



# **BCBC Energy Efficiency Requirements for Part 9 Buildings**

**Compliance Options  
BCBC 9.36.  
2014**



# 3 Compliance options

- **Prescriptive**
  - No HRV option or
  - with HRV
- **Prescriptive + Simple trade-offs**
- **Performance**



## 9.36.2.11. Simple Trade-Off Above Grade

- **3 Trade-off Options:**

- 1. Opaque to opaque
- 2. Transparent to transparent

areas remain same

- Limited to trades within same orientation

$$\sum_{i=1}^n \frac{A_{ir}}{R_{ir}} \geq \sum_{i=1}^n \frac{A_{ip}}{R_{ip}}$$



## 9.36.2.11. Simple Trade-Off Above Grade

$$\sum_{i=1}^n \frac{A_{ir}}{R_{ir}} \geq \sum_{i=1}^n \frac{A_{ip}}{R_{ip}}$$

### – 3. Opaque to transparent

- Can trade reduced window area for reduced attic insulation, **but**
  - Applies only to one storey buildings with a floor-ceiling height of 2.34 m
  - Intended for factory constructed houses/buildings
    - The max window & door area allowed is **15%**
    - Reference house window & door area is **17%**.



# Simple Trade Off Limitations

- Can't reduce walls and attic roofs below 55% of required R-value
- Can't reduce other opaque assemblies below 60% of required R-values
- Can't be applied to heated assemblies
  - (i.e. radiant heated panels)
- Can't be applied to components and assemblies already exempted
  - (i.e. allowance for ceiling insulation reduction at eave – no credit for a raised heel truss)



## 9.36.2.11. Simple Trade-Off Above Grade

- **Example: required  $RSI_{\text{eff}} = 2.78$**
- **200 m<sup>2</sup> total wall area;**
  - **Wall 1: 170 m<sup>2</sup>**
    - **2x6 @ 16" o/c, R-19 batt insulation; gyp bd. inside, plywood sheathing, rain screen, cement stucco:**
    - **Total effective RSI = 2.86**
  - **Wall 2: 30 m<sup>2</sup>**
    - **2x4 @ 16" o/c, R-14 batt insulation; gyp bd. Inside, OSB sheathing, vinyl siding:**
    - **Total effective RSI = 2.19**
    - **[Max trade-off value =  $2.19 / 2.78 \times 100 = 78\%$ ]**



## 9.36.2.11. Simple Trade-Off Above Grade

- **Example**
  - **Wall 1: 170 m<sup>2</sup>**
    - **2x6 @ 16" o/c, R-19 batt insulation; gyp bd. inside, plywood sheathing, rain screen, cement stucco:**
    - **From table A-9.36.2.6.(1)A:**
      - **2x6 @ 16" o/c, R-19 batt insulation effective R-value = 2.36**
      - **Additional layers (values from Table A.9.36.2.4.(1) D)**
        - **Interior air film 0.12**
        - **Gyp bd. 0.08**
        - **Ply sheathing 0.10**
        - **Rain screen cavity 0.15**
        - **Stucco 0.08**
        - **Exterior air film 0.03**
        - **Total: 0.50**
    - **Total effective RSI = 2.86**



## 9.36.2.11. Simple Trade-Off Above Grade

- Example
- 200 m<sup>2</sup> total wall area
  - Wall 1: 170 m<sup>2</sup>
    - 2x6 @ 16" o/c, R-19 batt insulation; gyp bd. inside, plywood sheathing, rain screen, cement stucco:
    - Total effective RSI = 2.86
  - Wall 2: 30 m<sup>2</sup>
    - 2x4 @ 16" o/c, R-14 batt insulation; gyp bd. Inside, OSB sheathing, vinyl siding:
    - Total effective RSI = 2.19

$$\sum_{i=1}^n \frac{A_{ir}}{R_{ir}} \geq \sum_{i=1}^n \frac{A_{ip}}{R_{ip}}$$





## 9.36.2.11. Simple Trade-Off Above Grade

Assembly	Area	Reference design values		Proposed trade-offs	
		RSI	A/RSI	RSI	A/RSI
Wall 1	170 m <sup>2</sup>	2.78	61.15	2.86	59.44
Wall 2	30 m <sup>2</sup>	2.78	10.79	2.19	13.69
		Total A/R:	71.94	Total A/R:	73.13
Increased A/R that needs to be compensated:					
$73.13 - 71.94 = 1.19$					
Subtract from A/R value required for improved wall:					
$59.44 - 1.19 = 58.25$					
Increased R value to compensate					
$170 \text{ m}^2 / 58.25 = 2.91$					
		Reference design values		Proposed trade-offs	
Wall 1	170 m <sup>2</sup>	2.78	61.15	2.91	58.25
Wall 2	30 m <sup>2</sup>	2.78	10.79	2.19	13.69
		Total A/R:	71.94		71.94



# 9.36.2.11. Simple Trade-Off Above Grade

Reference Building			
	Area (m2)	Effective RSI	A/R
Wall 1	170	2.78	61.15
Wall 2	30	2.78	10.79
Cumulative			71.94

Proposed Building			
	Area (m2)	Effective RSI	A/R
Wall 1	170	2.86	59.44
Wall 2	30	2.19	13.70
Cumulative			73.14

**Does Trade -off comply ?                      NO**

Proposed Building			
	Area (m2)	Effective RSI	A/R
Wall 1	170	2.92	58.24
Wall 2	30	2.19	13.70
Cumulative			71.94

**Wall 1- Effective RSI Required to comply.                      2.92**



## 9.36.5. Energy Performance Compliance

- **Performance Path**
  - The reference and proposed house must be modeled using the same approach and assumptions, except for proposed changes of components or energy efficiency features
  - Reference house for modeling is the same as proposed – but using prescriptive requirements; proposed house must have equal or better performance
  - Assumed operating conditions are provided
  - There are limits on glazing area for reference house
  - Full calculation option - HOT-2000 or equivalent.



