THE
STAINLESS REBAR
STANDARD

SALIT SPECIALTY REBAR
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Kevin Cornell, Editor December 2013

Rehabilitation of 80-year-old Pulaski Skyway in New Jersey

The Pulaski Skyway between Newark and Jersey City is 18,450 feet long spanning the Hackensack and Passaic Rivers. In 2007, the New Jersey Department of Transportation (NJDOT) announced long-range plans to replace the Skyway with four 12-foot-wide lanes (two in each direction), left and right shoulders, a four-foot-high concrete median barrier, and adequate entrance and exit ramps. The existing structure will be kept open as new lanes are constructed that carry Routes 1 and 9 traffic. The cost is projected to exceed $1 billion.

Bridge deck is comprised of a reinforced concrete slab on top of, and composite with, an unfilled steel grid.
Photos: Courtesy of Jersey Precast

Salit Specialty Rebar (http://stainlessrebar.com/) was contracted by Jersey Precast (http://www.jerseyprecast.com/) to supply 2,400 tons of EnduraMet™ 32Stainless XM-28 UNS# S24100 (http://stainlessrebar.com/stainless-rebar-is-cost-effective/types-of-stainless-steel-rebar/) for the deck replacement. The contractor is China Construction America, Inc. (http://www.chinaconstruction.us/).

There are 1,142 precast concrete decks specified for the project that require stainless steel rebar and 253 Exodermic® Grid Decks (http://www.exodermic.com/) with galvanized reinforcement. An Exodermic® (composite, unfilled steel grid) bridge deck is comprised of a reinforced concrete slab on top of, and composite with, an unfilled steel grid. It is mandatory that the precast and Exodermic® deck panels be aged for 120 days prior to shipping. The sizes of the precast decks include panels that are 8 foot 4 inches wide x 26 feet-4 7/8 inches long; 12 foot-1 inch wide x 26 feet-4 7/8 inches long; 10 feet-4 inches wide x 46 feet-3 3/8 inches long; and trapezoid panels 12 foot-1 inch x 14 feet-0" x 34 feet-6 ½ inches long.

Andy Foden, PE, PhD, Supervising Engineer and Senior Professional Associate with Parsons Brinckerhoff (http://www.pbworld.com/) said, "Taking into consideration the magnitude of this project and how it affects the entire region overall, limited access for deck repairs, and overall cost, NJDOT decided to use stainless steel reinforcement to extend the life of the deck." Start of precast deck shipment to the job site is on February 13, 2014. The last piece should be delivered on August 27, 2014.

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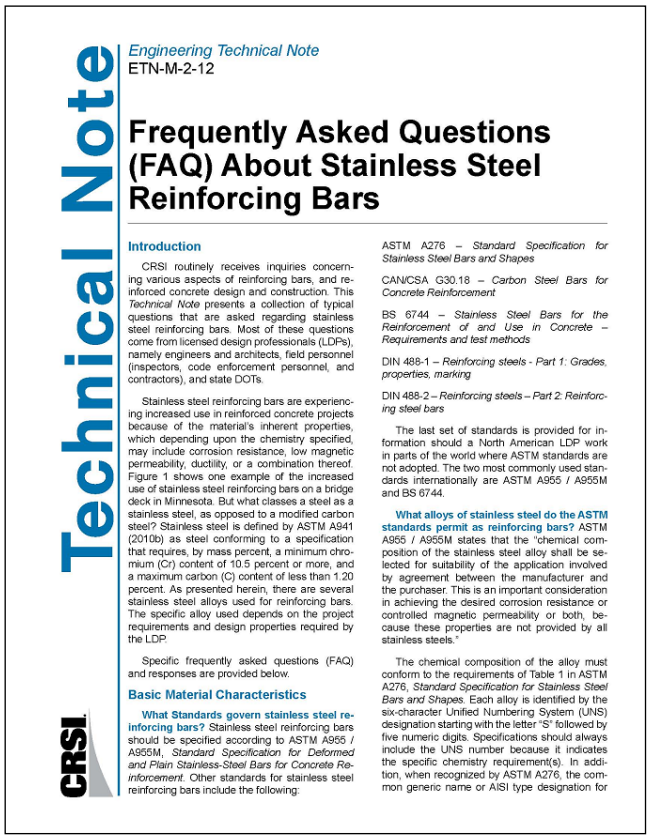
Frequently Asked Questions (FAQ) About Stainless Steel Reinforcing Bars



Technical Note

Engineering Technical Note
ETN-M-2-12

Frequently Asked Questions (FAQ) About Stainless Steel Reinforcing Bars

Introduction

CRSI routinely receives inquiries concerning various aspects of reinforcing bars, and reinforced concrete design and construction. This *Technical Note* presents a collection of typical questions that are asked regarding stainless steel reinforcing bars. Most of these questions come from licensed design professionals (LDPs), namely engineers and architects, field personnel (inspectors, code enforcement personnel, and contractors), and state DOTs.

