Oppdragsgiver:	Kristiansand kommune
Oppdragsnavn:	RA KRS Energi - Solceller Tveit
Oppdragsnummer:	652373-06
Utarbeidet av:	Anders Birkenes
Oppdragsleder:	Stine Lise Fossdal
Dato:	05.05.2026, rev00
Tilgjengelighet:	Åpent

Vurdering av solceller på tak Tveit Flerbrukshall

Sammendrag

Kristiansand kommune har forespurt Asplan Viak om å vurdere takets bæreevne på Tveit Flerbrukshall i forbindelse med planlagt etablering av solceller.

Figur 1 Oversikt Tveit flerbrukshall

Tveit flerbrukshall ble oppført i 2017, og Asplan Viak har gjennomgått dokumentasjon for beregninger av taket, for å kontrollere takets bæreevne.

BAU Planning som gjorde de opprinnelige dimensjoneringene, har kontrollregnet bærebjelker for tilleggslasten fra solcelle-paneler. BAU Planning har godkjent taket for etablering av solceller i den utstrekning det er planlagt.

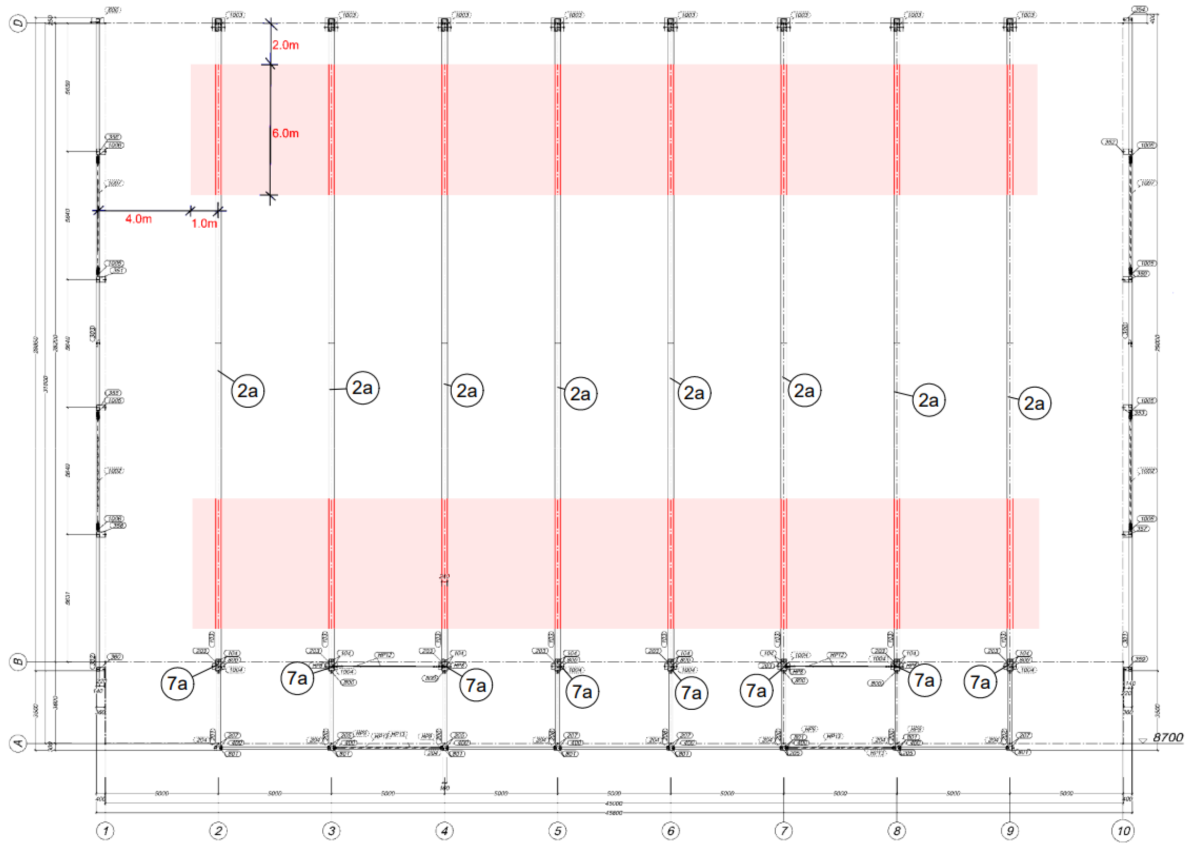
Asplan Viak har gjort vurderinger av Q-dekkets bæreevne. Den økte belastningen fra solceller er innenfor det som aksepteres.

Solcelleanlegg kan etableres i den utstrekning som er vist i Figur 2.

Oppbygning tak

Tveit flerbrukshall er oppført i 2017 og har dimensjoner 29 x 45 m. Takets bæresystem består av limtrebjelker med senteravstand 5,0 m og spennvidde 29 m. Over bjelkene er det etablert et dekke med Q-dekke (korrugerte stålplater), isolasjon og taktekking. Taket er utformet som et saltak med seks graders takfall.

Plassering



Figur 2 Plassering av solceller

Solcellenes foreslåtte plassering ligger nederst på takflaten, inntrukket fra randsoner med størst vindbelastning. Plasseringen er samtidig valgt for å gi minst mulig økning av bøyemoment for limtrebjelkene. Solcellenes egenvekt er oppgitt 30 kg/m2. Omfanget er vist i Figur 2.

Kontroll av limtrebjelker

BAU Planning v/Knut Dubslaff er kontaktet for å kontrollere limtrebjelkene i taket. Firmaet sto for dimensjonering av bjelkene ved oppføring av bygget. BAU Planning er forespurt om å kontrollere bjelkene inkludert tilleggsbelastning fra planlagte solceller vist i Figur 2.

Kontrollberegningene viser at bjelkene har en maksimal utnyttelse på 99 % for bøyemoment. På bakgrunn av dette godkjenner BAU Planning etablering av solceller på taket.

Kontroll av Q-dekke

Asplan Viak har gjennomgått oversendt dokumentasjon for dimensjonering av Q-dekket fra Sørmaskinering. Samlet vurdering, inkludert tilleggsbelastning fra solceller, viser akseptabel utnyttelse, og solcelleanlegg kan etableres på taket.

Brann

Konstruksjonen er ikke vurdert med hensyn til hvordan etablering av solcelleanlegg kan påvirke brannsikkerheten. Det er leverandørens ansvar å vurdere om det er behov for tiltak knyttet til brann.

Vedlegg

- Vedlegg 1: 2026-04-22 Statik_021026a_english

BAU PLANUNG

Ingenieurbüro für Bauplanung Dr. Dubslaff

Statische Berechnung

Auftrag 021026

Bauvorhaben:	Sporthall Kristiansand Kristiansand
Bauherr :	Tveit-Hallen Kalvåsveien 41 N-4658 Tveit
Entwurf:	Ederdahl & Nordbø AS Sivilarkitekter Østre Strandgate 1a N-4666 Kristiansand
Vorschriften:	DIN EN 1991-1 + NA (Lastannahmen) DIN EN 1995-1-1 + NA (Holzbau) DIN EN 1993-1 + NA (Stahlbau)
Baustoffe:	BSH-GL30c,GL24h Stahl S235JR

Literatur/EDV-Programme:
Schneider "Bautabellen" 25. Auflage
MB-Statikprogramme

Bearbeiter: Dr.-Ing. Knut Dubslaff
Qualifizierter Tragwerkwerksplaner IK Bau NRW
Sachkundiger für Holzschutz am Bau
Tel.: 02962/9769723
kd@ib-dubslaff.de

