## SUBCOMMITTEE ON MATERIALS
### 2017 Annual Meeting – Phoenix, AZ
#### Tuesday, August 8, 2017
3:15 – 5:00 PM MST

### TECHNICAL SECTION 3a Meeting Minutes
Hydraulic Cement and Lime

<table>
<thead>
<tr>
<th>Standard Designation</th>
<th>Summary of Proposed Changes</th>
<th>TS Only, Subcommittee Only or Concurrent? (TS / S / C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>M85</td>
<td>TS Ballot Item 1 - Remove Reference to C186</td>
<td>Subcommittee Only</td>
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<tr>
<td>M85</td>
<td>TS Ballot Item 2 - Revise Chloride Content Language</td>
<td>Subcommittee Only</td>
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<tr>
<td>M240</td>
<td>TS Ballot Item 3 - Include Reporting of Alkali Content of Natural Pozzolan</td>
<td>Subcommittee Only</td>
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<td>M240</td>
<td>TS Ballot Item 4 - New Note on ASR in Section 4.3</td>
<td>Subcommittee Only</td>
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<tr>
<td>M240</td>
<td>TS Ballot Item 5 - Delete Type LH Drying Shrinkage Requirement</td>
<td>Subcommittee Only</td>
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<tr>
<td>M240</td>
<td>TS Ballot Item 6 - Revise Type MS and HS Compressive Strength Limits</td>
<td>Subcommittee Only</td>
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<tr>
<td>M240</td>
<td>TS Ballot Item 7 - Revision of M240 Note 6 to Harmonize with C595 Note 6</td>
<td>Subcommittee Only</td>
</tr>
<tr>
<td>R70</td>
<td>Updates for ASTM Equivalency</td>
<td>Concurrent</td>
</tr>
<tr>
<td>T106</td>
<td>Updates for ASTM Equivalency</td>
<td>Concurrent</td>
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<tr>
<td>T107</td>
<td>Updates for ASTM Equivalency</td>
<td>Concurrent</td>
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<tr>
<td>T154</td>
<td>Updates for ASTM Equivalency</td>
<td>Concurrent</td>
</tr>
<tr>
<td>M327</td>
<td>Move note 1 to the body of the standard to make it mandatory language to match a change being made with ASTM. Cast Administrative Negative in coordination with ASTM fall balloting of this item.</td>
<td>Concurrent</td>
</tr>
</tbody>
</table>

**New Task Forces Formed:** None

**Task Force Name** | **Summary of Task** | **Names of TF Members**
-------------------|---------------------|------------------------
None.              |                     |                        |
Research Liaison: Bob Horwhat (Pennsylvania). Bob is retiring, so this TS is in need of a new Research Liaison.

Other Action Items:
Reconfirmation of T129, T132, T218, T219, T232

M85 will be changed editorially to change heat of hydration criteria from 1 decimal to 2 decimals.

A research problem statement on "Rating Concrete Permeability" was discussed and sent to TS 3c for further consideration. Another research problem statement on "Benchmarking Accelerated Laboratory Tests for ASR Field Performance" was submitted as a walk-on item. These problem statements were discussed, unofficially endorsed, and referred to TS 3c for further consideration.

1. Call to Order and Opening Remarks

Staton (MI) Chair and Trautman (MO) Vice Chair
AASHTO Liaisons – Puterbaugh (AASHTO) and Knake (AASHTO)
Sergeant at Arms – Blackburn (AL)
Research Liaison – Horwhat (PA)

The meeting was called to order at 3:17 PM. Introductions were made by members, guests, and friends.

2. Roll Call.

Members present are highlighted below.

<table>
<thead>
<tr>
<th>AASHTO Technical Section 3a Voting Members</th>
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</thead>
<tbody>
<tr>
<td>John</td>
</tr>
<tr>
<td>Brett</td>
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<tr>
<td>Brian</td>
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<tr>
<td>Christopher</td>
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<td>Robert</td>
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<td>Mladen</td>
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<tr>
<td>Robert</td>
</tr>
<tr>
<td>Darin</td>
</tr>
<tr>
<td>Charles</td>
</tr>
</tbody>
</table>

3. Approval of Technical Section Mid-Year Minutes – Attachment 1

A motion was made by Oklahoma and a second by Pennsylvania to approve the minutes as written. The motion passed unopposed.

4. Old Business

A. SOM Ballot Items
   1. Outstanding items from Mid-Year Meeting – No outstanding items.

B. TS Ballots – Attachment 2
2017 Annual Meeting (cont.)

All items passed with no negatives.

1. M85 – Item 1 – Remove reference to C186
   There was a comment from Rhode Island, as follows: “Should C1702 be added to Section 9.2?” Committee response: An abbreviated list of AASHTO and ASTM standards was included in the ballot detail description, which inadvertently did not include C1702. Review of the M85 showed that C1702 is, indeed, included in the listing of ASTM standards.

2. M85 – Item 2 – Revise chloride content language
   There was a comment from Pennsylvania regarding section 12.3, Note 2 vs. Note 8. Committee response: This was an auto formatting issue that caused numbering issues. This will be corrected to reflect correction to “Note 8” before the item moves to SOM ballot.

3. M240 – Item 3 – Include reporting of alkali content of natural pozzolan
   There was a comment from Missouri suggesting that instead of saying “alkali-silica reaction” would it be better to say “alkali-aggregate reaction.” Committee response: There was a brief explanation given that the intent is not to address ACR but ASR only, and that the note is intended to recommend not using the aggregate source if it is shown to be ACR susceptible.

4. M240 – Item 4 – New note on ASR in Section 4.3
   There was a comment from Missouri suggesting that instead of saying “alkali-silica reaction” would it be better to say “alkali-aggregate reaction.” Committee response: There was a brief explanation given that the intent is not to address ACR but ASR only, and that the note is intended to recommend not using the aggregate source if it is shown to be ACR susceptible.

5. M240 – Item 5 – Delete Type LH drying shrinkage requirement
   No comments

6. M240 – Item 6 – Revise Type MS and HS compressive strength limits
   No comments

7. M240 – Item 7 – Revision to M250 Note 6 to harmonize with C595 Note 6
   No comments

   A motion was made by New York and a second by Rhode Island to move all of the TS ballot items to full SCM ballot. The motion passed unopposed.

C. Task Force Reports - Attachment 3

1. TF 09 – 1 – Harmonization Task Group Update – Naranjo (TX) or Streeter (NY)
   Andy Naranjo provided a brief presentation regarding recent Task group activities. Seven items that were initiated by the task group earlier this year recently went through Tech Section 3a ballot (see above item 4b). The task group recommends a concurrent ballot for M 327 to move Note 1 in subsection 3.1.6 pertaining to companion samples for comparing cements containing processing additions to the body of the spec, thus, making this note a mandatory requirement. A similar change is currently being balloted in ASTM committee. It was suggested that an administrative negative be placed on the ballot in the event the ASTM ballot does not pass. A motion was made by New York and a second by Rhode Island to ballot the change concurrently. The motion passed unopposed.

   M85: Change the heat of hydration criteria from 1 decimal to 2 decimal places is recommended. This change can be made editorially.

   “Appendix X1 Fig. X1.1 example chloride reporting - Editorial change to report chloride content to 3 decimal places per AASHTO T 105 (change from 0.02% to 0.020%) in 2018 edition.”

   Upcoming Activities: The task group further reported that anticipated upcoming activities will include harmonization revisions to M85/C150, and M 240/C595, which will be discussed at the mid-year and other future meetings.

2. ASR Task Group Update – Ahlstrom (FHWA)
The task group will schedule a conference call to resolve the significant figure issue. There may be a NCHRP proposal or pooled fund study involving ASR field trials.

5. New Business
   A. Research Proposals – Horwhat (PA)
      1. 20-7 RPS

      There were no new 20-7 Research Problem Statements submitted.

   2. Full NCHRP RPS – Attachment 4
      a. Rating Concrete Permeability Based on Resistivity Measurements.

      Amii Hanna reported that this RPS was developed as recommended by the 20-7/Task 381 advisory panel. It was agreed by the panel that previously approved 20-7 project should be elevated to a full NCHRP research project. It was noted that this project is more applicable to TS 3c. TS 3a may also endorse this statement if felt that it is appropriate. Hence, it was recommended that this RPS be presented to TS 3c for their action. TS 3a could then follow the TS 3c lead in the event they extend their official endorsement.

      b. Benchmarking Accelerated Laboratory Test for ASR to Field Performance: Consideration of Cement and Alkali Contents and Influence of SCMs.

