Pro Clima Australia

An Australian Based Study on Airtightness and Moisture Management

PHIUSCON November 2023


QH
QANTAS
VH-OQH
AIRBUS A380

$28B

The cost of asthma to the Australian community in 2015

Powershift, Healthy and Comfortable Homes for All Australians, Background Paper, September 2018, Energy Consumers Australia

… and the insulation is perfect

The biggest component of the cost of asthma

$24.7B

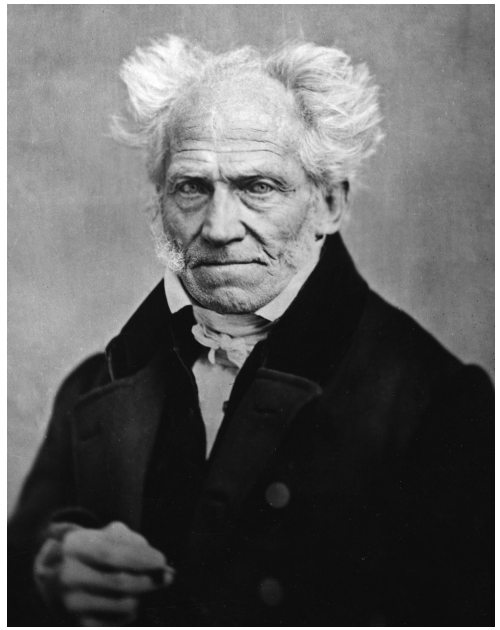
is the burden of disease, which includes the affect of disability and premature death

Deloitte Access Economics (DEA) 2015, The Hidden Cost of Asthma, report prepared for the Australia and National Asthma Council of Australia, November.

… and the insulation is perfect

pro clima Australian study

pro clima®



"Health is not everything, but without health, everything is nothing."

Arthur Schopenhauer (1788-1860)


An Australian Based Study On Airtightness and Moisture Management
Computer based simulation of the combined heat and moisture transport of wall assemblies; a roof construction review; and a field study of state-of-the-art construction practices in Australia
pro clima
AIRAH
DA07
CRITERIA FOR MOISTURE CONTROL DESIGN ANALYSIS IN BUILDINGS
pro clima
Australian study
pro clima


The Problem
The Science
Standards
WRB
Engineering
Roofing
Validation - Air tightness
Thermal Bridging
Construction Methods
An Australian Based Study On Airtightness and Moisture Management
Computer based simulation of the combined heat and moisture transport of wall assemblies; a roof construction review; and a field study of state-of-the-art construction practices in Australia
pro clima

AUTRALIA STUDY

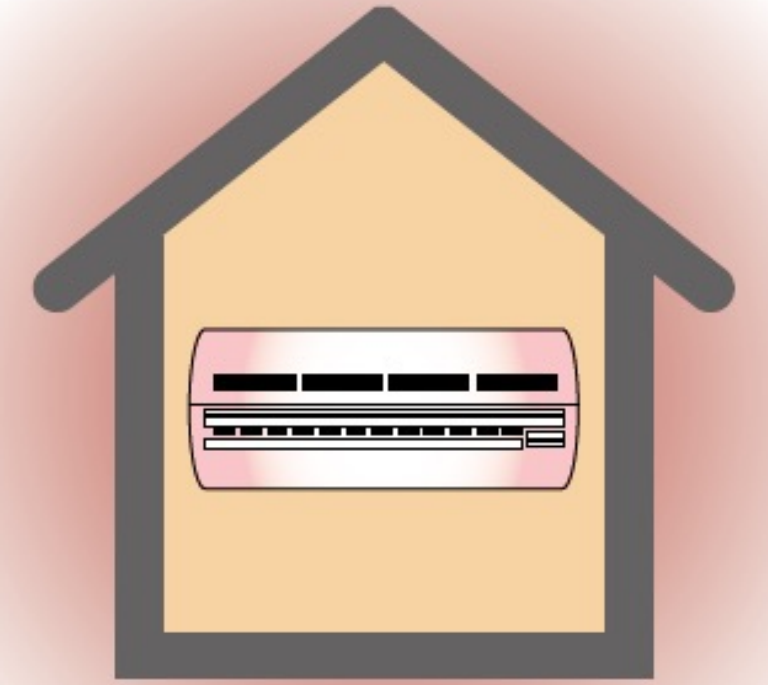
1

INTRODUCTION

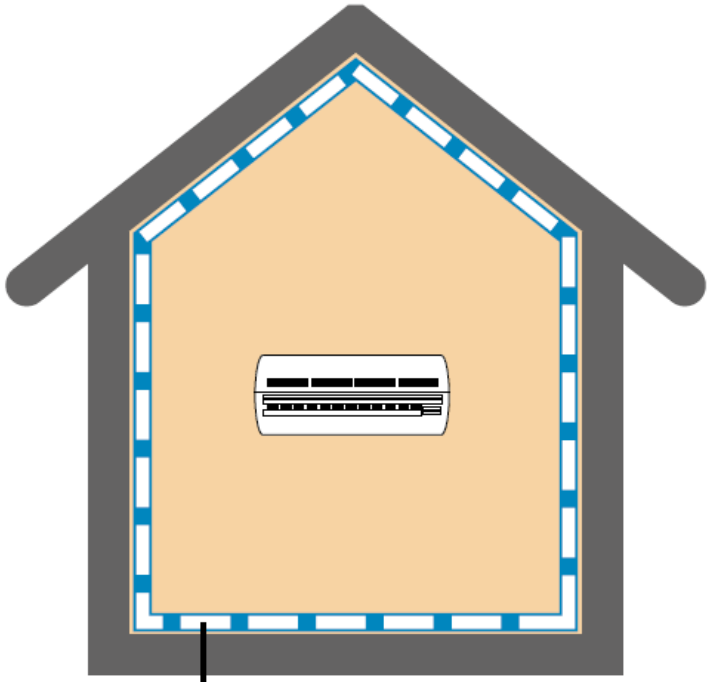
The basic premise is that air tightness is a good thing.

… and the insulation is perfect

Why Airtightness?

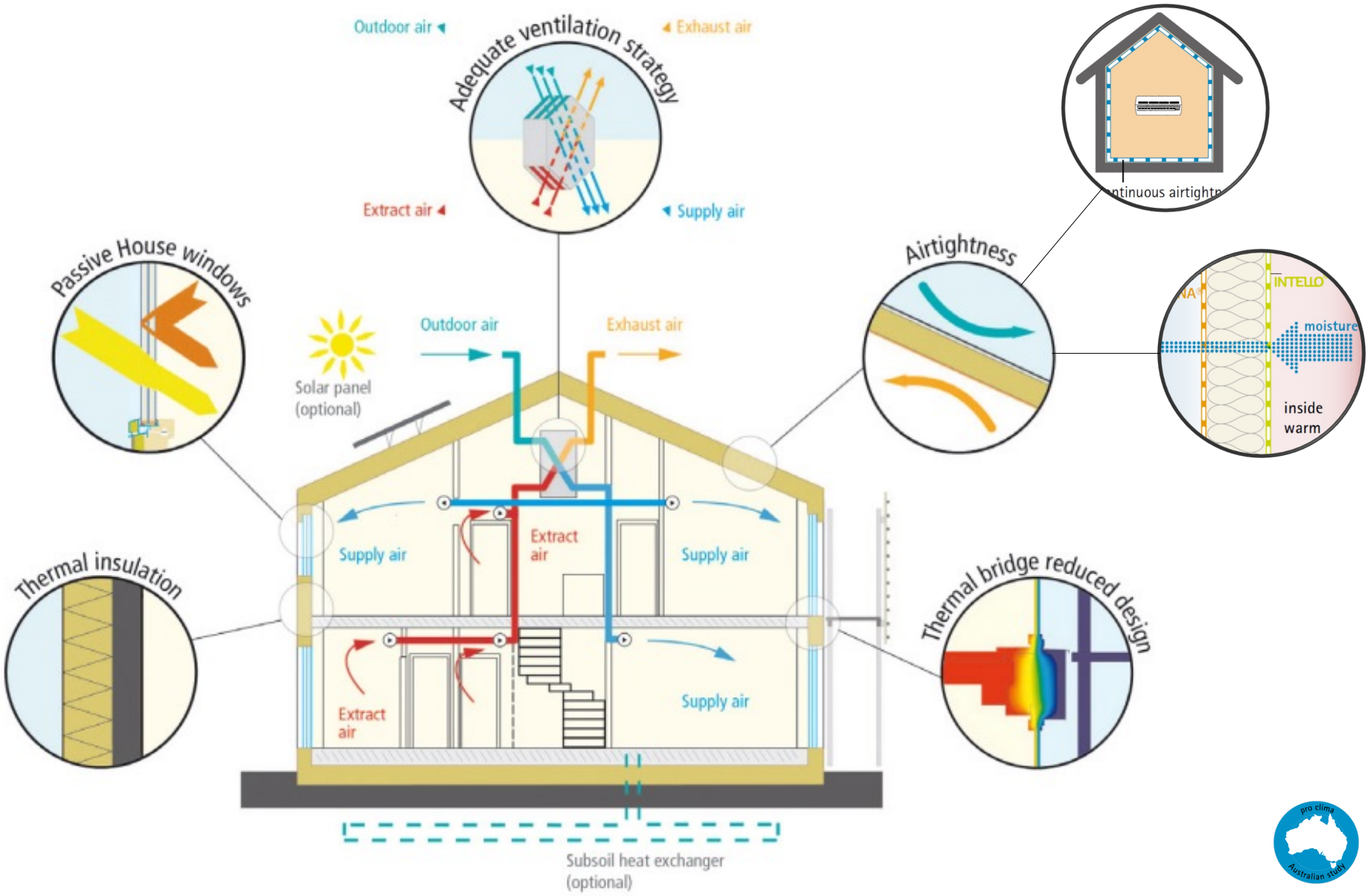


Why Airtightness?

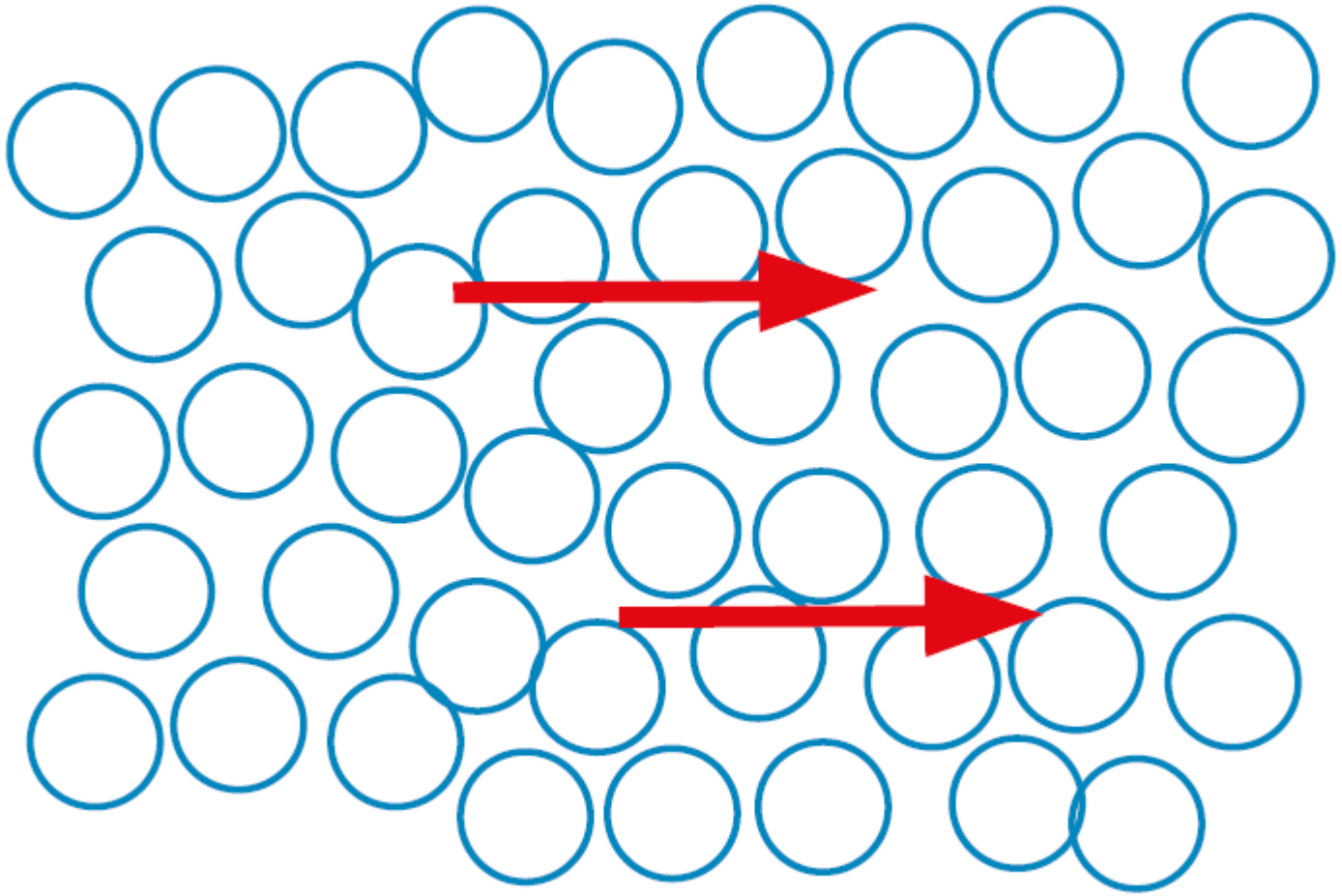


Continuous airtightness layer

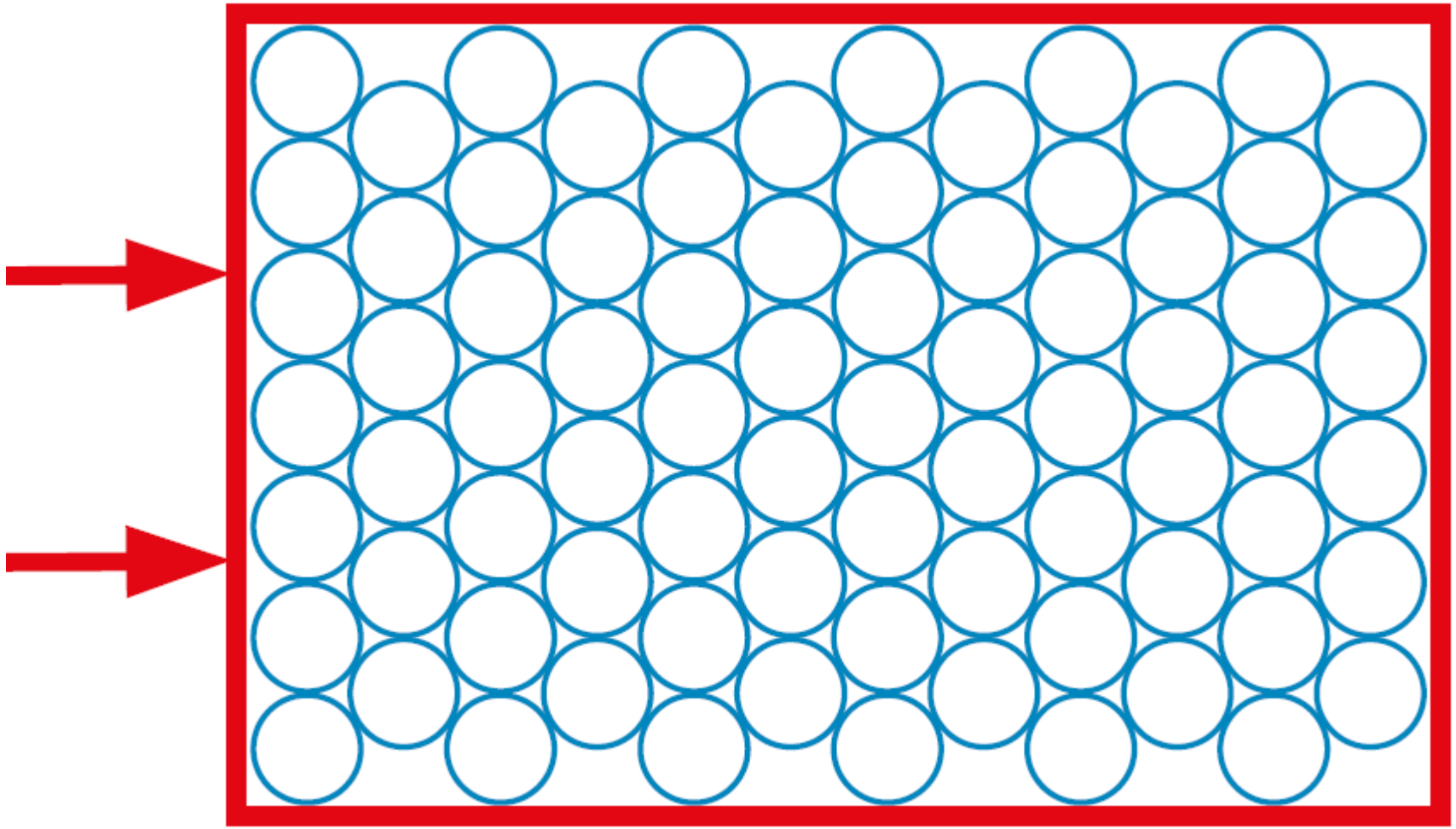
Why Airtightness?



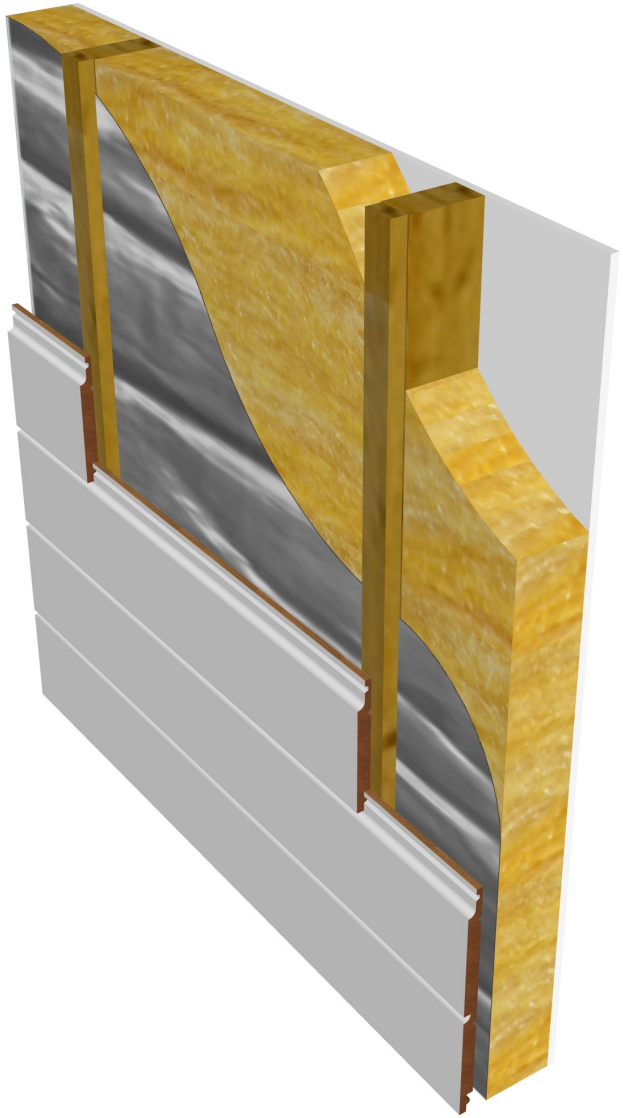
Insulation Effectiveness

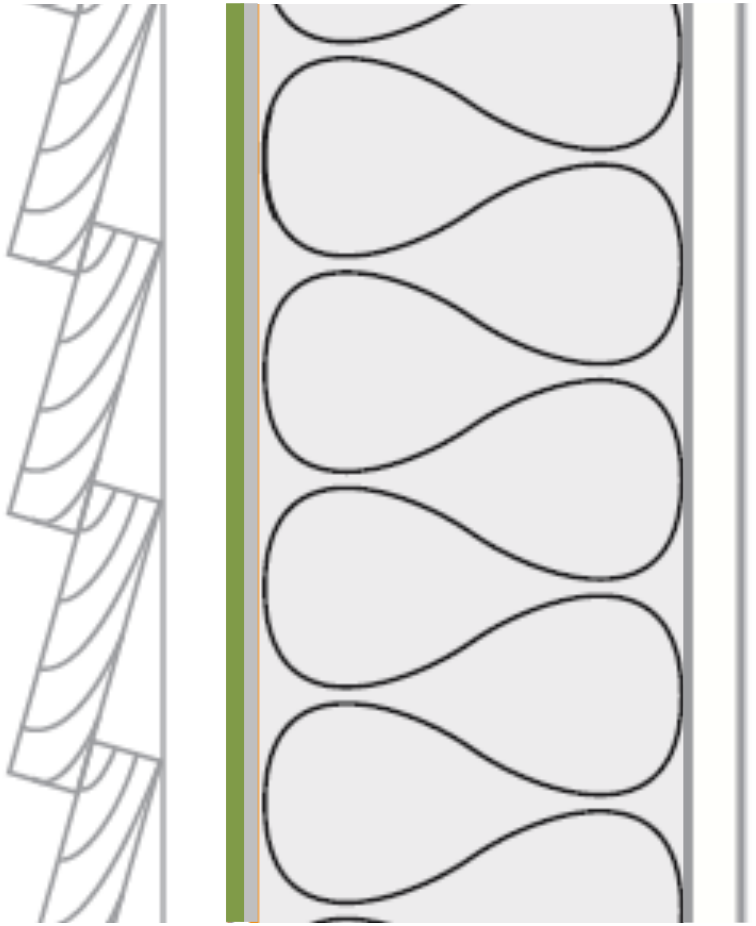


Insulation Effectiveness

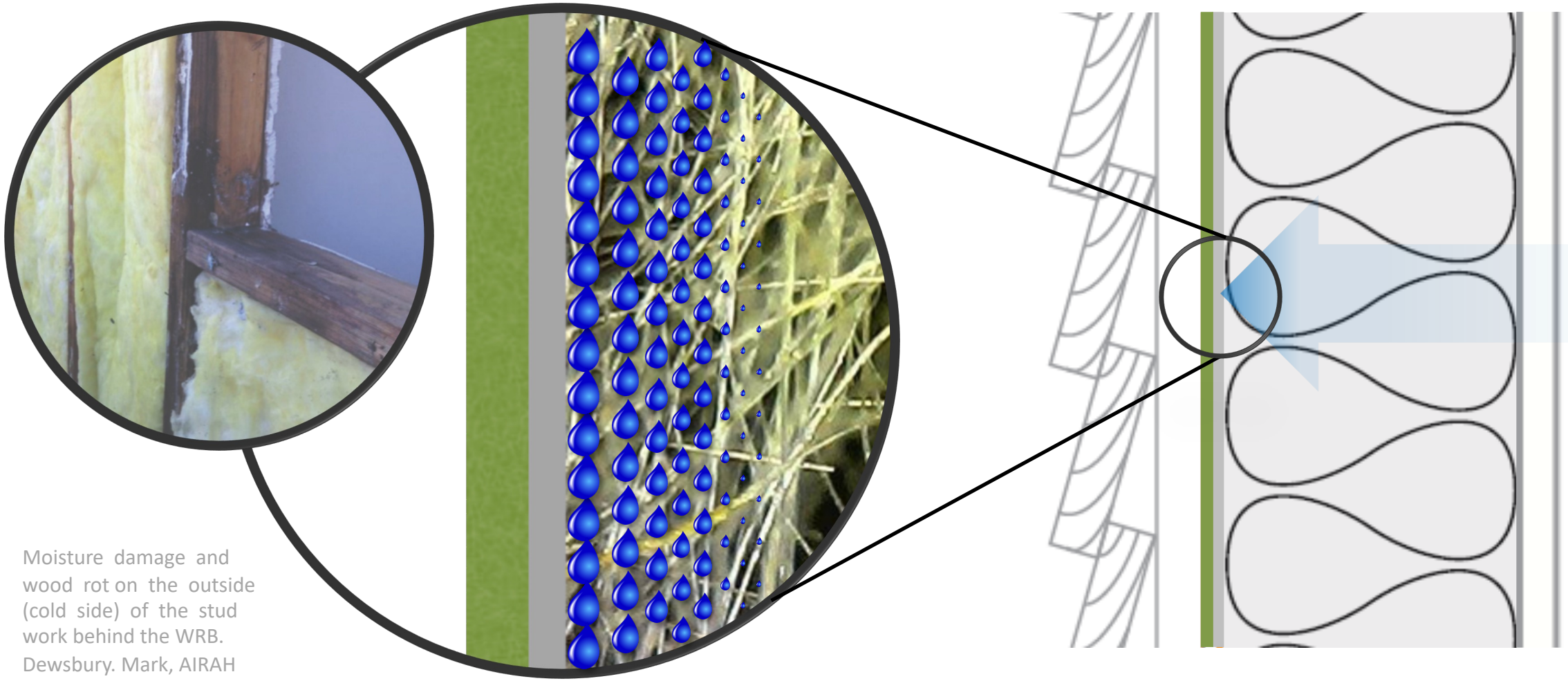


Well sealed vapour barriers (foils)



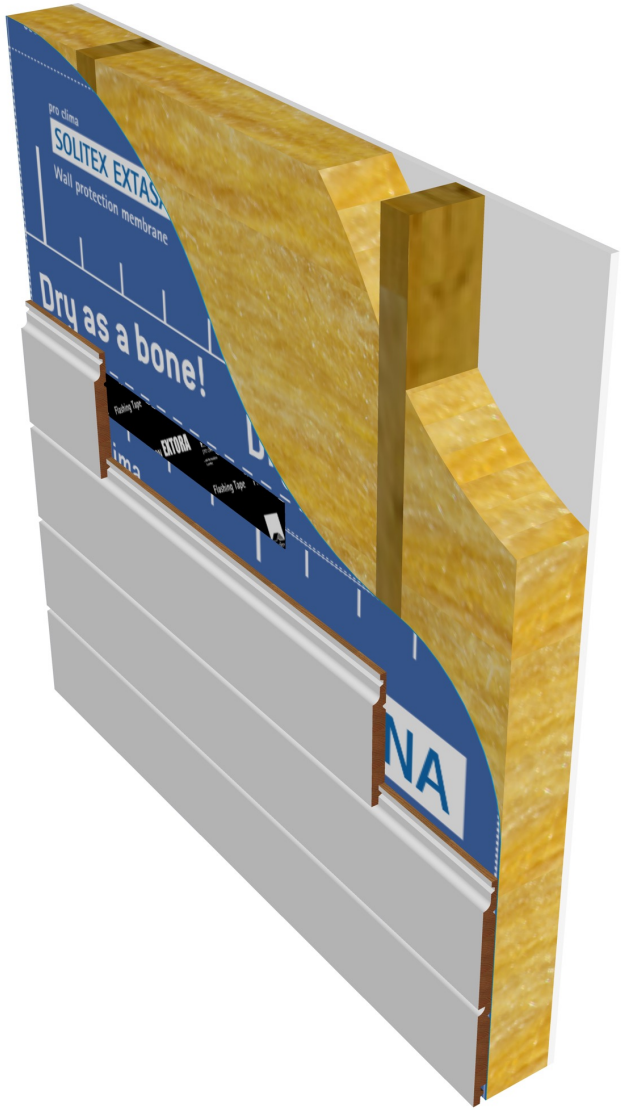


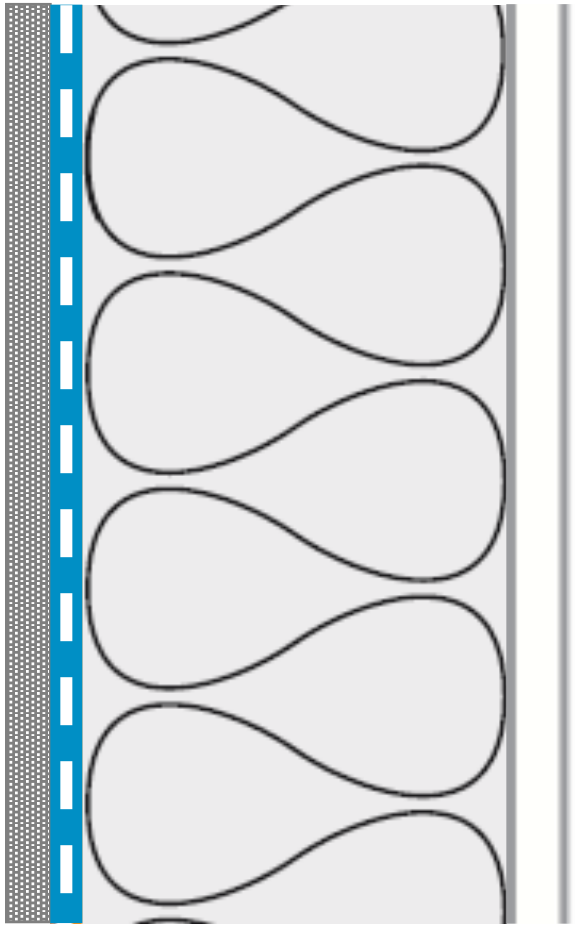
Well sealed vapour barriers (foils)



Moisture damage and wood rot on the outside (cold side) of the stud work behind the WRB. Dewsbury. Mark, AIRAH Building Physics Forum, 2018, Wollongong Australia.

