National Energy Code of Canada for Buildings (NECB) 2020

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Key Updates to NECB 2020

- 3.2.2 Above-ground components of the Building Envelope
- 4.2.1.5/6 Interior Lighting Power Allowance
- 5.2.12 Equipment Efficiency
- 8.4.2.9 Performance Path Air Leakage Calculation
- Part 10 Tiered Building Energy Performance Compliance
- Table C-2 Design Climate Data

Actual minimum requirements did not change ALL that much

Most significant impact of new code is the shift to *Performance* based compliance

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Agenda

- What is the NECB?
- NECB Adoption & Application
- Code Structure & Compliance Pathways
- Updates to Prescriptive Requirements
- Updates to Performance Path Requirements
- Overview of Performance Path Compliance

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The National Energy Code of Canada for Buildings

(If you've never heard of it – don't worry, you're not alone)

Brief Background

- Like the National Building Code, NECB is a model code
- Published versions:
  - MNECB 1997, NECB 2011, 2015, 2017, 2020
- First version adopted in Nova Scotia:
  - NECB 2011 – Effective Dec. 2014

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Application

- NECB applies to all new buildings and additions for which NBC Part 3, 4, 5, 6 applies
  - i.e., not Part 9 buildings
- NECB 2020 applies to retrofits ONLY to or within buildings that were originally constructed in accordance with the NECB
  - i.e., a retrofit must achieve energy performance equal to or better than the original design's energy performance, if any version of the NECB applied to the original project
- NECB does not apply to farm buildings

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Adoption of NECB 2020 in NS

NECB 2020 Effective Dates:

- Tier 1: April 1, 2025
- Tier 2: April 1, 2027
- Tier 3: April 1, 2029

What this means:

- Minimum energy performance requirements become incrementally more stringent every 2 years

For reference, other provinces that have adopted NECB 2020 include:
Tier 1: PEI, MB, SK, AB
Tier 2: NB

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NECB vs NBC 9.36

NBC 9.36:
Minimum energy performance requirements for Part 9 Buildings only (NBC 1.3.3.3)

NECB:
Minimum energy performance requirements for all other buildings (NBC 1.3.3.2)

In Nova Scotia, a new construction project applying for building permit *must* demonstrate compliance with the applicable energy code

Note: A project designed following NBC Part 9 can *elect* to demonstrate compliance following NECB in lieu of 9.36

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Covered under NECB:

- Minimum energy performance of new buildings, based on critical equipment and systems:
  - Envelope
  - Lighting
  - HVAC
  - Service hot water
  - Electrical systems & motors

NECB outlines *minimum* performance requirements

NOT covered:

- Carbon:
  - Emissions from buildings (operational carbon)
  - Embodied Carbon in building materials
- Energy Efficiency for appliances, process equipment
- Net Zero (Ready) requirements

NECB is *not* a design guideline (and does not dictate requirements for a "net zero" building)

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Structure/Parts

Prescriptive Requirements (minimum performance)

Defines Performance Path Modelling Requirements

Defines Performance Tiers (New in NECB 2020)

Division B, Part	Scope
1	General
3	Building Envelope
4	Lighting
5	HVAC
6	Service Water Systems
7	Electrical Power Systems and Motors
8	Building Energy Performance Compliance Path
10	Tiered Building Energy Performance Compliance

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Compliance Pathways

Energy Codes generally have two compliance pathways:

1. Prescriptive Compliance
   - Meet all prescriptive energy requirements of each system; no energy model required
2. Performance Compliance
   - Whole-building compliance demonstrated through energy modelling

Previous versions (NECB 2017 and prior):
Prescriptive OR Performance Path Compliance
NECB 2020:
Prescriptive Compliance available in Tier 1 *only*

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NECB 2020 Performance Tiers

NECB 2020 TIER	PERFORMANCE REQUIREMENT	COMPLIANCE PATHWAYS
Tier 1	Meet or exceed Tier 1 (Baseline)	Prescriptive or Performance
Tier 2	25% total energy savings vs. Tier 1	Performance only
Tier 3	50% total energy savings vs. Tier 1	Performance only
Tier 4	60% total energy savings vs. Tier 1	Performance only

Energy Modelling will be *mandatory* for permit applications (Part 3 buildings) as of April 2027

