Manitoba Energy Code for Buildings

Part 8 – Building Energy Performance Compliance Path

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Overview

• Scope, application, and limitations
• Calculation method
• Calculation rules
  • General
  • Building envelope (Part 3)
  • Lighting (Part 4)
  • Heating, ventilating, air conditioning (Part 5) and service water heating (Part 6)
• Modeling resources
• Summary
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Part 8 provides an alternative to using the **Prescriptive and Trade-off Paths** requirements of NECB Parts 3 to 7.
Scope

**Whole building approach**

Compliance is based on the annual energy consumption

- Proposed
  - “Annual Energy Consumption”

- Reference
  - “Building Energy Target”
Limitations

Sufficient information must be known on

- Building occupancy type(s)
- Location
- Components, materials, and assemblies
Limitations

Building envelope

• Thermally active element above-grade requires insulation
• Slab-on-grade permitted flexibility
• Designed to avoid air leakage, wetting or moisture by-pass

HVAC and service water heating

• All appliances and equipment performance efficiencies cannot be less than required by the applicable energy efficiency act

Lighting and Electrical systems

• None
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• **Modeling resources**
• **Summary**
Calculation method

Annual Energy Consumption

Space Heating Equipment

Space Cooling Equipment

Fans and Pumps

Appliances

Elevators and Escalators

Service Water Heating Equipment

Interior / Exterior Lighting Devices

Plug Loads and Misc. Equipment
Calculation method

Required detail

- Hourly time step during one year (8760)
- Climatic data files based on at least 10 years of real data
- Energy calculations must account for
  - Effects of thermal mass
  - Dynamic calculations of space temperatures
  - Cross effects of the building systems and internal loads
- Envelope assembly covering < 5% total assembly area need not be modeled separately
Calculation method

Framework for compliance calculation provided in Part 8

- No software specified
- Flexible to allow use of various tools
- ANSI/ASHRAE 140 “Evaluation of Building Energy Analysis Computer Programs” or equivalent test method
Calculation method

Some examples of tool options...


http://apps.eere.energy.gov/buildings/tools_directory/subjects_sub.cfm
Calculation method

**CAN-QUEST**

- Canadian adaptation of eQUEST
- Includes Canadian weather
- Supports metric and imperial measurements
- English and French interface

- Automatically generates NECB 2011 reference model
- **Warning!** MECB 2013 reference model not generated

Available for free from NRCan
Email [info.services@nrcan.gc.ca](mailto:info.services@nrcan.gc.ca) to request a copy
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Calculation rules - general

General building criteria held constant...

- Floor area and shape
- Thermal blocks
- Building types or space functions
- Building orientation
- Location of fenestration elements

- Occupancy density
- Service water heating loads
- Internal loads and schedules
- Supply, return and exhaust fan schedules
Calculation rules - general

Renewable and process energy

- Flexibility by silence on process load and energy from renewable sources
  - Guidance provided in Appendix for inclusion
    - Industrial processes
    - Medical imaging equipment
    - Computer servers
    - Cooking appliances in commercial kitchen or restaurant
- No credit for efficiency of purchased energy
Calculation rules - building envelope

Thermal characteristics

- Reference set to prescriptive
  - Opaque building assemblies (walls, roofs and floors)
  - Fenestration including spandrels (MECB 2013)
  - Requirement for vestibules
  - Continuity of insulation

- Proposed building as per specification
- Credit or energy penalty depending on where design falls with respect to prescriptive requirements
Calculation rules - building envelope

Impact of the fenestration and door area allowances (FDWR)

Credits

Reference

Energy Penalty
Calculation rules - building envelope

Credits

• Thermal mass (reference set to lightweight construction)
• Roof solar absorptance improvements (reference set to 0.7)
• External permanent shading devices

Graphics: http://sustainabilityworkshop.autodesk.com/
Calculation rules - building envelope

No credits

- Whole building air leakage rate of 0.25 (l/s · m²) same in both models
- Exterior shading by tree or other structure


Graphic: [http://www.greenspec.co.uk/building-design/solar-siting-orientation/](http://www.greenspec.co.uk/building-design/solar-siting-orientation/)
Credits

