

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

**KLH**<sup>®</sup>

**MADE FOR BUILDING**  
BUILT FOR LIVING

**TIMBER CONCRETE COMPOSITES**



## IMPRINT

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PRODUCT DESCRIPTION

# KLH® TCC SYSTEMS

## 01 PRODUCT DESCRIPTION

Timber concrete composite technology was first introduced into the construction industry several decades ago. The original application started with upgrading of existing timber beam floors.

Today the advantages of this technology are also used in new buildings – either with ribs or solid wood slabs.

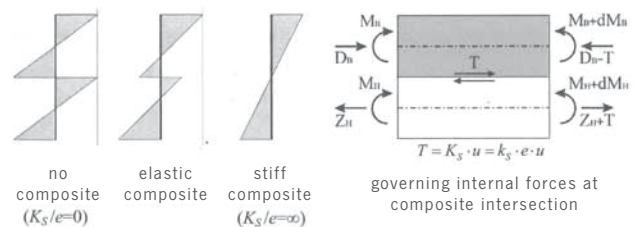
The combination using KLH® solid wood slabs is an obvious development, which brings technical and economic advantages, especially with large spans.

This combination utilises both the static and physical properties of the two building materials in a very efficient manner. In conventional concrete construction, the concrete, which performs well under compression, is reinforced with reinforcing steel in order to absorb the tensile forces that arise (usually on the underside of the floor).

As timber, unlike concrete, has a high tensile strength, the area of tensile stress is covered by the timber component in TCC applications. When using solid timber panels, the slab is also used as a formwork for the subsequent application of the concrete.



Preparation of KLH® TCC elements for pouring the concrete on site (TimCrete © Ramboll)



Stress distribution and decisive cutting forces on the composite beam (Holz-Beton-Verbund; König, Holschemacher, Dehn; 2004)

The shear resistant connection between the two building materials plays an essential role in this type of construction. The stiffer the shear connection is executed, the stronger is the TCC element.

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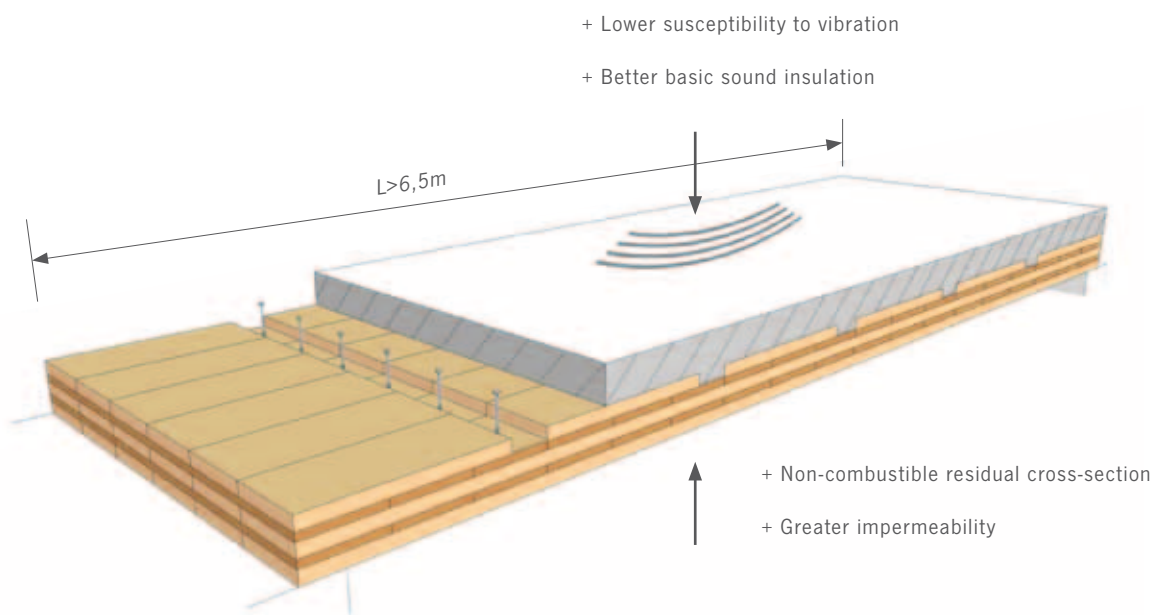
## ADVANTAGES

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### 02 THE KEY ADVANTAGES

The favourable static properties allow for large spans to be executed with increased stiffness and only a small gain in weight.

Partial prefabrication is often aimed at, for high cost effectiveness. The cost of formwork is reduced to a minimum due to the pre-installed timber slab.



TCC systems have a lower susceptibility to vibration, which has a positive effect, especially with large spans.

The fire resistance of the floor is also improved due to the non-combustible concrete layer. Especially the tightness against gas and fire extinguishing water is ensured over a prolonged period.

The additional weight of the concrete improves the acoustic properties of the floor. Additional mass for acoustic improvement can be largely dispensed with.

### 03 COMPOSITE SYSTEMS

Various composite systems can be used in the construction process. A differentiation can be made here between those methods with and those methods without general building regulations or inspectorate approval. Notched (bird's mouth) or grooved systems are by far the most cost effective systems to use. These systems do not have standard approval and must be calculated individually. However, this method is very efficient because of the minimal material costs and the low labour costs. Approved methods include certain types of screw connections and TCC shear connectors. With these composite systems, the effort for structural analysis is reduced, but they are associated with higher system costs.

