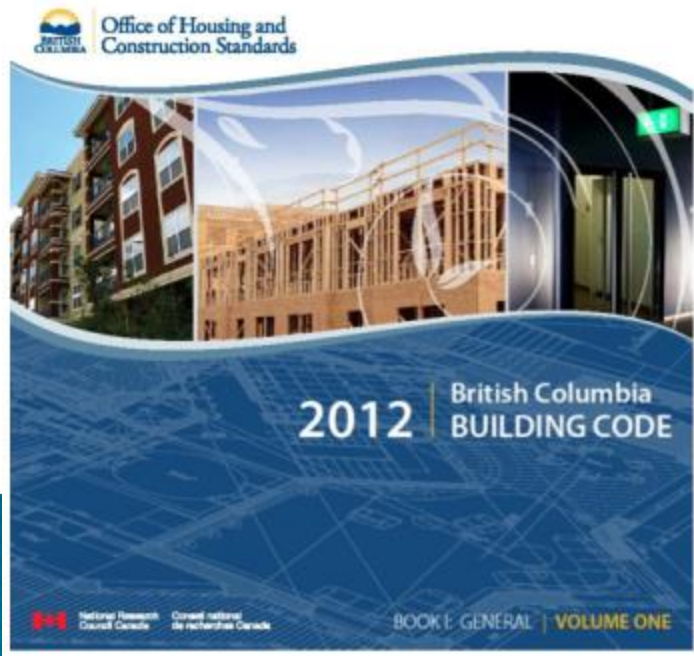




BCBC Energy Efficiency Requirements for Part 9 Buildings

Plan Review Lower Mainland





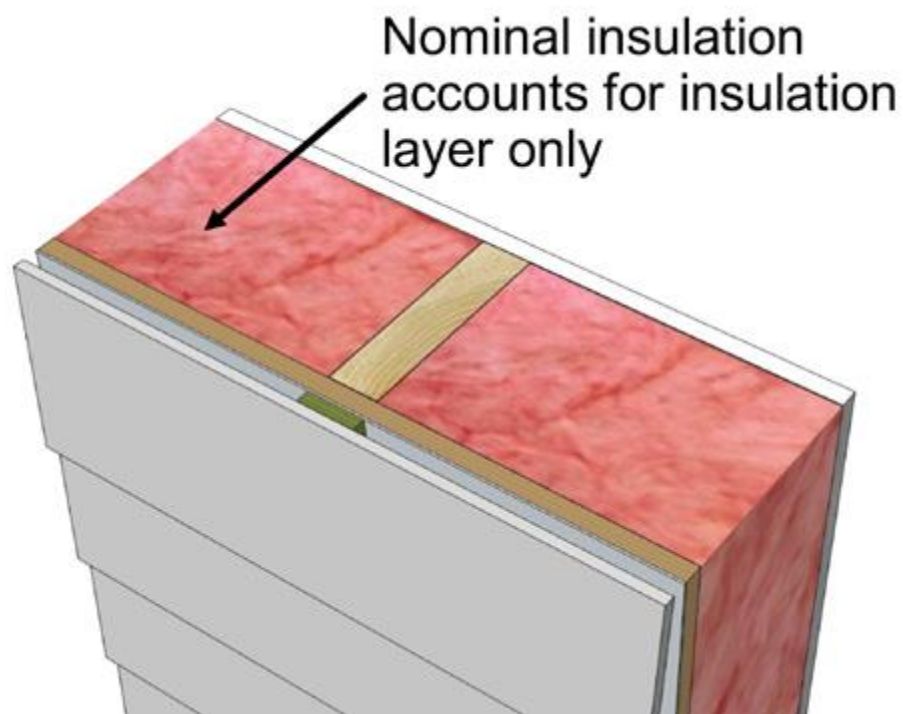
9.36. Energy Efficiency

- ▶ Changes to Provincial Energy Efficiency Requirements
- ▶ Commencing December 19, 2014, applications for building permits must comply with new requirements for energy efficiency in housing, small commercial and industrial buildings. The new building envelope requirements vary depending on your location.