      Andy Naranjo (TxDOT) presented the problem statement on ASR Exposure Block Testing. It was noted that this project is more applicable to TS 3c. TS 3a may also endorse this statement if felt that it is appropriate. Al Innis of LaFarge-Holcim commented that he felt that this was a good project, as there are many places where low-alkali cements are not available (especially in the Northeast). The current guidelines are based on empirical data. This will be critical to preventing ASR in the future. The committee felt that this was a very good project, however, the objective needs to be more clearly defined. It is suggested that this discussion be continued in TS 3c. A motion was made by Rhode Island and a second by Texas to endorse this statement, but defer official endorsement of this problem statement to TS 3c. It was recommended that the author refine the objective for this RPS before the TS 3c meeting (Note. The RPS included in Attachment 4 reflects revisions made by Andy Naranjo after the TS 3c meeting).

   B. AASHTO Resource/CCRL – Prowell (CCRL) – None.

   C. NCHRP Issues – Hanna (NAS)

   Amir Hanna reminded attendees that when submitting a RPS, please be concise regarding what the product of the research is going to be. Also, make sure that the research does not duplicate work that is already being done. Lastly, be reasonable in estimating funds so that your project is not underfunded. Especially research that requires laboratory work which is costly.

   D. Correspondence, calls, meetings – None.

   E. Presentation by Industry/Academia

      Dr. Larry Sutter gave a brief presentation on activities happening at ASTM and ACI related to non-hydraulic cements. A summary of the presentation is as follows:
      - There has been increasing interest in alternatives to Portland cement
      - At ACI, a group has been putting together a definition of alternative cement material (ACM). Dr. Sutter reminded the audience that this is a different material than an
alternative supplemental cementitious material (ASCM). An ACM is a product that can fully replace Portland cement in a mixture
• Possible alternatives can be categorized as clinkered, calcined, or non-clinkered
• Several real-world projects happening around the country
• There is a new ASTM subcommittee on Non-Hydraulic Cements. The first meeting was in June 2017
• Discussions at the first meeting included defining ACMs, barriers, and facilitating adoption of these materials
• Barriers include the lack of material specifications. In addition, existing test methods may not be appropriate for these materials and new test methods may be needed. Finally, current construction codes are based on conventional PCC
• ASTM is starting with a focus on development of performance specification for non-hydraulic cement for pre-cast applications and masonry
• ACI is forming a new committee focused on this material
• ACMs are not something that will be available shortly, rather, sometime in the distant future.

2. "It's Not Your Grandfather's Cement Anymore" – Oscar Tavares, Consultant

Oscar Tavares gave a brief presentation on the history of cement and cement production.
• Do the ASTM/AASHTO standards currently in place today reflect what should be considered the state-of-technology relative to quality-based manufacturing?
• In the mid 1950's there were over 150 manufacturing locations domestically
• Domestic plants mainly produced Portland Cements. 100% US ownership
• Today, there are less than 99 domestic facilities
• Today, less than 10 plants utilize the wet process
• The most recent development in plants was the precalcining kiln
• Older Portland cements were 95% clinker and 5% gypsum. In the 2000's there was a definition change in ASTM C150 that allowed the inclusion of limestone in Portland Cement (about 5%), reducing clinker to 90% (after grinding aide inclusion)
• The standards that we use today were developed primarily in the 1930's through the 1950's. Four additional standards were developed in 1950's and 1960's. Hence, innovation on cement testing is needed
• Production rates of cement have increased, but sampling rates have stayed the same
• The changes in production have had an impact on clinker quality
• A study that compared cements in 1998 vs. 1950's indicates an increase in sulfates and alkalis. This correlates with an increase in 1-day strength, but has little impact on longer-term strength testing
• The presentation suggested that states gain a better understand of cement manufacturing, review current cement testing standards, and take a more active role toward reviewing future changes in Portland cement standards
• The presentation suggested that a working group be developed to respond to user needs.

F. Proposed New Standards – None

G. Proposed New Task Forces – None

H. Standards Requiring Revision or Reconfirmation –
1. T129 - Amount of Water Required for Normal Consistency of Hydraulic Cement Paste
2. T132 - Tensile Strength of Hydraulic Cement Mortars
3. T218 - Sampling Hydrated Lime
4. T219 - Testing Lime for Chemical Constituents and Particle Size
5. T232 - Determination of Lime Content in Lime-Treated Soil by Titration
2017 Annual Meeting (cont.)

AASHTO will send these standards to reconfirmation ballot.

I. SOM Ballot Items (including any ASTM changes/equivalencies) –
   1. R 70 - *Use of Apparatus for the Determination of Length Change of Hardened Cement Paste, Mortars, and Concrete*
   2. T106 - *Compressive Strength of Hydraulic Cement Mortar (Using 50-mm or 2-in. Cube Specimens)*
   3. T 107 - *Autoclave Expansion of Hydraulic Cement*
   4. T154 - *Time of Setting of Hydraulic Cement Paste by Gillmore Needles*

These standards were reviewed and it has been determined that minor revisions are needed to bring these AASHTO standards in line with ASTM. A motion was made by Rhode Island and a second by New York to send these standards to concurrent ballot. The motion passed unopposed.

6. Open Discussion
   1. Bob Horwhat announced that he is retiring. Hence, the TS is in need of a new research liaison. Anyone wishing to volunteer, please contact the TS Chair.
   2. Awards and Accomplishments – The committee would like to thank Bob Horwhat for his volunteer activities as they relate to the TS 3a Research Liaison.
   3. Performance Engineered Concrete Mixtures (PEM) Pooled Fund update – Ahlstrom (FHWA) Eleven states committed along with the FHWA. Iowa DOT is the lead state for the pooled-fund project. In addition, there will be a tech-transfer deployment as part of the pooled-fund. FHWA is looking to provide additional funding opportunities for states that are looking to add aspects of performance testing into their state.

   Don Streeter (NY) mentioned that there will be a workshop at TRB all day Sunday on this subject.

   There was a pilot workshop with NYDOT, a 1-day training session. Let Gina know if you are interested in getting free training as part of the pilot. Don Streeter highly recommended this training, his technicians got a great deal out of it.

   3. Other - None

7. Adjourn  The meeting adjourned at 4:49 PM
SUBCOMMITTEE ON MATERIALS
Mid-Year Web Meeting
Wednesday, November 16, 2016
1:00 - 3:00 PM EST

TECHNICAL SECTION 3a
Hydraulic Cement and Lime

John Staton (MI) Chair and Brett Trautman (MO) Vice Chair
AASHTO Liaisons – Sonya Puterbaugh (Re:source) and Brian Johnson (Re:source)
Secretary – Gina Ahlstrom (FHWA)
Sergeant at Arms – Lyndi Blackburn (AL)

I. Call to Order and Opening Remarks – Staton
The Chair called the meeting to order at 1:04 pm.

Chair asked whether there was a formal recognition presented to Mark Felag for his past 25 years of efforts as TS 3a Chair. Katheryn Malusky mentioned that there was a letter of appreciation sent to him and there might be something else in addition in the works from AASHTO.

- Roll Call – Attendees were asked to sign in via email to Sonya, as follows:

<table>
<thead>
<tr>
<th>DOT Representatives from MI, MO, FL, HI, IL, NY, OK, TX, VA, WA, Ontario MOT</th>
<th>were present</th>
</tr>
</thead>
<tbody>
<tr>
<td>John Staton - MIDOT</td>
<td>Thach Thien - Caltrans</td>
</tr>
<tr>
<td>Brett Trautman - MODOT</td>
<td>John Melander - PCA</td>
</tr>
<tr>
<td>Katheryn Malusky - AASHTO</td>
<td>Mohammad Aqel – Ont.</td>
</tr>
<tr>
<td>Brian Johnson – AASHTO</td>
<td>Hanna Amir - NCHRP</td>
</tr>
<tr>
<td>Sonya Puterbaugh - AASHTO</td>
<td>Don Streeter - NYDOT</td>
</tr>
<tr>
<td>Tyler Moody - CCRL</td>
<td>Lyndi Blackburn - LADOT</td>
</tr>
<tr>
<td>Jan Prowell – AASHTO</td>
<td>Oak Metcalfe - MTDOT</td>
</tr>
<tr>
<td>Paul Tennis – PCA</td>
<td>Matt Romero - OKDOT</td>
</tr>
<tr>
<td>Michael Arasteh - FHWA</td>
<td>Bill Bailey - VDOT</td>
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</table>

II. Approval of Technical Section Minutes Annual Meeting 2016 – Minutes Attached

The chair summarized the minutes from the 2016 Annual Meeting. No comments were raised. Don Streeter (New York DOT) motioned for approval of the minutes, which was then seconded by Andy Naranjo (Texas DOT). The minutes were approved as written.

