worldstainless

Stainless Steel in Infrastructure: Bridges






Bridges on the cover page:

Golden bridge. Picture courtesy of TA Corporation.	Helix bridge. Picture courtesy of Outokumpu and photographer Andrea Goh.	Giboshi-bashi bridge. Picture courtesy of Tottori-city.
Pedestrian bridge in Ortisei. Picture courtesy of Centro Inox.	Hong Kong - Zhuhai - Macau bridge. Picture courtesy of Shutterstock.	Sölvesborg bridge. Picture courtesy of Outokumpu.

Introduction

There are hundreds of thousands of bridges in the world, over 600,000 in the USA alone. More and more are being built. They provide essential links between regions and countries. The costs of maintenance or/ and replacement amount to huge figures over time.

- Many Bridges are in a poor condition
- A lot of them were built after World War II for a projected life of 60 years plus
- Traffic has been heavier than planned
- Cutting maintenance costs has been a frequent practice

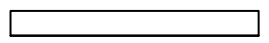
Life Cycle Cost (LCC) evaluations consistently show the benefits of providing operation with as little maintenance as possible over a lifetime exceeding a century. Stainless steels, especially Duplex stainless steels, offer an extremely attractive way of providing structural integrity over unlimited time, thanks to their high strength and their corrosion resistance that meets all climates and weather conditions. The extra cost over a cheap short-term solution is less than 10% when used in the critical areas.

The cases in this brochure illustrate the use of stainless steel for road, pedestrian, rail, mixed rail/ road/cycles traffic. They are located in hot and cold climates, inland and on the seaside.

Various product forms, tubes, tie rods, rebar, plates, fasteners, etc.. have been used, demonstrating the wide range of options available to the architects/civil engineers.

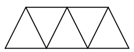
Bridge classification

Starting from a simple beam, various forms of bridge structures have been developed since the 18th century – when the first cast-iron arch bridge was built in England in 1779. A distinction is made between the following bridge types:



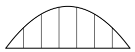
Girder bridges

In girder bridges, the simplest form of bridges, bending moments arise from the vertical load, which take on maximum values in the bridge spans and in the support area of multi-span structures. The girder webs absorb the transverse forces that are small in the spans and increase towards the supports. Girder bridges are easy to produce in terms of their structure, but the spans are limited and the use of materials is higher than for other types of bridges.



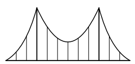
Truss bridges

In the case of truss bridges, which are constituted of connecting bars, it is better to calculate the bars according to their actual stress. Otherwise the same conditions exist as with the girder bridges. It should be noted that the architecturally desired, transparent structure of the bar structure can only be achieved if a correspondingly large height of truss is selected.



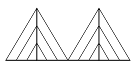
Arch bridges

In arched bridges, the roadway is suspended from an arched structure. The arched hollow box, which is often made of heavy plate, is only supported by abutments at each end. If the arch shape is optimally approximated to a square parabola, only pressure and no bending occurs in the cross section of the arch. Arch bridges allow medium to large spans. The bridge girder suspended for traffic management absorbs the horizontal loads (e.g. from wind).



Suspension bridges

Suspension bridges are the reverse of an arch bridge. Over pylons, load-bearing ropes are run from which the track girder is suspended.

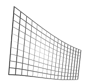


Cable-stayed bridges

In the case of cable-stayed bridges, the track girder is suspended from traction cables that are braced at an angle from a pylon or several pylons. The vertical loads are directed into the pylons and diverted vertically from them via pressure loads. The horizontal effects resulting from the deflection generate compressive forces in the road surface and are neutralized. The use of high pylons results in cable-stayed bridges with enormous spans.

Tension band bridges

Tension band bridges are characterized by a slight bend. The structure consists of tensioning straps that are subjected to tensile stress and transfer high horizontal forces into the abutments. They are only used for low loads and short spans (e.g. pedestrian bridges).



Surface structures

Three-dimensional surface structures optimize the load transfer and the use of materials and thus enable lighter construction methods. Supported by new theoretical and physical knowledge of modern calculation and processing methods, surface structures are being implemented more and more frequently.

Contents

Roadway bridges

Moreland Millennium Bridge in Kwa-Zulu Natal

Moreland Millennium at Kwa-Zulu Natal. Picture courtesy of Columbus Stainless.

Location:	Durban, South Africa
Crosses:	M41 highway in Umhlanga Rocks
Type:	arch bridge for roadway
Opened in:	2001
Materials:	3CR12 (45 tons) and 304 tubes (240 meters), Columbus Stainless
Stainless steel products:	masts (3CR12) and railing (304)
Architects:	GAPP Architects
Photographs:	Courtesy of Columbus
More information:	columbus.co.za

History

The Moreland Millennium Bridge is an iconic bridge which was commissioned in 1999 by the Durban Roads Department to be built over the M41 highway in Umhlanga Rocks. It is located in Durban, South Africa, approximately 1 km from the coastline. The bridge is aptly named to celebrate the 21st Century and the new Millennium.

Why stainless steel?

This iconic application is designed to use the combination of concrete and the dynamic use of stainless steel to capture its asymmetric setting. To ensure its longevity, the architects decided to build the structural components in stainless steel. Grade 304 was specified for the structural tubing and 3CR12 for the vertical masts. All the stainless steel supplied in this application was manufactured at Columbus Stainless. Due to budgetary constraints at the time of construction; the hand rails at street level were specified in galvanized steel. All the metal work was painted white, not only to enhance the desired aesthetics but also for corrosion considerations due to the applications proximity to the shoreline.

Over the years, regular flaking of the paint on the galvanized railings, due to paint damage and under-film creep, has resulted in significant corrosion, necessitating repainting on numerous occasions. The painted stainless steel, including 3CR12 structures, have shown no evidence of corrosion, even where damage to the paint has occurred. This application has highlighted the superior paint adhesion of stainless steel compared to galvanized steel in coastal applications.

Moreland Millennium at Kwa-Zulu Natal. Picture courtesy of Columbus Stainless.

Samuel De Champlain Bridge

Samuel De Champlain Bridge. Picture courtesy of North American Stainless

Location:	Montreal, Canada
Crosses:	St. Lawrence River
Type:	Cable-stayed bridge for roadway
Opened in:	2019 (replacement)
Materials:	Duplex 2304, North American Stainless
Stainless steel products:	rebar
Structural designer:	Poul Ove Jensen of the Firm Dissing & Weitling and Claude Provencher from the Firm Provencher & Roy
Photographs:	Courtesy of North American Stainless
More information:	northamericanstainless.com

Samuel De Champlain Bridge.
Picture courtesy of North American Stainless

History

The old Champlain bridge over the St Lawrence River, commissioned in 1962, conveyed some 57 million vehicles per year, the highest traffic for a bridge in Canada. At peak hours, up to 6200 vehicles crossed the bridge in a single direction. The bridge was not only remarkable by its length, 3.4 km, but also because its features a sufficient clearance over the seaway to allow the passage of sea-going vessels to and from the Great Lakes. The new bridge design is that of a cable-stayed bridge with a main span of 240 m. The bridge carries three separate transportation corridors; each of these supported by its own steel superstructure. Both North and South corridors have three lane highways with inner and outer shoulders. The North corridor also includes a 3.5 m lane for pedestrians and cyclists.

Why stainless steel?

The deck and the concrete of the old bridge were badly damaged by corrosion mainly caused by deicing salts over the years, while the traffic was much higher than what the bridge was designed for. Maintenance was more and more expensive just to keep it in service. The new bridge is built of reinforced concrete. New features include higher traffic capacity, lanes for public transportation vehicles (such a light rail service), larger clearances for ships above the seaway and an elegant design. 2304 duplex stainless steel rebar was used to resist corrosion by de-icing salts in the critical areas.

Samuel De Champlain Bridge.
Picture courtesy of North American Stainless

Hastings Bridge

Hastings Bridge. Picture courtesy of Corrosion Resistance Reinforcing, LCC

Location:	Hastings, Minnesota, USA
Crosses:	Mississippi River
Type:	Tied arch bridge for roadway
Opened in:	2013 (Replacement)
Materials:	Duplex 2304 (289 tons), North American Stainless
Stainless Steel products:	Rebar
Structural designer:	Parsons
Photographs:	Courtesy of Corrosion Resistance Reinforcing, LCC
More information:	northamericanstainless.com

History

The original Hastings bridge was the busiest 2-lane bridge in Minnesota with some 34,000 vehicles crossing daily. The new bridge, which has a tied arch as its main span, started construction in 2010 and the four-lane bridge opened to traffic in 2013.

Why stainless steel?

Due to the harsh winter conditions in Minnesota, with long winters and extensive use of road salt, the Minnesota Transport Department chose stainless steel rebar as the best alternative for rebar for this bridge. Even though the initial cost was higher than other alternatives, it was estimated that the use of stainless would translate over the long term into savings due to less maintenance needed.

Hastings Bridge. Picture courtesy of Corrosion Resistance Reinforcing, LCC

Cameron Heights Overpass

Cameron Heights Overpass. Picture courtesy of Terry Bourque.

Location:	Edmonton, Canada
Crosses:	roadway (Anthony Henday Drive)
Type:	bridge for roadway
Opened in :	2011
Materials:	Forta DX 2304, Outokumpu
Stainless steel products:	rebar
Photographs:	courtesy of Outokumpu
More information:	outokumpu.com

Why stainless steel?

Winters are very cold in Edmonton and the government demands a 100-year lifespan for its new roads. Therefore, the materials used for the bridge needed to resist the corrosive de-icing salts that are used often in winter. Most reinforced concrete structures are strengthened with rebar made from carbon steel. However, this is vulnerable to corrosion when installed in environments where they may be exposed to salts, such as marine environments or road projects in cold climates with de-icing salts frequently used. This corrosion leads to swelling of the rebar, which causes the concrete to crumble – leading to the need to repair or replace the structure prematurely.

To avoid this effect for the Cameron Heights overpass, 356 tons of Forta DX 2304 stainless steel rebar were used. Forta DX 2304 has superior corrosion-resistance that lends the bridge deck a 100 year lifespan, making it virtually maintenancefree.

Cameron Heights Overpass. Picture courtesy of Terry Bourque

History

Due to increasing congestion on the roads (and a prediction that traffic would double over the next 20 years) the Alberta Department of Transportation decided to add overpass bridges and flyovers to Edmonton's ring road, known as Anthony Henday Drive. The bridges and flyovers meant that the traffic lights could be removed to speed up traffic flows without putting drivers' safety at risk.

The bridge was opened to traffic in time for the winter of 2011 and is easing traffic flow. It has also required very little maintenance and is withstanding the harsh winters.

St. Croix Crossing Bridge

Location:	Stillwater, Minnesota, USA
Crosses:	St. Croix River
Type:	cable-stayed with box-girder bridge for roadway
Opened in:	2017 (replacement)
Materials:	Duplex 2304 (about 6,000 tons), North American Stainless
Stainless steel products:	rebar
Photographs:	courtesy of North American Stainless (overall view) courtesy of Corrosion Resistance Reinforcing, LCC (others)
More information:	northamericanstainless.com


St. Croix Crossing Bridge. Picture courtesy of Corrosion Resistance Reinforcing LCC

History

The original Stillwater lift bridge was built in 1931. The lift bridge has become a much-loved symbol of the city of Stillwater, nestled on the west bank of the St. Croix River. The St. Croix River Crossing Project called for the construction of a new four-lane bridge. Construction began in 2014 and the bridge was opened to vehicle traffic on August 2, 2017.


St. Croix Crossing Bridge. Picture courtesy of Corrosion Resistance Reinforcing LCC

Why stainless steel?

The new St. Croix Crossing Bridge is extradosed design, combining cable-stay engineering with box-girder construction (650 precast box girders). Only the second of its type in the U.S. Amount of concrete used: 139,219 cubic yards. Area of bridge where stainless reinforcement bar was used: Deck (approx. 6,000 Tons of Duplex 2304).

Athabasca River Bridge


Athabasca River Bridge. Picture courtesy of HOF - Greg Halinda

Location:	Alberta, Canada
Crosses:	Athabasca River
Type:	girder bridge for roadway
Opened in:	2011
Materials:	Forta LDX 2101, Outokumpu
Stainless steel products:	rebar
Structural Design:	Flatiron
Photographs:	courtesy of Outokumpu and
Photographer:	HOF / Greg Halinda
More information:	outokumpu.com

Athabasca River Bridge. Picture courtesy of Outokumpu.

History

Canada's Highway 63 is an important route for the country's oil and gas and mining industries, much of which are based around the center of Fort McMurray. With the industry growing rapidly, the Alberta government wanted to meet demand from growing levels of traffic and improve driver safety. The Athabasca River Bridge was designed to meet this need – but the project would be far from simple to execute. The Alberta Ministry of Transportation required a long-lasting, weather-resistant bridge that could handle heavy traffic loads, winter snow and ice, and the chloride salt that is used to clear snow and ice.

Completed in 2011, the bridge is making it simple and convenient for Alberta's residential and commercial drivers to cross the Athabasca. In 2012 – the first full year of operation – 503 supersized loads travelled over the bridge.

Why stainless steel?

The department commissioned construction and infrastructure firm Flatiron for the structural design and Outokumpu was enlisted to provide the stainless steel rebar. Outokumpu provided stainless steel rebar for every part of the bridge that could conceivably be exposed to deicing salts.

At 15,500 square meters, Athabasca River Bridge is the largest bridge in Alberta and needs to carry super-sized loads of up to 1,100 tons to support local industry. Getting the economics right was as important as getting the material right, so 340 tons of Forta LDX 2101 rebar was chosen as a cost-effective option. With C4-class corrosion resistance, it's also a highly durable one – designed for a long lifespan and adverse weather conditions.

Stonecutters Bridge


Stonecutters Bridge. Picture courtesy of iStock.

Location:	Hong Kong
Crosses:	Rambler Channel
Type:	Cable stayed Bridge for roadway
Opened in:	2009
Materials:	Forta DX 2205 plate and pipe, Outokumpu
Stainless steel products:	Top of the pylons and back span anchor pipes
Architects:	Ove Arup and partners
Photographs:	Courtesy of iStock
More information:	outokumpu.com

History

Stonecutters Bridge, Hong Kong, is a cable stayed structure with a total length of 1596 m and a main span of 1018 m. Opened at the end of 2009, the bridge crosses the Rambler Channel and is the main entrance to the busy Kwai Chung Container Port. It is visible from many parts of Hong Kong Island and Kowloon. The most striking features of the bridge are the twin tapered mono towers at each end supporting the 50 m wide deck.

Stonecutters Bridge. Picture courtesy of iStock.

Why stainless steel?

These tapered towers rise to 295 m above sea level; the lower sections are reinforced concrete while the upper 115 m are composite sections with an outer stainless steel skin and a reinforced concrete core.

Stonecutters Bridge. Picture courtesy of iStock.

Hong Kong – Zhuhai – Macau Bridge (HZMB)


Hong Kong - Zhuhai - Macau Bridge. Picture from Shutterstock.

Location:	Hong Kong, China
Crosses:	Lingdingyang of Pearl River Estuary
Type:	cable-sayed bridge for roadway
Opened in:	2018
Materials:	EN 1.4362 rebar, ROLDAN
Stainless steel products:	rebar
Structural designer:	Arup
Photographs:	courtesy of Cedinox magazine
More information:	cedinox.es

Hong Kong - Zhuhai - Macau Bridge.
Picture courtesy of Cedinox Magazine

Why stainless steel?

Stainless steel reinforced bars have proved to be the right, intelligent and cost-effective solution when used in an aggressive atmosphere or where access to areas potentially needing repair is difficult or even impossible. To build this mega-structure, stainless steel rebar made in Spain by ROLDAN has been used to achieve the highest quality standards.

Hong Kong - Zhuhai - Macau Bridge. Picture courtesy of Cedinox Magazine

History

A landmark bridge linking Hong Kong - Zhuhai – Macau is playing a strategic role and strengthening the economic development of this area. The construction began in 2009 and it has opened in 2018. When this magnificent bridge has been opened to traffic it only takes 40 minutes by car to go from Zhuhai to Hong Kong instead of 3 and a half hours.

The bridge is 55 km long, and the project also includes the construction of two artificial islands and a dual 3-lane tunnel that is the longest in the world of its kind.

Nou Road Bridge

Nou Road Bridge. Picture courtesy of JSSA.

Location:	Nou, Itoigawa, Niigata Prefecture, Japan
Crosses:	Nou river
Type:	girder bridge for roadway
Opened in:	2012 (renovation)
Materials:	SUS 410, NIPPON STEEL Stainless Steel Corporation
Stainless steel products:	rebar
Architects:	shin Kouzou Gijutu
Fabricator:	Mitsui-Sumitomo Construction
Photographs:	courtesy of JSSA
More information:	jssa.gr.jp

History

The concrete road bridge of a coastal road in the West of Japan had developed severe corrosion in its forcement. Besides the chloride-bearing marine atmosphere, the use of de-icing salts in winter was another cause of the damage.

