The ACI Concrete Sustainability Forum VII took place in Washington, DC, on October 29, 2014, at the ACI Fall Convention. The forum series originated in St. Louis, MO, in 2008, when ACI Committee 130, Sustainability of Concrete, was formed. Following the first workshop, consecutive forums were held in New Orleans, LA, in 2009; Pittsburgh, PA, in 2010; Cincinnati, OH, in 2011; Toronto, ON, Canada, in 2012; and Phoenix, AZ, in 2013.1-6

The topics presented in Washington, DC, exemplify the great progress in concrete sustainability throughout the last 6 years. In addition, it is apparent that the concept of resiliency is becoming increasingly important because of frequent extraordinary natural disasters around the world—events that seem to be the effects of climate change.

Forum VII comprised four parts:
• Presentations on Concrete Sustainability Forum history and lessons, ACI Committee 130’s sustainability guideline, sustainability in fib (International Federation for Structural Concrete) Model Code for Concrete Structures 2010, a low-carbon cement and concrete system, low-carbon footprint cement innovations, carbon dioxide (CO₂) use in concrete production, Federal Highway Administration’s (FHWA) sustainable pavements program, and resilient buildings and communities;
• An interactive panel discussion between the speakers and the audience facilitated by Koji Sakai;
• A luncheon lecture by Henry L. Green, President of the National Institute of Building Sciences (NIBS), titled “Resilience: It’s a Concrete Notion”; and
• A tour of the National Building Museum with a focus on the “Designing for Disaster” exhibit.

Forum VII Presentations
Concrete Sustainability Forum history and lessons
In his introduction to Forum VII, Koji Sakai, Representative, Japan Sustainability Institute, Sapporo, Japan, reviewed the content of previous concrete sustainability forums. In the last 6 years, 46 speakers have presented various sustainability issues. These forums have been very beneficial in promoting sustainability activities within ACI. He commented that in the beginning, the concrete industry as a whole did not know the direction to take with sustainability. After 6 years, however, we are reaching a certain level of understanding about the essence of sustainability. As evidence of this, both ACI and fib have incorporated “sustainability” into their codes.

ACI Committee 130 sustainability report
Julie K. Buffenbarger, Chair of ACI Committee 130, Sustainability of Concrete, and Construction Specialist, Lafarge, Medina, OH, outlined the current status of the preparation of ACI 130R, “Guideline to Concrete Sustainability.” The guide, an inclusive document encompassing the economic, environmental, and social benefits of concrete, will comprise sections on the design phase, materials selection, concrete manufacturing, construction, building use, end of service life, rating systems,
and a glossary. Resilience, climate mitigation, and adaptation will also be covered. The format of the document will be useful to policy makers, owners, designers, and contractors who must select and implement sustainable solutions to mitigate climate change and provide infrastructure resilience.

Based on ACI 130R, a sustainable assessor program and sustainable certification program will be developed.

**Sustainability in fib Model Code 2010**

Koji Sakai discussed the fib Model Code for Concrete Structures 2010, published in 2013. Considering the depletion of resources and the risks of climate change on a global scale, any unchecked increase in the use of resources and energy in the construction sector is obviously unacceptable from a sustainability point of view. Therefore, it is very important to incorporate sustainability into design codes to promote more sustainable concrete structures. The document requires that a structure be designed in such a way that the impact on the environment is appropriately taken into consideration in the life cycle. Environmental impacts can include selection of materials, execution methods, use, maintenance procedures, demolition and waste disposal, recycling procedures, and consumption of energy and resources. For the future revision of the fib Model Code 2010, a new design system, in which the relation of structural safety/serviceability and sustainability is clear, should be created.

**New materials for low-carbon cement and concrete system**

Etsuo Sakai, Professor at Tokyo Institute of Technology, Tokyo, Japan, presented the Energy CO2 Minimum (ECM) Cement Concrete System, developed by his research group under the support of the New Energy and Industrial Technology Development Organization (NEDO). The ECM cement concretes can be used in buildings, civil engineering structures, and foundations, as well as for soil stabilization. The high strength of ECM cement concrete is based on the packing fraction of blast furnace slag particles. A new high-range water-reducing admixture for blast furnace slag was also developed. The carbonation resistance of ECM cement concrete was improved by using high alite-clinker or expansive additives containing free CaO. These new materials have great advantages including 60% CO2 reduction, resistance to thermal cracking, durability enhancement, and high strength.

