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HIGH PERFORMANCE HOUSING GUIDE FOR SOUTHERN MANITOBA

A guide to the technology combinations selected by the participating builder group in their Local Energy Efficiency Partnerships (LEEP) workshops.

2016

Canada

Acknowledgements:

Natural Resources Canada would like to thank the builders who participated in the Manitoba Local Energy Efficiency Partnerships (LEEP) workshops to select new cost-effective energy saving technologies. Without their first-use experiences, this publication would not be possible.

The LEEP Builder Group was comprised of: **Arlt Homes, G&E Homes, Greentree Homes, Kensington Homes, Maric Homes, Parkhill Homes, Qualico Homes, Randall Homes, Signature Homes, and Ventura Homes**. Their work during and after the LEEP workshops also provided valuable information which directly aided the development of new energy efficiency measures for the Manitoba Building Code (MBC), such as the inclusion of Drain Water Heat Recovery (DWHR) systems. The builders also provided valuable insight which Manitoba Hydro used in the development of its Power Smart for New Homes Program, launched in late 2015.

The Manitoba LEEP workshops were made possible with financial support from **Manitoba Hydro** and the work of the **Manitoba Home Builders Association**.

We also acknowledge the contributions made by local building science experts and all the builder-invited manufacturers who informed the final stage of builder technology assessment, and in some cases, supported the builders with their first use of the technology.

Important Note:

The aim of this publication is to provide guidance to home builders who wish to assess the benefits and risks of building high performance homes in Manitoba. Because the subject is complex, and the decision to install and commission housing components and systems depend on many variables, this guide alone does not provide sufficient information to evaluate fully all the aspects of a potential system. The guide is also not intended to serve as a "how to" manual for the installation, operation and maintenance of a system. In all cases, qualified advice and assistance to supplement the information provided here should be sought. Builders should consult local utility and government agencies to ensure that proposed installations will meet all relevant codes and regulations.

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Cover photo credits: Upper left – Qualico Homes

Upper Right – Arlt Homes

Bottom Left – Maric Homes

Bottom Right – Ventura Homes

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SCOPE AND TECHNICAL CRITERIA

This guide has been developed to summarize some of the lessons learned by a group of leading Manitoba Builders as they used the Local Energy Efficiency Partnerships (LEEP) process to explore, select and apply a number of new energy efficient technologies.

The LEEP Builder group worked together in Winnipeg during 2014/15 to investigate a wide range of technologies and their applications. They identified a number of technological innovations that they felt had the potential to cost effectively reach an EnerGuide Rating System (ERS) score of 82. Cost optimization analysis by NRCan's CanmetENERGY showed that building ERS 82 housing in Manitoba has the potential to reduce a homeowner's annual operating costs.

> *"The LEEP process in our estimation was a success because it gave the Builders the opportunity, through their participation, to steer the wheel in regards to what we believe will work locally instead of having solutions created elsewhere and then pushed onto us."*
>
> **Dale Verville, Production Manager, Qualico Single Family Homes, Winnipeg, Manitoba**

The Manitoba LEEP builder group was informed by NRCan's technical resources, local building science experts and builder-selected manufacturers as they:

- Investigated over 40 energy saving technologies, with the goal of using them to achieve an EnerGuide Rating System (ERS) score of at least 82.
- Short-listed those technologies that showed the most promise for Manitoba, based upon standardized technology assessments.
- Defined the scenarios they wanted costed and the questions they wanted answered before deciding whether or not to trial technologies.
- Reviewed presentations from their selected manufacturers to better define costs and identify answers to various technical questions.
- Individually selected the technologies which were most appropriate for their high performance homes.

More information on LEEP is available on the web by using the search term 'NRCan LEEP', or by visiting http://www.nrcan.gc.ca/energy/efficiency/housing/leep/17338.
E-mail: nrcan.leep.rncan@canada.ca

Limitation of Geographic Application

This guide is based on construction practices in Southern Manitoba (Climate Zone 7A, 5000-5999 Heating Degree Days).

Builders seeking to adapt the technology combinations to a different climate zone should work with their design evaluator to ensure their designs:

- maintain durability in climates with different moisture, temperature or seismic conditions;
- align with local construction practices and conform with local building codes.

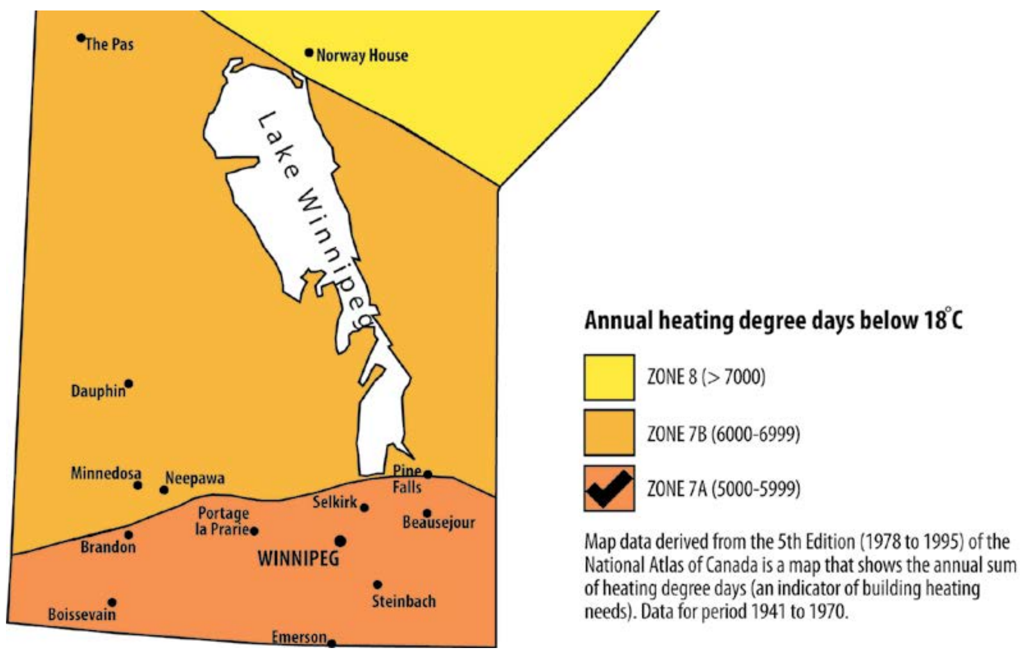

Figure 1: Map showing Climate Zone 7A (Southern Manitoba).

