

Alberta Transportation Class A Bridge Inspection Course

Level II Inspection of Concrete Bridge Elements



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Overview

- Function of Level II Inspections for Concrete Bridge Elements
- Level II Concrete Inspection/Test Methods
 - Equipment
 - What does test data indicate
 - How is the data used



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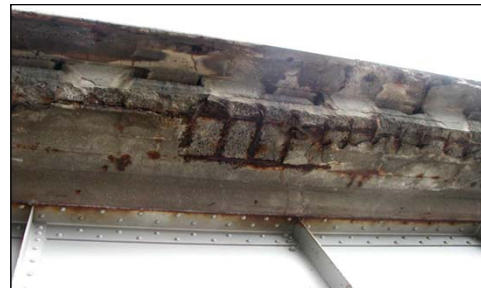
Level II inspections prevent surprises



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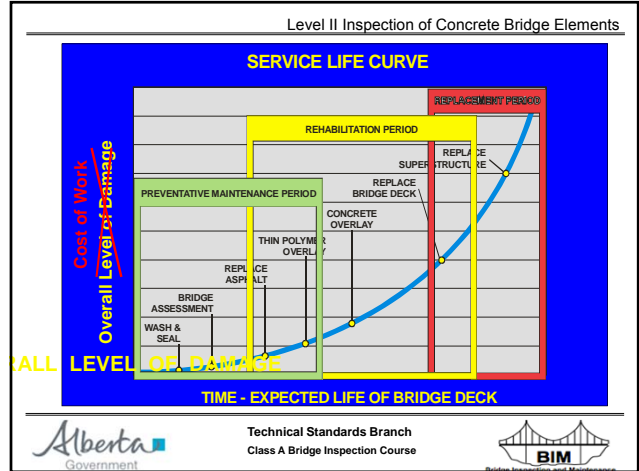
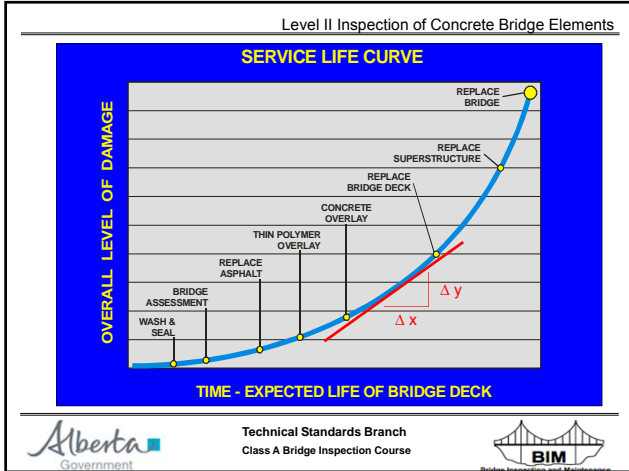


This Didn't Happen Overnight



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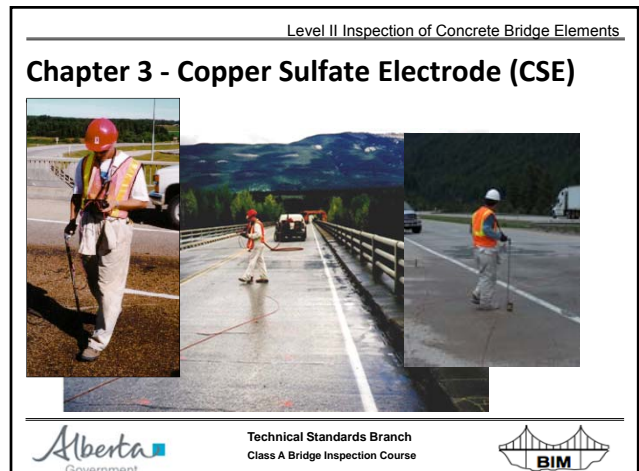
Level II Inspection of Concrete Bridge Elements