Nou Road Bridge. Picture courtesy of JSSA.

Why stainless steel?

For the refurbishment of the bridge, the selective use of ferritic stainless steel was a rational and cost-saving choice. Out of the four spans of the bridge structure, the exposed outer two needed to be replaced. The new concrete spans were cast on site and reinforced with type SUS410 stainless steel, which ideally fulfilled both the corrosion resistance and cost reduction requirements. While the use of stainless steel reinforcement in new roads and bridges is not uncommon, this case shows that the stainless steel option is also technically and economically viable in repair and renovation.

Bridge Cover

Bridge Cover. Picture courtesy of NIPPON STEEL Engineering Co., LTD.

Location:	Tokyo, Japan
Crosses:	railway
Materials:	SUS430J1L plate, NIPPON STEEL Stainless Steel Corporation
Stainless steel products:	cover plate
Photographs:	Courtesy of NIPPON STEEL Engineering Co., LTD.

History

In Japan, the importance of inspection and maintenance of bridges is now recognized more. In order not only to prevent serious accidents, but also to effectively use bridges, which are an important social infrastructure, it is necessary to extend the life of bridges through periodic inspections and planned repairs. This cover plate is a product to meet the need for preventive maintenance and long life of bridges. It is a permanent cover protected from deterioration factors such as wind, rain, solar radiation, and salinity, and it serves also as a permanent scaffolding that allows for safe and reliable visual inspection and repair work at any time.

Why stainless steel?

This is a high-performance exterior material for bridges that uses coated stainless steel with excellent durability for the exterior. By using stainless steel, durability of 100 years is expected. By using ferritic SUS430J1L, 3 major outcomes were achieved; (1) sufficient corrosion resistance, (2) a linear expansion coefficient close to carbon steel, and (3) cost stability. In addition to being able to expect longer-term durability by applying fluorine resin coating, it is also possible to deal with situations where harmony with the surrounding landscape is required as the coating can be different colors.

Bridge Cover. Picture courtesy of NIPPON STEEL Engineering Co., LTD.

Sheikh Jaber Al-Ahmad Al-Sabah causeway

Sheikh Jaber Al-Ahmad Al-Sabah causeway. Picture courtesy of Hyundai.

Location:	Kuwait
Crosses:	Kuwait Bay
Type:	cable-stayed bridge for roadway
Opened in:	2019
Materials:	Forta DX 2304, Outokumpu
Stainless steel products:	rebar
Contractors:	Hyundai Engineering and Combined Group Contracting
Photographs:	Courtesy of Outokumpu and Hyundai
More information:	outokumpu.com

History

One of the largest and most prestigious transport infrastructure endeavors in Kuwait and the region, the Sheikh Jaber Al-Ahmad Al-Sabah causeway stretches like a shimmering ribbon across Kuwait Bay – and in the process, dramatically improves access to the country's northern regions. Reducing drive time between Kuwait City and the Subiyah area from 70 minutes to less than 20 minutes, the causeway provides new strategic highway routes to facilitate planned development north of Kuwait City. Integrating the northern regions of the country with the densely populated central and southern regions, the causeway is also expected to reduce traffic congestion and improve safety. The causeway was officially inaugurated in May 2019.

Sheikh Jaber Al-Ahmad Al-Sabah causeway. Picture courtesy of Outokumpu.

Why stainless steel?

The 36-kilometer causeway was constructed on piles bored into the seabed. The signature cable-stayed bridge with an exquisite arch pylon faces unique challenges in a marine environment adjacent to heavily populated areas.

Salt water and carbon dioxide emissions pose significant threats. Forta duplex stainless steel rebar injects the project with high strength, exceptional corrosion resistance and reduced lifecycle costs.

Reinforced concrete combines low cost, versatility and high strength. However, over time the process of carbonation means that concrete loses the high alkalinity that protects carbon steel from corrosion. Stainless steel does not rely on concrete for its corrosion protection and is a straightforward solution when concrete is subject to the ingress of chlorides from marine environments.

Queensferry Crossing


Queensferry Crossing. Picture courtesy of Cedinox Magazine.

Location:	Scotland, United Kingdom
Crosses:	River Forth (Firth of Forth)
Type:	Cable-stayed bridge for roadway
Opened in:	2017 (replacement)
Materials:	EN 1.4401 (316) wire rod, Roldan
Stainless steel products:	Cable assemblies
Construction:	Forth Crossing Bridge Constructors (FCBC)
Photographs:	Courtesy of Cedinox magazine
More information:	acerinox.com

History

The Queensferry Crossing opened to traffic on 30 August 2017. It is the longest three-tower, cable-stayed bridge in the world and the highest bridge in the UK.

The Forth Replacement Crossing (FRC) is a major infrastructure project for Scotland, designed to safeguard a vital connection in the country's transport network, linking Edinburgh and Fife. The FRC project enables the existing Forth Road Bridge to be maintained as a dedicated public transport corridor as part of a Managed Crossing strategy. It carries public transport, pedestrians and cyclists and in the future, it could also be adapted to carry a Light Rapid Transit system.

Why stainless steel?

Stainless steel wire rod has been used in this project due to its excellent corrosion resistance even in chloride environments, high strength and ductility.

Queensferry Crossing. Picture courtesy of Cedinox Magazine.

Cala Galdana Bridge

Cala Galdana Bridge. Picture courtesy of PEDELTA and Outokumpu.

Location:	Menorca, Spain
Crosses:	Algendar River
Type:	Arch bridge for roadway
Opened in:	2005
Materials:	Forta DX 2205 plate, Outokumpu
Stainless steel products:	The load bearing arches and support beams for the concrete deck
Structural designer:	PEDELTA
Photographs:	Courtesy of PEDELTA and Outokumpu
More information:	outokumpu.com

History

For 30 years, a reinforced concrete arch bridge spanned the Algendar River on Menorca, Spain. But the harsh marine environment took its toll over time, causing severe structural damage. So in 2003, the Consell Insular de Menorca, decided that Cala Galdana needed a new road and pedestrian bridge to fit the setting, which is a UNESCO biosphere reserve. The new Cala Galdana Bridge became the first stainless steel road bridge in Europe when it opened in June 2005. Tourists can all enjoy the panoramic views of Cala Galdana's beaches available from the its 55 m-long, 13 m-wide walkway.

Cala Galdana Bridge. Picture courtesy of PEDELTA and Outokumpu.

Why stainless steel?

It would be designed for longevity and ease of maintenance. And, given the natural beauty of the area, it needed to be environmentally friendly. The engineers selected Forta DX 2205 duplex stainless steel, which offers high tensile strength and unbeatable durability in coastal environments due to its resistance to corrosion. In addition, stainless steel is 100% recyclable, so it is environmentally friendly. And the high ductility of Forta DX 2205 steel means it can easily be used for attractive modern designs such as that of the Cala Galdana Bridge.

Cala Galdana Bridge. Picture courtesy of PEDELTA and Outokumpu.

New Malizia Bridge

New Malizia Bridge. Picture courtesy of Centro Inox.

Location:	Siena, Italy
Crosses:	railway
Type:	Arch bridge for roadway
Opened in:	2005 (replacement)
Materials:	Uranus 35N plates, Industeel Italia Srl
Stainless steel products:	Arch
Architects:	Arch. Paola D'Orsi, Comune di Siena
Photographs:	From Inossidabile - Courtesy of Centro Inox
More information:	centroinox.it

History

The project for the reconstruction of the Malizia bridge arose both from the need to improve the flow of traffic and that of inserting an element into the landscape which was architecturally qualifying for the town of Siena. A functional and technologically innovative solution for a bridge which will cross over the vast railway seat below was found in the construction of a large arch, positioned between the two previously built carriageways.

Why stainless steel?

Uranus 35N duplex stainless steel was chosen for the construction of the arch, made up of 5 segments of welded tube, with an external diameter of 820 mm, obtained from plates with a thickness of 35 mm and width of 2,480 mm, supplied simply pickled. The segment tubes of the arch, each 10,700 mm long, were brake formed and joined longitudinally by submerged arc welding. A second brake forming process gave the elements their correct curvature. Lastly, the connections for the hangers were then inserted and welded. The external surface was shot-blasted using grit and protected by means of adhesive plastic.

New Malizia Bridge.
Picture courtesy of Centro Inox.

New Malizia Bridge.
Picture courtesy of Centro Inox.

New bridge on the river Brenta


New bridge on the river Brenta. Picture courtesy of Centro Inox.

Location:	Corte di Piove di Sacco, Italy
Crosses:	River Brenta
Type:	Arch Bridge for roadway
Opened in:	2006
Materials:	URANUS 35 N Duplex 2304 (EN 1.4362), Industeel Gruppo ArcelorMittal
Stainless steel products:	Arches
Architects:	Prof. Ing. Enzo Siviero
Photographs:	From Inossidabile - Courtesy of Centro Inox
More information:	centroinox.it

History

A formal and functional simplicity characterizes the new bridge on the river Brenta built in Corte di Piove di Sacco, near the city of Padua.

New bridge on the river Brenta.
Picture courtesy of Centro Inox.

New bridge on the river Brenta.
Picture courtesy of Centro Inox.

Why stainless steel?

The bridge is characterized by a pair of 16.5 m-high twin arches of made of 2304 (EN 1.4362) duplex stainless steel with a 1,300 mm diameter round section and thicknesses ranging from 12 to 26 mm, weighing in total 110 tons, which rest on two elliptically shaped piers and are linked up by cross-section stainless steel connections. The transversal section is formed by two driving lanes for vehicles, each 4.75 m wide, and by two 2.00 m-wide sidewalks, which provide easy transit to pedestrians and cyclists. The framework has a total length of about 120 m and consists of a system of longitudinal beams made of S355 steel with a HE-type profile, connected by a 30 cm-thick concrete slab. The bridge is externally lined with an EN 1.4304 (AISI 304) stainless steel carter, while it is supported in the central part by four hanging steel rods. These hanging rods support, in turn, two cross girders, which come out of the framework shell. The use of stainless steel in the construction of public works, such as for example bridges, cuts down the time spent in the building yard, and ensures resistance to corrosion, long life and performance, reduced maintenance operations, and considerable money saving. Today, in the case of metal bridges, the use of duplex stainless steels represents an innovative planning solution as these steels, in addition to high resistance to corrosion, have also considerable mechanical resistance, fatigue resistance, and weldability properties.

Nynäshamn Road Bridge

Nynäshamn Road Bridge. Picture courtesy of Outokumpu.

Location:	Nynäshamn, Sweden
Crosses:	river
Type:	Beam Bridge for roadway
Opened in:	2011
Materials:	Forta LDX 2101 plate, Outokumpu
Stainless steel products:	The supporting beams
Photographs:	Courtesy of Outokumpu
More information:	outokumpu.com

History

Located 60 miles from Stockholm in Sweden's Södermanland province, the Nynäshamn locality is a scenic harbour town with under 14,000 inhabitants and ferry links to Poland, Latvia and the Baltic island of Gotland. Small, but with a long history – with Iron Age grave fields and rune stones littering the countryside – it's an area with substantial local, tourist, and industrial vehicle traffic. It also requires quality road bridges that protect the public purse and offer low Total Cost of Ownership (TCO). The Nynäshamn bridge was completed in 2011. Today, it sees a great deal of daily vehicular traffic, it has an expected design life of around 80 years.

Nynäshamn Road Bridge. Picture courtesy of Outokumpu.

Why stainless steel?

Bearings are often a vulnerable part of many structures. They carry loads while allowing movements resulting from thermal expansion or from carrying loads. However, bearings require regular maintenance. Therefore, to achieve a maintenance-free bridge the Nynäshamn bridge was designed without bearings. Instead, it features a stiff frame with the abutments integrated into the load bearing structure. Forta LDX 2101-grade stainless steel I-beams – allowing the 42 m long bridge to form a stiff frame with no bearings at all required at the supports.

Allt Chonoglais Bridge

Allt Chonoglais Bridge. Picture courtesy of Outokumpu.

Location:	Scotland, UK
Crosses:	River Kinglass
Type:	bridge for roadway
Opened in:	2013 (replacement)
Materials:	Forta DX 2304, Outokumpu
Stainless steel products:	rebar
Structural designer:	Scotland Transerv, Glasgow
Photographs:	courtesy of Outokumpu
More information:	outokumpu.com

History

The Allt Chonoglais was the fourth bridge in the Scottish Government's £24 million upgrade program for bridges along the A82 road. Surveys found that the original 1932 bridge was too weak to meet future traffic needs, partly due to irreversible chloride-induced corrosion from decades of exposure to de-icing salts. Rather than replacing or refurbishing the bridge in sections, the government decided to replace the load-bearing parts of the bridge with a strong and low-maintenance steel structure, while retaining the granite stonework from the original bridge.

The Allt Chonoglais was completed ahead of schedule in September 2013. At 40 metres long, the bridge caters to the demands of modern-day traffic while featuring elements of the original bridge, including locally sourced granite and the original bridge supports. In addition, no changes were made that would impact the habitat of the riverbank below. Stainless steel will continue to provide a safer, robust and modernised bridge for at least 120 years.

Why stainless steel?

The main priority for the bridge was to have greater resistance to chloride corrosion. This meant anticipating which areas of the bridge would be exposed to de-icing salts during the winter months and specifying high-performance materials to ensure a long life. Critical concrete sections of the bridge were reinforced with the lean duplex alloy, Forta DX 2304 rebar, which combines competitive cost and chloride resistance, ensure long-term integrity of the reinforced concrete structure.

Junction Värtan


Junction Värtan. Picture courtesy of Outokumpu.

Location:	Stockholm, Sweden
Crosses:	roadway
Type:	junction in a roadway
Opened in:	2015
Materials:	Forta LDX 2101, Outokumpu
Stainless steel use:	rebar
Contractors:	Skanska
Photographs:	courtesy of Outokumpu
More information:	outokumpu.com

History

The Swedish capital Stockholm looks to a future with less traffic in the city: traffic will soon be re-routed away from the centre to a new ring road around Stockholm, complete with an urban motorway named Norra Länken – Northern Connection. Completed in phases by 2017, Norra Länken constitutes Sweden's largest road construction project to date.
The new motorway, which largely runs in tunnels, connects Sweden's main Baltic port at the Värta harbour (Värtahamnen) with the national Swedish and European road networks. Traffic flows will be joined in the major Junction Värtan at the harbour. Construction of this junction, realized with overpasses, takes four years and consumes ten thousand truckloads of concrete alone.

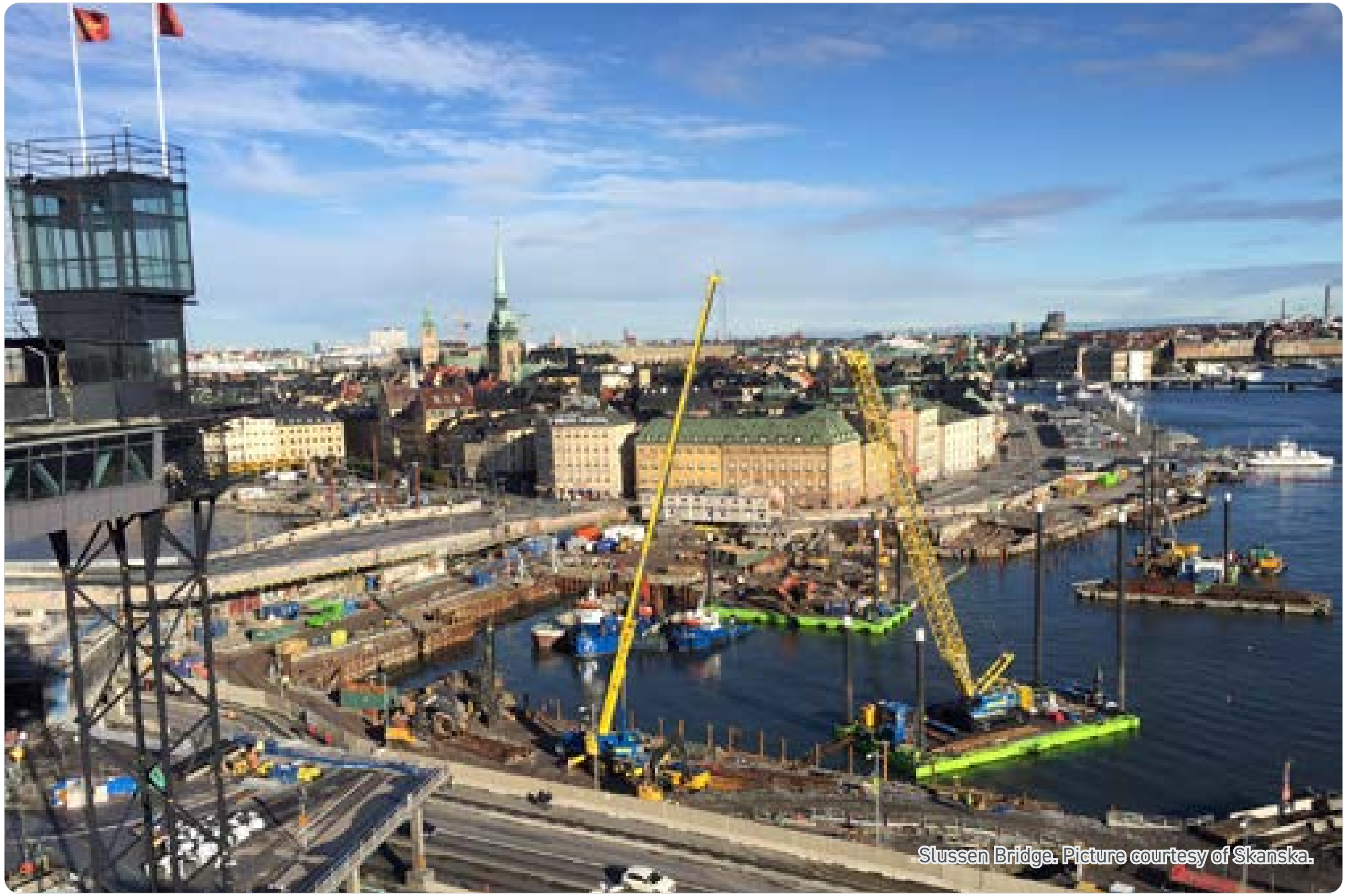
Junction Värtan. Picture courtesy of Outokumpu.

