

Challenges and Opportunities of Using HDG and Metalizing in Tandem

AGA Annual Conference 2022

St. Pete Beach

6 April 2022

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Raritan River replacement

High Steel Structures LLC

- Steel Bridge Fabricator
- Lancaster based since 1931
 - Began as High Welding
 - Now High Steel
 - Plants in Lancaster, PA, and Williamsport, PA
 - In-house metalizing capability in Williamsport



High Steel Structures LLC

High Construction Company

High Real Estate Group LLC

High Concrete Group LLC

Greenfield Architects Ltd.

High Steel Service Center LLC

High Associates Ltd.

StructureCare

High Transit LLC

High Structural Erectors

High Industries Inc.

High Environmental Health & Safety

High Hotels LLC

*High
Companies
Today*



High Steel

- About 150 bridges, 50,000 tons per year
- A small but steady number of bridges are galvanized
 - Most High Steel bridges are too large for galvanizing
- Metalizing is growing in popularity
 - Metalizing is adaptable to any size
 - The use of metalizing increases the demand for galvanizing
 - 2009 – Lake Champlain Bridge – contractor on site at High Steel
 - Converted some shop space to metalizing
 - 2012, 2013 – Bid ten metalized jobs



	2017	2018	2019	2020	2021
Metalized tons won	5,379	1,606	6,922	8,433	12,355
Number of projects	8	9	24	9	5



Modern Durability Solutions for Bridges

Choices

- Weathering Steel
- Paint
- Galvanizing
- Metalizing
- Stainless Steel
(A709 50CR)

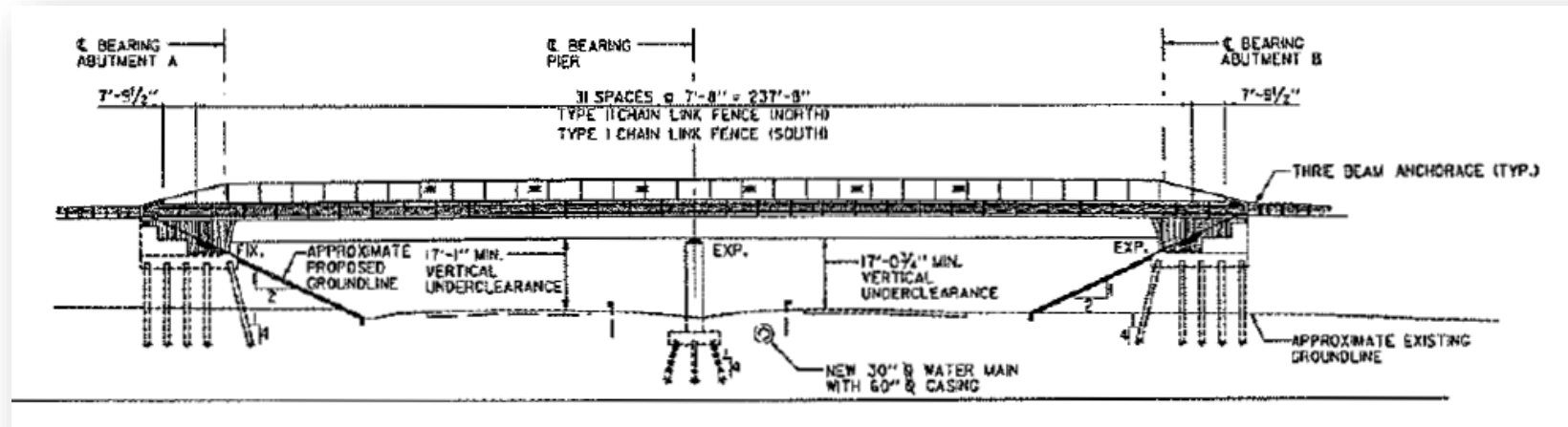
Owner Values

- Cost
 - First cost
 - Long term cost
- Schedule Impact
- Performance
 - Strong and growing desire to avoid or minimize maintenance, including coating maintenance
 - Avoidance traffic disruptions
 - Lack of maintenance funds

