American Iron and Steel Institute

DESIGN GUIDE 4

Durability of Cold-Formed Steel Framing Members

Second Edition, September 2004

Steel Framing Alliance™

Steel. The Better Builder.

DURABILITY OF COLD-FORMED STEEL FRAMING MEMBERS

September 2004

Published by the
Steel Framing Alliance™
Steel. The Better Builder.

DISCLAIMER

The material contained herein has been developed by the American Iron and Steel Institute. Diligent effort has been made to present accurate, reliable, and useful information on cold-formed steel framing design and installation. AISI acknowledges and is grateful for the contributions of the numerous researchers, engineers, and others who have contributed to the body of knowledge on the subject. Specific references are included in the document.

With anticipated improvements in understanding of the behavior of cold-formed steel framing and the continuing development of new technology, this material may eventually become dated. It is anticipated that AISI will publish updates of this material as new information becomes available, but this cannot be guaranteed.

The materials set forth herein are for general purposes only. They are not a substitute for competent professional advice. Application of this information to a specific project should be reviewed by a design professional. Indeed, in many jurisdictions, such review is required by law. Anyone making use of the information set forth herein does so at their own risk and assumes any and all liability arising therefrom.

PREFACE

This publication was developed by the American Iron and Steel Institute and is intended to provide designers with guidance in selecting coated steels and enhancing durability in commercial and residential buildings that utilize cold-formed steel framing members. AISI believes the information contained in this publication substantially represents industry practice and related scientific and technical information; however, the information herein is not intended to represent an official position of AISI or to restrict or exclude any other construction or design technique.

AISI acknowledges Douglas J. Rourke and X. Gregory Zhang as the primary authors of the first edition of this document, dated 1996. AISI is grateful to the following members of the Corrosion and Durability Task Group, a joint effort of the AISI Committee on Framing Standards and Light Gauge Steel Engineers Association, who helped develop this second edition.

Mark Crawford, S.E.	Simpson Strong-Tie
Nader Elhajj, P.E.	NAHB Research Center
Frank E. Goodwin, Sc.D.	International Lead Zinc Research Organization
Greg Greenlee	USP Structural Connectors
Jay Larson, P.E.	American Iron and Steel Institute
Howard Lau, P.E.	Shigemura, Lau, Sakanashi, Higuchi & Assoc.
Richard Layding, P.E.	NUCONSTEEL
Gary Rolih	SENCO Fastening Systems
Marge Spencer	Compass International
Al Toback	Loctite
Akira Usami	Dietrich Industries
X. Gregory Zhang	Teck Cominco Metals Limited

AISI also wishes to express their appreciation for the support of the Steel Framing Alliance and the American Zinc Association.

DURABILITY OF COLD-FORMED STEEL FRAMING MEMBERS

The purpose of this document is to give engineers, architects, builders and homeowners a better understanding of how galvanizing (zinc and zinc-alloy coatings) provides long-term corrosion protection to cold-formed steel framing members. This document also suggests guidelines for selecting, handling and using these steels in framing applications.

1.0 Design Life

The home is one of the few necessities that consumers expect to last a lifetime or more. For commercial property owners, each structure represents a significant investment. It is critical therefore, that a the framing material performs its function for as long as other critical components, such as the roofing, exterior and interior wall coverings, and flooring. For sufficient longevity, cold-formed steel framing needs proper corrosion protection.

Galvanizing has proven to be the most economical and effective way to protect steel. All steel framing materials used in residential and light commercial construction can be effectively protected by a galvanized coating.

2.0 Galvanizing

2.1 Definition

Galvanizing is a process whereby steel is immersed into a bath of molten zinc (850°F/450°C) to form a metallurgically bonded zinc coating. This same hot- dip immersion process is also used to produce zinc-aluminum alloy coatings.

