RENOVATING FOR ENERGY SAVINGS

Case studies

October 2004 Issue 10

Homes with Walkout Basements

Houses with walkout basements have always been built on hillsides and can be found in all parts of Canada. It is only in homes built since the late 1960s, though, that the basement has been treated as living space. The floor area of these houses, including the basement, is typically 270 m² (2,900 sq. ft.).

What you've got

- Sloping site
- A portion of the basement is at ground level
- Two, occasionally three floors
- Partially or fully finished basement
- An exterior door from the basement to the finished grade

How it's built

Actual construction details used in your house may differ, and over the years some improvements may have been done.

This is simply a general description:

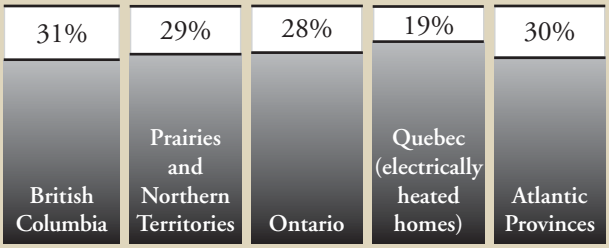
- Exterior walls: 2 x 4 in. stud walls with RSI 2.1 (R-12) or 2 x 6 in. walls with RSI 3.5 (R-20) batt insulation
- Ceiling: insulation RSI 4.2 (R-24) coastal BC to RSI 6.5 (R-38) in the Prairies, in Quebec and the North
- Windows: double-glazed or single-glazed with storms (except for coastal B.C.), triple-glazed in the North
- Exterior doors: hollow core wood panels
- Foundation: uninsulated concrete below grade, 2 x 4 in. stud walls with RSI 2.1 (R-12) batt insulation above grade; the top 600 mm (2 ft.) of the concrete foundation walls below grade may be insulated; fully insulated pressure treated wood foundations in the North

Improvements can

- Reduce energy use for space heating
- Reduce drafts
- Reduce summer overheating
- Reduce moisture and condensation problems
- Reduce noise from outside the house
- Reduce greenhouse gas emissions
- Improve indoor air quality
- Improve humidity levels in dry, northern houses
- Increase comfort level

POTENTIAL ENERGY SAVINGS

If all of the recommended improvements presented here are carried out, overall energy use can be reduced as shown below. Actual energy use is affected by weather and lifestyle, so specific energy savings may vary. If you, or a previous owner, have already carried out some energy-saving measures, the actual reduction in energy use will differ. The energy savings presented here are based on computer simulations done specifically for this type of house in each Canadian region.



How to select energy-saving improvements for homes with walkout basements. These improvements will save energy and reduce your heating bills, while making your house more comfortable to live in.

Canada

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Problems and Opportunities

- Air leakage area is distributed throughout the house, but is often concentrated at the joist header area. If all air leakage paths are combined, the average walkout basement house with finished living space would have a hole that is about 920 cm^2 (or roughly 11x14 in.). B.C. houses are leakier, with a hole about 1,600 cm^2. Houses in the North are tighter with a hole about 700 cm^2.
- Older houses do not generally have an effective ventilation system to maintain proper indoor air quality. There may be a noisy bathroom fan and a kitchen range hood fan. Homes built since the mid-1980s, especially those in the Atlantic region, may have air exchangers or HRV systems installed.
- Many of these homes will have the original furnace or boiler. If this equipment has been replaced, it is likely to be older, low-efficiency equipment that is only about 68 per cent (or less) efficient. Other than improved thermostats, electric baseboard equipment has not changed greatly in efficiency over the years. Water heating is usually provided by a conventional tank.

Draftproof Everywhere!