9.36. Energy Efficiency

Nominal Insulation





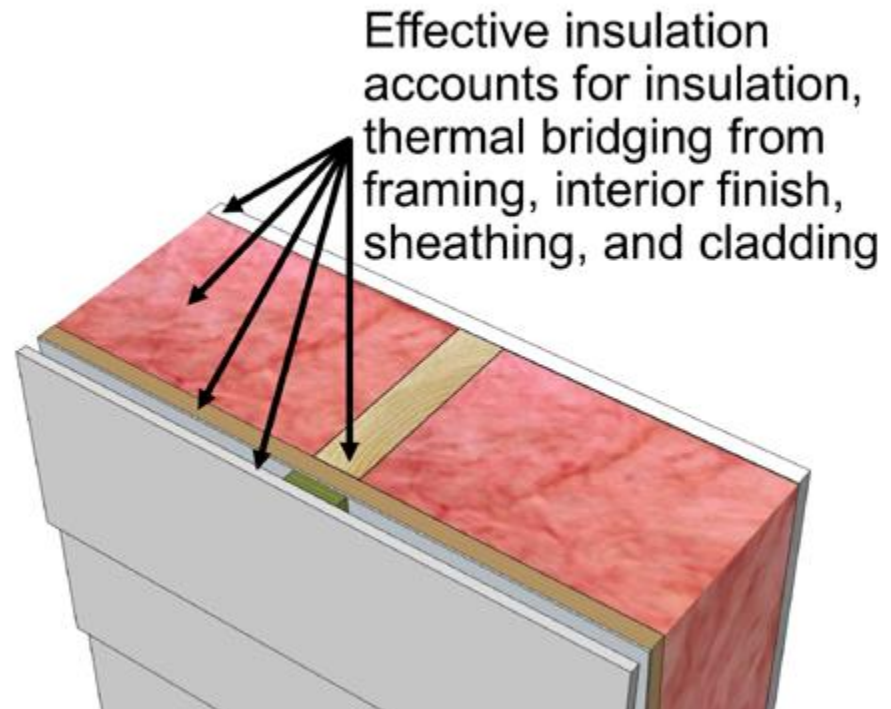
9.36. Energy Efficiency

- ▶ Thermal insulation
- ▶ requirements are now defined in terms of *effective* insulation. Previous versions of the Code referenced *nominal* insulation



