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MEMO

To: Members and Staff of the Fire Prevention and Building Safety Commission
From: John Hawkins
Date: May 2, 2011 REVISED May 5, 2011
Subject: Indiana Energy Conservation Code (InECC), Trade Off Envelope Method

Executive Summary:
The Trade Off Envelope Method is allowable under the current InECC. For each specific building project, the code allows three paths to building envelope compliance in section 4.2.1, 5.2.1 and 5.2.2. The three paths are: 1) Prescriptive Building Envelope Option, 2) Building Envelope Trade-Off Option, 3) Energy Cost Budget Method. The third option is described in Chapter 11, which was deleted by Indiana amendment, even though it remains referenced in Section 4.2.1.2. The first two compliance path options are still clearly available. Deleting chapter 11 has left a hole in the compliance pathways of the Standard that makes demonstration of compliance more difficult in Indiana. Prohibiting use of the Trade Off Envelope option would make demonstration of compliance effectively impossible for many buildings.

Unpacking the Prescriptive Envelope Compliance Provisions
Section 5.4 requires compliance with certain mandatory provisions. These are general requirements which are independent of the compliance path chosen. Some examples of mandatory provisions are: insulation must have a label or written certification from the manufacturer as to R-value; all joints around doors and windows must be sealed, caulked, gasketed or weatherstripped; dock doors must have weatherseals; etc.

Section 5.5 describes the prescriptive option, and includes an alternative for an area-weighted average calculation method. The area weighted average method allows trade-off calculations to be performed within each class of construction for each space conditioning category. For example, two different roof R-values within a single roof system in a non-residential building can use the area-weighted average method to show compliance, even if one section of roof has an R-value lower than allowed by Table 5.5. The calculations to show compliance with Section 5.5 must be performed using data contained in Appendices A, B and D.[1] For trade-offs between different types of envelope components or between different space conditioning categories (i.e., between residential and non-residential spaces), area weighted averaging is not permitted and the building envelope trade-off method must be used.

Section 5.6 describes the building envelope trade-off option. Unlike the area weighted average method, "(w)ith the trade-off option, the performance of one envelope component can be improved to make up for another component that may not meet the (energy code)"[2] Trade off calculations can also be performed between residential and non-residential envelope components. The trade off method uses a series of calculations developed from computerized simulations using DOE-2 software. [3] While possible, the calculations are generally too complex and time consuming to do by hand, yet they are far simpler than the calculations required by the Energy Cost Budget Method. The trade off method calculates an envelope performance factor, as defined in 3.2. The calculation method is described in Appendix C. The base and proposed building envelope performance factors should not be confused with baseline building performance and proposed building performance. The latter two are used in Appendix G. Building performance calculations predict and compare models of annual energy cost. Building envelope performance calculations only predict and compare models of steady state heat flow through a component such as a roof, wall, or floor. The reference to a "budget building" in 5.6.1.b. should be interpreted to mean "base envelope."[4] While more flexible than the area weighted average method, the trade-off option does not allow trade-offs between building systems. More efficient lighting, water heating and mechanical equipment designs cannot be traded off against envelope components using this method.

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[1] Appendices A through D in ASHRAE 90.1 are normative, and are part of the adopted Standard. They are essential to the standard, as they define calculation methodology, steady state heat flow data for various construction assemblies, climatic data, and other similar data. Appendix G, while not normative, is specifically referenced in the Indiana amendment to 5.7, and is therefore incorporated by reference as a part of the InECC. Comcheck software performs the prescriptive calculations in accordance with ASHRAE 90.1, and is available for free at http://www.energycodes.gov.

[2] User's Manual for ANSI/ASHRAE/IES Standard 90.1, pg 5-81.

[3] Ibid

[4] The term "budget building" appears nowhere in Appendix C, or in the User's Manual.

Was Indiana Correct to Delete Chapter 11?