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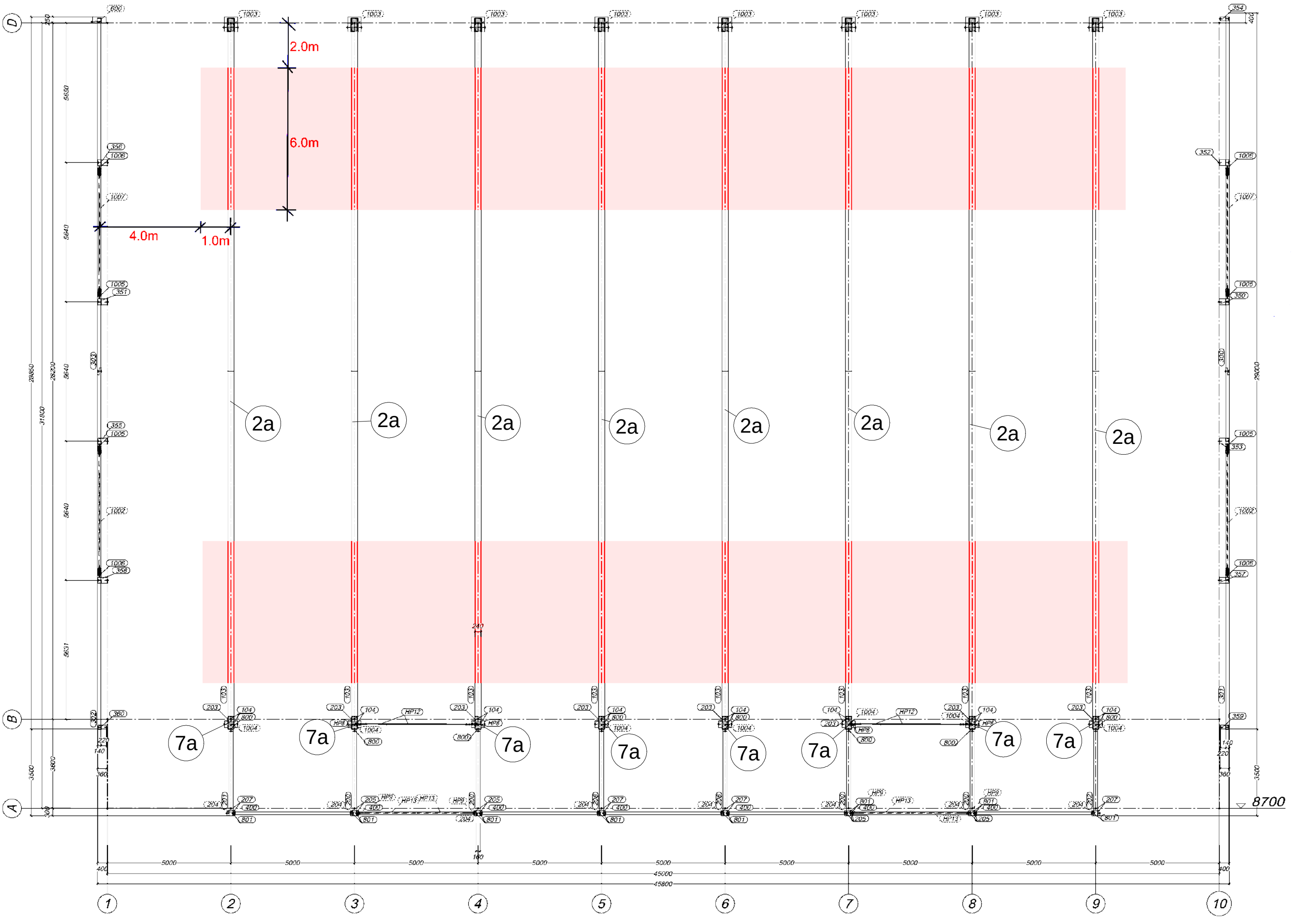
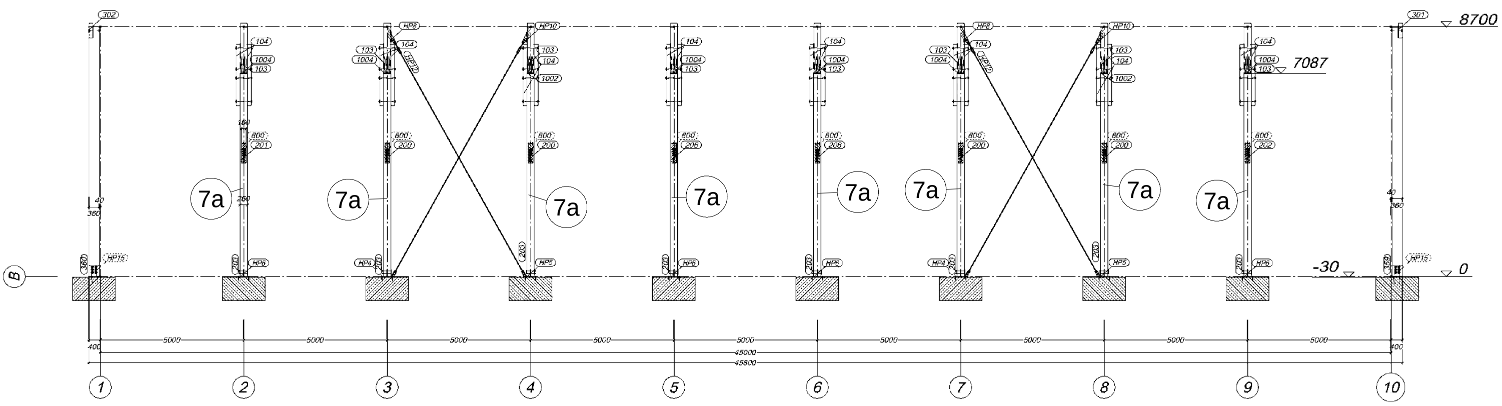
..	Allgemeine konstruktive Angaben	4
2a	Holz-Satteldachbinder BSH GL30c b/h = 26/164...26/210.2 cm	5
7a	Pendelst¿tze BSH GL24h b/h = 26/40 cm	17
7.1a	Schraubenbild FuÇpunkt	23
7.2a	Bolzen	24
7.3a	Skizze	26

Positionsübersicht



Grundriss Dach M 1:75



Achse B M 1:75

Allgemeine konstruktive Angaben

Bei der Berechnung handelt es sich um den Nachweis einer Bestandskonstruktion mit Zusatzlasten aus einer PV-Anlage. Grundlage ist die statische Berechnung vom Ingenieurb¿ro Dr. Dubslaff & Rosenkranz GmbH & Co. KG vom 31.08.2016.

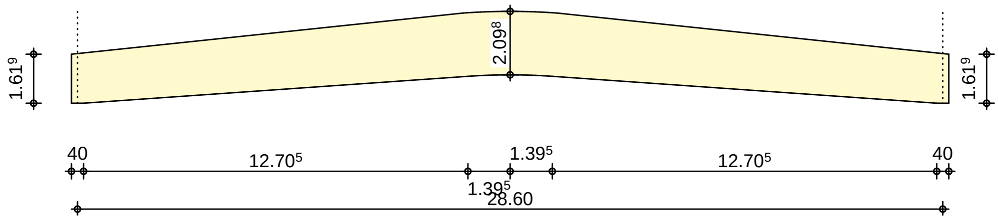
Lastannahmen

Schnee	s_k = 4.00 kN/mɭ
Dachkonstruktion inkl. Pfette	g = 1.10 kN/mɭ
Windlast	q_p = 0.753 kN/mɭ
PV-Anlage	q_k = 0.30 kN/mɭ

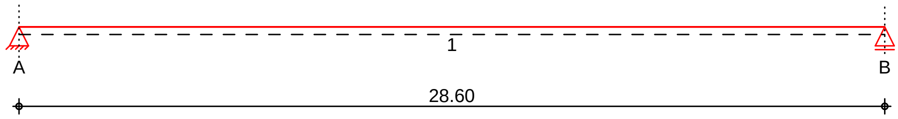
Pos. 2a — Holz-Satteldachbinder

system — curved girder

M 1:250



M 1:250



dimensions
mat./cross section

span	SC	l [m]	x [m]	mat.	b [cm]	h [cm]
1	1	28.60	0.00	*BSH GL30c*	26.0	164.0
			14.30		26.0	209.8
			28.60		26.0	164.0

supports

supp.	x [m]	b [cm]	$K_{T,z}$ [kN/m]
A	0.00	40.00	rigid
B	28.60	40.00	rigid

top chord pitch left	$ä_l$ =	6.00	Á
top chord pitch right	$ä_r$ =	6.00	Á
bottom chord pitch left	$ä_l$ =	4.00	Á
bottom chord pitch right	$ä_r$ =	4.00	Á
radius of curvature	r_{in} =	20.00	m
curvature zone left	c_l =	1.40	m
curvature zone right	c_r =	1.40	m
lamella thickness	t =	4.00	cm

member pos.

distance from verge	a_{Ov} =	5.00	m
load application width left	L_{bl} =	2.50	m
load application width right	L_{br} =	2.50	m

transv. pull reinf.

