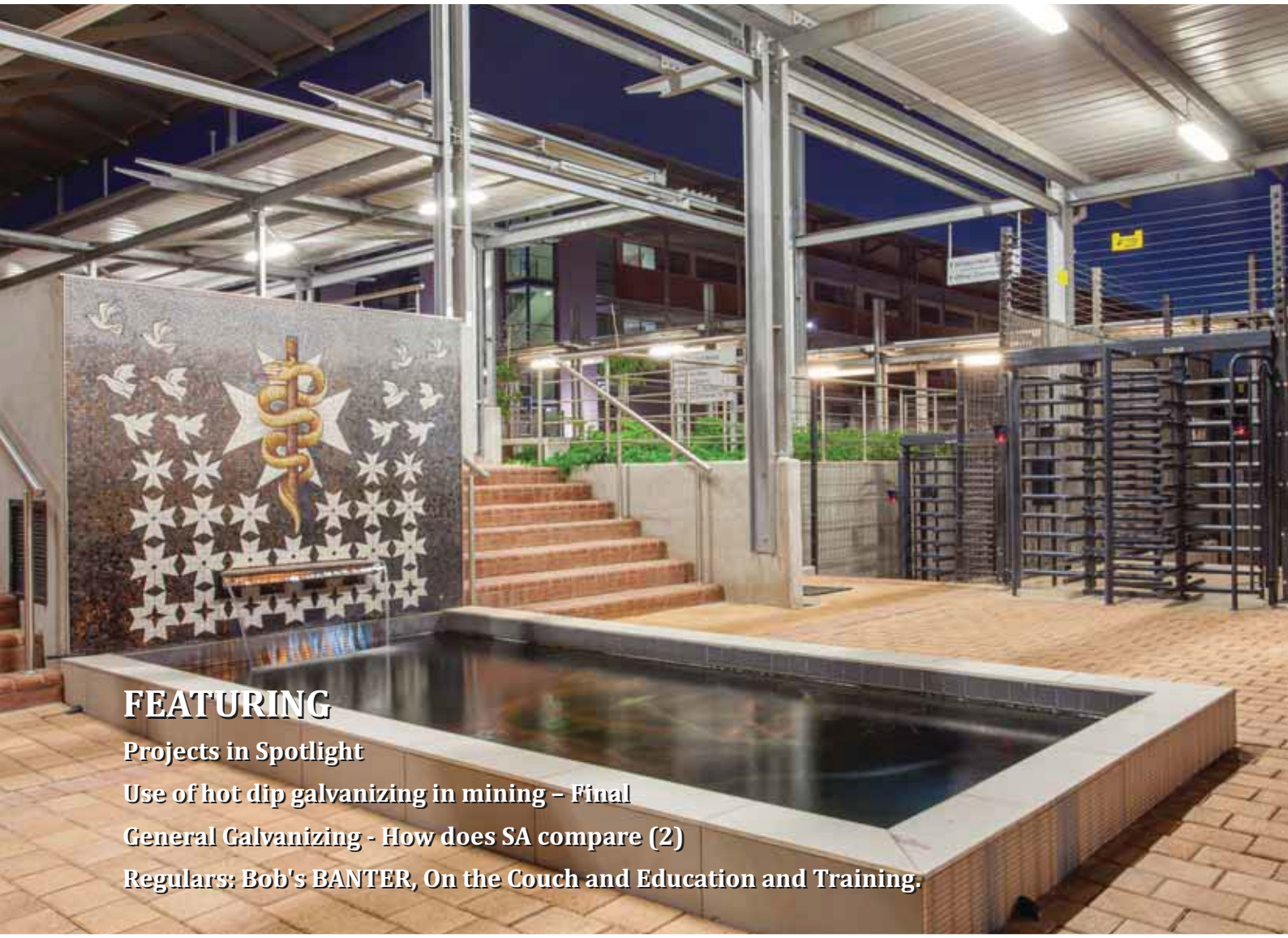
HOT DIP Galvanizing TODAY
59
Hot Dip Galvanizers Association Southern Africa 2014 Volume 11 Issue 3



FEATURING

Projects in Spotlight

Use of hot dip galvanizing in mining – Final

General Galvanizing - How does SA compare (2)

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Front Cover: The New Military Health Base Depot. The Last Glass House in Parktown. The Uzzi pedestrian Bridge in KZN and the "Boomslang" in the Aboretum in Kirstenbosch, Cape Town.

The Association is an information centre established for the benefit of specifiers, consultants, end users and its members.

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Hot Dip Galvanizers Association Southern Africa
Quality House, Unit U4, St. Christopher Road, St. Andrews, Bedfordview
P.O. Box 2212 Edenvale 1610 Tel: 011 456 7960 Fax: 011 454 6304 Email: hdgasa@icon.co.za Website: www.hdgasa.org.za

Executive Director: Shaun Amos Cell: 072 180 3733 Email: shaun@hdgasa.org.za
Office Manager: Saskia Salvatori Cell: 082 326 6080 Email: hdgasa@icon.co.za

Advertising and Sales: Anne van Vliet Tel: 011 462 5073 Cell: 082 775 0711 Email: mwvliet@mweb.co.za
Design and Layout: Sandra Addinall Tel: 011 868 3408 Email: cbtdesign@adcot.co.za
Reproduction and Printing: Camera Press Tel: 011 334 3815 Fax: 011 334 3912 Email: cpress@iafrica.com

Executive Director's Comment

This will be my final contribution to Hot Dip Galvanizing Today.

I have stepped down as the Executive Director being replaced by Mr Shaun Amos. Shaun comes to the Association with great operational experiences and a background that places him in an ideal position to revitalize the activities of the Association. Apart from his technical ability and commercial experiences, he has demonstrated his ability to acquire an in depth knowledge and understanding of hot dip galvanizing. I believe that with Shaun as the Executive Director, the Association will meet the future with renewed vision.

The zinc price is again causing concerns as the following numbers indicate. As I draft these comments for the magazine, the LMS price is quoted at US$2 270 per ton with a US$ to Rand exchange rate at 11-05 to 1. Assuming a US$250 per ton surcharge and converting to Rand, zinc costs approximately R27 846 per ton on todays pricing. Zinc together with energy and labour representing our industries major cost inputs, stability in hot dip galvanizing selling prices remains a challenge. This matter is most important when price medium to long term contracts.

This issue would normally feature our annual hot dip galvanizing awards. Unfortunately due to economic conditions brought about by strikes and a below budget performance, we were obliged to cancel our annual awards formal dinner. This step was taken with great reluctance as we had received a number of meritorious submissions, which deserve being published. Steps will be taken to publish these entries in future publications.

Looking to the future, with the continued development of renewable energy sources, the publicized DTI restrictions on defined imports versus local manufacture, such as power transmission lines, and the wider infrastructural development projects, we stand ready to meet the demands of the industry and its customers.

Bob Wilmot

Note from the Editor

It is with extreme sadness that I write this my last editorial comment for Hot Dip Galvanizing Today. I have been at the helm of the magazine since it was handed to me 19 years ago by the late Walter Barnett, the then Executive Director, as an eight page Journal.

The tremendous support I got from both Anne van Vliet who is responsible for advertising sales as well as keeping me editorially in line and Sandra Addinall who has painstakingly compiled and designed the previous and the new format of Hot Dip Galvanizing Today, was really appreciated and will sadly be missed.

The Association's main objective is to promote hot dip galvanizing and duplex coating systems as cost effective corrosion protective systems on behalf of our galvanizing members. These members make up about 90% of the current capacity of the galvanizers in South Africa.

Over the last 18 years I have enjoyed my interaction with Consulting Engineers and Architects throughout South Africa where I present an initial introduction of the Association and coating options. These professionals generally fulfill the role of specifiers of corrosion protection of steelwork used in projects. My initial interaction has been followed up as frequently as possible with subsequent visits where presentations and plant tours help to drive a better understanding of the coatings. In many of these instances trustworthy friendships have been formed over time.

Thank you to these Engineers and Architects who have in subsequent years made me feel extremely welcome each time I visited them.

To the final year Engineering, Architectural and Building Science students that I interacted with in various parts of the country particularly over the last few years, may you remember when you finally get to specify, the real choices one has to make when it comes to effective corrosion control and the role that Hot Dip Galvanizing and Duplex Coating Systems play in achieving this!

To the Association members who have supported my work, thank you for the support and confidence you have bestowed in me over the years.

The absence of the annual Awards Event which was sadly cancelled has led to Projects in Spotlight where we highlight a number of these deserving entries.

The Boomslang in Kirstenbosch Gardens; The Last Glass House; the New Military Health Base Depot and the Uzzi Bridge are just some of the projects.

We include the final part of the paper presented to Latingalva entitled 'The roll of the HDGASA in the direct or indirect promotion and use of hot dip galvanizing in various mining applications, including gold, platinum, iron ore and coal and future motivation of its use in the Petro Chemical Industry, in South Africa'.

The second part of 'General Galvanizing – How does South Africa compare' by Rob White is also included.

Regulars include our single and three day Hot Dip Galvanizers Inspectors course as well as 'Managing the unexpected' in Bob's BANTER.

On the Couch features two prominent specifying authorities including Henry Fagan (of Henry Fagan Consulting Engineers) and Mark Thomas (Mark Thomas Architects) both of whom were the designers of the Boomslang in Kirstenbosch Gardens.

Enjoy the "magazinc".

Terry Smith

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Kirstenbosch Tree Top Walkways

The partially finished "Boomslang" winds and dips its way through and over trees of the Aboretum.

The Centenary Tree Canopy Walkway is a curved steel and timber bridge that winds and dips its way through and over the trees of the Arboretum. Inspired by a snake skeleton, and informally called *'The Boomslang'* (meaning tree snake), it is a low-maintenance, low-impact sculptural raised walkway.

The Walkway takes the visitor from the forest floor into and through the trees and bursts out above the canopy, giving spectacular 360° vistas of the surrounding mountains, Garden and Cape Flats.

This walkway is 130m long, narrow and slender, with a few wider view-point areas, and lightly snakes its way through the canopy, in a discreet, almost invisible way. The walkway is crescent-shaped and takes advantage of the sloping ground; it touches the forest floor in two places, and raises visitors to over 11.5m above ground. It is more than just a traditional boardwalk, like a snake, it winds and dips.

The Arboretum is situated between the Protea Garden, Cycad Amphitheatre, the Dell, Mathews Rockery and the Concert Lawn.

The Centenary Tree Canopy Walkway was built in 2013-14 to celebrate the centenary of Kirstenbosch in 2013, and open to the public from 17 May 2014.

While the walkway has been designed to move as a snake would, it is intrinsically safe and can accommodate up to 1 300 people at one time.

Wheelchair friendly

The Boomslang is wheelchair-accessible, but the Arboretum is situated quite high in the Garden, so visitors in wheelchairs will need assistance to negotiate the steep gradients to get to the walkway.

How much did it cost?

The construction costs of around R5m are met entirely from bequests from many benefactors – in particular, R1m from the late Mary Mullins.

How long did it take to build?

The planning of the walkway started in 2012. The foundations were laid down in June 2013. Construction of the steel structure started in August 2013 and on-site construction of the framework began in November 2013. It was completed on 16 May and open to public from 17 May 2014.

Who is the architect, engineer and manufacturer?

This project is a collaboration between Mark Thomas Architects and Engineers Henry Fagan & Partners. Prokon Services in Blackheath did all the manufacturing with Andrew Rich who worked for three months on the drawings for the workshop.

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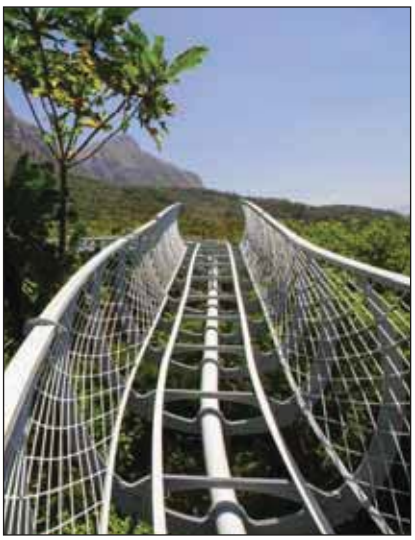

The carefully duplexed sections were hoisted by crane on site using soft slings and bolted in position to minimize disruption to the trees during construction.

Constructing the Boomslang

The main spine of the walkway is tubular steel, with welded ribs and a light mesh giving the cross bracing, allowing the whole form to act as a bridge-spanning beam. Continuous shaped timber handrails ensure the safety of the visitor. The decking is stained, treated, slatted pine, placed on edge and spaced to accommodate the walkway's curves.

The structure was pre-fabricated in 6m lengths with each 6m length consisting out of 3 parts, namely the left and right handrail sections as well as the central spine section.

Slings were used to load and off-load as well as throughout the galvanizing plant to prevent it from getting damaged. All components were cleaned using a galvanized iron cleaner to remove surface contaminants. Following water rinsing an etching product was used and left for about 15 minutes before being water rinsed again. Following drying, 2 coats of surface tolerant epoxy mastic were applied. Then for UV stabilization a final coat of polyurethane/ acrylic paint was applied.

These sections were then hoisted by crane on site also using slings and bolted together to minimalize disruption to the trees during assembly and reduced construction time in the Garden.

The foundations are submerged, hand-dug with reinforced concrete pads in select positions approximately 12m apart. The excavations for the foundations were done under careful supervision and care was taken not to compromise any root structures.

All that can be seen of the foundations are small concrete stub columns above ground, onto which the slender steel rod columns are bolted. These columns are H-sections and the steel rod around them was added to allow creepers to grow up the column.

The bridge was designed to allow some movement as pedestrians walk over it to enhance the feeling of being high amongst the trees. Nevertheless, it has been designed to safely support a load of up to half a ton on every square metre of bridge deck, i.e. over 1 300 people in total.

The total weight of the bridge is 15 650 kilogram with ±5.6km of 8mm round bar rods used. The bridge was painted with two layers of epoxy undercoat before installation and a top coat afterwards.

This is a first for South Africa with only something similar in London's Royal Botanical Garden, but our design is totally different and much more attractive.

Two more views of the snaking "Boomslang" over and through the tress of the Aboretum with stunning views of Table Mountain in the background.

