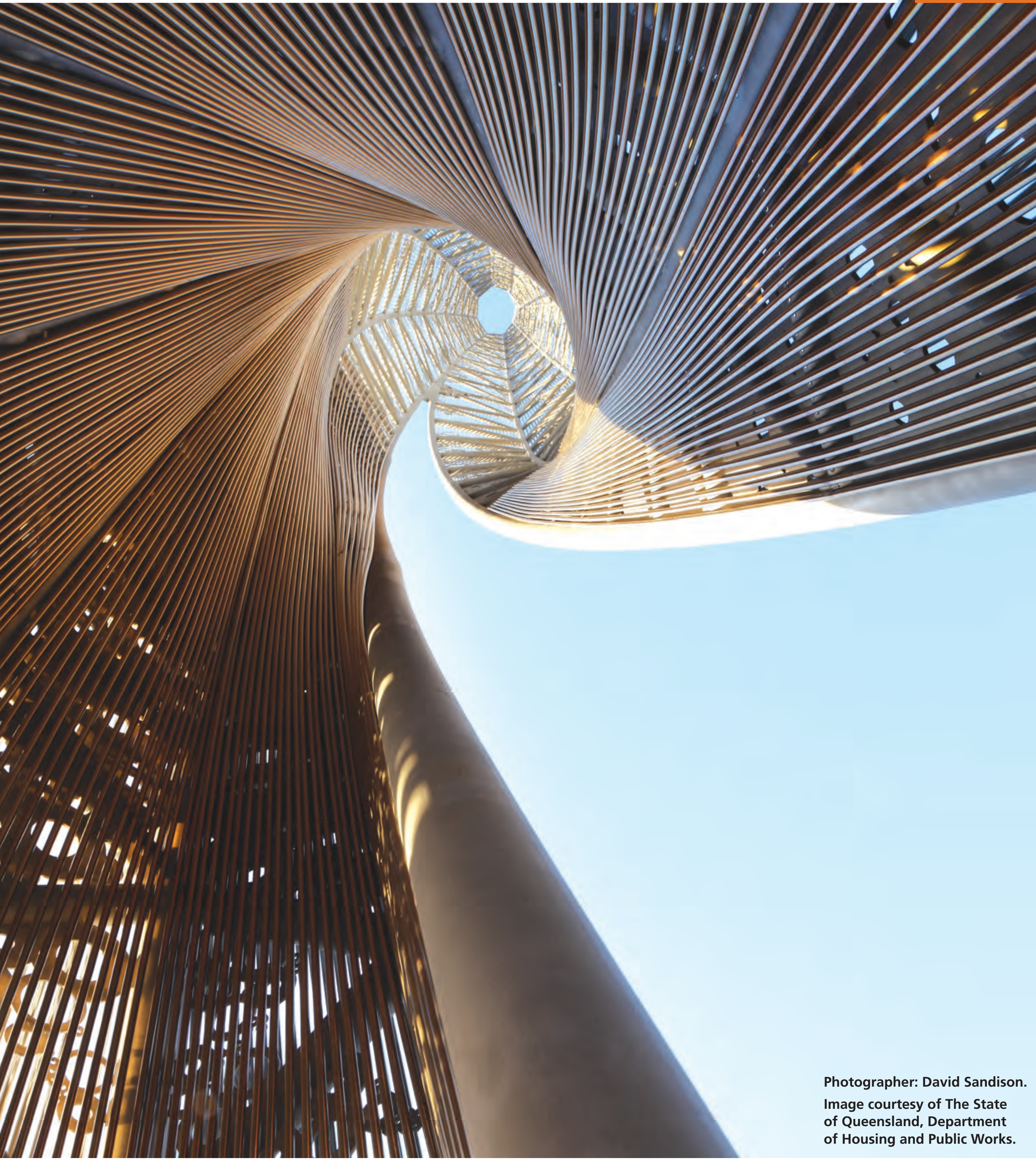
AUSTRALIAN STAINLESS

SPECIALISING IN STAINLESS STEEL AND ITS APPLICATIONS

51
AUTUMN
2012



Photographer: David Sandison.
Image courtesy of The State of Queensland, Department of Housing and Public Works.

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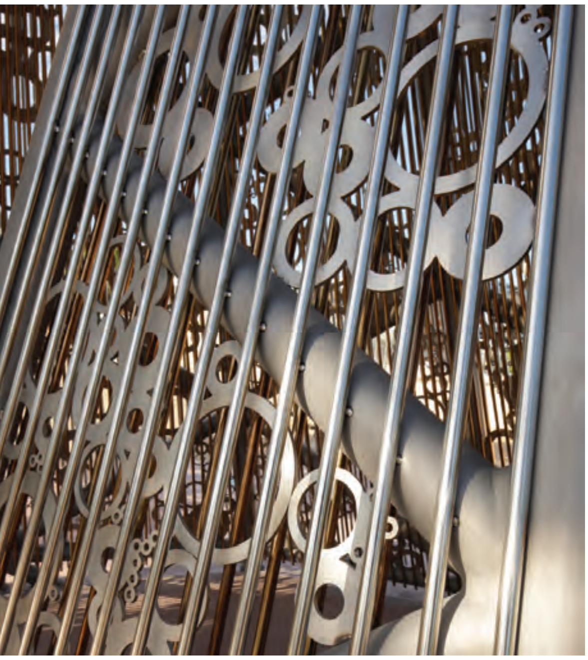
ASSDA

A STAINLESS ICON FOR BRISBANE'S SKYLINE



The Fibonacci spiral and the intersecting spines of a nautilus shell have inspired an impressive 23m high stainless steel sculpture at Kangaroo Point Park overlooking Brisbane's river.

