

The logo consists of the letters 'KLH' in a bold, white, sans-serif font, centered within a solid red square.

KLH[®]

MADE FOR BUILDING
BUILT FOR LIVING

STRUCTURAL PRE-ANALYSIS TABLES



IMPRINT

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STRUCTURAL PRE-ANALYSIS TABLES

The calculation model for KLH® solid wood panels must consider the influence of the layup (thickness, material, orientation), the internal stress distributions and local stress concentrations. Due to the shear flexible transverse layers, shear deformation may no longer be disregarded and the layup of the panel has to be taken into account.

Dimensioning and structural design follow Eurocode 5 (EN 1995-1-1 and EN 1995-1-2), taking into account the national standards set forth in ÖNORM B 1995-1-1 and ÖNORM B 1995-1-2. It should be pointed out that the national standards in various European countries differ from each other in some detailed aspects (e.g. different partial factors γ_M for “cross laminated timber” material). The material properties of KLH® solid wood panels required for structural design can be taken from the European Technical Assessment (ETA-06/0138).

The structural design of KLH® solid wood panels has to be carried out project-based and locally applicable standards and regulations have to be taken into account.

Due care is also advised when comparing panel thicknesses of KLH® elements with products from other manufacturers: due to different production processes, the cross laminated timber products may well have different properties, e.g. with respect to bending stiffness or shear strength. Please mind the relevant properties in the respective product approvals and take into account the differences in a comparative analysis.

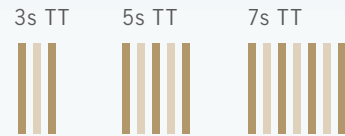
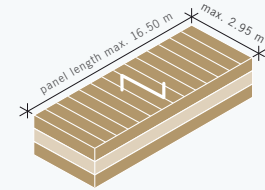
For the structural analysis of cross laminated timber, different models have been developed in the past. The structural analysis of KLH® solid wood panels is based on the shear-elastic beam theory (according to Timoshenko) or the shear-elastic orthotropic plate (according to Reissner-Mindlin). The properties of the composite cross section are thereby described appropriately. To receive correct results (internal forces and moments as well as deformations) is the use of suitable software for the purpose of structural analysis. The software provided on the website by KLH Massivholz GmbH is based on the above mentioned theory and thus a good choice.

STANDARD PANELS AND PANEL STRUCTURES

01 KLH® STANDARD PANEL TYPES AND STRUCTURES

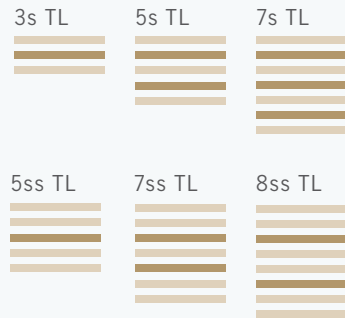
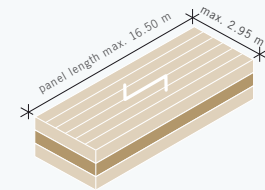
FOR THE WALL
Covering layer in the transverse panel direction TT

Nominal thickness	Layers Type	Lamella structure in [mm]								
		T	L	T	L	T	L	T	L	T
KLH 60 mm	3s TT	20	20	20						
KLH 70 mm	3s TT	20	30	20						
KLH 80 mm	3s TT	30	20	30						
KLH 90 mm	3s TT	30	30	30						
KLH 100 mm	3s TT	30	40	30						
KLH 110 mm	3s TT	40	30	40						
KLH 120 mm	3s TT	40	40	40						
KLH 100 mm	5s TT	20	20	20	20	20				
KLH 110 mm	5s TT	20	20	30	20	20				
KLH 120 mm	5s TT	30	20	20	20	30				
KLH 130 mm	5s TT	30	20	30	20	30				
KLH 140 mm	5s TT	30	20	40	20	30				
KLH 150 mm	5s TT	30	30	30	30	30				
KLH 160 mm	5s TT	40	20	40	20	40				



FOR CEILING AND ROOF
Covering layer in the longitudinal panel direction TL

Nominal thickness	Layers Type	Lamella structure in [mm]								
		L	T	L	T	L	T	L	T	L
KLH 60 mm	3s TL	20	20	20						
KLH 70 mm	3s TL	20	30	20						
KLH 80 mm	3s TL	30	20	30						
KLH 90 mm	3s TL	30	30	30						
KLH 100 mm	3s TL	40	20	40						
KLH 110 mm	3s TL	40	30	40						
KLH 120 mm	3s TL	40	40	40						
KLH 100 mm	5s TL	20	20	20	20	20				
KLH 110 mm	5s TL	20	20	30	20	20				
KLH 120 mm	5s TL	30	20	20	20	30				
KLH 130 mm	5s TL	30	20	30	20	30				
KLH 140 mm	5s TL	40	20	20	20	40				
KLH 150 mm	5s TL	40	20	30	20	40				
KLH 160 mm	5s TL	40	20	40	20	40				
KLH 170 mm	5s TL	40	30	30	30	40				
KLH 180 mm	5s TL	40	30	40	30	40				
KLH 190 mm	5s TL	40	40	30	40	40				
KLH 200 mm	5s TL	40	40	40	40	40				
KLH 160 mm	5ss TL	30+30	40	30+30						
KLH 180 mm	7s TL	20	40	20	20	20	40	20		
KLH 200 mm	7s TL	20	40	20	40	20	40	20		
KLH 220 mm	7s TL	30	40	30	20	30	40	30		
KLH 240 mm	7s TL	30	40	30	40	30	40	30		
KLH 180 mm	7ss TL	30+30	20	20	20	30+30				
KLH 200 mm	7ss TL	30+30	20	40	20	30+30				
KLH 220 mm	7ss TL	40+40	20	20	20	40+40				
KLH 240 mm	7ss TL	40+40	20	40	20	40+40				
KLH 260 mm	7ss TL	40+40	30	40	30	40+40				
KLH 280 mm	7ss TL	40+40	40	40	40	40+40				
KLH 300 mm	8ss TL	40+40	30	40+40	30	40+40				
KLH 320 mm	8ss TL	40+40	40	40+40	40	40+40				



Special panel layouts are available on request. By using double layers, for example the longitudinal or transverse stiffness of the panel can be further enhanced. The fire resistance of the KLH® solid wood panel can also be influenced by modifying the structures and can eventually be improved in relation to specific project requirements.

Charging widths
2.40 | 2.50 | 2.73 | 2.95 [m]

Maximum length 16.50 [m]
Maximum thickness 0.5 [m]

STRUCTURAL PRE-ANALYSIS TABLES

02 KLH® AS A VISIBLE WALL

2.1 SINGLE-SIDED FIRE EXPOSURE (FOR EXTERIOR WALLS)

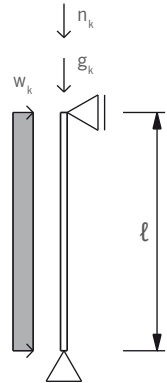
according to ETA-06/0138

ÖNORM EN 1995-1-1:2019 and ÖNORM B 1995-1-1:2019

ÖNORM EN 1995-1-2:2011 and ÖNORM B 1995-1-2:2011

Wind pressure: $w_k = 0,8 \text{ kN/m}^2$

Minimum panel thickness for various fire resistance classes (R 0 to R 90)



