**AGENDA**
**ACI Committee 345**
**Bridge Construction, Maintenance, and Repair**
**Fall 2015 Convention**
**Denver, CO**

**Sunday, Nov. 8, 2015, 1:30 pm to 3:30 pm**

**Chair: Jimmy Kim at University of Colorado Denver**
**Secretary: Chris Carroll at University of Louisiana at Lafayette**

1. Introductions

2. Approval of Spring 2015 (Kansas City, MO) minutes

3. Membership status
   The committee currently has 2 officers and 13 other voting members, 6 consulting members, and 23 associate members (44 members as shown in Appendix I)

4. Technical Sessions/Special Publication:

   a. "Sustainable Performance of Concrete Bridges and Elements Subject to Aggressive Environments: Monitoring, Evaluation, and Rehabilitation" moderated by Jimmy Kim, Baolin Wan, and Isamu Yoshitake (3 sessions for F2014 in Washington, D.C.): sponsored by ACI-201 (durability), 343 (bridge design), and 345 (to be published in 2015)
   b. "Design and Performance of Concrete Bridges and Buildings When Interacting with Soils and Foundations" in Denver, CO (F2015) moderated by Jimmy Kim and N.Y. Chang (two sessions in Denver, Monday afternoon), co-sponsored by ACI-343
   c. "Evaluation and Response of Bridges Subjected to Non-Conventional Live or Extreme Loads Meeting" in Philadelphia, PA, F2016 moderated by Jimmy Kim, Sri Sritharan, and Devin Harris, sponsored by ACI 345, 342 (Evaluation), and 341(Earthquake-resistant concrete bridges)

5. Liaison reports from other committees (TAC, 342, 343, others)

6. Status of Documents

   a. 345.1R-XX – Maintenance of Concrete Bridge Elements, Present Document Status – Staff edit (done Feb. 7, 2014), TAC review (done Aug 30, 2014), ballot 1 (done Sept 10, 2014), ballot 2 (done Mar 14, 2015), a final ballot (done Sept. 6, 2015). The last ballot will quickly be reviewed and all documents will be submitted to ACI

   b. 345.XR – Guide for Concrete Bridge Deck Repair and Rehabilitation (Chapters 4 and 5, ballot Sept 27, 2015)—Ballot results will be reviewed and other chapters will be discussed

7. New business

8. Adjournment

**Appendix I**
Membership as of Oct. 11, 2015: **44 members**

**Officers**: 2
Kim, Yail Jimmy (Chair); Carroll, Chris (Secretary)

**TAC Contact**
French, Catherine E

**Voting members**: 13
Beaver, Jesse; Brown, Michael C; Estenssoro, Luis Fernando; Foden, Andrew J; Gepraegs, Oliver K; Oglesby, Rita K; Sandberg, Harold R; Silfwerbrand, Johan L; Sprinkel, Michael M; St John, Paul J; Vaughn, Ronald E; Weyers, Richard E; Williams, Mark Erik

**Consulting members**: 6
Anderson, James C; Danley, Byron; Fouad, Fouad H; Harwood, Allan; Virmani,Yash; Wouters, Jeffrey

**Associate members**: 26

Al Wakeel Shahlaa A; Bartlett, F Michael; Branson, Tobias J W; Carrato, John L; Carter, Paul D; Castrodale, Reid W; Cumming, Neil A; Guth, Dena L; Haque, Mohammed E; Harris, Devin K; Hu, Minhu Paul; Huang, Jinwei; Hughes, Mark E; Klein, Gary J; Lee, Yoon-si; Morcous, George; Nash; Seo, Junwon; Simpson, John M; Smith, Jeffrey L; Soubra, Khaled S; Suh, Kwangsuk; Takhtovich, Eugene; Watts, Ralph D

**Appendix II**

**Chapter 1 – Introduction (*Brown*)**

**1.1 Purpose and Scope**

Includes activities normally considered as requiring repair and rehabilitation. Excluded are maintenance activities such as deck cleaning and concrete sealer applications.

Includes:

a) crack repair
b) pothole repair
c) restoration of skid resistance
d) overlays
e) demolition and deck removal are beyond scope of document

