

October 17, 2014

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Ms. Maeve McLaughlin, RFT
Engineering Technologist
Ministry of Forests, Lands and Natural Resource Operations
5th Floor - 1011 - 4th Avenue
Prince George BC
V2L 3H9

**Re: NON-DESTRUCTIVE TESTING ON BRIDGE K692
FINN CREEK FSR AT ADAMS RIVER BRIDGE**

Dear Mr. McLaughlin:

The **Ministry of Forests, Lands and Natural Resources Operations** retained **Associated Engineering** to complete a close-proximity inspection of the **Bridge K692 – Finn Creek FSR at Adams River Bridge**. **Julien Henley P.Eng., and Jamie Rupar Gilliatt EIT**, completed the inspection on September 10, 2014. In addition to the inspection, **Tim McCool**, of the **Acuren Group Inc. (Acuren)**, performed non-destructive testing (NDT) including ultrasonic shear wave and magnetic particle inspections at selected locations along the steel girders to identify defects which may not be visible to the naked eye. This letter summarizes the NDT results from Acuren, and our recommendations to the Ministry.

The steel girders comprise wide flange rolled beams that are butt welded together to achieve the total bridge length. There are a total of 16 butt welds in the four steel girders; eight of the butt welds are at the third points, and eight are close to the abutments (the number and location of the butt welds is a correction from what was previously reported, due to the identification of an additional butt weld close to the abutment). We inspected the bridge girders and tested the remaining four butt weld locations at the third span locations, which were not tested during the 2013 inspection. At each location, Acuren conducted ultrasonic shear wave testing of the butt welds, and magnetic particle testing of the adjacent stiffener welds.

The NDT results show that two of the four butt welds tested by ultrasonic shear wave have anomalies in the bottom flange welds where the weld did not meet the CSA W59 requirements (see attached non-destructive examination report from Acuren, dated September 10, 2014). In addition, all tested stiffener to bottom flange welds have rejectable undercut with two welds having linear indications indicative of a crack, as noted in Acuren's report.



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Ministry of Forests, Lands and Natural Resource Operations

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The anomalies and possible cracks in the welds may result in fracture of a girder and an associated loss of capacity. Given the numerous anomalies identified by Acuren's 2013 and 2014 inspections, we recommend that the Ministry mitigate the risks associated with the fracture of a girder by replacing the bridge, if they intend to use it for industrial purposes. The Ministry could also mitigate this risk by strengthening the steel girders. In this case, upon confirming the adequacy of the existing steel girder capacity, the girders could be strengthened by installing bolted splices at the butt weld locations. This would provide an alternative load path should the welds fail.

We trust this short letter provides the information required. If you have any questions, please call either Julien Henley or myself.

Yours truly,

Prepared by:

Jamie Rupar Gilliatt, M.Eng., EIT
Bridge Engineer

JRG/JH/skn

Reviewed by:

Julien Henley, M.A.Sc., P.Eng.
Manager – Municipal Bridges

Attachment:

- Acuren Group Inc. – Non-destructive Testing of Finn Creek at Adams River Bridge, September 10, 2014
- Associated Engineering – K692 Adams River Bridge 2014 Close Proximity Inspection Report



NONDESTRUCTIVE EXAMINATION REPORT

Acuren Group Inc.

12271 Horseshoe Way
Richmond, BC, Canada V7A 4V4
www.acuren.com

Phone: 604.275.3800
Fax: 604.274.7235



NDT, Inspection and Materials Engineering
a Rockwood Company

TO: Associated Engineering
Suite 300-4940 Canada Way
Burnaby, BC, Canada, V5G 4M5

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DATE: September 10, 2014

ACUREN JOB #: 6191974

P.O.: 20.101.196

ATTENTION: Jamie Rupar Gilliatt

WORK LOCATION: Adams River

PROJECT: Finn Creek FSR at Adams River Bridge K692

ITEM(S) TESTED: Girder Splices and fillet welding

PART #: Adams River Bridge MATERIAL: Carbon Steel THICKNESS: Misc.

SCOPE: Perform inspection as directed by Associated Engineering representative.

