

ENVIRONMENTAL PRODUCT DECLARATION

in accordance with ISO 14025 and EN 15804

Declaration holder	Studiengemeinschaft Holzleimbau e.V.
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Glued laminated timber Studiengemeinschaft Holzleimbau e.V.

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Institut Bauen
und Umwelt e.V.



1. General information

Studiengemeinschaft Holzleimbau e.V.

Programme holder

IBU – Institute Construction and Environment e.V.
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Declaration number

EPD-SHL-20120017-IBG1-E

This Declaration is based on the Product Category Rules:

Solid wood products, 07-2012
(PCR tested and approved by the independent Committee of Experts (SVA))

Issue date

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Prof. Dr.-Ing. Horst J. Bossenmayer
(President of Institut Bauen und Umwelt e.V.)

Prof. Dr.-Ing. Hans-Wolf Reinhardt
(Chairman of the Expert Committee (SVA))

Glued laminated timber

Holder of the Declaration

Studiengemeinschaft Holzleimbau e.V.
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Declared product/unit

1 m³ glued laminated timber

Area of applicability:

The content of this Declaration is based on information provided by approx. 50% of members, whereby the technology presented here is representative for all members. The results of the Life Cycle Assessment are therefore representative for all glued laminated timber beams manufactured in Germany. The holder of the Declaration is liable for the information and evidence on which it is based.

Verification

The CEN EN 15804 standard serves as the core PCR.

Verification of the EPD by an independent third party in accordance with ISO 14025

internal external

Dr. Frank Werner,
Independent auditor appointed by the SVA

2. Product

2.1 Product description

Glued laminated timber is an industrially-manufactured product for load-bearing structures. Glued laminated timber comprises at least three kiln dried coniferous wood planks or laminations which are glued together with the fibres running in parallel. Thanks to the initial material being strength-graded and homogenisation via its layered structure, it is hardened and tempered and has higher load-bearing capacities than conventional structural timber. On account of its manufacturing process, glued laminated timber is a very dimensionally stable building material which is subject to minimum cracks. Glued laminated timber can be manufactured as straight or curved beams. Apart from monitoring required for technical approval, manufacturing can also be subject to supplementary private monitoring in accordance with the provisions of the glued laminated timber monitoring symbol.

2.2 Application

Glued laminated timber is used as structural components for buildings and bridges.

2.3 Technical data

Glued laminated timber is manufactured from spruce, fir, pine, larch or Douglas fir. Other coniferous species are permissible but not typical.

Adhesives in accordance as per 2.6 are used for gluing. Glued laminated timber is manufactured with average moisture content of 12%. It is supplied in formats as per 2.5 and dimensional tolerances in

accordance with the Glued Laminated Timber Data Sheet published by Studiengemeinschaft Holzleimbau e.V.

The typical strength classes to DIN 1052: 2008 are GL24h, GL28c and GL32c. The products can be manufactured in supreme quality, visual quality or industrial quality in accordance with the Glued Laminated Timber Data Sheet. Use of wood preservatives in accordance with DIN 68800-3 is not typical and only permissible if other preservative means as per DIN 68800-2 are not sufficient on their own. Where wood preservatives are used in exceptional cases, they must be regulated in the form of a national technical approval.

Constructional data

Description	Value	Unit
Moisture content to DIN 1052 2008	≤ 15	%
Use of wood preservatives to DIN 68800 -3	Where other preservative means are insufficient	-
Typical species by trade name (EN 1912)	Spruce, fir, pine, larch, Douglas fir	

2.4 Placing on the market / Application rules

Glued laminated timber is subject to the general building authority requirements on glued laminated timber as per DIN 1052: 2008 or DIN EN 14080: 2005. Evidence of suitability for gluing load-bearing members (adhesive approval) must also be provided for the

products in accordance with DIN 1052:2008. Dimensioning is in accordance with DIN 1052: 2008 or DIN EN 1995-1-1: 2010-12 with the corresponding National Annex DIN EN 1995-1-1 NA.