Permanent load	Imposed load	HEIGHT WALL (buckling length ℓ)							
		2,73 m				2,95 m			
$g_{2,k}$	n_k	R 0	R 30	R 60	R 90	R 0	R 30	R 60	R 90
[kN/m]	[kN/m]								
10,00	10,00	3s 60 TT	3s 80 TT	5s 100 TT	5s 120 TT	3s 60 TT	3s 80 TT	5s 100 TT	5s 120 TT
	20,00					3s 60 TT			
	30,00					3s 60 TT			
	40,00					3s 60 TT			
	50,00					3s 60 TT			
20,00	10,00	3s 60 TT	3s 80 TT	5s 100 TT	5s 120 TT	3s 60 TT	3s 80 TT	5s 100 TT	5s 120 TT
	20,00					3s 60 TT			
	30,00					3s 60 TT			
	40,00					3s 60 TT			
	50,00					3s 60 TT			
30,00	10,00	3s 60 TT	3s 80 TT	5s 100 TT	5s 120 TT	3s 60 TT	3s 80 TT	5s 100 TT	5s 120 TT
	20,00				5s 120 TT				
	30,00				5s 120 TT				
	40,00				5s 120 TT				
	50,00				5s 120 TT				
40,00	10,00	3s 60 TT	3s 80 TT	5s 100 TT	5s 130 TT	3s 60 TT	3s 80 TT	5s 100 TT	5s 130 TT
	20,00					3s 60 TT			
	30,00					3s 60 TT			
	40,00					3s 60 TT			
	50,00					3s 60 TT			
50,00	10,00	3s 60 TT	3s 80 TT	5s 100 TT	5s 130 TT	3s 60 TT	3s 80 TT	5s 100 TT	5s 130 TT
	20,00					3s 60 TT			
	30,00					3s 60 TT			
	40,00					3s 60 TT			
	50,00					3s 60 TT			
60,00	10,00	3s 60 TT	3s 90 TT	5s 100 TT	5s 130 TT	3s 60 TT	3s 90 TT	5s 100 TT	5s 130 TT
	20,00					3s 60 TT			
	30,00					3s 60 TT			
	40,00					3s 60 TT			
	50,00					3s 60 TT			
60,00	10,00	3s 70 TT	3s 90 TT	5s 100 TT	5s 130 TT	3s 70 TT	3s 100 TT	5s 110 TT	5s 130 TT
	20,00					3s 70 TT			
	30,00					3s 70 TT			
	40,00					3s 70 TT			
	50,00					3s 70 TT			
60,00	10,00	3s 70 TT	3s 90 TT	5s 100 TT	5s 130 TT	3s 70 TT	3s 100 TT	5s 110 TT	5s 130 TT
	20,00					3s 70 TT			
	30,00					3s 70 TT			
	40,00					3s 70 TT			
	50,00					3s 70 TT			
60,00	10,00	3s 70 TT	3s 90 TT	5s 100 TT	5s 130 TT	3s 70 TT	3s 100 TT	5s 110 TT	5s 130 TT
	20,00					3s 70 TT			
	30,00					3s 70 TT			
	40,00					3s 70 TT			
	50,00					3s 70 TT			

R 0

R 30

R 60

R 90

STRUCTURAL PRE-ANALYSIS TABLES

Service class 1

Imposed load category A ($\psi_0 = 0,7$ and $\psi_2 = 0,3$): $k_{\text{mod}} = 0,8$

Wind loads ($\psi_0 = 0,6$ and $\psi_2 = 0,0$): $k_{\text{mod}} = 1,0$

Self-weight of KLH® is already taken into account in the table.

Load-bearing capacity

- a) verification of column stability (compression and deflection according to equivalent member method)
- b) verification of shear resistance

Structural fire design (single-sided fire exposure)

Application of KLHdesigner based on the „reduced properties method“ according to ETA-06/0138.

- a) charring rate $\beta_1 = 0,55$ mm/min regular charring rate (charring within one single layer)
- b) charring rate $\beta_2 = 0,80$ mm/min increased charring rate (after the failure / falling off of one layer)
- c) for local panel parts $b < 300$ mm higher charring rates are mandatory
- d) additional eccentricity due to burn-off taken into account

This table is only intended for structural pre-analysis purposes and does not replace necessary static calculations!

STRUCTURAL PRE-ANALYSIS TABLES

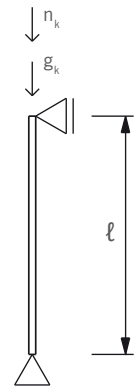
2.2 DOUBLE-SIDED FIRE EXPOSURE (FOR INTERIOR WALLS)

according to ETA-06/0138

ÖNORM EN 1995-1-1:2019 and ÖNORM B 1995-1-1:2019

ÖNORM EN 1995-1-2:2011 and ÖNORM B 1995-1-2:2011

Minimum panel thickness for various fire resistance classes (R 0 to R 60)



Permanent load	Imposed load	HEIGHT WALL (buckling length ℓ)						
		2,73 m			2,95 m			
$g_{2,k}$	n_k	R 0	R 30	R 60	R 0	R 30	R 60	
[kN/m]	[kN/m]							
10,00	10,00	3s 60 TT	3s 80 TT	7s 180 TT	3s 60 TT	3s 80 TT	7s 180 TT	
	20,00					3s 90 TT		
	30,00							
	40,00							
	50,00							
60,00								
20,00	10,00	3s 60 TT	3s 80 TT	7s 180 TT	3s 60 TT	3s 90 TT	7s 180 TT	
	20,00		3s 90 TT					
	30,00							
	40,00							
	50,00							
60,00	3s 70 TT							
30,00	10,00	3s 60 TT	3s 90 TT	7s 180 TT	3s 60 TT	3s 90 TT	7s 180 TT	
	20,00							3s 100 TT
	30,00							
	40,00							
	50,00							
60,00	3s 70 TT							
40,00	10,00	3s 60 TT	3s 90 TT	7s 180 TT	3s 60 TT	3s 100 TT	7s 180 TT	
	20,00		3s 100 TT					
	30,00							
	40,00							
	50,00							
60,00	3s 70 TT							
50,00	10,00	3s 60 TT	3s 100 TT	7s 180 TT	3s 60 TT	3s 100 TT	7s 180 TT	
	20,00							3s 110 TT
	30,00							
	40,00							
	50,00							
60,00	3s 70 TT							
60,00	10,00	3s 60 TT	3s 100 TT	7s 180 TT	3s 70 TT	3s 110 TT	7s 180 TT	
	20,00		3s 110 TT					
	30,00							
	40,00							
	50,00							
60,00	3s 70 TT							
					3s 80 TT			

R 0

R 30

R 60

STRUCTURAL PRE-ANALYSIS TABLES

Service class 1

Imposed load category A ($\psi_0 = 0,7$ and $\psi_2 = 0,3$): $k_{mod} = 0,8$
Self-weight of KLH® is already taken into account in the table.

Load-bearing capacity

a) verification of column stability (compression and deflection according to equivalent member method)

Structural fire design (double-sided fire exposure)

Application of KLHdesigner based on the „reduced properties method“ according to ETA-06/0138.

- a) charring rate $\beta_1 = 0,55$ mm/min regular charring rate (charring within one single layer)
- b) charring rate $\beta_2 = 0,80$ mm/min increased charring rate (after the failure / falling off of one layer)
- c) for local panel parts $b < 300$ mm higher charring rates are mandatory

This table is only intended for structural pre-analysis purposes and does not replace necessary static calculations!