Junction Värtan. Picture courtesy of Outokumpu.

Why stainless steel?

Junction Värtan should serve largely maintenance free for a very long time. To achieve this goal, the Stockholm Road Authority specified stainless steel reinforcement for the concrete structures from the very beginning of the design process, aware of the many benefits of stainless that would enable the long life span.
Roads in northern climates are particularly corrosive environments due to chlorides from de-icing salts. Stainless steel reinforcement bars, rebars for short, are an insurance against corrosion, which could result in structural failure. As such, stainless steel rebars help to avoid expensive repairs and resulting disruption to traffic.
The stainless grade austenitic EN 1.4404 (ASTM 316) was a standard grade used in corrosive conditions but lean duplex stainless steel LDX 2101® was introduced as a replacement for 1.4404. "Duplex LDX 2101® equals 1.4404 in terms of corrosion resistance. But as a low-alloyed stainless steel, LDX 2101® is far more cost efficient. It's very low nickel content results in good price stability, so it brings the benefit of much welcome predictability for long-term projects against fluctuations in the nickel price."

Slussen Bridge


Slussen Bridge. Picture courtesy of Skanska.

Location:	Stockholm, Sweden
Crosses:	Lake Mälaren
Type:	traffic junction
Opened in:	under construction
Materials:	1.4162 and 1.4362, Outokumpu
Stainless steel products:	rebar
Costruction:	Skanska Construction
Photographs:	Courtesy of Outokumpu and Skanska
More information:	outokumpu.com

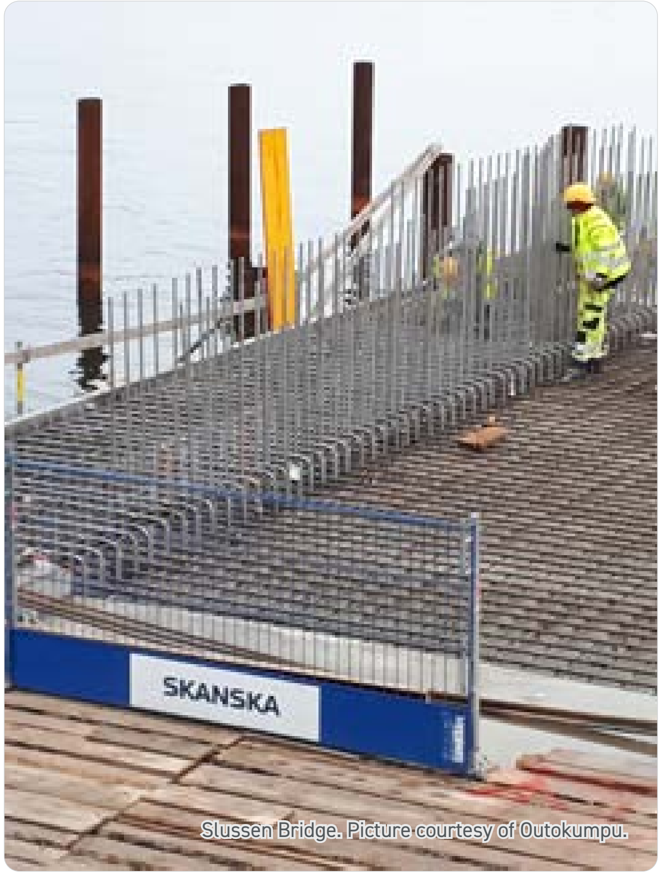
History

An archipelago of islands, the city of Stockholm is surrounded by water. Connecting two of those islands – Södermalm and the Old Town – is Slussen, an area that was created in the 17th century as a lock. Originally built as a means for easing navigation between the Baltic Sea and Lake Mälaren, Slussen is currently undergoing an upgrade by the city of Stockholm.

Rebuilt at least four times over the centuries, the area is home to Sweden's second largest transportation hub. What was planned as a traffic junction atop the lock now sees over 486,000 travellers pass over it every day. Problems with the foundations as well as rusting reinforcements and crumbling cement made it clear that the Slussen lock and the area surrounding it needed reconstruction to better serve the community.

After it is completed, the new lock will safeguard Stockholm's drinking water supply from Lake Mälaren for the future. The Slussen area will become a central meeting point for residents, housing glass-facaded buildings that appear inviting to passersby and a plaza that can serve as a public meeting area. A new bus terminal and rethought means of transportation – both on land and via boat – will give more space to all means of traffic, including bicycles and pedestrians.


Slussen Bridge. Picture courtesy of Outokumpu.



Slussen Bridge. Picture courtesy of Outokumpu.

Why stainless steel?

For use in the quays and embankment upgrades, Skanska Construction has thus far ordered stainless steel rebar in the EN 1.4162 and EN 1.4362 grades. The rebar is a reliable stainless steel support recommended for use in coastal barrier construction and bridges to offer unprecedented long-lasting support in areas where corrosion due to chloride is a risk. With reduced maintenance necessary, this stainless steel rebar will prove to be of longer-lasting support, giving it price advantages over the long term.

Flottsund Bridge


Flottsund Bridge. Picture courtesy of Outokumpu.

Location:	Flottsund, Uppsala, Sweden
Crosses:	river
Type:	opening bridge for roadway
Opened in:	2017
Materials:	Forta DX 2205 plate, Outokumpu
Stainless steel products:	structure for the opening bridge part
Architects:	ÅF
Structural designer:	Betong och stålteknik
Photographs:	courtesy of Outokumpu
More information:	outokumpu.com

Flottsund Bridge. Picture courtesy of Outokumpu.

History

Situated in Sunnersta, Southern Uppsala, the Flottsund bridge is a key connection for the city and the county. Linking Dag Hammarskjöld's Road with Country Road 255, it's been a vital route for car, bicycle, and pedestrian traffic entering and leaving the Fyrisån harbor basin – and one with a history of bridges that dates back to the 17th century.
In fact, owing to the area's strong spring rivers, several of these bridges have been destroyed. The previous bridge had been built in 1924 and had served the area well for many decades. But with its condition deteriorating – its wooden frames were in a particularly poor state – and traffic requirements only increasing, it was clear to Uppsala County that it was time for a change.
The new Flottsund Bridge blends seamlessly into the Uppsala landscape – without overwhelming it. It can be raised and lowered ensuring that road and river traffic can flow freely. The Flottsund bridge is a serious aesthetic, structural, and engineering accomplishment.

Why stainless steel?

The design was an opening bridge with solid connecting parts – intended to be wider than the original, with two lanes for vehicle traffic and separate walking and cycle lanes on each side. To minimize the environmental impact of the bridge, the designers decided to forgo hydraulics to eliminate the risk oil leakage. Instead, they adopted a 'panama wheel' which uses powerful electric motors to drive a geared wheel that raises the bridge deck.
The unique requirements of this design called for a composite construction: one which would bring concrete and stainless steel together to emphasize form, function, and a smooth opening mechanism.
The material for this the moving bridge deck: 130 tons of Forta DX 2205-grade duplex stainless steel was supplied. The benefit of duplex is its high strength, meaning smaller and lighter bridge deck. In turn, this requires less energy to operate and less powerful motors, saving the cost of the motors as well as utility bills.

Second Gateway Bridge


Second Gateway Bridge. Picture courtesy of Leighton Abigroup Joint Venture ABN.

Location:	Brisbane, Australia
Crosses:	Brisbane River
Type:	girder bridge for roadway
Opened in:	2010
Materials:	duplex stainless steel LDX 2101, Outokumpu
Stainless steel products:	rebar
Photographs:	Courtesy of Leighton Abigroup Joint Venture ABN
More information:	assda.asn.au

Second Gateway Bridge.
Picture courtesy of Leighton Abigroup Joint Venture ABN.

History

The Gateway Bridge in Queensland, Australia, is really one of those architectural marvels. The unique structure of the bridge crossing the Brisbane River was the first of its kind when built in 1986, with a record-breaking main span of over 260 meters stretching between two main piers. Reaching a height the equivalent of a 20-story building, the four-lane bridge had to be tall enough to allow boats to pass beneath yet low enough to accommodate the flight patterns of the nearby airport. After designers came up with the four-lane solution that connects the eastern suburbs of Brisbane to the city, growth in the suburbs had created an increase in traffic on the bridge. In 2005, an expansion and duplication was announced. The already-standing four-lane motorway was increased to six lanes; just a few meters away, a second bridge duplicating the look of the first began to take shape.

Second Gateway Bridge.
Picture courtesy of Leighton Abigroup Joint Venture ABN.

Why stainless steel?

Creating a 1,627 meter bridge with fully submerged foundations proved quite the architectural challenge. What made it even more challenging, was the government's request that the bridge maintain a 300-year service life – something that had never been tested before. That's where stainless steel rebar came into play. To limit the possibility of corrosion and therefore reduce the need for renovations, the bridge includes stainless steel on the two piers that are submerged. Just 130 of the 7,800 tonnes of steel used in the Second Gateway Bridge were stainless steel, which kept costs low. The design-life target is a testament to the size and importance of the bridge; it also showed the recognition that although initial costs may be higher, in the long-term, the savings on repairs and extended time the bridge is in use pay off those costs. When construction finished in 2010, the results were experienced by everyone who used the bridge, with some commuters noting they spent between 10 to 25 minutes less time in traffic. With the stainless steel reinforced piers, those smoother commutes will continue for centuries to come.

Story Bridge

Story Bridge. Picture courtesy of Atlas Steels.

Location:	Brisbane, Australia
Type:	cantilever bridge for roadway
Opened in:	2015
Materials:	316/316L, , Atlas Steels, Anzor Fasteners, Ronstan Tensile Architecture
Stainless steel products:	mesh, I-beam, angle bar, polished tube, coupling cable
Structural designer:	Freyssinet
Photographs:	courtesy of Atlas Steels
More information:	assda.asn.au

History

The 76-year old heritage-listed cantilever bridge now incorporates three-metre tall, stainless steel safety barriers on its pedestrian walkways. The $8.4 million project was completed in December 2015.
The design brief was to develop an anti-climb structure that was both functional and aesthetically appealing, whilst ensuring the heritage values of the bridge were maintained. This presented a number of engineering challenges, including the affixation of the barrier structure to the existing heritage-listed bridge without permanent methods of attachment, such as welding or other damaging techniques, whilst addressing the weight and wind load tolerances, ambient vibrations and noise potential. Visually, there was also a key design requirement to ensure pedestrian views of the river, Brisbane city and surrounds, and of the Story Bridge itself, was preserved.

Story Bridge. Picture courtesy of Atlas Steels.

Why stainless steel?

The concept solution delivered was a dynamic structural design that met the exacting demands of the specification. The design evolved to using laser-fused stainless steel open section beams for the posts, positioned approximately three metres apart with a blackened Carl Stahl X-TEND® stainless steel mesh barrier. The blackened Carl Stahl X-TEND® mesh was the key to achieving an unobtrusive composition and historical aesthetic, while providing the flexibility and tensile strength required for the structure's design and use of the laser-fused posts. The structure is a pivotal safety addition to the Story Bridge and exudes functionality in its excellent and unique engineered design. Stainless steel is unmatched in the materials selection for providing durability, structural performance, low maintenance, corrosion resistance and aesthetics.

Go-Between Bridge


Go-Between Bridge. Picture courtesy of ASSDA.

Location:	Brisbane, Australia
Crosses:	Brisbane River
Type:	cantilever, box girder bridge for roadway
Opened in:	2010
Materials:	316L/1.4462 Reval® 316L, Valbruna Australia
Stainless steel products:	rebar
Photographs:	courtesy of ASSDA
More information:	assda.asn.au

History

Formerly known as the Hale Street Link, the Go-Between Bridge connects Merivale and Montague Streets in West End to Coronation Drive and the Inner City Bypass in Milton. Constructed as part of the Brisbane City Council's TransApex plan, the Go-Between Bridge was designed to improve cross-river accessibility, reduce inner city traffic congestion, increase accessibility to Brisbane's recreational and cultural precincts and cater for future residential developments in West End and South Brisbane. The cantilever, box girder bridge stretches 274 metres over the Brisbane River and was built using stainless steel reinforcement with concrete foundations. Featuring a dedicated pedestrian and cyclist pathway, the Go-Between Bridge is 27 metres wide, with the main span measuring 117 metres. Named after iconic Brisbane rock band The Go-Betweens, the Go-Between Bridge was completed and officially opened to traffic in July 2010 with 14,000 vehicles crossing Brisbane's Go-Between Bridge every day.

Why stainless steel?

80 tonnes of grade 316L/1.4462 Reval® stainless steel in 12 mm, 16 mm, and 24 mm reinforcement bar, which was used for the two major pile caps and north abutment of the bridge, were supplied. Stainless steel was specified for the critical elements of the bridge to minimise life cycle costs, improve structural integrity and corrosion resistance. Particularly being located in a marine environment, Reval® stainless in reinforced concrete is ideal to resist chlorides and pitting corrosion. It has an expected service life of 100 years in concrete. By specifying stainless, the designers were able to reduce the area in which stainless rebar was used in the structure because of its tensile strength being higher than carbon steel. In addition, using stainless steel reinforcement in concrete structures is stronger than carbon steel and will prevent material fatigue ensuring longevity for public infrastructure.

Saint George bridge

Location:	Genova, Italy
Crosses:	Polcevera river, Turin-Genoa railway and Milan-Genoa railway
Type:	viaduct
Opened in:	2020
Materials:	concrete, carbon and stainless steel rebar
Stainless steel products:	250 tons of EN 1.4307 (AISI 304L) rebar
Photographs and text:	courtesy of Centro Inox
More information:	centroinox.it

History

The Morandi Bridge was a road viaduct in Genoa (Italy), constructed between 1963 and 1967 along Italy's A10 motorway over the Polcevera River, from which it derived its official name. The bridge was widely called "Ponte Morandi" after its structural designer, noted engineer Riccardo Morandi.
The bridge was an engineering and architectural landmark since its construction. It connected Genoa's Sampierdarena and Cornigliano districts across the Polcevera Valley. It also provided a critical artery of European Route E80, linking Italy and France.
When a 210-metre (690 ft) section of the viaduct collapsed during a rainstorm on 14 August 2018, 43 people died — leading to a year-long state of emergency in the Liguria region, extensive analysis of the structural failure, and widely varying assignment of responsibility.
The remains of the original bridge were demolished in August 2019. The replacement bridge, the Viadotto Genova-San Giorgio ("Genoa-Saint George Viaduct") was inaugurated on 3 August 2020.

San Giorgio Bridge, Genova, Italy.
Picture courtesy of Centro Inox.

San Giorgio Bridge, Genova, Italy.
Picture courtesy of Centro Inox.

Why stainless steel?

Stainless steel rebar plays a key role in ensuring not only structural strength but also resistance to corrosive phenomena, for maximum structural safety. Stainless steel has been provided in the areas considered the most delicate from the corrosion resistance point of view.
In detail, REVAL® (trademark of Acciaierie Valbruna) EN 1.4307 (AISI 304L) stainless steel was supplied. Since stainless steel, thanks to its intrinsic properties, allows considerable savings on maintenance costs for structures that, as in this case, are exposed to aggressive environments, this choice results to be the most economical solution in the long term. Other relevant characteristics of stainless steel rebar are their high mechanical strength, high ductility, excellent energy absorption capacity during seismic events, as well as low magnetic permeability and better fire resistance, compared to carbon steels.

