

## SHRP2

### Nondestructive Testing for Concrete Bridge Decks (R06A) Round 7

#### NYS DOT Summary

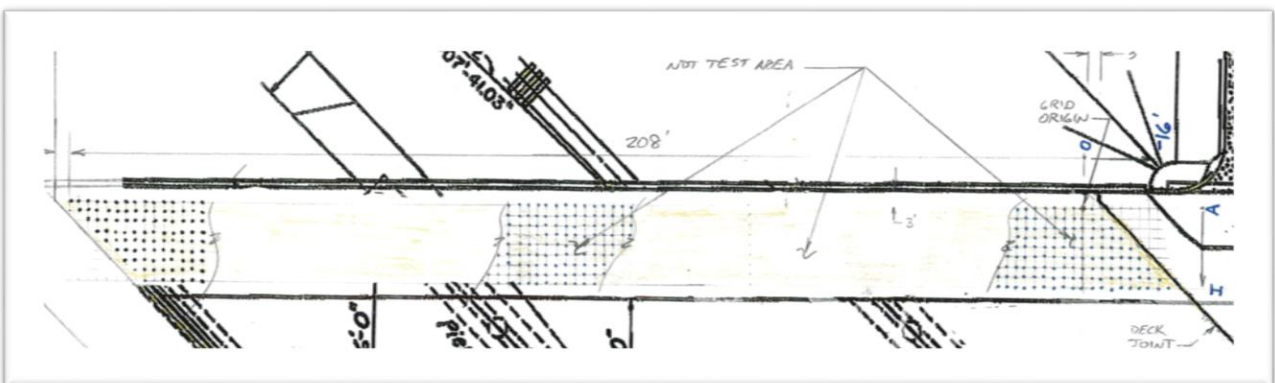
October 31, 2018

Program Purpose: Identify non-destructive testing (NDT) technologies that can reduce costs and time associated with bridge deck inspections while improving the accuracy and condition assessment of these inspections.

NYS DOT Workplan: The Region 3 Structures Unit wanted to use and evaluate mobile bridge deck NDT scanning equipment above and beyond what we already deploy. We'd like to incorporate some more modern techniques to detect both delamination (primary) and corrosion (secondary) deterioration. After reviewing Report S2-R06A-RR-1, it was determined that the Region would like to test out **Impact Echo equipment** for delamination detection over a single bridge test site for learning and comparison purposes.

#### Test Grid Site:

BIN 1049529  
I690 over CSX  
Town of Geddes  
Onondaga County, NY



Objective was to obtain top (and bottom) delamination location and quantities at the test site for the various rapid IE methods. This was a project-level experiment (versus a system-wide evaluation).

#### Testing Completed:

- NYS DOT - Regional Personnel  
-Chain Drag Sounding  
June 2017

- ABI (Advanced Bridge Inspections, LLC) - Demo  
-Rapid Automated Sounding (RAS); full lane width.  
June 2017
- BDI Inc. (Bridge Diagnostics Inc) – Work Plan Agreement  
Mobile Impact Echo; deck acoustic response measurements; full lane width.  
-Electrical Resistivity  
-Infrared thermography  
-High resolution video  
September 2017
- NYSDOT/Olson Instruments Impact Echo (SSS-IE) – Work Plan Rental Agreement  
-Surface Sonic Scanner; mobile walk behind cart unit.  
July 2018
- NYSDOT – Deck core verification  
Core samples and testing.  
July/August 2018
- NYSDOT GPR  
State forces; GSSI walk behind cart unit.  
July 2018  
(This non-IE testing was completed for project purposes. The data will be compared to IE results as well.)

Delamination Testing Results:

The following table presents the deck delamination values (% of **test grid**):

Top rebar mat delamination	
NYSDOT	15% Delam (19% deterioration*)
ABI	10%
BDI	13%
Olson Instruments SSS-IE	14%

\*This value includes areas that were patched and not included in the sounding delamination.

Bottom rebar mat delamination	
NYSDOT	Not feasible
ABI	Not feasible
BDI	8%
Olson Instruments SSS-IE	Feasible but not yet calculated

Findings/Observations:

- Generally, the top mat delamination values (% areas of test grid) were all relatively close.
- The NYSDOT chain drag effort involved numerous personnel (4 to 5 people) over a period of almost 3 hours to complete the field work. This involved grid layout, sounding, marking, measuring, and compiling the field data. Additional time was needed in the office to finish documenting the work.
- ABI test was overall very quick. The equipment deployed within minutes and tested a full lane width in one pass. The actual test run also only took a few minutes.
- BDI SounDAR equipment had issues during the day. There are three tests that could be used with the modular apparatus. Some contact, some with non-contact microphones. But it took time to set up and adjust the equipment for the various tests. Overall the operation did not run as smooth as anticipated. Numerous IE and ER tests were completed throughout the day. The SounDAR equipment did provide bottom delamination locations. BDI did complete some NDT tests (IR and HRV) that were above and beyond what was included in the scope of work.
- Olson Instruments SSS-IE: This piece of equipment was used over a three-day period. First day for NYSDOT personnel to get trained on use, and following two more days to test the grid site (and the rest of the bridge). Close to 100% bridge deck testing coverage was completed. Refining the raw data could be somewhat complicated and complex for a new user of the SSS-IE software. It would take some time and continued experience to make decisions on what could be a good versus bad data. However, generally good results can be completed using the software automatic processing only (without specific user editing).
- NYSDOT deck cores: We took some cores to try and confirm the bottom delamination locations detected by BDI. We took two cores in areas which showed bottom delaminations. We were unable to verify any deeper (bottom) delaminations from the extracted core samples. Cores were solid. Inability to verify bottom delaminations may be partly attributed to scaling and data mapping inconsistencies.

#### Summary:

All the tested project level Impact Echo technologies showed generally good delamination results. All the various methods had their strengths and weaknesses. There was not a definitive Impact Echo method that stood out as the most encompassing in assuring timely, accurate, and cost effective bridge deck evaluations.

Delamination Map Attachments:

- Test Grid Location Map
- NYSDOT Chain Drag Map
- ABI Delamination Map
- BDI Delamination Map
- Olson Instruments SSS-IE Maps

NYSDOT Work Plan (May 16, 2017), BDI Nondestructive Evaluation Report (Sept 30, 2017) and deck core information (photos and test results) can be supplied upon request.