TYPE(S) OF INSPECTION: Magnetic Particle, Ultrasonic Shear Wave

RESULTS:

This Adams River Bridge is found at the intersection of the Finn Creek forest service road and the Adams River. The bridge runs East West and is 4 Girders wide. To ease in identification the girders were numbered one to four from North to South. The weld splices were identified with letters A, B, C and D from West to East. Four (4) weld splices were inspected using Ultrasonic Shear Wave. The stiffeners in the area of the splices were inspected using black and color contrast magnetic particle. Results of the inspection are as follows:

Girder 1 Splice C: Ultrasonic Shear Wave The bottom splice, which measures 29.5 cm wide, was inspected using Ultrasonic Shear Wave as well as 50.0 cm of the web splice as measured from the bottom splice up. None of the welds inspected showed any rejectable indications using shear wave.

Girder 1 Splice C: Magnetic Particle. The adjacent stiffener fillet welds on the North and South sides of the girder were inspected using magnetic particle. The fillet welds were all found to have areas of rejectable undercut associated with the welds. The right side stiffener (looking south) fillet weld was found to have a linear indication in the center of a crater. The fillet weld was not wrapped in this location. The indication measured 10mm long and was located at the stiffener to flange connection at the termination of the fillet weld in a crater. All 2 of the stiffener to flange welds appear to have undercut in excess of the allowable in CSA W59.12.(Photo 1, and 3)

Girder 2 Splice B: Ultrasonic Shear Wave. The bottom splice, which measures 29.5 cm wide, was inspected using Ultrasonic Shear Wave as well as 50.0 cm of the web splice as measured from the bottom splice up. The web splice was found to be free from any rejectable indications. The flange splice was found to have one area that did not meet the requirements set out in the acceptance standard. An area 10mm long and at a depth of 17mm had a rating of 0. The indication is located at 150mm from the bottom flange edge and was at the center line of the weld.

Girder 2 Splice B: Magnetic Particle. The adjacent stiffener fillet welds on the North and South sides of the girder were inspected using magnetic particle. The fillet welds were all found to have areas of rejectable undercut associated with the welds. The right side stiffener fillet weld was found to have a linear indication

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CLIENT REPRESENTATIVE:

TECHNICIAN:

PRINT NAME:

Tim McCool
1st Technician
CGSB II/ASNTII/CWBII
Cert #5291/CWB8787

-
2nd Technician

	TOTAL HOURS	S.T.	O.T.	SHIFT
1ST TECHNICIAN:	18	12	4	Day ☒
2ND TECHNICIAN:				PM ☐
KILOMETRES:	800	OTHER CHARGES: YES ☒ NO ☐		



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Adams River Bridge K692 at the Finn Creek FSR

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indicative of a crack. The indication measured 10mm long and was located at the stiffener to flange connection at the outside toe of the weld. The indication is most likely caused by an improperly filled weld crater. (Photo 4, 5, and 6)

Girder 4 Splice B: Ultrasonic Shear Wave. The bottom splice, which measures 29.5 cm wide, was inspected using Ultrasonic Shear Wave as well as 50.0 cm of the web splice as measured from the bottom splice up. No indications were discovered in the web splice. The bottom splice was found to contain a rejectable indication from 23cm to 29.5cm as measured from the North edge of the splice. The indication was found at 15mm deep from the bottom surface and had a rating of 0. The location of the welding defect was verified by the magnetic particle inspection.

Girder 4 Splice B: Magnetic Particle. The adjacent stiffener fillet welds on the North and South sides of the girder were inspected using magnetic particle. The fillet welds were all found to contain areas of undercut in excess of the allowable stated in CSA W59.12. No areas of cracking were discovered during this inspection. (Photo 7, 8 and 9)

Girder 4 Splice C: Ultrasonic Shear Wave The bottom splice, which measures 29.5 cm wide, was inspected using Ultrasonic Shear Wave as well as 50.0 cm of the web splice as measured from the bottom splice up. None of the welds inspected showed any rejectable indications using shear wave.

Girder 4 Splice C: Magnetic Particle. The adjacent stiffener fillet welds on the North and South sides of the girder were inspected using magnetic particle. The fillet welds were all found to have areas of rejectable undercut and porosity associated with the welds. No areas of cracking were observed. (Photo 10, 11 and 12)



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Adams River Bridge K692 at the Finn Creek FSR

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TEST DETAILS: MAGNETIC PARTICLE

