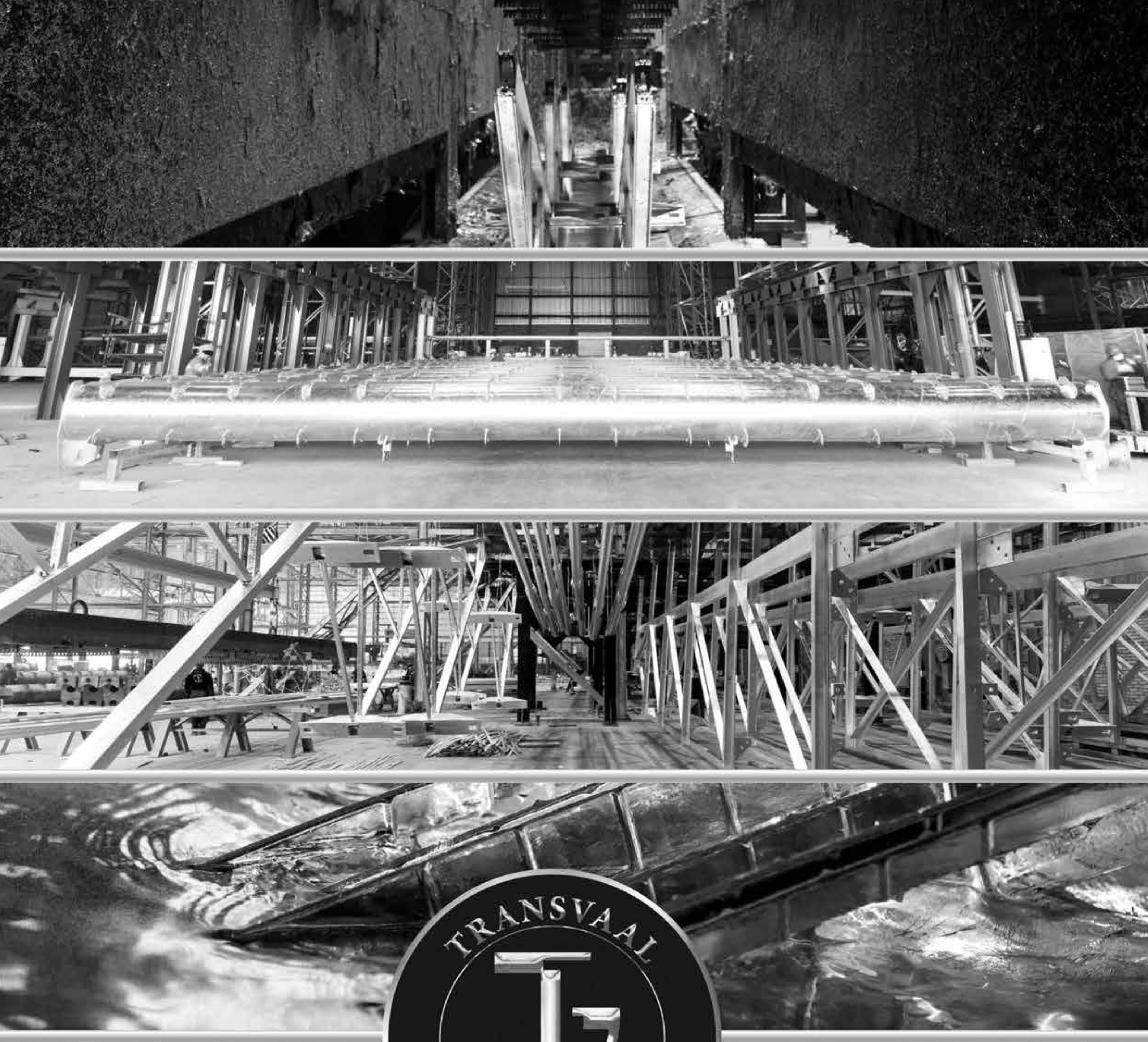
Volume 19 Issue 2
September/October 2022

HOT DIP GALVANIZING TODAY 80

The Official Publication of the Hot Dip Galvanizers Association Southern Africa

CORROSION CONTROL OF STEEL



6

11

14

Contents

THE ASSOCIATION IS AN INFORMATION CENTRE ESTABLISHED FOR THE BENEFIT OF SPECIFIERS, CONSULTANTS, END USERS AND ITS MEMBERS.

ISSN 1023/781X

PUBLISHED BY:
Hot Dip Galvanizers Association Southern Africa
Bedfordview Office Park, Building 1, Ground Floor, 3 Riley Road, Germiston
P.O. Box 2212 Edenvale 1610 Tel: 011 456 7960 Email: hdgasa@icon.co.za Website: www.hdgasa.org.za

Executive Director: Robin Clarke Cell: 082 902 5119 Email: robin@hdgasa.org.za

Publication Liaison: Anthony Botha Cell: 082 326 6080 Email: anthony@hdgasa.org.za

Design and Layout: Sandra Addinall Tel: 011 868 3408 Email: cbtdesign@adcot.co.za

Reproduction and Printing: Camera Press Tel: 011 334 3815 Email: cpquotes@camerapress.co.za

EXECUTIVE DIRECTOR'S Comment

Hot dip galvanizing remains a proven technology for corrosion control of iron and steel articles. This robust method of extending the service life of the iron or steel articles is misunderstood from time to time, even by those that specify it or who are unable to fully explain the benefits and mechanisms of corrosion control to end users. Also, derivatives of the technology such as additions of small amounts of other metals are often marketed as a revolutionary development, but the truth remains that the corrosion control mechanism has its roots in zinc and remains the same as that first used decades ago.