III. Old Business – Presentation Attached
A. SOM Ballot Items
1. Item 1: Concurrent ballot item to revise M 85 by removing reference to 5% in Note 3 and other items. (Affirmative 43, Negative 0, No Vote 8) There was no meeting discussion regarding this item.
2. Item 2: Concurrent ballot item to revise M 240 to include requirements for MS and HS designations for cements containing 5% to 15% limestone. (Affirmative 42, Negative 1, No Vote 8) (One Comment – Ontario MOT)

- The Ontario Ministry of Transportation comment stated: “The committee is proposing change in AASHTO M240 that will allow use of Portland limestone cements as moderate or high sulfate resistance cements. One argument provided in support of the change is that CSA standards currently include options to qualify PLC as sulfate resistant cement. However it does not mention that CSA only allows qualifying Portland limestone cements as sulfate resistant when they are used in combination with supplementary cementing materials. Which is quite different from what is being proposed. The CSA reference is therefore misleading.”

The Chair opened the discussion regarding the negative vote cast by the Ontario Ministry of Transportation and asked a member of the Joint AASHTO/ASTM Harmonization Task Group (JAAHTG) to provide a synopsis of their recent phone conversations with the Ontario MOT regarding the disposition of their negative ballot vote.

Andy Narango (Texas DOT), Cochairman of the JAAHTG, contacted Hannah Schell from Ontario Ministry of Transportation (MOT) via phone prior to the TS 3a meeting. He reported that Ontario MOT’s concerns were not related to the proposed changes to the standard. Rather, they were focused on a statement included in the rationale regarding current CSA standards that was felt to be misleading. During the November 9th web conference meeting of the JAAHTG, task group members discussed the negative and recommended that a clarification to the rationale be included in the minutes of the TS 3a Mid-Year meeting to address the negative. Ms. Schell subsequently agreed to withdraw the MOT’s negative with the understanding that clarifying language to the rationale would be included in those mid-year meeting minutes. John Melander read the following JAAHTG discussion as developed during the November 9th JAAHTG meeting:

**JAAHTG Discussion:** The rationale sentence in question was intended to contrast CSA provisions with US provisions, which currently do not allow blended cements with between 5% and 15% limestone to be qualified as sulfate resistant. As noted by the Ontario Ministry of Transportation comment, CSA currently includes options to qualify PLCs in combination with SCMs or in a blended cement containing SCMs as sulfate resistant. It was not the intent of the sentence in the rationale to mislead. More detail of the current CSA provisions is noted in PCA R&D SN3285a and Barcelo et al. (2014), which were referenced in the rationale. This information was considered when developing the proposed revision to AASHTO M 240 and ASTM C595.

**JAAHTG Recommendations:** Include the JAAHTG discussion of Ontario Ministry of Transportation comment in TS 3a Mid-Year Meeting minutes to clarify CSA provisions. Proceed to include balloted changes to M 240 in next edition of standard.

- Ontario MOT added (during meeting discussion) that there is also a restriction in water-cement ratio. Bill Baily (VDOT) commented that the water-cement ratio requirements are most likely included in the concrete specifications, rather than the cement specifications.
3. Item 3: Concurrent ballot item to revise M 240 to require the reporting of density. (Affirmative 45, Negative 6, No Vote 8) There was no meeting discussion regarding this item.

4. Item 4: Concurrent ballot item to revise M 240 to simplify compressive strength provisions for cements with special properties (MC, MH, A). (Affirmative 43, Negative 0, No Vote 8) There was no meeting discussion regarding this item.

5. Item 5: Concurrent ballot item to revise M 240 to add ASR guidance to facilitate the use of PP65. (Affirmative 43, Negative 0, No Vote 8) [Two Comments – PA, KS]. PennDOT provided an editorial comment, as follows: “change NA2Oe to be consistent with PP 65”. KDOT provided an editorial comment to “re-letter the notes”. These comments will be addressed editorially. There was no meeting discussion regarding this item.

6. Item 6: Concurrent ballot item to revise T 107 to add “procedures in 11.2 shall be followed” to the end of section 7.6. (Affirmative 43, Negative 0, No Vote 8) [One comment – PA]. PennDOT provided a comment which was editorial in nature, as follows: Revise from "Procedures in 11.2 shall be followed" to "Follow procedures in Section 11.2" to put in active voice, imperative mood and to add the word "Section". This comment will be addressed editorially. There was no meeting discussion regarding this item.

7. R 70 – Editorial – Title Change. This was a non-balloted item which was agreed at the annual meeting to be handled editorially. “The title of the standard should be changed to a dual standard because both English and metric units exist in it.” There was no meeting discussion regarding this item.

8. M 327 – Editorial – Note addition. This was a non-balloted item which was agreed at the annual meeting to be handled editorially. Revision to M 327 to include new Note 1: “Note 1 – The companion cements for comparison include a sample of the control cement not containing the processing addition and a sample of the cement containing the processing addition.” There was no meeting discussion regarding this item.

B. TS Ballot Items – There were no TS ballot items at this time.

C. Task Force Reports
   i. TF 09 – 1 – Harmonization Task Force Report – Naranjo/Melander
      • Andy Naranjo presented slides (included is slides 22-26) of the meeting presentation pertaining to current and anticipated future activities of the JAAHTG.
      • One administrative negative is currently in place to coordinate timing of changes to harmonized standards AASHTO M 85/ASTM C150 and AASHTO M 240/ASTM C595. This administrative negative will be withdrawn once the ballot revisions are uploaded to the AASHTO Publications website.
      • Andy Naranjo, Co-Chair, gave an open invitation for more AASHTO states to join the group.

IV. New Business
A. Research Proposals – There were no research proposals presented at this time.
   1. 20-7 RPS
   2. Full NCHRP RPS

B. Resource/CGR – Jan Prowell. Jan mentioned for general interest that the packaging of the slag cement reference sample were completed today, which should be ready for distribution in 2-3 weeks. It was mentioned that slag cement standards are actually covered under TS 3b, but sharing this information with the TS 3a group is appreciated.
C. NCHRP Issues – Amir Hanna. No problem statements were submitted for 2018 NCHRP program consideration related to cement/concrete; Amir asks that everyone look seriously at research needs and submit problem statements accordingly.

D. Correspondence, calls, meetings/Presentation by Industry/Academia. There was no meeting discussion regarding this item.

E. Proposed New Standards. There were no new standards presented at this time.

F. Proposed New Task Forces. There were no new task forces proposed at this time.

G. Standards Requiring Reconfirmation. Two standards (M 216, T153) are currently being balloted for reconfirmation, per action from the August 2016 annual meeting. There are no other standards up for reconfirmation at this time.

H. SOM Ballot items (including any ASTM changes/equivalencies). There were no new SOM ballots presented at this time.

V. Open Discussion - Group
   • Michael Arasteh of the FHWA Baltimore Resource Center commented that he has enjoyed participating in these meetings.
   • Don Streeter (NYDOT) reported that the Transportation Research Board (TRB) will be hosting an all-day workshop on Sunday, January 8, 2017 beginning at 9 am, focusing on “Durability of Accelerated Concrete”. This event will be part of the TRB’s World of Concrete Workshop, held as part of the Annual meeting of the TRB on January 8-12, 2017 in Washington DC.

VI. Adjourn Meeting adjourned at 1:53 pm.
**Tech Section 3a Ballots - 2017**

**Item #:** 1  
**Ballot Action:** Revise AASHTO M 85, Standard Specification for Portland Cement  
**Description:** Remove reference to C186

**Rationale:**
ASTM C186 has essentially been replaced by ASTM C1702 in practice as a standard test method for determining the heat of hydration of portland cements. As a result, it has been proposed to remove C186 from M 85 in order to simplify the requirements of the standard. This ballot provides detailed changes to support that proposal. The optional requirements in M 85 for heat of hydration when using ASTM C1702 were developed on the basis of an interlaboratory test program led by ASTM Subcommittee C01.26. That research confirmed that test methods C186 and C1702 are strongly correlated, but with a slight bias. Although the numerical limits are different for the two test methods, they are comparable. C1702 exhibits less variability than C:86, and uses equipment that is more readily available.

Proposed additions are shown **underlined in red** font and proposed deletions are shown in **red strikethrough** font. Other text is shown for information only. Note, footnote, table, and section numbers will be revised editorially as needed.

This proposal has been developed by TS 3a TF09-1, the Joint AASHTO-ASTM Harmonization Task Force, and a parallel proposal is being considered by ASTM Committee C01 for ASTM C150.

