Corrosion Resistant Steel for Steel Plate Girder Bridge Applications

Jason T. Provines, P.E.

VTCA-VDOT Consultant Forum
October 2, 2018
Why Corrosion Resistant Steel?

- Leading cause of bridge deterioration
- Costly repairs
Corrosion Resistant Reinforcing Steel

• Higher initial cost, more durability
• Class type depends on use and location
ASTM A709 Grade 50CR

• Formerly ASTM A1010
• Low grade stainless steel
  – Similar to ASTM A1035CS rebar
• Bridges: 6 in U.S. & 2 in Canada
50CR Base Metal

- 4-10x more corrosion resistance than A588 (FHWA & VT)
- Similar mechanical properties to typical A709
- Already in VDOT Structure & Bridge Manual
First Virginia 50CR Application

• Bridge replacement of Rt. 340 over South River in Waynesboro, VA

• Why 50CR?
  – Industrial site upstream of bridge
  – Proximity to water
  – Aesthetics*
Ordering 50CR Plate

• 50CR meets Buy America
• Sole source
  – VTRC has helped with exemptions
  – Could require longer lead times
50CR Fabrication

- Can be fabricated by traditional steel bridge fabricator
- Fabrication takes longer
- Some differences due to material
  - Safety – fume control when welding and cutting
  - Cutting method
50CR Welding

- Joint design is the same
- Welding electrodes are stainless steel
  - Meet Buy America
- Currently being balloted into D1.5 Bridge Welding Code
- VTRC welding study to allow for more efficiency
50CR Bolting

- Stainless steel fastener assemblies used
  - ASTM A193 Grade B8 bolts, ASTM A194 nuts, Grade 303 washers
- New tightening specs needed
- VTRC project on corrosion resistant bolts
50CR Construction

- No difference in construction or erection
Rt. 340 Bridge

- Opened to traffic in June 2017, ahead of schedule
- Won 2018 National Steel Bridge Alliance Prize Bridge Award for Short Span
Duplex Stainless Steel

• Grade 2205 is produced as plate material
  – Same as reinforcing steel
• Used for many bridges in Europe
• Used in structural applications in the US
  – Nuclear, oil and gas, offshore, etc.
• Design properties are similar or better to typical steels

Photo courtesy of ATI
(https://www.atimetals.com/Products/ati-2205)
San Diego Harbor Drive Bridge

- 1\textsuperscript{st} 2205 duplex stainless steel bridge in US
- Pedestrian bridge constructed in 2011
- Inspection in 2016 showed excellent results

Photo courtesy of Structure Magazine (https://www.structuremag.org/?p=827)
West 7th Street Bridge in Ft. Worth, TX

- Arch bridge built by TxDOT in 2013
- Used Grade 2205 steel for hanger bars

Photo courtesy of International Molybdenum Association (https://www.imoa.info/download_files/molyreview/IMOA_MolyReview_1-2018.pdf)
Where To Use CR Steel?

• Areas where uncoated A588 not recommended
• Aesthetics
• New designs
  – Marine coastal areas
  – Close to water or industrial site
  – Over potable water source
• Repairs
  – Same as new designs
  – Beam end repairs under joints
Upcoming CR Projects

- Jenkins Bridge Road Bridge
- Eastern Shore, VA
- 50CR plate girders

- Featherbed Lane over Catoctin Creek
- Loudon County, VA
- 50CR plate girders
Conclusions

- Grade 50CR steel offers more durability and enhanced corrosion resistance
- Corrosion resistant steel saves $$$ on future costly maintenance
- Included in specifications for ASTM, VDOT, and AASHTO/AWS (2020)
- Used for new design and repairs
- VTRC and FHWA can assist with these projects
Acknowledgements

- Virginia Department of Transportation (VDOT)
- Virginia Transportation Research Council (VTRC)
- VDOT Staunton District Bridge Section
- VDOT Structure & Bridge Division
- VDOT Materials Division
- ArcelorMittal
- High Steel Structures
- Interlock Steelworkers
- Fairfield-Echols
- Federal Highway Administration (FHWA)