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State of the Union
Cleaning and Painting Steel Bridges

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GPI Southeast, Inc.

- CURRENT PRACTICES AND MATERIALS
- LESSONS LEARNED
- THE LATEST

CURRENT PRACTICES AND MATERIALS

- NEW CONSTRUCTION
  - SHOP PRIME, FINISH IN FIELD
  - APPLY ALL COATS IN THE SHOP
- MAINTENANCE
  - SPOT REPAIR
  - SPOT REPAIR AND OVERCOAT
  - FULL REMOVAL AND REPLACEMENT
  - ZONE CLEANING AND PAINTING

NEW CONSTRUCTION

- SHOP PRIME, FINISH IN FIELD
  - Centrifugal Blasting to SSPC SP10, “Near White Blast”
  - Inorganic Zinc Rich Ethyl Silicate Primer
  - Field Application of Intermediate and Finish Coat
    - Intermediate – Epoxy ; Finish – Aliphatic Polyurethane
    - Intermediate – WB Acrylic ; Finish – WB Acrylic

CENTRIFUGAL WHEEL BLASTING

SHOP PRIME, FINISH IN FIELD

- ADVANTAGES
  - Automated Process Control – Primer Only
  - Better Access to Work – Primer Only
  - Abrasive is Recyclable
  - Finished Product Not Affected by Transportation / Erection Damage
- DISADVANTAGES
  - Less Access to Work in the Field
  - Interference of or by other Trades
  - Zinc Oxide Stain on Primer when Stockpiled

NEW CONSTRUCTION

- APPLY ALL COATS IN THE SHOP
  - Centrifugal Blasting to SSPC SP10, “Near White Blast”
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  - Shop Application of Intermediate and Finish Coat
    - Intermediate – Epoxy ; Finish – Aliphatic Polyurethane
    - Intermediate – WB Acrylic ; Finish – WB Acrylic

APPLY ALL COATS IN THE SHOP

- ADVANTAGES
  - Automated Process Control
  - Better Access to Work
  - Abrasive is Recyclable
  - Minimal or No Scaffolding / Containment in the Field
- DISADVANTAGES
  - Finished Product can be Affected by Handling Damage
  - Extensive Repair in the Field Defeats Purpose
  - Strict Dunnage Requirements need to be Specified

MAINTENANCE PAINTING

- SPOT REPAIR
- SPOT REPAIR AND OVERCOAT
- FULL REMOVAL AND REPLACEMENT
- ZONE CLEANING AND PAINTING

MAINTENANCE PAINTING
Spot Repair

- Solvent Clean – SSPC SP1
- Hand / Power Tool Clean – SSPC SP2/SP3
- Spot Prime
  - Surface Tolerant Epoxy (Aluminum Mastic)
  - Organic Zinc Rich Epoxy
- Spot Paint Intermediate and Finish
  - Intermediate – Epoxy; Finish – Aliphatic Polyurethane
  - Two Coats of WB Acrylic

SPOT REPAIR

- ADVANTAGES
  - Less Expensive
  - Minimal or No Scaffolding / Containment in the Field
- DISADVANTAGES
  - Aesthetics – Repairs do not usually “blend in”
  - Labor intensive once spot repairs exceed 25% of surface

SPOT REPAIR CANDIDATE

MAINTENANCE PAINTING
Spot Repair and Overcoat

- Pressure Wash / Solvent Clean – SSPC SP1
- Hand / Power Tool Clean – SSPC SP2/SP3
  Visible Rust and Loose Paint
- Spot Prime
  - Surface Tolerant Epoxy (Aluminum Mastic)
  - Organic Zinc Rich Epoxy
- Full Coat of Intermediate and Finish
  - Intermediate – Epoxy (ST); Finish – Aliphatic Polyurethane
  - Intermediate – Primer/Sealer; Finish - Aliphatic Polyurethane
  - Two Coats of WB Acrylic

SPOT REPAIR AND OVERCOAT

- ADVANTAGES
  - Less Expensive than Full Removal
  - May Delay Lead Paint Removal
- DISADVANTAGES
  - High Risk – Test Patch is Critical

