



MADE FOR BUILDING
BUILT FOR LIVING

CROSS-LAMINATED TIMBER

IMPRINT

© KLH Massivholz GmbH

Publisher and responsible for content: KLH Massivholz GmbH
Version: January 2018, Cross-Laminated Timber

.....

CONTENT

01	GENERAL INFORMATION	02
02	ADHESIVES AND LAMINATION PROCESS	03
03	PREFABRICATION OF BUILDING ELEMENTS	04
04	TECHNICAL APPROVALS AND CERTIFICATES	06
05	TECHNICAL DETAILS	07
06	STANDARD PANEL TYPES, DIMENSIONS AND PANEL BUILD UP	08
07	SURFACE QUALITY	10
08	SURFACE APPEARANCE REQUIREMENTS	11
09	AREAS OF APPLICATION	12
10	PRODUCT ADVANTAGES	13
11	OTHER BROCHURES IN PRINT AND ONLINE	15

GENERAL INFORMATION

CROSS-LAMINATED TIMBER



PRODUCT DESCRIPTION

The generic terminology for cross-laminated timber varies and may be country-specific. These include, among others, CLT, jumbo plywood or X-Lam.

KLH CLT is a versatile building material characterized by its dimensional stability, its dimensional accuracy and its high level of prefabrication. Therefore, KLH solid wood superstructure components are used for structural wall, floor slab and roof elements.

The biaxial qualities of the CLT provide multitude opportunities for exciting architectural designs. KLH elements can be combined with most building materials to generate stimulating interior and exterior design arrangements. Solid timber buildings are typically characterized by slender superstructures, which lead to a gain in net floor area.

KLH superstructures are installed by expert carpentry firms or construction companies, typically with the support of a mobile crane. An average of 25 minutes is needed for placing each element. However, this depends on the complexity of the superstructure and site conditions. The erection of the superstructure for a detached dwelling house of average size and without complicated installation conditions typically takes approx. 1 – 2 days. The installation teams are usually made up of four site operatives and a crane operator

MAXIMUM DIMENSIONS AND PRODUCED WIDTHS

Maximum panel length	16.50 m
Maximum panel width	2.95 m
Maximum panel thickness	0.50 m
Produced widths	2.40 / 2.50 / 2.73 / 2.95 m
Minimum production length	8.25 m – in 0.05m increments

MANUFACTURE

KLH solid wood elements are made up of at least 3 layers of timber lamellae that are arranged perpendicular to each other and then glued together under high laminating pressure to form large-format structural solid wood panels. Depending on the client's requirements, we can supply PEFC and FSC-certified KLH elements.

The transverse arrangement of the lamellae increases the load-bearing capacity and dimensional stability of the structural timber elements, whilst the impact of swelling and shrinkage is reduced to an insignificant minimum.

In accordance with the European Technical Assessment, only kiln dried timber with a moisture content of 12% (+/- 2%) is used for KLH CLT. Each individual lamella is machine strength graded in the factory. The overall production process is subject to internal and external quality control by authorised 3rd party auditors.

ADHESIVES AND LAMINATION PROCESS



PEFC or FSC-certified lamellae undergo machine strength grading and are sorted according to surface quality



Cross-laminated timber is produced on a just-in-time basis



Formaldehyde-free adhesive is used for laminating the individual layers



State-of-the-art CNC cutting machines facilitate simple and highly complex cutting patterns

ADHESIVES AND LAMINATION PROCESS

Only VOC-free and formaldehyde-free PUR adhesives are used in accordance with EN 15425. The adhesives have been tested and classified as TYPE 1 adhesives and have been approved for the production of load-bearing timber components.

The adhesive is applied automatically over the entire surface at approx. 0.15 kg/m² per joint.

The laminating pressure at 0.6 N/mm² used during the manufacture of KLH solid wood panels is 6 times higher when compared with vacuum press technology. The quality of the lamination of KLH CLT is therefore of high quality and the load-bearing capacity comparatively higher.

More on adhesives can be found at:
www.henkel-adhesives.de

PREFABRICATION OF BUILDING ELEMENTS

CNC CUTTING AND TOLERANCES

CLT building elements are prefabricated in the factory using state-of-the-art CNC cutting technology. CNC cutting is based on the approved fabrication drawings provided by the client and/or the construction company.

