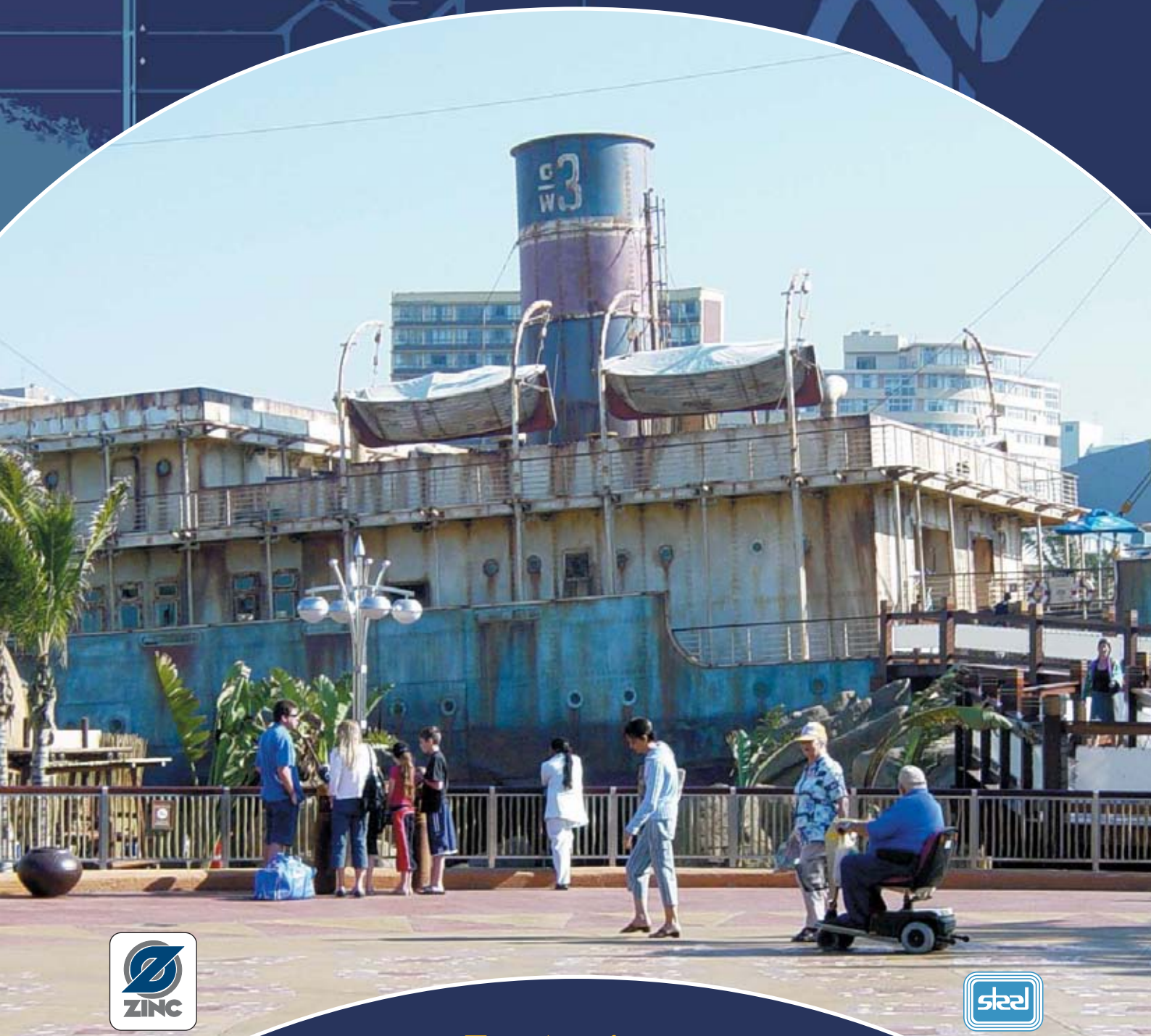
2004 Volume 1 Issue 1

HOT DIP GALVANIZING TODAY

HOT DIP GALVANIZERS ASSOCIATION Southern Africa



Featuring:

2004 Eskom Hot Dip Galvanizing Award Winners and Entries

The facts about using hot dip galvanized reinforcement in concrete

HOT DIP GALVANIZERS ASSOCIATION SOUTHERN AFRICA

PHOENIX Galvanizing GROUP

SABS

PHOENIX GALV SABS

SABS ISO 1461:

PHOENIX GALVANIZING

274 Aberdare Drive
Phoenix Industrial Park
4068

The Phoenix Galvanizing group comprises of four companies, namely:

- **Phoenix Galvanizing (Pty) Ltd**
- **Phoenix Galvanizing Transport**
- **Phoenix Galvanizing Centrifuge c.c.**
- **Kridor Investments c.c.**

Phoenix Galvanizing is a 100% Black Empowerment company, with Anni Ramkisson as Chairman, Roy Ramkisson as C.E.O., and two quality assurance directors being Yashoda and Latha Ramkisson.

Phoenix Galvanizing boasts one of the best designed galvanizing lines in the country with emphasis being placed on quicker turnaround, excellent service and quality.

The company is a member of the Hot Dip Galvanizers Association of Southern Africa (HDGASA).

Phoenix Galvanizing has the following accreditation:
SABS ISO 1461
SABS ISO 9001 - 2000
and prides itself in maintaining these standards.

Phoenix Galvanizing Transport provides a pickup and delivery service to Gauteng clients with a 48-hour turn around.

Being a customer focused company, Phoenix Galvanizing attributes its growth and success to the understanding of current and future customer needs; meeting customer requirements and striving to exceed customer expectations.

LINE 1

14m long x 1.4m wide x 2.5m deep

LINE 2

7m long x 1m wide x 3m deep

LINE 3

Centrifuge – handles threaded items and small components.
2.5m long x 0.9m wide x 1.2m deep

MANAGEMENT AND ADMIN STAFF

PHOENIX GALVANIZING TRANSPORT CC

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

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The phantom ship at uShaka Marine World theme park

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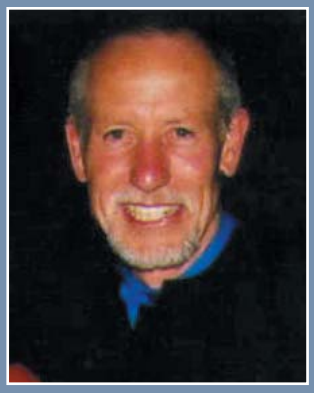
Hot Dip Galvanizing – Adding value to Steel

Note from the Editor

Besides the durable performance achieved by most hot dip galvanized coatings, used in aggressive conditions, there are many who specify the coating for its aesthetic appeal.
This interest in the coating from that perspective is encouraging as it can create new and exciting markets. Many applications have been extremely successful while others have been less successful. The less successful performances are generally not where galvanizing is tested in its traditional role, which is to provide corrosion protection, but to things such as aesthetics, which to date are less predictable. For those interested, we have compiled a checklist of important design aspects to assist the specifier during the design stage and also the galvanizer in achieving an acceptable finish.

It must however, be remembered that without the important role of proper **COMMUNICATION** between all parties involved in the project, the application of aesthetically pleasing hot dip galvanizing, will not necessarily be achieved.



Executive Director's Comment

In recent years we have heard a great deal regarding Sustainable Development. While the objectives of Sustainable Development are without doubt noble in every respect, we in the Hot Dip Galvanizing Industry are devoted to the long-term protection of one of our modern societies greatest assets, namely that of steel.

Corrosion of steel is not only a question of economics, but objectives such as the protection of our environment as well as the efficient use of our country's resources in the form of energy, materials and of course improvements to our standards of living. When one reflects on the environmental issues and huge energy and material resources that are employed to produce a single ton of steel, it makes complete sense that protection of such a ton of steel needs to receive a very high priority in terms of our Sustainable Development.

It is to this end that the Hot Dip Galvanizing Industry is committed and to which the Hot Dip Galvanizers Association was instituted. The use of zinc and its physical characteristics has for the past 175 years been used for long-term corrosion protection of steel in a variety of different environments. It has been repeatably proven and demonstrated by the successful performance of many steel installations that hot dip galvanizing remains the oldest, yet the most up to date, cost effective form of corrosion protection available to engineers and end users.

A review of the various nominations entered into our annual awards, again bears testimony to the ability of hot dip galvanizing as an effective corrosion protection system and demonstrates the validity of the inherent ability of hot dip galvanizing to meet the demands of the modern construction industry. The annual awards evening is also an opportunity for us to recognise companies and individuals who contribute to the advancement of hot dip galvanizing as a suitable corrosion protection system. In addition the awards evening is used as our marketing "front window" designed to illustrate the ability and capacity of the hot dip galvanizing industry to undertake a large range of different projects, be it mining, heavy structural steel projects through to architectural and aesthetically orientated installations.

