

6th International Workshop

Structural concrete in the Americas—a timely event

The 6th International Structural Concrete in the Americas Workshop was held March 19-20, 2010, in Chicago, IL. Eight sessions were held, with topics including: Historical and Modern Concrete Structures in Latin America, Differences in Application of ACI Building Code in Latin America, Bridges and Modern Concrete Structures, Current and Future ACI Documents, and Concrete Structural Wall Systems.

CHICAGO LEADERSHIP

Because it has such an outstanding portfolio of landmark concrete structures, the host city's engineers, institutions, and buildings provided fitting subjects for presentations in the workshop's opening session on Historical and Modern Concrete Structures in Chicago, which continued in Session 5. The first session was moderated by James Wight (who also served as Chair of the workshop). Speakers Tony Fiorato, Gene Corley, and Gary Klein summarized innovations from the Chicago-area engineering and construction community. Many of the innovations were developed at the Portland Cement Association (PCA); CTLGroup, which began as the research and development arm of the PCA; or firms founded by alumni of the two institutions. These innovations, such as improved testing technologies and using computers for concrete design, made today's high-rise structures possible.

Session 5 of the workshop was moderated by Lawrence Novak and provided the second part of the Chicago story. Speakers John Zils, Tony Kiefer, and Dane Rankin reviewed the rich history of high-rise construction in Chicago. Using examples that included Marina City, 311 South Wacker, Aqua, One Museum Park East, and Trump Tower, the speakers demonstrated that improved foundation technology and cutting-edge architectural and structural design must also be considered among Chicago's great contributions to the industry.

A BUILDING CODE FOR THE AMERICAS

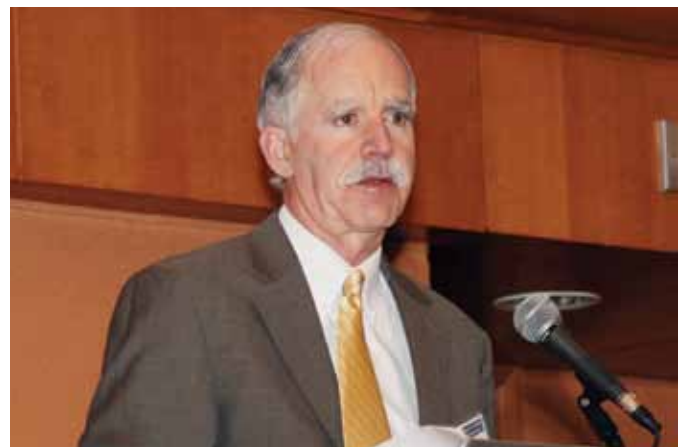
In his keynote luncheon presentation, Ken Bondy recounted the development of the Spanish translation of

ACI 318-05 (ACI 318S). Bondy related how, using the Chilean translation of ACI 318-02 as the basis, the Spanish Translation Task Group of ACI Committee 318 worked to develop consensus on the appropriate terms to be used within ACI 318S. "Concrete Terminology in Spanish-Speaking Countries," an ACI JOURNAL paper by Ignacio Martín published in November 1978, served as a reference for the disparate concrete terminology used throughout the Americas.

ACI 318S and translations of previous editions of ACI 318 have now been at least partially integrated into building codes in a number of countries, including Columbia, Peru, Mexico, Guatemala, Chile, and Argentina. Much of the workshop was therefore focused on how ACI 318 is used in those countries. Speakers noted that regional differences include modifications to:

- Load factors (to account for different levels of construction variability);
- Seismic requirements (to reflect drift limits imposed by local building codes); and
- Detailing requirements (to reflect local labor costs).

A particularly detailed assessment was provided by Hector Monzon-Despang, who discussed the Guatemalan perspective on ACI 318. Monzon-Despang offered that country-specific supplementary documents are needed to



James Wight, Chair of the Sixth International Workshop



The International Workshop Planning Committee, chaired by James Wight, invited five young practicing engineers to participate as speakers. At the workshop reception, they were presented with copies of *Concrete: A Pictorial Celebration*. From left, Magda Karina Carbajal-Valdivia, Peru; Remy Lequesne, U.S.; W. Julian Carrillo, Mexico; Luis Fargier-Gabaldon, Venezuela; and Ayhan Irfanoglu, U.S.

Workshop moderators (below) included Luis García, Thomas Schaeffer, James Cagley, James Wight, and José Izquierdo-Encarnación



improve local understanding and application of the code. Translations of ACI 318 have been used in Guatemala for 50 years, he noted, yet many engineers do not understand many of the provisions. Companion documents covering concrete testing, curing, placing, and other locally supervised issues covered in Chapters 3 through 6 of the code will help improve understanding. Also, because Chapter 12 is very difficult to understand, a code supplement with simplified requirements or explanations would be very helpful. Further, in countries with high seismic risk, more emphasis should be placed on seismic design issues, as nonseismic design is the exception. Designers would appreciate an up-front commentary and guide that places emphasis on earthquake-resistant design as the usual practice.

RECENT EARTHQUAKES

The Chilean earthquake occurred on February 27, less than a month before the workshop, and thus became an ad hoc topic of discussion. Augusto H. Holmberg provided photographic documentation and an initial interpretation of the performance of many of the structures. Holmberg noted that some structural walls exhibited what appeared to be compression failures. These walls were thin and had minimal confinement reinforcement, affecting compressive capacity of the concrete as well as bond capacity at lap splices.