2.5 Delivery status

The products are manufactured in the following preferred dimensions:
 Min. height: 100 mm
 Max. height: 2400 mm
 Min. width: 60 mm
 Max. width: 240 mm
 Max. lengths: 50 m

2.6 Base materials / Auxiliaries

Glued laminated timber comprises at least three kiln dried coniferous wood planks or laminations which are glued together with the fibres running in parallel Melamine-urea-formaldehyde adhesives (MUF) or polyurethane adhesives (PUR) as well as smaller volumes of phenol-resorcin-formaldehyde adhesives (PRF) are used for basic duroplastic glueing. The use of emulsion-polymer-isocyanate (EPI) adhesives is permissible but not yet typical in Germany. The average percentages of ingredients per m³ glued laminated timber for the Environmental Product Declaration:

- Coniferous wood, primarily spruce: approx. 87.45%
- Water: approx. 10.45%
- PUR adhesives: approx. 0.03%
- MUF adhesives: approx. 1.94%
- PRF adhesives: approx. 0.09%

The product has an average bulk density of 508.37 kg/m³.

2.7 Production

The manufacture of glued laminated timber involves kiln drying conventional sawn timber to approx. 12% moisture content, rough-planed and visually or automatically strength-graded. Depending on the requisite strength class, any board sections of lower strength are lopped out and the remaining board sections bonded via finger joints to form laminations of infinite length. The subsequent rough-planing process involves planing the laminations to thicknesses of up to 45 mm for pressing as at least 3-layer blanks after glueing the wide face in a straight or curved press bed. After hardening, the blanks are planed, bevelled, bound and packed. If necessary, they can be treated with weatherproof or wood preservative.

2.8 Environment and health during manufacturing

Waste air incurred is cleaned in accordance with statutory specifications. There are no risks for water or soil. The process waste water incurred is fed into the local waste water system. Noise-intensive machinery is encapsulated appropriately.

2.9 Product processing/installation

Glued laminated timber can be processed using conventional tools suitable for processing solid wood. The health and safety guidelines must also be observed during processing and/or assembly.

2.10 Packaging

Polyethylene, metal, solid wood, paper and cardboard are used as well as small percentages of other plastics.

2.11 Condition of use

The composition for the period of use complies with the composition of base materials in accordance with section 2.6 "Base materials".
 Approx. 221.3 kg carbon are bound in the product during use. This complies with approx 811 kg carbon dioxide at full oxidation.

2.12 Environment and health during use

Environmental protection: According to current knowledge, there are no risks for water, air and soil when the products are used as designated.

Health protection: According to current knowledge, no health risks are to be anticipated.

With regard to formaldehyde, glued laminated timber is low-emission thanks to its adhesive content, structure and particular use.

Laminated timber glued with PUR or EPI adhesives displays formaldehyde emission values in the range of natural wood (approx. 0.004 ml/m³). MDI emissions can not be measured within the detection limit of 0.05 µg/m³ for laminated timber glued with MDI or PUR adhesives. On account of the high reactivity displayed by MDI with water (humidity and wood moisture), it can be assumed that laminated timber thus glued displays MDI emissions close to zero shortly after manufacturing.

Laminated timber glued with MUF adhesives emanates formaldehyde subsequently. Measured using the limit value of 0.1 ml/m³ specified by the Ordinance on Chemicals, the values after testing (DIN EN 717-1: 2005) can be classified as low. Average emissions amount to approx. 0.04 ml/m³. In individual cases, they can account for up to approx. 0.06 ml/m³.

2.13 Reference Service Life (RSL)

Glued laminated timber has been used for more than 100 years.

When used as designated, infinite durability can be anticipated.

When used as designated, the service life of glued laminated timber is therefore the same as the service life of the respective building.

2.14 Extraordinary effects

Fire

Fire class D in accordance with DIN EN 13501-1; the toxicity of fire gases complies that of natural wood.

Description	Value
Building material class	D
Burning drips	d0
Smoke gas development	s2

Water

No ingredients are washed out which could be hazardous to water.

Mechanical destruction

The fracture surface of glued laminated timber displays an appearance typical for solid wood.

2.15 Re-use phase

In the event of selective de-construction, glued laminated timber can easily be re-used after the use phase has ended.

If glued laminated timber can not be re-used, it is directed towards thermal recycling for generating process heat and electricity on account of its high

calorific value of approx. 16 MJ/kg (with moisture of $u=12\%$).

During energetic recycling, the requirements outlined in the Federal Immission Control Act must be observed: Untreated laminated timber is allocated to waste code 17 02 01 in accordance with Annex III of the Regulation governing requirements on recycling and disposing of waste wood (AltholzV) dated 15.02.2002 (depending on the type of wood

preservative, treated laminated timber is allocated to waste code 17 02 04).

2.16 Disposal

Waste wood may not be landfilled in accordance with §9 AltholzV.

2.17 Further information

More detailed information is available at www.brettschichtholz.de.