Bob Wilmot
Executive Director
Hot Dip Galvanizers Association
Southern Africa

Dear Reader,

You will have noticed we have given the journal a new look and by including advertisers from the industry, now have a fully fledged magazine.

The next magazine will be published in October/November 2004, and from 2005 onwards the magazine will be published quarterly.

Should you wish to comment or participate by way of editorial that you consider newsworthy to our industry, kindly contact Anne van Vliet or alternatively the offices of the Association if you change your contact details.

2004 Eskom Hot Dip Galvanizing Awards – Overall Winner

uShaka Marine Park

Description

The centrepiece of the spectacular 17 hectare uShaka Marine World Theme park is the phantom ship.

Location:

Durban

Tonnes of Steel:

The ship was built of 320 tons of hot dip galvanized structural steel, with the main supporting structure being of heavy beam and column construction weighing 150 tons.

Project Partners:

Developer / Owner:
Mirage Leisure & Developments

Architect:
Urban Edge and Langa Makhanye

Specifier:
AKI Consulting Engineers

Project Manager:
SIP Project Managers

Main Contractor:
Impact Engineering

Hot Dip Galvanizer:
Phoenix Galvanizing (Pty) Ltd

Project Inception Date:

August 2002

Project Value:

More than R753 million to create the park

Information:

- The 80m long "rusting" 1930 merchant marine ship supposedly wrecked on the reef soon after it was launched was built on site.
- A special paint and cladding technique was used to create the illusion of natural marine weathering.
- The phantom ship houses restaurants, a food court and the Captain's bar from which one can enjoy spectacular views of the Durban beach front.
- The ship also serves as an entrance to the wreck, the underground aquarium boasting exhibits of over 200 species of marine life and the largest collection of sharks in the southern hemisphere.
- Much of this steel was adjusted as part of the process on site where the ship was assembled in order for it to take on the correct shape of the vessel.
- The steel was clad with fibre cement sheeting and themed to create a weathered and damaged appearance.
- The ship according to fantasy has been forcefully beached upon the reef in the late 1930's and creates the transition from land to below sea level by the way of a sunken galleon, with which the merchant marine ship is said to have collided.
- The wreck of the galleon leads in turn, to other imagined underwater wrecks. This is an exciting feature of the new aquarium that, apart from the species of marine life on display, the 500m meander is completely themed.
- The theme is that of shipwrecks celebrating the heritage of shipwrecks along the Durban coast.
- The walk takes the guest through four different shipwrecks, a Spanish Galleon equipped with canons, believed to have sunk in 1600. A passenger steamer sunk around 1900 and a cargo ship, sunk in the 1970's.
- Finally guests come into what has come to be known as the Dark Ship with strange cryptic writing and emblems appearing on it, which supposedly disappeared without trace in the early 1920's.
- The emphasis on this venture was black economic empowerment.

Innovation Category Winner

Alcatraz Security Systems

Description:

Added value to palisade fencing

Project Partners:

Developer / Owner:
Independent Development Trust

Architect:
Bartch (Pty) Ltd

Specifier:
BTKM Quantity Surveyors

Project Manager:
Bartch (Pty) Ltd

Main Contractor:
Alcatraz Security

Other:
VIN Architects

Hot Dip Galvanizer:
Morhot Galvanizers

Information:

- Due to the extremely competitive nature of the fabrication and erection of palisade fencing, Alcatraz Security Systems improved on the existing system, particularly the installation methods currently being used and examined the smaller items to improve on quality.
- Traditionally, most fastener stockists keep electro-plated fasteners, which if not correctly specified may be used instead of hot dip galvanized equivalents.
- Alcatraz developed their own fastening device, which was already hot dip galvanized, which they would keep as a stock item.
- The fastening device comprises a hot dip galvanized 12mm round pin, which fits tightly into a 15mm square tube after galvanizing.
- This device saves the cost of both bolt and flat bar.
- A washer welded into the center of the pin makes it impossible to remove after installation, thereby increasing security.
- The next item to be improved upon was the fixing method of palings to rails by using hot dip galvanized 8mm cup square bolts and anti-vandal shear nuts.
- Previously only electroplated fixing components were available, and in coastal areas premature corrosion of these components has already occurred by the time the site crews move offsite.
- On high security installations Alcatraz put a drop of lock tight on the thread of the cup square bolt, making it virtually impossible to remove a pale once installed.
- In order to reduce damage and speed up the installation process when attaching electric fencing and overhead razor wire to palisade fencing, a simple bracket was developed by Alcatraz.
- Bracket is made out of two pieces of angle iron which slide over the IPE post.

Value Adding Category Winner

Tricom

Description:

Hot Dip Galvanized mild steel angular lattice structures for the telecommunications industry, primed and painted for M-Cell

Location:

Mozambique

Tonnes of Steel:

750

Project Partners:

Developer / Owner:
Tricom Structures cc

Project Manager:
Phoenix Galvanizing (Pty) Ltd

Hot Dip Galvanizer:
Phoenix Galvanizing (Pty) Ltd

Information:

- Tricom is one of the largest telecommunications infrastructure manufacturing companies in South Africa and has a structure for most applications within the wireless telecom spectrum with most of their steel being exported into Africa.
- Towers are available in light, medium and heavy applications up to heights of 150m assembly configurations.
- All towers may be hand rigged and no cranes are required. This is an important feature considering installations in remote terrain where crane costs may be expensive or hard to obtain.
- Due to the tight deadline of the project, management at Phoenix decided to assist with part of the duplex coating after the steel had been hot dip galvanized, thus adding value to Tricom.
- Phoenix created a dedicated area to prevent over-spray contamination. Specialised stands had to be engineered to set steel for painting and 15 dedicated staff members employed and trained.
- Currently Phoenix offer the following services to Tricom; transport of goods from Pretoria, galvanizing and fettling of steel, washing down of galvanized steel with GalvPrep, rinsing steel with high-pressure cleaner, spray painting of primer, packaging and dispatch and transport back to Pretoria.

Empowerment Category Winner

Phoenix Galvanizing

Description:

Phoenix Galvanizing prides itself in the fact that all employees are from previously disadvantaged backgrounds.

Information:

- Phoenix has increased its female floor staff from 2 to 20 in 2004.
- Many of their value added services offered to clients have created more employment.
- Various training exercises are conducted on a regular basis in accordance with regulatory requirements, with a composite training register being maintained.
- In addition to this conferences and seminars are attended and publications are constantly reviewed and analysed.
- In their commitment in the promotion and understanding of the hot dip galvanizing process, Phoenix have trained their clients by means of Plant Tours.
- SABS ISO 9001:2000 Quality Management System and SABS ISO 1461:1999 accreditation.
- Currently engaged in the implementation of OHSAS 18001 and ISO 14001:1997 Environmental Management System.
- Phoenix is an industry leader in Black Empowerment Initiatives (BEE Initiatives).

Research & Development Category Winner

Galvastop

Description:

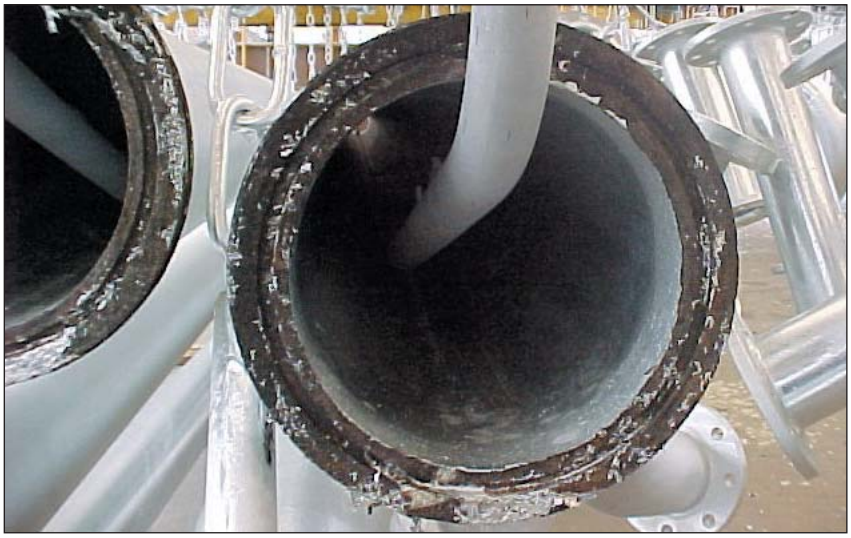
A rapidly air drying blend of synthetic resins specifically formulated for the Hot Dip Galvanizing Industry as a suitable and convenient stop off material.

