
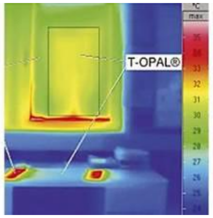


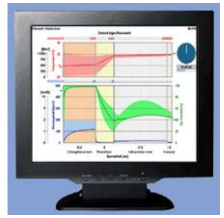
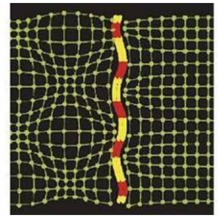


WUFI® Guideline

Assessing the risk of interstitial condensation runoff

Date: February 2026

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Contents

Introduction

Condensation in building components can develop **in vapor-permeable materials** (air, fiber insulation) **adjacent to water- and vapor-tight materials** (e.g., roofing membrane, vapor barriers, etc.).

If the amount exceeds a certain level, the condensation water can run off and cause problems in other areas of the building components – this must be avoided!

This guideline presents the **condensation water retention capacity (RC)** as a practical limit value (NaVe [1]) and describes how to assess the risk of condensation water runoff using hygrothermal simulation.

The assessing method recommended **until 2023** for hydrophobic mineral fiber insulation materials has been **replaced** by new findings and **extended** to other fiber insulation materials. In sorptive wood and cellulose fiber insulation materials, however, condensation conditions are rarely reached at the boundary layer.

Important: Since condensation is usually neither the first nor the only evaluation criterion, the other criteria should normally be checked first! These are described in guideline "Evaluation and Assessment of Hygrothermal Calculation Results“ in the recommended order as well as in the program's help text.

Different assessments by Glaser and WUFI®

In the **Glaser method**, condensation assessment is the crucial criteria, as this method does **not** take **moisture storage** into account.

The methods are described in DIN 4108-3 [2] and DIN EN ISO 13788 [3].

A construction is deemed acceptable if:

1. either no condensation occurs or
2. the amount of condensation remains below the specified limits and can dry out completely over the course of a year.

Moisture that accumulates in the construction is defined by Glaser as condensation – even if in reality there is no liquid water at this point because it is absorbed by the adjacent materials. For this reason, the limits for condensation in the Glaser method are sometimes set relatively high.

WUFI® explicitly takes moisture storage into account; the calculated amounts of condensation are therefore close to those actually expected in the building component, and the limit values are correspondingly lower.

Reference limit values of condensate amount in standards

DIN EN ISO 13788: 2012 (steady state calculation)	
Maximum condensate amount in order to prevent a runoff of liquid water from watertight surfaces	< 200 g/m²
DIN 4108-3: 2024 (steady state calculation)	
Maximum condensate amount per area (general)	< 1000 g/m²
At layer interfaces with a non-capillary absorbent layer	< 500 g/m²
BSI 5250: 2011 (general)	
A fine mist which does not run or drip	< 30 g/m²
Above this limit, droplets form and begin to run down vertical surfaces	30 - 50 g/m²
Above this limit, large drops form and begin to run down sloping surfaces	51 - 250 g/m² 70 g/m² will run down a 45° slope 150 g/m² will run down a 23° slope
Avoidance of large drops that can drip from horizontal surfaces	≤ 250 g/m²

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Condensation assessment with WUFI®

In the NaVe project [1], a measurement method was developed to determine the effective **condensation water retention capacity** in insulation at different boundary layers. Together with earlier studies [4], the influencing factors of **inclination**, **surface type**, and **moisture storage capacity of the fiber insulation material** can be considered.

On this basis, the risk of condensation calculated with WUFI® on the surface or at the interface between the insulation material and adjacent material can be evaluated.

The measured acceptable water content at the interface represents a mixture of water adsorbed in the insulation material, retained by the fiber structure and adhering to the surface of the vapour barrier or roofing membrane.

If the acceptable water content is exceeded, the condensation begins to run off.

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Limit values for assessing the risk of condensation runoff – overview

Level 1 contains **simple** and quickly verifiable **basic limit values**. If condensation runoff can already be excluded at this stage, the proof has been provided.

Otherwise, the limit values can be **refined** and **increased** if necessary**.** If even the highest limit value (Level 4) is exceeded, proof is not possible and the design must be modified accordingly.

Step-by-step increase of the limit values:

Level 1	RC_{min}						
⇩							
Level 2	RC_{min}	+	Slope surcharge				
⇩							
Level 3	RC_{min}	+	Slope surcharge	+	Surface surcharge		
⇩							
Level 4	RC_{min}	+	Slope surcharge	+	Surface surcharge	+	Material surcharge

RC_{min} : minimum retention capacity

- **50 g/m²** for water and vapor tight surfaces **without** adjacent insulation material
- **100 g/m²** for water and vapor tight surfaces **with** adjacent insulation material

Slope surcharge

RC_0 + Slope surcharge + Surface surcharge + Material surcharge

Slope-dependent surcharge:

Slope (α)	Slope surcharge
0° < α ≤ 5°	250 g/m²
5° < α ≤ 10°	200 g/m²
10° < α ≤ 15°	50 g/m²
15° < α ≤ 90°	0 g/m²

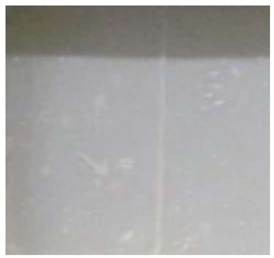
These values were derived from the measurements in [4].

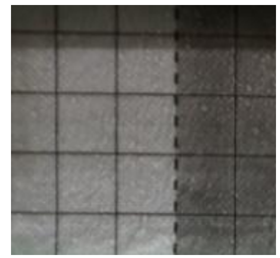
Additional information: In [4], the condensation water retention capacity was determined on a film laminated with spunbonded nonwoven fabric at various inclinations. The value of max. 100 g/m² measured at 90° corresponds to the minimum retention capacity determined in NaVe [1] for fiber insulation on a smooth, hydrophobic vertical surface – a film laminated with spunbonded fabric therefore behaves similarly to a film with adjacent fiber insulation.

Surface surcharge

RC_0 + Slope surcharge + Surface surcharge + Material surcharge

Surface-dependent surcharge:






Properties	Hydrophobic and smooth	Hydrophilic	Hydrophobic, fine structured	Hydrophobic, coarse texture
Example material	PE film	Metal plate	Film laminated with fleece	Film reinforced with fabric
Surface dependent surcharge [g/m²]	0	50	50	100

Note: **No** surface surcharge is applied if the surface properties are **unknown**!

