Commercial New Construction Code Compliance; Strategies for Accurate Assessment and Improved Compliance Rates

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Introduction

This poster presents the methodology and findings of a 2012 commercial construction baseline and code compliance study approximately 120 commercial buildings in Massachusetts and Rhode Island. The study included market actor interviews and the field evaluation of construction practices and equipment installation in relation to energy code mandates in the two states. The study was part of an ongoing evaluation effort of efficiency programs and served several purposes, including: determining code compliance rates as required for states accepting ARRA funding for energy efficiency efforts; updating baseline information for commercial new construction programs, gauging awareness of the Massachusetts Stretch Code and other "reach" codes, and establishing baselines and guidance for future energy code savings attribution.

Study methodologies employed included:

- Modification of the DOE/PNNL code compliance methodology recommended for ARRA mandated compliance verification for practicality, accuracy, and regional based impacts
- Development of an *iPad Filemaker* code compliance tool
- Development of custom spreadsheet to replace DOE/PNNL "Score & Store"
- Review of design documents for code compliance
- Site visits to verify and rate compliance
- Extensive interviewing of market actors and code officials
- Reporting of overall compliance rates and compliance by category

Conclusions resulting from the study include:

- Overall energy code compliance rates in the two states are generally over 75%
- Compliance rates associated with equipment rated efficiency levels is high; nearly 100%
- Compliance rates for installation associated code provisions, such as duct sealing and control strategies are lower
- Commercial sector energy codes have become complex and therefore challenging for building inspectors
- Opportunities exist to improve compliance rates through third-party assistance
- Improved training procedures are needed to promote higher energy code compliance
- Simulation modeling and other custom analysis approaches can be utilized to assess the energy impacts associated with overall compliance and individual provision compliance

As recommended by the DOE ARRA funding administrators, the evaluation team chose to utilize the DOE/PNNL methodology developed for commercial code compliance verification. This methodology is attractive because it provides a weighting system for the energy impacts of individual code compliance provisions. Three compliance tiers were established with tiers two and three estimated to have two and three times the energy impacts of tier one provisions, respectively. The DOE/PNNL methodology facilitates the recommended practice for code officials who are engaged in verifying code compliance during the construction process. That process involves a full review of construction documents followed by several site

visits to verify compliance. However, that process is not fully suited to the practicalities of baseline and code compliance studies. In order to make the process more usable for post-construction evaluation the team modified the methodology to reduce some of the implementation challenges while preserving its analytic advantages.

The modifications are summarized as:

- Utilizing questions that probe actual installed performance levels rather than simply "yes/no" in regards to code compliance. For example, recording actual U-Factors rather than simply ascertaining that code levels are met.
- Modifying compliance questions to allow for verification from actual field data, rather than relying on whether or not systems (lighting, mechanical, insulation, etc.) were installed "according to plans."
- Recording all observed practices directly in an iPad tool for direct upload to a custom analysis tool.
- Determining code compliance, and relative performance, for individual provisions, from recorded field data, rather than attempting to assess compliance in the field.

The above modifications, combined with extensive training of field personnel in cross-referencing obtained information to determine compliance levels of a variety of provisions, allowed the team to accurately gauge code compliance on an energy impact basis and facilitate the development of compliance enhancement programs.

With the regular introduction of more and more aggressive energy codes, and with the awareness of that standard practice in new construction tends to be somewhat lower than mandatory energy code compliance, efficiency program administrators are also becoming interested in understanding the energy impacts of different levels of compliance and building energy performance.

An ongoing phase of our code compliance evaluation effort involves definition and development of cost-effective modeling techniques to determine energy impacts. Engineering methodologies that are under consideration include simulation modeling, custom spreadsheet analysis, and a combined, integrated approach. Currently, we are conducting meetings with energy modeling experts to assess the merits of various techniques, striving to arrive at conclusions on the most suitable mix of approaches, including:

- Simulation modeling and analysis – Simulation analyses are being performed with DOE-2 based models like eQUEST. While the authors do understand the merits and analytical power of these tools, particularly for proto-typical buildings, we are also considering the challenges and costs of such analyses for real, complex facilities in which construction details may be poorly known. Thus, our intentions are to use simulation analyses to model code deficiencies associated with major envelope systems, central controls, and other whole building challenges.
- Custom spreadsheet analysis – For many stand-alone code requirements, including those for lighting, HVAC, local controls, and smaller envelope issues, custom-developed spreadsheet tools are typically most suitable. These can be more cost-effective, straightforward in use, and transparent in quality control assessment.
- Integrated approach – As indicated, there are merits to both simulation and custom spreadsheet modeling analyses. Our end objective will be to combine the two approaches, likely using the simulation for determining major building envelope, whole building control, and interactive impacts, and using spreadsheet analyses for lighting, unitary HVAC, and individual control measures.

The final results of our work will demonstrate a cost-effective and enhanced analysis protocol, providing energy impacts for a project from standard practice to compliance and then to premium efficiency. Such methodologies must be consistent with the need to assess complex new construction projects, while developing evaluation-ready energy results.