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A Rational Approach for Planning Bridge Repainting Projects

Southeast
Bridge Preservation Partnership

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Paul Vinik, P.E.
State Structural Materials Systems Engineer
Florida Department of Transportation

Jeff Pouliotte, P.E.
State Structure Maintenance Engineer
Florida Department of Transportation

Curtis "Wayne" Fleming
Senior Materials Office Technician
Virginia Department of Transportation

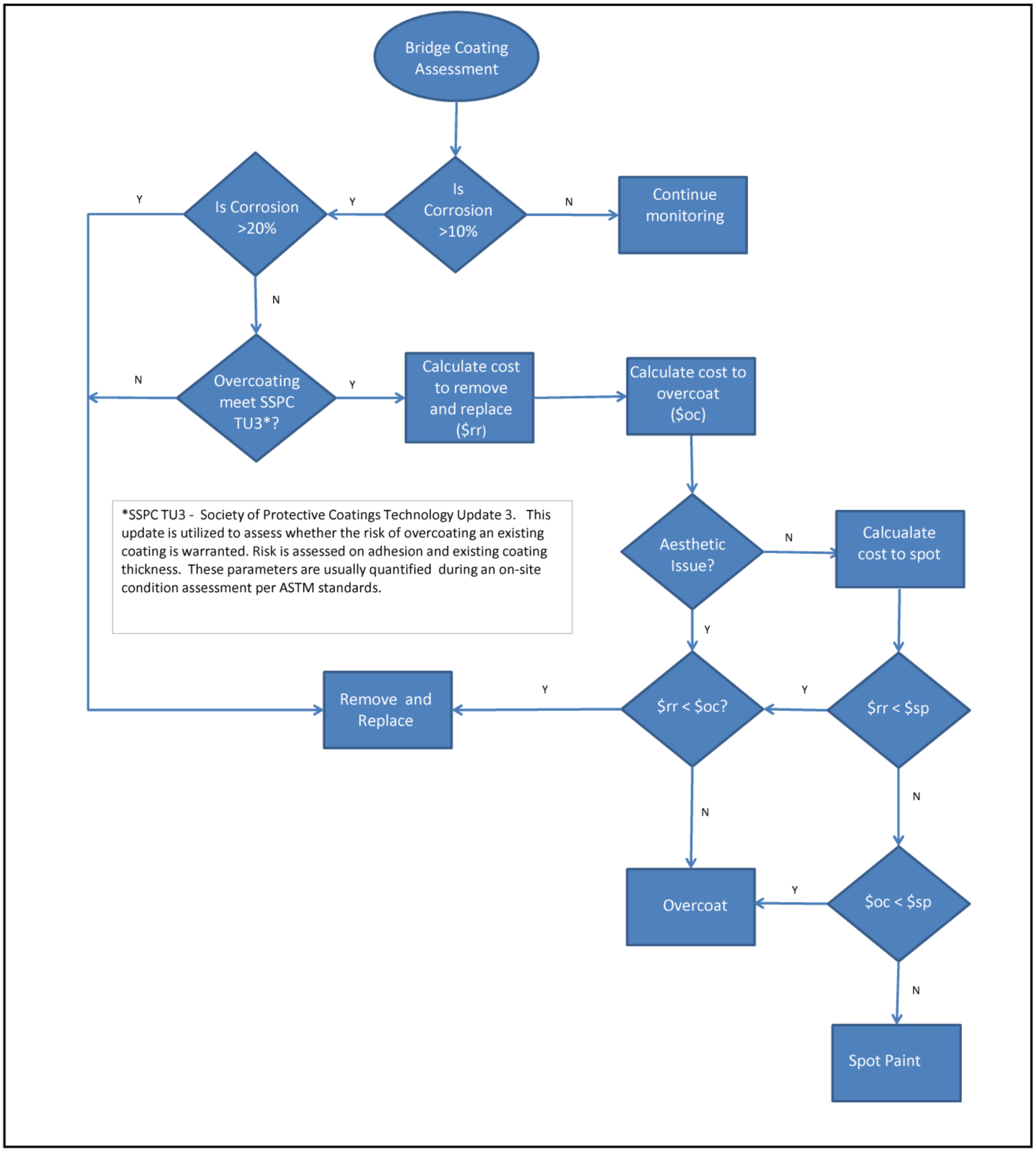
Introduction

The objective of a good bridge preservation program is to maximize service life while minimizing cost. This document is intended to help guide engineers to achieve this goal using a rational decision process and cost estimation calculation. A cost comparison spreadsheet, and process map (flow chart) have been developed as a part of this report. By using these tools an engineer can input project specific parameters and evenly compare the cost of all three alternative painting schemes. These schemes are: remove and replace the existing coating system, overcoat the existing coating system, or spot paint specific areas on the structure where the existing coating system needs restoration. By utilizing time-value of money calculations, the cost of these three schemes can be compared, allowing a cost effective engineering decision to be made and implemented with regard to restoration and preservation of existing steel bridges.

The estimation of cost requires that parameters such as estimated service life, cost for maintenance of traffic and other project and geographic specific variables be entered by the user. A definition of the input parameters is provided below:

1) Painting cost per square foot of structure (with and without lead). This has to be evaluated per structure, since labor costs, location (over land or water, etc.), and structure type (truss, built up girders, rolled girders, box girders, etc.) play a big role in the cost to paint a structure.
2) Expected service life. Unknowns such as whether the structure is in a coastal location or inland and the existing condition of the structure will affect the expected service life of the newly applied coating and must be taken into account.
3) Maintenance of traffic duration. How long will maintenance of traffic be required? This will depend on the size of the structure, accessibility and the number of hours per day the contractor can work, and therefore has to be determined on a project by project basis.