Types of Homes Assessed

The LEEP Builder Group assessed the impacts of using various combinations of energy-saving technologies applied to a typical Manitoba bungalow (see next page for baseline specifications). Later, these were also applied to a typical two-storey home.

LEEP Reference Home Designs:

To compare the new technologies against existing building practices (base case), the LEEP Builder Group chose to consider technology applications using a 148 m^2 (1,600 ft^2) bungalow of a popular style. A detached 223 m^2 (2,400 ft^2) two-storey home was used as a second reference point for this Guide.

Figure 2: Manitoba LEEP builder groups selected reference house, a 148 m^2 (1,600 ft^2) Bungalow. Photo credit: Parkhill Homes

Figure 3: Two storey 223 m^2 (2,400 ft^2) single family reference house. Illustration: Natural Resources Canada

Component	Baseline Specifications
Above Grade Walls	• Stucco • Spun-bonded Polyolefin weather resistant membrane • 11 mm (7/16″) OSB sheathing • 38x140 mm (2″x6″) wood frame wall at 400 mm(16″) o/c • RSI 3.52 (R-20) batt insulation • Sealed 6-mil polyethylene • 12 mm (½″) drywall
Basement Walls	• 204 mm (8″) concrete foundation wall • 38x89 mm (2″x4″) wood frame wall @ 610 mm (24″) o/c offset from concrete wall • RSI 3.52 (R-20) batt insulation • Sealed 6-mil polyethylene
Windows	Double-glazing with inert gas fill, 1 insulated spacer bar, and 1 low-E coating
Air Tightness	2.3 air changes per hour at 50 Pa (2.3 ACH)
Exposed Floors	• Sub-floor • Floor joists • RSI 5.63 (R-32) batt insulation • Sealed 6-mil polyethylene • 12 mm (1/2″) Drywall or 11 mm 7/16″ OSB
Space Heating	94% AFUE natural gas furnace with PSC motor
Water Heating	Electric tank, 189 litres (stand-by loss (Watts): 40 + (0.2V))
Heat Recovery Ventilation	Heat Recovery Ventilator (HRV) with a Sensible Recovery Efficiency (SRE) of 60% at 0°C and 62% at -25°C

Figure 4: The *Base Case* inputs were provided by the LEEP builder group to define existing construction practices. The resulting ERS ratings were 80 for the bungalow and 78 for the two storey modeled in HOT2000 version 10.51.

Technology Upgrades for Natural Gas Heated ERS 82 Homes

(as selected by Manitoba's LEEP Builder Group)

The following builder-chosen upgrades were used to improve the bungalow performance from a base case ERS 80 to ERS 82. When applied to the two-storey house, the upgrades improved it from its base case of ERS 78 to ERS 82.

Component	Bungalow	Two-Storey
Above grade walls	Upgrade to 38x89 mm (2″x4″), RSI 2.46 (R-12) nominal & RSI 1.76 (R-10) insulated foam sheathing with exterior air barrier	Upgrade to 38x140 mm (2″x6″), RSI 3.52 (R-20) nominal & RSI 1.76 (R-10) insulated sheathing with exterior air barrier
Basement walls	Upgrade to RSI 3.52 (R-20) nominal batt insulation in 38x89 mm or 38x140 mm (2″x4″ or 2″x6″) framing & RSI 1.76 (R-10) extruded polystyrene (XPS) on basement wall exterior	SAME UPGRADE AS BUNGALOW
Windows	No upgrade from base case	Upgrade to triple-glazing with 1 low-E coating, 2 insulated spacer bars and two inert gas fills
Airtightness	Improve from 2.3 ACH to 1.5 ACH	SAME UPGRADE AS BUNGALOW
Exposed Floors	N/A	Upgrade to RSI 6.69 (R-38) nominal
Space Heating	No change to Baseline Specification	No change to Baseline Specification
Water Heating	Electric tank water heater with Drain Water Heat Recovery (DWHR) 76 x1,067 mm (3″x42″) unit with 43% heat recovery efficiency	SAME UPGRADE AS BUNGALOW
Heat Recovery Ventilation	Replace mid-efficiency HRV with a SRE of 60% at 0°C and 62% at -25°C with an HRV or Energy Recovery Ventilator (ERV) with a SRE of 67% at 0°C and 60% at -25°C	SAME UPGRADE AS BUNGALOW

Figure 5: Upgrades as selected by Manitoba's LEEP builder group to achieve ERS 82 in Winnipeg for a home heated with Natural Gas.

The individual geometry, window-to-wall ratio, orientation, and geographic location will have an impact on the projected energy consumption of each home. Builders should work with local design evaluators to confirm their technology combinations.

Technology Upgrades for Electrically Heated ERS 82 Homes

(as selected by Manitoba's LEEP Builder Group)

The following builder-chosen upgrades reflect the requirements to improve the bungalow from a base case ERS80 to an ERS 82. For the two-storey, the upgrades were required to improve it from its base case of ERS 78 to an ERS 82.