Chapter 11 describes the Energy Cost Budget Method (ECB) and has been deleted by Indiana amendment. This method would have allowed trade offs between different building systems. This method requires computer simulation software[5]. Unlike the trade-off method, which calculates heat flow through a material, the ECB calculates an annual energy cost for the proposed design compared to an annual energy cost for a baseline design that complies with the prescriptive requirements. Note that the ECB cannot be used until a baseline prescriptive calculation using either section 5.5 or 5.6 is first performed. The ECB also allows consideration of onsite renewable energy sources (e.g., solar water heating, solar photovoltaic collectors, wind turbines) to demonstrate compliance. The ECB and Chapter 11 were deleted under the presumption that they were a performance based code. During public hearings, it was argued that Chapter 11 should not be deleted because Indiana has allowed performance based energy codes since 1984.[6] It is more accurate to say that Chapter 11 is not a performance standard. It is simply another way of measuring compliance, using a different unit of measurement, and is an essential part of ASHRAE 90.1.

Appendix G is a performance rating method. Where the ECB calculates an energy cost budget and compares it to a design energy cost, Appendix G compares a baseline building performance to a proposed building performance. It requires more detailed computer simulation modeling[7] than the ECB, and is intended to provide a standardized method for calculating a building's predicted design energy savings compared to baseline compliance with ASRAE 90.1. While it may seem at first glance that Appendix G and Chapter 11 are the same thing, they are not. Chapter 11 is a compliance path. Even though the measurement unit of Chapter 11 is energy cost, it is a simplified, theoretical measurement that does not predict actual energy cost. Appendix G is a standard for building a more detailed virtual building model and performing a complex computer simulation that attempts to predict actual building performance.[8] It provides a standard methodolgy for green building rating systems, and also for certain energy-savings tax incentives such as the Section 179D deduction. A building seeking LEED certification must demonstrate actual building energy performance using Appendix G.[9]

Section 5.7 was edited by Indiana to allow demonstration of compliance using whole building energy simulations performed by software meeting Appendix G. This amendment obviates the requirement to do a Comcheck report for projects which are designed as high performing energy saving buildings. The Indiana amendment to 5.7 helps to prevent silly paperwork for some projects, but it does not fill the gap in the compliance paths left by the deletion of Chapter 11.

Conclusion

The Trade-Off Envelope Method is clearly allowed by the language of the InECC. Deleting chapter 11 has left a hole in the compliance pathways of the Standard that makes demonstration of compliance more difficult in Indiana. Prohibiting use of the Trade Off Envelope option would make demonstration of compliance effectively impossible for many buildings.[10]

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[5] Suitable software tools are listed at http://apps1.eere.energy.gov/buildings/tools_directory/. As of the date of this memo, 393 software tools are listed.

[6] January 27,, 2010 letter from Ralph Gerdes presented at January 28, 2010 public hearing on LSA Document 09-388.

[7] As an example to provide some perspective, a recent eQuest computer simulation for a LEED certified building the author's firm is currently designing produced 1,300 pages of output.

[8] In an email to the author on this topic, Mark Darrall, AIA, LEED-AP, one of the co-authors of the Indiana amendments to Section 5.7 notes that there is a "huge debate right now about the predictive power of energy models, since there is no way to account for testing and balancing, commissioning, operation, and maintenance." He states that it may be more accurate to say that Appendix G provides a standard way for experienced design professionals to compare the performance of various energy conservation measures against the prescriptive requirements.

[9] This hasn't always been the case. Energy Consultant Henry Gifford has challenged USGBC in an anti-trust class action law suit (see http://www.greenrealestatelaw.com/wp-content/uploads/2010/10/Class-Action-Suit-v-USGBC-SDNY-10.12.10.pdf). In the latest version of the LEED scoring system, an Appendix G compliant simulation is required to document claims of energy savings.

[10] Dan Overby, Assoc. AIA, LEED-AP, who also co-authored the amendment to Section 5.7, points out in an email to the author that at best, this would stymie design creativity and detract from the potential quality of built works in Indiana. At worst, it would hamper economic development because the design and construction options would be so limited compared to the model codes used by other states.

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