Deterioration Factors at Girder Ends

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Overview

One of the most problematic areas at bridges is girder ends.

- Major contributing factors of deterioration
- The effects of corrosion
- What we can do to minimize corrosion

Corrosive Materials:

- Dirt and debris
- Bird droppings
- Salt and deicing chemicals
- Combination of the above

Dirt and Debris

Feature Carried:	I-95
Feature Crossed:	West River and Kimberly Avenue
Date Inspected:	4/28/05
Project No.:	170-2357

Photo # 26: Typical condition of bearings at pier 9 with heavy laminated rust, up to ¼ inch loss on rockers and masonry plate and heavily covered with bituminous concrete.

Bridges are Homes to Pigeons

Bird Droppings

The most frequently mentioned corrosion concern in cold regions of the country is the application of salt and deicing chemicals

Aetna Viaduct Bridge, Hartford, CT

Deicing Chemical Facts

Over $2 billion is spent each winter in this country on roadways and 15 million tons of deicing salts.

New equipment for upcoming winter

Connecticut's Use of Deicing Chemicals During a Storm

- In the winter of 2007 Connecticut eliminated the use of sand and began applying salt brine prior to storms. During the storm, salt or salt pre-wetted with calcium chloride or magnesium chloride is applied
- New practice works well in a wider range of temperatures
- Eliminates costly sand clean-up on roadways and sand build-up on bridge seats
- Better for the environment
- But troublesome to bridges

Calcium Chloride and Magnesium Chloride

Deicer	Lowest Effective Temperature, F*	Effect on Concrete/Metal	Effect on Carpet/Floors	Effect on Vegetation	Effect on Environment/ Water Quality
Sodium chloride	-6	severe	slight	severe	moderate
Calcium chloride	-67	severe	severe	moderate	slight
Magnesium chloride	-28	severe	severe	moderate	slight
Potassium chloride	+13	severe	slight	moderate	slight
Calcium Magnesium Acetate	+15	slight	moderate	slight	slight/moderate
Urea and other nitrogen salts	variable	none/severe	moderate	slight	severe
Sand or gravel	–	slight	moderate	none	slight

**The effective melting temperature depends on the concentration of the deicing chemical. Values generally represent the lowest effective melting temperature possible with highly concentrated solutions of the compound. (Source: Utah State University Extension, 2/99)*

Severe corrosion effects on metals and concrete

Accelerated Deterioration?

- In the past few years, significant increases of deterioration have been observed by the same inspection crew at the same bridge
- At some bridges, NBI condition ratings between inspection cycles have been downgraded by two categories (satisfactory to poor or fair to critical)
- In several instances, critical findings required repairs at bridges recently rehabilitated
- Worse case, newly discovered deterioration added to ongoing construction projects by change order