I-74 Mississippi River Bridge


I-74 Mississippi River Bridge. Used with permission © Iowa Department of Transportation.

Location:	Quad Cities region, Iowa and Illinois, United States
Crosses:	Mississippi River
Opened in:	2021
Materials:	concrete, carbon steel and stainless steel
Stainless steel products:	2507 super duplex anchor bolts, stainless steel reinforcing bar in the deck and barriers
Photographs and text:	Used with permission ©Iowa Department of Transportation
More information:	i74riverbridge.com

History

The I-74 Mississippi River Bridge historically has provided an important east-west link in the nation's transportation network. The I-74 bridge crosses the Mississippi River on two separate structures. The westbound bridge, Illinois to Iowa, was completed and opened in 1935. The eastbound bridge, Iowa to Illinois, was completed in 1959 and opened in 1960.

Planning a bridge for the future

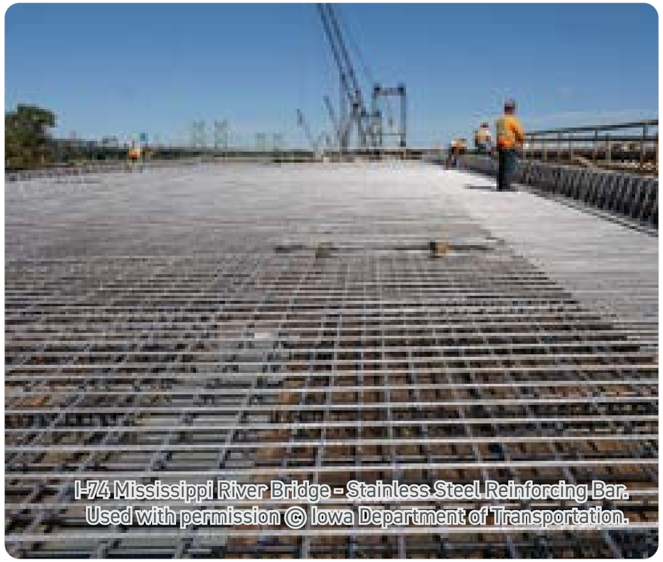
In 2016, the Iowa and Illinois departments of transportation joined forces with other agencies and local officials to conduct the I-74 Iowa-Illinois Corridor Study. This study evaluated transportation issues and recommended solutions to improve traffic flow and complement community goals and plans, with respect to the environment. A solution for the I-74 corridor was achieved by working collectively and communicating with concerned parties.

Building a bridge for the future

The I-74 Mississippi River Bridge project is part of a regional strategy for improving access across the Mississippi River in the Quad Cities. It includes the replacement of the I-74 twin bridges over the Mississippi River, interchange ramp reconfigurations, and interstate and local roadway improvements. Construction began in July 2017 and the new bridge fully opened to traffic in December 2021. The new bridge provides four lanes in each direction and two full size shoulders on the Iowa-bound bridge and Illinois-bound bridge. A multi-use path on the bridge connects to paths in Bettendorf and Moline. Between Middle Road in Bettendorf and Avenue of the Cities in Moline, I-74 has been expanded to three lanes in each direction with additional lanes at select locations.

Text courtesy of i74riverbridge.com

I-74 Mississippi River Bridge - Arch Anchorage and Bolts.
Used with permission © Iowa Department of Transportation.



I-74 Mississippi River Bridge - Stainless Steel Reinforcing Bar.
Used with permission © Iowa Department of Transportation.

Why stainless steel?

The concrete deck employs stainless steel exclusively, including in the barriers, to provide a long service life and minimize the need for extensive maintenance and disruptive deck replacement.

The arch segments are anchored to the foundations using specialized, high-strength stainless steel prestressed anchor rods developed as part of a research project to identify a corrosion-resistant material for this type of application, and the design team chose a duplex stainless steel (grade 2507) with a minimum tensile strength of 116 ksi. The bridges have a total of 384 anchor bolts. After installation, the bars are grouted in their ducts to provide an additional corrosion barrier and bond them to the surrounding concrete.

Gordie Howe International Bridge

Gordie Howe International Bridge. Picture courtesy of Windsor-Detroit Bridge Authority.

Location:	Windsor, Canada and Detroit, United States
Crosses:	Detroit River
Opens in:	December 2024
Materials:	concrete, carbon steel and stainless steel
Stainless steel products:	UNS S32304 and UNS S32205
Photographs and text:	courtesy of Windsor-Detroit Bridge Authority
More information:	gordiehoweinternationalbridge.com

History

The Gordie Howe International Bridge project is a once-in-a-generation undertaking. Not only will the project deliver much-needed transportation improvements for international travellers, it will also provide jobs and opportunities for growth to the Windsor-Detroit region and includes features that make this project truly distinctive.

The bridge itself is one of four components, so the overall project includes ports of entry in Canada and the U.S. as well as some work on I-75. It has a cable-stayed design and will be the longest main span of any cable-stayed bridge in North America. The total length will be approximately 2.5 km or 1.5 miles with a clear span of 853 metres. There will be no piers in the water. The bridge will have 6 lanes, three Canadian-bound and three US-bound with a dedicated multi-use path that will accommodate pedestrians and cyclists.

Text and pictures courtesy of Windsor-Detroit Bridge Authority.

Gordie Howe International Bridge.
Picture courtesy of Windsor-Detroit Bridge Authority.

Gordie Howe International Bridge.
Picture courtesy of Windsor-Detroit Bridge Authority.

Why stainless steel?

The bridge is a unique project with a challenging design using stainless steel in areas of corrosion.

Corbels support the bridge deck at the tower legs and provide a place to house the vertical, & transversal bearings, which act to transfer weight from the bridge deck to the tower. The corbels also accommodate a lock up device which restrains longitudinal movements of the bridge deck. Made of reinforced concrete that was cast in-place, each corbel is built with 55 tonnes/121,254 pounds of stainless-steel rebar, 46 millimeters post-tensioning bars and 75 cubic meters/98 cubic yards of concrete.

The Gordie Howe International Bridge project has stainless steel reinforced precast panels on the bridge deck. The tower legs and the piers also have stainless steel reinforcement within the de-icing exposure zones. They are areas exposed to de-icing chemicals used in winter conditions to prevent snow and ice build-up.

Golden Gate Bridge - suicide deterrent net

Suicide deterrent net at the Golden Gate Bridge. Picture sources from decorcable.com

Location:	San Francisco, United States
Crosses:	the one-mile-wide (1.6 km) strait connecting San Francisco Bay and the Pacific Ocean
Installation suicide nets:	January 2024
Materials:	stainless steel
Stainless steel products:	X-TEND mesh | 4.0mm x 120mm
Cable:	I-SYS | 26mm
More information:	en.wikipedia.org

History

The Golden Gate Bridge is the most used suicide site in the world. The deck is about 245 feet (75 m) above the water. After a fall of four seconds, jumpers hit the water at around 75 mph (120 km/h; 30 m/s). Most die from impact trauma. About 5% survive the initial impact but generally drown or die of hypothermia in the cold water.

After years of debate and an estimated more than 1,500 deaths, suicide barriers, consisting of a stainless steel net extending 20 feet from the bridge and supported by structural steel 20 feet under the walkway, began to be installed in April 2017. Construction was first estimated to take approximately four years at a cost of over $200 million. Installation of the nets was completed in January 2024. The metal nets are visible from the pedestrian walkways and are expected to be painful to land on.

Source: en.wikipedia.org

Suicide deterrent net at the Golden Gate Bridge.
Picture sources from decorcable.com

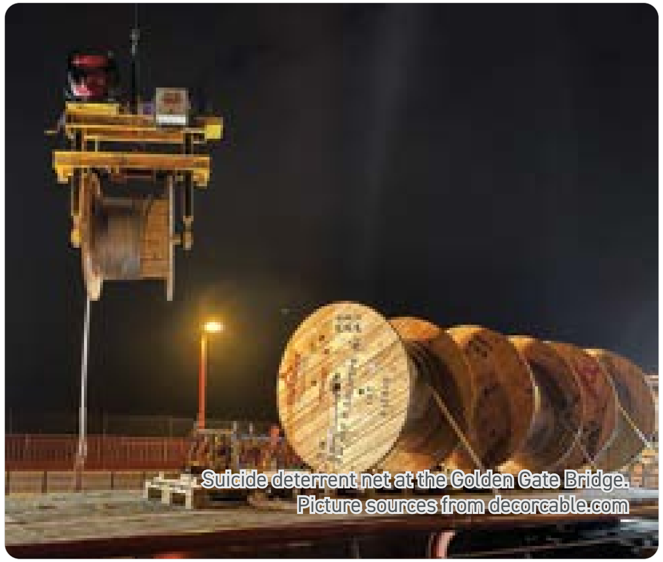
Why stainless steel?

X-TEND® Stainless Steel Cable Mesh was chosen as suicide deterrent netting for the Golden Gate Bridge. The X-TEND® mesh was installed around the perimeter and is extended 20 feet out along both sides of the 1.7 mile long bridge.

X-TEND® was chosen for its superior strength and its ability to be inconspicuous against the background of this historic site. Approximately 384,802 square feet of mesh was required for the suicide deterrent net system.

Source: decorcable.com

Suicide deterrent net at the Golden Gate Bridge.
Picture sources from decorcable.com



Suicide deterrent net at the Golden Gate Bridge.
Picture sources from decorcable.com

Railway bridges

Söderström Bridge

Söderström Bridge. Picture courtesy of Stål & Rörmontage.

Location:	Stockholm, Sweden
Crosses:	river
Type:	bridge for railway
Materials:	Forta LDX 2404 plate, Outokumpu
Stainless steel products:	the whole supporting structure
Fabricator:	Stål & Rörmontage
Photographs:	Courtesy of Stål & Rörmontage
More information:	outokumpu.com

History

The Söderström Bridge complex comprises four 174-metre long railway bridges. First opened in 1957, it connects Stockholm's Old Town to its Södermalm district and on to southern Sweden – so it is crucial for the city's subway traffic, facilitating over 330,000 passenger trips each day, equivalent to one train every three minutes. The bridges required maintenance in 2017.

The renovated Söderström Bridge complex is not only safer, but also able to support even higher traffic volumes. And since the bridge's bearing capacity is vital for freight as well as passenger trains entering and leaving Stockholm, this enhanced ability to handle high volumes of traffic will provide a big advantage for the city and its residents for decades to come.

Why stainless steel?

The original Söderström Bridge was built using carbon steel. This is strong and durable – both desirable qualities in a bridge – but it is also vulnerable to corrosion. Forta LDX 2404 duplex stainless steel beams were recommended for the material that would reduce future maintenance requirements. This steel offers good resistance to localised and uniform corrosion, as well as high strength and resistance to cracking.


Söderström Bridge. Picture courtesy of Stål & Rörmontage.


Söderström Bridge. Picture courtesy of Stål & Rörmontage.

Añorga Railway Bridge


Añorga Railway Bridge. Picture courtesy of Outokumpu and Photographer Havas Worldwide Helsinki

Location:	San Sebastián, Spain
Crosses:	roadway
Type:	railway bridge
Opened in:	2011
Materials:	Forta DX 2205 plate, Outokumpu
Stainless steel use:	full stainless bridge
Photographs:	courtesy of Outokumpu and Photographer Havas Worldwide Helsinki
More information:	outokumpu.com

Añorga Railway Bridge. Picture courtesy of Outokumpu and Photographer Havas Worldwide Helsinki

History

The Añorga railway bridge in San Sebastiàn is an essential part of a line that carries local and commuter trains along the railway line that follows the coast of northern Spain. A previous carbon steel bridge structure had been damaged beyond repair due to heavy corrosion. The local authority placed an order for a replacement in stainless steel to last 130 years without major maintenance.

Why stainless steel?

The bridge is exposed to rain and the previous bridge had required intensive maintenance over its lifespan, so it was crucial that the materials used for the new bridge would be corrosion resistant. Outokumpu supplied Forta LDX 2205 grade duplex stainless steel as it is light, durable and corrosion resistant, which reduces maintenance and renovation needs. The structure is the first railway bridge fully designed in stainless steel and it is performing well, with no sign of corrosion since it was completed in 2011.

Añorga Railway Bridge. Picture courtesy of Outokumpu and Photographer Havas Worldwide Helsinki

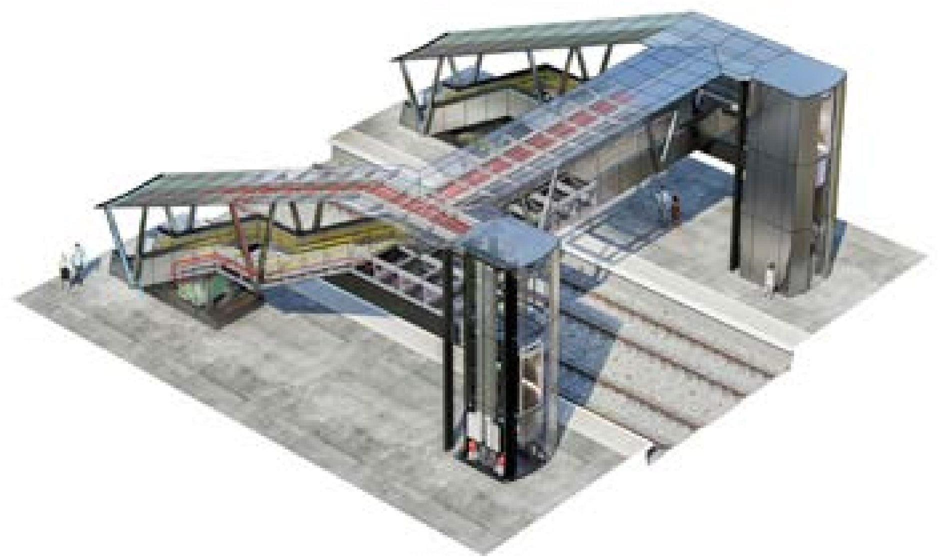
AVA Modular Railway Footbridge

AVA Modular Footbridge. Picture courtesy of the AVA Consortium.

Location: United Kingdom
Crosses: railway
Type: modular footbridge
Materials: stainless steel
Stainless steel use: frame with faceted cladding
Built by the AVA Consortium:

- Walkers Construction (Contractor)
- Expedition Engineering (Engineers and Lead Designer)
- Hawkins Brown Architects (Architects)
- X-Treme System (Manufacturer)
- SCX (Lift Supplier)

Photographs: courtesy of the AVA Consortium
More information: hawkinsbrown.com



AVA Modular Footbridge. Picture courtesy of the AVA Consortium.

Over the last few years, Anthony Dewar, Technical Head of buildings and Architecture and his team at Network Rail have been making inroads into the way rail footbridges are designed and procured. The AVA footbridge is a radical modular design being developed by a consortium of companies.

History

The bald statistics for railway footbridges make sobering reading. It can take a year on site to build one. Only a third it costs to build each bridge goes on the materials and the creation of the structure itself - the rest is contractor and client costs. What is more, the fall back footbridge design has not changed for years.

Rather then being built in a steel fabrication yard from standard sections, then shipped elsewhere to be painted before being transported to site as a full span length, the Ava bridge is designed to be assembled in 1.2 m long modules using structural elements cut from flat sheets of stainless steel and bolted together. The truss modules can be configured to suit the destination site, and fitted out with cladding, canopy, lighting and other mechanical and electrical services before being erected as close to finish as possible.

The aim of the project is not just to slash capital cost by a third and construction and construction time by half, but to reduce whole-life carbon, cut maintenance demands and hence costs, and improve reliability. Boosting accessibility is the fundamental goal and with the cost of the average footbridge cut from £3.6M to £2.6M, the number of footbridges being built can be boosted without any budget increase.
Source: New Civil Engineer

Why stainless steel?

Ross Chipperfield from Quantum Infrastructure clarified they have used stainless steel, which is more expensive ... but the reason it's so much cheaper and better for the environment is these bridges don't need to be painted. Traditional 1970s bridges and even bridges in the new catalogue [of bridge designs used by Network Rail] have got to be painted once every 30 years... Every time that's painted, that's roughly £1.2m [a time].
A bead blast process is used to blast it – give it a beautiful aesthetic – but it doesn't need to be treated after that. It's vandalism-proof, rain-proof ... It's been used in the food industry for 40 years because they want machines to not rust ...

Pedestrian bridges

Pedestrian Bridge at Kwa-Zulu Natal


Pedestrian Bridge at Kwa-Zulu Natal. Picture courtesy of Columbus Stainless.

