

**Minutes
ACI Committee 355
Anchorage to Concrete
October 28, 2001
Dallas, TX**

Call to Order: Chairman Ron Cook called the meeting to order at 10:00 AM. All members and guests in attendance were self-introduced. The Chairman requested that all members sign the attendance sheet and check the roster for correctness.

Roster/Address Changes: There were no membership changes.

Minutes: Motion by Meinheit, second by Klingner, to approve the Philadelphia minutes as written was unanimously approved.

Award: Chairman Cook gave Harry Chambers a plaque to recognize his long service to ACI 355 as a proponent of anchoring to concrete, first as chairman and then as secretary for many years. The Committee hopes that Harry continues as an active member of the Committee.

Status of ACI 318 Appendix D (CB30): Ron Cook gave an update on the status ACI 318 Appendix D. The Changes to ACI 318 including Appendix D were published in the June 2001 issue of *Concrete International* for a 90 day public comment period with a closing date of September later extended to October 14, 2001. The draft Response to Public Comments for Appendix D was handed out that contained proposed changes to the Appendix D Code and Commentary based on comments made by P. Carrato and R. Orr, both members of ACI 355.

In response to the public comments by P. Carrato, changes in the scope were proposed. A motion by R. Wollmershauser, seconded by M. Miltenberger, to support the changed scope statement in both the Code and Commentary was unanimously approved.

In response to the public comments by R. Orr with regard to the plastic hinge zone, a motion by M. Miltenberger, seconded by R. Wollmershauser, to support the proposed changes in revised language was unanimously approved.

It is expected that ACI 318 will act on these issues this week and approve Appendix D for inclusion in ACI 318-02.

Report from ACI 349 Subcommittee 3: Branko Galunic gave a report on the status of the recently approved ACI-349-01 including the new Appendix B. He indicated that some editorial changes need to be made to Appendix B. Some of these should be considered by ACI 318 for Appendix D. The Committee needs to prepare design examples in accordance with the new anchor revisions. Shear lugs also need a closer look.

Status of ACI 355.2 Public Comment Response: Ron Cook presented an update of the status of the processing of 355.2 to a full standard. He thanked the working group composed of R. Klingner, L. Mattis, D. Meinheit, C. La Vine, P. Carrato, and R. Wollmershauser [and R. Cook] for their efforts in contributing to the closure statement. The July 2, 2001 ballot was successful in that all items balloted passed both the majority of members voting to approve requirement as well as 2/3 of those voting yes and no. There is an October 12, 2001 ballot out, due on November 17, 2001 to resolve the negatives on the July 2, 2001 ballot of the closure statement. [It was later reported that

TAC on Sunday, October 28, 2001, approved the revised closure statement pending the results of the October 12, 2001 ballot.]

Discussion ensued about needed revisions to ACI 355.2. R. Wollmershauser reminded the Committee that an agreement between ACI and ASTM existed to the effect that when ACI had completed the standard, it was to be balloted in ASTM. At such time that ASTM approved a standard that met the requirements of ACI 318 Appendix D, then ACI would withdraw ACI 355.2. A motion was made by Orr with a second by Ireland for ACI 355 to prepare revision 1 to ACI 355.2. The vote was 10 for, 0 against, and 1 abstention. R. Wollmershauser was assigned the task by the chair to discuss the issue of ACI 355.2 remaining with ACI for a longer period.

Seminar on ACI 318 Appendix D and ACI 355.2: Ron Cook reported that he has attended the ACI Seminar Committee meeting Sunday morning to propose a seminar covering Appendix D and ACI 355.2. The idea originated with a small group of ACI 355 members. The Seminar Committee was very receptive. Three options were discussed: 1. a separate anchoring to concrete seminar, 2. add a partial day to the PCA/ACI seminar on ACI 318-02, and 3. a long distance [over the web] or CD seminar.

