Lunch & Learn

Holding the Heat: The Thermal Control Layer

12pm October 16th, 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!

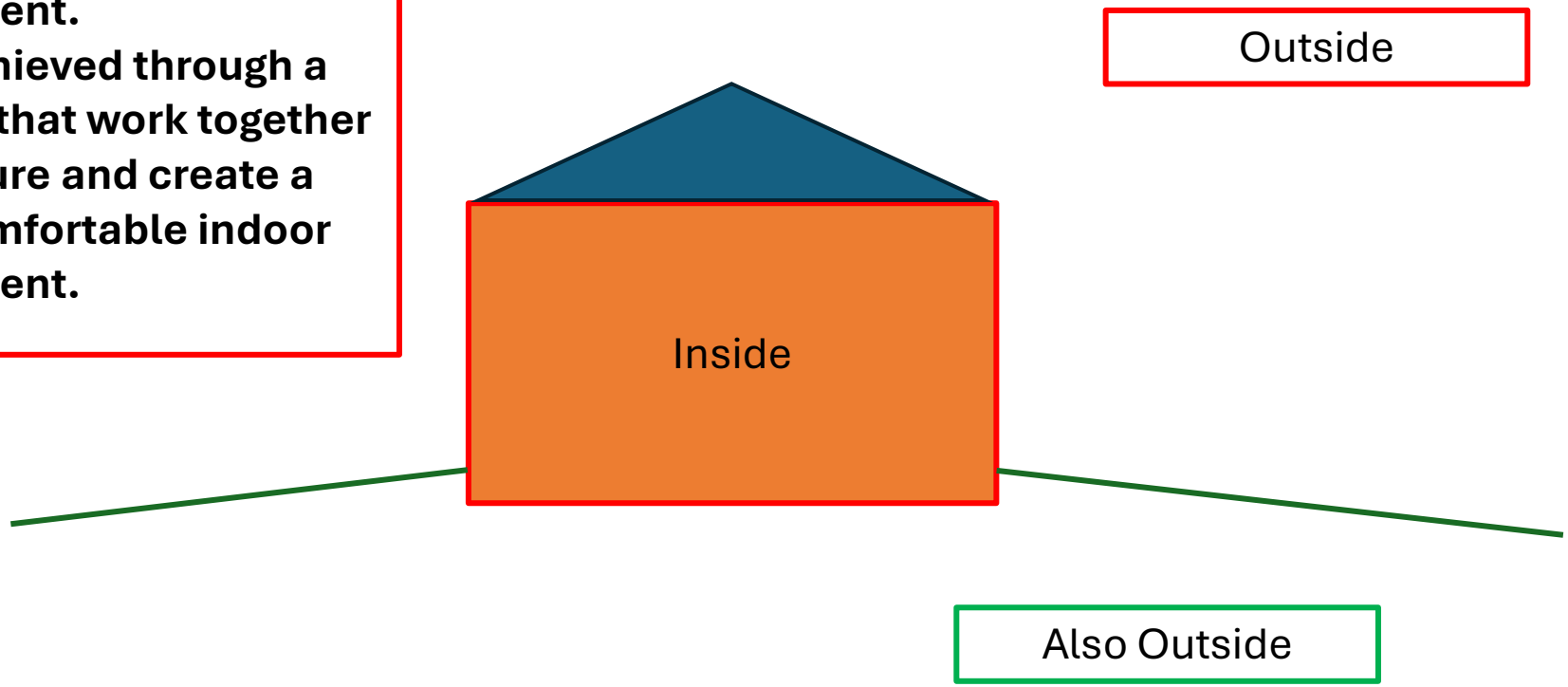
Today's Session:

- The Building Envelope **+RECAP**
- Hierarchy of Control Layers **+RECAP**
- Thermal Control Layer
- Methods of Heat Transfer
- Insulation Materials
-Resources

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 +RECAP

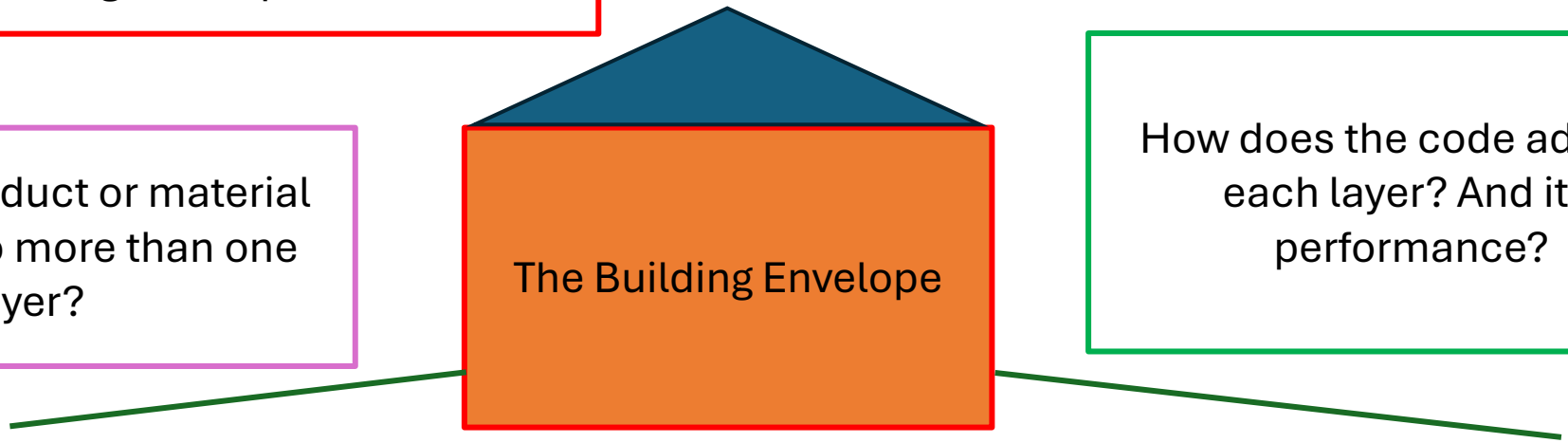
How Does it Work? What questions are we asking to understand the layers?

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?

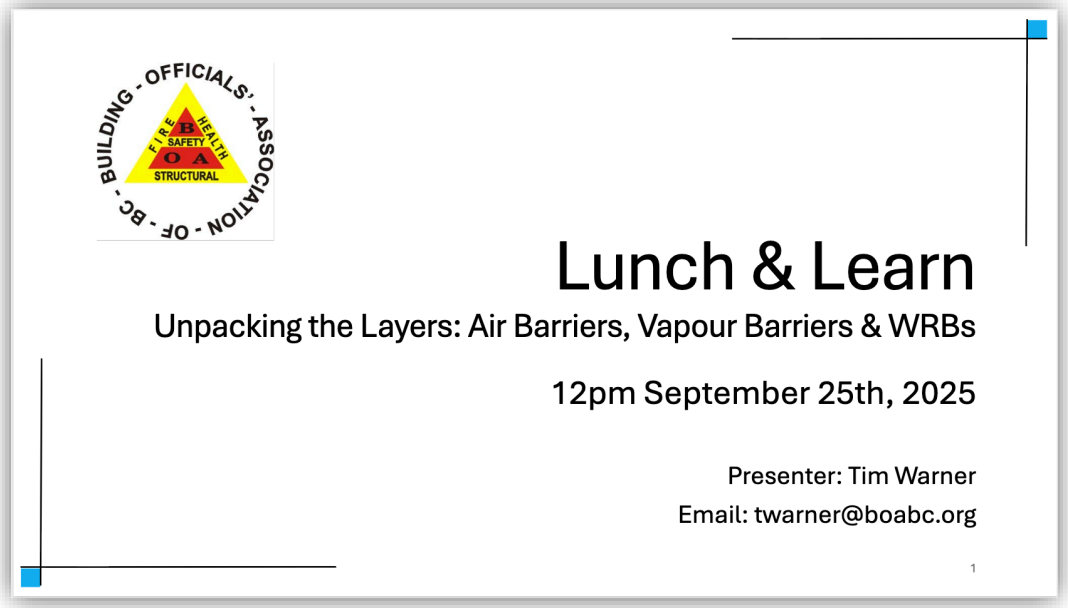
As building officials, how can we make good compliance decisions?

Bulk Water Control Layer +RECAP

How Does it Work?

Air and Vapour Control Layers +RECAP

How Do they Work?