ACCEPTANCE STANDARD: CSA W59, Clause 12				REVISION: 2013			
PROCEDURE #: CAN-MT-14P001		REVISION: 07		TECHNIQUE #: N/A		REVISION: N/A	
TYPE: Dry Visible				METHOD: Yoke			
PARTICLE BRAND: Circle Systems		PRODUCT No.: 66		CURRENT: AC		MT INSTRUMENT: Parker B-300	
PARTICLE COLOUR: Yellow				MT INSTRUMENT S/N: 15872		CAL DUE: Feb 2015	
SUSPENSION: N/A				BLACKLIGHT S/N: N/A		MAKE: N/A	
CONTRAST PAINT: N/A		PRODUCT No.: N/A		LIGHTING EQUIPMENT: 100W trouble light			
MAG TIME (SECONDS): 20		DEMAG REQUIRED?: No		LIGHT METER S/N: N/A		CAL DUE: N/A	
				LIGHT INTENSITY: N/A			
SURFACE CONDITION: As welded				SURFACE TEMPERATURE: Wet (oil) -20°C to 50°C			

TEST DETAILS: ULTRASONIC

ACCEPTANCE STANDARD: CSA W59, Clause 12				REVISION: 2013			
CSA W59 Table							
PROCEDURE #: 8.3		REVISION: 1		TECHNIQUE #: N/A		REVISION: N/A	
TYPE: Flaw Detection			METHOD: Contact				
INSTRUMENT: Olympus		MODEL: 600		S/N: 130521 404		CAL DUE: 4/2015	
CAL. BLOCK: IIW		S/N: AR001		CABLE-TYPE: RG 58U		LENGTH: 2m	
CAL. BLOCK: N/A		S/N: N/A		COUPLANT: UTX			
CAL. BLOCK: N/A		S/N: N/A		SPECIAL EQUIP.: N/A			

PROBE & TECHNIQUE DETAILS:

	TEST ANGLE (°)	PROBE TYPE	CRYSTAL SIZE	FREQ. (MHZ)	SERIAL NUMBER	DAMPING Ω	TEST FROM	REFERENCE REFLECTOR	TRANSFER VALUE	REFERENCE		SCAN dB	RANGE
										dB	% FSH		
1	0°	Single	12mm	1.0	G07303S9	-	Top surface	Back wall	35dB	20	100	30	200mm
2	70°	Single	16mm	2.25	01VRKK	-	A	1/16 SDH	0	39	80	64	250mm
3													
4													

SURFACE CONDITION: As Welded				SURFACE TEMPERATURE: 0 °C/32 °F to 120 °C/250 °F			
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PHOTOS

Photo 1:

Girder 1, Splice C. No rejectable indications were discovered while performing ultrasonic shear wave inspection.



Photo 2:

Girder 1, splice C. The right side adjacent stiffener (looking North). The fillet weld was not sealed as the rest of the stiffeners.

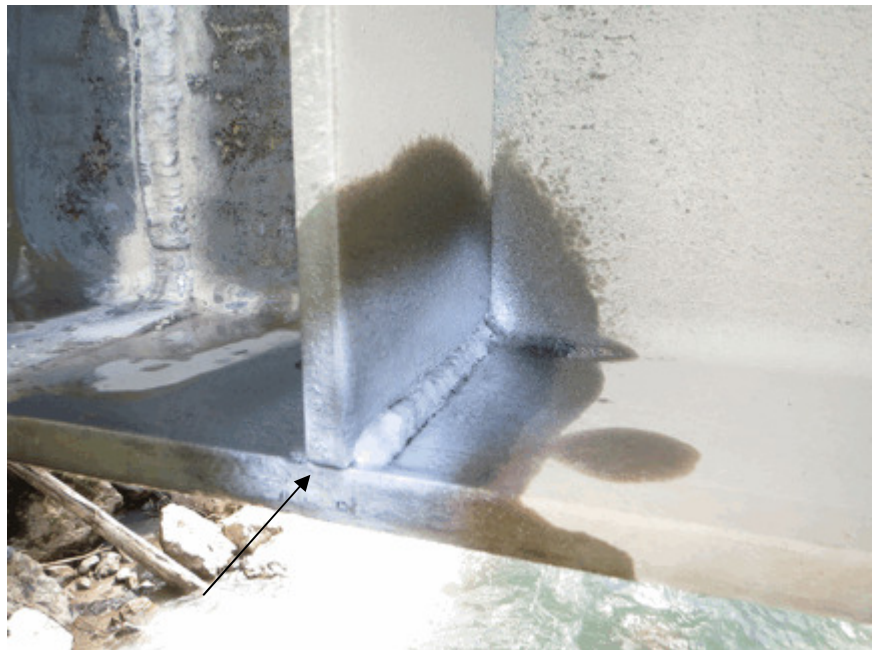


Photo 3:

This picture shows the left stiffener fillet weld (looking south) at Girder 1 Splice C. The weld size was as small as 4mm. Undercut was discovered while performing magnetic particle of the fillet welds adjacent the weld splices.