FULL REMOVAL AND REPLACE CANDIDATE

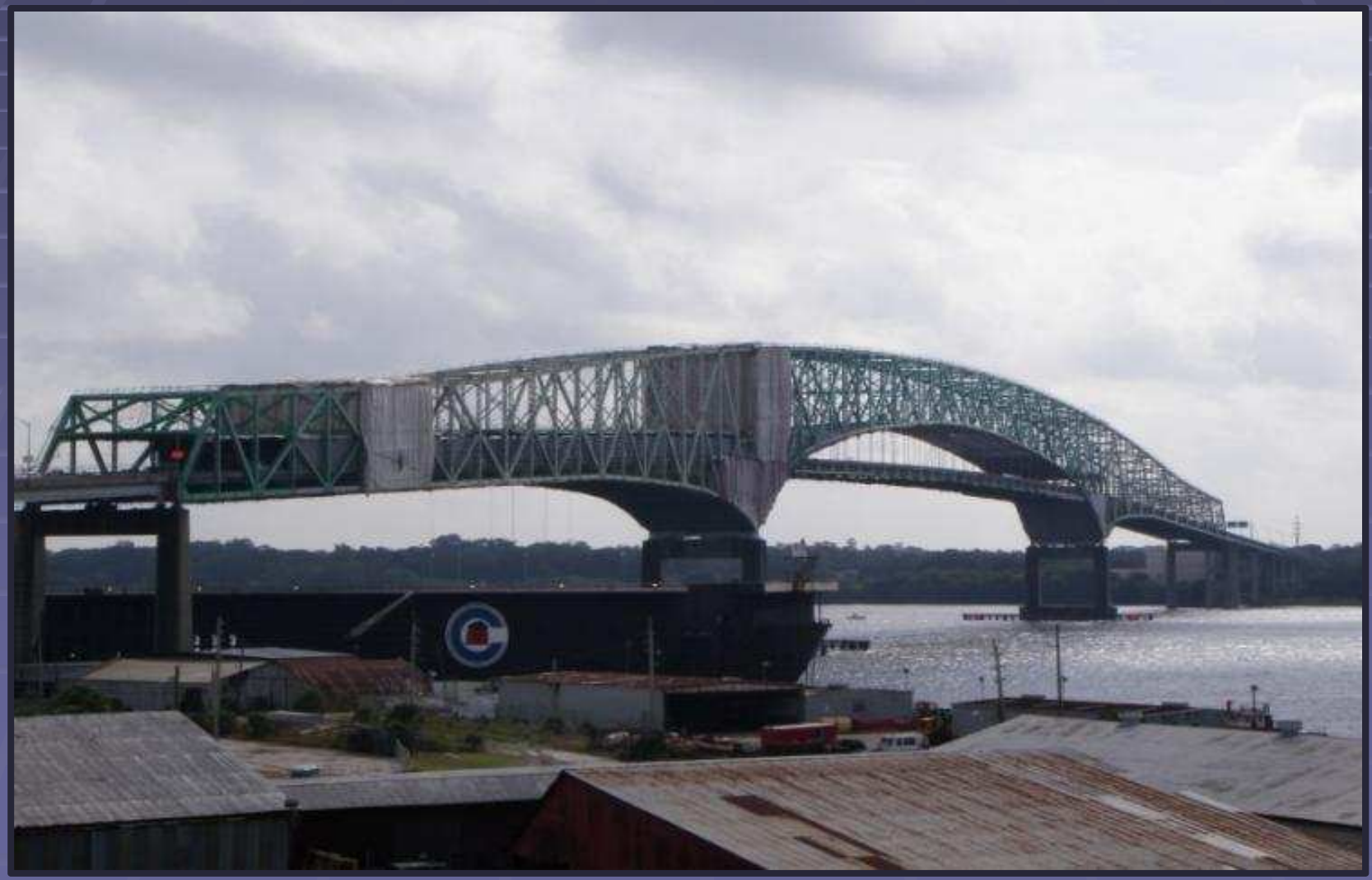
MAINTENANCE PAINTING
Full Removal and Replacement

- Pressure Wash / Solvent Clean – SSPC SP1
- Abrasive Blast – SSPC SP10 “Near White Blast”
- Prime
  - Surface Tolerant Epoxy (Aluminum Mastic)
  - Organic Zinc Rich Epoxy
- Apply Intermediate and Finish
  - Intermediate – Epoxy; Finish – Aliphatic Polyurethane
  - Two Coats of WB Acrylic

