Maintenance and servicing

This document explains the most important topics for maintenance and inspection and gives a recommendation for heating up the building. Our enclosed leaflets „Appropriate handling of glued laminated timber“ and „Appropriate handling of X-LAM (CLT)“, which contain rules from planning to maintenance, still apply. During both the construction phase and after completion of the building, it should be ensured that the supporting structure does not suffer any damage. The document serves as a tool to maintain the highest possible quality of the timber components in the long term, but does not cover all conceivable aspects, problems and causes that could damage the structure. Therefore, in addition to this, all other rules that require professional facility management for such a building must also be observed.

GENERAL

Glued laminated timber and cross laminated timber constructions do not generally require recurring maintenance measures in the sense of renewal or replacement of certain subcomponents under suitable general conditions.

The essential requirements for this are:

- Protection of the components from moisture and humidity during construction.
- Gentle heating of the building at the start of use.
- A constant climate that is subject only to seasonal fluctuations, if possible, or results in wood moisture content differences of ±2 %.
- No direct contact with moisture, e.g. through leaking roofing, roof drainage, piping, etc.
- Avoidance of condensation on installed or adjacent components.
- No increase in loads above the load level specified in the structural analysis.
- Professional load application.
- Coordination of the hall climate (temperature and humidity) with the glued load-bearing structure.
- Avoidance of climatic fluctuations due to use, e.g. changes in use, etc. In air-conditioned buildings, extremely low humidity (<30 %) or very high temperature differences (e.g. >5°) must be avoided.

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Pavilion Martin-Luther-Platz, Düsseldorf

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WOOD MOISTURE

Until the building is put into operation, excessive ambient humidity, e.g. wet trades in closed buildings or driving rain in non-closed building envelopes, as well as corresponding temperatures, can lead to increased wood moisture on the wooden components. Especially in the edge areas of the cross-sections, higher wood moisture levels occur, so that a moisture gradient develops from the outside to the inside. These construction site conditions must be avoided. The conditions that prevailed should be recorded in a comprehensible manner in the construction diary.

However, even if there are no external influences with regard to the wood moisture content, the factory-set wood moisture content of 10 +-2 % should be taken into account according to the subsequent use (heated or unheated rooms). Unheated buildings are generally not affected by excessive drying.

If a heated building is taken into use, the building components will dry out. The higher the moisture gradient in the cross-section and the faster drying occurs, the greater the transverse tensile stresses. The risk of shrinkage cracking increases. In air-conditioned buildings with extremely low relative humidity (<30 %) or buildings with very high temperature differences (e.g. >5°), the risk of shrinkage cracking is very high and experts may have to be consulted.

Suitable measures, e.g. regulated room temperature and air humidity for wood drying, must be taken to dry out completely moist building components in order to achieve slow post-drying.

GENTLE HEATING

Mainly the outer layers of the wood absorb moisture during construction. However, depending on the season and the length of the construction period, the moisture content of the wood may be significantly higher over the entire cross-section than during production or subsequent use. The ‚construction moisture' must therefore be gradually transferred to the equilibrium moisture of later use. This is achieved by careful heating and ventilation and the accompanying slow reduction of the relative humidity and the corresponding wood moisture content. Provided that a control system of the building climate via temperature and humidity is installed, the requirements can be easily implemented via a corresponding coordination with the air conditioning engineer. The process should be documented accordingly.

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In detail, proceed as follows:

a) Determination of the mean value of the wood moisture: measurement of the wood moisture at representative points and at different depths (e.g. 10, 20 and 40 mm), formation of the mean value.

b) Determination of the corresponding room climate for this equilibrium moisture content from the attached diagram (Figure 1).

c) Based on this, a relative humidity should be set approx. 5 % lower than under b). This relative humidity should be maintained until the mean value of the wood moisture content from the edge area and a depth of 4 cm corresponds to the set climate. This requires devices to regulate the ambient climate.

d) In further steps, the relative humidity should be reduced by a further 5% in each case to achieve further, gentle moisture release from the edge areas.

