CORROSION OF HIGHWAY BRIDGES IN VIRGINIA

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Outline

Introduction

Overview of Highway Bridges in Virginia

Corrosion Issues of Highway Bridges

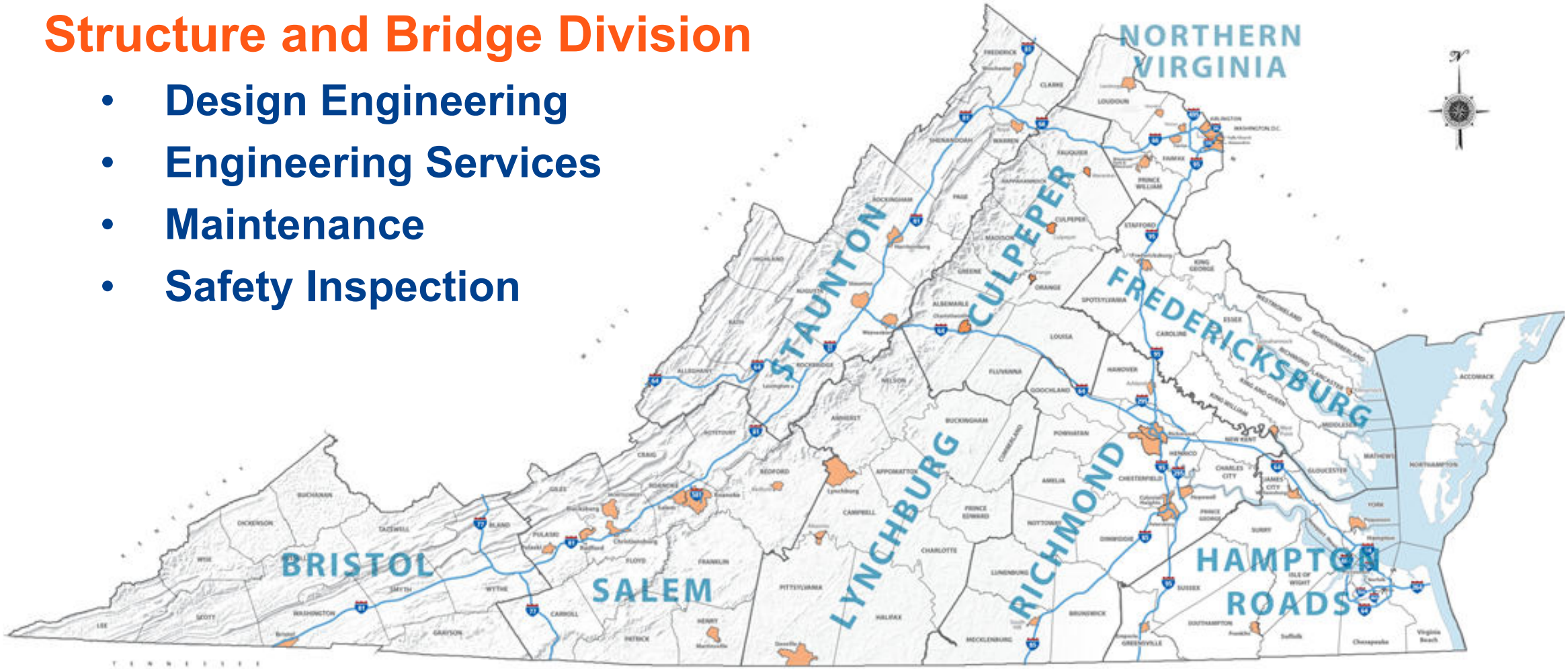
