NRC Canadian Codes Centre

2011 National Energy Code for Buildings (NECB) – Building Envelope

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Canada

Introduction

- Presentation is part of a series of seven
- Model code developed by Canadian Commission on Building and Fire Codes
- NECB must be adopted by provincial/territorial authorities to become law

Outline

- Scope and compliance
- Prescriptive requirements
  - Protection of insulation materials
  - Continuity of insulation
  - Building envelope thermal characteristics
  - Allowable areas of fenestration and doors
  - Air leakage
- Trade-off paths
- Performance path

Outline

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Scope

- Part 3 concerned with transfer of heat and air through the building envelope
  - Building materials
  - Building components
  - Building assemblies
  - Interfaces between them

Definition

Building envelope means the collection of components that separate conditioned space from unconditioned space, the exterior air or the ground, or that separate conditioned spaces intended to be conditioned to temperatures differing by more than 10°C at design conditions

Compliance options

- Prescriptive path
- Trade-off path
  - Simple trade-off
  - Detailed trade-off
- Performance path – whole-building modeling

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Prescriptive – insulation

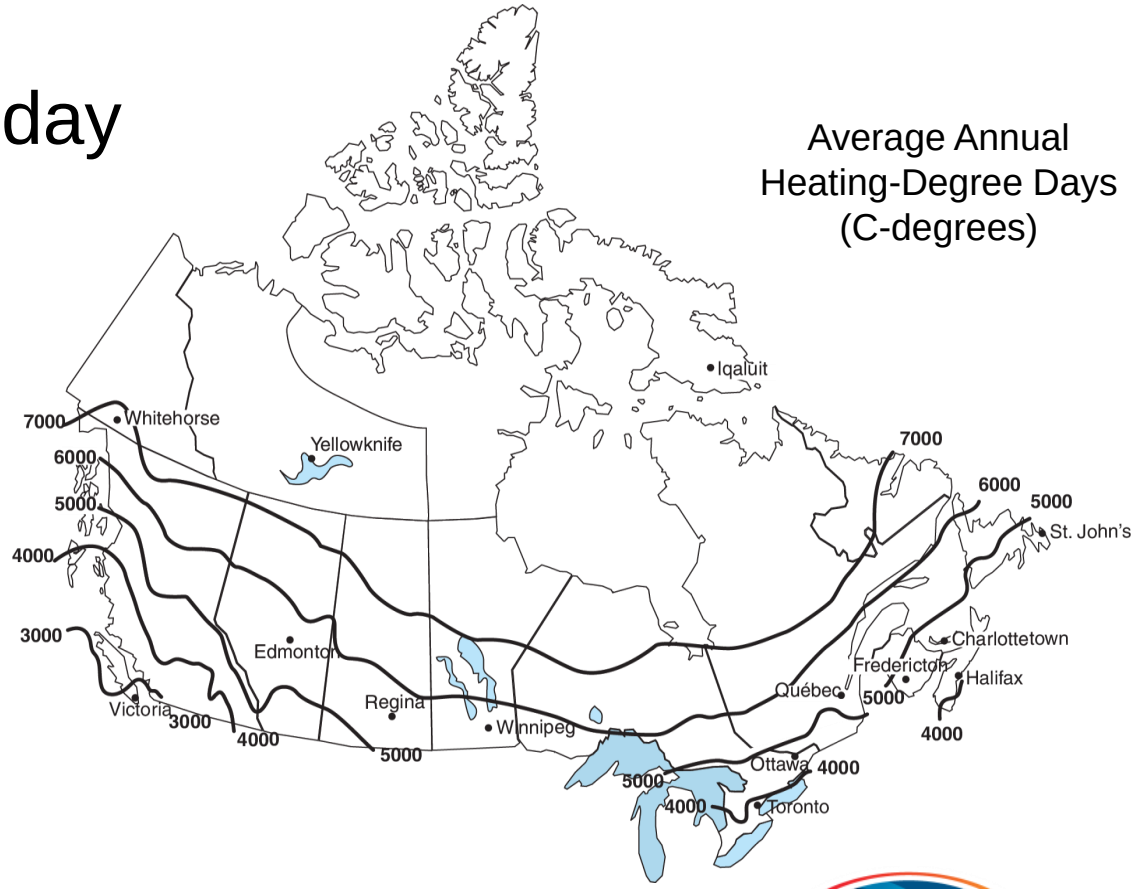
- Protection of insulation materials against
  - Air leakage or convection
  - Wetting
  - Moisture
- Continuity of insulation
  - At penetrations
    - Keep continuous or overlap