The cutting accuracy is within the building tolerances described in DIN 18203/Part 3 for wall, floor slabs and roof panels made of timber materials. For element sizes $> 1 \text{ m}^2$, a cutting accuracy of $\pm 2 \text{ mm}$ applies. This is based on standard panel types, standard cutting and a wood moisture content of 12%. For technical reasons the minimum element size for standard cutting is defined as 1 m long and 1 m wide.

In addition to the standard cutting process KLH offer project-specific and optimised cutting services that can be tailored to the requirements of the client or construction company.



STANDARD CUTTING FOR WALL, FLOOR AND ROOF ELEMENTS

- Longitudinal cuts at right angles to the panel surface, with some diagonal cuts up to a maximum cutting depth of 260 mm and max. 4 linear meters of milling of circular recesses in plan for floor and roof elements and/or max. 6 linear meters of milling for wall elements respectively.
- The internal corners for door and window cut-outs or other openings are executed with rounded edges as standard (radius of 20 mm); sharp internal corners can be provided at an additional charge.
- Standard cutting for floor and roof elements includes typical panel joints (half lap or rebate board, max. width for milling of the element: 90 mm)

OTHER CUTTING SERVICES

Any cutting services in addition to the standard cuts described above are categorised as “special cuts”. Following the initial verification of the technical feasibility these will be calculated and offered on a project-specific basis.

Examples of special cuts are:

- Specialist routing, drilling into the panel sides/edges
- Elements with special inner and outer contours/shapes
- Half lap joints and recesses on the underside of the panel or located in the centre of the element
- Cut outs for steel I-beams
- Cut outs for rafters and beams
- Cutting of small elements ($< 2 \text{ m}^2$)
- Double-sided processing of the elements
- Cut outs for sockets and conduits



TECHNICAL APPROVALS AND CERTIFICATES



EUROPEAN TECHNICAL
ASSESSMENT
ETA - 06/0138



GENERAL BUILDING APPROVAL
FOR GERMANY
Z-9.1-482



FRENCH APPROVAL
AT-3/12-731
AT-3/12-731 ADD 1
AT-3/12-731 ADD 2



JAPANESE APPROVAL
NTI-301



SEAL OF QUALITY FOR SPAIN
AITIM 31-01



Intertek
C#: 5009426
PRODUCT APPROVAL
FOR USA & CANADA
ANSI/APA PRG 320



QUALITY MANAGEMENT
In accordance with
ISO EN 9001:2015



ENVIRONMENTAL MANAGEMENT
In accordance with
ISO EN 14001:2015



ENERGY MANAGEMENT
In accordance with
ISO EN 50001:2011



Promoting Sustainable
Forest Management
www.pefc.co.uk

PEFC CERTIFICATION



The mark of
responsible forestry

FSC CERTIFICATION



ENVIRONMENTAL PRODUCT
DECLARATION (EPD)
In accordance with
ISO 14025 and EN 15804

DOWNLOAD OF CERTIFICATES

All approvals and certificates can be downloaded at www.klh.at.