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Redevelopment of the Tramways Building, Port Elizabeth

The Mandela Bay Development Agency (MBDA), the development arm of the Nelson Mandela Bay municipality, is responsible for a mandate area which consists of approximately 10.5 square km of land. Within that area there are a number of municipal properties that are not delivering any revenue in terms of rates or taxes, and also pockets of state land that are in disuse and will not be vital for future state use.

The historic Tramways Building is one of the first municipal buildings to undertake a facelift and forms part of the agency's plans to revitalise the central business district and Port Elizabeth harbour.

The Tramways Building has had a colourful history spanning over 116 years. It originally housed the city's electric trams as well as its own power station and workshops. Later additions included offices facing the river and later South Union Street. The building subsequently housed an ice rink and a number of small businesses.

The Tramways Building is at the entrance to Port Elizabeth's central business district and the mouth of the Lower Baakens River Valley and situated at the entrance of the Port Elizabeth Harbour, where it is a key building to the rejuvenation of the city's central business district.

Aurecon were appointed by the MBDA to undertake the structural design and site monitoring for the rejuvenation of the historic Tramways Building. The redevelopment entailed the refurbishing of existing structural steel elements and the design of new structures to be placed in the existing building envelope:

Corrosion protection

The building was a predominant industrial building during its life span. The MBDA design brief to the project team was to complement and fit in with the industrial feel of the building, with structural steel being the main structural element and feature of the building. As it is located less than 300m from the Port Elizabeth harbour and sits in the flood plain of the Baakens River Valley, the only solution was to use a duplex system

The revamped Tramways Building nearing completion.

A view of the historic Tramways building about 116 years ago.

A view of the internal duplexed steelwork during construction.

to provide corrosion protection to the new structural steelwork. A duplex system became the only option for this project because it addressed the client's brief to provide a sustainable solution while also adding an aesthetical appeal.

Rejuvenation of the existing roof structure

The two large halls which have now been combined were once used to house the off-duty coaches and trams. They will become a proposed exhibition area. The existing roof trusses and ornate cast iron monitor elements, as well as the riveted structural steel girders have been rehabilitated by a three coat paint system over a high pressure water and then abrasive blasted to Sa 2.5 surface.

All purlins on the existing roof were replaced with hot dip galvanized steel angles and duplex coated using a similar paint coating system to that used on the existing steelwork. In comparison it was found that the duplex coating system was more cost effective than the multiple paint coating including the inorganic zinc rich paint.

New steelwork: mezzanine, roof trusses and rafters

In the late 90s part of the existing building was burnt down in a fire. This roof was replaced with new structural steel trusses and rafters with a similar duplex coating system to the above.

New roof monitor louvers and fins

The original ornate cast iron monitors on the roof structure had lost their original timber louver fins. The MBDA gave a design mandate to reinstate the louver fins with a functional, aesthetically pleasing system ensuring that the exhibition space is naturally ventilated while at the same time minimising dust and water ingress.

Various material options were proposed to the client for approval. The preferred option was individual continuous hot dip galvanized bent plate louver fins, duplex coated in accordance with the new hot dip galvanized steel.

Gutters and dropboxes

Over time, all of the original cast iron gutters and drop boxes had either been stolen or replaced with asbestos gutters. The existing gutters were carefully removed and replaced with purpose made, pre-galvanized bent plate gutters, epoxy coated with the following instructions:

- Clean the galvanized surface using a quality industrial galvanized iron cleaner in combination with scotch bright pads to assure a water-break free surface. After the scrubbing operation is complete the surface shall be tested for water-break free condition. If not achieved, this operation shall be repeated until a water-break free surface is obtained.
- Once dry, follow up with a combination of an epoxy primer, intermediate high build epoxy then top coat of polyurethane with an overall paint DFT of 240 microns. Paint shall be applied strictly according to the paint manufacturer's instructions.

The new drop boxes were designed to complement the existing brickwork steps which are a prominent feature around the envelope of the building. Purpose made bent plate drop boxes were hot dip galvanized and painted to provide a full duplex system to the same specification to the one above.

Promote professionalism

The structural engineers (Aurecon) advised and recommended the proposed specification of the duplex coating system and helped to raise the awareness of the benefits of the system with the rest of the professional team.

A view of the internal duplexed steelwork during construction.

Aurecon worked closely with Sigma Coatings and the steel contractor Bisho Steel, to ensure that the MBDA received the best

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Further views of the new duplex coated steelwork installed to support the new mezzanine floor.

quality duplex system and that the finished product met the client's expectations.

Galvanising Techniques processed 68 645 tons of new steel work.

Provide service

Coating any surface requires careful preparation and good understanding of both painting and galvanizing. Sigma Coatings worked closely with Bisho Steel and Galvanizing Techniques to provide Aurecon with constant feedback during the fabrication and coating process. The client has been provided with a five year product and workmanship guarantee.

Celebration of superiority

The Tramways Building once added great status to the fledgling city of Port Elizabeth. It housed a power station that provided electricity to the city's prestigious Tramway fleet and the workshops that serviced these coaches from the turn of the 20th century.

Today, the project is part of the renovation and upgrading process of the inner city, which is being revitalised through creating markets for sport, ecology, arts and culture, education and training, conferencing and tourism. The duplex coating system will ensure that the Tramways Building will be functional for another 116 years.

Dissemination of knowledge

Junior Engineers and Young Engineers were seconded from the MBDA to Aurecon to gain knowledge of the structural and civil design aspects of the project. The Structural Engineers specified the hot dip galvanizing and the coating, while the Junior Engineers worked closely with Bisho Steel and Sigma Coatings to ensure that the duplex system was being applied and carried out correctly.

Sustainable resources

Although the Tramways Building project was not entered for a Green star rating, the project focussed on reusing many of the existing structural steel and timber elements in a creative and interesting way.

In conclusion

- A duplex system provides corrosion protection for at least twice as long as the individual lives of the galvanizing and paint used individually.
- A duplex system extends the service life of the product, thus decreasing maintenance costs for the MBDA.
- A duplex system provided the MBDA a solution of having the corrosion protection combined with the aesthetics of the key MBDA Grey/Blue colour which is a predominant colour that ties many of the MBDA projects.
- Duplex systems provided the MBDA an economic solution because of the extended time to first maintenance and delayed maintenance cycle. Initially, the cost of a Duplex System is higher because both corrosion protection systems must be paid for. However because of the synergistic effect, the initial premium cost pays off over the life of the project and in the end is less expensive than coating bare steel.

The historic Tramways Building is one of the first municipal buildings to undertake a facelift and plays a major part in the MBDA's plans to revitalise Port Elizabeth's central business district and harbour.

The roof rafters which were replaced following a fire in the nineties by a similar duplex coating system, were reused.

The design team have worked hard to ensure that the building has retained its historic character and charm, by utilising the advantages of hot dipped galvanizing and the long term cost benefit thereof.

The experience gained through this project is currently helping us to assist the MBDA on their future rejuvenation projects in the area.

We keep the Hot Dip Galvanizers Association of Southern Africa informed of all our major projects country wide and they in turn add tremendous value to our projects through advice to our engineers on the practicalities and technology required for quality hot dip galvanizing and duplex coating systems.

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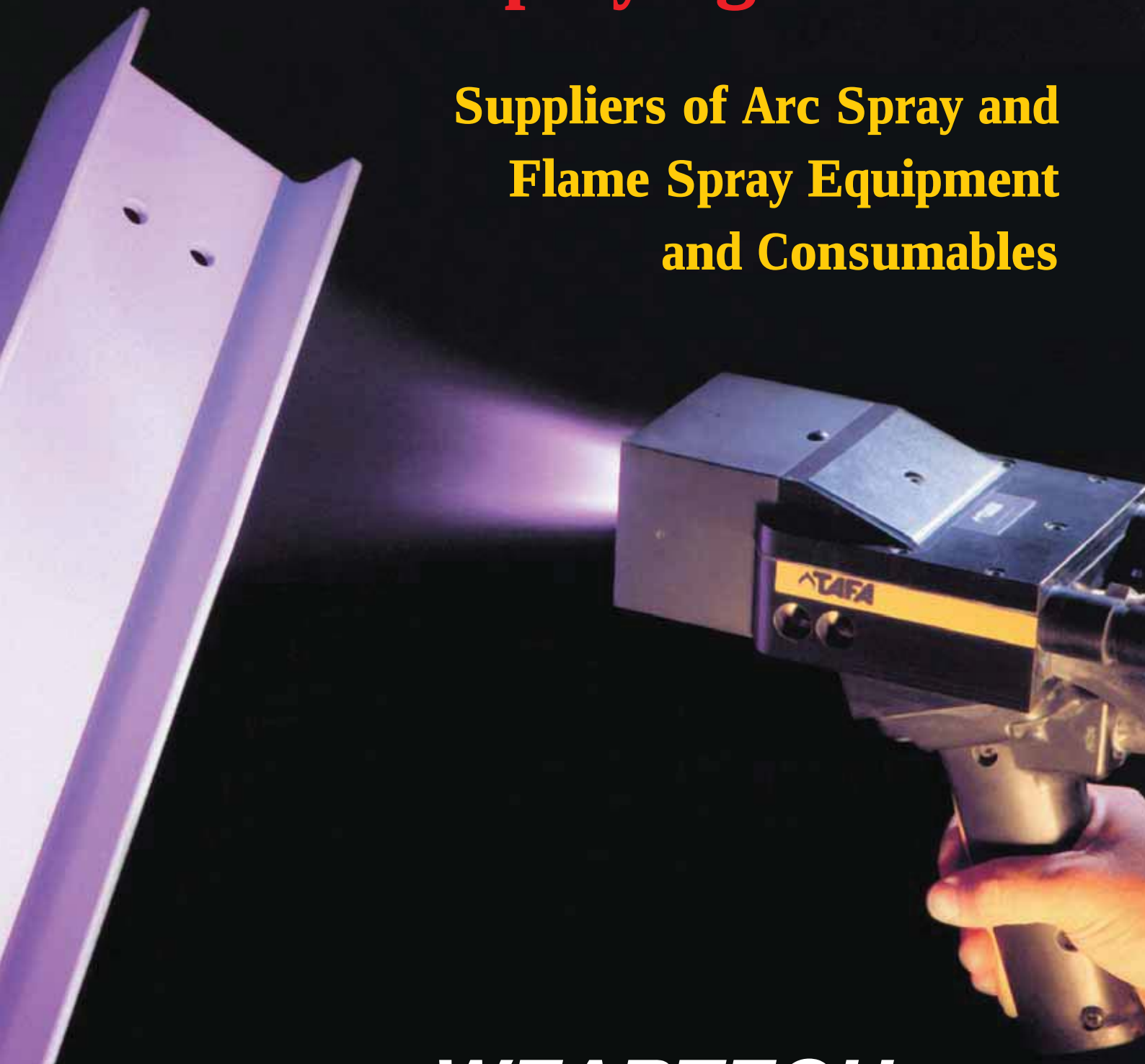

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New Military Health Base Depot

The Military Health Base Depot (MHBD) is a formation within the South African Military Health Service (SAMHS) responsible for the acquisition, stockpiling and distribution of medical supplies and pharmaceuticals. SAMHS required a larger, more secure and modern base to ensure optimum functioning of this crucial formation within the Department of Defence.

An existing military property of 64 571m² in Thaba Tshwane was selected as the most suitable site. A number of the existing buildings on site were identified to have significant heritage value and had to be retained in the new design.

The architect for this project was Jeremie Malan Architects in joint venture with Impendulo Design Architects. The structural steel engineer was Emzansi Consulting Engineers and the hot dip galvanizers were Supergalv and Robor Galvanizers.

In keeping with the historic warehouse character of the site and the storage function of the new buildings, the new design displays an industrial aesthetic. The existing hangar buildings use steel structures and sheeting extensively. The design exploits these aesthetics in the new buildings. Pre-painted steel sheeting on steel support structures is used as side and roof cladding for the large warehouse buildings. Steel, especially hot dip galvanized (HDG) steel, is the material of choice to provide structures that are low maintenance with a durable finish that remain attractive over time.

High level 3m wide cantilever hot dip galvanized steel truss, supports galvanized sun control grids below it.

Meticulous care was given to the detailing and construction of each building element, including HDG steel. Two architectural clerks of works and a structural resident engineer monitored construction quality throughout the project. Quality of work was addressed with the galvanizers, steelwork sub-contractors and the main contractor on a continual basis to ensure a quality product. Architectural, structural and workshop drawings were produced to detail each HDG steel member for the hot dip process. All connections (bolts, nuts, flanges, etc.) were detailed and constructed.

For the three largest buildings a HDG steel sun control grid is visible on the northern and southern facades. A high level truss that cantilevers three metres supports the HDG steel grid suspended below it. The structure carries aluminium sun control filigree and a steel roof over the truck loading bays. The filigree provides effective sun protection for the large office windows. The advantage of the design is that one cantilevered HDG steel truss with suspended elements is used in place of individual cantilevers at many levels. Columns could not be used at ground level because of vehicle movement at the loading bays. Horizontal and vertical HDG steel channels have finely detailed connections to accommodate filigree and canopy roofs. The structure reads as a light and semi-transparent vertical screen against the backdrop of the mass of the industrial scale building. HDG steel provides an excellent durable and maintenance-free finish at heights that would be difficult to reach in future.

Hot dip galvanized steel canopies provide protection for the pedestrian walkways linking different buildings across the site.

The HDG steel provided the designers with a lightweight structure to resolve aesthetic issues relating to sun control and covered spaces for pedestrians and vehicles. HDG steel provided answers to resolving difficult architectural and engineering challenges.

Hot dip galvanized (HDG) steel canopies provide protection for the pedestrian walkways linking different buildings across the site. The canopy roof in the heritage area is a lightweight structure cantilevered from a single line of columns to minimise the visual impact on the historic buildings and ensure free movement of pedestrians. In other areas sturdy concrete stub columns support the steel columns, emphasising the structural strength and relative lightness of steel. These light structures provide an unobtrusive and elegant physical link to the historic buildings. Their galvanized finish becomes a continuous visual element that binds the buildings and site into a cohesive whole with a strong identity.

The existing ammunition store was identified to have high heritage value as there are only a few remaining in the country. However, its brick walls were cracking badly and the concrete flat roof was in poor condition. Through creative design and the input of the engineer, a way was found to restrict further damage to the building while still ensuring an aesthetically pleasing end-product that preserves its historic integrity.