STRUCTURAL PRE-ANALYSIS TABLES

03 KLH® AS A CLADDED WALL

3.1 SINGLE-SIDED FIRE EXPOSURE (FOR EXTERIOR WALLS)

according to ETA-06/0138

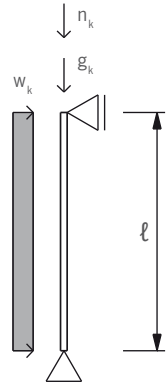
ÖNORM EN 1995-1-1:2019 and ÖNORM B 1995-1-1:2019

ÖNORM EN 1995-1-2:2011 and ÖNORM B 1995-1-2:2011

Wind pressure: $w_k = 0,8 \text{ kN/m}^2$

Minimum panel thickness for various fire resistance classes (R 30 to R 120)

with 15 mm fire rated gypsum plasterboard type F (GtF) on the fire exposed side



Permanent load	Imposed load	HEIGHT WALL (buckling length ℓ)							
		2,73 m				2,95 m			
$g_{2,k}$	n_k	R 30	R 60	R 90	R 120	R 30	R 60	R 90	R 120
[kN/m]	[kN/m]								
10,00	10,00	3s 80 TT	3s 80 TT	3s 120 TT	5s 110 TT	3s 80 TT	3s 80 TT	3s 120 TT	5s 110 TT
	20,00								
	30,00								
	40,00								
	50,00								
20,00	10,00	3s 80 TT	3s 80 TT	3s 120 TT	5s 110 TT	3s 80 TT	3s 80 TT	3s 120 TT	5s 110 TT
	20,00								
	30,00								
	40,00								
	30,00								10,00
20,00									
30,00									
40,00									
50,00									
40,00	10,00	3s 80 TT	3s 80 TT	3s 120 TT	5s 120 TT	3s 80 TT	3s 80 TT	3s 120 TT	5s 120 TT
	20,00								
	30,00								
	40,00								
	50,00								
50,00	10,00	3s 80 TT	3s 80 TT	3s 120 TT	5s 120 TT	3s 80 TT	3s 80 TT	3s 120 TT	5s 120 TT
	20,00								
	30,00								
	40,00								
	50,00								
60,00	10,00	3s 80 TT	3s 80 TT	3s 120 TT	5s 120 TT	3s 80 TT	3s 80 TT	3s 120 TT	5s 120 TT
	20,00								
	30,00								
	40,00								
	50,00								
60,00									

R 30

R 60

R 90

R 120

STRUCTURAL PRE-ANALYSIS TABLES

Service class 1

Imposed load category A ($\psi_0 = 0,7$ and $\psi_2 = 0,3$): $k_{\text{mod}} = 0,8$

Wind loads ($\psi_0 = 0,6$ and $\psi_2 = 0,0$): $k_{\text{mod}} = 1,0$

Self-weight of KLH® is already taken into account in the table.

Load-bearing capacity

- a) verification of column stability (compression and deflection according to equivalent member method)
- b) verification of shear resistance

Structural fire design (single-sided fire exposure)

Application of KLHdesigner based on the „reduced properties method“ according to ETA-06/0138.

- a) charring rate $\beta_1 = 0,55$ mm/min regular charring rate (charring within one single layer)
- b) charring rate $\beta_2 = 0,80$ mm/min increased charring rate (after the failure / falling off of one layer)
- c) for local panel parts $b < 300$ mm higher charring rates are mandatory
- d) additional eccentricity due to burn-off taken into account

Cladding

For the cladding directly to the KLH® surface, screw-fastened fire rated gypsum plasterboards type F (GtF according to ÖNORM EN 520 and ÖNORM B 3410 or DIN 18180) or equivalent panels are required. The fastening needs to comply with the state of the art and the current KLH® installation guidelines.

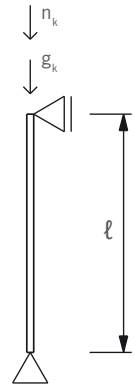
This table is only intended for structural pre-analysis purposes and does not replace necessary static calculations!

STRUCTURAL PRE-ANALYSIS TABLES

3.2 DOUBLE-SIDED FIRE EXPOSURE (FOR INTERIOR WALLS)

according to ETA-06/0138
 ÖNORM EN 1995-1-1:2019 and ÖNORM B 1995-1-1:2019
 ÖNORM EN 1995-1-2:2011 and ÖNORM B 1995-1-2:2011

Minimum panel thickness for various fire resistance classes (R 30 to R 120)
 with 15 mm fire rated gypsum plasterboard type F (GtF) on both sides



Permanent load	Imposed load	HEIGHT WALL (buckling length ℓ)							
		2,73 m				2,95 m			
$g_{2,k}$	n_k	R 30	R 60	R 90	R 120	R 30	R 60	R 90	R 120
[kN/m]	[kN/m]								
10,00	10,00	3s 80 TT	3s 80 TT	3s 120 TT	3s 100 TT	3s 80 TT	3s 80 TT	3s 120 TT	3s 100 TT
	20,00								
	30,00								
	40,00								
	50,00								
20,00	10,00	3s 80 TT	3s 80 TT	3s 120 TT	3s 100 TT	3s 80 TT	3s 80 TT	3s 120 TT	3s 100 TT
	20,00								
	30,00								
	40,00								
	50,00								
30,00	10,00	3s 80 TT	3s 80 TT	3s 120 TT	3s 100 TT	3s 80 TT	3s 80 TT	3s 120 TT	3s 100 TT
	20,00								
	30,00								
	40,00								
	50,00								
40,00	10,00	3s 80 TT	3s 80 TT	3s 120 TT	3s 100 TT	3s 80 TT	3s 80 TT	3s 120 TT	3s 100 TT
	20,00								
	30,00								
	40,00								
	50,00								
50,00	10,00	3s 80 TT	3s 80 TT	3s 120 TT	3s 100 TT	3s 80 TT	3s 90 TT	3s 120 TT	3s 100 TT
	20,00								
	30,00								
	40,00								
	50,00								
60,00	10,00	3s 80 TT	3s 80 TT	3s 120 TT	3s 100 TT	3s 80 TT	3s 90 TT	3s 80 TT	3s 100 TT
	20,00								
	30,00								
	40,00								
	50,00								

with 1 x 15 mm GtF on both sides



with 2 x 15 mm GtF on both sides



STRUCTURAL PRE-ANALYSIS TABLES

Service class 1

Imposed load category A ($\psi_0 = 0,7$ and $\psi_2 = 0,3$): $k_{\text{mod}} = 0,8$
Self-weight of KLH[®] is already taken into account in the table.

Load-bearing capacity

a) verification of column stability (compression and deflection according to equivalent member method)

Structural fire design (double-sided fire exposure)

Application of KLHdesigner based on the „reduced properties method“ according to ETA-06/0138.

- a) charring rate $\beta_1 = 0,55$ mm/min regular charring rate (charring within one single layer)
- b) charring rate $\beta_2 = 0,80$ mm/min increased charring rate (after the failure / falling off of one layer)
- c) for local panel parts $b < 300$ mm higher charring rates are mandatory

Cladding

For the cladding directly to the KLH[®] surface, screw-fastened fire rated gypsum plasterboards type F (GtF according to ÖNORM EN 520 and ÖNORM B 3410 or DIN 18180) or equivalent panels are required. The fastening needs to comply with the state of the art and the current KLH[®] installation guidelines.

