EIG CRSI®
EPOXY INTEREST GROUP

EPOXY-COATED REINFORCING STEEL IN

PARKING GARAGES

An important aspect of garage design is to ensure that the structure provides a long repair-free life. Designers face many choices for improving the performance of the concrete decks, columns and façades and to protect the structure against corrosion due to deicing and other salts. This document provides guidance on the use of epoxy-coated reinforcing steel and outlines its performance and benefits. Choosing epoxy-coated reinforcing steel for your next garage project will result in many years of performance.

Introduction

Over 24,000 parking garages are located throughout the United States; however, at least $600 million is spent yearly to repair parking decks in the U.S. typically a result of corrosion from deicing salts carried into the garage by cars.[1]

Parking garages without appropriate corrosion protection, such as epoxy-coated reinforcing steel may show deterioration within 10 to 15 years and costs for repairs may exceed $10/sf.[2] In addition, contractors generally need to remove a minimum of 100 spaces from service in order to affect a repair, which affects revenue in pay-to-park structures.

Damage to the concrete is frequently caused by deicing salts. These salts are often tracked into the garage by cars, where they drop onto the concrete floors. The salts migrate through the concrete and once they reach a certain concentration at the reinforcing bar, the bars corrode. As the steel corrodes, it occupies a larger volume than the original steel, resulting in cracking and spalling of the concrete.

Epoxy-coated reinforcing steel has been used to protect parking garages against corrosion-induced damage for over 40 years. One of the first constructed using this material was the La Crosse Center Parking Structure in La Crosse, Wisconsin in 1981. Recent surveys of this structure still find excellent performance.

Benefits

Excellent Corrosion Protection

Every year over 600,000 tons of epoxy-coated reinforcing steel is produced in the US and Canada. As of 2014, over 80,000 bridges and numerous buildings, wharfs and other structures contain epoxy-coated reinforcing steel. No other corrosion protection system for concrete has been as widely used as epoxy-coated reinforcing steel.

Cost effective life-cycle and excellent ROI

When compared with other protection systems, epoxy-coated reinforcing steel provides extended lives to concrete structures. When both first and life-cycle costs are considered, epoxy-coated reinforcing steel provide excellent returns on investment (ROI).

Nationwide availability

Epoxy-coated reinforcing steel is manufactured in over 35 different locations, nationwide. This enables owners and specifiers to obtain competitive bids for this material.

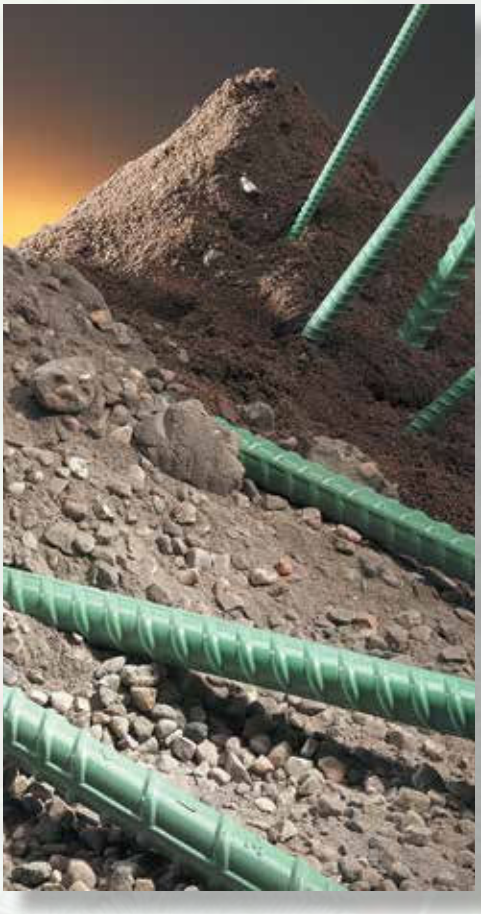
CRSI Certified Plants

Epoxy-coated reinforcing steel is available from over 35 plants certified by the Concrete Reinforcing Steel Institute. This program ensures that manufacturing facilities have procedures and operations to provide products that exceed purchasing specifications. No other corrosion protection system is independently certified.

REFERENCES:

[1] Pirro, B, "Parking Garage Repair - A Case Study, " Parking Today, September 2004.

[2] Shiu, K.N and Stanish, K, "Extending the Service Life of Parking Structures," Concrete International, Vol 30, No 4., April 2008.



Sustainability and LEED Credits

Epoxy-coated reinforcing steel is widely used and helps achieve the goals of sustainable development.