HDG steel I-columns were wrapped up around the building (without touching it) to carry a new steel roof for protection of the existing concrete roof. HDG steel angle straps were aligned continuously to the inside and outside of walls with a connecting bolt in-between, thus holding the existing walls tightly in position and preventing further cracking. The external facebrick finish therefore remains untouched. The HDG steel straps are connected back to the I-columns for extra stability. Once again HDG steel provided an answer to resolving a difficult architectural and engineering challenge.

Of the existing buildings on site, two old Bellman type steel aircraft hangars and one railway type platform building had to be retained and restored as per heritage legislation. All were re-fitted internally to accommodate new functions. The doors of one of the hangars were stripped of sheeting to expose its steel skeleton as a feature. The steel structure skeleton of another hangar was retained and re-cladded with steel and translucent roof sheeting to create a covered ceremonial area. Complete steel structures of another four hangars were carefully dismantled, documented and re-erected elsewhere.

Although HDG steel was not involved with these buildings, it was used as loose attachments in the form of walkways, balustrades and tree guards which further enhanced the contrast between old and new.

Details of HDG steel elements, their connections and their connections with other materials (e.g. aluminium filigree and aluminium ceilings) were carefully coordinated between architect and engineer to ensure the final manufactured product fits the architects' design concept.

As indicated before, the choice of finishes and building material was advised by the need for low maintenance costs and durability. There was also a need to balance the initial costs to the project budget. The project location being an inland area, the elements would not be exposed to a harsh environment. The design philosophy was also aimed at providing a landmark structure. A conscious decision was made to provide protection that was environmentally friendly and at the same time durable. Hot dip galvanized steel provided such protection. It was therefore decided that all exposed structural steel elements would be hot dip galvanized save for the refurbished elements since it would have been costly to dismantle and taken them offsite for galvanizing.

The design approach to the façade elements was such that on-site handling of the materials would be functional. The elements, especially the sunscreen steelwork, were designed in modular sections to ensure ease of coating (consideration was given to the accessible hot dip galvanizing bath sizes) and erection procedures as well as storage on site.

The Hot Dip Galvanizers Association of SA (HDGASA) was approached for technical assistance. A technical specification was drawn up which was approved by the HDGASA. Use of HDGASA literature for hot dip galvanizing and SANS 121 was used in putting together the specification. The specification considered addressing the coating thickness which would address the architectural finish required for the steel; preparation processes of the steelwork by the fabricator; logistical considerations; and erection processes on site.

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A checklist was also put together to ensure that the processes and procedures required for hot dip galvanising were met by both the Design Engineer, Fabricator, Galvanizer and Erection team. Regular visits were made to both the Fabricator and Hot Dip Galvanizers to ensure that the specifications were being adhered to. Coating thicknesses were measured at each visit to ensure that they were within the tolerances required.

The above process ensured a consistent quality coating that will add value to the project for many decades to come. It adds the value of a consistent, maintenance-free and extremely resilient finish that will outlast any other component or finish available in the market.

The project went a long way in ensuring that not only was hot dip galvanizing specified as a protective coating, but that consideration is given to architectural design requirements. The synergy of a durable protective coating and aesthetic value had to be managed with all role players playing a critical role in ensuring that this was achieved. The HDGASA ensured that role players were well conversed with the requirements of architectural hot dip galvanizing. Prior visits were arranged to Robor Galvanizers, an association member, to learn about hot dip galvanizing. This was attended by the Design Engineer, the Fabricator and HDGASA.

The Design Engineer also attended a workshop on the improvements in hot dip galvanizing technology which was conducted at Robor Galvanizers by Professor Stephens Yeomans of University of New South Wales, Canberra, Australia. This also showcased the extensive applications which hot dip galvanizing is being used for, such as galvanized reinforcing steel for durable concrete structures. This assisted the Design Engineer in ensuring that specifications and processes of implementing the project were met in line with international norms.

The New Military Health Base Depot is a high profile project for the Department of Public Works and the Department of Defence. It is a landmark project because of its size, quality and complexity. The critical function that the Military Health Service fulfils in the South African Military increases its importance and visibility further.

The extensive use of hot dip galvanized components exposed a number of role players (i.e. architects, engineers and multiple sub-contractors and foremen) to its unique characteristics and requirements. The scale and variety of application effectively showcases the material to laymen and those in the building industry. It becomes a very clear point of reference to those who have not been exposed to HDG steel before.

The use of a hot dip galvanized steel finish for the external elements impacts positively on the long term sustainability of the project.

A total of 350 tons of carefully detailed hot dip galvanized steel elements is a notable contribution to the galvanizing industry for a single project.

The use of a hot dip galvanized steel finish for the external elements impacts positively on the long term sustainability of the project. A strong and relatively lightweight material that requires no additional paint finishing or maintenance has obvious financial and environmental advantages. When used in high or hard to reach places its advantages over other finishes become even clearer.

The project is unique in the way that galvanized steel is used across an extended site - not only as a modular building element in various buildings, but also as an aesthetic visual element that joins the buildings, circulation routes and site. Galvanized steel, due to its unique properties, is utilized as a key ingredient to bind other materials, i.e. concrete, brick, steel sheeting and glass, into a coherent whole.

The new Military Health Base Depot is a unique project that posed many architectural challenges. Hot dip galvanized steel as building design element allowed the design team to come up with creative solutions that are strong, practical, no-maintenance yet aesthetically pleasing. By carefully considering its properties and advantages, HDG steel was used as the binding design element to create an industrial complex that is not only functional but also aesthetically appealing.

The architecturally interesting hot dip galvanized steel vehicle entrance welcomes all visitors to the depot.

The Last Glass House – new residence in Parktown

The 'Last Glass House' is situated on the rocky outcrop of the Westcliff Ridge, with a view to the west through existing electricity pylons, over a valley, with Auckland Park and Melville in the background. The owner/ developer is Roelof Petrus van Wyk and it was designed by architects Thomashoff & Partners.

Approximately 20 tons of steel was used in the construction of this private residence. The hot dip galvanizer was Robor (Pty) Ltd.

The brief was simple – to design a dwelling for an artist. This was to include a bedroom suite with an en-suite bathroom; kitchen; dining area; lounge area; study area; and a guest room facility. Ancillary facilities include a swimming pool, staff quarters and a storage facility.

The design is inspired by the rich history of Johannesburg – the goldmines and its industry, incorporating the essential functionality of the industrial buildings in central Johannesburg. A key characteristic is the use of mass-manufactured steel fenestration. Another element of inspiration was the galvanised steel electricity pylons located a few metres away from the site in a municipal servitude.

The site falls approximately 6 metres from east to west. The project was conceptualised as a series of interrelated spaces, defined by elements such as retaining walls, the horizontal planes of the terraces, and glass walls. Significant spaces contain major landscape elements, such as a massive century old oak tree, the pool, a landscaped mass of natural grass, and a landscaped earth berm.

These create a series of spaces or outdoor rooms integral to the landscape and with various degrees of privacy. The top terrace becomes a threshold space, with pedestrian and vehicle entrance and parking. The main structure is situated on the intermediate terrace, a semi-private external space that contains the swimming pool and entertainment area. The bottom terrace to the west is the most private - the double volume bedroom suite opens onto the garden under a large oak tree.

The total steelwork structure with glass windows and sheeting cladded gable end was custom fabricated to the client's specifications. The project is a showcase of innovation, technology and the creative use of hot dip galvanized steel.

The residential structure is 5m wide and 42m long, consisting of a single open plan space that contains most of the required functional areas. The steelwork structure comprises mainly of galvanized steel hollow sections forming the columns and window frames and galvanized hot rolled sections forming the rafters and eaves beams. The roofing material is continuous hot dip galvanized Brownbuilt sheeting supported on galvanized steel purlins.

The roof plan is 42m x 7.8m. The column heights vary from 4m to 7m. The rafter span between columns is 5.2m. Hot rolled sections, hollow sections and grating have also been used in other ancillary building elements inside and outside the main house such as timber floor supports, boundary walls, walkways, steps and ladders – all these elements were hot dip galvanized. Prefabricated shipping containers are used as additional freestanding units to supplement the main house.

The roof shape is unique in that it has a negative double roof angle or inverted apex with the gutter low point moving across the

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To the north and south of the main structure, the guest room facilities and staff quarters are accommodated in re-purposed industrial shipping containers.

The roof plan is 42m x 7.8m. The column heights vary from 4m to 7m. The rafter span between columns is 5.2m.

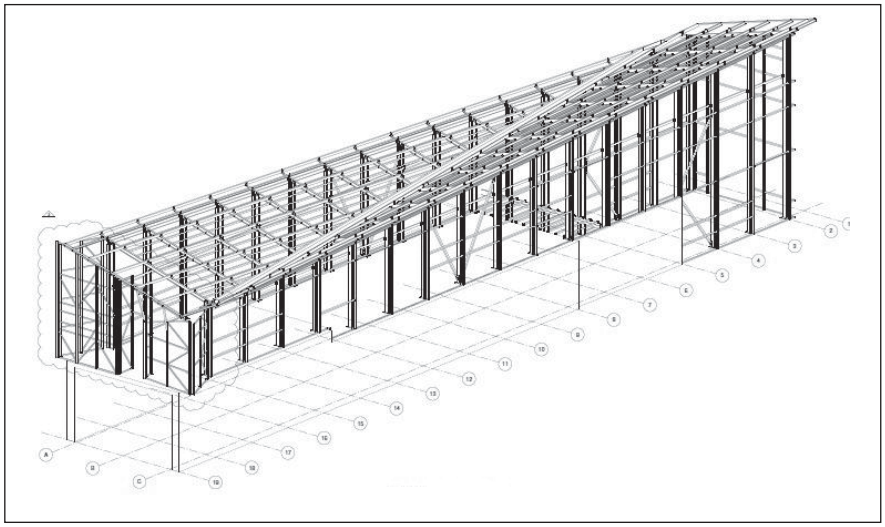
The manufacturing process (including the hot dip galvanizing process) was constantly kept in mind during the design process. Mock-ups were constructed on site to test detailing before the structure was manufactured and hot dip galvanized off site.

All window and door frames were custom designed and detailed – no standard windows or doors were installed. The design of these elements thus required the detailing of all aspects – from the installation methodology in the steel frame, to weather bars, pivot hinges and locks – all hot dip galvanized steel.

roof section from one column side to the other. This resulted in a different column height and rafter shape at each column grid line. This visual effect is visible in the ceiling that follows the rafter profile.

The total steelwork structure with glass windows and sheeting cladded gable end was custom fabricated to the client's specifications. The brief from the client further demanded that no flashings may be used. The steelwork frame was fabricated, welded and hot dip galvanized as complete portal frame elements with site connections kept to a minimum.

Where required site connection welds were necessary, the consequent damaged hot dip galvanized coating was successfully treated using the materials and methods required by the standard to obtain an acceptable coating repair.



The roof shape is unique in that it has a negative double roof angle or inverted apex with the gutter low point moving across the roof section from one column side to the other.

Hierarchies of privacy are obtained through vertical separation, by the use of a split-level configuration. To the north and south of the main structure, the guest room facilities and staff quarters are accommodated in re-purposed industrial shipping containers.

The complete steel structure was designed in detail by the engineer and architect, including all bolted connections and cladding details. The manufacturing process (including the hot dip galvanizing process) was constantly kept in mind during the design process – in fact, these processes primarily influenced each design decision. Mock-ups were constructed on site to test detailing before the structure was manufactured and hot dip galvanized off site.

Site connections by welding were kept to a minimum. All parts were cut, drilled and prepared at the factory off-site and then hot dip galvanized and finally transported from Centurion to Johannesburg. The complete structure was assembled in a period of two weeks on site.

The client required a finish on the steel that would protect against corrosion. It has been proven by existing hot dip galvanized structures in a relatively low corrosive environment such as Gauteng that the expected life span of the hot dip galvanizing corrosion protection is well in excess of 30 – 40 years. The finish had to be cost effective. Comparisons between hot dip galvanizing, applied paint, and powder-coating were drawn up and carefully considered.

The finish had to be resistant to specific on- and off-site conditions. The complete structure was manufactured off-site. The finish had to perform well and resist damage that could occur during transportation, and had to show resistance to rough conditions on site during assembly and during the construction process while the rest of the structure was completed.

The finish had to prove that it is UV resistant and performs well in all local weather conditions. The finish had to have a very specific aesthetic quality that would complement the galvanized steel electricity pylons on the adjacent site - the client wasn't interested in a monotonous, applied finish such as paint or a powder-coating finish.

In a typical residential development a house gets repainted on average every 4 – 5 years. Hot dip galvanizing's initial cost compared to the ongoing cycle of re-painting costs will be more cost effective.

The steelwork structure comprises mainly of galvanized steel hollow sections forming the columns and window frames and galvanized hot rolled sections forming the rafters and eaves beams.

Hot dip galvanizing proved to be the only finish that is long-lasting, corrosion resistant, cost effective, and adds value to the vision of an industrial and robust aesthetic. All the galvanized elements have a mean coating thickness of in excess of 55 microns.

It is very rare for buildings to be anything other than one-off products. Constructing this building included a fair amount of experimentation, and resolution of details, sometimes on site, with the detail drawings following on the manufactured component. Manufacturing and assembly marks and details were left exposed to retain the clarity and honesty of the manufacturing and assembly process. This has meant that normal imperfections usually removed during a phase of finishing were retained, as it was considered important not to sanitise the house from the story of its manufacture.

These are clearest at the connections and junctions between different materials. An effort was made to utilise appropriate material in keeping with its intended role and purpose.

All window and door frames were custom designed and detailed – no standard windows or doors were installed. The design of these elements thus required the detailing of all aspects – from the installation methodology in the steel frame, to weather bars, pivot hinges and locks – all hot dip galvanized steel.

The whole project team – engineer, contractor, subcontractors and the architect were involved in the decision-making process to solve the details. The whole team benefited from this collaborative problem solving process – knowledge and ideas were shared and the results were surprising and led to innovative design solutions.

The project is a showcase of innovation, technology and the creative use of hot dip galvanized steel. During construction, visitors from all over the country came to view the progress. Students from the University of Pretoria, the University of Johannesburg, Wits and Tshwane University of Technology visited the site with lecturers to view, learn, and get exposure to the innovative use of the materials and the framed structure. Architects, architectural firms, and engineers also visited the site to view and experience the progress.

As a unique architectural residential development it is foreseen that this project will be published and documented in the architectural residential media, giving it exposure and promoting the use of hot dip galvanizing.