Solutions to Mitigate Corrosion

Questions

Organization of VDOT

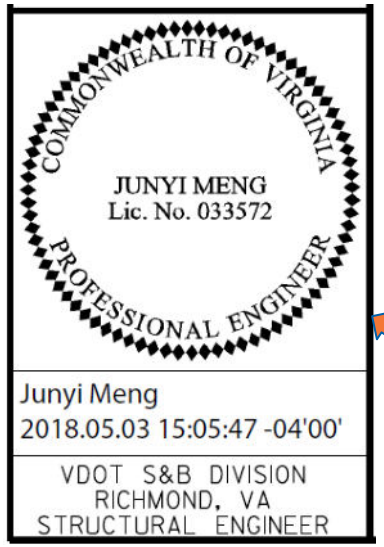
Structure and Bridge Division

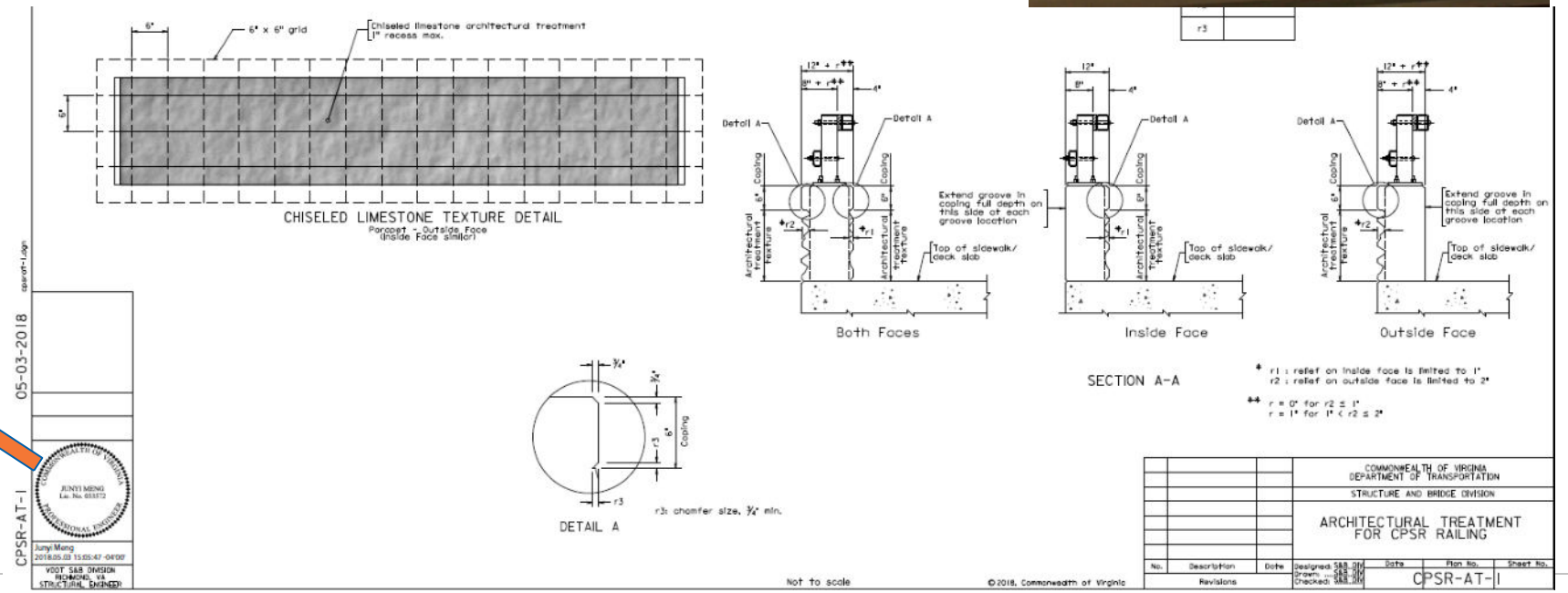
- Design Engineering
- Engineering Services
- Maintenance
- Safety Inspection