9.36. Energy Efficiency

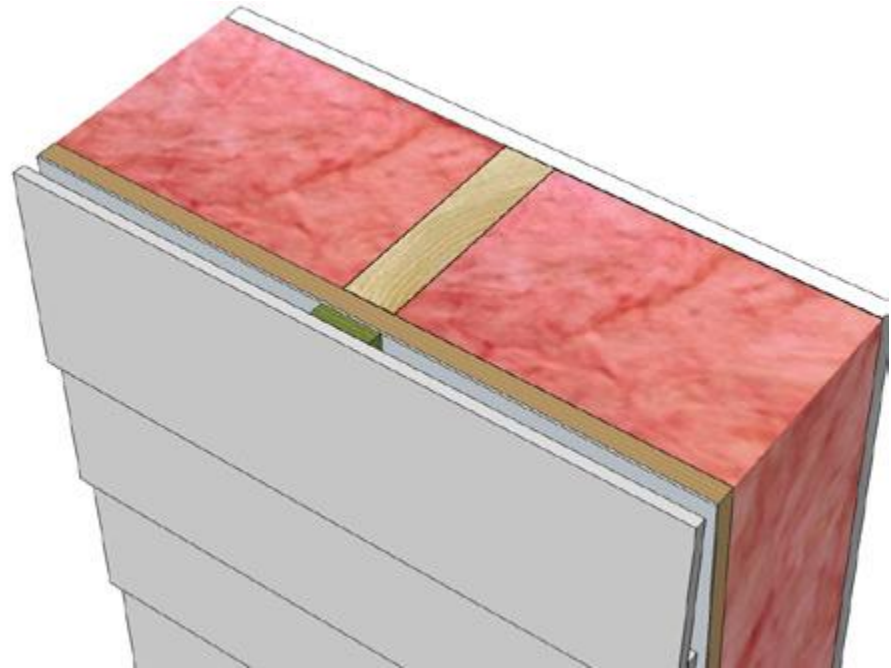
Effective Insulation





9.36. Energy Efficiency

Continuity of Effective Insulation

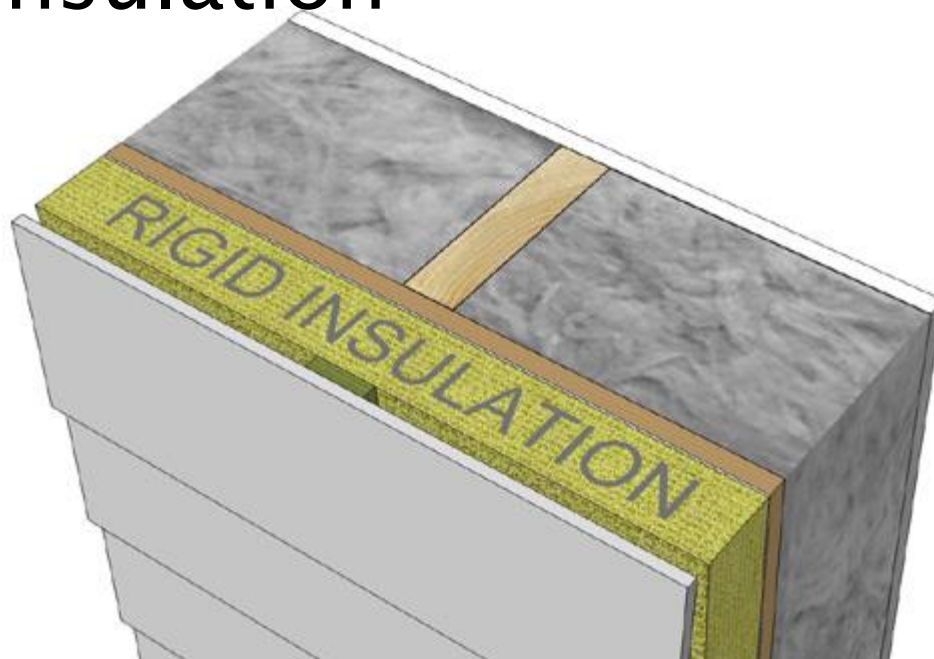


Insulation in the framing cavity achieves continuity of effective



9.36. Energy Efficiency

Continuous Insulation



Continuous insulation achieves continuity but is not required



9.36. Energy Efficiency

- ▶ **9.36.1.2. Definitions**
- ▶ 1) For the purpose of this Section, the term “common space” shall mean all spaces required to be *conditioned spaces* in accordance with the requirements of the Code that are not within a *suite* but shall not include crawl spaces and *vertical service spaces*. (See A-9.36.1.3.(3) in Appendix A.)



9.36. Energy Efficiency

- ▶ 9.36.1.2.(2)
- ▶ For the purpose of this Section, the term “overall thermal transmittance,” or U-value, shall mean the rate, in $W/(m^2 \cdot K)$, at which heat is transferred through a *building* assembly that is subject to temperature differences. (See Appendix A.)



9.36. Energy Efficiency

- ▶ 9.36.1.2.(4)
- ▶ For the purpose of this Section, the term “fenestration” shall mean all *building* envelope assemblies, including their frames, that transfer visible light, such as windows, clerestories, skylights, translucent wall panels, glass block assemblies, transoms, sidelights, sliding, overhead or swinging glass doors, and glazed inserts in doors, etc. (See Appendix A.)



9.36. Energy Efficiency

- ▶ **9.36.2.1. Scope and Application**
- ▶ 1) Except as provided in Sentence (2), this Subsection is concerned with the loss of energy due to heat transfer and air leakage through materials, components and assemblies, including their interfaces, forming part of the *building* envelope where it separates *conditioned space* from unconditioned space, the exterior air or the ground.



9.36. Energy Efficiency

- ▶ 9.36.2.1.2) The requirements of this Subsection also apply to components of a *building* envelope assembly that separate a *conditioned space* from an adjoining *storage garage*, even if the *storage garage* is intended to be heated.



9.36. Energy Efficiency

- ▶ 9.36.2.1.3) Except for skylight shafts addressed in Sentence 9.36.2.6.(3), for the purpose of this Subsection, wall assemblies inclined less than 60° from the horizontal shall be considered as roof assemblies, and roof assemblies inclined 60° or more from the horizontal shall be considered as wall assemblies.



9.36. Energy Efficiency

- ▶ 9.36.2.1.4) The properties, performance and installation of windows, doors and skylights shall also conform to Section 9.7.
- ▶ 9.36.2.1.5) The properties, location and installation of thermal insulation, *air barrier systems*, *vapour barriers*, and materials with low air or vapour permeance shall also conform to Section 9.25.



9.36. Energy Efficiency

- ▶ Review the proposed building plans.