The Dreunberg Solar Power Project

Two plants, at Linde, in the Northern Cape, and at Dreunberg, in the Eastern Cape, are being developed by Scatec Solar through its South African joint venture company. Both regions get a lot of sunlight, which allows for solar power to be generated. The two plants will produce more than 225-million kilowatt hours a year, enough to power 53 000 households.

The Dreunberg project, near Burgersfort in the Eastern Cape, covers approximately 225ha and will connect to the existing Dreunberg substation, less than 100m from the project site.

Contour Track offers a flexible tracker system for all terrain types. The system allows for maximum flexibility of plant design and a high standard of reliability and durability.

The unique feature of the Contour Track system is that is can be adapted for any terrain type. This eliminates the need for major earthworks resulting in a structure that has minimal impact on the surrounding environment.

Tricom was appointed as one of several contractors to manufacture the Dreunberg steel requirement, and the principle supplier of the Drive Stations due to their tight tolerances and Tricom's high quality manufacture.

The Dreunberg project specified the requirement for hot dip galvanizing. Without its own galvanizing facility, Tricom enlisted Galvadip as the sole galvanizer on this project.

The unique feature of the Contour Track system is that is can be adapted for any terrain type. This eliminates the need for major earthworks resulting in a structure that has minimal impact on the surrounding environment.

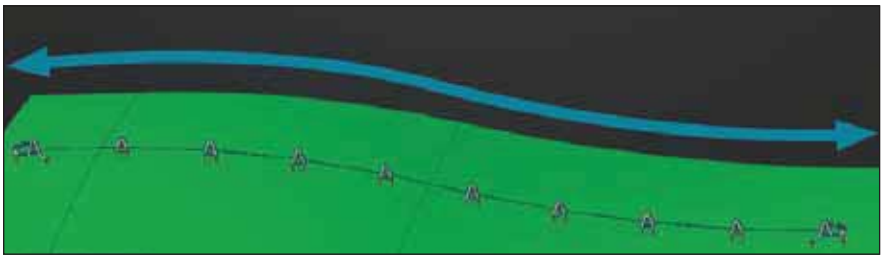


Figure 1: Contour Track Systems Adaptation to Terrain, illustrate how the system can be configured to span a contoured terrain.

As all components in solar plants such as this are continually exposed to the elements, corrosion protection must be effective. The initial cost of galvanizing was more expensive than the proposed paint system but in comparison from a life cycle perspective, hot dip galvanizing was selected over paint. Hot dip galvanizing has over the decades proved to be an effective corrosion protection system for solar projects.

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Hot dip galvanizing has over the decades proved to be an effective corrosion protection system for solar projects.

These frames allow the standard solar panels to rotate up to 90°, exposing them to UV rays from sunrise to sun set.

Hot dip galvanized steel components packed and ready for delivery.

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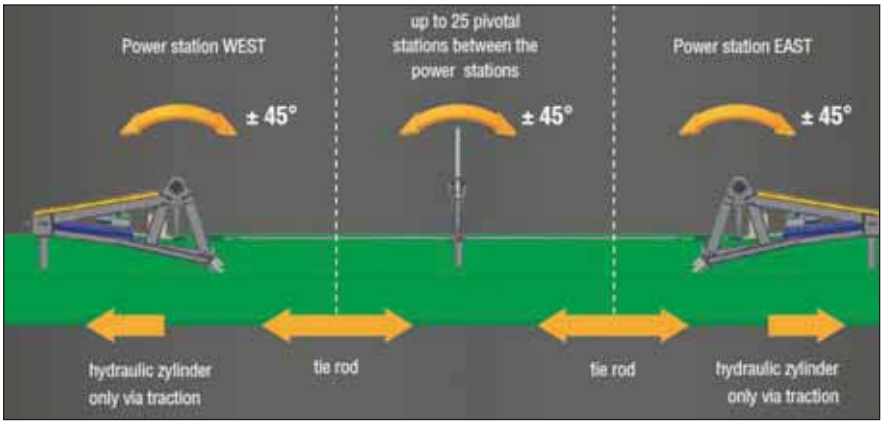
SILVERTON ENGINEERING

Hot dip galvanized steel components packed and ready for delivery.



The Contour Track system improves on the standard application of solar panels by tracking the sun throughout the day. Able to rotate up to 90°, the solar panels can be exposed to UV rays from sunrise to sun set.

Solar panels are becoming more and more common. Many housing complexes and game farms across South Africa utilise solar panels to generate energy to perform tasks such as heating water. These panels are generally in a fixed position and so are limited to their exposure to sunlight as the earth rotates.

The Contour Track system improves on these existing applications of solar panels by tracking the sun throughout the day. Able to rotate up to 90°, the solar panels can be exposed to UV rays from sunrise to sun set.

The Dreunberg project involves multiple phases involving multiple teams, both within the structure of a single contractor as well as between contractors. Tricom and Galvadip consulted almost daily throughout the cycle of the project – liaising on subjects such as high priority items, quality issues, product issues and potential improvements to the process and product.

Without teamwork between the two organisations, the project would have experienced a negative impact on its schedule.

In conclusion the quality standards and record requirements of Galvadip, Tricom and the client ensured the product coating met the highest possible standards.

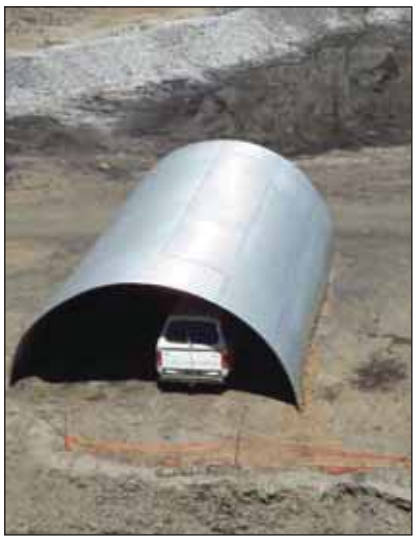
The project when fully operational will contribute to the national grid. Harnessing the sun's energy and converting it into electricity ultimately reduces the demand on Eskom's traditional power production.

Blast protection covers at Syferfontein

Hot dip galvanized steel corrugated products supplier Armco's culvert sections were used as canopies to protect labourers and equipment from falling rock, working in front of a high wall at Syferfontein.

Because of its strength, relative lightweight and resistance to fracture, the Armco corrugated steel structure was installed quickly, easily and without any incidents.

The product was used for a purpose other than it was designed for. The structure of the products provided easy transport and assembly on site. The hot dip galvanizing added additional protection against physical and environmental damage and also a uniform look and feel to the site as well as a cost effective means of providing barrier and corrosion protection.



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Cellular towers at Cell C Headquarters in Midrand

Sectional Poles, based in Hammanskraal is a market leader when it comes to manufacturing and installing cellular towers. They designed, manufactured, project managed and installed two cellular towers at the Cell C Head Office in Midrand.

What makes the project unique is the fact that besides the towers being functional they were also used as a marketing statement in daylight and when lit up at night.

The towers have a unique look to them that sets them apart from the standard cellular mast common to the market. The towers have been featured in various technology articles relating to their innovative design.

Hot dip galvanizing was used as the primary barrier against corrosion and finished off with a duplex coating for added aesthetics, colour as well as a secondary corrosion protection barrier.

The main contractor and developer was Sectional Poles with Armco Galvanizers galvanizing 120 ton of steel.

The informative top of the Cell C tower.

Conveyor river bridges

By March 2015 Sasol Mining's existing coal mine, Brandspruit will be replaced by Impumelelo Coal Mine supplying coal to Sasol Synfuels coal-to-liquids operation in Secunda.

A number of overland conveyors designed to transport 8.5Mtpa of coal are being built by a number of companies of lengths up to 27km long. With overland conveyors this long, invariably obstacles will be encountered along the way.

Two such obstacles were the Waterval and Kaalspruit rivers where bridges had to be constructed.

The bridges were fabricated and installed at the rivers to ensure the overland conveyors could safely travel over the bridges. The bridge project lasted 10 months, 4 months for planning, drawing and fabrication and the installation took 6 months. 12 people were involved with the manufacturing and 10 people with the installation. For long term durability, Sasol specified that all the steel had to be hot dip galvanized.

The developer/owner was Sasol, main contractor Liviero Civils, steel fabricator Voldeo cc and galvanizer Armco Galvanizers.

The hot dip galvanized bridge together with side and top cladding hoisted into position over the river.

A view of the bridge through the centre.

The completely assembled hot dip galvanized bridge.

Uzizi Pedestrian Bridge in the Tugela Ferry District

The Uzizi pedestrian bridge which now forms a permanent structure over the Tugela River was erected to create a safe crossing point for the local community. The local community used to cross the river using 20lt buckets for their clothes and then floated alongside the buckets across the river. Children attending school on the opposite bank went through the same routine.

The bridge, completed in June 2013 is situated less than 100km from the coast in rural Kwa-Zulu Natal.

A paint coating was considered but was declined due to questions over application reliability, potential mechanical damage and over time difficulty of future maintenance, which when required may have had potential negative effects on the biodiversity of the river system and general environment.

Costing R8.7 million the bridge consists of two mass concrete foundations which anchor the support cables, which in turn are supported by a concrete pier with 2 columns (6m high) about 120m apart on either side of the river. A hot dip galvanized suspended girder type walkway is fixed to the two support cables.

Two hot dip galvanized steel access ramps with supporting concrete columns allow for safe access and exiting of the bridge.

With hot dip galvanizing, maintenance will not be required in the medium to long term and hence the choice is more environmentally friendly in the long run.

The long term cost effectiveness will by far out-weigh the alternative paint coating system due to the maintenance-free life that hot dip galvanizing has to offer the user. The reliability and predictability of the zinc coating will provide the local community with an aesthetically pleasing steel structure which will improve the community's daily living conditions by offering safe human and animal crossing of the Tugela river years into the future.

Nonkhoo & Associates were the developers, with the designer being Geoff Boutell of GDB Engineers, Project Manager Prassi Nonkhoo, Main Contractor Ingoyama Nicon and Galvanizer Bay Galvanizers.

Above: Two views of the Uzzi Bridge.

The hot dip galvanized suspended girder type walkway and components are fixed to two support cables that are fixed 120m apart on either side of the river.

Beth Diane Armstrong: artist

Beth is a sculptor working primarily in steel. After completing her Masters of Fine Arts with distinction at Rhodes University in 2010, she has had two solo exhibitions, as well as private and public commissions.

In 2013 her first large-scale sculpture was bought by Standard Bank and installed in their new building in Rosebank, Johannesburg. Most recently her work was exhibited with the Southern Guild in June 2014 at the Design Miami/Basel design fair in Basel, Switzerland.

Her large permanent public artwork in Oostvoorne in the Netherlands,was commissioned by the Kern Kunst Westvoorne Foundation.

Background to the Oostvoorne sculpture

The Kern Kunst Westvoorne Foundation in the Netherlands commissioned three permanent artworks by South African artists to be installed in various towns in the Netherlands. Working through the NIROX Foundation in South Africa, they invited six artists to submit portfolios of their work for review. From these, three artists were selected to submit proposed ideas in response to their brief. Beth Armstrong was one and the other two artists selected were Rodan Kane Hart based in Cape Town and Phumulani Ntuli from Johannesburg.

The brief given to each artist was to design and manufacture a flagpole artwork with a maximum height of 8m. The main inspiration of the work was to be 'nature' but it could take on any form as long as it could hoist a flag. Considering the very wet conditions in the Netherlands, the work needed to be strong, durable and resistant to corrosion. The flags to be flown are the eight United Nation Millennium Development Goals in alliance with African and European culture.

The eight goals are to eradicate extreme poverty and hunger; to achieve universal primary education; to promote gender equality and empower women; to reduce child mortality; to improve maternal health; to combat HIV/AIDS, malaria and other diseases; to ensure environmental sustainability and lastly – global partnership and development.

Sculpture symbolism

In response to the brief Beth chose to work with the actual form and structure of flagpoles, manipulated and reconfigured to suggest a natural form. Her flagpole artwork is made up of eight flagpoles and their configuration suggests, rather abstractly, the form of a tree. She wanted to make a simple and elegant artwork that is both interesting from a distance and from close up and that is dynamic – looks different from different viewpoints. Each pole acts as a stand-in/support/representation of one of the eight UN Millennium Goals. Even though there will be only one flag flying at a time, the other poles represent the unison of the goals; that one goal cannot really be achieved without the support and unity of the other goals.

One of the flags representing one of the eight goals, flies in the wind of the newly installed flagpole artwork in position in the Netherlands.

In support of the Africa and European cultural alliance Beth chose to work with the image of a tree. Tree symbolism and meaning is prominent in every culture and religion. Trees are a universal, recognisable image and generally have very strong and

Beth cutting the sections.

Checking the final configuration of the pole artwork before hot dip galvanizing.

After hot dip galvanizing, adding the final touch up with zinc metal spraying prior to painting.

positive connotations. The image of a tree represents growth, regeneration, wisdom, protection, strength and time. Trees provide many analogies to human development. They are amazing microcosms of exchange, growth and development.

Beth's sculpture will be installed in the centre of a traffic circle/roundabout in the town of Oostvoorne, Netherlands.

The sculpture was made with the help of owner Trent Wiggill and the staff at Tridarc cc.

Why hot dip galvanizing and duplex paint systems

The sculpture needed to withstand the wet weather in the Netherlands and remain corrosion free for many years. Beth chose to both galvanize and paint the work to ensure the best protection.

She found Robor Galvanizers on the internet and chose them over their competitors because of the helpfulness and friendliness of the staff. "Right from the first phone call they treated me like a top client whose work was important to them" says Beth. "As the job progressed they continually engaged with me and educated me on the hot dip galvanizing process. Being an avid learner of new things and continually looking to expand my knowledge and working options, I greatly appreciated this. And I was very happy with the job done."

Poles being primed with the first coat of paint.

The completed components have been wrapped and are being packaged for delivery.

For the final paint coating Beth chose Bulldog Projects for their helpful assistance and expertise in applying duplex coating systems.

Beth says, "The completed sculpture looked far greater than I had originally imagined it would be following the robustness of the two coating processes".

New bulk liquid berth and floating breakwater

To prevent further erosion by the wave action of entering and exiting shipping becoming a huge threat to the mangrove plant life and animal species at the mangrove trees in the Port of Richards Bay, a concrete breakwater was constructed.