Relative Up-Front Cost of Durability Solutions

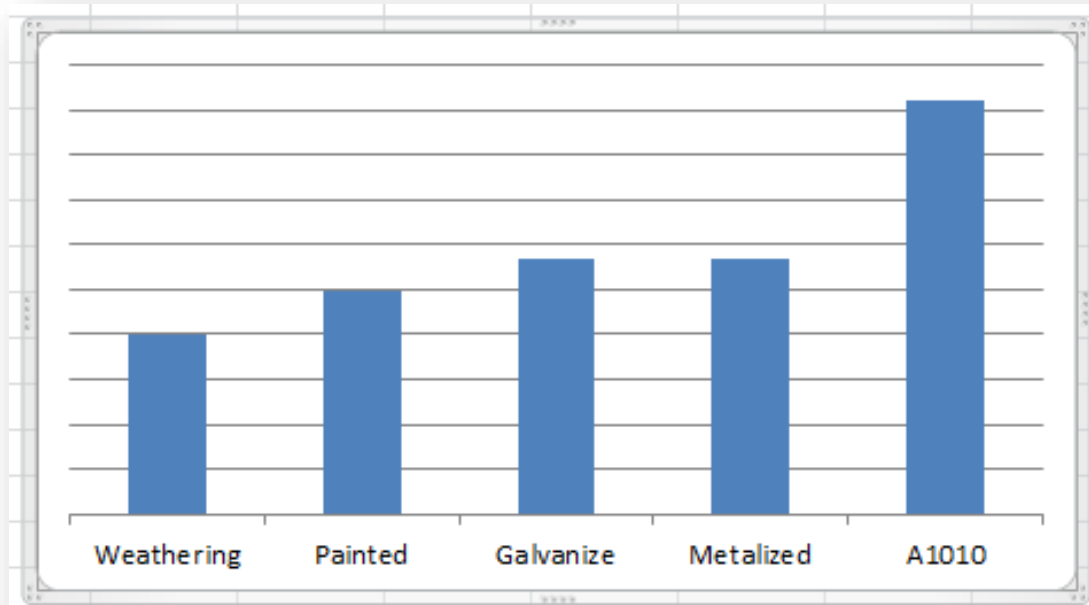
High Steel Exercise of 2017

- FOB
- Continuous 2-span bridge, 230' long
- 10 lines, 30 plate I-girders, parallel flanges, 52"
- 99 cross frames
- No bearings
- Delivery of 130 miles



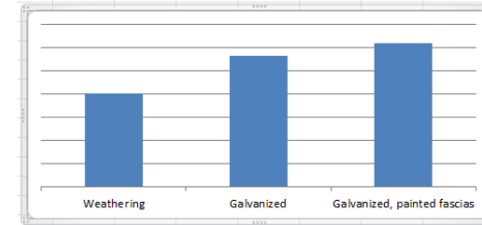
Durability Strategies

• Weathering	W	
• Painted	P	24%
• Galvanized	G	41%
• Metalized	M	42%
• A1010 (50Cr)	A	130%



Galvanizing Strategies

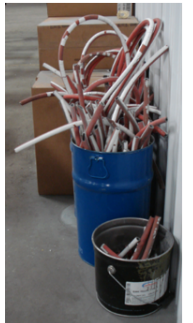
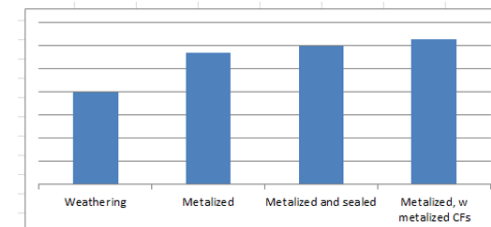
• Weathering	W	
• Galvanized	G	41%
• Galvanized & fascia paint	GF	54%