TECHNICAL DETAILS

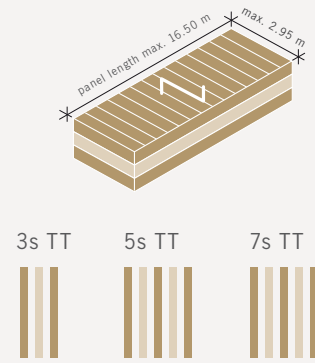
PRODUCT NAME/BRAND	KLH
OTHER PRODUCT NAMES	Cross-laminated timber (CLT), X-Lam
APPLICATION	Structural elements for walls, floors and roofs
DURABILITY	Service classes 1 and 2 according to EN 1995-1-1
WOOD SPECIES	Spruce (pine, fir, stone pine and other wood types on request)
PANEL BUILD UP	3, 5, 7 or more layers depending on structural requirements
LAMELLAE	Thickness 20 to 45 mm, technically dried, quality-sorted and finger-jointed (with additional internal sorting to ensure compliance with our high material specifications)
STRENGTH CLASS	C 24 according to EN 338, maximum 10% C 16 permitted (compare ETA-06/0138)
ADHESIVE	Formaldehyde-free PUR adhesive, approved for load-bearing and non-load-bearing components indoors and outdoors according to EN 15425
LAMINATING PRESSURE	At least 0.6 N/mm ²
WOOD MOISTURE CONTENT	12% (+/- 2%) on delivery
MAXIMUM ELEMENT DIMENSIONS	Length 16.50 m width 2.95 m thickness 0.50 m
PRODUCED WIDTHS	2.40 2.50 2.73 2.95 m
SURFACE QUALITY	Non-visual quality (NVQ) Non-visual quality+ (NVQ+) Industrial visual quality (IVQ) Domestic visual quality (DVQ) Special surfaces on request
WEIGHT	5.5 kN/m ³ according to ÖNORM B 1991-1-1:2011 for structural analysis 500 kg/m ³ for determination of transport weight
MOISTURE MOVEMENT	In panel plane 0.01% per % change in wood moisture content, perpendicular to panel plane (panel thickness direction) 0.24% per % change in wood moisture content
THERMAL CONDUCTIVITY	$\lambda = 0.12 \text{ W/(m}^{\circ}\text{K)}$ according to EN ISO 10456
HEAT CAPACITY	$c_p = 1600 \text{ J/(kg}^{\circ}\text{K)}$ according to EN ISO 10456
VAPOUR RESISTANCE	$\mu = 20 \text{ to } 50$ according to EN ISO 10456
AIR TIGHTNESS	KLH solid wood panels can generally be used as airtight layers. Connections to other components, butt joints, penetrations, etc. must be sealed appropriately.
REACTION TO FIRE	Euro class D-s2, d0
RESISTANCE TO FIRE	According to ETA - 06/0138

STANDARD PANEL TYPES, DIMENSIONS AND PANEL BUILD UP

FOR THE WALL

Covering layer in the transverse panel direction TT

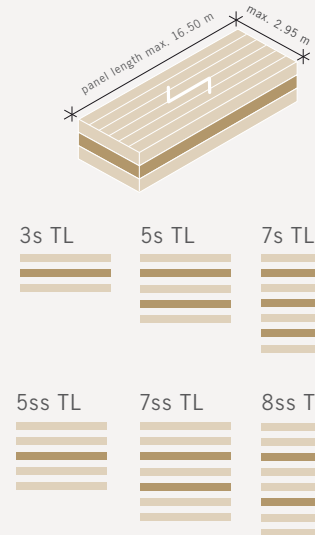
Nominal thickness				Panel Typ		Thickness of lamellas in mm					
						T	L	T	L	T	L
KLH	60 mm	3s	TT			20	20	20			
KLH	70 mm	3s	TT			25	20	25			
KLH	80 mm	3s	TT			30	20	30			
KLH	90 mm	3s	TT			30	30	30			
KLH	100 mm	3s	TT			30	40	30			
KLH	110 mm	3s	TT			35	40	35			
KLH	120 mm	3s	TT			40	40	40			
KLH	100 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



FOR FLOOR 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		





SURFACE QUALITY

SURFACE QUALITY

KLH solid wood panels are typically produced from spruce lamellae as standard and are available in three different visual surface qualities, which can be combined as required. This applies for all previously illustrated panel types and without restriction. Our recently added non-visual+ surface (NVQ+) provides a cost-effective alternative for floor and roof elements (TL panels) for industrial or commercial buildings.

The minimum requirement criteria for each surface is illustrated in a table at www.klh.at

SUMMARY OF THE INDIVIDUAL SURFACES

	DOMESTIC VISUAL QUALITY (DVQ)	INDUSTRIAL VISUAL QUALITY (IVQ)	NON VISUAL QUALITY+ (NVQ+)	NON VISUAL QUALITY (NVQ)
AREA OF APPLICATION	Visual grade components for domestic applications	Visual grade components for industrial applications	Components with very limited visual requirements. For roof and floor elements in industrial buildings or similar.	Non visual grade components - structural and non-structural elements to be lined and not left exposed
SURFACE QUALITY GRADE	high	medium	low	very low
MACHINED EDGES	chamfered joints	chamfered joints	no chamfered joints	no chamfered joints
SURFACE FINISH EX-FACTORY	sanded (single or double sided) or brushed (single sided)	sanded (single or double sided)	thicknesses 90-250 mm planed with rotation marks other thicknesses partially sanded	planed only
SURFACE TREATMENT AT FACTORY	on request	on request	not available	not available

SURFACE TREATMENT AND SPECIAL SURFACES

Both the industrial visual quality and the domestic visual quality panels are supplied fully sanded.

