



- Exterior Retrofit for 1960s and 1970s Raised Bungalow
- 10% or 25% Space Heating Energy Savings



**Figure 1:** Raised bungalow

## 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 finish, 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 airtightening a house 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 is easier to make the insulation and air barrier system 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.

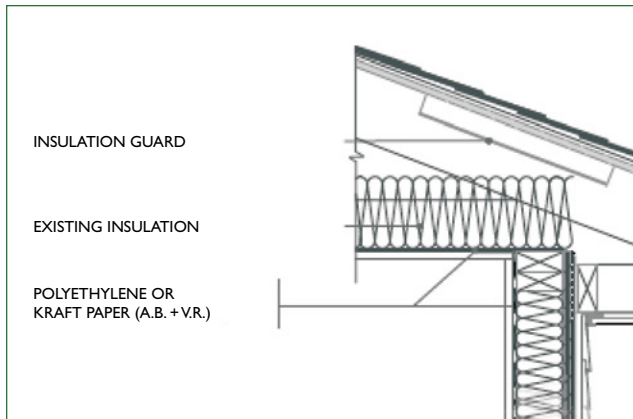
This fact sheet provides guidance for exterior energy efficiency building envelope retrofits to 1960s and 1970s raised bungalows that can reduce space heating energy consumption by 10 per cent or 25 per cent. It describes the starting point (what you have now), air sealing and insulation options to achieve 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 and 1970s raised bungalow will vary depending on its age and location and on whether any upgrades have already been completed. The building envelope of a typical 170 m<sup>2</sup> - 200 m<sup>2</sup> (1,830 sq. ft. - 2,153 sq. ft.) house of this vintage with finished basement will likely be clad with masonry, siding or stucco. Figure 2 illustrates common materials, insulation RSI-value (R-value), and assemblies for this type of building, subject to regional variations. Houses such as these generally have high air leakage with measured airtightness values averaging above 6.0 air changes per hour at an applied air pressure difference of 50 pascals (ACH<sub>50</sub>).

Houses built in the 1960s and 1970s also tend to 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.

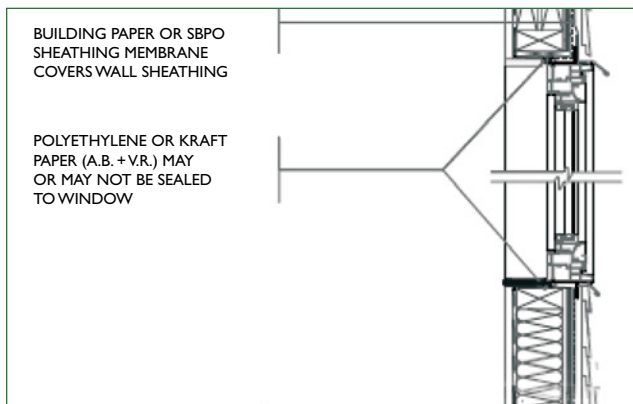
Figure 3 shows a general approach to retrofitting the same wall shown in Figure 2—from the attic to the basement. The following section describes five specific building envelope retrofit options, three of which can be used to achieve 10-per-cent space heating energy savings and two of which can be used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



**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-3.8 – 4.6 (R-22 – 26).

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.

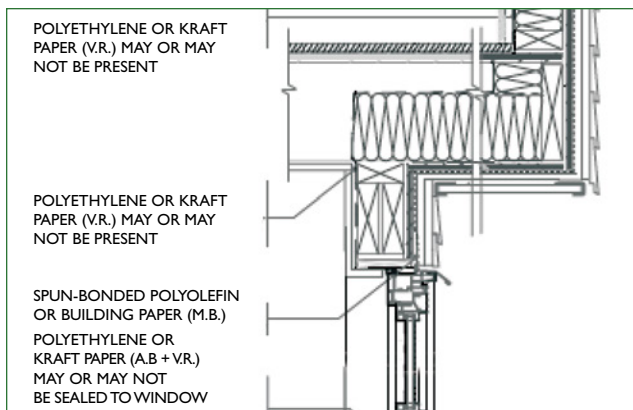


**Windows and doors**

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.