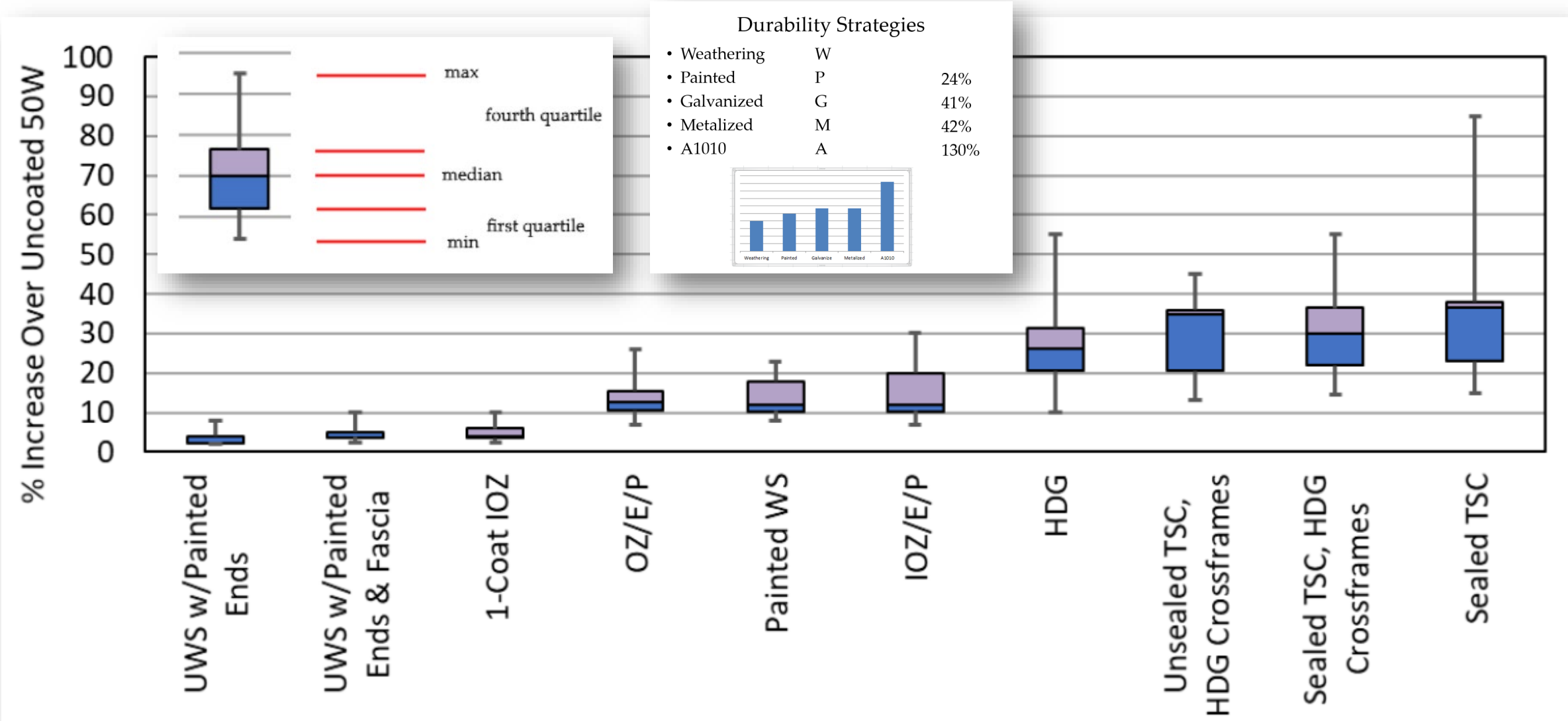
- NB: Girder depth: should not be deeper than galvanizing tanks are wide

Metalizing Strategies

• Weathering	W	
• Metalized	M	42%
• Metalized & sealed	MS	49%
• Metalized & sealed, metalized cross frames	MM	57%