The breakwater spanned 660m consisting of 44 square floating reinforced concrete pontoons that were placed along berth 208.

Each 15m long, 5m wide and 1.5m high pontoon was constructed from reinforced concrete using hot dip galvanized steel reinforcing bars. Following this, 12mm diameter hot dip galvanized reinforcing was fixed around the top and sides of the pontoon and cast in a layer of concrete.

The risk of boats/ships bumping into the pontoon causing structural damage, posed a real threat and for this reason a polystyrene base was over coated with a 3mm coat of poly-urea coating applied by an industrial spray gun, after which it was given a 2mm layer of "Bidim" a nonwoven needle punched geotextile made from polyester, glued onto the polystyrene using contact adhesive and then left to dry.

One of the compounding reasons for specifying hot dip galvanized reinforcing steel was the fact that rough sea conditions may result in minor cracks in the concrete leading to surface staining, cracking and eventual spalling of the concrete. This would inevitably lead to increased maintenance and possible eventual failure of the structural concrete.

Each pontoon at the casting yard was now lifted onto a low bed trailer coupled to a mechanical horse and pulled about 150m to the beach area, where they were unloaded onto the prepared slipway to be hauled about 60m across the beach and into the water.

The slipway was constructed using sandbags, stone, Bidim and cement which in turn supported a rail system on which each pontoon would be pulled.

Using a rubber duck a messenger rope was attached to a 30mm thick steel cable and taken to the tugboat which towed each pontoon with the assistance of the incoming tide about 2km to the actual site next to Richards Bay Coal Terminal where the pontoons were individually anchored in place.

Specially made hot dip galvanized helix anchors were then placed in position and drilled on average 10.5 metres deep into the ocean floor by a marine engineering team.

To test the anchors, six ton lifting bags were then connected to each anchor and inflated to ensure that they will keep the pontoons in position.

Following the anchor test the pontoons were connected to the anchors by "Seaflex" cable.

Separating the pontoons from each other were rubber spacers, kept in place by marine grade stainless steel rods and bolts and supported by purpose made 30mm thick Duplex coated steel washers.

Not only will the hot dip galvanized reinforcing be the backbone in keeping these pontoons together by extending the life but the pontoons themselves will serve in the frontline to protect this coastal stretch ensuring a sustainable plant life to be enjoyed for future generations.

This project undoubtedly moved Bay Galvanisers and the industry at large one step closer to the regular use of hot dip galvanized reinforcing in the highly corrosive surrounding coastal areas.

The coated polystyrene block configuration with the initial layer of hot dip galvanized reinforcing bars prior to casting the concrete.

A completed pontoon arriving at the beach by horse and trailer.

A pontoon being launched into the sea being towed to its final location.

The pontoons in their final position alongside Berth 208.

Transformer radiators for Eskom or local authority sub stations

Over the past 30 years almost 60 000 (about 30 000 tons) of these mild steel radiator fins have been manufactured and used in various configurations for cooling purposes by Eskom and local municipalities at electrical sub-stations all across South Africa.

The functionality of these radiator fins lies mostly in their unique shape, size and multi-configuration but their proven durability to the surrounding environment lies in the fact that they have always been hot dip galvanized.

One of the uniquely designed and fabricated 1mm thick cold formed pressed panels are inverted 180° against another panel and continuously welded on all the edges making up a complete radiator fin. The completed fins are then spaced an optimum distance apart by welding three solid mild steel spacer rods to the edges of the fins.

The entire radiator configuration is then connected to a feeder and header pipe.

The configuration of connected radiator fins is then pressure tested for potential leaks under water after which snorkel pipes are added to the radiator outlet pipes so that only the outside will be cleaned in the chemical cleaning process. Note should a leak be detected, the potential for an explosion in the molten zinc bath is highly probable and can result in serious injuries for the galvanizing personnel as well as destruction of the radiator product. Any leaks will be subsequently re-welded.

Following pressure testing the radiator configuration is now dipped into molten zinc, whereupon moisture and air will now escape from the insides of the tubes via the snorkels, resulting in successful hot dip galvanizing. The thin uniquely shaped and pressed radiator fins do not distort in the molten zinc.

While hot dip galvanizing of open section steelwork has been undertaken generally successfully for many years by many galvanizers where good fabrication quality achieves good hot dip galvanizing. The unique reliance on the manufacturing arm of the company producing these radiator fins providing consistent build quality enables the galvanizer to achieve a guaranteed quality product 100% of the time. The local radiators compete against imported products and thus quality is of utmost importance to prevent unnecessary importation.

The 1mm thick cold formed pressed panels are inverted 180° against another panel and continuously welded on all the edges making up a complete radiator fin.

A typical coating thickness reading (65.6um) on a radiator fin after many years of exposure. See recent Case Histories.

The only training that customers require is the method of transport and loading and offloading of the transformer radiators without mechanical damage.

Many of these radiators are currently in service in sub stations around South Africa. Recently three Eskom sub stations were inspected and evaluated for the purpose of reporting case histories.

See Duine, Rietvlei and Plattekloof Sub Stations in the Western Cape, reported in the two last magazines.

Completing the manufactured radiator.

Pressure testing the completed radiator to ensure no leaks.

Landing platforms, Saldanha Bay

Introduction

Galvatech's client Guerini Marine was required to provide a landing platform for the personnel disembarkation from the iron ore carriers when mooring at the port of Saldanha.

Owing to the decks of the ore carriers being about 25m above the landing pier the positioning of personal disembarkation gangways was difficult to safely secure without the introduction of these moveable platforms.

Spatial constraints also required that the platforms be moved out of the way during ship docking activities.

The environment in which these platforms would operate also posed many challenges in that there were constant corrosive elements present as with marine works, this compounded by a permeating presence of red iron ore dust. This dust itself is also highly corrosive and congestive as can be witnessed by the state of the roads and vehicles operating within the port.

Previous existing mechanisms were in place but due to corrosion and seizing of working parts had their short comings.

The design and construction challenges facing Guerini Marine provided the following innovative working solution:

- A three metre reaching double cantilever platform fitting into 1.5m space
- Capable of supporting a cantilevered load of 1000kN
- Modular and easily transportable with easy erection prospects
- Corrosion resistance to the immediate marine environment and iron ore dust
- Working parts that are resistant to fouling
- Safe and easy to use

Exposure after one day on site.

The design of the structure addressed the load bearing requirements as well as the difficulties of transferring the self-weight of the structure smoothly throughout its operation. This was done by analysing the structural components independently as well as in conjunction with the adjacent mechanisms.

The designer paid special attention to minimising tolerances in order to avoid any jarring as loads transferred, as well as preventing jamming of the mechanisms. The project presented a unique set of challenges in that it involved the manufacture and machining of interactive components that then had to undergo the duplex system corrosion protection and still remain within tolerances.

A major obstacle encountered was the limitation that pre-constructing prior to galvanizing could result in warping and it was thus decided that the bulk of the components would need to be made up and machined to sizes and then bolted together post-galvanizing, requiring more detailing and a large degree of accuracy.

The procedure involved galvanizing and monitoring of deflections. Any deflection detected post galvanizing required straightening and final adjustments before being coated with the final protective layers.

The client specified a duplex system, also requiring the contractor to ensure that the condition of the surface will be at worst RE2 on the European scale of degree of rust, after 10 years in an environment of frequent salt spray, chemicals and polluted coastal atmosphere.

Ensuring straightness and maintaining the set tolerance of the hot dip galvanized component.

In position ready for use.

The duplex system was selected and quality ensured by specifying that both the hot dip galvanizing and paint application be carried out in a single factory-controlled environment in order that the quality control system enforced by Galvatech's supplier could be successfully implemented and controlled to ensure optimum corrosion protection.

Complete corrosion protection was assured by correct venting of all internal tubular sections and hard-to-reach areas of bare steel by way of the fact that molten zinc could penetrate all orifices where no air pockets existed.

The advantages of hot dip galvanizing over alternative protection mechanisms were evaluated, considering a number of factors that led to the unanimous choice of using a duplex system.

Weather dependency

- Hot dip galvanizing can be done any day of the year, the process totally independent of weather conditions.
- Painted systems often experience project delays because of unpredictable weather.
- When the parameters of safe and quality painting (temperature, humidity, wind) are stretched or compromised, coating failure is almost assured.

Temperature range

- Hot dip galvanized steel provides superior corrosion protection when in service in a range of temperatures, sustained from minus 25°C to 200°C.
- Most paints perform poorly in temperatures greater than 95°C.

Corrosion protection

- Hot dip galvanizing provides both cathodic and barrier protection to steel, delivering a rust- and maintenance-free system in most environments for 75 years or more.
- Paint is a barrier protector only, and when scratches and cracks occur, corrosion of the underlying steel is almost immediate.

Coating thickness

- The metallurgical reaction between molten zinc at about 450°C and iron in steel ensures a uniform and guaranteed coating thickness, documented in ISO specifications.
- Paint coating thickness on all surfaces is as variable and uniform as the applicator's expertise, with corners and edges highly susceptible to corrosion because of thin films.

Bond strength

- The alloying of zinc and iron in the hot dip galvanized coating means the zinc and steel metallurgically become one, yielding a coating bond ten times greater than the strictly mechanical bond of paint to steel.

Hardness / abrasion resistance

- With a coating hardness greater than that of steel alone, galvanized steel provides a durable, scratch-resistant coating that maintains the integrity of the overall corrosion protection system.
- Paints are generally not resistant to scratching, cracking, or impact, resulting in compromised coating where corrosion begins and maintenance painting is required.

Service life

- Hot dip galvanized steel commonly provides maintenance-free corrosion protection for 75 years or more exposed atmospherically, especially as the general environment and air have become cleaner as a result of environmental regulation.
- Sun, heat, wind, and weathering are constants that result in paint typically requiring touch-up and replacement in 12 – 15 years. The carry over effect costing far more than galvanizing over the intended life of the project. This provides a financial cost benefit of reducing maintenance, replacement intervals with added benefit of minimising environmental impact.
- A composite team of personnel were involved in that the contract involved proposing a solution, appointing a designer, manufacture, assembly and installation, load testing and commissioning.
- The contract was governed by the NEC3 Option 3 ensuring hands on management with open communication. This was a leading factor in demanding stringent quality controls.

Specifier/Developer/Owner: Transnet

Architect: WML Coast

Project Manager: Elton Arendse

Main Contractor: Guerrinni Marine Construction

Galvanizer: Galvatech.

American Galvanizers Association – Web page http://www.galvanizeit.org/

Bob's BANTER!

Achieving our desired future means managing the unexpected

We normally understand 'time' to be something like an unseen line that has been with us since the day we were conceived: it has taken us through the *past*, is accompanying us in the *present* and will be with us in the *future*, until we die. We know what the past has been, we manage the present as best we can, but most of us have great difficulty in comprehending the future. But, we have a great desire to know the future and often make very serious attempts to do so, like beliefs in biblical prophecy, divination, astrology, scenario planning and forecasting. The practice and art of Futurology, or Future's Thinking, postulates possible, probable, and preferable futures, seeking to know and understand what is likely to continue, what is likely to change, and what is novel. Companies use these techniques to plot the achievement of their strategic objectives.

We are all Futurologists at heart-it's in our genes. We *have* to know what the future will hold for us. We are often quite exact in our predictions and are encouraged to be like this by our parents and family, our religious beliefs, fortune tellers and motivational speakers, who tell us that if we believe strongly and positively, we surely will get what we want. Anticipation and expectation are large parts of our make-up as human beings.

But, what we often fail to do, however, is to know and understand what we have to do to get to where we want to be and what can go wrong along the way. Thinking about these two things are nowhere near as pleasurable as dreaming of a desirable future.

In the harsh real world, personal anticipation and expectation must be matched by knowledge of what is required to achieve the end result, and importantly, to know how to deal with the unexpected, unpredictable and unanticipated. Our greatest challenge is not just to visualize the future but to know how to deal with the unexpected. We may have the right intention, we may take the right action, but because of uncertainty, actual events may not coincide with planned actions and the outcomes could be unexpected.

Our failure to deal with the unexpected is often on account of not having enough time to think of everything, not trying to understand current trends that may decide the future, failing to plan ahead and not attending to what we have to do *now* to achieve what we want in the future. We also often take too long to recognise that the continual change happening around us now can dilute the realism of our expectations. Once we belatedly recognise that the unexpected is unfolding, our efforts at containment are often too late.

To manage the unexpected, we need to organise ourselves in such a way that we are better able to notice the unexpected as it evolves around us and to work to soften the impact it will have on us. This approach is often simply called being 'mindful' and means continually updating our interpretation of the external environment with respect to the context of our intentions, recognising problems and identifying solutions. Mindfulness gives us the ability to recognise potentially damaging signals and to act with purpose. It gives us the capability to see significance in what's happening around us and to incorporate an understanding of the continually occurring unexpected in the context of our plans.

Having a positive view of the future and a personal vision are wonderful characteristics of human beings. The probability of achieving our vision is, however, a function of how well we can manage the unexpected.

The Association wishes to thank Bob Andrew who is a consulting value engineer and honourary member of the Association for his article. *He can be contacted on anneve@iafrica.com or boband@mweb.co.za.*

Introductory Galvanizers Inspection Course

This one day course has been designed to be more simple and more practical than the 3-day galvanizers inspectors course discussed elsewhere in this magazine.

Topics to be covered and discussed are:

- Brief description about corrosion
- How zinc protects
- The hot dip galvanizing process
- Inspection before and after hot dip galvanizing
- Multiple choice question test for course effectiveness.

Should you require some background information on hot dip galvanizing and its acceptance and have a limited formal education, this course is for you!

Contact our offices for more details.

The use of hot dip galvanizing in mining in Southern Africa PART 3

The role of the HDGASA in the direct or indirect promotion and use of hot dip galvanizing in various mining applications, including gold, platinum, iron ore and coal and future motivation of its use in the Petro Chemical Industry, in South Africa.

Author: Terry Smith Technical Marketing Director – Hot Dip Galvanizers Association Southern Africa.

CASE HISTORIES

Petro SA

The company

The Petroleum Oil and Gas Corporation of South Africa (PetroSA) is a wholly owned subsidiary of CEF and its main activities include the exploration and production of crude oil and natural gas off the southeast coast of South Africa.