Thermal Control Layer

Overview

Heat Transfer Sources

Cold Climate

Summer Heat

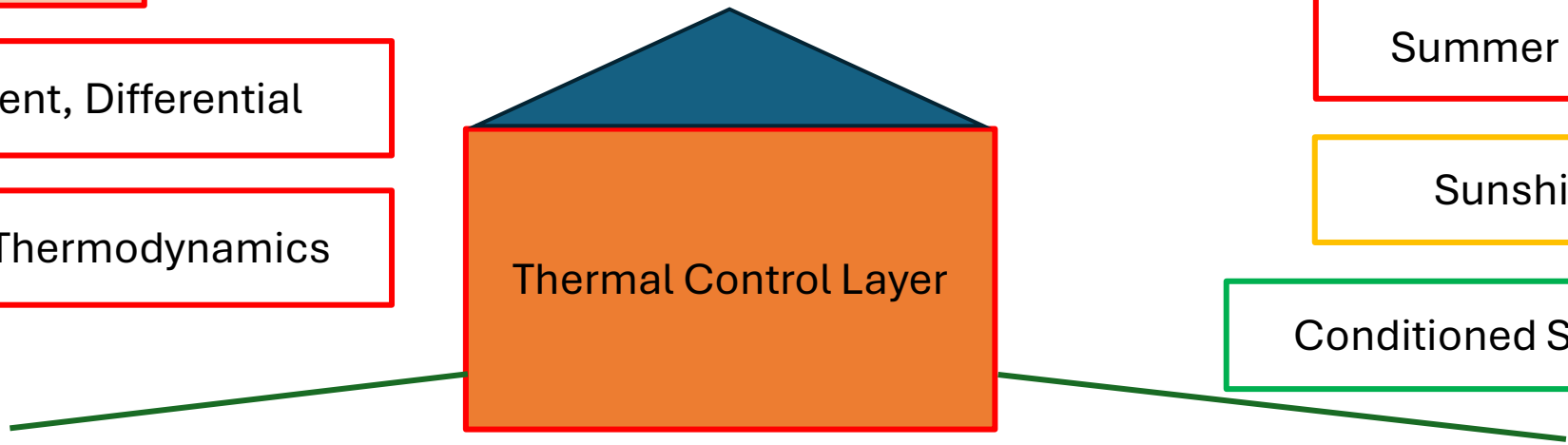
Sunshine

Conditioned Space

Heat Transfer Forces

Heat Gradient, Differential

2nd Law of Thermodynamics

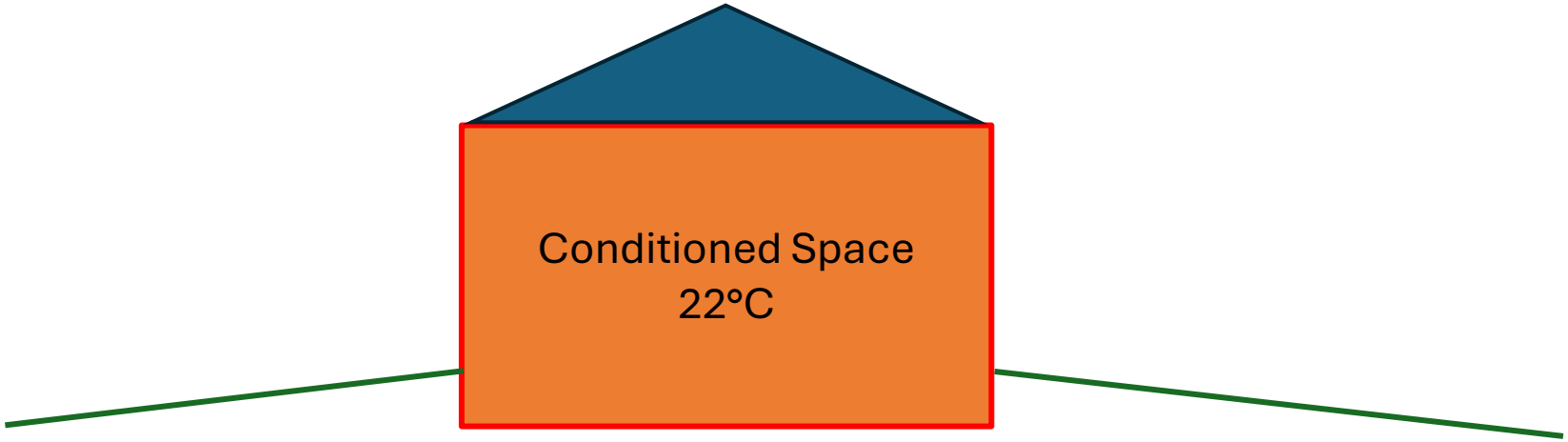


What are the consequences?