Alberta Transportation Level II Inspections of Concrete Elements

Level II BIM Manual

- Chapter 2 - Concrete Deck Inspection
- Chapter 3 - Copper Sulfate Electrode Testing
- Chapter 4 - Chloride Testing

Alberta Government Technical Standards Branch Class A Bridge Inspection Course BIM



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Chapter 3 - Copper Sulfate Electrode (CSE) Testing

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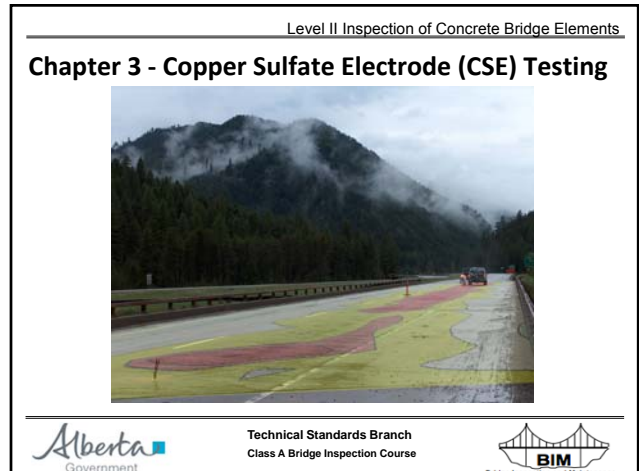
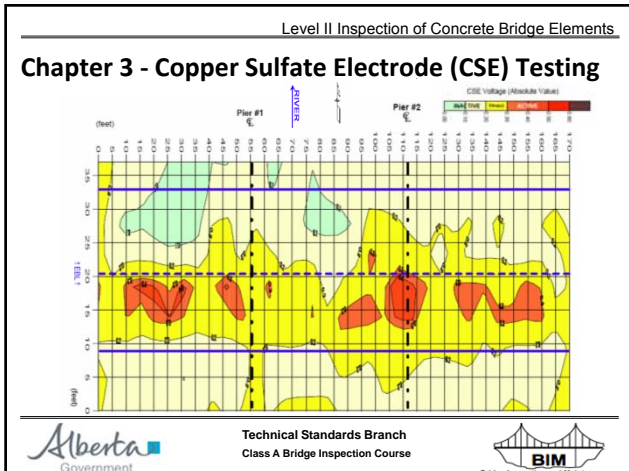
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Chapter 3 - Copper Sulfate Electrode (CSE) Testing

ASTM C876 Interpretation of Results


	Half-Cell Potential (Absolute Value)	Percent of Test Area	
INACTIVE AREA (0 to -0.2V): 95% Probability that active corrosion is not occurring	0.000 to 0.099 V	0.0	1.4
	0.100 to 0.199 V	1.4	
TRANSITION AREA (-0.2V to -0.35V): Potential for active corrosion indeterminate	0.200 to 0.299 V	20.8	33.6
	0.300 to 0.349 V	12.7	
ACTIVE AREA (-0.35V to -0.8V): 95% Probability that active corrosion is occurring	0.350 to 0.399 V	14.7	65.0
	0.400 to 0.499 V	30.3	
	0.500 to 0.599 V	19.5	
	0.600 to 0.699 V	0.5	
	0.700 to 0.799 V	0.0	


