



SHRP2 R06A IAP Round 7 Concrete Bridge Deck NDT New York State DOT Participation Summary

Bridge Test Site
BIN 1049529
I690 over CSX RR

07/12/2016

Prepared by: Dan Jones
NYSDOT
333 E. Washington Street
Syracuse, NY 13202
Presented by:

SHRP 2 R06A Round 7 – New York State DOT Peer Exchange Presentation – January 2019

Program Purpose:

- Identify non-destructive testing technologies that can reduce cost and time associated with bridge deck evaluations while improving the accuracy and condition assessment of these inspections.

NYSDOT Workplan:

- The Region 3 Structures Unit wanted to test and evaluate mobile bridge deck NDT scanning equipment above and beyond what we already deploy.
- Progress beyond “Chain Dragging”!
- Become familiar with other more modern NDT technology. Evaluate for possible implementation in NYSDOT.
- Goals include completing NDT deck evaluations faster, with higher accuracy, utilizing less resources, and in a safer fashion with less impact to travelling public.

SHRP 2 R06A Round 7 – New York State DOT Peer Exchange Presentation – January 2019

- After reviewing Report S2-R06A-RR-1, it was determined that the Region would like to specifically test out **Impact Echo** equipment for delamination detection over a single bridge test site for learning and comparison purposes.
- Emphasis was placed on addressing the needs on project level (not system wide) bridge deck evaluations.
- Assist bridge designers on the bridge deck replacement/rehabilitation decision and the selection from various specialized monodeck overlay treatments.

Sample Deck Condition Photos



SHRP 2 R06A Round 7 – New York State DOT Peer Exchange Presentation – Jan 2019

New York State DOT Field work:

Summer 2017

- Subject Matter Expert General NDT Training – Olson Engineering
- New York State DOT Personnel – Chain Drag Sounding
- Advanced Bridge Inspections, LLC – Rapid Automated Sounding
- Bridge Diagnostics Inc. - SoundDAR Impact Echo

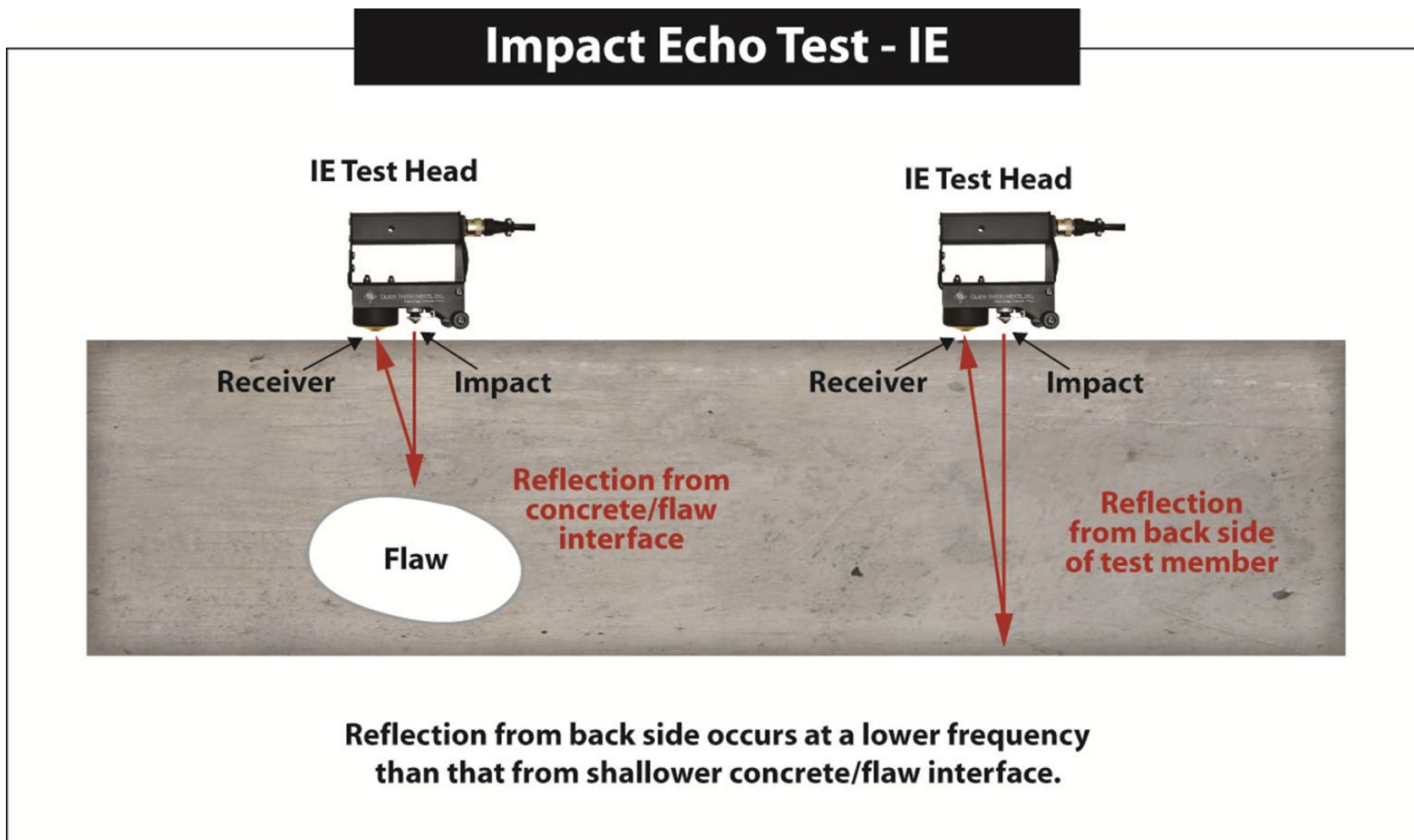
Summer 2018

- Olson Instruments – Surface Sonic Scanner Impact Echo Testing
- New York State DOT Personnel – GPR and Deck Validation Coring