- Draftproof, or air seal, the top of foundation walls, around window and door frames, at attic hatches and chimneys, ceiling penetrations around light fixtures and wiring, and service penetrations through the exterior walls. Keep weatherstripping at doors and windows in good condition.
- If there is an attached garage, with or without living space above it, special attention must be paid to air sealing where the garage and house share surfaces.
- Pay special attention to the joist header area. Cut rigid board to fit the cavities and then seal with caulking to reduce air leakage. Often walkout basements have "pony walls," a short stud wall built on top of a partial foundation wall. Usually these walls are already finished and there is a ledge where the two walls meet. Seal the header area and the junction. Seal behind baseboards on the main floor as well.
- Large patio doors and windows in the basement are often a major source of air leakage. The frames should be sealed and the doors should be weatherstripped.

For details on draftproofing, see *Keeping the Heat In* by Natural Resources Canada

Improvements that can save energy in homes with walkout basements.

The best time to carry out energy-saving improvements is when you are planning other renovations. Carry out the air sealing and insulation upgrades before you invest in a new heating or mechanical system. A tighter house with better thermal properties has a smaller heating load and a different ventilation requirement. A qualified contractor can help you with this.

Ⓐ Windows

Energy-efficient windows greatly improve comfort levels, virtually expanding the usable space in the house, as the area near the windows is no longer cold and drafty. Replacing windows can also improve house appearance, and increase resale value. The most energy-efficient choice is high-performance units with selective glazing (such as double-glazed units with a low-e coating, argon gas fill and insulating spacers).

Homes built between 1960 and 1980 may have aluminum frame "sashless sliders," (where the glazing sits directly in tracks in the frame). Reduce condensation problems by installing new sliders set in sashes, or adding magnetic storms to the interior or replace the complete unit. These windows are most likely reaching the end of their usable life and should be replaced. Start by upgrading basement windows, which are of special concern in walkouts because they make up a good portion of the exposed wall surface of the lower floor, reducing the effective insulating value and increasing the air leakage potential of the above-grade wall. This affects the comfort level throughout the house.

Existing wood-frame windows can be retrofitted using custom, double-glazed units in the original sash. If window repair is required, replacements should be high performance units.

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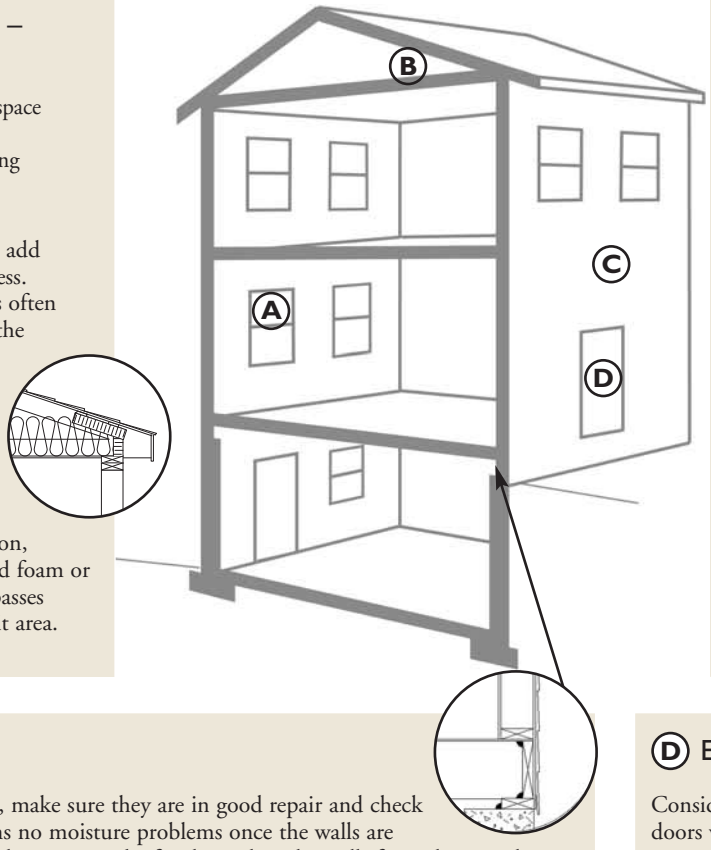
(B) Ceiling/Roof Insulation – *Increase to at least:*

