

ENERGY EFFICIENT CONSTRUCTION
PROGRAM

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TECHNICAL GUIDE TO THE
ASSEMBLY AND FINISHING WORK
OF A PRE-FABRICATED HOUSE

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1. INTRODUCTION

You have chosen a pre-fabricated house and decided to take on responsibility for some of the work in relation to Novoclimat requirements (owner-built). The ministère des Ressources naturelles et de la Faune will therefore issue you a Novoclimat Certificate of Performance. This guarantees that the products sold meet specifications approved by the Department and provide energy performance exceeding standards currently in force.

This certificate of performance differs from Novoclimat Certification. To be certified, a house must be constructed entirely by a Novoclimat-certified contractor. The house will be inspected twice free of charge by evaluator-consultants trained by the ministère des Ressources naturelles et de la Faune. Don't hesitate to contact your manufacturer for further information.

This guide has been prepared to help owners who want to do the assembly work themselves obtain good energy performance for their home that is comparable to a Novoclimat-certified house. If all the recommendations contained in this document are complied with, the performance of the house you assemble yourself should meet Novoclimat requirements, and result in increased comfort and high-quality ventilation of your living space. You will also achieve real energy savings.

2. HOW TO USE THE GUIDE

This document is divided into three distinct parts. The first chapter is devoted to the building envelope, the second, to the ventilation system, and the third, to requirements relating to the plumbing, heating and ventilation systems. Covering only a few of the most important requirements, this guide provides a short summary of the detailed technical requirements of the Novoclimat concept. To help you find things more easily, the sections on the building envelope and the ventilation system begin with cut-away views of a Novoclimat building envelope. Each major component in these technical drawings is marked with a number referring to the relevant explanation or specification in the following pages.

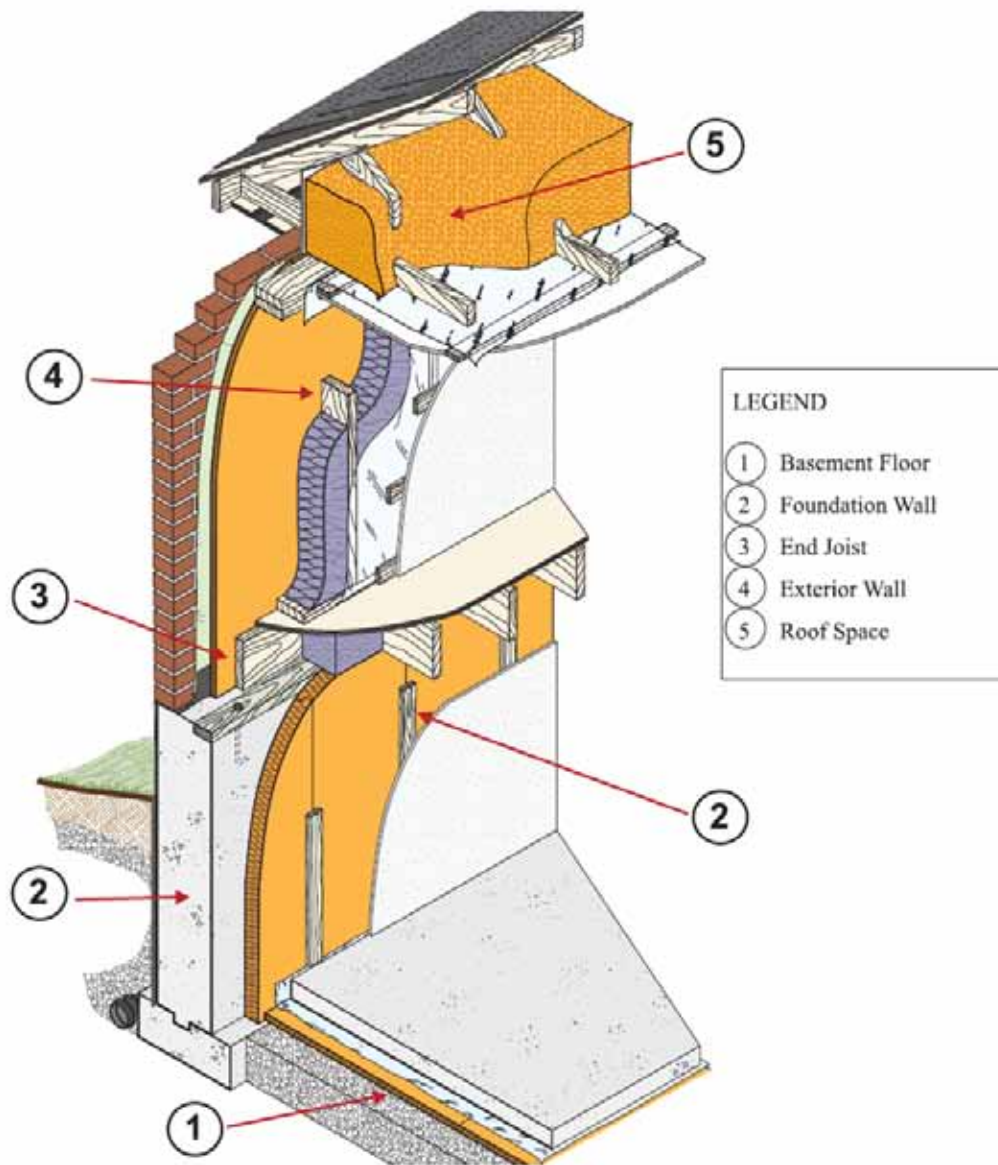
The ministère des Ressources naturelles et de la Faune proposes the most popular methods to help you meet the requirements specified in the program. To make these requirements easier to understand, we have deliberately simplified them as much as possible. But we encourage you to consult the section about pre-fabricated houses on the Web site at this address:

www.efficaciteenergetique.mrnf.gouv.qc.ca, "My home" section.