• Interior, site and exterior lighting power density
  • Reference as per prescriptive requirement
  • Proposed as specified
• Occupancy sensors
  • 10% credit
• Daylighting
  • Use trade-off if none in software used
No credits

- Lighting power density allowances in dwelling units not mandated in Part 4
  - 5 W/m² used in reference and proposed buildings
HVAC system selection for reference case

- Based on space function or building type
- System selection table

<table>
<thead>
<tr>
<th>Building or Space Type of the Proposed Building</th>
<th>Size of Building or Space</th>
<th>Type of HVAC System Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Area: office, banking, health care clinic, library, retail/mall concourse, gymnasium, athletic play area, swimming pool, exercise centre, dressing room, lighting control room, atrium</td>
<td>Maximum 2 storeys</td>
<td>System 3</td>
</tr>
<tr>
<td></td>
<td>More than 2 storeys</td>
<td>System 6</td>
</tr>
<tr>
<td>Indoor Arena: ice rinks, curling rinks</td>
<td>All sizes</td>
<td>System 7</td>
</tr>
</tbody>
</table>
### HVAC system types

- Seven system types to represent reference, based on current practice
- ‘Fuel neutral’ means same as proposed building

<table>
<thead>
<tr>
<th>System #</th>
<th>System type</th>
<th>Fan control</th>
<th>Cooling type</th>
<th>Heating type</th>
</tr>
</thead>
<tbody>
<tr>
<td>System 3</td>
<td>Single zone packaged rooftop with baseboard heating</td>
<td>Constant volume</td>
<td>Air-cooled direct expansion</td>
<td>Fuel-fired or electric resistance furnace for rooftop; hot water with fuel-fired boiler, or electric resistance for baseboards</td>
</tr>
<tr>
<td>System 6</td>
<td>Multi-zone built-up system with baseboard heating</td>
<td>Variable volume</td>
<td>Water-cooled water chiller</td>
<td>Baseboards: electric resistance or hydronic with fuel-fired boiler</td>
</tr>
<tr>
<td>System 7</td>
<td>Four-pipe fan coil</td>
<td>Constant volume</td>
<td>Water-cooled water chiller</td>
<td>Hydronic with electric resistance or fuel-fired boiler</td>
</tr>
</tbody>
</table>
Calculation rules - HVAC

- Heat recovery credit
  - Central exhaust > 150 kW, above 50% efficiency
- Ventilation
  - Reference constant volume, except office type > 2 storeys
- Cooling with outside air above Part 5 requirements
Calculation rules - HVAC

Radiant systems - credit provided

- In-floor, in-ceiling or in-wall radiant systems modeled with 2°C difference in temperature set-point (e.g. heating to 21°C versus 19°C)
Other – credit optional

- Heating system
  - Constant speed pumping
  - Hot water supply temperature reset

- Cooling system
  - For hydronic, number of chillers based on plant size
  - For direct expansion, number of stages based on size
  - For cooling tower, number of cells based on size
  - Temperature drops

- Fan part load performance characteristics
Credits optional

- Equipment oversizing addressed
  - Reference heating equipment not oversized by > 30%
  - Reference cooling equipment not oversized by > 10%

- Part load performance characteristics
  - Reference defaults provided
  - Proposed as specified can be used
Calculation rules - HVAC and SWH

No credit

- Outdoor air rate same
  - Except for displacement ventilation
  - Demand control ventilation for heated parking garages
- Space temperature throttling of $1^\circ$C
- Equipment operation
  - Supply and storage tank temperature
  - Number of water heaters
- Priority order for use of equipment with multiple energy type systems provided
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Modeling Resources

Red River College – two-day CanQUEST training (October and November)

The American Institute of Architects – The AIA Energy Modeling Guide
http://info.aia.org/aia/energymodeling.cfm

Rocky Mountain Institute – Building Energy Modeling for Owners and Managers
http://www.rmi.org/EnergyModelingWorkstream

IBPSA USA – BEMBook (Building Energy Modeling Body of Knowledge)
http://www.bembook.ibpsa.us/
Summary

• Reference building linked to prescriptive requirements
• More consistent reference
  • Introduction of FDWR based on HDD
  • HVAC selection based on building type
• Most flexibility and detail of all compliance paths in acceptable solutions
Questions?

Thank you

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