HOT DIP **Galvanizing** TODAY 62

Hot Dip Galvanizers Association Southern Africa 2016 Volume 13 Issue 1

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HOT DIP **Galvanizing** TODAY 62

Hot Dip Galvanizers Association Southern Africa 2016 Volume 13 Issue 1

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

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Bedfordview Office Park, Building 2, Ground Floor, 3 Riley Road, Germiston
P.O. Box 2212 Edenvale 1610 Tel: 011 456 7960 Fax: 011 450 0728 Email: hdgasa@icon.co.za Website: www.hdgasa.org.za

Executive Director: Robin Clarke Cell 082 909 5119, Email robin@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: anne@communiquepr.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

December 2015 marked a very poignant milestone in the history of the Hot Dip Galvanizers Association. Mr. Bob Wilmot retired as Executive Director of the Association after fourteen years of service. During his tenure, Bobs' passion for the industry and his work ethic were vital ingredients in ensuring the wellbeing of the Association.

Over very many years both Bob and erstwhile colleagues at the Association have amassed an impressive technical library pertaining to all aspects of hot dip galvanizing and associated corrosion control technologies. Some examples such as case studies and technical information sheets are to be found on the recently refreshed Association website – www.hdgasa.org.za.

I was fortunate to have worked with Bob for several months prior to his retirement. His mentorship during the hand over phase has been invaluable both for me and also I believe for the Association and its members.

2016 will be an immensely challenging year, with most economists predicting an approximate 1% growth in the economy and only a marginal upturn within a few sectors in the manufacturing sphere in the first quarter of 2017.

Not only is South African industry facing these massive challenges due to macro-economic factors outside of our control, but some internal issues need to be resolved to restore investor confidence and to boost public funded spending.

What will be our attitude in the face of these challenges?

An old saying "pressure turns coal into diamonds" should possibly be trotted out here! Those entities that choose to actively seek new opportunities, improve service and quality to customers whilst doing so at "fair value", will probably survive and be well positioned to benefit from any upturn when the present cycle reverses itself.

Whilst the stated objective of our Association is to promote the understanding and use of hot dip galvanizing and duplex coatings as a preferred method of corrosion control, within the spirit of the challenge above, the team at the Hot Dip Galvanizers Association will continually reassess how we deliver this core objective and other mandates from our members.

Training and workshops offered by the Association

The Association has introduced a Corrosion and Metallic Coatings Workshop which is currently awaiting CPD approval. This one day workshop has been designed to provide delegates with an understanding of different environments, the more common forms of corrosion and a range of metallic coatings; with the emphasis on hot dip galvanizing and its service life performance in the various environments.

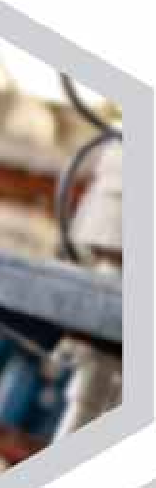
Since our last issue of Hot Dip Galvanizing Today, the Association has run five Level II courses at our Bedfordview Office. Of the twenty eight delegates that attended, ten achieved over 75% and sixteen delegates passed with a score greater than 50%.

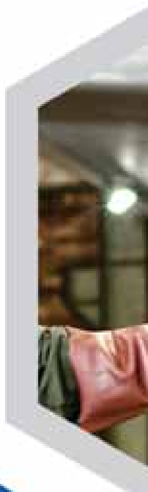
We are available to offer the training and workshops anywhere in the country on the basis that we have six or more candidates.

Level II – September 2015.

Level II – February 2016.

Full course details and application forms are available on our website www.hdgasa.org.za





Dynamic Instruments comments on our Level II Course

It's well documented that South Africa and the continent of Africa has electrical and power supply challenges. Against this backdrop, DYNAMIC INSTRUMENTS was founded in 1988. As South Africa evolved into a democratic Nation and as the new dispensation addressed electrical and power supply shortages, the founding members of DYNAMIC INSTRUMENTS had the foresight to recognize that key to all aspects of development is the provision of energy. With increased focus on development in resolving these challenges came the need to address the critical requirements of consistent, ongoing and affordable energy and power.

It is with this in mind that DYNAMIC INSTRUMENTS began to design, construct and maintain the required infrastructure for power stations. In so doing these power stations continue to keep South Africa dynamically powered and energized. Through our dynamic, highly skilled and professional staff compliment, we also consider the environment and ecology in the area of electricity, energy and power. Through hard work, dedication and investment in our people we have been successfully certified ISO9001:2008 by TUV Rheinland with our certification registered with the Deutsche Akkreditierungsstelle (DAkkS) during 2015.

Quality assurance is achieved through' the two pillars – people and systems. The development of OUR people is critical both in terms of upskilling and the motivational aspect of investing in their training. To this end DYNAMIC INSTRUMENTS has to date put 11 of our staff, from various disciplines within the company i.e. Site Management, Quality Control as well as procurement through the HDGASA inspectors' course during 2015.

Benefits we have seen:

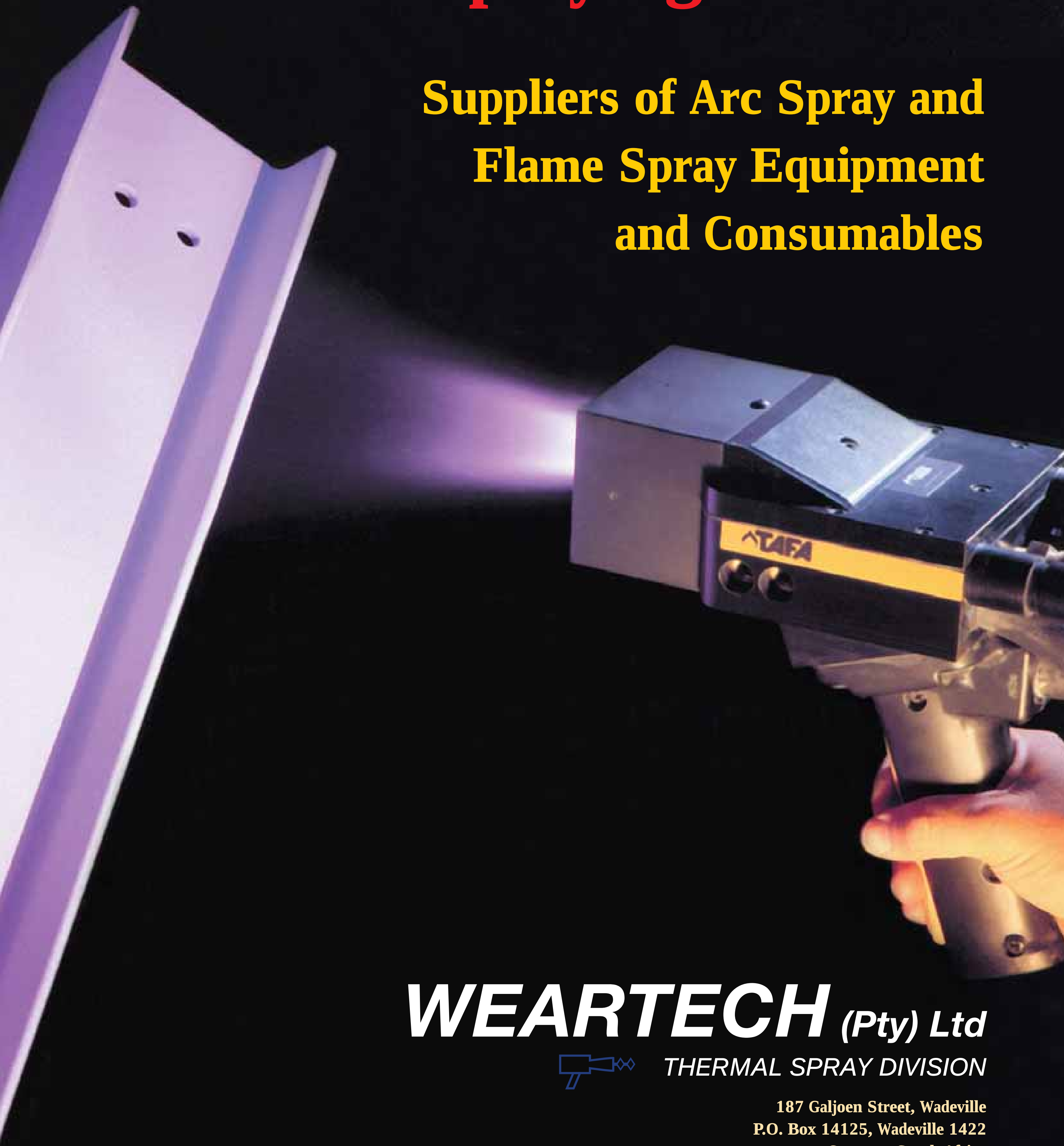
1. Staff motivation.
2. Knowledge of corrosion and corrosion control system.
3. Applying the knowledge gained to identify and mitigate possible corrosion related non conformances.
4. Using the knowledge to make supplier inspection and on-site inspection decisions.
5. Ability to interact with confidence with suppliers, site personnel and clients re these matters.
6. Knowledge transfer to junior team members ensuring higher quality inspections performed.

Part of the internal DYNAMIC INSTRUMENTS evaluation was to have all trained staff members develop an item related to the hot dip galavanizing processes and products related to our organization, from the procurement phase until final handover to our client. Thanks to the knowledge gained from the HDGASA inspectors' course this exercise was not only completed successfully but had now also added greater value to our internal Quality Management System as we now have a more definitive and prescriptive manner when placing orders on our various hot dip galvanizer suppliers.

Not only have DYNAMIC INSTRUMENTS benefitted from the knowledge gained from the training but we have now also have a partner in the form of the Hot Dip Galvanizers Association when further technical assistance is required, as evidenced with the problem solving of a corrosion related incident on our of our projects.

Gary Wyngaardt
Quality Manager – Dynamic Instruments.
www.dyninst.co.za
Email: head.office@dyninst.co.za

Zinc Metal Spraying?



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Metallurgical investigation into the origin of cracks at welded connections on a hot dip galvanized fabricated structural steel perimeter walkway platform

Figure 1a: Hot dip galvanized walkway platform with severely distorted 50 x 50 x 4mm angle section chords. Cracks were discovered after hot dip galvanizing at a number of the welded connections at the ends of the angle section chords. The angle sections had been welded to the 90° corner between the I-beam chords as shown in the left image in Figure 1b.

Figure 1b: The image on the left shows the connection between the angle section chord and the two I-beam chords at a 90° T-joint. The arrows indicate the position of a crack in the angle section chord. The image on the right shows the same crack. The crack had developed in the unaffected base metal next to the weld heat affected zone of a fillet weld.

