ZAC

North American Performance Validation

For

AESTHETICS

and

DURABILITY

the choice for buildings is

PREPAINTED 55% Al-Zn COATED STEEL

55% Al-Zn

THE MAGIC FORMULA

FOR METAL BUILDINGS

55% Al-Zn
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The range of metallic and non-metallic materials for building construction is so broad that choosing the right materials can become confusing. By selecting ***modern coated steels***, you can avoid these headaches because ***modern coated steels*** are ***engineered materials*** with the optimum combination of **S•A•F•E** attributes — predictable **S**trength, unique **A**ffordability, premier eco-**F**riendly credentials and **E**nduring performance.*

The durability of ***modern coated steels*** is the result of the corrosion protection that the metallic coating provides to the steel. The most familiar example of coated steels is hot-dip galvanized steels whose zinc coating protects the steel from corrosion and gives many years of useful life, which in most cases far exceeds that of conventional non-metallic materials. Newer, more advanced coatings such as 55% Al-Zn coated steels provide for even longer service life and extend the durability of ***modern coated steels.***

In North America, Europe and Africa, it's generally known as Galvalume®, Aluzinc®, Z-Nal®, Zintro-Alum® or Galval® and other internationally recognized trademarks. But whatever the name, one thing is certain: 55% Al-Zn is the ***Magic Formula*** for guaranteeing the long-term durability of prepainted metal buildings. Even in the most aggressive acid rain environments, the 55 % Al-Zn coating continues to provide protection long after the corrosion protection of ordinary zinc coatings has been exhausted. This means that the 55% Al-Zn coating will provide a minimum of twice the expected life as hot-dip galvanized coatings of the same coating thickness.

It's no surprise, then, that 55% Al-Zn coated steels are the fastest-growing coatings in the construction market. The technology to make these advanced coatings is licensed by BIEC International Inc. to manufacturers in more than 28 countries on six continents. The exponential growth of these coated steels has seen more than 45 million tons produced in the last ten years, and with licensees and the aggressive substitution of these products for other materials with inferior **S•A•F•E** attributes, it is predicted that the cumulative global production of 55% Al-Zn coated steels will exceed 100 million tons by the end of the decade. One of the fastest growing application segments for 55% Al-Zn coated steels is in prepainted products. It is becoming increasingly clear that the performance advantages of prepainted 55% Al-Zn coatings far exceed those of other roofing materials. Thus, 55% Al-Zn is the ***Magic Formula*** for metal buildings.

This report covers surveys of established metal buildings utilizing both prepainted 55% Al-Zn coated, and prepainted hot-dip galvanized, steels in the most aggressive acid rain zones of North America.

* *A recent survey by Ducker International identified service life/longevity and life cycle costs as the most important criteria in the selection of roofing systems and indicated that the metal industry was ideally positioned based on current solutions and offerings.*

Galvalume®, Aluzinc®, Z-Nal®, Zintro-Alum®, and Galval® are internationally recognized and registered trademarks of BIEC International Inc. or one of its licensed producers.

