GALVANIZED REBAR: IT WORKS.

Corrosion Resistant + Durable + Economic + Sustainable

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The Corrosion Problem

Corrosion damage to reinforced concrete structures in the United States costs an estimated $20 billion annually. This figure is expected to grow by $500 million each year as existing infrastructure continues to age.

Addressing corrosion after construction is expensive and disruptive as all or part of the structure needs to be closed periodically for maintenance and repair. Failure to properly address corrosion can also lead to catastrophic structural failures with potentially deadly consequences.

Many of these costs and safety issues are avoidable if the potential for corrosion is minimized during construction through proper design and material selection. This is especially critical for the reinforcing steel and the structural steel connectors used to strengthen and join concrete sections.

Galvanizing, the process where steel parts are immersed in a bath of molten zinc, has a proven track record and should be your first choice in corrosion protection—because it works.

Despite precautionary measures and best practice, concrete structures remain vulnerable to reinforcement corrosion.

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Reinforcement Corrosion: Cause and Effect

Bare (or black) steel reinforcement bars rely entirely on protection provided by the surrounding concrete. However, concrete permits the passage of chlorides from deicing salts, sea salts or other corrosive substances to the rebar because of its natural permeability, and also through cracks and expansion joints. Even carbon dioxide from the air will eventually result in rebar corrosion.

Corrosion can be managed by reducing concrete permeability through optimal water/cement ratios; appropriate compaction and curing conditions; the use of concrete impregnation methods or membrane-type concrete coatings; and by providing a good depth of concrete cover over the rebar.

All of these measures can delay the corrosion of rebar, but not prevent it. The use of galvanized rebar has real benefits in improving the safety and reliability of reinforced concrete, even when the measures described above are used.

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All coatings are not equal

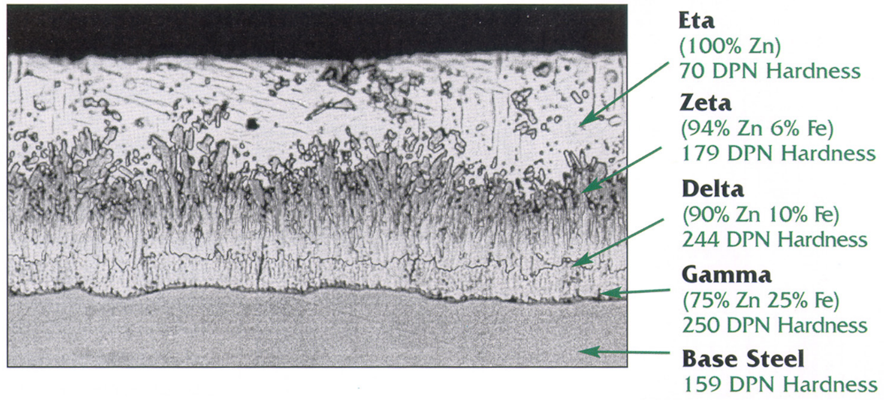
There are two basic types of coatings: *barrier and sacrificial. Most coatings can be classified as barrier because they provide basic protection from air and water penetration to the steel they are covering. Sacrificial or zinc coatings offer barrier protection, but also provide a secondary line of defense if the barrier coating is damaged as the zinc sacrifices itself, or corrodes preferentially before the steel.*

Barrier Protection

All coating systems are designed to provide barrier protection to the substrate they cover. Barrier coatings are only effective as long as the coating remains intact. Any scratch, cut, or abrasion exposes the underlying steel to corrosive forces.

When steel protected only by a barrier coating is damaged or weathered, corrosion will initiate at the unprotected surface and quickly expand from that point outward. This is caused by the growth of iron oxides under the coating, which stresses the coating, causing failure and subsequent expansion of the unprotected area.

Galvanized zinc coatings form an impervious metallic zinc barrier around the steel to isolate the steel surface from the surrounding concrete. This barrier is the first line of defense in protecting the steel from corrosion.



