Energy Efficiency Building Envelope Retrofits

- Exterior Retrofit for 1960s and 1970s Two-Storey Houses
- 10% or 25% Space Heating Energy Savings

Figure 1: Two-storey detached house

EXTERIOR RETROFIT

The building envelope can be retrofitted from either the exterior or the interior. The choice will largely depend on the house's interior and exterior finishes, layout and construction, lot line setback requirements, other renovation needs and whether or not the house will be occupied during the renovation. There are several advantages to insulating and air tightening from the exterior. An exterior retrofit covers cracks, holes and thermally conductive materials (called 'thermal bridges'); it allows you to detect and repair water entry problems; it doesn't affect interior finishes or reduce room sizes, it makes it easier to ensure the insulation and air-barrier system is continuous; it keeps the structure at a more uniform temperature; and it provides an opportunity to update the appearance of the house.

RETROFIT FOR ENERGY SAVINGS

One of the best ways to reduce the energy consumption of an existing house is to add insulation to the roof, walls and basement, upgrade windows and doors, and seal cracks, leaks and holes. These improvements, called "energy efficiency building envelope retrofits," help to reduce heat losses in the winter and heat gains in the summer, and should result in lower energy bills, improved comfort and reduced outside noise intrusion.

This fact sheet provides guidance for exterior energy efficiency building envelope retrofits to 1960s and 1970s two-storey houses that can reduce space heating energy consumption by 10 per cent and 25 per cent. It describes the starting point (what you have now), air-sealing and insulation options to achieve the targeted energy savings, technical considerations to keep in mind in the planning of the retrofit project, and general precautions.

What You Have Now

The pre-retrofit construction of a 1960s or 1970s two-storey house will vary depending on its age and location and on whether any upgrades have already been completed. The building envelope of a typical, 250-m^2 (2,691-sq.-ft.), two-storey, masonry, siding- or stucco-clad house of this vintage with finished basement will likely include the materials and assemblies shown in figure 2, subject to regional variations. Houses such as these are generally quite leaky with measured airtightness values averaging above 6.0 air changes per hour (ACH_{50}).

Houses built in the 1960s and 1970s also tend be lightly insulated. It is common to find attics with a single layer of insulation and walls with insulating values that are half that required in new homes. Basements usually have modest levels of insulation, if any at all. Fortunately, there are many opportunities to improve the energy efficiency of the building envelope. Insulation, air sealing and window technology have evolved significantly. For example, higher RSI-value (R-value) insulation is now available, low-emissivity coatings, gas fills and superior seals and spacers improve the thermal performance of windows considerably, and airtightness techniques are better understood.

Figure 3 shows a general approach to retrofitting the same wall shown in figure 2—from the attic to the basement. The following section describes five specific building envelope retrofit options, three of which can be used to achieve 10-per-cent space heating energy savings and two of which can be used to achieve 25-per-cent savings.

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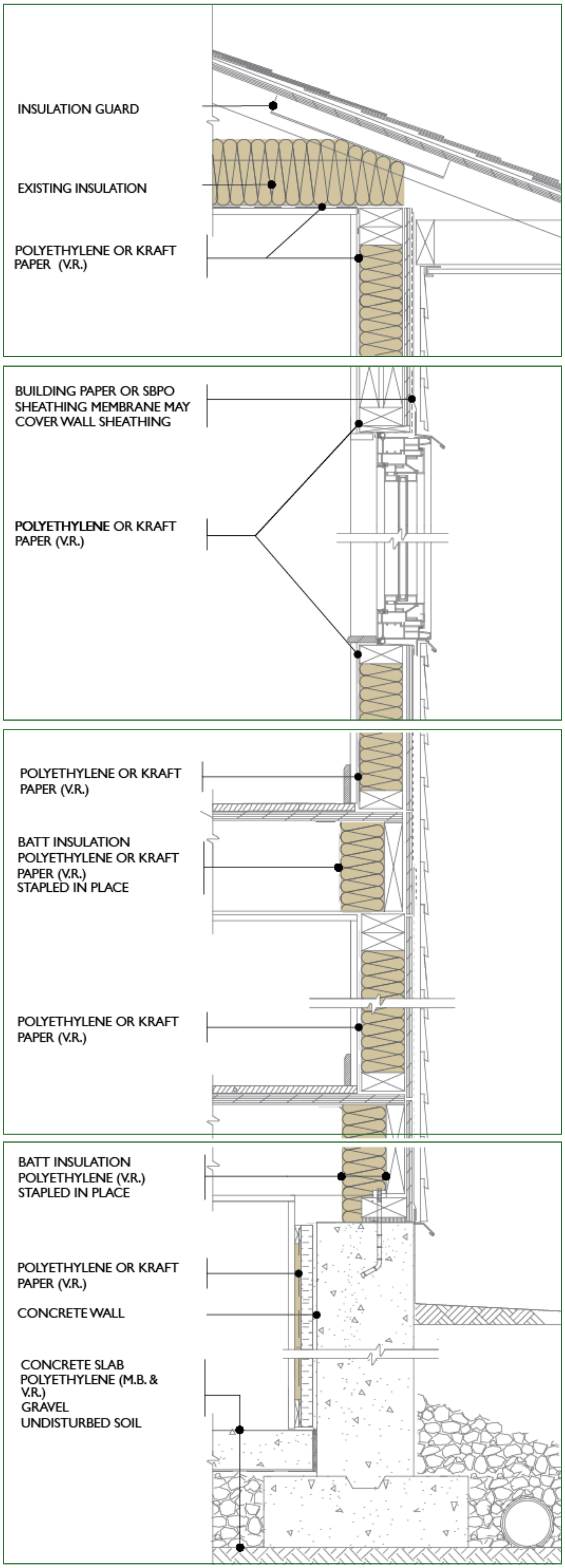