SUMMARY OF FINDINGS

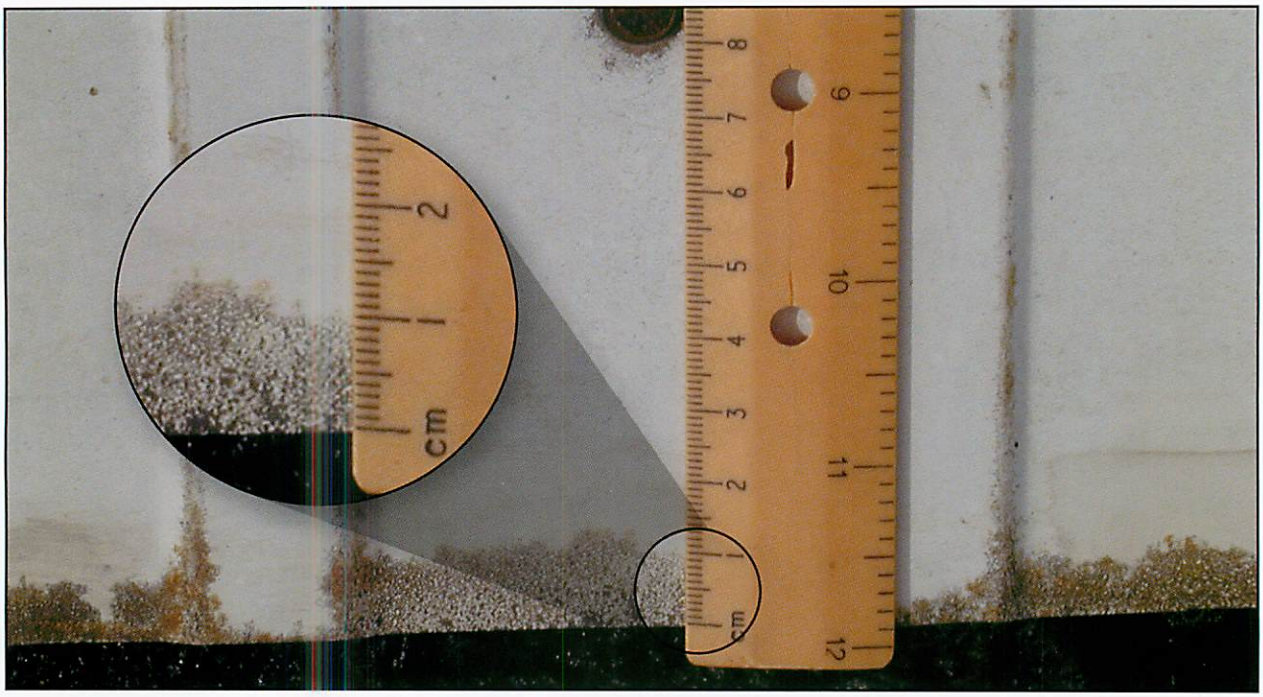
- Different areas of a building panel will deteriorate at different rates depending on (a) the amount of strain experienced by the metal in forming the panel and (b) the time of wetness experienced by the panel during use. In areas of high strain, such as at minor ribs, crazing of the paint film and cracking of the underlying metallic coating allow corrosion to initiate. The most aggressive corrosion is observed at drip edges where the increased times of wetness mean that corrosion agents are present for longer periods of time. In other areas, with lower strains and/or reduced times of wetness, corrosion continues to occur but usually at a much slower rate. In these locations, material performance differences are not as noticeable and extended exposure times are needed before the superior durability of 55% Al-Zn coated steels becomes evident.

- On initial exposure, the rate of deterioration at the panel sites subjected to the most aggressive corrosion – the drip edge – can be marginally lower for prepainted hot-dip galvanized steels than it is with the more advanced prepainted 55% Al-Zn coated steels. This behavior will persist for a period of time that depends on a number of factors, such as the specifics of the environment and the metallic coating weight; typically it lasts 5 to 7 years. However, it is not sustained and after about 10 years, neglible performance differences exist. Extended exposures, beyond 10 years, increasingly show the enhanced durability of 55% Al-Zn coated steels, with the rate of deterioration of the prepainted hot-dip galvanized substrates being more than twice that of prepainted 55% Al-Zn steel substrates. This classical performance 'cross-over' effect in the corrosion performance at the most corrosion-prone panel areas has been observed in many studies throughout the world. In less corrosion-prone areas, the performance differences between the coated steels are negligible and the overall performance improvements of 55% Al-Zn coated steels are evident from the initial exposure.

