GALVANIZED STEEL

This option represents the lowest upfront cost. However, it is also the least durable. Adding a paint finish will significantly enhance the durability of galvanized steel, but the eventual deterioration of this finish must be anticipated. Depending on environmental factors, including ultraviolet light exposure, a painted galvanized system will maintain a good appearance for 10-25 years. It will remain serviceable for some time after that.

Unpainted galvanized steel will weather over time, turning a duller gray as the zinc coating builds a patina. The zinc will erode over time, however, allowing unprotected carbon steel to rust. This process will be accelerated by the presence of airborne abrasives (like sand) and atmospheric moisture.

Testing of galvanized steel at Kure Beach in North Carolina showed .68 mils per year of loss after 13 years of marine exposure (reference Table 13 in the attached excerpt from the Nickel Development Institute (NIDI) Reference Book 11 024). Information in Table 14 of the same reference suggests a useful life of bare galvanized at 5-15 years in a rural, low pollution environment.

Table II: Atmospheric Corrosion Datain Panama
— Weight loss measured in mils/year after 16 years exposure

METAL	CRISTOBAL (COSTAL)		MIRAFLORES (ILAND)	
	AVG. LOSS	DEEPEST PIT	AVG. LOSS	DEEPEST PIT
T316 Stainless	<.01	<4.92	0	<4.92
Aluminum 1100	<.01	<4.92	<.01	<4.92
Aluminum 6061 T-6	<.01	<4.92	<.01	<4.92
Nickel (99.9%)	<.01	<4.92	<.01	<4.92
Alloy 400	<.01	<4.92	<.01	<4.92
Catridge Brass	<.02	<4.92	<.01	<4.92
Nickel-Silver	.02	<4.92	.02	<4.92
Muntz Metal	.03	<4.92	<.01	<4.92
Cast Bronze	.02	5.98	<.01	32.99
Copper (99.9%)	.03	<4.92	<.01	<4.92
Lead (99%)	.05	<4.92	.04	<4.92
Low Alloy Steel	.04	17.01	.28	22.01
Cast Gray Iron	.32	37.01	.28	37.01
Cast Iron (18% Ni)	.59	59.02	.24	9.02
Carbon Steel	.47	39.02	.43	25.98
Wrought Iron	.94	60.98	.63	37.01

— Data courtesy of the Nickel Development Institute

Table III:
Average Corrosion Weight Loss at Kure Beach, NC
— Weight loss measured in mils/year after 13 to 16 years exposure

METAL	CORROSION RATE
T316 Stainless	<.0001
T304 Stainless	<.0001
Galvalume®	.33
Galvanized Steel	.68
Wrought Iron	5.8

— Data courtesy of the Nickel Development Institute

In short, if the useful life of a building, in a mild environment, is expected to exceed 20 years, galvanized needs to be painted, and repainting or panel replacement needs to be anticipated at about the 20-year point to maintain a good appearance, with corrosion failure of the system likely to occur less than 20 years later. In a marine environment, a significantly shorter life span can be anticipated.

ALUMINUM

As in the case of galvanized, painting or anodizing aluminum will greatly enhance its useful life. The appearance of the paint finish will be roughly the same as galvanized. Anodizing also adds protection from the elements, but consistency of appearance from panel to panel is difficult to achieve.

The NIDI tables indicate bare aluminum will corrode at a rate approaching .07 mils per year in an inland environment. Further, bare aluminum will oxidize, which may not be desirable from a cosmetic standpoint.

We would suggest that like galvanized, painted aluminum will look good for 10-25 years. However, it will remain serviceable for a matter of decades after the appearance has deteriorated. This is also true of bare aluminum, if a chalky oxide surface (that will develop) is acceptable. However, in a marine environment, significant deterioration can occur. Photo A was taken in Tampa, Florida in 2002. The painted aluminum panels installed in 1982, were corroded to the point of failure in less than 20 years.

Photo A: *20 Yr. Old Painted Aluminum Panels - Tampa, FL*

Table IV: Atmospheric Corrosion Data in South Africa *— Weight loss measured in mils/year after 20 years exposure*

METAL	CITY					
	PRETORIA	DURBAN BAY	CAPE TOWN	DURBAN BLUFF	WALVIS BAY	SASOLBURG
	ATMOSPHERE					
	Rural: Low Pollution	Marine: Moderate Pollution	Marine: Moderate Pollution	Severe Marine: Mod/Low Pollution	Severe Marine: Low Pollution	Industrial: High Pollution
T316 Stainless	.001	.001	.001	.01	.004	
T304 Stainless	.001	.003	.005	.02	.004	
T430 Stainless	.001	.02	.01	.07	.02	.004
93103 Aluminum	.01	.021	.17	.77	.18	.11
95251 Aluminum	.01	.14	.15	.66	.16	
96063 Aluminum	.01	.12	.14	.79	.19	
96082 Aluminum	.02	.14	.13	1.09	.23	
96261 Aluminum				.93	.15	.12
Copper	.22	.037	.28	.97	1.51	.55
Zinc	.13	.91	1.14	4.37		.6
Weathering Steel	.9	8.35	3.6	31.89	45.28	4.21
Mild Steel	1.7	14.61	10.12	86.22	33.31	5.91

— Data courtesy of the Nickel Development Institute

STAINLESS STEEL

The results of field tests on stainless steel outlined in the NIDI tables suggest negligible metal thickness loss to corrosion. Further, stainless steel maintains its original appearance through its natural passive film layer of “invisible” chromium oxide. The only maintenance normally required is to keep gutters free of debris and wash the building periodically (often many years apart) to maintain a good appearance.