Cracks had been discovered at welded connections on a structural steel walkway platform after hot dip galvanizing. Examining photographs of the cracks on the walkway platform it was found that:

1. Most of the cracks were at connections between 50 x 50 x 4mm diagonal structural steel angle section chords welded to much larger section I-beams at T-joints between longitudinal and transverse chords *(cf. Figure 1a to 1c)*.
2. Some of the angle diagonal chords had fractured completely *(cf. Figure 1c).*
3. Some of the fracture locations were some distance from the weld heat affected zones in the unaffected base metal *(cf. Figure 1c).*
4. Through-thickness cracks had also developed in the webs of some of the I-beams at the toes of fillet welds joining the angle section chords to the webs of the transverse chords *(cf. Figure 1c).*
5. Cracks hadlso developed from the relatively sharp 90° corners at T-joints between the flanges of I-beams *(cf. Figure 1d).*
6. Many of the angle section chords had distorted/buckled severely during hot dip galvanizing *(cf. Figure 1a).*

Following the cracking of the first walkway platforms, the designers had changed the design of the angle section diagonal chord joint. The angle section diagonal chords were now welded to the webs of the transverse I-beam chords situated in between the longitudinal I-beam chords next to the T-joints between the transverse and longitudinal I-beam chords (compare the top image in *Figure 1b* with the bottom image in *Figure 2d*).

1. Cracks were discovered again at the angle section diagonal chord welded joints after hot dip galvanizing of the first platform walkway fabricated to the new design *(cf. Figure 2a to 2c)*.
2. Many of the angle section diagonal chords, restrained by large section longitudinal and transverse I-beam chords, had distorted/buckled severely during hot dip galvanizing *(cf. Figure 2d)*.
3. The severity of the cracking at and in the vicinity of the welded connections between the angle section chords and

the I-beam chords appears to be less than on the original platform design.

Main findings of metallographic and fractographic examinations

Cracking mechanism

1. Four different cracking mechanisms can be triggered during hot dip galvanizing.
   i. Distortion Cracking
   ii. Hydrogen Embrittlement
   iii. Strain Age Embrittlement and
   iv. Liquid Metal Assisted Cracking (LMAC)

i. Distortion Cracking

Although some of the angle section diagonal chords had become severely distorted or buckled as a result of differential heating during dipping of the walkway platform in the hot dip galvanized bath at approximately 450°C, the findings of this investigation confirmed the cracking mechanism not to be Distortion Cracking.

ii. Hydrogen Embrittlement

iii. Strain Age Embrittlement

This form of cracking is associated with severely cold worked steel subjected to ageing or warm-working at temperatures less than 600°C. The cracking on the walkway platforms examined had not been associated with cold worked steel. The cracks had developed in hot rolled angle section chords and I-beam chords.

iv. Liquid Metal Assisted Cracking (LMAC)

Metallographic and fractographic examination of the cracks revealed that the cracks had developed by liquid metal assisted cracking (LMAC)

Summary and conclusion

1. Cracks were discovered at the highly restrained fillet welded connections on structural steel perimeter walkway platforms after hot dip galvanizing.
2. Similar cracks had been found after hot dip galvanizing after the design of the highly restrained welded

Figure 1c: Some of the angle section chords had fractured completely in the base metal some distance from the fillet welds and weld heat affected zones (left). The image on the right shows cracks that had penetrated the web of an I-beam chord at the fillet welded connection between the angle section chord and web of the I-beam chord at the opposite side. The failure of the angle section chord in the top image is similar to the LMAC failure of a diagonal chord on girder reported by CROSS in the United Kingdom. [CROSS (Confidential Reporting on Structural Safety), "Liquid Metal Assisted Cracking (1)", Report ID: cross45, Published: Newsletter No 4 - November 2006, http://www.structural-safety.org/view-report/cross46].

Figure 1d: Examples of cracks that had developed in I-beam flanges from 90° corners at T-joints between I-beam flanges.

Figure 2a: The left image shows the new walkway platform with the design of the connections between the diagonal angle section chords and the I-beam chords modified. This is the first walkway platform that had been hot dip galvanized after the modification of the connection design. Cracks were discovered at a number of the welded connections between the 50 x 50 x 4mm diagonal angle section chords and the webs of the transverse 160 x 82mm I-beam chords at opposite sides of the middle longitudinal 406 x 178mm I-beam.

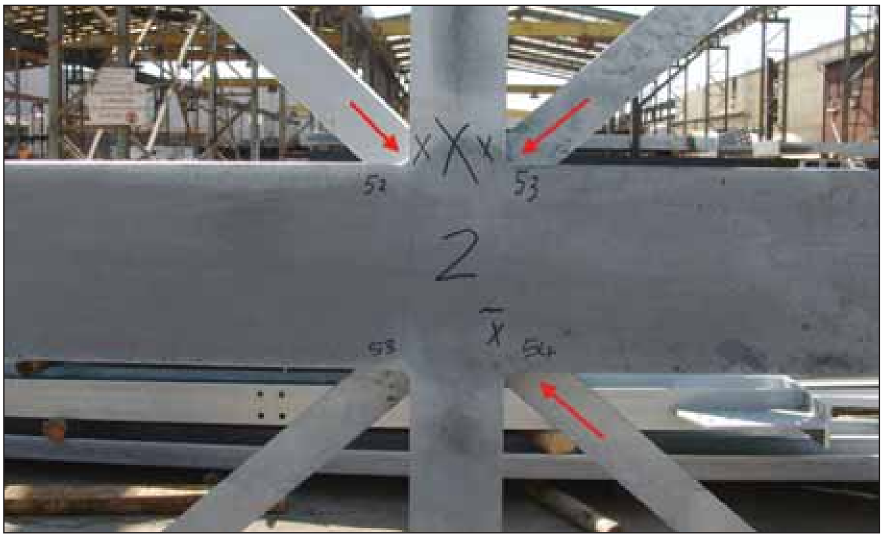

Figure 2c: Examples of cracks in the web of a transverse I-beam chord at fillet welds at the connection between a diagonal angle section chord and transverse I-beam chord in the top image in Figure 2a. The cracks had developed at highly restrained welds.

Figure 2b: Examples of cracks at welds in the web of the transverse I-beam chord at welded connections between the angle section chord and the transverse I-beam chord in the top image in Figure 2a. The cracks had developed at highly restrained welds.

connections on the walkway platforms had been modified.

3. Metallographic and fractographic examination revealed that the cracks had developed by liquid metal assisted cracking (LMAC) during hot dip galvanizing, an uncommon cracking mechanism for hot dip galvanizing of welded structural steelwork.

4. The design of the walkway platforms did not satisfy the British Constructional Steelwork Association's guidelines published during 2005 for minimising the risk of LMAC during hot dip galvanizing of welded structural steelwork.

5. The design of the walkway platforms resulted in excessive thermally-induced stresses being introduced at the highly restrained welded connections during hot dip galvanizing.

6. Although other factors also contributed to the LMAC of the walkway platforms, it is concluded that a substantial deficiency in the design of the walkway platforms had been the main factor triggering LMAC at specific highly restrained welded connections on the platforms.

For the full detailed report visit our web site www.hdgasa.org.za

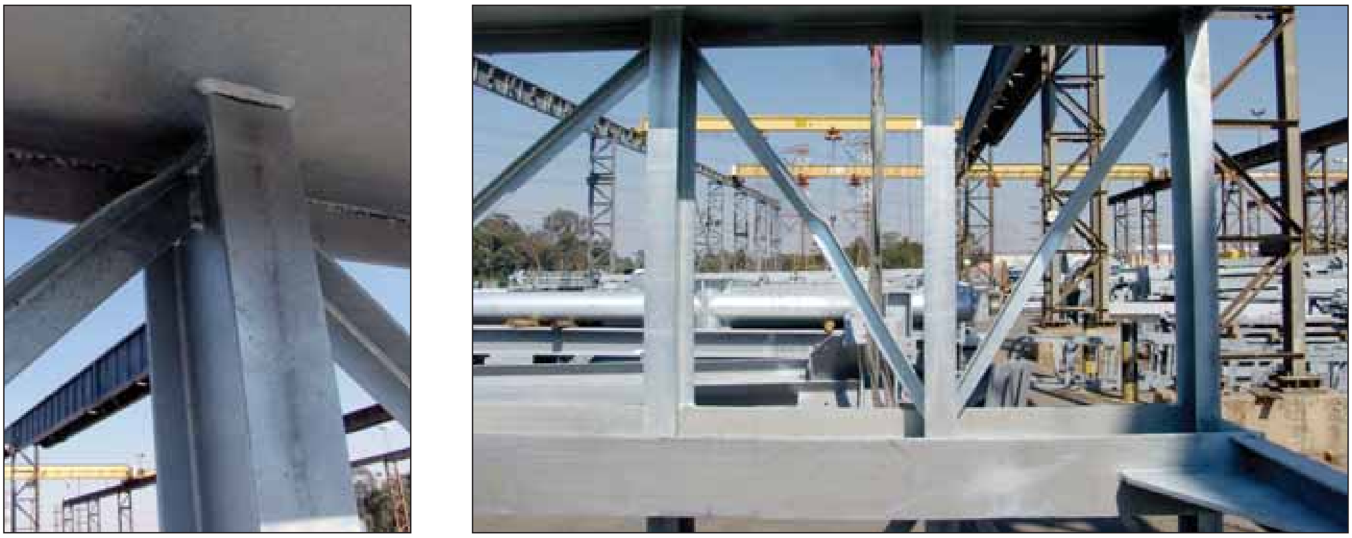

Figure 2d: Examples of distorted/buckled angle section chords. The cracks were associated with the welded connections between these diagonal angle section chords and the webs of the transverse I-beam chords.

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Galvanizing of steel – all around us

During his recent trip to Australia and New Zealand, Dr. Rod Rankine professional consultant and long standing acquaintance of the Hot Dip Galvanizers Association of Southern Africa, was once again struck by the proliferation of hot dip galvanized items that form part of our daily lives.

It was also apparent to Rod that a high degree of attention to detail was being paid to the manufacturability, ease of galvanizing and erection of these items.

A store in Australia selling steel sections, commonly used by the diy handyman already galvanized and with associated fasteners. Galvanized Bolts, nuts and washers available in blister packs.

Scenic World, Blue Mountains, Australia. The entire cable car docking station, walkways, handrails and fence paneling has been hot dip galvanized.

Scenic world again, illustrating the architects use of the natural elements of steel and wood and the contrasting use of duplexing-paint on galvanizing – to achieve the desired aesthetic effects.

A very standard hand rail system, but note the engineering attention to detail. The holes are slotted during manufacturing to avoid on site modifications and all the spacing shims are galvanized. These design considerations eliminate the risk of compromised corrosion control.

New South Wales sea cliff bridge with single car lanes and adjacent pedestrian walkway. All barriers and rails hot dip galvanized.

The support structures for car ports.

An innovative children's jungle gym in New Zealand.

Well-designed bracket for attachment of guard rails on the NSW cliff bridge.

Decorative handrails at City coffee shop.

An innovative "clip together" hand rail and barrier system.

Design considerations: venting and drainage

The Hot Dip Galvanizers Association SA prints and distributes a Wall Chart that assists in the design and fabrication of articles for hot dip galvanizing.

A common area that requires attention is the selection and placement of vent and drain holes to ensure safe and effective galvanizing of the articles.

Extracts from our wall chart follows:

When designing a structure which is to be hot dip galvanized, it must be borne in mind that articles are immersed into and withdrawn from a bath of molten zinc heated to a temperature of about 450°C. Design and fabrication is required to conform to acceptable standards which apply, regardless of whether a galvanized or a painted coating is to be applied. In the case of galvanizing, some additional requirements which aid access and drainage of molten zinc, will improve the quality of the coating and also reduce costs.

With certain fabrications, holes which are present for other purposes may fulfil the requirements of venting of air and draining of zinc; in other cases it may be necessary to provide extra holes for this purpose.

