

ACI Committee 209 –CREEP AND SHRINKAGE IN CONCRETE
ACI Spring 2013 CONVENTION – PHOENIX
Monday, October 21, 2013
8:30 – 11:30 AM
Meeting Room: C-104 A
Hyatt Regency and Convention Center
Phoenix, AZ

NOTES

1. Opening of the Meeting: Call to Order and Welcome

The meeting was called to order by Chairman Chiorino at 8:35 AM and all in attendance were welcomed to the meeting.

2. Welcome and Introduction of Members

Attendees:

MEMBERS

Mario Chiorino, Chair
Domingo J. Carreira, Secretary
Andy Taylor, TAC Contact

Akthem Al-Manaseer
Zdenek Bazant
Gianluca Cusatis
Matthew D'Ambrosia
Marwan Daye
Raymond Gilbert
Will Hansen
Hesham Marzouk
Hani Nassif
Mario Sassone

ASSOCIATE MEMBERS

Tengfei Fu
Brock Hedegaard
Mauricio Lopez
Roman Wendner
Carin Roberts-Wollmann

VISITORS

Shingo Asamoto
Brian Erler
Pierre Esselinck
Jose Gallardo
Robert Hernandez
William Hunnicut
Mike Kreger
Tetsuya Mishima
Gustavo Polidoro
Jim Preskenis
John Roberts
Steve Schref
Madhumita Sircar
Noriko Suzuki
Orville Werner

Jerzy Zemajtis ACI Staff

Apologies

Voting members Walter Dilger and Carlos Videla offered apologies for not being able to attend the meeting.

3. Announcements

Next meeting: Monday, March 24 Grand Sierra Resort, Reno, NV 10:00 AM - 1:00 PM

Changes in membership:

- Formerly associate member Roman Wendner was proposed to become voting member. The Committee agrees.
- Two associate members resigned.
- Roster update. The updated roster will be incorporated in the Committee Website

Other Announcements:

- Chairman Chiorino reported on current publication of Section 7.2.4 “Analysis of structural effects of time-dependent behavior of concrete” in the final book edition of *fib* Model Code 2010 (printed for *fib* by Ernst&Sohn, October 2013) in harmonized format with ACI 209.3R-XX document. “Analysis of Creep and Shrinkage Effects in Concrete Structures”.
- In what concerns international harmonization, Chairman Chiorino reported on the presentation he made last Saturday October 19 to TAC, in his position of member on “Worldwide Harmonization of Codes and Standards for Structural Concrete”. In this presentation, Chiorino evidenced the fact that the formats adopted for the specific item “Analysis of Structural Effects of Time-dependent Behaviour of Concrete (Creep and Shrinkage)” represents a successful case-study of a fully harmonized approach at international pre-standard and standard levels in a confined sector. This successful outcome was obtained as a result of the coordination activity, of which he was personally in charge, in the 1970-1990s: at pre-standard level first within CEB, and related Manual (1984) and sections of Recommendations and Model Codes (1978, 1990), and subsequently within *fib* in the *fib* Textbook on Structural Concrete (2008), and finally in *fib* Model Code 2010; at standard level within ACI 209 in ACI 209.3R-XX finally approved and under final editing (2013). A précis was also autonomously incorporated (with some imprecisions to be revised soon) by CEN (European standard ambient) in Appendix KK of Eurocode 2: Design of concrete structures - Part 2: Concrete bridges (2004).
The presentation to TAC is available on the Committee 209 website under the window Correspondence/Papers/Worldwide Harmonization. of Codes and Standards for Structural Concrete.
- Al-Manasser presented a paper about comparison models with MC2010.

4. Approval of Minutes from the Spring 2013 meeting in Minneapolis.

Chairman Chiorino asked for review and approval of the minutes from the Spring 2013 meeting in Minneapolis. There were no comments. All voting Members voted in favour. Minutes are approved.

5. Status of reports:

- ACI 209.1R-05 “Report on Factors Affecting Shrinkage and Creep of Hardened Concrete.”
Committee did not meet the deadline indicated by TAC to respond to TAC Comments to the revised version of the document. After a discussion with TAC representatives, and in consideration also of recent progress in the international debate on the subject of the report, Chair Chiorino suggests to the Committee to re-approve for the next five years the original 2005 document, and to start soon a process of more fundamental revision. Re-

approval can be formally asked to TAC and new revised version, when ready, will restart the submission process. Previous TAC comments will be a guideline for revision. Re-approval request needs to be balloted through a letter ballot procedure.

A sub-committee working group will take in charge the revision process: Sassone offers to coordinate and committee approves. Wendner proposes to be member of the working group. Committee approves.

- ACI 209.2R-08 “Guide for Modeling and Calculating Shrinkage and Creep in Hardened Concrete.”