Recycled content: Epoxy-coated reinforcing steel is made using readily available reinforcing steel generally made using over 97 percent of recycled materials from primarily post-consumer sources. They are coated using environmentally friendly coatings in safe operations.

Embodied energy: The embodied energy of epoxy-coated reinforcing steel during manufacture is lower than that of other corrosion-resistant reinforcing steels.

Shipping: Epoxy-coated reinforcing steel is made from locally sourced materials available near most major cities. Other products may be produced in limited locations requiring additional shipping.

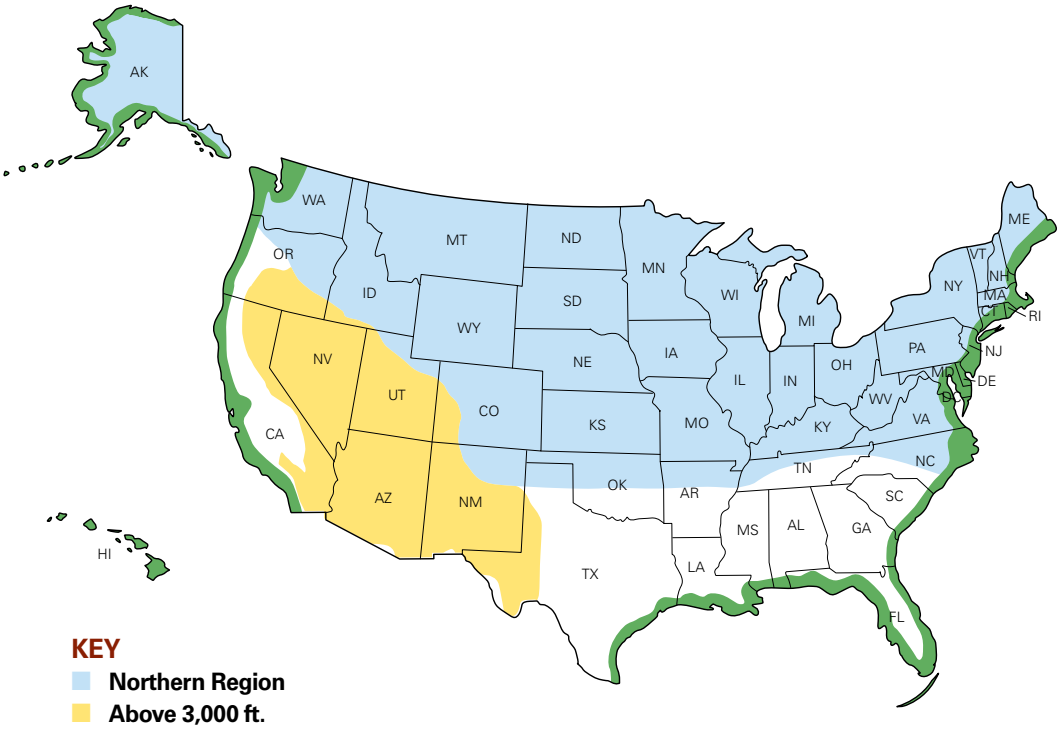
Durability: Epoxy-coated reinforcing steel has provided more than 40 years of excellent performance and has been shown in many independent studies to substantially increase the durability of concrete structures.

Cost: Epoxy-coated reinforcing steel is less expensive than most of the other corrosion-protection systems.

LEED Credits: The Leadership in Energy and Environmental Design (LEED) Green Building Rating System was developed by the U.S. Green Building Council (USGBC) and used by the Canadian Green Building Council (CGBG). Currently it is the most widely used rating system for environmentally sustainable design, construction and operation of buildings and neighborhoods. Epoxy-coated reinforcing steel may assist with credits for recycled content and regional materials. For information on how these may be utilized visit ***www.epoxyinterestgroup.org*** or contact your material supplier regarding your specific project needs.

Where to use Epoxy-Coated Reinforcing Steel

Epoxy-coated reinforcing steel should be used in all areas north of Interstate Highway I-40 from the Atlantic ocean, west to the Continental divide, plus all areas above 3000 ft in elevation. Epoxy-coated reinforcing steel should also be considered for areas within 5 miles of a major sea, such as the Pacific, Atlantic and Gulf of Mexico to protect against air-borne salts.



KEY

- **Northern Region**
- **Above 3,000 ft.**
- **Coastal**

Walker, H.C. "Durability Systems for Post-Tensioned Concrete Parking Structures," Concrete Construction 1990.