- RSI 7 (R 40) natural gas or oil space heating
- RSI 9 (R 52) electric space heating
- RSI 5.6 (R 32) in coastal British Columbia

The amount of insulation you can add depends on roof structure and access. Houses with low-slope roof trusses often don't have adequate insulation at the eaves. The best choice here is blown-foam insulation, giving high R-values and good air sealing. Friction-fit, high-density rigid board at the eaves will also give higher insulation values in this area but is more labour-intensive. Leave room for ventilation, or install ventilation baffles (shaped foam or plastic) where the roof sheathing passes over the exterior wall into the soffit area.



(C) Exterior Walls

Insulate walls and ceilings between the living space and the garage to at least the same standard as the other exterior walls.

If you redo the siding on your house, take this opportunity to increase insulation levels and do some air sealing. Insulation can be blown into the wall cavities from the outside. If the wall cavities are already insulated, add a layer of exterior insulation and a house-wrap air barrier. If at the same time, you can replace the windows with better-performing units, the combined retrofit gives your older house a facelift, better energy efficiency and higher levels of comfort while saving you money on labour costs. Obtain a professional contractor's advice on how to approach this retrofit.

Basement Walls

Before insulating foundation walls, make sure they are in good repair and check site drainage. Good drainage means no moisture problems once the walls are insulated. If existing moisture problems cannot be fixed, insulate the walls from the outside (at least 600 mm (2ft.)) below grade for poured concrete, from top to bottom for concrete block).

If you are insulating from the inside, most building codes require a moisture barrier on the basement wall, and an air and vapour barrier on the warm side of the insulation. Here are three ways to meet most code requirements:

A) lay polyethylene sheets or tar paper on the basement wall, build a stud wall with batt insulation and seal the warm side with polyethylene;
B) use an approved, rigid-board insulation thick enough to give RSI 2.1 (R-12) and finish it with a fire-resistant material (e.g., gypsum board);
C) lay 25 mm (1 in.) of extruded polystyrene board insulation against the basement wall, build a stud wall with batt insulation and finish with gypsum board.

Headers should have at least RSI 2.1 (R-12) rigid-foam, friction-fit into each cavity and sealed with caulking or foam-in insulation to reduce air leakage. Blown-in polyurethane foam can also be used.

The concrete foundation walls are usually poorly insulated. If the interior finish is paneling that can be reinstalled easily, upgrading this area can be reasonably inexpensive. If not, insulate on the outside as described above.

Ensure that proper window wells are installed, or that existing wells are in good repair.

(D) Exterior Doors

Consider replacing older, wooden exterior doors with metal, insulated units, which are more durable, easier to weatherstrip, and maintain their appearance with lower maintenance needs.

If your walkout basement has patio doors in the path of prevailing winter winds, consider replacing sliding doors with hinged, insulated metal “garden doors” with high performance glazing, for a better seal against the wind and reduce heat loss. For older doors of any sort, keep the weatherstripping in good condition, upgrade the hardware and block off mailslots or other openings as part of your draftproofing measures.

General Energy Efficiency Notes

- Cover hot water pipes within 3 m (9 ft.) of the water tank with pipe insulation—and if possible, insulate all accessible hot water pipes.
- Insulate electric hot water tanks with an insulation blanket.
- Install programmable thermostats to lower temperatures at night or during the day when your home is unoccupied: stay at or above 16°C (61F) minimum temperature to prevent condensation and mold problems, and maintain heat in all rooms.
- Replace leaky dampers and repair chimney flues on woodstoves and fireplaces.
- Glass doors on fireplaces will reduce air leakage up the chimney when not in use.
- Consider other options for fireplaces: an electric fireplace insert (no fuel safety issues), EPA-rated insert unit, or convert to a direct-vent natural gas fireplace insert.
- Gas fireplaces: look for direct-vent units with intermittent electronic ignition systems, or other easy means of turning off and relighting the pilot light.
- Replace your old oil- or gas-fired water heater with a side-wall vent unit or a high-efficiency electric water heater. This eliminates the chimney and associated air leakage and backdrafting problems.