Component	Bungalow	Two-Storey
Above grade walls	Upgrade to 38x89 mm (2″x4″), RSI 2.46 (R-12) nominal & RSI 1.76 (R-10) insulated foam sheathing with exterior air barrier	Upgrade to 38x140 mm (2″x6″), RSI 3.52 (R-20) nominal & RSI 1.76 (R-10) insulated sheathing c/w exterior air barrier
Basement walls	Upgrade to RSI 3.52 (R-20) nominal batt insulation in 38x89 mm or 38x140 mm (2″x4″ or 2″x6″) framing & RSI 1.76 (R-10) extruded polystyrene (XPS) on basement wall exterior	SAME UPGRADE AS BUNGALOW
Windows	No upgrade from base case	Upgrade to triple-glazing with 1 low-E coating, 2 insulated spacer bars with and two inert gas fills
Air tightness	Improve from 2.3 ACH to 1.5 ACH	SAME UPGRADE AS BUNGALOW
Exposed floors	N/A	Upgrade to RSI 6.69 (R-38) nominal
Space Heating	No change to Baseline Specification	Replace electric, forced air furnace with 40,000 btu/hr Cold Climate Air Source Heat Pump with Coefficient of Performance (COP) = 2.75
Water Heating	Electric tank water heater with Drain Water Heat Recovery (DWHR) 76x1,067 mm (3″x42″) unit with 43% heat recovery efficiency	SAME UPGRADE AS BUNGALOW
Heat Recovery Ventilation	Replace mid-efficiency HRV with a SRE of 60% at 0°C and 62% at -25°C with an HRV or Energy Recovery Ventilator (ERV) with a SRE of 67% at 0°C and 60% at -25°C	SAME UPGRADE AS BUNGALOW

Figure 6: Upgrades as selected by Manitoba's LEEP builder group to achieve ERS 82 in Winnipeg for a home heated with Electricity.

The individual geometry, window-to-wall ratio, orientation, and geographic location will have an impact on the projected energy consumption of each home. Builders should work with local design evaluators to confirm their technology combinations.

TECHNOLOGIES USED IN MANITOBA TRIALS

This section has been assembled to show how some of the LEEP builders applied the various technologies in their Show Homes.

The builder experience is accompanied with responses from the trialed-product manufacturers as presented during the LEEP workshops. Only gas-heated homes were trialed up to the time this publication was developed. In order to make this guide relevant to electrically heated homes, Cold Climate Air Source Heat Pumps (CCASHP) have also been included.

The information should be treated as a starting point for further explorations with local designers, Certified Energy Advisors, and product suppliers.

The illustrations are provided to help explain concepts only and are not intended to be instructional.

Foam Board Sheathed and Air Sealed Exterior Walls

The Manitoba LEEP builder group was looking for more energy efficient wall systems that:

- were cost effective
- minimized any related reductions to the interior space
- made it easier to air seal
- could eliminate the need for some components currently being used in their wall systems
- could reduce quality assurance time
- were packaged by manufacturers to address full system installation

Figure 7: Close-up of the exterior air barrier system using extruded polystyrene rigid insulation with sealed joints used on a Winnipeg trial home, 2015.
Photo credit: Gary Proskiw

Figure 8: Rigid foam insulation system used in Winnipeg trial home to replace exterior wood sheathing as well as the air barrier, 2015.
Photo credit: Gary Proskiw

Technical information requested by LEEP builder group from trialed manufacturer:

Q1: What window and door jamb extension details are used?

Manufacturer response: Window jamb extensions can be eliminated if the conventional 38x140 mm (2″x6″) wall is replaced with a 38x89 mm (2″x4″) wall with 51 mm (2″) of extruded polystyrene (XPS) foam, thereby maintaining the same wall thickness.

If a 38x140 mm (2″x6″) wall is employed, depending on the thickness of the insulation and style of window, builders may be required to include window jamb extensions.

Q2: What vapour permeance issues are there when using rigid XPS insulation, i.e. Section 9.25 of the 2010 National Building Code of Canada?

Manufacturer response: The XPS sheathed wall assembly, constructed with 2″ of XPS insulation applied to the exterior of either a 38x89 mm (2″x4″) or 38x140 mm (2″x6″) wood frame wall, would meet the requirements of Section 9.25 Heat Transfer, Air Leakage and Condensation Control. The exterior insulation helps maintain a warmer wall cavity.

Q3: Describe the lateral bracing details if the regular OSB sheathing is eliminated.

Manufacturer response: If the OSB sheathing is eliminated, the lateral support can be provided by let-in metal bracing.

Q4: Describe typical air barrier details for the exterior air barrier approach and the levels of airtightness which can be achieved.

Manufacturer response: Air barrier details consist of gaskets, tapes and ship-lapped rigid board stock insulation. Houses constructed with this approach have demonstrated an airtightness of 1.5 air changes per hour at a depressurization of 50 pascals (1.5 ACH) or less (at the framing stage), before the polyethylene vapor barrier membrane and drywall have been installed.

Q5: Is an exterior air/weather barrier still required?

Manufacturer response: If an exterior air barrier approach is used with tapes and sealants that have been CCMC-certified to meet the requirements of a weather barrier, then the housewrap may be eliminated.

Note that with proper detailing, this approach has the potential to also eliminate the use of oriented strand board sheathing, spray foam in the headers, and air tight electrical boxes.

How the technology was used during the trial:

Figures 9 & 10: Pictures of two Manitoba LEEP field trial homes under construction.
Photo credits: Figure 9: Gary Proskiw, Figure 10: Gio Robson

A complete packaged system was installed with the insulation and all necessary exterior air and weather barrier components according to the manufacturer's installation details.

- A layer of XPS rigid foam insulation added to the exterior of the wall framing.
- Installed insulation of sufficient thickness to keep the cavity warm enough to reduce the potential of moisture forming on the outer face of the batt insulated wall cavity.
- Fastened the rigid foam insulation directly to the framing.
- Used let-in metal bracing to provide the rigidity necessary when the oriented strand board was eliminated.
- Used gaskets and tapes to create the air barrier system.
- As part of this first trial, builders installed a spun-bonded polyolefin membrane under the wire lath of their stucco application. The builders have asked the insulation manufacturer to work with a stucco manufacturer to develop a solution that could eliminate the need for the membrane.

You can web search for these additional resources:

- Canadian Home Builders' Association Builders' Manual.
- Canadian Wood Council, Wall Thermal Design Calculator.
- Baker, P. (2013), Building America Report – External Insulation of Masonry Walls and Wood Framed Walls.

Typical above-grade wall to roof transition

Details must be developed with your preferred insulation system manufacturer.

