Canadian Sheet Steel Building Institute

Sheet Steel Facts 47

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Alternative Means of Proving Compliance with the National Energy Code for Buildings 2015

Figure 1: Retail Steel Building System

Introduction

The latest edition of the National Energy Code for Buildings (NECB) was published 2015. It is a National Model Code that can be adopted by the Provinces and Territories to the extent it meets their needs. At the present time five provinces have adopted some energy conservation regulations. The NECB applies to the construction of new buildings that are required to meet the provisions of Part 3 of the National Building Code of Canada, or the applicable Provincial Building Code.

There are three paths through which building designs may comply with NECB 2015:

1. The Prescriptive Path (Section 3.2) in which assemblies and components must meet minimum prescribed performance requirements.
2. The Simple Trade-off Path (Sub-Section 3.3.1) in which certain assemblies or components may not meet the prescribed performance requirements, while other assemblies or components exceed the prescribed performance requirements, such that the overall performance of the building will not use more energy.
3. The Performance Path (Section 3.4) in which the Trade-Off methodology is extended to include equipment inside the building, (i.e. fans, appliances, elevators, etc.) and a computer model is used to determine that the building assemblies, components and equipment in aggregate, will not use more energy than the reference building envelope energy target.

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The Prescriptive Path provides maximum overall thermal transmittance for the building walls, roof, fenestration and doors. The advantage of the Prescriptive Path is that it is very easy to use; however, it often places the full burden for meeting the energy code targets on the building envelope. This can result in the insulated wall and roof assemblies being over-designed. With a little additional work a more cost-efficient solution can be obtained by using the other NECB options; the Simple Trade-off Path or the Performance Path.

Example of the Simple Trade-Off Path

The Simple Trade-off Path demonstrates that the sum of the areas of vertical (or horizontal) assemblies of the building envelope multiplied by their respective overall thermal transmittance is not more than the corresponding assemblies in the reference building. The reference building for the Simple Trade-off Path is the same building used with the Prescriptive Path. If certain components are more energy efficient than those prescribed in the Prescriptive Path, the trade-off calculation is permitted to take this increased performance into account.

Taking advantage of the Simple Trade-off Path can provide a significant cost advantage for insulated sheet steel wall and roof assemblies. The data given in Table 1 summarizes the calculations for three cities in Canada with two different building configurations that would be similar to the retail building shown in Figure 1. These calculations are for the wall area, but a similar process can be used for the roof.

The steps for using the simple trade-off method are as follows:

- Line 1 lists the Heating Degree Days (HDD) that comes from the climatic data for the specific location. The climatic data in Appendix C of the National Building Code of Canada can be used unless the local jurisdiction requires other values. NBCC 2015 has been used in this example.
- The maximum U-factors in Line 2 for the walls come from Table 3.2.3.1 in NECB and depend on the HDD.
- The maximum U-factors in Line 3 for the fenestration come from Table 3.2.2.3 in NECB. Note that the maximum U-factors for doors are the same as for the fenestration. These values also depend on the HDD.
- The maximum allowable total vertical fenestration and door area to gross wall area ratio (FDWR) is determined in accordance with Article 3.2.1.4. For HDD less than 4000, the maximum FDWR = 40%. For HDD between 4000 and 7000, FDWR = (2000-0.2xHDD)/3000. For HDD over 7000, the minimum FDWR = 20%.
- Using the simple trade-off calculation from Article 3.3.3.2, the maximum U-factor for the NECB reference building is calculated as follows and given in Line 5:
  Max U (ref. bldg.) = (1-Max_FDWR)(Max Uwall) + (Max_FDWR)(Max UFen)
- The FDWR in Line 6 is the ratio for the proposed building. In this example two ratios are selected: 8% and 20%.
- The Max U (Wall) given in Line 7 is calculated as follows:
  Max U (Wall) = [(Max U (ref. bldg.)- (FDWR)(Max Ufen)]/ (1-FDWR)
- The R-values given in Lines 8 and 9 are conversions for the U-factor from Line 7.
- The R-values given in Line 10 are taken from Table 3.2.2.2 in NECB and are the prescriptive requirements for opaque building walls.

The benefits of the Simple Trade-off Path are demonstrated in the comparison of Lines 9 and 10 in Table 1. It is worth noting that the minimum allowable R-values shown in Line 9 are well below the R-values commonly used in insulated sheet steel wall assemblies.