Example

Measuring depth / Measuring point	10 mm	20 mm	40 mm	average Ø
Measuring point 1	13,2 %	14,5 %	15,5 %	14,4 %
Measuring point 2	12,4 %	13,8 %	14,9 %	13,7 %
Measuring point 3	14,1 %	15,4 %	15,8 %	15,1 %
Measuring point 4	14,2 %	14,8 %	15,0 %	14,7 %
Average Ø	13,5 %	14,6 %	15,30 %	**14,5 %**

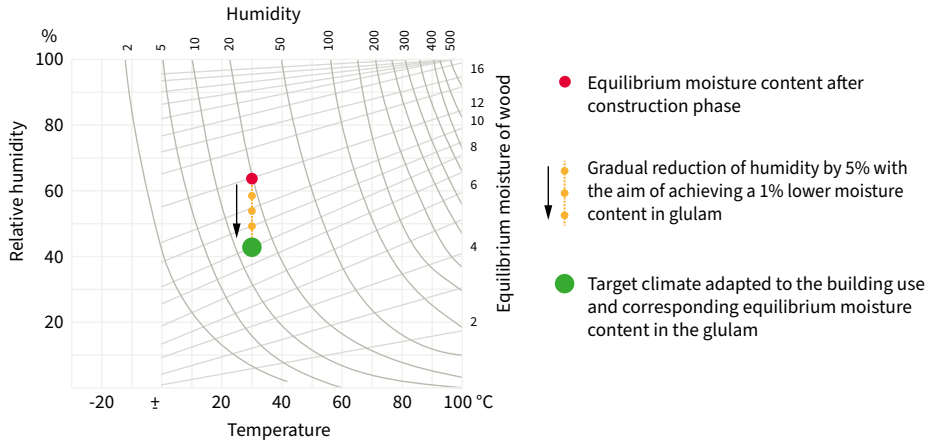

Figure 1: Diagram for evaluating the equilibrium moisture content in wood from the interaction of humidity and temperature.

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At a temperature of 20 °C, this would correspond to a compensation climate of approx. 70 % air humidity. In a second step, the air humidity should be reduced by about 5 to 10 % until an average wood humidity of about 13.5 % is achieved.

This reduction should be repeated in stages until a balance humidity is achieved that can be expected in the final usage climate.

Reference values for temperatures, relative humidities and expected wood moisture contents for different uses (based on Dietsch)

Insulated and heated buildings under normal operation				
	Wood moisture in [%]		Mean value	Mean value Relative
Use	Mean value	Annual fluctuations	Temperature in [°C]	humidity in [%]
Production and sale	6 – 7	< 2	15 – 25	< 40
Swimming	8 – 9	< 1,5	≈ 30	< 50
Sport	8 – 10	< 2	≈ 20	< 50
Average insulated, heated	6 – 10	< 2	> 20	< 50
Partially open, uninsulated and unheated buildings under normal operation				
Riding	14 – 17	3 – 5	10 – 15	70 – 80
Livestock farming (cold barns)	14 – 17	4 – 5	10 – 15	65 – 75
Storage	11 – 16	4 – 5	10 – 15	60 – 75
Average partially open, uninsulated and unheated	12 – 16	4	10 – 15	> 65

PERIODIC INSPECTION OF THE WOODEN STRUCTURE

The construction should be inspected at regular intervals. The following intervals are recommended as maintenance intervals, unless there are special occurrences:

1. Before the heater is put into operation.
2. Annually within the first five years of use.
3. After five years at 3-year intervals.

It is recommended to carry out the inspection during the coldest season (December to February), as the relative humidity inside the building is usually at a low level and cracks in the wooden structure are more likely to appear then.

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During these inspections, a direct visual inspection should be carried out, during which the following points should be checked, in addition to other apparent changes:

1. Wood moisture control at different measuring points and within different depths.
2. Check of the climate in the building (humidity and temperature) and comparison with the equilibrium moisture content of the wood according to Fig. 1.
3. Investigation if the construction is in direct contact with moisture sources. These can be:
   - Leaks in the roof structure.
   - Leaks from the roof drainage system.
   - Leaks from piping.
   - Condensation on installed or adjacent building components.

   Such problems are often identifiable by water stains, discoloration or running marks on the structure.
4. Examination for cracks in the glulam area.
5. Examination in the area of junction points and splices.
6. Building physics boundary conditions:
   - Air tightness of the building envelope.
   - Facade connections.
   - Ventilated roofs with convection from the inside.
   - Connections of the vapor barrier.