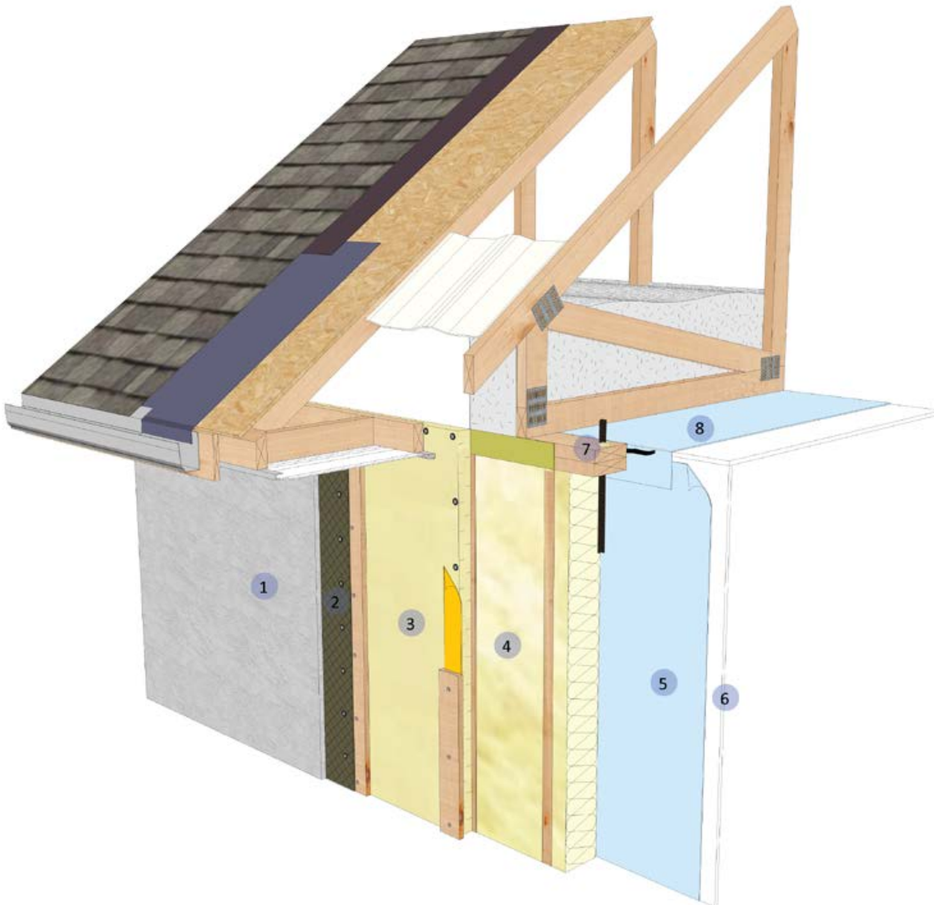

Figure 11: Simplified view of an above grade wall to roof transition as trialed by the Manitoba LEEP builder group with an exterior insulated and air sealed wall/roof system. Illustration: Natural Resources Canada

Major Components:

1. Stucco cladding
2. 19x89 mm (1″x4″) vertical wood furring strips over sealed XPS to create a drainage plane with metal lath / building paper composite product mechanically fastened to the wood furring strips
3. XPS insulation with taped seams (CCMC approved weather barrier tape) and compressible sealing gaskets on uppermost and bottommost wall perimeter to form air and weather barrier
4. 38x89 or 38x140 mm (2″x4″ or 2″x6″) wall with let in brace and batt insulation
5. 6 mil polyethylene vapour barrier, or type 2 vapour barrier
6. 13 mm gypsum board
7. air barrier continuity detail at top plate interior to exterior transition
8. 6 mil, sealed polyethylene (primary ceiling air/vapour barrier)

Typical below-grade to above-grade wall transition

Details must be developed with your preferred insulation system manufacturer.

Figure 12: Illustration of a below grade wall to above grade wall transition employing exterior insulation. Illustration: Natural Resources Canada

Major Components:

1. Stucco cladding
2. 19x89 mm (1″x4″) vertical wood furring strips over sealed XPS to create a drainage plane with metal lath / building paper composite product mechanically fastened to the wood furring strips
3. XPS insulation with taped seams (CCMC approved weather barrier tape) and compressible sealing gaskets on uppermost and bottommost wall perimeter to form air and weather barrier
4. 38x89 or 38x140 mm (2″x4″ or 2″x6″) wall with let-in brace and batt insulation
5. 6 mil polyethylene vapour barrier, or type 2 vapour barrier
6. 13 mm gypsum board
7. Flashing taped to XPS insulation using CCMC approved weather barrier tape
8. Compressible sealing gaskets on bottommost wall perimeter to form air barrier
9. Insulation between floor joists (with vapour barrier)
10. Sill gasket

Typical window detail for wall with exterior insulation

Details must be developed with your preferred insulation system manufacturer.

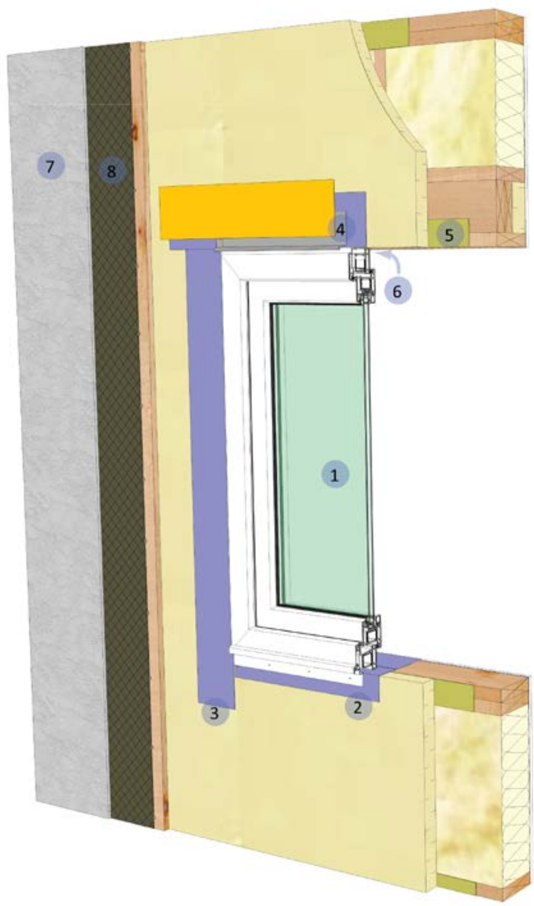

Figure13: Builders installed flange windows and fastened through insulation into framing. Illustration: Natural Resources Canada

Major Components:

1. Flange window
2. Flashing tape around rough opening
3. Flashing tape over windows flanges
4. Metal head flashing taped to XPS
5. Foam Gasket
6. Air sealing measures at window edge

Floors above Unheated Space

To achieve the ERS 82 performance target builders chose to apply XPS insulation where living space was located above a garage or other unconditioned space.