In essence when steel is immersed into molten zinc a reaction is triggered in which metallic alloys of zinc and iron develop to form a coating. These coatings take difference forms dependent on the chemical composition of the iron or steel being hot dipped. A secondary influence on the appearance of the coating may be the thickness of the material since the rate of cooling during extraction from the kettle as well as speed to quenching may play a role.

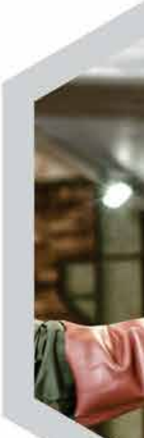
Unlike other corrosion control technologies that are centred solely on the formation of a barrier against the environment, the zinc- based coatings developed during the hot dip galvanized process acts not only as a barrier, but most importantly as an electronegative anode in relation to the carbon steel substrate. Should the coating be breached, or even naturally erode due to the corrosive environment, the zinc anode sacrifices itself in preference to the steel and adds the service life we desire. Consequently, it is obvious that the greater the amount of zinc available, the better the service life. Both the South African standard – ISO 121:2011, and the identical international standard, ISO 1461:2009 have been written to reflect this requirement and minimum masses of zinc/m² are stipulated in these documents. Naturally, non-destructive tests cannot be performed on each article after galvanizing, so to verify the weight of zinc on the coating the method is to take very many thickness readings across the representative surfaces of the article, average these readings and multiply the thicknesses by the known specific gravity of zinc. This determines the coating mass. More readings that are taken enhances the accuracy of the mass calculation.

Why is all the of above technical information of importance?

The understanding of the technology, why the standards are compiled as they are, and the ability to assess the outcome of the galvanizers work in relation to the standard is critical for the growth and continued support of the technology.

It is for this reason that a proactive stance has been taken and both one day and three day courses developed to enhance the understanding of the hot dip galvanizing technology. The Association also values any opportunities to tailor existing course material into shorter info sessions and seminars to assist larger teams in this regard.






EDITORIAL COMMENT
in this issue

In this issue, some of the more typical technical aspects of dealing with hot dip galvanizing are highlighted. It has been said that *"Everybody gets so much information all day long that they lose their common sense."* Hopefuly the reality of the simplicity and practicality found in the following will help us maintain rather than lose our 'Common Sense'

- The differences and similarities between hot dip galvanizing standards is in principle a directed view in finding the common sense in both ISO and US standards.
- Dealing with stresses of the material and some common sense tips.
- Welding of galvanized steel (Part 1), it's not that much different to the uncoated steel.
- We revisit a project of refurbishment and renewal using the Duplex System, bringing a grand building once delapidated back to a thriving centre of life.
- Training throughout South Africa – If you dont know, then we can help you learn. Empowering the workforces of galvanizers, fabricators and all who want to benefit from the eons of hot dip galvanizing technology at their call.
- Intergalva 2022 – A brief review and overview of the global hot dip galvanizing conference attended by the HDGASA and others in Rome.
- Paolo Trenchiro – RIP as we say farewell.

Be safe, be well and be aware – these are the true values of any BBB approach to life.

TRIBUTE TO Paolo Trinchero

Paolo Trinchero, passed away on Sunday the 21st of August. Paolo was the CEO of the SAISC for the past 9 years, since 2013. We received the news of Paulo's passing with great sadness. Our professional paths crossed in many spheres related to the steel and galvanizing industry. Always friendly and accommodating, it was a pleasure chatting to Paolo and exchanging ideas. No doubt he will be missed by all. Our sincere condolences to all from the team at the Hot Dip Galvanizers Association.

Paolo was passionate about anything related to steel and in the face of the last few very challenging years. The innovations for steel – including 'green' or renewable steel were Paolo's vision for a strong proponent of innovation and sustainability throughout the sector.

Paolo leaves behind his beloved wife Lora and their three children, Giulio, Angelo and Sabrina. The condolences of the Hot Dip Galvanizing Association and its members is extended and our thoughts and prayers are with them during this time of bereavement and loss.

PTL PRODUCTS
COATINGS & CHEMICALS

SOLUTIONS FOR HOT DIP GALVANIZING THROUGH PARTNERSHIPS

PROVIDERS OF ALL CHEMICAL REQUIREMENTS

- Highly efficient, low temperature and cost saving alkaline and acidic degreasers
- Acid fume suppressants and inhibitors
- Full range of fluxes
- Passivation, chrome and chrome 3
- White rust removers
- Paint strippers
- Nickel tablets – proven to reduce zinc pick up and improve overall finish
- Stopgalv – excellent masking product where no galvanizing is required
- Raw materials eg. ammonium chloride, zinc chloride, caustic soda lye
- Powder coating powder for duplex coatings

- **Comprehensive solutions nationwide**
- **Technical support and testing**
- **Product available from your nearest branch**

www.ptl-sa.com

Gauteng: Head Office
Unit 5 Green Africa Industrial Park,
88 Main Reef Road, Wychwood, Germiston
Tel: 011 616 0150/1
Email office@ptl-sa.com

KwaZulu-Natal: Tel: 066 380 5460

CapeTown: Tel: 021 551 9079

Port Elizabeth & East London: Tel: 071 638 6524

GQEBERHA – NELSON MANDELA BAY TRAMWAYS TERMINUS BUILDING

restoration revisited

THE TRAMWAYS BUILDING HAS HAD A COLORFUL HISTORY SPANNING OVER 116 YEARS.

The former tram and bus terminus in Port Elizabeth, built more than 140 years ago, was abandoned in the mid-1990s. The building was exposed to harsh coastal elements and was extensively used by homeless persons as a shelter. Fires started by the homeless resulted in some sections burning down. A project was undertaken in the early 2000's to transform the heritage site into a development featuring a mixture of tourism, leisure, entertainment and office spaces. Aurecon was tasked with the structural design and refurbishment. Aurecon chose to ensure effective corrosion control of this restoration project by extensive use of the Duplex system, anchored in hot dip galvanized corrosion control technology, designed to ensure an 80-plus year lifespan for the refurbished Grand Dame of Gqeberha.

