Maine Policy Review

Volume 17
Issue 2 *Climate Change and Energy*

2008

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by Richard K. Renner

"How many solar collectors will we have,
and where will they go?"
"It will be green because we will have solar hot water."
"I know that building is efficient because
it has geo-thermal heat."

I am an architect specializing in environmentally responsible, or green, design, and these are statements I often hear from clients or individuals interested in energy- and resource-efficient design. (Note that I avoid the over-used term "sustainable," because so far, no, or at best, very little, current building construction is truly sustainable.) Since the construction and operation of buildings require a huge portion of our national and global energy budgets, the increasing interest in making buildings more efficient is encouraging. But focusing on the technology that supplies energy and resources without first addressing the demand for them is putting design and construction priorities in the wrong order. In this article, I would like to suggest a different, more effective order of priorities (one that we try to use in our practice), and then briefly discuss how this approach might lead to better buildings.

Efficient boilers and furnaces, geothermal systems that harvest heat from groundwater or the earth, solar collectors that create electricity or heat water, windmills, and other technologies supply heating, cooling, and electricity to meet demands created by buildings and their occupants. However, no matter how efficient, none of these technologies alone guarantees that a building is environmentally responsible and their use should be considered only after addressing the fundamental and important issues of building resource and energy demand. Using efficient or "green" technologies to meet excessive or unnecessary energy and resource demands is not the path toward the high levels of environmental responsibility that are needed to address climate change.

So when we design, before we think about using the sun to generate electricity or hot water, or tapping groundwater to heat and cool, we look for any and every reasonable way to reduce a building's demand for resources and energy. In short, we seek to minimize a building's "loads." Addressing this first takes advantage of the most cost-effective ways to maximize building efficiency, and only after reducing energy and resource demands to their feasible and practical lower limits can we responsibly add the hardware (supply) to meet those demands.

This is not just a philosophical or moral issue: compared to the costs of decreasing the energy and resource needs of buildings, heating, cooling, and energy-producing systems are expensive to install; all require energy and resources to manufacture and install; and many, such as an efficient boiler or a geothermal system, have ongoing energy and relatively intense maintenance requirements. For financial reasons alone, it makes sense to reduce demand and therefore, the size of the systems required to satisfy the demand. Addressing a building's fundamentals is not as glamorous or visible as adding a solar collector, but it is, I believe, more cost-effective. It is easy to add a collector later, or change to a more effective one, but once a building is constructed, improving the performance of its basic elements (e.g., walls, windows, or roof) can be difficult and costly.

What are a building's loads? They can be many and varied, but simply stated, they are the energy and resources required to construct, operate, maintain, and, perhaps, renovate and dismantle the building. Demand for heating, cooling, and ventilation are readily apparent loads, which may account for the fixation on solar collectors and similar systems. Less obvious, but still important, are the "upstream" loads associated with the production and manufacture of building materials and components and the "downstream" loads of change and demolition.

And this is why size matters: there is a direct relationship between a building's size, its demand for energy and resources, and the size of its carbon footprint. The larger a building's size, the larger are its loads. This is why, for example, the LEED-Home rating system penalizes large homes and rewards smaller ones. Rigorously reducing a building's size to what is truly needed, and then using thoughtful, comprehensive design to eliminate unnecessary space and to take full advantage of what remains, are steps critical to environmentally responsible building. The goal is to do more with less, for the space we don't build is the greenest of all.

This can become a positive feedback loop, since reducing size can free funds to improve the quality and performance of building components and systems, further reducing loads. Selecting and detailing these components and systems to maximize energy efficiency is another important part of the design process. In short, we ask, "Is this square foot or cubic foot really necessary and, if it is, how can it be designed to minimize energy and resource demand over the life of the building?" Only after rigorously asking and answering this question will we think about adding solar collectors or other technologies.

Now, it may seem that focusing on the details of resource and energy use will compromise a designer's ability to be truly creative, and attention to these details may sound dull in comparison with the goal of creating aesthetically interesting buildings. But it is worth noting that not having to think about these issues is a relatively recent luxury, made possible by the availability of unrealistically inexpensive energy. For most of recorded history, and even longer, the designers and constructors of buildings have had to pay serious attention to climate, energy, and resources. In fact, the charm and attraction of many of the places that we spend large amounts of time, money, and energy to visit (e.g., hill towns in Italy or island villages in Greece) derive from their response to local climate, resource, and landscape conditions and constraints.

Good architects have always considered the details of building function and construction. This was articulated centuries ago by Vitruvius, a first century, B.C., Roman architect and engineer, in his famous statement that good buildings possess three important qualities: "commodity, firmness, and delight." Commodity is functional appropriateness, meeting the functional needs of the building's users. Firmness is strength and durability. And delight, obviously, is aesthetic quality. In the face of climate change and environmental degradation, we have the responsibility of expanding the scope of these categories. Doing so can be an opportunity instead of a burden.

So, I am suggesting that "commodity" should now include meeting functional needs with a rigorous economy of space. At the same time, it should also include the recognition that building use almost always changes over time, and buildings should be designed to facilitate such change. "Firmness" should be expanded beyond strength and durability (which, itself, needs renewed attention) to include reduced vulnerability to unpredictable and expensive energy sources and supplies, making the structure more robust in the face of a wider range of potentially destructive forces. It also means that buildings can increase, instead of compromising, the security, stability, and livability of their natural, built, social, and political contexts. And "delight" should recognize that a high level of aesthetic interest and quality can derive from a building's expression and celebration of the imperatives of efficiency and environmental responsibility. For example, if walls must be thicker to increase insulation levels, windows can have deeper sills, flared sides, and, therefore, more character. Techniques for gathering daylight and controlling solar gain can add distinct and interesting architectural interest to buildings. Window patterns can, and should, respond to the different environmental conditions (day-lighting, shading, heat loss and gain) of each side of the building (which means that environmentally responsible designs should not look the same on all sides).

If we want to meet the challenge of climate change and approach sustainability, we must reduce our demands on energy and resources. When architects seriously grapple with the imperative and details of minimizing building loads and maximizing building efficiency, designs must respond to the specifics of climate, microclimate, and context. There will be a great opportunity to develop buildings that are profoundly affected by the constraints and opportunities of their location and, therefore, to begin to define strong regional and place-appropriate design vocabularies. An architecture that effectively addresses the challenge of climate change will embody, express, and enhance patterns of place and life.

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