## 9.36.5. Energy Performance Compliance Definitions

- “Reference house”
  - Assumes house design using all applicable prescriptive requirements, same fuel, occupancy, and climate data
- Annual energy consumption
  - Total annual space heating, and hot water energy consumption
- House energy target
  - Annual energy consumption consumption of reference house
- Principal ventilation rate
  - Normal operating exhaust capacity of ventilation system



## 9.36.5.4. Energy Performance Calculation

- **Energy modeling calculations must take into account:**
  - **Space heating**
  - **Ventilation**
  - **Service water heating**
  - **Space cooling, where installed**
  - **Backup systems can be disregarded provided the equipment is not required to provide space conditioning**



## 9.36.5.4. Energy Performance Calculation

- Modeling is done hourly then averaged
- Standard set point temperatures are used
  - 21 ° C for living spaces above grade
  - 19 ° C in basement
  - 15 ° C in heated crawlspace
  - 25 ° C cooling set-point if cooling is installed
- If a computer program is used, the modeling must be done for both reference and proposed house. The software must be tested in accordance with ASHRAE standard for evaluating building energy analysis software
  - (HOT 2000 is compliant)



## 9.36.5.4. Energy Performance Calculation

- Climate data must be based on a min. 10 years data
- Where climatic data is not available, calculations must use data that best matches climate at building site.



## 9.36.5.4. Energy Performance Calculation

- **Building envelope**
  - Above ground walls & roof assemblies
  - Floors & walls in contact with ground
- **Doors, windows & skylights**
  - Orientation, overall thermal transmittance, shading factors (but skylights shall have no shading) from permanent shading elements
  - Fenestration area must be identical in proposed & reference house
- **Where effect of thermal mass is being considered, contents of house are not to be considered**





## 9.36.2.3. Calculation of Ceiling, Wall, Fenestration and Door Areas

- Calculation of ceiling, wall, fenestration and door areas are to be done from the interior face.
- Calculation is required when trade-offs are considered, or for the performance option
- Calculation of these areas is not necessary if compliance is prescriptive.



## 9.36.2.3. Calculation of Ceiling, Wall, Fenestration and Door Areas

- Total roof-ceiling area is the sum of the interior surface areas of insulated roof-ceiling assemblies and of skylight openings.
- The wall area is the sum of the interior surface areas of all exterior *building* envelope assemblies above finished ground level that are inclined  $60^\circ$  or more from the horizontal. This includes
  - a) *rim joists*,
  - b) fenestration and doors,
  - c) insulated walls extending from finished ground level to the interior side of the insulated roof-ceiling assembly, and
  - d) the exposed areas of below-ground *building* envelope assemblies, where fenestration or doors are located below the plane of the adjacent finished ground.



## 9.36.2.3. Calculation of Ceiling, Wall, Fenestration and Door Areas

- Fenestration and door dimensions used are rough opening areas
- For bow windows and bays, the area is calculated along the surface of each plane



skylight



bow window



curved window



## 9.36.5. Energy Performance Compliance

Default assumptions for the reference house:

- 2.5 air changes @ 50 Pascals airtightness
- Prescriptive Effective R-values for envelope assemblies
- Area and orientation of fenestration and doors to be modeled as being equally distributed on all sides of the house
- Limits on fenestration to gross wall area ratio (FDWR) for reference house:
  - As proposed if FDWR is between 17% and 22%
  - 17% if FDWR of house is less than 17%
  - 22% if FDWR is greater than 22%
  - For buildings with more than 2 dwellings, 40%



## 9.36.5.4. Energy Performance Calculation

- **HVAC systems**
  - Must account for energy consumption of each heating, ventilating and cooling system
  - Each heating & cooling system must be accounted for
- **Both reference and proposed house must be modeled as being:**
  - Heated,
  - Cooled or
  - Heated and cooled



## 9.36.5.4. Energy Performance Calculation

- During heating season, any solar or internal gains that cause an increase in space temperature beyond 5.5 °C are excluded from calculations.



## 9.36.5.4. Energy Performance Calculation

- Service water heating
- Ground water temperatures determined by climate data
- Delivered water temperature to be assumed to be 55° C
- Assumed hot water loads loads:
  - 225 L/ day for houses with or without a *secondary suite*, or
  - 140 L/day per *dwelling unit* for other types of residential *buildings*.



# Energy Performance Documentation

- **Information required on drawings (2.2.8.2.):**
  - Effective R-values of all opaque envelope assemblies
  - Overall thermal transmittance (U-values)
  - Window to wall ratio
  - HVAC equipment specs
  - Ventilation rates
  - Airtightness assumptions
  - Features that differ from reference house





# Energy Performance Documentation

- **House performance compliance report (2.2.8.3.)**
  - Project information, incl. address & geographic location
  - Name & version of calculation tool (incl. list of any changes made by user to the software)
  - Climatic data used
  - Summary of envelope & HVAC systems
  - Energy performance summary
  - Statement that calculation was performed in compliance with 9.36.5