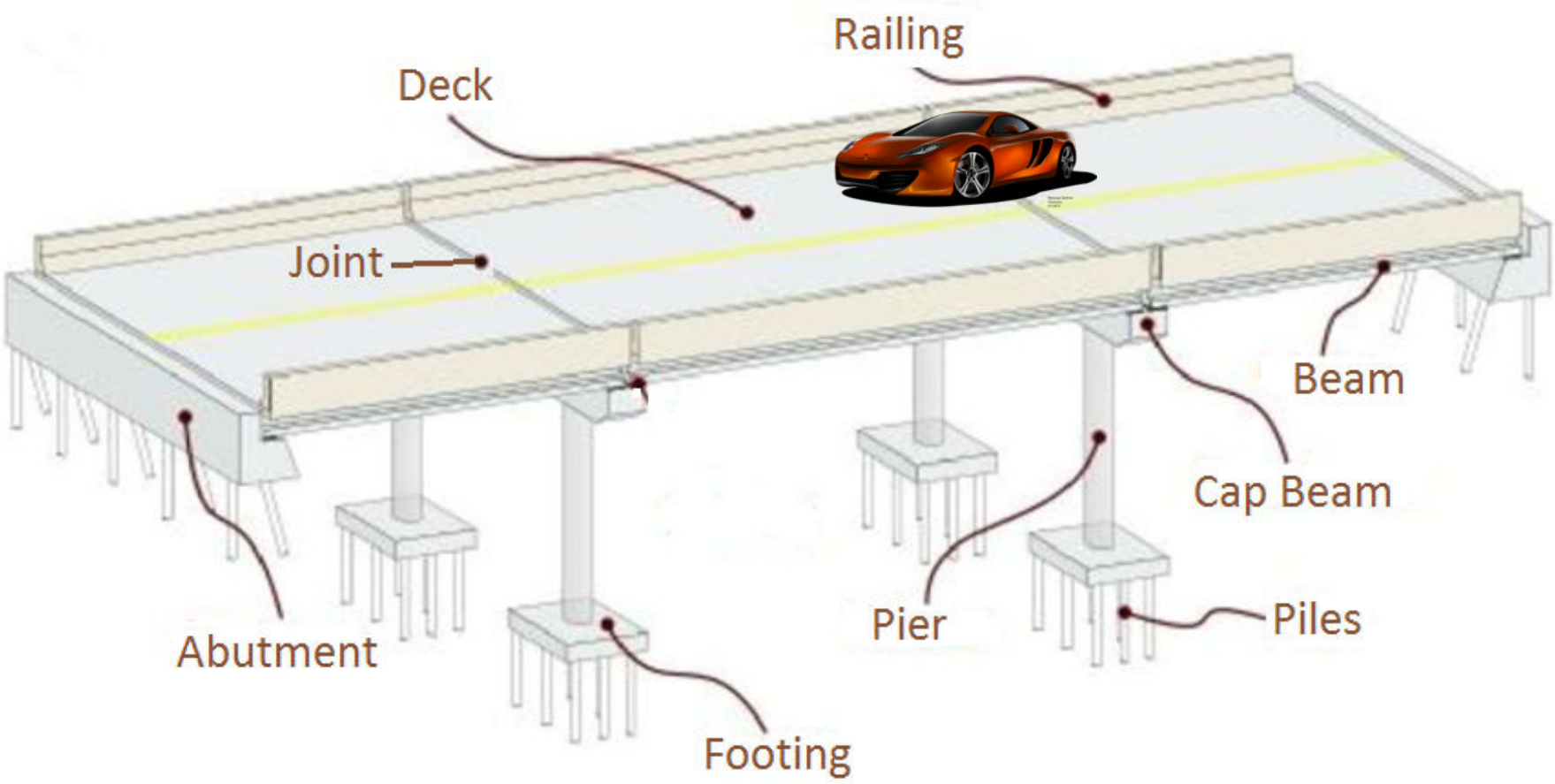
Roles and Responsibilities of Engineering Services

- Develops and Maintains Manuals and Guides for Bridge Design
- Provides Technical Support for Bridge Design and Construction





Bridge Components



Overview of Highway Bridges in Virginia

- Over 21,000 Bridges and Culverts in Virginia
- 10 feet Long to Mile Long
- Small Traffic to Huge Traffic
- Timber, Concrete and Steel Bridges
- Friendly Environment to Harsh Environment

Corrosion Issues of Highway Bridges in Virginia

Applying Salt

Steel Beam

Steel Pipe Culvert

Corrosion Issues of Highway Bridges in Virginia

Concrete Beam

Pile Bents

Bottom of Deck

Corrosion Issues of Highway Bridges in Virginia

Steel Cable

CORROSION IS A LEADING CAUSE OF BRIDGE DETERIORATION

Chemical Equation:

$4Fe + 3O_2 \rightarrow 2Fe_2O_3$

$4Fe(OH)_2 + O_2 + xH_2O \rightarrow 2Fe_2O_3.(x+4)H_2O$

Good News

Highway Bridges in Virginia are safe.

