



American Galvanizers Association

**American Galvanizers Association –
Galvanize the Future
Edgar K. Schutz Scholarship**

Prepared for:
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Dean Bridgens:

Please review the attached article regarding the benefits of using hot-dip galvanized products in all aspects of construction. Students need to be informed of the fact that hot-dip galvanizing has many benefits that include; cost effectiveness, durability, longevity, availability, versatility, and sustainability while being aesthetically pleasing.

Since galvanizing is a viable solution to corrosion control in many aspects of construction, students need the information contained in the article. If students understand the characteristics and performance of hot-dip galvanized steel, they will facilitate the increase use of galvanizing to enhance future engineering and design projects.

Your consideration is appreciated in including the information about hot-dip galvanizing in the curriculum of the Construction and Design Technologies Department.

Respectfully submitted,



Adam Smyser

HOT-DIP GALVANIZING IS NEEDED INFORMATION

What is the purpose of educating students and future architects and engineers at Pennsylvania College of Technology? Is the purpose of education about preparing students for a specific career? Or is it about teaching students discipline and the ability to explore new ideas and to think independently? Education may not have a single purpose, however students should be provided with pertinent information that will assist them to use cost-effective and sustainable methods of construction once employed.

The nation's long-term transportation needs, decaying roads, bridges, railroads and transit systems are estimated in costing the United States \$129 billion a year, according to a report recently issued by a professional group whose members are responsible for designing and building such infrastructure. "Today's report provides the cold hard truth that America's economic recovery and long-term competitiveness will suffer if we continue to under-invest in our future," With 25,000 state owned bridges, Pennsylvania has the third largest number of bridges in the nation, and at the same time leads the nation in the number of bridges classified as "structurally deficient." The average age of bridges on the Pennsylvania state system is over 50 years.

Historically, Pennsylvania has not considered hot-dipped galvanizing as an option for superstructures and has consistently relied on paint as the primary method of corrosion protection. Hot-dipped galvanizing can provide direct and indirect cost benefits, with a high level of sustainability compared to other corrosion protection systems. While galvanizing has always been recognized as a means of corrosion control, hot-dip galvanizing can be specified for reasons including lower initial cost, durability, longevity, availability, versatility, sustainability, and even aesthetic. Students enrolled in the architect/engineering curriculum need to be educated in all aspects of galvanizing that will address the needs of the future.

COST

In comparison to other forms of corrosion protection, hot-dip galvanizing has the perception of being cost prohibitive on an initial cost basis. Increased technology and the stable price of zinc has made the hot-dip galvanizing process much more efficient in the last several years. On an initial basis, hot-dip galvanizing is often less expensive than other corrosion protection systems.

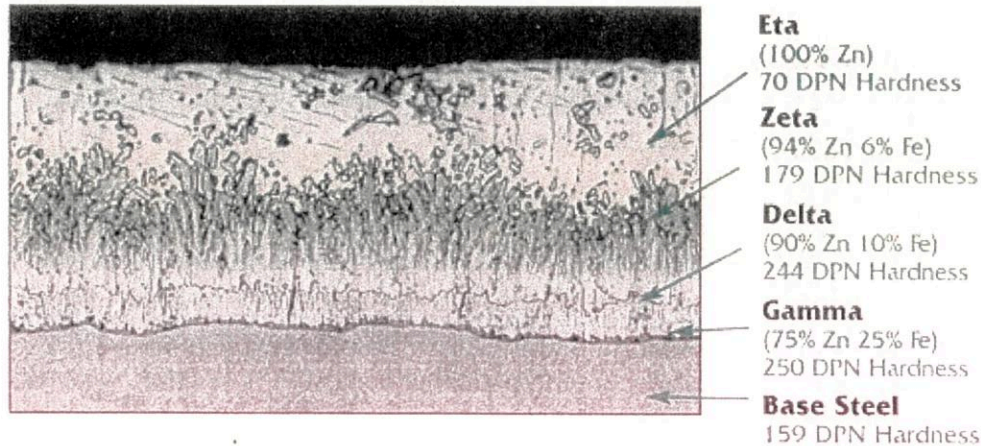
Hot-dip galvanizing must be considered based on a life-cycle costs in comparison to other coating systems. Life-cycle cost (LCC) is a more complete analysis because it considers the total cost over the life of the project (initial + maintenance). While other coating systems have escalating costs and continual costs of maintenance, hot-dip galvanized steel requires no maintenance for 70+ years in most environments. Many other corrosion protection systems, such as paint and powder coatings, have seen cost increases of 100% or more in the past five years. These other protective systems require maintenance on a more frequent basis, increasing the life-cycle costs. Direct maintenance costs for any project are typically 2-5 times the initial cost, and the indirect costs are even worse, 5-11 times the direct cost of repair.

