CN2000® TEST PROJECT ON BRIDGE PYLONS EXPOSED TO THE TIDAL EFFECTS OF SEA-WATER

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US TEST PROJECT CONDUCTED BY KELSO COATINGS ON BRIDGE PILES EXPOSED TO TIDAL EFFECTS OF SEA-WATER

In March 2008, Kelso Coatings was contacted to conduct a test project in a Southern United State to prove the amazing capabilities of the **CN2000®** series of waterproof materials on Bridge Piles exposed to tidal effects of sea-water.

Chlorides are the "crime culprit" that causes corrosion damage to millions of bridges around the world, and cause major economic losses in all countries worldwide.

While chloride corrosion to the steel rebar is the main form of concrete structural damage, studying the mechanism of deterioration shows that waterproofing and anticorrosive treatments must be carried out on bridge structures to extend their service life.

For this, the **CN2000®** series of waterproof materials have excellent waterproof and anti-corrosion properties and play an important role in the rejuvenation and protection of these structures.

Key words: Concrete Deterioration - Reinforcing Steel Oxidization – Waterproof - Anti-corrosion - Service Life - CN2000® Cementitious Capillary Crystalline Waterproofing (CCCW) Series of Waterproof Materials

Introduction

Bridges – the solidification of art, which have distinct images and strong appeal, reflect the characteristics of the times, and record the course of the development of human civilization. Only the strong, solid and durable stability of the bridge building structure can really show their immortal vitality. However, over the past 20 years, on a worldwide scope, bridge damage caused by spreading ice melting salt and the major damages and economic losses resulting from these actions, are truly amazing.

In 1986, a group of experts were formed by Europe, North America, Australia, Japan etc. These 16 countries, conducted a detailed and overall survey as to the status of about 800,000 cement concrete road bridges (length of at least 5 meters) in these countries and transnational, the results showed that the reinforcing steel bar corrosion and freezing and thawing damage are the two most intrusive forms of damage and this damage becomes more serious with the use of de-icing salt.

If Governments want to repair or update these damaged bridges, the cost can be as high as $500 to $900 U.S. per square meter, far higher than the cost of the original structure. This developing trend is not really very optimistic.

According to earlier statistics, among the 575 thousand bridges in the United States, more than half have evident damage; 40 percent of the bridges have insufficient bearing capacity, and must be repaired and reinforced; and bridges with serious damage and that are in a critical state are numbered at about 90,000.

There are on average, several thousand bridges partially or completely damaged each year and their life expectancy is reduced to less than 20 years. In the 1990’s, the maintenance costs in the United States for these bridges, has been as high as 155 billion U.S. dollars, and is four times as much as their original cost.

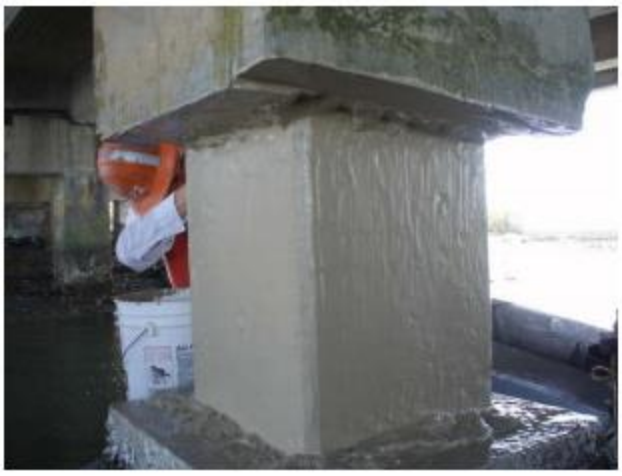
Piles Exposed to the Tidal Effects of Sea Water

We need to point out specifically, that the pile position in the interface of water and air, the "water level changing area" or "waves splashing zone", suffers the erosion damage of above ground (atmosphere) and underwater (complete soaking area) environment concurrently and makes this portion of the pile, an area that suffers the most serious corrosion damage. The wet and dry cycle and freeze-thaw cycle of physical damages are particularly notable in this position. Due to the concrete in this position being in a relatively oxygen-rich environment, it promotes the rapid corrosion of the steel reinforcing bars.

Actions of sea life and microbial biochemical reactions in this oxygen-rich environment will also have their negative effects on the pile as well.

The excellent waterproof properties of the **CN2000®** line of waterproof products will effectively resist the corrosion damage to the piles, produced by the harsh environments where they are in service.