Most cold-formed steel is galvanized by unwinding coils of cold-rolled steel and feeding the sheet continuously through a molten zinc bath at speeds up to 600 feet per minute (200 meters/minute). As the steel exits the molten zinc bath, air "knives" blow off the excess coating from the steel sheet and control the coating thickness to the specification requirement. The coated sheet steel is passivated, oiled and recoiled for shipment to the fabricator (Townsend, 1995).

2.2 Types of Coatings

The continuous galvanizing process can apply a number of different coatings that vary in thickness, appearance and alloy composition.

- Galvanized: The name, galvanized, usually refers to the "standard" continuous coating that is basically pure zinc. About 0.2% aluminum is added to the galvanizing bath to form a thin, inhibiting, iron-aluminum layer on the steel surface that ensures formation of a pure zinc coating. The finished coating has good formability and corrosion resistance, and provides excellent sacrificial protection (Section 4.2).
- Galfan®: Galfan® is a 95% zinc - 5% aluminum/mischmetal coating. Galfan® is known for its improved corrosion resistance compared to galvanized.
- Galvalume®: Galvalume® is a 55% aluminum, 1.5% silicon and 43.5% zinc alloy coating. Galvalume® provides superior barrier corrosion resistance over galvanized coatings.

2.3 Types of Surface Finishes

Zinc and zinc-alloy coatings can differ in appearance based on the size of spangle or type of surface finish. Spangle is the flowery pattern that results as molten zinc grains grow and are then frozen in place as the coating solidifies. Spangle size can be controlled or eliminated by various processing techniques. The presence or absence of spangle has no influence on corrosion performance or other engineering properties of the coating.

2.4 Coating Weights and Thicknesses

The galvanizer controls how much coating is put on the steel. The amount of coating put on the steel is measured by coating weight (ounces per sq. foot, grams per sq. meter) or by thickness (mils, microns). Table 2.1 lists various commercially available continuously galvanized coatings.

Table 2.2 lists the minimum coating requirements for structural and non-structural framing members, as prescribed by ASTM A1003 *Standard Specification for Sheet Steel, Carbon, Metallic and Non-Metallic Coated for Cold-Formed Framing Members*. For further details on coating specifications, refer to ASTM A653 (Galvanized), A792 (Galvalume®) and A875 (Galfan®). Coating requirements for framing members also appear in ASTM C 645 and C 955.

A heavier coating may be advisable in applications where the environment is particularly corrosive. Section 3 contains more information on the performance of zinc coatings in various environments and identifies areas where additional protection may be required.

3.0 Durability of Galvanized Steel Framing

The durability of zinc-based coatings is a function of time of wetness and composition of the atmosphere (refer to section 4 for details). Since residential galvanized steel framing is intended for dry indoor environments, the corrosion rate of zinc should be very low. According to the corrosion rates in section 3.1 and the minimum coating thicknesses specified in Table 2.2, zinc-based coatings can easily protect steel for the design life of the structure.

Just as water leakage, excessive humidity or condensation will damage any construction material over time, so will it accelerate the corrosion of zinc coatings. However, if a building is built to code and properly ventilated and maintained, moisture should not be a concern for galvanized steel framing.

Additional corrosion protection is recommended for structures built in particularly aggressive environments; i.e., humid coastal areas (LGSEA, 2003).

3.1 Performance in Structures

The corrosion rate of zinc coatings in an indoor atmosphere of a residential house is generally very low. According to a three-year British Steel study (John, 1991), the corrosion of zinc is lower than 0.1 µm per three-year period in houses located in different rural, urban, marine and industrial atmospheres (Figure 3.1). This indicates that under similar conditions a 10-µm zinc coating should last for more than 300 years. This coating thickness is similar to a G40/Z120 coating (10 m = 0.39 mils).

According to a recent five-year study by the National Association of Home Builders Research Center (ILZRO, 2003), where corrosion test samples were installed and monitored in the exterior walls and ventilated crawl and attic spaces of four houses located in different geographic locations (inland, marine and industrial) in North America, the life expectancy of the coating is estimated to range from 220 to over 1,100 years with an average of 650 years for all samples at all locations (Appendix A).