Be careful to follow these recommendations closely, **because any omission or modification may affect the overall performance of your house.**

3. HOUSE ENVELOPE

CUT-AWAY VIEW OF THE ENVELOPE



3.1 BASEMENT FLOOR INSULATION

1 Basement Floor Insulation

Rigid Panel Insulation

Insulating Value Required: RSI 0.88 (R-5)

Note: Some situations require superior insulation levels.

In the case of a heating floor, the required insulating value is RSI 1.7 (R-10).

If a floating slab-on-grade without foundation is used, the required insulating value is RSI 1.32 (R-7.5) under the slab and over the end joist. However, the slab's end joist must be insulated from the exterior and extend horizontally into the ground over a minimum width of 600 mm (2 feet) around the building.

All slabs-on-grade must have a vapour barrier membrane. The membrane must be installed under the concrete slab and the joints must be sealed or overlap by at least 300 mm (12 inches).

Application

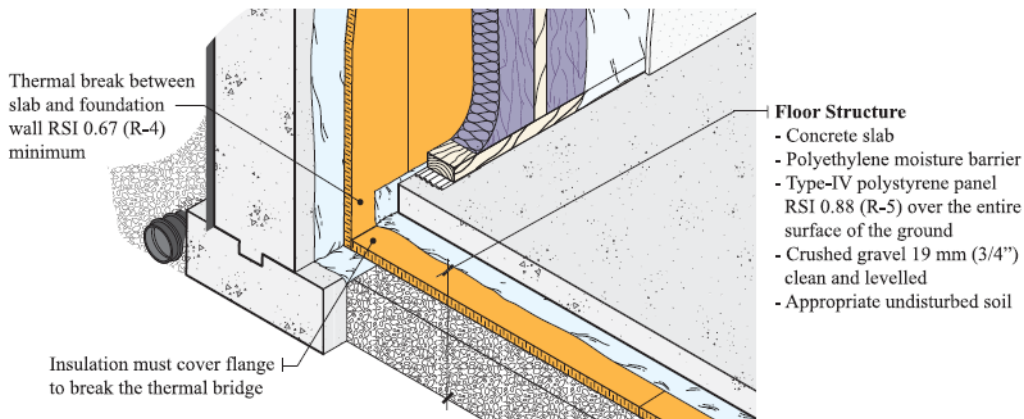
- A. Place Type-IV rigid polystyrene RSI 0.88 (R-5) insulation panels beneath the entire area of the concrete slab, directly on the crushed stone.
- B. Incorporate a thermal break with minimum insulating value RSI 0.67 (R-4) between the slab and the foundation wall. We can incorporate this thermal break by applying a strip of rigid insulation or by spraying polyurethane foam onto the lower part of the foundation wall before pouring the slab.
- C. Cover the insulation with a Type-1 polyethylene moisture barrier.

Alternative:

There is another option available for the implementation of point A: you can insulate only the floor perimeter beneath the concrete slab using a rigid insulation panel with an insulating value of RSI 1.32 (R-7.5). The insulation must cover a minimum width of 1.2 meters (4 feet) around the perimeter of the slab. Continue implementing points B and C, as described above.

WARNING

Certain types of rigid panel insulation are not designed to be installed under concrete slabs. Check with the manufacturer that you are using correct products.



3.2 INSULATION OF FOUNDATION WALLS (THREE PROPOSED OPTIONS)

2 Foundation Walls Option A

Rigid Panel Insulation

Insulating Value Required: RSI 2.99 (R-17)

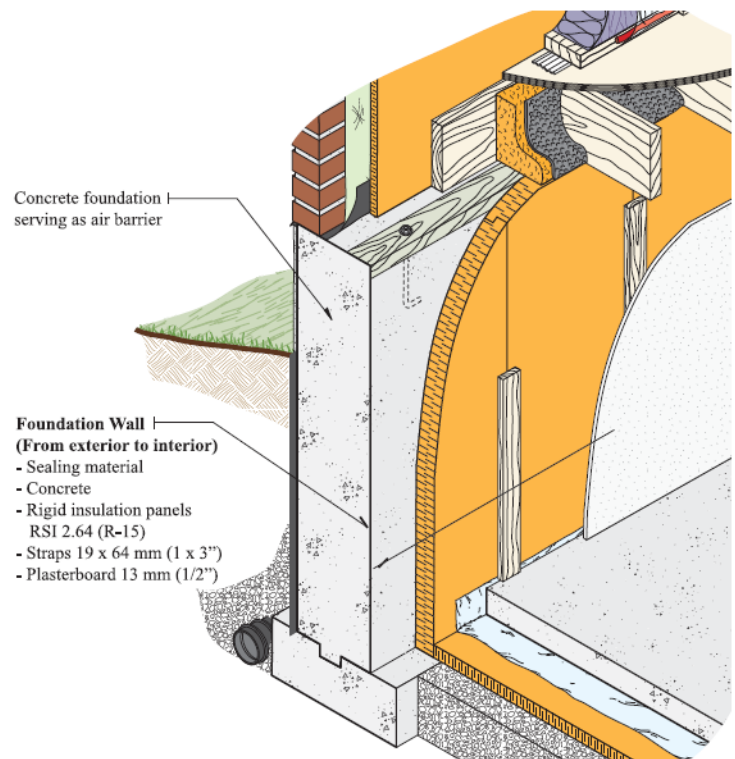
Note: This value may include the insulating value of each of the materials making up the wall, such as the plasterboard, air spaces and concrete. In this case, the insulation itself must have a minimum value of RSI 2.64 (R-15).