4) Cost per day for Maintenance of Traffic. This will change relative to the extent of traffic control needed on a daily basis. For example, is the structure 6 lanes in an urban area or 2 lanes in a rural area?
5) What is the surface area of the structure?
6) Heavy metals present?
7) Percent corrosion? What is the amount of corrosion present on the structure that will need to be addressed prior to painting?
8) The current interest rate.

By entering this information the spreadsheet will calculate the cost of the three coating schemes, which can be utilized in conjunction with the flow chart to determine the most economical long term decision.


Bridge Coating Assessment
Is Corrosion >10%
N
Continue monitoring
Y
Is Corrosion >20%
Y
N
Overcoating meet SSPC TU3*?
N
Y
Calculate cost to remove and replace ($rr)
Calculate cost to overcoat ($oc)
*SSPC TU3 - Society of Protective Coatings Technology Update 3. This update is utilized to assess whether the risk of overcoating an existing coating is warranted. Risk is assessed on adhesion and existing coating thickness. These parameters are usually quantified during an on-site condition assessment per ASTM standards.
Aesthetic Issue?
N
Calcualate cost to spot
Y
$rr < $oc?
Y
Remove and Replace
Y
$rr < $sp
N
N
Overcoat
Y
$oc < $sp
N
Spot Paint

Painting Costs $/ft2*				Maintenance of Traffic Required (Days)*
	Pb	No Pb	Expected Service Life	
Spot Paint	10	7	4.5	30
Over Coat	5	3	9	75
Remove & Replace	8	5	20	100

*The values in this table need to be specific to the structure.

20 year Coating Maintenance Combinations

Remove and Replace	Overcoat	Spot Paint
1		
	2	1
	1	3
		5

Green Input Parameters

Red Calculated Parameters

Example Conditions	
650	Maintenance of Traffic Cost ($/day)
150,000	ft2
yes	Pb Present
19%	Corrosion
3%	Interest rate

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20 year analysis

Remove and Replace

Future Value of MOT at yr 20		($118,349.07)
Future Value Cost to Remove and Replace		**($2,303,255.07)**
Present Value Cost of Paint without MOT	$	1,200,000.00
Present Value Cost of Paint with MOT	$	1,265,000.00

2 overcoats and 1 spot paint (5% progressive corrosion)

Future Value of MOT at yr 20		($177,247.85)
Present Value Cost to Overcoat		($750,000.00)
Value of Initial Overcoat at yr 20		($1,365,566.25)
Value of second Overcoat at yr 20		($1,042,796.57)
Value of Spot paint at yr 20		($461,864.31)
Total Future Value Cost at year 20		**($3,047,474.98)**
Present Value Cost		$1,673,742.48