Additionally, a survey was performed in May 1995 on a 20-year-old steel-framed house in Stoney Creek, Ontario (DeMeo, 1995). The inspection revealed no visible signs of corrosion of the zinc coating or the steel studs. Coating thickness measurements taken on exterior and interior studs showed no measurable loss in coating thickness.

3.2 Interior Walls

Interior, non-load bearing walls will likely experience the most benign atmosphere in the home. It is unlikely that these steel members will be subject to moisture on a regular basis and the coatings specified in Table 2.2 should give adequate protection.

Venting of rooms that generate considerable amounts of moisture (i.e., bathroom, kitchen) should be to the outside, not into wall or ceiling cavities.

3.3 Exterior Walls

Proper building practices that include vapor barriers and

Table 2.1 Zinc Coating Weights (Mass) / Thickness

Coating Designation	Minimum Requirement Total Both Sides		Thickness Nominal per Side	
	(oz/ft²)	(g/m²)	(mils)	(microns)
Galvanized				
G40/Z120	0.40	120	0.34	8.5
G60/Z180	0.60	180	0.51	12.7
G90/Z275	0.90	275	0.77	19.4
Galfan®				
GF45/ZGF135	0.45	135	0.39	9.8
GF60/ZGF180	0.60	180	0.53	13.3
GF90/ZGF275	0.90	275	0.79	19.8
Galvalume®				
AZ50/AZ150	0.50	150	0.80	20.0

Table 2.2: ASTM A 1003 Coating Weight Requirements

Framing Member Designation	Minimum Coating Designations		
	A 653/A 653M	A 792/ A 792M	A 875/875M
Structural	G60/Z180	AZ50/AZ150	GF30/ZGF90
Non-Structural	G40/Z120	AZ50/AZ150	GF30/ZGF90

thermal breaks should eliminate any significant moisture exposure to exterior wall framing. Poorly constructed walls could result in some moisture condensation. Galvanizing provides protection to the steel in this situation, but moisture cannot be allowed to collect.

Particular attention should be paid to the bottom track of exterior walls that may collect moisture during erection or during the service life of the wall. A vapor barrier or sill gasket should also be installed between the track and the foundation to prevent underside corrosion in the event that the concrete substrate gets wet.

For most applications, the minimum coatings specified in Table 2.2 should be adequate. Heavier coatings may be considered for aggressive industrial and coastal environments (LGSEA, 2003).

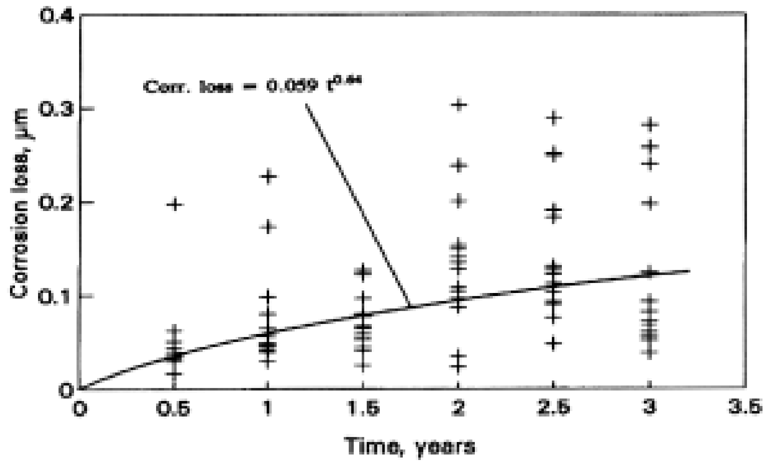


Figure 3.1
Corrosion loss of galvanized steel, exposed in the loft of 15 residential houses located in three different geographical areas in England, UK, as a function of exposure time (John, 1991). The data points are the mean values of six samples for each house; the equation in the figure is the best fit from linear regression analysis.

