SUMMARY

Ontario continues to promote some of the most progressive regulations in North America for reductions of Green House Gas (GHG) emissions and improvements for energy conservation in buildings. With each iteration of the Building Code (OBC), the requirements related to energy performance have increased. These regulations are captured in OBC Part 12 Resource Conservation and Environmental Integrity and Supplementary Standard SB-10 Energy Efficiency Supplement. These requirements cover:

- New buildings and additions to existing buildings within the scope of OBC Part 3.
- Non-Residential Building with the scope of Part 9.

The energy efficiency of existing buildings is covered in Parts 10 & 11.

Architects will naturally focus on the building envelope provisions of SB-10 but should be conversant with the impact of Mechanical and Electrical requirements on their design as well.

Beginning Jan 01, 2017 designers have 8 paths for Compliance for buildings within the scope of Parts 3:

<table>
<thead>
<tr>
<th>Path</th>
<th>Compliance Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASHRAE 90.1-2010 (90.1-2010) + SB-10 Division 3, Chapter 2 as it read on \r\nDecember 31st 2016 (until December 31, 2017).</td>
<td>Prescriptive, Trade-Off &amp; Performance options</td>
</tr>
<tr>
<td>ASHRAE 90.1-2013 (90.1-2013) + SB-10 Division 3, Chapter 2</td>
<td>Prescriptive, Trade-Off &amp; Performance options</td>
</tr>
<tr>
<td>ASHRAE 90.1-2010 (90.1-2010) + OBC SB-10 Division 2 Chapter 2 + 13%</td>
<td>Performance option</td>
</tr>
<tr>
<td>National Energy Code for Buildings (NECB 2011) + OBC SB-10 Division 2, \r\nChapter 3 + 13%</td>
<td>Performance option</td>
</tr>
<tr>
<td>ASHRAE 90.1-2010 + 5% + 13%</td>
<td>Performance option</td>
</tr>
<tr>
<td>Model National Energy Code for Buildings (MNECB) 1997 + 25% + 13% (until \r\nDecember 31, 2017)</td>
<td>Performance option</td>
</tr>
</tbody>
</table>

For Non-Residential Building within the scope of Part 9 Division 5 offers a prescriptive path similar to Division 3, Chapter 2.

GHG in the form of Carbon Dioxide Equivalents (CO₂e) are regulated by SB-10. Buildings which comply with the prescriptive requirements of SB-10 will meet these requirements.

This Practice Tip focuses on the prescriptive paths and trade off options for Part 3 Buildings and for Part 9 Non-residential buildings.
SB-10 ORGANIZATION
Like other OBC Supplementary Standards, SB-10 is organized in Divisions and Chapters:

Division 1 General.
Division 2 Energy Efficiency Design Before January 01, 2017
   - Chapter 1 General
   - Chapter 2 Additional Requirements to ANSI/ASHRAE/IES Standard 90.1 2010
   - Chapter 3 Additional Requirements to the 2011 NECB.
Division 3 Energy Efficiency Design After December 31, 2016
   - Chapter 1 General
   - Chapter 2 Additional Requirements to ANSI/ASHRAE/IES Standard 90.1 2013
   - Chapter 3 Additional Requirements to NECB 2015.
Division 4 Buildings of Non-Residential Occupancy within the Scope of Part 9 (before January 01, 2017).
Division 5 Buildings of Non-Residential Occupancy within the Scope of Part 9 (after December 31, 2016).