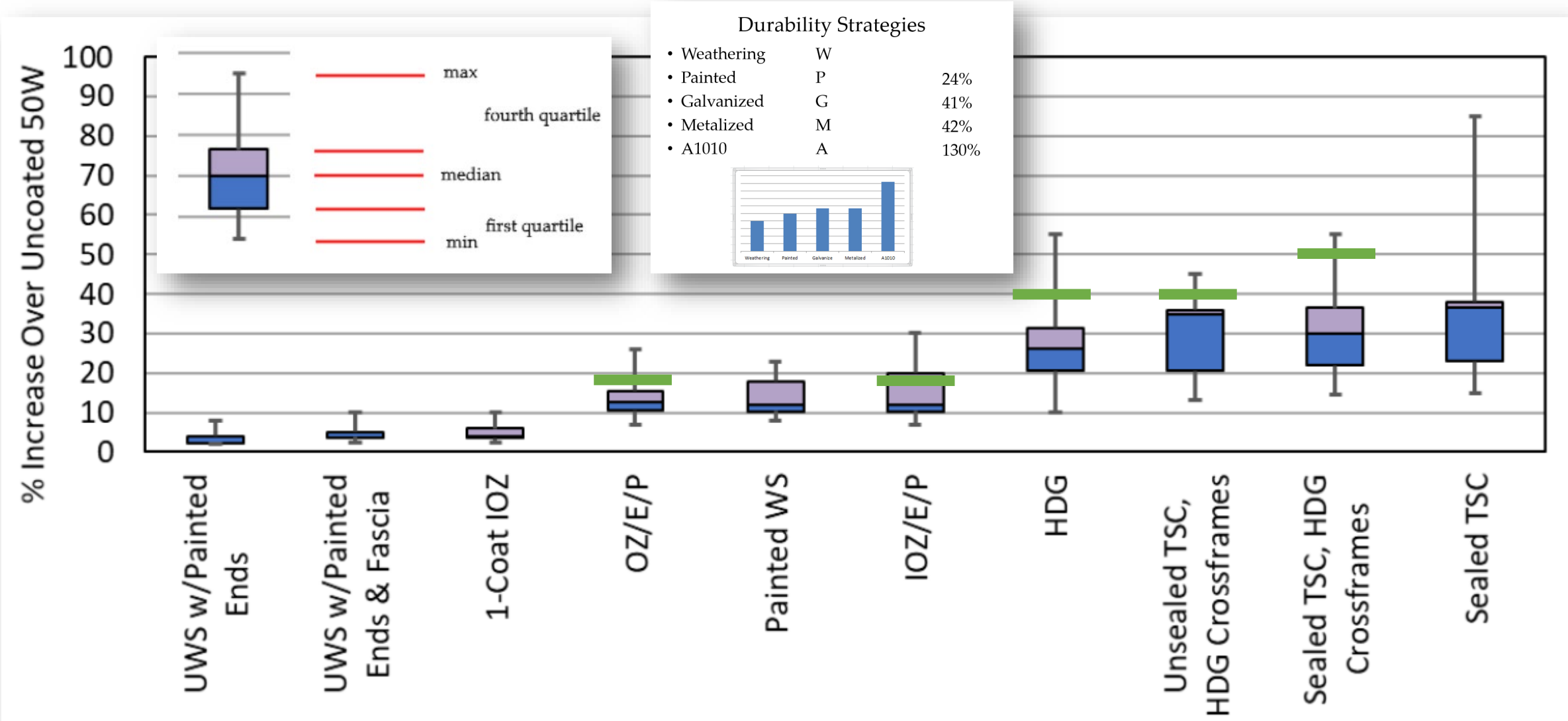


Relative % cost increase, delivered, FOB, for typical fabricated steel superstructures – NSBA study



Ref: 2020 World Steel Bridge Symposium, Jeff Carlson, "Introduction to Modern Corrosion Protection Systems"

Relative % cost increase, delivered, FOB, for typical fabricated steel superstructures – NSBA study



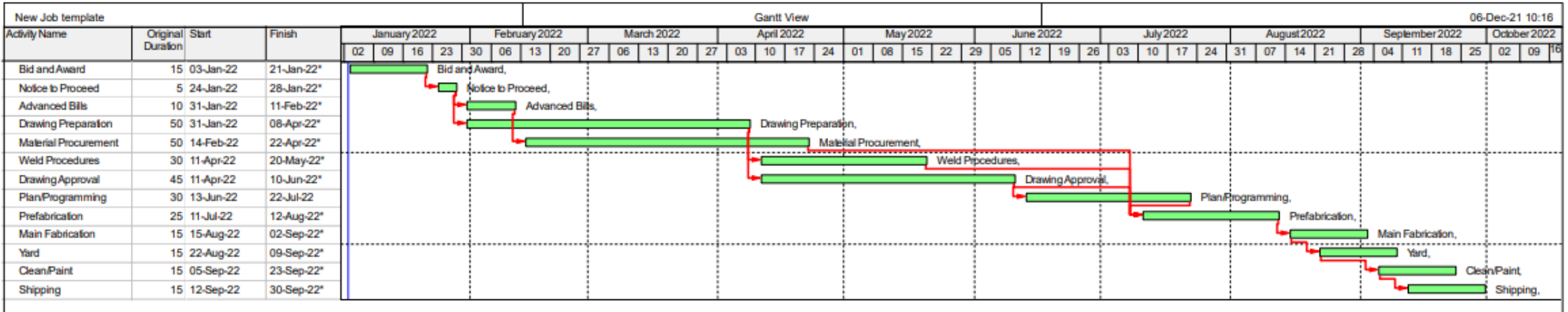
Ref: 2020 World Steel Bridge Symposium, Jeff Carlson, "Introduction to Modern Corrosion Protection Systems"