#### GROOVES

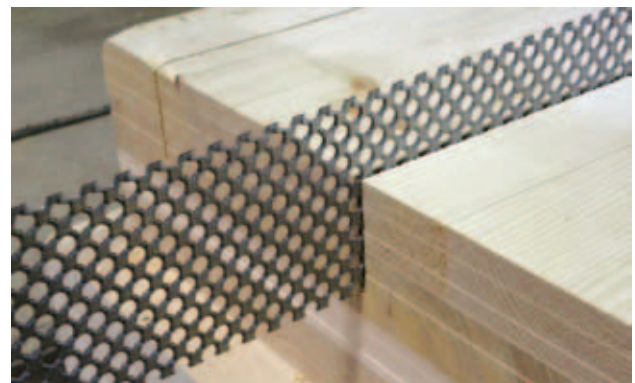
Grooves are milled into the timber slab which take over the shear connection between the timber and the concrete. In order to intercept the deflection forces, additional wood screws are used. It is possible to dispense with securing by means of screws, but the screw connection results in a more favourable distribution of forces in the cross-section. This method is one of the most cost-effective variants due to the low consumption of connectors and the standardised milling process.



Elements with grooves and wood screws for securing transverse tensile forces (ABA HOLZ van Kempen GmbH, [www.aba-holz.de](http://www.aba-holz.de))

#### TCC SHEAR CONNECTORS

In this system, perforated plates or flat steel strips are glued or pressed into the timber slab. There is no need to provide additional securing points against lift off. Mounting of the connecting strips is conveniently carried out in the factory.



Glued perforated plates, TCC-system

#### SCREW CONNECTIONS

In general, these connections use screws, driven in at a specific angle, with a stop device (dependent on the system) to set the insertion depth.



On site assembly of elements with screw connectors ([www.ancon.at](http://www.ancon.at))

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CASE STUDY HAMBURG

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## 04 CASE STUDY HAMBURG

Completion: 2013  
 4-storey residential building  
 Construction of the shell in 4 weeks

### TCC SYSTEM:

- Grooves with tensile reinforcement
- Spans of 7.5 m
- Prefabrication in the factory
- Delivery of the finished parts with cantilever
- KLH® 5s 180 mm DL + 100 mm Concrete



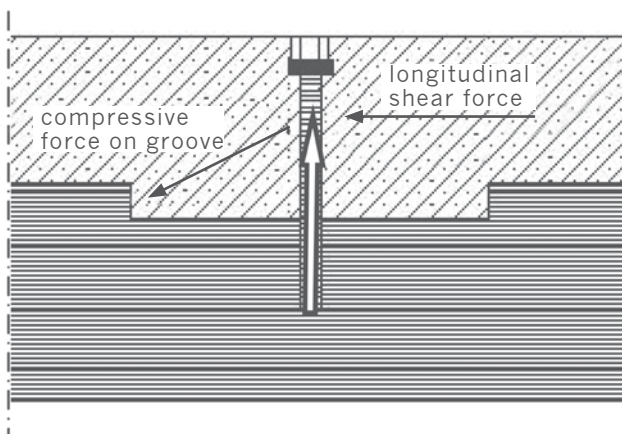
([www.planpark-architekten.de](http://www.planpark-architekten.de),  
 Photos: ABA Holz van Kempen GmbH und C. Lohfink)

## 05 PRODUCTION



To realise specific project requirements, KLH® relies on its proven expertise and flexibility in production.

KLH® production lines enable the automated milling of the necessary grooved sections, required for transmission of the static forces in the TCC floor.



Transmission of shear forces in tension reinforced grooves  
(Structural and deformation behaviour of grooves in laminated timber-concrete floor, B. Michelfelder, 2006)

In the following preliminary design table (page 07), the number of grooves was set at six in order to achieve the highest possible composite stiffness.

The dimensioning of the grooves arises from several factors. The minimum width and number of the grooves are specified by the necessary transmission of shear forces. The depth of the groove must be adjusted to the top layer of the KLH® solid wood panel.

The fabrication of slots for inserting the sheets should also be carried out in the factory. Afterwards, gluing of the perforated plates can also be carried out in the KLH® special production.

It is mandatory to assure proper handling for transport and assembling of prefabricated elements.



Perforated plates glued in at the factory (TimCrete © Ramboll)



PRELIMINARY DESIGN

## 06 KLH® TCC FLOOR ELEMENT – SINGLE SPAN BEAM

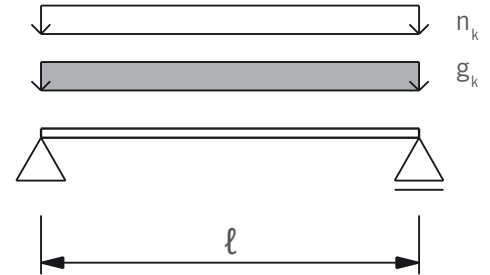
### VERIFICATION OF VIBRATION FOR FLOOR CLASS I

Minimum panel thickness for R 60

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



Concrete grade C 50/60

Groove rigidity 500 kN/mm (SLS), 6 grooves per element

Creep coefficient concrete  $\phi = 2.0$ , concrete shrinkage  $\epsilon = 414 \cdot 10^{-6}$

#### Service class 1

$k_{def} = 0,6$

Imposed load (including additional load for light partition walls): 3.8 kN/m<sup>2</sup> for DK I

Constant load: 2 kN/m<sup>2</sup> in addition to supporting structure (KLH® and concrete)

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

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

#### Load capacity

a) verification of bending stresses

b) verification of shear stresses

	Floor class I		
	KLH® strength	Concrete strength	Total height
Span $l$	[mm]	[mm]	[mm]
6,5 m	160	80	240
7,0 m	160	90	250
7,5 m	180	90	270
8,0 m	180	95	275
8,5 m	200	95	295
9,0 m	200	100	300

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







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