Lunch & Learn

Unpacking the Layers: Air Barriers, Vapour Barriers & WRBs

12pm September 25th, 2025

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Disclaimer

Information presented today does not directly represent the opinions of the Building Officials Association of BC (BOABC). This presentation is conceptual and for informal educational purposes only. The presenter and Association takes no responsibility for application of any concepts or interpretations in this presentation to specific projects. The slides must not be considered complete or exhaustive. Code provisions have been generally represented and may not reflect all exceptions.

Land Acknowledgement

Welcome!

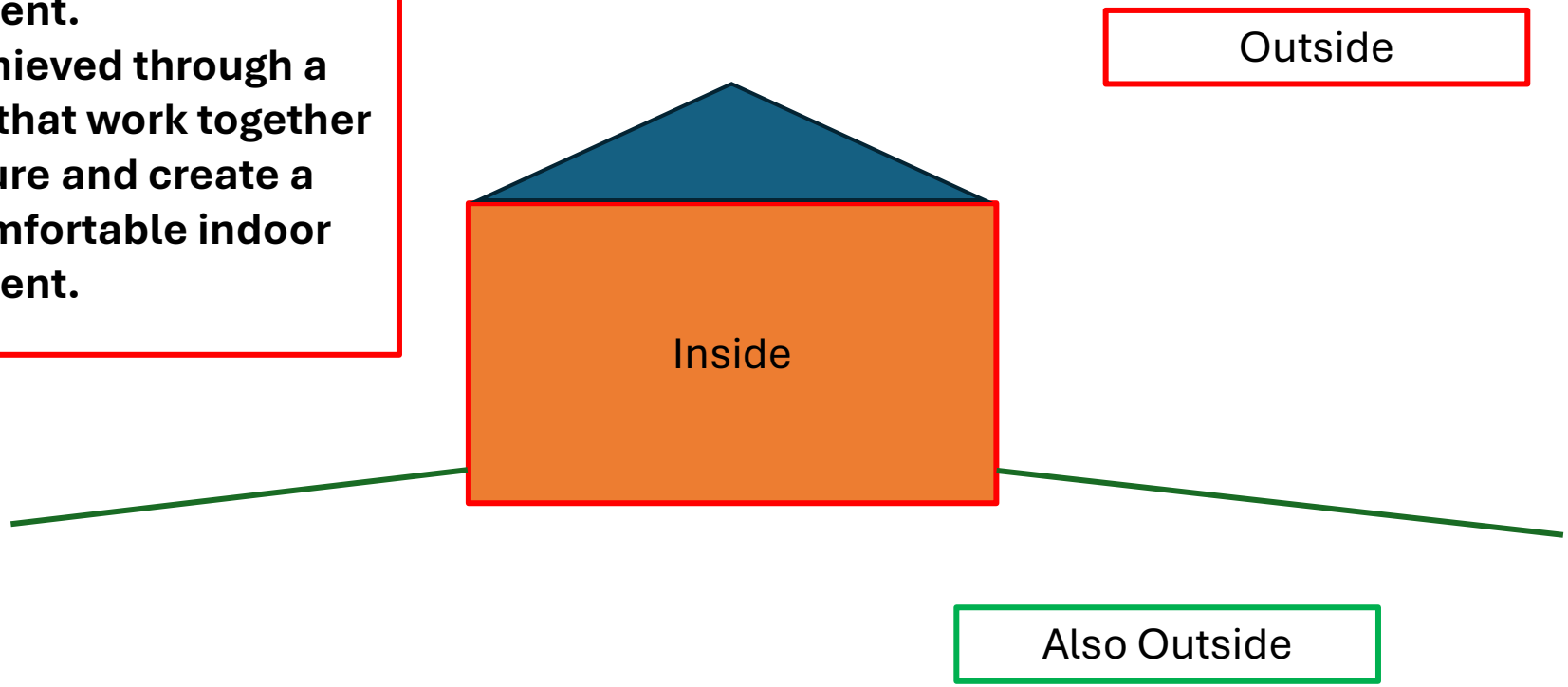
Today's Session:

- The Building Envelope **+RECAP**
- Hierarchy of Control Layers **+RECAP**
- Air Barriers, Vapour Barriers and WRBs
- Dew Point

Building Envelope +RECAP

What is it?

The building envelope is the system of assemblies and materials that separate the inside of a building from the outside environment.
This separation is achieved through a series of control layers that work together to protect the structure and create a durable, safe, and comfortable indoor environment.



Building Envelope +RECAP

Hierarchy of Control Layers

Bulk Water Control Layer

Air Control Layer

Vapor Control Layer*

Thermal Control Layer

The "Big 4" Control Layers

also Sound, Light, Pests…

Building Envelope Control Layers

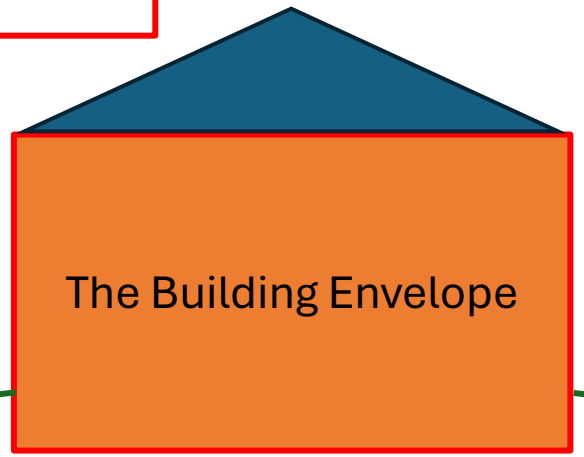
How Does it Work? What questions are we asking to understand the layers?

How does each control layer work?

What forces drive interaction across the building envelope?

What are the sources of the environmental issue that we're trying to control?

Does one product or material contribute to more than one layer?



How does the code address each layer? And it's performance?

As building officials, how can we make good compliance decisions?

