CE 28 j

Before You Start an Energy-Efficient Retrofit—The Building Envelope

The building envelope is the outer layer of the building that separates the living space from the outdoor environment, both above and below grade. Many older homes have high heating requirements because of high rates of air leakage and building envelope areas that are not well insulated.

Like any renovation, retrofitting the building envelope requires careful planning. Before you decide to go ahead with the project, it is important to clearly identify the areas that you want to improve. Just as important is a thorough inspection of the existing structure so that any current problems can be corrected.

HEALTHY HOUSING™

There are many ways to improve the energy efficiency of the building envelope and make your house healthier for you, the community and the environment. When retrofitting the building envelope, be sure to consider:

- **Occupant health**—moisture control strategies, use of low emission materials and products, ventilation for improved indoor air quality.
- **Energy efficiency**—effective air and moisture barriers and insulation, energy-efficient windows and HVAC systems.
- **Resource efficiency**—materials with recycled content, building details that minimize the amount of material used.
- **Environmental responsibility**—durable materials that will last longer and minimize future waste in landfill sites, recycling fixtures to reduce construction waste.
- **Affordability—**a tighter, well-insulated building envelope to reduce ongoing operating costs, durable products to reduce future repair and replacement expenses.

COMMON SITUATIONS

Many homeowners suffer for years, living in houses that are cold, drafty or have high heating bills, especially on windy days during the heating season. The process of improving the energy efficiency of the entire building envelope can seem like an overwhelming task. An understanding of the principle that the house functions as a system (see the House as a System section) is critical for anyone undertaking a building envelope retrofit. Prioritizing the different aspects of the work and learning about viable retrofit techniques can help you to work through the many decisions that must be made.

To help you recognize problems and to plan an energy-efficient retrofit, consider these important areas:

- **Assessing the building**—-the house may be cold, drafty and expensive to heat. A thorough assessment of the building envelope is critical and will help you to prioritize the different aspects of the work.
- **Structural problems**—-there may be structural or water leakage problems. Any existing problems and damage must be repaired as part of the retrofit project.

