Although bridge construction extends back thousands of years, steel bridge painting is in its infancy. The first iron bridge was built in 1779, and the first steel was used in a bridge in 1828. Coated bridges from the 19th century survive, raising the question, “Can coatings protect steel bridges for the next hundred years?” This article briefly reviews bridge construction, along with the history of bridge painting. The author discusses how to achieve 100 years of service life using current materials and offers recommendations for improving steel bridge painting.

A Brief History of Bridge Construction and Painting

Wood and Stone Bridges

For thousands of years, it is likely that bridges only a few feet long had been constructed of stones, logs, or tree trunks. One of the most unusual bridge stories, from an account by Herodotus, the ancient Greek historian, relates to the invasion of Greece in 480 B.C. by the Persian King Xerxes. He had his army construct a mile long “pontoon bridge” across the Hellespont to invade Greece. That bridge was made of wooden planks laid across cables supported by more than 600 wooden boats lashed together with ropes.

Wood bridges served an important function, but their service life was limited, as was their ability to span long distances. Even larger, complex wooden structures (like the bridge over the River Kwai in World War II) were limited in individual span length. More important, these structures were eventually unable to resist the forces of nature and were destroyed by fire or rotting.

Another form of bridge was the basic stone structure. A stone bridge of unknown origin at Tarr, England, is made of stones carefully piled on other stones across the Barle River. While complex, stone bridges surviving, like those constructed before and during Roman times, could not span wide expanses. Bridge construction was therefore limited to locations where the topography allowed points of support that could be placed relatively close together, usually no more than about 100 ft (30.5 m).

Though none survive, it is believed that most of the bridges from Roman times were constructed of timber. The most famous surviving Roman “bridges” are those used in the aqueducts and are constructed of the characteristic circular (Roman) stone arches.

The Modern Era of Bridges

The era of the modern bridge began with the development of iron and steel, strong
materials that would enable bridges to efficiently span long distances. Steel raised the issue of corrosion protection as a durability consideration.

**Iron Bridges**

With the advent of iron production in 1779, cast iron structural members were possible. The properties of cast iron made it ideal for certain types of structures. Because cast iron is strong when compressed (having compressive strength) but weaker when stretched (low tensile strength), cast iron bridges and bridge elements tended to be in shapes like arches, where the forces are mainly compressive. The first cast iron bridge was built in Coalbrookdale, England, in 1779.

The development and use of wrought iron occurred in approximately 1790, just after the first uses of iron in bridges. Wrought iron is a specially worked form of iron that is strong when stretched (having tensile strength). By approximately 1800, the development of wrought iron made possible its use in bridge components that required tensile strength. Cast iron and wrought iron or combinations of the two were the materials of choice for iron bridges from about 1779 to the 1840s. Both cast iron and wrought iron were resistant to corrosion.

**Steel Bridges**

The steel era in bridge construction actually began in the early 1800s while most bridges were still being built of cast and wrought iron. Steel was first used in a 300-foot (91-meter) suspension bridge built in 1828 in Vienna, Austria. In 1828, however, steel was produced in small batches. The batch process had several aspects that limited the more widespread use of steel in bridges. First, batch processing meant that steel was produced in limited quantities. Second, the steel varied from batch to batch in properties. Finally, batch processing meant that steel was expensive. It is not known what means of corrosion protection was used on the first steel bridges.

The 1850 invention of the Bessemer process for making steel yielded a more plentiful and less costly material with improved properties. Thereafter, steel began to emerge as the material of choice for the construction for bridges. The Eads Bridge in St. Louis, Missouri, still in use, was constructed with steel arches in 1874. Shortly thereafter, the first steel arch bridge in Europe, the Maria Pia Bridge in Portugal, was completed in 1877. The construction of New York City’s landmark Brooklyn Bridge, an iconic suspension bridge, followed in 1883. The Firth of Forth railroad bridge, a massive steel cantilever bridge in Scotland, was completed in 1890.

Unlike iron, steel requires corrosion protection.

**Lead and Chromium Compounds as Early Corrosion Inhibitors**

While steel has been used in bridges for only about 125 years, corrosion protection of the steel has been recognized as a concern for that entire time. Most of the
history of coating steel bridges for corrosion protection can be summarized in one phrase: “lead-based paint.” The use of lead and chromium, both heavy metals, as pigments in paint to protect steel bridges appears to have been well established by the time the Firth of Forth rail bridge was built.

