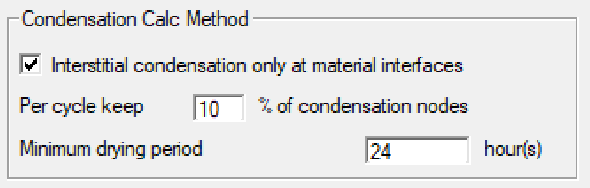
CONDENSATION MODULE SETTINGS
IN TRISCO

Introduction

The Condensation module in TRISCO introduces three new calculation parameters. Understanding these parameters is essential for achieving accurate results while optimizing computation time. A detailed discussion of the simulation methodology of Condensation module and the origin of these parameters can be found in the article and video of S3 on the Knowledge base.

The aim of the present document is to give the user general guidelines for these settings.



Condensation Calc Method

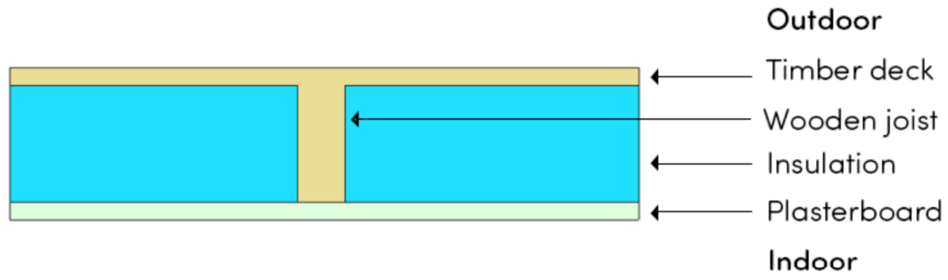
☑ Interstitial condensation only at material interfaces

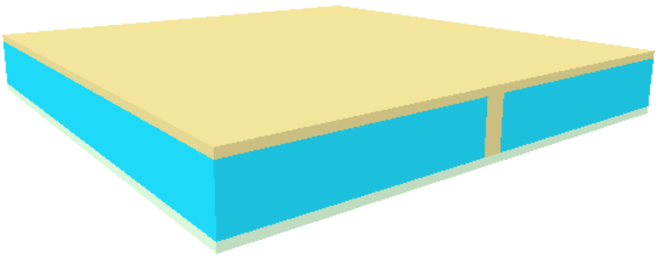
Per cycle keep 10 % of condensation nodes

Minimum drying period 24 hour(s)

Figure 1. Parameters in Condensation Calculation Method

To illustrate the impact of these parameters, we consider a roof structure modelled in TRISCO, as shown in Figure 2.



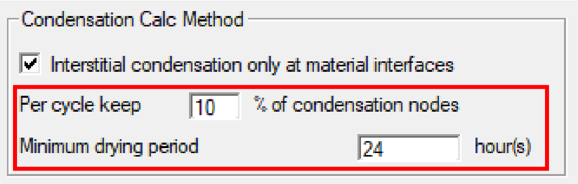


Colour	Material	Thermal Conductivity λ (W/mK)	Vapour resistance factor μ (-)
15	Timber	0.13	50
133	Insulation	0.03	1.5
161	Plasterboard	0.25	10

Figure 2. Flat roof construction

1. Interstitial condensation only at material interfaces.

With the first parameter enabled condensation is forced to take place at material interfaces only (interface between different block colours), which complies with EN ISO 13788.
To study this parameter the simulation is limited to a 1-month period, with boundary conditions set as follows: outdoor conditions at -5°C and 70% RH, and indoor conditions at 20°C and 80% RH. Throughout all simulations in this parameter study, the following settings are kept constant: each cycle keeps **10%** of condensation nodes, and the minimum drying period is fixed at **1 day.**



Condensation Calc Method

☑ Interstitial condensation only at material interfaces

Per cycle keep 10 % of condensation nodes

Minimum drying period 24 hour(s)

Figure 3. Second and Third parameters are kept constant

We will analyze three cases for the first parameter:

a. A single block of insulation
b. Multiple blocks of insulation with same μ-value 1.5.
c. Multiple blocks of insulation with different μ-value 1.5 and 1.2.

a. A single block of insulation.

Roof_single_insulation_1month.trc

The results show that:

- When the parameter is **unticked**: minor condensation and evaporation occur within the insulation layer.
- When the parameter is **ticked**: TRISCO balances these effects and only presents the final results at the material interfaces.