3.4 Floor Joists and Roof Trusses

Second story floor joists as well as joists over enclosed basements are not likely to be exposed to aggressive conditions. For joist tracks that attach directly to concrete or exterior walls, precautions should be taken so that the environment remains dry and that a vapor barrier is installed between the joist track and concrete wall.

Floor joists installed in basements and crawl spaces not having a slab can be exposed to the outside environment. In these cases, greater corrosion protection is recommended due to the likelihood of exposure to extended periods of high humidity.

Even with normal ventilation, roof trusses are still generally more exposed to the surrounding environment than other areas of the house. This may be a concern in aggressive industrial or marine environments (LGSEA, 2003). A prolonged roof leak may cause localized corrosion of the affected roof truss.

4.0 Corrosion Properties of Zinc

It is well known that steel rusts when left unprotected in almost any environment. Applying a thin coating of zinc to steel is an effective and economical way to protect steel from corrosion. Zinc coatings protect steel by providing a physical barrier as well as cathodic protection to the underlying steel.

4.1 Barrier Protection

The main mechanism by which galvanized coatings protect steel is by providing an impervious barrier that does not allow moisture to contact the steel. Without moisture (the electrolyte) there is no corrosion. The nature of the galvanizing process ensures that the metallic zinc coating has excellent coating adhesion and abrasion resistance.

Galvanized coatings will not degrade over time as with other barrier coatings such as paint. However, zinc is a reactive material and will corrode slowly over time (Figure 3.1). For this reason, the protection offered by galvanized coatings is proportional to the coating thickness.

4.2 Cathodic Protection

Another important protection mechanism is zinc's ability to galvanically protect steel. When base steel is exposed, such as at a cut or scratch, the steel is cathodically protected by the sacrificial corrosion of the zinc coating adjacent to the steel. This occurs because zinc is more electronegative (more reactive) than steel in the galvanic series as shown in Table 4.1.

In practice, this means that a zinc coating will not be undercut by rusting steel (Figure 4.1) because the steel cannot corrode adjacent to the zinc coating. The exposure of the underlying steel caused by coating damage or at a cut edge, will not result in corrosion of the steel and thus will not affect the performance of the coating or the steel structure (Zhang, 2005).

4.3 Corrosion Process

The ability of a zinc coating to protect steel depends on zinc's corrosion rate. It is therefore important to under-

Table 4.1: **Galvanic Series of Metals and Alloys**

Corroded End - Anodic
(Electronegative)

Magnesium
Zinc
Aluminum
Cadmium
Iron or Steel
Stainless Steels (active)
Lead
Tin
Copper
Gold

Protected End - Cathodic or most noble
(Electropositive)

Note: Any one of these metals and alloys will theoretically corrode while protecting any other that is lower in the series as long as both form part of an electric circuit.

stand zinc's corrosion mechanism and what factors affect zinc's corrosion rate.

Freshly exposed galvanized steel reacts with the surrounding atmosphere to form a series of zinc corrosion products. In air, newly exposed zinc reacts with oxygen to form a very thin zinc oxide layer. When moisture is present, zinc reacts with water resulting in the formation of zinc hydroxide. A final common corrosion product to form is zinc carbonate as zinc hydroxide reacts with carbon dioxide in the air. Other zinc compounds containing sulfate or chloride can also be present in the corrosion products formed in industrial or marine environments. The zinc corrosion products formed in atmospheric environments are usually a thin, tenacious and stable layer that provides protection to the underlying zinc. These corrosion products are what give zinc its low corrosion rate in most environments.

Zinc corrosion rates correlate with two major factors: time of wetness, and concentration of air pollutants (Zhang, 1996). Corrosion only occurs when the surface is wet. The effect of wetting on zinc's corrosion rate depends on the type of moisture. For example, while the moisture from rainfall may wash away zinc's corrosion products, that formed by condensation usually can evaporate and leave the corrosion products in place. Since residential steel framing should be dry almost all the time, zinc's corrosion rate will be very low.

