



Service Life Design Requirements

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Anne-Marie Langlois, P.E.



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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
 - Rapid chloride migration NTBuild 492
 - Acid soluble chloride content ASTM C1152
 - Plastic air content
 - Hardened air content
 - 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

- *Expected Service Life and Cost Considerations for Maintenance and New Construction Protective Coating Work*, Helsel, Jayson L. et al, NACE Corrosion 2008 Conference & Expo Paper #08279, 2008.
- ISO 12944-2 Paints and varnishes - Corrosion protection of steel structures by protective paint systems, Part 2: Classification of environments.
- ISO 9223: 2012, Corrosion of metals and alloys. Corrosivity of atmospheres. Classification, determination and estimation.
- ASTM G101-04. *Standard guide for estimating the atmospheric corrosion resistance of low-alloy steel*, American Society for Testing and Materials, 2004.
- The American Galvanizers Association,
<http://www.galvanizeit.org/hot-dip-galvanizing/how-long-does-hdg-last/in-the-atmosphere/time-to-first-maintenance>

Questions?

Patricia Bush

AASHTO Program Manager for Engineering

phutton@ashto.org

Mike Bartholomew

CH2M

mike.bartholomew@ch2m.com

Anne-Marie Langlois

COWI North America

aml@cowi.com

AASHTO SHRP2 R19A Website:

<http://shrp2.transportation.org/Pages/ServiceLifeDesignforBridges.aspx>

FHWA GoSHRP2 Website:

www.fhwa.dot.gov/GoSHRP2/