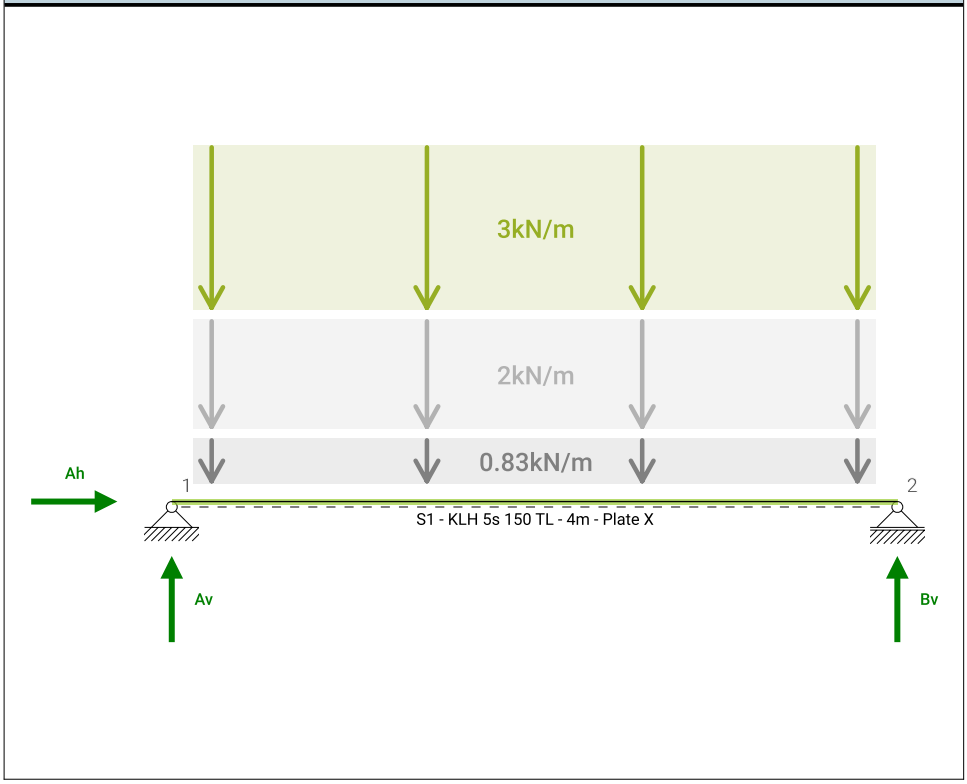
Project: Žalec - plošča



Design standard
EN 1995-1-1:2014

CALCULATION RESULTS

ULS		
M	32%	S1
N	0%	S1
M+N	32%	S1
V	19%	S1
Stability	32%	S1

Criterion R (resistance)		✓
Criterion E (integrity)		✓
Criterion I (insulation)		✓
M (fire)	66%	S1
N (fire)	0%	S1
M+N (fire)	66%	S1
V (fire)	10%	S1
Stability (fire)	**66%**	**S1**

SLS		
Appearance	62%	S1
Avoid Damages	53%	S1

SUPPORT REACTION

	g_k		n_k		s_k		w_k		F_d
	min	max	min	max	min	max	min	max	
A_H (1) [kN]	-	-	-	-	-	-	-	-	-
A_V (1) [kN]	5.65	5.65	6	-	-	-	-	-	16.63 [3]
B_V (2) [kN]	5.65	5.65	6	-	-	-	-	-	16.63 [3]

VIBRATION			
f_1 [Hz]	9.75		
a_{rms} [m/s²]	0.080	VCL I	S1
w_{stat} [mm/kN]	0.24 (97%)	VCL I	S1

STRESSES AND DEFORMATIONS

Element		N_d		V_d		M_d		w_{inst}		w_{fin}		$w_{net,fin}$	
ID	Surface	min	max	min	max	min	max	min	max	min	max	min	max
		[kN]		[kN]		[kNm]		[mm]		[mm]		[mm]	
SCL 1 **S1** **1-2** REI 90	KLH 5s 150 DL	-	-	-16.63 [3]	16.63 [3]	-	16.63 [3]	-	7.12 (53%)	-	9.85 (49%)	-	9.85 (52%)
	Wood Wood	-	-	-8.65 [5]	8.65 [5]	-	8.65 [5]						

1) permanent (k_{mod}=0.6) 2) long (k_{mod}=0.7) 3) medium (k_{mod}=0.8) 4) short (k_{mod}=0.9) 5) short very / short (k_{mod}=1.0) 6) very short (k_{mod}=1.1)

KLH

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MATERIAL CONSTANTS

Material	$f_{m,k}$	$f_{t,0,k}$	$f_{t,90,k}$	$f_{c,0,k}$	$f_{c,90,k}$	$f_{v,k}$	$f_{v,R,k}$	$E_{0,mean}$	$G_{0,mean}$	$G_{90,mean}$
	[N/mm²]	[N/mm²]	[N/mm²]	[N/mm²]	[N/mm²]	[N/mm²]	[N/mm²]	[N/mm²]	[N/mm²]	[N/mm²]
KLH (C24)	24	16.5	0.12	24	2.7	2.7	1.2	12,000	690	50

NODE

ID	X	Z	Support	Orientation	Hinge	Loaded
	[m]	[m]				
1	0	0	pin	0°	no	no
2	4	0	roller	0°	no	no

