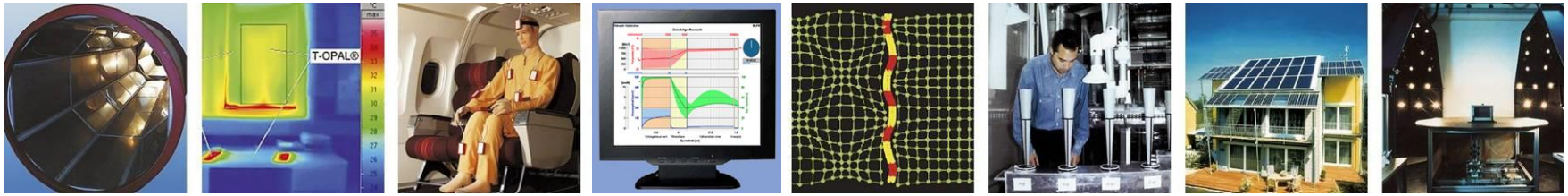

WUFI®

Guideline for the Calculation and Evaluation of an ETICS with Wood Fibre Insulation

Date: July 2024

Fraunhofer IBP

vdnr

Content

Introduction

This guideline provides support for the evaluation of **wood fibre ETICS** from **manufacturers represented in the „Verband Dämmstoffe aus nachwachsenden Rohstoffen e.V.“ (vdnr) [1]** using transient hygrothermal simulations.

First, the necessary **input data** and **evaluation criteria** are described in general.

The procedure from input to evaluation is then explained using examples of **light wood fibre insulation on lime silica brick masonry**.

Scope of Application

This guideline applies exclusively to wood fibre ETICS from the following manufacturers represented in the „Verband Dämmstoffe aus nachwachsenden Rohstoffen e.V.“ (vdnr):

Gutex Holzfaserplattenwerk
Gutenburg 5
D-79761 Waldshut-Tiengen
Telefon: 0 77 41/60 99-0
Fax: 0 77 41/60 99-57
www.gutex.de
info@gutex.de

SOPREMA GmbH (NL Leutkirch)
Wangener Straße 58
D-88299 Leutkirch
Telefon: 0 75 61/98 55-0
Fax: 0 75 61/98 55-30
www.pavatex.de
pavatex@soprema.de

Holzwerk Gebr. Schneider GmbH
Kappel 28
D-88436 Eberhardzell
Telefon: 0 73 55/93 20-0
Fax: 0 73 55/93 20-300
www.schneider-holz.com
info@schneider-holz.com

Steico SE
Otto-Lilienthal-Ring 30
D-85622 Feldkirchen
Telefon: 0 89/99 15 51-0
Fax: 0 89/99 15 51-700
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info@steico.com

Scope of Application

The evaluation method as well as the limit values regarding wood rot in this guideline deviate from DIN 68800-2 [2] and WTA-Guideline 6-8 [3].

They are based on practical experience of the manufacturers represented in the vdnr, are guaranteed by the manufacturers themselves and apply to:

Wood Fibre ETICS on mineral surfaces in new constructions or refurbishments with the following properties of the wood fibre insulation material:

- Thickness: 60 – 240 mm
- Density: 110 – 185 kg/m³
- Thermal conductivity λ_D: > 0.037 W/mK

For products beyond the specifications mentioned above, vdnr or the represented companies have no experience!

Overview: Settings in WUFI

Important settings in WUFI :

What	How	Slide
Orientation	Main direction for driving rain or North. Calculate both, evaluate the more critical one.	10, 32
Initial moisture new building	Water content corresponding to 95 % RH for plaster and adhesive, 5 % by mass or also 95 % RH for lime silica brick, 50 % RH for wood fibre insulation	13, 34
Initial moisture old building	In the case of already dried-out old buildings with good rain protection, an equilibrium moisture content corresponding to 80 % RH can be assumed in the solid building materials. 50 % RH for wood fibre insulation	13, 34
Calculation start	For explicit consideration, two separate calculations are required (alternative 1). From 1 April for simplified consideration of the drying phase (alternative 2).	14 - 15, 38 - 46
Outdoor climate	Hygrothermal Reference Year (HRY)	17, 36
Indoor climate	According to DIN 4108-3: „normal moisture load +5 % (design)“	18, 37

Overview: Settings in WUFI

Other possible settings in WUFI :

What	How	Slide
Rain entry	Usual recommendation: 1 % of the driving rain behind the ETICS into the adhesive layer (5 mm). The rain leakage can be omitted if a particularly rainproof design of the window connection is guaranteed, e.g. according to guideline [6]. Such a design is recommended by the manufacturers represented in vdnr e.V., which is why the simulation is carried out here without this leakage.	19, 31

Overview: Evaluation

Important evaluation criteria:

What	Where	How	Slide
Moisture accumulation in the component	Water content in the whole construction	Total water content should not increase continuously!	21, 50
„Normal“ evaluation of the wood fibre insulation	Exterior or interior 10 mm (more critical position) of the wood fibre insulation	According to DIN 68800-2: 18 % by mass must not be exceeded permanently - a temporary increase in moisture content of up to 20 % by mass for a maximum of 3 months can be tolerated.	22, 24, 52 - 55
ETICS wood fibre insulation according to the scope of this guideline	Exterior or interior 10 mm (more critical position) of the wood fibre insulation	First two years after installation: up to max. 80 % by mass in the winter months, significant drying in the second year. Long-term maximum pore air humidity according to the criteria of WTA 6-8 (for solid wood) in the 10-day average.	23 - 24, 52 - 54, 55 - 59
Mould	Interior surface	Hourly temperature and moisture conditions must not exceed the LIM curve.	25, 60

Overview: Evaluation

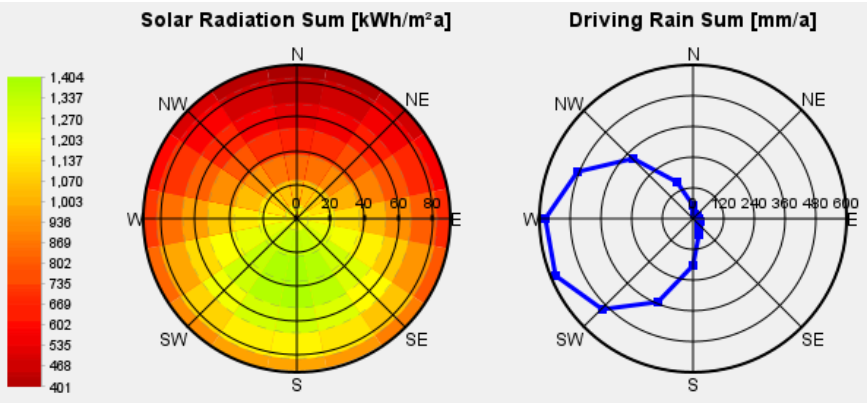
Other possible evaluation criteria:

What	Where	How	Slide
Frost damage	Boundary layer: plaster – wood fibre insulation	Below 0 °C, the water content should not significantly exceed the free saturation of the material.	26, 61 - 66
Transient heat transfer coefficient	Whole construction	Comparison of transient with steady-state U-values during the heating period.	27, 67

Orientation

The relevant orientation is the main direction of driving rain (in Germany this is usually West) and, if necessary, North, as this is where the lowest radiation gains occur. Alternatively, the most unfavourable real orientation can be used for specific projects.

Note:
The climate analysis can be helpful to identify the critical orientation.



Example: Climate analysis in WUFI®. Annual sums of radiation (left) and driving rain distribution (right).

Surface Transfer Coefficients

Heat Transfer Coefficient

Exterior Surface

The heat transfer coefficient for a wall is usually 17 W/m²K. The 25 W/m²K proposed in some standards corresponds to an average wind speed of higher than 6 m/s, which is well above the average value for Germany with about 3.5 m/s and thus too far on the safe side. (If the short-term behaviour of the surface temperatures is also to be evaluated, the setting "wind-dependent" may be used.)

Interior Surface

The heat transfer coefficient at the interior surface is assumed to be 8 W/m²K according to DIN 4108-3 [7].

Surface Transfer Coefficients

Short-Wave Radiation Absorptivity

The short-wave radiation absorptivity should be selected depending on the colour of the exterior plaster.

Explicit Radiation Balance

The explicit radiation balance is usually not required for wall assemblies - except for higher demands on the accuracy of the calculated surface temperatures or if undercooling and condensation are to be quantitatively evaluated.

Notes on the Input – Initial Conditions

Initial Conditions

In order to take into account the drying of construction moisture, the typical construction moisture of the individual layers can be used from the WUFI® database. However, these are sometimes assigned with high certainties. If the masonry is **carefully protected from precipitation** during the installation, the following reference values may be used for the initial moisture in the different layers:

Material	Initial Moisture
Plaster, mortars, adhesive layers	Equilibrium moisture content at **95 % RH**
Lime silica brick, concrete	Equilibrium moisture content at **95 % RH, but minimum 5 % by mass**
Brick, expanded clay concrete, pumice concrete	In the past, 100 kg/m³ (due to mortar moisture and sprinkling) was often given in the literature. With rain protection and thin mortar layers, an **initial moisture content of 50 kg/m³** can be assumed.
Wood fibre insulation	Equilibrium moisture content at **50 % RH** on condition of dry storage until installation. Otherwise 80 % RH.
Historic / existing buildings (dry)	In already dried-out historic / existing buildings with good rain protection, an equilibrium moisture content corresponding to 80 % RH can be assumed in the solid building materials in a simplified way.

The initial temperature can be set at 20 °C.

Notes on the Input – Calculation Period

Consider drying during the construction phase explicitly (Alt. 1)

For design purposes, it is recommended to start the calculation on 1st of October, as the building component first gets even more humid in the following winter months, before a possible drying out begins in spring. This start date is therefore usually the worst case.

After the installation of the wall construction until start of use (by the occupants), the construction can already partially dry out. If this temporary phase is to be considered, it has to be calculated separately. In this example, it is assumed that occupancy does not begin until 6 months after finishing the exterior walls.

- Phase 1 „unused“: from 1st of October to 1st of April simplifies assumption of outdoor air conditions also indoors.
- Phase 2 „occupied“: from 1st of April in the second year for e. g. 5 years with indoor climate according to DIN 4108-3

If the unused phase is shorter, the calculation periods must be adjusted accordingly!

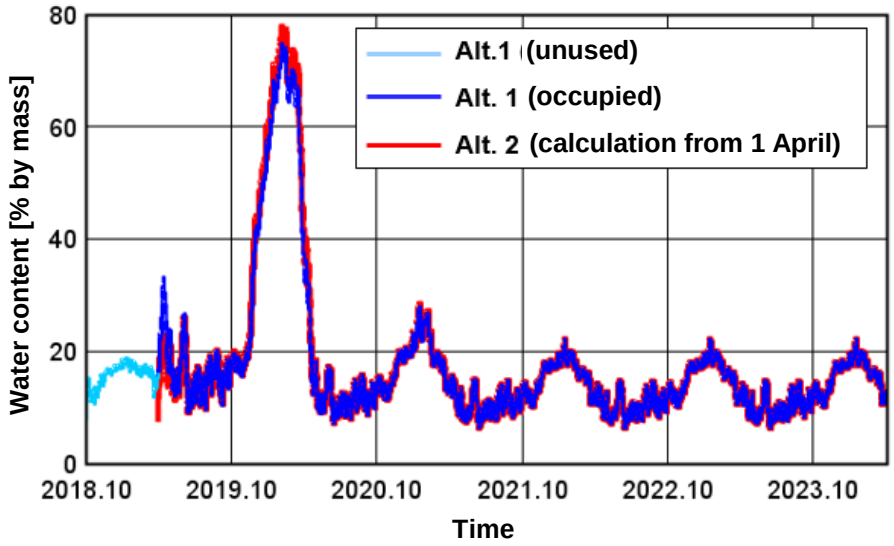
Notes on the Input – Calculation Period

Consideration of drying during the construction phase in a simplified way (Alt. 2)

The division into two phases before and after the start of use is quite complex in terms of simulation technology.

If the calculation is started in spring, the main drying takes place in summer. The maximum humidities occurring in winter in this case (red curve) are very similar to the mo (light blue and dark blue curve).

This approach has been verified for different typical locations in Germany and can therefore be chosen as an alternative.



Due to the significantly simpler processing, a calculation from 1st of April with standard indoor climate can be used in practice instead.

Calculation Period

The calculation period depends on how long the construction needs to reach its dynamic equilibrium.

In most cases, a calculation time of **5 years** is sufficient for the kind of building components considered here, which are relatively open to diffusion on the outside.

Outdoor Climate

Climate data appropriate for the location of the building should be used.

For Germany:

For this purpose, DIN 4108-3 [7] recommends the **hygrothermal reference years (HRY)**, which were created for 11 locations in Germany as part of a research project [8]. These locations are representative for the respective climate region. For more information, please refer to the *WUFI® Help (F1) → Topic: Hygrothermal Reference Years*

Notes on the Input - Climate

Indoor Climate

By default, we recommend to use the indoor climate with medium moisture load + 5% for design purposes according to DIN 4103-3 Appendix D [7].

Alternatively, depending on the use of the building, the indoor climate according to EN 15026 [9] with medium or high occupancy or other conditions, which are applicable to the building, can be used.

Rain Leakages

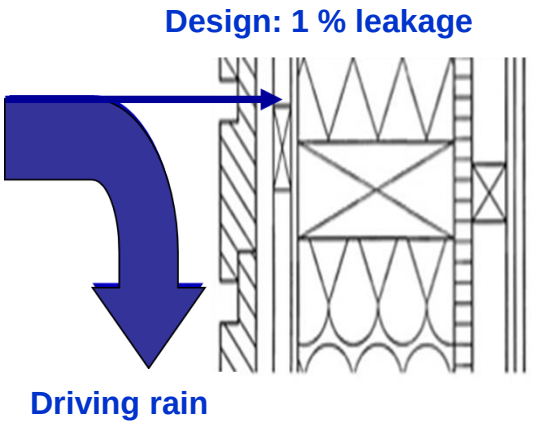
According to WTA 6-2 [5], leaks, e. g. at window connections of ETICS, can be taken into account by a moisture source in order to reach a larger fault tolerance of such an insulation system.

For this purpose, 1 % of the driving rain reaching the wall can be assumed to be the source of moisture in the outer 5 mm of the adhesive layer.

Note: In the case of wooden constructions and wood fibre ETICS, rain penetration at connection details should be avoided as far as possible!

If a rainproof window connection is made, e. g. according to [6], no consideration of this moisture entry is necessary.

Such a design is recommended by vdnr for the constructions examined here!



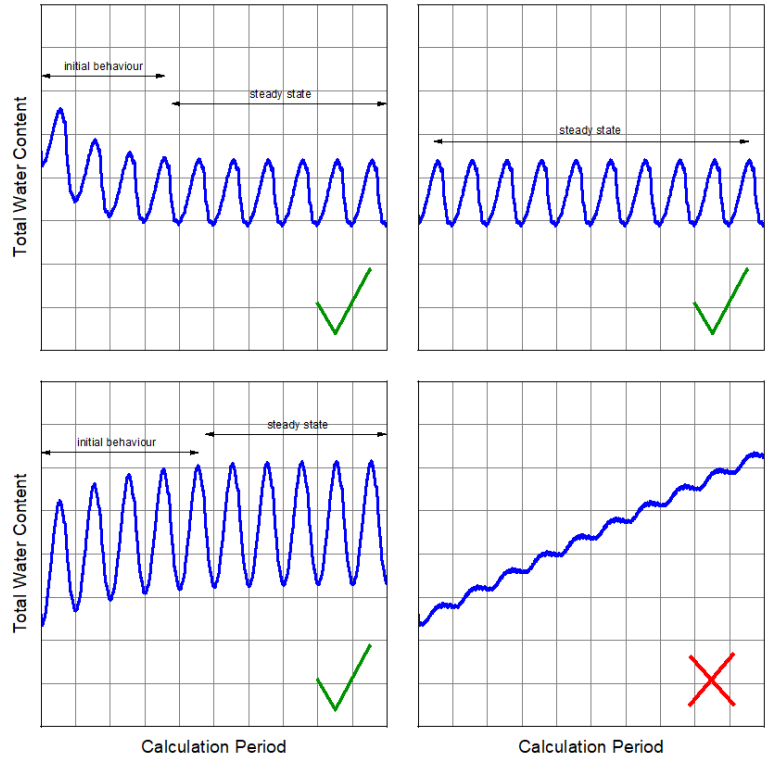
Evaluation Criteria – General

- The results of hygrothermal simulations are the temperature and humidity profiles over time as well as the water content and temperature profiles in the different material layers.
- The results need to be evaluated individually and assessed depending on the materials used.
- **Evaluation criteria**, that are specifically relevant to wood fibre ETICS are discussed more detailed in this guide. These are:
    - Total water content
    - Wood moisture
    - Mould growth
    - Frost damage
    - Increase of the U-value

Evaluation Criteria – Total Water Content

Total Water Content

No excessive amount of moisture may accumulate in the construction ***permanently***!
The course is evaluated as follows:



- ***Decreasing*****:** component dries out
- ***No change over annual cycle*****:**
  dynamic equilibrium is reached
- ***Short-term increase*****:**
  moisture level in equilibrium state higher than the initial moisture level set;
  often unproblematic
- ***Long-term increase*****:**
  permanent moisture accumulation in the construction
  (higher wetting than drying – may be acceptable at low levels if no critical moisture conditions are reached during lifetime)

Evaluation Criteria – Wood Moisture

Limit Values for Wood and Wood-Based Materials:

The limit values specified in DIN 68800-2 [2] apply to load-bearing solid wood or wood-based materials in wooden structures and relate to
- 20 % by mass for solid wood (avoid rotting processes) and
- 18 % by mass for wood-based materials (beginning strength loss of the materials)

In ETICS, wood fibre insulation is usually also relevant for load-bearing capacity, as the exterior plaster layer is often only attached to the substructure via the insulation. However, the sufficient strength of the system, even with corresponding moisture exposure, is tested within the scope of the certification and can therefore be assumed. Therefore the limit of 18 % by mass is actually not relevant here.

For wood fibre insulation, neither general nor specific limit values for the products used in ETICS regarding the maximum permitted moisture content are available from regulations or standards.

Therefore, the manufacturers represented in the “Verband Dämmstoffe aus nachwachsenden Rohstoffen e.V.” (vdnr) have defined their own limit values which they guarantee for their products.

Evaluation Criteria – Wood Moisture

Special limit values for wood fibre ETICS within the scope of this guideline (see slide 4 - 5 for scope):

For the evaluation of the calculated material moisture, reference is made to the following criteria recommended and responsible by the manufacturers of wood fibre insulation materials organized by the “Verband Dämmstoffe aus nachwachsenden Rohstoffen e.V“. These criteria exceed the limit values of DIN 68800 for wood fibre ETICS.