Project Partners:

Developer / Owner:
Orlik Speciality Chemicals

Information:

- Established in 1985, Orlik Speciality Chemicals operates in the manufacture and supply of metal-finishing technologies.
- As a company, Orlik has endeavoured to sustain the latest technologies and developments.
- In 1999 Orlik were approached to develop a product specifically for the hot dip galvanizing industry, namely a mask off agent, with the end-user needing to be able to pre-apply this product, with the product being resistant enough to go through the entire hot dip galvanizing process.
- For any coating this is an extreme test as not only the corrosive properties of the chemicals but also the high fluctuations in temperatures provide a difficult environment for the product.
- The benefit of the process is that it is fairly easily applied and then allowed to dry for approximately 2 hours before processing the components.
- After the process is completed the product is easily removed with a brush and is left as a charred residue.
- Galvastop has become popular in South Africa and overseas, with exporting to America, Taiwan, Australia, Egypt, Kenya and France.
- The process has saved a tremendous amount of regrinding and stripping.
- Fields of application for Galvastop are the Oil Pipelines in Saudi Arabia, Automotive Industry (Delta Motor Vehicles), U-Haul Vans, Oil Rigs in Nigeria and North Sea, Tractor Manufacturers in USA and the heavy artillery industry.



Prominent Projects Category Winner

New Terminal at Port Elizabeth Airport

Description:

The project consists of a covered walkway which provides safe and sheltered access between the terminal buildings and the aircraft. The walkway acts as a visual and actual link between the original departure building and the new arrivals terminal.

Location:

Port Elizabeth

Tonnes of Steel:

21

Project Partners:

Developer / Owner:
Airports Company South Africa

Architect:
Stauch Vorster / ADA

Specifier:
Stauch Vorster / ADA

Structural Engineer:
Sigma Consulting

Main Contractor:
Alfdav SBT

Steelwork:
Triple S Steel Services

Hot Dip Galvanizer:
Galvanising Techniques

Project Inception Date:

February 2004

Project Value:

R329 000

Information:

- It was important that the walkway should not obstruct any views out from the terminals and the arched roof covering of cranked aluminium sheeting is carried on a graceful and slender support system of hot dip galvanized posts and purlins.
- Passengers are separated and directed by an innovative system of hot dip galvanized handrails with gates, which provide flexible, but controlled access routes.
- The design stability of the structure was provided by the moment bases which were fabricated out of a 300 diameter 20mm thick base plate in which a 130 diameter circular hole was formed to receive the 127 diameter circular hollow section column. This large hole at the base of the column plus optimally sized holes in the column cap plates simultaneously facilitated ideal fill, drainage and vent holes respectively, for the free flow of molten zinc. The edges of the hole were chamfered to obtain the maximum size fillet welds so that the plate formed a collar around the column base.
- The motivation was to achieve the maximum moment capacity at the base, in order to omit vertical cross bracing to achieve the clean straight lines and to avoid any obstruction with pedestrian movement.
- All sections were designed around a 5m module and site bolted. The entire walkway was surveyed and each column was cut to length prior to hot dip galvanizing to accommodate the variations of the walkway levels, but to maintain the rafters and horizontal struts all at one level. No site welding and hence no coating repairs were required after erection of the structure.
- The main frame comprised 127 diameter tubular sections and the purlins rectangular hollow sections for aesthetic reasons. A further consideration of the square tube purlin section was to potentially eliminate any possible water condensation accumulation even though the inside of the purlin was hot dip galvanized. The ends of the purlins were left open.
- All bolt connections were designed in conjunction with the architect to achieve a double shear type connector which is architecturally pleasing, with a lesser industrial appearance.

Sustainable Performance Category Winner

Storms River Bridge

Location:

Eastern Cape

Project Partners:

Developer / Owner:
SA National Roads Agency

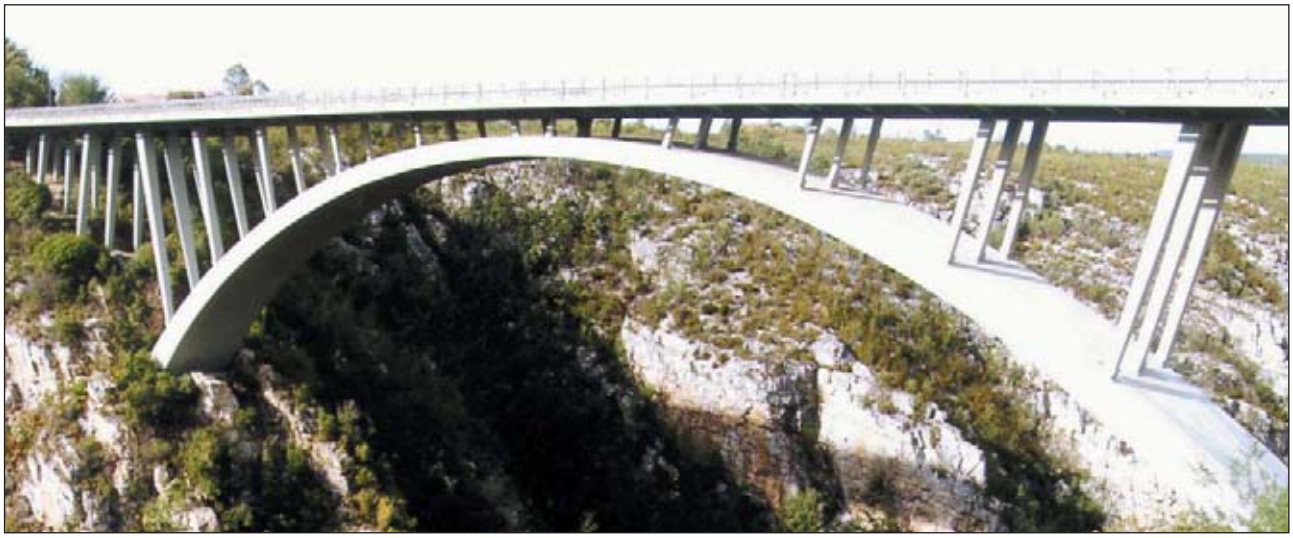
Engineers:
Hawkins Hawkins & Osborn Africa

Main Contractor:
Concor Construction (Pty) Ltd

Hot Dip Galvanizer:
Cape Galvanising (Pty) Ltd

Information:

- Eighteen years after the rehabilitation and widening of the bridge, the hot dip galvanized balustrades, stanchions, support girders and walkways on the Storms River Bridge are still in immaculate conditions and show no signs of deterioration.
- Situated within 5km from the sea the original specification called for a zinc coating thickness of 140µm as the engineers required an extra long lifetime from the galvanized coating and called for a zinc coating thickness specified in BS 5493.
- This was achieved by shot-blasting all the steelwork prior to hot dip galvanizing.
- The bridge aesthetically, is still one of the most beautiful in South Africa and was designed by Di Ricordo Morandi of Italy and constructed in 1956.
- It was widened and strengthened in 1986 by increasing the overall width of the deck to 11.45m from 8.18m by using steel box girders to support the widened concrete slabs of the cantilever.
- The arch itself was strengthened by the addition of externally bonded steel plates at the crown. The walkways and balustrades were installed at this time.
- Indications are that the client can expect another 50 years life from the balustrades and 35 years from the chequer plate walkways due to extra wear from pedestrians.
- A duplex system can be applied at a later date to extend the lifetime further should this be required.
- Coating thickness is as follows:
  - a mean for the handrails of 176µm
  - a mean for the stanchions of 201µm
  - a mean for the plates of 152µm.



Oribi Plaza – Phase 3

Innovation Category

Description:
Third phase of new additions to Oribi Plaza which will house the new Halfway Toyota Automark Showroom

Location:
Port Shepstone, Kwazulu Natal

Project Partners:
Developer / Owner:
Oribi Plaza (Pty) Ltd

Architect:
Aslam Engar

Specifier:
Anton van Riet

Project Manager:
Oribi Plaza (Pty) Ltd

Main Contractor:
Jay Brown Steel

Hot Dip Galvanizer:
Phoenix Galvanizing (Pty) Ltd

Lighting of Nelson Mandela Bridge

Innovation Category

Description:
The creation of an urban landmark by capping the pylons with beacons fitted with colour change luminaries to provide an accent light that could be seen from a distance.