Further, both the Eads (1874) and Brooklyn Bridge (1883) were painted with lead-based paint, as were most steel bridge in the U.S. until around 1970. Among other things, lead-based coatings were inexpensive, did not require extensive mixing and agitation, and were easy to apply. Even in 2007 dollars, costs would probably be between $0.50 and $0.75 per square foot. Although dispersion of the pigment in long oil binders (e.g., linseed, flax, and fish oils) did require some effort, it was easily accomplished with simple tools available to virtually all painters.

Lead-based coating materials could be applied to surfaces under a wide range of circumstances, from very dry to semi-damp. Importantly, the coating was able to “wet” the steel surface and adhere well to mill-scale-covered surfaces. When repainting was required, the material could easily be recoated with itself. In fact, it was commonly believed that “the more paint, the better,” because it was the lead pigment that provided the corrosion protection. This belief was actually true, until the coating thickness measured around 30 to 50 mils (750 to 1,250 microns). (One mil is 1/1,000 of an inch; a dollar bill is about 5 mils thick.) After decades of exposure to the elements, the alkyd and linseed oil binders would begin to dry out, oxidize, embrittle, chalk, erode, and generally deteriorate. When these binder materials deteriorated to the point where the cohesive strength of the coating was exceeded by the tensile forces, the coating spontaneously delaminated. At these higher thicknesses, the coating was subject to disbonding from itself, the substrate, or both.

The lead-(and chromate-) pigmented coatings could be applied to minimally cleaned surfaces. The normal required cleaning consisted of solvent cleaning followed by hand- or power-tool cleaning, either of which removed only loose contaminants before coating application. Intact mill scale remained on virtually the entire steel surface. The oil binder carried the inhibitive lead and chromate pigments into cracks and crevices of the mill scale to the steel, where they passivated and protected the steel from corrosion.

In coastal or marine exposure conditions, oil- and lead-based paint would last for as few as five years before touch-up was needed; however, in milder environments, the coatings could last for decades. At least one third of the United States lies in mild weather zones, where these coatings would be more than adequate for decades.

Despite all of its strengths as a coating material, this means of protecting steel from corrosion began to end in the U.S. in the 1970s when the legislators and Federal regulators began to recognize the environmental and health risks from lead and chromium pigments in paints and other substances primarily when the lead paint was applied or removed, not when it was intact. But by the 1970s, protective coatings for bridges had already begun to change.

The Recent "Era" Steel Bridge Coatings

Around 1970, many state highway departments switched to a completely new approach to protecting steel bridges from corrosion. The approach included much more expensive surface preparation and the application of a three-coat, high-performance system consisting of a zinc-rich primer followed by two vinyl coating layers. The most important change was that the new system required the complete removal of all mill scale from the surface of the steel. Shop painting required the use of labor-intensive open-nozzle blast cleaning or the acquisition of expensive centrifugal blast cleaning equipment. Cleaning costs alone—$1.00 to $1.25 per sq ft—more than equaled the entire as-applied cost of the earlier systems.

On the cleaned steel surface, the tiny metallic zinc particles of the primer could be in intimate, metal-to-metal contact with the steel substrate, and thereby create an anode-cathode relationship. Zinc, as the anode, would be sacrificed in a slow reaction, which produces harmless by-products, and the cathode (steel) would be protected. The two coating layers applied over the zinc-rich primer protected it from the surrounding atmosphere, thereby extending the primer's ability to provide long-term protection to the steel beneath.

In a landmark article in the JPCL in May 1985, Leyland surveyed all U.S. state highway departments, asking them to identify the coating systems they used on new steel and in maintenance applications. He also asked for their general thoughts about the systems they were specifying. Leyland’s survey revealed that while modern era high-performance coating systems were used at that time in about half the states, the other states

Wood was one of the materials used on the earliest bridges. Photographer: da-kuk
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were using the lead- and chromium-based systems, mostly for maintenance painting. Leyland’s research revealed that, at that time, the states used two coating systems predominantly: a basic lead silico-chromate system and the newer, three-coat system composed of an inorganic zinc-rich primer with a vinyl midcoat and vinyl topcoat.

The changes noted by Leyland signaled that the end was near for lead and chromium pigments in bridge coatings used for either new construction or maintenance painting. Less and less of the material was used on steel bridges, and currently, little, if any, lead-based paint is applied.

Current bridge coating technology has changed incrementally since about 1970. Corrosion protection of a steel substrate is rooted in the use of a zinc-rich primer. Because of air pollution issues related to their solvent content, the two vinyl coating layers whose use Leyland noted in 1985 have largely been discontinued on bridges.

