

Commercial Construction: Time to Overhaul Energy Code Compliance and Enforcement Approaches

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ABSTRACT

Extensive experience working with code officials and conducting commercial baseline and code compliance studies has led the authors to the conclusion that conventional approaches to energy code enforcement are obsolete. There is a need for new, innovative approaches, in order to keep pace with rapidly advancing codes and the drive toward high performance buildings. The overwhelming majority of code enforcement officials find it challenging to enforce the energy code requirements for increasingly complex buildings and systems.

The authors' recent experience with commercial code compliance projects includes:

- extensive interviews throughout 2012 with code officials in two New England states;
- concurrent interviews with design professionals regarding code compliance processes;
- commercial new construction baseline/code compliance studies in four states during 2011-2012; and
- code compliance training for hundreds of code officials in New York, Massachusetts, Rhode Island, and New Hampshire, from 2007 to the present.

Through this work (we have learned, beyond any doubt, that effective compliance with, and enforcement of, energy codes for commercial construction is not being realized. Code officials consistently state that they possess neither the time, nor the tools, to enforce increasingly complex code provisions and emerging technologies and approaches. A universal message from code officials is that the structural integrity of the buildings, combined with the safety of the occupants is a priority that leaves little time for energy code concerns.

The authors propose the design and deployment of new mechanisms for enforcing energy codes. These could include third party energy assistance with energy code compliance and enforcement; efficiency program project assistance targeting energy codes, design community circuit riding focused on energy code compliance, designated energy code officials, and a collaborative effort that shares reach-code and base energy-code responsibilities.

Introduction

Building energy codes in the U.S. have come a long way in the past two decades, both for residential and commercial construction. For residential construction the advances have primarily involved improvements in envelope design and construction affecting insulation levels and air sealing, along with some lighting and appliance revisions. For commercial construction the advancements are much more comprehensive, involving multiple disciplines and affecting design and construction across multiple sectors, requiring the cooperation of nearly all design and construction actors in meeting code requirements.

The authors' extensive experience working with code officials, training code officials and design/construction market actors, and conducting commercial baseline and code compliance

studies has informed a conclusion that conventional approaches that rely primarily on code official inspections for energy code enforcement are obsolete. Revised approaches are needed to keep pace with rapidly advancing codes and the drive toward high performance buildings. The overwhelming majority of code enforcement officials are understandably ill-equipped to enforce the energy code requirements for increasingly complex buildings and systems.

The paper first draws distinctions between enforcement and compliance, proposing that enhanced enforcement is not the only path to improved compliance. We discuss the difficult task faced by code officials attempting to enforce increasingly complex commercial codes, and then address alternative approaches to increased reliance on code official training for improving enforcement activities.

Enforcement vs. Compliance Assistance

Of prime importance to understand, for those involved with improving commercial building energy performance, is that commercial building codes, with rare exception, are not enforced in the same manner, or to the same degree, as are health and safety codes. This is clear from all of our interviews with code officials in several states, and has been documented in several studies. This is not to say that they are not complied with, as in large part they are. But they are certainly not enforced in any systematic manner. The lack of conventional enforcement has led to compliance methodologies that are more cooperative in nature than they are investigative and punitive. As a consequence code compliance varies more with the knowledge of design professionals and market actors, and the ability and willingness of code officials and those market actors to cooperatively assure compliance, than it does with strictness of enforcement. For example, when the architect, contractor, and code official have an informed discussion as to what air-barrier material and technique is to be utilized, an effective air-barrier is more likely to be implemented than if the code official simply checks to see that an air-barrier is installed. The same would be true of the new skylight/daylight provisions.

Although some members of the design/construction community will resist the enactment of more stringent codes, once enacted, market actors generally want to comply with energy code provisions. In addition, in many (perhaps most) states, if they are registered professionals (architects, engineers, licensed contractors) they are held legally responsible for meeting code requirements, energy codes included. In many jurisdictions, design professionals are required to sign statements that their projects are designed to code, and in some states they are responsible for ensuring that their design is actually built to code.