Material surcharge

RC$_0$ + Slope surcharge + Surface surcharge + **Material surcharge**

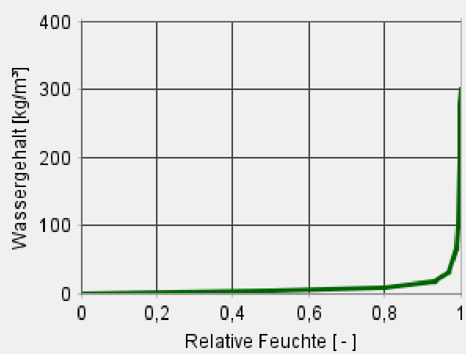
Material surcharge for sorptive insulation materials:

Material surcharge [g/m²]
= 20 [m·g/kg] * **u_{80}** [kg/m³]
(u_{80} : sorption moisture at 80% relative humidity)

X

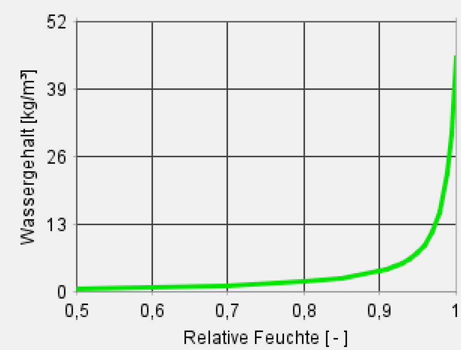
For measured moisture storage functions (dark green curve, black values), u_{80} can be taken from the table in the data set.

Nr.	R.F. [-]	Wassergehalt [kg/m³]
1	0	0
2	0,5	4
3	0,65	5
4	0,8	9
5	0,93	17,5
6	0,97	30
7	0,99	65,53
8	0,995	98,8
9	0,999	193,29
10	0,9995	228,16
11	0,9999	276,38
12	1	300



If an internal moisture storage function (light green curve/values) is used, no material-specific surcharge can be applied.

Nr.	R.F. [-]	Wasserge... [kg/m³]
1	0	0
2	0,5	0,461
3	0,6	0,687
4	0,7	1,06
5	0,8	1,79
6	0,85	2,49
7	0,9	3,83
8	0,91	4,26
9	0,92	4,78
10	0,93	5,43
11	0,94	6,27
12	0,95	7,38
13	0,96	8,94
14	0,97	11,3



Additional information for hydrophilic mineral fiber insulations

Non-hydrophobic mineral fiber insulation materials can retain **more condensation** than hydrophobic ones.

For such products, the condensation water retention capacities can be measured **on a product-specific basis** and used instead of the standard values!

Glasswool

Example: product-specific condensation water retention capacity in the material information in the WUFI database

Manufacturer's notes:
High performance glasswool, type "Natura" with vegetable binder without formaldehyde

Measured product-specific dew water retention capacity:
For the evaluation of the dew water runoff risk, the following limit values can be used.:
- 22 kg/m^3 on unknown or hydrophobic smooth surfaces (e.g., PE film)
- 27 kg/m^3 on hydrophilic smooth or finely structured surfaces (e.g., non-woven laminated film)
- 32 kg/m^3 on hydrophilic, coarse structured surfaces (e.g., fabric-reinforced film)

Measured limit values are currently available for following products (02/2026):

ISOVER ISOCONFORT 032, ISOVER SWISSROLL 030, ISOVER UNIROLL 034

Proceeding in WUFI® - Determination of condensation water amount

For evaluation purposes, the condensation amount at the boundary layer must be determined.

- In **fiber insulation**, condensation can spread somewhat within the fiber structure – accordingly, a **10 mm** thick area is evaluated in this case.
- In **air layers**, condensation occurs directly at the interface – here, a **1 mm** thick area is evaluated.

Position of condensation	Evaluation area (thickness)	Minimum limit value RC_{min}
in fiber insulation	10 mm	100 g/m²
in an air layer	1 mm	50 g/m²

Proceeding in WUFI® - Condensation in air layers

Modeling air layers

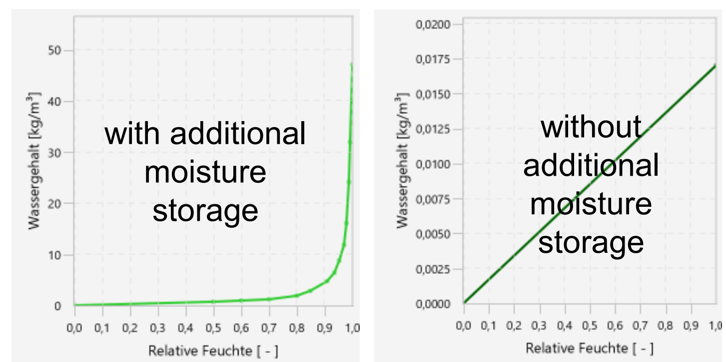
When condensation forms in air layers adjacent to vapor-tight layers (such as waterproofing membranes or metal), it remains directly on the surface and is evaluated in WUFI in a separate, 1 mm thick layer.

Normally, air layers are used "without additional moisture storage". This, however, often causes numerical problems in case of condensation, due to their extremely low moisture storage capacity. Therefore, material data with internal moisture storage function (light green) is used for the **1 mm thick boundary areas,** where condensation can occur.

The WUFI® database contains air layers **<u>with</u>** (left) and **<u>without</u> additional moisture storage** (right).

The artificially increased moisture storage capacity of these air layers enables the determination of the amount of condensation that occurs as liquid water (= condensation) in real air layers.