Location:
Newtown, Gauteng

Project Partners:
Developer / Owner:
National Roads Agency

Architect:
Dissing & Lighting A/S and Paul Ove Jensen

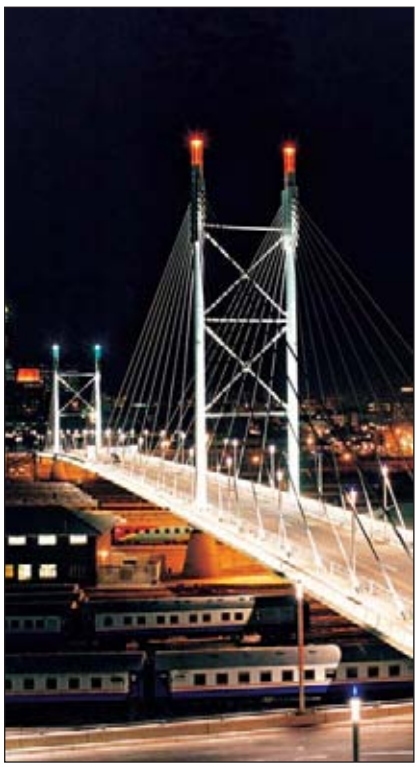
Specifier:
P.D. Naidoo and A Potgieter

Project Manager:
Grinaker LTA and W. Jerling

Main Contractor:
Grinaker LTA and W. Jerling

Sub Contractor:
Societ (Lighting Architect) and Patrick Rimoux

Hot Dip Galvanizer:
Armco Galvanizers



Clifton Cliffhanger

Innovation Category

Description:
The provision of lateral support for a site in Clifton where a new block of luxury apartments are being built down to the waters edge.

Location:
Clifton, Western Cape

Tonnes of Steel:
65

Project Partners:
Developer / Owner:
Rowbow Investments

Architects:
Dennis Fabian, Berman, Hackner and Stefan Antoni

Specifier:
Kantey & Templar

Project Manager:
Franki Afrika (Pty) Ltd

Main Contractor:
WBHO Construction (Pty) Ltd

Hot Dip Galvanizer:
Cape Galvanising (Pty) Ltd

Project Completion Date:
October 2005

FlagAd

Innovation Category

Description:
Fixed Flag Advertising

Project Partners:
Choles Signs (t/a Prosign)

Hot Dip Galvanizer:
ConGalv (Pty) Ltd

Project Inception Date:
1998

Dead Tree Cell Mast

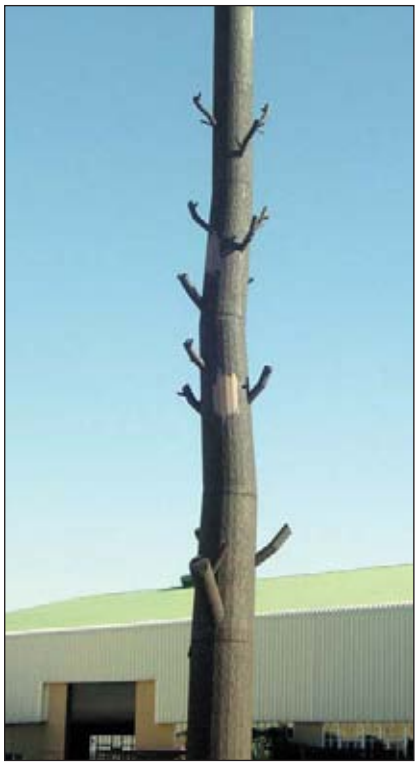
Innovation Category

Description:
Camouflaged elevated mounting position for cellular telephony with an ecologically pleasing appearance with little or no maintenance.

Tonnes of Steel:
6

Project Partners:
Customer:
Mast Projects

Hot Dip Galvanizer:
Barloworld Galvanizers



Maydon Wharf Fruit Terminal

Value Adding Category

Description:
The refurbishment and development of the additional cold storage fruit terminal facilities on Maydon Wharf Durban

Location:
Maydon Wharf, Durban

Tonnes of Steel:
330

Type Of Steel:
Structural

Project Partners:
Client:
Commercial Cold Storage

Architect:
Mike Paterson Associates

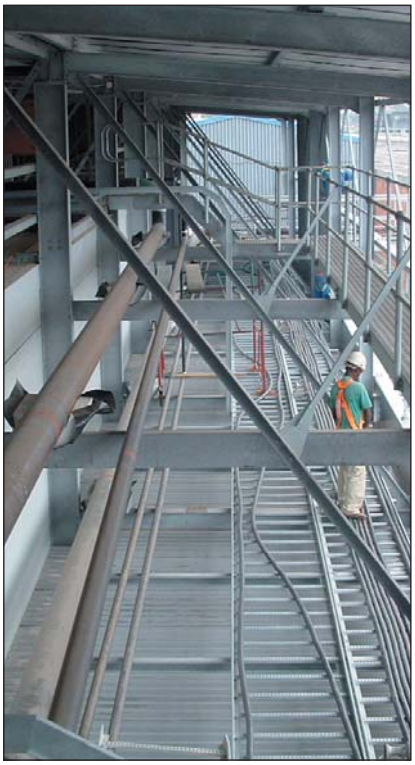
Project Manager:
Peter Worthington-Smith

Steelwork Contractor:
Scott Steel Projects

Hot Dip Galvanizer:
Cape Galvanising (Pty) Ltd

Project Inception Date:
October 2003

Project Value:
R5.3 million



bosal House of Irrigation

Value Adding Category

Description:
Hot Dip Galvanizing of above ground coupling irrigation systems, providing low maintenance, cost effective equipment for agriculture, landscaping and industrial applications

Location:
Mozambique

Tonnes of Steel:
750

Project Partners:
Developer / Owner:
bosal Afrika

Project Manager:
Phoenix Galvanizing (Pty) Ltd

Hot Dip Galvanizer:
Phoenix Galvanizing (Pty) Ltd

Debmar Atlantic

Value Adding Category

Description:
Processing Plant upgrade on the off-shore diamond mining vessel the "Debmar Atlantic"

Location:
Off-Shore

Tonnes of Steel:
130 tons of structural steel was used for the module construction

Project Partners:
Developer / Owner:
De Beers Marine (Namibia)

Specifier:
De Beers Marine

Project Manager:
De Beers Marine

Main Contractor:
PBA Projects (Pty) Ltd

Other:
SA Five (Pty) Ltd (Fabrication) and Belmet Marine (Pty) Ltd (Installation)

Hot Dip Galvanizer:
Cape Galvanising (Pty) Ltd

Project Inception Date:
2003

Rand York Castings

Value Adding Category

Description:
A specialist steel fabrication company who is an OEM supplier to both the civil and mining sectors.

Location:
Export

Project Partners:
Developer / Owner:
Rand York Castings (Pty) Ltd

Project Manager:
Phoenix Galvanizing (Pty) Ltd

Hot Dip Galvanizer:
Phoenix Galvanizing (Pty) Ltd

Barloworld Galvanizing

Empowerment Category

Description:
The upliftment and empowerment of all staff is of great importance

"The long-term sustainability of the business along with skills development, promotion, empowerment and rewards provide the basis for individual wealth creation. In recognising that the South African economy of the future will be very much in the hands of previously disadvantaged people, we have a responsibility to drive the upliftment of our people."

Vendor Mobile Stands

Empowerment Category

Description:
Informal trading stall to facilitate the growing number of hawkers in the Johannesburg CBD

Project Partners:
Wilde at Heart Interiors

Collage Design

C&S Ornamental Iron Works

Dell S.A.

ConGalv (Pty) Ltd

Metrorail – False Bay

Research and Development Category

Description:
Electrification Steelwork for Metrorail. Research and development of duplex coatings.

Location:
False Bay, Western Cape

Type Of Steel:
Electrification Steelwork

Project Partners:
Developer / Owner:
S.A.R.C.C.

Structural Engineer:
Africon

Specifier:
A.van der Walt

Project Manager:
A. van der Walt

Main Contractor:
Tractional Enterprises

Other:
Metro Rail

Hot Dip Galvanizer:
Cape Galvanising (Pty) Ltd

Galvaglo

Research and Development Category

Description:
The prevention of wet storage stain (white rust) from forming on hot dip galvanized steel products when transported in severe conditions.

Project Partners:
Developer / Owner:
Orlik Speciality Chemicals

Hot Dip Galvanizer:
Barloworld Galvanizer

Project Inception Date:
2003

Lazy Shades

Prominent Projects Category

Description:
Leisure Beach Seating Facility

Location:
Hibiscus Coast, Margate Beach

Project Partners:
Developer / Owner:
Cor Blackie

Project Manager:
Cor Blackie

Main Contractor:
South Coast Powder Coaters

Hot Dip Galvanizer:
Phoenix Galvanizing (Pty) Ltd

Project Inception Date:
March 2004

Crocodile River Pedestrian Bridge

Prominent Projects Category

Description:
Hot dip galvanizing of the support columns, walkway side supports, hand railings and cables.

Location:
Lowveld National Botanical Garden, Nelspruit

Project Partners:
Developer / Owner:
National Botanical Institute

Architect:
Theunissen Jankowitz

Specifier:
LHL Civil Engineers

Project Manager:
Mithro Construction Management

Main Contractor:
Themba Lethu

Other:
VIN Architects

Hot Dip Galvanizer:
Armco Galvanizers

Dome Venue

Prominent Projects Category

Description:
A portable venue for South African Tourism's exhibition tour – South Africa

Project Partners:
Project Partners:
Art of Light and ConGalv (Pty) Ltd

Melrose Arch

Prominent Projects Category

Description:
Hot dip galvanized structural steel for the roof, side and front structure of the office building and shopping complex at Melrose Arch.