Specifications/Standards

- ➔ ASTM C1383-04(2010) - Standard Test Method for Measuring the P-Wave Speed and the Thickness of Concrete Plates Using the Impact-Echo Method
- ➔ ACI 228.2R-13 - Nondestructive Test Methods for Evaluation of Concrete in Structures (Section 2.2.3 – Impact Echo Method)

Description of the IE Method



Physical Principle

$$D = \beta V_p / (2 * f)$$

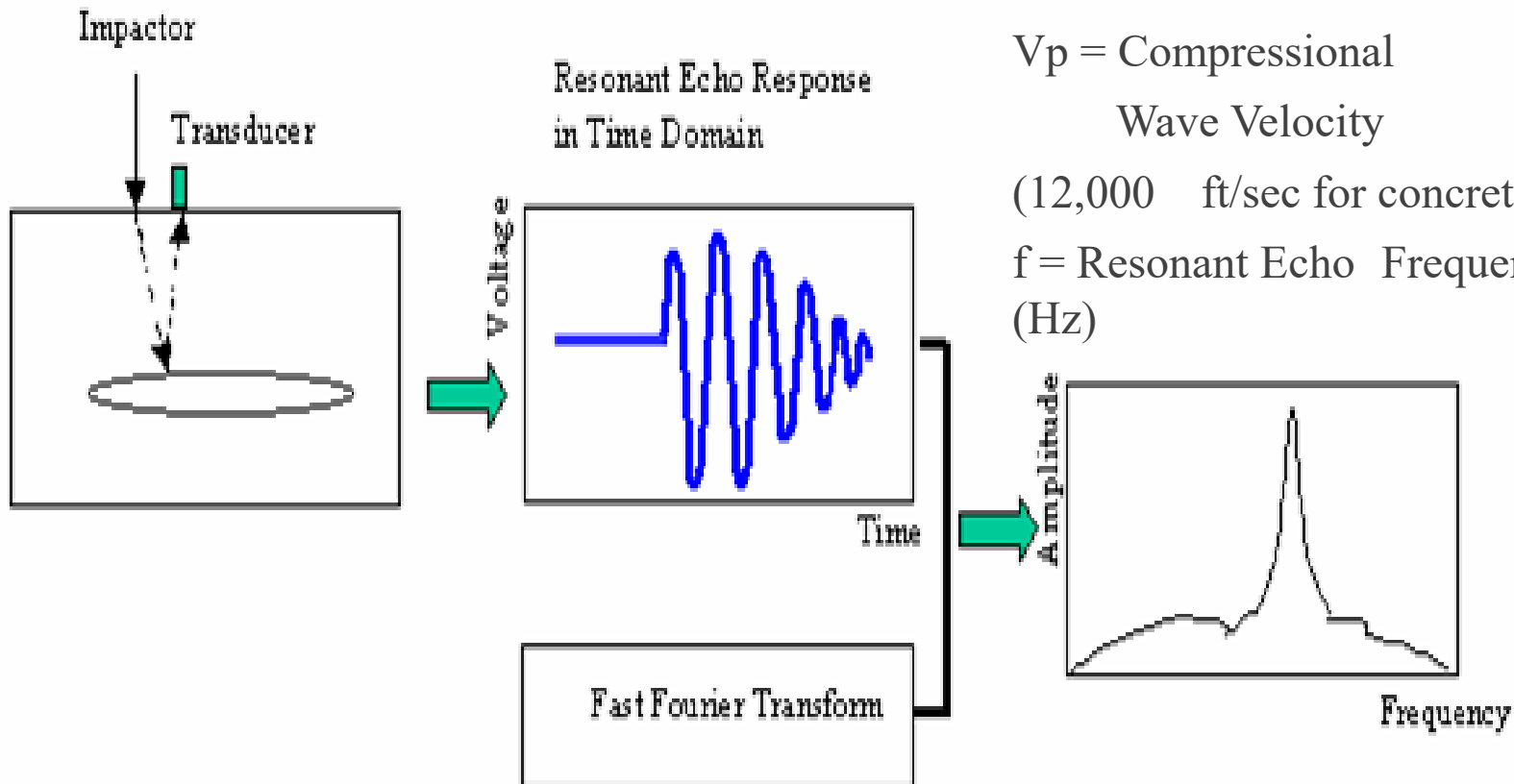
β = Shape Factor (0.96 for slab/wall shape)

D = Thickness

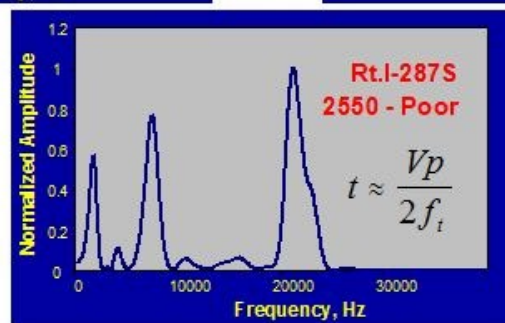
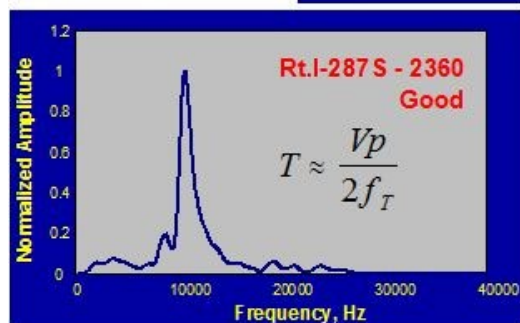
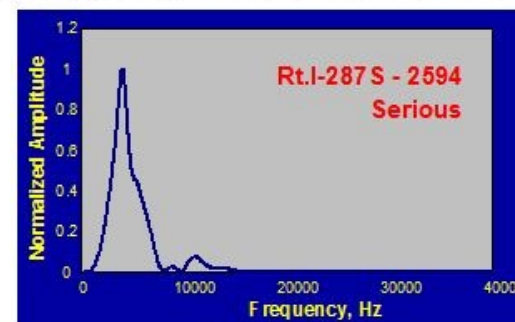
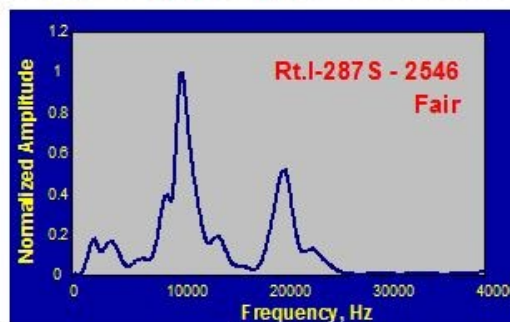
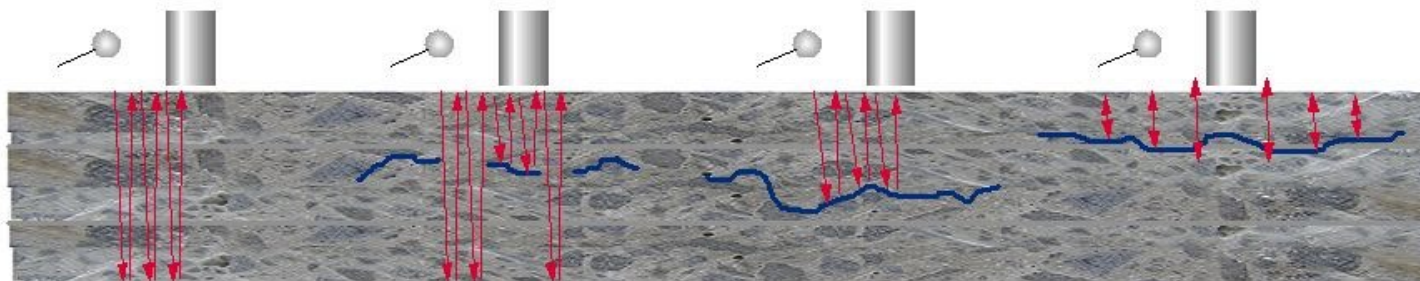
V_p = Compressional
Wave Velocity