Prescriptive – building envelope thermal characteristics

- Maximum overall thermal transmittance for
  - Above-ground opaque building assemblies
  - Fenestration
  - Doors and access hatches
  - Assemblies in contact with the ground
- Overall thermal transmittance in W/(m^2•K) is inverse function of effective thermal resistance (RSI) in metric units

Prescriptive – building envelope thermal characteristics

- Varies only with heating degree-day of building location



Prescriptive – above-ground opaque building assemblies

	Heating Degree-Days of Building Location, Celsius degree-days					
	Zone 4: Less than 3000	Zone 5: 3000 to 3999	Zone 6: 4000 to 4999	Zone 7A: 5000 to 5999	Zone 7B: 6000 to 6999	Zone 8: Greater than or equal to 7000
Maximum Overall Thermal Transmittance (U-value, W/(m²•K))						
Walls	**0.315**	0.278	0.247	0.210	0.210	0.183
Roofs	**0.227**	0.183	0.183	0.162	0.162	0.142
Floors	**0.227**	0.183	0.183	0.162	0.162	0.142

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Walls	0.315 (min R-18)	0.278	0.247	0.210	0.210	**0.183 (min R-31)**
Roofs	0.227 (min R-25)	0.183	0.183	0.162	0.162	**0.142**
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Floors	0.227 (min R-25)	0.183	0.183	0.162	0.162	**0.142 (min R-40)**

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*U-values reduced by 20% where radiant heating or cooling included in assembly

Prescriptive – fenestration

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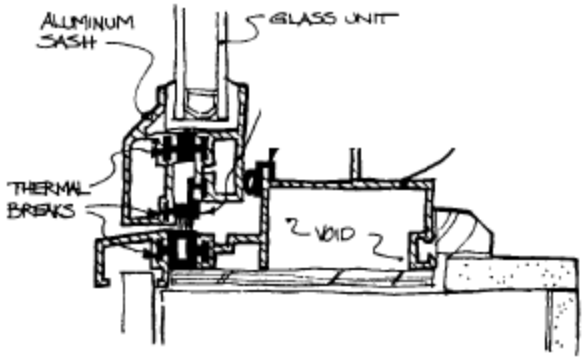
All Fenestration	2.4	2.2	2.2	2.2	2.2	1.6



Double glazing units with:
- Low-emissivity coating
- Non-metallic spacer

Prescriptive – fenestration

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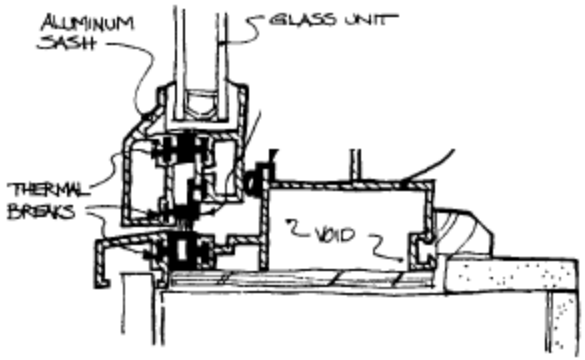

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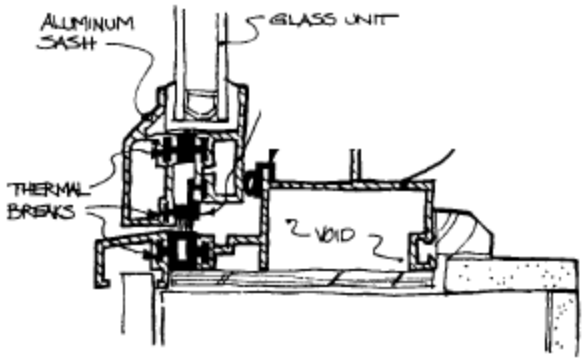

Double glazing units with:
- Low-emissivity coating
- Non-metallic spacer
- Argon fill