1 Overcoat and 3 spot paints (5% progressive corrosion)

Future Value of MOT at yr 20		($166,934.11)
Present Value Cost to Overcoat	$	(750,000.00)
Value of Initial Overcoat at yr 20		($1,365,566.25)
Value of First Spot Paint at yr 20		($500,542.35)
Value of Second Spot Paint at yr 20		($528,531.65)
Value of Third Spot Paint at yr 20		($541,496.09)
Total Future Value Cost at year 20		**($3,103,070.45)**
Present Value Cost		$1,704,276.77

5 spot paints (5% progressive corrosion)

Future Value of MOT at yr 20		($149,300.12)
Present Value Cost to Spot Paint	$	(285,000.00)
Value of initial Spot Paint at yr 20		($518,915.17)
Value of 2nd Spot Paint at yr 20		($572,792.63)
Value of 3rd Spot Paint at yr 20		($604,822.01)
Value of 4th Spot Paint at yr 20		($619,657.79)
Value of 5th Spot Paint at yr 20		($621,127.87)
Total Future Value Cost at year 20		**($3,086,615.60)**
Present Value Cost		$1,695,239.40

Suggested Guidelines to achieve Quality Steel Bridge Repainting Projects

There are many alternatives and inputs associated with this decision process. It is difficult to execute this scheme without a fundamental structural and coatings knowledge base. In order to assist the responsible party, the following references and insight are provided:

- Like any other contracted project, in order to obtain representative bids that can be compared fairly, a well defined scope of work is critical
- A specification or contract must be developed that clearly articulates the required levels of surface preparation and coating application. This contract should include quality control inspection frequencies and methodologies for verification of contract requirements.
- A strong quality assurance program should be implemented to verify that contractor quality control is effective. Quality assurance should incorporate hold-point-inspections to verify work is compliant with the contract. A hold-point is defined in the contract as a stoppage of work until quality assurance testing and compliance evaluation up to the present time is complete. Hold-point-inspections typically include:
    - Surface contamination assessment prior to abrasive blasting.
    - SSPC Guide 15: Field Methods for Retrieval and Analysis of Soluble Salts on Steel and other Nonporous Substrates. SSPC WJ 1-4: Water Jet Cleaning of Metals, Surface Preparation and Cleanliness prior to Primer Application.
        - ASTM D 4417: Standard Test Methods for field measurement of surface profile of blast cleaned steel
        - SSPC AB1/AB2/AB3: Standards for the cleanliness of abrasives used to blast clean steel.
        - SSPC SP1: Solvent Cleaning
        - SSPC SP6: Commercial Blast Cleaning
        - SSPC SP10: Near White Blast Cleaning
        - SSPC Vis 1: Guide and Reference photographs for Steel Surfaces Prepared by Dry Abrasive Blast Cleaning
    - Prime, intermediate and finish coatings application including stripe coating.
        - SSPC PA1: Shop, Field and Maintenance Painting of Steel
        - Coating Manufacturer's Product Data Sheet
        - SSPC PA2: Measurement of Dry Coating Thickness Using Magnetic Gages
        - Department of the Navy Tech Data Sheet 82-08: Paint Failures – Causes and Remedies
- In addition to those above, the following technical updates, guides and standards are available and are often incorporated into contract documents:
    - ASTM D-610 Test Method for Evaluating Degree of Rusting on Painted Steel Surfaces
    - ASTM D-714 Test Method for Evaluating Degree of Blistering Paints
    - SSPC Technology Update No. 3 Overcoating

- ASTM D 4541: Standard **Test** Method for **Pull-Off** Strength **of Coatings** Using Portable Adhesion Testers.
- U.S. Department of Transportation, Federal Highway Administration, Bridge Preservation Guide, Publication No. FHWA-HIF-11-042
- SSPC QP1 Certification: Field Application to Complex Industrial and Marine Structures
- SSPC QP2 Certification: Field Removal of Hazardous Coatings
- SSPC QP2 Certification: Certification for Coating and Lining Inspection Companies

The theoretical design life of a bridge has until recently been 50 years, but with the evolution of new design guidelines and construction materials the anticipated service life for newly constructed bridges is 75 years or greater. The anticipation of a longer service life for coated steel bridges can only be achieved in an economical fashion if bridge practioners take advantage of the tools at their disposal, and base repainting decisions on well thought out economic evaluations. It is also essential to have properly qualified (NACE Certified) contractor and inspection personnel, a good quality control plan and practices, quality assurance inspections to ensure that the plan is being followed, and the Institutional courage to hold Contractors to their contractual obligations.