9.36. Energy Efficiency

- ▶ Additional Information
- ▶ **New Residence: Lower Mainland**
- ▶
- ▶ **Proposed mechanicals:**
- ▶ Gas-fired forced air furnace
- ▶ Gas-fired domestic hot water tank
- ▶ Ventilation: principal exhaust fan in main bathroom
- ▶
- ▶ **Construction assemblies:**
- ▶
- ▶ Wall between house and garage:
- ▶ 2x6 @ 16" o/c with R-20 batt insulation
- ▶ ½" gypsum board interior and exterior
- ▶
- ▶ **Windows**
- ▶ Double glazed vinyl frame windows



9.36. Energy Efficiency

- ▶ Must the proposed building comply with 9.36?



9.36. Energy Efficiency

- ▶ 9.36.1.3.2) Subsections 9.36.2. to 9.36.4. apply to
- ▶ a) *buildings of residential occupancy* to which Part 9 applies,



9.36. Energy Efficiency

- ▶ What are the methods that may be used to obtain compliance?



9.36. Energy Efficiency

- ▶ 9.36.1.3.(2)
- ▶ a) the prescriptive or trade-off requirements in Subsections 9.36.2. to 9.36.4.,
- ▶ b) the performance requirements in Subsection 9.36.5., or
- ▶ c) the NECB.



9.36. Energy Efficiency

- ▶ QUESTION
- ▶ The proposed building is in which Climate Zone?