Location:
Melrose, Johannesburg

Type of Steel:
Universal Beams and Circular Hollow Sections

Project Partners:
Architect:
TC Design

Project Manager:
LC Consulting Engineers

Main Contractor:
Grinaker LTA

Sub-Contractor:
Tass Engineering

Hot Dip Galvanizer:
Armco Galvanizers

South Deep Mine

Prominent Projects Category

Description:
Hot dip galvanizing of components for the South Deep Mine

Location:
Witwatersrand Basin, Westonaria, Johannesburg

Tonnes of Steel:
500

Project Partners:
Client:
MM&G Engineering

Hot Dip Galvanizer:
Barloworld Galvanizers

Miele Building

Prominent Projects Category

Description:
Art Gallery

Location:
Sandton, Johannnesburg

Project Partners:
Developer / Owner:
Miele (Pty) Ltd

Architect:
Boogertman Krige Architects

Other:
Gothic Construction

Other:
A&D General Services cc

Hot Dip Galvanizer:
ConGalv (Pty) Ltd

The facts about using hot dip galvanized reinforcement in concrete

Introduction

Much discussion and debate has and continues to take place with regard to the pros and cons surrounding the question of hot dip galvanizing of reinforcing bars in concrete. From these debates, it is clear that a number of misconceptions have arisen through a lack of knowledge of the hot dip galvanized coating. Because of this, opportunities to improve structural integrity and service life could, in the medium to long term, be overlooked or lost.

The purpose of this article is to address many of the issues that arise when hot dip galvanizing of reinforcing steel is debated. The intention is to provide information on the various factors involved so that informed decisions can be made.

It can be theorized from research and practical experience, in coastal areas, that for a South African marine environment: **"The life to first annual maintenance of a black bar reinforced concrete structure which failed by "concrete spalling" after about 10 years could have been enhanced to over 30 years if the re-bar had initially been hot dip galvanized".** This postulation assumes a concrete cover of 40mm minimum and > 40Mpa strength concrete (ordinary Portland Cement). Ref No.1.

Factors that Determine Durability of Reinforced Concrete

Environment

As is the situation with corrosion of all materials, the environment in which the product is situated, will have a major influence on the service life of that product. The external environment is the major factor to be considered when designing all types of structures and reinforced concrete is no exception. It is the environment that carries the corrosive elements such as oxygen, carbon dioxide, moisture, and chlorides in sea spray and of course seawater. It therefore follows that structures located close to the coastline and in particular prevailing winds off the sea, are subjected to a greater potential to corrosive attack than inland areas.

Notwithstanding this comment, certain marine environments can be less corrosive than others, while inland environments, such as industrial sites, can present highly corrosive substances to a structure. It is not sufficient to apply corrosion protection in marine environments only, but rather each case must be assessed on specific site conditions. Concrete structures subjected to aggressive salts and gases represent conditions where corrosion can be a problem and therefore requires design attention.

In time, pH levels in the concrete are reduced into a range from pH12 to 8, due to the inevitable ingress of carbon dioxide (CO_2). In this pH range, zinc performs exceptionally well, while the rate of corrosion of unprotected steel would be increasing.

In service the pH level of cured concrete at the concrete rebar interface is eventually reduced into the range of pH8 to 12, due to the ingress carbon dioxide (CO_2) and/or chlorides in marine environments. In this pH range corrosion of the hot dip galvanized (zinc) coating is minimum, while in comparison, the rate of corrosion of unprotected steel is increased considerably, due to the loss of a protective oxide passive film.

Quality of Concrete

The quality and permeability of the concrete represents the most important or critical factor to be considered when reviewing the corrosion protection properties of a structure. Permeability is influenced by the following factors:

- *Concrete Mix* - Low concrete permeability is a function of the bonding between the aggregate and the cement, water/cement ratio and size and grading of the aggregate.
- *Compaction* – Adequate and controlled compaction has an influence on both the quality of the concrete and its permeability.
- *Curing* – Site curing procedures also influence permeability and ultimately concrete quality.

Depth of Cover

Depth of cover over the reinforcing steel is of major significance when corrosion protection of steel is being considered. Notwithstanding the depth of concrete cover required in terms of the specification, the final cover is often determined by practical

While minimum cover can be specified the cover that is ultimately achieved is frequently dependant on practical considerations.

considerations at the time of the actual placing or pouring of the concrete. The reinforcing steel could shift within the shuttering or formwork and this could remain undetected due to restrictions during the pouring process.

From the above comments it is clear that the structural performance of reinforced concrete and the onset of corrosion of the reinforcing steel is largely determined by the quality of the concrete and placement of the steel. It is therefore clear that provision of corrosion protection to the reinforcing steel, by hot dip galvanizing, does not replace the requirement for good quality concrete. The purpose of corrosion protection of reinforcing steel is to extend the ultimate service life of the structure once the corrosive agents, present in an aggressive environment, have penetrated concrete.

The cost of galvanizing the re-bar far out weighs the cost of repair on concrete spalling that results from the corrosion of uncoated reinforcing steel.

Structural Failure due to Corrosion

In order to place the need for hot dip galvanizing of reinforcing steel into context, we need to discuss a typical failure of a reinforced concrete structure as a result of the corrosion of the reinforcing steel.

Sequence of events leading to the corrosion of the reinforcing steel

- In time the corrosive substances will penetrate the concrete. The time taken is a function of the quality of the concrete.
- Once the corrosive elements have penetrated through to the reinforcing steel, corrosion "rust" will intensify (*see* 1 *in figure* 1).
- **The products of corrosion (Ferrous chloride, Ferrous oxide & Ferrous Hydroxide "rust" will occupy a greater (2.5 times) volume than that of the parent steel from which they are formed.**
- The greater volume sets up tensile stresses within the concrete surrounding the reinforcing bars (*see* 2 *in figure* 1).
- The stress buildup leads to "cracking" of the concrete, which in turn allows greater environmental access to the steel and an increase in the rate of corrosion (*see* 3 *in figure* 1).
- This in turn leads to greater stress and ultimately the "spalling off" of concrete.

From the foregoing discussion it should be clear that the quality of concrete remains the most important factor when corrosion protection of a structure is considered. The hot dip galvanizing of reinforcing steel is no substitute for poor concrete quality

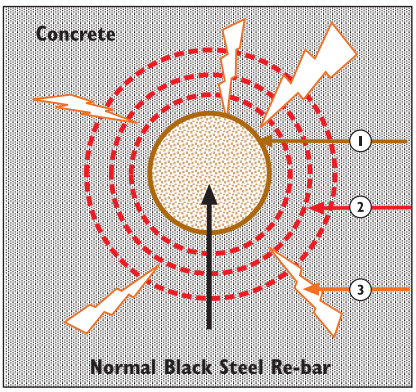
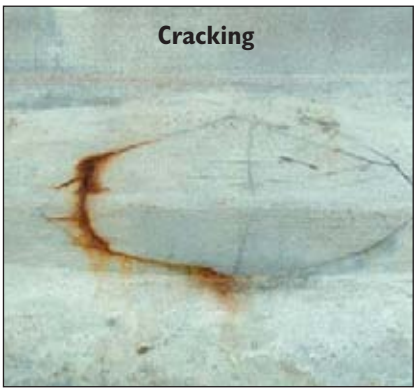


Figure 1.

and the controlled placement of the reinforcing steel. The purpose of hot dip galvanizing of reinforcing steel is to extend the service life of concrete structure by delaying the onset of a frequently catastrophic result of corroding reinforcing steel.

In order to place the question of hot dip galvanized reinforcing bars into context, we need to discuss what transpires when reinforcing is cast into concrete. How does the zinc



This series of photographs illustrates the sequence of events leading up to the ultimate failure of the reinforced concrete structure.

Once spalling has occurred, it becomes very difficult to repair; therefore prevention is far better than a cure!

coating react with the newly poured and curing concrete? What reactions take place when corrosion induced substances penetrate through to the reinforcing steel?

Zinc Reaction with newly poured Concrete

From the diagram of the corrosion rates of zinc versus the pH value of the environment, we see that zinc is attacked in acid (pH values 0 to 6) and again in highly alkaline conditions. (pH > 12.5). The fact that zinc corrodes at pH levels >12.5, gives rise to a misconception with regard to the performance of hot dip galvanized reinforcing steel.

Freshly poured "wet" concrete has a pH >12.5, which will cause it to react with zinc. This reaction progressively ceases whilst the concrete is curing, and is inhibited when the galvanized rebar is chromate passivated, as is normal practice, by the galvanizer.

