



WHERE  
IDEAS  
CAN  
GROW.

**MM**  
MAYR MELNHOF HOLZ



**MM masterline**  
glued laminated timber (glulam)





## WHERE IDEAS CAN GROW.

Mayr-Melnhof Holz Holding AG is one of the most prominent companies in the European wood-processing industry. As the market leader in the glued laminated timber (glulam) sector, it is a driving force behind the advancement of cross-laminated timber, the building material of the future. It is only companies with strong roots that are able to grow and surpass themselves, and indeed, Mayr-Melnhof Holz's roots go back as far as 1850. The corporate group draws on over 170 years of experience in processing the raw material, wood, which it sources exclusively from sustainably managed forests. For Mayr-Melnhof Holz, secure sources of supply, consistent traceability of the raw material's origin, transparent quality assurance of products and ongoing optimization of processes lay the foundations for reliability and product quality.





Mayr-Melnhof Holz products



**MM masterline**  
glued laminated timber (glulam)



**MM vistaline**  
duo and trio beams



**MM profideck**  
glulam floor panels



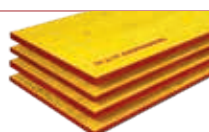
**MM blockdeck**  
glulam boards



**MM HBE**  
solid wood building elements



**MM crosslam**  
cross-laminated timber (CLT)



**K1 yellowplan**  
shuttering panels



**HT 20plus**  
formwork beams

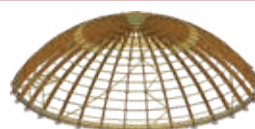


**MM sawn** timber

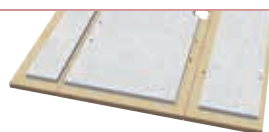


**MM royal**pellets

Engineered glulam and engineering services



**MM complete**  
timber engineering  
and complete systems  
by HUTEMANN



**XC LAM CONCRETE**  
wood-concrete composite elements  
by MMK

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# MM masterline

glued laminated timber (glulam)

## Glued laminated timber – solutions for every building project

**MM masterline** is the mark of quality for glued laminated timber, the popular building material produced by the corporate group, Mayr-Melnhof Holz. The **MM masterline** brand name stands for versatility, first class production, competent advice and a reliable delivery service. As an internationally-focused corporate group, we provide architects, engineers, timber construction specialists, processors and retail customers around the world with advice on how to plan and implement traditional and sophisticated, creative building projects. We are always ready to take on unusual requirements.



### Advantages

- Freely defined shapes and many different dimensions
- High structural strength with low self-weight compared to bulk density
- Excellent strength of shape and dimensional stability
- High level of prefabrication and therefore low-noise and low-dust assembly as well as short construction times
- Long-span components
- Precise sizing for individual project requirements

### Structural elements

- Walls
- Floors
- Roof structures
- Roof frameworks
- Beams
- Posts

### Areas of application

- Detached houses and multi-family houses
- Commercial, office and industrial buildings
- Warehouses and exhibition stands
- Communal buildings such as nursery schools, schools and care homes
- Tourism buildings such as hotels and restaurants
- Leisure facilities such as sports halls and swimming pools
- Churches and religious buildings
- Special constructions such as bridge frameworks



Certified according to the Construction Products Regulation (CPR)  
EN 14080:2013



Promoting Sustainable Forest Management  
www.pefc.org



Seal of approval for healthy living environments  
(IBR Rosenheim)

## Facts & figures MM masterline

### Wood species

- spruce
- larch

### Surfaces

- visual quality (VI)
- non-visual quality (NVI)

### Dimensions

- width: 6 cm to 28 cm (standard cross-sections up to 20 cm)
- height: 10 cm to 220 cm
- length: 4 m to 56.30 m
- available on request: block glued glulam, glulam with large finger joints and special shapes requiring CNC machining

### Product standard

- EN 14080:2013

### Strength classes

- GL24c
- GL24h
- GL28c
- GL28h
- GL30c
- GL30h
- GL32 (on request)

### Shapes

- straight
- with rise
- round post  
(diameter: 12 cm to 24 cm)
- curved

## High structural strength, dimensional stability and lightweight

The trend towards environmentally-friendly building is increasingly motivating architects and engineers to use the natural building material, wood, as a key architectural feature in the widest variety of construction projects. If it's good for the climate, it's good for everyone!