FULL REMOVAL AND REPLACEMENT

- ADVANTAGES
  - Longest Lasting Maintenance Solution
    - Increases Time Between Public Inconveniences
  - Lowest Risk for Premature Failure
- DISADVANTAGES
  - Highest Initial Cost

Hart Bridge – Jacksonville, FL



MAINTENANCE PAINTING
Zone Repair

- Pressure Wash / Solvent Clean – SSPC SP1
- Abrasive Blast – SSPC SP10 “Near White Blast”
- Prime
  - Surface Tolerant Epoxy (Aluminum Mastic)
  - Organic Zinc Rich Epoxy
- Apply Intermediate and Finish
  - Intermediate – Epoxy; Finish – Aliphatic Polyurethane
  - Two Coats of WB Acrylic

LESSONS LEARNED

- PROFILE (ANCHOR PATTERN)
- CAULKING
- STRIPING
- SLIP CRITICAL CONNECTIONS
- CLEAR COATS

LESSONS LEARNED
Profile (Anchor Pattern)

- New Compressors Supply Higher Pressures – Resulting in Deep Profiles
- Excess Profiles can result in pin-point rusting, paint waste, insufficient cure
- Pressure needs to be lowered or small abrasive needs to be used

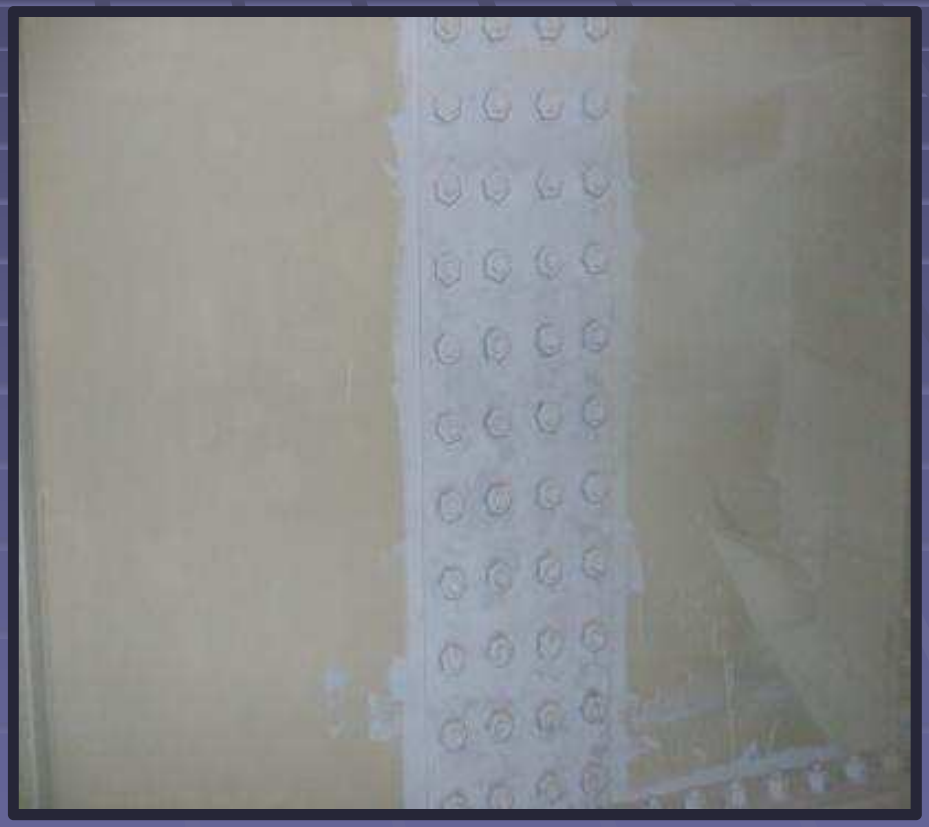
LESSONS LEARNED
Caulking

- Can significantly increase coatings system life
- Need to Specify:
  - Paintable
  - Compatibility with Coatings
  - Cure Time

LESSONS LEARNED
Striping

- The first signs of rust are typically on sharp edges
- Pressure and curing pulls coating away from these surfaces.
- Specify primer and intermediate stripe coats