Designed by UK public space artist Wolfgang Buttress, Venus Rising features 10,790 individual welds and over 7km of grade 316 and 2205 duplex stainless steel tube, pipe and round bar supplied by ASSDA Sponsor, Sandvik.

Having worked with stainless steel for over 25 years, Buttress said that the material's strength, ability to look good over time with minimal maintenance, and the flexibility of finishes works well both practically and aesthetically.

"The variety of finishes which can be achieved with stainless steel through polishing, glass blasting and heat treatment is great. The material needs to be strong, resilient and look as good in 50 years as it does on installation," Buttress said.

Initial fabrication works took place in the UK before being transported to Brisbane for final assembly. D&R Stainless, an ASSDA member and Accredited Fabricator, continued the fabrication of the 11.5 tonne spire-like sculpture over a period of six weeks. It used the artistic vision of Buttress, as well as renders and 3D models to guide the assembly of the sculpture.

The central design of the sculpture was to create a piece of artwork that was visibly prominent and exemplified strength, elegance and weightlessness. The sculpture features a criss cross ladder-type construction with heavy wall pipes that gently twist to create a hollow spiral. Visitors can enter the sculpture at the base level and gaze up at the sky through an opening at the top.

"I wanted to make connections between the Brisbane River and the sky above. It was important to me that the sculpture works on an intimate scale as well as being seen from afar," Buttress said.

"Visually, the most challenging part of the project was to try and maintain harmony between form and sculpture. I wanted the piece to have a delicacy but also be strong."

The main structure of the sculpture features 2205 duplex stainless with cladding tubes at the bottom of the structure starting at 12mm, ascending to 8mm and 10mm tube through the middle and 6mm and 8mm solid round bar at the top. Tubes were supplied in 6m lengths and welded together to create continuous lines of tubing for the stretch of the sculpture.

12mm thick stainless steel tubes in the skeleton of the structure extend about half way up and were heat treated in a stress relieving oven. This transformed the colour of the steel into a golden hue to create a contrast effect in the sculpture.

"We cut 30 to 40 small lengths of stainless steel at various thicknesses and baked them at different temperatures from 100˚ C up to 400˚ C. After comparing the various shades and hues, I chose the golden colour in the end which required heating to around 300˚ C," Buttress said.

Grade 316 polished stainless steel tubing was used for the middle cladding on the exterior of the structure.

Stainless steel rings were laser cut from LDX 2101 plate in various thicknesses from 20mm down to 3mm, and welded to the body of the sculpture to create an intricate lace-like effect.

The main structure was bead blasted to create a uniform finish and all tubes were chemically cleaned.

Both TIG and MIG welding processes were used, with both solid wire and flux cord used in the MIG welding technique. Di-penetration testing was conducted offsite on the welding of the body of the sculpture to ensure structural integrity.

D&R Stainless director Karl Manders said that while fabricating stainless steel was familiar territory, the application was different and stimulating.

"We found the project intriguing because while we were producing a delicate structure, the core components of the fabrication were quite complex. Our business focuses on heavy industrial applications, and the materials we used for Venus Rising are those used in the heart of the mining and petrochemical industries," Manders said.

"The experience of this project was intense but satisfying. We made Wolfgang's vision come to life."

Buttress said D&R Stainless was a perfect fit for the project and they will also be on board for an upcoming sculpture for The University of Canberra.

"Their understanding of the properties of stainless steel was second to none and their craftsmanship exemplary. It was great to witness such pride in their workmanship," Buttress said.

Commissioned by the Queensland Government, Venus Rising was selected in a public vote as the winning design from over 60 submissions and was unveiled in late January 2012.