Photo 4:

Girder 2, splice B.



Photo 5:

Girder 2, splice B. This picture is of the left stiffener (looking North) and shows the typical fillet weld in this area. Individual lengths of rejectable undercut were noted as well as crater cracks.



Photo 6:

The left side stiffener (looking south), at the Girder 2 Splice B location. Note the excessive undercut at the top leg of the fillet weld as well as the improperly wrapped end.



Photo 7:

Girder 4, Splice B.



Photo 8:

Girder 4, Splice B. This fillet weld is located on the left side stiffener (looking south). The weld was found to contain rejectable undercut as well as a size ranging from 4mm to 10mm. Note the excess weld and poor appearance of the weld.



Photo 9:

Girder 4, Splice B. During the ultrasonic inspection of the bottom flange weld, a rejectable indication ran along the length of the splice and was noted at the edge of the material. Magnetic particle inspection verified the location of the indication.



Photo 10:

Girder 4, Splice C.



Photo 11:

Girder 4, Splice C. The fillet weld was wrapped at the end but is substandard containing porosity and undercut.



Photo 12:

Girder 4, Splice C. This is the right side stiffener (looking north). Note the undercut at the edge of the stiffener and along the fillet weld length.



Bridge No.	K692	Road Name	Finn Creek FSR										Inspection Date	2014-09-10	
STA.	Forest District										Access Notes				
28 km	Headwaters Forest District														
Bridge Length	Stream Crossing										Inspected By				
23.7 m	Adams River										J. Henley / J. Rupar				
UTM Zone	Easting										Northing				
11	355973										5763321				
No. Spans	Installation Date			Current Load Rating			Deck Width			Project No.			Anticipated Replacement		
1	1990			59 Tonnes			4100 mm			2014 2725			2019		
Span / Length (m)	1	22.5	2		3		4		5		6		7		
Comments															
<p>Excellent: New or almost new condition and properly installed</p> <p>Good: Structurally sound, in good repair and have minimal wear</p> <p>Fair: Structurally sound, but show moderate wear or preliminary indications of rot or corrosion</p> <p>Poor: Structurally unsound, major items in need of repair or replacement, or bridge load rating should be reduced</p> <p>Abutment, spans, piers numbered from left bank, facing downstream / girders numbered from upstream to downstream.</p>															
Approaches															
Approach Road	Fair		Vegetation overgrowth adjacent to approaches. Potholes and settlement of road at bridge deck.												
Alignment	Fair		Horizontal curve.												
Signage	Fair		No bridge ahead signs. 15 km/hr, speed restriction & load posting on right approach only (left approach sign in bush).												
Delineators	Good														
Fenders	N/A		No fenders.												
Overall	Fair														
Deck - Span 1															
Running Surface	Fair		4-65mm x 250mm running planks on each wheel track, gravel on sub-deck between planks & on deck edge. Right end upstream flare: large gap, rail flared but deck does not extend to rail (see figure 12).												
Deck Ties	Good		90mm x 250mm untreated sub-deck, sound.												
Subdeck	Fair		200mm x 250mm creosote treated ties at 400mm, sound.												
Nails	Fair														
Deck to Girder Bolts	Good														
Curb Rails and Risers	Fair		No decay, minor rub damage.												
Hardware	Fair		Minor corrosion on the non-galvanized curb bolts. Loose nuts - don't bear against upstream ties.												
Overall	Fair														