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Prescriptive Path Compliance (Tier 1 only)

- *Demonstrate* compliance with all prescriptive requirements
  - *"Demonstrate"* = complete applicable prescriptive compliance documentation as required by the AHJ

- If prescriptive requirements not met, must use performance path
  - *exception: NECB 2020 provides an option to follow trade-off path for envelope systems
  - (HVAC trade-off eliminated)

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Performance Path Compliance

- Whole-building energy modelling of the *Proposed* building design in comparison to a *Reference* building design defined by NECB Part 8 (8.4.4)
- Proposed building model must demonstrate lower total energy consumption compared to the Reference model
- Required energy savings vary by tier:
  - Tier 1: better than reference (~5% or higher)
  - Tier 2: >25%
  - Tier 3: >50%
  - Tier 4: >60%

Performance Path is the *only* compliance option for Tiers 2 and above

i.e., after April 1, 2027 in Nova Scotia

Updates to Prescriptive Requirements: Key Changes

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Envelope Thermal Performance

Baseline Envelope Parameters	NECB 2020 U-value	NECB 2020 R-Value	NECB 2017 R-Value	% increase in NECB 2020
Above-ground opaque building assemblies				
Walls	0.240	23.7	23.0	3%
Roofs	0.138	41.1	36.4	13%
Floors	0.156	36.4	31.0	17%
All fenestration	1.73	3.3	3.0	10%
All doors	1.9	3.0	3.0	0%
Building Assemblies in Contact with the Ground				
Walls	0.284	20.0	UNCHANGED	-
Roofs	0.284	20.0		

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Lighting Power Density (LPD)

Space Type	NECB-2017 LPD (W/m2)	NECB-2020 LPD (W/m2)	% Reduction
Multi-purpose room	11.5	10.5	9%
Corr. < 2.4m wide	7.1	4.4	38%
Dwelling unit(s)	5.0	5.0	0%
Electrical/Mechanical	4.6	4.6	0%
Fitness centre - exercise area	5.4	9.6	-78%
Lobby - elevator	7.3	7.0	4%
Office - enclosed	10	8.0	20%
Sales area	13.1	11.3	14%
Stairway	6.2	5.3	15%
Parking garage	1.5	1.5	0%
Storage area	10.4	5.5	47%
Lounge	6.7	6.3	6%
Washroom	9.1	6.8	25%

Minimum Equipment Efficiency

Table 5.2.12.1.-N
Performance Requirements for Boilers
Forming Part of Sentences 5.2.12.1.(1), 6.2.2.4.(2), 6.2.2.5.(1) and 8.4.4.18.(6)

Type of Equipment	Cooling or Heating Capacity, kW	Performance Testing Standard	Rating Conditions	Minimum Performance[1]
Electric	< 88	[2]	—	Must be equipped with automatic water temperature control[3]
	≥ 88		—	—
Gas-fired[4]	< 88	CAN/CSA-P.2	See standard	AFUE = 90% (water)[3] AFUE = 82% (steam)[3]
	≥ 88 and < 733	DOE 10 CFR, Part 431, Subpart E, Appendix A	See standard	E_t ≥ 90% (water) E_t ≥ 81% (steam)
	≥ 733 and < 2 930		See standard	E_c ≥ 90% (water) E_t ≥ 82% (steam)

Table 5.2.12.1.-B
Performance Requirements for Single-Package Vertical Air Conditioners (SPVAC) and Heat Pumps (SPVHP)[1]
Forming Part of Sentences 5.2.12.1.(1), 6.2.2.4.(2), 6.2.2.5.(1) and 8.4.4.18.(6)

Type of Equipment	Cooling or Heating Capacity, kW	Performance Testing Standard	Rating Conditions	Minimum Performance[2]
SPVAC and SPVHP in cooling mode	< 70	CAN/CSA-C746	< 19 kW	EER = 11
			≥ 19 kW and < 40 kW	EER = 10
			≥ 40 kW and < 70 kW	EER = 10
SPVHP in heating mode			< 19 kW	COP_h = 3.3
			≥ 19 kW and < 40 kW	COP_h = 3.0
			≥ 40 kW and < 70 kW	COP_h = 3.0

