Manitoba Energy Code for Buildings 2013

City of Brandon Planning & Building Safety Department

January 29, 2015

Outline

- History
- Compliance Paths
- Part 3 – Building Envelope
- Trade-off Requirements
- The Performance Path
- Potential Issues

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NECB Overview

Model National Energy Code was created in 1997 and updated in 2011 as the National Energy Code

The goal was set to increase energy performance levels by 25%

Through modeling, approximately 26.2% improvement was achieved through the 2011 NECB

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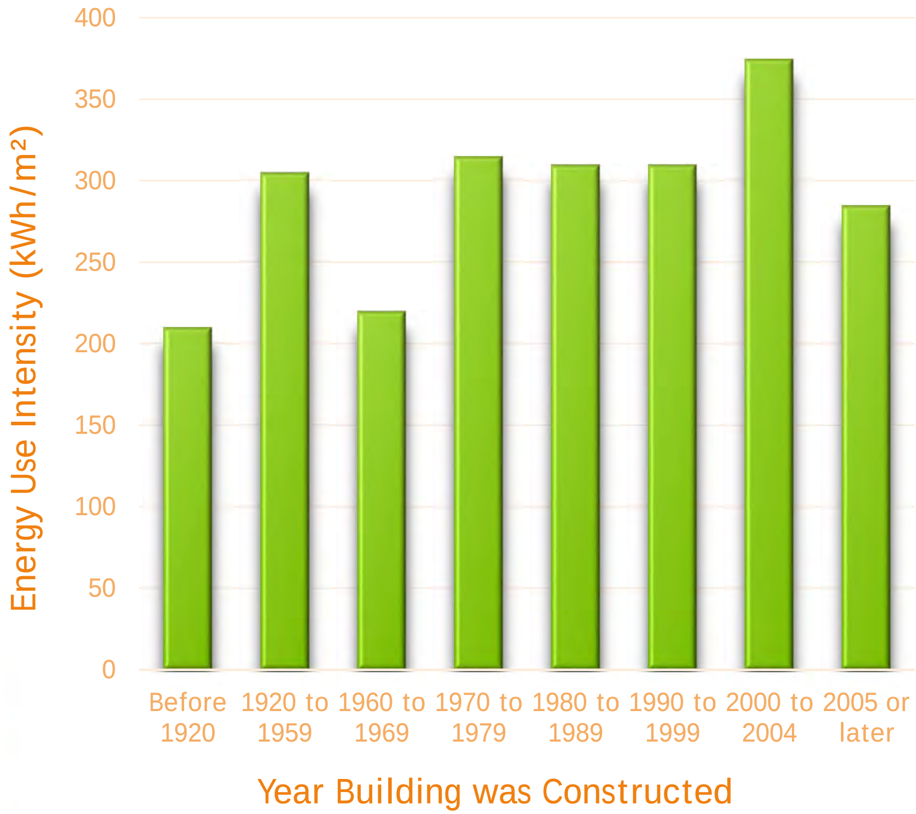
Buildings don't appear to be getting better



- 2009 Data
- Why is this happening?
  - Data does not come with explanation
  - Most older buildings have been renovated with newer HVAC
  - Most older buildings have a "computer on every desktop"
- Energy codes will help

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Ref: Survey of commercial and institutional Energy Use in Buildings – 2009 NRCan

Overall effective enclosure
-many old buildings are better than we think

1864
Province House, Charlottetown
R-4, 30% FDWR

Note: new double glazed windows, but no insulation in walls

2008
Your Town
R-3, 80% or greater FDWR

Note: High performance windows and R15 spandrel panel in curtain walls

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Adoption of the NECB by Province as of 2013

Manitoba (NECB 2011) To be enforced Dec. 1, 2014

Nova Scotia (NECB 2011)

British Columbia and Vancouver

- ASHRAE 90.1-2010 or
- NECB 2011

Ontario

- Energy Efficiency Supplement SB-10 with 3 parts:
  - ASHRAE 90.1-2010 + 189.1-2009 Envelope
  - 5% less energy use than ASHRAE 90.1-2010
  - 25% less energy than MNECB 2007

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NECB 2011 User's Guide

- Release date – December 2013
- Helps users understand how to use the code
- Describes basic modelling methods
- Includes general information how CAN-QUEST works
- Includes information on assumptions made in CAN-QUEST
- Includes NECB 2011 interpretations and limitations
- Provides example calculations and designer checklists

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NECB Compliance Paths

Prescriptive Path

Trade-off Path within some parts

- Building Envelope, simple and detailed
- Interior lighting
- HVAC
- Service water heating

Performance compliance path

- Whole building Modeling – engineering solution

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Prescriptive path -overview

- Relatively easy to implement
- Must comply with all requirements
- Common for simpler and smaller buildings
  - Offices, retail etc.
- Requires high performance building envelope

