Service Life Design Requirements

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What Is the Objective?

• Longer time before obsolescence and/or major rehabilitation:
  – Reduced maintenance and rehabilitation costs
  – Reduced disruption to users
  – Less reliance on outside contractors to do the work
  – No surprises re maintenance and rehab requirements

• Lower full-life costs… with reasonable initial cost premium

• Design, construction and quality management that provides confidence that the objectives will be achieved

• Scope: concrete, structural steel, cables, M&E systems, pavements and wearing courses
What Do We Need for Specifications?

• Definition for service life
• Design methodology
• A limit state
• Avoid vague statements like:
  ➢ "Bridges are to be designed with consideration given to the Department’s 100-year-bridge life initiative."
  ➢ "The service life of the structure shall be 100 years.”
Definition of Service Life

• CSA A23.1-14 and S6: Service life — the time during which the structure performs its design function without unforeseen maintenance or repair.

• ACI 365: Service life (…) is the period of time after (…) placement during which all the properties exceed the minimum acceptable values when routinely maintained.

• AASHTO LRFD: The period of time that the bridge is expected to be in operation.

• *fib* Bulletin 34 - Model Code for Service Life Design: Design Service Life – assumed period for which a structure or a part of it is to be used for its intended purpose.
Design methodology

- fib Bulletin 34 Model Code for Service Life Design
- fib Model Code for Concrete Structures 2010
- ISO 16204:2012 Service Life Design of Concrete Structures
Limit State

• Concrete components must resist chloride ingress such that corrosion is not initiated within the service life based on a target confidence level of 90%.

• Specific service lives for different components:
  – Non-replaceable components
  – Replaceable components:
    • Bearings
    • Expansion joints
    • Concrete barriers
    • Coatings for structural steel (paint system)
Specifications

• Service life is the actual period of time during which a structure performs its design function without unforeseen costs for maintenance and repair.

• Non-replaceable components (state which ones) shall be designed for a 100 year service life.

• The service life of concrete components shall be in accordance with Bulletin 34, Model Code for Service Life Design, written by the International Federation for Structural Concrete (fib), February 2006.

• Concrete components must resist chloride ingress such that corrosion is not initiated within the service life based on a target confidence level of 90%.
Specifications

- Specific service life for non-replaceable components
  - Bearings
  - Expansion joints
  - Concrete barriers
  - Coatings for structural steel (paint system)
Specifications

• Testing during construction can be specified:
  – Monitoring the concrete durability properties
    o Rapid chloride migration NTBuild 492
    o Acid soluble chloride content ASTM C1152
    o Plastic air content
    o Hardened air content
    o Aggregates properties (AAR)
  – Monitoring as-built concrete covers
Service Life Design for Steel Structures
SLD: Steel Structures

• Typical elements that are considered:
  – Coatings for structural steel
  – Bearings
  – Expansion joints

• No models, no documents similar to what is produced for concrete structures

• A system that will provide the required service life is designed
  – System requires maintenance
  – Rely on information from suppliers and past experience from Owners
Resources


• ISO 12944-2 Paints and varnishes - Corrosion protection of steel structures by protective paint systems, Part 2: Classification of environments.


Questions?

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AASHTO SHRP2 R19A Website:
http://shrp2.transportation.org/Pages/ServiceLifeDesignforBridges.aspx

FHWA GoSHRP2 Website:
www.fhwa.dot.gov/GoSHRP2/