The fact that, with the exception of states with no mandatory energy code, market actors are typically required to meet energy code provisions, combined with evidence that the same market actors want their projects to be in compliance, forces the conclusion that what is needed is improved energy code compliance *assistance*, not improved enforcement. The two methodologies can reach the same ends, but one relies upon the cooperation of professionals, the other on the policing of professionals.

The Code Officials' Dilemma

Over the past 15 years, the authors have interacted with several hundred code officials through interviews, trainings, project inspections, circuit riding, evaluations, etc. Through these relationships we have learned a great deal about code officials and the challenges they face. A short list includes the following:

- Code officials almost universally have a background in residential construction. Many are retired or part-time builders. Residential building is a physically demanding profession and many became code officials to ease physical burdens.
- Many non-energy related duties and responsibilities are assigned. According to the Building Codes Assistance Project (BCAP), code officials have as many as fifteen codes to enforce. This varies greatly by location, but structural codes and health and safety codes are typically covered by the same staff people.
- Training opportunities are limited and often focus on residential construction.
- Training programs for commercial construction are often misguided, focusing on simply repeating the code provisions, rather than covering the science and techniques that support the code. For example, many states utilize the training presentations offered by the DOE's Building Energy Codes Program (<http://www.energycodes.gov/resource-center/training-catalog>) for in-person trainings. For the commercial code, these trainings simply repeat each code provision with some illustrative photographs or graphics. There is no discussion as to the purpose of the provision, or the proper techniques required. These types of training programs ignore the fact that code provisions are not meant to be memorized, as they can easily be looked-up in the code book.

From 2008 through 2013 the authors conducted dozens of comprehensive interviews with code officials in association with several code training programs and code compliance evaluations performed in three of the states. In addition, hundreds of code officials have been surveyed about their approaches for commercial energy code compliance. The results were as follows:

- Over 90% typically rely on a signed compliance statement from a design professional, and/or review a report generated by COMcheck, a software tool that compiles user inputs for code provisions and calculates compliance. Because COMcheck inputs are fully user selectable, the output only demonstrates compliance if all of the inputs are accurate.
- Less than 10% review plans in any detail for energy code compliance.
- Less than 5% report ever having calculated the lighting power density for a building or space, or even understand how to do so.
- Less than 5% believe that they have an understanding of “complex mechanical systems” as defined by the energy code.
- A majority believe that energy codes are advancing faster than they can handle.
- All report that energy codes are low on the priority list compared with other code duties.
- A majority feel that energy codes were unfairly added to their duties without a corresponding increase in compensation.
- A majority believe that the broadening of codes to impact more types of renovation projects will not be enforced.

(DNV-KEMA, ERS 2008, ERS 2010, ERS 2011, ERS 2012, ERS 2013)

As an example of the feedback received from code officials, the following are the key observations from interviews with Massachusetts code officials reported for the code compliance evaluation completed in 2012:

- Building officials generally do not feel qualified to determine energy code compliance for complex HVAC systems and their controls; lighting power densities; and the type, quantity, and locations of lighting controls.
 - Building and inspection service departments generally report being understaffed and overloaded with code inspections, zoning enforcement, plan reviews, and field work.
 - Use of *COMcheck* reports to document commercial energy code compliance is sporadic and varies by jurisdiction.
 - *COMcheck* reports are often accepted as stand-alone proof of compliance.
 - Owners and design teams report more challenges in meeting commercial energy code requirements for the building envelope measures than lighting and HVAC requirements.
 - There is currently no compliance mechanism that requires design engineers to justify their design decisions independently of *COMcheck*.
- (DNV-KEMA, ERS, 2012)

The last bullet refers to the requirement that designers accurately size HVAC systems to building loads. As reported by the Massachusetts code officials, the requirement exists and is intended to be enforced by them, but they have no mechanism for assessing compliance with the provision.

In addition, as this is being written, the authors are completing an evaluation of energy code compliance enhancement programs, funded through DOE-ARRA and implemented by state energy programs. The interviews with code officials in the participant states (confidential) resulted in results nearly identical to those listed above.

