

AUSTRALIAN STAINLESS

SPECIALISING IN STAINLESS STEEL AND ITS APPLICATIONS

54
SPRING
2014



Image credit: Ben Wrigley

ISSUE 54 PROUDLY SPONSORED BY



PUBLISHED BY



Riverwalk Reborn

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 has now opened to the public, connecting New Farm to the Brisbane City via the Howard Smith Wharf Precinct.

Engineered by Arup, the Riverwalk has a design life of 100 years and sits 3.4m 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, durable structure while achieving high aesthetic qualities. Stainless steel was deemed suitable to achieve both objectives while also providing the necessary strength required.

Key design elements featuring stainless steel include balustrades, skate stops, help point enclosures, light posts, signage, electrical enclosures, deck furniture and bins at the node structures. For additional durability, stainless steel reinforcement conforming to BS10088 and BS 6744:2001 was used in the soffit of the precast concrete girders where the structure could be subject to wetting and chloride contamination in the future.

Constructed by John Holland, the project involved a high level of collaboration between multiple suppliers and fabricators to meet the exacting demands of the specification.

John Holland Project Engineer Cameron Pahor said one challenge was programming works in accordance with project specifications to reduce contamination between carbon steel and stainless steel, both of which were used within the precast concrete girders incorporated into the Riverwalk.

Modelling of the reinforcing in 3D by Vectors Computer Aided Drafting also meant exact dimensions were ascertained, reducing waste of stainless steel reinforcing.

ASSDA Sponsor Valbruna Australia Pty Ltd's Queensland construction division was contracted to supply 385 tonnes of stainless steel reinforcing bar, with The Australian Reinforcing Company (ARC) sub-contracted to schedule, cut and bend the rebar in a specifically prepared quarantine location to prevent processing and storage contamination issues.

Valbruna Special Products Manager Scott Ford said the majority of the rebar (in diameters ranging from 12mm to 40mm) was produced to precise precast tolerances predominantly using Reval® special Grade AISI 2304 (1.4362). Grades 2205, 316L and 304L were also used due to the unexpected increase in tonnage required: nearly 40% more than original project calculations was required, making the Riverwalk the largest use of stainless steel rebar in Australia to date.

Mr Ford said stainless steel rebar ensured the Riverwalk met the required 100 years life cycle, while minimising ongoing maintenance costs.



"Using stainless steel rebar ensures that a landmark structure such as the Riverwalk is kept open to the public rather than lengthy maintenance closures due to corrosion issues," he said.

Down time was also minimised during construction, with Valbruna holding extensive stocks on the floor in both Italy and Australia of stainless Reval® rebar, enabling delivery to site within 48-72 hours of final approval of drawings. Manual templates were produced for many of the bars to ensure the accuracy of the bends and eliminate site down time.

Minimising maintenance for the visual elements of the Riverwalk was also a priority. To this end, ASSDA Sponsor Midway Metals supplied 275 tonnes of grade 316 stainless steel and two tonnes of welding consumables for the construction of around 1900m of balustrading. Midway also supplied 100 litres of Avesta pickling gel that was used to passivate all welds on the balustrades.

Midway Metals Brisbane Branch Manager Sean Lewsam said some of the specified handrail sizes were not available in Australia (e.g. 150x50x6mm rectangular hollow section or RHS) and had to be air freighted in to meet strict deadlines.

Midway supplied the project with 3,522 metres of RHS, 14,500 metres of round bar, 1,924 metres of HRAP (hot rolled, annealed, pickled) flat bar, 1,500 metres of flat bar from their slitting and flat bar machines, and 2,000 metres of mirror tube, storing the material in a dedicated holding area for the duration of the project.

Specific-sized Grade 316 plates were acquired (132 tonnes in total ranging from 10mm to 16mm) to minimise off cuts and wastage during the plasma cutting of stiffener plates, 1,500 base plates and 1,000 staunchions for the balustrades. Around 26 tonnes of laser cut profile plates ranging from 5mm to 20mm were also supplied.

ASSDA Member Southern Stainless was contracted to fabricate and install three different types of balustrading (solid uprights, mesh wire and glass infill), as well as the other visible stainless steel elements of the project using the stainless steel and welding consumables supplied by Midway Metals.