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STRUCTURAL PRE-ANALYSIS TABLES

04 KLH® AS A FLOOR - SINGLE-SPAN BEAM

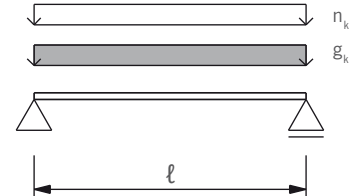
4.1 VERIFICATION OF VIBRATION WITH HIGH REQUIREMENTS (WET SCREED)

according to ETA-06/0138

ÖNORM EN 1995-1-1:2019 and ÖNORM B 1995-1-1:2019

ÖNORM EN 1995-1-2:2011 and ÖNORM B 1995-1-2:2011

Minimum panel thickness for a specific load-span-combination



Permanent load $g_{2,k}$	Imposed load n_k		SPAN OF SINGLE-SPAN BEAM ℓ						
	category	[kN/m ²]	3,00 m	4,00 m	5,00 m	6,00 m	7,00 m		
1,00	A	1,50	5s 120 TL	5s 140 TL	5s 170 TL	7s 220 TL	7s 240 TL		
		2,00							
		2,80							
	B	3,00		5s 140 TL	7ss 260 TL				
		3,50							
		4,00							
	C	5,00							
		A		1,50	5s 120 TL	5s 140 TL	5s 170 TL	7s 220 TL	7s 240 TL
				2,00					
2,80									
B	3,00	5s 140 TL	7ss 260 TL						
	3,50								
	4,00								
C	5,00								
	A	1,50	5s 120 TL	5s 140 TL	5s 180 TL	7s 220 TL	7s 240 TL		
		2,00							
2,80									
B	3,00	5s 140 TL	7ss 280 TL						
	3,50								
	4,00								
C	5,00								
	A	1,50	5s 120 TL	5s 140 TL	5s 200 TL	7s 220 TL	7s 240 TL		
		2,00							
2,80									
B	3,00	5s 140 TL	7ss 280 TL						
	3,50								
	4,00								
C	5,00								
	A	1,50	5s 120 TL	5s 150 TL	5s 200 TL	7s 220 TL	7ss 280 TL		
		2,00							
2,80									
B	3,00	5s 140 TL	7ss 280 TL						
	3,50								
	4,00								
C	5,00	7ss 260 TL							

R 60

R 90

R 120

STRUCTURAL PRE-ANALYSIS TABLES

Service class 1

$$k_{def} = 0,6$$

Imposed load category A and B ($\psi_0 = 0,7$ and $\psi_2 = 0,3$): $k_{mod} = 0,8$

Imposed load category C ($\psi_0 = 0,7$ and $\psi_2 = 0,6$): $k_{mod} = 0,9$

Self-weight of KLH® is already taken into account in the table.

Deflection limits according to ÖNORM EN 1995-1-1:2019

a) characteristic design situation: $w_{Q,inst} \leq \ell/300$ and $(w_{fin} - w_{G,inst}) \leq \ell/200$

b) quasi-permanent structural design situation: $w_{fin} \leq \ell/250$

Vibration verification according to ÖNORM B 1995-1-1:2019

a) floor slab class I: slab between different utilisation units (e.g. separating floor slabs for apartments or offices);
6 cm wet screed, floating on filler

b) limiting value of the frequency and stiffness criterion: $f_{1,min} \geq 4,5$ Hz; $f_1 \geq f_{gr} = 8$ Hz; $w_{stat} \leq w_{gr} = 0,25$ mm

c) modal damping ratio for cross-laminated timber floor slabs with floating screed and heavy floor structure: $\zeta = 4,0$ %

d) limiting value acceleration (required at $f_{1,min} \leq f_1 \leq f_{gr}$): $\alpha_{rms} \leq \alpha_{gr} = 0,05$ m/s²

e) floor slab width (b) $\leq 1,2 \cdot \text{span}$ (1,2*1)

Load-bearing capacity

a) verification of bending resistance

b) verification of shear resistance

Structural fire design (single-sided fire exposure)

Application of KLHdesigner based on the „reduces properties method“ according to ETA-06/0138.

a) charring rate $\beta_1 = 0,65$ mm/min regular charring rate (charring within one single layer)

b) charring rate $\beta_2 = 1,00$ mm/min increased charring rate (after the failure / falling off of one layer)

c) for local panel parts $b < 300$ mm higher charring rates are mandatory

d) the minimum panel thicknesses (for R 0) automatically reach fire resistance according to coloured marking

This table is only intended for structural pre-analysis purposes and does not replace necessary static calculations!

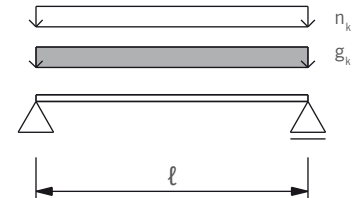
STRUCTURAL PRE-ANALYSIS TABLES

4.2 VERIFICATION OF VIBRATION WITH HIGH REQUIREMENTS (DRY SCREED)

according to ETA-06/0138

ÖNORM EN 1995-1-1:2019 and ÖNORM B 1995-1-1:2019

ÖNORM EN 1995-1-2:2011 and ÖNORM B 1995-1-2:2011



Minimum panel thickness for a specific load-span-combination

Permanent load $g_{2,k}$	Imposed load n_k		SPAN OF SINGLE-SPAN BEAM l					
	category	[kN/m ²]	3,00 m	4,00 m	5,00 m	6,00 m	7,00 m	
1,00	A	1,50	5s 130 TL	5s 150 TL	5s 170 TL	7s 220 TL	7ss 280 TL	
		2,00						
		2,80						
	B	3,00						
		3,50						
		4,00						
	C	5,00						
		1,50						
		2,00						
1,50	A	1,50	5s 130 TL	5s 150 TL	5s 180 TL	7s 220 TL	7ss 280 TL	
		2,00						
		2,80						
	B	3,00						
		3,50						
		4,00						
	C	5,00						7s 240 TL
		1,50						
		2,00						
2,00	A	1,50	5s 130 TL	5s 150 TL	5s 190 TL	7s 240 TL	7ss 280 TL	
		2,00						
		2,80						
	B	3,00						
		3,50						
		4,00						
	C	5,00						
		1,50						
		2,00						
2,50	A	1,50	5s 130 TL	5s 150 TL	5s 200 TL	7s 240 TL	7ss 280 TL	
		2,00						
		2,80						
	B	3,00						
		3,50						
		4,00						
	C	5,00						
		1,50						
		2,00						
3,00	A	1,50	5s 130 TL	5s 150 TL	5s 200 TL	7s 240 TL	7ss 280 TL	
		2,00						
		2,80						
	B	3,00						
		3,50						
		4,00						
	C	5,00						7ss 260 TL

R 60

R 90

R 120

STRUCTURAL PRE-ANALYSIS TABLES

Service class 1

$$k_{def} = 0,6$$

Imposed load category A and B ($\psi_0 = 0,7$ and $\psi_2 = 0,3$): $k_{mod} = 0,8$

Imposed load category C ($\psi_0 = 0,7$ and $\psi_2 = 0,6$): $k_{mod} = 0,9$

Self-weight of KLH® is already taken into account in the table.

Deflection limits according to ÖNORM EN 1995-1-1:2019

a) characteristic design situation: $w_{Q,inst} \leq \ell/300$ and $(w_{fin} - w_{G,inst}) \leq \ell/200$

b) quasi-permanent structural design situation: $w_{fin} \leq \ell/250$

Vibration verification according to ÖNORM B 1995-1-1:2019

a) floor slab class I: slab between different utilisation units (e.g. separating floor slabs for apartments or offices);
dry screed, floating on heavy filler (at least 60 kg/m²)

b) limiting value of the frequency and stiffness criterion: $f_{1,min} \geq 4,5$ Hz; $f_1 \geq f_{gr} = 8$ Hz; $w_{stat} \leq w_{gr} = 0,25$ mm

c) modal damping ratio for cross-laminated timber floor slabs with floating screed and heavy floor structure: $\zeta = 4,0$ %

d) limiting value acceleration (required at $f_{1,min} \leq f_1 \leq f_{gr}$): $\alpha_{rms} \leq \alpha_{gr} = 0,05$ m/s²

e) floor slab width (b) $\leq 1,2 \cdot \text{span}$ (1,2*1)

Load-bearing capacity

a) verification of bending resistance

b) verification of shear resistance

Structural fire design (single-sided fire exposure)

Application of KLHdesigner based on the „reduced properties method“ according to ETA-06/0138.

a) charring rate $\beta_1 = 0,65$ mm/min regular charring rate (charring within one single layer)

b) charring rate $\beta_2 = 1,00$ mm/min increased charring rate (after the failure / falling off of one layer)

c) for local panel parts $b < 300$ mm higher charring rates are mandatory

d) the minimum panel thicknesses (for R 0) automatically reach fire resistance according to coloured marking

This table is only intended for structural pre-analysis purposes and does not replace necessary static calculations!