Effects of Deterioration

Result of Corrosion

Frozen Bearings

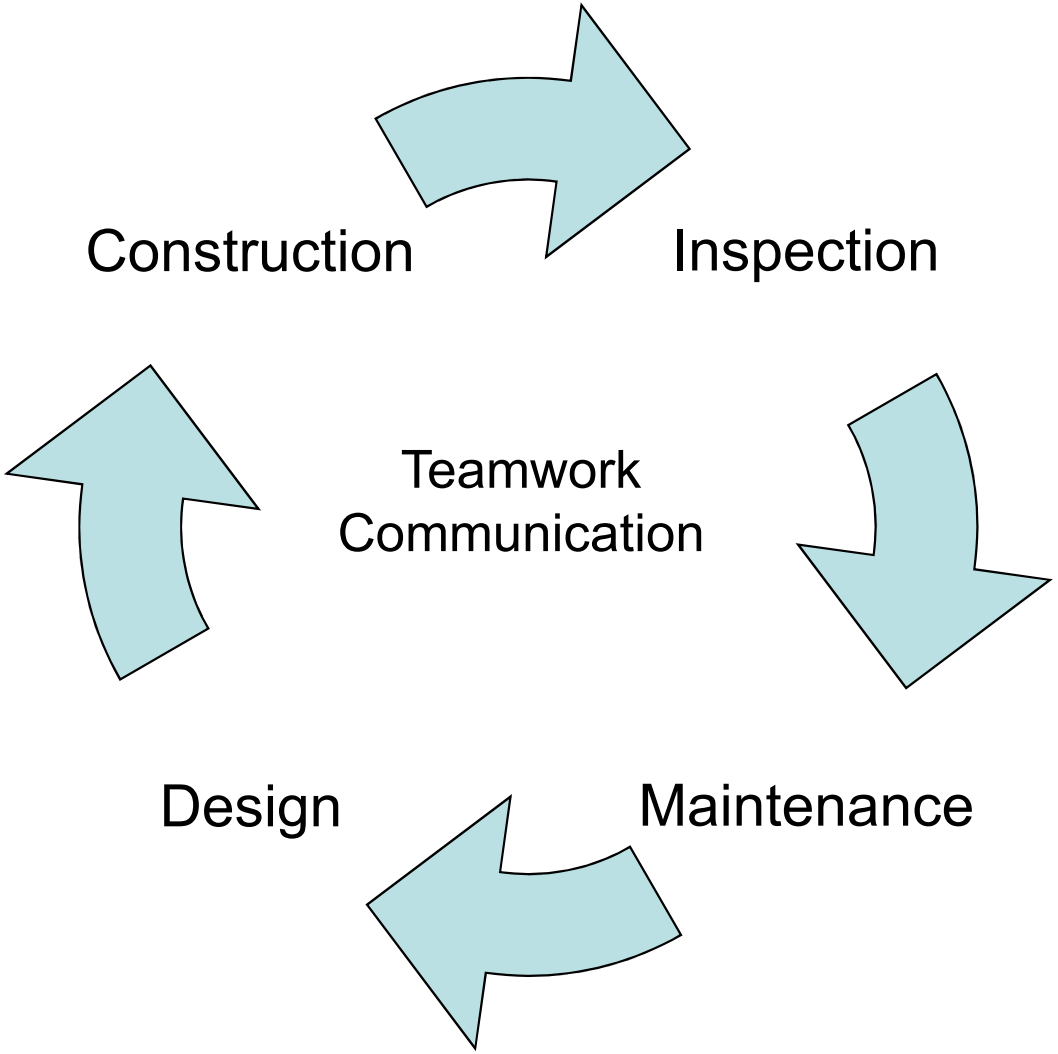
Broken Bearings

Frozen bearings can result in damage to the substructure…

Spalling of Concrete Girder

Precast Deck Unit Bridge

Combating Deterioration



Resources + Personnel + $$$$$$$$$

"Buy-in" from key decision makers is essential in the efforts to protect our massive capital investment in bridges.

What can be done to minimize corrosion at bridges?

- Design maintenance-free/maintainable bridges
- Preventative bridge maintenance program
- Bird netting
- Washing bridges to remove roadway salts, deicing chemicals, dirt, and bird droppings

Select and detail good deck joints

Failed deck joint during rain storm

Elements of a Good Bridge Design

Weathering steel,
elastomeric bearings,
proper deck drainage

Continuity over piers,
painting of girder ends

Slab over backwall

Integral Abutments and Piers

Before concrete pour

After concrete pour

Preventative Maintenance Program

Cleaning Drainage System

Painting Girder Ends

Sealing Joints

Bird Netting

Managing deicing chemicals

- Train personnel on deicing equipment use
- Calibration of equipment and spot check
- Increase use of roadway and vehicle equipped temperature sensors
- Bridge washing program

Who washes bridges? - survey result

- Maine – Yes, and applies a protective oil
- Maryland – Used to but no longer because of environmental issues
- New Hampshire – Yes, has Best Management Practices
- New Jersey – No
- New York – Yes, MOU excludes washing over trout streams, disrupting migratory birds, and dislodging flaking paint
- Pennsylvania – Yes, under general maintenance permit and utilizes Federal funds
- Vermont – Yes, has policy with environmental agencies but discussions are ongoing.
- Rhode Island - Yes

RIDOT ARRA Projects

Project	Description	RI Contract Number	City/Town	Estimated Cost
Bridge Washing C - 11	Powerwashing of 65 of Rhode Island's 772 bridges to remove road salts, dirt and bird droppings. Includes: Burrillville, Charlestown, Cranston, East Greenwich, Exeter, Hopkinton, Johnston, Narragansett, North Kingstown, Richmond, South Kingstown, Warwick, West Greenwich, West Warwick, and Westerly. RIDOT goal of powerwashing all bridges with 10 contracts every 5 years.	**2009-CM-025**	Statewide	$984,000
Bridge Washing C - 10	Powerwashing of 65 of Rhode Island's 772 bridges to remove road salts, dirt and bird droppings. Includes: Cumberland, East Providence, Lincoln, North Smithfield, Pawtucket, Portsmouth, Providence, and Tiverton. RIDOT goal of powerwashing all bridges with 10 contracts every 5 years.	**2009-CM-024**	Statewide	$1,392,000

Connecticut does not wash bridges due to environmental issues but we have begun discussing the need for such a program.

I’d like to end my presentation with the question…

What are your experiences with cleaning bridges?

Thank you.

References

- United State Environmental Protection Agency (EPA) “Source Water Protection Practices Bulletin,” August 2010

- Rhode Island ARRA information, n.d., from: http://www.recovery.ri.gov/programs/TransportationMap.php#statewide

- Utah State University Extension, February 1999