KLH®

MADE FOR BUILDING
BUILT FOR LIVING

STRUCTURAL PRE-ANALYSIS TABLES

IMPRINT

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CONTENT

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.

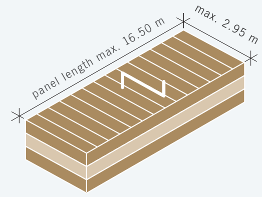
For the structural analysis of cross laminated timber, different models have been developed in the past. The structural analysis of KLH solid wood panels is based on the shear-elastic beam theory (according to Timoshenko) or the shear-elastic orthotropic plate (according to Reissner-Mindlin). The properties 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.

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
KLH	60 mm	3s	TT	20	20	20				
KLH	70 mm	3s	TT	25	20	25				
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	35	40	35				
KLH	120 mm	3s	TT	40	40	40				
KLH	100 mm	5s	TT	20	20	20	20	20		
KLH	110 mm	5s	TT	25	20	20	20	25		
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	30	20	30	30		
KLH	150 mm	5s	TT	30	35	20	35	30		
KLH	160 mm	5s	TT	30	35	30	35	30		
KLH	180 mm	7s	TT	30	20	30	20	30	20	30

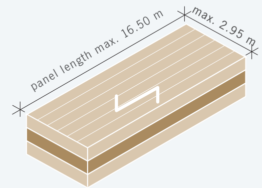


3s TT 5s TT 7s TT

FOR CEILING AND ROOF

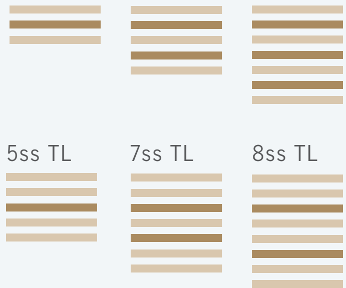
Covering layer in the longitudinal panel direction TL

				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	35	20	35				
KLH	100 mm	3s	TL	35	30	35				
KLH	110 mm	3s	TL	35	40	35				
KLH	120 mm	3s	TL	40	40	40				
KLH	100 mm	5s	TL	20	20	20	20	20		
KLH	110 mm	5s	TL	20	25	20	25	20		
KLH	120 mm	5s	TL	20	30	20	30	20		
KLH	130 mm	5s	TL	35	20	20	20	35		
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	25	40	25	40		
KLH	180 mm	5s	TL	40	30	40	30	40		
KLH	190 mm	5s	TL	40	35	40	35	40		
KLH	200 mm	5s	TL	40	40	40	40	40		
KLH	160 mm	5ss	TL	30+30	40	30+30				
KLH	200 mm	7s	TL	20	40	20	40	20	40	20
KLH	220 mm	7s	TL	30	35	30	30	30	35	30
KLH	240 mm	7s	TL	30	40	30	40	30	40	30
KLH	200 mm	7ss	TL	30+30	25	30	25	30+30		
KLH	210 mm	7ss	TL	30+30	30	30	30	30+30		
KLH	220 mm	7ss	TL	40+40	20	20	20	40+40		
KLH	230 mm	7ss	TL	35+40	20	40	20	40+35		
KLH	240 mm	7ss	TL	40+40	20	40	20	40+40		
KLH	250 mm	7ss	TL	35+40	30	40	30	40+35		
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		



3s TL 5s TL 7s TL

5ss TL 7ss TL 8ss TL



Special panel layups 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.

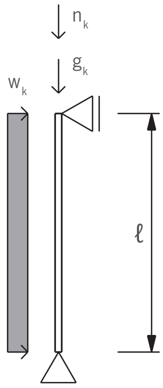
Charging widths
2.40 | 2.50 | 2.73 | 2.95 [m]

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

KLH

02 KLH AS A VISIBLE WALL

2.1 SINGLE-SIDED FIRE EXPOSURE (FOR EXTERIOR WALLS)



according to ETA-06/0138
ÖNORM EN 1995-1-1:2015 and ÖNORM B 1995-1-1:2015
ÖNORM EN 1995-1-2:2011 and ÖNORM B 1995-1-2:2011

Wind pressure: w_k = 0,8 kN/m²
Minimum panel thickness for various fire resistance classes (R 0 to R 90)

<table>
<tr><th>Permanent load</th><th>Imposed load</th><th colspan="8">HEIGHT WALL (buckling length ℓ)</th></tr>
<tr><th>$g_{2,k}$</th><th>n_k</th><th colspan="4">2,73 m</th><th colspan="4">2,95 m</th></tr>
<tr><th>[kN/m]</th><th>[kN/m]</th><th>R 0</th><th>R 30</th><th>R 60</th><th>R 90</th><th>R 0</th><th>R 30</th><th>R 60</th><th>R 90</th></tr>
<tr><td rowspan="6">10,00</td><td>10,00</td><td rowspan="6">3s 60 TT</td><td rowspan="6">3s 80 TT</td><td rowspan="6">5s 100 TT</td><td rowspan="6">5s 120 TT</td><td rowspan="6">3s 60 TT</td><td rowspan="6">3s 80 TT</td><td rowspan="6">5s 100 TT</td><td rowspan="6">5s 120 TT</td></tr>
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<tr><td>30,00</td></tr>
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<tr><td>30,00</td><td rowspan="4">3s 70 TT</td></tr>
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<tr><td>60,00</td></tr>
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<tr><td>50,00</td></tr>
<tr><td>60,00</td><td>3s 80 TT</td></tr>
</table>

R 0 | R 30 | R 60 | R 90

Service class 1

Imposed load category A (ψ_0 = 0,7 and ψ_2 = 0,3): k_{mod} = 0,8
Wind loads (ψ_0 = 0,6 and ψ_2 = 0,0): k_{mod} = 1,0
Self-weight of KLH is already taken into account in the table.

Load-bearing capacity

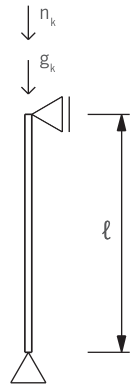
a) verification of column stability (compression and deflection according to equivalent member method)
b) verification of shear resistance

Structural fire design (single-sided fire exposure)

Application of KLHdesigner based on the „reduced properties method“ according to ETA-06/0138.
a) charring rate β_1 = 0,55 mm/min regular charring rate (charring within one single layer)
b) charring rate β_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!