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Prescriptive path – sample requirements

- Maximum U-value for walls, roofs, window elements and other envelope elements
- Maximum fenestration-and-door-to-wall (FDWR) ratio of 20-40%, depending on zone. (Brandon's is 28%)
- Maximum installed lighting power density
  - Occupancy and daylighting controls is some spaces
- HVAC plant minimum performance requirements (boilers, chillers)
- HVAC distribution performance requirements (fans, pumps)
- Exhaust air heat recovery required in some cases

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Trade-off path overview

- Can only trade-off within each part
- Trade off available for
  - Part 3: Envelope
    - Simple Trade-off
    - Detailed path (use CAN-QUEST WIZARD)
  - Part 4: Lighting
  - Part 5: HVAC
  - Part 6: Service Water Heating

Spreadsheet tools available from NRCan (Parts 4, 5 and 6)

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Performance Path - Overview

- Requires energy Modeling
  - CAN-QUEST specifically developed for NECB-2011
    - Automatically creates reference building according to NECB-2011 rules at the same time that the modeler develops the proposed building model
- "Full trade-off path" – In other words, you can trade off between different parts of the code. This is the most flexible path from a design perspective.

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NECB-2011 Compliance Paths

NECB 2011 Path	Tools	Documentation
Prescriptive	Checklists	• Checklists from AHJ • Letter of Assurance
Trade-Off	Checklists and software tools (excel) • HVAC • Service Water Heating • Lighting	• Software output file/document • Checklists for non trade-off elements • Calculation for envelope (simple trade off) • Letter of Assurance
Performance	Energy Modeling Software: CAN-QUEST	• Software output file • Software compliance report • Letter of assurance

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NBC table C-2 determines heating degree days (HDD)

Climate Zone	Heating degree Days (@18°C)
Zone 8	>7000
Zone 7B	6000 to 6999
Zone 7A	5000 to 5999
Zone 6	4000 to 4999
Zone 5	3000 to 3999
Zone 4	<3000

Brandon is 5760 HDD, therefore falls in Zone 7A

Prescriptive – building envelope thermal characteristics

- Move from nominal R values to effective U values – MUST BE CALCULATED
- Walls in Zone 7A will now be effective R27
- Roofs and floors in Zone 7A will now be effective R35
- U value = 1/RSI
- R value = RSI x 5.685

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Above-ground opaque assembly thermal requirements for zone 7A

Assembly	U Value W/(m²·K)	Effective R Value
Roofs & Exposed Floors	0.162	R 35
Walls	0.210	R 27
Below Grade Walls	0.284	R 20
Floors (No Radiant Heat)	0.757 for 1.2m	R 7.5 for 4’
Floors (Radiant Heat)	0.757	R 7.5 Full Area

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Some common wall systems will require careful consideration

- Performance path may be preferable for buildings that use these wall systems:
  - Z-girt walls
  - Steel stud walls
  - Pre-fabricated steel buildings

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Sample Steel Building

- Flat Roof (4-ply built-up roofing (BUR) and steel deck)
- Steel stud framed walls
- Insulated concrete slab floor

Example 3-2 – Roof: Flat Roof (4-ply built-up roofing (BUR) and steel deck)

Figure A shows a roofing assembly with 4-ply BUR and a steel deck.

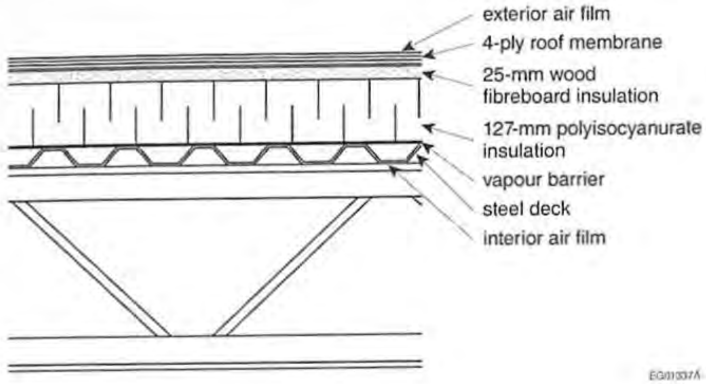

Figure A
Flat roof – 4-ply BUR and steel deck (section view)

Since the assembly contains only continuous materials and the metal decking does not penetrate the thermal insulation, the isothermal planes method is used to calculate the overall thermal transmittance. The RSI values of all the assembly's components can be obtained from Tables 3-5 to 3-9, taking into account the thickness of the materials and the RSI values of the interior and exterior air films. If the roof insulation is tapered to allow roof drainage, the average insulation thickness would be taken into account in the calculations. The overall thermal transmittance, U_T, can be calculated as follows:

Assembly Components	RSI, $(m^2 \cdot K)/W$
Exterior air film	0.03
4-ply roof membrane (built-up roofing, 10 mm)	0.06
25-mm wood fibreboard insulation (insulating fibreboard)	0.40
127-mm polyisocyanurate insulation	4.85
Vapour barrier	0.00
Steel deck	0.00
Interior air film	0.11
RSI_T	5.45
$U_T = 1/RSI_T$	0.183

Max U-Value of 0.162
This roof assembly does not comply

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Example 3-1 – Floor: Insulated Concrete Slab-on-Grade

Figure A shows an insulated concrete slab-on-grade with radiant heating.