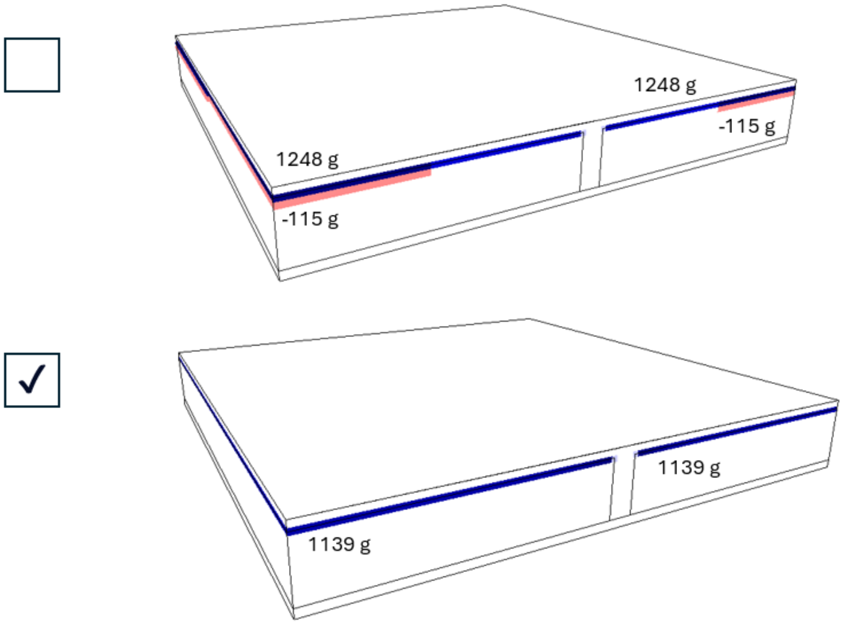
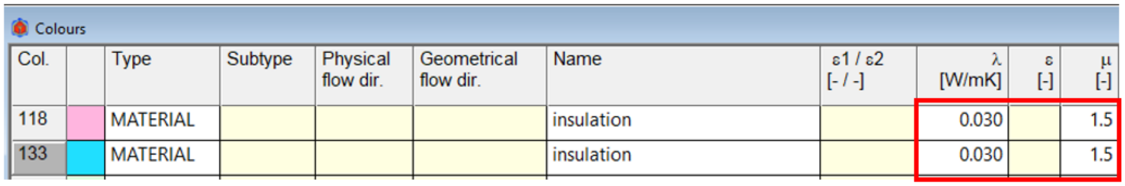


Figure 4. Case (a) result

b. Multiple blocks of insulation with same μ-value 1.5.

Roof_multiple_insulation_case_b.trc

With the same model, the insulation has been divided into six smaller layers, each having the same μ-value of 1.5, as in Figure 5.



Colours

Col.		Type	Subtype	Physical flow dir.	Geometrical flow dir.	Name	ε1 / ε2 [- / -]	λ [W/mK]	ε [-]	μ [-]
118	🟪	MATERIAL				insulation		0.030		1.5
133	🟦	MATERIAL				insulation		0.030		1.5

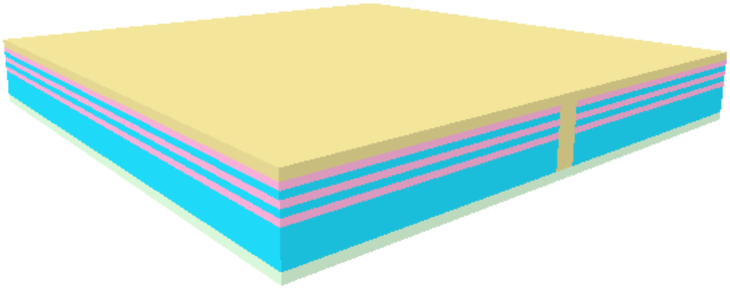


Figure 5. Case (b) setting

With multiple layers of insulation, a clear difference can be observed when the parameter is unticked, similar to case (a).