3. LCA: Calculation rules

3.1 Declared unit

The declared unit in the LCA is the provision of 1 m³ glued laminated timber with a mass of 508.37 kg/m³, 12% wood moisture, 10.494% water content and 2.057% adhesive content.

Declared unit

Description	Value	Unit
Declared unit	1	m ³
Gross density	508.37	kg/m ³
Conversion factor for 1 kg	0.00196707	-
Moisture content on delivery	12	%
Adhesive content in relation to overall mass	2.057	%
Water content in relation to overall mass	10.494	%

3.2 System boundary

The Declaration type corresponds with an EPD "from cradle to plant gate, with options". Contents include the production stage, i.e. from the provision of raw materials to the production plant gate (cradle to gate, Modules A1 to A3) as well as elements of the End of Life (Modules C2 to C4). The benefits and loads beyond the product life cycle are also analysed (Module D).

Module A1 analyses the provision of wood from forestry resources, the provision of other pre-treated wood products and the provision of adhesives. Transport of these substances is considered in Module A2. Module A3 handles the provision of fuels, consumables and electricity as well as the manufacturing processes on site. These essentially involve debarking, cutting, drying, planing and profiling processes as well as gluing and packing the products.

Module C2 takes consideration of transport to disposal; Module C3 handles preparation and sorting of waste wood; Module D analyses thermal recycling as well as the ensuing benefits in the form of a system extension.

3.3 Estimates and assumptions

As a general rule, all material and energy flows for the products required for production are established specifically on site. It was only possible however to estimate the emissions from incineration and other processes incurred on site on the basis of literary references. All other data is based on average values. More detailed information on all estimates and assumptions made is documented in (S. Rüter, S. Diederichs: 2012).

3.4 Cut-off criteria

The choice of material and energy flows analysed is aligned towards their involvement in renewable and non-renewable primary energy for each unit process. A decision on the flows to be analysed was based on

studies already available on analysing wood products. At least those material and energy flows were analysed which account of 1% of the renewable or non-renewable primary energy used, whereby the total of flows not considered does not exceed 5% of the indicators outlined. No known material or energy flows below the 1% limit were ignored.

The inputs and outputs identified from the company data were examined for plausibility.

The expenses involved in providing the infrastructure (i.e. machinery, buildings etc.) of the entire primary system were not taken into consideration. This is based on the assumption that the total expenses associated with building and maintaining infrastructure do not exceed the 1% of total expenses referred to above. The requisite energy expenses for operating the infrastructure were taken into consideration in the form of heat and electricity. More detailed information on all estimates and assumptions made is documented in (S. Rüter, S. Diederichs: 2012).

3.5 Background data

All background data was taken from the GaBi Professional Data Base.

3.6 Data quality

With the exception of forest wood, the background data used for wood raw materials for material and energy use refers to the years 2008 to 2010. The power mix originates from 2009 while the provision of forest wood was taken from a publication dated 2008 which is essentially based on details from the years 1994 to 1997. All other information was taken from the GaBi Professional Data Base which does not permit any exact containment of quality. As the essential information is based on primary, highly-representative data surveys, the data quality can be regarded as very good.

3.7 Period under review

Data was collected over the period from 2009 to 2011, whereby data was always available for the respective calendar year. The data is therefore based on the years 2008 to 2010. All information is based on average values over 12 consecutive months.

3.8 Allocation

The allocations carried out comply with the EN 15804:2012 and are explained in detail in S. Rüter, S. Diederichs: 2012. The following essential system expansion processes and allocations were carried out.

General information

All material-inherent features were allocated according to physical causalities; all other allocations were performed on an economic basis. An exception is represented by the allocation of requisite heat in

combined heat and power facilities which was allocated on the basis of the exergy of electricity and process heat.

Module A1

- Forestry: Expenses associated with forestry were allocated to logs and industrial wood on the basis of their prices.
- The provision of waste wood does not take consideration of any expenses from the previous life cycle.

Module A3

- Wood-processing industry: Expenses were allocated to the primary products and residual materials on the basis of their prices.
- With the exception of wood-based materials, the disposal of waste incurred during production was on the basis of a system expansion. Heat and electricity generated are credited to the system in the form of

substitution processes. The credits achieved here are significantly less than 1% of overall expenses.

- In the case of combined generation of heat and power, all expenses associated with firing were allocated to this after exergy of these two products.
- The provision of waste wood does not take consideration of any expenses from the previous life cycle (similar to Module A1).

Module D

The system expansion process performed in Module D complies with an energetic recycling scenario for waste wood.

