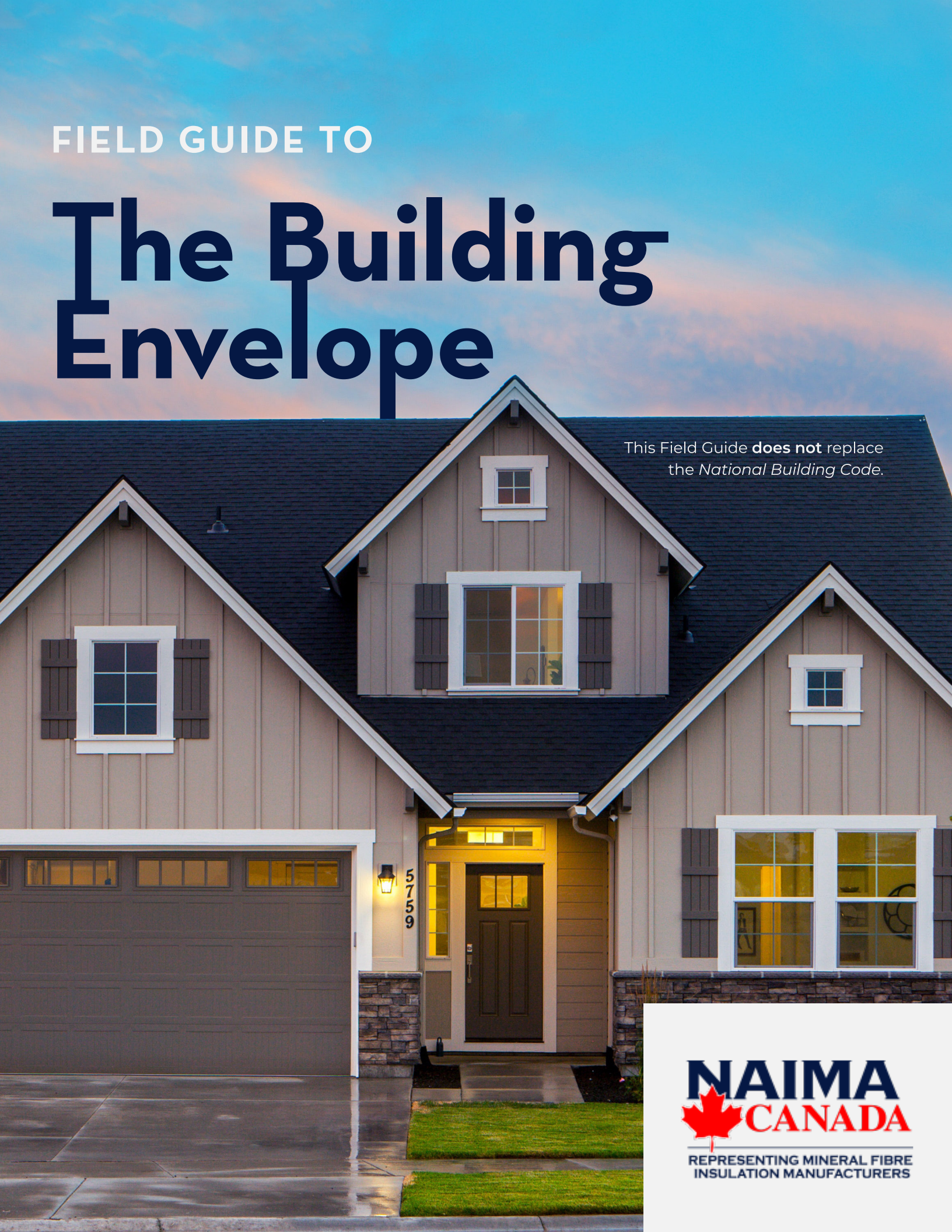
FIELD GUIDE TO

The Building Envelope



This Field Guide **does not** replace the *National Building Code*.