Figure 14: Example of foam board sheathing applied to the underside of a floor above a garage. Photo credit: Owens Corning Canada

How the technology was used during the trial:

- 13 mm gypsum board
- 51 mm (2″) XPS insulation (seams taped for air sealing purposes)
- RSI 4.93 (R-28) fibreglass batt 38 x 235 mm (2″x10″) floor joist
- 6 mil sealed polyethylene vapour barrier, or type 2 vapour barrier
- Subfloor
- Finished flooring

You can web search for these additional resources:

- Canadian Home Builders' Association Builders' Manual.

Triple Glazed High Performance Windows

The Manitoba LEEP builder group was looking for windows that could:

- increase comfort, and mitigate sound transmission
- contribute to reaching the ERS 82 performance level (reduce winter heat loss and summer heat gain)

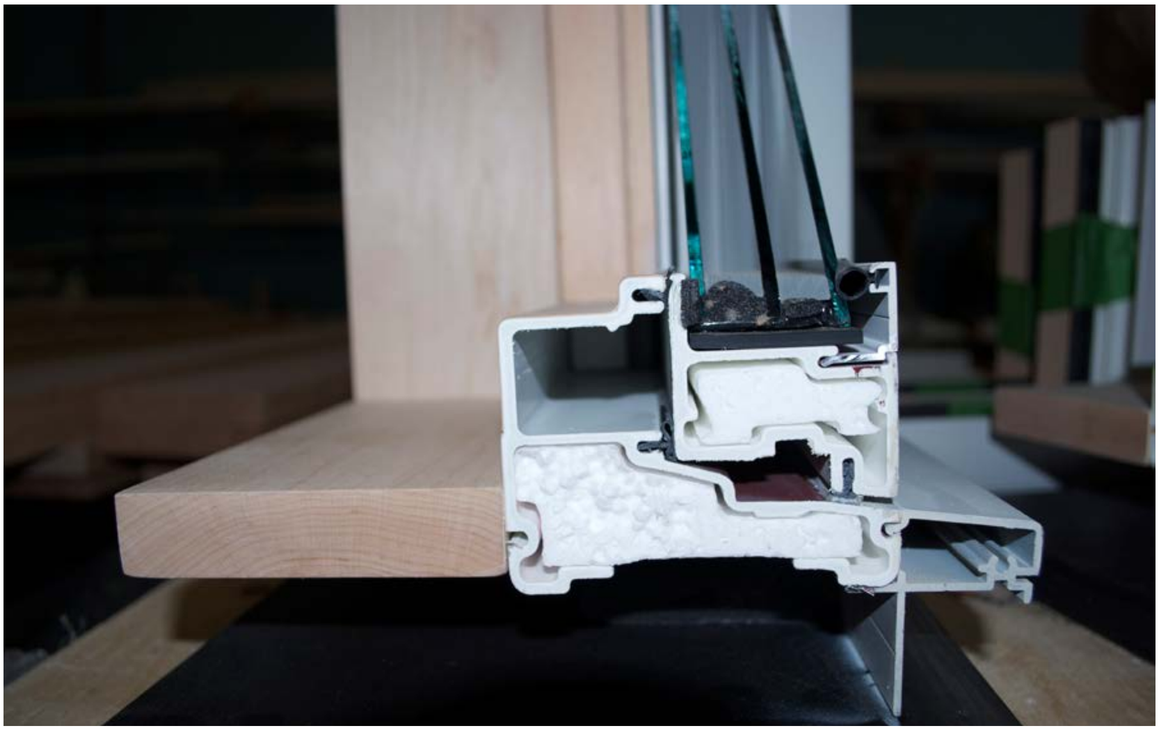

Figure 15: Image of a triple glazed high performance window. Photo: Natural Resources Canada

Since the builder group already had gained enough knowledge through the LEEP technical materials, they moved forward with directly exploring the application and upgrade costs with local manufacturers. Therefore, no Q&A manufacturer information is provided.

How the technology was used during the trial:

Triple glazed windows with insulated spacers, low-E coatings and argon gas fills were installed. See the “Typical Window Detail for Wall with Exterior Insulation” page to learn how builders installed the windows in walls with exterior rigid insulation.

You can web search for these additional resources:

- Canadian Home Builders’ Association Builders’ Manual.
- Natural Resources Canada’s Office of Energy Efficiency for higher performance ENERGY STAR® windows (there is a window selection database of products available)
- Fenestration Canada
- Fenestration Manitoba

Enhanced Energy Efficient Foundation Systems

The Manitoba LEEP builder group was looking for foundation systems that used rigid insulation to:

- improve the thermal performance of their basement walls
- reduce the likelihood of moisture related call backs
- install on either the interior or exterior faces of the cast-in-place concrete foundation walls

Figures 16 & 17: Example of manufacturer's below-grade interior and exterior rigid insulation foundation systems. Photo credit: Owens Corning Canada

Technical information requested by LEEP builder group from trialed manufacturer:

Q1: Are there any code compliance and inspection-related issues?

Manufacturer response: Both of these wall assemblies use conventional building materials and construction techniques and should not pose challenges from a code compliance perspective.

Q2: What are the above grade requirements for finishing exterior foundation insulation that terminates above grade?

Manufacturer response: For below grade walls with exterior insulation, builders can apply lath and cement stucco, install a cement board with a parged finish, or compatible acrylic finish directly to the XPS foam with fiberglass reinforcing mesh at the joints and over fasteners.

Q3: What below grade fastening requirements are there?

Manufacturer response: Masonry anchors with a plastic washer (minimum 1″ diameter) with minimum 1″ penetration into concrete.