After removing the concrete shield, 2 coats of **CN2000®B** is applied by brush to the exposed pylon to a thickness of +1mm and allowed to set for 1 hour between coats

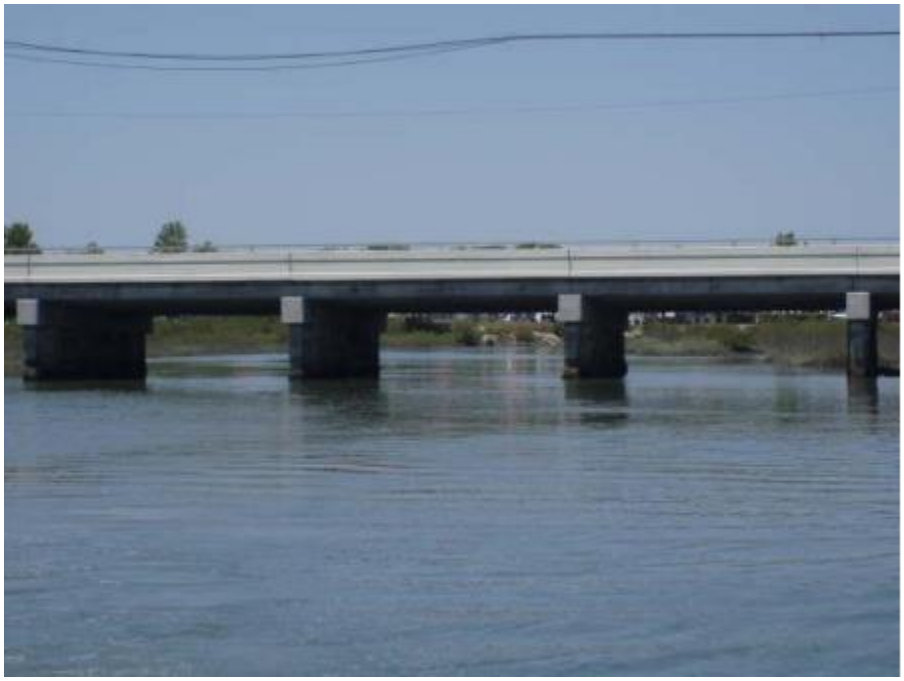


Once the final **CN2000®B** coating has set, a flexible coating of **CN2000® C+D** is applied to ensure proper hydration of the **CN2000®B** and to prevent contamination of the coating by seawater and to allow the proper 24 hour curing of the **CN2000®B** coatings.

NOTE: The application of the CN2000® C+D in this project was utilized as a physical barrier and waterproof membrane to protect the **CN2000®B** coating during its 24 hour curing phase in the same way one would use a plastic film, due to the rising tide and splashing of the salt water. Normally on a static structure such as piles, the proper application and curing of **CN2000®B** would be sufficient to ensure a permanent waterproof membrane on the pile.

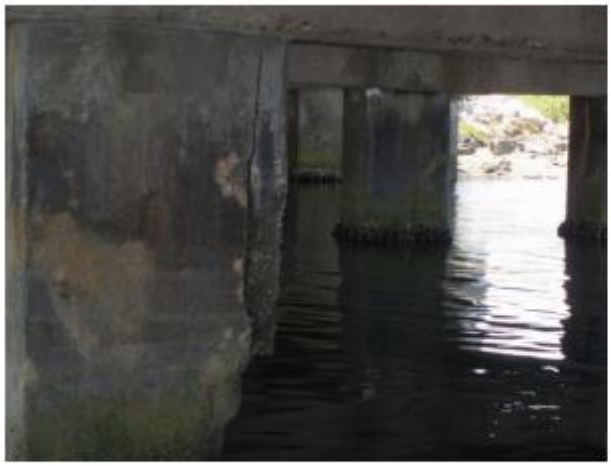
The Test Project:

Piles - Supporting a Bridge, Spanning a Tidal Channel in the Southern U.S.