For complete protection, molten zinc must be able to flow freely to all parts of the surfaces of a fabrication. With hollow sections or where there are internal compartments, the galvanizing of the internal surfaces eliminates any danger of hidden corrosion occurring in service.

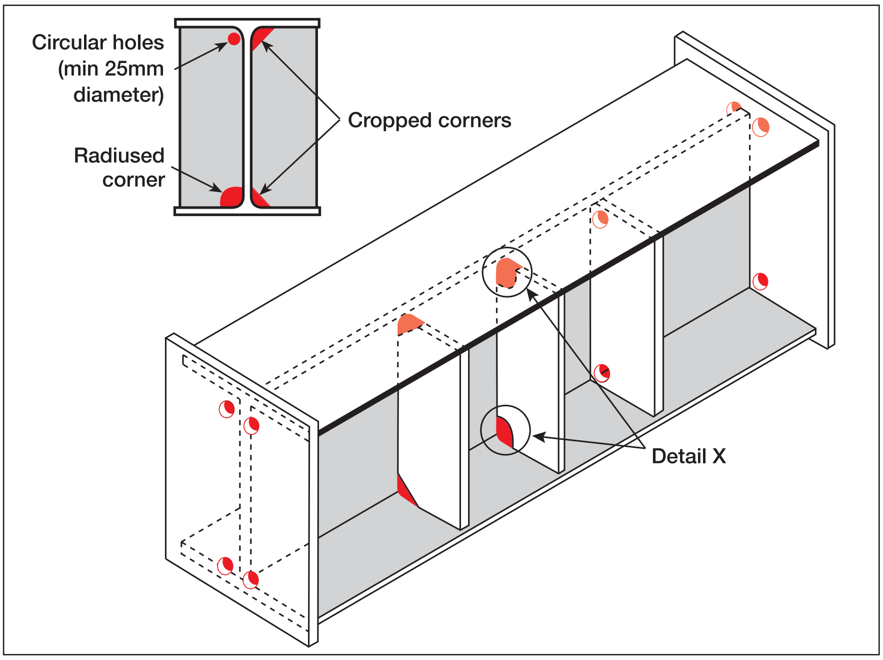


Figure 1.

Some general principles for guidance are:

- Holes both for venting and draining should be as large as possible. The absolute minimum hole sizes are given in *table 1*.
- Holes for venting and draining should be diagonally opposite one another at the high point and low point of the

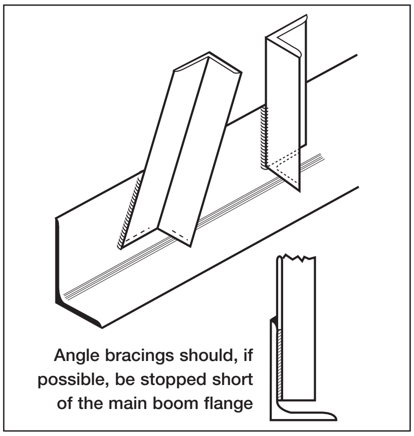


Figure 2.

GUIDELINES FOR MINIMUM VENT AND DRAINAGE HOLE SIZES - REQUIRED BY SECTION LENGTH											
Tube Dia	≤ 50	60 - 76	89	102 - 114	127 - 152	165	219	245	273	324	355
RHS Sizes (mm)	50 x 30	80 x 40	80 x 80	90 x 90	160 x 80	200 x 100	180 x 180	200 x 200	300 x 200	400 x 200	300 x 300
	60 x 40	70 x 70	120 x 60	120 x 80	120 x 120	150 x 150	250 x 150	220 x 220	250 x 250		450 x 250
	50 x 50	100 x 50		100 x 100	150 x 100				340 x 200		
	60 x 60	76 x 76			140 x 140						
Length (m)	Hole size (mm)										
1	10 (12)	10 (12)	10 (12)	12 (2x10)	16 (2x12)	20 (2x16)	25 (2x20)	30 (2x25)	30 (2x25)	40 (2x30)	40 (2x30)
2	10 (12)	10 (12)	12 (2x10)	12 (2x10)	16 (2x12)	20 (2x16)	25 (2x20)	30 (2x25)	30 (2x25)	40 (2x30)	50 (2x40)
3	10(12)	12 (2x10)	12 (2x10)	12 (2x10)	16 (2x12)	20 (2x16)	25 (2x20)	30 (2x25)	40 (2x30)	50 (2x40)	50 (2x40)
4	12 (2x10)	12 (2x10)	16 (2x12)	16 (2x12)	16 (2x12)	25 (2x20)	25 (2x20)	30 (2x25)	40 (2x30)	50 (2x40)	2x50 (3x40)
5	12 (2x10)	16 (2x12)	16 (2x12)	16 (2x12)	25 (2x20)	25 (2x20)	30 (2x25)	30 (2x25)	50 (2x40)	50 (2x40)	2x50 (3x40)
6	12 (2x10)	16 (2x12)	20 (2x16)	20 (2x16)	25 (2x20)	25 (2x20)	50 (2x30)	50 (2x40)	50 (2x40)	2x50 (3x40)	2x50 (3x40)
7	16(2x12)	16 (2x12)	20 (2x16)	20 (2x16)	25 (2x20)	25 (2x20)	50 (2x30)	50 (2x40)	50 (2x40)	2x50 (3x40)	2x50 (3x40)
8	16 (2x12)	16 (2x12)	20 (2x16)	25 (2x20)	25 (2x20)	2x25 (3x20)	50 (2x30)	50 (2x40)	2x50 (3x40)	2x50 (3x40)	2x50 (3x40)
9	16(2x12)	16 (2x12)	25 (2x20)	25 (2x20)	2x25 (3x20)	2x25 (3x20)	50 (2x30)	2x50 (3x40)	2x50 (3x40)	2x50 (3x40)	2x50 (3x40)
10+	20 (2x16)	25 (2x16)	25 (2x20)	25 (2x20)	2x25 (3x20)	2x25 (3x20)	50 (2x30)	2x50 (3x40)	2x50 (3x40)	2x50 (3x40)	2x50 (3x40)
Note: The hole sizes specified above may be substituted with a larger number of smaller holes. (minimum ø 10mm for vent and ø 12mm for fill/drain hole)											

Table 1.

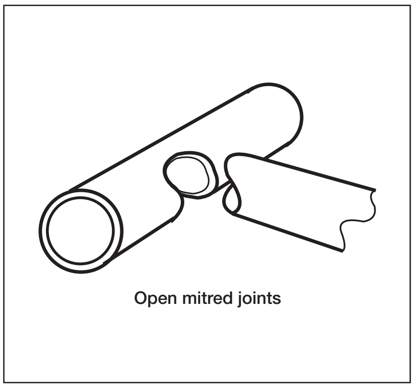


Figure 3.

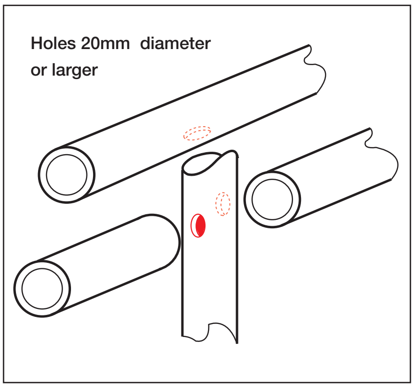


Figure 4.

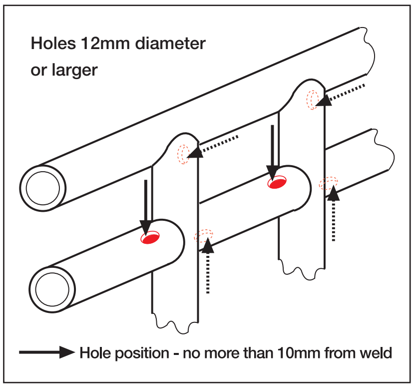


Figure 5.

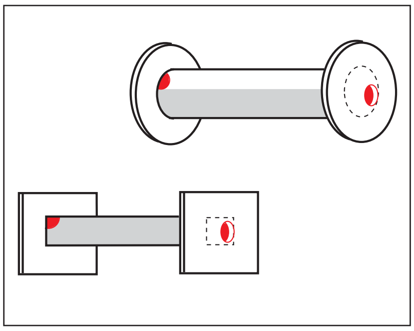


Figure 6.

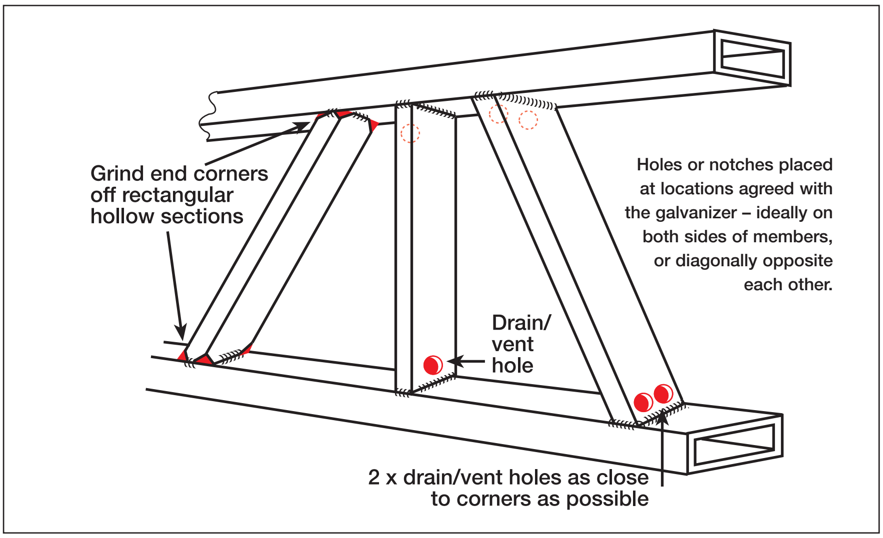


Figure 7.

fabrication as it is suspended for galvanizing *(figure 9)*.

- With hollow sections sealed at the ends, holes should be provided, again diagonally opposite one another, as near as possible to the ends of the hollow member *(figure 7)*. In some cases it may be more economical to provide "V" or "U" shaped notches *(figure 8)* in the ends of the tubes, or to grind corners off rectangular hollow sections. These procedures will provide ideal means for venting and draining.
- Where holes are provided in end plates or capping pieces, they should be placed diagonally opposite to one another, off centre and as near as possible to the wall of the member to which the end plate is connected *(figure 6)*.
- Internal and external stiffeners, baffles, diaphragms, gussets etc., should have the corners generously cropped with centre holes (particularly for "Road Sign Gantry" type of configurations) to aid the flow of molten zinc and to prevent air entrapment *(figures 1, 10 and detail X)*.
- Bolted joints are best made after hot dip galvanizing.

Venting, filling and drainage

External stiffeners, welded gussets and webs on columns and beams and gussets in channel sections should have their corners cropped. The gaps created should be as large as possible (detail X is preferable) without compromising structural strength. If welding is required around the edge created, a radiused corner is desirable to facilitate continuity of the weld around the cut end to the other side. Circular holes are less effective: if used, they should be as close to corners and edges as practicable. Where more convenient, the cropped corners or holes may be in the main beam. Consultation with the galvanizer, regarding the appropriate vent and drainage hole sizes is recommended.