Bulk Water Control Layer

Overview

Bulk Water Sources

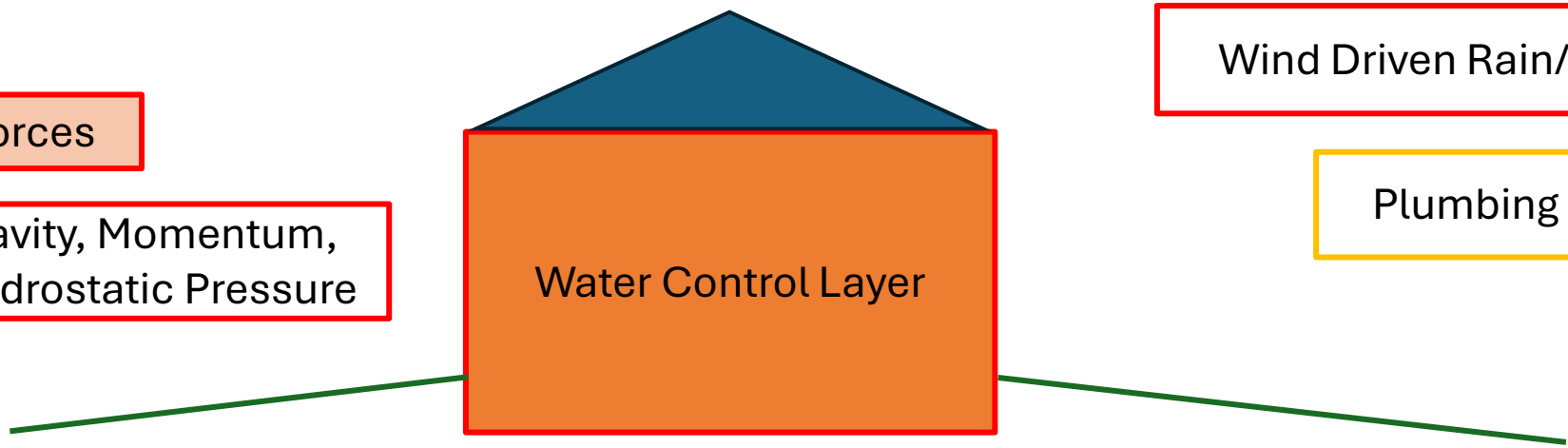
Rain/Snow

Wind Driven Rain/Snow

Plumbing Leaks

Bulk Water Forces

Moved by Gravity, Momentum, Capillarity, Hydrostatic Pressure



What are the consequences?

Water in the Ground

Air Control Layer

Overview

Air Movement Sources

Wind Pressure

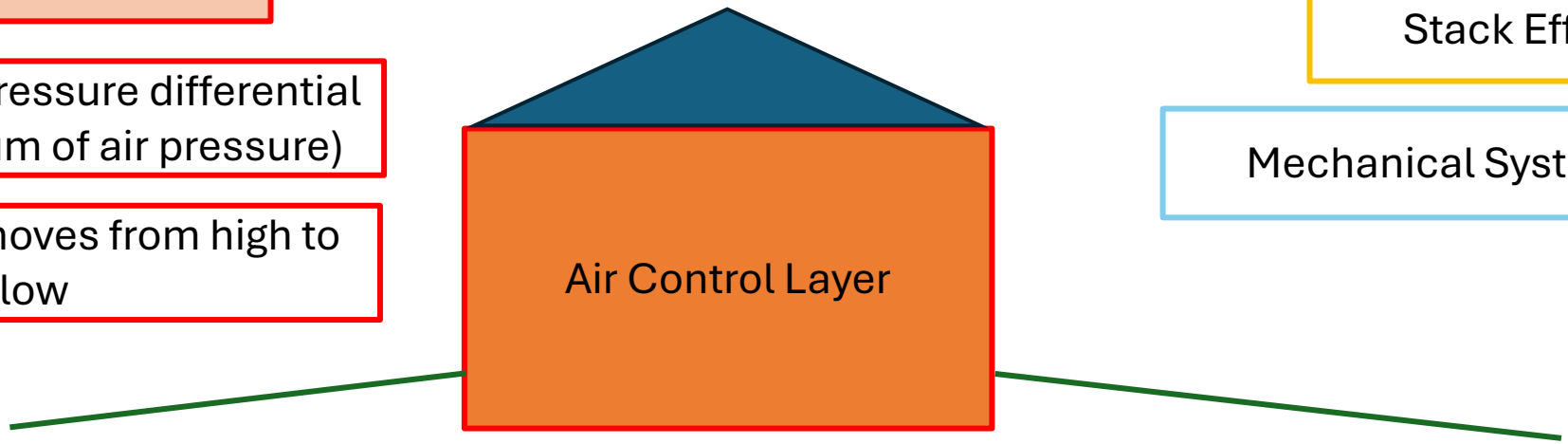
Stack Effect

Mechanical Systems

Air Movement Forces

Moved by air pressure differential (the equilibrium of air pressure)

Air pressure moves from high to low



What are the consequences?

Vapour Control Layer

Overview

Vapour Pressure Sources

Humans

Plants

Building Materials

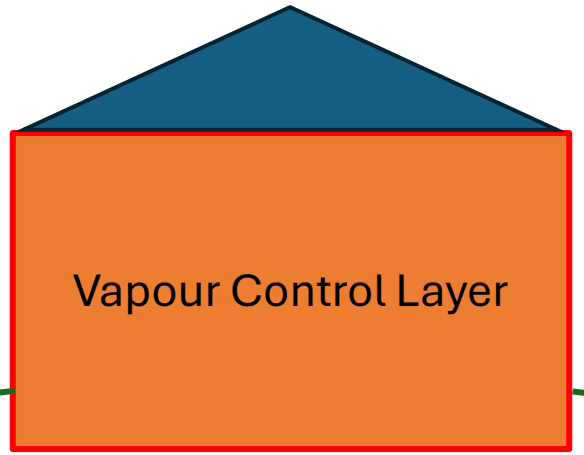
Humidification

Water Leaks

Vapour Pressure Forces

Moved by vapour pressure differential (the equilibrium of vapour pressure)

Vapour pressure moves from high to low



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Bulk Water Control Layer

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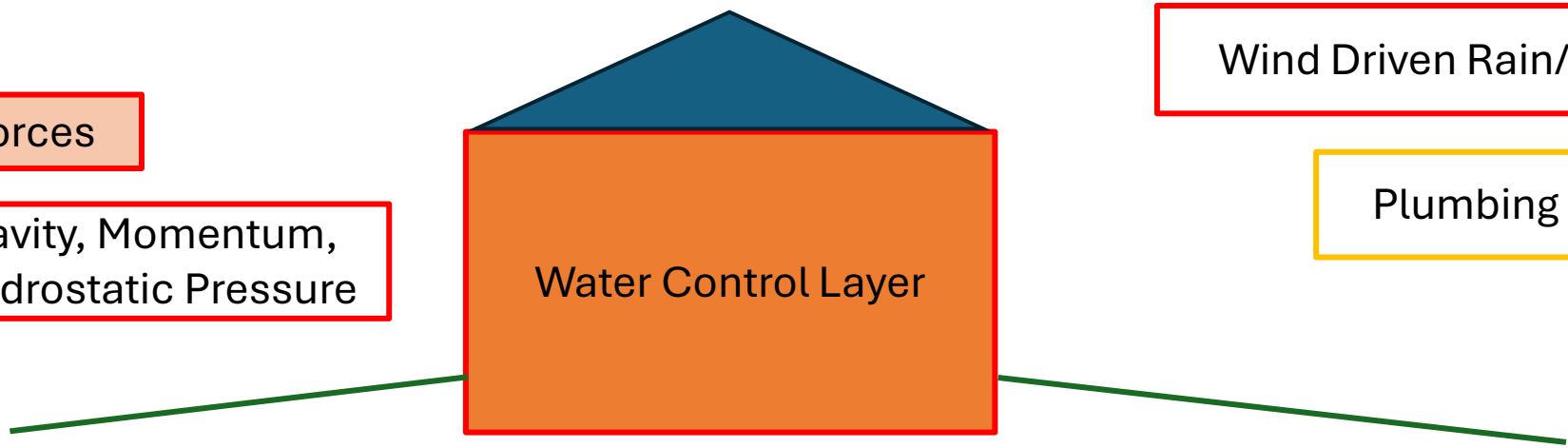


