LOAD TEST REPORT OF

CHANNEL BRIDGES ACROSS SOUTH CAROLINA

SUBMITTED TO

SCDOT

SUBMITTED BY

Michael W Craig, PE
1001 Wade Ave, Suite 400
Raleigh, NC 27605
919-609-1800
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SOUTH CAROLINA LICENSED PROFESSIONAL ENGINEER
No. 27612
MICHAEL W. CRAIG

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MAJOR CONTRIBUTORS

Bo Yan, PhD

Istiaque Hasan, PhD

Mohamad Sacko

William Michell

Casey Howard

Zack Van Burnt

Andy Foden, PhD

David Johnson

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Executive Summary

Table 1 Summary of Tested Bridge Condition and Distribution Factor

Asset ID	Design Live Load (H10/H15)	Slab Width (in.)	Reflective Cracking (None/Minor/Moderate /Severe)	Tie Rod Condition (Good/Poor)	Asphalt Thickness (in.)	Gaps[1] (in.)	Tested DF (Lane)
03888	H10	33.0	None/Minor	Good	4.50	0.08	0.24
04548	H10	33.0	None/Minor	Good	4.00	0.57	0.25
03647	H10	33.0	Moderate	Good	4.50	0.54	0.28
04399	H10	33.0	Moderate	Poor	2.00	0.50	0.29
03313	H15	30.5	Localized Moderate	Good	1.25	0.31	0.30
04131	H10	33.0	Moderate	Good	4.00	0.22	0.31
03266	H10	33.0	Moderate	Good	2.00	0.24	0.31
04875	H10	33.0	Moderate	Poor	1.50	0.31	0.34
04488	H10	33.0	Moderate	Poor	4.50	0.45	0.35
04398	H10	33.0	Moderate	Good	2.00	0.26	0.36
04545	H10	33.0	Severe	Poor	4.00	N/A[2]	0.39
05741	H10	33.0	Severe	Good	5.00	0.59	0.41
04798	H10	33.0	Localized Severe	Good	4.00	0.27	0.43
04801	H10	33.0	Severe	Poor	4.00	0.24	0.44
04333	H10	33.0	Severe	Poor	1.50	0.39	0.46
04803	H10	33.0	No Asphalt	Poor	0.00	N/A[2]	0.50

1: Average gaps on each side of controlling channel sections
2: N/A Inspection data is not available

1 Scope

In this report, the live load distribution of channel bridges with 2.5 inch of web bottom thickness (skinny leg channel's) in South Carolina are summarized. The goal of this report is to identify the visual variables or indicators on a skinny leg channel bridge that have direct correlation to measured distribution factors recorded on the instrumented bridges. Distribution factors have been grouped by the different readily visually inspectable potential indicators including asphalt thickness, year of construction, design load, width of slabs, gaps between slabs, condition of post tensioned rods and degree of reflective cracking, to identify potential patterns. In addition, NDT was performed on each instrumented structure to verify that subject structures match existing plans. Based on identified patterns, as well as engineering judgment, we produced an inspection guide to allow engineers to determine more appropriate distribution factors for skinny leg channel bridges in South Carolina. In this report, 16 channel bridges having different superstructure conditions have been selected and diagnostic load testing was performed. Results of this diagnostic load tests in conjunction with observed conditions of superstructure components were analyzed and are presented here.

2 Objectives

The main objectives of this project were:

- Perform diagnostic load tests on set of skinny leg channel bridges
- Inspect the condition of superstructure components
- Verify rebar and prestressing steel matches existing plans
- Calculate LLDF based on diagnostic load tests results
- Correlate superstructure element conditions to LLDF to better understand the factors that affect load sharing
- Create an inspection guide to assist in assigning appropriate LLDF for standard "skinny leg" channel bridges

3 Bridge Description

The skinny leg channel bridges are designed for H10 or H15 truck loads. The channel sections are precast prestressed concrete section with a span length of 30 ft. Figure 1 shows a typical cross section of a single channel and bridge. The bridge cross section typically consists of 10 or more precast prestressed channel sections. Each of the channels are either 30.5 in. (H15) or 33 in. (H10) wide. Channels are tied together by transverse tie rods at fourth points along the span. Thickness of the flange is 5 in. and tapered web is 2.5 in. thick at the bottom.

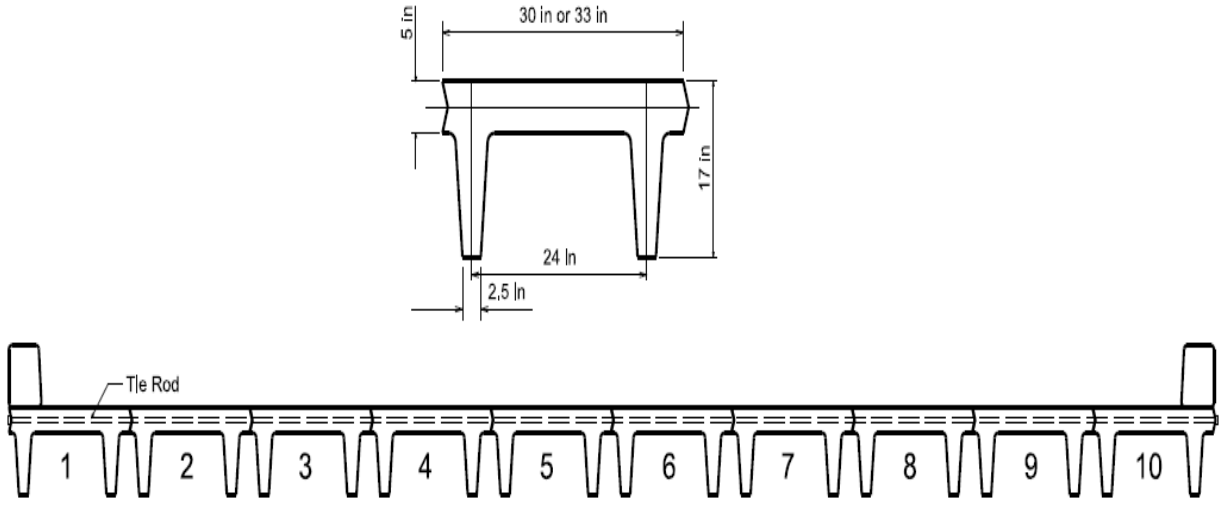


Figure 1: Typical cross section of a single channel section and the entire bridge deck.

4 Conditions of Superstructure Components and NDT Tests

4.1 Reflective Cracking Qualifying

Reflective cracking caused by the independent movement of one slab relative to the adjacent slab was identified as a key potential inspectable indicator after the completion of our Phase 1 testing. A visual guide was created to aid with qualifying the degree of reflective cracking into 3 categories, none/minor, moderate and sever. The following images (Figure 2, Figure 3 and Figure 4) depict none/minor, moderate and sever reflective cracking.

Figure 2 Bridge Deck Asphalt Overlay; None/Minor Reflective Cracking

Figure 3 Bridge Deck Asphalt Overlay; Moderate Reflective Cracking

Figure 4 Bridge Deck Asphalt Overlay; Severe Reflective Cracking

4.2 Tie Rod Condition Qualifying

During the visual inspection, all tie rods where sounded with a hammer. This crude inspection process gave indications of a broken or poorly tighten tie rods. However, the process also may have provided false positive results because the process cannot determine if the tie rods are providing adequate post tensioning to allow the shear keys between slabs to lock as designed. In the attached tables, if the tested span had a tie rod that was determined to be loose or broken, the "Tie Rod Condition" for that span was listed as "poor". If the post tensioning was sounded and had no indications of broken or lose elements, the "Tie Rod Condition" was identified as "good" in tables.

4.3 Nondestructive Testing (NDT)

Nondestructive Testing (NDT) was performed on the channels to confirm the size and number of prestressing strands as shown in the standard plans. Three different types of NDT were performed: Ultrasonic Tomography, Ground Penetrating Radar and Profoscope. Figure 5 shows a standard skinny channel cross section at midspan with five 3/8" dia. stress-relieved prestressing strands. Figure 6 shows field data collections using Profoscope (Proceq), Ultrasonic Tomography (MIRA) and GPR (Proceq).

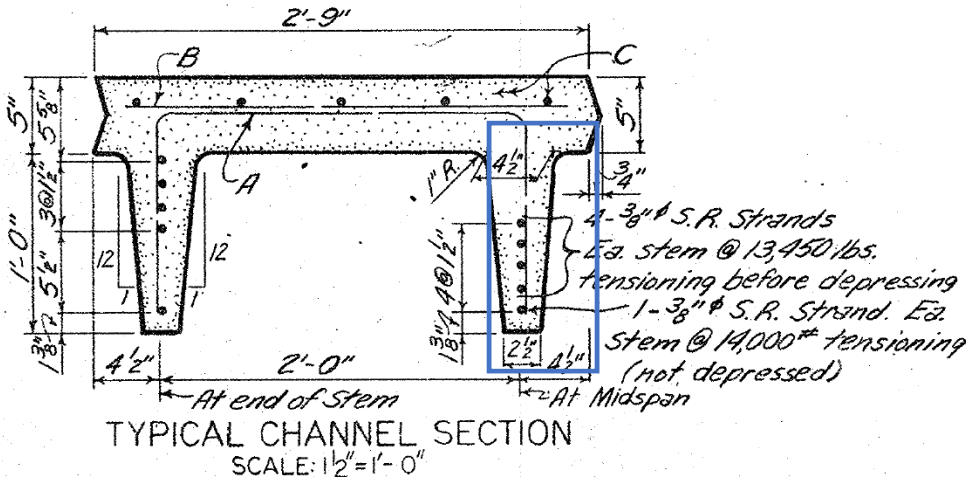


Figure 5. Prestressing Strand Details in a Standard Plan

(a) (b) (c)

Figure 6. NDT Tests: (a) Profoscope, (b) MIRA, (c) Proceq GPR.

Profoscope showed a diameter of 0.5 in. for most tested bridges. The accuracy of Profoscope rebar diameter measurement is within 1/8". GPR is a strong tool for locating rebar, however, it was impossible to get a full sweep of GPR antenna from bottom to top of channel legs. MIRA ultrasonic tomography was the most convenient NDT method in terms of accessibility in this case. The MIRA was able to locate 5 prestressing strands in all tested bridges, matching the plans. Figure 7 shows a MIRA B-Scan of the channel leg for bridge BR04131. All 16 bridges matched rebar and strand size and location per let standard plans.

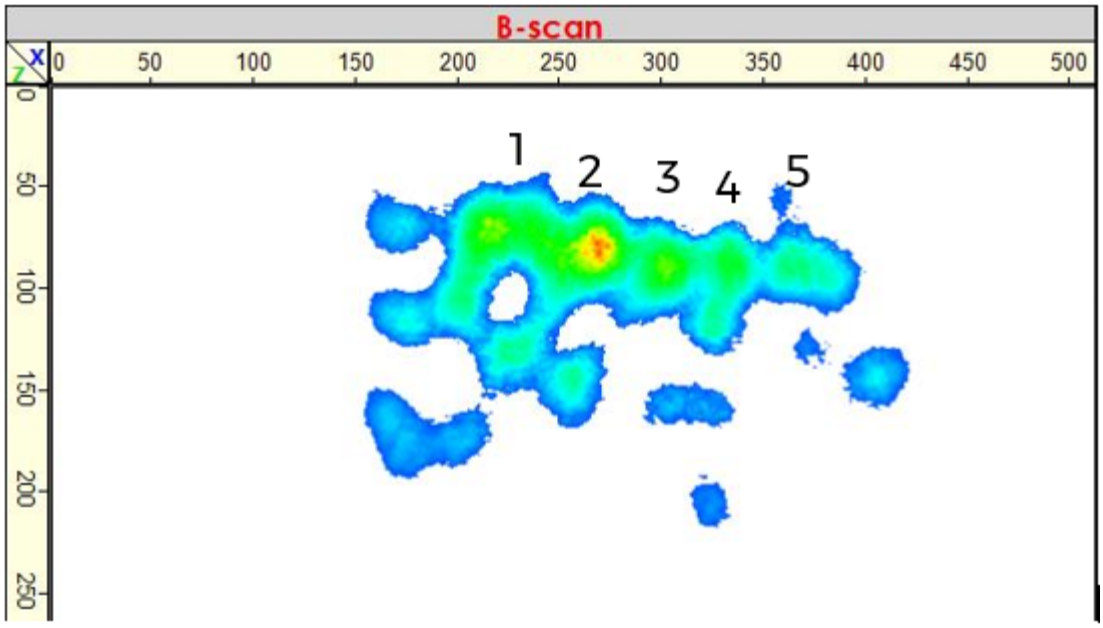


Figure 7: MIRA B-Scan showing 5 Prestressing Strands (BR04131)

5 Instrument Description

Load tests were conducted with ST350 strain transducers manufactured by Bridge Diagnostic Inc (BDI). ST350 is a resistance-based full Wheatstone Bridge strain gauge designed with four fully 350 Ω foil gages. The range of strain that can be measured is ± 2000 micro-strain. Nominal gauge length of ST350 strain transducers is 3 inches. Gauge length can be extended to 24 inches by adding an extension arm. Figure 8 shows a ST350 strain transducer installed at the bottom of the web of a channel section. Details of SE350 strain transducer were attached in Appendix E.

Figure 8: ST350 Strain Transducer with 9-in. extension arm.

The data collection from the sensors are done using the STS4 system from BDI. All strain sensors are connected to STS4 nodes through electrical cables. The STS4 node communicates with the STS4 base station via Wi-Fi connection. A laptop with a STS4 data collection software communicates with the base station via Wi-Fi during the load test. Figure 9 shows schematics of the STS4 data collection system.

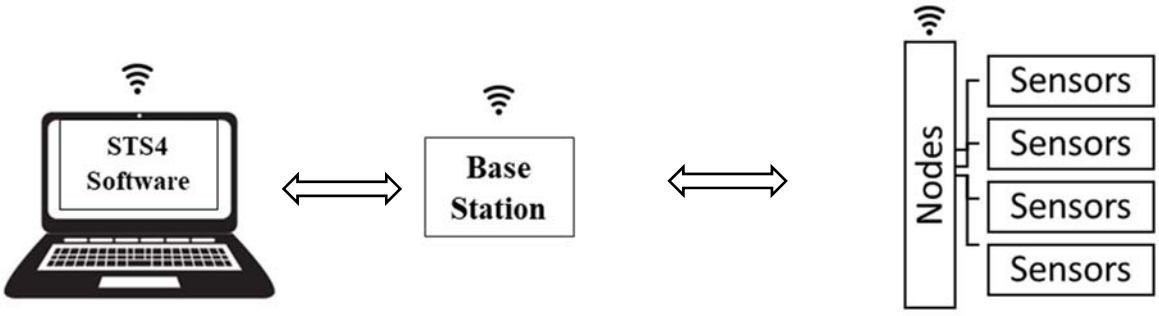


Figure 9 BDI STS4 data collection schematics.

6 Load Test

6.1 Test Phase

To provide for an economical, effective load testing effort, the entire load testing process for skinny channel bridges were conducted in 2 phases as described below:

- Phase 1: Initial load test consisted of two detailed instrumented channel bridges, BR04803 and BR04545, which are representative of the skinny channel bridges. Initial tests were intended to: 1) provide an understanding of the necessary sensors to capture the response of structures; 2) determine truck weight that could be utilized to effectively load the skinny channel bridges for load test purposes; and 3) decide effective load path for load test purposes.

- Phase 2: Included load testing target bridges with refined instrumentation plans. Load tests were conducted in conjunction with gathering visually observable conditions linking bridge conditions and the load distribution.

6.2 Instrumentation Plan

For phase 1 the spans where instrumented with strain sensors at mid span bottom of the legs, the mid span of the soffit and in the potential negative moment areas at the girder ends. After phase 1 of the investigation was complete, it was concluded as expected that little negative moment was observed at the girder ends and the neutral axis was near the interface of the bottom of the deck and the channel legs. Based on these findings it was determined fewer stain gauges would be required to allow our team to accurately determine distribution factors for phase 2. Phase two was completed with strain sensors on all legs at mid span. The sensor layout for phase 2 is presented in Figure 10 and Figure 11.

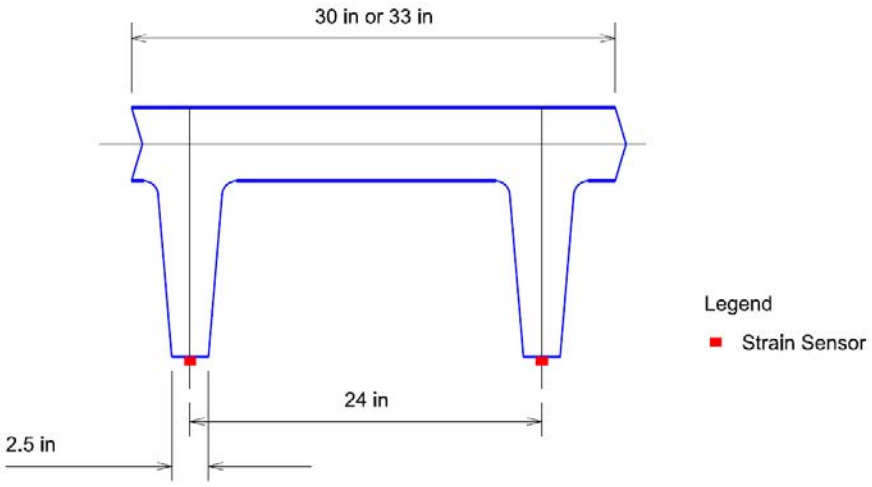


Figure 10: Strain Sensor at Both Leg of the Channel Section.

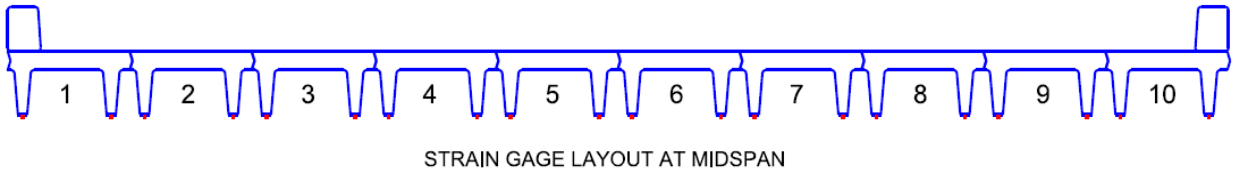


Figure 11: Strain Sensor Layout at Mid-span.

The gauge length of the sensors was reduced from 18" in phase 1 to 12" in phase 2. It was determined that, the manufactured 3 in. gauge length was not adequate to account for the variation of elastic strain of prestressed concrete channel sections, and effects of potential crack openings. The measured strain presented here must be divided by 6 for phase 1 tests and 4 for phase 2 tests to account for this increased gauge length and convert the measured strain to actual strain.

Sensors were mounted on the bridges following manufacturer's recommendations. First, grinded the concrete surface to remove localized uneven surfaces and then wiped with acetone to remove any dust or grease. The sensors were then mounted on concrete surface using Loctite epoxy adhesive and accelerator for quick setting. Figure 12 shows the installed strain sensors.

Figure 12: Strain Gauge Installation

6.3 Load Test Vehicle

The first two bridges (BR04803 and BR04545) were tested with dump trucks in phase one during the last week of November 2019. The axle configuration of the dump truck is shown in Figure 16 and Figure 17. During phase 1, single and double dump trucks were utilized loaded near capacity of the bridge, as determined with 2-D BrR model of the bridge. The first two load tests where problematic in that the strain sensor became loose due to the degree of deflection of the channel members. From the lesson learned from phase 1, it was determined that a truck with a lower GVW will be appropriate for testing these skinny leg channel bridges. For phase 2, we utilized a lower weight bucket truck as shown in Figure 14 . The axle weight and wheel configurations of the bucket truck are presented in Figure 15 and Table 2. Details of the truck information is attached in Appendix F.

Figure 13 Phase 1 Load Test Truck

Figure 14: Phase 2 Load Test Bucket Truck.