Stainless steel reinforcing bars are experiencing increased use in reinforced concrete projects because of the material's inherent properties, which depending upon the chemistry specified, may include corrosion resistance, low magnetic permeability, ductility, or a combination thereof. Figure 1 shows one example of the increased use of stainless steel reinforcing bars on a bridge deck in Minnesota. But what classes a steel as a stainless steel, as opposed to a modified carbon steel? Stainless steel is defined by ASTM A941 (2010b) as steel conforming to a specification that requires, by mass percent, a minimum chromium (Cr) content of 10.5 percent or more, and a maximum carbon (C) content of less than 1.20 percent. As presented herein, there are several stainless steel alloys used for reinforcing bars. The specific alloy used depends on the project requirements and design properties required by the LDP.

Specific frequently asked questions (FAQ) and responses are provided below.

Basic Material Characteristics

What Standards govern stainless steel reinforcing bars? Stainless steel reinforcing bars should be specified according to ASTM A955 / A955M, *Standard Specification for Deformed and Plain Stainless-Steel Bars for Concrete Reinforcement*. Other standards for stainless steel reinforcing bars include the following:

ASTM A276 – *Standard Specification for Stainless Steel Bars and Shapes*

CAN/CSA G30.18 – *Carbon Steel Bars for Concrete Reinforcement*

BS 6744 – *Stainless Steel Bars for the Reinforcement of and Use in Concrete – Requirements and test methods*

DIN 488-1 – *Reinforcing steels - Part 1: Grades, properties, marking*

DIN 488-2 – *Reinforcing steels – Part 2: Reinforcing steel bars*

The last set of standards is provided for information should a North American LDP work in parts of the world where ASTM standards are not adopted. The two most commonly used standards internationally are ASTM A955 / A955M and BS 6744.

What alloys of stainless steel do the ASTM standards permit as reinforcing bars? ASTM A955 / A955M states that the "chemical composition of the stainless steel alloy shall be selected for suitability of the application involved by agreement between the manufacturer and the purchaser. This is an important consideration in achieving the desired corrosion resistance or controlled magnetic permeability or both, because these properties are not provided by all stainless steels."

The chemical composition of the alloy must conform to the requirements of Table 1 in ASTM A276, *Standard Specification for Stainless Steel Bars and Shapes*. Each alloy is identified by the six-character Unified Numbering System (UNS) designation starting with the letter "S" followed by five numeric digits. Specifications should always include the UNS number because it indicates the specific chemistry requirement(s). In addition, when recognized by ASTM A276, the common generic name or AISI type designation for

CRSI

[Click here](http://www.crsi.org/index.cfm/engineering/notes) to download a copy of Technical Note ETN-M-2-12 from the CRSI Website at (http://www.crsi.org/index.cfm/engineering/notes)

The [Concrete Reinforcing Steel Institute](http://www.crsi.org/) (CRSI) (http://www.crsi.org/) routinely receives inquiries concerning various aspects of reinforcing bars, and reinforced concrete design and construction. The CRSI has published a "Technical Note" (http://www.crsi.org/index.cfm/engineering/notes) that presents a collection of typical questions that are asked regarding stainless steel reinforcing bars. Most of these questions come from licensed design professionals (LDPs), including engineers and architects, field personnel (inspectors, code enforcement personnel, and contractors), and state DOTs.

Stainless steel reinforcing bars are experiencing increased use in reinforced concrete projects because of the material's inherent properties, which depending upon the chemistry specified, may include corrosion resistance, low magnetic permeability, ductility, or a combination thereof.

There are many publications reporting on the use of stainless steel reinforcing bars on bridge decks. But what classes a steel type as stainless steel, as opposed to a modified carbon steel? Stainless steel is defined by [ASTM A941 (2010b), *Standard Terminology Relating to Steel, Stainless Steel, Related Alloys, and Ferroalloys*](http://www.astm.org/Standards/A941.htm) (http://www.astm.org/Standards/A941.htm), as steel conforming to a specification that requires, by mass percent, a minimum chromium (Cr) content of 10.5 percent or more, and a maximum carbon (C) content of less than 1.20 percent. There are several stainless steel alloys used for reinforcing bars. The specific alloy used depends on the project requirements and design properties required by the LDP.

Stainless steel rebar deck on a bridge near Sioux Falls, South Dakota
Photo courtesy of Sioux City Foundry Co.