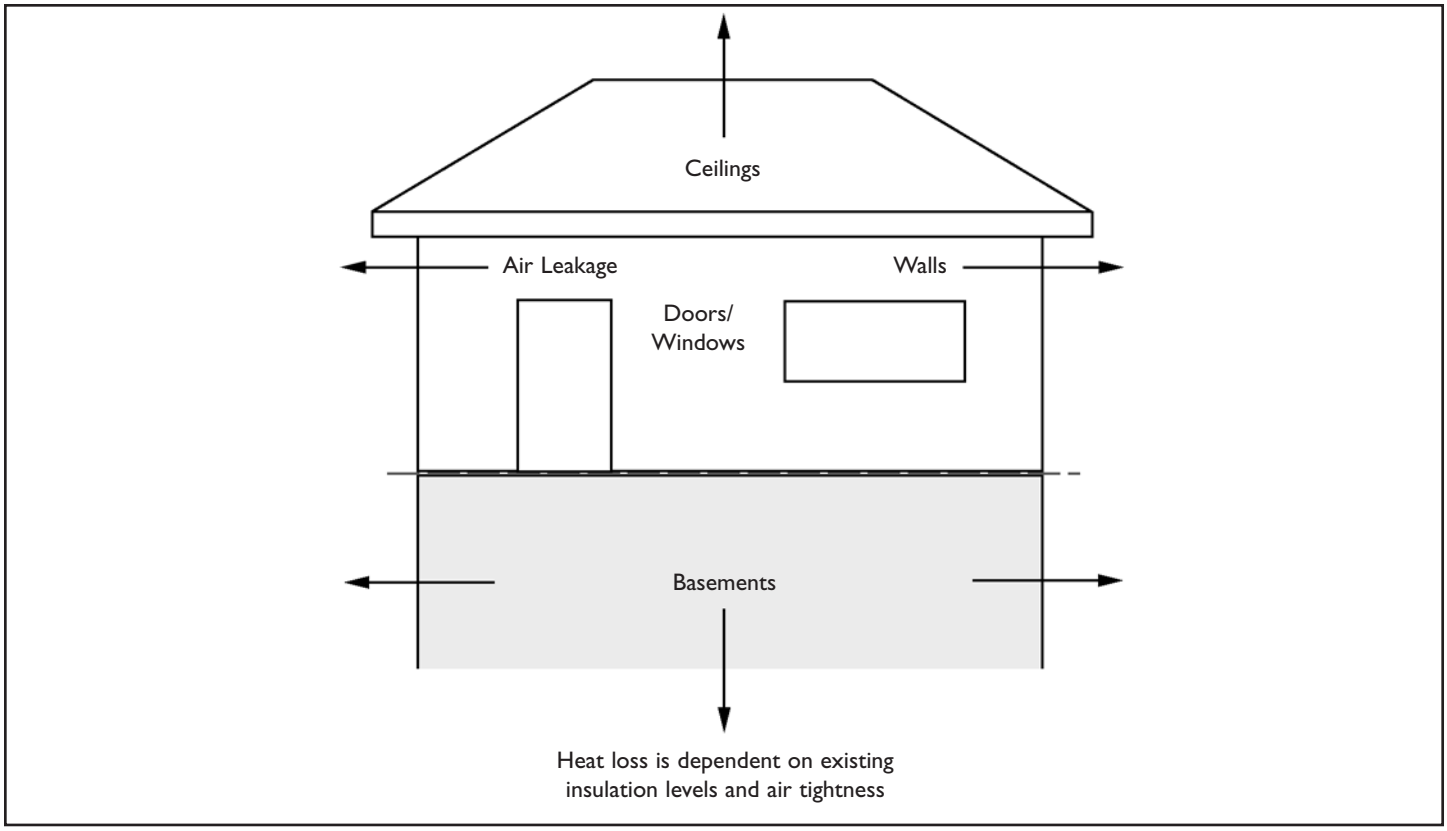

Figure 1

- **Building envelope components**—the building envelope may be poorly insulated, leaky or energy inefficient. Understanding the options available for upgrading the various elements of the building envelope requires research or professional help.
- **Moisture**—there may be moisture problems in the existing house that must be identified and remedied. Retrofit work may increase humidity levels in the building.
- **Heating and ventilation**—inadequate and inefficient heating and ventilation may be symptoms of a poorly performing building envelope.
- **Finishes**—finishes may be damaged from moisture problems associated with poor building envelopes.

HOUSE AS A SYSTEM

A house is much more than just four walls and a roof—it's an interactive system made up of many components including the basic structure, heating, ventilating and air conditioning (HVAC) equipment, the external environment; and the occupants. Each component influences the performance of the entire system. A renovation provides an opportunity to improve how your house performs.

Retrofitting the building envelope often results in a better insulated, more airtight building that is easier to heat and more comfortable to live in. Reduced air leakage and heat loss may require changes to HVAC equipment.

AVOID SURPRISES

A retrofit of the building envelope should not be started until all decisions about construction details have been thought through. Thorough planning will help you to develop a realistic understanding of the work to be done and the costs involved. Here are some of the likely situations that people encounter. However, every situation is unique and you may need to hire a qualified professional to do a thorough investigation, find the problems and suggest the best solutions.

