Challenge: Creating Regulatory Green Building Codes

State and local jurisdictions, often due to political pressures, are developing green building or sustainable building codes. A daunting task. Unlike other building code requirements, there is no national model code for green or sustainable buildings written in mandatory language other than requirements for low-rise residential buildings. In some instances, jurisdictions have opted to set levels of compliance with the US Green Building Council (USGBC) Leadership in Energy and Environmental Design for New Construction (LEED-NC) as their requirements. Unfortunately, LEED-NC is not written in mandatory language that can be easily regulated and enforced. The LEED-NC program is an excellent approach for achieving green buildings through contractual arrangements among project owners, contractors and designers or to serve as a basis to determine tax credits, however, the lack of enforceable mandatory language makes LEED-NC less than ideal for a regulatory building code.

For low-rise residential buildings, the International Code Council (ICC) and the National Association of Home Builders (NAHB) jointly developed and published the National Green Building Standard, ICC 700-2008. The standard uses a points-based system consistent with key elements in the USGBC LEED-NC Version 2.2. The points system is split into three categories. The first includes threshold levels for site design and development for sustainable subdivisions. The second is for green building design and construction and the third for additions and renovations. While these provisions are in mandatory language, enforcement as a green building code could be very difficult since there are few baseline requirements that must be applied to every building. For site development, depending on the level of sustainability desired or required by the jurisdiction, compliance options range from as few as 79 points to more than 175 points out of a possible 326 points. For the green building component, it is even more complicated with a range of 222 to more than 697 points out of 1000 plus possible points.

ASHRAE Standard and ICC Code Emphasize Energy

Efforts are underway to produce sustainability codes and standards by major developers of standards and model building codes. The first and most advanced effort is that of the American Society of Heating Refrigerating and Air-Conditioning Engineers (ASHRAE). ASHRAE has partnered with USGBC to develop a standard that addresses key elements of LEED-NC. Standard Design of High-Performance Green Buildings Except Low-Rise Residential Buildings, commonly referred to as ASHRAE Standard 189.1, was published in February.
This document focuses on 1) site development 2) water efficiency 3) energy and atmosphere 4) materials and resources and 5) indoor environmental quality. The Standard can be adopted by reference into the locally enforced building code to establish design and construction requirements for green and sustainable buildings.

Another national effort is a proposed green building code being developed by the International Code Council (ICC) to address design, construction and operation of all buildings other than low-rise residential buildings. This document, aptly named the International green Construction Code (IgCC), contains mandatory requirements and optional compliance electives in seven key areas: 1) natural resource conservation and responsible land use and development 2) material resource conservation and efficiency 3) energy conservation, efficiency and earth atmosphere quality 4) water resource conservation and efficiency 5) indoor environmental quality and comfort 6) building operations, maintenance and owner education and 7) existing buildings.

The proposed approach of optional compliance electives may be used in several ways. A jurisdiction wishing to have greener buildings than what is achieved with the mandatory requirements may set target levels of additional compliance electives that must be met. Jurisdictions also may require specific compliance electives be satisfied in addition to the mandatory requirements based on specific needs or environmental issues important to their communities. The jurisdiction may also choose to combine optional strategies to implement a more rigorous green or sustainable building code.

From the materials standpoint, ASHRAE Standard 189.1 is generic, focusing on features such as reuse of materials and recycled content; regionally extracted, harvested, processed and manufactured materials; construction waste and renewable materials. Earlier drafts of the IgCC had criteria for these generic features related to materials, but also had provisions specific to individual building materials with initial focus addressed in chapters of the International Building Code (IBC). Specific requirements for concrete, aluminum, masonry, steel, wood, glass and glazing, gypsum board and plaster, and plastic were dropped from the public review draft.

Both ASHRAE Standard 189.1 and IgCC emphasize overall energy performance expectations. Currently the most significant positive environmental impact that can be made through the design and construction of buildings is by reducing heating, cooling and lighting loads provided by energy generated using fossil fuels. This emphasis in codes and standards is expected to change over the years. The US Department of Energy is encouraging programs requiring Net Zero Energy Buildings by 2050. Net energy consumption from utility grids for heating, cooling or lighting buildings will be neutral (i.e. zero).

Energy used for building operations must be generated on site or, by some definitions, be provided by green power. Green power is considered to be energy produced via renewable power generation systems including photovoltaics, wind, tidal or geothermal. Excess energy generated on-site is passed on to the energy grid for credit and allows the building to draw from the energy grid when on-site generation may not be possible. As the use of fossil fuels to operate or generate power for buildings is reduced, the percentage of fossil fuels that must be used to produce, transport, deconstruct and remove building materials will be seen as a more significant component with regard to environmental impact.