Application

- A. Cover the entire surface of the foundation wall, from the top of the wall to the concrete slab, with rigid insulation panels (see Warning).
- B. Secure the insulation panels to the concrete using nails or screws. Avoid leaving an air space between the back of the panels and the concrete in order to prevent condensation between them.
- C. The insulating panels and plastic foam must always be covered with a recognized material to protect them from fire, thus creating a thermal barrier. To allow the installation of this material (think of plasterboard for example), straps must first be anchored onto the panel insulation.

WARNING

If one of the foundation walls is adjacent to a garage foundation, the insulation must still cover the whole surface (as if the garage didn't exist). Depending on the type of insulation used (expanded polystyrene panels, for example), a polyethylene moisture barrier may have to be placed directly on the concrete wall before placing the rigid insulation, and covering the insulation with a vapour barrier. Consult the manufacturer's requirements in this regard.



2 Foundation Walls Option B

Rigid Insulation Panel and Blanket Insulation

Insulating Value Required: RSI 2.99 (R-17)

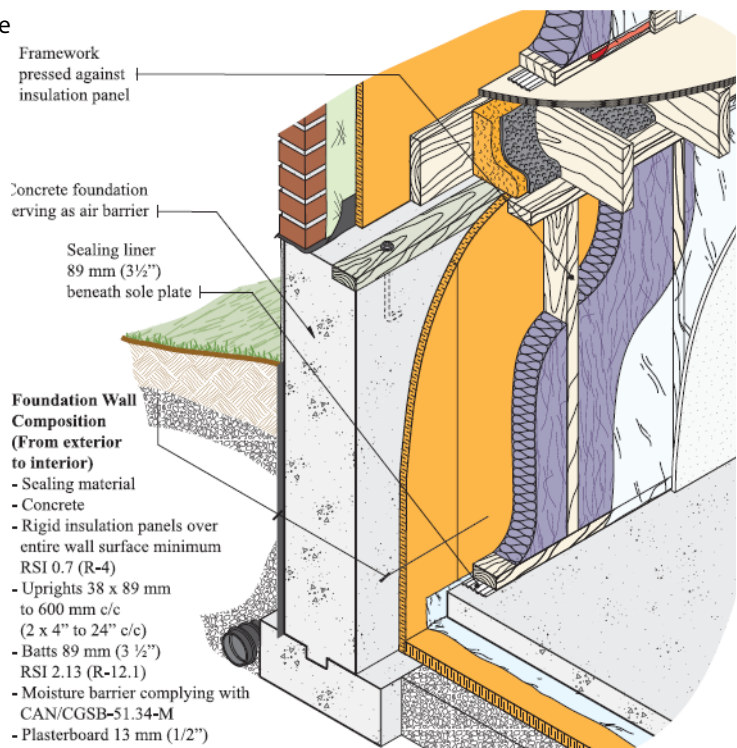
Note: This value may include the insulating value of each of the materials making up the wall, such as plasterboard, air spaces and concrete. In this case, the insulation itself must have a minimum value of RSI 2.64 (R-15).

Application

- A. Cover the entire surface of the foundation wall, from the top of the wall to the concrete slab, with rigid insulation panels.
- B. Secure the insulation panels to the concrete wall using nails or screws. Avoid leaving an air space between the back of the panels and the concrete in order to prevent condensation between them.
- C. Press a frame made of wooden uprights against the insulation panels. A sealing liner must first be placed on the ground, beneath the sole plate of this frame.
- D. Insert the batts between the uprights, pressing them carefully against the insulation panels and leaving no air spaces.
- E. Secure a vapour barrier to the wooden uprights before installation of the interior finishing.

WARNING

Even if one of the foundation walls is adjacent to a garage foundation, the insulation must cover the whole surface (as if the garage didn't exist). According to the type of insulator used (expanded polystyrene panels, for example), it may be necessary to install a polyethylene moisture barrier directly on the concrete wall before placing the rigid insulation, and covering it with a vapour barrier. Consult the manufacturer's requirements in this regard.