(12,000 ft/sec for concrete)

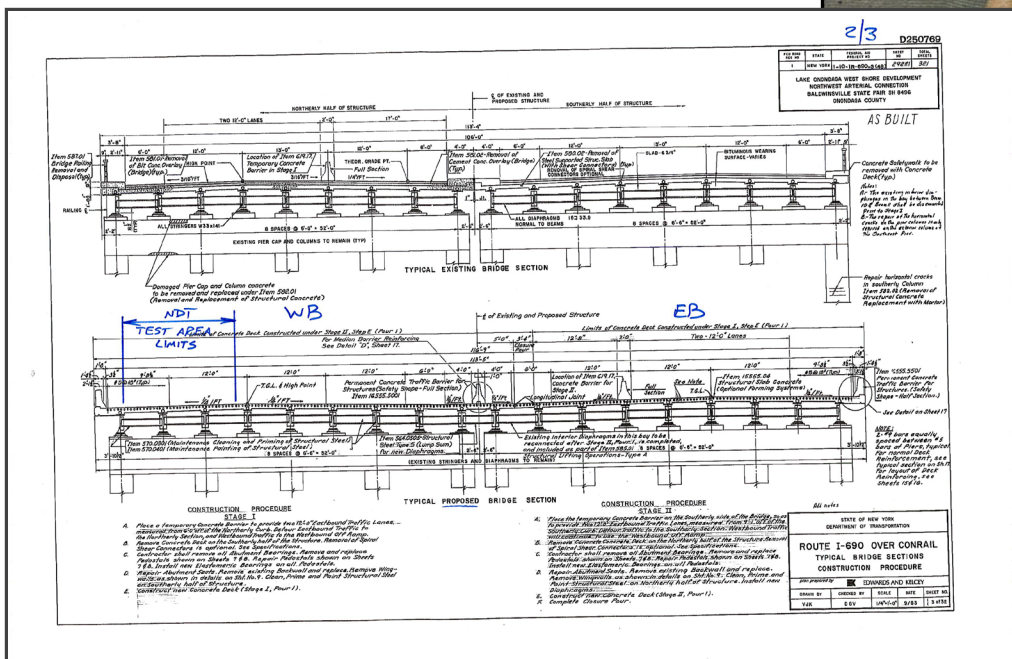
f = Resonant Echo Frequency
(Hz)