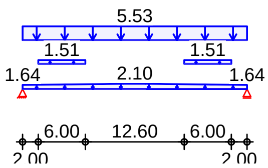
type	number [-]	material	d [mm]
screwed in Standardgewindestange	10 * 1	4.8	16

<u>loadings</u> loadings on the system

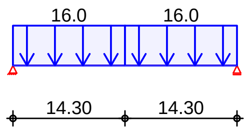
<u>graphic</u> loading graphics (action based)

actions

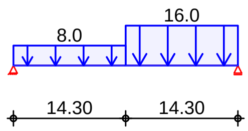
Gk



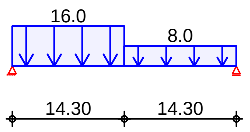
Qk.S.A



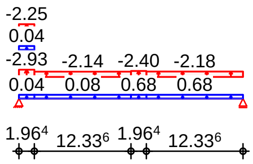
Qk.S.B



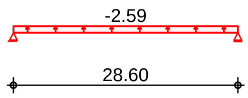
Qk.S.C



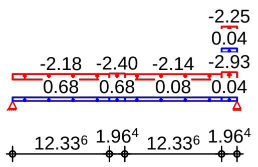
Qk.W.000



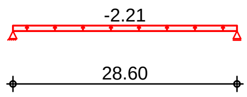
Qk.W.090



Qk.W.180



Qk.W.270



<u>distributed loads</u> block loads
in z-direction

		span	dir.	comm.	a [m]	s [m]	q_{lft} [kN/m]	q_{rgt} [kN/m]
action *Gk*		1	global	dead w.	0.00	12.90	1.64	2.10
		1	global	dead w.	12.90	2.79		2.10
		1	global	dead w.	15.70	12.90	2.10	1.64
	(a)	1	global	roofing	0.00	28.60		5.53
	(b)	1	local		2.00	6.00		1.50
	(b)	1	local		20.60	6.00		1.50
action *Qk.S.A*		1	global	full load	0.00	14.30		16.00
		1	global	full load	14.30	14.30		16.00
action *Qk.S.B*		1	global	half load	0.00	14.30		8.00
		1	global	full load	14.30	14.30		16.00
action *Qk.S.C*		1	global	full load	0.00	14.30		16.00
		1	global	half load	14.30	14.30		8.00
action *Qk.W.000*		1	local	range F+	0.00	1.96		0.04
		1	local	range F-	0.00	1.96		-2.93
		1	local	range G+	0.00	1.96		0.04
		1	local	range G-	0.00	1.96		-2.25
		1	local	range H+	1.96	12.34		0.08
		1	local	range H-	1.96	12.34		-2.14
		1	local	range I+	16.26	12.34		0.68
		1	local	range I-	16.26	12.34		-2.17
		1	local	range J+	14.30	1.96		0.68
		1	local	range J-	14.30	1.96		-2.40
action *Qk.W.090*		1	local	range H	0.00	28.60		-2.59
action *Qk.W.180*		1	local	range F+	26.64	1.96		0.04
		1	local	range F-	26.64	1.96		-2.93
		1	local	range G+	26.64	1.96		0.04
		1	local	range G-	26.64	1.96		-2.25
		1	local	range H+	14.30	12.34		0.08

	span	dir.	comm.	a [m]	s [m]	q_{lft} [kN/m]	q_{rgt} [kN/m]
	1	local	range H-	14.30	12.34		-2.14
	1	local	range I+	0.00	12.34		0.68
	1	local	range I-	0.00	12.34		-2.17
	1	local	range J+	12.34	1.96		0.67
	1	local	range J-	12.34	1.96		-2.40
action *Qk.W.270*	1	local	range I	0.00	28.60		-2.21

(a)	Dachkonstruktion	1.0	=	1.00	kN/m²
	Pfetten	0.10	=	0.10	kN/m²
			=	1.10	kN/m²
(b)	PV-Anlage	0.3*5.0	=	1.50	kN/m

<u>char.intern.forces</u> characteristical internal forces

at girder (load application width 5.00m)

<u>table</u> internal forces (per action)

	span	x [m]	$M_{y,k,min}$ [kNm]	$M_{y,k,max}$ [kNm]	$V_{z,k,min}$ [kN]	$V_{z,k,max}$ [kN]
action *Gk*	1	0.00	0.00*	0.00	115.36	115.36*
		14.30	813.65	813.65*	0.00	0.00
		28.60	0.00	0.00	-115.36*	-115.36
action *Qk.S.A*	1	0.00	0.00*	0.00	228.80	228.80*
		14.30	1635.92	1635.92*	0.00	0.00
		28.60	0.00	0.00	-228.80*	-228.80
action *Qk.S.B*	1	0.00	0.00*	0.00	143.00	143.00*
		14.30	1226.94	1226.94	28.60	28.60
		16.09	1252.50	1252.50*	0.00	0.00
		28.60	0.00	0.00	-200.20*	-200.20
action *Qk.S.C*	1	0.00	0.00*	0.00	200.20	200.20*
		12.51	1252.50	1252.50*	0.00	0.00
		14.30	1226.94	1226.94	-28.60	-28.60
		28.60	0.00	0.00	-143.00*	-143.00
action *Qk.W.000*	1	0.00	0.00	0.00	-36.88*	3.24
		14.30	-227.59	38.55	-8.29	10.32
		14.36	-227.59*	38.67	-8.16	10.28
		17.48	-216.00	41.98*	-0.90	8.16
		28.60	0.00	0.00	-7.55	31.58*
action *Qk.W.090*	1	0.00	0.00	0.00*	-37.21*	-37.21
		14.30	-266.02*	-266.02	0.00	0.00
		28.60	0.00	0.00	37.21	37.21*
action *Qk.W.180*	1	0.00	0.00	0.00	-31.58*	7.55
		11.12	-216.00	41.98*	-8.16	0.90
		14.24	-227.59*	38.67	-10.28	8.16
		14.30	-227.59	38.55	-10.32	8.29
		28.60	0.00	0.00	-3.24	36.88*
action *Qk.W.270*	1	0.00	0.00	0.00*	-31.81*	-31.81
		14.30	-227.46*	-227.46	0.00	0.00
		28.60	0.00	0.00	31.81	31.81*

<u>combinations</u> combinations acc. to DIN EN 1990

	Ek	KLED	ĭ (Ā*Ǵ*EW)	
quasi-permanent	**1**		**1.00*Gk**	
permanent/transient	2	st	1.35*Gk	
	3	**ku**	**1.35*Gk**	**+1.50*Qk.S.A**

Ek	KLED	ĭ (Ā*Ǵ*EW)		
4	ku	1.35*Gk	+1.50*Qk.S.B	
5	ku	1.35*Gk	+1.50*Qk.S.C	
6	sh/vs	1.35*Gk	+1.50*Qk.W.000 (b)	
7	sh/vs	1.35*Gk	+1.50*Qk.W.000 (c)	
8	sh/vs	1.35*Gk	+1.50*Qk.W.000 (a)	
9	sh/vs	1.35*Gk	+1.50*Qk.W.090	
10	sh/vs	1.35*Gk	+1.50*Qk.W.180 (b)	
11	sh/vs	1.35*Gk	+1.50*Qk.W.180 (c)	
12	sh/vs	1.35*Gk	+1.50*Qk.W.180 (a)	
13	sh/vs	1.35*Gk	+1.50*Qk.W.270	
14	sh/vs	1.35*Gk	+1.50*Qk.S.A	+0.90*Qk.W.000 (b)
15	**sh/vs**	**1.35*Gk**	**+1.50*Qk.S.A**	**+0.90*Qk.W.000 (c)**
16	sh/vs	1.35*Gk	+1.50*Qk.S.A	+0.90*Qk.W.000 (a)
17	sh/vs	1.35*Gk	+0.75*Qk.S.A	+1.50*Qk.W.000 (b)
18	sh/vs	1.35*Gk	+0.75*Qk.S.A	+1.50*Qk.W.000 (c)
19	sh/vs	1.35*Gk	+0.75*Qk.S.A	+1.50*Qk.W.000 (a)
20	sh/vs	1.35*Gk	+1.50*Qk.S.A	+0.90*Qk.W.090
21	sh/vs	1.35*Gk	+0.75*Qk.S.A	+1.50*Qk.W.090
22	sh/vs	1.35*Gk	+1.50*Qk.S.A	+0.90*Qk.W.180 (b)
23	**sh/vs**	**1.35*Gk**	**+1.50*Qk.S.A**	**+0.90*Qk.W.180 (c)**
24	sh/vs	1.35*Gk	+1.50*Qk.S.A	+0.90*Qk.W.180 (a)
25	sh/vs	1.35*Gk	+0.75*Qk.S.A	+1.50*Qk.W.180 (b)
26	sh/vs	1.35*Gk	+0.75*Qk.S.A	+1.50*Qk.W.180 (c)
27	sh/vs	1.35*Gk	+0.75*Qk.S.A	+1.50*Qk.W.180 (a)
28	sh/vs	1.35*Gk	+1.50*Qk.S.A	+0.90*Qk.W.270
29	sh/vs	1.35*Gk	+0.75*Qk.S.A	+1.50*Qk.W.270
30	sh/vs	1.35*Gk	+1.50*Qk.S.B	+0.90*Qk.W.000 (b)
31	sh/vs	1.35*Gk	+1.50*Qk.S.B	+0.90*Qk.W.000 (c)
32	sh/vs	1.35*Gk	+1.50*Qk.S.B	+0.90*Qk.W.000 (a)
33	sh/vs	1.35*Gk	+0.75*Qk.S.B	+1.50*Qk.W.000 (b)
34	sh/vs	1.35*Gk	+0.75*Qk.S.B	+1.50*Qk.W.000 (c)
35	sh/vs	1.35*Gk	+0.75*Qk.S.B	+1.50*Qk.W.000 (a)
36	sh/vs	1.35*Gk	+1.50*Qk.S.B	+0.90*Qk.W.090
37	sh/vs	1.35*Gk	+0.75*Qk.S.B	+1.50*Qk.W.090
38	sh/vs	1.35*Gk	+1.50*Qk.S.B	+0.90*Qk.W.180 (b)