Bridge No.	K692	Road Name	Finn Creek FSR	Inspection Date	2014-09-10
Superstructure - Span 1					
Girders	Fair	4- W33 Rolled beams butt welded to W33 at each abutment, total of 16 butt welds in girders. The detailing and apparent weld repairs to the girders suggests they may have been used in another structure prior to installation. Paint is generally faded, coating has typically failed at a number of locations along length of girders where there is light corrosion. Sag noted in all girders. Section removed from botom flange of girder 1 at the left abutment. Acuren Group Inc. performed non-destructive testing at selected locations along the steel girders. Four out of 16 butt welds were tested by ultrasonic shear wave; additionally, magnetic particle testing was performed on the adjacent stiffener welds at each location. The NDT ultrasonic shear wave testing identified anomalies in two bottom flange welds. In addition, all tested stiffener to bottom flange welds have rejectable under cut, with two welds having linear indications indicative of a crack.(see attached non-destructive examination report from Acuren, dated September 10th, 2014).			
Bracing	Good				
Diaphragms	Fair	Torch cuts noted in C channel diaphragms at two locations in bay 2 adjacent to the right abutment.			
Hardware	Good				
Overall	Fair				
Abutment - Left					
Bearings	Fair	Neoprene bearing walked out under girder 4. Other bearings not visible. The girders are in bearing against the downstream restraints, suggesting the structure may have previously moved, see figure 22.			
Ballast Wall	Good	Sheet pile breast wall. Ballast wall consists of cedar logs. Downstream log rotten & disintegrating (see figure 27), fill containment not compromised.			
Caps or Sills	Good	Concrete sill supported on gravel fill behind sheet pile wall.			
Fill	Fair				
Riprap	Good				
Overall	Fair				
Abutment - Right					
Bearings	Poor				
Ballast Wall	Fair	Sheet pile breast wall. Ballast wall consists of cedar logs. Downstream log rotten & disintegrating (see figure 25), fill containment not compromised. Flashing between ballast wall logs & girders damaged at both the upstream & downstream ends.			
Caps or Sills	Good	Concrete sill supported on gravel fill behind sheet pile wall. Debris collecting on cap - similar to previous inspection.			
Fill	Good				
Riprap	Good				
Overall	Fair				

Bridge No.	K692	Road Name	Finn Creek FSR	Inspection Date	2014-09-10
Hazards					
High Water		NO			
Scour		NO			
Ice		NO			
Debris		NO			
Aggradation		NO			
Channel					
Estimated Present Water Level Depth		1 m			
Estimated Present Water Level Width		13.3 m			
Estimated High Water Level Clearance		4.5 m			

Bridge No.	K692	Road Name	Finn Creek FSR	Inspection Date	2014-09-10
Repair Description and Cost Estimate					
No.	Description	Priority	Cost Estimate		
1	Reinstall left approach load posting & speed restriction.	High	\$100.00		
2	Install bridge ahead signs at both approaches.	Low	\$500.00		
3	Brush adjacent to approaches when road is in use.	Low	\$600.00		
4	Regrade approaches when road is in use.	Low	\$250.00		
			\$1,450.00		
<p>High: Immediate, non-recurring repair to assure public safety</p> <p>Medium: Ongoing, regular maintenance items to protect capital investment</p> <p>Low: Minor maintenance items or improvements to extend service life</p> <p>The cost estimate for individual maintenance items reflects the cost of materials and labour for completing a task; it does not include any costs associated with mobilization, demobilization, delivery of materials, engineering or contract administration.</p>					
Monitoring Items					
No.	Description				
1	Monitor welds in the girders.				
2	Monitor abutment ballast walls, cedar logs rotten, but still functioning.				
3	Monitor bearings.				
Comments				Seal	
<p>The bridge is generally in fair condition. We recommend installation of bridge ahead signs as well as speed restriction and load posting signs at the left approach. NDT testing identified two anomalies in the bottom flange welds. Based on these observations, if the Ministry intends to utilize the bridge for industrial purposes, we recommend that the Ministry consider replacing the bridge. The Ministry could also mitigate this risk by strengthening the steel girders. In this case, upon confirming the adequacy of the existing steel girder capacity, the girders could be strengthened by installing bolted splices at the butt weld locations. This would provide an alternative load path should the welds fail.</p> <p>The theoretical remaining service life of the bridge is unknown due to the possibility that the girders were used in another structure prior to installation. The anticipated replacement, based on current condition, is approximately 5 years.</p>				 2014.10.17	

Bridge No.	K692	Road Name	Finn Creek FSR	Inspection Date	2014-09-10
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Figure 2: Downstream elevation.

