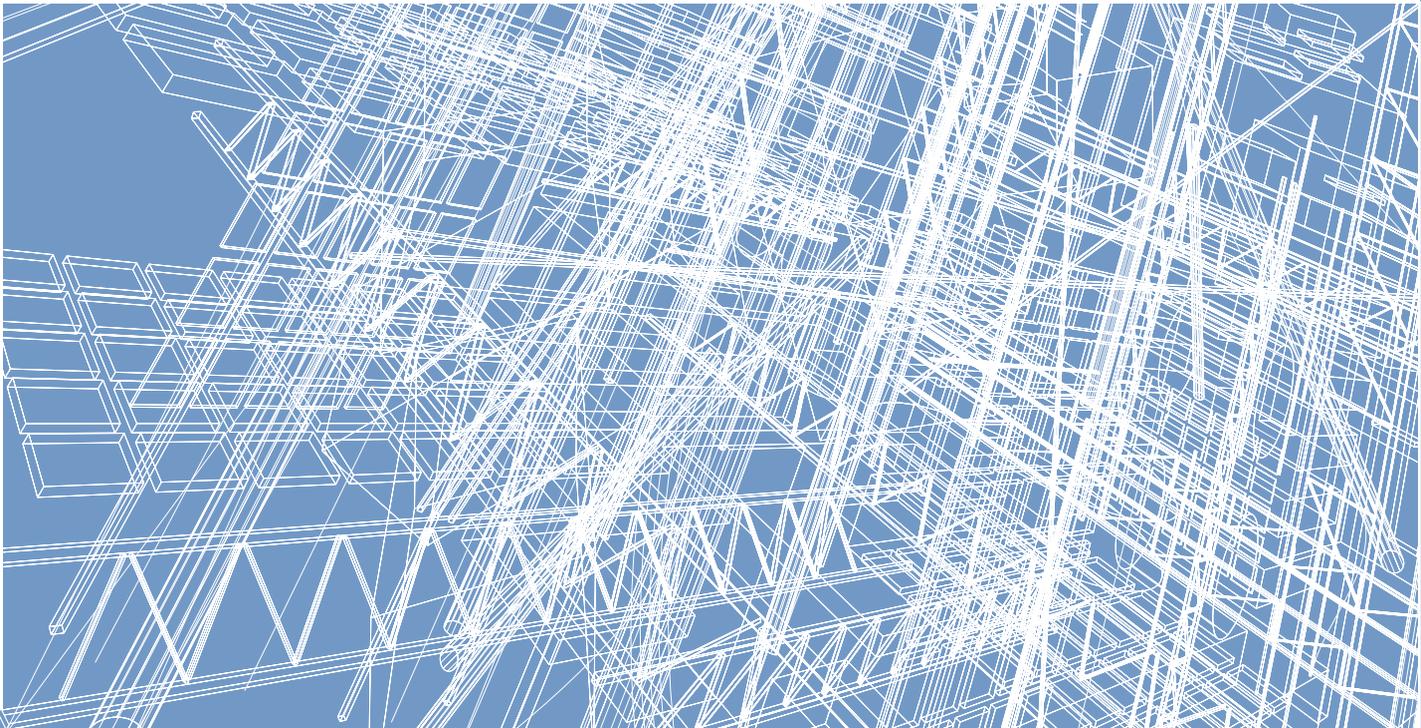


Parking for the Future

a collection of hot-dip galvanized steel parking garages



Hot-dip galvanizing has provided steel corrosion protection for over 150 years, and has been used in parking garages for over 30 years. When it comes to protecting steel from the inevitable onset of corrosion, no other coating provides the numerous benefits of hot-dip galvanizing. Whether it is cost, aesthetics, speed of erection, corrosion protection, environmental sustainability, safety, or all of the above, galvanizing delivers unparalleled performance over other corrosion protection methods.

Corrosion Protection

Zinc metal is used to coat steel in the galvanizing process and provides a metallic protective barrier to the underlying steel. The zinc coating acts as a barrier between the bare steel and the atmosphere, similar to the protection provided by paint, and is the first level of protection against corrosion. When examined in a wide range of environments, zinc metal typically corrodes at 1/40th the rate of bare steel.