2.2 DOUBLE-SIDED FIRE EXPOSURE (FOR INTERIOR WALLS)



according to ETA-06/0138
ÖNORM EN 1995-1-1:2015 and ÖNORM B 1995-1-1:2015
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)					
$g_{2,k}$	n_k	2,73 m			2,95 m		
[kN/m]	[kN/m]	R 0	R 30	R 60	R 0	R 30	R 60
10,00	10,00	3s 60 TT	3s 80 TT	7s 180 TT	3s 60 TT	3s 80 TT	7s 180 TT
10,00	20,00	3s 60 TT	3s 80 TT	7s 180 TT	3s 60 TT	3s 80 TT	7s 180 TT
10,00	30,00	3s 60 TT	3s 80 TT	7s 180 TT	3s 60 TT	3s 80 TT	7s 180 TT
10,00	40,00	3s 60 TT	3s 80 TT	7s 180 TT	3s 60 TT	3s 80 TT	7s 180 TT
10,00	50,00	3s 60 TT	3s 80 TT	7s 180 TT	3s 60 TT	3s 90 TT	7s 180 TT
10,00	60,00	3s 60 TT	3s 80 TT	7s 180 TT	3s 60 TT	3s 90 TT	7s 180 TT
20,00	10,00	3s 60 TT	3s 80 TT	7s 180 TT	3s 60 TT	3s 80 TT	7s 180 TT
20,00	20,00	3s 60 TT	3s 80 TT	7s 180 TT	3s 60 TT	3s 90 TT	7s 180 TT
20,00	30,00	3s 60 TT	3s 90 TT	7s 180 TT	3s 60 TT	3s 90 TT	7s 180 TT
20,00	40,00	3s 60 TT	3s 90 TT	7s 180 TT	3s 60 TT	3s 90 TT	7s 180 TT
20,00	50,00	3s 60 TT	3s 90 TT	7s 180 TT	3s 60 TT	3s 90 TT	7s 180 TT
20,00	60,00	3s 60 TT	3s 90 TT	7s 180 TT	3s 60 TT	3s 90 TT	7s 180 TT
30,00	10,00	3s 60 TT	3s 90 TT	7s 180 TT	3s 60 TT	3s 90 TT	7s 180 TT
30,00	20,00	3s 60 TT	3s 90 TT	7s 180 TT	3s 60 TT	3s 90 TT	7s 180 TT
30,00	30,00	3s 60 TT	3s 90 TT	7s 180 TT	3s 60 TT	3s 90 TT	7s 180 TT
30,00	40,00	3s 60 TT	3s 90 TT	7s 180 TT	3s 60 TT	3s 90 TT	7s 180 TT
30,00	50,00	3s 60 TT	3s 100 TT	7s 180 TT	3s 60 TT	3s 100 TT	7s 180 TT
30,00	60,00	3s 60 TT	3s 100 TT	7s 180 TT	3s 70 TT	3s 100 TT	7s 180 TT
40,00	10,00	3s 60 TT	3s 90 TT	7s 180 TT	3s 60 TT	3s 90 TT	7s 180 TT
40,00	20,00	3s 60 TT	3s 90 TT	7s 180 TT	3s 60 TT	3s 100 TT	7s 180 TT
40,00	30,00	3s 60 TT	3s 100 TT	7s 180 TT	3s 60 TT	3s 100 TT	7s 180 TT
40,00	40,00	3s 60 TT	3s 100 TT	7s 180 TT	3s 60 TT	3s 100 TT	7s 180 TT
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50,00	20,00	3s 60 TT	3s 100 TT	7s 180 TT	3s 60 TT	3s 100 TT	7s 180 TT
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60,00	20,00	3s 60 TT	3s 100 TT	7s 180 TT	3s 60 TT	3s 100 TT	7s 180 TT
60,00	30,00	3s 60 TT	3s 100 TT	7s 180 TT	3s 70 TT	3s 110 TT	7s 180 TT
60,00	40,00	3s 70 TT	3s 100 TT	7s 180 TT	3s 70 TT	3s 110 TT	7s 180 TT
60,00	50,00	3s 70 TT	3s 100 TT	7s 180 TT	3s 70 TT	3s 110 TT	7s 180 TT
60,00	60,00	3s 70 TT	3s 100 TT	7s 180 TT	3s 70 TT	3s 110 TT	7s 180 TT

R 0 R 30 R 60

Service class 1

Imposed load category A (ψ_0 = 0,7 and ψ_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)

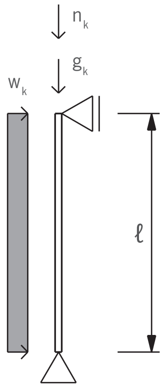
Structural fire design (double-sided fire exposure)

Application of KLHdesigner based on the „reduced properties method" according to ETA-06/0138.
a) charring rate β_1 = 0,55 mm/min regular charring rate (charring within one single layer)
b) charring rate β_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!

03 KLH AS A CLADDED WALL

3.1 SINGLE-SIDED FIRE EXPOSURE (FOR EXTERIOR WALLS)



according to ETA-06/0138
ÖNORM EN 1995-1-1:2015 and ÖNORM B 1995-1-1:2015
ÖNORM EN 1995-1-2:2011 and ÖNORM B 1995-1-2:2011

Wind pressure: w_k = 0,8 kN/m²
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

<table>
<tr><th>Permanent load</th><th>Imposed load</th><th colspan="8">HEIGHT WALL (buckling length ℓ)</th></tr>
<tr><th>$g_{2,k}$</th><th>n_k</th><th colspan="4">2,73 m</th><th colspan="4">2,95 m</th></tr>
<tr><th>[kN/m]</th><th>[kN/m]</th><th>R 30</th><th>R 60</th><th>R 90</th><th>R 120</th><th>R 30</th><th>R 60</th><th>R 90</th><th>R 120</th></tr>
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<tr><td>60,00</td></tr>
</table>

R 30 | R 60 | R 90 | R 120

Service class 1

Imposed load category A (ψ_0 = 0,7 and ψ_2 = 0,3): k_{mod} = 0,8
Wind loads (ψ_0 = 0,6 and ψ_2 = 0,0): k_{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

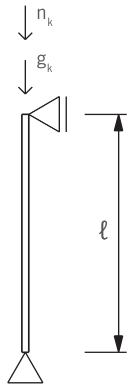
Structural fire design (single-sided fire exposure)

Application of KLHdesigner based on the „reduced properties method" according to ETA-06/0138.
a) charring rate β_1 = 0,55 mm/min regular charring rate (charring within one single layer)
b) charring rate β_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, srew-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!



3.2 DOUBLE-SIDED FIRE EXPOSURE (FOR INTERIOR WALLS)

according to ETA-06/0138
ÖNORM EN 1995-1-1:2015 and ÖNORM B 1995-1-1:2015
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 the fire exposed side

