KLH®

MADE FOR BUILDING
BUILT FOR LIVING

STRUCTURAL PRE-ANALYSIS TABLES

IMPRINT

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CONTENT

STRUCTURAL PRE-ANALYSIS TABLES

The calculation of KLH solid wood panels is carried out under the aspect of flexibly connected cross sections. The longitudinal layers are connected via flexible transverse layers. Therefore, bending caused by transverse forces (shear deformations of the transverse layers, "rolling shear") can no longer be disregarded. Dimensioning and structural design follow the 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 component safety coefficients for "plywood board" material).

The product characteristics of the KLH solid wood panel required for structural design can be taken from the European Technical Approval (ETA-06/0138). The static test for KLH solid wood panels must be made separately for each project, and the locally applicable standards and regulations have to be followed. Due care is also advised when comparing panel thicknesses of KLH elements with products by other manufacturers: due to different production processes, the plywood board products may well have different properties, e.g. as regards bending stiffness or shear strength. Please read the key values in the relevant product approvals and take into account the differences in the comparative calculation.

For the calculation of plywood board elements, different calculation methods have been developed. The calculation can be carried out with the so-called shear analogy, the γ-method or even as a girder grid. In practical construction work, the γ-method is most often used. It is an approximation method developed for flexibly connected bending girders, but is also applicable for plywood boards. Instead of the flexibility of the connecting devices, the shear deformation of the transverse layers is taken into account. In practical construction work, this method is sufficiently exact. It is also included in the DIN 1052 and the Eurocode 5. For structural design, the net moments of inertia are calculated with a reduction coefficient and the resulting effective moments of inertia provide verification.

01 KLH STANDARD PANEL TYPES AND STRUCTURES

COVERING LAYER IN THE TRANSVERSE PANEL DIRECTION TT (WALL)

Nominal thickness in mm	in layers	Lamella structure [mm]					Standard panel widths [m]	Maximum panel lengths [m]
		T	L	T	L	T		
57	3 I	19	19	19			2.40 / 2.50 / 2.72 / 2.95	16.50
72	3 I	19	34	19			2.40 / 2.50 / 2.72 / 2.95	16.50
94	3 I	30	34	30			2.40 / 2.50 / 2.72 / 2.95	16.50
120	3 I	40	40	40			2.40 / 2.50 / 2.72 / 2.95	16.50
95	5 I	19	19	19	19	19	2.40 / 2.50 / 2.72 / 2.95	16.50
128	5 I	30	19	30	19	30	2.40 / 2.50 / 2.72 / 2.95	16.50
158	5 I	30	34	30	34	30	2.40 / 2.50 / 2.72 / 2.95	16.50

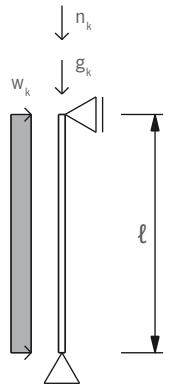
COVERING LAYER IN THE LONGITUDINAL PANEL DIRECTION TL (CEILING/ROOF)

Nominal thickness in mm	in layers	Lamella structure [mm]							Standard panel widths [m]	Maximum panel lengths [m]
		L	T	L	T	L	T	L		
60	3 I	19	22	19					2.40 / 2.50 / 2.72 / 2.95	16.50
78	3 I	19	40	19					2.40 / 2.50 / 2.72 / 2.95	16.50
90	3 I	34	22	34					2.40 / 2.50 / 2.72 / 2.95	16.50
95	3 I	34	27	34					2.40 / 2.50 / 2.72 / 2.95	16.50
108	3 I	34	40	34					2.40 / 2.50 / 2.72 / 2.95	16.50
120	3 I	40	40	40					2.40 / 2.50 / 2.72 / 2.95	16.50
95	5 I	19	19	19	19	19			2.40 / 2.50 / 2.72 / 2.95	16.50
117	5 I	19	30	19	30	19			2.40 / 2.50 / 2.72 / 2.95	16.50
125	5 I	19	34	19	34	19			2.40 / 2.50 / 2.72 / 2.95	16.50
140	5 I	34	19	34	19	34			2.40 / 2.50 / 2.72 / 2.95	16.50
145	5 I	34	21.5	34	21.5	34			2.40 / 2.50 / 2.72 / 2.95	16.50
162	5 I	34	30	34	30	34			2.40 / 2.50 / 2.72 / 2.95	16.50
182	5 I	34	40	34	40	34			2.40 / 2.50 / 2.72 / 2.95	16.50
200	5 I	40	40	40	40	40			2.40 / 2.50 / 2.72 / 2.95	16.50
201	7 I	34	21.5	34	22	34	21.5	34	2.40 / 2.50 / 2.72 / 2.95	16.50
226	7 I	34	30	34	30	34	30	34	2.40 / 2.50 / 2.72 / 2.95	16.50
208	7 II	68	19	34	19	68			2.40 / 2.50 / 2.72 / 2.95	16.50
230	7 II	68	30	34	30	68			2.40 / 2.50 / 2.72 / 2.95	16.50
248	7 II	74	30	40	30	74			2.40 / 2.50 / 2.72 / 2.95	16.50
* 260	7 II	80	30	40	30	80			2.40 / 2.50 / 2.72 / 2.95	16.50
* 280	7 II	80	40	40	40	80			2.40 / 2.50 / 2.72 / 2.95	16.50
247	8 II	68	21.5	68	21.5	68			2.40 / 2.50 / 2.72 / 2.95	16.50
* 300	8 II	80	30	80	30	80			2.40 / 2.50 / 2.72 / 2.95	16.50
* 320	8 II	80	40	80	40	80			2.40 / 2.50 / 2.72 / 2.95	16.50

* Special panel types

Special panel structures are available on request. By using double layers, for example the longitudinal or transverse rigidity 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.