Moisture storage function



Proceeding in WUFI® - Condensation in air layers

Modeling air layers

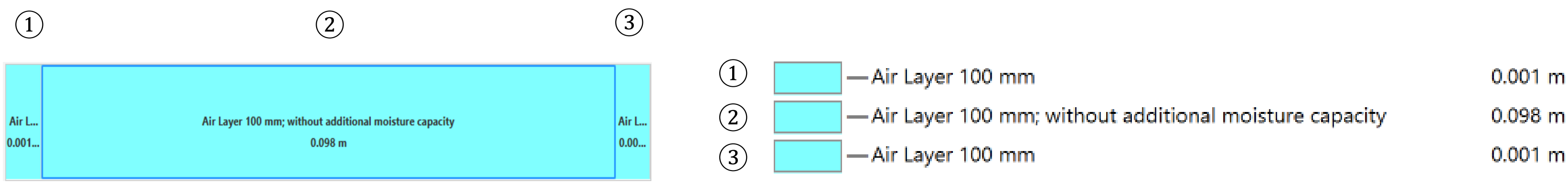
The procedure for a 100 mm thick air layer adjacent to vapor barrier layers where condensation could occur is illustrated here **using 1 mm thick boundary layers.**

Middle layer ②:

"Air layer 100 mm; without additional moisture storage," thickness 98 mm

Boundary layers ① and ③:

"Air layer 100 mm," thickness 1 mm

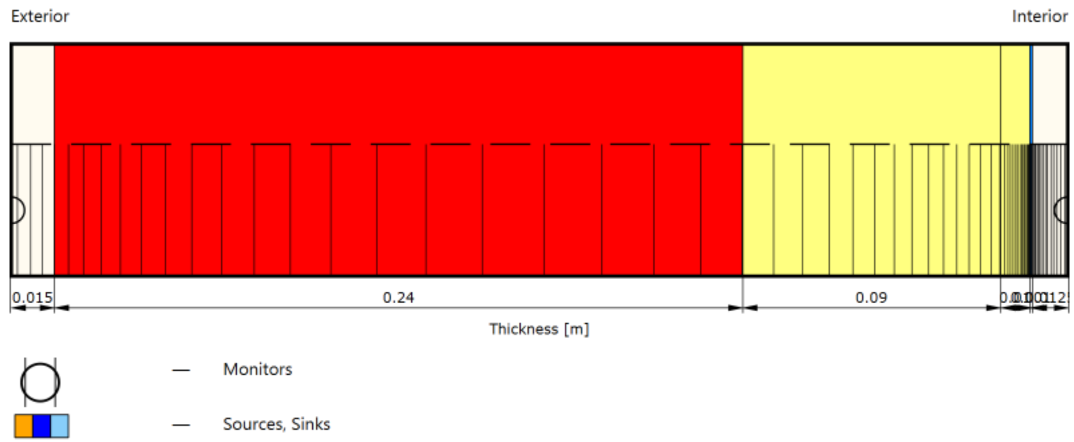


Important: **All three** air layers must be assigned with material data corresponding to the **thickness** of the actual air layer (not the layer thickness modeled in WUFI®).

Proceeding in WUFI® - Example 1: Exterior wall

This example shows a simulation of an internally insulated exterior wall.
The risk of condensation runoff in the mineral fibre insulation after the change of use of the building to a cooling warehouse is assessed.

Construction



Material Data

*Cement Lime Plaster (stucco, A-value: 0.5 kg/m2h0.5)	0.015 m
Solid Brick Masonry	0.24 m
*Mineralwool (0,035 W/mK)	0.09 m
*Mineralwool (0,035 W/mK)	0.01 m
*vapour reterder (sd=2m)	0.001 m
Gypsum Board	0.0125 m

Proceeding in WUFI® - Example 1: Exterior wall

Boundary conditions

Location:	Holzkirchen
Orientation:	North (without rain load)
Shortwave absorptivity α:	0.6 (medium hue)
Longwave emissivity ε:	Not taken into account (usually not relevant for walls)
Simulation takes rain into account:	Yes
Indoor climate:	Constant 7 °C and 70 % RH (cold storage room)
Initial condition:	Equilibrium humidity 80 % RH
Start of calculation:	1st of October

Proceeding in WUFI® - Example 1: Exterior wall

Condensation in fiber insulation material

1. Identification of the critical area

   - **Identification** of positions with relative humidity close to 100% RH in the **WUFI® film.** Below ~99% RH, critical condensation is unlikely.

2. Determination of the amount of condensation

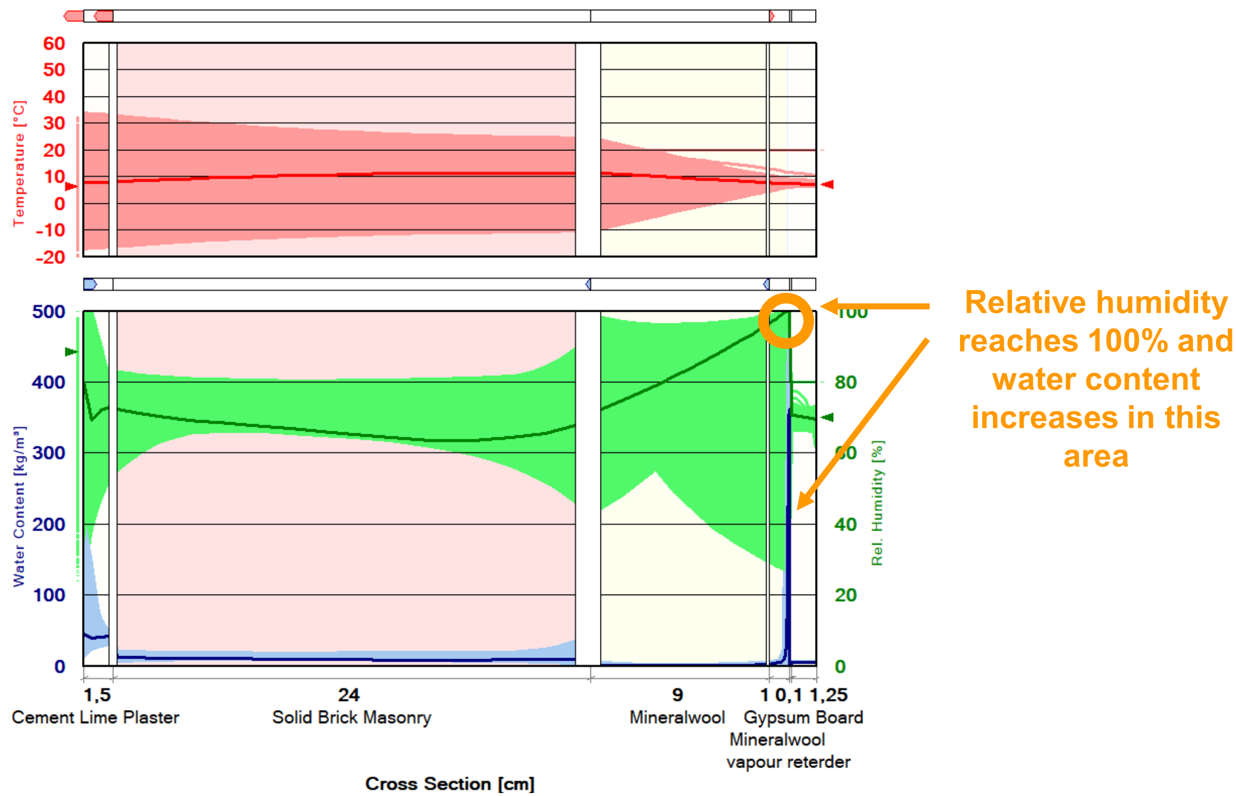
   - Plot the water content in the **critical 10 mm** in **WUFI® Graph**.
   - Alternative: Separate the critical 10 mm area before the simulation.
     The water content of this layer is then shown directly in the navigation tree under "Results" → „Water content in materials" and only needs to be converted to g/m².