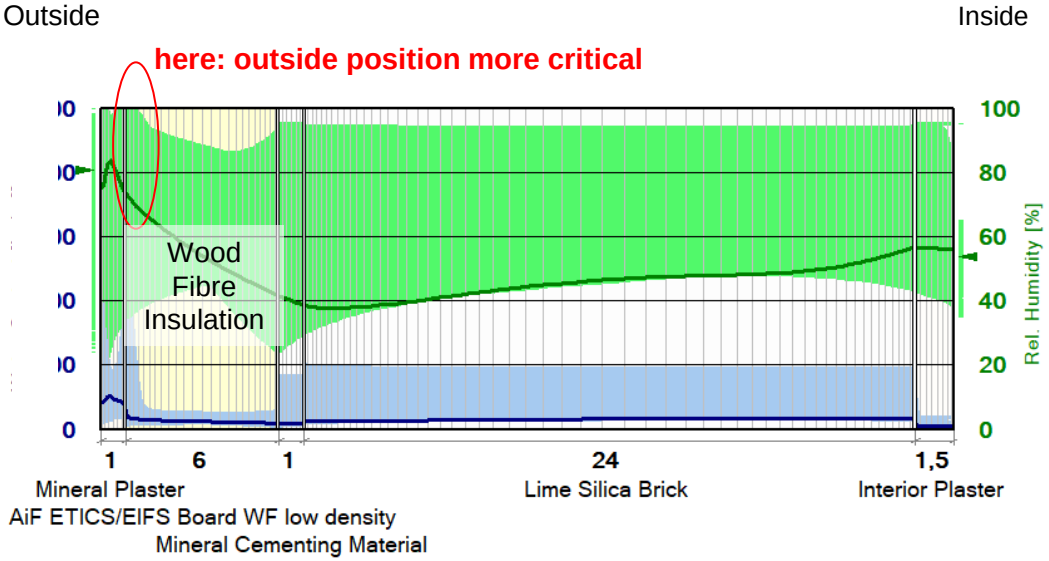
1. In the first two years, the calculated **material moisture** may temporarily reach **max. 80 % by mass in the critical area** during the winter months (Europe: from 1st of November to 1st of April of the following year).
2. In the second winter the material moisture must remain **significantly lower**.
3. In the long-term behaviour (beginning from the third year), the calculated material moisture in the critical area must not exceed the **WTA limit curve** in the **10-day average value**.

Important: Due to the special conditions, the above mentioned limit values are represented by the manufacturers exclusively for wood-fibre ETICS that correspond to the scope of this guideline (see “Scope of Application” slides 4 - 5). The manufacturers have no experience for other products.

Evaluation Criteria – Wood Moisture

Evaluation of wood fibre ETICS

- The average water content over a one centimetre thick layer in the most critical area of the wood fibre insulation material should be evaluated in accordance with WTA Guideline 6-8 (for Central European climate: outside under the plaster in winter; for warm and humid outdoor climates and air-conditioned interior: the inner side may be more critical).
- The WUFI® film helps to identify the critical position, if necessary.



Evaluation Criteria – Mould Growth

Evaluation of the mould risk:

- Mould growth is possible on the interior surface as well as on material surfaces connected to cavities at higher humidity conditions.
- Evaluation of the interior surface with the help of the limit isopleths, which represent the minimum growth conditions.

  - Conditions remains below the limit curve values:
    mould growth is not possible
  - Conditions exceeds the limit curve:
    Risk depends on duration and intensity of exceeding
    (transient verification possible with the post-process module WUFI® Bio)

Evaluation Criteria – Risk of Frost

Risk of frost at the boundary layer between insulation and exterior plaster:

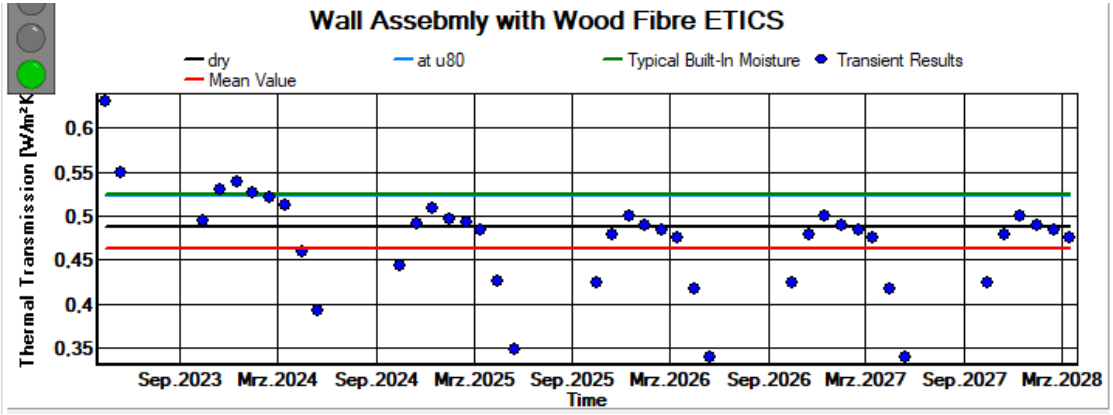
- The exterior plaster of the ETICS itself is usually resistant to frost.
- However, larger moisture accumulations at the boundary between insulation and exterior plaster (e.g. in case of drying out building moisture) should be avoided during frost conditions.
- Frost damage cannot be safely excluded if the moisture content is significantly above the free saturation of the insulation material.

If this cannot be ensured, a construction period in spring should be chosen so that a large part of the moisture can dry out before winter.

Evaluation Criteria – Increase of U-value

Influence of the moisture content on the insulation value (optional)

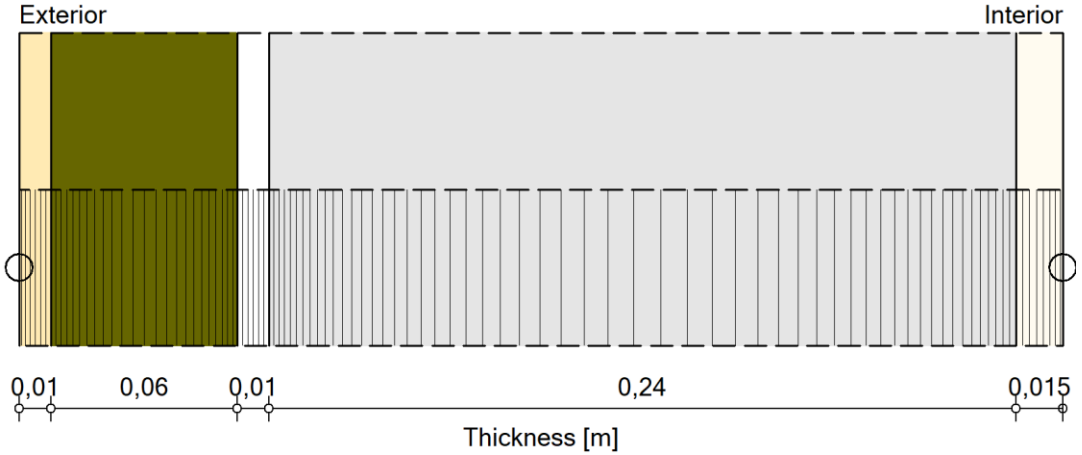
- Increased moisture content in the building component can lead to an increase in the thermal transmission (U-value).
- If required, the transient U-value can be compared with the steady state U-value.
- The increase of the thermal conductivity depending on the moisture content is defined in the WUFI® material database for most materials. The post-process module “Thermal Transmission” allows this evaluation.



Example: Input

Wall assembly with wood fibre ETICS (from outside to inside):

- Mineral Plaster (stucco, A-value: 0.1 kg/m²√h) 0.01 m
- AiF ETICS/EIFS Board WF low density 0.06 m
- Mineral Cementing Material 0.01 m
- Lime Silica Brick 0.24 m
- Interior Plaster (Gypsum Plaster) 0.015 m



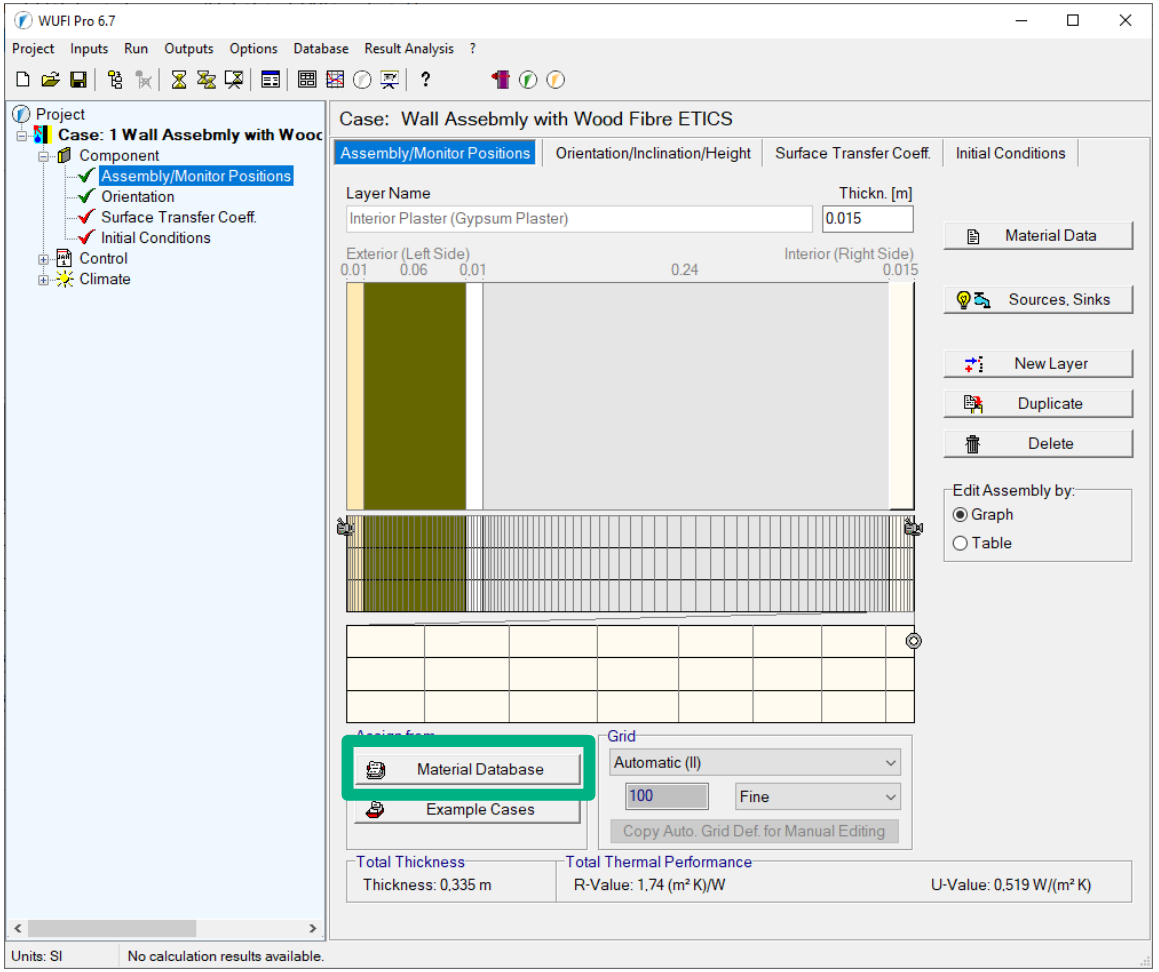
Example: Input

Boundary Conditions:

- Orientation: West
- Inclination: 90°
- Exterior plaster (Colour = normal bright)
- Exterior climate: Holzkirchen
- Interior climate: medium moisture load + 5 % (design climate)
  according to DIN 4108-3

Example: Input

Component - Assembly / Monitor Positions



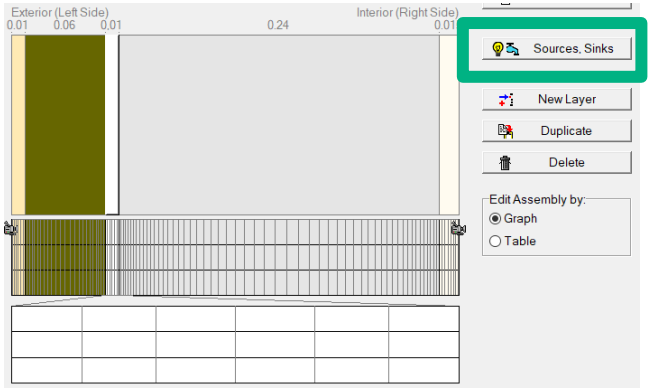
Select materials from the database and specify thickness.

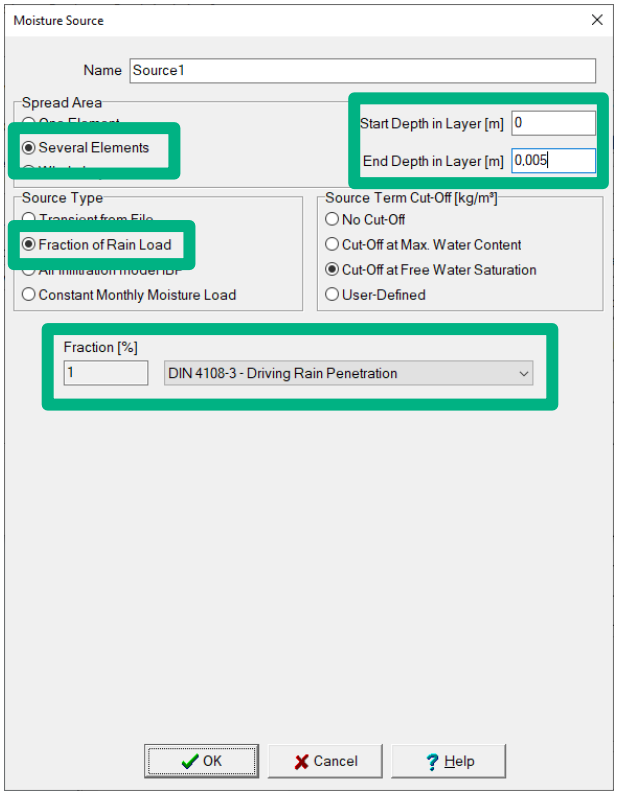
Example: Input

Component - Assembly / Monitor Positions

Moisture Source (optional)*

1. Select adhesive layer
2. Choose „Sources, Sinks“
3. „Moisture Source“ with 1 % of the rain load in the exterior 5 mm of the adhesive layer.

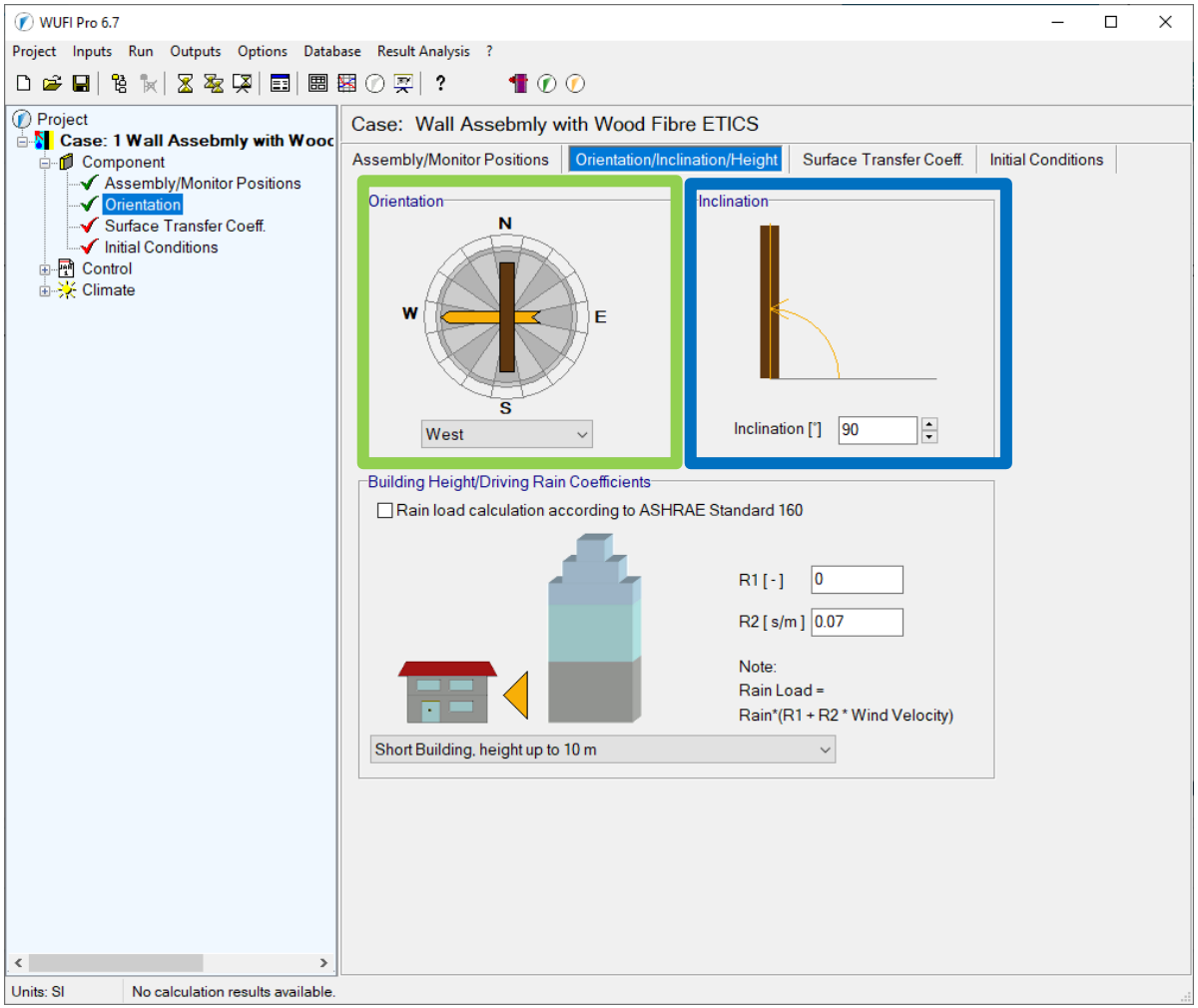




* Note: Due to the recommendation of vdnr to make the connections as rainproof as possible (see slide 19), the moisture source is not included in the example calculated here.