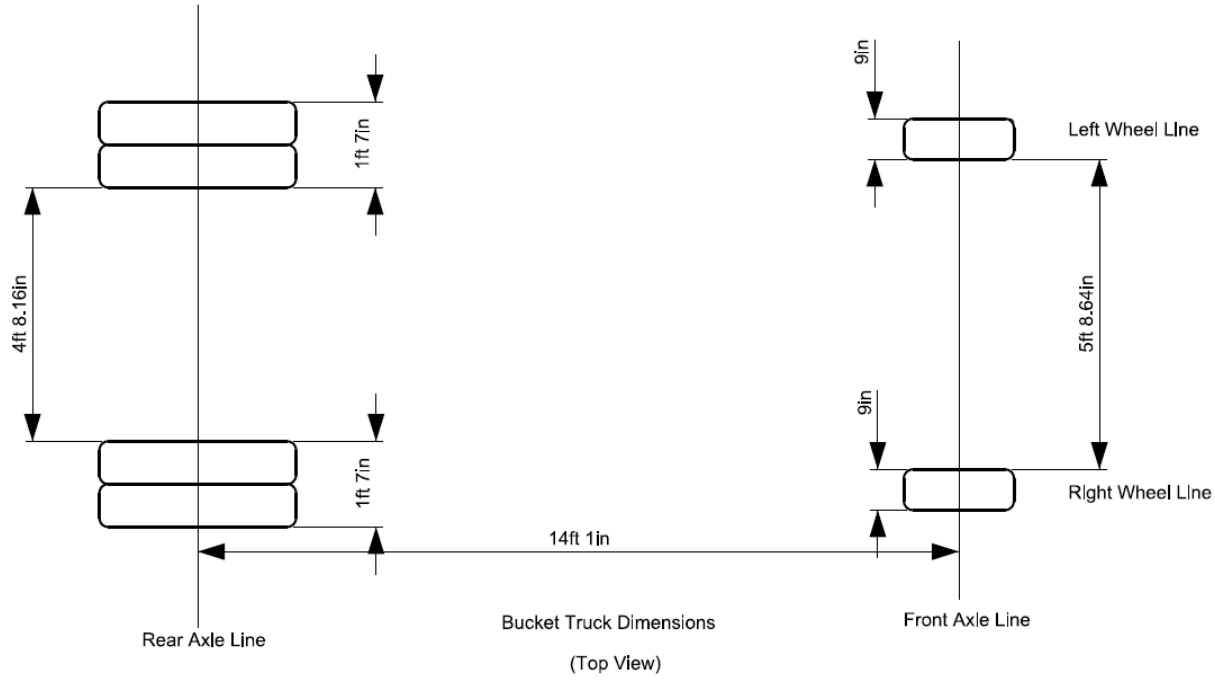


Figure 15: Wheel Configuration of the Load Test Bucket Truck

	Measured Wheel Load (lbs.)	
	Front Axle	Rear Axle
Right Wheel Line	2580	5980
Left Wheel Line	3040	5960

Table 2: Measured Axle Loads of the Load Test Bucket Truck

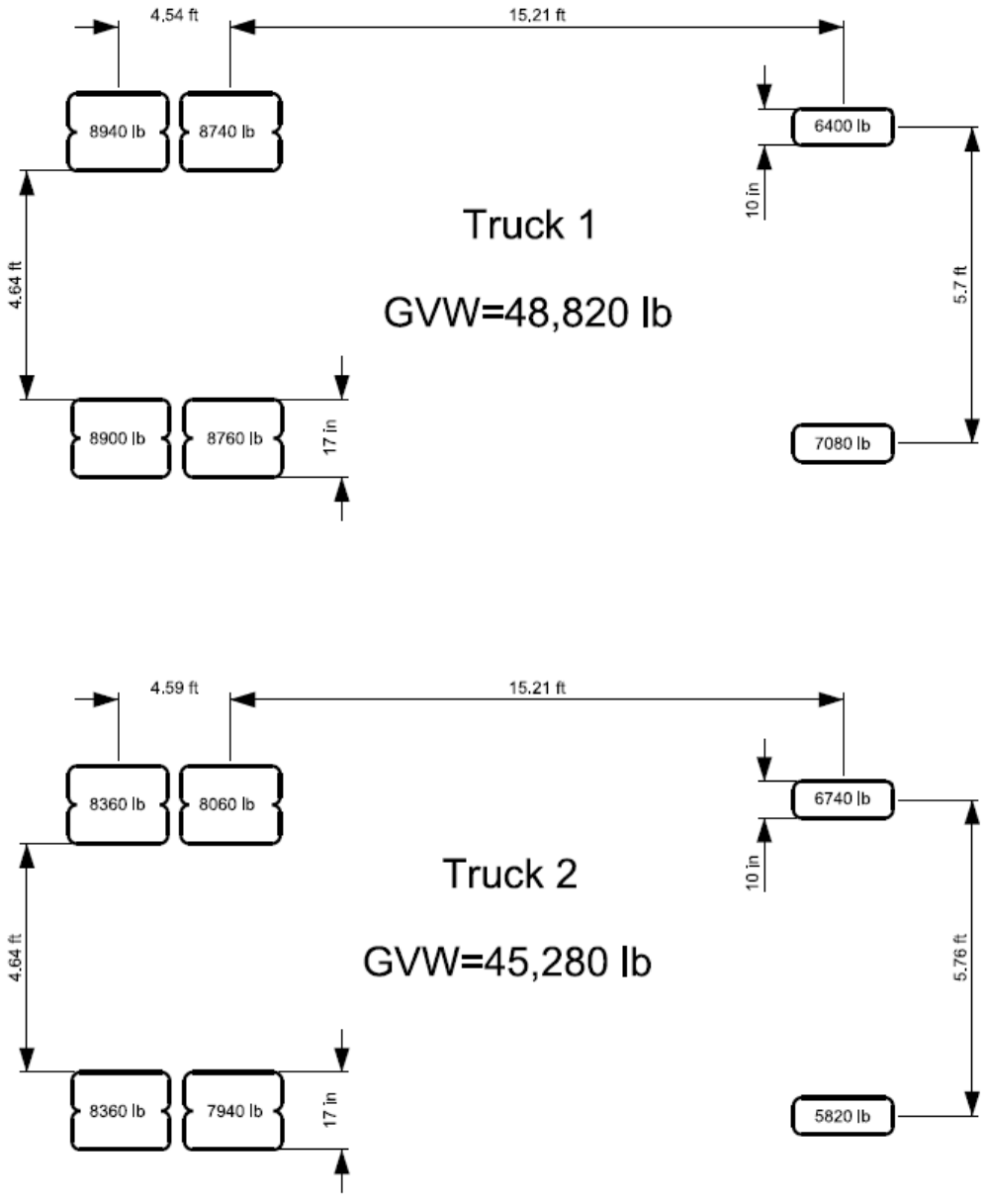


Figure 16: Bridge BR 04803 Load Test Vehicle

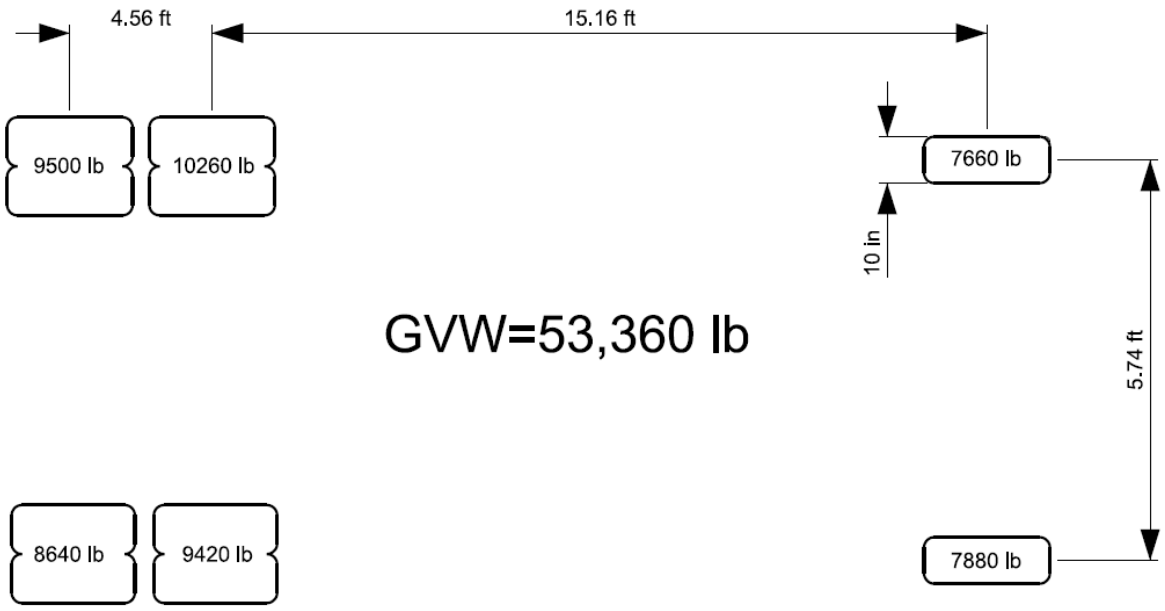


Figure 17: Bridge BR 04545 Load Test Vehicle

6.4 Wheel Path During Load Test

One of the main objectives of this diagnostic load test effort was to evaluate the governing transverse distribution factor of skinny leg channel girders. To ensure the maximum distribution factor was captured at each bridge 2 to 9 runs where completed on each channel the truck could physically drive across. Scenario-1 in Figure 18 shows the load test wheel paths used in this investigation. The rear axle positions of the load test truck are shown in 8 different test cases. Alternate wheel scenarios are shown in Appendix B.

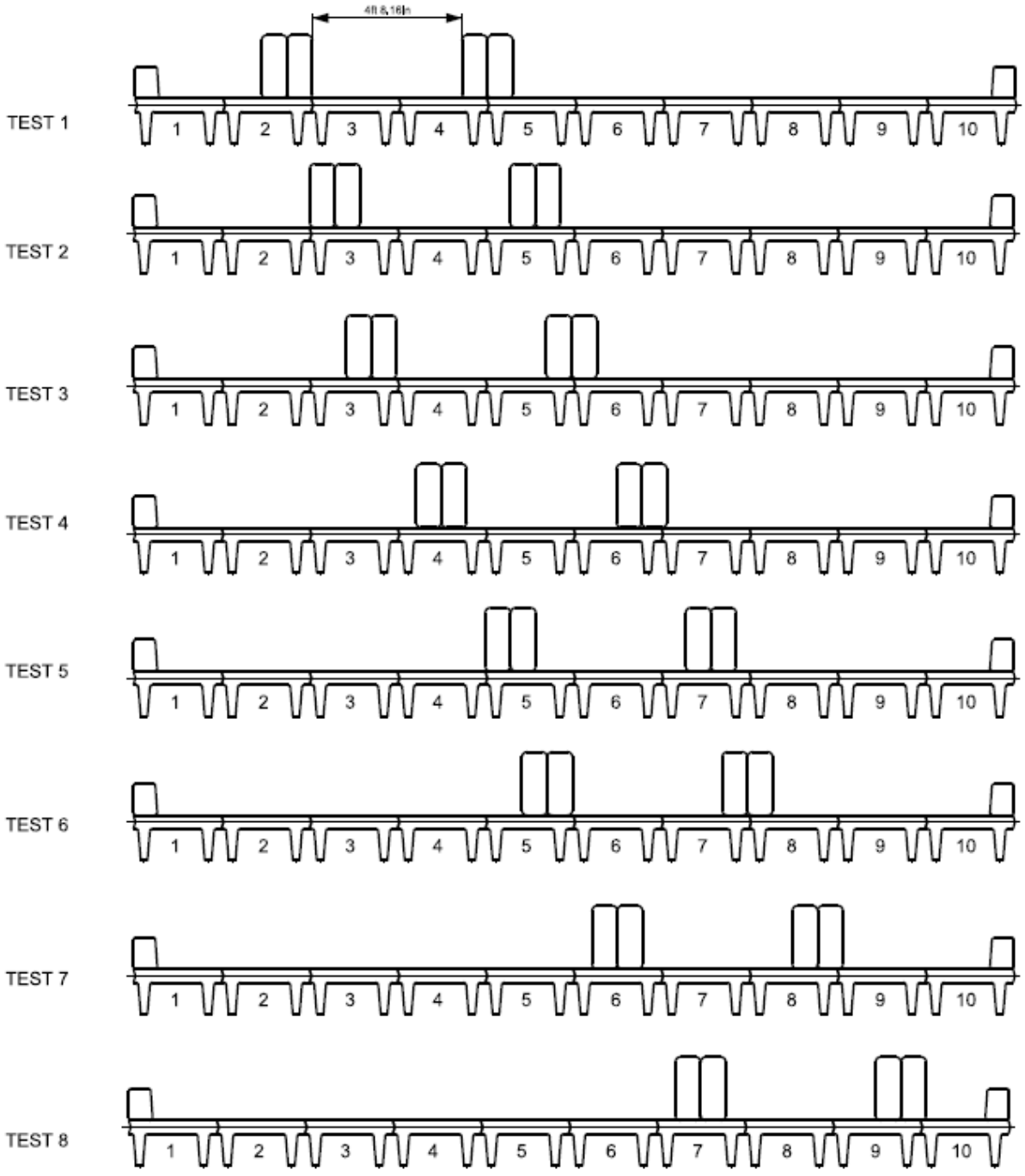


Figure 18: Load Test Wheel Path Scenario-1

6.5 Conducting the Load Test

The load test truck was driven at crawl speed (3-5mph) following the wheel path as discussed in the previous section. Longitudinal lines on the joints between two channels were marked on the bridge deck using temporary paint to facilitate the wheel line alignment during load test as shown in Figure *19*.

In Phase 2, each of the test case was repeated at least twice to ensure the repeatability of tested data. 16 truck passes were conducted to complete 8 sets of test cases. For the first 4 bridges (04545, 04803, 03888 and 05741), 11 test cases were run with 3 passes per test for a total of 33 tests per bridge.

Figure 19 Temporary Marking Lines on the Bridge Deck for Proper Truck Alignment During the Load Test

The sampling rate during data collection was set as 10 Hz. On-site data validation was ensured by careful observation of data. Tested data was checked for linearity, reproducibility and symmetry. Any sensor behavior that was inconsistent and unexpected was immediately addressed.

For Phase 1, prior to testing, the trucks were positioned completely off the bridge. Three pre-tests were conducted:

1. Zero out sensors, record data and watch for excessive drift. This allowed cables to "warm up" and any initial fluctuations to stabilize.
2. Re-zero sensors and repeat the above test.
3. Run a single truck across the bridge. Following the test, verify that values are recorded on each sensor, and that their relative magnitudes and signs generally align with expectations. If any apparently erroneous readings are observed, check sensor responsiveness manually, and repeat this pre-test.

For Phase 2, prior to testing, the trucks were positioned completely off the bridge. And the following pre-tests were conducted:

1. Zero out sensors, recorded data and watched for excessive drift. This allowed cables to "warm up" and any initial fluctuations to stabilize.
2. Run a single truck across the bridge. Following the test, verify that values are recorded on each sensor, and that their relative magnitudes and signs generally align with

expectations. If any apparently erroneous readings are observed, check sensor responsiveness manually, and repeat this pre-test.

During testing, one person monitored the laptop and recorded data. A second person was responsible for guiding trucks onto assigned marks and coordinating with all team members. The third person drove the truck and two additional people were provided for traffic control.

6.6 Distribution Factor Calculation

Ignoring stiffness contribution from curbs for end channels, the distribution factor of a girder or channel was calculated using the following equation:

$$DFM_i = \frac{\varepsilon_i}{\sum_{j=1}^{n} \varepsilon_j}$$

Where ε_i is the maximum measured strain at a channel during a load test and $\sum_{j=1}^{n} \varepsilon_j$ is the summation of strains of all the girders/channels at the same point in time. See Appendix G for sample calculations.

7 Load Test Results

In this section, load test results for each of tested bridges are presented. Results reported herein include general bridge information, test date, wheel location scenario, tie rod condition, asphalt overlay reflective cracking condition and the calculated Distribution Factor (DF) from load tests. DFs were calculated for all channels for each test case following the procedure mentioned in Section 6.5 of this report. Maximum DFs for each of the channels are presented in a bar chart along with the average gap between channels and calculated AASHTO DF. Maximum strains for all sensors for each test case are also presented in Appendix A. The strain time history for the controlling test case for all tested bridge is presented below. Strain gauges are named in accordance with the location of channels and legs. For example, C1L1 indicates the strain gage installed at channel 1 at left leg. Similar C1L2 indicates the strain gage installed at right leg of channel 1.

7.1 BR 03888

Table 3: BR03888 Load Test Summary

Asset ID	03888
Date:	01/22/2020
Wheel Scenario.	Wheel on Channel 2 Right Edge
Reflective Crack	**None**
Tie Rod Condition	Good
Asphalt Thickness	4.5 in.
Year Built	1962
ADT	5100
County	Greenville
Features Intersected	Bushy Creek
Latitude	34.87396389
Longitude	-82.26667583
Load Test DF	**0.24**

Figure 20 BR03888 Top of Deck

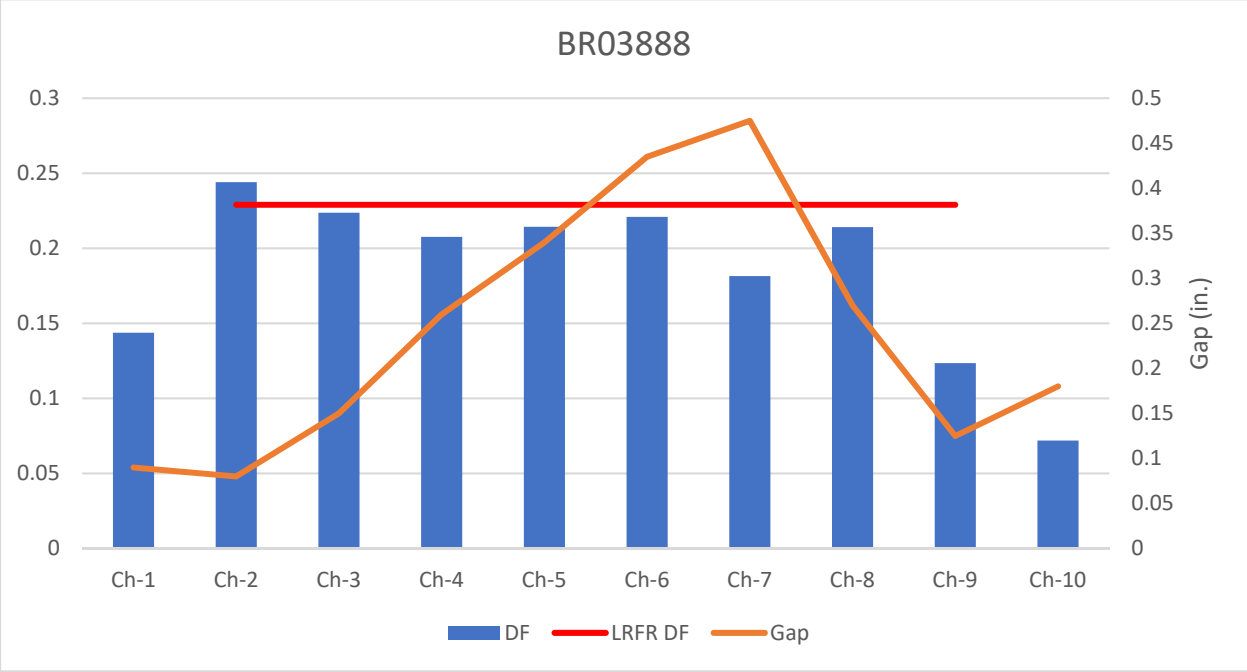


Figure 21 Maximum DF of BR03888 Channels for all Test Cases

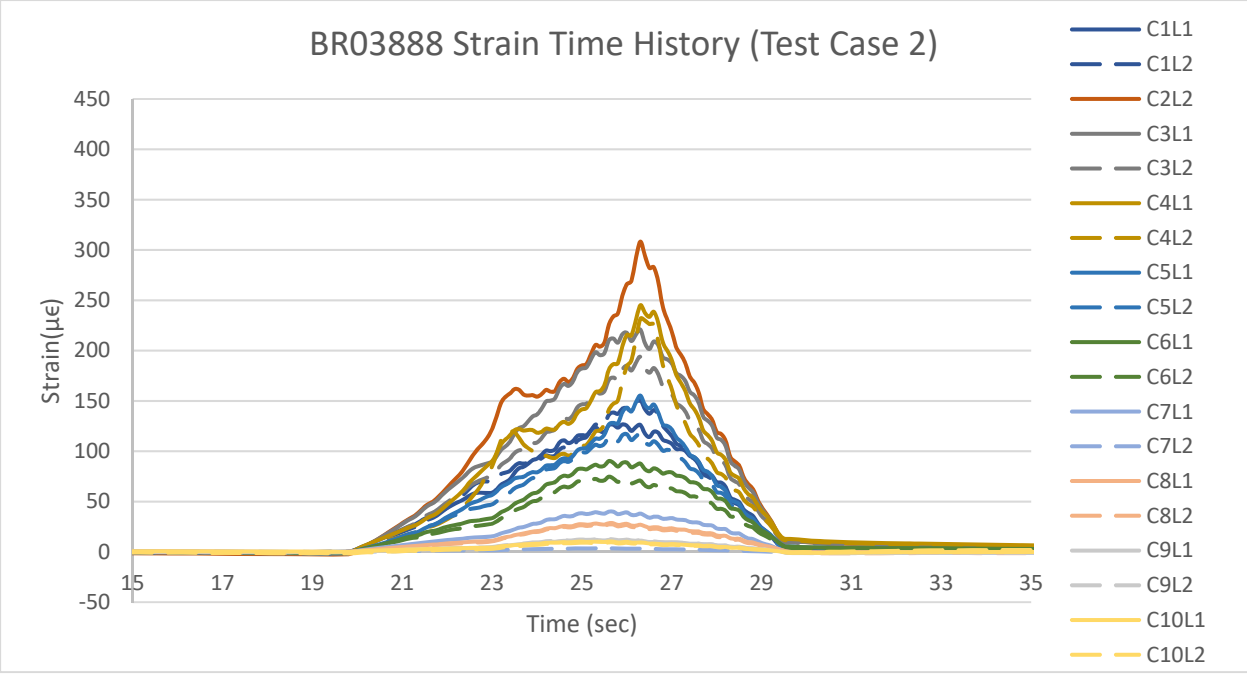


Figure 22 Strain Time History of Controlling Test Case for all Strain Gauges of BR03888 (12-in gauge length)

7.2 BR 04548

Table 4 BR04548 Load Test Summary

Asset ID	04548
Date:	1/30/2020
Wheel Scenario.	Wheel on Middle of Channel 7
Reflective Crack	**Minor\Moderate**
Tie Rod Condition	Good
Asphalt Thickness	4 in.
Year Built	1965
ADT	950
County	Greenville
Features Intersected	Enoree River
Latitude	34.9537694
Longitude	-82.3333875
Load Test DF	**0.25**

Figure 23 BR04548 Top of Deck

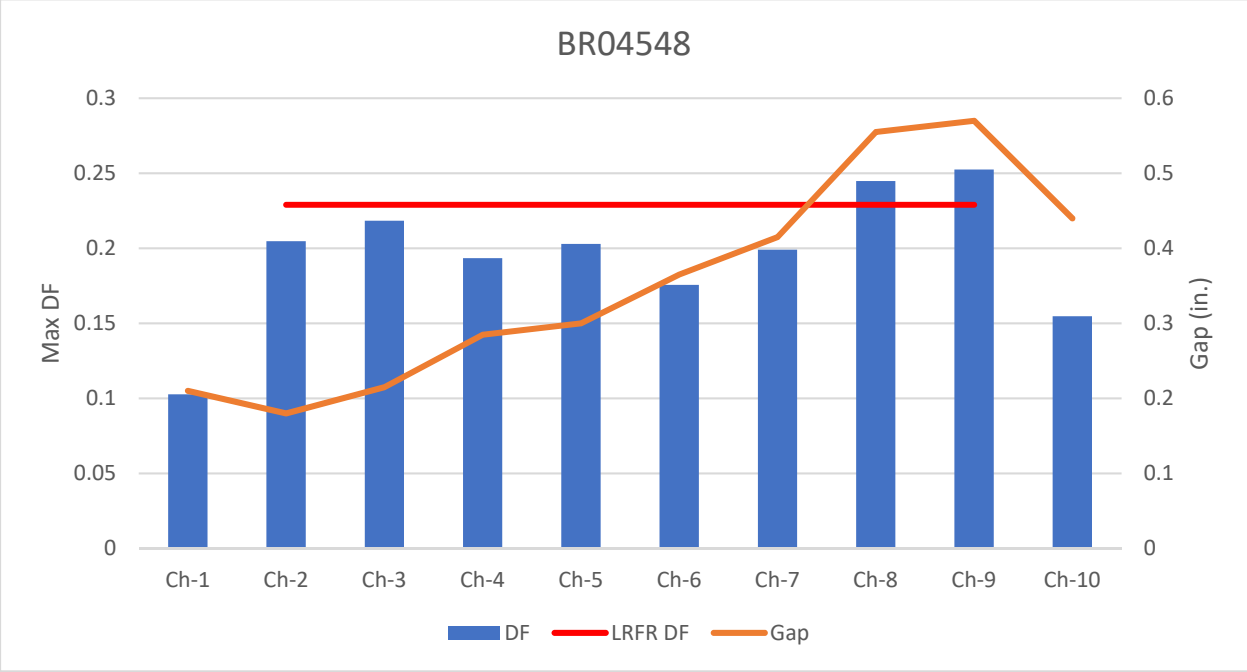


Figure 24 Maximum DF of BR04548 Channels for all Test Cases

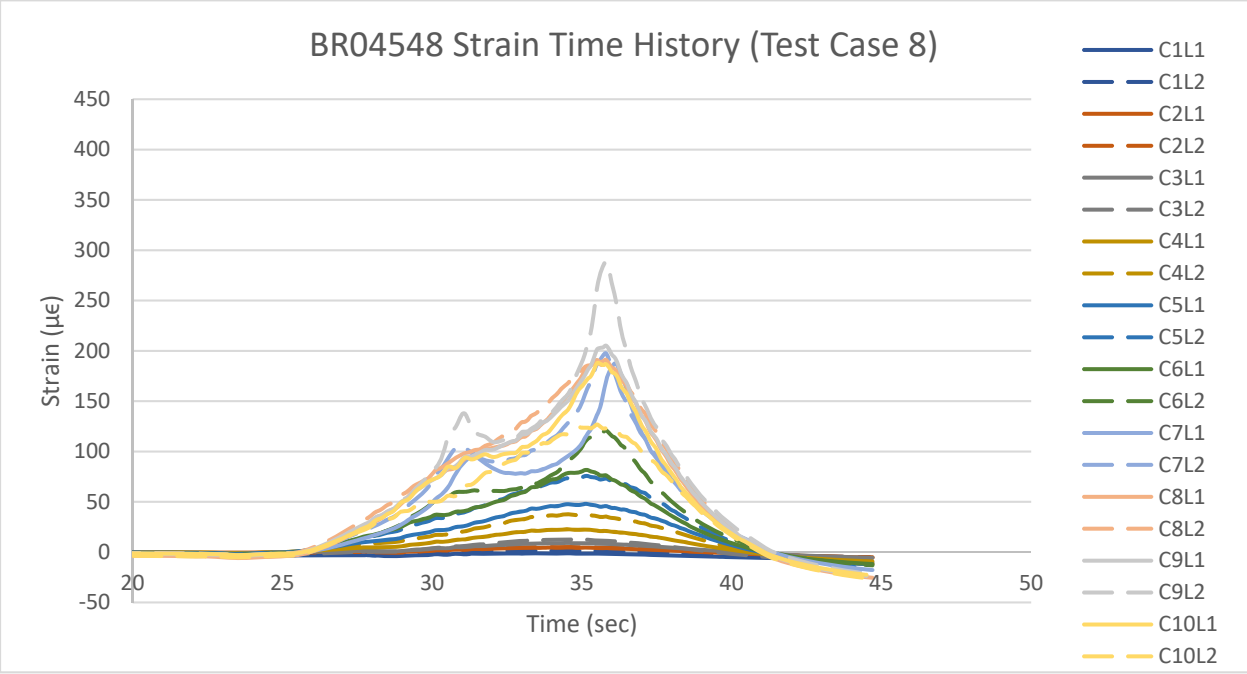


Figure 25 Strain Time History of Controlling Test Case for all Strain Gauges of BR04548 (12-in gauge length)