Ek KLED ĭ (Ā*Ǵ*EW)

39	sh/vs	1.35*Gk	+1.50*Qk.S.B	+0.90*Qk.W.180 (c)
40	sh/vs	1.35*Gk	+1.50*Qk.S.B	+0.90*Qk.W.180 (a)
41	sh/vs	1.35*Gk	+0.75*Qk.S.B	+1.50*Qk.W.180 (b)
42	sh/vs	1.35*Gk	+0.75*Qk.S.B	+1.50*Qk.W.180 (c)
43	sh/vs	1.35*Gk	+0.75*Qk.S.B	+1.50*Qk.W.180 (a)
44	sh/vs	1.35*Gk	+1.50*Qk.S.B	+0.90*Qk.W.270
45	sh/vs	1.35*Gk	+0.75*Qk.S.B	+1.50*Qk.W.270
46	sh/vs	1.35*Gk	+1.50*Qk.S.C	+0.90*Qk.W.000 (b)
47	sh/vs	1.35*Gk	+1.50*Qk.S.C	+0.90*Qk.W.000 (c)
48	sh/vs	1.35*Gk	+1.50*Qk.S.C	+0.90*Qk.W.000 (a)
49	sh/vs	1.35*Gk	+0.75*Qk.S.C	+1.50*Qk.W.000 (b)
50	sh/vs	1.35*Gk	+0.75*Qk.S.C	+1.50*Qk.W.000 (c)
51	sh/vs	1.35*Gk	+0.75*Qk.S.C	+1.50*Qk.W.000 (a)
52	sh/vs	1.35*Gk	+1.50*Qk.S.C	+0.90*Qk.W.090
53	sh/vs	1.35*Gk	+0.75*Qk.S.C	+1.50*Qk.W.090
54	sh/vs	1.35*Gk	+1.50*Qk.S.C	+0.90*Qk.W.180 (b)
55	sh/vs	1.35*Gk	+1.50*Qk.S.C	+0.90*Qk.W.180 (c)
56	sh/vs	1.35*Gk	+1.50*Qk.S.C	+0.90*Qk.W.180 (a)
57	sh/vs	1.35*Gk	+0.75*Qk.S.C	+1.50*Qk.W.180 (b)
58	sh/vs	1.35*Gk	+0.75*Qk.S.C	+1.50*Qk.W.180 (c)
59	sh/vs	1.35*Gk	+0.75*Qk.S.C	+1.50*Qk.W.180 (a)
60	sh/vs	1.35*Gk	+1.50*Qk.S.C	+0.90*Qk.W.270
61	sh/vs	1.35*Gk	+0.75*Qk.S.C	+1.50*Qk.W.270
62	st	1.00*Gk		
63	ku	1.00*Gk	+1.50*Qk.S.A	
64	ku	1.00*Gk	+1.50*Qk.S.B	
65	ku	1.00*Gk	+1.50*Qk.S.C	
66	sh/vs	1.00*Gk	+1.50*Qk.W.000 (b)	
67	sh/vs	1.00*Gk	+1.50*Qk.W.000 (c)	
68	sh/vs	1.00*Gk	+1.50*Qk.W.000 (a)	
69	sh/vs	1.00*Gk	+1.50*Qk.W.090	
70	sh/vs	1.00*Gk	+1.50*Qk.W.180 (b)	
71	sh/vs	1.00*Gk	+1.50*Qk.W.180 (c)	
72	sh/vs	1.00*Gk	+1.50*Qk.W.180 (a)	
73	sh/vs	1.00*Gk	+1.50*Qk.W.270	
74	sh/vs	1.00*Gk	+1.50*Qk.S.A	+0.90*Qk.W.000 (b)

Ek KLED ĭ (Ā*Ǵ*EW)

75	sh/vs	1.00*Gk	+1.50*Qk.S.A	+0.90*Qk.W.000 (c)
76	sh/vs	1.00*Gk	+1.50*Qk.S.A	+0.90*Qk.W.000 (a)
77	sh/vs	1.00*Gk	+0.75*Qk.S.A	+1.50*Qk.W.000 (b)
78	sh/vs	1.00*Gk	+0.75*Qk.S.A	+1.50*Qk.W.000 (c)
79	sh/vs	1.00*Gk	+0.75*Qk.S.A	+1.50*Qk.W.000 (a)
80	sh/vs	1.00*Gk	+1.50*Qk.S.A	+0.90*Qk.W.090
81	sh/vs	1.00*Gk	+0.75*Qk.S.A	+1.50*Qk.W.090
82	sh/vs	1.00*Gk	+1.50*Qk.S.A	+0.90*Qk.W.180 (b)
83	sh/vs	1.00*Gk	+1.50*Qk.S.A	+0.90*Qk.W.180 (c)
84	sh/vs	1.00*Gk	+1.50*Qk.S.A	+0.90*Qk.W.180 (a)
85	sh/vs	1.00*Gk	+0.75*Qk.S.A	+1.50*Qk.W.180 (b)
86	sh/vs	1.00*Gk	+0.75*Qk.S.A	+1.50*Qk.W.180 (c)
87	sh/vs	1.00*Gk	+0.75*Qk.S.A	+1.50*Qk.W.180 (a)
88	sh/vs	1.00*Gk	+1.50*Qk.S.A	+0.90*Qk.W.270
89	sh/vs	1.00*Gk	+0.75*Qk.S.A	+1.50*Qk.W.270
90	sh/vs	1.00*Gk	+1.50*Qk.S.B	+0.90*Qk.W.000 (b)
91	sh/vs	1.00*Gk	+1.50*Qk.S.B	+0.90*Qk.W.000 (c)
92	sh/vs	1.00*Gk	+1.50*Qk.S.B	+0.90*Qk.W.000 (a)
93	sh/vs	1.00*Gk	+0.75*Qk.S.B	+1.50*Qk.W.000 (b)
94	sh/vs	1.00*Gk	+0.75*Qk.S.B	+1.50*Qk.W.000 (c)
95	sh/vs	1.00*Gk	+0.75*Qk.S.B	+1.50*Qk.W.000 (a)
96	sh/vs	1.00*Gk	+1.50*Qk.S.B	+0.90*Qk.W.090
97	sh/vs	1.00*Gk	+0.75*Qk.S.B	+1.50*Qk.W.090
98	sh/vs	1.00*Gk	+1.50*Qk.S.B	+0.90*Qk.W.180 (b)
99	sh/vs	1.00*Gk	+1.50*Qk.S.B	+0.90*Qk.W.180 (c)
100	sh/vs	1.00*Gk	+1.50*Qk.S.B	+0.90*Qk.W.180 (a)
101	sh/vs	1.00*Gk	+0.75*Qk.S.B	+1.50*Qk.W.180 (b)
102	sh/vs	1.00*Gk	+0.75*Qk.S.B	+1.50*Qk.W.180 (c)
103	sh/vs	1.00*Gk	+0.75*Qk.S.B	+1.50*Qk.W.180 (a)
104	sh/vs	1.00*Gk	+1.50*Qk.S.B	+0.90*Qk.W.270
105	sh/vs	1.00*Gk	+0.75*Qk.S.B	+1.50*Qk.W.270
106	sh/vs	1.00*Gk	+1.50*Qk.S.C	+0.90*Qk.W.000 (b)
107	sh/vs	1.00*Gk	+1.50*Qk.S.C	+0.90*Qk.W.000 (c)
108	sh/vs	1.00*Gk	+1.50*Qk.S.C	+0.90*Qk.W.000 (a)

Ek KLED ĭ (Ā*Ǵ*EW)

