

1.14.11. MULTI-MODAL CONDITION ASSESSMENT OF CONCRETE BRIDGE DECKS

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Reinforced concrete bridge decks are exposed to several types of deterioration processes: corrosion, alkali-silica reaction (ASR), carbonation, shrinkage, freeze-thaw actions, etc. The most commonly found problem is corrosion induced bridge deck delamination. Previous studies have shown that surveys of bridge relying on a single non-destructive evaluation (NDE) technology provide only a limited information about condition of concrete bridge decks. To overcome limitations of individual technologies, a complementary approach using several NDE technologies should be used in bridge deck evaluation.

The presented approach utilizes a suite of NDE technologies, namely: impact echo (IE), ultrasonic echo (UE), ultrasonic surface waves (USW), ground penetrating radar (GPR), half-cell potential and electrical resistivity. In addition, some of the techniques were implemented using multiple devices. For example, the GPR evaluation was conducted using 1.5 and 2.6 GHz ground-coupled and 1 GHz air-coupled dual polarization antennas. Similarly, impact echo testing was conducted using three different devices. The suite of the NDE technologies was implemented on evaluation of bridge decks on nine bridges in Iowa, U.S.A. The NDE evaluation was complemented by “ground-truth” measurement on the cores extracted from all nine bridge decks.

The condition assessment using the six NDE technologies has clearly shown their advantages and limitations. For example, the GPR surveys provided assessment of concrete deterioration at relatively high speeds of data collection. On the other hand, the IE and UE provided high accuracy in detection and characterization of delaminations in the deck, but at a lower testing speed. Half-cell potential test provided accurate assessment of likelihood of corrosion, while the USW test provided accurate assessment of the effects of deterioration processes and defects on mechanical properties, primarily the elastic modulus degradation. Most importantly, the surveys have shown advantages of the use of multi-modal NDE surveys in the comprehensiveness of condition assessment of concrete bridge decks.