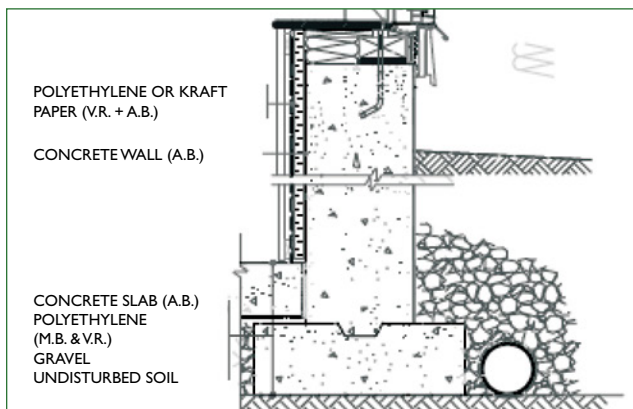


**Above-grade walls**

Siding, stucco, masonry or other cladding over OSB or plywood sheathing with 38x89 mm (2x4 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.

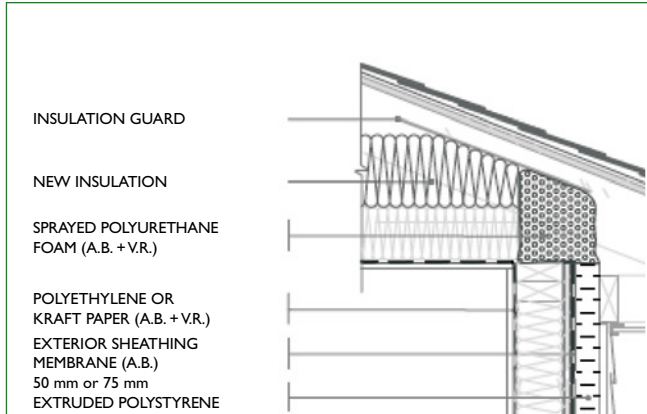


**Below-grade walls**

Concrete or concrete block foundation wall with exterior dampproofing. Interior 38x38 mm (2x2 in.) wood-frame wall filled with batt insulation, providing a nominal RSI-1.1 – 1.6 (R-6 – 9).

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.

**Figure 2:** Pre-retrofit section through roof and ceiling, above- and below-grade walls, floors and basement slab of a raised bungalow

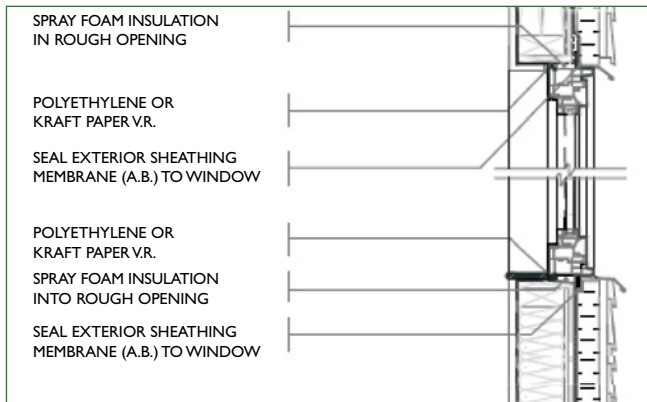


### Roof or attic

Install additional fiberglass 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.

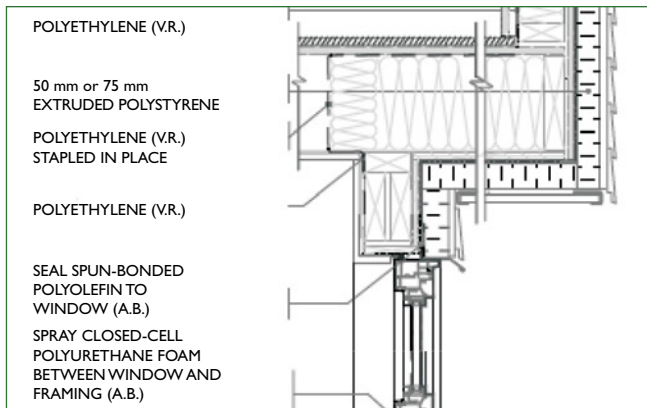
Ensure insulation guard (baffle), installed between trusses on underside of roof sheathing is unblocked, providing adequate ventilation to attic space.