Welded pipe sections

Closed sections must never be incorporated in a fabrication. Sections should be interconnected using open mitred joints as illustrated in *figure 3*, or interconnecting holes should be drilled before fabrication as in *figure 4*.

Alternatively external holes may be positioned as in *figure 5*, a method which is often preferred by the galvanizer, since quick visual inspection shows that the work is safe to galvanize.

Pipe ends can be left open, or provided with removable plugs *(see unwanted vent holes)*.

Small tubular fabrications

Small tubular fabrications must be vented, preferably with holes not less than 10mm diameter *(see table 1)*.

Unwanted vent holes

These may be closed by hammering in lead plugs after galvanizing and filing off flush with surrounding surfaces.

Tubular fabrications / hollow structurals

Drain/vent hole sizes should be preferably 25% of internal diameter or diagonal dimension for sections yielding a maximum cross sectional area of 180cm^2. This percentage can be dependent on the shape of the fabrication, therefore consultation with the galvanizer at the design stage is

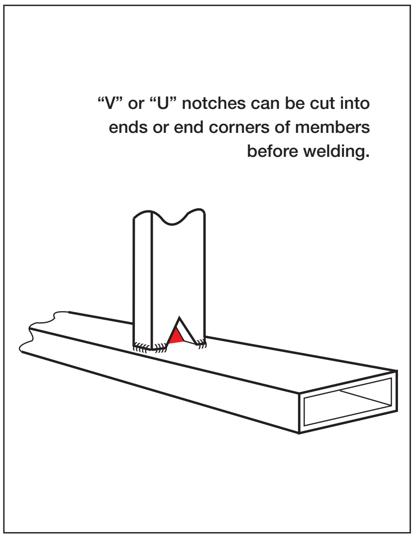


Figure 8.

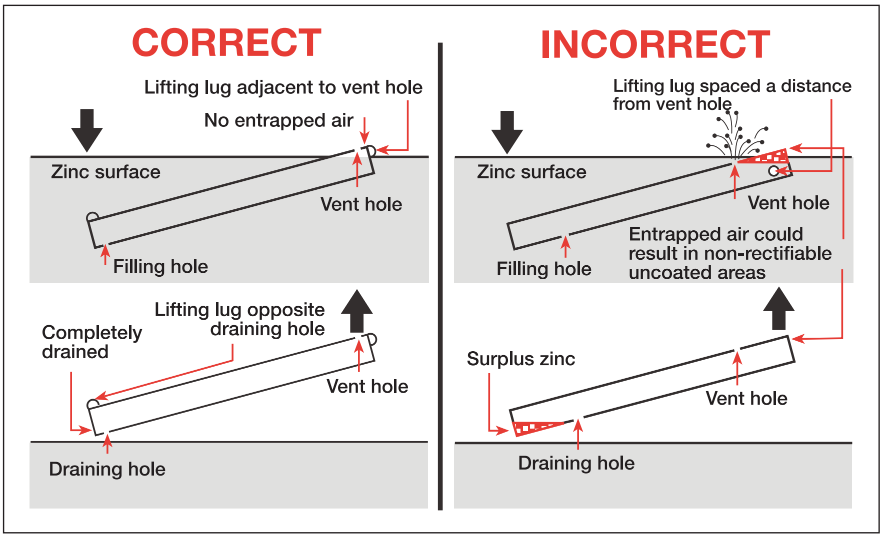


Figure 9.

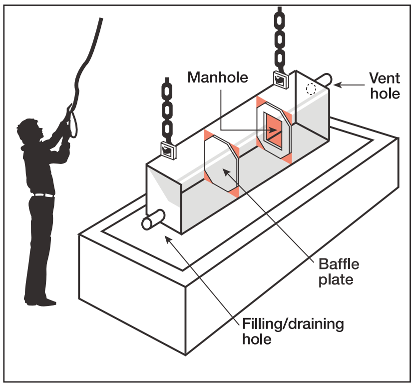


Figure 10.

recommended. FOR MUCH IMPROVED COATING QUALITY, REDUCED COATING GROWTH, PROVIDING AN IMPROVED AESTHETICALLY PLEASING APPEARANCE, APPROPRIATELY SIZED AND POSITIONED FILL, DRAIN AND VENT HOLES CAN MAKE A HUGE CONTRIBUTION.

Tanks and closed vessels

When both internal and external surfaces are to be hot dip galvanized at least one filling and draining hole must be provided, with a vent hole diagonally opposite to allow the exit of air during immersion. For each 0.5 cubic metres of volume, provide one fill/drain hole of minimum size ø60mm and vent hole of minimum size ø40mm.

Internal baffles should be cropped as illustrated or as per detail X above, especially for structures such as "Road Sign Gantries" which also require considerably larger centre holes in baffle plates and base plates. Man-holes or pipes should finish flush inside to prevent trapping excess zinc.

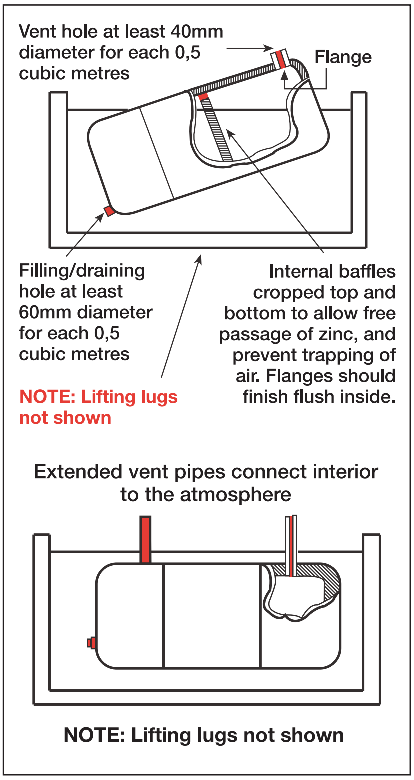


Figure 11.

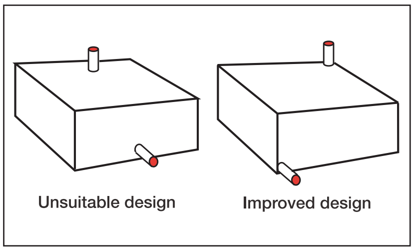


Figure 12.

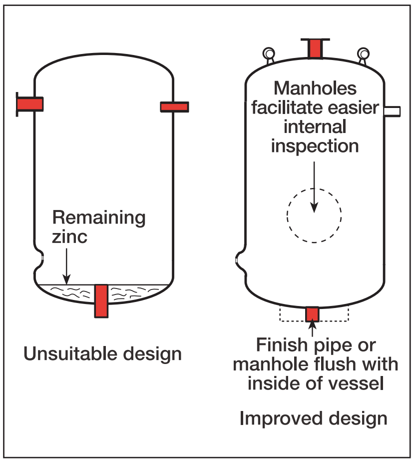


Figure 13.

Lifting lugs should be provided opposite the biggest and most accessible filling / draining hole and adjacent to the vent hole on the opposite end *(see figure 9)*. The lugs must be designed to accommodate the excess mass of molten zinc within the cylinder / pipe on withdrawal.

Large vessels require an appropriate size manhole in the baffle.

When vessels and heat exchangers etc., are not to be galvanized inside, 'snorkel' tubes or extended vent pipes must be fitted after discussion with the galvanizer, to allow air to exit above the level of molten zinc in the galvanizing bath.

The Design for Hot Dip Galvanizing Wall Chart is available from the Association.

Please e-mail to enquire about the price.

Materials of construction

Materials of construction have been evolving to improve the fundamental characteristics of strength, lightness and corrosion resistance. The development of structural steel structures has for many years been subjected of significant technical advances. Structural engineers have perfected design criteria that have allowed for the construction of higher and higher buildings, larger power stations, modern stadia and mining infrastructure to the point where we find steel on many, if not all, and construction sites. Such sophisticated technical developments encompass newer grades of steels, incorporating structural strength requirements, design of connections, including sophisticated fasteners, welding criteria, safety factors, ease and speed of construction and the challengers of meeting architectural designs.

Within this environment of research and development, the subject of corrosion control has not always received the same attention on the part of engineers. Ultimate service life of steel structures has not received the same focus as that devoted to structural designs. Corrosion control specifications are integrated into factors such as; conservation of resources, sustainable development and even global warming and our carbon foot print. Achieving a maintenance free service life of a structure is becoming as important as meeting a structural design specification. Questions such as recyclable materials need to be considered in the selection of the materials of construction and that includes the corrosion control system to be employed.

Steel has many very positive attributes and, as such, represents one of the most modern materials of construction available to engineers. However, as is the case with most materials of construction, it is subject to corrosion. Corrosion of steel is dependent on two major factors: the type of corrosion control system selected at the design stage, and a detailed evaluation of the environmental conditions to be encountered.

Environmental conditions

Corrosive environments can be divided into several categories that are either encountered in nature or are as a result of human activity.

- Atmospheric
- Soils, as in buried structures
- Water
- Chemical and steel plants, mines, agricultural and numerous other industries.

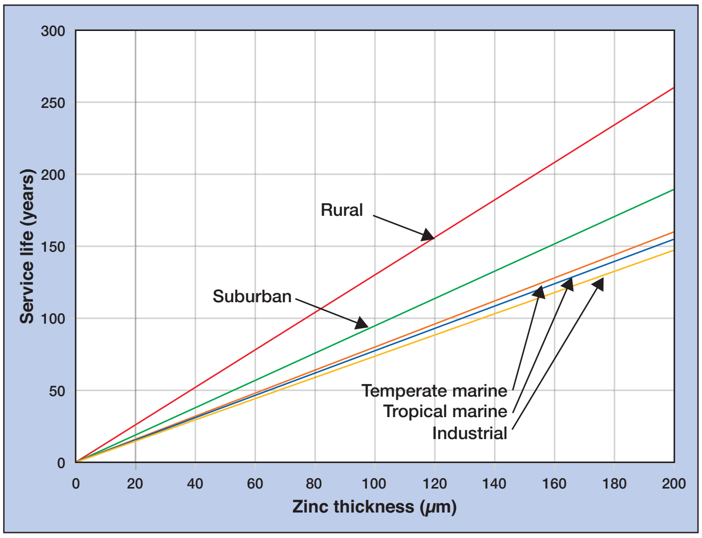
Each one of the above can be divided into sub-categories; benign, interior of buildings, parts of urban inland conditions and some of the more severe coastal and marine conditions.

Variations in both soils and waters have an impact on how long a structure meets operational conditions. Significant variations occur within each identified environment and it is for this reason that a detailed study and evaluation of the specific environmental conditions needs to be assessed before selecting a corrosion control system.

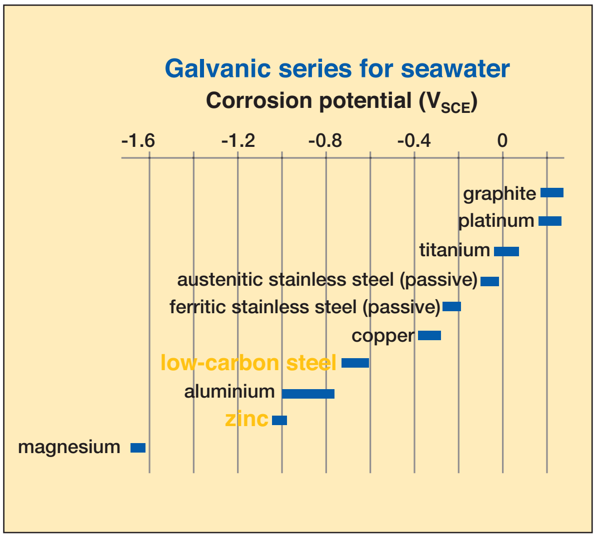
Sacrificial anodes electrically connected (bolted) to the carbon steel hull of a ship.