**Detailed Changes:**

**AASHTO Designation: M 85-17**

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**2. REFERENCED DOCUMENTS**

**2.1. AASHTO Standards:**

**2.2. ASTM Standards:**
- **C51**, Standard Terminology Relating to Lime and Limestone (as used by the industry)
6. CHEMICAL COMPOSITION

6.1. Portland cement of each of the ten types shown in Section 1 shall conform to the respective standard chemical requirements prescribed in Table 1. In addition, optional chemical requirements are shown in Table 2.

**Note 5**—The limit on the sum, C₃S + 4.75C₃A, in Table 1 provides control on the heat of hydration of the cement and is consistent with an ASTM C186 7-day heat of hydration limit of 335 kJ/kg (80 cal/g) or an ASTM C1702 3-day heat of hydration limit of 315 kJ/kg (75 cal/g).

**Note 6**—There are cases where performance of a cement is improved with SO₃ in excess of the Table 1 limits in this specification. ASTM C563 is one of several methods a manufacturer can use to evaluate the effect of sulfate content on cement characteristics. Whenever SO₃ content of a cement exceeds Table 1 limits, ASTM C1038/C1038M results provide evidence that excessive expansion does not occur at this higher sulfate content.

**Table 4—Optional Physical Requirements**

<table>
<thead>
<tr>
<th>Cement Type</th>
<th>Applicable Test Method</th>
<th>I and II</th>
<th>IA and IIA</th>
<th>II(MH)</th>
<th>II(MH)A</th>
<th>III and IIIA</th>
<th>IV</th>
<th>V</th>
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<tbody>
<tr>
<td>False set, final penetration, minutes, percent</td>
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<td>Heat of hydration (alternate methods)?</td>
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<td>3 days, max, kJ/kg (cal/g)</td>
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<td>255 (60)</td>
<td></td>
<td></td>
<td>200</td>
<td>200</td>
</tr>
<tr>
<td>Heat of solution:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7 days, max, kJ/kg (cal/g)</td>
<td></td>
<td></td>
<td>290 (60)</td>
<td>290 (60)</td>
<td></td>
<td></td>
<td>225</td>
<td>225</td>
</tr>
<tr>
<td>28 days, max, kJ/kg (cal/g)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Strength, not less than values shown:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Compressive strength, MPa (psi), 28 days</td>
<td>T 106M/T 106</td>
<td>28.0</td>
<td>22.0</td>
<td>28.0</td>
<td>22.0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sulfate resistance, 14 days, max, % expansion*</td>
<td>ASTM C452/C452M</td>
<td>/</td>
<td>/</td>
<td>/</td>
<td>/</td>
<td></td>
<td>0.040</td>
<td></td>
</tr>
<tr>
<td>Turbidimeter test</td>
<td>T 986/98 T 98</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

There are optional requirements only if specifically requested. Availability should be verified. See Note 2 in Section 4.

* The method used shall be identified on all mill test reports that include these data. When the sample fails to meet the requirements of the heat of solution method, the isothermal conduction calorimetry method shall be used, and the requirements for the isothermal conduction calorimetry method shall govern.

**Note 6**—There are cases where performance of a cement is improved with SO₃ in excess of the Table 1 limits in this specification. ASTM C563 is one of several methods a manufacturer can use to evaluate the effect of sulfate content on cement characteristics. Whenever SO₃ content of a cement exceeds Table 1 limits, ASTM C1038/C1038M results provide evidence that excessive expansion does not occur at this higher sulfate content.

9. TEST METHODS

9.1. Determine the applicable properties enumerated in this specification in accordance with the following methods:

Tech Section 3a
9.1.1. *Air Content of Mortar*—T 137;

9.1.2. *Chemical Analysis*—T 105;

9.1.3. *Strength*—T 106M/T 106;

9.1.4. *False Set*—T 186;

9.1.5. *Fineness by Air Permeability*—T 153;

9.1.6. *Fineness by Turbidimeter*—T 98M/T 98;

9.1.7. *Heat of Hydration*—ASTM C1702 or ASTM C186;

9.1.8. *Autoclave Expansion*—T 107M/T 107;

*Tech Section 3a*
Item #: 2
Ballot Action: Revise AASHTO M 85, Standard Specification for Portland Cement
Description: Revise chloride content language

Rationale:
When Section 12.3 was added to C150, several voters noted that the text referred to “total chloride content” whereas ASTM C114 refers to “acid-soluble chloride content.” Although these values are typically the same for the majority of cements, there may be cases in which the typical method of analysis (XRF) determines a higher value (total) than would be determined in an acid-soluble analysis (referee method). Building codes commonly reference the water-soluble chloride content of concrete. However, ASTM C114 and AASHTO T 105 methods determine the acid-soluble (or total) chloride content of cement, which would be equal to or higher than a water-soluble chloride content. Thus the value reported for cement will be conservative from the perspective of estimating the contribution of cement to a concrete’s water-soluble chloride content.

The proposed change would remove the adjective “total” from the text of Section 12.3 and change Note 8 to remove the discussion related to total and water-soluble chloride values. There is no water-soluble test for cement, so that sentence could be viewed as misleading.

It may be worth noting that this proposal does not change the requirements of the specification, but is intended to clarify terminology that may not be familiar to all readers of the standard. In addition, ACI 318 has approved methods to estimate chloride content for concrete mixtures and discussion on chloride content in its commentary.

Proposed additions are shown underlined in red font and proposed deletions are shown in red strikethrough font. Other text is shown for information only. Note, footnote, table, and section numbers will be revised editorially as needed.

This proposal has been developed by TS 3a TF09-1, the Joint AASHTO-ASTM Harmonization Task Force, and a parallel proposal is being considered by ASTM Committee C01 for ASTM C150.
12. MANUFACTURER’S STATEMENT

12.3. At the request of the purchaser, the manufacturer shall report the **total chloride content** as determined using T 105, in percent by mass of the cement, in the manufacturer’s report (see Note 8).

**Note 8**—Chlorides in concrete come from multiple ingredients, and cement chloride content may be required in the estimation of to estimate concrete chloride content. Requirements for concrete chloride content are provided in building codes and other documents. Total chloride content is higher than water soluble chloride content, which is commonly referenced in codes.
Item #: 3
Ballot Action: Revise AASHTO M 240, Standard Specification for Blended Hydraulic Cements
Description: Include reporting of alkali content of natural pozzolan

Rationale:
A previous ballot item included requirements to report the equivalent alkali content of portland cement, fly ash, slag, or silica fume, when requested and if used. Comments on the ballot recommended that reporting of equivalent alkalis of natural pozzolans also be required when requested. These characteristics are potentially useful in developing concrete mixtures following AASHTO R 80 to help mitigate ASR. Natural pozzolans are also generally beneficial in mitigating the potential for deleterious expansion due to ASR and reporting the equivalent alkali content of natural pozzolans used in blended cements may be useful in designing concrete mixtures.

This ballot modifies section 15.5 to include reporting of equivalent alkali content of natural pozzolan when requested, and changes reference to PP 65 to R 80.

Proposed additions are shown underlined in red font and proposed deletions are shown in red strikethrough font. Other text is shown for information only. Note, footnote, table, and section numbers will be revised editorially as needed.

This proposal has been developed by TS 3a TF09-1, the Joint AASHTO-ASTM Harmonization Task Force, and a parallel proposal is being considered by ASTM Committee C01 for ASTM C595.

Detailed Changes:

AASHTO Designation: M 240M/M 240-17

15.5 Upon request of the purchaser in the contract or order, the manufacturer shall report the following characteristics of constituents of the blended cement: the equivalent alkali content (Na₂Oₑ = %Na₂O + 0.658 × %K₂O) of any portland cement, slag, fly ash, natural pozzolan, or silica fume; the CaO content of any fly ash; and the SiO₂ content of any silica fume. (See Note 13.)

Note 13—The characteristics listed in 15.5 may be requested in order to follow guidance provided in PP 65 R 80 to reduce the risk of deleterious expansion due to alkali-silica reaction in concrete.
Item #: 4

Ballot Action: Revise AASHTO M 240, Standard Specification for Blended Hydraulic Cements

Description: New Note on ASR in Section 4.3

Rationale:
Changes to M 240 to reference AASHTO R 80 for guidance on mitigating potential alkali-silica reaction in concrete and to remove Option R removed reference to ASR resistance of blended cements from Section 4.3 on Special Properties. Since many blended cement do impart improved resistance to deleterious alkali-silica reaction, it was agreed to consider as new business inserting text in a note in Section 4.3 to highlight this property. This ballot proposes to add such text a new Note 7, with reference to R 80 for more information.

This proposal is based on M 240-17, additions are shown underlined in red font and proposed deletions are shown in red strikethrough font. Other text is shown for information only. Note, footnote, table, and section numbers will be revised editorially as needed.

This proposal has been developed by TS 3a TF09-1, the Joint AASHTO-ASTM Harmonization Task Force, and a parallel proposal is being considered by ASTM Committee C01 for ASTM C595.