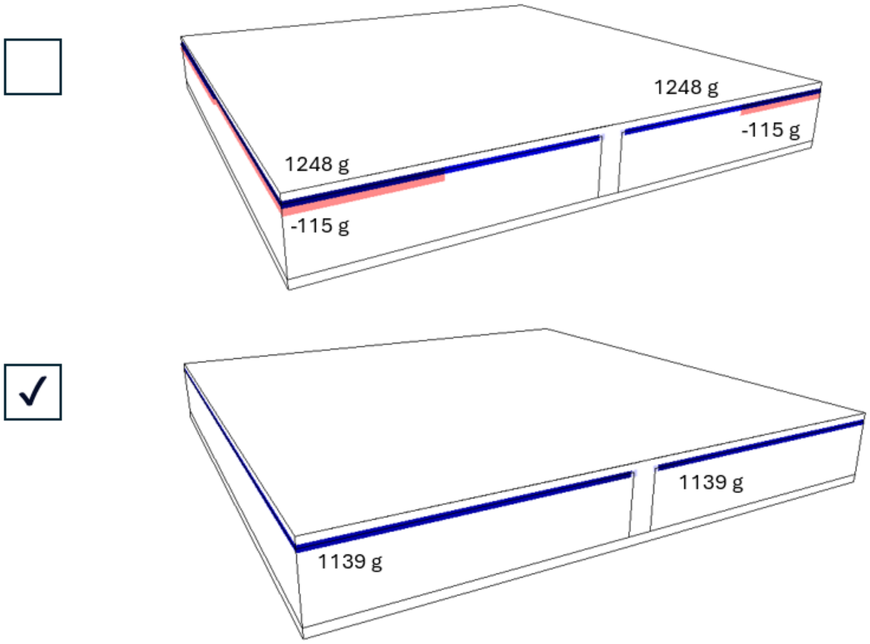
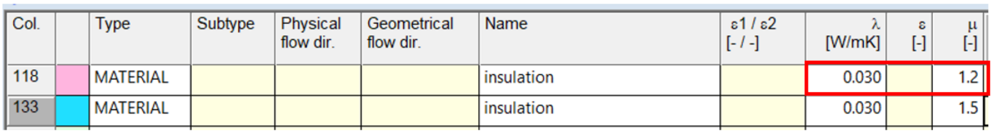


Figure 6. Case (b) result

c. Multiple blocks of insulation with different μ-value 1.5 and 1.2.

Roof_multiple_insulation_case_c.trc

Changing the μ-value of one insulation layer to 1.2, as in Figure 7, makes the result more pronounced due to increased permeability of the insulation.



Col.		Type	Subtype	Physical flow dir.	Geometrical flow dir.	Name	ε1 / ε2 [- / -]	λ [W/mK]	ε [-]	μ [-]
118	🟥	MATERIAL				insulation		0.030		1.2
133	🟦	MATERIAL				insulation		0.030		1.5

Figure 7. Case (c) setting

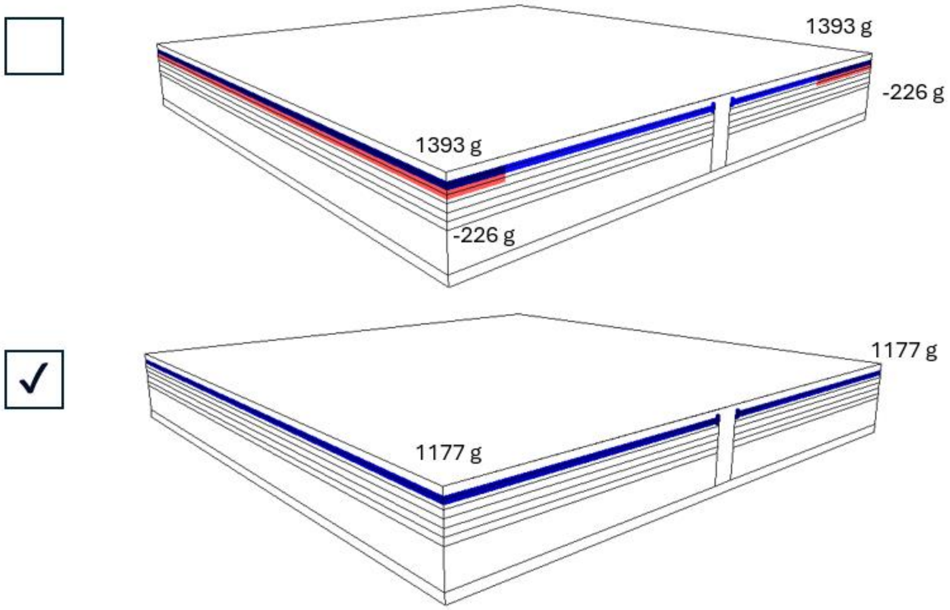


Figure 8. Case (c) result

As in Figure 9, unticking the parameter leads to more fluctuations, with condensation and evaporation occurring within the material. However, when the function is ticked, these effects are balanced, resulting in only condensation. The overall net condensation remains identical in all cases, indicating that this function does not have a significant impact on the final result.