The Tramways Building has had a colorful history spanning over 116 years. It originally housed the municipality electric tram transport system and included the city's own power station and workshops. Later additions included an office facing the river followed later by South Union Street, and still later an ice rink and a number of small businesses.

The Tramways Building is at the entrance to Gqeberha's central business district and the mouth of the Lower Baakens River Valley and situated at the entrance of the Gqeberha Harbour.

Aurecon were appointed by the Mandela Bay Development Agency (MBDA) to undertake the structural design and site monitoring for the rejuvenation of the historic Tramways Building.

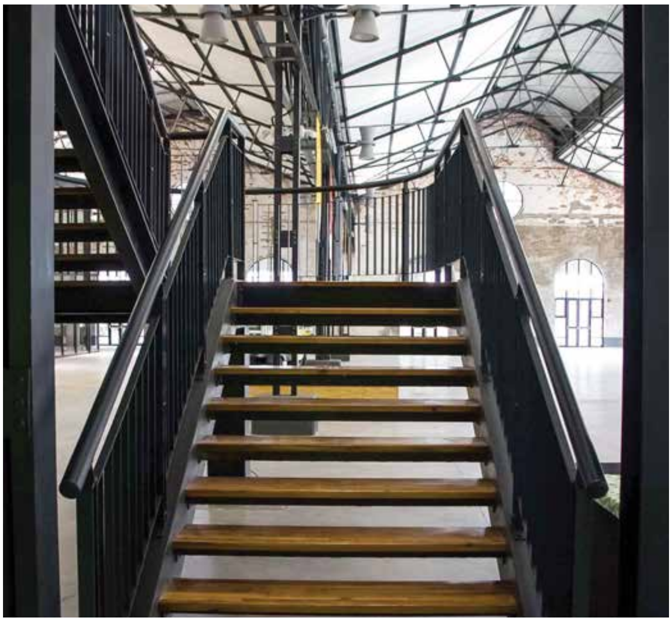
The redevelopment entailed both the refurbishing of existing structural steel elements as well as the design of new structures to be placed in the existing building envelope.

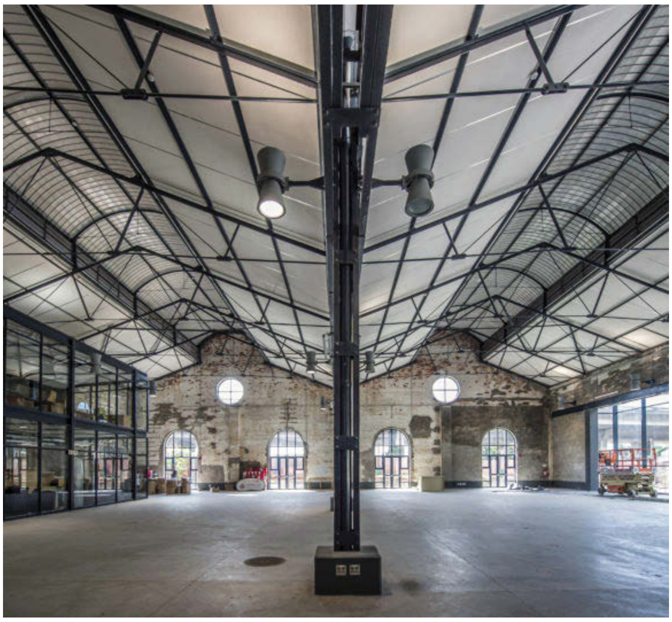
The dominant elements of the design are steel structures. Since the building is located within the Baakens River Valley flood plain and less than three hundred meters away from the Gqeberha Harbour, a solution was sought that optimised the corrosion control of the structures. A Duplex system was specified whereby a suitable paint system was used to overcoat the hot dip galvanized finish of the structural steel.

The aim of the project is part of the renovation and upgrading process of the inner city, which needed to be revitalised through creating markets for sport, ecology, arts and culture, education and training, conferencing and tourism. The Duplex Coating System promised to provide both a pleasing aesthetic finish and ensure a service life in excess of eighty years.

Over the intervening years since the completion of the rehabilitation up to 2022 the Tramway Building has met and exceeded the expectations set out by the NMBA. The Tramways Building has been hosting events in Art, Community, and Education. With a full calendar of events, life was restored and is valiantly and beautifully being maintained with the ease that the chosen Duplex System has been providing for more than a decade.

For more on DUPLEX SYSTEMS visit the HDGASA website www.hdgasa.org.za.





WHAT IS THE DIFFERENCE BETWEEN ASTM A123/A153 and SANS 121 (ISO1461)?

OF LATE THE ASSOCIATION HAS BEEN RECEIVING NUMEROUS ENQUIRIES ASKING FOR CLARITY ON THE DIFFERENCES BETWEEN ASTM A123 AND A153 AND SANS 121: 2011(ISO1461:2009).

North American, USA, specifiers, and galvanizers typically use ASTM A123 and A153 for steel products and fasteners to be hot dip galvanized. However, ISO 1461:2009 is most preferred in the international galvanizing industry for both large structural pieces and centrifuged hardware. ISO 1461 is used as an adopted form in the UK, South Africa [SANS 121:2011 (ISO 1461:2009)], several European countries, and Mauritius. Sometimes Canada, the United States, and Mexico use the ISO 1461:2009 standard in place of the ASTM A123 and A153.