The American Galvanizers Association (AGA) has developed an online [Life-Cycle Cost Calculator \(LCCC\)](#). The LCCC automates the calculation found in the specification ASTM A1068 and allows you to compare the initial and life-cycle cost of hot-dip galvanizing to 30+ other corrosion protection systems. To use the calculator, you input the specific parameters of your project (real or hypothetical) in three quick screens, and then the LCCC will provide a customized, printable comparison of initial and life-cycle costs of galvanizing to your selected corrosion protection system.

DURABILITY

Hot-dip galvanizing has unmatched durability in harsh environments, therefore making the process a viable specification for industrial, power and utility and infrastructure projects. The metallurgical bond of the coating to the steel is unique in that the zinc coating becomes part of the steel rather than a surface treatment. The three biggest factors in hot-dip galvanizing's durability are abrasion resistance, uniform protection, and complete coverage.

A unique characteristic of the hot-dip galvanized (HDG) coating is the development of tightly-bonded abrasion resistant intermetallic layers. The cross-section of a galvanized steel coating shows the three intermetallic layers (Gamma, Delta, and Zeta) and top layer of pure zinc (Eta). During the galvanizing process, these layers develop naturally during a metallurgical reaction between the iron in the steel and zinc in the kettle.



The photomicrograph also shows the hardness of each of the layers as a Diamond Pyramid Number (DPN). The multiple layers of coating are harder than the underlying steel thereby providing exceptional abrasion resistance. The outside layer is quite ductile which provides some impact resistance which, coupled with the inner layers, makes damaging the HDG coating very difficult. Galvanizing has a bond strength of approximately 3,600 psi, outperforming other coatings with typical bond strength of 300-600 psi. Hot-dip galvanizing provides unmatched protection against damage during transport and erection

The process of hot-dip galvanizing allows the thickness of the coating to be consistent on both the corners and edges as well as the flat surfaces. The tendency of other brush or spray applied coatings is to thin at the corners and edges. Additionally, due to galvanizing being an immersion process, hot-dip galvanizing provides complete coverage on both exterior and interior surfaces. This interior coverage is paramount in preventing corrosion on all surfaces of the member. Hollow structures that are painted have no corrosion protection on the interior surfaces.

LONGEVITY

Hot-dip galvanizing provides a maintenance free longevity even in the harshest environments. The corrosion resistance of zinc coatings is determined primarily by the thickness of the coating but varies with the severity of environmental conditions. Each environment affects hot-dip galvanizing differently based on a unique set of corrosion variables. The predictability of the lifetime of a coating is important for planning and budgeting for required maintenance.

Whether exposed in the atmosphere, subjected to blazing UV rays, snow, and/or other elements, submerged in water, embedded in soil or concrete, or various other environments, hot-dip galvanized steel can withstand the different corrosive elements and fulfill the intended design life..