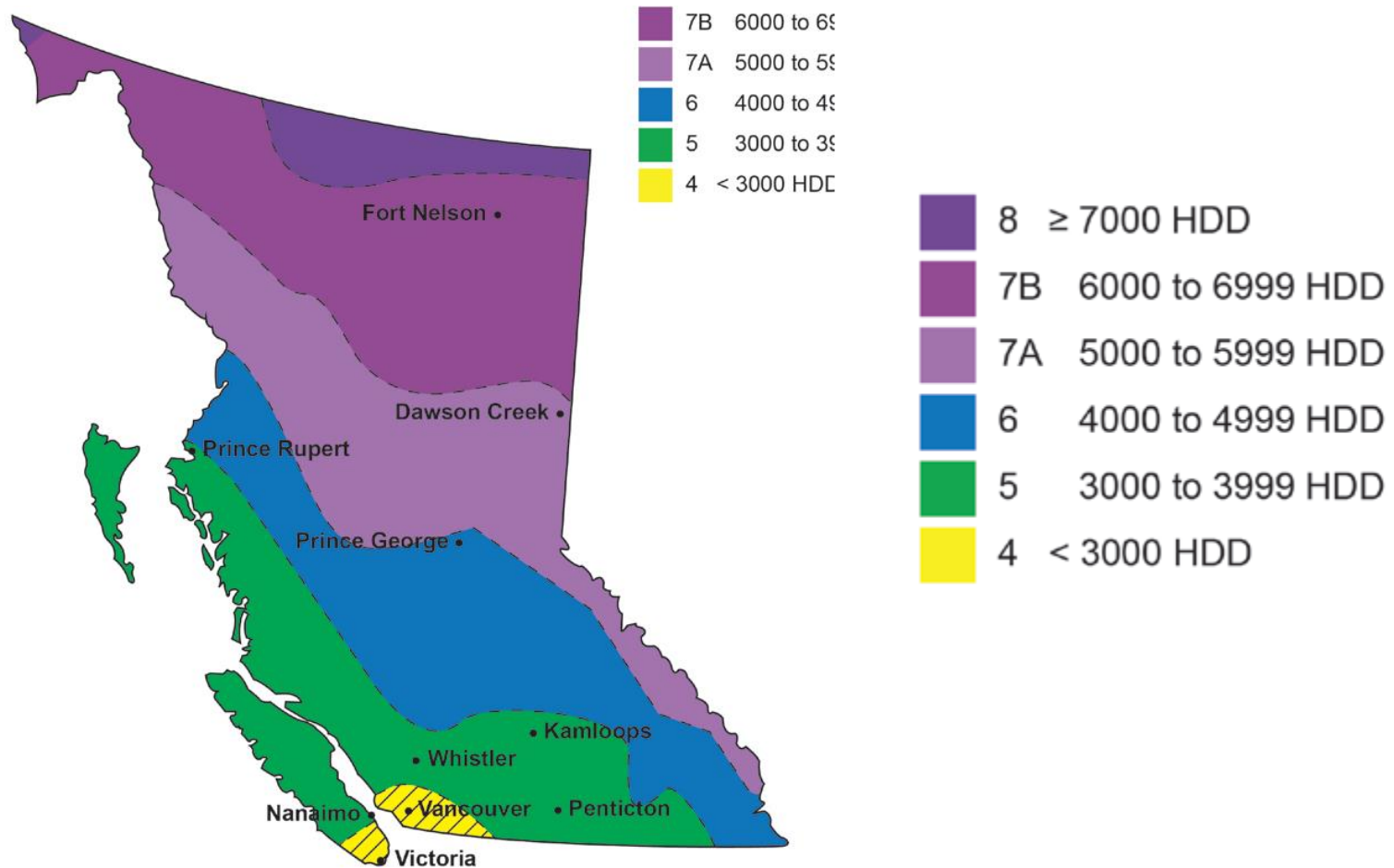


9.36. Energy Efficiency

- ▶ ANSWER
- ▶ The proposed building is in which Climate Zone ?
- ▶ Climate Zone 4



9.36. Energy Efficiency





9.36. Energy Efficiency

- ▶ QUESTION Using Table 9.36.2.6.A
- ▶ For the proposed building, what are the required minimum effective thermal resistance of the opaque assemblies for the following:
 - ▶ Ceilings below attics?
 - ▶ Cathedral ceiling and flat roofs?
 - ▶ Walls?
 - ▶ Floors over unheated spaces?
 - ▶ Slab?



9.36. Energy Efficiency

- ▶ ANSWERS
- ▶ Minimum effective thermal Resistance (RSI)
- ▶ Ceiling below attics – 6.91
- ▶ Cathedral ceiling and flat roofs– 4.67
- ▶ Walls– 2.78
- ▶ Floors over unheated spaces – 4.67
- ▶ Foundation wall – 1.99
- ▶ Slab – 0



9.36. Energy Efficiency

QUESTION

- ▶ For the proposed building what are the required thermal characteristics of Fenestration, Doors and Skylights?



9.36. Energy Efficiency

ANSWERS

- ▶ From Table 9.36.2.7.A
- ▶ Fenestration and Doors Max U Value 1.80
- ▶ From Table 9.36.2.7.(2
- ▶ Skylights 2.90