ISO 1461, Hot Dip Galvanized Coatings on Fabricated Iron and Steel Articles Specifications and Test Methods, is produced by the International Organization for Standardization (ISO) as an industry standard for galvanizing. The standard holds requirements for hot dip galvanized steel comparable to those found in both ASTM A123, Standard Specification for Zinc (Hot Dip Galvanized) Coatings on Iron and Steel Products, and ASTM A153, Standard Specification for Zinc Coating (Hot Dip) on Iron and Steel Hardware.

Galvanizers should be aware of some small differences between the two specifications. These differences exist within the testing methods of the two standards and slight overlaps in coating thickness requirements.

The ASTM and ISO standards share similar testing requirements for coating thickness. Both A123 and 1461 use a magnetic or electronic coating thickness gauge as the primary means for determining the mean coating thickness of hot dip galvanized steel. Both standards also rely on the weigh-strip-weigh procedure (referred to as the gravimetric method [ISO1460] in ISO 1461:2009) as an alternate method of determining coating thickness when magnetic gauges are not appropriate or as a referee method when the coating is under dispute.

Sampling for coating thickness testing

The sampling requirements are extremely similar between the standards. Each standard requires a certain number of test articles or specimens to be randomly selected and taken from a lot and then tested for coating thickness. The number of articles or specimens to be pulled from the lot is determined by *ISO 1461:2009 Table 1*, which is exactly the same as the charts found in ASTM A123 section 7.3 and ASTM A153 section 6.2. However, a difference lies in how the average coating thickness is determined after the lot is broken down into this control sample.

ISO 1461 requires that after a control sample is produced from the lot, the articles need to be further broken down into reference areas. Each reference area requires a minimum of five individual readings to be taken within a minimum area of > $10cm^2$ to determine a local coating thickness average. The reference area averages are then aggregated and used to determine the mean coating thickness of the article. In contrast, ASTM A123 calls for the control sample to be made up of specimens. Once the specimens are determined, they need not be broken down any further. A123 also

calls for a minimum of five measurements to be taken within each specimen, but these are to be widely dispersed throughout the volume of the specimen rather than spaced closely together. The extent of the sampling should be to determine a mean average coating as representative of the coating surface as practicable. These small differences are probably negligible for a galvanizer and their customer but, may be relevant in the case that a dispute does arise.

More differences between the standards are present in the minimum average thickness requirements. These differences may be considered. *Table 1* has been included to highlight these subtle differences between the standards.

Table 1 assumes that the steel is being galvanized according to the thicknesses in the left-hand column. This column uses the standard units of mm found in ISO 1461:2009. The table then gives the requirements of ISO 1461:2009, and the thickness of steels whose A123 requirements overlap.

The information provided is pedantic in showing the small variances of virtually no practicable concern but which may be material in the case of a dispute arising.

Source: Sub edited from material published by GA of USA, with appreciation and HDGASA materials on hand. This article provides general information only and is not intended as a substitute for competent professional examination and verification as to suitability and applicability. The information provided herein is not intended as a representation or warranty on the part of HDGASA. Anyone making use of this information assumes all liability arising from such use.

Table 1: Coating thickness comparison ISO 1461 vs ASTM A123.

1

Category of steel by thickness as per Table 3 of ISO 1461:2009	Minimum Mean Coating Thickness as per Table 3 of ISO 1461:2009	Equivalent steel categories i.r.o ASTM A123	Minimum Mean Coating Thickness as per ASTM A123
Steel > 6mm	85µm	• Structural Shapes 6.0mm and ≤ 6.4mm • Structural Shapes > 6.4mm • Plate 6mm to ≤ 16mm • Plate > 16mm • Pipe and Tube > 6.0mm	• 75µm (≈ 3 MIL) • 100µm (≈ 4 MIL) • 75µm (≈ 3 MIL) • 100µm (≈ 4 MIL) • 75µm (≈ 3 MIL)
Steel > 3mm to ≤ 6mm	70µm	• Structural Shapes and Plate 3.0mm to ≤ 3.2mm • Pipe and Tubing 3.0mm to ≤ 3.2mm • Structural Shapes, Pipe and Tubing, and Plate > 3.2mm to ≤ 6mm	• 65µm (≈ 2.6 MIL) • 45µm (≈ 1.8 MIL) • 75µm (≈ 3 MIL)
Steel ≥ 1.5mm to ≤ 3mm	55µm	• Structural Shapes and Plate 1.6mm to ≤ 3.0mm • Structural Shapes and Plate ≤ 1.5mm to ≤ 1.6mm • Pipe and Tubing ≤ 1.5mm to ≤ 3.0mm	• 65µm (≈ 2.6 MIL) • 45µm (≈ 1.8 MIL) • 45µm (≈ 1.8 MIL)
Steel < 1.5mm	45µm	• Structural Shapes, Pipe and Tubing, and Plate < 1.5mm	• 45µm (≈ 1.8 MIL)

WELDING
and hot dip galvanized steel

Nearly all hot dip galvanized steel fabrications involve welding of the steel elements. All structural steel welding should be carried out by qualified professionals to the relevant welding specification and standards. By observing current best industry practices, the welded joints and fabricated article may be expected to be able to meet the quality and strength of welds sought by the end user.

Galvanized steels are easily and satisfactorily welded using all generally practiced welding techniques. Closer control of welding conditions than for uncoated steel is usually necessary but procedures are simple and well established.

Where galvanized steel is to be welded, adequate ventilation must be provided. If adequate ventilation is not available, supplementary air circulation must be provided. In confined spaces, a respirator must be used. Grinding of edges prior to welding may be permitted to reduce zinc oxide fumes formed during welding and eliminate weld porosity which can sometimes occur. All uncoated weld areas must have the corrosion protection renovated congruent to the standard applicable to the coating i.e., for hot dip galvanized coating SANS 121:2011 (ISO1461:2009) Paragraph 6.3 refers.