The fascination with glued laminated timber lies in the fact that the timber components can be formed into virtually any shape. Glued laminated timber elements made from strength-graded, planed wood lamellas, bonded in parallel, are becoming increasingly popular due to their high structural strength, excellent dimensional stability, cost effectiveness and versatility. The possibilities for combining high-quality bonded beams with a straight or curved design or with excessive dimensions are virtually unlimited! **MM masterline** raw panels are configured to your individual specifications in the factory, with precise dimensional accuracy, on CNC machines. The high level of prefabrication and flexible dimensions that can thus be achieved ensure quick assembly at the building site with low levels of dust. Mayr-Melnhof Holz's glued laminated timber ranges from standard goods and goods made to order, to complicated engineered glulam components.

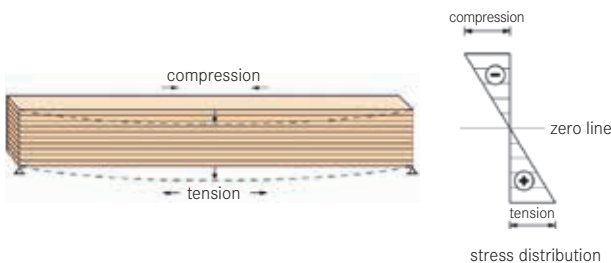
# Technical data



## Glulam

Glulam is made up of at least two board lamellas bonded together with the grain running parallel. Glulam is generally subjected to bending stresses, with the highest stresses occurring in the tension and compression zones. As glulam has a layered structure, the bonded lamellas can be arranged according to strength class in the areas of the beam that are subject to different elastic mechanical forces. For example, in a beam subject to bending stress, high-strength lamellas can be arranged according to the stress distributed across the height of the beam in the tension and compression areas. Lower strength lamellas can be used in the intermediate layers.

Example of a beam subject to bending stress:



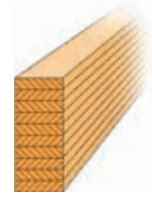
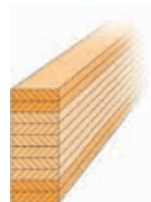
## Wood species

- Spruce (*Picea abies*)
- Larch (*Larix*)

## Structure

**C** = combined structure. Higher strength lamellas at the edges.

**H** = homogeneous structure. Lamellas in the same strength class arranged over the entire cross-section.



## Product standard

EN 14080:2013

## Design values for the strength classes (selection)

Mechanical properties	Name	GL24c	GL24h	GL28c
Bending strength	$f_{m,g,k}$	24.00	24.00	28.00
Tensile strength	$f_{t,0,g,k}$	17.00	19.20	19.50
Compressive strength	$f_{c,0,g,k}$	21.50	24.00	24.00
Modulus of elasticity	$E_{0,g,mean}$	11,000	11,500	12,500
Modulus of elasticity	$E_{0,g,05}$	9,100	9,600	10,400
Bulk density	$\rho_{g,k}$	365	385	390

Units: all strength and stiffness values in N/mm<sup>2</sup>; bulk density in kg/m<sup>3</sup>.

## Bonding

Adhesive based on melamine resin (MUF), type 1 according to EN 301, approved for bonding load-bearing wood components in indoor and outdoor areas.

Adhesive for finger joints: MUF (EN 301-I-90-FJ-0,3-S).

Adhesive for surface bonding: MUF (EN 301-I-90-GP-0.3-S).

## Colour of the bonded joint

Light bonded joint (melamine resin adhesive) or dark bonded joint (phenol-resorcinol resin) for special bonding tasks.

## Lamella thicknesses

In service classes 1 and 2, lamellas with a thickness of up to 45 mm can be used. On curved glued laminated timber elements, the thickness of the lamellas is reduced according to the curve applied to the element. For glued laminated timber in service class 3, standard EN 14080 recommends either choosing a lamella thickness of < 35 mm or agreeing with the customer on a lamella thickness of 40 mm.

