# International Zinc Association

## *Life-cycle costing of protective coatings for steel*

# *Investing in the Future*

## *An IZA Market Development Project*

# The Concept of Life Cycle Costing

Life Cycle Costing (LCC) offers property owners a means of assessing the cost-effectiveness of alternative protective coatings for steelwork to be used in any new construction project over the design life of the structure. The two coatings that will usually be considered for protecting steelwork are:

- a paint system (primer plus one or more topcoats)
- hot dip galvanizing

This brochure introduces the concept of Life Cycle Costing while the CD Contains the model that is programmed to generate comparisons of painting and galvanizing costs, based on real-life data entered by the user. A current version of Microsoft Excel is required to run the model.

## First Cost vs Life Cycle Cost

Often during the course of a construction project, decisions on steel protection become secondary to other engineering issues. It can be tempting to take a minimum cost approach and deal with any later corrosion problems as maintenance expense as they arise. However, the true cost of protecting steelwork from corrosion requires a whole of life approach. Account needs to be taken, not only of the initial coating costs, but also of reasonably predictable future costs that are essential in maintaining coating integrity over the life of the project.

A lifetime approach is important because the cost of maintaining protective coatings will invariably be much higher than the initial coating cost.

## First Costs

First costs include materials and labour, as well as transport, inspection, repair of any damage during transport or erection and late delivery penalties.

## Lifetime Costs.

These will be determined by the number of times the coating requires maintenance during the structure's life and any contingent costs incurred as a result of replacement of corroded components or loss of production or use of the structure.

## Future Maintenance Costs.

Maintenance will usually incur costs associated with:

- mobilizing plant and labor.
- access to the structure (scaffolding)
- materials (abrasives, paint, etc).
- provision of services (compressed air, transport, accommodation).
- environmental and OH&S management (hazard containment)
- lost production from or use of the structure being maintained.

It is a fact that costs prevailing today will not be the same in the future. Maintenance costs will be impacted by inflation, which the LCC Model accommodates by expressing future costs in terms of their **Net Present Value (NPV)**. NPV involves the use of interest rates, inflation rates and taxation impacts, to test the benefit of spending less now on coatings (minimum first cost approach), against the cost of future maintenance.

In addition to inflation, it must be kept in mind that increasingly stringent environmental and occupational health and safety requirements will impact on the cost of materials, energy and labour, as well as the cost of containment and residue disposal.

*Larger hot dip galvanizing baths allow large structural fabrications such as this power pole to be coated quickly and cost effectively.*

# Hot Dip Galvanized Coatings .......

## Hot Dip galvanized coatings – why they are a lifetime investment

The process of hot dip galvanizing applies a metallic coating to chemically cleaned steel by dipping it in a bath of molten zinc at a temperature of approximately 450°C.

The process causes zinc to alloy with the steel to produce a protective coating for steel that is unique in the following ways:

1. The coating is metallurgically bonded to the steel and consists mainly of zinc-iron alloys.
2. These alloy layers are harder than mild steel and resist impact and abrasion.
3. All surfaces of the steel fabrication that come in contact with the molten zinc will be uniformly coated, inside and out, on edges and in cavities.
4. The coating is self-inspecting and will not form if the steel is not perfectly clean.

## Predictable life = predictable cost

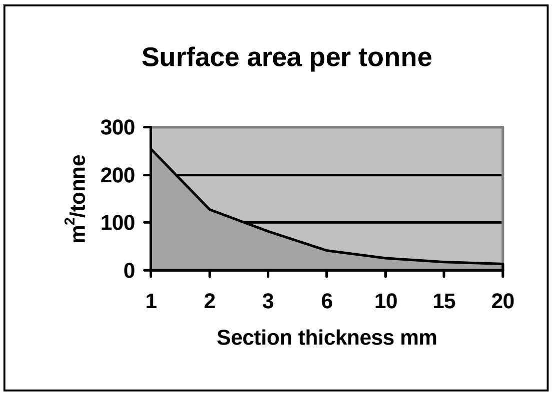
Hot dip galvanized coatings have a history of use exceeding 150 years. Their performance is well established in most of the world's atmospheric environments.

Galvanized coatings corrode at a MUCH SLOWER rate than steel (18 times and up to 80 times in aggressive environments). Except in the most aggressive marine conditions, hot dip galvanized coatings will last the design life of a structure without requiring any additional protective coating or touch-up maintenance during the life of the structure.

