Condition Assessment Guide for Bridge Coatings

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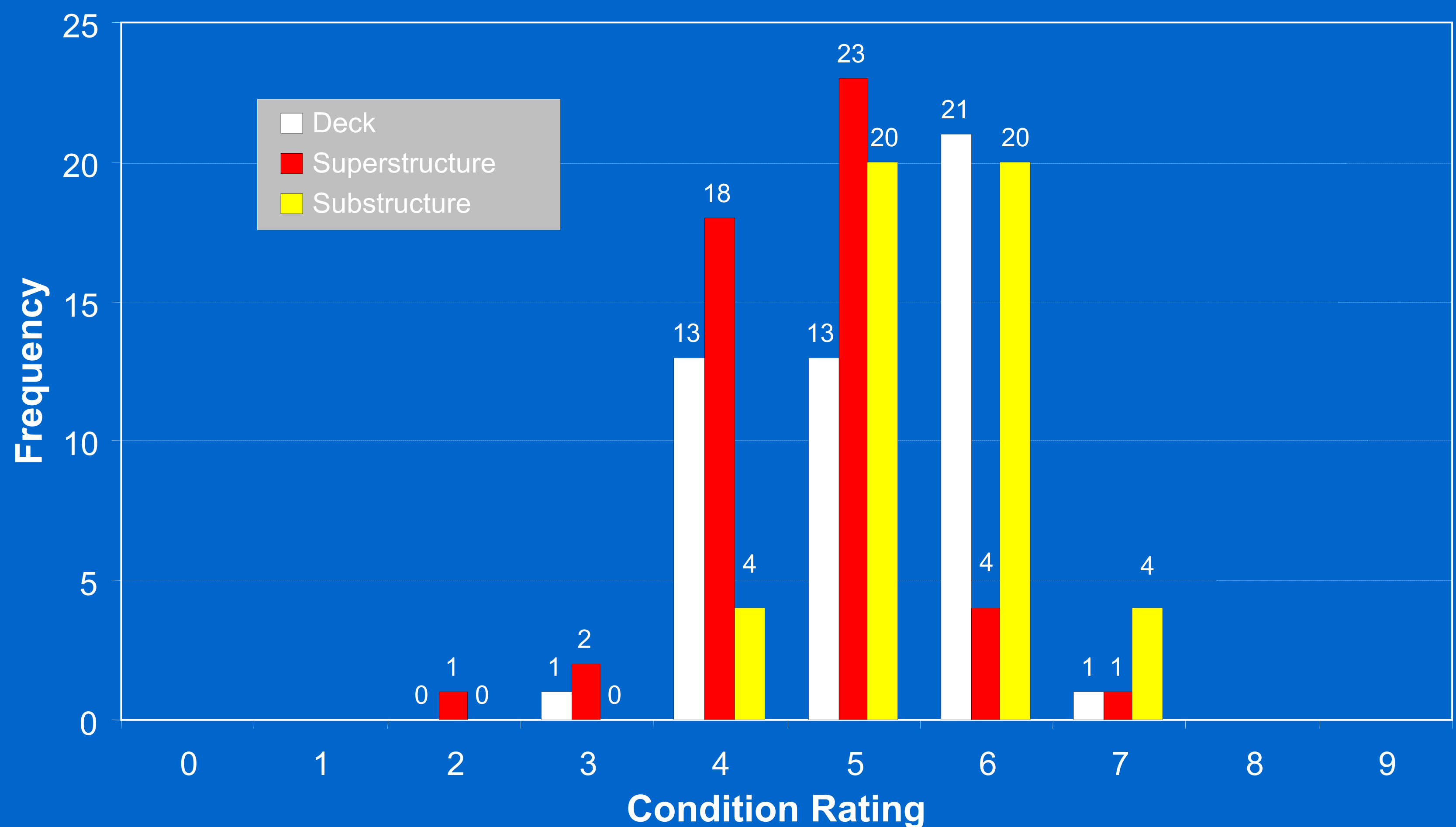
Goals