STRUCTURAL PRE-ANALYSIS TABLES

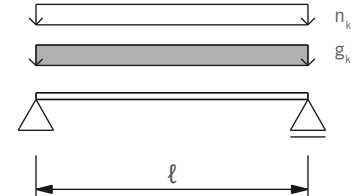
4.3 VERIFICATION OF VIBRATION WITH LOW REQUIREMENTS

according to ETA-06/0138

ÖNORM EN 1995-1-1:2019 and ÖNORM B 1995-1-1:2019

ÖNORM EN 1995-1-2:2011 and ÖNORM B 1995-1-2:2011

Minimum panel thickness for a specific load-span-combination



Permanent load	Imposed load		SPAN OF SINGLE-SPAN BEAM l						
	$g_{2,k}$ [kN/m ²]	n_k category [kN/m ²]	3,00 m	4,00 m	5,00 m	6,00 m	7,00 m		
1,00	A	1,50	5s 100 TL	5s 120 TL	5s 150 TL	5s 160 TL	5s 200 TL		
		2,00				5s 170 TL			
		2,80							
	B	3,00		5s 130 TL	5s 160 TL	5s 190 TL	7ss 220 TL		
		3,50							
	C	4,00		5s 140 TL	5s 170 TL	7ss 200 TL			
		5,00							
	1,50	A		1,50	5s 100 TL	5s 120 TL	5s 150 TL	5s 180 TL	5s 200 TL
				2,00				5s 200 TL	
2,80									
B		3,00	5s 130 TL	5s 160 TL		5s 200 TL	7ss 220 TL		
		3,50							
C		4,00	5s 140 TL	5s 170 TL		7ss 200 TL	7ss 240 TL		
		5,00							
2,00		A	1,50	5s 100 TL		5s 120 TL	5s 150 TL	5s 190 TL	7ss 240 TL
			2,00						
	2,80								
	B	3,00	5s 130 TL		5s 170 TL	7ss 200 TL			
		3,50							
	C	4,00	5s 140 TL		5s 180 TL	7ss 200 TL			
		5,00							
	2,50	A	1,50		5s 100 TL	5s 130 TL	5s 160 TL	5s 190 TL	7ss 240 TL
			2,00						
2,80									
B		3,00	5s 140 TL	5s 180 TL		5s 200 TL			
		3,50							
C		4,00	5s 110 TL	5s 140 TL		7ss 220 TL			
		5,00							
3,00		A	1,50	5s 100 TL		5s 130 TL	5s 160 TL	5s 200 TL	7ss 240 TL
			2,00						
	2,80								
	B	3,00	5s 140 TL		5s 180 TL	7ss 220 TL			
		3,50							
	C	4,00	5s 110 TL		5s 140 TL	7ss 220 TL			
		5,00							

R 30

R 60

R 90

R 120

STRUCTURAL PRE-ANALYSIS TABLES

Service class 1

$$k_{def} = 0,6$$

Imposed load category A and B ($\psi_0 = 0,7$ and $\psi_2 = 0,3$): $k_{mod} = 0,8$

Imposed load category C ($\psi_0 = 0,7$ and $\psi_2 = 0,6$): $k_{mod} = 0,9$

Self-weight of KLH® is already taken into account in the table.

Deflection limits according to ÖNORM EN 1995-1-1:2019

a) characteristic design situation: $w_{Q,inst} \leq \ell/300$ and $(w_{fin} - w_{G,inst}) \leq \ell/200$

b) quasi-permanent structural design situation: $w_{fin} \leq \ell/250$

Vibration verification according to ÖNORM B 1995-1-1:2019

a) floor slab class II: slab within the utilisation unit (e.g. detached house); floating wet screed (even without filler); dry screed, floating on heavy filler (at least 60 kg/m²)

b) limiting value of the frequency and stiffness criterion: $f_{1,min} \geq 4,5$ Hz; $f_1 \geq f_{gr} = 6$ Hz; $w_{stat} \leq w_{gr} = 0,50$ mm

c) modal damping ratio for cross-laminated timber floor slabs with floating screed and heavy floor structure: $\zeta = 4,0$ %

d) limiting value acceleration (required at $f_{1,min} \leq f_1 \leq f_{gr}$): $\alpha_{rms} \leq \alpha_{gr} = 0,10$ m/s²

e) floor slab width $(b) \leq 1,2 \cdot \text{span}$ (1,2*1)

Load-bearing capacity

a) verification of bending resistance

b) verification of shear resistance

Structural fire design (single-sided fire exposure)

Application of KLHdesigner based on the „reduced properties method“ according to ETA-06/0138.

a) charring rate $\beta_1 = 0,65$ mm/min regular charring rate (charring within one single layer)

b) charring rate $\beta_2 = 1,00$ mm/min increased charring rate (after the failure / falling off of one layer)

c) for local panel parts $b < 300$ mm higher charring rates are mandatory

d) the minimum panel thicknesses (for R 0) automatically reach fire resistance according to coloured marking

This table is only intended for structural pre-analysis purposes and does not replace necessary static calculations!

STRUCTURAL PRE-ANALYSIS TABLES

05 KLH® AS A FLOOR - DOUBLE-SPAN BEAM

5.1 VERIFICATION OF VIBRATION WITH HIGH REQUIREMENTS (WET SCREED)

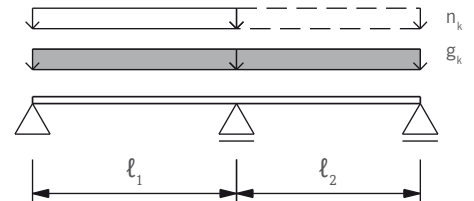
according to ETA-06/0138

ÖNORM EN 1995-1-1:2019 and ÖNORM B 1995-1-1:2019

ÖNORM EN 1995-1-2:2011 and ÖNORM B 1995-1-2:2011

Imposed load not favourable in some spans

Minimum panel thickness for a specific load-span-combination



Permanent load $g_{2,k}$	Imposed load n_k		SPAN OF DOUBLE-SPAN BEAM l_1 $l_2 = 0,8 \cdot l_1$ to $1,0 \cdot l_1$								
	[kN/m ²]	category	3,00 m	4,00 m	5,00 m	6,00 m	7,00 m				
1,00	A	1,50	5s 110 TL	5s 130 TL	5s 150 TL	5s 180 TL	7s 200 TL				
		2,00									
		2,80									
	B	3,00					7ss 220 TL				
		3,50									
		4,00									
	C	5,00									
		1,50					5s 110 TL	5s 130 TL	5s 160 TL	5s 180 TL	7s 200 TL
		2,00									
2,80											
B	3,00	7s 220 TL									
	3,50										
	4,00										
C	5,00										
	1,50	5s 110 TL	5s 130 TL	5s 160 TL	5s 190 TL	7s 220 TL					
	2,00										
2,80											
B	3,00					7s 240 TL					
	3,50										
	4,00										
C	5,00										
	1,50				5s 110 TL	5s 130 TL	5s 160 TL	5s 190 TL	7s 220 TL		
	2,00										
2,80											
B	3,00	7s 240 TL									
	3,50										
	4,00										
C	5,00										
	1,50	5s 110 TL	5s 130 TL	5s 160 TL					5s 190 TL	7ss 240 TL	
	2,00										
2,80											
B	3,00										
	3,50										
	4,00										
C	5,00										

R 30

R 60

R 90

R 120

STRUCTURAL PRE-ANALYSIS TABLES

Service class 1

$$k_{def} = 0,6$$

Imposed load category A and B ($\psi_0 = 0,7$ and $\psi_2 = 0,3$): $k_{mod} = 0,8$

Imposed load category C ($\psi_0 = 0,7$ and $\psi_2 = 0,6$): $k_{mod} = 0,9$

Self-weight of KLH® is already taken into account in the table.