Location:	Durban, South Africa
Crosses:	railway (Warner Beach Station)
Type:	girder bridge for pedestrians
Opened in:	late 1990s (replacement)
Materials:	3CR12, Columbus Stainless
Stainless steel products:	rebar
Photographs:	courtesy of Columbus Stainless
More information:	columbus.co.za

History

In South Africa, the failures attributed mainly to the corrosion of the rebar are prevalent along the coast and are mainly attributed to wind-borne salt carried inland due to strong prevailing winds. A classic example is of a series of pedestrian bridges installed on the KwaZulu Natal south coast, located about 60 km and 120 km south of Durban. The location of the bridges span rivers at their outflow into the sea, therefore the bridges are exposed throughout their existence to regular heavy spray from breaking waves during onshore and alongshore winds. These bridges were constructed in the 1950s using concrete reinforced with uncoated mild steel rebar. Over the course of the years, severe spalling and falling concrete was experienced. During the course of the mid 1990's, after 40 years in service, an extensive and expensive rehabilitation process was embarked on to repairs the structural integrity and safety of these bridges.

Pedestrian Bridge at Kwa-Zulu Natal. Picture courtesy of Columbus Stainless.

Why stainless steel?

Due to extensive catastrophic failure of the existing bridges, 3CR12 reinforcing bar was proposed. A series of bridges were installed along the coast, following the success 5 years of research in accelerated corrosion conditions. Examination of these bridges after 20 years in service reveals that 3CR12 rebar has demonstrated itself to be economically viable in this application, even in this harsh marine environment. 3CR12's self-repairing characteristics of the chrome oxide layer means the corrosion protection integrity is maintained even if mechanically damaged during handling. The advantages received are high strength, less maintenance and lower life cycle cost compared to the conventional carbon steel reinforced structure.

Garrison Crossing (Fort York Pedestrian and Cycle Bridge)

Garrison Crossing. Picture courtesy of PEDELTA.

Location:	Toronto, Canada
Crosses:	Rail corridors
Type:	Arch Bridge for pedestrians
Opened in:	2019
Materials:	UR 2205 Duplex stainless steel plate 300 tons, Industeel
Stainless steel products:	all stainless steel bridge
Architects:	CreateTO
Structural designer:	PEDELTA
Photographs:	Courtesy of PEDELTA
More information:	industeel.arcelormittal.com

History

Designed by Pedelta Canada Inc., a member of the Dufferin Construction Company team, Garrison Crossing features the first stainless steel bridges to be built in Canada. Garrison Crossing features two bridge structures spanning two rail corridors in downtown Toronto. One bridge structure spans from the South Stanley Park extension over the Kitchener rail corridor and lands on the north side of Ordnance Triangle Park. The second bridge structure begins on the south side of Ordnance Triangle Park and spans over the Lakeshore West rail corridor, landing in the Fort York grounds.


Garrison Crossing. Picture courtesy of PEDELTA.

Why stainless steel?

Duplex stainless steel was chosen because of its exceptional mechanical properties: it has a unique and beautiful appearance, it is highly durable, lightweight and corrosion and weather resistant, requires less maintenance and provides reduced life-cycle costs. Aside from the concrete deck and wood handrails, Garrison Crossing is comprised entirely of stainless steel. The north bridge structure is 130 metric tonnes and the south bridge structure is 125 metric tonnes.

Harbor Drive Pedestrian Bridge


Harbor Drive Pedestrian Bridge. Picture courtesy of iStock.

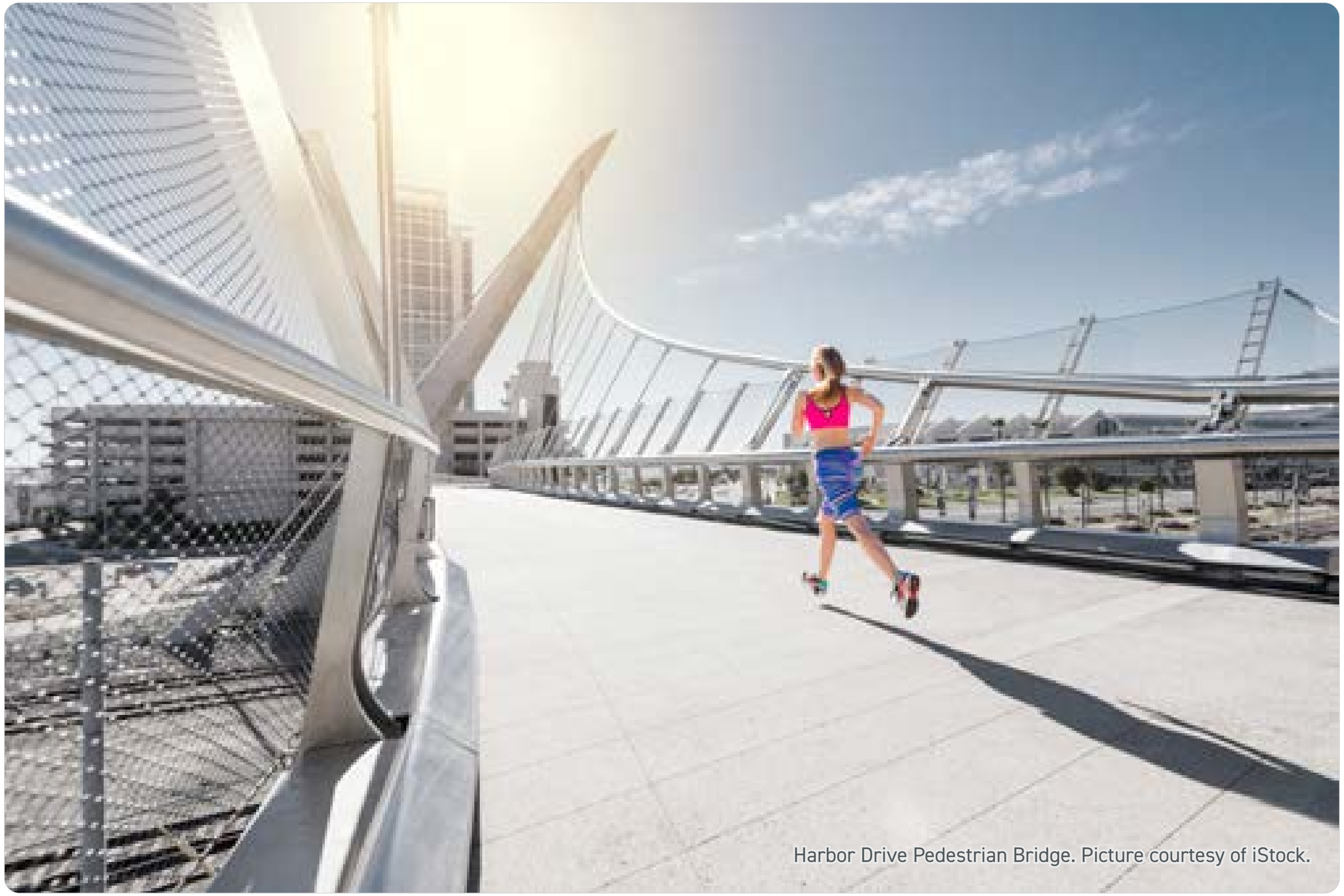
Location:	San Diego, USA
Crosses:	Roadway and railway
Type:	Suspension bridge for pedestrians
Opened in:	2011
Materials:	Forta DX 2205, 317LMN (cable support system), Outokumpu
Architects:	Rabines Architects
Photographs:	Courtesy of iStock/ Michael Svoboda
More information:	outokumpu.com

History

The new landmark footbridge provides pedestrian access between the city's spectacular Balboa Park and the picturesque natural harbour of San Diego Bay, spanning six railroad tracks and several lanes of vehicle traffic.

Why stainless steel?

Designed to serve over 100 years, the bridge is built with a material that enables reliable, maintenance-free service over the design life in the maritime Pacific climate: duplex stainless steel of Forta DX 2205. Other key reasons for the material choice were aesthetics and strength.



Harbor Drive Pedestrian Bridge. Picture courtesy of iStock.

New Farm Riverwalk

New Farm Riverwalk. Picture courtesy of Cedinox Magazine

Location:	Brisbane, Australia
Crosses:	Brisbane river
Type:	Girder bridge for pedestrians
Opened in:	2014 (replacement)
Materials:	AISI 316L plate 158 tons, COLUMBUS STAINLESS Duplex EN 1.4362 rebar, Valbruna
Stainless Steel products:	Rebar, structural and aesthetic parts
Engineering:	Arup
Fabricator:	MIDWAY METALS
Photographs:	Courtesy of Cedinox magazine
More information:	cedinox.es

History

Brisbane's New Farm Riverwalk is one of the city's beloved icons. Originally constructed in 2003, the Riverwalk was used daily by over 3000 cyclists, pedestrians and runners before it was washed away during the 2011 floods. After a construction period of nearly 18 months, Brisbane City Council's re-imagined New Farm Riverwalk opened to the public, connecting New Farm to the Brisbane City via the Howard Smith Wharf Precinct.

Why stainless steel?

Engineered by Arup, the Riverwalk has a design life of 100 years and sits 3.4 m above mean sea level on robust piles. Critical to its design and life expectancy is the extensive use of stainless steel for both structural and aesthetic purposes. Brisbane City Council's two key objectives of the project were to achieve a low maintenance and durable structure while achieving high aesthetic qualities. Stainless steel was deemed suitable to achieve both objectives while also providing the necessary strength required.

New Farm Riverwalk. Picture courtesy of Cedinox Magazine

Christina and John Markey Memorial Pedestrian Bridge

Christina and John Markey Memorial Pedestrian Bridge. Picture courtesy of Rosales + Partners.

Location:	Revere in MASS, USA
Crosses:	roadway
Type:	cable-stayed bridge for pedestrians
Opened in:	2013
Materials:	stainless steel
Stainless steel products:	balustrade and railing cables
Architects:	Rosales + Partners, Boston, Mass.
Photographs:	courtesy of Rosales + Partners

History

The Markey bridge is the first cable-stayed pedestrian-only bridge in the state and gives pedestrians access from a busy plaza to the beach. As they walk across the 46 m long bridge pedestrians are treated to a magnificent view of the Atlantic Ocean. It's a bridge worth crossing. The Christina and John Markey pedestrian bridge at Revere in Massachusetts is a memorial to, and was funded by, John Markey and his wife, parents of Edward Markey, a US Senator.
Since the bridge was opened in 2013, pedestrian traffic to the beach has increased significantly and there are plans to open a hotel there in the near future. The Markey bridge is a stunning and iconic landmark in the area and is a source of pride to the surrounding community.

Christina and John Markey Memorial Pedestrian Bridge.
Picture courtesy of Rosales + Partners.

Christina and John Markey Memorial Pedestrian Bridge. Picture courtesy of Rosales + Partners.

Why stainless steel?

The successful completion of this bridge was a result of close collaboration between all companies involved including Ronstan Tensile Architecture who supplied many of the materials, notably the stainless steel components which make the appearance of the bridge so appealing. All the stainless steel components, including the balustrade and railing cables, and the galvanised stays, are of high quality construction in order to weather the climate and the marine conditions of the area. The stays have a galvanised coating to protect them from any possible pollutants from the nearby industry. The 16 m high towers incline outwards with the stainless steel pedestrian railings also inclining to match, all these stainless steel components are tapered and set at an angle giving different visual experiences depending on the vantage point. To further enhance the aesthetics of this unique bridge, integrated lighting has been incorporated into the stainless steel balustrade making it a beautiful and colourful sight when viewed at night from the beach or the sea.

Helix Bridge

Helix Bridge. Picture courtesy of Outokumpu and Photographer Andrea Goh

Location:	Singapore
Crosses:	Marina Bay
Type:	Bridge for pedestrians
Opened in:	2010
Materials:	Forta DX 2205 (plate and tubular), Outokumpu
Stainless steel products:	all stainless steel bridge
Architects:	Cox Group and Architects 61
Photographs:	Courtesy of Outokumpu and Photographer Andrea Goh
More information:	outokumpu.com

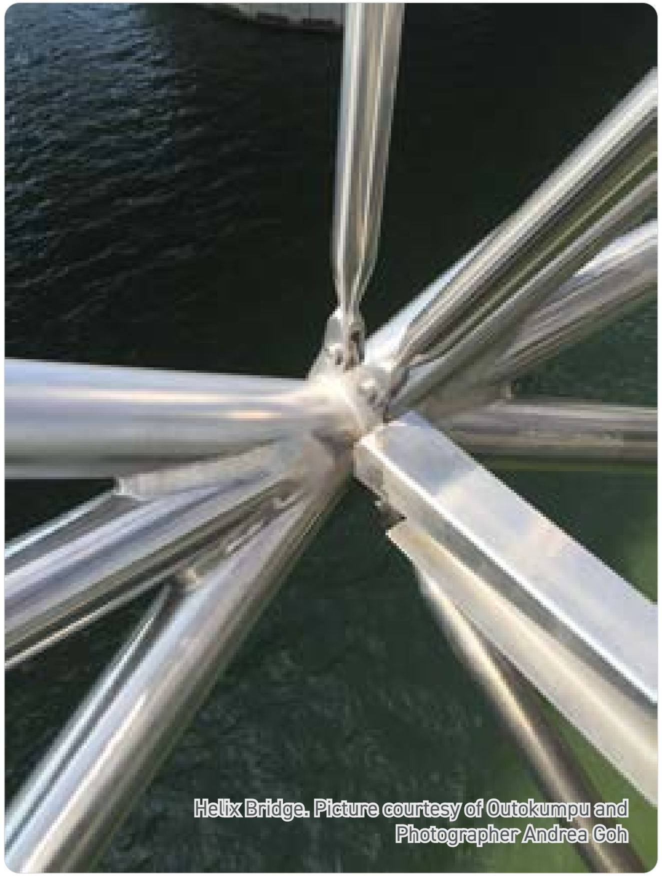
Why stainless steel?

The source of inspiration for the structure was the DNA molecule. It provided a deceptively lightweight solution to a bridge that curves in plan and is tubular in section, this geometry being devised to integrate structure, deck and canopy within its overall 10.8 metre diameter. The economy of material facilitated by the DNA-based structure prompted the Singapore Urban Development Authority to have the bridge fabricated in duplex stainless steel. Duplex stainless steel grade Forta DX 2205 was used to create a structure with improved mechanical properties compared to austenitic steels. It also met the corrosion resistance requirements easily, reducing the possibility of stress corrosion cracking, while also providing high fatigue strength.
For the Helix Bridge, the high strength of duplex stainless steel led to material savings that meant the cost of the material was equivalent to using carbon steel. Moreover, over the 100-year design life of the structure, analysis showed that stainless steel will provide a lower cost option than using carbon steel due to savings in maintenance and regular inspections and repainting. Stainless steels are naturally resistant to corrosion and do not require extensive maintenance.


Helix Bridge. Picture courtesy of Outokumpu and Photographer Andrea Goh

History

The Helix Pedestrian Bridge spans the mouth of the Singapore River where it opens onto Marina Bay. It links the established Raffles Avenue district with the new Bay precinct that contains the Sands Resort and the Gardens By The Bay, and leads around to the CBD Financial District.
The project encompassed both the pedestrian bridge and a new vehicular bridge, the latter running straight across the river mouth. The pedestrian bridge is curved in plan to distance pedestrians from the traffic while also enabling pedestrians to connect from one bridge to the other at mid-span. The bridge is 285 metres long, made up of three 65 metre spans and two 45 metre end spans.


Helix Bridge. Picture courtesy of Outokumpu and Photographer Andrea Goh

Golden Bridge


Golden Bridge. Picture courtesy of TA Corporation.

Location:	Da Nang, Vietnam
Crosses:	Ba Na Hills
Type:	girder bridge for pedestrians
Opened in:	2018
Materials:	stainless steel
Stainless Steel products:	handrails
Architects:	TA Corporation
Photographs:	Courtesy of TA Corporation
More information:	tiongaik.com.sg


Golden Bridge. Picture courtesy of TA Corporation.


Golden Bridge. Picture courtesy of TA Corporation.

History

The Golden Bridge is a 150-meter-long pedestrian bridge in the Bà Nà Hills resort, near Da Nang, Vietnam. It is a walkway between two cable-car stations within the mountain-top resort. The bridge was designed by TA Landscape Architecture based in Ho Chi Minh City. The bridge opened in June 2018.

Why stainless steel?

The curved bridge held up by two giant hands has a timber deck with stainless steel golden coloured handrails.


Golden Bridge. Picture courtesy of TA Corporation.

Sasashima Komeno Bridge


Sasashima Komeno Bridge. Picture courtesy of JSSA.

Location:	Nagoya, Japan
Crosses:	railway
Type:	girder bridge for pedestrians
Opened in:	2011
Materials:	SUS 329J4L and SUS 304, Nippon Yakin Kogyo Co., Ltd.
stainless steel products:	decorative panels
Fabricator:	Rintatsu Co.,Ltd.
Photographs:	Courtesy of JSSA
More information:	jssa.gr.jp

History

During the course of a land re-adjustment project in Nagoya City, a footbridge was built to connect areas of the City which had been divided into smaller sections with limited rail links.

Why stainless steel?