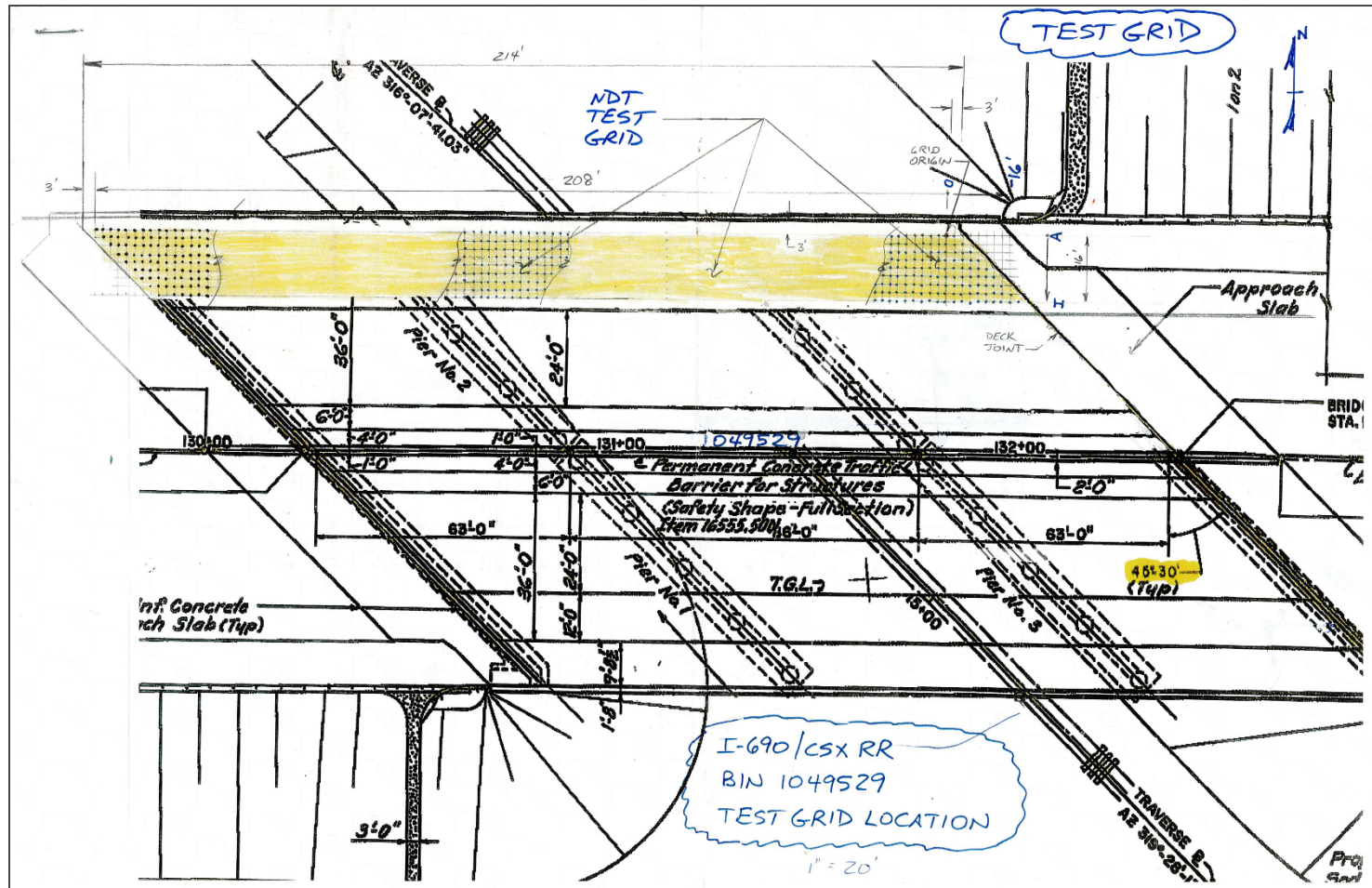
Physical Principle (continued)



I-690 over CSX RR; BIN 1049529 Town of Geddes, NY BRIDGE DECK NDT SITE



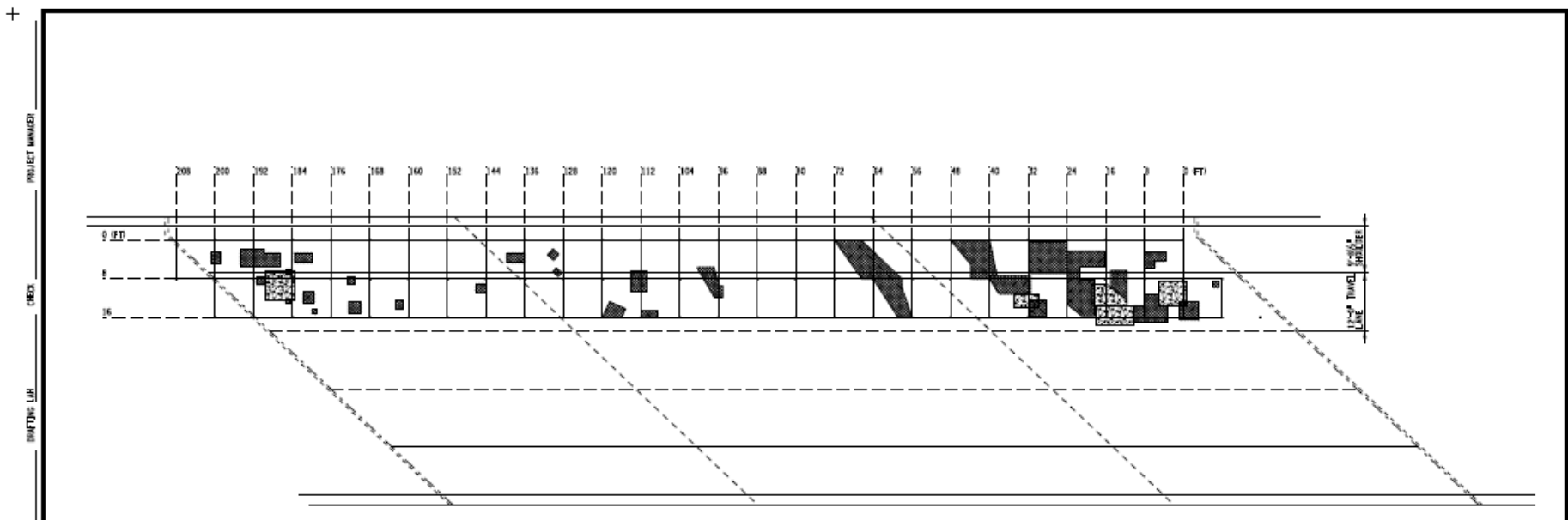
I-690 over CSX RR; BIN 1049529 BRIDGE DECK NDT GRID





New York State DOT Regional Personnel:

- Mark out test grid.
- Chain drag/hammer sound test grid.
- Mark out delaminations.
- Mapping and Quantity work-ups.



NOTE
 DELAMINATION AREAS ARE ROUGH DIMENSIONS TAKEN
 PATCHES ARE ROUGH SIZE ESTIMATES (NOT TO SCALE)

TOTAL AREA DISPECTED: 3328.00 SF
 TOTAL DELAMINATION AREA: 491.41 SF
 PERCENT OF DECK DELAMINATED: 14.77%
 TOTAL PATCH AREA: 134.00 SF
 PERCENT OF DECK PATCHED: 4.03%
 PERCENT OF DECK DETERMINATED: 18.79%

■ DELAMINATION AREA
 ▨ PATCH AREA

DATA COLLECTED 6/15/2017

New York State DOT BIN 1049529
 WESTBOUND LANE

Chain Drag Sounding & Inspection Results:

- 15% Test Grid Delaminations
- 4% Test Grid Patched Areas



PROJECT MANAGER	PROJECT MANAGER
CHECK	CHECK
DRAFTING LHM	DRAFTING LHM
CHECK	CHECK
BELOW LHM	BELOW LHM
DESIGN SUPERVISOR	DESIGN SUPERVISOR
PROJECT MANAGER	PROJECT MANAGER
ALTERED BY: Dm	ALTERED BY: Dm
AFFIX SEAL:	AFFIX SEAL:

AS-BUILT REVISIONS DESCRIPTION OF ALTERATIONS	PK#	BRIDGES 1049529	CULVERTS	ALL DIMENSIONS IN FT UNLESS OTHERWISE NOTED BIN 1049529 CHAIN DRAG DATA 3-650 OVER CSX	CONTRACT NUMBER
					DRAWING NO. ST-01 SHEET NO. 1
COUNTY: ONONDAGA	SECTION: 3				

IT IS A VIOLATION OF LAW FOR ANY PERSON, UNLESS THEY ARE ACTING UNDER THE DIRECTION OF A LICENSED PROFESSIONAL ENGINEER, ARCHITECT, LANDSCAPE ARCHITECT, OR LAND SURVEYOR, TO ALTER AN ITEM ON ANY WAY. IF AN ITEM BEARING THE STAMP OF A LICENSED PROFESSIONAL IS ALTERED, THE ALTERING ENGINEER, ARCHITECT, LANDSCAPE ARCHITECT, OR LAND SURVEYOR SHALL STAMP THE DOCUMENT AND INCLUDE THE NOTATION "ALTERED BY" FOLLOWED BY THEIR SIGNATURE, THE DATE OF SUCH ALTERATION, AND A SPECIFIC DESCRIPTION OF THE ALTERATION.



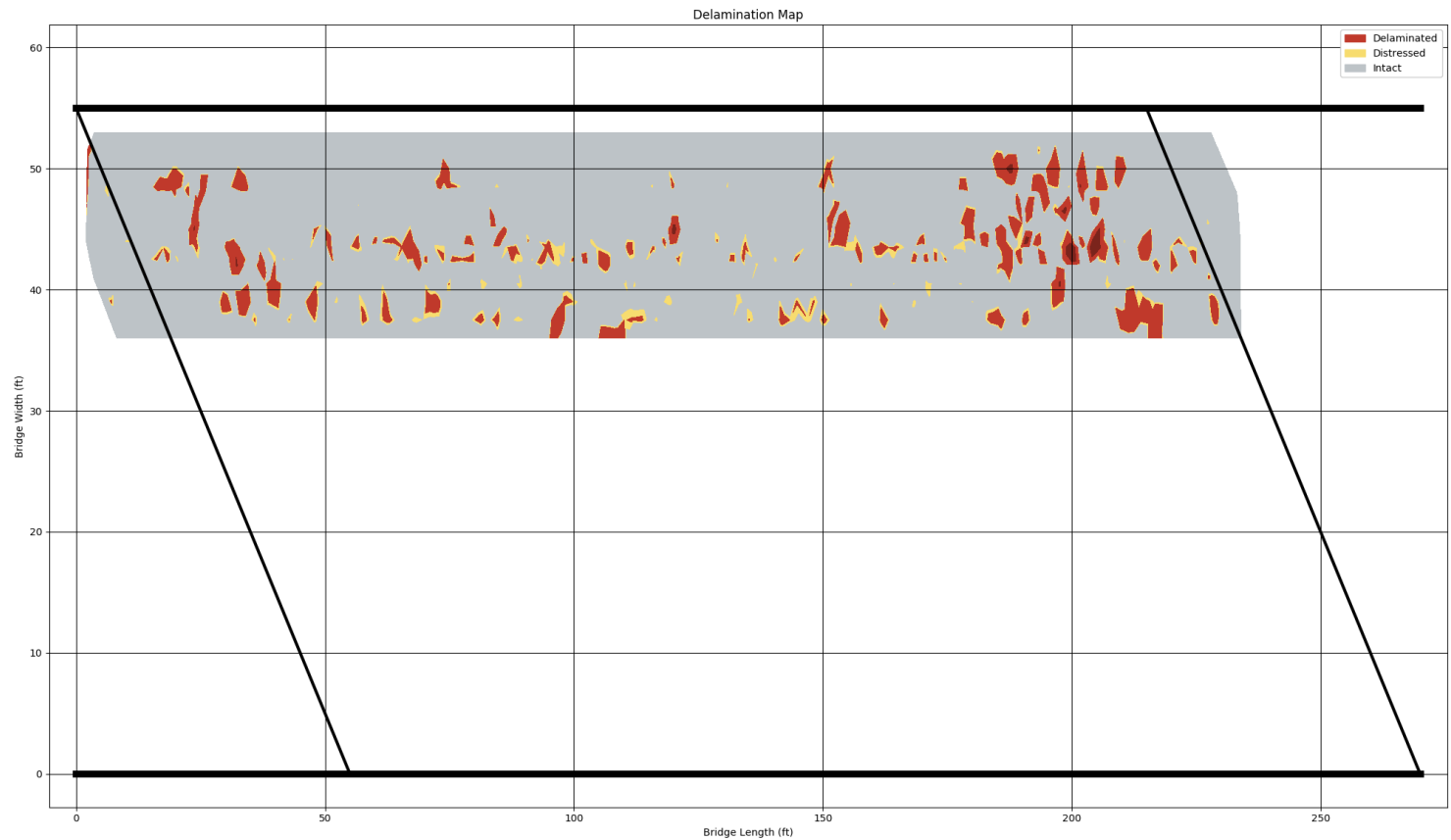
FILE NAME: C:\EN\JAMESON\CHAIN DRAG DATA.dwg
 DTIME: 6/15/2017 10:58:30 AM
 USER: JAMESON



Advanced Bridge Inspections LLC:

“Rapid Automated Sounding (RAS) Device”:

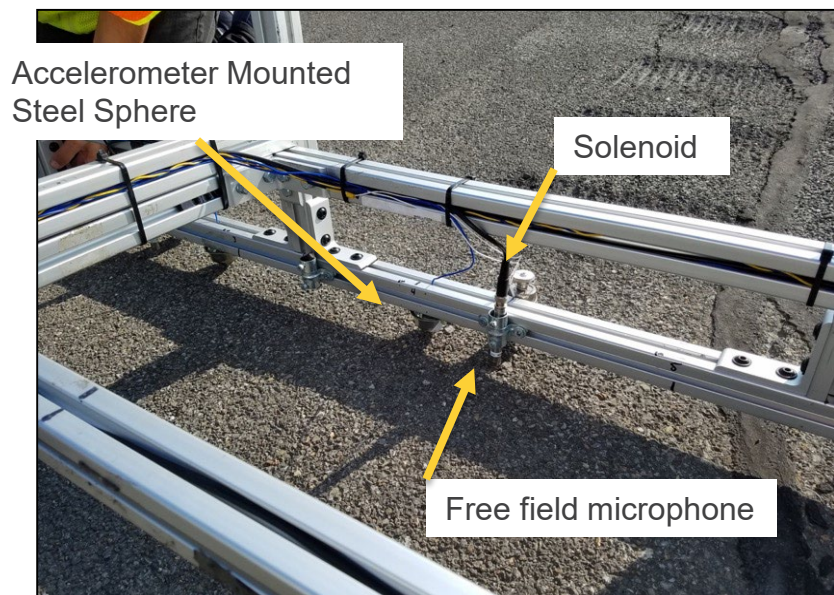
- Mobile trailer with 9 automated mallets with onboard microphones. Resonant frequency sounding/scanning.
- Top mat (shallow) delamination detection only.
- Thousands of impacts are generated.
- Mapped to specific positions using GPS and LIDAR.
- Entire 12' lane scanning capability.
- 2 MPH acquisition speed.
- Rapid deployment once on site.



Advanced Bridge Inspections LLC

Right lane and shoulder (test grid) results:

- 10% Top Mat Delaminated/Distressed



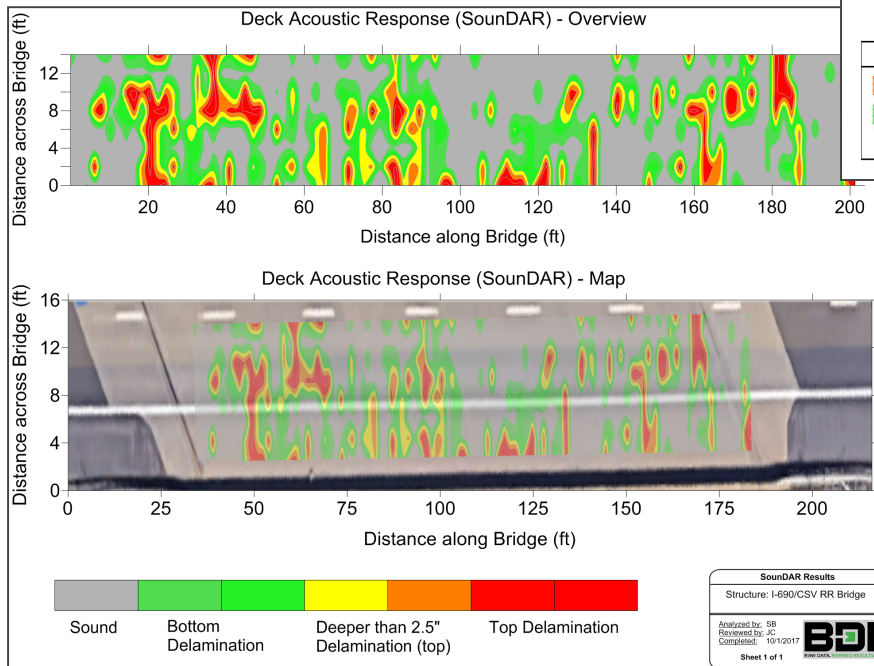
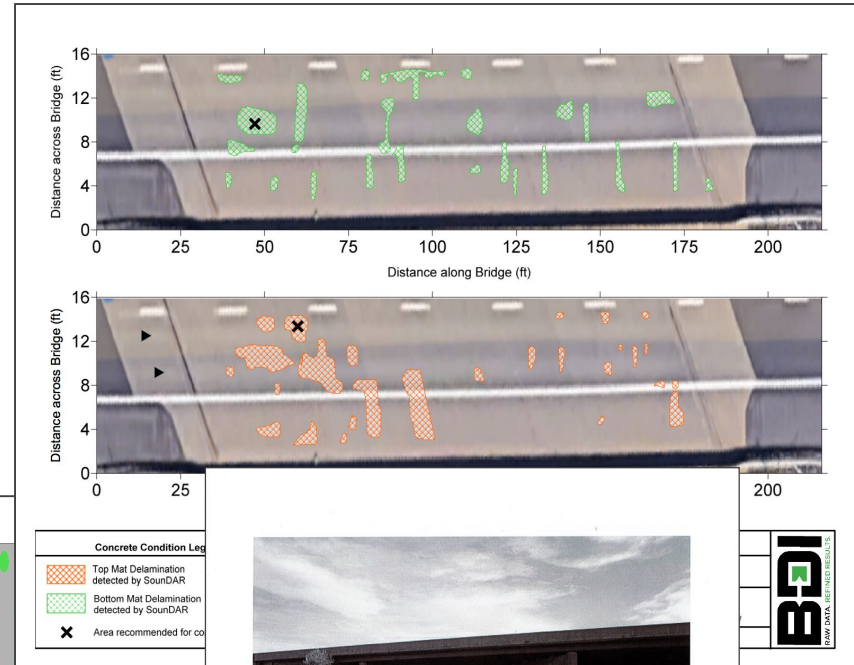
Bridge Diagnostics Inc: “SounDAR”

- Automated solenoid based impactors with piezo electric transducers.
- Modular System: Modified to complete automated chain drag (dragged chains and near field microphones).
- Full lane width capability; purported 3 – 5 MPH acquisition speed.
- Top and Bottom mat reinforcement delamination detection capability.

Bridge Diagnostics Inc.