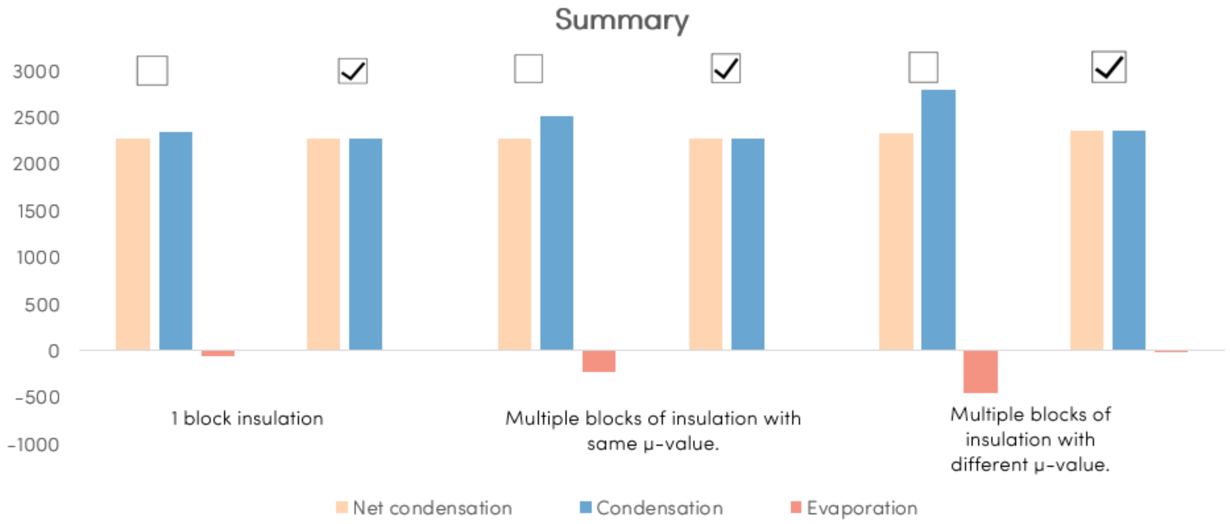
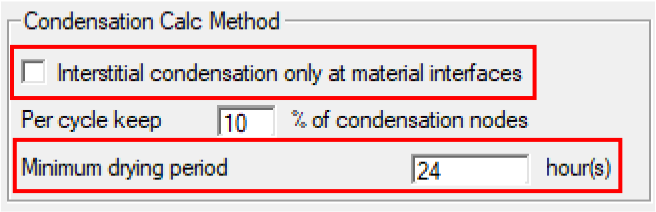


Figure 9. Summary of the first parameter test

2. Per cycle keep … % of condensation nodes.

[Roof_single_insulation_1month.trc]

The second parameter impacts the iteration method used to solve the coupled heat and vapour transport equations. The smaller this parameter is chosen, the more accurate the result (but also the longer the simulation time).
Similarly, the following settings are kept constant:



Condensation Calc Method

☐ Interstitial condensation only at material interfaces

Per cycle keep 10 % of condensation nodes

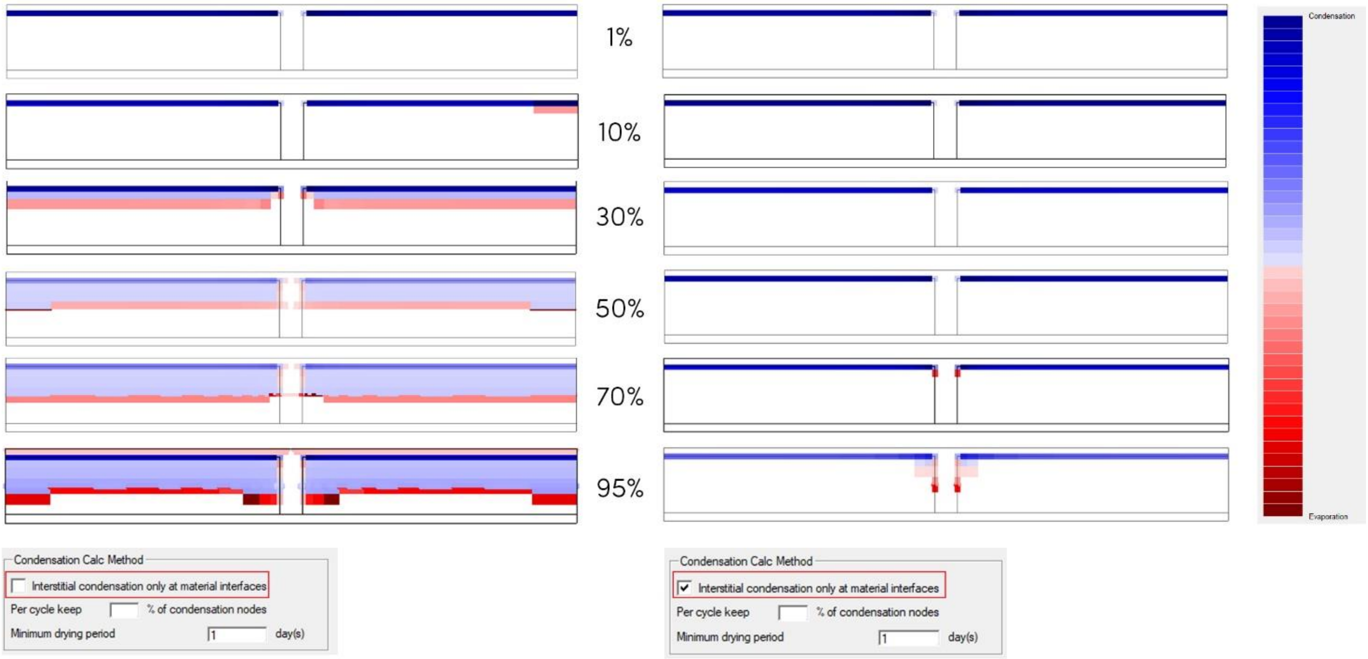
Minimum drying period 24 hour(s)