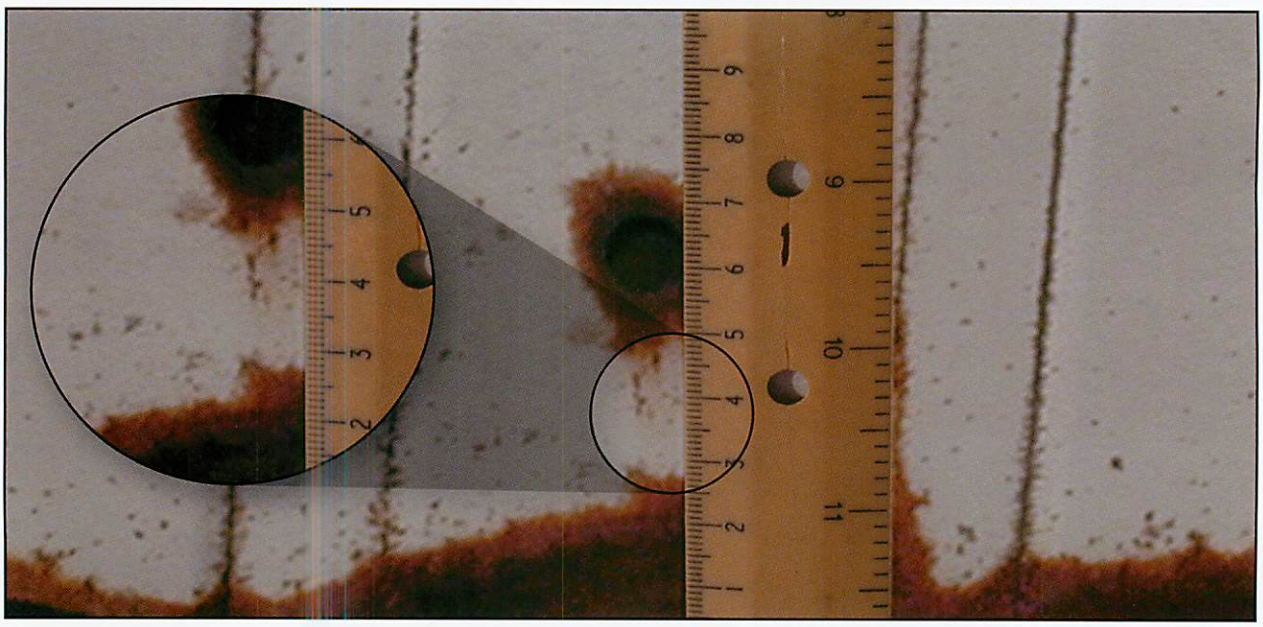
- When the metallic coating and the steel substrate in hot-dip galvanized steel are exposed to corrosion agents, either through coating cracks or at cut edges, the zinc preferentially corrodes to sacrificially protect the steel substrate. This anodic dissolution of the zinc occurs quite rapidly. When all of the zinc has been consumed, the steel will rust and eventually perforate. The appearance of red rust signifies that the zinc coating has exhausted all ability to protect the steel from further corrosion. For 55% Al-Zn coatings, the zinc reservoir is smaller so that the initial sacrificial protection provided to the steel is not as effective. But, the aluminum in the 55% Al-Zn coating significantly modifies the corrosion process because, in this case, the corrosion products are insoluble and restrict access of the corrosion agents to the steel, with the result that the corrosion rate is reduced from the higher initial rate.

- These field surveys have consistently confirmed that for long-term durability, 55% Al-Zn coated steel is a superior substrate for prepainted applications than hot-dip galvanized steel. While the prepaint coating provides the aesthetics, it is the choice of substrate that defines the overall product life. For both aesthetics and long-term durability, 55% Al-Zn coated steels is the superior choice of substrate for prepainted applications.

At the drip edge, the increased time of wetness produces the most aggressive corrosion — 55% Al-Zn coatings enhance the long term durability of prepainted steels