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Both, ASHRAE Standard 189.1 and IgCC, have targets for achieving increased energy efficiency for the operation of buildings. Thermal mass is considered in documents. However, prescriptive methods for implementing benefits of thermal mass in exterior walls are only in the ASHRAE Standard 189.1. In the IgCC process, the Brick Industry Association (BIA), International Masonry Institute (IMI), National Concrete Masonry Association (NCMA) and Portland Cement Association (PCA) have continually made efforts to incorporate thermal mass provisions into the requirements. Such provisions are important to assure effective and efficient methods for combining energy conservation features provided by thermal resistance and thermal diffusivity, the latter being the ability of massive building materials.

Building fires such as this one in Chicago can spread to other buildings. More fire resistant masonry construction minimizes damage and reduces the demand on community resources.

Photos courtesy of PCA
to reduce and delay heating and cooling loads. They also help direct designers and owners to options that include thermal mass for passive solar and natural ventilation strategies to further reduce heating and cooling loads.

In March, sponsoring organizations of both the IgCC and ASHRAE 189.1 agreed to have ASHRAE 189.1 included as an alternative jurisdictional compliance option within the IgCC. This allows multiple compliance options, eliminating competition and confusion in the adoption of appropriate code and standard provisions that encourage the design and construction of more sustainable buildings. Both compliance methods are now limited primarily to energy conservation, site development, indoor air quality and water conservation. Therefore, it will be more difficult to expand provisions of the parent document, the IgCC, to result in a more comprehensive code appropriately combining accessibility, aesthetics, cost-effectiveness, function and operation, historic preservation, security and safety, as well as productivity with sustainability.

How sustainable are buildings if they require frequent routine maintenance and repairs or must be replaced, reconstructed or renovated after disasters?

ASTM Standards Focus on Environmental Impacts

In addition to ASHRAE Standard 189.1 and IgCC, other standardization efforts are underway at the American Society for Testing and Materials (ASTM). ASTM Committee E60 on Sustainability is developing several standards that may ultimately be used in the previously mentioned standards and codes for design and construction of green or sustainable buildings. For buildings and construction, key existing documents or those under development address cleaning materials and methods, environmental life cycle assessment for building materials and products, data collection for sustainability assessment, earthen building walls, green roof systems, general principles of sustainability, water conservation, marketing and product claims, environmentally preferable products, wastewater, rain water and product category rules for building products. Proposed standards with very broad scopes are slow in their advancement through the development process. Generic and narrow-scaled standards continue to be developed at a much faster pace.

An earlier draft of the IgCC and several ASTM standards have proposed language that focuses on just environmental impacts of the materials themselves without consideration of performance of the materials or products in their intended applications. Key areas being identified for comparison of building products and materials are: green house gas and global warming potential, energy efficiency and renewable energy, water efficiency and quality, material optimization, acidification, smog, ozone depletion and eutrophication. For many applications, this could misdirect designers and owners away from materials otherwise suitable for green or sustainable buildings. This confusion and misdirection could be as simple as ignoring the high embodied energy used to produce fibrous glass insulation relative to other building materials versus the energy conserved over the life of a building because the required insulation levels are set high.

A materials approach may mislead and misdirect designers, specifiers and owners when complete systems for an intended application are not addressed. For example, specifications may require light gauge steel framing to consist of at least 14% zinc as a galvanic coating for corrosion resistance, whereas reinforcing steel used in masonry is inherently protected by the masonry itself, but not given credit in green building requirements. They may call for additional thermal resistance insulation for increased R-value, but without adequate consideration of the placement and use of masonry with its inherent thermal mass benefits. Structural steel members may require sprayed-on fire protection to achieve the same performance levels obtained inherently with non-combustible masonry construction. Additional acoustical treatments and finishes may be required for many building systems in lieu of considering masonry’s inherent ability to reduce sound transmission. Some finishes may be eliminated by allowing masonry to be left exposed. Key sustainability features of masonry construction are wall systems that provide many intended functions specifically required for occupancy and use.

Enhanced Durability, Increased Disaster Resistance

Significant components for truly sustainable buildings appear to be overlooked on almost all nationally developed sustainability guides, certification programs, standards and codes. Crucial components lacking are those related to enhanced durability, increased disaster resistance and improved property protection. How sustainable are buildings if they require frequent routine maintenance and repairs or must be replaced, reconstructed or renovated after disasters? For example, the US Army Corps of Engineers reported that after Hurricane Katrina, 44 million cubic yards of construction materials and building contents were disposed of in landfills. In addition, five years later, communities are struggling to attract businesses and provide housing, schools and services in areas affected by the disaster. Business and home owners are still paying for repairs.