Figure 2: Pre-retrofit section through roof, walls, floors and basement

Roof and attic

Plywood or oriented strand board (OSB) on top of roof trusses or rafters with approximately 200 mm (8 in.) of glass-fibre insulation fitted between the bottom truss chords, providing a nominal RSI-4.5 – 5.5 (R-25 – 31).

The height of the roof trusses between the top and bottom chords is usually quite shallow where the trusses are supported on the exterior walls and, therefore, there may not be sufficient height at the eaves for additional insulation.

Windows and doors

Wood or vinyl framed windows, either single-glazed or double-glazed with metal spacer bar and air-filled cavity.

If they haven't already been replaced, the windows in these houses are often leaky and provide poor thermal performance.

The space between the window and the rough opening might be leaky.

Above-grade walls

Siding, stucco, masonry or other cladding over OSB or plywood sheathing with 38 × 89 mm (2 × 4 in.) wood-frame walls. The wood-frame cavity may contain fibreglass batt insulation, providing a nominal RSI-2.0 – 2.6 (R-11 – 15).

A polyethylene sheet vapour retarder may be installed on the inside of the wall framing and covered with gypsum board; in some cases, kraft paper-backed batt insulation may be present and stapled to the wood studs to secure the insulation in place.

The interior surface of the rim joist might have batt insulation stuffed in the space between floor joists. A polyethylene sheet vapour retarder on top of the insulation may or may not be present.

Below-grade walls

Concrete or concrete block foundation wall with exterior dampproofing. Interior 38 × 38 mm (2 × 2 in.) wood-frame wall filled with batt insulation, providing a nominal RSI-1.1 – 2.2 (R6 – 12).

The interior surface of the rim joist might have batt insulation stuffed in the space between floor joists. A polyethylene sheet vapour retarder on top of the insulation may or may not be present.

If there is polyethylene under the floor slab, this will act as both a moisture barrier and a vapour barrier.