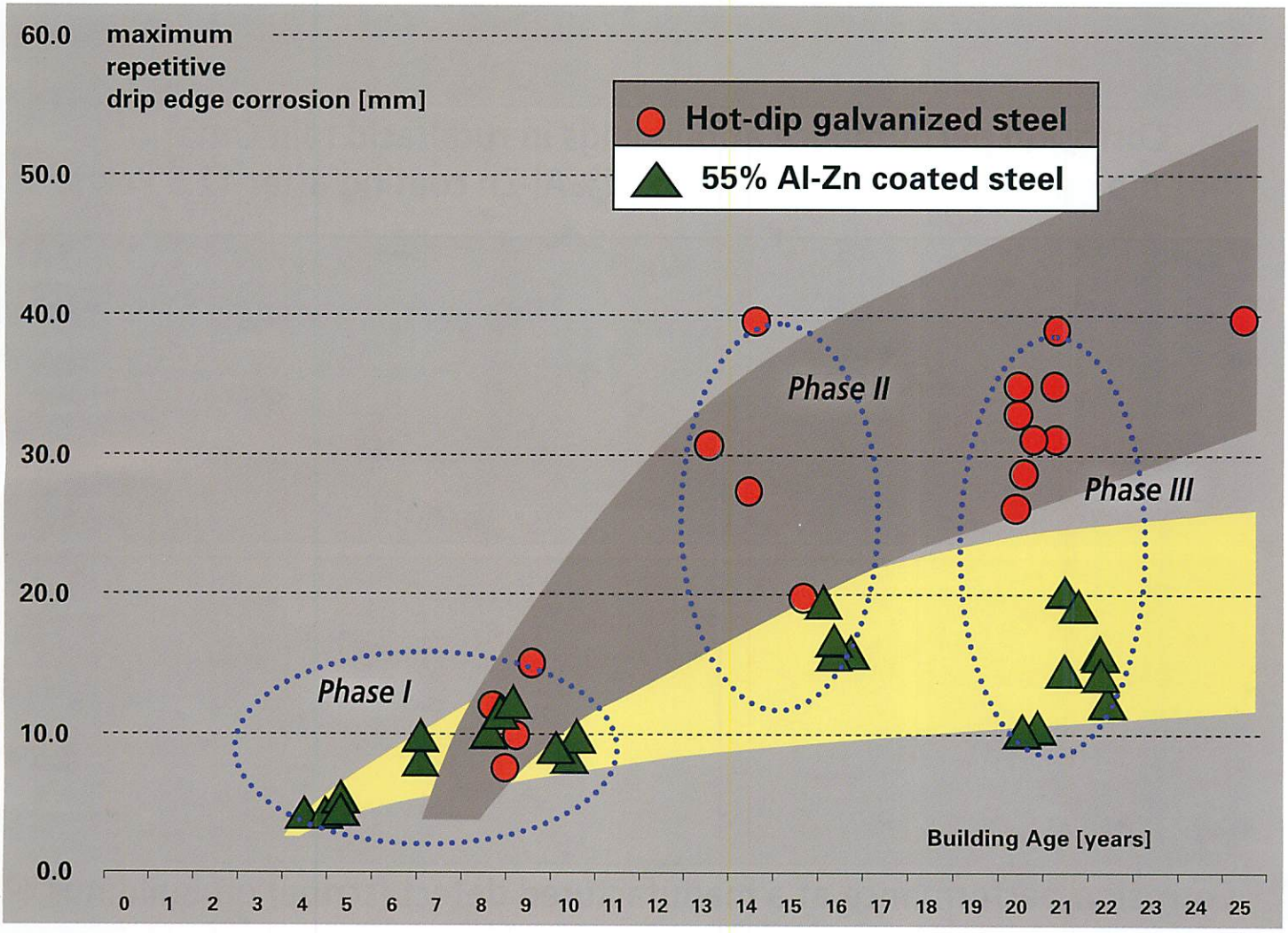
Drip edge of a prepainted GALVALUME roof on a 20-year old building in an acid rain environment, Pennsylvania, U.S.A.



Drip edge of a prepainted galvanized steel roof on a 21-year old building in an acid rain environment, Pennsylvania, U.S.A.

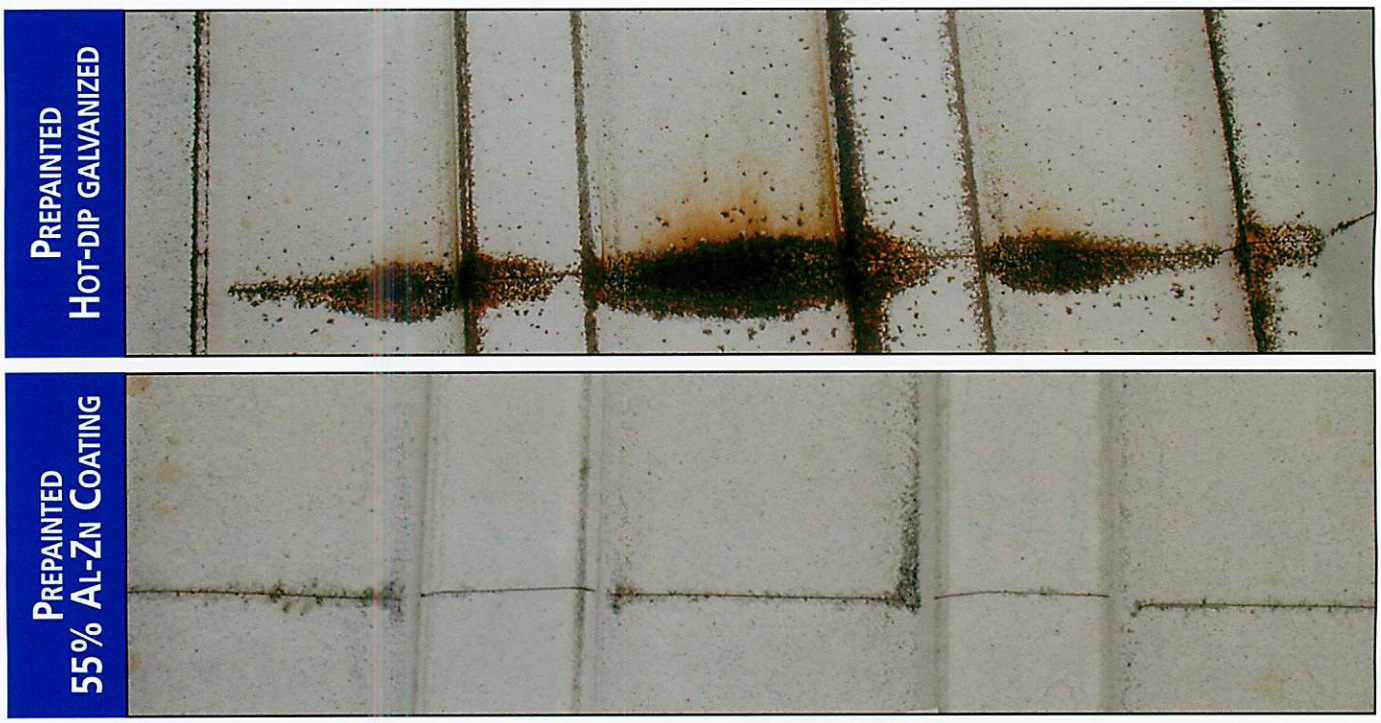
In depth evaluations of buildings with ages from 5 years to more than 25 years, located in the most acid rain prone areas of North America, confirm three phases of relative performances of prepainted 55% Al-Zn coated steel and prepainted hot-dip galvanized steel in the most severe corrosion-prone area of the roof — the drip edge.