- Improve the data available for managing coatings across inventory of ~4000 steel bridges
- Provide guidelines that improve the reliability of inspection data
  - Reliability: ability to perform its intended function
    - Consistency
    - Data useful for decision making

Inspection Variability



Motivation

- Subjective rating scales are practical for recording coatings conditions
- Industry standards focus on up-close evaluations of coatings
  - Doesn't match needs for bridges, where all conditions may exist to some extent
  - Need to assess coatings within the context of a routine inspection

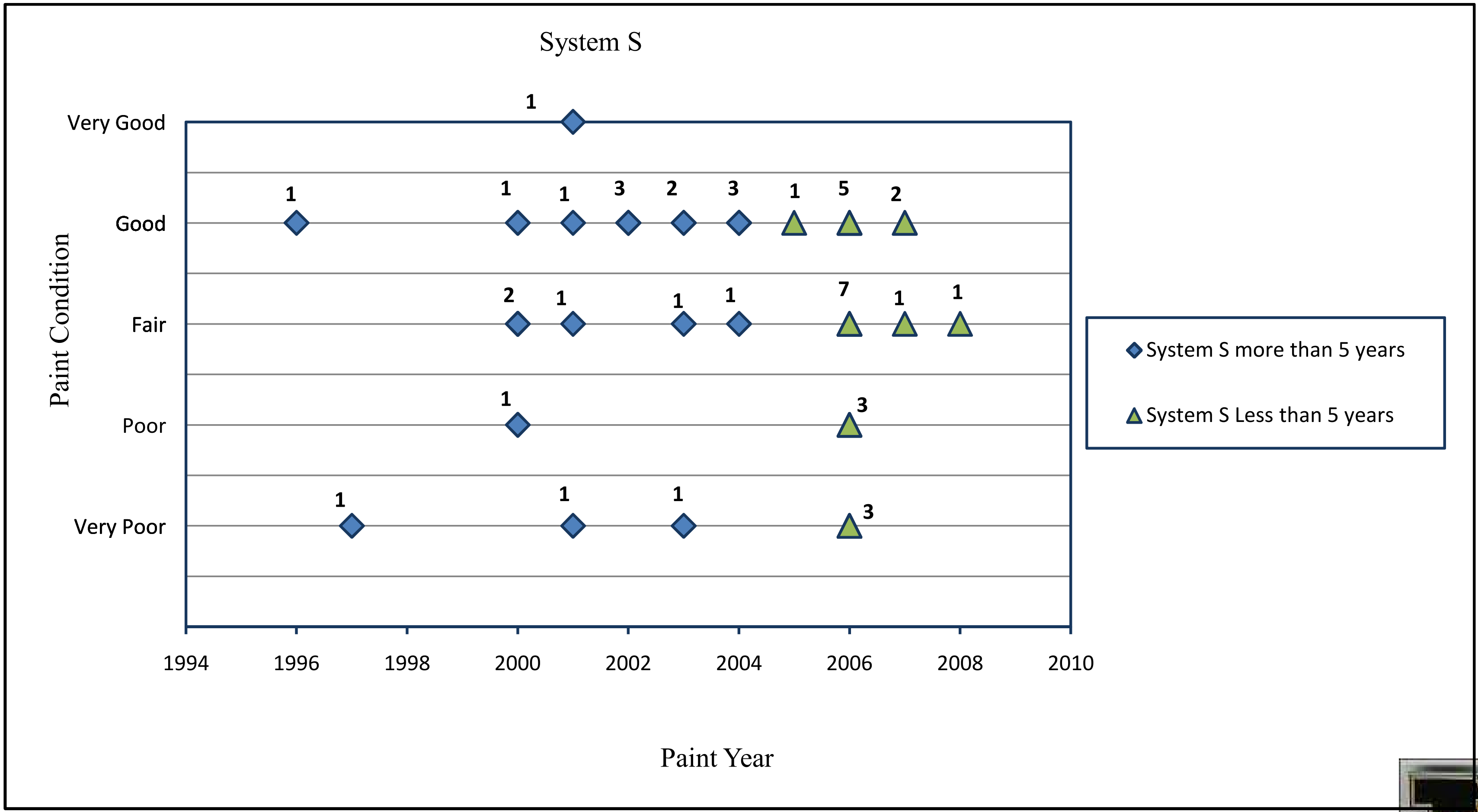
Project Overview

- Survey bridge coatings conditions in the field
  - Evaluate over-coating performance, CSA
  - Coating performance in general
  - Factors effecting coating performance
- Visual assessment tool to improve reliability of condition rating
  - Provide improved data for decision making
    - Programmatic needs, etc.