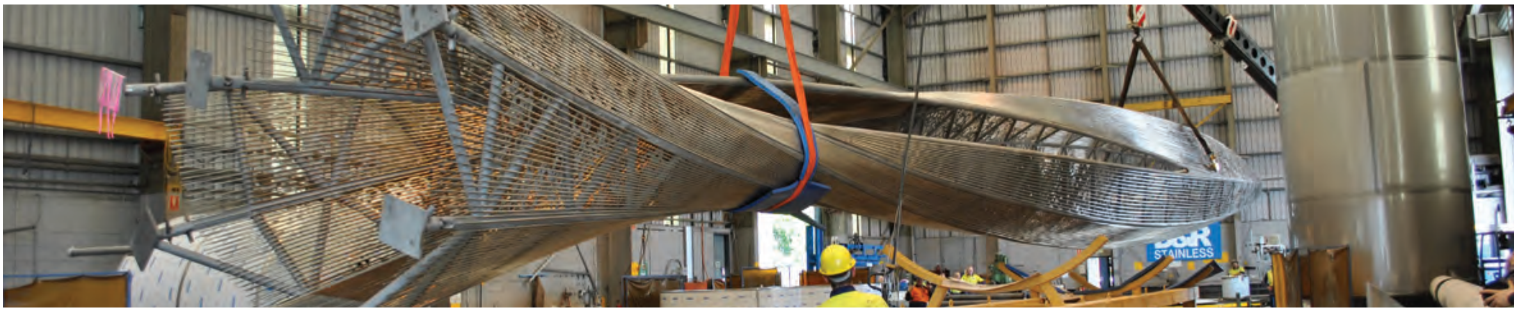


Image above courtesy of Wolfgang Buttress.
Opposite page: Photographer: David Sandison. Images courtesy of The State of Queensland, Department of Housing and Public Works.

STAINLESS = FRESHNESS

As bottled water continues to gain popularity in Australia, maintaining the quality and purity of the water extracted from natural springs is paramount.

This is just one example within the food and beverage sector where hygiene is vitally important and, therefore, stainless steel continues to be the material of choice for processing and storage facilities.

In 2011, Coca-Cola Amatil (CCA) commissioned 'Project Flint' to upgrade three spring water storage tanks for their Moorabbin plant in Victoria plus an additional two tanks for their Thebarton plant in South Australia.

GEA Process Engineering Australia engaged Byford Equipment on behalf of CCA to fabricate and install the five storage tanks.

GEA Engineering's General Manager Operations, Andrew Fillery, said stainless steel was an important specification as the tanks had to cope with the chemical and thermal rigours of cleaning processes.

"Stainless steel was chosen for process and hygienic reasons, and the vessels needed to withstand the process and cleaning conditions where mild caustic and acid CIP solutions were used," said Fillery.

Strength and durability was key for the 200,000L capacity silos, which measured 4.7m in diameter by 14.5m high for the Moorabbin site and 5.5m in diameter by 10m high for the Thebarton plant.

ASSDA Sponsor Midway Metals supplied 27 tonnes of grade 304 stainless steel coil with a 2B finish in 2mm, 2.5mm, 3mm and 4mm thicknesses. The coil widths were 1219mm and 1500mm.

With a team of five fabricators on the project, the tanks were welded together using a semi-automatic MIG welding process. The welds were then pickled to restore the chromium oxide layer and abstain from rusting.

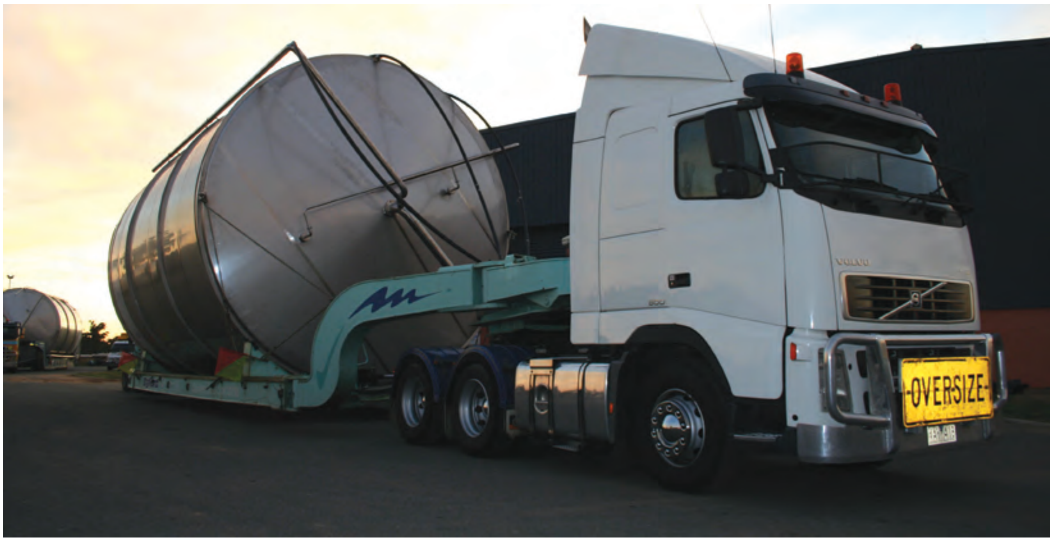
Byford Equipment's Project Manager Geoff Smallwood said coordinating the delivery of the tanks was a challenge, given the logistics of travelling through three states by road.

The delivery of the vessels was critical added Fillery, as there were specific installation windows to work within.

The storage tanks were delivered from Byford's workshop in New South Wales to Moorabbin in March 2011. The two remaining tanks were delivered to Thebarton a month later for installation. It took one day and one crane to install each tank on site.

The connecting pipework was positioned on site, which was grade 304 polished tube in diameters ranging from 38mm to 150mm and purge welded prior to installation.

Images below courtesy of Byford Equipment.