Weld quality

The appearance of the welded area after hot dip galvanizing typically corresponds to the weld appearance prior to galvanizing. The higher the quality of the weld, the higher the quality of the galvanizing in that zone. SANS 10162 and SAN 14713 provide details of various weld quality levels required for structural steel applications and the best practices for fabricating steel for hot dip galvanizing as the corrosion control technology to be used. Overall, the quality of the weld will reflect in the consistency of the hot dip galvanized coating.

Zinc oxide

Welding hot dip galvanized steel vaporizes the zinc coating near the arc. The zinc oxidizes in the air to a fine white powder. Prolonged unprotected inhalation of zinc oxide may produce ephemeral side effects. Prevention in workers, such as welders, involves avoidance of direct contact with zinc oxide fumes, through exhaust ventilation systems and personal protective equipment such as fume helmets or respirators. As with all welding, proper ventilation and fume exhaust are of first priority and detailed information on managing this aspect is available from the SAIW.

Gas Metal Arc (GMA) welding aka $C0_2$ and MIG (Metal Inert Gas) welding

In this issue we will focus on Gas Metal Arc welding due to the extensive use of the welding technology in use throughout Southern Africa, GMA - MIG or CO_2 welding is a versatile semi-automatic welding process that is convenient and easy to use. It is particularly suited to the welding of thinner materials.

In the GMA welding of galvanized steel, the presence of the zinc coating has no effect on weld properties although a degree of weld spatter is produced. Arc stability is excellent and is not affected by the galvanized coating, however, some reduction in welding speed is required.

Galvanized steel can be welded satisfactorily using pure carbon dioxide shielding gas which provides excellent weld penetration, but produces considerable weld spatter. The use of a spatter-release compound may be worthwhile. This compound must be thoroughly removed prior to the renovation of the corrosion control coating as it affects the adhesive bond strength.

Alternatively, the more expensive Ar – CO_2 or Ar – CO_2 – O_2 mixes provide adequate weld penetration, a superior weld bead, and far less spatter. A 92% Ar – 5% CO_2 – 3% O_2 mixture has been found to provide excellent results on galvanized sheeting up to 3.0mm thick.

GMA welding speeds should be lower than on uncoated steel as specified to allow the galvanized coating to burn off at the front of the weld pool. The reduction in speed is related to the thickness of the galvanized coating, the joint type, and the welding position, and is generally of the order of 10% to 20%.

Fillet welds in steel with thicker galvanized coatings may be welded more readily if the current is increased by 10 Amps. The increased heat input promotes the burning away of the thicker zinc coating at the front of the weld pool.

Penetration of the weld in galvanized steel is less than for uncoated steel requiring slightly wider gaps to be provided for butt welds. A slight side-to-side movement of the welding torch helps to achieve consistent penetration when making butt welds in the flat position.

Butt welds in the overhead and horizontal-vertical positions require little to no reduction in speed because the zinc vapour rises away from the weld zone. To achieve complete penetration in the overhead position on sheeting with heavy coatings, say > 85µm, weld current should be increased by 10 Amps and voltage by 1 Volt.

Welds in the vertical downwards position may require a speed reduction of 25% to 30% by comparison with uncoated steel, depending on the joint type and coating thickness, to prevent rising zinc vapour from interfering with arc stability.

An extension of the GMA process, GMA braze welding utilizes a filler metal with a lower melting point than the parent metal. The joint relies neither on capillary action nor on intentional melting of the parent metal. Shielding gases of Ar – O_2 type are the most suitable, the low oxygen level being sufficient to permit excellent edge wash and a flat weld without causing surface oxidation. The low heat input minimizes damage to the coating on the underside of the parent plate, enables the corrosion-resistant bronze filler to cover any of the coating damaged by the arc, and minimizes the level of distortion when welding sheet metal components.

Source and acknowledgement: Sub-edited from and amended for Southern African context from GAA Published materials.

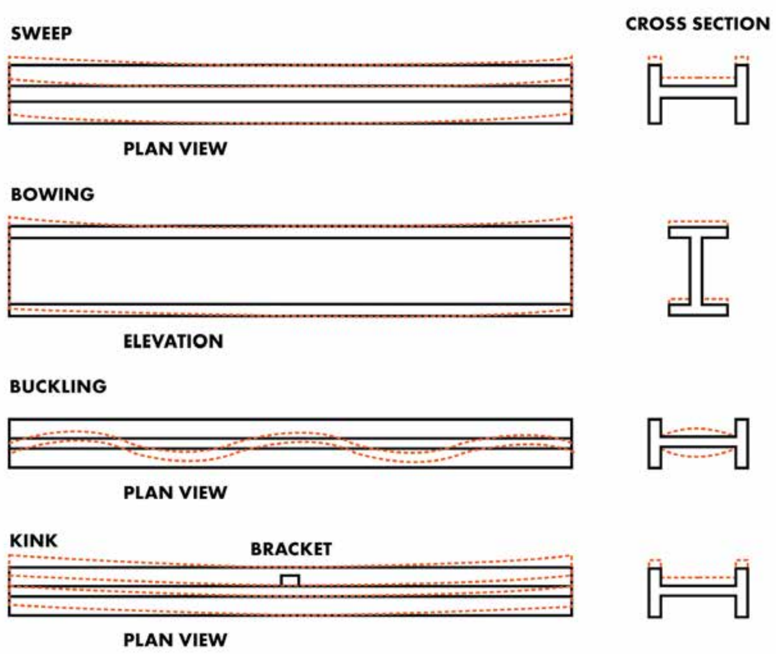
DEALING WITH RESIDUAL STRESSES
of fabricated articles to be hot dip galvanized