109	sh/vs	1.00*Gk	+0.75*Qk.S.C	+1.50*Qk.W.000 (b)
110	sh/vs	1.00*Gk	+0.75*Qk.S.C	+1.50*Qk.W.000 (c)
111	sh/vs	1.00*Gk	+0.75*Qk.S.C	+1.50*Qk.W.000 (a)
112	sh/vs	1.00*Gk	+1.50*Qk.S.C	+0.90*Qk.W.090
113	sh/vs	1.00*Gk	+0.75*Qk.S.C	+1.50*Qk.W.090
114	sh/vs	1.00*Gk	+1.50*Qk.S.C	+0.90*Qk.W.180 (b)
115	sh/vs	1.00*Gk	+1.50*Qk.S.C	+0.90*Qk.W.180 (c)
116	sh/vs	1.00*Gk	+1.50*Qk.S.C	+0.90*Qk.W.180 (a)
117	sh/vs	1.00*Gk	+0.75*Qk.S.C	+1.50*Qk.W.180 (b)
118	sh/vs	1.00*Gk	+0.75*Qk.S.C	+1.50*Qk.W.180 (c)
119	sh/vs	1.00*Gk	+0.75*Qk.S.C	+1.50*Qk.W.180 (a)
120	sh/vs	1.00*Gk	+1.50*Qk.S.C	+0.90*Qk.W.270
121	sh/vs	1.00*Gk	+0.75*Qk.S.C	+1.50*Qk.W.270
122	sh/vs	1.35*Gk	+1.50*Qk.W.000 (d)	
123	sh/vs	1.35*Gk	+1.50*Qk.S.A	+0.90*Qk.W.000 (d)
124	sh/vs	1.35*Gk	+0.75*Qk.S.A	+1.50*Qk.W.000 (d)
125	**sh/vs**	**1.35*Gk**	**+1.50*Qk.S.B**	**+0.90*Qk.W.000 (d)**
126	sh/vs	1.35*Gk	+0.75*Qk.S.B	+1.50*Qk.W.000 (d)
127	sh/vs	1.35*Gk	+1.50*Qk.S.C	+0.90*Qk.W.000 (d)
128	sh/vs	1.35*Gk	+0.75*Qk.S.C	+1.50*Qk.W.000 (d)
129	sh/vs	1.00*Gk	+1.50*Qk.W.000 (d)	
130	sh/vs	1.00*Gk	+1.50*Qk.S.A	+0.90*Qk.W.000 (d)
131	sh/vs	1.00*Gk	+0.75*Qk.S.A	+1.50*Qk.W.000 (d)
132	sh/vs	1.00*Gk	+1.50*Qk.S.B	+0.90*Qk.W.000 (d)
133	sh/vs	1.00*Gk	+0.75*Qk.S.B	+1.50*Qk.W.000 (d)
134	sh/vs	1.00*Gk	+1.50*Qk.S.C	+0.90*Qk.W.000 (d)
135	sh/vs	1.00*Gk	+0.75*Qk.S.C	+1.50*Qk.W.000 (d)
136	sh/vs	1.35*Gk	+1.50*Qk.W.180 (d)	
137	sh/vs	1.35*Gk	+1.50*Qk.S.A	+0.90*Qk.W.180 (d)
138	sh/vs	1.35*Gk	+0.75*Qk.S.A	+1.50*Qk.W.180 (d)
139	sh/vs	1.35*Gk	+1.50*Qk.S.B	+0.90*Qk.W.180 (d)
140	sh/vs	1.35*Gk	+0.75*Qk.S.B	+1.50*Qk.W.180 (d)

Ek KLED ĭ (Ā*Ǵ*EW)

	No.	type			
	141	sh/vs	1.35*Gk	+1.50*Qk.S.C	+0.90*Qk.W.180 (d)
	142	sh/vs	1.35*Gk	+0.75*Qk.S.C	+1.50*Qk.W.180 (d)
	143	sh/vs	1.00*Gk	+1.50*Qk.W.180 (d)	
	144	sh/vs	1.00*Gk	+1.50*Qk.S.A	+0.90*Qk.W.180 (d)
	145	sh/vs	1.00*Gk	+0.75*Qk.S.A	+1.50*Qk.W.180 (d)
	146	sh/vs	1.00*Gk	+1.50*Qk.S.B	+0.90*Qk.W.180 (d)
	147	sh/vs	1.00*Gk	+0.75*Qk.S.B	+1.50*Qk.W.180 (d)
	148	sh/vs	1.00*Gk	+1.50*Qk.S.C	+0.90*Qk.W.180 (d)
	149	sh/vs	1.00*Gk	+0.75*Qk.S.C	+1.50*Qk.W.180 (d)
perm./trans. supp. r.	150	st	1.35*Gk		
	151	sh/vs	1.35*Gk	+1.50*Qk.S.A	+0.90*Qk.W.000 (c)
	152	sh/vs	1.35*Gk	+1.50*Qk.S.A	+0.90*Qk.W.180 (c)
	153	sh/vs	1.00*Gk	+1.50*Qk.W.090	

a: wind load case pressure luv + suction lee
b: wind load case suction luv + suction lee
c: wind load case pressure luv + pressure lee
d: wind load case suction luv + pressure lee
st: permanent
ku: short
sh/vs: short/very short

The combined deformations already include creep shares k_{def}.

<u>design int. forces</u> design internal forces

at girder (load application width 5.00m)

<u>table</u> internal forces (decisive)

	span	x [m]	$M_{y,d}$ [kNm]	$V_{z,d}$ [kN]
comb. *3*	1	0.00	0.00*	498.94*
		14.30	3552.30*	0.00
		28.60	0.00	-498.94*
comb. *15*	1	0.00	0.00*	501.85*
		14.30	3587.00	1.94
		14.37	3587.05*	-0.49
		28.60	0.00	-505.73*
comb. *23*	1	0.00	0.00*	505.73*
		14.23	3587.05*	0.49
		14.30	3587.00	-1.94
		28.60	0.00	-501.85*
comb. *125*	1	0.00	0.00*	346.45*
		14.30	2868.52	52.18
		15.77	2907.51*	0.92
		28.60	0.00	-455.49*
comb. *141*	1	0.00	0.00*	455.49*
		12.83	2907.51*	-0.92
		14.30	2868.52	-52.18
		28.60	0.00	-346.45*

design deform. — design deformations

at girder (load application width 5.00m)

table — deformations (decisive)

	span	x [m]	$w_{z,d}$ [mm]
comb. *1*	1	0.00	0.00*
		14.30	49.74*
		28.60	0.00

mat./cross section — material and sectional values acc. DIN EN 1995-1-1

material

wood	$f_{m,k}$	$f_{t,90,k}$	$f_{c,0,k}$	$f_{c,90,k}$ [N/mm²]	$f_{v,k}$	$E_{0,mean}$
BSH GL30c	30.0	0.5	24.5	2.5	3.5	13000

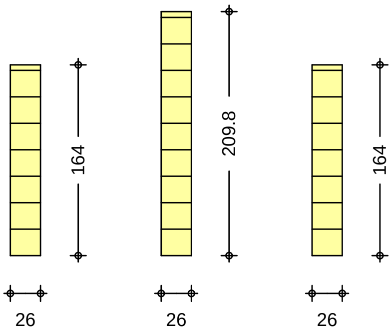
sectional values

span	x [m]	b_{net} [cm]	h [cm]	A [cm²]	I_y [cm⁴]
1	0.00	26.0	164.0	4264.0	9557045.3
	1.77	26.0	171.6	4462.6	10955250.5
	14.30	24.4	209.8	5118.3	18768244.7
	26.83	26.0	171.6	4462.6	10955250.5
	28.60	26.0	164.0	4264.0	9557045.3

graphic

M 1:65

truss sections



transv. pull reinf. — screwed in Standardgewindestange

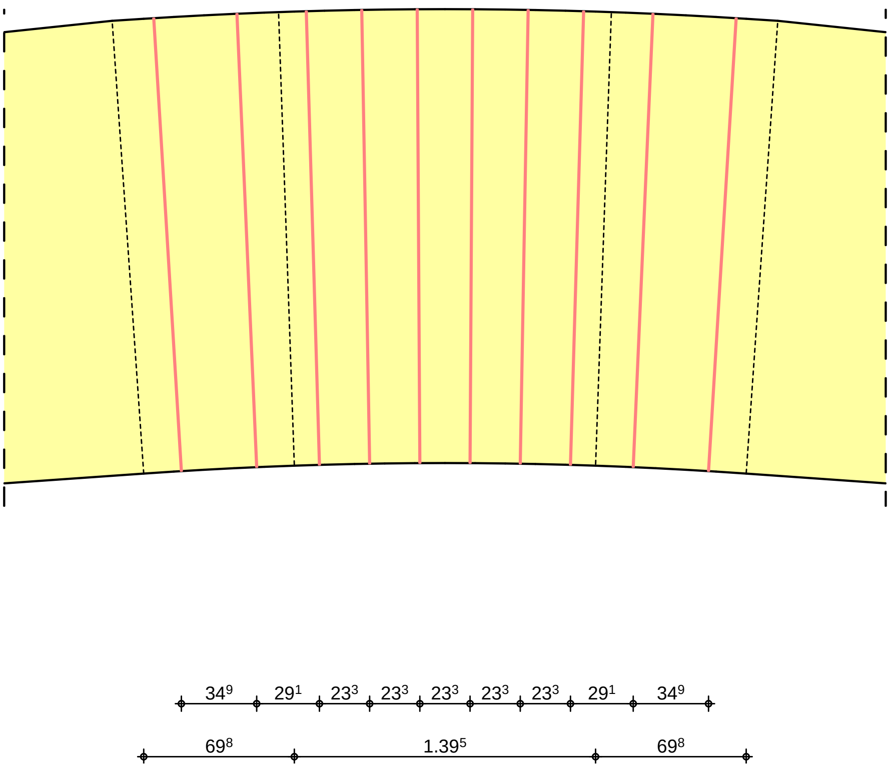
mat.	d [mm]	$f_{ax,k}$ [N/mm²]	f_{ub} [N/mm²]	$F_{ax,Rk,A}$ [kN]	$F_{ax,Rk,Z}$ [kN]
4.8	16	8.58	400.00	171.86	40.72

number and distances

location	n [-]	n_1 [-]	a_1 [mm]	l_{ef} [mm]
inside c/2 = 1395 mm	1	6	250	1009
outside c/4 = 698 mm	1	2	322	

n: number of rows within the distance a_1
n_1: number within the inner or outer range resp.
a_1: distance of the fasteners in grain direction

M 1:35



<u>verifications (ULS)</u>

verifications at ultimate limit state acc. to DIN EN 1995-1-1

- The bending and tensile strengths were modified with the coefficient k_h acc. to 3.3(3).

