

NBC 9.36.5 Calculator Tool Manual

Natural Resources Canada has provided a multi-application calculator tool for Microsoft Excel to support some of calculations required in the document, "Guidelines for Using HOT2000 with the Performance Path of the 2010 National Building Code of Canada Subsection 9.36.5."

An Appendix in the guidelines provides the relevant procedures and equations for performing the calculations manually. The calculator tool has been created to automate and simplify the process.

Note that this calculator tool uses macros in Microsoft Excel. Users must have Microsoft Excel to use this calculator and macros must be enabled in Excel.

This calculator tool is made up of three separate calculators that assist in performing the following calculations:

- Calculator 1: Converting Service Water Heating equipment's Thermal Efficiency (E_t) and Standby Loss (SL) to an approximate Energy Factor (EF).
- Calculator 2: Calculating an RSI-value estimate of a window's center of glass, edge of glass, frame and center of glass SHGC.
- Calculator 3: Calculating an RSI-value for a composite basement or walkout type foundation's insulation.

References:

Reference to the "2010 National Building Code of Canada" will be prefaced with "NBC." Reference to "Manual Reference" or Appendix Reference" refer the reader to "Guidelines for Using HOT2000 with the Performance Path of the 2010 National Building Code of Canada Subsection 9.36.5."

Common Buttons:

On the main menu page are the following buttons:

- "English" and "Français" for language selection.
- "C:1: Energy Factor Conversion Calculator" to access this calculator.
- "C:2: Window Calculator" to access this calculator.
- "C:3: Composite Foundation Calculator" to access this calculator.

Within each individual calculator are the following buttons:

- "Main Menu" to return to the main menu page.
- "English" and "Français" for language selection.
- "Calculate" to perform calculations based on inputs.
- "Reset" to clear previous entries.

C:1 Energy Factor Conversion Calculator

Manual Reference: Sections 5.11 and 6.7 Service Water Heating

Appendix Reference: B.1: Approximation of Energy Factor from Thermal Efficiency and Standby Loss

Purpose:

HOT2000 v10.51 uses Energy Factor to model the efficiency of Service Water Heating (SWH)/Domestic Hot Water (DHW) equipment. Many of the entries in NBC Tables 9.36.5.16 and 9.36.4.2 rate SWH as Standby Loss (S in %/hr or SL in W). To simplify the conversion of thermal efficiencies to Energy Factor this calculator has been created.

Required Inputs:

- Energy source
- Thermal Efficiency (E_t %)
- Input Power (KBtu/h or W)
- Standby Loss type (% , BTU/hr or W)
 - If Standby Loss Type “%” is selected, the tank volume in litres is required too.
- Standby Loss (W)

Once the required inputs have been entered, click on “Calculate.” The calculation results will then be seen at the bottom of the calculator in the “Outputs” box.

C:2 Window Calculator

Manual Reference: Section 5.6.1 Fenestration Calculations and Modeling

Appendix Reference: B.2: Adjusting Solar Heat Gain Coefficient and U-value for Fenestration

Purpose:

The overall heat transfer coefficient (in RSI or U-value) and overall solar heat gain coefficient (SHGC) for windows are based on testing using standard-sized windows. The results are then applied to all windows of the same design regardless of size. For energy modeling in HOT2000, a window’s overall heat transfer coefficient and overall SHGC must be adjusted to compensate for size effects.

This calculator is designed to estimate a window’s RSI-values for “Center of Glass,” “Edge of Glass,” “Frame” and the “Center of Glass SHGC” based on a window’s specifications. Required inputs should be attainable based on the proposed house plans and by acquiring window details from the manufacturer. The calculation results may then be used in HOT2000’s “Code Editor” to create a “User Defined” window code.

Required Inputs:

- Overall U-Value ($W/m^2 \text{ } ^\circ C$)

- Overall Solar Heat Gain Coefficient
- Window Height (mm)
- Window Width (mm)
- Frame Height (mm)
- Window Type
- Glazing Type
- Fill Type
- Spacer Type
- Frame Material

Once the required inputs have been entered, click on “Calculate.” The calculation results will then be seen at the bottom of the calculator in the “Outputs” box. Note that the frame height is the average thickness of the window frame.

C:3 Composite Foundation Calculator

Manual Reference: Section 5.8.3.1 Basement and walkout type foundations

Appendix Reference: B.3: Determining a Composite Foundation Added Insulation Effective RSI-value

Purpose:

This calculator is to be used only for composite foundation insulation where a basement or walkout is present. It will assist in calculating the effective thermal resistance values of added interior or exterior foundation insulation where sections of the foundation have differing insulation values. HOT2000’s “Composite RSI/R Calculator” for basement and walkout type foundations use an incorrect value for the foundation wall effective RSI-value and therefore should not be used. This calculator assumes that the insulation is placed on the basement wall as is shown in HOT2000’s “Insulation Configuration Button” but varies around the basement’s perimeter.