The location of the footbridge (above the railways) makes regular maintenance difficult and the overall length of 156 meters made it necessary to optimise the weight of the structure. With these factors to be considered, SUS329J4L, a duplex stainless steel which has high strength properties and is particularly corrosion-resistant, was adopted for decorative panels inside and outside the girders.

Terrace Bridge

Terrace Bridge. Picture courtesy of NIPPON STEEL Stainless Steel Corporation.

Location:	Tokyo, Japan
Crosses:	Sumida River
Type:	girder bridge for pedestrians
Opened in:	2018
Materials:	SUS 323L plate, NIPPON STEEL Stainless Steel Corporation
Stainless steel products:	structure
Photographs:	Courtesy of NIPPON STEEL Stainless Steel Corporation
More information:	stainless.nipponsteel.com

History

The Tokyo Metropolitan Government maintains the riverbed of the Sumida River as a promenade, "The Sumida River Terrace". Tokyo is trying to create an attractive riverside space, including continuation of the Sumida River Terrace, which is often divided by waterways, with pedestrian bridges. This time, a pedestrian bridge at Kiyosumi was replaced. It opened in March 2018.

Why stainless steel?

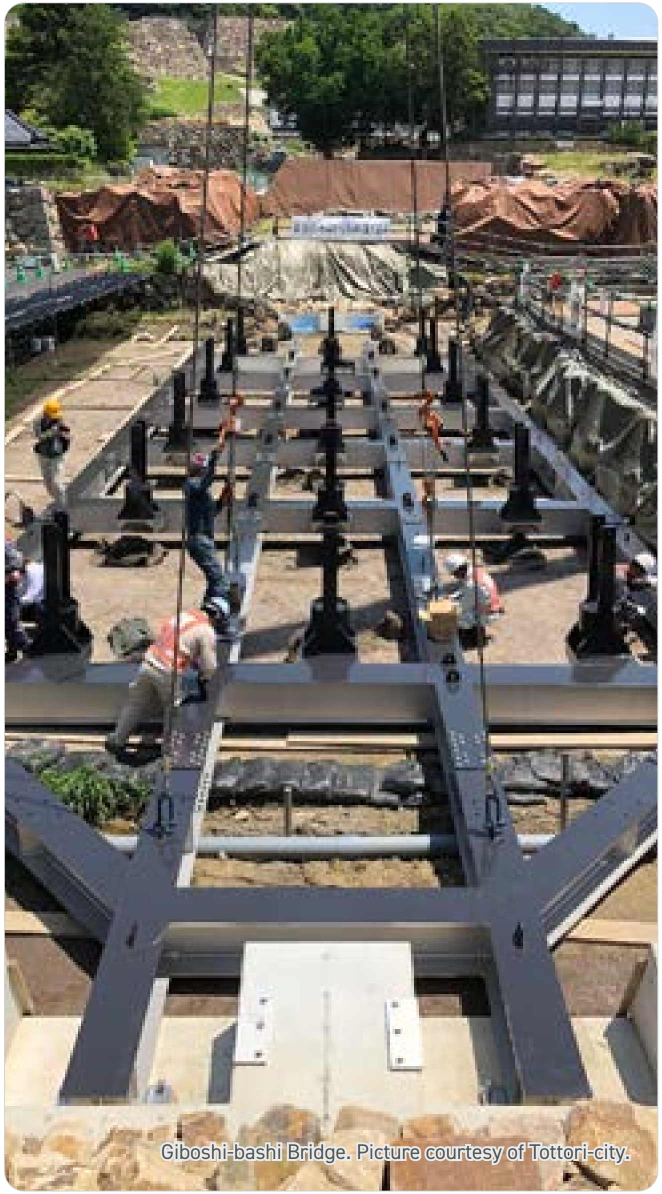
The bridge was originally made of carbon steel. However, there is low clearance under the bridge beam and it is difficult to repaint. This time, a maintenance-free and high-performance duplex stainless steel SUS 323L was adopted for the main part of this bridge. It is the first stainless steel road bridge in Japan. 50 tons of SUS 323L were used.

Terrace Bridge. Picture courtesy of NIPPON STEEL Stainless Steel Corporation.

Giboshi-bashi Bridge

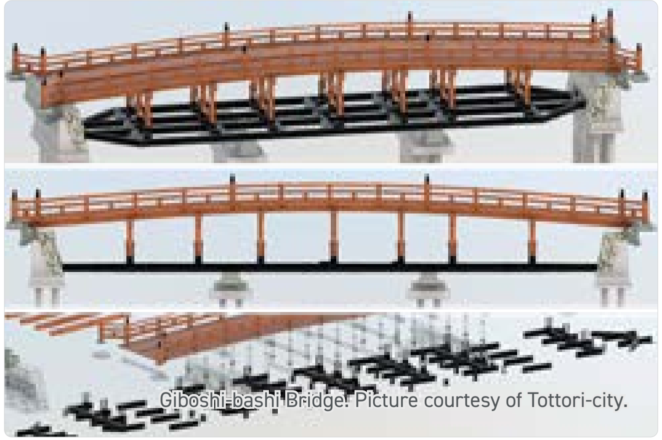
Giboshi-bashi Bridge. Picture courtesy of Tottori-city.

Location:	Tottori-city, Japan
Crosses:	moat
Type:	bridge for pedestrians
Opened in:	2018
Materials:	NSSC2120 (SUS821L1) plate and long, NIPPON STEEL Stainless Steel Corporation
Stainless steel products:	structure
Design & Engineering:	Japan Cultural Heritage Consultancy NIPPON ENGINEERING CONSULTANTS CO., LTD. Kanebako Structural Engineers
Constractor:	TODA Corporation
Fabricator:	Narasaki Seisakusyo Co., Ltd.
Photographs:	Courtesy of Tottori-city, Japan


Giboshi-bashi Bridge. Picture courtesy of Tottori-city.

History

Tottori City is restoring the approach to the main entrance of the Tottori-jo Castle, in the Edo period. Giboshi-bashi Bridge was founded in 1621, and the last work was done in 1868, 151 years ago. Today's reconstruction is a restoration of the wooden Giboshi-bashi Bridge over the outer moat of the Tottori-jo Castle ruins. In order to preserve the remains of the bridge piers at the bottom of the moat and faithfully reproduce the Giboshi-bashi Bridge based on the ancient documents, a new construction method was adopted in which a beam was constructed under the water and the wooden bridge was placed on this.
The Giboshi-bashi Bridge was completed in October 2018, and the restoration work on the entire Tottori-jo Castle Ruins is continuing.


Giboshi-bashi Bridge. Picture courtesy of Tottori-city.

Why stainless steel?

As a material possessing the sufficient durability and strength to make this construction method possible, duplex stainless steel NSSTS 2120 developed by NIPPON STEEL Stainless Steel Corporation has been adopted for the entire steel structure from structural members to nuts and bolts. This is the first case that NSSTS 2120 nut and bolts have been adopted for public works. The bridge is 6 meters wide and 36 meters long. NSSTS 2120 used approximately 50 tons of plates and bars.

Padre Arrupe Footbridge

Padre Arrupe Footbridge. Picture courtesy of Outokumpu and Photographer Havas Worldwide Helsinki

Location:	Bilbao, Spain
Crosses:	Nervión River
Type:	Girder bridge for pedestrians
Opened in:	2003
Materials:	Forta DX 2304 Duplex stainless steel plate 480 tons, Outokumpu
Stainless steel products:	segments
Architects:	Estudio Guadiana
Photographs:	Courtesy of Outokumpu and Photographer Havas Worldwide Helsinki
More information:	outokumpu.com

History

Named after a Jesuit priest from Bilbao, the Padre Arrupe footbridge is a vital point of connection between the Guggenheim Museum and the University of Deusto. Designed by engineer José Antonio Fernández Ordóñez and finished by his son, Lorenzo, it was vital for this walkway to complement the pre-existing architecture nearby. But it also had to be safe, strong and able to withstand environmental corrosion.
Finished with a covering of Lapacho wood to prevent slipping, the Pasarela Padre Arrupe was the first stainless steel footbridge in Spain. It has now become a key part of the local landscape, gaining the nickname 'The Dragonfly' due to its striking appearance.

Padre Arrupe Footbridge. Picture courtesy of Outokumpu and Photographer Havas Worldwide Helsinki

Why stainless steel?

Forta DX 2304 duplex stainless steel is notable for its durability, aesthetics and strength.
This makes it perfect for footbridges, which undergo heavy use from pedestrians and cyclists every day. But it also resists corrosion and cracking, ensuring protection from environmental damage over a long life. And with the special plate surface finish used in this project, Forta DX 2304 delivers enduring beauty alongside exceptional performance and minimal maintenance demands.

Padre Arrupe Footbridge. Picture courtesy of Outokumpu and Photographer Havas Worldwide Helsinki

Celtic Gateway Bridge

Celtic Gateway Bridge. Picture courtesy of Outokumpu

Location:	Wales, United Kingdom
Crosses:	Old Holyhead Harbour
Type:	Arch bridge for pedestrians
Opened in:	2006
Materials:	Forta DX 2304 Duplex stainless steel 220 tons, Supra 316L/4404, Outokumpu
Stainless steel products:	Archs, handrails
Architects:	Gifford and Partners
Photographs:	Courtesy of Outokumpu
More information:	outokumpu.com

History

The Celtic Gateway Bridge in Holyhead, UK, is a pedestrian and cycle link between the town's railway station and harbor. 2.4 million passengers pass through the port of Holyhead in a year into the town. Although the ferry terminal and the railway station are only about 250 metres, access between the two was difficult until the construction of the Celtic Gateway. The Gateway Bridge made easier to access between the port and the town centre.

Celtic Gateway Bridge. Picture courtesy of Outokumpu

Celtic Gateway Bridge. Picture courtesy of Outokumpu

Why stainless steel?

Being a bridge that crosses an ocean harbor, the conventional approach would be to specify stainless steel to Corrosion Resistance Class (CRC) IV under the EN 1993-1-4 standard for steel structures. Forta DX 2205 is normally recommended for CRC IV. However, the harbour is well-sheltered with little risk of splashing from waves or high speed boat traffic and can be classified as being a coastal location that is 800-900 meters from the harbour mouth. Consequently, the bridge can be interpreted as requiring CRC III – a rating that is also consistent with the ability to resist the corrosive effects of de-icing salts over the winter months. Forta LDX 2101 or Forta DX 2304 stainless steels are recommended for CRC III so this bridge is constructed of Forta DX 2304 with a smooth surface finish (Ra=0.4-0.5 µm), with hand rail components being manufactured from Supra 316L/4404.
An inspection of the bridge took place in 2015 and found it in generally good condition after 12 years' service.

TRUMPF Bridge


TRUMPF Bridge. Picture courtesy of Andreas Schnubel.

Location:	Ditzingen, Germany
Crosses:	Gerlinger Strasse (roadway)
Type:	shell bridge for pedestrians
Opened in:	2018
Materials:	Forta DX2205 plate, Outokumpu
Stainless steel products:	all stainless steel bridge
Architects:	Schlaich Bergermann & Partner
Photographs:	courtesy of Andreas Schnubel
More information:	outokumpu.com

History

The new footbridge over Gerlinger Strasse connects two production areas of the headquarters of TRUMPF in Ditzingen and enables employees to cross the busy regional road safely. The bridge is a lightweight shell construction, which due to the high efficiency of the supporting structure is made of only 2 cm thin, double curved stainless steel sheets. The shell edge is reinforced by upstands which twist towards the four base points to form triangular bearing points. Further bracing in the shell surface were completely omitted. Pedestrians walk directly on the steel shell, which is coated on the walking area to prevent slipping. Holes corresponding to the flow of force were cut into the shell with TRUMPF laser machines. The size and density of the apertures depend on the degree of utilisation of the supporting structure. In the area of the walking surface, the apertures are replaced by approximately 14,300 smaller holes filled with glass plugs. The bridge was welded together on site from several individual parts and lifted into its final position by a heavy-duty crane. The lightness of the bridge is underlined by the very transparent and anti-reflective allglass railings. Barkow Leibinger (Berlin) supported Architect Schlaich Bergermann & Partner with architectural consultancy.

TRUMPF Bridge. Picture courtesy of Andreas Schnubel.

Why stainless steel?

Duplex stainless steel was selected for its corrosion-resistant properties, as the roadway below saw a lot of traffic and it needed to stand up to the road salts and icy conditions in winter.

Bascule Pedestrian Bridge

Bascule Pedestrian Bridge. Picture copyrighted by PCCP Architectes

Location:	Lyon, France
Crosses:	At the confluence of the rivers Rhône and Saône
Type:	bridge for pedestrians
Opened in:	2009
Materials:	2205 / EN 1.4462 (Uranus 45), Industeel
Stainless steel products:	structural parts
Architects:	Patricia Colinet, PCCP, Paris
Photographs:	© PCCP Architectes
More information:	industeel.arcelormittal.com

History

At the confluence of the rivers Rhône and Saône in Lyon, a new quarter has grown around a new iconic museum. As part of the upgraded environment, a pedestrian bridge leads over a former dock which is now devoted to leisure activities. The structure was designed as a bascule bridge to allow also larger ships to enter the dock.

Why stainless steel?

The architects suggested a filigree shape, which should be outlined during the night by LED lighting. The aesthetic ambitions made weight saving essential and led to the selection of duplex stainless steel. Its high mechanical strength made it possible to reduce wall thickness by about 30% compared with carbon steel. The material ensures a long and virtually maintenance free service life. Making applied corrosion protection redundant, duplex stainless steel also contributes to the high sustainability profile of the bridge.

Bascule Pedestrian Bridge. Picture copyrighted by PCCP Architectes

Footbridge for skiers

Footbridge for skiers. Picture courtesy of Centro Inox

Location:	Selva Di Val Gardena, Italy
Crosses:	roadway
Type:	girder bridge for pedestrians
Opened in:	2003
Materials:	AISI 304L (EN 1.4307)
Stainless steel products:	stairs and walkway
Architects:	Dr. Ing. Flavio Mussner
Photographs:	From Inossidabile - Courtesy of Centro Inox
More information:	centroinox.it

History

A footbridge permitting skiers (about 8,000 people/day in the winter season) to reach the chairlift without crossing the main road has been installed in Selva di Val Gardena (Bolzano).

Footbridge for skiers. Picture courtesy of Centro Inox

Why stainless steel?

To reduce environmental impact, they chose a light and transparent structure using stainless steel and polycarbonate panels.
To access the skiers' footbridge, they installed a stainless steel, helicoidal **staircase** of 2.20 m wide, covered in polycarbonate, formed by a Neville type spatial, reticular structure.
Above the main road the **footbridge** is in stainless steel, about 2.20 m wide, about 17.50 m long and about 2.60 m high, also covered in a reticulated structure.
The entire walkway is in AISI 304L (EN 1.4307) stainless steel. The tubes were welded in TIG with Scotch Brite surface finishing. The welded joints were also done in TIG, with pure Argon gas protection and EN 19 12 3 Si (AISI ER 316 LSi) weld material.
The weight of the finished walkway and the staircase is approx. 11 tons.

Footbridge for skiers. Picture courtesy of Centro Inox

Pedestrian Bridge in Ortisei

Pedestrian Bridge in Ortisei. Picture courtesy of Centro Inox.

Location:	Val Gardena, Italy
Crosses:	River
Type:	Bridge for pedestrians
Opened in:	2005
Materials:	EN 1.4301 (AISI 304) plate, EN 1.4401 (AISI 316) wire
Stainless Steel products:	Uprights of the parapet, wire rope of railings, handrail
Architects:	Arch. Lukas Burgauner
Photographs:	From Inossidabile - Courtesy of Centro Inox
More information:	centroinox.it

History

In the town of Ortisei, in Val Gardena, a pedestrian bridge, opened in January 2005, connects the zone where the Hotel Cavallino Bianco is located with the cable car station for the Alpe di Siusi. It is a single structure, 65 m high, with steel cables and a 3 metres wide metallic deck.
It is supported by 8 Y shaped elements, of variable dimensions, and with a welded double T profiles.
The loadbearing inferior cables are composed of two 80 mm diameter tension rods, constructed with hot galvanized high-tensile steel wires. The stabilizing lateral cables are also composed of two 80 mm diameter tension rods.

Pedestrian Bridge in Ortisei. Picture courtesy of Centro Inox.

Pedestrian Bridge in Ortisei. Picture courtesy of Centro Inox.

Why stainless steel?

- the uprights of the parapet, 15 mm thick, interaxis 1,750 mm, made of satin finished EN 1.4301 (AISI 304) steel;
- the infill cables of the parapet, formed with spiral cables, 6 mm in diameter, made of EN 1.4401 (AISI 316) steel, interaxis 100 mm, equipped with turnbuckles at both extremities;
- the handrail made of satin finished EN 1.4301 (AISI 304) steel, with an oval section of about 160x80 mm, with the lighting system incorporated;
- the lateral protections wire mesh, with an 80 mm mesh, 2 mm diameter wires, completed with various accessories;
- the inferior lining of the deck made of stretch flattened EN 1.4301 (AISI 304) steel sheet.

