

International Workshop on High Performance Fiber Reinforced Cementitious Composites in Structural Applications

**May 23-26, 2005
Honolulu, Hawaii
U.S.A.**

Organized by:

The University of Hawaii
The University of Michigan

Co-Sponsored by:

International Union of Laboratories and Experts in
Construction Materials, Systems and Structures (RILEM)
American Concrete Institute (ACI)
Japan Concrete Institute (JCI)

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Introduction

Research and development of High Performance Fiber Reinforced Cementitious Composites (HPFRCC) have generated a wealth of information on the features of these composites, which are defined by an ultimate tensile strength higher than their first cracking strength and the formation of multiple cracking during the inelastic deformation process. While the potential benefits of HPFRCC on structural response and performance have been experimentally demonstrated, specific procedures for structural implementation of HPFRCC in form of design guidelines, manufacturing processes, and evaluation and quality control tools are rarely available.

This workshop aims at alleviating these shortcomings through a concerted effort by an international group of researchers. Participants from the international research communities, the construction industry, structural designers, and materials suppliers are invited to contribute to a sequence of topics emphasizing the design and implementation of HPFRCC in new and existing structures. In a coordinated approach, this workshop attempts to generate a report on the international state-of-the-art on HPFRCC structural applications.

Workshop Structure and Themes

The organizational structure of the Workshop on HPFRCC in Structural Applications, i.e. themes for individual paper contributions and task groups, is based on potentially relevant sections of the Building Code Requirements for Structural Concrete (ACI 318-02). Although this particular document specifies design guidelines for applications of structural concrete in the United States, the subject matter of the individual sections is similar to that in other national building codes. Focus on these sections for the organizational structure of the workshop will therefore maintain general applicability of the state-of-the-art report and other workshop outcomes.

In preparation of the workshop, task groups on subjects related to the individual building code sections described below have been established. Workshop participants are invited to submit papers on the topics outlined below in correspondence to the task group themes. The paper contributions will be made available in electronic format prior to the workshop for review (www.hpfrcc-workshop.org) and will be presented during the first two days of the workshop to serve as the initial basis for discussion. The objective of the task groups is to develop and summarize the technical contents of their respective section/topic during the workshop based on the papers submitted and discussions held on the individual topics. The paper contributions and task group recommendations will be made available in the workshop proceedings (printed and electronic format) through RILEM.

This workshop is expected to result in a report of the current state of knowledge on HPFRCC for structural applications as well as in a definition of tasks to be accomplished for future incorporation of HPFRCC in relevant building codes.

Invited Topics and Task Groups

A) STANDARDS FOR MATERIALS AND TESTING

- a. HPFRCC constituent materials, admixtures, additives
- b. Mix proportions
- c. Mechanical properties (tension, compression, flexure, shear, shrinkage, creep)
- d. Testing methods and round robin tests
- e. Quality control

B) DURABILITY

- a. Long term development of HPFRCC material properties
- b. Serviceability limit state
- c. Shrinkage and temperature deformations
- d. Effect of HPFRCC on corrosion of steel reinforcement
- e. Freeze-thaw behavior
- f. Service life in chemically aggressive environments
- g. Ion diffusion and leaching

C) PROCESSING AND APPLICATION METHODS

- a. Mixing
- b. Placing
- c. Curing
- d. Quality inspection

D) DESIGN ASSUMPTIONS FOR HPFRCC FOR USE IN STRUCTURAL ANALYSIS

- a. Idealization/simplification of stress-strain behavior (elastic/plastic)
- b. Strain limit
- c. Crack width limit

E) FLEXURE AND AXIAL LOADS

- a. Design assumptions (strain compatibility, tensile stress block, compressive stress block)
- b. HPFRCC contribution to moment capacity
- c. Control of failure mode

F) SHEAR AND TORSION

- a. Shear strength provided by HPFRCC
- b. Minimum shear reinforcement
- c. Minimum torsion reinforcement
- d. Shear friction