			Vancouver		Montreal		Edmonton	
Input Data	1	HDD	3000	3000	4200	4200	5120	5120
	2	Max U(wall)	0.315	0.315	0.247	0.247	0.21	0.21
	3	Max U(fenestration)	2.4	2.4	2.2	2.2	2.2	2.2
	4	Max FDWR	0.4	0.4	0.387	0.387	0.325	0.325
	5	Max U (ref. bldg.)	1.149	1.149	1.002	1.002	0.857	0.857
Simple Trade-off Path	6	FDWR	0.08	0.20	0.08	0.20	0.08	0.20
	7	Max U-Wall	1.040	0.836	0.898	0.703	0.741	0.522
	8	Min R-Wall (metric)	0.96	1.20	1.11	1.42	1.35	1.92
	9	Min R-Wall (Imperial)	**5.5**	**6.8**	**6.3**	**8.1**	**7.7**	**10.9**
Prescriptive	10	Min R-Wall (Imperial)	**18.0**	**18.0**	**23.0**	**23.0**	**27.0**	**27.0**

Table 1: Example Simple Trade-Off Calculations

The Performance Path

The Performance Path uses the energy modeling to compare the annual energy use of a proposed design against that of a “baseline” building, which has the same size and shape as the proposed design, but is minimally compliant with the energy code in all other aspects. The Performance Path allows for a project to be complaint with the energy code by trading off lower performing systems, such as the building envelop, with higher performing systems, such as higher efficiency mechanical equipment or lighting. The goal of the Performance Path is to allow compliance with greater design flexibility.

The CSSBI commissioned Morrison-Hershfield to undertake Performance Path modeling of a retail steel building system similar to the one shown in Figure 1. The energy model was developed using EnergyPlus v8.4 and considered the following variables:

- Three climate zones (4, 6 and 7A)
- Two HVAC systems
- Lighting savings: 0% to 45% of NECB baseline
- Glazing values: U-0.5 to U-0.25
- Wall and roof R-values: R-10 to R-40
- FDWR of 8% and 20%
- Slab F-Factor: R-10 to R-7.5

Given the number of variables, a total of 20,736 different options were analyzed representing different combinations. The results were presented graphically similar to the output shown in Figure 2. These curves illustrate various options that would comply with the energy code. For example, comparing the red line to the yellow line shows how the code can be met with an R15 and R20 wall respectively. Similar curves can be generated based on other variables. The report from Morrison-Hershfield is available on the CSSBI web site at www.cssbi.ca/products/steel-building-systems. The principal conclusion from this study was the demonstration that there are a wide variety of options for meeting the energy code requirements, and the most cost-effective solution is not to simply add more insulation in the wall and roof assemblies.

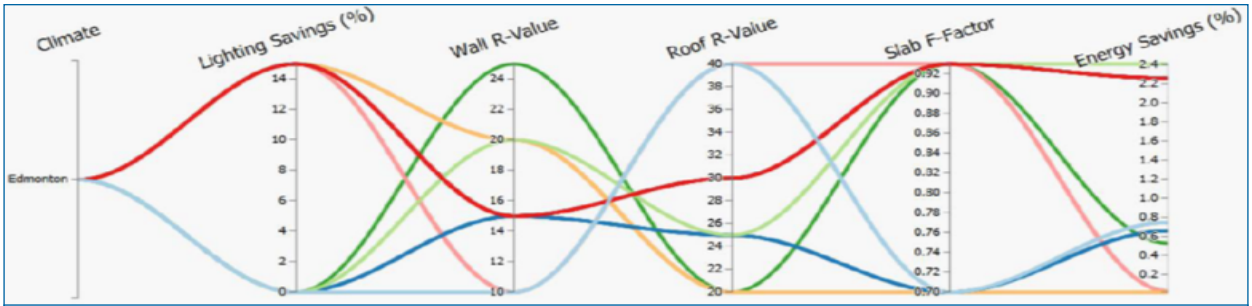

Figure 2: Minimum Performance Scenarios for Edmonton

Additional Resources

There are a number of resources available to prove compliance with the energy codes including the following:

- CAN-QUEST energy modeling software
  http://www.nrcan.gc.ca/energy/efficiency/buildings/eenb/16600
- COMcheck commercial compliance software https://www.energycodes.gov/comcheck
- Users Guide – National Energy Code of Canada for Buildings 2011
  http://www.nrc-cnrc.gc.ca/eng/publications/codes_centre/2014_user_guide_necb2011.html
- ASHRAE 90.1 Energy Standard for Buildings Except Low-Rise Residential Buildings
  https://www.ashrae.org/resources--publications/bookstore/standard-90-1

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