<table>
<tr><th>Permanent load</th><th>Imposed load</th><th colspan="8">HEIGHT WALL (buckling length ℓ)</th></tr>
<tr><th>$g_{2,k}$</th><th>n_k</th><th colspan="4">2,73 m</th><th colspan="4">2,95 m</th></tr>
<tr><th>[kN/m]</th><th>[kN/m]</th><th>R 30</th><th>R 60</th><th>R 90</th><th>R 120</th><th>R 30</th><th>R 60</th><th>R 90</th><th>R 120</th></tr>
<tr><td rowspan="6">10,00</td><td>10,00</td><td rowspan="6">3s 80 TT</td><td rowspan="6">3s 80 TT</td><td rowspan="6">3s 120 TT</td><td rowspan="6">3s 100 TT</td><td rowspan="6">3s 80 TT</td><td rowspan="6">3s 80 TT</td><td rowspan="6">3s 120 TT</td><td rowspan="6">3s 100 TT</td></tr>
<tr><td>20,00</td></tr>
<tr><td>30,00</td></tr>
<tr><td>40,00</td></tr>
<tr><td>50,00</td></tr>
<tr><td>60,00</td></tr>
<tr><td rowspan="6">20,00</td><td>10,00</td><td rowspan="6">3s 80 TT</td><td rowspan="6">3s 80 TT</td><td rowspan="6">3s 120 TT</td><td rowspan="6">3s 100 TT</td><td rowspan="6">3s 80 TT</td><td rowspan="6">3s 80 TT</td><td rowspan="6">3s 120 TT</td><td rowspan="6">3s 100 TT</td></tr>
<tr><td>20,00</td></tr>
<tr><td>30,00</td></tr>
<tr><td>40,00</td></tr>
<tr><td>50,00</td></tr>
<tr><td>60,00</td></tr>
<tr><td rowspan="6">30,00</td><td>10,00</td><td rowspan="6">3s 80 TT</td><td rowspan="6">3s 80 TT</td><td rowspan="6">3s 120 TT</td><td rowspan="6">3s 100 TT</td><td rowspan="6">3s 80 TT</td><td rowspan="6">3s 80 TT</td><td rowspan="6">3s 120 TT</td><td rowspan="6">3s 100 TT</td></tr>
<tr><td>20,00</td></tr>
<tr><td>30,00</td></tr>
<tr><td>40,00</td></tr>
<tr><td>50,00</td></tr>
<tr><td>60,00</td></tr>
<tr><td rowspan="6">40,00</td><td>10,00</td><td rowspan="6">3s 80 TT</td><td rowspan="6">3s 80 TT</td><td rowspan="6">3s 120 TT</td><td rowspan="6">3s 100 TT</td><td rowspan="6">3s 80 TT</td><td rowspan="6">3s 80 TT</td><td rowspan="5">3s 120 TT</td><td rowspan="6">3s 100 TT</td></tr>
<tr><td>20,00</td></tr>
<tr><td>30,00</td></tr>
<tr><td>40,00</td></tr>
<tr><td>50,00</td></tr>
<tr><td>60,00</td><td>3s 80 TT</td></tr>
<tr><td rowspan="6">50,00</td><td>10,00</td><td rowspan="6">3s 80 TT</td><td rowspan="6">3s 80 TT</td><td rowspan="5">3s 120 TT</td><td rowspan="6">3s 100 TT</td><td rowspan="6">3s 80 TT</td><td rowspan="3">3s 80 TT</td><td rowspan="2">3s 120 TT</td><td rowspan="6">3s 100 TT</td></tr>
<tr><td>20,00</td></tr>
<tr><td>30,00</td><td rowspan="4">3s 80 TT</td></tr>
<tr><td>40,00</td><td rowspan="3">3s 90 TT</td></tr>
<tr><td>50,00</td></tr>
<tr><td>60,00</td><td>3s 80 TT</td></tr>
<tr><td rowspan="6">60,00</td><td>10,00</td><td rowspan="6">3s 80 TT</td><td rowspan="3">3s 80 TT</td><td>3s 120 TT</td><td rowspan="6">3s 100 TT</td><td rowspan="6">3s 80 TT</td><td rowspan="6">3s 90 TT</td><td rowspan="6">3s 80 TT</td><td rowspan="6">3s 100 TT</td></tr>
<tr><td>20,00</td><td rowspan="5">3s 80 TT</td></tr>
<tr><td>30,00</td></tr>
<tr><td>40,00</td><td rowspan="3">3s 90 TT</td></tr>
<tr><td>50,00</td></tr>
<tr><td>60,00</td></tr>
</table>

with 1 x 15 mm GtF on both sides	R 30	R 60	R 90	
with 2 x 15 mm GtF on both sides			R 90	R 120

Service class 1

Imposed load category A (ψ_0 = 0,7 and ψ_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 β_1 = 0,55 mm/min regular charring rate (charring within one single layer)
b) charring rate β_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

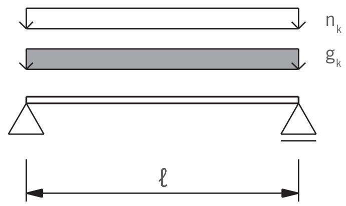
For the cladding directly to the KLH surface, srew-fastened fire rated gypsum plasterboards type F (GtF according to ÖNORM EN 520 and ÖNORM B 3410 or DIN 18180) or equivalent panels are required. The fastening needs to comply with the state of the art and the current KLH installation guidelines.

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

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 1995-1-1:2015 and ÖNORM B 1995-1-1:2015
ÖNORM EN 1995-1-2:2011 and ÖNORM B 1995-1-2:2011



Minimum panel thickness for a specific load-span-combination

<table>
<tr><th>Permanent load</th><th colspan="2">Imposed load</th><th colspan="5">SPAN OF SINGLE-SPAN BEAM ℓ</th></tr>
<tr><th>$g_{2,k}$</th><th colspan="2">n_k</th><th rowspan="2">3,00 m</th><th rowspan="2">4,00 m</th><th rowspan="2">5,00 m</th><th rowspan="2">6,00 m</th><th rowspan="2">7,00 m</th></tr>
<tr><th>[kN/m²]</th><th>category</th><th>[kN/m²]</th></tr>
<tr><td rowspan="7">1,00</td><td rowspan="3">A</td><td>1,50</td><td rowspan="7">5s 120 TL</td><td rowspan="5">5s 140 TL</td><td rowspan="7">5s 170 TL</td><td rowspan="7">7s 220 TL</td><td rowspan="5">7ss 260 TL</td></tr>
<tr><td>2,00</td></tr>
<tr><td>2,80</td></tr>
<tr><td rowspan="2">B</td><td>3,00</td></tr>
<tr><td>3,50</td></tr>
<tr><td rowspan="2">C</td><td>4,00</td><td rowspan="2">5s 140 TL</td><td rowspan="2">7ss 280 TL</td></tr>
<tr><td>5,00</td></tr>
<tr><td rowspan="7">1,50</td><td rowspan="3">A</td><td>1,50</td><td rowspan="7">5s 120 TL</td><td rowspan="5">5s 140 TL</td><td rowspan="7">5s 170 TL</td><td rowspan="7">7s 220 TL</td><td rowspan="7">7ss 280 TL</td></tr>
<tr><td>2,00</td></tr>
<tr><td>2,80</td></tr>
<tr><td rowspan="2">B</td><td>3,00</td></tr>
<tr><td>3,50</td></tr>
<tr><td rowspan="2">C</td><td>4,00</td><td rowspan="2">5s 140 TL</td></tr>
<tr><td>5,00</td></tr>
<tr><td rowspan="7">2,00</td><td rowspan="3">A</td><td>1,50</td><td rowspan="7">5s 120 TL</td><td rowspan="2">5s 140 TL</td><td rowspan="7">5s 180 TL</td><td rowspan="6">7s 220 TL</td><td rowspan="7">7ss 280 TL</td></tr>
<tr><td>2,00</td></tr>
<tr><td>2,80</td><td rowspan="5">5s 140 TL</td></tr>
<tr><td rowspan="2">B</td><td>3,00</td></tr>
<tr><td>3,50</td></tr>
<tr><td rowspan="2">C</td><td>4,00</td></tr>
<tr><td>5,00</td><td>7s 240 TL</td></tr>
<tr><td rowspan="7">2,50</td><td rowspan="3">A</td><td>1,50</td><td rowspan="7">5s 120 TL</td><td rowspan="7">5s 140 TL</td><td rowspan="7">5s 200 TL</td><td rowspan="5">7s 240 TL</td><td rowspan="7">7ss 280 TL</td></tr>
<tr><td>2,00</td></tr>
<tr><td>2,80</td></tr>
<tr><td rowspan="2">B</td><td>3,00</td></tr>
<tr><td>3,50</td></tr>
<tr><td rowspan="2">C</td><td>4,00</td><td rowspan="2">7s 240 TL</td></tr>
<tr><td>5,00</td></tr>
<tr><td rowspan="7">3,00</td><td rowspan="3">A</td><td>1,50</td><td rowspan="7">5s 120 TL</td><td rowspan="7">5s 150 TL</td><td rowspan="7">5s 200 TL</td><td rowspan="2">7s 240 TL</td><td rowspan="7">7ss 280 TL</td></tr>
<tr><td>2,00</td></tr>
<tr><td>2,80</td><td rowspan="4">7s 240 TL</td></tr>
<tr><td rowspan="2">B</td><td>3,00</td></tr>
<tr><td>3,50</td></tr>
<tr><td rowspan="2">C</td><td>4,00</td></tr>
<tr><td>5,00</td><td>7ss 250 TL</td></tr>
</table>