Pile Description

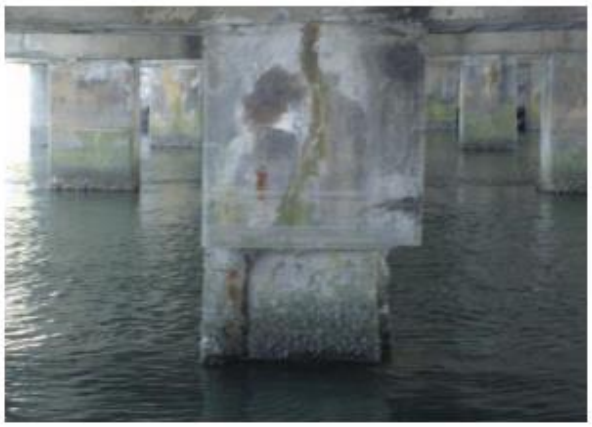
Each Pile that supports the bridge is an independent reinforced concrete column 18 inches by 18 inches and is entirely shielded by a 6 inch concrete shielding jacket.



The above 2 photo's show the extensive damage to the concrete shielding jackets, which now allows the corrosive environmental effects and the tidal actions to attack the unprotected reinforced concrete structure of the pylon.

Preparation for the Test Project:

3 weeks prior to the Test Project, Department of Transportation workers removed a 24 inch section of the 6 inch concrete shielding jacket of the sea water/air interface zone, on 1 pile and ½ of the concrete shielding jacket of a second pile, for comparison purposes.



The above 2 photo's show the exposed reinforced concrete piles (fully exposed pile on the left, and the partially exposed pile on the right).

After only 3 weeks of exposure to the environmental effects, one can note the extensive growth of barnacles and other sea life, and the saturation of the sea water/air interface zone of the concrete pile with salt water, resulting in the chlorides affecting the steel reinforcing bars within the concrete structure causing damaging corrosion of the steel reinforcing bars.

At low tide, when the work area was completely exposed, Department of Transportation workers under the guidance of **Kelso Coatings** personnel and under the watchful eye of State Environment Conservation Personnel thoroughly cleaned the exposed piles down to the substrate.

After cleaning, the exposed substrate was saturated with fresh water and the first coat of **CN2000®B** was applied by brush coating in the proscribed manner to a thickness of +0.5mm to all the exposed surfaces of the pile and the exposed surfaces of the concrete shielding jacket. After 1 hour, when the **CN2000®B** had set (not sticky to the touch) a second coat (+0.5mm) was applied to bring the coating to the proscribed thickness of +1mm

After the second coat of **CN2000®B** had set, (1 hour) D.O.T. workers applied a flexible **CN2000®C+D** coating by brush over the areas previously coated with **CN2000®B** to ensure a complete waterproof membrane of the pile to protect the **CN2000®B** coating from the environment to allow proper curing.

NOTE: The application of the CN2000® C+D in this project was utilized as a physical barrier and waterproof membrane to protect the **CN2000®B** coating during its 24 hour curing phase in the same way one would use a plastic film as a protective barrier, due to the rising tide and splashing of the salt water. Normally on a static structure such as piles, the proper application curing of **CN2000®B** would be sufficient to ensure a permanent waterproof membrane

After removing the concrete shield, 2 coats of **CN2000®B** is applied by brush to the exposed pile to a thickness of +1mm and allowed to set for 1 hour between coats.

Once the final **CN2000®B** coating has set, a flexible coating of **CN2000® C+ D** is applied to ensure proper hydration of the **CN2000®B** and to prevent contamination of the coating by seawater and to allow the 24 hour curing of the **CN2000®B** coatings.

Piles successfully waterproofed with the **CN2000®** line of waterproof products will cure in only 24 hours

CN2000® Cementitious Capillary Crystalline Waterproofing (CCCW) Products

Used in the Pile Test Project

CN2000®B (CCCW)

CN2000®B is high tech dry powder preparation that when properly mixed with water and applied to a clean concrete substrate surface that has been completely saturated with fresh water in the prescribed manner will form a permanent waterproof coating on static concrete surfaces.

The Characteristics of CN2000®B (CCCW)

Waterproof and impervious	Anti-Corrosion Properties
High strength	High stability
Long life-span	Self-healing ability
Economical	Cures in 24 hours
Convenient Application and Installation	Normal ventilation (allows concrete to breath)

Environmentally Friendly Product

CN2000®C (liquid material) **CN2000®D** (dry powder)

CN2000®C+D

This product is a high tech composite type of coating that combines organic and inorganic materials to form a flexible waterproof membrane.

By mixing the 2 products in the proscribed manner the **CN2000®C** activates the dispersing agent in the **CN2000®D** forcing a hydro-reaction, causing the creation of a macromolecule polymer that forms a continuous, flexible membrane with a specified strength and elasticity.