CROSS SECTIONS

ID	Panel type	Material	Load-bearing function	cover layer	B/H	Fire
					[m]	
A	KLH 5s 150 DL	KLH (C24)	as a plate	longitudinal (X)	1	yes

CROSS SECTIONS - FIRE

ID	Fire exposure		Fire duration	Surface 1	Surface 2
			[min]		
A	1	CE/RO	90	Wood Surface	Wood Surface

CROSS SECTIONS - CHARACTERISTICS VALUES

ID		EJ	GA	GJ_T	J_{net}	W_{net}	A_{net}
		[kNm²]	[kN]	[kNm²]	[m⁴]	[m³]	[m²]
A	y	3,059.04	15,000	412.91	2.55E-4	3.4E-3	0.11
	z	110,000	50,600		9.17E-3	1.83E-2	

CROSS SECTIONS - CHARACTERISTICS VALUES - FIRE

ID		EJ_{fi}	GA_{fi}	$GJ_{T,fi}$	$J_{net,fi}$	$W_{net,fi}$	$A_{net,fi}$
		[kNm²]	[kN]	[kNm²]	[m⁴]	[m³]	[m²]
A	y	320.02	9,025.89	234.9	2.32E-5	4.73E-4	0.05
	z	57,040	23,894.44		4.13E-3	8.27E-3	

ELEMENTS

ID	Start node	End node	Cross section	Length	L_{ref}	SCL
				[m]	[m]	
S1	1	2	A	4	4	SCL 1

ELEMENTS - STABILITY

ID		L_k	L_{ef}	k_c	k_{crit}	$k_{c,fi}$	$k_{crit,fi}$
		[m]	[m]				
S1	y	4	4	0.48	1	0.11	1
	z	4		1		1	

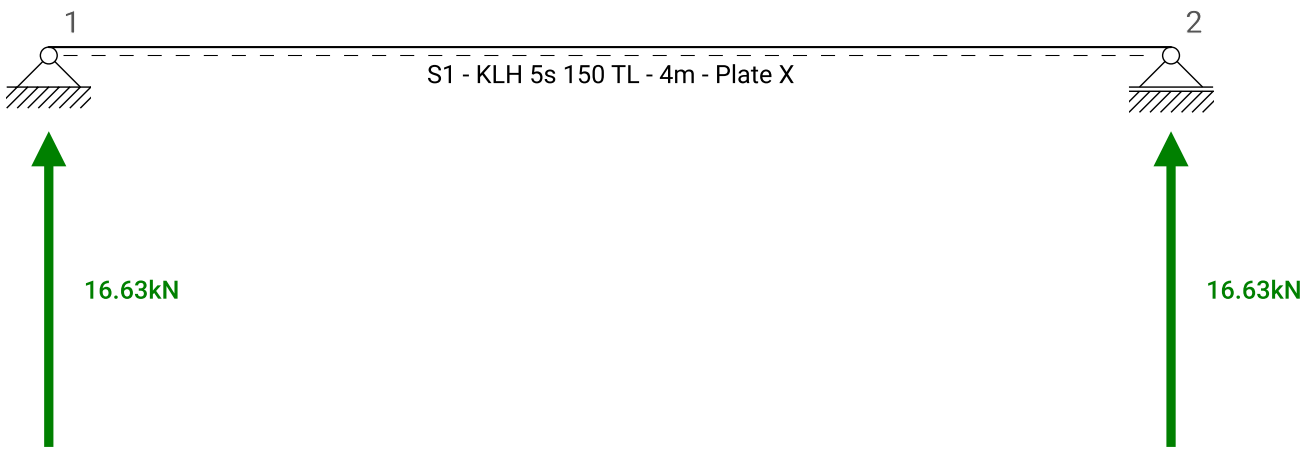
LOAD CATEGORY

	Load category	Type	Direction	Duration	k_{mod}	$gamma_{inf}$	$gamma_{sup}$	psi_0	psi_1	psi_2
$g_{1,k}$	Dead loads	G1	global	permanent	0.6	1	1.35	-	-	-
$g_{2,k}$	Dead loads	G2	global	permanent	0.6	1	1.35	-	-	-
$n_{A,k}$	Imposed loads category A: domestic, residential areas	NA	global	medium	0.8	0	1.5	0.7	0.5	0.3