2 Foundation Walls Option C

Sprayed-In-Place Polyurethane Foam

Insulating Value Required: RSI 2.99 (R-17)

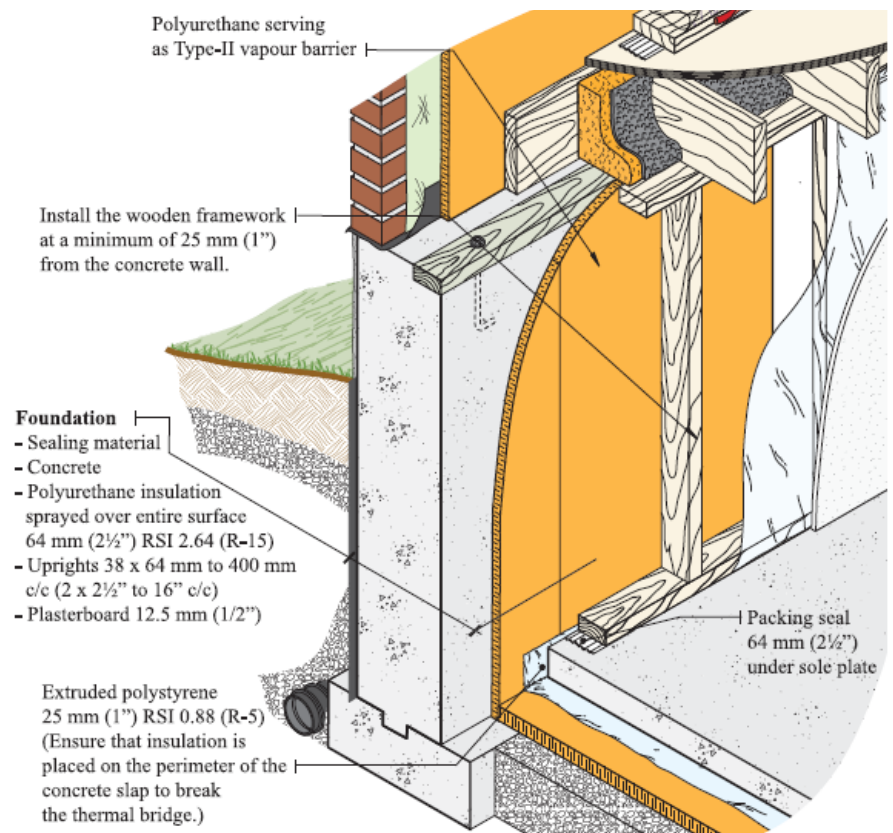
Note: This value may include the insulating value of each of the materials making up the wall. Assuming an insulating value of RSI 0.042 per mm of thickness (R-6 / inch), 64 mm (2.5") of polyurethane foam would be sufficient.

Application

- Erect a frame with wooden uprights placed at a minimum distance of 25 mm (1") from the concrete wall. A sealing liner must first be placed on the ground under the sole plate of this structure.
- Spray the polyurethane foam behind and between the uprights over the entire height of the foundation wall (from the basement floor to the ground floor joists).
- Complete the interior finishing of the walls by securing plasterboard to the framework uprights.

WARNING

If one of the foundation walls is adjacent to a garage foundation, the insulation must still cover the whole surface (as if the garage didn't exist). Strong fumes may be given off during and following application of the polyurethane foam. It is therefore important to comply with the ventilation and occupation requirements issued by the manufacturer of the product used.



3.3 END JOIST INSULATION

3 End Joist

Sprayed-In-Place Polyurethane Foam

Insulating Value Required: RSI 4.3 (R-24,5)

Note: This value may include the insulating value of each of the materials making up the wall to the height of the end joist. Assuming an insulating value of RSI 0.042 per mm of thickness (R-6 / inch), 89 mm (3.5") polyurethane foam would be sufficient.

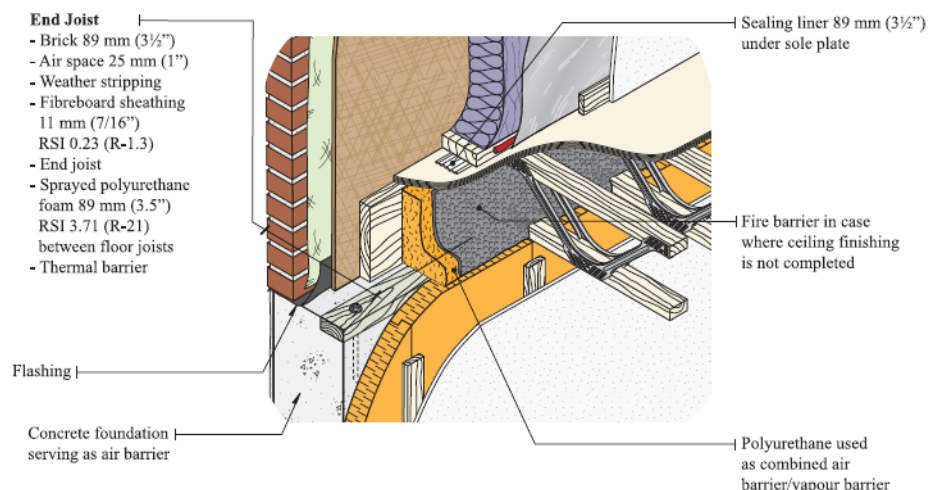
Depending on the type of pre-fabricated house chosen, the manufacturer may offer another method to insulate and seal the end joist. Consult the work performance specifications provided by the house manufacturer.

Application

- A. Spray insulating polyurethane foam inside, on the header beam and between all floor joists.
- B. This insulation must be applied so that it covers the joints between the header beam and other structural elements. The foam must also completely cover the top of the foundation wall as far as the insulation already in place on the foundation wall.
- C. Independently of the insulation method used for the end joist, it is important to caulk, using polyurethane foam or acoustical sealant, the area around openings made in the end joist after the insulation work. Among other things, caulk the areas around the electrical service entrance, exterior plumbing ducts, the dryer vent, etc.