02 KLH AS AN EXTERIOR WALL



Wind pressure: w_k = 0.80 kN/m²
Minimum panel thicknesses for various fire resistance classes (R0 to R90)

according to approval ETA-06/0138
ÖNORM EN 1995-1-1:2009 and ÖNORM B 1995-1-1:2010
ÖNORM EN 1995-1-2:2011 and ÖNORM B 1995-1-2:2011

Constant load	Imposed load	HEIGHT OF EXTERIOR WALL (buckling length, ℓ)											
g_k*)	n_k	2.40 m				2.72 m				2.95 m			
[kN/m]	[kN/m]	R 0	R 30	R 60	R 90	R 0	R 30	R 60	R 90	R 0	R 30	R 60	R 90
10.00	10.00	3s 57 TT	3s 94 TT	5s 95 TT	5s 128 TT	3s 57 TT	3s 94 TT	5s 95 TT	5s 128 TT	3s 57 TT	3s 94 TT	5s 95 TT	5s 128 TT
	20.00												
	30.00												
	40.00												
	50.00									3s 72 TT			
	60.00											5s 125 TT	
20.00	10.00	3s 57 TT	3s 94 TT	5s 95 TT	5s 128 TT	3s 57 TT	3s 94 TT	5s 95 TT	5s 128 TT	3s 57 TT	3s 94 TT	5s 95 TT	5s 128 TT
	20.00												
	30.00												
	40.00									3s 72 TT		5s 125 TT	
	50.00							5s 125 TT					
	60.00					3s 72 TT							
30.00	10.00	3s 57 TT	3s 94 TT	5s 95 TT	5s 128 TT	3s 57 TT	3s 94 TT	5s 95 TT	5s 128 TT	3s 57 TT	3s 94 TT	5s 95 TT	5s 128 TT
	20.00												
	30.00							5s 125 TT		3s 72 TT		5s 125 TT	
	40.00												
	50.00			5s 125 TT		3s 72 TT			5s 158 TT				5s 158 TT
	60.00												
40.00	10.00	3s 57 TT	3s 94 TT	5s 95 TT	5s 128 TT	3s 57 TT	3s 94 TT	5s 125 TT	5s 128 TT	3s 57 TT	3s 94 TT	5s 125 TT	5s 128 TT
	20.00												
	30.00			5s 125 TT						3s 72 TT			5s 158 TT
	40.00					3s 72 TT			5s 158 TT				
	50.00												
	60.00	3s 72 TT			5s 158 TT								
50.00	10.00	3s 57 TT	3s 94 TT	5s 125 TT	5s 128 TT	3s 57 TT	3s 94 TT	5s 125 TT	5s 128 TT	3s 72 TT	3s 94 TT	5s 125 TT	5s 158 TT
	20.00												
	30.00								5s 158 TT				
	40.00				5s 158 TT	3s 72 TT					5s 95 TT		
	50.00	3s 72 TT					5s 95 TT						
	60.00												
60.00	10.00	3s 57 TT	3s 94 TT	5s 125 TT	5s 128 TT	3s 72 TT	3s 94 TT	5s 125 TT	5s 158 TT	3s 72 TT	3s 94 TT	5s 125 TT	5s 158 TT
	20.00												
	30.00				5s 158 TT						5s 95 TT		
	40.00	3s 72 TT					5s 95 TT			3s 94 TT			
	50.00												
	60.00												

*) in addition to the own weight of the KLH elements (the own weight of KLH is already taken into account in the table)

Fire resistance: R0 R30 R60 R90

Service class 1

Imposed load category A ($\psi_0 = 0.7$ and $\psi_2 = 0.3$): $k_{mod} = 0.8$
Wind loads ($\psi_0 = 0.6$ and $\psi_2 = 0$): $k_{mod} = 0.9$

Load-bearing capacity

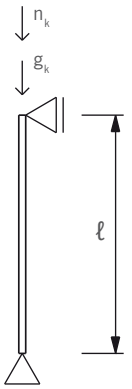
a) Test as a buckling bar (compression and deflection according to equivalent beam method)
b) Test of shear stress

Structural fire design (one-sided burn-off)

a) Charring rate $\beta_0 = 0.67$ mm/min if the burn-off only takes place in the covering layer or in the top double-layer
b) Charring rate $\beta_0 = 0.76$ mm/min if several layers are affected (for the entire time of fire exposure)
c) 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!

03 KLH AS AN INTERIOR WALL



No wind pressure
Minimum panel thicknesses for various fire resistance classes
(R0 to R90) in case of one-sided fire exposure

according to approval ETA-06/0138
ÖNORM EN 1995-1-1:2009 and ÖNORM B 1995-1-1:2010
ÖNORM EN 1995-1-2:2011 and ÖNORM B 1995-1-2:2011

Constant load	Imposed load	HEIGHT OF INTERIOR WALL (buckling length, ℓ)											
g_k*)	n_k	2.40 m				2.72 m				2.95 m			
[kN/m]	[kN/m]	R 0	R 30	R 60	R 90	R 0	R 30	R 60	R 90	R 0	R 30	R 60	R 90
10.00	10.00	3s 57 TT	3s 94 TT	5s 95 TT	5s 128 TT	3s 57 TT	3s 94 TT	5s 95 TT	5s 128 TT	3s 57 TT	3s 94 TT	5s 95 TT	5s 128 TT
	20.00												
	30.00												
	40.00												
	50.00												
	60.00									3s 72 TT		5s 125 TT	
20.00	10.00	3s 57 TT	3s 94 TT	5s 95 TT	5s 128 TT	3s 57 TT	3s 94 TT	5s 95 TT	5s 128 TT	3s 57 TT	3s 94 TT	5s 95 TT	5s 128 TT
	20.00												
	30.00												
	40.00											5s 125 TT	
	50.00							5s 125 TT		3s 72 TT			
	60.00												
30.00	10.00	3s 57 TT	3s 94 TT	5s 95 TT	5s 128 TT	3s 57 TT	3s 94 TT	5s 95 TT	5s 128 TT	3s 57 TT	3s 94 TT	5s 95 TT	5s 128 TT
	20.00												
	30.00							5s 125 TT				5s 125 TT	
	40.00												
	50.00			5s 125 TT						3s 72 TT			5s 158 TT
	60.00					3s 72 TT			5s 158 TT				
40.00	10.00	3s 57 TT	3s 94 TT	5s 95 TT	5s 128 TT	3s 57 TT	3s 94 TT	5s 125 TT	5s 128 TT	3s 57 TT	3s 94 TT	5s 125 TT	5s 128 TT
	20.00												
	30.00			5s 125 TT									5s 158 TT
	40.00								5s 158 TT	3s 72 TT			
	50.00					3s 72 TT							
	60.00				5s 158 TT								
50.00	10.00	3s 57 TT	3s 94 TT	5s 125 TT	5s 128 TT	3s 57 TT	3s 94 TT	5s 125 TT	5s 128 TT	3s 57 TT	3s 94 TT	5s 125 TT	5s 158 TT
	20.00												
	30.00								5s 158 TT				
	40.00				5s 158 TT	3s 72 TT				3s 72 TT			
	50.00										5s 95 TT		
	60.00	3s 72 TT											
60.00	10.00	3s 57 TT	3s 94 TT	5s 125 TT	5s 128 TT	3s 57 TT	3s 94 TT	5s 125 TT	5s 158 TT	3s 72 TT	3s 94 TT	5s 125 TT	5s 158 TT
	20.00												
	30.00												
	40.00				5s 158 TT	3s 72 TT					5s 95 TT		
	50.00	3s 72 TT					5s 95 TT						
	60.00												