Example: Input

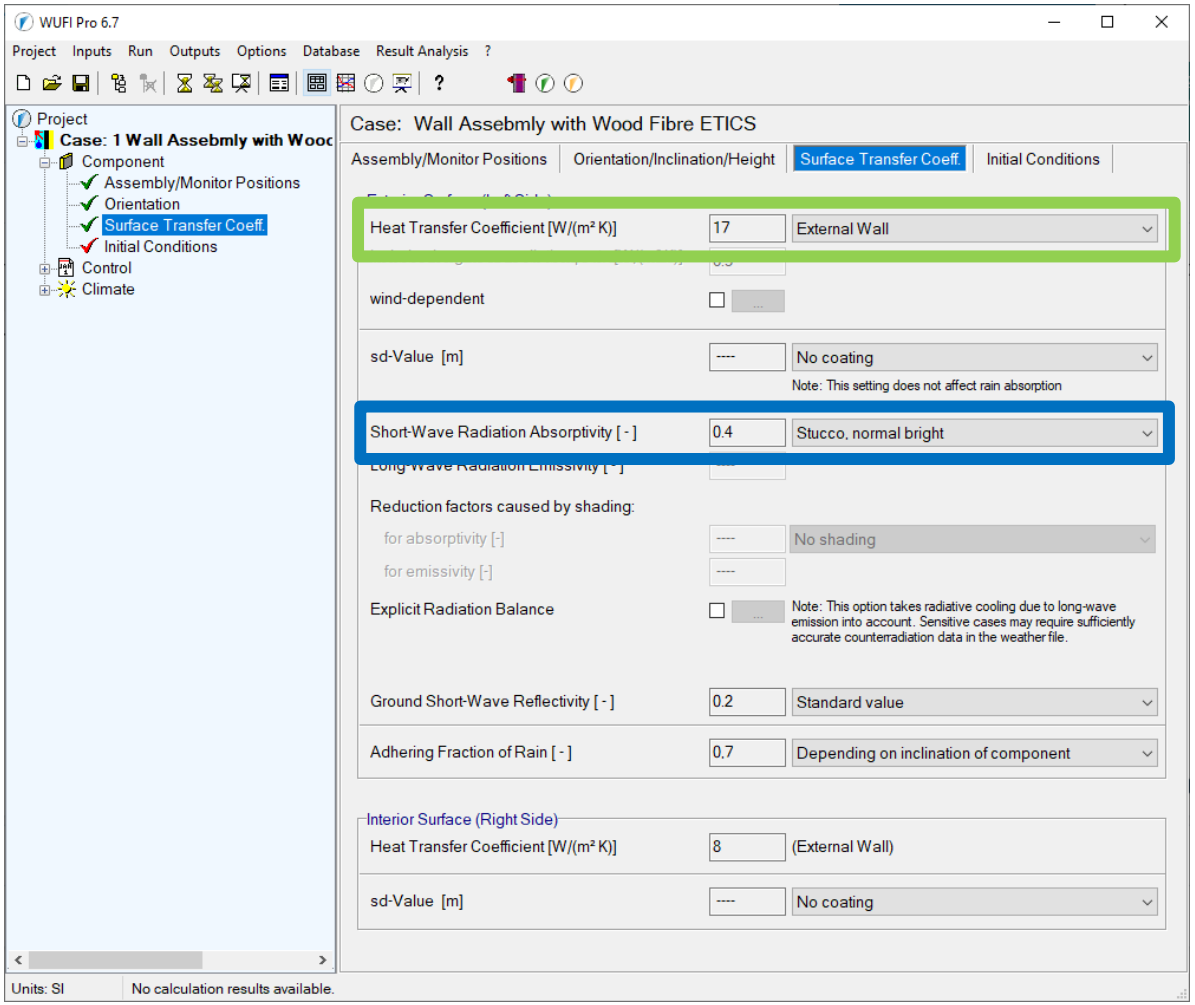
Component - Orientation



Adjust orientation and inclination.

Example: Input

Component – Surface Transfer Coeff.

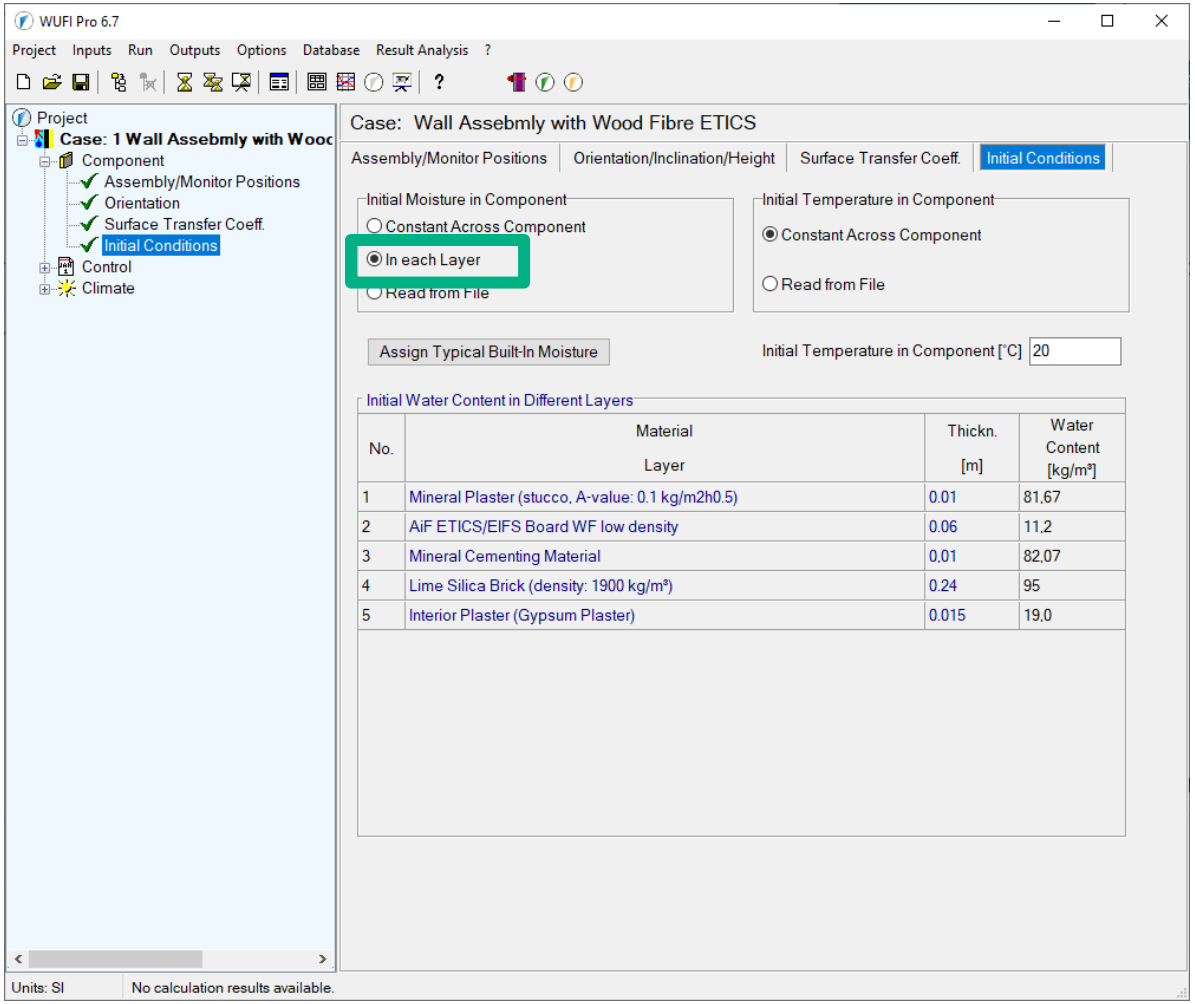


Heat Transfer Coefficient for „External Wall“ = 17 W/m²K

Adjust colouring of the exterior plaster

Example: Input

Component – Initial Conditions



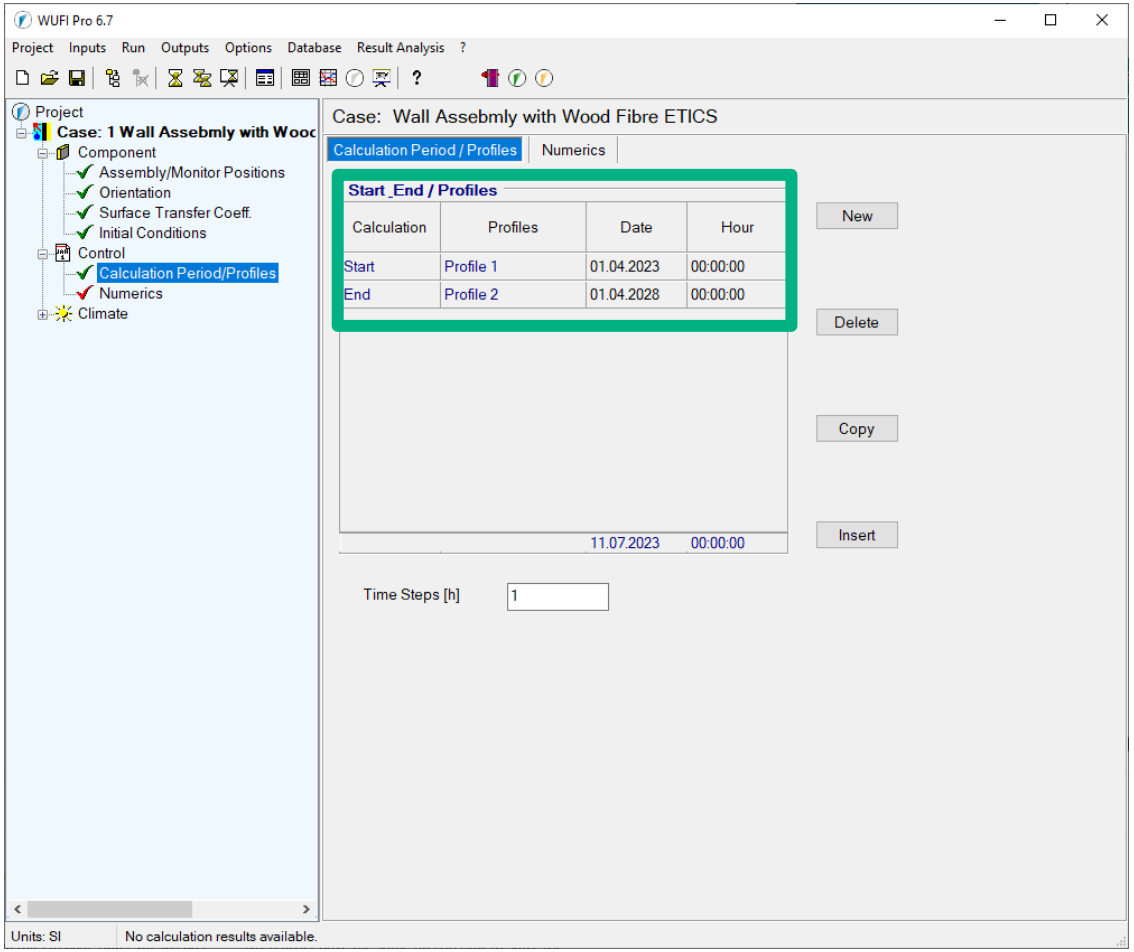
Initial Moisture:

- Exterior plaster, adhesive layer, interior plaster: 95 % RH
- Wood fibre insulation: 50 % RH
- Lime silica brick: 5 % by mass (= density * 0.05)

Tip:
The equilibrium water content at a certain relative humidity can be specified by selecting „Constant Across Component“.

Example: Input

Control – Calculation Period / Profiles



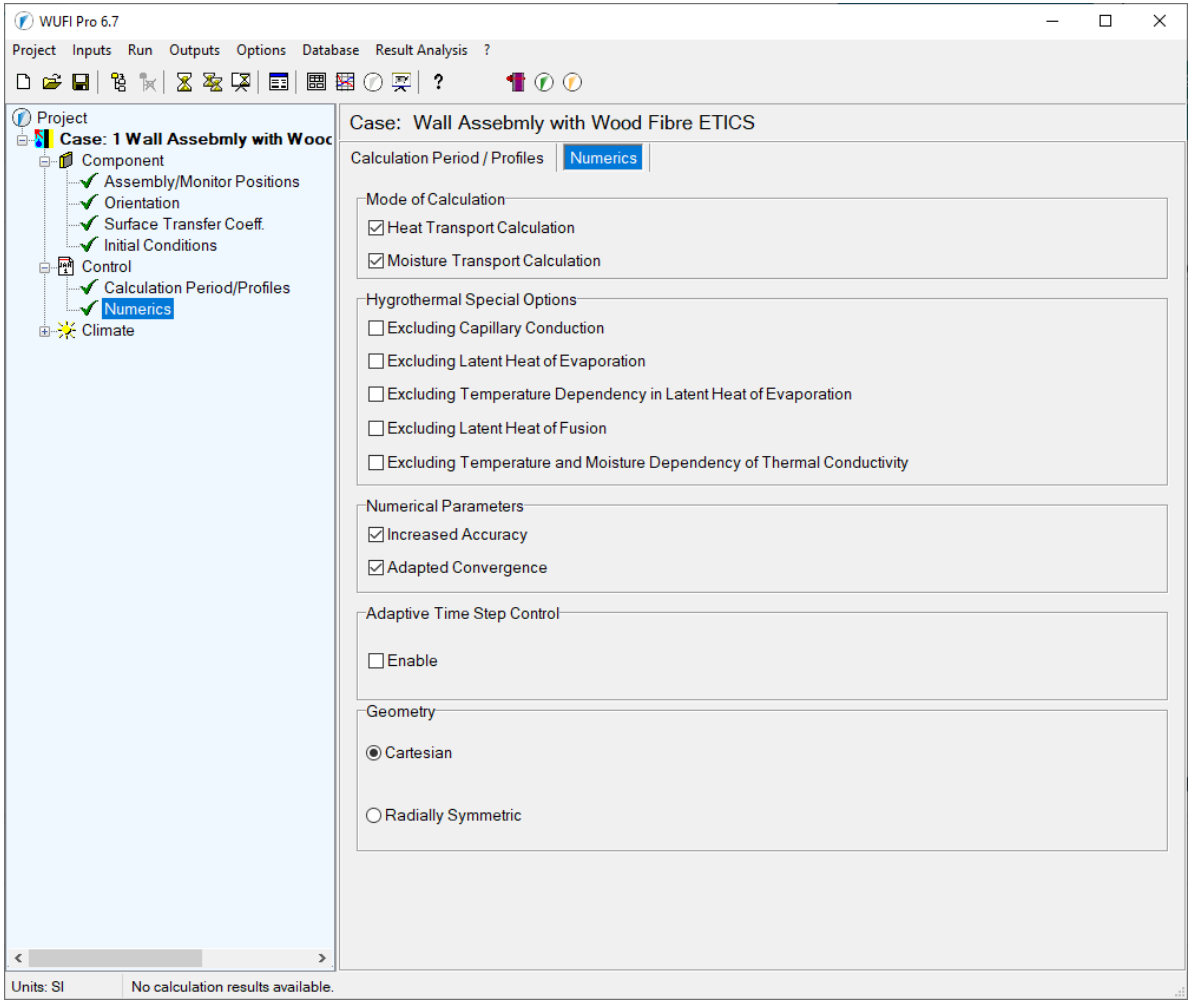
Adjust calculation period:

Here:
Calculation start at the beginning of April for the simpler „Alternative 2“.

For „Alternative 1“ with separate calculations adjust accordingly
(see slide 39-46)

Example: Input

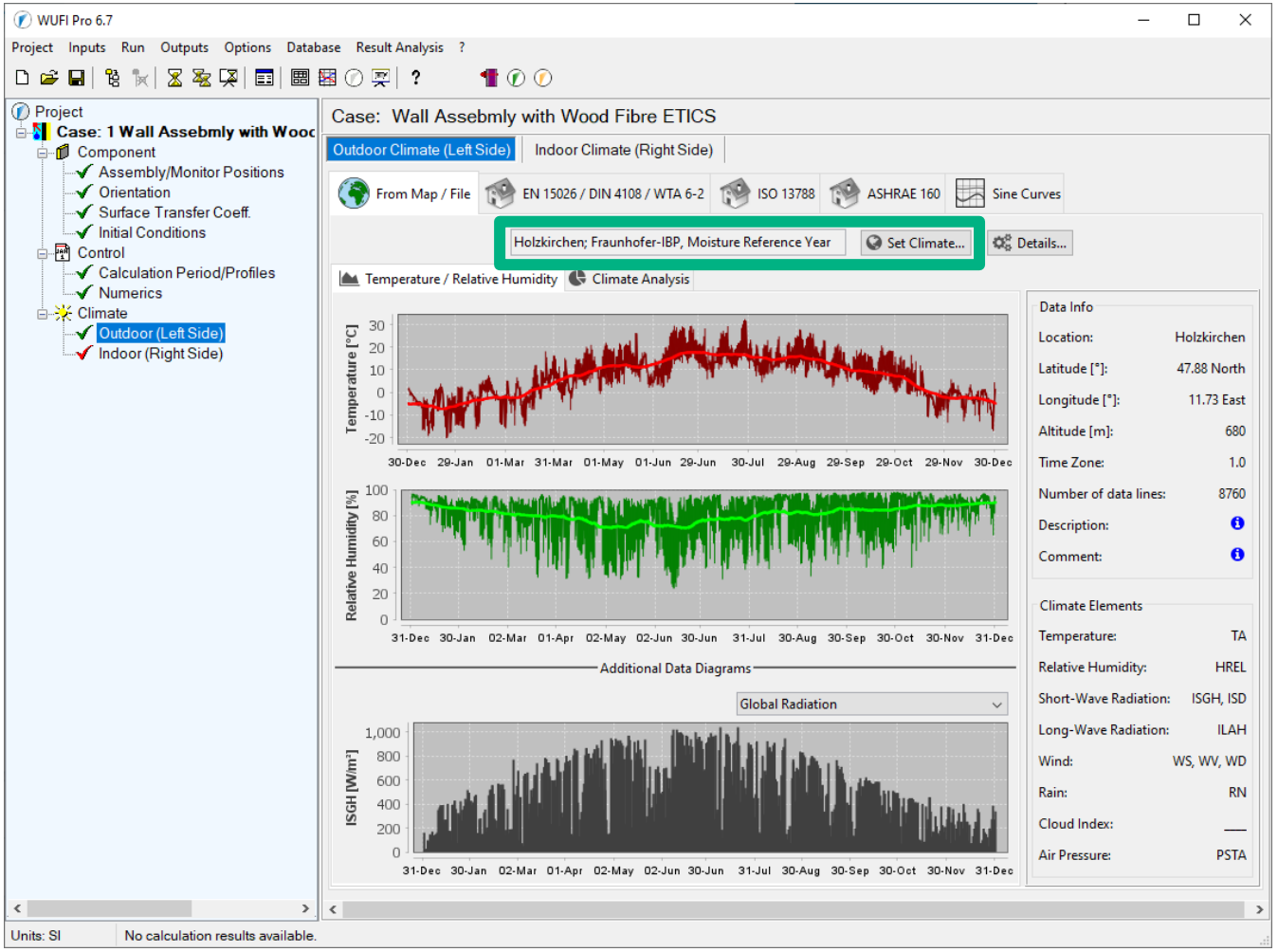
Control – Numerics



No changes required.