ACI staff were requested to check the viability of marketing such a seminar to help determine which option was preferred. It was further discussed that all three options could be pursued. The committee began discussing the format and content of such a seminar. It was concluded the design examples were needed as well as a design guide. Discussion was deferred to the discussion on the Design Guide.

Joint ACI 318, 349, 355 Design Guide: Ron Cook presented a written summary of the history of the design guide activities in ACI 355. See attachment. A motion by Klingner, seconded by Chambers, to support the development of a design guide as a high priority of the Committee and authorize the Design Guide Task Group to come back with a proposal, was unanimously approved. Interested members were encouraged to meet at 3:30 PM for the Task Group meeting. Minutes of the Task Group meeting are attached.

Anchorage Programs of Interest:

a. Chris Heinz reported that he had made some calculations for certain applications for undercut anchors using the CCD method. Compared to the previous ACI 349 45-degree cone method, the edge and spacings become significantly larger and require deeper embedments to get ductility.

b. Don Meinheit gave an update of the PCI welded stud shear testing. The following equation was determined to be a very good fit to the test data.

$$V_{co} = 22\lambda\sqrt{f'_c(BED)^{4/3}}$$

When reduced by the 5% fractile, the equation becomes:

$$V_{co} = 16.5\lambda\sqrt{f'_c(BED)^{4/3}}$$

where BED = back edge distance
= de3 + Σ
and de3 is the front edge distance (c₁ in the CCD equations)

The test data correlated very well to the BED to the 1.33 power.

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Other variables were investigated including the spacing between anchors (S_x) parallel to the free edge. Concrete breakout capacity depended on overall spacing of the two outer-most or end anchors (designated as X). As the ratio of X to BED became large, the capacity approached the single anchor capacity in breakout. When $X/BED = 1$, the capacity was that of a single anchor.

For X spacing for 2 or more studs in the back row,

$$C_x = 0.85 + (X/BED) \quad \text{for } 1.0 \leq C_x \leq 2.0$$

Where X is the overall out-to-out dimension of the outermost studs in the back row of the anchor group.

X = 1.0 for a connection with only one stud in the back row. At a spacing of 3.5 BED, the anchors act independently.

The thickness was also investigated.

$$C_h = 1.0 \text{ for } h > 1.75 \text{ BED}$$

$$C_h = 0.75\sqrt{(h/BED)} \text{ for } h \leq 1.75 \text{ BED}$$

Discussion ensued about the use of the PCI results and the data inclusion in the ACI anchor database. The data will be made available and could be included in the database.

Unfinished Business: There was no unfinished business.

New Business:

- a. The date and time of the Spring meeting in Detroit was proposed to be Sunday April 21, 2002 from 8:30 AM to 1:00 PM. A task group meeting will be held later that day, possibly from 3:30 PM to 6:30 PM.

Meeting was adjourned at 1:00 PM.

Respectfully submitted,
Richard E. Wollmershauser
Secretary

Members in attendance: J. Ardahl, H. Chambers, R. Cook, S. Eskildsen, B. Galunic, C. Heinz, B. Ireland, R. Klingner, H. Lancelot, C. La Vine, R. McGlohn, D. Meinheit, M. Miltenberger, R. Orr, R. Smith, B. Turley, R. Wollmershauser

Guests: H. Asher, R. Becket, J. Hammell, P. Iverson, J. Krohn, Nam-Ho Lee, M. Ricketts, M. Smock, D. Ward

Attachments:

1. Corrected roster
2. Summary of Design Guide Activities

Minutes
Joint Design Guide Task Group
ACI Committees 355, 249, and 318
October 28, 2001
Dallas, TX

The Joint Task Group meeting was called to order by Chairman Ron Cook. At 3:30 PM.

Members and others in attendance: R. Becker, H. Chambers, R. Cook, S. Eskildsen, B. Galunic, J. Hammell, C. Heinz, B. Ireland, R. Klingner, C. La Vine, Nam-Ho Lee, R. McGlohn, D. Meinheit, M. Miltenberger, R. Orr, B. Turley, D. Ward, R. Wollmershauser.