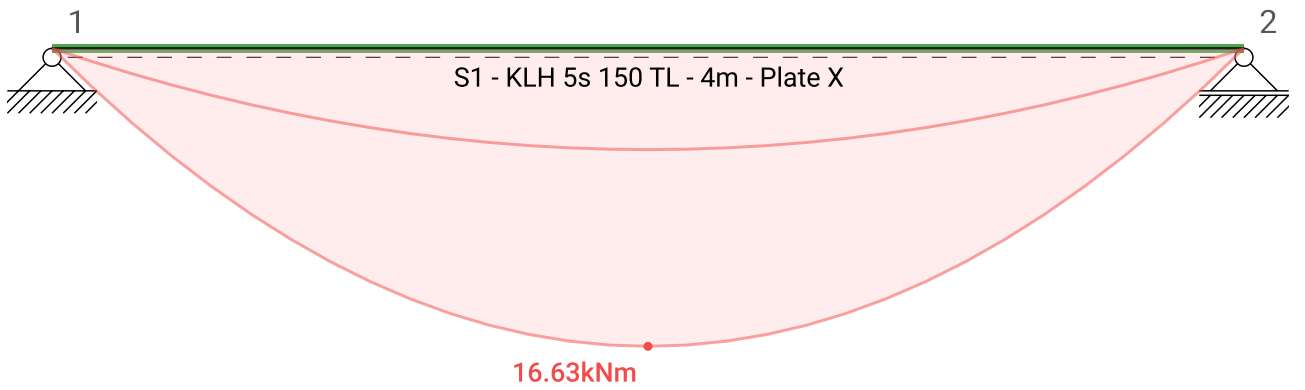
ELEMENT LOADS

Element	G1	G2	NA	
ID	[kN/m]	[kN/m]	[kN/m]	
S1	0.83	2	3	

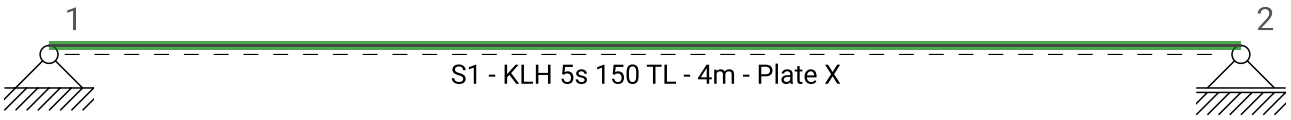
ULS - forces and moments - reactions forces



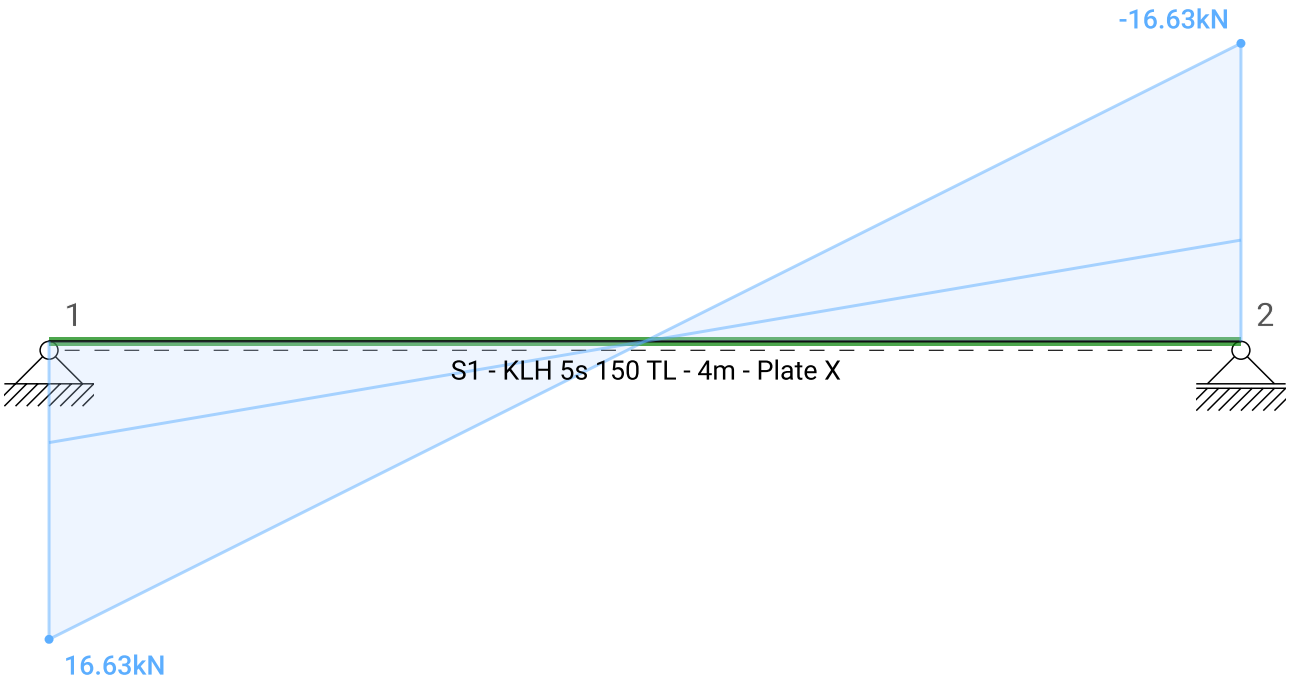
ULS - forces and moments - bending moment (M)



ULS - forces and moments - normal force (N)



ULS - forces and moments - shear force (V)



ULS - FORCES AND MOMENTS - VERIFICATION

Element	M - leading						
ID	x_i	M_d	N_d related	min / max	k_{mod}	Equation EC5	Utilisation
		[kNm]	[kN]				
S1	0	0	0	min	0.6	(6.1)	0%
	0.5	16.63	0	max	0.8	(6.11)	32%

Element	N - leading						
ID	x_i	N_d	M_d related	min / max	k_{mod}	Equation EC5	Utilisation
		[kN]	[kNm]				
S1	0	0	0	min	0.6	(6.1)	0%
	0	0	0	max	0.6	(6.1)	0%