3.9 Comparability

As a general rule, EPD data can only be compared or evaluated when all of the data sets to be compared have been generated in accordance with EN 15804 and the building context or product-specific characteristics are taken into consideration.

4. LCA: Scenarios and other information

The scenarios on which the Life Cycle Assessment is based are described in detail below.

End of Life (C1-C4)

Description	Value	Unit
Waste wood for energy recovery	508.37	kg

Re-use, recovery and recycling potential (D), relevant scenario details

Description	Value	Unit
Electricity generated (per t atro waste wood)	1231	kWh
Waste heat utilised (per t atro waste wood)	2313	MJ

In the form of waste wood, the product is recycled at the end of life in the same composition as the declared unit. Thermal recycling in a bio-mass power plant is assumed with a total efficiency of 35% and an electric efficiency of 23%, whereby incineration of 1 tonne of wood (atro) (with 18% wood moisture) generates approx. 1231 kWh electricity and 2313 MJ useful heat. The exported energy substitutes fuels from fossil sources, whereby it is assumed that the thermal energy is generated from natural gas and the substituted electricity complies with the German power mix for 2009.

5. LCA: Results

SYSTEM BOUNDARIES (X = INCLUDED IN THE LCA; MND = MODULE NOT DECLARED)

Product stage			Construction process stage		Use stage							End-of-Life stage				Benefits and loads beyond the system boundary
Raw material supply	Transport	Production	Transport	Construction-installation process	Use	Maintenance	Repairs	Replacement	Refurbishment	Operational energy use	Operational water use	De-construction / Demolition	Transport	Waste processing	Landfilling	Re-use, recovery or recycling potential
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
X	X	X	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	X	X	X	X

LCA RESULTS – ENVIRONMENTAL IMPACT: 1 m³ glued laminated timber

Parameter	Unit	A1	A2	A3	C2	C3	C4	D
GWP	[kg CO ₂ equiv.]	-7.548E+2	3.674E+1	7.233E+1	4.589E-1	8.188E+2	0.0E+0	-3.724E+2
ODP	[kg CFC11 equiv.]	5.126E-6	1.944E-6	1.408E-5	9.0E-10	1.186E-6	0.0E+0	-8.511E-5
AP	[kg SO ₂ equiv.]	2.423E-1	1.825E-1	3.613E-1	1.97E-3	6.981E-3	0.0E+0	-3.829E-1
EP	[kg (PO ₄) ³ equiv.]	6.135E-2	3.098E-2	6.714E-2	4.565E-4	5.893E-4	0.0E+0	-3.715E-3
POCP	[kg ethene equiv.]	4.453E-2	1.642E-2	8.703E-2	2.132E-4	4.642E-4	0.0E+0	-2.565E-2
ADPE	[kg Sb equiv.]	5.371E-4	1.17E-6	1.357E-4	9.7E-9	1.225E-7	0.0E+0	-6.454E-6
ADPF	[MJ]	8.804E+2	4.89E+2	8.129E+2	6.475E+0	4.616E+1	0.0E+0	-4.194E+3

Legend GWP = Global Warming Potential; ODP = Ozone Depletion Potential; AP = Acidification Potential of soil and water; EP = Eutrophication Potential; POCP Photochemical Ozone Creation Potential; ADPE = Abiotic Depletion Potential for Elements; ADPF = Abiotic Depletion Potential of Fossil Fuels

LCA RESULTS – USE OF RESOURCES: 1 m³ glued laminated timber

Parameter	Unit	A1	A2	A3	C2	C3	C4	D
PERE	[MJ]	6.273E+2	1.173E+1	1.859E+3	8.578E-3	4.701E+0	0.0E+0	-3.388E+2
PERM	[MJ]	8.567E+3	0.0E+0	2.974E+1	0.0E+0	0.0E+0	0.0E+0	0.0E+0
PERT	[MJ]	9.195E+3	1.173E+1	1.888E+3	8.578E-3	4.701E+0	0.0E+0	-3.388E+2
PENRE	[MJ]	9.509E+2	5.573E+2	1.3E+3	6.507E+0	8.777E+1	0.0E+0	-7.617E+3
PENRM	[MJ]	1.045E+2	0.0E+0	0.0E+0	0.0E+0	0.0E+0	0.0E+0	0.0E+0
PENRT	[MJ]	1.055E+3	5.573E+2	1.3E+3	6.507E+0	8.777E+1	0.0E+0	-7.617E+3
SM	[kg]	0.0E+0	0.0E+0	0.0E+0	0.0E+0	0.0E+0	0.0E+0	0.0E+0
RSF	[MJ]	4.535E+1	0.0E+0	4.197E+1	0.0E+0	0.0E+0	0.0E+0	4.406E+3
NRSF	[MJ]	0.0E+0	0.0E+0	0.0E+0	0.0E+0	0.0E+0	0.0E+0	0.0E+0
FW	[m ³]	8.233E+2	8.594E+1	7.019E+2	1.22E-1	4.987E+1	0.0E+0	3.475E+3