Field Survey

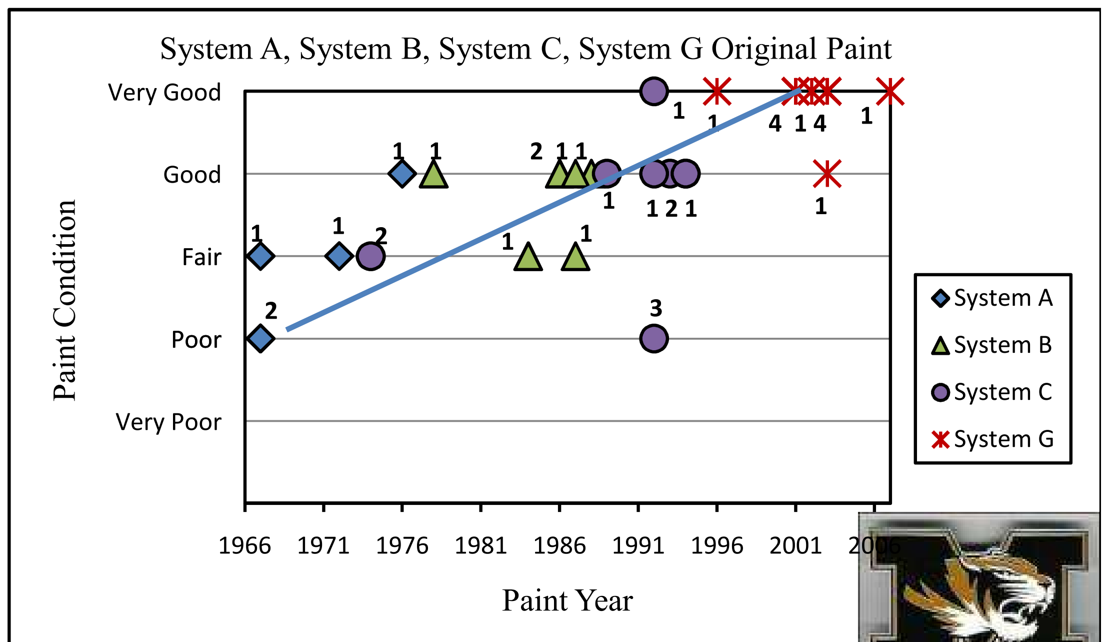
- 96 bridges across 10 MoDOT districts
- Obtain standard set of photographs
- Rate bridges for end – span and mid-span conditions
- Cross section of coating systems that are in the inventory
  - Focus on system S over-coatings, some young system G (current technologies)
  - Other systems in the inventory

System S Overall



Other Systems

- System A, B and C
  - 33 system A, B or C
  - Worst are gone
- Systems with 35 to 40+ years of service in fair to good condition
- When in poor or very poor condition, correlates with direct drainage onto the structure
  - Deck drains, deteriorated saturated decks, joints



Example

Visual Inspection Guide

- Developed subjective rating system for coatings
  - Procedure, visual guide and pocket guide
- Rate coating conditions on log scale that relates to maintenance actions
  - Fair condition up to 1% - Touch up
  - Poor condition up to 10% - Overcoat
  - Very poor = Recoat