The more highly engineered stainless steel finish treatments offered by our company provide excellent consistency of appearance without any coatings to deteriorate. When the proper grade is selected, our products are covered by a 30-year Contrarian Metal Resources warranty (please refer to grade selection and product data sheets in the PRODUCTS section). We would expect the useful life to actually be some number of decades beyond that. Stainless steel building panels have existed for as long as 70 years (Chrysler & Empire State Buildings, for example), maintaining a good appearance without failure. There are no known stainless buildings constructed prior to the late 1920’s. In short, count on stainless steel existing with little maintenance for the useful life of the building.

Photos B, C, D, E & F were taken a year ago at the LaQue Laboratories test site at Kure Beach, NC. The metal coupons were installed 820 feet from mean high tide for the duration noted.

Photo B:
Painted Cast Aluminum
12 Yrs.

Photo C:
Painted Carbon Steel
12 Yrs.

Photo D:
Zinc
40 Yrs.

Photo E:
Type 304 Stainless Steel
59 Yrs.

Photo F:
Type 316 Stainless Steel
59 Yrs.

TITANIUM

Although it is considerably more expensive than stainless steel, titanium provides the best value in severely corrosive environments. In almost any location, it will perform for decades. It has a somewhat duller surface aspect than stainless steel. It is also inherently more variable in appearance. However, the special processing of our InvariTech™ and InvariSand™ finishes provides good consistency of appearance. Titanium is at home in severe seacoast environments where salt spray can be expected to dry on the building panel surfaces. Even Type 316 stainless will deteriorate under these conditions. Our Titanium bears a 30 year limited warranty (please refer to product data sheets in the PRODUCTS section). For more information about titanium properties, you will find RMI Titanium to be quite helpful at www.rmititanium.com.

ZINC

Heavy gauge zinc roofing panels have existed for more than a century in Europe without failure. Although the NIDI tables suggest improved performance in a marine environment compared to some metals, there is a degree of erosion corrosion that must be anticipated in coastal areas. Zinc panel systems must be back ventilated in order to prevent corrosion from the interior surfaces propagated by trapped moisture. Our InvariTique With Back Coat™ has a coil coating on the back side that eliminates the need for traditional zinc ventilation requirements. Warranties for our zinc products are available on a specific project basis, upon our assessment of the environment and design review. More about the ventilation requirements of ZINC can be found in the INFORMATION TOPICS section. For additional information regarding the properties of zinc, Alltrista Zinc Products is an excellent resource at www.allzinc.com.

Aside from erosion corrosion of metals in given environments, there are also fabrication and installation issues that can affect performance. Architectural metal panel systems that do not drain well can promote galvanic and crevice corrosion, for example. We offer some basic rules to follow when designing with metals:

- **Provide sufficient drainage** so as not to allow water to collect on metal surfaces.
- **Separate dissimilar metals** with plastic washers or other means.
- **Provide a degree of back ventilation** to prevent moisture from being trapped on the interior surfaces of the panels.
- **Remove heat tint** (from welding) from the surface of the metal through chemical or mechanical means.
- **Advise owners to periodically wash the panels** and keep gutters clear of debris.

Following these guidelines will increase the life span of your panel system.

If there is any doubt about selecting the best material for your project, please contact us. Our metallurgical engineers are available to provide assistance. We can also provide material cost estimates of different options to help you evaluate the lowest cost material in the long run.

CONTRARIAN METAL RESOURCES

Phone: 724-779-5100
Toll-Free: 866-360-5100

Visit us on the web at:
www.metalresources.net

METALLIC CORROSION

Aside from catastrophic damage, metallic corrosion is clearly the chief cause of metal building panel failure. When architectural metal panels corrode, there are undesirable consequences that go beyond cosmetics. Corroding panel systems will begin to leak, causing potentially significant damage to the interior of a building. Repair costs can be substantial, usually involving removal and replacement. Studies conducted in recent years by both Batelle Laboratories and the National Association of Corrosion Engineers (NACE) concur that in the united States alone, we spend $300 billion per year combating metallic corrosion. The Batelle study estimates the $100 billion of this cost can be avoided with proper material selection. This suggests that to a significant degree, we are penny wise and pound foolish with the metals we specify. In terms of architectural metal applications, we argue that life cycle costing should be taken into account when selecting materials. More about life cycle costing can be found in INFORMATION TOPICS – LIFE CYCLE COSTING.

Contrarian Metal Resources was founded on a philosophy of designing for performance, using corrosion resistant metals. We supply high performance metals that, when properly specified and installed, will last the useful life of a building with little or no maintenance.

Determining the expected corrosion performance of a given metal in a given location can be difficult. Each application is unique and different metals will experience different corrosion rates, depending on the environment. There is no simple set of rules that apply in all cases. However, we can offer some insight into the relative corrosion resistance of different metals.

We offer general comments below concerning the life expectancy of different metal options. Tables I - IV are corrosion rate tables excerpted from The Nickel Development Institute (NiDI) Reference Book Series No. 11024 entitled Stainless Steels in Architecture, Building and Construction; which provide information based on the performance of different metals in a variety of environments. More information, including free printed and downloadable publications, can be obtained at www.stainlessarchitecture.com.

Table I: Average Corrosion Weight Loss in Japan – *Weight loss measured in mils/year after 4 or 5 years of exposure.*

MATERIAL	PACIFIC COAST		SEA OF JAPAN COAST	INLAND		INDUSTRIAL	
	Omaezaki	Makurazaki	Wajima	Takayama	Obihiro	Kawasaki	Tokyo
T304 Stainless	.003	.006	.0035	.0055	.0059	.033	.037
Aluminum	.157	.118	.118	.071	.122	2.421	.118
Weathering Steel	30.12	20.63	19.29	14.094	14.45	72.24	44.13
Carbon Steel	41.42	32.05	27.68	19.21	16.97	156.81	70.75

— Data courtesy of the Nickel Development Institute