Building Relationships with General Contractors: Transforming Standard Practice

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ABSTRACT

Much time and effort have been spent investigating and implementing strategies to achieve long-term behavioral changes among the building design communities of architects, engineers, and specifiers. However, the realm of impacting a General Contractor's (GC's) construction practice remains relatively uncharted territory.

Working with GCs can be an effective way to achieve long-term market transformation toward construction of high-performance, energy-efficient buildings. Up-front investments in relationship building, education, and incentives can create a decreased need for financial assistance and efficiency program staff involvement over time. As GCs come to recognize the value of energy efficiency for their clients, they become willing to spend time and resources to develop their capabilities in delivering high quality, energy-efficient buildings.

This paper describes one example of GC transformation, as evidenced by the evolution of the company's construction practices on a series of seven multifamily buildings. In this case, the GC had experience in constructing multifamily buildings, but was not familiar with many of the building systems and practices necessary to achieve a truly energy-efficient building. Types of assistance provided to the GC included: (1) education in the value of energy efficiency; (2) training in key technical components of efficient building envelopes, mechanical systems, and lighting design; (3) upgrading standard plan details; (4) on-site demonstration of key construction details; (5) development of quality control methods; and (6) customized financial incentives. Through this assistance, the GC has become a committed partner, and a true advocate for construction of energy-efficient buildings, even without direct involvement from efficiency program staff.

Introduction

Typically energy efficiency / demand side management programs for new construction have focused on promoting and ensuring measure incorporation through design team meetings with architects and engineers, very tight specifications, well-documented plans, and building commissioning. Although this may be the most common approach to new construction program implementation, there are other ways to further new-construction energy efficiency by building relationships with GCs. The hypothesis is: "Building a relationship with a GC will result in reduced design time, lower measure costs, and lower incentives needed to leverage the installation of the energy efficiency measures." The GC is in a key position—he or she is the person who actually builds the building. Depending on how they are brought into the design process, GCs could either be the biggest barrier or the biggest ally to the implementation of energy efficiency measures. In the end, the goal is to have better buildings built, with more energy-efficient components, all at lower costs for the owner and lower incentives for energy efficiency programs.

Vermont Case Study

In Vermont, there has been a unique opportunity to test this model and explore the relationship between the local energy efficiency program and a GC. The local energy efficiency program in this case study is Efficiency Vermont. Efficiency Vermont is a statewide program providing cash incentive and technical assistance to all Vermont rate payers. This program is funded by an efficiency charge on each rate payer's electric bill. The GC in this case study is a medium-sized general contracting firm, established in 1934, that has 65 employees and builds approximately 250,000 square feet of new construction each year. The GC and developer partnered on a series of projects to develop seven multifamily buildings on a 25-acre parcel of land in South Burlington, Vermont, zoned for high-density housing and commercial use. The developer and GC planned to design and construct the buildings using the "design-build" process. Efficiency Vermont and the GC agreed to work together to test this model of relationship building using the construction of the seven buildings as the center of the experiment. Table 1 provides a summary of the buildings' characteristics and construction timelines.

Table 1. Summary of Buildings

Building Number	Building Description	Building Square Feet	Number of Residential Units	Design Start Date, Construction Duration	Construction Complete Date
1	Affordable[1] Multifamily[2] Rental	40,260	40	08/2000, 11 months	06/2002
2	Affordable Multifamily Rental	40,260	40	08/2000, 11 months	06/2002
3	Affordable Multifamily Rental	40,260	40	10/2000, 9 months	10/2002
4	Affordable Multifamily Rental	40,260	40	10/2000, 9 months	10/2002
5	Affordable Multifamily Condos	67,580	65	07/2003, 6 months	04/2005
6	Market Rate[3] Multifamily Condos	138,764	89	11/2003, 6 months	06/2005
7	Market Rate Multifamily Condos	101,110	74	03/2005, 6 months	12/2006

[1] *definition of Affordable housing – rental or condo units restricted to tenants with incomes of 80% of median income or less*
[2] *definition of Multifamily is any building with 4 units or more*
[3] *definition of Market Rate – rental or condo units available to tenant of any income*

Over the last six years, the Vermont Energy Investment Corporation, which operates Efficiency Vermont, has grown to understand the design and construction process and has learned how to incorporate the organization into this process. Thus, Efficiency Vermont has become an asset to the building team instead of an interference. Efficiency Vermont understands team goals, and moves beyond the initial, minimal relationship between the GC and program personnel. More details on how Efficiency Vermont achieved this transition are presented later in this paper.

