

# Delaware Department of Transportation

## Use of IE for Concrete Deck Inspection

For

FHWA's Monthly NDE Webinar Series

July 24, 2023





# Impact Echo Trial



- 2015: sort of our “trial” year to evaluate the IE technology
- Completed on our Interstate I95 & I495 Corridors (51 bridges)
- Accomplished using multiple Impact Echo “Canes”
- Condition Maps automatically generated versus hand-drawing hammer sounding findings



# Impact Echo Trial

- Condition Map Generated for Each Bridge

## 5.29. BRIDGE ID 1-800

Table 31. List of the surveyed structure and delamination assessment for Bridge ID 1-800: percentage of deck area in various states of delamination

Bridge ID	Direction of Travel	Condition Index	Delamination State Distribution (%)			
			Good	Fair	Poor	Serious
1-800	South	73.0	48	26	16	10

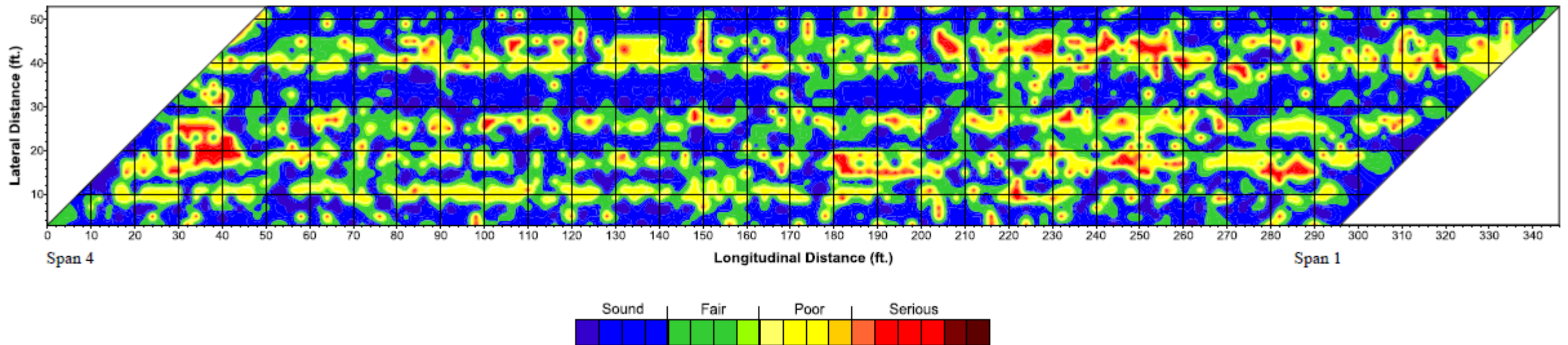


Figure 5.30. Delamination condition map for Bridge 1-800



# Impact Echo Trial

- Provided Condition Index to Prioritize Work Needs Amongst the Bridges
- Lower Condition Index → Higher Priority
- Final Report Included a Priority Grouping

Bridge ID	Feature Crossed	Condition Index	Deck Delamination Distribution (%)			
			Good	Fair	Poor	Serious
1-704	Christina Creek	66.9	41	31	9	19
1-705	Christina Creek	52.6	20	41	9	30
1-708	SR 72/South Chapel St.	64.8	32	42	8	18
1-709	SR 72/South Chapel St.	66.7	40	34	8	18
1-716	SR 1 / Korean War Vet. Mem.	73.1	37	47	7	8
1-716A	SR 1 / Korean War Vet. Mem.	87.6	76	15	1	7
1-717	SR 1 / Korean War Vet. Mem.	37.5	9	37	8	47
1-719	Christina Creek	60.3	34	33	9	24
1-720	Christina Creek	76.6	51	31	9	8
1-738	I-95, I-495 SB To I-295 NB	66.1	29	48	10	14
1-739	I 295-SB	74.4	41	46	3	10
1-740	I 295-SB	91.4	80	15	2	3
1-766	Talley Road	82.8	61	29	4	6
1-767	Talley Road	74.1	47	34	9	10
1-768	CSX Railroad	73.7	50	30	5	14
1-769	CSX Railroad	79.8	53	33	8	5
1-771	Shipley Road	81.6	57	32	6	5
1-772	Shipley Road	77.2	56	29	2	13
1-775	Marsh Road	81.3	59	28	5	7
1-776	Marsh Road	83.6	66	21	7	6
1-781	Silverside Road	81.1	58	28	9	5
1-782	Silverside Road	74.7	47	33	10	9
1-786	Glenrock Drive	81.1	63	21	8	8
1-787	Glenrock Drive	76.3	52	29	9	9
1-790	Darley Road	79.9	61	22	9	8
1-791	Darley Road	84.2	61	27	9	2