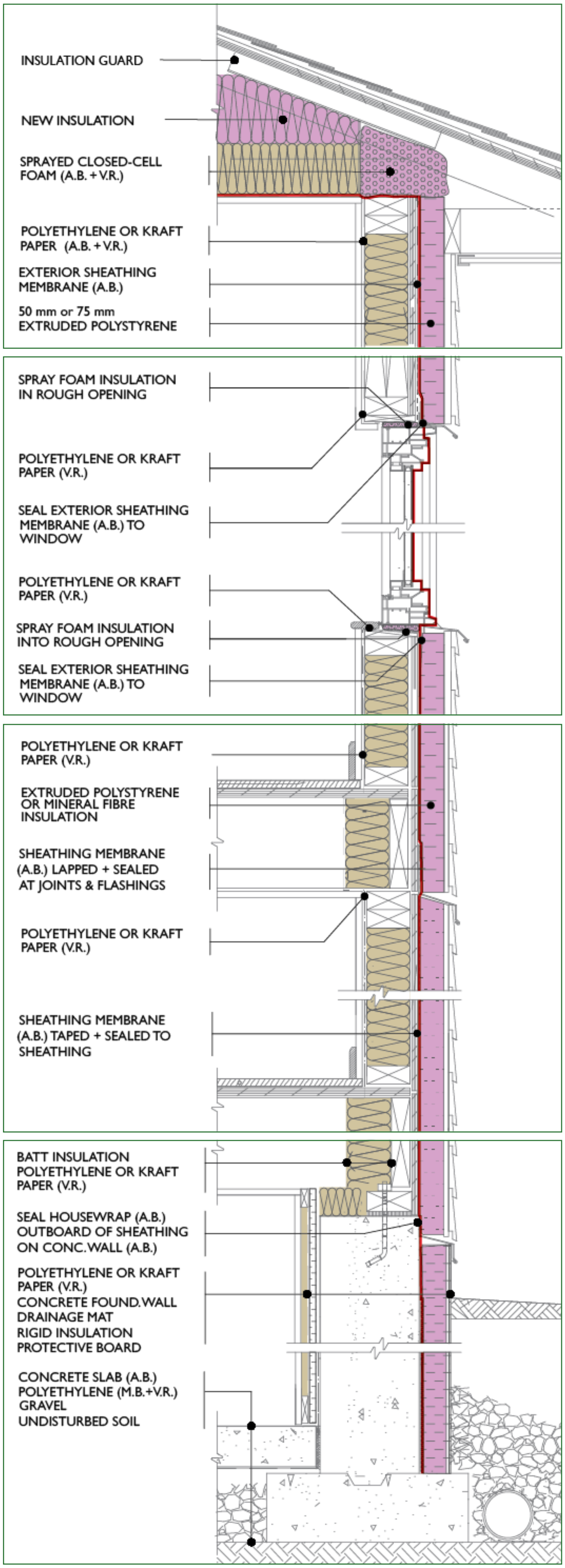


Figure 3: Retrofit option 4 – Post-retrofit section through roof, walls, floors and basement

Roof and attic

Install additional fibreglass batt or blown-in insulation on top of existing ceiling insulation.

Remove exterior soffits to install spray-in-place foam above the exterior wall, between roof truss chords, to provide thermal protection at shallow truss space as well as airtightness at ceiling-exterior wall connection.

Ensure insulation guard (baffle), installed between trusses on underside of roof sheathing is unblocked, providing adequate ventilation to attic space.

Windows and doors

Ensure that replacement windows and doors are ENERGY STAR®-rated or better, and appropriate for your location (heating-degree-day zone).

Consider higher window performance criteria for operable units (for example, sliding, single- and double-hung, casement, tilt-and-turn and awning windows), especially in regions where wind-driven rains are commonly experienced. Consider sub-sill flashings to drain incidental moisture away from the rough opening and the wall assembly.

Above-grade walls

Remove existing cladding finish.

Install exterior sheathing membrane (that is, the air barrier) over top of existing sheathing board, ensuring all joints, laps and penetrations in and through the membrane are properly sealed to form a continuous, airtight system.

Install continuous rigid insulation (in layers, if appropriate) over the exterior opaque wall areas. Install vertical furring over the rigid insulation, fastened directly to the studs, creating a drainage cavity behind the new exterior cladding.

Below-grade walls

Excavate soil around the perimeter of foundation wall to top of footing.

Install new dampproofing (if missing) and a continuous layer of rigid insulation over the exterior of the foundation wall. Install a drainage mat either directly over the dampproofing, or over the rigid insulation.

Where the insulation is not covered by a drainage mat, install protection board to protect insulation from backfilling operations. Where the foundation insulation extends above grade level, apply a polymer-modified parging on a metal mesh over top of the insulation to provide protection.

Before planning a retrofit for a specific house, CMHC recommends that a qualified residential energy service provider undertake an EnerGuide audit of the house. The audit should measure the airtightness of the pre-retrofit house, suggest upgrades to the heating system, and locate areas where air leaks should be sealed and insulation should be added. Audits and ratings can be obtained from service organizations licensed under Natural Resources Canada's EnerGuide program. For more information on finding a qualified service organization, visit http://oee.nrcan.gc.ca/residential/personal/16352.

BUILDING ENVELOPE RETROFIT OPTIONS FOR SPACE HEATING ENERGY SAVINGS

Energy efficiency retrofits can be done in some or all of the critical areas of the building envelope: roof or attic, above-grade walls, windows and doors, and below-grade walls. The choice of where to retrofit and the amount of insulation to add will depend on the desired level of heating energy savings and budget.

The condition of the house, local renovation costs and energy prices will all influence the cost-effectiveness of the retrofit. The homeowner may choose some or all of the following options:

- Improve airtightness.
- Add insulation in the roof or attic.
- Add insulation on the exterior of below-grade (basement) walls.
- Add insulation on the exterior of above-grade walls.
- Replace windows with ENERGY STAR® windows.

Improving airtightness by sealing cracks, holes and gaps in the building envelope is relatively inexpensive and has a big effect on reducing energy loss, making it the most cost-effective measure. In other words, it leads to the greatest savings of heating energy per dollar spent. Moreover, an airtight house gains the full benefit of all the other retrofit measures because air leakage can reduce the thermal resistance of some types of insulation. Because of this, all proposed retrofit options described below include improving the airtightness by 30 per cent. Improved airtightness reduces air leakage into the house and may require improved mechanical ventilation, such as that provided by a heat recovery ventilator, to maintain acceptable indoor air quality. The measures required to achieve this level of airtightness can be determined by an energy audit.