- ***In Phase I,*** which lasts for about 10 years the relative corrosion performance is similar; zinc's initially more effective sacrificial protection is not sustained and at the end of this phase, there is no difference in relative performance.
- ***In Phase II,*** from 10 to 15 years of life – beyond the useful life of many competitive non metallic materials – the combination of barrier and sacrificial protection of 55% Al-Zn coatings begins to outperform the sacrificial corrosion protection mechanism of hot-dip galvanized steels.
- ***In Phase III,*** which is the period in excess of 15 years, the enhanced durability of prepainted 55% Al-Zn coated steels is increasingly evident and the rate of corrosion is less than half the rate of prepainted hot-dip galvanized steel.



To resist corrosion initiated at panel bends and damage sites, 55% Al–Zn coated steel is a better choice of substrate for prepainting

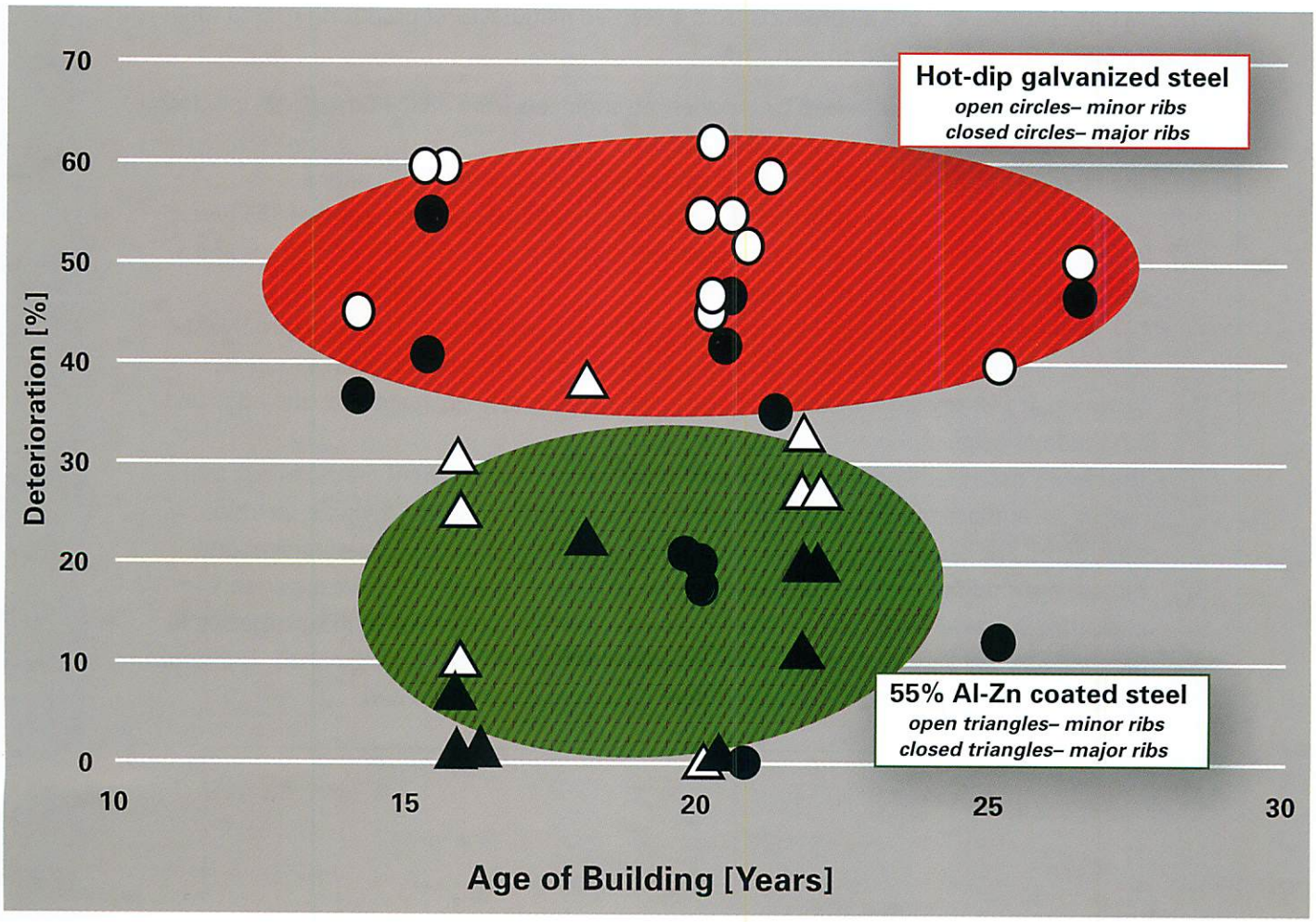
Corrosion performance at buildings in rural/acid rain Ontario: hot-dip galvanized after 21 years; 55%Al-Zn coating after 17.5 years.