  Check into integrated space and water heating systems (i.e., a boiler for space heating fitted with a "tankless coil" or "indirect heater" that provides domestic hot water). A solar hot water system can produce up to 60 per cent of your annual water heating needs. Solar hot water systems, instantaneous water heaters and other options are becoming more affordable as they become more readily available.
- Before replacing your existing furnace or boiler, carry out any air sealing, draftproofing, insulation upgrades and other energy-saving improvements to the walls, windows and doors and then give your whole heating system a tune-up.
- **It is important to know how airtight your house is to ensure there is no backdrafting of flue gases into the house when exhaust fans are operating. A combustion safety test, carried out by a qualified contractor can indicate if depressurization is a potential problem.**
- Control energy loss in the furnace room by installing automatic, motorized duct dampers on the combustion air line. The same can be done on the fresh-air intake of most furnaces. This prevents large amounts of cold air from entering the plenum between firing cycles.
- Oil heating systems are often oversized. Changing to a smaller nozzle size can improve system performance.
- Controlled air change—fresh air in, stale air out—is important for good indoor air quality. If you have a forced-air heating system it may be possible to add a heat recovery ventilator (HRV) to the system. In houses without forced-air heating or fuel-fired equipment, a good quality quiet fan in a central bathroom or hall and an exterior-exhausting range hood fan may be an appropriate option. Your ventilation system should be designed and installed by a qualified technician to ensure that the operation and venting of any combustion appliance in the house is not compromised.
- In the coldest periods of winter, the indoor humidity should be between 30 and 35 per cent to avoid condensation on windows. Invest in a low-cost hygrometer to monitor the relative humidity levels in your home. If winter humidity levels are too high, try increasing your ventilation rate (for example, by running a small bathroom fan continuously).
- When winter humidity levels are low, it is often due to excessive air leakage. Better air sealing will raise humidity and save energy. If, after air sealing work has been completed, there is still a problem with low humidity levels, a humidification system may be required.

Space Heating System

If your house was built before 1985, consider replacing your warm air furnace or boiler with a new, high-efficiency unit. Your heating contractor can do a heat-loss calculation to properly size the furnace to your home's requirements. If your home has central air conditioning, the new furnace will also have to be matched to the existing A/C unit. In some cases, space and water heating systems can be integrated so that only one boiler or heating unit is required to carry out both tasks.

Increase the efficiency of your forced-air system by sealing ductwork wherever it is easily accessible.

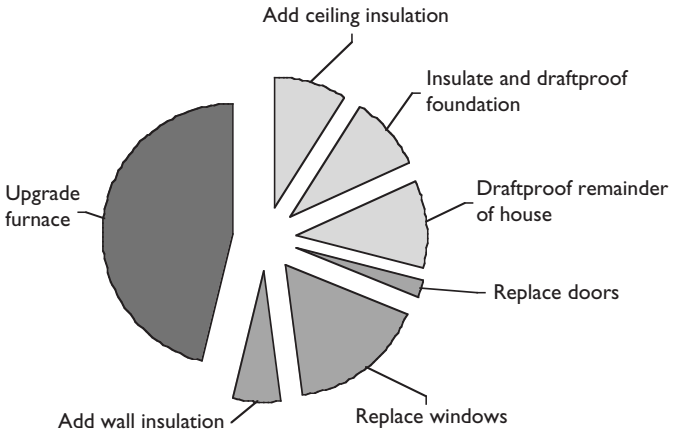
Install newer, more accurate thermostats in electrically heated houses.

