HOUTA KANTOOR-
structural report

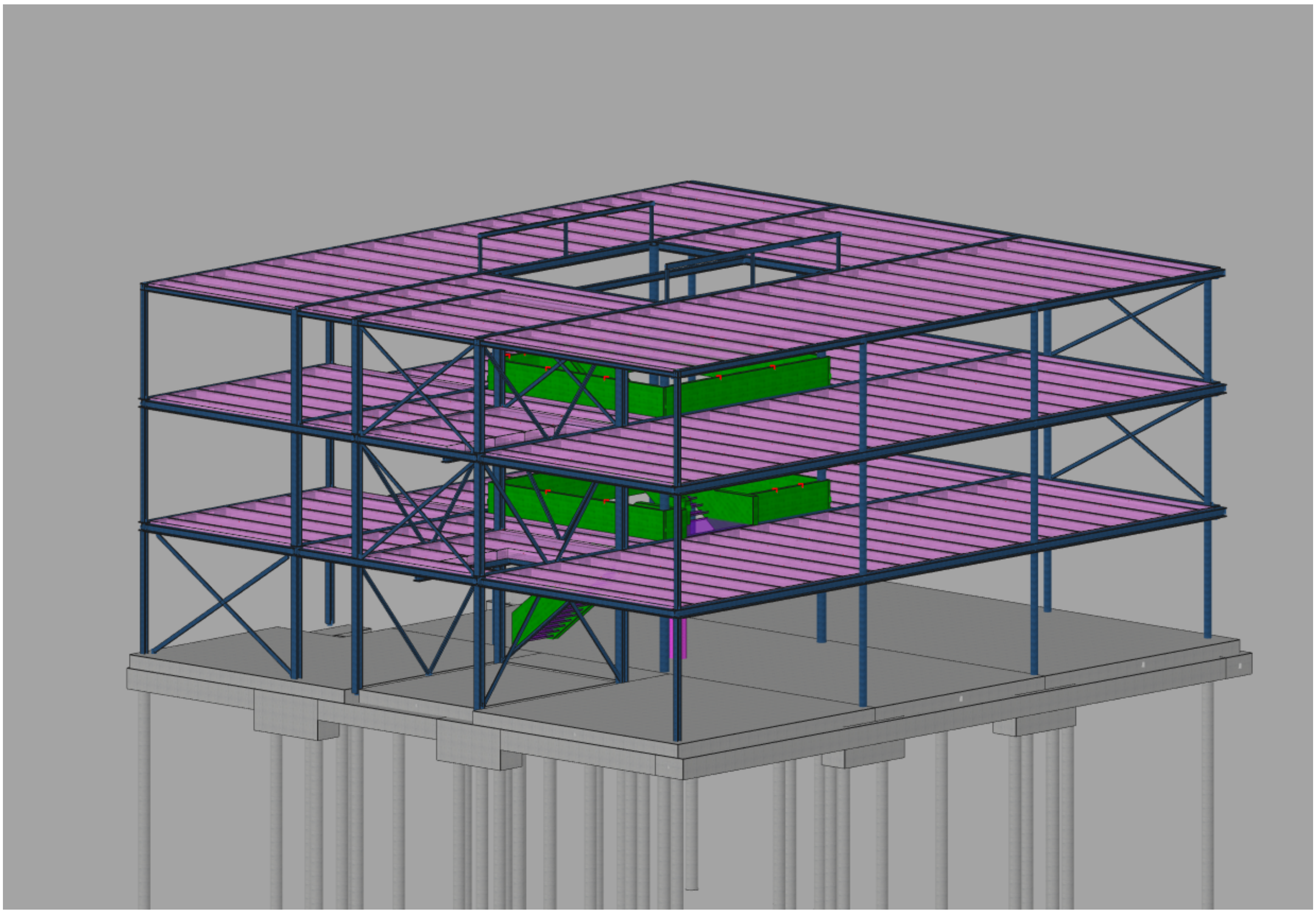


Table of content

Basis of design

binderholz

264417_HOUTA_Kantoor	LOCATION:	Netherlands
	EDITED BY:	maxsch
	DATE:	03.04.2023

A - GENERAL INFORMATION

Note: The listed construction build-ups are to be adhered to. Any modifications such as the use of different materials and/or a change of dimensions, must be reviewed with the responsible engineers.

B - DEAD LOADS (OVERALL LOAD WITHOUT CLT)

-roof 180	g_k	1,0	kN/m²	**Load acc. to document:** Detail 18 22-02-2023
-floor 280	g_k	0,85	kN/m²	**Load acc. to document:** Detail 18 22-02-2023
-floor 260	g_k	0,91	kN/m²	**Load acc. to document:** Detail 18 22-02-2023
-floor 220	g_k	1,03	kN/m²	**Load acc. to document:** Detail 18 22-02-2023

B - DEAD LOADS (COMPOSITION floor 280)

Load acc. to document: Detail 18 22-02-2023

	Thickness (mm)	Density (kg/m³)	Weight (kg/m²)
- Fermacell vloerelement	25	1	30,0
- Fermacell korrels	100	300	30,0
- Plafond	1	25	25,0
- CLT	280	480	134,4
- Total weight			219,4
- Total weight (without CLT)			**85,0**

B - DEAD LOADS (COMPOSITION floor 260)

Load acc. to document: Detail 18 22-02-2023

	Thickness (mm)	Density (kg/m³)	Weight (kg/m²)
- Fermacell vloerelement	25	1	30,0
- Fermacell korrels	120	300	36,0
- Plafond	1	25	25,0
- CLT	260	480	124,8
- Total weight			215,8
- Total weight (without CLT)			**91,0**

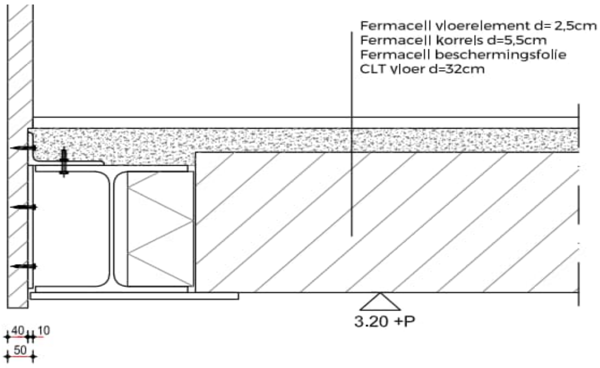
B - DEAD LOADS (COMPOSITION floor 220)

Load acc. to document: Detail 18 22-02-2023

	Thickness (mm)	Density (kg/m³)	Weight (kg/m²)
- Fermacell vloerelement	25	1	30,0
- Fermacell korrels	160	300	48,0
- Plafond	1	25	25,0
- CLT	220	480	105,6
- Total weight			208,6
- Total weight (without CLT)			**103,0**

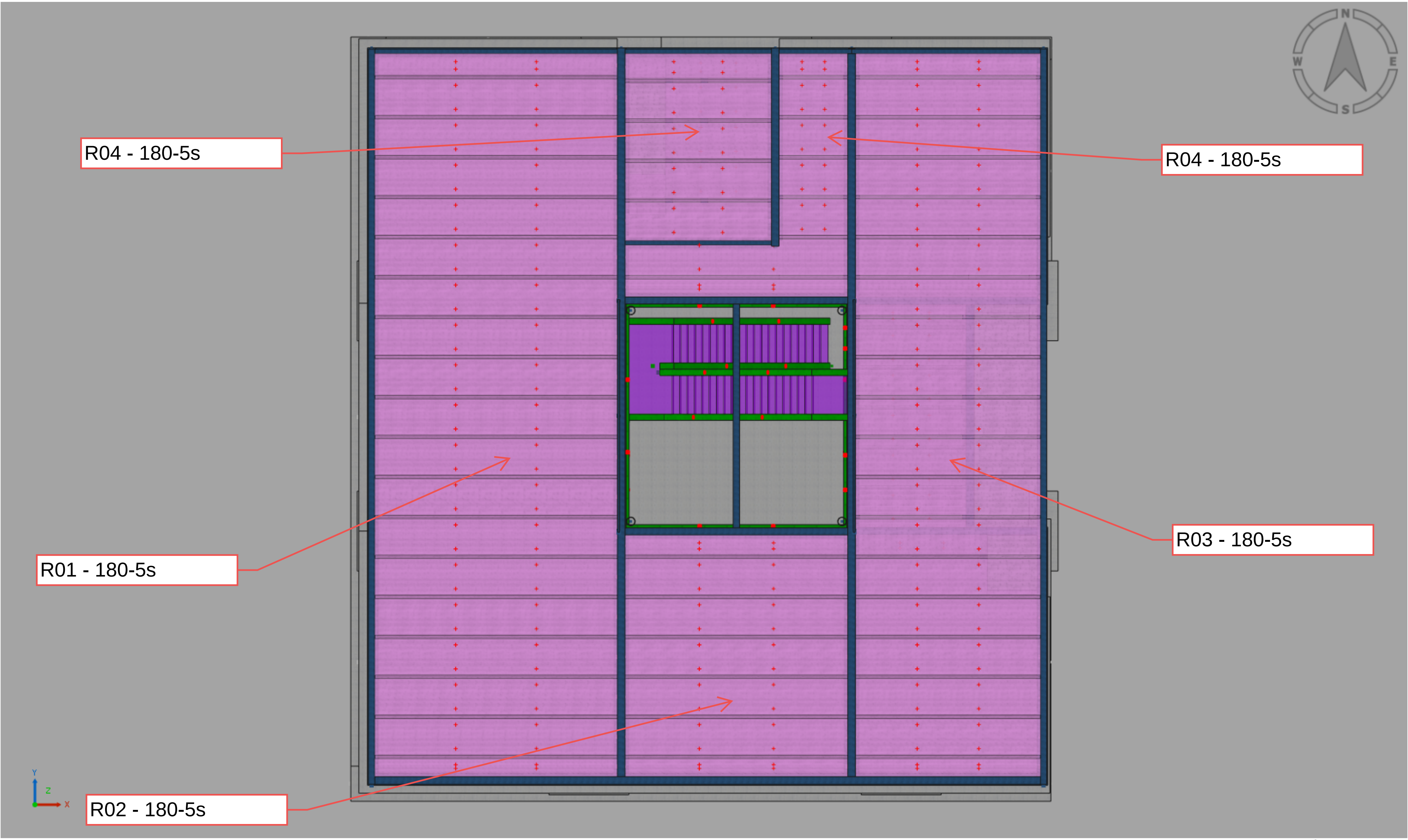
D - Liveload

- Category B - office premises	q_k	*3,00*	kN/m²	…..
- Category H - roofs	q_k	*1,00*	kN/m²	…..

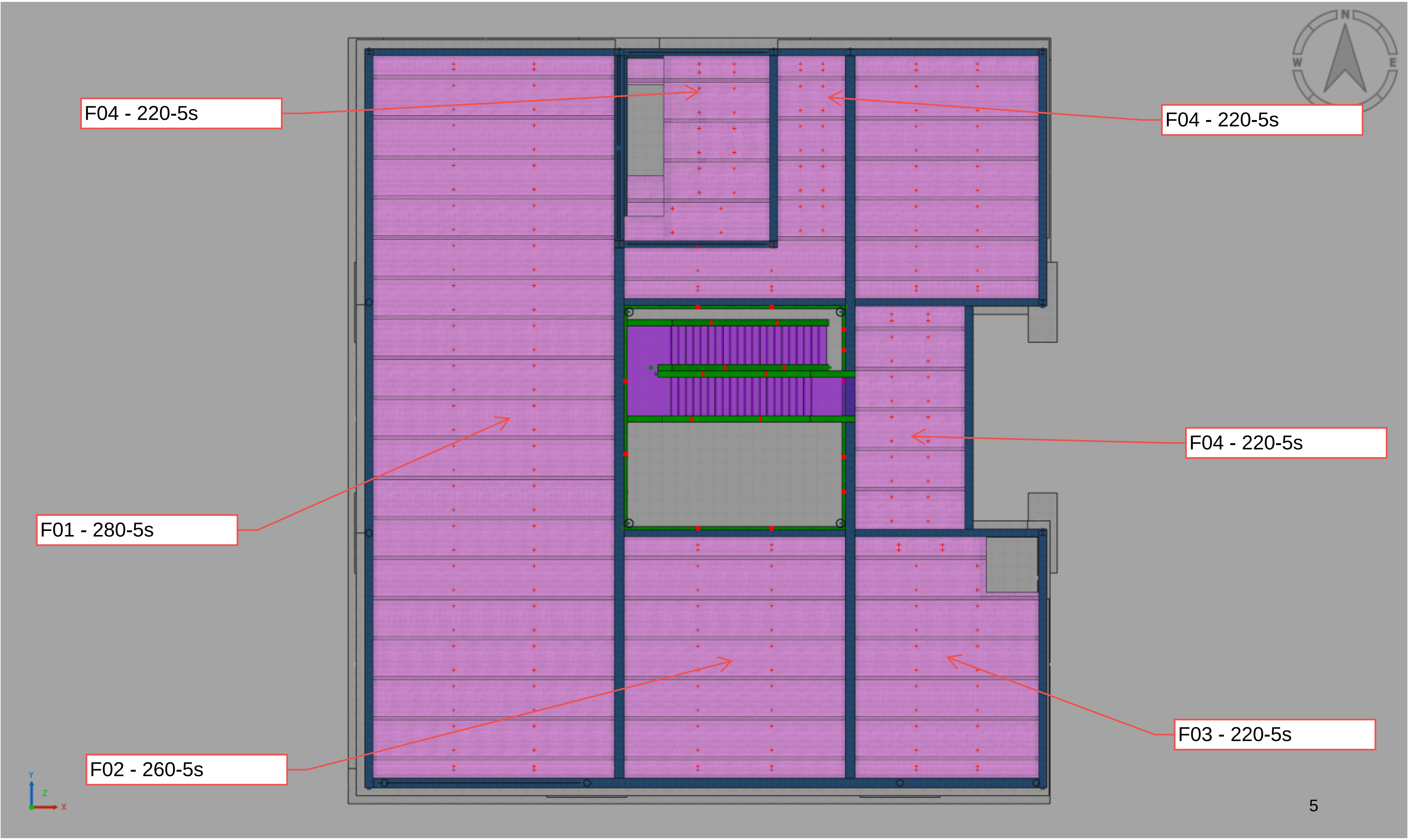


Stuctural member plan

Roof

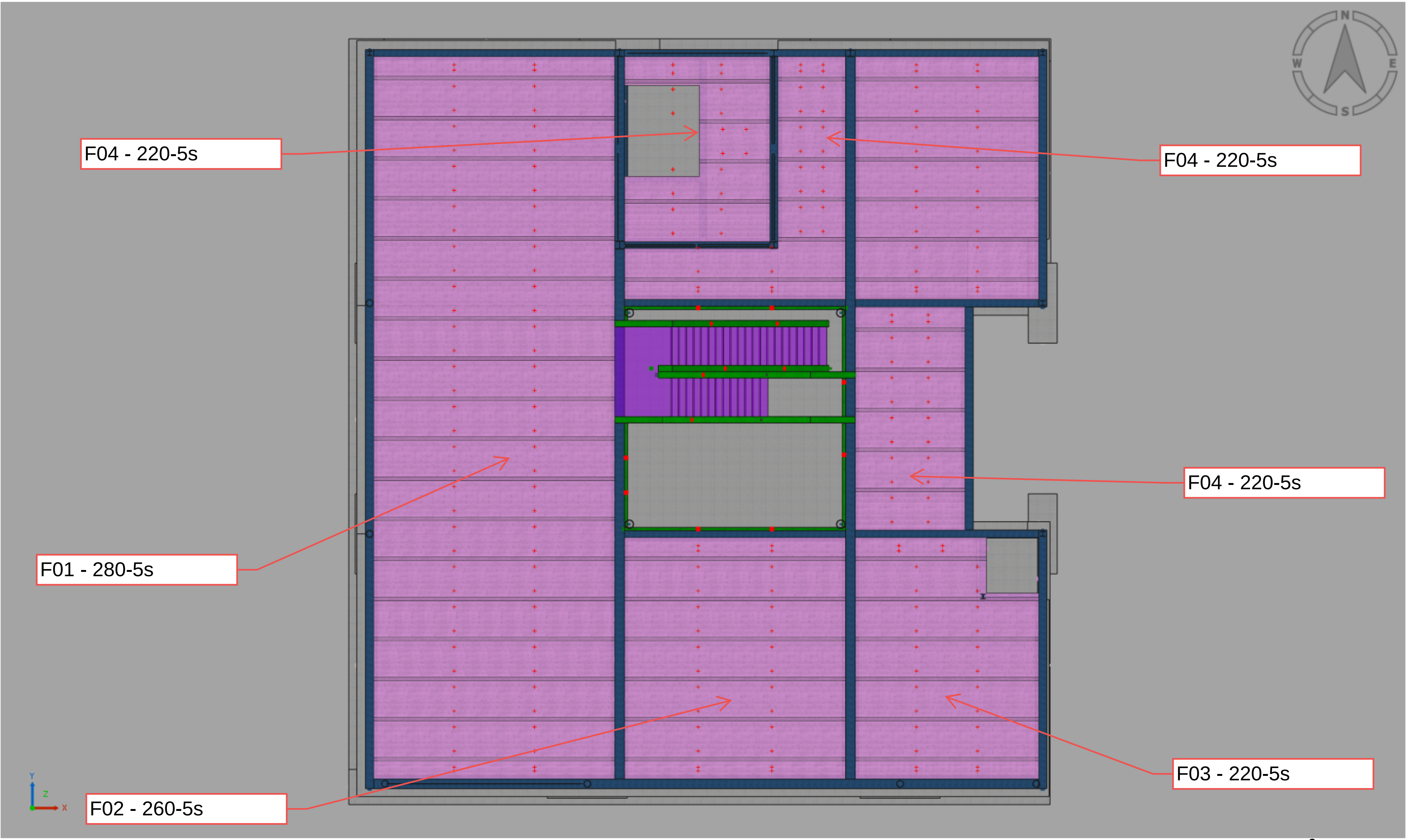


2nd Floor



F04 - 220-5s
F04 - 220-5s
F04 - 220-5s
F01 - 280-5s
F02 - 260-5s
F03 - 220-5s
N
W
E

1st Floor



F04 - 220-5s
F04 - 220-5s
F04 - 220-5s
F01 - 280-5s
F03 - 220-5s
F02 - 260-5s
N
W
E
S
Y
Z
X

Design of clt elements

binderholz CLT BBS – continuous beams | floors

Full Version

Design following [EN] EN 1995-1-1:2019, "ETA-06/0009:2017. DiBt Z-9.1-534:2014"

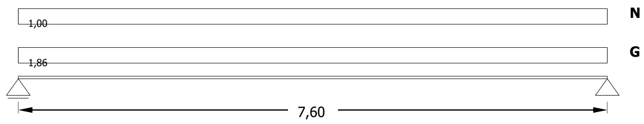
WallnerMild

General

Service Class	NKL	1			kdef	0,80	
		Members in closed, heated areas			k sys	1,10	
Serviceability		Full	g1 und g2 werden für w inst berücksichtigt			Serviceability	irreversible
Include cant.upward defl.		no			allow.w,inst		ℓ / 300
					allow.w,fin	ℓ / 250	ℓ / 200
Fire		R 90					
		1	single sided	t ch 0,00 min	β 0	0,90	mm/min
				β f 0,47 mm/min	β 1a	0,90	mm/min (25mm)
				t f 0,00 min	β 1b	0,90	mm/min
					ρ	480	kg/m³

Design Results

Total	93 %
Moment	41 %
Transverse force	18 %
Deflection	
Appearance	89 %
Avoid Damages	93 %
Vibration	keine Anforderung
Fire	
Moment	69 %
Transverse force	9 %



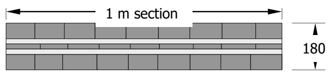
System

span	Lengths Li [m]	Uniform loads g 2,k [kN/m]	g 1,k + g 2,k [kN/m]	n k [kN/m]	s k [kN/m]	w k [kN/m]
			G	N	S	W
		g 1,k =	0,86			
cantilever Li						
span 1	7,60	1,00	1,86	1,00		
span 2						
span 3						
span 4						
span 5						
span 6						
span 7						
cantilever Re						

cross section

Producer:	Binder
Type:	BBS 125
Element:	**180 5s**
	Coverlayer in direction of span axis

layer i	thickness di [mm]	orientation °	material
1	60	0	C24
2	20	90	C24
3	20	0	C24
4	20	90	C24
5	60	0	C24
6			C24
7			C24
8			C24
9			C24
d	180	5	C24



binderholz

Single loads

span	Loadgroup	First single load x_F [m]	F_k [kN]	Second single load x_F [m]	F_k [kN]
cantilever Li					
cantilever Li					
span 2					
span 3					
span 4					
span 5					
span 6					
span 7					
cantilever Re					

Vibration design

Load definitions

	Loadgroup	Loadtype		Loadapp.
Selfweight	G	G	Ständige Lasten	full
Liveload	N	NH	H: Dächer	spanwise
Snow	S	S2	Orte unter 1000 m Seehöhe	full
Wind	W	W	Windlasten	full

DKL III keine Anforderung

1.1 Frequency Requirement

f_1	4,71	Hz	
f_{gr}	-	Hz	

1.2. Acceleration requirement for low frequencies f1 ≤ Hz

a_{rms}	0,18	m/s²	
a_{gr}	-	m/s²	OK

2. Stiffness criterion

w_{stat}	0,41	mm	
w_{grenz}	-	mm	OK

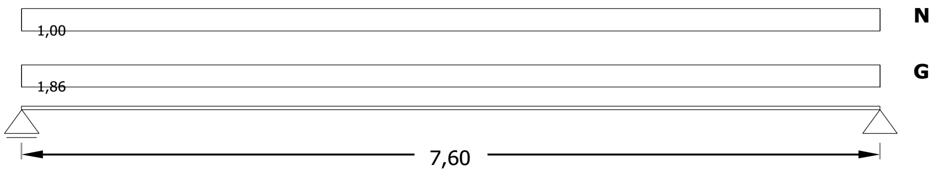
binderholz CLT BBS – continuous beams | floors
Full Version
Design following [EN] EN 1995-1-1:2019, "ETA-06/0009:2017. DiBt Z-9.1-534:2014"
WallnerMild

General

Service Class	1	
Members in closed, heated areas		
Fire	R 90	1
Serviceability	Full	

Standards referenced
EN 1995-1-:2009
[EN] EN 1995-1-1:2019
"ETA-06/0009:2017. DiBt Z-9.1-534:20

System



Loadgroup	Loadtype	Safety	Loadduration		Combination Values		
		γ	kled	kmod	ψ_0	ψ_1	ψ_2
G	G	1,35	ständig	0,60	-	-	-
N	NH	1,50	kurz	0,90	-	-	-
S	S2	1,50	kurz	0,90	0,50	0,20	-
W	W	1,50	s.kurz/kurz	1,00	0,60	0,20	-

cross section

Binder	BBS 125	**180 5s**

layer i	thickness di [mm]	burned di [mm]	orientation °	material
1	60,0	60,0	0	C24
2	20,0	20,0	90	C24
3	20,0	12,0	0	C24
4	20,0	0,0	90	C24
5	60,0	0,0	0	C24
6				C24
7				C24
8				C24
9				C24
d	180,0	92,0	5 s	C24

Design values of actions

ULS		Value	span	position x/l	k-mod	Length
V d [kN]	**maximum values**	15,26	span 1	0,00	0,90	7,60
	min	-15,26	span 1	1,00	0,90	7,60
M d [kNm]	**maximum values**	29,00	span 1	0,50	0,90	7,60
	min	0,00	0	0,00	1,00	0,00

SLS		span				cantilever			
k_{def} = 0,80		Value	span	position x/l	Length	Value	span	position x/l	Length
quasi-permanent		(guarantee useability and appearance)							
$EJ \cdot w_{fin}$	**maximum values**	145,75	span 1	0,50	7,60	0,00	0	0,00	0,00
	min	0,00	0	0,00	0,00	0,00	0	0,00	0,00
Characteristic situation		(avoid demage at members below)							
$EJ \cdot w_{Q,inst}$	**maximum values**	124,41	span 1	0,50	7,60	0,00	0	0,00	0,00
	min	0,00	0	0,00	0,00	0,00	0	0,00	0,00
$w_{fin} - w_{G,inst}$	**maximum values**	189,19	span 1	0,50	7,60	0,00	0	0,00	0,00
	min	0,00	0	0,00	0,00	0,00	0	0,00	0,00

binderholz CLT BBS – continuous beams | floors
Design following [EN] EN 1995-1-1:2019, "ETA-06/0009:2017. DiBt Z-9.1-534:2014"

Cross-section Values Reference length for cross-section values in beams over one spans : l* = l

	Ref.length	XS-Values			Comp.to full cross-section		
A eff	1,00 m	1.400	cm2	78% of	A tot	1.800	cm2
I eff,F	7,60 m	44.840	cm4	92% of	I tot,F	48.600	cm4
I eff,K	0,00 m	-	cm4		I tot,K	48.600	cm4
W eff	7,60 m	5.143	cm3	95% of	W tot	5.400	cm3

Calculation as semi-rigid composite

Verification of Ultimate Limit States

Bending		span 1, x/l = 0,50			
	M d	29,00 kNm	f m,k	18,00 N/mm²	
			γ M	1,3 [EN]	
			k mod	0,9	
			k sys	1,1 system value	
41%	σ m,y,d	5,64 N/mm²	f m,y,d	13,71 N/mm²	
Shear stress		span 1, x/l = 1,00			
	V d	-15,26 kN			
	l*	7,6 m			
	S eff	3.650 cm³	f v,k	2,00 N/mm²	
9%	τ v,d	0,12 N/mm²	f v,d	1,38 N/mm²	
	Rolling Shear				
	S R,eff	3.600 cm³	f v,R,k	1,00 N/mm²	
18%	τ R,d	0,12 N/mm²	f v,R,d	0,69 N/mm²	

Verification of Serviceability Limit States

Displacements — Cantilever upward deflection not included

93%	E 0,mean	12.000 N/mm²
	γ M	1,0

		J_{eff} [cm⁴]	w [mm]	L* [m]	zul f	w_{max} [mm]	
	Appearance $w_{net,fin}$	44.840	**27,1**	7,60	l / 250	**30,4**	89%
89%	span 1, x/l = 0,50	-	**0,0**	0,00	l / 125	**0,0**	0%
	Avoid Damages w_{inst}	44.840	**23,1**	7,60	l / 300	**25,3**	91%
	span 1, x/l = 0,50	-	**0,0**	0,00	l / 150	**0,0**	0%
	w_{fin}	44.840	**35,2**	7,60	l / 200	**38,0**	93%
93%	span 1, x/l = 0,50	-	**0,0**	0,00	l / 100	**0,0**	0%

fire design

R 90 1
β0 0,90 mm/min

Accidental Situation		Value	span	position x/l	k-mod	Length
V fi [kN]	**max**	7,08	span 1	0,00	-	7,60
	min	-7,08	span 1	1,00	-	7,60
M fi [kNm]	**max**	13,46	span 1	0,50	-	7,60
	min	0,00	0	0,00		0,00

Bending				
	M fi	13,46 kNm	f m,k	18,00 N/mm²
	ℓ*	7,60 m	k fi	1,15
	W eff,fi	942 cm3	γ M,fi	1,00
			k mod,fi	1,00
69%	σ m,y,fi	14,29 N/mm²	f d,fi	20,70 N/mm²
Shear stress				
9%	V fi	-7,08 kN		
	I eff,fi	4.924,89 cm4		
	S eff,fi	773,56 cm3	f v,k	2,00 N/mm²
	S R,eff,fi	730,00 cm3	f v,R,k	1,00 N/mm²
5%	τ v,fi	0,11 N/mm²	f v,fi	2,30 N/mm²
9%	τ v,R,fi	0,10 N/mm²	f v,R,fi	1,15 N/mm²

Vibrations in residential floors WAHR

proof of human induced vibrations in floors according to ÖNORM B 1995-1-1:2014

floor-vibration-class (DKL)

DKL III keine Anforderung

no requirement

Floors without vibration requirements, floors of non-residential rooms or undeveloped attics.

dimensions

OK	l	7,60	m	Span des maßgebenden Feldes (ohne Kragarm)
	b	9,12	m	Floor width

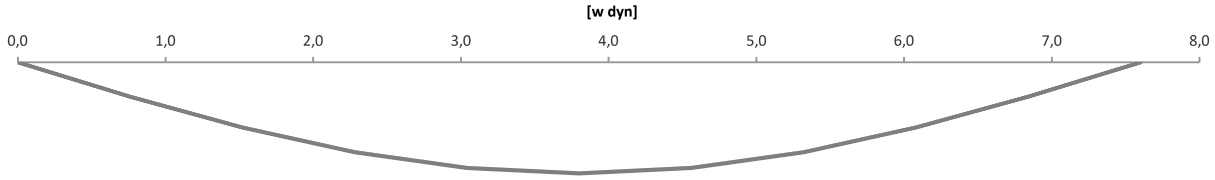
Construction: Brettsperrholzdecken mit schwimmendem Estrich und schwerem Fußbodenaufbau

D	4,00%		damping

Stiffness

$(EI)_{1,\ell}$	5,381	MNm² / m	floot in main span direction
$(EI)_{2,\ell}$	-	MNm² / m	screed (stiff layer) in main span direction
$(EI)_{\ell}$	5,381	MNm² / m	
$(EI)_{1,b}$	0,206	MNm² / m	floor across main span direction
$(EI)_{2,b}$	0,468	MNm² / m	screed (stiff layer) across main span direction
$(EI)_{b}$	0,674	MNm² / m	

Eigenmode



1.1 Frequency Requirement

	$(f1)_{\ell}$	4,58	Hz	first eigenfrequency for general beams without lateral distribution
	k_{fb}	1,030		improvement by lateral distribution
	f_1	4,71	Hz	first eigenfrequency of the floor with lateral distribution
	f_{gr}	-	Hz	limit
-	Requirement not met: continue with clause 1.2			

1.2. Acceleration requirement for low frequencies f1 ≤ - Hz

	f_{min}	4,50	Hz	Frequency limit against resonance (Requirement met)
	b_F	4,11	m	effective with in vibration modes
	$(M^*)_{\ell}$	722	kg	modal mass for general beams without lateral distribution
	M^*	2.968	kg	modal mass of the floor with lateral distribution
	F_0	700	N	wight-force of a person walking on the floor
	α	0,152		impact factor for given frequency
	a_{rms}	0,179	m/s²	existing accelleration
-	a_{gr}	-	m/s²	limit

2. Stiffness criterion

	$(w_{stat})_{\ell}$	1,70	mm	deflection from unit load F = 1 kN without lateral distribution
	b_F	4,11	m	effective with in vibration modes
	w_{stat}	0,41	mm	deflection from unit load F = 1 kN with lateral distribution
-	w_{grenz}	-	mm	limit

Informativ: Eigenfrequenz für Einfeldträger laut EN 1995-1-1 mit quasi-ständigen Lasten

L	7,60	m	
$m_{q.perm}$	194	kg/m²	$\Sigma g_i + \Sigma \psi_2 \cdot q_i$
$f_{1,EN}$	4,53	Hz	

Informativ: Kriterium nach Hu, Chui

269%

Support forces for load transmission

Support	Dsgn.Value	char.Wert	Loadcode		Dsgn.Value	char.Wert	Loadcode
	Maximalwerte			**Minimalwerte**			
A G,k		7,08	G	A G,k		7,08	G
A N,k		3,80	NH	A N,k		0,00	NH
A d	**15,26**			**A d**	**9,56**		
B G,k		7,08	G	B G,k		7,08	G
B N,k		3,80	NH	B N,k		0,00	NH
B d	**15,26**			**B d**	**9,56**		

binderholz CLT BBS – continuous beams | floors

Full Version

Design following [EN] EN 1995-1-1:2019, "ETA-06/0009:2017. DiBt Z-9.1-534:2014"

WallnerMild

General

Service Class	NKL	1		kdef	0,80
		Members in closed, heated areas		k sys	1,10
Serviceability		Full	g1 und g2 werden für w inst berücksichtigt		
Include cant.upward defl.		no			
Fire		R 90			
		1	single sided		

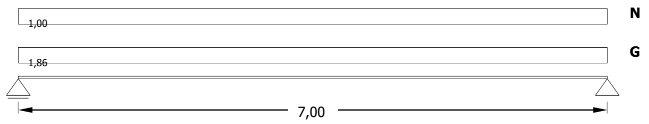
	Serviceability	irreversible
allow.w,inst		ℓ / 300
allow.w,fin	ℓ / 250	ℓ / 200

t ch	0,00	min
β f	0,47	mm/min
t f	0,00	min

β 0	0,90	mm/min
β 1a	0,90	mm/min (25mm)
β 1b	0,90	mm/min
ρ	480	kg/m³

Design Results

Total	73 %
Moment	35 %
Transverse force	16 %
Deflection	
Appearance	70 %
Avoid Damages	73 %
Vibration	keine Anforderung
Fire	
Moment	59 %
Transverse force	8 %



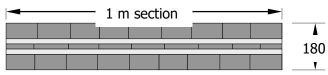
System

span	Lengths Li [m]	Uniform loads g 2,k [kN/m]	g 1,k + g 2,k [kN/m] G	n k [kN/m] N	s k [kN/m] S	w k [kN/m] W
		g 1,k =	0,86			
cantilever Li						
span 1	7,00	1,00	1,86	1,00		
span 2						
span 3						
span 4						
span 5						
span 6						
span 7						
cantilever Re						

cross section

Producer:	Binder
Type:	BBS 125
Element:	**180 5s**
	Coverlayer in direction of span axis

layer i	thickness di [mm]	orientation °	material
1	60	0	C24
2	20	90	C24
3	20	0	C24
4	20	90	C24
5	60	0	C24
6			C24
7			C24
8			C24
9			C24
d	180	5	C24



binderholz

Single loads span	Loadgroup	First single load x_F [m]	F_k [kN]	Second single load x_F [m]	F_k [kN]
cantilever Li					
cantilever Li					
span 2					
span 3					
span 4					
span 5					
span 6					
span 7					
cantilever Re					

Vibration design

Load definitions

	Loadgroup	Loadtype		Loadapp.
Selfweight	G	G	Ständige Lasten	full
Liveload	N	NH	H: Dächer	spanwise
Snow	S	S2	Orte unter 1000 m Seehöhe	full
Wind	W	W	Windlasten	full

DKL III keine Anforderung

1.1 Frequency Requirement

f_1		5,56	Hz	
f_{gr}	-		Hz	

1.2. Acceleration requirement for low frequencies f1 ≤ Hz

a_{rms}		0,15	m/s²	
a_{gr}	-		m/s²	OK

2. Stiffness criterion

w_{stat}		0,35	mm	
w_{grenz}	-		mm	OK

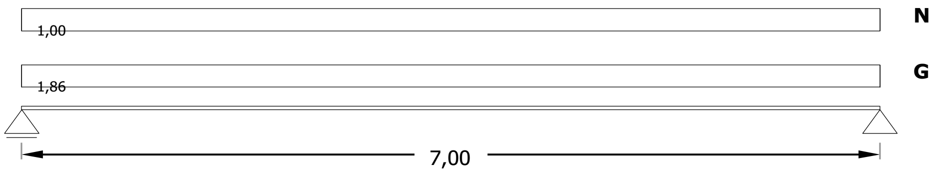
binderholz CLT BBS – continuous beams | floors
Full Version
Design following [EN] EN 1995-1-1:2019, "ETA-06/0009:2017. DiBt Z-9.1-534:2014"
WallnerMild

General

Service Class	1	
Members in closed, heated areas		
Fire	R 90	1
Serviceability	Full	

Standards referenced
EN 1995-1-:2009
[EN] EN 1995-1-1:2019
"ETA-06/0009:2017. DiBt Z-9.1-534:20

System



Loadgroup	Loadtype	Safety	Loadduration		Combination Values		
		γ	kled	kmod	ψ_0	ψ_1	ψ_2
G	G	1,35	ständig	0,60	-	-	-
N	NH	1,50	kurz	0,90	-	-	-
S	S2	1,50	kurz	0,90	0,50	0,20	-
W	W	1,50	s.kurz/kurz	1,00	0,60	0,20	-

cross section

Binder	BBS 125	**180 5s**

layer i	thickness di [mm]	burned di [mm]	orientation °	material
1	60,0	60,0	0	C24
2	20,0	20,0	90	C24
3	20,0	12,0	0	C24
4	20,0	0,0	90	C24
5	60,0	0,0	0	C24
6				C24
7				C24
8				C24
9				C24
d	180,0	92,0	5 s	C24

Design values of actions

ULS		Value	span	position x/l	k-mod	Length
V d [kN]	**maximum values**	14,06	span 1	0,00	0,90	7,00
	min	-14,06	span 1	1,00	0,90	7,00
M d [kNm]	**maximum values**	24,60	span 1	0,50	0,90	7,00
	min	0,00	0	0,00	1,00	0,00

SLS		span				cantilever			
k_{def} = 0,80		Value	span	position x/l	Length	Value	span	position x/l	Length
quasi-permanent		(guarantee useability and appearance)							
$EJ \cdot w_{fin}$	**maximum values**	104,89	span 1	0,50	7,00	0,00	0	0,00	0,00
	min	0,00	0	0,00	0,00	0,00	0	0,00	0,00
Characteristic situation		(avoid demage at members below)							
$EJ \cdot w_{Q,inst}$	**maximum values**	89,54	span 1	0,50	7,00	0,00	0	0,00	0,00
	min	0,00	0	0,00	0,00	0,00	0	0,00	0,00
$w_{fin} - w_{G,inst}$	**maximum values**	136,16	span 1	0,50	7,00	0,00	0	0,00	0,00
	min	0,00	0	0,00	0,00	0,00	0	0,00	0,00

Cross-section Values Reference length for cross-section values in beams over one spans : l* = l

	Ref.length	XS-Values			Comp.to full cross-section		
A eff	1,00 m	1.400	cm2	78% of	A tot	1.800	cm2
I eff,F	7,00 m	44.498	cm4	92% of	I tot,F	48.600	cm4
I eff,K	0,00 m	-	cm4		I tot,K	48.600	cm4
W eff	7,00 m	5.132	cm3	95% of	W tot	5.400	cm3

Calculation as semi-rigid composite

Verification of Ultimate Limit States

Bending span 1, x/l = 0,50

	M d	24,60 kNm	f m,k	18,00 N/mm²	
			γ M	1,3	[EN]
			k mod	0,9	
			k sys	1,1	system value
35%	σ m,y,d	4,79 N/mm²	f m,y,d	13,71 N/mm²	

Shear stress span 1, x/l = 1,00

	V d	-14,06 kN		
	l*	7 m		
	S eff	3.650 cm³	f v,k	2,00 N/mm²
8%	τ v,d	0,12 N/mm²	f v,d	1,38 N/mm²
	Rolling Shear			
	S R,eff	3.600 cm³	f v,R,k	1,00 N/mm²
16%	τ R,d	0,11 N/mm²	f v,R,d	0,69 N/mm²

Verification of Serviceability Limit States

Displacements — Cantilever upward deflection not included

73% E 0,mean 12.000 N/mm²

γ M 1,0

		J_{eff} [cm⁴]	w [mm]	L* [m]	zul f	w_{max} [mm]	
	Appearance $w_{net,fin}$	44.498	**19,6**	7,00	l / 250	**28,0**	70%
70%	span 1, x/l = 0,50	-	**0,0**	0,00	l / 125	**0,0**	0%
	Avoid Damages w_{inst}	44.498	**16,8**	7,00	l / 300	**23,3**	72%
	span 1, x/l = 0,50	-	**0,0**	0,00	l / 150	**0,0**	0%
	w_{fin}	44.498	**25,5**	7,00	l / 200	**35,0**	73%
73%	span 1, x/l = 0,50	-	**0,0**	0,00	l / 100	**0,0**	0%

fire design

R 90 1

β0 0,90 mm/min

Accidental Situation		Value	span	position x/l	k-mod	Length
V fi [kN]	max	6,52	span 1	0,00	-	7,00
	min	-6,52	span 1	1,00	-	7,00
M fi [kNm]	max	11,42	span 1	0,50	-	7,00
	min	0,00	0	0,00		0,00

Bending

	M fi	11,42 kNm	f m,k	18,00 N/mm²
	ℓ*	7,00 m	k fi	1,15
	W eff,fi	942 cm3	γ M,fi	1,00
			k mod,fi	1,00
59%	σ m,y,fi	12,12 N/mm²	f d,fi	20,70 N/mm²

Shear stress

8%	V fi	-6,52 kN		
	I eff,fi	4.920,37 cm4		
	S eff,fi	773,56 cm3	f v,k	2,00 N/mm²
	S R,eff,fi	730,00 cm3	f v,R,k	1,00 N/mm²
4%	τ v,fi	0,10 N/mm²	f v,fi	2,30 N/mm²
8%	τ v,R,fi	0,10 N/mm²	f v,R,fi	1,15 N/mm²

Vibrations in residential floors WAHR

proof of human induced vibrations in floors according to ÖNORM B 1995-1-1:2014

floor-vibration-class (DKL)

DKL III keine Anforderung

no requirement

Floors without vibration requirements, floors of non-residential rooms or undeveloped attics.