- Eutrophication - excessive nutrients in bodies of water, usually caused by runoff of nutrients (animal waste, fertilizers, sewage) from land, which causes dense growth of plant life; plant decomposition depletes the oxygen supply, leading to death of animal life.
PCA, recognizing the need for increased safety, security and property protection for sustainable buildings and communities, has routinely encouraged that appropriate requirements be incorporated into national reference standards, model building codes, certification programs and guidelines. Unfortunately, balance requirements necessary to satisfy the American National Standards Institute (ANSI) accredited consensus processes employed by standards development organizations typically limit the concrete and masonry industries to a single voice on the committees of many of these programs. With entities such as the American Institute of Architects (AIA), NAHB, Building Owners and Managers Association (BOMA) and several material interest groups such as steel and wood opposing recommendations of the concrete and masonry industries, favorable actions are rarely successful.

BOMA is on record in a variety of forums advising they would support safer and more secure building construction as long as it did not cost one penny more to build. Individuals representing AIA have testified that codes must be the absolute minimum for life safety and all other design and construction decisions should be contractual among owners, designers and contractors. NAHB routinely opposes code changes that increase the cost of new construction. The reality is, it is not enough to consider only initial costs to incorporate functional resilience in sustainable buildings. Significant savings are in the routine operation, use and even reuse of these quality, durable buildings. These savings along with initial construction costs should be taken into consideration to improve buildings and protect the environment.

PCA has compiled building code requirements that provide common sustainability requirements combined with functional resilience provisions to achieve substantially more sustainable construction. These requirements are formatted as amendments and appendices to the IBC to facilitate adoption by state and local governments. Opposition suggests that simply adding energy conservation features, air quality measures, material resources and site selection provisions and water conserving fixtures to buildings built to minimum life safety code requirements is all that is necessary for sustainable structures. In fact, most sustainability programs developed today do not even require that buildings are built to minimum life safety requirements of the building code, much less consider significant property losses.

Community Impact of Property Loss

Direct property losses for common building damage from natural and man-made events, including thunder storms and other wind storms, tornados, hail storms, wild fires, structure fires, flooding and tropical storms are shown in Graphs 1 and 2. Hurricanes and tropical storms are included in Graph 2. They were not shown in Graph 1 due to the inordinate damage that resulted from Hurricane Katrina. Earthquake damage in the US is not shown because data indicates limited damage during the time period. As shown in Graph 2, in 2008, direct property losses due to natural disasters were approximately $38 billion. The trend in the average annual direct property losses due to disasters remains equal to about 5% of the total value of new construction put in place each year. Damaged property ultimately must be repaired or replaced. In many instances, damaged materials, especially contaminated or organic materials with moisture damage, are no longer suitable for reuse or reconstruction and must go to landfills or be incinerated.

Direct property losses do not consider community resources required for emergency response, the loss of tax revenues to jurisdictions by homeowners who relocate or businesses that relocate or simply go out of business. Most economists estimate that for every one job lost due to a disaster there is a resultant loss of approximately 2.5 other jobs. Direct property losses also do not reflect reduction in resources expended for disaster relief. Combining typical sustainability features with an appropriate level of increased disaster resistance and enhanced durability are necessary to minimize the overall negative impact of these disasters to the community.

New building construction with sustainability that includes functional resilience provides increased safety and security and protects property. Enhanced property protection reduces losses to individuals and communities and reduces the amount of building materials and contents that must be disposed of when disasters occur. These requirements can also serve as a solid basis for achieving certification of green buildings.

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To learn more about high performance building requirements for sustainability, visit the PCA website at: cement.org/codes. Proposed requirements to amend the IBC in mandatory language are available for downloading. Many of the requirements are consistent with the intent of ASHRAE Standard 189.1 and USGBC LEED-NC rating system. Code changes for functionally resilient sustainable buildings are limited to the aspects of building design and construction typically within the purview of most building code departments. Continued resistance can be anticipated from some competitive industry groups and interest groups dedicated to promoting the lowest possible initial cost for buildings, regardless of long term impacts to owners and future owners, our communities and the planet. Minimum life safety requirements in building codes may be seen as too expensive to provide adequate reductions in the initial cost of buildings. Waivers from adopted building code requirements to build less than minimum code are being requested and approved
more frequently. This trend is contrary to sustainable and resilient buildings. It needs to be reversed.

Forward Thinking Leaders

While resistance can be expected, the concrete and masonry industries anticipate that interest groups not normally active in codes and standards development will rise to the occasion to encourage adoption of high performance building requirements

Types of organizations that might see the long term benefits from adopting provisions such as those prepared by PCA include: American Red Cross Chapters, the fire service (i.e. state and local fire marshals, fire fighters and fire chiefs), the insurance industry interests (i.e. insurers and state insurance commissioners), state and federal energy departments and emergency management agencies, USGBC chapters and forward thinking community leaders. All these parties have an interest in increasing safety, security, property protection and disaster resistance for people and employers in their communities for the long term benefits of sustainability – social, economic and environmental.

Wind damage by tornadoes, hurricanes and other high wind events can also be minimized with more disaster resistant masonry construction.