Commercial Code Complexity

Until one looks closely at the recently updated model commercial energy codes (International Energy Conservation Code [IECC] 2009 and 2012), it is reasonable to assume that the stricter versions simply increase minimum efficiency levels of equipment, increase insulation levels, and require improved air sealing. However, the reality is that the newer versions include complexities that would be unfamiliar to professionals with a background in residential construction. The following three examples from IECC 2012 illustrate the difficult language and concepts now included in the code:

- “Automatically reset the supply water temperature using zone-return water temperature, building-return water temperature as an indicator of building heating or cooling demand. The temperature shall be capable of being reset by at least 25 percent of the design supply-to-return water temperature difference.”
- “Skylights in office, storage, automotive service, manufacturing, non-refrigerated warehouse, retail store, and distribution/sorting area spaces shall have a glazing material or diffuser with a measured haze factor greater than 90 percent when tested in accordance with ASTM D1003.”

It is clear that the complexity of the commercial energy code, especially larger commercial buildings, is very challenging for non-energy specialists. Although some code development activities are seeking simpler compliance paths, including prescriptive packages and outcome-based compliance, the current direction is toward further code complexity.

Shrinking Budgets

During the same time period that energy codes have been increasing in complexity, state and local budgets for building code enforcement have been reduced. Throughout New England, for example, many local governments have eliminated some code official positions, choosing to share staff and duties with contiguous municipalities. When that course of action turned out to be impractical, many municipalities moved to limit code official positions to part time. ARRA grants have helped to mitigate this situation in recent years.

Alternative Approaches

It is clear that alternative approaches to enhancing compliance are needed if compliance is to keep up with advancing energy codes. Of course, if budgets are restricted, a source of funding also needs to be identified; this is covered in the next section.

In addition to prescriptive packages, and outcome-based compliance alternatives, two basic concepts are being proposed for alternative compliance methodologies: energy efficiency (EE) programs targeting code compliance; and third-party assistance with code compliance. The two should not be considered mutually exclusive and could be implemented as an integrated program.

Further, for cooling-dominant climates, the alternative approaches could be implemented by electric utilities alone. For heating-dominant regions, gas and electric utilities could work together to offer a jointly funded and administered program.

Comprehensive Efficiency Programs to Enhance Code Impacts

Efficiency programs for commercial buildings typically promote and pay incentives for many of the same provisions as those addressed by codes. Both new construction and retrofit programs nearly always promote lighting and HVAC controls, efficiency levels for heating and cooling, efficient lighting technologies, etc. In addition, many programs pay incentives for achieving low lighting power densities, providing daylight and daylight controls, improving insulation, windows and air sealing, and a variety of commissioning efforts. All of these areas are also addressed by code, and codes are increasingly applying these provisions to renovations and repairs.

Despite the fact that the same measures are often addressed we know of no programmatic efforts to date in which code officials and program administrators collaborate beyond training efforts. This provides a significant opportunity for program administrators who are looking to meet expanded savings goals. Massachusetts and Rhode Island are currently in the early stages of implementing a code compliance assistance model of this type. B.C. Hydro, the city of Vancouver, and several building trades professional organizations are jointly developing compliance enhancement strategies that also move in this direction. A program model of this type would include the following features:

- Developing comprehensive program incentive structures for commercial new construction and major renovations. This has been done of course, most notably with protocols such as LEED-NC and NBI's Advanced Buildings program, as well as with the development of stretch/reach codes. Yet nobody has effectively tied these programs directly to code compliance.