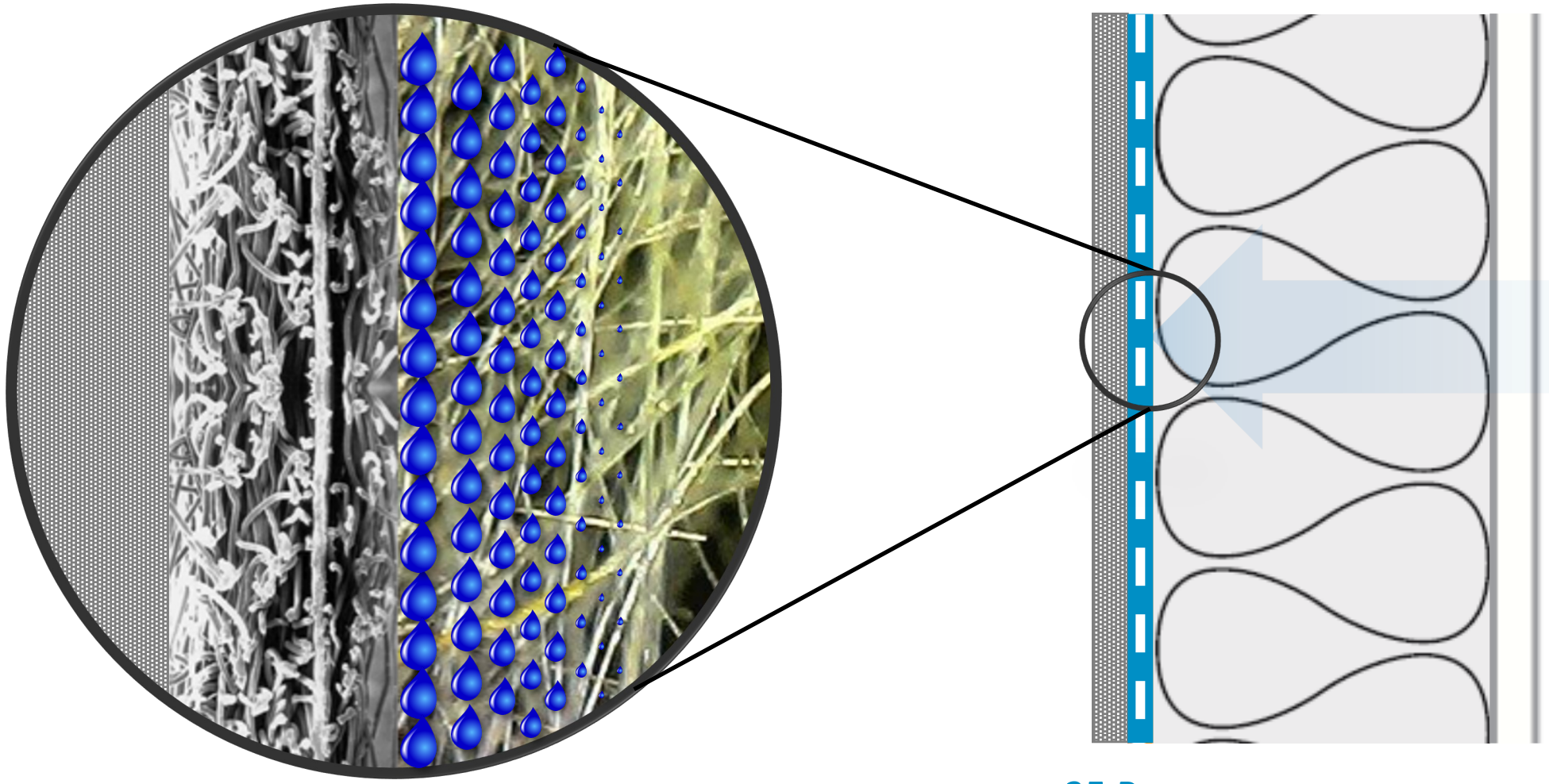
Vapour permeable (no cavity)





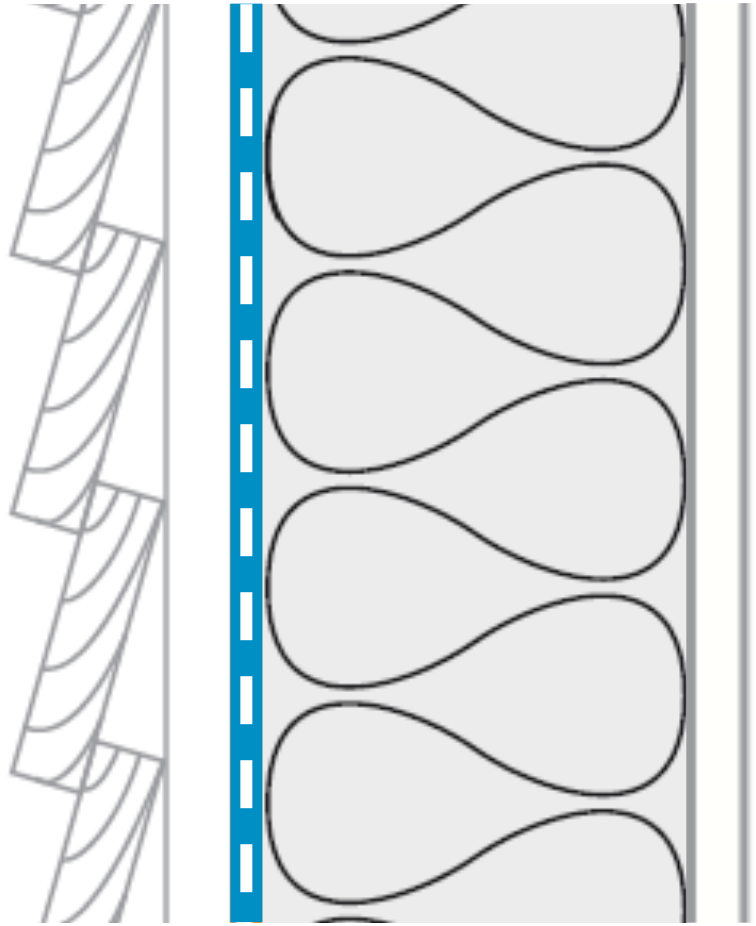
35 Perms

Vapour permeable (no cavity)



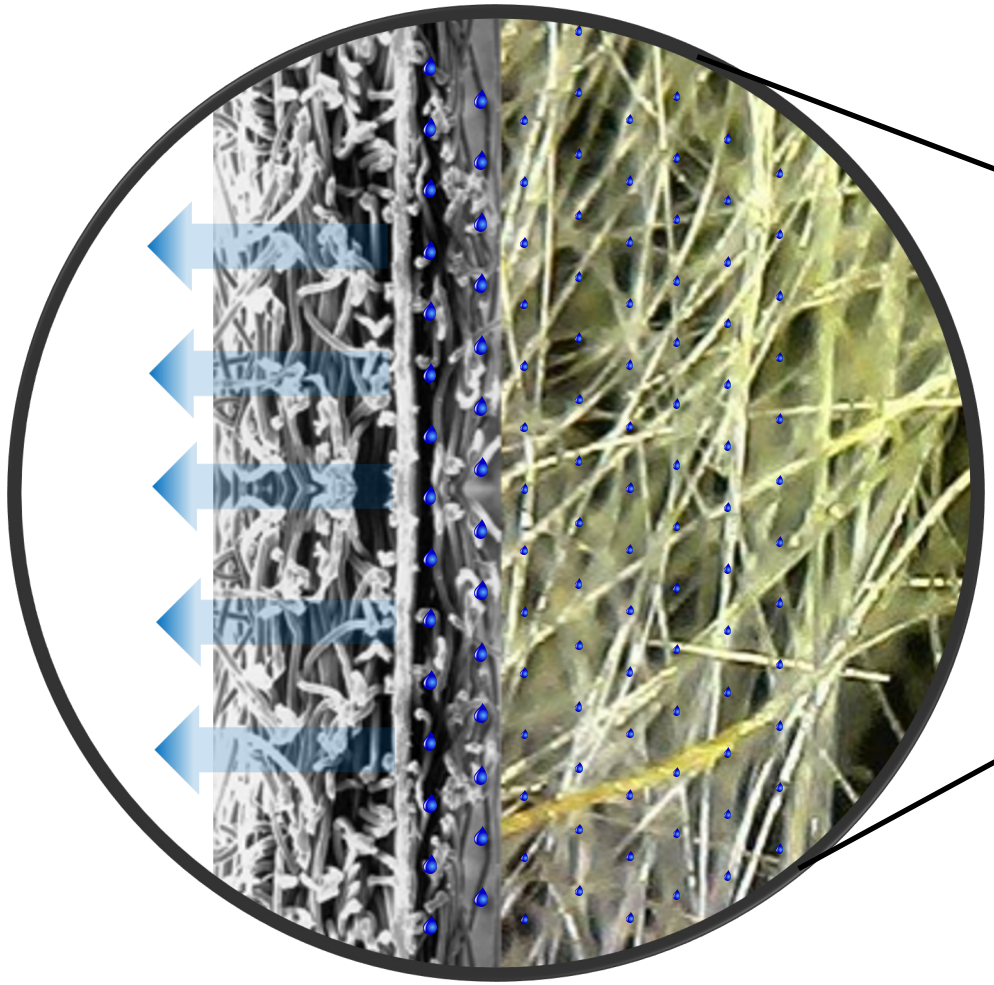
35 Perms

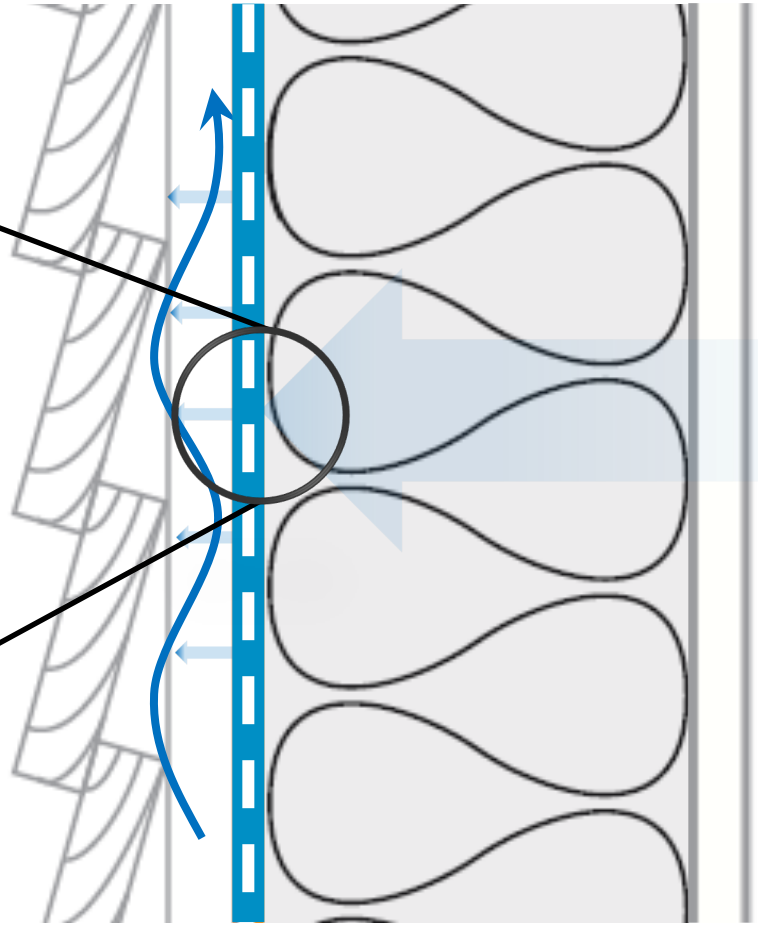
Vapour permeable (with cavity)



35 Perms

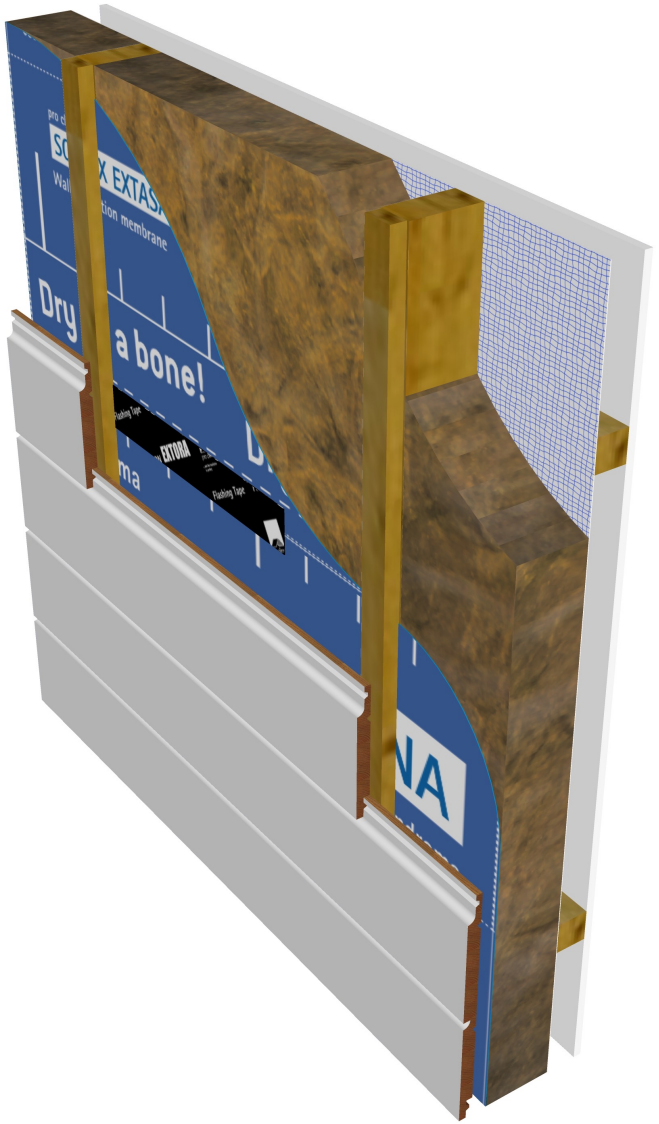
Vapour permeable (with cavity)

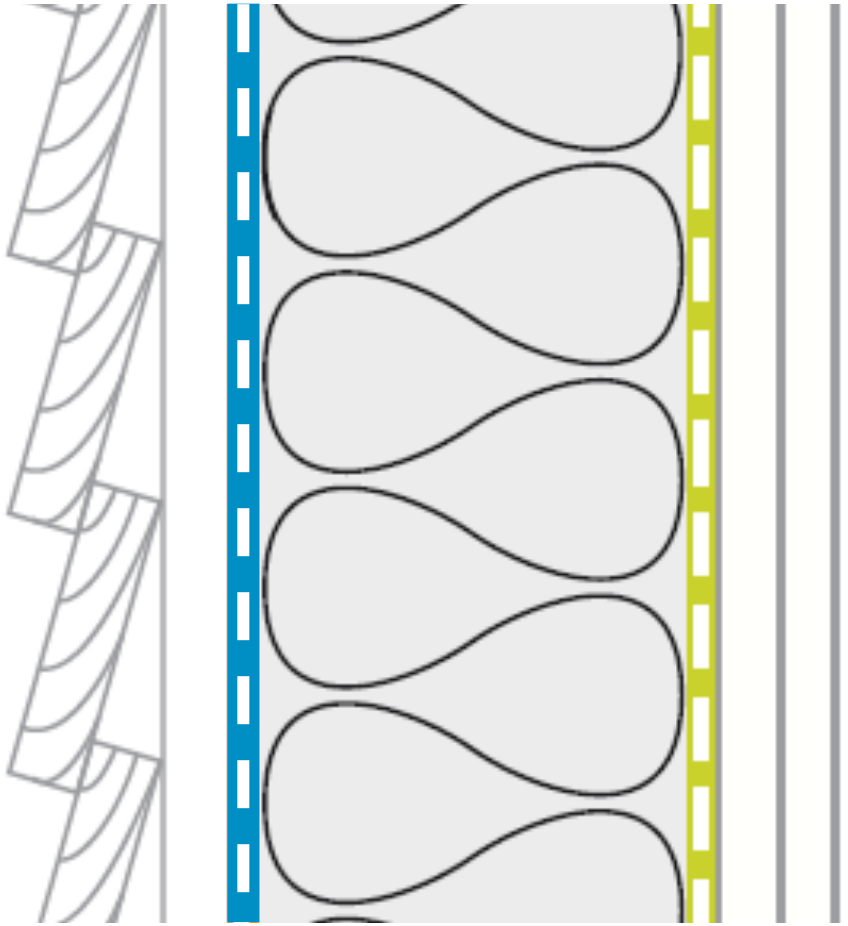




35 Perms

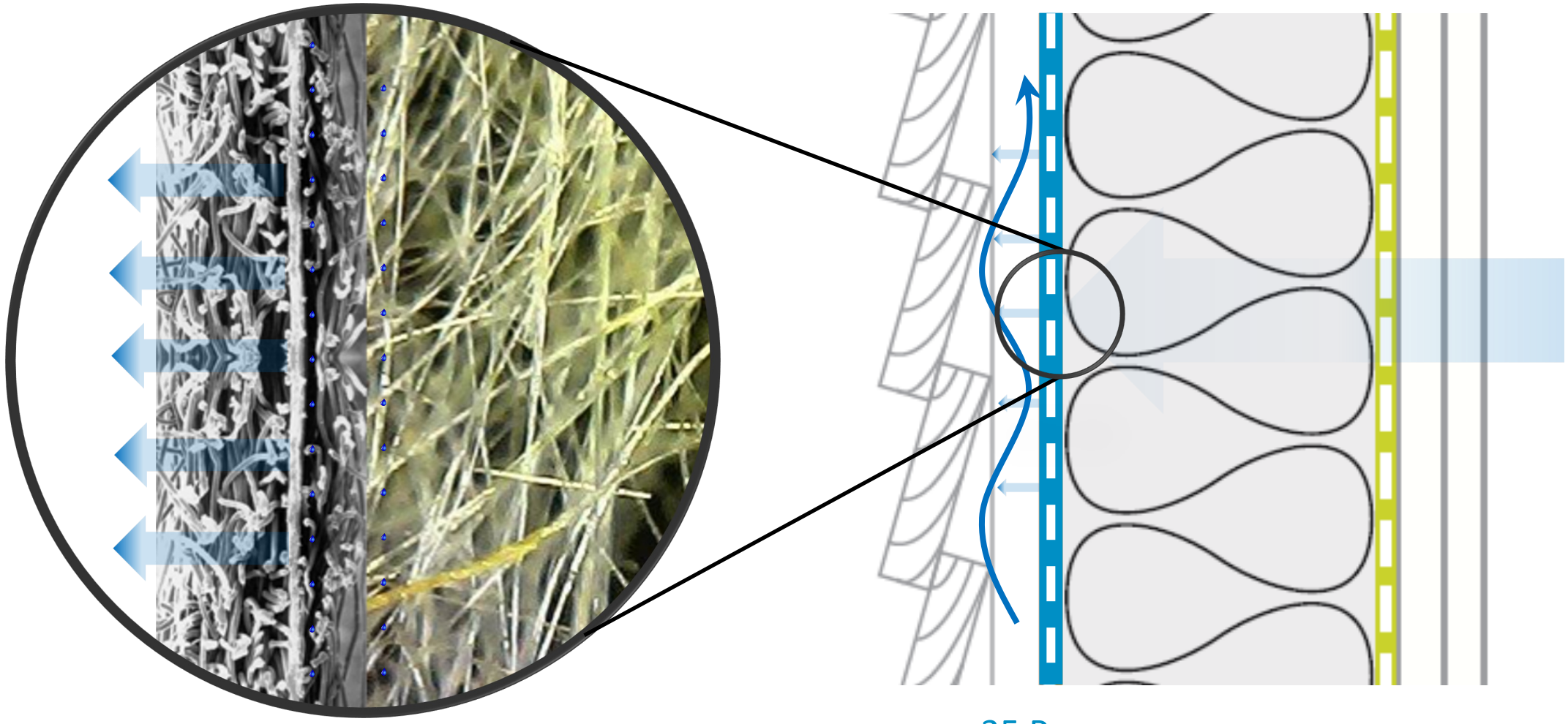
Vapour permeable (with cavity) & smart vapour retarder





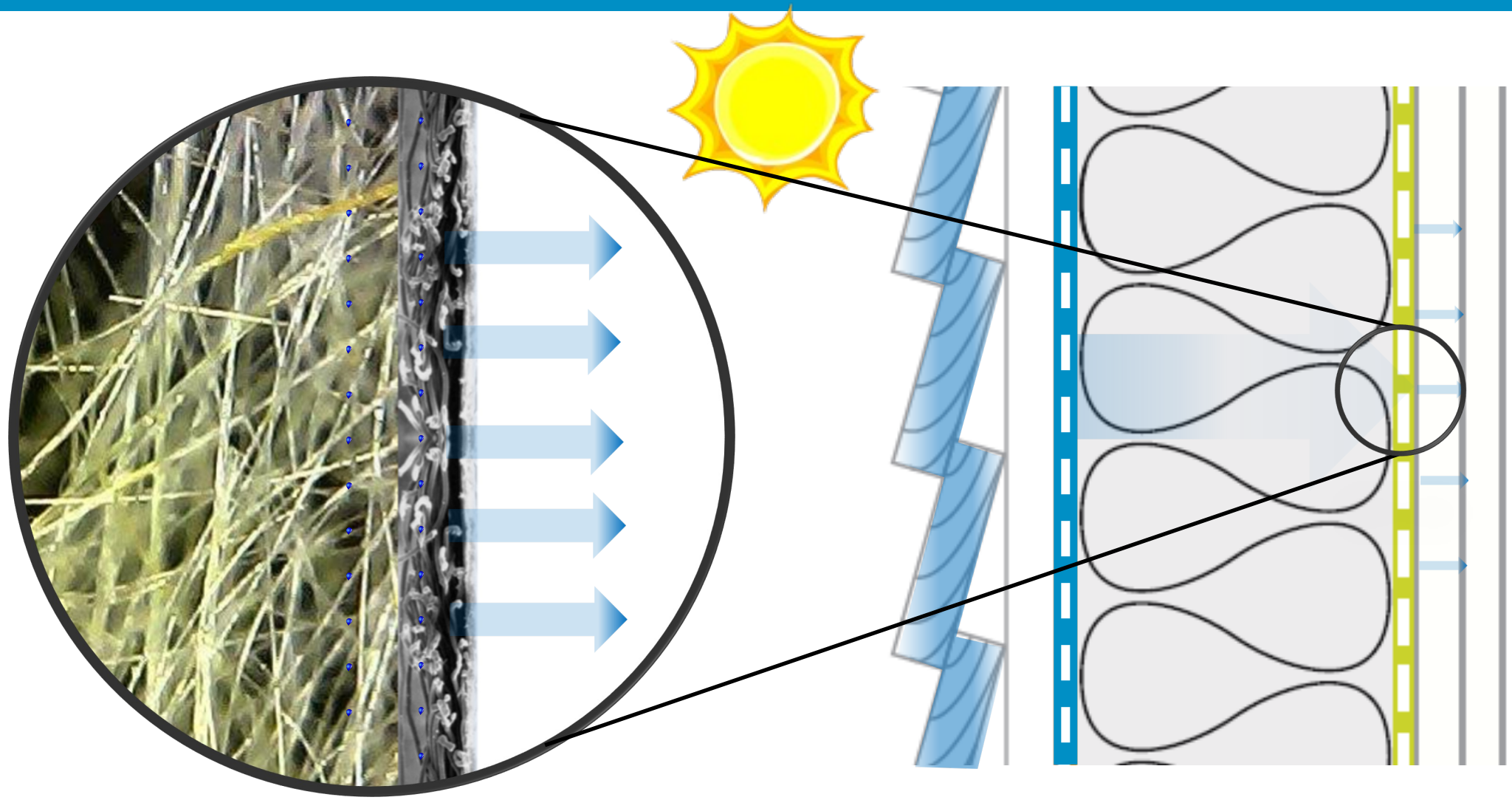
35 Perms

Vapour permeable (with cavity) & smart vapour retarder



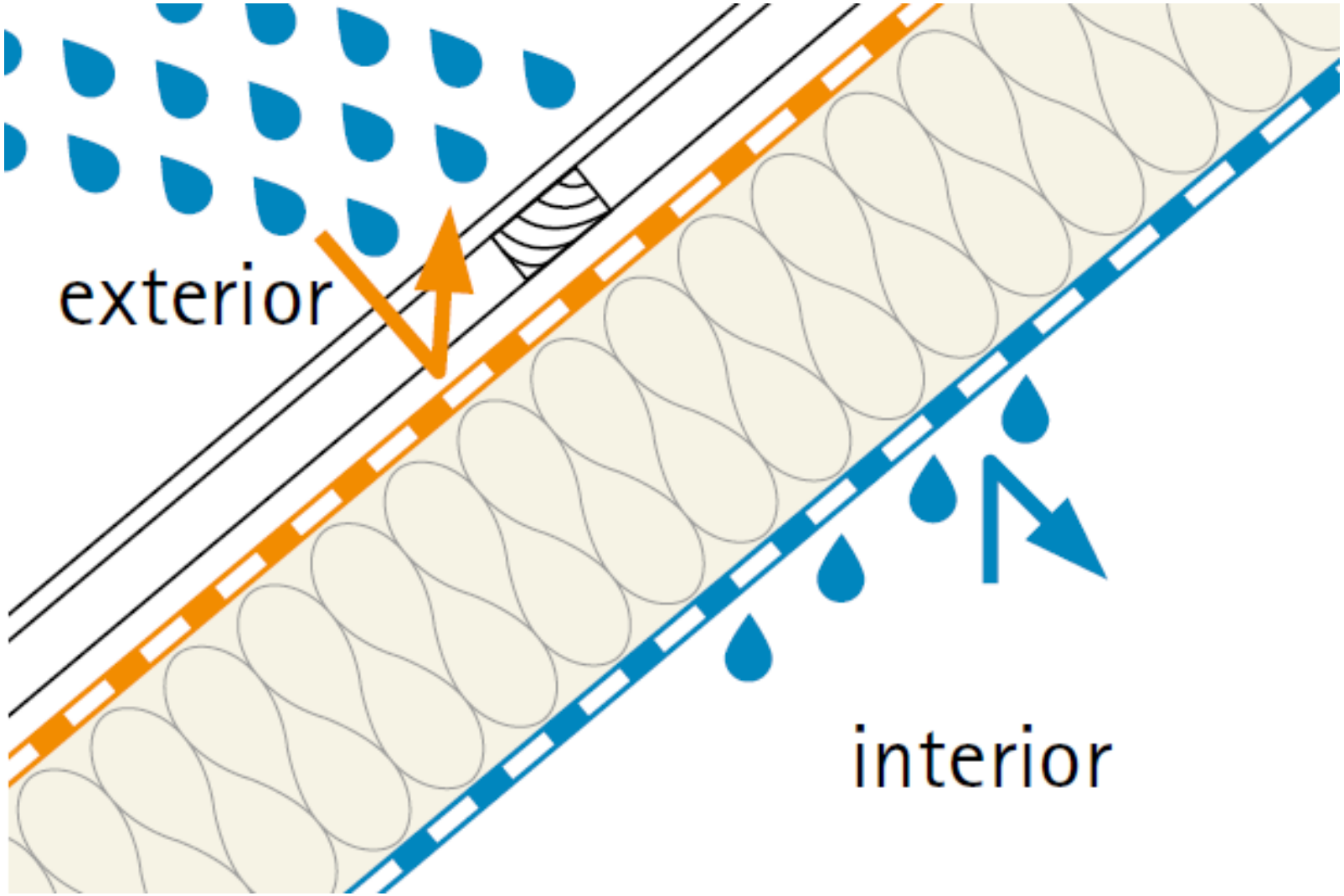
35 Perms

Vapour permeable (with cavity) & smart vapour retarder

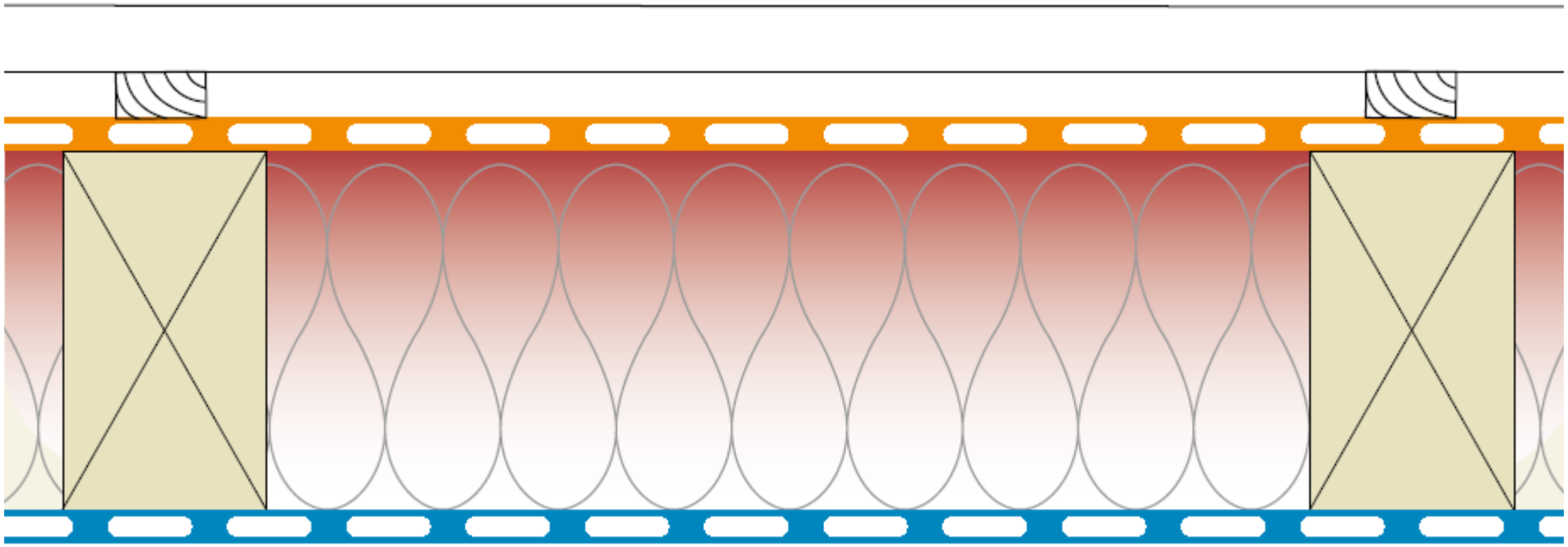


35 Perms

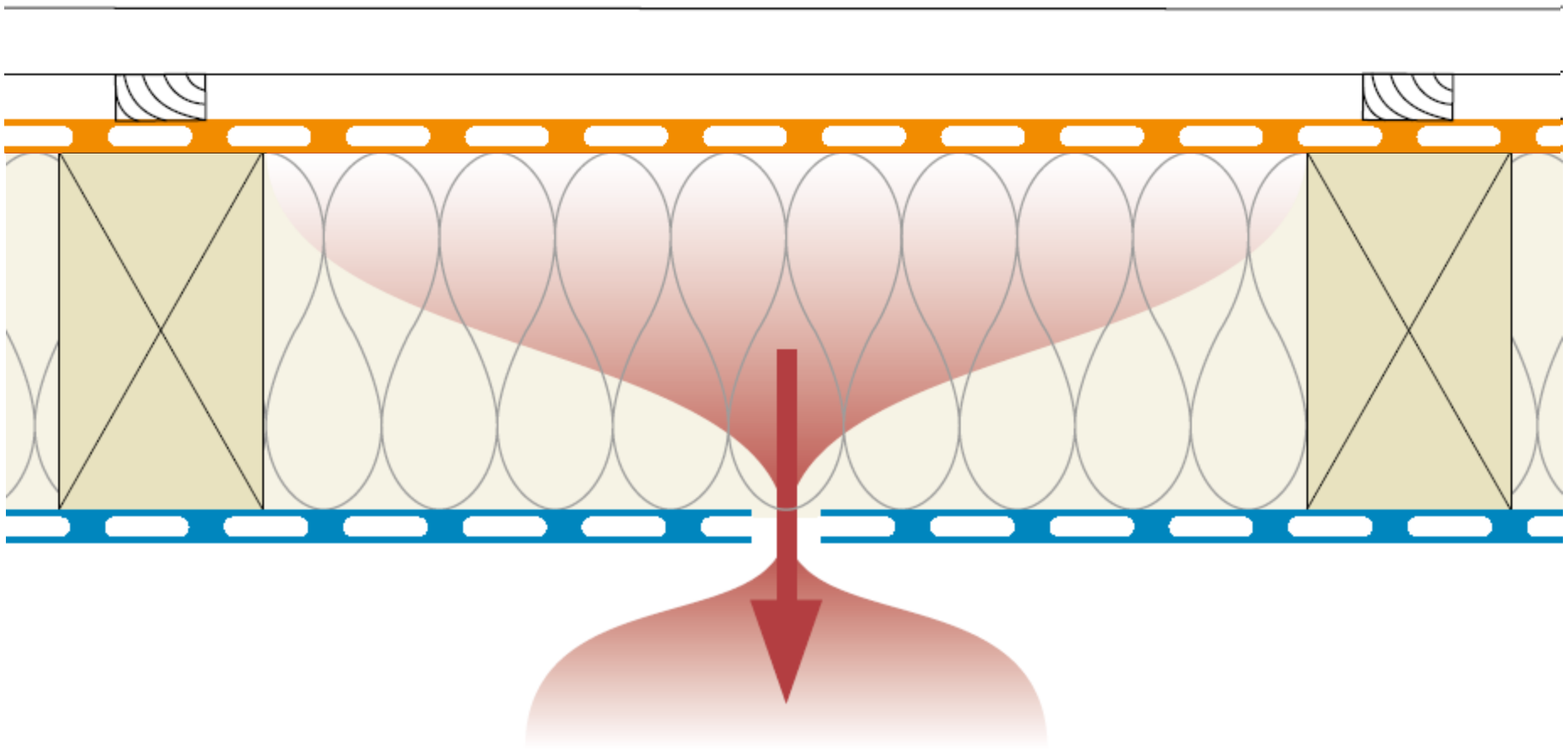
Ideal Constructions – (Moisture)