Figure 10. First and Third parameters are kept constant

A parameter study will be conducted with varying percentages of condensation nodes at 1%, 10%, 30%, 50%, 70%, and 95%.

As shown in Figure 11, from top to bottom, the results vary significantly with different percentages. A higher percentage of nodes results in increased condensation and evaporation within the material, leading to less accurate results.

From left to right, Figure 11 illustrates the effect of the **first parameter** (Interstitial condensation only at material interfaces). On the left, condensation and evaporation occur within the insulation, while on the right, they occur only at the material surface.



Condensation Calc Method

☐ Interstitial condensation only at material interfaces

Per cycle keep ☐ % of condensation nodes

Minimum drying period 1 day(s)

Condensation Calc Method

☑ Interstitial condensation only at material interfaces

Per cycle keep ☐ % of condensation nodes

Minimum drying period 1 day(s)

Figure 11. Results with different percentages and first parameter

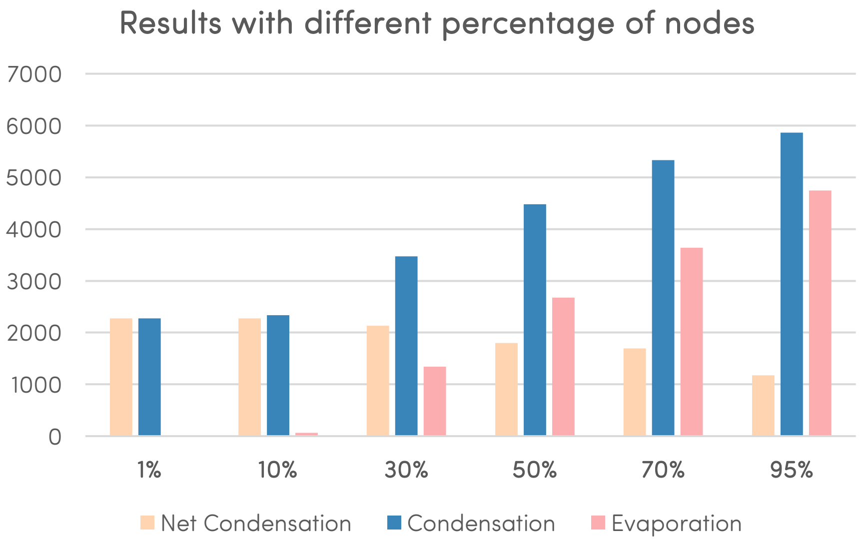