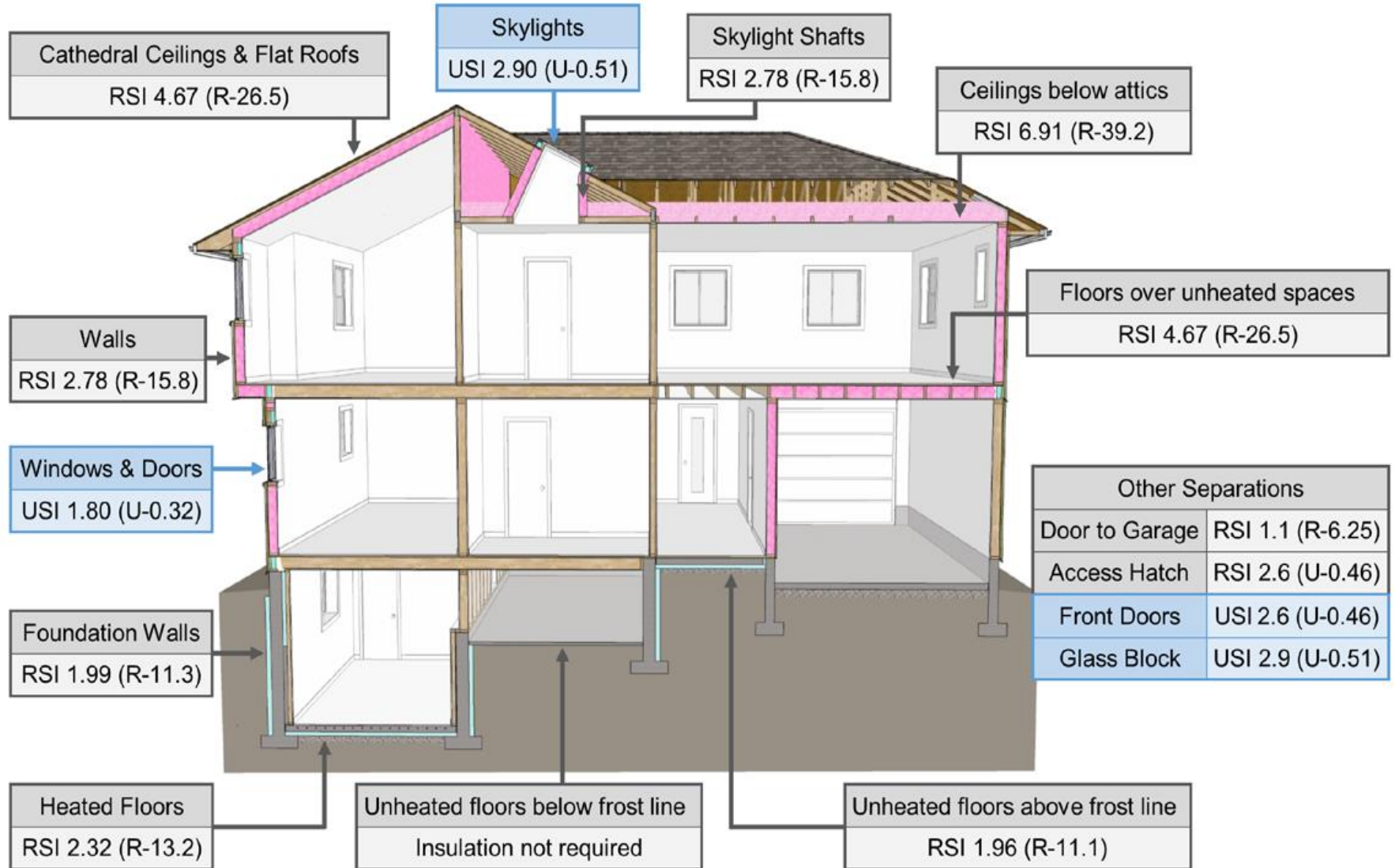


9.36. Energy Efficiency

ENERGY PERFORMANCE RATINGS		
U-Factor 1.80 W/m²•K	Solar Heat Gain Coefficient 0.19	Visual Transmittance 0.35
Energy Rating 17	Air Leakage 1.2 L/s/m²	
BC's Best Window Company A100 Series Casement window Vinyl frame, Double glazed, Low-E coating Argon fill		
Certification Agency Logo	Energy performance ratings certified to CSA A440.2-09. Ratings are determined for a fixed set of environmental conditions and a specific reference product size. Certification agency does not recommend or warrant product for any specific use.	



9.36. Energy Efficiency





9.36. Energy Efficiency

Building Envelope

Required Effective
Insulation R Value

Actual effective
Insulation R Value

Wall

2.78 (15.78)

Ceiling

6.91 (39.23)

Basement Walls

1.97 (11.18)

Basement Floors

0

Fenestration& Doors

U Value 1.80

Skylights

U Value 2.90

Floors over unheated spaces

4.67 (26.5)



9.36. Energy Efficiency

QUESTION

- ▶ The proposed building has a gas furnace, hot water tank and fireplace.
- ▶ What are the required ratings for each?



9.36. Energy Efficiency

ANSWERS

Equipment	Heating or cooling Capacity KW	Standard	Minimum Performance
Gas Furnace	117.23	ANSI Z83.8/ CSA 2.6	$E_t \geq 81\%$
Gas Fireplace	–	–	–
Component	Input	Standard	Performance Requirement
Gas Fired Service Water Heating	$\geq 22\text{KW}$	ANSI Z21.10.3/ CSA 4.3	$E_t \geq 80\%$ and standby loss $< \text{rated}$ <u>$(800 + 16.57)$</u>



9.36. Energy Efficiency

- ▶ **A-9.36.2.4.(1) Calculating the Effective Thermal Resistance of Building Envelope Assemblies.** The general theory of heat transfer is based on the concept of the thermal transmittance through an element over a given surface area under the temperature difference across the element (see Sentence 9.36.1.2.(2))



9.36. Energy Efficiency

- ▶ To calculate effective thermal resistance, Section 9.36. requires contributions from all portions of an assembly.