### Windows and doors

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

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

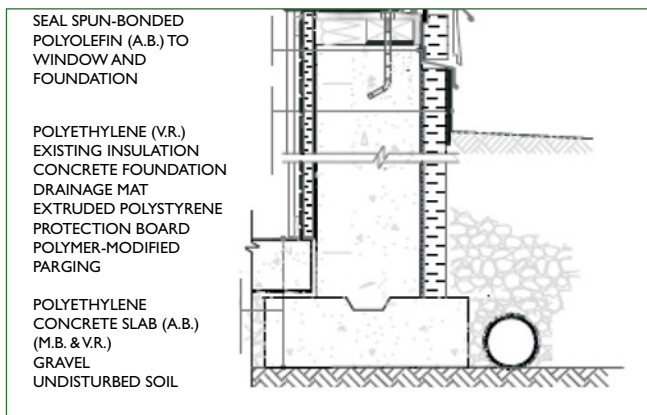


### Above-grade walls

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 membrane are properly sealed to form a continuous, airtight system.

Install continuous rigid insulation (in layers, if appropriate) over the exterior wall areas and underneath overhangs and projections. Install vertical furring over the rigid insulation, fastened directly to the stud framing; creating a drainage cavity behind the new exterior cladding and a base to which the siding can be attached.



### Below-grade walls

Excavate soil around the perimeter of foundation wall to the top of the 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 back-filling operations. Where the foundation insulation extends above grade level, apply polymer-modified parging on a metal mesh over top of the insulation for protection and a finished appearance.

**Figure 3:** Post-retrofit section through roof and ceiling, above- and below-grade walls, floors and basement slab of a raised bungalow

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

The following energy efficiency retrofit measures can be cost-effective subject to the condition of the house, assemblies and materials, local renovation costs and energy prices:

- 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 and doors with ENERGY STAR® windows and doors.

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 attic to achieve a 10-per-cent energy saving. Retrofit option 4 involves improving airtightness by 30 per cent and 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 space heating 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 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:** Suggested exterior retrofit options with improved airtightness and nominal added RSI-value (R-value) to achieve space heating energy savings of 10 and 25 per cent or more

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 insulating 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 units with ENERGY STAR<sup>®</sup> 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.

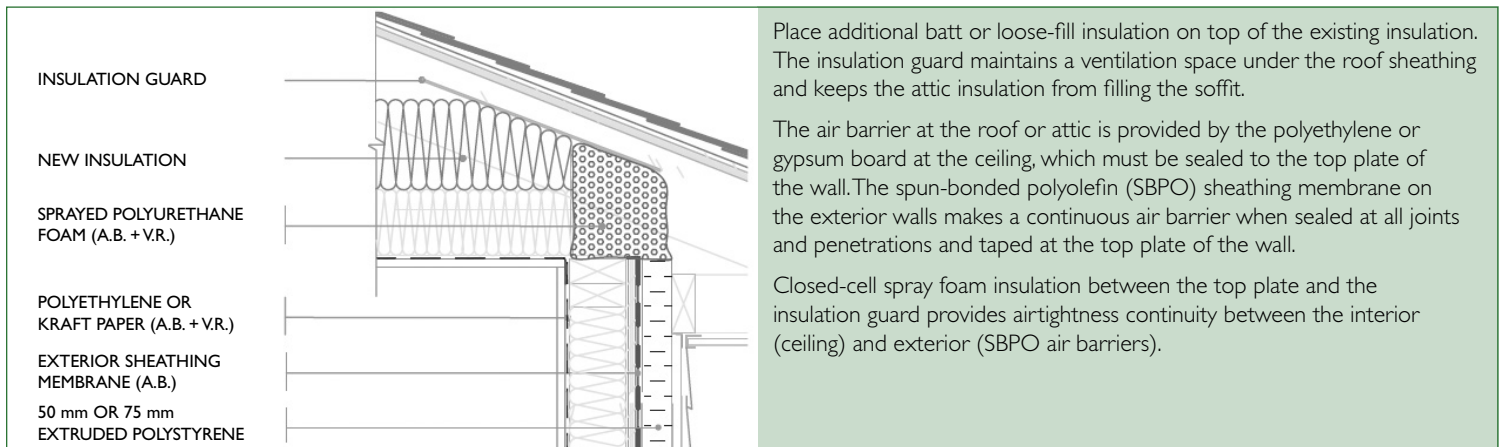
## TECHNICAL CONSIDERATIONS

### 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 build-up, 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).