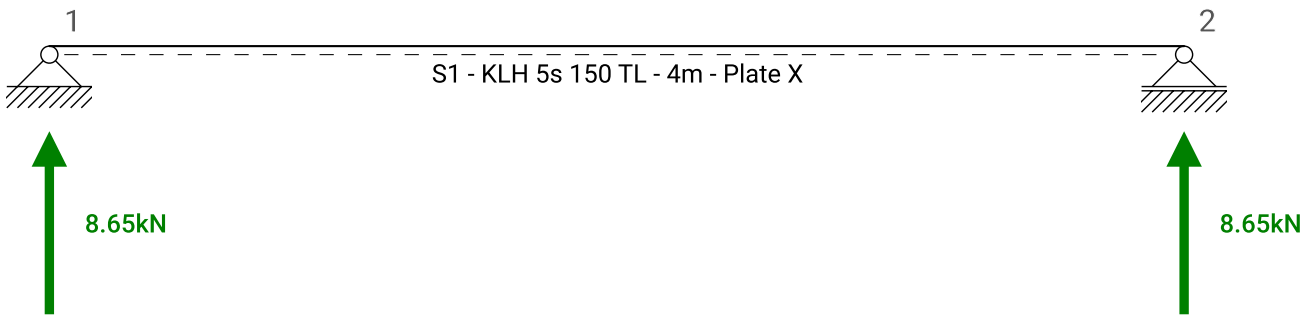
Element	V - leading						
ID	x_i	V_d	M_d related	min / max	k_{mod}	Equation EC5	Utilisation
		[kN]	[kNm]				
S1	1	-16.63	0	min	0.8	(6.13)	19%
	0	16.63	0	max	0.8	(6.13)	19%

ULS - FORCES AND MOMENTS - DESIGN VALUES OF THE LOAD-BEARING CAPACITIES AND ASSOCIATED STABILITY FACTORS

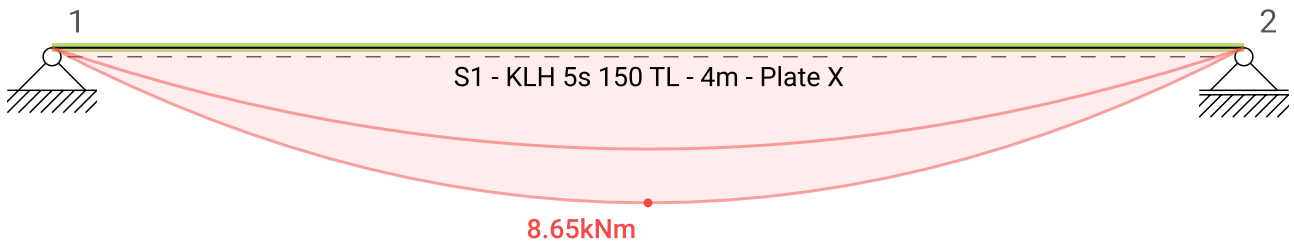
Element	M_{Rd}	$N_{c,0,Rd}$	$N_{t,0,Rd}$	V_{Rd}	$k_{c,y}$	$k_{c,z}$	k_{crit}
ID	[kNm]	[kN]	[kN]	[kN]	[-]	[-]	[-]
S1	52.20 3)	1,267.20 1)	873.60 1)	88.99 3)	0.48	1.00	1.00

1) permanent (k_{mod}=0.6) 2) long (k_{mod}=0.7) 3) medium (k_{mod}=0.8) 4) short (k_{mod}=0.9) 5) short very / short (k_{mod}=1.0) 6) very short (k_{mod}=1.1)

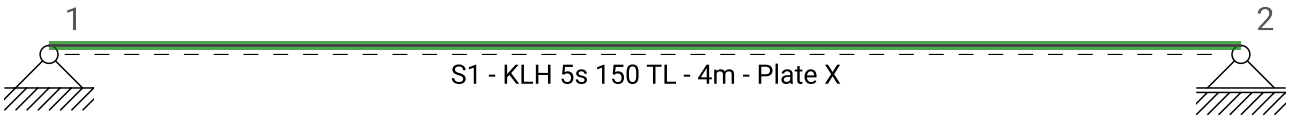
ULS - forces and moments fire - reaction forces



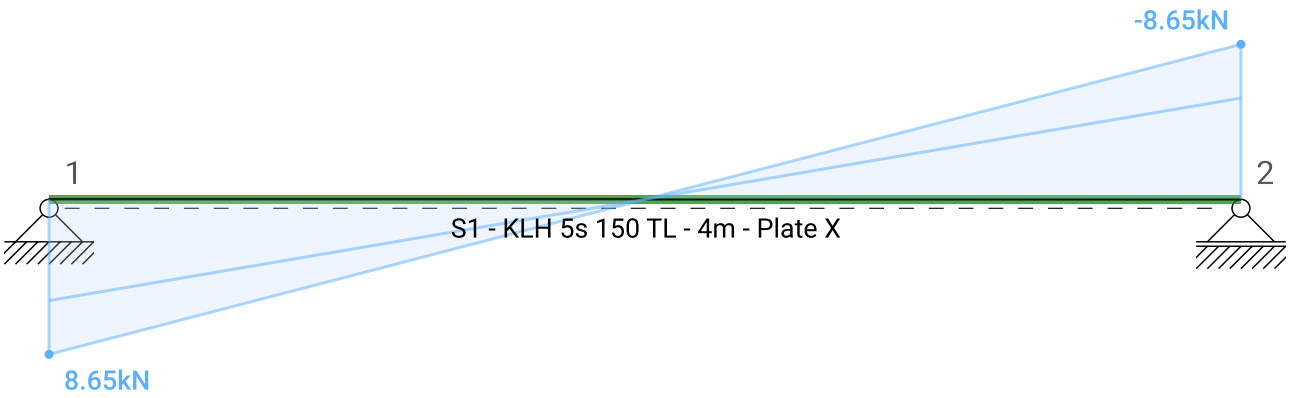
ULS - forces and moments fire - bending moment (M)