Table 1 identifies three different building envelope retrofit options that target space heating energy savings of approximately 10 per cent or more and two additional retrofit options that target space heating energy savings of 25 per cent or more. For example, retrofit option 1 involves improving the airtightness of the house by 30 per cent and adding RSI-3.52 (R-20) insulation to the roof or attic to achieve a 10-per-cent energy saving. Retrofit option 4 involves improving the airtightness of the house by 30 per cent and

Retrofit Option #	Retrofit Measures					Space Heating Energy Saved
	Improve Airtightness by 30%	Add Insulation in Roof or Attic	Add Insulation to Exterior of Below-Grade Walls	Add Insulation to Exterior of Above-Grade Walls	Replace Windows and Doors with ENERGY STAR® Windows and Doors	
1	✓	RSI-3.52 (R-20)				10% (or more)
2	✓		RSI-1.76 (R-10)			
3	✓			RSI-1.76 (R-10)		
4	✓	RSI-3.52 (R-20)	RSI-2.64 (R-15)	RSI-2.64 (R-15)		25% (or more)
5	✓					

Table 1: Exterior retrofit options for 10-per-cent and 25-per-cent (or more) space heating energy savings

adding RSI-3.52 (R-20) insulation to the roof or attic, and RSI-2.64 (R-15) to below-grade walls and above-grade walls to achieve a 25-per-cent energy saving.

For all options, greater energy savings can be achieved by undertaking more measures or by using more insulation than specified. The choice of retrofit options and the measures they include will depend on what suits the house, as well as the desired energy savings and the renovation budget.

Retrofit options 1 and 2 can be undertaken without affecting the above-grade walls of the house. However, option 2 entails excavating the foundation and would only be cost-effective when other foundation repairs requiring full excavation are needed. Option 3 includes removing the exterior finish and trim on outside walls, installing a spun-bonded polyolefin (SBPO) air-barrier membrane over the sheathing, and installing new rigid insulation and then new siding. Be sure that the added insulation does not reduce the distance to property lines to less than what is required by local zoning and the building code.

Option 4 is a more comprehensive retrofit that targets a 25-per-cent space heating energy reduction. It entails adding insulation to both the above-grade and below-grade walls to achieve a higher thermal insulation value than that used in the 10-per-cent options. This means using insulation that is thicker or that has a higher RSI-value (R-value) per unit thickness.

The window and door replacement in option 5 entails removing and replacing the existing fenestration with ENERGY STAR®-rated windows and doors and insulating and air sealing the junction between the new windows or doors and the wall air barrier. This is typically done by spraying insulating foam into the cavity between the windows and doors and their respective rough openings.

TECHNICAL CONSIDERATIONS

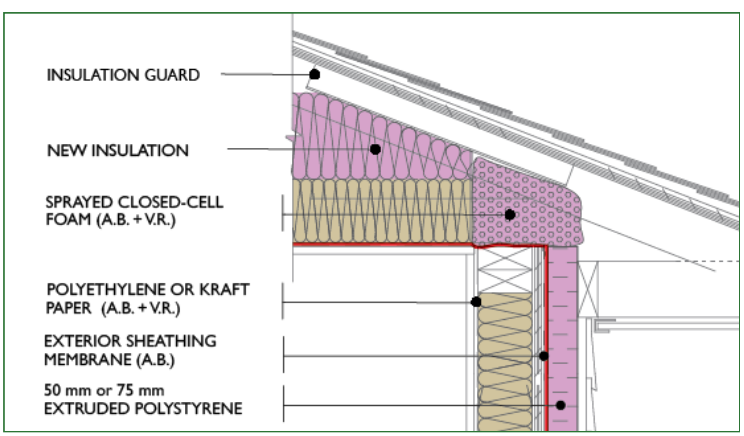
Roof and attic

Insulation

Retrofit work in the attic provides a good opportunity to ensure that the attic space is properly vented. Attic venting depends on airflow from the soffits and prevents moisture buildup which can lead to deterioration of framing, roof sheathing and other building components. If the house doesn't have insulation guards (baffles) under the roof sheathing where the rafters or trusses sit on the exterior wall, these should be installed prior to adding more insulation.

The existing attic likely contains batt or blown-in insulation above the ceiling, which will remain in place while the roof and attic retrofit is carried out. The shape and slope of the roof will determine where and how much insulation can be added. Where space permits, RSI-3.52 (R-20) insulation can be added by blowing approximately 150 mm (6 in.) of loose-fill, glass-fibre, mineral wool or cellulose directly on top of the existing insulation. Alternatively, 150 mm (6 in.) of glass-fibre or mineral wool batts can be placed over the existing insulation (figure 4).

Where there is limited or insufficient space for insulation at the roof-exterior wall junction, closed-cell foam insulation with a higher RSI-value (R-value) may be used. It should be sprayed from the exterior between the top of the wall and the underside of the insulation guards, as shown in figure 4. It can also be done from the inside of the attic if the clearance between the roof sheathing and ceiling below permits.



Place additional batt or loose-fill insulation on top of the existing insulation. The insulation guard maintains a ventilation space under the roof sheathing.

The ceiling air barrier, provided by either the polyethylene or gypsum board, must be continuous with the wall air-barrier system. This detail shows the ceiling polyethylene air barrier connecting with the exterior spun-bonded polyolefin sheathing membrane (air barrier).

Closed-cell spray foam insulation between the top plate and the insulation guard provides airtightness continuity between the interior (ceiling) and exterior (SBPO) air barriers.