Figure 12. Summary of the second parameter test

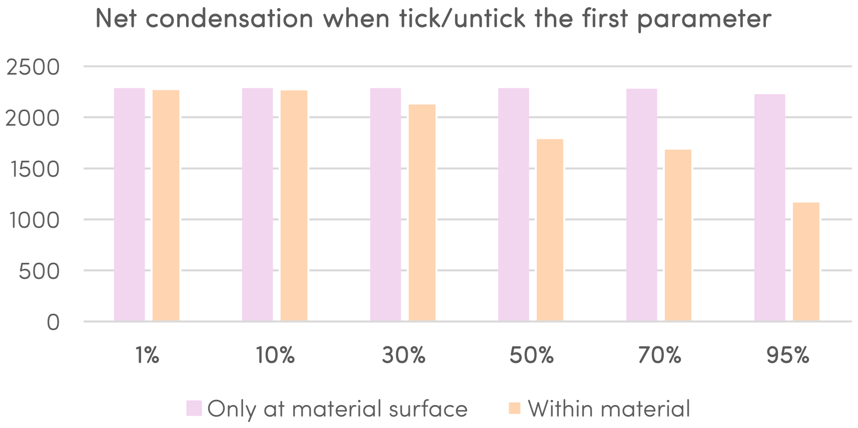


Figure 13. Summary of the first parameter test

As shown in the Figure 12 and Figure 13, a lower percentage of nodes provides more accurate results but requires longer simulation times. A 10% setting is recommended as a balanced choice, while 30% or 50% may be more appropriate for complex models.

3. Minimum drying period: … days.

D_HIGH_September.trc

This example is from Annex D, EN ISO 13788, and has already been performed in the A11 document in Knowledge base.
We consider a flat roof model with moisture introduced in the middle of the insulation layer. The insulation has been divided into different materials with the same thermal conductivity and vapour diffusion factor.

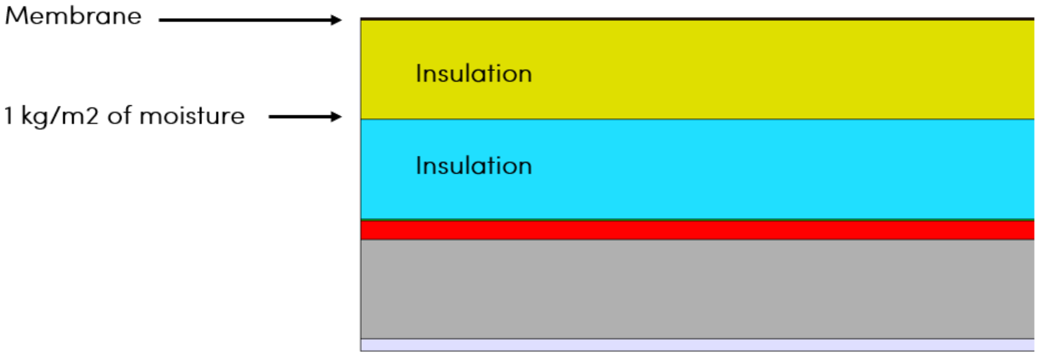
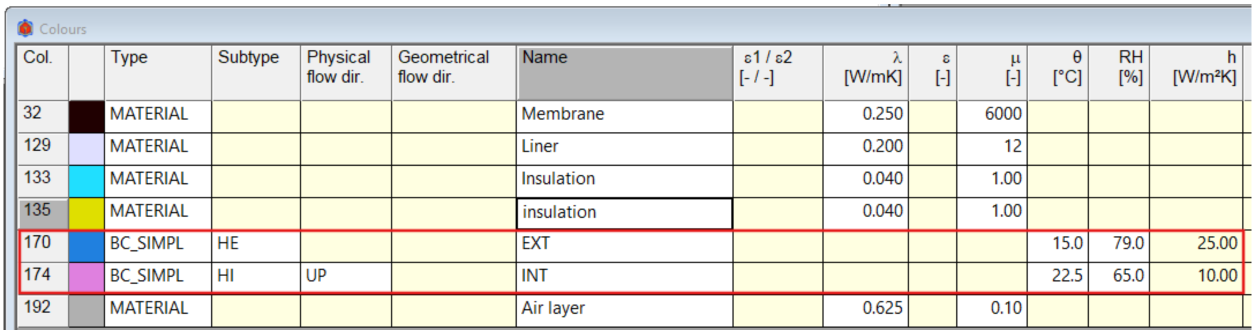


Figure 14. Flat roof model

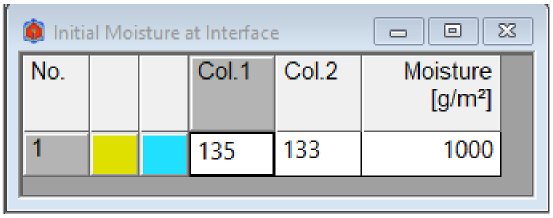
The properties of the materials, such as thermal conductivity and vapour diffusion factor, along with the boundary conditions in September, are specified as follows:



Col.		Type	Subtype	Physical flow dir.	Geometrical flow dir.	Name	ε1 / ε2 [- / -]	λ [W/mK]	ε [-]	μ [-]	θ [°C]	RH [%]	h [W/m²K]
32	🟫	MATERIAL				Membrane		0.250		6000			
129	⬜	MATERIAL				Liner		0.200		12			
133	🟦	MATERIAL				Insulation		0.040		1.00			
135	🟨	MATERIAL				insulation		0.040		1.00			
170	🟦	BC_SIMPL	HE			EXT					15.0	79.0	25.00
174	🟪	BC_SIMPL	HI	UP		INT					22.5	65.0	10.00
192	⬜	MATERIAL				Air layer		0.625		0.10			

Figure 15. Materials' properties

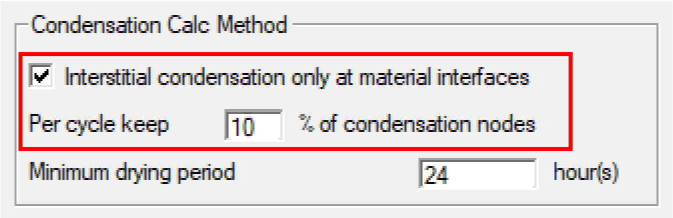
1 kg/m2 of moisture was introduced in the middle of the insulation layer.



No.			Col.1	Col.2	Moisture [g/m²]
1	🟨	🟦	135	133	1000

Figure 16. Initial Moisture

The other two parameters should be fixed as below.



Condensation Calc Method

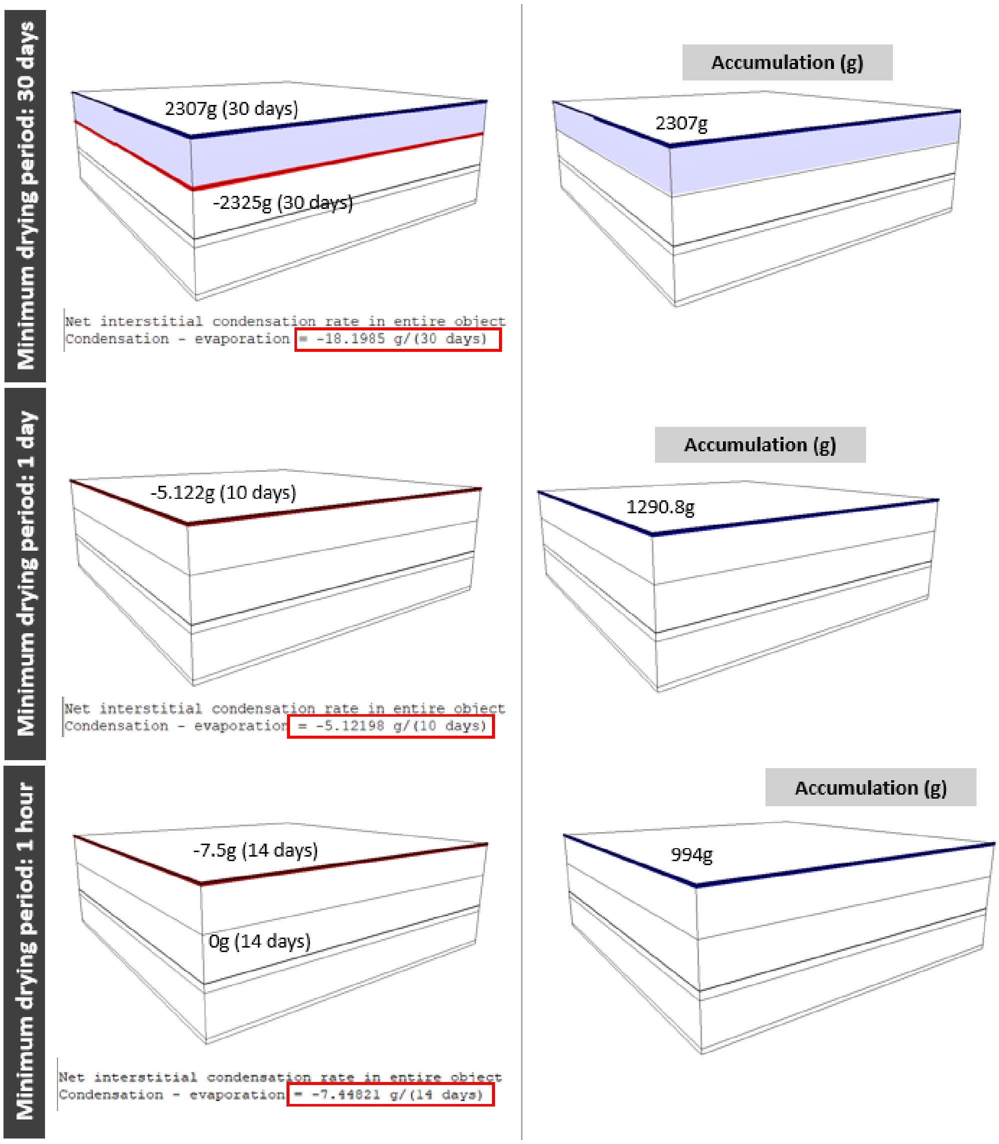
☑ Interstitial condensation only at material interfaces