ULS - forces and moments fire - normal force (N)



ULS - forces and moments fire - shear force (V)



ULS - FORCES AND MOMENTS FIRE - VERIFICATION

Element	M - leading (fire)							
ID	Fire duration	x_i	$M_{d,fi}$	$N_{d,fi}$ related	min / max	k_{mod}	Equation EC5	Utilisation
	[min]		[kNm]	[kN]				
S1	90	0	0	0	min	1.0	(6.1)	0%
		0.5	8.65	0	max	1.0	(6.11)	66%

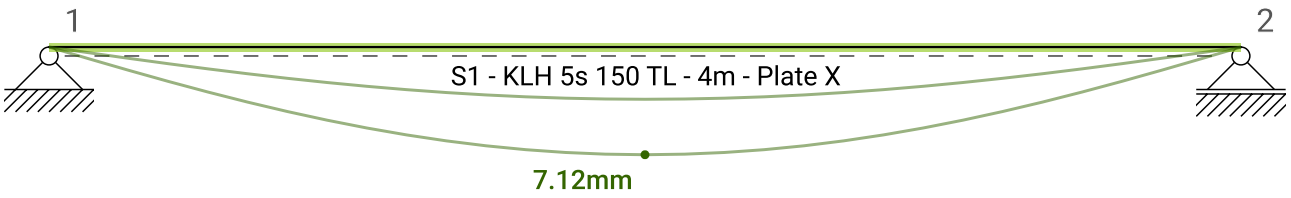
Element	N - leading (fire)							
ID	Fire duration	x_i	$N_{d,fi}$	$M_{d,fi}$ related	min / max	k_{mod}	Equation EC5	Utilisation
	[min]		[kN]	[kNm]				
S1	90	0	0	0	min	1.0	(6.1)	0%
		0	0	0	max	1.0	(6.1)	0%

Element	V - leading (fire)							
ID	Fire duration	x_i	$V_{d,fi}$	$M_{d,fi}$ related	min / max	k_{mod}	Equation EC5	Utilisation
	[min]		[kN]	[kNm]				
S1	90	1	-8.65	0	min	1.0	(6.13)	10%
		0	8.65	0	max	1.0	(6.13)	10%

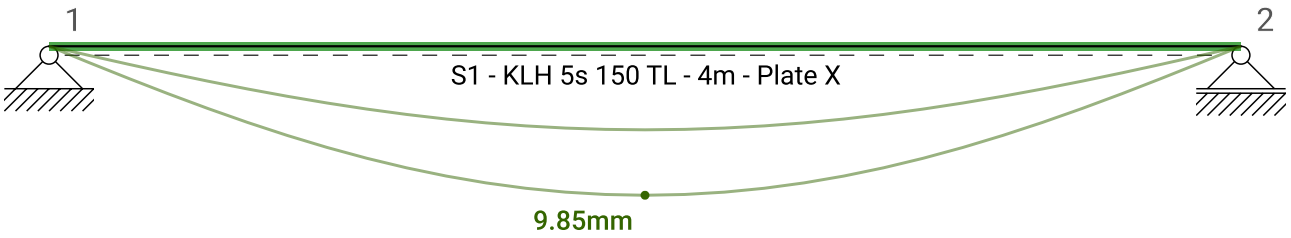
ULS - FORCES AND MOMENTS FIRE - DESIGN VALUES OF THE LOAD-BEARING CAPACITIES AND ASSOCIATED STABILITY FACTORS

Element	$M_{Rd,fi}$	$N_{c,0,Rd,fi}$	$N_{t,0,Rd,fi}$	$V_{Rd,fi}$	$k_{c,y,fi}$	$k_{c,z,fi}$	$k_{crit,fi}$
ID	[kNm]	[kN]	[kN]	[kN]	[-]	[-]	[-]
S1	13.06	1,163.00	867.00	83.67	0.11	1.00	1.00

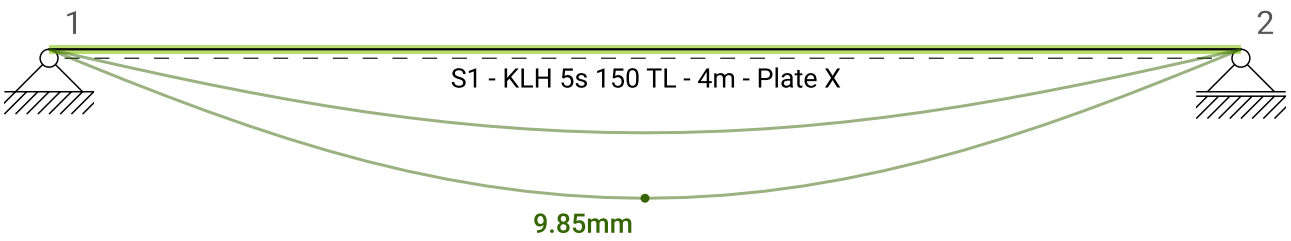
SLS - deformation - w_{inst}



SLS - deformation - w_{fin}



SLS - deformation - $w_{net,fin}$



SLS - DEFORMATIONS

Element	$w_{inst} = w_{char.(G+Q)}$							
ID	k_{def}	Limit	w_{grenz}	x_i	min	x_i	max	Util.
			[mm]		[mm]		[mm]	
S1	0.6	L/300	13.33	1	-	0.5	7.12	53%

