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## Concrete Deck Testing – Correlation Results

*Walter N. Hucal, P.E.*

Interstate highways are mercilessly subjected to heavy truck and traffic loading demands. Due to these demands, the Delaware River Joint Toll Bridge Commission (DRJTBC) requested a bridge deck and roadway condition study on a 4.75 mile stretch of Interstate 78 under their jurisdiction, from the west abutment of the Delaware River Bridge in Pennsylvania to the Still Valley Interchange in New Jersey. The purpose of this study is to determine which recommendations would be necessary to protect DRJTBC's investment for the next 15 years without the need for additional major roadway and bridge repairs or rehabilitation.

The scope of work is comprehensive and complex, covering numerous engineering disciplines. One of many key components in this study is to evaluate the condition and integrity of the concrete decks for six bridge structures along this corridor, including the seven-span continuous, 1,222-foot long dual-structure Delaware River Bridge. In order to carry out this evaluation, the following six non-destructive tests (NDT) need to be performed: visual inspection; delamination check via hammer and chain drag; chloride content analysis; half-cell potential readings; concrete cover via pachometer; and four-inch diameter coring.

It is important to note that the six structures under investigation are approximately 20 years old, and the top mat of transverse and longitudinal rebar is epoxy coated.

The findings from each test, respectively, show:

- Transverse cracks no greater than 1/30" of moderate density exist across the structures. No significant spalls are observed, and hence rebar is not exposed. Minor SIP corrosion is noted in small isolated areas.
- Delaminations typically occur in small isolated areas (approximately 0.05% of total deck area), except for a one-span structure, where nearly 5% of total deck area is delaminated along a longitudinal construction joint.
- Six of 64 pulverized concrete samples (~30 grams) indicate chloride content greater than two pounds per cubic yard of concrete. This value is the assumed threshold to initiate rebar corrosion.
- Numerous half-cell values were measured and recorded at nodes across a six-foot by six-foot grid referenced across the concrete

deck area. Values range from -60mV to -800mV. A half-cell value of -350mV is the assumed threshold likely to indicate rebar corrosion. A value more negative than this increases the likelihood of corrosion.

- Concrete cover for rebar varies from 1½" to 4". The average value hovers between 2" to 2½". Locations of low concrete cover did not disturb the integrity of the concrete.
- Four-inch diameter coring is only performed following half-cell contour mapping across the deck area, and locating areas of steep half-cell gradients (i.e., where rebar corrosion is likely and would need to be verified physically and visually).

The findings from all NDTs are then correlated in order to accurately evaluate the deck condition. Very little correlation is found between the chloride content and the associated half-cell value for a test location.

All half-cell values, even if they are more negative than the -350mV threshold, are deemed to be of no consequence, as the epoxy coating prevents any electrical continuity between the reference rebar and the rebar test location. In the circumstance where either chloride or half-cell, or both values, exceed the assumed threshold giving rise to initiate rebar corrosion, the associated concrete cover is generally 2½". Furthermore, any evidence of significant cracks, spalls, concrete deterioration, or delaminations is not visually observed. Finally, if a four-inch diameter core is necessary to extract from the suspected contaminated location (at least based on theoretical threshold values), it is found that the epoxy coating layer is completely bonded to the rebar after it was removed from the core sample.

In other words, despite the concrete deck containing contaminating elements conducive to rebar corrosion, the epoxy coating appears to effectively shield the rebar from such corrosion.

Repair of isolated delaminated concrete deck areas notwithstanding, and the presence of numerous fine transverse cracks which allow for additional intrusion of chlorides into the concrete deck, the low correlation between the high chloride content results with associated half-cell values compounded with visual evidence and the age of the bridges point to the apparent effectiveness of the epoxy-coated rebar. ■