The stainless steel that turns a corner – AWM 404GP™

Lock seamed spiral wound ducts ask a lot of the metal, even more of the forming tools. But AWM 404GP™ Ferritic Stainless Steel is easy on the tools without needing a dedicated, costly set, is easy on the pocket, and has at least the same corrosion resistance as grade 304. Pictured are some of the 25 tonnes of ducts in Mindarie Resource Recovery Facility treating 100,000 tonnes of household waste annually in Perth.
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GUIDELINES FOR USE OF STAINLESS STEEL IN SOIL

Stainless steel can provide excellent service underground. It is stronger than polymers and copper and its resistance to chlorides and acidic soils is significantly better than carbon or galvanised steels.

The performance of stainless steel buried in soil depends on the nature of the buried environment. If the soil has a high resistivity and is well drained, performance can be excellent even in conditions where other unprotected materials suffer degradation.

BASIC RULES

The Nickel Institute guidelines for burial of bare stainless steel in soil require:

- No stray currents (see below) or anaerobic bacteria,
- pH greater than 4.5,
- Resistivity greater than 2000 ohm.cm.

Additional recommendations include the absence of oxidising manganese or iron ions, avoidance of carbon-containing materials and ensuring a uniform, well drained fill. If the guidelines are breached, then either a higher resistivity is required, i.e. measures to lower moisture or salts and ensure resistivity exceeds 10,000 ohm.cm, or else additional protective measures may be required.

In comparison, the piling specification (AS 2159) guidelines for mild steel require a pH greater than 5 and resistivity greater than 5000 ohm.cm for soils to be non-aggressive. It is rare for bare mild steel to be buried, i.e. typical specifications include a wrap or coating possibly with a cathodic protection system.

SPECIFIC ISSUES

- Uniform soil packing is required as variable compaction can induce differential aeration effects.
- Avoid organic materials in the fill around buried stainless steel as they can encourage microbial attack.
- Avoid carbon-containing ash in contact with metals in soils. Localised galvanic attack of the metal can occur.
- Oxygen access is critical. Having good drainage and sand backfill provides this. A sand-filled trench dug through clay may become a drain and it is not appropriate. Stainless steels generally retain their passive film provided there is at least a few ppb of oxygen, i.e. 1000 times less than the concentration in water exposed to air.
- Chlorides are the most frequent cause of problems with stainless steels. In soils, the level of chlorides vary with location, depth and, in areas with rising salinity, with time. High surface chlorides may also occur with evaporation. This is a problem for all metals although stainless steels are not usually subject to structural failure.

The general guidelines for immersed service are that in neutral environments at ambient temperatures and without crevices, 304/304L may be used up to chloride levels of 200ppm, 316/316L up to about 1000ppm chloride and duplex (2205) up to 3600ppm chloride. The super duplex alloys (PRE>40) and the 6% molybdenum super austenitic stainless steels are resistant to seawater levels of chloride, i.e. approximately 20,000ppm. These guidelines are easy to apply in aqueous solutions.

Soil tests for chlorides may not exactly match actual exposure conditions in the soil. Actual conditions may be more (or less) severe than shown by the tests. The difference is calculable but in practice, the aqueous limits can be used as general guidelines. More specific recommendations, based on published guidelines, are provided in *Table 1*.

It may seem redundant to assess both chlorides and resistivity. Both are required as the resistivity is primarily affected by water content and if it is low, then quite high chlorides could be tolerated – as seen by the choice of 304/304L in high chloride/high resistivity conditions. Despite these recommendations, most Australian practice is to use 316/316L or equivalent, primarily because of variable soils.

- Good drainage and uniform, clean backfill are essential for bare stainless.
- Duplex or super duplex could be replaced with appropriate austenitics and 304/304L could be replaced with a lean duplex.
- Ferritic stainless steels of similar corrosion resistance (usually classified by Pitting Resistance Equivalent [PRE]) could also be used underground.

Potential acid sulphate soils are widespread, particularly in coastal marine areas as described in http://www.derm.qld.gov.au/land/ass/index.html. Once disturbed and drained, which also allows oxygen access, such soils typically become more acidic than pH 4 and will attack metals (although stainless steels will be less readily attacked than other metals). Detailed assessment is required if using metals in such an environment as the effect of other aggressive ions is likely to be more severe at low pH.

SOIL

Natural soils are a mixture of coarse pebbles, sand of increasing fineness through to silts and clays where the particles are less than 5 μm in diameter. Some of the particles contain soluble salts that, if mixed with water, are likely to be corrosive. Normally, soils also contain organic material from decaying plants or ash, which can provide nutrients for microbial activity or galvanic effects, respectively.

If water is present in the soil, corrosion can take place. Metals below the water table can corrode (following the rules for immersed service). However if the soil is well compacted so oxygen cannot gain access or corrosion products cannot diffuse away, then corrosion would be stifled - even for carbon steel. Above the water table, moisture comes from percolating rain, which will, over time, leach away soluble corrosives and make the soil less aggressive. This also means that in dry climates, salts may accumulate and when there is rain, the run-off or percolating water is very aggressive. Deposited salts can also be a problem in marine zones almost regardless of rainfall.