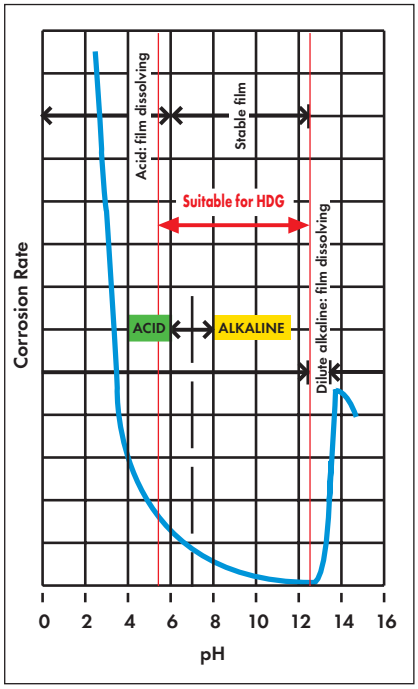
During initial contact of the galvanized reinforcing steel with that of the wet concrete, the outer zinc layer of the galvanized coating reacts to form zincates. This reaction ceases as the concrete hardens leaving the zinc coating largely intact and able to provide corrosion protection of the reinforcing steel.

A further misconception that arises out of the fact that insoluble zinc salts and the evolution of hydrogen is formed at the interface of the newly poured (wet) concrete and the hot dip galvanized reinforcing bars, is the question of reduced bond strength.

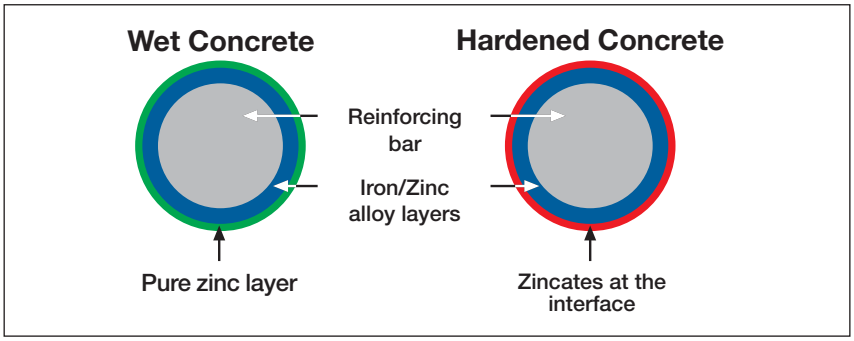
Bond Strength of Concrete to Hot Dip Galvanized Reinforcing Bars

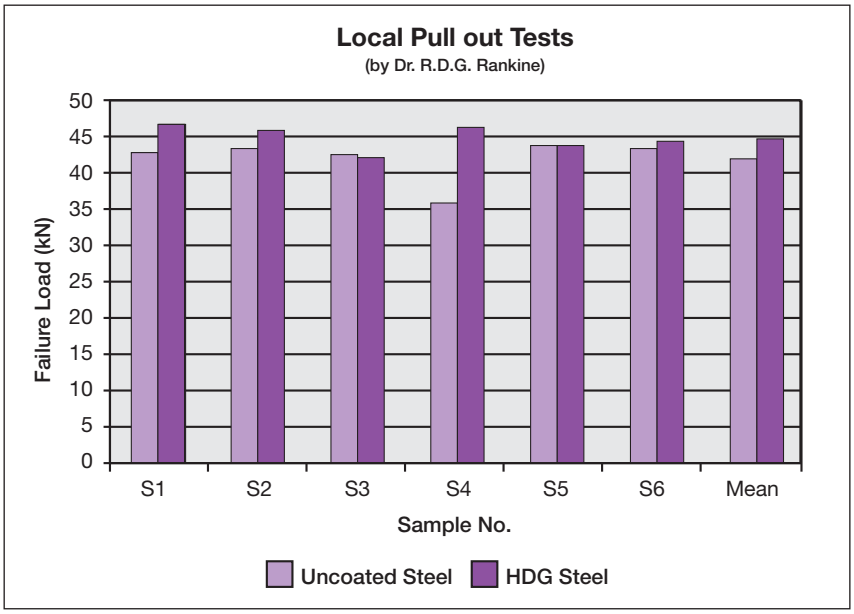
The results of numerous and extensive programmes of pull-out tests conducted by a number of researches around the world, as well as the latest series of local tests conducted by Dr. R.G.D. Rankine of the School of Concrete Technology, shows that the bond strength is not reduced when compared with black re-bar. In point of fact, it was found that an actual increase in the bond strength was observed. The bar chart below reflects the results obtained during the tests conducted by Dr. Rankine. (Ref. No.2)

It is also said that the evolution of hydrogen gas at the galvanized surface will reduce the bond strength. This problem does not arise if chromium-containing compounds, naturally present in cement, which is frequently, but not always the case. As a precaution, chromate passivation, has in the past, been added to the cement mix, when hot dip galvanized re-bar is employed. It is of course, normal practice that hot dip galvanized reinforcing steel is passivated in sodium bi-chromate solution within the galvanizing operation and therefore the problem of hydrogen evolution does not arise.



The relative corrosion rates (y axis) of zinc in terms of the pH scale (x axis)





Corroded re-bar resulting in the "spalling off" of the concrete cover.

Areas of concrete that have been repaired following the corrosion of the re-bar and the "spalling off" of the concrete. Such repairs are difficult to carry out and generally have limited success.

Repairs to the re-bar on this bridge structure proved to be unsuccessful in that the corroding reinforcing bars have again removed the concrete.

Recent Site Visits and Observations

The following photographs are illustrations of actual sites were uncoated reinforcing bars were used in concrete that was undoubtedly specified in terms of concrete quality and minimum depths of cover. In the case of one particular site both hot dip galvanized re-bar as well as uncoated re-bar was used. Where hot dip galvanized re-bar was used no spalling was found, while the uncoated bars were corroding and spalling of the concrete had taken place.

Conclusion

Hot dip galvanizing is not used to replace poor quality concrete, but is used to add value and longevity to the reinforced concrete structure and overcome practical difficulties in meeting the FULL requirements of a given specification. Hot dip galvanizing of re-bar is an economical and cost effective process that can be expected to substantially extend the useful service life of concrete structures in marine and other corrosive environments. The marginal cost increase (1 to 2%) of the total cost of a project is money well spent and will without doubt provide justifiable returns.

References:

1. A *review of Hot Dip Galvanized Steel Reinforcing in Concrete Structures Exposed to South African Coastal Marine Environments by Professor Dennis Twigg.*
2. *Galvanized Steel Rebar in South Africa by Dr. Rod Rankine.*

Article Submitted by:
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March 2004

HOT DIP GALVANIZED POLES OFFER REGIONAL OPPORTUNITIES FOR ELECTRICAL DISTRIBUTION

For a number of years, IZA has supported the American Iron and Steel Institute (AISI) semina promoting the advantages of steel utility poles. At a recent IZA Market Development Comm Helsinki, Finland, the role of IZA in transferring this opportunity became clear.

Hot dip galvanized steel offers advantages over traditional wood products; zinc-coated steel is stronger, more durable and more environmentally friendly. The use of hot dip galvanized coatings for the corrosion protection of steel avoids the hazardous treatments required for wood. In addition, in remote locations where access for maintenance is difficult, the resistance to insects and rot makes hot dip galvanized steel the most cost-effective choice.

Case histories published this year show the increasing trend of adoption of hot dip galvanized steel poles in the USA. Austin (Texas) Power turned to steel as the solution to problems with the use of multiple wooden poles when turning corners, thereby enabling the utility to keep within the designated rights of way. However, Austin Power says a cost benefit analysis confirmed that time and money are saved when using steel while increasing system reliability. Today, steel poles are a standard part of Austin's distribution system and are used in over 90% of major new distribution projects.

Using the AISI expertise, contact has been made between pole manufacturers in France and South Africa. Working with South African regional electricity giant Eskom, work is underway in optimising the design for local conditions. Although still early days, it is hoped that a total cost product will be competitive against wood. LATIZA in South America has also shown interest in the initiative and will be looking for similar opportunities. These regional co-operations showcase the opportunities provided by the new Regional groupings working together with the IZA Committee on General Galvanizing.

This IZA contribution was made possible by INTERNATIONAL ZINC ASSOCIATION – SOUTHERN AFRICA (IZASA)

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Related hot dip galvanizing specifications and the South African National Standards (SANS) equivalents

Although the specification name changes are immediately effective, for convenience purposes, the change will be implemented over the next 5 years.

Note: For export purposes, all existing ISO and EN standards will remain the same.

General Hot Dip Galvanizing Specifications:

SABS ISO 1461 has been replaced by SANS 121 – Hot dip galvanized coatings on fabricated iron and steel articles – Specifications and test methods.

SABS EN 10240 has been replaced by SANS 32 – Internal and/or external protective coatings for steel tubes – Specification for hot dip galvanized coatings applied in automatic or semi-automatic plants.

SABS ISO 14713 has been replaced with SANS 14713 – Protection against corrosion of iron and steel in structures – Zinc and aluminium coatings – Guidelines.