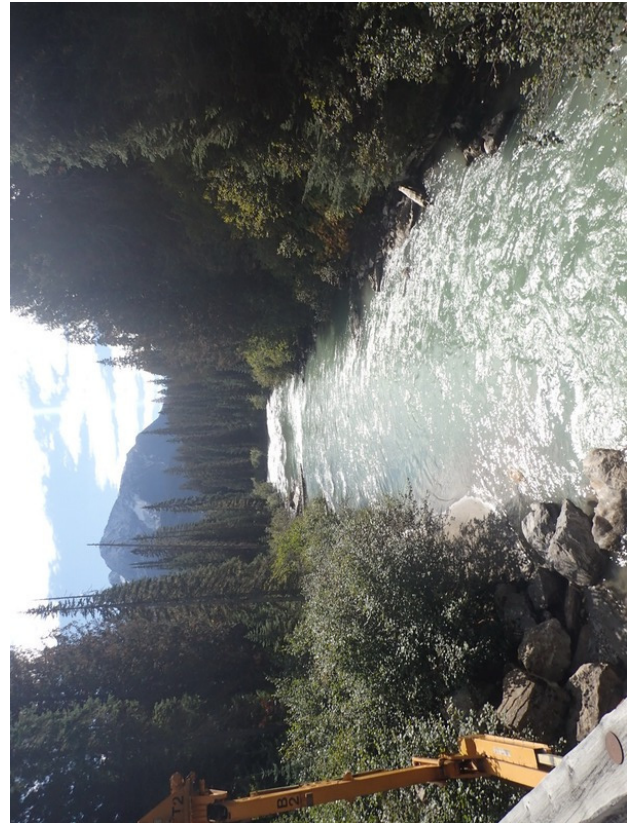


Figure 4: Looking downstream.



Figure 1: Upstream elevation.



Figure 3: Looking upstream.

Bridge No.	K692	Road Name	Finn Creek FSR	Inspection Date	2014-09-10
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Figure 6: Load posting and speed limit signs at right approach.



Figure 8: Left approach - note potholes at end of deck.



Figure 5: Right approach.



Figure 7: Left approach.

Bridge No.	K692	Road Name	Finn Creek FSR	Inspection Date	2014-09-10
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Figure 10: Typical deck condition.



Figure 12: Right approach - note gap between decking and rail.



Figure 9: Load posting and speed limit signs - left approach.



Figure 11: Minor rub damage to rail.

Bridge No.	K692	Road Name	Finn Creek FSR	Inspection Date	2014-09-10
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Figure 14: Exterior girder & tie condition, girder 4 shown.



Figure 16: Section removed from girder 1 at left abutment.



Figure 13: Typical sub deck condition.



Figure 15: Interior girder condition, girder 3 shown - coating failure with light corrosion.

Bridge No.	K692	Road Name	Finn Creek FSR	Inspection Date	2014-09-10
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Figure 18: Typical undercutting on stiffener weld - girder 4 location C downstream stiffener shown.



Figure 20: Ultrasonic shear wave testing.

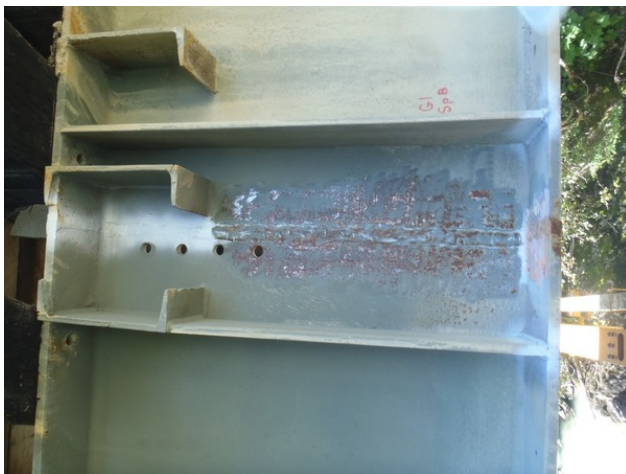


Figure 17: Girder splice condition, location of previously performed NDT testing.



Figure 19: Torch cut in bay 2 diaphragm adjacent to right abutment.

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Figure 22: Right abutment girder 1 bearing upstream face - note bearing against restraint.



Figure 24: Right abutment upstream face - typical condition of flashing.



Figure 21: Right abutment.



Figure 23: Right abutment - typical condition of flashing between girders and debris collecting on bearings.

Bridge No.	K692	Road Name	Finn Creek FSR	Inspection Date	2014-09-10
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Figure 26: Left abutment.



Figure 28: Left abutment concrete sill.



Figure 25: Right abutment downstream face - disintegrating ballast logs.



Figure 27: Left abutment downstream face - disintegrating ballast logs.