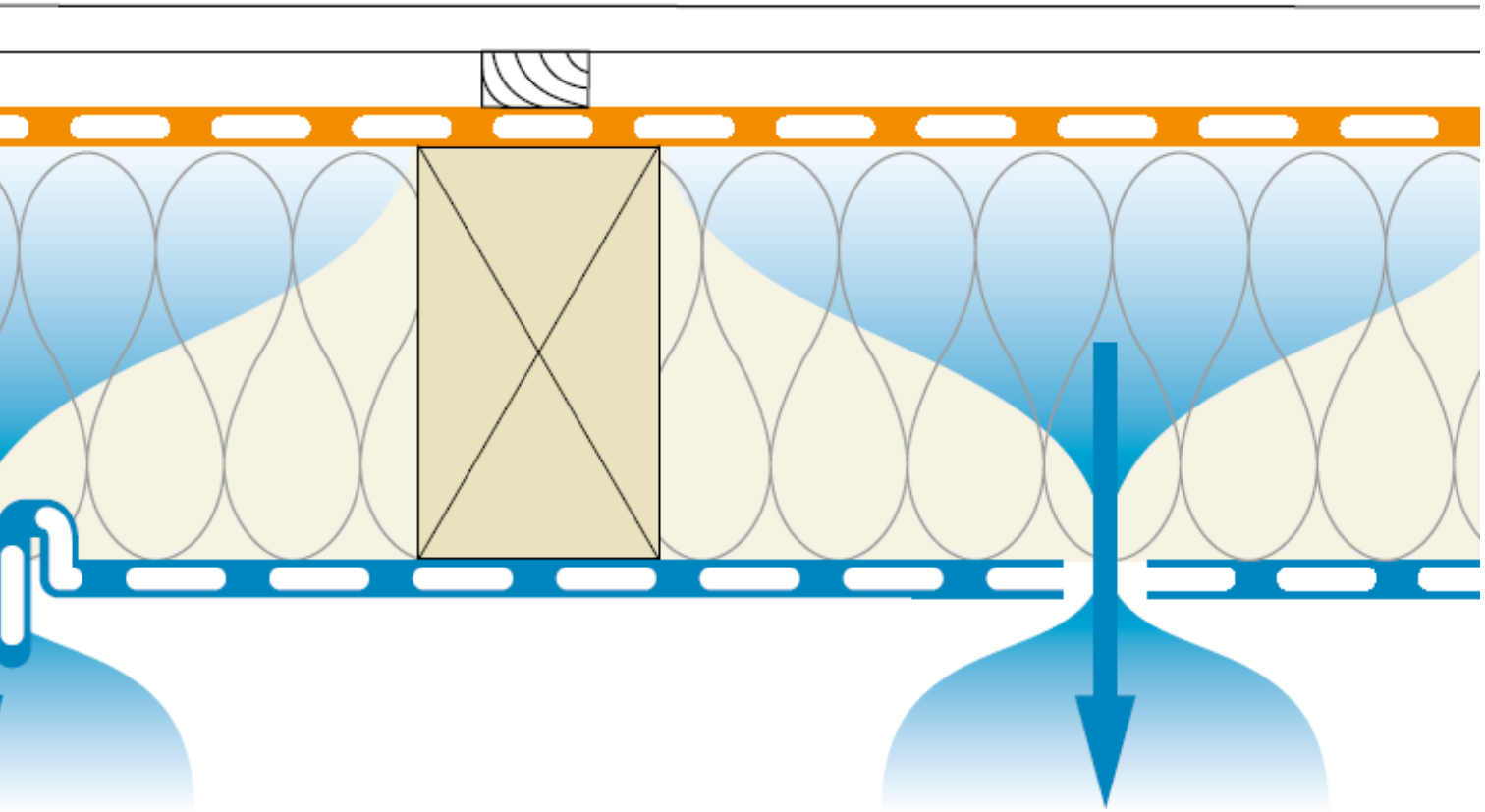
Ideal Constructions – (Heat)



Ideal Constructions – (Heat)



Ideal Constructions – (Cold)



AUTRALIA STUDY 2

PATHS OF MOISTURE TRANSPORT

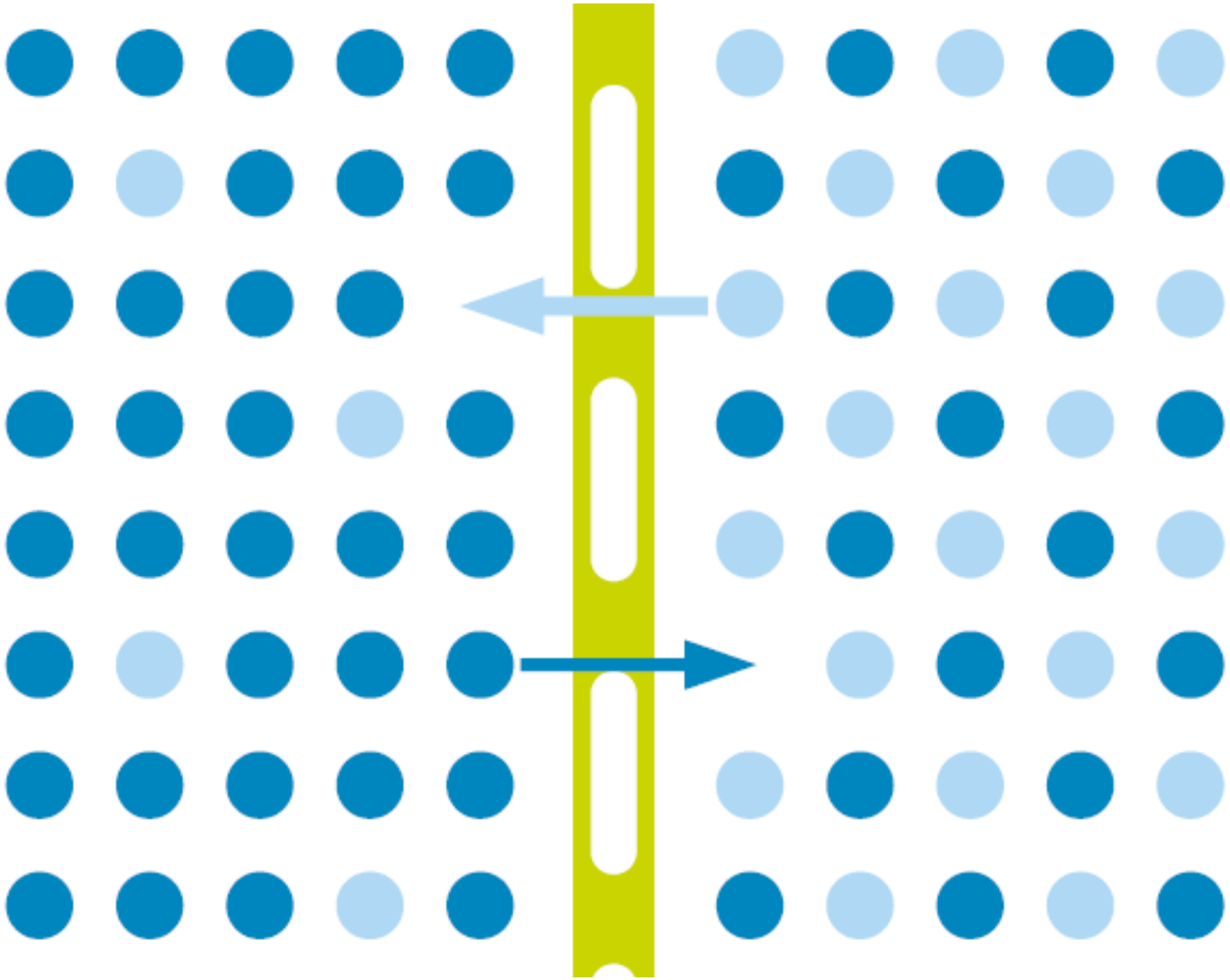
Moisture can damage our buildings. How it gets into the structure can occur in a variety of ways. High performance Passive Houses are not immune.

… and the insulation is perfect

pro clima Australian study

pro clima®

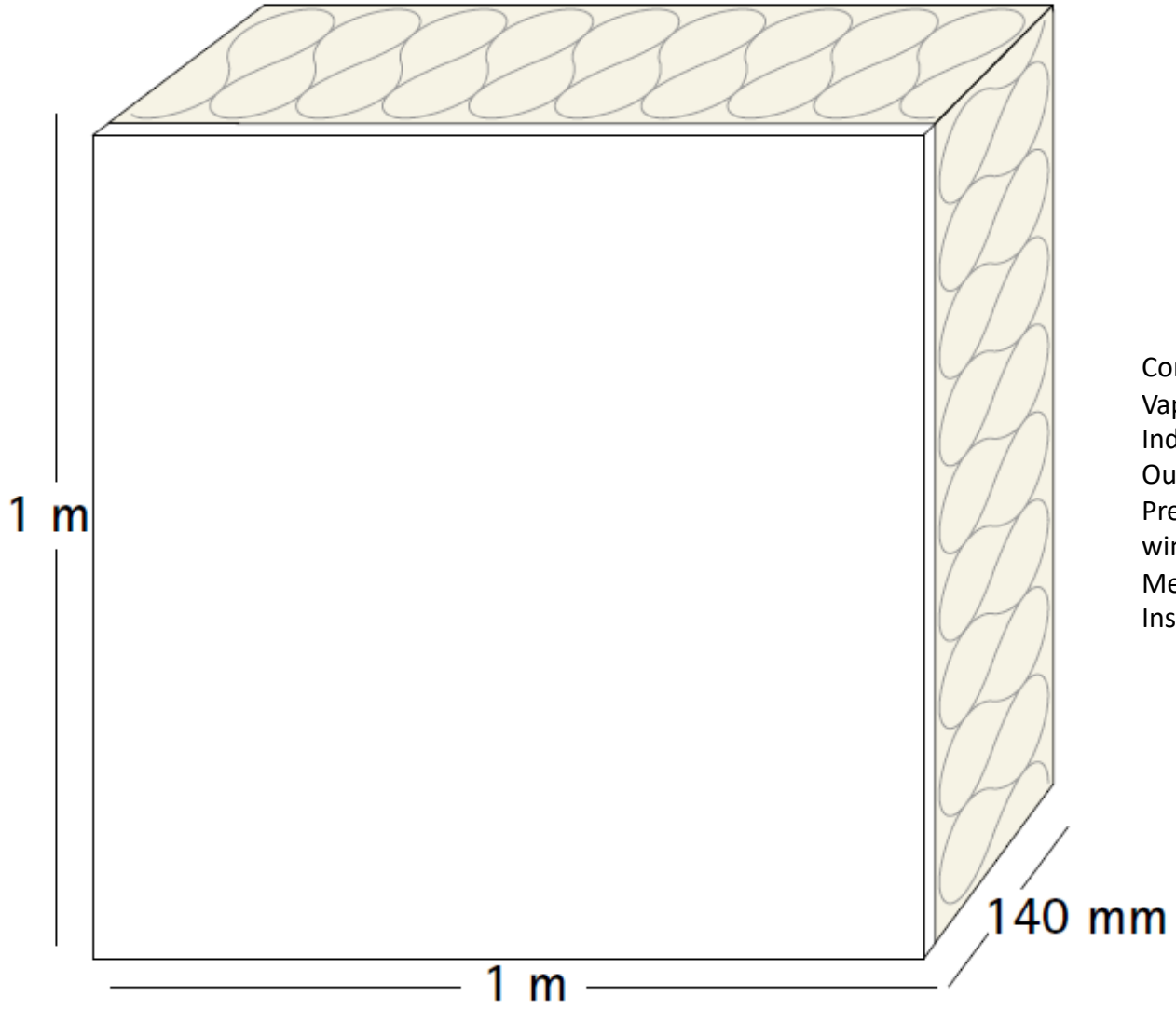
Moisture transport due to diffusion



Moisture transport due to diffusion

Moisture transport due to diffusion in winter, at a vapour resistance of 150 MNs/g, Moisture transport in winter due to diffusion:

$0.5\ g/m^2 \times 24\ h$



Conditions:
Vapour retarder sd value = 30 m (150 MNs/g)
Indoor temperature = +20°C
Outdoor temperature = 0°C
Pressure difference = 20 Pa corresponds to wind force 2 – 3
Measurement carried out by: Fraunhofer Institute for Building Physics, Stuttgart

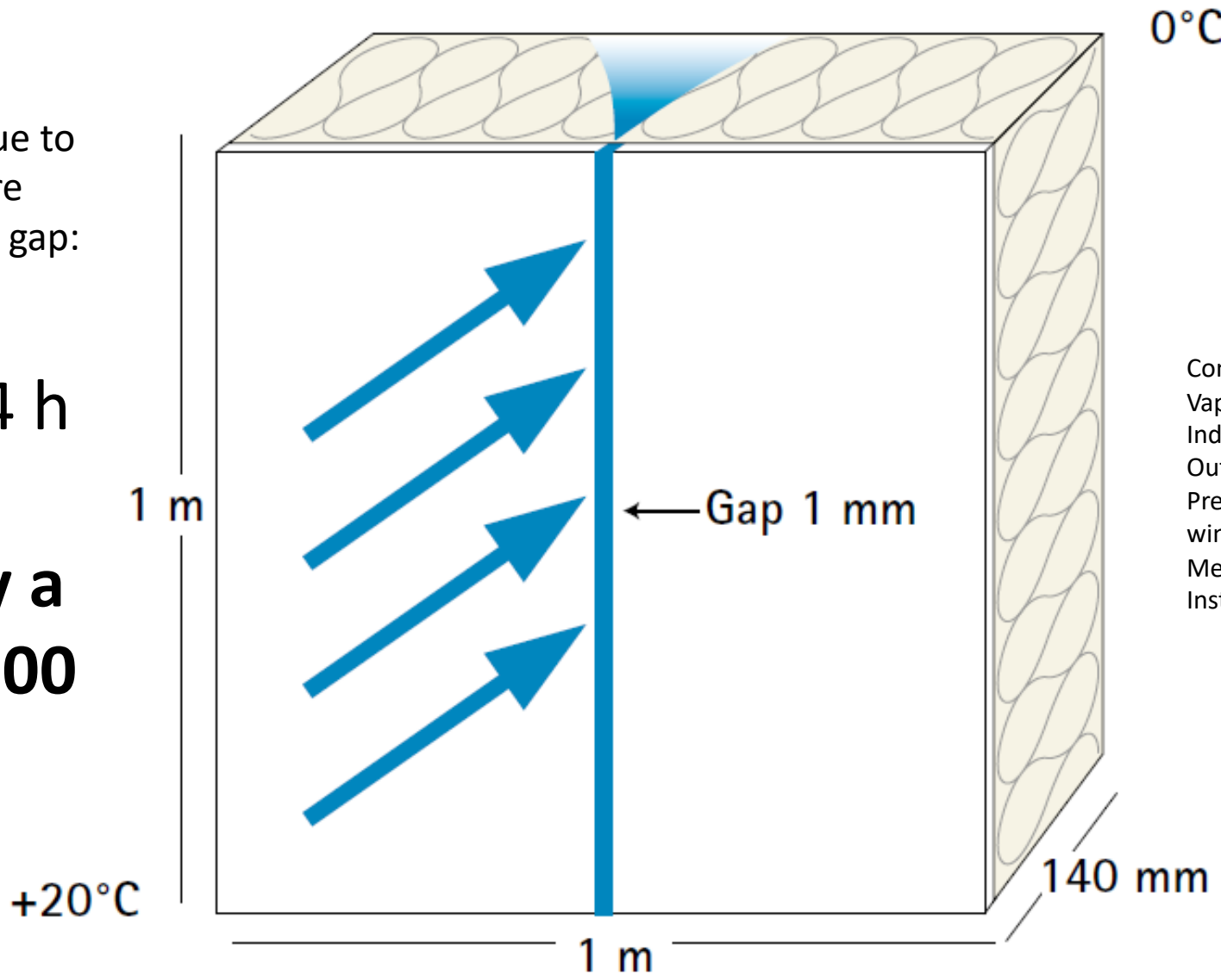
pro clima

Moisture transport due to diffusion

Amount of moisture due to convection, moisture transport, with a 1 mm gap:

800 g/m x 24 h

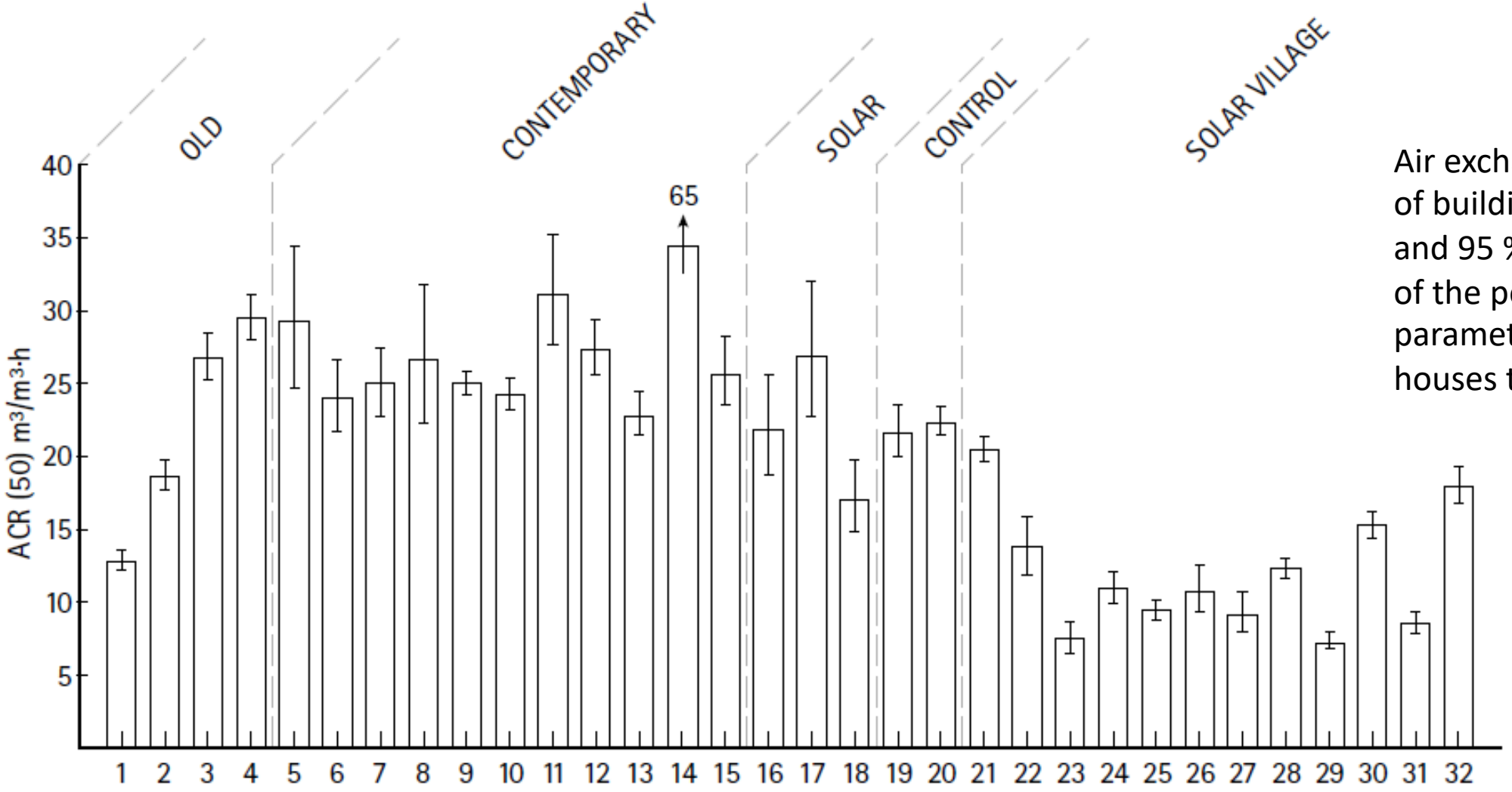
Increased by a factor of 1,600



Conditions:
Vapour retarder sd value = 30 m (150 MNs/g)
Indoor temperature = +20°C
Outdoor temperature = 0°C
Pressure difference = 20 Pa corresponds to wind force 2 – 3
Measurement carried out by: Fraunhofer Institute for Building Physics, Stuttgart

pro clima

Leaky Australian houses = Poor vapour control

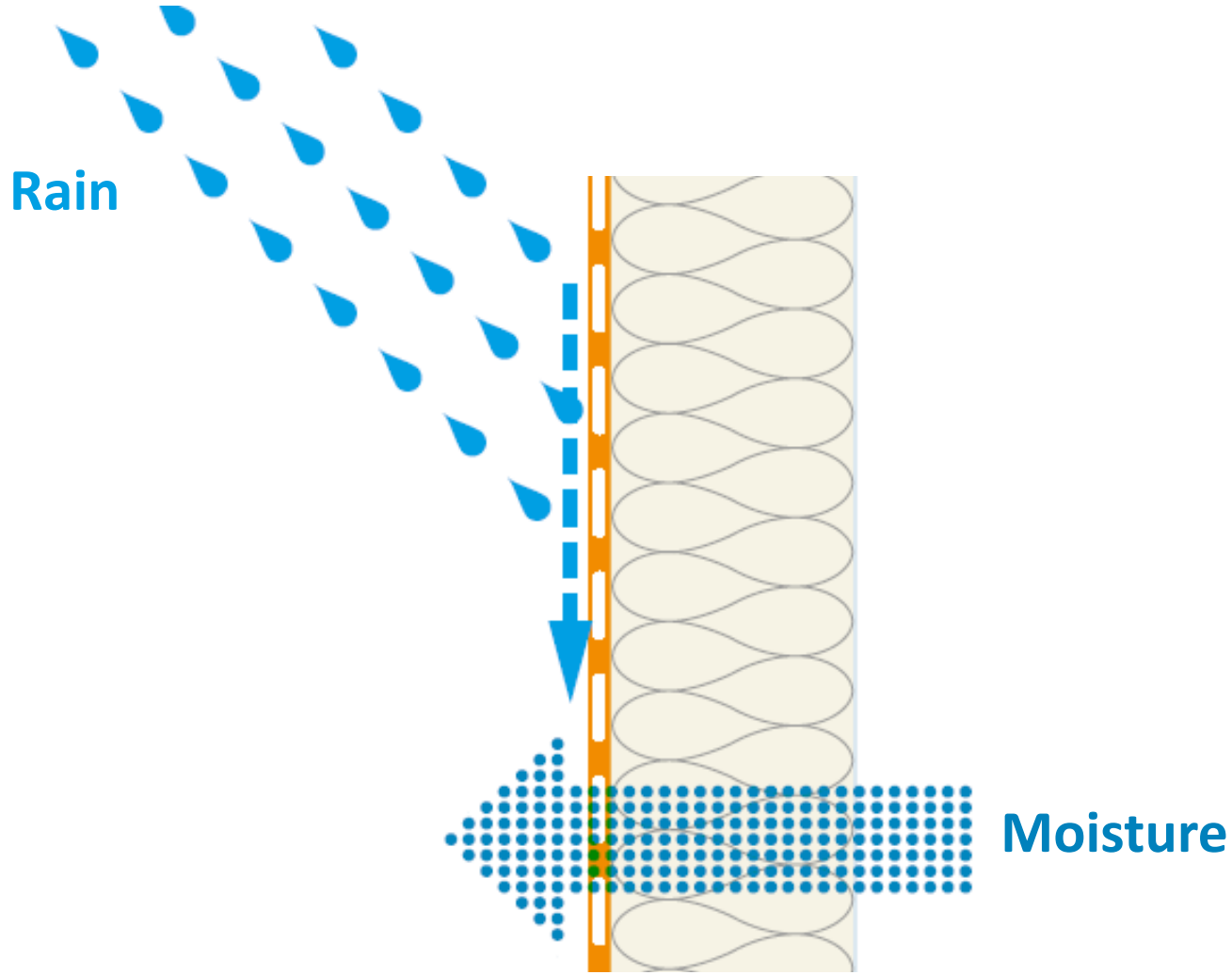


Air exchange rate (n_{50} value) of buildings, estimated values and 95 % confidence intervals of the permeability parameter ACR(50) for the houses tested.

Briggs. K. L, Bennie. I, Michell. D, Air Permeability of Some Australian Houses, Building and Environment, Vol 21, No. 2, pp 89-96, 1986

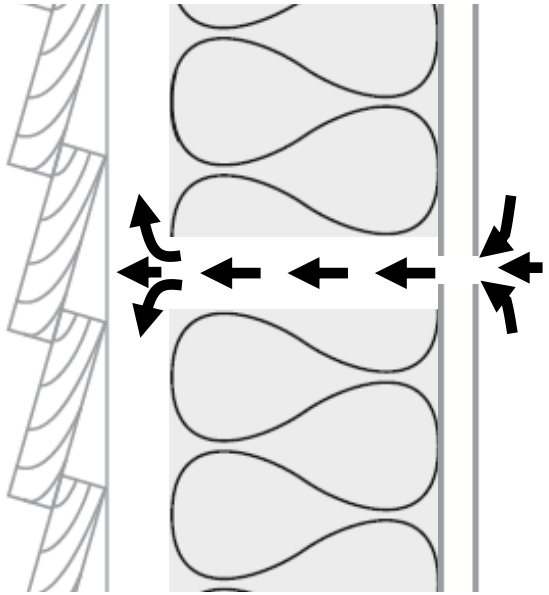
pro clima

Weathertight is airtight



Energy leaks and moisture leaks

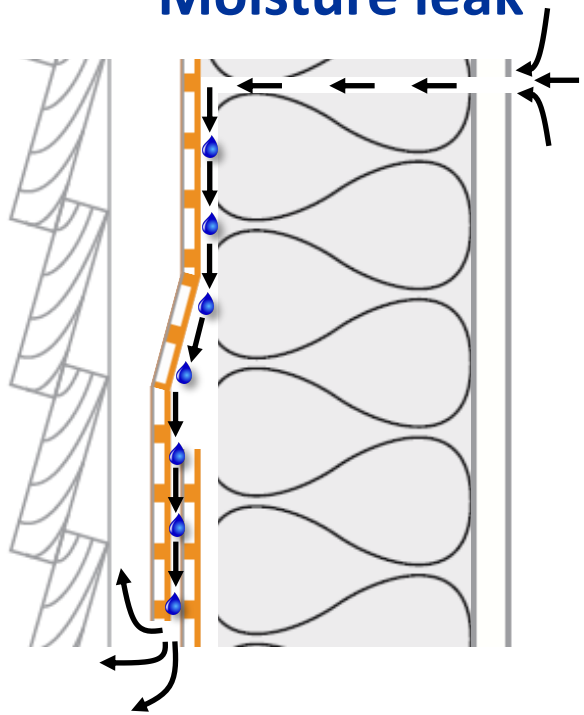
Energy leak



Warming of the flow path in case of straight air path

No or only little condensation

Moisture leak



Cooling of the air in case of slow and tortuous air path

Potential of serious condensation

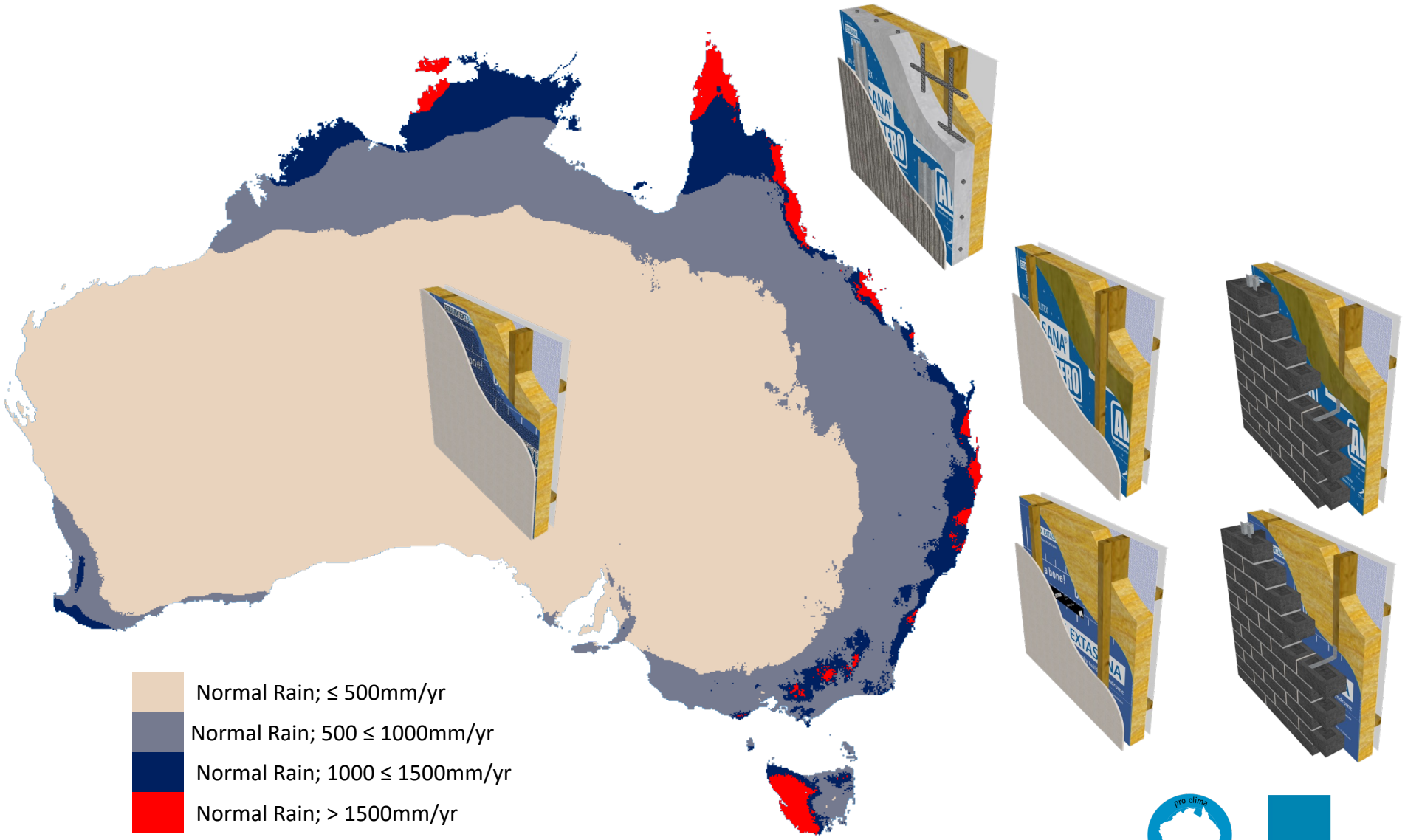
AUTRALIA STUDY 3

THIS IS AUSTRALIA

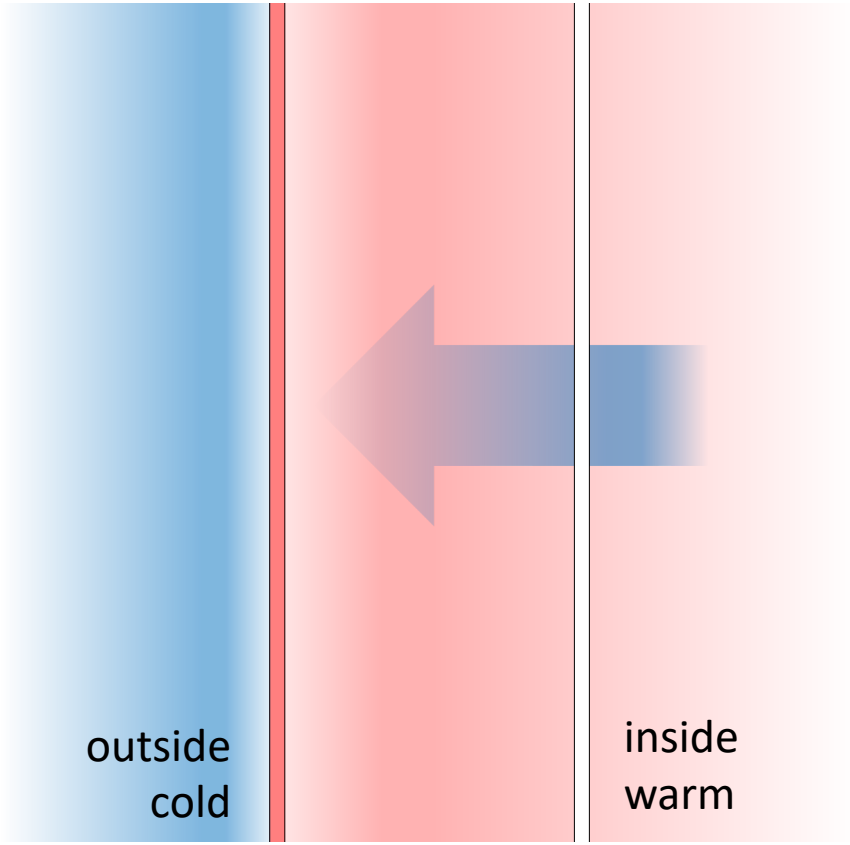
The pro clima Australia Study focuses on the local issues, climate and solutions