Legend PERE = Primary energy, renewable; PERM = Primary energy, renewable, used as raw materials; PERT = Total use of renewable primary energy; PENRE = Primary energy, non-renewable; PENRM = Primary energy, non-renewable, used as raw materials; PENRT = Total use of non-renewable primary energy; SM = Use of secondary materials; RSF = Renewable secondary fuels; NRSF = Non-renewable secondary fuels; FW = Use of fresh water resources

LCA RESULTS – OUTPUT FLOWS AND WASTE CATEGORIES: 1 m³ glued laminated timber

Parameter	Unit	A1	A2	A3	C2	C3	C4	D
HWD	[kg]	7.492E-2	0.0E+0	2.54E-2	0.0E+0	0.0E+0	0.0E+0	1.531E+0
NHWD	[kg]	2.323E-2	0.0E+0	9.339E-3	0.0E+0	0.0E+0	0.0E+0	4.618E-5
RWD	[kg]	6.198E-2	2.44E-2	1.741E-1	1.146E-5	1.489E-2	0.0E+0	-1.064E+0
CRU	[kg]	0.0E+0	0.0E+0	0.0E+0	0.0E+0	0.0E+0	0.0E+0	0.0E+0
MFR	[kg]	0.0E+0	0.0E+0	0.0E+0	0.0E+0	5.081E+2	0.0E+0	0.0E+0
MER	[kg]	0.0E+0	0.0E+0	1.543E+0	0.0E+0	5.081E+2	0.0E+0	-5.096E+2
EEE	[MJ]	0.0E+0	0.0E+0	0.0E+0	0.0E+0	0.0E+0	0.0E+0	0.0E+0
EET	[MJ]	0.0E+0	0.0E+0	0.0E+0	0.0E+0	0.0E+0	0.0E+0	0.0E+0

Legend HWD = Hazardous waste, disposed of; NHWD = Non-hazardous waste, disposed of; RWD = Radioactive waste, disposed of; CRU = Components for re-use; MFR = Materials for recycling; MER = Materials for energy recovery; EEE = Exported energy, electricity; EET = Exported energy, thermal

6. LCA: Interpretation

The interpretation focuses on the production phase (Modules A1 to A3) as it is based on specific information provided by the company.

Global Warming Potential

Of the fossil greenhouse gases analysed in Modules A1 to A3, 35% is attributed to the provision of raw materials, 22% to transport and 43% to production. The provision of wood raw materials also comprises extensive areas of the refining chain as the appropriate

refined products are purchased for production. Electricity consumption in the plant is an essential influential factor (25%).

Analysis of carbon from bio-mass

A total of approx. 1049 kg carbon dioxide enters the system in the form of carbon stored in the bio-mass, of which 57 kg carbon dioxide are emitted along the upstream chains and 175 kg within the framework of heat generation on site. The volume of carbon

ultimately stored in the glued laminated timber is extracted from the system when recycled in the form of waste wood.

Acidification Potential

The combustion of wood and diesel are the sources of essential relevance for emissions representing a potential contribution towards the acidification potential. Drying the bought-in products, provision of the requisite heat and utilisation of fuels in forestry account for around 27% of emissions. The emissions from the provision of adhesives are negligible by comparison (4%). Transport of raw materials accounts for another 23% while heat generation on site makes a total contribution of 32% to all cradle-to-gate emissions.

Summer Smog Formation Potential

Emissions contributing to the formation of ground-level ozone are primarily incurred during wood drying. Nitric oxides from incineration processes also play a role. 24% of emissions are incurred during drying on site. Furthermore, essential percentages of the drying processes are incurred in the upstream chains. Transport expenses only play a subordinate role.

Eutrication Potential

33% of emissions contributing towards eutrication (primarily nitric oxides) are incurred during wood firing on site, 28% during the drying and incineration processes associated with the upstream chains and 11% in manufacturing the adhesives.