Example: Input

Climate – Outdoor (Left Side)



Select location

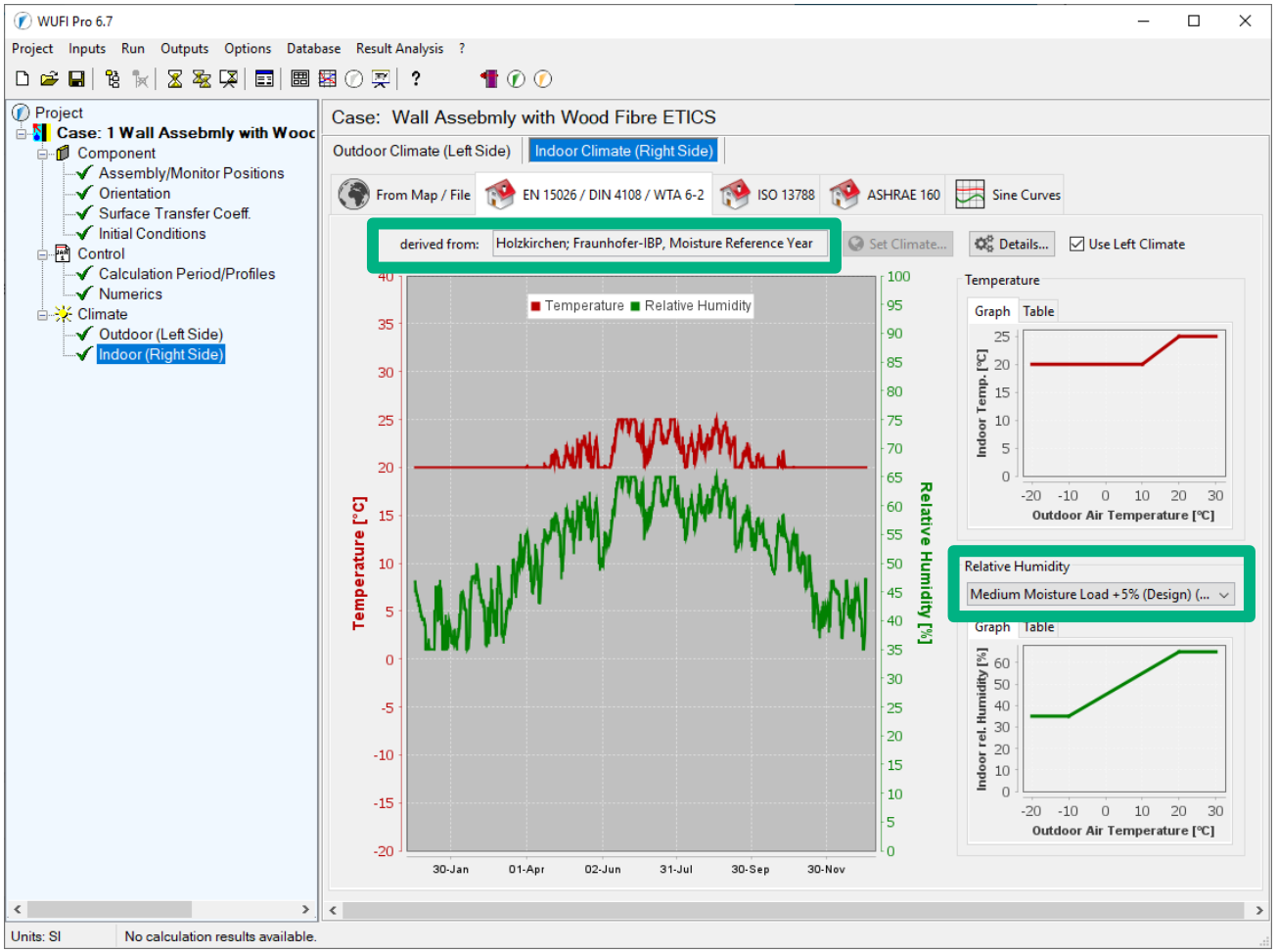
Note: In WUFI® the hygrothermal reference years (HRY) for Germany are directly available:

Braunlage, Chemnitz, Fichtelberg, Fürstenzell, Hamburg, Kassel, Lindenberg, Mannheim, Potsdam, Stötten, Warnemünde

For more Information, see WUFI® Help (F1) → Topic: Hygrothermal Reference Years

Example: Input

Climate – Indoor (Right Side)



No change required for „medium moisture load +5% (design)“

Example: Input Alternative 1

Procedure for considering drying during the construction phase (Alternative 1 - see slide 14).

Step 1: Enter the input data as described before. Enter the name for the case with „unheated“.

Step 2: In the first 6 months (1st of October to 1st of April), the outdoor air conditions are also applied at the inside.

Step 3: Export the profiles of temperature and water content for the end of the calculation (1st of April) (see WUFI® program help)

Step 4: Create a new case „occupied climate“ and copy all entries of the „unheated“ case.

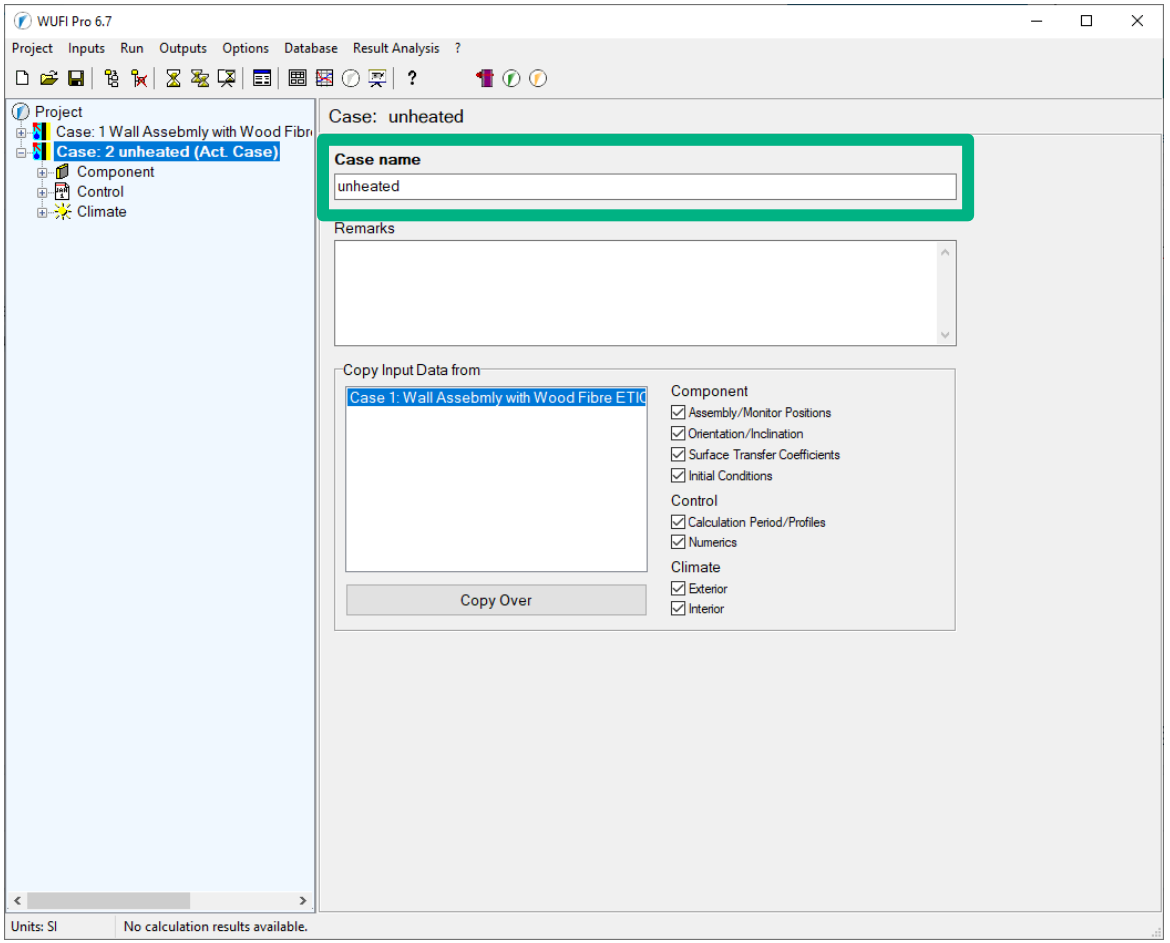
Step 5: Import the exported profiles of temperature and water content as initial conditions (see WUFI® program help)

Step 6: Replace indoor climate with design climate according to DIN 4108-3.

Step 7: Calculate the case „occupied climate“ from 1st of April for 5 years.

Example: Input Alternative 1

Step 1: Enter the input data as described before. Enter the name for the case with „unheated“.

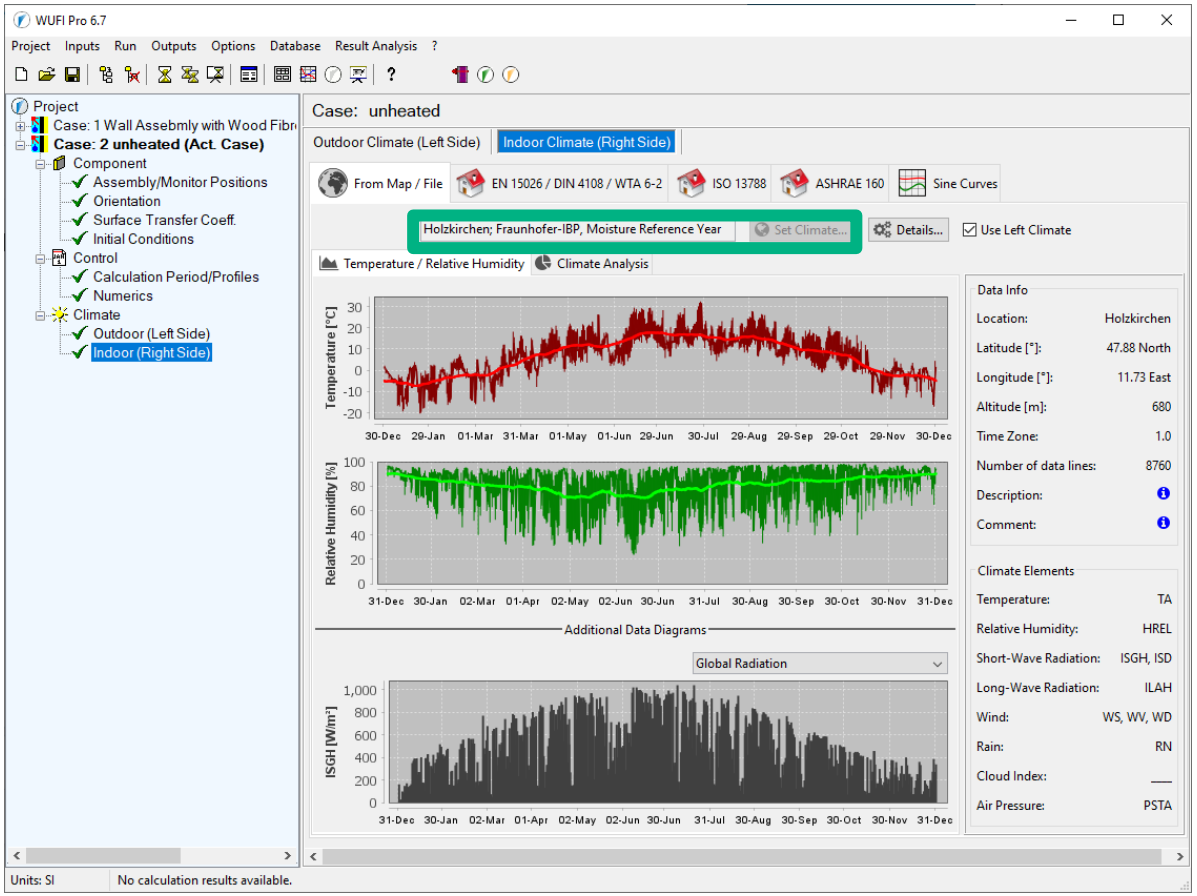


Click on „Case“ in the menu tree to enter the case name.

Enter all input data except climate and calculation period according to the previous descriptions.

Example: Input Alternative 1

Step 2: In the first 6 months (1st of October to 1st of April), the outdoor air conditions are also applied at the inside.

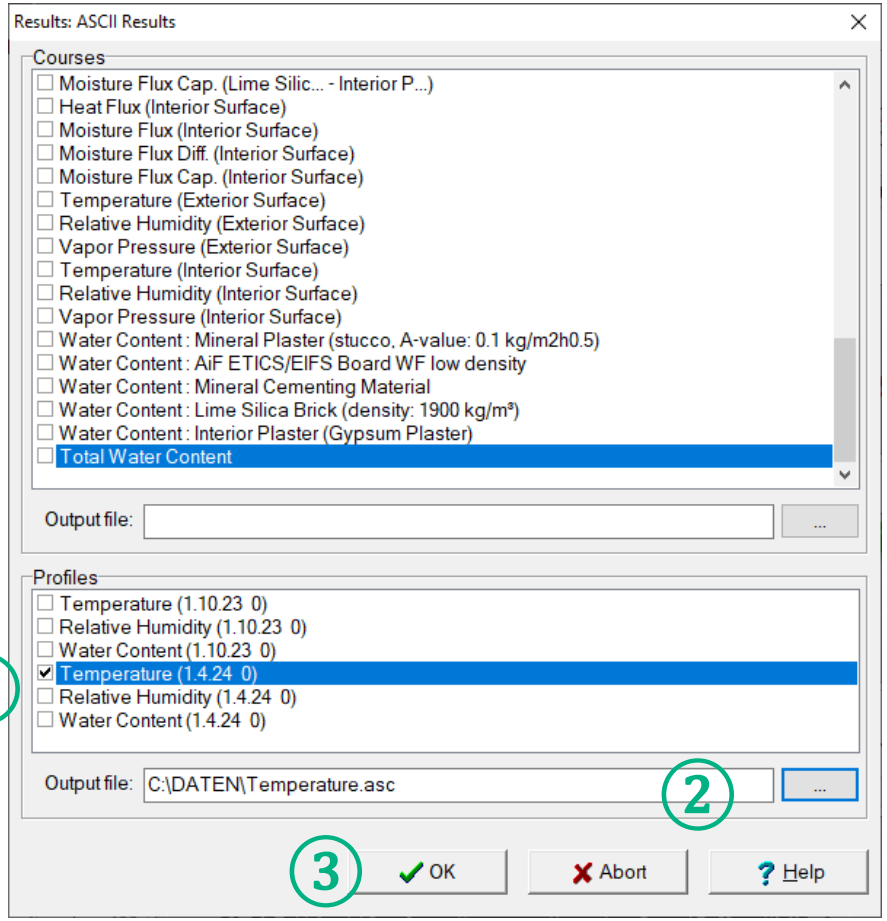


1. **„Calculation Period“**
   replace with
   Start: 01.10.2023
   End: 01.04.2024

2. **Climate → „Indoor (Right Side)“**
   replace with the outdoor climate used (from Map / File)

Example: Input Alternative 1

Step 3: Export the profiles of temperature and water content for the end of the calculation (1st of April).



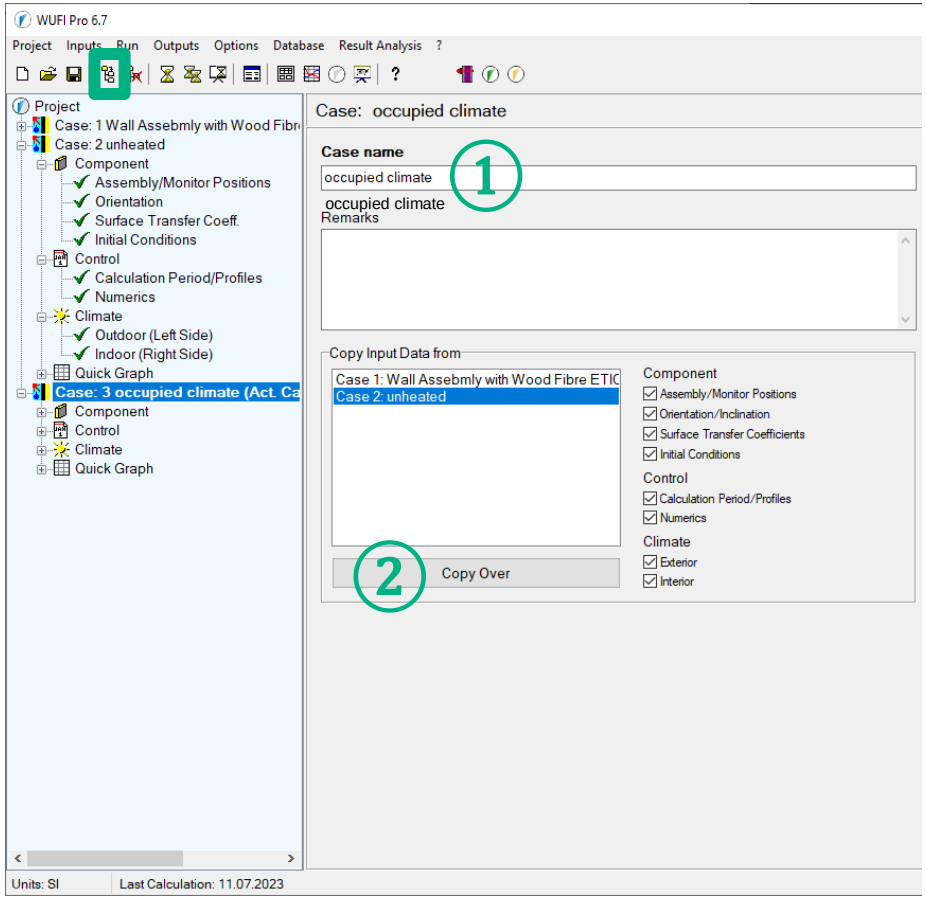
Start calculation: 

Then:
Outputs → **ASCII-Export…**

1. Select the profiles of the temperature at the end of the calculation (1st of April).
2. Save file e.g. as „Temperature.asc“.
3. Enter „OK“.
4. Repeat the procedure for the water content (1st of April) and save it e.g. as „WaterContent.asc“.

Example: Input Alternative 1

Step 4: Create a new case „occupied climate“ and copy all entries of the „unheated“ case.

