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Stainless Steel Reinforcement

Stainless steels extend the lifetimes of reinforced concrete structures.

When it comes to building or repairing reinforced concrete structures so that **life-cycle costs** are minimized, many authorities are specifying the use of **stainless steel reinforcing bars** (rebars) instead of the traditional carbon steel rebars.

Nickel improves the mechanical properties of stainless steels and helps to boost their corrosion resistance. Commonly specified alloys for stainless steel rebar are shown below (nominal compositions in weight %, balance iron):

Alloy	Type	UNS No.	% Cr	% Ni	% Mo	% N	% C (max)
Type 304	Austenitic	S30400	18	8	-	-	0.08
Type 316	Austenitic	S31600	17	12	2.5	-	0.08
Type 316 LN	Austenitic	S31653	17	12	2.5	0.13	0.03
2304	duplex	S32304	23	4	0.3	0.1	0.03
2205	duplex	S31803	22	5	3	0.14	0.03

These alloys can provide long-term corrosion resistance when concrete is exposed to chloride-containing environments, e.g., road salt and sea water. They have been used as rebar in highway bridges, ramps & barrier walls, parking garages, tunnels, sea walls & marine facilities, building foundations and restorations.

The US Federal Highway Administration (FHWA) organized extensive corrosion testing to find rebar materials that could extend the lifetime of reinforced concrete bridges to 75-100 years, when the concrete was contaminated with chlorides. Their 1998 report (FHWA-RD-98-153) concluded that stainless steel rebars, like Type 316, would be capable of providing that required lifetime.

In Europe, Ni-containing stainless steel rebars have been widely used since the 1980s. In North America, their use in highway bridges has been steadily growing since the mid 1990s, with many large bridges being constructed or extensively repaired.

Stainless steel components for concrete reinforcing: rebar, U-bent rebar, threaded rebar, tie-wire and rebar coupler. (Photo Courtesy of F. N. Smith)

Installation of stainless steel rebar at the French Creek Bridge, Chautauqua Co., NY. (Photo Courtesy of Dunkirk Specialty Steel)

Listed below are just a few examples of projects that have utilized stainless steel rebar:

Project	Date	Rebars	Approx. tonnage
Bridge on I-696, near Detroit, MI	1984	Type 304	33
Underpass, Newcastle, Tyneside, UK	1995	Type 316	265
Bridge, Ajax, Ontario, Canada	1998	Type 316LN	150
Ramp for Garden State Parkway, New Jersey	1998	Alloy 2205	165
Haynes Inlet Slough Bridge, Oregon	2003	Alloy 2205	400
Broadmeadows Bridge, Ireland	2003	Type 316	186
Belt Parkway Bridge, Brooklyn, NY	2004	Alloy 2205	200
Driscoll Bridge, New Jersey	2005	Mostly 2205	1300
Woodrow Wilson Bridge, VA and MD	2007	316LN & 2205	1000
Hastings Bridge, Minnesota	2010	Alloy 2304	365
Cameron Heights Dr. Bridge, Edmonton, AB	2010	Alloy 2304	190
S. Saskatchewan River Bridge, Medicine Hat, AB	2011	Alloy 2304	194
Sakonnet River Bridge, Rhode Island	2012	Alloy 2205	800
Hurdman Bridge, Hwy 417, Ottawa, Canada	2014	Alloy 2205	323
Kenaston Overpass, Winnipeg, Manitoba	2014	Alloy 2304	200
Sea wall construction, Arabian Gulf	2009	Alloy 2205	4000
Parking garage, Brighton, MA	~ 1999	316LN & 304	21
Thorold Tunnel, Ontario, Canada	2004	Type 316LN	60

Stainless steel rebar is substituted for carbon steel rebar only in critical parts of the structure that will experience corrosive conditions. For bridges, experience has shown that the total project cost increase when using stainless steel rebar can be 3%, or less. The actual cost increase will depend on the size and complexity of the bridge design. The use of stainless steel rebar is predicted to extend the useful life of the structure to 75-100 years, with the consequent savings on repairs and/or early replacement.

Stainless steel rebars are produced according to ASTM A955. Depending on the stainless steel grade selected, yield strengths > 75 ksi (520 MPa) and tensile strengths > 100 ksi (690 MPa) can be achieved. Stainless steel rebars also have superior toughness, ductility and fatigue resistance. These properties are beneficial in earthquake-prone regions and in low temperature applications.

The use of Ni-containing stainless steel rebar is expected to continue to increase as Federal, State, Provincial and local governments demand much lower maintenance costs, fewer disruptions and longer lifetimes for their bridges and other important concrete structures.

Along with stainless rebar, other stainless steel components such as tie-wire, rebar couplers, dowels and welded-wire mesh are available to complete the corrosion resistant system.

Do you want to know more?

Get in touch with the Nickel Institute. The Nickel Institute fosters open communication towards all nickel-containing materials

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