Notes to Table 5.2.12.1.-B:
(1) Components or equipment regulated in the "Energy Efficiency Regulations" at the time of publication of the Code (see Article 1.1.1.3. of Division A).
(2) The symbols and abbreviations that appear in this column have the following meanings:
COP_h = *coefficient of performance* in heating mode, in W/W
EER = *energy-efficiency ratio*, in (Btu/h)/W

Fuel-Fired *Service Water* Heaters							
Gas-fired, storage-type[4][7]	≤ 22 kW	—	≥ 76 and < 208	—	CAN/CSA-P.3	FHR < 68	UEF ≥ 0.3456 – (0.00053 V_s)
						68 ≤ FHR < 193	UEF ≥ 0.5982 – (0.00050 V_s)
						193 ≤ FHR < 284	UEF ≥ 0.6483 – (0.00045 V_s)
						FHR ≥ 284	UEF ≥ 0.6920 – (0.00034 V_s)
			≥ 208 and < 380			FHR < 68	UEF ≥ 0.6470 – (0.00016 V_s)
						68 ≤ FHR < 193	UEF ≥ 0.7689 – (0.00013 V_s)
						193 ≤ FHR < 284	UEF ≥ 0.7897 – (0.00011 V_s)
						FHR ≥ 284	UEF ≥ 0.8072 – (0.00008 V_s)
	> 22 kW and ≤ 30.5 kW	≤ 454	—	—	CAN/CSA-P.3	All values of FHR	UEF ≥ 0.8107 – (0.00021 V_s)
	All others	—	—	—	DOE 10 CFR, Part 431, Subpart G, Appendix A	ΔT = 50°C	E_t ≥ 90% SL ≤ 0.84 [(1.25 Q) + (16.57 $\sqrt{V_t}$)]

Summary of Equipment Efficiency Changes

Equipment Type	NECB 2017	NECB 2020
Air-Source Heat Pumps (COP)*	3.1	3.3
Boilers (Min. Efficiency)	0.83	0.9
Gas-fired DHW (Min. Efficiency)	0.8	0.9

*Update to a specific category of heat pumps (packaged vertical heat pumps <70 kW)

These changes to equipment efficiency impact the Reference building definition when following Performance Path Compliance (i.e., the reference has become more efficient)

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Updates to Performance Path Requirements: Key Changes

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Air Infiltration

- Previous versions of NECB did *not* provide a mechanism for buildings to demonstrate energy savings via airtight construction practices
  - Reduced infiltration was not an eligible energy savings measure for performance path compliance
- NECB 2020 introduces a new approach to assessment of air infiltration for performance path compliance
  - Modelled infiltration rate is project-specific

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8.4.2.9 Performance Path Airtightness

- NECB 2020 Maximum prescribed envelope infiltration: 1.5 L/s at 75 Pa.
  - Use NECB 2020 8.4.2.9.(2) to determine equivalent at 5 Pa.

- NECB 2017: 0.25 L/s at 5 Pa
  - 0.25 L/s was NOT a performance requirement

Air Leakage

1) The energy model calculations shall account for air leakage through the *building envelope*.

2) The air leakage rate of the *building envelope* shall be adjusted using the following equation:

$$I_{AGW} = C \times I_{75Pa} \times \frac{S}{A_{AGW}}$$

where

I_{AGW} = adjusted air leakage rate of the *building envelope* at a typical operating pressure differential of 5 Pa and relative to the area of the above-ground walls, in L/(s×m²),

C = (5 Pa / 75 Pa)^n, where n = flow exponent, which shall be 0.60, if no whole *building* test result is available, or the calculated value, if whole *building* testing is carried out in accordance with Article 3.2.4.2. and a series of tests are conducted at different differential pressures,

I_{75Pa} = assumed or measured normalized air leakage rate of the *building envelope* at a pressure differential of 75 Pa, in L/(s×m²),

where the measured air leakage rate at a pressure differential of 75 Pa is calculated as I_{75Pa} = Q/S,

where Q = volume of air flowing through the *building envelope* when subjected to a pressure differential of 75 Pa, determined in accordance with ASTM E779, "Standard Test Method for Determining Air Leakage Rate by Fan Pressurization," in L/s, and

S = total area of the *building envelope*, as per Sentence 3.2.4.2.(1), in m², and

A_{AGW} = total area of above-ground walls, in m².