Pedestrian Bridge in Ortisei. Picture courtesy of Centro Inox.

Pedestrian Bridge in Scheggino


Pedestrian Bridge in Scheggino. Picture courtesy of Centro Inox.

Location:	Valnerina, Italy
Crosses:	River Nara
Type:	Bridge for pedestrians
Materials:	EN 1.4301 (AISI 304), ThyssenKrupp Acciai Speciali Terni SpA
Stainless Steel products:	Whole structure
Architects:	Arch. Alessandro Balucani
Photographs:	From Inossidabile - Courtesy of Centro Inox
More information:	centroinox.it

History

Situated in the south-east part of Umbria, Scheggino is a small town of the Valnerina, which spreads out in the valley along the banks of the river Nera. A pedestrian bridge connects the old town centre with the new car park situated close to the torrent Valcasana, in order to relieve from car traffic congestion the historic part of the town. The bridge covers a distance of 14.39 m, including the two vertical posts supporting the steel cables, while the bridge scaffolding is 1.60 m wide.

Pedestrian Bridge in Scheggino. Picture courtesy of Centro Inox.

Why stainless steel?

All elements most subject to wear and tear have been made of EN 1.4301 (AISI 304) stainless steel. Therefore, the higher costs for this structure born at the beginning will allow considerably reducing maintenance costs. The whole structure has been made of stainless steel, as this material ensures high structural performances and resists to corrosion. The visual impact of this bridge is minimal, since it does neither show any relevant section in terms of visible mass, nor require anti-corrosion protective coatings and invasive treatments to be periodically repeated. This is an essential characteristic for a pedestrian bridge situated in a natural environment that has to be preserved.

Bridge across the E4 in Södertälje

Bridge across the E4 in Södertälje. Picture courtesy of Stål & Rörmontage.

Location:	Södertälje, Sweden
Crosses:	Road
Type:	Girder Bridge for pedestrians
Opened in:	2018
Materials:	Forta LDX 2101 plate, Outokumpu
Stainless Steel products:	The whole bridge
Fabricator:	Stål & Rörmontage
Photographs:	Courtesy of Stål & Rörmontage
More information:	outokumpu.com

History

A diverse, multicultural city located 30 km outside of Stockholm, Södertälje is an important economic center for Sweden as a whole. But with a growing population comes increasing vehicle and foot traffic. When it identified that the existing wooden pedestrian and cycle bridge had come to the end of its life after only 20 years, the Municipality of Södertälje identified an urgent need for a longlasting stainless steel replacement.

The Södertälje Bridge was completed in 2018 after being pre-fabricated and delivered to site in sections for speedy installation to minimize the duration of road closures. It's now helping pedestrians and cyclists cross this busy road with maximum ease, safety, and accessibility – and Stål & Rörmontage has estimated that the duplex stainless steel bridge will cost a fraction of a wood or carbon steel alternative over its design life.

Why stainless steel?

The municipality of Södertälje commissioned fabricator Stål & Rörmontage to design it. The firm developed a design based on its own patented approach, which created an attractive bridge with a low lifetime cost. But the design created clear requirements for stainless steel.

Using high-strength duplex stainless steel Forta LDX 2101 duplex stainless allowed the designers to reduce the size and weight of the structure, which saves on costs of materials as well as transport and installation. In addition, the corrosion-resistant material is designed for a lifespan of around 100 years – while minimizing future maintenance costs, as no painting or hazardous coatings are needed.

Bridge across the E4 in Södertälje. Picture courtesy of Stål & Rörmontage.

Sölvesborg Footbridge


Sölvesborg Bridge. Picture courtesy of Outokumpu.

Location:	Sölvesborg, Sweden
Crosses:	Sölvesborg Bay
Type:	arch bridge for pedestrians
Opened in:	2013
Materials:	Forta LDX 2101 plate, Outokumpu
Stainless steel products:	the whole supporting structure
Architects:	Ronny Södergren, Sölvesborg
Fabricator:	Stål & Rörmontage
Photographs:	Courtesy of Outokumpu
More information:	outokumpu.com

History

The city of Sölvesborg in Sweden had been seeking to build a bridge to the Listerlandet peninsula since 1947. But it was only in 2012 that they were ready to begin building a design created by architect Ronny Södergren with support from construction company Stål & Rörmontage. The bridge enables residents in nearby Listerlandet to cycle or walk to the city centre in just a few minutes. As Europe's longest pedestrian bridge, it was also a design that would put Sölvesborg on the architectural map. And one that required a lot of steel.

The design features three 60-metre steel bridge arches as well as a long wooden deck with steel supports and railings, taking the total bridge length to 756 metres. The arches support the main platform so needed to be strong and durable. In addition, the bridge site is next to a bird sanctuary so the materials also had to be environmentally friendly. It provides a connection between urban and rural landscapes, with benches placed on the bridge so those crossing can stop, sit and enjoy the view over the bay and city. This effect is enhanced at night by a lighting system that changes colour with the seasons, allowing the bridge to blend in with its surroundings. This remarkable structure has now become a landmark. In March 2016, the Swedish national postal service PostNord even released a postage stamp featuring the Sölvesborg bridge.

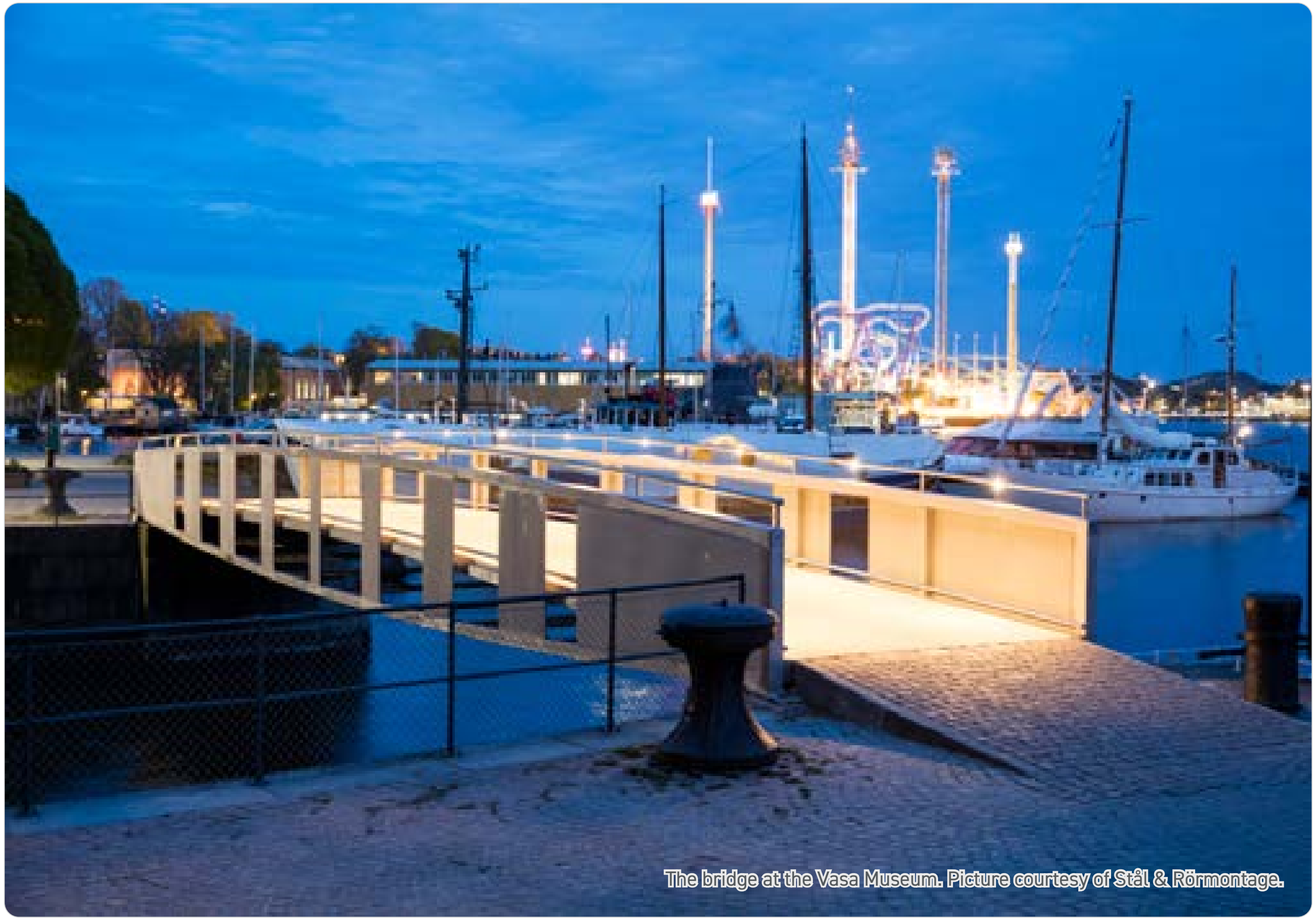
Why stainless steel?

Unlike carbon steel, Duplex stainless steel LDX210 doesn't require surface treatment or painting and only needs minimal maintenance. As well as protecting the environment, this reduces the overall life-cycle costs of a structure. Stainless steel is also fully recyclable, which will further increase the bridge's sustainability when it eventually reaches the end of its life. With the supporting structure made using 150 tons of LDX210, the bridge finally opened in 2013.

Sölvesborg Bridge. Picture courtesy of Outokumpu.

Sölvesborg Bridge. Picture courtesy of Outokumpu.

The bridge at the Vasa Museum


The bridge at the Vasa Museum. Picture courtesy of Stål & Rörmontage.

Location:	Stockholm, Sweden
Crosses:	river
Type:	bridge for pedestrians
Opened in:	2017
Materials:	duplex stainless steel
Fabricator:	Stål & Rörmontage
Photographs:	Courtesy of Stål & Rörmontage
More information:	outokumpu.com

History

On behalf of the Royal Djurgård Administration, Stål & Rörmontage constructed, manufactured and installed a 20 meter long and 3.5 meter wide walkway and bicycle bridge which opened a new, requested walkway along the Djurgårds quay outside the Vasa museum in Stockholm. The bridge opened in February, 2017.

Why stainless steel?

The bridge weighs about 7 tons and is built in stainless steel duplex steel. With LCC in focus, this is a particularly suitable material for bridges that otherwise suffer from expensive maintenance work.

The bridge at the Vasa Museum. Picture courtesy of Stål & Rörmontage.

Likholefossen Bridge


Likholefossen Bridge. Picture courtesy of Outokumpu.

Location:	Gaularfjellet Mountains, Norway
Crosses:	Gaulravssdraget River
Type:	bridge for pedestrians
Opened in:	2004
Materials:	Forta LDX 2101 plate, Outokumpu
Stainless steel products:	full stainless bridge
Photographs:	Courtesy of Outokumpu
More information:	outokumpu.com

History

The Likholefossen bridge was built by Norway's public roads administration across the scenic Gaulravssdraget river to complete a hiking track called the Waterfall Path from Nystølen to Eldal. The light, stainless steel bridge gives hikers the feeling of standing in the waterfall.
Fifteen years later, the bridge is still functional, attractive and has required little maintenance. In fact, it is often cited as a feature of the landscape and a highlight of the hike.

Why stainless steel?

The bridge is completely inaccessible by road, which meant that the bridge had to be pre-assembled and flown in by helicopter ready for installation. In addition, the bridge needed to be durable – being constantly exposed to water from the river and waterfall, corrosion resistance was paramount. With that in mind, Forta LDX 2101-grade stainless steel was supplied as it is light, durable and corrosion resistant. The Likholefossen bridge was the first to be built with Forta LDX 2101 stainless steel.

Likholefossen Bridge. Picture courtesy of Outokumpu.

Siena Footbridge


Siena Footbridge. Picture courtesy of Outokumpu.

Location:	Siena, Italy
Crosses:	roadway
Type:	bridge for pedestrians
Opened in:	2006
Materials:	Forta LDX 2101 plate, Outokumpu
Stainless steel products:	all structural parts supporting the concrete deck
Architects:	Seteco Ingegneria s. r. l
Photographs:	Courtesy of Outokumpu
More information:	outokumpu.com

History

Siena is one of the world's most-visited cities. A UNESCO World Heritage Site with a rich history, lively entertainment, and beautiful vistas, it's a place with a distinctive heritage – and an uncharacteristically large number of pedestrians.

When it planned to double the size of a busy highway separating the city center from the suburb of Ruffolo, the City of Siena commissioned a new pedestrian crossing from Seteco Ingegneria s.r.l. for the architectural and structural design.

Today, the Siena footbridge provides better access for locals and tourists alike in the city. It's a relatively new addition to a city with rich and ancient traditions, but it's one that's been largely embraced by the community. A visually arresting and convenient structure, the Siena Footbridge is as striking as it is useful – and will provide a long life with low maintenance.

Why stainless steel?

The proposed bridge had substantial stainless steel requirements. The structure provided a 2 m wide footway over the motorway in a single 60 m long span, with a reinforced concrete deck slab supported on two 500 mm beams running the length of the bridge. Forta LDX 2101 duplex stainless steel was supplied for these beams as well as for two 12 meter high pylons that support them from either end of the bridge. Forta LDX 2101, designed to last 120 years – and supports all structural parts beneath the concrete deck of the 60 m bridge, offers good corrosion resistance for the benign inland environment. In addition, it offers the right combination of high strength, ductility, formability and weldability, with its high strength enabling Seteco Ingegneria to create a lightweight structure.

Siena Footbridge. Picture courtesy of Outokumpu.

Siena Footbridge. Picture courtesy of Outokumpu.

Zumaia Footbridge


Zumaia Footbridge. Picture courtesy of Outokumpu.

Location:	Zumaia, Spain
Crosses:	river
Type:	truss bridge for pedestrians
Opened in:	2008
Materials:	duplex stainless steel EN 1.4462, Outokumpu
Stainless steel products:	truss
Architects:	PEDELTA
Photographs:	Picture courtesy of PEDELTA
More information:	outokumpu.com

History

The bridge, located in front of the sports arena, has improved the pedestrian flow between the two banks of the river. The municipality wanted to avoid the use of automobile traffic in the area, improving the mobility of bicycles and pedestrians in the urban district. In this bridge's location, a town with a rich cultural memory and natural surroundings, a sensationalist, exhibitionist or superfluous structure would not fit. The idea is to design a bridge that enhances the natural value of the river and understands its environment, instead of creating a useless or pointless landmark.

Zumaia Footbridge. Picture courtesy of Outokumpu.

Why stainless steel?

Pedelta's proposal is a pure and sober structure, but with an innovating and challenging spirit. The bridge crosses a 28 m long channel and has a 5 m wide deck. The structural outline is clear and conceptually very simple: two Vierendeel trusses which function as a guardrail and where the lateral lighting and handrail is integrated. Pure simplicity. It is the first bridge structurally combining two high performance and corrosion-resistant materials: stainless steel and glass fiber reinforced polymers (GFRP).
Pedelta received the Civil engineering mention award (2nd Prize) in Construmat Exhibition for the Zumaia hybrid (Stainless steel and GFRP) footbridge (2009).

Zumaia Footbridge. Picture courtesy of Outokumpu.

Sant Fruitos Pedestrian Bridge


Sant Fruitos Pedestrian Bridge. Picture courtesy of PEDELTA.

Location:	Sant Fruitós, Spain
Crosses:	Roadway N-141C
Type:	arch bridge for pedestrians
Opened in:	2009
Materials:	duplex stainless steel EN 1.4162, Outokumpu
Stainless steel products:	all load bearing structural elements
Architects:	PEDELTA
Photographs:	Picture courtesy of PEDELTA
More information:	outokumpu.com

Sant Fruitos Pedestrian Bridge. Picture courtesy of PEDELTA.

Sant Fruitos Pedestrian Bridge. Picture courtesy of PEDELTA.

Sant Fruitos Pedestrian Bridge. Picture courtesy of PEDELTA.

History

The district of Rosaleda, a new residential area in the town of Sant Fruitos that holds more than 6% of its population, was isolated from the commercial area of Casanova and the rest of the urban core by the state road N-141C. The crossing of this four lane road, which connects the town of Manresa with the town of Vic, has caused many accidents over the last few years. For this reason, the Municipality decided to completely eliminate this risk by building a signature pedestrian bridge.

Why stainless steel?

The two main concepts proposed for this bridge are the use of a classical arch structure as the main element and the use of high-performance and structurally innovative materials Stainless Steel and GFRP (Glass Fiber Reinforced Polymer). The arch, with a span of 40 m, is leaned to create a dynamic and tense feeling, and joins the deck for greater structural efficiency. The structure is conceived in a way that does not transmit the horizontal forces from the arch to the ground, avoiding expensive foundation systems. The arch is anchored directly to the deck on one side of the slab edge and through a strut element on the other.