Design For Climate

Rain and wind

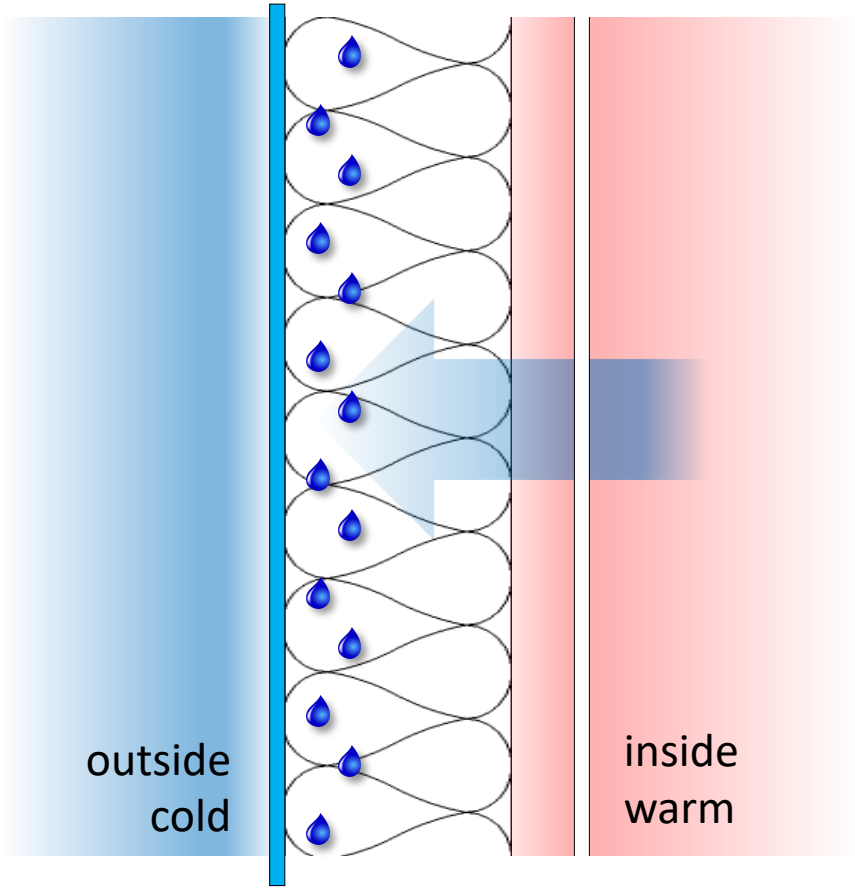


Pre 2005 energy efficiency



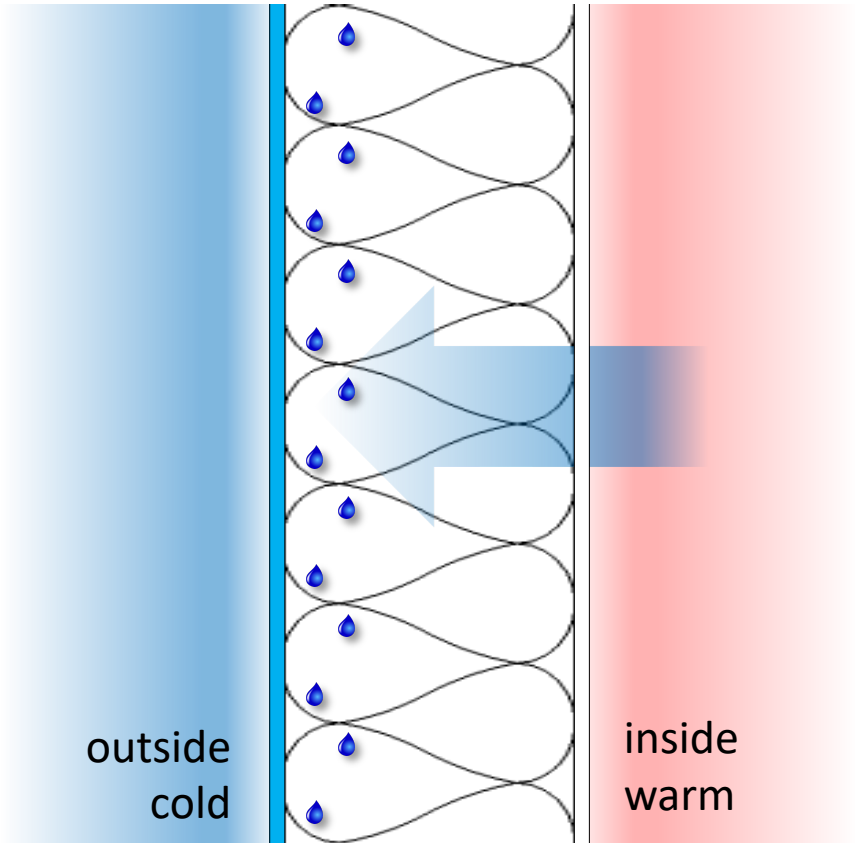
Foil membrane only, 90 mm stud bay,
10 mm plasterboard

Post 2005 energy efficiency



With R1,5 (75 mm) or 2.0 (90 mm) fibrous insulation layers: Foil, 75 mm Fibrous insulation, 10 mm plasterboard

Post 2016 energy efficiency



Post 2016 energy efficiency: with R2.5 (90 mm) or 2.7 (90 mm) fibrous insulation layers: foil, 90 mm fibrous insulation, 10 mm plasterboard. Mould and decay in these situations were not a matter of poor workmanship but the consequence of a system error.

Damp and wet issue

"The extent of the problem may include **40 % of all Class 1 and Class 2 buildings."**

"The Committee received evidence that buildings that have been exposed to **water damage** (and subsequently experienced high levels of mould and dampness) **may contribute to ill health in susceptible individuals.**

Health effects described by inquiry participants were varied, often debilitating, and included cognitive and physical symptoms."

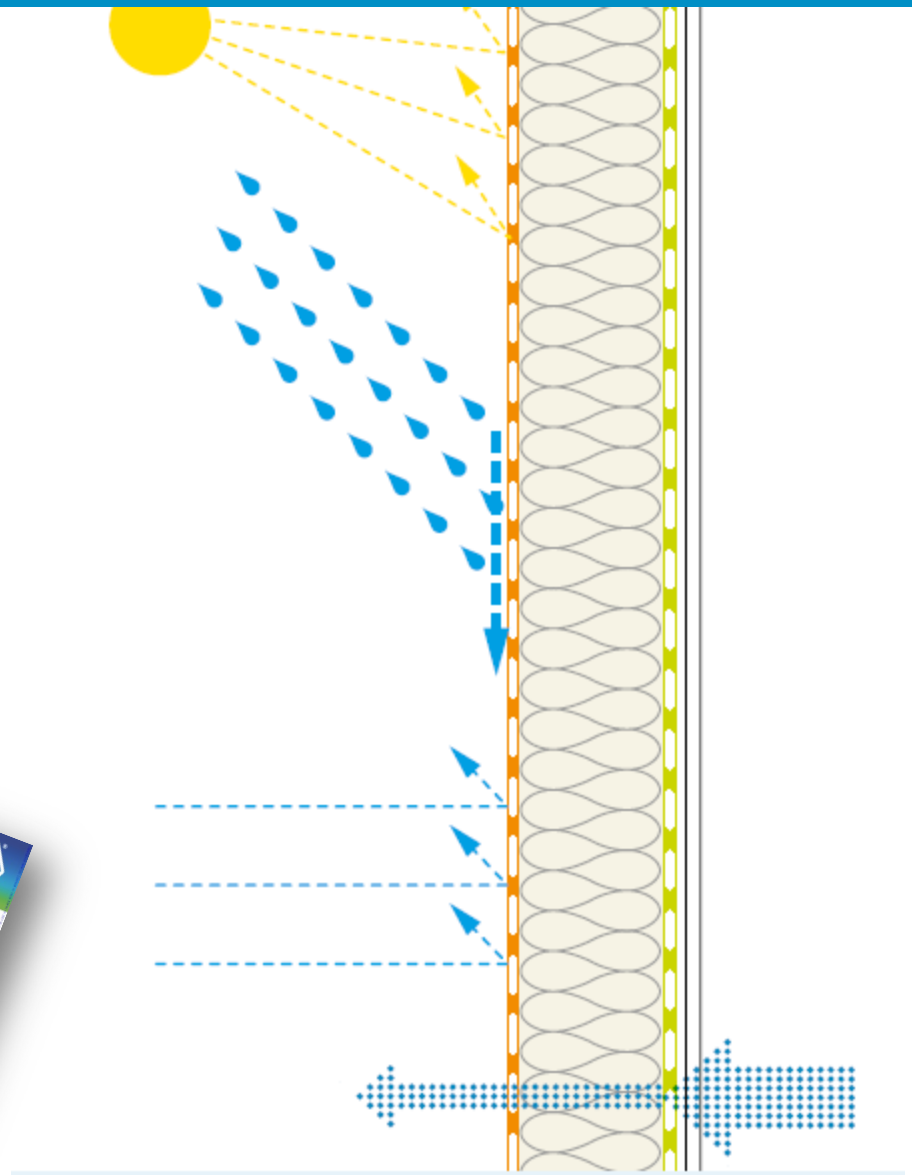
"40.19 % (n=1297) of the defects identified in the reports were categorised to building fabric and cladding"

"We have read numerous reports which identify the prevalence of serious **compliance failures** in recently constructed buildings. These include **non-compliant cladding, water ingress leading to mould** and structural compromise,"

pro clima Australian study

pro clima®

Design solution (AIRAH DA07)



pro clima

AUTRALIA STUDY 4

WEATHER RESISTIVE BARRIERS (WRB)

Selection of Weather Resistive Barriers (WRB) is important as the long term durability of the entire structure relies on this.

pro clima Australian study

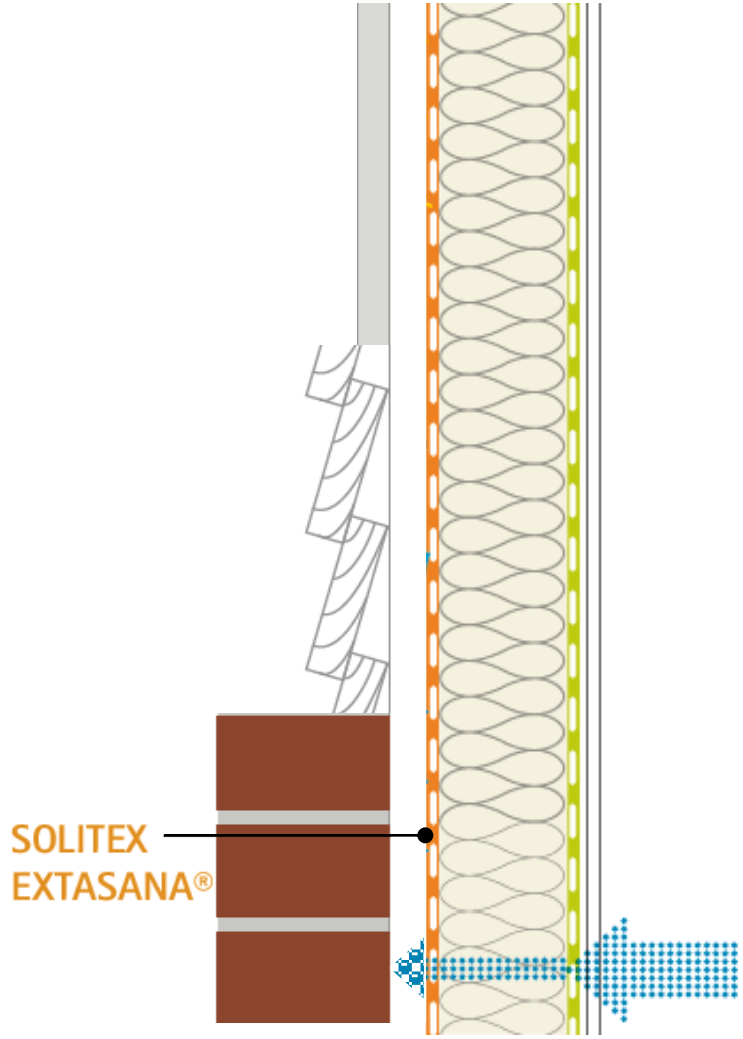
pro clima®

Don’t rely on caulk

Jonathan Braun, QCA Building Envelope Testing, Winipeg Canada.

Second Line of Defence

Jonathan Braun, QCA Building Envelope Testing, Winipeg Canada.