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

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. 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). The closed-cell foam insulation provides 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 galvanized 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 or foam board 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

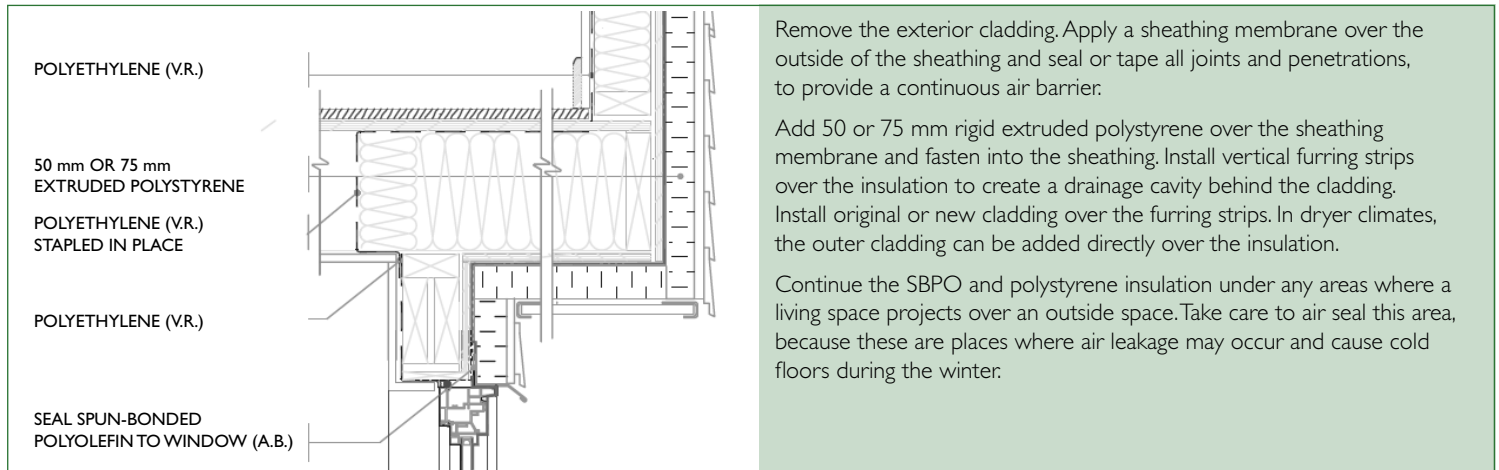
To insulate over the exterior wall, the cladding and other materials are removed down to the exterior sheathing. This provides an opportunity to install a new, continuous air-impermeable sheathing membrane over the existing sheathing. Rigid insulation—for example, extruded polystyrene (XPS) or rigid 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.

In raised bungalows, it is common for the main floor to project out from the lower, basement wall as a cantilevered living area (Figure 5). When insulating the exposed floor from the exterior, remove the sheathing underneath the joists and fill the space between the cantilevered joists with insulation, extending inwards as far as the interior of the wall below. Then cover with new sheathing, a sheathing membrane, and insulation. This will reduce heating costs and substantially improve the thermal comfort in this area of the house.



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.

Add 50 or 75 mm rigid extruded polystyrene over the sheathing membrane and fasten into the sheathing. Install vertical furring strips over the insulation to create a drainage cavity behind the cladding. Install original or new cladding over the furring strips. In dryer climates, the outer cladding can be added directly over the insulation.

Continue the SBPO and polystyrene insulation under any areas where a living space projects over an outside space. Take care to air seal this area, because these are places where air leakage may occur and cause cold floors during the winter.

**Figure 5:** Above-grade walls and overhangs: Insulation added over sheathing membrane

## 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 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 ventilation window should be open if necessary to vent the airspace between the exterior door and the storm door to the exterior, thereby preventing damage to the door components due to excessive solar heat buildup.