## Wood moisture content

12% ( $\pm 2\%$ )

## Bulk density (mean values)

Spruce ..... approx. 430 kg/m<sup>3</sup>  
Larch ..... approx. 590 kg/m<sup>3</sup>

## Thermal conductivity

$\lambda = 0.13$  W/(mK) parallel to the bonded joints

$\lambda = 0.15$  W/(mK) perpendicular to the bonded joints

## Water vapour resistance factor

$\mu = 20$  to 40 (with a 12% moisture content)

## Emissions and volatile organic compounds (VOC)

- Formaldehyde class E1.
- Glulam is well within the limit values of emission class E1 ( $\leq 0.1$  ppm HCHO).
- VOC: IBR expert opinion (available on request).

## Reaction to fire

Glulam classification:

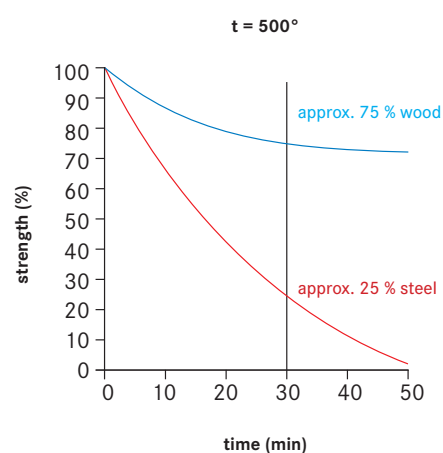
### Fire classification according to EN 14080 (table 11)

Minimum mean bulk density ..... 380 kg/m<sup>3</sup>

Euroclass ..... D

Smoke opacity ..... s2

Burning droplets ..... d0



At a temperature of approx. 500 °C, steel loses 75% of its strength after 30 minutes, whereas wood only loses 25% of its strength in the same amount of time.

## Fire resistance

Calculated charring rate: 0.7 mm/min according to EN 1995-1-2 (table 3.1).

## Shrinkage and swelling

Wood is a natural building material which both absorbs and releases moisture. The equilibrium moisture content of the component depends on the climatic conditions of the surroundings. To avoid changes in its dimensions, the building component's wood moisture content must be suitable for its intended place of installation.

At the time of production, glulam has a moisture content of approx. 12% ( $\pm 2\%$ ). This corresponds to an equilibrium moisture content at a room temperature of 20 °C and a relative humidity of 65%.

In height and width, glulam is subject to an average swelling and shrinkage ratio of  $\alpha_v = 0.24\%$  per 1% change in wood moisture content ( $\Delta u$ ). In most cases, changes in length corresponding to  $\alpha_{ull} = 0.01\%$  can be ignored.

# Quality

## Visual quality

Glulam is available in two different surface qualities.

**Visual quality (VI):** designed for use in visible areas (e.g. living areas, nursery schools, schools or sports halls).

**Non-visual quality (NVI):** designed for use where there are no requirements for visual appearance (e.g. industrial buildings, compost plants, agricultural buildings such as stables or clad supporting and roof beams).

## Surfaces

Planed on four sides and chamfered.



*visual quality*

*non-visual quality*

## Quality criteria

Criteria	Visual quality (VI)	Non-visual quality (NVI)
Planing quality	rough areas not permitted	rough areas permitted
	plane marks permitted up to 1 mm in depth	plane marks permitted
Knots	intergrown knots permitted	intergrown knots permitted
	knot holes permitted Ø ≤ 20 mm permitted Ø > 20 mm to be repaired using wood plugs	knot holes permitted
Resin pockets	permitted up to 5 × 50 mm	permitted
Pith	permitted	permitted
Insect attack	bore holes permitted (max. 2 mm)	galleries permitted (max. 2 mm)
Discolourations	blue stain and red stripe permitted on up to 5% of the visible surface	blue stain and red stripe permitted
	nail-tough brown stripes not permitted	nail-tough brown stripes permitted
Shrinkage cracks	up to 4 mm in width permitted	unlimited

### Important information about quality criteria

- The quality criteria refer to the surface quality at the time the product is delivered.
- After delivery, the customer must make sure that the glulam products are stored and assembled in a manner that is suitable for the respective materials.
- As wood is a natural raw material and therefore subject to atmospheric conditions, there may be slight differences to the criteria specified above.

