ACI Committee 360

Design of Slabs-on-Ground

MEETING AGENDA

Monday, March 26, 2018

Salt Lake City, UT

2:00PM - 6:30PM

Grand America Hotel

Room – Imperial Ballroom A

1. Call to order
   Scott Tarr – Chair

   A. Introduction of attendees.

   B. Do not forget to sign one of the attendance sheets. Indicate "voting", "associate" or "visitor".

   C. Update member contact information on ACI's web site

   i) It is important that everyone's email address is correct with ACI because that is the email address that is used to send committee correspondence and notice for ballots.

   ii) Go to http://www.concrete.org "Login" then "Members" then "Address Change" to update the information.

   D. Membership changes.
2. Comments concerning the minutes from the previous 2 meetings
   A. Detroit Spring 2017
      a. Vote to approve the Detroit Spring 2017 committee meeting minutes.
   B. Anaheim Fall 2017
      a. Vote to approve the Anaheim Fall 2017 committee meeting minutes.

3. Reports from related Committees
   A. Committee 302        Rick Smith
   B. Committee 330        Eldon Tipping
   C. Committee 301        Scott Tarr

4. Harvey Haynes, ACI 224 – White Paper: Early Entry Contraction Joints and Their Depth Criterion and White Paper: Problem Related to Aspect Ratio of Contraction Joints. (These white papers are attached for review prior to discussion)

5. Next Document Revision
   A. Word document for editing is on the web site “360R-XX All Chapters & Appendixes 26AUG10.doc”
   B. Document Figures – Wayne Walker in charge. All changes to be given to Wayne.
   C. Discussion of the current state of the document – where we are and where we need to go.
   D. Chapter subcommittee reports.
      a. Chapter 1 – Introduction        Bill Brickey
      b. Chapter 2 – Notation and Definitions   Barry Foreman
      c. Chapter 3 – Slab Types        John Rohrer
      d. Chapter 4 – Soil Support Systems for Slab-on-Ground   Bill Brickey
      e. Chapter 5 – Loads           Jim Loper
      f. Chapter 6 – Joints          Robert Rodden
      g. Chapter 7 – Design of Unreinforced Slabs   Allen Face
      h. Chapter 8 – Design of Slabs Reinforced for Crack Width Control  Mike McPhee
      i. Chapter 9 – Design of Shrinkage-Compensating Concrete Slabs  Brad Fricks
      j. Chapter 10 – Design of Post-Tensioned Slabs-on-Ground  Bob Anderson
k. Chapter 11 – Fiber Reinforced Concrete Slabs-on-Ground  
   Mike McPhee

l. Chapter 12 – Structural Slabs on Ground Supporting Building Code Loads

m. Chapter 13 – Design of Slabs for Refrigerated Facilities  
   Barry Foreman

n. Chapter 14 – Reducing the Effects of Slab Shrinkage and Curling  
   Pat Harrison

o. Chapter 15 – References  
   Barry Foreman

p. Appendices

5. New Business
   A. Open Discussion
   B. Miscellaneous

6. Adjourn
White Paper: Early-Entry Contraction Joints and Their Depth Criterion

By Harvey Haynes, ACI 224

Introduction
Currently, ACI Committee 332 is revising Residential Code Requirements for Structural Concrete (ACI 332-14) and Commentary. In the Code, two topics exist on contraction joints that need consideration for revision. These topics need consensus among ACI 224, 332, and 360 to assist 332 in moving forward with revisions. This white paper discusses the topics, background information, and proposed revisions. The topics are early-entry contraction joints and the depth criterion that should apply to these joints.

Early-Entry Contraction Joints
The conventional term “early-entry sawcutting” applies to contraction joints installed in slabs-on-ground by a specialty saw that is used as soon as concrete can support the equipment and operator. This sawcutting should occur within hours after concrete placement, while the concrete is still in its stiffening phase, and prior to strength development by calcium silicate hydrate formation.

Other types of contraction joints, which are installed in fresh concrete, are not recognized as early-entry contraction joints. These joints are mechanical devices, also called formed or preformed joints, and tooling, grooving, or scoring the surface of the slab during finishing operations. It is logical and technically accurate to label these joints as early-entry contraction joints, and to treat these joints in the same manner as early-entry sawcuts.

Currently, ACI 332-14 does not treat mechanical inserts and tooled joints as early-entry contraction joints. Mechanical inserts and tooled joints are grouped with conventional, wet or dry, diamond-blade, sawcutting. Conventional sawcutting requires concrete to develop sufficient strength so that the diamond blade does not ravel the edges of the sawcut. A wait period of 4 to 12 hours is required before these saw cuts can be installed. Clearly, mechanical-inserts and tooled joints do not compare with conventional sawcut joints. Rather, they compare with early-entry sawcuts.

Consensus is needed to acknowledge that mechanical-inserts, tooled, and early-entry sawcuts are similar early-entry contraction joints and should be treated in a similar manner when applying contraction joint depth criteria.