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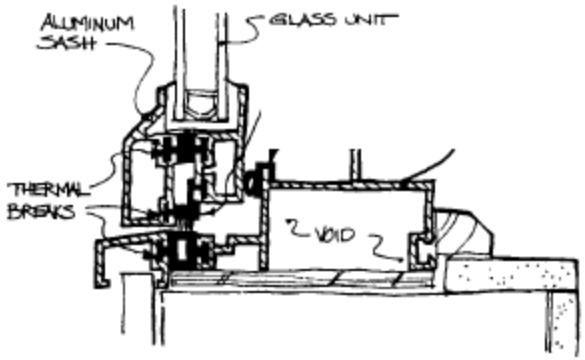

Triple glazing units with:
- Low-emissivity coating
- Non-metallic spacer
- Argon fill

Prescriptive – doors and access hatches

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Maximum Overall Thermal Transmittance (U-value, W/(m²•K))						
Doors	2.4	2.2	2.2	2.2	2.2	1.6

- Relaxation: $U \leq 4.4$ W/(m²•K) if assembly area ≤ 2% of gross wall area
- Exemption for storm, automatic sliding glass, revolving doors, fire shutters
- Access hatches $U \leq 1.3$ W/(m²•K)

Prescriptive – assemblies in contact with ground

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Maximum Overall Thermal Transmittance (U-value, W/(m^2•K))						
Walls	0.568	0.379	0.284	0.284	0.284	0.210
Roofs	0.568	0.379	0.284	0.284	0.284	0.210
Floors	0.757 for 1.2m	0.757 for 1.2m	0.757 for 1.2m	0.757 for 1.2m	0.757 for 1.2m	0.379 full area

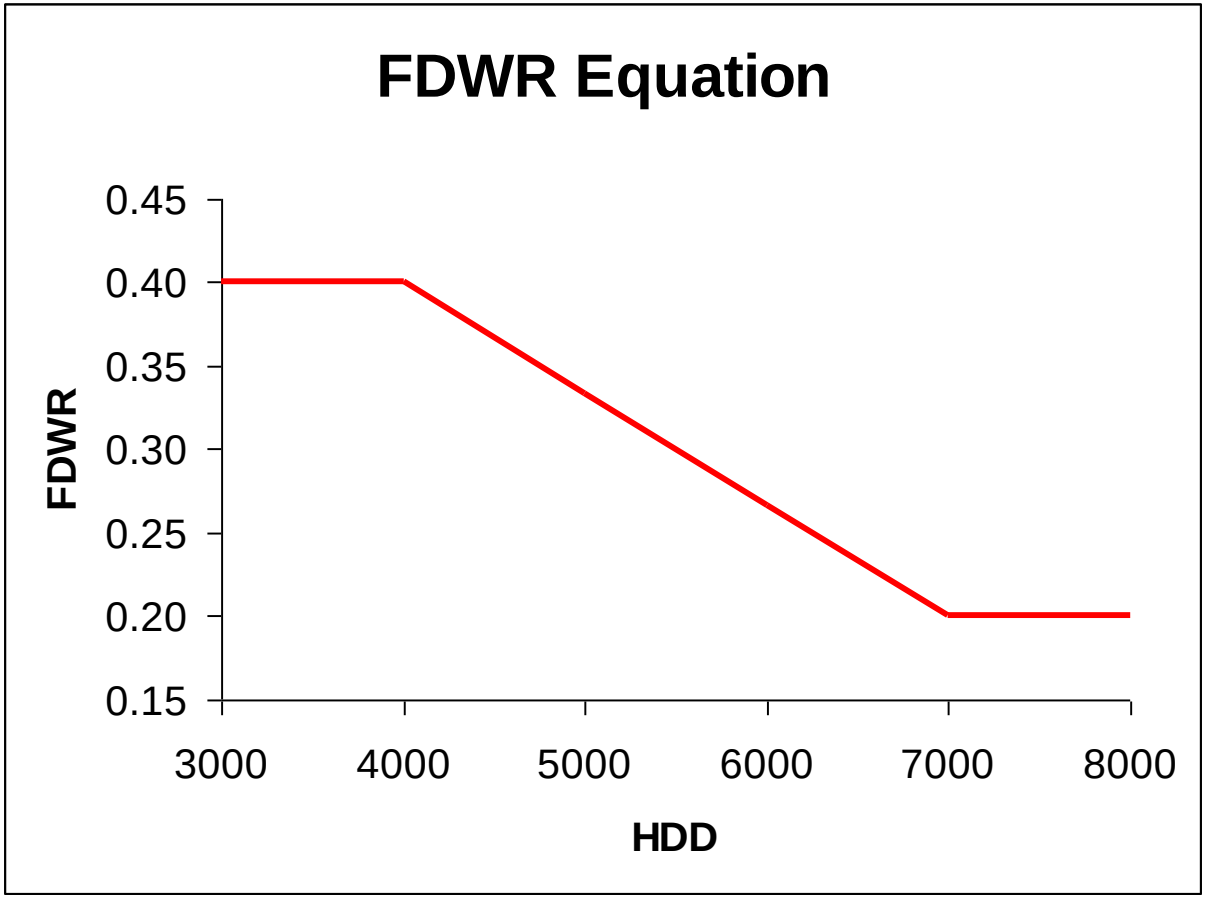
Prescriptive – assemblies in contact with ground