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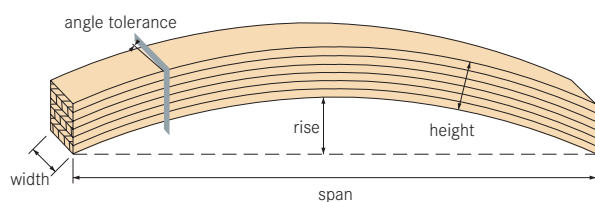
## Dimensional tolerances for straight components

In principle, our glulam products are manufactured to the exact dimensions ordered. However, production tolerances and the natural shrinkage and swelling behaviour of wood may lead to dimensional deviations in the cross-section.

The dimensional tolerances for glulam are regulated in EN 14080:2013. The reference moisture measurement is 12%.

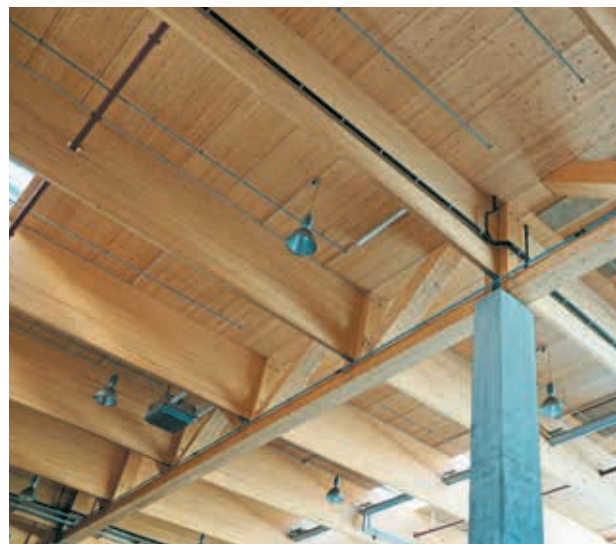
Width	60 mm ≤ b ≤ 300 mm		
Width tolerance	±2 mm		
Height	100 mm ≤ h ≤ 400 mm	400 mm < h ≤ 2,500 mm	
Height tolerance	+4 mm/-2 mm	-2 mm	
Length	< 2 m	2 m to < 20 m	> 20 m
Length tolerance	±2 mm	±0.1%	±20 mm

## Dimensional tolerances for curved components



Curved element	With CNC machining	Without CNC machining
Angle	deviation: max. 4% of the width	±1°
Width and height	deviation: max. 1%	±1 mm
Rise deviation	up to ±2 mm per meter of curve length	±1 mm

When curved components are produced, the raw piece of glulam timber is manufactured with surplus dimensions before being trimmed down to the exact size with CNC processing machines. For this reason, for orders for curved parts, thanks to CNC processing methods, we are able to guarantee a high level of dimensional accuracy, not only in terms of the individual curve but also for each piece in the series of components.



## Important information

The restoring forces must be taken into account on curved components according to the radius and number of lamellas.

## Crack formation

Depending on the ambient conditions to which the wood is exposed, shrinkage cracks can occur as a result of the material's natural shrinkage and swelling behaviour. The external areas of the component can absorb moisture, particularly during the construction phase. To prevent the formation of shrinkage cracks, this building moisture must be gradually eliminated and the equilibrium moisture content restored through adequate ventilation and careful heating of the building.

Shrinkage cracks can occur on the surfaces and along the bonded joints of the glulam components. On components not subjected to transverse stress related to the structure, these shrinkage cracks can be tolerated up to a depth of one sixth (1/6) of the component width (on each side).

If the component is directly exposed to the weather or extremely fluctuating climatic conditions, the risk of shrinkage cracks increases.