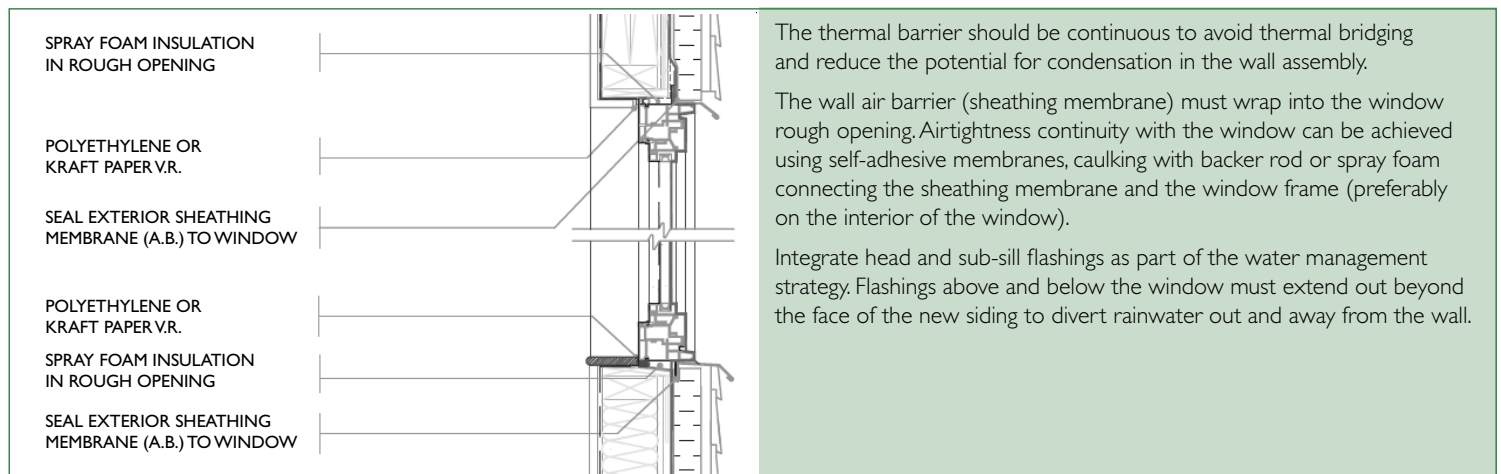
## Airtightness

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). Many different approaches are possible depending on the window design, the wall assembly and the position of the window within the rough opening.<sup>1</sup> 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.



**Figure 6:** Sheathing membrane air barrier sealed to window

<sup>1</sup> Refer to CMHC's "Design, Selection and Commissioning of Window Installations."