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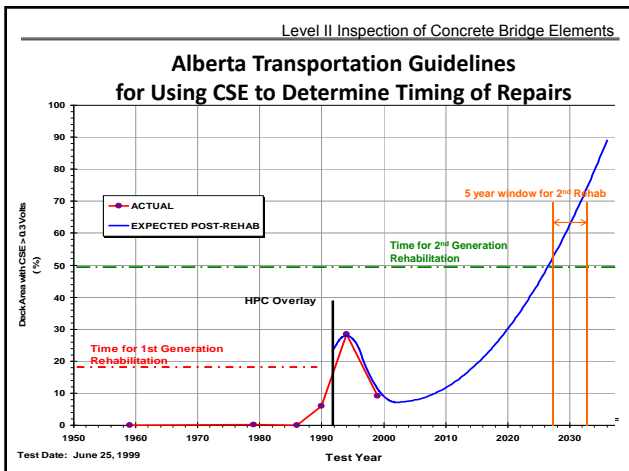
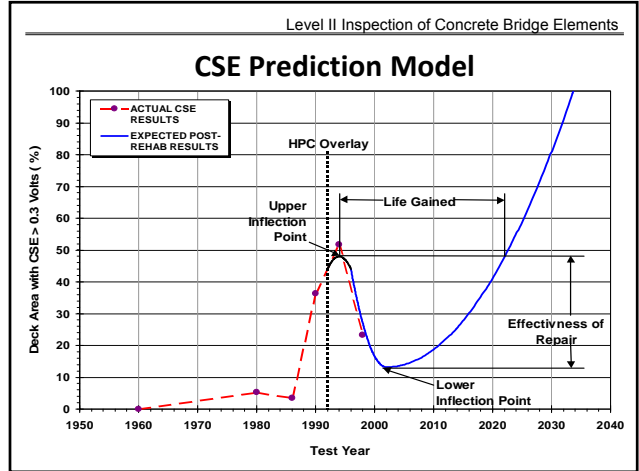
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Chapter 3 - Copper Sulfate Electrode (CSE) Testing





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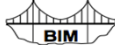


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Chapter 4 – Chloride Content Testing




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Chapter 4 – Chloride Content Testing

0.03 % Chloride per unit weight of concrete is known as the corrosion threshold value.

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Chapter 4 – Chloride Content Testing

Increasing Cl⁻ Contamination

BRIDGE FILE: 12011501

TEST SAMPLE: 1B

> 0.03%

SAMPLE DEPTH: 50 mm (40 – 60 mm)

TEST DATE: July 15, 2003

Typical Results – CIP Deck

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Chapter 4 – Chloride Content Testing

Rapid Chloride Test Method

Advantages

- Speed of testing
- Economical
- Tests completed on site

Disadvantages

- Testing completed on site
- Not to be taken on decks with waterproofing membranes in good condition

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Chapter 4 – Chloride Content Testing

RCT-500

Calibration Liquids

Electrode Solution

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Chapter 4 – Chloride Content Testing

Selection of Test Locations:

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Chapter 4 – Chloride Content Testing

BRIDGE FILE: 75058N
C.P.R. Overpass At Leduc

Typical Results:

- Bar Chart
- Plan View of Bridge Deck

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Chapter 2 – Concrete Deck Inspection

- **Quantitative** – Rating Methodology Different than Level I
- **Programmed** – Cyclic Basis to Monitor Condition
- **Specialized tools** – For Portions of the Inspection

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Chapter 2 – Concrete Deck Inspection

Rating Methodology:

Rating	Description
9	Very Good
8	Good
7	Good
6	Adequate
5	Adequate
4	Poor
3	Poor
2	Immediate Action
1	Immediate Action

Concrete Deck Inspection					
Wearing Surface		Last: Now: Explanation of Condition			
Polymer (Y/N)	N				
ACP (Y/N)	N				
Chip Seal Coat (Y/N)	Y				
Year Installed	1999				
Avg. Total Thickness (mm)	1298.1				
Area (m ²)					
Steel Coat					
Type	CHP	SEAL	COAT		
Polymer Rating (% Area)	0	0	0	0	0
Least	0	0	0	0	100
Now	0	0	0	0	100
ACP Rating (% Area)					
Polymer Rating (% Area)	0	0	0	0	0
Least	0	0	0	0	100
Now	0	0	0	0	100
Chip Seal Coat Rating (% Area)					
Polymer Rating (% Area)	0	0	0	0	0
Least	0	0	0	0	100
Now	0	0	0	0	100
Chip seal coat has all but worn off.					
Polymer Total Debonded Area (m ²)					
ACP Total Debonded Area (m ²)					
ACP Average Measured Depth (mm)					
ACP Crack Frequency (m/m)					
Chip Seal Coat Total Area (m ²)	999	999	1009	1009	1009
1009 m ² of total seal coat (1-85%)					