Southern Stainless General Manager Matthew Brown said all stainless steel components were manually polished to a 600 grit finish prior to assembly and welded in compliance with AS1554.6. After fabrication, the 960 balustrades panels (each weighing between 180 and 220kg) were electropolished in-house to Ra<0.5 and then hand polished with silicone-based polish prior to being wrapped and delivered to site for installation. The end product is both visually appealing and certain to stand the test of time.

Strength testing was undertaken for the balustrade/girder connections to ensure the stainless steel couplers, bolts and ferules (supplied by ASSDA Member Ancon Building Products) would not damage the cast-in items during a flood occurrence.



Riverwalk's robust design makes it resilient to future flood events. The opening span has been relocated to reduce the likelihood of debris getting caught on the structure, and some elements have been designed to collapse in extreme events (rather than withstand the flood waters), reducing the force on the piles.

With the re-imagined Riverwalk now a fixture on the Brisbane's riverscape once again, residents and visitors can look forward to enjoying the unique experience that Riverwalk offers well into the future.

ASSDA MEMBER CONTACTS:

Valbruna Australia Pty Ltd
 Greg Childs, Queensland Manager
 greg.childs@valbruna.com.au

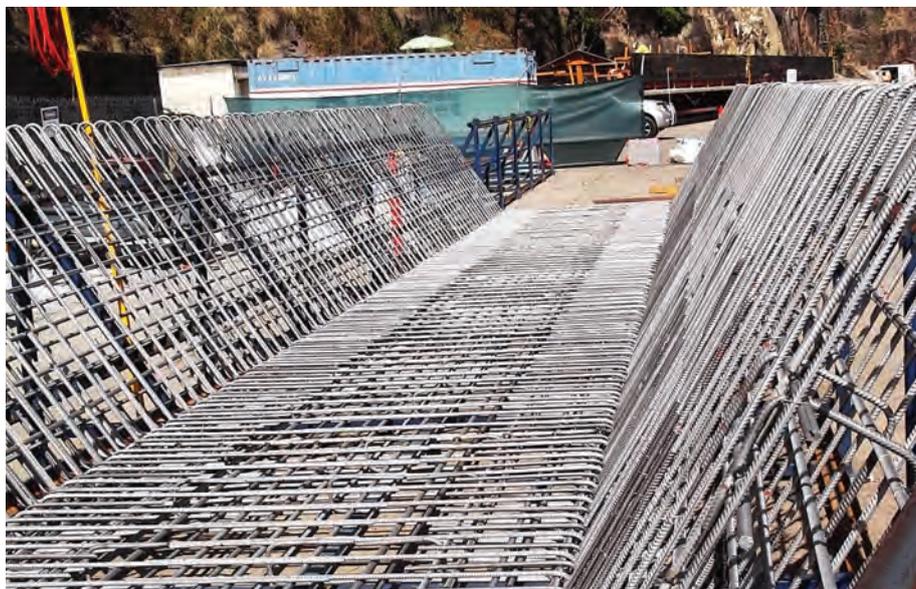
Scott Ford, Special Products Manager
 scott.ford@valbruna.com.au

+61 7 3807 9733
 www.valbruna.com.au

Midway Metals Pty Ltd
 Sean Lewsam, Brisbane Branch Manager
 +61 7 3287 2811
 seanl@midwaymetals.com.au
 www.midwaymetals.com.au

Southern Stainless Pty Ltd
 Matthew Brown, General Manager
 +61 7 5537 6955
 matt@southernstainless.com.au
 www.southernstainless.com.au

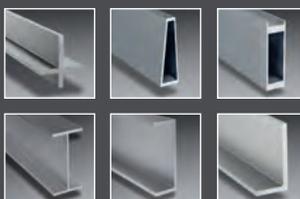
Ancon Building Products
 Scott Brook, Technical Engineer
 1300 304 320
 s.brook@ancon.com.au
 www.ancon.com.au



STANDARD SHAPES

beams – tees – angles – channels

We keep the biggest and most comprehensive stock of hot rolled and **laser fused** Stainless Steel Structural in 304/L and 316/L in South East Asia.