(See Note A-8.4.2.9.(2).)

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Impacts of 8.4.2.9

- Rate is based on building massing
  - Calculated baseline infiltration rate in much higher in low-rise buildings with large roof area
- Higher modelled infiltration = Higher modelled heating load
  - More energy savings achieved from efficient HVAC
- Opportunity to account for energy savings associated with reduced infiltration
  - But! Building must be tested

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Other Related Changes

- Updates to Design Climate Data (Table C-2)
  - Impacts Heating Degree Days
- Most of Nova Scotia still >4,000 HDD (i.e., zone 6)
  - Except Yarmouth & Liverpool @ 3,990 HDD

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Overview of Performance Path Compliance

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Key Elements of Performance Path

- Model must be developed in an ASHRAE 140 compliant energy modelling software
- Proposed building model must accurately reflect actual design
  - i.e., the design submitted for building permit application
- Reference building model must meet requirements outlined in NECB Part 8
  - And building geometry, zoning, space usage/schedules must be identical to proposed

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Performance Path Compliance

1. Develop proposed building energy model based on design documentation, in accordance with NECB 2020 8.4.3
2. Develop applicable reference building energy model in accordance with 8.4.4

   Reference building characteristics vary by project
3. Determine annual energy consumption of Proposed and Reference; verify project compliance

   Proposed energy consumption < Reference energy consumption

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A Few Critical Highlights

Three key elements that influence overall project compliance:

1. Reference & Proposed Envelope
   - Effective thermal performance calculations for proposed design
   - % Glazing area in proposed design
2. Reference HVAC System Definition
3. Reference Energy Recovery Ventilation Requirements

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Effective Thermal Performance Calculations (3.1.1.7)

- Effective thermal performance = net assembly R value
- Calculation addresses all pathways of heat loss through opaque assembly:
  - Insulation
  - Studs
  - Floor slabs
  - Balconies
  - Corners
  - Glazing perimeters
  - Parapets

3.1.1.7. Calculation of Overall Thermal Transmittance

1) In calculating the *overall thermal transmittance* of assemblies for purposes of comparison with the provisions in Section 3.2., the effect of thermal bridging shall be considered for

a) closely spaced repetitive structural members, such as studs and joists, and ancillary members, such as lintels, sills and plates,
b) major structural elements that penetrate or intersect the *building envelope* (see Note A-3.1.1.7.(1)(b)),
c) the junctions between the following *building envelope* materials, components, and assemblies:
   i) glazing assemblies,
   ii) spandrels,
   iii) parapets,
   iv) roof-to-wall junctions,
   v) corners, and
   vi) edges of walls or floors, and
d) secondary structural members (see Note A-3.1.1.7.(1)(d)).

Note: this change was introduced in NECB 2017; i.e. effective in NSBC since Jan. 2020

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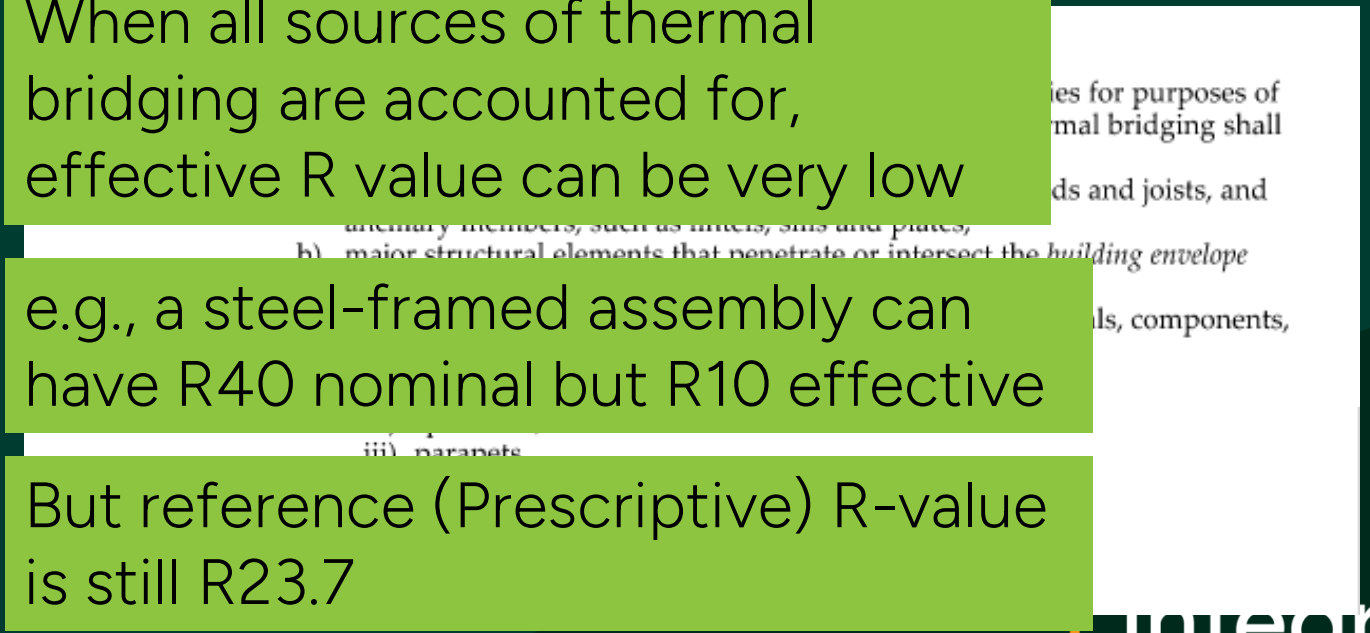
  - Balconies
  - Corners
  - Glazing perimeters
  - Parapets