Thermal Control Layer

Heat Transfer Forces

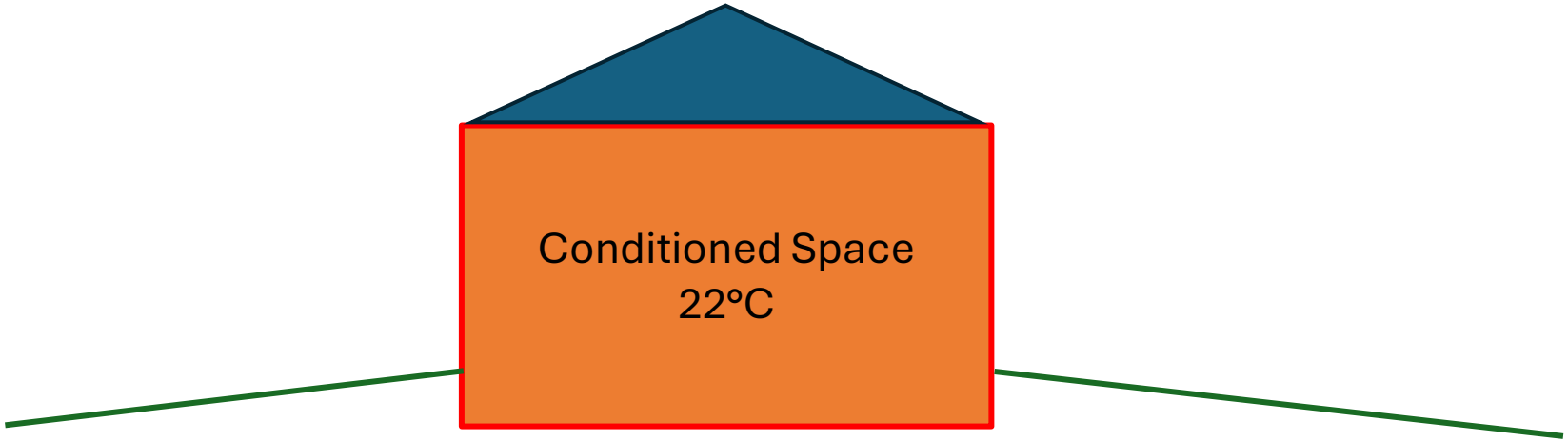
Cold Climate
-4°C



Thermal Control Layer

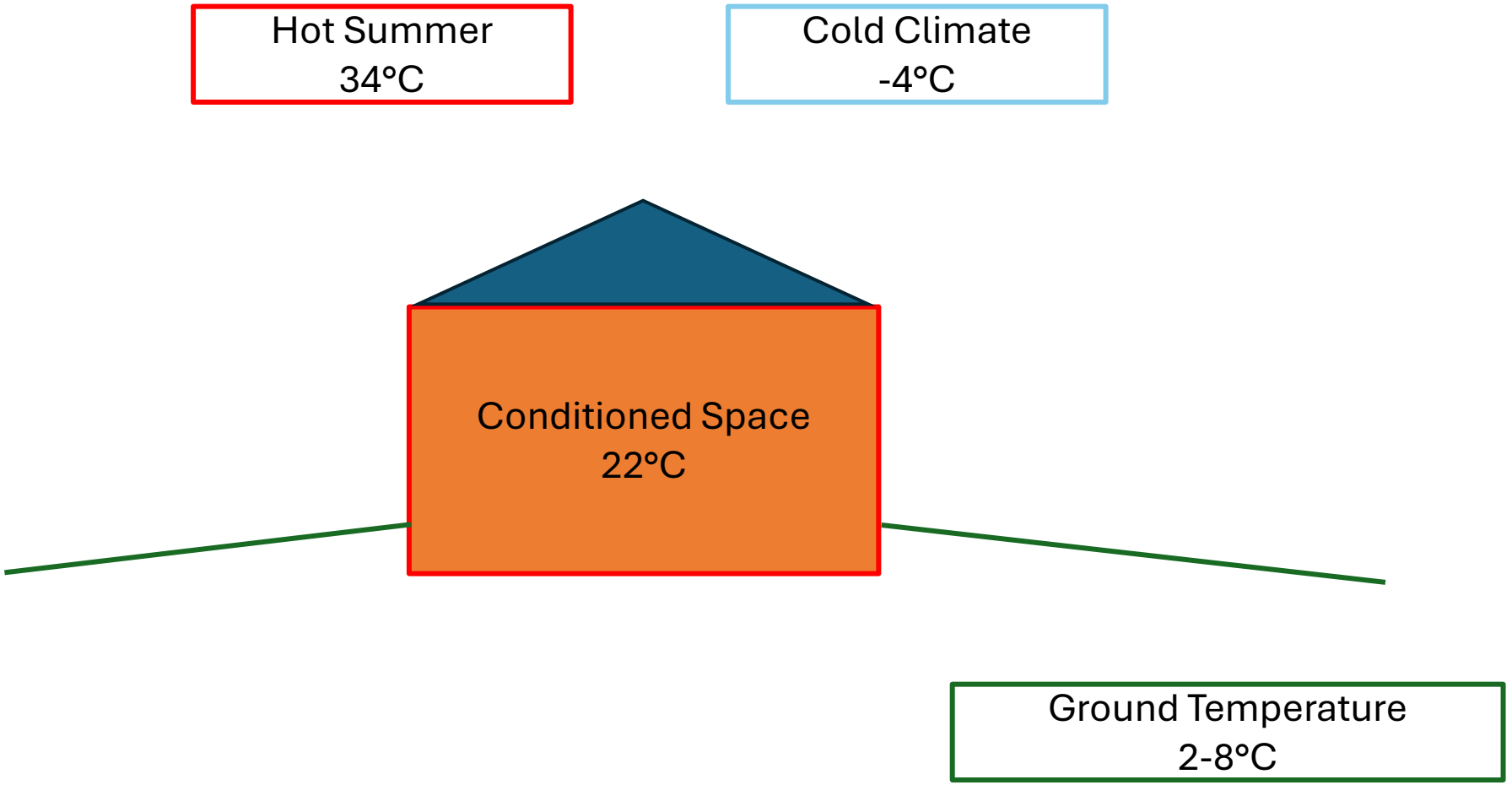
Heat Transfer Forces – Heat Gradient

Hot Summer
34°C



Thermal Control Layer

Heat Transfer Forces – Heat Gradient



Thermal Control Layer

Heat Transfer Forces – 2nd Law of Thermodynamics

Heat always flows spontaneously from **hot to cold**, never from cold to hot — unless work is done.

Heat Transfer Forces – Rate of Transfer

$$Q = U \times A \times \Delta T$$

Q = Heat flow rate (the amount of heat transferred)

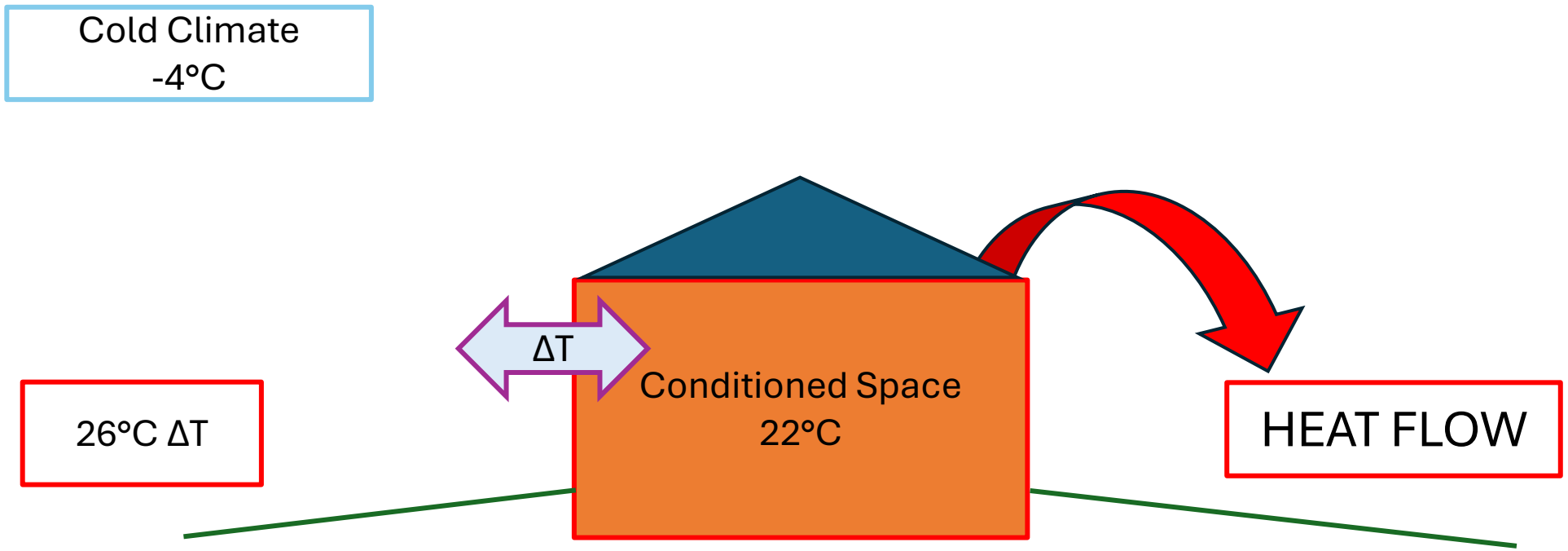
U = Overall heat-transfer coefficient — how easily heat passes through the assembly