Unlike paints and other organic coatings, the nature of the metallic zinc coating provides another level of corrosion protection known as cathodic protection. Cathodic protection simply means the zinc (galvanizing) will preferentially corrode prior to steel when the two are in contact with one another. Therefore, if galvanized steel becomes damaged from handling or there is corrosion to the extent that bare steel is exposed to the atmosphere, the surrounding zinc will protect the exposed areas.

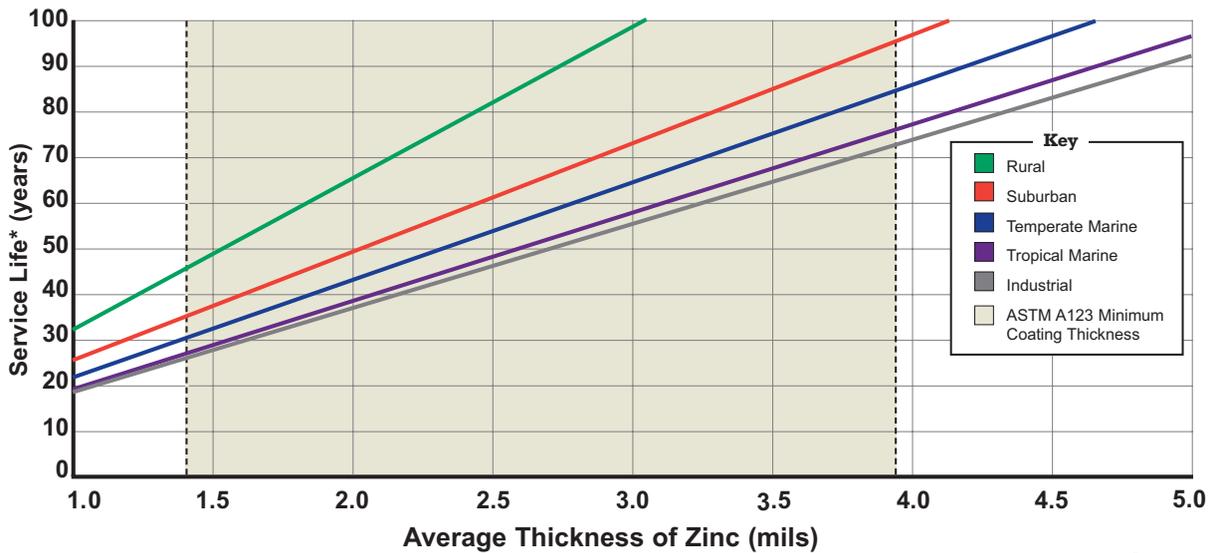
Hot-dip galvanizing also provides a third level of protection that results from the natural development of zinc corrosion products into a protective layer known as the patina. When hot-dip

galvanizing is exposed to the atmosphere it begins to develop zinc corrosion products on the surface. After months of exposure these corrosion products build up and react with elements in the atmosphere to form an inert, relatively insoluble layer of zinc carbonate. Once formed, the patina provides a highly corrosion-resistant layer that acts as another barrier to prevent corrosive elements from penetrating and damaging the underlying steel.

Service life of the hot-dip galvanized coating is directly proportional to the thickness of the coating. According to ASTM specifications, galvanizers must achieve certain minimum coating thicknesses, based on the type and thickness of the steel, to provide adequate service life for the steel product.

Recent studies of corrosion rates collected worldwide indicate galvanized coatings provide excellent long-term corrosion protection. These corrosion rates were analyzed in order to produce a service-life chart based on the thickness of the galvanized coating in five general environmental classifications.

Service-Life Chart for Hot-Dip Galvanized Steel



*Service life is defined as the time to 5% rusting of the steel surface. 1 mil = 25.4µm = 0.56oz/ft²

Concrete Deterioration

Several concrete parking garages and over 600,000 concrete bridges in North America are in need of repair at an estimated cost of \$200 billion; four times the original construction cost! This concrete infrastructure deterioration is the largest civil engineering challenge facing the western world.