*) in addition to the own weight of the KLH elements (the own weight of KLH is already taken into account in the table)

Fire resistance: R0 R30 R60 R90

Service class 1

Imposed load category A (ψ_0 = 0.7 and ψ_2 = 0.3): k_{mod} = 0.8

Load-bearing capacity

a) Test as a buckling bar (compression according to equivalent beam method)

Structural fire design (one-sided burn-off)

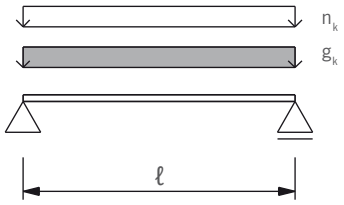
a) Charring rate β_0 = 0.67 mm/min if the burn-off only takes place in the covering layer or in the top double-layer
b) Charring rate β_0 = 0.76 mm/min if several layers are affected (for the entire time of fire exposure)
c) Additional eccentricity due to burn-off taken into account

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

04 KLH AS A CEILING – SINGLE-SPAN GIRDER

4.1 VIBRATION TEST FOR LOW REQUIREMENTS

Minimum panel thicknesses for R0 (cold dimensioning)



according to approval ETA-06/0138
ÖNORM EN 1995-1-1:2009 and ÖNORM B 1995-1-1:2010
ÖNORM EN 1995-1-2:2011 and ÖNORM B 1995-1-2:2011

Constant load	Imposed load		SPAN OF SINGLE-SPAN GIRDER, ℓ								
g_k*)		n_k	3.00 m	3.50 m	4.00 m	4.50 m	5.00 m	5.50 m	6.00 m	6.50 m	7.00 m
[kN/m²]	CAT	[kN/m²]									
1.00	A	1.50	3s 78 TL	3s 90 TL	3s 95 TL	3s 108 TL	3s 120 TL	5s 140 TL	5s 162 TL	5s 182 TL	5s 200 TL
		2.00					5s 140 TL				
		2.80			3s 108 TL	3s 120 TL		5s 145 TL		5s 200 TL	
	B	3.00						5s 162 TL	5s 182 TL		7s 201 TL
		3.50	3s 90 TL								
	C	4.00		3s 108 TL	3s 120 TL	5s 140 TL	5s 162 TL	5s 182 TL	5s 200 TL	7ss 208 TL	7ss 230 TL
		5.00	3s 95 TL	3s 120 TL	5s 140 TL	5s 145 TL	5s 182 TL	5s 200 TL	7ss 208 TL		
1.50	A	1.50	3s 78 TL	3s 90 TL	3s 108 TL	3s 120 TL	5s 140 TL	5s 162 TL	5s 182 TL	5s 200 TL	5s 200 TL
		2.00	3s 90 TL								7s 201 TL
		2.80		3s 95 TL							7ss 208 TL
	B	3.00				5s 140 TL					
		3.50			3s 120 TL		5s 145 TL		5s 200 TL		
	C	4.00	3s 95 TL	3s 120 TL	5s 140 TL	5s 145 TL	5s 182 TL	5s 200 TL	7s 201 TL	7ss 208 TL	7ss 230 TL
		5.00	3s 108 TL			5s 162 TL			7ss 208 TL	7ss 230 TL	7ss 248 TL
2.00	A	1.50	3s 90 TL	3s 95 TL	3s 108 TL	5s 140 TL	5s 140 TL	5s 162 TL	5s 182 TL	5s 200 TL	7ss 208 TL
		2.00					5s 145 TL				
		2.80		3s 108 TL	3s 120 TL		5s 162 TL	5s 182 TL	5s 200 TL	7ss 208 TL	
	B	3.00									
		3.50									
	C	4.00	3s 95 TL	3s 120 TL	5s 140 TL	5s 162 TL	5s 182 TL	5s 200 TL	7ss 208 TL	7ss 230 TL	7ss 248 TL
		5.00	3s 108 TL				5s 200 TL				
2.50	A	1.50	3s 90 TL	3s 108 TL	3s 120 TL	5s 140 TL	5s 162 TL	5s 182 TL	5s 200 TL	7ss 208 TL	7ss 208 TL
		2.00									
		2.80									7ss 230 TL
	B	3.00			5s 140 TL			5s 200 TL			
		3.50									
	C	4.00	3s 108 TL	3s 120 TL		5s 162 TL	5s 200 TL		7ss 208 TL	7ss 230 TL	7ss 248 TL
		5.00		5s 140 TL	5s 145 TL	5s 182 TL		7ss 208 TL		7ss 248 TL	
3.00	A	1.50	3s 90 TL	3s 108 TL	3s 120 TL	5s 140 TL	5s 162 TL	5s 182 TL	5s 200 TL	7ss 208 TL	7ss 230 TL
		2.00									
		2.80			5s 140 TL			5s 200 TL	7s 201 TL		
	B	3.00	3s 95 TL	3s 120 TL		5s 145 TL	5s 182 TL				
		3.50							7ss 208 TL		
	C	4.00	3s 108 TL		5s 145 TL	5s 182 TL	5s 200 TL	7ss 208 TL		7ss 230 TL	7ss 248 TL
		5.00		5s 140 TL	5s 162 TL				7ss 230 TL	7ss 248 TL	7ss 260 TL