A = Surface area of the assembly

ΔT = Temperature difference across the assembly

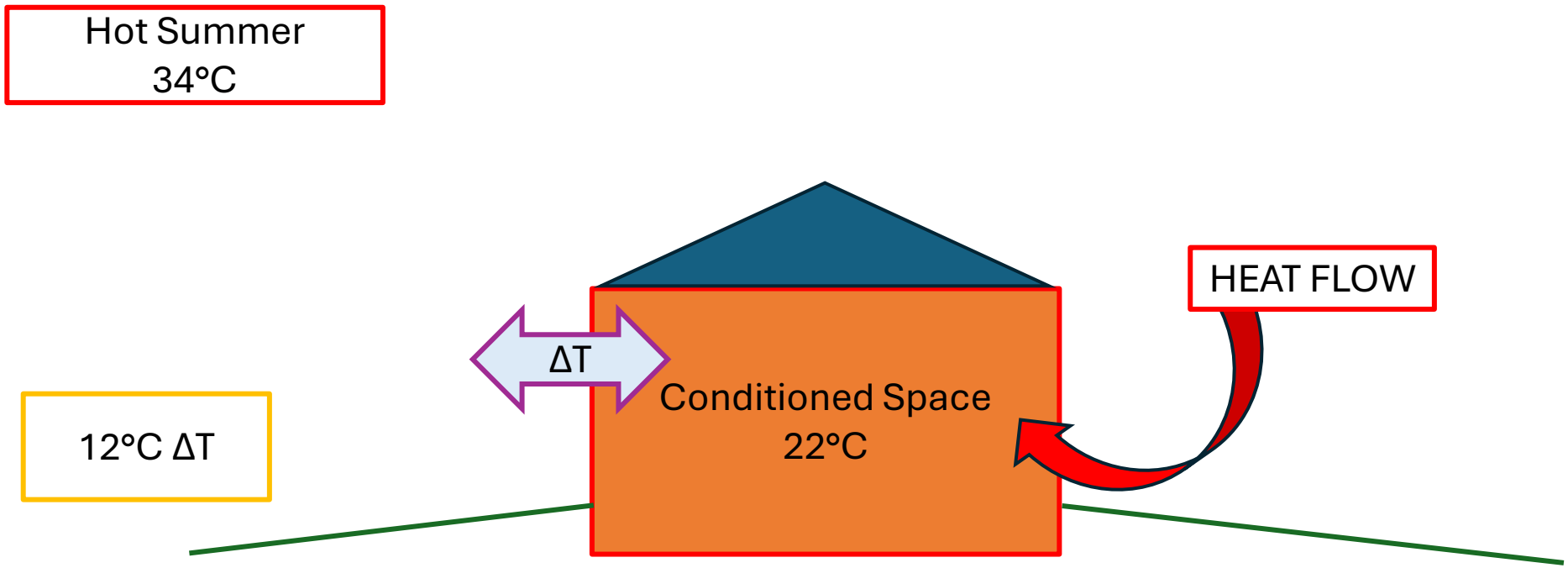
Thermal Control Layer

Heat Transfer Forces – Heat Gradient, Flow and Rate



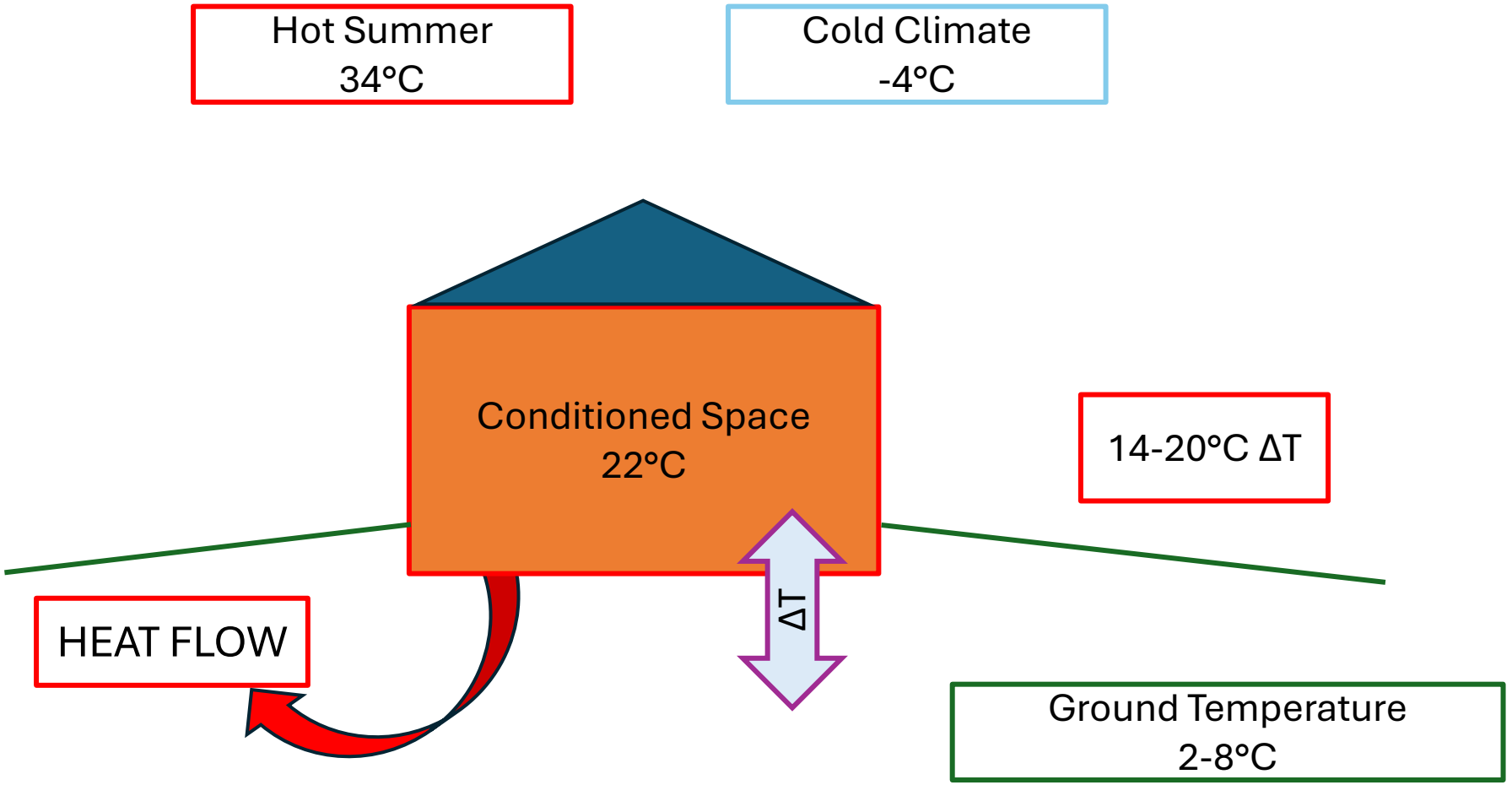
Thermal Control Layer

Heat Transfer Forces – Heat Gradient, Flow and Rate



Thermal Control Layer

Heat Transfer Forces – Heat Gradient, Flow and Rate



Thermal Control Layer

Heat Transfer Forces - Modes of Transfer

Mode	How it Works	Example
Conduction	Heat moves *through solids* by direct molecular contact. Fast-moving (hot) molecules transfer energy to slower (cold) ones.	A metal handle warming when it touches a hot pot.
Convection	Heat moves by *fluid motion*. *W*arm air or water becomes lighter, rises, and is replaced by cooler fluid.	Warm air rising to a ceiling, or drafts near a window.
Radiation	Heat travels as *infrared waves* through air or vacuum. It doesn't need a medium.	Feeling warmth from the sun through a window.

Thermal Control Layer

Where does the Code fit in?

Section 9.25. Heat Transfer, Air Leakage and Condensation Control

9.25.1. General

9.25.1.1. Scope and Application

1) This Section is concerned with heat, air and water vapour transfer and measures to control condensation.

2) All walls, ceilings and floors separating *conditioned space* from unconditioned space, the exterior air or the ground shall be

a) provided with

i) thermal insulation conforming to Subsection 9.25.2. and Section 9.36.,

ii) an air barrier conforming to Subsection 9.25.3. and Section 9.36., and

iii) a *vapour barrier* conforming to Subsection 9.25.4., and

b) constructed in such a way that the properties and relative position of all materials conform to Subsection 9.25.5.

(See Note A-9.25.1.1.(2).)

Source: BC Building Code 2024, Province of British Columbia

Thermal Control Layer

Where does the Code fit in?

9.25 The Thermal, Air and Vapour Control Layers	9.36 Energy Efficiency
To ensure the building envelope effectively separates the interior from exterior conditions	To limit overall energy use by setting minimum insulation, airtightness, and system efficiency requirements.
Functional, Material and Installation Properties	Prescriptive and Performance Targets
Governs how the envelope must function physically	Governs how much energy efficiency (and hence insulation) the envelope must deliver

Thermal Control Layer

Where does the Code fit in?

No Definition

Functional Control Properties

9.25.2. Thermal Insulation

9.25.2.1. Required Insulation

1) All walls, ceilings and floors separating heated space from unheated space, the exterior air or the exterior *soil* shall be provided with sufficient thermal insulation to prevent moisture condensation on their room side during the winter and to ensure comfortable conditions for the occupants. (See Note A-9.1.1.1.(1).)

Source: BC Building Code 2024, Province of British Columbia

Thermal Control Layer

Where does the Code fit in?

Material Properties

9.25.2.2. Insulation Materials

1) Except as required in Sentence (2), thermal insulation shall conform to the requirements of

a) ASTM C726, "Standard Specification for Mineral Wool Roof Insulation Board"
b) CAN/CGSB-51.25-M, "Thermal Insulation, Phenolic, Faced"
c) CGSB 51-GP-27M, "Thermal Insulation, Polystyrene, Loose Fill"
d) CAN/ULC-S701.1, "Standard for Thermal Insulation, Polystyrene Boards"
e) CAN/ULC-S702.1, "Standard for Mineral Fibre Thermal Insulation for Buildings, Part 1: Material Specification,"
f) CAN/ULC-S703, "Standard for Cellulose Fibre Insulation (CFI) for Buildings"
g) CAN/ULC-S704.1, "Standard for Thermal Insulation, Polyurethane and Polyisocyanurate, Boards, Faced,"
h) CAN/ULC-S705.1, "Standard for Thermal Insulation – Spray Applied Rigid Polyurethane Foam, Medium Density – Material Specification" or
i) CAN/ULC-S706.1, "Standard for Wood Fibre Insulating Boards for Buildings."

2) The *flame-spread ratings* requirements contained in the standards listed in Sentence (1) shall not apply. (See Note A-9.25.2.2.(2).)

3) Insulation in contact with the ground shall be inert to the action of *soil* and water and shall be such that its insulative properties are not significantly reduced by moisture.

Source: BC Building Code 2024, Province of British Columbia

Thermal Control Layer

Where does the Code fit in?

Installation Properties

9.25.2.3. Installation of Thermal Insulation

1) Insulation shall be installed so that there is a reasonably uniform insulating value over the entire face of the insulated area.

2) Insulation shall be applied to the full width and length of the space between furring or framing.

3) Except where the insulation provides the principal resistance to air leakage, thermal insulation shall be installed so that at least one face is in full and continuous contact with an element with low air permeance. (See Note A-9.25.2.3.(3).)