Costing

All too often a corrosion control system is selected on the basis of initial costs only. Little or no consideration is given to the question of a maintenance free service life and the costs involved should maintenance be required during the life of a structure. Initial costs are misleading and engineers should address their final selection in terms of life cycle costing and even extend such



Service life of hot dip galvanized coatings as a function of zinc thickness and specific environments.



Galvanic Series for Some Common Metals: The figure illustrates the process of cathodic protection (CP) provided by zinc in respect of low carbon steel. This process is reversed for more noble coatings over carbon steel, for example tin, lead, copper, nickel and chrome.

considerations to recyclable factors and the impact on the environment.

Another concern is that a more expensive corrosion control system will be discarded due to budgetary constraints. This is short sighted as far as the end user or owner of a project is concerned. When applying a life cycle cost analysis, costs initially found to be more expensive may well indicate a totally different situation with significant savings being found due to no or minimal maintenance requirements.

Selection of materials of construction

Apart from carbon steel, most other materials are subject, to a greater or lesser extent, to the ravages of corrosion. In selecting the materials of construction this fact needs to be considered. For example, zinc in combination with carbon steel will result in the zinc sacrificing itself in order to protect the structural component (carbon steel). This characteristic of different metals can be explained by considering the galvanic series of metals.

Galvanic protection (CP)

When zinc is in electrical contact (coupled) to a more noble metal, such as carbon steel, the process of galvanic corrosion of zinc results in "galvanic protection" of the coupled "electro-positive" metal (carbon steel). This property of zinc has been used in many applications, especially for the protection of carbon steel by hot dip galvanizing. The carbon steel is protected by the zinc coating by means of both a barrier protection, a zinc carbonate ($ZnCO_3$) patina and the galvanic effect. Zinc acts as the sacrificial anode, while carbon steel becomes the cathode within a corrosion cell. Besides galvanizing, zinc is also widely used cathodically as bulk sacrificial anode material for cathodic protection of carbon steel structures, for example pipelines and the hull of a ship. The principles of protecting steel structures through sacrificial zinc anodes are in essence the same as those through impressed current by a rectifier. When a cathodic current is passed through steel, the potential of the steel will, in the region where iron is thermo-dynamically stable, become inert.

In most natural environments, zinc ($ZnCO_3$) corrodes much less than carbon steel, by a factor of 10-100 times. The protection of steel by zinc coating is, thus, mainly through the barrier effect. However, at the places where the zinc coating is removed or defective, thereby leaving the steel exposed, galvanic action between steel and zinc will protect the exposed steel from corrosion. The galvanic corrosion rates of zinc and, at the same time, the extent of galvanic protection for the steel, can be determined based on dimensional and environmental factors.

How long will it last?

Everyone who specifies carbon steel has a vested interest in this question. It should be addressed when determining what corrosion control system to select to achieve a design service life of a structure.

Fundamentally we do not stop corrosion, we simply slow down the rate of corrosive attack. As described above, zinc has the characteristics of both barrier protection ($ZnCO_3$) as well as cathodic protection. It therefore follows that as zinc is a slowly corroding barrier, the more zinc that we have to corrode, (thickness of coating), the longer the estimated service life. Knowing the thickness of a zinc coating and the rate of zinc corrosion within a given environment we can estimate the service life of a carbon steel structure.

As an example we can make use of an ISO specification, viz, ISO 9223, when encountering atmospheric corrosion.

Summary of ISO 9223 Specification

The ISO 9223 specification considers three key factors in determining the atmospheric corrosion rate of zinc. These factors are:

1. Time of wetness, Table 1 – Classification of time of wetness ( ) being the period that the zinc surface is covered by liquid containing the corrosive elements (Electrolyte).
2. Airborne pollution containing sulphur dioxide (SO_2), Table 2 – Classification of pollution by sulphur-containing substances represented by (SO_2) and
3. Airborne pollution containing salinity, Table 3 – Classification of pollution by airborne salinity represented by chloride usually in the form of chlorides carried in the prevailing winds from off the sea.

Two specific methods that were employed to determine the classification of atmospheric corrosivity were:

1. Environmental classification in terms of time of wetness and atmospheric pollution, (ISO 9225) and
2. Classification based on corrosion rates measured on exposed standard metal specimens, (ISO 9226).

Category	Corrosivity	Typical environments - Examples	
		Indoor	Outdoor
C 1	Very Low	Dry, air-conditioned with low relative humidity and insignificant pollution, e.g. offices, schools, museums.	Dry zone very low pollution and time of wetness, e.g. certain deserts, central Artic/Antarctica.
C 2	Low	Unheated, no air-conditioning with restricted variation in temperature, humidity and minimum condensation and pollution, e.g. storerooms, sports halls.	Temperate zone (dry or cool) with minimum pollution (SO_2 < 5 μg/m³), short time of wetness, e.g. rural areas, subarctic areas, some arid and desert areas, small villages or towns.
C 3	Medium	Moderate frequency of condensation, pollution from process plant, e.g. food-processing, laundries, breweries, dairies	Temperate zone with medium (SO_2 5 to ≤ 30μg/m³) or some effect of chlorides, e.g. urban areas, between a one to thirty kilometres (depending on prevailing winds, buildings, vegetation and topography) from the ocean, or within one hundred metres of sheltered coastal areas with low chloride deposits
C 4	High	High frequency of condensation, time of wetness, high pollution from production process, e.g. industrial processing plants, swimming pools.	Temperate, subtropical to topical, low to high pollution (SO_2 30 to ≤ 90μg/m³) or substantial chloride effect, e.g. < one kilometres of the ocean or within one hundred metres of sheltered coastal areas and outside the splash zone of salt water.
C 5	Very High	High frequency of condensation, periods of time of wetness, and/or high pollution from production process, e.g. certain mines, caverns for industrial purposes, unventilated sheds in subtropical and tropical zones.	Subtropical to topical, periods of time of wetness, very high industrial pollution (SO_2 90 to ≤ 250μg/m³) or significant chloride effect/ deposits, e.g. industrial polluted areas, jetties and offshore structures, within a few hundred metres of the ocean and certain exposed areas along the coastline.
CX	Extreme	Almost permanent condensation or extended periods of exposure to extreme humidity and/or high pollution from production process, e.g. unventilated sheds in humid tropical zones with penetration of outdoor pollution including airborne chlorides and other pollutants and particulate matter.	Subtropical to topical, extended time of wetness, very high industrial pollution (SO_2 >250μg/m³) or significant and extended chloride effect/ deposits, e.g. highly industrialised and polluted areas, jetties and offshore structures, within a few hundred metres of the ocean with extended periods of on-shore prevailing winds and certain exposed areas along the coastline and within the splash zone of salt water.

Table 1: Description of typical atmospheric environments related to the estimation of corrosivity categories.

Corrosivity Category	Corrosion Rates (rcorr) and service life in years for Hot Dip Galvanized Coated Steel (Ref ISO 1461:2009 & ISO 9223:2012)				
	Units	Zinc r_{corr}	55μm mean coating thickness for steel ≥ 1.5mm to ≤ 3mm (years)	70μm mean coating thickness for steel > 3 mm to ≤ 6 mm (years)	85μm mean coating thickness for steel > 6 mm (years)
C 1	μm/a	r_{corr} ≤ 0.1	> 80	> 80	> 80
C 2	μm/a	0.1 < r_{corr} ≤ 0.7	< 78	> 80	> 80
C 3	μm/a	0.7 < r_{corr} ≤ 2.1	26 to ≤ 78	33 to < 80	40 to > 80
C 4	μm/a	2.1 < r_{corr} ≤ 4.2	13 to ≤ 26	16 to ≤ 33	20 to ≤ 40
C 5	μm/a	4.2 < r_{corr} ≤ 8.4	6.5 to ≤ 13	8.3 to ≤ 16	10 to ≤ 20
CX	μm/a	8.4 < r_{corr} ≤ 25	2.2 to 6.5	2.8 to 8.3	3.4 to ≤ 10

Table 2: Estimated Service Life for Hot Dip Galvanized Steel (zinc) complying with SANS 121 (ISO 1461:2009) and subjected to atmospheric environmental conditions classified in terms of ISO 9223:2012.

Tables used in the development of the Atmospheric Classifications

(Reference source ISO 9223:2012)

Various tables are published within the ISO 9223:2012 specifications and are listed here for reference purposes. Detailed data pertaining to each of these tables are contained within the ISO 9223:2012 specification.

Table B.1 – Time of wetness in different exposure conditions (τ)

Table B.2 – Outdoor concentration of some of the most important pollutants in different types of environments (a range of pollutants)

Table B.3 – Grouping of pollution by sulphur containing substances represented by SO2

Table B.4 – Grouping of pollution by airborne salinity represented by chloride

Table C.1 – Description of typical atmospheric environments related to the estimation of corrosivity categories

The typical descriptions detailed in Table 1 are intended as a general guide and it is recommended that a review of actual site conditions should be undertaken before finalising the applicable corrosive category. A general review of existing hot dip galvanized structures is an ideal method used to establish the corrosive conditions in the general area of a particular site.

The conservative and wide range of service life estimates shown in Table 2 are only intended as a general guide. It is a recommended requirement that a more detailed assessment of the actual site environmental conditions should be investigated in order to refine longevity expectations for hot dip galvanized carbon steel.

Considerable zinc corrosion rates are also available for most soils and water and represent a valuable basis for designing one corrosion control system and estimating a service life of a structure.

Conclusion

It should be evident from the above discussion that when selecting materials of construction; corrosion control, environmental conditions, life cycle costs and ultimate service life are factors that are as important as the structure design details. An invitation to the corrosion control engineer to participate in the structural steel design team, is an important consideration and should not be overlooked nor forgotten.

Purlins manufactured from hot dip coil

NJW Profiles (Pty) Ltd is a Rosslyn based company and a licenced manufacturer of Metsec purlin systems.

They have submitted an article which highlights their product development culture and the partnership developed with ArcelorMittal during this process.

Pre-engineered purlin systems... moving the goal posts

The performance of a pre-engineered cold formed purlin system is not guaranteed unless the specified grade of steel is used in manufacture; that profile size and shape tolerances are met when roll forming, and of course on how it is all connected together onto the main structure.

Metsec Purlin Systems are designed around steel with a guaranteed minimum yield strength of 450 n/mm². NJW profiles (Pty) Ltd is the licensed Metsec manufacturer in South Africa.

Metsec Systems have been manufactured in South Africa for the last 17 years and at the time of the South African launch, the specified grade was 350 n/mm² (minimum yield strength). This was easily obtained from Iscor and later from ArcelorMittal. A design upgrade took the minimum yield strength requirement to 390 mpa and this challenged ArcelorMittal for a while but most production batches were accepted.