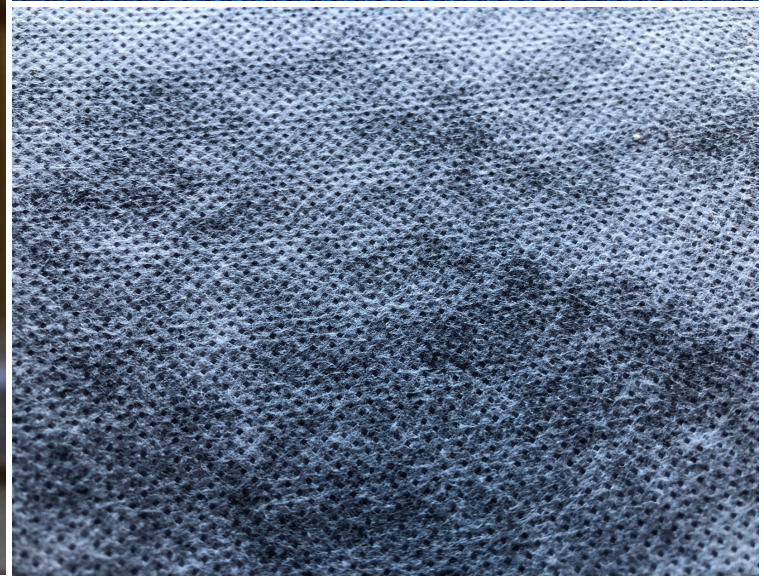
pro clima

UV Aging

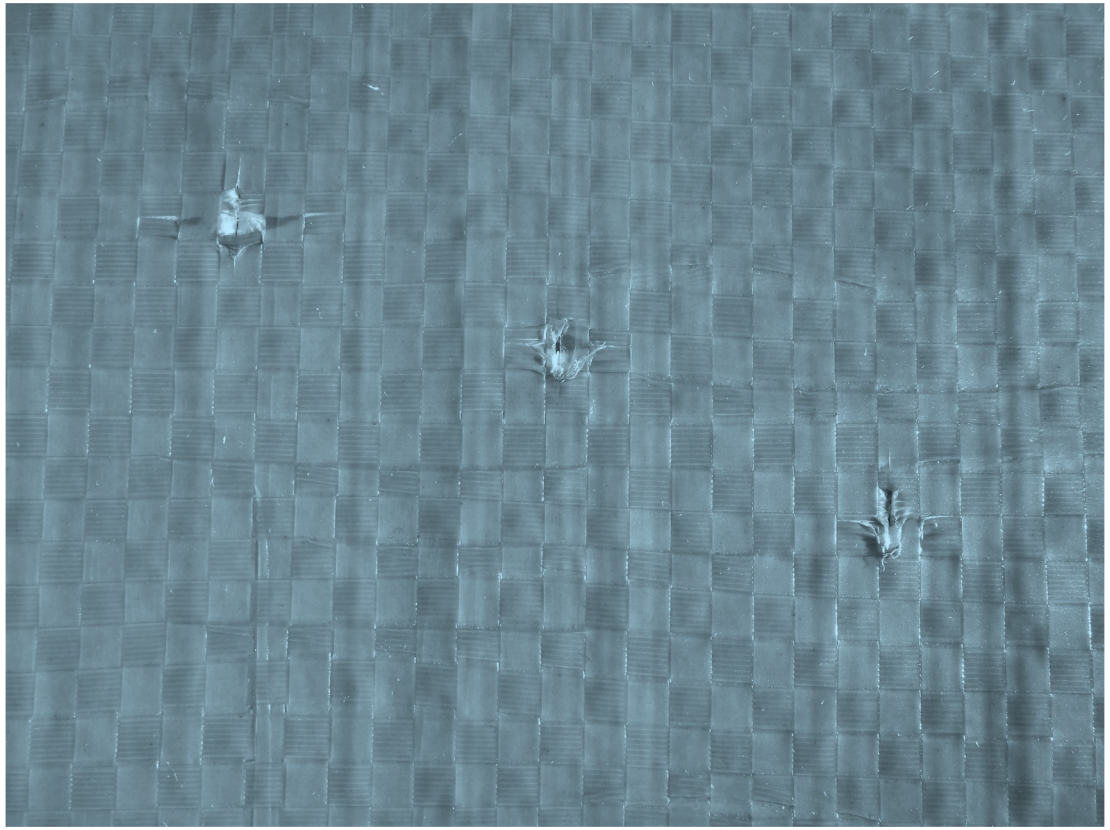
pro clima Australian study

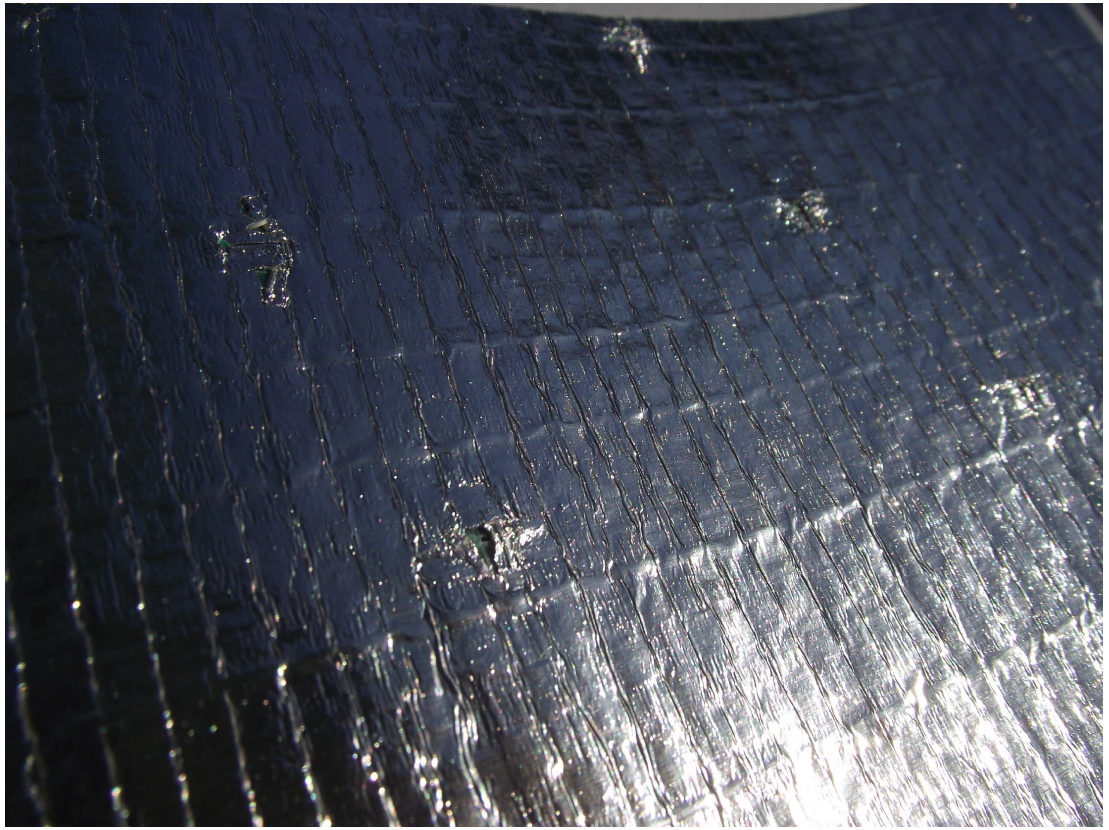
pro clima®

Temperature Resistance

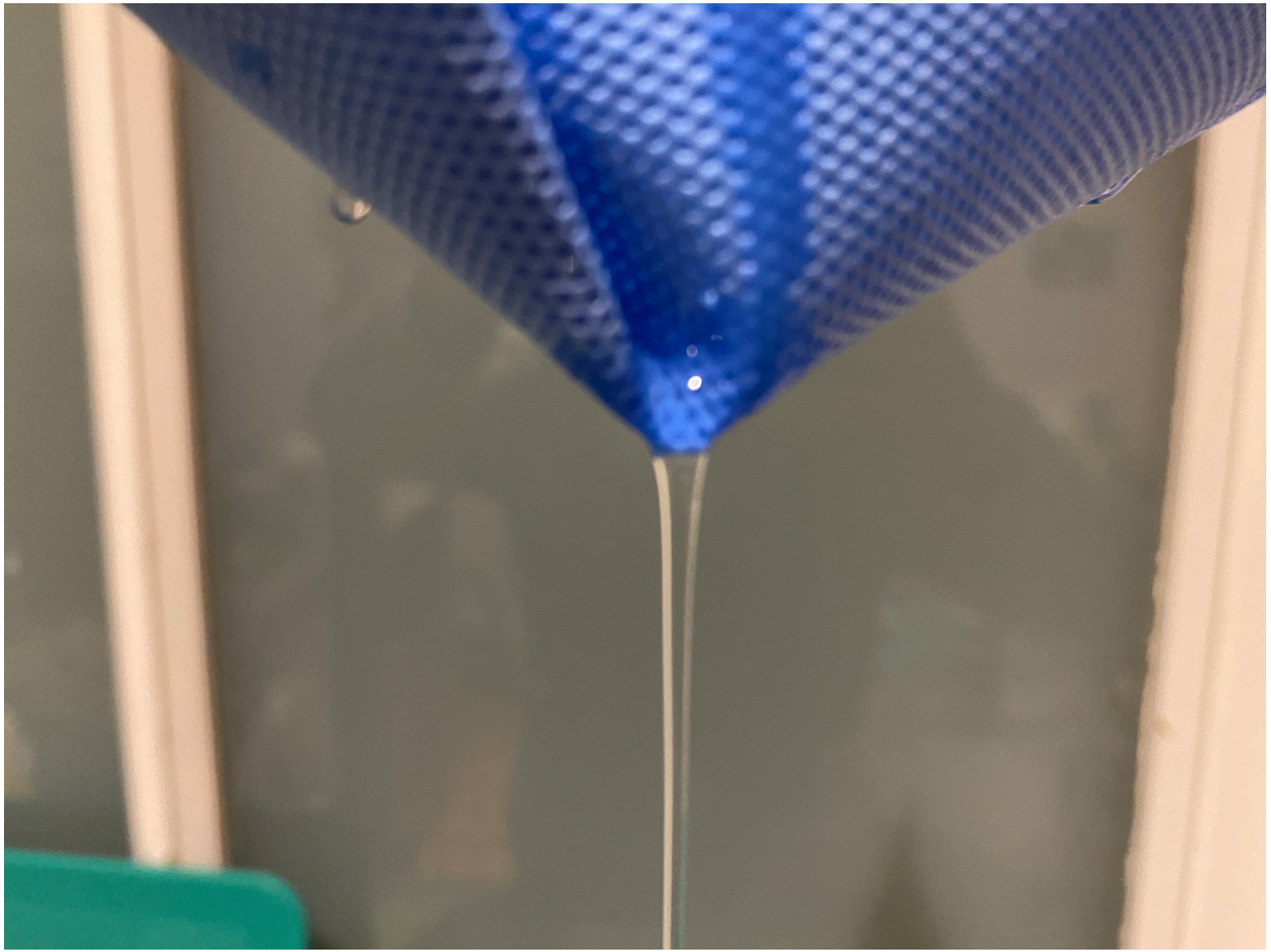


Perforations, deterioration and water protection

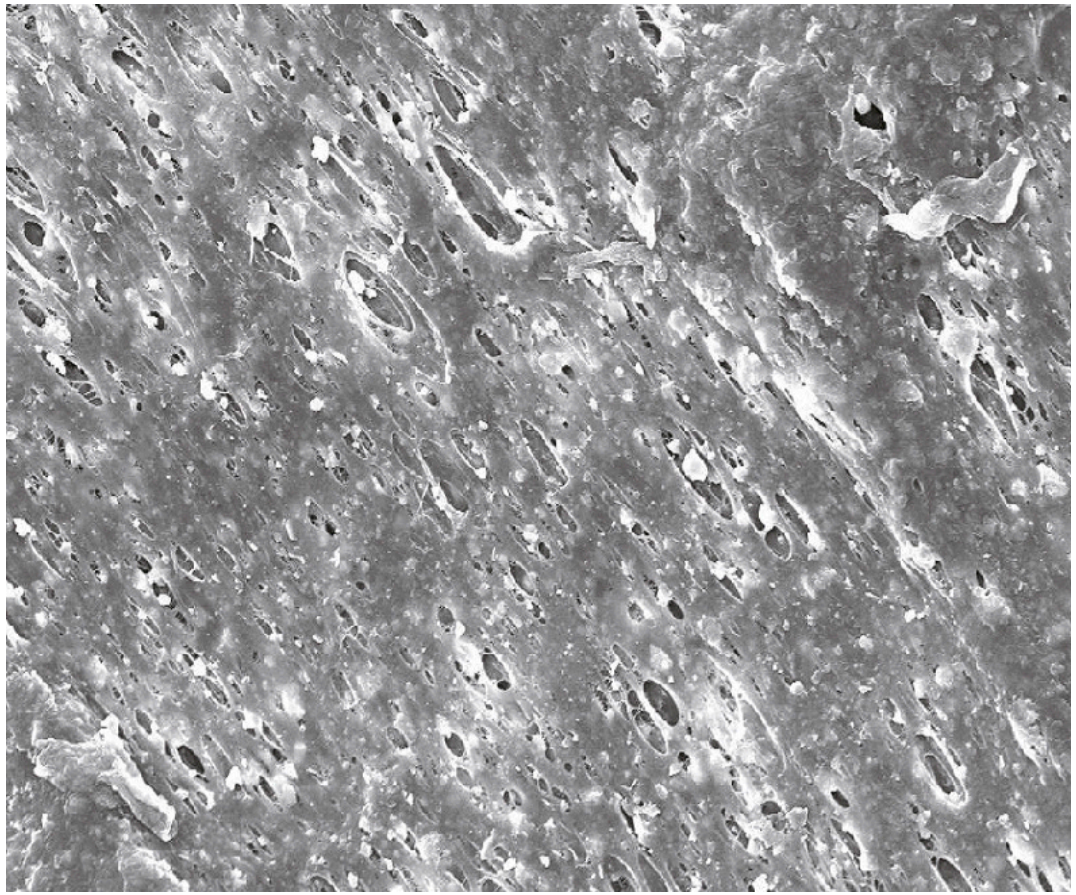


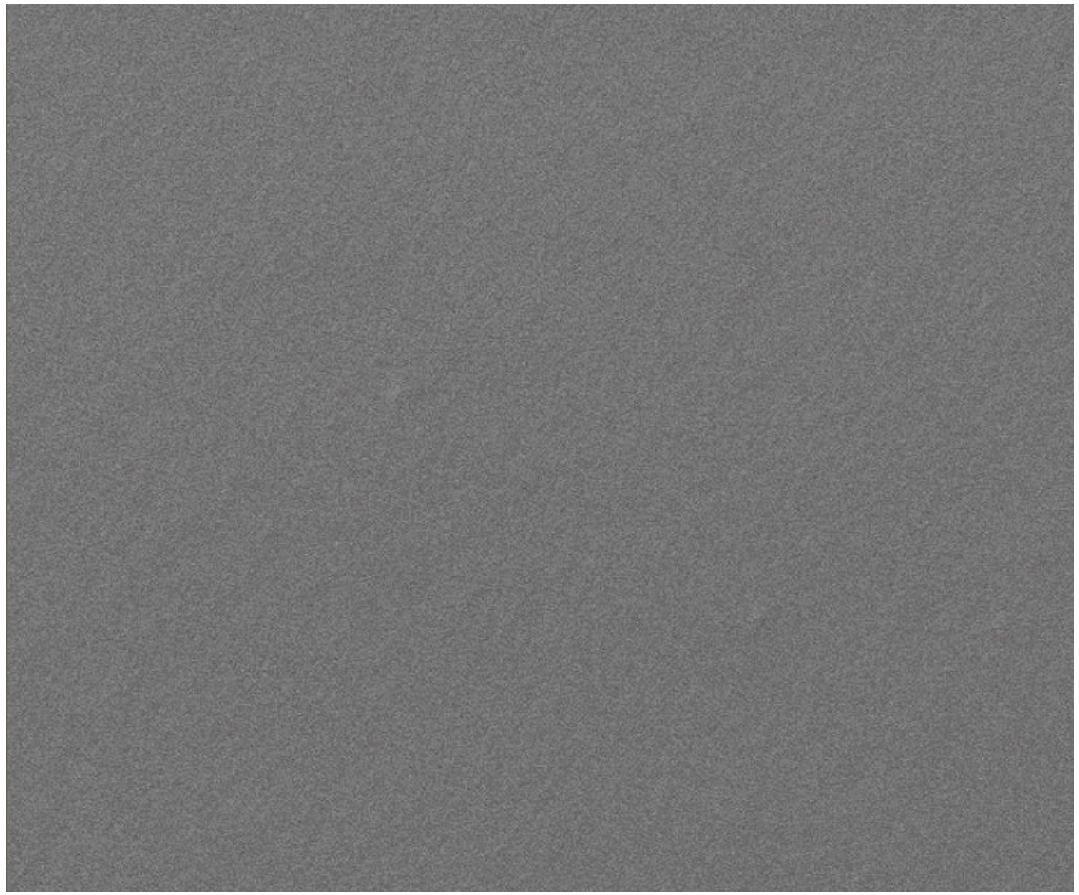


Surfactants and tenting

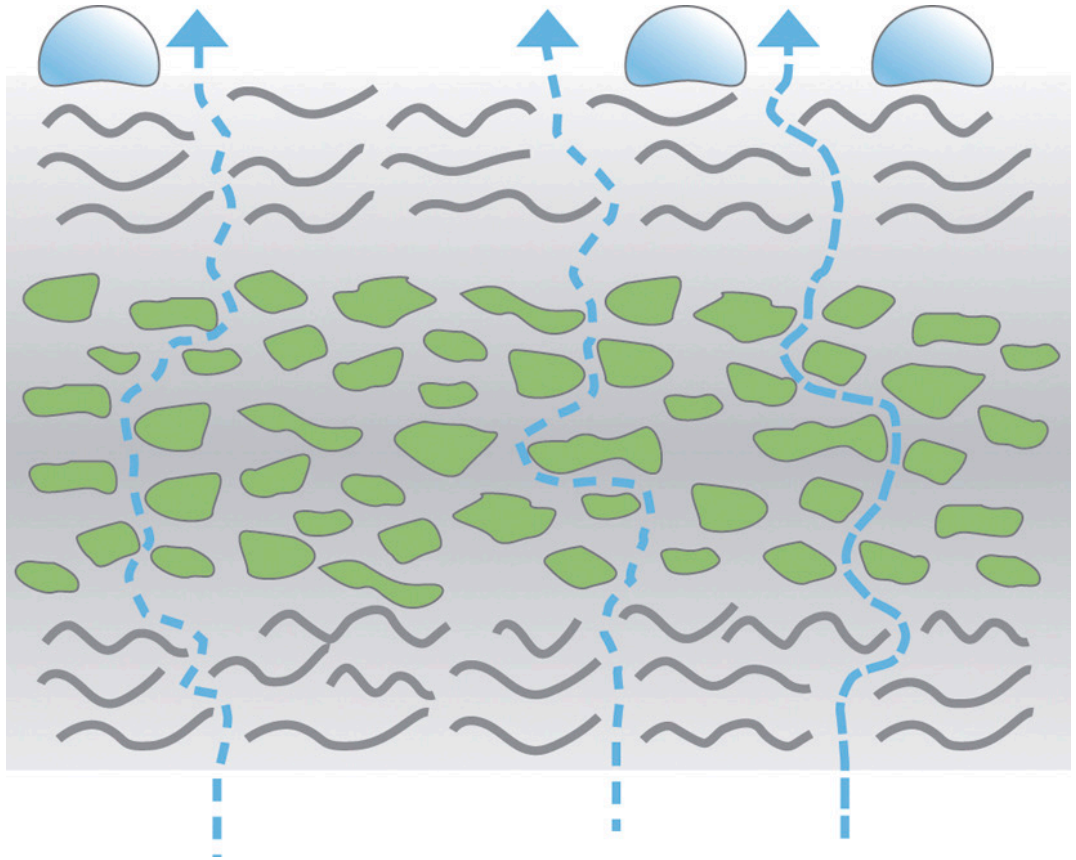


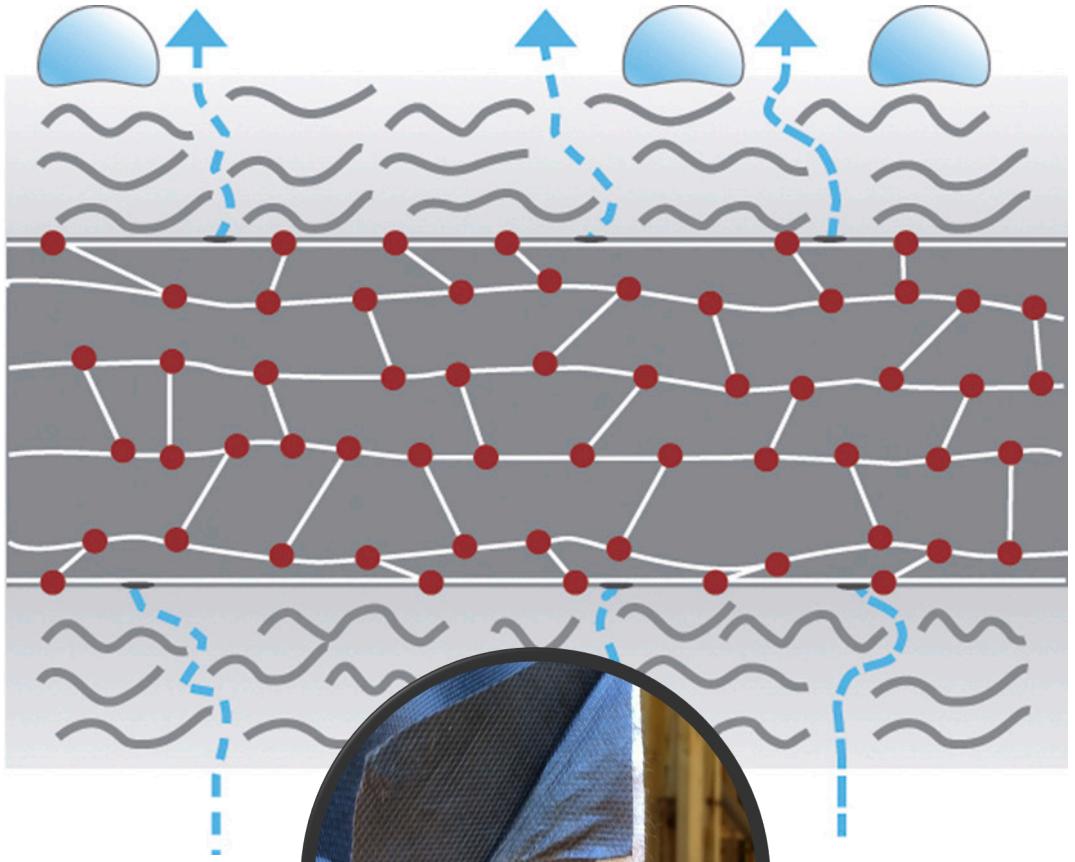
Micro-porous and Non-porous



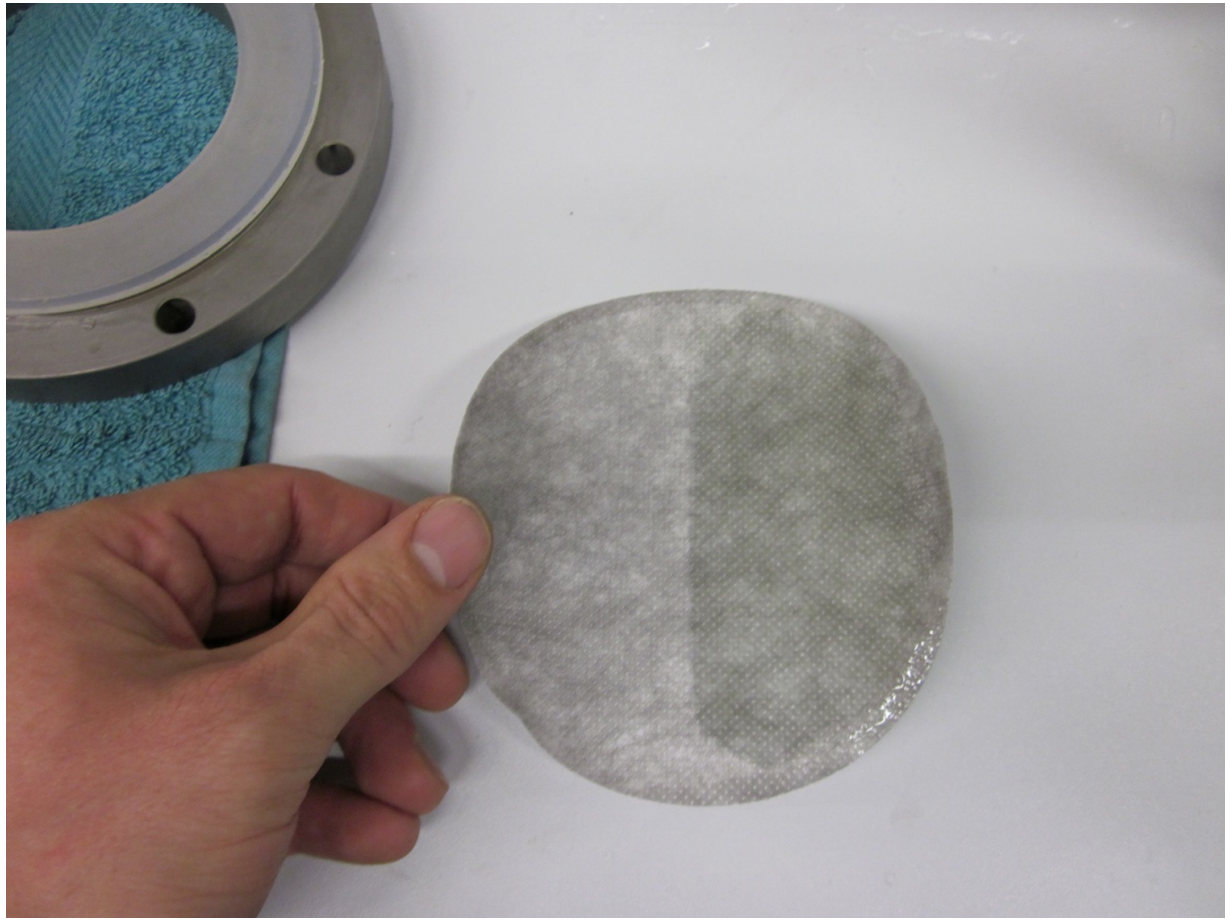


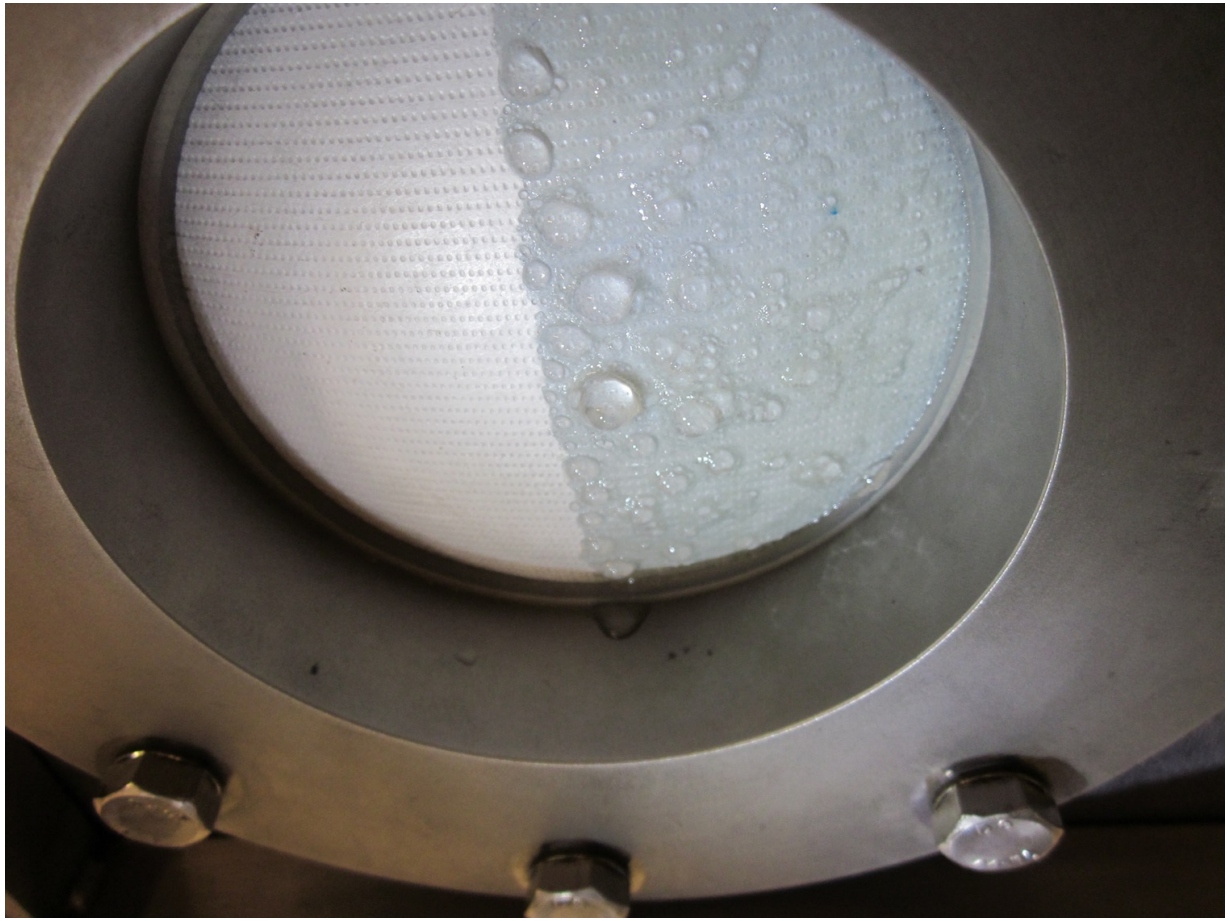
Micro-porous and Non-porous



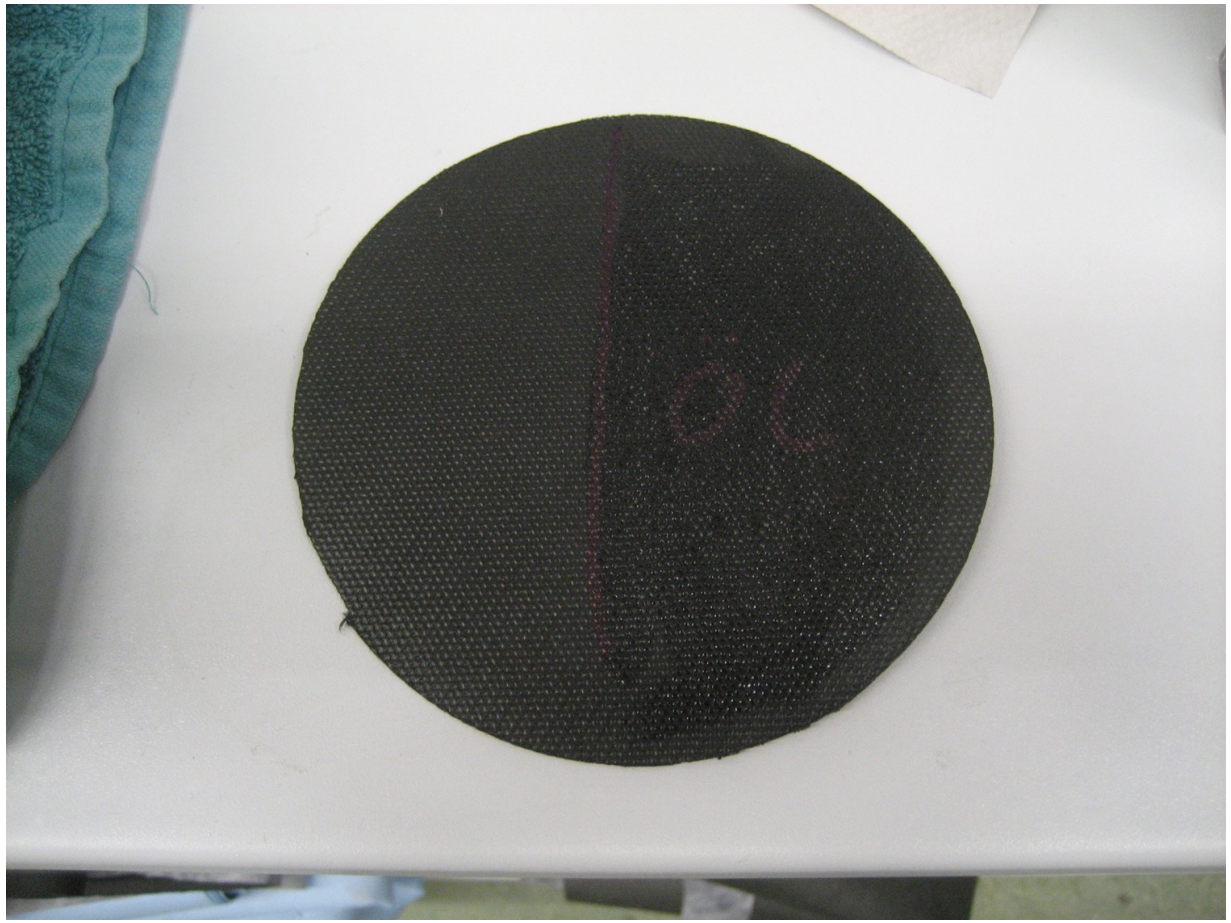


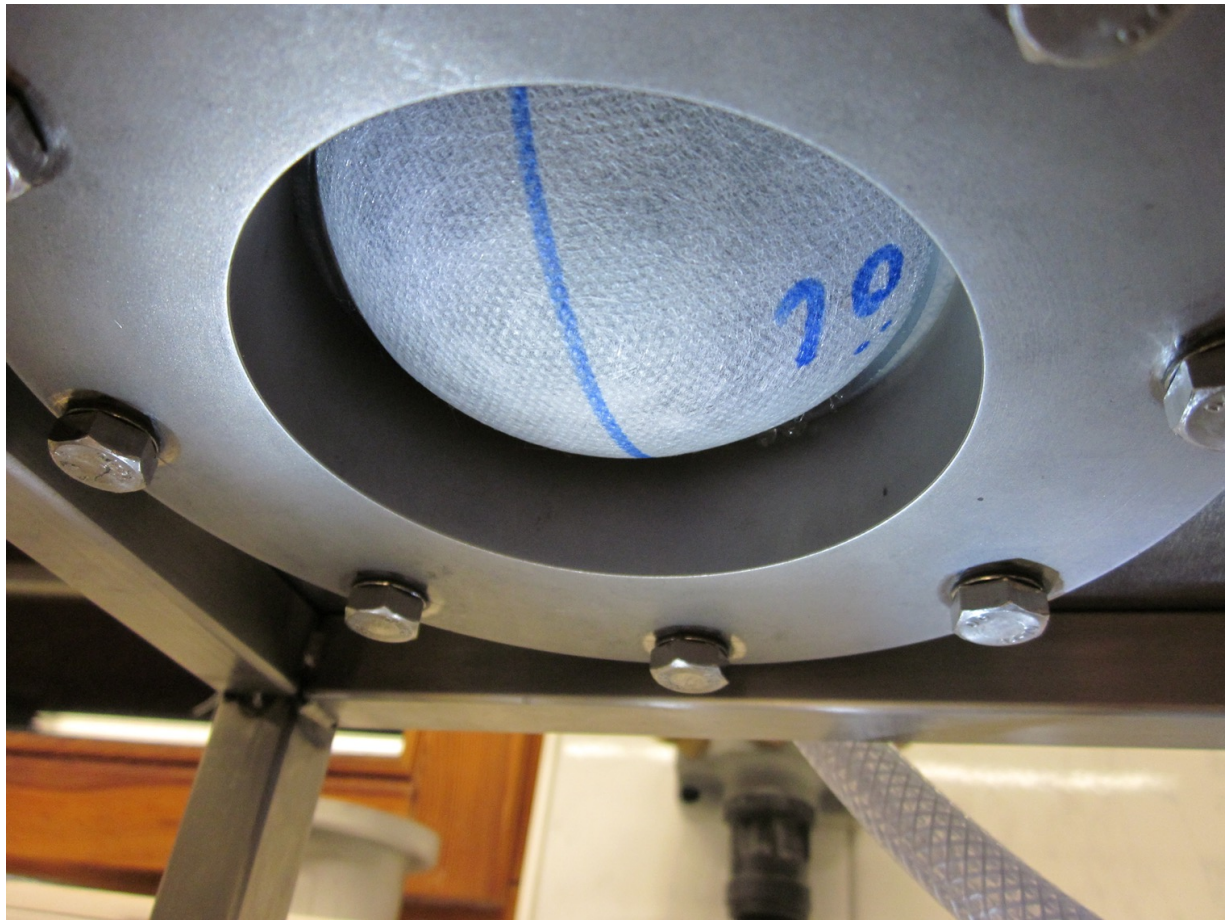
Micro-perforations, surfactants and tenting





Micro-perforations, surfactants and tenting





AUTRALIA STUDY 5

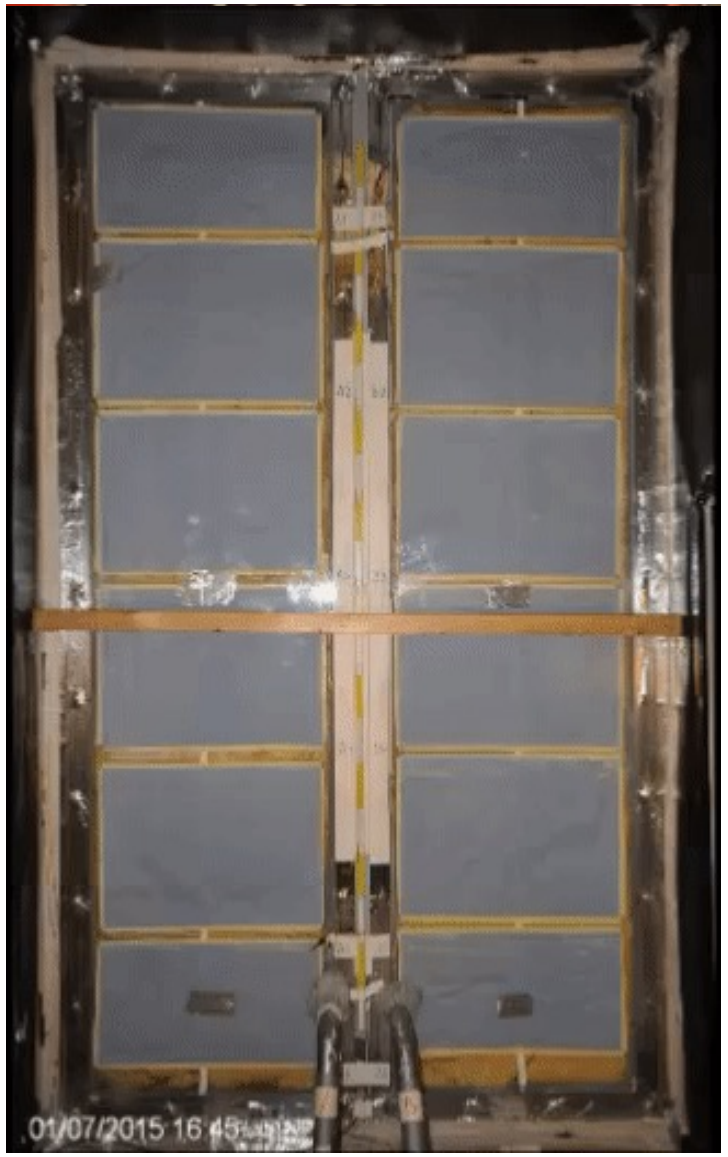
MOULD INDEX

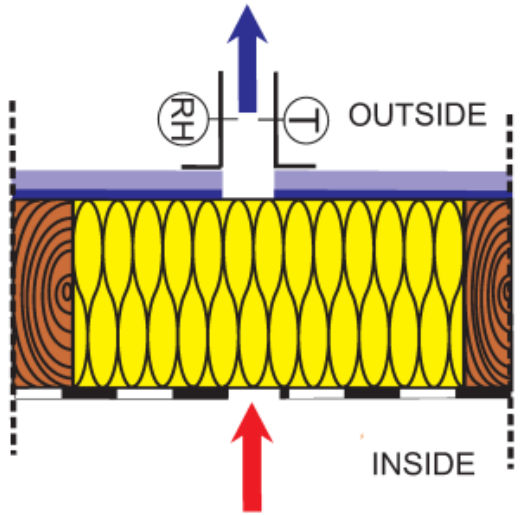
What is it and why do I care?

Hygrothermal design principles – air transported water vapour

Warm Side

Cold Side



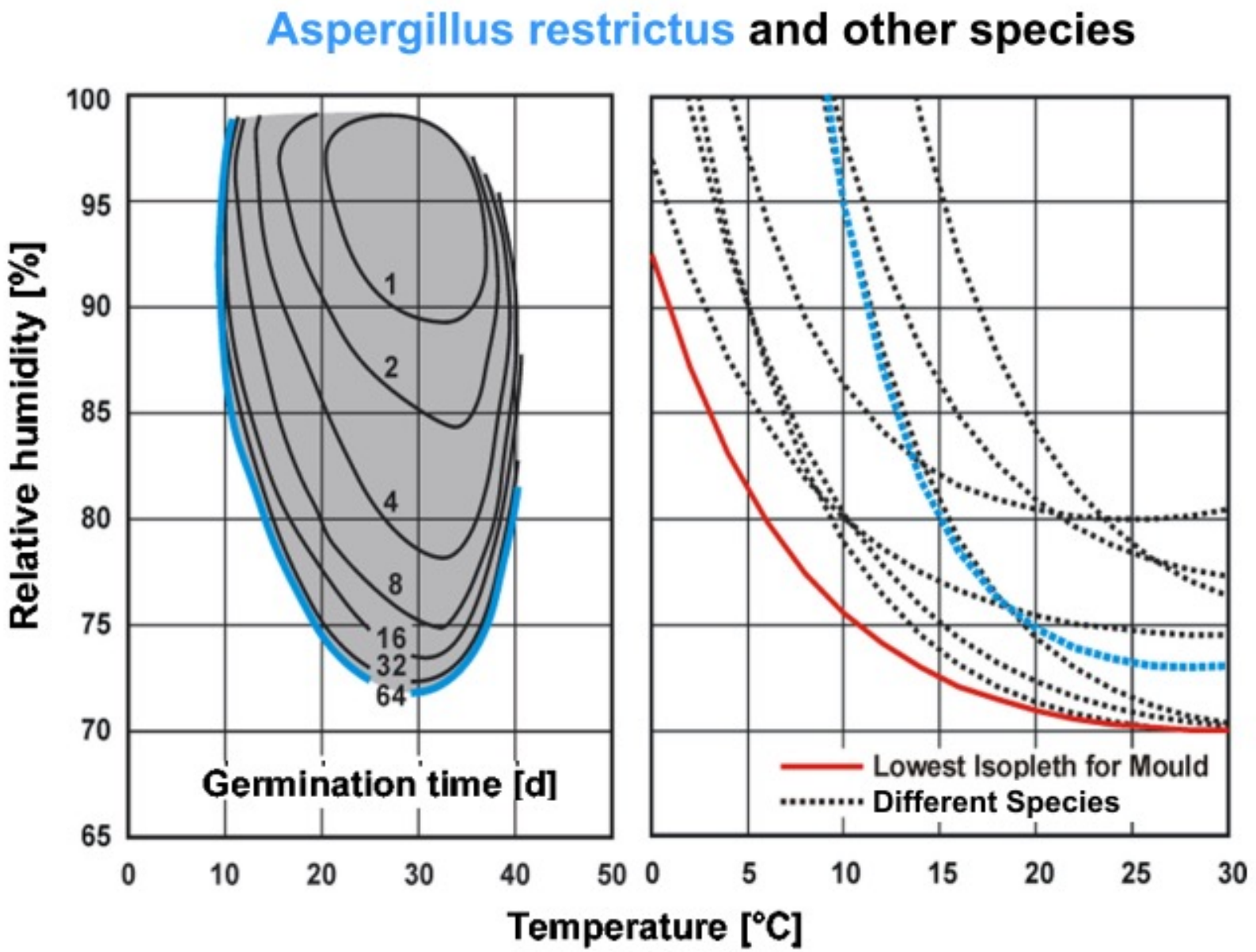


One 5mm hole in the middle of the warm side, air extraction at the bottom of cold side (5Pa)

Kolsch, Ph., Zirkelbach, D., Nusser, B., Wagner, R., Zegowitz, A., Kunzel, H.M.: Air-flow through Lightweight Wall Assemblies - Influence of Size and Location of Leakages. Buildings XIII Conference, ASHRAE 2016, pp. 459-484

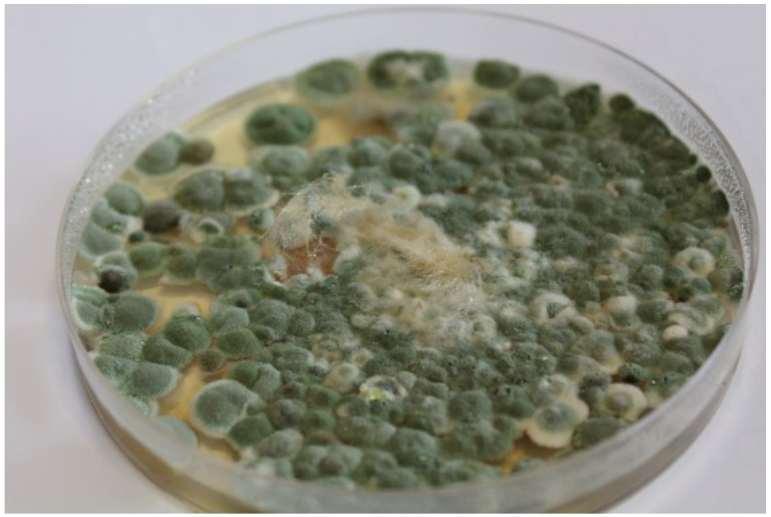
pro clima

Calculable – temperature, humidity and time

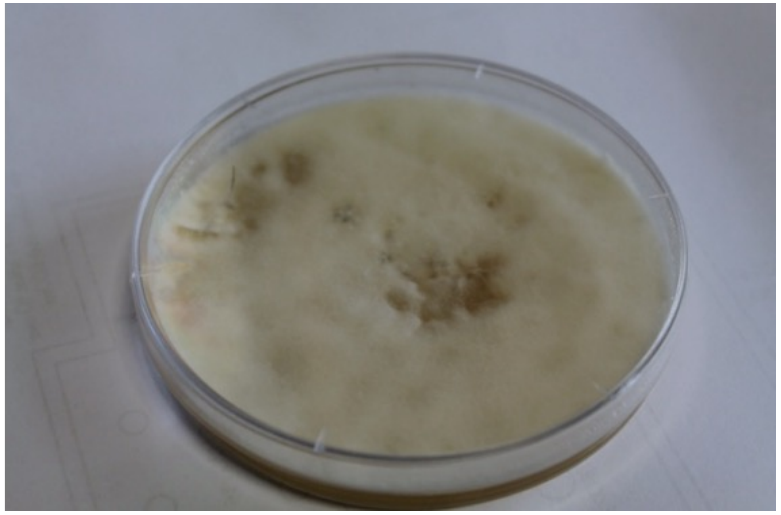


pro clima

The real world – temperature, humidity and time

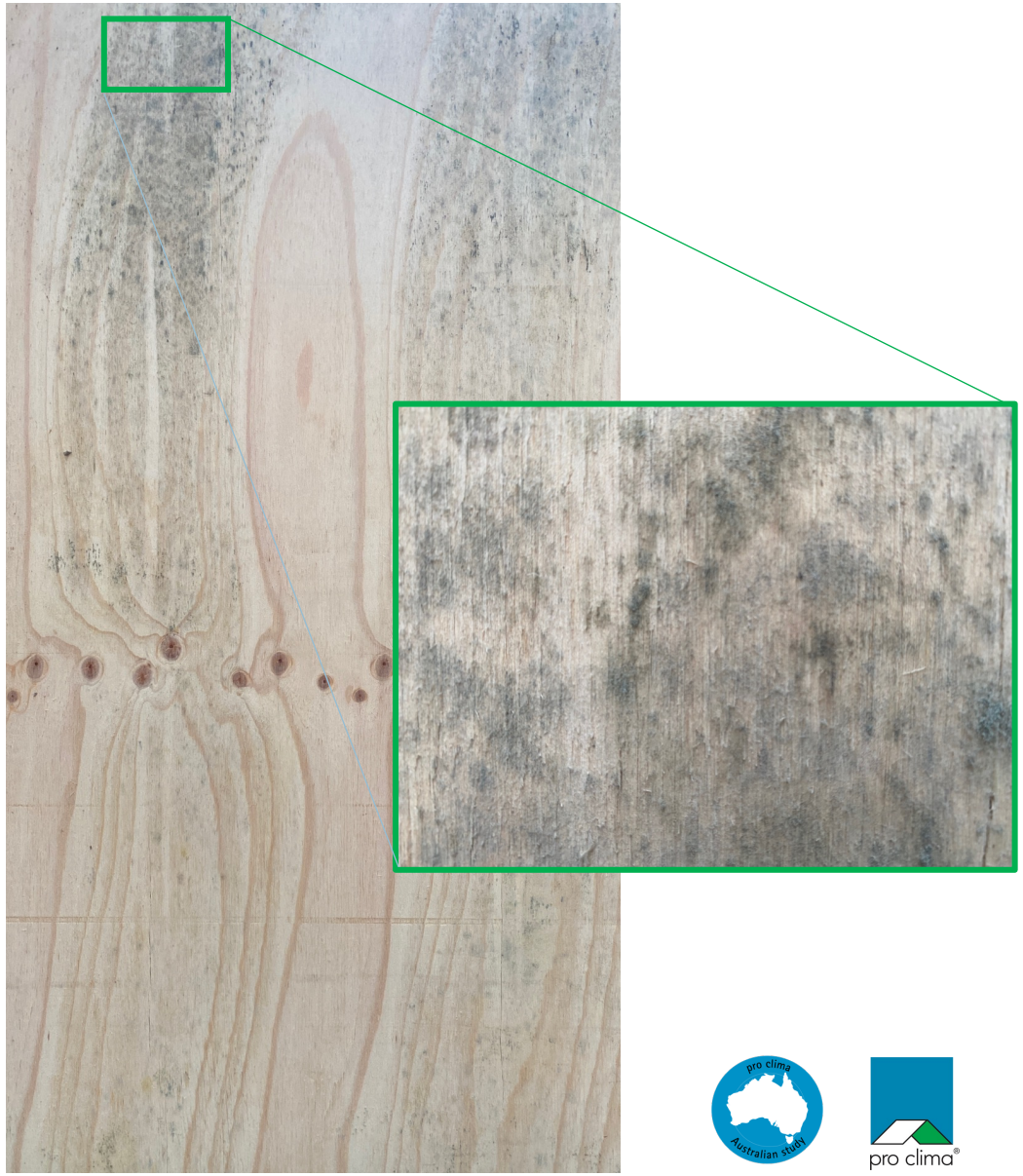


Location of collected sample of damp insulation. Fungi identified from damp insulation are penicillium, Cladosporium and alternaria.