# Structural elements

## Standard cross-sections

We keep the following standard cross-sections in stock at Mayr-Melnhof Holz:

Height (In cm) ▼	Widths (in cm) ▶									
	6	8	10	12	14	16	18	20	22	24
10		8/10	10/10							
12	6/12	8/12		12/12						
14		8/14			14/14					
16		8/16	10/16	12/16	14/16	16/16				
18							18/18			
20	6/20	8/20	10/20	12/20	14/20	16/20	18/20	20/20		
22									22/22	
24		8/24	10/24	12/24	14/24	16/24	18/24	20/24		24/24
28				12/28	14/28	16/28	18/28	20/28		
32		8/32			14/32	16/32	18/32	20/32		
36						16/36		20/36		
40								20/40		
44										
48										

Standard cross-sections in standard lengths 12 m, 13.50 m, 16 m and 18 m are always available in film-wrapped units.

## Special cross-sections

Special cross-sections can be produced from standard cross-sections. In this case, a standard cross-section is planed down to the required special dimension (for example, the delivered dimension of 15 × 30 cm is planed down from the standard dimension of 16 × 32 cm). Special cross-sections are available at short notice and charged according to the related costs.

## Goods made to order

Elements on timber lists are made to order in (the best adapted) standard lengths or trimmed down to a set length specified by the customer.

## Standard lengths

In general, made-to-order standard lengths are delivered in one length with an additional allowance of 0.7 cm. In this case, the standard lengths are either limited to the maximum transport length of 13.50 m or to the longest length in the order.

## Set lengths (lengths specified by the customer)

For an additional fee, individual components can be trimmed down to a precise length, with a tolerance of ±2 mm.



# Special shapes — range of products

## Engineered glulam

### Straight components without a rise

Components which are over 80 cm in height and over 18.00 m in length.

### Components with a rise

Straight components with a rise (use of a glulam press)

### Single and double pitched roof trusses

- Single pitched roof truss with a straight underside.
- Double pitched roof truss with a straight underside
- Double pitched roof truss with a curved underside.
- Double pitched roof truss with a rise

### Fish belly roof truss

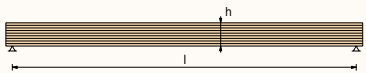
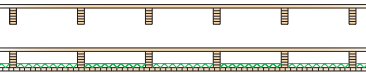
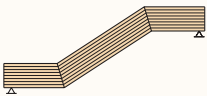
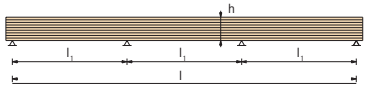
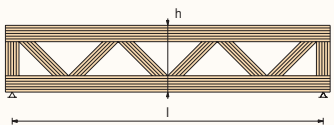
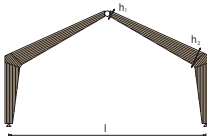
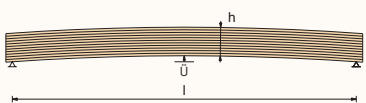
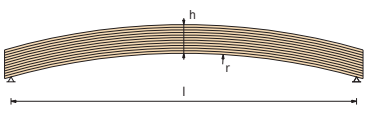
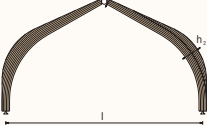
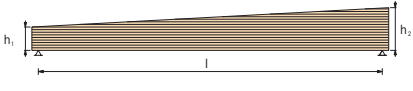
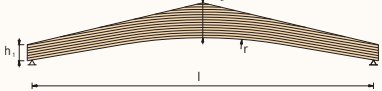
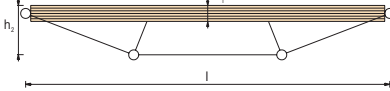
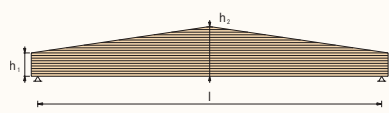
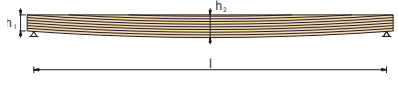
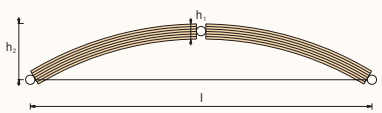
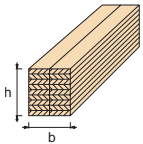
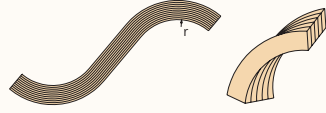
### Curved components with a uniform cross-section