R 60 **R 90** **R 120**

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 1995-1-1:2015

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 1995-1-1:2015

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 $f_{1,min} \leq f_1 \leq f_{gr}$): $a_{rms} \leq a_{gr} = 0,05$ m/s²
e) floor slab width (b) ≤ 1,2 * span (1,2*l)

Load-bearing capacity

a) verification of bending resistance
b) verification of shear resistance

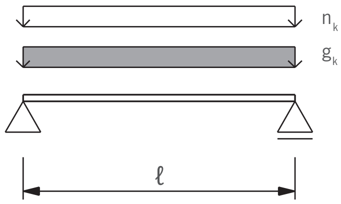
Structural fire design (single-sided fire exposure)

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!

4.2 VERIFICATION OF VIBRATION WITH HIGH REQUIREMENTS (DRY SCREED)

according to ETA-06/0138
ÖNORM EN 1995-1-1:2015 and ÖNORM B 1995-1-1:2015
ÖNORM EN 1995-1-2:2011 and ÖNORM B 1995-1-2:2011



Minimum panel thickness for a specific load-span-combination

<table>
<tr><th>Permanent load</th><th colspan="2">Imposed load</th><th colspan="5">SPAN OF SINGLE-SPAN BEAM ℓ</th></tr>
<tr><th>$g_{2,k}$</th><th colspan="2">n_k</th><th rowspan="2">3,00 m</th><th rowspan="2">4,00 m</th><th rowspan="2">5,00 m</th><th rowspan="2">6,00 m</th><th rowspan="2">7,00 m</th></tr>
<tr><th>[kN/m²]</th><th>category</th><th>[kN/m²]</th></tr>
<tr><td rowspan="7">1,00</td><td rowspan="3">A</td><td>1,50</td><td rowspan="7">5s 130 TL</td><td rowspan="7">5s 150 TL</td><td rowspan="7">5s 170 TL</td><td rowspan="7">7s 220 TL</td><td rowspan="7">7ss 280 TL</td></tr>
<tr><td>2,00</td></tr>
<tr><td>2,80</td></tr>
<tr><td rowspan="2">B</td><td>3,00</td></tr>
<tr><td>3,50</td></tr>
<tr><td rowspan="2">C</td><td>4,00</td></tr>
<tr><td>5,00</td></tr>
<tr><td rowspan="7">1,50</td><td rowspan="3">A</td><td>1,50</td><td rowspan="7">5s 130 TL</td><td rowspan="7">5s 150 TL</td><td rowspan="7">5s 170 TL</td><td rowspan="7">7s 220 TL</td><td rowspan="7">7ss 280 TL</td></tr>
<tr><td>2,00</td></tr>
<tr><td>2,80</td></tr>
<tr><td rowspan="2">B</td><td>3,00</td></tr>
<tr><td>3,50</td></tr>
<tr><td rowspan="2">C</td><td>4,00</td></tr>
<tr><td>5,00</td></tr>
<tr><td rowspan="7">2,00</td><td rowspan="3">A</td><td>1,50</td><td rowspan="7">5s 130 TL</td><td rowspan="7">5s 150 TL</td><td rowspan="7">5s 190 TL</td><td rowspan="5">7s 240 TL</td><td rowspan="7">7ss 280 TL</td></tr>
<tr><td>2,00</td></tr>
<tr><td>2,80</td></tr>
<tr><td rowspan="2">B</td><td>3,00</td></tr>
<tr><td>3,50</td></tr>
<tr><td rowspan="2">C</td><td>4,00</td><td rowspan="2">7s 240 TL</td></tr>
<tr><td>5,00</td></tr>
<tr><td rowspan="7">2,50</td><td rowspan="3">A</td><td>1,50</td><td rowspan="7">5s 130 TL</td><td rowspan="7">5s 150 TL</td><td rowspan="7">5s 200 TL</td><td rowspan="5">7s 240 TL</td><td rowspan="7">7ss 280 TL</td></tr>
<tr><td>2,00</td></tr>
<tr><td>2,80</td></tr>
<tr><td rowspan="2">B</td><td>3,00</td></tr>
<tr><td>3,50</td></tr>
<tr><td rowspan="2">C</td><td>4,00</td><td rowspan="2">7s 240 TL</td></tr>
<tr><td>5,00</td></tr>
<tr><td rowspan="7">3,00</td><td rowspan="3">A</td><td>1,50</td><td rowspan="7">5s 130 TL</td><td rowspan="7">5s 150 TL</td><td rowspan="7">5s 200 TL</td><td rowspan="2">7s 240 TL</td><td rowspan="7">7ss 280 TL</td></tr>
<tr><td>2,00</td></tr>
<tr><td>2,80</td><td rowspan="4">7s 240 TL</td></tr>
<tr><td rowspan="2">B</td><td>3,00</td></tr>
<tr><td>3,50</td></tr>
<tr><td rowspan="2">C</td><td>4,00</td></tr>
<tr><td>5,00</td><td>7ss 250 TL</td></tr>
</table>

R 60 R 90 R 120

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 1995-1-1:2015

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 1995-1-1:2015

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 $f_{1,min} \leq f_1 \leq f_{gr}$): $a_{rms} \leq a_{gr} = 0,05$ m/s²
e) floor slab width (b) ≤ 1,2 * span (1,2*l)

Load-bearing capacity

a) verification of bending resistance
b) verification of shear resistance

Structural fire design (single-sided fire exposure)

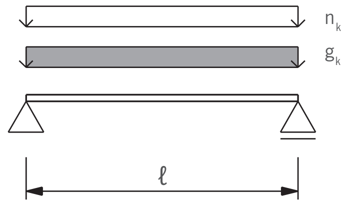
Application of KLHdesigner based on the „reduced properties method“ according to ETA-06/0138.
a) charring rate $\beta_1 = 0,65$ mm/min regular charring rate (charring within one single layer)
b) charring rate $\beta_2 = 1,00$ mm/min increased charring rate (after the failure / falling off of one layer)
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!

