Minimizing the impact of third-party testing on the Concrete Industry

David Resweber, Steven Longfellow, Brien Mallon, Brandon Horton
Agenda

Variation in third party strength testing
Observed field data
Australian history and methods
FHWA examples
Proposal to improve concrete acceptance testing
Who is Watching Out for the Cylinders?

by Karthik H. Obla, Orville R. (Bud) Werner, John L. Hausfeld, Kevin A. MacDonald, Gregory D. Moody, and Nicholas J. Carino

Concrete International - August 2018
Initial Curing is a frequent problem

Field Observation

Properly stored in initial curing environment 1/3 of time

<table>
<thead>
<tr>
<th>Contributing Companies</th>
<th>Number of Assessments August, 2015</th>
<th>Number of Assessments YTD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Restone Concrete</td>
<td>22</td>
<td>96</td>
</tr>
<tr>
<td>Martin Marietta</td>
<td>33</td>
<td>121</td>
</tr>
<tr>
<td>Ready Mixed Concrete Co.</td>
<td>6</td>
<td>26</td>
</tr>
<tr>
<td>Trans Colorado Concrete</td>
<td>4</td>
<td>12</td>
</tr>
<tr>
<td>Transit Mix Concrete</td>
<td>8</td>
<td>35</td>
</tr>
<tr>
<td>United Companies</td>
<td>8</td>
<td>31</td>
</tr>
<tr>
<td>Aggregate Industries</td>
<td>7</td>
<td>18</td>
</tr>
<tr>
<td>Metro Mix Concrete</td>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td>Grand Junction Ready Mix Concrete</td>
<td>13</td>
<td>17</td>
</tr>
</tbody>
</table>

Average Score 9 [Properly stored in an initial curing environment] 30% 36%

Average score 34% 30%
Observed Third Party Technician Data
Business Case for Improving the Initial Curing

Review - Benefits of proper curing

1. Better durability
2. Improved sustainability
3. Reduced construction time
4. Minimize low strength investigations to only genuine situations
5. Foster a better partnering environment
6. Increase confidence in concrete construction
7. Maintain competitiveness
Two most common mixtures with $f'_c \leq 4000$ psi

For mixtures where specifications do not include any one of the following requirements - Max w/cm or minimum cementitious factor or fixed over-design value such as 1200 psi or early-age strength

<table>
<thead>
<tr>
<th></th>
<th>Weighted Average</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2018</td>
</tr>
<tr>
<td>Standard deviation (S), psi</td>
<td>484</td>
</tr>
<tr>
<td>Specified strength, psi</td>
<td>4042</td>
</tr>
<tr>
<td>Strength increment, psi</td>
<td>1460</td>
</tr>
</tbody>
</table>

Over design is above our target of 800 psi
Why Target OD = 800 psi?

Statistically a target OD of 800 psi ensures just a 1-in-1000 failure probability for good quality concrete (S = 433 psi)

<table>
<thead>
<tr>
<th>$S$, psi</th>
<th>Target OD, psi</th>
</tr>
</thead>
<tbody>
<tr>
<td>600</td>
<td>1300</td>
</tr>
<tr>
<td>500</td>
<td>1000</td>
</tr>
<tr>
<td>433</td>
<td>800</td>
</tr>
<tr>
<td>300</td>
<td>520</td>
</tr>
</tbody>
</table>

Average overdesign is 660psi above target overdesign of 800psi. Assuming 1lb of cement represents 10 psi. 66lbs of cement overage = $4.21 (assuming $6/sack)
Australian Methods/History

- Prior to 1970 - Trust in Producers Questioned
- 3\textsuperscript{rd} party Testing began in the 1970’s and continued to the early 1990’s
- Early 1990’s - Trust in 3\textsuperscript{rd} Party Testing Companies Questioned
- Early 1990’s - Transition to Producer Controlled QA/QC process
- Little to no pushback from the industry
Australian Standards

AS 1379-2007

• Mix Trials to confirm mix is suitable.
• QA tests as construction proceeds.
• Generally producer tested. Third-party lab is the exception.
Producer Accreditation

NATA National Association of Testing Authorities, Australia

• NATA is one of four bodies that form Australia’s standards and conformance infrastructure. The others are Standards Australia, the National Measurement Institute and the Joint Accreditation System of Australia and New Zealand.

• Producer, Government and Third-party laboratories.
US Adherence Standards

Federal Highway Administration: CFR 637B

• Quality control sampling and testing results may be used as part of the acceptance decision provided that:

• The sampling and testing has been performed by qualified laboratories and qualified sampling and testing personnel.

• The quality of the material has been validated by the verification testing and sampling. Verification sampling shall be performed on samples that are taken independently of the quality control samples.

• The quality control sampling and testing is evaluated by an IA program.
US Adherence Standards
FHWA: Defined

637B – Prescribes policies procedures and guidelines to assure the quality of materials and construction for Federal Aid Highway projects.

637B aligns with both AASHTO & ASTM. CCRL accreditation required to meet governing standards.

Qualified Lab – Laboratories that are capable as defined by local State Transportation Departments.
ACI Standards

- ACI 301 - 1.6.3.2(e) Owners testing agency will conduct concrete strength test...
  - Owners prerogative

- ACI 318 – 26.12.1.1(b) The testing agency performing acceptance testing shall comply with ASTM C1077.
  - Challenging convention but not the code
Proposal to provide supplier lead concrete testing for the XYZ High Rise Project:

Ready Mix Concrete Supplier:

- Provide on-site testing utilizing ACI certified (or equivalent) technicians and utilizing a CCRL accredited lab (or as agreed).
- We will test all concrete delivered to the project at specified intervals.
- Test results will be shared with the Owner, General Contractor and any other subcontractor involved in a timely manner.
- We guarantee the performance of all concrete supplied.
- In the case there is a test result that does not meet specification, we will provide further testing.
Proposal to provide supplier lead concrete testing for the XYZ High Rise Project:

Owner/General Contractor:

- Provide space, power and access for Curing Box.
- Has the option to hire 3rd party testing company to do side by side testing and/or Field and Lab observation.
Feedback from GC’s, Architects & Engineers

• All acknowledged problems with 3rd party testing.
• Not convinced every producer is equally ethical and committed to ensuring reliable and honest results - Architect
• Pulling the business from 3rd party testers could be politically difficult - Architect
• Sees it as a viable option for commercial projects but not likely on state, federal or municipal projects. – GC
• Would need a very high level of confidence in the producer to rely on concrete producer test data versus an independent lab.- PE
• Feels that producer QA is the best and most logical way to go. You could manufacture a superior, economical and more consistent product if the producer could control the entire process – PE
This is How

• Target specific projects to convert and develop case studies
• Overcome objection with a fact based approach.
• Lab Accreditation Programs and Guidance
• NRMCA and State Association Promotion