Detailed Changes:

**AASHTO Designation: M 240M/M 240-17**

4.3. Special Properties:

4.3.1. Air-entraining cement, when desired by the purchaser, shall be specified by adding the suffix (A) to the type designation under Section 4.1.1. (See Note 5.)

**Note 5**—A given mass of blended cement has a larger absolute volume than the same mass of portland cement. This should be taken into consideration in purchasing cements and in proportioning concrete mixtures.

4.3.2. Moderate heat of hydration, when desired by the purchaser, shall be specified by adding the suffix (MI) to the type designation under Section 4.1.1.

4.3.3. Moderate sulfate resistance, when desired by the purchaser, shall be specified by adding the suffix (MS) to the type designation under Section 4.1.1.

4.3.4. High sulfate resistance, when desired by the purchaser, shall be specified by adding the suffix (HS) to the type designation under Section 4.1.1.

4.3.5. Low heat of hydration, when desired by the purchaser, shall be specified by adding the suffix (LH) to the type designation under Section 4.1.1.

**Note 6**—Special characteristics attributable to slag or pozzolan will vary based on quantities contained within the blended cements.

**Note 7**—R 80 provides guidance on use of blended hydraulic cements in concrete mixtures where potential for deleterious alkali-silica reaction is of concern.

Tech Section 3a
Item #: 5
Ballot Action: Revise AASHTO M 240, Standard Specification for Blended Hydraulic Cements
Description: Delete Type LH drying shrinkage requirement

Rationale:
AASHTO M 85 does not have any requirements for drying shrinkage, but M 240 (only for Type LH) does have shrinkage requirements. Shrinkage of concrete is mainly dependent on the volume of aggregate, the elastic modulus of the aggregate, water content, and w/cm of the cement paste fraction. The influence of cement type has little if any impact. The shrinkage test used in M 240 does not relate to shrinkage in concrete and drying shrinkage should be measured on concrete.

The changes being balloted include:
(a) removal of T 160 from Section 2, Referenced Documents,
(b) deletion of the drying shrinkage limit for Type LH cement from Table 3, and
(c) deletion of 11.1.4.

Proposed additions are shown underlined in red font and proposed deletions are shown in red strikethrough font. Other text is shown for information only. Note, footnote, table, and section numbers will be revised editorially as needed.

This proposal has been developed by TS 3a TF09-1, the Joint AASHTO-ASTM Harmonization Task Force, and a parallel proposal is being considered by ASTM Committee C01 for ASTM C595.

Detailed Changes:
AASHTO Designation: M 240M/M 240-17

2. REFERENCED DOCUMENTS

2.1. AASHTO Standards:
- T 153, Fineness of Hydraulic Cement by Air Permeability Apparatus
- T 160, Length Change of Hardened Hydraulic Cement Mortar and Concrete
- T 192, Fineness of Hydraulic Cement by the 45-μm (No. 325) Sieve
Table 3—Physical Requirements for Blended Cements with Special Properties

<table>
<thead>
<tr>
<th>Special Property Designation</th>
<th>Applicable Test Method</th>
<th>A</th>
<th>MS</th>
<th>HS</th>
<th>MH</th>
<th>LH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air content of mortar:</td>
<td>T 137</td>
<td></td>
<td>16*</td>
<td>12</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>min, volume %</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>max, volume %</td>
<td></td>
<td>22*</td>
<td>12</td>
<td>12</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>Compressive strength, MPa [psi], min.</td>
<td>T 106M/ T 106</td>
<td>10.0 [1450]</td>
<td>11.0 [1600]</td>
<td>11.0 [1600]</td>
<td>10.0 [1450]</td>
<td>11.0 [1600]</td>
</tr>
<tr>
<td>3 days</td>
<td></td>
<td>16.0 [2320]</td>
<td>18.0 [2610]</td>
<td>18.0 [2610]</td>
<td>17.0 [2470]</td>
<td>11.0 [1600]</td>
</tr>
<tr>
<td>7 days</td>
<td></td>
<td>22.0 [3190]</td>
<td>28.0 [4060]</td>
<td>25.0 [3620]</td>
<td>22.0 [3190]</td>
<td>21.0 [3050]</td>
</tr>
<tr>
<td>28 days</td>
<td></td>
<td>290 [70]</td>
<td>250 [60]</td>
<td>330 [80]</td>
<td>290 [70]</td>
<td>64</td>
</tr>
<tr>
<td>Heat of hydration, max, kJ/kg</td>
<td>ASTM C186</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>[cal/g]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>290 [70]</td>
<td>250 [60]</td>
</tr>
<tr>
<td>7 days</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>28 days</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water requirement, max</td>
<td>T 106M/ T 106</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>weight % of cement</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>290 [70]</td>
<td>250 [60]</td>
</tr>
<tr>
<td>Drying shrinkage, %</td>
<td>T 160</td>
<td></td>
<td>0.10</td>
<td>0.05</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sulfate resistance, %</td>
<td>ASTM C1012</td>
<td></td>
<td>0.10</td>
<td>0.05</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Expansion at 180 days</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Expansion at 1 year</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* These requirements apply only if specified and are designated by suffixes A, MS, HS, MH, or LH as appropriate to type designations LL, IP, ES (70), or IT(ES-70). See Section 4.3. Requirements for fineness, autoclave expansion, autoclave contraction, and time of setting shall conform to Table 2.

* These air content requirements apply to cements with multiple special property designations when one of those designations is (A).

* When multiple special property designations are applied, the set of strength requirements for the special property designation with the lowest 7-day minimum strength requirement shall apply.

* Testing at 1 year shall not be required when the cement meets the 180-day limit. A cement failing the 180-day limit shall not be rejected unless it also fails the 1-year limit.

11. **TEST METHODS**

11.1.44. **Drying Shrinkage—T 160.** Make three specimens using the proportion of dry materials of 1 part of cement to 2.75 parts of T 106M/T 106 graded Ottawa sand. Use a curing period of 6 days and an air storage period of 28 days. Report the linear contraction during air storage based on an initial measurement after the 6-day water-curing period.
Item #: 6

Ballot Action: Revise AASHTO M 240, Standard Specification for Blended Hydraulic Cements

Description: Revise Type MS and HS compressive strength limits

Rationale:
Comments on a previous ASTM ballot suggested simplifying compressive strength provisions for MS- and HS-designated blended cements. The differences between the default strength requirements in Table 2 and the strength provisions in Table 3 for cements designated with moderate- (MS) or high- (HS) sulfate resistance are relatively small. This change would simplify the requirements of the specification by raising the minimum strength requirements for these cements to those of Table 2.

This proposal is based on M 240-17, additions are shown underlined in red font and proposed deletions are shown in red strikethrough font. Other text is shown for information only. Note, footnote, table, and section numbers will be revised editorially as needed.

This proposal has been developed by TS 3a TF09-1, the Joint AASHTO-ASTM Harmonization Task Force, and a parallel proposal is being considered by ASTM Committee C01 for ASTM C595.
### AASHTO Designation: M 240M/M 240-17

#### Table 2—Physical Requirements for Blended Cements

<table>
<thead>
<tr>
<th>Cement Type</th>
<th>Applicable Test Method</th>
<th>IL, IP, IS(≤70), IT(S &lt; 70)</th>
<th>IS(≥70), IT(S ≥ 70)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fineness</td>
<td>T 153, T 192</td>
<td>a</td>
<td>a</td>
</tr>
<tr>
<td>Density</td>
<td>T 133</td>
<td>a</td>
<td>a</td>
</tr>
<tr>
<td>Autoclave expansion, mix, %a</td>
<td>T 107M/T 107</td>
<td>0.80</td>
<td>0.80</td>
</tr>
<tr>
<td>Autoclave contraction, max, %b</td>
<td>T 107M/T 107</td>
<td>0.20</td>
<td>0.20</td>
</tr>
<tr>
<td>Time of initial setting, Vicat test:</td>
<td>T 131</td>
<td>45</td>
<td>45</td>
</tr>
<tr>
<td>Set, minutes, not less than</td>
<td></td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>Set, hours, not more than</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Air content of mortar, volume %, max</td>
<td>T 137</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>Compressive strength, minimum, MPa [psi]:</td>
<td>T 106M/T 106</td>
<td>13.0 [1890]</td>
<td>7</td>
</tr>
<tr>
<td>3 days</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7 days</td>
<td>20.0 [2900]</td>
<td>5.0 [720]</td>
<td></td>
</tr>
<tr>
<td>28 days</td>
<td>25.0 [3620]</td>
<td>11.0 [1600]</td>
<td></td>
</tr>
</tbody>
</table>

---

*a The amount retained when wet-sieved on a 45-μm (No. 325) sieve, specific surface by air permeability apparatus, m²/kg, and density, g/cm³, shall be reported on all mix test reports requested under Section 15.4.