Figure 4: Roof and attic—closed-cell sprayed insulation at eaves

To provide backing against which the insulating foam can be applied, a vertical 'dam,' made of suitably rigid material such as plywood, can be installed against the existing insulation between the ceiling and the insulation guard (baffle). Closed-cell foam insulation is sprayed into the space over the exterior walls to provide an airtight connection between the wall and ceiling air-barrier systems. This prevents air movement from reducing the effectiveness of the insulation (called 'wind washing'), and wind gusts from displacing the loose-fill insulation.

Airtightness

Experience has shown that the installation of a continuous air-barrier system, properly detailed and constructed, can reduce air leakage by 30 per cent. It can also optimize the performance of the insulation by preventing air movement through it. The airtightness of the ceiling assembly between the house and attic space should be improved prior to the insulation upgrade to prevent heat loss and, more importantly, moisture migration from the house to the attic. The ceiling air barrier is ideally located below or at the insulation level, and can consist of either existing polyethylene in the ceiling or the gypsum board as the primary air-barrier materials. Take care to seal all penetrations through the ceiling air barrier as follows:

- Replace existing ceiling-mounted electrical boxes with airtight electrical boxes and caulk the joint between the box and the ceiling air barrier.
- Enclose recessed pot lights in approved airtight metal boxes to prevent the light fixture from contacting the insulation and overheating, and to prevent air leakage from the house to the attic through the pot light assembly. Seal the joint between the metal box and the ceiling air barrier with caulking. If the retrofit work provides an opportunity to move the lighting out of the attic and into the house, this would be a preferable approach, as the fewer penetrations through the ceiling into the attic, the better.
- Construct and install airtight gypsum board rigid insulation boxes around the recessed portions of bathroom exhaust fans. Caulk and seal the joint between the boxes and the ceiling drywall or polyethylene air barrier. Ensure exhaust ductwork is insulated and air sealed from the fan housing to the exterior. Exhaust fans must not vent into attic spaces.
- Install metal flanges to seal the space between masonry chimneys and the ceiling air barrier, where gaps are common. Caulk the joint between the flange and ceiling and the flange and masonry. For metal flues serving furnaces and hot water heaters, install special metal flange collars to seal the joint between the flue and air-barrier system. Consult a qualified mechanical contractor experienced with the venting system of the appliance served.
- Install neoprene collars around plumbing stacks and seal between the flange and ceiling air barrier.
- Place a compressible foam gasket around the attic hatch opening. Install fasteners to hold the hatch down firmly against the gasket.
- Locate and caulk the holes allowing wiring to pass through the wall top plates into the attic space.
- If necessary, caulk or spray insulating foam along any ceiling-wall joints to improve the continuity of the air-barrier system over top of the interior partition walls.

The ceiling air barrier should be sealed to the air barrier in the exterior wall assembly to provide continuity between the attic and wall air-barrier systems (figure 4). The closed-cell sprayed foam insulation where the roof meets the wall can act as a transition to connect the ceiling air barrier with the wall air barrier.

Above-grade walls

Insulation

To insulate over the exterior wall, the cladding and other materials are removed down to the exterior sheathing. This provides an opportunity to install a new, continuous air-impermeable sheathing membrane over the existing sheathing. Rigid insulation—for example, extruded polystyrene (XPS) or rigid mineral fibre board—is then applied continuously over the sheathing membrane and fastened to the sheathing or the framing behind. Adding 50 mm (2 in.) of XPS provides RSI-1.76 (R-10) thermal resistance that, in combination with air sealing, can lead to a 10-per-cent (or more) space heating energy reduction (see table 1). Adding 75 mm (3 in.) of XPS, providing RSI-2.64 (R-15), may be needed as a part of a retrofit project targeting the 25-per-cent (or more) heating energy reduction shown in table 1. Over time, gaps can form between the insulation boards, undermining insulating performance. To prevent this, the insulation can be applied in overlapping layers.

In exterior wall retrofits, the use of highly vapour-permeable insulating materials, such as rigid mineral fibre, can improve the ability of the retrofitted wall assembly to dry out should any moisture get into the walls from either the interior (humidity) or the exterior (rain). This is especially the case if an interior vapour retarder (such as polyethylene) exists in the wall assembly that prevents drying to the inside. If a low-permeance insulation foam board such as XPS is installed on the outside of a wall assembly that has interior polyethylene, any moisture that gets into the wall assembly will have difficulty drying out to either the interior or the exterior. The trapped moisture could result in problems such as mold growth and rotting of wall studs and sheathing. Therefore, if XPS or similar materials are used, it is very important to prevent moisture from getting into the wall assembly by reducing the number of airflow pathways into the wall from the inside, ensuring the house is adequately ventilated to control humidity levels, and by properly detailing the exterior wall assembly so that it can deflect and drain rain away from the walls and dry out if it does get wet.

