AGENDA
ACI Committee 345
Bridge Construction, Maintenance, and Repair
Spring 2018 Convention
Salt Lake City, UT

Sunday, March 25, 2018, 1:30 pm to 3:30 pm

Chair: Jimmy Kim at University of Colorado Denver
Secretary: Sam Keske at Wiss, Janney, Elstner Associates, Inc.

1. Introductions

2. Approval of Fall 2017 (Anaheim, CA) minutes

3. Membership status
   The committee currently has 3 officers and 13 other voting members, 5 consulting members, and 29 associate members: 50 members in total

4. Technical Sessions/Special Publication:

   a. "Durability of Concrete Members Incorporated with Conventional and Advanced Materials" in Detroit (S2017) moderated by Jimmy Kim, Isamu Yoshitake, and Mark F, Green; co-sponsored by 201 (durability); an SP is under development (to be completed by the spring of 2018)
   b. "Advances in Concrete Bridges: Design, Construction, and Rehabilitation" in Salt Lake City, UT (two sessions, S2018) moderated by Jimmy Kim, co-sponsored by ACI-342 and -343: Monday (4:00-6:00) and Tuesday (8:30-10:30)
   c. "Durability of New or Repair Materials for Bridge Maintenance" by Johan Silfwerbrand and Andy Foden (discussed in SP2017)
   d. "Advances in Construction, Evaluation and Repair of Concrete Structures and Materials: International Perspectives with KCI and TCI" (four sessions, S2019) moderated by Jimmy Kim, Thomas Kang and Henry Lee, co-sponsored by ACI-369
   e. "Prestressed Concrete with Conventional and Nonconventional Materials" (F2019, call for abstracts by July 31, 2018), moderated by Jimmy Kim and Hiroshi Mutsuyoshi (JPCI)

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

6. Status of Documents

   a. 345.XR – Guide for Concrete Bridge Deck Repair and Rehabilitation
      Chapter 3 – Condition Evaluation (*St. John & Smith*)
      Chapter 8 – Electrochemical Methods (*Brown*)
      Chapter 9.1 Sidewalks *(Foden)*
      Chapter 9.2 Parapets *(Williams)*

7. New business
   - Conference announcement: Bridge Engineering Institute Conference (BEI-2019), July 22-25, 2019, Honolulu, HI. www.beibridge.org

8. Adjournment

Appendix I

Chapter 1 – Introduction (*Kim*)

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 (*Kim*)

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*) Completed and Balloted

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*) Completed and Balloted

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)*: Completed and Balloted

6.1 Overview

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

Chapter 7 – Overlays (*Sprinkel & Silfwerbrand*): Completed and Balloted

7.1 Scope

7.2 Need for Overlays

7.2.1 Restored or Strengthened Load-Carrying Capacity

7.2.2 Waterproof Barrier
7.2.3 Skid Resistance
7.2.4 Wearing Course
7.2.5 Reduction of Wheel Load Effect

7.3 Required Properties of Overlays

7.3.1 Properties required of all overlays
7.3.1.1 Adhesion to concrete
7.3.1.2 Cohesion
7.3.1.3 Skid Resistance
7.3.1.4 Durability
7.3.2 Properties required of waterproof barriers
7.3.2.1 Impermeability
7.3.2.2 Crack Resistance
7.3.2.3 Temperature Compatibility

7.4 Types of Overlays

7.4.1 Plain Concrete Overlays
7.4.2 Reinforced Concrete Overlays
7.4.3 Fiber Concrete Overlays
7.4.4 Latex Modified Concrete Overlays
7.4.5 Hydraulic Cement Concrete Overlays
7.4.6 Polymer Overlays
7.4.7 Membrane and AC Overlays

7.5 Design Considerations

7.6 Construction Considerations

7.6.1 Scarification and Removal of Unsound Concrete
7.6.2 Cleaining
7.6.3 Substrate Preparation
7.6.4 Placement and Consolidation
7.6.5 Curing
7.6.6 Skid Resistance
7.6.7 Traffic Vibrations

7.7 Other Considerations

7.7.1 Material Performance Specifications
7.7.1.1 Cement Type
7.7.1.2 w/cm
7.7.1.3 Aggregate Size
7.7.1.4 Air Content
7.7.1.5 Slump
7.7.1.6 Compressive Strength
7.7.1.7 Shrinkage
7.7.1.8 Ductility
7.7.2 Environmental Considerations
7.7.2.1 Climate
7.7.2.2 Traffic

Chapter 8 – Electrochemical Methods (*Brown*) to be completed in Feb. 2017 and balloted by Mar

8.1 Overview of reinforcement corrosion causes and processes (ACI 222R?)

8.1.1 Influence of OH^- and pH

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 *(Williams)*

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