Sample scraped from the side of roof truss. Fungi identified from side of truss is penicillium.

Hygrothermal design principles – consequences



No growth

MI = 0

Descriptions of Mould Index as described in AIRAH DA07. Originally derived from experimental results by Finnish research institute VTT and the Fraunhofer Institute for Building Physics.

pro clima Australian study

pro clima®

Several local mould growth colonies on surface (microscope)

MI = 2

Descriptions of Mould Index as described in AIRAH DA07. Originally derived from experimental results by Finnish research institute VTT and the Fraunhofer Institute for Building Physics.

pro clima Australian study

pro clima®

Visual findings, < 10 % coverage, or < 50 % coverage (microscope)

MI = 3

Descriptions of Mould Index as described in AIRAH DA07. Originally derived from experimental results by Finnish research institute VTT and the Fraunhofer Institute for Building Physics.

Heavy and tight growth, coverage about 100 %

MI = 6

Descriptions of Mould Index as described in AIRAH DA07. Originally derived from experimental results by Finnish research institute VTT and the Fraunhofer Institute for Building Physics.

pro clima Australian study

pro clima®

6 Point Scale

MI = 6

Heavy and tight growth, coverage about 100 %

MI = 3

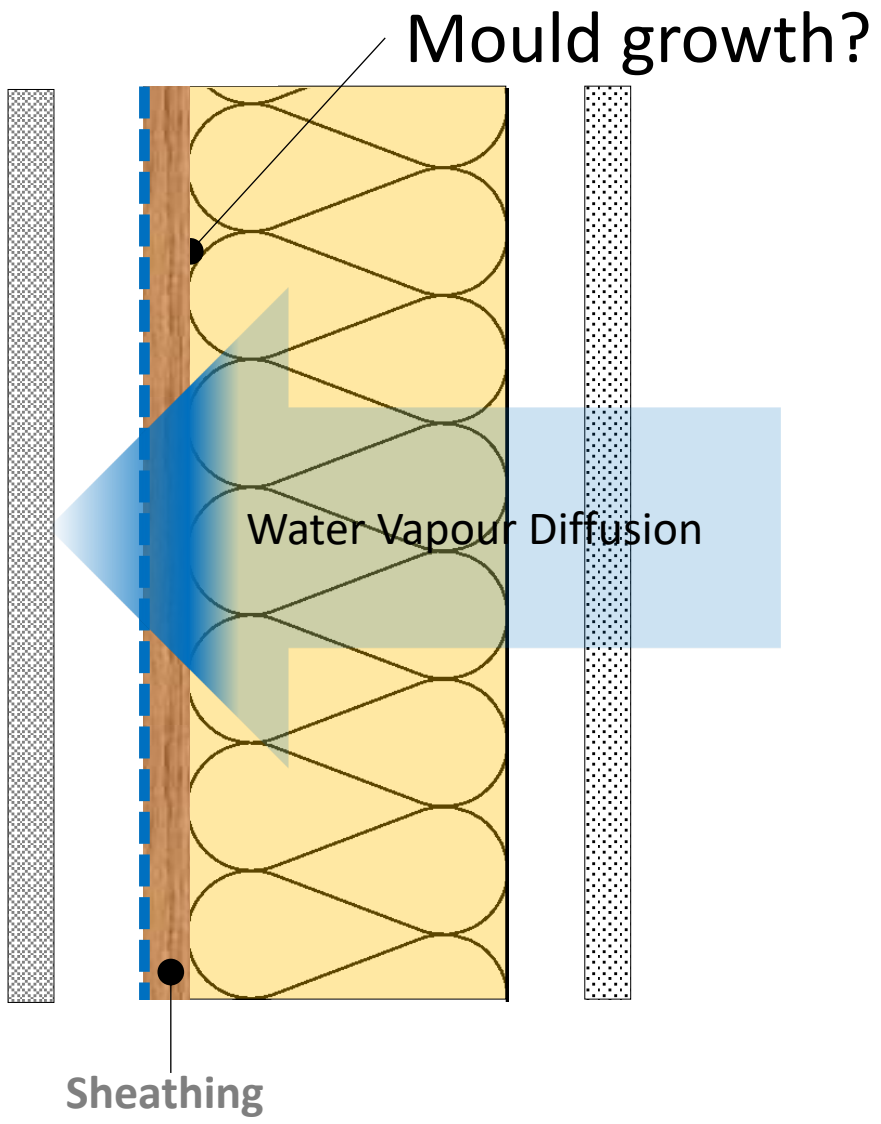
Visual findings of mould on surface, < 10 % coverage, or < 50 % coverage of mould (microscope)

MI = 2

Several local mould growth colonies on surface (microscope)

MI = 0

No growth



pro clima

AUTRALIA STUDY 6

WALLS

Non-Tropical

The design of wall systems across variable climates is highly calculable. The more airtight it is the more predictable the outcome is.

… and the insulation is perfect

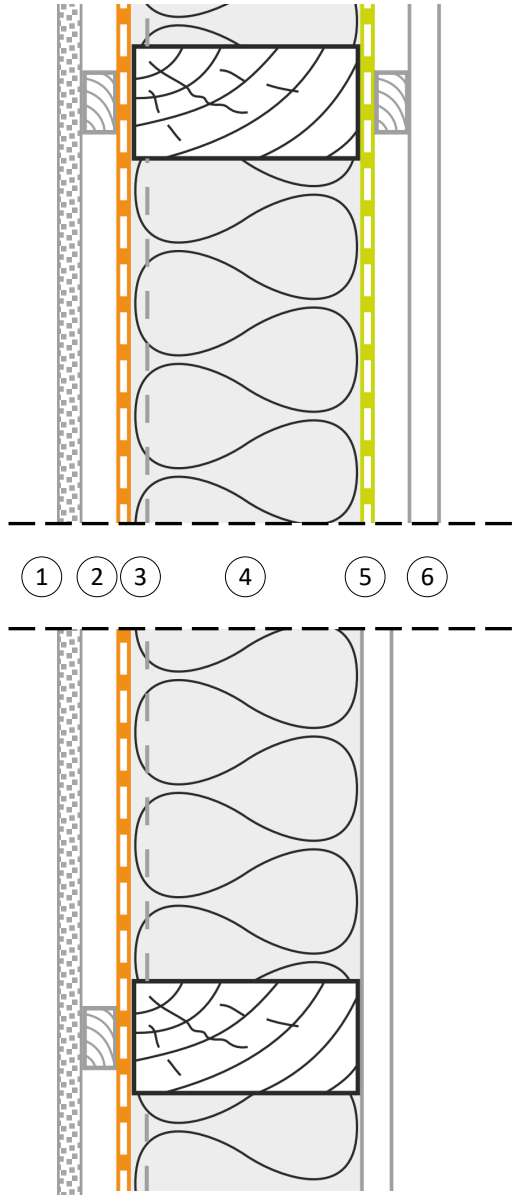
pro clima Australian study

pro clima®

With or without a smart vapor retarder

Version A1

1 Pre-finished fibre cement, 10mm
2 Drainage cavity, 20mm
3 Wall wrap, SOLITEX EXTASANA®
4 Insulation, 90mm
5.1 No Airtightness layer (A2)
5.2 Airtightness layer INTELLO® PLUS (A1)
6 Gypsum Plasterboard, 10mm

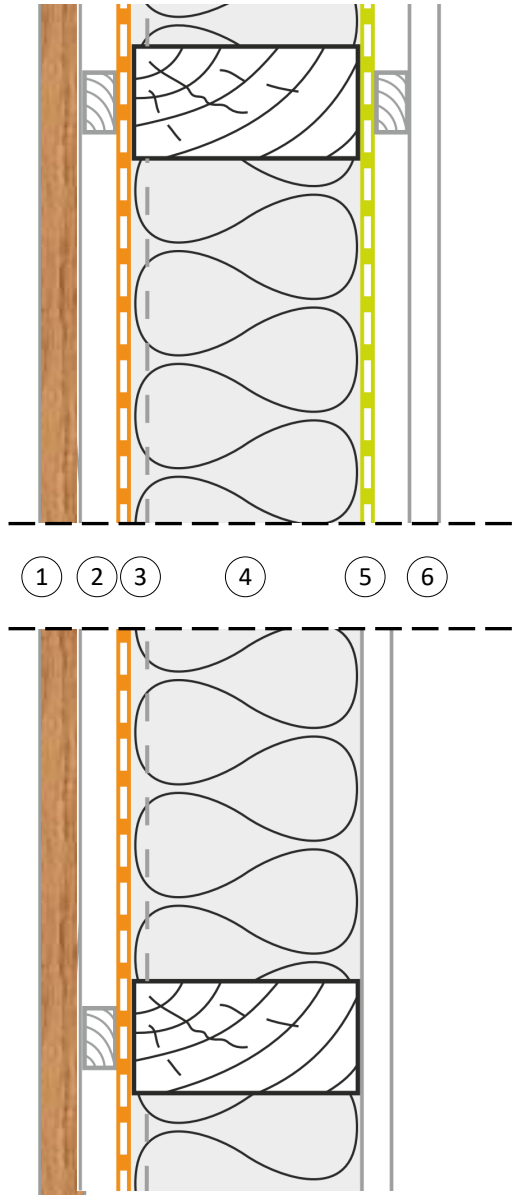


Version A2

With or without a smart vapor retarder

Version B1

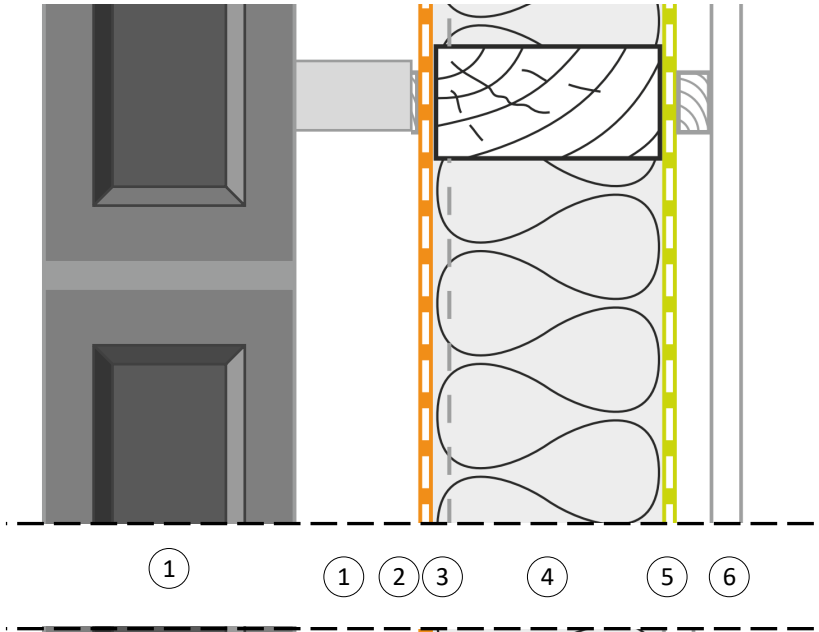
1 Timber weatherboards, 19mm
2 Drainage cavity, 20mm
3 Wall wrap, SOLITEX EXTASANA®
4 Insulation, 90mm
5.1 No Airtightness layer (B2)
5.2 Airtightness layer INTELLO® PLUS (B1)
6 Gypsum Plasterboard, 10mm



Version B2

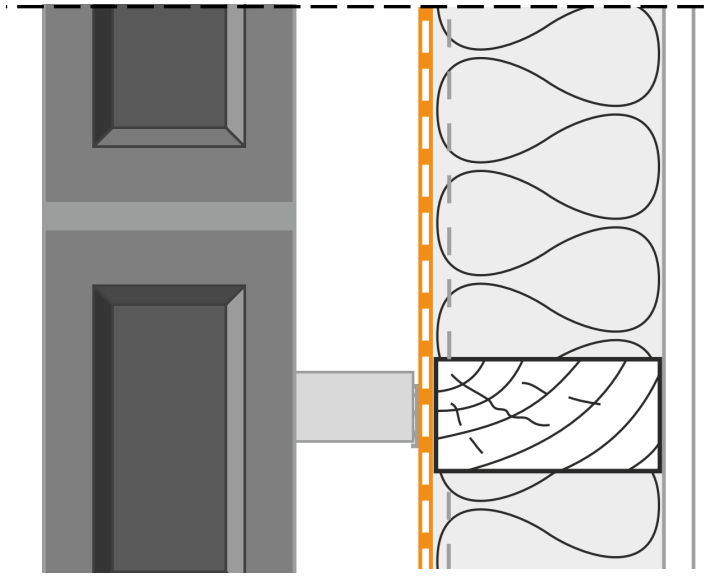
With or without a smart vapor retarder

Version C1

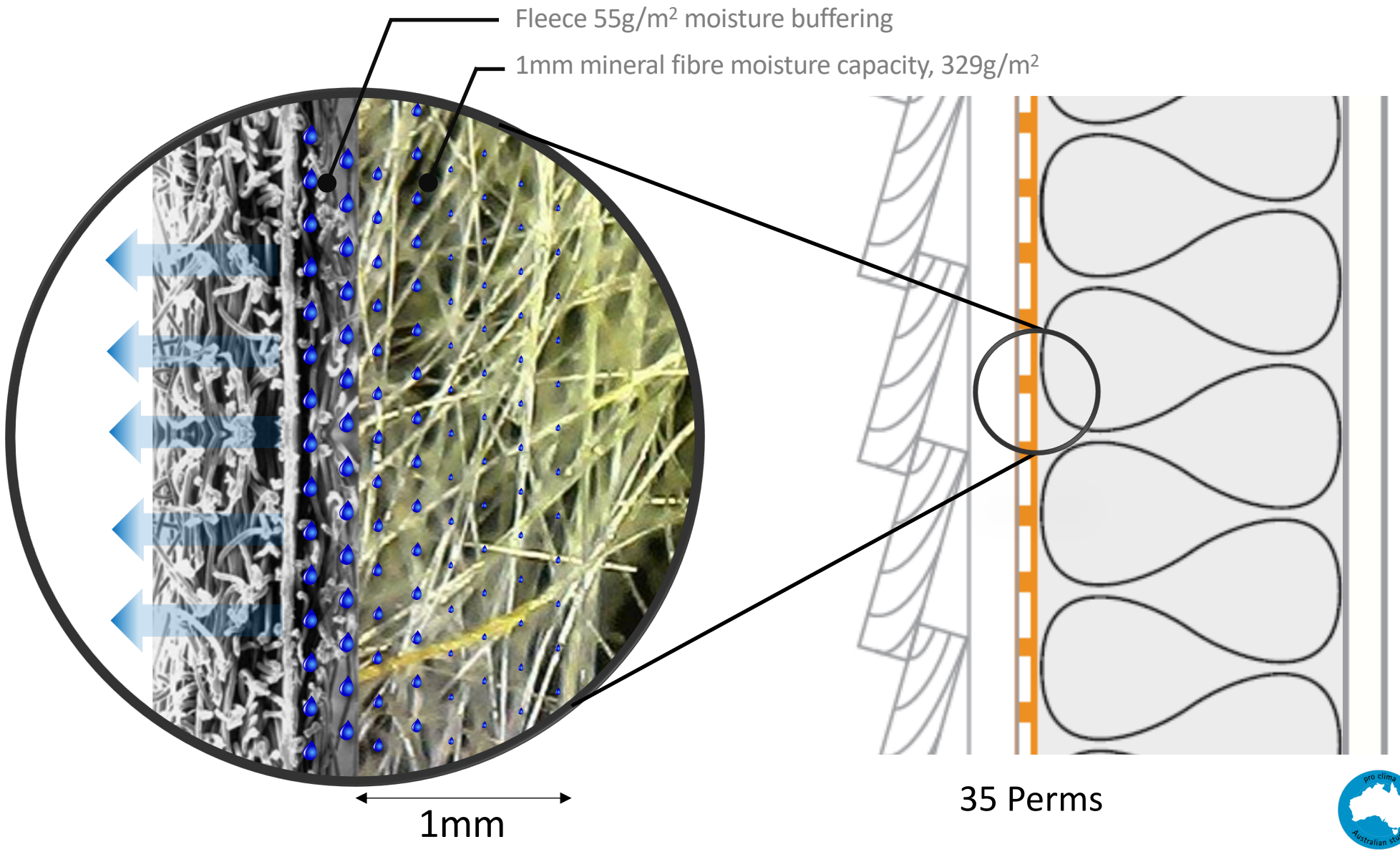


1 Brickwork, 110mm
2 Drainage cavity, 50mm
3 Wall wrap, SOLITEX EXTASANA®
4 Insulation, 90mm
6.1 No Airtightness layer (C2)
6.2 Airtightness layer INTELLO® PLUS (C1)
7 Gypsum Plasterboard, 10mm