7.3 BR 03313

Table 5 BR03313 Load Test Summary

Asset ID	03313
Date:	2/3/2020
Wheel Scenario.	Wheel on Left Edge of Channel 2
Reflective Crack	**Localized Moderate**
Tie Rod Condition	Good
Asphalt Thickness	1.25 in.
Year Built	1960
ADT	126 (Currently Closed to Traffic)
County	Greenville
Features Intersected	Reedy River
Latitude	34.99049167
Longitude	-82.3500375
Load Test DF	**0.30**

Figure 26 BR03313 Top of Deck

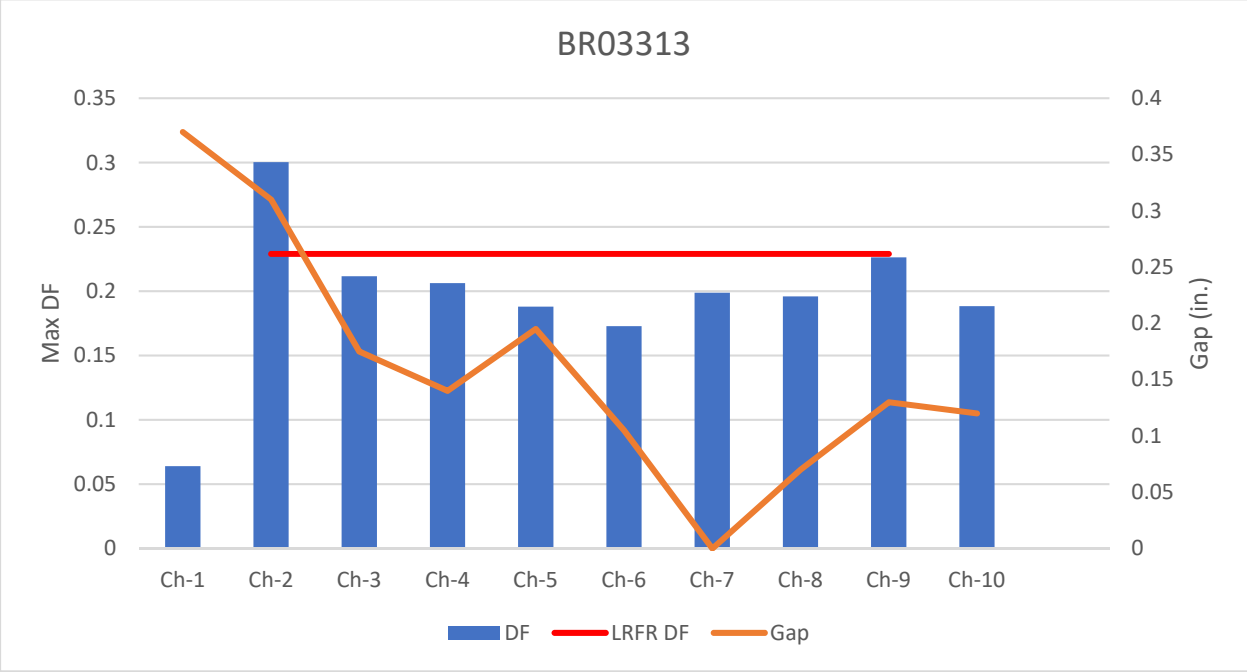


Figure 27 Maximum DF of BR03313 Channels for all Test Cases

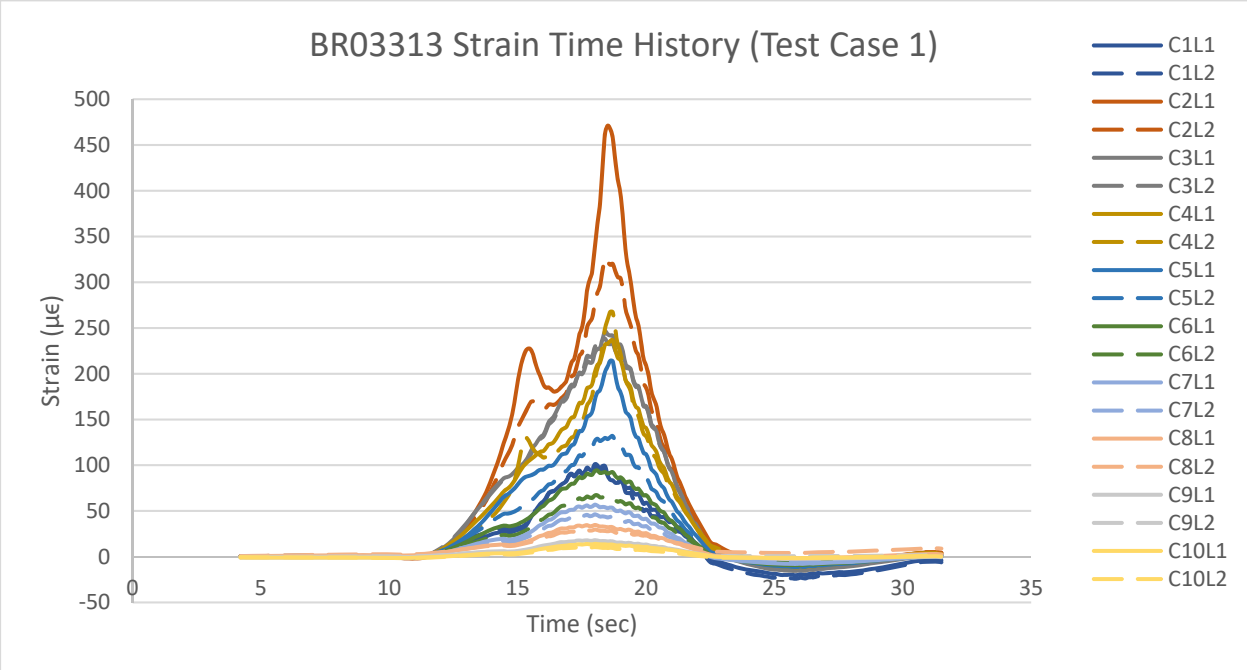


Figure 28 Strain Time History of Controlling Test Case for all Strain Gauges of BR03313 (12-in gauge length)

Table 6 BR04131 Load Test Summary

Asset ID	04131
Date:	02/01/2020
Wheel Scenario.	Wheel on Middle of Channel 7
Reflective Crack	**Moderate**
Tie Rod Condition	Good
Asphalt Thickness	4 in.
Year Built	1963
ADT	7100
County	Greenville
Features Intersected	Enoree River
Latitude	34.87172222
Longitude	-82.2342589
Load Test DF	**0.31**

Figure 29 BR4131 Top of Deck

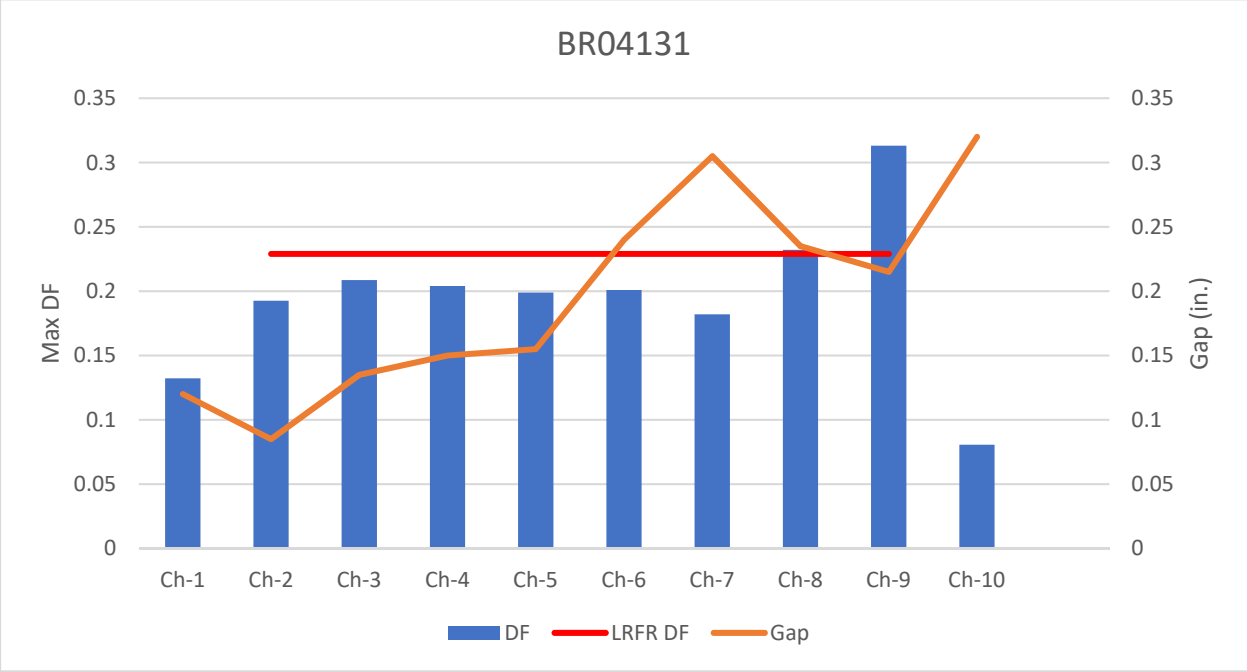


Figure 30 Maximum DF of BR04131 Channels for all Test Cases

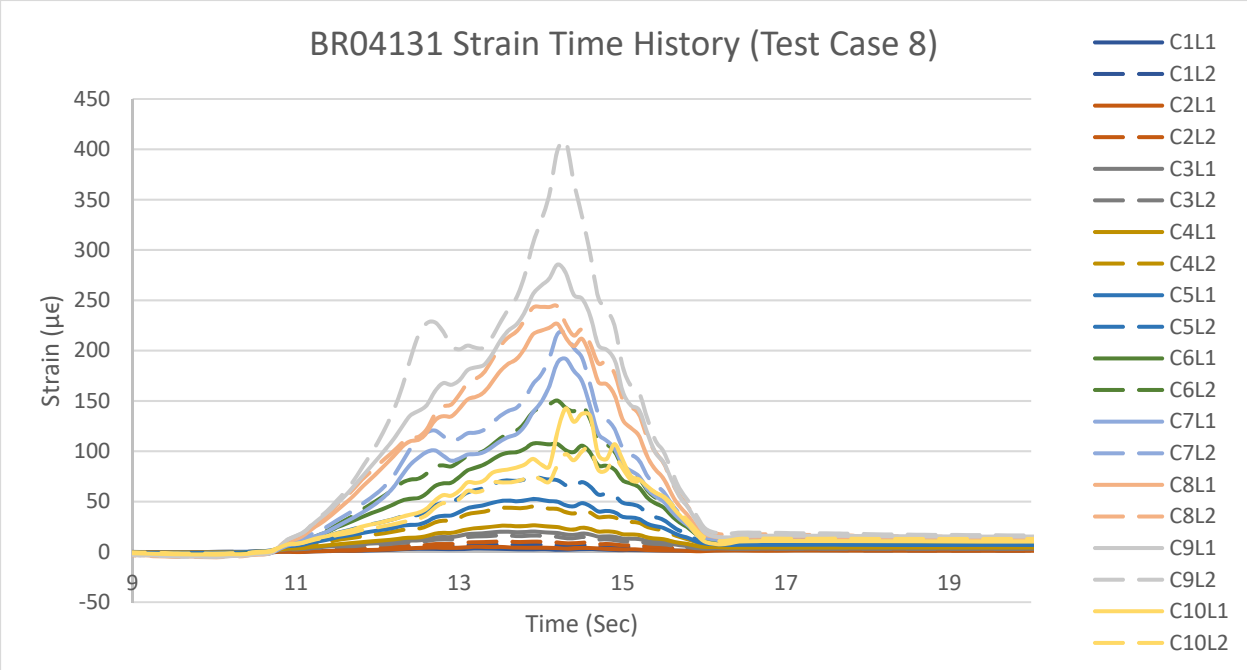


Figure 31 Strain Time History of Controlling Test Case for all Strain Gauges of BR04131 (12-in gauge length)

Table 7 BR03647 Load Test Summary

Asset ID	03647
Date:	02/11/2020
Wheel Scenario.	Wheel on Left Edge of Channel 5
Reflective Crack	**Moderate**
Tie Rod Condition	Good
Asphalt Thickness	4.5 in.
Year Built	1961
ADT	175
County	Fairfield
Features Intersected	Branch of Big Wateree Creek
Latitude	34.4841417
Longitude	-80.9671239
Load Test DF	**0.28**

Figure 32 BR03647 Top of Deck

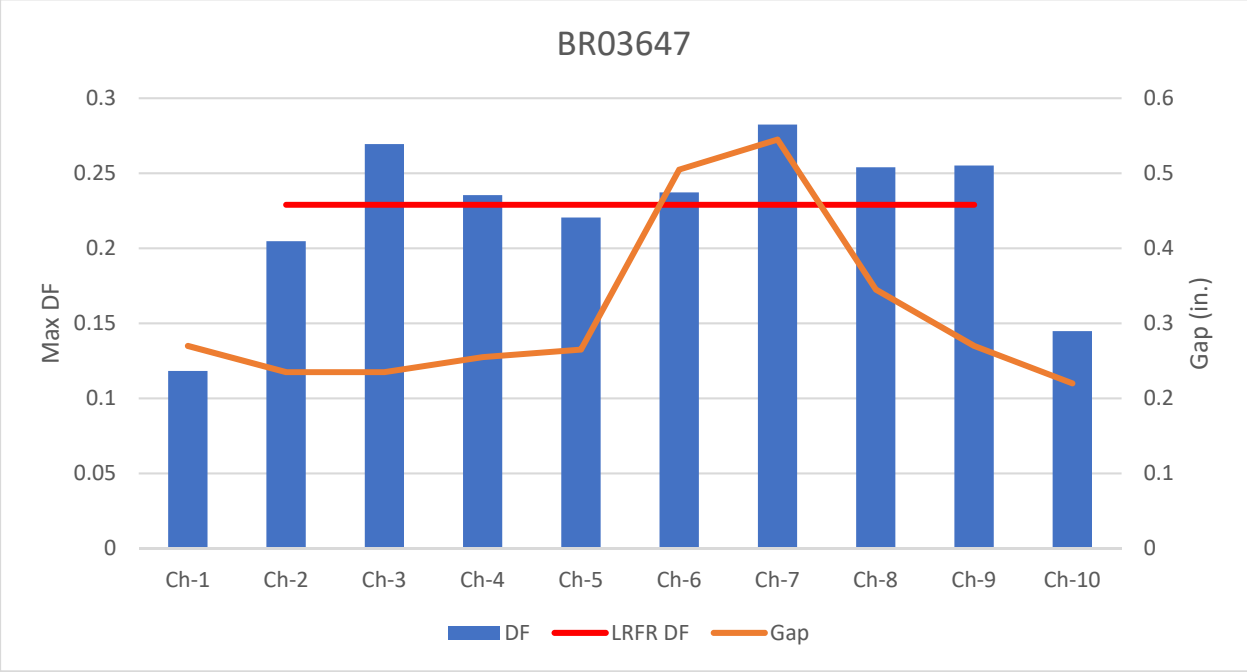


Figure 33 Maximum DF of BR03647 Channels for all Test Cases

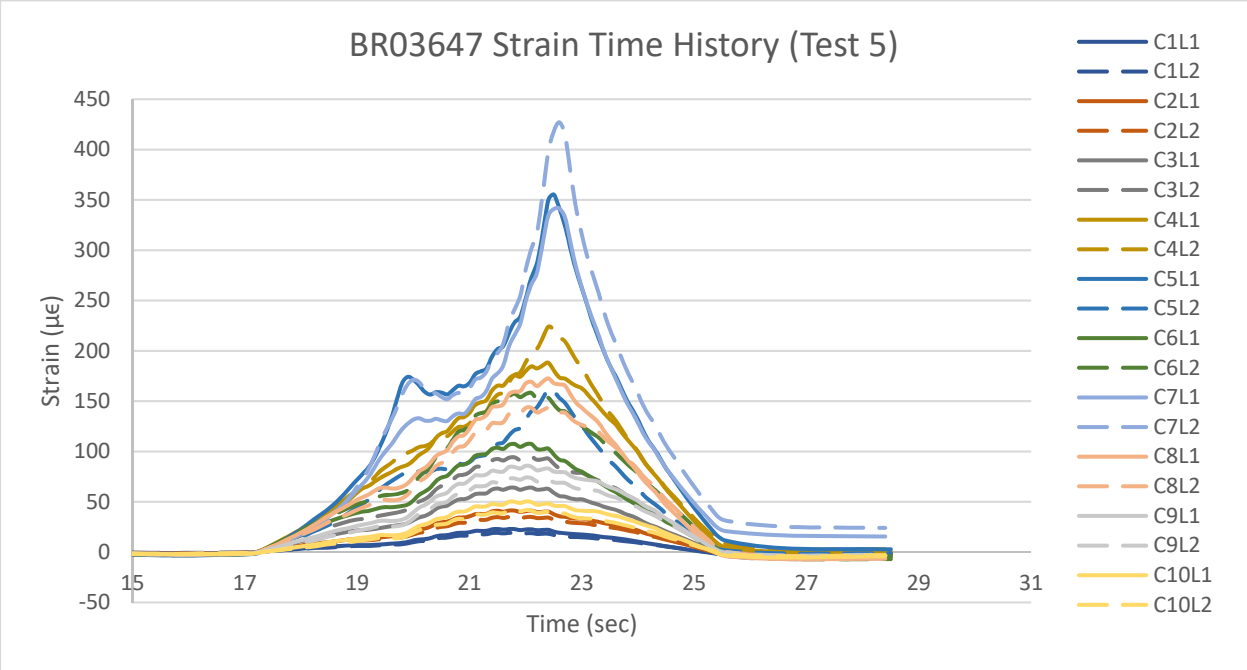


Figure 34 Strain Time History of Controlling Test Case for all Strain Gauges of BR03647 (12-in gauge length)

Table 8 BR4398 Load Test Summary

Asset ID	04398
Date:	02/11/2020
Wheel Scenario.	Wheel on Middle of Channel 4
Reflective Crack	**Moderate**
Tie Rod Condition	Good
Asphalt Thickness	2 in.
Year Built	1964
ADT	1320
County	Pickens
Features Intersected	Wolf Creek
Latitude	34.8627639
Longitude	-82.7011692
Load Test DF	**0.36**

Figure 35 BR04398 Top of Deck

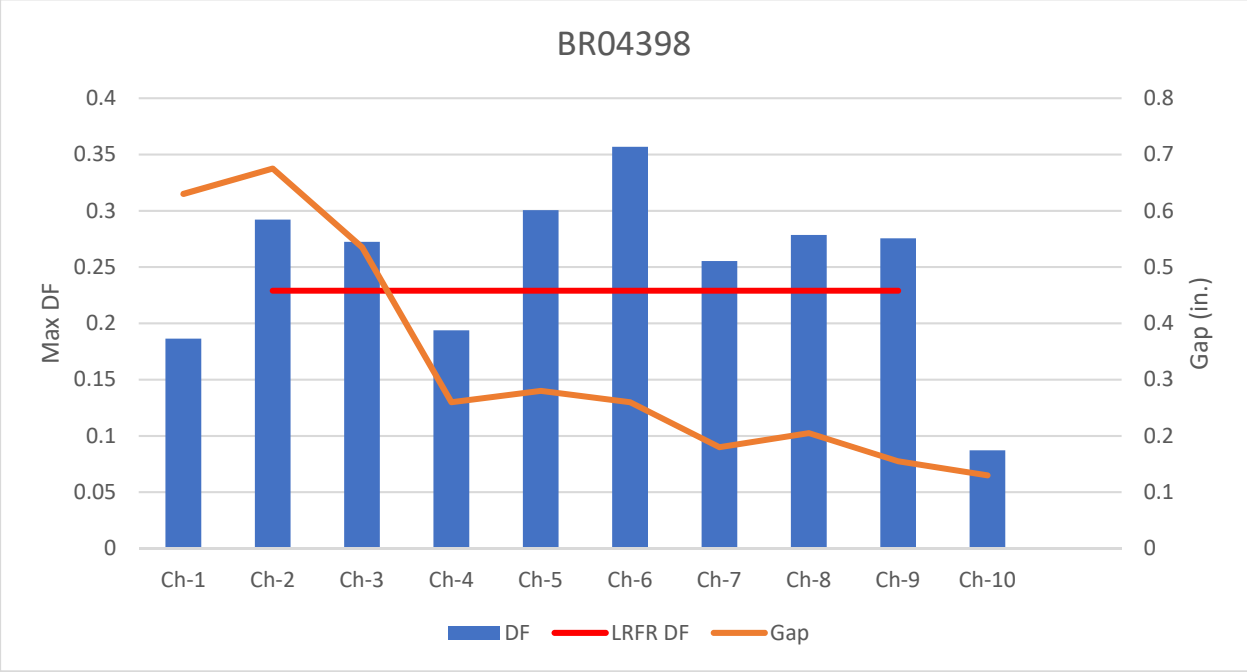


Figure 36 Maximum DF of BR04398 Channels for all Test Cases

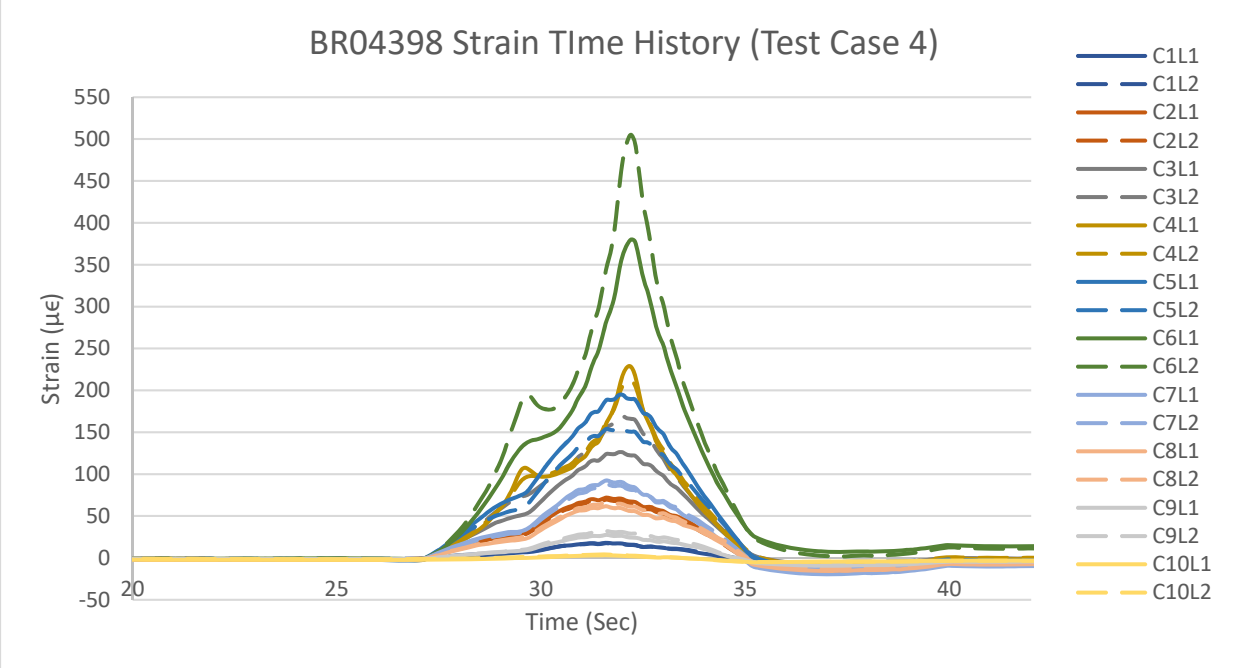


Figure 37 Strain Time History of Controlling Test Case for all Strain Gauges of BR04398 (12-in gauge length)