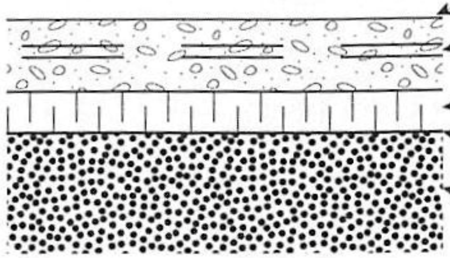

Figure A
Insulated concrete slab-on-grade (section view)

Since the assembly contains only continuous materials, the isothermal planes method is used to calculate the overall thermal transmittance. The RSI values of all the assembly's components can be obtained from Tables 3-5 to 3-9, taking into account the thickness of the materials and the RSI value of the interior air film. The overall thermal transmittance, U_T, can be calculated as follows:

Assembly Components	RSI, $(m^2 \cdot K)/W$
Vapour barrier	0.00
64-mm expanded polystyrene insulation – Type 2	1.79
100-mm cast-in-place concrete slab (normal density aggregate)	0.04
Interior air film	0.16
RSI_T	1.99
$U_T = 1/RSI_T$	0.503

Max U-Value of 0.757
This floor assembly complies

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8” Cavity Studs @ 24” o.c. R25 Insulation

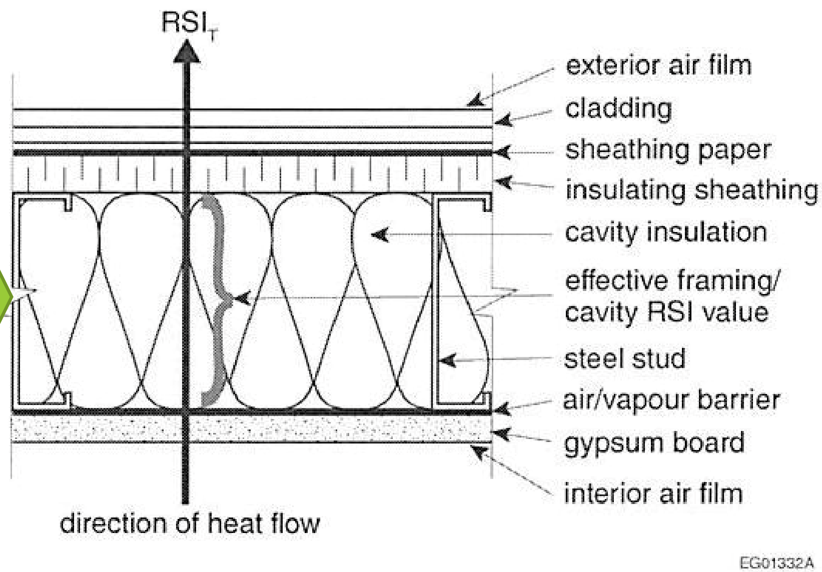

Figure 3-3
Graphical representation of U-value calculation for metal-frame construction

VALUES TAKEN FROM TABLE 3-9 OF THE MECB 2013 USER’S GUIDE

- Air film = 0.03
- Stucco = 0.0135
- Sheathing paper = 0.011
- 1” Insulating Fiberboard= 0.4
- Effective framing/cavity RSI value = 1.69
- Vapour Barrier = None
- Gypsum board = 0.1525
- Air Film = 0.12

Total RSI = 2.417 (m²·K)/W
Total U-Value = 1/RSI = 0.414 W/(m²·K)
Max allowable U value = 0.210 W/(m²·K)

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Fenestration-and-Door-to-Wall Ratio (FDWR)

- Based on heating degree-days (HDD) of building location

Zone 7A FDWR ≤ (2000-0.2HDD)/3000

For Brandon, that means: 28.27% MAX FDWR

- Skylights are limited to 5% of the gross roof area
- HDD are found in MBC Appendix C – Climatic and Seismic Information for Building Design in Canada

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Overall Thermal Transmittance of Fenestration & Doors

Component	U Value	Effective R Value
All fenestration	2.0	2.84
All doors	2.2	2.58

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Assemblies in contact with the ground thermal requirements