dimensions

OK	l	7,00	m	Span des maßgebenden Feldes (ohne Kragarm)
	b	8,40	m	Floor width

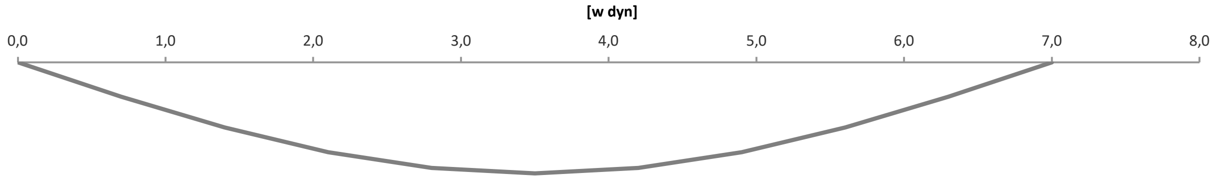
Construction: Brettsperrholzdecken mit schwimmendem Estrich und schwerem Fußbodenaufbau

D	4,00%		damping

Stiffness

$(EI)_{1,\ell}$	5,340	MNm² / m	floot in main span direction
$(EI)_{2,\ell}$	-	MNm² / m	screed (stiff layer) in main span direction
$(EI)_{\ell}$	5,340	MNm² / m	
$(EI)_{1,b}$	0,206	MNm² / m	floor across main span direction
$(EI)_{2,b}$	0,468	MNm² / m	screed (stiff layer) across main span direction
$(EI)_{b}$	0,674	MNm² / m	

Eigenmode



1.1 Frequency Requirement

	$(f1)_{\ell}$	5,39	Hz	first eigenfrequency for general beams without lateral distribution
	k_{fb}	1,030		improvement by lateral distribution
	f_1	5,56	Hz	first eigenfrequency of the floor with lateral distribution
	f_{gr}	-	Hz	limit
-	Requirement not met: continue with clause 1.2			

1.2. Acceleration requirement for low frequencies f1 ≤ - Hz

	f_{min}	4,50	Hz	Frequency limit against resonance (Requirement met)
	b_F	3,79	m	effective with in vibration modes
	$(M^*)_{\ell}$	665	kg	modal mass for general beams without lateral distribution
	M^*	2.523	kg	modal mass of the floor with lateral distribution
	F_0	700	N	wight-force of a person walking on the floor
	α	0,108		impact factor for given frequency
	a_{rms}	0,150	m/s²	existing accelleration
-	a_{gr}	-	m/s²	limit

2. Stiffness criterion

	$(w_{stat})_{\ell}$	1,33	mm	deflection from unit load F = 1 kN without lateral distribution
	b_F	3,79	m	effective with in vibration modes
	w_{stat}	0,35	mm	deflection from unit load F = 1 kN with lateral distribution
-	w_{grenz}	-	mm	limit

Informativ: Eigenfrequenz für Einfeldträger laut EN 1995-1-1 mit quasi-ständigen Lasten

L	7,00	m	
$m_{q.perm}$	190	kg/m²	Σ g i + Σ ψ 2 · q i
$f_{1,EN}$	5,37	Hz	

Informativ: Kriterium nach Hu, Chui

212%

Support forces for load transmission

Support	Dsgn.Value	char.Wert	Loadcode		Dsgn.Value	char.Wert	Loadcode
	Maximalwerte			Minimalwerte			
A G,k		6,52	G	A G,k		6,52	G
A N,k		3,50	NH	A N,k		0,00	NH
A d	**14,06**			**A d**	**8,81**		
B G,k		6,52	G	B G,k		6,52	G
B N,k		3,50	NH	B N,k		0,00	NH
B d	**14,06**			**B d**	**8,81**		

binderholz CLT BBS – continuous beams | floors

Full Version

Design following [EN] EN 1995-1-1:2019, "ETA-06/0009:2017. DiBt Z-9.1-534:2014"

WallnerMild

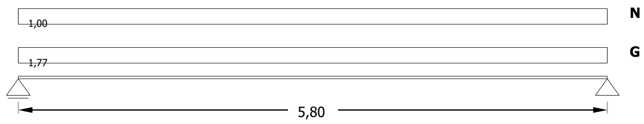
General

Service Class	NKL	1		
		Members in closed, heated areas		
Serviceability		Full	g1 und g2 werden für w inst berücksichtigt	
Include cant.upward defl.		no		
Fire		R 90		
		1	single sided	
			t ch	0,00 min
			β f	0,47 mm/min
			t f	0,00 min

kdef	0,80	
k sys	1,10	
	Serviceability	irreversible
allow.w,inst		ℓ / 300
allow.w,fin	ℓ / 250	ℓ / 200
β 0	0,90	mm/min
β 1a	0,90	mm/min (25mm)
β 1b	0,90	mm/min
ρ	480	kg/m³

Design Results

Total	61 %
Moment	32 %
Transverse force	14 %
Deflection	
Appearance	58 %
Avoid Damages	61 %
Vibration	keine Anforderung
Fire	
Moment	59 %
Transverse force	8 %



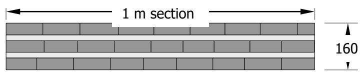
System

span	Lengths Li [m]	Uniform loads g 2,k [kN/m]	g 1,k + g 2,k [kN/m] G	n k [kN/m] N	s k [kN/m] S	w k [kN/m] W
		g 1,k =	0,77			
cantilever Li						
span 1	5,80	1,00	1,77	1,00		
span 2						
span 3						
span 4						
span 5						
span 6						
span 7						
cantilever Re						

cross section

Producer:	Binder
Type:	BBS 125
Element:	**160 5s**
	Coverlayer in direction of span axis

layer i	thickness di [mm]	orientation °	material
1	40	0	C24
2	20	90	C24
3	40	0	C24
4	20	90	C24
5	40	0	C24
6			C24
7			C24
8			C24
9			C24
d	160	5	C24



binderholz

Single loads span	Loadgroup	First single load x_F [m]	F_k [kN]	Second single load x_F [m]	F_k [kN]
cantilever Li					
cantilever Li					
span 2					
span 3					
span 4					
span 5					
span 6					
span 7					
cantilever Re					

Load definitions

	Loadgroup	Loadtype		Loadapp.
Selfweight	G	G	Ständige Lasten	full
Liveload	N	NH	H: Dächer	spanwise
Snow	S	S2	Orte unter 1000 m Seehöhe	full
Wind	W	W	Windlasten	full

Vibration design

DKL III keine Anforderung

1.1 Frequency Requirement

f_1	6,92	Hz	
f_{gr}	-	Hz	

1.2. Acceleration requirement for low frequencies f1 ≤ Hz

a_{rms}	0,11	m/s²	
a_{gr}	-	m/s²	OK

2. Stiffness criterion

w_{stat}	0,31	mm	
w_{grenz}	-	mm	OK

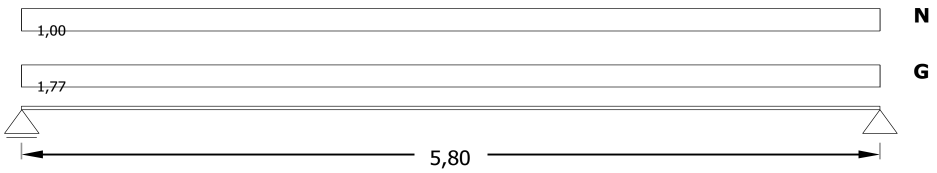
binderholz CLT BBS – continuous beams | floors
Full Version
Design following [EN] EN 1995-1-1:2019, "ETA-06/0009:2017. DiBt Z-9.1-534:2014"
WallnerMild

General

Service Class	1	
Members in closed, heated areas		
Fire	R 90	1
Serviceability	Full	

Standards referenced
EN 1995-1-:2009
[EN] EN 1995-1-1:2019
"ETA-06/0009:2017. DiBt Z-9.1-534:20

System



Loadgroup	Loadtype	Safety	Loadduration		Combination Values		
		γ	kled	kmod	ψ_0	ψ_1	ψ_2
G	G	1,35	ständig	0,60	-	-	-
N	NH	1,50	kurz	0,90	-	-	-
S	S2	1,50	kurz	0,90	0,50	0,20	-
W	W	1,50	s.kurz/kurz	1,00	0,60	0,20	-

cross section

Binder	BBS 125	**160 5s**

layer i	thickness di [mm]	burned di [mm]	orientation °	material
1	40,0	40,0	0	C24
2	20,0	20,0	90	C24
3	40,0	12,0	0	C24
4	20,0	0,0	90	C24
5	40,0	0,0	0	C24
6				C24
7				C24
8				C24
9				C24
d	160,0	72,0	5 s	C24

Design values of actions

ULS		Value	span	position x/l	k-mod	Length
V d [kN]	maximum values	11,27	span 1	0,00	0,90	5,80
	min	-11,27	span 1	1,00	0,90	5,80
M d [kNm]	maximum values	16,34	span 1	0,50	0,90	5,80
	min	0,00	0	0,00	1,00	0,00

SLS		span				cantilever			
k_{def} = 0,80		Value	span	position x/l	Length	Value	span	position x/l	Length
quasi-permanent		(guarantee useability and appearance)							
EJ·w_{fin}	maximum values	46,89	span 1	0,50	5,80	0,00	0	0,00	0,00
	min	0,00	0	0,00	0,00	0,00	0	0,00	0,00
Characteristic situation		(avoid demage at members below)							
EJ·$w_{Q,inst}$	maximum values	40,79	span 1	0,50	5,80	0,00	0	0,00	0,00
	min	0,00	0	0,00	0,00	0,00	0	0,00	0,00
w_{fin} – $w_{G,inst}$	maximum values	61,63	span 1	0,50	5,80	0,00	0	0,00	0,00
	min	0,00	0	0,00	0,00	0,00	0	0,00	0,00

binderholz CLT BBS – continuous beams | floors
Design following [EN] EN 1995-1-1:2019, "ETA-06/0009:2017. DiBt Z-9.1-534:2014"

Cross-section Values Reference length for cross-section values in beams over one spans : l* = l

	Ref.length	XS-Values			Comp.to full cross-section		
A eff	1,00 m	1.200	cm2	75% of	A tot	1.600	cm2
I eff,F	5,80 m	28.864	cm4	85% of	I tot,F	34.133	cm4
I eff,K	0,00 m	-	cm4		I tot,K	34.133	cm4
W eff	5,80 m	3.758	cm3	88% of	W tot	4.267	cm3

Calculation as semi-rigid composite

Verification of Ultimate Limit States

Bending span 1, x/l = 0,50

	M d	16,34 kNm	f m,k	18,00 N/mm²
			γ M	1,3 [EN]
			k mod	0,9
			k sys	1,1 system value
32%	σ m,y,d	4,35 N/mm²	f m,y,d	13,71 N/mm²

Shear stress span 1, x/l = 1,00

	V d	-11,27 kN		
	l*	5,8 m		
	S eff	2.600 cm³	f v,k	2,00 N/mm²
7%	τ v,d	0,10 N/mm²	f v,d	1,38 N/mm²
	Rolling Shear			
	S R,eff	2.400 cm³	f v,R,k	1,00 N/mm²
14%	τ R,d	0,09 N/mm²	f v,R,d	0,69 N/mm²

Verification of Serviceability Limit States

Displacements — Cantilever upward deflection not included

61%	E 0,mean	12.000 N/mm²
	γ M	1,0

		J_{eff} [cm⁴]	w [mm]	L* [m]	zul f	w_{max} [mm]	
	Appearance $w_{net,fin}$	28.864	**13,5**	5,80	l / 250	**23,2**	58%
58%	span 1, x/l = 0,50	-	**0,0**	0,00	l / 125	**0,0**	0%
	Avoid Damages w_{inst}	28.864	**11,8**	5,80	l / 300	**19,3**	61%
	span 1, x/l = 0,50	-	**0,0**	0,00	l / 150	**0,0**	0%
	w_{fin}	28.864	**17,8**	5,80	l / 200	**29,0**	61%
61%	span 1, x/l = 0,50	-	**0,0**	0,00	l / 100	**0,0**	0%

fire design

R 90 1
β0 0,90 mm/min

Accidental Situation		Value	span	position x/l	k-mod	Length
V fi [kN]	max	5,13	span 1	0,00	-	5,80
	min	-5,13	span 1	1,00	-	5,80
M fi [kNm]	max	7,43	span 1	0,50	-	5,80
	min	0,00	0	0,00		0,00

Bending

	M fi	7,43 kNm	f m,k	18,00 N/mm²
	ℓ*	5,80 m	k fi	1,15
	W eff,fi	605 cm3	γ M,fi	1,00
			k mod,fi	1,00
59%	σ m,y,fi	12,29 N/mm²	f d,fi	20,70 N/mm²

Shear stress

8%	V fi	-5,13 kN		
	I eff,fi	2.475,90 cm4		
	S eff,fi	468,65 cm3	f v,k	2,00 N/mm²
	S R,eff,fi	424,62 cm3	f v,R,k	1,00 N/mm²
4%	τ v,fi	0,10 N/mm²	f v,fi	2,30 N/mm²
8%	τ v,R,fi	0,09 N/mm²	f v,R,fi	1,15 N/mm²

Vibrations in residential floors WAHR

proof of human induced vibrations in floors according to ÖNORM B 1995-1-1:2014

floor-vibration-class (DKL)

DKL	III	keine Anforderung

no requirement

Floors without vibration requirements, floors of non-residential rooms or undeveloped attics.

dimensions

OK	l	5,80	m	Span des maßgebenden Feldes (ohne Kragarm)
	b	6,96	m	Floor width

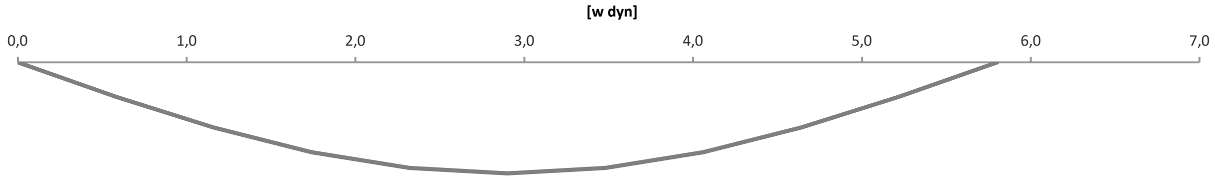
Construction: Brettsperrholzdecken mit schwimmendem Estrich und schwerem Fußbodenaufbau

D	4,00%	damping

Stiffness

$(EI)_{1,\ell}$	3,464	MNm² / m	floot in main span direction
$(EI)_{2,\ell}$	-	MNm² / m	screed (stiff layer) in main span direction
$(EI)_{\ell}$	3,464	MNm² / m	
$(EI)_{1,b}$	0,436	MNm² / m	floor across main span direction
$(EI)_{2,b}$	0,468	MNm² / m	screed (stiff layer) across main span direction
$(EI)_{b}$	0,904	MNm² / m	

Eigenmode



1.1 Frequency Requirement

	$(f1)_{\ell}$	6,53	Hz	first eigenfrequency for general beams without lateral distribution
	k_{fb}	1,061		improvement by lateral distribution
	f_1	6,92	Hz	first eigenfrequency of the floor with lateral distribution
	f_{gr}	-	Hz	limit
-	Requirement not met: continue with clause 1.2			

1.2. Acceleration requirement for low frequencies f1 ≤ - Hz

	f_{min}	4,50	Hz	Frequency limit against resonance (Requirement met)
	b_F	3,77	m	effective with in vibration modes
	$(M^*)_{\ell}$	523	kg	modal mass for general beams without lateral distribution
	M*	1.970	kg	modal mass of the floor with lateral distribution
	F_0	700	N	wight-force of a person walking on the floor
	α	0,063		impact factor for given frequency
	a_{rms}	0,111	m/s²	existing accelleration
-	a_{gr}	-	m/s²	limit

2. Stiffness criterion

	$(w_{stat})_{\ell}$	1,16	mm	deflection from unit load F = 1 kN without lateral distribution
	b_F	3,77	m	effective with in vibration modes
	w_{stat}	0,31	mm	deflection from unit load F = 1 kN with lateral distribution
-	w_{grenz}	-	mm	limit

Informativ: Eigenfrequenz für Einfeldträger laut EN 1995-1-1 mit quasi-ständigen Lasten

L	5,80	m	
$m_{q.perm}$	190	kg/m²	Σ g i + Σ ψ 2 · q i
$f_{1,EN}$	6,30	Hz	

Informativ: Kriterium nach <u>Hu, Chui</u>

161%

Support forces for load transmission

Support	Dsgn.Value	char.Wert	Loadcode		Dsgn.Value	char.Wert	Loadcode
	Maximalwerte			Minimalwerte			
A G,k		5,13	G	A G,k		5,13	G
A N,k		2,90	NH	A N,k		0,00	NH
A d	**11,27**			**A d**	**6,92**		
B G,k		5,13	G	B G,k		5,13	G
B N,k		2,90	NH	B N,k		0,00	NH
B d	**11,27**			**B d**	**6,92**		

binderholz CLT BBS – continuous beams | floors

Full Version

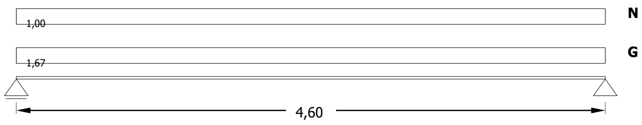
Design following [EN] EN 1995-1-1:2019, "ETA-06/0009:2017. DiBt Z-9.1-534:2014" WallnerMild

General

Service Class	NKL	1			kdef	0,80
		Members in closed, heated areas			k sys	1,10
Serviceability		Full	g1 und g2 werden für w inst berücksichtigt			
Include cant.upward defl.		no				
Fire		R 90				
		1	single sided	t ch	0,00	min
				β f	0,47	mm/min
				t f	0,00	min

	Serviceability	irreversible
allow.w,inst		ℓ / 300
allow.w,fin	ℓ / 250	ℓ / 200

β 0	0,90	mm/min
β 1a	0,90	mm/min (25mm)
β 1b	0,90	mm/min
ρ	480	kg/m³



Design Results

Total	80 %
Moment	25 %
Transverse force	13 %
Deflection	
Appearance	41 %
Avoid Damages	43 %
Vibration	keine Anforderung
Fire	
Moment	80 %
Transverse force	6 %

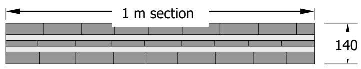
System

span	Lengths Li [m]	Uniform loads g 2,k [kN/m]	g 1,k + g 2,k [kN/m] G	n k [kN/m] N	s k [kN/m] S	w k [kN/m] W
		g 1,k =	0,67			
cantilever Li						
span 1	4,60	1,00	1,67	1,00		
span 2						
span 3						
span 4						
span 5						
span 6						
span 7						
cantilever Re						

cross section

Producer:	Binder
Type:	BBS 125
Element:	**140 5s**
	Coverlayer in direction of span axis

layer i	thickness di [mm]	orientation °	material
1	40	0	C24
2	20	90	C24
3	20	0	C24
4	20	90	C24
5	40	0	C24
6			C24
7			C24
8			C24
9			C24
d	140	5	C24



binderholz

Single loads span	Loadgroup	First single load x_F [m]	F_k [kN]	Second single load x_F [m]	F_k [kN]
cantilever Li					
cantilever Li					
span 2					
span 3					
span 4					
span 5					
span 6					
span 7					
cantilever Re					

Vibration design

Load definitions

	Loadgroup	Loadtype		Loadapp.
Selfweight	G	G	Ständige Lasten	full
Liveload	N	NH	H: Dächer	spanwise
Snow	S	S2	Orte unter 1000 m Seehöhe	full
Wind	W	W	Windlasten	full

DKL III keine Anforderung

1.1 Frequency Requirement

f_1	9,42	Hz	
f_{gr}	-	Hz	

1.2. Acceleration requirement for low frequencies f1 ≤ Hz

a_{rms}	0,07	m/s²	
a_{gr}	-	m/s²	OK

2. Stiffness criterion

w_{stat}	0,28	mm	
w_{grenz}	-	mm	OK

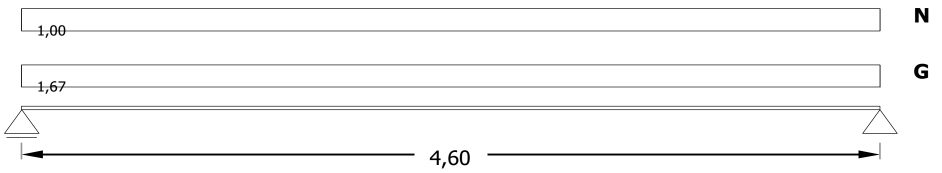
binderholz CLT BBS – continuous beams | floors Full Version
Design following [EN] EN 1995-1-1:2019, "ETA-06/0009:2017. DiBt Z-9.1-534:2014" WallnerMild

General

Service Class	1	
Members in closed, heated areas		
Fire	R 90	1
Serviceability	Full	

Standards referenced
EN 1995-1-:2009
[EN] EN 1995-1-1:2019
"ETA-06/0009:2017. DiBt Z-9.1-534:20

System



Loadgroup	Loadtype	Safety	Loadduration		Combination Values		
		γ	kled	kmod	ψ_0	ψ_1	ψ_2
G	G	1,35	ständig	0,60	-	-	-
N	NH	1,50	kurz	0,90	-	-	-
S	S2	1,50	kurz	0,90	0,50	0,20	-
W	W	1,50	s.kurz/kurz	1,00	0,60	0,20	-

cross section Binder BBS 125 **140 5s**

layer i	thickness di [mm]	burned di [mm]	orientation °	material
1	40,0	40,0	0	C24
2	20,0	12,0	90	C24
3	20,0	0,0	0	C24
4	20,0	0,0	90	C24
5	40,0	0,0	0	C24
6				C24
7				C24
8				C24
9				C24
d	140,0	52,0	5 s	C24

Design values of actions

ULS		Value	span	position x/l	k-mod	Length
V d [kN]	maximum values	8,64	span 1	0,00	0,90	4,60
	min	-8,64	span 1	1,00	0,90	4,60
M d [kNm]	maximum values	9,94	span 1	0,50	0,90	4,60
	min	0,00	0	0,00	1,00	0,00

SLS		span				cantilever			
k_{def} = 0,80		Value	span	position x/l	Length	Value	span	position x/l	Length
quasi-permanent		(guarantee useability and appearance)							
$EJ\cdot w_{fin}$	maximum values	17,55	span 1	0,50	4,60	0,00	0	0,00	0,00
	min	0,00	0	0,00	0,00	0,00	0	0,00	0,00
Characteristic situation		(avoid demage at members below)							
$EJ\cdot w_{Q,inst}$	maximum values	15,58	span 1	0,50	4,60	0,00	0	0,00	0,00
	min	0,00	0	0,00	0,00	0,00	0	0,00	0,00
$w_{fin} - w_{G,inst}$	maximum values	23,38	span 1	0,50	4,60	0,00	0	0,00	0,00
	min	0,00	0	0,00	0,00	0,00	0	0,00	0,00

binderholz CLT BBS – continuous beams | floors
Design following [EN] EN 1995-1-1:2019, "ETA-06/0009:2017. DiBt Z-9.1-534:2014"

Cross-section Values Reference length for cross-section values in beams over one spans : l* = l

	Ref.length	XS-Values			Comp.to full cross-section	
A eff	1,00 m	1.000 cm2	71% of		A tot	1.400 cm2
I eff,F	4,60 m	19.489 cm4	85% of		I tot,F	22.867 cm4
I eff,K	0,00 m	- cm4			I tot,K	22.867 cm4
W eff	4,60 m	2.958 cm3	91% of		W tot	3.267 cm3

Calculation as semi-rigid composite

Verification of Ultimate Limit States

Bending		span 1, x/l = 0,50		
	M d	9,94 kNm	f m,k	18,00 N/mm²
			γ M	1,3 [EN]
			k mod	0,9
			k sys	1,1 system value
25%	σ m,y,d	3,36 N/mm²	f m,y,d	13,71 N/mm²
Shear stress		span 1, x/l = 1,00		
	V d	-8,64 kN		
	l*	4,6 m		
	S eff	2.050 cm³	f v,k	2,00 N/mm²
7%	τ v,d	0,09 N/mm²	f v,d	1,38 N/mm²
	Rolling Shear			
	S R,eff	2.000 cm³	f v,R,k	1,00 N/mm²
13%	τ R,d	0,09 N/mm²	f v,R,d	0,69 N/mm²

Verification of Serviceability Limit States

Displacements — Cantilever upward deflection not included

43%	E 0,mean	12.000 N/mm²
	γ M	1,0

		J_{eff} [cm⁴]	w [mm]	L* [m]	zul f	w_{max} [mm]	
	Appearance $w_{net,fin}$	19.489	**7,5**	4,60	l / 250	**18,4**	41%
41%	span 1, x/l = 0,50	-	**0,0**	0,00	l / 125	**0,0**	0%
	Avoid Damages w_{inst}	19.489	**6,7**	4,60	l / 300	**15,3**	43%
	span 1, x/l = 0,50	-	**0,0**	0,00	l / 150	**0,0**	0%
	w_{fin}	19.489	**10,0**	4,60	l / 200	**23,0**	43%
43%	span 1, x/l = 0,50	-	**0,0**	0,00	l / 100	**0,0**	0%

fire design

R 90 1
β0 0,90 mm/min

Accidental Situation		Value	span	position x/l	k-mod	Length
V fi [kN]	max	3,85	span 1	0,00	-	4,60
	min	-3,85	span 1	1,00	-	4,60
M fi [kNm]	max	4,42	span 1	0,50	-	4,60
	min	0,00	0	0,00		0,00

Bending				
	M fi	4,42 kNm	f m,k	18,00 N/mm²
	ℓ*	4,60 m	k fi	1,15
	W eff,fi	267 cm3	γ M,fi	1,00
			k mod,fi	1,00
80%	σ m,y,fi	16,58 N/mm²	f d,fi	20,70 N/mm²
Shear stress				
6%	V fi	-3,85 kN		
	I eff,fi	533,33 cm4		
	S eff,fi	200,00 cm3	f v,k	2,00 N/mm²
	S R,eff,fi	0,00 cm3	f v,R,k	1,00 N/mm²
6%	τ v,fi	0,14 N/mm²	f v,fi	2,30 N/mm²
0%	τ v,R,fi	0,00 N/mm²	f v,R,fi	1,15 N/mm²

Vibrations in residential floors WAHR

proof of human induced vibrations in floors according to ÖNORM B 1995-1-1:2014

floor-vibration-class (DKL)

DKL III keine Anforderung

no requirement

Floors without vibration requirements, floors of non-residential rooms or undeveloped attics.

dimensions

OK	l	4,60	m	Span des maßgebenden Feldes (ohne Kragarm)
	b	5,52	m	Floor width

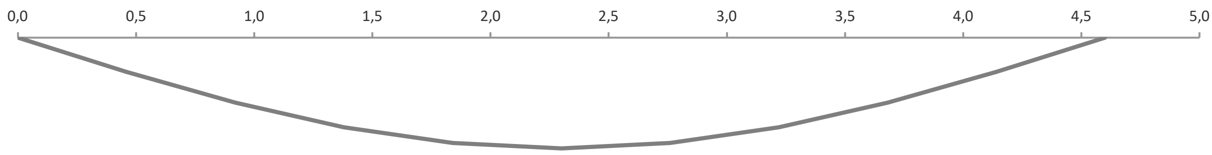
Construction: Brettsperrholzdecken mit schwimmendem Estrich und schwerem Fußbodenaufbau

D	4,00%		damping

Stiffness

$(EI)_{1,\ell}$	2,339	MNm² / m	floot in main span direction
$(EI)_{2,\ell}$	-	MNm² / m	screed (stiff layer) in main span direction
$(EI)_{\ell}$	2,339	MNm² / m	
$(EI)_{1,b}$	0,204	MNm² / m	floor across main span direction
$(EI)_{2,b}$	0,468	MNm² / m	screed (stiff layer) across main span direction
$(EI)_{b}$	0,672	MNm² / m	

Eigenmode



1.1 Frequency Requirement

	$(f1)_{\ell}$	8,82	Hz	first eigenfrequency for general beams without lateral distribution
	k_{fb}	1,067		improvement by lateral distribution
	f_1	9,42	Hz	first eigenfrequency of the floor with lateral distribution
	f_{gr}	-	Hz	limit
-	Requirement not met: continue with clause 1.2			

1.2. Acceleration requirement for low frequencies f1 ≤ - Hz

	f_{min}	4,50	Hz	Frequency limit against resonance (Requirement met)
	b_F	3,06	m	effective with in vibration modes
	$(M^*)_{\ell}$	392	kg	modal mass for general beams without lateral distribution
	M^*	1.200	kg	modal mass of the floor with lateral distribution
	F_0	700	N	wight-force of a person walking on the floor
	α	0,023		impact factor for given frequency
	a_{rms}	0,067	m/s²	existing accelleration
-	a_{gr}	-	m/s²	limit

2. Stiffness criterion

	$(w_{stat})_{\ell}$	0,84	mm	deflection from unit load F = 1 kN without lateral distribution
	b_F	3,06	m	effective with in vibration modes
	w_{stat}	0,28	mm	deflection from unit load F = 1 kN with lateral distribution
-	w_{grenz}	-	mm	limit

Informativ: Eigenfrequenz für Einfeldträger laut EN 1995-1-1 mit quasi-ständigen Lasten

L	4,60	m	
$m_{q.perm}$	180	kg/m²	Σ g i + Σ ψ 2 · q i
$f_{1,EN}$	8,46	Hz	

Informativ: Kriterium nach Hu, Chui

113%

Support forces for load transmission

Support	Dsgn.Value	char.Wert	Loadcode		Dsgn.Value	char.Wert	Loadcode
	Maximalwerte			Minimalwerte			
A G,k		3,85	G	A G,k		3,85	G
A N,k		2,30	NH	A N,k		0,00	NH
A d	**8,64**			**A d**	**5,19**		
B G,k		3,85	G	B G,k		3,85	G
B N,k		2,30	NH	B N,k		0,00	NH
B d	**8,64**			**B d**	**5,19**		

binderholz CLT BBS – continuous beams | floors

Full Version

Design following [EN] EN 1995-1-1:2019, "ETA-06/0009:2017. DiBt Z-9.1-534:2014"

WallnerMild

General

Service Class	NKL	1	
		Members in closed, heated areas	
Serviceability		Full	g1 und g2 werden für w inst berücksichtigt
Include cant.upward defl.		no	
Fire		R 90	
		1	single sided

t ch	0,00	min
β f	0,47	mm/min
t f	0,00	min

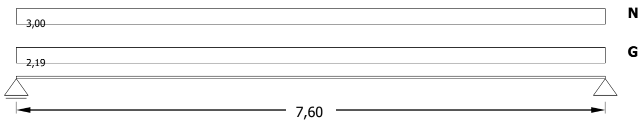
kdef	0,80	
k sys	1,10	

	Serviceability	irreversible
allow.w,inst		ℓ / 300
allow.w,fin	ℓ / 250	ℓ / 200

β 0	0,90	mm/min
β 1a	0,90	mm/min (25mm)
β 1b	0,90	mm/min
ρ	480	kg/m³

Design Results

Total	49 %
Moment	38 %
Transverse force	24 %
Deflection	
Appearance	44 %
Avoid Damages	49 %
Vibration	not fulfilled
Fire	
Moment	36 %
Transverse force	11 %



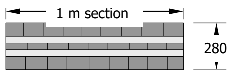
System

span	Lengths Li [m]	Uniform loads g 2,k [kN/m]	g 1,k + g 2,k [kN/m]	n k [kN/m]	s k [kN/m]	w k [kN/m]
			G	N	S	W
		g 1,k =	1,34			
cantilever Li						
span 1	7,60	0,85	2,19	3,00		
span 2						
span 3						
span 4						
span 5						
span 6						
span 7						
cantilever Re						

cross section

Producer:	Binder
Type:	BBS 125
Element:	280 5s
	Coverlayer in direction of span axis

layer i	thickness di [mm]	orientation °	material
1	80	0	C24
2	40	90	C24
3	40	0	C24
4	40	90	C24
5	80	0	C24
6			C24
7			C24
8			C24
9			C24
d	280	5	C24



binderholz

Single loads span	Loadgroup	First single load x_F [m]	F_k [kN]	Second single load x_F [m]	F_k [kN]
cantilever Re					
span 1					
span 2					
span 3					
span 4					
span 5					
span 6					
span 7					
cantilever Re					

Load definitions

	Loadgroup	Loadtype		Loadapp.
Selfweight	G	G	Ständige Lasten	full
Liveload	N	NB	B: Büroflächen	spanwise
Snow	S	S2	Orte unter 1000 m Seehöhe	full
Wind	W	W	Windlasten	full

Vibration design

proof of vibration
ES-RMS$_{90}$ - D
see page 5

DKL I not fulfilled

1.1 Frequency Requirement

f_1	7,89 Hz	
f_{gr}	8,00 Hz	

1.2. Acceleration requirement for low frequencies f1 ≤ Hz

a_{rms}	0,07 m/s²	
a_{gr}	0,05 m/s²	!!!

2. Stiffness criterion

w_{stat}	0,13 mm	
w_{grenz}	0,25 mm	OK

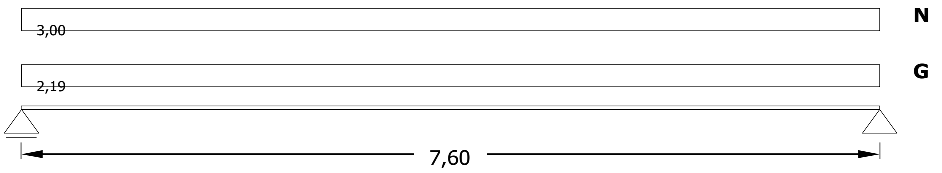
binderholz CLT BBS – continuous beams | floors Full Version
Design following [EN] EN 1995-1-1:2019, "ETA-06/0009:2017. DiBt Z-9.1-534:2014" WallnerMild

General

Service Class	1	
Members in closed, heated areas		
Fire	R 90	1
Serviceability	Full	

Standards referenced
EN 1995-1-:2009
[EN] EN 1995-1-1:2019
"ETA-06/0009:2017. DiBt Z-9.1-534:20

System



Loadgroup	Loadtype	Safety	Loadduration		Combination Values		
		γ	kled	kmod	ψ_0	ψ_1	ψ_2
G	G	1,35	ständig	0,60	-	-	-
N	NB	1,50	mittel	0,80	0,70	0,50	0,30
S	S2	1,50	kurz	0,90	0,50	0,20	-
W	W	1,50	s.kurz/kurz	1,00	0,60	0,20	-

cross section Binder BBS 125 **280 5s**

layer i	thickness di [mm]	burned di [mm]	orientation °	material
1	80,0	80,0	0	C24
2	40,0	40,0	90	C24
3	40,0	40,0	0	C24
4	40,0	32,0	90	C24
5	80,0	0,0	0	C24
6				C24
7				C24
8				C24
9				C24
d	280,0	192,0	5 s	C24

Design values of actions

ULS		Value	span	position x/l	k-mod	Length
V d [kN]	maximum values	28,36	span 1	0,00	0,80	7,60
	min	-28,36	span 1	1,00	0,80	7,60
M d [kNm]	maximum values	53,87	span 1	0,50	0,80	7,60
	min	0,00	0	0,00	1,00	0,00

SLS		span				cantilever			
k_{def} = 0,80		Value	span	position x/l	Length	Value	span	position x/l	Length
quasi-permanent		(guarantee useability and appearance)							
$EJ \cdot w_{fin}$	maximum values	241,93	span 1	0,50	7,60	0,00	0	0,00	0,00
	min	0,00	0	0,00	0,00	0,00	0	0,00	0,00
Characteristic situation		(avoid demage at members below)							
$EJ \cdot w_{Q,inst}$	maximum values	225,63	span 1	0,50	7,60	0,00	0	0,00	0,00
	min	0,00	0	0,00	0,00	0,00	0	0,00	0,00
$w_{fin} - w_{G,inst}$	maximum values	333,15	span 1	0,50	7,60	0,00	0	0,00	0,00
	min	0,00	0	0,00	0,00	0,00	0	0,00	0,00

Cross-section Values Reference length for cross-section values in beams over one spans : l* = l

	Ref.length	XS-Values			Comp.to full cross-section		
A eff	1,00 m	2.000	cm2	71% of	A tot	2.800	cm2
I eff,F	7,60 m	150.506	cm4	82% of	I tot,F	182.933	cm4
I eff,K	0,00 m	-	cm4		I tot,K	182.933	cm4
W eff	7,60 m	11.722	cm3	90% of	W tot	13.067	cm3

Calculation as semi-rigid composite

Verification of Ultimate Limit States

Bending		span 1, x/l = 0,50			
	M d	53,87 kNm	f m,k	18,00	N/mm²
			γ M	1,3	[EN]
			k mod	0,8	
			k sys	1,1	system value
38%	σ m,y,d	4,60 N/mm²	f m,y,d	12,18	N/mm²
Shear stress		span 1, x/l = 1,00			
	V d	-28,36 kN			
	l*	7,6 m			
	S eff	8.200 cm³	f v,k	2,00	N/mm²
13%	τ v,d	0,15 N/mm²	f v,d	1,23	N/mm²
	Rolling Shear				
	S R,eff	8.000 cm³	f v,R,k	1,00	N/mm²
24%	τ R,d	0,15 N/mm²	f v,R,d	0,62	N/mm²

Verification of Serviceability Limit States

Displacements — Cantilever upward deflection not included

49%	E 0,mean	12.000 N/mm²
	γ M	1,0

		J_{eff} [cm⁴]	w [mm]	L* [m]	zul f	w_{max} [mm]	
	Appearance $w_{net,fin}$	150.506	**13,4**	7,60	l / 250	**30,4**	44%
44%	span 1, x/l = 0,50	-	**0,0**	0,00	l / 125	**0,0**	0%
	Avoid Damages w_{inst}	150.506	**12,5**	7,60	l / 300	**25,3**	49%
	span 1, x/l = 0,50	-	**0,0**	0,00	l / 150	**0,0**	0%
	w_{fin}	150.506	**18,4**	7,60	l / 200	**38,0**	49%
49%	span 1, x/l = 0,50	-	**0,0**	0,00	l / 100	**0,0**	0%

fire design

R 90 1

β0 0,90 mm/min

Accidental Situation		Value	span	position x/l	k-mod	Length
V fi [kN]	max	14,04	span 1	0,00	-	7,60
	min	-14,04	span 1	1,00	-	7,60
M fi [kNm]	max	26,67	span 1	0,50	-	7,60
	min	0,00	0	0,00		0,00

Bending					
	M fi	26,67 kNm	f m,k	18,00	N/mm²
	ℓ*	7,60 m	k fi	1,15	
	W eff,fi	3.618 cm3	γ M,fi	1,00	
			k mod,fi	1,00	
36%	σ m,y,fi	7,37 N/mm²	f d,fi	20,70	N/mm²
Shear stress					
11%	V fi	-14,04 kN			
	I eff,fi	30.349,06 cm4			
	S eff,fi	2.688,89 cm3	f v,k	2,00	N/mm²
	S R,eff,fi	2.666,67 cm3	f v,R,k	1,00	N/mm²
5%	τ v,fi	0,12 N/mm²	f v,fi	2,30	N/mm²
11%	τ v,R,fi	0,12 N/mm²	f v,R,fi	1,15	N/mm²

Vibrations in residential floors WAHR

proof of human induced vibrations in floors according to ÖNORM B 1995-1-1:2014

floor-vibration-class (DKL)

DKL I not fulfilled

high requirement

Floors deviding utilisation units, deviding floors in multy-family dwellings, floors in offices with PC-use or meeting rooms, hallways with short spans.

dimensions

! not OK !

l	7,60	m	Span des maßgebenden Feldes (ohne Kragarm)
b	9,12	m	Floor width

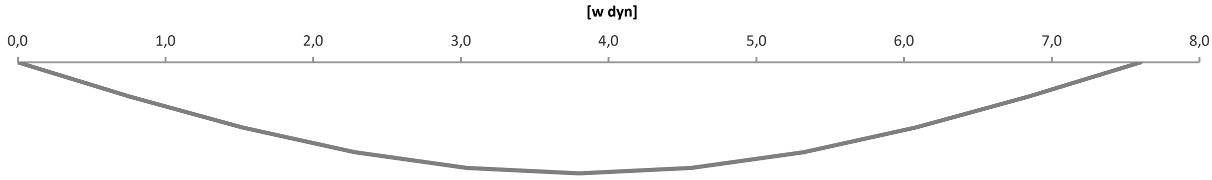
Construction: XLAM-floors without or with leight-wight build-ups.