- Utilizing the alternative path for code compliance that allows adherence to an “above code” performance protocol that is demonstrably stricter than the base code. This path is codified in both IECC 2009 and 2012 as well as the corresponding ASHRAE 90.1 standards.
- Working with code compliance officials to develop a mechanism whereby efficiency program administrators assist and report on code compliance by making available data on the performance level achieved for the code impacted measures. The output template for this reporting could readily be developed from a spreadsheet or database tool.
- Making code compliance a mandatory requirement of the comprehensive program, so that any provision not meeting a reach-code level would need to meet minimum code levels. This requirement is currently part of LEED, NBI Advanced Buildings, and the Collaborative for High Performance Schools (CHPS) protocols. But it is not well understood or executed, with compliance being either assumed or recorded with all the same issues discussed earlier in this paper.
- Providing integrated code and program compliance assistance as a primary feature.
- Maintaining a staff of energy specialists who work with design and construction teams to ensure compliance with the above code program. This could be done by one of two mechanisms:
 1. Hire energy specialists for each discipline.
 2. Issue an RFP/RFQ soliciting bids from firms/individuals for program support in the disciplines of building envelope, lighting, and HVAC.

Third-Party Assistance with Code Compliance

It is known from the recent code compliance studies performed in several states, that code compliance rates for commercial buildings average around 75%–80% (Misuriello et al 2012). Recent code compliance studies in Massachusetts and Rhode Island identified specific compliance issues with lighting controls, HVAC sizing, duct sealing, and systems testing/commissioning, as well as a variety of envelope requirements. The 75-80% compliance rate does not mean that 75% of commercial building are in compliance, but rather that on average 75% of the energy code provisions, weighted by impact, are in compliance. Considering that the DOE estimates that the next commercial model energy code will achieve 8.5% in savings compared with the current mode code (<https://www.energycodes.gov/determinations>.) the savings from improved compliance rates are non-trivial. Further work is now being performed in Massachusetts, California, and other states, as well as at the national level, to better define actual long-term energy impacts of non-compliance with key code provisions. A recently completed study in the state of New York concluded that even with a compliance rate of more than 80%, the savings lost to non-compliance in the commercial sector totaled \$9.6 million annually (Harper et al. 2012).

For any efficiency program territory, the 25% compliance gap represents a significant potential for savings. And these are potential savings that are not being addressed because code compliance is assumed. For projects that reach compliance rates better than 75%, often due to efficiency program participation, the delta in savings is not credited, again because code compliance is assumed. With regulatory agreement that a code compliance gap exists and that closing the gap generates assignable savings, efficiency programs would offer third-party code compliance assistance directly to project teams and/or to the assigned code official. The third-party assistants could, and should, promote above-code performance, but a main objective would

be to improve compliance rates. Although some jurisdictions have instituted third-party code compliance programs for residential construction, similar programs for commercial construction are in early planning stages. (Meres et al. 2012)

An example of how third-party assistance might work would be as follows:

- The code official contacts the program management and notifies them of a project in the design phase that represents challenges for code compliance, either because of project complexity or staffing challenges.
- A representative of the third-party program meets with the design team and the code official, offering to assist with compliance issues and at the same time promoting the efficiency program's offerings for design/construction above-code levels.
- One or more specialists are assigned to the project and assist the design team with compliance issues. At this point the specialists would assist the code official in determining compliance based on design features. For states which require or encourage compliance affidavits, the specialists would review such documentation providing guidance for both the design team and the code official.
- As the project progresses, the specialist(s) records compliance as well as above-code performance levels. A compliance checklist would be supplied to the code official, and the recorded performance levels would be used to calculate savings compared with typical/standard practice.
- The record is compiled in a spreadsheet or database tool, and a copy is provided to the design team, project owners, and the code official. The code compliance agency would retain lawful authority for compliance, while depending on jurisdictional rulemaking, regulatory authority would allow program implementers to claim some or all of calculated energy savings and associated emissions credits.

Alternative Funding Sources

With code enforcement efforts already underfunded, it is not likely that state and municipal budgets would fund alternative compliance efforts, even if they were fully convinced of their efficacy. Alternative funding mechanisms are needed for compliance assistance that is not code-enforcement focused. Two alternative funding sources are readily available depending upon jurisdictions: electric and gas System Benefit Charge (SBC) funds and greenhouse gas traded funds.