CUSTOM SHAPES

If you can design it, we can make it

Alloys that we can custom produce shapes include 304/L, 316/L, 317/L, 321, 409, 410, 316Ti, 254 SMO, 904/L, AL6XN, C-276, 2101, 2205, 2507

Stainless Structural Asia Pte Ltd 18 Boon Lay Way, Tradehub 21, #10-139, Singapore 609966
 Tel: +65 6793 2282 Fax: +65 6570 8912 Email: sales@ssasia.sg www.stainless-structurals.sg



General Corrosion Resistance

The normal state for stainless

This technical article is an abbreviated version of ASSDA Technical FAQ 8. Please visit www.assda.asn.au to download this FAQ.

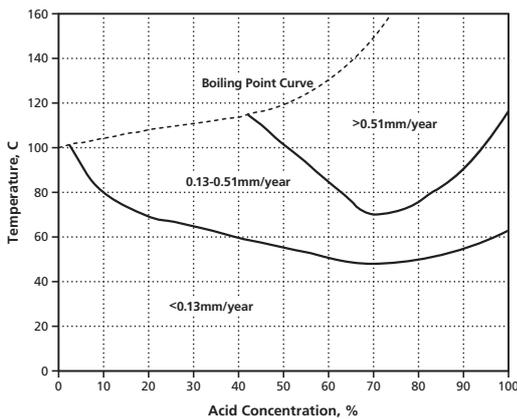
Stainless steels resist corrosion because they have a self-repairing "passive" oxide film on the surface. As long as there is sufficient oxygen to maintain this film and provided that the level of corrosives is below the steel's capacity of the particular material to repair itself, no corrosion occurs. If there is too high a level of (say) chlorides, pitting occurs. As an example, 316 works well in tap water (<250ppm) all over Australia, but will rapidly corrode in seawater because seawater has very high chloride levels (20,000ppm).

If there is not enough oxygen and the local corrosives are not high enough to cause pitting, then general corrosion can occur. This might happen in a crevice (which has very limited oxygen) or in a strong, reducing acid (such as mid concentrations of sulphuric acid). General corrosion can occur when there are stray currents flowing from stainless steel to ground. This can happen in mineral extraction if the bonding arrangements are inadequate during electrowinning. General corrosion may also occur from galvanic effects, e.g. if a conductive carbon gasket is used on stainless steel in an aggressive environment.

Quantifying corrosion resistance

For circumstances where general corrosion is expected, graphs are available called iso-corrosion curves. They plot the effect of a single chemical and corrosion rate for temperature against concentration. An example is the graph below of a 42% nickel alloy 825 in pure sulphuric acid with air access. This graph shows that the corrosion rate increases with temperature, and that provided the temperature is less than ~45°C and a corrosion rate of 0.13mm/year is acceptable, alloy 825 would be suitable for any concentration of pure sulphuric acid. The boiling point curve is often included to show the limits of data at atmospheric pressure.

825 in Pure Sulphuric Acid



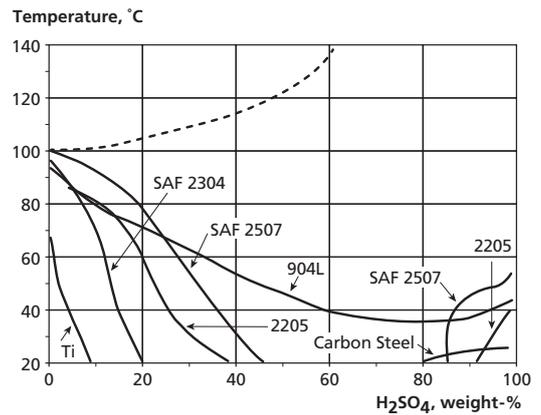
These rates are a hard conversion from inch units (0.001 inch per year), whereas metric data refers to <0.1mm/year, <0.5mm/year and >0.5mm/year and may include cautions about risks of pitting or cracking.

Most of the following graphs are from the *Outokumpu Corrosion Handbook*. The specific alloy compositions are tabulated in that Handbook.

However, a series of graphs showing the results for one material over the full range of concentrations and temperatures is cumbersome, and so multi-material plots are used for the initial material selection. Titanium is frequently included because of the widespread expectation that it is the "super" solution - although the data shows this is not always correct.

The graph below shows data for duplex stainless grades in pure sulphuric acid. However, only the 0.1mm/year lines are drawn for each alloy because it is assumed that a loss of 0.1mm/year would be acceptable for continuous exposure during 365 days per year. This assumption may not be acceptable if, for example, the process using the acid required very low iron levels. For each material, the temperature and concentrations of pure sulphuric acid that are below the line would mean a corrosion rate of less than 0.1mm/year.