Table 9 BR4875 Load Test Summary

Asset ID	04875
Date:	02/04/2020
Wheel Scenario.	Wheel on Middle of Channel 7
Reflective Crack	**Moderate**
Tie Rod Condition	Poor
Asphalt Thickness	1.5 in.
Year Built	1966
ADT	551
County	Pickens
Features Intersected	Eighteen Mile Creek
Latitude	34.71899722
Longitude	-82.7335825
Load Test DF	**0.34**

Figure 38 BR04875 Top of Deck

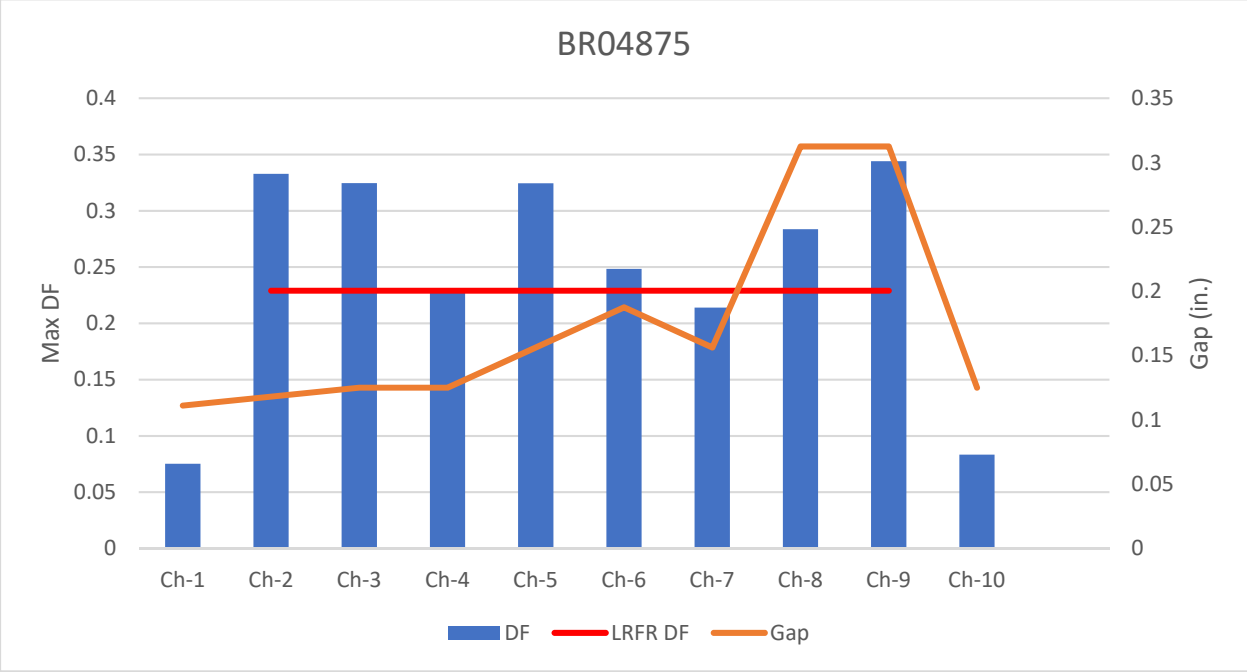


Figure 39 Maximum DF of BR04875 Channels for all Test Cases

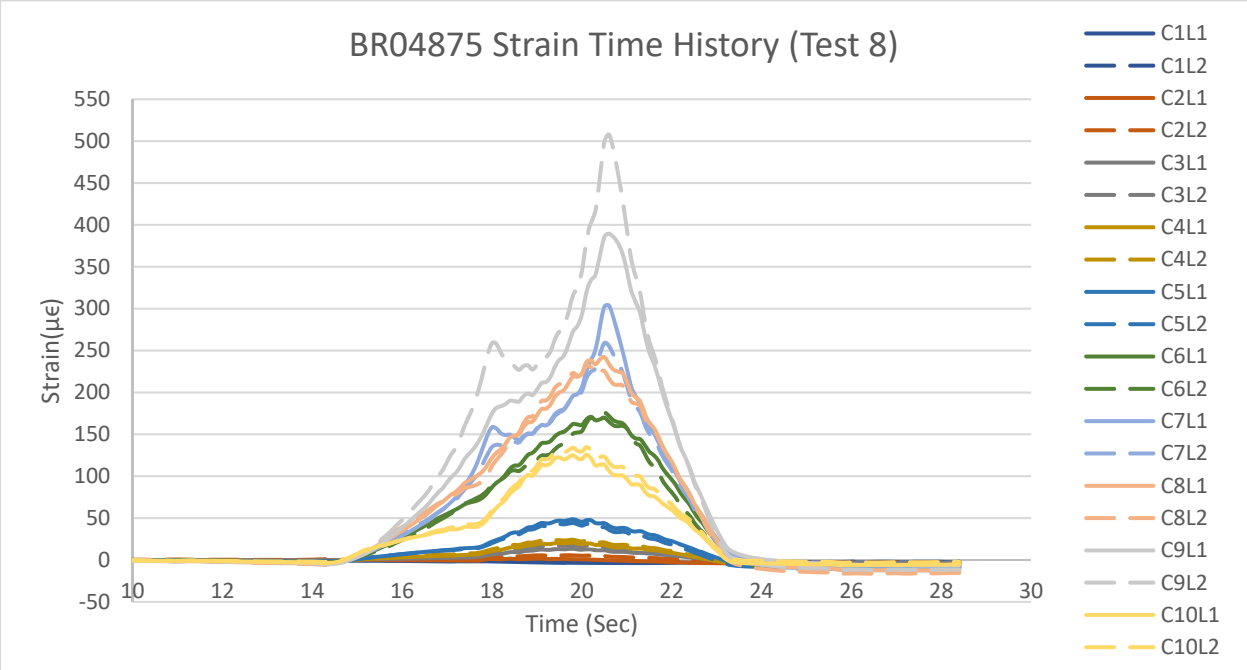


Figure 40 Strain Time History of Controlling Test Case for all Strain Gauges of BR04875 (12-in gauge length)

Table 10 BR4488 Load Test Summary

Asset ID	04488
Date:	02/10/2020
Wheel Scenario.	Wheel on Left Edge of Channel 5
Reflective Crack	**Moderate**
Tie Rod Condition	Poor
Asphalt Thickness	4.5 in.
Year Built	1965
ADT	210
County	Chester
Features Intersected	South Fork Creek
Latitude	34.79098889
Longitude	-81.0842081
Load Test DF	**0.35**

Figure 41 BR04488 Top of Deck

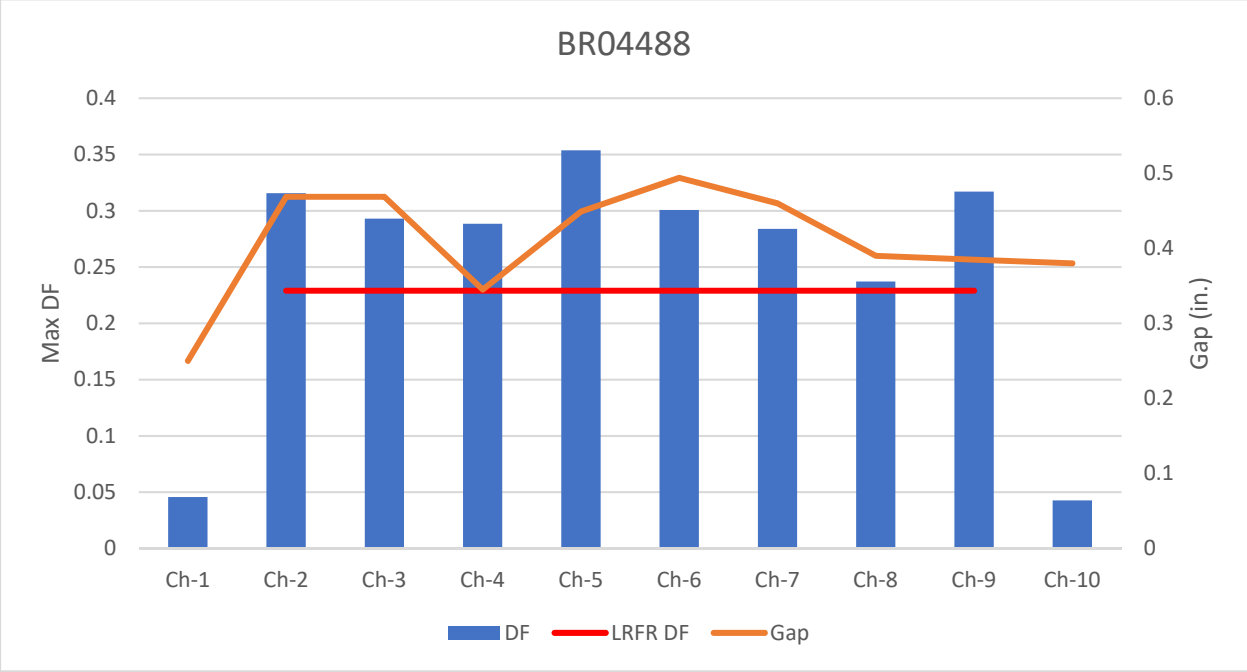


Figure 42 Maximum DF of BR04488 Channels for all Test Cases

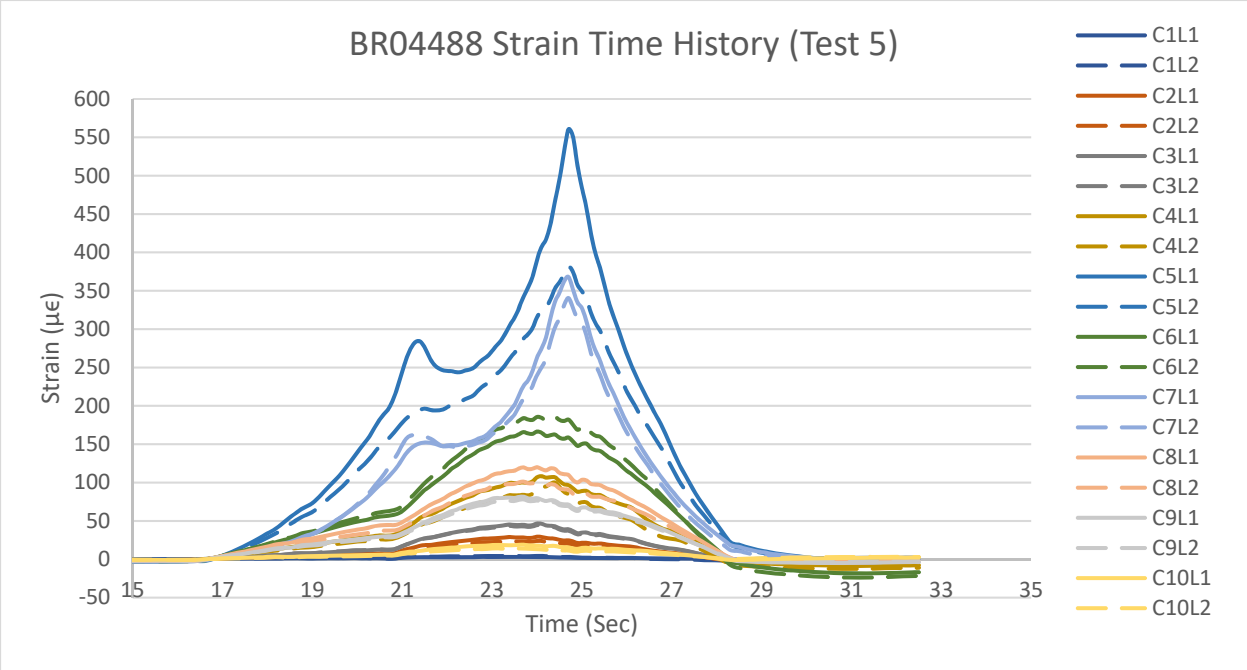


Figure 43 Strain Time History of Controlling Test Case for all Strain Gauges of BR04488 (12-in gauge length)

7.9 BR 03266

Table 11 BR03266 Load Test Summary

Asset ID	03266
Date:	02/12/2020
Wheel Scenario.	Wheel on Middle of Channel 7
Reflective Crack	**Minor Moderate**
Tie Rod Condition	Good
Asphalt Thickness	2 in.
Year Built	1960
ADT	150
County	Fairfield
Features Intersected	Mills Creek
Latitude	34.3194472
Longitude	-81.2344417
Load Test DF	**0.31**

Figure 44 BR03266 Top of Deck

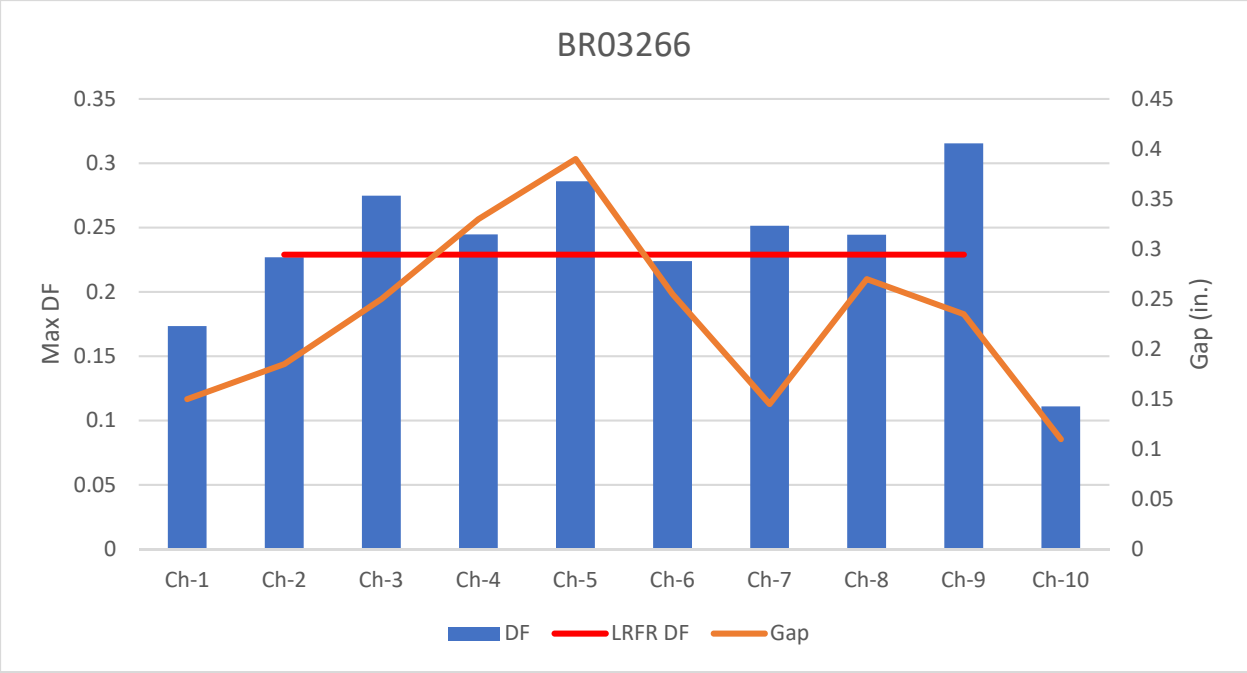


Figure 45 Maximum DF of BR03266 Channels for all Test Cases

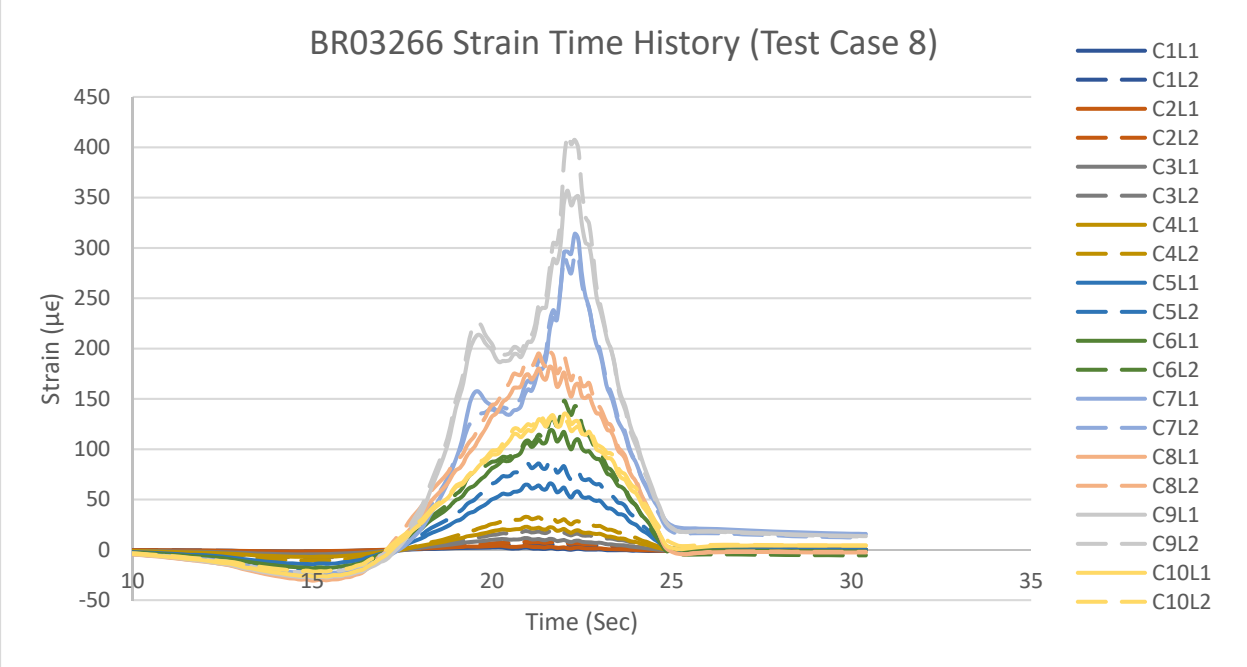


Figure 46 Strain Time History of Controlling Test Case for all Strain Gauges of BR03266(12-in gauge length)

Table 12 BR4399 Load Test Summary

Asset ID	04399
Date:	02/05/2020
Wheel Scenario.	Wheel on Left Edge of Channel 2
Reflective Crack	**Severe**
Tie Rod Condition	Poor
Asphalt Thickness	2 in.
Year Built	1964
ADT	261
County	Pickens
Features Intersected	Tributary to Praters Creek
Latitude	34.84048333
Longitude	-82.76809861
Load Test DF	**0.29**