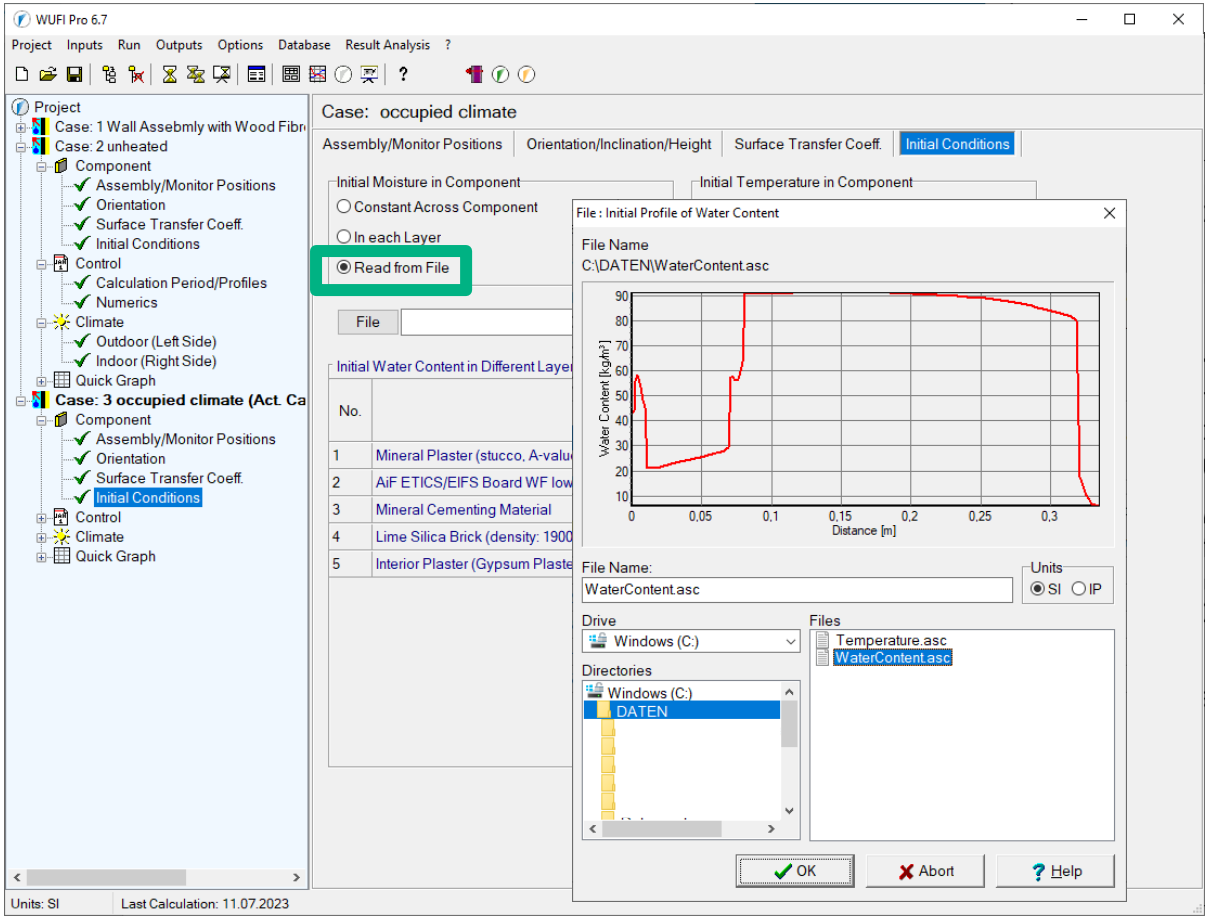


Project → **New Case** 

1. Enter „occupied climate“ as case name.
2. Copy input data from:
   Select „Case 2: unheated“,
   enter „Copy Over“.

Example: Input Alternative 1

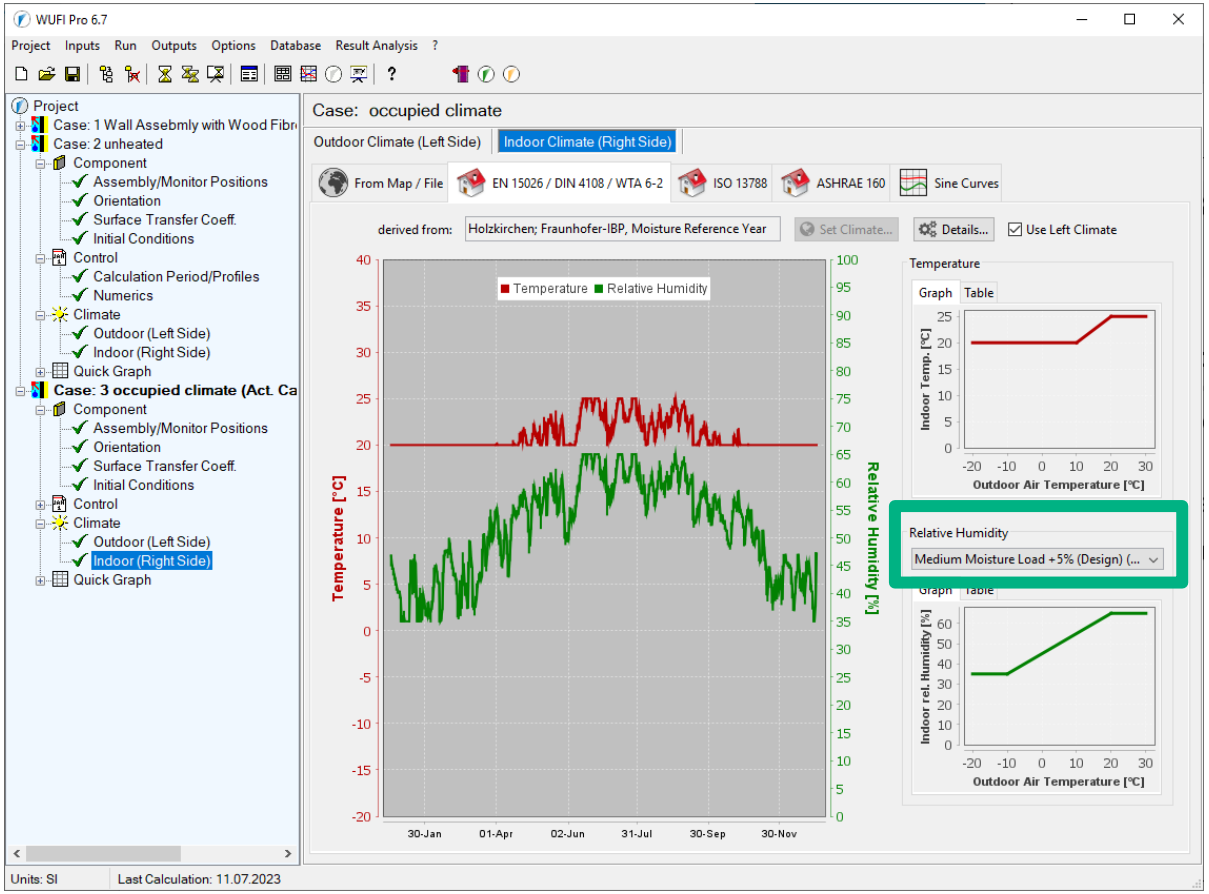
Step 5: Import the exported profiles of temperature and water content as initial conditions.



1. **„Initial Conditions“ →** „Initial Moisture in Component“: Select „Read from File“
2. Select file with the water content profile („WaterContent.asc“) and enter „OK“.
3. Repeat the procedure for the temperature.

Example: Input Alternative 1

Step 6: Replace indoor climate with design climate according to DIN 4108-3.



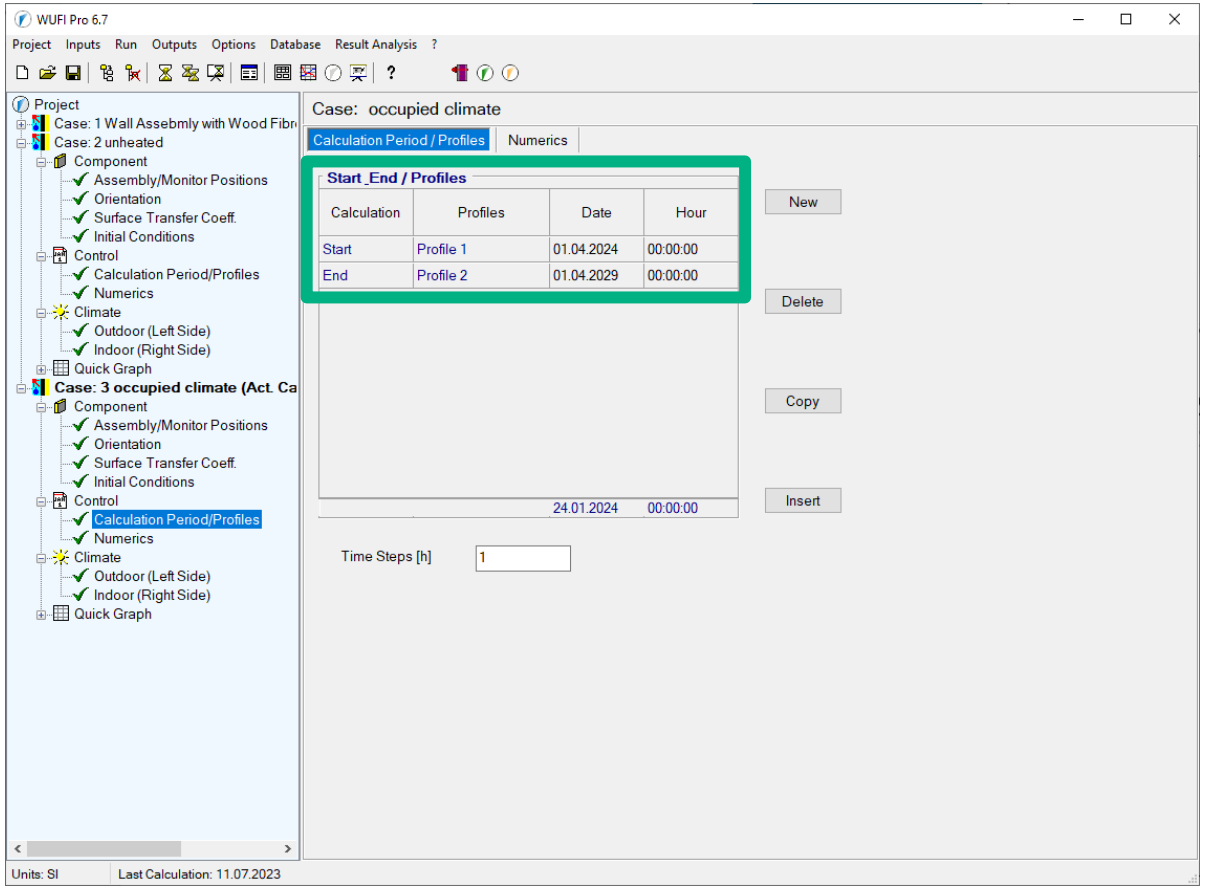
1. **Climate → „Indoor (Right Side)“**
   Select „EN 15026 / DIN 4108 / WTA 6-2“

2. Select moisture load:

   „medium moisture load +5 % (design)“

Example: Input Alternative 1

Step 7: Calculate the case „occupied climate“ from 1st of April for 5 years.



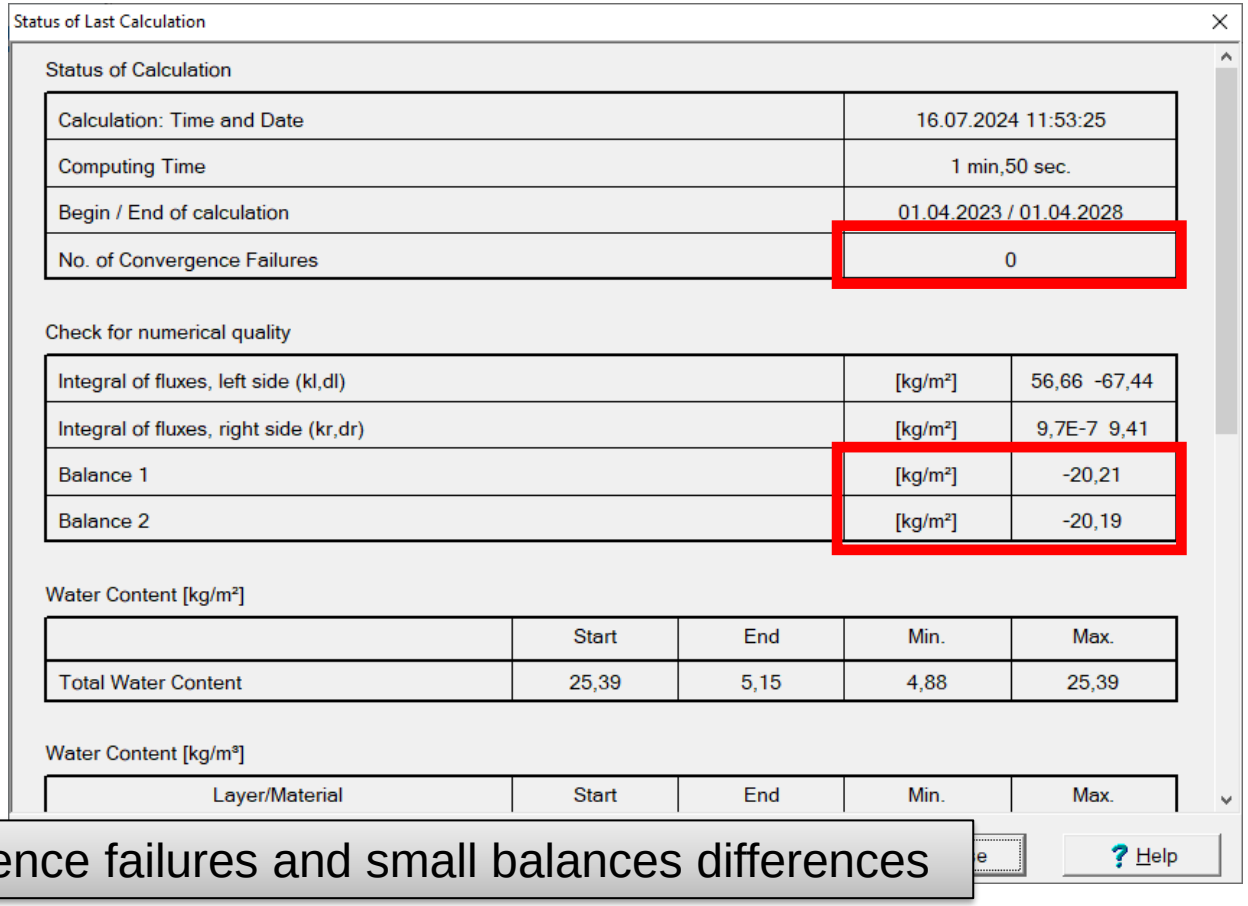
Change **„Calculation Period“**:

Start: 01.04.2024
End: 01.04.2029

Example: Evaluation

General:

Evaluation of the numerical qualitiy of the results.

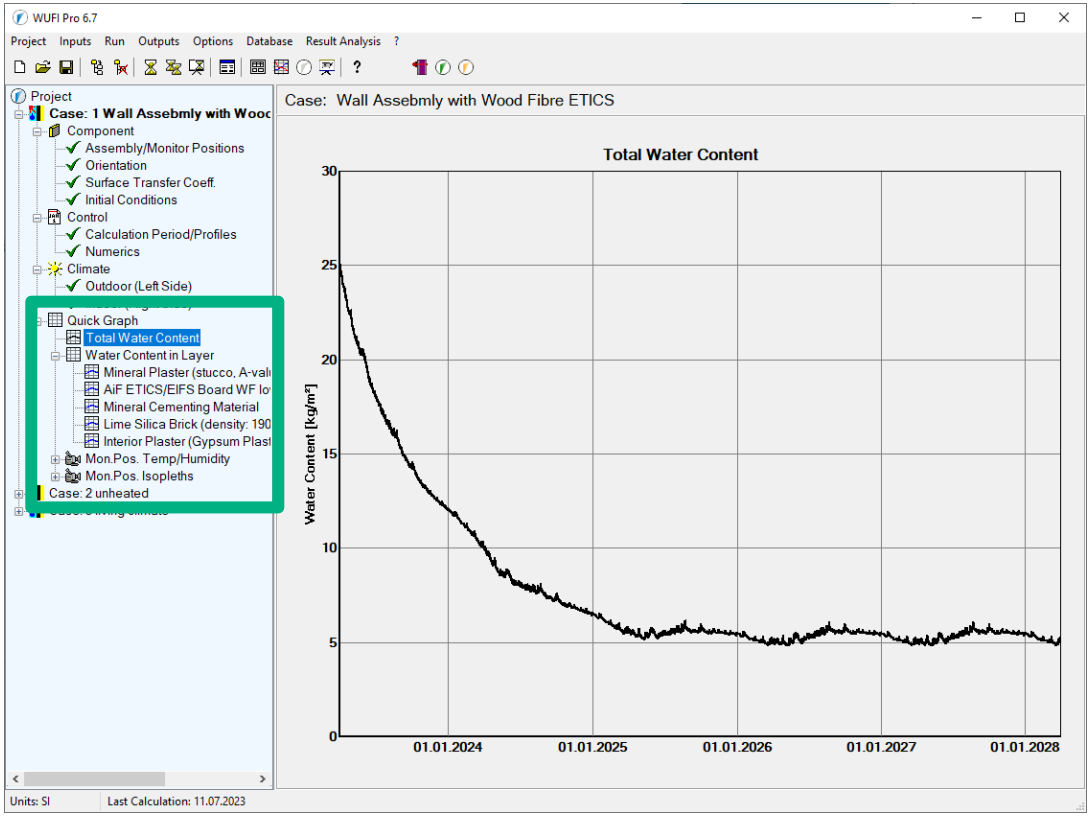


No convergence failures and small balances differences

Example: Evaluation

General:

WUFI offers different visualisation options of the simulation results for evaluation.

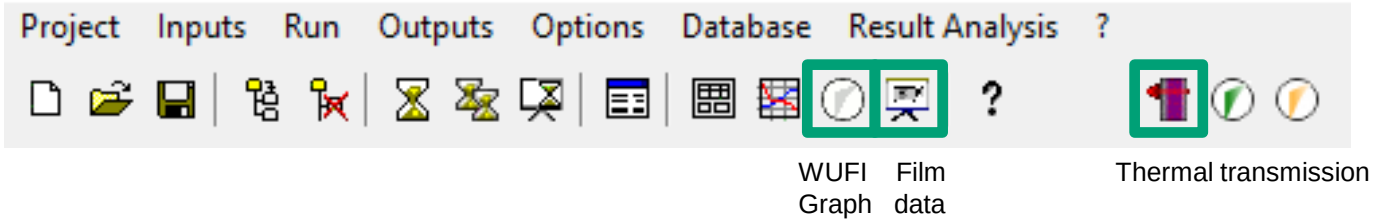


Quick Graph:

The water content of the whole component and of each layer and the temperature and relative humidity as well as isopleths at the monitor positions are displayed directly in the project tree.