Quantifying Market Transformation

Working closely with the GC and its subcontractors, the results of Efficiency Vermont's efforts to achieve high-performing, energy-efficient buildings show an increasing number and sophistication of implemented measures, and fewer incentives needed to overcome market financial barriers.

Table 2 outlines the progression of energy efficiency measures over the past six years. The first group of buildings eventually included energy efficiency measures that were above minimum code requirements, but the effort invested in getting those first measures incorporated into the design was a tremendous task and took nearly 12 months of meetings and analyses. As Efficiency Vermont worked together with the GC on each subsequent building, trust and confidence were established, such that the building team was willing to consider additional energy efficiency components in each of the successive buildings. It is important to note that all buildings were designed and constructed to a level above local energy code requirements. In Vermont, there is no commercial energy code; however, there is a land use permit requirement that buildings meet ASHRAE 90.1 2001 minimums.

Table 2. Progression of Energy-Efficiency Components

Measure Type	Buildings 1-4	Building 5	Building 6	Building 7
Envelope	Fiberglass	Fiberglass	Fiberglass	Fiberglass
	Minimal airsealing	Airsealing	Airsealing	Airsealing
		Spray foam	Spray foam	Spray foam
Space Heating	85% NG[1] boilers	92% Condensing NG boilers	92% Condensing NG boilers	92% Condensing NG boilers
Ventilation	Central HRV[2]	Individual HRV	Individual HRV	Individual HRV
Air Conditioning	None provided	Non-ENERGY STAR® window units	Central chilled water system	Efficient water source heat pumps
Lighting	All L&CFL[3]	All L&CFL	All L&CFL	All L&CFL
		Occupancy sensors	Occupancy sensors	Occupancy sensors
				Super T8s
Mechanical Controls	No VFD[4] in design	VFD on heating hot water loop	VFD on chilled and hot water loops	VFD on heat pump loop, and controls

[1] NG: Natural Gas
[2] HRV: Heat Recovery Ventilation
[3] L&CFL: Linear & Compact Fluorescent Lighting
[4] VFD: Variable Frequency Drive

Table 3 shows how efforts in developing a relationship with the GC, along with its mechanical, electrical, and insulation subcontractors, resulted in decreasing measures costs, and reduced incentives required to leverage the installation of measures.

Table 3. Progression by Financial Incentives

Building(s)	Incremental Measure Cost ($)	Incentive	
1-4	1.83/sq ft	$835/unit	$0.83/sq ft
5	1.94/sq ft	$700/unit	$0.67/sq ft
6	1.69/sq ft	$900/unit	$0.58/sq ft
7	1.85/sq ft	$675/unit	$0.49/sq ft

Initially, because the GC and its subcontractors anticipated a high cost and risk associated with energy efficiency, bid pricing for many measures came in at double the amount that Efficiency Vermont had expected, based on the program's experience with other similar projects in the area. The materials to be used for the original baseline buildings had already been selected from known sources and were known to be available. Additionally, the contractors were well skilled at installing these baseline materials, using their standard methods. Bid requests for changes in materials resulted in higher-than-estimated pricing to incorporate the extra time and cost of finding a source for a product, learning how to install it, and motivating efforts to do something besides standard practice. For custom projects, the program provides incentives based on a package of energy efficiency upgrades, and not on individual measures. In the beginning, Efficiency Vermont had to provide an increase in the total incentive to get the developers and GC past these perceived additional costs. By the time the fifth building was being designed and built, the perceived financial risk in implementing energy efficiency components had significantly decreased. Many of the efficiency components and installation methods had become part of standard practice for the GC and their subcontractors. As a result, the bid costs for energy efficiency components also decreased, as did the packaged incentive amount.

One particular example of how GC pricing can decrease over time for similar applications can be seen in the cost of energy-efficient compact fluorescent lighting. In the first building, the bid alternate to add a single compact fluorescent fixture in the living room and bedrooms was $180 per fixture, including installation. That amount was much higher than Efficiency Vermont's estimate of approximately $75, which was based on the program's experience with past projects. In the fifth building, the cost of adding compact fluorescent lighting was only $85.