Hot dip galvanizing is a highly cost-effective method of protecting structural steel fabrications against corrosion. Its usage can be traced back almost one hundred years. A disadvantage of the galvanizing process however, is that the large temperature gradients that are generated in fabrications, coupled with the (uncontrolled) release of internal stresses during the galvanizing process, can cause distortion during the hot dipping and cooling of the galvanizing operation. It is not unusual for these distortions to exceed the allowable out of straightness tolerances for structural components. This article reports on the paper which examined the causes of the distortion and the usage of a system known as Vibratory Stress Relieving (VSR) as a means of either preventing or greatly minimising this distortion. The VSR system is already being used in many parts of the world with a high success rate on components prior to them being galvanized, and thereby minimising the distortion, or as in many cases, completely eliminating the distortion. The Vibratory Stress Relieving Service has been in commercial use here in South Africa since the mid-eighties and the service is now available in all major centres of South Africa, Botswana, Zambia and Namibia.

Distortion of a component during / following hot dip galvanizing is a problem that is encountered by galvanizers worldwide. Although unacceptable distortion only occurs in a very small percentage of the tens of thousands of components that are galvanized daily, it is this very small percentage that creates problems for the galvanizer and the fabricator thus leading to designers and fabricators seeking other less efficient means of corrosion protection. Fabrications often contain a myriad of locked-in stresses resulting from the original rolling process, cold working if applicable, hole punching, and through the joining (welding) processes involved. Poor conceptual design and detailing of components, coupled with a lack of knowledge as to the galvanizing process on the part of the fabricator can also contribute to the high stresses locked into the component.

Research shows that temperatures as used in the hot dip process (450 - 460°C) will bring the steel into the temperature range where it will lose about a reduction of anything of about 35% in the yield strength of most steel grades. This reduction is only temporary, as the yield strength will revert back to its normal strength upon the cooling of the material.

Figure 1: Typical distortion in beams.



1

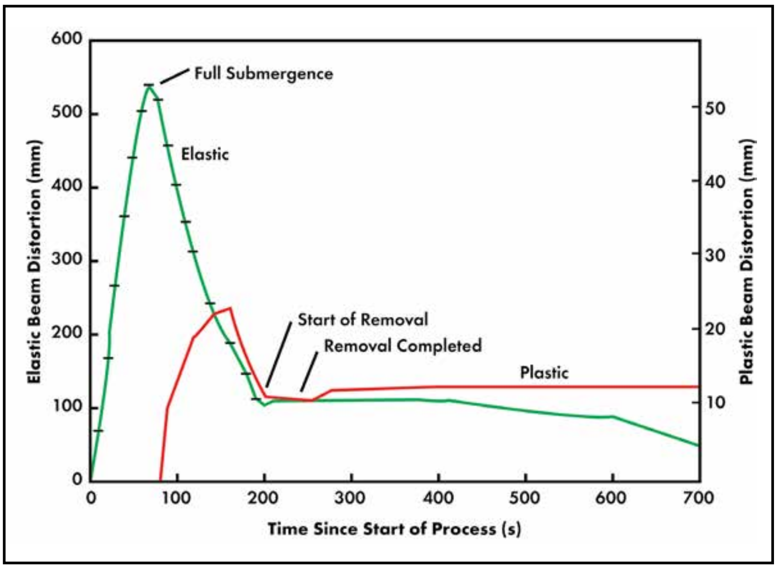
This reduction combined with an uncontrolled release of stresses when immersed into the galvanizing bath will often bring about the unwanted distortion. These stresses to the combined effect can result in 'plastic' strains. In the case of plate girders, the result is web buckling distortion. The magnitude of the distortion is often a complex function of component geometry and dipping practice. Following removal from the zinc bath, the component may either be allowed to cool on the shop floor or it may be chromate dipped in a cooler temperature than the molten zinc having a quenching effect. As with heating, the changes in temperature during cooling can generate unwanted thermal stresses. Structural beams form a significant percentage of the wide product range that is suitable for hot dip galvanizing. Large fabricated plate girder beams are costly items and, owing to their size and strength, they may not be easily straightened after distortion has occurred.

The principal source of the distortion in large beams is a variation in the longitudinal stresses over the cross sections of the beams. Longitudinal stresses run parallel to the length of the beam and there are three common types of distortion that can result from the variation in these stresses. These are detailed in *Figure 1.*

The more complex distortion such as twisting is a result of a combination of longitudinal, transverse and sheer stresses. Other minor influences upon the degree of distortion are sometimes caused by the liquid drag forces incurred as the beam is withdrawn from the zinc bath. This will also depend upon the position of the support points as the effect will be maximised when the beam is being withdrawn as the yield strength of the steel will have been reduced and the beam will be lacking the buoyancy effect from the molten zinc.

A structural beam following galvanizing should always be allowed to cool whilst resting upon a flat surface as any beam at 450°C with the corresponding reduction in

2



yield strength while resting upon supports will experience additional forces due to the effects of gravity which will produce bending moments and associated bending stresses in the beam.

These stresses will reduce naturally over time (the ageing or weathering process). The reduction can be also accelerated by the bumping during the loading operations and whilst in transit on the back of a bouncing truck / trailer which can compound the distortion, causing unexpected problems on arrival at the work site.

A particularly severe problem of beam distortion following galvanizing was noted by our associate company VSR (UK). The galvanizers were Hereford Galvanizing who at the time was contracted for the galvanizing of many fabricated beams for Forth Engineering Ltd, contractors to the Ministry of Defence. The beams ranged in length from 8m to 12m and all having additional braces welded to the webs, some of the beams would distort up to 22mm following the galvanizing. Initially, the UK Welding Institute was called upon to assist and they suggested various welding solutions, none of which solved the problem.

