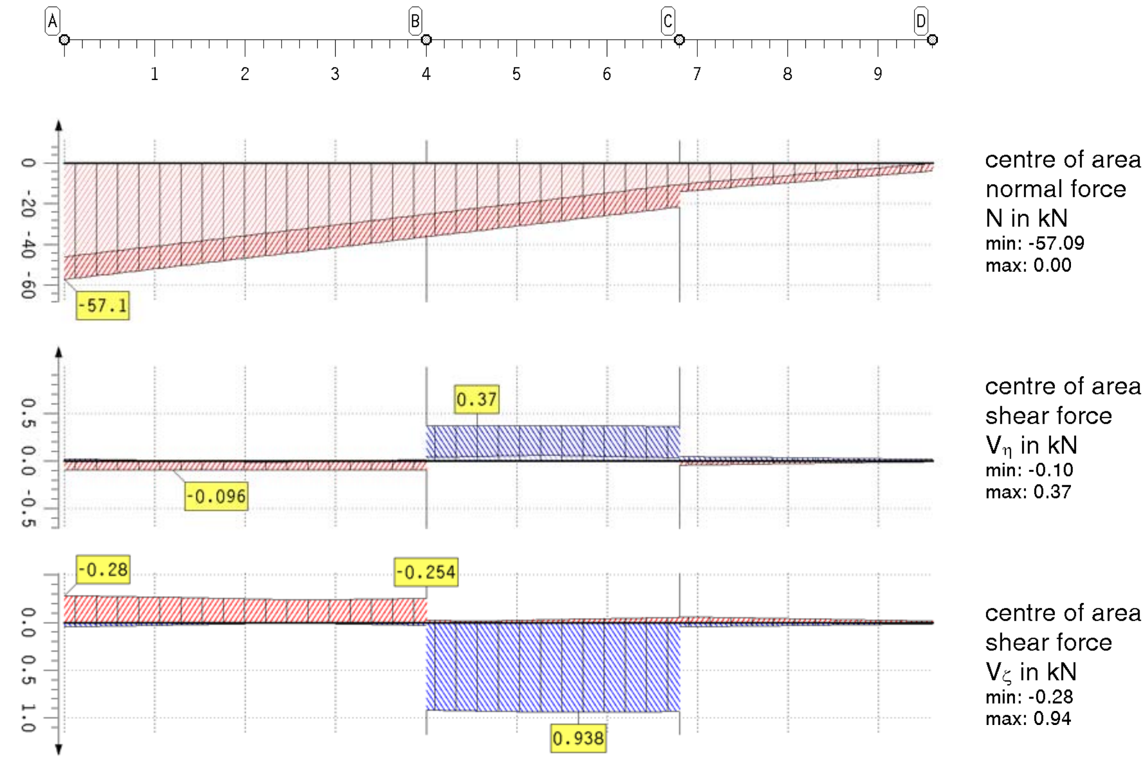


centre of area
torsional moment
T in kNm
min: -0.00
max: 0.00

centre of area
flexural moment
M_η in kNm
min: -0.63
max: 1.98

centre of area
flexural moment
M_ζ in kNm
min: -0.78
max: 0.36

extremal internal forces and moments in system of principal axis

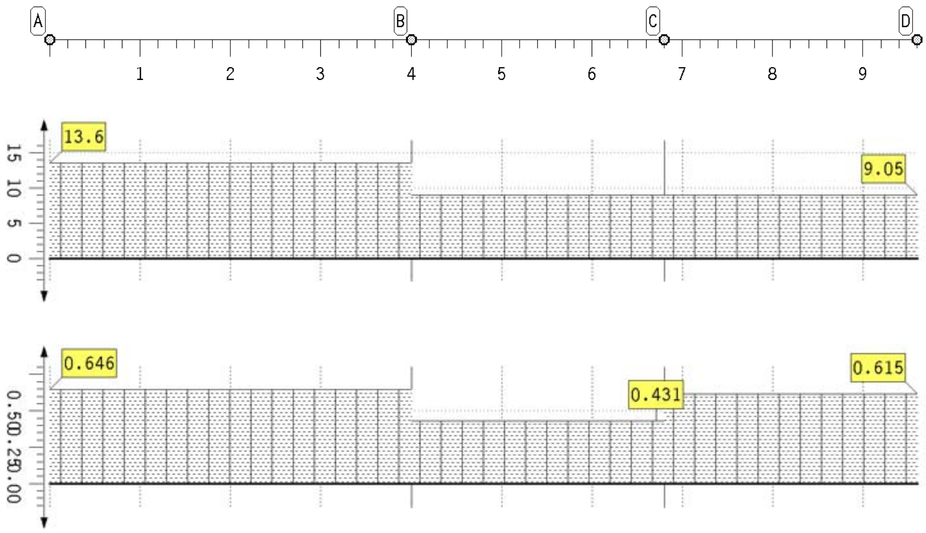


extremal internal forces and moments in system of principal axis

The shear forces V_η, V_ζ, the normal force N and the flexural moments M_η, M_ζ refer to the centre of area.

point	x	type	N	V_η	V_ζ	T	M_η	M_ζ
-	m		kN	kN	kN	kNm	kNm	kNm
A	0.000	min	-57.1	-0.10	-0.28	-0.00	-0.0	-0.1
		max	-46.0	0.02	0.05	0.00	0.4	0.0
	1.100	min	-51.3	-0.10	-0.27	-0.00	-0.0	-0.0
		max	-40.2	0.00	0.03	0.00	0.1	0.0
	2.200	min	-45.5	-0.10	-0.24	-0.00	-0.2	-0.0