Vertical furring strips fastened to the existing wall studs through the new insulation provide a solid backing for the new cladding and a space to drain and dry any moisture that may penetrate the cladding. The retrofitted wall assembly will be thicker than the original, resulting in a space between the new cladding and the windows and doors. The new cladding can be returned back into the wall assembly to connect with the windows and doors or the joint may be covered with an appropriate width of flashing, trim or window-door jamb extension.

Airtightness

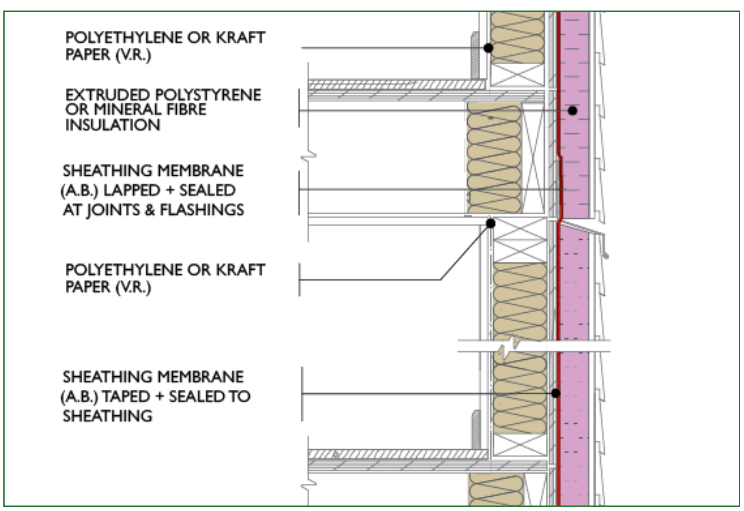
The exterior retrofit approach provides a good opportunity to apply a continuous, airtight air-barrier system over the exterior of the wall. Airtightness can be improved in the walls by using a sheathing membrane such as spun-bonded polyolefin (SBPO) as the main air-barrier layer and sealing at all joints and penetrations including windows, doors, vent hoods, outside faucets and electrical penetrations. The sheathing membrane is also sealed to the attic-ceiling air-barrier system (as described previously) and to the basement air-barrier system, which may be the foundation walls themselves. Ensure that the air-barrier system is continuous through attached garages, covered porches, decks and balconies.

Windows and doors

Insulation

Installing new energy-efficient doors and windows with either double or triple glazing, low-emissivity coatings and low-conductivity insulated frames (vinyl or fibreglass) can provide significant energy savings. As shown in table 1, combining new energy-efficient windows and doors with improvements to the airtightness of the house may achieve a 25-per-cent space heating energy savings, or better.

The simplest approach to selecting energy-efficient windows and doors is to choose new ones that meet the ENERGY STAR® rating appropriate for the location's heating-degree-day zone. Alternatively, it is also possible to customize the window depending on performance needs. For instance, a low-e coating applied to the inside surface of the outside pane will reflect much of the sun's energy back to the exterior, thereby reducing unwanted solar heat gains in the summer. If the coating is applied to the outside surface of the inside pane, this will allow more of the sun's energy into the house and will also help reflect internal heat back into the house to reduce the space heating requirements. Other factors



Remove the exterior cladding. Apply a sheathing membrane over the outside of the sheathing and seal or tape all joints and penetrations, to provide a continuous air barrier.

Install rigid insulation (extruded polystyrene or mineral fibre–refer to table 1 for insulation values) over the sheathing membrane and fasten into the sheathing. Install vertical furring over the insulation to create a drainage cavity behind the cladding.

Install original or new cladding over the furring strips. In drier climates, the outer cladding can be added directly over the insulation.

Figure 5: Above-grade walls—insulation and air sealing outboard of stud-frame wall

such as the type of coating, the number of panes of glazing (double or triple glazing) and the type of gas fill will also affect window performance. Consider reviewing your options with a window specialist.

Replacing architecturally significant doors may not be desirable, but poorly insulated doors can cause a significant loss of energy in a well-insulated house, particularly in cold climates. Consider installing storm doors outside the existing ones to reduce heat loss. During summer months, the storm door vent should be open to allow the heated air between the doors to escape to the exterior, thereby preventing damage to the door components.

Airtightness

Window and door openings are prone to excessive air leakage, particularly through the gaps between the window or door frames and the wall assembly (that is, through the rough opening). Older windows with worn gaskets and weatherstripping or warped sashes and frames can also contribute significantly to the overall air leakage of the house. If the windows are in relatively good condition from a structural and operational point of view, it may be possible to retrofit new gaskets and weatherstripping. Check operating hardware to ensure that the windows are well sealed and secure when in the closed position. Repair worn hardware and air tighten the rough opening to reduce heat losses.