Topcoat materials have evolved and are chosen for properties such as their durability, aesthetics, edge retention, color, and compliance with air quality regulations. Currently, the systems commonly in use involve a zinc-rich primer with an epoxy midcoat and a polyurethane or polyaspartic topcoat; a zinc-rich primer with an epoxy midcoat and a fluoropolymer or polysiloxane topcoat; a zinc-rich primer with a waterborne acrylic midcoat and topcoat.

Other systems consist of all acrylic coatings; and some consist of lead-free and chromate-free oil alkyd coating materials. Still other systems use multiple coats of calcium sulfonate-containing materials. (For details and cleaning specs, see Volume 1 Good Painting Practice and Volume 2 Systems and Specifications published by SSPC: The Society for Protective Coatings.)

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Aqueducts, made of stone, are the most famous surviving bridges from the Roman empire. Photographer: Tomazi

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How Long Do Systems Last?
NTPEP Testing of Coating Systems with Zinc Rich Primers

In about 2000, the American Association of State Highway and Transportation Officials (AASHTO) initiated a coatings testing program under its National Transportation Product Evaluation Program (NTPEP). Paid for by the paint suppliers and performed by an independent laboratory, the program consists of an extensive series of tests in accordance with Specification R31, "Evaluation of Coating Systems with Zinc-Rich Primers." Test results are available online, so that departments of transportation (DOTs) can access the data as well as decide which materials "pass the bar" and are included in specifications or on Qualified Products Lists (QPLs). The program eliminates the necessity for every DOT to test each material.

Service Life of Zinc Rich Primer Based Coating Systems

The service life before first touch-up of the high-performance systems using a zinc rich primer is about 30 years, in most circumstances. However, even in the northern tier of states that heavily use roadway deicing materials, many structures coated in the early 1970s are in very good condition and are only now even beginning to approach the time for their first touch up. The first touch up includes repairs to extend the service life of the topcoat.

The service life of a zinc-rich primer is limited only by actions that scratch, perforate, or damage the topcoats and, in doing so, pierce, remove, or expose the zinc layer. This process causes the zinc to react by sacrificing itself to protect the steel beneath. The reaction creates white powdery byproducts that often will cover the reaction site in a self-healing process. As long as the layers of coating over the zinc-rich primer are periodically maintained, the full service life of a system in the field has yet to be reached. With periodic field maintenance, a zinc-rich system with any of the available mid-coats and topcoats should be able to match or exceed the extended service life of 100 years provided by its predecessor, lead-based paint.

Cost Concerns with Zinc Rich Systems

Significant upfront costs are associated with the use of a shop applied, three-coat system consisting of an inorganic or organic zinc-rich primer and two other coating layers. The time and space required for proper shop application of a three-coat system make painting unattractive to steel fabricators, who are subject to tightening schedules and demand for accelerated bridge construction by owners anxious to meet project deadlines. The dry-to-handle time required between coating layers, often 24 hours, also causes steel members to be moved within the shop multiple times. Excessive moving of often large, heavy steel members in the shop is inefficient and expensive.

The cost of removing mill scale is also high. Centrifugal blast cleaning machines efficiently remove mill scale, but they
Another Unknown: The Effect Of Changing VOC Target Limits On Coating Performance

Changes in volatile organic compound (VOC) requirements generated by the Clean Air Act of 1970 and its amendments (e.g., 1977, 1990) influence the selection of coatings. The Clean Air Act Amendments mandate a maximum of 450 g/L of VOC for industrial maintenance coatings. Various other target limits exist as well. The Northeast Protective Coating Committee (NEPCOAT) member states use a limit of 340 g/L for approved coatings. California’s South Coast Air Quality Management District leads the way in environmental conservation, using a VOC target of 100 g/L. In the past, other California VOC targets have spread across the country.

Meeting VOC requirements has meant that coating manufacturers have reformulated their coatings to remove and replace solvents with other technologies. A new array of waterborne, high-solids, and other high-performance coatings is being developed by coating suppliers. These coatings are being tested via the NTPEP or other protocol. This new generation of coatings represents materials that do not have the 35-year field history of the solvent-based epoxy systems first used in the early 1970s. The new materials may perform better, worse, or about the same. After extensive testing via NTPEP, NEPCOAT, or other protocols, coatings suppliers are confident that the performance of these reformulated coating materials will be the same and quite likely better.