4) Insulation shall be installed over the full height of *foundation* walls enclosing a *basement* or heated crawl space. (See also Note A-9.36.2.5.(5).)

5) Insulation around concrete slabs-on-ground shall be located so that heat from the *building* is not restricted from reaching the ground beneath the perimeter, where exterior walls are not supported by footings extending below frost level.

Source: BC Building Code 2024, Province of British Columbia

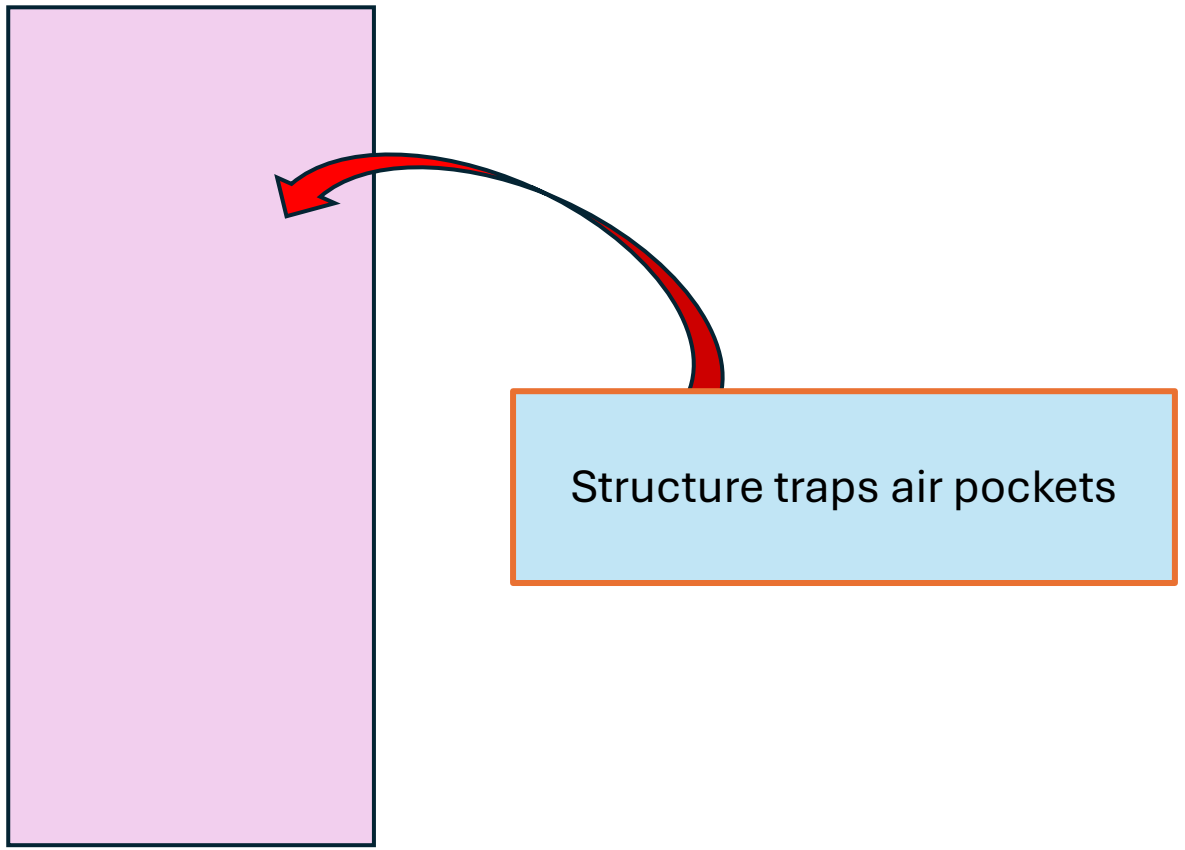
Thermal Control Layer

Material Properties of Insulation

Glass Fibre Insulation

Available in batts and loose fill

Traps air pockets to reduce conduction



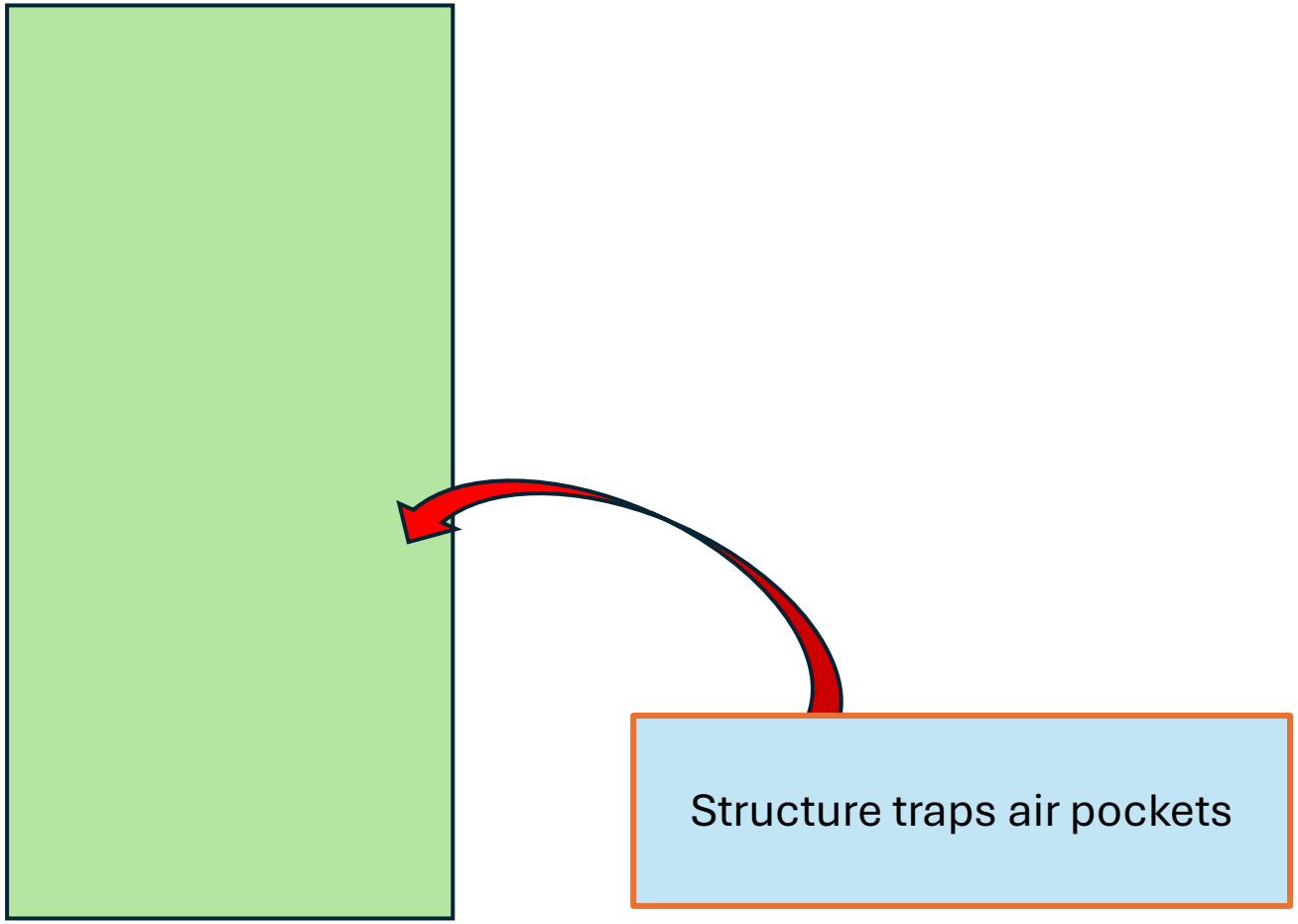