CRACK FORMATION

Cracks are naturally present in all wood; they are caused by the ambient climate. Shrinkage cracks can occur on the surfaces of glulam and X-LAM components - even along the glue joint. Therefore, cracks are ‚normal' to some degree in all structural wood products. Some explanations and notes are given below.

In cross laminated timber, cracking occurs mainly in the outer layers. In the state of construction, a certain amount of moisture absorption takes place. Through the transfer to the later use, the wood equilibrium moisture gradually sets in. As a result, shrinkage cracks may occur, although these are not of structural significance and may also cause cracking noises.

However, cracks in glulam must not exceed a certain level. Regardless of the surface quality, crack depths of up to 1/6 of the component width measured with a 0.1 mm thick feeler gauge are harmless for components without planned transverse tensile stress, and up to 1/8 of the structural width from each side for components with planned transverse tensile stress. For deeper cracks, the safety should be checked by an expert.

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In the case of direct weathering, strongly changing climatic stresses and very wide cross sections (> 20 cm), the tendency to crack formation increases.

Areas where beams penetrate walls enclosing rooms and are exposed to very different climatic zones, e.g. outdoors and indoors, are also critical. Here, cracks in the laminated timber can occur in the area of wall or facade penetration, as the climate tends to be significantly more humid on the outside than on the inside.

When examining cracks, this procedure should be followed:

- Crack ends should be marked with pencil points and date entry to document their future development.
- Maximum crack depths should be measured with a 0.1 mm feeler gauge.
- A specialist should be called in for cracks deeper than 90 mm.
- Wood moisture content should be recorded in the area of the cracks at various depths.
- The cracks should be documented in an appropriate document with the exact location, length, depth and wood moisture content of the adjacent lamellae and at different depths (e.g. 10, 20 and 40 mm depth).

SURFACE TREATMENT

A wood moisture content that remains below 17% over the long term is important to prevent microorganisms from destroying the wood. To ensure this, constructive wood preservation must be observed or breathable coatings must be used that reduce the absorbency of the wood and reduce the absorption of moisture.

In the case of structural components in roofed outdoor areas that are protected against permanent moisture, longevity is a given. For example, horizontal surfaces on which moisture can remain for a long time should be avoided. Bevels or sheet metal covers should be placed at these locations.

Structural components are protected from wetness or direct weathering by means of widely projecting canopies, cladding and covers. From this point of view, constructive wood preservation aims at minimizing moisture. It is primarily a matter of avoiding long-term moisture. Short periods of wetness are less problematic for the material.

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The so-called graying of the wood surface is caused by solar radiation. The UV light contained there attacks the lignin layer of the wood and often causes the silver-gray discoloration. A surface protection for this is provided by a color treatment of the wood. The color tones of the varnishes are achieved via micronized pigments, which are located in the color layer and reflect the solar radiation. As long as the color layer is intact, the lignin layer cannot be attacked by UV radiation.

Coatings that serve as weather protection must be checked at regular intervals, see pages 4 + 5, and touched up if necessary to ensure optimum wood protection. In the case of very light or very dark paint coats, shrinkage cracks may be particularly visible on the component surfaces.

For the color coating, the product BSH-Varnish is recommended internally as additional protection against moisture absorption and at the same time against soiling during transport and assembly. The technical data sheet of the manufacturer Koch & Schulte is enclosed.

MAINTENANCE CONTRACT WITH THE DERIX GROUP

According to the inspections listed on page 4 + 5, we recommend an annual inspection of the supporting structure. We will be pleased to submit our offer for the maintenance contract on request.

The inspection includes a visual inspection of the supporting structure and the connections, including a written and pictorial description of any damage that has occurred, as well as the corresponding proposals for the elimination of damage due to mechanical or weather-related influences, if applicable, or a proposal for the further damage-free maintenance of the components.

During the inspection, the client or customer will provide an appropriate working platform/climber to reach the higher areas free of charge.

The inspection includes the arrival and departure as well as a max. 5-hour inspection and will be provided in a separate document if required.

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