Ayhan Irfanoglu's topic was planned well before the Chilean earthquake struck, though it proved timely. In his presentation, Irfanoglu contrasted the Chilean and Californian schools of thought. Chilean practice calls for simple, prescriptive-based designs, requiring a minimum amount of information. Shear wall areas of about 3% of tributary floor area are required, leading to walls with no boundary elements. Design and construction are therefore simple and straight forward, and walls are used to limit drift and avoid uncertainty without reliance on detailing. Empirical evidence shows that the concrete structures performed well in Chile. Californian practice calls for elegant, performance-

based designs, requiring a great deal of detailed information. Inelastic behavior is expected and accepted, so ductile detailing, with very dense reinforcing, is required. These systems could be sensitive to uncertainties in the construction and ground motion. Empirical evidence of their performance, however, is not yet available.

The earthquake in Haiti, which occurred on January 12, was also a topic for discussion. Ramón Carrasquillo reported that the majority of the deaths occurred in nonengineered, low-cost structures. Unfortunately, Haiti is reconstructing with the same detailing that was used in the past. Lessons learned—that essential facilities must continue to work and low-cost buildings must not collapse—can be achieved through specification of performance levels. For rapid reconstruction, however, prescriptive recommendations are required. For the simplest structures, perhaps simplistic diagrams showing how to build will provide the greatest benefit.

Presentations on structural wall systems were also timely. W. Julian Carrillo reported on structural walls in low-rise construction. These walls can be very economical, as they are only 100 mm (4 in.) thick and the concrete strength is from 15 to 20 MPa (2000 to 3000 psi). Tests of walls with varying aspect ratios and reinforcement levels were discussed.

Burcu Burak reported on her research on wall ratios—the ratio of the sum of the structural wall area to the floor

area. Using several different earthquake records, analyses showed that at ratios above 1.5%, more than 90% of the seismic base shear is carried in walls. Large ratios may not be beneficial from an economic standpoint.

Remy Lequesne reported on research of fiber-reinforced concrete coupling beams. High-performance fiber-reinforced concrete is designed to strain harden and contributes significantly to total shear capacity. Coupling beams can therefore be constructed with reduced amounts of conventional shear reinforcing, allowing additional simplifications in the detailing of the anchorage zones for diagonal bars.

NEW DOCUMENTS **Essential requirements**

José Izquierdo-Encarnación reported on ACI 314.1, “Essential Requirements for Reinforced Concrete Buildings.” Intended to provide automatic code compliance, this document applies to low-rise structures using structural walls to provide earthquake resistance. ACI 314.1 will include numerous figures, and the order of the sections will follow the design process.

While ACI 314.1 will provide advantages for designers, including a design checklist, detailing requirements, and bar cut-off locations, it also has enormous potential as a resource for a first reinforced concrete course. It was developed as a vehicle to meet the code requirements for buildings of limited area and height in an easy, conservative, and simplified manner, but it is not an alternative standard and does not compete with ACI 318. Instead, ACI 314.1 is intended to comply with ACI 318-08, ASCE 7, and the International Building Code.

Repair code

Lawrence Kahn discussed the development of ACI 562, “Evaluation, Repair, and Rehabilitation of Concrete Buildings.” A basic motivation for ACI 562 was provided by a survey showing that about 50% of the people using ACI 318 are using it for the design of repairs. As a result,

ACI’s Strategic Development Council and the International Concrete Repair Institute drafted Vision 2020: Concrete Repair. Vision 2020 called for the creation of a repair and evaluation code to establish uniform practices for evaluation, design, material selection, and application. Stated goals included raising the level of performance; establishing clear responsibilities for the owner, engineer, and constructor; and providing building officials with the means to issue permits.

To develop the required document, ACI Committee 562, Evaluation, Repair, and Rehabilitation of Concrete Buildings, was established in 2006. The committee’s philosophy is based on establishing performance requirements; encouraging creativity and flexibility; enhancing life safety; helping owners extend service lives of their structures; and assuring maintenance of our architectural heritage. This recognizes that maintenance of our current building infrastructure is the most sustainable course for the building industry, yet that existing stock must also be maintained in a safe condition.

The document will assign responsibilities to owners, engineers, and contractors so that no one avoids their duties. The owner will be responsible for known conditions and maintenance; the constructor will be responsible for reporting uncovered defects and following specifications; and the engineer will be responsible for evaluation, repair and durability design, sequencing, and means and methods. The engineer must therefore work hand-in-hand with the constructor.

A draft of the new document is scheduled for 2011. Currently, plans call for a publication date of 2012.

Especificaciones para concreto estructural

Ramón Carrasquillo reported on the Spanish version of ACI 301-10, which will be completed in 2011. Because ACI 301 is written for the contractor, it specifies how to do things and what is expected in submittals. The language is mandatory, but the front-end matter includes notes for specification writers, including listings of

optional and mandatory requirements and submittals to be provided in the project documents.

LOOKING FORWARD

James Cagley closed the workshop by thanking the speakers, moderators, and attendees. He observed that the event was a great success, and the consensus was that ACI should continue to hold international workshops. The next workshop is tentatively set for March 16-17, 2012, in Dallas, TX.



Workshop speakers gathered for a group photo