The pH of the atmosphere, rain or other liquids that contact zinc have a significant effect on corrosion rate. Moderately acidic conditions or fairly strong basic conditions may increase zinc's corrosion rate. Most industrial atmospheres contain sulfur in the form of sulfur dioxide and sulfuric acid, which are corrosive to zinc.

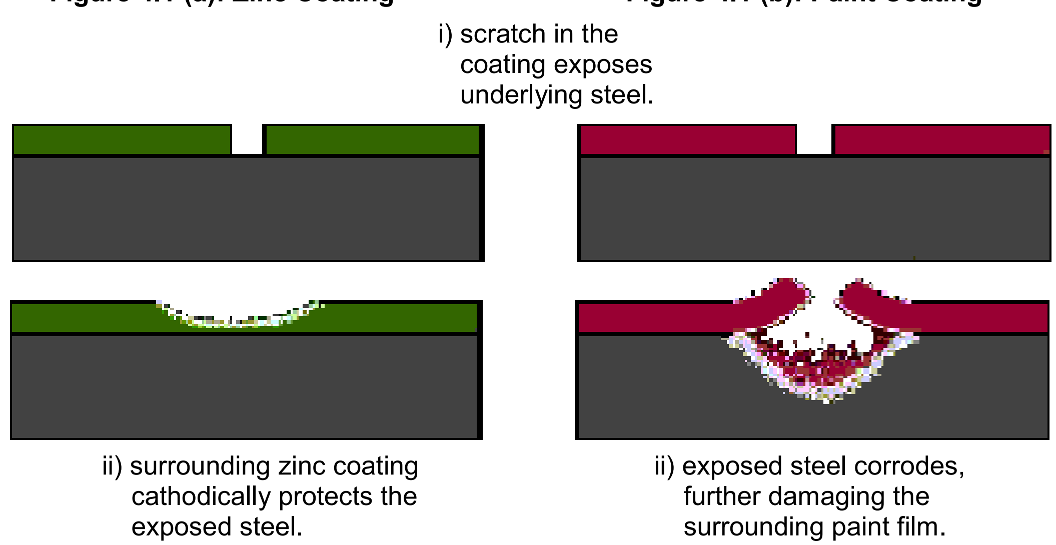
Chloride environments (i.e., marine) have a lesser effect on zinc's corrosion rate than sulfur compounds. Nevertheless, because chlorides can be prevalent in coastal environments, chlorides may likely be of concern necessitating extra corrosion protection.

4.4 Wet Storage Stain

"Wet Storage Stain" is a term traditionally used in the galvanizing industry to describe the white zinc corrosion product that sometimes forms on the galvanized steel surfaces during storage and transport.

When freshly galvanized steel is stored or installed with moisture trapped behind contacting surfaces and access

Figure 4.1 (a): Zinc Coating **Figure 4.1 (b): Paint Coating**



to free-flowing air is restricted, zinc hydroxide may form. This is a voluminous, white, non-protective corrosion product. Zinc hydroxide can form during a single incident of wetting, by rain or condensation; however, once the affected areas are exposed and allowed to dry, it generally has little harmful effect on the long-term performance of galvanized steel. If the damp, restrictive conditions continue, then zinc corrosion may proceed rapidly down to the base steel. Most galvanized sheet products receive some form of surface treatment to help prevent the formation of wet storage stain.