Figure 47 BR04399 Top of Deck

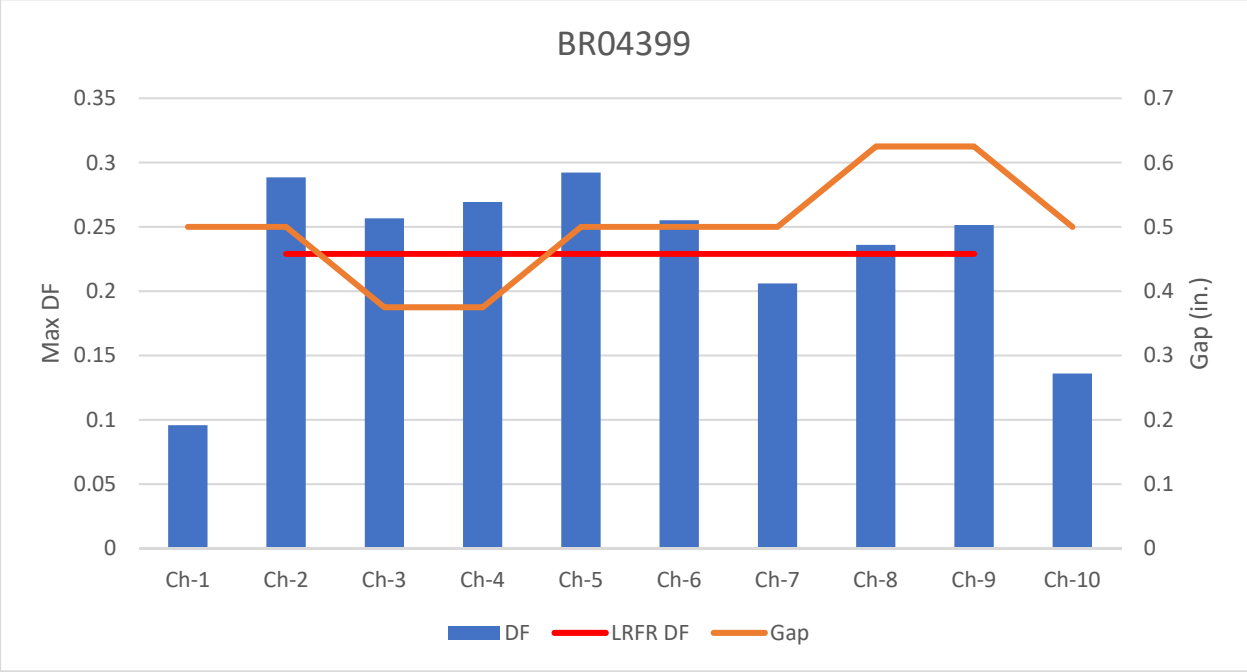


Figure 48 Maximum DF of BR04399 Channels for all Test Cases

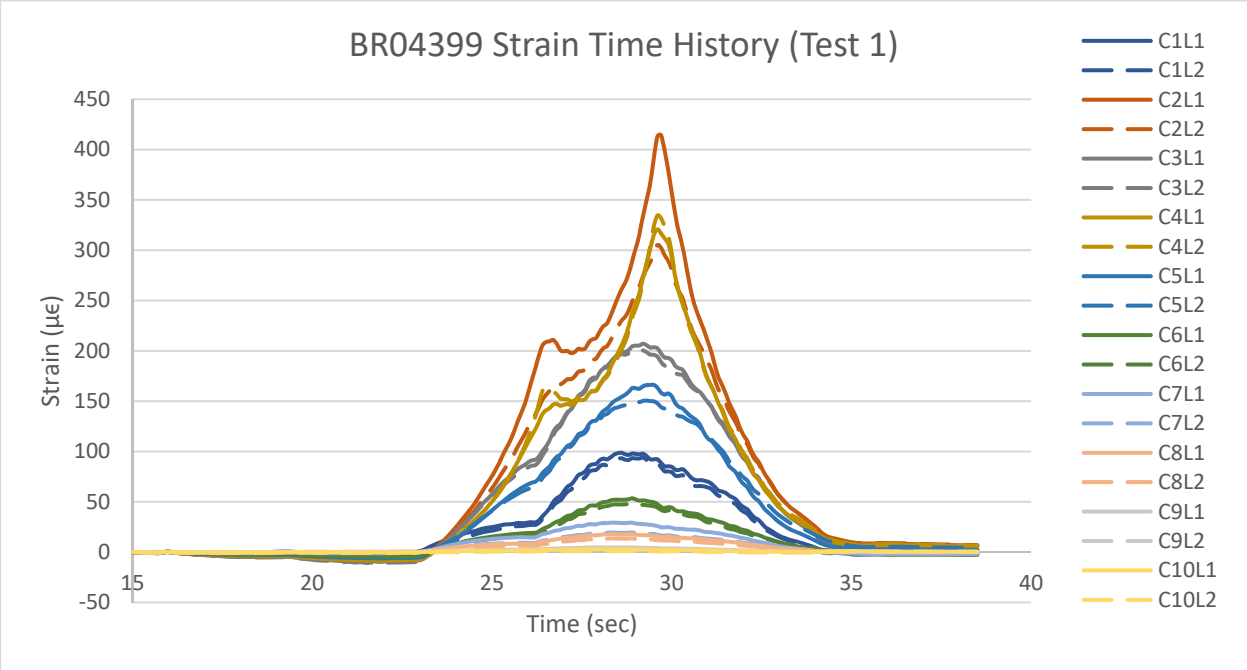


Figure 49 Strain Time History of Controlling Test Case for all Strain Gauges of BR04399 (12-in gauge length)

Table 13 BR05741 Load Test Summary

Asset ID	05741
Date:	01/23/2020
Wheel Scenario.	Wheel on Right Edge of Channel 4
Reflective Crack	**Severe**
Tie Rod Condition	Good
Asphalt Thickness	5 in.
Year Built	1970
ADT	1950
County	Greenville
Features Intersected	Tributary to Rocky Creek
Latitude	34.8249778
Longitude	-82.2669417
Load Test DF	**0.41**

Figure 50 BR05741 Top of Deck

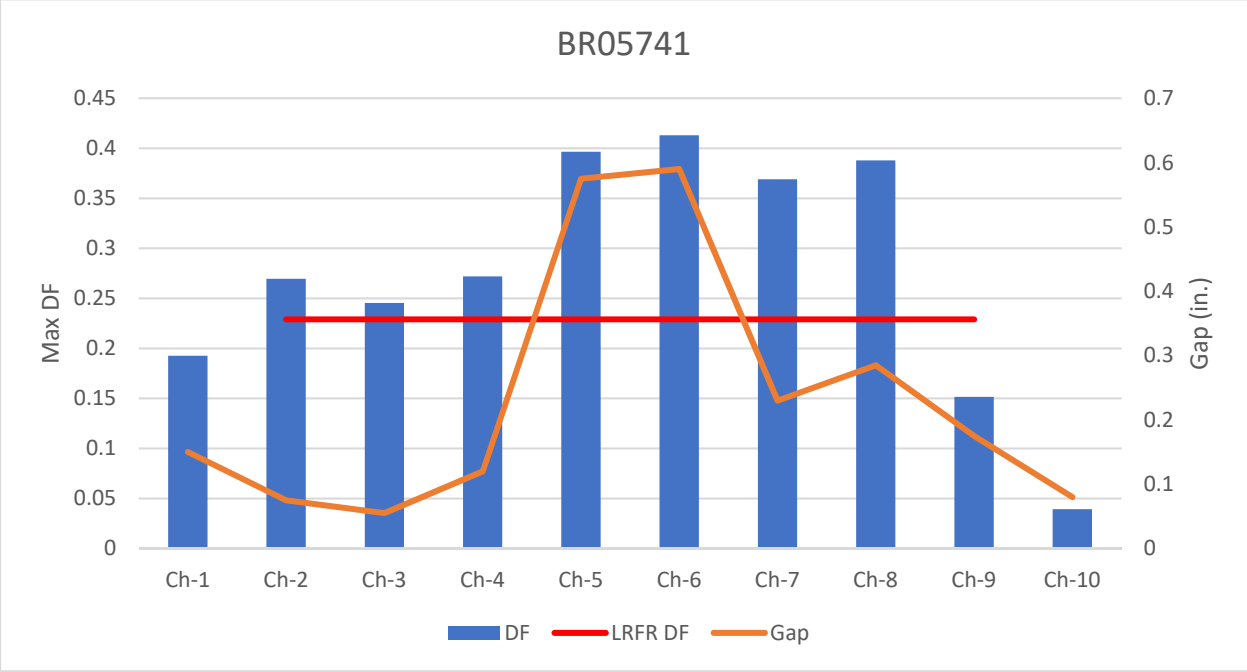


Figure 51 Maximum DF of BR5741 Channels for all Test Cases

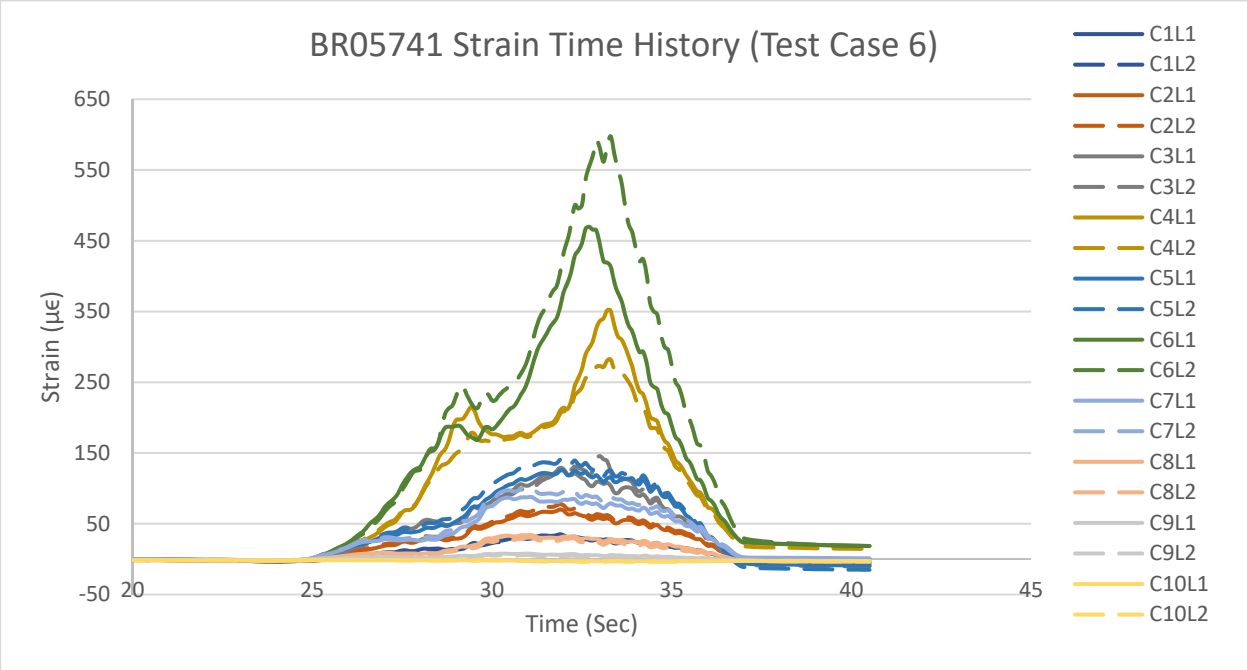


Figure 52 Strain Time History of Controlling Test Case for all Strain Gauges of BR05741(12-in gauge length)

Table 14 BR04333 Load Test Summary

Asset ID	04333
Date:	01/31/2020
Wheel Scenario.	Wheel on Middle of Channel 7
Reflective Crack	**Severe**
Tie Rod Condition	Poor
Asphalt Thickness	1.5 in.
Year Built	1964
ADT	969
County	Greenville
Features Intersected	Langston Creek
Latitude	34.880575
Longitude	-82.41769417
Load Test DF	**0.46**

Figure 53 BR04333 Top of Deck

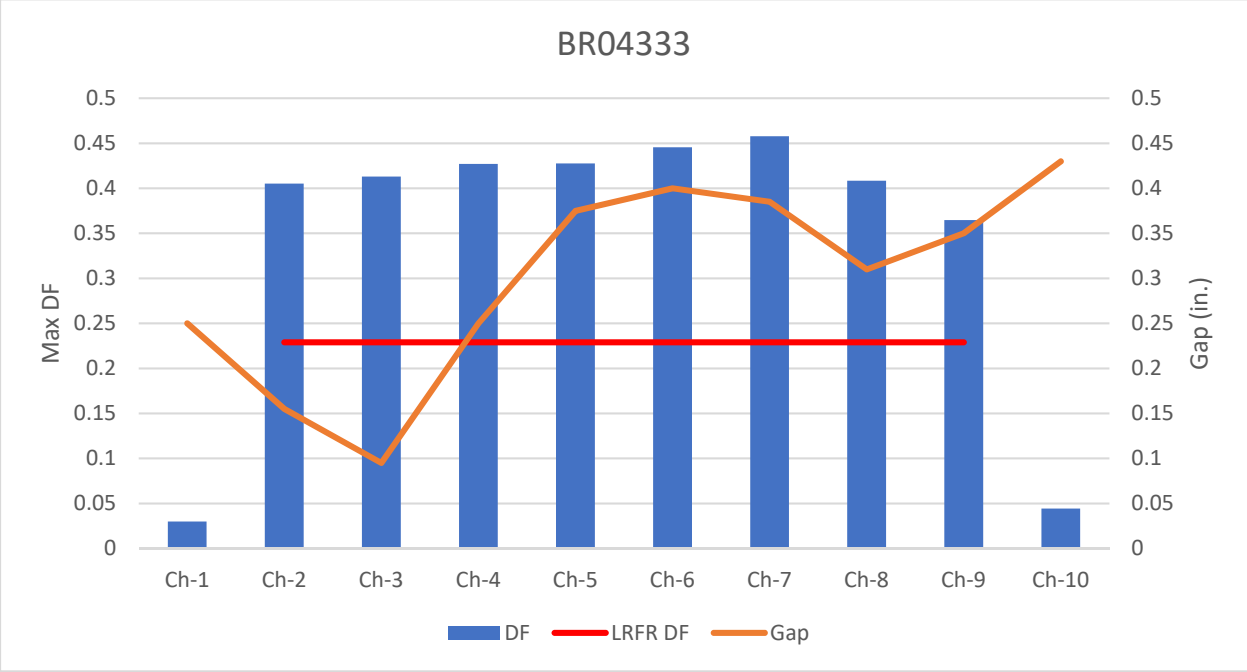


Figure 54 Maximum DF of BR04333 Channels for all Test Cases

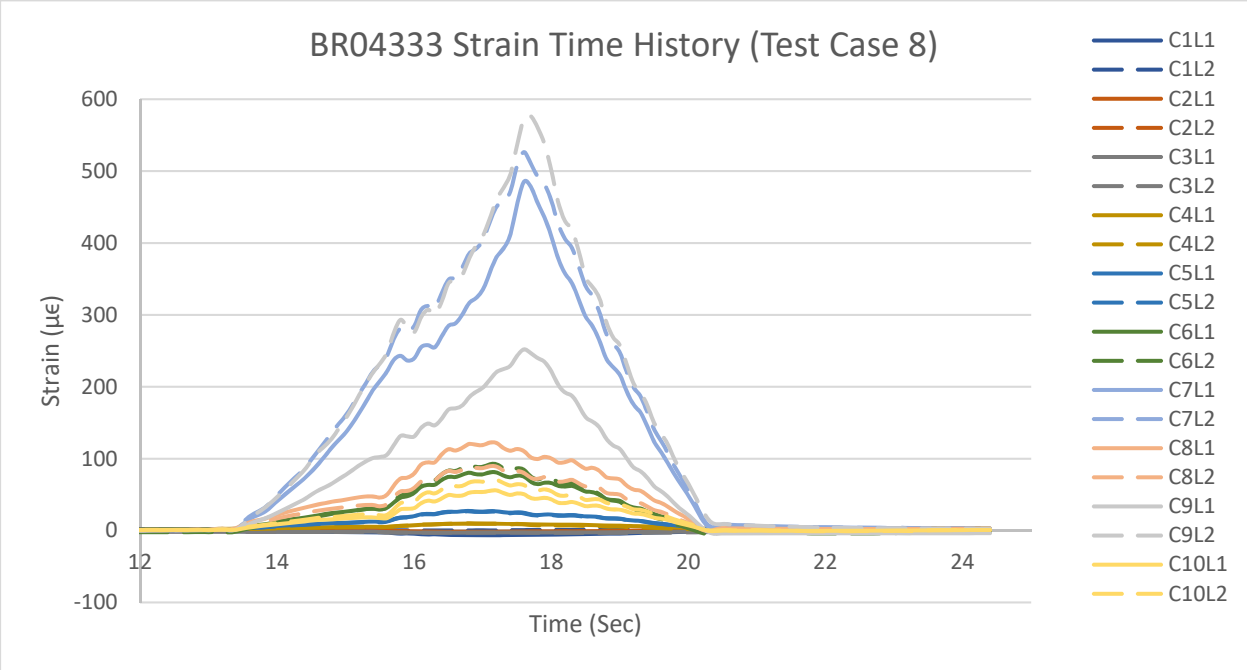


Figure 55 Strain Time History of Controlling Test Case for all Strain Gauges of BR04333(12-in gauge length)

Table 15 BR04798 Load Test Summary

Asset ID	04798
Date:	02/02/2020
Wheel Scenario.	Wheel on Middle of Channel 6
Reflective Crack	**Localized Severe**
Tie Rod Condition	Good
Asphalt Thickness	4 in.
Year Built	1966
ADT	468
County	Greenville
Features Intersected	Enoree River
Latitude	34.9963639
Longitude	-82.3834667
Load Test DF	**0.43**

Figure 56 BR04798 Top of Deck

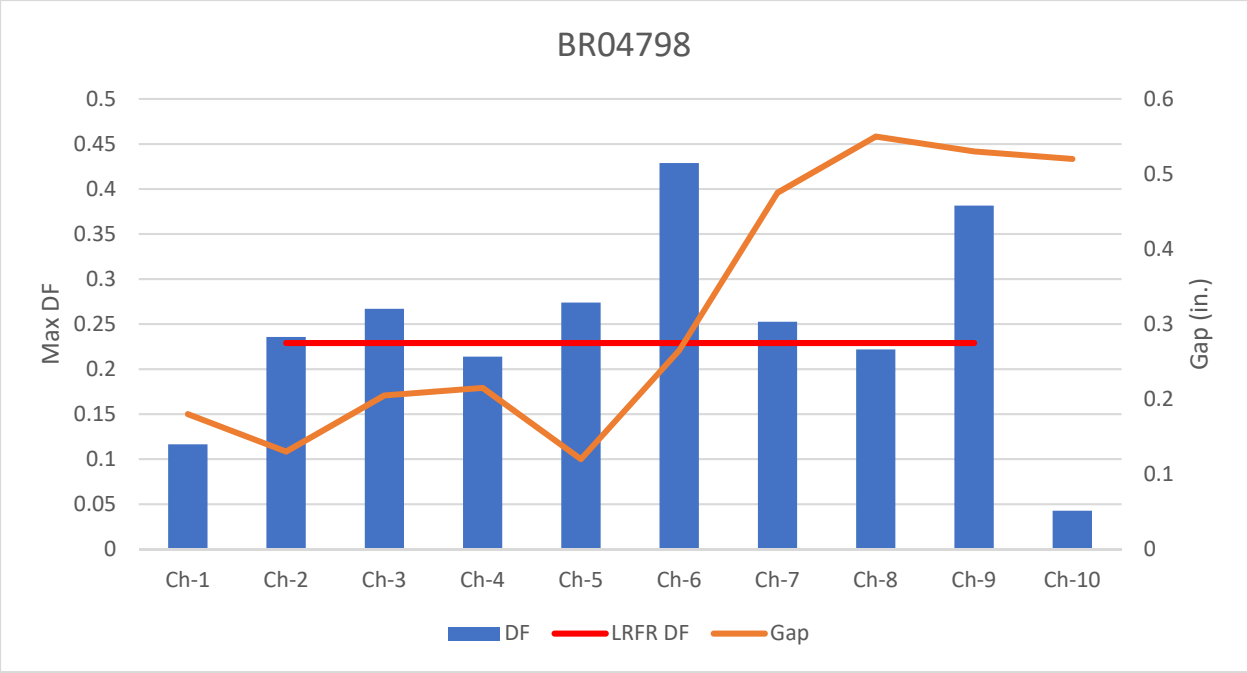


Figure 57 Maximum DF of BR04798 Channels for all Test Cases

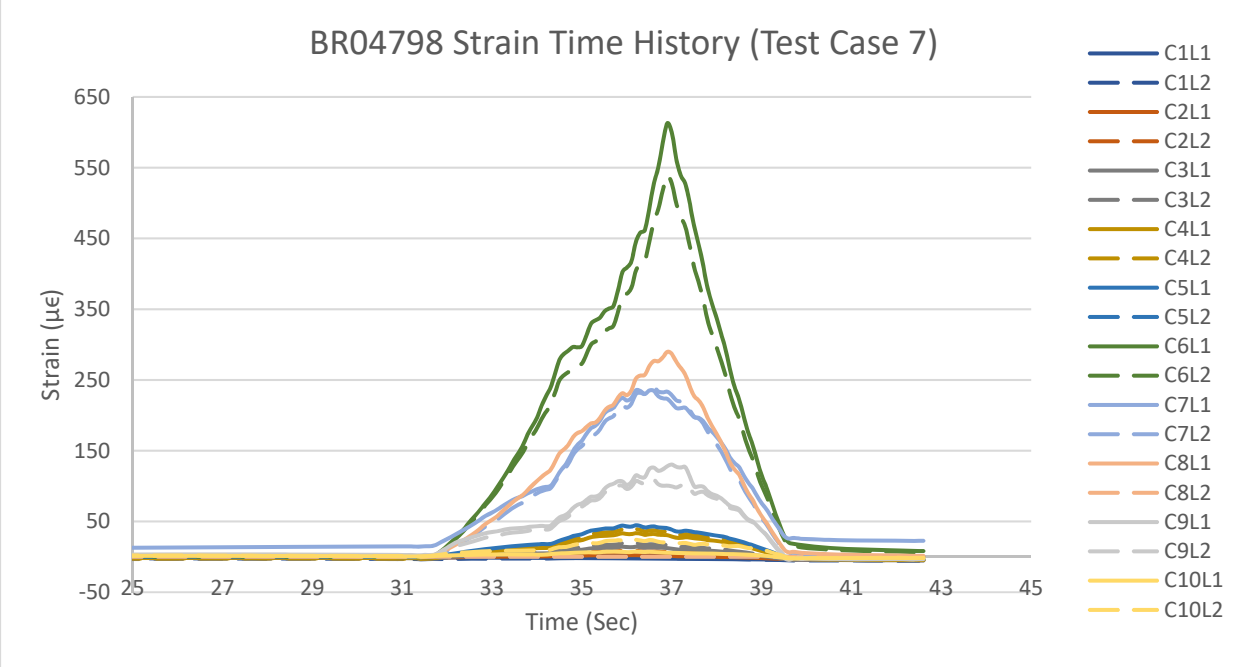


Figure 58 Strain Time History of Controlling Test Case for all Strain Gauges of BR04798 (12-in gauge length)

7.14 BR 04801

Table 16 BR04801 Load Test Summary

Asset ID	04801
Date:	01/29/2020
Wheel Scenario.	Wheel on Middle of Channel 6
Reflective Crack	**Severe**
Tie Rod Condition	Poor
Asphalt Thickness	4 in.
Year Built	1966
ADT	950
County	Greenville
Features Intersected	Buckhorn Creek
Latitude	34.94903333
Longitude	-82.33367361
Load Test DF	**0.44**