Required Inputs:

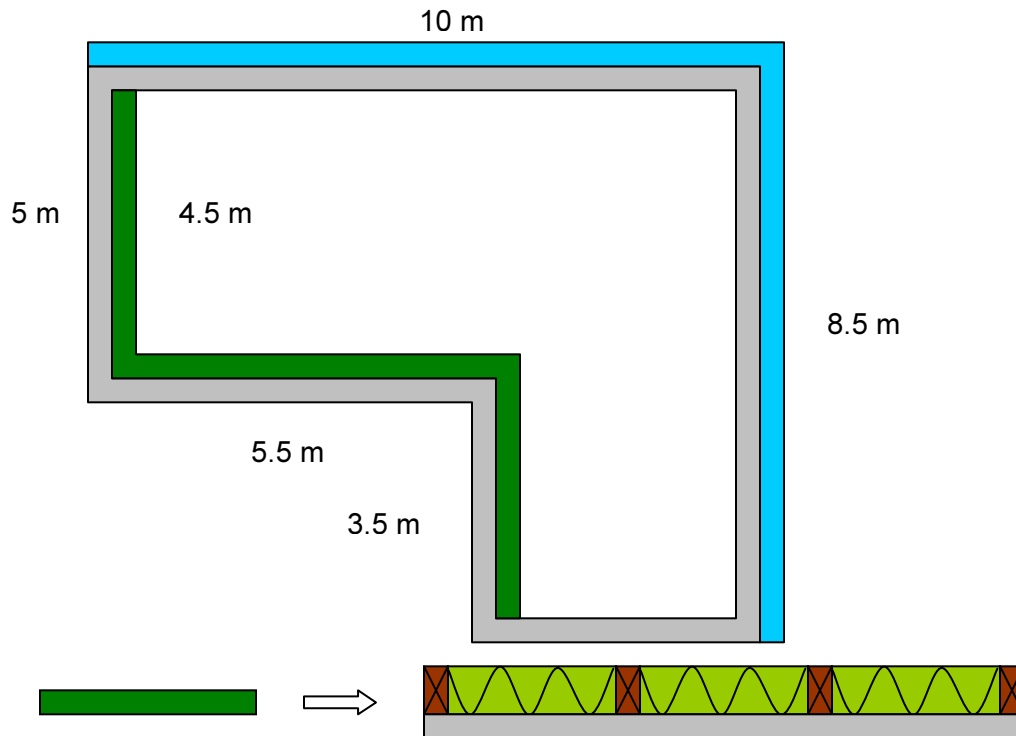
- Foundation material type
- Perimeter fractions
- Effective RSI-value of added insulation for each fraction

Please note the following requirements:

- For each “Section” used, input the length of wall as a perimeter fraction. If one “Section” applies to 50% of the basement wall perimeter, input “0.5” for that “Section.” Ensure that the sum of the “Sections” and “Remainder” add up to a “Total” of “1.”
- Enter the “Effective RSI” value for the added insulation only. The “Foundation Material” selection will account for the RSI-value of the basement wall itself.
- If there is interior and exterior insulation, use the calculator to calculate the effective RSI-values of each separately.

Once the required inputs have been entered, click on "Calculate." The calculation results will then be seen at the bottom of the calculator in the "Outputs" box.

Foundation Example: For this exercise, a concrete basement has both interior and exterior insulation. To simplify calculations, consider the walls to be 0.25 m thick.



EXTERIOR

Exterior perimeter total: 37 m

Linear meters of insulation coverage:

- $10 \text{ m} + 8.5 \text{ m} = 18.5 \text{ m}$

Percentage of exterior wall that is insulated.

- $18.5 \text{ m} / 37 \text{ m} = 0.5$ (50%)

Calculate the effective RSI-value of the insulation, which is 38 mm of extruded polystyrene IV. According to NBC Table A-9.36.2.4.(1)D, extruded polystyrene types 2-4 have an RSI of $0.035(\text{m}^2.\text{K})/\text{W}$ per mm.

- $0.035 \times 38 \text{ mm} = 1.33 \text{ RSI}$

In "C.3: Composite Foundation Calculator" perform the following steps:

1. Select "Foundation Material Concrete"
2. Input "Section 1 Perimeter Fraction" as "0.5"
3. Input "Effective RSI" as "1.33"
4. Click on "Calculate"

The calculated "Effective RSI" may now be used in HOT2000's "Exterior Added Insulation" field as a "User Specified" value.

INTERIOR

Interior perimeter total: 35 m

Linear meters of insulation coverage:

- $4.5\text{ m} + 5.5\text{ m} + 3.5\text{ m} = 13.5\text{ m}$

Percentage of interior wall that is insulated.

- $13.5\text{ m}/35\text{ m} = 0.39$ (39%)

Determine the effective RSI-value of the insulation, which is a 2x4 stud wall with R-12 batts. According to NBC Table A-9.36.2.4.(1)D, an R-12 batt has an RSI of 2.11.

In "C.3: Composite Foundation Calculator" perform the following steps:

1. Select "Foundation Material Concrete"
2. Input "Section 1 Perimeter Fraction" as "0.39"
3. Input "Effective RSI" as "2.11"
4. Click on "Calculate"

The calculated "Effective RSI" may now be used in HOT2000's "Interior Added Insulation" field as a "User Specified" value.