4.5 Contact with Non-Metallic Materials:

- Mortar and Plaster: Damp, freshly prepared mortar and plaster may attack zinc and zinc-alloy coatings, but corrosion ceases when the materials become dry. Since these materials absorb moisture, care should be taken to either keep them dry or isolate the steel framing from the plaster or mortar.
- Wood: Galvanized steel does not react with dry wood. Galvanized steel can be safely fastened to dry or most moderately damp woods. Galvanized nails and screws have been used successfully to join wood for years.
- Pressure-Treated Wood: There are a variety of chemicals used to pressure-treat wood to help protect the components from attack by termites, other insects, and fungal decay. Recent testing has indicated that ACQ, CBA-A, CA-B and ACZA, i.e., the new generation copper-based products, are more corrosive to galvanized steel than the former CCA, which was voluntarily withdrawn from the market for many applications in 2003. Viable options for cold-formed steel framing that should be considered would seem to include specifying the less-corrosive sodium borate pressure treatment, isolating the steel and wood components, or avoiding use of pressure-treated wood (SFA, 2004).
- Dry-wall and Insulation Products: Dry-wall and various dry insulating products (mineral wool, cellulose and rigid foam) do not react with galvanized steel.
- Concrete: Freshly poured concrete may react with galvanized coatings because it is wet and highly alkaline (pH 12 to 13). However, as the concrete cures and dries, it becomes non-aggressive to these coatings. Since curing times are relatively short, the corrosion of the coating is minimal. Good-quality concrete that is free of chlorides is not corrosive to zinc.

4.6 Contact with Other Metals

Bi-metallic interaction is an electrochemical reaction that can occur between some dissimilar metals or alloys that causes corrosion of one metal and protection of the other. The reaction will only occur when the dissimilar metals are connected to form an electrical circuit and an electrolyte (such as moisture) is present. It is this reaction that is responsible for the galvanic protection of steel by zinc coatings at the place where the coating is damaged.

Based on outdoor atmospheric studies (Zhang, 1996), Table 4.2 presents the relative galvanic corrosion rate of zinc when coupled to various metals. In normal indoor environments moisture levels are very low and consequently the galvanic action between dissimilar metals is much lower than in outdoor environments. The galvanic interaction between dissimilar metals is complex and expert opinion should be sought on the advisability of combining different materials. The extent of the galvanic action depends on the metals coupled. Advice given should fall into one of three categories:

- The choice is satisfactory and unlikely to cause a corrosion problem
- Switch to a suitable combination
- Use the materials selected but electrically insulate the bi-metallic couple.

According to Table 4.2, galvanic corrosion of zinc is the most severe when in contact with steel, copper or brass under moist conditions. If contact between galvanized coatings and copper/brass or bare steel cannot be avoided, then insulated, non-conductive gaskets should be used at the contact points to prevent localized consumption of the galvanized coating.

Table 4.2: Galvanic Corrosion Rate of Zinc Coupled to Other Common Commercial Metals (Zhang, 1996)

Coupled Alloy	Zinc Corrosion Rate
Mild Steel	High
Stainless Steel	Low
Brass	High
Copper	High
Lead	Medium
Nickel	Medium
Aluminum	Low

On the other hand, contact between galvanized coatings and aluminum or stainless steel results in less bi-metallic corrosion. However, insulating the materials may be advisable in humid environments.

5.0 Building with Galvanized Steel

5.1 Fabricating Galvanized Framing Members

Galvanized steel is shipped to fabricators as coils. The coils are slit lengthwise into individual "ribbons" of galvanized steel strip. These ribbons are roll-formed and cut to length, and holes are often punched to produce the various steel sections used for framing.

Galvanized zinc coatings are metallurgically bonded to the steel sheet and will not spall or flake off during these forming operations. Zinc also cathodically protects any steel exposed at cut edges (Section 4.2).

5.2 Erection and Handling

A galvanized metallic coating is very adherent and abrasion resistant. As a result, normal handling during distribution, storage and erection should not damage the zinc coating. Job site procedures such as shearing, cutting or fastening will expose bare steel, but this is of no consequence because of zinc's ability to cathodically protect any cut edges.

Precautions should be taken to avoid the formation of white rust (4.3.2) at all points in the distribution cycle and when storing galvanized steel at the job site. The galvanized steel should be stored to allow proper drainage and good ventilation so that all surfaces can dry after becoming wet.

In particularly aggressive conditions, such as humid coastal environments, extra effort should be taken to minimize outdoor exposure of the galvanized studs during storage and erection.

5.3 Welding

Galvanized steel can be joined by spot or continuous welding. Welding may be an economical joining method when shop fabricating wall or roof assemblies. Although both welding operations volatilize the zinc coating at the weld site, spot welding is a much more localized process. When coating damage at a spot weld area is relatively small, in the order of 1/16 inch (1.5 mm) or less, repair is generally not needed.