NAIMA CANADA

REPRESENTING MINERAL FIBRE INSULATION MANUFACTURERS

TOPICS IN THIS FIELD GUIDE INCLUDE:

- Improving the Building Envelope
- Effective Insulation Values, R-Value
- Continuous Insulation
- Thermal Bridging
- Openings
- Building Air Tightness
- Moisture
- The Whole Home Approach

WHAT IS THE BUILDING ENVELOPE?

The building envelope of a house is comprised of all the assemblies that separate the controlled indoor conditions of the home from the uncontrolled outdoor environment.

Such assemblies include:

⟩ Above grade walls

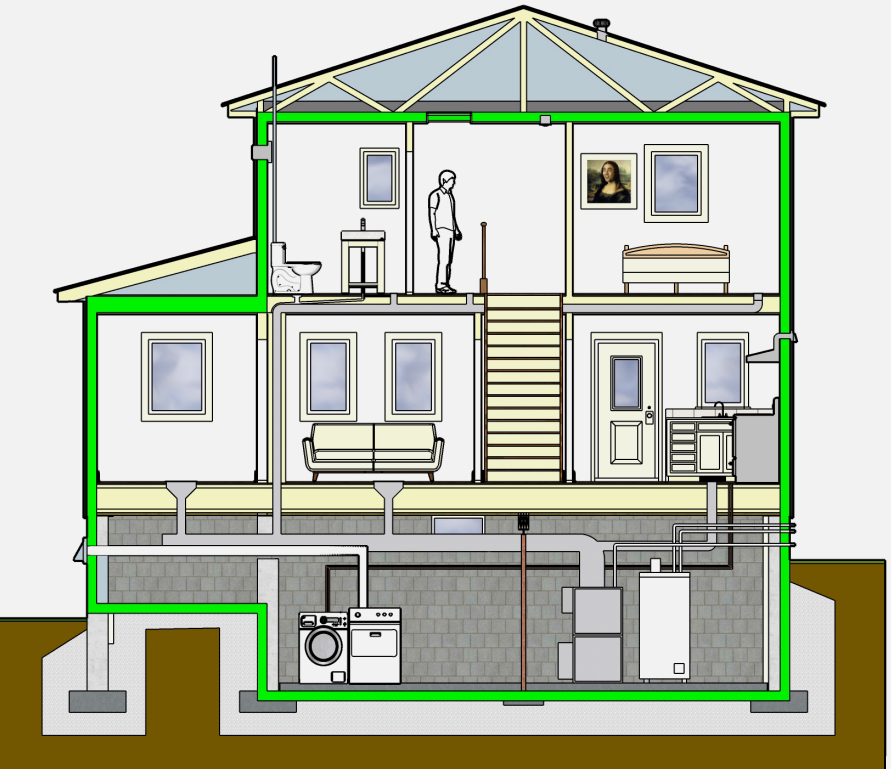
⟩ Below Grade Walls

⟩ Roofs

⟩ Overhanging Floors

⟩ Windows & Doors

Controlling how the indoor conditions interact with the outdoor environment has **many benefits**. It can help make the home more comfortable and healthier, more durable, and reduce energy consumption (lower energy bills and reduce your carbon footprint).



WHAT IS THE BUILDING ENVELOPE?

Comfort & Health

A well designed and properly constructed building envelope can contribute to the comfort and health of a home by improving air quality, reducing thermal drafts, and managing humidity levels which could otherwise instigate mould or mildew growth in unseen parts of a home (such as inside walls and ceilings, beneath finished floors).

Durability

The durability of the assemblies in a home is linked to building envelope performance because unwanted moisture is a leading factor in premature deterioration. Building envelope airtightness prevents moisture laden air from passing through exterior walls, floors, ceilings, etc. Building envelope vapour barriers limit vapour diffusion between the indoor and outdoor spaces. Building envelope thermal insulation keeps assembly components at warm enough temperatures to prevent condensation on cold surfaces which could lead to pooling of water and degradation.

Energy & Money

An airtight and well insulated building envelope also reduces heat transfer through exterior assemblies. We use energy to heat our homes in the winter and cool them in the summer, so by limiting how quickly heat can escape (winter) or infiltrate (summer) the building makes better use of the energy we are consuming and paying money for.