Pure Sulphuric Acid



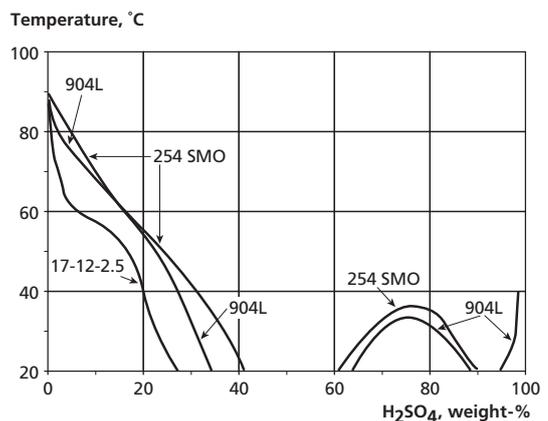
Isocorrosion diagram, 0.1 mm/year, in naturally aerated sulphuric acid of chemical purity. Broken-line curve represents the boiling point.

What about impurities and additives?

The graphs below show (and note the temperature scale changes from earlier graphs) the dramatic reduction in corrosion resistance when 200mg/L of chlorides (below) are added to sulphuric acid or ten times that amount, i.e. 2,000mg/L (above right). The heavily reducing range from about 40% to 60% acid concentration defeats even the high nickel 904L and 254/654 grades.

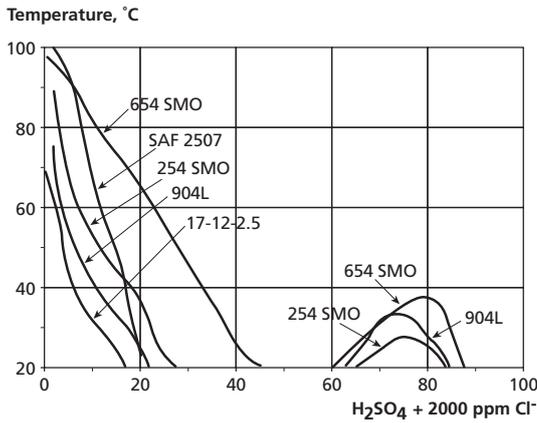
Nevertheless, a number of grades are potentially suitable for concentrations below 20% sulphuric even with significant chlorides. However, the graphs also show that at the other end of the concentration scale, the oxidising conditions, which occur for sulphuric acid above about 90%, are extremely aggressive if the acid is impure.

Sulphuric Acid with 200ppm Chloride



Isocorrosion diagram, 0.1 mm/year, in sulphuric acid with an addition of 200 ppm chlorides.

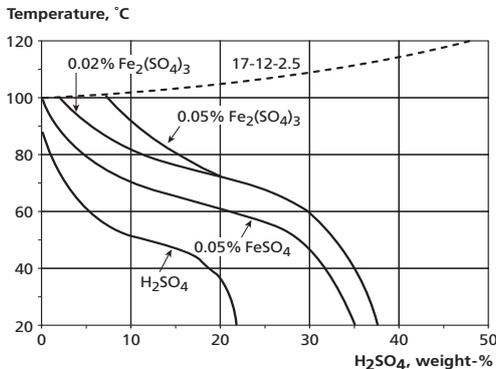
Sulphuric Acid with Chloride



Isocorrosion diagram, 0.1 mm/year, in sulphuric acid with an addition of 2000 ppm chlorides.

Some additives act as inhibitors to corrosion and this can be critical in selecting suitable materials for mineral extraction processes. For example, the graph below shows that adding iron ions to sulphuric acid improves the resistance of 316. Adding oxidising cupric ions has a similar effect but as with any inhibitor, attack can occur in crevices where the inhibitors may be used up. And despite the requirement for oxidising conditions to ensure stability of the stainless steel's passive layer, it is possible to add too much oxidant, e.g. small additions of chromic acid are good, but more than about 0.5% increasingly reduces corrosion resistance. It is relatively common to refer to the redox potential (rather than concentrations of oxidising ions) if the chemistry is not simple.

Sulphuric Acid with Iron Sulphate



Isocorrosion diagram, 0.1 mm/year, for steel 17-12-2.5 in sulphuric acid of chemical purity and in sulphuric acid with the given addition of iron sulphate. Broken-line curve represents the boiling point.