Figure 59 BR04801 Top of Deck

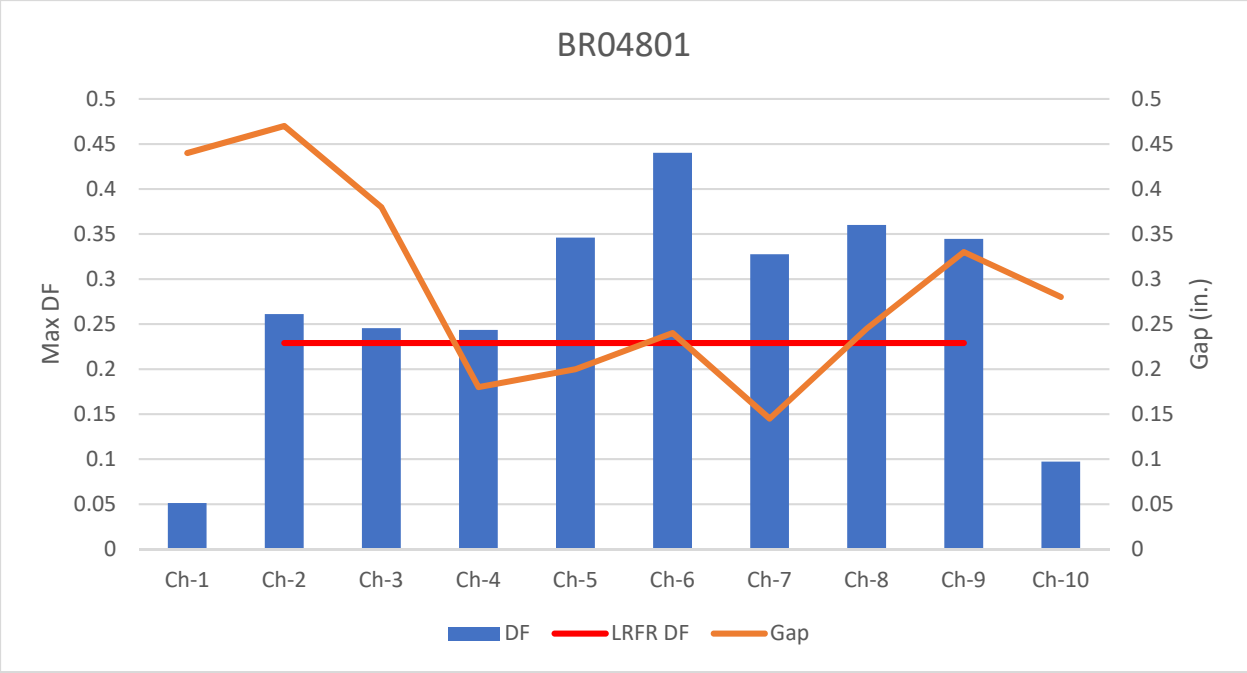


Figure 60 Maximum DF of BR04801 Channels for all Test Cases

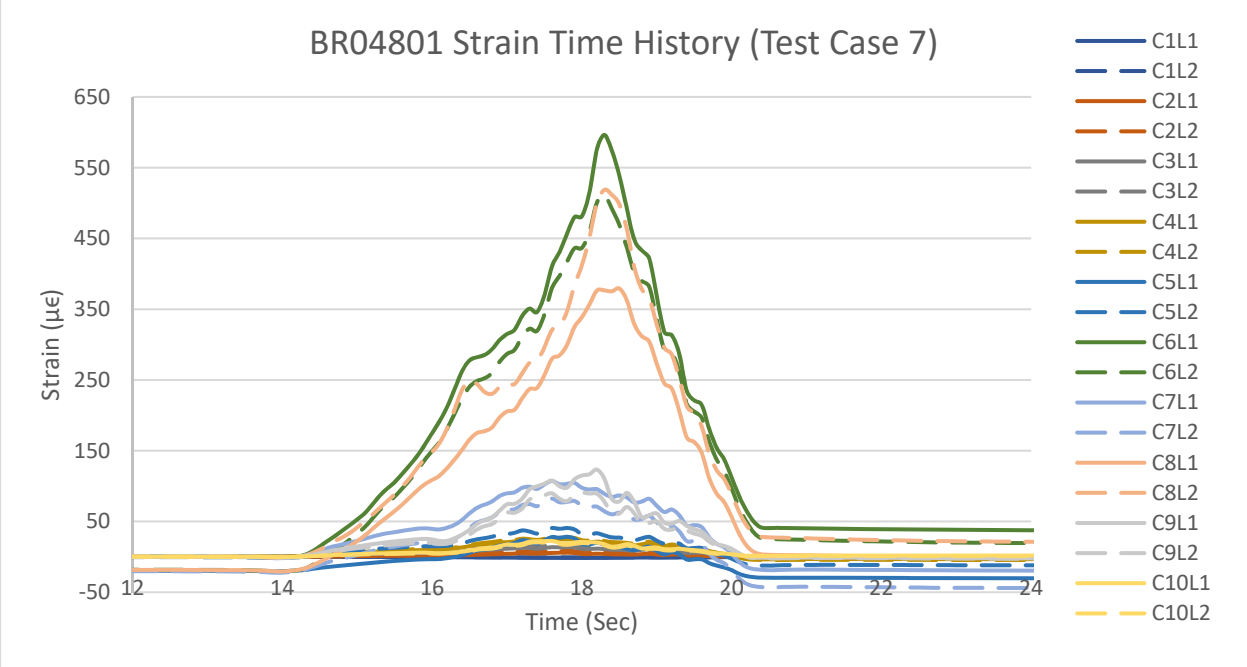


Figure 61 Strain Time History of Controlling Test Case for all Strain Gauges of BR04801 (12-in gauge length)

7.15 BR 04545

DF were calculated based on the first 6 tests, due to sensor failures on the remaining runs. BR04545 was the first channel bridge of this load test effort.

Table 17 BR04545 Load Test Summary

Asset ID	04545
Date:	11/25/2019
Wheel Scenario.	Wheel on Left of Channel 3
Reflective Crack	**Severe**
Tie Rod Condition	Good
Asphalt Thickness	N/A
Year Built	1965
ADT	468
County	Greenville
Features Intersected	Brushy Creek
Latitude	34.87959167
Longitude	-82.33375111
Load Test DF	**0.39**

Figure 62 BR04545 Top of Deck

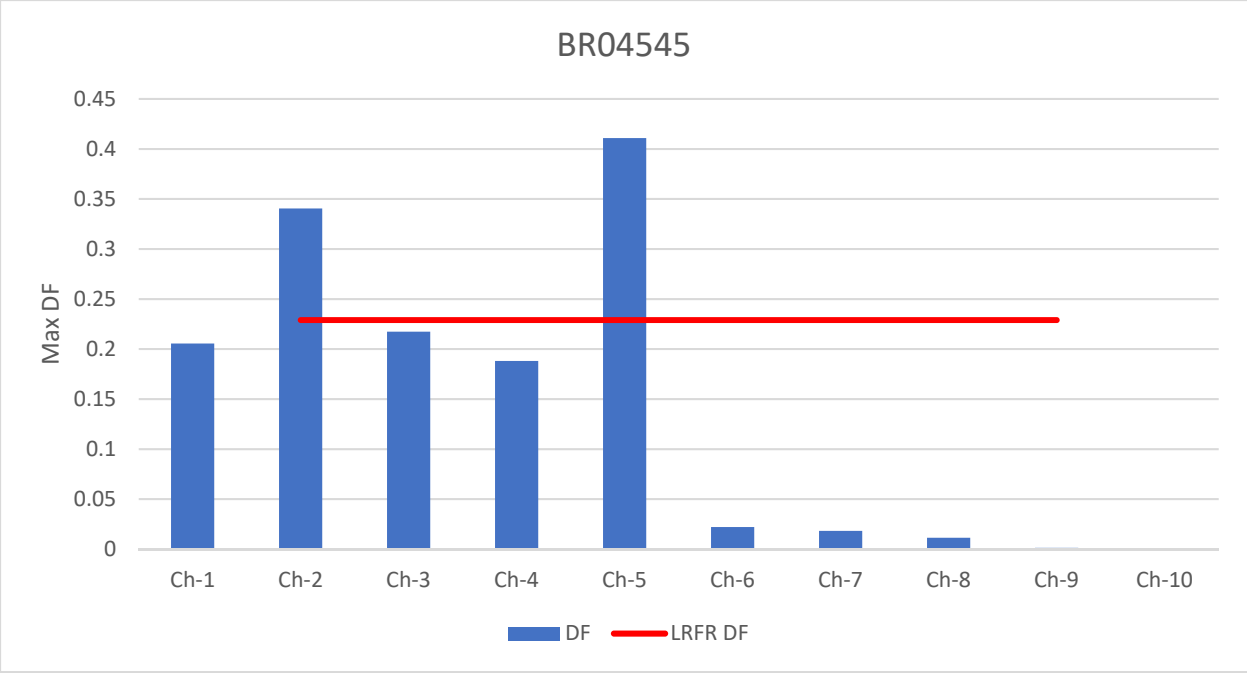


Figure 63 Maximum DF of BR04545 Channels for all Test Cases

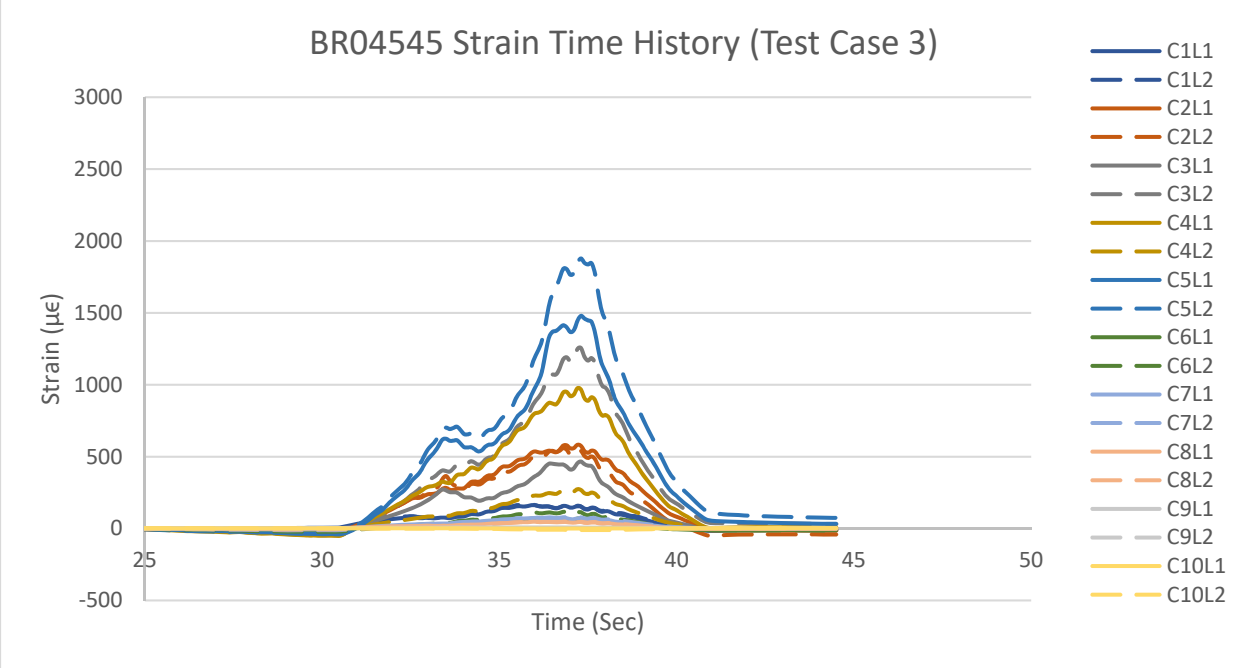


Figure 64 Strain Time History of Controlling Test Case for all Strain Gauges of BR04545 (18-in gauge length)

Table 18 BR04803 Load Test Summary

Asset ID	04803
Date:	11/26/2019
Wheel Scenario.	Wheel on Left of Channel 3
Reflective Crack	**No Asphalt**
Tie Rod Condition	Good
Asphalt Thickness	No Asphalt
Year Built	1966
ADT	150
County	Greenville
Features Intersected	Little Creek
Latitude	34.6264
Longitude	-82.3008678
Load Test DF	**0.50**

Figure 65 BR04803 Top of Deck

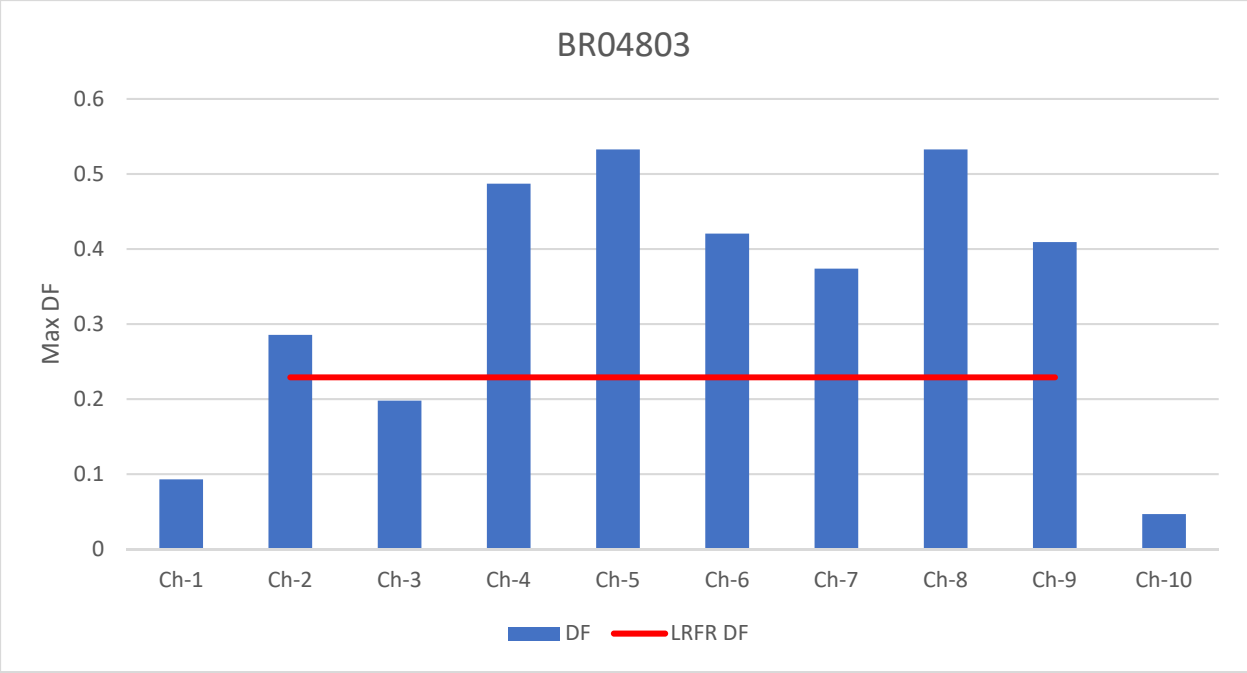


Figure 66 Maximum DF of BR04803 Channels for all Test Cases

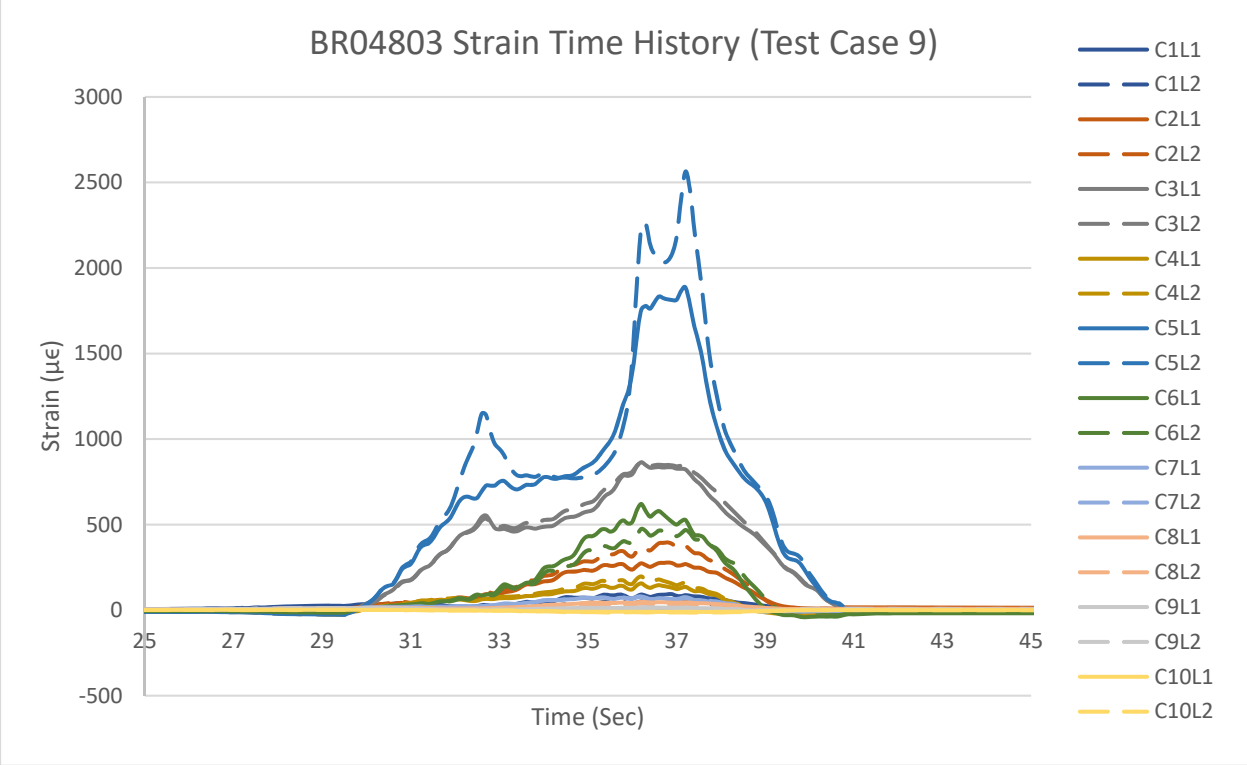


Figure 67 Strain Time History of Controlling Test Case for all Strain Gauges of BR04803 (18-in. gauge length)

7.17 Data Interpretation

The distribution factors obtained from the load test were compared against the other inspected parameters. Table 19 lists the potential inspectable parameters along with the load test distribution factors for all the tested bridges. The parameters are Year Built, Design Live Load, Slab Width, Reflective Cracking, Superstructure Condition, Tie Rod Condition, Asphalt Thickness and Gap between channels.

It was observed that there was direct correlation between the extent of reflective cracking and the distribution factor from the load test. There was less load sharing as the extent reflective cracking increased. No other coloration was identified between inspectable conditions and distribution factor including, broken or loss tie rods.

Table 19 Parameters of Load Test Distribution Factor of Skinny Leg Channel Bridges

Asset ID	Year Built	Design Live Load	Slab Width	Reflective Cracking	Superstructure Condition	Tie Rod Condition	Asphalt Thickness	Gaps[1]	Tested DF
		(H10/H15)	(in.)	(None/Minor/Moderate/Severe)	1-9	(Good/Poor)	(in.)	(in.)	(Lane)
3888	1962	H10	33.0	None/Minor	5	Good	4.50	0.08	0.24
4548	1965	H10	33.0	None/Minor	4	Good	4.00	0.57	0.25
3647	1961	H10	33.0	Moderate	5	Good	4.50	0.54	0.28
4399	1964	H10	33.0	Moderate	6	Poor	2.00	0.50	0.29
3313	1960	H15	30.5	Localized Moderate	4	Good	1.25	0.31	0.30
4131	1963	H10	33.0	Moderate	4	Good	4.00	0.22	0.31
3266	1960	H10	33.0	Moderate	4	Good	2.00	0.24	0.31
4875	1966	H10	33.0	Moderate	6	Poor	1.50	0.31	0.34
4488	1965	H10	33.0	Moderate	6	Poor	4.50	0.45	0.35
4398	1964	H10	33.0	Moderate	7	Good	2.00	0.26	0.36
4545	1965	H10	33.0	Severe	6	Poor	N/A[2]	N/A[2]	0.39
5741	1970	H10	33.0	Severe	5	Good	5.00	0.59	0.41
4798	1966	H10	33.0	Localized Severe	7	Good	4.00	0.27	0.43
4801	1966	H10	33.0	Severe	5	Poor	4.00	0.24	0.44
4333	1964	H10	33.0	Severe	6	Poor	1.50	0.39	0.46
4803	1966	H10	33.0	No Asphalt	5	Poor	0.00	N/A[2]	0.50

8 Comparison of Load Test Results

8.1 Comparison between AASHTO and Tested Live Load Moment Distribution Factor

AASHTO live load distribution factor shown below was calculated per AASHTO LRFD 8th Table 4.6.6.2.2b-1 for moment in interior channels, with typical cross-section "i" per Table 4.6.2.2.1-1. Distribution factors for exterior channels were calculated using lever rule per Table 4.6.2.2.2d. Detailed calculation was shown in Appendix C. Appendix C also included the BrR load rating factors for SC Legal Vehicles on H10 and H15 Channel bridges. LRFR and LFR Rating factors were shown using calculated DF (LRFD and Standard Specification), DF=0.35 and DF=0.5.

Table 20 Comparison between AASHTO and Tested Live Load Moment Distribution Factor

Asset ID	Design Live Load	Load Test Distribution Factor	Controlling Girder/Channel	AASHTO LRFD	
				Exterior	Interior
03888	H10	0.24	Ch-2	0.261	0.228
04548	H10	0.25	Ch-9	0.261	0.228
03647	H10	0.28	Ch-7	0.261	0.228
04399	H10	0.29	Ch-5	0.261	0.228
03313	H15	0.30	Ch-2	0.261	0.229
04131	H10	0.31	Ch-9	0.261	0.228
03266	H10	0.31	Ch-9	0.261	0.228
04875	H10	0.34	Ch-9	0.261	0.228
04488	H10	0.35	Ch-5	0.261	0.228
04398	H10	0.36	Ch-6	0.261	0.228
04545	H10	0.39	Ch-5	0.261	0.228
05741	H10	0.41	Ch-6	0.261	0.228
04798	H10	0.43	Ch-6	0.261	0.228
04801	H10	0.44	Ch-6	0.261	0.228
04333	H10	0.46	Ch-7	0.261	0.228
04803	H10	0.5	Ch-5	0.261	0.228

8.2 Comparison between Theoretical and Tested Strain

Actual maximum strain measured during load testing and corresponding calculated strain due to test vehicle were compared, as shown in Table 21. Only bridges tested under bucket truck were included in this table.

Actual strain (ε_T) was calculated using the measured strain divide by an amplification factor equal to the ratio between gage length (L_{gage}) and standard gage length (3 in.), then times 1.1 to include the extension effect, as suggested by the BDI user manual v2.2.

$$\varepsilon_T = \frac{l_{gage}}{3in} * 1.1$$

Theoretical strain (ε_c) was calculated using following equation per Manual of Bridge Evaluation 3rd Edition 8.8.2.3.1-3:

$$\varepsilon_c = \frac{L_T}{S * E}$$

Where:

L_T = calculated theoretical load effect in member corresponding to measured strain

S = section modulus

E = member modulus of elasticity

Since section behaviors are within elastic range under the truck loadings, gross section modulus was used for the calculation of theoretical strain. Detailed calculations are shown in Appendix D.

It was found that the theoretical strains were greater than the measured strains during the load tests. The reasons for this difference is likely due to a higher modulus of elasticity of the concrete, some partial rotational stiffness at the supports and the partial stiffness contribution from the asphalt overlay.

Table 21 Comparison between Theoretical and Tested Strain

Asset ID	Design Live Load	Load Test Distribution Factor (Lane)	Strain Gage Length (in)	BDI Maximum Strain ($x10^{-6}$)	Actual Maximum Strain (ε_T) ($x10^{-6}$)	Theoretical Strain (ε_c) ($x10^{-6}$)	Actual/ Theoretical Strain
03888	H10	0.24	12	332.70	91.49	143.15	0.64
04548	H10	0.25	12	288.37	79.30	149.11	0.53
03647	H10	0.28	12	427.04	117.44	167.01	0.70
04399	H10	0.29	12	414.30	113.93	172.97	0.66
03313	H15	0.30	12	472.03	129.81	181.36	0.72
04131	H10	0.31	12	409.35	112.57	184.90	0.61
03266	H10	0.31	12	466.97	128.42	184.90	0.69
04875	H10	0.34	12	587.27	161.50	202.80	0.80
04488	H10	0.35	12	560.46	154.13	208.76	0.74
04398	H10	0.36	12	516.50	142.04	214.72	0.66
05741	H10	0.41	12	604.87	166.34	244.55	0.68
04798	H10	0.43	12	612.85	168.53	256.48	0.66
04801	H10	0.44	12	596.31	163.99	262.44	0.62
04333	H10	0.46	12	616.06	169.42	274.37	0.62

9 Load Rating Modification Factor K from Load Testing

The calculated load rating results can be modified based on load testing results through an adjustment factor "K" per MBE 3rd 8.8.2.3.

$$K = 1 + K_a K_b$$

Where $K_a = \frac{\varepsilon_c}{\varepsilon_T} - 1$, to account for the benefit derived from load test. K_a is positive for all tested skinny leg channel bridges in this report with a value between 0.3 to 0.9 approximately.