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SDDOT specifying stainless steel rebar for bridge decks

Twin bridges on Interstate 90 span SD Highway 115

250 tons of stainless steel grade Duplex 2304

Contractor overcame challenges with tie wire and bar supports

Photos: Jared Gusso, Sioux Falls Construction Company

South Dakota Department of Transportation (SDDOT) continues to specify stainless steel rebar for bridge decks. I-90 overpasses at SD 115 (Cliff Ave.), Sioux Falls, had become obsolete after service since the early 1960s.

The project involved replacement of two bridges and a functionally obsolete interchange. SD Hwy 115 was widened and services upgraded to handle additional development in the area. This was the last section of interstate to be replaced from the Minnesota boarder to 120 miles west over a 10 year program.

Construction of the structures required shut down of the obsolete west bound lane in April 2013 and reopen on July 20. After the new deck was opened, the east bound lane was closed for replacement of the structure beginning July 29 to be reopened November 1. Each bridge is 42 feet – 8 inches wide and 375 feet long.

Salit Specialty Rebar (SSR) (http://stainlessrebar.com/) was contracted by Sioux City Foundry, a long-established rebar fabricator from Sioux City, Iowa to supply approximately 250 tons of stainless steel grade Duplex 2304. This rebar is a duplex stainless steel type with a structure that is a balance of ferritic and austenitic. It has high strength and toughness, resistance to stress corrosion cracking, high thermal conductivity, low thermal expansion, and easy fabrication.

There was a learning curve from both the DOT and contractor perspectives on installation techniques, tie wire, bar supports and what is expected for certifications and testing. The project was challenging due to the live traffic under the structures and converting from a Diamond Interchange to a Single Point.

Sioux City Foundry (http://www.siouxcityfoundry.com/) is an active member of the Concrete Reinforcing Steel Institute(CRSI). The contractor was Sioux Falls Construction Company (http://www.sfconst.com/)

Stainless steel a major component of many new and rehabilitated bridges

New bridge over Little Bay on the Spaulding Turnpike (NH) Photo: Roy W. Stevens and Dan Musselwhite (Cianbro Companies)

Over two hundred million trips are taken daily across deficient bridges in the nation's 102 largest metropolitan regions. In total, one in nine of the nation's bridges are rated as structurally deficient, while the average age of the nation's 607,380 bridges is currently 42 years. The percentage of bridges that are either functionally obsolete or structurally deficient has been declining slowly over the last decade as states and cities increased efforts to prioritize repairs and replacements. In 2012, one in nine, or just below 11%, of the nation's bridges were classified as structurally deficient. The number of bridges defined as functionally obsolete has also declined, with currently 24.9% of the nation's bridges defined in either deficiency category. However, while billions have been spent annually on bridge construction, rehabilitation, and repair in the last twenty years, current funding levels are not enough to repair or replace the nation's large-scale, urban bridges, which carry a high percentage of the nation's traffic. To illustrate, the nation's 66,749 structurally deficient bridges make up one-third of the total bridge decking area in the country, showing that those bridges that remain classified as structurally deficient are significant in size and length, while the bridges that are being repaired are smaller in scale. (2013 Report Card for America's Infrastructure – ASCE, http://www.infrastructurereportcard.org/a/#p/bridges/overview)

Duplex stainless steels started playing an increasingly important role in the construction of bridges over the past 20 years, wherever specific environmental conditions combine with the need for high load-bearing capability. Salit Specialty Rebar has supplied some of the earliest bridge rehabilitation projects using stainless steel. With a need and demand for resilient infrastructure, SSR's products are being used more widely, resulting in SSR's growth and expansion to serve existing and new customers. Following is a selection of high profile bridges built or rehabilitated with SSR products since 2010.

Patroon Island truss deck bridge: Work involves replacing the truss bridge's decks and bearings, along with rehabilitation of the ramps.

The Osborne Street Bridge Rehabilitation project in the City of Winnipe, Manitoba. The rehabilitation was necessary because of severe spalling of the bridge deck.

A new four-lane bridge, in addition to the rehabilitation of the existing Little Bay Bridge, (NHDOT) doubled the traffic capacity and improve safety along this section of the Spaulding Turnpike.