Table 4. Summary of Transformation

	Energy Use Index (kBtu[1]/sq ft)	Design Cost (per sq ft)[b]	Construction Cost (per sq ft)[b]	Incentive paid (per sq ft)
Standard Building	59[a]	$3.75-$4.50	$70-120	Not applicable
Buildings 1-4	54[c]	$3.95	$75.50	$0.83
Building 5	37[c]	$3.90	$85.65	$0.67
Building 6	27[c]	$4.15	$95.85	$0.58
Building 7	Not applicable	$3.85	$107.55	$0.49

Sources: [a] EIA Residential Data 2001; [b] Wright & Morrissey, Inc.; [c]Green Mountain Power usage data, 2003-2005 and Vermont Gas Systems usage data, 2003 – 2005..

[1] Kilo British thermal units

It is important to note the difference between buildings 1 through 4 and buildings 5 through 7. The first four buildings are owned and operated by a local non-profit affordable housing organization as rental housing. Buildings 5 through 7 were built by developers as condo units with more amenities than the rental units and therefore the overall construction costs were higher. Despite the cost difference in the building types, the overall efficiency of the buildings continues to improve as seen by the actual energy bills tabulated above as an energy use index (EUI).

Achieving High Performance

The first step in changing the standard method of incorporating energy efficiency into buildings is to ask the following questions: (1) What does the client / owner want from the energy efficiency / demand side management (DSM) program? (2) What are the project energy goals? and (3) What are the barriers to achieving those energy goals?

Identify Project Needs and Set Energy Goals

The first step in working with the GC and design team is to find out what their expectations and interests are in relation to energy efficiency and building performance. Determine what level of energy efficiency they want to achieve, and find out how the design and construction process flows. Then determine the best way for energy efficiency components to be introduced and incorporated into the process. In Efficiency Vermont's case, the most important element to the GC and developer at that time was assistance in submitting their land use permit application (which has a section on minimum energy efficiency requirements). This first meeting was an opportunity to see what they needed, discuss energy-efficient building construction and establish a working relationship. The non-profit organization that planned to own the first four affordable housing buildings had an interest in lowering energy bills, providing a quality living environment, and low maintenance costs. As usual, they had a set budget and first costs were a substantial barrier. The GC was prepared to provide the client with a baseline building for a set price, using the standard materials and methods used with past buildings.

Determine Barriers

It is very important to identify and understand the barriers to implementing energy efficiency in any project. The barriers that contractors identify may not actually be the true barriers. It may be that they don't want to take the time to try something new because of perceived cost or budget implications – and they might not actually present as a barrier this concern to the team. Actual barriers might include: increased cost of non-standard practice, fixed budgets, and fear of the unknown. Efficiency Vermont discovered that the most prevalent barrier among contractors and developers was a desire to stay with standard practice. The GC and subcontractors were experienced with certain ways of doing things, which meant that they could complete their work more quickly and maintain a lower, more competitive cost by continuing to perform work with "tried and true" approaches. Any changes to their standard way of doing things would take time to learn and would therefore cost more.

Overcoming Barriers

Build Relationships

Building relationships in any team is a fundamental requirement to working effectively. The key is to establish one point of contact within each organization and build upon that relationship. Getting to know individuals on a personal level and understanding their priorities are important first steps. Efficiency Vermont scheduled regular design team meetings with the same group of people, and built a relationship with the team, while bringing efficiency options to the table. Over the next 12 months, the meetings addressed lighting, boilers, windows, wall insulation, appliances, and ventilation strategies. They also provided additional technical assistance to the project team including product sourcing, savings calculations, and technical research of efficient technologies. In one case, a "lunch and learn" for the entire design team (including the GC) addressed all possible lighting options for the units, as well as the advantages and disadvantages of each option. Additionally, energy efficiency could be demonstrated via tours to other successful projects in similar buildings. Efficiency Vermont also reviewed the plans and specifications at each point in the design process, and provided comments back to the team. In this way, the design team was spared the added work associated with analyzing and tracking all of the energy efficiency measures in the final design.