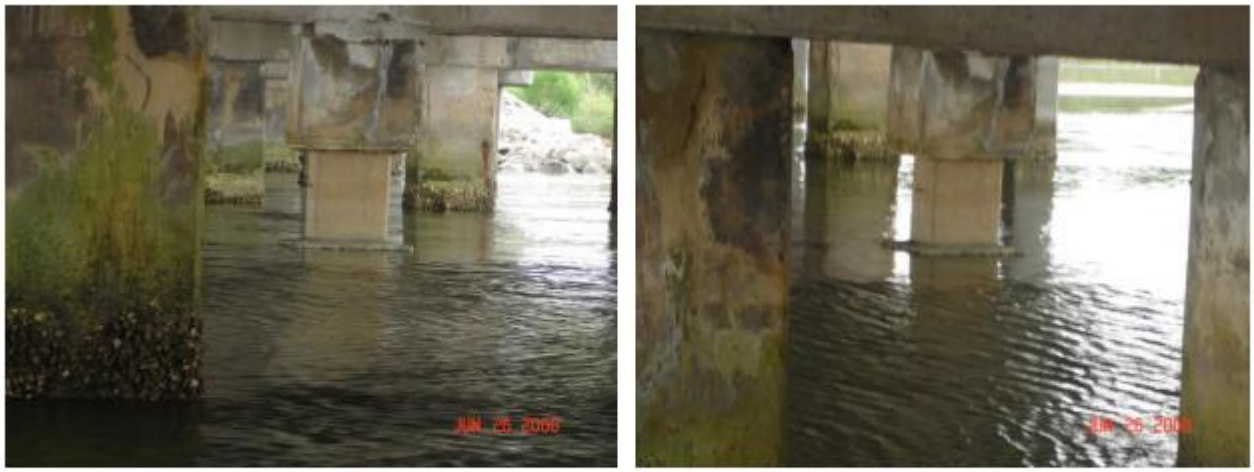
This waterproof coating membrane structure can be used in waterproofing of flex joints and the deformation joints built into concrete structures. The **CN2000®C+D** product has excellent strength, elasticity and low-temperature flexible performance, adhesive strength as well as being nontoxic and **Environmentally Friendly**. **CN2000®C+D** is resistant to ultra-violet radiation, and resists the effects of aging.

In addition to having the same characteristics as **CN2000®B** (CCCW) that are noted above, **CN2000®C+D** offers high tensile strength, flexibility at low temperatures and elongation abilities, adhesive strength on the damp concrete structures surface and maintains a high impervious strength.

TEST PROJECT UPDATE JUNE 26, 2008

On June 26, 2008, Kelso Coatings personnel attended the test site for the CN2000®B (CCCW), CN2000®C+D application utilized in the Pile Test Project.

We are all pleased with the preliminary results of our observations and the effectiveness of the protective coatings.



After 3 months exposed to the corrosive environmental effects and the tidal actions, the test piles appear almost the same, as the day the **CN2000®** coatings were applied

Our initial observations include:

- **Although the CN2000®C+D coating only cured 1½ hour prior to being submerged by the rising tide, our observations indicate that the bonding to the substrate is still consistent.**
- **The CN2000® coatings have maintained their integrity and continue to protect the piles.**
- **There is no apparent erosion damage to the coated piles.**
- **Barnacles and other sea life are not adhering to the CN2000®C+D coating.**

Results of further tests and observations will be added to this document in the months to come.

The simple and convenient application of **CN2000® Cementitious Capillary Crystalline Waterproofing (CCCW) Series of Waterproof Materials** has resulted in a permanent waterproof membrane to the test pile, effectively replacing a vast quantity of concrete that previously, had to be intermittently removed and replaced and never really provided a waterproof membrane, but only a thick, porous physical barrier between the corrosive environment and the steel structure within the concrete of the pile.

The test project utilizing **CN2000® Cementitious Capillary Crystalline Waterproofing (CCCW) Series of Waterproof Materials** on the bridge piles exposed to tidal effects of sea-water in this Southern U.S. State will be analyzed by the Ministry of Transportation technical personnel over the next few months along with the technical data and sample products that were supplied to Department by **Kelso Coatings**.

Kelso Coatings is confident that all expectations of the **CN2000® (CCCW) Series of Waterproof Materials** will be met and exceeded in this test project, and in the future, **CN2000®** will be the choice of this State for its waterproofing material needed for infrastructure projects.

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