*b The specimens shall remain firm and hard and show no signs of distortion, cracking, checking, pitting, or disintegration when subjected to the autoclave expansion test.

*c The time of setting of cements containing a user-requested accelerating or retarding functional addition need not meet the limits of this table, but shall be stated by the manufacturer.
### Table 3—Physical Requirements for Blended Cements with Special Properties

<table>
<thead>
<tr>
<th>Special Property Designation&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Applicable Test Method</th>
<th>A</th>
<th>MS</th>
<th>HS</th>
<th>MH</th>
<th>LH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air content of mortar:</td>
<td>T 137</td>
<td>16&lt;sup&gt;b&lt;/sup&gt;</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>min, volume %</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>max, volume %</td>
<td></td>
<td>22&lt;sup&gt;b&lt;/sup&gt;</td>
<td>12</td>
<td>12</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>Compressive strength,&lt;sup&gt;c&lt;/sup&gt; min, MPa [psi]:</td>
<td>T 106M/ T 106</td>
<td>10.0 [1450]</td>
<td>11.0 [1600]</td>
<td>11.0 [1600]</td>
<td>10.0 [1450]</td>
<td>—</td>
</tr>
<tr>
<td>3 days</td>
<td></td>
<td>13.0 [1890]</td>
<td>13.0 [1890]</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>7 days</td>
<td></td>
<td>14.0 [2060]</td>
<td>14.0 [2060]</td>
<td>17.0 [2470]</td>
<td>11.0 [1600]</td>
<td>—</td>
</tr>
<tr>
<td>28 days</td>
<td></td>
<td>16.0 [2320]</td>
<td>16.0 [2320]</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Heat of hydration, max, kJ/kg [cal/g]:</td>
<td>ASTM C186</td>
<td></td>
<td></td>
<td></td>
<td>290 [70]</td>
<td>250 [60]</td>
</tr>
<tr>
<td>7 days</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>28 days</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>330 [80]</td>
<td>250 [70]</td>
</tr>
<tr>
<td>Water requirement, max weight % of cement</td>
<td>T 106M/ T 106</td>
<td></td>
<td></td>
<td></td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Drying shrinkage, max, %</td>
<td>T 160</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>—</td>
</tr>
<tr>
<td>Sulfate resistance, max, %</td>
<td>ASTM C1012</td>
<td></td>
<td></td>
<td></td>
<td>0.10</td>
<td>0.05&lt;sup&gt;d&lt;/sup&gt;</td>
</tr>
<tr>
<td>Expansion at 180 days</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>—</td>
</tr>
<tr>
<td>Expansion at 1 year</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.10&lt;sup&gt;d&lt;/sup&gt;</td>
<td>—</td>
</tr>
</tbody>
</table>

---

<sup>a</sup> These requirements apply only if specified and are designated by suffixes A, MS, HS, MH, or LH as appropriate to type designations II, III, IV, V, or VI. See Section 4.1. Requirements for fineness, autoclave expansion, autoclave contraction, and time of setting shall conform to Table 2.

<sup>b</sup> These air content requirements apply to cements with multiple special property designations when one of those designations is (A).

<sup>c</sup> When multiple special property designations are applied, the set of strength requirements for the special property designation with the lowest 7-day minimum strength requirement shall apply.

<sup>d</sup> Testing at 1 year shall not be required when the cement meets the 180-day limit. A cement failing the 180-day limit shall not be rejected unless it also fails the 1-year limit.
Item #: 7

Ballot Action: Revise AASHTO M 240, Standard Specification for Blended Hydraulic Cements

Description: Revision of M 240 Note 6 to harmonize with C595 Note 6

Rationale:
Currently Note 6 of ASTM C595 states:

NOTE 6—Special characteristics attributable to slag, Pozzolan or limestone will vary based on quantities contained within the blended cements.

However, Note 6 of AASHTO M 240 states:

Note 6—Special characteristics attributable to slag or Pozzolan will vary based on quantities contained within the blended cements.

The inconsistency apparently resulted as an oversight in developing a previous M 240 ballot item to include provisions for portland-limestone blended cement. Given that limestone can be a constituent of a blended cement and may impact its special characteristics, the harmonization task group recommends revising Note 6 of AASHTO M 240 to be consistent with the language of ASTM C595 Note 6.

This proposal is based on M 240-17. Proposed additions are shown underlined in red font and proposed deletions are shown in red strikethrough font.

This proposal has been developed by TS 3a Task Force 09-01, a joint AASHTO-ASTM task force.

Detailed Changes:

AASHTO Designation: M 240M/M 240-17

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Note 6—Special characteristics attributable to slag or Pozzolan or limestone will vary based on quantities contained within the blended cements.
AASHTO TS3a
Joint AASHTO-ASTM Harmonization Task Group Report
August 2017 Annual Meeting

Background: The Joint AASHTO-ASTM Harmonization Task Group was established in 2003 with the mission of evaluating differences between AASHTO M 85 and ASTM C150 portland cement standards and developing recommendations for resolving those differences. That was accomplished with the 2009 editions. Subsequently the scope of the task group was broadened to include harmonizing the provisions of AASHTO M 240 and ASTM C595 blended cement standards in addition to maintaining consistent requirements in AASHTO M 85 & ASTM C150 as well as AASHTO M 327 & ASTM C465. The current mission statement reads:

“To evaluate existing provisions of AASHTO and ASTM hydraulic cement standards and to develop recommendations for improvements to these standards, such that they better meet the collective needs of AASHTO members and ASTM user, general interest, and producer members.”

Task Group members and participants are:

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<th>Name</th>
<th>Organization</th>
<th>Representing</th>
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<td>Texas DOT</td>
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Five JAAHTG ballot items (items 1, 2, 3, 4 and 5) from SOM 2016 – Rolling Ballot 1 are included in the 2017 AASHTO materials standards as follows:

#1 – M 85 proposal to remove MBI and TOC requirements for limestone
designations for portland-limestone cements
#2 – M 240 proposal to include requirements for sulfate resistance
#3 – M 240 proposal to require reporting of density
#4 – M 240 proposal to revise strength requirements
#5 – M 240 proposal to revise provisions related to ASR resistance

Five parallel items had been balloted in ASTM C01 and are included ASTM C150-17 and C595-17.

As approved at the August 2016 SOM TS 3a meeting, M 327-11(2015) was editorially revised to include a non-mandatory Note 1 consistent with ASTM C465-16.
**Current Activities:** The JAAHTG continues to work on a number of proposed changes to cement and blended cement specifications, primarily to address comments made by AASHTO and ASTM members when reviewing previous ballot items. The task group developed seven (7) ballot items with rationales for revisions to AASHTO M 85 and M 240 that were circulated to TS 3a members as *Tech Section 3a – M85 and M240 Ballot (SOM_TS3A-17-01)*. The items were:
1. M85 – Remove reference to C186
2. M85 – Revise chloride content language
3. M240 – Include reporting of alkali content of natural pozzolan
4. M240 – New note on ASR in Section 4.3
5. M240 – Delete Type LH drying shrinkage requirement
6. M240 – Revise Type MS and HS compressive strength limits
7. M240 – Revision to M240 Note 6 to harmonize with C595 Note 6.

There were no negatives returned on these items. Affirmatives with comment were returned on Items 1, 2, 3, & 4. Editorial revisions to Item #1 section numbering (the section on References should be Section 2, not Section 9) and to Item #2 note numbering (the note being modified is Note 8, not Note 2) are recommended in response to comments. No changes are recommended to SOM_TS3A-17-01 Ballot Items #3 and #4. Parallel changes to ASTM C150 and C595 are presently being considered by ASTM C01 letter ballot. The JAAHTG recommends that these seven items be forwarded to SOM 2017 Rolling Ballot #1.

The JAAHTG also recommends that a proposed change to AASHTO M 327 be included in SOM 2017 Rolling Ballot #1 as a concurrent ballot. The ballot would move provisions of Note 1 into the body of Section 3.1.6 to make those provisions mandatory and to clarify language. A parallel ballot is being circulated concurrently to ASTM C01 and C01.10.