The primary cause of the deterioration is corrosion of bare steel reinforcement. Unless protected by a coating such as zinc, applied in the hot-dip galvanizing process, bare steel will corrode. Because rust occupies a volume 4 to 6 times greater than the original steel's volume, the concrete will inevitably crack, spall, and need replacement.

Given operating expense cutbacks and maintenance budget restrictions, construction design must incorporate competitive, durable, and maintenance-free materials. This is exactly why galvanized steel is the preferred material for parking garages. Used on deck reinforcing steel, structural steel, handrails, sign supports, and a host of other steel products, galvanized steel delivers maintenance-free structures for generations.

When poor concrete performance leads to parking structure repair or demolition, there are three individually significant and collectively staggering areas of cost. The first is the direct cost of labor and materials to remediate and/or replace. This is the largest and most quantifiable cost, and usually the focus of decision-making. The second is indirect and includes parking unavailability, traffic delays, loss of asset and personnel productivity, and stress. Finally, associated with repairs and replacement, is the need to drill, blast, crush and transport more aggregate, coal, and iron ore to make, package, and transport construction products. All of these require additional, yet avoidable consumption of energy and natural resources.



Environmental

With respect to Mother Earth, galvanizing is an industry of recycled materials and process components. The zinc used for galvanizing is a naturally occurring element found in abundance worldwide. Zinc is also used in a variety of consumer products from lip balms and ointments to toys and cars, is a recommended part of our diet, and is necessary for all human life.

Lowes Parking Garage

This construction of the Lowes Parking Garage – at the Lowes Headquarters in Mooresville, NC – was initially planned as an all-concrete parking structure. However, upon further investigation of the overall cost and benefit of having a low maintenance structure, the garage was specified with hot-dip galvanized steel. This provided Lowes with a substantial cost savings in the construction cost per square foot, and hot-dip galvanizing offered the maintenance-free properties every building owner dreams of. The architect was also able to maintain the initial vision and design by simply adding a thin concrete skin on the exterior of the building.



Originally focusing on a concrete structure, a proposed design utilizing castellated beams was not only aesthetically attractive to Lowes, but delivered a \$300,000 initial cost savings over pre-cast concrete.

Nearly 1,700 tons (1,520 metric tons) of hot-dip galvanized structural columns, fascia beams, concrete embeds, lintels, handrails, and castellated beams were used on the project. While some of the castellated beams were over 60 feet long, they were easily handled by the galvanizer. It is not often that a parking structure is viewed as an attractive piece of a building complex, but, in this case, the aesthetic value of a castellated beam garage elevates this Lowes structure to an integral element of its appealing natural surroundings.



Hot-dip galvanized castellated beams.

LOWES HQ

Manchester Airport Parking Garage

The Manchester Airport Parking Garage is a multilevel structure comprised of 3200 tons (2900 metric tons) of steel that was hot-dip galvanized in 1999. Galvanized steel was selected based on its aesthetic appeal, quick turnaround (delivery time to the job-site), and maintenance-free performance illustrated by a similar garage built in 1979 in Cambridge, MA.

The parking garage is located in a fairly aggressive urban environment where the most recent (20-year) temperature range is from -4 F to 100 F (-15 C to 38 C). With 44 inches (112 cm) of precipitation each year and close proximity to the Merrimack River, the parking structure steel columns and fascia screens must weather the attack of airborne road salts, sulfur dioxide emissions from jet fuel, highly concentrated automotive traffic, and high relative humidity. With a minimum of 3.9 mils (99 microns) of zinc coating, the galvanized columns will easily deliver 30 to 40 years of maintenance-free protection from corrosion.