Should you require UV protection, varnished elements or any other surface treatment, please contact us. The same applies to surfaces in other types of wood, which we can offer depending on customer requirements and the availability of raw materials.

IMPORTANT NOTE

Visual quality components require special care during loading, as well as during and after installation.

SURFACE APPEARANCE REQUIREMENTS

Criteria	Domestic visual (DVQ)	Industrial visual (IVQ)	Non visual + (NVQ +)	Non visual (NVQ)
Surface finish	sanded	sanded	thicknesses 90 - 250 mm: planed with rotation traces other thicknesses: partially sanded	planed
Wood species	one single species	predominantly one single species spruce / fir ($\leq 10\%$) are regarded as one type of wood	predominantly one single species spruce / fir ($\leq 10\%$) are regarded as one type of wood	addition of other timber species possible
Colour and texture	mostly balanced	generally balanced	no requirements	no requirements
Blue stain and red tinge	slight discolouration permitted ($\leq 3\%$)	slight discolouration permitted ($\leq 5\%$)	slight discolouration permitted ($\leq 8\%$)	no restrictions
Knots, tightly intergrown	permitted	permitted	no restrictions	no restrictions
Knots, black	permitted $\leq 25\text{ mm } \varnothing$	permitted $\leq 35\text{ mm } \varnothing$	permitted $\leq 45\text{ mm } \varnothing$	no restrictions
Loose knots, knot holes	permitted $\leq 12\text{ mm } \varnothing$	permitted $\leq 12\text{ mm } \varnothing$	permitted $\leq 25\text{ mm } \varnothing$	no restrictions
Resin pockets	to some extent permitted $\leq 3 \times 50\text{ mm}$	to some extent permitted $\leq 5 \times 70\text{ mm}$	no restrictions	no restrictions
Piths	to some extent permitted length $\leq 800\text{ mm}$	to some extent permitted length $\leq 1000\text{ mm}$	no restrictions	no restrictions
Bark ingrowth	not permitted	not permitted	no restrictions	no restrictions
Wane	not permitted	not permitted	not permitted	permitted
Compression wood	to some extent permitted	to some extent permitted	permitted	no restrictions
Boreholes from inactive insect attack	not permitted	not permitted	to some extent permitted	to some extent permitted
Wood moisture content during production	$\leq 12\%$	$\leq 12\%$	$\leq 14\%$	$\leq 14\%$
Cracks and joints (at a reference moisture measurement of 12%)	to some extent permitted $\leq 1,5\text{ mm}$	to some extent permitted $\leq 2\text{ mm}$	to some extent permitted $\leq 4\text{ mm}$	to some extent permitted $\leq 6\text{ mm}$
Surface defects	to some extent permitted $\leq 12\text{ mm } \varnothing$	to some extent permitted $\leq 12\text{ mm } \varnothing$	no restrictions	no restrictions
Surface re-treatment (Filling and plugging of branch holes, strips, etc.)	permitted	permitted	permitted	no restrictions
Defects on panel/lamellae edges	to some extent permitted	to some extent permitted	permitted	no restrictions
Making good of element edges manually, using sand paper	yes	yes	yes	no
Chamfer on DL panels	yes	yes	no	no
Validity	<p>The above surface quality requirements apply as follows:</p> <ul style="list-style-type: none"> - upon delivery, - to the top layer only, - not to endgrain of the elements. <p>The criteria for surface quality NVQ apply to narrow sides. The endgrain of the elements cannot be supplied as visual grade quality.</p> <p>Surface quality NVQ + is currently only available for DL panels.</p>			
Crack formation	CLT will behave like all natural solid wood products and a change of the visual appearance including the formation of small cracks and fissures due to change in moisture content is product specific and cannot be prevented.			