For both new and existing windows, it is imperative that the wall air-barrier system (for example, the newly installed SBPO sheathing membrane, existing interior drywall or polyethylene or concrete foundation wall) be sealed to, and made continuous with, the window or door frame at the wall-window interface. Peel-and-stick membranes, construction tape, caulking with a backer rod, and spray-in foam are examples of materials that can be used to achieve a continuous airtight seal at these locations (figure 6). An airtight seal at the wall-window interface is also an effective means of reducing the risks of rainwater penetration. A rainwater penetration management strategy at window and door locations should also include sub-sill membranes and flashings at head and sill locations to direct water away from the windows and wall assembly.

As with many other measures, it may not be cost-effective to replace the windows and doors just to achieve energy savings. However, if the windows were to be replaced for other reasons (such as sealed unit failures, increased maintenance needs, etc.), then installing energy-efficient windows would reduce energy costs, improve occupant comfort and reduce the potential for condensation on the windows.

Below-grade walls

Insulation

The existing basement wall usually consists of cast-in-place concrete or concrete block. If the house is experiencing foundation moisture problems, an exterior below-grade retrofit may be an opportunity to address the moisture problems at the source. Applying insulation to the exterior of foundation walls helps to keep the basement walls warm, which reduces the risk of condensation and improves interior comfort conditions (figure 7).

The exterior retrofit approach entails excavating around the foundation to the top of the footing. If necessary, new dampproofing can be applied to the exterior face of the foundation wall. Next, a drainage mat is fastened to the outside face of the wall and rigid insulation (for example,

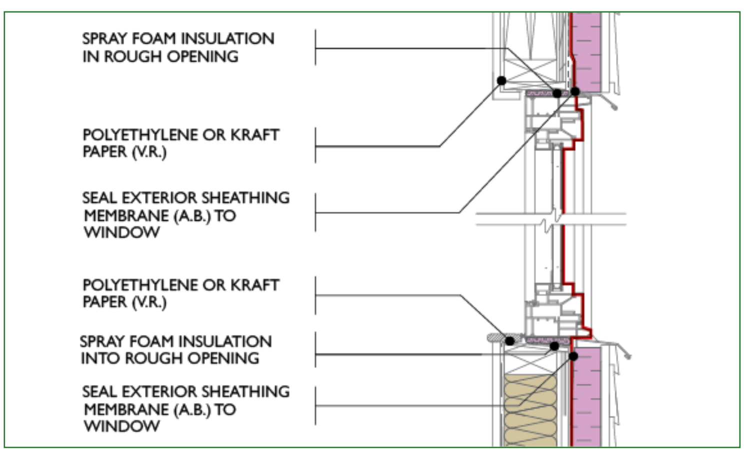
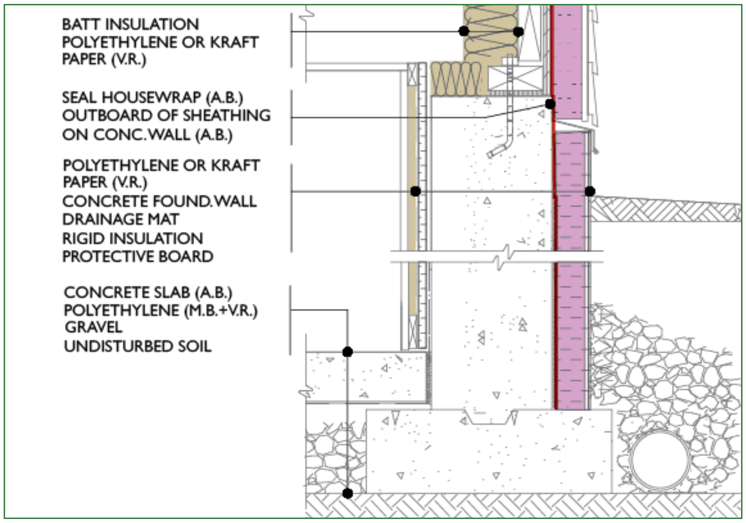


Figure 6: Sheathing membrane air barrier sealed to window

The thermal barrier should be continuous to avoid thermal bridging and reduce the potential for condensation in the wall assembly. Therefore, the window should be installed so that the insulated glazing is in line with the insulation in the wall.

The wall air barrier (sheathing membrane) must wrap into the window rough opening. Airtightness continuity with the window can be achieved using self-adhesive membranes, caulking with a backer rod or spray foam between the sheathing membrane and the window frame (preferably on the interior of the window).

Integrate sub-sill flashings as part of the water management strategy. Flashings above and below the window must extend out beyond the face of the new siding to divert incidental rainwater out and away from the wall.



If water is observed to be leaking into the below-grade assembly from outside, it should be corrected before the insulation retrofit is completed.

Excavate soil around the perimeter of the foundation to the top of the footing. Install dampproofing (if missing). Install rigid insulation (extruded polystyrene or mineral fibre–see table 1 for insulation values) and a drainage mat up to the above-grade wall insulation. Apply polymer-modified parging on mesh over the insulation above grade. Install a prefinished metal flashing at the base of the cladding over the exterior insulation at the foundation and extending over the cement parging.

It would not be cost-effective to install insulation under the concrete slab, unless the slab has to be replaced for other reasons. Installing insulation on top of the floor slab will reduce headroom.