Rating	Description
Very Good	Perfect, new condition. The coating is a new coating system with very little or no damage. This condition correlates to the SSPC rating 10, less than 0.01 % rust and SSPC-9 (Greater than 0.01 up to 0.03%).
Good	Some very minor corrosion: The coating system is in good condition, with little overall corrosion/rust corresponding to SSPC 8 (greater than 0.03 and up to 0.1 %).
Fair	The coating has observable damage corresponding to SSPC-7 (greater than 0.1 and up to 0.3 %) to SSPC-6 (Greater than 0.3% up to 1%).
Poor	The coating has widespread corrosion corresponding to SSPC-5(Greater 1% up to 3%) to SSPC-4 (Greater than 3% up to 10%).
Very Poor	The coating system is in advanced stages of deterioration, with greater than 10% rust corresponding to SSPC-3 or less.

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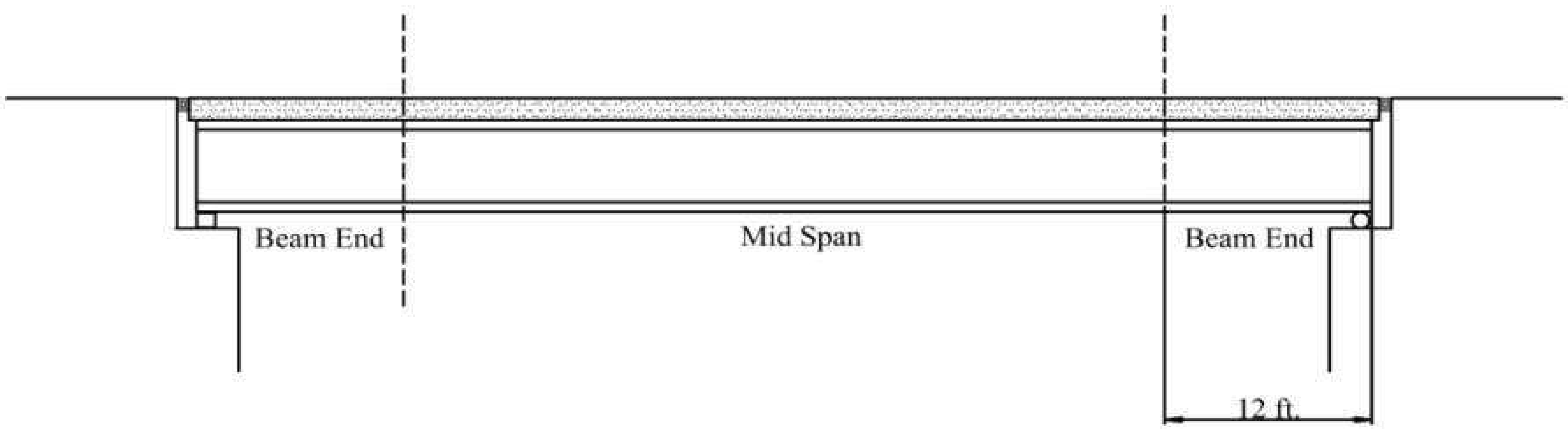
Ratings for Bridges

- 2 ratings
  - Mid-span
  - Beam ends
- Overall conditions



Visual Inspection Process

- Visual guide that can be used to
  - Train inspectors
  - Reference for field work
- Increase reliability of inspection data
  - Consistency of field evaluations
  - Condition states tied to maintenance action
- 8 x 10 photographs, reproducible

Very Poor

Poor

Good

Visual Guide

- Visual guides include field photographs of
  - Fascia girder mid-span
  - Fascia girder end-span
  - Interior beams, mid-span
  - Interior beams, end-span
  - Close-up (macros)

Visual Inspection Guide

- Visual guide includes photographs from the perspective of the inspector
  - Industrial guides typically show close – ups that require significant interpretation to apply to a bridge
    - Low reliability
- Subjective rating scale
  - Always some room for discussion……
  - Average conditions at beam ends and mid-span
  - Primary member rating