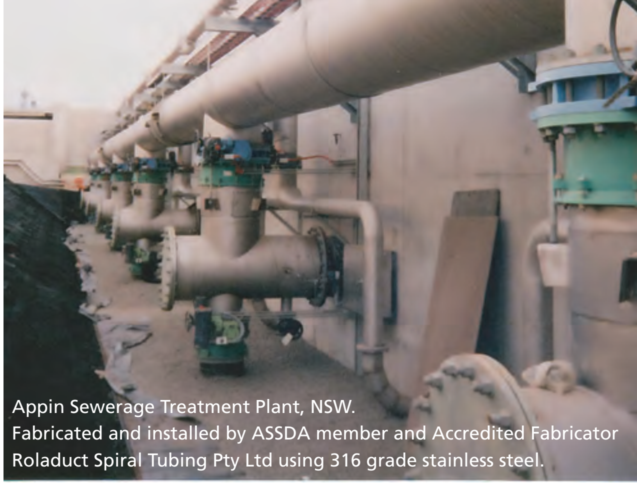
Most of the moisture above the water table is bound to particles but if there is sufficient water content, typically more than about 20%, enough water is free to wet buried metals.

1. **Properly specified stainless steel can provide the longest service underground. It is strong compared to plastics and copper, and is more reliably corrosion resistant than carbon steel.**
2. ***Table 1* guides grade choice for soil conditions.**
3. **Normal fabrication practices apply: welds must be pickled and carbon steel contamination avoided.**
4. **Pipelines must be buried in clean sand or fine, uniform fill in a self-draining trench that avoids stagnant water. Organic or carbonaceous fill must be avoided.**

TABLE 1 **SPECIFIC GRADE RECOMMENDATIONS**

Resistivity Ω.cm	Chloride ion concentration (ppm)			
	200	1000	2000	15,000
>5000	304/304L			
2000-5000	316/316L/2304		2205	Super duplex
1000-2000	2205		Super duplex	
<1000	Super duplex			

Source: ArcelorMittal.



Appin Sewerage Treatment Plant, NSW.
Fabricated and installed by ASSDA member and Accredited Fabricator Roladuct Spiral Tubing Pty Ltd using 316 grade stainless steel.

CASE STUDIES

The Nickel Institute published a five year Japanese study in 1988 (#12005) showing 304 and 316 gave good service in buried soil, although vertically buried pipes did suffer some minor pitting and staining apparently due to differential aeration effects.

› NI #12005 describes a five year burial exposure in Japan at 25 sites with highly varied corrosivity. After five years in marine sites, horizontal 304 pipes showed no pitting but some crevice attack under vinyl wrap. Only one 316 pipe showed any attack.

› Vertical 304 pipe suffered attack near the base at some sites apparently due to differential aeration effects.

› An Idaho study of a 33-year NIST burial found 12% Cr martensitics perforated. The 'lake sand' site had high ground water with pH 4.7 at recovery. Sensitised 304 was attacked worse than annealed but both suffered attack along the rolling direction from edges.

› 316 was not attacked even if sensitised.

As noted, duplex stainless steel of similar corrosion resistance (PRE) to 304 and 316, respectively, would be expected to provide similar results when buried.

On a more practical level, there are several common approaches that are used when burying stainless steel:

› Wrap the stainless steel pipe in a protective material, such as a petrolatum tape, prior to burial. If the wrapping is effective (typically an overlap no less than 55% of the wrap width is specified), then the nature of the external surface of the buried pipe is of no consequence. In this case, stainless steel is only used for its internal corrosion resistance, i.e. its resistance to corrosion by the fluid which the pipe is carrying. Some authorities prohibit this practice because of concerns that damage to the wrap could cause a perforating pit in severe environments.

› Ensure that the soil environment surrounding the buried stainless steel is suitable for this application. In this case, the trench is dug so that it is self-draining, without there being areas where stagnant water can accumulate in contact with the buried pipe. The stainless steel pipe is then placed on a sand or crushed aggregate bed and covered by similar material. Under these circumstances, 316 grade stainless steel can be quite a suitable choice. US practice is to use 304 but Australian soils are quite variable and there have been mixed experiences with 304.

› Above ground sections of pipework are often stainless steel as they are at risk of mechanical damage while underground pipework is polymeric - polyethylene (PE) or fibre reinforced plastic (FRP) - despite the risk of damage due to soil movement.