WARNING

Even if a section of the end joist is adjacent to a garage, the insulation must cover the entire surface (as if the garage didn't exist). Plastic foams must be always protected by a recognized material to protect them against fire, thus creating a thermal barrier in accordance with section 9.10.16.10 of the 1995 National Building Code. Do not cover wiring and electric components with polyurethane foam.



3.4 EXTERIOR WALL INSULATION

4 Exterior Walls (Above Ground)

Insulating Value Required: RSI 4.3 (R-24,5)

When you buy a pre-fabricated house that is eligible for a Novoclimat Certificate of Performance, you are buying a product for which manufacturing and implementation methods have been developed that make it possible for a house assembled in accordance with the instructions provided, to fully or at least partially meet the energy performance objectives of a certified house. It is therefore the manufacturer's responsibility to comply with the technical requirements of the Novoclimat program, particularly those pertaining to insulation and to the on-site delivery of construction components, such as exterior walls, floor assemblies, roof elements, doors and windows, or the end joist.

Certain manufacturers of pre-fabricated houses offer their customers the choice of assembling the house on the site themselves. If you pick this alternative, we suggest that you carefully follow the work instructions provided by the manufacturer. Among other things, we will discuss how to install walls and vapour barriers, how to achieve satisfactory airtightness, and how to properly install doors and windows.

Whatever type of house you buy, it is important that the air barrier and vapour barrier system in the walls never be perforated and that all openings such as those around exterior plumbing ducts, dryer vents, electrical boxes, etc., be properly caulked using polyurethane foam, acoustical sealant or construction tape (red).

WINDOWS

Requirements

Sealed double glazing, with argon, low-E film and insulating barrier

Application

- Install windows in accordance with manufacturer's recommendations.
- Do not install them too close to the exterior wall. All windows (except those in the basement) must be placed in the walls so that the axis of the window pane is in line with the insulated portion of the wall.
- An aluminum or steel window frame must have a thermal break.
- Seal and insulate around windows using low expansion polyurethane foam.

DOORS

Requirements

Steel doors insulated with polyurethane

Application

- Install doors in accordance with the manufacturer's recommendations.
- Seal and insulate around doors using low expansion polyurethane foam.

3.5 ROOF SPACE INSULATION

5 Roof Space Insulation

Loose or Blanket-Type Insulation

Insulating Value Required: RSI 7.0 (R-41)

Note: Depending on the type of pre-fabricated house chosen, the manufacturer may offer another method for insulating and sealing the roof. Consult the work performance specifications provided by the manufacturer.

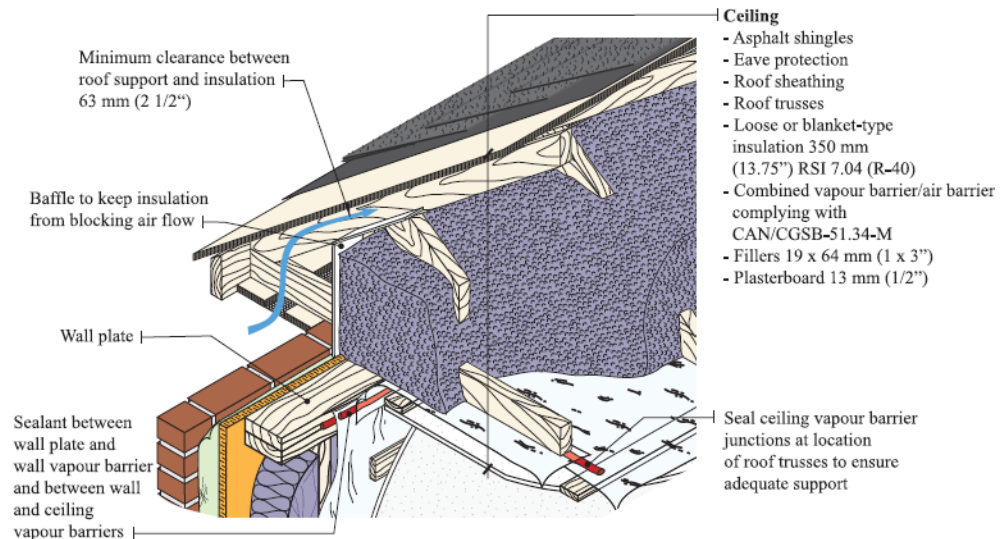
Application

- A. Ensure that the ceiling vapour barrier is airtight by applying an acoustic sealant to the vapour barrier joints. To provide adequate support, these joints should be aligned with the roof trusses.
- B. Seal the ceiling vapour barrier to the ducts, pipes and access hatch crossing the vapour barrier with acoustical sealant or tape.
- C. Seal the ceiling vapour barrier to the wall vapour barrier/air barrier. To avoid mistakes here, apply a sealing joint between the wall plate and the wall vapour barrier and between the wall vapour barrier and the ceiling vapour barrier.
- D. Insulate the roof space by placing the insulating material evenly over the whole surface, taking care to entirely cover the roof-truss chords.