Right lane (test grid) results:

- Probable Top Delamination = 13%
- Probable incipient (deeper) top delamination = 3%
- Probable Bottom Delamination = 9%
- Sound = 74%



Concrete Condition Legend	
	Top Mat Delamination detected by SoundAR
	Bottom Mat Delamination detected by SoundAR
	Area recommended for core

SoundAR Results
 Structure: I-690/CSV RR Bridge

Analyzed by: SB
 Reviewed by: JC
 Completed: 10/1/2017

Sheet 1 of 1

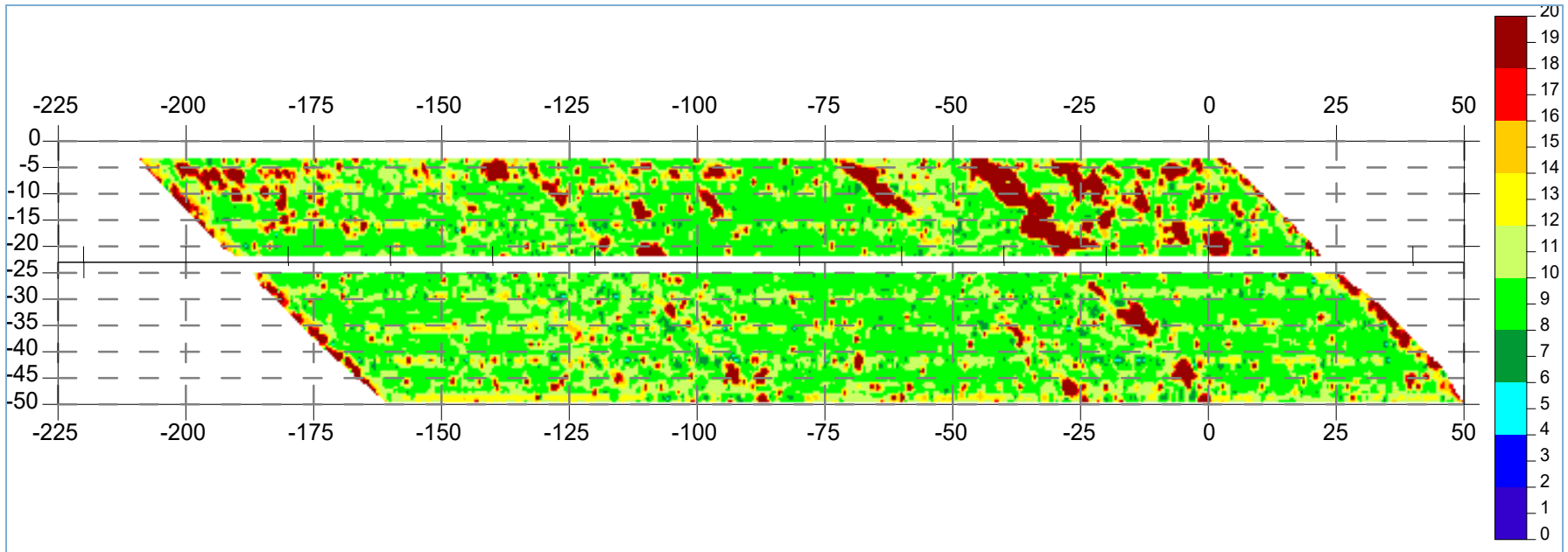


NONDESTRUCTIVE EVALUATION OF BRIDGE 1049529, I-690 OVER CSX RR

NEW YORK STATE DEPARTMENT OF TRANSPORTATION

BDI Project: 17-07-003-NY
 September 30, 2017



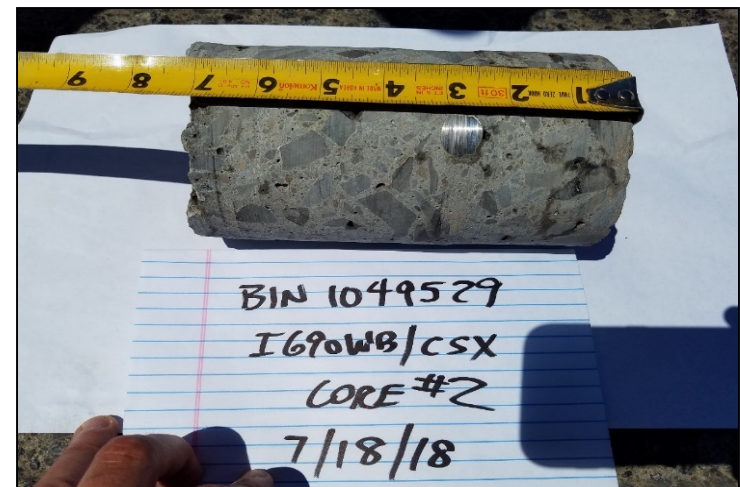
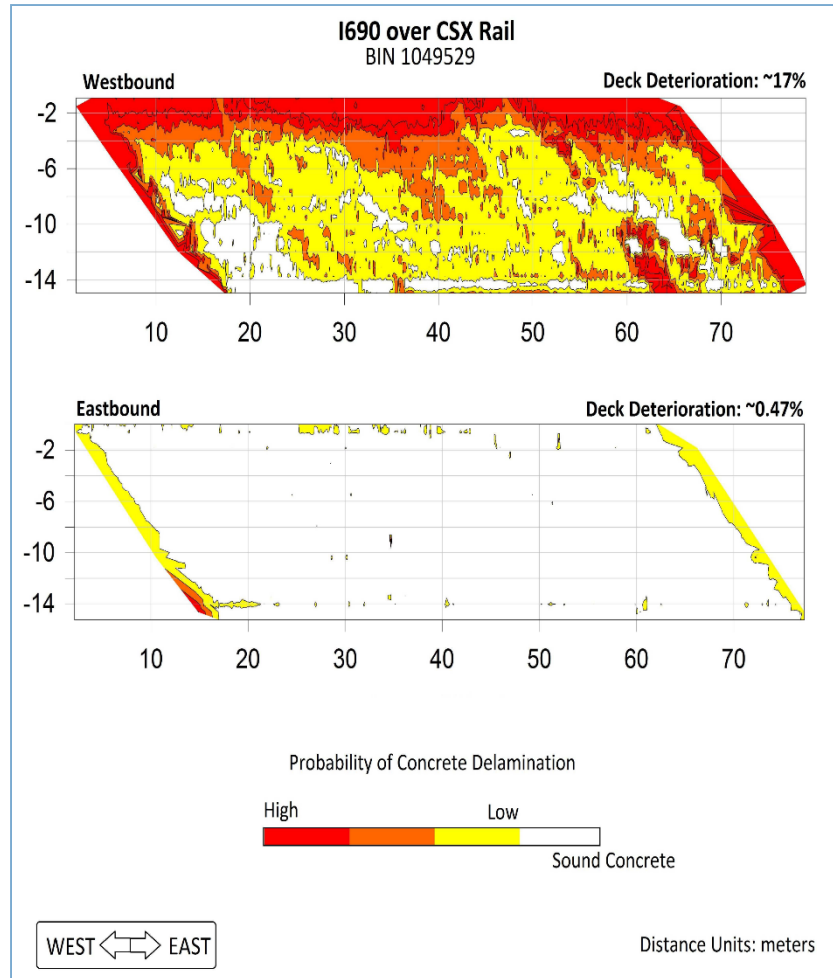