**Future Business:** A number of issues and recommendations have come about based on comments made by AASHTO and ASTM members when reviewing previous ballot items. Additionally, new issues have been raised asking for clarification of the standards that may require revisions. Future issues already being considered by the JAAHTG include:

- **AASHTO M 85 and ASTM C150**
  - Low alkali cement criteria
  - C1702 Heat of hydration criteria
  - Appendix X1 Fig. X1.1 example chloride reporting - Editorial change to report chloride content to 3 decimal places per AASHTO T 105 (change from 0.02% to 0.020%) in 2018 edition
  - As new business consider deleting reference to ASTM C150 Tables 2 & 4 under Fig X1.1 Optional Requirements
  - Direct determination of phases

- **AASHTO M 240 and ASTM C595**
  - Inclusion of C1702 Heat of hydration
  - Chloride content reporting
  - Revision of Sections 9 & 11
  - Refinements to Table 4
AASHTO STANDING COMMITTEE ON RESEARCH
AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS

NCHRP Problem Statement

I. PROBLEM NUMBER

To be assigned by NCHRP staff.

II. PROBLEM TITLE

Rating Concrete Permeability Based on Resistivity Measurements

III. RESEARCH PROBLEM STATEMENT

The AASHTO T 277/ASTM C 1202, Electrical Indication of Concrete Ability to Resist Chloride Ion Penetration, has been widely accepted for assessing durability of concrete. The test provides an indication of the concrete’s ability to resist chloride ion penetration but it has many shortcomings: it is slow and time consuming, destructive, prone to errors caused by sample heating, and fails to adequately capture features associated with supplementary cementitious materials (SCMs). Electrical resistivity measurements (AASHTO T 358, Standard Method of Test for Surface Resistivity Indication of Concrete’s Ability to Resist Chloride Ion Penetration) have the potential of providing performance-based evaluation of concrete although they may not always yield accurate results. However, the data obtained from these measurements do not relate to concrete water permeability. It is suggested that a formation factor that incorporates the ratio of the resistivity ($\rho$) of the bulk concrete to the resistivity ($\rho_\text{p}$) of the pore solution or other approaches can be used to provide a better assessment of transport properties. There is need to evaluate the feasibility of using this or other approaches as a tool for rating concrete permeability based on resistivity measurements.

IV. LITERATURE SEARCH SUMMARY

Literature search revealed numerous publications related to concrete air and water permeability but none that explicitly relate concrete water permeability to resistivity properties.

V. RESEARCH OBJECTIVE

The objective of this project is to develop recommendations for rating concrete water permeability based on electrical resistivity measurements.

Tasks: Accomplishment of the project objective will require at least the following tasks.

Phase I:

Task 1. Review literature, ongoing research findings, and current practices relevant to the characterization and measurement of concrete water permeability and its relationship to electrical resistivity. This information may be assembled from published and unpublished reports, contacts with academia, transportation agencies, industry organization, and other sources.
Task 2. Identify and evaluate concrete mixture and test parameters that influence concrete water permeability (e.g., aggregate sources, including lightweight aggregates, cementitious materials, water to cementitious materials ratios, age of concrete, and curing regimen) and the methods currently used in the United States and other countries for measuring concrete water permeability and relating it to resistivity measurements. Discuss the merits and deficiencies of these methods, and recommend potential methods for use in laboratory evaluations, for further evaluation in Phase II.

Task 3. Develop a research plan for an experimental investigation, to be executed in Phase II, for (1) developing and demonstrating test methods for measuring water permeability, (2) evaluating the effects of a range of the concrete mixture parameters (aggregate source, combinations of portland cement and different supplementary cementitious materials, water/cementitious materials ratios, age of concrete, etc.) identified in Task 2 on concrete water permeability and consider the range of CaO/(Al₂O₃+SiO₂) ratios obtained for mixtures made with 100% portland cement to those made with commonly used SCM types and proportions, and (3) relating concrete water permeability to electrical resistivity measurements.

Note: The research plan must provide detail on the work proposed for Phase II. The work proposed for Task 5 must be divided into subtasks, and the work proposed in each subtask (e.g., details of the experimental investigation, including proposed test procedures, test variables, specimen details and materials, replication; the rationale for proposed experimental plan; data analysis procedures; and other information to illustrate relevance of the proposed work to achieving project objectives) must be described in detail. The proposed research plan must be free from any aspects that could be perceived as jeopardizing the objectivity of the research.

Task 4. Prepare an interim report that documents the research performed in Tasks 1 through 3. Following review of the interim report by the NCHRP, the research team will be required to make a presentation to the project panel. Work on Phase II of the project will not begin until the interim report is approved and the Phase II work plan is authorized by the NCHRP. The decision on proceeding with Phase II will be based on the contractor's documented justification of the updated work plan.

Phase II:

Task 5. Execute the plan approved in Task 4. Based on the results of this work recommend (1) a test method for measuring concrete water permeability, and (2) a means for rating concrete as very low, low, moderate, and high permeability based on resistivity values. If a protocol for the recommended test method is not currently available, it should be developed and presented in AASHTO format. The recommendations for rating concrete permeability based on resistivity measurements shall be prepared in the form of a recommended practice in AASHTO format.

Task 6. Prepare a draft final deliverable that documents the entire research effort, and submit for NCHRP review. The test protocol and recommended practice shall be prepared as stand-alone documents appropriate for incorporation into the AASHTO Standard Specifications for Transportation Materials and Methods of Sampling and Testing.

VI. ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD

Recommended Funding: $500,000
**Research Period**: 30 months

**VII. URGENCY, PAYOFF POTENTIAL, AND IMPLEMENTATION**

Concrete durability and service life is greatly influenced by its water permeability. However, measuring water permeability of concrete is difficult. By relating water permeability to electrical resistance that can be easily measured, durability can be easily assessed and if necessary and adjustment be made to achieve the level of permeability required for the desired service life. The developed test protocol and recommended practice will be prepared for incorporation into the AASHTO Standard Specifications for Transportation Materials and Methods of Sampling and Testing.

Limited work on this topic was approved under NCHRP Project 20-07/Task 381. However, the Advisory Panel agreed on the need for a more comprehensive research effort to consider the relevant mixture parameters and test conditions needed for producing well-supported findings. The panel prepared a draft research problem statement and provided it to the AASHTO Highway Subcommittee on Materials (SOM) Tech Sections 3a, 3b, and 3c to seek endorsement and SOM approval and submittal to the NCHRP for funding from NCHRP FY 2019 Program.

**VIII. PERSON(S) DEVELOPING THE PROBLEM**

Advisory Panel for NCHRP Project 20-07(381)
in cooperation with SOM Tech Sections 3a, 3b, and 3c
(John Stanton, Mick Syslo, and Brian Eagan, Chairs)

**IX. PROBLEM MONITOR**

**X. DATE AND SUBMITTED BY**

Date:
Submitted by the AASHTO Highway Subcommittee on Materials
I. PROBLEM NUMBER

To be assigned by NCHRP staff.

II. PROBLEM TITLE

Benchmarking Accelerated Laboratory Tests for ASR to Field Performance: Consideration of Cement and Alkali Contents and Influence of SCMs

III. RESEARCH PROBLEM STATEMENT

Developing new test methods and benchmarking existing laboratory test methods aimed at assessing alkali-aggregate reactivity and preventive measures remain central challenges to the concrete and aggregate industry. The so-called perfect test method to assess the potential for alkali-silica reaction (ASR) would be capable of assessing actual job concrete mixtures, in a relatively short period of time (e.g. 1-6 months or less) and would accurately predict true field performance. Unfortunately, we do not have such a test method. The recently developed AASHTO R 80-17 Practice (previously AASHTO PP 65) and ASTM C 1778-16 Guide have significant improved the way the concrete industry assesses aggregates for potential alkali-silica reactivity and, subsequently, selects appropriate mitigation methods to use potentially alkali-silica reactive aggregates in new concrete construction. These documents were a result of several FHWA- and DOT-funded research projects on evaluating the potential for and the prevention of alkali-silica reaction\(^1,2,3\) together with consideration of the existing approach by the Canadian Standards Association (CSA).\(^4\) A unique feature of these projects was the use of long-term outdoor exposure sites to bench-mark accelerated laboratory tests to concrete exposed to actual environmental fluctuations. The concrete mixtures that were investigated primarily followed mixture proportions specified in ASTM C 1293 including cement contents and alkali contents. This is often considered our most reliable test method for assessing aggregate reactivity. As a result, the current guidance documents (AASHTO PP 65 and ASTM C 1778) are based on mixtures that have high cement contents (708 lb/yd\(^3\) (420 kg/m\(^3\))) and high alkali contents (0.95% or 1.25% Na\(_2\)O\(_{eq}\)). These have been criticized as not properly capturing concrete mixtures with lower cement contents (e.g. < 708 lb/yd\(^3\) (420 kg/m\(^3\))) and/or lower alkali loadings. Furthermore, recent results from long-term exposure sites have indicated that the amount of SCM required to control ASR expansion in the concrete prism test (ASTM C 1293) or that required when following the AASHTO R 80-17 practice or ASTM C 1778 guide may not be sufficient to control expansion in outdoor exposure blocks with high contents of high-alkali cements.\(^5,6\) Testing SCM mixtures in exposure blocks with more moderate (and realistic) alkali levels is required to determine if this is merely an artifact of the severe alkali loadings used in previous exposure-block studies.