LESSONS LEARNED
Striping



LESSONS LEARNED
Slip Critical Connections

- Primer with Minimum of Class B Slip Coefficient Usually Required
- Must Account for Cure Time
- Shop Priming of Replacement Parts is Beneficial

LESSONS LEARNED
Clear Coats

- Very Difficult to Apply
  - Skilled Applicator Needed
  - Dry Film Thickness is Critical
  - Passes have to be at same angle / distance
  - Difficult to Touch Up
  - Roller may be recommended
- Moisture Sensitive

LESSONS LEARNED
Clear Coats

"Milky" Appearance Caused by Excessive Dry Film Thickness

THE LATEST

- Trend Towards Longer Life and Less Coats
  - FHWA Mandate Requires Longer Lasting Materials
  - Less Coats Means Cost Savings
  - Metallizing
- Recent FHWA Research
  - 100 Year Coating System
  - One Coat System

THE LATEST

- Metallizing
  - Less Expensive More Portable Equipment
  - Higher Initial Cost – Lower Life Cycle Cost
  - Long Service Life - Some applications have been in service in excess of 50 years.
  - Superior Life Cycle Cost - Due to the long service life, and reduced interim maintenance.
  - Cold Weather Friendly - Metallizing can be applied in any temperature, unlike most coating systems.
  - No curing period - Metallizing does not require any time to cure or recoat, allowing the entire thickness to be placed in a single work shift.

THE LATEST

- Metallizing - Disadvantages
  - Higher initial cost than most coating systems.
  - Requires higher degree of surface preparation than most coating systems (SSPC SP5)
  - Less user friendly than most coating systems, requiring trained and experienced operators.
  - Requires a sealer for maximum performance.
  - May require the use of a cosmetic overcoat.
  - May be affected by some liquid deicing compounds (chlorides).

THE LATEST
Metallizing

Rainbow Bridge, Niagara Falls

THE LATEST
100 Year Coating System

- FHWA in-house study under a congress mandated high performance steel program.
- Main objective is to identify and evaluate coating materials that can provide 100 years of virtually maintenance-free service life for the steel bridge structures.
- This study started in November 2008 as a 42-month in-house research project at Turner-Fairbank Highway Research Center

THE LATEST
100 Year Coating System

Natural Weathering with Salt Spray

Natural Weathering without Salt Spray

THE LATEST
One Coat System

3-coat control (Organic Zn + Epoxy + Polyurethane)

2-coat control (MCU-Zn + Polyaspartic)

Polyaspartic (ASP)

Epoxy Mastic (EM)

Calcium Sulfonate Alkyd (CSA)

Glass Flake Reinforced Polyester (GFP)

High Build Acrylic (HBAC)

Waterborne Epoxy (WBEP)

Polysiloxane (SLX)

Urethane Mastic (UM)

THE LATEST
One Coat System

- Volatile Content & solid Content
- Pigment Content
- Energy Dispersive X-Ray (EDX)
- Dry Film Thickness (SSPC PA2)
- Pencil Scratch Hardness (ASTM D3363)
- Fourier Transform Infrared (FTIR) Spectroscopy
- Pull-off Adhesion (ASTM D4541)
- Number of Coating Defects/Holidays (ASTM D5162)