<u>bending</u>
para. 6.4

verification of bending resistance

	x [m]	Ek	k_{mod} [-]	M_{yd} [kNm]	ǯm,0,d / ǯm,Ä,d [N/mm²]	fm,0,d / fm,Ä,d [N/mm²]	Ǥ [-]
span 1	*(L =28.60 m)*						
	14.30	3	0.90	3552.30	20.66	20.77	
					20.66	20.77	0.99*

<u>shear force</u>
para. 6.1.7

verification of lateral force resistance

	x [m]	Ek	k_{mod} [-]	$V_{z,d}$ [kN]	ǰd [N/mm²]	$f_{v,d}$ [N/mm²]	Ǥ [-]
span 1	0.00	3	0.90	436.85	2.15	2.42	0.89
	1.77	3	0.90	436.85	2.06	2.42	0.85
	14.30	125	1.00	52.18	0.21	2.69	0.08
	14.30	141	1.00	-52.18	0.21	2.69	0.08
	26.83	3	0.90	-436.85	2.06	2.42	0.85
	28.60	3	0.90	-436.85	2.15	2.42	0.89*

<u>stability (TFB)</u>
para. 6.3

verification of lateral buckling

	x [m]	Ek	k_{mod} [-]	M_{yd} [kNm]	ǯm,d [N/mm²]	f*m,d [N/mm²]	Ǥ [-]
buckling span 1	*(lef,m = 6.15m, kcrit = 0.99, km,Ä = 0.98, h0,65 = 1.79m)*						
	6.15	3	0.90	2411.72	15.91	20.37	0.79
buckling span 2	*(lef,m = 6.15m, kcrit = 0.96, km,Ä = 0.98, h0,65 = 2.01m)*						
	10.90	3	0.90	3354.07	18.65	20.37	0.95
buckling span 3	*(lef,m = 4.00m, kcrit = 1.00, km,Ä = 0.96, h0,65 = 2.10m)*						
	14.30	3	0.90	3552.30	19.85	19.95	0.99*
buckling span 4	*(lef,m = 6.15m, kcrit = 0.96, km,Ä = 0.98, h0,65 = 2.01m)*						

	x [m]	Ek	k_{mod} [-]	M_{yd} [kNm]	$\sigma_{m,d}$ [N/mm²]	$f^*_{m,d}$ [N/mm²]	η [-]
	17.70	3	0.90	3354.07	18.65	20.37	0.95
buckling span 5	*($l_{ef,m}$ = 6.15m, k_{crit} = 0.99, $k_{m,A}$ = 0.98, $h_{0,65}$ = 1.79m)*						
	22.45	3	0.90	2411.72	15.91	20.37	0.79

$f^*_{m,d}$: $k_{m,A}$ * $f_{m,d}$

<u>transv. tension</u> verification of transverse pull with reinforcement
<u>transv. pull reinf.</u> verification of transverse pull reinforcement
NCI NA.6.8.5

	x [m]	ac	k_{mod} [-]	$F_{t,90,d}$ [kN]	$F_{ax,Rd,A}$ [kN]	$F_{ax,Rd,Z}$ [kN]	η [-]
span 1	14.30	15	1.00	30.46	132.20	32.57	0.94*

<u>verifications (SLS)</u> verifications in serviceability limit state acc. to DIN EN 1995-1-1

<u>deformations</u> verification of deformations
para. 7.2

	x [m]	Ek	code	w_{prov} [mm]		w_{perm} [mm]	η [-]
span 1	*(L= 28.60 m, SC 1, k_{def} = 0.60)*						
	14.30	1	$w_{net,fin}$	49.7	l/300=	95.3	0.52*

<u>support reactions</u>

char. supp. react. characteristic support reactions (per action)

	supp.	$F_{z,k,min}$ [kN]	$F_{z,k,max}$ [kN]
action *Gk*	A	115.36	115.36
	B	115.36	115.36
action *Qk.S.A*	A	228.80	228.80
	B	228.80	228.80
action *Qk.S.B*	A	143.00	143.00
	B	200.20	200.20
action *Qk.S.C*	A	200.20	200.20
	B	143.00	143.00
action *Qk.W.000*	A	-36.88	3.24
	B	-31.58	7.55
action *Qk.W.090*	A	-37.21	-37.21
	B	-37.21	-37.21
action *Qk.W.180*	A	-31.58	7.55
	B	-36.88	3.24
action *Qk.W.270*	A	-31.81	-31.81
	B	-31.81	-31.81

design supp. react.

	supp.	$F_{z,d}$ [kN]
comb. *150*	A	155.74
	B	155.74
comb. *151*	A	501.85
	B	505.73
comb. *152*	A	505.73
	B	501.85
comb. *153*	A	59.55
	B	59.55

summary — summary of verifications

verifications (ULS) — verifications in ultimate limit state

verification	span	x [m]		G [-]
bending	1	14.30	OK	0.99
shear force	1	28.60	OK	0.89
lateral buckling	1	14.30	OK	0.99
transv. pull reinf.	1	14.30	OK	0.94

verifications (SLS) — verifications in serviceability limit state

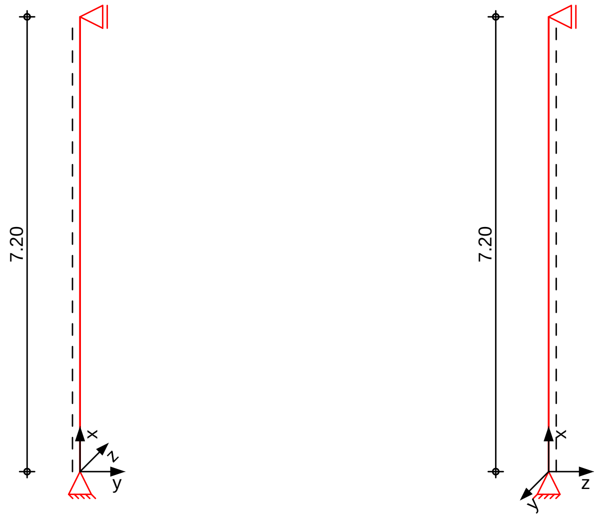
verification	span	x [m]		G [-]
sag	1	14.30	OK	0.52

Pos. 7a — Pendelst¿tze

system — pinned column of wood acc. DIN EN 1995-1-1

system

M 1:120



dimensions
mat./cross section

	l [m]	material	b_y/b_z [cm]
	7.20	*BSH GL24h*	26/40

service class 1 heated interior

loadings — loadings on the system

distributed loads in x-direction — uniform loads

	comm.	a [m]	s [m]	q_b [kN/m]	q_t [kN/m]
action *Gk*	dead w.	0.00	7.20		0.38

single loads in x-direction — single loads

		comm.	a [m]	F_x [kN]	e_y [cm]	e_z [cm]
action *Gk*	(a)		7.20	115.36	0.0	0.0
	(b)		7.20	6.29	0.0	0.0
action *Qk.S.A*	(a)		7.20	228.80	0.0	0.0
	(c)		7.20	67.16	0.0	0.0
action *Qk.S.B*	(a)		7.20	143.00	0.0	0.0
action *Qk.S.C*	(a)		7.20	200.20	0.0	0.0
action *Qk.W.000*	(a)		7.20	3.23	0.0	0.0
	(d)		7.20	0.14	0.0	0.0
action *Qk.W.090*	(a)		7.20	-37.20	0.0	0.0
	(e)		7.20	-59.76	0.0	0.0
	(f)		7.20	-3.65	0.0	0.0
action *Qk.W.180*	(a)		7.20	7.55	0.0	0.0
	(g)		7.20	-7.21	0.0	0.0
action *Qk.W.270*	(a)		7.20	-31.81	0.0	0.0
	(h)		7.20	59.76	0.0	0.0
	(i)		7.20	-3.65	0.0	0.0

(a) from pos. '2a', support 'A' (page 15)