The Welding Institute then recommended that they try applying the VSR process to the girders at the fabricator's workshop prior to delivery to the galvanizers.

Figure 2: Time estimates of distortion during dipping and removal.

Figure 3: Beam VSR treated prior to galvanizing.

Figures 4 and 5: Examples of fabricated structural beams undergoing VSR treatment to effect a reduction in the distortion. *(Photos courtesy of Tass Engeneering)*

3

4

5

An on-site study into the galvanizing process was carried out by observing deflection for a plate girder being dipped in the vertical direction, bottom flange first into the zinc. It was established that initially the beam would bend within the elastic range, reaching its peak deflection at total submergence which would correspond to the maximum temperature differential between the upper and lower flanges. Plastic (permanent) deformation commences following this as the beam heats up and the yield point of the steel decreases. Further temperature increases result in continuing plastic deformation with the first, the lower and the hottest flange yielding resulting in a permanent bending of the beam, with the top flange yielding to provide stress relief and a reduction of the beam distortion. This is clearly detailed in *Figure 2*, amazingly this distortion occurred within 3½ minutes of total submergence in the bath of molten zinc!

During the removal process, the top flange cools slightly more rapidly, thereby increasing the stress over the rest of the beam. With the lower portion of the web and the bottom flange being hotter, it yields even more, resulting in a small increase in the plastic (permanent) distortion.

A photograph of one of the beams undergoing a VSR treatment is detailed in *Figure 3*.

Beam dimensions – Height 1 050mm, Width 390mm, Length 6 - 12m, Web thickness 16mm, Flange thickness 30mm.

Steel properties at 30°C – Modulus of elasticity $200GNm^{-2}$*, Coefficient of expansion* $1.2\times10^{-5}K^{-1}$*, Thermal Conductivity* $45Wm^{-1}K^{-1}$*, Yield Point* $277Nm\ m^{2}$

Galvanising conditions – Bath temperature ±455°C, Dipping angle 30° to horizontal with webs vertical, Dipping velocity average 500mm/min, Removal velocity average 1m/min.

Initially the first beam received a frequency scan which was recorded upon a graphic print out for further reference purposes. The beams were basically identical and as their natural frequencies are in part determined by size, shape and mass, it was assumed that the other beams would be very similar in their modal response.

The trial beams were then VSR treated at their first bending mode in each plane for 8 minutes, a total of just 24 minutes treatment per beam. Following the galvanizing process the beams maintained a tolerance of within 7mm, well within the specified tolerance of 10mm rendering them all fit for service with no further rework after galvanizing. The procedure was then adopted to include VSR on all beams prior to galvanizing.

Tass Engineering, a well-known and respected Johannesburg based company specialising in structural steel, had been contracted to fabricate a large quantity of beams for Eskom's Medupi Ash and Coal Project. The average size of these beams was 1m in height by 10m in length with a flange width of around 450mm. They were fabricated using structural grade steel. The welding process was completed using submerged arc welding, (a process which can minimise welding stresses owing to the lower cooling rate of the welding).

Following the hot dip galvanizing process areas of buckling, distortion were measured along the webs of the beams, the specified tolerance of which was 7mm. Following galvanizing the worst amount of the distortion measured was 11mm and as such the entire batch of beams was rejected by the on-site inspector. (The distortion simulated that as can be seen detailed at item 3 in *Figure 1*).

After trying, without too much success, various methods of mechanical straightening of these beams, a local VSR agent was approached with a view to vibratory stress relieving the remaining batch of beams with the required end result being that of limiting web distortion to within tolerance if not completely eliminating the distortion.

Treatment of these beams averaged around 25 minutes each with the first resonant frequency being at around 34Hz. Following the VSR treatment the worst of the distortion had been greatly reduced, in some instances by as much as 8mm with the remainder of the buckling all being brought back to within the required tolerance.

Prior to VSR treatment the expert staff at Tass Engineering had attempted to press out some of the distortion but owing to the high residual stresses within the structure this had proven to be impossible. Although VSR had brought the beams back into tolerance a mechanical press was used to remove some of the remaining high spots and owing to the material relaxation brought about by the successful stress relief process the beams were now easy to process.

The fabricated beams as shown above are being treated with the intent of removing the buckling distortion that had been caused by the varying temperature gradients that had been induced during the hot dip galvanising process and the results obtained were as required.

However, technically this is not the ideal scenario for the treatment of beams of this type and size. Through the additional handling of the beams and combined with the attachment of the VSR equipment (using heavy duty clamps) to the component there is always the risk of damaging small areas of the expensive galvanised coating which of course is undesirable to the end user. The correct refurbishment of any small uncoated areas can be successfully addressed in terms of SANS121:2011(ISO 1461: 2009) thereby ensuring effective extended lifespan of the corrosion protection.

A far more satisfactory result would have been achieved to utilized the VSR process at the final stage of the beams production or just prior to the galvanising process being carried out. It is after all these high and often uneven stresses that are locked into the component that when rapidly released by the galvanising temperatures potentially giving rise to distortion.
A beam treated in this manner if the galvanising procedure and subsequent storage of the beam whilst cooling is correct would exhibit little or no distortion along its axis.

Of the hundreds of components that are treated daily in South Africa using the on-site VSR service it is unknown what percentage requires the services of the hot dip galvanizers as no survey has ever been carried out.

What is now known is that where stress relief or component stability is required VSR can match that of thermal stress relief. A fact which is proven by the thousands of different users of the service on the hundreds of different components ranging from fan impellors, machine and pump base plates, through to heavy fabrications.