Thermal Control Layer

Material Properties of Insulation

Mineral Fibre Insulation

Available in batts and loose fill

Traps air pockets to reduce conduction



Thermal Control Layer

Material Properties of Insulation

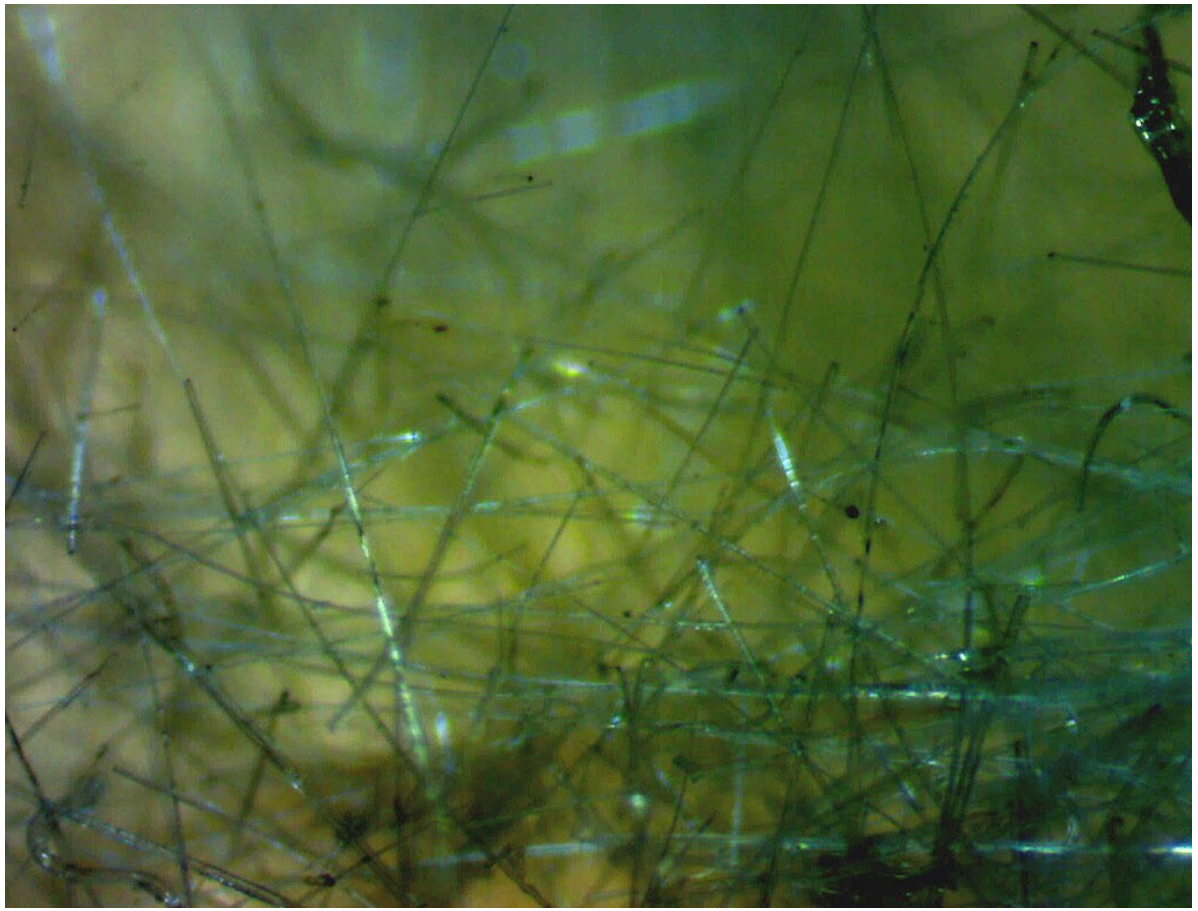


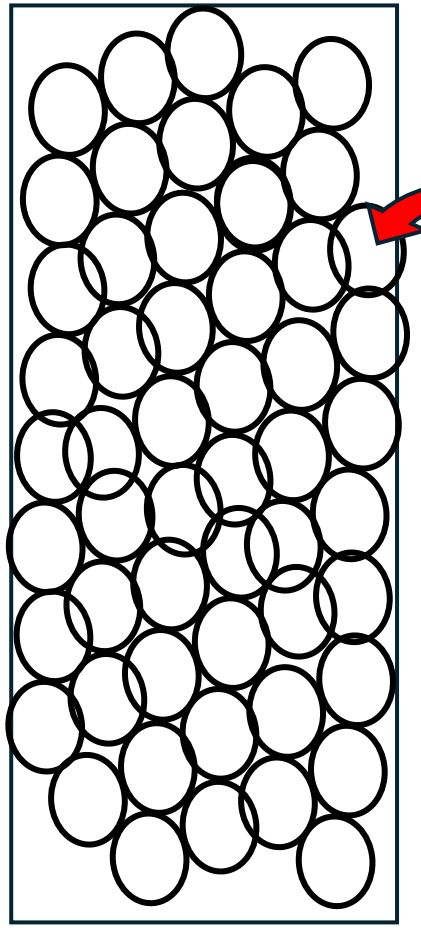
Photo: Achim Hering

Thermal Control Layer

Material Properties of Insulation

Expanded Polystyrene Insulation (EPS)

Preformed beads of polystyrene resin expanded under heat/pressure, then bonded in a form



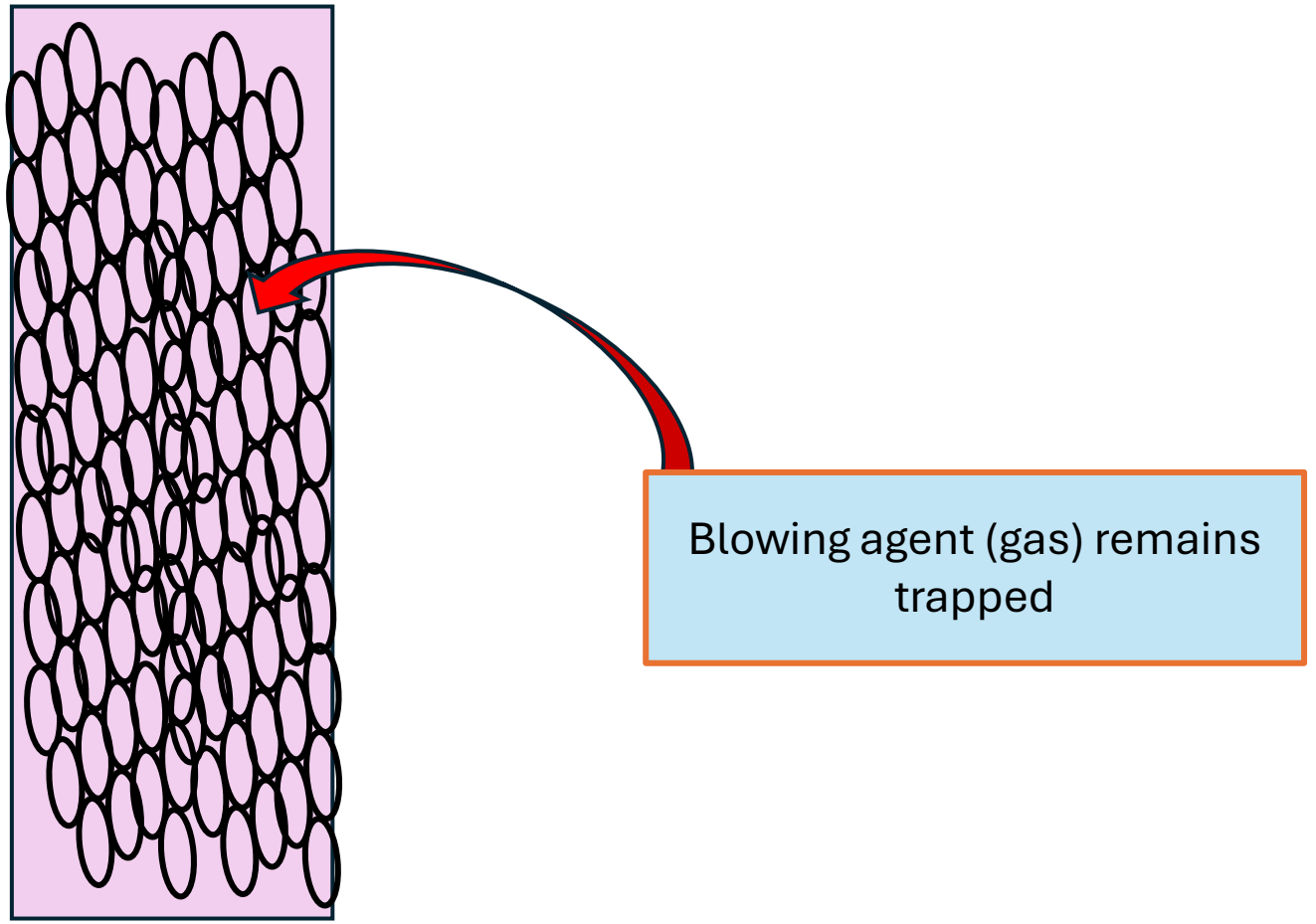
Starts as pentane gas, which diffuses and is replaced with air

Thermal Control Layer

Material Properties of Insulation

Extruded Polystyrene Insulation (XPS)