WARNING

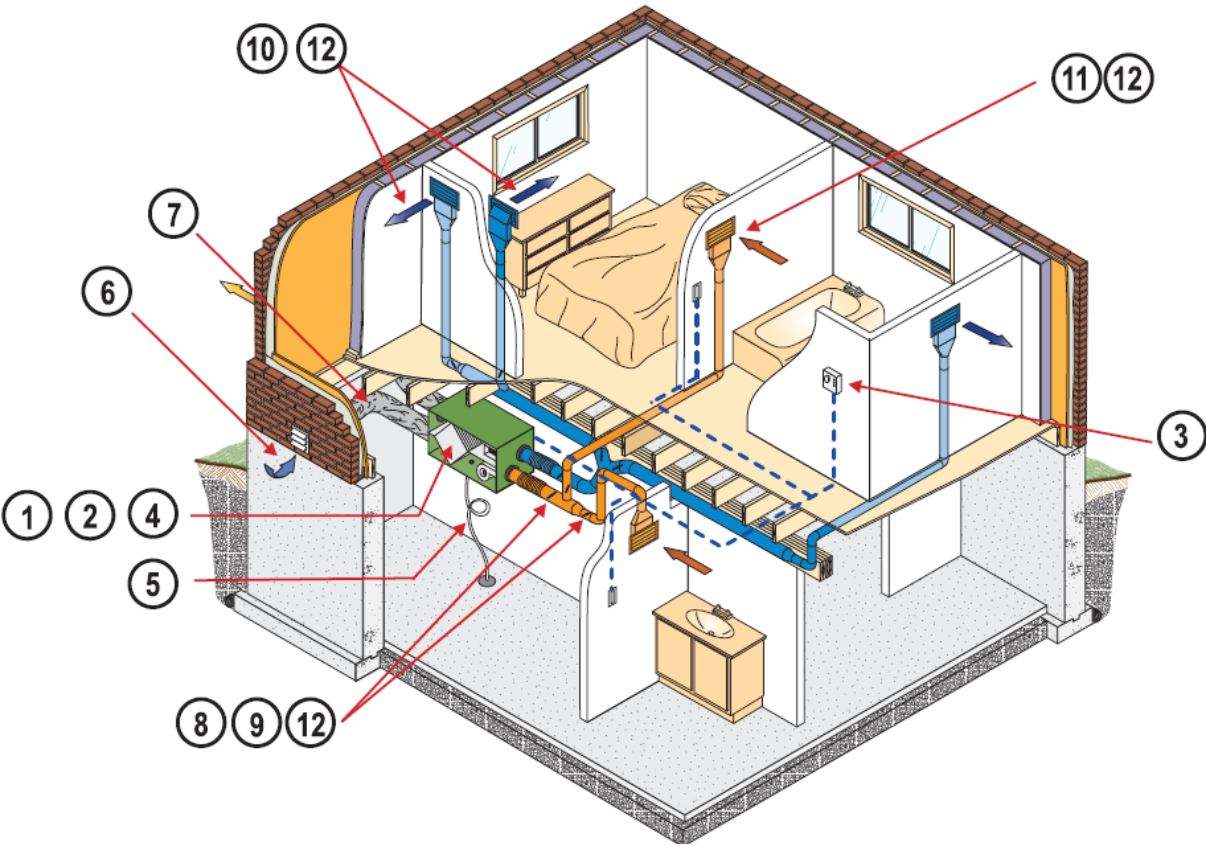
The perimeters of components that radiate heat such as chimneys or recessed lights must be made airtight using fire resistant products: sheet metal, fireproof plasterboard, high-temperature sealing, etc.

Leave at least 63 mm (2 1/2") clearance between the insulating material and the substrate in order to permit adequate ventilation of roofs in accordance with regulations in force.



4. INSTALLATION OF CENTRAL VENTILATION SYSTEM

REFERENCE CUT-AWAY VIEW



IMPORTANT RECOMMENDATION

Retain the services of a Novoclimat-certified ventilation specialist to ensure that your installation complies with Novoclimat requirements. Specialists have received training to install this type of system in accordance with Novoclimat's specific criteria.

You can consult the list of ventilation specialists who have received Novoclimat certification on the Website at www.efficaciteenergetique.mrnf.gouv.qc.ca or by phoning 1-877-727-6655.

In addition to performing the work in accordance with trade practices, this specialist must, among other things, comply with the ventilation requirements prescribed under the program, such as the installation of a heat recovery ventilator (HRV) rather than a simple air exchange system, rigid ducts to ensure good airflow throughout the system, air vents to ensure occupant comfort, etc. These requirements are summarized in the following pages. **Please note that the section numbers refer to the numbers in diagram 4.**

4.1 ELIGIBLE VENTILATION UNITS

1

- HVI-certified heat recovery ventilators (**HRVs**) are the only type of device that meet the requirements of the Novoclimat program.
- Heat recovery efficiency at an outdoor air temperature of -25°C must be equal to or greater than **60%**.
- The unit's defrost mode must not use **any heating element** and must not cause internal depressurization of the house.

4.2 REQUIRED CAPACITY OF CHOSEN HRV (VENTILATING POWER)

2

- The HRV's capacity, meaning the ventilating power that the HRV **must be able to provide**, must be calculated in accordance with section 9.32 of the 1995 National Building Code,
- In short, the ventilation capacity is established by calculating 5 litres of air/second (**10.6** cubic feet of air per minute) for each open or closed room in the house. Add 5 l/s (10.6 CFM) for the **master bedroom** and for the **basement**, if unfinished. Example: a 10-room house with an unfinished basement would require a minimum ventilation capacity of 60 l/s (127.8 CFM).