Duplex Varieties

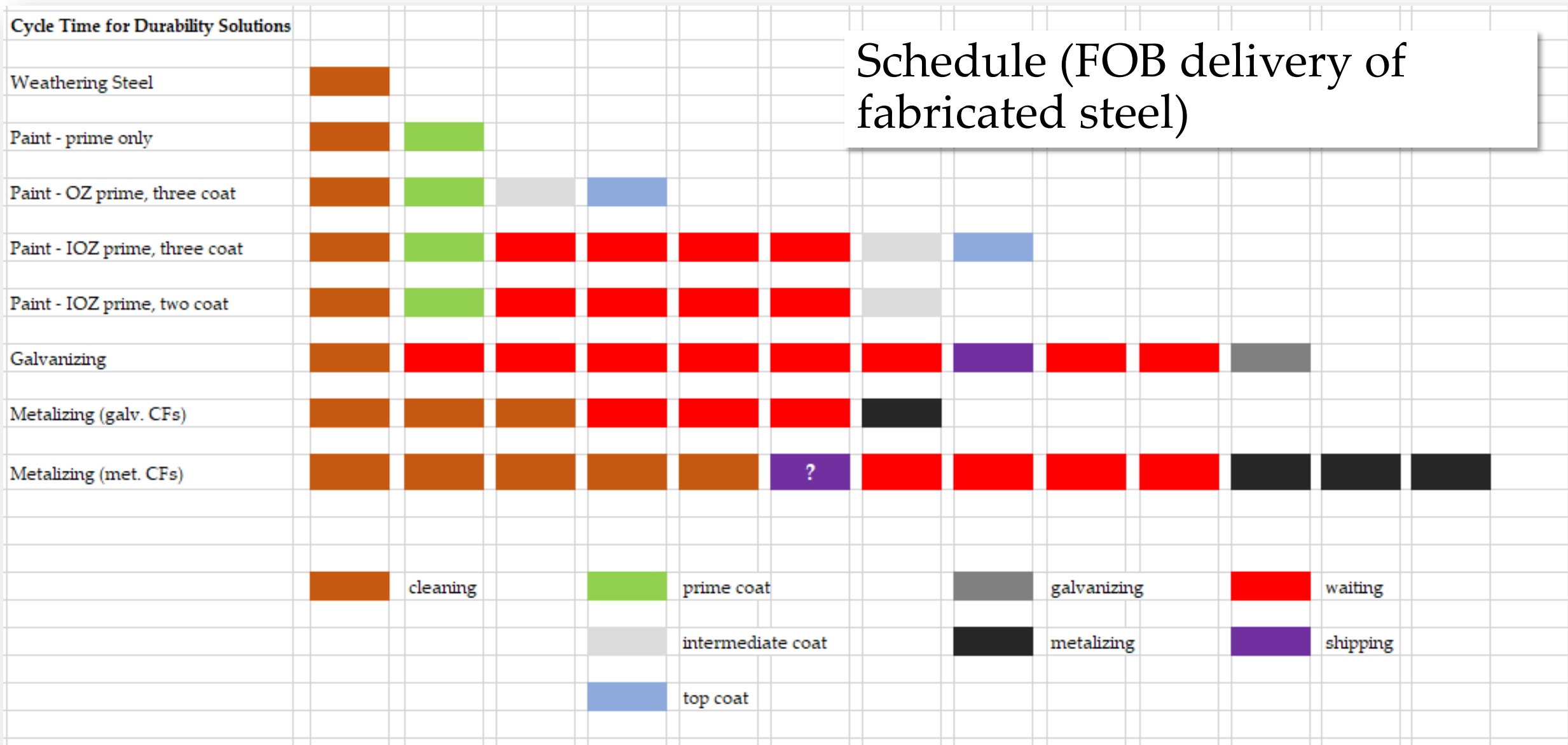
- Paint on galvanizing (shown)
- Paint on metalizing
- Cost increase of 65% to 75% over uncoated weathering steel



Schedule (FOB delivery of fabricated steel)

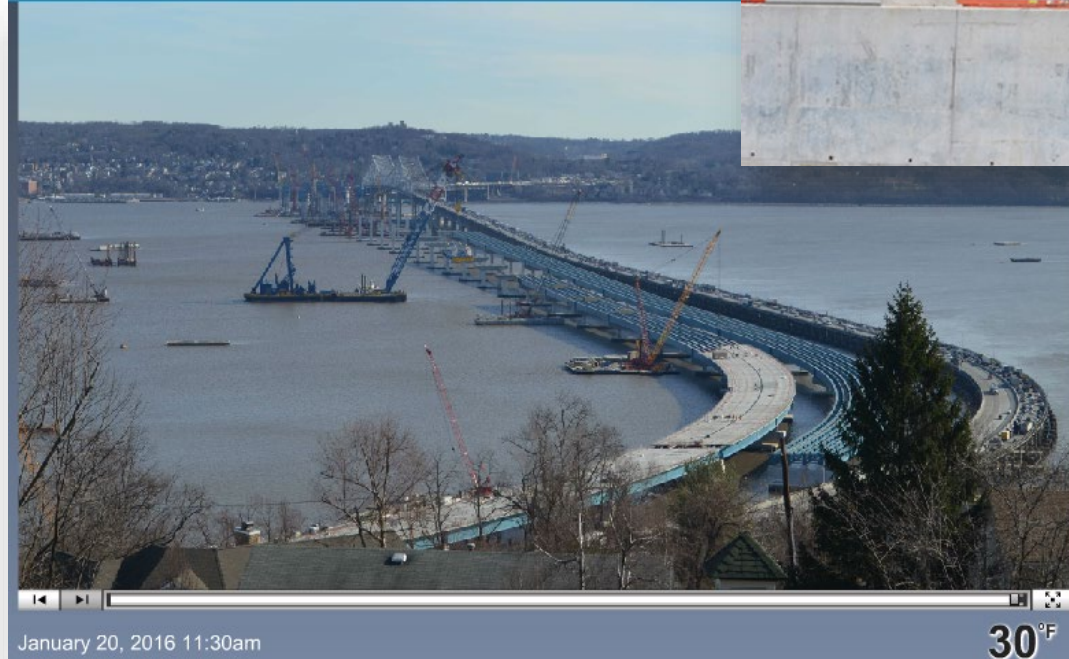


Schedule (FOB delivery of fabricated steel)