Provide On-Site Training

On-site training is not only a great way to solidify a relationship with the GC, but also a good opportunity to conduct regular site inspection of energy efficiency measures. Efficiency Vermont project staff regularly attended construction meetings and walked the site after the meeting to look at the progress on implementing the energy efficiency measures. Direct meetings with the site superintendent to review details on airsealing, duct work, mechanical systems, and insulation also provided opportunities to ask about construction approaches and understand details of the construction process and schedule. Another great way to support the relationship with a GC is to offer the site superintendent some tools. A foam gun kit (Todol Products, Inc.) for airsealing and the *EEBA Guide to Cold Climates (EEBA Guide, 2001),* which included flashing and air sealing details were small-expense items that made a great impression, improved the relationship, and provided a useful training tool.

Perform Diagnostic Testing – Seeing is Believing

Diagnostic testing is one of the best ways to demonstrate the benefits of energy efficiency to an owner, GC project manager, and site superintendent. Energy savings calculations on paper and drawings on plans are not always sufficient to convince project participants of the value of energy efficiency. Visual confirmation can be a much more powerful motivator for changing a GC's attitude about energy efficiency. For example, blower doors were set up in two separate apartment units to demonstrate air leakage from the exterior walls and windows. One of the units had been airsealed using the foam gun Efficiency Vermont had given the GC, and the other unit had not yet been airsealed. An infrared camera was used to demonstrate to the site workers the difference in performance between the two units. The camera also revealed where the sealing job was substandard. This became a great method for the site superintendent in identifying areas in which additional quality control was needed. An infrared camera also identified areas where fiberglass insulation was not installed very well. This gave the GC sufficient evidence to hold one of its subcontractors to a higher standard of work.

In the first group of buildings, airsealing was implemented only at minimum levels. As a result, the first two buildings experienced substantial ice dams that resulted in interior water damage. The ice dams were just a symptom of the bigger problem, air leakage, but the very visible ice dams and drywall damage were of concern to the owner and GC. The team agreed to implement additional airsealing and insulating measures, and subsequently agreed to share with Efficiency Vermont the costs of additional work performed by the insulation contractor on buildings 3 and 4. The results of the additional airsealing on buildings 3 and 4 was noticeable in the winter when there was snow. There is less melting and damming forming on those two buildings as compared to buildings 1 and 2. From that point on, the GC regularly incorporated closed-cell foam spray to provide airsealing and insulation in critical areas.

Some of the above energy efficiency components have real and measurable benefits. For example, blower door testing has been performed on two of the six completed buildings, Buildings 1 and 5. The results of this testing demonstrates how progressive improvements in air sealing implementation have led to lower reductions in air leakage rates. Blower door testing results for Buildings 1 and 5 are:

- Building 1: air leakage rate of 12,750 cubic feet per minute (CFM) at 50 Pascals, equivalent to 0.16 air changes per hour (ACH).
- Building 5: air leakage rate of 15,920 CFM at 50 Pascals, equivalent to 0.10 ACH.

Recognize and Praise Good Work

Praise and recognition should be given to those who do good work. Since the general contractor is the entity that actually constructs the building, its staff is typically the greatest ally in this process. This is just another step toward solidifying the relationship between the energy-efficiency / DSM program and the GC and developer. It is important to provide positive feedback and recognition every time something is done correctly or with great effort. During the open house ceremony and tour of one of the newly completed buildings, Efficiency Vermont made a point to recognize that the GC was a pivotal partner in the construction of the building. Efficiency Vermont also presented the building with ENERGY STAR® plaques to signify that the GC team had met all the requirements of the ENERGY STAR Multifamily Homes program.

Conclusion

By the time Efficiency Vermont was working on the fifth building, the standard practice of the General Contractor and its subcontractors had changed. Many of the energy efficiency measures that had proven tough to include in the first building had become standard design practice for the fifth. The GC used the education and experience it gained on these seven buildings to bid successfully on and to negotiate more than 300 additional units of multifamily housing in and around the county. The GC has been told that its focus on energy efficiency and on-site quality control measures were instrumental in the decision to award it these projects.

Leveraging the role of the general contractor in new construction projects can be a very successful method in which efficiency programs can install more measures and provide lower incentives. The time and energy spent up front in building a trusting relationship with the general contractor and incorporating it into the design process can result in increased penetration of efficiency measures and high performance buildings, all at lower costs. Over time, the contractor and subcontractors will change their standard practice to include energy efficiency, thus transforming the market. This will lead to greater market penetration of energy efficiency, and a reduced need for technical assistance and financial incentives over time.

References

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