Example: Evaluation

General:
WUFI offers different ways of visualising the simulation results for evaluation.



WUFI® Graph
Detailed evaluations at any position or area as well as special evaluations, e.g. of wood moisture content according to WTA 6-8, are possible.

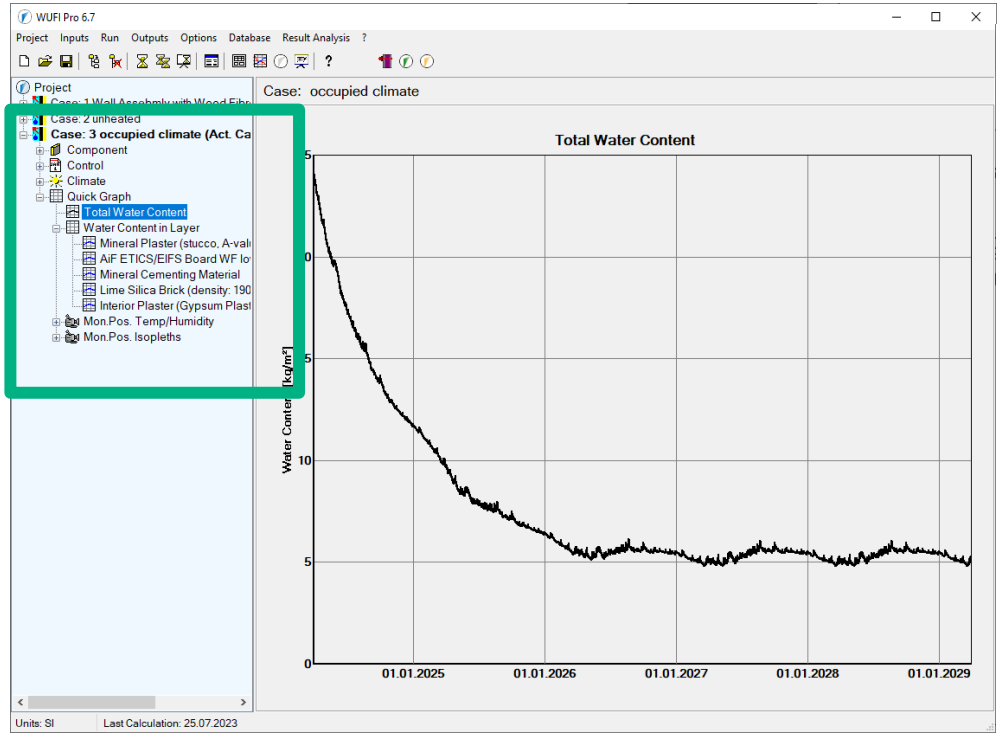
Film data
The temporal change of the temperature, RH and water content profiles of the component are shown as a film.

Thermal transmission
Post process module, which allows to determine the transient U-values.

Example: Evaluation

From here on, the results of Alternative 2 (see slide 15) are evaluated as an example, whereby the drying period is taken into account in a simplified way.

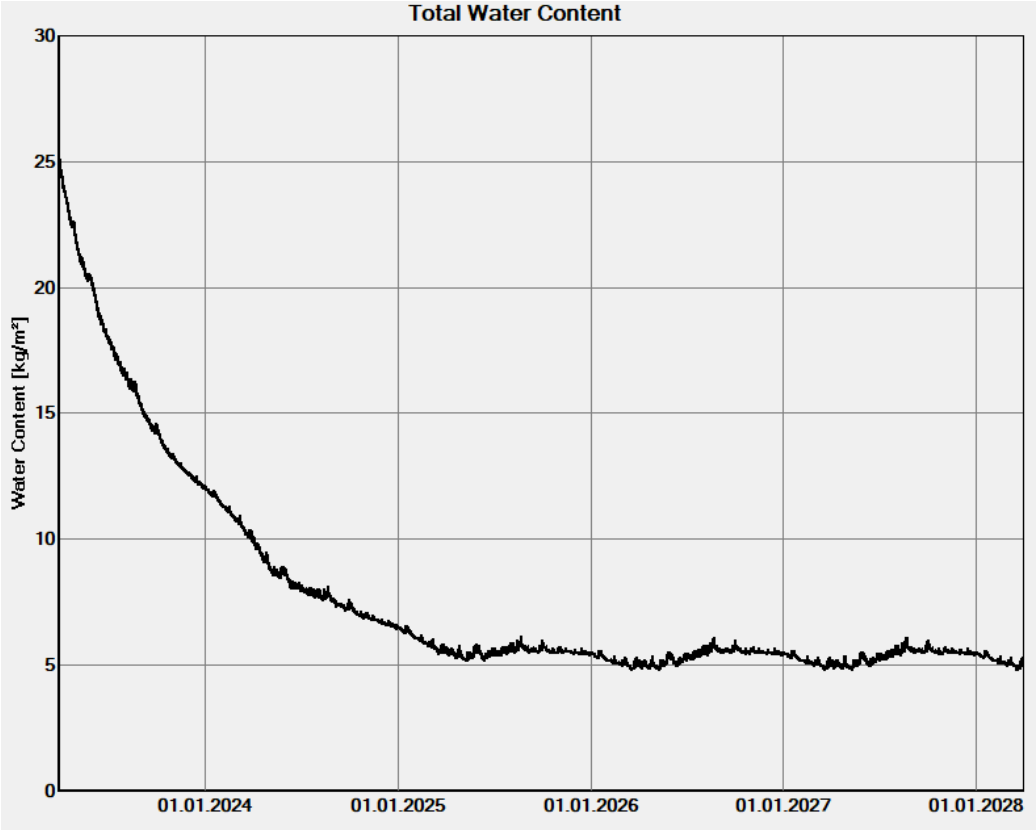
If the drying period is calculated separately (Alternative 1, see slide 14, 39-46), the results under living climate are considered to evaluate the long-term behaviour of the wood fibre ETICS (not included in the guideline).



Example: Evaluation

Total Water Content:

Total water content of the component
(Quick Graph → Total Water Content or WUFI® Graph)



Evaluation:

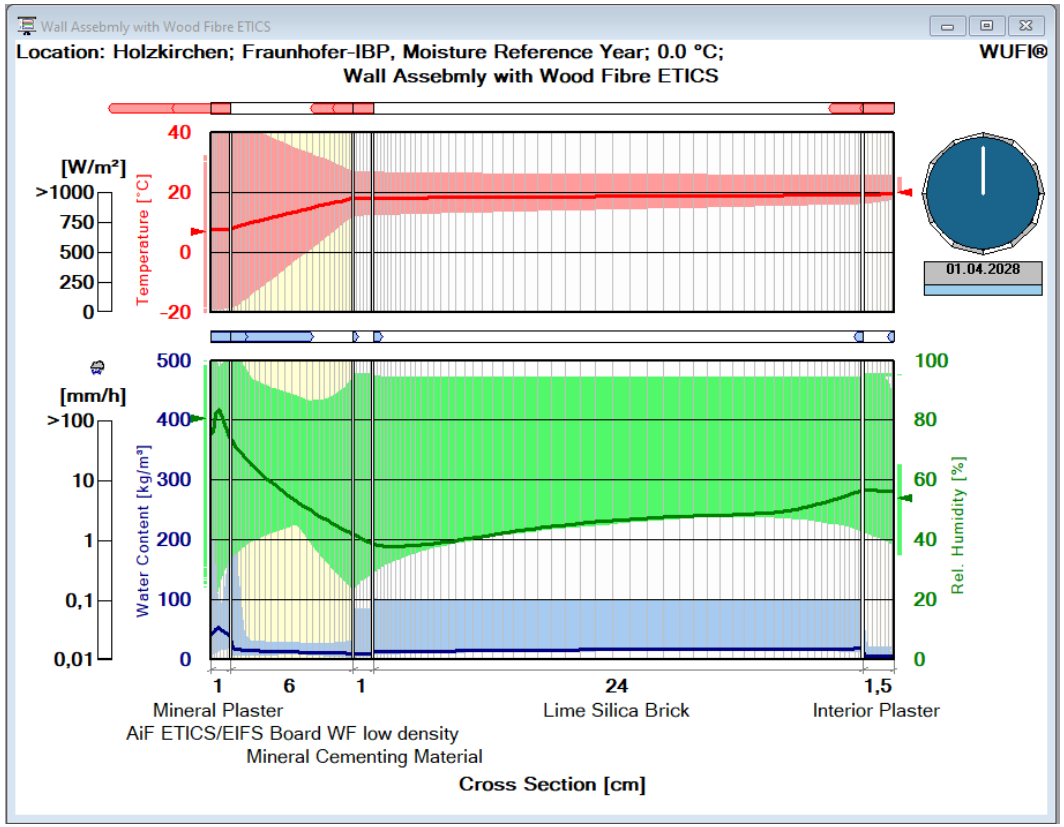
The total water content of the component decreases → The construction dries out.

Dynamic equilibrium from the third year.

Example: Evaluation

Distribution of Moisture and Temperature:

Profiles of temperature, relative humidity and water content in the component during the calculation period (view film)



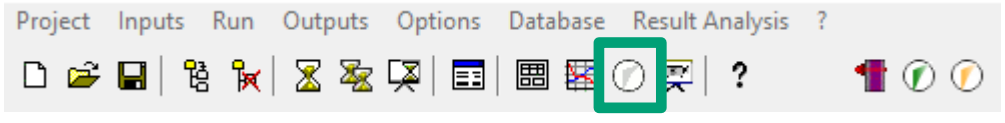
Evaluation:

The outer side of the wood fibre insulation is more critical than the inner side.

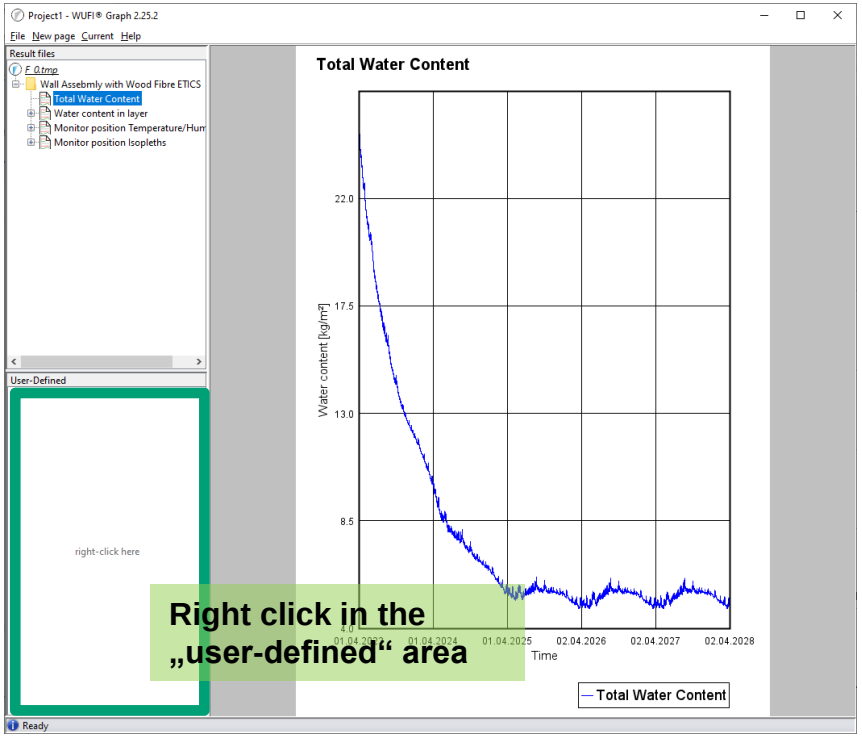
Tip:
„Outputs“ → „View Film“

Example: Evaluation

Evaluation of the wood moisture according to WTA 6-8 and DIN 68800:
Wood moisture in the exterior centimetre of the wood fibre insulation (WUFI® Graph)



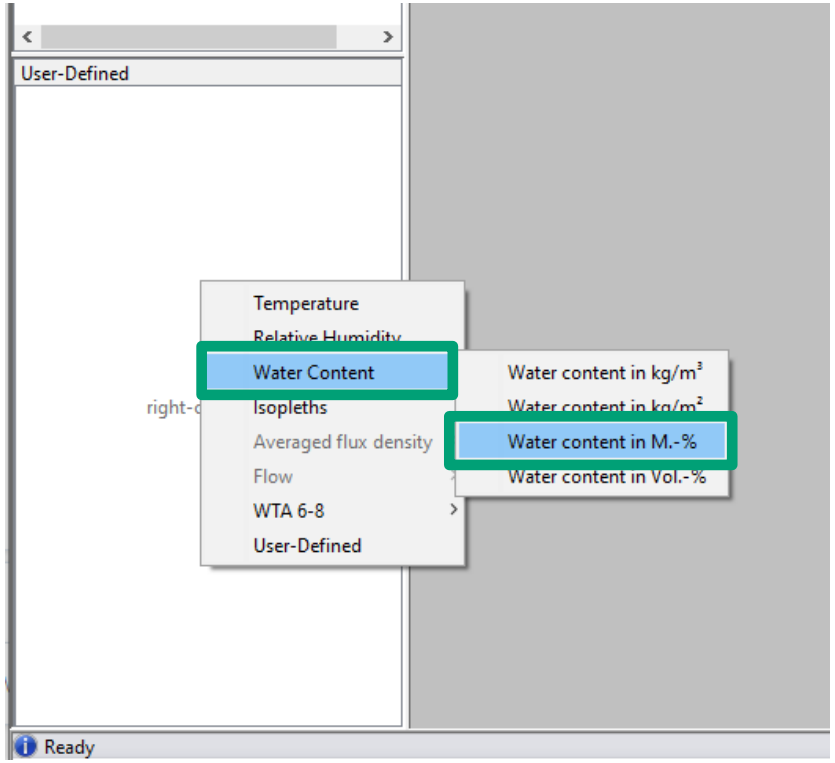
Open WUFI Graph



Right click in the „user-defined“ area

Example: Evaluation

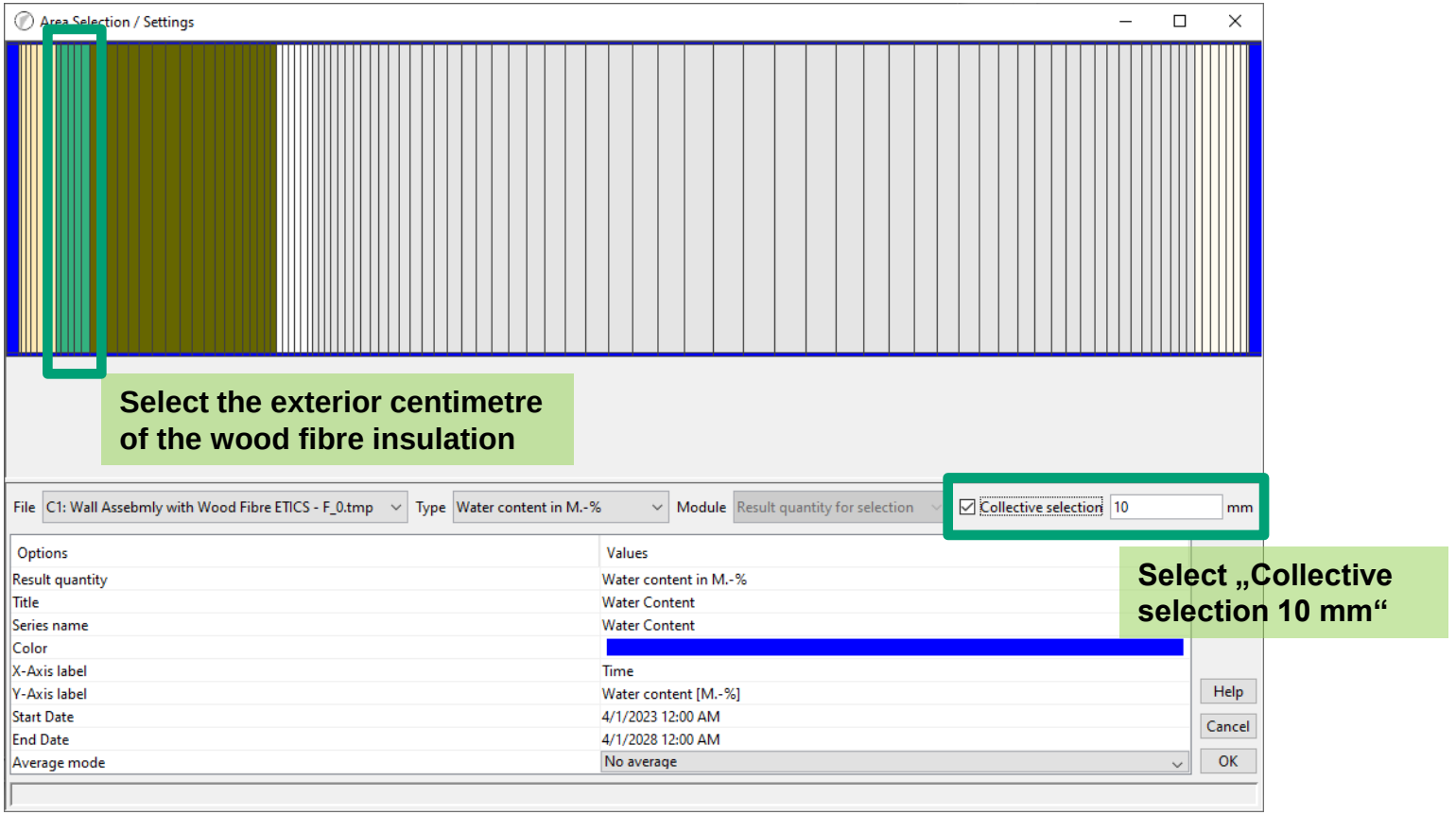
Evaluation of the wood moisture according to WTA 6-8 and DIN 68800:
Wood moisture in the exterior centimetre of the wood fibre insulation (WUFI® Graph)