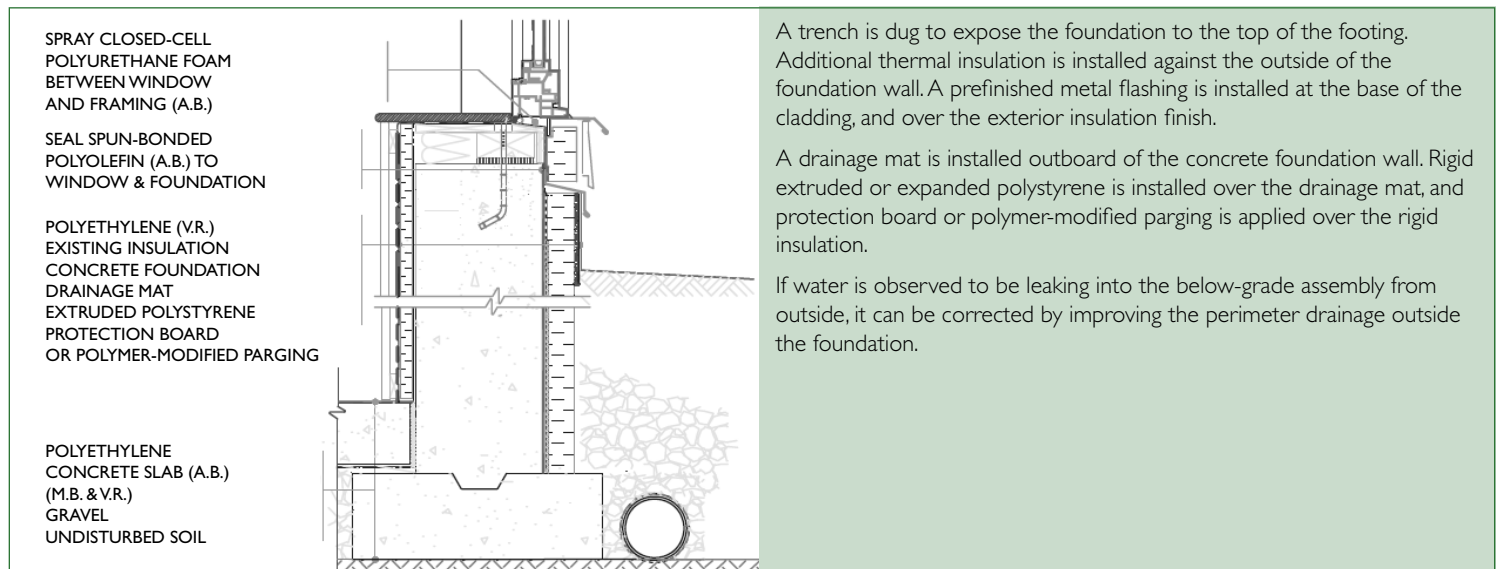
## Below Grade Walls

### 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).

In raised bungalows, the upper portion of the basement wall may be an insulated stud frame similar to the walls on the main floor of the house. For these areas, implement the same insulation and airtightening strategies that were used for the above-grade walls.

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, 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. Protect the insulation between the top of the foundation and grade from exposure to ultraviolet radiation and mechanical damage by water-resistant protective board, such as fibre-cement board, or cover with metal lath and polymer-modified cement parging.

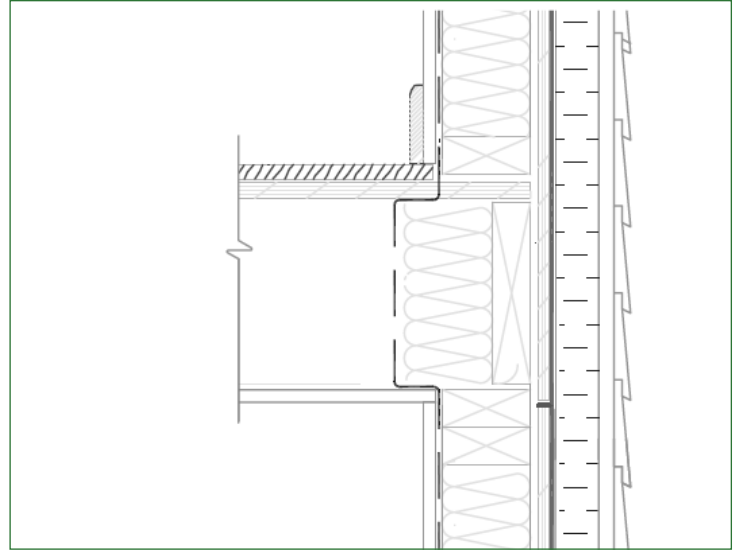


**Figure 7:** Insulation and air sealing below-grade walls

## 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. Foundation walls constructed of concrete masonry blocks may not be suitable to function as an air barrier. A properly functioning air barrier system must be continuous throughout the assembly and all penetrations, cracks, holes or openings through the foundation wall and the interface between the floor slab, footing and foundation wall must be sealed.

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 exterior 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 and 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 efficient building envelope retrofit so that the problems do not worsen.

**Ventilation:** A highly energy efficient building envelope retrofit will provide a more air-tight 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 (e.g. hobbies, pets, 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](http://www.cmhc.ca).

©2012, Canada Mortgage and Housing Corporation  
Printed in Canada  
Produced by CMHC

21-11-13



67980

The information contained in this publication represents current research results available to CMHC. Readers are advised to evaluate the information, materials and techniques cautiously for themselves and to consult appropriate professional resources to determine whether information, materials and techniques are suitable in their case. The text is intended as general information only and project and site-specific factors of climate, aesthetics, practicality, utility and compliance with applicable building codes and standards must be taken into consideration. Any reliance or action taken based on the information, materials and techniques described herein are the responsibility of the user. CMHC accepts no responsibility for consequences arising from the reader's use of the information, materials and techniques described herein.