4.3 VERIFICATION OF VIBRATION WITH LOW REQUIREMENTS

according to ETA-06/0138
ÖNORM EN 1995-1-1:2015 and ÖNORM B 1995-1-1:2015
ÖNORM EN 1995-1-2:2011 and ÖNORM B 1995-1-2:2011

Minimum panel thickness for a specific load-span-combination



<table>
<tr><th>Permanent load</th><th colspan="2">Imposed load</th><th colspan="5">SPAN OF SINGLE-SPAN BEAM ℓ</th></tr>
<tr><th>$g_{2,k}$</th><th colspan="2">n_k</th><th rowspan="2">3,00 m</th><th rowspan="2">4,00 m</th><th rowspan="2">5,00 m</th><th rowspan="2">6,00 m</th><th rowspan="2">7,00 m</th></tr>
<tr><th>[kN/m²]</th><th>category</th><th>[kN/m²]</th></tr>
<tr><td rowspan="7">1,00</td><td rowspan="3">A</td><td>1,50</td><td rowspan="7">5s 100 TL</td><td rowspan="5">5s 120 TL</td><td rowspan="6">5s 150 TL</td><td rowspan="4">5s 160 TL</td><td rowspan="4">5s 200 TL</td></tr>
<tr><td>2,00</td></tr>
<tr><td>2,80</td></tr>
<tr><td rowspan="2">B</td><td>3,00</td></tr>
<tr><td>3,50</td><td>5s 170 TL</td><td rowspan="3">7ss 220 TL</td></tr>
<tr><td rowspan="2">C</td><td>4,00</td><td rowspan="2">5s 130 TL</td><td>5s 190 TL</td></tr>
<tr><td>5,00</td><td>5s 160 TL</td><td>5s 200 TL</td></tr>
<tr><td rowspan="7">1,50</td><td rowspan="3">A</td><td>1,50</td><td rowspan="7">5s 100 TL</td><td rowspan="4">5s 120 TL</td><td rowspan="5">5s 150 TL</td><td rowspan="5">5s 180 TL</td><td rowspan="2">5s 200 TL</td></tr>
<tr><td>2,00</td></tr>
<tr><td>2,80</td><td rowspan="4">7ss 220 TL</td></tr>
<tr><td rowspan="2">B</td><td>3,00</td></tr>
<tr><td>3,50</td><td rowspan="3">5s 130 TL</td></tr>
<tr><td rowspan="2">C</td><td>4,00</td><td>5s 160 TL</td><td>5s 200 TL</td></tr>
<tr><td>5,00</td><td>5s 170 TL</td><td>7ss 200 TL</td><td>7ss 230 TL</td></tr>
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<tr><td>2,00</td></tr>
<tr><td>2,80</td><td rowspan="4">5s 130 TL</td><td rowspan="5">7ss 240 TL</td></tr>
<tr><td rowspan="2">B</td><td>3,00</td></tr>
<tr><td>3,50</td></tr>
<tr><td rowspan="2">C</td><td>4,00</td><td rowspan="2">5s 170 TL</td><td rowspan="2">7ss 200 TL</td></tr>
<tr><td>5,00</td><td>5s 110 TL</td><td>5s 140 TL</td></tr>
<tr><td rowspan="7">2,50</td><td rowspan="3">A</td><td>1,50</td><td rowspan="5">5s 100 TL</td><td rowspan="5">5s 130 TL</td><td rowspan="5">5s 160 TL</td><td rowspan="5">5s 190 TL</td><td rowspan="7">7ss 240 TL</td></tr>
<tr><td>2,00</td></tr>
<tr><td>2,80</td></tr>
<tr><td rowspan="2">B</td><td>3,00</td></tr>
<tr><td>3,50</td></tr>
<tr><td rowspan="2">C</td><td>4,00</td><td rowspan="2">5s 110 TL</td><td rowspan="2">5s 140 TL</td><td>5s 170 TL</td><td>7ss 200 TL</td></tr>
<tr><td>5,00</td><td>5s 180 TL</td><td>7ss 210 TL</td></tr>
<tr><td rowspan="7">3,00</td><td rowspan="3">A</td><td>1,50</td><td rowspan="5">5s 100 TL</td><td rowspan="5">5s 130 TL</td><td rowspan="5">5s 160 TL</td><td rowspan="5">5s 200 TL</td><td rowspan="5">7ss 240 TL</td></tr>
<tr><td>2,00</td></tr>
<tr><td>2,80</td></tr>
<tr><td rowspan="2">B</td><td>3,00</td></tr>
<tr><td>3,50</td></tr>
<tr><td rowspan="2">C</td><td>4,00</td><td>5s 110 TL</td><td rowspan="2">5s 140 TL</td><td>5s 180 TL</td><td>7ss 210 TL</td><td rowspan="2">7ss 250 TL</td></tr>
<tr><td>5,00</td><td>5s 120 TL</td><td>5s 190 TL</td><td>7ss 220 TL</td></tr>
</table>

R 30 R 60 R 90 R 120

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 1995-1-1:2015

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 1995-1-1:2015

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 $f_{1,min} \leq f_1 \leq f_{gr}$): $a_{rms} \leq a_{gr} = 0{,}10$ m/s²
e) Floor slab width (b) ≤ 1,2 * span (1,2*l)

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

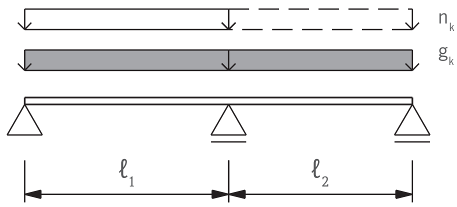
This table is only intended for structural pre-analysis purposes and does not replace necessary static calculations!

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 1995-1-1:2015 and ÖNORM B 1995-1-1:2015
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	Imposed load		SPAN OF DOUBLE-SPAN BEAM ℓ_1	ℓ_2 = 0,8*ℓ_1 to 1,0*ℓ_1			
$g_{2,k}$	n_k		3,00 m	4,00 m	5,00 m	6,00 m	7,00 m
[kN/m²]	category	[kN/m²]					
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 210 TL
		3,50					
	C	4,00		5s 130 TL			7ss 210 TL
		5,00					
1,50	A	1,50	5s 110 TL	5s 130 TL	5s 160 TL	5s 180 TL	7s 200 TL
		2,00					
		2,80		5s 130 TL			7s 220 TL
	B	3,00					
		3,50					
	C	4,00					
		5,00					
2,00	A	1,50	5s 110 TL	5s 130 TL	5s 160 TL	5s 190 TL	7s 220 TL
		2,00					
		2,80				5s 190 TL	
	B	3,00					
		3,50					
	C	4,00					
		5,00	5s 110 TL				7s 220 TL
2,50	A	1,50	5s 110 TL	5s 130 TL	5s 160 TL	5s 190 TL	7s 220 TL
		2,00					
		2,80					
	B	3,00					
		3,50					
	C	4,00	5s 110 TL				7s 220 TL
		5,00					7ss 240 TL
3,00	A	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					
	C	4,00	5s 110 TL				
		5,00					

R 30 R 60 R 90 R 120

Service class 1

k_{def} = 0,6
Imposed load category A and B (ψ_0 = 0,7 and ψ_2 = 0,3): k_{mod} = 0,8
Imposed load category C (ψ_0 = 0,7 and ψ_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 1995-1-1:2015

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 1995-1-1:2015

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 $f_{1,min} \leq f_1 \leq f_{gr}$): $a_{rms} \leq a_{gr} = 0{,}05$ m/s²
e) Floor slab width (b) ≤ 1,2 * span (1,2*l)

Load-bearing capacity

a) verification of bending resistance
b) verification of shear resistance

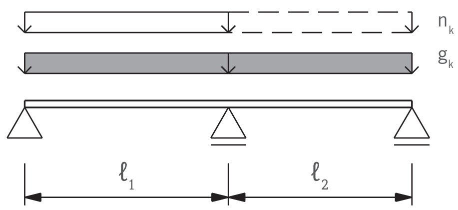
Structural fire design (single-sided fire exposure)

Application of KLHdesigner based on the „reduced properties method“ according to ETA-06/0138.
a) charring rate β_1 = 0,65 mm/min regular charring rate (charring within one single layer)
b) charring rate β_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!

