



# Tech Brief

## Blacktop Resurfacing of Bridge Decks

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### BACKGROUND

Delamination (spalling) of bridge decks has become a serious issue because a great number of structures have severely deteriorated structural properties; however, reinforced-concrete durability has not been given proper attention in design, realization and maintenance. Concrete deterioration results from freezing and thawing, aggressive chemical exposure, abrasion, corrosion of metals, and chemical reactions of aggregates, often resulting in an environmental “overload”. There are an increased number of structures with shorter life spans, and also structures that have been repaired inadequately. Such inadequate repairs often have detrimental environmental affects as well, i.e. pollution.

### HERE'S THE PROBLEM

There is a need to determine an economically and technically feasible means of repair strategy for reinforced concrete structures, and establish guidelines for the repair of reinforced concrete structures that have been affected by reinforcement corrosion.

### AND, HERE'S THE SOLUTION

To create a bridge deck overlay evaluation plan. This will occur through evaluation of different types of overlays used in bridge deck structures, and their required properties, and determine the influences external factors impact them, in order to determine means of realization of repair.

### BUT HOW CAN IT BE DONE?

- By developing standardized measurement methods to assess service life of concrete used as a construction material, and to be used as a tool in prediction of repair. Results from standardized testing can be used in design to determine the material properties and parameters for quality assurance and quality control.

## THESE ARE OBJECTIVES...

- To gain a thorough understanding of degradation mechanisms which alter properties of structural elements and structural systems.
- To establish a repair strategy that ensure adequate materials and procedures are used to slow down, rather than hasten, deterioration.
- To develop a means of repairing damaged structures that are economical and ecologically sound.

## HERE IS WHAT WE DID...

This procedure began with a review of the background bridge deck deterioration. The primary causes of deterioration were found to be based on reinforced steel corrosion. This corrosion often produces an expansive force that causes concrete to spall above the steel. Such deterioration is a result of environmental overload.

The second step in this research project was field performance and demonstration. It was discovered that ample cover over the steel and use of a low-permeability, air-entrained concrete assures good durability in a majority of cases. However, a more positive protection is needed for more severe exposure. In these cases, an epoxy-coated reinforcing steel, cathodic protection, chemical corrosion inhibitors, or other means, are necessary.

Establishing a standard means of assessment for the quality and condition of materials, lead us to develop some experimental test methods. Analysis was done on permeability to fluids, and the diffusion of ions. Due to a lack of standard measurement methods, it was difficult to develop objective criteria needed for prediction and assessment of the service life of concrete as a construction material and barrier.

The third segment of this research was classifying environmental loads based on reinforced concrete performance. Because every structure is supposed to be designed for dead, live, and special loads, its bearing capacity must not be exceeded. However, it was found that the poor condition of existing off-shore and under-water structures demonstrates a need for developing a design procedure that will consider environmental and durability conditions. From this analysis it is proposed that environmental loads are considered in design procedures.

The fourth segment was creating a new mix design through laboratory experimentation. Through a knowledge supported mix design, we created a new concrete production means. This approach resulted in a development of an information system CAMDOC for the computer aided mix design. CAMDOC was shown to provide the ability of simple reaction to all variable changes in the concrete mix, equipment and concrete production, for the purpose of concrete quality control.

## WHAT IS THE NEXT STEP?

To further this research, the next step is to implement a mathematical model for durability design and monitor its success in insuring greater bearing conditions during the entire life service of reinforced concrete structures. This means supplementing the existing design procedure with new criterion that increase bearing capacity under conditions of a simultaneous action of traditional and environmental loads. In addition, a means of developing a protective system should be created to minimize future damage to existing structures. Evaluation of two such systems is recommended- one being replacement of existing concrete with a concrete containing a corrosion inhibitor, and the other being the use of overlays of asphalt concrete with corrosion inhibitors.

### FOR MORE INFORMATION CONTACT:

NJDOT PROJECT MANAGER:	Mr. Robert Baker
<b>e-mail</b>	
UNIVERSITY PRINCIPAL INVESTIGATOR:	Dr. Ali Maher
UNIVERSITY:	<b>Rutgers University -CAIT</b>
PHONE NO.	<b>(732) 445-2569</b>
<b>e-mail</b>	<b>mmaher@rci.rutgers.edu</b>

A final report is available online at <http://www.state.nj.us/transportation/research/research.html>

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