Select „Water content in M.-%“

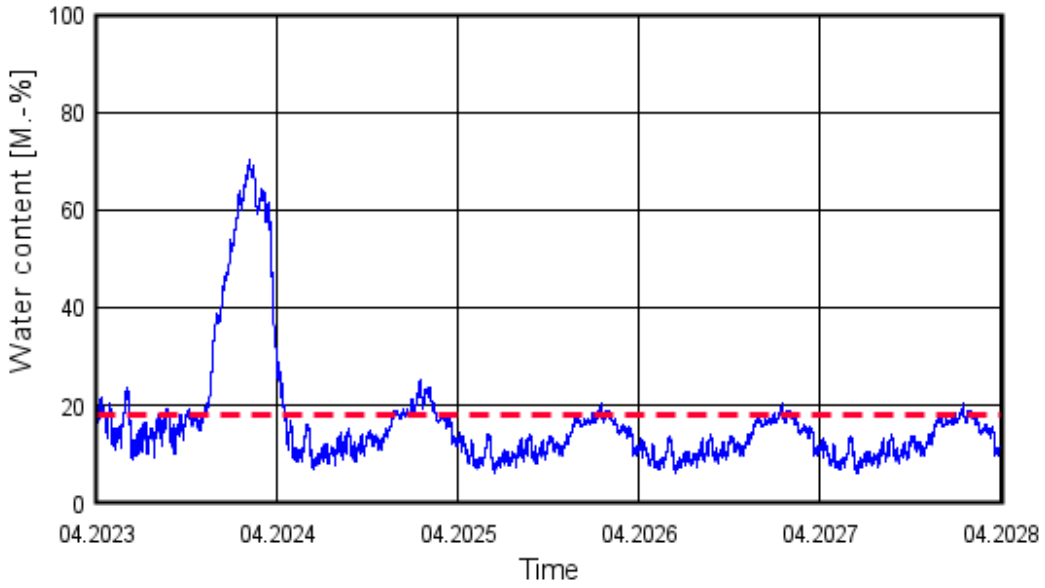
Example: Evaluation

Evaluation of the wood moisture according to WTA 6-8 and DIN 68800:
Wood moisture in the exterior centimetre of the wood fibre insulation (WUFI® Graph)



Example: Evaluation

Evaluation of the wood moisture according to WTA 6-8 and DIN 68800:
Wood moisture in the exterior centimetre of the wood fibre insulation (WUFI® Graph)



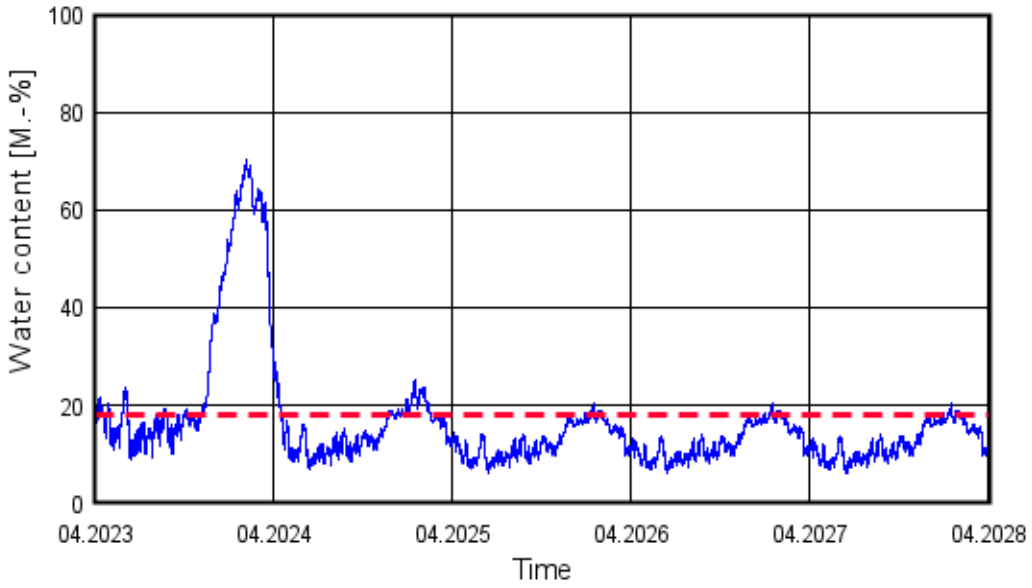
„Normal“ evaluation for any wood-based material:
Criteria see slide 22

In the first and second year, the water content clearly exceeds 18 % by mass.

From the third year on, 18 % by mass is exceeded only shortly and slightly.

Example: Evaluation

Evaluation of the wood moisture according to WTA 6-8 and DIN 68800:
Wood moisture in the exterior centimetre of the wood fibre insulation (WUFI® Graph)



Special evaluation only for wood fibre ETICS according to „Scope of application“ (see silde 4-5):

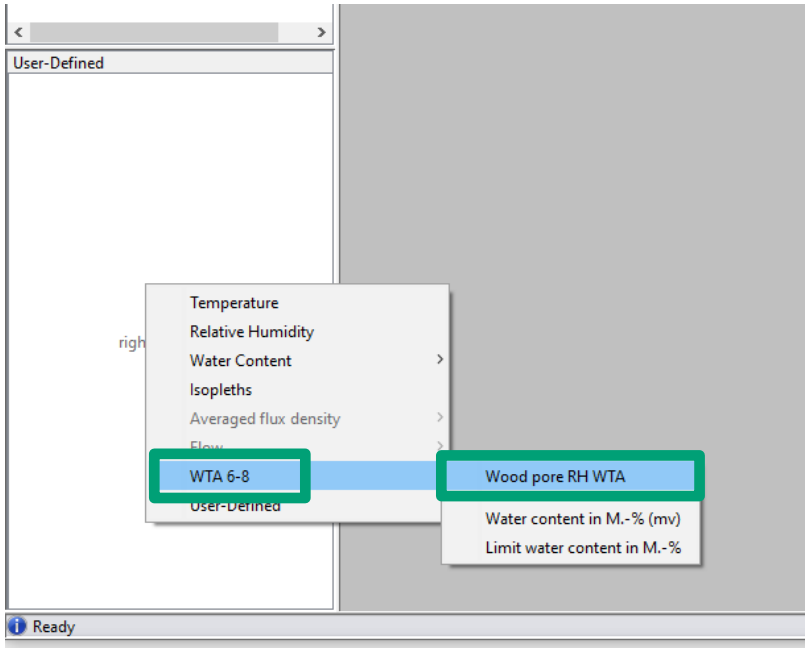
Criteria see slide 23

1. 80 % by mass are not exceeded
2. The moisture content in the second winter with less than 30 % by mass is significantly lower than the first winter with 71 % by mass.
3. From the third year on, 18 % by mass is exceeded only shortly and slightly – the permanent moisture conditions are evaluated according to the WTA Guideline on the following slides.

Example: Evaluation

*Special evaluation of wood fibre ETICS according to WTA 6-8 *:*

Evaluation of the pore RH in the 10-day average in the exterior centimetre of the wood fibre insulation (WUFI® Graph)



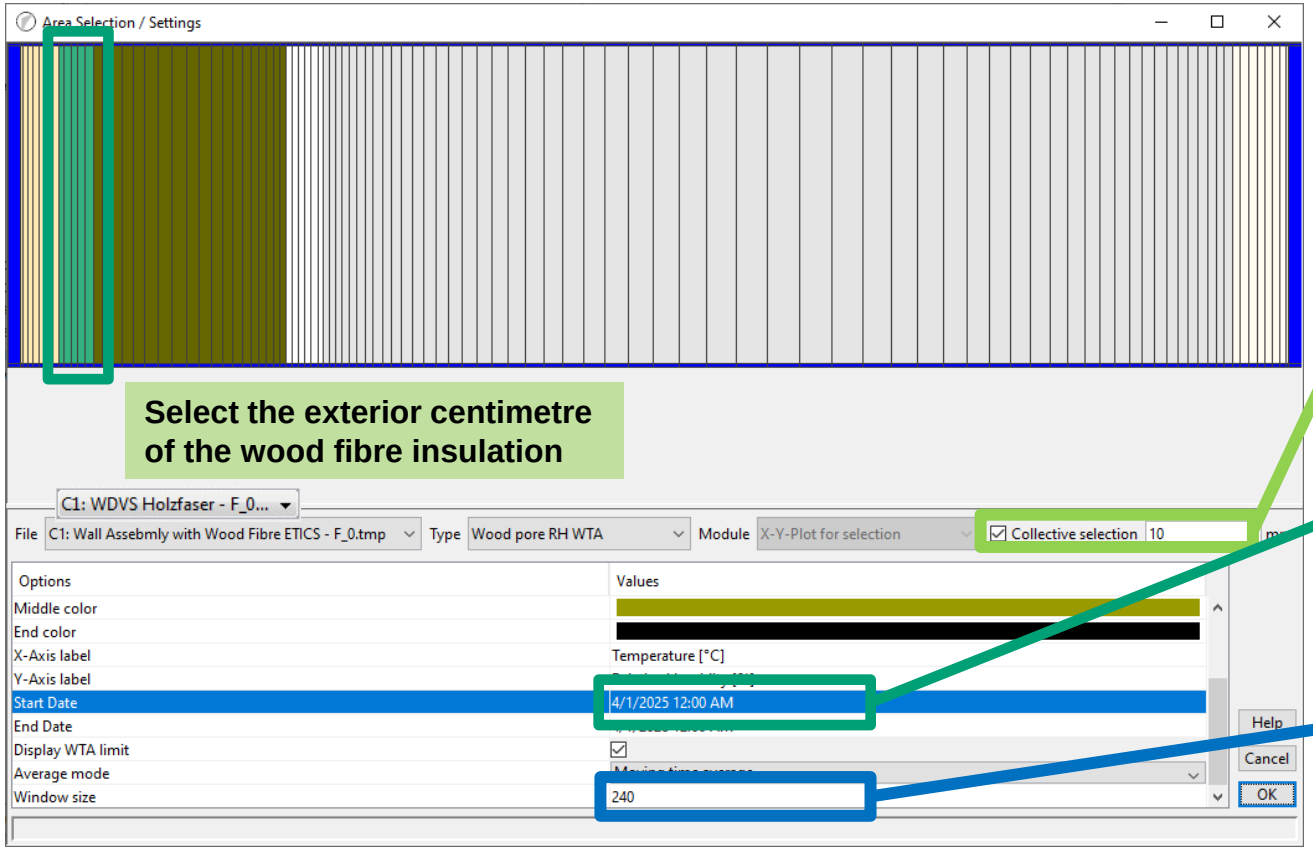
Select „Wood pore RH WTA“

** Guaranteed by the manufacturers (see slide 4-5) for the products within the scope of this guideline*

Example: Evaluation

*Special evaluation of wood fibre ETICS according to WTA 6-8 *:*

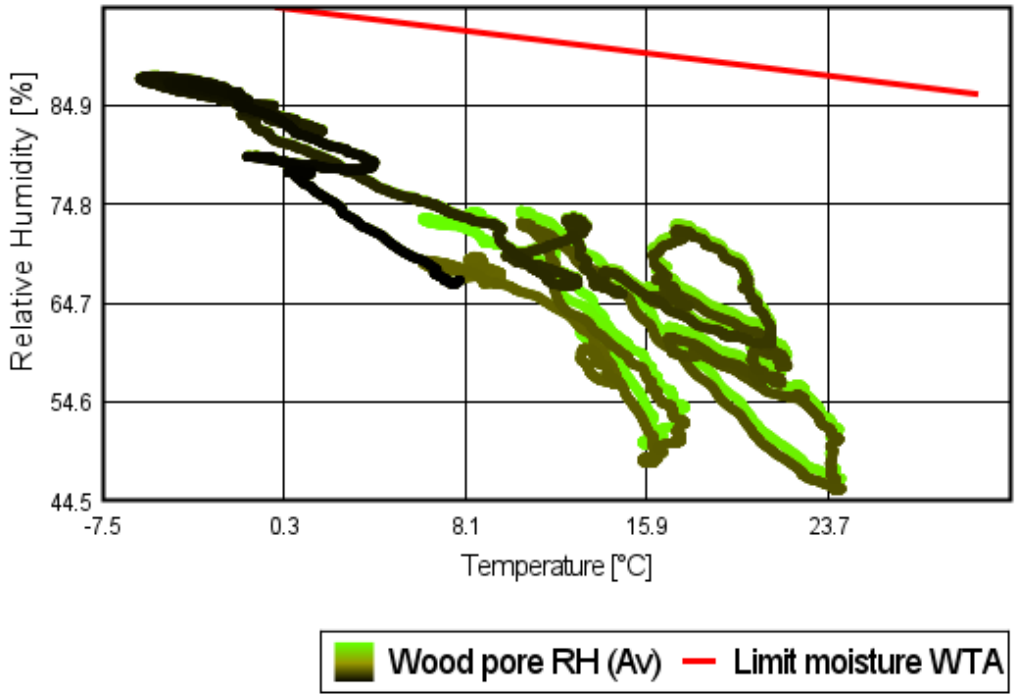
Evaluation of the pore RH in the 10-day average in the exterior centimetre of the wood fibre insulation (WUFI® Graph) - see slide 23



** Guaranteed by the manufacturers (see slide 4-5) for the products within the scope of this guideline*

Example: Evaluation

*Special evaluation of wood fibre ETICS according to WTA 6-8 *:*
Evaluation of the pore RH in the 10-day average in the exterior centimetre of the wood fibre insulation (WUFI® Graph) - see slide 23



Special evaluation only for wood fibre ETICS according to „Scope of application“ (see silde 4-5):

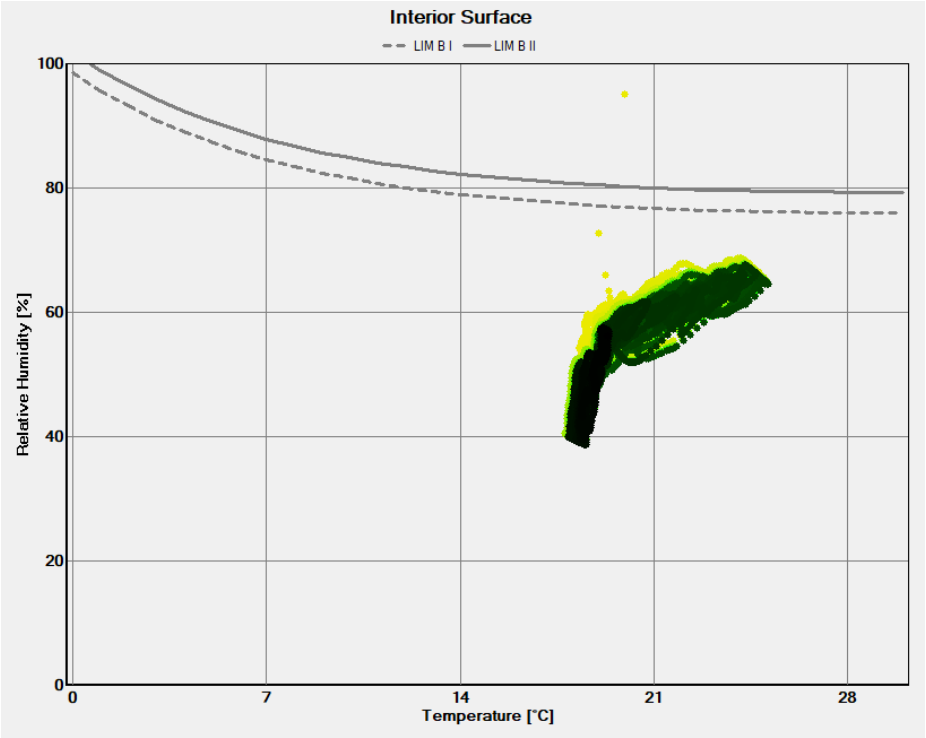
The 10-day mean values of relative humidity and temperature no longer exceed the limit value according to WTA 6-8 (beginning with the third year).

** Guaranteed by the manufacturers (see slide 4-5) for the products within the scope of this guideline*

Example: Evaluation

Mould Growth:

Isopleths on the interior surface
(Quick Graph → Mon.Pos. Isopleths → Interior Surface)



Calculation period: Start End

Evaluation:

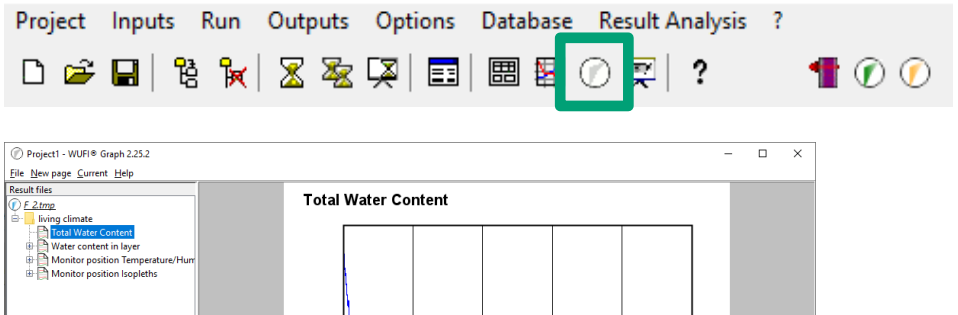
The temperatures and rel. humidities are (after the first hour) clearly below the LIM curves.

⇨ Therefore a risk of mould growth on the interior surface can be excluded.