**Chapter 2 – Notations and Definitions (Brown)**

**Chapter 3 – Condition Evaluation (*Paul St. John & Jeff Smith*)**

**3.1 Overview**

3.1.1 Deterioration Processes and Mechanisms
3.1.2 Repair vs Rehabilitation

**3.2 Documentation Review**

**3.3 Field Survey Techniques**

3.3.1 Visual Examination of Bridge Deck
3.3.2 Conventional Delamination Detection
3.3.2.1 Chain Drag
3.3.2.2 Hammer Sounding
3.3.3 Electrochemical Testing
3.3.3.1 Electrical Half-Cell Potential Survey (ASTM C 876)
3.3.3.2 Corrosion Rate Evaluation
3.3.3.2.1 Linear Polarization
a) Unguarded electrode
b) Guarded electrode
3.3.3.2.2 Potentiostatic Electrochemical Impedance Spectroscopy
3.3.4 Resistance and Resistivity
3.3.4.1 2-point Direct-Path Resistance
3.3.4.2 2-point Probe Resistivity
3.3.4.3 4-point Wenner Array
3.3.5 Physical Sampling
3.3.5.1 Coring
3.3.5.1.1 Compressive and Tensile Strength & Modulus
3.3.5.1.2 Petrographic Evaluation
a) Aggregate Type/Condition
b) Cement Paste Quality
c) Air Entrainment
d) Deleterious Reactions (ASR, Carbonation, DEF, Sulfate Attack)
e) Construction quality (freezing/thawing damage, over-finishing, honeycombing, cold joints)

f) Presence of pozzolans or mineral admixtures
g) Presence of surface treatments/penetrating sealers

3.3.5.2 Drilling/Concrete Powder Sampling

3.3.6 Chloride Concentration Testing

3.3.6.1 Acid-soluble Chloride Titration

3.3.6.2 Water-soluble Chloride Titration

3.3.6.3 Rapid Chloride Test using Calibrated Ion-Selective Electrode

3.3.6.4 X-ray Defraction technique

3.3.6.5 Chloride Profiling and Diffusion Modeling

3.3.7 Non-Destructive Evaluation Methods

3.3.7.1 Infrared Thermography

3.3.7.2 Ground Penetrating Radar

3.3.7.3 Sonic Methods - Impact Echo

3.3.7.4 Ultrasonic Methods and Surface Wave Methods

**Chapter 4 – Material and Method Selection (*Weyers & St. John*) Ballot issued Sept 27, 2015**

**4.1 Overview**

**4.2 Materials**

4.2.1 Crack repair

4.2.1.1 Gravity systems – MMA

4.2.1.2 Pressurized systems – epoxy

4.2.2 Pothole Repair

4.2.2.1 Types of Rapid Systems

4.2.2.1.1 Temporary

4.2.2.1.2 Permanent

4.2.2.2 Polymer Systems

4.2.2.2.1 Pre-packaged systems

4.2.2.2.2 Proportioned systems

4.2.2.3 Asphalt Concrete

4.2.2.4 Rapid Strength Gain Systems – concrete

4.2.3 Skid Resistance

4.2.3.1 Polymer concrete overlays

4.2.3.2 Grooving

4.2.4 Overlays

4.2.4.1 Polymer Concrete Overlays

4.2.4.2 Asphalt Overlays

4.2.4.2.1 Without Membrane

4.2.4.2.2 With Membrane

4.2.4.3 Concrete Overlays

4.2.4.3.1 Rapid Strength Gain Concrete

4.2.4.3.2 Latex Modified Concrete

4.2.4.3.3 Low-slump Dense Concrete

4.2.4.3.4 Microsilica Concrete

**4.3 Methods**

4.3.1 Criteria

Remaining service life required:

a) Time of repair to rehabilitation

b) Rehabilitation to replacement

4.3.2 Performance Aspects
4.3.2.1 Service Life
4.3.2.2 Costs
4.3.2.3 Traffic Conditions
4.3.2.4 Weather Conditions
4.3.3 Specifications and Testing of Systems

**Chapter 5 – Removal Methods and Surface Preparation (*Williams*) Ballot issued Sept 27, 2015**

**5.1 Overview**

In addition to project-specific requirements, method selection must also be guided by the following principles of sound practice:

1) The structure to be coated should not be damaged.
2 ) Reinforcing steel should not be damaged nor its bond with the concrete loosened.
3 )Vibration, impact, or thermal loads applied should not weaken the concrete.

**5.2 Method Overview** (Present in order from least to most aggressive)

5.2.1 Low-Pressure Water Cleaning (Cleaning Method)
5.2.2 Grinding (Erosion Method)
5.2.3 Abrasive Blasting (Pulverizing Method)
5.2.4 Steel Shotblasting (Pulverizing Method)
5.2.5 Scarifying (Impact Method)
5.2.6 Needle Scaling (Impact Method)
5.2.7 High and Ultra High.Pressure Water Jetting (Erosion Method)
5.2.8 Scabbling (Impact Method) – too much risk of micro-cracking?
5.2.9 Flame Blasting (Expansion Method)
5.2.10 Milling (Impact Method) – too much risk of micro-cracking?
5.2.11 Full Depth Removal – Saw cut, chipping hammers

**5.3 Method Selection Process** – Reduce risk of micro-cracking

**5.4 Summary/Conclusions**

**Chapter 6 – Repair Methods (*St. John/Kim/Williams)***

**6.1 Overview Complete (Williams)**

**6.2 Standard Repairs**

6.2.1 Patching
6.2.2.1 Partial Depth
6.2.2.2 Full-Depth
6.2.2 Crack Repair
6.2.2.1 Gravity Fill Methods
a) Rout and Seal
b) Flood coat
6.2.2.2 Pressure Methods
a) Epoxy Injection