Pùnt da Suransuns

Pùnt da Suransuns. Picture courtesy of Martin Linsi, Wädenswil

Location:	Thusis, Grisons, Switzerland
Crosses:	Hinterrhein River
Type:	stress-ribbon bridge for pedestrians
Opened in:	1999
Materials:	EN 1.4462 (ribbons), EN 1.4435 (handrails)
Stainless steel products:	ribbons, handrails
Architects:	Conzett Bronzini Partner AG
Photographs:	Martin Linsi, Wädenswil

History

The Punt da Suransuns is a stress-ribbon bridge with a span of 40 meters carrying a footpath across the Hinterrhein river through the Viamala gorge.

Why stainless steel?

Spray laden with de-icing salt from a nearby main road posed a potential problem, so all the steel components of the bridge were made of highly alloyed stainless steel with good corrosion-resistance. The stress-ribbons are made of duplex stainless steel which also has excellent strength properties.

3D printed steel bridge

3D printed steel bridge. Picture courtesy of MX3D and Thea van den Heuvel.

Location:	Amsterdam, Netherlands
Crosses:	canal
Type:	3D Printed Bridge for pedestrians
Opened in:	2021
Materials:	stainless steel, ArcelorMittal
Stainless steel products:	whole bridge
Architects/designer:	Joris Laarman Lab
Technology:	MX3D
Photographs:	courtesy of MX3D; Thea van den Heuvel; Adriaan de Groot; Jan de Groen
More information:	mx3d.com/industries/infrastructure smartbridgeamsterdam.com


3D printed steel bridge. Picture courtesy of MX3D.

History

Amsterdam based startup MX3D has 3D printed a fully functional stainless steel bridge to cross one of the oldest and most famous canals in the center of Amsterdam, the Oudezijds Achterburgwal.

Length: 12.2 meter
Width: 6.3 meter
Height: 2.1 meter

The MX3D bridge has been tested at the University of Twente. The bridge was tested under a 17 ton load. Equipped with a state-of-the-art sensor network, the MX3D Bridge is also an intelligent piece of infrastructure, able to make sense of its environment and own state. This 'Smart Bridge' is a groundbreaking research project that allows the City of Amsterdam to analyze pedestrian and crowd behavior.


3D printed steel bridge. Picture courtesy of MX3D and Adriaan de Groot.


3D printed steel bridge. Picture courtesy of MX3D and Jan de Groen

Vilafant Pedestrian Bridges

Vilafant Pedestrian Bridges. Picture courtesy of PEDELTA

Location:	Girona, Spain
Crosses:	railway
Type:	truss bridges for pedestrians
Opened in:	2011
Materials:	Duplex Stainless Steel EN 1.4162, Outokumpu
Stainless steel products:	truss
Architects:	PEDELTA
Photographs:	picture courtesy of PEDELTA

Vilafant Pedestrian Bridges. Picture courtesy of PEDELTA

History

The high speed railway line connecting Barcelona and the French border crosses the Municipality of Vilafant 6 m below the ground level. To cross the sunken railroad, two pedestrian bridges have been planned. The structure, with one span of 46 m, is monolithically connected with the abutments. The use of unusual geometric shapes fabricated using stainless-steel and GFRP are blended in an innovative fashion, giving rise to an austere and elegant solution.

Vilafant Pedestrian Bridges. Picture courtesy of PEDELTA

Why stainless steel?

The two bridges have a main longitudinal span of 45.2 m and a deck width of 4 m. The structures are built-in on both abutments. The two bridges have a 4.3 m wide clear deck with a cross section consisting of two outwardly inclined hybrid trusses. An innovative structural hybrid truss has been designed. The combination of a stainless steel Vierendeel truss configuration with GFRP panels between vertical members creates an efficient, continuous structural web.

The geometry of the truss follows the structural demands from the integral frame configuration, having a variable height between 3.4 m at the abutment and 1.2 m at mid-span. The deck is built using slim GFRP ribbed panel planks over the transverse floor beams.

Two different floor beams are alternated every 1.02 meters: I-GFRP 300x150x15 mm for lightness and Stainless Steel rectangular 350×300 mm beams for rigidity. The GFRP panels between vertical elements in the Vierendeel trusses consist of a sandwich of two ribbed elements glued together for a total of an 80 mm thick translucent wall. The GFRP panels are continuously connected to both chords with stainless-steel bolts.

Folke Bernadotte Bridge

Folke Bernadotte Bridge. Picture courtesy of Stål & Rörmontage AB.

Location:	Stockholm, Sweden
Crosses:	Djurgårdsbrunn Bay
Type:	bridge for pedestrians
Opened in:	2019
Materials:	Forta LDX 2101, Outokumpu
Stainless steel products:	structural
Fabricator:	Stål och Rörmontage
Photographs:	courtesy of Stål & Rörmontage
More information:	outokumpu.com


Folke Bernadotte Bridge. Picture courtesy of Stål & Rörmontage.


Folke Bernadotte Bridge. Picture courtesy of Stål & Rörmontage.

History

The new bridge adds qualities for the continued development of the walking city of Stockholm and increases accessibility for both pedestrians and cyclists. The stainless steel bridge links the museum park in northern Djurgården with Rosendal in southern Djurgården. The new bridge location gives Gärdet and the new Djurgårdsstaden a good connection to Djurgården and the Swedish capital's green oasis, the Royal National City Park.
King Carl XVI Gustaf and Queen Silvia of Sweden opened the Folke Bernadotte Bridge on 17 September 2019 in Stockholm. The new bridge is named after the Red Cross leader, diplomat and mediator Count Folke Bernadotte af Wisborg (1895-1948).

Why stainless steel?

The 98 meter long pedestrian and bicycle bridge is made of duplex steel and assembled by Stål och Rörmontage. The bridge parts were then transported to Stockholm for assembly. A steel bridge provides good opportunities for a high degree of prefabrication, a high degree of prefabrication minimizes the environmental impact on site and provides many other advantages as a larger part of the production can take place in a controlled and safe environment. Duplex steel releases very low amounts of metal ions to the environment and bridges made of it do not require any environmentally hazardous coating. What is more, duplex steel is scrap-based and 100 % recyclable.

Newcastle Memorial Walk


Newcastle Memorial Walk. Picture courtesy of Bryce Thomas and Simone de Peak.

Location:	Newcastle, Australia
Type:	bridge for pedestrians
Opened in:	2015
Materials:	316L, Atlas Steels
Stainless steel products:	section, frame, handrail
Designer:	EJE Architecture
Photographs:	Courtesy of Bryce Thomas and Simone de Peak
More information:	assda.asn.au

History

The much-anticipated Newcastle Memorial Walk opened on 24 April 2015 on the eve of the Anzac centenary, and features spectacular 360-degree views of Newcastle city and coastline. The 450 m raised walkway forms part of Newcastle City Council's 'Bathers Way Project', a $29 million foreshore development and revitalisation program to link Merewether Beach with Nobby Beach via a coastal walk.

In commemoration of the Anzacs the walkway features silhouettes of soldiers, laser cut from 10 mm thick weathering steel, specified to withstand the coastal wind load. These silhouettes are engraved with 3,860 family names of almost 11,000 known Hunter Valley men and women who served in the Australian Imperial Force, Royal Australian Navy, Australian Army Nursing Service and British and Commonwealth forces during World War I from 1914-1918.

More than two million people visit Newcastle's beaches every year, and the Newcastle Memorial Walk is already one of Australia's most remarkable coastal walkways and a significant World War I tribute.

Why stainless steel?

The walkway has a structural design life of 70 years, as required by Newcastle City Council. Grade 316L stainless steel was specified due to its sustainable, corrosion resistance and ductile properties. The cliff top location of the walkway overlooking the Pacific Ocean was also a determining factor given the high wind and salt exposure. 64 tonnes of stainless steel were supplied for the walkway, the bridge section frames and the handrails and balustrades.

Newcastle Memorial Walk. Picture courtesy of Bryce Thomas and Simone de Peak.

Newcastle Memorial Walk. Picture courtesy of Bryce Thomas and Simone de Peak.

Elizabeth Quay Pedestrian Bridge

Elizabeth Quay Pedestrian Bridge. Picture courtesy of Stirlings Performance Steels

Location:	Perth, Australia
Crosses:	Swan River
Type:	cable-stayed Bridge for pedestrians
Opened in:	2016
Materials:	2304 Reval® reinforcement bar: Valbruna Australia 2205 and 316/316L plate, wire mesh panels, tube, pipe, channel, angle: Stirlings Australia laser cut and polished 2205, 316 and 316L plate: Vulcan Stainless
Stainless steel products:	rebar, handrails, balustrades, support posts, mesh barriers, kerbing, fascia panels and kick rail stations
Structural designer:	Arup
Fabricator:	Unifab Welding
Photographs:	Courtesy of Stirlings Performance Steels and Unifab Welding

Elizabeth Quay Pedestrian Bridge. Picture courtesy of Stirlings Performance Steels

History

The Elizabeth Quay Pedestrian Bridge is a key feature of the Elizabeth Quay mixed-use development project core to revitalising Perth's CBD. Designed and engineered by Arup, the cable-stayed suspension bridge features a leaning double arch, is 22 m high, 5 m wide and is suspended over the inlet of the Swan River with a clearance of 5.2 m from the water. The 110 m long meandering pedestrian and cyclist bridge allows for continuous movement around the Quay, connecting the new promenades, an island and ferry terminal.

A key architectural feature of Elizabeth Quay, the pedestrian footbridge was opened to the public in January 2016. It exudes in quality, aesthetic appeal and durability with its extensive use of stainless steel, and is certain to provide the structural and material performance required to stand the test of time. Offering 360-degree views, the bridge is an exciting addition to Perth's CBD and provides increased opportunity for locals and tourists to interact with the Swan River and reinvigorated waterfront destination.

Why stainless steel?

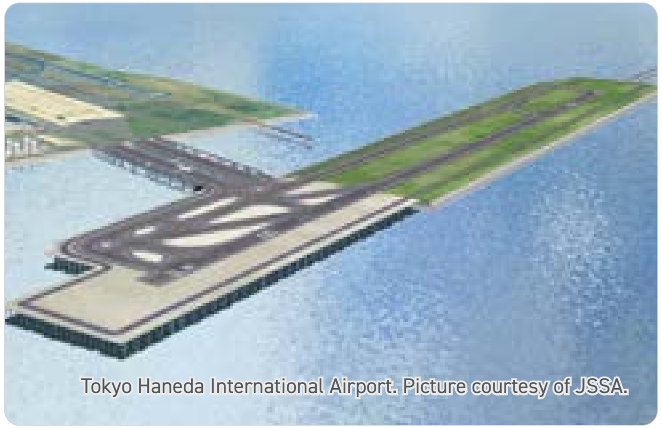
Installed exclusively in the splash zones of the concrete piers, stainless steel reinforcement was specified to resist corrosion attack and prevent concrete spalling. In addition, the overall mass of the concrete piers had to be minimised in order to support and achieve the sleek, sinuous design of the almost 200 tonne arches. Reduction in concrete mass decreases the overall protection of the installed reinforcement bar, resulting in stainless steel as the material of choice to achieve the slimmer river piers and meet the demands of the architectural design.

Other types of bridges

Tokyo Haneda International Airport

Tokyo Haneda International Airport. Picture courtesy of JSSA.

Location:	Tokyo, Japan
Crosses:	Tokyo Bay
Type:	runway
Opened in:	2010 (expansion)
Materials:	NAS354N (UNS N08354) for the upper part in the splash zone NSSTS270 / NAS185N (SUS 312L, UNS S31254, EN 1.4547) for the lower part in the tidal zone NIPPON STEEL Stainless Steel Corporation/ Nippon Yakin Kogyo Co., Ltd.
Stainless steel products:	stainless steel-clad structural steel circular hollow sections
Fabricator:	Nippon Steel Engineering Co., Ltd and Joint Ventures
Photographs:	Courtesy of JSSA
More information:	jssa.gr.jp


Tokyo Haneda International Airport. Picture courtesy of JSSA.


Tokyo Haneda International Airport. Picture courtesy of JSSA.

History

When Tokyo Haneda International Airport was expanded, the scarcity of land made it necessary to build the new runway D out into the sea. The supporting structure of a connecting bridge to the artificial island is in direct contact with sea water.

Why stainless steel?

Reconciling the 100 year durability requirement with Life Cycle Cost constraints was a challenge. Organic coatings would have required regular repair and caused unacceptable maintenance cost. In the case of titanium, by contrast, initial cost would have been prohibitive.

Technically and economically, the cladding of structural steel with high-end austenitic stainless steel turned out to be an optimal solution.
For the tidal zone, a 20 % Cr, 18 % Ni and 6 % Mo grade with a PRE value of 43 was used. Contrary to common belief, the corrosion load is highest in the part which is not permanently wet. In such recessed areas, splash water dries without rainwater washing the chloride-containing deposits away. For these conditions, a 23 % Cr, 35 % Ni and 7.5 % Mo grade with a PRE value of 51 was found most appropriate.
The first-time application of this technique in an airport facility won the stainless steel producers the ISSF New Applications Award in May 2015.

Takayo water pipe bridge

Takayo water pipe bridge. Picture courtesy of JSSA.

Location:	Hekinan City, Aichi Prefecture, Japan
Crosses:	river
Type:	truss-stiffening type bridge for water pipe
Opened in:	replacement
Materials:	SUS 316
Stainless steel products:	pipe structures
Photographs:	courtesy of JSSA
More information:	jssa.gr.jp

History

When drinking water or sewage lines have to cross rivers and canals, they are often integrated into the girders of road and rail bridges or attached to them. In Hekinan, the steel water pipe of one such bridge had developed leaks and needed to be replaced. On this occasion, its capacity was increased to meet growing demand. However, the necessary larger pipe would have been impractical to integrate into the existing bridge. The municipal authorities therefore decided to erect a separate structure alongside the road bridge. The design was of the truss-stiffening type, in which the conduit has two functions: besides conveying the water, it also serves as the lower chord member of a truss.

Why stainless steel?

Molybdenum-alloyed grade SUS316 was used for three reasons. Firstly, this grade is known to be corrosion resistant in any usual drinking water composition. Water quality is unaffected. Secondly, under coastal atmospheric conditions the outer surfaces should be expected to be corrosion resistant. Repair coatings, which are typical of ageing steel or cast iron counterparts, become redundant. The stainless steel structure was found to be the most cost-effective option from a life cycle costing point of view. Finally, the exceptional ductility of austenitic stainless steels is an advantage in seismic conditions. Stainless steel is tougher than carbon steel or cast iron and can undergo stronger deformation without breaking. In the event of earthquakes, it is essential to maintain drinking water supply as a key element of public infrastructure. The requirement to defy both chloride-containing coastal atmosphere and earthquakes is quite typical of Japanese locations. Therefore, it is not surprising that about 40 % of all pipe bridges involve stainless steel in this country.

University of Birmingham Steam Bridge

University of Birmingham Steam Bridge. Picture courtesy of Simon Kennedy.

Location:	Birmingham, UK
Crosses:	railway and canal
Type:	bridge for steam
Opened in:	2012
Materials:	316 2K vertical finish
Stainless steel products:	curved laser cut cladding panels
Architects:	MJP Architects
Fabricator:	Sorba BV
Photographs:	Simon Kennedy
More information:	mjparchitects.co.uk

University of Birmingham Steam Bridge.
Picture courtesy of Simon Kennedy.

History

MJP were commissioned to design an architecturally elegant 60 m bridge to carry services as part of the University of Birmingham's Combined Heat & Power network and sustainable energy strategy. The stainless steel Steam Bridge is a key component of a forwardlooking program.

Why stainless steel?

After in-depth technical research into the cladding material and discussions with the British Stainless Steel Association about the appropriate specification of surface finish a curved 2k vertical finished, lasercut, Grade 316 stainless steel was chosen as the most practical and attractive solution.
Because of the bridge's location over a busy railway and canal the durability of the steel surface was very important as the cladding has a 60 year design life with little or no opportunity for maintenance or cleaning. The surface characteristics of the selected finish needed to be effective in reducing the risk of build-up of atmospheric pollutants on a "dirty" site with aggressive ferrous brake dust and diesel exhaust.

University of Birmingham Steam Bridge.
Picture courtesy of Simon Kennedy.

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About worldstainless

worldstainless is a not-for-profit research and development association which was founded in 1996 as the International Stainless Steel Forum.

Vision

Sustain our future with stainless steels

Membership of the ISSF

worldstainless has two categories of membership namely:

a. **company members** who are producers of stainless steels (integrated mills and re-rollers)
b. **affiliated members** who are national or regional stainless steels industry associations.

worldstainless now has 57 members in 26 countries. Collectively they represent approximately 90% of the total production of stainless steels.

More information

For more information about worldstainless, please consult our website worldstainless.org.

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