Cost approximately $500,000 or more and require continuous maintenance. Consequently, cleaning costs alone in most shops are thought to be around $1.00 to $1.25 per sq ft. The cost of the zinc-rich primer and the two layers applied over it can be as much as $0.75 to $1.00 per sq ft (material costs only). When application and overhead costs are included, a properly cleaned and fully coated steel bridge member could cost as much as $3.00 to $4.00 per sq ft when it is ready to ship to the field.

Extending the Life of Old Bridges
Problems associated with old bridges are related to lead paint management. Since the decision in the early 1970s to discontinue the use of lead-based paint, DOTs have two basic approaches to management: remove the entire aged system and replace it with a new system, or repair it following an engineered maintenance painting approach. The decision to repair or replace an aged system is a crucial one in terms of the life-cycle cost of the bridge’s corrosion protection system.

The engineered approach, the logical and most economical strategy, is to maintain the coating on the structure in a serviceable condition, extend the service life of the existing coating as long as possible to reduce life-cycle cost, and postpone the expensive removal and replacement of lead-based paint.

In other words, the engineered approach is to manage the life of the coating system by touching up the paint before it needs to be removed on a wholesale basis. It means painting the structure “before it needs painting,” so that the areas that are corroded can be managed and minimized. In doing so, the service life of the lead-based paint that is in place and protecting a vast majority of the structure’s surface area can be effectively extended. An effective service life extension, often measured in decades, is possible in some cases. Regulations do not require that lead-based paint be removed. Until it must be removed for good reason, such as when the coating is very thick, poorly adherent, and corrosion is present over more than 16% of the bridge, lead-based paint can remain in place. Above that 16%, efforts to repair the coating may be counterproductive, and the structure should be scheduled for complete coating removal and replacement.

Employing an engineered maintenance painting approach means going “against the grain,” since a traditional bridge painting strategy is to wait until the paint on the bridge is beyond its service life and in poor visual condition before recognizing a need to repaint. Proper removal of lead paint is costly. Blast cleaning itself is costly. Not only must contractors remove layers of lead paint, but also they generally must remove old mill scale to create a suitable surface for recoating. The amount of blast cleaning increases costs. In addition, to prevent lead debris from conta-
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coating could be approaching 55 to 80 years, while still intact and protecting the steel substrate. At this point, 100 years of service is well within reach.

(SSPC has a chapter in Volume 1 Good Painting Practice devoted to expected service life of coating systems.)

• Inexpensive and Durable New Coatings

Often paint industry insiders complain that, “We could solve the problem, but it is going to cost more.”

Reflecting on the development of steel bridge painting over the last 125 years, the technology of corrosion protection gravitated toward the “lowest common denominator.” For example, lead-based paints were likely the corrosion-inhibitive coatings of choice because they were both effective and inexpensive. Research should be undertaken to find or develop such an inexpensive, easily applied, long-lasting (but non-toxic) coating material to replace lead.

• Making Steel Bridge Painting the Obvious Choice

In about 1999 or 2000, the first major change in the three-coat system of the 1970s came about in response to the challenges presented by the necessity to fully contain overpass bridges during lead paint removal and repainting operations. Since roadways had to be closed to clean and paint these structures, it was believed that significant savings could accrue with the development of a fast-curing, two-coat system. The two-coat system could be applied over blast-cleaned steel and would deliver the same protection to the steel surface that a three-coat system would provide. Since then, various materials have been developed, tested, and offered to the bridge painting community. In 2004, a two-coat paint system was approved by North East Protective Coatings Committee (NEPCOAT).

Additionally, since the two-coat system approved by NEPCOAT cures quickly, in about one hour, its use in the field during maintenance repainting of steel bridges in either daytime or night-
time allows bridges to be repainted with fewer or perhaps no daytime lane closures.

In the shop, the two-coat system’s use should increase shop throughput because the time spent simply drying is dramatically reduced. According to data on shop painting costs that Appleman collected for a Federal Highway Administration (FHWA) funded study, the cost to abrasive blast clean steel to remove mill scale and to apply a three-coat system in the shop is about 11 to 12% of the total cost of newly fabricated bridge steel. Blast cleaning and primer application alone cost about one-half that total, or 6%. By inference, it appears that the use of two coats of paint in place of three can reduce the cost of fabricated bridges by approximately one-half the difference or about 3%. A 3% savings in the total cost of the fabricated steel bridge member is substantial. For example, on a one-million-dollar bridge (a 500-ton bridge at $1/lb), the 3% savings will be $30,000.