		max	-34.4	-0.02	0.01	0.00	0.0	0.1
B	4.000	min	-36.1	-0.09	-0.25	-0.00	-0.6	0.0
		max	-25.0	0.02	0.03	0.00	0.0	0.3
B	4.000	min	-36.1	0.04	-0.02	-0.00	-0.6	0.0
		max	-25.0	0.37	0.92	0.00	0.0	0.3
	4.467	min	-33.6	0.05	-0.02	-0.00	-0.2	0.0
		max	-22.5	0.37	0.93	0.00	0.0	0.1
	5.587	min	-27.8	0.05	-0.03	-0.00	-0.0	-0.3
		max	-16.7	0.37	0.94	0.00	0.8	-0.1
C	6.800	min	-21.4	0.03	-0.05	-0.00	-0.1	-0.8
		max	-10.3	0.36	0.93	0.00	2.0	-0.1
C	6.800	min	-13.9	-0.05	-0.06	-0.00	-0.1	-0.0
		max	-10.3	0.04	0.05	0.00	0.1	0.4
D	9.600	min	-3.6	-0.01	-0.02	-0.00	-0.0	-0.0
		max	0.0	0.01	0.01	0.00	0.0	0.3
minimum			**-57.1**	**-0.10**	**-0.28**	**-0.00**	**-0.6**	**-0.8**
maximum			**0.0**	**0.37**	**0.94**	**0.00**	**2.0**	**0.4**

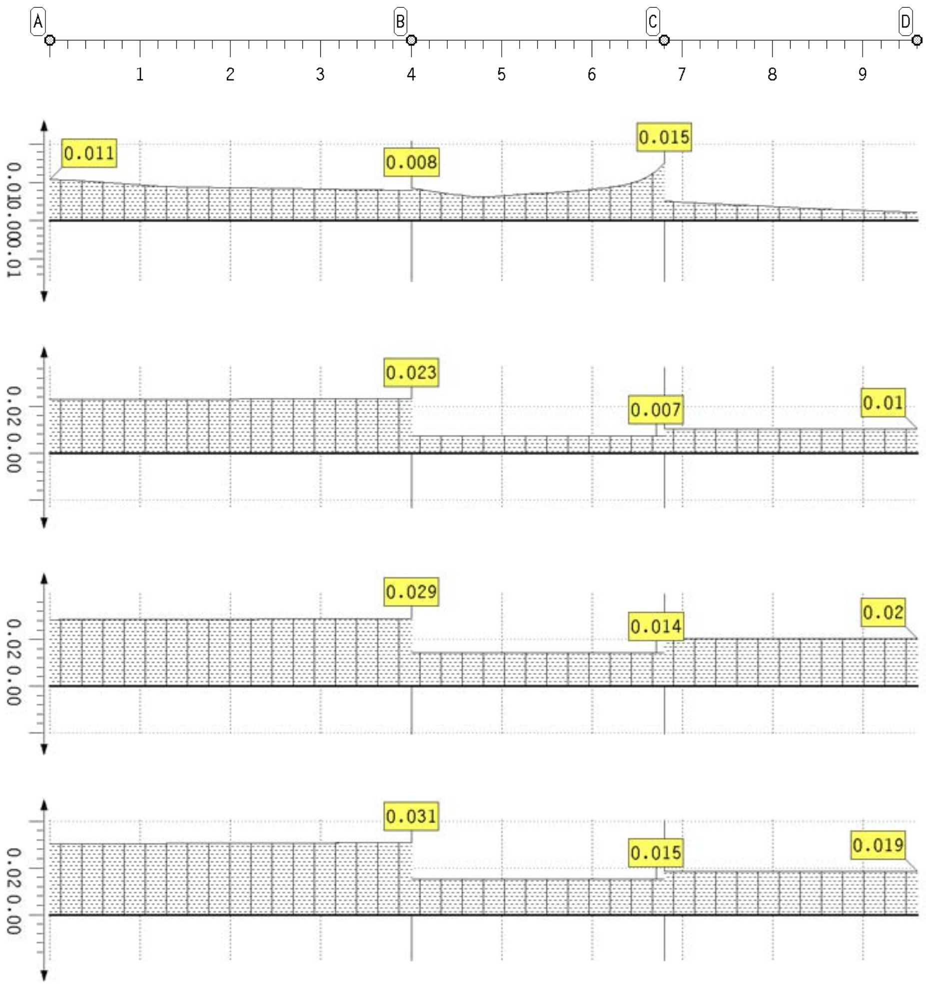
general design results of reinforced concrete