D	2,50%		damping

Stiffness

$(EI)_{1,\ell}$	18,061	MNm² / m	floot in main span direction
$(EI)_{2,\ell}$	-	MNm² / m	screed (stiff layer) in main span direction
$(EI)_{\ell}$	18,061	MNm² / m	
$(EI)_{1,b}$	1,615	MNm² / m	floor across main span direction
$(EI)_{2,b}$	-	MNm² / m	screed (stiff layer) across main span direction
$(EI)_{b}$	1,615	MNm² / m	

Eigenmode



1.1 Frequency Requirement

$(f1)_{\ell}$	7,73	Hz	first eigenfrequency for general beams without lateral distribution
k_{fb}	1,021		improvement by lateral distribution
f_1	7,89	Hz	first eigenfrequency of the floor with lateral distribution
f_{gr}	8,00	Hz	limit

! not OK ! Requirement not met: continue with clause 1.2

1.2. Acceleration requirement for low frequencies f1 ≤ 8 Hz

	f_{min}	4,50	Hz	Frequency limit against resonance (Requirement met)
	b_F	3,78	m	effective with in vibration modes
	$(M^*)_{\ell}$	850	kg	modal mass for general beams without lateral distribution
	M^*	3.211	kg	modal mass of the floor with lateral distribution
	F_0	700	N	wight-force of a person walking on the floor
	α	0,043		impact factor for given frequency
	a_{rms}	0,074	m/s²	existing accelleration
! not OK !	a_{gr}	0,050	m/s²	limit

2. Stiffness criterion

	$(w_{stat})_{\ell}$	0,51	mm	deflection from unit load F = 1 kN without lateral distribution
	b_F	3,78	m	effective with in vibration modes
	w_{stat}	0,13	mm	deflection from unit load F = 1 kN with lateral distribution
OK	w_{grenz}	0,25	mm	limit

Informativ: Eigenfrequenz für Einfeldträger laut EN 1995-1-1 mit quasi-ständigen Lasten

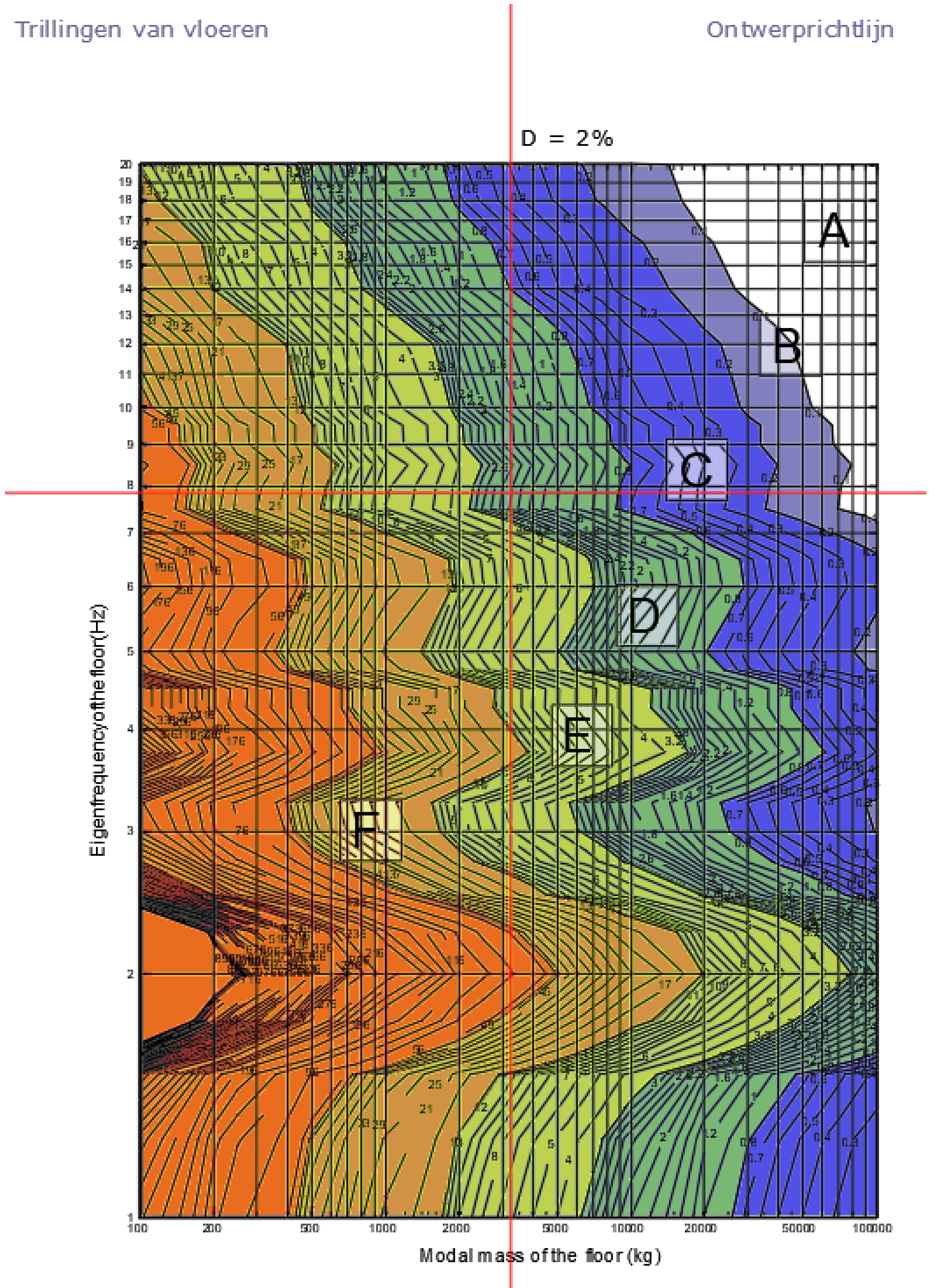
L	7,60	m	
$m_{q.perm}$	315	kg/m²	$\Sigma\, g\, i + \Sigma\, \psi\, 2 \cdot q\, i$
$f_{1,EN}$	6,51	Hz	

Informativ: Kriterium nach Hu, Chui

98%

Support forces for load transmission

Support	Dsgn.Value	char.Wert	Loadcode		Dsgn.Value	char.Wert	Loadcode
	Maximalwerte			Minimalwerte			
A G,k		8,34	G	A G,k		8,34	G
A N,k		11,40	NB	A N,k		0,00	NB
A d	**28,36**			**A d**	**11,26**		
B G,k		8,34	G	B G,k		8,34	G
B N,k		11,40	NB	B N,k		0,00	NB
B d	**28,36**			**B d**	**11,26**		



Figuur 4: ES-RMS90 voor 2% Demping

binderholz CLT BBS – continuous beams | floors

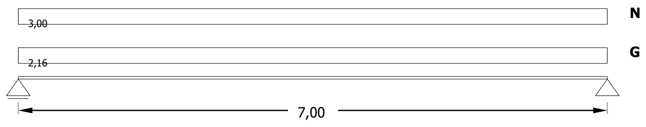
Full Version

Design following [EN] EN 1995-1-1:2019, "ETA-06/0009:2017. DiBt Z-9.1-534:2014"

WallnerMild

General

Service Class	NKL	1				kdef	0,80	
		Members in closed, heated areas				k sys	1,10	
Serviceability		Full	g1 und g2 werden für w inst berücksichtigt				Serviceability	irreversible
Include cant.upward defl.		no				allow.w,inst		ℓ / 300
						allow.w,fin	ℓ / 250	ℓ / 200
Fire		R 90						
		1	single sided	t ch	0,00 min	β 0	0,90	mm/min
				β f	0,47 mm/min	β 1a	0,90	mm/min (25mm)
				t f	0,00 min	β 1b	0,90	mm/min
						ρ	480	kg/m³



Design Results

Total	46 %
Moment	36 %
Transverse force	24 %
Deflection	
Appearance	41 %
Avoid Damages	46 %
Vibration	fulfilled
Fire	
Moment	33 %
Transverse force	10 %

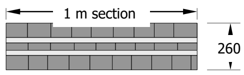
System

span	Lengths Li [m]	Uniform loads g 2,k [kN/m]	g 1,k + g 2,k [kN/m] G	n k [kN/m] N	s k [kN/m] S	w k [kN/m] W
		g 1,k =	1,25			
cantilever Li						
span 1	7,00	0,91	2,16	3,00		
span 2						
span 3						
span 4						
span 5						
span 6						
span 7						
cantilever Re						

cross section

Producer: Binder
Type: BBS 125
Element: **260 5s**
Coverlayer in direction of span axis

layer i	thickness di [mm]	orientation °	material
1	80	0	C24
2	30	90	C24
3	40	0	C24
4	30	90	C24
5	80	0	C24
6			C24
7			C24
8			C24
9			C24
d	260	5	C24



binderholz

Single loads

span	Loadgroup	First single load x_F [m]	F_k [kN]	Second single load x_F [m]	F_k [kN]
cantilever Re					
span 1					
span 2					
span 3					
span 4					
span 5					
span 6					
span 7					
cantilever Re					

proof of vibration
ES-RMS$_{90}$ - D
see page 5

Vibration design

Load definitions

	Loadgroup	Loadtype		Loadapp.
Selfweight	G	G	Ständige Lasten	full
Liveload	N	NB	B: Büroflächen	spanwise
Snow	S	S2	Orte unter 1000 m Seehöhe	full
Wind	W	W	Windlasten	full

DKL I fulfilled

1.1 Frequency Requirement

f_1	8,56 Hz	
f_{gr}	8,00 Hz	

1.2. Acceleration requirement for low frequencies f1 ≤ Hz

a_{rms}	0,07 m/s²	
a_{gr}	0,05 m/s²	OK

2. Stiffness criterion

w_{stat}	0,15 mm	
w_{grenz}	0,25 mm	OK

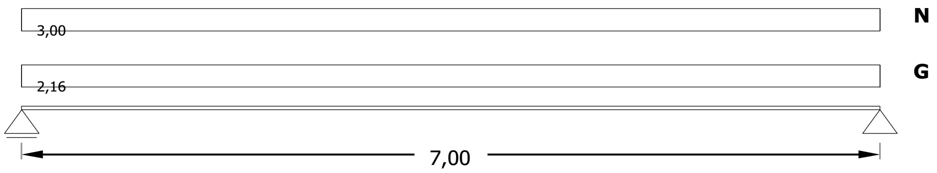
binderholz CLT BBS – continuous beams | floors
Full Version
Design following [EN] EN 1995-1-1:2019, "ETA-06/0009:2017. DiBt Z-9.1-534:2014"
WallnerMild

General

Service Class	1	
Members in closed, heated areas		
Fire	R 90	1
Serviceability	Full	

Standards referenced
EN 1995-1-:2009
[EN] EN 1995-1-1:2019
"ETA-06/0009:2017. DiBt Z-9.1-534:20

System



Loadgroup	Loadtype	Safety	Loadduration		Combination Values		
		γ	kled	kmod	ψ_0	ψ_1	ψ_2
G	G	1,35	ständig	0,60	-	-	-
N	NB	1,50	mittel	0,80	0,70	0,50	0,30
S	S2	1,50	kurz	0,90	0,50	0,20	-
W	W	1,50	s.kurz/kurz	1,00	0,60	0,20	-

cross section Binder BBS 125 **260 5s**

layer i	thickness di [mm]	burned di [mm]	orientation °	material
1	80,0	80,0	0	C24
2	30,0	30,0	90	C24
3	40,0	40,0	0	C24
4	30,0	22,0	90	C24
5	80,0	0,0	0	C24
6				C24
7				C24
8				C24
9				C24
d	260,0	172,0	5 s	C24

Design values of actions

ULS		Value	span	position x/l	k-mod	Length
V d [kN]	maximum values	25,95	span 1	0,00	0,80	7,00
	min	-25,95	span 1	1,00	0,80	7,00
M d [kNm]	maximum values	45,41	span 1	0,50	0,80	7,00
	min	0,00	0	0,00	1,00	0,00

SLS		span				cantilever			
k_{def} = 0,80		Value	span	position x/l	Length	Value	span	position x/l	Length
quasi-permanent		(guarantee useability and appearance)							
$EJ \cdot w_{fin}$	maximum values	172,08	span 1	0,50	7,00	0,00	0	0,00	0,00
	min	0,00	0	0,00	0,00	0,00	0	0,00	0,00
Characteristic situation		(avoid demage at members below)							
$EJ \cdot w_{Q,inst}$	maximum values	161,25	span 1	0,50	7,00	0,00	0	0,00	0,00
	min	0,00	0	0,00	0,00	0,00	0	0,00	0,00
$w_{fin} - w_{G,inst}$	maximum values	237,74	span 1	0,50	7,00	0,00	0	0,00	0,00
	min	0,00	0	0,00	0,00	0,00	0	0,00	0,00

Cross-section Values Reference length for cross-section values in beams over one spans : l* = l

	Ref.length	XS-Values			Comp.to full cross-section	
A eff	1,00 m	2.000 cm2	77% of	A tot	2.600	cm2
I eff,F	7,00 m	125.194 cm4	85% of	I tot,F	146.467	cm4
I eff,K	0,00 m	- cm4		I tot,K	146.467	cm4
W eff	7,00 m	10.377 cm3	92% of	W tot	11.267	cm3

Calculation as semi-rigid composite

Verification of Ultimate Limit States

Bending		span 1, x/l = 0,50		
	M d	45,41 kNm	f m,k	18,00 N/mm²
			γ M	1,3 [EN]
			k mod	0,8
			k sys	1,1 system value
36%	σ m,y,d	4,38 N/mm²	f m,y,d	12,18 N/mm²
Shear stress		span 1, x/l = 1,00		
	V d	-25,95 kN		
	l*	7 m		
	S eff	7.400 cm³	f v,k	2,00 N/mm²
12%	τ v,d	0,15 N/mm²	f v,d	1,23 N/mm²
	Rolling Shear			
	S R,eff	7.200 cm³	f v,R,k	1,00 N/mm²
24%	τ R,d	0,15 N/mm²	f v,R,d	0,62 N/mm²

Verification of Serviceability Limit States

Displacements — Cantilever upward deflection not included

46%	E 0,mean	12.000 N/mm²
	γ M	1,0

		J_{eff} [cm⁴]	w [mm]	L* [m]	zul f	w_{max} [mm]	
	Appearance $w_{net,fin}$	125.194	**11,5**	7,00	l / 250	**28,0**	41%
41%	span 1, x/l = 0,50	-	**0,0**	0,00	l / 125	**0,0**	0%
	Avoid Damages w_{inst}	125.194	**10,7**	7,00	l / 300	**23,3**	46%
	span 1, x/l = 0,50	-	**0,0**	0,00	l / 150	**0,0**	0%
	w_{fin}	125.194	**15,8**	7,00	l / 200	**35,0**	45%
46%	span 1, x/l = 0,50	-	**0,0**	0,00	l / 100	**0,0**	0%

fire design

	R 90	1
β0	0,90 mm/min	

Accidental Situation		Value	span	position x/l	k-mod	Length
V fi [kN]	max	12,80	span 1	0,00	-	7,00
	min	-12,80	span 1	1,00	-	7,00
M fi [kNm]	max	22,41	span 1	0,50	-	7,00
	min	0,00	0	0,00		0,00

Bending				
	M fi	22,41 kNm	f m,k	18,00 N/mm²
	ℓ*	7,00 m	k fi	1,15
	W eff,fi	3.291 cm3	γ M,fi	1,00
			k mod,fi	1,00
33%	σ m,y,fi	6,81 N/mm²	f d,fi	20,70 N/mm²
Shear stress				
10%	V fi	-12,80 kN		
	I eff,fi	25.595,77 cm4		
	S eff,fi	2.450,00 cm3	f v,k	2,00 N/mm²
	S R,eff,fi	2.400,00 cm3	f v,R,k	1,00 N/mm²
5%	τ v,fi	0,12 N/mm²	f v,fi	2,30 N/mm²
10%	τ v,R,fi	0,12 N/mm²	f v,R,fi	1,15 N/mm²

Vibrations in residential floors WAHR

proof of human induced vibrations in floors according to ÖNORM B 1995-1-1:2014

floor-vibration-class (DKL)

DKL I fulfilled

high requirement

Floors deviding utilisation units, deviding floors in multy-family dwellings, floors in offices with PC-use or meeting rooms, hallways with short spans.

dimensions

OK	l	7,00	m	Span des maßgebenden Feldes (ohne Kragarm)
	b	8,40	m	Floor width

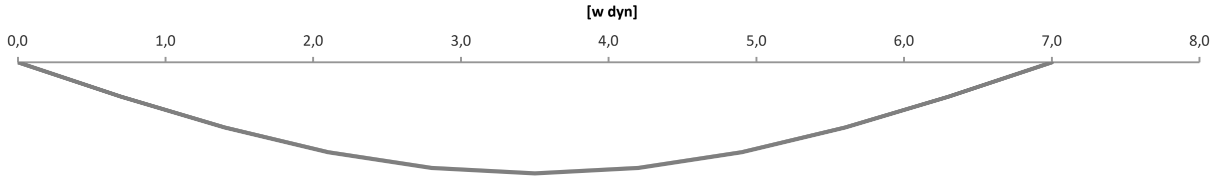
Construction: XLAM-floors without or with leight-wight build-ups.

D 2,50% damping

Stiffness

$(EI)_{1,\ell}$	15,023	MNm² / m	floot in main span direction
$(EI)_{2,\ell}$	-	MNm² / m	screed (stiff layer) in main span direction
$(EI)_{\ell}$	15,023	MNm² / m	
$(EI)_{1,b}$	0,911	MNm² / m	floor across main span direction
$(EI)_{2,b}$	-	MNm² / m	screed (stiff layer) across main span direction
$(EI)_{b}$	0,911	MNm² / m	

Eigenmode



1.1 Frequency Requirement

	$(f1)_{\ell}$	8,44	Hz	first eigenfrequency for general beams without lateral distribution
	k_{fb}	1,015		improvement by lateral distribution
	f_1	8,56	Hz	first eigenfrequency of the floor with lateral distribution
	f_{gr}	8,00	Hz	limit
OK	Requirement met: clause 1.2 not required			

1.2. Acceleration requirement for low frequencies f1 ≤ 8 Hz

	f_{min}	4,50	Hz	Frequency limit against resonance (Requirement met)
	b_F	3,16	m	effective with in vibration modes
	$(M^*)_{\ell}$	770	kg	modal mass for general beams without lateral distribution
	M*	2.431	kg	modal mass of the floor with lateral distribution
	F_0	700	N	wight-force of a person walking on the floor
	α	0,033		impact factor for given frequency
	a_{rms}	0,075	m/s²	existing accelleration
! not OK !	a_{gr}	0,050	m/s²	limit

2. Stiffness criterion

	$(w_{stat})_{\ell}$	0,47	mm	deflection from unit load F = 1 kN without lateral distribution
	b_F	3,16	m	effective with in vibration modes
	w_{stat}	0,15	mm	deflection from unit load F = 1 kN with lateral distribution
OK	w_{grenz}	0,25	mm	limit

Informativ: Eigenfrequenz für Einfeldträger laut EN 1995-1-1 mit quasi-ständigen Lasten

L	7,00	m	
$m_{q.perm}$	315	kg/m²	$\Sigma g_i + \Sigma \psi_2 \cdot q_i$
$f_{1,EN}$	7,00	Hz	

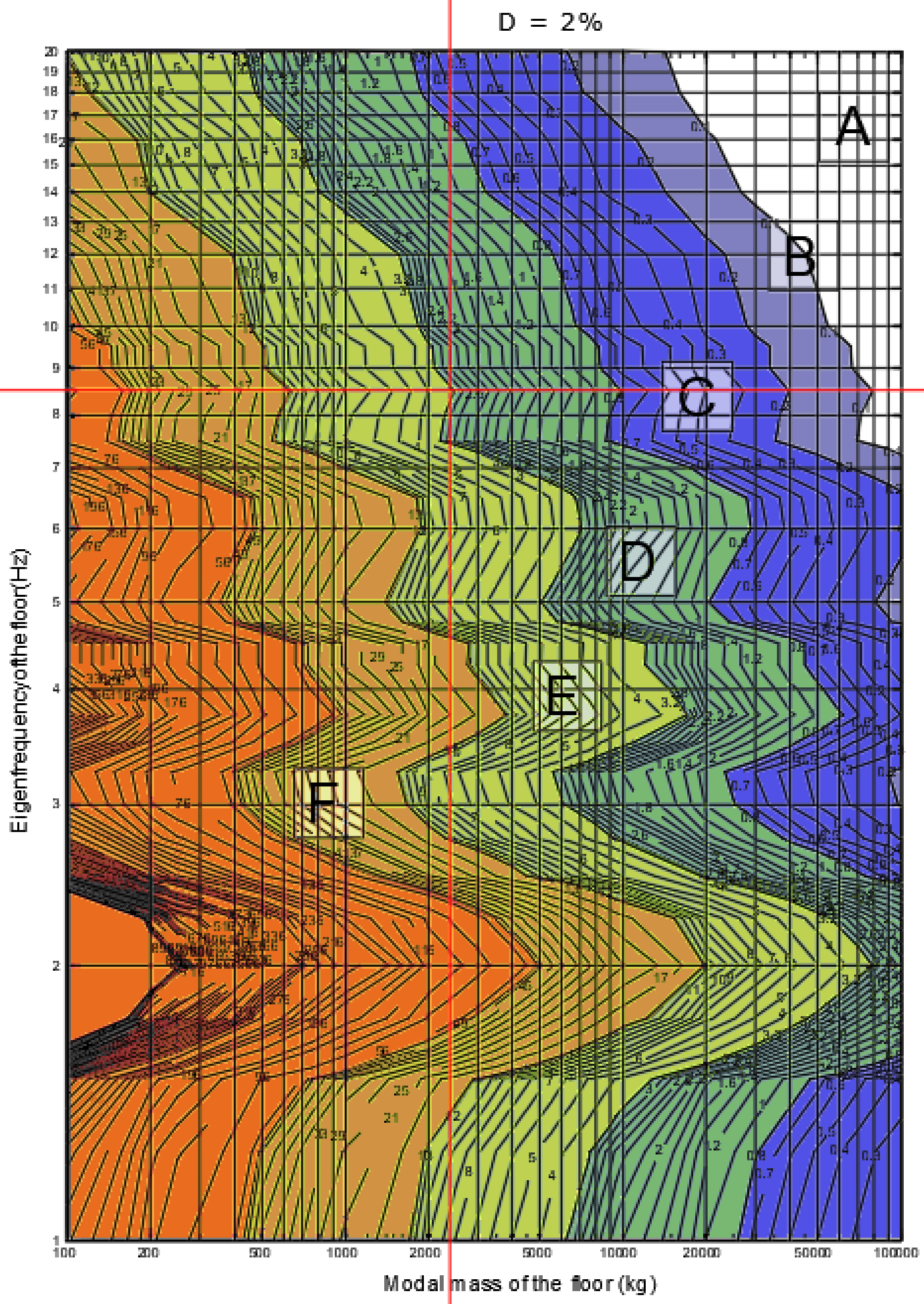
Informativ: Kriterium nach Hu, Chui

94%

Support forces for load transmission

Support	Dsgn.Value	char.Wert	Loadcode		Dsgn.Value	char.Wert	Loadcode
	Maximalwerte			Minimalwerte			
A G,k		7,55	G	A G,k		7,55	G
A N,k		10,50	NB	A N,k		0,00	NB
A d	**25,95**			**A d**	**10,20**		
B G,k		7,55	G	B G,k		7,55	G
B N,k		10,50	NB	B N,k		0,00	NB
B d	**25,95**			**B d**	**10,20**		

Trillingen van vloeren Ontwerprichtlijn



Figuur 4: ES-RMS90 voor 2% Demping

binderholz CLT BBS – continuous beams | floors

Full Version

Design following [EN] EN 1995-1-1:2019, "ETA-06/0009:2017. DiBt Z-9.1-534:2014"

WallnerMild

General

Service Class	NKL	1	Members in closed, heated areas
Serviceability		Full	g1 und g2 werden für w inst berücksichtigt
Include cant.upward defl.		no	
Fire		R 90	
		1	single sided

t ch	0,00	min
β f	0,47	mm/min
t f	0,00	min

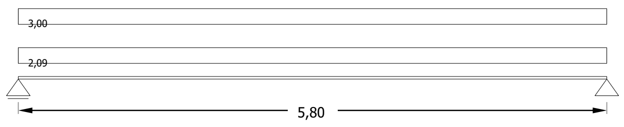
kdef	0,80	
k sys	1,10	

	Serviceability	irreversible
allow.w,inst		ℓ / 300
allow.w,fin	ℓ / 250	ℓ / 200

β 0	0,90	mm/min
β 1a	0,90	mm/min (25mm)
β 1b	0,90	mm/min
ρ	480	kg/m³

Design Results

Total	45 %
Moment	35 %
Transverse force	23 %
Deflection	
Appearance	39 %
Avoid Damages	45 %
Vibration	fulfilled
Fire	
Moment	28 %
Transverse force	10 %



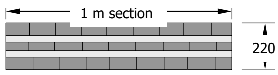
System

span	Lengths Li [m]	Uniform loads g 2,k [kN/m]	g 1,k + g 2,k [kN/m] G	n k [kN/m] N	s k [kN/m] S	w k [kN/m] W
		g 1,k =	1,06			
cantilever Li						
span 1	5,80	1,03	2,09	3,00		
span 2						
span 3						
span 4						
span 5						
span 6						
span 7						
cantilever Re						

cross section

Producer:	Binder
Type:	BBS 125
Element:	**220 5s**
	Coverlayer in direction of span axis

layer i	thickness di [mm]	orientation °	material
1	60	0	C24
2	30	90	C24
3	40	0	C24
4	30	90	C24
5	60	0	C24
6			C24
7			C24
8			C24
9			C24
d	220	5	C24



binderholz

Single loads span	Loadgroup	First single load x_F [m]	F_k [kN]	Second single load x_F [m]	F_k [kN]
cantilever Re					
span 1					
span 2					
span 3					
span 4					
span 5					
span 6					
span 7					
cantilever Re					

Vibration design

proof of vibration
ES-RMS$_{90}$ - D
see page 5

Load definitions

	Loadgroup	Loadtype		Loadapp.
Selfweight	G	G	Ständige Lasten	full
Liveload	N	NB	B: Büroflächen	spanwise
Snow	S	S2	Orte unter 1000 m Seehöhe	full
Wind	W	W	Windlasten	full

DKL I fulfilled

1.1 Frequency Requirement

f_1	9,83 Hz	
f_{gr}	8,00 Hz	

1.2. Acceleration requirement for low frequencies f1 ≤ Hz

a_{rms}	0,06 m/s²	
a_{gr}	0,05 m/s²	OK

2. Stiffness criterion

w_{stat}	0,15 mm	
w_{grenz}	0,25 mm	OK

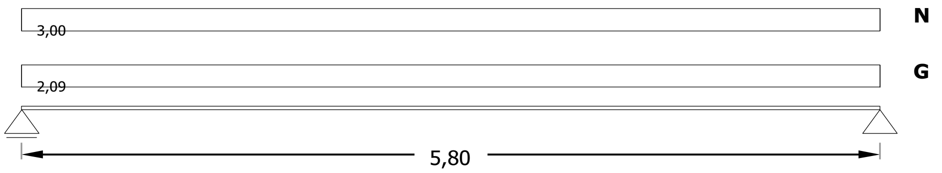
binderholz CLT BBS – continuous beams | floors
Full Version
Design following [EN] EN 1995-1-1:2019, "ETA-06/0009:2017. DiBt Z-9.1-534:2014"
WallnerMild

General

Service Class	1	
Members in closed, heated areas		
Fire	R 90	1
Serviceability	Full	

Standards referenced
EN 1995-1-:2009
[EN] EN 1995-1-1:2019
"ETA-06/0009:2017. DiBt Z-9.1-534:20

System



Loadgroup	Loadtype	Safety	Loadduration		Combination Values		
		γ	kled	kmod	ψ_0	ψ_1	ψ_2
G	G	1,35	ständig	0,60	-	-	-
N	NB	1,50	mittel	0,80	0,70	0,50	0,30
S	S2	1,50	kurz	0,90	0,50	0,20	-
W	W	1,50	s.kurz/kurz	1,00	0,60	0,20	-

cross section Binder BBS 125 **220 5s**

layer i	thickness di [mm]	burned di [mm]	orientation °	material
1	60,0	60,0	0	C24
2	30,0	30,0	90	C24
3	40,0	40,0	0	C24
4	30,0	0,0	90	C24
5	60,0	0,0	0	C24
6				C24
7				C24
8				C24
9				C24
d	220,0	130,0	5 s	C24

Design values of actions

ULS		Value	span	position x/l	k-mod	Length
V d [kN]	**maximum values**	21,22	span 1	0,00	0,80	5,80
	min	-21,22	span 1	1,00	0,80	5,80
M d [kNm]	**maximum values**	30,76	span 1	0,50	0,80	5,80
	min	0,00	0	0,00	1,00	0,00

SLS		span				cantilever			
k_{def} = 0,80		Value	span	position x/l	Length	Value	span	position x/l	Length
quasi-permanent		(guarantee useability and appearance)							
$EJ \cdot w_{fin}$	**maximum values**	79,20	span 1	0,50	5,80	0,00	0	0,00	0,00
	min	0,00	0	0,00	0,00	0,00	0	0,00	0,00
Characteristic situation		(avoid demage at members below)							
$EJ \cdot w_{Q,inst}$	**maximum values**	74,94	span 1	0,50	5,80	0,00	0	0,00	0,00
	min	0,00	0	0,00	0,00	0,00	0	0,00	0,00
$w_{fin} - w_{G,inst}$	**maximum values**	110,14	span 1	0,50	5,80	0,00	0	0,00	0,00
	min	0,00	0	0,00	0,00	0,00	0	0,00	0,00

binderholz CLT BBS – continuous beams | floors Full Version
Design following [EN] EN 1995-1-1:2019, "ETA-06/0009:2017. DiBt Z-9.1-534:2014" WallnerMild

Cross-section Values Reference length for cross-section values in beams over one spans : l* = l

	Ref.length	XS-Values			Comp.to full cross-section		
A eff	1,00 m	1.600	cm2	73% of	A tot	2.200	cm2
I eff,F	5,80 m	72.294	cm4	81% of	I tot,F	88.733	cm4
I eff,K	0,00 m	-	cm4		I tot,K	88.733	cm4
W eff	5,80 m	7.158	cm3	89% of	W tot	8.067	cm3

Calculation as semi-rigid composite

Verification of Ultimate Limit States

Bending		span 1, x/l = 0,50			
	M d	30,76 kNm		f m,k	18,00 N/mm²
				γ M	1,3 [EN]
				k mod	0,8
				k sys	1,1 system value
35%	σ m,y,d	4,30 N/mm²		f m,y,d	12,18 N/mm²
Shear stress		span 1, x/l = 1,00			
	V d	-21,22 kN			
	l*	5,8 m			
	S eff	5.000 cm³		f v,k	2,00 N/mm²
12%	τ v,d	0,15 N/mm²		f v,d	1,23 N/mm²
	Rolling Shear				
	S R,eff	4.800 cm³		f v,R,k	1,00 N/mm²
23%	τ R,d	0,14 N/mm²		f v,R,d	0,62 N/mm²

Verification of Serviceability Limit States

Displacements — Cantilever upward deflection not included

45%	E 0,mean	12.000 N/mm²
	γ M	1,0

		J_{eff} [cm^4]	w [mm]	L* [m]	zul f	w_{max} [mm]	
	Appearance $w_{net,fin}$	72.294	**9,1**	5,80	l / 250	**23,2**	39%
39%	span 1, x/l = 0,50	-	**0,0**	0,00	l / 125	**0,0**	0%
	Avoid Damages w_{inst}	72.294	**8,6**	5,80	l / 300	**19,3**	45%
	span 1, x/l = 0,50	-	**0,0**	0,00	l / 150	**0,0**	0%
	w_{fin}	72.294	**12,7**	5,80	l / 200	**29,0**	44%
45%	span 1, x/l = 0,50	-	**0,0**	0,00	l / 100	**0,0**	0%

fire design

R 90 1
β0 0,90 mm/min

Accidental Situation		Value	span	position x/l	k-mod	Length
V fi [kN]	max	10,40	span 1	0,00	-	5,80
	min	-10,40	span 1	1,00	-	5,80
M fi [kNm]	max	15,08	span 1	0,50	-	5,80
	min	0,00	0	0,00		0,00

Bending				
	M fi	15,08 kNm	f m,k	18,00 N/mm²
	ℓ*	5,80 m	k fi	1,15
	W eff,fi	2.581 cm3	γ M,fi	1,00
			k mod,fi	1,00
28%	σ m,y,fi	5,84 N/mm²	f d,fi	20,70 N/mm²
Shear stress				
10%	V fi	-10,40 kN		
	I eff,fi	16.952,19 cm4		
	S eff,fi	1.920,00 cm3	f v,k	2,00 N/mm²
	S R,eff,fi	1.920,00 cm3	f v,R,k	1,00 N/mm²
5%	τ v,fi	0,12 N/mm²	f v,fi	2,30 N/mm²
10%	τ v,R,fi	0,12 N/mm²	f v,R,fi	1,15 N/mm²

Vibrations in residential floors WAHR

proof of human induced vibrations in floors according to ÖNORM B 1995-1-1:2014

floor-vibration-class (DKL)

DKL	I	fulfilled

high requirement

Floors deviding utilisation units, deviding floors in multy-family dwellings, floors in offices with PC-use or meeting rooms, hallways with short spans.

dimensions

OK	l	5,80	m	Span des maßgebenden Feldes (ohne Kragarm)
	b	6,96	m	Floor width

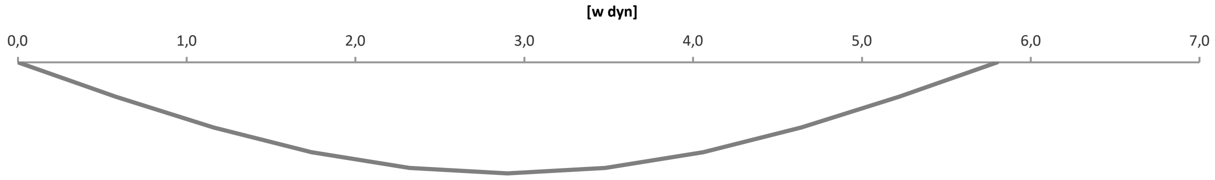
Construction: XLAM-floors without or with leight-wight build-ups.

D	2,50%	damping

Stiffness

$(EI)_{1,\ell}$	8,675	MNm² / m	floot in main span direction
$(EI)_{2,\ell}$	-	MNm² / m	screed (stiff layer) in main span direction
$(EI)_{\ell}$	8,675	MNm² / m	
$(EI)_{1,b}$	0,900	MNm² / m	floor across main span direction
$(EI)_{2,b}$	-	MNm² / m	screed (stiff layer) across main span direction
$(EI)_{b}$	0,900	MNm² / m	

Eigenmode



1.1 Frequency Requirement

	$(f1)_{\ell}$	9,59	Hz	first eigenfrequency for general beams without lateral distribution
	k_{fb}	1,025		improvement by lateral distribution
	f_1	9,83	Hz	first eigenfrequency of the floor with lateral distribution
	f_{gr}	8,00	Hz	limit

OK Requirement met: clause 1.2 not required

1.2. Acceleration requirement for low frequencies f1 ≤ 8 Hz

	f_{min}	4,50	Hz	Frequency limit against resonance (Requirement met)
	b_F	2,99	m	effective with in vibration modes
	$(M^*)_{\ell}$	617	kg	modal mass for general beams without lateral distribution
	M^*	1.845	kg	modal mass of the floor with lateral distribution
	F_0	700	N	wight-force of a person walking on the floor
	α	0,020		impact factor for given frequency
	a_{rms}	0,059	m/s²	existing accelleration
! not OK !	a_{gr}	0,050	m/s²	limit

2. Stiffness criterion

	$(w_{stat})_{\ell}$	0,45	mm	deflection from unit load F = 1 kN without lateral distribution
	b_F	2,99	m	effective with in vibration modes
	w_{stat}	0,15	mm	deflection from unit load F = 1 kN with lateral distribution
OK	w_{grenz}	0,25	mm	limit

Informativ: Eigenfrequenz für Einfeldträger laut EN 1995-1-1 mit quasi-ständigen Lasten

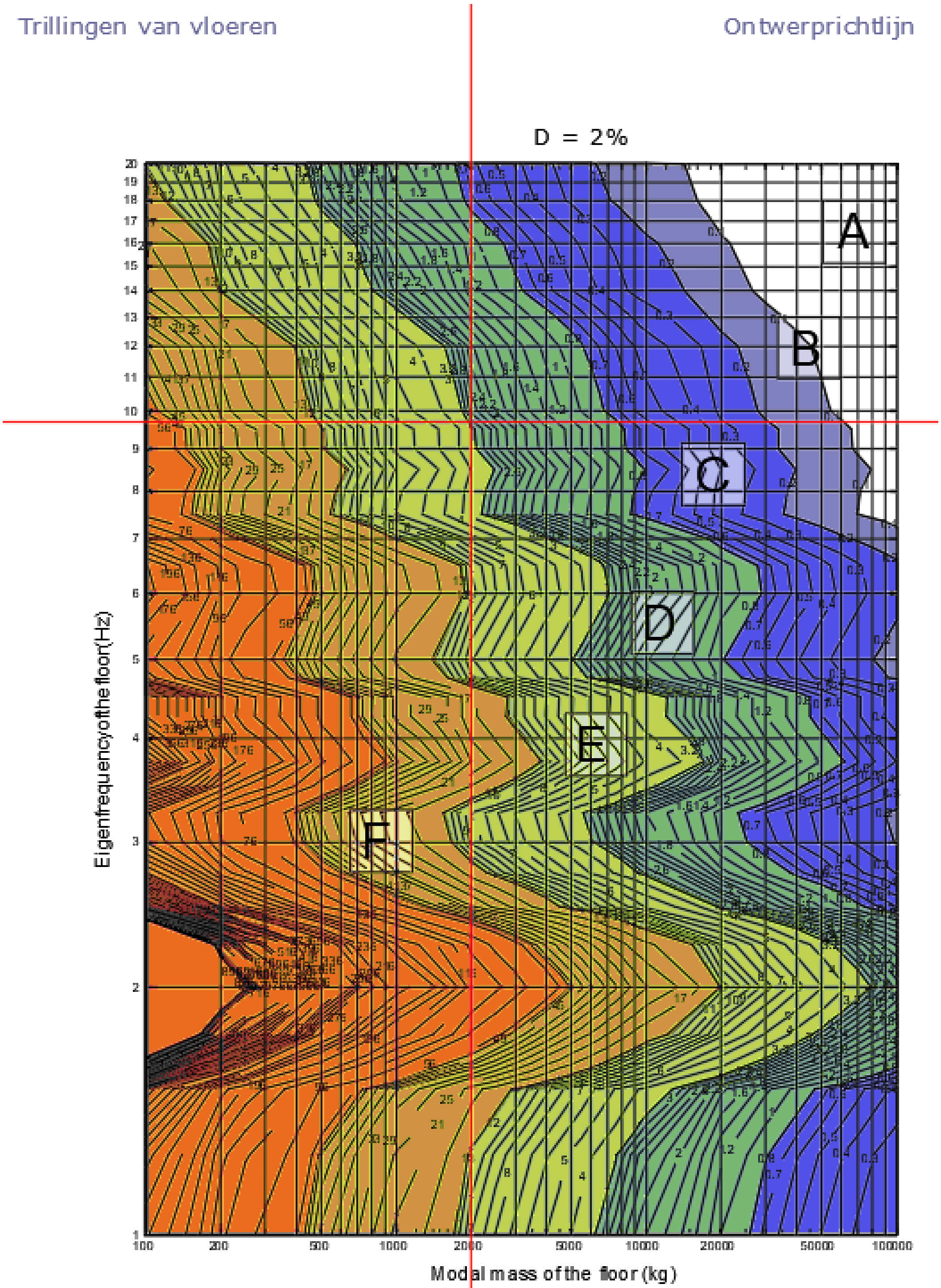
L	5,80	m	
$m_{q.perm}$	312	kg/m²	$\Sigma g_i + \Sigma \psi_2 \cdot q_i$
$f_{1,EN}$	7,79	Hz	

Informativ: Kriterium nach Hu, Chui

83%

Support forces for load transmission

Support	Dsgn.Value	char.Wert	Loadcode		Dsgn.Value	char.Wert	Loadcode
	Maximalwerte			Minimalwerte			
A G,k		6,05	G	A G,k		6,05	G
A N,k		8,70	NB	A N,k		0,00	NB
A d	**21,22**			**A d**	**8,17**		
B G,k		6,05	G	B G,k		6,05	G
B N,k		8,70	NB	B N,k		0,00	NB
B d	**21,22**			**B d**	**8,17**		



Figuur 4: ES-RMS90 voor 2% Demping

binderholz CLT BBS – continuous beams | floors

Full Version

Design following [EN] EN 1995-1-1:2019, "ETA-06/0009:2017. DiBt Z-9.1-534:2014"

WallnerMild

General

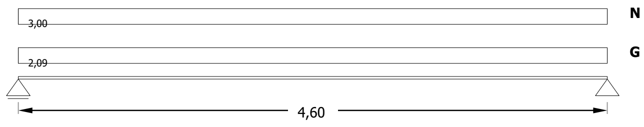
Service Class	NKL	1		kdef	0,80
		Members in closed, heated areas		k sys	1,10

				Serviceability	irreversible
Serviceability	Full	g1 und g2 werden für w inst berücksichtigt	allow.w,inst		ℓ / 300
Include cant.upward defl.	no		allow.w,fin	ℓ / 250	ℓ / 200

Fire	R 90					
	1	single sided	t ch	0,00 min	β 0	0,90 mm/min
			β f	0,47 mm/min	β 1a	0,90 mm/min (25mm)
			t f	0,00 min	β 1b	0,90 mm/min
					ρ	480 kg/m³

Design Results

Total	24 %
Moment	23 %
Transverse force	19 %
Deflection	
Appearance	21 %
Avoid Damages	24 %
Vibration	fulfilled
Fire	
Moment	18 %
Transverse force	8 %



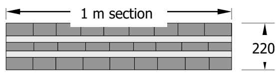
System

span	Lengths Li [m]	Uniform loads g 2,k [kN/m]	g 1,k + g 2,k [kN/m] G	n k [kN/m] N	s k [kN/m] S	w k [kN/m] W
		g 1,k =	1,06			
cantilever Li						
span 1	4,60	1,03	2,09	3,00		
span 2						
span 3						
span 4						
span 5						
span 6						
span 7						
cantilever Re						

cross section

Producer: Binder
Type: BBS 125
Element: **220 5s**
Coverlayer in direction of span axis

layer i	thickness di [mm]	orientation °	material
1	60	0	C24
2	30	90	C24
3	40	0	C24
4	30	90	C24
5	60	0	C24
6			C24
7			C24
8			C24
9			C24
d	220	5	C24



binderholz

Single loads span	Loadgroup	First single load x_F [m]	F_k [kN]	Second single load x_F [m]	F_k [kN]
cantilever Re					
span 1					
span 2					
span 3					
span 4					
span 5					
span 6					
span 7					
cantilever Re					