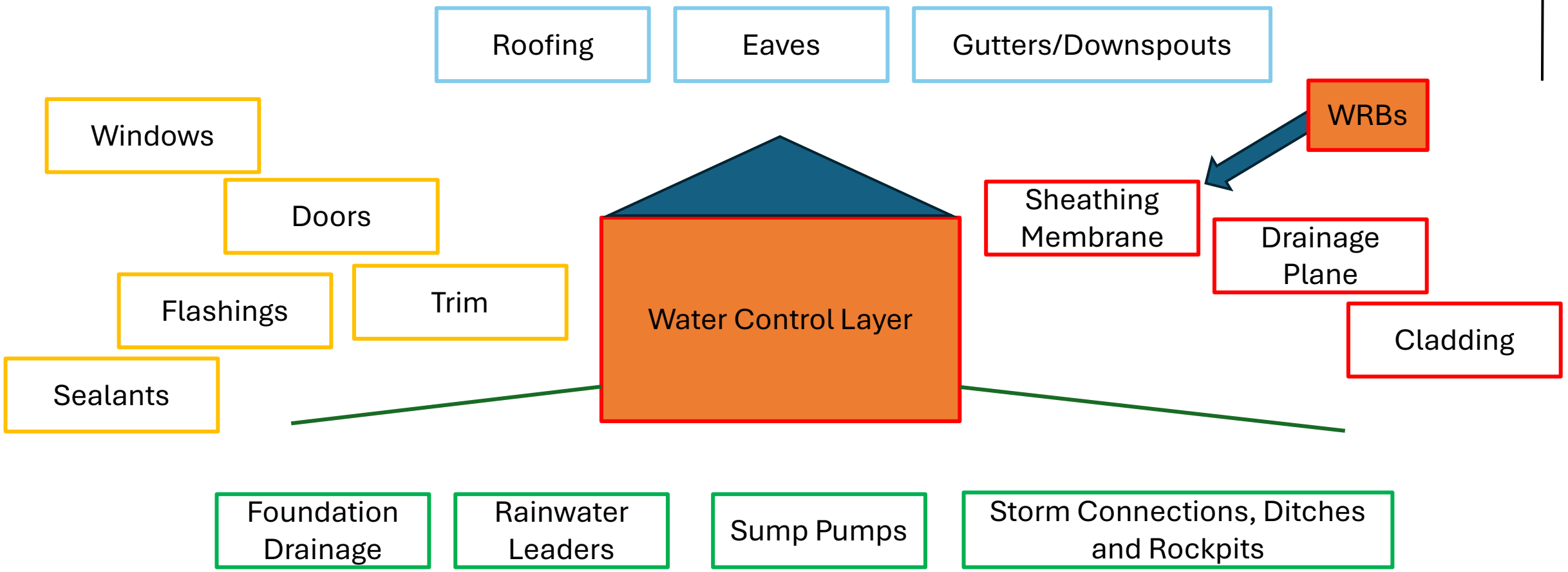
What are the consequences?

Water in the Ground

Bulk Water Control Layer

How Does it Work? What are the Components?

Bulk Water Control Layer Components



Bulk Water Control Layer

How Does it Work?

Water Resistive Barriers

Where does the code fit in?

No Definition

Functional Control Properties

9.27.3. Second Plane of Protection

9.27.3.1. Elements of the Second Plane of Protection
(See Note A-9.27.3.1.)

1) The second plane of protection shall consist of a drainage plane having an appropriate inner boundary and flashing to dissipate rainwater to the exterior.

2) Except for cladding systems conforming to Subsection 9.27.14., the inner boundary of the drainage plane shall comply with Articles 9.27.3.2. to 9.27.3.6.

3) The protection provided by the second plane of protection shall be maintained

a) at wall penetrations created by the installation of components and services such as windows, doors, ventilation ducts, piping, wiring and electrical outlets, and

b) at the interface with other wall assemblies.

4) Flashing material and its installation shall comply with Articles 9.27.3.7. and 9.27.3.8.

Source: BC Building Code 2024, Province of British Columbia

Water Resistive Barriers

Where does the code fit in?

Material Properties

Installation Properties

9.27.3.2. Sheathing Membrane Material Standard

1) Sheathing membranes shall conform to the performance requirements of CAN/CGSB-51.32-M, "Sheathing, Membrane, Breather Type."

9.27.3.3. Required Sheathing Membrane and Installation

1) Except as provided in Articles 9.27.3.4. to 9.27.3.6., at least one layer of sheathing membrane shall be applied beneath cladding.

2) Sheathing membrane required in Sentence (1) shall be applied so that joints are lapped not less than 100 mm.

3) Where sheathing membrane required in Sentence (1) is applied horizontally, the upper sheets shall overlap the lower sheets.

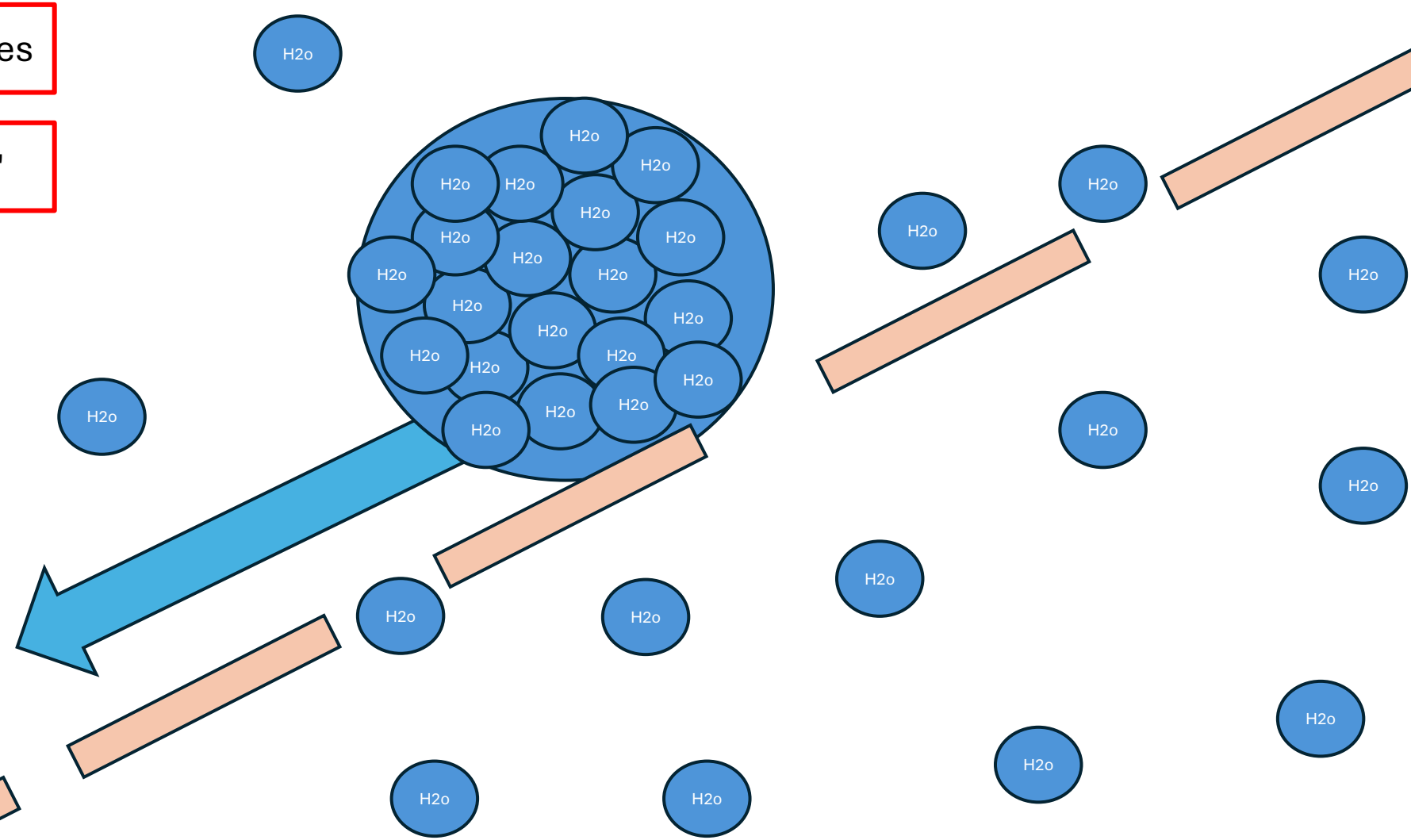
Source: BC Building Code 2024, Province of British Columbia