ASK YOURSELF . . .	CONSIDER YOUR OPTIONS . . .	. . . AND IF YOU DON'T
Assessing the building		
■ What are the existing insulation levels of the various parts of the house? ■ How airtight is the building? ■ How energy-efficient are the windows and doors? ■ Is there sufficient ventilation?	■ Have a professional energy audit done of your house. The audit should include a blower door test to determine the airtightness of the house. A professional audit will help you to prioritize your retrofit options. The audit will also help to identify ventilation needs required after a retrofit.	■ You may be wasting money on retrofit work that will have little overall benefit. ■ You may be unaware of important retrofit possibilities. ■ You may underestimate the ventilation needs in your home and end up with poor indoor air quality.
Structural problems		
■ Are there any structural deficiencies in the existing house that need to be repaired? ■ Are there any roofing, flashing, siding, basement or window and door details that allow water penetration of the building envelope?	■ Carry out a complete inspection before you start. You may need to hire a structural engineer or a qualified home inspector. ■ Use contractors that are familiar with energy-efficient construction practices to carry out repair work.	■ Unforeseen problems will lead to unexpected costs and delays during construction. ■ Structural deficiencies can lead to cracked finishes, floor vibration, bowed or displaced walls, floors or roof structures and possible structural failure.
Building envelope components		
■ Can basement areas be air sealed and insulated in a way to avoid mold problems? ■ What options are there for improving the insulation and airtightness of the walls? Ceiling areas? ■ How can the energy efficiency of the windows and doors be improved? ■ What knowledge and skills are required to undertake the work?	■ Insulate basements on the outside. If this is not possible, insulate on the inside, as long as dryness is guaranteed. Proper detailing is essential. ■ Add insulating sheathing to the outside of main wall areas, if possible. Fully insulating wall cavities is another, more difficult, possibility. Insulate and air seal floor perimeters. ■ Add extra insulation in attics. Air seal to eliminate drafts in all areas. ■ Repair, air seal or replace windows and doors. ■ Assess the skills needed through discussions with a trained auditor or renovator. Do some preliminary research.	■ Poorly detailed work can lead to moisture and mold problems. ■ The potential to improve the energy efficiency of your home may be wasted. ■ Improper practices can compromise the effectiveness of the work.

ASK YOURSELF . . .	CONSIDER YOUR OPTIONS . . .	. . . AND IF YOU DON'T
Moisture		
■ Is there any evidence of moisture problems in the existing building envelope? These can include water damaged finishes, water stains or visible mold growth on any surfaces, blistered or peeled paint, cracked or missing caulking and condensation on windows, wall or ceiling surfaces.	■ Determine the source of the moisture that is causing the problems. It may be from building envelope leaks, plumbing leaks or condensation on cold surfaces. ■ Clean up visible mold growth according to CMHC procedures. ■ Insulate, air seal and use energy-efficient windows to provide warmer inside surface temperatures. ■ Repair or replace all deteriorated finishes or structural components. ■ Provide ventilation and eliminate sources of moisture to control high humidity. Air sealing will usually increase indoor humidity levels, so good, balanced ventilation is critical. ■ Maintain caulking, grout and flashings to prevent water access to the building structure.	■ Unresolved water damage problems will continue and will lead to further deterioration of the building, including newly renovated areas. ■ Mold growth caused by excess moisture can be a source of serious indoor air quality (IAQ) problems. ■ Superficial cleanup or hiding moisture damage behind new finishes will allow deterioration to continue.
Heating and ventilation		
■ How efficient is the heating system? ■ Will the existing heating system have to be modified to meet the reduced demand after the retrofit work? ■ Is the retrofit an opportunity to install a more energy-efficient heating system? ■ Does the house have a ventilation system and will it handle the needs of the occupants after the retrofit?	■ Make sure that the heating system is reviewed by an HVAC professional. ■ Seek professional help to determine ventilation options. Consider a ventilation system that includes heat recovery. ■ Many existing furnaces are oversized. Choosing a new, properly sized furnace can lead to a smaller, less expensive furnace and possible gains in efficiency.	■ An oversized or poorly installed heating system will not work efficiently in your newly retrofitted home. Air sealing can reduce the air needed by heating appliances and cause backdrafting. Ensure that make-up or combustion air is available. ■ Improper ventilation can lead to lingering odours and excess humidity.