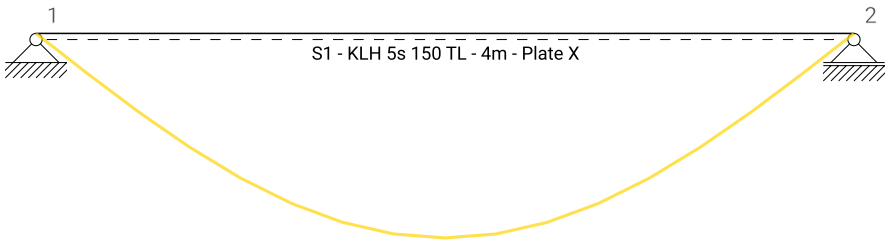
Element	$w_{fin} = w_{q.p.(G+Q)}$							
ID	k_{def}	Limit	w_{grenz}	x_i	min	x_i	max	Util.
			[mm]		[mm]		[mm]	
S1	0.6	L/200	20	1	-	0.5	9.85	49%

Element	$w_{net.fin} = w_{q.p.(G+Q)} - w_{creep}$							
ID	k_{def}	Limit	w_{grenz}	x_i	min	x_i	max	Util.
			[mm]		[mm]		[mm]	
S1	0.6	L/250	16	1	-	0.5	9.85	62%

SLS - DEFORMATIONS - BY LOAD CASE

Element	Load	x_i	$w_{inst,min}$	x_i	$w_{inst,max}$	x_i	$w_{fin,min}$	x_i	$w_{fin,max}$
ID	Group		[mm]		[mm]		[mm]		[mm]
S1	G1	1.00	-0.00	0.50	1.01	1.00	-0.00	0.50	1.61
	G2	1.00	-0.00	0.50	2.45	1.00	-0.00	0.50	3.91
	NA	1.00	-0.00	0.50	3.67	1.00	-0.00	0.50	4.33

SLS - vibration - f_1



f_1: 9.75 Hz

SLS - VIBRATIONS - SYSTEM

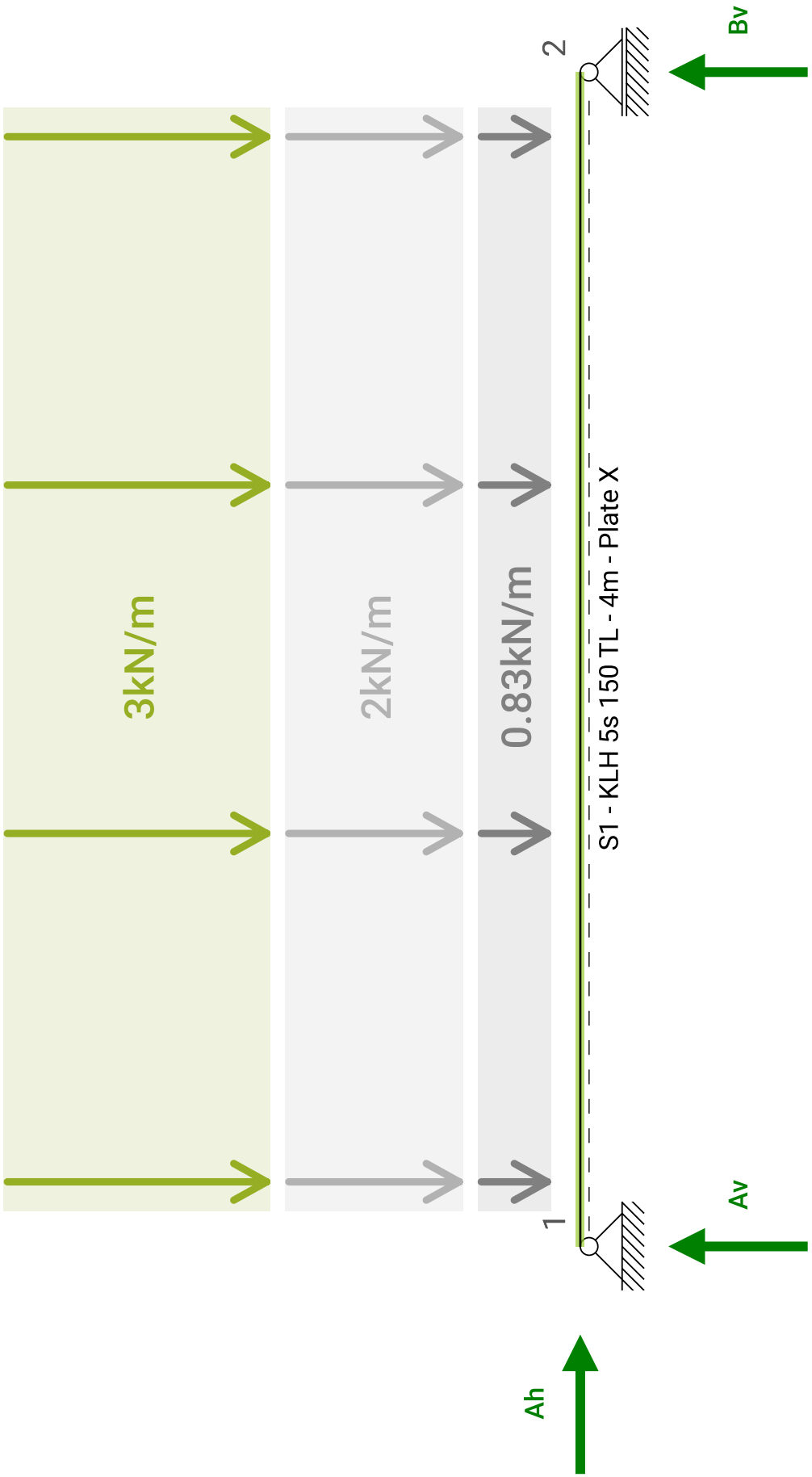
1. natural frequency overalll system	Modal mass overall system	Damping overall system
[Hz]	[kg]	[%]
9.75	1,186.35	3.0