5.2 VERIFICATION OF VIBRATION WITH HIGH REQUIREMENTS (DRY SCREED)

according to ETA-06/0138
ÖNORM EN 1995-1-1:2015 and ÖNORM B 1995-1-1:2015
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

<table>
<tr><th>Permanent load</th><th colspan="2">Imposed load</th><th colspan="5">SPAN OF DOUBLE-SPAN BEAM ℓ_1 $\ell_2 = 0{,}8*\ell_1$ to $1{,}0*\ell_1$</th></tr>
<tr><th>$g_{2,k}$</th><th colspan="2">n_k</th><th rowspan="2">3,00 m</th><th rowspan="2">4,00 m</th><th rowspan="2">5,00 m</th><th rowspan="2">6,00 m</th><th rowspan="2">7,00 m</th></tr>
<tr><th>[kN/m²]</th><th>category</th><th>[kN/m²]</th></tr>
<tr><td rowspan="7">1,00</td><td rowspan="3">A</td><td>1,50</td><td rowspan="7">5s 110 TL</td><td rowspan="5">5s 140 TL</td><td rowspan="7">5s 160 TL</td><td rowspan="5">5s 190 TL</td><td rowspan="3">7s 200 TL</td></tr>
<tr><td>2,00</td></tr>
<tr><td>2,80</td></tr>
<tr><td rowspan="2">B</td><td>3,00</td><td rowspan="4">7s 220 TL</td></tr>
<tr><td>3,50</td></tr>
<tr><td rowspan="2">C</td><td>4,00</td><td rowspan="2">5s 140 TL</td><td rowspan="2">5s 190 TL</td></tr>
<tr><td>5,00</td></tr>
<tr><td rowspan="7">1,50</td><td rowspan="3">A</td><td>1,50</td><td rowspan="7">5s 110 TL</td><td rowspan="5">5s 140 TL</td><td rowspan="7">5s 170 TL</td><td rowspan="5">5s 190 TL</td><td rowspan="2">7s 200 TL</td></tr>
<tr><td>2,00</td></tr>
<tr><td>2,80</td><td rowspan="5">7s 220 TL</td></tr>
<tr><td rowspan="2">B</td><td>3,00</td></tr>
<tr><td>3,50</td></tr>
<tr><td rowspan="2">C</td><td>4,00</td><td rowspan="2">5s 140 TL</td><td rowspan="2">5s 190 TL</td></tr>
<tr><td>5,00</td></tr>
<tr><td rowspan="7">2,00</td><td rowspan="3">A</td><td>1,50</td><td rowspan="6">5s 110 TL</td><td rowspan="5">5s 140 TL</td><td rowspan="7">5s 170 TL</td><td rowspan="2">5s 190 TL</td><td rowspan="6">7s 220 TL</td></tr>
<tr><td>2,00</td></tr>
<tr><td>2,80</td><td rowspan="5">5s 190 TL</td></tr>
<tr><td rowspan="2">B</td><td>3,00</td></tr>
<tr><td>3,50</td></tr>
<tr><td rowspan="2">C</td><td>4,00</td><td rowspan="2">5s 140 TL</td></tr>
<tr><td>5,00</td><td>5s 110 TL</td><td>7s 220 TL</td></tr>
<tr><td rowspan="7">2,50</td><td rowspan="3">A</td><td>1,50</td><td rowspan="5">5s 110 TL</td><td>5s 140 TL</td><td rowspan="7">5s 170 TL</td><td rowspan="7">5s 190 TL</td><td rowspan="5">7s 220 TL</td></tr>
<tr><td>2,00</td><td rowspan="6">5s 140 TL</td></tr>
<tr><td>2,80</td></tr>
<tr><td rowspan="2">B</td><td>3,00</td></tr>
<tr><td>3,50</td></tr>
<tr><td rowspan="2">C</td><td>4,00</td><td rowspan="2">5s 110 TL</td><td>7s 220 TL</td></tr>
<tr><td>5,00</td><td>7ss 240 TL</td></tr>
<tr><td rowspan="7">3,00</td><td rowspan="3">A</td><td>1,50</td><td rowspan="5">5s 110 TL</td><td rowspan="7">5s 150 TL</td><td rowspan="7">5s 170 TL</td><td rowspan="7">5s 190 TL</td><td rowspan="7">7ss 240 TL</td></tr>
<tr><td>2,00</td></tr>
<tr><td>2,80</td></tr>
<tr><td rowspan="2">B</td><td>3,00</td></tr>
<tr><td>3,50</td></tr>
<tr><td rowspan="2">C</td><td>4,00</td><td rowspan="2">5s 110 TL</td></tr>
<tr><td>5,00</td></tr>
</table>

R 30   R 60   R 90   R 120

Service class 1

k_{def} = 0,6
Imposed load category A and B (ψ_0 = 0,7 and ψ_2 = 0,3): k_{mod} = 0,8
Imposed load category C (ψ_0 = 0,7 and ψ_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 1995-1-1:2015

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 1995-1-1:2015

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 $f_{1,min} \leq f_1 \leq f_{gr}$): $a_{rms} \leq a_{gr} = 0,05$ m/s²
e) Floor slab width (b) ≤ 1,2 * span (1,2*l)

Load-bearing capacity

a) verification of bending resistance
b) verification of shear resistance

Structural fire design (single-sided fire exposure)

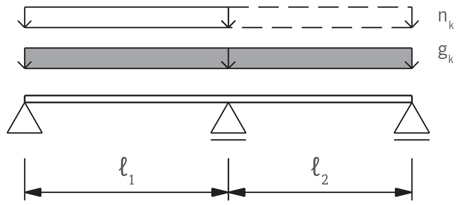
Application of KLHdesigner based on „reduced properties method“ according to ETA-06/0138.
a) charring rate β_1 = 0,65 mm/min regular charring rate (charring within one single layer)
b) charring rate β_2 = 1,00 mm/min increased charring rate (after the failure / falling off of one layer)
c) for local 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!