Vibration design

proof of vibration
ES-RMS$_{90}$ - D
see page 5

Load definitions

	Loadgroup	Loadtype		Loadapp.
Selfweight	G	G	Ständige Lasten	full
Liveload	N	NB	B: Büroflächen	spanwise
Snow	S	S2	Orte unter 1000 m Seehöhe	full
Wind	W	W	Windlasten	full

DKL I fulfilled

1.1 Frequency Requirement

f_1	14,92 Hz	
f_{gr}	8,00 Hz	

1.2. Acceleration requirement for low frequencies f1 ≤ Hz

a_{rms}	0,01 m/s²	
a_{gr}	0,05 m/s²	OK

2. Stiffness criterion

w_{stat}	0,10 mm	
w_{grenz}	0,25 mm	OK

binderholz CLT BBS – continuous beams | floors Full Version

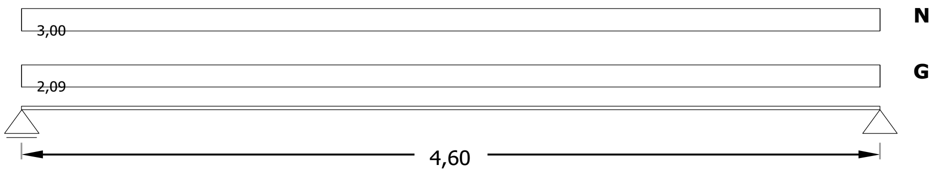
Design following [EN] EN 1995-1-1:2019, "ETA-06/0009:2017. DiBt Z-9.1-534:2014" WallnerMild

General

Service Class	1	
Members in closed, heated areas		
Fire	R 90	1
Serviceability	Full	

Standards referenced
EN 1995-1-:2009
[EN] EN 1995-1-1:2019
"ETA-06/0009:2017. DiBt Z-9.1-534:20

System



Loadgroup	Loadtype	Safety	Loadduration		Combination Values		
		γ	kled	kmod	ψ_0	ψ_1	ψ_2
G	G	1,35	ständig	0,60	-	-	-
N	NB	1,50	mittel	0,80	0,70	0,50	0,30
S	S2	1,50	kurz	0,90	0,50	0,20	-
W	W	1,50	s.kurz/kurz	1,00	0,60	0,20	-

cross section

Binder	BBS 125	**220 5s**

layer i	thickness di [mm]	burned di [mm]	orientation °	material
1	60,0	60,0	0	C24
2	30,0	30,0	90	C24
3	40,0	40,0	0	C24
4	30,0	0,0	90	C24
5	60,0	0,0	0	C24
6				C24
7				C24
8				C24
9				C24
d	220,0	130,0	5 s	C24

Design values of actions

ULS		Value	span	position x/l	k-mod	Length
V d [kN]	maximum values	16,83	span 1	0,00	0,80	4,60
	min	-16,83	span 1	1,00	0,80	4,60
M d [kNm]	maximum values	19,35	span 1	0,50	0,80	4,60
	min	0,00	0	0,00	1,00	0,00

SLS		span				cantilever			
k_{def} = 0,80		Value	span	position x/l	Length	Value	span	position x/l	Length
quasi-permanent		(guarantee useability and appearance)							
EJ·w_{fin}	maximum values	31,34	span 1	0,50	4,60	0,00	0	0,00	0,00
	min	0,00	0	0,00	0,00	0,00	0	0,00	0,00
Characteristic situation		(avoid demage at members below)							
EJ·$w_{Q,inst}$	maximum values	29,65	span 1	0,50	4,60	0,00	0	0,00	0,00
	min	0,00	0	0,00	0,00	0,00	0	0,00	0,00
$w_{fin} - w_{G,inst}$	maximum values	43,58	span 1	0,50	4,60	0,00	0	0,00	0,00
	min	0,00	0	0,00	0,00	0,00	0	0,00	0,00

binderholz CLT BBS – continuous beams | floors
Full Version
Design following [EN] EN 1995-1-1:2019, "ETA-06/0009:2017. DiBt Z-9.1-534:2014"
WallnerMild

Cross-section Values Reference length for cross-section values in beams over one spans : l* = l

	Ref.length	XS-Values			Comp.to full cross-section	
A eff	1,00 m	1.600 cm2	73% of	A tot	2.200	cm2
I eff,F	4,60 m	68.054 cm4	77% of	I tot,F	88.733	cm4
I eff,K	0,00 m	- cm4		I tot,K	88.733	cm4
W eff	4,60 m	7.046 cm3	87% of	W tot	8.067	cm3

Calculation as semi-rigid composite

Verification of Ultimate Limit States

Bending		span 1, x/l = 0,50			
	M d	19,35 kNm	f m,k	18,00 N/mm²	
			γ M	1,3 [EN]	
			k mod	0,8	
			k sys	1,1 system value	
23%	σ m,y,d	2,75 N/mm²	f m,y,d	12,18 N/mm²	
Shear stress		span 1, x/l = 1,00			
	V d	-16,83 kN			
	l*	4,6 m			
	S eff	5.000 cm³	f v,k	2,00 N/mm²	
10%	τ v,d	0,12 N/mm²	f v,d	1,23 N/mm²	
	Rolling Shear				
	S R,eff	4.800 cm³	f v,R,k	1,00 N/mm²	
19%	τ R,d	0,12 N/mm²	f v,R,d	0,62 N/mm²	

Verification of Serviceability Limit States

Displacements — Cantilever upward deflection not included

24%	E 0,mean	12.000 N/mm²
	γ M	1,0

		J_{eff} [cm⁴]	w [mm]	L* [m]	zul f	w_{max} [mm]	
	Appearance $w_{net,fin}$	68.054	**3,8**	4,60	l / 250	**18,4**	21%
21%	span 1, x/l = 0,50	-	**0,0**	0,00	l / 125	**0,0**	0%
	Avoid Damages w_{inst}	68.054	**3,6**	4,60	l / 300	**15,3**	24%
	span 1, x/l = 0,50	-	**0,0**	0,00	l / 150	**0,0**	0%
	w_{fin}	68.054	**5,3**	4,60	l / 200	**23,0**	23%
24%	span 1, x/l = 0,50	-	**0,0**	0,00	l / 100	**0,0**	0%

fire design

R 90 1

β0 0,90 mm/min

Accidental Situation		Value	span	position x/l	k-mod	Length
V fi [kN]	max	8,25	span 1	0,00	-	4,60
	min	-8,25	span 1	1,00	-	4,60
M fi [kNm]	max	9,48	span 1	0,50	-	4,60
	min	0,00	0	0,00		0,00

Bending				
	M fi	9,48 kNm	f m,k	18,00 N/mm²
	ℓ*	4,60 m	k fi	1,15
	W eff,fi	2.569 cm3	γ M,fi	1,00
			k mod,fi	1,00
18%	σ m,y,fi	3,69 N/mm²	f d,fi	20,70 N/mm²
Shear stress				
8%	V fi	-8,25 kN		
	I eff,fi	16.547,68 cm4		
	S eff,fi	1.920,00 cm3	f v,k	2,00 N/mm²
	S R,eff,fi	1.920,00 cm3	f v,R,k	1,00 N/mm²
4%	τ v,fi	0,10 N/mm²	f v,fi	2,30 N/mm²
8%	τ v,R,fi	0,10 N/mm²	f v,R,fi	1,15 N/mm²

Vibrations in residential floors WAHR

proof of human induced vibrations in floors according to ÖNORM B 1995-1-1:2014

floor-vibration-class (DKL)

DKL I fulfilled

high requirement

Floors deviding utilisation units, deviding floors in multy-family dwellings, floors in offices with PC-use or meeting rooms, hallways with short spans.

dimensions

OK	l	4,60	m	Span des maßgebenden Feldes (ohne Kragarm)
	b	5,52	m	Floor width

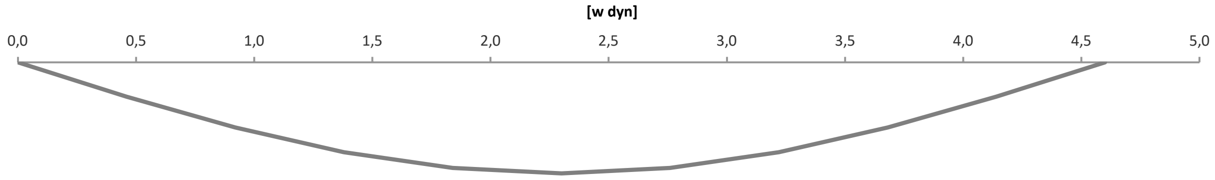
Construction: XLAM-floors without or with leight-wight build-ups.

D 2,50% damping

Stiffness

$(EI)_{1,\ell}$	8,166	MNm² / m	floot in main span direction
$(EI)_{2,\ell}$	-	MNm² / m	screed (stiff layer) in main span direction
$(EI)_{\ell}$	8,166	MNm² / m	
$(EI)_{1,b}$	0,880	MNm² / m	floor across main span direction
$(EI)_{2,b}$	-	MNm² / m	screed (stiff layer) across main span direction
$(EI)_{b}$	0,880	MNm² / m	

Eigenmode



1.1 Frequency Requirement

	$(f1)_{\ell}$	14,55	Hz	first eigenfrequency for general beams without lateral distribution
	k_{fb}	1,026		improvement by lateral distribution
	f_1	14,92	Hz	first eigenfrequency of the floor with lateral distribution
	f_{gr}	8,00	Hz	limit
OK	Requirement met: clause 1.2 not required			

1.2. Acceleration requirement for low frequencies f1 ≤ 8 Hz

	f_{min}	4,50	Hz	Frequency limit against resonance (Requirement met)
	b_F	2,40	m	effective with in vibration modes
	$(M^*)_{\ell}$	489	kg	modal mass for general beams without lateral distribution
	M^*	1.172	kg	modal mass of the floor with lateral distribution
	F_0	700	N	wight-force of a person walking on the floor
	α	0,003		impact factor for given frequency
	a_{rms}	0,012	m/s²	existing accelleration
OK	a_{gr}	0,050	m/s²	limit

2. Stiffness criterion

	$(w_{stat})_{\ell}$	0,25	mm	deflection from unit load F = 1 kN without lateral distribution
	b_F	2,40	m	effective with in vibration modes
	w_{stat}	0,10	mm	deflection from unit load F = 1 kN with lateral distribution
OK	w_{grenz}	0,25	mm	limit

Informativ: Eigenfrequenz für Einfeldträger laut EN 1995-1-1 mit quasi-ständigen Lasten

L	4,60	m	
$m_{q.perm}$	304	kg/m²	$\Sigma g i + \Sigma \psi 2 \cdot q i$
$f_{1,EN}$	12,16	Hz	

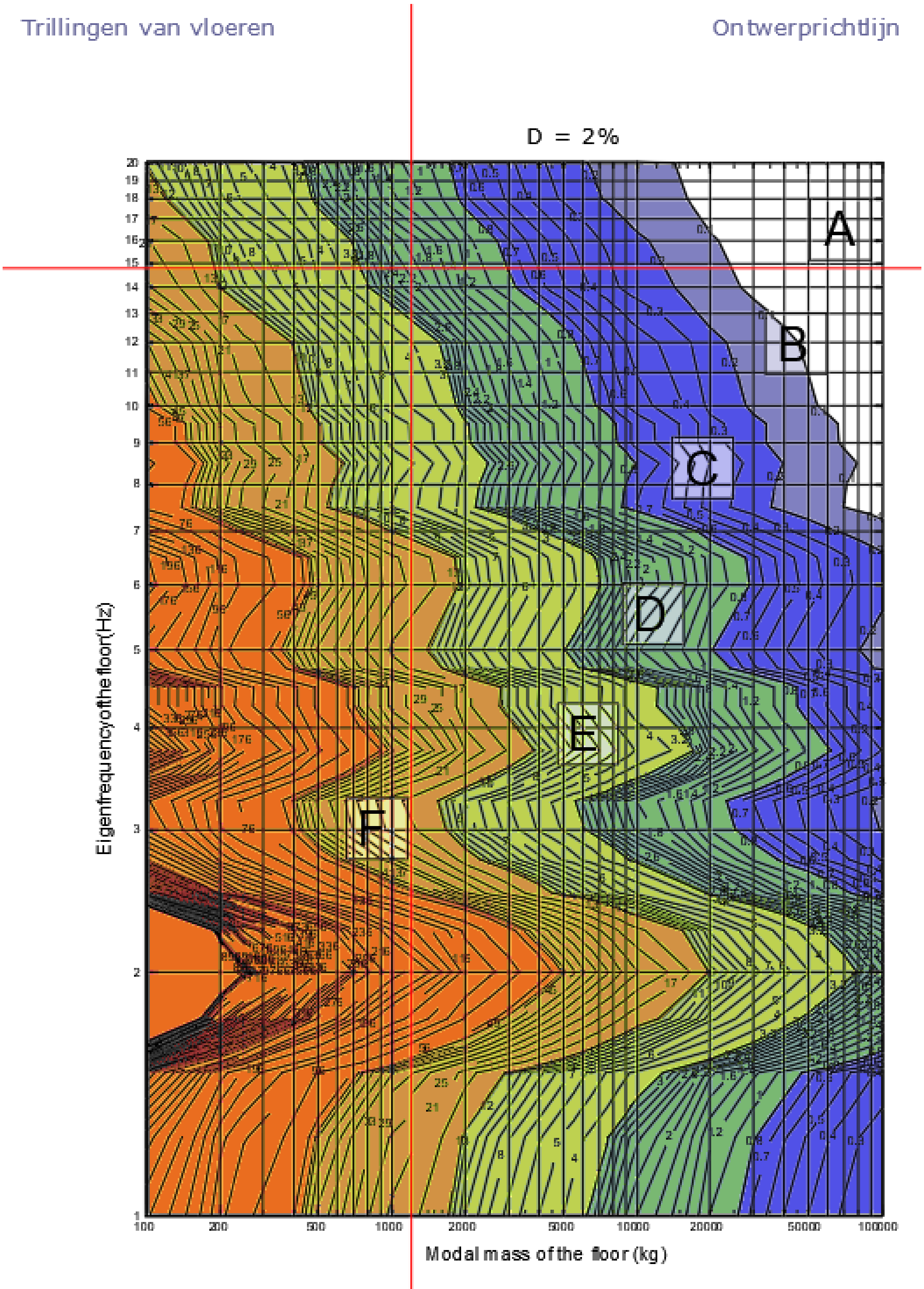
Informativ: Kriterium nach Hu, Chui

46%

binderholz CLT BBS – continuous beams | floors
Design following [EN] EN 1995-1-1:2019, "ETA-06/0009:2017. DiBt Z-9.1-534:2014"

Support forces for load transmission

Support	Dsgn.Value	char.Wert	Loadcode		Dsgn.Value	char.Wert	Loadcode
	Maximalwerte			Minimalwerte			
A G,k		4,80	G	A G,k		4,80	G
A N,k		6,90	NB	A N,k		0,00	NB
A d	**16,83**			**A d**	**6,48**		
B G,k		4,80	G	B G,k		4,80	G
B N,k		6,90	NB	B N,k		0,00	NB
B d	**16,83**			**B d**	**6,48**		



Figuur 4: ES-RMS90 voor 2% Demping

Bracing analysis

Horizontal loads in the floor (load force distribution)

Windbelasting

Externe stuwdruk conform NEN-EN-1991-1-4 art 4.5

Windgebied III	Onbebouwd	h =	11,000 m	q_z =	0,73 kN/m²

Referentieperiode = 50 jaar, Terreineffecten niet meegenomen

Windbelasting

Externe stuwdruk conform NEN-EN-1991-1-4 art 4.5

Basiswindsnelheid

$V_b = C_{dir} * C_{season} * V_{b,0}$

fundamentele waarde van de basiswindsnelheid	$V_{b,0}$ =	24,5	[m/s]
windrichtingfactor	C_{dir} =	1	[-[
seizoensfactor	C_{season} =	1	[-]
basiswindsnelheid algemeen	$V_{b,0}$ =	24,5	[m/s]

Waarschijnlijkheidsfactor

$C_{prob} = \left(\frac{1 - K * ln(-ln(1-p))}{1 - K * ln(-ln(0{,}98))}\right)^n$

vormparameter (NB)	K =	0,281	[-]
referentieperiode	=	50	jaar
jaarlijkse overschrijdingskans	p =	0,02	[-]
exponent (NB)	n =	0,5	[-]
waarschijnlijkheidsfactor	C_{prob} =	1,00	[-]
basiswindsnelheid inclusief waarschijnlijkheidsfactor $(C_{prob} * v_{b,0})$	V_b =	24,50	[m/s]

Terreinruwheid

$C_r(z) = k_r * ln\left(\frac{z}{z_0}\right)$ *voor* $z_{min} < z < z_{max}$

$C_r(z) = C_r(z_{min})$ *voor* $z < z_{min}$

ruwheidslengte (tabel 4.1 NB)	z_0 =	0,2	[m]
terreinfactor	K_r =	0,209	[-]
hoogte gebouw boven maaiveld	z =	11	[m]
maximale hoogte volgens NEN-EN 1993-1-4	z_{max} =	200	[m]
minimale hoogte vastgesteld in tabel 4.1 NB	z_{min} =	4	[m]
ruwheidsfactor	$C_r(z)$ =	0,84	[-]

Gemiddelde windsnelheid

$v_m(z) = c_r(z) * c_0(z) * v_b$

orrografiefactor	C_0 =	1,00	[-]
ruwheidsfactor	$C_r(z)$ =	0,84	[-]
basiswindsnelheid	v_b =	24,50	[m/s]
gemiddelde windsnelheid	V_m =	20,56	[m/s]

Windturbulentie

$\sigma_v = k_r * v_b * K_l$

terreinfactor	K_r =	0,209	[-]
basiswindsnelheid	V_b =	24,50	[m/s]
turbulentiefactor	K_l =	1	[-]
standaardafwijking	σ_v =	5,13	[-]

turbulentie intensiteit

$l_v(z) = \frac{\sigma_v}{v_m(z)}$ *voor* $z_{min} < z < z_{max}$

$l_v(z) = l_v(z_{min})$ *voor* $z < z_{min}$

standaardafwijking	σ_v =	5,13	[-]
gemiddelde windsnelheid	v_m =	20,56	[m/s]
turbulentie-intensiteit	$I_v(z)$ =	0,250	[-]

Extreme stuwdruk

$q_p(z) = (1 + 7 * l_v(z)) * 0{,}5\rho * v_m^2$

turbulentie-intensiteit	$I_v(z)$ =	0,250	[-]
dichtheid van de lucht tijdens stormcondities	ρ =	1,25	[kg/m³]
gemiddelde windsnelheid	v_m =	20,56	[m/s]
extreme stuwdruk	$q_p(z)$ =	725	[kg/ms²]
	$q_p(z)$ =	0,73	[kN/m²]

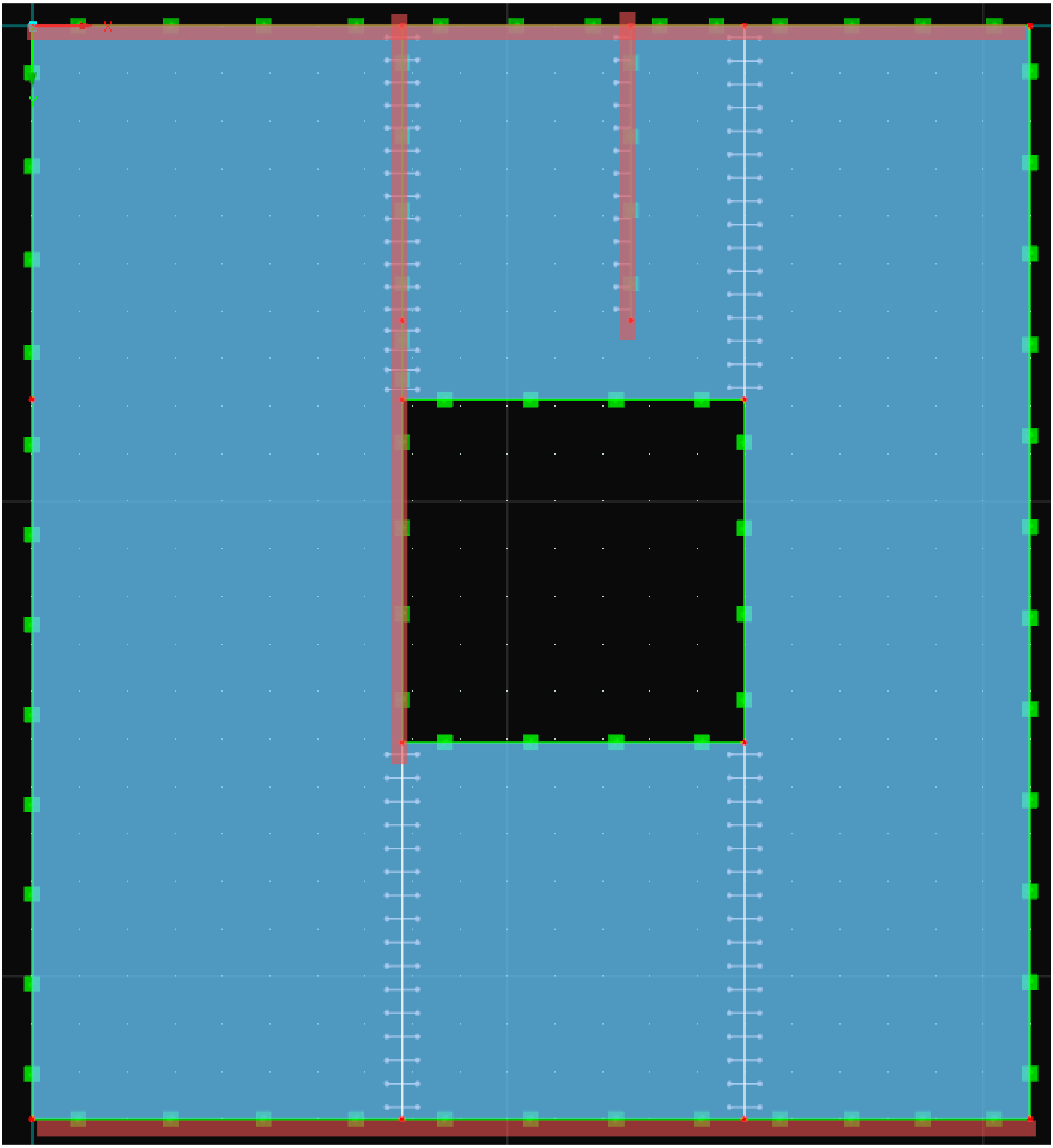
q_{pz} = ≈ 0,75 kN/m2
CsCd = 1,00
q_w = 1,00 x (0,8 + 0,5) x 0,75 kN/m2 = 0,975 kN/m^2

<u>first floor</u>
$q_{w,tot}$ = 0,975 kN/m2 x (0,5 x 4,3m + 0,5 x 3,6m) = 3,85 kN/m

<u>second floor</u>
$q_{w,tot}$ = 0,975 kN/m2 x (0,5 x 3,6m + 0,5 x 3,6m) = 3,51 kN/m

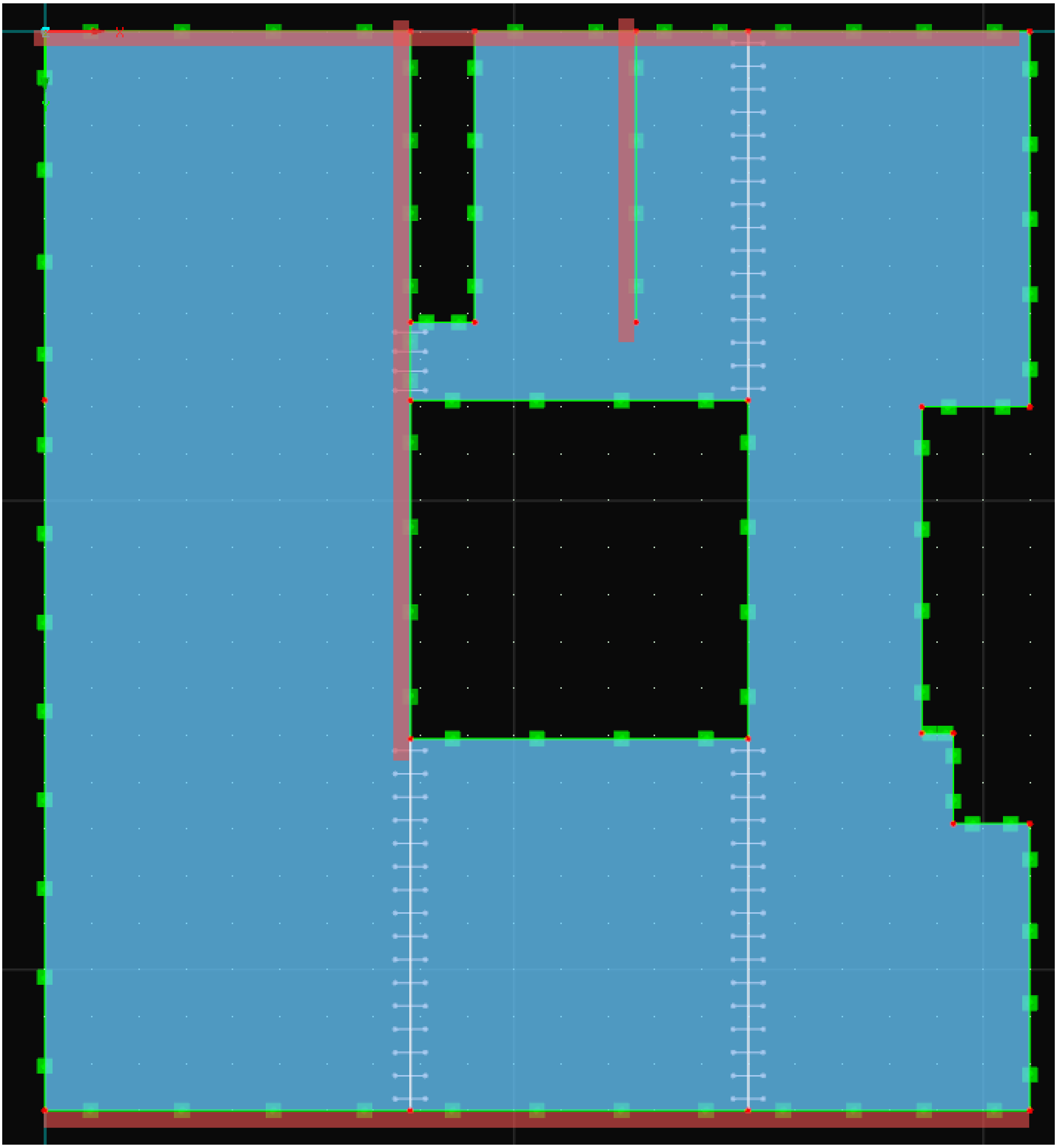
<u>roof</u>
$q_{w,tot}$ = 0,975 kN/m2 x (0,5 x 3,6m) = 1,76 kN/m