Water Resistive Barriers

Where does the code fit in?

Material Properties

"Breather Type"



Air Control Layer

How Does it Work?

Air Movement Sources

Wind Pressure

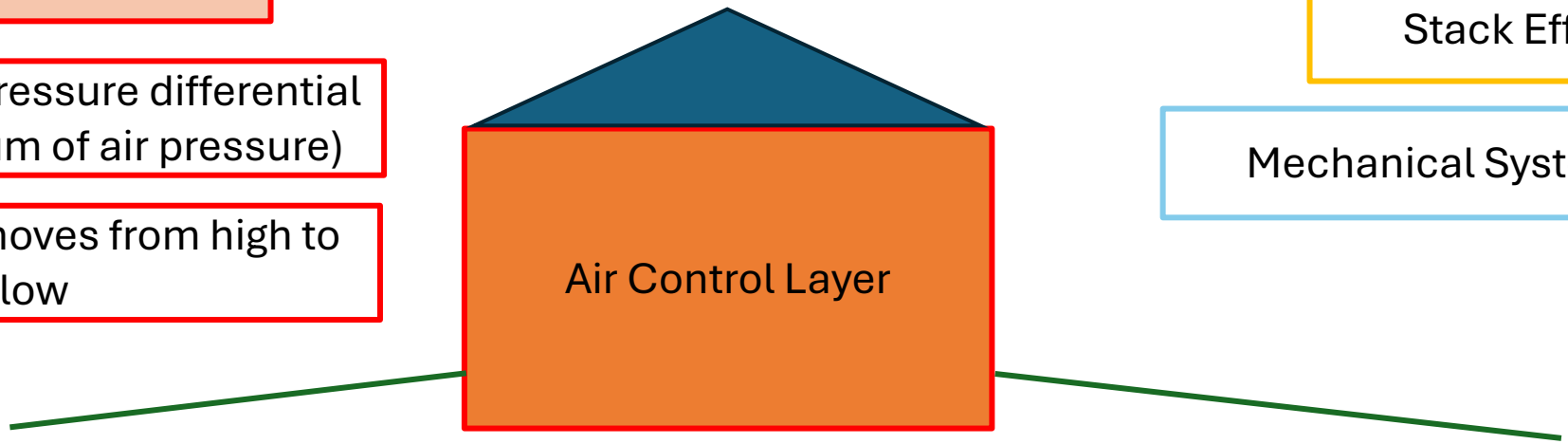
Stack Effect

Mechanical Systems

Air Movement Forces

Moved by air pressure differential (the equilibrium of air pressure)

Air pressure moves from high to low



What are the consequences?

Air Control Layer

Where does the Code fit in?

Definition

Air barrier system means the assembly installed to provide a continuous barrier to the movement of air.

Functional Control Properties

9.25.3. Air Barrier Systems

9.25.3.1. Required Barrier to Air Leakage

1) Wall, ceiling and floor assemblies separating *conditioned space* from unconditioned space or from the ground shall be constructed so as to include an *air barrier system* that will provide a continuous barrier to air leakage

a) from the interior of the *building* into wall, floor, *attic or roof spaces*, sufficient to prevent excessive moisture condensation in such spaces during the winter, and

b) from the exterior or the ground inward sufficient to

i) prevent moisture condensation on the room side during winter,

ii) ensure comfortable conditions for the occupants, and

iii) minimize the ingress of *soil* gas.

(See Note A-9.25.3.1.(1).)

Source: BC Building Code 2024, Province of British Columbia

Air Control Layer

Where does the Code fit in?

Part 9 Material Properties

9.25.3.2. Air Barrier System Properties
(See Note A-9.25.5.1.(1).)

1) *Air barrier systems* shall possess the characteristics necessary to provide an effective barrier to air infiltration and exfiltration under differential air pressure due to stack effect, mechanical systems or wind.

2) Where polyethylene sheet is used to provide airtightness in the *air barrier system*, it shall conform to CAN/CGSB-51.34-M, "Vapour Barrier, Polyethylene Sheet for Use in Building Construction."

Source: BC Building Code 2024, Province of British Columbia

Air Control Layer

Where does the Code fit in?

Part 9 Material Properties

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Source: BC Building Code 2024, Province of British Columbia

9.36 also requires full building assessment of performance air barrier system

Air Control Layer

Where does the Code fit in?

Part 5 Material Properties

Table 5.4.1.1.
Maximum Air Leakage Rates for Air Barrier Assemblies
Forming Part of Sentences 5.4.1.1.(3) and (6) and 5.4.1.2.(1) and (2)

Performance Class	Maximum Air Leakage Rate, L/(s×m^2), at a Pressure Differential of 75 Pa
1	0.05
2	0.10
3	0.15
4	0.20
5	0.50

Source: BC Building Code 2024, Province of British Columbia

Air Control Layer

Where does the Code fit in?

Installation Properties

9.25.3.3. Continuity of the Air Barrier System

1) Where the *air barrier system* consists of an air-impermeable panel-type material, all joints shall be sealed to prevent air leakage.

2) Except as provided in Sentence 9.25.3.6.(3), where the *air barrier system* consists of flexible sheet material, all joints shall be

a) sealed, or

b) lapped not less than 100 mm and clamped, such as between framing members, furring or blocking, and rigid panels.

Source: BC Building Code 2024, Province of British Columbia

Air Control Layer

Where does the Code fit in?

Installation Properties cont.