Depth Criteria for Contraction Joints
Today, common practice within the design and construction industry is to install contraction joints to a depth of ¼ the slab thickness. Early-entry sawcuts are an exception. ACI 360.R-10, Design of Concrete Slabs-on-Ground permits early-entry sawcuts to be 1 in. deep for slab thickness up to 9 in. ACI 332 has adapted this criterion in their Residential Code.
About 30 years ago, the company Soff-Cut introduced the early-entry sawcutting technology. The sawcutting equipment cut joints to a depth of only 1 in. After many years of field use, the prevailing view was that cutting a joint 1 in. deep in young concrete was effective in activating contraction joints in slabs up to 9 inches thick. This is the background information for establishing the depth criterion of 1 in. for slabs up to 9 in. thick.

Concern exists today that the depth criterion of 1 in. for slabs up to 9 in. thick, which is 1/9 the slab thickness, is not appropriate. Field experience has shown that these contraction joints do not consistently activate. A revised depth criterion is appropriate, and the criterion should apply to all types of early-entry contraction joints.

The criterion of 1/5 the slab thickness is considered as an appropriate recommendation. The justification for this depth relates to many examples of post-construction investigations where early-entry contraction joints (particularly tooled joints and early-entry sawcut joints) were installed less than the specified ¼ slab thickness and the joints were found to have activated. Also, revising the existing criterion of 1/9 the slab thickness to 1/5 is a conservative revision.

Consensus in needed to approve the depth criterion of 1/5 the slab depth for early entry contraction joints, which include mechanical-inserts, tooled, and early-entry sawcutting. The traditional depth criterion of ¼ the slab thickness applies to wet or dry conventional sawcut joints in hardened concrete.

Summary
The existing text in ACI 332-14, which relates to both topics discussed above, is:

10.5.2(d) Joint depth shall be ¼ the slab thickness for formed or tooled joints, or dry-cut sawed joints in hardened concrete.
10.5.2(e) Joint depth shall be a minimum of 1 in. for slab depths up to 9 in. for early-entry sawed joints.

If consensus exists, these sections could be revised to read:

10.5.2(d) Joint depth shall be ¼ the slab thickness for formed or tooled joints, or wet or dry-cut sawed joints in hardened concrete.
10.5.2(e) Joint depth shall be a minimum of 1 in. for slab depths up to 9 in. for 1/5 the slab thickness for mechanical inserts, tooled, or early-entry sawed joints.

This white paper relates only to obtaining consensus on the topics, not approving the revised text to ACI 332-14. The topics for consensus are repeated:

A) Mechanical-inserts, tooled, and early-entry sawcuts should be treated as early-entry contraction joints.
B) The contraction joint depth criterion of 1/5 the slab thickness should be applied to early entry contraction joints.
White paper: Problem Related to Aspect Ratio of Contraction Joints

By Harvey Haynes, ACI 224

Introduction
The Residential Code, ACI 332-14, Section 10.5.2(c) states “Slab sections defined by contraction joints shall have an aspect ratio no greater than 1.5”. This requirement has the unanticipated effect of restricting the contraction joint spacing to distances less than those given in Table 10.5.2, Maximum Contraction Joint Spacing for Slab-on-Ground without Steel Reinforcement. This white paper will explain the problem and provide a proposed solution.

Problem
The problem relates to slabs-on-ground that are monolithically joined to perimeter footings. Slabs isolated from footings do not experience the problem. The maximum contraction joint spacing for the slab, $S$, is defined by Table 10.5.2. The aspect ratio of a rectangular section of slab, where $S_a$ is the short side and $S_b$ is the long side, is limited by $S_b/S_a = 1.5$.

The distance of the first joint away from the footing also has a spacing limitation of $S_a \leq S/2$, which is given in ACI 224.R4-13, Guide to Design Detailing to Mitigate Cracking (Figure 1). When the first joint away from the footing is $S_a = 0.5S$, then the following substitution shows:

Given: $S_b = 1.5 S_a$

and $S_a = 0.5(S)$

Then $S_b = 1.5(0.5S) = 0.75(S)$ $S_b \text{ can never equal } S, \text{ which is not appropriate.}$

An example is given in Figure 2 to show the problem.

Solution
A solution is to change the wording in the code to read “Slab sections defined by contraction joints, where all four sides are free to contract, shall have an aspect ratio no greater than 1.5”. The Commentary can say that slab sections where one or more sides are not free to contract, such as slabs-on-ground monolithically attached to footings, have no limitation on aspect ratio.
Figure 1. Contraction joint spacing criteria from ACI 224.R4-13, Guide to Design Detailing to Mitigate Cracking.
Figure 2. Difficulty with aspect ratio of 1.5
when slab monolithic with footing.

\\[ S_b = 9' \]

\[ S_c \]
\[ S_a = 12' \]
\[ S_a = 6' \]

Slab \( t = 4'' \)

From Table 10.5.2: Allowable CT span \( S_{CT} = 12' \)

**Step 1**: \( S_a \) limited to \( 0.5 S_c = 0.5(12') = 6' \)

**Step 2**: \( S_b \) limited to \( 1.5 S_a = 1.5(6') = 9' \)

**Step 3**: \( S_c \) limited to \( 1.5 S_b = 1.5(9') = 13.5' \)

\( S_c \) limited to \( \delta = 12' \)

\( \text{No Good} \)