- Developing a One-Coat Paint System
  The cost of protecting steel could be nearly halved (from approximately 11 to 12% to approximately 6%) by developing and using a one-coat system. The savings on the hypothetical 500-ton bridge purchased for $1/lb will be an additional $30,000. As yet, no suitable one-coat material has been successfully identified, tested, or approved. A pending FHWA research study is awaiting funding (see http://www.pooledfund.org/documents/solicitations/924.pdf).
- Training and Prequalifying Contractors and Painters
  The issues that limit service life are, in part, training related and partly influenced by how bridge painting contracts are awarded—which is generally to the lowest bidder, not necessarily the lowest responsible bidder.
  SSPC operates effective training and certification programs for painting contractors and painters. Improvement in performance in this area comes when owners demand an end to unacceptable workmanship. In some cases, training requirements for contractors and painters may need to be tightened. Available from SSPC, coatings suppliers, consultants, unions, and others, training for painters should be fully utilized. Contractor prequalification programs like those of SSPC should be specified.
  Where needed, painting contractor prequalification requirements should be re-examined, updated, and utilized to be sure that the job is really awarded to the lowest responsible bidder.
- Replacing Deicing Materials Containing Chlorides
  DOTs have used road salt (sodium chloride) heavily for 50 years as a deicer, but the ultimate price of salt-induced corrosion is very high. Alternative deicing materials should be re-examined to see whether a material that is less corrosive to steel but still effective as a deicer can be identified.
- Removing Chlorides From Contaminated Steel Surfaces
  A means is needed to remove chloride contamination from bridge steel before repainting. Chloride contamination is believed to be the single biggest reason coatings fail on bridge repainting projects.
  In spite of past research, an economical, practical means of chloride removal/remediation on existing steel is not yet available. Several methods, including both dry and wet abrasive blast cleaning methods as well as water jetting, have been noted as possible methods of chloride remediation.
  Unfortunately, a method to measure the amount of chlorides remaining within the pits on pitted steel surfaces after cleaning has not yet been developed either.
  The issue of chloride removal/remediation on steel surfaces before repainting should be more thoroughly researched.
- Recognizing the Importance of Maintenance Painting
  Bridge painting must be seen by Federal, state, and local government agencies as a legitimate, crucially important, ongoing maintenance activity that is funded adequately every year.
- Total Mill Scale Removal
  There is doubt in the author’s mind whether the removal of all mill scale is necessary. It is acknowledged that in the steel/mill scale galvanic couple, steel becomes the anode and therefore will corrode in the presence of moisture. However, there is a great deal of practical evidence to suggest that its complete removal may be overkill. In mild service environments, the presence of mill scale in conjunction with a fast-curing, two-coat (or one-coat) paint system could prove to be effective for decades. The use of such an approach could reduce the cost of corrosion protection on those structures by as much as 75 percent. Note that in Europe, the blast cleaning standard for Commercial Blast Cleaning allows some mill scale to...
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<tr>
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<td>U.S. Navy</td>
<td>Sole Spec</td>
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<td>Carrier Deck Edge Elevator Cables</td>
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**Corrosion Under Insulation**

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<td>Refrigerant Lines</td>
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**Crevice Corrosion**

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<td>Bridges</td>
<td>State DOT</td>
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This material does not solve all problems. Currently applications are limited to “hidden corrosion” situations which are not exposed to mechanical abuse or weather.

In the coming months, we will be developing extensive web resources and a related corrosion blog. While we are doing this, you can review a good summary of what has been done so far by visiting [www.rg2400.com](http://www.rg2400.com), or by visiting [www.polyguard-products.com](http://www.polyguard-products.com). We will also send you a desktop corrosion test kit so you can test the material in saltwater.
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remain. In the United States, an old Maryland State Highway Administration pictorial standard for Commercial Blast Cleaning also allowed flecks of mill scale to remain. Blast cleaning standards SSPC-SP 5, White Metal Blast Cleaning; SSPC-SP 10, Near White Metal Blast Cleaning; and SSPC-SP 6, Commercial Blast Cleaning require the complete removal of all mill scale. Some mill scale is permitted to remain on surfaces blast cleaned in accordance with SSPC-SP 14, Industrial Blast Cleaning.

In short, the need to completely remove mill scale should be re-examined. Coatings that can keep water from the mill scale/paint interface may prove that the old practice of painting over mill scale can still be effective in the modern age of steel bridges. Research should be undertaken regarding the need to remove mill scale and to what extent.