Deflection limits according to ÖNORM EN 1995-1-1:2019

a) characteristic design situation: $w_{Q,inst} \leq \ell/300$ and $(w_{fin} - w_{G,inst}) \leq \ell/200$

b) quasi-permanent structural design situation: $w_{fin} \leq \ell/250$

Vibration verification according to ÖNORM B 1995-1-1:2019

a) floor slab class I: slab between different utilisation units (e.g. separating floor slabs for apartments or offices);
6 cm wet screed, floating on filler

b) limiting value of the frequency and stiffness criterion: $f_{1,min} \geq 4,5$ Hz; $f_1 \geq f_{gr} = 8$ Hz; $w_{stat} \leq w_{gr} = 0,25$ mm

c) modal damping ratio for cross-laminated timber floor slabs with floating screed and heavy floor structure: $\zeta = 4,0$ %

d) limiting value acceleration (required at $f_{1,min} \leq f_1 \leq f_{gr}$): $\alpha_{rms} \leq \alpha_{gr} = 0,05$ m/s²

e) floor slab width (b) $\leq 1,2 \cdot \text{span}$ (1,2*1)

Load-bearing capacity

a) verification of bending resistance

b) verification of shear resistance

Structural fire design (single-sided fire exposure)

Application of KLHdesigner based on the „reduced properties method“ according to ETA-06/0138.

a) charring rate $\beta_1 = 0,65$ mm/min regular charring rate (charring within one single layer)

b) charring rate $\beta_2 = 1,00$ mm/min increased charring rate (after the failure / falling off of one layer)

c) for local panel parts $b < 300$ mm higher charring rates are mandatory

d) the minimum panel thicknesses (for R 0) automatically reach fire resistance according to coloured marking

This table is only intended for structural pre-analysis purposes and does not replace necessary static calculations!

STRUCTURAL PRE-ANALYSIS TABLES

5.2 VERIFICATION OF VIBRATION WITH HIGH REQUIREMENTS (DRY SCREED)

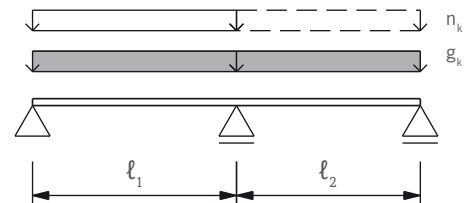
according to ETA-06/0138

ÖNORM EN 1995-1-1:2019 and ÖNORM B 1995-1-1:2019

ÖNORM EN 1995-1-2:2011 and ÖNORM B 1995-1-2:2011

Imposed load not favourable in some spans

Minimum panel thickness for a specific load-span-combination



Permanent load $g_{2,k}$	Imposed load n_k		SPAN OF DOUBLE-SPAN BEAM l_1 $l_2 = 0,8 \cdot l_1$ to $1,0 \cdot l_1$				
	[kN/m ²]	category	3,00 m	4,00 m	5,00 m	6,00 m	7,00 m
1,00	A	1,50	5s 110 TL	5s 140 TL	5s 160 TL	5s 190 TL	7s 200 TL
		2,00					
		2,80					
	B	3,00		5s 140 TL		5s 190 TL	7s 220 TL
		3,50					
		4,00					
	C	4,00		5s 140 TL		5s 190 TL	7s 220 TL
		5,00					
		5,00					
1,50	A	1,50	5s 110 TL	5s 140 TL	5s 170 TL	5s 190 TL	7s 200 TL
		2,00					
		2,80					
	B	3,00		5s 140 TL		5s 190 TL	7s 220 TL
		3,50					
		4,00					
	C	4,00		5s 140 TL		5s 190 TL	7s 220 TL
		5,00					
		5,00					
2,00	A	1,50	5s 110 TL	5s 140 TL	5s 170 TL	5s 190 TL	7s 220 TL
		2,00					
		2,80					
	B	3,00		5s 140 TL		5s 190 TL	7s 220 TL
		3,50					
		4,00					
	C	4,00		5s 110 TL		5s 140 TL	7s 240 TL
		5,00					
		5,00					
2,50	A	1,50	5s 110 TL	5s 140 TL	5s 170 TL	5s 190 TL	7s 220 TL
		2,00					
		2,80					
	B	3,00		5s 140 TL		5s 190 TL	7s 220 TL
		3,50					
		4,00					
	C	4,00		5s 110 TL		5s 140 TL	7s 240 TL
		5,00					
		5,00					
3,00	A	1,50	5s 110 TL	5s 150 TL	5s 170 TL	5s 190 TL	7s 240 TL
		2,00					
		2,80					
	B	3,00		5s 150 TL		5s 170 TL	7s 240 TL
		3,50					
		4,00					
	C	4,00		5s 110 TL		5s 150 TL	7s 240 TL
		5,00					
		5,00					

R 30

R 60

R 90

R 120

STRUCTURAL PRE-ANALYSIS TABLES

Service class 1

$$k_{def} = 0,6$$

Imposed load category A and B ($\psi_0 = 0,7$ and $\psi_2 = 0,3$): $k_{mod} = 0,8$

Imposed load category C ($\psi_0 = 0,7$ and $\psi_2 = 0,6$): $k_{mod} = 0,9$

Self-weight of KLH® is already taken into account in the table.

Deflection limits according to ÖNORM EN 1995-1-1:2019

a) characteristic design situation: $w_{Q,inst} \leq \ell/300$ and $(w_{fin} - w_{G,inst}) \leq \ell/200$

b) quasi-permanent structural design situation: $w_{fin} \leq \ell/250$

Vibration verification according to ÖNORM B 1995-1-1:2019

a) floor slab class I: slab between different utilisation units (e.g. separating floor slabs for apartments or offices);
dry screed, floating on heavy filler (at least 60 kg/m²)

b) limiting value of the frequency and stiffness criterion: $f_{1,min} \geq 4,5$ Hz; $f_1 \geq f_{gr} = 8$ Hz; $w_{stat} \leq w_{gr} = 0,25$ mm

c) modal damping ratio for cross-laminated timber floor slabs with floating screed and heavy floor structure: $\zeta = 4,0$ %

d) limiting value acceleration (required at $f_{1,min} \leq f_1 \leq f_{gr}$): $\alpha_{rms} \leq \alpha_{gr} = 0,05$ m/s²

e) floor slab width ($b \leq 1,2 \cdot \text{span}$ (1,2*1))

Load-bearing capacity

a) verification of bending resistance

b) verification of shear resistance

Structural fire design (single-sided fire exposure)

Application of KLHdesigner based on „reduced properties method“ according to ETA-06/0138.

a) charring rate $\beta_1 = 0,65$ mm/min regular charring rate (charring within one single layer)

b) charring rate $\beta_2 = 1,00$ mm/min increased charring rate (after the failure / falling off of one layer)

c) for local panel parts $b < 300$ mm higher charring rates are mandatory

d) the minimum panel thicknesses (for R 0) automatically reach fire resistance according to coloured marking

This table is only intended for structural pre-analysis purposes and does not replace necessary static calculations!