Larger diameter spot welds and continuous welds may remove the zinc coating from relatively large and critical areas of the structure. In these cases, the damaged areas should be repaired with zinc rich touch-up paint (there are many commercially available products specifically for this purpose) or by zinc metallizing.

5.4 Fasteners

Steel framing fasteners are usually protected against corrosion by electroplated zinc coatings. Zinc-plated coatings are typically thinner and therefore not quite as protective as the galvanized coatings on the surrounding steel framing members. Coatings with a 24-hour corrosion resistance before red rust, as tested in accordance with Section 9.3 in ASTM F1941, are recommended as the minimal level of corrosion protection for zinc-coated residential steel framing fasteners. Other tests may be appropriate for other types of fasteners (LGSEA, 1999).

For more aggressive environments, improved fastener corrosion protection can be achieved with different organic, plated or even duplex (i.e., zinc base plus organic topcoat) coatings. Fastener suppliers can provide further information on the level of corrosion protection that is recommended for particular environments and the level of protection provided by specific coating types.

6.0 Conclusions

Zinc and zinc-alloy hot-dip galvanized coatings are economical and recommended methods of providing long-term corrosion protection of steel framing members.

The galvanizing process produces a tough metallic coating that can withstand the physical demands created during distribution, site storage and erection of the steel framing members.

In most climate-controlled environments or installations where the steel framing is not exposed (i.e., enclosed walls), the corrosion rate of zinc and zinc alloy coatings is very low. By using the recommended coating weights, steel framing can last literally hundreds of years.

Time of wetness and concentration of air pollutants will affect zinc's corrosion rate. Situations that expose steel framing to extended periods of wetness or aggressive atmospheres should be avoided. Thicker zinc coatings or organic topcoats can be specified for increased corrosion protection in areas where aggressive conditions cannot be avoided.

Appendix A

Summary: ILZRO Research Program ZC-4

In 1997, the NAHB Research Center commenced work on a project that would investigate the corrosion performance of cold-formed steel framing components under the guidance and sponsorship of the International Lead Zinc Research Organization (ILZRO). Four test sites were established and test samples installed.

Test samples were retrieved from each test site at intervals of one, three, and five years after installation. The results of the coating loss analysis on the samples are shown below.

Corrosion Samples

The corrosion samples consisted of galvanized, galvalume, and galfan coatings in the form of plates and segments of C-section stud.

Coating Thickness of Sample Materials

Material	Coating Specification (Metric)	Coating Specification (English)	Measured Coating Thickness (microns)
Galvanized 1	Z180	G60	38
Galvanized 2	Z180	G60	29
Galfan®	ZGF275	AZ90	47
Galvalume® 1	AZ180	AZ60	60
Galvalume® 2	AZ180	AZ50	45

Test Sites and Installation

The four test sites represented a range of climates and typical building types for each region to enable the application of the field results to a large selection of structures and climates.

Site No.	Location	Distance to Water	Environment	Foundation	Exterior Finish
01	Miami, FL	Several miles from Atlantic Ocean	Humid, Inland	Slab-on-grade	Stucco
02	Leonardtown, MD	Less than 75 feet from Potomac River	Semi-marine with humid summers	Crawlspace	Vinyl siding
03	Long Beach Island, NJ	Less than 1/4 mile from Atlantic Ocean	Marine	Piers with enclosed area under house	Aluminum siding
04	Hamilton, Ontario	Inland	Industrial with cold winters	Basement	Brick Veneer

Estimated Life

The average corrosion rate (life expectancy) of the samples can be estimated using the calculation method in ASTM G 1-90 (ASTM) and shown below:

Corrosion rate = (KxW)/(AxTxD)

Where:

K = constant = 8.76×10^7 µm/year,

W = mass loss in grams,

A = area in cm^2

T = time of exposure in hours, and

D = density in g/cm^3

The mass loss used (W) is the 5-year maximum single mass loss for each of the coating types and sample locations. This provides a conservative estimate (lower bound) for the life span of each coating type. For example, the maximum single mass loss for the Galfan plates at the New Jersey site (crawl space) is 0.01 grams for year five retrieval. This mass loss is used in the corrosion rate calculation. Furthermore, the estimated life expectancy shown in the table below is conservatively based on 75 percent of the initial coating thickness.