THE CODE LISTS EFFECTIVE INSULATION VALUES

WHAT DOES THIS MEAN?

When you buy insulation at a store, it is labelled with its nominal RSI (Canadian) and nominal R-value (US) which describes the product's thermal resistance, or insulating property. The higher the RSI or R-value, the greater the insulating power.

The better the insulation is, the slower heat moves through it, and the warmer you stay inside during the winter. Which in Canada, can be long, long months.

While products are labelled with their *nominal* values, the Building Code sets insulation requirements in terms of *effective* values. A *nominal* value describes how a single product resists heat transfer. Code requirements in Canada are listed in **effective RSI** because it describes how an overall assembly resists heat transfer. The effective value for a wall essentially combines the nominal values of the individual components that make up the wall, and determines how effective the whole assembly will be at resisting heat transfer.

The installation of continuous insulation maximizes the effective RSI (R-value) of an assembly because it insulates over the individual components that are poor insulators, like wood studs.

HOW TO IMPROVE THE BUILDING ENVELOPE

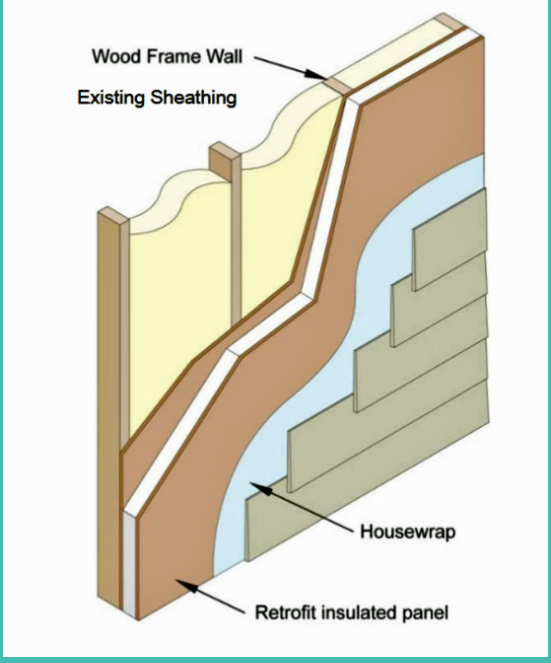
Top up Cavity Insulation and/or Install Continuous Insulation

Many old homes can lack sufficient levels of insulation in between the studs in their exterior walls and attic so renovation work that touches these areas is a great opportunity to replace the existing insulation with products that properly fill the cavities and provide the needed thermal resistance.

Installing continuous insulation can drastically improve the overall thermal resistance performance of an assembly by insulating over all of the thermal bridging structural components.

Thermal bridging occurs where a non-insulative component of an assembly provides a shortcut for heat transfer to pass through rapidly instead of slowly passing through insulation, which is designed to resist heat flow.

Since controlling heat flow is a positive contributor to a durable, healthy, energy efficient home, it is important to protect against thermal bridging by using continuous insulation installed from either the inside or outside of the building envelope.



HOW TO IMPROVE THE BUILDING ENVELOPE

What's a Thermal Bridge?

A thermal bridge occurs where an area of insulation isn't continuous and is penetrated by a material that is more prone to heat loss. Think about a 2x6 wall. Without some sort of exterior or interior continuous layer of insulation, the studs act as thermal bridges. The insulation isn't continuous and heat moves through the wood more easily than it does through the insulated portions of the wall.

Openings

Openings are often extremely leaky owing to the number of cracks formed by the pieces joining in this area. Proper insulation integration and air sealing is important around openings, like outlets and junction boxes since they represent holes in the building envelope. Make sure to cut insulation to the properly fit around openings instead of compressing it, since compressed insulation reduces its thermal resistance.

Attic Openings

The attic hatch should be insulated with insulated covers or a piece of batt insulation at the same R-value as the attic requirements and it should be secured in place properly.