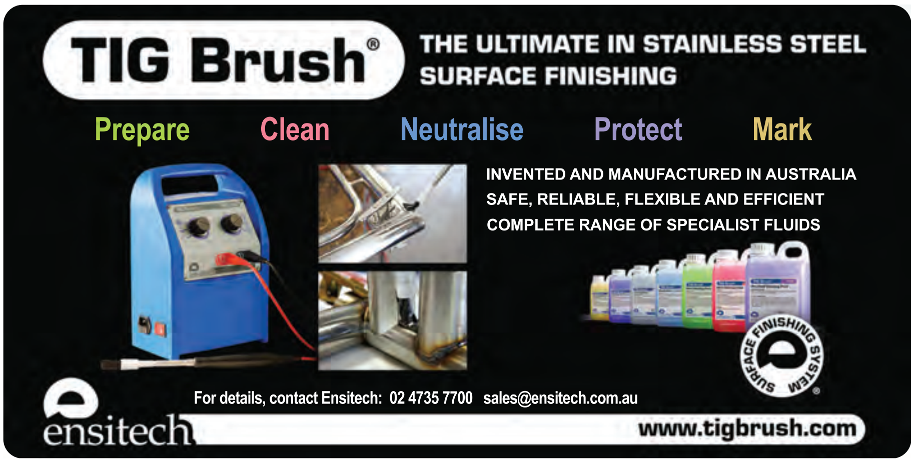
In all of these cases, the assumption is that the stainless steel has been fabricated to best practice. This includes pickling of welds (or mechanical removal of heat tint and chromium depleted layer followed by passivation to dissolve sulphides) and ensuring that contamination by carbon steel has been prevented. It is also assumed that the buried stainless steel does not have stickers or heavy markings that could cause crevices and lead to attack.

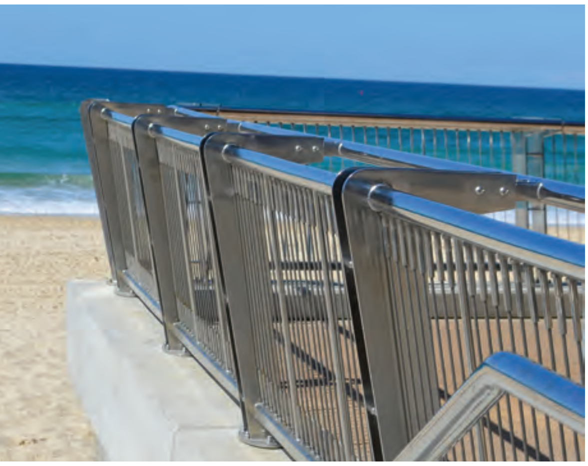
STRAY CURRENTS

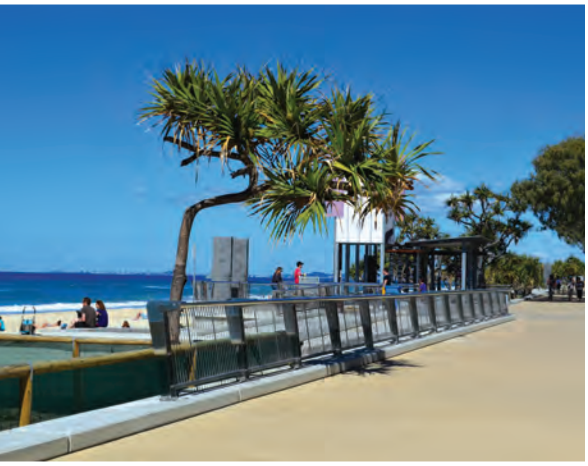
All buried metals, including stainless steels, are at risk if there are stray currents from electrically driven transport, incorrectly installed or operated cathodic protection systems, or earthing faults in switchboards. Stray current corrosion can be identified as it causes localised general loss rather than pitting. It is also very rapid.

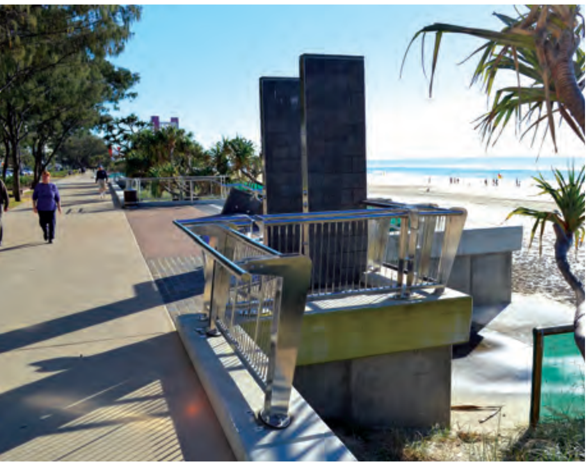
WHAT TEST METHODS ARE USED?

There are Australian and ASTM standards giving basic measurements of resistivity on site with 4 pin Wenner probes or in a soil box in the laboratory. More detailed checking includes water content, chlorides, organic carbon or Biological Oxygen Demand (BOD), pH and redox (or Oxidation Reduction Potential [ORP]) potential – which assess microbial attack risk but also captures the effect of oxidising ions and dissolved oxygen. Most of these test methods are covered in "Soil Chemical Methods: Australasia" written by George E Rayment and David J Lyons and published by CSIRO.









A STAINLESS FACELIFT FOR SURFERS PARADISE

Stainless is a key feature in the urban design and revamp of one the Gold Coast's most iconic and vibrant tourist destinations.

The $25 million Surfers Foreshore Project was commissioned by the Gold Coast City Council (GCCC) to redevelop the beachfront area between Laycock Street and View Avenue in Surfers Paradise.

Aimed at improving infrastructure and visitor recreation, the new promenade features new lifeguard towers, amenity blocks, beach shelters, picnic areas with barbeques, and increased pedestrian and disability access to the beach.