AREAS OF APPLICATION

AREAS OF APPLICATION


Due to their structural properties KLH solid wood elements are used for stability as well as for load-bearing and non-load-bearing building components.

Cross laminated timber can also be used to create cantilevering elements, point-loaded constructions, prefabricated pods and modules.


KLH have to date supplied cross laminated timber for more than 20,000 projects worldwide. KLH Massivholz projects were completed in the following categories:

- Detached residential dwelling houses
- Multi story residential apartment buildings
- Terraced houses
- Student housing
- Retirement homes
- Schools and kindergartens
- Hotels
- Civic and Public buildings
- Event halls
- Industrial and commercial buildings
- Refurbishment & Extensions
- Special buildings
-




Single family house Ammersee |  Dirk Wilhelmy, www.wilhelmy-fotografie.de




Multi story residential building Mühlweg |  KLH



Hotel mama thresl Leogang |  Christian Schöch / Hotel mama thresl



Student hostel Mineroom |  ©J. Konstantinov

PRODUCT ADVANTAGES

BUILDING WITH KLH HAS MANY ADVANTAGES

- Ecologically sustainable
- Renewable resource
- Positive ecobalance
- A healthy and comfortable room climate
- Lasting value
- Individuality in architecture and design
- Flexible room design without a grid pattern
- More net floor space
- Technically approved and CE-certified building product
- Quality controlled and ISO-certified production procedures

- CNC cutting and high accuracy of fit
- Lighter than conventional building materials
- Short construction period and dry construction method
- Suitable for earthquake regions
- Easy assembly and installation
- Less noise on site
- Smaller crews- safer sites
- Less vehicle movements for deliveries
- No requirement for curing times
- Easy to fix into

FLUCTUATIONS IN THE ROOM CLIMATE

Wood is a natural, non-homogeneous building material which has a compensating effect on the room climate.

Extreme variations of relative humidity and temperature may lead to cracks and fissures on the surfaces of the timber elements.

We therefore recommend that extreme temperature variations are avoided, specifically during the construction phase of the building.

For visual grade applications the ideal relative humidity of the environment is controlled to range between 40-60%

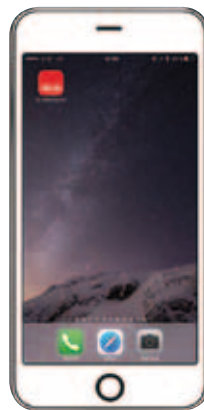
THERE'S MORE TO KLH CROSS-LAMINATED TIMBER

KLH is not only a manufacturer of building elements, but a valuable project partner. We therefore offer a range of specialist professional services in addition to the manufacture of CLT components.

Whether you require assistance relating to building physics or construction details, our highly qualified team of specialists will be happy to help. We can also offer support in the preparation of working and fabrication drawings.

ONLINE SUPPORT

Please visit our website to download our design software for KLH solid wood panels or to use the online version of the KLHdesigner. For all of you who would like to design with KLH ,on the go' , please download our mobile version of the KLH designer app