3. Comparison with the limit values

   - If the water content remains below the minimum limit value **RC_{min} (100g/m²),** no condensation can generally run off.
   - If the minimum limit value RC_{min} is exceeded, the limit value can be increased with applicable surcharges (see slide 7).
   - If the limit value including all available surcharges is also exceeded, condensation cannot be ruled out, and the construction should be modified.

Proceeding in WUFI® - Example 1: Exterior wall

Evaluation WUFI ® Film – Checking of the critical position



Note: Before evaluating condensation, a "normal" evaluation of the construction should be carried out! See also: Handling typical constructions

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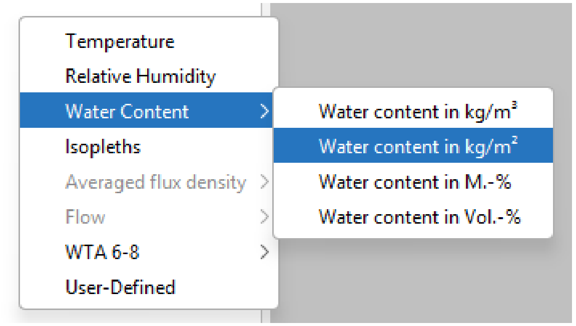
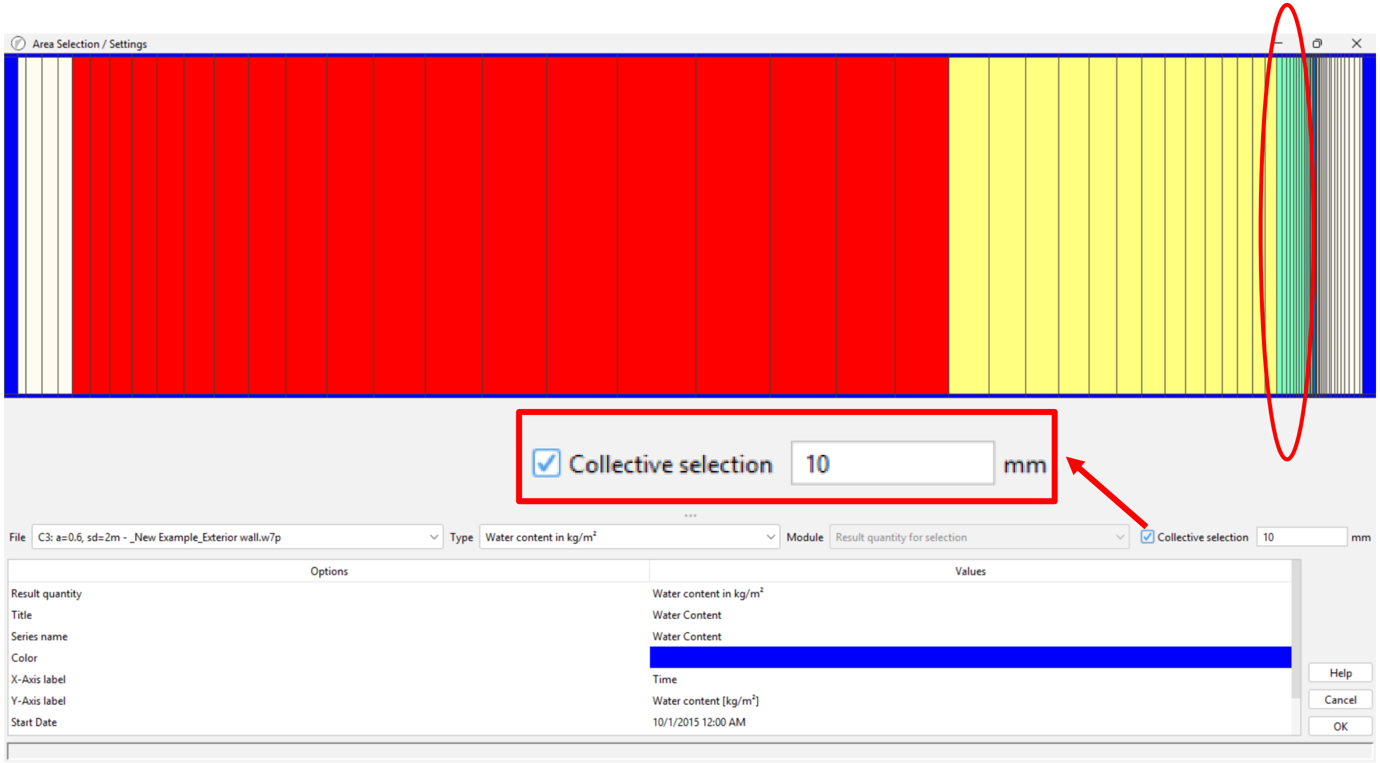
Proceeding in WUFI® - Example 1: Exterior wall

Evaluation in WUFI® Graph:

1. Select "Water content in kg/m²"
2. Select inner 10 mm of the insulation layer





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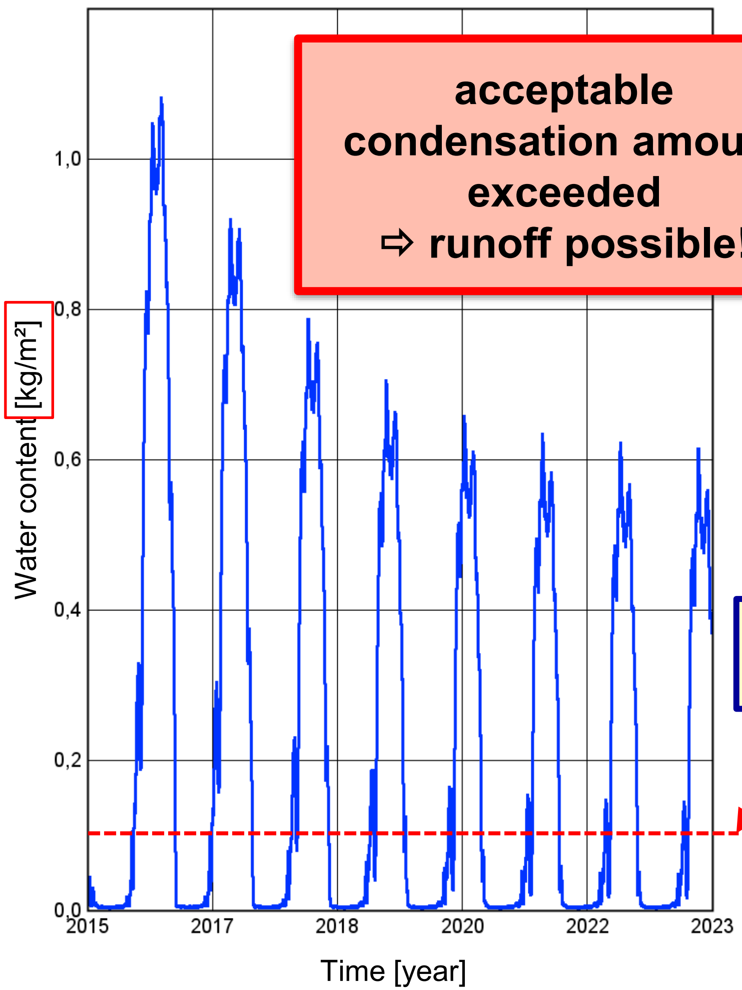
Proceeding in WUFI® - Example 1: Exterior wall

Water content in 10 mm [kg/m²]



Note the unit!
[kg/m²] = 1000 [g/m²]

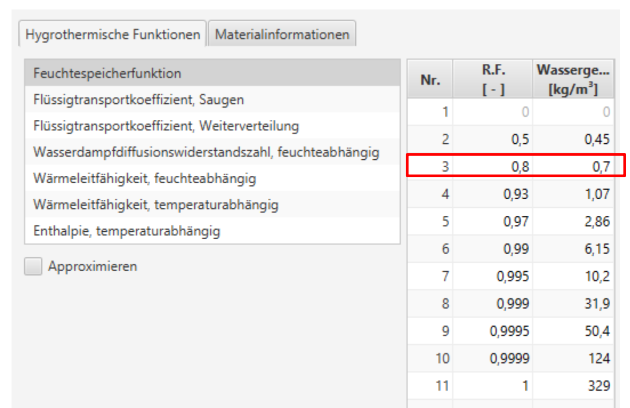
Limit value
114 g/m²
=
0.114 kg/m²

Limit value [g/m²]

RC_{min} + Slope surcharge + Surface surcharge + Material surcharge

Level	Part	Value [g/m²]	Total limit value [g/m²]
1	RC_{min}	100	100
2	Slope surcharge	0	100
3	Surface surcharge*	0	100
4	Material surcharge**	14	114

*: Vapor barrier unknown or PE film (smooth and hydrophobic)
**: Sorption moisture at 80 %RH is 0.7 kg/m³ (from moisture storage function) → Material surcharge: 20 x 0.7 = 14 g/m²



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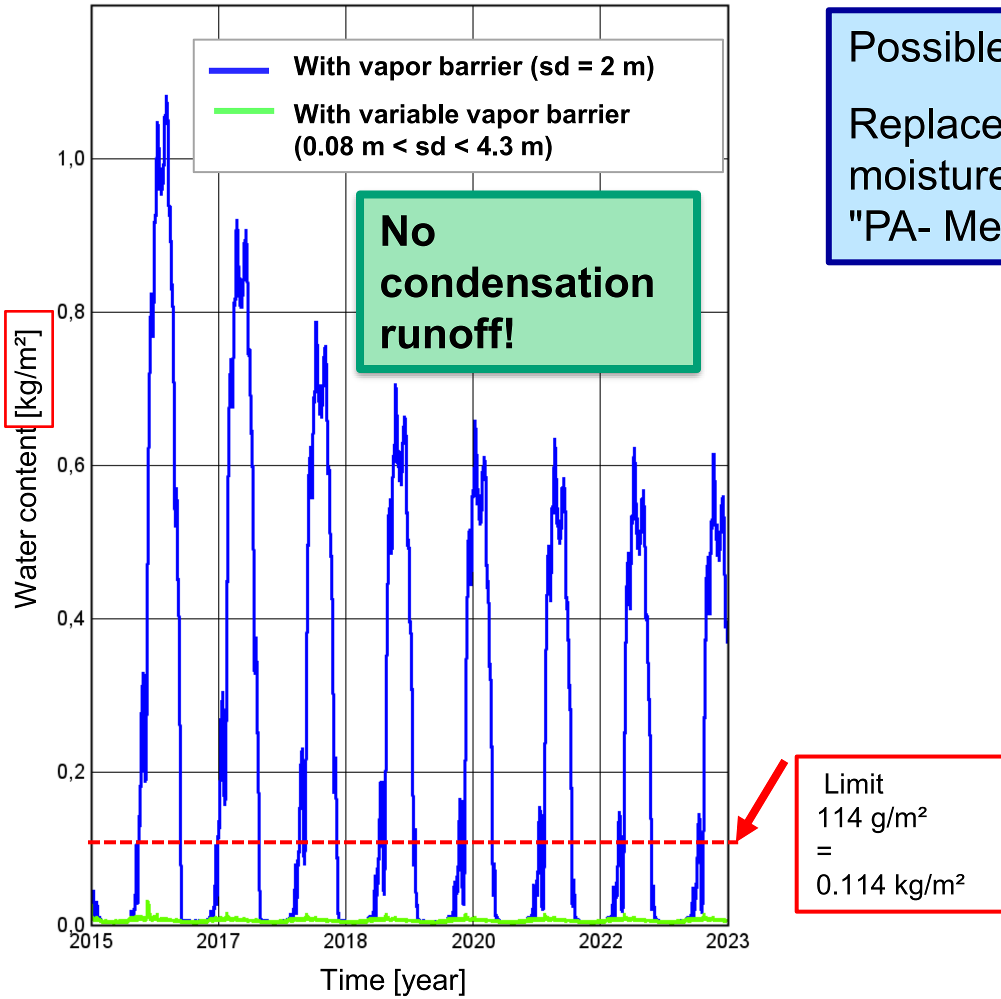
Proceeding in WUFI® - Example 1: Exterior wall