Cuomo Bridge (TZ replacement)

- High Steel's part (10 of 20 units) of the approaches:
 - 793 girders
 - 2852 cross frames and other diaphragms
 - 1052 sub stringers
- For shop coatings, only organic zinc / epoxy / urethane could support the schedule



High Steel's Position and Practices

- If considering metalizing for your bridge
 - Be mindful of the project schedule
 - Do metalize the girders, but
 - Galvanize the parts that will fit in a kettle
 - Such as, especially, cross frames and other diaphragms
 - And anchor assemblies on cable stay bridges
 - Unless the parts are also to be painted
- +95% success rate converting metalized cross frames and anchor assemblies to galvanizing

Metalizing / Galvanizing Combination

When metalizing is being used on bridges, High Steel recommends combining the use of metalizing and galvanizing within projects to reduce overall cost and improve the project schedule while ensuring proper coverage of all members.

Use galvanizing for components like cross-frames which fit within a galvanizing kettle, because they usually have complex, difficult-to-reach surfaces that are not well-suited to metalizing but that can be galvanized easily.

From High Steel's website

Combined Metalizing / Galvanizing

- Metalize large, broad pieces (like girders)
- Galvanize smaller bridge components
 - Especially cross frames



Metalizing gun



Paint gun





Preblasting

- High Steel has adopted a policy of preblasting beams to be galvanized





Faying Surfaces

- Achieve sufficient friction
 - Not an issue if correct class is used in design
- Creep
 - Loss of tension over 10 mils
 - Non-issue with AASHTO clamping force reduction
- NB
 - AASHTO adopting new rules for design in bearing for crossframe to girder connections

Table 6.13.2.8-3—Values of K_s

For Class A surface conditions	0.30
For Class B surface conditions	0.50
For Class C surface conditions	0.30
For Class D surface conditions	0.45

The following descriptions of surface condition shall apply to Table 6.13.2.8-3:

- Class A Surface: unpainted clean mill scale, and blast-cleaned surfaces with Class A coatings,
- Class B Surface: unpainted blast-cleaned surfaces to SSPC-SP 6 or better, and blast-cleaned surfaces with Class B coatings, or unsealed pure zinc or 85/15 zinc/aluminum thermal-sprayed coatings with a thickness less than or equal to 16 mils,
- Class C Surface: hot-dip galvanized surfaces, and
- Class D Surface: blast-cleaned surfaces with Class D coatings.

Reference AASHTO LRFD

AASHTO / NSBA Steel Bridge Collaboration Specifications



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AASHTO / NSBA Steel Bridge Collaboration Specifications

- Preblast beams and girders
- Thickness
 - Minimum: ASTM A123
 - Maximum
 - None, but
 - If > 20 mils
 - Visual check for spider cracking, flaking, or other delaminations
 - Stout knife test (A123)
- Faying surfaces
 - Free of prominences
 - No power wire brushing if slip critical

Other Possibilities

- Combine galvanized cross frames with painted steel?
 - Might work well with single-coat IOZ (current approach of interest)
 - Mixed feelings from fabricators
 - Would not want to paint them (okay for single-coat IOZ jobs?)
 - Less control, less work, but more capacity

Summary

- High Steel's Keys
 - Quality coating
 - Proud of our product
 - Don't want issues in the field
 - No schedule impacts
 - Preferably, galvanizing smaller, complicated components instead of metalizing them
 - Like to self perform
 - Sometimes need help with capacity
- Durability is growing value for DOTs
 - Has always been important
 - Focused has increased, particularly with respect trying to minimizing maintenance
 - Many perceive that metalizing and metalizing / galvanizing give them superior performance
- Use of metalizing is increasing
 - This is driving increased use of galvanizing for other components





Thank You!