9.36. Energy Efficiency

- ▶ A 9.36.2.4.(1)
- ▶ Calculating the Effective Thermal Resistance of a Wood-frame Assembly: Isothermal-Planes and Parallel-Path Flow Methods



9.36. Energy Efficiency

- ▶ A 9.36.2.4.(1)
- ▶ To calculate the effective thermal resistance of a building envelope assembly containing wood framing, RS_{leff} , add up the results of the following calculations:
- ▶ (cont'd)



9.36. Energy Efficiency

- ▶ **A 9.36.2.4.(1)**
- ▶ **A.** calculate the effective thermal resistance of all layers with continuous materials using the isothermal-planes method, and
- ▶ **B.** calculate the effective thermal resistance of the framing portion, $RSI_{parallel}$, using the following equation, which is taken from the parallel-path flow method described in the ASHRAE 2009, “ASHRAE Handbook – Fundamentals”
- ▶ (cont'd)



9.36. Energy Efficiency

- ▶ RSIF = thermal resistance of the framing member obtained from Table A-9.36.2.4.(1)D.,
- ▶ RSIC = thermal resistance of the cavity (usually filled with insulation) obtained from Table A-9.36.2.4.(1)D.,
- ▶ % area of framing and Cavity = value between 0 and 100 obtained from Table A-9.36.2.4.(1)A. or by calculation, and



9.36. Energy Efficiency

Parallel-Path Flow Method

$$RSI_{\text{parallel}} = \frac{100}{\frac{\% \text{ area of framing } (A_f)}{RSI_f} + \frac{\% \text{ area of cavity } (A_c)}{RSI_c}}$$

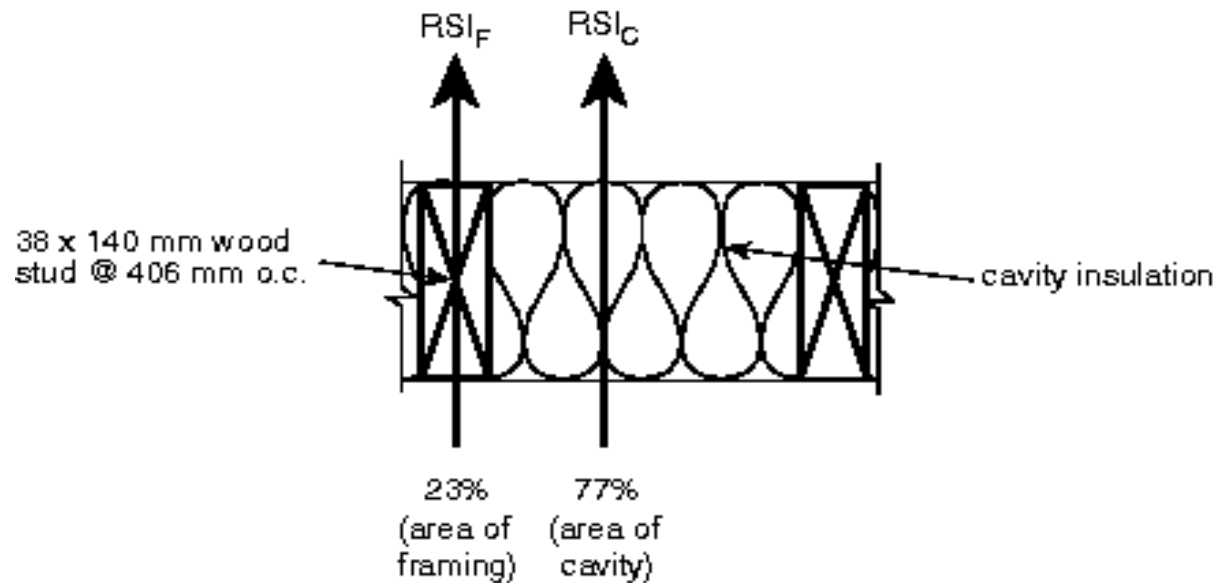


9.36. Energy Efficiency

- ▶ Determine the % of framing and Cavity in a standard 2X6 wall (38x140).



9.36. Energy Efficiency



EG0077 5A.



9.36. Energy Efficiency

- ▶ 1. Determine the thermal resistance of each continuous material layer incorporated in the assembly using Table A-9.36.2.4.(1)D.



9.36. Energy Efficiency

- ▶ Use the formula to determine effective insulation

$$\frac{\% \text{ area of framing } (A_f)}{RSI_f} + \frac{100}{\frac{\% \text{ area of cavity } (A_c)}{RSI_c}}$$



9.36. Energy Efficiency

Building Envelope

Required Effective
Insulation R Value

Actual effective
Insulation R Value

Wall

2.78 (15.78)

2.36

Ceiling

6.91 (39.23)

Basement Walls

1.97 (11.18)

Basement Floors

0

Fenestration& Doors

U Value 1.80

Skylights

U Value 2.90

Floors over unheated spaces

4.67 (26.5)



9.36. Energy Efficiency

▶ From Table A-9.36.2.4.(1)D.