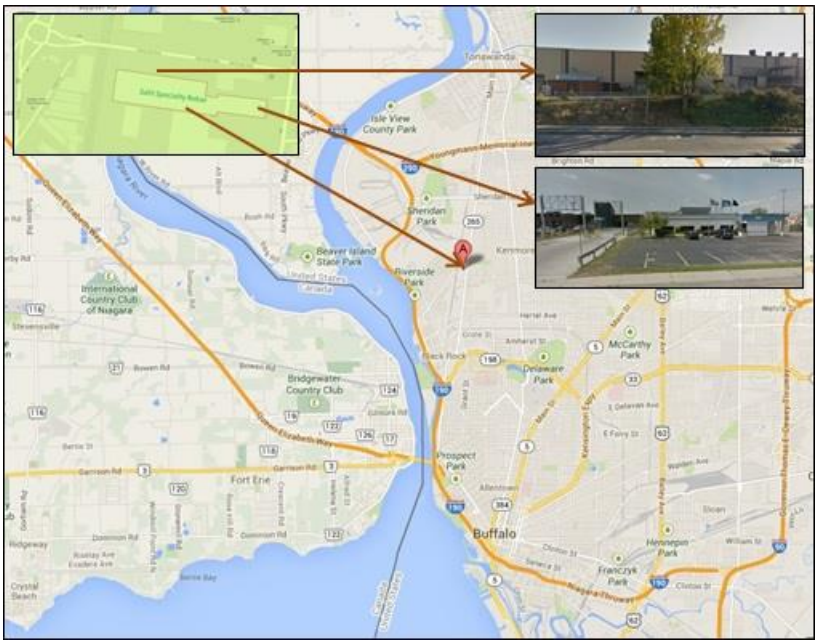
In 2011, the 83-year-old South Punalu'u Stream Bridge (Hawaii DOT) was replaced with a new structure reinforced with stainless steel rebar that meets vehicular load, safety, and seismic standards.

The Stone Creek Bridge on the Alaska Highway was replaced with a four-lane bridge using stainless steel rebar in its columns, beams and deck in 2011.

Relocation and replacement of Louisiana's Caminada Bay Bridge became a significant state project after Katrina.

The Tynehead pedestrian overpass connects the Tynehead Regional Park and the Surrey Bend Regional Park in Surrey, British Columbia.

SSR acquires Buffalo facility for an expanded service



Salit Specialty Rebar – 1050 Military Road, Buffalo, NY 14217

Salit Specialty Rebar (http://stainlessrebar.com/) has acquired a facility in Buffalo, New York to expand its services and easily supply clients in Canada and the United States with an expanding range of stainless steel products. The facility is located at 1050 Military Road, approximately 6 km from the Peace Bridge, a major international toll crossing spanning the Niagara River between Fort Erie, Ontario, and Buffalo, New York. This is SSR's second facility in the Niagara Falls/Buffalo region.

The 40,000 square-foot facility was opened in October, 2013, employing 14 people. The operation is set up for two 10-hour shifts, six to seven days each week.

RMS Shearline

SSR's facility on Military Road includes a new RMS Shearline that can be operated conventionally, or controlled by computer software. Integrated with the Shearline is a RMS 611 Hydraulic Guillotine Shear, which is a completely automated Shearing System. The 611 Shear can substantially increase productivity while reducing shearing costs compared with conventional shears. The unique design of the 611 Shear makes it virtually impossible for an operator to place fingers or hands anywhere near the moving parts of the shear. The RMS station has double loading tables and double discharge.

RMS 611 Hydraulic Guillotine Shear

MEP Planet 20 Plus coil machine

Another feature of the facility is a new MEP Planet 20 Plus coil machine (http://www.youtube.com/watch?v=5mLPSDVcfGs) used for coil processing, straightening and shaping. The high productivity of the Planet 20 (http://www.retecon.co.za/retecon/reinforcing-steel/stirrup-shape-benders-coil/mep/planet-20-plus/) is for serial production (same diameter with two wires up to 16 mm) and "classified" production, when processing individual building elements such as beams and columns (variable diameters with single wire up to 20 mm).

The Buffalo facility of SSR was established to complement Salit's Niagara Falls facility, and to firmly establish the company as the leading supplier of cut stainless steel rebar and preformed stainless steel rebar and mesh in North America.

Upcoming Events 2014

2014

World of Concrete (http://www.worldofconcrete.com/)**:** Las Vegas Convention Center: Las Vegas, Nevada

Celebrating 40 years, WOC is the industry's only annual international event dedicated to the commercial concrete and masonry construction industries showcasing leading industry suppliers. WOC features innovative

tools, construction machinery, construction equipment, safety training courses and training, technologies and unlimited networking opportunities to give you new ways to sustain and grow your business. World of Concrete is considered by many to be one of the top shows in the industry. The outdoor exhibit areas, including the hugely popular Artistry in Decorative Concrete, make World of Concrete THE event to attend in 2014 between January 20 and 24.

Plan to meet ***Salit Specialty Rebar*** (http://stainlessrebar.com/) *technical specialists at World of Concrete 2014, Booth 292 located in the North Hall.*

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