G) SPECIAL CONSIDERATIONS

- a. HPFRCC/steel reinforcement interface
- b. Impact
- c. Fatigue
- d. Fire

H) SEISMIC DESIGN

- a. HPFRCC contribution to flexural strength
- b. HPFRCC contribution to shear strength
- c. Joints, connections, plastic hinge regions
- d. Coupling beams

Call for Papers

In the preparation of the individual paper contributions and in the development of the task group documents, the authors and task groups should describe a conceptual framework supported by experimental evidence. If appropriate, authors are encouraged to consider the general guidelines and structure outlined below. This will help facilitate a focused discussion and make the process of finding a consensus more efficient.

1) EFFECT OF HPFRCC ON RESPONSE AND PERFORMANCE OF STRUCTURAL MEMBERS

- a. What mechanisms in HPFRCC benefit the response and performance of structural members in comparison to conventional steel reinforced concrete?
- b. Which features of HPFRCC behavior are relevant to the response and performance of structural members (strength and strain capacity in tension, compression, and shear, crack width, crack spacing, energy dissipation, stiffness).
- c. What are the qualitative and quantitative advantages of using HPFRCC instead of conventional concrete? (shear reinforcement, bond, development length, confinement, ductility, integrity, spalling, crack width control, processing, workability, durability and service life).
- d. Can these beneficial features be utilized repeatedly (energy dissipation, fiber pullout, fiber rupture, matrix spalling, etc.)?

2) INCORPORATION OF HPFRCC MATERIAL PROPERTIES IN STRUCTURAL DESIGN

- a. Identify relevant material properties of HPFRCCs to incorporate in structural design (fiber bridging stress-crack opening relationship, stress-strain relationship in tension, compression, shear, crack width, crack spacing, shrinkage, creep).
- b. Suggest effective and meaningful test methods to obtain these properties
- c. Suggest concise simplifications of HPFRCC properties (beyond those already described for conventional concrete) relevant for structural design

3) ANALYSIS OF EXAMPLES OF HPFRCC USED IN STRUCTURAL APPLICATIONS

- a. Availability of constituent materials and effect of variability in constituent material properties
- b. Comparison of initial cost of HPFRCC vs. conventional concrete (materials, equipment, curing, design procedures, training, etc.)
- c. Life-cycle performance and cost
- d. Cost-benefit analysis
- e. Ecological aspects
- f. Case studies

4) IMPROVEMENTS, RESEARCH NEEDS AND DIRECTIONS, FUTURE WORK, CODE IMPLEMENTATION STRATEGIES

Abstracts

Abstracts should be limited to 200 words, outlining the concept and major conclusion of the paper. Authors should indicate their preferred Task Group (A through H). Submission will be facilitated online at www.hpfrcc-workshop.org.

Key dates

Submission of abstracts: November 15, 2004
Paper submission: February 28, 2005

Workshop Venue

The workshop will be held at the Hyatt Regency Waikiki in Honolulu, Hawaii, U.S.A.

Room rates for workshop participants are \$149 for a standard room and \$189 for rooms with guaranteed ocean view. Reservations can be made directly with the hotel by phone at +1 808 921 6026. The group rate is guaranteed until April 8, 2005 and can be booked using reference "UH Manoa HPFRCC". More information can be found at <http://waikiki.hyatt.com/property/index.jhtml>.

Honolulu International Airport (HNL) is served directly by major airports in the United States as well as in Asia. The workshop venue is located approximately 15min from the airport and can be reached by taxi, rental car, or shuttle.



Workshop fee

| | Before February 28, 2005 | After February 28, 2005 |
|---------------------|--------------------------|-------------------------|
| Participant | \$475 | \$575 |
| Student | \$225 | \$275 |
| Accompanying person | \$150 | \$150 |

The registration fee may be reduced depending on the availability of external funding for the workshop. The registration fee includes a copy of the workshop proceedings, the reception, lunches and coffee breaks during the workshop, and the banquet. Registration forms can be downloaded at www.hprfcc-workshop.org.

Workshop Steering Committee

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