4.3 CONTROLS

3

- The HRV control system must include the following modes: stop, low-flow exchange, intermittent low-flow exchange, high-flow exchange and high-flow recirculation (except in the case of a hot-air furnace).
- The change to "high-flow" mode can be controlled by a pollutant detector coupled with a cyclic timer, or by a **dehumidistat**.
- **Bathrooms** that are ventilated by the HRV must have a control (**timer**, pushbutton or other) allowing the activation of the device's high-flow exterior exchange mode, if necessary.
- The HRV may be coupled to a hot-air furnace, but hook-ups must allow **starting the furnace fan when starting the HRV**.

4.4 LOCATION OF THE UNIT

4

- The ventilation unit must be installed in an accessible **clean heated space**, and **never be installed in a garage or roof space**.
- Unless there are serious constraints, the unit must be **located in the basement**, near the water heater and a floor drain or a plumbing return line permitting proper adjustment.
- The unit must be installed in accordance with the **manufacturer's recommendations**.

4.5 HRV DRAINAGE

5

- **The HRV must have a drain** allowing condensation run-off in accordance with the Plumbing Code in force. Among other things, it must have a drain trap (water seal). **The HRV drain must end in a floor drain**, cesspool or compliant plumbing return.

4.6 EXTERIOR VENTS FOR FRESH AIR INTAKE AND STALE AIR EXHAUST

6

- An outdoor **fresh air intake must be located at least** at 457 mm from the ground (**18 inches**) **and at least** 183 cm (**72 inches**) **from any stale air exhaust**, the edge of a parking area, or any other source of contamination.
- HRV air intakes and exhausts must be **permanently labelled**: "Fresh Air Intake", or "Stale Air Exhaust".

4.7 COLD-SIDE DUCTS

7

- Cold-side ducts (fresh air intake from outside and exhaust of stale air to the outside) may be made of flexible materials, but must be adequately **insulated**.
- These flexible ducts must be **as short as possible**, properly **supported and stretched** in order to reduce the internal roughness of the duct.

4.8 WARM-SIDE DUCTS

8

- With exceptions, all intake and exhaust ducts on the warm side of the system (towards the interior of the house) must be made of **rigid** materials that can be adequately cleaned when necessary.
- Unless there are serious constraints (house with no basement, for example), ducts must always be located in the basement ceiling, walls and floors, and not in roof spaces or in unheated spaces.
- Branching, **T fittings** and right-angled elbows and 90° elbows without radius **are prohibited** for warm side intake ducts.
- All cross joints, cracks and holes in ducts must be covered with aluminum **sealing tape**.

4.9 BALANCING DAMPERS

9

- **All ducts** (including those on upper floors) leading to a vent **must have balancing dampers** installed in an accessible location as far from the vent as possible.
- The main balancing dampers must be installed right at the fixture vent on the main air intake duct in the rooms in the house and on the main stale air exhaust duct. Such dampers are not required when the installed HRV already has built-in balancing dampers.

4.10 INTAKE VENTS (FRESH AIR)

10

- In a system not connected to a hot-air furnace, an **intake vent** must be **installed in every bedroom, on each floor** that does not have a bedroom, in the **main living room**, and in any room often used as an **office** or work space.
- Vents must be placed at the **top of the wall** and project air towards the ceiling in order to ensure maximum occupant comfort.
- In the case of a setup with a forced hot air system, the network of intake ducts already in place will be used.

4.11 STALE AIR EXHAUST VENTS

11

- An exhaust vent will be installed in each bathroom. Washrooms (without bath or shower) may be served by an autonomous extractor.
- The HRV stale air exhaust vents must be installed at the **top of walls or in the ceiling**, as close as possible to sources of humidity, odours or pollutants, and in order to encourage proper air circulation.
- Recycled air return vents in forced air systems must be installed in open areas and at the bottom of walls at least 102 mm (**4"**) from the floor, in order to reduce the amount of dust entering the ducts.
- A forced air system must, as a minimum, have one return vent per floor (including the basement).

4.12 BALANCING FLOWS

12

- Balancing ventilation flows is a very important stage in the proper installation of a ventilation system. It consists in adjusting the quantity of outdoor air entering the device to the same quantity of air evacuated from the house by the HRV.
- The installer should balance the total flows of fresh air and exhaust air and the flow from all network vents using a measurement method and instruments approved by the Novoclimat program.

5. REQUIREMENTS RELATING TO HEATING, PLUMBING, ELECTRICITY AND AIR QUALITY

5.1 HEATING AND SAFETY

5.1.1 Heating

- All the following heating systems are eligible: self-contained units such as baseboards, convectors and heating panels, and central forced air and hot water systems that use electrical, fuel oil, natural gas, or propane heat generators, or air/air and air/water heat pumps (geothermics).
- With natural gas, propane and fuel oil devices, combustion must take place within a sealed circuit, which means that the air supplying the burner must come directly from outdoors through an approved insulated duct.
- Self-contained electrical heating devices such as electric baseboard heaters must be regulated by **electronic thermostats** (with electronic temperature detection and modulation of heating power). For central heating systems, the required thermostats must be **programmable**.

5.1.2 Solid Fuel Heating

Back-up heating devices using solid fuel must comply with the following requirements:

- The **doors** must be sealed with heat resistant **sealant bead** and have glass windows sealed to the frame.
- The devices must have an **outdoor air delivery** duct to supply combustion without using indoor air from the house. This duct must have an insulated closing mechanism. An adjustment key must also make it possible to control combustion.
- These devices must comply with local requirements and satisfy one of the following requirements with respect to performance and air emissions: standard CSA B415.1-M92 or **EPA** standard 40 CFR Part 60.