*) in addition to the own weight of the KLH elements (the own weight of KLH is already taken into account in the table)

Fire resistance: R0 R30 R60 R90

Service class 1

$k_{def} = 0.8$

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 $\psi_2 = 0.6$): $k_{mod} = 0.9$

Deflection limits according to ÖNORM EN 1995-1-1:2010

a) characteristic structural 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 test according to Eurocode 5 and Kreuzinger / Mohr

a) Attenuation factor $\varsigma = 2.5$ %; cement screed 5 cm; room width b = 1.2* ℓ
b) $f_1 \geq 4.5$ Hz; $w_F \leq 1.5$ mm/kN; $v < v_{limit}$; $a < 0.40$ m/s^2 (vibrations noticeable but not disturbing)

Load-bearing capacity

a) Test of bending stress
b) Test of shear stress

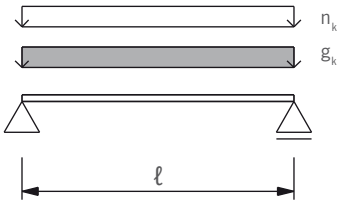
Structural fire design (one-sided burn-off)

a) Charring rate $\beta_0 = 0.67$ mm/min if the burn-off only takes place in the covering layer or in the top double-layer
b) Charring rate $\beta_0 = 0.76$ mm/min if several layers are affected (for the entire time of fire exposure)
c) The minimum panel thicknesses (for R0) 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!

4.2 VIBRATION TEST FOR INCREASED REQUIREMENTS

Minimum panel thicknesses for R0 (cold dimensioning)



according to approval ETA-06/0138
ÖNORM EN 1995-1-1:2009 and ÖNORM B 1995-1-1:2010
ÖNORM EN 1995-1-2:2011 and ÖNORM B 1995-1-2:2011

Constant load	Imposed load		SPAN OF SINGLE-SPAN GIRDER, ℓ								
g_k*)		n_k	3.00 m	3.50 m	4.00 m	4.50 m	5.00 m	5.50 m	6.00 m	6.50 m	7.00 m
[kN/m²]	CAT	[kN/m²]									
1.00	A	1.50	3s 78 TL	3s 90 TL	3s 120 TL	5s 140 TL	5s 162 TL	5s 200 TL	7ss 208 TL	7ss 208 TL	7ss 230 TL
		2.00		3s 95 TL							
		2.80	3s 90 TL				5s 182 TL				
	B	3.00		3s 108 TL		5s 145 TL					
		3.50									
	C	4.00	3s 95 TL	3s 120 TL	5s 140 TL	5s 182 TL				7ss 230 TL	7ss 248 TL
		5.00	3s 108 TL		5s 162 TL		5s 200 TL				7ss 260 TL
1.50	A	1.50	3s 90 TL	3s 108 TL	3s 120 TL	5s 145 TL	5s 182 TL	5s 200 TL	7s 201 TL	7s 201 TL	7ss 208 TL
		2.00									
		2.80			5s 140 TL	5s 162 TL				7ss 208 TL	7ss 230 TL
	B	3.00					5s 200 TL				
		3.50									
	C	4.00	3s 95 TL	3s 120 TL	5s 145 TL				7ss 208 TL	7ss 230 TL	7ss 248 TL
		5.00	3s 108 TL	5s 140 TL	5s 162 TL	5s 182 TL				7ss 248 TL	7ss 260 TL
2.00	A	1.50	3s 90 TL	3s 108 TL	5s 140 TL	5s 162 TL	5s 200 TL	5s 200 TL	7s 201 TL	7ss 208 TL	7ss 230 TL
		2.00									
		2.80		3s 120 TL							7ss 248 TL
	B	3.00				5s 182 TL			7ss 208 TL	7ss 248 TL	7ss 260 TL
		3.50						7s 201 TL	7ss 230 TL		7ss 280 TL
	C	4.00	3s 108 TL	5s 140 TL	5s 162 TL						
		5.00									
2.50	A	1.50	3s 90 TL	3s 120 TL	5s 140 TL	5s 162 TL	5s 182 TL	5s 200 TL	7s 201 TL	7ss 208 TL	7ss 230 TL
		2.00				5s 182 TL					7ss 248 TL
		2.80	3s 95 TL						7ss 208 TL	7ss 230 TL	
	B	3.00						7s 201 TL			
		3.50						7ss 208 TL			
	C	4.00	3s 108 TL	5s 140 TL	5s 162 TL		5s 200 TL		7ss 230 TL	7ss 248 TL	7ss 280 TL
		5.00									
3.00	A	1.50	3s 95 TL	3s 120 TL	5s 140 TL	5s 182 TL	5s 182 TL	5s 200 TL	7ss 208 TL	7ss 230 TL	7ss 248 TL
		2.00			5s 145 TL						
		2.80									
	B	3.00									7ss 260 TL
		3.50	3s 108 TL		5s 162 TL						
	C	4.00		5s 140 TL			5s 200 TL	7ss 208 TL	7ss 230 TL	7ss 248 TL	7ss 280 TL
		5.00	3s 120 TL							7ss 260 TL	8ss 300 TL

*) in addition to the own weight of the KLH elements (the own weight of KLH is already taken into account in the table)

Fire resistance: : R0 R30 R60 R90

Service class 1

$k_{def} = 0.8$

Imposed load categories 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 $\psi_2 = 0.6$): $k_{mod} = 0.9$

