Outline

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

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
Adoption of the NECB by Province as of 2013

<table>
<thead>
<tr>
<th>Province</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manitoba (NECB 2011)</td>
<td>To be enforced Dec. 1, 2014</td>
</tr>
<tr>
<td>Nova Scotia (NECB 2011)</td>
<td></td>
</tr>
</tbody>
</table>
| 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 use than MNECB 2007      |
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
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
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
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
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
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.
## NECB-2011 Compliance Paths

<table>
<thead>
<tr>
<th>NECB 2011 Path</th>
<th>Tools</th>
<th>Documentation</th>
</tr>
</thead>
</table>
| 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 |
NBC table C-2 determines heating degree days (HDD)

<table>
<thead>
<tr>
<th>Climate Zone</th>
<th>Heating degree Days (@18°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zone 8</td>
<td>&gt;7000</td>
</tr>
<tr>
<td>Zone 7B</td>
<td>6000 to 6999</td>
</tr>
<tr>
<td>Zone 7A</td>
<td>5000 to 5999</td>
</tr>
<tr>
<td>Zone 6</td>
<td>4000 to 4999</td>
</tr>
<tr>
<td>Zone 5</td>
<td>3000 to 3999</td>
</tr>
<tr>
<td>Zone 4</td>
<td>&lt;3000</td>
</tr>
</tbody>
</table>

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
Above-ground opaque assembly thermal requirements for zone 7A

<table>
<thead>
<tr>
<th>Assembly</th>
<th>U Value W/(m²·K)</th>
<th>Effective R Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roofs &amp; Exposed Floors</td>
<td>0.162</td>
<td>R 35</td>
</tr>
<tr>
<td>Walls</td>
<td>0.210</td>
<td>R 27</td>
</tr>
<tr>
<td>Below Grade Walls</td>
<td>0.284</td>
<td>R 20</td>
</tr>
<tr>
<td>Floors (No Radiant Heat)</td>
<td>0.757 for 1.2m</td>
<td>R 7.5 for 4’</td>
</tr>
<tr>
<td>Floors (Radiant Heat)</td>
<td>0.757</td>
<td>R 7.5 Full Area</td>
</tr>
</tbody>
</table>
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
Sample Steel Building

- Flat Roof (4-ply built-up roofing (BUR) and steel deck)
- Steel stud framed walls
- Insulated concrete slab floor
Max U-Value of 0.162
This roof assembly does not comply
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:

<table>
<thead>
<tr>
<th>Assembly Components</th>
<th>RSI, (m²·K)/W</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vapour barrier</td>
<td>0.00</td>
</tr>
<tr>
<td>64-mm expanded polystyrene insulation – Type 2</td>
<td>1.79</td>
</tr>
<tr>
<td>100-mm cast-in-place concrete slab (normal density aggregate)</td>
<td>0.04</td>
</tr>
<tr>
<td>Interior air film</td>
<td>0.16</td>
</tr>
<tr>
<td>$\text{RSI}_T$</td>
<td>1.99</td>
</tr>
<tr>
<td>$U_T = 1/\text{RSI}_T$</td>
<td><strong>0.503</strong></td>
</tr>
</tbody>
</table>

Max U-Value of 0.757
This floor assembly complies
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

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

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

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)
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
Overall Thermal Transmittance of Fenestration & Doors

<table>
<thead>
<tr>
<th>Component</th>
<th>U Value</th>
<th>Effective R Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>All fenestration</td>
<td>2.0</td>
<td>2.84</td>
</tr>
<tr>
<td>All doors</td>
<td>2.2</td>
<td>2.58</td>
</tr>
</tbody>
</table>
Assemblies in contact with the ground thermal requirements

<table>
<thead>
<tr>
<th>Assembly</th>
<th>U Value</th>
<th>Effective R Value</th>
</tr>
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<tbody>
<tr>
<td>Roofs</td>
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<td>0.757</td>
<td>R 7.5</td>
</tr>
</tbody>
</table>
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
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.
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
Part 3 Trade-off Path
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
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
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
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

\[
\text{Total proposed System efficiency} \geq \text{Total referenced System efficiency}
\]
Part 5 Trade-off limitations

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

\[ \text{Total proposed System efficiency} \geq 0 \]
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.
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
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
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
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
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
For more information contact:
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m.fischer@brandon.ca