After carefully observing the 20-year, maintenance-free performance of a galvanized steel garage in Cambridge, MA, the engineering firm for the Manchester Airport Parking Garage chose hot-dip galvanizing for several reasons. The primary decision factor was the elimination of expensive maintenance for the first 25 to 30 years of the garage structure's life. With smaller maintenance budgets forecasted for future years, the choice of hot-dip galvanizing would free up future budget funds for much-needed new projects on the airport property. Secondly, the initial cost of the galvanizing was less than the proposed two-coat paint system. Additionally, the pleasing aesthetic appearance of the zinc patina and its uniformity over many years was an important factor. There would be no unsightly paint fading, cracking or chipping on this innovative design. Finally, and critical to the entire team of owner, architect, designer and construction contractor, was the certainty the factory-controlled galvanizing process would pose no schedule delay due to weather.

MANCHESTER AIRPORT



Harrisburg Multi-modal Parking Facility

Guaranteed to deliver a maintenance-free lifetime of 50 years or more, hot-dip galvanizing was selected to protect the structural columns, girders, splice plates, tubing, and stair framing of this parking garage and rental car facility. Besides this functional quality, the appearance of the zinc coating unified the facility with the surroundings of the airport itself.

Use of galvanized steel also allowed for an open, flexible floor plan required for the first-level rental car facility—through the use of exposed moment frames—while still protecting the structure from the corrosive road salts deposited within. According to the Harrisburg airport director (who had a very positive experience using hot-dip galvanized steel on the Manchester New Hampshire airport), “The designers liked the strong contextual relationship between a galvanized multi-modal facility and the airport’s new terminal.”



HARRISBURG AIRPORT



The hybrid structural system, featuring hot-dip galvanized steel columns and beams, in combination with precast double tees, gives the facility a visual openness and a compositional synergy with the mostly-transparent envelope and metal cladding of the new terminal. Galvanizing—functional, versatile, and aesthetically appealing!



North Colorado Medical Center Parking Garage

North Colorado Medical Center (NCMC) serves as the primary full-service tertiary facility for northern and eastern Colorado, southern Wyoming, and western Nebraska. In May of 2002, facility management decided to triple the size of the emergency care department. Along with this increase in hospital capacity, the need to expand the parking facility for improved convenience became apparent. Walker Parking Consultants was hired to design a new 750-space parking facility on the medical campus.

Constructing the garage from galvanized steel was an easy decision when a cost analysis was performed versus a common two-coat paint system. The initial cost to galvanize the structure was more economical than applying a basic zinc primer to the steel and a field-applied top-coat. In addition, estimates showed the paint system would have to be touched up in 5 years. Hot-dip galvanizing wouldn't require touch-ups, and should provide 50 years of maintenance-free corrosion protection in the harsh environment of northern Colorado. Therefore, the overall life-cycle cost of the galvanized coating is far less than the cost associated with initial painting and continued maintenance over a 50-year period. The longevity of the coating was the key reason why hot-dip galvanizing was specified.



Hot-dip galvanized cable barrier.

NORTH COLORADO MEDICAL CENTER

SKY HARBOR INTERNATIONAL RENTAL CAR CENTER

Sky Harbor International Airport Rental Car Center

In 2005, the Sky Harbor International Airport began construction of a 5600-space parking garage facility to accommodate and consolidate all of the rental car companies into one convenient location. Touted as the third largest rental car market in the world, Phoenix, AZ has become a popular, rapidly expanding tourist destination due to its moderate winter weather and numerous resort locations.

The design of the facility called for 2,000 tons (1,785 metric tons) of steel which comprised all the major structural components as well as other miscellaneous steel pieces. All 2,000 tons were specified for hot-dip galvanizing to ensure long life and low maintenance.

The flexible turnaround times galvanizers can provide also proved to be a huge benefit to the overall success of the project. One challenge the contractor faced was limited space available to store large quantities of steel on the job site. The galvanizer was able to store the large quantity of steel at the galvanizing plant and provide staged delivery as pieces were galvanized and sent to the job site on the day they were erected. This allowed the erection to proceed seamlessly without delay while freeing up the already limited construction site space.



Hot-dip galvanized structural beams.



Arizona State University Parking Garage



The expansion of Arizona State University recently included the construction of a large, five-story parking facility. Hot-dip galvanized steel was used in this parking garage for its aesthetic appeal and also to protect the automobiles from UV rays and other corrosive elements in Arizona. The parking structure contains many different HDG pieces, including the parking canopy, columns and beams for the skin structure, crash barrier, and guard rails totaling 150 tons (135 metric tons) of steel.