Deflection limits according to ÖNORM EN 1995-1-1:2010

a) characteristic structural 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 test according to Eurocode 5 and Kreuzinger / Mohr

a) Attenuation factor $\varsigma = 2.5$ %; cement screed 5 cm; room width b = 1.2* ℓ
b) $f_1 \geq 4.5$ Hz; $w_F \leq 1.5$ mm/kN; $v < v_{limit}$; $a < 0.10$ m/s² (vibrations considered to be disturbing)
c) Vibration acceleration was tested with an imposed load of the category C, in addition with $\psi_2 = 0.3$

Load-bearing capacity

a) Test of bending stress
b) Test of shear stress

Structural fire design (one-sided burn-off)

a) Charring rate $\beta_0 = 0.67$ mm/min if the burn-off only takes place in the covering layer or in the top double-layer
b) Charring rate $\beta_0 = 0.76$ mm/min if several layers are affected (for the entire time of fire exposure)
c) The minimum panel thicknesses (for R0) automatically reach fire resistance according to coloured marking

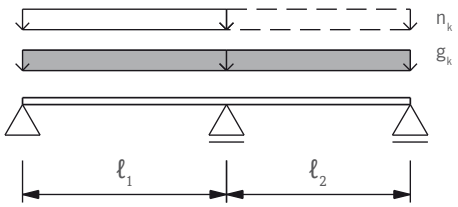
This table is only intended for structural pre-analysis purposes and does not replace necessary static calculations!

05 KLH AS A CEILING – DOUBLE-SPAN GIRDER

5.1 VIBRATION TEST FOR LOW REQUIREMENTS

Minimum panel thicknesses for R0 (cold dimensioning)
Imposed load not favourable in some spans

according to approval ETA-06/0138
ÖNORM EN 1995-1-1:2009 and ÖNORM B 1995-1-1:2010
ÖNORM EN 1995-1-2:2011 and ÖNORM B 1995-1-2:2011



Constant load g_k*)		Imposed load n_k	SPAN OF DOUBLE-SPAN GIRDER ℓ_1 ℓ_2 = 0.8*ℓ_1 to 1.0*ℓ_1								
[kN/m²]	CAT	[kN/m²]	3.00 m	3.50 m	4.00 m	4.50 m	5.00 m	5.50 m	6.00 m	6.50 m	7.00 m
1.00	A	1.50	3s 57 TL	3s 78 TL	3s 78 TL	3s 90 TL	3s 108 TL	3s 120 TL	5s 140 TL	5s 140 TL	5s 140 TL
		2.00			3s 90 TL						5s 145 TL
		2.80	3s 78 TL					5s 140 TL			5s 162 TL
	B	3.00				3s 95 TL				5s 145 TL	
		3.50		3s 90 TL		3s 108 TL	3s 120 TL			5s 162 TL	5s 182 TL
	C	4.00			3s 108 TL	3s 120 TL	5s 140 TL	5s 145 TL	5s 162 TL	5s 182 TL	5s 200 TL
		5.00	3s 90 TL	3s 95 TL				5s 162 TL	5s 182 TL	5s 200 TL	7s 201 TL
1.50	A	1.50	3s 78 TL	3s 78 TL	3s 90 TL	3s 90 TL	3s 108 TL	5s 140 TL	5s 140 TL	5s 140 TL	5s 162 TL
		2.00				3s 95 TL	3s 120 TL			5s 145 TL	
		2.80				3s 108 TL				5s 162 TL	5s 182 TL
	B	3.00		3s 90 TL							
		3.50									
	C	4.00	3s 90 TL		3s 108 TL	3s 120 TL	5s 140 TL	5s 162 TL	5s 182 TL	5s 200 TL	7s 201 TL
		5.00		3s 95 TL	3s 120 TL	5s 140 TL					7ss 208 TL
2.00	A	1.50	3s 78 TL	3s 78 TL	3s 90 TL	3s 108 TL	3s 120 TL	5s 140 TL	5s 140 TL	5s 162 TL	5s 182 TL
		2.00									
		2.80		3s 90 TL					5s 145 TL		
	B	3.00									
		3.50			3s 95 TL				5s 162 TL	5s 182 TL	5s 200 TL
	C	4.00	3s 90 TL	3s 95 TL	3s 108 TL	5s 140 TL	5s 140 TL	5s 162 TL	5s 182 TL	5s 200 TL	7ss 208 TL
		5.00		3s 108 TL	3s 120 TL		5s 145 TL	5s 182 TL	5s 200 TL		
2.50	A	1.50	3s 78 TL	3s 90 TL	3s 90 TL	3s 108 TL	3s 120 TL	5s 140 TL	5s 145 TL	5s 162 TL	5s 182 TL
		2.00									
		2.80			3s 95 TL	3s 120 TL	5s 140 TL		5s 162 TL	5s 182 TL	5s 200 TL
	B	3.00									
		3.50			3s 108 TL						
	C	4.00	3s 90 TL	3s 95 TL	3s 120 TL	5s 140 TL	5s 145 TL	5s 162 TL	5s 200 TL	5s 200 TL	7ss 208 TL
		5.00		3s 108 TL			5s 162 TL	5s 182 TL		7s 201 TL	
3.00	A	1.50	3s 78 TL	3s 90 TL	3s 95 TL	3s 120 TL	3s 120 TL	5s 140 TL	5s 162 TL	5s 182 TL	5s 200 TL
		2.00					5s 140 TL				
		2.80			3s 108 TL			5s 145 TL			
	B	3.00									
		3.50	3s 90 TL						5s 182 TL	5s 200 TL	
	C	4.00		3s 108 TL	3s 120 TL	5s 140 TL	5s 162 TL	5s 182 TL	5s 200 TL	7s 201 TL	7ss 208 TL
		5.00								7ss 208 TL	7ss 230 TL

*) in addition to the own weight of the KLH elements (the own weight of KLH is already taken into account in the table)