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Chapter 2 – Concrete Deck Inspection

Level II Concrete Deck Inspection Form Sections:

- Wearing Surface
- Concrete Overlay
- Concrete Deck
- Edge Elements (curbs/barriers/ medians/sidewalks)
- Deck Joints




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Chapter 2 – Concrete Deck - Wearing Surface

		Last	Now	Explanation of Condition	
Wearing Surface					
Polymer? (Y/N)			Y		
ACP? (Y/N)			N		
Chip Seal Coat? (Y/N)			Y		
Seal Coat	Type	CONVENTIONAL CHIP SEAL COAT		Year Installed	Avg. Total Thickness (mm)
				2004	1892.2
Polymer Rating (% Area)					
Last					
Now					Covered by seal coat.
ACP Rating (% Area)					
Last					
Now					
Chip Seal Coat Rating (% Area)					
Last					
Now					There are areas of lost chip and epoxy.
Polymer Total Debonded / Lost Area (mm)					
ACP Total Debonded / Lost Area (mm)					
ACP Average Measured Depth (mm)					
ACP Crack Frequency (mm)					
Chip Seal Coat Total Lost Area (mm)					



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Chapter 2 – Concrete Deck Inspection

Deck Delamination Survey
– ASTM D4580









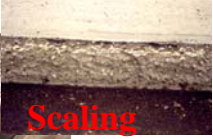
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Chapter 2 – Concrete Deck Inspection


Measured Damage:



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Chapter 2 – Concrete Deck Inspection - Concrete Overlay


Concrete Overlay																						
Overlay? (Y/N)	Y																					
(Span Type : CT)																						
(Span Numbers : 1, 2, 3, 4)																						
Last Now Explanation of Condition																						
(Overlay type : CONCRETE (HIGH DENSITY))																						
(Area(m ²) : 1298.1)																						
(Year Installed : 1978)																						
(Thickness(mm) : 50)																						
(Average Cylinder Strength(Mpa) :																						
<table border="1"> <tr> <th>Overlay Rating (% Area)</th> <th>9-7</th> <th>6-5</th> <th>4</th> <th>3</th> <th>2/1</th> <th>NX</th> </tr> <tr> <td>Last</td> <td>0</td> <td>70</td> <td>10</td> <td>0</td> <td>0</td> <td>20</td> </tr> <tr> <td>Now</td> <td>0</td> <td>65</td> <td>15</td> <td>0</td> <td>0</td> <td>20</td> </tr> </table>		Overlay Rating (% Area)	9-7	6-5	4	3	2/1	NX	Last	0	70	10	0	0	20	Now	0	65	15	0	0	20
Overlay Rating (% Area)	9-7	6-5	4	3	2/1	NX																
Last	0	70	10	0	0	20																
Now	0	65	15	0	0	20																
Total Crack Length - Medium/Wide (m)		371	<55																			
Total Scaled Area - Light (m ²)		0	0																			
Total Scaled Area - Moderate/Heavy/Severe (m ²)		84	<30																			
Spalled Area (m ²)		1	<1.5																			
Patched Area (m ²)		0	0																			
Average Measured Cover Depth (mm)		100	>100																			
Standard Deviation of Measured Cover Depth (mm)		14	<15																			

Partially covered by chip seal coat.
There is widespread cracking along the overlay. Several core patches are deteriorated.