The Metsec Purlin Division in the UK have a continuous improvement program. This is necessary in order to remain competitive and also to be able to keep up to date with new stringent structural and environmental regulations both applicable to their own market and for export markets. They are the biggest supplier of purlins in the UK and export into Europe and the Middle East. All orders are cut to length and punched, ready for erection. It is a complete system being sold and not just lengths of steel.

To illustrate the intense pace of the product improvement mission at the Metsec Purlin Division, the design software 17 years ago was referenced as Metspec 6. We are currently using Metspec 12.
The ongoing improvements necessitate changes being made to the purlin design software which is made available to engineers. Some changes are subtle whilst others involve a change in the grade of steel specified for the product.

The big and initially troublesome change came when the goal posts were moved once again and the flange widths on the bigger purlin sizes were substantially reduced when the minimum yield strength was increased to 450 n/mm². Material thickness was not reduced. It must be noted that all changes are subjected to full scale testing at the University of Strathclyde.

This was an important change. Reduced weight of the roof structure being paramount and also reduced cost and selling price. Metsec prefer their licenced manufacturers to be issuing the same version of design software to engineers as what they are doing in the UK. In other words we have to keep up to date. This made it necessary to procure the 450 coil as quickly as possible in order that we could distribute Metspec 12 locally (the correct reference for this coil is S450GD).

ArcelorMitall had to pull out all of the stops and the support from their marketing and product development, as well as engineering staff, was enthusiastic considering that we were (and still are) the only purchaser of this grade of coil for roll forming of roofing support profiles. However, there were delays in getting to the point where we were all satisfied that AMSA could produce the coil consistently within spec. Only at this point (in mid 2014) were we confident in releasing the new design software to structural engineers and other professionals.
Final testing prior to the issue of test certificates for individual coils can only take place after hot dip galvanizing. In fact the galvanizing procedure needs to be carefully controlled so as not to adversely affect the recipe.

The coil is manufactured at Saldhana and is then sent to Vanderbijlpark for galvanizing to Z275 coating.

We are often asked if we can supply our purlins in an uncoated finish for hot dip galvanizing later. This may be required in very severe corrosion environments. This is not really possible when you understand that the most popular thicknesses of coil that we purchase are 1.4mm, 1.6mm and 2.0mm. These thicknesses, coupled to purlin lengths of 10 – 14 meters, may distort in the hot dip galvanizing process. The preferred solution is to apply a duplex coating if this will help meet the corrosion resistance specification.

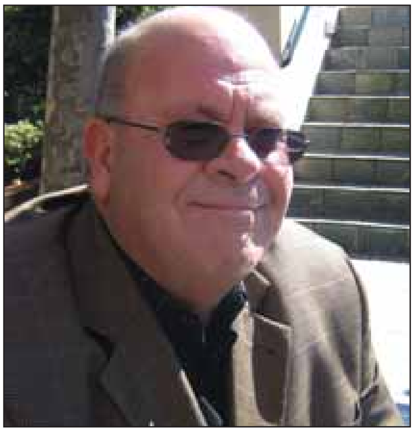
The Metsec Purlin systems are fine tuned to provide long spanning capability with light weight steel. The "sleeved system" and the ultra-economical "heavy end bay sleeved system" are equal to the best in the world and are guaranteed and underwritten. The design software is also world class. The steel needs to be of the correct specification.

Importation of similar grades of coil is possible and mostly price equal, but this is not necessary when one can buy "South African" and at the same time have more confidence in delivery lead times whilst also enjoying a better cash flow.

Pregalv steel allows for quicker production as there are only two stages in the process. Roll and punch in line then load the delivery vehicle. No extra stage for painting and drying prior to bundling, no second or third coats on the building site. Z275 Pregalv meets most requirements and is extremely cost effective.

The S450GD coil which we purchase from ArcelorMittal meets the Metsec requirement. Important to note that although this coil is substantially more expensive than commercial quality type pregalv, the weight saving and long spanning of the Metsec system usually provides a saving on the project and the systems are tested and guaranteed. NJW Profiles provides material test certificates for all production batches.

What a disappointment: There are no black holes!



For me, today was a great disappointment. It was a more disappointing day than the day last year when we lost the 2013 Rugby Championship. The source of the disappointment: the announcement by Stephen Hawking that black holes don't exist[1].

According to Hawking, while in classical theory there can be no escape of anything from a black hole, our old friend quantum theory does allow energy and information to escape, so there you are.

The concept of black holes has been around the scientific community for at least 200 or more years. In 1783, a Cambridge don, John Michell, wrote a paper in the Philosophical Transactions of the Royal Society of London, about what he called 'dark stars'. He pointed out that: "a star that was sufficiently massive and compact, would have such a strong gravitational field that light could not escape". Such objects are what we now call black holes, because that is what they are, black voids in space. Although we would not be able to see them, because the light from them would not reach us, we would still feel their gravitational attraction. Actually the first use of the term 'black hole' in print was by journalist Ann Ewing in her article 'Black Holes' in Space", dated 18 January 1964, which was a report on a meeting of the American Association for the Advancement of Science. She was reporting on the lecture given by John Wheeler in which it is said he used the term 'black hole' in a lecture, leading some to credit him with coining the phrase.

I loved the concept of black holes because they are stranger than anything that can be dreamt up by science fiction writers. I have watched dozens of lectures on YouTube and read numerous books, including Stephen Hawking's classic 'A Brief History of Time', which was published in 1988 and has sold more than 10 million copies[2]. Hawking's concepts of worm holes, time travel, multi universes, singularities, event horizons, Hawking radiation and black hole 'haircuts' all evolved out of his work on black holes and have been a great source of interest for me. Almost any physicist of note will mention black holes at some time or other. Hawking gave black holes a celebrity status of their own. Dark holes are spoken about by the public although there are very few people who really understand either what they are or their mechanisms. I remember my Mother used to call my brother's very untidy bedroom a black hole, for once anything went into it, like dinner plates, cups, library books, hired DVDs, etc. there was very little chance of them coming out.

The concept of a black hole also gave rise to the term 'singularity', which is often used to describe the precise moment when the Big Bang occurred. The point at which all matter and energy is sucked into the black holes by increasingly more powerful gravitational forces as far as it can go (and who knows how far this is) is called a singularity. This point is difficult to describe mathematically and, perhaps as something of a 'cop out' it is called a singularity. All equations trying to describe this point result in infinity, like infinitely small or infinitely dense. Singularity is the entity of matter and energy compressed into one point. Quantum theory equations would be more appropriate, but unfortunately the mathematical link between classical theory and quantum theory appears to be a bridge too far to cross.

Not all physicists, however, agreed with Hawking, notably John Preskill, who in 1997 bet Hawking (I think the stake was $100) that information was not lost in black holes. The implications of information being lost in black holes led to the Susskind-Hawking scientific 'battle', where Leonard Susskind publicly 'declared war' on Hawking's solution, with Susskind publishing a popular book about the debate in 2008 *(The Black Hole War: My battle with Stephen Hawking to make the world safe for quantum mechanics)*. The solution to the problem that concluded the battle is the holographic principle and the string theory interpretation of it by Susskind, which to me at any rate made everything that more difficult to understand, but alas that is Physics, nothing ever gets simpler only more complicated.

With the advent of larger and larger particle accelerators (like the Large Hadron Collider at CERN, in Geneva, Switzerland) researchers have found that creating microscopic black holes using particle accelerators requires less energy than previously thought. If physicists do succeed in creating black holes with such energies on Earth, the achievement could prove the existence of extra dimensions in the universe, and this could be very interesting: we may even find a universe in which the Springboks win the Rugby Championship).

When the most powerful particle accelerator in the world, the Large Hadron Collider, was coming online, scientists wondered if it might become a black hole 'factory' generating a black hole as often as every second. Particles zip at high speeds around the 27 kilometre circular atom smasher before colliding into one another to create explosive energies. At its maximum, each particle beam that the LHC fires packs as much energy as a 400-ton train travelling at about 195 kilometre per hour. So far, researchers have detected no black holes at the Large Hadron Collider. Still, theoretical interest in this possibility remains alive. Now, using supercomputers, researchers can simulate collisions among particles zipping near the speed of light and have shown that black holes could form at lower energies than previously thought.

So, are we going to miss the massive black holes as postulated by Hawking? I don't think so, as with all the new technology we have today, and with all the ongoing debates and intellectual 'wars' between physicists and cosmologists, science and physics will continue to fascinate us for many more years to come.

References

[1] http://www.nature.com/news/stephen-hawking-there-are-no-black-holes-1.14583

[2] http://www.hawking.org.uk/into-a-black-hole.html

Hot Dip Galvanized Case Study No. 23

Rural pedestrian bridges

The Application

During the rainy seasons, many rivers are subject to flooding at which times rural areas of the country become isolated and cut off. Many rural communities are often forced to attempt an unsafe river crossing or face a long, time consuming detour to access service amenities such as trading stores, schools, clinics and hospitals.

Initiatives on the part of various authorities, together with the affected communities, identified the desperate need to construct suitable and safe river crossings. This initiative, over the past three or four years, has seen the construction of various types of pedestrian bridges that are now benefitting the local communities in such affected areas.

This case study is a review of some of these river crossings.

Environmental conditions

In terms of the ISO 9223:2012 specification, environmental conditions in many rural areas conform to a corrosive category of C2 or C3. Refer to the Associations'

Ha Mofutho near Quasha's Nek, Lesotho, Senqu River.

Bisi Pedestrian Bridge, KwaZulu Natal Umzimkhulu.

Information Sheet No. 8, "Corrosion of Zinc – Corrosivity of atmospheres". Corrosion rates for zinc in a C2 atmospheric conditions ranges from 0.1 to ≤0.7 and for C3 from 0.7 to ≤2µm per year. By choosing to use hot dip galvanizing for corrosion control, the engineers have delivered a maintenance free service life bridge crossing of more than 50 years into the future.

Sites

Many of these bridges are located in remote areas with restricted access and infrastructural support. Bridges are manufactured of steel; fabricated in the main industrial centres, hot dip galvanized and road transported to the rural sites. Semi and unskilled crews are then used to erect the structure on the prepared foundations. Site activities using this type of structure are generally a lot easier than building the concrete equivalent.

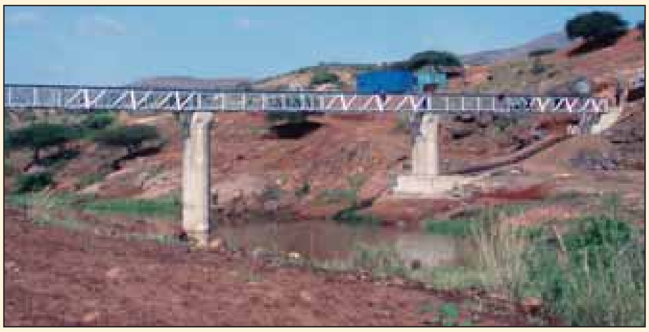
Conclusion

The primary features and benefits achieved on these projects were:

1. Cost and economic effectives of hot dip galvanizing, given the site location and non-availability of local materials and equipment.
2. Versatility of hot dip galvanized steel and the proven and effective methods used to combat corrosive elements within the given environment.
3. Alternative corrosion control coatings cannot match the performance of hot dip galvanizing when one considers the rough handling involved in loading, transportation and offloading at such an isolated site.
4. Design requirements of durability and maintenance free longevity have been achieved by way of the metallurgically bonded hot dip galvanized zinc coating, both from the standpoint of a "barrier protection" as well as "cathodic protection".