# IE Trial Performance & Comparison

- NBI Deck Rating assignment guidance based on deck element condition ratings  
(Ex. Element #12 w/ 5-15% in CS2 & < 5% in CS3 → NBI Deck Rating = 6)
- Compared NBI Deck Rating assigned during the latest routine inspection (2014/2015) to that of the NBI Deck Rating based on just the IE results

Comparison of NBI Deck Rating from Last Routine Inspection vs. NBI Deck Rating assigned based on Impact Echo	NBI Deck Rating Increase/Decrease Scenario Based on IE Results	# of Bridges	# Bridges w/ Reduced NBI Deck to a 5 based on IE	# Bridges w/ Reduced NBI Deck to a 6 based on IE
	# bridges the NBI Deck Condition Rating would reduced by 1	32 (63%)	2	30
	# bridges the NBI Deck Condition Rating would reduced by 2	3 (6%)	2	1
	# bridges the NBI Deck Condition Rating remained the same ( <b>see Note</b> )	16 (31%)	N/A	N/A
		51	4 8%	31 61%

Note: Of the 16 bridges in which the NBI Deck Rating remained the same, all had more delam identified with IE . The reason why the NBI Deck rating is the same is because the increase in % delam wasn't enough to drop the NBI Rating down to the next condition state.



# Implementation of IE Into Bridge Inspection Program

## Additional Impact Echo Implementation Details

- We are currently in our 10<sup>th</sup> year of testing using IE
- 2015-2017: Multiple IE hand wands with marking our 2'x2' grid pattern was used
- Starting in 2018, switched to using tow behind unit with 12 Sensors that take readings every 40ms → results in much tighter grid for evaluating deck and producing condition maps
- Including IE testing to be completed in 2023:
  - Tested 436 bridge decks (76% of our concrete deck bridges)  
Equates to ~ 7.1M sq.ft. of deck area
- Cost Info Comparison:
  - IE Testing Using Hand Wands = \$0.95/sq.ft.
  - IE Testing Using Towable Unit = \$0.21/sq.ft.
  - Consultant Cost for Traditional Deck Sounding = \$1.00/sq.ft.





# Implementation of IE Into Bridge Inspection Program

## Lessons Learned Regarding IE

- As with any technology, product, or service – not everything is perfect
  - Require vendor to submit a calibration plan and testing procedures
  - Require vendor to submit a QC/QA
  - If utilizing hand-wands, require an extra hand-wand be available on site and that it be calibrated
  - Need to check the results for obvious issues (ex. compare to prior inspection or deck testing results)
  - Perform QC/QA checks on random sampling of the IE Results (ex. 1 bridge per day of IE testing)
  - Discuss with your organization's traffic safety folks ahead of time to confirm MOT limitations
  - Try to identify all possible bridge deck testing needs prior to vendor traveling to your State
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# QUESTIONS/ COMMENTS

Contact Info: Jason Arndt, P.E.  
Bridge Management Engineer  
[Jason.Arndt@delaware.gov](mailto:Jason.Arndt@delaware.gov)  
(302) 760-2309