Curved roof truss

### Freely defined special shapes

Freely defined contours (e.g. three-dimensional components)

## Beam systems

<b>Static system</b>		
<b>Straight beam (single-span)</b> 	<b>Rib panels and cassette elements</b> 	<b>Finger joints</b> 
<b>Straight beam (two or more spans)</b> 	<b>Lattice truss (lattice girder)</b> 	<b>Three-pin portal frame with finger-jointed haunch</b> 
<b>Straight beam with static rise</b> 	<b>Arch</b> 	<b>Three-pin portal frame with curved haunch</b> 
<b>Single pitched beam</b> 	<b>Double pitched beam with curved underside (pitched cambered beam)</b> 	<b>Tied systems with straight beam</b> 
<b>Double pitched beam</b> 	<b>Fish belly beam</b> 	<b>Tied systems with curved beam</b> 
<b>Block glued glulam</b> 	<b>Freely defined shapes</b> 	<p>d = lamella thickness                      l = span                      h = height                      b = width                      U = rise                      * recommended roof pitch</p>

**The following applies to engineered glulam:**

- A separate rise is necessary depending on the manufacturing process.
- The rises are limited to 1/200 or 1/300, i.e. to between approx. 4 cm and 15 cm.
- The shape of the curve can be chosen freely (simple, double or elliptical curves).
- Radii from 1.00 m are possible.
- The lamella thickness is dependant on the smallest curve radius.
- The maximum rise of an element is 4.00 m.
- Precise CNC machining is possible at the customer’s request.
- Transport restrictions must be observed.

**Block glued glulam**

Glulam board widths greater than 28 cm must be “block glued” whereby two or more standard cross-sections are glued together to form one permanent, structurally effective unit. The manufacture of block glued glulam is regulated in EN 14080:2013.

- Block glued glulam may only be used in service classes 1 and 2.

**Large finger joints**

Individual components can be connected by large finger joints in a structurally effective way to form an angled load-bearing shape. Given that the finger joints reduce the strength of the structure (see also DIN 20000-3), the tensile and bending strength for the characteristic design value of the connected glulam components must be reduced as follows:

GL24h .....	80%
GL28h .....	75%
Above GL28 .....	not possible

The production method is regulated in EN 14080:2013.

- Proven production method ensuring the transfer of forces, for example, in glulam frames.
- Higher level of safety compared to mechanical connections.
- Uniform shrinkage and swelling behaviour of the connected elements.



**Screw press bonding**

To produce high-strength rib panels and cassette elements, glulam beams and wood-based panels are permanently glued by means of screw press bonding.

This production method is regulated in DIN EN 1995-1-1/NA:2010-12, NCI NA 6.8.1 (NA.4) and DIN 1052-10:2012-05.

- Large spans with less material are possible through the use of hollow box elements.
- Flush floor beam with wood-based panels without a visible load-bearing structure.
- Technical installations can be integrated if the preliminary planning is sufficiently detailed.
- Flat plane supporting structures with an initial waterproofing layer applied in the factory.

**Pre-assembled components**

Wooden components can be joined manually according to traditional methods, or with the use of CNC processing machines. Angle and bevel cuts, chamfers and boreholes are some of the more basic processing techniques. More complex techniques such as dovetail joints, mitre joints, grooves, slots and rounding off, can usually be implemented more efficiently on one of our modern CNC joinery portals, depending on the number of pieces and the complexity of the joint.