**6.3 Repairs with Advanced Composites Complete (Kim)**

**Chapter 7 – Overlays (*Sprinkel & Silfwerbrand*)**

**7.1 Scope**

**7.2 Need for Overlays**

7.2.1 Restored or Strengthened Load-Carrying Capacity **Complete (Silfwerbrand)**

8.1.2 Influence of chloride
8.1.3 Other factors

**8.2 Electrochemical testing for corrosion**

8.2.1 Corrosion potential
8.2.1.1 Methods
8.2.1.2 Limitations and constraints
8.2.2 Corrosion rate
8.2.2.1 Methods
a) Linear Polarization
b) Electrochemical Impedance Spectroscopy
8.2.2.2 Limitations and constraints
8.2.3 Resistivity

**8.3 Electrochemical Treatment Processes**

8.3.1 Impressed Current Applications
8.3.1.1 Cathodic Protection and Prevention (NACE RP0290-2000)
8.3.1.1.1 Methods
a) Overlays containing Strip or Mesh Anodes
b) Conductive Coatings
8.3.1.1.2 Limitations and Constraints
8.3.1.2 Electrochemical Chloride Extraction (NACE 01101)
8.3.1.3 Re-alkalization
8.3.2 Galvanic Applications
8.3.2.1 Cathodic Protection and Prevention
8.3.2.1.1 Methods
a) Galvanic Coatings
b) Bulk Anodes and Distributed Anodes
8.3.2.1.2 Limitations and Constraints

**Chapter 9 – Appurtenances, Joints, Parapets and Approach Slabs**

**9.1 Sidewalks *(Foden)***

9.1.1 Introduction to Concrete Sidewalks
9.1.2 Types of Loads/Stresses Acting on Sidewalks
9.1.3 Possible Damages of Concrete Sidewalks
9.1.3.1 Concrete Problems (Deterioration, Cracking, Abrasion, Corrosion, Water Leakage, Delamination, Surface Smoothing, Freeze-Thaw, Disintegration, etc.)
9.1.3.2 Damage Due to Moving/Static Loads of Heavy Vehicles
9.1.3.3 Fracture or Settlements in Sidewalks with Hollow Like Section
9.1.3.4 Load Effects to Cantilevered Sidewalks
9.1.3.5 Other Damages
9.1.4 Repair, Rehabilitation or Strengthening Techniques
9.1.5 Stress Reduction Techniques
9.1.6 Reinforcement Requirements
9.1.7 Surface Preparation
9.1.8 Overlays and Coatings
9.1.9 Placements Methods

**9.2 Parapets *(Foden)***

9.2.1 Introduction to Concrete/Steel Parapets

9.2.2 Types of Loads/Stresses Acting on Parapets
9.2.3 Possible Damages of Parapets
9.2.3.1 Concrete Problems (Deterioration, Cracking, Corrosion, Water Leakage, Delamination, Freeze-Thaw, Disintegration, etc.)
9.2.3.2 Damage Due to Impact Effects of Moving Vehicles
9.2.3.3 Steel.Concrete Connections
9.2.3.4 Other Damages
9.2.4 Reinforcement Requirements
9.2.5 Repair, Rehabilitation or Strengthening Techniques

**9.3 Joints**

9.3.1 Bridge Deck Joints Classification **Complete (Carroll)**
9.3.2 Expansion/Non-Expansion Joint Functions **Complete (Carroll)**
9.3.3 Traffic Bearing Expansion Joints **Complete (Carroll)**
9.3.4 Other Types and Features (Carroll: may be deleted?)
9.3.5 Review of Current Practice **Complete (Carroll)**
9.3.5.1 Design Procedures **Complete (Carroll)**
9.3.5.2 Construction Practice **Complete (Carroll)**
9.3.5.3 Selection Guidelines **Complete (Carroll)**
9.3.6 Possible Problems with Bridge Deck Joints
9.3.7 Deck Joints Maintenance, Repair and Rehabilitation Practice (address below)
6.1.2.c
6.2.3 Joint Repairs
6.2.3.1 Joint Types
6.2.3.2 Surface Preparation
6.2.3.3 Joint anchorage repair or replacement

9.3.8 Deck Joints Waterproofing and Sealing
9.3.9 Lessons for Maximizing Joint Service Life

**9.4 Approach Slabs *(Williams/Harris)***

9.4.1 Introduction to Approach Slabs
9.4.2 Types and Features
9.4.3 Reinforcement Requirements
9.4.4 Seismic Effects to Approach Slabs
9.4.5 Possible Damages for Approach Slabs
9.4.6 Settlement in Approach Slabs and Abutment Backfill
9.4.7 Repair and Rehabilitation of Approach Slabs