National Concrete Bridge Council (NCBC) Research Update

by

Danielle D. Kleinhans, Ph.D., P.E.
Concrete Reinforcing Steel Institute
Chair, National Concrete Bridge Council

AASHTO SCOBS Meeting
Portland, OR
June 16 - 20, 2013

National Concrete Bridge Council

- American Coal Ash Association
- American Segmental Bridge Institute
- Concrete Reinforcing Steel Institute
- Expanded Shale, Clay, and Slate Institute
- National Ready Mixed Concrete Association
- Portland Cement Association
- Precast/Prestressed Concrete Institute
- Post-Tensioning Institute
- Silica Fume Association
- Wire Reinforcement Institute
PT Grout with Elevated Chlorides

2013 AASHTO SCOBS
Portland Oregon
June 20, 2013

Reggie Holt, P.E.
Federal Highway Administration

Background

• PT grout with elevated chlorides was initially discovered in a PT straddle cap in TX (2010).
• PT grout used in TX bridge was a pre-bagged thixotropic product called SikaGrout 300PT.
• Follow up investigations by PT grout manufacturer, Sika, determined that its 300PT SikaGrout product from its Marion OH plant was sometimes produced with levels of chloride well above the specified limit.
• The cement used in the 300PT product has been identified as the source of the chlorides.
# Completed Projects

<table>
<thead>
<tr>
<th>Project</th>
<th>University</th>
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<tr>
<td>Use of Ultrahigh-Strength Reinforcement in Columns of Frames to Resist Seismic Loads</td>
<td>Purdue University</td>
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<tr>
<td>Evaluation of the Orientation of 90° and 180° Reinforcing Bar Hooks in Wide Members</td>
<td>Missouri University of Science &amp; Technology</td>
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Coiled Bar Properties

School
Texas Tech University
Principal Investigator
Dr. Sang-Wook Bae
Matching Funds
Nominal - TX Tech Foundation
Status - Ongoing

Lap Splices in Thin Members

School
Purdue University
Principal Investigator
Dr. Santiago Pujol
Matching Funds
Purdue Foundation
Erico
Status – Report writing
Spiral Stirrups
School
University of Cincinnati
Principal Investigator
Dr. Bahram Shahrooz
Funding
Pankow Foundation
CRSI and PCI
Status – Report writing

High-Strength Bar Hooks
School
University of Kansas
Principal Investigator
Drs. David Darwin & JoAnn Browning
Funding
EPRI, CRSI, KDOT, Pankow
Status - Ongoing
High-Strength Bar Heads
School
University of Kansas
Principal Investigator
Drs. David Darwin & Adolfo Matamoros
Funding
EPRI, CRSI
Status - Ongoing

Bar Bending
School
NC State University
Principal Investigator
Dr. Rudolf Seracino
Funding
CRSI & NC State Foundation
Status - Ongoing
Lap Splice Locations

School
Univ. of Massachusetts
Principal Investigator
Dr. Sergio Breña
Funding
CRSI, UMass SDI, & Robert Brack
Status - Starting

Slender Columns

School
Purdue University
Principal Investigator
Dr. Robert Frosch
Matching Funds
Purdue, ACI, CRSI, PCI, CiF of NYC
Status – Ongoing
High-Strength Rebar

- Classed as yield \((f_y) \geq 80 \text{ ksi}\)
- Collaborative research consortium?

High-Strength Rebar

- Economic analysis
- Develop generic material requirements (ASTM spec)
- Structural research
- Code adoption
ESCSCI Research Update

Internal Curing
Purdue University – Dr. Jason Weiss
– Corrosion of reinforcement in restrained slabs
– IC transport properties
  • Tested RCPT, conductivity, chloride profile
– Transport for service life models
  • Quantifying sustainability aspects IC
  • Diffusion characteristics: D & m coefficients
– Several demonstration projects completed
– Educational video series
Internal Curing

Brigham Young Univ. – Dr. Spencer Guthrie
- IC bridge decks are being monitored and compared with conventional concrete decks at 2 sites
- Initial results indicate reduced permeability and greatly reduced cracking on IC decks