PROCEDURES FOR PRESCRIPTIVE AND SIMPLE TRADE OFF COMPLIANCE

Part 3 Buildings

- Determine if your building is exempt from the requirements of SB-10. Open air buildings, camps, seasonal buildings and some industrial buildings are exempt.
- SB-10 assumes a high level of air tightness in accordance with OBC Division B Part 5. While always important, the selection of appropriate materials, attention to detail and careful review during construction are critical to meeting Ontario’s energy conservation targets.
- Determine the area of windows, doors and skylights and their percentage of the exterior walls and roofs respectively. This will determine which compliance paths are available to you. The Division 3 Chapter 2 prescriptive paths limit the area of windows and doors to 40% of the vertical envelope area (FDWR) and the area of skylights to 3% (5% until December 31st, 2016) of all roofs (SRR). The NECB 2015 option in Chapter 3 has higher prescriptive envelope requirements and limits window area from 40% FDWR for locations with Heating Degree Days (HDD) ≤ 4000 and 20% FDWR if HDD >7000. The allowable area decreases linearly from 40% - 20%. Appendix A to NECB includes a table for interpolation between 4000 – 7000 HDD. Trade-off options may permit the designer to increase the FDWR above 40% by using higher performance windows and lower U values for the walls or increasing the area of skylights by decreasing the U value of the roof.
- Some window manufacturers provide easy to use graphs for determining the fenestration system U value based on centre of glass U value and the percentage of glass to rough opening. The National Fenestration Rating Council (NFRC) standard ANSI/NFRC 100-2014 sets out the procedures for determining the overall U value of windows. Software such as “Therm” may also be used.
- Determine the area of structural penetrations such as balconies, suspended and roof top equipment supports. These thermal bridges are limited to 2% of the exterior building envelope area, walls, roofs, exposed floors, doors and fenestration. Brick ties, flashings and intermediate structural connections are permitted thermal bridges.
- Determine the number of HDD for your building’s location from OBC Volume 2 SB-1. ASHRAE climate zones 5, 6 and 7 are referenced in SB-10 Chapter 2. Climate zones 4 – 8 are referenced in NECB 2015. Division 5 zones has 2 zones: below 5000 HDD and above 5000HDD.
- Select the appropriate tables from SB-10 Division 3 Chapters 2, 3, Division 5 or ASHRAE 189.1 and record the required U, R, F and C values for the envelope components.
- This PT assumes that M&E Engineers will design their systems to comply with SB-10 and will provide the necessary documentation. Advise your Engineers which path will be used. Review the equipment requirements as they may affect the building envelope. Electric space heating for instance requires higher performance levels.

Chapter 2 - ASHRAE 90.1 2013 + SB-10 Division 3, Chapter 2

- Review ASHRAE 90.1-2013 and SB-10 Division 1 and Division 3 Chapter 2 General information to help you understand the 90.1 standard is in Chapters 1-4. Chapter 5, Building Envelope, contains the requirements for envelope compliance including the mandatory provisions. Aside from M&E changes it is largely this chapter that SB-10 Division 3, Chapter 2 modified to suit Ontario’s requirements. Appendix A of 90.1 has useful tables for converting assembly insulation thermal resistance RSI(R) values to assembly thermal transmittance U values. Section 5.6 and Appendix C describe the method for trading between building elements. Software is required.
The procedure performance levels found in 90.1 LEED building. From a strictly envelope design perspective 189.1

As the title suggests, ASHRAE 189.1 covers many good design practices including much of what one expects to find in a LEED building. From a strictly envelope design perspective 189.1-2014 requires an increase of 10% in the performance levels found in 90.1-2013.

The procedures are similar to those described for SB-10 Division 3, Chapter 2 above.
Part 9 Non-residential Buildings

Division 5 - Buildings of Non-Residential Occupancy within the Scope of Part 9 (after December 31, 2016)
Beginning Jan 01, 2017 designers have 2 paths for Compliance for non-residential buildings within the scope of Part 9:

- SB-10 Division 5 as in read on December 31st 2016 (until December 31, 2017). Prescriptive option
- SB-10 Division 5 Prescriptive option

The procedures are similar to those described for SB-10 Division 3, Chapter 2 above.

Carbon Dioxide Equivalents (CO\textsubscript{2e})

CO\textsubscript{2e} are a measure of the impact of energy use on the environment and global warming. They vary not only by the amount of energy used but by the source of that energy. The energy used to heat water by electricity generated from natural gas delivered over the grid produces twice the CO\textsubscript{2} of water heated on site by natural gas.

To determine CO\textsubscript{2e} use the formula: \( \text{CO}_{2e} = \sum \text{energy by source in kWh} \times \text{CO}_2 \text{ emission factor in kg/kWh} \) from Table 1.1.2.2.