SLS - VIBRATIONS - DETAILS

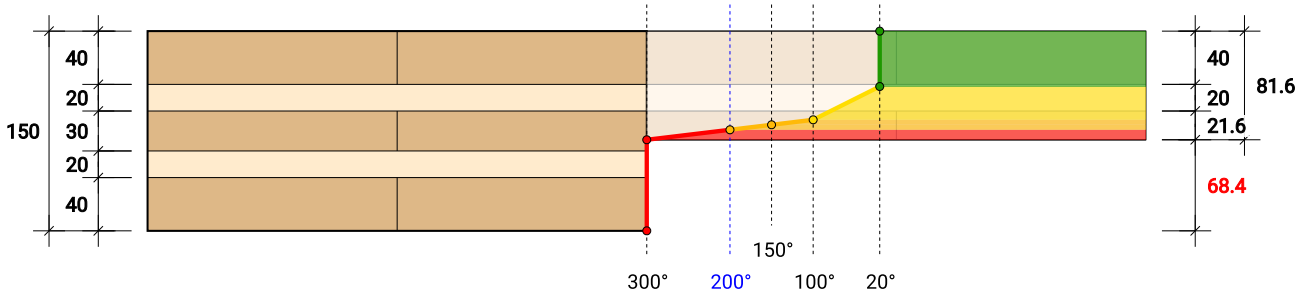
Element	VCL	Damping	Cross distribution		Build-up		
ID			b_{floor}	b_F	Type	Screed	Height
		[%]	[m]	[m]			[m]
S1	VCL I	3.0	4.8	2.06	screed without filling	No	0.00

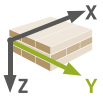
SLS - VIBRATIONS - VERIFICATION

Element	VCL	a_{rms}	w_{stat}	f_{lim}	f_{min}	a_{lim}	w_{lim}	Utilisation
ID		[m/s²]	[mm/kN]	[Hz]	[Hz]	[m/s²]	[mm/kN]	
S1	VCL I	0.080	0.24	8	4.5	0.05	0.25	97%


3kN/m
2kN/m
0.83kN/m
S1 - KLH 5s 150 TL - 4m - Plate X
1
2
Av
Bv
Ah

KLH 5s 150 TL





Dimensions in **[mm]**

Value	Input
KLH panel	KLH 5s 150 TL
Fire type	Floor/Roof
Design standard	ETA
Time of fire exposure	90 minutes
Surface 1	Wood

Criterion E
Integrity

Criterion I
Insulation

TEMPERATURE GRADIENT WITHIN THE MEMBER (GLOBAL)

	Face 1	Face 2	Description
d_{300}	68.4 mm	0.0 mm	Position of the char-line
d_{200}	75.9 mm	0.0 mm	Relevant for the position of fasteners
d_{150}	79.65 mm	0.0 mm	Relevant for the EI criterion in half-laps
d_{100}	83.4 mm	0.0 mm	Position of the 100° isotherm
d_{20}	108.4 mm	0.0 mm	Position of the 20° isotherm
β_m	0.76 mm/min	0.0 mm/min	Min charring rate

Tables and images are based on ETA-06/0138 in combination with EN 1995-1-2.

SOFTWARE INPUT PARAMETERS

STIFFNESS AND CROSS SECTION PROPERTIES FOR EDP-BASED ANALYSIS

Stiffness properties for the modelling of KLH-Elements as shear-flexible plate structure by means of FEM				
Description		b = 1m		Unit
		X	Y	
EJ	Bending stiffness	3,060.00	316.00	kNm²/m
GJ	Torsional stiffness	114.00		kNm²/m
GA	Shear stiffness	15,000.00	4,450.00	kN/m
EA	Extensional stiffness	1,320,000.00	480,000.00	kN/m
GA2	In-plane shear stiffness	50,600.00		kN/m

Stiffness properties for the modelling of KLH-Elements as orthotropic plate by means of FEM				
Description		b = 1m		Unit
		X	Y	
t_{red}	Reduced plate depth	145.00	68.00	mm
G_{mean}	G-Modulus for plate action[1, 2]	78.00		N/mm²
E_{mean}	E-Modulus (MOE) for plate action	12,000.00		N/mm²
t_{red}	Reduced membrane depth	110.00	40.00	mm
G_{mean}	G-Modulus for membrane action[1, 3]	552.00		N/mm²
E_{mean}	E-Modulus (MOE) for membrane action	12,000.00		N/mm²

Stiffness properties for the modelling of KLH-Elements as grillage using lattice frame software (shear-flexible)				
Description		b = 1m		Unit
		X	Y	
b_{red}	Equivalent beam width	906.00	921.00	mm
h	Beam depth	150.00	70.00	mm
G_{mean}	G-Modulus for plate action[1, 2]	132.00	83.00	N/mm²
E_{mean}	E-Modulus (MOE) for plate action	12,000.00		N/mm²
b_{red}	Equivalent beam width	110.00	40.00	mm
G_{mean}	G-Modulus for membrane action[1, 3]	552.00	1,518.00	N/mm²
E_{mean}	E-Modulus (MOE) for membrane action	12,000.00		N/mm²

1) The shear modulus applies to the equivalent rectangular cross section and has been adapted accordingly (i.e. increased by a factor of 6/5), since the current FE programs generally do not allow any further specifications.
2) The shear modulus for the plate action specified here represents the less favourable value for the X and Y directions.
3) The shear modulus for the membrane action specified here represents the less favourable value for the X and Y directions.