ESTIMATED LIFE EXPECTANCY (ASTM G1-90)

SITE LOCATION	SAMPLE MATERIAL	SAMPLE LOCATION	MASS LOSS (grams)*	EXPOSURE DURATION (months)	CORROSION RATE (µm/yr)	ESTIMATED LIFE EXPECTANCY (years)
Hamilton, Ontario	Galvanized 2	Attic	0.01	62	0.0275	791
		Wall	0.01	62	0.0275	791
	Galvalume	Attic	0.01	62	0.0523	645
		Wall	0.01	21	0.1545	218
	Galfan	Attic	0.01	62	0.0293	1204
		Wall	0.01	62	0.0293	1204
Miami, Florida	Galvanized 2	Attic	0.01	52	0.0328	664
	Galvalume		0.02	52	0.1248	270
	Galfan		0.04	52	0.1397	252
Long Beach Island, New Jersey	Galvanized 1	Wall	0.01	60	0.0284	1004
		Floor	0.01	60	0.0284	1004
		Under Deck	0.01	60	0.0284	1004
	Galvalume	Wall	0.01	60	0.0541	624
		Floor	0.01	60	0.0541	624
		Under Deck	0.01	60	0.0541	624
	Galfan	Wall	0.02	60	0.0605	582
		Floor	0.01	60	0.0303	1165
		Under Deck	0.01	60	0.0303	1165
Leonard Town, Maryland	Galvanized 2	Attic	0.01	65	0.0262	830
		Wall	0.02	65	0.0524	415
		Crawl/Open	0.03	65	0.0786	277
	Galvalume	Attic	0.01	44	0.0737	458
		Wall	0	17	0.0000	--
		Crawl/Open	0.02	65	0.0998	338
	Galfan	Attic	0.01	65	0.0279	1262
		Wall	0.02	65	0.0559	631
		Crawl/Open	0.01	65	0.0279	1262

* The mass loss shown is the maximum single mass loss or gain (absolute value) for each sample from year five retrieval

References

DeMeo, L.D., “20 Year Inspection of LSF at DESH,” Dofasco Inc. unpublished report, 1995.

John, V., “Durability of Galvanized Steel Building Components in Domestic Housing,” British Steel Technical - Welsh Laboratories, 1991.

LGSEA, “Corrosion Protection for Cold-Formed Steel Framing in Coastal Areas,” Technical Note 140, Light Gauge Steel Engineers Association, 2003.

LGSEA, “Fastener Corrosion,”, Technical Note 560-5b, Light Gauge Steel Engineers Association, 1999.

ILZRO, “Galvanized Steel Framing for Residential Buildings,” International Lead Zinc Research Organization, 2003.

SFA, “Pressure Treated Wood and Steel Framing,” Issue Paper Vol. 1 Issue 4, Steel Framing Alliance, 2004.

Townsend, H.E., “Continuous Hot Dip Coatings,” Metals Handbook, ASM International, 1995.

Zhang, X.G., “Corrosion and Electrochemistry of Zinc,” Plenum Publishing Corp., 1996.

Zhang, X.G., “Corrosion of Zinc and Its Alloys,” ASM Metals Handbook, ASM International, 2005.

ASTM G1-90 (1999) e1. Standard Practice for Preparing, Cleaning, and Evaluating Corrosion Test Specimens. American Society for Testing and Materials, West Conshohocken, PA

Steel Framing Alliance™
1201 15th Street, N.W., Suite 320
Washington, D.C. 20005
(202) 785-2022 • Fax: (202) 785-3856
www.steelframingalliance.com