Petro SA refinery was commissioned as "Mossgas" in 1987. This is one of the world's largest gas to liquids (GTL) refineries, and has always been a leader in the challenge of commercialising the GTL processes.

Petro SA was formed in July 2000 out of a merger of the business of Mossgas and Soekor to effectively develop and exploit the crude oil and gaseous hydrocarbon resources of South Africa.

Location

Petro SA is situated about 2.5 to 3km from the coast and about 13km to the west of Mossel Bay's central business district.

Application

During a site inspection to determine the condition of certain paint systems that were in discussion, a number of hot dip galvanized cable ladders and trays were inspected and found to be in excellent condition. These cable ladders and trays were purportedly installed at plant inception. As the resulting coating thicknesses could not be photographed as proof of their performance, for safety and security reasons, it was decided to evaluate the hot dip galvanized lighting masts on the outer perimeter of the plant and if they were in an acceptable condition, compile a report for circulation as there is a possibility that a new oil refinery Project Mthombo would be built at Coega Harbour in a similar position relative to Mossgas on the coast.

The perimeter lighting masts at Petro SA in Mossel Bay have been exposed to the environment since the inception of the plant in 1987, making them about 25 years old. Due to some misunderstandings on the possibility of Liquid Metal Embrittlement in structural steel when hot dip galvanizing is used for petro chemical plants, the report was ultimately emailed to Richard Rood P.E. – Coatings, Insulation and Fireproofing, KBR Engineering, Houston, Texas, for his comments. *(Photos 1 – 4)*

Response from KBR regarding our query on Liquid Metal Embrittlement

From: Richard Rood PE – KBR Engineering

Subject: Performance of hot dip galvanizing at Petro SA

Although LME can occur with certain alloys under certain conditions, LME as not been a problem with structural steel. KBR's standard practice on nearly all petrochemical projects over the past 60 years has been to hot dip galvanize all structural steel; including all platform steel,handrails, ladders, cages, grating, etc. The only exceptions we recommend painting over hot dip galvanizing of structural steel are:

1. *High strength bolting which is mechanically galvanized to avoid hydrogen embrittlement,*
2. *Large welded steel structures (e.g., modular steel which can't fit in galvanizing vats),*
3. *Steel fabricated and erected in countries that do not have galvanizing facilities, except we do require that all platform steel, handrails, ladders, cages, grating, etc. be hot dip galvanized.*

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Photos 1 and 2: The perimeter masts at Petro SA near Mossel Bay that have been installed since plant inception (25 years).

Photos 3 and 4: Coating thickness on the holding down nut 211µm and on the mast 159µm respectively.

4. *Special applications which require thermal spray aluminum or zinc-aluminum (85/15) with sealers.*

Disadvantages of (paint) coatings are:

1. *Maintenance of the items listed above are extremely difficult if not impossible.*
2. *Paint coatings are easily damaged during shipping, handling and erection, and require more field touch-up.*
3. *Paint coatings have a considerably shorter life expectancy than hot dip galvanizing.*
4. *Paint coatings are more costly, increases TIC, and maintenance painting costs.*
5. *Paint coatings are dependent on weather conditions and causes shop problems which affect EPC schedules.*

Galvanized structural steel has many advantages over painted steel, such as;

1. *Galvanizing provides long term corrosion protection (20 to 30 years) that cannot be provided by traditional coating systems (5 to 10 years).*
2. *Galvanizing forms a Zn-Fe alloy with the steel. This alloy is extremely tough and not prone to mechanical damage. If it becomes damaged corrosion protection is still provided by the remaining galvanizing.*
3. *Galvanizing is more economical than coatings, reduces plant TIC as well as maintenance painting costs.*
4. *Galvanizing greatly aids projects constructability which has the following benefits:*
   - *Shorten the overall EPC schedule*
   - *Reduces field work and rework*
   - *Reduces the projects TIC costs*
   - *Value added is improved*
   - *Safety is enhanced due to minimized field rework, especially at elevated locations*

Protection of structural steel by painting is difficult due to:

1. *Sharp edges and corners on structural shapes lead to early coating failures and corrosion problems.*
2. *Interior surfaces of angles, channels and I-beams are difficult to coat properly and lead to early coating failures and corrosion problems.*
3. *Coatings do not provide corrosion protection in crevices, faying surfaces, and bolted connections.*
4. *Coated welded attachments and upper surfaces of pipe support beams pose corrosion problems.*

Reference from Amplats (Anglo Platinium Management Services) taken from Master Specification No ADC 001

"Although successful in many areas, eg. surface plants, protective paint coatings are of limited use in shafts. The coatings are easily damaged during erection and service and they cannot be effectively maintained in the corrosive shaft environment. Access within a shaft for maintenance is also extremely difficult. Since paint coatings offer very little by way of effective corrosion protection, the steel undergoes rapid corrosion which is generally of a pitting nature, and perforation of the steel. Hot dip galvanizing provides a hard abrasion and corrosion resistant surface which, in addition, provides protection to the base steel at points of damage. The nature of the corrosion on galvanized surfaces is also uniform and the risk of pitting corrosion is reduced.

In order to cater for the very corrosive conditions in upcast shafts and in the lower regions of downcast shafts, use is made of duplex coatings which comprise of a hard durable paint coating over hot dip galvanized surfaces.

In the conditions that prevail at the shaft bottom loading facilities (very severe corrosion and abrasion) the use of 3CR12 may be considered instead of hot dip galvanizing or duplex coatings.

In very abrasive situations, eg. loading chutes, abrasion resistant steel such as Roqlast are more effective.

Both 3CR12 and abrasion resistant steels would not be expected to last for the full service life of the shaft and would require replacement at fairly frequent intervals.

For temporary shaft situations, eg. sinking and mid-shaft loadings, the corrosive conditions would be present for a shorter period of time, eg. 2 to 4 years compared to 25 to 30 years for permanent shaft fittings."

Reference from Anglo Coal

Thinus Schmidt, Principal Mechanical Engineer of Anglo Coal quoted the following: "Hot dip galvanizing is our preferred corrosion protection system for all structural steel used at Anglo American Thermal Coal for surface and underground applications. We've had a few instances in the past where we had to grant concessions to contractors to supply painted structural steel because no slot could be secured at galvanizers at the period when South Africa

went through a construction boom.

We are currently well advanced with the detail design of the first phase of a major project which has a design life of 60 years. We have subsequently specified a heavy duty hot dip galvanized coating for all structural steel. Based on our investigation, we expect that the coating will be sufficient for the entire design life."

Conclusion

The successful specifying and application of hot dip galvanizing and duplex coating systems with any mining specifier is dependent on:

- Experienced and self-motivated member association staff in collaboration with all interested members, committed to providing quality coatings in accordance with set specifications.
- Initial introduction and ongoing education of mining specifiers in their understanding of the coatings appropriate use for the conditions at hand.
- Education of mining specifiers and technical personnel on the design required for components that are to be successfully hot dip galvanized or duplex coated.
- Education of the steelwork contractors on the fabrication standard for hot dip galvanizing.
- Where environmental conditions are initially considered inappropriate for its use, appropriate testing of applicable samples that are hot dip galvanized or duplex coated, should be exposed, monitored and reported.
- Added value services, such as hot dip galvanized fasteners, appropriate repair materials and other fixing devices should be made readily available.
- Involvement of appointed galvanizer/s in large projects on the project team.
- Based on proven past performance the following corrosion control in mining will generally proof successful:
  - Deep level mine steelwork – HDG.
  - At worst, lower 10 – 15% Duplex Coated.
  - PGM Smelters, Metallurgical & Gas Plants – Duplex Coated.
  - Coal Washing Plants Duplex Coated.
  - Generally all Conveyors and Transfer Towers – HDG (unless coastal).
  - Other than acidic areas in Petro Chemical Plants, HDG is acceptable (unless coastal).

Finally, overall success in the mining industry will result from unrelenting and frequent representation to the specifiers, unbiased and open minded specifiers, who through the positive results they experience in curtailing long term costs and safe working conditions to their staff, will happily repeat specifying of hot dip galvanizing and duplex coating systems and freely supply the references that are included in this paper!

References and acknowledgements

I wish to thank and acknowledge the following persons and companies for their contributions to this paper:

- Bob Wilmot – Executive Director HDGASA.
- Walter Barnett – Past Executive Director HDGASA (Deceased).
- Bob Andrew – Consulting Value Engineer and Honorary Life Member of HDGASA.
- Koos Viljoen – Petro SA and Richard Rood of KBR.
- Thinus Schmidt of Anglo Coal.
- Anglo American, Anglogold Ashanti and Amplats (Anglo Platinium Management Services).

Referenced papers

"Hot dip galvanized steel as an appropriate and realistic material of construction for mine shafts." Authors: Bob Andrew; Walter Barnett and Bob Wilmot and *"Hot Dip Galvanized Steel used in Deep Level South African Mines." Author: Bob Wilmot – Executive Director HDGASA.*

General galvanizing – how does SA compare globally? PART 2 – TECHNOLOGY

Part 1 discussed the general galvanizing market-place and how South Africa fairs when globally benchmarked. In Part 2, I would like to discuss a more contentious subject, namely that of technology. Is South Africa on a par, better or worse when compared to its peers overseas? Without sitting on the fence, clearly there is good and bad. However, one interesting observation, only drawn to my attention recently, is the lack of developmental studies (perhaps research?) being carried out locally. My recollection is that the last published study was an M. Sc. study on the role of nickel sponsored through the Tshwane University of Technology. It is interesting that one of the co-authors, Dr Peter Olubambi recently organised an Electrochemistry Workshop as part of the recent Africor Conference. This was a hands-on workshop with potentiostats galore and over half the delegates came from Africa outside of South Africa. Perhaps we have a revival in interest in corrosion studies and thus galvanizing technology?

I would like to focus on the way technology has changed the industry. For many years incremental changes, such as reduced number of welds and shaping of galvanizing kettles represented key improvements. Pressure from regulators (mainly environmental), rising energy costs and the ability to model changes through modern easily applied numerical methods have allowed the industry to investigate each part of the galvanizing process and optimise it with respect to the other processes. Modelling permits all manner of options to be considered irrespective of how far-fetched. Most reputable equipment suppliers and some service providers are able to overlay models with their own practical experience. This is also the case with the larger galvanizing groups where experience and theory can be pooled over a large number of plants.

With limited space, it is not possible to cover the galvanizing process in depth but rather provide an overview of progress. *Table 1* shows some of the process changes and the drivers for these. I will discuss some of the key issues in turn.

Plant layout and utilisation – Plant layout has evolved over the years from the straight through type to the "L" shape to even the "U" shape. The development from the use of monorail systems to automatic distribution systems and automatic plant handling and operation has increased markedly in Europe specifically. The driver

PROCESS	OUTPUT	EMISSIONS TO AIR	EMISSIONS TO WATER	EMISSIONS TO SOLID WASTE	TECHNOLOGIES USED FOR IMPROVEMENT
Material receipt	Ability to identify and tag materials for processing				
Jigging	Material safely jigged and sorted to permit optimum processing		Salts, etc. from stripping	Scrapped wires	Off-site recycling Non-galvanizable wires and hooks (Ti)
Degreasing	Clean surfaces	Water Vapour, VOCs	1 – 2 kg/t	0 – 5 kg/t sludge (0 – 0.2 kg oily sludge)	Use of acid degreasers Use of synthetic fabrication oils Chemical improvements Emission/heat controls Chemical management Filtration systems
Acid pickling	Removal of scales and oxides only	Acid fumes 0 – 50mg/m^3 Water vapour	Spent acids in water 12 – 20 kg/t (HCl)	Process sludges	Kleingarn Diagram (maximise acid usage Use of inhibitors Recycling/Regeneration Emission controls Chemical management
Water rinses	Chemicals and contaminations washed off and surface pH neutral	Water Vapour <7l/t	Dissolved salts, acids, bases	Metal sludges	Counter current multi-stage rinses Put in systems to reduce drag out
Fluxing	Clean protected surface	Ammonia, ammonium chloride		Metal sludges	Salt balancing Fe removal Chemical additions to reduce Zn consumption and aid surface reactivity Purification systems
Galvanizing	Targeted thicknesses and minimum defects	Dust =10 – 100 mg/m^3 Zinc = 2 – 20 mg/m^3 Hydrogen Chloride = 1 – 2 mg/m^3 Ammonium Chloride fumes = 0.1 – 0.6 kg/t		Ash = 6 – 18.5 kg/t Dross = 3 – 10 kg/t Zinc splashing	Alloy additions Bath parameter management (heat flux, systems, ash and dross production, etc.) Emission controls
Quenching & passivation	Cooling and temporary surface protection	Water vapour, zinc oxide	Metals and acid wastes, zinc, chromium salts	Zinc and other metal sludges	Minimised water use New passivators

Table 1. Process changes in general galvanizing.

here is logistics and labour costs. Globally, typical kettle sizes have grown from 8m to 12m today. There are of course much larger kettles in some regions. The plants in South Africa tend, on the whole to be of the old straight type with little or no automation. Dips per hour have increased for new plants to between 5 and 8 and dip weights, permitted by the introduction of larger kettles, has increased to averages of 2 tonnes per dip. Typical productivity levels have gone from 7.5 man hours per tonne in the 1980s to as low as 4 today in European plants.

Degreasing – Probably the most significant change in degreasing is the introduction of acid degreasing. There are various opinions on its effectiveness but certainly, when it can be applied, it clearly has the advantage of enabling the omission of a water rinse stage and, as the system is not heated, enables greater use of any waste heat in other process stages.

Acid pickling – Either sulphuric (H2SO4) or hydrochloric (HCl) acids can be used for pickling. In the USA, where H2SO4 dominated for many years there is a move to the use of HCl for pickling. The use of the Kleingarn system to optimise HCl pickling and, therefore, acid usage has been known since 1988. This uses the produced iron salts as an additional pickling agent and shows the optimum pickling composition to be used. The German Standard VDI 2579 shows the limiting acid composition values to be followed to ensure that fuming does not occur. *Figure 1* is a combination of the two – the Kleingarn and VDI figures (not shown here). It essentially provides a guideline in terms of the maximum temperature that can be used for the optimum pickling condition for a given acid concentration. As expected, fume production is greatest as the acid concentration rises. It can easily be demonstrated that until the acid concentration has fallen below around 130 to 140 g/l fuming will probably occur in all galvanizing plants (It should be noted that *Figure 1* is produced without taking into account changing solubilities for Fe salts, etc. it should, therefore, only be used as a general guideline). It is for this reason that many modern plants have enclosed process areas with extraction systems to remove acid fumes from the working and surrounding environment. There are but a few general galvanizing plants in South Africa that use such enclosed pre-treatment areas.