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Chapter 2 – Concrete Deck Inspection - Concrete Deck


Deck																						
(Span Type : CT)																						
(Span Numbers : 1, 2, 3, 4)																						
(Deck Type : CONCRETE (CLASS C))																						
(Area(m ²) : 1298.1)																						
(Year Constructed : 1957)																						
(Year Relined :)																						
(Thickness(mm) : 190)																						
(Average Cylinder Strength(MPa) :																						
<table border="1"> <tr> <th>Type</th> <th>Size</th> <th>Design Cover (mm)</th> <th>Spacing (mm)</th> </tr> <tr> <td>Long Reinforcing</td> <td>REINFORCING STEEL</td> <td>10</td> <td>25</td> </tr> <tr> <td>Trans. Reinforcing</td> <td>REINFORCING STEEL</td> <td>19</td> <td>25</td> </tr> </table>		Type	Size	Design Cover (mm)	Spacing (mm)	Long Reinforcing	REINFORCING STEEL	10	25	Trans. Reinforcing	REINFORCING STEEL	19	25									
Type	Size	Design Cover (mm)	Spacing (mm)																			
Long Reinforcing	REINFORCING STEEL	10	25																			
Trans. Reinforcing	REINFORCING STEEL	19	25																			
Deck Top Rating (% Area)																						
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Overlay Rating (% Area)	9-7	6-5	4	3	2/1	NX																
Last	0	0	0	0	0	>100																
Now	0	0	0	0	0	>100																
Total Crack Length - Medium/Wide (m)		1	<1																			
Total Scaled Area - Light (m ²)		N	N																			
Total Scaled Area - Moderate/Heavy/Severe (m ²)		N	N																			
Delaminated Area (m ²)		N	N																			
Spalled Area (m ²)		N	N																			
Patched Area (m ²)		N	N																			
Average Measured Cover Depth (mm)		N	N																			
Standard Deviation of Measured Cover Depth (mm)		N	N																			
Deck Underlaid Rating (% Area)																						
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Overlay Rating (% Area)	9-7	6-5	4	3	2/1	NX																
Last	0	72	1	0	0	25																
Now	0	72	1	0	0	25																
Total Blasted Area - Moderate (m ²)		0	<1																			
Total Blasted Area - Heavy/Severe (m ²)		0	0																			
Total Crack Length - Medium/Wide (m)		140	<25																			
% of Medium/Wide Cracks Blasted		80	<85																			

Could not inspect span 3 due to water levels.
Blasting between G1/G2 on the south span.
There is rebar and shear cracking along the CT girders.
There are marks to medium wide transverse cracks in the deck underlaid. Isolated spalled patch between G2/G3 S4 (north span).



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Chapter 2 – Concrete Deck Inspection - Edge Elements


Edge Elements																						
Curbed? (Y/N)	Y																					
Parapets? (Y/N)	N																					
Last Now Explanation of Condition																						
Medians? (Y/N)		N																				
Shoulders? (Y/N)		N																				
Curb																						
(Type : CONCRETE)																						
(Clear Length(m) : 178.8)																						
(Height(mm) :)																						
(Width(mm) :)																						
(Average Cylinder Strength(MPa) :																						
<table border="1"> <tr> <th>Reinforcement Type</th> <th>Size</th> <th>Design Cover (mm)</th> <th>Spacing (mm)</th> </tr> <tr> <td></td> <td>19</td> <td>50</td> <td>100</td> </tr> </table>		Reinforcement Type	Size	Design Cover (mm)	Spacing (mm)		19	50	100													
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	19	50	100																			
Curb Rating (% Length)																						
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Overlay Rating (% Length)	9-7	6-5	4	3	2/1	NX																
Last	0	100	0	0	0	0																
Now	0	>100	0	0	0	0																
Total Crack Length - Medium/Wide (m)		38	<50																			
Total Scaled Length - Light (m)		4	<5																			
Total Scaled Length - Moderate/Heavy/Severe (m)		0	0																			
Delaminated Length (m)		0	0																			
Spalled Length (m)		0.1	<0.1																			
Patched Length (m)		7	<5																			
Average Measured Cover Depth (mm)		64	<70																			
Standard Deviation of Measured Cover Depth (mm)		21	<14																			

Transverse cracking.
Isolated areas of exposed rebar due to insufficient concrete cover along the west curb.