(b) from pos. '11' B (Fz), Gk (max) *(5)
1.257*(5) = 6.29 kN

(c) from pos. '11' B (Fz), Qk.S.A (max) *(5)
13.431*(5) = 67.16 kN

(d) from pos. '11' B (Fz), Qk.W.000 (max) *(5)
0.028*(5) = 0.14 kN

(e) from pos. '6' variable 'Axw' *(-1)
59.760*(-1) = -59.76 kN

(f) from pos. '11' B (Fz), Qk.W.090 (max) *(5)
-0.729*(5) = -3.65 kN

(g) from pos. '11' B (Fz), Qk.W.180 (max) *(5)
-1.441*(5) = -7.21 kN

(h) from pos. '6' variable 'Axw'
59.760 = 59.76 kN

(i) from pos. '11' B (Fz), Qk.W.270 (max) *(5)
-0.729*(5) = -3.65 kN

single loads in y-direction

single loads

	comm.	a [m]	F_y [kN]
action *Qk.W.090*	(a)	0.00	37.35

(a) from pos. '6' variable 'Hk'
37.350 = 37.35 kN

distributed loads in z-direction

uniform loads

	comm.	a [m]	s [m]	q_b [kN/m]	q_t [kN/m]
action *Qk.W.000*	(a)	0.00	7.20		2.67
action *Qk.W.090*	(b)	0.00	7.20		-3.00
action *Qk.W.180*	(c)	0.00	7.20		-1.22
	(d)	0.00	7.20		-3.00

(a) from pos. '01' Wind, D, WeD, Qk.W.000 *(5.0)
0.534*(5.0) = 2.67 kN/m

(b) from pos. '01' Wind, B, WeD, Qk.W.090 *(5.0)
-0.600*(5.0) = -3.00 kN/m

(c) from pos. '01' Wind, E, WeD, Qk.W.180 *(5.0)
-0.243*(5.0) = -1.22 kN/m

(d) from pos. '01' Wind, B, WeD,
Qk.W.270 *(5.0)
-0.600*(5.0) = -3.00 kN/m

combinations — combinations acc. to DIN EN 1990
depiction of decisive combination

permanent/transient

Ek	KLED	ĭ (Ā*Ǵ*EW)		
2	ku	1.35*Gk	+1.50*Qk.S.A	
7	sh/vs	1.35*Gk	+1.50*Qk.W.180	
13	sh/vs	1.35*Gk	+1.50*Qk.S.A	+0.90*Qk.W.180
38	sh/vs	1.00*Gk	+1.50*Qk.W.090	

ku: short
sh/vs: short/very short

design int. forces — design internal forces

table — internal forces (decisive)

	x [m]	N_d [kN]	$M_{y,d}$ [kNm]	$V_{z,d}$ [kN]
comb. *2 (BC)*	7.20	-608.15*	0.00	0.00
	0.00	-611.89*	0.00*	0.00*
comb. *7 (BC)*	7.20	-164.74*	0.00	22.76*
	3.60	-166.61	-40.97*	0.00
	0.00	-168.48*	0.00*	-22.76*
comb. *13 (BC)*	7.20	-608.46*	0.00	13.66*
	3.60	-610.33	-24.58*	0.00
	0.00	-612.20*	0.00*	-13.66*
comb. *38 (BC)*	7.20	29.27*	0.00	16.20*
	3.60	27.88	-29.16*	0.00
	0.00	26.50*	0.00*	-16.20*

mat./cross section — material and sectional values acc. DIN EN 1995-1-1

material

material	f_{mk}	f_{t0k}	f_{c0k}	f_{c90k}	f_{vk}	E_{mean}
			[N/mm²]			
BSH GL24h[f]	24.0	19.2	24.0	2.5	3.5	11500

f: lamella orientation flat

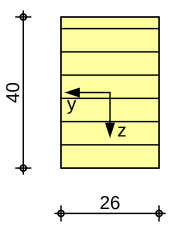
cross section

type	b_y [cm]	b_z [cm]	A [cm²]	I_y [cm⁴]	I_z [cm⁴]
RE	26.0	40.0	1040	138667	58587

RE: rectangular section

graphic — cross section graphic [cm]

M 1:20



buckling/cant coefficients

axis	i [cm]	Ǩ [-]	$Ǩ_{rel}$ [-]	k_c [-]
y	11.55	62.35	0.99	0.77
z	7.51	95.93	1.53	0.39
m	13.05	55.16	0.40	1.00

<u>verifications (ULS)</u>

verifications at ultimate limit state acc. to DIN EN 1995-1-1

- The bending and tensile strengths were modified with the coefficient k_h acc. to 3.3(3).
- According to DIN EN 1995-1-1/NA NCI NA.5.9 a consideration of creep is not required for service class 1.

<u>bending</u>
para. 6.1

verification of bending resistance

x	Ek	k_{mod}	N_d / M_{yd} / M_{zd}	$\sigma_{0,d}$ / $\sigma_{my,d}$ / $\sigma_{mz,d}$	$f_{0,d}$ / $f_{my,d}$ / $f_{mz,d}$	η
[m]		[-]	[kN,kNm]	[N/mm²]	[N/mm²]	[-]
(L = 7.20 m, $k_{c,y}$ = 0.77, $k_{c,z}$ = 0.39, k_{crit} = 1.00)						
3.61	38	1.00	27.89	0.27	15.38	
			-29.16	4.21	19.23	
			0.00	0.00	18.46	0.24
3.58	7	1.00	-166.62	1.60	18.46	
			-40.97	5.91	19.23	
			0.00	0.00	18.46	0.44
3.57	13	1.00	-610.35	5.87	18.46	
			-24.58	3.55	19.23	
			0.00	0.00	18.46	0.93
0.00	13	1.00	-612.20	5.89	18.46	
			0.00	0.00	19.23	
			0.00	0.00	18.46	0.81
0.00	7	1.00	-168.48	1.62	18.46	
			0.00	0.00	19.23	
			0.00	0.00	18.46	0.22
0.00	2	0.90	-611.89	5.88	16.62	
			0.00	0.00	17.30	
			0.00	0.00	16.62	0.90
0.00	38	1.00	26.50	0.25	15.38	
			0.00	0.00	19.23	
			0.00	0.00	18.46	0.02

<u>shear force</u>
para. 6.1.7

verification of lateral force resistance

x	Ek	k_{mod}	$V_{z,d}$ / $V_{y,d}$	$\tau_{z,d}$ / $\tau_{y,d}$	$f_{zv,d}$ / $f_{yv,d}$	η
[m]		[-]	[kN]	[N/mm²]	[N/mm²]	[-]
7.20	13	1.00	13.66	0.28	2.69	
			0.00	0.00	2.69	0.10
7.20	7	1.00	22.76	0.46	2.69	
			0.00	0.00	2.69	0.17
0.00	38	1.00	-16.20	0.33	2.69	
			0.00	0.00	2.69	0.12

<u>stability</u>
para. 6.3

stability verification

The influence of stability is included in the verification of bending resistance. The following fictitious bar lengths are regarded.

fictitious bar length

l	$l_{ef,cy}$	$l_{ef,cz}$	$l_{ef,m}$
[m]	[m]	[m]	[m]
7.20	7.20	7.20	7.20

<u>support reactions</u>

char. supp. react.

	supp.	$F_{x,k}$ [kN]	$F_{z,k}$ [kN]	$M_{y,k}$ [kNm]	$F_{y,k}$ [kN]	$M_{z,k}$ [kNm]
action *Gk*	A	124.42	0.00	0.00	0.00	0.00
	B		0.00		0.00	
action *Qk.S.A*	A	295.96	0.00	0.00	0.00	0.00
	B		0.00		0.00	
action *Qk.S.B*	A	143.00	0.00	0.00	0.00	0.00
	B		0.00		0.00	
action *Qk.S.C*	A	200.20	0.00	0.00	0.00	0.00
	B		0.00		0.00	
action *Qk.W.000*	A	3.38	9.61	0.00	0.00	0.00
	B		9.61		0.00	
action *Qk.W.090*	A	-100.61	-10.80	0.00	37.35	0.00
	B		-10.80		0.00	
action *Qk.W.180*	A	0.34	-15.17	0.00	0.00	0.00
	B		-15.17		0.00	
action *Qk.W.270*	A	24.30	0.00	0.00	0.00	0.00
	B		0.00		0.00	

design supp. react.
permanent/transient

supp.	$F_{x,d,min}$ / $F_{x,d,max}$ [kN]	EK	$F_{z,d,min}$ / $F_{z,d,max}$ [kN]	EK	$M_{y,d,min}$ / $M_{y,d,max}$ [kNm]	EK	$F_{y,d,min}$ / $F_{y,d,max}$ [kN]	EK	$M_{z,d,min}$ / $M_{z,d,max}$ [kNm]	EK
A	-26.5	108	-23	71	0.00	65	0.00	65	0.00	65
	633.8	79	14.4	69	0.00	65	56.0	70	0.00	65
B			-23	71			0.00	65		
			14.4	69			0.00	65		