The acid recycling system of Metsep has benefited the industry for many years. The industry in South Africa originally used sulphuric acid. However, one company, Babcock, persuaded the majority of galvanizers to move over to HCl and to jointly establish a recycling operation – Metsep. Thus a co-operative company was set up to recycle acid on behalf of the industry, providing for a centralised, large scale recycling operation which has enabled the industry to cost-effectively recycle its acid and thus meet its environmental obligations as a whole industry. Small scale recycling technology is available but, it is difficult to see how the costs would compete with the centralised operation of Metsep.

Water rinsing – Much has been written about multistage counter-current rinsing and its effectiveness is beyond doubt. However, its adoption in South Africa is largely piece-meal. Thus carry-over of entrained and adherent salts, and incomplete neutralisation results in greater acid usage and treatment requirements for the flux agents. Internationally, the use of closed loop rinsing resulting in essentially zero discharge is gaining acceptance.

Fluxing – The production of a clean, zinc wettable surface remains the key requirement for the fluxing stage of the process. The range of

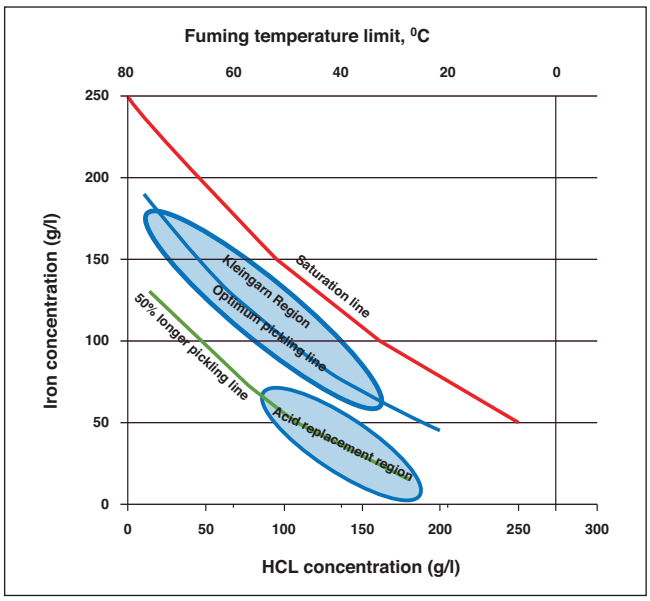

Figure 1: Schematic of the optimum pickling concentration showing the minimum ambient temperature required to prevent fuming.

chemical additives is vast and many galvanizers produce their own flux from process stage wastes with many of the complications that this yields. It is difficult to understand why flux treatment or filtering is not the norm throughout the industry globally so perhaps it is not surprising that some galvanizers in South Africa do not use flux-treatment. However, its benefits have been demonstrated ad-nauseum. The use of "low-fume" fluxes is growing in popularity and this trend extends to the local industry. The need to optimise heating has been well demonstrated and is usually practiced. A recent study on the incorporation of drying systems provides for interesting insight. Firstly, it has to be said that maximum advantage of the use of an alloys system requires a surface that is clean and dry to be effective. Over two thirds of the survey respondents said that they saw the benefits of having a drier with all respondents indicating that they would not remove it. The reduction of splashing, fume, ash production; the improvement in surface appearance, lower zinc consumption and less distortion noted by respondents, are all benefits that can be thought through with a little effort. Of course, the extensive use of "cheap" electricity in South Africa has meant that waste heat (typical when gas is used) is in short supply. However, rises in local electricity tariffs may well act as an incentive for change in this regard.

Galvanizing – This is best discussed with reference to some key factors.

1. Alloys – There is insufficient space to go through the developments of alloy additions in general galvanizing and many good review papers are available (such as those by Zervoudis and Pankert). Suffice to say that reactive steels are not new and the first documented history of the widespread use of zinc-nickel alloys dates back to 1983 by the Wedge Group in the United Kingdom. Indeed by 1984 ten companies in the UK were using zinc-nickel. There is a long history of use and the South African industry has lagged far behind in the use of zinc alloy systems in galvanizing. Fortunately, there have been some changes since the demise of Zincor but inexperience in the use of alloys has made the local industry a real laggard in terms of adoption of later and key technologies. New zinc-aluminium alloys, used in general galvanizing, whilst not in widespread use, have been shown to

continued on page 36...

provide for better corrosion resistance than traditional galvanized coatings and are being used in Japan and other regions. The Association has worked hard to develop new markets but the adage of "galvanizing is an industrial coating, get used to it" has limited its entry into markets requiring an aesthetic finish.

Most galvanizers in South Africa still use lead (Pb) in the kettle at the saturation level. Current thought is that the coating produced meets all the environmental requirements in terms of Pb content. Reasons for the heightened awareness relate to existing requirements in Europe which restrict the Pb levels in components used in some electrical (except higher voltage equipment) and automotive components with the aim of reducing the presence of hazardous materials within recycling processes for those components. Although the regulations limit the Pb content in the coating to 0.1%, there is an exemption for batch galvanized steel that currently allows up to 0.35% Pb in the total component. With the maximum solubility of Pb in molten Zn around 1.2% and presence in the coating often as low as 50% of the level in the melt, it can be seen that all normally encountered products have a total component (coating and substrate) Pb value significantly less than the current limit.

The 0.35% Pb exemption in electrical components will expire in 2016 and efforts are underway to secure an extension beyond 2016. There are also new regulatory pressures on Pb in Europe that may affect the presence of Pb in the galvanizing process and its products. The use of Bismuth as an alternative to lead is widespread globally. However, bath composition management will have to improve locally to use Bismuth effectively.

2. Energy efficiency – Much has been said recently about the cost of energy. However, energy only has a real cost if it is wasted as one assumes that it is like any input – measureable, controllable and chargeable. Most galvanizers in South Africa use electric (resistance) heating systems although this is beginning to change. The use of electricity, originally prompted by its low price, has enabled the industry to really optimise the zinc heating process. The control technology has moved with the times with almost all kettles using modern state of the art controllers such as PLC systems with thyristers. The requirements for insulation and heat preservation are largely mastered. Theory advises us that providing heat evenly around the kettle will maximise energy use and kettle life. This is generally the case with electricity, all things being equal.

   As some galvanizers move over to using gas, an advantage that the local industry will have is that it will be able to adopt the latest technologies such as high velocity pulse fired end burners and multiple furnace spaces to optimise hear transfer. This has taken many years of development elsewhere and recently the use of computational fluid dynamics (CFD) analyses will refine matters further. Indeed the use of CFD would provide for the optimisation of electric radiant/conduction heating also although, to the author's best knowledge, electric heating has not been investigated. This may well be an interesting area worthy of further analysis. An increase in use of gas will enable the use of waste heat for pre-treatment use.

   The loss of waste heat, inefficient (or excessive) extraction systems, the use of heat covers and compressed air management were mentioned as possible energy improvement measures that should be taken by the industry as reported in the 2000, UK government report on Energy Efficiency Opportunities in the UK Galvanizing Industry. Although much of this relates to the use of non-electric use as the primary zinc kettle heating medium, an interesting observation was the suggestion of the use of Combined Heat and Power (CHP) systems to provide for electrical power and heat recovery opportunities. In the current electricity supply climate affecting many industries in South Africa, the use of CHP could well be worth investigating. The simple use of covers over all heated process tanks can save considerable energy costs during production down-time. Other than kettle covers, these are not widely used in South Africa.

Quenching and passivation – The main change that has occurred in terms of post-galvanizing treatment is the restrictions imposed upon the use of chromate passivation. Many alternative proprietary products are out there ranging from the change to Chromium III salts to the use of what are essentially organic coatings (such as the use of acrylics passivators). Some are good, some not so good. Interestingly, a survey carried out by ILZRO a few years ago indicated that none really gave the protection afforded by dichromate. However, ideas have moved on and systems such as fogging show great promise but can be expensive to install. One cautionary is to ensure that no volatiles are emitted should an organic passivator be used.

In some applications the brightness of the galvanizing coating is not preferred, typically in transmission and street furniture markets. The use of phosphate and other post-treatment systems has been used effectively to prematurely age (and so ensure a consistent coating colour) the darkening of the initial coating. South Africa remains conservative in terms of post-galvanizing treatments.

Environmental issues

It is safe to say that environmental regulations, in terms of discharges, are a major cause for some concern in any "traditional" industry. The drive to zero discharge (air and water) is not a new concept and the industry should be able to take advantage of almost 40 years of experience in the Chemical Process Industry. It is not my intention to either pillory of praise the industry but, it is important to understand that environmental matters seem to illicit the most volatile comments from environmental groups sometimes with, sometimes without foundation. However, and notwithstanding the emotions, environmental regulations are here to stay and are likely to become more stringent as time goes by. *Table 1* deliberately refers to their impact in terms of land, air or water.

Solid and waste water streams are produced by the galvanizing process but these can be easily managed. Value products such as ash and dross are generally sold, with or without prior treatment to remove solid zinc. Sludges and the like are disposed of via carriage off-site by an approved waste treatment company. South Africa is no different from most countries in this regard and normally acquits itself well. There are technologies, mentioned above, to reduce waste water streams. Zero discharge, in terms of salt loading, is easily achievable and many modern galvanizing plants already have quite sophisticated water treatment plants. Again, local industry performs well. The new legislation via the waste act appears to be well understood.

continued on page 38...

5 LINCOLN RD, BENONI SOUTH, 1502 | PO BOX 15040, FARRARMERE, 1518
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SMT GALVANIZERS

SMT Galvanizers are specialists in the hot dip galvanizing of all types of fasteners including the treating of embrittlement on site. We do offer a wide variety of services to our clients by creating a comprehensive supply chain for all their galvanizing needs. Our expert services are procured by hand railing, flooring, construction, fabrication, civil and general engineering industries for open dipping.

All work is done according to SABS-ISO 1461SANS 121 Specifications. SMT Group is SABS and SATAS accredited and BEE compliant.

SMT Group offers the following services,

- **Hot dip galvanizing** - spinning and dipping;
- **Electroplating** - Barrel work (Yellow and trivalent blue passivating);
- **Electroplating** - Jigging up to 3.5meters;
- **De-embritteling** on site;
- **Fabrication** workshop with certified welding operators;
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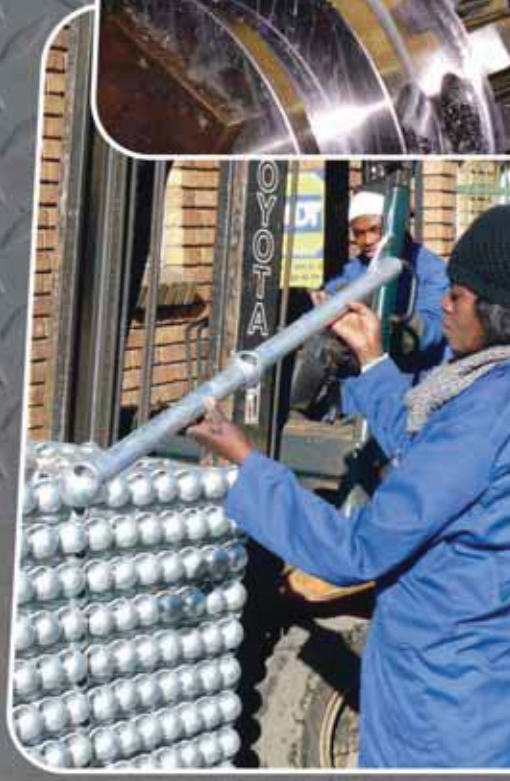

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SATAS

SEESA BEE COMPLIANT

SMT GALVANIZERS
SPINNING & DIPPING

SMT Galvanizers (Spinning & Dipping) | **jan@smtgroup.co.za**
SMT Electroplaters | **kevin@smtgroup.co.za**
SMT Steel (Engineering) | **bernadette@smtgroup.co.za**

DESCRIPTION	CHEMICAL SYMBOL	mg/m³ UNDER NORMAL CONDITIONS OF 6% O_2, 273 KELVIN AND 101.3 kPa	NOTES
Particulate matter	Not applicable	10	New plants
Particulate matter	Not applicable	15	Existing plants
Hydrogen Chloride	HCl	30	

Table 2. Key fume restrictions values for the galvanizing industry (South Africa).

Note: *It is common to see mg/Nm³ meaning milligrams per normal cubic metre – the amount of gas which when dry occupies a cubic metre at a temperature of 0 °C and an absolute pressure of 1 atmosphere, i.e. Standard Temperature and Pressure. Thus, observed values are "normalised" to STP. This is done to aid regulatory comparison.*

It is in the area of air quality management that emotions run high. To put things in perspective though, in Ekurhuleni (in which 48% of all metal value adding occurs in South Africa), Industry only contributes 7% of the change in ambient air quality! The issue is that it is continuous and has local impact. Each municipality has an Air Quality Management Plan and has to put in control measures in respect of dust, noise and offensive odours. Thus, Industry has also to remember that municipalities have a responsibility on their side which has to be met. Compliance with the Air Quality Act (1998) and the National Environmental Management: Ait Quality Act – NEMAQA (2004) brings South Africa in line with global requirements. The requirements in terms of licenses are now effective and although somewhat tardy, most of the local galvanizing industry is now within the "system". The requirement for particulates should be understood in terms of impact upon health. This relates to the particle size and the chemical composition. Size is critical as it defines where particles will deposit and accumulate. Large dust particles are generally caught in the nasal passages and easily expelled whereas smaller particulates (<10µm stated as PM10 particulates) pass through and are deposited in the alveolar (or gas exchanging) regions of the lungs. For this reason, it is not only the general fume composition values that are used for occupational exposure but the PM10 values. Hot dip galvanizing emissions are limited in terms of fume composition and particulates in general *(Table 2)*.

The installation of extraction systems at the zinc kettle is becoming the norm internationally. In the USA between 2003 and 2007 industry survey respondents indicated a 196% increase in the use of enclosures. The pressure to improve and enclose the kettle working area will increase in South Africa like it or not.

The UK Department of State's Guidance Notes for Activities (2013) provide good guidance on current Best Available Technology. This is tabulated in *Table 3*.