STRUCTURAL PRE-ANALYSIS TABLES

5.3 VERIFICATION OF VIBRATION WITH LOW REQUIREMENTS

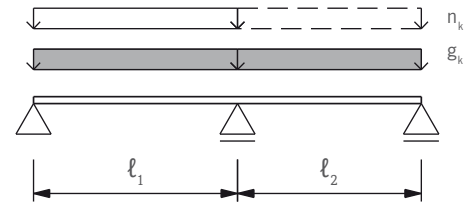
according to ETA-06/0138

ÖNORM EN 1995-1-1:2019 and ÖNORM B 1995-1-1:2019

ÖNORM EN 1995-1-2:2011 and ÖNORM B 1995-1-2:2011

Imposed load not favourable in some spans

Minimum panel thickness for a specific load-span-combination



Permanent load $g_{2,k}$	Imposed load n_k		SPAN OF DOUBLE-SPAN BEAM l_1 $l_2 = 0,8 \cdot l_1$ to $1,0 \cdot l_1$							
	[kN/m ²]	category	3,00 m	4,00 m	5,00 m	6,00 m	7,00 m			
1,00	A	1,50	3s 110 TL	5s 110 TL	5s 130 TL	5s 160 TL	5s 170 TL			
		2,00								
		2,80								
	B	3,00						5s 110 TL	5s 140 TL	5s 180 TL
		3,50						5s 120 TL	5s 200 TL	
		4,00								
1,50	A	1,50	3s 110 TL	5s 110 TL	5s 140 TL	5s 160 TL	5s 180 TL			
		2,00								
		2,80								
	B	3,00						5s 110 TL	5s 170 TL	5s 200 TL
		3,50								
		4,00								
2,00	A	1,50	3s 110 TL	5s 110 TL	5s 140 TL	5s 160 TL	5s 190 TL			
		2,00								
		2,80								
	B	3,00						5s 120 TL	5s 170 TL	7ss 200 TL
		3,50								
		4,00								
2,50	A	1,50	3s 110 TL	5s 120 TL	5s 150 TL	5s 160 TL	5s 200 TL			
		2,00								
		2,80								
	B	3,00						5s 180 TL	7ss 200 TL	
		3,50								
		4,00								
3,00	A	1,50	3s 110 TL	5s 120 TL	5s 150 TL	5s 170 TL	7ss 220 TL			
		2,00								
		2,80								
	B	3,00						5s 140 TL	7ss 220 TL	
		3,50								
		4,00								
C	4,00	7ss 220 TL								
	5,00									

R 30

R 60

R 90

R 120

STRUCTURAL PRE-ANALYSIS TABLES

Service class 1

$$k_{def} = 0,6$$

Imposed load category A and B ($\psi_0 = 0,7$ and $\psi_2 = 0,3$): $k_{mod} = 0,8$

Imposed load category C ($\psi_0 = 0,7$ and $\psi_2 = 0,6$): $k_{mod} = 0,9$

Self-weight of KLH® is already taken into account in the table.

Deflection limits according to ÖNORM EN 1995-1-1:2019

a) characteristic design situation: $w_{Q,inst} \leq \ell/300$ and $(w_{fin} - w_{G,inst}) \leq \ell/200$

b) quasi-permanent structural design situation: $w_{fin} \leq \ell/250$

Vibration verification according to ÖNORM B 1995-1-1:2019

a) floor slab class II: slab within the utilisation unit (e.g. detached house); floating wet screed (even without filler); dry screed, floating on heavy filler (at least 60 kg/m²)

b) limiting value of the frequency and stiffness criterion: $f_{1,min} \geq 4,5$ Hz; $f_1 \geq f_{gr} = 6$ Hz; $w_{stat} \leq w_{gr} = 0,50$ mm

c) modal damping ratio for cross-laminated timber floor slabs with floating screed and heavy floor structure: $\zeta = 4,0$ %

d) limiting value acceleration (required at $f_{1,min} \leq f_1 \leq f_{gr}$): $\alpha_{rms} \leq \alpha_{gr} = 0,10$ m/s²

e) floor slab width (b) $\leq 1,2 \cdot \text{span}$ (1,2*1)

Load-bearing capacity

a) verification of bending resistance

b) verification of shear resistance

Structural fire design (single-sided fire exposure)

Application of KLHdesigner based on the „reduced properties method“ according to ETA-06/0138.

a) charring rate $\beta_1 = 0,65$ mm/min regular charring rate (charring within one single layer)

b) charring rate $\beta_2 = 1,00$ mm/min increased charring rate (after the failure / falling off of one layer)

c) for local panel parts $b < 300$ mm higher charring rates are mandatory

d) the minimum panel thicknesses (for R 0) automatically reach fire resistance according to coloured marking

This table is only intended for structural pre-analysis purposes and does not replace necessary static calculations!

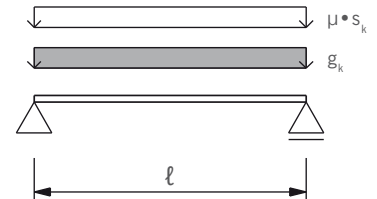
STRUCTURAL PRE-ANALYSIS TABLES

06 KLH® AS A ROOF - SINGLE-SPAN BEAM

according to ETA-06/0138

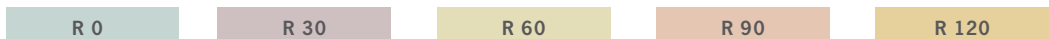
ÖNORM EN 1995-1-1:2019 and ÖNORM B 1995-1-1:2019

ÖNORM EN 1995-1-2:2011 and ÖNORM B 1995-1-2:2011



Minimum panel thickness for a specific load-span-combination

Permanent load	Snow load on roof	SPAN OF SINGLE-SPAN BEAM l				
		3,00 m	4,00 m	5,00 m	6,00 m	7,00 m
$g_{2,k}$	$s = \mu \cdot s_k$					
[kN/m ²]	[kN/m ²]					
0,50	1,00	3s 60 TL	3s 80 TL	3s 100 TL	3s 120 TL	5s 140 TL
	2,00	3s 80 TL	3s 90 TL	3s 120 TL	5s 140 TL	5s 160 TL
	3,00		3s 100 TL	5s 130 TL	5s 150 TL	5s 180 TL
	4,00	3s 90 TL	3s 110 TL	5s 140 TL	5s 170 TL	5s 200 TL
	5,00		3s 120 TL	5s 150 TL	5s 180 TL	7ss 220 TL
	6,00		5s 130 TL	5s 160 TL	5s 200 TL	
	7,00	3s 100 TL	5s 140 TL	5s 170 TL	7ss 200 TL	7ss 240 TL
1,00	1,00	3s 80 TL	3s 90 TL	3s 100 TL	5s 140 TL	5s 160 TL
	2,00		3s 100 TL	3s 120 TL	5s 150 TL	5s 180 TL
	3,00	3s 90 TL	3s 110 TL	5s 140 TL	5s 160 TL	5s 200 TL
	4,00		3s 120 TL	5s 150 TL	5s 180 TL	7ss 200 TL
	5,00		5s 160 TL	5s 190 TL	7ss 220 TL	
	6,00	3s 100 TL	5s 140 TL	5s 170 TL		7ss 200 TL
	7,00	3s 110 TL	5s 180 TL	7ss 200 TL	7ss 240 TL	
	5s 140 TL		5s 180 TL	7ss 210 TL		
1,50	1,00	3s 80 TL	3s 90 TL	3s 120 TL	5s 150 TL	5s 180 TL
	2,00		3s 100 TL	5s 130 TL	5s 160 TL	5s 190 TL
	3,00	3s 90 TL	3s 110 TL	5s 140 TL	5s 170 TL	5s 200 TL
	4,00		3s 120 TL	5s 150 TL	5s 180 TL	7ss 220 TL
	5,00		5s 130 TL	5s 160 TL	5s 200 TL	7ss 240 TL
	6,00	3s 100 TL	5s 140 TL	5s 170 TL	7ss 200 TL	
	7,00	3s 110 TL	5s 180 TL	7ss 200 TL	7ss 210 TL	
	5s 140 TL		5s 180 TL	7ss 210 TL		
2,00	1,00	3s 80 TL	3s 100 TL	5s 130 TL	5s 160 TL	5s 200 TL
	2,00		3s 110 TL	5s 140 TL	5s 170 TL	
	3,00	3s 90 TL	3s 120 TL	5s 150 TL	5s 180 TL	7ss 200 TL
	4,00		5s 160 TL	5s 200 TL	7ss 220 TL	
	5,00		3s 100 TL	5s 170 TL		7ss 200 TL
	6,00	3s 110 TL	5s 140 TL	5s 180 TL	7ss 210 TL	7ss 240 TL
	7,00		5s 180 TL	7ss 210 TL	7ss 240 TL	
2,50	1,00	3s 80 TL	3s 110 TL	5s 140 TL	5s 170 TL	7ss 200 TL
	2,00		3s 120 TL	5s 150 TL	5s 180 TL	
	3,00	3s 90 TL	5s 130 TL	5s 160 TL	5s 190 TL	7ss 220 TL
	4,00		5s 140 TL	5s 170 TL	7ss 200 TL	
	5,00		3s 100 TL	5s 180 TL	7ss 200 TL	
	6,00	3s 110 TL	5s 140 TL	5s 180 TL	7ss 220 TL	7ss 240 TL
	7,00		5s 150 TL	5s 190 TL	7ss 220 TL	7ss 260 TL