Makanise Bridge known as Pongola Bridge, KwaZulu Natal Richards Bay area.

Insuze Bridge – KwaZulu Natal.



Sikwebezi Bridge – KwaZulu Natal.

Zwelitsha Pedestrian Bridge over the Buffalo River, Eastern Cape – hot dip galvanized and painted.

KwaJolwayo Bridge.

Ntombe River Bridge, Northern KwaZulu Natal near the site of the Battle of Ntombe drift 1879 – hot dip galvanized and painted.

Ncome Museum Pedestrian Spiral Bridge, KwaZulu Natal – the site of the Battle of Blood River, 16 December 1838.

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

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- **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;
- **High Tech engineering workshop** - cnc milling, turning and dynamic balancing;
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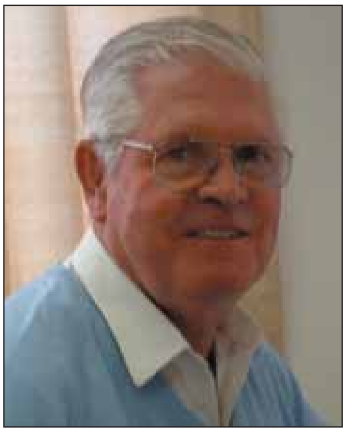
SMT Electroplaters | **kevin@smtgroup.co.za**
SMT Steel (Engineering) | **bernadette@smtgroup.co.za**

HOT DIP GALVANIZING MEMBERS

GALVANIZER	LOCATION	TEL. NO	SPIN	NO. OF LINES	BATH SIZES (L x W x D) (m)
GAUTENG					
ArcelorMittal South Africa	Vanderbijlpark	016 889 9111		3	Sheet galvanizer
Armco Galvanizers	Isando	011 974 8511		1	13.2 x 1.5 x 2.2
Armco Galvanizers - Randfontein	Randfontein	011 693 5825		1	6.5 x 1.3 x 2.0
Babcock Ntuthuko Powerlines (Pty) Ltd	Nigel	011 739 8200		1	12.0 x 1.4 x 1.8
Galferro Galvanisers	Springs	011 817 3667		4	13.5 x 1.65 x 2.5
					6.8 x 0.9 x 1.4
					6.5 x 0.9 x 1.5
					6.45 x 0.755 x 0.9
Galvadip (Pty) Ltd	Silverton	012 843 8000		1	7.0 x 1.7 x 2.0
Lianru Galvanisers cc	Nigel	011 814 8658		2	7.2 x 1.3 x 1.6
					4.5 x 1.3 x 1.6
Monoweld Galvanizers	Germiston	011 876 2900		3	14.0 x 1.35 x 2.5
					10.0 x 2.0 x 4.0
			Tube		Dia 42mm to 114mm
					max tube length 6.7m
Pro-Tech Galvanizers (Pty) Ltd	Nigel	011 814 4292	•	2	3.2 x 1.1 x 1.5
					3.0 x 1.1 x 1.2
Robor Tube	Elandsfontein	011 971 1600		1	Tube & Pipe Galvanizer
SMT Galvanizers	Benoni South	011 421 1495	•	2	2.6 x 1.0 x 1.5
					2.0 x 1.0 x 1.5
Transvaal Galvanisers	Nigel	011 814 1113		4	12.5 x 1.2 x 1.8
In-line and general					9.0 x 1.0 x 1.0
					8.0 x 1.2 x 1.5
					6.0 x 1.3 x 1.3
WESTERN CAPE					
Advanced Galvanising (Pty) Ltd	Bellville	021 951 6242		1	14.0 x 1.4 x 3.0
Galvatech (Pty) Ltd	Bellville	021 951 1211		1	7.5 x 1.5 x 2.6
Helderberg Galvanizing	Strand	021 845 4500		1	5.5 x 0.8 x 2.4
South Cape Galvanizing (Pty) Ltd	George Industria	044 884 0882		2	3.7 x 0.94 x 2.3
(NB: big line is not in operation)					(5.5 x 1.0 x 2.6)
EASTERN CAPE					
Galvanising Techniques cc	Port Elizabeth	041 486 1432		1	12.0 x 1.3 x 2.3
Galvaspin (Pty) Ltd	Port Elizabeth	041 451 1947	•	1	3.0 x 1.2 x 1.8
Morhot (Pty) Ltd	East London	043 763 1143		1	7.0 x 2.5 x 1.5
KWAZULU/NATAL					
A&A Galvanisers	Pietermaritzburg	033 387 5783	•	1	3.3 x 0.9 x 1.9
Bay Galvanisers	Richards Bay	035 751 1942		1	5.0 x 1.2 x 2.5
Durban Galvanizing (Pty) Ltd	Briardene	031 563 7032		1	9.5 x 1.3 x 3.0
Phoenix Galvanizing (Pty) Ltd	Phoenix	031 500 1607	•	2	14.0 x 1.4 x 2.5
					3.0 x 1.2 x 1.2
Pinetown Galvanizing	Pinetown	031 700 5599		1	9.0 x 1.2 x 3.0
Voigt & Willecke (Pty) Ltd	Durban	031 902 2248		1	14.0 x 1.3 x 2.5
INTERNATIONAL					
MAURITIUS					
Galvanising Co Ltd	Port Louis	+230 234 5118		1	7.0 x 0.75 x 1.68
ZIMBABWE					
Essar Tubes	Graniteside	+263772833477		1	10.0 x 1.1 x 1.0

- *Sheet, wire, pipe and other in-line galvanizing members dedicate their plants to the galvanizing of their own products. The bath sizes are inside dimensions and not maximum component size. Kindly take note of the expansion of the component when dipped into molten zinc or discuss with relevant galvanizer.*



PERSONALITY PROFILE

BOB WILMOT

The end of 2015 saw a prominent personality in the hot dip galvanizing fraternity and Executive Director of the Association retiring. We catch up with Bob Wilmot to find out what his plans are for the future.

How did you get involved in this industry?

In 1969 I joined Armco (Pty) Ltd as works engineer. The company was wholly owned by Armco International, a subsidiary of the Armco Steel Corporation. At that time Armco Steel Corporation was rated as the 4th largest steel company in the USA.

One of my first assignments was to investigate the feasibility of building a hot dip galvanizing plant to process the steel products that were being manufactured at the Isando factory. Apart from knowing that zinc coatings were applied to provide corrosion control, I had no idea of the different types of zinc coatings and certainly no idea about what was involved in the hot dip galvanizing process.

The majority of steel products that were being produced by the Armco operation in South Africa were being hot dip galvanized in order to provide corrosion control in both atmospheric and soil "buried" environmental conditions. As a result I was drawn into the fascinating science of corrosion of carbon steels and how zinc was being used to provide extended service life of carbon steel structures.

What do you have planned during your retirement?

The short answer to your question is that I plan to spend more time in my workshop. I enjoy building, creating or restoring things that present a challenge, and that will have some value once brought back to their original condition.

Tell us a little about yourself, your home life, your hobbies and passions

I matriculated from King Edward VII School in 1962, spent 1963 in the army followed by 4 years studying mechanical engineering at the Wits Technikon. I was fortunate to receive a bursary from SEIFSA to go to college and be enrolled on what was called a "sandwich course". The course involved 6 months full time technical studies at college and six months in industry to gain practical experience. I enjoyed my studies, which provide the theoretical knowhow, and at the same time provided exposure to the practical aspects of engineering.

Maureen and I were married in 1968, were blessed with two wonderful children. Colleen was born in 1971 and Robert in 1973. Colleen gained a PHD in physical science, and is now the head of the science department at St. Johns College. Robert also studied engineering, but added a BCom Management Degree as part of his studies. He is currently the General Manager at an engineering company involved with structural steel and filtration systems for power stations.

Both our children now have families of their own with each having a son and a daughter, which makes Maureen and me proud grandparents of four very active grandchildren.

Two restored MGs: The black sedan is a 1948 Y Type and the red tourer is a 1949 MG TC both fully restored to the original factory specifications

1933 MG J2 fully restored.

A model of a 1795 Royal Navy frigate.

My hobbies all involve hands-on practical activities from model ship building, to the restoration of MG motor cars and any items of historical or of practical value.

What professional achievement are you most proud of?

Perhaps the happiest time of my professional career was my 22 years at Armco Isando. Starting as the Works Engineer I was able to continue my engineering passion. I later become involved in the industrial engineering aspects of production and then as a profit centre manager. As Managing Director I was exposed to the financial aspects of business. Being part of the large American steel company, I gained experience from my exposure to both US and European business contacts.

During my time at Armco South Africa and the fact that we were wholly owned by Armco USA we were exposed to the politics of the 1980s. The US parent company wished to disinvest in South Africa, so a 51% share was taken up by a local SA company and became Armco Robson. Later we became total owned by Murray and Roberts and the company name changed to Armco Superlite.

Having been exposed to hot dip galvanizing from a corrosion control standpoint and the ongoing study into the feasibility of building the Armco Isando hot dip galvanizing plant, approval was finally obtained in 1996 when we joined the Murray and Roberts Group.

I was finally able to implement all our theoretical studies into the construction of a hot dip galvanizing plant that was designed to meet the needs of our internally manufactured steel products at that time.

I later joined the Macsteel Group in the Tube and Pipe plant with a commission to project-manage the construction of their fully automatic hot dip galvanizing plant to process their manufactured products.

From this background, corrosion of carbon steel and hot dip galvanizing became a passion that involved engineering practice (thermodynamics, strengths of materials, metallurgy, chemistry, machine design and plant layouts), and included financial management and return on investment.

Who has had the biggest influence in your life?

I would say without doubt that Maureen, who I met when I was still at school, has been my advisor, critic and support for more than 50 years. Maureen ensured a stable and happy home life for our family.

What is your philosophy of life?

I value honesty, integrity and implementing a philosophy I learnt from my grandfather, "If a thing is worth doing, it is worth doing well".

What is your favourite reading?