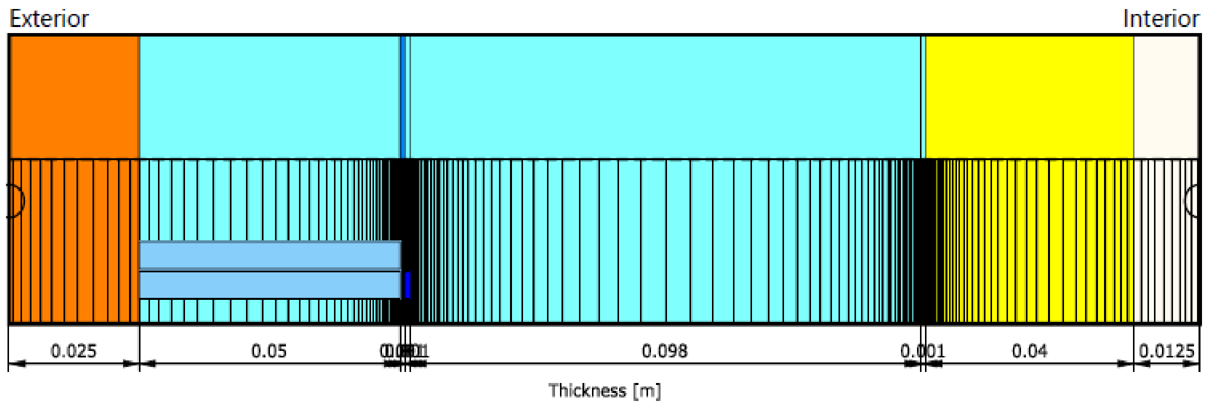
Possible improvement:

Replace the interior vapor retarder with a moisture-variable vapor retarder, e.g., "PA- Membrane" from the WUFI database.

Proceeding in WUFI® - Example 2: Flat roof

This example considers a flat roof construction that does not meet the „deemed to satisfy" requirements of DIN 4108-3 (2024) Chapter 5 [2] due to its insufficiently diffusion-open underlay membrane.
It is assessed whether condensation water can runoff from the underlay membrane.

Construction



Material Data

Material	Thickness
Softwood (formwork, thin layers)	0.025 m
Air Layer 50 mm	0.05 m
*PE-Membrane (sd = 5 m)	0.001 m
Air Layer 100 mm	0.001 m
Air Layer 100 mm; without additional moisture capacity	0.098 m
Air Layer 100 mm	0.001 m
*PU (0.03 W/mK)	0.04 m
Gypsum Board	0.0125 m

Proceeding in WUFI® - Example 2: Flat roof

Boundary conditions

Location:	Holzkirchen
Orientation:	North
Slope:	2°
Add. s_d-value of exterior surface:	250 m (replaces roofing membrane)
Shortwave radiation absorption α:	0.8 (dark color)
Longwave radiation emission ε:	0.9
Shading:	by „Rack-mounted PV modules (WTA 6-8)"
Simulation takes rain into account:	No (waterproof surface)
Indoor climate:	Design indoor climate according to DIN/EN/WTA
Initial condition:	Equilibrium humidity 80 % RH, 20 °C
Calculation start:	1st of October

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Proceeding in WUFI® - Example 2: Flat roof

Condensation in an air layer on a water- and vapour-tight surface

1. Modeling the air layer
   - Divide the air layer in which condensation can occur accordingly (see slide 14).
2. Determination of the condensation amount in the **critical 1 mm** thick air layer
   - Check the water content in this layer directly after the calculation under "Results" → „Water content in materials" in the navigation tree in WUFI® Pro. The value in kg/m³ corresponds directly to the value in g/m² for a thickness of 1 mm.
3. Comparison of the water content with the limit values
   - If the water content remains below the minimum limit value **RC_{min} (50 g/m²),** no condensation can generally run off.
   - If the minimum limit value RC_{min} is exceeded, the limit value can be increased with applicable surcharges (see slide 7).
   - If the limit value including all available surcharges is also exceeded, condensation cannot be ruled out and the construction should be modified.

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Infiltration moisture source

The German wood protection standard DIN 68800-2 [5] requires the consideration of an additional moisture souce due to air infiltration in all timber structures. Since hygrothermal simulation is a transient process, the IBP air infiltration model [6] is used with the following conditions:

- Height of the connected heated air space: 5 m
- Air tightness class: B (q_{50} = 3m³/m²h)
- Source area: in 1 mm air layer directly below the underlay membrane

Proceeding in WUFI® - Example 2: Flat roof

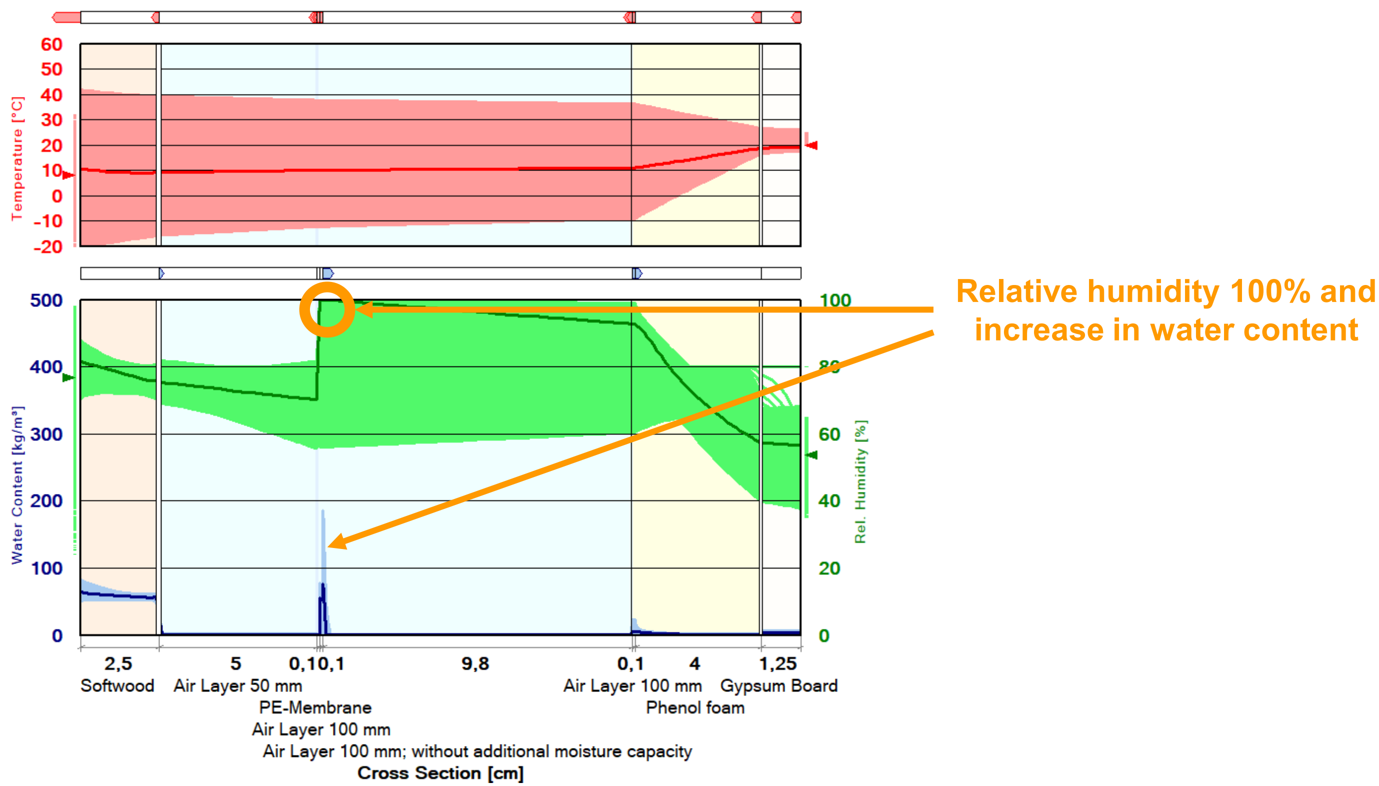
Ventilation in the upper 50 mm thick air layer