	Areas (ft ²)			Notes
WB1	3379.6	<16"		Right Shoulder / Right Lane
	562.9	>16"	14.28%	
Total	3942.5			
WB2	4981.8	<16"		Middle Lane / Left Lane / Left Shoulder
	260.2	>16"	4.96%	
Total	5242			
Combined	8361.4	<16"		All West Bound
	823.1	>16"	8.96%	
Total	9184.5			

Olson Instruments SSS-IE

Right lane (test area) Results:

- 14% Top Mat Delaminations
- XX % Bottom Mat Delaminations



New York State DOT completed:

- GPR (entire bridge)
- Deck Coring (4 cores): Chloride profiles generated and compression tests completed.

I-690 over CSX RR; BIN 1049529 BRIDGE DECK NDT TEST RESULTS

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

Top rebar mat delamination	
NYSDOT (Chain drag)	15% (19% overall deterioration*)
ABI (Rapid Automated Sounding)	10%
BDI (SoundAR)	13%
Olson Instruments SSS-IE	14%

*This overall value includes areas that were patched and not included in the original chain drag sounding delamination.

Bottom rebar mat delamination	
NYSDOT (Chain drag)	Not feasible
ABI (Rapid Automated Sounding)	Not feasible
BDI (Soundar)	8%
Olson Instruments SSS-IE	Feasible but not yet calculated

NYS DOT (CHAIN DRAG SOUNDING)

Speed:

- 3 to 4 hours of setting up grid, sounding, marking, measuring and mapping.
- Additional time in office to finalize mapping and quantities.

Accuracy:

- Generally good top mat delamination results.
- Generally higher SF delamination due to “squaring off” sounded areas.
- Rounding off and combining sounded areas into larger approximated areas.

Field Performance Comments:

- Chain drag experience was limited. Some time to get up to speed. Operator subjectivity a factor.
- Road noise a factor to some degree.

General Comments:

- This is a time consuming operation involving numerous people exposed to traffic.
- Difficult to complete chain dragging of entire bridges (often only get a sample selection) due to time and effort involved. Especially the case on larger bridge areas.

ADVANCED BRIDGE INSPECTIONS, LLC (RAPID AUTOMATED SOUNDING)

Scanning Capability:

- Full 12' lane scanning capability. Top mat (shallow) resonant frequency scanning.

Speed:

- Rapid deployment.
- Rapid scanning. Two sweeps of the test grid (a few minutes per trip down the grid).

Accuracy:

- Generally good top mat delamination detection. Was not far off from other methods.

Field Performance Comments:

- No significant technical issues. Generally, a smooth operation.

General Comments:

- Solid looking deck areas within the test grid did have delaminations (picked up by RAS).
- Does provide quick sounding to differentiate between highly delaminated versus good condition decks.

BRIDGE DIAGNOSTICS, INC. (SounDAR)

Scanning Capability:

- Full 12' lane scanning capability. Multiple modular attachment set-ups for both resonant frequency and contact IE testing.

Speed:

- In this test case – slow deployment and moderately slow scanning speed.

Accuracy:

- Good top mat delamination accuracy (similar to other test methods).
- Did provided bottom mat delamination results.

Field Performance Comments:

- Technical difficulties throughout the day. The contact IE equipment did have some issues.
- Chain drag/free field microphone went smoother once set up.

General Comments:

- The multiple modules provided a lot of scanning data (but took time).
- Other various NDT work completed throughout the day (Electrical Resistivity; Infrared Thermography, and High Resolution video).

OLSON INSTRUMENTS (SSS/IE)

Scanning Capability:

- Automated rolling wheel cart system – sensor wheel spacing 6” to 24” wide.

Speed:

- Slow walking pace. Slightly slower than GPR walk behind cart unit.

Accuracy:

- Good top mat delamination accuracy (similar to other test methods).
- Bottom mat delamination detection capability...we did not utilize the software and all of the data to determine precise quantity.

Field Performance Comments:

- No significant issues during field data accumulation, a fairly smooth operation.

General Comments:

- Refining the raw data could be somewhat complicated for a new user of the SSS-IE software
- Take some time (and continued experience) to make decisions on what could be noted as “good” versus “bad” data. Note that the automatic software processing helped yield good results (without significant user editing).

FINAL REMARKS:

- This was an excellent opportunity to try other bridge deck NDT equipment beyond chain dragging.
- The data has also been used to complete the design for the rehabilitation of this bridge. The bridge deck will require localized repairs and will be milled 1" and filled with a 1" Polyester Polymer Overlay. Contract letting June 2019.
- The New York State DOT will use this Impact Echo study information to assist with any larger scale bridge deck NDT scanning or equipment purchasing needs.

CONTACT INFORMATION:

Dan Jones
NYSDOT
333 East Washington Street
Syracuse, NY 13202
(315) 428-3207
Dan.H.Jones@dot.ny.gov





Click to edit Master title style

Click to edit Master text styles

Line Graph Heading