reinf.
As_l in cm^2
max: 13.57

reinforcement ratio
μ_s in %
max: 0.65

Results of calculation in state 2



utilization of
cross-section design res.
max: 0.01

minimal
effective
cross-section area
A_{eff}/A_c
min: 0.01

minimal
eff. sec. mom. of area
about the η-axis
$I_{\eta,eff}/I_{\eta,c}$
min: 0.01

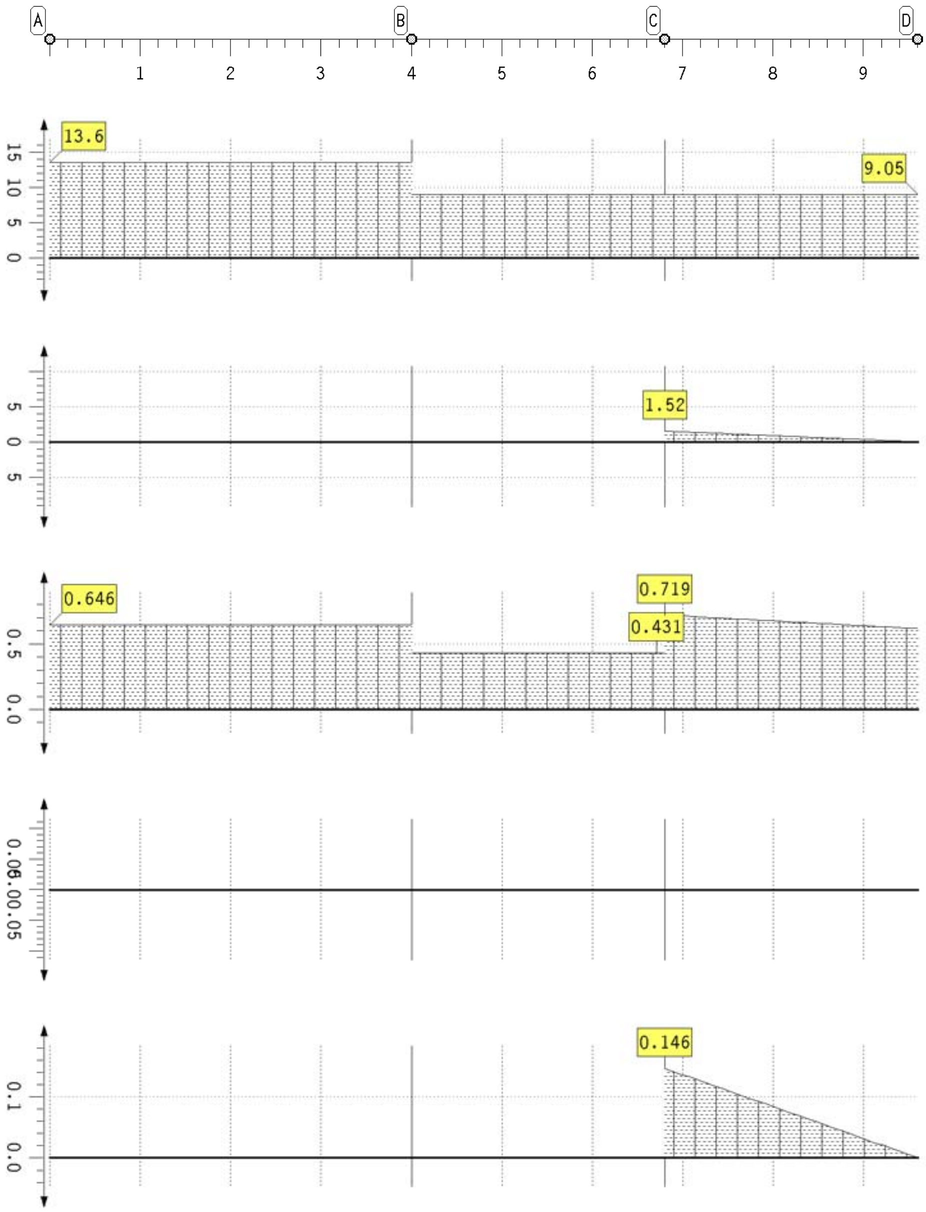
minimal
eff. sec. mom. of area
about the ζ-axis
$I_{\zeta,eff}/I_{\zeta,c}$
min: 0.02