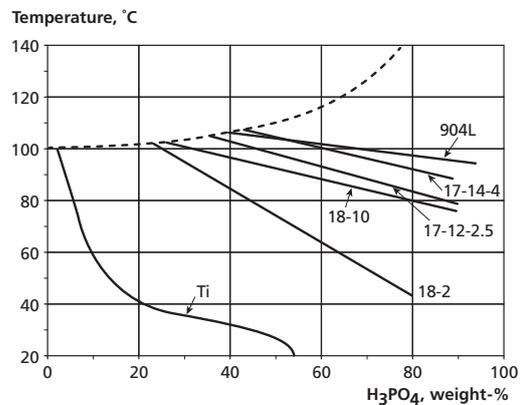
The data in this section is intended to show that while these iso-corrosion graphs are useful in predicting corrosion rates for specific pure compounds, the addition of aggressive ions, oxidisers or crevices conditions require more detailed consideration.

Materials selection for other chemicals

A very common chemical is phosphoric acid, which is used in cleaning, pre-treatments, food preparation and a host of other applications. It requires increasing chemical resistance with high temperatures and concentrations. For pure phosphoric acid, the iso-corrosion curves show a progression from ferritic 444, through the austenitic 304, 316, 317 to 904L. This is not an oxidising acid so although it removes iron contamination, it does not strengthen the passive film on stainless steels.

Phosphoric acid is frequently associated with chloride or fluoride ions especially in production from rock phosphate. The variation in composition in this wet process acid (WPA) means that iso-corrosion plots are of limited use. However, with thermally produced acid and various impurities, a plot of corrosion rate vs. contaminant ion concentration may be used instead of an iso-corrosion graph. It is critical to realise that iso-corrosion curves provide trend data and not precise values.

Phosphoric Acid



Isocorrosion diagram, 0.1 mm/year, for stainless steel in phosphoric acid of chemical purity. Broken-line curve represents the boiling point.

Alkalis

Austenitic stainless steels are resistant to general corrosion for all concentrations of sodium hydroxide and, for high concentrations, the usual problem is lack of solubility. However, at near boiling temperatures, austenitic stainless steels (and especially those with extensive chromium carbide precipitates) are susceptible to cracking. All this data can be shown on one graph.

Summary

If you intend to use a stainless steel with a new, relatively pure chemical, iso-corrosion curves offer an initial guide to the temperature and concentration limits against general attack. If there are contaminants or oxidants present, then the corrosion susceptibility can increase or decrease significantly and specialist advice should be obtained.



Specialists in Fabricating Stainless Steels



Ancon®

BUILDING PRODUCTS

Tel: 1300 304 320

▶ www.ancon.com.au/fabrications

International Tel: +61 (0) 2 8808 3100

Star Light, Star Bright

The magic of a clear night sky filled with stars has inspired many creative souls. Now, through a collaboration between science and art, a stainless steel sculpture installed at the Australian National University in Canberra brings new depth to the connection between ourselves and the stars above.



Image credit: Ben Wrigley

The 4 metre diameter, mirror-polished stainless steel sphere (called UNA), which sits in the science precinct at ANU, is so much more than first meets the eye. Designed by UK artist Wolfgang Buttress, UNA features 9,100 laser-cut perforations, which were mapped in collaboration with ANU astrophysicist Dr Daniel Bayliss.

The holes match the 9,100 stars that we can see with the naked eye from Earth and vary in size according to the brightness of the stars in the night sky (the brighter the star, the larger the hole).

Inside the sphere sits a second, two metre diameter mirror polished, stainless steel sphere. When viewed through one of the outer perforations, the internal sphere reflects small points of light from the outer sphere, creating, according to Mr Buttress, a microcosm of our perceived night sky.

"One makes connections to one self and the stars above. We are all made from stardust," he said.

The magic enters a different realm at night, thanks to the fibre optic lights that sit in the centre of the two spheres, casting a glow through the perforations.

Mr Buttress said the use of stainless steel and high quality fabrication were integral to the success of the project.

Aside from the ability to be mirror polished, he said stainless steel was specified due to its strength, resilience and, if maintained properly, the fact that it will look as good in 50 years as it does now.