**Innovations in the cement industry to reduce carbon footprint**

Laurent Barcelo, Manager of Strategic Projects for Lafarge Canada, Pointe-Claire, QC, Canada, described low-carbon-footprint cement innovations. There are three main levers to reduce CO2 in cement manufacture, including energy efficiency, alternative fuels and biomass, and clinker substitution. The main impediment is the use of limestone. With ordinary portland cement (OPC), the opportunities to reduce CO2 are limited. However, there are two solutions outside traditional OPC boundaries: Aether® (belite-calcium sulfo-aluminate-ferrite clinker) cement and Solidia Technologies® (carbonate-based binder) cement. The CO2 footprint of OPC, Aether cement, and Solidia cement is 816, 571, and 570 kg/tonnes (1632, 1142, and 1140 lb/ton), respectively. The two systems demonstrate improved performance in comparison with OPC.

**Beneficial CO2 use in concrete production**

Sean Monkman, VP Technology Development, CarbonCure Technologies, Halifax, NS, Canada, explained their use of CO2 in concrete production by injecting it as an admixture into precast masonry products and wet-mixed concrete. The technology improves performance of industrially produced masonry block and strength of the carbonated wet-mixed concrete at 28 and 56 days, when the control and carbonated concretes had equivalent water contents. Pore solution pH has been found to be unaffected by the carbonation treatment. The CO2 is a rheology-modifying agent that suggests several novel future uses of the carbonation technology. The environmental footprint of the resulting concrete was improved because the absorbed CO2 was permanently converted into solid carbonate products rather than released into the air as a greenhouse gas.

**Sustainable pavements program**

Gina M. Ahlstrom, Senior Pavement Engineer, FHWA Office of Asset Management, Pavements, and Construction, Washington, DC, highlighted the FHWA’s sustainable pavement program. The FHWA initiated the program to assist engineers and practitioners in understanding sustainability and how it relates specifically to pavement material selection, design, construction, preservation, and maintenance. The guidelines for the design, construction, preservation, and maintenance of sustainable pavements using asphalt and concrete materials are under development. The target audiences are State Department of Transportation practitioners, designers, maintenance engineers, materials engineers, construction engineers, inspectors, planners, and others.

**Resilient buildings and communities**

Donn C. Thompson, Director of Market Development, Portland Cement Association, Skokie, IL, discussed withstanding storms. The destruction from natural disasters causes social, economic, and environmental losses. Their costs and consequences continue to rise year after year. Assumptions are often made that these increases are due to stronger, more frequent storms. However, the root cause of greater disaster impacts to individuals, their homes, and their communities is the result of reduced property protection requirements in model building codes beginning in the late 1970s. In addition to this, more vulnerable construction is being developed. Our towns and cities are less resilient. It is necessary to strengthen building code requirements to enable our built environment to better resist the impact of high
winds, fire, and floods, and to enable communities to recover more quickly when impacted by disaster. It was concluded that concrete can offer the solutions that the environmental movement seeks.

Panel Discussion
The Sustainability Forum presentations were followed by questions addressed to the speakers from the audience on the low-carbon technologies—CarbonCure, Solidia Technologies™, and Aether™ cements—as well as the FHWA's sustainable pavements program and the progress of the ACI Committee 130 document. Each of the panelists discussed building codes and the need for higher performance standards regarding to the resilience of buildings at great length.

The last question posed to the panelists pertained to the future of sustainable construction and the direction necessary by the concrete industry. Several panelists voiced concern for solutions in response to climate change including resilient design, low-carbon materials, reporting transparency with environmental product declarations, and the need for higher performance standards regarding to the resilience of buildings at great length.

National Building Museum Tour
From earthquakes and hurricanes to rising sea levels and flooding, natural disasters can strike anywhere and at any time. Recent history shows that no region of the United States is immune from the rising costs of storm and disaster damage. In light of this stark reality, the National Building Museum curated a multimedia exhibition titled “Designing for Disaster,” a call-to-action for citizen preparedness—from design professionals and local decision-makers to homeowners and school children—investigating how and where to build communities that are safer and more disaster-resistant.

During the tour, ACI convention attendees explored new solutions for, and historical responses to, a range of natural hazards. Artifacts from past disasters, such as a door battered by Hurricane Katrina, expressed the destructive, persistent, life-altering power of nature.
Attendees also experienced a true-to-life “safe room”—one of the few defenses against a tornado or violent storm—specified by the Federal Emergency Management Agency, in which exposed layers illustrate how it was built to withstand tornado-force winds and flying debris. And a “wall of wind” invited attendees to test various roof profiles against simulated hurricane-force winds (modeled at Florida International University’s wind testing facility) to see which shape performs best. The exhibit explored a range of flexible design and planning schemes, public policies, and new forecasting technologies ranging from engineering advancements and seismic retrofits of esteemed historic buildings to interactive displays that demonstrate how to strengthen homes, hospitals, schools, and landscapes.

The exhibition remains open to the public through August 2, 2015.

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References


Selected for reader interest by the editors.