VDOT is a leading transportation agency in USA.

VDOT's mission: Keep Virginia Moving!

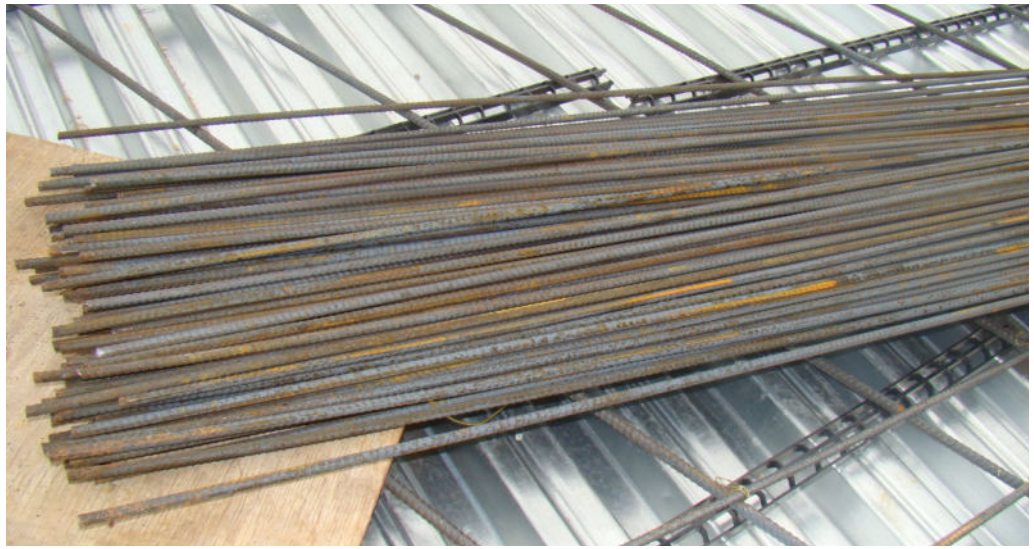
Solutions

- **Protection – Using Jointless Bridges**

- **New Materials – Corrosion Resistant Materials such as Stainless Steel and Carbon Fiber Reinforced Polymer (CFRP)**
- **Improved Materials – Low Permeability Concrete**
- **Advanced Design Theory**

Corrosion Resistant Reinforcing Steel

- Low Carbon and Chromium
- Stainless Steel



Weathering Steel Beams

A tightly adherent protective rust “patina” acts as skin to prevent further corrosion to the steel beneath.

Coated Steel Beam

Weathering Steel Beam

Corrosion Resistant Steel Beams

The 1st All-Corrosion Resistant Steel Bridge in the USA

Route 340 over South River in Waynesboro

Grade 50W

Element	Composition (%)
Carbon (C)	0.19 max
Manganese (Mn)	0.80–1.25
Phosphorus (P)	0.03 max
Sulfur (S)	0.03 max
Silicon (Si)	0.30–0.65
Nickel (Ni)	0.4 max
Chromium (Cr)	0.40–0.65

Grade 50CR

Element	Composition (%)
Carbon (C)	0.03 max
Manganese (Mn)	1.5 max
Phosphorus (P)	0.04 max
Sulfur (S)	0.01 max
Silicon (Si)	1 max
Nickel (Ni)	1.5 max
Chromium (Cr)	10.5-12.5

Carbon Fiber Reinforced Polymer (CFRP) Reinforcement

The 1st All-CFRP Bridge in the USA

Route 49 over Aaron's Creek in Halifax County

Natural Bridge

Conclusion

Chemistry is everywhere in our lives.

Chemistry is fascinating to learn and use.

Questions?

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