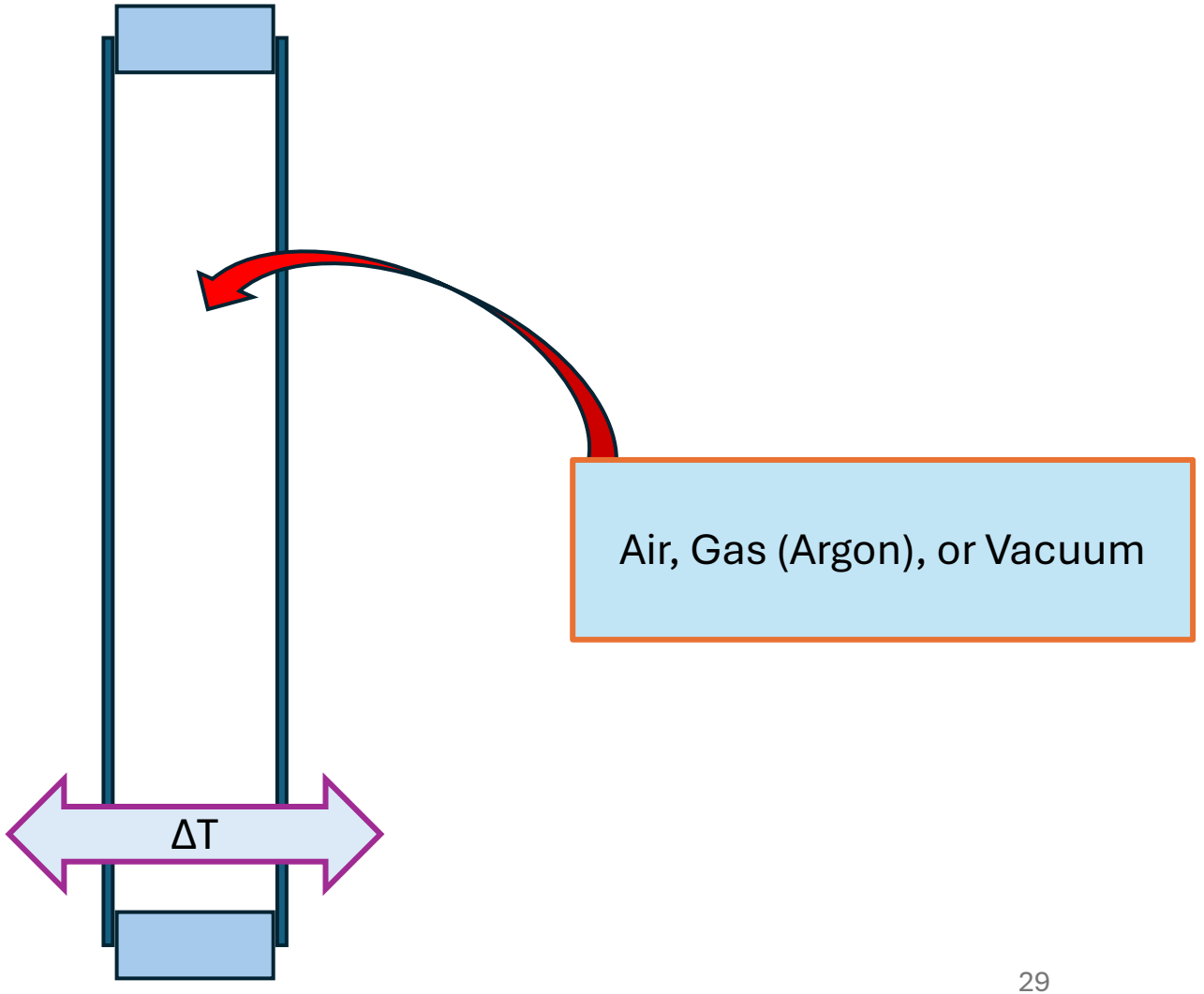
Melted polystyrene resin and blowing agent are extruded through a die.