Recommended fastener spacing: Starting at 6″ from top edge use screws spaced 305 mm (12″) center to center horizontally and 610 mm (24″) center to center vertically. Builders must confirm fastener type, length, embedment, and spacing with local insulation supplier.

Q4: How can the transition between below and above grade walls be addressed so that framing lines up with the outside face of the foundation insulation?

Manufacturer response: If exterior board insulation is added to both the walls and the foundation, then the outside faces of the board insulation will line up. If only the foundation uses exterior insulation, then the top of it will have to be capped and flashed, or depending on the thickness of the rigid insulation the wall framing can be cantilevered out to line up with the exterior face of the foundation.

Q5: Regarding moisture management and condensation control – what are the system's advantages with regards to inward and outward bound vapour diffusion?

Manufacturer response: Where the XPS is applied on the interior face of the concrete it prevents moisture within the concrete wall from diffusing inward in the spring time. Where XPS is applied on the outside face of the concrete, it can serve as an effective capillary break from soil moisture. The presence of the interior polyethylene controls vapour diffusion from the inside.

Q6: Backfill requirements – does the system require any special considerations especially if the backfill is frozen?

Manufacturer response: Care has to be exercised when backfilling with frozen soil to ensure that frozen soil "boulders" do not damage the insulation.

How the technology was used during the trial:

The exterior of the foundation wall had a layer of rigid foam insulation applied below grade with:

- 2″ (50 mm) thick XPS rigid insulation
- appropriate flashing at the transition between the foundation and the above grade construction

The LEEP builder group also considered using:

Full height interior insulated basement wall systems with rigid board insulation which are typically composed of:

- a conventional poured concrete foundation wall
- interior XPS rigid board insulation or mineral wool board, and
- batt insulation installed in a conventionally wood framed wall

You can web search for these additional resources:

- Canadian Home Builders' Association Builders' Manual.
- Smegal, J. Straube, J (2010) Building America Special Research Project: High-R Foundations Case Study Analysis.

Typical Foundation Wall System with Exterior Rigid Insulation

Details must be developed with your preferred insulation system manufacturer.

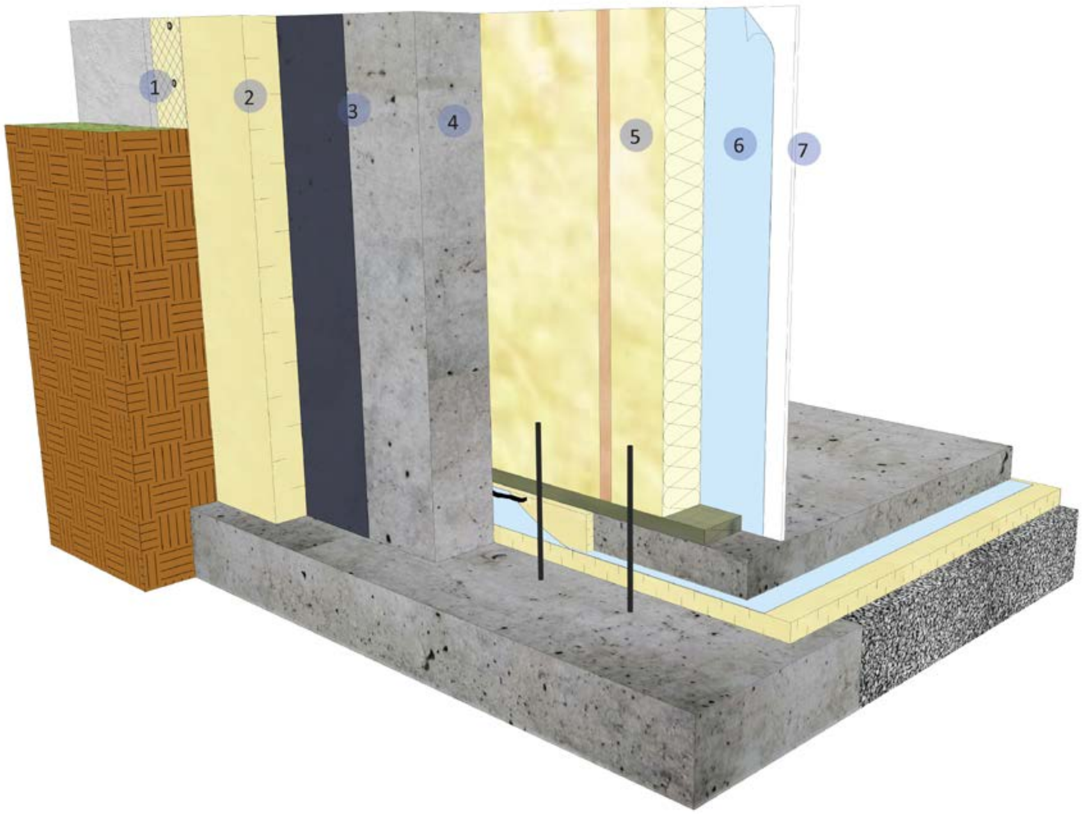

Figure 18: Approach 1 – Example of an exterior insulated foundation wall system. Contact the local manufacturer representative for specific application details. Illustration: Natural Resources Canada

Major Components:

1. Cement parging or stucco over lath
2. XPS insulation
3. Self-adhered, spray or roll applied membrane
4. 204mm (8″) concrete foundation wall
5. 38x89 or 38x140 mm (2″x4″ or 2″x6″) wall with batt insulation.
6. 6 mil, polyethylene vapour barrier, or type 2 vapour barrier
7. 13 mm gypsum board (optional)

Typical Foundation Wall System with Interior Rigid Insulation

Details must be developed with your preferred insulation system manufacturer.