Buildings which comply with the prescriptive requirements of SB-10 generally satisfy the OBC CO\textsubscript{2e} limits and you are not required to record the CO\textsubscript{2e}. If you are using energy modeling, the design buildings' emissions must be less than or equal to that of the same building designed in accordance with the prescriptive requirements. Most energy modelling software will provide a prediction of the energy used by type. With this breakdown and the CO\textsubscript{2} emission factors provided in SB-10, designers can calculate and record CO\textsubscript{2e} on form 11 from MMAH.

REFERENCES

Definitions and Conversion Factors

1. **C-Factor (Thermal Conductance):** A measure of the heat flow through a building construction (e.g. a wall or window) or a given thickness of material (e.g. insulation). Lower numbers indicate better insulating properties. C-Factor does not include the boundary air or soil films. The units for C-Factor are W/m\( ^2 \)°K (Btu/hr•ft\( ^2 \)°F).
2. **Classes of Construction:** Doors: non-swinging, metal coiling and swinging, Fenestration: vertical and skylights, Floors: mass, steel joist and wood joist/other, Roofs: attic and other, metal building and insulation entirely above deck, Slab-on-Grade: heated and unheated, Walls: above-grade, below-grade, mass, metal building, steel-framed and wood framed/other.
3. Energy use is typically measured in Gigajoules (GJ) and kilowatt hours (kWh). 1 GJ = 278 kWh. Electricity is measured in kWh. Fuel Oil is measured in litres, 1 L = 10.20kWh. Natural Gas is measured in m\(^3\), 1 m\(^3\) = 10.36 kWh. Liquid propane is measured in m\(^3\), 1 m\(^3\) = 7091.67 kWh.
4. **F-Factor:** A measure of the heat loss along the perimeter of a slab-on-grade. Lower numbers indicate better insulating properties. The units for F-Factor are W/m\(^2\)°K (Btu/hr•ft\(^2\)°F).
5. **HDD18:** Heating Degree Days 18 is the sum of the number of degrees the daily mean outside air temperature was below 18° C in a year. The imperial equivalent is HDD65, The conversion factor is HDD18 = 5/9•HDD65.
6. **HDD15:** Heating degree days 15 is the sum of the number of degrees the daily mean outside air temperature was below 15° C in a year.
7. **Parallel Path Losses:** The effect on the thermal resistance of an assembly caused by framing members and structural penetration in the same plane as the insulation. Insulation is used to fill the cavities created by the framing and as continuous insulation. Parallel path losses take into account the effect of thermal bridging and can be significant. The effective RSI value of a 92 steel stud wall with only mineral fibre insulation between the studs is approximately 50% of the RSI of the insulation. For a 150 steel stud this drops to 35% of the nominal R value of the insulation.
8. **Space Conditioning Category:** Non-residential conditioned space, residential conditioned space and semi-heated space.
9. **U-Factor (Thermal Transmittance):** A measure of the heat flow through a *class of construction* (e.g. a wall, roof, floor or window) including the boundary air films for a given thickness of material (e.g. insulation). Lower numbers indicate better insulating properties. The units for U-Factor are W/m²·K (Btu/hr·ft²·°F). U – Factor is the inverse of R-Value.

**Codes, Standards and Guides**
7. OBC Volume 1 Division B, Part 12 Resource Conservation and Environmental Integrity, MMAH.
8. OBC Volume 2 SB-10 Supplementary Standard SB-10, MMAH.

**Software**

**Other References**
1. All Practice Tips within the PT.36 Series.
2. Conway Architect Inc., OBC SB-10 Prescriptive Solutions Slide Presentation: [https://www.slideshare.net/GerryConwayOAMRAIC/obc-sb10-conway-architect-inc-2017-03-29?qid=d54f236d-358c-4716-b5e3-71b9ed5b7a0a&v=&b=&from_search=1](https://www.slideshare.net/GerryConwayOAMRAIC/obc-sb10-conway-architect-inc-2017-03-29?qid=d54f236d-358c-4716-b5e3-71b9ed5b7a0a&v=&b=&from_search=1)

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