Poor Condition – Exterior Beam End-Span

Poor Condition – Facia Girder Mid-Span

Poor Condition – Interior Beam End-Span

Poor Condition – Interior Beam Mid-Span

Pocket Guide

GOOD

POOR

GOOD

POOR

Reliability Testing for visual guide

- 5 Photographic test sets
  - Fascia end span, mid span
  - Interior end span, mid span
  - Macro (close-ups)
- Inspectors rearrange images from very good to very poor

Results of Reliability Testing

- 5 inspectors took the test from MoDOT, one coatings consultant
- 3 inspectors from MoDOT scored 100% on all 5 tests
- 6 inspectors scored 100% on the close-up photos
  - Easiest to do…..

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Results of Reliability Testing

- Overall Test analysis
  - For 6 inspectors, 19 errors, 13%
- Errors most commonly occurred for
  - End spans of fascia girders
  - In the good-fair-poor range
    - i.e. for fascia girder end spans, Very good/ very poor (20%) for good-fair-poor (33%)
- Without initial training of full instruction

Conclusions

- Comprehensive guide for condition evaluation was developed
  - Visual standards for practical use
  - Condition states related to maintenance actions
  - Visual guide and pocket guide
  - Testing of consistency
- Focus over-coating on fair to poor, very poor only recoat
- Performance of existing coatings
  - System S appears to be provide coatings life extension consistent with 10 year expectation
    - Early failures associated with very poor conditions at recoating, and direct drainage (<5 yrs)
    - Long-life associated with good drainage
      - >10 yrs
  - Same was true for historical systems A, B, C
- Primary factors: 1: Drainage, 2: Surface prep, 3: Drainage

Conclusions

- Implementation:
  - Train inspectors (1 hr), give them pocket guide and visual guide
  - Develop data in bridge management system(24 months)
  - Implement spreadsheet to manage coatings work looking forward
    - Prioritize maintenance painting as bridge preservation activity
  - Reduce re-coatings
    - Go green, save money
  - Don’t use sophisticated deterioration curve
    - Inventory won’t support that (mixed coatings, partial recoatings, unknown coating, snowflakes, infant death syndrome)
    - Let condition assessment drive
  - Use simple rules of thumb for prediction
    - Deck in good condition, long life
    - Deck in poor condition, short life

Questions?

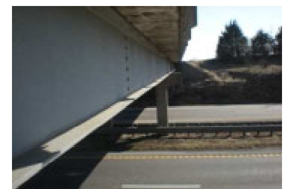
Backup slides

Field Survey Nutshells

- System S coatings less than 5 years old (23)
  - Some early failures where
    - Very poor condition
    - Constant-wet…..
    - Infant death
- 74% were in fair to good condition

SYSTEM S					
Coating less than 5 years					
Bridge Number	**Paint Year**	**TMS Condition**	**End- Span Field Rating**	**Mid-Span Field Rating**	**Overall Field Rating**
A0048	2006	Good	Fair	Good	Fair
A0095	2006	Good	Good	Good	Good
A0491	2006	Good	Very Poor	Very Poor	Very Poor

A0491: Facia girders were good condition, mid- span was very poor condition, partially recoated, old system is not available.




A0557	2006	Good	Fair	Poor	Poor
A1256	2006	Fair	Fair	Fair	Fair
G0519	2006	Good	Fair	Good	Fair
L0928	2006	Good	Poor	Poor	Poor

L0928: One end of the facia girder was in good, the other end was very poor condition. Partially recoated.


S0352	2006	Good	Poor	Poor	Poor
A0025	2006	Good	Poor	Very Poor	Very Poor

A0025:End- span was in poor condition, mid-span was in very poor condition. Partially recoated.


T0561	2007	Good	Good	Good	Good
A1414	2006	Good	Good	Good	Good
A2551	2006	Good	Good	Good	Good
A3200	2006	Good	Fair	Fair	Fair

Field Survey Nutshells

- System S coatings more than 5 years old (21)
- **81%** were in fair to good condition
- Poor condition = poor drainage