3) Where an interior wall meets an exterior wall, ceiling, floor or roof required to be provided with air barrier protection, the *air barrier system* shall extend across the intersection.

4) Where an interior wall projects through a ceiling or extends to become an exterior wall, spaces in the wall shall be blocked to provide continuity across those spaces with the *air barrier system* in the abutting walls or ceiling.

5) Where an interior floor projects through an exterior wall or extends to become an exterior floor, continuity of the *air barrier system* shall be maintained from the abutting walls across the floor assembly.

6) Penetrations of the *air barrier system*, such as those created by the installation of doors, windows, electrical wiring, electrical boxes, piping or ductwork, shall be sealed to maintain the integrity of the *air barrier system* over the entire surface.

7) Where access hatches and sump pit covers are installed through assemblies constructed with an *air barrier system*, they shall be weatherstripped around their perimeters to prevent air leakage.

8) Clearances between *chimneys* or *gas vents* and the surrounding construction that would permit air leakage from within the *building* into a wall or *attic or roof space* shall be sealed by *noncombustible* material to prevent such leakage.

Source: BC Building Code 2024, Province of British Columbia

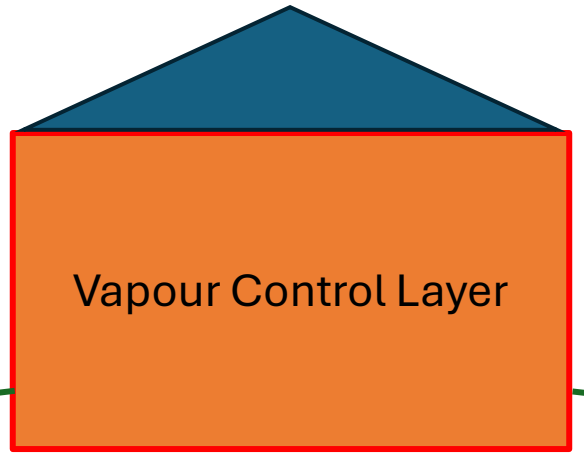
Vapour Control Layer

How Does it Work?

Vapour Pressure Forces

Moved by vapour pressure differential (the equilibrium of vapour pressure)

Vapour pressure moves from high to low



Vapour Pressure Sources

Humans

Plants

Building Materials

Humidification

Water Leaks

What are the consequences?

Vapour Control Layer

Where does the Code fit in?

Definition

Vapour barrier means the elements installed to control the diffusion of water vapour. (See Note A-1.4.1.2.(1).)

Source: BC Building Code 2024, Province of British Columbia

Vapour Control Layer

Where does the Code fit in?

Functional Control Properties

Material Properties

9.25.4. Vapour Barriers

9.25.4.1. Required Barrier to Vapour Diffusion

1) Thermally insulated wall, ceiling and floor assemblies shall be constructed with a *vapour barrier* so as to provide a barrier to diffusion of water vapour from the interior into wall spaces, floor spaces or *attic or roof spaces*.

9.25.4.2. Vapour Barrier Materials

1) Except as provided in Sentence (2), *vapour barriers* shall have a permeance not greater than 60 ng/(Pa×s×m^2) measured in accordance with ASTM E96/E96M, "Standard Test Methods for Water Vapor Transmission of Materials" using the desiccant method (dry cup).

Source: BC Building Code 2024, Province of British Columbia

Vapour Control Layer

Where does the Code fit in?

Material Properties cont.

4) Where polyethylene is installed to serve only as the *vapour barrier*, it shall comply with Clause 4.4, Thermal Stability, and Clause 5.7, Oxidative Induction Time, of CAN/CGSB-51.34-M, "Vapour Barrier, Polyethylene Sheet for Use in Building Construction."

5) Membrane-type *vapour barriers* other than polyethylene shall conform to the requirements of CAN/CGSB-51.33-M, "Vapour Barrier Sheet, Excluding Polyethylene, for Use in Building Construction."

6) Membrane-type *vapour barriers* other than polyethylene that are susceptible to deterioration under prolonged exposure to direct ultraviolet radiation shall

a) be covered, or

b) only be installed in locations that are not exposed to direct ultraviolet radiation after the completion of construction.

(See Note A-9.25.4.2.(6).)

7) Where a coating is applied to gypsum board to function as the *vapour barrier*, the permeance of the coating shall be determined in accordance with CAN/CGSB-1.501-M, "Method for Permeance of Coated Wallboard."

8) Where foamed plastic insulation functions as the *vapour barrier*, it shall be sufficiently thick so as to meet the requirement of Sentence (1).

Source: BC Building Code 2024, Province of British Columbia

Vapour Control Layer

Where does the Code fit in?

Installation Properties

9.25.4.3. Installation of Vapour Barriers

1) Products installed to function as the *vapour barrier* shall protect the warm side of wall, ceiling and floor assemblies.

2) Where different products are used for the *vapour barrier* and the insulation, the *vapour barrier* shall be installed sufficiently close to the warm side of the insulation to prevent condensation at design conditions. (See Notes A-9.25.4.3.(2) and A-9.25.5.1.(1).)

3) Where the same product is used for the *vapour barrier* and the insulation, the product shall be installed sufficiently close to the warm side of the assembly to prevent condensation at design conditions. (See Notes A-9.25.4.3.(2), A-9.25.5.1.(1) and A-9.25.5.2.)

Source: BC Building Code 2024, Province of British Columbia

Vapour Control Layer

Where does the Code fit in?

Installation Properties

9.25.4.3. Installation of Vapour Barriers

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3) Where the same product is used for the *vapour barrier* and the insulation, the product shall be installed sufficiently close to the warm side of the assembly to prevent condensation at design conditions. (See Notes A-9.25.4.3.(2), A-9.25.5.1.(1) and A-9.25.5.2.)

Source: BC Building Code 2024, Province of British Columbia

Vapour Control Layer

Where does the Code fit in?

Installation Properties

A-9.25.4.3.(2) Location of Vapour Barriers. Assemblies in which the vapour barrier is located partway through the insulation meet the intent of this Article provided it can be shown that the temperature of the vapour barrier will not fall below the dew point of the heated interior air.

Source: BC Building Code 2024, Province of British Columbia

Vapour Control Layer

Where does the Code fit in?

NBC2020 addition

Vapour Barrier

It is important to understand the difference between the functions of a vapour barrier and an air barrier. Vapour barrier materials and assemblies are intended to restrict the movement of water vapour due to vapour pressure differentials, while air barrier materials and assemblies are intended to restrict the movement of air due to air pressure differentials.
Note that a vapour barrier is also referred to as a "vapour diffusion retarder."

Why is it important to know the difference?

Source: BC Building Code 2024, Province of British Columbia

Vapour Control Layer

Position of Vapour Barriers

9.25.5. Properties and Position of Materials in the Building Envelope

9.25.5.1. General
(See Note A-9.25.5.1.)

1) Except as provided in Sentences (2) to (4), sheet and panel-type materials incorporated into assemblies described in Article 9.25.1.1. shall conform to Article 9.25.5.2., where

a) the material has

i) an air leakage characteristic less than 0.1 L/(s×m^2) at 75 Pa, and

ii) a water vapour permeance less than 60 ng/(Pa×s×m^2) when measured in accordance with ASTM E96/E96M, "Standard Test Methods for Water Vapor Transmission of Materials" using the desiccant method (dry cup) (see Note A-9.25.5.1.(1)(a)(ii)), and

b) the intended use of the interior space where the materials are installed will not result in high moisture generation.

