MINUTES – FALL 2004 MEETING
ACI 408 - BOND AND DEVELOPMENT OF REINFORCEMENT
Sunday, October 24, 2004
8:30 – 11:30 a.m.
Union Square 21 – Hilton San Francisco
San Francisco, CA

Members attending: JoAnn Browning, Tess Ahlborn, Jun Zuo, Adolfo Matamoros, Voula Pantazopoulou, Peter Bischoff, Max Porter, Robert Barnes, LeRoy Lutz, Robert Frosch, David Darwin, Neil Hawkins.

Associate members: Carol Shield, Cathy French,


1. Welcome
   The meeting was called to order by David Darwin at 8:30 am.

2. Introductions

3. Approval of the minutes from the Washington meeting
   Minutes are approved without changes

4. Membership changes
   Robby Barnes and Koray Tureyen were promoted to voting members.

5. ACI 408.1 Design Provisions for bars in tension
   a. Ballot results 408.1R-90
      The ballot to withdraw committee document 408.1R-90 was approved.
   b. Results of TAC review of 408.1-XX
      The TAC review resulted in 66 technical comments, of which the majority is editorial in nature. There was a small number of primary comments that need to be addressed. These changes will have to be reviewed and the document will be re-balloted accordingly.

      The main concern of TAC was that the document presented a competing standard with 318. A possible alternative suggested by Dan Falconer was to include the document as an appendix to the State of the Art report. However, it is unclear whether this will be acceptable to TAC because this item will discussed until after the current 408 meeting.

      Leroy Lutz suggests writing a technical paper by the committee explaining the derivation of the procedure and with some design examples. Dave Darwin brings up the possibility of rewriting the document in a more generic form so that it can be used
with codes other than the 318 Building Code. Robert Frosch proposes that the method should be presented as a suggested procedure for bond design in the future rather than a design standard.

There was consensus among the committee to proceed with placing the proposed provisions as an appendix of the state-of-the art report.

Dave Darwin commented on a comparison of different design procedures for bond he performed for a recently submitted paper. His analysis showed that the AASTHO procedure was less conservative than those of other codes. He found that for the data set in the bond database 53% of the tests had unconservative estimates of bond strength. The design procedure in the CEB-FIP code had results that were more unconservative than those of the Eurocode, in part because the form in which the latter accounts for the effect of concrete compressive strength on bond strength.

Dave Darwin requests opinions on what are possible alternative to proceed with the code. Cathy French indicates that it is likely that there will be resistance in committee 318B to adopting provisions that change the form in which the effect of concrete compressive strength is considered to the power of 1/4th. However, it may be useful to submit this proposed changed for balloting to assess the response of the committee. Other topics that 318-B would like to receive assistance on are high-strength reinforcement, headed bars, and bond problems that may arise due to the difference between the actual strength of reinforcement and the nominal strength allowed by the code for design.

6. ACI Committee 408 Database 10-2001
   a. Status of the bond database

      The database has been posted in the ACI web page. The database is being compiled by Jun Zuo so if committee members have data to add the can contact him or Dave Darwin. The data included is from splice and development length.

   b. Input for updating the database

      Robert Frosch will forward information on some corrections to the database. Carol Shield volunteers information on tests from FRP bars.

7. Ballot to withdraw “Suggested Development, Splice, and Hook Provisions for Deformed Bars in Tension (ACI 408.1R-90)”

   Removal of the document was successfully approved.

8. Recommendations for changes in Chapter 12 of ACI 318

   Dave Darwin will confer with Cathy French on how the committee can assist 318-B on their mission.


   A previous effort took place 7 years ago in which Voula Pantazopoulou, Jim Cox, and Steve McCabe developed a draft of a state of the art report. There were several versions of the report circulated. The previous report was abandoned because a similar report was put forth by and CEB-FIP group. The old report addressed bond
modeling with different procedures ranging from very basic ones to finite element analysis. New ideas have changed considerably so that new information available that can be used to update the state of the art. Laura Lowes volunteers to bring up the idea in committee 447 to try to develop a joint committee document.

Also modeling under cyclic loading is a topic not addressed in the FIP report.

10. Design provisions for drilled and grouted bars

No report was given by the members of the committee.


Dave Darwin thanked Adolfo Matamoros for his work in organizing the three technical sessions.

12. Bond of FRP Reinforcement – State-of-the-Art report

Committee 440 is working on a state of the art report for FRP. There is a chapter of this document that addresses bond, but there is no comprehensive document about the state of the art in bond of FRP reinforcement. Robert Frosch indicates that bond strength of glass bars seems to be independent of deformation pattern because the effect of the modulus is more significant than the effect of the deformation.

Robert with Carol Shield prepared an outline of the document last convention. Voula Pantazopoulou and Max Porter volunteer to help as well. Carol Shield will chair the subcommittee in charge of this document. Carol Shield recently proposed a design expression in committee 440. The goal of the group is to develop a draft of the document by the New Orleans convention. An August 31 deadline is established for developing a draft of the document.

13. Headed Bars

There are questions about the minimum head size that must be used. Adolfo Matamoros will work on identifying an equation for design using headed bars and prepare a presentation on design provisions for headed bars for the Spring convention.

14. High-strength steel \( f_y > 100 \text{ ksi} \)

There is interest in committee 318 to address the effect of high-strength reinforcement. David Darwin indicates that 408.3 has been shown to work with bars with yield strengths of up to 103 ksi through evaluation of test results in the bond database. Dave Darwin also indicated that according to his research the ACI 318 code equations become unconservative for steel with yield strengths greater than 80 ksi. Because for stresses greater than 100 ksi the increase in bond strength with development length becomes very small, the design equations become unconservative.

15. Research presentations

Tess Alhorn gave a brief summary on the NCHRP project on Bond being conducted at Purdue and Oklahoma State Universities. Work will be wrapped up in the next year.
Voula Pantazopoulou is working on performance-based criteria for design for bond and development of reinforcement and bond of post-installed FRP bars. She is also working on the development of a new testing procedure (tensile-pullout tests) which can be used to test the development length in a tension field.

Cathy French requests the assistance on two additional topics: the effect of compression reactions on development length in strut-and-tie models, and how to qualify wire to show that it has adequate development. Committee members indicate that ASTM has a pullout test for qualifying epoxy coated reinforcement and that splice tests may be used as an alternative.

Lisa Feldman is conducting research on the bond strength of plain bars to evaluate seismic resistance.

Robert Frosch is conducting an experimental study with approximately 40 beams with different types of FRP reinforcement including glass and carbon. He is working on the development of a model that addresses both FRP and steel reinforcement.

David Darwin has been reviewing different codes vis a vis the ACI 408 bond database.

16. Other business
  David Darwin thanks committee members for attending.

17. Next meeting
  The next meeting will take place on Sunday morning at 8:30 am in New York.

18. Adjournment
  The meeting was adjourned at 11:03 am