Natl Conc Pvmt Techn Ctr – Dr. Peter Taylor
- IC deck is to be placed on a bridge in Buchanan County, IA, in mid-June

LWA Fines for Air Entrainment

Oklahoma State University - Dr. Tyler Ley
- Preliminary testing with mortar showed potential for LWA fines to protect the paste like air entrainment
- In concrete testing, both the conventional mixes (no LWA) and mixes with LWA fines failed the standard freeze-thaw testing
- Waiting on final report
Using Fine LWA to Mitigate ASR in Concrete

Oregon State University - Dr. Jason Ideker
– Research is just getting underway
– Slabs have been cast and placed at exposure site
– Dr. Michael Thomas at UNB is also on research team

LWC for PS Piles

Auburn University - Dr. Brian Anderson
– 12 in. square PS piles were cast and driven in summer of 2012
  • Control, Sand LWC & Partial LWC (LWA was used for 50% of coarse aggr) piles
– No problems with driving any of the piles
– Concluded that LWC could be used for prestressed piles
– Work has been completed and a dissertation is available
Field Implementation & Evaluation of Crack-Reduction Technologies

Kansas University - Dr. David Darwin
- Major study to evaluate different crack reduction strategies in field installations
- Identified as an Industry Critical Technology (ICT) by the Strategic Development Council (SDC) of ACI
- Internal curing using LWA will be considered as an option
- ESCSI is one of several sponsors
- Work to begin Sept 2012

Market Evaluation & Road Map for Use of IC in Concrete Pavements

Applied Research Assoc. - Dr. Mike Darter
- Preliminary evaluation of potential for using IC with LWA to improve the service life of concrete pavements
- Initial findings indicate that there is potential to reduce cracking in pavements and extend service life
NRMCA/PCA Research Update

MIT Concrete Sustainability Hub

- $10 million Investment Over 5 Years (2010-2015)
- Funded Equally by RMCREF & PCA
- NRMCA Providing Technical Support and Guidance
- NRMCA and State Associations Have a Critical Role in the Technology Transfer
MIT Concrete Sustainability Hub: Goals

- Identify Areas in Which Concrete Excels
- Identify Opportunities for Improvement
- Create Solid Technical Basis for Future Industry Development

MIT Concrete Sustainability (CS) Hub

- Life Cycle Analysis (LCA)
  - Incorporating Variability

- Life Cycle Cost Analysis (LCCA)
  - Construction Materials: Equal Inflation Rates?
  - Incorporating Variability

- Genesis of Concrete project
  - Develop new generation of "green" cement-based materials
Life Cycle Analysis (LCA)

LCA-investigation and valuation of the environmental impacts of a given product.

Scope Of LCA Pavement Research

Scope includes all effects attributable to the pavement design.

- Extraction and production
- Transportation
- Onsite equipment

Materials → Construction → Use → End-of-Life

Maintenance
- Materials
- Construction
- Traffic delay

- Pavement-Vehicle Interaction
  - Roughness
  - Deflection
- Albedo
- Carbonation
- Lighting

- Pavement Removal / Milling
- Landfilling
- Recycling
- Transportation
PCI Research Update

Strand Acceptance Criteria

- Kansas State University
  - 2011 to 2014
- Standard Test for Strand Bond (STSB)
  - NCHRP Report 603
  - Pullout strength at 0.1 in. slip
Strand Bond Project

• Strand proposed to be qualified by pullout test in mortar – now ASTM A1081
• Project includes ruggedness testing, reproducibility round robin testing, sensitivity analysis, and beam flexural testing
• Goal – establish an acceptance value for pullout strength

Round Robin Labs

• FHWA Turner-Fairbanks
• Florida DOT
• Kansas DOT
• Texas DOT
• Missouri DOT
• Ohio DOT
• Louisiana DOT
Strand Bond

- Missouri S&T
  - PCI Fellowship
  - SCC and HVFA

NEXT Beam

- University of Massachusetts Amherst
  - PCI Fellowship
  - Monitoring to refine distribution factors
Beam Deformations

- Virginia Tech
  - PCI Fellowship
  - Variability of sweep in 128 bridge girders ranging from 120-140ft.

Concrete Bridges

Thank You