- SBC funding – By demonstrating to regulators that code compliance is less than 100%, and that utility-sponsored programs can both improve compliance rates and integrate compliance with comprehensive design approaches, there is nothing that should stand in the way of assigning a portion of efficiency program budgets to code compliance assistance efforts. This approach is now being considered in several states, but has yet to be fully implemented. For example, SBC funded efficiency programs in Massachusetts and Rhode Island are currently engaged in energy code support programs and are in the planning stages of evaluating the proper attribution of savings.
- Greenhouse gas reduction funding – Both the California Global Warming Solutions Act, and the Northeast States' Regional Greenhouse Gas Initiative identify energy efficiency improvements in buildings as principal activity areas targeted for funding through their

respective cap and trade programs. As “lost opportunity” approaches, improved code compliance and comprehensive new construction efficiency should be priorities for greenhouse gas-linked programs. A distinct advantage over some SBC-funded program models is that greenhouse gas cap and trade funds typically can be utilized in a fuel neutral manner.

Other Related Recommendations

In order for any code compliance assistance program to succeed, the authors believe that some fundamental changes are needed in approaches to training and code official support activities. Recommendations that coincide with changes in code compliance protocols include:

- Replacing conventional code training with basic building science training – Codes are documented in “code books,” which are designed to be reference materials. There is no need or purpose for code officials or market actors to memorize codes. Given that reality, it is a curiosity as to why most code compliance courses simply go through each of the provisions as though the goal is for the attendees to memorize each one of them. Far better that attendees learn the building science reasons for the measures and the effects of the measure on overall energy impacts. One hour to ½ day course modules on air and moisture control, air vs. vapor barriers, daylighting, building commissioning, HVAC system sizing, etc. could be offered to both code officials and market actors. Proper energy code training should cover: *why* the provision was developed and *how* the provision could be best implemented, not simply what it states.
- Performing circuit riding focused on specific projects – Concepts are better retained when they are related to actual project examples. Replacing much of conventional training with visiting design teams to review code compliance related to their current portfolio of projects will result in higher retention of code concepts.
- Equipping code officials with the right tools – Most code officials receive a copy of the current IECC, or an equivalent used in their jurisdiction, and little if anything else. However, there are many resources available that would help code officials, as well as third-party actors, better assist design teams. The IECC itself offers several additional guides that further explain code provisions and compliance paths. In addition, many reference books on building science are available from Building Science Corporation and others that explain building science concepts and offer approaches for design/construction that comply with current codes and typically extend above-code performance.
- A combination of "carrots and sticks" would be useful for promoting improved code official knowledge. Several states now require some form of continuing education for code officials. Offering bonuses for additional training is another possible avenue.

Conclusion

There are two critical paths for improved energy performance through energy codes: enhanced code provisions, and enhanced code compliance. To date, there has been much focus and progress on the former, and less on the latter. Further, what emphasis has been placed on improved compliance has focused mostly on improving code enforcement through additional

code official training. The majority of such training, however, simply outlines the code provisions, typically with the identical language contained in the relevant codebook.

The promised savings associated with advancing energy codes will not be realized without significant adjustments to the ways in which compliance is ensured. Stronger enforcement by code officials is not something that appears possible, for commercial buildings, given the growing complexity, without significant changes to training approaches and compliance assistance. Training for code officials and market actors alike should focus on the basic building science behind strengthened code provisions, as well as compliance methodologies, rather than simply restating code language. Improved training, however, is not sufficient given the growing complexity of the commercial code, and alternative paths toward enhanced compliance need to be implemented. Efficiency programs, whether administered by utilities, or quasi-governmental agencies, are ideal vehicles for improving energy code compliance rates. Such programs address many of the same building elements, and work with the same market actors. Joint code compliance and energy efficiency program implementation should be encouraged for reaching common goals. For this to happen, program administrators need to work with regulators to develop criteria for assigning savings associated with improved compliance as well as above code performance. The recent and current introduction of complex code provisions, combined with a growing focus on greenhouse gas emissions, creates a favorable environment for the implementers of energy codes, and efficiency programs, to work together on enhanced compliance with complex codes.

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