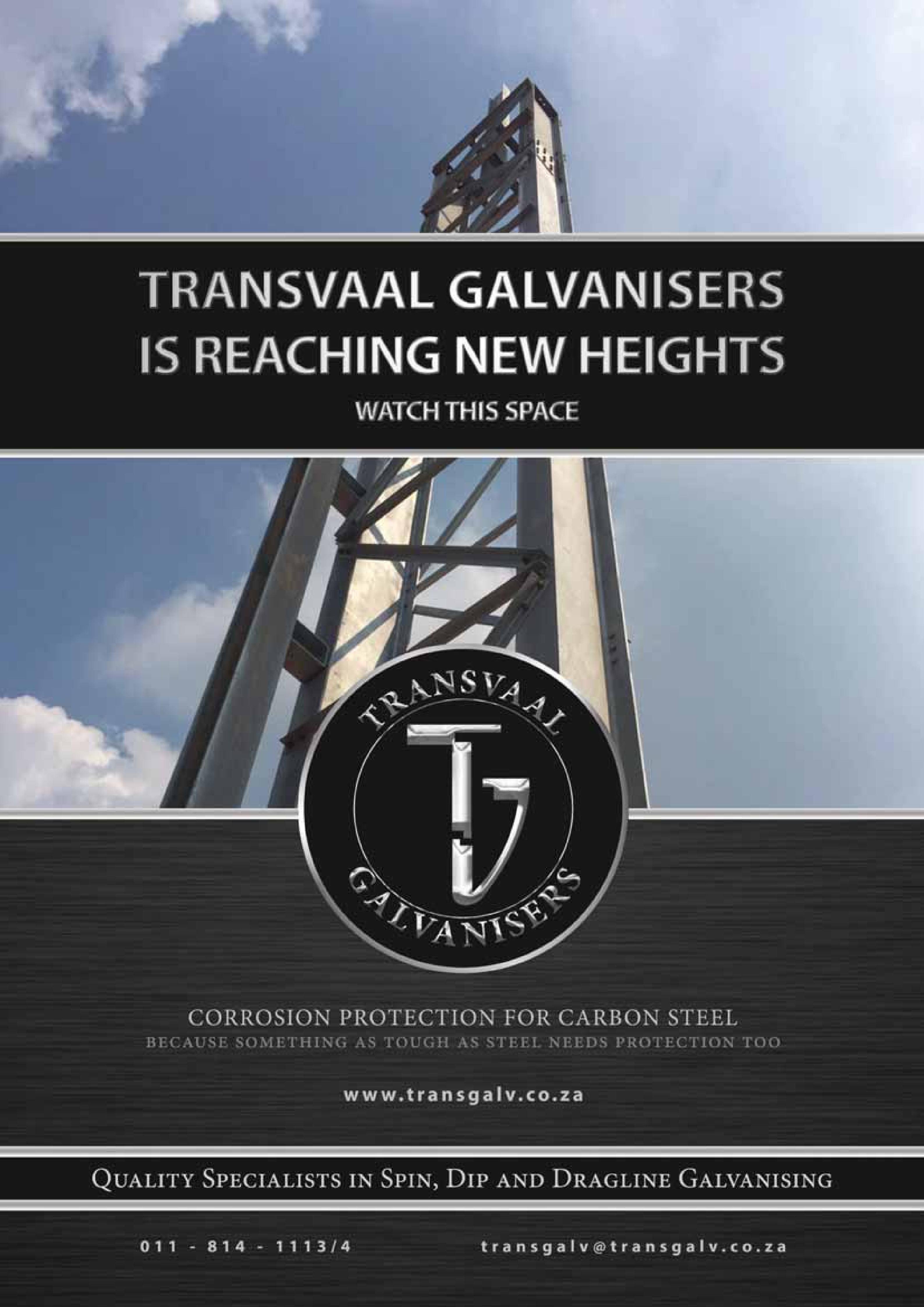
I only read non-fiction with my favourite being military history, but history in general. I also do a lot of research reading on how ships were built in the past, as well as researching technical details when undertaking a MG restoration project, or for that matter developments in hot dip galvanizing and specifically corrosion, but science in general.

Do you have any dislikes?

Dishonesty, rumour mongering and lack of teamwork within an organization.

Complete the sentence... *Five o'clock on a Friday, you* review the activities of the past week, listing follow ups and future actions. In addition activities for the week end are reviewed, and plans made for the next step in the current project.

The Association would like to acknowledge the advertisers and thank them for their support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2016 Annual Golf Day

The annual Golf Day of the Association was held at a very wet Benoni Country Club on Thursday the 10th March 2016.

Due to rain eventually stopping play, not everyone could complete the course. The scores were adjusted by the Proshop in order to determine the winning teams.

The winners of this year's Golf Day, with a score of 100, were the team from SA Galvanizing Services. Well done to Adriaan Louw, Johann Redlinghuys, Thorne van Zyl and Steve Van Zyl.

The dreaded Pink Lady, sponsored by Transvaal Galvanisers, was brought home by Jan Steyn, Okkie Engelbrecht, Robbie Arnoldie and Hennie Blaauw of Lianru Galvanisers.

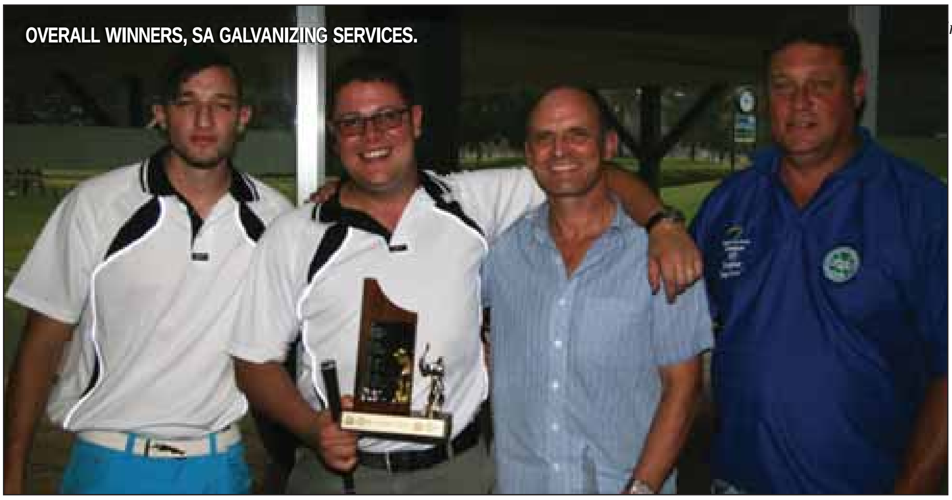
Second, third and fourth place was determined on a count out as each team scored 90. Second place was awarded to Gino, Jacques, Andre and Anthonie of Armco Galvanizers.

In third place we had Macsteel Tube and Pipe, consisting of Donald Sutherland, Jim Sanderson, Pieter Fourie and Clive James.

Ryan Liebenberg, Edzard Verseput, Kyle Palmer and Steve Endley from O-line Support Systems received the fourth prize.

Nearest the Pin was awarded to Steve Van Zyl, with Francesco Indiveri hitting the longest drive. Thank you to Monoweld Galvanizers for sponsoring.

In proving that the last three holes of a round will automatically adjust your score to what it really should be; the Longest Day was awarded to the team from Krome Metal Chemicals consisting of Struan Orlik, Bennie Vorster, Duncan Thompson and Ivan van Straten.


OVERALL WINNERS, SA GALVANIZING SERVICES.

Thank you to our sponsors for their contributions, without which we would not be able to hold a Golf Day. The sponsors are: Armco Galvanizers, Babcock Ntuthuko Powerlines, Krome Metal Chemicals, Lianru Galvanisers, Monoweld Galvanizers and Transvaal Galvanisers.


SECOND PLACE, ARMCO GALVANIZERS.


THIRD PLACE, MACSTEEL TUBE AND PIPE.


FOURTH PLACE, O-LINE SUPPORT SYSTEMS.


LONGEST DAY, KROME METAL CHEMICALS.


LONGEST DRIVE, FRANCESCO INDIVERI.


NEAREST THE PIN, STEVE VAN ZYL.

HOT DIP GALVANIZING...
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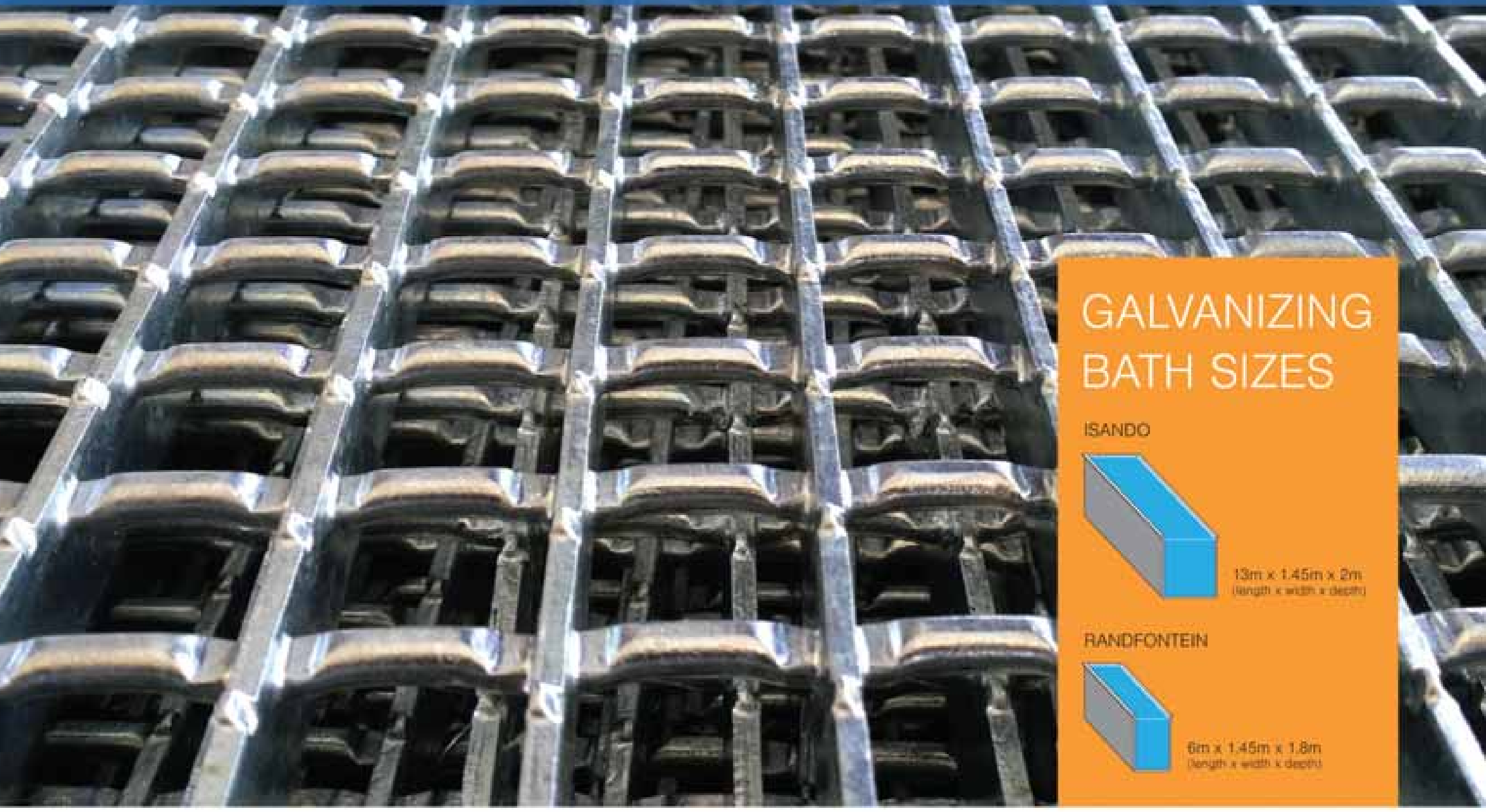

GALVANIZING BATH SIZES

ISANDO

13m x 1.45m x 2m
(length x width x depth)

RANDFONTEIN

6m x 1.45m x 1.8m
(length x width x depth)

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.

Armco Galvanizers Randfontein is our second facility based in the Randfontein area. Randfontein has an average output of plus minus 800 tons per month and is geared up to handle light to medium structural steel up and till 6m in length.

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.

Isando | **Tel.** +27 11 974 8511

Randfontein | **Tel.** +27 11 693 5825

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