With galvanizing, the first cost is almost always the last cost of protecting exposed steelwork

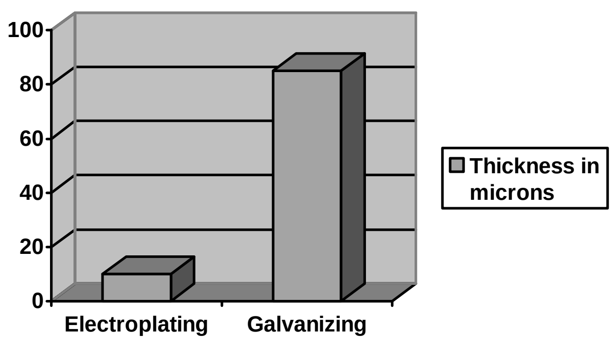
## First cost of galvanized coatings

Hot dip galvanized coatings are always quoted as a cost per tonne of steel, whereas paint coatings are usually costed by surface area (in square metres). Consequently, the cost of hot dip galvanizing is not directly proportional to the surface being treated, but rather to the total weight of steel involved.




## The importance of coating thickness

The life of a galvanized coating is proportional to its thickness. Thinner zinc coatings such as electroplating (sometimes referred to as electro-galvanizing or cold galvanizing) are not as durable as hot dip coatings, even though there is little difference in first cost.



# or ..........................Paint Coatings

## Coating Reliability

While hot dip galvanized coatings are factory-applied under controlled conditions, painting is a manual process that is labor intensive and dependent on operator skills.

Nevertheless, paint coatings offer the flexibility of application on-site as well as in a painting shop.

Also, a variety of paint systems is available from a simple ‘wire brush and primer’ to exotic paint systems applied over blast-cleaned surfaces.

However, this flexibility comes at a price. Paint application is restricted to external surfaces and uniformity becomes difficult with complex fabrications. Paint coatings are affected by temperature, humidity and condensation during application and are easily damaged during transport and erection.

Critical steps in applying both paint and galvanized coatings are compared in the table below.

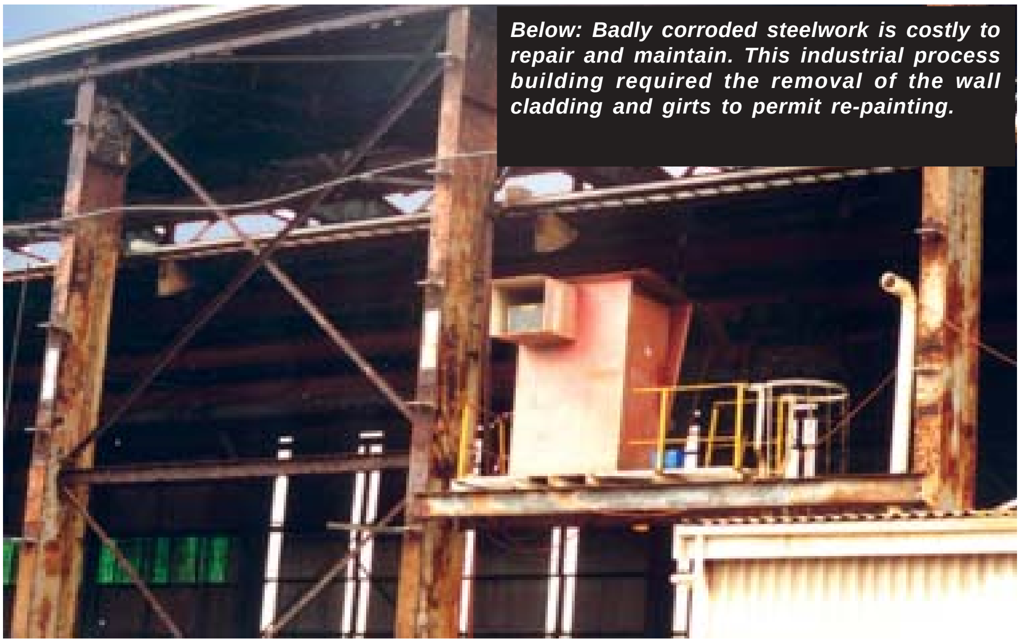
| Process | Paint | Galvanizing |
|---|---|---|
| Surface preparation | M | P |
| Prime | M | N/A |
| Cure primer | M | N/A |
| Topcoat 1 | M | N/A |
| Cure topcoat 1 | M | N/A |
| Topcoat 2 | M | P |
| Cure topcoat 2 | M | N/A |
| Load and transport | M | N/A |