(See Note A-9.25.5.1.(1).)

Source: BC Building Code 2024, Province of British Columbia

Vapour Control Layer

Position of Vapour Barriers

9.25.5.2. Position of Low Permeance Materials
(See Note A-9.25.5.2.)

1) Sheet and panel-type materials described in Article 9.25.5.1. shall be installed

a) on the warm face of the assembly (see also Article 9.25.4.2.),

b) at a location where the ratio between the total thermal resistance of all materials outboard of its innermost impermeable surface and the total thermal resistance of all materials inboard of that surface is not less than that required by Table 9.25.5.2., or

c) outboard of an air space that is vented to the outdoors.

2) For walls, the air space described in Clause (1)(c) shall comply with Clause 9.27.2.2.(1)(a).

Source: BC Building Code 2024, Province of British Columbia

Vapour Control Layer

Position of Vapour Barriers

Table 9.25.5.2.
Ratio of Outboard to Inboard Thermal Resistance
Forming Part of Sentence 9.25.5.2.(1)

Heating Degree-Days of *Building* Location (1), Celsius degree-days	Minimum Ratio of Total Thermal Resistance Outboard of Material's Inner Surface to Total Thermal Resistance Inboard of Material's Inner Surface
up to 4 999	0.20
5 000 to 5 999	0.30
6 000 to 6 999	0.35
7 000 to 7 999	0.40
8 000 to 8 999	0.50
9 000 to 9 999	0.55
10 000 to 10 999	0.60
11 000 to 11 999	0.65
12 000 or higher	0.75

Source: BC Building Code 2024, Province of British Columbia

The Dew Point

Dew Point Basics

Air temperature → measure of heat energy.

All air holds water vapour; capacity changes with temperature.

Warm air holds more moisture than cold air.

Relative Humidity (RH) → how full the air is compared to its capacity.

Saturation (100% RH) → air is “full”; extra vapour condenses.

Dew Point → temperature where air reaches saturation.

Condensing Surface → any surface colder than the dew point where moisture will form.

The Dew Point

Dew Point Basics

On a humid July day, the dew point might be around 19 °C.

Your beer can is sitting at 5 °C — way below that line — so the air next to it instantly reaches 100% RH and dumps water on the can.

The Dew Point

Dew Point Basics

Outside (cold in Winter)

22C 40%RH

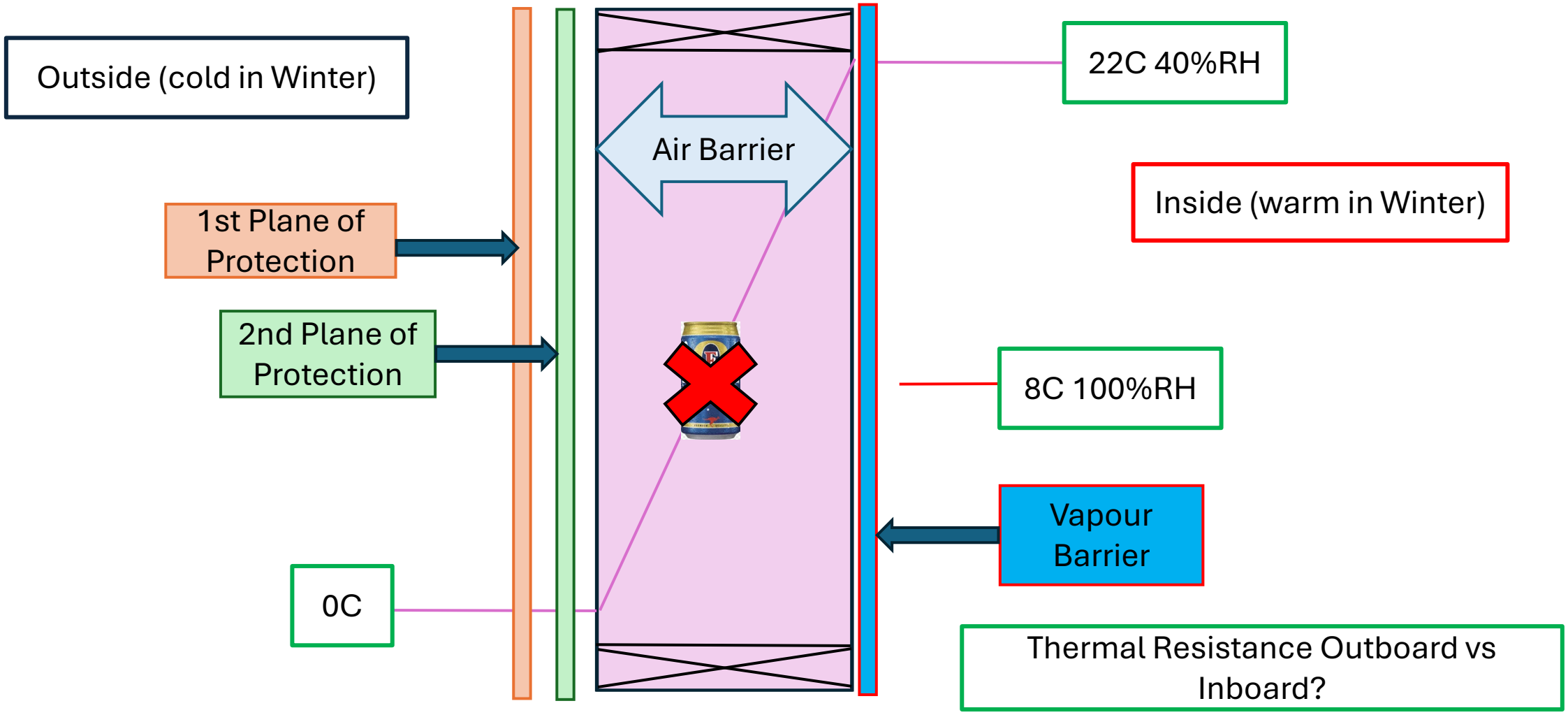
8C 100%RH

0C

Inside (warm in Winter)