Corrosion and Steel Reinforcement

Corrosion Mechanisms

When steel is placed into concrete it develops a passive oxide film due to the high pH of the concrete. This passive film prevents further corrosion. Bars extracted from very old concrete may exhibit no evidence of corrosion.

The protective film may be disrupted by carbonation of the cement paste, which reduces the pH, or through the ingress of chloride ions into the concrete, from either deicing salts or sea water. The rate of carbonation and penetration of chloride ions is governed by the permeability of the concrete, which may be reduced using concrete with lower water-cement ratios or additions of materials such as fly ash, silica fume or slag cement.

The amount of chloride ion to initiate corrosion of uncoated steel in concrete is generally considered to be between 1.2 - 2.0 lb cu yd by weight of concrete. Once this level is reached, the passive film on the steel is disrupted and corrosion initiates. As the corrosion products of iron are greater than the initial metal, cracking and damage to the concrete occurs.

Where epoxy-coated reinforcing steel is used, corrosion may initiate at breaks or holes in the coating; however, the corrosion rates are substantially reduced. Laboratory tests have demonstrated over 98 percent reduction in corrosion rates even when damage is present.[1]

[1] *Lee, S.K. and Krauss, P.D., "Long-Term Performance of Epoxy-Coated Steel Reinforcing Steel in Heavy Salt-Contaminated Concrete," FHWA Report FHWA HRT-04-090, 2004.*

Figure A

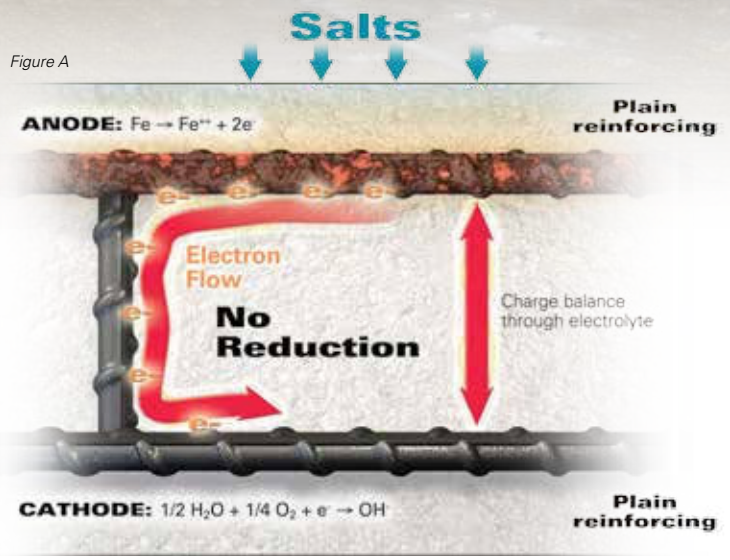
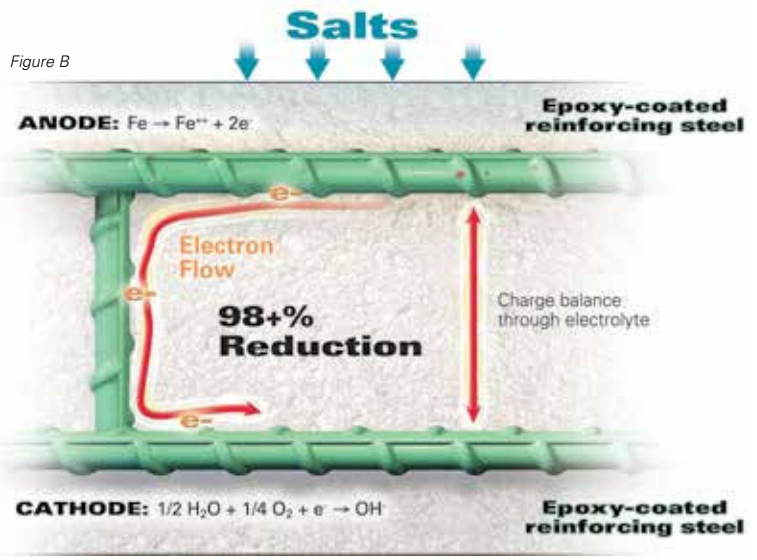


Figure B



BY THE NUMBERS...

$600 million — spent yearly to repair parking decks

Without epoxy-coated reinforcing steel garages may show deterioration within 10 to 15 years

Costs for repairs may exceed $10 per square foot

Providing Corrosion Protection

High Performance at a low cost – Epoxy-Coated Reinforcing Steel

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