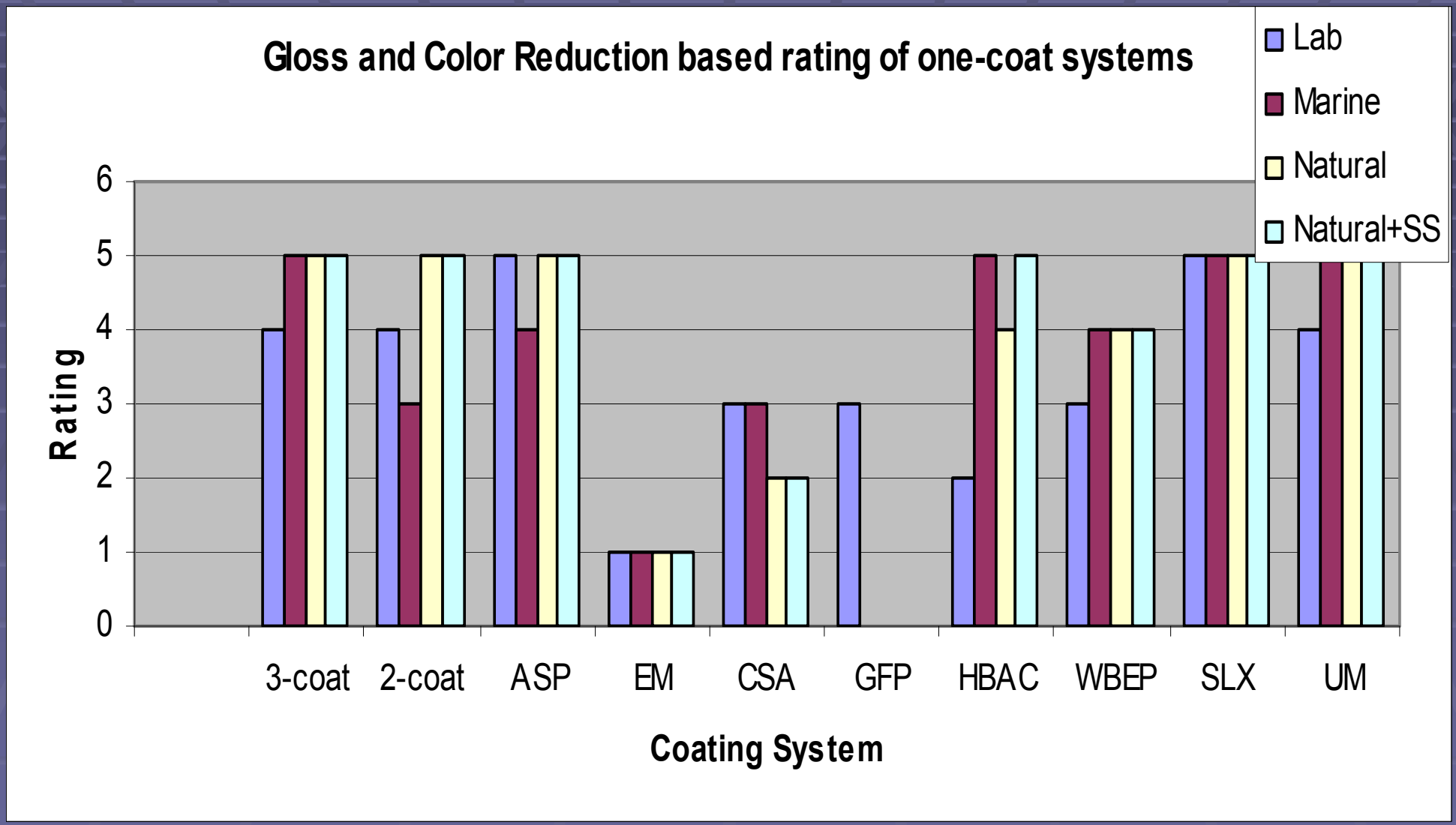
THE LATEST
One Coat System

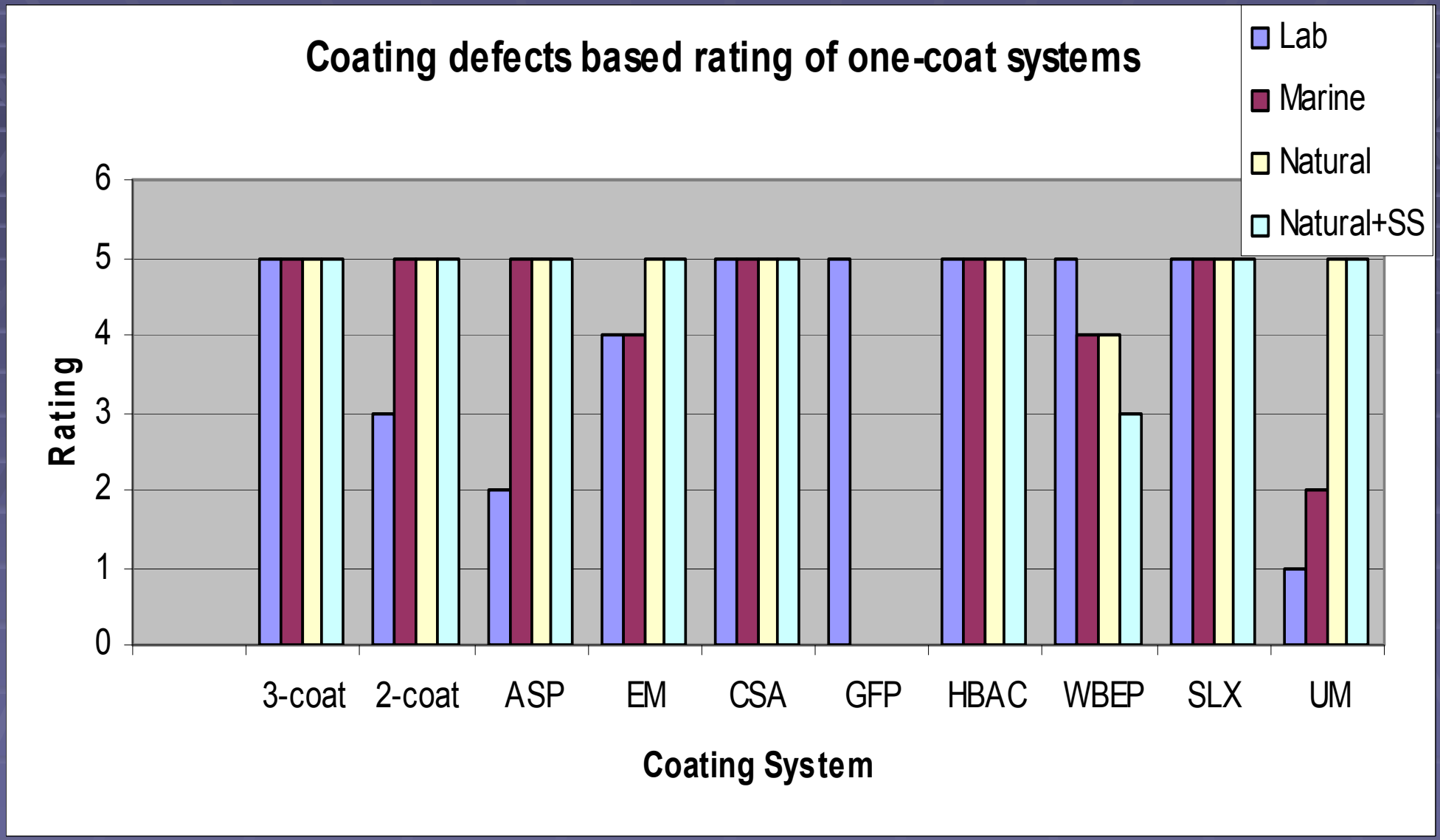
THE LATEST
One Coat System

- **Accelerated Weathering**
- **Mild Weathering Environment Exposure**
- **Mild Weathering Environment + Salt Spray Exposure**
- **Harsh Marine Environment Exposure**

THE LATEST
One Coat System

- Surface Defects and Failures
  (By holiday detector and microscope)
- Reduction of Coating Impedance Properties
- Rust Creepage (ASTM D7087)
- Gloss and Color (ASTM D523 & ASTM D2244)
- Pencil Scratch Hardness (ASTM D3363)
- Adhesion Strength (ASTM D4541)


Gloss and Color Reduction based rating of one-coat systems
Lab
Marine
Natural
Natural+SS
Rating
6
5
4
3
2
1
0
3-coat
2-coat
ASP
EM
CSA
GFP
HBAC
WBEP
SLX
UM
Coating System