HOUTA KANTOOR-
roof



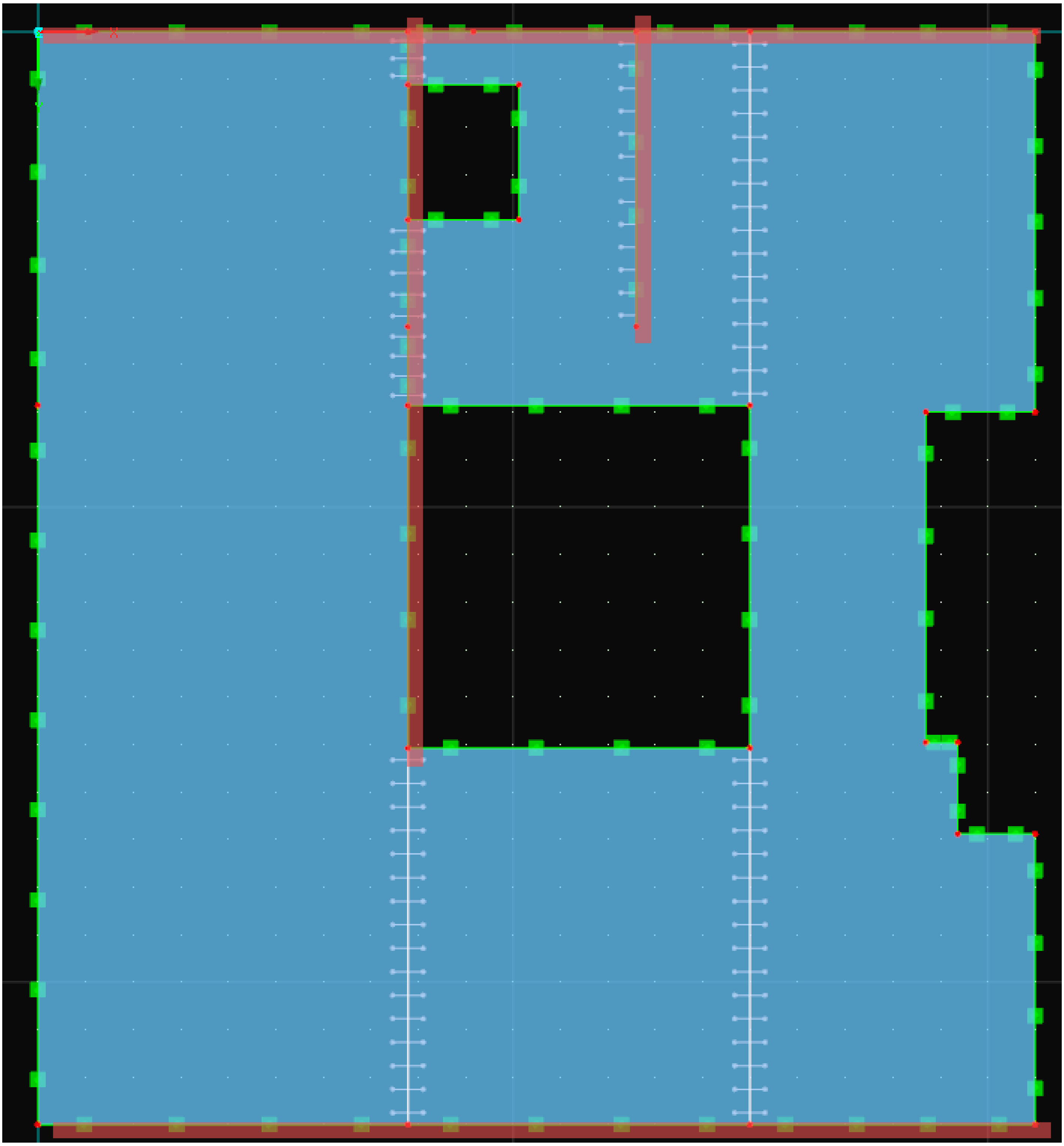
bracing axis

HOUTA KANTOOR-
2.floor



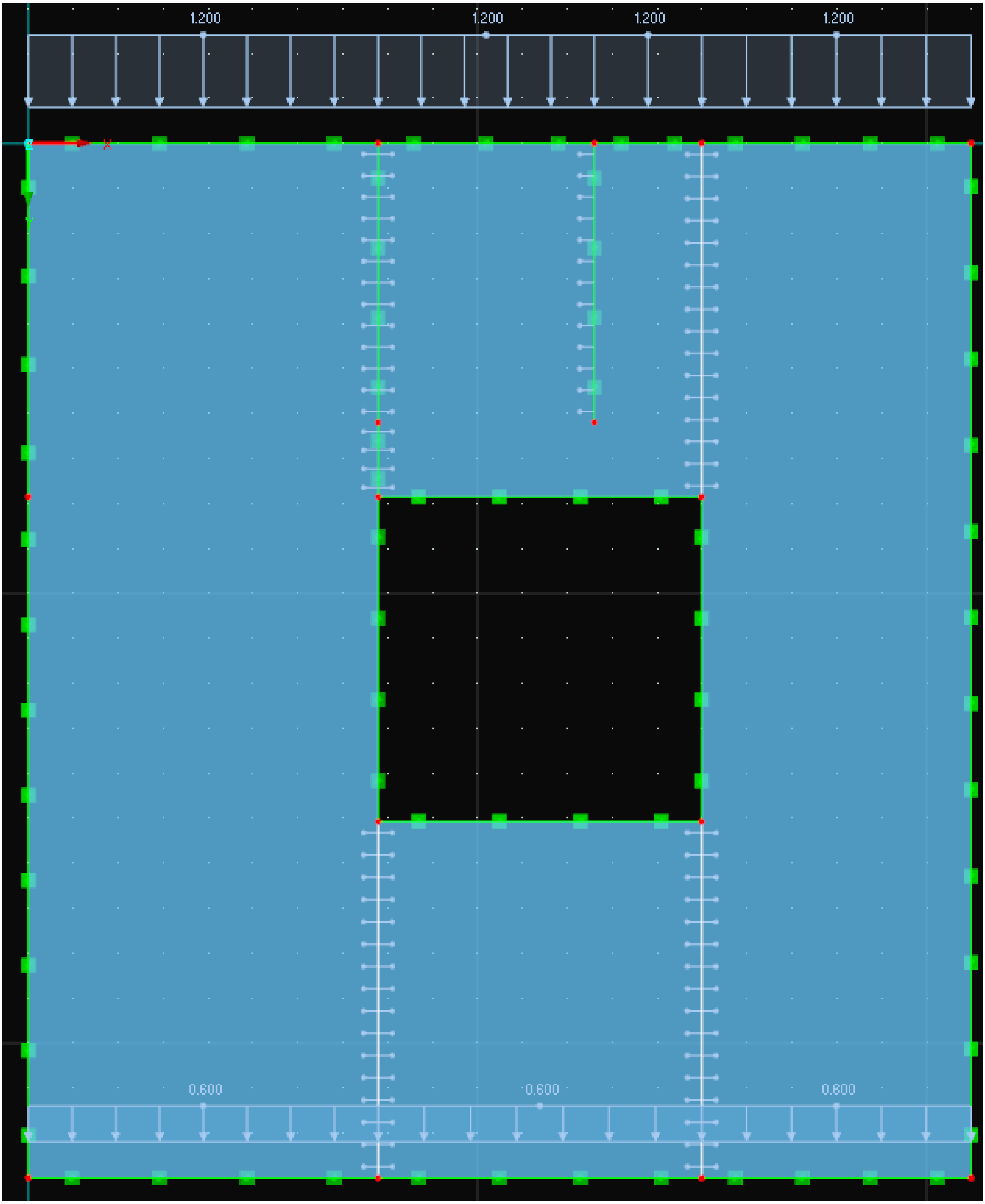
bracing axis

HOUTA KANTOOR-
1.floor

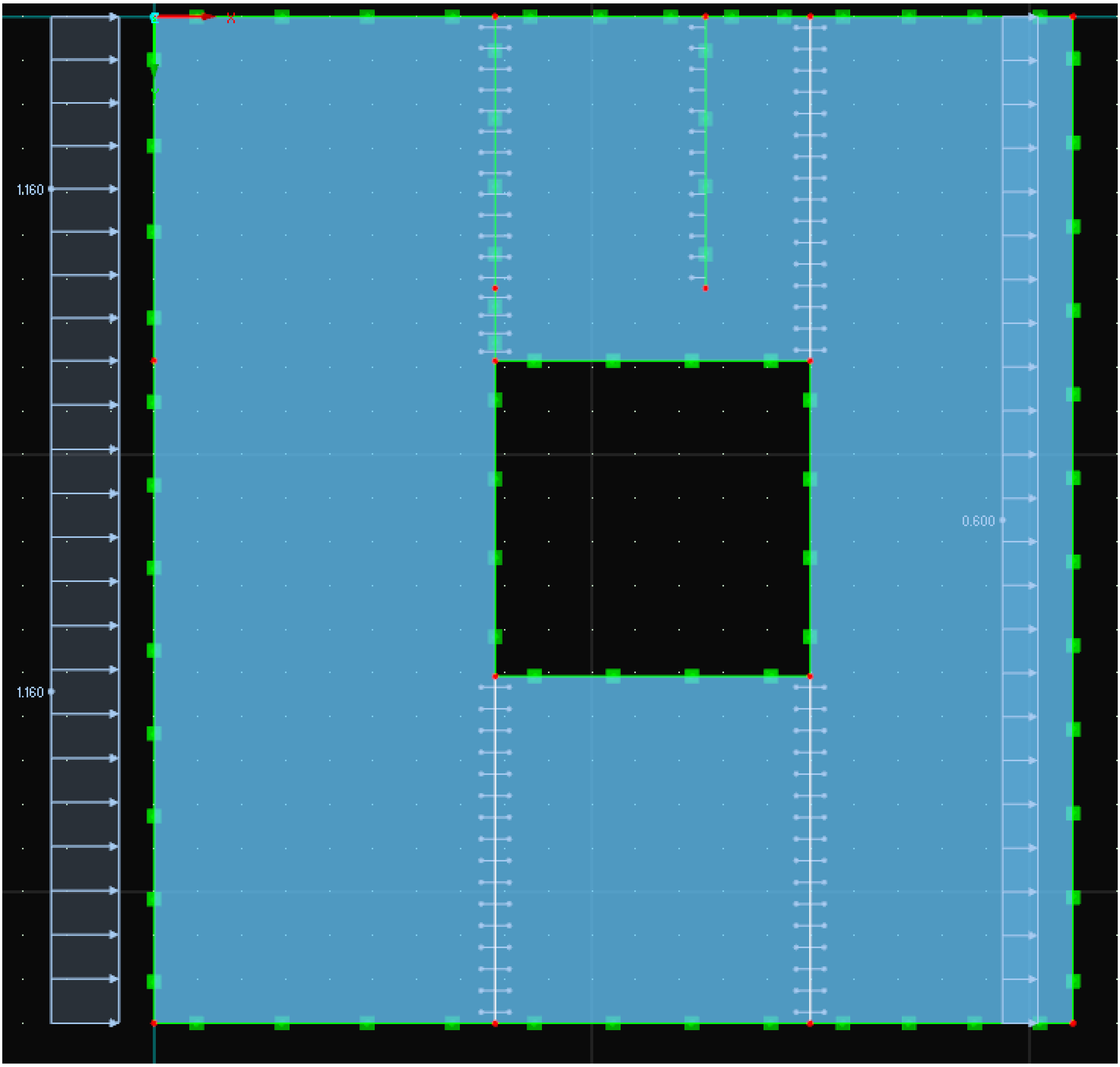


bracing axis

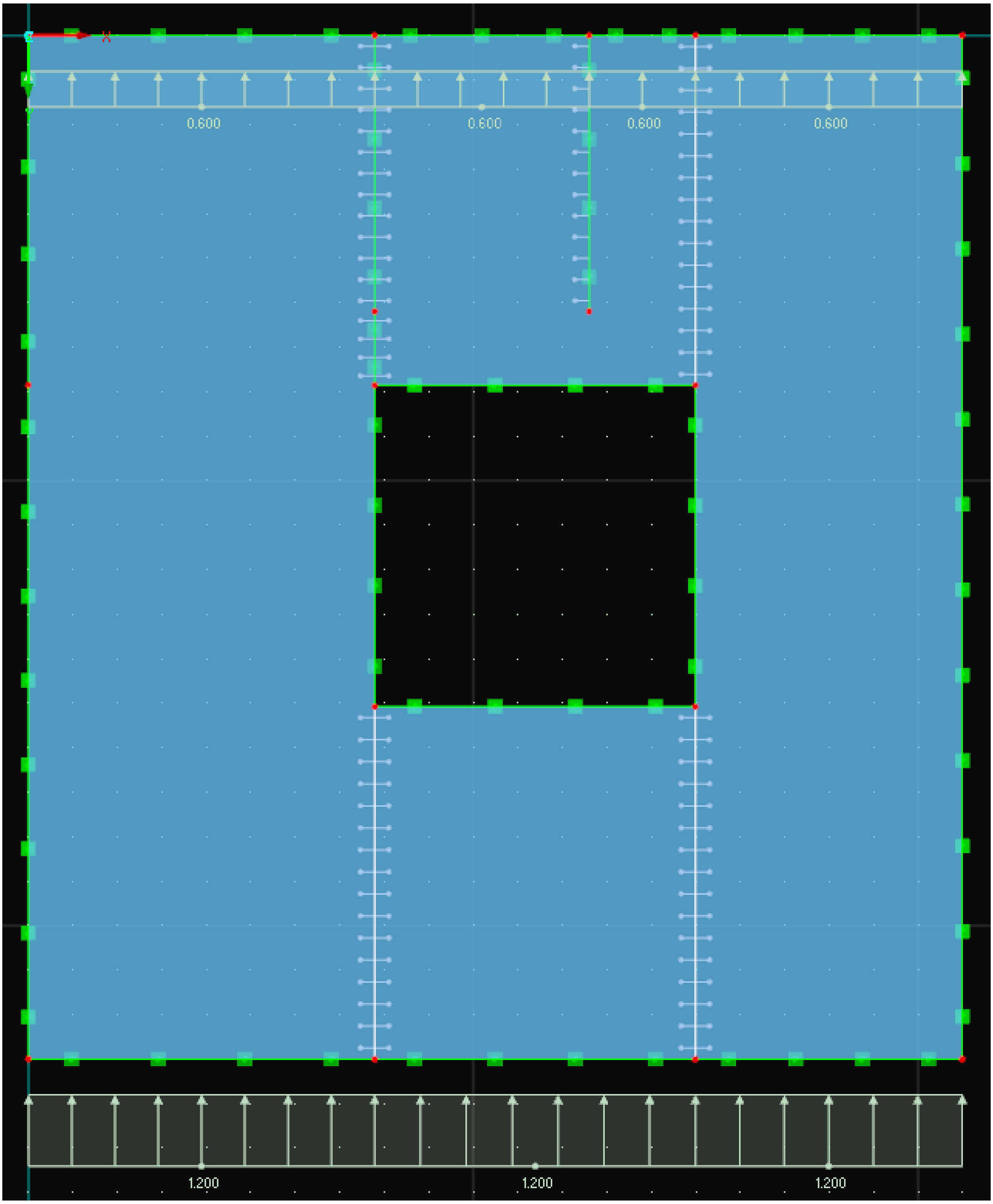
HOUTA KANTOOR-
load cases-
wind in +Y



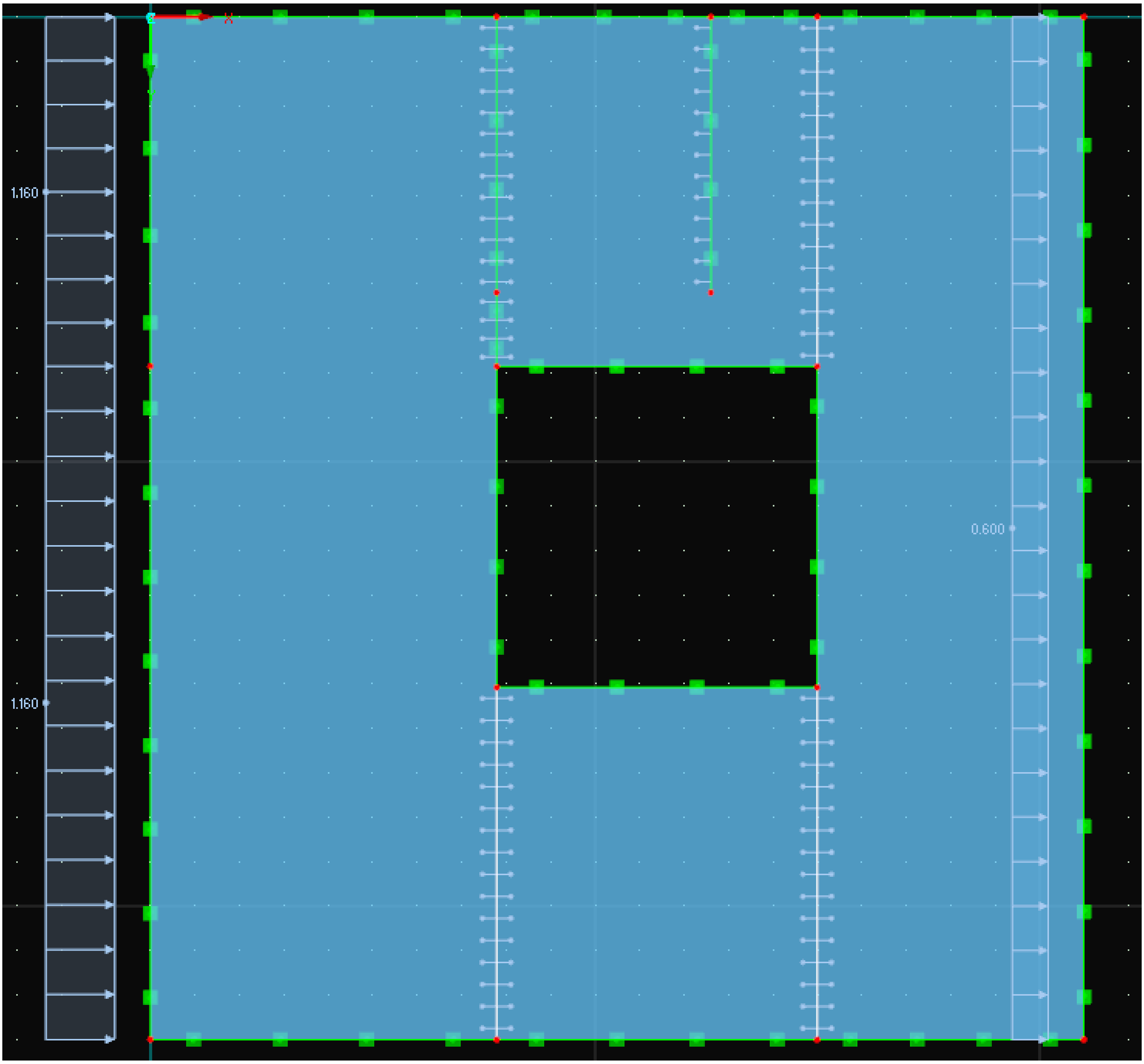
HOUTA KANTOOR-
load cases-
wind in +X



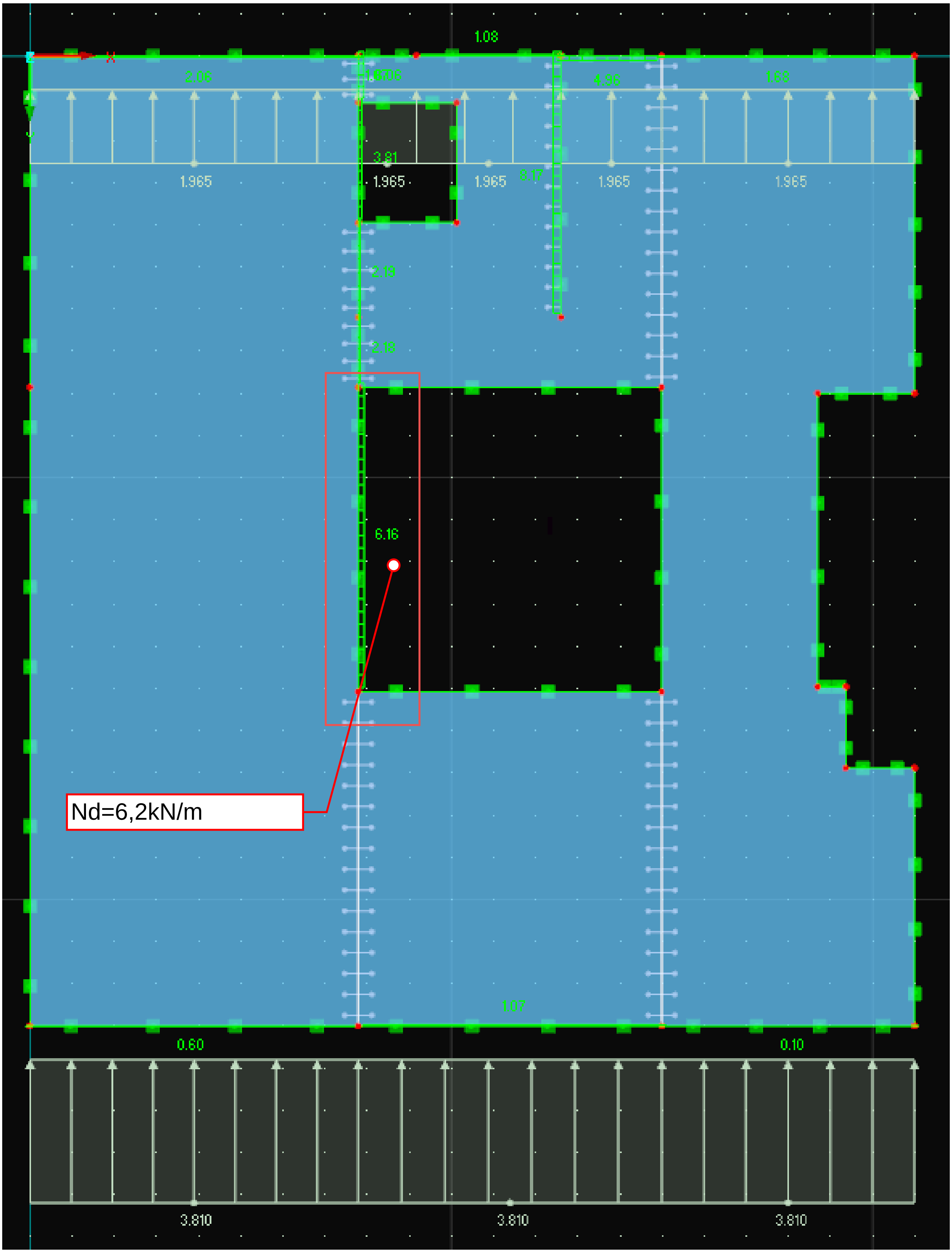
HOUTA KANTOOR-
load cases-
wind in -Y



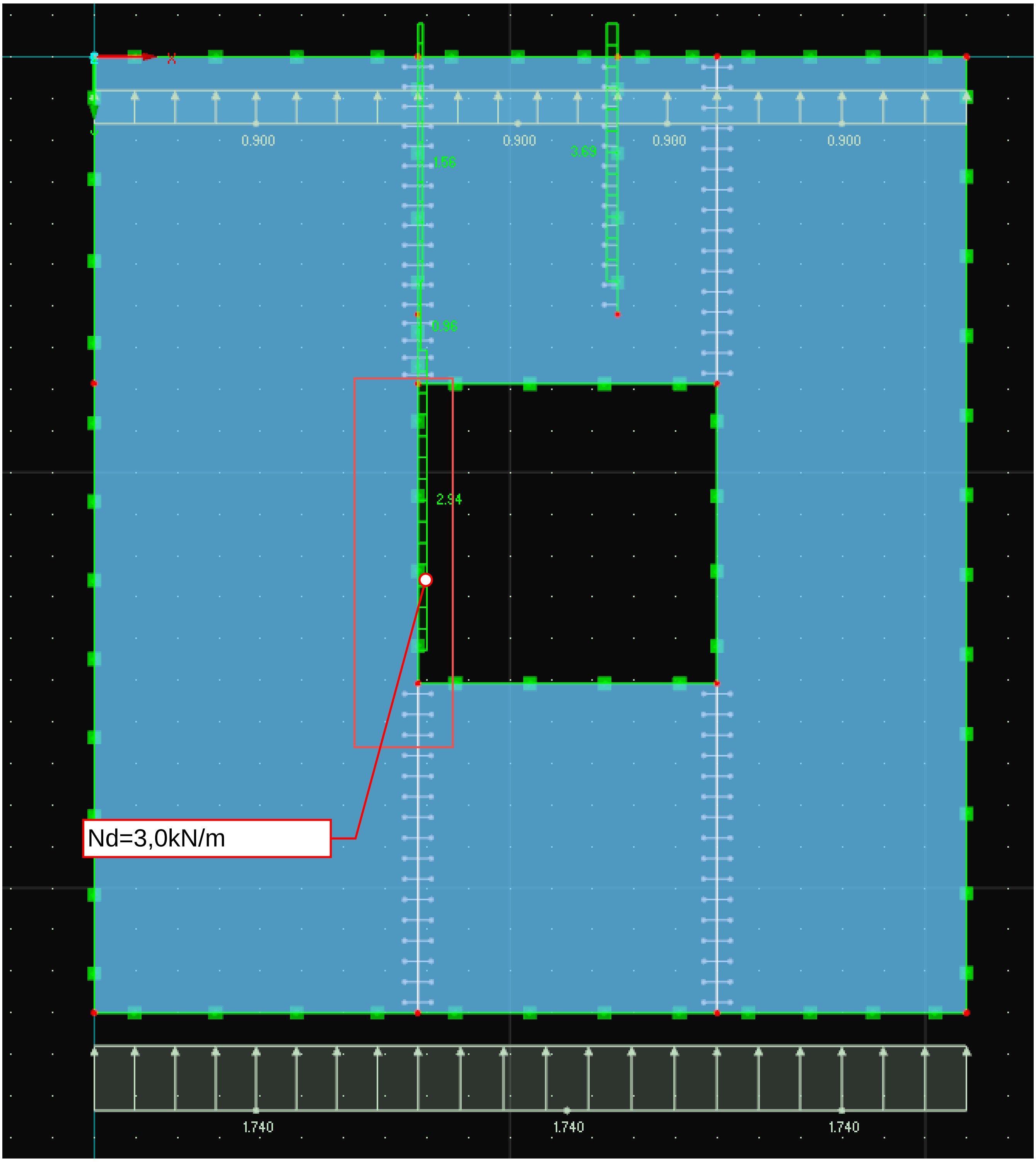
HOUTA KANTOOR-
load cases-
wind in -X



HOUTA KANTOOR-
deceisive shear force for joint connection in
case of wind (timber to steel - 1.-2.Floor)

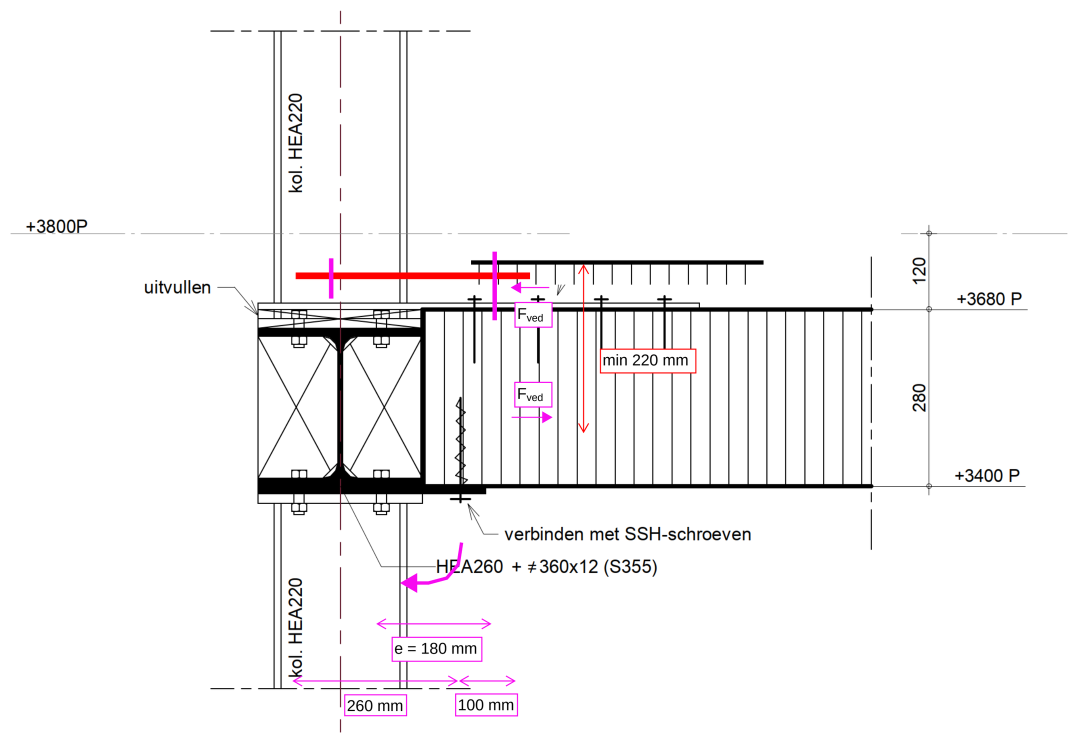


HOUTA KANTOOR-
deceisive shear force for joint connection in case of wind (timber to steel - roof)



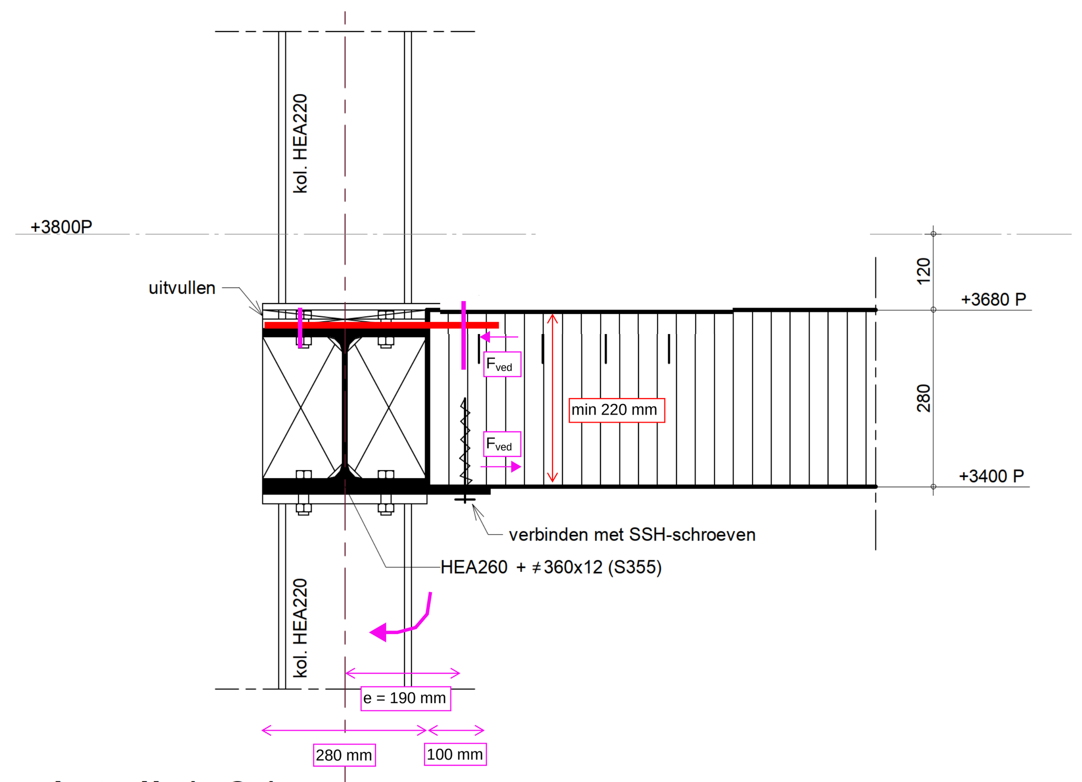
Design of connections

elevation floors bearing beams (red marked in the plan)



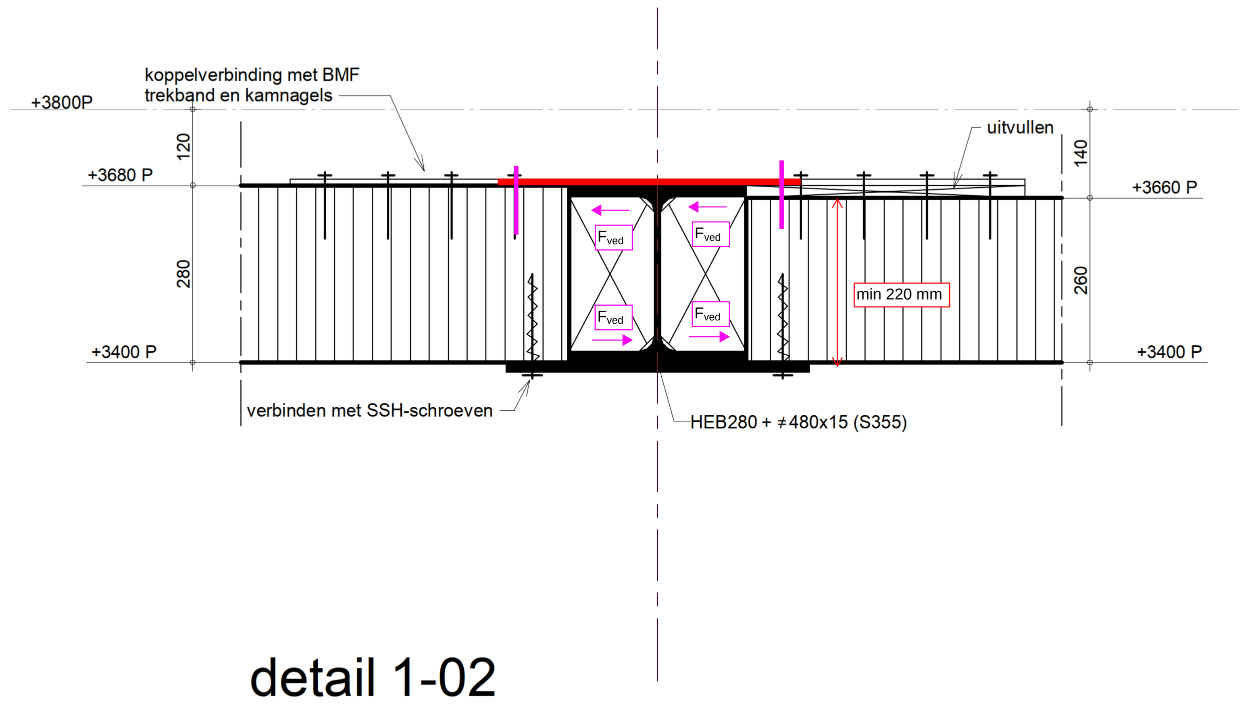
detail 1-01
1 : 10

axis 1 and 4



detail 1-01
1 : 10

axis 2 and 3 (in between axis B-C)



detail 1-02
1 : 10

axis 2 and 3 (in between axis A-B en C-D)

The maximum torsion axis 1-4

q_k = 0,5 x 7,8m x (1,2 x 2,97 kN/m2 (max) + 1,5 x 3,0) = 31,5 kN/m
excentricity = 180 mm
T_{ed} = 31,5 kN/m x 0,18m = 5,7 kNm/m
h = 220 mm
$F_{v,ed}$ = 5,7 kNm/m / 0,22m = 26 kN/m

The maximum torsion axis 2-3 (in between B-C)

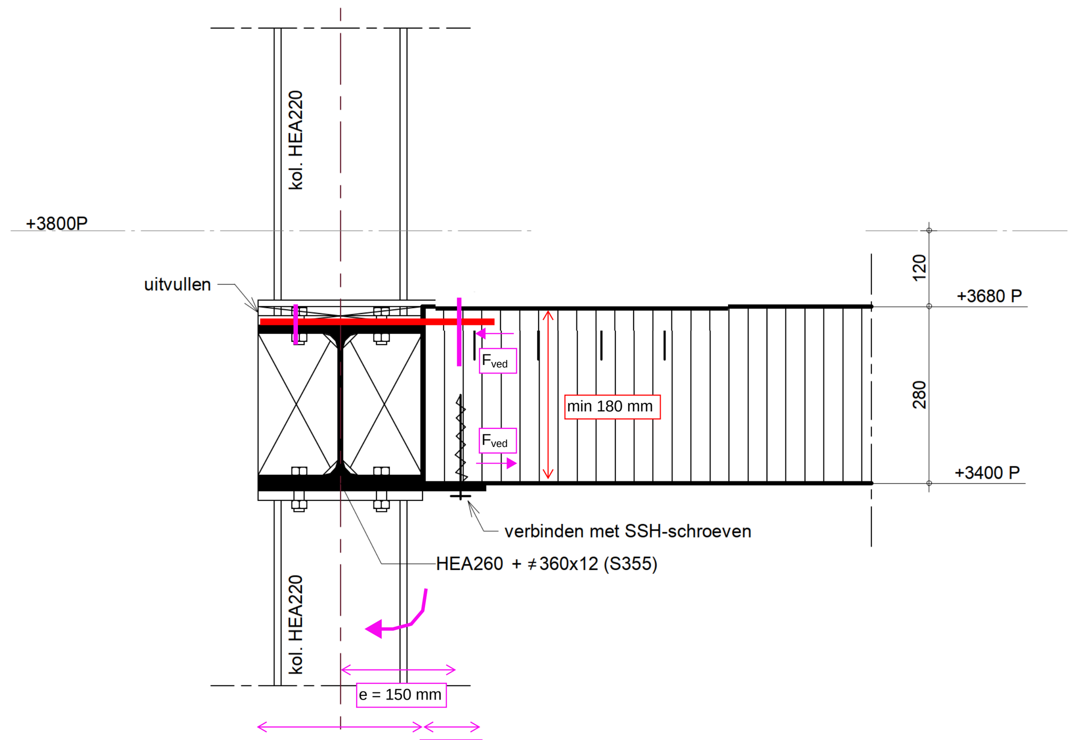
q_k = 0,5 x 7,8m x (1,2 x 2,97 kN/m2 (max) + 1,5 x 3,0) = 31,5 kN/m
excentricity = 190 mm
T_{ed} = 31,5 kN/m x 0,19m = 6,0 kNm/m
h = 220 mm
$F_{v,ed}$ = 6,0 kNm/m / 0,22m = 27 kN/m

The maximum torsion axis 2-3 (in between A-B en C-D)

q_k = 0,5 x 7,8m x (1,5 x 3,0) = 17,6 kN/m
excentricity = 190 mm
T_{ed} = 17,6 kN/m x 0,19m = 3,4 kNm/m
h = 220 mm
$F_{v,ed}$ = 3,4 kNm/m / 0,22m = 16 kN/m

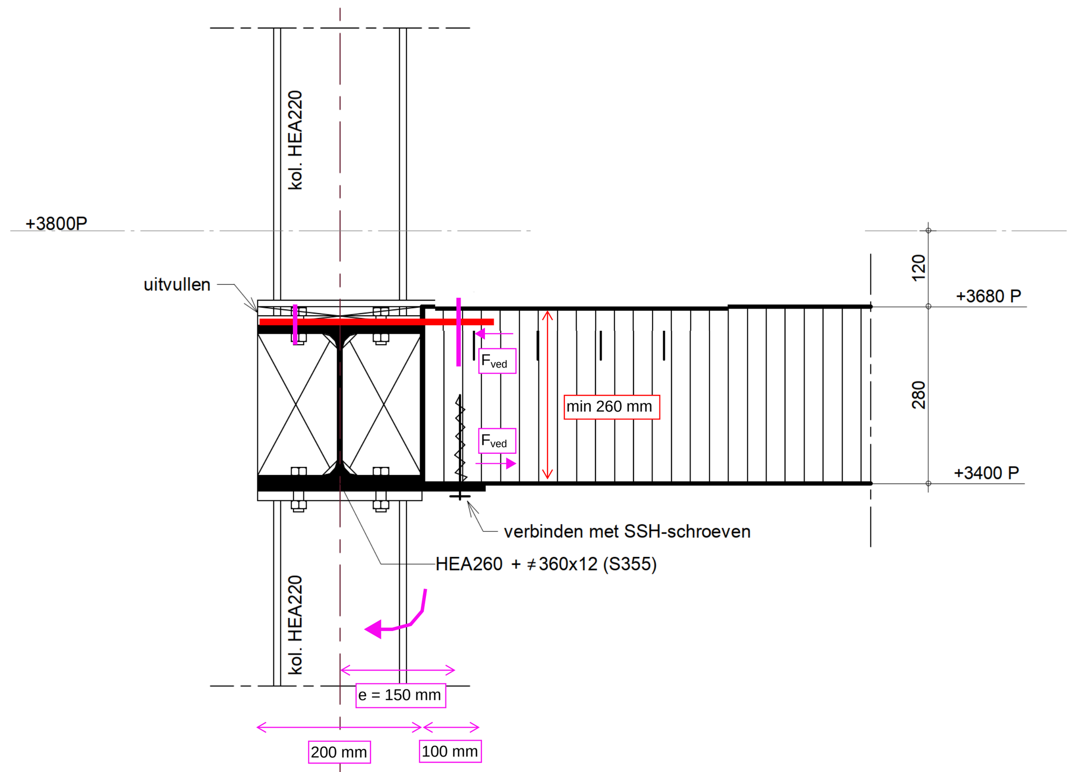
I would suggest that all the beams in between axis 2-3 with lower loads , are calculated with this torsion force and horizontal reactions

Roof floor bearing beams (red marked in the plan)



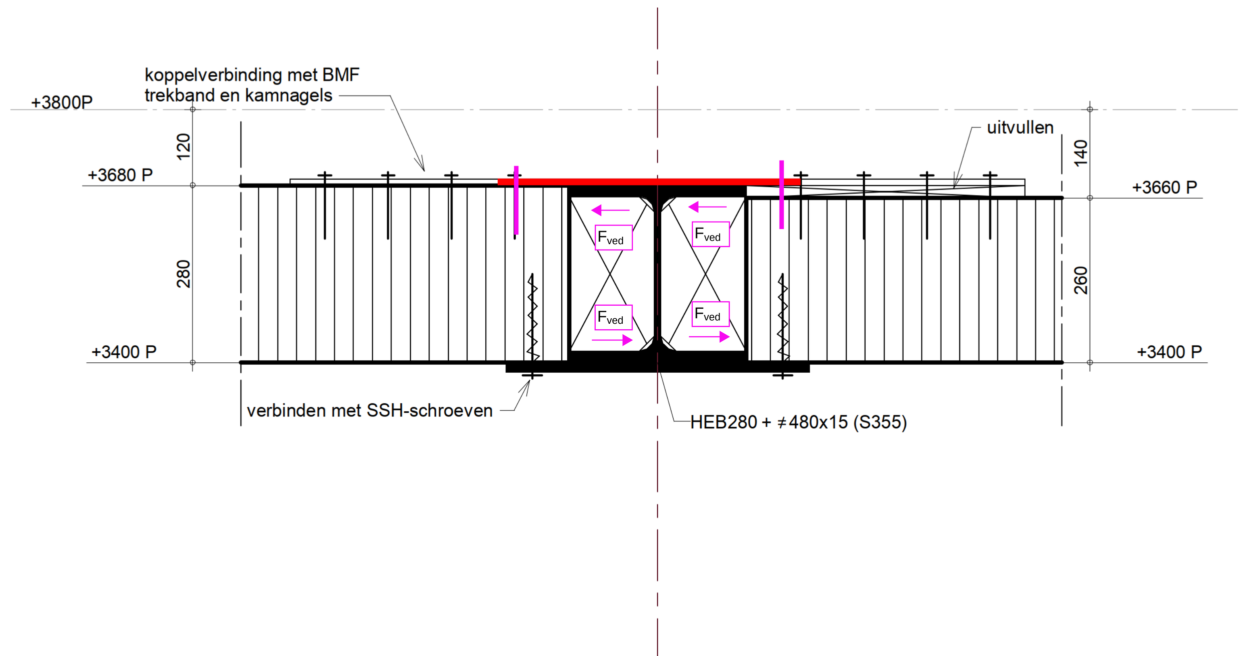
detail 1-01
1 : 10

axis 1 and 4



detail 1-01
1 : 10

axis 2 and 3 (in between axis B-C)



detail 1-02
1 : 10

axis 2 and 3 (in between axis A-B en C-D)

The maximum torsion axis 1-4

q_k = 0,5 x 7,8m x (1,2 x 1,30 kN/m2 (max) + 1,5 x 1,0) = 20 kN/m
excentricity = 180 mm
T_{ed} = 20 kN/m x 0,15m = 3 kNm/m
h = 180 mm
$F_{v,ed}$ = 3 kNm/m / 0,18m = 17 kN/m

The maximum torsion axis 1-4

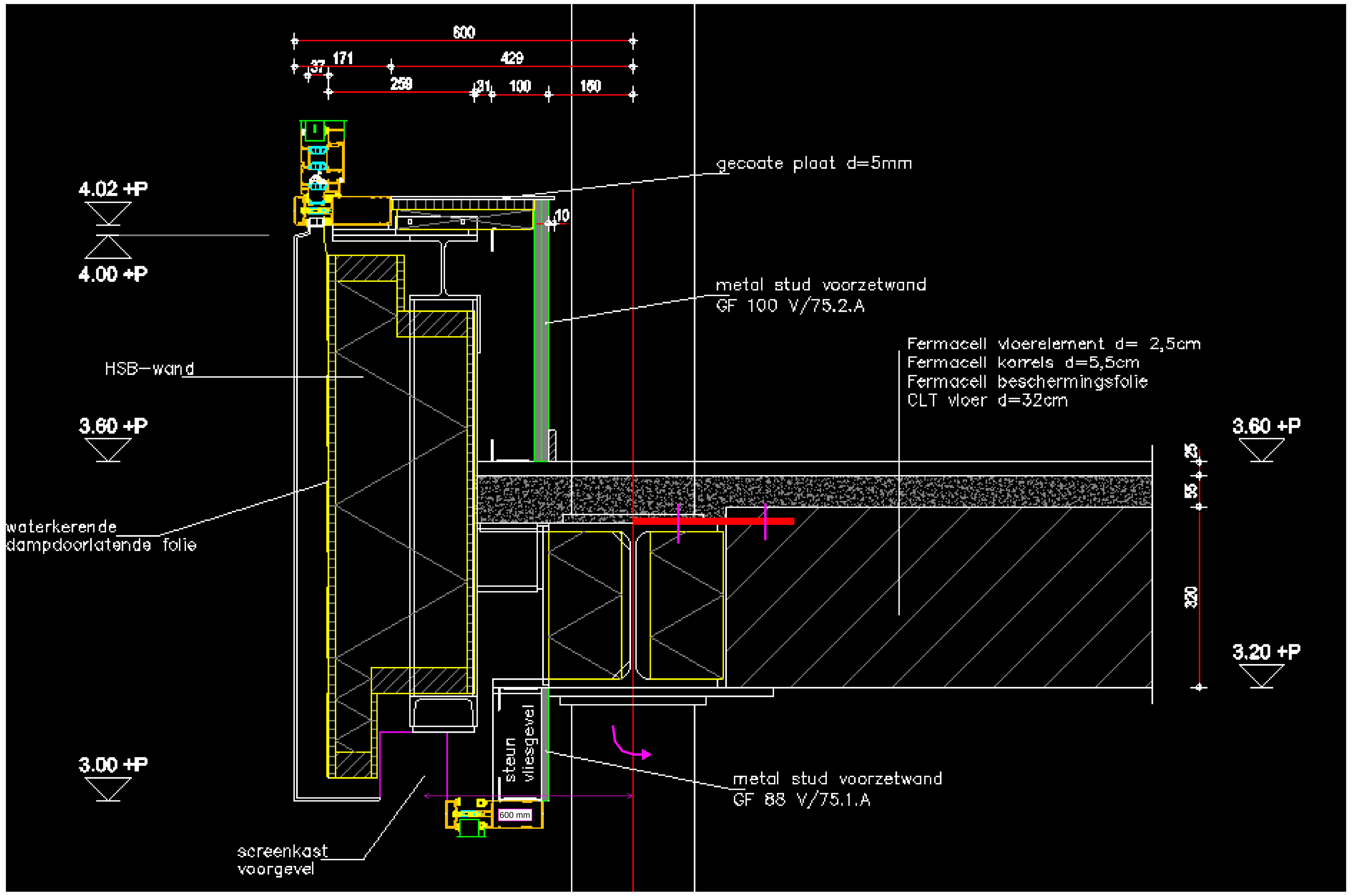
q_k = 0,5 x 7,8m x (1,2 x 1,30 kN/m2 (max) + 1,5 x 1,0) = 20 kN/m
excentricity = 180 mm
T_{ed} = 20 kN/m x 0,15m = 3 kNm/m
h = 180 mm
$F_{v,ed}$ = 3 kNm/m / 0,18m = 17 kN/m

The maximum torsion axis 2-3 (in between A-B en C-D)

q_k = 0,5 x 7,8m x (1,5 x 1,0) = 6,0 kN/m
excentricity = 150 mm
T_{ed} = 6 kN/m x 0,15m = 0,9 kNm/m
h = 180 mm
$F_{v,ed}$ = 0,9 kNm/m / 0,18m = 5 kN/m

I would suggest that all the beams in between axis 2-3 with lower loads , are calculated with this torsion force and horizontal reactions

NOT bearing beams (blue marked in the plan)



q_k = 1,0 kN/m2 (façade) x 3,2m = 3,2 kN/m

excentricity = 600 mm

T_{ed} = 3,2kN/m x 0,6m = 2,0 kNm/m

h = 200 mm (minimal)

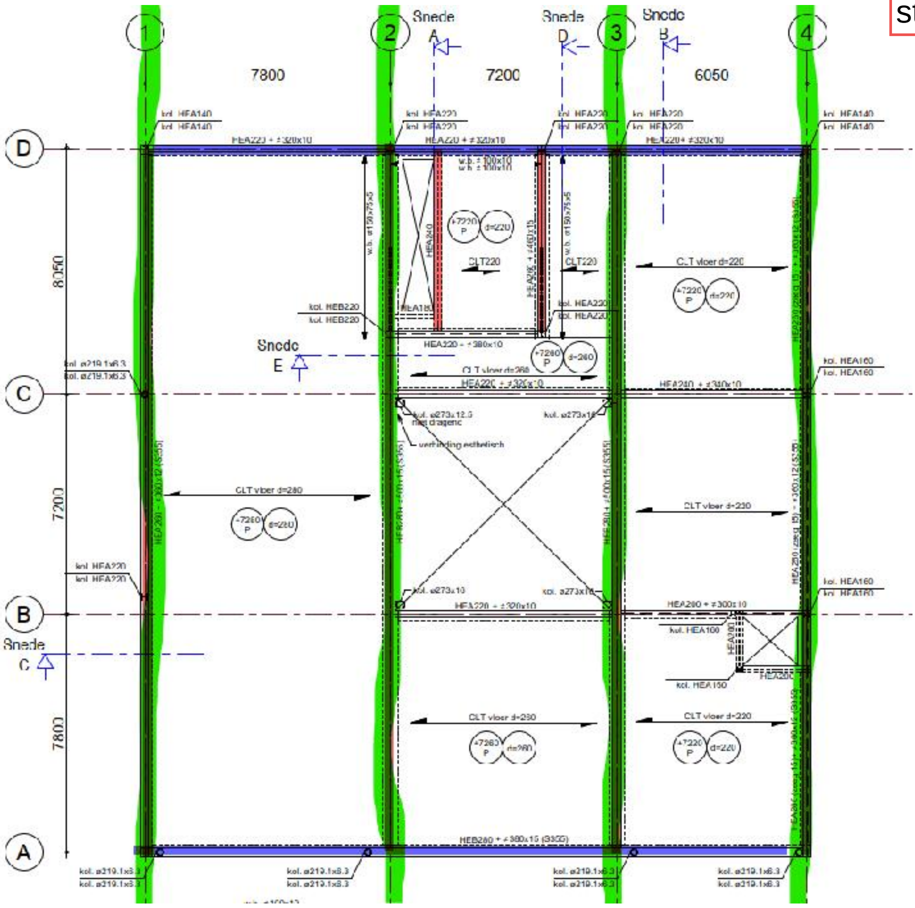
$F_{t,ed}$ = 2,0 kNm/m / 0,20m = 10 kN/m

Project:
Houta Kantoor
Verification:
Lateral resistance of screws according to EN 1995-1-1 and ETA of the manufacturer
Engineer:
matede

binderholz

D01- lower connection steel-clt

Location: 1.Floor and 2.Floor (Axis 1-4) Detail Nr:



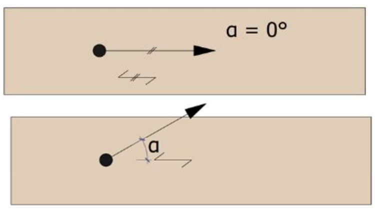
Screws:

Schmid partially thread Dual head	d	12,0	mm	diameter
	d_k	17,0	mm	diameter head
	$M_{y,Rk}$	46900,0	Nmm	yield Moment
	$f_{ax,k}$	11,0	N/mm²	withdrawal resistance
Rapid Ø10x200	$f_{head,k}$	17,1	N/mm²	head pull-through
	L	200,0	mm	screw length
	b	100,0	mm	thread length

Rapid dual 12x200

Connection:

Steel-Timber



Timber component:

BBS 125 - plane side	ρ_k	350,00	kg/m³	
CLT plane side	t_1	220,00	mm	
	α_1	0	°	grain force angle

Steel plate:

t	15,0	mm

Project:
Houta Kantoor
Verification:
Lateral resistance of screws according to EN 1995-1-1 and ETA of the manufacturer
Engineer:
matede

(thick acc. to EN 1995-1-1, 8.2.3)

Geometry:

n_1	5	[-]	(a_1-direction)
n_2	1	[-]	(a_2-direction)
a_1	200,0	mm	
n_{ef}	5,0	[-]	$n_{ef} = min \begin{cases} n \\ n^{0,9} * \sqrt[4]{\frac{a_1}{13 * d}} \end{cases}$
n_{total}	5,0	[-]	$n_{total} = n_{ef} * n_2$

5pcs/m e=200mm

Project:
Houta Kantoor
Verification:
Lateral resistance of screws according to EN 1995-1-1 and ETA of the manufacturer
Engineer:
matede

binderholz

Load:

$F_{v,Ed}$	27,00	
k_{mod}	0,8	
y_m	1,3	

max. torsion force

Resistance:

$F_{head.k}$	4,94	kN	decisive
$F_{ax.k}$	13,20	kN	

$$F_{head.k} = f_{head} * d_k^2$$

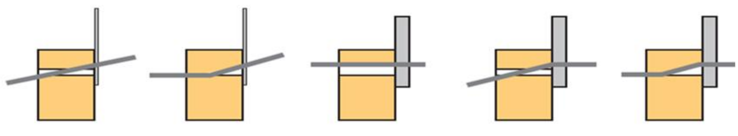
$$F_{ax.k} = f_{ax} * l_{ef} * d$$

$F_{v,Rk}$	9,91	kN	per member and joint
$F_{v,Rk} * n_{total}$	49,53	kN	
$F_{v,Rd}$	30,48	kN	

$$F_{v,Rk} = F_{v,Rk} + min\begin{cases} 0{,}25 * F_{ax,Rk} \\ 0{,}25 * F_{head,Rk} \end{cases}$$

$$F_{v,Rd} = \frac{F_{v,Rk} * k_{mod}}{\gamma_m} * n_{total}$$

failure mode: e) 9906,83



Check:

η 0,89 [-]

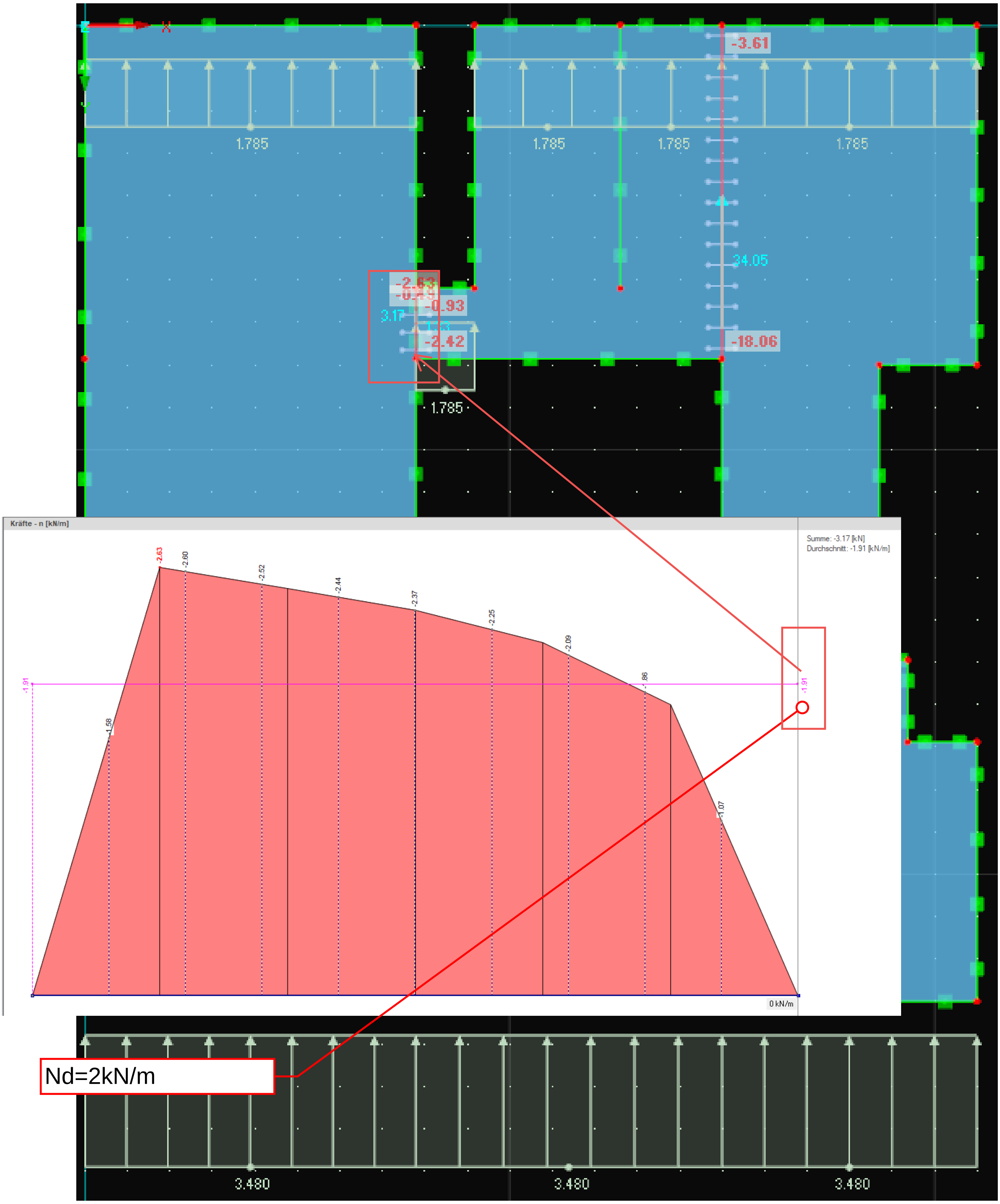
$$\eta = \frac{F_{v,Ed}}{F_{v,Rd}}$$

screw distance:

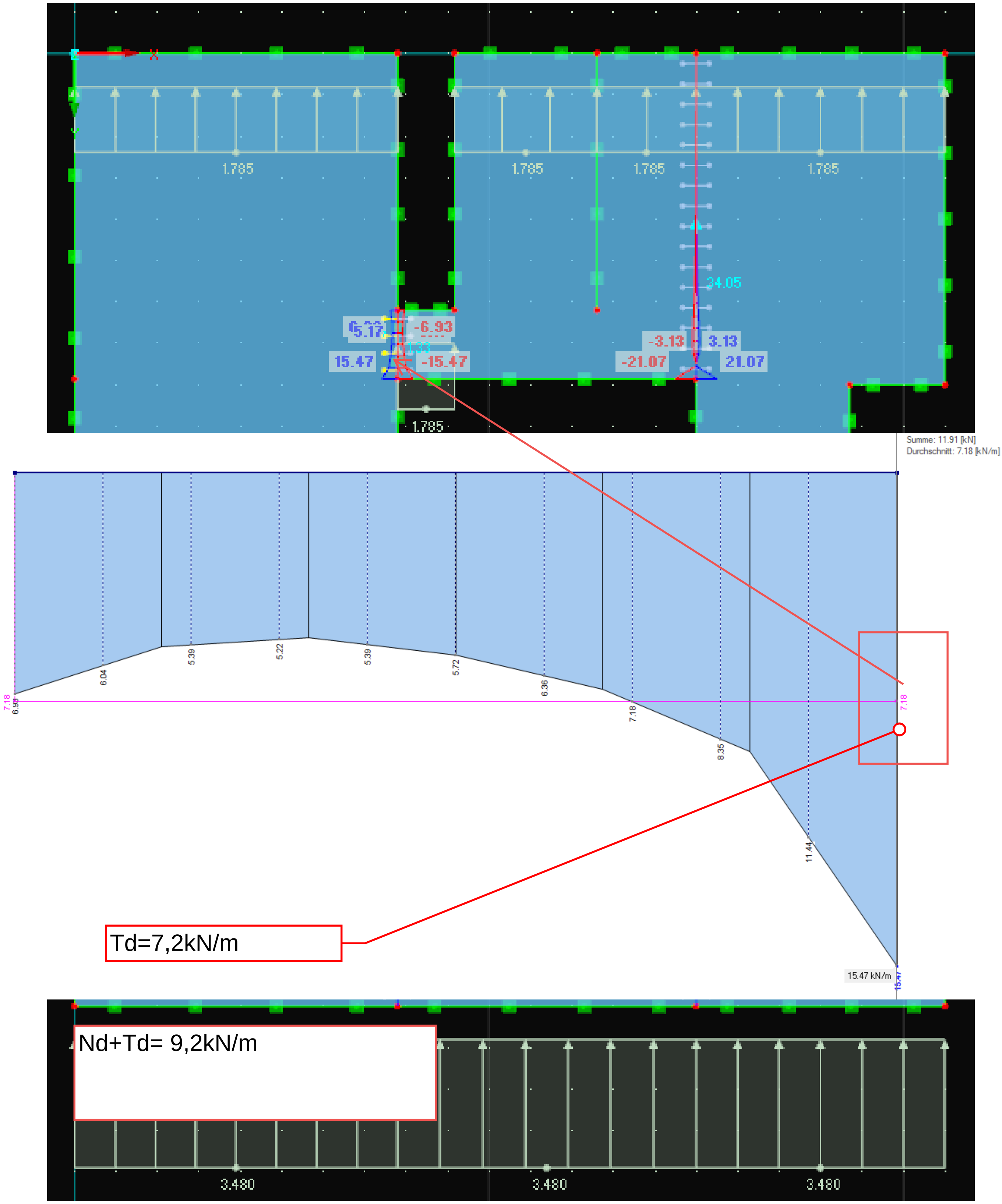
component 1	a_1	a_2	$a_{3,t}$	$a_{3,c}$	$a_{4,t}$	$a_{4,c}$
necessary:	4xd	4xd	80mm	4xd	4xd	3xd
	32,0 mm	32 mm	80 mm	32 mm	32 mm	24 mm
existent:	40,0 mm	40,0 mm	80,0 mm	40,0 mm	40,0 mm	30,0 mm
status:	OK	OK	OK	OK	OK	OK

component 2	a_1	a_2	$a_{3,t}$	$a_{3,c}$	$a_{4,t}$	$a_{4,c}$
necessary:	4xd	4xd	80mm	4xd	4xd	3xd
	32 mm	32 mm	80 mm	32 mm	32 mm	24 mm
existent:	40,0 mm	40,0 mm	80,0 mm	40,0 mm	40,0 mm	30,0 mm
status:	OK	OK	OK	OK	OK	OK

HOUTA KANTOOR-
deceisive shear and tension force for joint connection in case of wind (timber to steel)



HOUTA KANTOOR-
deceisive shear and tension force for joint connection (timber to steel)

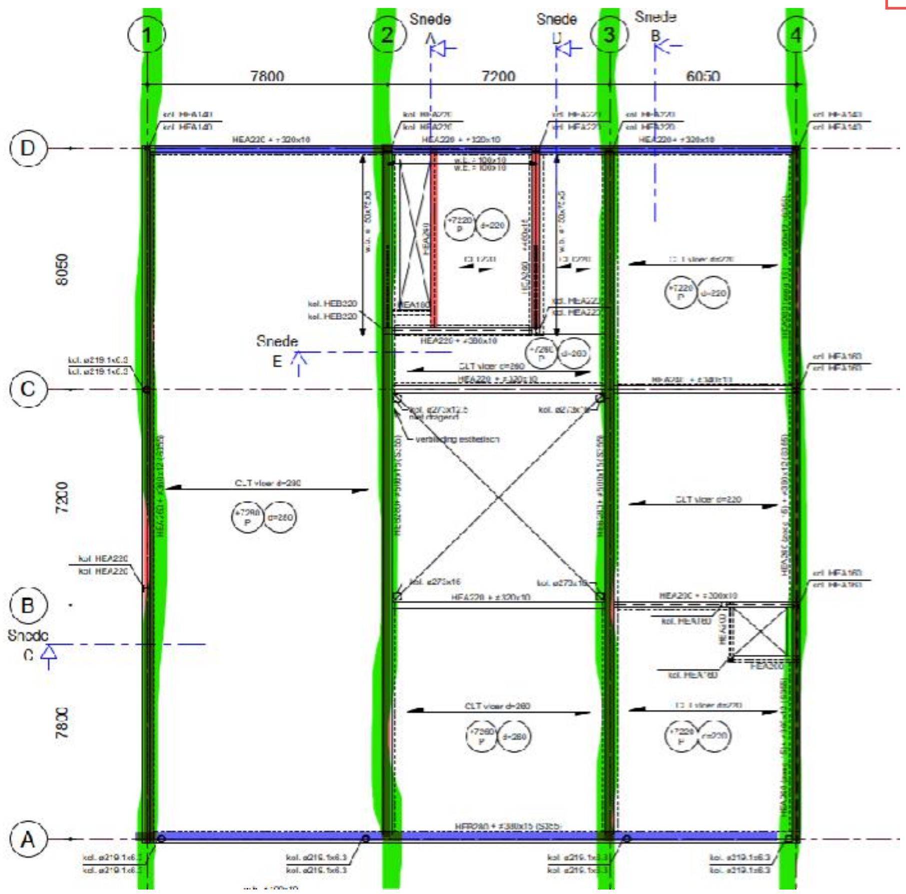


binderholz

Project:
Houta Kantoor
Verification:
Lateral resistance of screws according to EN 1995-1-1 and ETA of the manufacturer
Engineer:
matede

Location: 1.Floor and 2.Floor (Axis 1-4)

Detail Nr: D01- lower connection steel-clt



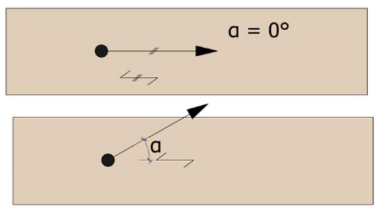
Screws:

Schmid partially thread Dual head	d	12,0	mm	diameter
	d_k	17,0	mm	diameter head
	$M_{y,Rk}$	46900,0	Nmm	yield Moment
	$f_{ax,k}$	11,2	N/mm²	withdrawal resistance
Rapid Ø10x200	$f_{head,k}$	17,1	N/mm²	head pull-through
	L	200,0	mm	screw length
	b	100,0	mm	thread length

Rapid dual 12x200

Connection:

Steel-Timber



Timber component:

BBS 125 - plane side CLT plane side	ρ_k	350,00	kg/m³	
	t_1	220,00	mm	
	α_1	0	°	grain force angle

Steel plate:

t	15,0	mm	

Project:
Houta Kantoor
Verification:
Lateral resistance of screws according to EN 1995-1-1 and ETA of the manufacturer
Engineer:
matede

(thick acc. to EN 1995-1-1, 8.2.3)

Geometry:

n_1	5	[-]	(a_1-direction)
n_2	1	[-]	(a_2-direction)
a_1	300,0	mm	
n_{ef}	5,0	[-]	$n_{ef} = min \begin{cases} n \\ n^{0,9} * \sqrt[4]{\frac{a_1}{13 * d}} \end{cases}$
n_{total}	5,0	[-]	$n_{total} = n_{ef} * n_2$

5pcs/m e=200mm

Project:
Houta Kantoor
Verification:
Lateral resistance of screws according to EN 1995-1-1 and ETA of the manufacturer
Engineer:
matede

binderholz

Load:

$F_{v,Ed}$	36,20	
k_{mod}	1	
γ_m	1,3	

decisive case: max. torsion force incl. max wind force (27kN/m +9,2 kN/m)

Resistance:

$F_{head.k}$	4,94	kN	decisive
$F_{ax.k}$	13,44	kN	

$$F_{head.k} = f_{head} * d_k^2$$

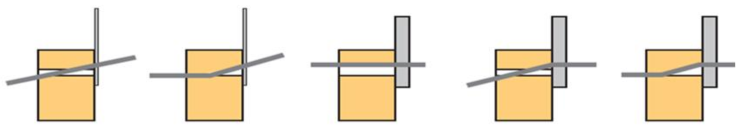
$$F_{ax.k} = f_{ax} * l_{ef} * d$$

$F_{v,Rk}$	9,91	kN	per member and joint
$F_{v,Rk} * n_{total}$	49,53	kN	
$F_{v,Rd}$	38,10	kN	

$$F_{v,Rk} = F_{v,Rk} + min\begin{cases} 0{,}25 * F_{ax,Rk} \\ 0{,}25 * F_{head,Rk} \end{cases}$$

$$F_{v,Rd} = \frac{F_{v,Rk} * k_{mod}}{\gamma_m} * n_{total}$$

failure mode: e) 9906,83



Check:

η 0,95 [-]

$$\eta = \frac{F_{v,Ed}}{F_{v,Rd}}$$

screw distance:

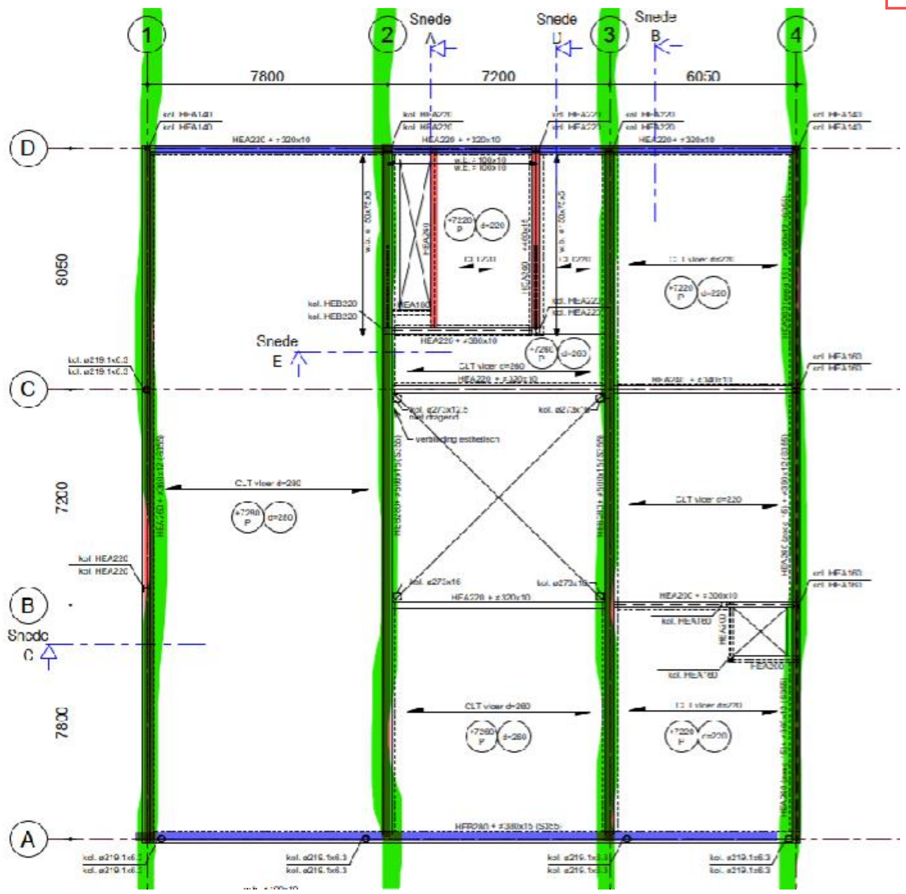
component 1	a_1	a_2	$a_{3,t}$	$a_{3,c}$	$a_{4,t}$	$a_{4,c}$
necessary:	4xd	4xd	80mm	4xd	4xd	3xd
	32,0 mm	32 mm	80 mm	32 mm	32 mm	24 mm
existent:	40,0 mm	40,0 mm	80,0 mm	40,0 mm	40,0 mm	30,0 mm
status:	OK	OK	OK	OK	OK	OK

component 2	a_1	a_2	$a_{3,t}$	$a_{3,c}$	$a_{4,t}$	$a_{4,c}$
necessary:	4xd	4xd	80mm	4xd	4xd	3xd
	32 mm	32 mm	80 mm	32 mm	32 mm	24 mm
existent:	40,0 mm	40,0 mm	80,0 mm	40,0 mm	40,0 mm	30,0 mm
status:	OK	OK	OK	OK	OK	OK

Project:
Houta Kantoor
Verification:
Lateral resistance of screws according to EN 1995-1-1 and ETA of the manufacturer
Engineer:
matede

binderholz

Location:	**1.Floor and 2.Floor (Axis 1-4)**	Detail Nr:	D02- upper connection steel-clt



Screws:

Schmid
partially thread
Dual head

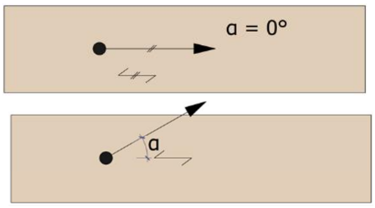
Rapid Ø10x200

Rapid dual 12x200

d	12,0	mm	diameter
d_k	17,0	mm	diameter head
$M_{y,Rk}$	46900,0	Nmm	yield Moment
$f_{ax,k}$	11,2	N/mm²	withdrawal resistance
$f_{head,k}$	17,1	N/mm²	head pull-through
L	200,0	mm	screw length
b	100,0	mm	thread length

Connection:

Steel-Timber



Timber component:

BBS 125 - plane side
CLT plane side

ρ_k	350,00	kg/m³
t_1	220,00	mm
α_1	0	°

grain force angle

Steel plate:

t	15,0	mm

binderholz

(thick acc. to EN 1995-1-1, 8.2.3)

Geometry:

n_1	4	[-]	(a_1-direction)
n_2	2	[-]	(a_2-direction)
a_1	50,0	mm	
n_{ef}	2,6	[-]	$n_{ef} = min \begin{cases} n \\ n^{0,9} * \sqrt[4]{\frac{a_1}{13 * d}} \end{cases}$
n_{total}	5,2	[-]	$n_{total} = n_{ef} * n_2$

Project:
Houta Kantoor
Verification:
Lateral resistance of screws according to EN 1995-1-1 and ETA of the manufacturer
Engineer:
matede

binderholz

Load:

$F_{v,Ed}$	36,20	
k_{mod}	1	
γ_m	1,3	

decisive case: max. torsion force incl. max wind force (27kN/m +9,2 kN/m)

Resistance:

$F_{head.k}$	4,94	kN	decisive
$F_{ax.k}$	13,44	kN	

$$F_{head.k} = f_{head} * d_k^2$$

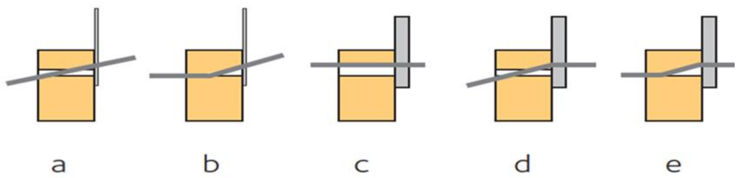
$$F_{ax.k} = f_{ax} * l_{ef} * d$$

$F_{v,Rk}$	9,91	kN	per member and joint
$F_{v,Rk} * n_{total}$	51,91	kN	
$F_{v,Rd}$	39,93	kN	

$$F_{v,Rk} = F_{v,Rk} + min\begin{cases} 0{,}25 * F_{ax,Rk} \\ 0{,}25 * F_{head,Rk} \end{cases}$$

$$F_{v,Rd} = \frac{F_{v,Rk} * k_{mod}}{\gamma_m} * n_{total}$$

failure mode: e) 9906,83



Check:

η 0,91 [-]

$$\eta = \frac{F_{v,Ed}}{F_{v,Rd}}$$

screw distance:

component 1	a_1	a_2	$a_{3,t}$	$a_{3,c}$	$a_{4,t}$	$a_{4,c}$
necessary:	4xd	4xd	80mm	4xd	4xd	3xd
	32,0 mm	32 mm	80 mm	32 mm	32 mm	24 mm
existent:	40,0 mm	40,0 mm	80,0 mm	40,0 mm	40,0 mm	30,0 mm
status:	OK	OK	OK	OK	OK	OK

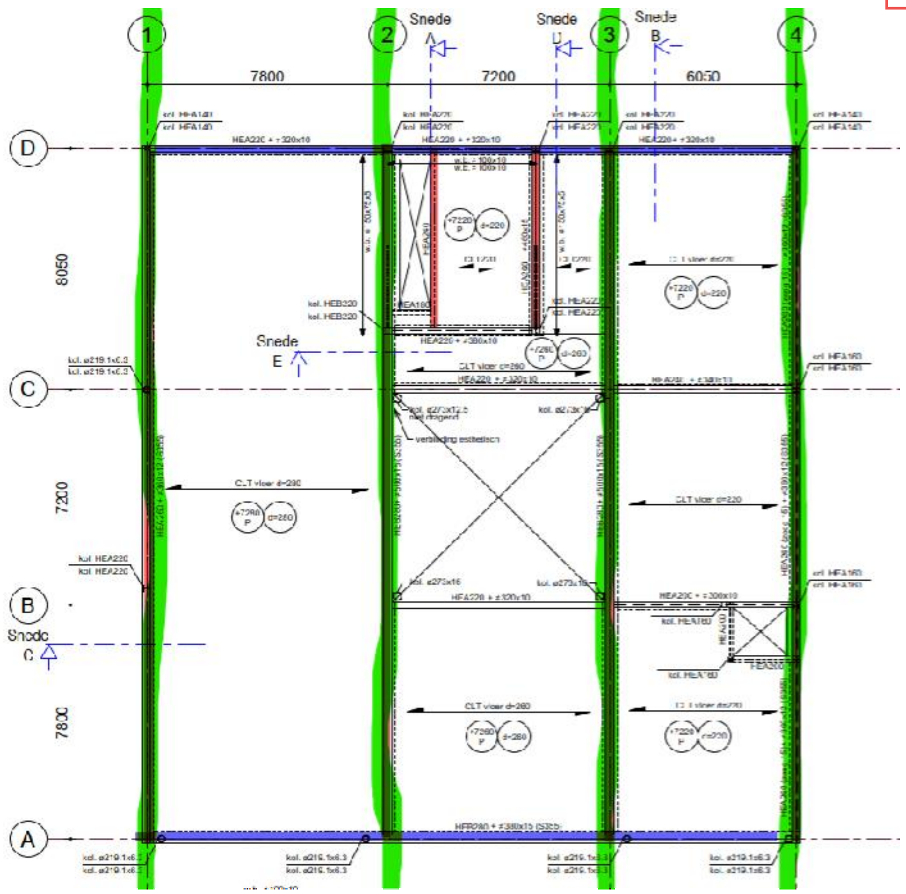
component 2	a_1	a_2	$a_{3,t}$	$a_{3,c}$	$a_{4,t}$	$a_{4,c}$
necessary:	4xd	4xd	80mm	4xd	4xd	3xd
	32 mm	32 mm	80 mm	32 mm	32 mm	24 mm
existent:	40,0 mm	40,0 mm	80,0 mm	40,0 mm	40,0 mm	30,0 mm
status:	OK	OK	OK	OK	OK	OK

Project:
Houta Kantoor
Verification:
Lateral resistance of screws according to EN 1995-1-1 and ETA of the manufacturer
Engineer:
matede

binderholz

D03- upper connection timber-clt

Location: 1.Floor - 2.Floor (Axis 1-4) Detail Nr:



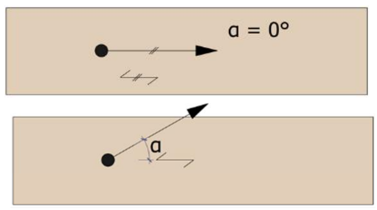
Screws:

Schmid partially thread Dual head	d	10,0	mm	diameter
	d_k	18,5	mm	diameter head
	$M_{y,Rk}$	33000,0	Nmm	yield Moment
	$f_{ax,k}$	9,5	N/mm²	withdrawal resistance
Rapid Ø10x100	$f_{head,k}$	12,2	N/mm²	head pull-through
	L	100,0	mm	screw length
	b	60,0	mm	thread length

Rapid 10x200

Connection:

Timber-Timber



Timber component 1:

BBS 125 - plane side 3-layer solid wood	ρ_k	350,00	kg/m³	
	t_1	20,00	mm	
	α_1	0	°	grain force angle

Steel plate:

t	0,0	mm

Project:
Houta Kantoor
Verification:
Lateral resistance of screws according to EN 1995-1-1 and ETA of the manufacturer
Engineer:
matede

(thin acc. to EN 1995-1-1, 8.2.3)

Geometry:

n_1	3	[-]	(a_1-direction)
n_2	5	[-]	(a_2-direction)
a_1	200,0	mm	
n_{ef}	3,0	[-]	$n_{ef} = min\begin{cases} n \\ n^{0,9} * \sqrt[4]{\frac{a_1}{13 * d}} \end{cases}$
n_{total}	15,0	[-]	$n_{total} = n_{ef} * n_2$

Project:
Houta Kantoor
Verification:
Lateral resistance of screws according to EN 1995-1-1 and ETA of the manufacturer
Engineer:
matede

binderholz

Load:

$F_{v,Ed}$	36,20	
k_{mod}	1	
γ_m	1,3	

decisive case: max. torsion force incl. max wind force (27kN/m +9,2 kN/m)

Resistance:

$F_{head.k}$	4,18	kN	decisive
$F_{ax.k}$	5,70	kN	
$F_{v,Rk}$	3,22	kN	per member and joint
$F_{v,Rk} * n_{total}$	48,19	kN	
$F_{v,Rd}$	37,07	kN	

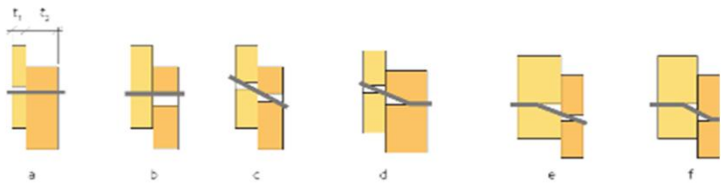
$$F_{head.k} = f_{head} * d_k^2$$

$$F_{ax.k} = f_{ax} * l_{ef} * d$$

$$F_{v,Rk} = F_{v,Rk} + min\begin{cases} 0,25 * F_{ax,Rk} \\ 0,25 * F_{head,Rk} \end{cases}$$

$$F_{v,Rd} = \frac{F_{v,Rk} * k_{mod}}{\gamma_m} * n_{total}$$

failure mode: d) 3219,78



Check:

η 0,98 [-]

$$\eta = \frac{F_{v,Ed}}{F_{v,Rd}}$$

screw distance:

component 1	a_1	a_2	$a_{3,t}$	$a_{3,c}$	$a_{4,t}$	$a_{4,c}$
necessary:	4xd	4xd	80mm	4xd	4xd	3xd
	32,0 mm	32 mm	80 mm	32 mm	32 mm	24 mm
existent:	40,0 mm	40,0 mm	80,0 mm	40,0 mm	40,0 mm	30,0 mm
status:	OK	OK	OK	OK	OK	OK

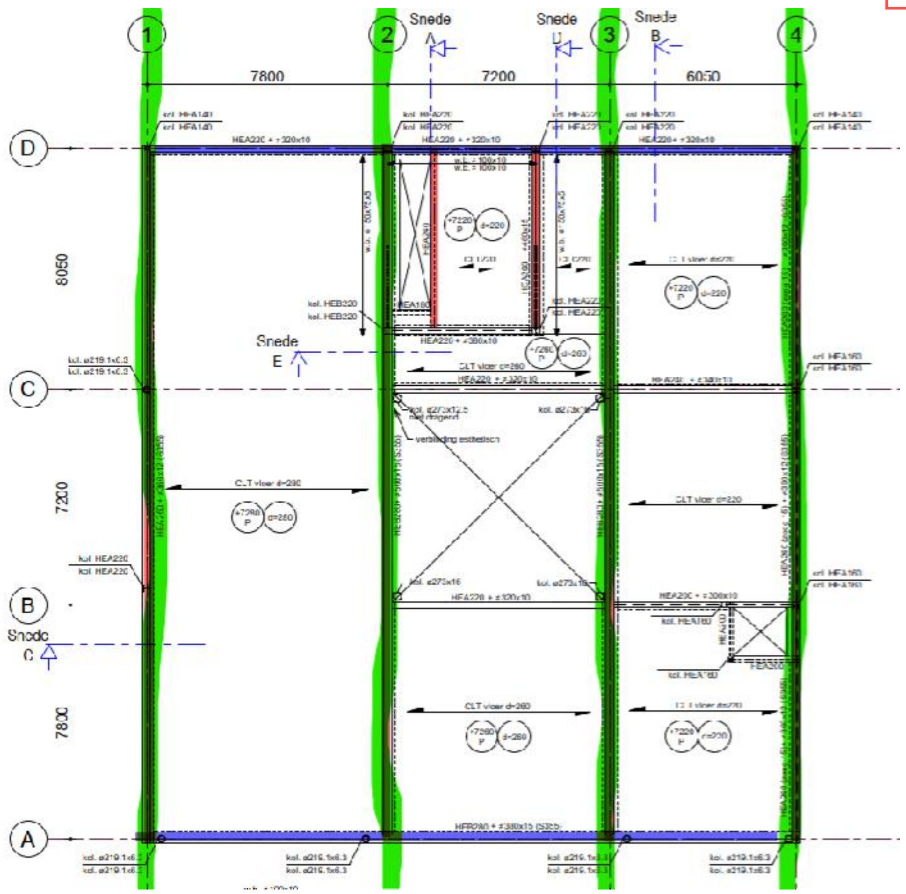
component 2	a_1	a_2	$a_{3,t}$	$a_{3,c}$	$a_{4,t}$	$a_{4,c}$
necessary:	4xd	4xd	80mm	4xd	4xd	3xd
	32 mm	32 mm	80 mm	32 mm	32 mm	24 mm
existent:	40,0 mm	40,0 mm	80,0 mm	40,0 mm	40,0 mm	30,0 mm
status:	OK	OK	OK	OK	OK	OK

Project:
Houta Kantoor
Verification:
Lateral resistance of screws according to EN 1995-1-1 and ETA of the manufacturer
Engineer:
matede

binderholz

Location: Roof (Axis 1-4)

Detail Nr: D04- lower connection steel-clt



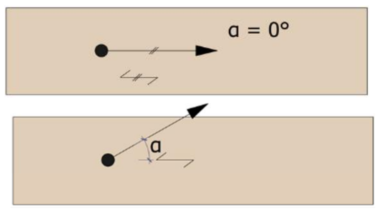
Screws:

Schmid partially thread Dual head	d	12,0	mm	diameter
	d_k	17,0	mm	diameter head
	$M_{y,Rk}$	46900,0	Nmm	yield Moment
	$f_{ax,k}$	11,2	N/mm²	withdrawal resistance
Rapid Ø10x200	$f_{head,k}$	17,1	N/mm²	head pull-through
	L	200,0	mm	screw length
	b	100,0	mm	thread length

Rapid dual 12x200

Connection:

Steel-Timber



Timber component:

BBS 125 - plane side CLT plane side	ρ_k	350,00	kg/m³	
	t_1	180,00	mm	
	α_1	0	°	grain force angle

Steel plate:

t	12,0	mm	

Project:
Houta Kantoor
Verification:
Lateral resistance of screws according to EN 1995-1-1 and ETA of the manufacturer
Engineer:
matede

(thick acc. to EN 1995-1-1, 8.2.3)

Geometry:

n_1	1	[-]	(a_1-direction)
n_2	3	[-]	(a_2-direction)
a_1	300,0	mm	
n_{ef}	1,0	[-]	$n_{ef} = min\begin{cases} n \\ n^{0,9} * \sqrt[4]{\frac{a_1}{13 * d}} \end{cases}$
n_{total}	3,0	[-]	$n_{total} = n_{ef} * n_2$

3pcs/m e=300mm

Project:
Houta Kantoor
Verification:
Lateral resistance of screws according to EN 1995-1-1 and ETA of the manufacturer
Engineer:
matede

binderholz

Load:

$F_{v,Ed}$ 20,00

k_{mod} 1
$γ_m$ 1,3

<u>decisive case:</u> max. torsion force incl. max wind force (17kN/m +3 kN/m)

Resistance:

$F_{head.k}$ 4,94 kN — decisive — $F_{head.k} = f_{head} * d_k^2$
$F_{ax.k}$ 13,44 kN — $F_{ax.k} = f_{ax} * l_{ef} * d$

$F_{v,Rk}$ 9,91 kN — per member and joint

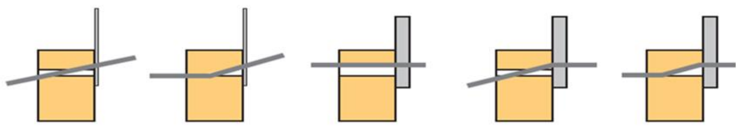
$F_{v,Rk} * n_{total}$ 29,72 kN

$$F_{v,Rk} = F_{v,Rk} + min\begin{cases} 0{,}25 * F_{ax,Rk} \\ 0{,}25 * F_{head,Rk} \end{cases}$$

$F_{v,Rd}$ 22,86 kN

$$F_{v,Rd} = \frac{F_{v,Rk} * k_{mod}}{\gamma_m} * n_{total}$$

failure mode: e) 9906,83



Check:

η 0,87 [-]

$$\eta = \frac{F_{v,Ed}}{F_{v,Rd}}$$

screw distance:

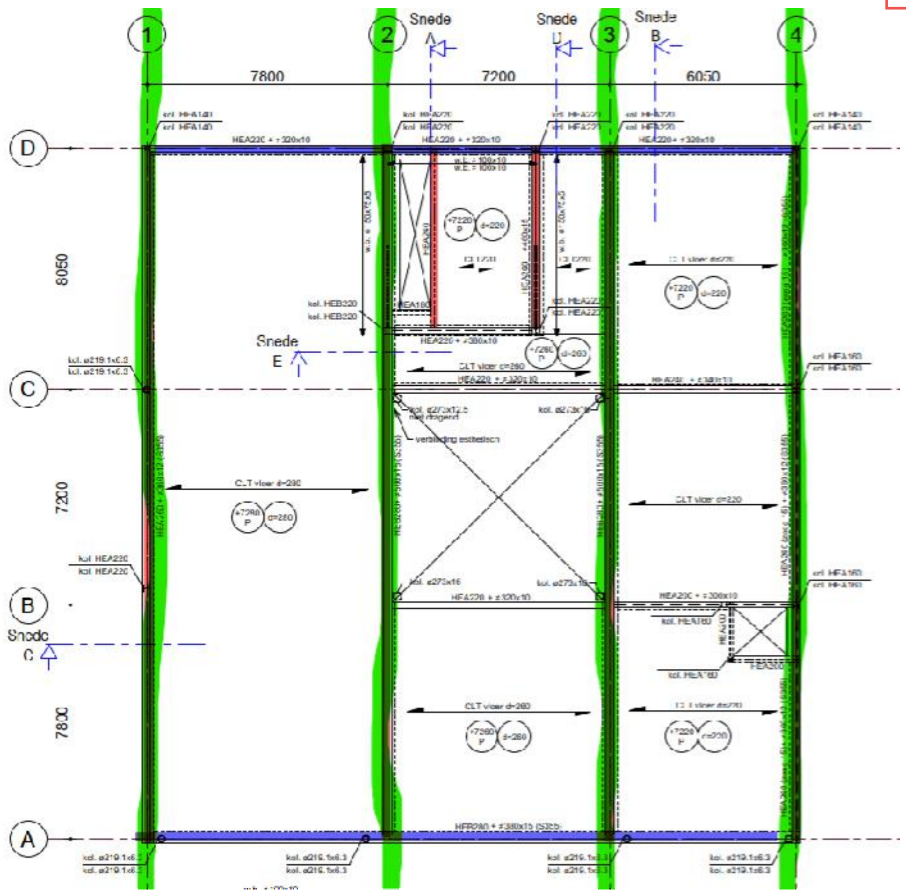
component 1	a_1	a_2	$a_{3,t}$	$a_{3,c}$	$a_{4,t}$	$a_{4,c}$
necessary:	4xd	4xd	80mm	4xd	4xd	3xd
	32,0 mm	32 mm	80 mm	32 mm	32 mm	24 mm
existent:	40,0 mm	40,0 mm	80,0 mm	40,0 mm	40,0 mm	30,0 mm
status:	OK	OK	OK	OK	OK	OK

component 2	a_1	a_2	$a_{3,t}$	$a_{3,c}$	$a_{4,t}$	$a_{4,c}$
necessary:	4xd	4xd	80mm	4xd	4xd	3xd
	32 mm	32 mm	80 mm	32 mm	32 mm	24 mm
existent:	40,0 mm	40,0 mm	80,0 mm	40,0 mm	40,0 mm	30,0 mm
status:	OK	OK	OK	OK	OK	OK

Project:
Houta Kantoor
Verification:
Lateral resistance of screws according to EN 1995-1-1 and ETA of the manufacturer
Engineer:
matede

binderholz

Location: Roof (Axis 1-4) Detail Nr: D05-upper connection steel-clt



Screws:

Schmid
partially thread
Dual head

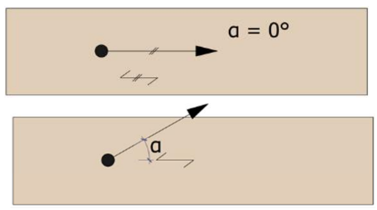
Rapid Ø10x200

Rapid dual 12x200

d	12,0	mm	diameter
d_k	17,0	mm	diameter head
$M_{y,Rk}$	46900,0	Nmm	yield Moment
$f_{ax,k}$	11,2	N/mm²	withdrawal resistance
$f_{head,k}$	17,1	N/mm²	head pull-through
L	200,0	mm	screw length
b	100,0	mm	thread length

Connection:

Steel-Timber



Timber component:
BBS 125 - plane side
CLT plane side

ρ_k	350,00	kg/m³	
t_1	180,00	mm	
α_1	0	°	grain force angle

Steel plate:

t	12,0	mm

binderholz

(thick acc. to EN 1995-1-1, 8.2.3)

Geometry:

n_1	2	[-]	(a_1-direction)
n_2	2	[-]	(a_2-direction)
a_1	60,0	mm	
n_{ef}	1,5	[-]	$n_{ef} = min \begin{cases} n \\ n^{0,9} * \sqrt[4]{\frac{a_1}{13 * d}} \end{cases}$
n_{total}	2,9	[-]	$n_{total} = n_{ef} * n_2$

Project:
Houta Kantoor
Verification:
Lateral resistance of screws according to EN 1995-1-1 and ETA of the manufacturer
Engineer:
matede

binderholz

Load:

$F_{v,Ed}$	20,00	
k_{mod}	1	
γ_m	1,3	

decisive case: max. torsion force incl. max wind force (17kN/m +3 kN/m)

Resistance:

$F_{head.k}$	4,94	kN	decisive
$F_{ax.k}$	13,44	kN	

$$F_{head.k} = f_{head} * d_k^2$$

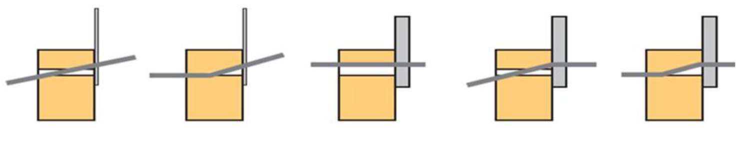
$$F_{ax.k} = f_{ax} * l_{ef} * d$$

$F_{v,Rk}$	9,91	kN	per member and joint
$F_{v,Rk} * n_{total}$	29,12	kN	
$F_{v,Rd}$	22,40	kN	

$$F_{v,Rk} = F_{v,Rk} + min\begin{cases} 0{,}25 * F_{ax,Rk} \\ 0{,}25 * F_{head,Rk} \end{cases}$$

$$F_{v,Rd} = \frac{F_{v,Rk} * k_{mod}}{\gamma_m} * n_{total}$$

failure mode: e) 9906,83



Check:

η 0,89 [-]

$$\eta = \frac{F_{v,Ed}}{F_{v,Rd}}$$

screw distance:

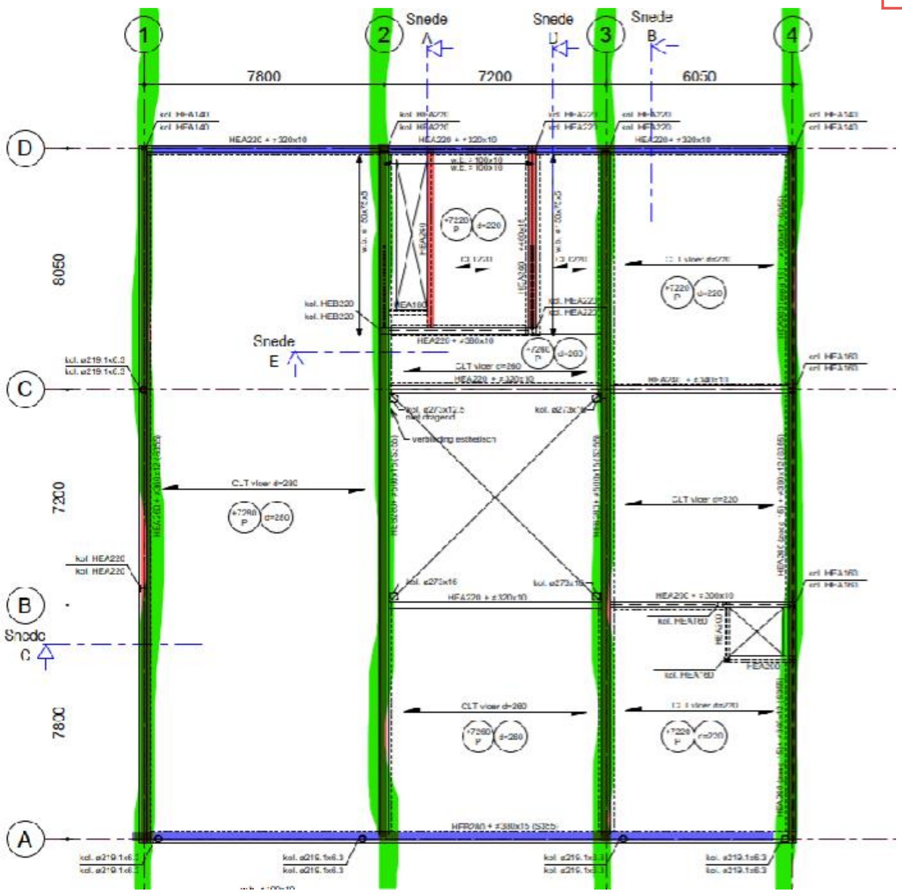
component 1	a_1	a_2	$a_{3,t}$	$a_{3,c}$	$a_{4,t}$	$a_{4,c}$
necessary:	4xd	4xd	80mm	4xd	4xd	3xd
	32,0 mm	32 mm	80 mm	32 mm	32 mm	24 mm
existent:	40,0 mm	40,0 mm	80,0 mm	40,0 mm	40,0 mm	30,0 mm
status:	OK	OK	OK	OK	OK	OK

component 2	a_1	a_2	$a_{3,t}$	$a_{3,c}$	$a_{4,t}$	$a_{4,c}$
necessary:	4xd	4xd	80mm	4xd	4xd	3xd
	32 mm	32 mm	80 mm	32 mm	32 mm	24 mm
existent:	40,0 mm	40,0 mm	80,0 mm	40,0 mm	40,0 mm	30,0 mm
status:	OK	OK	OK	OK	OK	OK

Project:
Houta Kantoor
Verification:
Lateral resistance of screws according to EN 1995-1-1 and ETA of the manufacturer
Engineer:
matede

binderholz

Location: Roof (Axis 1-4) Detail Nr: D06-upper connection timber-clt



Screws:

Schmid
partially thread
Dual head

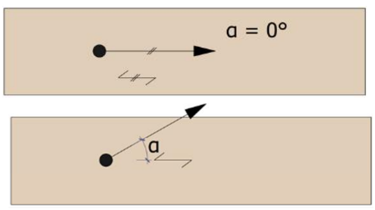
Rapid Ø10x100

Rapid 10x200

d	10,0	mm	diameter
d_k	18,5	mm	diameter head
$M_{y,Rk}$	33000,0	Nmm	yield Moment
$f_{ax,k}$	9,5	N/mm²	withdrawal resistance
$f_{head,k}$	12,2	N/mm²	head pull-through
L	100,0	mm	screw length
b	60,0	mm	thread length

Connection:

Timber-Timber



Timber component 1:
BBS 125 - plane side
3-layer solid wood

ρ_k	350,00	kg/m³	
t_1	20,00	mm	
α_1	0	°	grain force angle

Steel plate:

t	0,0	mm

(thin acc. to EN 1995-1-1, 8.2.3)

Geometry:

n_1	3	[-]	(a_1-direction)
n_2	3	[-]	(a_2-direction)
a_1	200,0	mm	
n_{ef}	3,0	[-]	$n_{ef} = min\begin{cases} n \\ n^{0,9} * \sqrt[4]{\frac{a_1}{13 * d}} \end{cases}$
n_{total}	9,0	[-]	$n_{total} = n_{ef} * n_2$

Project:
Houta Kantoor
Verification:
Lateral resistance of screws according to EN 1995-1-1 and ETA of the manufacturer
Engineer:
matede

binderholz

Load:

$F_{v,Ed}$	20,00	
k_{mod}	1	
y_m	1,3	

decisive case: max. torsion force incl. max wind force (17kN/m +3 kN/m)

Resistance:

$F_{head.k}$	4,18	kN	decisive
$F_{ax.k}$	5,70	kN	

$$F_{head.k} = f_{head} * d_k^2$$

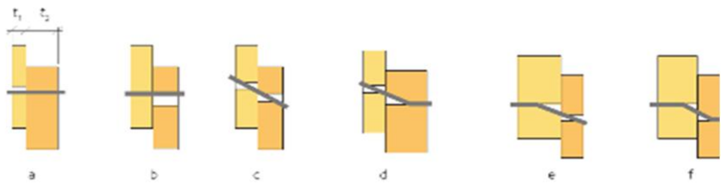
$$F_{ax.k} = f_{ax} * l_{ef} * d$$

$F_{v,Rk}$	3,22	kN	per member and joint
$F_{v,Rk} * n_{total}$	28,92	kN	
$F_{v,Rd}$	22,24	kN	

$$F_{v,Rk} = F_{v,Rk} + min\begin{cases} 0{,}25 * F_{ax,Rk} \\ 0{,}25 * F_{head,Rk} \end{cases}$$

$$F_{v,Rd} = \frac{F_{v,Rk} * k_{mod}}{\gamma_m} * n_{total}$$

failure mode: d) 3219,78



Check:

η 0,90 [-]

$$\eta = \frac{F_{v,Ed}}{F_{v,Rd}}$$

screw distance:

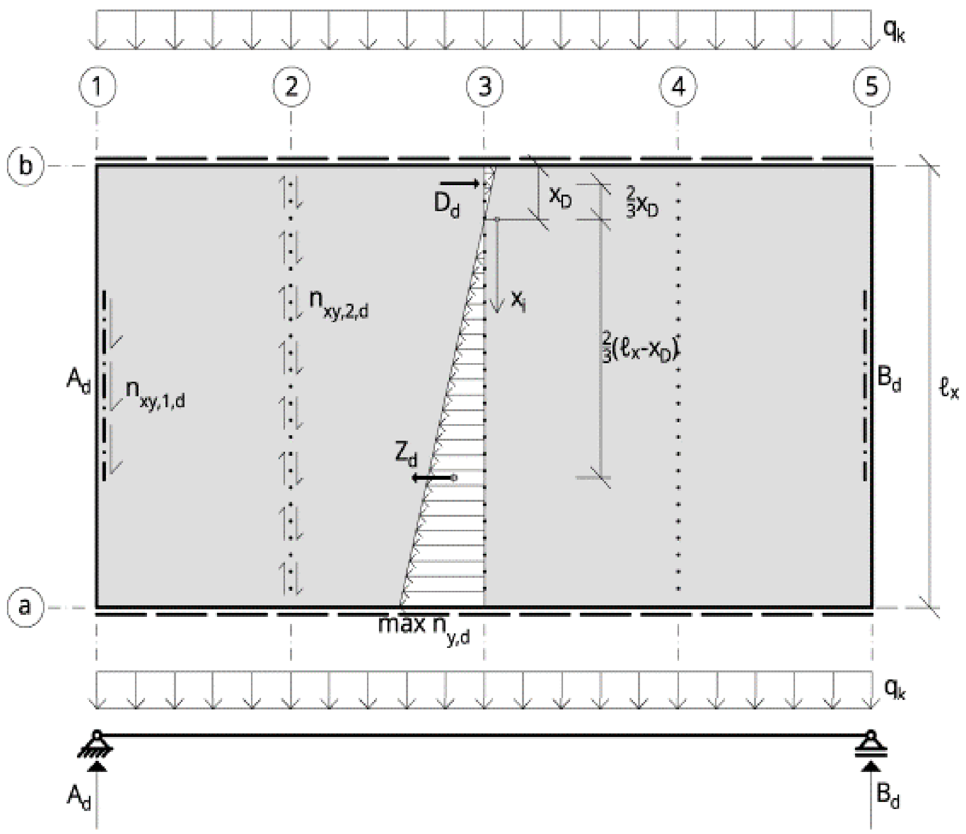
component 1	a_1	a_2	$a_{3,t}$	$a_{3,c}$	$a_{4,t}$	$a_{4,c}$
necessary:	4xd	4xd	80mm	4xd	4xd	3xd
	32,0 mm	32 mm	80 mm	32 mm	32 mm	24 mm
existent:	40,0 mm	40,0 mm	80,0 mm	40,0 mm	40,0 mm	30,0 mm
status:	OK	OK	OK	OK	OK	OK

component 2	a_1	a_2	$a_{3,t}$	$a_{3,c}$	$a_{4,t}$	$a_{4,c}$
necessary:	4xd	4xd	80mm	4xd	4xd	3xd
	32 mm	32 mm	80 mm	32 mm	32 mm	24 mm
existent:	40,0 mm	40,0 mm	80,0 mm	40,0 mm	40,0 mm	30,0 mm
status:	OK	OK	OK	OK	OK	OK

HOUTA KANTOOR-
diaphragm
slab-joint connection (clt to clt)

en,

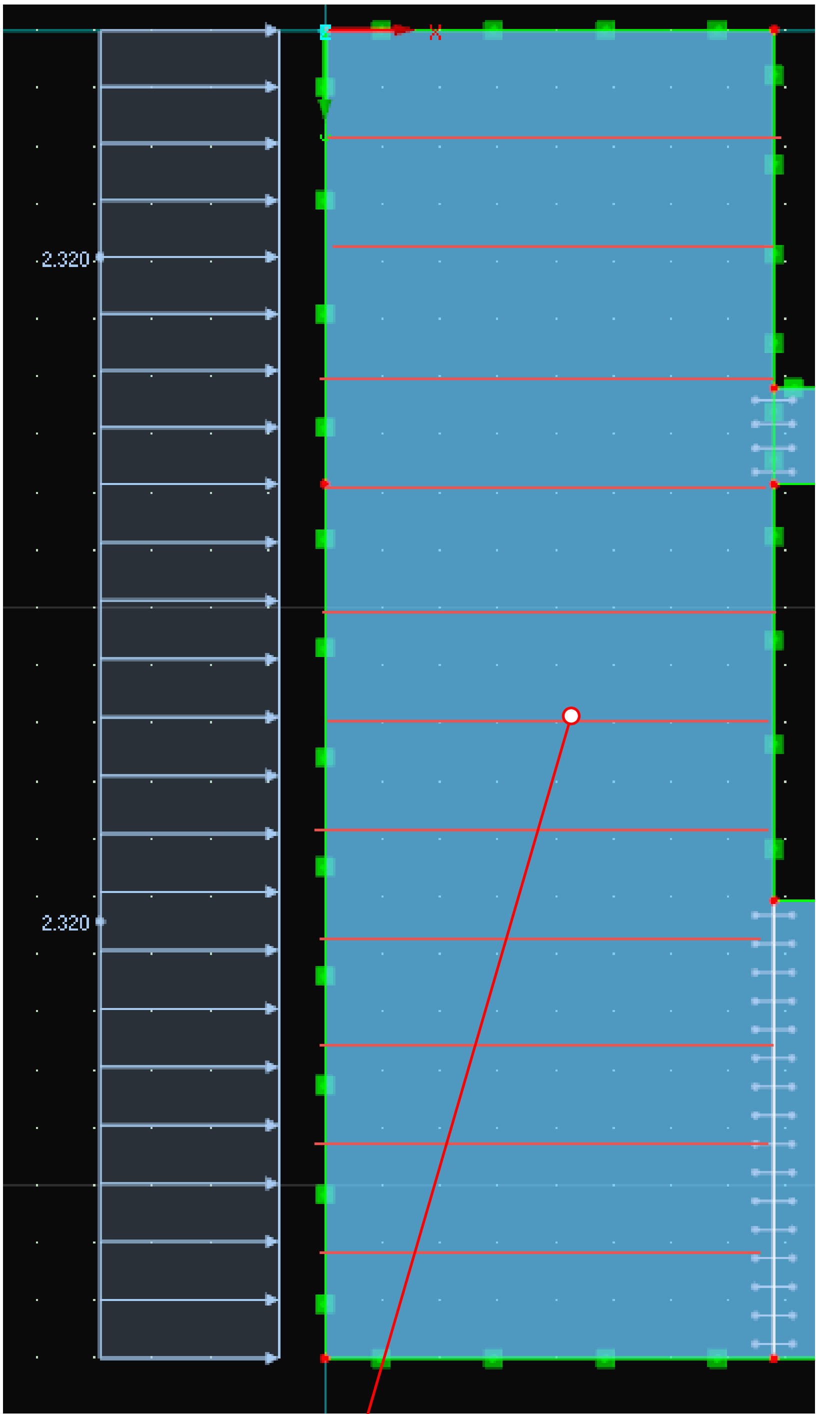
Projekt	**Houta_Kantoor**
Bauteil	**Diaphragm**



Spannweite	L x	**7,70**	m	Spannweite des Deckenfeldes
Breite	L y	**22,50**	m	Abstand der aussteifenden Wände
				dieses Feld wird als Einfeldträger betrachtet
	b y	**2,50**	m	Fugenraster der Deckenscheibe
Windlast	w k	**0,60**	kN/m²	Gesamtwinddruck auf die Aussenwände
	h e	**3,90**	m	Einflusshöhe des Winddrucks
				für die betrachtete Deckenscheibe

Aufnahme der Fugenzugkraft Z d

kontinuierlich durch Verschraubung



max. force in joints:
11,1kN/m

Schub n_{xy} in den Deckenstoßfugen

Lasttyp	γ Q	k led	k mod
W	1,5	short-term / in	1

q k	2,34	kN/m	charakteristischer Wert der Windlast
q d	3,51	kN/m	Bemessungswert der Windlast
k mod	1,00		Lastdauerbeiwert

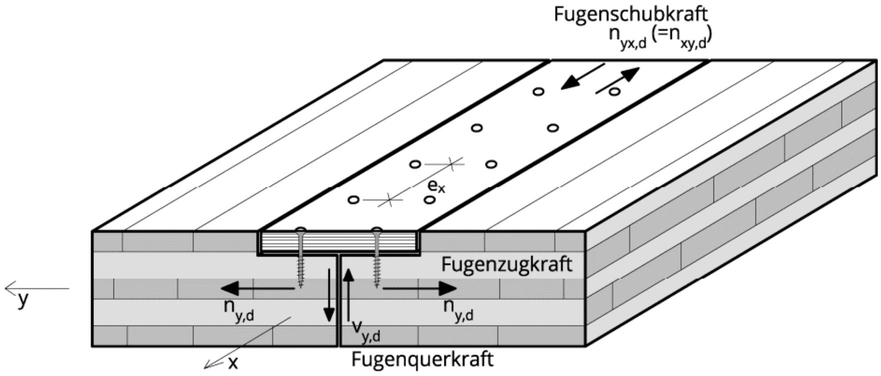
Schubkräfte

	Fuge	Position y [m]	Fugenschubkraft n xy,i,d [kN/m]	Elementbreite [m]
	1	0,00	5,13	2,50
	2	2,50	3,99	2,50
	3	5,00	2,85	2,50
	4	7,50	1,71	2,50
	5	10,00	0,57	2,50
	6	12,50	0,57	0,00
	7	12,50	0,57	2,50
	8	15,00	1,71	
	9	17,5		
90%	10	20		
			3,99	

Fugenzugkräfte

Fuge	Position y [m]	Fugenzugkraft max ny,i,d kontinuierlich [kN/m]	Z i,d punktuell [kN]
1	0,00	0,00	0,00
2	2,50	4,44	17,09
3	5,00	7,77	29,91
4	7,50	9,99	38,46
5	10,00	11,10	42,74
6	12,50	11,10	42,74
7	12,50	11,10	42,74
8	15,00	9,99	38,46
		11,10	42,74

Zusammenstellung der Ergebnisse



Anschluss des Deckenfeldes zur Wandscheibe

n xy,1,d	5,13	kN/m	Anschlusskraft zur Wand pro Laufmeter Fuge
N xy,1,d	39,4875	kN	Anschlusskraft zur Wand als Gesamtkraft

größte Fugenschubkraft

Fuge	2		
n xy,d	3,99	kN/m	maximale Fugenschubkraft
zugeh. n y,d	4,44	kN/m	zugehörige Fugenzugkraft

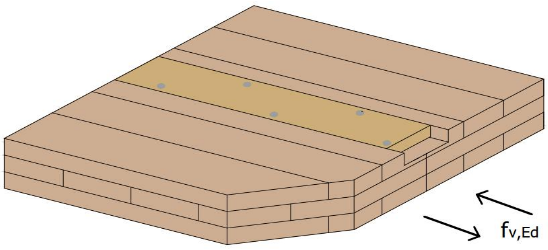
größte Fugenzugkraft pro Laufmeter am Rand

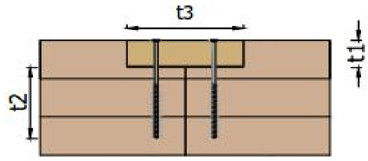
Fuge	5		
n y,d	11,10	kN/m	maximale Fugenzugkraft
zugeh. n xy,d	0,57	kN/m	zugehörige Fugenschubkraft

Slab or Wall - joint with milled-in cover strips, screws or nails
Calculated acc. to EN 1995-1-1:2009, Blaß 2013

binderholz

Projekt	Houta Kantoor
Position	slab joint connection





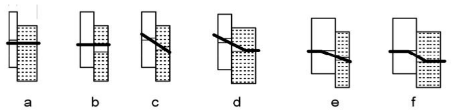
	format		BBS 125	
Fasteners				
	fasteners		Screws (generell)	
	diameter	d	8,0 mm	
	effectif diameter	d_{eff}	8,0 mm	
	head diameter	d_k	14 mm	
	lengh	L	100 mm	
	thread-/profilelengh	L_{gew}	60 mm	
	material		4,6	
	screw angle	α_1	90 °	
Crosssection				
milled-in cover strips	material		3-layer panel	
	thickness	t_1	27 mm	
	width	t_3	160 mm	
	density	ρ	350 kg/m³	
			not predrilled	
BBS	product		140-5s	40-20-20-20-40
	depth	t_2	73 mm	
	effectiv thread lengh	l_{eff}	60 mm	
	min. thread lengh	t_{min}	32 mm	4 x d
	density	ρ	350 kg/m³	
Load				
	design load	$f_{v,Ed}$	11,1 kN/m	
	modification factor	k_{mod}	1,0	

Slab or Wall - joint with milled-in cover strips, screws or nails
Calculated acc. to EN 1995-1-1:2009, Blaß 2013

binderholz

Resistance	char. tension strengh	$f_{u,k}$	400,0 N/mm²
	plastic moment	$M_{y,Rk}$	26743 Nmm
milled-in cover strip	embedment strength	$f_{h,1,k}$	20,6 N/mm²
BBS lateral face	embedment strength	$f_{h,2,k}$	15,4 N/mm²
	ratio of strength	β	0,75
	pull out resistance	$F_{ax,Rk}$	6519 N
	head penetration	$F_{h,ax,Rk}$	2401 N
	rope action	$F_{ax,Rk}$ / 4	600 N

event of failure: shear
transferable force per fastener and joint



	4456 N	a	embedment strength milled-in cover strip
	8982 N	b	embedment strength BBS lateral face
	3768 N	c	torison strengh of fastener
	2914 N	d	bending strength of fastener BBS
	4289 N	e	bending strength of fastener of milled-in cover strip
	3758 N	f	bending strenght of fastener of joint
$F_{v,Rk}$	**2914 N**	**d**	

Verification

$F_{v,Rk}$	2,9 kN
γ_m	1,3
$F_{v,Rd}$	2,24 kN
$F_{v,Ed}$	11,10 kN

[EN]

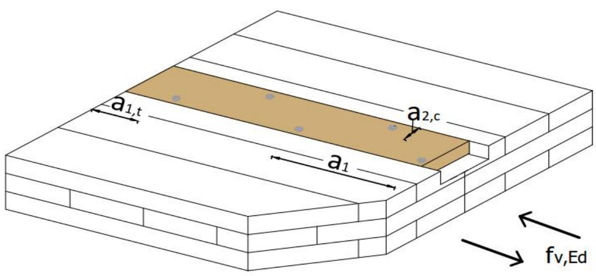
erf. N **5 Stk./m**

screw distances

5pcs/m, e=200mm

center distance	$a_{1,erf.}$	20,0 cm	(acc. to Calculation)
min. center distance	$a_{1,min}$	3,2 cm	(acc. to Blaß
chosen edge distance	$a_{2,c,vorh.}$	4,0 cm	(acc. to chosen t_3)
min. edge distance	$a_{2,c,min}$	3,2 cm	(acc. to Blaß)
min. edge distance tensionside	$a_{1,t,min}$	4,8 cm	(acc. to Blaß)

min. distances are OK!



HOUTA KANTOOR-
support compression
(clt to steelbeam)

binderholz CLT BBS – continuous beams | floors

Design following [EN] EN 1995-1-1:2019, "ETA-06/0009:2017. DiBt Z-9.1-534:2014"

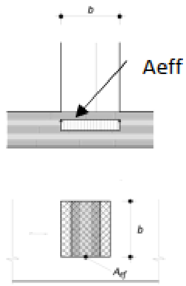
Support forces for load transmission

Support	Dsgn.Value	char.Wert	Loadcode		Dsgn.Value	char.Wert	Loadcode
	Maximalwerte			**Minimalwerte**			
A G,k		8,34	G	A G,k		8,34	G
A N,k		11,40	NB	A N,k		0,00	NB
A d	**28,36**			**A d**	**11,26**		
B G,k		8,34	G	B G,k		8,34	G
B N,k		11,40	NB	B N,k		0,00	NB
B d	**28,36**			**B d**	**11,26**		

max. support force
F01

Verification compression on support - perpendicular to the grain - CLT

$N_{c,90,d}$	29,0	kN	b	7,0	cm
A_{eff}	700	cm²	l	100,0	cm
Material	CLT				
$f_{c,90,k}$	2,5	N/mm²	l_{min}	18,00	cm
$f_{c,90,d}$	1,54	N/mm²	γ_m	1,30	
$K_{c,90}$	1,50		K_{mod}	0,8	
$\sigma_{c,90,d}$	**0,41**	**N/mm²**	**0,18**	**≤1,0**	



$$\frac{\sigma_{c,90,d}}{k_{c,90} * f_{c,90,d}} \leq 1{,}0$$

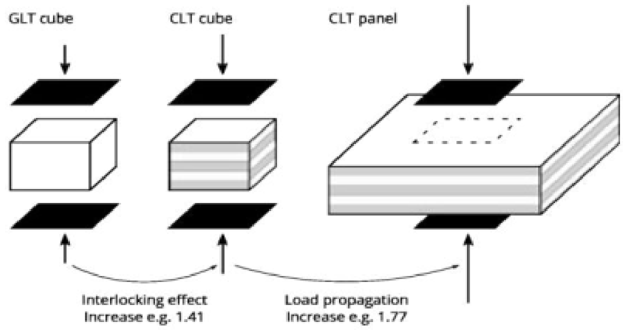


Figure 4.29 Lateral compressive strength of cross-laminated timber with examples for increase factors compared to GLT

The deformation limiting effect allows for an increase of the lateral compressive strength of $f_{c,90,k}$ = 2.5 N/mm² for glued-laminated timber to the 1.2-fold value $f_{c,90,k}$ = 3.0 N/mm² for cross-laminated timber[1].

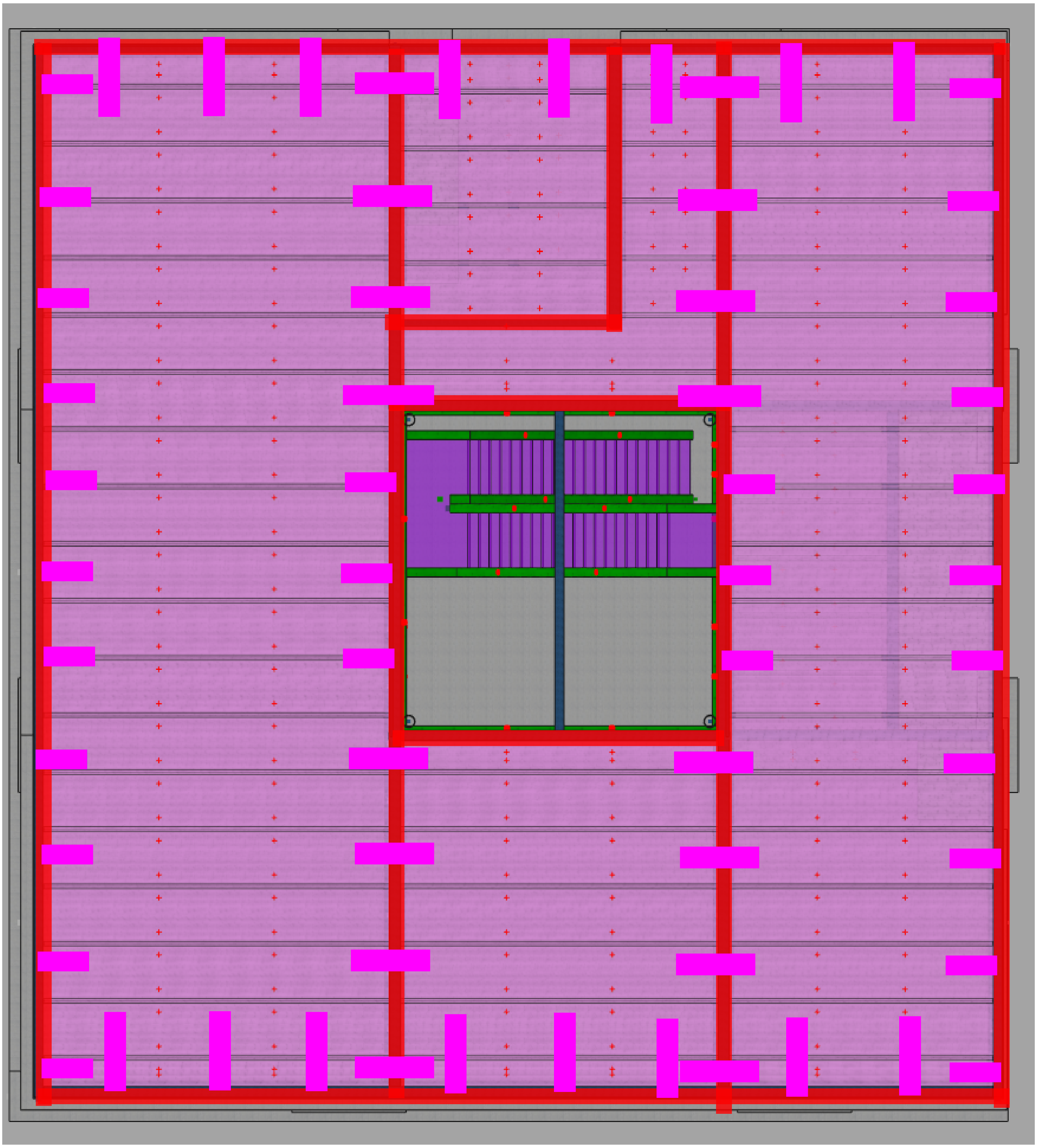
Via the factor $k_{c,90}$, the real situation in the building is considered. Therefore, the verification of stress is as follows:

$$\sigma_{c,90,d} = \frac{F_d}{A_{90}} \leq k_{c,90} \cdot f_{c,0,d} \qquad (4.40)$$

Table 4-2 Factor $k_{c,90}$ for load propagation in CLT floors

Walls		Supports		
Inside (centred)	**Edge**	**Inside (centred)**	**Edge**	**Corner**
1.80	1.50	1.80	1.50	1.30

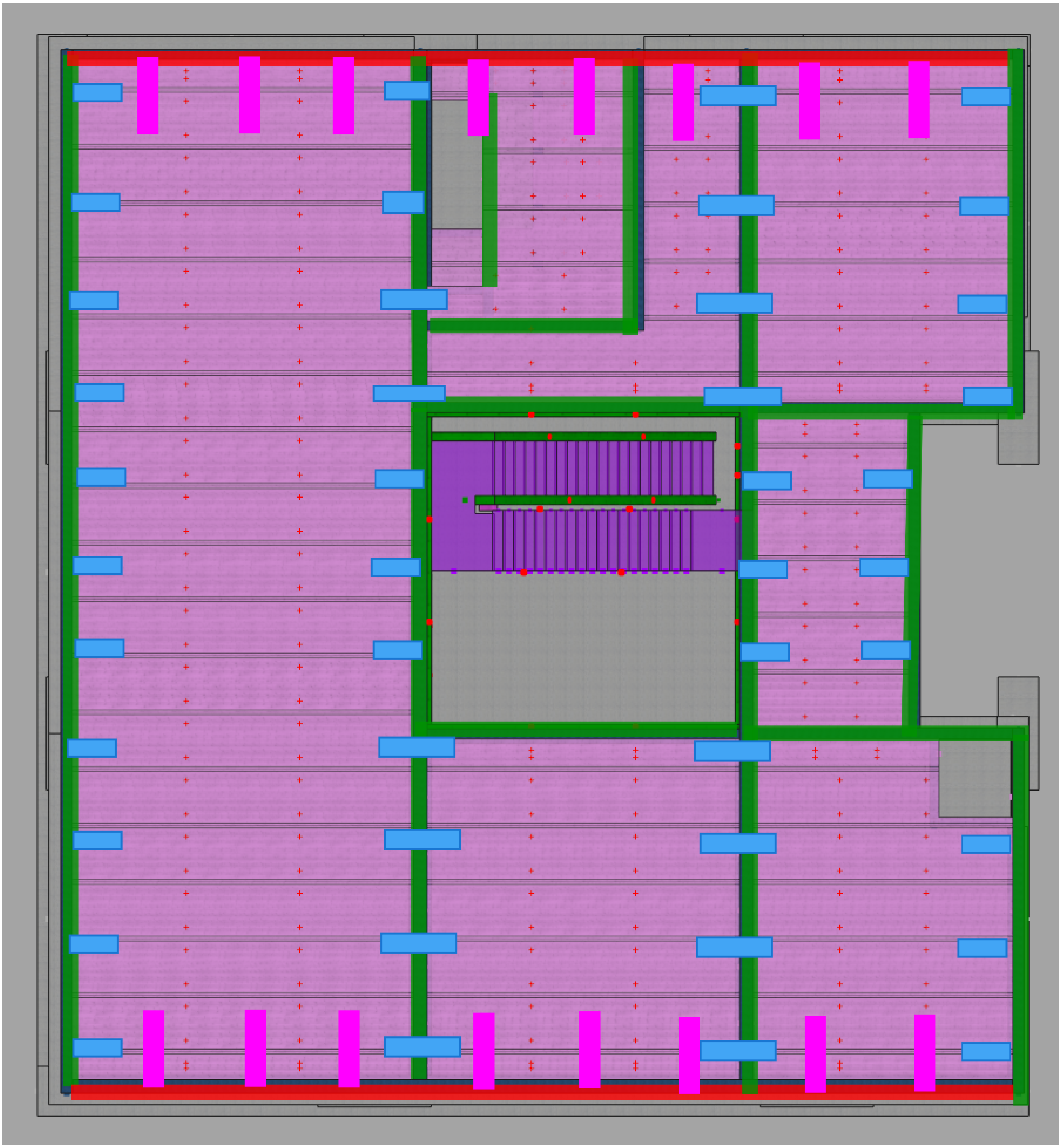
HOUTA KANTOOR-
detail overview -roof



D04 (e=300mm)

D05+D06
(e=1000mm)

HOUTA KANTOOR-
detail overview -2.floor



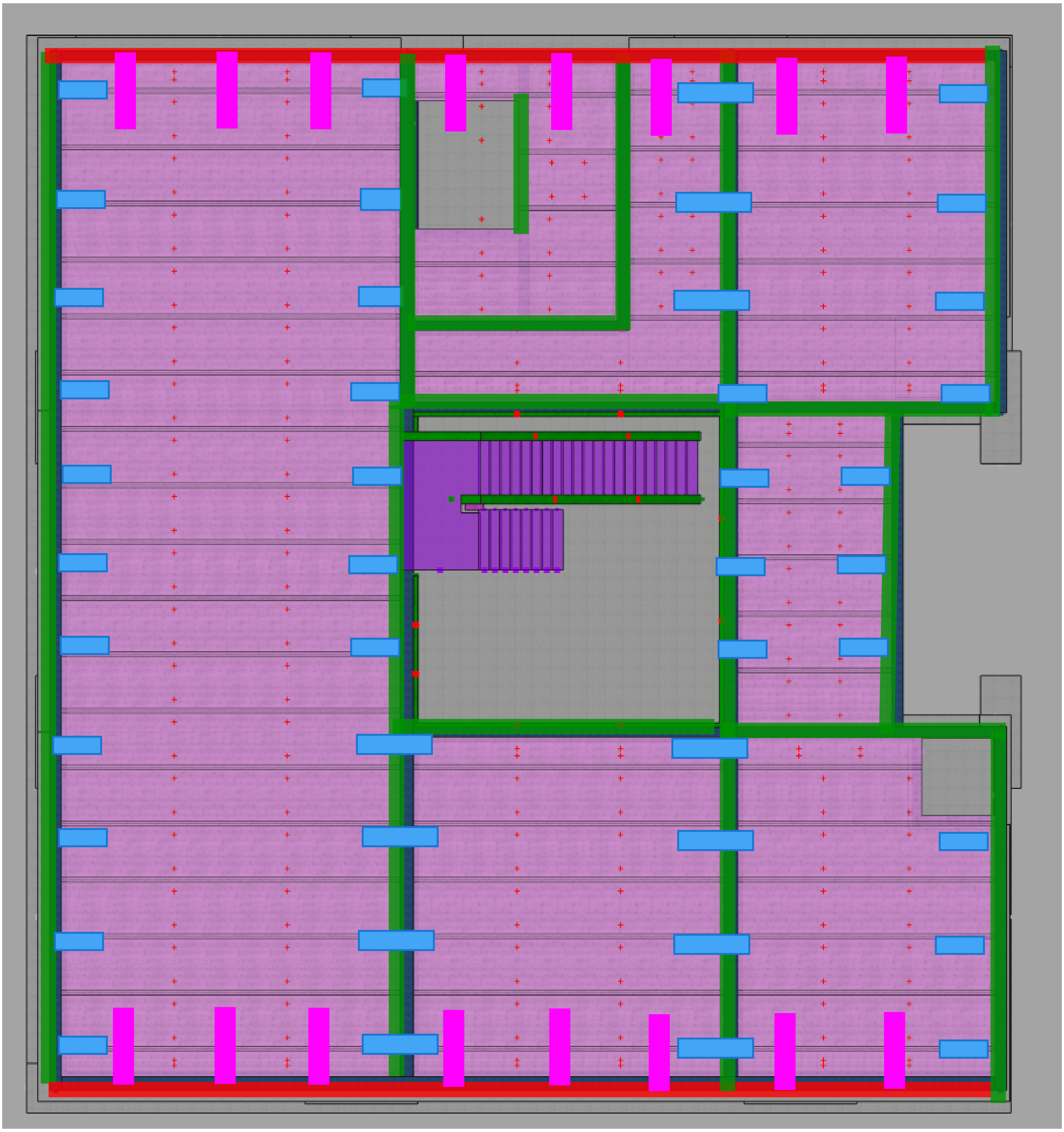
D01 (e=200mm)

D04 (e=300mm)

D02+D03
(e=1000 mm)

D05+D06
(e=1000mm)

HOUTA KANTOOR-
detail overview -1.floor

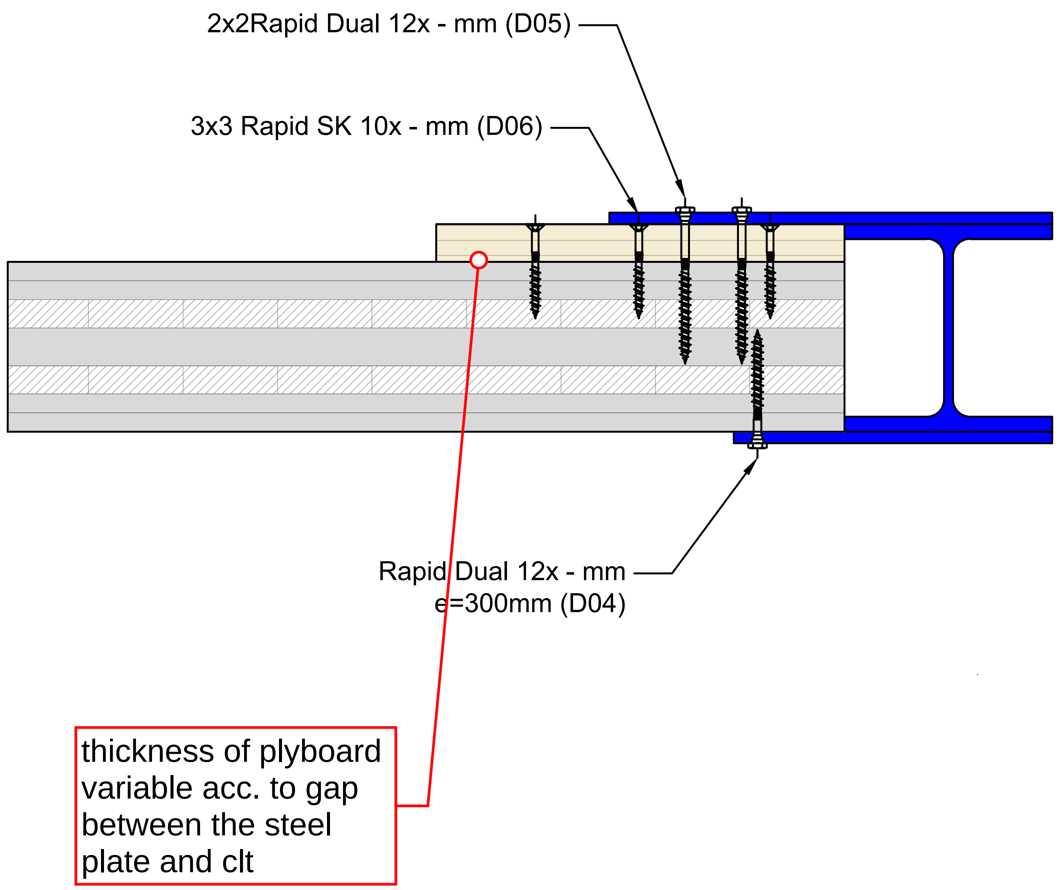


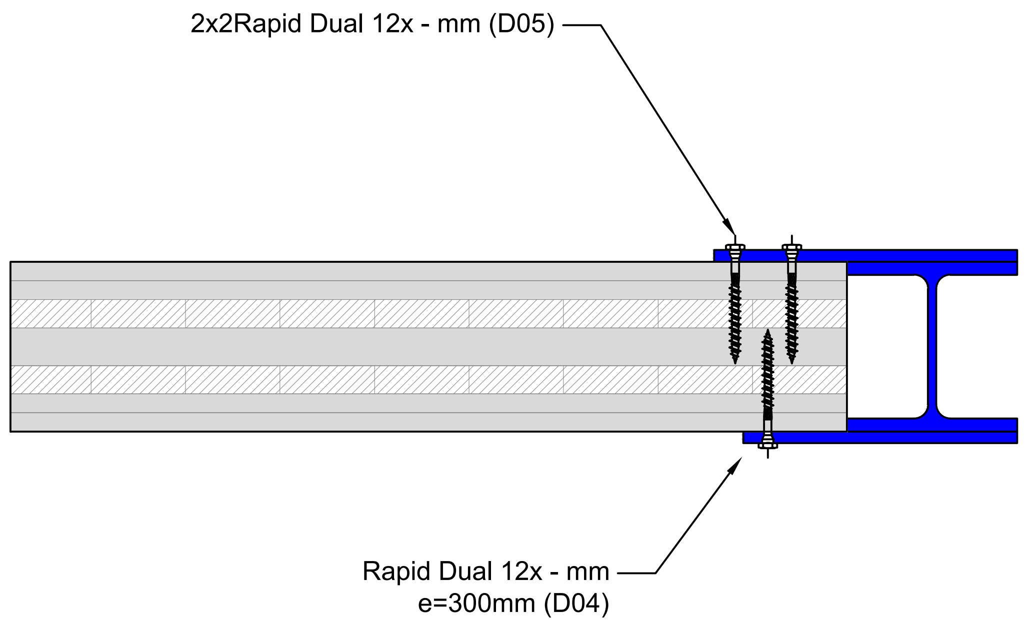
D01 (e=200mm)