Fire resistance: R0 R30 R60 R90

Service class 1

$k_{def} = 0.8$

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 $\psi_2 = 0.6$): $k_{mod} = 0.9$

Deflection limits according to ÖNORM EN 1995-1-1:2010

a) characteristic structural 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 test according to Eurocode 5 and Kreuzinger / Mohr

a) Attenuation factor $\varsigma = 2.5$ %; cement screed 5 cm; room width b = 1.2* ℓ
b) $f_1 \geq 4.5$ Hz; $w_F \leq 1.0$ mm/kN; $v < v_{limit}$; $a < 0.40$ m/s^2 (vibrations noticeable but not disturbing)

Load-bearing capacity

a) Test of bending stress
b) Test of shear stress

Structural fire design (one-sided burn-off)

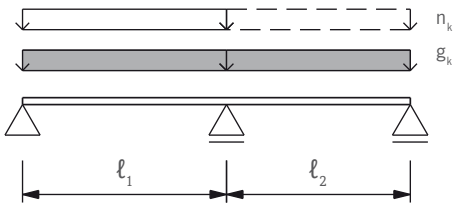
a) Charring rate $\beta_0 = 0.67$ mm/min if the burn-off only takes place in the covering layer or in the top double-layer
b) Charring rate $\beta_0 = 0.76$ mm/min if several layers are affected (for the entire time of fire exposure)
c) The minimum panel thicknesses (for R0) automatically reach fire resistance according to coloured marking

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

5.2 VIBRATION TEST FOR INCREASED REQUIREMENTS

Minimum panel thicknesses for R0 (cold dimensioning)
Imposed load not favourable in some spans

according to approval ETA-06/0138
ÖNORM EN 1995-1-1:2009 and ÖNORM B 1995-1-1:2010
ÖNORM EN 1995-1-2:2011 and ÖNORM B 1995-1-2:2011



Constant load g_k*)		Imposed load n_k	SPAN OF DOUBLE-SPAN GIRDER, ℓ_1 ℓ_2 = 0.8*ℓ_1 to 1,0*ℓ_1								
[kN/m²]	CAT	[kN/m²]	3.00 m	3.50 m	4.00 m	4.50 m	5.00 m	5.50 m	6.00 m	6.50 m	7.00 m
1.00	A	1.50	3s 60 TL	3s 78 TL	3s 90 TL	3s 120 TL	5s 140 TL	5s 162 TL	5s 182 TL	5s 182 TL	5s 182 TL
		2.00			3s 95 TL						
		2.80	3s 78 TL	3s 90 TL	3s 108 TL			5s 182 TL			5s 200 TL
	B	3.00				5s 140 TL	5s 145 TL				
		3.50									
	C	4.00		3s 108 TL	5s 140 TL	5s 145 TL	5s 162 TL			5s 200 TL	7ss 230 TL
		5.00	3s 90 TL			5s 162 TL			5s 200 TL	7ss 208 TL	
1.50	A	1.50	3s 78 DL	3s 90 TL	3s 108 TL	5s 140 TL	5s 145 TL	5s 182 TL	5s 182 TL	5s 182 TL	5s 200 TL
		2.00									
		2.80									
	B	3.00					5s 162 TL				
		3.50			3s 120 TL						7s 201 TL
	C	4.00	3s 90 TL	3s 108 TL	5s 140 TL	5s 162 TL			5s 200 TL	7ss 208 TL	7ss 230 TL
		5.00		3s 120 TL							7ss 248 TL
2.00	A	1.50	3s 78 TL	3s 90 TL	3s 108 TL	5s 140 TL	5s 162 TL	5s 162 TL	5s 182 TL	5s 182 TL	5s 200 TL
		2.00			3s 120 TL					5s 200 TL	7ss 208 TL
		2.80									
	B	3.00		3s 95 TL							
		3.50									
	C	4.00	3s 90 TL	3s 120 TL	5s 140 TL			5s 182 TL	5s 200 TL	7ss 208 TL	7ss 248 TL
		5.00				5s 145 TL			7s 201 TL	7ss 230 TL	
2.50	A	1.50	3s 78 TL	3s 95 TL	3s 120 TL	5s 140 TL	5s 162 TL	5s 162 TL	5s 182 TL	5s 200 TL	7ss 208 TL
		2.00									
		2.80		3s 108 TL		5s 145 TL					7ss 230 TL
	B	3.00									
		3.50			5s 140 TL						
	C	4.00	3s 90 TL	3s 120 TL		5s 162 TL		5s 182 TL	5s 200 TL	7ss 230 TL	7ss 248 TL
		5.00							7ss 208 TL		
3.00	A	1.50	3s 78 TL	3s 108 TL	5s 140 TL	5s 145 TL	5s 162 TL	5s 162 TL	5s 182 TL	5s 200 TL	7ss 230 TL
		2.00								7s 201 TL	
		2.80	3s 90 TL			5s 162 TL			5s 200 TL	7ss 208 TL	
	B	3.00									
		3.50									
	C	4.00		3s 120 TL				5s 182 TL	7s 201 TL	7ss 230 TL	7ss 248 TL
		5.00	3s 95 TL					5s 200 TL	7ss 208 TL		7ss 260 TL

*) in addition to the own weight of the KLH elements (the own weight of KLH is already taken into account in the table)

Fire resistance: : R0 R30 R60 R90

Service class 1

$k_{def} = 0.8$

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 $\psi_2 = 0.6$): $k_{mod} = 0.9$

Deflection limits according to ÖNORM EN 1995-1-1:2010

a) characteristic structural 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 test according to Eurocode 5 and Kreuzinger / Mohr

a) Attenuation factor $\varsigma = 2.5$ %; cement screed 5 cm; room width b = 1.2* ℓ
b) $f_1 \geq 4.5$ Hz; $w_F \leq 1.0$ mm/kN; $v < v_{limit}$; $a < 0.10$ m/s^2 (vibrations considered to be disturbing)
c) Vibration acceleration was tested with an imposed load of the category C, in addition with $\psi_2 = 0.3$

Load-bearing capacity

a) Test of bending stress
b) Test of shear stress

Structural fire design (one-sided burn-off)

a) Charring rate $\beta_0 = 0.67$ mm/min if the burn-off only takes place in the covering layer or in the top double-layer
b) Charring rate $\beta_0 = 0.76$ mm/min if several layers are affected (for the entire time of fire exposure)
c) The minimum panel thicknesses (for R0) automatically reach fire resistance according to coloured marking

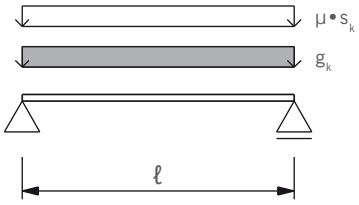
This table is only intended for structural pre-analysis purposes and does not replace necessary static calculations!