Vibratory Stress Relieving can now be found in all major centres of South Africa. The process is quick, and it is clean with no scaling or discoloration to the component, and more importantly, there is no unwanted change in the materials properties or loss of material yield strength. The system is also fully portable, running off a 220v single phase supply, with no atmospheric pollution as is in comparison to a thermal stress relieving oven.

One must always remember that VSR is not a replacement for thermal stress relieving, it is merely an acceptable alternative, and there still remain some applications that will require the use of a furnace. Where a metallurgical change is not required VSR is fast becoming the preferred method of stress relieving owing to time and cost savings. Treatment capacity ranges from less than 1kg to in excess of 150 000kg, the process can be carried out either at the fabricator's own premises or at the galvanizing plant.

INTERGALVA 2022

The 26th International Galvanizing Conference was held at the Rome Marriott Park Hotel, Italy from 20 - 24 June 2022. The Intergalva series of conferences started in 1950. Intergalva 2022 was organised by European General Galvanizers Association (EGGA) and hosted by Associazione Italiana Zincatura (AIZ). A 3-day conference programme on the latest industry developments, with simultaneous interpretation in (Italian/French/German/Spanish/English) provided practical and forthcoming technological insights in the field of hot dip galvanizing worldwide.

Robin Clarke, Executive Director of the Hot Dip Galvanizers Association Southern Africa had an early start to the conference with a meeting of all galvanizing associations. The state of the global industry was central to the meeting with reinforcement of the cooperative global relations being maintained. Several other members from the HDGASA participated as delegates including Riaan De Beer and Mark Venn of Galferro and Francesco Indiveri and Dale Kent of Transvaal Galvanising. Several of the talks and papers presented will be published in forthcoming issues of the HDGASA magazine.

The Intergalva 2022 conference program was developed in response to the significant challenges faced by the galvanizing industry in energy supply and the future decarbonization of operations. The importance of batch galvanized steel to achieving society's net-zero goals and achieving greater circularity was also explored. The event included a major exhibition of plant, equipment, process chemicals and services. Visits to galvanizing plants in Italy highlighted the current trends in the HDG plant and technology. Intergalva 27 is scheduled for 2024 in Benelux.

TRAINING
throughout South Africa

THE HOT DIP GALVANIZERS ASSOCIATION SOUTHERN AFRICA (HDGASA) HAS BEEN AT WORK WITH EXTENSIVE CALLS FOR TRAINING THROUGHOUT SOUTH AND SOUTHERN AFRICA.

The HDGASA has run several successful courses of *Level I – Introduction to Hot Dip Galvanizing* and the advanced course *Level II* for accreditation of Hot Dip Galvanizing Inspectors.

Candidates from galvanizing members shored up their professionalism and ensured they had the requisite level of knowledge and competency to provide the highest level of service to customers throughout Southern Africa.

Companies including ***Central Support Systems (Pty) Ltd*** ensured that their sales and technical teams were well capable of assisting their customers with a range of galvanized solutions for cabling and electrical support systems. ***Baltimore Aircoil Company*** held training at their facility and offices in Cape Town to ensure the highest level of competency amongst their technical team regarding the range of cooling system solutions that are hot dip galvanized for extended service life.

Several independent innovators and forthcoming players in the fabrication field attended as part of their competency development regarding design and fabrication for corrosion control by hot dip galvanizing.

The next HDGASA Level II advanced course is on the schedule for October 2022. *Seats are limited – book now to avoid disappointment.*

"Knowledge is the only instrument of production that is not subject to diminishing returns" John Maurice Clark

Level I: Introduction to Hot Dip Galvanizing

The HDGASA one day INTRODUCTION TO HOT DIP GALVANIZING course is designed to provide an initial understanding of the concepts relating to hot dip galvanized coatings applied for corrosion control of steel components. The course comprises six modules. In order for the course to be viable we require six or more candidates to attend. Arrangements can also be made for this course to be held at a venue of your choosing for more than six candidates. In addition to the course, a special visit to a hot dip galvanizing plant may be arranged on a separate date, should six or more candidates be interested and able to attend.

Level II: Certified Galvanizing Inspectors

The HDGASA advanced Level II course provides the necessary skills to assess the quality and conformance of Hot Dip Galvanized coatings and Duplex Systems to the applicable specification. Delegates are introduced to other metallic type coating specifications and their application for corrosion control design.

The course provides an in-depth interpretation of the specifications and accepted best practice procedures for determining coating thickness, visual inspection of surface finishes as well as the evaluation of these coatings for corrosion control of steel components. The course includes a visit to a hot dip galvanizing plant where delegates will have an opportunity to assess finished product against the relevant quality standards on a real time first hand basis.

Three Continuous Professional Development (CPD) points are awarded to delegates attending the entire course. Bookings are limited to a maximum of 10 people, with applications treated on a first-come-first-serve basis. In order for the course to be viable we require 6 or more candidates to attend. Arrangements can also be made for the course to be held at a venue of your choice for more than 6 candidates.

ENROL IN A COURSE TODAY!
CALL 011 456 7960
EMAIL: hdgasa@icon.co.za

COURSES OFFERED

INCLUDES ELECTRONIC 'HDGASA INSPECTOR TOOLKIT'

HOT DIP GALVANIZERS ASSOCIATION SOUTHERN AFRICA

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.

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.

Armco Superlite is listed in accordance with the BSI ISO 9001:2015 quality scheme which ensures the quality of all products and services produced by **Armco Superlite**. Specific customer quality plans are drawn up where required for any of our operations.

Armco holds the SATAS mark for Hot Dipped Galvanized steel and all products galvanized at our premises are according to the SANS 121 / ISO 1461 specification. Galvanizing certificates are supplied on request.

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

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

Web. www.armco.co.za

ARMCO SUPERLITE

OBO Bettermann Group