Sacrificial Protection

The excellent corrosion protection offered by zinc coatings or galvanizing derives from both the low natural corrosion rate of zinc coupled with its ability to extend protection to adjacent exposed steel areas, an effect known as cathodic protection. The coating also exhibits strong adhesion to the underlying steel surface due to its unique metallurgical bond that, together with the inherent toughness of a metallic coating, provides superior resistance to mechanical damage. The combination of these features results in a very durable coating, enabling concrete structures to be more tolerant of variability in concrete quality and reinforcement placement.

The use of galvanized reinforcement is uniquely advantageous:

- It offers excellent resistance to chloride salt attack and is unaffected by concrete carbonation.
- Zinc's cathodic protection inhibits corrosion at any minor coating discontinuity and also prevents 'undercutting' of the coating, confining any corrosion risk to the local area of exposed steel.
- Zinc corrosion results in little accompanying volume change. Unlike with steel corrosion, there is no adverse impact on the surrounding concrete. Research shows that any corrosion products simply diffuse into the adjacent concrete, helping to fill micro porosity that further inhibits corrosion.

Durable

A strong metallurgical bond between the steel rebar and zinc coating is created during the galvanizing process. Galvanizing is metallurgically bonded to the steel up to 3,600 psi, meaning when rebar is dropped, kicked, stepped on, or rubbed against existing concrete or other rebar pieces on the job-site, the protective coating will remain tightly adhered. This durable zinc coating will withstand the effects of UV light, temperature extremes, and exposure to rain or snow, thus protecting the rebar both as it waits to be used and while in use. From installation through the use phase, galvanized rebar is abrasion resistant and durable.

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A Sustainable Material

Galvanizing lengthens the life of steel and concrete structures enabling a huge conservation of natural resources by reducing the waste inherent with premature end-of-life.

Material specifiers and product engineers in key end-use markets such as building, construction, and transportation are increasingly interested in selecting materials that have the best environmental profile while meeting traditional cost, quality, and technical performance criteria.

Measuring the impact and resource requirements associated with zinc production against the impact and the benefits of using zinc during other stages in the product life cycle show zinc as a very sustainable material. The environmental footprint of galvanized coatings has also been documented.

Galvanizing can extend the life of steel and concrete structures to 100 years or more, enabling huge conservation of natural resources by reducing the waste inherent with premature end-of-life. Energy savings are also accrued through minimized maintenance and upkeep. The end-of-life recycling of zinc coated steel also adds to this conservation because energy requirements for re-melting steel and recovering the zinc are less than those required for producing the original metals.

The zinc and galvanizing industries understand that environmental and sustainability programs are integral to their future and are committed to updating the already favorable life-cycle information.

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Standards

Galvanized reinforcing steel can be ordered under ASTM specifications A767: Zinc coated (galvanized) steel bars for concrete reinforcement, and A1094: Specification for continuous hot-dip galvanized steel bars for concrete reinforcement.

It can also be ordered internationally under ISO Specification 14657: Zinc coated steel for reinforcement of concrete.

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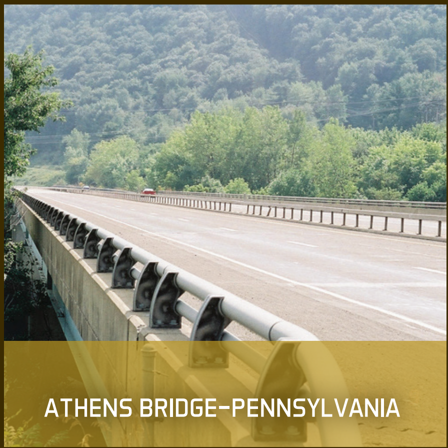

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Galvanized rebar has been protecting concrete structures in North America for over 75 years. There are many iconic and critical buildings, roadways, and bridges that rely on galvanized rebar for corrosion protection every day.

Learn more at:
www.galvanizedrebar.com

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