5.3 VERIFICATION OF VIBRATION WITH LOW REQUIREMENTS

according to ETA-06/0138
ÖNORM EN 1995-1-1:2015 and ÖNORM B 1995-1-1:2015
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



<table>
<tr><th>Permanent load</th><th colspan="2">Imposed load</th><th colspan="5">SPAN OF DOUBLE-SPAN BEAM ℓ_1 $\ell_2 = 0{,}8 \cdot \ell_1$ to $1{,}0 \cdot \ell_1$</th></tr>
<tr><th>$g_{2,k}$</th><th colspan="2">n_k</th><th rowspan="2">3,00 m</th><th rowspan="2">4,00 m</th><th rowspan="2">5,00 m</th><th rowspan="2">6,00 m</th><th rowspan="2">7,00 m</th></tr>
<tr><th>[kN/m²]</th><th>category</th><th>[kN/m²]</th></tr>
<tr><td rowspan="7">1,00</td><td rowspan="3">A</td><td>1,50</td><td rowspan="7">3s 100 TL</td><td rowspan="5">5s 110 TL</td><td rowspan="6">5s 130 TL</td><td rowspan="7">5s 160 TL</td><td rowspan="5">5s 170 TL</td></tr>
<tr><td>2,00</td></tr>
<tr><td>2,80</td></tr>
<tr><td rowspan="2">B</td><td>3,00</td></tr>
<tr><td>3,50</td></tr>
<tr><td rowspan="2">C</td><td>4,00</td><td rowspan="2">5s 110 TL</td><td>5s 180 TL</td></tr>
<tr><td>5,00</td><td>5s 140 TL</td><td>5s 200 TL</td></tr>
<tr><td rowspan="7">1,50</td><td rowspan="3">A</td><td>1,50</td><td rowspan="7">3s 100 TL</td><td rowspan="2">5s 110 TL</td><td rowspan="6">5s 140 TL</td><td rowspan="6">5s 160 TL</td><td rowspan="5">5s 180 TL</td></tr>
<tr><td>2,00</td></tr>
<tr><td>2,80</td><td rowspan="4">5s 110 TL</td></tr>
<tr><td rowspan="2">B</td><td>3,00</td></tr>
<tr><td>3,50</td></tr>
<tr><td rowspan="2">C</td><td>4,00</td><td>5s 190 TL</td></tr>
<tr><td>5,00</td><td>5s 120 TL</td><td>5s 140 TL</td><td>5s 170 TL</td><td>5s 200 TL</td></tr>
<tr><td rowspan="7">2,00</td><td rowspan="3">A</td><td>1,50</td><td rowspan="7">3s 100 TL</td><td rowspan="5">5s 110 TL</td><td rowspan="5">5s 140 TL</td><td rowspan="6">5s 160 TL</td><td rowspan="5">5s 190 TL</td></tr>
<tr><td>2,00</td></tr>
<tr><td>2,80</td></tr>
<tr><td rowspan="2">B</td><td>3,00</td></tr>
<tr><td>3,50</td></tr>
<tr><td rowspan="2">C</td><td>4,00</td><td>5s 120 TL</td><td rowspan="2">5s 140 TL</td><td>5s 200 TL</td></tr>
<tr><td>5,00</td><td>5s 130 TL</td><td>5s 170 TL</td><td>7ss 200 TL</td></tr>
<tr><td rowspan="7">2,50</td><td rowspan="3">A</td><td>1,50</td><td rowspan="7">3s 100 TL</td><td rowspan="5">5s 120 TL</td><td rowspan="5">5s 140 TL</td><td rowspan="5">5s 160 TL</td><td rowspan="5">5s 200 TL</td></tr>
<tr><td>2,00</td></tr>
<tr><td>2,80</td></tr>
<tr><td rowspan="2">B</td><td>3,00</td></tr>
<tr><td>3,50</td></tr>
<tr><td rowspan="2">C</td><td>4,00</td><td rowspan="2">5s 130 TL</td><td rowspan="2">5s 140 TL</td><td>5s 170 TL</td><td>7ss 200 TL</td></tr>
<tr><td>5,00</td><td>5s 180 TL</td><td>7ss 200 TL</td></tr>
<tr><td rowspan="7">3,00</td><td rowspan="3">A</td><td>1,50</td><td rowspan="7">3s 100 TL</td><td rowspan="3">5s 120 TL</td><td rowspan="7">5s 150 TL</td><td rowspan="6">5s 170 TL</td><td rowspan="5">7ss 220 TL</td></tr>
<tr><td>2,00</td></tr>
<tr><td>2,80</td></tr>
<tr><td rowspan="2">B</td><td>3,00</td><td>5s 120 TL</td></tr>
<tr><td>3,50</td><td rowspan="3">5s 130 TL</td></tr>
<tr><td rowspan="2">C</td><td>4,00</td><td rowspan="2">7ss 220 TL</td></tr>
<tr><td>5,00</td><td>5s 180 TL</td></tr>
</table>

R 30   R 60   R 90   R 120

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 1995-1-1:2015

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 1995-1-1:2015

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 $f_{1,min} \leq f_1 \leq f_{gr}$): $a_{rms} \leq a_{gr} = 0{,}10$ m/s²
e) Floor slab width (b) ≤ 1,2 * span (1,2*l)

Load-bearing capacity

a) verification of bending resistance
b) verification of shear resistance

Structural fire design (single-sided fire exposure)

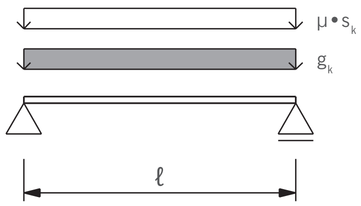
Application of KLHdesigner based on the „reduced properties method“ according to ETA-06/0138.
a) charring rate $\beta_1 = 0{,}65$ mm/min regular charring rate (charring within one single layer)
b) charring rate $\beta_2 = 1{,}00$ mm/min increased charring rate (after the failure / falling off of one 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!

KLH

06 KLH AS A ROOF - SINGLE-SPAN BEAM

according to ETA-06/0138
ÖNORM EN 1995-1-1:2015 and ÖNORM B 1995-1-1:2015
ÖNORM EN 1995-1-2:2011 and ÖNORM B 1995-1-2:2011



