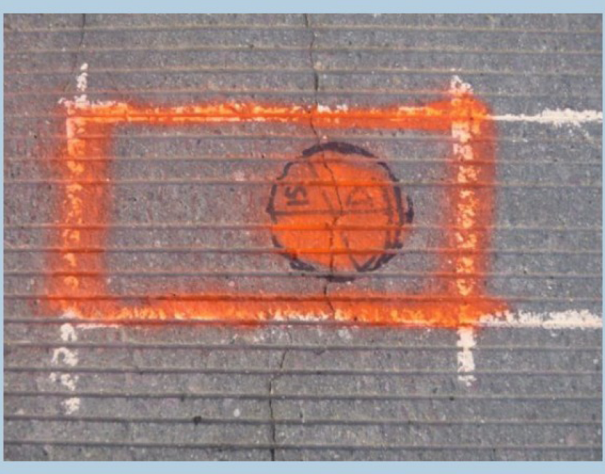
June 5, 2019

Plastic doesn't rust

Plastic might be both the curse and the comfort of modern day living. We all worry about the ever-growing pile of plastic entering landfills and the oceans. At the same time, life has become so much easier as this miracle material finds its way into more and more uses. Even car engines, today, contain a significant amount of plastic.

One of the great advantages (and challenges!) of plastic is that it doesn't corrode. And engineers are finding ever-increasing and innovative uses. WHKS engineers were recently involved in a pilot project with the Iowa Department of Transportation to evaluate ways to protect and preserve highway bridge decks using polymer (plastic)-embedded concrete.

Apart from the bridge structure, which provides the support and carries the weight down to the foundations set in soil or rock, the bridge deck is the horizontal surface that traffic drives on. It's pretty apparent than an 80,000-pound tractor trailer, rolling along at 70 mph, is rough on a bridge deck. Put hundreds of these over the bridge every day, add thousands more cars and apply a heavy dose of rain, snow, ice and road salt and you have a recipe for a bridge deck that will deteriorate quickly.



Deck cores were precisely located with regard to existing deck reinforcing. Cores were occasionally drilled through reinforcing and deck cracks to determine extent of chloride intrusion and corrosion.

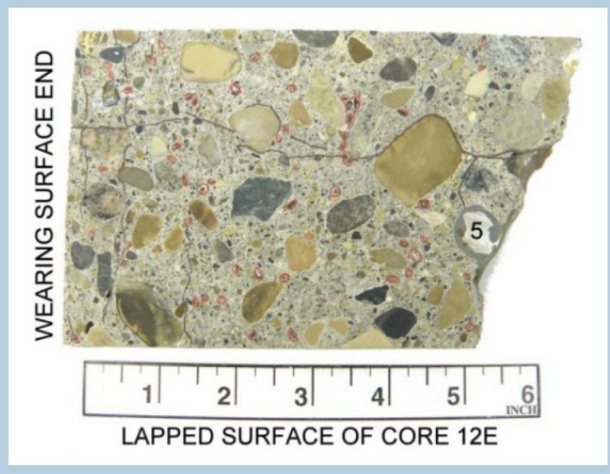
Structural engineers have become pretty good at holding the weight and dealing with the constant vibration. The challenge has been the corrosion that invariable happens when water and salt meet the steel that reinforces a bridge deck's concrete surface.

The pilot project studied 30 relatively new bridges on three highway corridors in Iowa. Most serious bridge repair and maintenance doesn't begin until it's been 25 to 30 years or more. By then, the salt will typically have penetrated through countless micro-cracks and begun to corrode the steel reinforcing. By looking at newer bridges, the engineers are hoping to find preventative maintenance techniques that can stave off costly and disruptive repairs.

Concrete deck cores were drilled and sent for testing to establish chloride levels and extent of corrosion-related damage in the deck.

The study looked at bridges that had been in service on average 25 years or less and divided them into two categories - those with decks that are still in almost-new condition and those on which salt corrosion had already begun. The decks in good shape were then given a thin coating of polymer, which is essentially a pancake batter-like layer of plastic-embedded concrete. The decks that were already showing salt intrusion had a surface layer of salt-laden concrete removed with an extremely high-pressure water stream. Then a layer of new, high density concrete was poured as an overlay.

These two preservation techniques, at a fraction of the cost of major bridge deck repair and replacement, might offer a way of extending the service life of highway bridges.



Petrographic analysis was performed to identify any deficiencies or long-term durability issues in the concrete.

The study's not done yet. Engineers will go back to these bridges and see how the new surfaces have performed compared to the traditional methods. If the theories are correct, these plastic-coated bridges could save a lot of infrastructure repair costs.