Thermal Control Layer

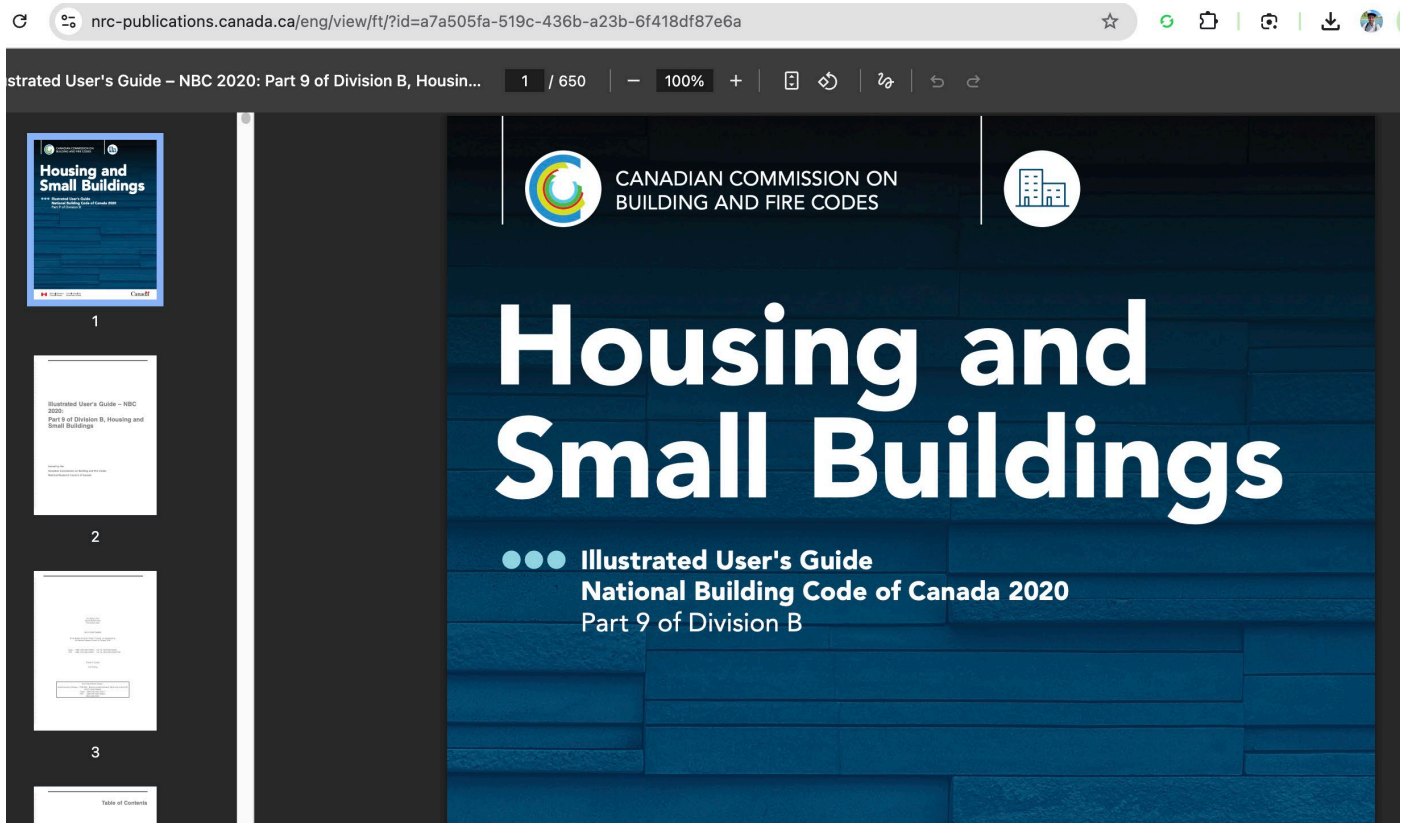
Material Properties of Windows

Double Glazed Window



Resources

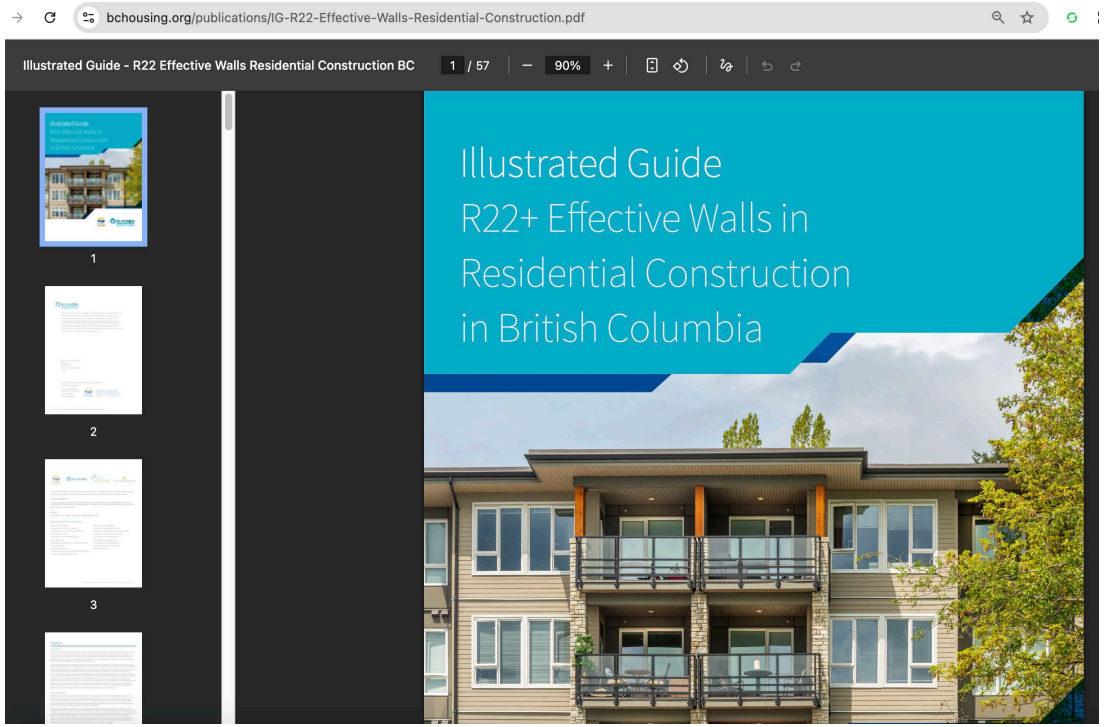
Illustrated User's Guide



https://nrc.canada.ca/en/certifications-evaluations-standards/codes-canada/codes-canada-publications/illustrated-users-guide-national-building-code-canada-2020-part-9-division-b-housing-small-buildings

Resources

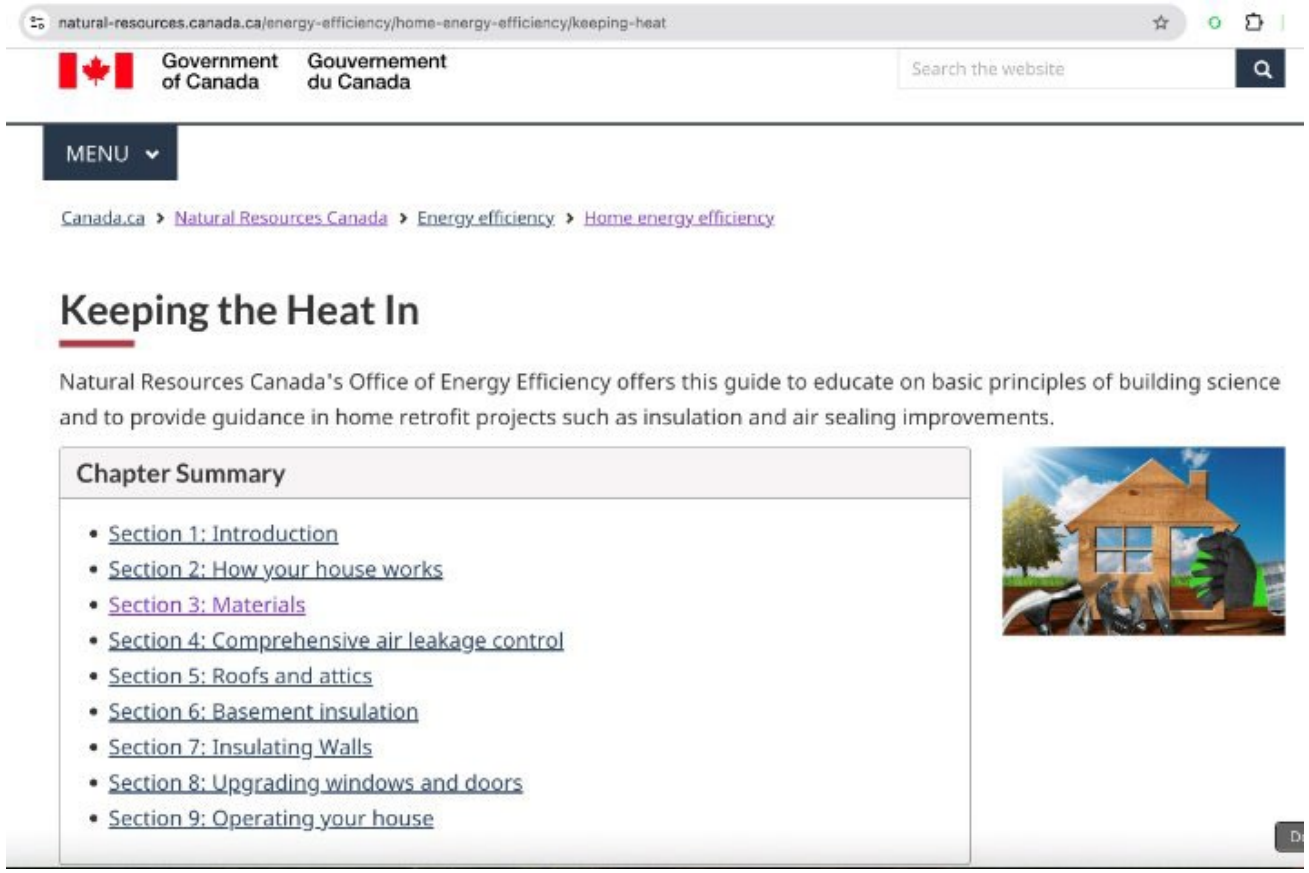
BC Housing – Illustrated Guide R22+ Effective Walls



https://www.bchousing.org/publications/IG-R22-Effective-Walls-Residential-Construction.pdf

Resources

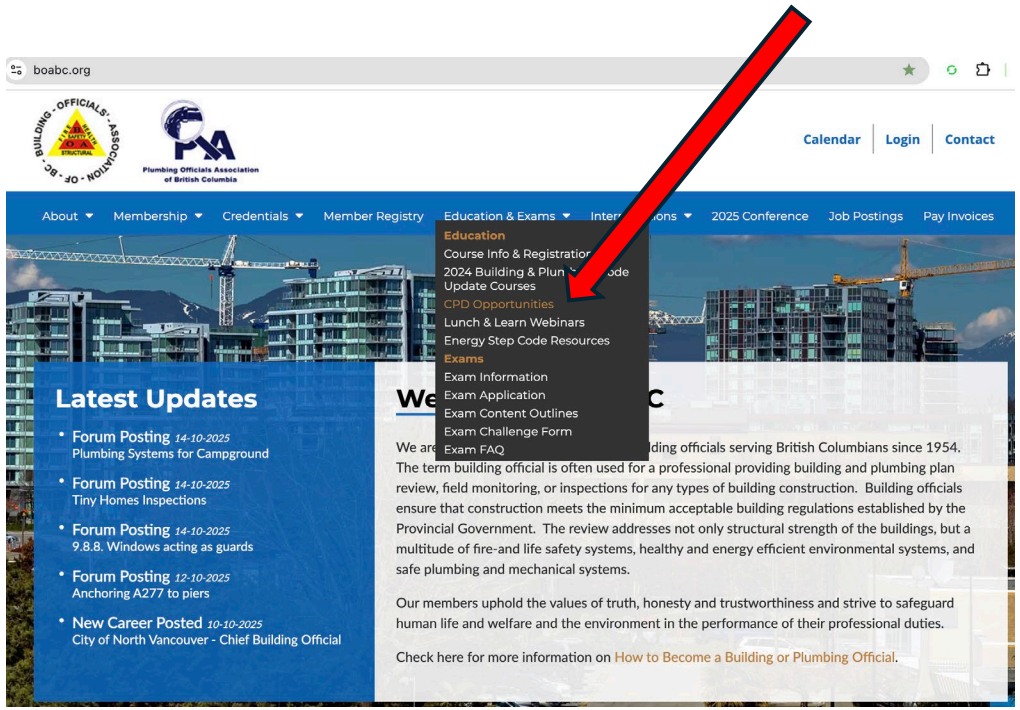
Natural Resources Canada- Keeping the Heat In



https://natural-resources.canada.ca/energy-efficiency/home-energy-efficiency/keeping-heat

Next Session

Understanding AI Assisted Regulatory Workflows



https://boabc.org/new-training-course-available-understanding-ai-assisted-regulatory-workflows/

End/Questions:

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