Ozone Depletion Potential

60-70% of emissions with ozone depletion potential are incurred during generation of electricity for the processes in the upstream chains on site.

Range of results

The individual results of participating companies differ from the average results in the Environmental Product Declaration. Deviations of +59%/-41% (GWP), +61%/-34% (AP) and +39%/-22% (POCP) were measured for the three GWP, AP and POCP indicators in relation to the results outlined here. These deviations are primarily attributable to differences in the fuels used and specific electricity consumption values during the processes.

Use of primary energy

Renewable energy carriers are primarily used in the form of wood for generating process heat. Of the total of 2585 MJ, 87 MJ are incurred by burning waste wood.

Non-renewable energy is primarily used for generating electricity and in the form of fuels for the transport processes. Smaller quantities are also required for manufacturing the adhesives.

Depletion of abiotic resources

Resources depleted for material utilisation are largely used for manufacturing the machining tools.

Resources for energy utilisation are largely depleted for the electricity supply.

Waste

Special waste is primarily incurred during the provision of consumables (approx. 20%) and adhesives (approx. 50%)

7. Requisite evidence

The following evidence of environmental and health relevance was provided:

7.1 Formaldehyde

A total of 7 measurement reports were available on formaldehyde emissions. The measurements were carried out by experienced test laboratories. Maximum steady state emission values were established. The measurements were performed in test chambers in accordance with DIN EN 717-1: 2005 at a uniform temperature of 23 °C, relative humidity of 45% and a ventilation rate of 1.0 per hour. Loading factors differed in some cases. The measured values were therefore initially used to calculate the area-specific emission rates.

As anticipated, most of the measured values (22) are available for glued laminated timber with MUF adhesive. The average area-specific emission rate is 34.8 µg/h x m². With reference to a loading factor of 0.3 m²/m³ suggested by the Stuttgart Materials Testing Institute and specified in the DIN EN 14080:2005, this gives rise to a formaldehyde equalisation concentration in the test chamber of 0.008 ml/m³. This value is less than one-tenth of the limit value of 0.1 ml/m³ in accordance with the Ordinance on Chemicals. If the highest values measured (71 mg/h x m³) are taken as a basis for derivation, this results in an equalisation concentration of 0.017 mg/m³. Laminated timber glued using PUR adhesive gives rise to area-specific

emission rates in the range of non-adhesive wood. The derived equalisation concentration is approx. 0.004 ml/m³. Similar values were also measured for other, non-adhesive types of wood and comply with the natural formaldehyde emissions by wood.

7.2 MDI

When glued laminated timber is glued, the MDI contained in the polyurethane adhesives reacts out in full. MDI emissions from the hardened laminated beams are not therefore possible: there is no test standard in place.

The tests submitted are concerned with the temporary MDI emissions arising during glueing in the factory. As there is no standardised measurement process in place for these emissions, one of the tests submitted determined the MDI emissions on the basis of the measurement method for determining formaldehyde emissions outlined in EN 717-2: 1995.

Result: MDI emissions were not detected in any of the 7 glued laminated timbers examined within the framework of the detection limit (0.05 µg/m³). An additional test based on a project-related measurement method involving a wooden lamella glued with PUR adhesive but not hardened displayed MDI emissions slightly above the detection limit (0.05 µg/m³) during the first two hours after applying the adhesive. MDI emissions could not be measured after that.

8. References

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EN 15804:2012-04, Sustainability of construction works — Environmental product declarations — Core rules for the product category of construction products

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Beuth Verlag, Berlin:

DIN 1052: 2008-04, Design of timber structures – General rules and rules for buildings

DIN 68800-2: 2012-02, Wood preservation – Part 2: Preventive constructional measures in buildings

DIN 68800-3: 2012-02, Wood preservation – Part 3: Preventive protection of wood with wood preservatives

DIN EN 717-1:2005-01, Wood-based panels – Determination of Formaldehyde release – Part 1: Formaldehyde emission by the chamber method

DIN EN 717-2:1995-01, Wood-based panels – Determination of Formaldehyde release – Part 2: Formaldehyde emission by the gas analysis method

DIN EN 1995-1-1: 2010-12, Eurocode 5: Design of timber structures – Part 1-1: General – Common rules and rules for buildings

DIN EN 1995-1-1/NA: 2010-12, National Annex – Nationally determined parameters – Eurocode 5: Design of timber structures – Part 1-1: General - Common rules and rules for buildings

DIN EN 14080: 2005-09, Timber structures – Glued laminated timber – Requirements

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