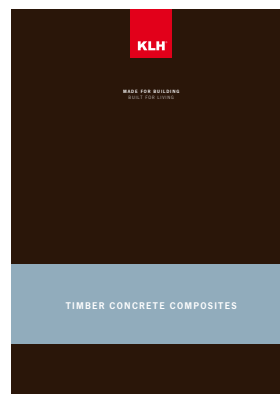
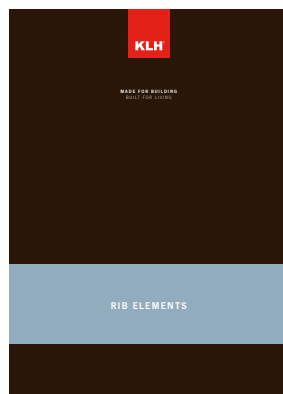
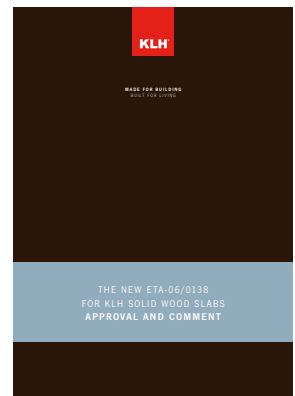
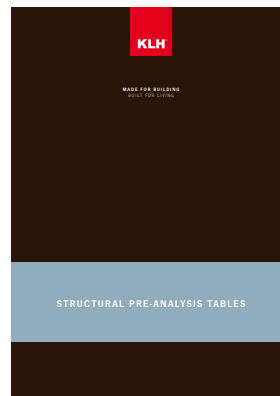
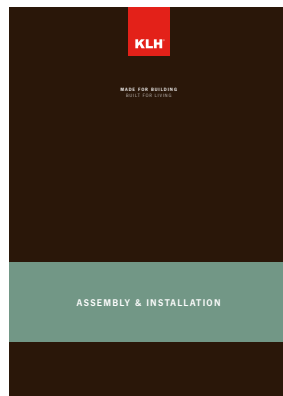
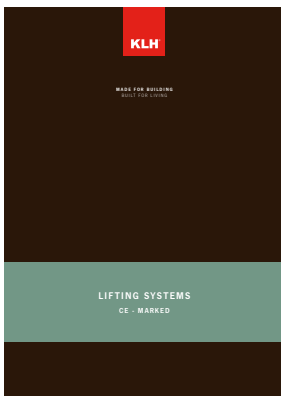
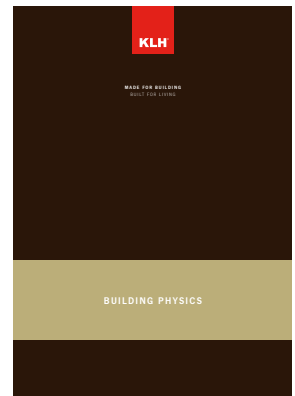
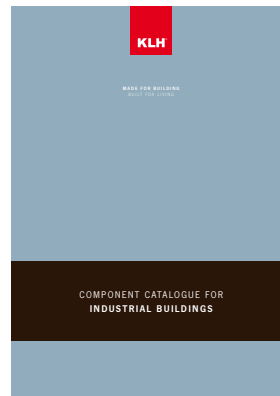
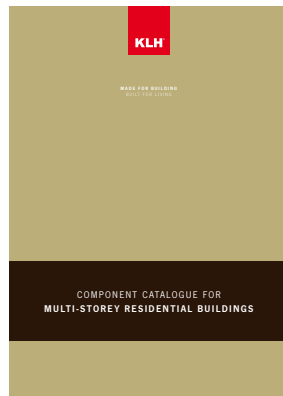
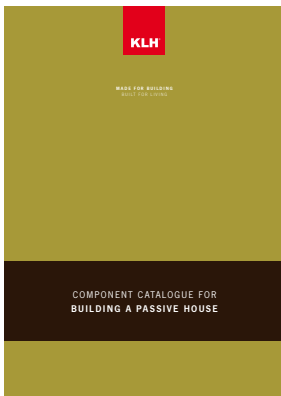
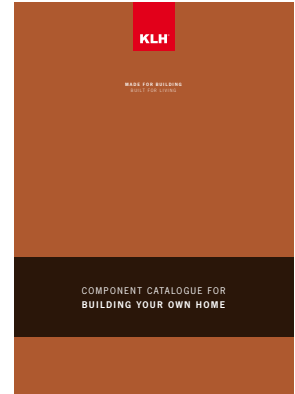
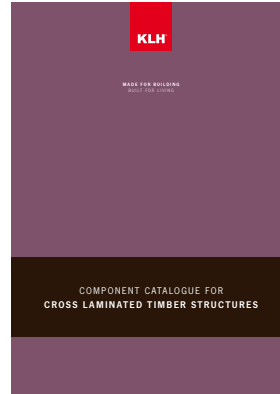
QR code for
KLHdesigner



QR code for
website



OTHER BROCHURES IN PRINT AND ONLINE



please visit <http://www.klh.at/en/download/>
to download any of the above brochures





KLH MASSIVHOLZ GMBH

Gewerbestraße 4 | 8842 Teufenbach-Katsch | Austria

Tel +43 (0)3588 8835 0 | Fax +43 (0)3588 8835 20

office@klh.at | www.klh.at



For love of nature



Printed on ecologically friendly paper