Coating defects based rating of one-coat systems
Lab
Marine
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Rating
0
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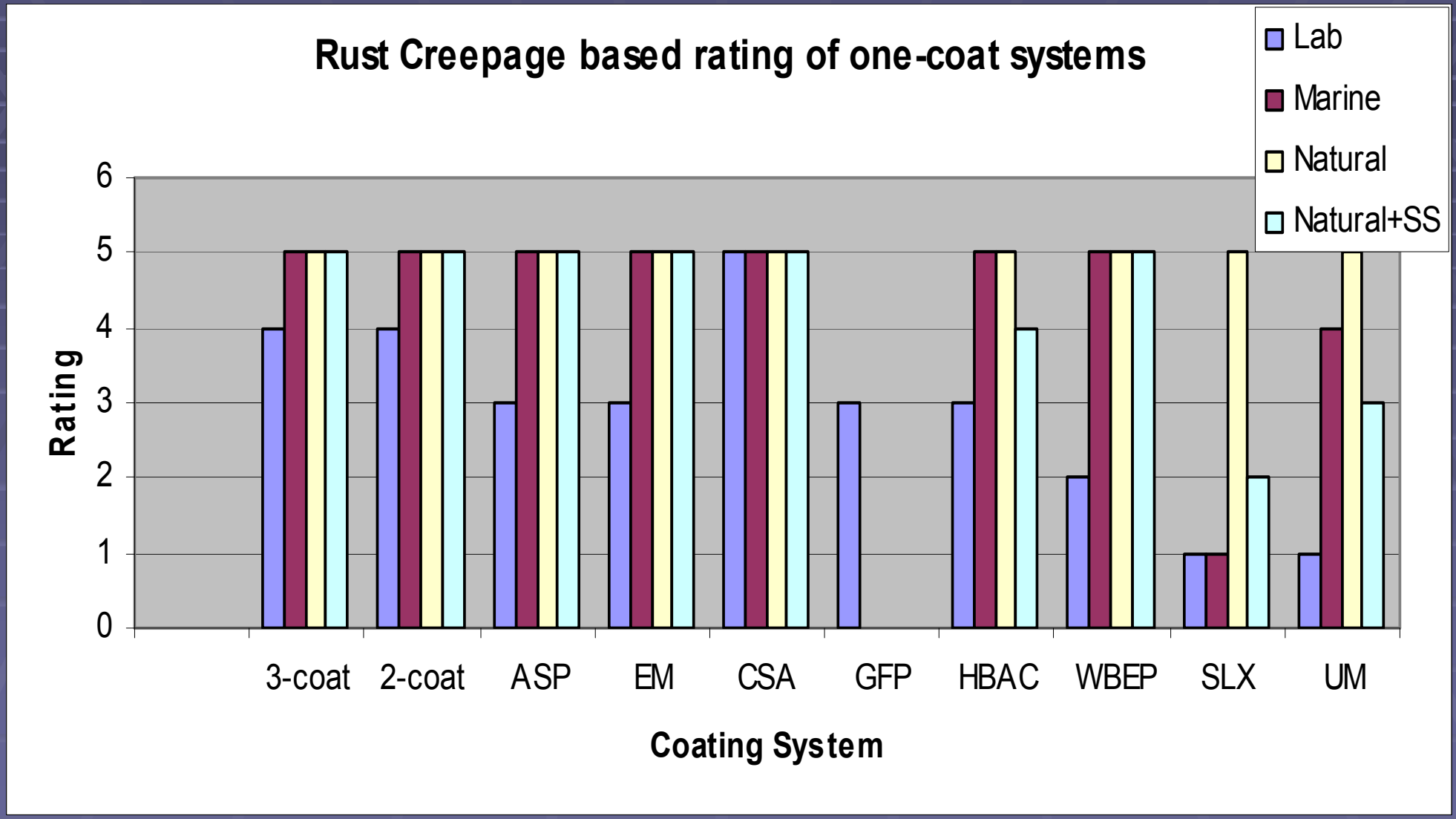
Rust Creepage based rating of one-coat systems
Lab
Marine
Natural
Natural+SS
Rating
0
1
2
3
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5
6
3-coat
2-coat
ASP
EM
CSA
GFP
HBAC
WBEP
SLX
UM
Coating System

THE LATEST
One Coat System

- All one-coat systems had varying degrees of performance with respect to the controls.
- The CSA had the overall best performance in this study. However, its drawbacks included weak adhesion and it never hardened.
- Glass flake reinforced polyester also gave a promising performance in the accelerated lab testing.

THE LATEST
One Coat System

- SLX had the overall best weather resistance, followed by ASP and UM.
- Except for UM and WBEP, the coating systems tested virtually have not exhibited surface failures after outdoor exposures.
- The adhesion data did not correlate well with other performance such as creepage and surface failure.

SUMMARY

- Three coat systems based on zinc rich primers are the most commonly used today
- The trend currently is toward fewer coats and longer performance
- Regardless of the materials or procedure, good painting practices, e.g. caulking, striping, are imperative for long coatings life

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