- Roofs < 1.2 m below ground
- Walls
  - Insulate to lesser of 2.4 m below ground or bottom of wall
  - Footings < 0.6 m below ground → insulate slab perimeter to 1.2 m
  - Embedded radiant heating/cooling → reduce U-value by 20%
- Floors < 0.6 m below grade → insulate
  - Full area in zone 8 and if ducts/radiant heating/cooling embedded
  - 1.2 m around perimeter, except climate zone 8

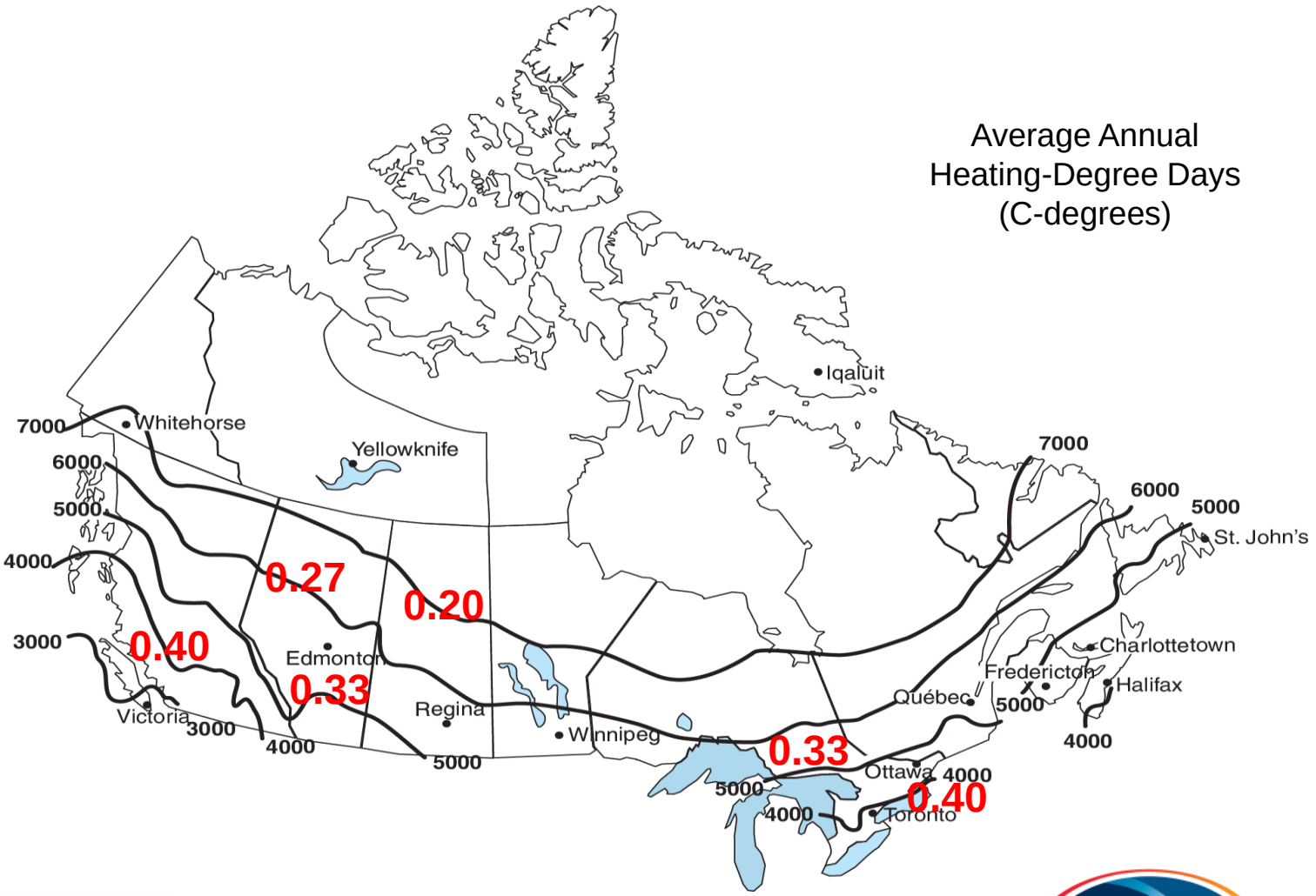
Prescriptive – FDWR

- Skylights – max. 5% of gross roof area
- Fenestration-and-door-to-wall ratio (FDWR)
  - Based on heating degree-days (HDD) of location
  - FDWR = 0.40 for HDD < 4000
  - FDWR ≤ (2000-0.2HDD)/3000 for 4000 ≤ HDD ≤ 7000
  - FDWR = 0.20 for HDD > 7000

Prescriptive – FDWR



Prescriptive – FDWR



Prescriptive – air leakage

- Conditioned space – continuous air barrier system
- Opaque assemblies – air barrier assembly required
- Metal and glass curtain walls, windows → tested to referenced standards
  - Higher air leakage rate for operable windows

Prescriptive – air leakage

- Doors → tested to referenced standards
  - Higher air leakage rate for
    - Revolving doors
    - Automatic commercial sliding doors
    - Overhead doors
    - Main entry exterior doors