As one of the most modern and high-performance CNC timber processing centres in Europe, we offer you:

- modern joinery portals to meet differing requirements
- precise joinery with the highest dimensional accuracy
- complicated angle cuts, lathing, rounding, milling and boring
- dimensional accuracy including within one series
- efficiency and therefore lower costs

To guarantee efficient and cost-effective CNC processing, we can process the data provided to us in the form of single piece drawings or as a model from one of the following file formats:

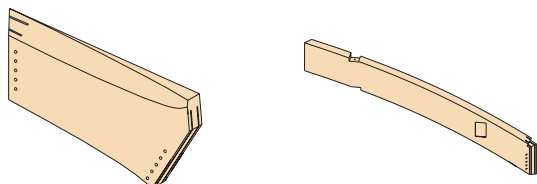
- SAT
- IFC
- DWG/DXF
- Cadwork 2D/3D
- BVN, BVX, BTL

We will agree on a suitable file format with you according to your individual project.

### Machining and joinery machines

Large components, curves and cassette elements are processed with extremely high accuracy on CNC-controlled five-axis machining portals:

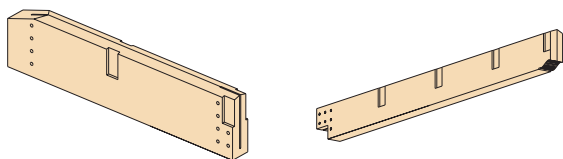
- Machining dimensions up to 33.80 m in length, 5.00 m in width and 0.28 m in height (Reuthe site).
- Machining dimensions up to 53.00 m in length, 4.50 m in width and 0.48 m in height (Olsberg site).
- Cutting of straight and curved components, large format panels (e.g. cross-laminated timber panels) and cassette elements.
- Fully-automated tool changing units.

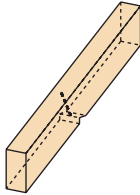
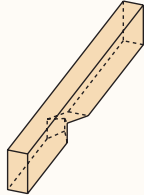
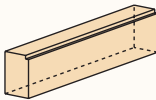
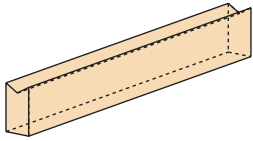
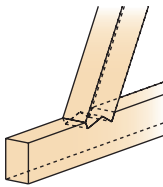
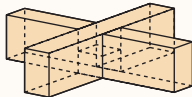
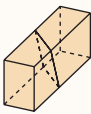
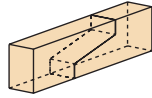
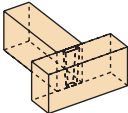
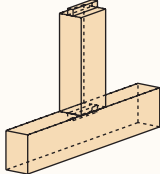


### Processing straight components (off-the-shelf timber)

Straight components are processed on our Hundegger systems as follows:

- K2i: machining dimensions up to 23.00 m in length, 1.30 m in width and 0.30 m in height
- RD: machining dimensions up to 24.00 m in length, 1.30 m in width and 0.30 m in height



CNC processing possibilities	
 <p>birdsmouth (incl. 8 mm hole for rafter nail)</p>	 <p>halving birdsmouth for valley rafters</p>
 <p>rebate</p>	 <p>V groove</p>
 <p>double notched joint</p>	 <p>cross-halving joint</p>
 <p>plain scarf joint</p>	 <p>ribbed scarf joint</p>
 <p>dovetail joint</p>	 <p>plain mortise and tenon</p>

# Additional services

## Technical advice

At Mayr-Melnhof Holz, we provide you with support and competent technical advice related to your individual building project. For instance, our services comprise basic structural physics advice and simple preliminary dimensioning.

## Structural analysis, working drawings and installation planning

On request, we offer you structural calculations as well as working drawings and installation planning, carried out by our own engineering offices or selected partner companies.

## In-plant pre-assembly

On request, Mayr-Melnhof Holz offers to install steel and connection components. In-plant pre-assembly reduces subsequent assembly costs at the construction site and simplifies processes.

## Timber and steel components

Various cost-effective and efficient joining techniques are available in modern timber construction. This includes:

- steel plate shaped parts
- welded steel parts
- specifically designed fitted bolts and dowels
- self-tapping dowels
- high tensile screws

## Fasteners

We use standard fasteners made by established manufacturers (joist anchors, cleats, purlins, bolts, screws, etc.).