The spheres incorporate around 2000kg of 4mm 316L, 2B finish stainless steel, which was supplied in 24 pieces by ASSDA Major Sponsor Sandvik Materials Technology. The pieces were laser cut to shape in-house on one of Sandvik's four laser machines. Sandvik VIC/TAS State Manager Stephen Orridge said each hole was unique in its shape and the work involved about 40 hours of programming.

The sheet was pressed by Dished & Flanged Ends to create the curved forms for both the inner and outer spheres. ASSDA Member and Accredited Fabricator NRG Piping then joined and welded each segment with only 1mm tolerance, followed by polishing. NRG Piping co-ordinated the fabrication, transport and installation of UNA.

Mr Buttress said the welding had to be done carefully to minimise distortion as all would be seen when it was mirror polished. "There is nowhere to hide. NRG Piping are amazing fabricators as they totally understand the properties and essence of stainless steel," he said.

Because the inner sphere had to be positioned inside the outer sphere during the fabrication process, a 600mm hole at the base allowed enough room for a welder to get access inside to polish out the internal welds.

The end result is one of the artist's favourite pieces that he has created. "By day, the inner world is revealed on close inspection and at night it has a different character as light pours out of her like a beacon. It works on a micro and macro level, at day and by night. It was a great marriage between art, architecture and engineering," Mr Buttress said.

ASSDA MEMBER CONTACTS:

NRG Piping Pty Ltd
Karl Manders, Director
+61 7 3807 1119
karl@nrgpiping.com.au
www.nrgpiping.com.au

Vulcan Stainless (formerly Sandvik Materials Technology)
Stephen Orridge, VIC/TAS State Manager
+61 3 9238 7200
stephen.orridge@vulcansteel.com.au

Cutting Stainless Steel Tube?
Cold, Quick, In-Situ, Clean; cut it with **NOVARTEC**

AIRQUIP + PIPE TOOL
PTY LTD

team@airquippipetool.com.au
Ph: 1800 088 990

GREATER CERTAINTY. GREATER QUALITY.

Find your local ASSDA Accredited Fabricator at www.assda.asn.au

ASSDA ACCREDITED

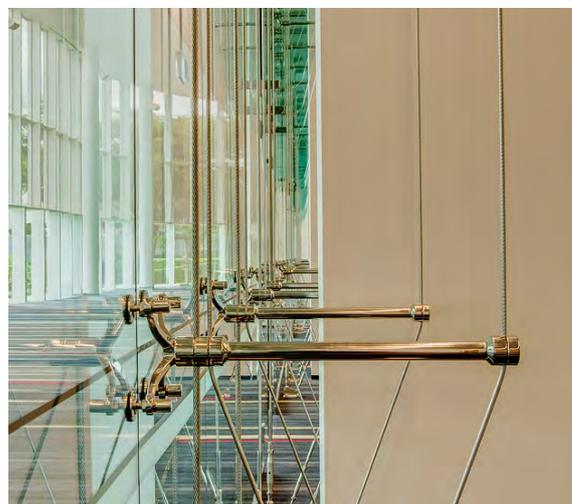


Image credit: John Williamson, House Guru

Grand Designs

A grand ballroom demands high impact aesthetics combined with maximum functionality, both of which have been supplied in spades at the recently refurbished RACV Royal Pines on Queensland's Gold Coast.

Central to Stage 1 of the award-winning refurbishment is a 55 metre long and 5 metre high floor-to-ceiling glass wall anchored and framed by nearly a tonne of stainless steel wire rope and fittings. The wall ensures an impressive visual impact, as well as enabling a flood of natural light, a stunning view, and flexible exhibition options.

Designed by Joseph Pang Design Consultants and project managed by Schiavello Constructions, ASSDA Member Structural Dynamics (Australia) Pty Ltd (Strudyna - an entity under the Arcus Wire Group) was contracted to work with Queensland Glass to meet the demanding needs of the wall's design.

Strudyna Architectural Manager Ross Munro said the installation was extremely complex, as well as being the team's first retrofit glass façade project involving engineering, supply and installation.

The client requested a vertical cable truss, internal glass façade and mirror polished fittings to ensure a high-end finish to compliment the refurbishment.

Mr Munro said the retrofit installation meant there were many challenges associated with working with an existing engineered structure.