The ventilation of the upper area of the flat roof can be simplified by considering an air exchange source.

The following assumptions are made for this example:

- Air exchange rate (ACH): 0.5 [1/h] constant for a (weak) flat roof ventilation
- Source area: In the entire air layer under the roof sheathing

Evaluation WUFI ® Film – Checking of the critical position

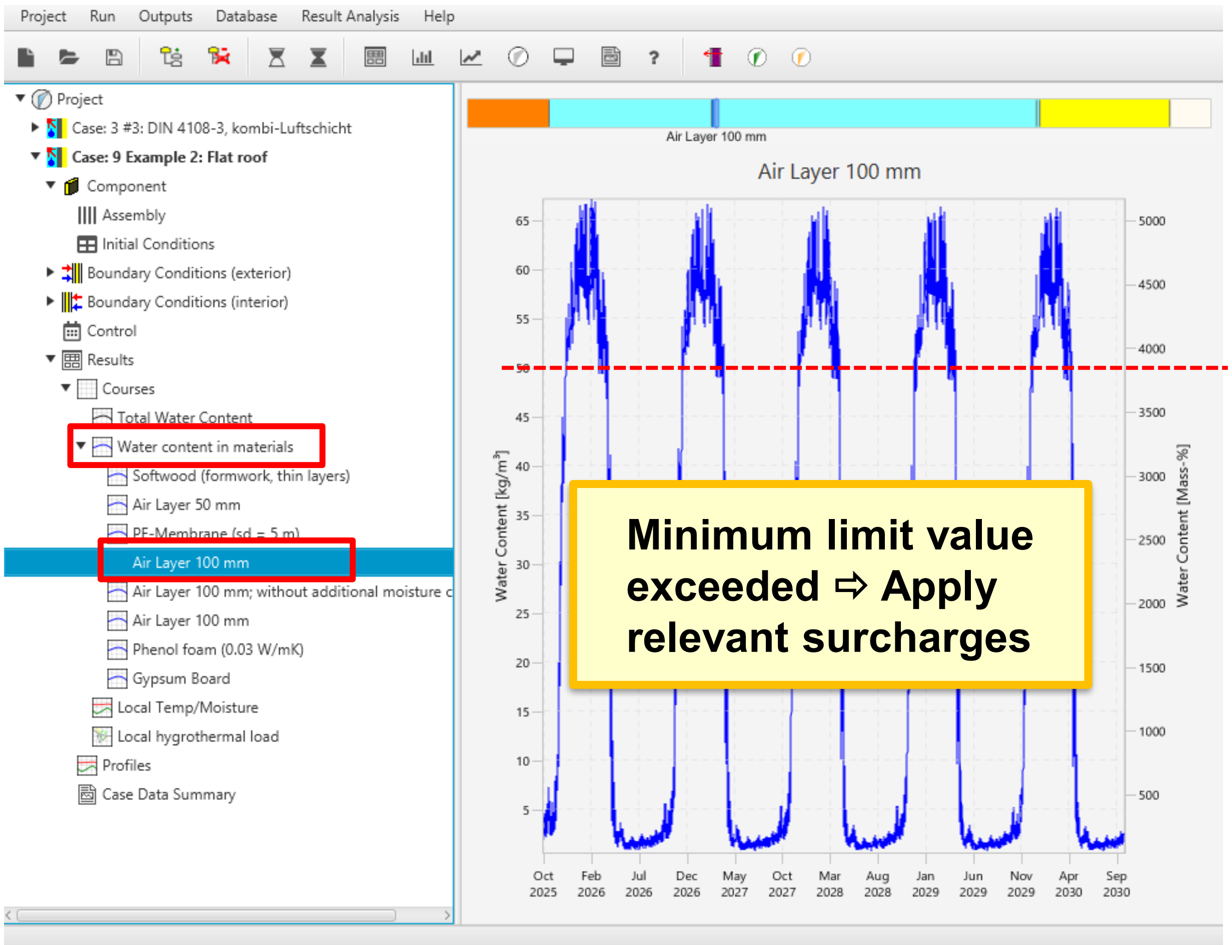


Note: Before evaluating condensation, the "normal" evaluation of the construction should be carried out! See also: Handling of typical constructions and Guideline for calculation of flat roofs

Proceeding in WUFI® - Example 2: Flat roof

Evaluation of water content in layer

Water content in the 1 mm air layer under the underlay (PE-Membrane) [kg/m³]



Minimum limit value exceeded ⇨ Apply relevant surcharges

Minimum limit values
= 50 [g/m²]

<u>Note the unit!</u>
Conversion of water content from [kg/m³] to [g/m²] for a 1 mm thick layer:

1 [kg/m³] =
1000 [g/m³] * 0.001 [m] = 1 [g/m²]

The values in [kg/m³] can be directly compared with the limit values in [g/m²]!

