The thermal performance of a component is determined by its U-value or “thermal transmittance”. The location, structure and thermal conductivity λ of the materials contained must be known to calculate this value. The thermal conductivity of wood is essentially determined by its bulk density and wood moisture content and can be calculated for a CLT panel using the equation below.

$\lambda = 0.000146 \times \rho_k + 0.035449$

$\lambda$ = thermal conductivity in [W/mK]

$\rho_k$ = characteristic bulk density for a reference wood moisture content of u = 12% in [kg/m³]

The characteristic bulk density of CLT layers has been determined as $\rho_k$ = 512 kg/m³.
Applying these figures results in a thermal conductivity for CLT of 0.110 W/mK.

$\lambda = 0.000146 \times 512\ kg/m^3 + 0.035449 = 0.110\ W/mK$

This figure has been validated by the SP Technical Research Institute of Sweden for CLT [1].

The Austrian standard ÖNORM B 3012 [2] also gives a λ value of 0.11 W/mK for spruce.

An average value of 12 % is assumed for wood moisture content, whereby less than 12 % wood moisture content should be expected in external walls during the relevant winter months. With less wood moisture content, the actual thermal conductivity value reduces further.

The Austrian standard ÖNORM EN 12524 [3] specifies a rated thermal conductivity of 0.13 W/mK for wood in the relevant bulk density range.

**U-value of a CLT panel**

A CLT external wall panel with a thickness of 100 mm is used in the following example to demonstrate how to calculate the U-value. The calculation takes account of the internal and external heat transfer coefficients.

| | |
|---|---|
| **Thermal transmittance** | $U = \frac{1}{R_{si} + \sum \frac{d_i}{\lambda_i} + R_{se}}$ |
| **Heat transmission resistance** | $R_{si} = 0{,}13\ m^2K/W$<br>$R_{se} = 0{,}04\ m^2K/W$ |
| **Thermal conductivity of CLT** | $\lambda_{CLT} = 0{,}11\ W/mK$ |
| **Thermal transmittance** | $U_{CLT,100} = \frac{1}{0{,}13\ m^2K/W + \frac{0{,}1\ m}{0{,}11\ W/mK} + 0{,}04\ m^2K/W} = 0{,}927\ W/m^2K$ |

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Fig. 1 shows a graph on which the U-values of non-clad CLT panels are plotted depending on panel thickness.

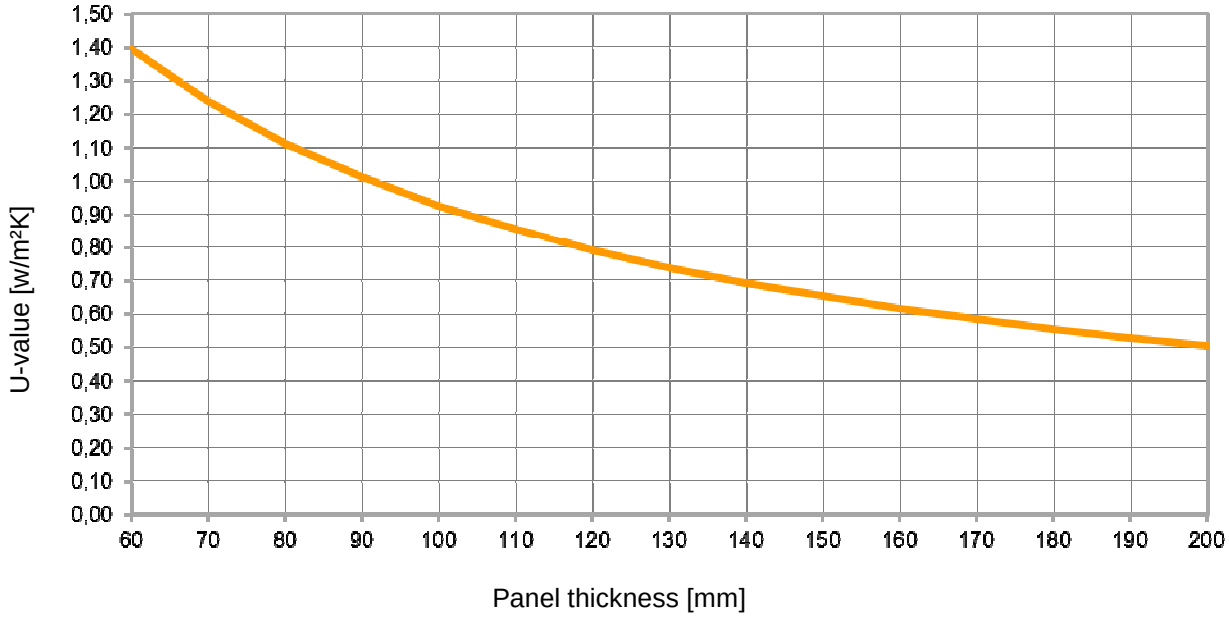


**Fig. 1: U-values of non-clad CLT exterior wall panels**

### U-value of an insulated CLT panel

The U-value of a CLT panel with a thickness of 100 mm in conjunction with 16 cm-thick insulation material of thermal conductivity group WLG 040 is calculated as follows:

| | |
|---|---|
| **Thermal transmittance** | $U = \frac{1}{R_{si} + \sum \frac{d_i}{\lambda_i} + R_{se}}$ |
| **Heat transmission resistance** | $R_{si} = 0{,}13\ m^2K/W$<br>$R_{se} = 0{,}04\ m^2K/W$ |
| **Thermal conductivity of CLT** | $\lambda_{CLT} = 0{,}11\ W/mK$ |
| **Thermal transmittance** | $U = \frac{1}{0{,}13\ m^2K/W + \frac{0{,}1\ m}{0{,}11\ W/mK} + \frac{0{,}16\ m}{0{,}04\ W/mK} + 0{,}04\ m^2K/W}$<br>$= 0{,}197\ W/m^2K$ |

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Fig. 2 shows a graph on which the U-values of insulated CLT panels with a thickness of 100 mm are plotted depending on the thickness of the insulation material (thermal conductivity group WLG 040).

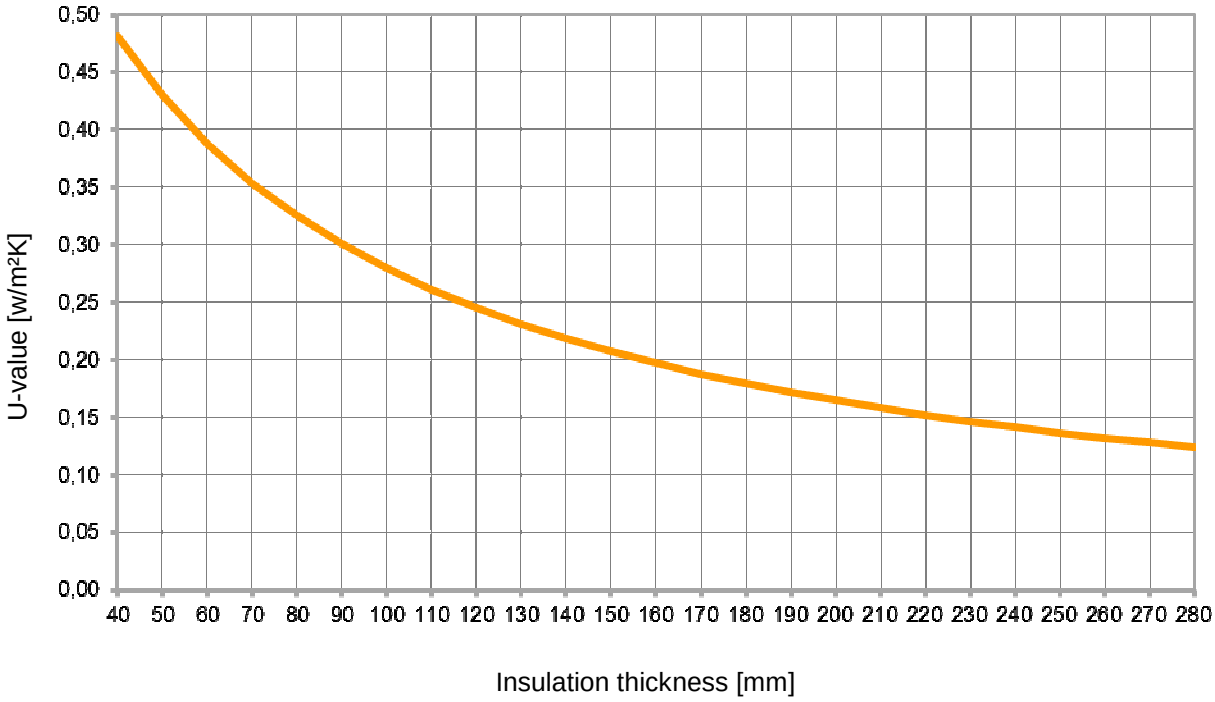


**Fig. 2: U-values of insulated 100 mm CLT external wall panels depending on the thickness of the insulation (WLG 040 insulation material)**

### Airtightness

A CLT panel's air or convection tightness is another decisive factor for thermal performance. As CLT panels are made of single-layer panels, they are extremely airtight. The airtightness of CLT panels and of panel joints was tested and confirmed by the Holzforschung Austria (Research Institute of the Austrian Society for Wood Research) in 2008 [4]. The test report specifies that the panel joints and the CLT panel itself are so airtight that volumetric rates of flow were outside the measurable range.

[1] Assessment: Declared thermal conductivity (2009-07-10); SP Technical Research Institute of Sweden, SE-50462 Boras

[2] ÖNORM EN B 3012 (2003-12-01); Wood species - Characteristic values for terms and symbols of ÖNORM EN 13556

[3] ÖNORM EN 12524 (2000-09-01); Building materials and products. Hygrothermal properties. Tabulated design values

[4] HOLZFORSCHUNG AUSTRIA (2008-06-11); Test report; airtightness test on a panel with two different types of joint