ASK YOURSELF . . .	CONSIDER YOUR OPTIONS . . .	. . . AND IF YOU DON'T
Finishes		
■ What finishes will need to be replaced during the retrofit work? ■ What skills are needed to properly install the finishes? ■ What finishes will minimize the impact on indoor air quality?	■ Do your research. There are many new and different products on the market. Choose the product that meets your needs for water resistance, durability or cleaning. Consider maintenance-free or low maintenance materials. ■ Determine the preparation and installation requirements for each type of finish. ■ Choose finishes that are environmentally friendly such as paints that carry the EcoLogo symbol or caulking designed for indoor use.	■ Selecting finishes that don't match the use will yield poor results and require high levels of ongoing maintenance. ■ Improper preparation or installation of finishes will void the warranty. ■ Chemical off gassing may compromise the indoor air quality of your home.

REWARDS

- A well-executed building envelope retrofit will result in a warmer, more comfortable living space.
- Improved airtightness and increased levels of insulation will help to reduce heating costs.
- Repairing structural problems and leaks in the building envelope will prolong the life of your house.
- Added ventilation will improve the indoor air quality of your home.
- Warmer interior surfaces will help to prevent condensation and mold growth.

SKILLS TO DO THE JOB

A homeowner with good fix-it skills may be able to do some of the work on the building envelope renovations such as:

- Removing old siding, window or door units.
- Caulking or repairing of windows and doors.
- Installing insulation and a vapour barrier.
- Air-sealing the building.
- Painting.

Consider hiring a professional renovator to manage the project or for structural and finish work. If you are doing it yourself, you may still want to hire subcontractors to do work such as siding, basement insulation and installation of replacement windows.

Installation of a ventilation system or modification of the heating system should be done by a qualified HVAC contractor.

Remember to obtain all necessary permits, get a written contract, ensure that workers use safe working practices and are covered by workers' compensation. Protect yourself, your family and your home.

COSTING YOUR PROJECT

The cost of the renovation work will depend on the condition of the existing structure, local labour and material costs and the extent of the work to be done. Costs of finishes and fixtures vary widely. A good budget checklist will help you to develop a realistic cost for the project before you start.

Some of the items to include are:

- Energy audit and assessment of the existing structure
- Permit costs
- Basement insulation and air sealing
- Insulation improvement and air sealing of walls and ceiling areas
- Window and door repair or replacement
- Heating system adjustment or servicing
- Ventilation
- Painting
- Waste disposal

Use the Building Envelope Retrofit Worksheet to record the present condition, any problems related to the building envelope, proposed changes and preliminary costing.

Building Envelope Retrofit Worksheet

	Present Condition/Problems	Proposed Changes	Cost
Basement: Walls and Floor • Insulation and Air Sealing			
Walls and Ceilings • Insulation and Air Sealing			
Exposed Floors (over unheated space) • Insulation and Air Sealing			
Windows			
Doors			
Heating, Ventilating and Air Conditioning			
Other			

To find more About Your House fact sheets plus a wide variety of information products, visit our website at www.cmhc.ca. You can also reach us by telephone at 1-800-668-2642 or by fax at 1-800-245-9274.

Priced Publications

Building Materials for the Environmentally Hypersensitive	*Order No. 61089*
Healthy Housing Renovation Planner	*Order No. 60957*
Homeowner's Inspection Checklist	*Order No. 62114*
Renovator's Technical Guide	*Order No. 61946*
The Clean Air Guide: How to Identify and Correct Indoor Air Problems in Your Home	*Order No. 61082*

Free Publications

About Your House *fact sheets:*

Measuring Humidity in Your Home	*Order No. 62027*
Understanding Window Terminology	*Order No. 62031*
Hiring a Contractor	*Order No. 62277*
Assessing the Renovation Project	*Order No. 62246*
Before You Start Repairing and Replacing Materials—Exterior Walls	*Order No. 62260*
Assessing the Comfort and Safety of Your Home's Mechanical Systems	*Order No. 62266*
Sample Renovation Contract	*Order No. 62351*

Printed in Canada
Produced by CMHC 07-03-07
Revised 2003, 2005, 2007

62264