06 KLH AS A ROOF – SINGLE-SPAN GIRDER

Deflection

Appearance and avoidance of damage

Minimum panel thicknesses for R0 (cold dimensioning)



according to approval ETA-06/0138

ÖNORM EN 1995-1-1:2009 and ÖNORM B 1995-1-1:2010

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

Constant load g_k*)	Snow load on roof $s = \mu^* s_k$	SPAN OF SINGLE-SPAN GIRDER, ℓ								
[kN/m²]	[kN/m²]	3.00 m	3.50 m	4.00 m	4.50 m	5.00 m	5.50 m	6.00 m	6.50 m	7.00 m
0.50	1.00	3s 57 TL	3s 78 TL	3s 78 TL	3s 90 TL	3s 95 TL	3s 108 TL	3s 120 TL	5s 140 TL	5s 145 TL
	2.00	3s 78 TL		3s 90 TL	3s 95 TL	3s 108 TL	3s 120 TL	5s 140 TL		5s 162 TL
	3.00		3s 90 TL	3s 95 TL	3s 108 TL	3s 120 TL	5s 140 TL	5s 145 TL	5s 162 TL	5s 182 TL
	4.00	3s 90 TL		3s 108 TL	3s 120 TL	5s 140 TL	5s 145 TL	5s 162 TL	5s 182 TL	5s 200 TL
	5.00		3s 108 TL	3s 120 TL	5s 140 TL	5s 145 TL	5s 162 TL	5s 182 TL	5s 200 TL	7ss 208 TL
	6.00					5s 162 TL	5s 182 TL	5s 200 TL	7ss 208 TL	
	7.00	3s 95 TL	3s 120 TL	5s 140 TL	5s 145 TL	5s 182 TL	5s 200 TL			7ss 230 TL
1.00	1.00	3s 78 TL	3s 78 TL	3s 90 TL	3s 95 TL	3s 108 TL	3s 120 TL	5s 140 TL	5s 162 TL	5s 182 TL
	2.00									
	3.00		3s 90 TL	3s 95 TL	3s 108 TL	3s 120 TL	5s 140 TL	5s 145 TL		
	4.00	3s 90 TL		3s 108 TL	3s 120 TL	5s 140 TL	5s 145 TL	5s 162 TL	5s 182 TL	5s 200 TL
	5.00		3s 108 TL	3s 120 TL	5s 140 TL	5s 145 TL	5s 162 TL	5s 182 TL	5s 200 TL	7ss 208 TL
	6.00					5s 162 TL	5s 182 TL	5s 200 TL	7ss 208 TL	
	7.00	3s 95 TL	3s 120 TL	5s 140 TL	5s 145 TL	5s 182 TL	5s 200 TL			7ss 230 TL
1.50	1.00	3s 78 TL	3s 90 TL	3s 95 TL	3s 108 TL	3s 120 TL	5s 140 TL	5s 162 TL	5s 182 TL	5s 200 TL
	2.00									
	3.00									
	4.00	3s 90 TL		3s 108 TL	3s 120 TL	5s 140 TL	5s 145 TL			
	5.00		3s 108 TL	3s 120 TL	5s 140 TL	5s 145 TL	5s 162 TL	5s 182 TL	5s 200 TL	7ss 208 TL
	6.00					5s 162 TL	5s 182 TL	5s 200 TL	7ss 208 TL	
	7.00	3s 95 TL	3s 120 TL	5s 140 TL	5s 145 TL	5s 182 TL	5s 200 TL			7ss 230 TL
2.00	1.00	3s 78 TL	3s 90 TL	3s 108 TL	3s 120 TL	5s 140 TL	5s 162 TL	5s 182 TL	5s 200 TL	5s 200 TL
	2.00									
	3.00									
	4.00	3s 90 TL								
	5.00		3s 108 TL	3s 120 TL	5s 140 TL	5s 145 TL				7ss 208 TL
	6.00					5s 162 TL	5s 182 TL	5s 200 TL	7ss 208 TL	
	7.00	3s 95 TL	3s 120 TL	5s 140 TL	5s 145 TL	5s 182 TL	5s 200 TL			7ss 230 TL
2.50	1.00	3s 90 TL	3s 95 TL	3s 120 TL	5s 140 TL	5s 140 TL	5s 162 TL	5s 182 TL	5s 200 TL	7ss 208 TL
	2.00									
	3.00									
	4.00									
	5.00		3s 108 TL			5s 145 TL	5s 182 TL			
	6.00					5s 162 TL		5s 200 TL	7ss 208 TL	
	7.00	3s 95 TL	3s 120 TL	5s 140 TL	5s 145 TL	5s 182 TL	5s 200 TL			7ss 230 TL

*) in addition to the own weight of the KLH elements (the own weight of KLH is already taken into account in the table)

Fire resistance: R0 R30 R60 R90

Service class 1

$k_{def} = 0.8$

Snow load at an altitude ≤ 1.000m above sea level ($\psi_0 = 0.5$ and $\psi_2 = 0$): $k_{mod} = 0.9$

Deflection limits according to ÖNORM EN 1995-1-1:2010

a) characteristic structural 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) Test of bending stress
b) Test of shear stress

Structural fire design (one-sided burn-off)

a) Charring rate $\beta_0 = 0.67$ mm/min if the burn-off only takes place in the covering layer or in the top double-layer
b) Charring rate $\beta_0 = 0.76$ mm/min if several layers are affected (for the entire time of fire exposure)
c) The minimum panel thicknesses (for R0) automatically reach fire resistance according to coloured marking

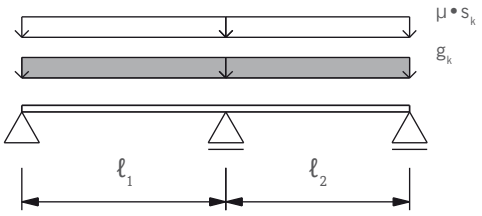
This table is only intended for structural pre-analysis purposes and does not replace necessary static calculations!