A709 - 50CR

- For design
 - Available in thicknesses up to 2"
 - Cost of fabricated bridge is 2 to 2.5 times normal cost
 - Lead times about the same or slightly longer
- If using, for specifications
 - Address welding consumables (by classification) to avoid specification conflicts
 - D1.5 ballot underway
 - Avoid carbon on surfaces to be welded
 - Use PT in lieu of MT for prescribed surface weld testing
- Notes (not spec issues)
 - There are some significant welding practice differences (fabrication learning curve)
 - Stainless steel consumables have double the chrome of 50CR – will not weather as quickly; bridge will have nice weld highlights for a while
 - No oxygen cutting; plasma used for heavier cutting, including CNC processing; otherwise use normal cutting processes
 - Bending, heat curving / straightening, drilling are basically the same
 - D1.5 is developing language; this will cover the spec issues as of 2025



Uncoated Weathering Steel

- Lowest cost
 - Cost for coating and coating application
 - None, or
 - Low for end paints
 - Cost for maintenance?
- Most expedient regarding fabrication and construction schedule
- FHWA Guidance (Advisory T5140.22)
 - Avoid coast and areas of high rainfall, high humidity, persistent fog
 - When using - eliminate joints or divert water; avoid water traps
 - Maintenance – address corrosion, control drainage

Weathering Steel

- Recent Connecticut Study
 - Considered 138 structures
 - Structures with old details – leaks, average section loss of 0.093" or greater
 - New detailing
 - Integral abutment, concrete diaphragm, or deck over backwall – much better
 - End paints – no evidence of corrosion
 - Insufficient number of saltwater crossings to draw conclusions
 - Recommendations
 - Continue with CT design practices
 - Increase thickness in critical areas only, including over electrified rail
 - Paint beam ends on leaky bridges
 - Paint bridges with slab to back of backwall detail
 - Results suggest that the MD and VA bridge issues were related to very high salt use in the DC area in very high traffic areas
- Staining – drip pans, drip bars keep under control
- FHWA guidelines – updates under development
- NSBA recommendations – under development

Study of Corrosion Performance of Weathering Steel Bridges

State Project No. 170-3301

CHA Project Number: 064341

Prepared for:



Connecticut Department
of Transportation
2800 Berlin Turnpike
Newington, CT 06131

Prepared by:

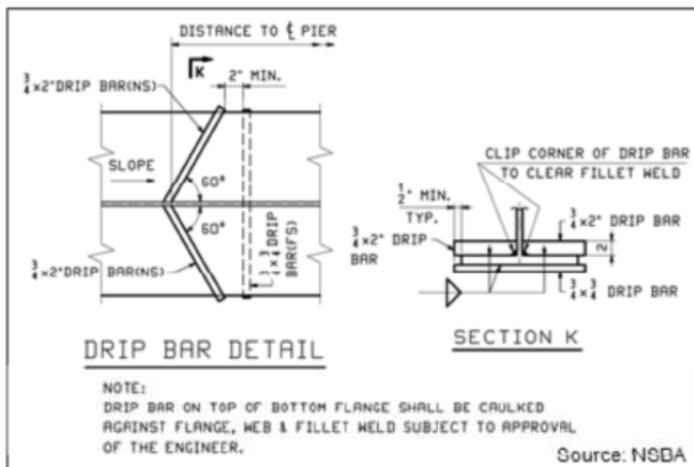
CHA
CHA Companies, Inc.
101 East River Drive, 1st Floor
East Hartford, CT 06108
Phone: (860) 290-4100