The project designer spent time with the galvanizer to learn more about the process in order to create details that worked well with the HDG process, such as the steel framing from which to hang the stainless steel skin. The skin

Bolting the structure together after galvanizing, as opposed to welding the steel together prior to galvanizing, allows for easier processing at the galvanizing plant and ultimately increased the quality of the galvanized finish.



is used to help provide shade and protection from the elements for the parked vehicles. The galvanizer also suggested bolting the frame together in lieu of welding to minimize the size of the pieces that were galvanized, eliminating unnecessary progressive dipping.

Using galvanized steel allowed the contractors to complete the project on time and under budget. In fact, the project was such a success that an expansion of the facility using galvanized steel is planned.

ARIZONA STATE UNIVERSITY

Charlotte Douglas International Airport Parking Garage

Having specified several thousand tons of hot-dip galvanized steel on many previous parking garage facilities, HNTB is no stranger to the superior corrosion protection it provides. In the construction of the parking garage at the Charlotte Douglas Airport in 2005, they not only specified HDG for corrosion resistance, but for aesthetics as well.

It was the vision of the designer to incorporate a convex exterior façade somewhat similar to the curvature of an airplane wing. In order to accomplish this vision, stainless steel cladding was attached to a galvanized structural steel frame. Galvanized and stainless steel, which look similar, provide a uniform appearance, creating an architecturally appealing design. Furthermore, the combination of galvanized steel and stainless steel is more economical than specifying stainless steel for the entire structure.



CHARLOTTE DOUGLAS



Hot-dip galvanized parking garage fascia.

Three-hundred tons of HDG steel was used for bow-string trusses, embed plates and anchors, stair towers, stairways, hand rails, and castellated beams. By avoiding paints and using hot-dip galvanized steel, the garage will not require costly paint maintenance due to the heavy car and pedestrian traffic the garage will accommodate. A "twin" garage, utilizing the same design, is scheduled to be constructed in the summer of 2006.

Uses for Hot-Dip Galvanized Steel In Parking Garages

From enclosure panels to structural elements in masonry and brick, hot-dip galvanizing is readily specified for optimum long-term corrosion protection. Non-structural steel elements such as handrails, security gates, ornamental fencing, light fixtures, and grating are also galvanized, providing the additional benefit of enhanced aesthetic appeal.

All of the structural elements in a parking garage must be sound. Additionally, they must be consistent with the overall aesthetic appeal of the structure. Hot-dip galvanized steel exceeds these important requirements, and the protection afforded by galvanizing ensures that your design is corrosion-free for generations. The combined advantages of cost-effectiveness and durability make hot-dip galvanizing an excellent choice today and tomorrow.

The following list provides insight into some of the numerous available uses for hot-dip galvanized steel in parking garages.

Anchor Bolts	Curb Angles	Guiderail	Pipe Hangers
Anchor Rods	Drain Pipes	Handicap Railings	Pipe Stanchions
Anchoring Clips	Drains	Hatches	Precast Hardware
Angles	Embedments	HVAC Supports	Railings
Architectural Panels	Equipment Screens	Joists	Reinforcing Steel
Attachment Devices	Exterior Stair Channel & Stringers	Ladders	Relieving Angles
Beams	Fascia Support Steel	Leveling Plates	Roof Trusses
Benches	Fasteners	Light Fixtures	Scuppers
Bicycle Racks	Fences/Gates	Light Poles	Signs & Sign Supports
Brick Ledges	Fire Escapes	Lightning Rods	Stair Stringers
Brick Ties	Flag Poles	Lintels	Sun Screens
Building System Frames	Foot Bridges	Louvers	Trash Containers
Canopy Supports	Fountain Accessories	Manhole Covers	Tree Grates
Catwalks	Garage Support Steel	Mesh & Embedded Items	Tree Guards
Channels	Girts	Metal Sculptures	Trellises
Columns	Grating	Ornamental Steel	Utility Covers
Crash Barriers		Pipe Bollards	Window Wall Supports



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