The committee agrees on waiting before updating ACI 209.2R-08. Recent rapidly developing research on updating of current models need to be consolidated before updating the documents. Bazant underlines that current versions of prediction models could bring to incorrect design. He informs the Committee that, in what concerns B3 creep and shrinkage prediction model, a new version is currently almost completed and submitted for publication to RILEM Materials and Structures journal. The new version of model, called B4, has been calibrated on a wide set of experimental tests and on the data collected about large deflections on built bridges.

Chair Chiorino underlines that excessive deflections of large bridges are normally the result of the complex combination of mechanical phenomena, which include beside concrete creep, concrete cracking and steel relaxation. Attention should be paid to safety: designers must become aware that design has to be safe even in presence of large model uncertainties. He also suggests to disseminate the idea that besides bridges, even tall buildings should be monitored, one advantage being the absence of cracking in the main vertical structural elements.

- ACI 209.3R-XX. “Analysis of Creep and Shrinkage Effects in Concrete Structures”
Chiorino, as chair of the Editorial Committee of this document reported that through the last ballots the document stands as finally approved by the Committee. The editorial process intended to meet TAC recent requirements (in particular a specific Chapter 2 devoted to Notations) is in progress. The final edited version should be submitted to TAC by spring –summer 2014.
- ACI 209.4R-XX “Test Methods for Creep and Shrinkage”, Hani Nassif.
Nassif reports on the state of the document. The work is still in progress. Volunteers could help on shrinkage. The draft will circulate online and contribution can be given to the conclusions. One issue is the possible link with ASTM. A draft will be presented by springtime.

6. Presentations:

- Presentation by Bryan Erler of Erler Engineering Ltd, Chicago on his present work on “In-service Inspection of Post-tensioned Nuclear Containments Requirements” and the possible involvement of ACI 209 Committee in this subject.
In case of ungrouted, unbonded tendons in containments it is possible to measure forces. There are guidelines that specify these inspections. A lot of data of lift-off readings over decades are available. One year tests are generally performed and used as predictive basis. Vessels are commonly designed for 60 psi pressure, parallel to seismic events. Historically designers were using the 209 time functions.

- Presentation by Zdenek P Bazant of his work on cyclic creep of concrete. Presentation was based on the paper circulated to the committee earlier to stimulate discussion. Bazant suggested that cyclic creep should be taken into account a part of new document 1R, as well as the interaction with steel relaxation.

7. Sub-committee tasks:

- **209-0C Models Applicability and Uncertainty**

D'Ambrosia asked to have an official sub-committee designation for the report “Creep, and Shrinkage Models, Applicability and related Uncertainties”. He suggested to schedule a meeting before Reno spring convention. Main issue of sub-committee should be to give indications on how to behave in presence of model uncertainties, and on proper strategies for model calibration and assessment..

In particular, the document should focus on: Statistical quantification; Updating of predicting models; Tools for prediction in presence of significant uncertainty; Probabilistic tools.

- **209-0D Numerical Methods and 3D Analyses**

Cusatis reported about the sub-committee established for the report: “Guidelines for 3D Time-dependent Numerical Analyses of Concrete Structures Based on Rate-type Creep Laws”. The sub-committee includes Beghini, D’Ambrosia, Wendner, Bazant, Cusatis, Sassone. Cusatis suggested Wendner as new Chair for the sub-committee. The Committee approved.

A brief debate took place within the Committee on the prospective content of the report to be produced by the sub-committee and on the structure of the sub-committee. Conclusions are indicated in the following.

Document should contain a state of art and general concepts for application and validation. It should also define the limits to practical use. Viscoelastic Poisson Ratio should be taken into account. A specific investigation about the complexity of structural models (3D-2D-1D) and non linear effects should be made. The accuracy of analyses based on rate-type constitutive laws, compared with analyses based on hereditary integral constitutive laws of ageing linear viscoelasticity should be evaluated, as well as numerical efficiency of these two approaches and their relation with the combined discretizations in time and space.

The sub-committee should include a mix of academics and practitioners in the field of structural design. A proposal is done to ask Beghini of SOM to contribute, as well as someone from HDR and TY Lin and other prominent engineering companies involved in design and construction of important sequential structures, like, typically, large span bridges and tall buildings. It is deemed important to involve also people from the ambient of computer codes developers.

Wendner suggested that the state of art will be presented in a Special Session and in a Special Publication entitled “3D Time-dependent Numerical Analyses of Concrete Structures”, at the ACI Spring 2015 Kansas City Convention. SP will require at least 10 manuscripts. Zachary Grasley is proposed to be invited to this Session.

8. Adjournment

The meeting adjourned at 11:30 AM.