**Closing Thoughts**

Mill scale takes us full circle. The lead and chromate systems could adhere to steel with mill scale. For the zinc-rich systems that succeeded lead systems, mill scale had to be removed. Finding replacement coatings that can tolerate mill scale or determining that mill scale does not always require complete removal will be a significant step toward lowering the cost of bridge painting while maintaining coating service life of many decades, even 100 years.

Eric Kline, executive vice president/senior consultant for KTA, has over 35 years of experience in the protective coatings industry and is an active member of SSPC.
While the development and widespread use of polyurethanes and polysiloxanes have increased the longevity of topcoats, there still exist considerable differences in the long-term durability of zinc-rich primers and topcoats.

Fluoropolymers, developed in the 1960s, have always offered intriguing possibilities for coatings. Their desirable properties include extreme weatherability and chemical resistance, low surface energy for anti-graffiti properties, and corrosion resistance. The use of fluoropolymer resins for topcoats would allow for the retention of desirable topcoat properties (corrosion protection, original color and gloss) for as long or longer than those achieved by zinc-rich primers. Unfortunately, the application characteristics of fluoropolymers have limited their use in field-applied coatings. Most fluoropolymers form films only at high temperatures, either by melting or coalescing from solvents. Adhesion of fluoropolymers to metal is poor, but can be improved by the addition of other resins, which can compromise other physical properties. In addition, many fluoropolymers are difficult to recoat due to their low surface energy.

To address these shortcomings, researchers in Japan developed a group of products known generically as FEVE (fluoroethylene vinyl ether) resins in the early 1980s. Coatings made from them offer the weatherability of fluoropolymers combined with properties found in conventional coatings like polyurethanes. Coating properties can be modified by slight changes in the structure of the FEVE resin, which are soluble in solvents, and can be made water-compatible, making them familiar and easy to use in the field. The chemistry used in formulating FEVE-based coatings is exactly the same as that of conventional polyurethanes, and application equipment is exactly the same as well. Thus, FEVE coatings can be applied in the shop for new construction, or in the field for bridge rehabilitation.

Although initially somewhat more expensive than urethanes or siloxanes, fluoropolymers offer considerable reductions in coating life cycle costs, in bridge downtime, and in traffic problems during repainting.

Coatings made with FEVE resins also offer excellent corrosion resistance. Zinc-rich primers are the main defense against corrosion on steel bridges. Conventional topcoats gradually lose thickness and erode over time due to degradation by UV light, rain, wind, and chemicals. When the conventional topcoat erodes completely, the midcoat begins to degrade, increasing the probability of corrosion. Fluorourethanes do not lose significant thickness over time, and therefore continue to impede the movement of corrosion initiators through the topcoat.

Recently, bridge designers have begun to explore the use of more varied colors in bridge topcoats, moving away from standard lighter colors like yellow and grey. Fluorourethane topcoats offer the possibility of using unconventional colors for bridges, while ensuring the designer that the original gloss and appearance will remain intact for many years.

Most of the long-term research on FEVE-based coatings has been done in Japan. In the 1980s, a series of bridges were recoated, usually half with a FEVE-based topcoat, and the other half with a topcoat commonly in use at the time. The condition of these bridges was monitored over time, and as a result, FEVE topcoats have now been used on dozens of bridges in Japan. Probably the best known is the Akashi Straits Bridge, which is the world’s longest suspension bridge. The bridge is over 12,000 feet in length, with the single longest span of over 6,000 feet. The bridge was opened in 1994. Coatings were primarily shop applied and finished in the field. Multiple FEVE topcoats are meant to give a coating life in excess of 60 years.

Based on extensive testing over the past 25 years, the Japanese Ministry of Land, Transport, and Infrastructure issued its new national specifications for coatings for steel bridges in August 2006. “Japanese Specifications for Steel Bridge Coatings” requires fluoropolymer topcoats on all bridges in Japan, for both new construction and rehabilitation. Bridges topcoated with fluoropolymer resins are expected to have useful lives, exceeding 50 years in some cases, to significantly reduce costs associated with recoating bridges in the field, and to postpone the need for recoating of new bridges.

FEVE fluorourethanes are beginning to find application in the U.S. as well. A series of bridges in Nashville, TN, have been fully or partially topcoated with fluorourethanes: the Shelby Street Bridge, Gateway Bridge, the Woodland Street Bridge, and the Victory Memorial Bridge.
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