SABS ISO 2063 has been replaced by SANS 2063 – Metallic and other in-organic coatings – Thermal spraying – Zinc, aluminium and their alloys.

Continuously Hot Dip Galvanized Sheet Specifications:

SABS ISO 4998 has been replaced by SANS 4998 – Continuous hot dip zinc coated carbon steel sheet for structural quality.

SABS ISO 3575 has been replaced by SANS 3575 – Continuous hot dip zinc coated carbon steel sheet for commercial, lock forming and deep drawing grades.

Continuously Hot Dip Galvanized Wire Specifications:

SABS 675 has been replaced by SANS 675 – Specification. Zinc coated fencing wire (plain and barbed).

SABS 935 has been replaced by SANS 935 – Specification. Hot dip (galvanized) zinc coatings on steel wire.

Mohale feeder roads and bridge

Background and purpose of the project

The project formed part of Phase 1B of the Lesotho Highlands Water Project. It involved the construction of two vehicular and one pedestrian bridge across the Mohale Dam for the Lesotho Highlands Development Authority (LHDA). The purpose of this contract was to mitigate one of the adverse impacts of the Mohale dam on the vulnerable communities around the impounded area. The water body forms a barrier across established pathways between communities, and this contract as part of the feeder roads project provides transport links between different areas around the Mohale Dam basin.

The Mohale Feeder Roads Engineering Joint Venture (Stewart Scott (Pty) Ltd and Africon Lesotho) was awarded the tender for the design of the Mohale Feeder Roads system and seven bridge structures. Included in the tender was the provision for a site monitoring team for the construction of the three largest bridge structures. The client, Lesotho Highland Development Authority (LHDA), was responsible for the site monitoring of the remaining four smaller bridge structures.

Construction activities commenced in June 2001 and were substantially completed in February 2003, for a final contract sum of M 84 million. (M = Maloti, equal to the Rand value)

The Works embodied in the construction contract briefly comprised the following:

- A single lane vehicular bridge, 449m long and 91m high, across the Senqunyane River next to the village of Ha Mokhosi and just below the confluence of the Bokong and Senqunyane rivers;
- A single lane vehicular bridge, 308m long and 72m high, across the Bokong River, near Ha Mokhathi;
- The Limapong footbridge (see left), 273m long and 63m high, across the Senqunyane river near Ha Leshapa; and
- Construction of the feeder roads on the approaches to the vehicular bridges.

The bridges were founded by means of concrete spread footings on basalt bed rock. The piers were constructed using continuous slip form paving techniques. The continuous composite decks for the vehicular bridges consist of closed steel box girders with concrete deck slabs. The continuous deck for the footbridge is a structural steel box truss with a precast concrete walkway.

The main objectives of this project:

- Employment of local labourers from surrounding communities.
- To facilitate access to local communities around and across the proposed Mohale Dam.
- Technology transfer to the Client, LHDA.
- Economical Design of vehicular

and pedestrian bridges.

- Liaison with local communities, government and other stakeholders on the finalisation on routes and crossing positions for the Feeder Road project.

Technical design of the project

Limapong Footbridge

The deck girder is a 273m long seven span continuous bolted steel box truss. All steel was hot dip galvanized. The overall height of the steel truss was 3 115m and the width was 2.07m.

The walkway consisted of 75mm thick pre-cast pre-stressed concrete deck planks laid loose on the bottom chord of the box truss. The deck planks had cast in studs on the underside to prevent dislocation.

The handrails consisted of fully welded hot dip galvanized steel panels with vertical bars, bolted to the trusses.

The net trafficable height inside the box truss was 2.53m and the net width 1.65m.

The 70 deck segments were fabricated and pre-assembled off site in 3.9m lengths which were bolted together on site and incrementally launched from the right (southern) abutment to the left abutment.

The deck was supported 3.5m above the Full Supply Level on two concrete abutment columns and six concrete piers. All the piers had rounded rectangular solid upper portions of between 23 and 29m height with cross-sectional dimensions of 2.95m wide by 1.2m thick. The northernmost pier (pier 1) had a rectangular solid bottom portion of 5.0m high with plan dimensions of 3.5m wide by 2.0m thick. The four centre piers had rectangular hollow bottom portions of up to 36.6m high with cross-sectional dimensions of 4.0m by 3.0m and a wall thickness of 0.3m all round. All portions of all piers, except the bottom portion of pier 1, were built by sliding concrete construction. Pier 3 was the tallest with an overall height to deck level of 63.5m.

The piers were supported on spread footings dowelled into basalt bedrock, the largest bases being 7,5m long by 6,0m wide by 1,4m thick.

Eshowe Pedestrian Bridge

This project involved the construction of a continuous, three span, pedestrian bridge across Main Road P47/4. The bridge functions as an access walkway for the homesteads on the eastern side of Main Road 47/4 to the town of Eshowe.

The outer two spans of the 43m long bridge are 10m whilst the inner span is 23m. The superstructure comprises a steel frame supporting precast concrete planks that form the walkway. The steel frame is supported on four reinforced concrete piers, which are founded on spread footings.

The construction of the foundations, piers, concrete stairways, concrete planks, paved walkways and fencing was included in the Contract with MB Ndolvu, a local Stage 3 Constractor. The contractor had never constructed a bridge before.

A Steelcon, a steel fabricator from Eshowe, was selected as the Sub Contractor to prefabricate and erect the steel bridge deck. The deck was fabricated in 5 sections. For the deck erection, the middle 3 sections were spliced together and then lifted by a crane onto the 2 inner piers, after which the outer 2 sections where positioned and spliced.

The Client is the Department of Transport, and the Eshowe Municipality. KZN Department of Transport appointed Stewart Scott International as consultants to design and supervise the construction of the footbridge.

MISCONCEPTIONS

Miss Conception puts it "straight"

"Miss Conception" rectifies incorrect impressions concerning hot dip galvanizing.

Specify* HEAVY DUTY *hot dip galvanizing or cadmium electro-plating for superior corrosion protection of fasteners. The mechanical action of a spanner will damage the coating.

True or False?

There are several different methods whereby a zinc coating can be applied to fasteners to provide a protective coating. These include zinc or cadmium electro deposition (electroplating), mechanical plating, sherradizing and hot dip galvanizing. All these processes provide a degree of protection. For practical reasons, the most commonly used systems are hot dip galvanizing and zinc or cadmium electroplating which is frequently and misleadingly described as electro galvanizing.

The two most important factors to consider when selecting the most effective protective system are resistance to mechanical damage of the protective coating during assembly and tensioning and the long-term protective properties of the coating. Let us consider these two important attributes and the degree to which they apply to both zinc electroplating and hot dip galvanizing. Incidentally, cadmium electroplating is frowned upon by environmentalists and in fact it is banned in many countries due to the toxic properties of this metal, particularly when the coating is cut or welded.

The resistance to mechanical damage and adhesion properties of both electroplating and hot dip galvanizing are far superior to those provided by organic coatings although the mechanism whereby adhesion is achieved is somewhat different in each case.

Hot dip galvanizing has the added benefit of a series of hard iron/zinc alloys within the coating structure. This significantly reduces the possibility of coating damage during tensioning.

As far as corrosion resistant durability is concerned, the thickness of a zinc coating determines its corrosion resistant life. Unfortunately, the thickness of a zinc coating that can be applied by the electro-deposition process is distinctly limited to the extent that the zinc electroplated coating applied to bolts and nuts is unlikely to exceed a thickness of about 10µm. In contrast, the coating applied by hot dip galvanizing normally averages between 50 and 60 µm in thickness which equates to at least five times the corrosion resistant life of a relatively thick zinc electroplated coating. In other words, hot dip galvanizing provides heavy-duty corrosion protection for fastener assemblies.

Heavy-duty coatings as in an additional 25% thickness that may be specified for structural steel, cannot be achieved in the case of hot dip galvanized fasteners. The reason for this is that after the galvanizing process, all bolts and nuts must be efficiently centrifuged to remove excess zinc and if this were not done successfully, the oversized nut would not be able to freely screw onto the bolt.

The coating is therefore limited to about 60µm, which when viewed from a corrosion perspective, can be less protective when used to couple hot dip galvanized structural steel together. Structural steel normally results in a coating thickness of greater than 85µm and in the case of aggressive environments, when a heavy duty coating is specified, at least 105µm. To ensure that the corrosion resistant life of the hot dip galvanized fastener roughly equates to the life of the coating on the structure, additional protection in the form of a suitable paint may be used. Most paints will adhere to well degreased galvanized surfaces but alkyd enamel paints should not be applied directly onto zinc.