  - Loading docks seal with trucks that interface

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Simple trade-off

- Very easy to apply
- Allows flexibility while maintaining minimum performance level set by prescriptive
- Based on trading U-values, FDWR
  - Not permitted for additions
  - Not permitted for semi-heated buildings
  - Above-ground only
  - Trade only vertical to vertical, horizontal to horizontal

Simple trade-off

Proposed

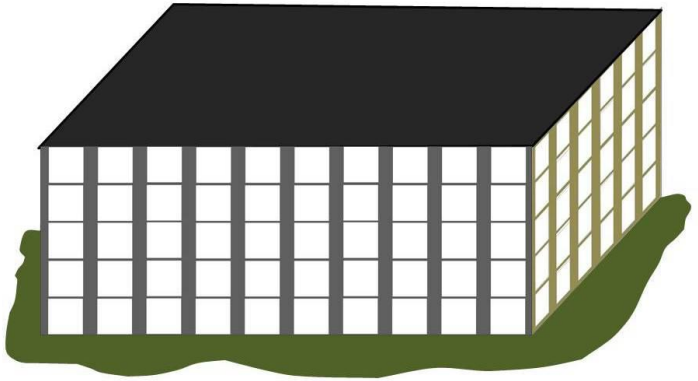
Reference

$$\sum_{i=1}^{n} U_{ip} A_{ip} \leq \sum_{i=1}^{n} U_{ir} A_{ir}$$

Simple trade-off

Example – Building in Toronto

Prescriptive = 40%



Simple Trade-off = 65%
(with better windows and walls)

Detailed trade-off

- Scaled-down performance compliance
- Annual energy consumption of proposed building envelope $\leq$ energy target of reference building envelope
- Parameter inputs for calculations: areas of assemblies, U-values, configuration, orientation, thermal mass

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Performance compliance limitations

- Limits on U-values of above-ground assemblies with embedded radiant heating/cooling
- Building envelope air leakage is neutral

Questions?

www.nationalcodes.nrc.gc.ca

Thank you