The goal of this research is to cast concrete exposure blocks that will be exposed to real environmental exposure conditions with moderate alkali loadings and lower cement contents to provide the crucial long-term benchmarking for the development of ASR test methods for job mixtures and to validate and/or calibrate the prescriptive measures in AASHTO R 80-17 and ASTM C 1778. Several modified accelerated test methods that show promise to assess aggregate reactivity and potential mitigation options will also be investigated. While this represents an important long-term investment, the results from the exposure blocks cast in this research are the
ONLY way to build confidence within the concrete and aggregate industry for modifications to the current guidelines in regard to assessing alkali-aggregate reactivity. The researchers on this proposal are intimately involved in the key committees at ASTM and AASHTO responsible for ASR standards development and were the key players in getting the current AASHTO R 80-17 and ASTM 1778 standards adopted. They are ideally positioned to further modifications to these methods and to directly implement results of this research effort into such documents.

IV. LITERATURE SEARCH SUMMARY

Data from long-term exposure blocks located in Austin, Texas; Ottawa, Ontario, Canada; Fredericton, New Brunswick, Canada; Treat Island, Maine and most recently Corvallis, Oregon provide the most representative samples for benchmarking ASR in field concrete to accelerated laboratory tests within North America. In fact, the current prescriptive approach for assessing and determining preventive measures for ASR in AASHTO R 80-17 and ASTM C 1778 is based on results of laboratory and field investigations at these sites. A significant challenge however is that the cement content and concrete alkali loading (total alkalies in kg/m³) in these evaluation methods are higher than what would be found in most concrete elements in the field. The reason behind this is due to the alkali leaching that occurs in the ASTM C 1293 method. In this test method the high relative humidity (95-100%) and elevated temperature (38°C) produced around the specimens promotes leaching of ions, namely alkali ions (Na and K) and calcium from the prisms. Over the course of the test, this essentially reduces the “fuel for the fire” of ASR. As a result the ASTM C 1293 method requires a high cement and high alkali content to combat this issue and to ensure the test method is capable of evaluating a full range of potentially reactive aggregates from slow and low expanding aggregates to fast and high expanding aggregates. This of course is a critical departure from concrete in service where typically larger elements will only suffer leaching in the outer skin of the concrete element.7

Our collective data shows that ASTM C 1293 provides the best correlation for determining aggregate reactivity while the ultra-accelerated ASTM C 1260 is marginal at best for aggregate reactivity. In the past few years, these test methods have been shown to have shortcomings with regards to properly assessing mitigation measures, specifically in predicting the dosage required to control reactivity below expansion limits of 0.04% in field blocks. A large number of exposure blocks are failing in the field, despite showing passing ASTM C 1293 two-year prism results or 2-week ASTM C 1567 results.8,9 The main issue with the C 1293 test is the leaching of alkalis. One of the problems with ASTM C 1567 is the supply of an inexhaustible reservoir of alkalis throughout the test which tends to mask the influence that SCMs may have on the availability of alkalis. Also with ASTM C 1567 the need to process aggregate (crushing and grading) may alter the outcome. Further, in the ASTM C 1293 test method with SCMs, a lower initial alkali loading may be used since only the Portland cement portion is augmented to 1.25% Na₂O eq. These are three key features to address in new test methods. New methods that are currently under investigation include:

- the miniature concrete prism test (MCPT)10,11,12
- the concrete cylinder test (CCT)13

Establishing correlations between the accelerated tests and actual field exposure remain a critical research need.

V. RESEARCH OBJECTIVE
The primary objective of this research is to improve the accuracy of accelerated ASR test methods through the benchmarking of data from exposure blocks cast and stored on outdoor exposure sites across the United States.

Tasks: Accomplishment of the project objective will require at least the following tasks.

Phase I:

Task 1. Review existing literature, ongoing research findings from existing exposure sites, and current practices relevant to AAR.

Task 2. Identify concrete mixtures and develop a research plan for an experimental investigation for Phase II.

Phase II:

Task 3. Casting of exposure blocks to meet the objective of this research project. It is anticipated at least 150 additional mixtures will be cast to supplement the existing database from outdoor exposure sites; the variables to be considered will include:

- A wide range of reactive aggregates with an emphasis on low to moderately reactive aggregates as much of the existing data has been gathered from highly or extremely reactive aggregates
- Cement contents in the range used in pavements and highway structures (300 – 400 kg/m³)
- Various cement alkali levels especially cements of low (0.4 to 0.6% Na₂Oeq) and moderate (0.6 to 0.8% Na₂Oeq) alkali content
- A wide range of SCM types and contents with focus on moderate levels typically used in pavements (e.g. 15 to 25% fly ash, 25 to 35% slag)
- Environmental exposure - blocks from each mixture will be placed in three locations to represent various temperature/humidity ranges.

Task 4. In addition to exposure blocks, samples will also be cast from each mixture for laboratory testing using the currently most-promising performance tests.

Task 5. It is anticipated that the principal outcomes/products from this research program will include the following:

- Draft revisions to the prescriptive measures that are currently in ASTM R 80-17 and ASTM C 1778.
- Recommendations for improving ASTM and/or AASHTO performance tests and a draft standard(s) for the most promising test(s)
- Prepare a draft final deliverable that documents the entire research effort, and submit for NCHRP review.

VI. ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD
VII. URGENCY, PAYOFF POTENTIAL, AND IMPLEMENTATION

Currently, there is great deal of excitement surrounding the new unified approach in dealing with alkali-aggregate reactivity in North America. Some of that excitement is positive and some of it is skeptical. One of the biggest challenges that aggregate, cement and concrete producers are raising questions about is the aggressive nature of the laboratory testing and field exposure sites in regard to high cement contents and high alkali contents. As outlined in this proposal there is a significant need to increase the breadth of our laboratory and especially exposure block repository from which modifications to the requisite standards will be made. There is a call from the industry to provide critical benchmarking data from exposure sites on moderate alkali content and moderate cement contents in regard to impacts on alkali-silica reactivity. This proposed research will provide this crucial missing data and represents an important and needed effort to increase the reliability of our methods for determining susceptibility to ASR and appropriate mitigation techniques to avoid the reaction. It is also clear that modifications to our laboratory tests are needed to capture the performance of SCMs in regard to controlling ASR. Certainly, a logical question is “why were these types of mixtures not investigated initially”? Producing large-scale exposure blocks is an incredibly time- and labor-intensive task and it took great effort to convince funding agencies to invest in large-scale and long-term investigations such as this. As a result, not every possible scenario could be realized. In addition, what we have learned from the existing exposure sites is that there is a disconnect between our laboratory and field testing. This justifies the need for continued study as outlined in this proposal. From an urgency standpoint, it is critical to start the exposure outdoors as soon as possible, as time is working against us. It is common that we say, “we should do this, or we should start this” and then five years or ten years in the future nothing was started and we have the same questions. The time to initiate this work is now so that we can start realizing the beneficial knowledge it will provide as soon as we possibly can. If the work is not started now (e.g. the project is not funded) the industry will continue to have these same questions and we will be further and further from answering this critical questions that will ultimately improve the AASHTO R 80-17 and ASTM C 1778 guidance documents.

The target audience for the findings of this research are incredibly broad as ASR can affect nearly every structure that is exposed to the elements. In particular the audience would include: FHWA, AASHTO Subcommittee on Materials (SOM), ASTM Subcommittees C09.26 Chemical Reactions and C09.50 Risk Management for Alkali Aggregate Reactions, all State DOTs, concrete, aggregate, cement and ready-mix producers and owners of transportation structures (e.g. pavements, bridges, ports, airports) and other important concrete structures including dams, foundations, mass concrete, nuclear power structures, etc. The key decision-makers who can approve, influence or champion implementation of the research products would be:

- Collin Lobo – NRMCA
- Gina Ahlstrom – FHWA

The AASHTO committees and other individuals/organizations with responsibly of adoption of the results would include:

- Chair of AASHTO SOM
• Chair of ASTM C 09.26
• Chair of ASTM C09.50
• Chair of ACI 201 – Guide to Durable Concrete

Several State DOTs that would be willing to evaluate the research products in their agency would include:
• Texas
• Maryland
• Pennsylvania
• Wyoming
• California
• Massachusetts
• South Dakota

VIII. PERSON(S) DEVELOPING THE PROBLEM

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X. DATE AND SUBMITTED BY

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