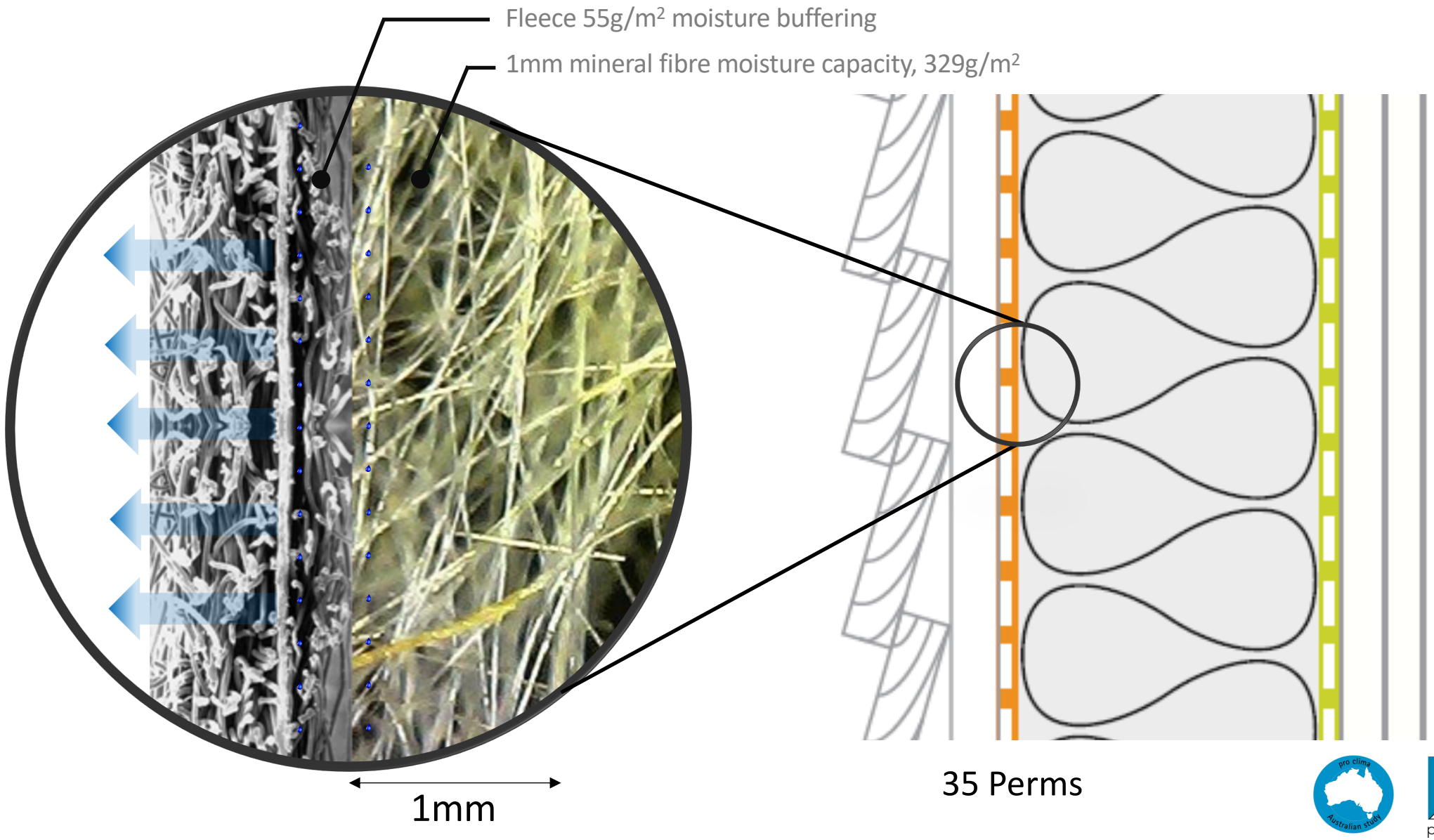
Version C2



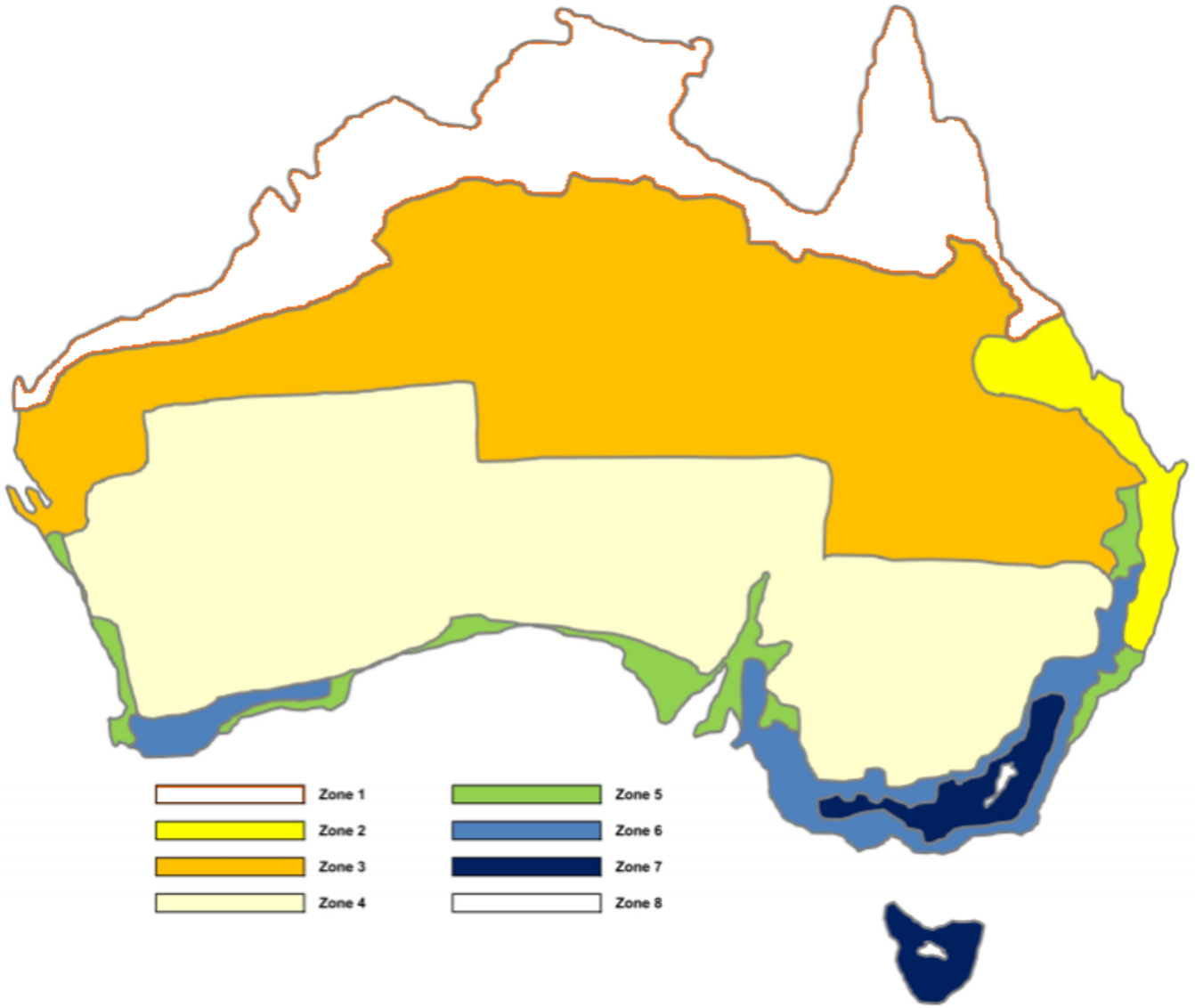
With or without a smart vapor retarder



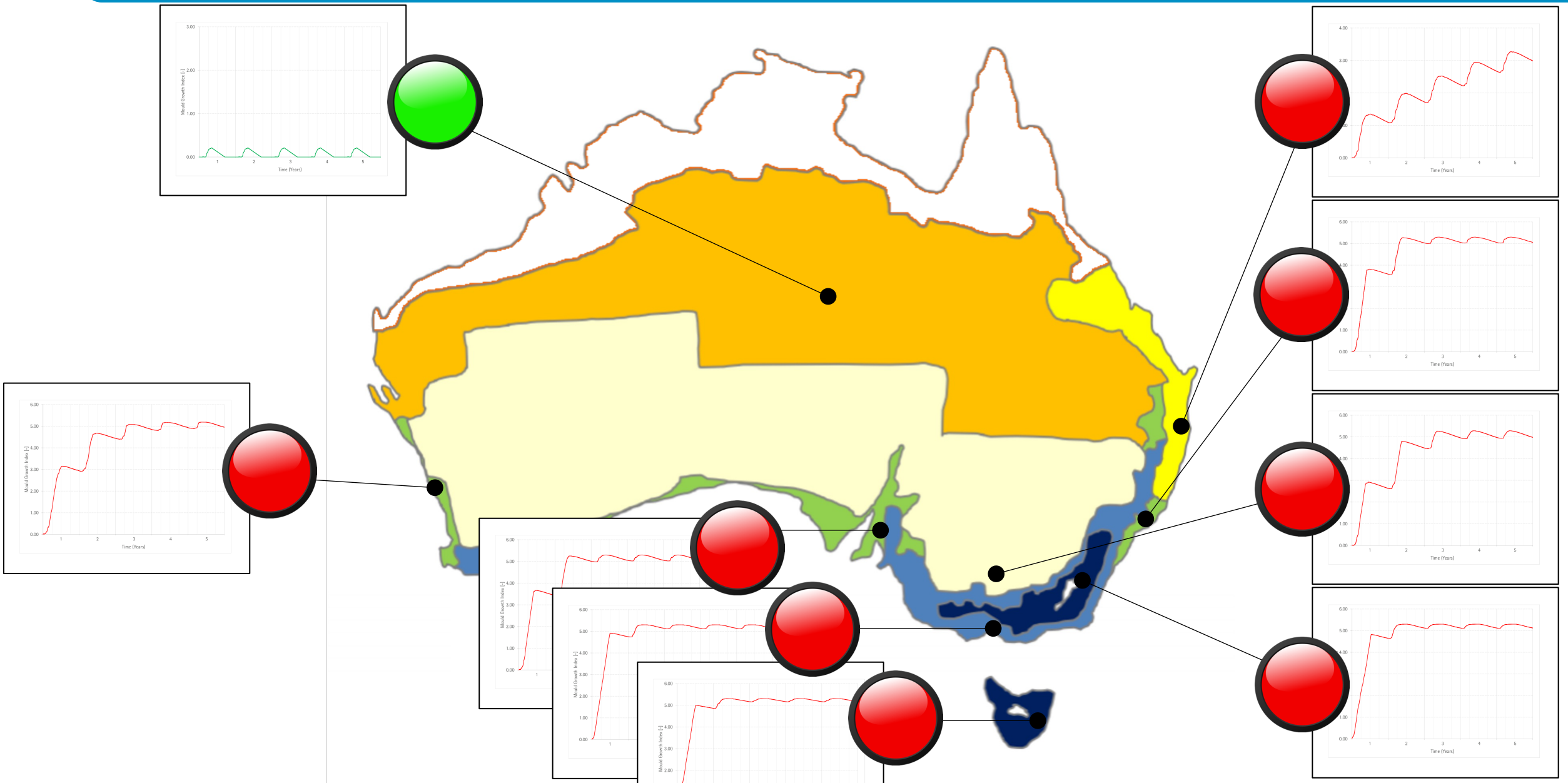
With or without a smart vapor retarder



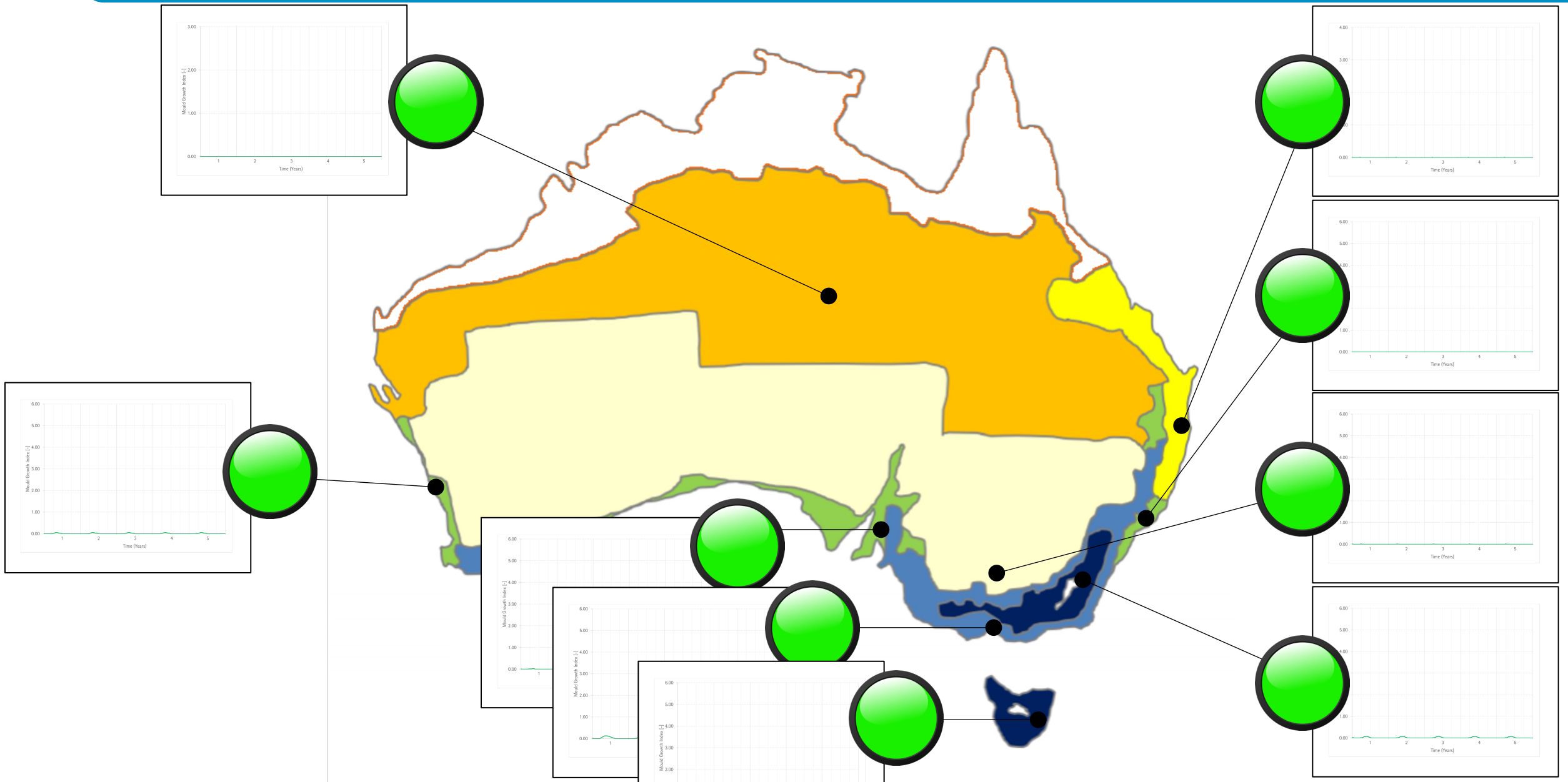
Calculation without a smart vapor retarder



Calculation without a smart vapor retarder



Calculation with a smart vapor retarder



AUTRALIA STUDY 7

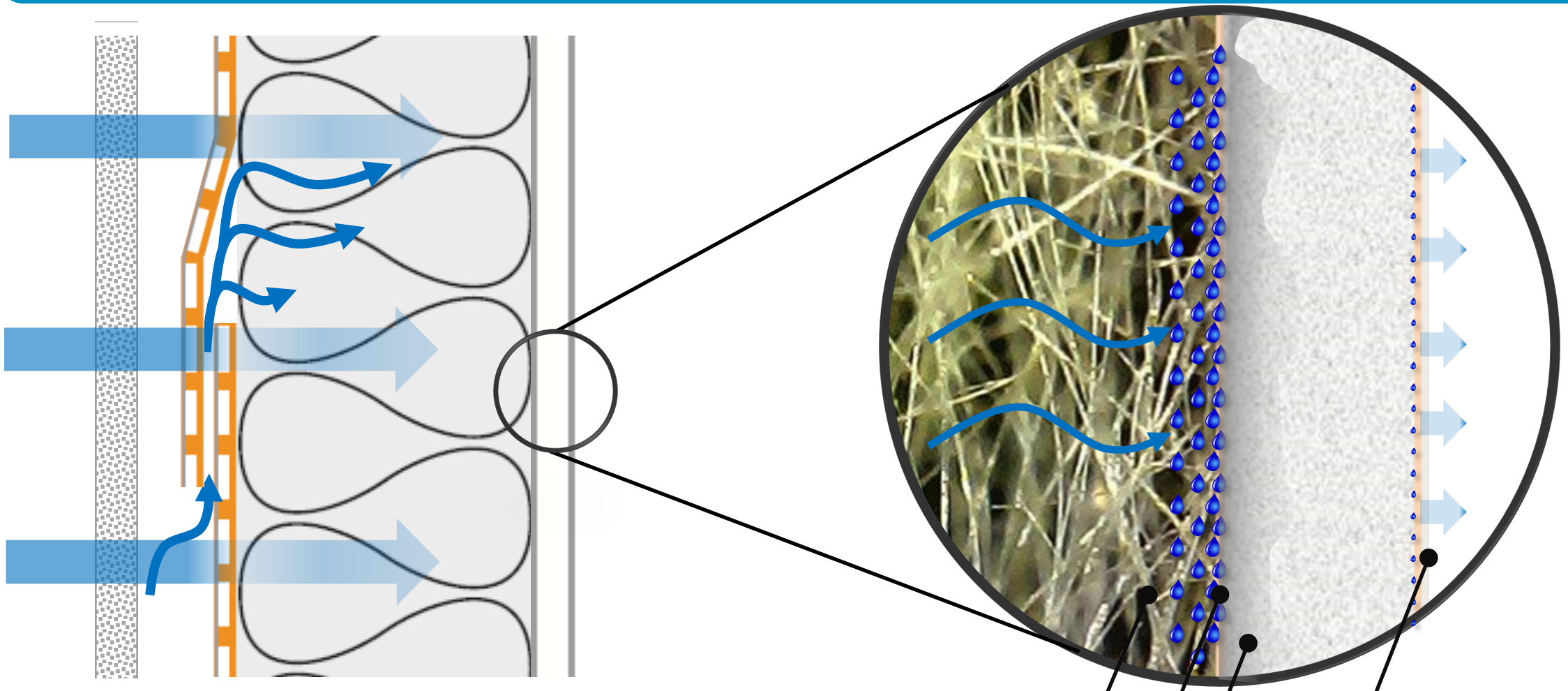
WALLS

Tropical

The tropics are backwards

… and the insulation is perfect

Poorly sealed WRB



35 Perms

Humid conditions in the 1mm glasswool layer

Gypsum paper facing (food for mould)

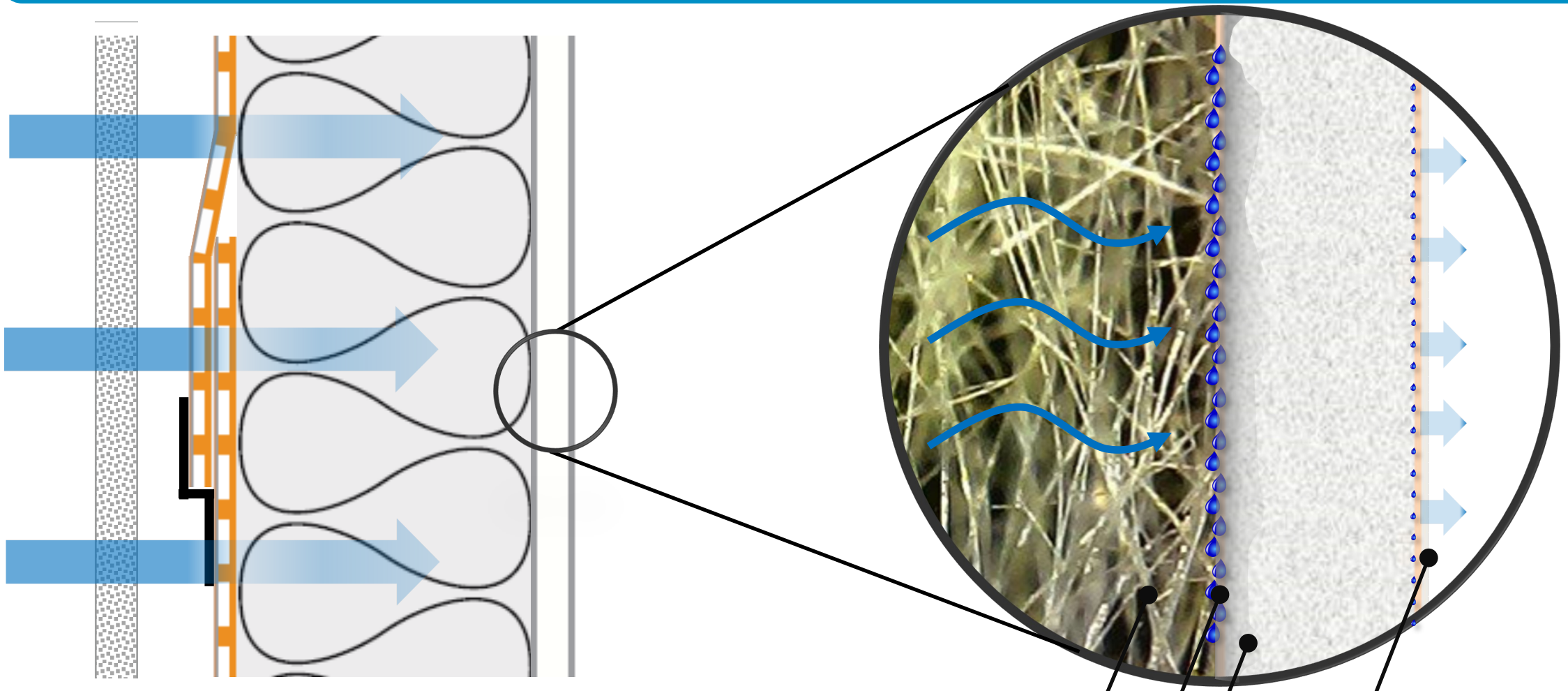
Mould growth risk on paper face and within gypsum

Semi-gloss paint finish (3.5 MN.s/g) resists drying

pro clima Australian study

pro clima®

Sealed WRB



35 Perms

Humid conditions in the 1mm glasswool layer

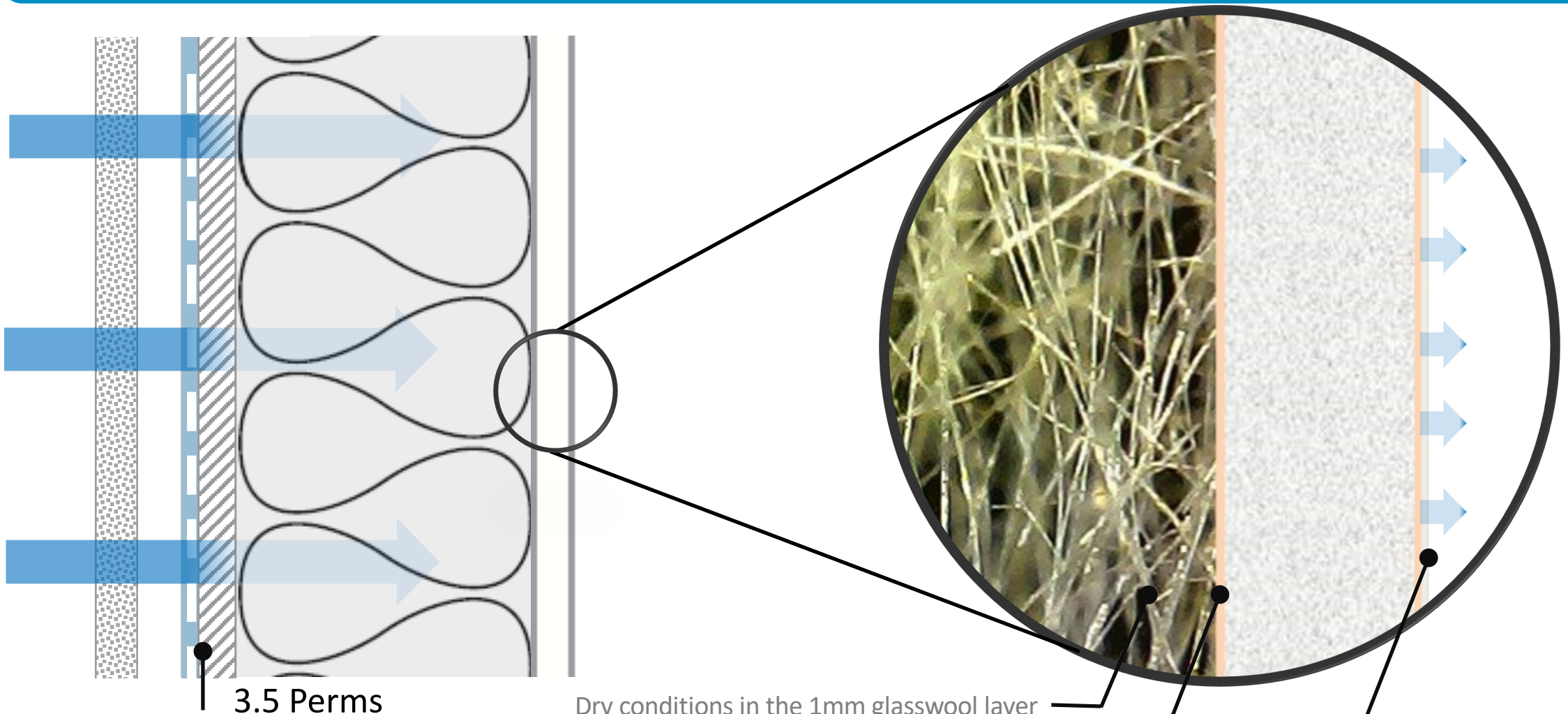
Gypsum paper facing (food for mould)

Mould growth risk on paper face and within gypsum

Semi-gloss paint finish (3.5 MN.s/g) resists drying

pro clima

Rigid bracing board with peel & stick membrane



3.5 Perms

Wind tight composite WRB system used for diffusion control limiting water vapour into assembly.

Dry conditions in the 1mm glasswool layer

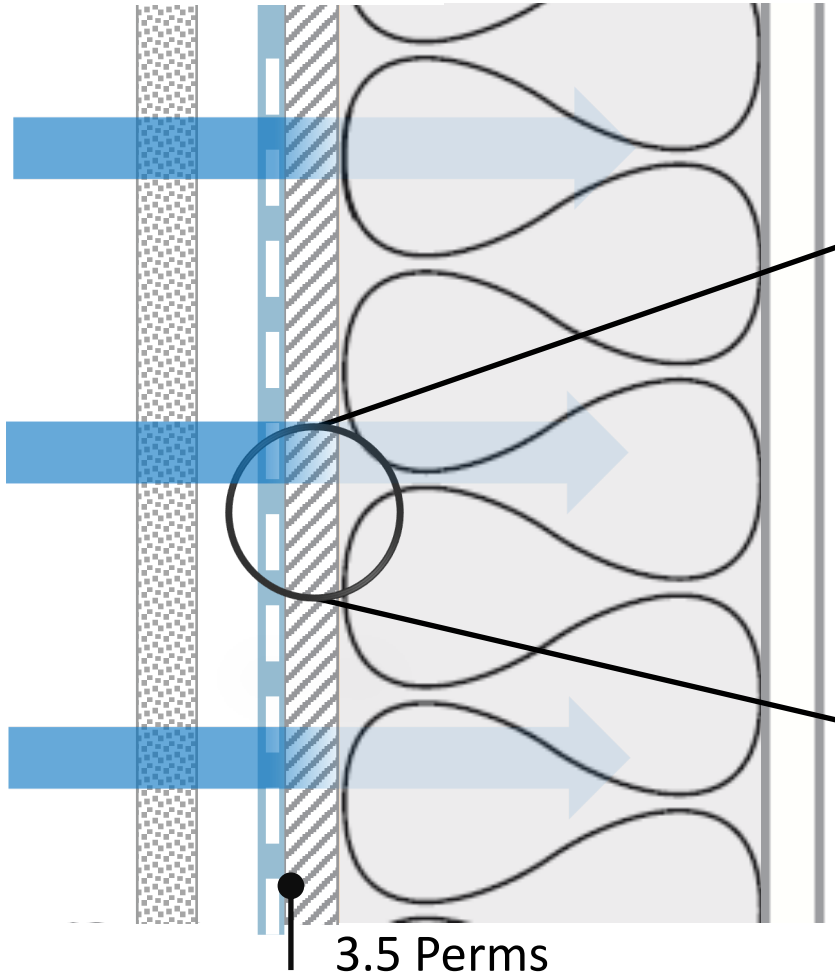
Gypsum paper facing (Dry)

Semi-gloss paint finish (3.5 MN.s/g)

pro clima Australian study

pro clima®

Rigid bracing board with peel & stick membrane



3.5 Perms

Wind tight composite WRB system used for diffusion control limiting water vapour into assembly.

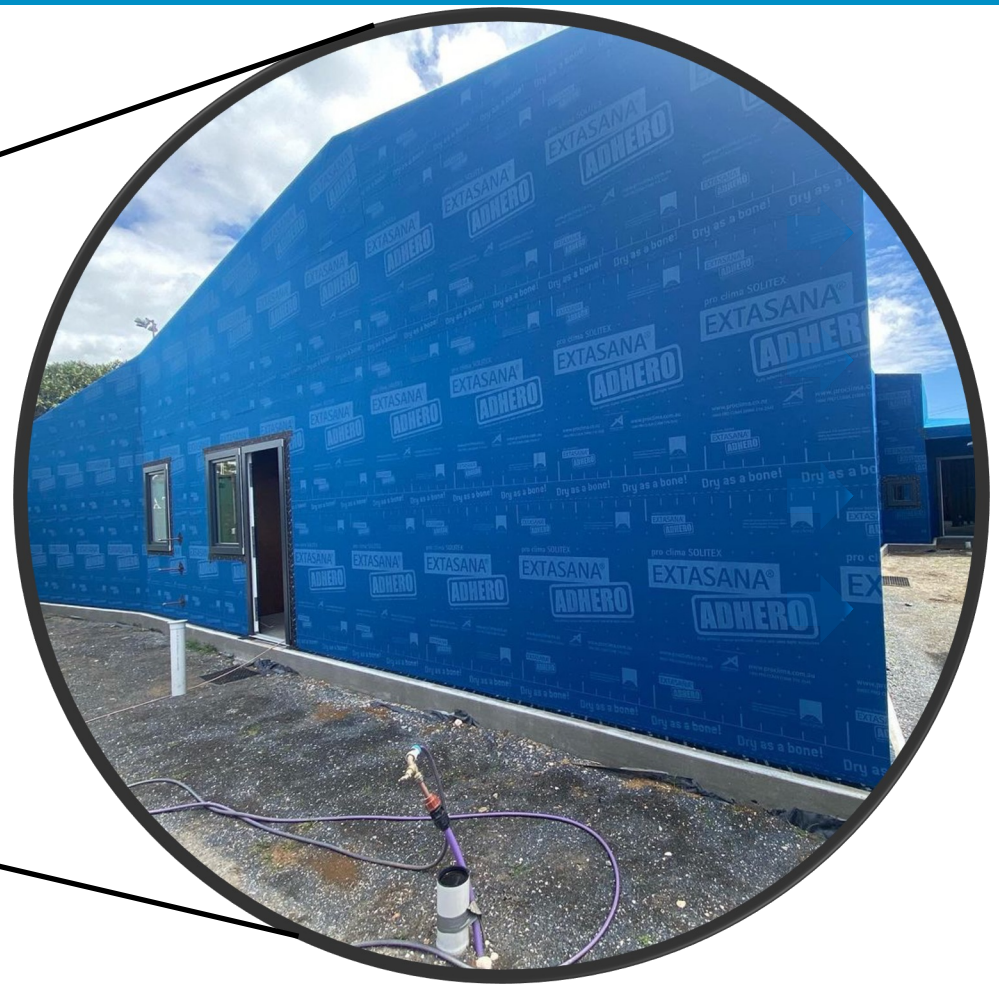
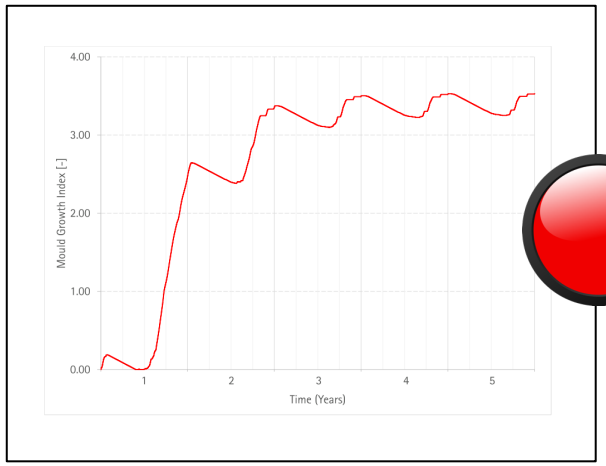
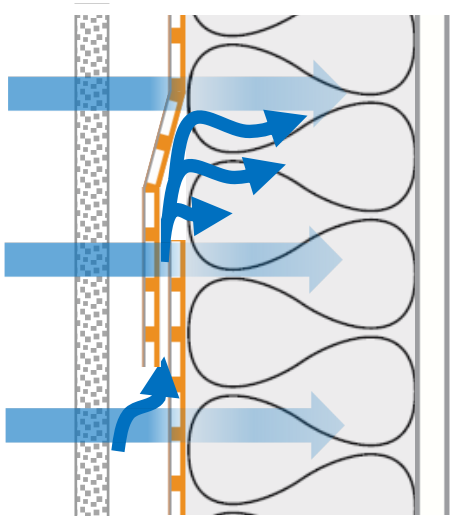