07 KLH AS A ROOF – DOUBLE-SPAN GIRDER

Deflection

Appearance and avoidance of damage
Minimum panel thicknesses for R0 (cold dimensioning)
Snow load evenly distributed on both spans

according to approval ETA-06/0138
ÖNORM EN 1995-1-1:2009 and ÖNORM B 1995-1-1:2010
ÖNORM EN 1995-1-2:2011 and ÖNORM B 1995-1-2:2011



Constant load g_k*)	Snow load on roof $s = \mu^* s_k$	SPAN OF DOUBLE-SPAN GIRDER, ℓ_1 $\ell_2 = 0{,}8^*\ell_1$ to $1{,}0^*\ell_1$								
[kN/m²]	[kN/m²]	3.00 m	3.50 m	4.00 m	4.50 m	5.00 m	5.50 m	6.00 m	6.50 m	7.00 m
0.50	1.00	3s 57 TL	3s 57 TL	3s 78 TL	3s 78 TL	3s 90 TL	3s 90 TL	3s 95 TL	3s 108 TL	3s 120 TL
	2.00									
	3.00		3s 78 TL		3s 90 TL	3s 95 TL	3s 108 TL	3s 120 TL	3s 120 TL	5s 140 TL
	4.00	3s 78 TL		3s 90 TL		3s 108 TL	3s 120 TL	5s 140 TL	5s 140 TL	5s 145 TL
	5.00		3s 90 TL		3s 108 TL	3s 120 TL	5s 140 TL		5s 145 TL	5s 162 TL
	6.00			3s 95 TL				5s 145 TL	5s 162 TL	
	7.00			3s 108 TL	3s 120 TL	5s 140 TL		5s 162 TL	5s 182 TL	5s 182 TL
1.00	1.00	3s 57 TL	3s 78 TL	3s 78 TL	3s 90 TL	3s 90 TL	3s 90 TL	3s 108 TL	3s 120 TL	5s 140 TL
	2.00									
	3.00					3s 95 TL	3s 108 TL	3s 120 TL		
	4.00	3s 78 TL		3s 90 TL		3s 108 TL	3s 120 TL	5s 140 TL	5s 140 TL	5s 145 TL
	5.00		3s 90 TL		3s 108 TL	3s 120 TL	5s 140 TL		5s 162 TL	5s 162 TL
	6.00			3s 95 TL				5s 145 TL		5s 182 TL
	7.00			3s 108 TL	3s 120 TL	5s 140 TL		5s 162 TL	5s 182 TL	5s 200 TL
1.50	1.00	3s 57 TL	3s 78 TL	3s 90 TL	3s 90 TL	3s 90 TL	3s 108 TL	3s 120 TL	5s 140 TL	5s 140 TL
	2.00									
	3.00					3s 95 TL				
	4.00	3s 78 TL				3s 108 TL	3s 120 TL	5s 140 TL		5s 145 TL
	5.00		3s 90 TL		3s 108 TL	3s 120 TL	5s 140 TL		5s 162 TL	5s 162 TL
	6.00			3s 95 TL				5s 145 TL	5s 182 TL	5s 182 TL
	7.00			3s 108 TL	3s 120 TL	5s 140 TL		5s 162 TL		5s 200 TL
2.00	1.00	3s 78 TL	3s 78 TL	3s 90 TL	3s 90 TL	3s 108 TL	3s 120 TL	5s 140 TL	5s 140 TL	5s 145 TL
	2.00									
	3.00									
	4.00				3s 95 TL					5s 162 TL
	5.00		3s 90 TL		3s 108 TL	3s 120 TL	5s 140 TL		5s 162 TL	5s 182 TL
	6.00			3s 95 TL	3s 120 TL			5s 145 TL	5s 182 TL	5s 200 TL
	7.00			3s 108 TL		5s 140 TL	5s 145 TL	5s 162 TL	5s 200 TL	
2.50	1.00	3s 78 TL	3s 90 TL	3s 90 TL	3s 95 TL	3s 108 TL	3s 120 TL	5s 140 TL	5s 145 TL	5s 162 TL
	2.00									
	3.00									
	4.00									
	5.00				3s 108 TL	3s 120 TL	5s 140 TL	5s 145 TL	5s 162 TL	5s 182 TL
	6.00			3s 95 TL	3s 120 TL	5s 140 TL		5s 162 TL	5s 182 TL	5s 200 TL
	7.00	3s 90 TL		3s 108 TL			5s 162 TL	5s 182 TL	5s 200 TL	

*) in addition to the own weight of the KLH elements (the own weight of KLH is already taken into account in the table)

Fire resistance: R0 R30 R60 R90

Service class 1

$k_{def} = 0.8$

Snow load at an altitude ≤ 1.000m above sea level ($\psi_0 = 0.5$ and $\psi_2 = 0$): $k_{mod} = 0.9$

Deflection limits according to ÖNORM EN 1995-1-1:2010

a) characteristic structural 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) Test of bending stress
b) Test of shear stress

Structural fire design (one-sided burn-off)

a) Charring rate $\beta_0 = 0.67$ mm/min if the burn-off only takes place in the covering layer or in the top double-layer
b) Charring rate $\beta_0 = 0.76$ mm/min if several layers are affected (for the entire time of fire exposure)
c) The minimum panel thicknesses (for R0) 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!

NOTES

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