<u>summary</u> summary of verifications

<u>verifications (ULS)</u> verifications in ultimate limit state

verification	x [m]		G [-]
bending	3.57	OK	0.93
shear force	7.20	OK	0.17

<u>St¿tzenfuÇ</u>

Belastung

min $F_{x,d}$ = -26.50 kN
$F_{z,d}$ = 16.20 KN
$F_{y,d}$ = 56.03 kN

Versatzmoment Anschluss St¿tze Stahlteil

M_d = 16.20*36 = 583.20 kNcm

Belastung Bolzen

F_d = 17.29 kN

gew. <u>Bolzen M 16 4.6</u>

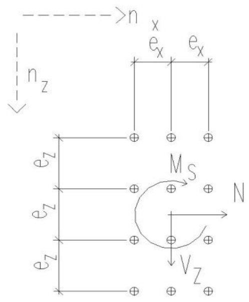
R_d = <u>32.32 kN > 17.29 kN</u>

Pos. 7.1a Schraubenbild FuÇpunkt

Einzelbelastung Verbindungsmittel

Schraubenbild

Anzahl Spalten	n_x =	2
Abstand Spalten	e_x =	8,0 cm
Anzahl Zeilen	n_z =	3
Abstand Zeilen	e_z =	10,0 cm



Belastung

Moment	M =	583,20 kNcm
Querkraft	V_Z =	16,20 kN
Längskraft	N =	26,50 kN

Polares Flächenmoment Schraubenbild

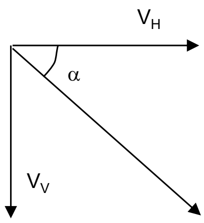
$I_P = n/12 * [(n_X^2-1) * e_X^2 + (n_Z^2-1) * e_Z^2]$

$I_P =$ 496,00 cm²

Vertikalanteil

$V_V = V_Z/n + M/I_P * (n_X-1)*e_X/2$

$V_V =$ 7,40 kN



Horizontalanteil

$V_H = N/n + M/I_P * (n_Z-1)*e_Z/2$

$V_H =$ 16,17 kN

Resultierende Belastung pro Verbindungsmittel

$V_b = (V_V^2 + V_H^2)^{1/2}$

V_b = 17,79 kN

Lastwinkel

$\alpha = \arctan (V_V / V_H)$

α = 24,6 °

(c) IBDURO

Pos. 7.2a Bolzen

Verbindung mit stiftförmigen metallischen Verbindungsmitteln

Schnittigkeit: Zweischnittige Verbindung

Nutzungsklasse: 1
KLED: kurz
k_{mod}: 0,9

Schichtfolge: Holz/HWS - Stahlblech - Holz/HWS

Seitenhölzer: Brettschichtholz GL24h
Dicke t_1 [mm]: 125,00 mm
$t_{1,req}$: 94,41 mm

Stahlblech innen: S235
Dicke t_2 [mm]: 8,00 mm
$t_{2,req}$: 0,00 mm

Verbindungsmittel: Bolzen
Durchmesser: 16,00 mm
Materialgüte: 4,6

U-Scheibe: 18/68

Kraft-Faser-Winkel Holz 1 α_1: 24,6 °
Kraft-Faser-Winkel Holz 2 α_2: 0,0 °

Verbindung mit stiftförmigen metallischen Verbindungsmitteln

Verbindungsart:
Zweischnittige Verbindung

Schichtfolge:
Holz/HWS - Stahlblech - Holz/HWS

Seitenhölzer:

Material:	Brettschichtholz GL24h
Materialstärke:	125 mm
Kraft-Faser-Winkel:	25 °
Charakt. Lochleibungsfestigkeit:	24,06 N/mm²
K_{mod}:	0,9

Stahlblech innen:

Material:	S235
Materialstärke:	8 mm
Kraft-Faser-Winkel:	0 °
Charakt. Lochleibungsfestigkeit:	#NV
$k_{mod,2}$:	0,9

Verbindungsmittel:

Gewählt:	Bolzen
Durchmesser:	16,00 mm
Berechnung $M_{y,Rk}$:	16,00 mm
U-Scheibe:	18/68
Scheiben-Nettofläche:	6377 mm²
Materialgüte:	4,6
Zugfestigkeit $f_{u,k}$:	400 N/mm²
Charakt. Fließmoment:	162141 Nmm

Lasteinwirkung:

Nutzungsklasse:	1
Lasteinwirkungsdauer:	kurz
Teilsicherheitsbeiwert γ_m:	1,1

Tragfähigkeit auf Abscheren je Scherfuge nach DIN EN 1995-1:

$R_{1,k}$ =	48118 N	$R_{2,k}$ =	21741 N
$R_{3,k}$ =	18171 N	$R_{4,k}$ =	15801 N
$R_{5,k}$ =	---	$R_{6,k}$ =	---
$R_{7,k}$ =	---		

Tragfähigkeit in Richtung der Stiftachse nach DIN EN 1995-1:

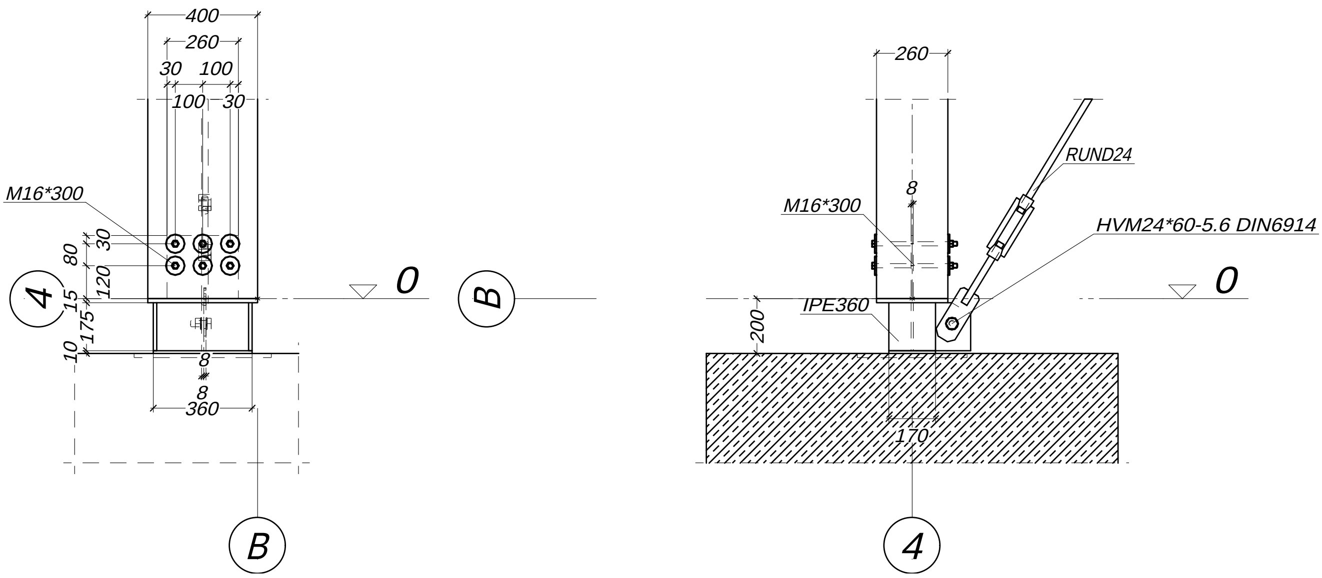
ΔR_k = 3950 N

Abminderungsfaktor ω_1 inf. der Mindestholzdicken: **1,00**

Tragfähigkeit der Verbindung nach DIN EN 1995-1:

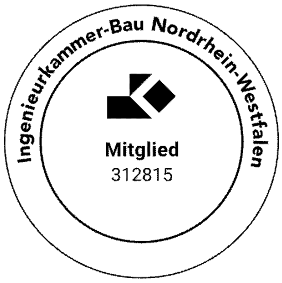
$$R_d = \frac{k_{mod} \cdot \omega_1 \cdot (\mathrm{R}_{min,\mathrm{k}} + \Delta\mathrm{R}_{min,\mathrm{k}})}{\gamma_m} = \mathbf{32320\ N}$$

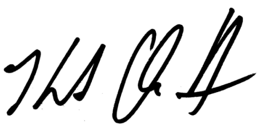
Pos. 7.3a **Skizze**



Weitere konstruktive Details sind den Ausf¿hrungsplªnen zu entnehmen.

Diese Statik ist nur in Verbindung mit dem aktuellen Pr¿fbericht g¿ltig. Eventuelle Gr¿neintragungen sind bei der Ausf¿hrung zu ber¿cksichtigen.





Statik aufgestellt: Olsberg, den 22.04.2026

Dr.-Ing. K. Dubslaff
Sachkundiger f¿r Holzschutz am Bau

Eingetragen in die Liste qualifizierte
Tragwerksplaner bei der IK Bau NRW
Nummer QT0301

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