Where K_b is to account for uncertainties of the enhancements accounted for in the K_a calculation, as determined in Table 22. A "K" factor above 1, represents a benefit of field load test on the load rating factor. T and W in this table are unfactored test vehicle effect and unfactored gross rating load effect, respectively.

As a sample calculation, we selected Type 3-3 shown in Table 23. In Table 23, "T" is the unfactored load effect from the load test truck and "W" is the unfactored load effect of Type 3-3 truck. Theoretical cracking moment (Mcr) for H10 Channel section is 108.57 kip-ft. Since 1.33W is smaller than the cracking moment (Mcr), member behavior can be extrapolated to 1.33W with a T/W ratio of 0.509, which will result a Kb value of 0.8.

Based on "K" factors of all tested skinny channel bridges, it was noted that there was no correlation between bridge inspection data, bridge construction year and the K factor, as shown in Table 24. "K" factor can be above 1 with a tested DF larger than the AASHTO specified DF. A "K" factor above 1, represents a benefit of field load test on the load rating factor. The average K factor of all bridges tested was 1.41, the lowest k factor was 1.2 and the maximum k factor was 1.7. The k factors can be directly multiplied into the BrR 2d ratings to calculate a corrected effective rating.

Table 22 Values for K_b (MBE 3rd Table 8.8.2.3.1-1)

Can member behavior be extrapolated to 1.33W?		Magnitude of Test Load			K_b
Yes	No	$\frac{T}{W} < 0.4$	$0.4 < \frac{T}{W} \leq 0.7$	$\frac{T}{W} > 0.7$	
√		√			0
√			√		0.8
√				√	1.0
	√	√			0
	√		√		0
	√			√	0.5

Table 23 Calculations of K_a, K_b and K for Load Rating Vehicle Type 3-3

Asset ID	Design Live Load	Load Test Distribution Factor	T (kip-ft.)	W (kip-ft.)	1.33W < M_{cr}	T/W	K_a	K_b	K
03888	H10	0.24	21.154	41.533	Yes	0.509	0.565	0.8	1.45
04548	H10	0.25	22.036	43.263	Yes	0.509	0.880	0.8	1.70
03647	H10	0.28	24.680	48.455	Yes	0.509	0.422	0.8	1.34
04399	H10	0.29	25.561	50.185	Yes	0.509	0.518	0.8	1.41
03313	H15	0.3	26.443	51.916	Yes	0.509	0.397	0.8	1.32
04131	H10	0.31	27.324	53.646	Yes	0.509	0.643	0.8	1.51
03266	H10	0.31	27.324	53.646	Yes	0.509	0.440	0.8	1.35
04875	H10	0.34	29.968	58.838	Yes	0.509	0.256	0.8	1.20
04488	H10	0.35	30.850	60.568	Yes	0.509	0.354	0.8	1.28
04398	H10	0.36	31.731	62.299	Yes	0.509	0.512	0.8	1.41
05741	H10	0.41	36.138	70.952	Yes	0.509	0.470	0.8	1.38
04798	H10	0.43	37.901	74.413	Yes	0.509	0.522	0.8	1.42
04801	H10	0.44	38.782	76.143	Yes	0.509	0.600	0.8	1.48
04333	H10	0.46	40.545	79.604	Yes	0.509	0.620	0.8	1.50

Table 24 comparison of K factors to observable conditions

Asset ID	Design Live Load	Year	Reflective Cracking (None/Minor/Moderate/Severe)	Tie Rod Condition (Good/Poor)	Asphalt Thickness (in.)	Gaps[1] (in.)	Tested DF (Lane)	K (K_b=0)[2]	K (K_b=0.8)[3]
03888	H10	1962	None/Minor	Good	4.50	0.08	0.24	1	1.45
04548	H10	1965	None/Minor	Good	4.00	0.57	0.25	1	1.70
03647	H10	1961	Moderate	Good	4.50	0.54	0.28	1	1.34
04399	H10	1964	Moderate	Poor	2.00	0.50	0.29	1	1.41
03313	H15	1960	Localized Moderate	Good	1.25	0.31	0.30	1	1.32
04131	H10	1963	Moderate	Good	4.00	0.22	0.31	1	1.51
03266	H10	1960	Moderate	Good	2.00	0.24	0.31	1	1.35
04875	H10	1966	Moderate	Poor	1.50	0.31	0.34	1	1.20
04488	H10	1965	Moderate	Poor	4.50	0.45	0.35	1	1.28
04398	H10	1964	Moderate	Good	2.00	0.26	0.36	1	1.41
05741	H10	1970	Severe	Good	5.00	0.59	0.41	1	1.38
04798	H10	1966	Localized Severe	Good	4.00	0.27	0.43	1	1.42
04801	H10	1966	Severe	Poor	4.00	0.24	0.44	1	1.48
04333	H10	1964	Severe	Poor	1.50	0.39	0.46	1	1.50

1: Average gaps on each side of controlling channel sections
2: K_b of tested bridges, for all SCDOT Load Rating levels, except for Type 3-3, SC-SU2, and SC Representative School Bus
3. K_b of tested bridges, for SCDOT Load Rating levels: Type 3-3, SC-SU2, and SC Representative School Bus

10 Visual Guide for Distribution Factor Selection

Based on the results and observations of all tested bridges, the following Visual Guide was developed to assist in determine the distribution factor of 2.5" leg channel bridges in South Carolina. Our findings concluded that there was strong correlation between the degree of reflective cracking in the deck and the corresponding Distribution Factors. In all cases the distribution factors were found to be at or above the AASHTO LRFD and LFD codes. We recommend engineering judgment be utilized in conjunction with this visual guide in determining distribution factors for load ratings of this bridge type.

If post-tensioned rods are sounded and not identified as being loose or broken, the distribution factor for the 2 ½" leg channels can be based on the degree of reflective cracking. Following photos provide visual guide for the inspector's reference. If post-tensioned rods are loose when inspected, use 0.5 distribution factor for the LRFR load rating regardless of degree of reflective cracking.

Reflective Crack Condition	Tie Rod Condition	Recommended DF (Lane)
None/Minor	Good	Follow AASHTO
Moderate	Good	0.35
Severe	Good	0.5
Any Condition	Poor/Loose	0.5

Reflective Cracking: None/Minor – DF = Follow AASHTO

Reflective Cracking: Moderate – DF = 0.35 Lane

Reflective Cracking: Moderate – DF = 0.35 Lane

Reflective Cracking: Severe – DF = 0.5 Lane

Reflective Cracking: Severe – DF = 0.5 Lane

Reflective Cracking: Localized Severe – DF = 0.5 Lane

Appendix A: Maximum Strains of All Sensors

In Appendix A, maximum strains recorded during the load test of all bridges are presented. The strain gauges are named accordingly to the channel and leg of the channel they are located in. For example, C1L1 indicates the strain gage installed at channel 1 at the left leg. Similar C1L2 indicates the strain gage installed at right leg of channel 1. If the strain presented here is to be used to verify a model or any other types of calculation, the value must be adjusted for the gauge length of the sensor.

Table 25 BR03888 Maximum Strains of all Strain Gauges for all Test Cases (Channel 1 to Channel 5)

TEST	Run	C1L1	C1L2	C2L1	C2L2	C3L1	C3L2	C4L1	C4L2	C5L1	C5L2
1	1	136	172	243	276	215	195	244	212	129	111
	2	137	174	252	281	219	196	245	213	131	111
	3	141	184	256	282	217	199	246	209	129	109
2	4	132	160	257	298	222	195	250	230	143	114
	5	129	145	241	307	219	189	240	238	156	119
	6	127	151	250	308	221	194	245	232	155	117
3	7	92	91	140	315	656	189	204	511	462	223
	8	90	90	139	314	288	197	210	199	249	245
	9	93	93	146	326	287	196	210	202	246	237
4	10	79	75	118	245	637	235	224	511	445	290
	11	82	76	120	250	660	230	219	539	476	282
	12	78	71	112	220	333	243	228	184	248	301
5	13	49	44	250	113	323	198	267	272	240	215
	14	52	47	75	120	642	205	264	518	447	227
	15	59	51	96	145	206	228	270	197	195	241
6	16	52	43	82	121	167	188	276	208	188	215
	17	52	43	82	124	173	195	276	205	188	218
	18	53	45	85	127	175	199	278	205	187	217
7	19	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	20	37	28	60	84	114	112	219	252	211	202
	21	36	27	59	83	111	111	216	251	212	202
8	22	31	22	50	68	96	95	179	224	232	221
	23	32	23	52	70	97	94	178	216	227	224
	24	33	23	54	71	99	98	190	238	232	219
9	25	19	10	30	36	57	55	108	99	199	290
	26	19	11	31	39	60	56	104	98	190	289
	27	22	14	37	46	68	63	116	114	125	307
10	28	17	10	27	32	49	48	90	84	161	266
	29	18	11	30	37	57	53	96	91	162	259
	30	20	11	32	39	59	55	100	94	168	269
11	31	12	7	19	23	35	34	63	58	98	136
	32	11	7	21	25	39	37	64	61	96	129
	33	12	6	20	25	38	35	62	60	94	130

Table 26 BR03888 Maximum Strains of all Strain Gauges for all Test Cases (Channel 6 to Channel 10)

TEST	Run	C6L1	C6L2	C7L1	C7L2	C8L1	C8L2	C9L1	C9L2	C10L1	C10L2
1	1	77	68	36	4	36	44	29	29	27	22
	2	78	67	36	3	25	24	12	11	10	12
	3	76	66	35	3	25	24	10	11	9	7
2	4	86	71	38	3	27	25	12	12	9	10
	5	93	77	41	4	29	28	13	13	11	11
	6	90	75	40	4	29	27	12	13	10	9
3	7	N/A	351	318	5	137	38	18	289	15	278
	8	133	108	61	5	42	39	18	18	13	16
	9	127	102	58	5	39	38	17	18	13	18
4	10	N/A	359	69	5	47	45	20	21	15	16
	11	N/A	402	70	5	48	46	21	23	17	19
	12	187	135	73	5	51	50	23	24	18	18
5	13	575	242	620	7	258	76	36	577	25	493
	14	N/A	372	132	7	80	76	37	36	27	25
	15	321	231	127	110	77	74	33	30	22	21
6	16	291	255	152	127	90	87	40	36	27	24
	17	299	251	142	119	84	80	36	32	23	23
	18	303	256	141	120	84	81	36	33	25	23
7	19	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	20	218	247	219	178	124	116	54	49	38	33
	21	217	250	230	182	124	120	56	51	40	35
8	22	206	220	225	195	137	129	60	54	43	40
	23	207	217	222	195	140	133	63	57	45	43
	24	209	231	234	198	137	132	62	56	44	42
9	25	259	207	185	239	207	199	85	80	64	60
	26	259	210	184	235	204	199	87	80	64	60
	27	237	207	190	243	198	186	82	77	62	59
10	28	288	223	184	236	229	237	98	91	71	65
	29	288	230	192	237	228	244	101	93	72	66
	30	278	220	186	234	225	231	96	90	70	66
11	31	261	283	215	232	219	312	171	134	97	88
	32	256	283	N/A	N/A	N/A	N/A	178	136	100	91
	33	254	281	N/A	N/A	N/A	N/A	178	137	99	89

Table 27 BR04548 Maximum Strains of all Strain Gauges for all Test Cases

TEST	Run	C1L1	C1L2	C2L1	C2L2	C3L1	C3L2	C4L1	C4L2	C5L1	C5L2
1	1	82.451	118.05	162.45	217.23	187.7	143.28	159.11	191.5	173.94	124.33
	2	71.881	104.88	144.03	216.94	196.34	140.6	155.37	185.67	176.09	128.27
2	3	51.24	72.428	103.59	163.45	245.44	159.47	161.31	165.45	175.2	174.06
	4	53.213	73.324	103.59	160.53	248.72	165.37	164.09	167.2	176.85	180.54
3	5	41.436	57.028	79.594	114.24	179.01	188.71	180.94	162.4	164.13	216.66
	6	43.113	60.358	83.394	120.6	188.57	184.41	177.44	163.23	166.35	215.59
4	7	43.421	31.14	45.631	54.695	83.697	117.18	166.44	193.31	174.48	184.34
	8	35.564	31.628	46.268	57.338	88.405	124.84	178.95	189.85	172.38	186.51
5	9	40.515	18.558	27.314	32.246	49.716	67.664	96.1	156.19	188.72	186.65
	10	38.143	19.836	29.002	34.51	53.028	71.583	101.32	164.54	195.9	190.06
6	11	39.206	13.063	20.041	22.432	35.801	49.181	71.114	112.27	141.98	228.15
	12	40.61	14.199	20.69	23.942	37.259	51.217	72.925	115.32	143.02	223.65
7	13	8.7619	7.9618	13.243	14.544	23.297	31.285	48.539	75.917	96.417	164.29
	14	39.322	7.8012	12.455	13.521	21.464	41.845	44.579	70.197	88.738	150.02
8	15	11.195	1.5702	4.6872	5.1889	9.1733	12.675	22.793	37.63	47.94	75.587
	16	34.258	2.3153	5.5495	5.5954	9.3345	36.061	23.86	39.066	49.861	78.953
TEST	**Run**	**C6L1**	**C6L2**	**C7L1**	**C7L2**	**C8L1**	**C8L2**	**C9L1**	**C9L2**	**C10L1**	**C10L2**
1	1	82.908	50.926	46.093	45.366	58.859	64.804	51.835	34.615	26.317	45.77
	2	86.909	52.549	46.232	30.375	24.035	17.67	11.327	7.7283	5.2908	35.656
2	3	115.47	67.492	59.458	38.408	31.025	21.505	13.747	8.8813	6.0795	33.945
	4	121.12	69.004	61.119	40.987	34.199	23.62	14.932	9.9669	6.4698	32.115
3	5	168.14	89.267	78.531	52.507	44.216	30.893	19.7	13.552	9.1913	34.415
	6	159.56	85.726	75.355	50.716	41.257	29.816	19.01	13.696	9.1263	31.639
4	7	171.34	180.57	168.27	101.18	84.36	58.278	37.005	26.022	17.702	35.834
	8	176.2	173.48	155.86	96.126	79.874	55.458	35.189	24.522	16.759	30.009
5	9	152.11	151.24	205.78	186.07	155.76	100.27	59.195	40.056	27.722	35.409
	10	154.7	155.43	211.7	183.58	153.26	97.786	57.491	38.543	26.718	32.319
6	11	182.94	140.91	165.68	237.14	248.1	160.26	85.466	55.96	38.717	34.712
	12	176.83	140.15	164.98	233.15	241.68	155.06	82.964	54.266	37.116	33.651
7	13	185.71	159.94	165.45	172.84	225.76	274.16	168.65	90.973	62.282	51.35
	14	172.4	167.77	170.24	166.26	206.62	265.96	213.13	107.76	71.149	57.62
8	15	81.603	120.98	187.56	197.6	191.14	189.86	205.21	288.36	187.64	126.88
	16	86.339	128.93	203.87	191.17	190.17	195.15	217.03	276.76	175.37	121.39

Table 28 BR3313 Maximum Strains of all Strain Gauges for all Test Cases

TEST	Run	C1L1	C1L2	C2L1	C2L2	C3L1	C3L2	C4L1	C4L2	C5L1	C5L2
1	**1**	97.49	101.11	471.04	326.18	246.24	238.29	236.56	267.55	214.14	131.90
	2	94.71	95.35	472.03	321.94	244.96	236.03	237.35	266.92	214.77	129.25
2	**3**	69.80	71.64	350.03	329.97	280.99	234.43	207.85	245.08	270.85	175.65
	4	71.17	60.35	355.24	317.72	267.30	225.01	206.37	244.67	259.98	162.98
3	**5**	42.60	43.84	167.38	186.79	266.23	293.66	219.31	189.95	219.40	275.80
	6	42.67	42.10	167.31	191.98	263.31	289.19	217.51	187.33	217.05	269.00
4	**7**	24.93	26.75	78.74	83.27	110.50	169.90	272.45	253.98	202.66	187.94
	8	25.83	30.02	83.48	86.68	115.55	176.14	272.57	247.74	202.78	191.50
5	**9**	19.14	23.52	54.16	55.14	73.28	104.55	129.28	180.11	271.47	218.34
	10	18.63	21.43	52.42	53.32	72.46	100.64	128.09	177.57	268.71	219.84
6	**11**	14.48	22.33	44.14	45.97	59.75	83.73	101.55	136.91	204.47	250.19
	12	12.51	16.07	39.61	40.00	53.92	77.25	93.60	129.98	193.67	246.91
7	**13**	6.42	10.94	23.05	25.30	32.62	49.06	58.84	76.74	109.71	164.91
	14	5.90	12.13	21.82	27.31	32.48	49.93	57.00	77.40	106.82	166.50
8	**15**	5.32	8.82	12.80	16.67	19.65	29.88	33.34	44.70	61.20	80.94
	16	5.42	9.76	14.53	17.27	19.90	28.83	33.91	43.60	59.45	81.97
TEST	**Run**	**C6L1**	**C6L2**	**C7L1**	**C7L2**	**C8L1**	**C8L2**	**C9L1**	**C9L2**	**C10L1**	**C10L2**
1	**1**	94.31	67.17	56.86	46.31	34.72	29.69	18.06	13.79	14.02	10.57
	2	92.89	65.76	56.30	42.54	30.67	26.70	17.16	10.05	13.54	10.77
2	**3**	116.12	78.98	64.33	50.94	32.83	29.64	18.03	13.52	13.15	12.17
	4	115.00	77.18	68.53	49.84	36.85	27.79	20.32	11.14	13.50	9.53
3	**5**	225.22	139.11	113.20	84.77	59.70	47.29	32.79	23.04	21.90	18.38
	6	221.48	136.59	114.77	84.65	60.54	45.30	30.71	22.03	20.92	19.63
4	**7**	195.84	238.39	228.25	160.66	111.21	78.46	54.68	37.57	36.21	30.42
	8	195.34	238.44	223.50	156.97	104.83	75.99	53.19	35.58	31.43	27.78
5	**9**	187.32	190.69	219.72	292.46	217.07	135.73	96.37	61.13	55.88	46.75
	10	189.56	190.56	221.35	297.07	220.72	134.81	96.10	64.30	60.36	51.75
6	**11**	199.39	178.82	199.78	304.68	263.59	167.99	120.22	76.27	73.16	60.38
	12	204.18	178.41	197.72	290.46	264.31	169.97	122.23	76.63	72.12	59.93
7	**13**	201.72	212.95	201.38	205.39	196.79	276.38	246.09	134.60	132.52	95.16
	14	198.36	210.82	199.23	203.96	195.83	273.50	241.61	136.62	134.68	98.26
8	**15**	101.85	154.75	210.09	263.04	203.57	193.22	237.47	323.04	278.69	198.37
	16	102.54	152.20	208.36	268.71	206.03	193.61	221.02	316.98	274.29	180.97

Table 29 BR4131 Maximum Strains of all Strain Gauges for all Test Cases

TEST	Run	C1L1	C1L2	C2L1	C2L2	C3L1	C3L2	C4L1	C4L2	C5L1	C5L2
1	1	114.13	164.71	171.12	234.74	146.48	231.25	166.93	256.79	199.27	121.68
	2	116.7	165.51	165.3	224.94	146.15	220.23	166.8	251.81	193.01	121.67
2	3	82.977	108.79	100.89	170.91	159.84	286.23	158.62	193.58	219.72	207.85
	4	85.565	115.44	105.91	178.27	167.16	290.04	167.63	205.99	225.91	213.79
3	5	59.249	80.67	76.694	119.79	193.24	198.16	185.19	179.94	163.66	225.55
	6	64.476	89.05	81.046	133.83	192.91	220.64	183.22	190.35	177.89	235.07
4	7	40.215	51.757	49.595	75.005	120.98	108.52	190.74	243.5	176.32	169.06
	8	40.487	51.246	48.353	73.903	122.83	106.78	184.43	244.41	181.23	168.79
5	9	22.806	28.626	30.226	42.978	70.7	65.144	97.327	181.3	205.31	179.12
	10	24.474	30.337	31.915	45.521	74.748	68.36	106.03	218.37	240.45	186.06
6	11	17.854	24.775	26.139	37.198	61.416	56.229	81.128	147.03	195.86	250.19
	12	17.556	24.371	24.666	36.258	59.718	54.511	79.165	142.86	187.43	243.26
7	13	9.0436	11.923	11.596	18.771	33.521	29.378	44.846	76.173	90.562	140.85
	14	10.336	14.788	15.523	22.564	37.201	33.474	49.843	83.77	97.329	153.84
8	15	1.4422	5.1321	3.9336	8.0003	16.929	13.667	22.337	39.803	47.726	68.958
	16	3.5142	7.2443	5.1232	10.377	20.237	16.449	26.391	45.09	52.662	74.572
TEST	**Run**	**C6L1**	**C6L2**	**C7L1**	**C7L2**	**C8L1**	**C8L2**	**C9L1**	**C9L2**	**C10L1**	**C10L2**
1	1	96.652	60.9	42.643	30.891	26.377	22.687	15.262	11.719	0.5772	-0.229
	2	96.841	61.364	43.465	32.043	27.707	23.42	17.245	13.594	1.4325	0.4112
2	3	147.01	87.129	61.121	44.811	39.711	32.635	25.597	21.797	3.2814	4.2255
	4	155.29	94.532	65.944	49.423	43.924	34.375	28.639	24.864	4.863	3.1899
3	5	227.09	125.32	82.851	58.835	50.998	41.179	33.261	29.692	4.6172	3.8187
	6	227.64	123.4	83.68	61.4	54.666	42.99	35.051	31.029	5.8902	5.4227
4	7	211.41	236.87	165.14	104.25	91.23	69.88	58.556	52.582	11.16	12.511
	8	205.94	230.74	168.92	106.54	93.407	71.785	60.464	54.577	12.518	17.326
5	9	182.37	180.33	176.85	167.14	159.24	116.11	94.37	86.196	19.095	17.414
	10	182.9	187.38	216.91	188.94	155.17	110.67	94.129	85.086	19.554	18.995
6	11	211.59	175.24	173.94	243.03	229.87	155.07	126.94	115.38	26.654	26.724
	12	206.34	173.66	169.18	234.25	222.65	155.19	125.53	113.08	25.122	23.476
7	13	221.2	207.7	172.51	185.81	223.41	284.67	217	188.12	43.053	39.101
	14	250.25	199.17	167.08	191.44	242.35	268.17	194.68	171.2	41.647	38.271
8	15	105.78	152.06	196.4	202.48	217.36	242.59	295.98	409.35	73.707	61.401
	16	107.72	150.37	191.88	217.36	226.56	243.87	285.44	408.24	142.56	103.1