▶ Thermal Resistance Values of Common Building Materials

▶ Interior air film	0.12	
▶ ½ inch Gyproc	0.07	12.5 mm X 0.0061 per mm
▶ 6mil poly	0.0	
▶ ½ inch plywood	0.109	12.5Xmm X .0087
▶ ½ inch air space	0.16	
▶ 3 coat stucco	0.013	15mm X .0009 per mm
▶ Exterior air film	<u>0.03</u>	
▶ Total	0.502	

▶ 0.42 was required to comply with code



9.36. Energy Efficiency

Building Envelope

Required Effective
Insulation R Value

Actual effective
Insulation R Value

Wall

2.78 (15.78)

2.86

Ceiling

6.91 (39.23)

Basement Walls

1.97 (11.18)

Basement Floors

0

Fenestration& Doors

U Value 1.80

Skylights

U Value 2.90

Floors over unheated spaces

4.67 (26.5)



9.36. Energy Efficiency

QUESTION

- ▶ Calculate foundation wall thermal resistance
- ▶ 8" CONCRETE FOUNDATION WALL,
- ▶ 1" STANDOFF
- ▶ 2X4 FURRING WALL W/ R12 BATT
- ▶ INSULATION
- ▶ 6 MIL POLY AVB
- ▶ 1 / 2" GYPSUM WALLBOARD



Energy Efficiency

ANSWER

8" CONCRETE WALL	.0812	.004 per mm
1" STANDOFF	.16	
2X4 FURRING WALL (assume 16 oc)		
W/ R12 BATTINSULATION	1.64	
6 MIL POLY AVB	.00	
1 /2" GYPSUM WALLBOARD	.07	
Interior Air Film	<u>0.12</u>	
Total	2.07	

Required 1.97



9.36. Energy Efficiency

Building Envelope

Required Effective
Insulation R Value

Actual effective
Insulation R Value

Wall

2.78 (15.78)

2.86

Ceiling

6.91 (39.23)

Basement Walls

1.97 (11.18)

2.07

Basement Floors

0

Fenestration& Doors

U Value 1.80

Skylights

U Value 2.90

Floors over unheated spaces

4.67 (26.5)



9.36. Energy Efficiency

- ▶ Calculate if the roof assembly of proposed building complies with 9.36.



9.36. Energy Efficiency

- ▶ ROOF ASSEMBLY
- ▶ ASPHALT SHINGLES
- ▶ UNDERLAYMENT
- ▶ 1 / 2" PLYWOOD SHEATHING
- ▶ ROOF TRUSSES AT 24" O.C.
- ▶ R-40 LOOSE FILL FIBREGLOSS INSULATION
- ▶ 6 MIL POLY AVB
- ▶ 5 / 8" GYPSUM WALLBOARD



9.36. Energy Efficiency

▶ Air Film (interior)	.11	
▶ 5/8" GYPSUM WALLBOARD	.096	.0061 per mm
▶ 6 MIL POLY AVB	.00	
▶ R-40 LOOSE FILL FIBREGLASS INSULATION	5.71	.01875 per mm
▶ 2"X4" 24" O.C Roof truss (Cavity)	1.48	
▶ Air Film exterior	<u>.03</u>	
▶ <u>Total</u>	7.426	



9.36. Energy Efficiency

Building Envelope

Required Effective
Insulation R Value

Actual effective
Insulation R Value

Wall

2.78 (15.78)

2.86

Ceiling

6.91 (39.23)

7.426

Basement Walls

1.97 (11.18)

2.07

Basement Floors

0

Fenestration& Doors

U Value 1.80

Skylights

U Value 2.90

Floors over unheated spaces

4.67 (26.5)



9.36. Energy Efficiency

- ▶ Does the wall between the garage and dwelling unit comply with 9.36?
- ▶ 1 / 2" GYPSUM WALLBOARD
- ▶ 2X6 STUDS AT 16" O.C.
- ▶ R-20 BATT INSULATION
- ▶ 6 MIL POLY AVB
- ▶ 1 / 2" GYPSUM WALLBOARD



9.36. Energy Efficiency

▶ Air Film	.12
▶ ½ inch gyproc	.07
▶ 6 mil poly	.00
▶ 2X6 with R 20	2.36
▶ ½ gyproc	.07
▶ Air film	<u>.03</u>
▶ Total	2.65

▶ Required 2.78 less .16 = 2.62





9.36. Energy Efficiency

► Questions