The Dew Point

Dew Point and the Position of Low Permeance Materials



The Dew Point

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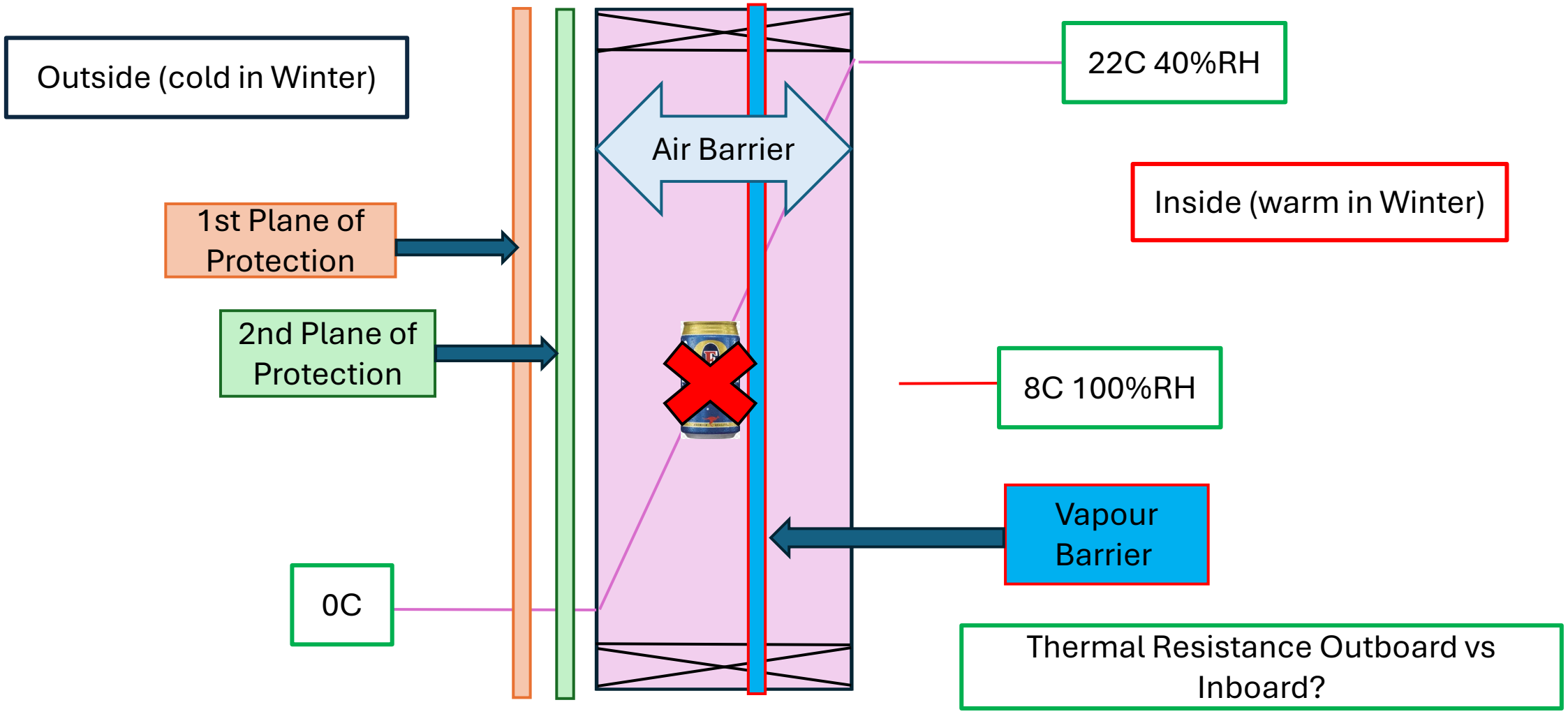

The Dew Point

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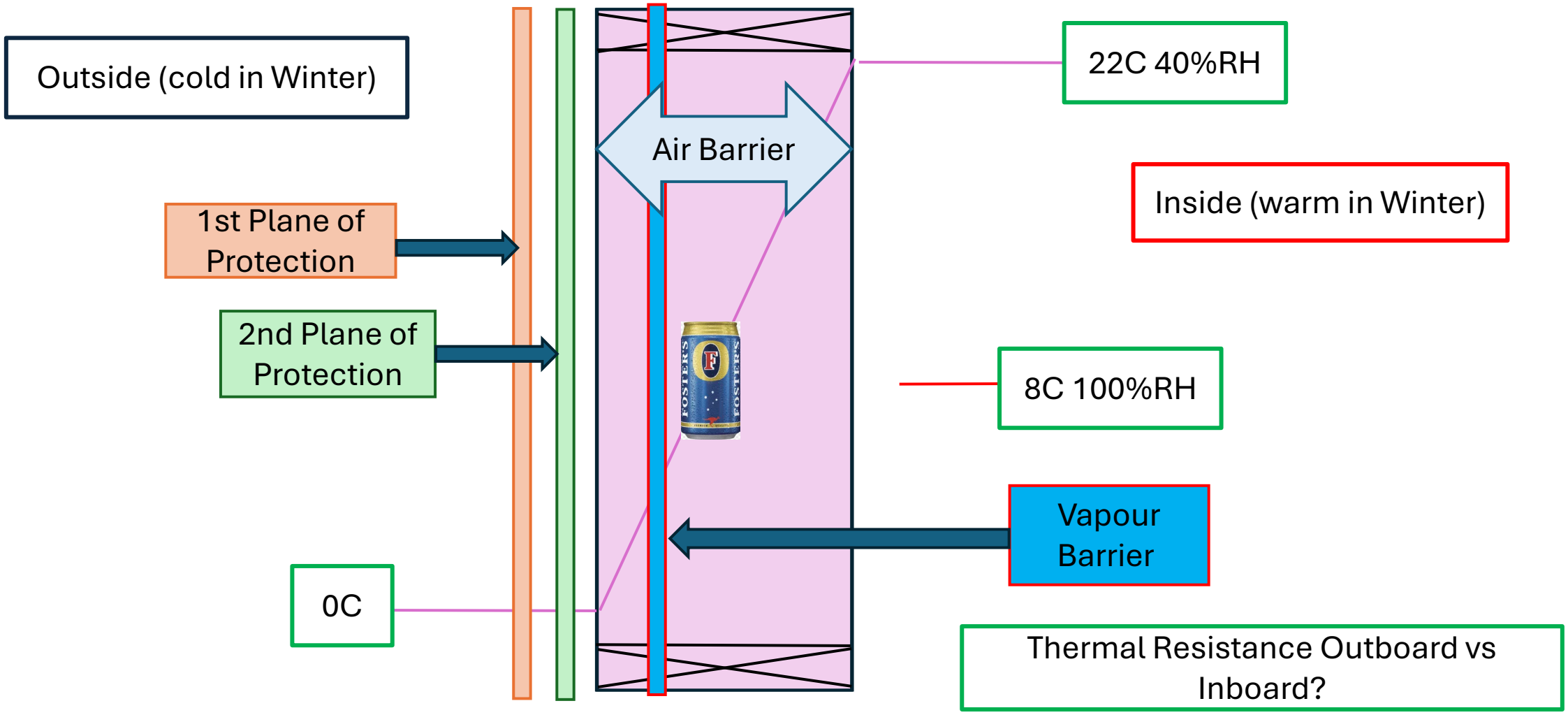
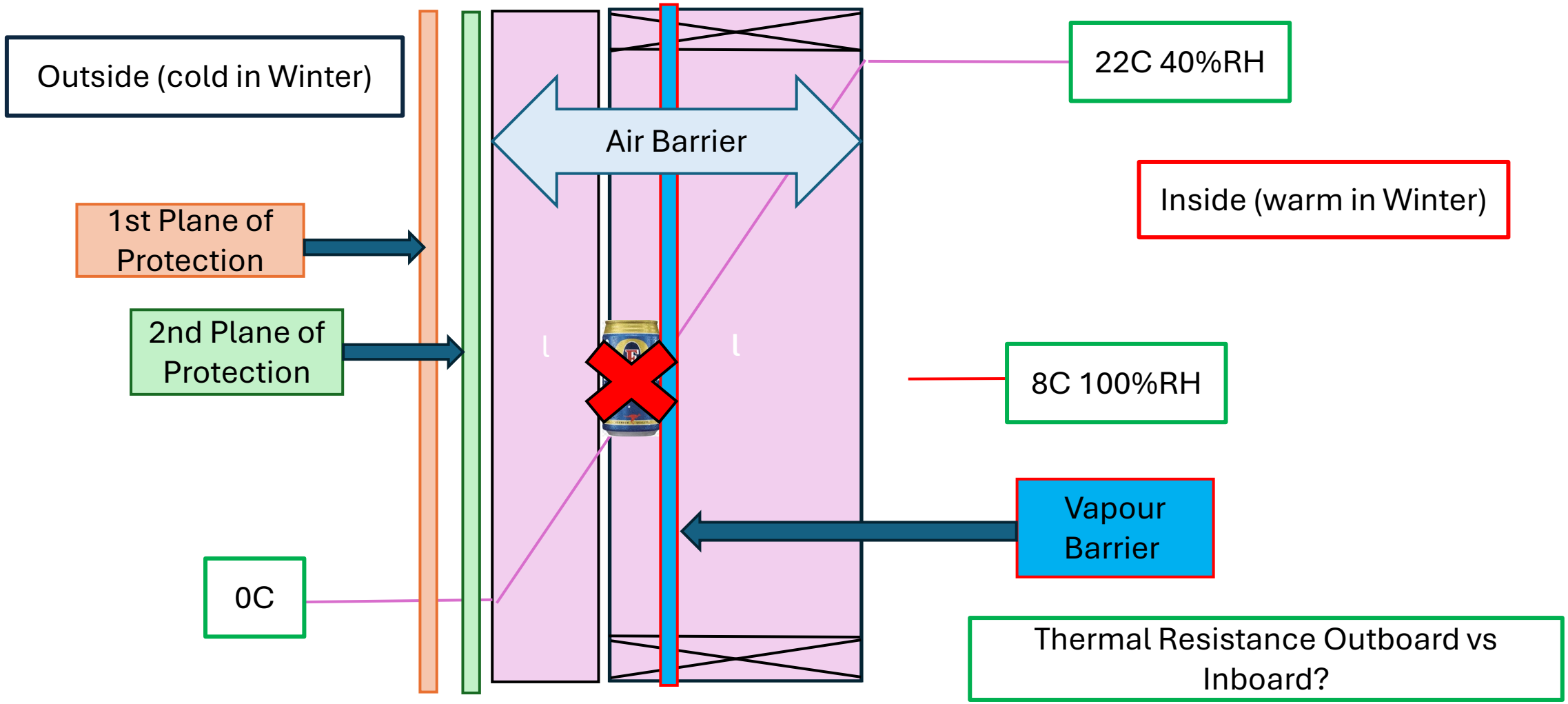