5.1.3 Wood-burning Fireplaces

Devices that burn wood and wood pellets must comply with the following requirements:

- They must have butt-jointed doors, a refractory brick (or equivalent) combustion chamber and high temperature glass windows (pyroceramic glass).
- They must always have an outdoor air delivery duct to supply combustion without using indoor air from the house. This duct must have an insulated closing mechanism.

5.1.4 Carbon Monoxide Protection

- A home **carbon monoxide detector** must be installed (according to the manufacturer's instructions) in **every room** where there is a fuel-burning device.
- If the house has a wood or wood pellets stove, the **range hood** must be medium power, with an airflow of less than 600 cubic feet per minute (ideally less than 160 cubic feet per minute). This makes it possible to avoid any excessive depressurization of interior air in the house, which can cause smoke backdrafts.
- When the house has a garage with a door that provides direct access to the house, a home carbon monoxide detector must be installed near this door in accordance with the manufacturer's instructions.

5.2 INDOOR AIR QUALITY

5.2.1 Indoor Painting

Indoor paint work must preferably be done with latex paint to reduce polluting fumes in the ambient air in the house.

5.2.2 Floor Finishing

For better air quality, choose factory-varnished wooden floors or use a water based varnish.

5.2.3 Discharge of Ambient Air Contaminants

When all work has been completed and before the house is occupied, adequately ventilate the house (high air flow for at least 48 hours) to reduce the concentration of polluting fumes produced during the work.

5.3 PLUMBING

5.3.1 Water Heater

- The water heater must comply with one of the following standards: standard CSA/C 191.1 M90 for electrical water heaters, CAN1 4.1 M85 for gas water heaters, or CAN/CSA B211 M90 for oil water heaters.
- Hot water **hoses** for water heater discharge must be **insulated** over a minimum distance of 3 m (10') from the water heater exit, using insulation with a minimum thickness of 12 mm (1/2").

5.3.2 Plumbing Devices

- Toilets must use a maximum of **6 litres** of water per flush.

5.4 ELECTRICITY

5.4.1 Electrical Outlets and Accessories

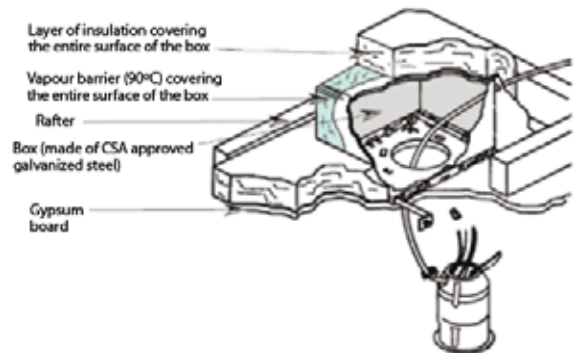
- **Electrical outlets** used to power block heaters or winter light decorations must be **controlled by switches** situated indoors.
- It must be possible to control **outdoor lighting devices** from indoors, unless they have a motion detection system or **photoelectric cell** control.

5.4.2 Tips for installing electrical fixtures that perforate the building envelope

When installing electrical boxes, it is common to perforate the building envelope and create air infiltrations. The following measures must be applied to prevent heat loss and humidity exfiltrations that could lead to the premature deterioration of the building envelope.

A. Installing a recessed lighting fixture in a ceiling that is insulated (Any electrical installation must be performed by a qualified electrician)

- Choose a box made of galvanized steel (check codes in effect).
- Install a vapour barrier that complies with standard CAN/CGSB-51.34-M (6 mil polyethylene 6 mil) over the entire surface of the electrical box and seal it with the ceiling's vapour barrier (a plastic box that is approved and specially designed for this purpose can also be used).
- If the electrical power supply wire goes through the vapour barrier, make sure to seal the perforation.
- Finally, install the insulation over and around the box (using the same insulation width as the roof space).



B. Installing electrical boxes (Any electrical installation must be performed by a qualified electrician)

- Install a few layers of polyethylene behind the electrical boxes to prevent them from perforating the vapour barrier.

Wall



- When the flexible or rigid material used as an air/vapour barrier must be perforated to install the boxes, make sure you install a flexible vapour barrier of polyethylene type or a plastic box specially designed for this purpose and seal the boxes properly to the vapour barrier of the wall to prevent air infiltrations.

Ceiling



Wall



5.5 INSPECTION AND BLOWER DOOR TEST

Even if you have taken all appropriate precautions while doing sealing work, the airtightness of a house can be confirmed only by a blower door test.

According to the Novoclimat program requirements, the total flow rate of air from the house (air leaks from cracks in exterior walls and the insulated ceiling) must be 2.5 air changes per hour or less. This value is determined using a standardized blower door test carried out before interior finishing work is complete in order to facilitate any corrective work that may be necessary.

You may request to have your work inspected and a blower door test performed for your house. However, in the case of a pre-fabricated house receiving a Certificate of Performance, these services will be at your own expense. Novoclimat advisor/evaluators that are mandated by the ministère des Ressources naturelles et de la Faune are at your disposal.

You can obtain a list of Novoclimat advisor/evaluators and the list of builders certified under the program by consulting the Website at www.efficaciteenergetique.mrnf.gouv.qc.ca, "My home" section or calling 1-877- 727-6655.



FOR MORE INFORMATION :

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1-877-727-6655

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