Per cycle keep 10 % of condensation nodes

Minimum drying period 24 hour(s)

Figure 17. First and Second parameters are kept constant

The simulation will be run with minimum drying period set to **1 hour, 1 day and 30 days** in September and the results are reported in Figure 18.



```
Net interstitial condensation rate in entire object
Condensation - evaporation = -18.1985 g/(30 days)
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```
Net interstitial condensation rate in entire object
Condensation - evaporation = -5.12198 g/(10 days)
```

```
Net interstitial condensation rate in entire object
Condensation - evaporation = -7.44821 g/(14 days)
```

Figure 18. Results with different minimum drying period settings

To illustrate the importance of the Minimum drying rate we analyse here the results for 30 days. The vapour balance below the membrane is illustrated below. Given by the materials' properties (**λ, μ, d**), we can calculate the temperature and vapour pressure at the interfaces of each layer.

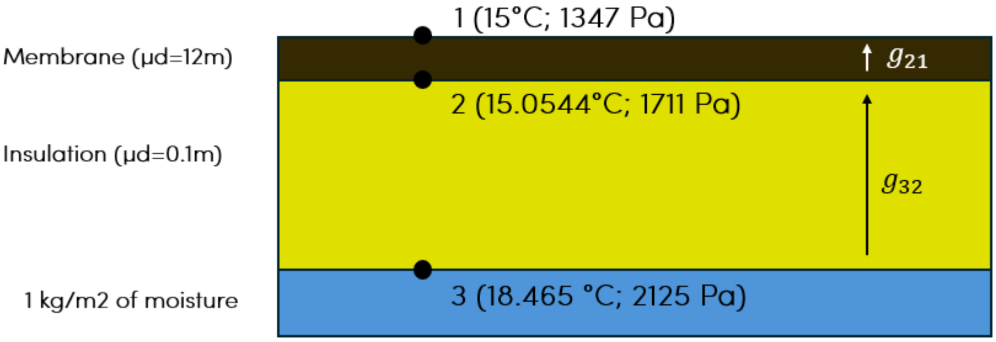

Figure 19. Illustration of vapour transport

The water vapour flow rate between these layers are calculated as per the given equation:

$$g = \frac{\delta_0}{\mu}\frac{\Delta p}{d} = \delta_0 \frac{\Delta p}{s_d}$$

where $\delta_0 = 2 \times 10^{-10}$ kg/(m·s·Pa).

$$g_{32} = \delta_0 \frac{2125 - 1711}{0.1}.3600.24.1000 = 71.5 \frac{\mathrm{g}}{\mathrm{m}^2.\mathrm{day}} = 2146 \frac{\mathrm{g}}{\mathrm{m}^2.30\ \mathrm{days}}$$

$$g_{21} = \delta_0 \frac{1711 - 1347}{12}.3600.24.1000 = 0.52 \frac{\mathrm{g}}{\mathrm{m}^2.\mathrm{day}} = 15.7 \frac{\mathrm{g}}{\mathrm{m}^2.30\ \mathrm{days}}$$

- **From point 3 to point 2**: With an evaporation rate of **71.5 g/(m^2·day)** and an initial moisture content of 1 kg/m^2, it is expected to take approximately 14 days for the moisture to pass through the insulation layer, assuming a minimum drying period of 1 day. However, since the software was forced to extend the minimum drying period to 30 days, it continued to calculate drying at the same rate even after the moisture was depleted. This resulted in an overestimated evaporation value of **2325 g** by the end of the month, which is inaccurate.
- **From point 2 to point 1**: Similarly, the evaporation rate was calculated as **15.7 g/(m^2·30 days)**, corresponding to approximately **18 g** of evaporation as shown in TRISCO.

With a Minimum drying rate of 1 day, still the same process (but less pronounced) will result in an overestimation of the condensation below the membrane. For the example of instance it is thus recommended to use a Minimum drying period of 1 hour.
It should be noted that this is a rather extreme example with an imposed moisture excess of 1 kg/m^2 within a vapour open material. Typically a Minimum drying period of 1 day will be sufficient.