May 24, 2021



Weathering Steel Aesthetics

- Blast fascia girders
- Use drip pans, drip bars (properly) for stain control



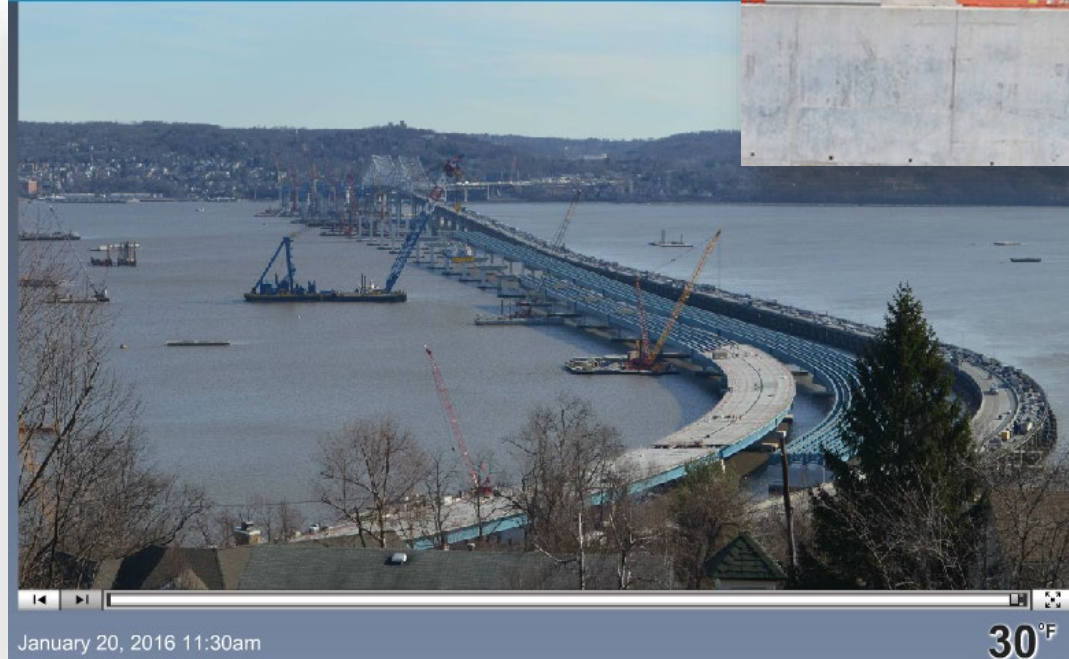
Paint

- Most Common Today: Three Coat Systems
 - Organic zinc primer / epoxy intermediate coat / urethane topcoat
 - Inorganic zinc primer / epoxy intermediate coat / urethane topcoat
- Other Systems to Consider
 - Single-Coat IOZ
 - Two-coat – IOZ primer / polyaspartic topcoat



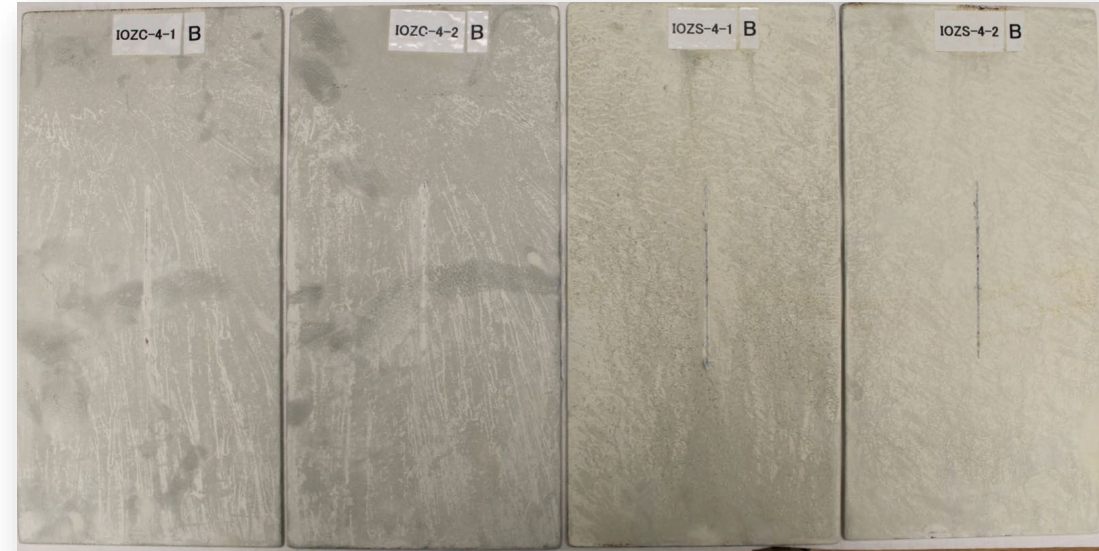
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Single Coat Inorganic Zinc Primer

- TxDOT study of IOZ and thermal spray
 - IOZ panels shown, ASTM D5894 at 4000 hours
 - Excellent results; similar to zinc thermal spray, better than aluminum thermal spray
- Florida study of IOZ
 - Excellent result after 35,000 hours
- Some DOTs have done this with success, including Missouri DOT
- Not for all environments or conditions
 - Avoid when pH is < 5 , > 10 – a deicing concern



Paint Aesthetics

- Common: Basic urethane
- Alternate:
 - Better urethane
 - Fluoropolymer
 - Polysolixane
 - Can be a single coat over IOZ
 - Also, stronger color – choose grays and greens tend to do better than bright reds and yellows
- Example, Pittsburgh airport
 - Original: red urethane – faded badly
 - Recoat: red fluoropolymer urethane – 10+ years still good
- Cost for superior paint
 - Perhaps \$20k on \$1 million of fabricated steel
 - Assuming painting all the steel – i.e., not just fascia components
 - Schedule and capacity – no change
- Single coat IOZ with painted fascia girders?



Coating Capacity by Number of Fabricators

- Fabrication and coating capacity based on current AISC certifications
 - Bridge fabrication: 317
 - Fracture critical endorsement: 151
 - Sophisticated paint endorsement: 260
- Galvanizing
 - Beams for 60' bridge 59
 - Crossframes, 5' x 10' 125
- Metalizing
 - Some bridge fabricators
 - Coating subcontractors, including
 - Facilities, and
 - On-site subcontractors – may work at fabricators

Thank You!