*M = Manual P = Process N/A = Not applicable*

In addition, a number of other process and environmental factors are critical in determining coating reliability.

| Factor | Paint | Galvanizing |
|---|---|---|
| Temperature | I | N/A |
| Dew Point | C | N/A |
| Shelf life | I | N/A |
| Mixing – 2 pack | C | N/A |
| Weather – Rain, wind | I | N/A |
| Time between processes | C | N/A |
| Humidity | I | N/A |
| Coating thickness | M | P |
| Shape of item* | I | N/A |
| Operator skill | M | P |

*I = Important C = Critical M = Manual P = Process*
*N/A = Not Applicable*



*Below: Badly corroded steelwork is costly to repair and maintain. This industrial process building required the removal of the wall cladding and girts to permit re-painting.*

# Life-cycle Costing - Practical Application in the Real World

## Case Study - Queens Wharf Tower

Queens Wharf Tower was built in 1988 as part of a tourism development project, in Newcastle, on the east coast of Australia.

The steel tower contains approximately 120 tonnes of structural steel and tubular façade panels.


*The Queens Wharf Tower*

*The tower painting contractor used a complete containment system during the re-painting operation*

The steelwork on the tower was required to be painted for aesthetic reasons. A price of $A850/tonne (approximately $A102,000) was submitted for galvanizing and painting the structure. This was rejected in favor of paint-only at a cost of $A450/tonne – an apparent saving of $A48,000. Queens Wharf tower is located in a marine environment on a major harbor and less than 1 km from the Pacific Ocean surf.

By 1995, only seven years after construction, the paint coating on the tower had deteriorated badly and after evaluating the remediation requirements, a contract was let in 1999 to repaint the tower.

As containment systems had to be used, the Queens Wharf Tower was shut to public use for a period of approximately 6 months in 2000 for coating repairs. The final repair cost was $A425,000.

Adjacent to the tower are a number of hot-dip galvanized structures, installed in 1983. These are all still in excellent condition and have an estimated remaining maintenance free life of 50 years.

Use of the Life Cycle Costing Model included with this brochure would have helped to avoid such costly maintenance painting and would have shown that galvanizing in the first place, even with the additional cost of painting over the galvanizing for architectural reasons, provided the most cost-effective answer to protecting the steel tower from corrosion.

*Almost all areas of the Queens Wharf Tower suffered similar corrosion within 6 years of installation*

*Hot dip galvanized catenary masts are 50 metres from Queens Wharf and were galvanized in 1983. Thickness tests of the galvanized coating in 2003 indicate a remaining life of at least 50 years.*

# International Zinc Association

The International Zinc Association (IZA) was estsblished in 1990 as the peak organisation for the zinc industry internationally and its membership represents 60% of world mine production and 70% of world smelter production of zinc.

The strategic focus of the IZA includes:

- Market development
- Environmental issues
- Education/image/information
- Zinc and health
- Sustainable development

In 1996, the IZA commenced an active market development program through a network of members and affiliates in Europe, North America, Asia/Pacific, Latin America, India and Southern Africa.

Cooperative market research and development with the auto industry and the hot dip galvanizing industry has led to greater usage of zinc and zinc coated steel in automobiles in the first instance, and to an increase in the hot dip galvanizing industry's share of the total steel coating market.

The IZA's target in its first five-year marketing plan of increasing zinc usage over normal growth levels by 500,000 tonnes per year has been achieved.

This IZA initiative, of developing a life cycle costing model for protective coatings for steel, is aimed at helping specifiers, property owners and public authorities understand the cost benefits of galvanized coatings compared to alternative methods of steel protection.

In South East Asia alone (excluding China), the potential exists to hot dip galvanize another 1,000,000 tonnes of steel per year if hot dip galvanizing was selected over cheaper coatings that do not offer the same life cycle benefits.

**Countries where IZA has Market Development Projects**

## CONTACT IZA

IZA has a wide range of services and resources available to support the development of zinc usage and understanding, globally.

A number of publications are available covering the use of zinc-based coatings for steel protection, zinc and health and zinc and the environment.

In addition, the IZA has a comprehensive internet site (**www.zincworld.com**) designed to provide an information hub for those seeking knowledge of zinc and its applications.

Enquiries for publications and other information can be made through the IZA internet site, or by contacting:

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