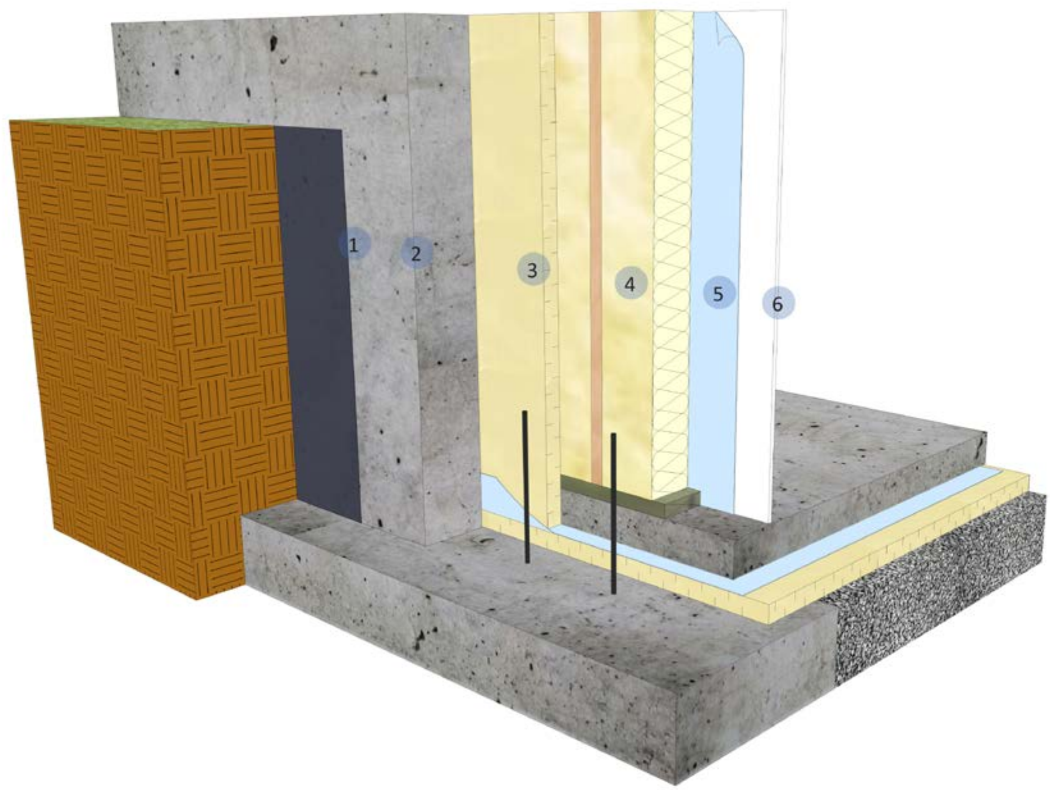

Figure 19: Approach 2 – Example of an interior insulated foundation wall employing rigid insulation materials. Contact the local manufacturer representative for specific application details. Illustration: Natural Resources Canada

Major Components:

1. Self-adhered, spray or roll applied membrane
2. 204mm (8″) concrete foundation wall
3. 51 mm (2″) XPS insulation
4. 38x89 or 38x140 mm (2″x4″ or 2″x6″) stud wall with RSI 3.52 (R-20) batt insulation
5. 6mil, sealed polyethylene air/vapour barrier
6. 13 mm gypsum board

Intelligent Ventilation Controls for High Performance Heat or Energy Recovery Ventilators (HRV or ERV)

The Manitoba LEEP builder group was looking to:

- understand how humidity levels could be better controlled throughout both the heating and cooling seasons
- assess whether intelligent controls for high performance HRVs/ERVs could provide fresh air while reducing the risk of excessive dryness in the winter and excessive moisture in summer

Figure 20: Image of an installed advanced controller in a LEEP field trial home. Photo credit: Gio Robson

Technical information requested by LEEP builder group from trialed manufacturer:

Q1: What can be done to ensure ventilation systems perform optimally?

Manufacturer response: Builders should seek HRV models that include a backflow damper in the warm side of the exhaust stream, to ensure that cold dry air does not enter the house when the furnace is operating but the HRV is not. This helps avoid over-ventilation during cold and dry winter months which can lead to shrinking of wood floors. The backflow dampers also reduce heating loads.

Smart controllers which allow homeowners to set, and leave, their controls alone can also be installed. These controls are a way to address a common homeowner complaint of not knowing how to set their HRV/ERV controls, having to adjust them at least seasonally, and settings that can lead to overly dry or moist conditions, depending on the time of year.

Q2: Are there potential problems when HRV/ERVs are combined with humidifiers in tight houses?

Manufacturer response: During the winter, HRV's are designed to remove moisture from the air while humidifiers add moisture to the air. If there is little moisture production in the house, the air can become too dry and the devices will fight each other.

Q3: What are the comfort and energy benefits of a "smart" controller?

Manufacturer response: Smart HRV controls offer little energy benefit; however, they allow homeowners to automatically provide ventilation at rates that are appropriate given changing humidity levels throughout the year.

Q4: What is an ERV? Is it an option in our climate?

Manufacturer response: ERV stands for Energy Recovery Ventilator and works similarly to an HRV, with the exception that the ERV recovers moisture as well as heat. The ERV's ability to reclaim moisture from outgoing air and reintroduce it to the ventilation stream was seen as a way to reduce over-drying during the winter months and reduce latent cooling loads in the summer.

Note: Builders that chose to install an ERV selected a model from which the core could be removed, and an HRV core could be installed in its place. Prior to LEEP there had been little use of ERVs in Manitoba. Builders should consult suppliers and manufacturers to find out which ERV models are appropriate for the Manitoba climate.

How the technology was used during the trial:

The intelligent controller, intended to vary the ventilation rate based upon temperature and relative humidity, was installed on the main level. It was used to control the operation of an appropriately sized ERV with airflows that had been balanced by the installing contractor.

You can web search for these additional resources:

- The ENERGY STAR® HRV / ERV List, including those tested to cold-weather conditions, is available on Natural Resources Canada's web site.
- A Certified Product Directory of all HRV/ERV products is available on-line from the Home Ventilating Institute (HVI). Not all listed products have been cold-weather tested for the Canadian climate. The Heating, Refrigerating and Air Conditioning Institute of Canada (HRAI) provides education and training for the design and installation of ventilation systems, and a list of certified designers and installers.

Drain Water Heat Recovery (DWHR)

The Manitoba LEEP builder group was looking to:

- improve the energy performance of hot water heating systems
- ensure ease of installation

Figure 21: Installed Drain Water Heat Recovery system in LEEP field trial home.
Photo credit: Gio Robson

Technical information requested by LEEP builder group from trialed manufacturer:

Q1: How are they plumbed and what do you do if there is more than one stack?