## Waterproofing and coatings

In principle, our glulam components are delivered untreated. However, regional building regulations or individual customer requirements may require the application a chemical surface treatment. On request, our service portfolio includes the application of:

- primers
- varnish

## Just-in-time delivery service

By arrangement, Mayr-Melnhof Holz delivers the components in the assembly sequence just-in-time, directly to the construction site. The components are numbered and packaged.

## MM complete by Hüttemann

We are also happy to manage the entire construction project, from official approval to turnkey delivery.



## Packaging and logistics



### Packaging (LDPE plastic film)

- Protects the components from dirt and splash water during transport.
- Only provides limited protection of the component against UV radiation and water absorption.
- Is not suitable for storing glulam components for long periods.

The wrapping film must be removed immediately after delivery, to prevent condensation from forming.

### Transport by truck

Components with a maximum length of 13.60 m can be transported in open or closed trucks. The trucks are loaded at our factories by means of side loaders. Any loading of goods by crane must be agreed with our dispatchers in advance.

Direct deliveries to construction sites are only possible by agreement with our dispatcher. In this respect, please note the following:

- Heavy duty transport requires an access road that can be driven upon.
- The possibility of unloading the goods by crane or forklift truck must be clarified in advance.
- Fixed delivery deadlines are only possible after confirmation by Mayr-Melnhof Holz, due to distances and road conditions.

### Special methods of transport

Components exceeding 13.60 m in length, 2.40 m in width and 2.60 m in height require a special method of transport which is subject to approval due to national and international traffic laws.

Our on-site dispatchers are experienced in this area and will endeavour to find the best solution in each case. In order to provide you with the best possible advice, it is important that you inform us of the exact component dimensions.

Special methods of transport must be requested on a case-by-case basis and require a longer delivery time than standard methods of transport.

### Container

Box containers or open top containers (OT), 20 ft (approx. 6 m) or 40 ft (approx. 12 m) in length are used for maritime transport. Box containers are more difficult to load and unload than open top containers, however they are cheaper and more readily available. Components longer than 12 m can be shipped by sea using conventional methods (*break bulk*).

### Railway

Depending on the destination and manufacturing plant, transport by railway wagon can be an economic solution. A choice of three types of wagon is available depending on the component dimensions and availability.

# Our sites

**Sweden**

- Bergkvist Siljan Insjön**  
saw mill
- Bergkvist Siljan Mora**  
saw mill
- Bergkvist Siljan Skog**  
round timber procurement

**Germany**

- Mayr-Melnhof Holz Wismar**  
second transformation
- Mayr-Melnhof Holz Olsberg**  
second transformation
- Mayr-Melnhof Holz Reuthe**  
second transformation, pellets production
- Mayr-Melnhof Holz Gaihorn am See**  
second transformation

**The Czech Republic**

- Mayr-Melnhof Holz Paskov**  
saw mill, pellets production

**Austria**

- Mayr-Melnhof Holz Leoben**  
saw mill, pellets production, second transformation

**KAUFMANN  
BAUSYSTEME**

**MMK**

### Contact details of our second transformation sites:



**Mayr-Melnhof Holz Gaihorn GmbH**  
 Nr. 182 · 8783 Gaihorn am See · Austria  
 T +43 3617 2151 0 · gaihorn@mm-holz.com

**Mayr-Melnhof Holz Reuthe GmbH**  
 Vorderreuthe 57 · 6870 Reuthe · Austria  
 T +43 5574 804 0 · reuthe@mm-holz.com

**Mayr-Melnhof Holz Wismar GmbH**  
 Am Torney 14 · 23970 Wismar · Germany  
 T +49 3841 221 0 · wismar@mm-holz.com

**Mayr-Melnhof Holz Olsberg GmbH**  
 Industriestraße · 59939 Olsberg · Germany  
 T +49 2962 806 0 · olsberg@mm-holz.com

[www.mm-holz.com](http://www.mm-holz.com)