Assembly	U Value	Effective R Value
Roofs	0.284	R 20
Walls	0.284	R 20
Floors (for 1.2m)	0.757	R 7.5

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Trade-off Paths by part

- Part 3 ENVELOPE
  - Simple trade-off
  - Detailed trade-off
- Part 4 Lighting
  - Trade-off tool available
- Part 5 HVAC
  - Trade-off tool available
- Part 6 Service Water Heating
  - Trade-off tool available

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Part 3 Trade-off Path

- Vertical above ground portions are only permitted to be traded off with other vertical above ground portions of the building envelope.
- Horizontal above ground portions are only permitted to be traded off with other horizontal above ground portions of the building envelope.
- Specific rules apply with additions.
  - Part 3 requirements apply to additions with space-heating systems or have provisions for the future installation of such systems.

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Part 3 Trade-off Path
Simple trade-off

- Very easy to apply
- Allows flexibility while maintaining minimum performance level set by prescriptive requirements
- 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

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Part 3 Trade-off Path
Detailed trade-off

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

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Part 4 Trade-off Path

- Applies to interior lighting only
- Allows the designer to trade off areas within the building and take into account daylighting and toplighting schemes
- More detailed calculations required
- Used when prescriptive path (building area and/or space-by-space method) power limits are exceeded.
- Building owner requires higher light levels, yet doesn't qualify for exemptions

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Part 4 Trade-off Path

- Compliance is based primarily on energy (kWh) as opposed to (W)
- Compliance achieved when:

Installed Interior Lighting Energy (IILE)

≤

Interior Lighting Energy Allowance (ILEA)

Part 4 Trade-off requirements

- Use trade-off to calculate **annual** interior lighting energy consumption
- No trade off for exterior lighting
- Includes impact of daylighting and occupancy controls
- Trade off spreadsheet available from NRCan

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Part 5 Trade-off Path

- System efficiency approach considers HVAC system as a whole
- Allows improvement in other system parts to compensate for one component not meeting a prescriptive requirement
- Intended to permit flexibility for typical design

Total **proposed** System efficiency ≥ Total **referenced** System efficiency

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Part 5 Trade-off limitations

- Energy sources must be natural gas, propane, oil or electricity
- Back-up equipment must meet prescriptive requirements

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Part 6 Trade-off Path

- System efficiency approach considers Service Water Heating system as a whole
- Allows improvement in other system parts to compensate for one component not meeting a prescriptive requirement
- Intended to permit flexibility for typical design

$$\text{Total } \textbf{proposed} \text{ System efficiency} \geq 0$$

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Part 6 Trade-off limitations

- Energy sources must be natural gas, propane, oil or electricity
- Backup systems must meet prescriptive requirements
- System must be either tank, instantaneous, or space-heating boiler

Performance Path Requirements

- Use of energy model to show that the proposed design uses less site energy than the reference design
- Reference model designed to MECB-2013 prescriptive requirements defines the *"Building Energy Target"*
- CAN-QUEST can automatically create an MECB-2013 reference model for the *"Building Energy Target.*
- Software must meet ANSI/ASHRAE 140 standard

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Building Energy Target is:

- Annual energy use of the reference building where:
  - The reference building is designed to MECB-2013 prescriptive requirements and other rules defined in Section 8 on the MECB-2013.
  - The model includes all energy uses in the building that affect heating and cooling systems
- Where they are compliant with the prescriptive requirements, you can exclude:
  - Lighting of unconditioned spaces
  - Exterior lighting
  - Ventilation of unconditioned spaces

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Why use the performance path?

- It offers the greatest flexibility for demonstrating compliance
- It is often the only alternative when the design is non-compliant due to:
  - High FWDR values
  - Predominantly curtain-wall or window-wall envelope
  - Lighting requirements
  - HVAC limitations
  - Service water heating requirements

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Compliance issues

- Ensuring that the design of new structures and additions meet the code
- Max FDWR requirements – may force projects into the Performance Path
- Meeting U-Values on all assemblies
  - Many assemblies commonly used now **DO NOT** meet the requirements
  - Pre-Engineered Buildings pose more of a challenge to designers

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More Compliance issues

- Some warranty issues may include:
  - Meeting the air barrier requirements
  - Attention to inboard/outboard insulation and location of vapour barrier and air barrier
- Engineering issues
  - Added cost and time to projects
  - Poor integration of design consultants may lead to potential compliance issues
  - Data on some materials may prove to be difficult to obtain, such as U-value and efficiency values

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Even More Compliance Issues!

- Future projects may require re-design if submitted after December First
- The OFC’s compliance checklist is very large, time consuming and burdensome. Currently it must be submitted electronically only
- There will be a level of trust between AHJ’s and designers on the basis that the trade-off’s are complete and truthful

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