> **Manufacturer response:** DWHR units are typically plumbed in either an "equal" flow (preheat the water heaters cold water supply and cold water to fixtures) or "unequal" flow (preheat either the hot water heaters cold water supply or cold water supply only) configurations, depending on the layout of the plumbing system. If there is more than one stack, then either two DWHR units can be installed in series or a single unit can be installed on the stack which receives the greater share of the shower flow.

Q2: How are the savings affected by occupancy or water use?

> **Manufacturer response:** The greater the hot water usage, the greater the savings. So more people, or more water usage per occupant, will increase the savings. However, these devices are much more effective when the hot water and drain water flows occur simultaneously – such as during showers.

Q3: What is the life expectancy and what potential problems can be expected?

> **Manufacturer response:** Since the DWHR unit is all copper; the life expectancy should be similar to other plumbing elements made from copper, and will depend on the mineral composition of the water.

How the technology was used during the trial:

The Drain Water Heat Recovery (DWHR) units were installed to pre-warm the cold incoming water entering the hot water tank, as follows:

- All the shower drains were connected to a single drain stack (to maximize efficiency and cost).
- The DWHR unit used was 76x1,067 mm (3″x42″), with a rated efficiency of approximately 43%, installed vertically, in an “unequal” flow configuration (pre-heating the hot water heater’s cold water supply), and attached to a single drain stack with typical plumbing connectors.

You can web search for these additional resources:

- Centre for Energy Advancement through Technological Innovation (CEATI) for an on-line Energy Savings Calculator.
- A List of Drain-Water Heat Recovery Systems is available on Natural Resources Canada’s web site.

Typical Drain Water Heat Recovery unit, showing piping layout:

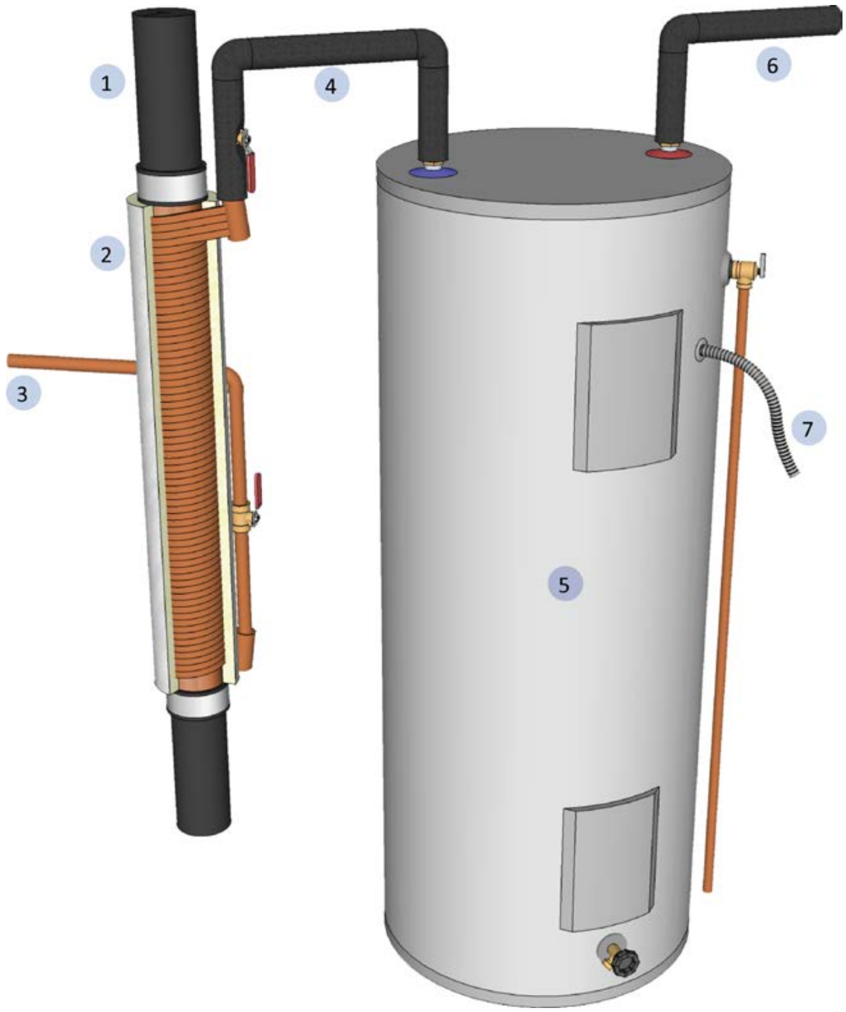

Figure 22: Illustration of a Drain Water Heat Recovery System (DWHR)
Illustration: Natural Resources Canada

Major Components:

1. Plumbing drain stack
2. Heat recovery coil (insulation optional) copper coil heat exchanger which surrounds a vertical copper drain pipe (there are no moving parts)
3. Mains water supply to DWHR stack
4. Water supply to tank
5. Water heater (gas or electric)
6. Hot water supply to fixtures
7. Electrical or gas supply

TECHNOLOGY CONSIDERED IN MANITOBA TRIALS

Cold Climate Air Source Heat Pumps (CCASHP) (not trialed)

The Manitoba LEEP builder group was looking for:

- efficient heating and cooling systems for electrically heated homes
- heat pump systems that could perform in cold weather applications

A Winnipeg based Certified Energy Advisor determined through energy modelling that a CCASHP would enable the two-storey electrically heated home to achieve the ERS 82 performance target.

Since all LEEP builders trial built in areas with natural gas, no trial experiences are available.

Figure 23: Image of an installed CCASHP at the Canadian Centre for Housing Technology, Ottawa. Photo: Natural Resources Canada

You can web search for these additional resources:

- Performance Assessment of a Cold-Climate Air Source Heat Pump Research Highlight, 2014, Canada Mortgage and Housing Corporation.

More information on LEEP is available on the web by using the search term ‘NRCan LEEP’, or by visiting http://www.nrcan.gc.ca/energy/efficiency/housing/leep/17338.

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