MOISTURE

Vapour Barriers

Vapour barriers restrict vapour diffusion through the building envelope. This means that when opposing sides of an exterior assembly have different levels of moisture in the air, there will be a limited drive of humidity from the high vapour pressure side to the low pressure side.

Air Barriers

Of course, air barriers play a large role in controlling unwanted moisture because they restrict air flow, and the drive of moisture laden air is greater than that of vapour diffusion.

Insulation

Insulation resists heat transfer through the building envelope, which allows designers to choose which parts of the assembly will be warm during which seasons. This is important because airborne moisture will condense into a liquid on sufficiently cold surfaces.

These three components manage moisture movement which is why it is important to have a continuous vapour barrier, an airtight barrier system with proper ventilation, and maximize insulation levels for optimal heat flow control.

When assessing moisture damage, the leakage location that caused the damage may not be nearby! Water can wick through porous materials and in some instances even climb against gravity so keep this in mind when searching for the water leakage point in an assembly.

Familiarizing yourself with the blower door test process and ACH score is one of the best ways to prove the homes you're building are of high quality when it comes to airtightness and energy performance.

7.

BUILDING AIR TIGHTNESS

An *air-tight building envelope* typically saves energy and money, and one of the common ways of characterizing a building's air tightness is by measuring its **Air Changes per Hour**. This metric is typically listed as the building's ACH60 (Air Changes per Hour at 60 Pa Pressure Differential) and it quantifies how much of the total volume of air inside a building would leak through the building envelope over the course of an hour, if there is an air pressure difference of 60 Pa between indoors and outdoors.

To measure this, a *Blower Door fan system* is installed and sealed into an exterior door frame, where the fan depressurizes or pressurizes the home, and measurements are taken of how hard the fan has to work to achieve a given list of indoor/outdoor air pressure differences.

The test can be used to place the stamp of approval on a building's sealing measures or it can expose gaps in the system for further improvements.

Complying with energy efficient construction programs like CHBA's Net Zero Program, Passive House Canada, EnergyStar, R-2000, or the BC Energy Step Code requires a complete air tightness strategy and an airtightness test goes a long way in locating weak points that require more sealing.

WHOLE HOME APPROACH

To optimize the building envelope's performance, we must attend to the whole system as well as to the details.

It's important to understand that the systems in a home affect one another. The building envelope should be the main focus when trying to improve the quality and performance of a home since a well-insulated and airtight "jacket" decreases the need for expending energy to remain comfortable.

It's a cost-effective approach to maximize the performance of the building envelope since it reduces energy loads and provides the opportunity to downsize the heating, cooling, and ventilation equipment. Reduced energy loads typically come with inherent cost savings, while downsized equipment comes with the reduced upfront cost of a smaller system. Properly sized equipment will run more efficiently, which consistently saves energy and money to provide homeowners a return on their investment on the building envelope.

The good news for builders is that insulating and air sealing the building envelope correctly is one of the most cost-effective, higher-return investments when designing for higher performance. **It all boils down to good building practices.**

Like a windbreaker over a sweater, our homes need both good insulation and proper air sealing for the whole system to work right. As we build and renovate towards a lower energy use, building professionals need to build skills in insulating properly and either to or above code, as well as air sealing to make houses really perform.

TRAINING FOR BUILDING PROFESSIONALS

Free Online Courses

Air Barriers for Professionals - *All Levels*

Practically oriented information for residential construction workers and renovators who deal with air tightness, insulation and various control barriers to improve the energy efficiency of homes.

Certificate upon completion

REGISTER ›

Insulation & Air Sealing Training - *All Levels*

This course provides you with the knowledge and skills required to install common residential insulation products in a safe and effective manner based on the most up to date building science principles behind the Building Codes.

Certificate upon completion

REGISTER ›

NAIMA CANADA

REPRESENTING MINERAL FIBRE INSULATION MANUFACTURERS

Jillian McArthur

Communications Specialist

141 Laurier Avenue W, Suite 500
Ottawa, Ontario K1P 5J3
613-402-5287

www.naimacanada.ca