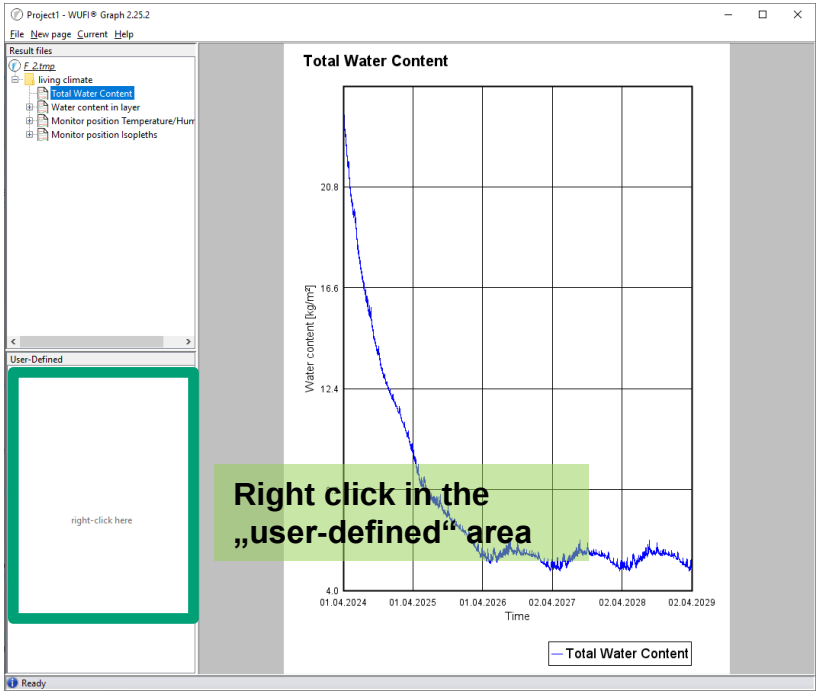
Example: Evaluation

Frost risk: Boundary layer insulation – exterior plaster

Additional evaluation of water content and temperature at the boundary layer between wood fibre insulation material and exterior plaster (WUFI® Graph)



Open WUFI Graph

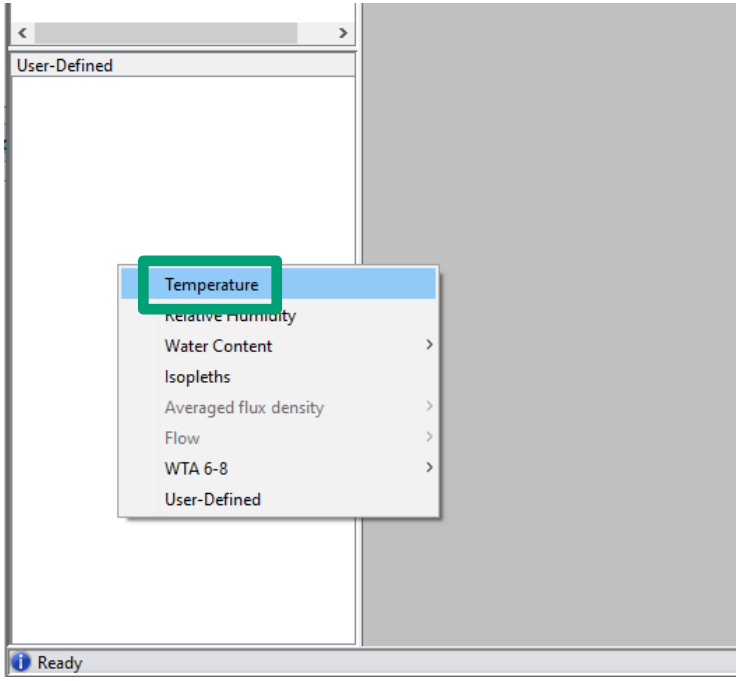


Right click in the „user-defined“ area

Example: Evaluation

Frost risk: Boundary layer insulation – exterior plaster

Additional evaluation of water content and temperature at the boundary layer between wood fibre insulation material and exterior plaster (WUFI® Graph)

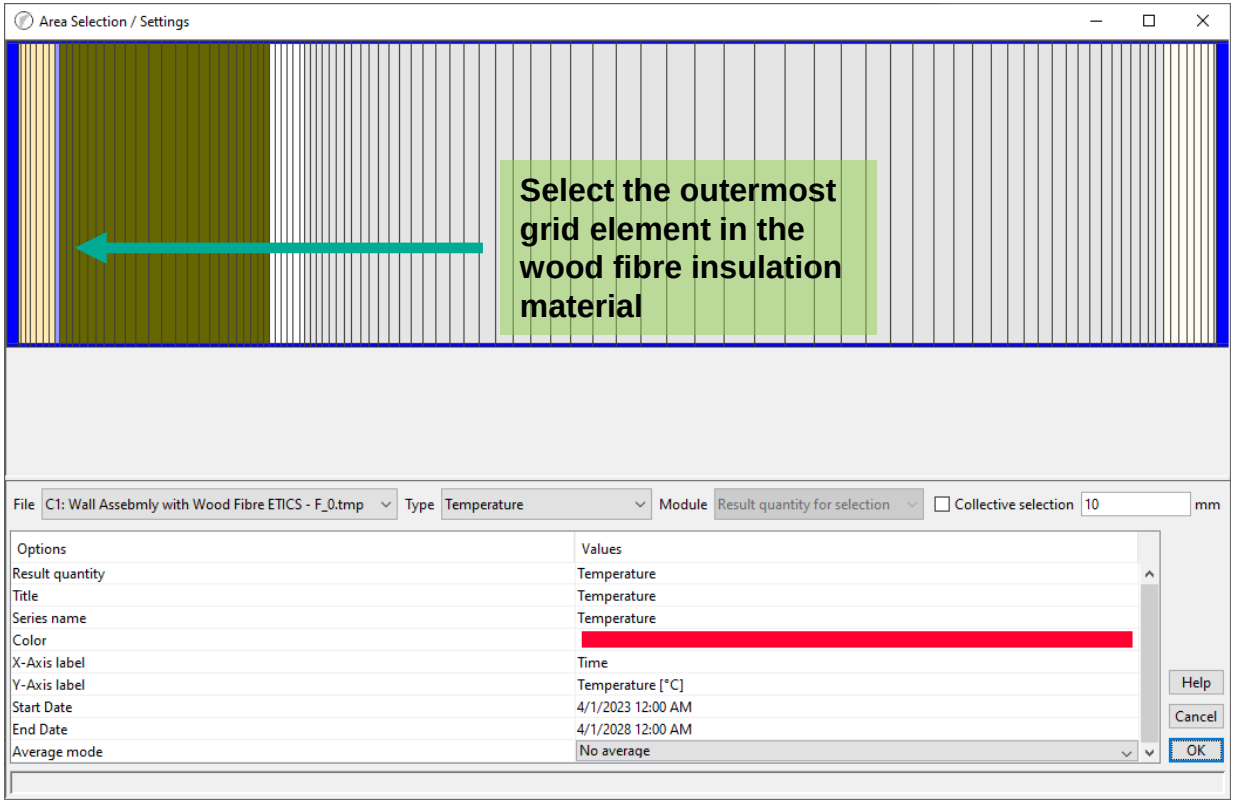


Select „Temperature“

Example: Evaluation

Frost risk: Boundary layer insulation – exterior plaster

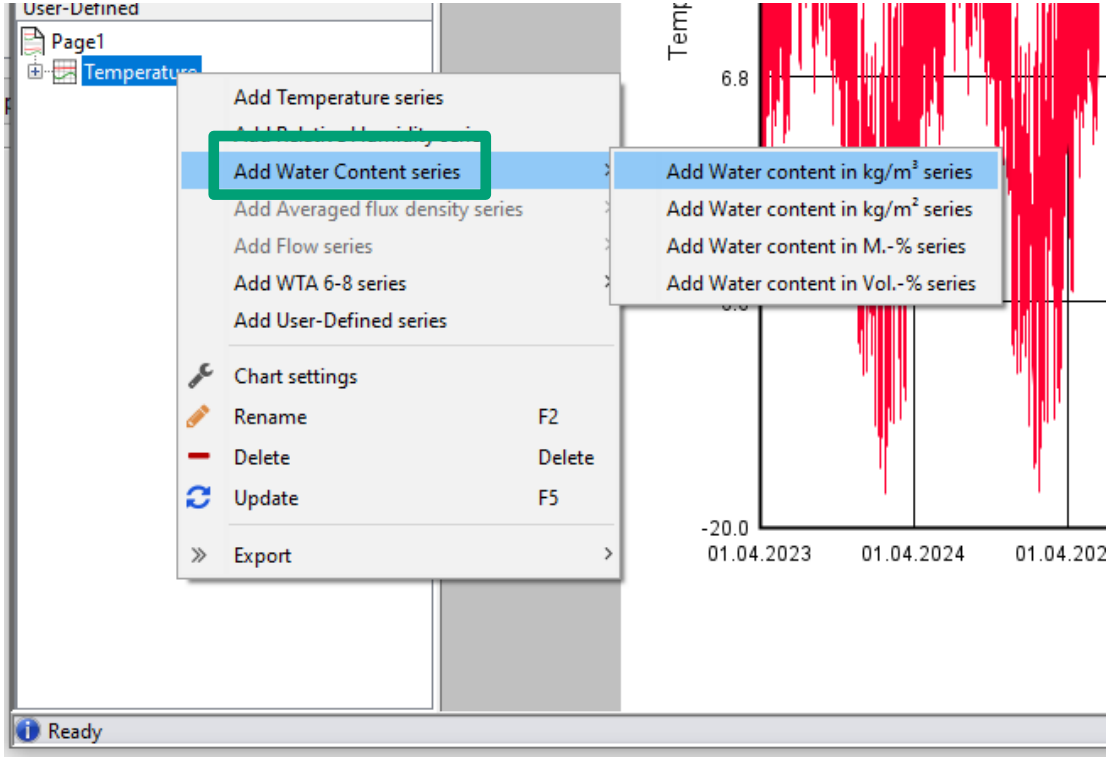
Additional evaluation of water content and temperature at the boundary layer between wood fibre insulation material and exterior plaster (WUFI® Graph)



Example: Evaluation

Frost risk: Boundary layer insulation – exterior plaster

Additional evaluation of water content and temperature at the boundary layer between wood fibre insulation material and exterior plaster (WUFI® Graph)



Right click on the previously created graph with the temperature

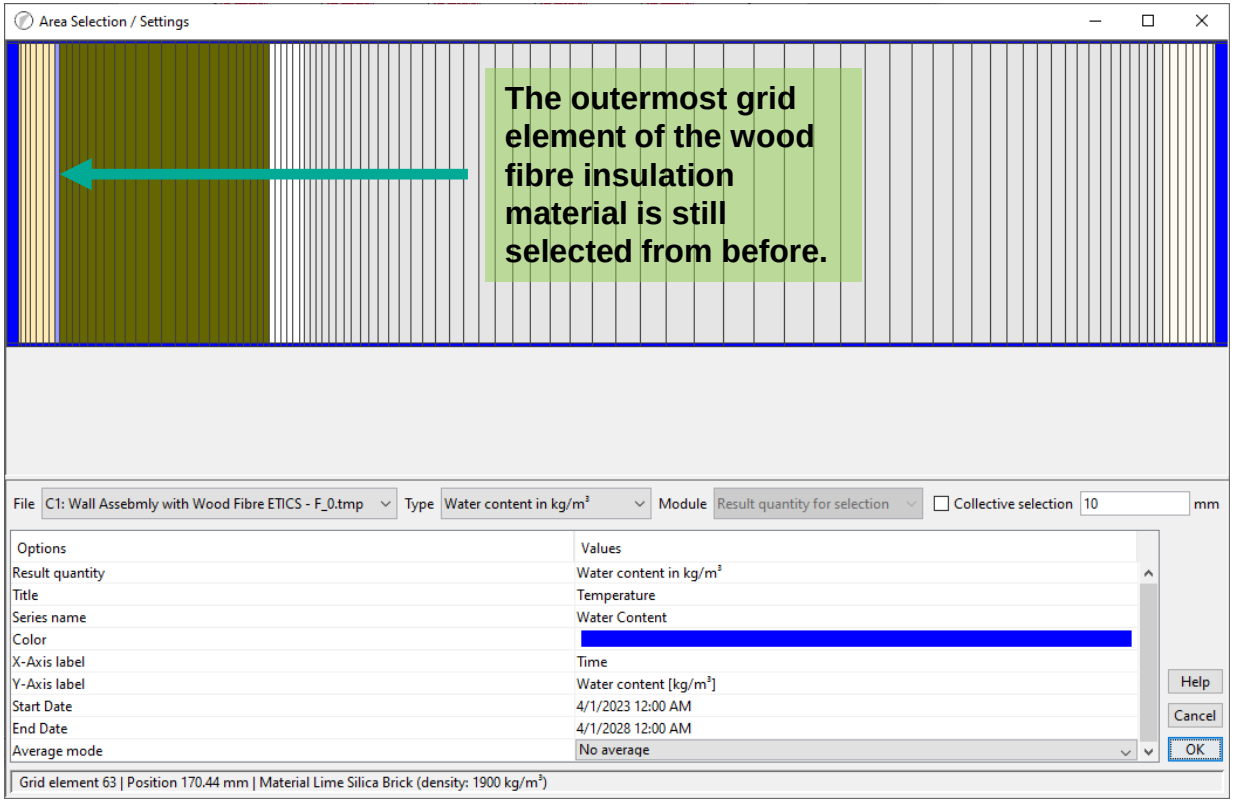
→„Add Water content series“

→„Add Water content in kg/m³ series“

Example: Evaluation

Frost risk: Boundary layer insulation – exterior plaster

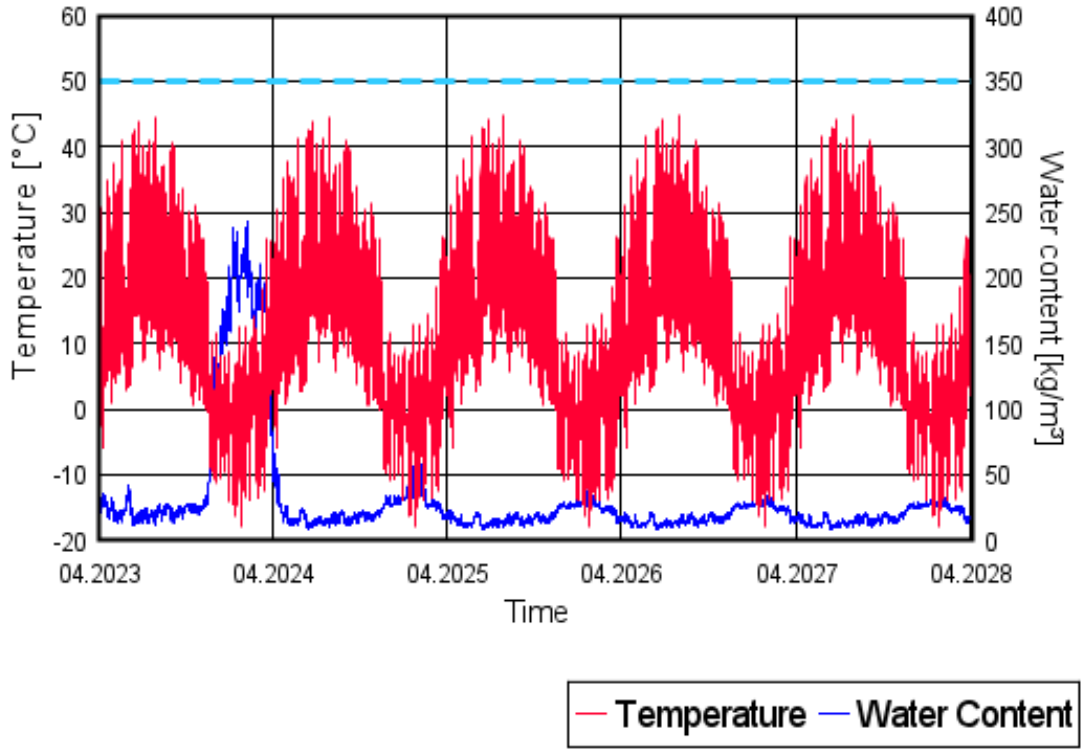
Additional evaluation of water content and temperature at the boundary layer between wood fibre insulation material and exterior plaster (WUFI® Graph)



Example: Evaluation

Frost risk: Boundary layer insulation – exterior plaster

Additional evaluation of water content and temperature at the boundary layer between wood fibre insulation material and exterior plaster (WUFI® Graph)



Evaluation:

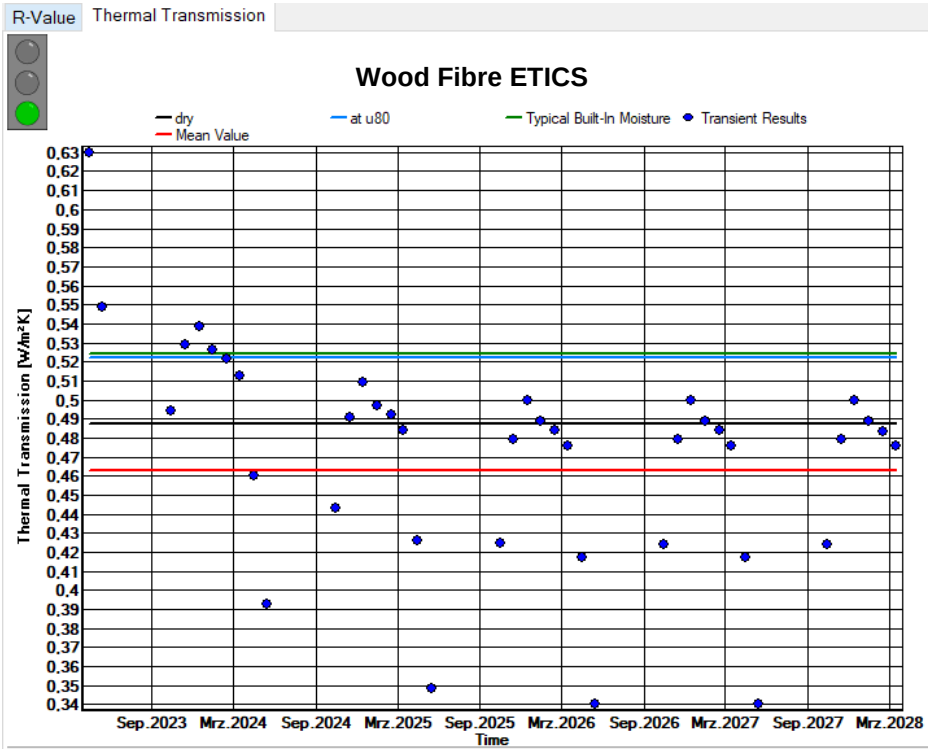
The maximum water content in the wood fibre insulation material (blue curve) does not exceed the free saturation (here 350 kg/m³) even during the drying period.

⇨ This shows that there is no risk of frost damage at this position if the plaster itself is frost-resistant.

Example: Evaluation

Transient U-value:

Additional evaluation of the transient heat transmission coefficient of the component (WUFI® Thermal Transmission)



Evaluation from an energy point of view:

The transient U-value taking into account the influences of moisture, radiation, heat storage and latent heat can be compared with the steady-state values.

Here, only during drying in the first year higher U-values result compared with the steady-state values at design moisture content of 80 % RH (u_{80}).

Literature

[1] Verband Dämmstoffe aus nachwachsenden Rohstoffen e.V. vdnr. Website: https://www.vdnr.net

[2] DIN 68800-2: Holzschutz – Teil 2: Vorbeugende bauliche Maßnahmen im Hochbau. Beuth Verlag, February 2022.

[3] WTA-Merkblatt 6-8: Feuchtetechnische Bewertung von Holzbauteilen – Vereinfachte Nachweise und Simulationen. August 2016.

[4] DIN EN 1995-1-1: Design of timber structures. Part 1-1: General – Common rules and rules for buildings. Beuth Verlag, December 2010.

[5] WTA-Guideline 6-2/E: Simulation of heat and moisture transfer. December 2014.

[6] Österreichische Arbeitsgemeinschaft Fensterbank: Richtlinie Fensterbank für deren Einbau in WDVS- und Putzfassaden, in vorgehängten Fassaden sowie für Innenfensterbänke - 4. Auflage 03-2020.

[7] DIN 4108-3: Klimabedingter Feuchteschutz, Anforderungen, Berechnungsverfahren und Hinweise für Planung und Ausführung. Beuth Verlag, October 2018.

[8] Research Report: Energieoptimiertes Bauen: Klima- und Oberflächenübergangsbedingungen für die hygrothermische Bauteilsimulation. IBP-Bericht HTB-021/2016. Durchgeführt im Auftrag vom Projektträger Jülich (PTJ UMW). July 2016.

[9] DIN EN 15026: Hygrothermal performance of building components and building elements – Assessment of moisture transfer by numerical simulation. Beuth Verlag, July 2007.