Figure 7: Below-grade walls—insulation and air sealing outboard of foundation wall

extruded polystyrene insulation or rigid mineral fibre) is installed outboard of it, in the thickness necessary to provide the thermal resistance for the desired energy performance level outlined in table 1. As an alternative, the drainage mat could be applied over the insulation. The exterior insulation is fastened to the wall using concrete screws and large washers. Protect the insulation between the top of the foundation and grade from exposure to ultraviolet radiation and mechanical damage with water-resistant protective board, such as fibre-cement board, or cover with metal lath and polymer-modified cement parging.

Airtightness

In an exterior below-grade insulation retrofit, the concrete foundation wall can function as the air barrier. Any penetrations, cracks, holes or openings through the foundation wall and the interface between the floor slab and foundation wall must be sealed. Concrete masonry block foundation walls may contain leakage paths at the joints, which must be sealed in order to function as an air barrier.

Sill plates at the top of the foundation wall and the rim joist area are prone to excessive air leakage. This can be corrected by extending the newly installed SBPO air-barrier and sheathing membrane down over the top of the concrete wall and sealing it to the concrete wall below (figure 8).

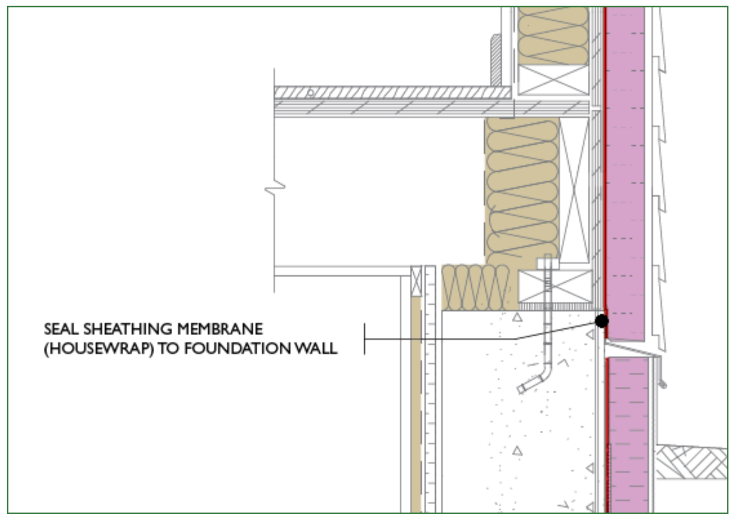


Figure 8: Rim joist with exterior insulation and air-barrier system

A WORD OF CAUTION

Assess the condition of the house for pre-existing problems and anticipate the possible effects of the retrofit work on indoor air quality, building envelope durability, heating appliance performance or other possible performance issues, in order to avoid unintended consequences of a building envelope energy-efficiency retrofit.

Pre-existing problems: The house may have moisture problems (high humidity, water leaks, dampness, mold, etc.) in the roof, walls, floors or foundation; indoor air quality problems (stale air, lingering odours, soil gas, pollutant emissions from household products, etc.); radon or other soil gases; structural sags, cracks and deflections; or the presence of hazardous materials such as asbestos, lead paint and rodent/bird waste. Pre-existing problems should be corrected prior to undertaking an energy efficiency building envelope retrofit so that the problems do not worsen.

Ventilation: A highly energy-efficient building envelope retrofit will provide a more airtight house, which is important for reducing energy consumption. However, this will also result in less incidental ventilation, which would otherwise be provided by a leaky enclosure. This can cause the air in the retrofitted house to seem stale and odours to linger longer. Odours from previously unnoticed sources (such as hobbies, pets or stored items) may become more apparent and more objectionable. Therefore, energy-efficient mechanical ventilation should also be included in any home energy retrofit strategy. This can be accomplished by adding a heat recovery ventilator (HRV) or an energy recovery ventilator (ERV). This ventilation should improve occupant health and comfort.

Building envelope durability: Installing additional insulation can increase the risk of moisture to the building envelope if inside and outside sources of moisture are not controlled.

Heating appliance performance: Reducing heat losses through the envelope may result in the existing furnace or boiler being oversized for the house. Oversized heating equipment does not operate efficiently as it tends to cycle on and off more frequently. Reducing air leaks in a house with chimney-vented furnaces, water heaters and fireplaces can reduce the amount of air needed for safe and efficient operation.

Consult with a qualified energy service provider, building professional, home inspector or contractor before the retrofit to better understand, and plan for, pre-existing conditions and possible unintended consequences of the retrofit project. Often, corrective measures can be planned that not only prevent problems but also add value to the overall project. For more information on retrofit and renovation considerations, visit CMHC's website at www.cmhc.ca.

REFERENCES

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Building Enclosure Design Guide – Wood-Frame Multi-Unit Residential Buildings
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Renovating for Energy Savings – Case Studies: available online at
http://www.cmhc.ca/en/co/renoho/reensa/index.cfm

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