When all sources of thermal bridging are accounted for, effective R value can be very low



e.g., a steel-framed assembly can have R40 nominal but R10 effective

But reference (Prescriptive) R-value is still R23.7

Note: this change was introduced in NECB 2017; i.e. effective in NSBC since Jan. 2020

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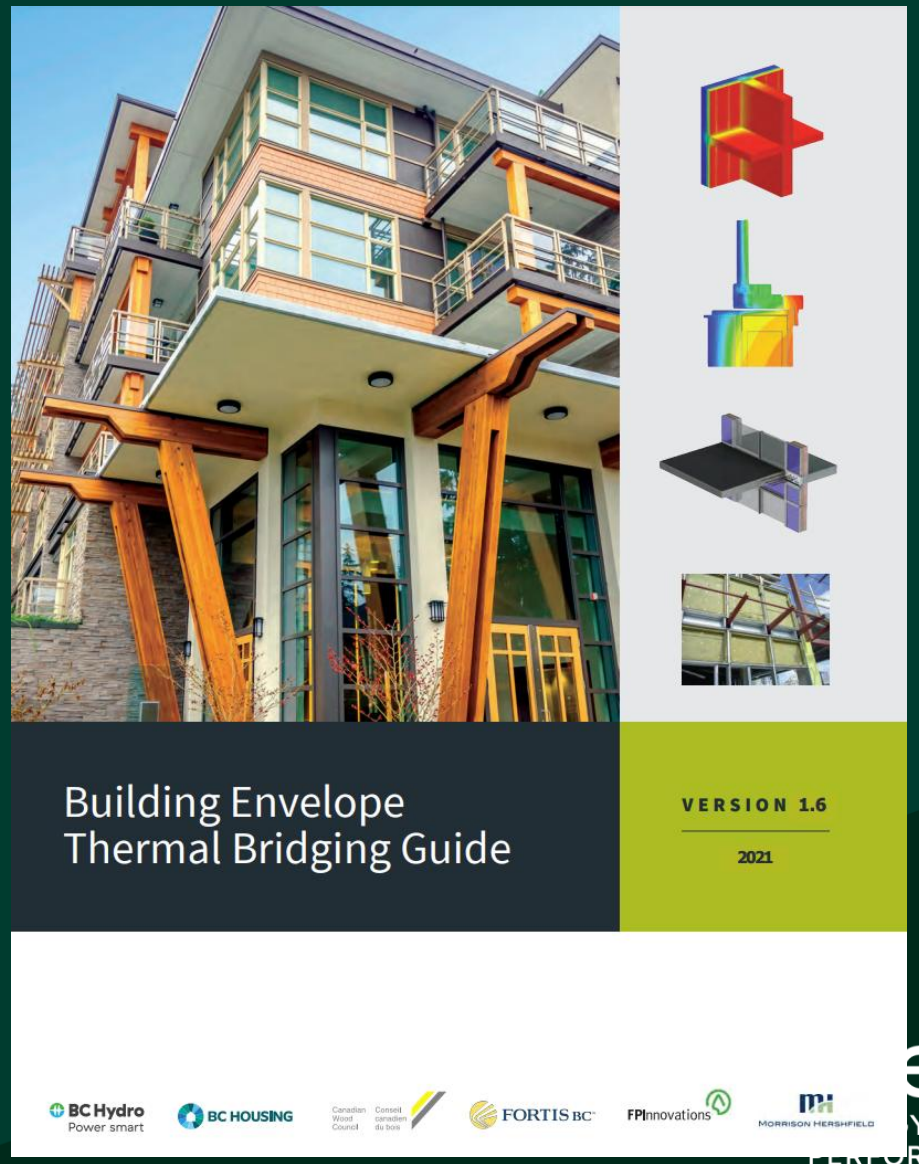
Effective Thermal Performance Calculations