Final thoughts

Technology is a strange thing and most galvanizers appear to have little understanding of the competition, namely paint or perhaps more appropriately, heavy duty coatings (HDC). Applied for a similar reason to galvanizing the advantage of colour is not lost on us. Hence the use of duplex systems which are actively promoted by the general galvanizing industry. Thus, the use of Life Cycle Analyses, focusing on environmental impact, is at best naive but perhaps arrogant or just plain foolish! Better to focus on lifetime cost. HDCs have moved forward tremendously in recent times. High Build, low VOC, water based, self-healing are terms that the galvanizer should be familiar with to ensure that he is best positioned to see how his coating compares. In addition, familiarity with codes such as the ISO 12944 series would help galvanizers understand the technicalities of their competition. Table A.9 in Part 5 of ISO 12944 covers duplex systems!

Overall the general galvanizing industry in South Africa does meet the remit of providing an efficient corrosion resistant coating. However, in today's world, much more is expected and in this regard the author is of the opinion that there is a long way to go locally in fully benefiting from what the galvanizing industry has to offer. This will impact upon the local industry's ability to take real advantage of the markets commonly served in other regions, future markets and market growth opportunities north of the country.

I am indebted to the Associations and colleagues globally from whom I have been able to draw information for use in this article.

The Association wishes to thank Rob White of IZASA for this article.

PARTICULATE MATTER SOURCE	EMISSION LIMIT	TYPE OF MONITORING	FREQUENCY OF MONITORING
All galvanizing baths	15 mg/m³	Manual extractive test to comply with BS ISO 1241: 2002 or BS EN 13284: Part 1	At least once a year and quarterly for low fuming flux operations where continuous indicative monitoring is not being used.
Galvanizing baths not using low fuming flux but using abatement plant	15 mg/m³	Indicative monitoring	Continuous
All authorised emission points from low fuming flux operations without abatement prior to discharge	No persistent visible emission	Operator observations	At least daily
Stack or duct emissions from contained sources other than galvanizing	20 mg/m³	Continuous indicative monitoring plus manual extractive testing to comply with BS ISO 1241: 2002 or BS EN 13284: Part 1	Continuous At least once a year
Fugitive emissions from galvanizing baths	No persistent visible emission	Operator observations	At least daily
Hydrochloric acid pickling plant	30 mg/m³ Chloride (expressed as HCl)	Manual Extractive test	Annually

Table 3. Contained emissions to air associated with the use of BAT.

3 CPD POINTS

3-day Galvanizers Inspectors Course

Hot dip galvanizing is one of the most widely used methods of protecting steel from corrosion. During and after fabrication and after hot dip galvanizing the coating is inspected for compliance with the relevant specifications.

The course commences at a selected venue where course material is presented and reviewed, the lecturer encourages discussions between delegates and himself. Each lecture is preceded by a number of pertinent questions on the previous lecture.

Once the delegates have a reasonable knowledge of the coating, including its inspection criteria, the venue moves to a selected galvanizer where a batch of incoming components are discussed en-group and then in teams, preselected hot dip galvanized components are inspected and reports are required to be completed.

If available at the galvanizer or other venue, preparation by sweep blasting and/or chemical treatment is demonstrated and duplex coatings are discussed.

The course will provide delegates with sufficient knowledge to advise on fabrication for successful hot dip galvanizing and also test, inspect and interpret test results after hot dip galvanizing.

COURSE DURATION AND CONTENTS

Day 1 (08h00 to 16h00)

- Introduction to the Environment, Steel Types & Corrosion
- Understanding Zinc Coatings (How does Zinc Protect?); ISO 9223 & ISO 12944
- Design, Fabrication and Inspection before Hot Dip Galvanizing SANS (ISO) 14713:1999
- The General Hot Dip Galvanizing Processes
  SANS 121 (ISO 1461:2009) Batch type Galvanizing
  SANS 32 (EN10240:1997) Automatic Tube and Pipe plants
  SANS 10684:2009 Hot Dip Galvanizing of Friction Grip Fasteners

Day 2 (08h00 to 16h00)

- Duplex Coatings and Hot Dip Galvanized Reinforcement in Concrete
- Inspection after Hot Dip Galvanizing including test procedures, application of specifications and reporting.
- Quality Assurances in Coating Applications, application of Specifications and Control Documentation of a QA System
- Hot Dip Galvanizing Plant Visit followed by syndicate Inspection of finish materials wait final release.

Day 3 (08h00 to 15h00)

- Syndicate Report Back and discussion, with revision and course overview.
- Two part examination on Course Effectiveness

(Should duplexing by wet spray or powder coating be available, this will be included in the tour)

Course schedule may be altered and interesting activities added for the benefit of delegates.

Following the course and successful result in a three part exam, the delegate will be issued with a certificate and if required, registered as an approved HDGSA Galvanizing Inspector. Registration will be confirmed on an annual basis. Successful galvanizing inspectors will become Affiliate Galvanizing Inspector Members of the HDGASA for the year.

VENUE AND NUMBER OF DELEGATES

The courses are usually run in Johannesburg from the Hot Dip Galvanizers Association in St Andrews, Bedfordview and also from a suitable venue in Cape Town. Bookings are limited to 10 people per course on a first come first serve basis. Courses in other areas are possible, contact HDGASA.

DATE AND TIME

Courses commence at 08h00 sharp and end at 16h30 (or as otherwise instructed). Lunch and refreshments will be provided. Comprehensive course notes can be collected from our offices two weeks before the course (this is highly recommended).

Johannesburg:
25 to 27 February; 18 to 20 March; 13 to 15 May; 24 to 26 June;
12 to 14 August; 7 to 9 October; 25 to 27 November.

Cape Town:
4 to 6 March; 3 to 5 June; 30 September to 2 October.

Special courses can be arranged for a minimum of 6 delegates at appropriate venues in South Africa.

COURSE COST AND PAYMENT TERMS

R4 200.00 per person exclusive of VAT. Should you have two or more delegates from the same company, course costs will be R4 000.00 per person exclusive of VAT. Please note that payment is due on the first day of training. Cheques are to be made out to "Hot Dip Galvanizers Association SA". Members qualify for a discount.

CONTINUOUS PROFESSIONAL DEVELOPMENT (CPD)

By attending the Association's 3 day course Galvanizing Inspectors Course, you will obtain 3 points (accredited by ECSA).

SHOULD YOU BE INTERESTED, KINDLY CONTACT SASKIA SALVATORI AT THE ASSOCIATION

On the Couch.....

By Desere Strydom

Mark Thomas & Henry Fagan

The talk of the town, since its official opening in May this year has been The Boomslang. This 130-metre aerial treetop walkway in Kirstenbosch Gardens is part architecture, part sculpture, part art and an engineering feat of curved steel and timber that winds and dips its way through and over the trees of the Arboretum. *On the Couch* caught up with the team behind this marvel, **Architect Mark Thomas and Consulting Structural and Civil Engineer, Henry Fagan.**

MARK THOMAS

Please tell us briefly about your background I was at primary school in Pietermaritzburg, (I spent a lot of time on bicycles and outdoors), balance of my schooling was in Cape Town and I studied at the UCT Architectural School.

What inspired you to become an architect I studied art at school and my girlfriends brother was an architectural student, we visited him in his studio where the Rolling Stones were playing full blast, and I thought, this is the right thing to study!

Please give us a brief career overview I have worked for the last 26 years both in Johannesburg and in Cape Town, as a registered Professional Architect. I held the post of associate at GAPP Architects and Urban Designers in the late 80's and was co-director of the award winning architectural firm Visser Thomas Architects (Pty) Ltd, between 1995 and 2008. We completed many exciting projects for a variety of clients countrywide and abroad. The range of projects I have been involved with varies from large luxury homes on the Atlantic Seaboard, to hotels, schools and shopping centres. I have been involved with the design development of varied commissions and have personally managed the successful construction of numerous large and complex projects. I am a registered member of the South African Council for the Architectural Profession (SACAP) and a member of the Cape Institute for Architecture (CIA).

Do you have any industry role models or someone whose work you greatly admire and am inspired by? Yes, Jack Barnett, the architect of the Baxter theatres is an inspiration, as is Geoff George, Bert Pepler and the mighty Luis Barragan.

You have a penchant for recycling especially in the sculptural work that you do. Can you tell us a little more about that? We are all surely conscious that we need to be looking at what can be recycled, whether it be materials or buildings, it's pure common sense.

Are there any career highlights that stand out and why? At one stage in my previous practice, we had a fantastic, motivated and energetic team of architects and creatives working for us. We worked from a renovated old rambling home in the City Bowl and there was tangible creativity in what we were doing. Collaborative and collective input created more than the sum of the parts (like this project with Henry Fagan the engineer and young architect Chris Bissett)

Please tell us about the inspiration for Die Boomslang The site was the inspiration for the project. A curving structure made the most sense in terms of being able to shape the walk around the existing trees, the materials we used were logical in terms of what they were for, steel for long spans and timber for the tactile aspect.

Corrosion protection is always a pickle on the coast, when using steel. Was the structure specifically designed to be hot dip galvanized from inception or was it an afterthought? Initially we looked at using Corten steel, for the self-limiting corrosion properties and satin finish. Once that was not possible, hot dip galvanized steel was the next option.

Were there certain design elements that needed to be reworked to accommodate the hot dip galvanizing process? Yes, the lengths and sizes of each portion of bridge had to make sense in terms of the galvanizing baths and the transport methods.

What are your thoughts on hot dip galvanizing in general as a corrosion control measure in architecture? Most hot dip galvanized structures end up requiring on site-welding and cold galvanizining. A truly pre-manufactured structure that is galvanized then bolted together on site, makes sense in terms of corrosion control. The overcoating with epoxy and paint gives further corrosion resistance.

Please tell us a little more about yourself I have a wonderful family, 3 daughters and good friends.

What are your hobbies and passions? I love doing carpentry work and anything to do with wood, I am a keen runner and social cyclist.

Please complete the sentence. Five pm Friday afternoon and Mark Thomas is... working out where to meet to throw frisbee on the beach.

Also see:
www.markthomasarchitects.co.za

HENRY FAGAN

Please tell us briefly about your background I was fortunate to have spent my early 12 years on a small farm outside Pretoria. I went to the German School in town. Thereafter we moved to Cape Town, where I attended Camps Bay High School and finally Jan van Riebeeck High School for my last two years at school. I then joined the SA Navy Permanent Force and after a year at Gordon's Bay started studying engineering at Stellenbosch University.

What inspired you to become an engineer? Designing and constructing objects has always fascinated me. At the age of 16 I built myself a Dabchick sailing dingy which I enjoyed racing in regattas. I enjoy the practical applications of maths and engineering was the obvious career choice for me. My intention was to specialise in ship construction but after a year at university I realised that structural engineering combined my interest in structures and architecture. By then I had already developed an appreciation of architecture from my architect dad.

Please give us a brief career overview After graduating from Stellenbosch I joined Liebenberg & Stander, where I worked in the bridge design section, gaining excellent experience from some very highly regarded engineers such as Dr Liebenberg and Prof Rolf Kratz and assisting with very interesting projects such as the Bloukrans Bridge. In 1979 / 80 I obtained a master's degree in structures at the University of British Columbia in Canada, thanks to a bursary from Rotary. After working in Vancouver for a few months I returned to Liebenberg & Stander for two years, before taking up a lecturing post at UCT for two years. I started my own practice in 1984, with Jacques Retief soon joining me as a partner. This year we celebrate the 30th anniversary of our practice!

Do you have any industry role models or someone whose work you greatly admire and are inspired by? Prof Kratz, for his clarity of understanding and explaining structural principles, Maillart, Nervi and Niemeyer for the beauty and simplicity of their structures and buildings, my architect dad, for the uncompromising honesty and creativity of his work.

You are a staunch supporter of using hot dip galvanizing as a preferred method of corrosion control. Please tell us how this came about I suppose we are all concerned about the long-term performance of our projects. Hot dip galvanizing seems to be the best way of prolonging the life span of steel structures before corrosion sets in.

Are there any career highlights that stand out and why? I am fortunate to have been involved in many special projects, including Klein Constantia Winery and Maturation Cellar, Hartleyvale Hockey Stadium, V&A swing bridge, Cape Town Stadium, Mapungubwe Interpretation Centre, Dube Square Canopy and now, of course, the Boomslang.

Die Boomslang was a great collaborative effort between yourself and Mark Thomas. Were you involved from design phase? Mark and I worked together on every detail of the project from the very start, after Mark and Adam had planned the concept of the route through the trees. Rather than the engineer designing the structure and the architect adding the practical components such as balustrades and walkway, everything is integrated into a sculpture.

Corrosion protection is always a pickle on the coast, when using steel. Was the structure specifically designed to be hot dip galvanized from inception or was it an afterthought? Corrosion protection was on our mind from the beginning.

What are your thoughts on hot dip galvanizing in general as a corrosion control measure? It seems to be the best defence against corrosion we have, especially if combined with a good paint spec.

Please tell us a little more about yourself My life has generally been a very happy one. We are a close family. I am very lucky still to have both my parents, not only alive, but still working daily in their office. I love spending time with my son, who is finishing

his BA in Psychology at UCT this year, and I have the most wonderful girlfriend, a nuclear physicist at Koeberg.

What are your hobbies and passions? Classical music, cycling (I have completed 27 Argus Cycle Tours and 6 Cape Epics), designing gadgets, beautiful structures, friends and family.

Please complete the sentence. Five pm Friday afternoon and Henry Fagan is... probably still working in the office, but looking forward to the cycle rides planned for the weekend.

Also see: www.fagan.co.za

Des Ray for HDG Today 2014

Consistently delivering superior quality galvanized products to all our customers

Armco Galvanizers Isando has been operating since 1989. Geared up to accommodate heavy structural steel up and till 13m in length. Isando has an average output of plus minus 2000 tons per month. With an improved lay down area and increased loading capacity by addition of a tower crane we strive to give "A" class service to all our customers big or small.

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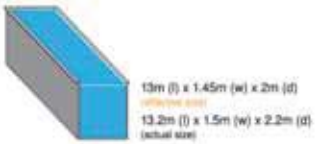
The company has it's own SANS 121 2000 ISO 1461 accredited Hot Dip Galvanizing plants. And is listed under the SABS ISO 9001 scheme.

GALVANIZING BATH SIZE

ISANDO



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