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Chapter 2 – Concrete Deck Inspection - Deck Joints

Deck Joints			
(Type : GLAND (WABO-MAUER, TRANSFLEX, ETC))			
(Number of Joints : 2)			
(Expansion / Fixed? : EXPANSION)			
(Location : A1, A2)			
% Inspected	100	>100	Inspected joints after a hard snow/rain, no leakage was observed.
% Joints Leaks	0	<0	
% Joint Length Leaks	0	0	There are horizontal cracks in the abutments. There are vertical cracks along the piers.
Superstructure Damage Rating	6	<6	
Substructure Damage Rating	6	<6	
Level 1 Joint Rating	7	<7	



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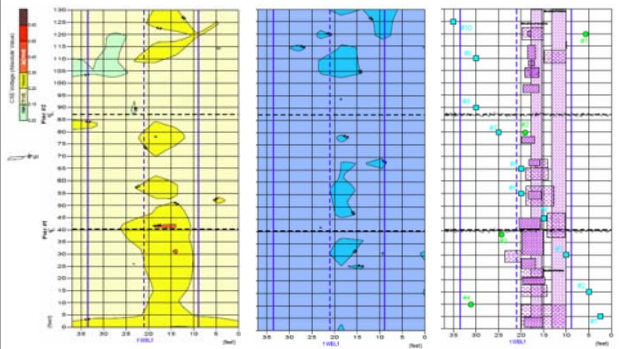
Concrete Cover Measurement






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CSE Results + Cover Depth Results + Deck Inspection Results

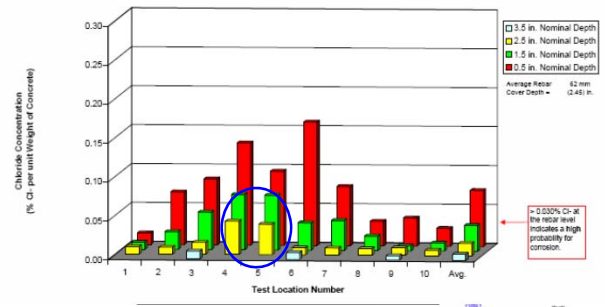




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+ Chloride Test Results





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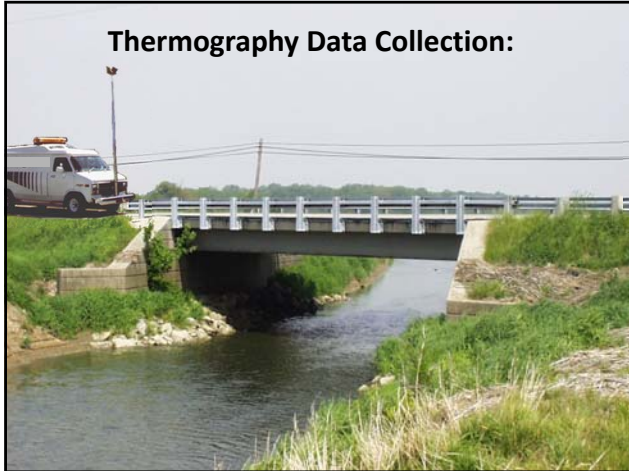
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Other Level II Inspection/Testing Methods for Concrete Bridge Elements:

- Thermography
- Ground Penetrating Radar (GPR)
- Schmidt Hammer
- Coring
- Linear Polarization


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Thermography

Delamination Reinforced Bridge Deck

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Ground Penetrating Radar Data Collection:

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Ground Penetrating Radar Data :

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Schmidt Hammer:



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Coring:



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Linear Polarization Testing:



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QUESTIONS ???



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