AVAILABILITY and VERSATILITY

Hot-dip galvanized (HDG) steel is versatile and readily available. A wide variety of shapes and sizes ranging from small nuts, bolts, and fasteners to larger structural pieces, and even the most intricately detailed artistic pieces, can be galvanized

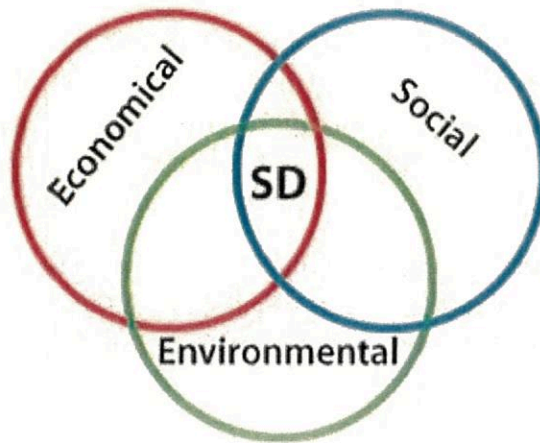
Since hot-dip galvanizing is a factory process, galvanizing can occur at any time thus not limiting availability on the construction site. Other protection methods, specifically paint, depend on proper conditions to accomplish the work at the job site. Since zinc solidifies upon completion of the process, there is no need for cure time allowing shipping and erection to occur within days. Additionally, galvanized materials can be stored outside with no detrimental affect to the integrity of the coating.

Zinc is the 27th most abundant material in the Earth's crust. The abundance of zinc, along with the availability of iron, contributes to the fact that galvanized products should be available now and in the future. In addition to their abundance, zinc and steel are also both 100% recyclable without the loss of any chemical or physical properties. This essentially ensures galvanized steel is an infinitely renewable building material.

With galvanized steel, you can do more with less. Because of the high strength-to-weight ratio, specifying projects with steel saves materials and energy. In fact, on average one ton of steel provides the same strength as eight tons of concrete, and according to the World Steel Association, the strength-to-weight ratio minimizes substructure costs and can also save money on transportation and handling.

SUSTAINABILITY

Sustainable development is the social, economic, and environmental commitment to growth and development that meet the needs of the present without compromising the ability of future generations to meet their own needs. Hot-dip galvanizing, because of its maintenance-free longevity, 100% recyclability, minimal environmental impact, and economic savings for future generations, can contribute positively to sustainable development initiatives.



When you couple galvanized steel's low environmental impact with its superior economic benefits (low life-cycle cost), it is simple to see hot-dip galvanized steel truly is a smart and sustainable construction material

AESTHETICS

Galvanized steel offers an attractive, natural gray finish that blends with the natural surroundings. As galvanized steel weathers and the zinc patina forms, the coating becomes a uniform matte gray. The non-intrusive finish of hot-dip galvanizing compliments and blends in with any environment, whether it be rural or urban areas. While the matte, gray finish of hot-dip galvanized steel may not be suitable for every project, a duplex system of galvanizing and then painting or powder coating over to the desired color may be an alternative. The duplex system does not sacrifice the corrosion protection, benefits and extended maintenance of hot-dip galvanized steel. The combination of hot-dip galvanized steel and paint or powder coating provide a synergistic effect. The paint/powder extends the life of the coating by providing an additional barrier coating to the zinc layers, while the galvanized steel prolongs the life of the paint coating by preventing underfilm corrosion and peeling. The result of the two coatings working in synergy is extended corrosion protection. The service life of a duplex system is 1.5 to 2.3 times the sum of the individual systems.

As architecturally exposed structural steel (AESS), hot-dip galvanized members allow a visual confirmation the steel is in good condition. The most recent upswing in industrial/architectural design movement can utilize the exposed structural steel member as a focus point in the project design. The high strength-to-weight ratio and ductility of steel allows for curves, arches, and intricate patterns and designs when planning design projects. It is important to ensure they remain beautiful design elements by protecting them against corrosion. Hot-dip galvanized AESS elements can fight corrosion for decades without stifling your design freedom.

CONCLUSION

Nelson Mandela stated that education is the most powerful weapon which you can use to change the world. Information regarding hot-dipped galvanizing may not be a weapon that will change the world, however the information can initiate a change as to the methods used to provide a long-term viable infrastructure. Student at Pennsylvania College of Technology deserve to have as much information regarding viable solutions that will intimately improve America's infrastructure.

The American Galvanizers Association site. Hot-Dip Galvanizing, 2016. Web. 3 March 2016.

Pennsylvania Department of Transportation site. Projects and Programs, 2016. Web. 5 March 2016.

The Education Trends site. Education Quotes. Web. 10 March 2016.