reactions in support points (incl. γ_F)

point	x	type	AP_X	AP_Y	AP_Z	AM_X	AM_Y	AM_Z
-	m		kN	kN	kN	kNm	kNm	kNm
A	0.000	min	-0.12	-0.13	-57.09	-0.01	-0.35	-0.00
		max	0.37	0.16	-45.99	0.13	0.04	0.00
B	4.000	min	-1.16	-0.46	-0.00	-0.00	-0.00	-0.00
		max	0.06	-0.02	0.00	0.00	0.00	0.00
C	6.800	min	-0.10	-0.04	-0.00	-0.00	-1.72	-0.01
		max	1.02	0.37	0.00	0.70	0.06	0.01
D	9.600	min	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
		max	0.00	0.00	0.00	0.00	0.00	0.00

SUMMARY

Verification results of reinforced concrete



reinf.
As_l in cm^2
max: 13.57

longitudinal reinforcement
due to torsion
As_T in cm^2
max: 1.52

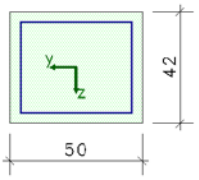
reinforcement ratio
μ_s in %
max: 0.72

stirrup reinforcement
due to shear force
(total)
as_w in cm^2/m
max: 0.00

stirrup reinforcement
due to torsion
(per side)
as_{wT} in cm^2/m
max: 0.15

COMPILATION BY SECTIONS

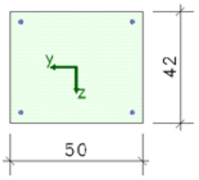
section 1



longit. reinf.	d_s cm	selected	$A_{s,sel}$ cm^2
perimeter	4.0	12 Ø 12	13.57

Nr	verification	executed	ok	note
1	EC 2 design calculation	yes	yes	
2	EC 2 crack limitation	yes	yes	
3	EC 2 buckling safety Z2	yes	yes	
5	EC 2 fire prot.- buckling safety Z2	yes	yes	

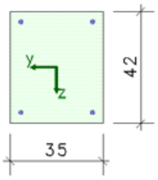
section 2



longit. reinf.	d_s cm	selected	$A_{s,sel}$ cm^2
corners	4.0	4 Ø 12 2er bun.	9.05

Nr	verification	executed	ok	note
1	EC 2 design calculation	yes	yes	
2	EC 2 crack limitation	yes	yes	
3	EC 2 buckling safety Z2	yes	yes	
5	EC 2 fire prot.- buckling safety Z2	yes	yes	

section 3



longit. reinf.	d_s cm	selected	$A_{s,sel}$ cm^2
corners	4.0	4 Ø 12 2er bun.	9.05

Nr	verification	executed	ok	note
1	EC 2 design calculation	yes	yes	
2	EC 2 crack limitation	yes	yes	
3	EC 2 buckling safety Z2	yes	yes	
5	EC 2 fire prot.- buckling safety Z2	yes	yes	

Conclusion

All verifications could be executed successfully in all sections.