Other energy-saving improvements

- Water-saving fixtures: low-flush or dual-flush toilets, faucet and shower flow restricters, front-loading clothes washer that reduce water heating loads.
- Energy-efficient appliances: replace and recycle older refrigerators, freezers, electric ranges and dishwashers with Energy Star® rated models.
- Energy-efficient lighting: the average house has 27 lightbulbs in it. On average, lighting in a house consumes 1,800 kWh annually. Switch to fluorescent, compact fluorescent and task lighting.

Average Energy Savings by Improvement

Based on computer simulations, the pie chart below indicates ***an average percentage of potential total energy savings*** that can be expected for each type of improvement: insulation and draftproofing 29%; door and window replacement 19%; exterior wall insulation 6%; furnace upgrade 46%.



Special Health and Safety Considerations

When you make improvements to your home you change the way it operates. This can affect the health and safety of the house and occupants. Review the following table carefully before carrying out your energy improvements.

If you do this	It can cause this	Can be solved by this
Draftproof your house	Depressurization by exhaust fans could cause backdrafting of combustion flue gases.	Replace combustion appliances with direct-vent appliances or incorporate make-up air. If there is a fireplace or woodstove, ensure there is adequate venting and that combustion air is available.
Check ventilation	Exhaust-only ventilation can lead to excessive depressurization and spillage of flue gases from combustion equipment. Supply-only ventilation can lead to excessive pressurization and condensation/frost problems.	Have a qualified contractor carry out a depressurization test to determine if a balanced ventilation system is required.
Upgrade the furnace	Higher noise levels if the ducts are not properly sized for the higher airflows.	Size the heating system for both the heating load and existing ducting, seal all exposed ductwork connections to reduce vibration.
Install high-efficiency water heater and furnace	Reduced air-change rate, stuffiness and higher humidity levels because high-efficiency sealed combustion units exhaust very little house air compared to a standard unit with a chimney.	Install a proper ventilation system.
Replace the windows	Increased airtightness can lead to higher humidity levels, resulting in condensation on the windows and other cooler surfaces.	Install a proper ventilation system with automatic humidity control.

CMHC's
Renovating for Energy Savings series

Issue 1 Pre-World War II Houses
Issue 2 Post-War 11/2-Storey Homes
Issue 3 Post-1960s Two-Storey Homes
Issue 4 1960s-70s One-Storey Homes
Issue 5 Split-Level Homes
Issue 6 Split-Entry Homes
Issue 7 Mobile Homes
Issue 8 Duplexes and Triplexes
Issue 9 Row Houses
Issue 10 Homes with Walkout Basements
Issue 11 Common Additions

Additional Information and Resources
CMHC Canadian Housing Information Centre (CHIC)

- ***Building, Renovating and Maintaining***
  www.cmhc.ca/en/co/renoho/index.cfm
- ***About Your House***
  www.cmhc.ca/en/co/co_001.cfm

Natural Resources Canada

- **Office of Energy Efficiency**
  www.oee.nrcan.gc.ca Tel. 1-800-387-2000
- **Publications**
  www.oee.nrcan.gc.ca/publications/infosource
- **Keeping the Heat In**
  www.oee.nrcan.gc.ca/keep_heat_in/

Canadian Home Builders' Association (CHBA)

The impact of specific improvements for your house can also be provided by technicians and qualified trades persons. The Renovation Council of your local Home Builders' Association can provide some references, or contact the CHBA
www.chba.ca Tel. 613-230-3060

- **In Quebec, please contact the APCHQ** (Association provinciale des constructeurs d'habitations du Québec) at www.APCHQ.com tel. 514-353-9960 or ACQ (Association de la construction du Québec) at www.ACQ.org Tel. 514-354-0609
- **The Renovation Roadmap**
  Website developed by CHBA, CMHC and NRCAN
  www.myhomereno.com

Provincial Governments

Provincial Government departments will frequently provide detailed recommendations for your region.

Local Utilities

Your local energy utility can usually provide detailed recommendations for your region.

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