Corrosion performance at a manufactured defect (scribe) on buildings in heavy industrial Ontario after 20 years exposure.

The choice of substrates for the prepaint system has a major influence on the corrosion durability of bends in the panel.

Long-term evaluations confirm that 55% Al-Zn coated steels outperform hot-dip galvanized at panel bends. At the more heavily-strained minor ribs, the performance differences are even more evident with the hot-dip galvanized performance deteriorating more than twice as fast as 55% Al-Zn coatings after 15 to 20 years exposure.



During roll forming, the major ribs are formed first and serve as locking points for the subsequent forming that produces the minor ribs. The minor bends are therefore more highly strained and can cause the paint and the metallic coatings to crack. When the zinc's galvanic protection has been depleted, the prepainted hot-dip galvanized steel begins to quickly corrode and the appearance of red rust at the bends indicates the corrosion protection from the zinc has been exhausted. In contrast, the corrosion products of the coating of 55% Al-Zn inhibit further corrosion and extend the useful life of the building.

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The North American field inspection surveys covered in this paper were carried out in 2004 and 2005. They confirm the results of controlled long-term outdoor evaluations of test coupons — in aggressive acid rain environments, the long-term durability of prepainted 55% Al-Zn coated steels is superior to that of prepainted hot-dip galvanized steels and other roofing materials. These steels are marketed in North America, Europe and Africa under a variety of brand names, including GALVALUME, ALUZINC, Z-NAL, ZINTRO-ALUM, GALVAL, etc. but all products from a licensed manufacturer producing coated steels with 55% Al-Zn ***Magic Formula*** will perform similarly.

- The inspections were performed by experienced engineers from BIEC International Inc. and from manufacturing licensees in North America.
- The buildings inspected used 55% Al-Zn coated steels designated AZ50, with a nominal coating thickness of 20 µm [0.0008 in] and a nominal coating weight of 150 g/sq.m [0.50 oz./sq.ft]. The G90 hot-dip galvanized coating had the same nominal thickness and a coating weight of 275 g/sq.m [0.9 oz./sq.ft].
- The inspectors noted the age, location, slope, general appearance and local environmental conditions of the buildings, in addition to measuring both the visibility and severity of corrosion at five key component locations – flat panel, major rib, minor rib, drip edge and longitudinal edge.
- The results described in this paper are based on the use of a consistent methodology that rapidly determines the overall performance of the coated steels from a visible corrosion standpoint. The results are based on close visual examination, careful measurement and subsequent study of photographic evidence by professionals with extensive experience in evaluating material performance. The results represent the performance to be expected in the field and will vary with exposure environment and specific paint system used. The results reported in this paper are, therefore, neither guaranteed nor warranted.

ZAC

55% Al-Zn Coated Sheet Producers of North America, Europe and Africa

For more information and details of manufacturers and sales agencies,
visit www.steelroofing.com or www.roofsteel.com

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