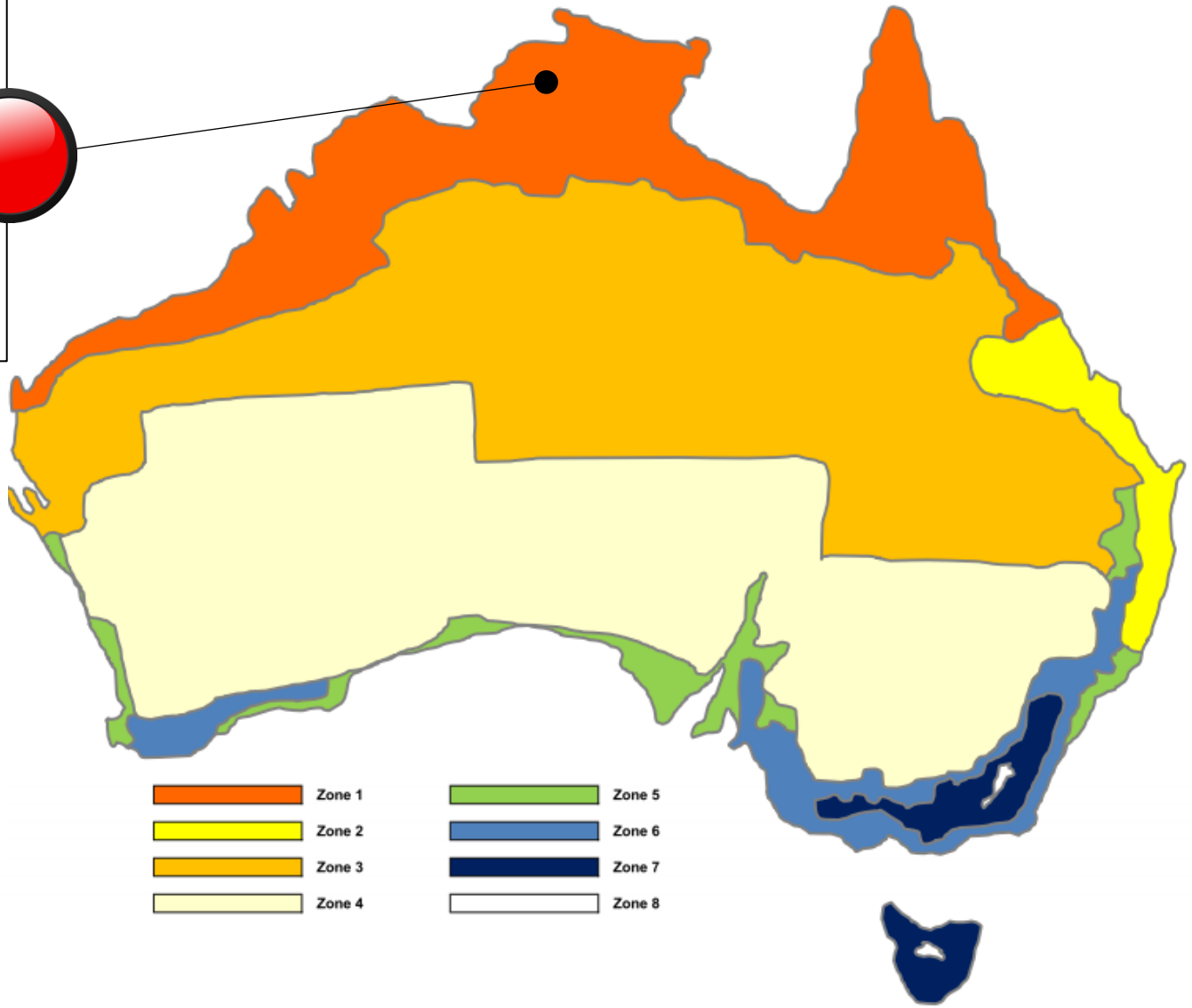
Image credit: Scholten Group

pro clima

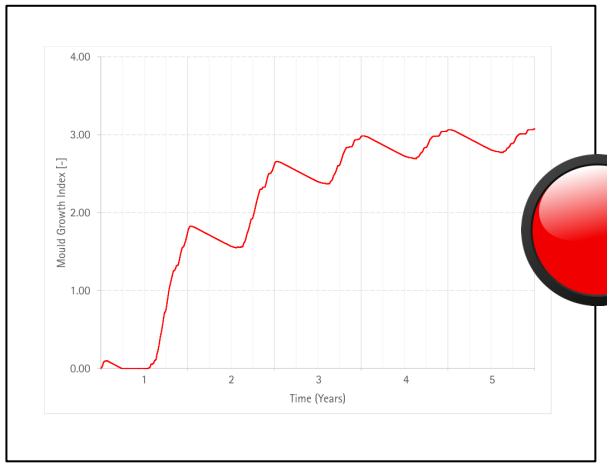
Calculation with air leaky external WRB

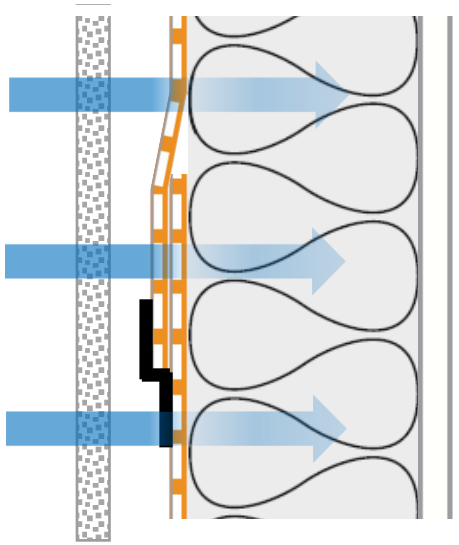


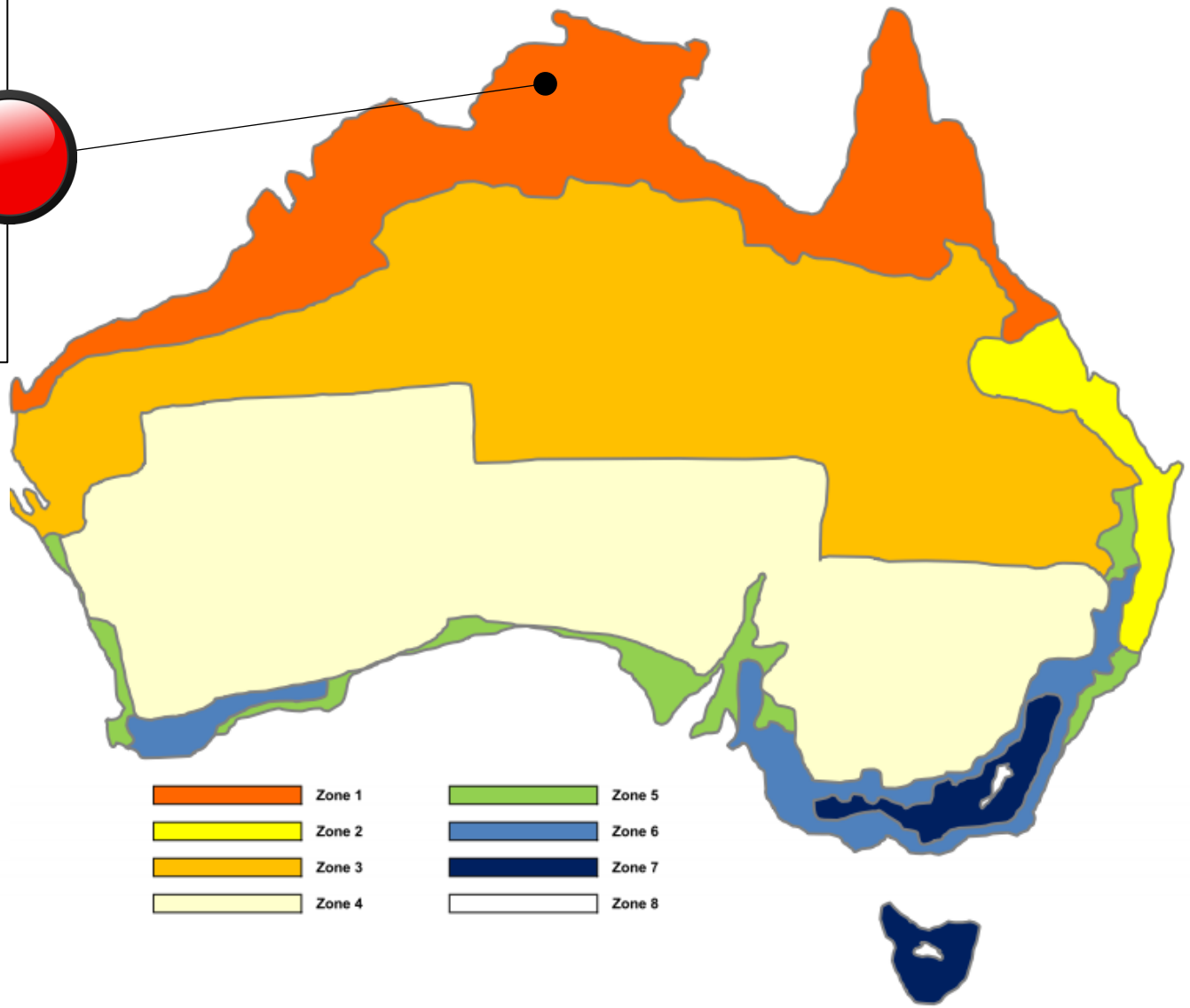




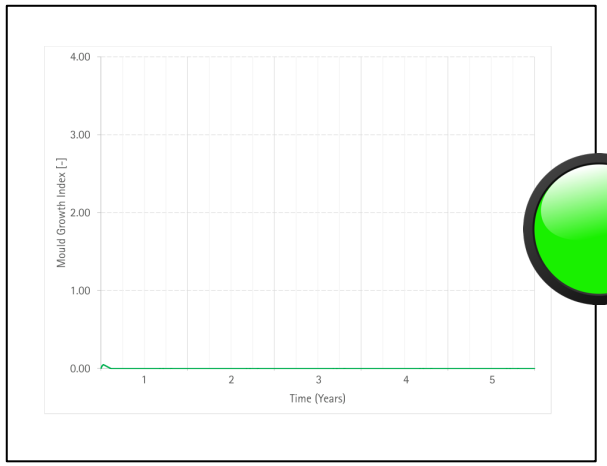
Calculation with sealed external WRB

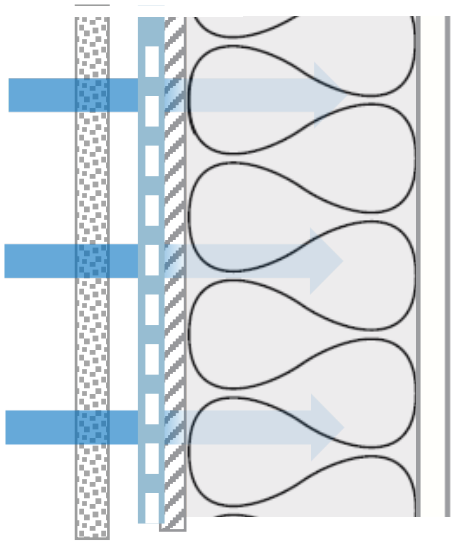


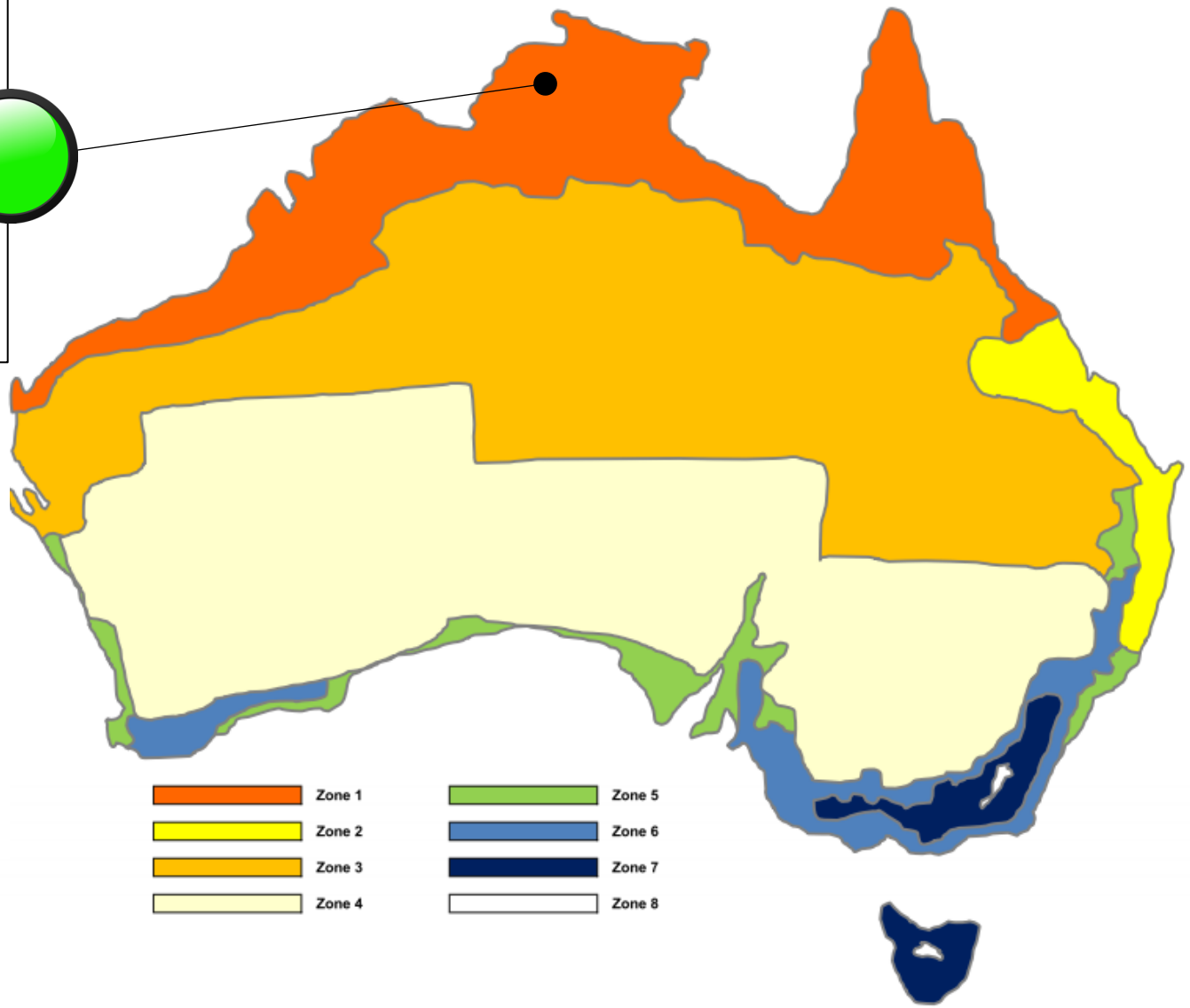




Calculation with sealed fully adhesive WRB







pro clima

AUTRALIA
STUDY

8

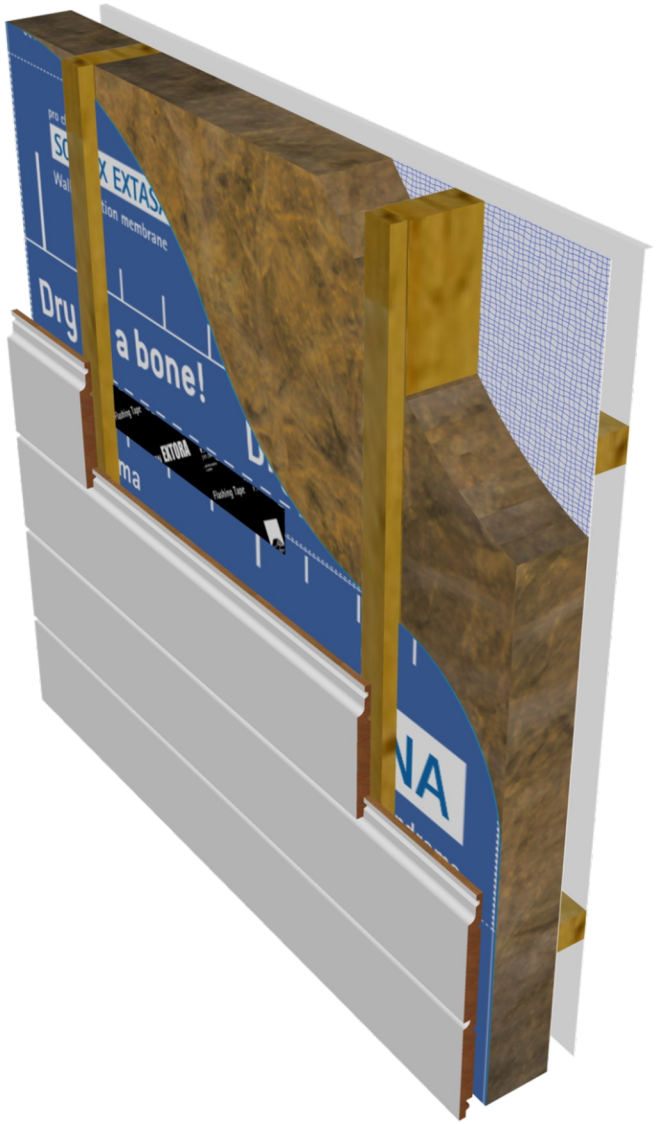
ROOFING

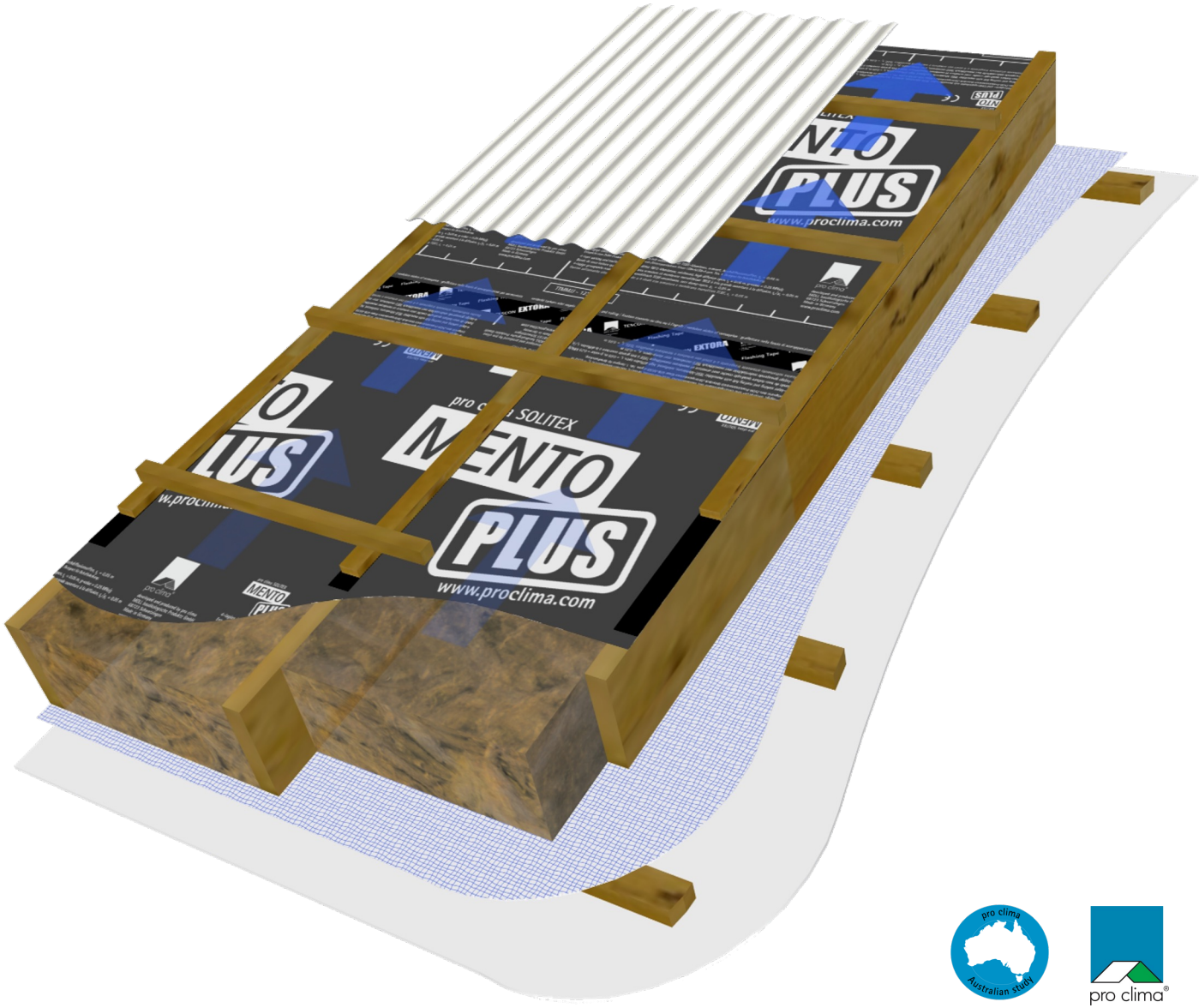
The perfect roof is a wall.
The perfect wall is a roof.

… and the insulation is perfect

pro clima

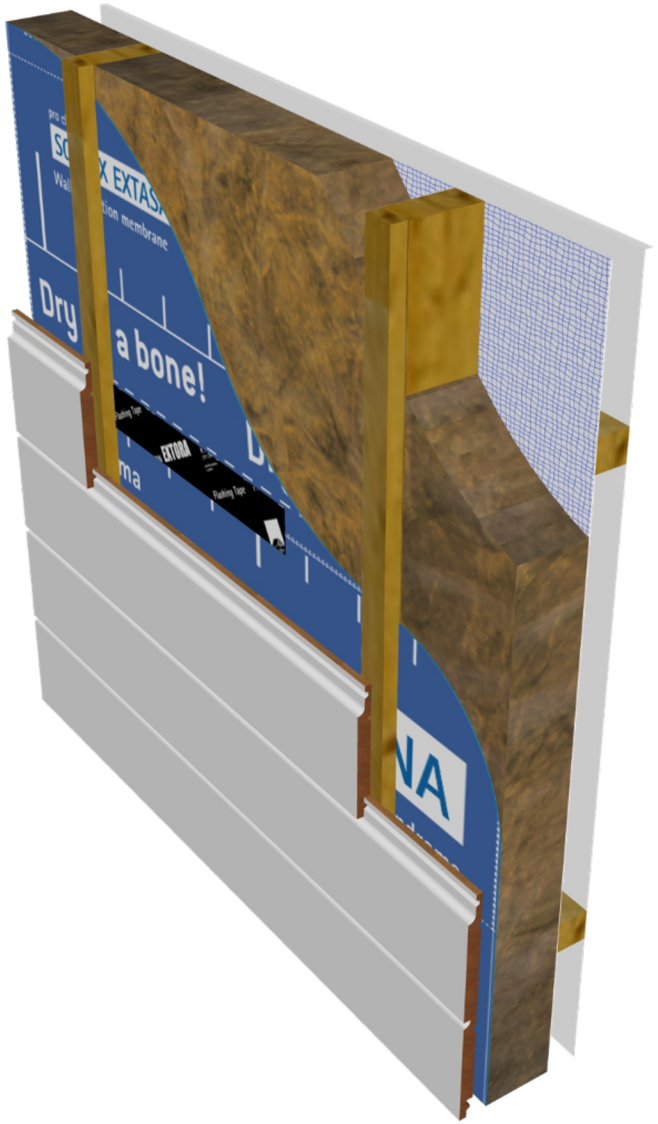
The Perfect Roof is a Wall

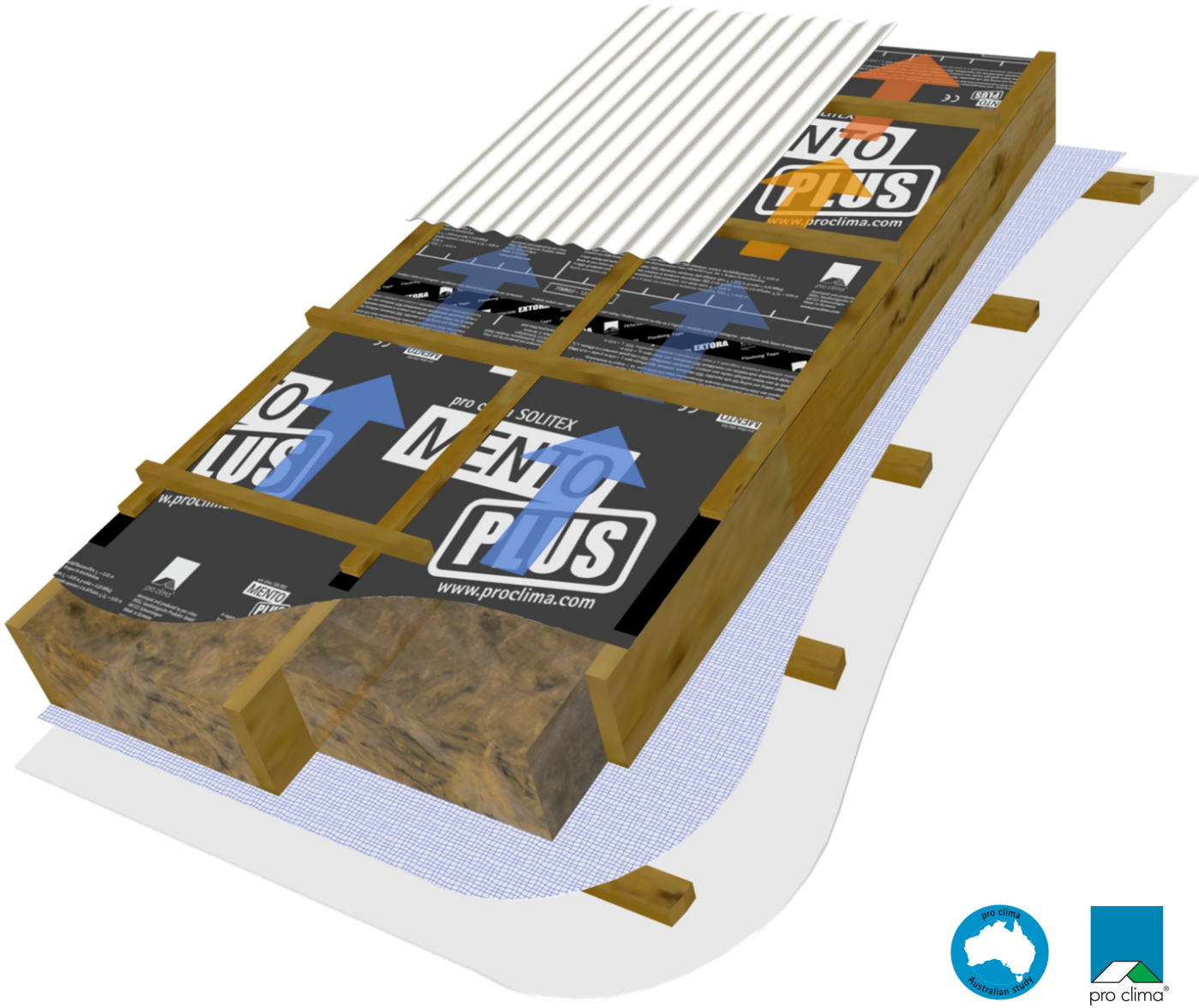




pro clima

The Perfect Roof is a Wall





pro clima

AUTRALIA STUDY 9

QUALITY ASSURANCE OF AIRTIGHTNESS

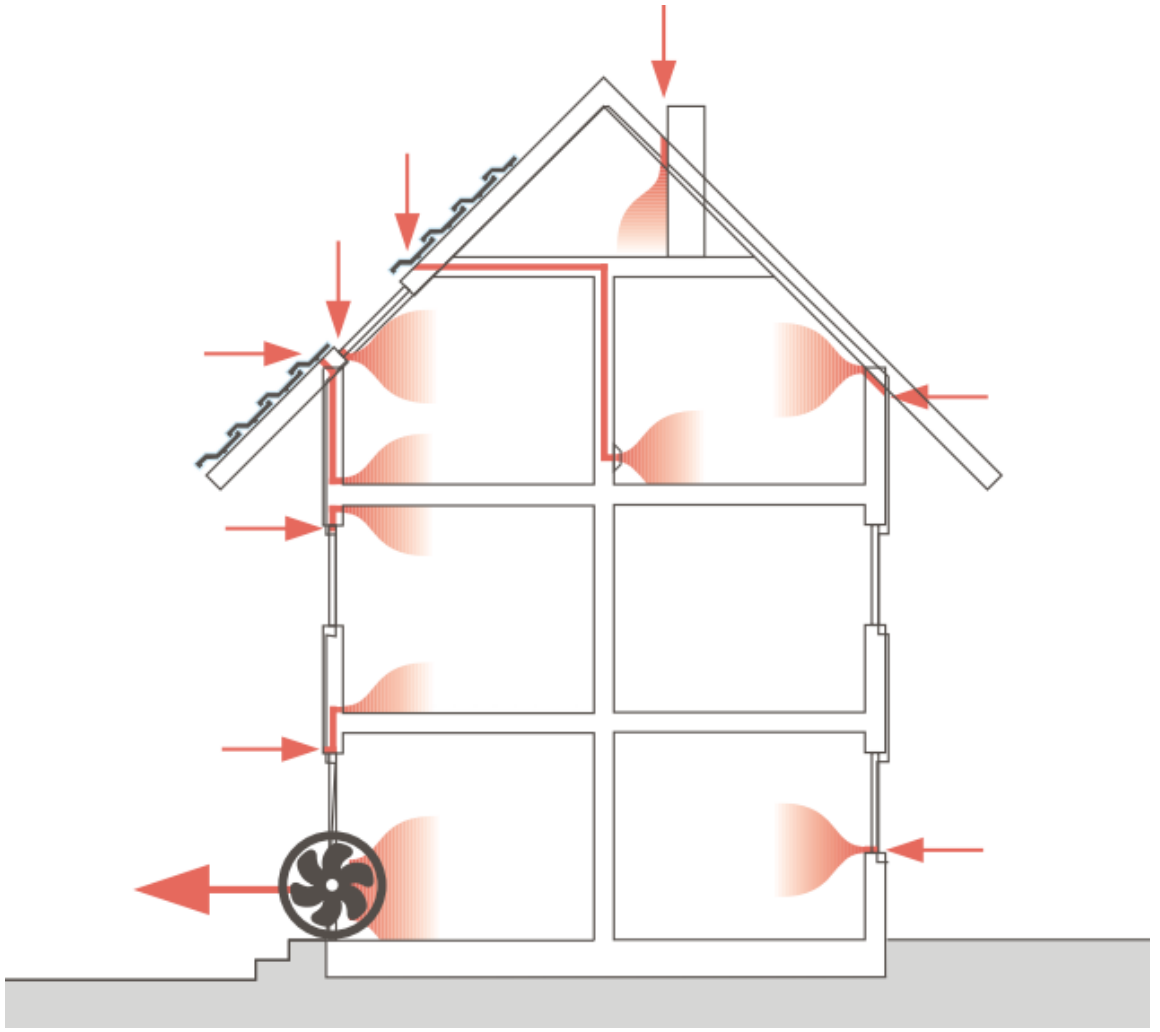
Vapour control can only be achieved in an airtight building

… and the insulation is perfect

pro clima Australian study

pro clima®

AS/NZS ISO 9972:2015 Determination of air permeability of buildings



pro clima

AUTRALIA STUDY 10

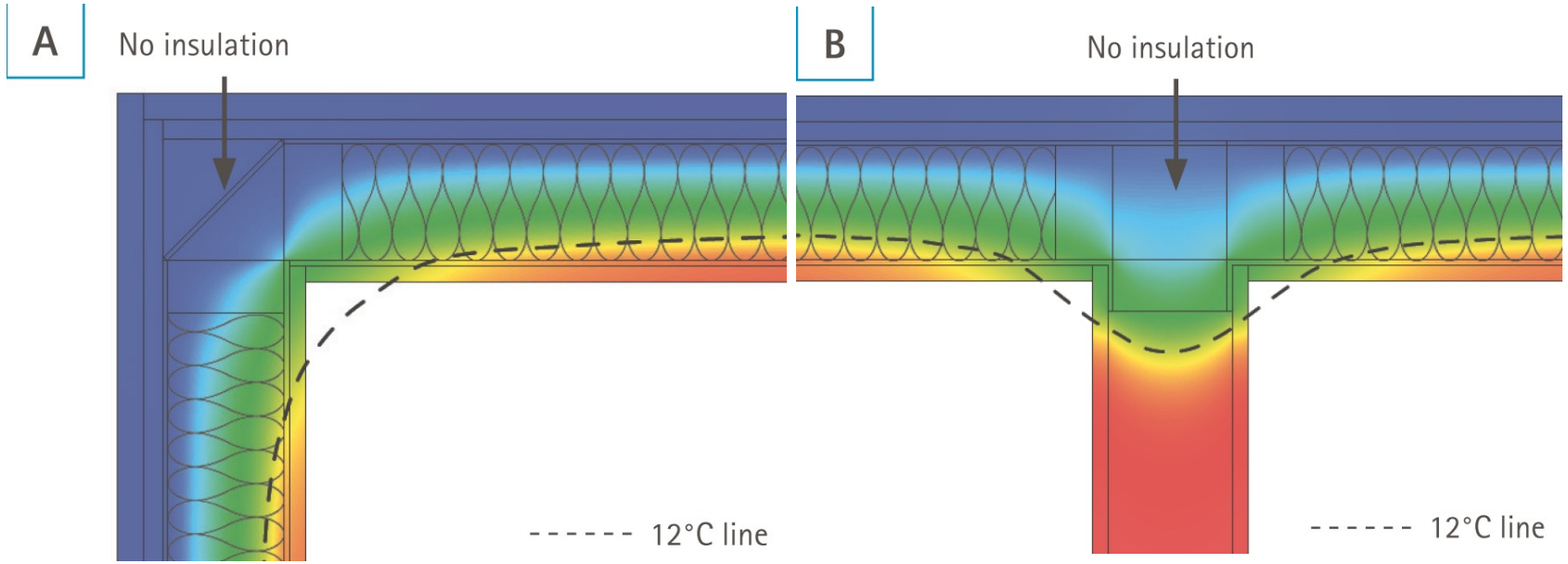
THERMAL BRIDGING

Thermal bridging should be eliminated for optimal moisture control.

pro clima Australian study

pro clima®

Cold spots



AUTRALIA STUDY 11

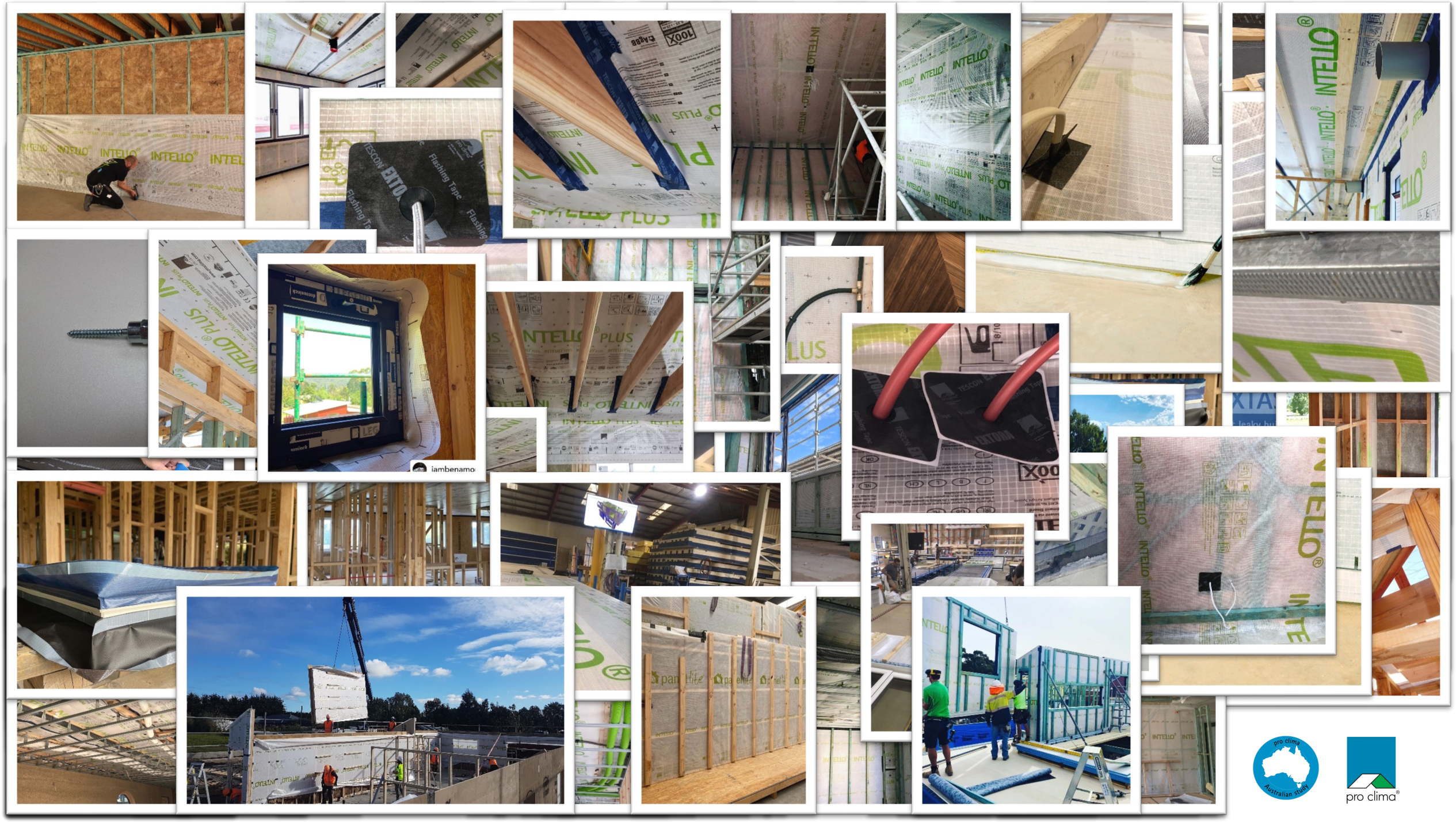
NOTES ON PLANNING AND CONSTRUCTION

The best product and best systems can’t compensate for poor workmanship.

… and the insulation is perfect

pro clima Australian study

pro clima®


INTELLO
INTELLO PLUS
Flashing Tape
pro clima
Australian study

https://proclima.com.au/pro-clima-australia-study/

… and the insulation is perfect