Managing Contractor Abigroup Contractors Pty Ltd appointed ASSDA member and Accredited Fabricator J&T Mechanical Installation to fabricate and install the stainless steel architectural handrails and balustrades across stages 1, 2 and 3.

Trent Todd, J&T Mechanical Installation's Director, said that with the handrails and balustrades being installed less than 30m from the shoreline, stainless steel was the only choice to withstand the harsh coastal environment to help resist tea staining and ensure long-term durability and performance.

A 2009 GCCC study in affiliation with Griffith University saw the GCCC adopt stainless steel as the default specification for structures with a design life of more than 19 years in foreshore zones.

This followed research results showing the material required lower maintenance and was the most effective in life cycle costs when compared with hot dipped galvanized (HDG) steel, paint systems and duplex systems using both HDG and paint.

At a total cost of approximately $80,000, the stainless steel handrails and balustrades span 1300m across the esplanade that fronts Surfers Paradise Beach.

Grade 316L stainless steel was specified for these elements of the project, which included 36 sheets of 10mm thick plate measuring 1500mm x 3000mm supplied by ASSDA member Allplates. ASSDA Sponsor STM Tube Mills Pty Ltd supplied 1300m of 50.8mm x 1.6mm thick tube. Another 3500m of 1/4" wire was also sourced for the balustrading.

All the flat and tube components including 124 stanchions were laser cut and folded by Allplates.

Stanchions and base plates were machine polished to 600 grit by ASSDA member and Accredited Fabricator Minnis & Samson to give the stainless steel an even polish and the stanchions a square edge. The stanchions were electropolished before being delivered back to J&T Mechanical Installation's workshop for assembly.

J&T Mechanical Installation fabricated the top (50.8mm x 1.6mm tube) and bottom (folded channel, 4mm thick) rail frames with two vertical 16mm diameter solid round bar intermediate supports. Infill wires at 6.4mm diameter were positioned with swage fittings and lock nuts on each end to construct the vertical balustrades.

On site, J&T Mechanical Installation completed civil works prior to installation, including pre-drilling with the fasteners for the base plates to which the stanchions were then bolted. The rail frames were welded to the stanchions in 2.1m sections.

Following installation, a proprietary stainless steel cleaner was applied to remove any oxides, and a mild cleaner was followed to provide surface protection and inhibit corrosion.

Architectural feature lighting was installed to illuminate the pedestrian walkways at night.

The Surfers Foreshore Project was completed in April 2011 and today continues to thrive as the Gold Coast's most popular entertainment precinct where city meets the surf.

Images courtesy of Allplates.

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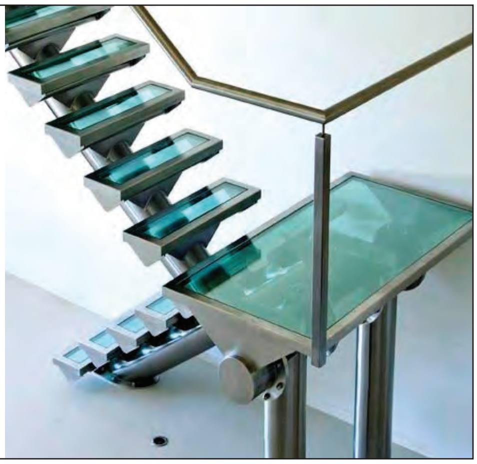


STAINLESS BRIDGES THE GAP

THE GO-BETWEEN BRIDGE

With 14,000 vehicles crossing Brisbane's Go-Between Bridge every day, stainless reinforcement is playing a vital structural role on Brisbane's first inner city bridge built in over 40 years.

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 $338 million project commenced in 2008 and was built by the Hale Street Link Alliance (Bouygues Travaux Publics, MacMahon Holdings, Seymour Whyte Holding and Hyder Consulting).

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.

ASSDA sponsor Valbruna Australia supplied 80 tonnes of grade 316L/1.4462 Reval® stainless steel in 12mm, 16mm, and 24mm reinforcement bar, which was used for the two major pile caps and north abutment of the bridge.

Valbruna Australia's Managing Director, Ian Moffat, said 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," Moffat said.

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.

Moffat said Valbruna had 30% of stainless rebar already in stock, with the rest of the material having been shipped from their warehouse in Dubai and direct from their mill in Vicenza, Italy.

"Between the three locations, we were able to supply the stainless steel early and well within the specified timeframe," Moffat said.

All Reval® stainless steel was produced and tested on site at the Acciaierie Valbruna S.p.A mill in Italy and manufactured to ISO 9001:2008 norms as certified by Lloyd's Register Quality Assurance.

The Reval® stainless rebar was delivered to Neumann Steel in Currumbin for scheduling, cutting and bending.