- Three options for completing effective thermal performance analysis:
  1. Calculations per ASHRAE/ISO/BETBG methods
  2. 2/3D thermal simulation
  3. Laboratory testing
- Most projects are well suited to BETBG method



Sample Result Following BETBG Method

Wall details:

3.5" brick with ties at 24" oc vert and 16" oc horiz
1.5" XPS @~R5/inch=~R7.5 nominal exterior
6" steel stud 16" oc, w/ 2" spray foam @~R6/inch & R14 batt = R26 nominal interior
Total ~ R36 nominal (including brick, drywall, airspace)

Overall Opaque Wall Thermal Performance Values

Base Building		Proposed Building	
Opaque U-Value (BTU/hr ft²°F)	Enter Base Building U-Value	Opaque U-Value (BTU/hr ft²°F)	0.130
Effective R-Value (hr ft²°F/BTU)	-	Effective R-Value (hr ft²°F/BTU)	7.7

Proposed Building Entries

								Totals	1239.9	100%
Add/Remove Detail	Transmittance Type	Include	Transmittance Description	Area, Length or Amount Takeoff	Units	Transmittance Value	Units	Source Reference	Heat Flow (BTU/hr°F)	%Total Heat Flow
Add Clear Field	Clear Field	☑	Wall 01 clear field	9541.13	ft²	0.049	BTU/ hr ft² °F	5.1.61	470.5	38%
Add Linear Interface Detail	Linear Interface Detail	☑	Window Perimeter	1375.32	ft	0.113	BTU/ hr ft °F	5.3.6	155.8	13%
Remove Linear Interface Detail	Linear Interface Detail	☑	Corners						0.2	6%
Remove Linear Interface Detail	Linear Interface Detail	☑	Intermediate slab						26.2	34%
Remove Linear Interface Detail	Linear Interface Detail	☑	Parapet	302.33	ft	0.388	BTU/ hr ft °F	5.5.13	117.2	9%

This means that ~60% of the wall's heat loss is through thermal bridging

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Reference HVAC Systems

- Reference building HVAC type selected based on proposed design
- Generally,
  - If proposed building is heated with fuel or electric resistance, NECB defines specific HVAC system type
  - If proposed building is heated with any type of heat pumps, reference building is heated with single-zone heat pumps
- Reference HVAC system types have a major impact on compliance model results

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Reference Energy Recovery Ventilation

- Energy Recovery Ventilation is required for ventilation systems operating 24/7 (5.2.10.1)
  - Except for systems serving a single dwelling unit (5.2.10.4.1)
- Example: Multi-unit building with individual ERVs in proposed design
  - Reference model includes energy recovery in corridor ventilation systems
  - Reference building apartment zones modelled with direct fresh air supply

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Summary: Performance Path

- Performance Path compliance is project-specific, provides flexibility in achieving code requirements
- Approach is based on balancing energy penalties (e.g. envelope heat loss) with energy savings measures (e.g. energy recovery)
- Analysis is typically conducted by project energy consultant or mechanical designer
- Must be completed prior to building permit application

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What do Energy Code Changes Mean for Projects?

- Increased focus on energy performance during design process
- Energy modelling becomes standard practice in all projects

***New requirements *are* achievable using standard design/construction practices

The End! Questions?

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