Minimum panel thickness for a specific load-span-combination

<table>
<tr><th>Permanent load</th><th>Snow load on roof</th><th colspan="5">SPAN OF SINGLE-SPAN BEAM ℓ</th></tr>
<tr><th>$g_{2,k}$</th><th>$s = \mu^{*} s_k$</th><th rowspan="2">3,00 m</th><th rowspan="2">4,00 m</th><th rowspan="2">5,00 m</th><th rowspan="2">6,00 m</th><th rowspan="2">7,00 m</th></tr>
<tr><th>[kN/m²]</th><th>[kN/m²]</th></tr>
<tr><td rowspan="7">0,50</td><td>1,00</td><td>3s 60 TL</td><td>3s 80 TL</td><td>3s 100 TL</td><td>3s 120 TL</td><td>5s 140 TL</td></tr>
<tr><td>2,00</td><td>3s 70 TL</td><td>3s 90 TL</td><td>3s 120 TL</td><td>5s 140 TL</td><td>5s 160 TL</td></tr>
<tr><td>3,00</td><td rowspan="2">3s 80 TL</td><td>3s 100 TL</td><td>5s 130 TL</td><td>5s 150 TL</td><td>5s 180 TL</td></tr>
<tr><td>4,00</td><td>3s 110 TL</td><td>5s 140 TL</td><td>5s 170 TL</td><td>5s 200 TL</td></tr>
<tr><td>5,00</td><td>3s 90 TL</td><td>3s 120 TL</td><td>5s 150 TL</td><td>5s 180 TL</td><td>7ss 210 TL</td></tr>
<tr><td>6,00</td><td rowspan="2">3s 100 TL</td><td>5s 130 TL</td><td>5s 160 TL</td><td>5s 200 TL</td><td>7ss 220 TL</td></tr>
<tr><td>7,00</td><td>5s 140 TL</td><td>5s 170 TL</td><td>7ss 200 TL</td><td>7ss 230 TL</td></tr>
<tr><td rowspan="7">1,00</td><td>1,00</td><td rowspan="2">3s 70 TL</td><td>3s 90 TL</td><td>3s 100 TL</td><td>5s 130 TL</td><td>5s 160 TL</td></tr>
<tr><td>2,00</td><td>3s 100 TL</td><td>3s 120 TL</td><td>5s 150 TL</td><td>5s 180 TL</td></tr>
<tr><td>3,00</td><td>3s 80 TL</td><td>3s 110 TL</td><td>5s 140 TL</td><td>5s 160 TL</td><td>5s 190 TL</td></tr>
<tr><td>4,00</td><td rowspan="2">3s 90 TL</td><td rowspan="2">3s 120 TL</td><td>5s 150 TL</td><td>5s 180 TL</td><td>7ss 200 TL</td></tr>
<tr><td>5,00</td><td rowspan="2">5s 160 TL</td><td>5s 190 TL</td><td>7ss 210 TL</td></tr>
<tr><td>6,00</td><td rowspan="2">3s 100 TL</td><td>5s 130 TL</td><td rowspan="2">7ss 200 TL</td><td>7ss 220 TL</td></tr>
<tr><td>7,00</td><td>5s 140 TL</td><td>5s 170 TL</td><td>7ss 230 TL</td></tr>
<tr><td rowspan="7">1,50</td><td>1,00</td><td>3s 70 TL</td><td>3s 90 TL</td><td>3s 120 TL</td><td>5s 150 TL</td><td>5s 180 TL</td></tr>
<tr><td>2,00</td><td rowspan="2">3s 80 TL</td><td>3s 100 TL</td><td>5s 130 TL</td><td>5s 160 TL</td><td>5s 190 TL</td></tr>
<tr><td>3,00</td><td>3s 110 TL</td><td>5s 140 TL</td><td>5s 170 TL</td><td>5s 200 TL</td></tr>
<tr><td>4,00</td><td>3s 90 TL</td><td>3s 120 TL</td><td>5s 150 TL</td><td>5s 180 TL</td><td>7ss 210 TL</td></tr>
<tr><td>5,00</td><td rowspan="2">3s 100 TL</td><td>5s 130 TL</td><td>5s 160 TL</td><td>5s 200 TL</td><td>7ss 220 TL</td></tr>
<tr><td>6,00</td><td rowspan="2">5s 140 TL</td><td>5s 170 TL</td><td>7ss 200 TL</td><td>7ss 230 TL</td></tr>
<tr><td>7,00</td><td>3s 110 TL</td><td>5s 180 TL</td><td>7ss 210 TL</td><td>7ss 240 TL</td></tr>
<tr><td rowspan="7">2,00</td><td>1,00</td><td rowspan="2">3s 80 TL</td><td>3s 100 TL</td><td>5s 130 TL</td><td>5s 160 TL</td><td rowspan="2">5s 200 TL</td></tr>
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<tr><td>7,00</td><td>5s 150 TL</td><td>5s 190 TL</td><td>7ss 220 TL</td><td>7ss 250 TL</td></tr>
</table>

R 0 | R 30 | R 60 | R 90 | R 120

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 1995-1-1:2015

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)

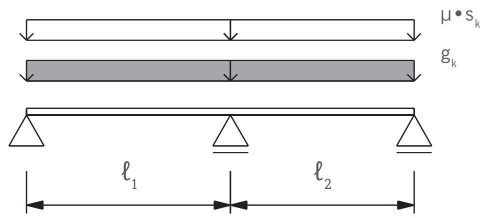
Application of KLHdesigner based on the „reduced properties method“ according to ETA-06/0138.
a) charring rate $\beta_1 = 0,65$ mm/min regular charring rate (charring within one single layer)
b) charring rate $\beta_2 = 1,00$ mm/min increased charring rate (after the failure / falling off of one layer)
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!

07 KLH AS A ROOF - DOUBLE SPAN BEAM

according to ETA-06/0138
ÖNORM EN 1995-1-1:2015 and ÖNORM B 1995-1-1:2015
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 $\ell_2 = 0{,}8 \cdot \ell_1$ to $1{,}0 \cdot \ell_1$				
$g_{2,k}$ [kN/m²]	$s = \mu \cdot s_k$ [kN/m²]	3,00 m	4,00 m	5,00 m	6,00 m	7,00 m
0,50	1,00	3s 60 TL	3s 60 TL	3s 70 TL	3s 90 TL	3s 100 TL
	2,00		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 130 TL	5s 150 TL
	5,00			3s 120 TL	5s 140 TL	5s 170 TL
	6,00	3s 80 TL	3s 100 TL	5s 130 TL	5s 150 TL	5s 190 TL
	7,00		3s 110 TL	5s 140 TL	5s 170 TL	7ss 200 TL
1,00	1,00	3s 60 TL	3s 70 TL	3s 80 TL	3s 100 TL	3s 120 TL
	2,00		3s 80 TL	3s 90 TL	3s 110 TL	5s 130 TL
	3,00			3s 100 TL	3s 120 TL	5s 140 TL
	4,00	3s 70 TL	3s 90 TL	3s 110 TL	5s 130 TL	5s 160 TL
	5,00		3s 100 TL	3s 120 TL	5s 150 TL	5s 180 TL
	6,00	3s 80 TL		5s 130 TL	5s 160 TL	7ss 200 TL
	7,00		3s 110 TL	5s 140 TL	5s 180 TL	
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2,00	1,00	3s 60 TL	3s 80 TL	3s 90 TL	3s 120 TL	5s 140 TL
	2,00			3s100 TL	5s 130 TL	
	3,00	3s 70 TL	3s 90 TL	3s 110 TL		5s 160 TL
	4,00		3s 100 TL	3s 120 TL	5s 140 TL	5s 180 TL
	5,00	3s 80 TL		5s 130 TL	5s 160 TL	5s 200 TL
	6,00		3s 110 TL	5s 140 TL	5s 180 TL	7ss 200 TL
	7,00	3s 90 TL	3s 120 TL	5s 150 TL	5s 200 TL	
2,50	1,00	3s 60 TL	3s 80 TL	3s 100 TL	3s 120 TL	5s 150 TL
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	3,00			3s 120 TL	5s 140 TL	5s 170 TL
	4,00		3s 100 TL	5s 130 TL	5s 150 TL	5s 190 TL
	5,00	3s 80 TL	3s 110 TL	5s 140 TL	5s 170 TL	7ss 200 TL
	6,00		3s 120 TL	5s 150 TL	5s 180 TL	7ss 210 TL
	7,00	3s 90 TL			5s 200 TL	

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NOTES

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