There was a consensus of those present that the design examples should be approached first, before considering the content of the design guide. The design examples could form the basis for a PCA/ACI seminar covering ACI 318 Appendix D and ACI 355.2.

Design Examples: A format for the design examples was agreed to and will be sent out via email by Chairman Cook. The Klingner memo giving the design examples of 1991 was distributed. The primary purpose of the design examples then was to compare the CB30 CCD method to the 349 method.

Variables of anchor types for the design examples were developed and should be used in some of the design examples. These include:

- Cast-in-place bolts (headed bolts and embedded nuts)
- Cast-in-place welded headed studs
- Cast-in-place L and J bolts
- Post-installed mechanical anchors
 - regular
 - sleeved

It was the consensus that the task group start with the PCA design examples and build from there. The first six were generally taken from the 1991 task group (see Klingner memo), which was used in the PCA *Strength Design of Anchorage to Concrete* document. An extended list of proposed design examples was developed and assignments made for each. The following table presents this information.

No.	Design Example	Responsible Persons
1	Single anchor – tension - away from edges <ul style="list-style-type: none">- uncracked – CIP- cracked – post-installed	Robert McGlohn Dick Wollmershauser
2	Tension group near an edge	Ron Cook / Bruce Ireland
3	Single anchor – shear – near edge	Ron Cook / Bruce Ireland
4	Single anchor – tension & shear – near edge	Ron Cook / Bret Turley
5	Groups of anchors in tension and shear – 4 bolts – near 2 edges	Don Ward / Sam Eskildsen
6	Group of fasteners in tension near one edge with eccentricity	Bret Turley / Ron Cook
7	Multiple anchor connection subjected to tension and shear <ul style="list-style-type: none">- elastic - plastic	Richard Klingner / Nam-Ho Lee / Chris Heinz
8	Multiple anchor connection loaded in “torsion”	Nam-Ho Lee / Chris Heinz
9	Lap splice of bars & anchors – column base pier	Sam Eskildsen / Richard Orr
10	Hairpin type supplemental reinforcement / large edge distance / thickness influence	Roger Becker / Branko Galunic

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11	Eccentric shear directed away from the free edge	Roger Becker / Sam Eskildsen
12	Prying action force on anchor	Branko Galunic / Richard Klingner
13	Shear parallel to free edge	Bruce Ireland / Robert McGlohn / Richard Wollmershauser (data)

The first person generally is the team leader to perform the example, the second person to check the example.

In one of the design examples with groups of anchors in tension, the use of seismic considerations should be covered.

The task group agreed that there was some urgency to complete the design examples as soon as possible. The following schedule was developed.

- Ron Cook to mail out design example format to task group members.
- Each group works assigned design examples by January 31, 2002 and send to Ron.
- Ron to assemble and distribute to task group.
- Comments back by February 28, 2002.
- Mail all design examples to ACI 355 members on April 1, 2002.
- Discuss at ACI 355 April 21, 2002 meeting.
- After April 2002 committee meeting, ballot the design examples.

Design Guide Content: The task group received copies of three tables of contents:

1. From Rick Klingner's original draft as modified in 1997,
2. From the CEB Design Guide, and
3. From the PCA document on "Strength Design of Anchorage to Concrete."

It was decided to let a "Table of Contents Task Group" consider and recommend a table of contents/content for the Design Guide and report at the April 2002 meeting. The task group is composed of Ron Cook, Richard Klingner, Don Meinheit, and Dick Wollmershauser.

In an earlier discussion, Rich Klingner recommended that the design guide cover the issue of the effect of preload on fatigue. It was also suggested that the group consider additional tests that should be covered.

The meeting was adjourned at 6:10 PM.

Respectfully submitted,
Richard E. Wollmershauser
Secretary