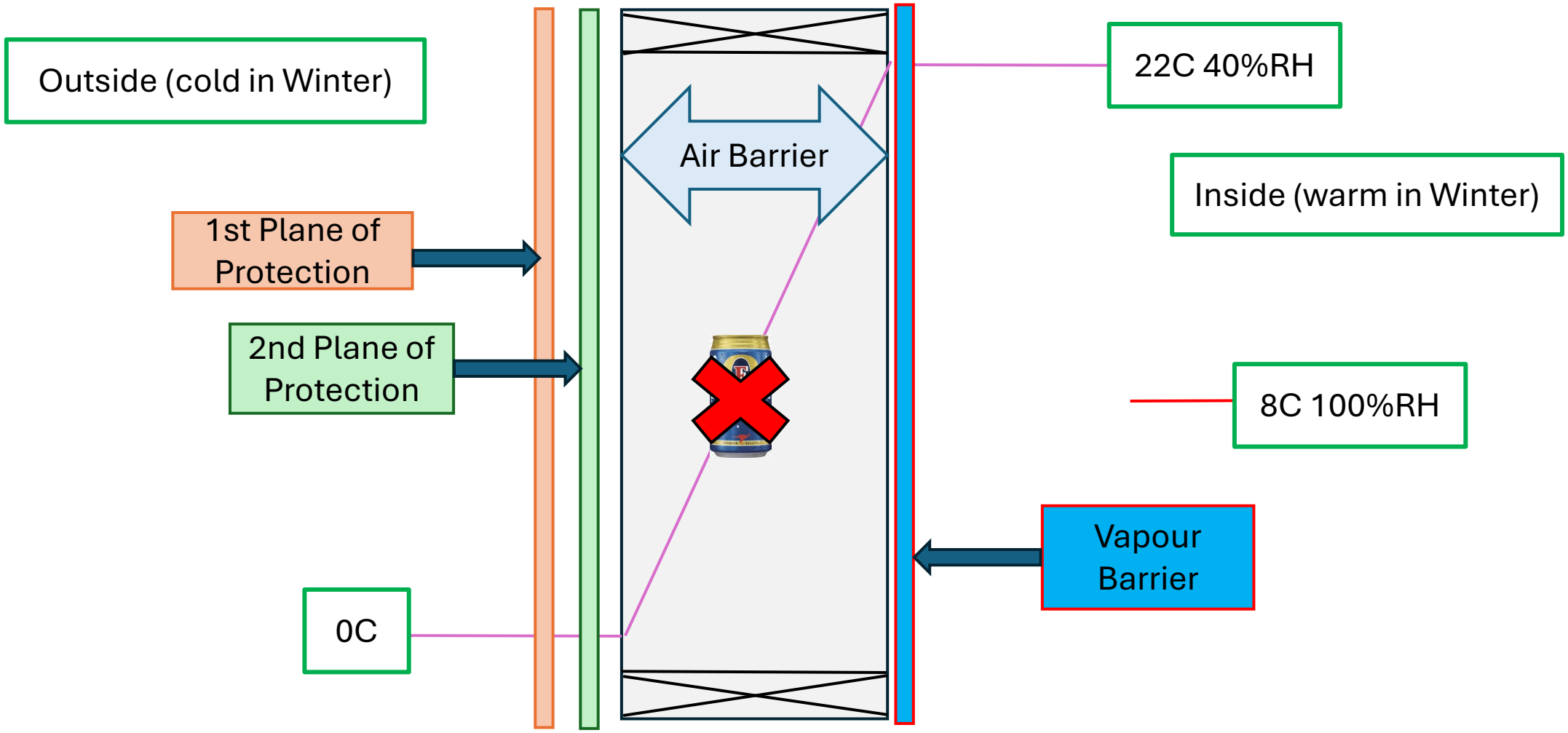
The Dew Point

Dew Point and the Position of Low Permeance Materials



The Dew Point

Dew Point Basics



End/Questions:

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