STRUCTURAL PRE-ANALYSIS TABLES

Service class 1

$k_{def} = 0,6$

Snow load at an altitude ≤ 1000 m above sea level ($\psi_0 = 0,5$ and $\psi_2 = 0,0$): $k_{mod} = 0,9$

Self-weight of KLH® is already taken into account in the table.

Maximum roof inclination 15°

Deflection limits according to ÖNORM EN 1995-1-1:2019

a) characteristic design situation: $w_{Q,inst} \leq \ell/300$ and $(w_{fin} - w_{G,inst}) \leq \ell/200$

b) quasi-permanent structural design situation: $w_{fin} \leq \ell/250$

Load-bearing capacity

a) verification of bending resistance

b) verification of shear resistance

Structural fire design (single-sided fire exposure)

Application of KLHdesigner based on the „reduced properties method“ according to ETA-06/0138.

a) charring rate $\beta_1 = 0,65$ mm/min regular charring rate (charring within one single layer)

b) charring rate $\beta_2 = 1,00$ mm/min increased charring rate (after the failure / falling off of one layer)

c) for local panel parts $b < 300$ mm higher charring rates are mandatory

d) the minimum panel thicknesses (for R 0) automatically reach fire resistance according to coloured marking

This table is only intended for structural pre-analysis purposes and does not replace necessary static calculations!

STRUCTURAL PRE-ANALYSIS TABLES

07 KLH® AS A ROOF - DOUBLE SPAN BEAM

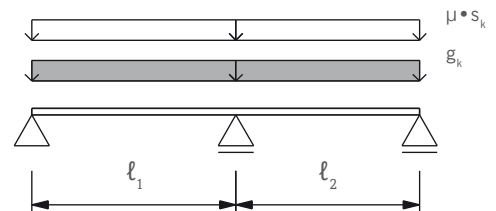
according to ETA-06/0138

ÖNORM EN 1995-1-1:2019 and ÖNORM B 1995-1-1:2019

ÖNORM EN 1995-1-2:2011 and ÖNORM B 1995-1-2:2011

Snow load evenly distributed on both spans

Minimum panel thickness for a specific load-span-combination



Permanent load	Snow load on roof	SPAN OF DOUBLE-SPAN BEAM l_1				
		3,00 m	4,00 m	5,00 m	6,00 m	7,00 m
$g_{2,k}$	$s = \mu \cdot s_k$	$l_2 = 0,8 \cdot l_1$ to $1,0 \cdot l_1$				
[kN/m ²]	[kN/m ²]					
0,50	1,00		3s 60 TL	3s 80 TL		3s 100 TL
	2,00	3s 60 TL	3s 70 TL	3s 90 TL	3s 100 TL	3s 120 TL
	3,00		3s 80 TL	3s 100 TL	3s 120 TL	5s 140 TL
	4,00	3s 70 TL	3s 90 TL	3s 110 TL	5s 140 TL	5s 150 TL
	5,00		3s 110 TL	3s 120 TL		5s 170 TL
	6,00	3s 80 TL	3s 100 TL	5s 140 TL	5s 150 TL	5s 200 TL
	7,00		3s 110 TL		5s 170 TL	7ss 200 TL
1,00	1,00		3s 70 TL	3s 80 TL	3s 100 TL	3s 120 TL
	2,00	3s 60 TL	3s 80 TL	3s 90 TL	3s 110 TL	5s 130 TL
	3,00		3s 80 TL	3s 100 TL	3s 120 TL	5s 140 TL
	4,00	3s 70 TL	3s 90 TL	3s 110 TL	5s 140 TL	5s 160 TL
	5,00		3s 100 TL	3s 120 TL	5s 150 TL	5s 180 TL
	6,00	3s 80 TL	3s 100 TL	5s 140 TL	5s 160 TL	
	7,00		3s 110 TL		5s 180 TL	7ss 200 TL
1,50	1,00		3s 70 TL	3s 90 TL	3s 110 TL	5s 130 TL
	2,00	3s 60 TL	3s 80 TL	3s 100 TL	3s 120 TL	5s 140 TL
	3,00		3s 80 TL	3s 100 TL	3s 120 TL	5s 150 TL
	4,00	3s 70 TL	3s 90 TL	3s 110 TL	5s 140 TL	5s 170 TL
	5,00		3s 100 TL	3s 120 TL	5s 150 TL	5s 190 TL
	6,00	3s 80 TL	3s 110 TL	5s 140 TL	5s 170 TL	
	7,00		3s 120 TL		5s 190 TL	7ss 200 TL
2,00	1,00		3s 80 TL	3s 100 TL	3s 120 TL	5s 140 TL
	2,00	3s 60 TL	3s 80 TL	3s 100 TL	5s 130 TL	
	3,00	3s 70 TL	3s 90 TL	3s 110 TL	5s 140 TL	5s 160 TL
	4,00	3s 80 TL	3s 100 TL	3s 120 TL	5s 140 TL	5s 180 TL
	5,00		3s 110 TL	5s 140 TL	5s 160 TL	7ss 200 TL
	6,00	3s 90 TL	3s 120 TL	5s 150 TL	5s 180 TL	
	7,00		3s 120 TL	5s 150 TL	5s 200 TL	7ss 220 TL
2,50	1,00		3s 80 TL	3s 100 TL	3s 120 TL	5s 150 TL
	2,00	3s 60 TL	3s 80 TL	3s 100 TL	3s 120 TL	5s 160 TL
	3,00	3s 70 TL	3s 90 TL	3s 110 TL	5s 130 TL	5s 170 TL
	4,00	3s 80 TL	3s 100 TL	3s 120 TL	5s 140 TL	5s 190 TL
	5,00		3s 110 TL	5s 130 TL	5s 150 TL	7ss 200 TL
	6,00	3s 90 TL	3s 120 TL	5s 140 TL	5s 170 TL	
	7,00		3s 120 TL	5s 150 TL	5s 180 TL	7ss 220 TL

R 0

R 30

R 60

R 90

R 120

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d) the minimum panel thicknesses (for R 0) automatically reach fire resistance according to coloured marking

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