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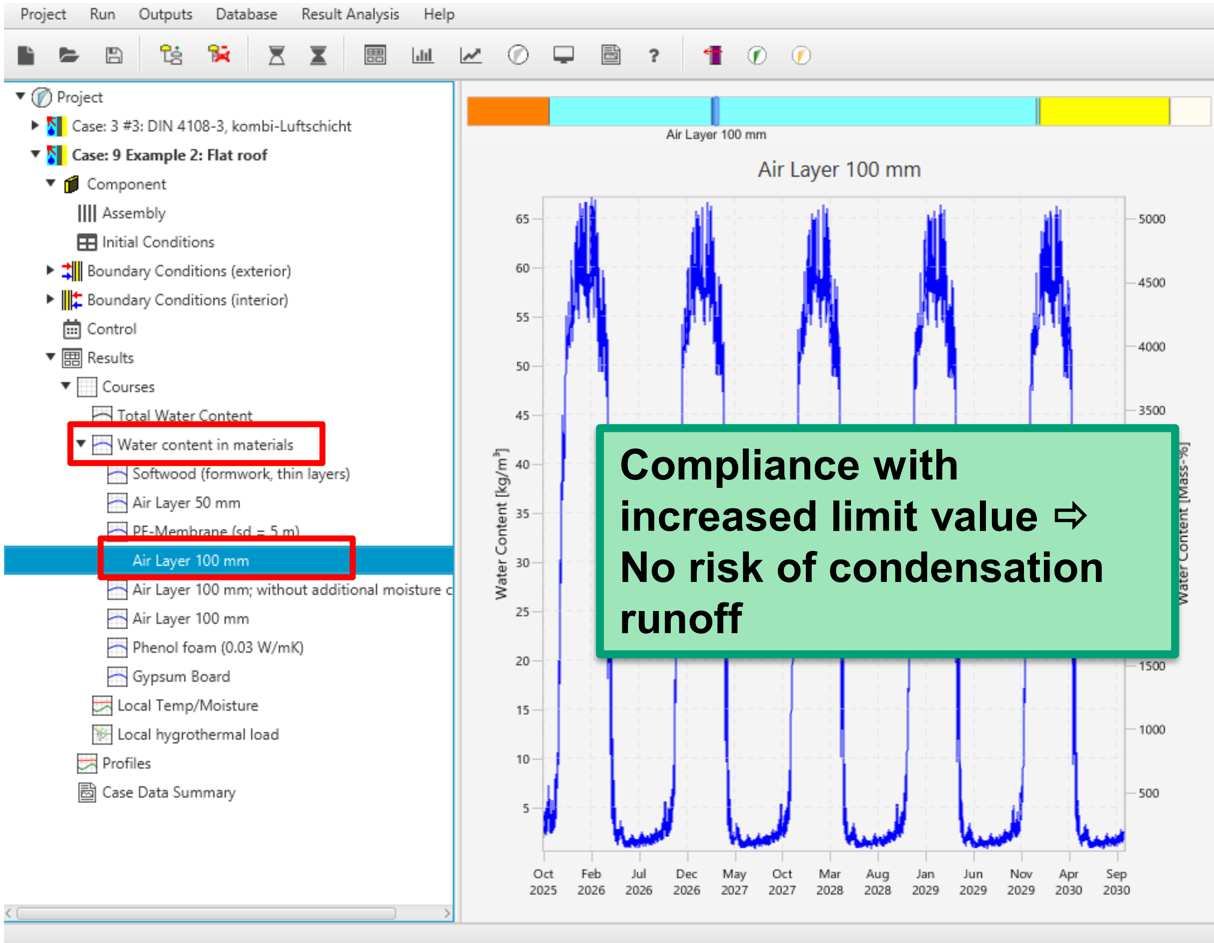
Proceeding in WUFI® - Example 2: Flat roof

Evaluation of water content in layer

Water content in the 1 mm air layer under the underlay (PE-Membrane) [kg/m³]



Compliance with increased limit value ⇨ No risk of condensation runoff

The maximum water content in the 1 mm air layer (approx. 66 g/m²) remains well below the limit value of 300 g/m² increased by the slope surcharge (+250 g/m² for 2° slope, see slide 9)

RC_{min} + Neigungszuschlag

Level	Part	Value [g/m²]	Total limit value [g/m²]
1	RC_{min}	50	50
2	Slope surcharge	250	300

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Literature

[1] Erarbeitung wissenschaftlich begründeter Bewertungskriterien und Implementierung eines Nachweisverfahrens für die schadenfreie energetische Bestandssanierung und Neubauplanung (NaVe). Research report EnOB: Energieoptimierte Gebäude und Quartiere - dezentrale und solare Energieversorgung Auftrag des Bundesministeriums fur Wirtschaft und Energie (BMWi), Forderkennzeichen:03ET1649 A/B, 2023. Link

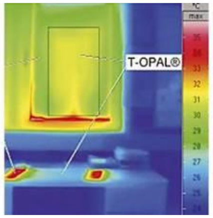
[2] DIN 4108-3: Thermal protection and energy economy in buildings – Part 3: Protection against moisture subject to climate conditions – requirements and directions for design and construction. Beuth Verlag, March 2024.

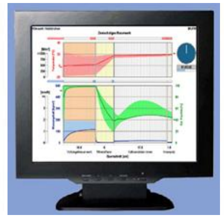
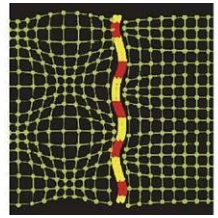
[3] EN ISO 13788: Hygrothermal performance of building components and building elements - Internal surface temperature to avoid critical surface humidity and interstitial condensation - Calculation methods. Beuth Verlag, Mai 2013.

[4] Janssens, A.: Reliable control of interstitial condensation in lightweight roof systems. Dissertation, Heverlee 1998. ISBN 90-5682-148-2. Link

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

[6] Zirkelbach, D.; Künzel, H.M.; Schafaczek, B. and Borsch-Laaks, R.: Dampfkonvektion wird berechenbar – Instationäres Modell zur Berücksichtigung von konvektivem Feuchteeintrag bei der Simulation von Leichtbaukonstruktionen. Proceedings 30. AIVC Conference, Berlin 2009. Link


WUFI® Guideline

Assessing the risk of interstitial condensation runoff

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