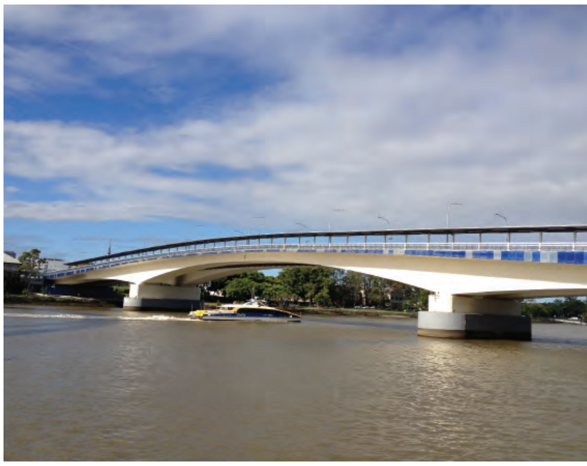
A cut-to-length shear line machine was used, as well as a level off-coil machine to cut and bend the material into the finished product. All machines were cleaned before use to remove dust and carbon steel residue to avoid contamination of the stainless steel.

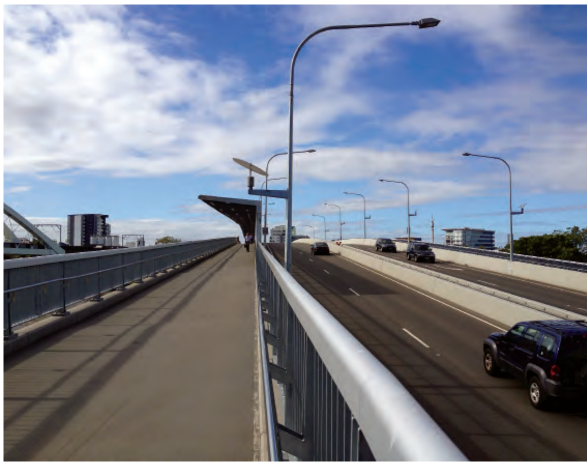
Neumann Steel's Reinforcing Scheduler, Greg Prider, said the project was extremely complex and difficult to schedule.

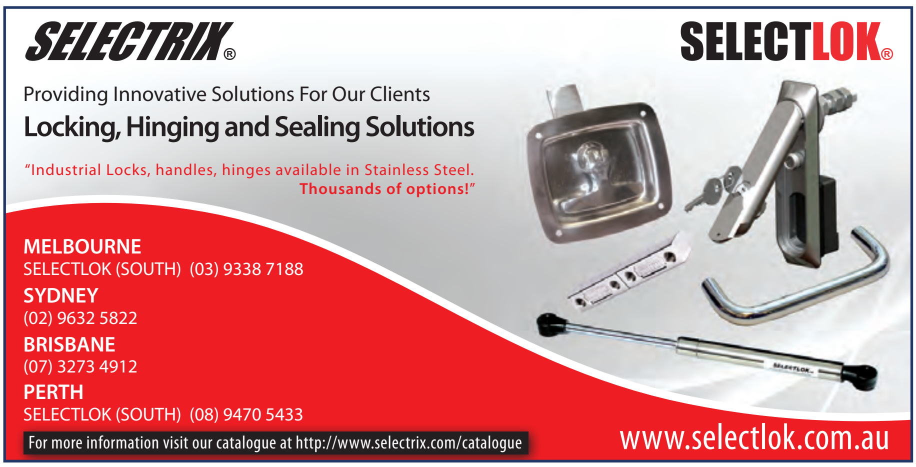
"As the precast concrete units were manufactured at another site, we had tight tolerances to work with. It was critical to be precise in cutting and bending the stainless rebar to avoid unnecessary additional costs," Prider said.

Following six weeks of scheduling, the stainless rebar was sent to the Brisbane Barge Berth, where precasting of the concrete units were assembled before transporting the modules direct to site by barge for installation.

Named after iconic Brisbane rock band The Go-Betweens, the Go-Between Bridge was completed and officially opened to traffic in July 2010.







PacRim Stainless 2012

brought to you by ASSDA

100 years of stainless steel: reflecting on the past; planning for the future

October 18 - 19, 2012
Hyatt Sanctuary Cove, Gold Coast, Queensland

PacRim Stainless 2012 is Australasia's premier networking and knowledge-sharing event, attracting both national and international delegates and speakers.

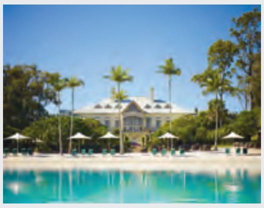
Our 2012 conference celebrates two significant milestones: ASSDA's 20th year representing the Australian stainless steel industry, and a century since stainless steel was created, patented and produced.

This year's theme - **100 years of stainless steel: reflecting on the past; planning for the future** - celebrates our industry's proud achievements while planning its survival through these uncertain economic times.

PROGRAM OVERVIEW

- Two half-day conference sessions
- Friday afternoon option of annual PacRim Golf Ambrose, an industry tour or another leisure activity
- Sessions will focus on:
    - global, bird's-eye view of the industry and how Australia and other regions are negotiating economic challenges
    - case studies from specifiers, asset owners and councils
    - success in a high dollar, open market
    - survivability through innovation: new strategies and technologies to survive market challenges, maintain and grow global market share

To register you interest, contact nicolee_s@assda.asn.au



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