CROSS SECTION PROPERTIES FOR MANUAL CALCULATION

Cross-section values								
Description		Normal temperature		Fire (global)		Fire (local)		Unit
		b = 1m		b = 1m		b = 10cm		
		X	Y	X	Y	X	Y	
$J_{net,t}$	Net moment of inertia (tension side)	25,492.00	2,633.00	2,667.00	64.00	102.00	5.00	cm^4
$J_{net,c}$	Net moment of inertia (compression side)	25,492.00	2,633.00	2,319.00	59.00	90.00	4.00	cm^4
A_{net}	Net cross-sectional area	1,100.00	400.00	496.00	161.00	41.00	13.00	cm^2
A_{eff}	Effective cross-sectional area	1,500.00	700.00	816.00	416.00	70.00	20.00	cm^2
i_{net}	Net radius of gyration	48.00	26.00	22.00	6.00	15.00	6.00	mm
$e_{s,Ra1}$	Distance between center of gravity and edge 1	75.00	35.00	51.00	10.00	47.00	11.00	mm
$e_{s,Ra2}$	Distance between center of gravity and edge 2	75.00	35.00	31.00	10.00	23.00	9.00	mm
$W_{net,Ra1}$	Section modulus for edge 1	3,399.00	752.00	473.00	56.00	16.00	3.00	cm^3
$W_{net,Ra2}$	Section modulus for edge 2	3,399.00	752.00	587.00	58.00	19.00	4.00	cm^3

CHARACTERISTIC PROPERTIES ACCORDING TO ETA-06/0138:2021

MEMBRANE ACTIONS (TAB. A)

Characteristic load-carrying capacity for In-plane actions								
Description		Normal temperature		Fire (global)		Fire (local)		Unit
		b = 1m		b = 1m		b = 10cm		
		X	Y	X	Y	X	Y	
$N_{t,0,Rk}$	Tensile force – Constant distribution	1,820.00	660.00	867.00	337.00	63.28	25.56	kN
$N_{t,0,m,Rk}$	Tensile force – Variable distribution	2,640.00	960.00	1,279.00	482.00	69.60	30.18	kN
$N_{c,0,Rk}$	Compressive force – Without column stability problem	2,640.00	960.00	1,163.00	482.00	63.28	30.18	kN
$N_{c,loc,Rk}$	Compressive force – Narrow side – Local load introduction	3,960.00	1,440.00	1,786.00	644.00	132.69	38.65	kN
$N_{c,90,Rk}$	Compressive force – Narrow side – Compression perpendicular	891.00	416.00	891.00	416.00	89.10	41.58	kN
$N_{c,2.73,Rk}$	Compressive force – Column stability – Buckling lenght: 2.73 m	2,035.00	298.00	311.00	0.00	11.96	0.00	kN
$N_{c,2.95,Rk}$	Compressive force – Column stability – Buckling lenght: 2.95 m	1,894.00	260.00	277.00	0.00	10.27	0.00	kN
$N_{c,3.50,Rk}$	Compressive force – Column stability – Buckling lenght: 3.50 m	1,537.00	191.00	201.00	0.00	7.34	0.00	kN
$N_{c,5.00,Rk}$	Compressive force – Column stability – Buckling lenght: 5.00 m	868.00	0.00	101.00	0.00	3.62	0.00	kN
$N_{xy,KF,Rk}$	In-plane shear force – General action	360.00	360.00	170.00	170.00	11.31	11.31	kN
$V_{TR,Rk}$	In-plane shear force – Beam-like elements (H = 1 m)	394.00	262.00	203.00	138.00	15.68	9.15	kN

PLATE ACTIONS (TAB. B)

Characteristic load-carrying capacity for out-of-plane actions								
Description		Normal temperature		Fire (global)		Fire (local)		Unit
		b = 1m		b = 1m		b = 10cm		
		X	Y	X	Y	X	Y	
$M_{c,Rk}$	Bending moment – Compression edge	8,157.00	1,806.00	1,306.00	154.00	45.00	9.00	kNcm
$M_{t,Rk}$	Bending moment – Tension edge	8,157.00	1,806.00	1,621.00	161.00	53.00	11.00	kNcm
$dM_{EL,Rk}$	Reduction of bending moment – due to single load (SL)	-	-	-	-	-	-	kNcm/kN
V_{Rk}	Shear force	139.05	63.20	83.67	41.41	10.38	4.08	kN
%(EJ)	Bending stiffness in case of fire	100.00	100.00	12.00	3.00	5.00	2.00	%

CROSS-SECTION DATA

Nominal KLH cross section		Residual KLH cross section	
t_i	ORI_i	global	local
40.0 mm	X	40.0 mm	40.0 mm
20.0 mm	Y	20.0 mm	20.0 mm
30.0 mm	X	21.6 mm	9.7 mm
20.0 mm	Y	0.0 mm	0.0 mm
40.0 mm	X	0.0 mm	0.0 mm
150.0 mm		81.6 mm	69.7 mm