"The suspended concrete floor had been built to a specific load capability and included post-tension cables within the concrete floor that had to be accommodated. This affected the loads that could be applied to the cable truss to keep the structure rigid, while considering slab deflection with loads from occupancy," he said.

The cable truss façade featured frameless hinged doors that were also emergency exit doors, so there were no horizontal cable elements to stabilise the trusses.

Around 926kg of grade 316 stainless steel were used in the job, including fittings/castings and 8mm and 12mm Hamma X-Strand. Hamma X-Strand is stainless steel wire strand with a high quality shine finish manufactured by KOS in South Korea to Arcus Wire Group's specifications, including annealing, pre-forming of wires and finished lay length, which significantly improves performance.

Electro bath polishing was used on the wire rope and floor and head tension plate brackets, while the spyders, rotules and compression posts were hand mirror polished.

In addition to the glass wall fixtures, other elements of stainless steel in the refurbished space included a staircase and handrail constructed by Arden Architectural Staircases and around 60 metres of 38mm grade 316 curved handrail fabricated and installed on an existing staircase by ASSDA Accredited Fabricator and Member Stainless Aesthetics.

ASSDA MEMBER CONTACTS:

Structural Dynamics (Australia) Pty Ltd
 Ross Munro, Architectural Manager
 +61 7 5568 7084, ross@strudyna.com.au
 www.strudyna.com.au

Stainless Aesthetics Pty Ltd
 Mike Mooney, Director
 +61 7 3899 5738 or 0433 709 327
 mike@stainlessaesthetics.com.au
 www.stainlessaesthetics.com.au

TIG Brush™
 stainless steel weld cleaning system

We make stainless stain LESS

www.tigbrush.com
 P: +61 2 4735 7700

An exciting change for stainless in Australia and New Zealand

Sandvik Materials Technology is now VULCAN STAINLESS...

... and we are still dedicated to providing you with the best in stainless products and services.

Plus, now as an independent company, we can expand our operations to better support the Australian and New Zealand markets while still having access to the full Sandvik stainless product line.



**VULCAN
STAINLESS**

ABOUT ASSDA

The **Australian Stainless Steel Development Association (ASSDA)** is a not-for-profit industry group that aims to increase the consumption of stainless steel in Australia. Established in 1992, ASSDA represents more than 200 member companies representing the stainless steel spectrum, including overseas mills, stockists and distributors, fabricators, engineering consultants, end-users and service providers. ASSDA aims to foster the understanding and use of stainless steel in Australia by developing the competence and efficiency of the industry through promotion, education and training, the provision of adequate technical advice and industry accreditation.

ASSDA could not continue without the valuable support of its sponsors and members, who work with ASSDA to grow the market for stainless steel.

www.assda.asn.au

ASSDA
AUSTRALIAN STAINLESS STEEL
DEVELOPMENT ASSOCIATION

ASSDA SPONSORS 1



ASSDA SPONSORS 2

Midway Metals, Outokumpu Stainless, Stainless Structural Asia, Stoddart Manufacturing, YC Inox Co., Ltd

ASSDA SPONSORS 3

Australian Stainless Distributors Pty Ltd, Dalsteel Metals Pty Ltd, Prochem Pipeline Products, Sanwa Pty Ltd, Stal tube Oy, Valbruna Australia Pty Ltd, Winsmore Pty Ltd

AUSTRALIAN STAINLESS is proudly brought to you by the Australian Stainless Steel Development Association (ASSDA).

MORE INFORMATION Enquiries for further information on any material presented in this publication should be directed to ASSDA:

Level 4, 243 Edward Street P +61 7 3220 0722
Brisbane QLD 4000 AUSTRALIA F +61 7 3220 0733
www.assda.asn.au E assda@assda.asn.au

EDITORIAL Contributions of story ideas specialising in stainless steel and its applications are welcome from members and non-members of ASSDA.

ADVERTISING Advertise in the only publication that targets more than 7,000 readers in the Australian stainless steel industry. Rates available at www.assda.asn.au/blog/

CONTACT Lissel Port, ASSDA Communications Manager: lissel_p@assda.asn.au

DISCLAIMER ASSDA sources articles and advertisements from a variety of contributors and accordingly does not accept responsibility for the accuracy of the contents of this publication nor the suitability of specific applications referred to herein for any particular use. Competent advice should be sought before acting on any matter contained in this publication.