A hot dip galvanized coating can be applied to bolts from M8 and upwards. Internal nut threads are tapped oversize to predetermined limits in order to accommodate the coating thickness provided by hot dip galvanizing. This does not have a negative effect on the mechanical properties of tensioned fasteners. Internal nut threads are not coated as this would necessitate oversize tapping to an extent that the strength of a fastener assembly could be compromised if tensioned to provide the specified clamping force as laid down in relevant specifications. The absence of a zinc coating on internal nut threads does not impact negatively on the corrosion resistant properties of hot dip galvanized fasteners due to the sacrificial properties of the surrounding zinc coating.

High strength bolts and nuts up to grade 10.9 are now hot dip galvanized on a regular basis.

EULOGY – Jan van Eijnsbergen

From left, Karla (Jan's wife), Walter Barnett and Jan van Eijnsbergen on one of their South African visits.

It is with regret that we announce the death of the Internationally renowned coating technologist J.F.H. van Eijnsbergen at the age of 90 years.

Jan gained respect throughout the world for his in-depth knowledge of both organic and metal protective coatings. In 1994, he published the well-known book entitled "Duplex Systems" (hot dip galvanizing plus paint) which he was able to review and update just prior to his death, with the intention of publishing the second edition.

Over a period of some thirty years Jan visited South Africa on numerous occasions. He often referred to South Africa as his second home where at Corrosion Institute Conferences and other technical functions his presentations were of an exceptionally high standard. He was fluent in five languages which enabled him to communicate and lecture in most countries.

Jan reluctantly referred to his days as a young man during World War II but those of us who knew him well, learnt something of his activities of bravery in the Dutch Underground movement against the oppressive invaders for which in later years, he was awarded a knighthood by Queen Wilhelmina.

The Hot Dip Galvanizing Industry in South Africa and elsewhere throughout the world owes much to this exceptional man for his outstanding contribution towards a better understanding and appreciation of the benefits that hot dip galvanizing and duplex systems can provide in the prevention of corrosion.

During the formative years of our Association and even in later years, his enthusiasm, technical expertise and loyalty have been a pillar of strength. He was a great teacher and those of us who benefited from his tuition are forever indebted to him.

During his early years, Jan was employed in Switzerland as a paint chemist. He became interested in the merits of metal coatings and in particular hot dip galvanizing. This led to his appointment as Director of the Stichting Doelmatig Verzinken (Dutch Hot Dip Galvanizers Association), which under his guidance became a dynamic force providing a wealth of technical information that benefited the hot dip galvanizing industry throughout the world. His knowledge as a paint chemist was of considerable benefit in the development of "duplex systems", a title which he coined to describe the concept of synergistic corrosion protection which is provided by the combined use of hot dip galvanizing and a heavy duty paint coating.

It was at a hot dip galvanizer's international conference held at the Royal Garden Hotel in London's West End some thirty five years ago that led to Jan's introduction to South Africa. His technical presentation at this conference was most impressive, so much so that we agreed to invite him to South Africa in the following year for a series of lectures in Cape Town, Durban, Pretoria and Johannesburg. Little did we realise at the time that this would be the first of numerous visits during subsequent years. Jan essentially described South Africa as his second home. There was nothing he enjoyed more than a visit to Kruger National Park during an interlude between lectures. His general knowledge was vast and the conversation would switch from subjects as diverse as music, politics, ecology, history and most frequently corrosion science and hot dip galvanizing. He was an avid photographer and his favourite of the big five was the elephant. On one occasion, he was photographing two elephants that were standing no more than 20 meters from the car. The larger of the beasts decided that he had taken enough pictures and promptly charged towards the car with ears flapping. Fortunately the car was situated on an incline since the first attempt to start the car's engine that had been switched off was unsuccessful.

An amusing incident, which occurred on the occasion of his first visit to South Africa, comes to mind. We were admiring the scenery in the Valley of a Thousand Hills prior to an evening lecture in Durban when we came across five young children line up on the roadside and clad only in their birthday suits. Jan leapt out of the car to photograph these little ones. He later remarked that the picture of the five little boys would create much interest with his friends back in The Hague. When told that this knowledge of the human anatomy seemed to be somewhat sketchy since the five little boys were in fact five little girls he packed up laughing and said that he bowed to my superior knowledge!

During lectures and discussions, Jan van Eijnsbergen oozed enthusiasm. He was never self-opinionated or arrogant which is no doubt why he created so many lasting friendships around the world.

We at the Association wish Jan a fond farewell. May his soul rest in peace.

Walter's Corner

Could we exist without Zinc?

I recently referred to the universal dictionary for a concise definition of the term heavy metal. I found two. The first defined heavy metal as a metal with relatively high density while the second, as a style of rock music characterised by a heavy bass beat and use of powerful amplification. Strange how identical words can convey vastly different meanings depending on the context in which they are used. Even the first meaning of the term heavy metal has changed somewhat from the original intention which was to define a material of a dense structure, so much so that the present connotation is almost synonymous with words such as harmful, hazardous and even poisonous. While this may to a degree be true of some heavy metals, e.g. lead and cadmium in specific circumstances, it is incorrect and misleading to infer that all so-called heavy metals are harmful and to be avoided. This is far from the truth.

The creator in his wisdom provided mankind with numerous elements that are essential for the continued existence and development of the human race. Among these are of course oxygen, nitrogen and metals such as iron. We tend to place considerable value on materials such as gold, silver and precious stones, which I suppose we could survive without while taking for granted more mundane substances that are essential for our very existence. Take for example zinc. Were it not for the presence of zinc compounds in the soil, plant life would not be able to flourish while animal and human existence would have long since vanished. Nature has a remarkable ability to provide a balance. For example, should the system contain zinc in excess of the essential amount for our well being, this excess zinc is automatically excreted. This is in contrast to substances which are not nutritional such as lead which when absorbed into the system remains the cause of lead poisoning. Zinc was first discovered in China many centuries ago, long before it became known in Europe for its valuable and diverse uses. It is a fascinating metal with intriguing attributes.

The melting point of this metal is 419.5°C, boiling point 908°C and it has a relative density of 7.14 at 25°C. It is used to form a wide variety of alloys including brass, bronze and nickel silver. By far the most valuable property of zinc in industry is its effective ability to provide a protective coating on steel which would otherwise be attacked by corrosion. Over half the entire worlds' total production of this metal is used for corrosion prevention while in South African about 80% of local zinc production is used for this purpose, mainly by way of the hot dip galvanizing process.

The word galvanizing has a very interesting history which in itself highlights one of the important mechanisms whereby zinc protects steel from corrosion attack. An Italian physician by the name of Galvani Luigi (1737 – 1798) observed during experiments that he could make frog's legs twitch. Erroneously, he concluded that electricity was a fluid in nerve tissue. His name, however, became the accepted term to describe galvanism which is the generation of an electrical current by chemical means. Years later, French scientists discovered that galvanism (French galvanique or galvonisme) was produced when zinc came into direct contact with iron in the presence of an electrolyte such as water with iron or steel constituting the cathode and zinc the anode. It was later observed that in such a situation the anode (zinc in this case) would be corroded preferentially and the cathode (steel) would be protected. This has led to the use of terms such as galvanic couple, galvanic corrosion and the well-documented galvanic series of metals. Little did medical practitioner Galvani Luigi anticipate in his wildest dreams that his name would become synonymous in future centuries with the corrosion science discipline and corrosion prevention mechanism. The concept of cathodic protection is an important feature of a hot dip galvanized coating since as long as the coating is present corrosion of the underlying steel is not possible while small exposed steel surfaces are also protected. The zinc protects the steel by sacrificing itself or in other words it is a wasting protector. Since zinc corrodes at a substantially slower rate than steel, long-term protection is provided in most environments while the thickness of the coating will of course determine the protective life that it will provide. The next significant discovery was that when clean steel is exposed to molten zinc, a chemical reaction ensues with the result that iron / zinc alloys are formed at the interface between the zinc and the iron or steel. These alloys which are hard, corrosion and abrasion resistant, provide a metallurgical bond between the zinc coating and the underlying steel.

The third valuable attribute of a coating applied to steel by immersion in molten zinc was eventually shown to be the provision of a largely impermeable barrier between the steel and the surrounding environment.

Hot dip galvanizing on a modest commercial scale commenced in France during the 19th century. Among other more romantic exports from France at the time such as exotic cuisine, tasty wine and pretty girls, hot dip galvanizing emerged in England and other European countries.

From a lowly beginning as what was aptly described as a back yard operation, it is today a vibrant, sophisticated industry supported by up-to-date research and technology, a fascinating example of an ancient concept which is old yet ever new.

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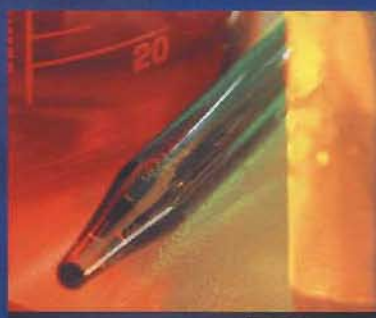

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