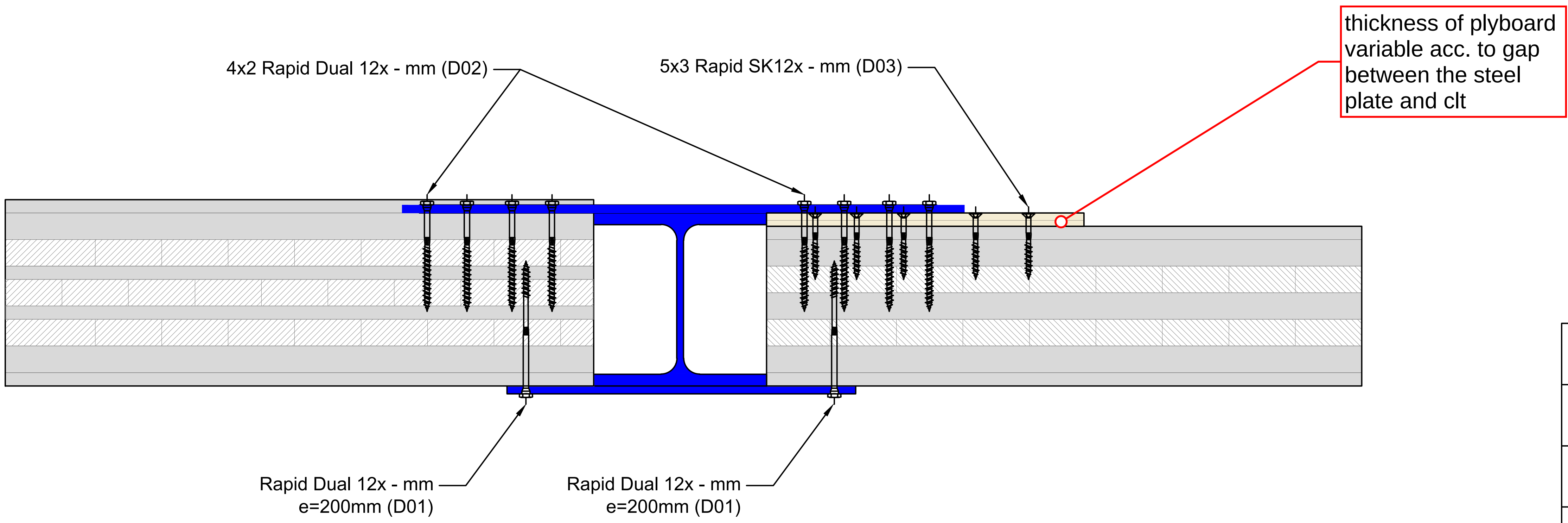
D04 (e=300mm)

D02+D03
(e=1000 mm)

D05+D06
(e=1000mm)







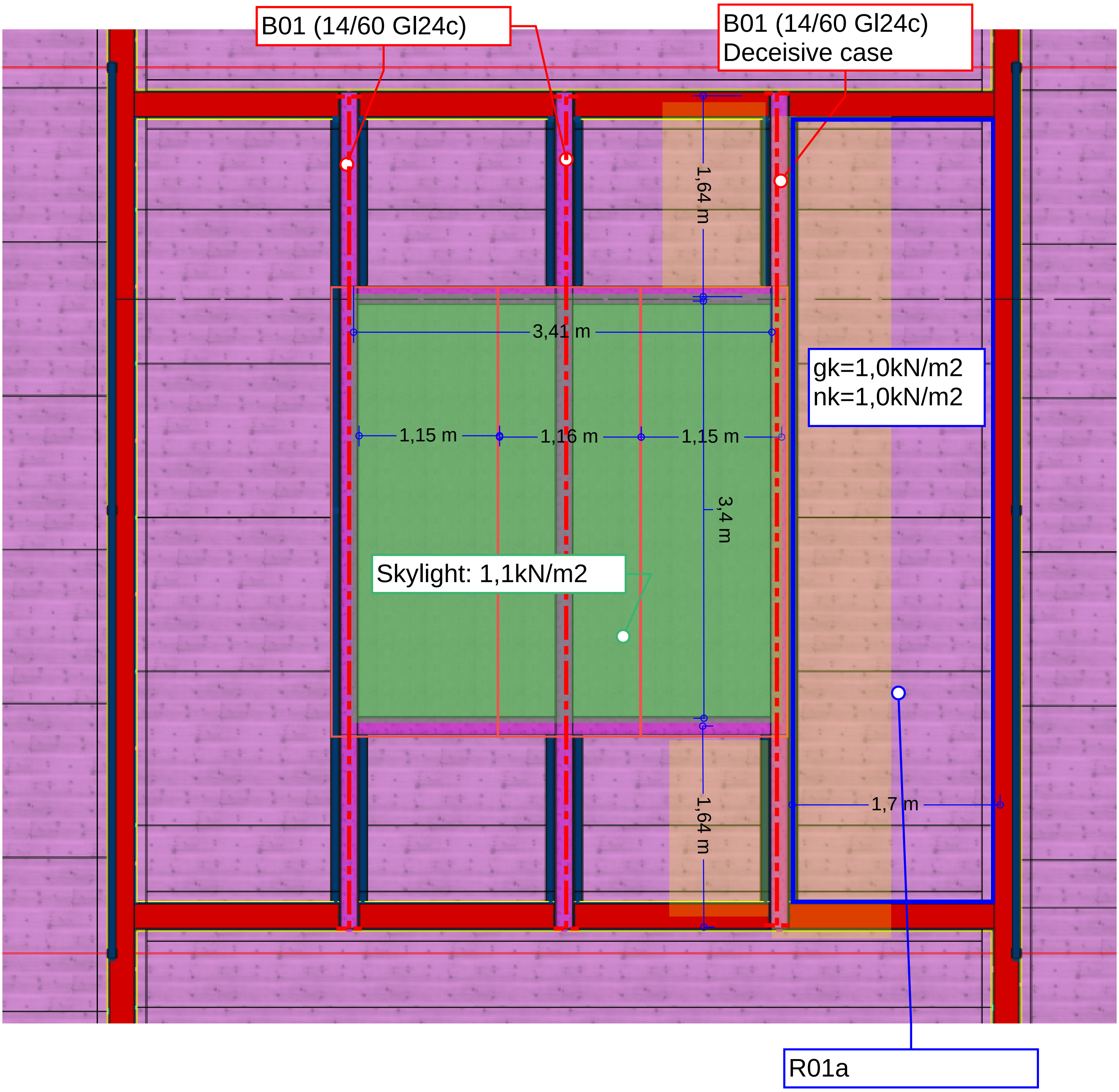
Screwing distance on the steel plate underneath has been cumulated to 200mm in the final connection details.

PROJECT TITLE HOUTA_KANTOOR	
CONTENT schematic details	
FLOOR LEVEL 1-3	
DRAWN BY Matede	DATE 07.04.2023
SCALE	

binderholz
Binderholz-Bausysteme GmbH
Solvay-Halvic-Straße 46
A-5400 Hallein
fon +43.6245.70500-7143
www.binderholz.com
office@binderholz.com

Calculation of the skylight beams

Overview skylight-beams



binderholz BRETTSPERRHOLZ BBS – Durchlaufträger | Decken

Vollversion

Bemessung nach [EN] EN 1995-1-1:2019, "ETA-06/0009:2017. DiBt Z-9.1-534:2014"

WallnerMild

Allgemeines

Nutzungsklasse	NKL	1	Bauteile in geschlossenen, beheizbaren Bereichen
Gebrauchstauglichkeit		Voll	g1 und g2 werden für w inst berücksichtigt
Kragarmaufbiegungen ber.		nein	
Brand		R 90	
		1	einseitig

t ch	0,00	min
β f	0,47	mm/min
t f	0,00	min

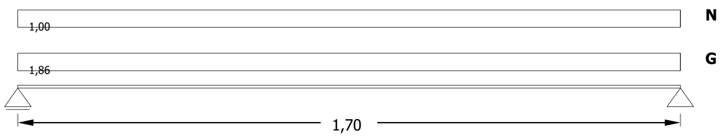
kdef	0,80	
k sys	1,10	

	Erscheinungsb.	Schadensverm.
zul w,inst		ℓ / 300
zul w,fin	ℓ / 250	ℓ / 200

β 0	0,90	mm/min
β 1a	0,90	mm/min (25mm)
β 1b	0,90	mm/min
ρ	480	kg/m³

Bemessungsergebnisse

Maßgebend	7 %
Moment	3 %
Querkraft	7 %
Durchbiegung	
Erscheinungsbild	2 %
Schadensvermeidung	2 %
Schwingung	erfüllt
Brand	
Moment	3 %
Querkraft	2 %



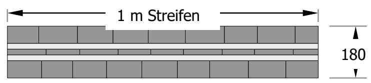
Querschnitt

Hersteller:	Binder
Typ:	BBS 125
Element:	**180 5s**
	Decklage in Spannrichtung

System

Feld	Längen Li [m]	Gleichlasten g 2,k [kN/m]	g 1,k + g 2,k [kN/m]	n k [kN/m]	s k [kN/m]	w k [kN/m]
			G	N	S	W
		g 1,k =	0,86			
Kragarm Li						
Feld 1	1,70	1,00	1,86	1,00		
Feld 2						
Feld 3						
Feld 4						
Feld 5						
Feld 6						
Feld 7						
Kragarm Re						

Lage i	Stärke di [mm]	Orientierung °	Material
1	60	0	C24
2	20	90	C24
3	20	0	C24
4	20	90	C24
5	60	0	C24
6			C24
7			C24
8			C24
9			C24
d	180	5	C24



binderholz

Einzellasten Feld	Lastgruppe	erste Einzellast x_F [m]	F_k [kN]	zweite Einzellast x_F [m]	F_k [kN]
Kragarm Re					
Feld 1					
Feld 2					
Feld 3					
Feld 4					
Feld 5					
Feld 6					
Feld 7					
Kragarm Re					

Schwingungsnachweise

Lastangaben

	Lastgruppe	Lasttyp		Laststellung
Eigengewicht	G	G	Ständige Lasten	gesamt
Nutzlast	N	NH	H: Dächer	feldweise
Schnee	S	S2	Orte unter 1000 m Seehöhe	gesamt
Wind	W	W	Windlasten	gesamt

DKL erfüllt

1.1. Frequenzanforderung

f_1	93,45 Hz
f_{gr}	8,00 Hz

1.2. Beschleunigungsanforderung bei niedriger Frequenz f1 ≤ H:

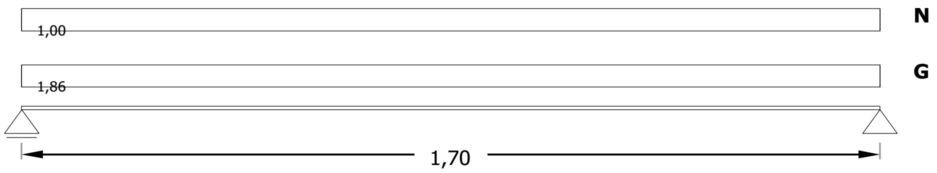
binderholz BRETTSPERRHOLZ BBS – Durchlaufträger | Decken
Vollversion
Bemessung nach [EN] EN 1995-1-1:2019, "ETA-06/0009:2017. DiBt Z-9.1-534:2014"
WallnerMild

Allgemeines

Nutzungsklasse	1	
Bauteile in geschlossenen, beheizbaren Bereichen		
Brand	R 90	1
Gebrauchstauglichkeit	Voll	

Verwendete Normen
EN 1995-1-:2009
[EN] EN 1995-1-1:2019
"ETA-06/0009:2017. DiBt Z-9.1-534:20

System



Lastgruppe	Lasttyp	Sicherheit	Lastdauer		Kombinationsbeiwerte		
		γ	kled	kmod	ψ_0	ψ_1	ψ_2
G	G	1,35	ständig	0,60	-	-	-
N	NH	1,50	kurz	0,90	-	-	-
S	S2	1,50	kurz	0,90	0,50	0,20	-
W	W	1,50	kurz / sehr kurz	1,00	0,60	0,20	-

Querschnitt Binder BBS 125 **180 5s**

Lage i	Stärke di [mm]	Abgebrannt di [mm]	Orientierung °	Material
1	60,0	60,0	0	C24
2	20,0	20,0	90	C24
3	20,0	12,0	0	C24
4	20,0	0,0	90	C24
5	60,0	0,0	0	C24
6				C24
7				C24
8				C24
9				C24
d	180,0	92,0	5 s	C24

Bemessungswerte der Einwirkung

ULS		Wert	Feld	Stelle x/l	k-mod	Länge
V d [kN]	**Maximalwerte**	3,41	Feld 1	0,00	0,90	1,70
	min	-3,41	Feld 1	1,00	0,90	1,70
M d [kNm]	**Maximalwerte**	1,45	Feld 1	0,50	0,90	1,70
	min	0,00	0	0,00	1,00	0,00

SLS		Feld				Kragarm			
k_{def} = 0,80		Wert	Feld	Stelle x/l	Länge	Wert	Feld	Stelle x/l	Länge
quasi-ständig		(Gewährleisten von Benutzbarkeit und Erscheinungsbild)							
$EJ \cdot w_{fin}$	**Maximalwerte**	0,36	Feld 1	0,50	1,70	0,00	0	0,00	0,00
	min	0,00	0	0,00	0,00	0,00	0	0,00	0,00
Charakteristische Bemessungssit		(Vermeidung von Schäden an darunter liegenden Bauteilen)							
$EJ \cdot w_{Q,inst}$	**Maximalwerte**	0,31	Feld 1	0,50	1,70	0,00	0	0,00	0,00
	min	0,00	0	0,00	0,00	0,00	0	0,00	0,00
$w_{fin} - w_{G,inst}$	**Maximalwerte**	0,47	Feld 1	0,50	1,70	0,00	0	0,00	0,00
	min	0,00	0	0,00	0,00	0,00	0	0,00	0,00

binderholz BRETTSPERRHOLZ BBS – Durchlaufträger | Decken
Bemessung nach [EN] EN 1995-1-1:2019, "ETA-06/0009:2017. DiBt Z-9.1-534:2014"

Querschnittswerte Bezugslänge für Feldquerschnittswerte bei Trägern über ein Felder : l* = l

	Bezugslng.	QS-Werte			Vergl. zum Vollquerschnitt		
A eff	1,00 m	1.400	cm2	78% von	A tot	1.800	cm2
I eff,F	1,70 m	25.446	cm4	52% von	I tot,F	48.600	cm4
I eff,K	0,00 m	-	cm4		I tot,K	48.600	cm4
W eff	1,70 m	4.223	cm3	78% von	W tot	5.400	cm3

Berechnung nach nachgiebigem Verbund

Nachweise in den Grenzzuständen der Tragfähigkeit

Biegespannung	Feld 1, x/l = 0,50				
	M d	1,45 kNm	f m,k	18,00 N/mm²	
			γ M	1,3 [EN]	
			k mod	0,9	
			k sys	1,1 Systembeiwert	
3%	σ m,y,d	0,34 N/mm²	f m,y,d	13,71 N/mm²	

Schubspannung	Feld 1, x/l = 1,00			
	V d	-3,41 kN		
	l*	1,7 m		
	S eff	3.650 cm³	f v,k	2,00 N/mm²
4%	τ v,d	0,05 N/mm²	f v,d	1,38 N/mm²
	Rollschub			
	S R,eff	3.600 cm³	f v,R,k	1,00 N/mm²
7%	τ R,d	0,05 N/mm²	f v,R,d	0,69 N/mm²

Nachweise in den Grenzzuständen der Gebrauchstauglichkeit

Verformungen — Kragarmaufbiegungen nicht berücksichtigt

2%	E 0,mean	12.000 N/mm²
	γ M	1,0

		J_{eff} [cm⁴]	w [mm]	L* [m]	zul f	w_{max} [mm]	
	Erscheinungsbild $w_{net,fin}$	25.446	**0,1**	1,70	l / 250	**6,8**	2%
2%	Feld 1, x/l = 0,50	-	**0,0**	0,00	l / 125	**0,0**	0%
	Schadensvermei w_{inst}	25.446	**0,1**	1,70	l / 300	**5,7**	2%
	Feld 1, x/l = 0,50	-	**0,0**	0,00	l / 150	**0,0**	0%
	w_{fin}	25.446	**0,2**	1,70	l / 200	**8,5**	2%
2%	Feld 1, x/l = 0,50	-	**0,0**	0,00	l / 100	**0,0**	0%

Brandbemessung

R 90 1
β0 0,90 mm/min

Aussergewöhnliche Bem.Sit.		Wert	Feld	Stelle x/l	k-mod	Länge
V fi [kN]	**max**	1,58	Feld 1	0,00	-	1,70
	min	-1,58	Feld 1	1,00	-	1,70
M fi [kNm]	**max**	0,67	Feld 1	0,50	-	1,70
	min	0,00	0	0,00		0,00

Biegespannung				
	M fi	0,67 kNm	f m,k	18,00 N/mm²
	ℓ*	1,70 m	k fi	1,15
	W eff,fi	978 cm3	γ M,fi	1,00
			k mod,fi	1,00
3%	σ m,y,fi	0,69 N/mm²	f d,fi	20,70 N/mm²
Schubspannung				
2%	V fi	-1,58 kN		
	I eff,fi	4.508,73 cm4		
	S eff,fi	773,56 cm3	f v,k	2,00 N/mm²
	S R,eff,fi	730,00 cm3	f v,R,k	1,00 N/mm²
1%	τ v,fi	0,03 N/mm²	f v,fi	2,30 N/mm²
2%	τ v,R,fi	0,03 N/mm²	f v,R,fi	1,15 N/mm²

Schwingungsnachweis für Wohnungsdecken WAHR

Nachweis personeninduzierter Schwingungen von Decken gemäß ÖNORM B 1995-1-1:2014

Deckenklasse

DKL I erfüllt

hohe Anforderung

Decken zwischen unterschiedlichen Nutzungseinheiten, Wohnungstrenndecken in Mehrfamilienwohnhäusern, Decken in Büros mit PC-Nutzung oder Besprechungsräumen, Flure mit kurzen Spannweiten.

Abmessungen

OK	l	1,70	m	Spannweite des maßgebenden Feldes (ohne Kragarm)
	b	2,04	m	Breite Deckenfeld

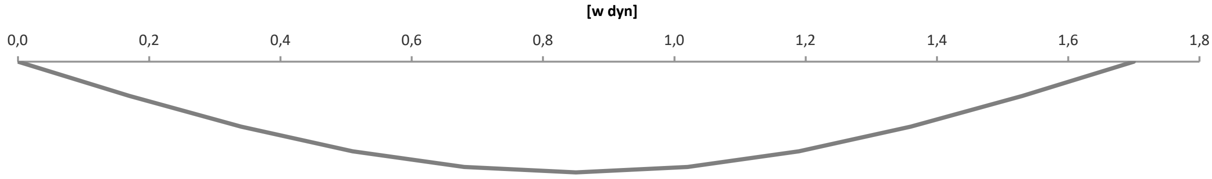
Ausführung: Brettsperrholzdecken mit schwimmendem Estrich und schwerem Fußbodenaufbau

D	4,00%	Dämpfung

Steifigkeit

$(EI)_{1,\ell}$	3,054	MNm² / m	Decke in Hauptspannrichtung
$(EI)_{2,\ell}$	-	MNm² / m	Estich (tragende Schicht) in Hauptspannrichtung
$(EI)_{\ell}$	3,054	MNm² / m	
$(EI)_{1,b}$	0,181	MNm² / m	Decke quer zur Hauptspannrichtung
$(EI)_{2,b}$	0,468	MNm² / m	Estich (tragende Schicht) quer zur Hauptspannrichtung
$(EI)_{b}$	0,649	MNm² / m	

Schwingeigenform



1.1. Frequenzanforderung

	$(f1)_{\ell}$	89,00	Hz	Erste Eigenfrequenz für allgemeine Träger ohne Querverteilung
	k_{fb}	1,050		Verbesserung durch Querverteilungswirkung
	f_1	93,45	Hz	Erste Eigenfrequenz der Decke mit Querverteilung
	f_{gr}	8,00	Hz	Grenzwert
OK	Erfüllt: Abschnitt 1.2 nicht erforderlich			

1.2. Beschleunigungsanforderung bei niedriger Frequenz f1 ≤ 8 Hz

	f_{min}	4,50	Hz	Grenzfrequenz gegenüber Resonanz (Bedingung erfüllt)
	b_F	1,05	m	im Schwingungsfall mitwirkende Breite
	$(M^*)_{\ell}$	162	kg	modale Masse für allgemeine Träger ohne Querverteilung
	M^*	169	kg	modale Masse der Decke mit Querverteilung
	F_0	700	N	Gewichtskraft einer auf der betrachteten Decke gehenden Person
	α	0,000		Faktor für den Frequenzanteil
	a_{rms}	0,000	m/s²	vorhandene Beschleunigung
OK	a_{gr}	0,050	m/s²	Grenzwert

2. Steifigkeitskriterium

	$(w_{stat})_{\ell}$	0,02	mm	Felddurchbiegung aus Einheitslast F = 1 kN ohne Querverteilung
	b_F	1,05	m	im Schwingungsfall mitwirkende Breite
	w_{stat}	0,02	mm	Felddurchbiegung aus Einheitslast F = 1 kN mit Querverteilung
OK	w_{grenz}	0,25	mm	Grenzwert

Informativ: Eigenfrequenz für Einfeldträger laut EN 1995-1-1 mit quasi-ständigen Lasten

L	1,70	m	
$m_{q.perm}$	259	kg/m²	Σ g i + Σ ψ 2 · q i
$f_{1,EN}$	59,05	Hz	

Informativ: Kriterium nach Hu, Chui

4%

binderholz BRETTSPERRHOLZ BBS – Durchlaufträger | Decken
Bemessung nach [EN] EN 1995-1-1:2019, "ETA-06/0009:2017. DiBt Z-9.1-534:2014"

Auflagerkräfte zur Lastweitergabe

Auflager	Bem.Wert	char.Wert	Lastkürzel		Bem.Wert	char.Wert	Lastkürzel
	Maximalwerte			Minimalwerte			
A G,k		1,58	G	A G,k		1,58	G
A N,k		0,85	NH	A N,k		0,00	NH
A d	**3,41**			**A d**	**2,14**		
B G,k		1,58	G	B G,k		1,58	G
B N,k		0,85	NH	B N,k		0,00	NH
B d	**3,41**			**B d**	**2,14**		

Allgemeiner Träger mit und ohne Gelenken

Wallner, Mild

Projekt	**Houta_Kantoor**
Bauteil	**B01_beam**

Allgemeines

Festigkeitsklasse **GL24c** Glued-laminated timber

Nutzungsklass **NKL** **2** kdef 0,80

Members in open, roofed areas

Gebrauchstauglichkeit

	Felder		Kragarme	
	zul wQ,inst	zul w,fin	zul wQ,inst	zul w,fin
Erscheinungsbild		ℓ / 250		ℓ / 125
Quasi-ständige Bemessungssituation				
Schadensvermeidung	ℓ / 300	ℓ / 200	ℓ / 150	ℓ / 100
Charakteristische Bemessungssituation (w g,1,inst muß nicht berücksichtigt werden)				

☐ **Aufbiegungen berücksichtigen**

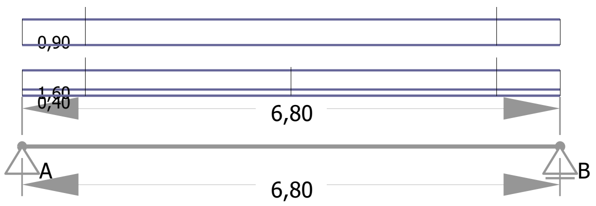
Brandanforderung

R 0 Abbrandrate β n 0,70 mm/min

Breite **2** Seiten

Höhe **1** Seite

Area loads or line loads have been converted into point loads



Gelenke

aus

Abmessungen und Einwirkungen

approx. 4kN (weight of skylight for 1 beam)

	[m]	...ngen	Eigengewicht g 1,k [kN/m] Lastkürzel:	Ständige Aufl. g 2,k [kN/m] G	Nutzlast n k [kN/m] NH	Schnee s k [kN/m] S2	Wind w k [kN/m] W	x [m]
KL		Gleichlast						
1	6,80	Gleichlast	0,40	1,60	0,90			
		Einzellast 1		4,00	0,00	0,00	0,00	3,40
		Einzellast 2		5,30	3,00	0,00	0,00	0,80
		Einzellast 3		5,30	3,00	0,00	0,00	6,00
2		Gleichlast						
3		Gleichlast						
4		Gleichlast						
5		Gleichlast						
6		Gleichlast						
7		Gleichlast						
KR		Gleichlast						

gk= 1,64m x 1,6kN/m x2 (R01a)

nk=1,64m x0,9kN/m x2 (R01a)

Auflager	Bem.Wert	char.Wert	Lastkürzel		Bem.Wert	char.Wert	Lastkürzel
	Maximalwerte			Minimalwerte			
A G,k		1,58	G	A G,k		1,58	G
A N,k		0,85	NH	A N,k		0,00	NH
A d	**3,41**			**A d**	**2,14**		
B G,k		1,58	G	B G,k		1,58	G
B N,k		0,85	NH	B N,k		0,00	NH
B d	**3,41**			**B d**	**2,14**		

(1.10.2022)

Querschnitt

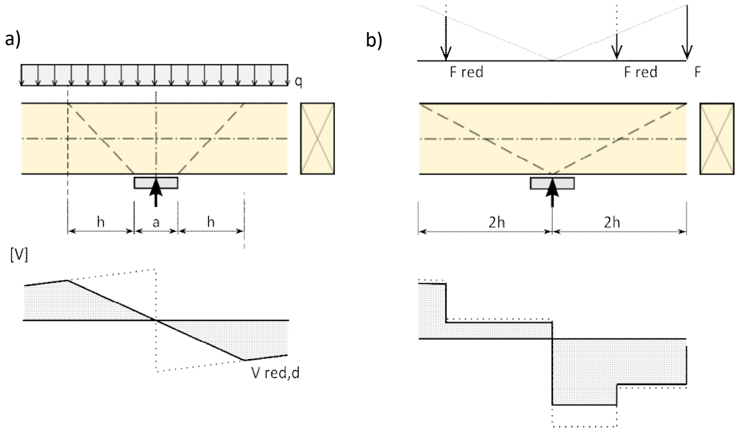
b	**14,00** cm	ρ m	400 kg/m³
h	**60,00** cm		

	Ausnutzung
Total	32 %
Tragfähigkeit	
Moment	32 %
Transverse force	30 %
Kippen	-
Gebrauchstauglichkeit	
Appearance	25 %
Avoid Damages	23 %
Brandfall	
Moment	0 %
Transverse force	0 %

☐ a) Berücksichtigung der maßgebenden Querkraft (nach ÖNORM B 1995-1-1:2014, NA 6.1.7-2)

a **16,00** cm

☐ b) Auflagernahe Einzellasten für Querkraft abmindern (nach ÖNORM B 1995-1-1:2014, NA 6.1.7-2)



Allgemeiner Träger mit und ohne Gelenken

Bemessung nach Eurocode 5 (EN 1995-1-1) Wallner-Mild

	γ M	1,25	
	E 0,mean	11.000	N/mm²
23	ρ m	400	kg/m³

Lasttyp	Safety	Loadduration		Combination Values		
	γ	kled	kmod	ψ_0	ψ_1	ψ_2
G	1,35	permanent	0,60	-	-	-
NH	1,50	short-term	0,90	-	-	-
S2	1,50	short-term	0,90	0,50	0,20	-
W	1,50	:erm / instant:	1,00	0,60	0,20	-

Grenzzuständer der Tragfähigkeit

Ergebnisse

			kmod [-]	Ort	x [m]
min M d	0,00	kNm	1	Feld 1	0,00
max M d	30,51	kNm	0,6	Feld 1	3,40
min V d	-19,04	kN	0,6	Feld 1	6,80
max V d	19,04	kN	0,6	Feld 1	0,00

Bemessung

	A	840	cm²			
	W y	8.400	cm³			
	M				(Zeile 6)	
	max M y,d	30,51	kNm			
	k m	0,7		k mod	0,60	
32 %	σ m,y,d	3,63	N/mm²	f m,y,d	11,52	N/mm²
	V d	-19,04	kN	min V	(Zeile 3)	
	A	840	cm²	f V,d	1,68	N/mm²
				k cr	0,670	
30 %	τ V,d	0,34	N/mm²	f · k cr	1,13	N/mm²

Grenzzuständer der Tragfähigkeit im Brandfall

Ergebnisse

			kmod [-]	Ort	x [m]
min M fi,d	0,00	kNm		Feld	0,00
max M fi,d	22,60	kNm		Feld 0	3,40
min V fi,d	-14,10	kN		Feld 0	6,80
max V fi,d	14,10	kN		Feld 0	0,00

Bemessung

β N	0,7	mm/min	Abbrandrate
t	0	min	Brandwidestandsdauer

Allgemeiner Träger mit und ohne Gelenken

Bemessung nach Eurocode 5 (EN 1995-1-1) Wallner-Mild

	d ef	0	mm	effektiver Abbrand			
	b fi	14	cm	effektive Breite abgebrannt			
	h fi	60	cm	effektive Höhe abgebrannt			
	A	840	cm²				
	W y	8.400	cm³				
	M					(Zeile 6)	
	max M y,fi	22,60	kNm				
	k m	0,7			k fi	1,25	
9 %	σ m,y,fi	2,69	N/mm²		f m,y,fi	30,00	N/mm²
	V d	-14,10	kN		min V	(Zeile 3)	
	A	840	cm²		f V,fi	3,50	N/mm²
					k cr	0,670	
11 %	τ V,fi	0,25	N/mm²		f · k cr	2,35	N/mm²

Allgemeiner Träger mit und ohne Gelenken

Bemessung nach Eurocode 5 (EN 1995-1-1) Wallner-Mild

Grenzzustände der Gebrauchstauglichkeit

Erscheinungsbild: Langzeitverformung in der quasi-ständigen Bemessungssituation

	w min	Char.Wert		
	w g,k	0,00 mm	Feld 1	
	w n,k	0,00 mm	x =	0,00 m
	w s,k	0,00 mm	ℓ_{ref} =	6,80 m
	w w,k	0,00 mm	w zul	ℓ / 250
0 %	**w**	**0,00 mm**	w zul	27,20 mm

	w max	Char.Wert		
	w g,k	6,88 mm	Feld 1	
	w n,k	0,00 mm	x =	3,40 m
	w s,k	0,00 mm	ℓ_{ref} =	6,80 m
	w w,k	0,00 mm	w zul	ℓ / 250
25 %	**w**	**6,88 mm**	w zul	27,20 mm

Schadensvermeidung: Anfangsverformung in der charakteristischen Bemessungssituation

	w min	Char.Wert		
	w g,k	0,00 mm	Feld 1	
	w n,k	0,00 mm	x =	0,00 m
	w s,k	0,00 mm	ℓ_{ref} =	6,80 m
	w w,k	0,00 mm	w zul	ℓ / 300
0 %	**w**	**0,00 mm**	w zul	22,67 mm

	w max	Char.Wert		
	w g,k	3,82 mm	Feld 1	
	w n,k	1,40 mm	x =	3,40 m
	w s,k	0,00 mm	ℓ_{ref} =	6,80 m
	w w,k	0,00 mm	w zul	ℓ / 300
23 %	**w**	**5,22 mm**	w zul	22,67 mm

Schadensvermeidung: Langzeitverformung in der charakteristischen Bemessungssituation

	w min	Char.Wert		
	w g,k	0,00 mm	Feld 1	
	w n,k	0,00 mm	x =	0,00 m
	w s,k	0,00 mm	ℓ_{ref} =	6,80 m
	w w,k	0,00 mm	w zul	ℓ / 200
0 %	**w**	**0,00 mm**	w zul	34,00 mm

	w max	Char.Wert		
	w g,k	6,48 mm	Feld 1	
	w n,k	1,40 mm	x =	3,40 m
	w s,k	0,00 mm	ℓ_{ref} =	6,80 m
	w w,k	0,00 mm	w zul	ℓ / 200
23 %	**w**	**7,87 mm**	w zul	34,00 mm

Allgemeiner Träger mit und ohne Gelenken

Bemessung nach Eurocode 5 (EN 1995-1-1)

Schnittgrößen in [kN] und [kNm], Formänderungen in [m] und [rad]

Schnittgrößen in [kN] und [kNm]

		N	V	M	kmod	Stab	x/l	x	l kipp
N	**min**	**0,00**	0,00	0,00	1,00				6,80
	max	**0,00**	0,00	0,00	1,00				6,80
V	**min**	0,00	**-19,04**	0,00	0,60	0	1,0	6,800	6,80
	max	0,00	**19,04**	0,00	0,60	0	0,0	0,000	6,80
M	**min**	0,00	0,00	**0,00**	1,00				6,80
	max	0,00	2,70	**30,51**	0,60	0	0,5	3,400	6,80

Außergewöhnliche Bemessungssituation (psi1)

		N	V	M		Stab	x/l	x	l kipp
N_{fi}	**min**	**0,00**	0,00	0,00	1				6,80
	max	**0,00**	0,00	0,00	1				6,80
V_{fi}	**min**	0,00	**-14,10**	0,00	1	0	1,0	6,800	6,80
	max	0,00	**14,10**	0,00	1	0	0,0	0,000	6,80
M_{fi}	**min**	0,00	0,00	**0,00**	1				6,80
	max	0,00	2,00	**22,60**	1	0	0,5	3,400	6,80

Formänderungen in [m] und [rad]

		wx	wy	phi	Stab	x/l	x
wx	**min**	**000,00E+00**	000,00E+00	000,00E+00			
	max	**000,00E+00**	000,00E+00	000,00E+00			
wy	**min**	000,00E+00	**-19,34E-03**	19,30E-03	6	1,0	1,000
	max	000,00E+00	**42,27E-03**	-519,97E-06	5	0,5	3,500
phi	**min**	000,00E+00	12,38E-03	**-17,56E-03**	5	0,1	0,700
	max	000,00E+00	1,62E-06	**19,44E-03**	5	1,0	7,000

Stab	Länge
0	6,800
1	
2	
3	
4	
5	
6	
7	
8	
9	5,000
10	1,000
11	
12	
13	
14	
15	
16	

Schwingungen

Erste Eigenfrequenz des Trägers ohne Berücksichtigung der Querverteilung

f 1	9,40		erste Eigenfrequenz
M*	1.245	5	Modale Masse
w stat	0,24	1	Durchbiegung zufolge F = 1 kN

Allgemeiner Träger mit und ohne Gelenken

Bemessung nach Eurocode 5 (EN 1995-1-1)

Auflagerkräfte

	Bem.Wert [kN]	Char.Wert [kN]	Lastkürzel	kmod
A g,k		14,10	G	
A n,k		6,06	NH	
A s,k		0,00	S2	
A w,k		0,00	W	
A d	19,04	-		0,6

	Bem.Wert [kN]	Char.Wert [kN]	Lastkürzel	kmod
B g,k		14,10	G	
B n,k		6,06	NH	
B s,k		0,00	S2	
B w,k		0,00	W	
B d	19,04	-		0,6

Gelenkskräfte

Projekt: Houta

Connection between glulam beams

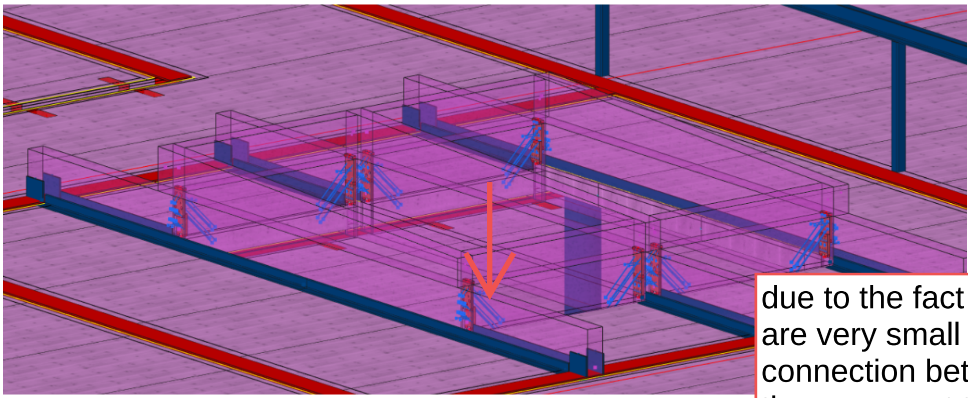
Verification:
Withdrawal resistance according to EN 1995-1-1 and ETA-12/0373 (Schmid Schrauben Hainfeld GmbH)

Engineer:
matede

binderholz

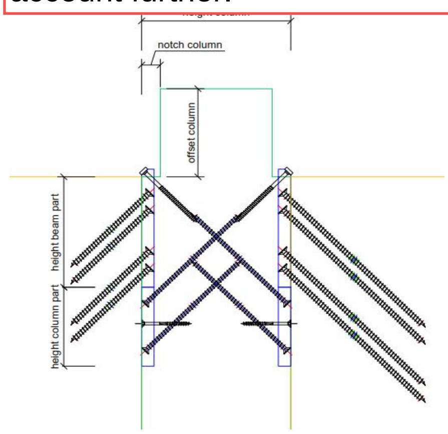
Location:

Detail Nr: 123456
Date: 12.05.2023



due to the fact that the loads are very small for the connection between the beams they were not taken into account further.

system sketch:



Basics of design:

V_d	57,00	[kN] - design load
n	1,00	[-] number of b-fix connectors
F_d	57,00	[kN] - load per connector

max. load for connection

k_{mod}	0,9	[-]	according to EC 1995-1-1: 2010-12
γ_m	1,3	[-]	according to EC 1995-1-1: 2010-12
$\gamma_{m,2}$	1,25	[-]	according to EC 1993-1-8: 2010-12

Strength:

Column:	GL 24c	according to EN 14080:2013-09
Beam:	GL 24c	according to EN 14080: 2013-09

Dimension:

	width	height
Column:	140 mm	140 mm
Beam:	140 mm	600 mm

offset column	0 mm
notch column	0 mm
screw goes through more layers	JA
screw goes through more layers	NEIN
column connecor	two-sided

Choosen screw length:

Column:	140 mm	mit Ø 8 mm	screw length OK
Beam:	400 mm	mit Ø 10 mm	screw length OK

Choosen number of screws:

Calc:	Off	
Column:	8 Stück	input if Automatik "off"
Beam:	6 Stück	

B-fix connecter and order of screws:

Column:	B-FIX-C-8	*mit*	8 x Schmid Rapid VG-S Ø8 x 140	Height:	135 mm
Beam:	B-FIX-B-6	*mit*	6 x Schmid Rapid VG-S Ø10 x 400	Height:	188 mm

Resistance of the screw groups:

Connector column R_d:	57,11	[kN]	100%
Connector Beam R_d:	158,84	[kN]	36%

check member - shear (reduced cross section) OK

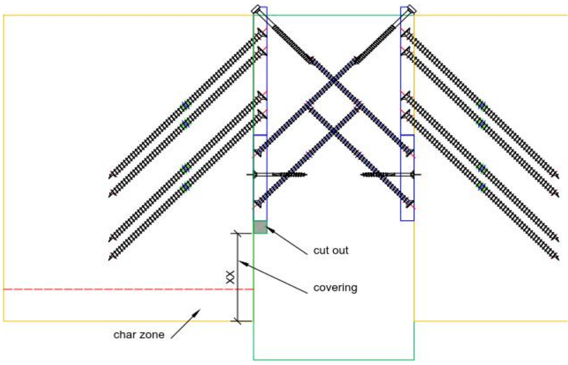
Projekt:
256696 The Bond
Verification:
Withdrawal resistance according to EN 1995-1-1 and ETA-12/0373 (Schmid Schrauben Hainfeld GmbH)
Engineer:
Markus Tripolt

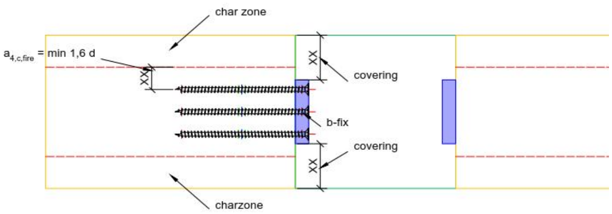
Fire protection:

Protection of the connector per timber covering

Fire duration:		0 min		
Needed covering on the sides:		0 mm	Existing covering on the sides:	20 mm
	$a_{4,c,fire}$ =	35 mm	(min. 16 mm)	
Needed covering on the bottom:		0 mm	Existing covering on the bottom:	257 mm

(Design of covering according to suggestion of V. Hoffman, "Brandverhalten von Verbindungen mit Vollgewindeschrauben", 6. HolzBauSpezial HBS 2015)





schematic drawing