Table 30 BR3647 Maximum Strains of all Strain Gauges for all Test Cases

TEST	Run	C1L1	C1L2	C2L1	C2L2	C3L1	C3L2	C4L1	C4L2	C5L1	C5L2
1	1	170.78	143.81	306.3	222.09	221.89	241.01	287.26	321.59	287.6	117.53
	2	161.52	141.86	293.32	227.98	246.98	251.27	283.1	316.53	295.95	120.63
2	3	94.756	89.949	165.31	180.81	358.31	304.63	252.61	256.73	371.9	182.55
	4	93.455	81.494	157.38	144.38	371.78	333.18	257.23	261.68	375.22	201.28
3	5	77.825	66.828	125.91	105.46	313.1	390.95	273.15	266.52	345.13	234.14
	6	81.06	69.181	132.3	111.05	330.14	398.3	275.37	271.85	351.7	238.7
4	7	41.333	30.569	68.846	55.614	104.79	154.97	372.96	326.93	295.39	131.35
	8	42.965	32.503	71.939	58.512	109.89	169.79	373.27	329.31	300.17	135.17
5	9	23.017	19.151	41.328	35.072	64.181	94.741	188.22	223.98	355.26	161.68
	10	26.182	21.342	45.523	37.727	69.18	103.37	196.19	243.56	354.77	152.49
6	11	20.867	17.472	37.425	31.353	57.966	87.237	160.21	191.28	324.14	193.4
	12	22.368	18.485	39.335	32.865	60.533	90.206	166.95	195.2	335.21	182.89
7	13	10.092	7.8481	17.288	14.576	28.514	41.25	72.08	69.733	102.38	59.893
	14	9.056	8.5321	17.676	15.803	29.267	44.742	74.203	80.226	113.78	65.861
8	15	4.6564	4.5561	8.7268	7.9168	14.5	23.402	37.501	44.613	64.547	39.084
	16	4.416	4.6048	8.5716	8.2523	14.846	24.773	38.743	47.355	67.724	41.644
TEST	**Run**	**C6L1**	**C6L2**	**C7L1**	**C7L2**	**C8L1**	**C8L2**	**C9L1**	**C9L2**	**C10L1**	**C10L2**
1	1	50.736	57.962	31.662	32.558	21.48	17.646	13.568	8.0425	5.5108	3.4456
	2	56.814	65.541	37.569	38.358	26.269	22.268	16.486	10.92	8.6116	4.8621
2	3	81.461	90.748	48.655	50.236	33.15	29.067	20.734	14.039	10.393	7.4759
	4	80.112	87.849	47.4	49.329	30.861	27.646	18.622	13.444	9.4185	6.5875
3	5	109.29	116.91	60.037	62.539	39.614	35.894	23.425	18.179	12.827	9.3313
	6	107.99	116.55	58.737	60.762	38.902	34.961	22.957	17.615	12.689	8.7332
4	7	237.54	373.64	190.2	152.72	82.988	75.241	46.294	38.64	27.132	21.784
	8	235.33	365.86	193.43	153.92	83.516	75.187	46.841	38.355	26.902	21.779
5	9	107.51	158.2	341.25	427.04	172.68	143.41	85.807	74.251	50.416	41.877
	10	114.55	165.18	362.07	389.96	163.82	138.09	83.053	71.667	49.549	40.995
6	11	110.74	156.82	266.29	388.82	266.28	181.01	102.17	87.74	61.383	50.909
	12	112.02	161.35	291.38	421.2	236.53	169.64	99.011	84.916	59.494	50.164
7	13	319.15	404	222.36	280.69	365.11	420.98	191.46	159.11	109.27	95.729
	14	285.87	383.46	221.58	268.17	318.5	390.08	230.48	173.75	118.93	102.03
8	15	78.367	103.43	405.87	414.01	242.77	274.7	346.88	391.04	242.85	191.99
	16	84.26	112.6	415.83	387.3	249.06	283.23	362.33	364.6	226.15	179.33

Table 31 BR4398 Maximum Strains of all Strain Gauges for all Test Cases

TEST	Run	C1L1	C1L2	C2L1	C2L2	C3L1	C3L2	C4L1	C4L2	C5L1	C5L2
1	1	193.67	274	395.03	250.05	215.56	225.08	259.84	208.25	175.03	125.68
	2	181.37	263.73	404.43	251.67	214.19	222.84	262.77	211.27	176.58	126.83
2	3	89.087	74.321	370.87	359.39	251.39	211.38	206.59	261.05	308.52	196.54
	4	86.017	72.006	358.79	354.07	248.33	209.53	200.37	254.74	311.52	196.44
3	5	53.815	44.873	157.67	163.6	376.31	308.93	206.34	210.98	380.7	375.39
	6	51.111	43.832	154.68	159.95	375.99	316.56	208.27	213.07	378.72	382.89
4	7	18.146	17.64	72.1	69.76	126.26	169.2	228.26	211.62	194.75	155.76
	8	20.859	19.071	75.969	74.492	128.43	174.33	238.91	215.8	194.37	155.66
5	9	5.8993	7.0023	41.447	40.616	68.239	84.118	110.11	159.53	353.51	266.65
	10	7.6116	8.2008	43.415	41.967	71.627	88.596	115.44	180.34	344.61	250.67
6	11	8.9437	9.0332	39.138	39.049	62.394	76.081	97.786	132.76	305.7	335.8
	12	2.8597	5.351	35.353	35.642	60.476	73.751	94.39	127.71	301.55	336.74
7	13	0.2952	2.2432	11.005	11.364	19.487	22.62	30.041	34.308	59.579	53.984
	14	0.2363	1.4211	10.258	11.941	19.409	23.603	30.357	35.228	63.699	58.244
8	15	1.2553	1.945	3.1655	7.1902	8.4364	13.177	15.701	19.981	31.409	29.024
	16	2.1709	2.0563	3.1099	7.2418	8.4283	13.036	15.478	19.59	31.458	28.838
TEST	**Run**	**C6L1**	**C6L2**	**C7L1**	**C7L2**	**C8L1**	**C8L2**	**C9L1**	**C9L2**	**C10L1**	**C10L2**
1	1	31.01	38.258	15.798	13.241	10.571	8.6582	10.578	12.899	17.356	15.831
	2	31.553	39.05	17.429	15.129	12.866	10.926	13.609	17.684	6.8466	6.5768
2	3	43.324	56.211	21.075	19.583	14.831	14.314	13.255	11.852	2.2487	1.7579
	4	44.194	56.878	23.493	21.506	16.423	16.276	10.677	14.228	4.0651	3.6235
3	5	68.065	92.909	32.123	33.081	22.745	25.714	9.8948	11.097	1.3041	1.0759
	6	66.807	91.124	32.092	33.547	23.216	26.594	10.733	11.125	2.9837	1.1722
4	7	380.1	505.2	92.626	88.178	61.79	66.15	27.565	32.015	3.4088	4.3769
	8	395.1	516.5	97.32	91.487	65.075	69.367	28.832	32.834	5.0855	6.3415
5	9	144.68	178.98	313.54	267.39	186.3	152.13	52.01	52.703	12.474	11.94
	10	152.49	191.18	325.83	259.79	182.77	149.31	50.033	49.79	11.779	12.305
6	11	135.64	166.29	233.57	282.87	260.17	189.03	63.023	65.183	17.655	18.271
	12	134.13	163.41	228.87	284.19	272.71	191.42	63.014	65.463	16.69	17.027
7	13	415.98	496.28	211.07	218.76	334.66	406.9	157.13	147.7	33.474	37.502
	14	413.55	494.93	211.69	219.84	335.72	403.95	159.82	144.53	30.543	35.579
8	15	136.11	167.69	356.41	289.97	256.06	274.96	310.93	394.59	116.73	104.55
	16	141.72	178.46	347.71	285.12	260.61	283.84	298.75	382.7	112.69	104.81

Table 32 BR4875 Maximum Strains of all Strain Gauges for all Test Cases

Test No.	Run	C1L1	C1L2	C2L1	C2L2	C3L1	C3L2	C4L1	C4L2	C5L1	C5L2
1	1	127.55	110.84	587.27	342.18	254.2	280.65	350.2	289.1	196.48	153.27
	2	121.5	101.14	583.16	348.08	253.4	276.89	344.58	298.22	200.79	155.89
2	3	100.88	84.99	467.71	412.41	230.85	228.98	269.31	350.22	300.8	196.2
	4	97.494	82.079	475.16	402.49	230.95	232.65	272.48	354.96	288.63	193.43
3	5	34.38	26.92	101.1	83.007	480.22	428.27	247.91	225.81	405.36	436.83
	6	33.585	25.092	99.147	82.944	477.36	437.33	242.4	221.43	393.59	422.05
4	7	16.64	12.714	53.389	45.972	189.78	240.88	340.27	269.45	204.9	171.53
	8	14.177	11.851	46.999	41.79	172.8	213.23	298.09	301.12	218.11	176.27
5	9	3.4854	3.8031	24.403	23.399	86.746	89.666	111.9	118.9	504.96	362.18
	10	3.8408	3.8934	22.884	24.797	85.188	90.339	112.32	123.92	503.82	353.63
6	11	4.4377	5.7573	22.859	24.673	77.749	82.052	102.08	110.1	437.35	427.78
	12	3.8675	4.6773	21.344	23.324	77.362	82.516	103.14	111.78	450.75	420.19
7	13	0.2349	1.5341	10.08	11.577	35.224	36.193	46.886	46.626	111.98	96.202
	14	0.1678	0.1948	6.9169	9.1543	30.778	33.015	42.508	42.825	102.93	86.973
8	15	0.0289	0.1711	1.6692	5.6857	13.375	17.729	20.687	24.151	48.671	44.334
	16	0.0033	0.618	1.8381	7.2216	13.43	18.954	22.069	26.009	48.889	44.545
Test No.	Run	C6L1	C6L2	C7L1	C7L2	C8L1	C8L2	C9L1	C9L2	C10L1	C10L2
1	1	37.553	32.057	27.363	19.9	18.324	14.013	5.759	3.8229	2.1476	2.0832
	2	36.205	39.619	26.782	18.676	17.241	12.716	4.3941	2.2244	1.5587	1.6805
2	3	43.267	36.646	32.193	24.144	22.914	16.942	7.1474	3.7567	2.9449	1.3317
	4	45.111	37.283	32.475	22.822	20.899	14.565	4.3746	4.6332	13.322	6.9123
3	5	116.26	75.387	61.308	44.022	39.69	32.849	12.17	9.7798	5.6594	3.4293
	6	129.91	88.39	71.576	50.149	45.685	37.159	14.668	12.318	7.5496	4.943
4	7	325.14	334.43	204.85	120.4	106.89	88.536	35.924	36.678	15.601	14.122
	8	280.13	325.51	251.22	131.29	114.3	93.329	38.797	39.029	15.835	14.032
5	9	184.84	180.28	286.94	265.27	219.78	161.13	66.725	68.12	26.746	25.371
	10	187.98	181.8	278.37	249.3	212.16	156.44	65.065	68.13	26.015	25.729
6	11	166.37	146.14	229.22	289.36	266.26	184.22	75.67	77.275	30.555	30.312
	12	169.67	149.67	233.84	290.42	255.23	180.17	72.692	75.114	29.369	28.467
7	13	415.13	257.99	267.83	268.05	332.75	438.1	141.2	141.55	53.807	55.135
	14	374.46	279.6	265.85	248.16	299.63	442.94	190.94	169.4	60.501	63.054
8	15	170.93	175.91	303.7	258.95	242.17	232.24	389.53	507.97	125.68	134.73
	16	173.78	179.02	306.68	257.11	246.62	233.61	401.81	515.23	119.08	127.99

Table 33 BR4488 Maximum Strains of all Strain Gauges for all Test Cases

TEST	Run	C1L1	C1L2	C2L1	C2L2	C3L1	C3L2	C4L1	C4L2	C5L1	C5L2
1	1	53.101	78.372	452.81	333.75	259.7	234.87	365.89	366.87	167.16	127.35
	2	54.021	80.476	470.05	337.06	264.3	240.51	372.58	362.22	162.78	125.39
2	3	44.698	64.674	373.64	358.85	251.21	222.98	249.49	280.6	359.43	202.82
	4	44.014	63.602	365.01	363.45	252.81	225.2	234.73	264.49	387.18	221.01
3	5	24.444	35.943	147.48	133.05	375.14	389.02	157.9	141.19	362.46	367.66
	6	26.228	38.355	157.3	142.17	397.37	367.56	174.85	153.11	451.18	442.1
4	7	9.9137	15.035	65.721	50.535	111.84	109.87	385.19	314.27	186.66	154.55
	8	9.9707	15.308	62.682	48.62	106.68	103.73	378.95	328.94	179.95	149.95
5	9	2.8682	4.294	29.545	24.917	46.863	45.511	110.38	104.82	549.26	374.72
	10	3.251	4.4974	29.429	23.946	46.644	44.523	108.35	100.02	560.46	381.38
6	11	2.4301	2.9971	24.92	21.59	39.448	39.265	88.151	74.383	469.41	432.87
	12	2.42	3.3858	25.366	22.216	40.379	40.347	84.999	72.521	440.14	422.3
7	13	0.5217	0.7463	10.369	10.12	16.709	17.909	35.86	30.244	95.494	68.218
	14	0.3733	0.6547	9.7838	10.237	16.77	18.224	36.465	31.863	102.91	78.053
8	15	0.6809	0.845	3.8031	5.1696	7.781	8.9793	19.552	19.721	41.46	33.459
	16	0.7274	0.7885	3.4152	4.8966	7.6991	8.9245	19.456	19.556	41.206	33.19
TEST	**Run**	**C6L1**	**C6L2**	**C7L1**	**C7L2**	**C8L1**	**C8L2**	**C9L1**	**C9L2**	**C10L1**	**C10L2**
1	1	32.381	33.51	25.934	23.714	13.207	10.957	9.2291	7.6554	1.2596	0.1667
	2	33.258	34.573	26.619	24.599	13.487	10.984	9.745	7.3188	1.3795	0.1756
2	3	41.644	42.59	33.224	30.7	16.83	13.918	11.991	9.8231	1.7206	0.8692
	4	38.631	40.822	31.47	29.021	14.801	12.076	10.797	7.998	1.6686	0.9981
3	5	173.42	129.89	66.466	57.736	29.249	25.67	21.201	19.457	4.9313	3.5872
	6	91.211	89.573	51.472	50.654	24.508	22.776	17.729	17.445	3.168	1.8587
4	7	361.37	387.64	184.35	121.8	57.181	51.866	41.827	41.197	8.7256	7.058
	8	347.79	387.35	207.6	135.72	60.162	54.403	44.405	43.16	9.6691	7.8472
5	9	168.19	187.38	359.44	334.28	118.9	100.15	81.025	77.021	18.845	14.359
	10	166.48	185.63	368.06	340.55	120.01	101.21	81.611	78.063	18.97	14.142
6	11	153.37	168.81	244.04	309.76	228.07	137.15	110.35	99.026	23.88	18.717
	12	154.42	166.6	232.33	306.47	249.78	146.29	114.15	102.19	25.943	20.355
7	13	379.59	396.37	207.87	188.93	266.72	330.77	273.75	203.27	45.018	37.969
	14	374.58	376.15	208.6	192.98	274.42	331.97	256.98	195.38	43.463	37.596
8	15	139.98	172.44	369.82	342.18	238.81	270.44	314.15	486.14	69.475	60.488
	16	138.76	172.28	373.95	342.5	239.19	271.57	316.33	479.73	65.522	57.948

Table 34 BR3266 Maximum Strains of all Strain Gauges for all Test Cases

TEST	Run	C1L1	C1L2	C2L1	C2L2	C3L1	C3L2	C4L1	C4L2	C5L1	C5L2
1	1	186.26	278.97	317.22	263.24	215.33	255.49	304.92	318.07	139.49	132.63
	2	178.58	271.99	312.65	278.02	214.38	249.13	303.37	333.67	148.48	136.01
2	3	146.42	228.84	213.52	335.98	223.24	230.25	218.96	315.74	286.74	214.42
	4	150.57	233.16	220.04	354.95	231.78	236.96	221.05	319.73	297.95	224.91
3	5	59.645	71.314	74.571	121.24	335.7	392.8	185.87	205.39	304.46	397.69
	6	61.043	71.729	75.833	130.87	323.11	377.89	181.68	201.04	309.32	408.25
4	7	33.651	36.643	40.697	56.295	114.86	186.08	301.13	336.75	236	269.7
	8	27.953	29.96	34.91	47.83	102.87	165.46	289.03	331.64	225.83	258.06
5	9	15.686	17.997	20.08	29.061	56.242	79.908	126.81	219.88	381.27	365.48
	10	18.022	20.083	21.988	31.136	59.231	83.993	126.61	215.03	388.09	382.81
6	11	14.482	17.407	18.564	25.053	48.205	66.037	93.744	130.5	348.99	458.27
	12	13.969	17.407	17.991	26.17	48.045	68.182	94.176	132.32	340.24	466.97
7	13	5.3142	7.794	7.9078	12.599	23.371	33.523	45.268	62.267	130.16	177.93
	14	5.5109	7.4755	7.6976	11.778	22.501	31.852	43.502	60.48	135.45	193.57
8	15	2.5161	5.639	4.0126	7.8933	11.691	18.528	22.75	32.618	65.867	88.425
	16	2.0958	5.0032	3.3702	7.7545	10.409	17.612	21.155	31.373	59.752	81.019
TEST	**Run**	**C6L1**	**C6L2**	**C7L1**	**C7L2**	**C8L1**	**C8L2**	**C9L1**	**C9L2**	**C10L1**	**C10L2**
1	1	64.87	46.694	34.457	26.639	18.19	12.038	9.4267	4.7104	4.5978	2.9345
	2	64.576	47.518	34.453	27.951	18.359	12.472	9.2142	5.9198	4.226	2.6631
2	3	87.388	63.694	44.951	37.154	22.246	16.396	10.431	6.2901	3.8076	2.6024
	4	90.291	67.199	47.126	40.658	24.129	19.105	12.664	8.9414	5.53	3.8629
3	5	178.41	107.06	68.551	62.947	29.406	27.778	13.498	13.95	5.2334	7.1243
	6	176.58	104.63	67.577	63.812	30.481	29.603	16.336	15.78	7.7096	7.5217
4	7	285.87	275.95	183.13	151.13	68.968	61.708	35.15	32.69	15.963	17.774
	8	265.05	268.98	185.34	145.41	60.042	56.493	29.463	29.641	12.717	15.05
5	9	201.86	183.19	333.74	337.72	108.89	94.966	50.3	48.823	20.617	24.496
	10	210.22	188.24	331.75	347.81	121.01	101.57	53.572	51.566	22.99	28.07
6	11	228.45	179.02	238.63	315.25	263.92	165.32	83.09	73.58	33.963	39.226
	12	244.77	182.74	234.17	310.24	284.75	185.89	91.257	79.858	39.733	42.769
7	13	312.3	266.75	219.9	228.3	263.95	355.31	212.3	142.06	59.903	66.761
	14	304.24	253.43	215.04	230.82	269.97	357.74	184.14	134.43	55.589	62.356
8	15	118.22	148.11	313.98	293.28	181.91	195.89	356.92	412.08	134.93	133.92
	16	109.35	133.16	305.4	303.03	181.08	191.62	341.2	425.82	152.04	140.36

Table 35 BR4399 Maximum Strains of all Strain Gauges for all Test Cases

TEST	Run	C1L1	C1L2	C2L1	C2L2	C3L1	C3L2	C4L1	C4L2	C5L1	C5L2
1	1	113.35	141.88	405.6	274.6	196.06	194.73	342.21	295.79	151.17	136.67
	2	98.774	94.009	414.3	305.02	207.07	200.45	320.77	334.43	166.16	150.62
2	3	74.267	70.098	309.49	340.26	220.7	204.01	220.66	302.92	272.22	194.48
	4	77.809	74.18	323.47	339.28	219.54	205.8	238.78	319.95	258.5	190.37
3	5	36.461	36.068	158.41	159.62	333.53	295.6	185.92	205.18	323.53	382.15
	6	37.95	36.515	149.18	149.23	329.01	309.76	185.3	202.27	321.15	406.84
4	7	18.13	17.877	76.905	73.532	97.722	112.03	317.18	325.11	196.92	205.77
	8	17.625	17.581	76.152	72.512	95.552	108.97	299.32	322.8	204.67	213.02
5	9	9.1797	8.9821	41.995	41.287	50.051	56.962	117.76	150.18	353.46	329.93
	10	9.6389	8.5779	43.186	43.497	52.27	59.011	127.56	173.46	348.91	303.93
6	11	8.0692	7.9928	37.483	37.781	45.165	51.279	106.02	124.34	310.72	386.89
	12	7.8753	7.9281	36.543	37.335	43.999	49.73	102.68	121.3	299.54	398.25
7	13	3.7261	3.6449	20.519	22.482	26.036	30.603	57.754	65.516	138.28	178.86
	14	3.8921	3.7843	20.641	22.561	25.974	30.62	56.799	64.27	136.18	179.71
8	15	2.1254	2.5869	10.383	12.007	13.874	16.917	31.584	37.076	67.562	81.116
	16	1.8953	2.3173	10.382	12.333	13.988	17.137	31.791	37.623	65.948	80.582
TEST	**Run**	**C6L1**	**C6L2**	**C7L1**	**C7L2**	**C8L1**	**C8L2**	**C9L1**	**C9L2**	**C10L1**	**C10L2**
1	1	49.04	43.412	28.497	18.855	17.169	13.067	4.0693	3.93	2.8323	1.2125
	2	53.588	48.732	29.387	19.493	17.857	13.667	4.7551	4.2613	2.9943	1.378
2	3	70.529	61.687	36.996	24.437	21.84	16.781	5.5675	5.324	3.0503	1.7784
	4	67.96	59.828	36.255	24.211	22.203	17.322	5.6665	5.4278	3.5936	2.2299
3	5	128.69	104.84	58.648	39.475	35.138	28.338	9.2051	9.7777	5.3694	4.1596
	6	127.05	106.3	56.457	38.458	33.557	27.486	9.6413	9.8903	5.7375	4.099
4	7	289.26	362.06	164.41	94.482	78.494	61.93	24.845	27.436	14.525	13.693
	8	258.94	343.57	189.55	104.21	86.637	67.646	25.932	28.73	14.999	14.758
5	9	185.22	192.25	245.01	236.33	183.06	120.88	50.001	55.958	30.323	31.238
	10	191.93	200.19	249.14	222.77	173.6	116.75	47.369	52.835	29.007	29.541
6	11	186.4	180.76	198.69	258.85	243.64	144.02	56.729	63.639	34.455	36.638
	12	185.93	178.48	194.7	257.75	258.04	153.43	59.591	66.456	36.457	38.412
7	13	317.93	316.29	194.95	188.21	271.41	299.11	110.1	114.38	61.549	65.502
	14	284.84	326.87	193.4	182.4	256.44	313.98	119	119.43	65.027	68.973
8	15	130.67	187.56	259.59	219.59	199.27	192.39	224.48	354.92	163.36	158.18
	16	130.73	190.3	258.78	220.61	202.16	192.28	227.41	364.59	162.22	158.63

Table 36 BR5741 Maximum Strains of all Strain Gauges for all Test Cases (Channel 1 to Channel 5)

TEST	Run	C1L1	C1L2	C2L1	C2L2	C3L1	C3L2	C4L1	C4L2	C5L1	C5L2
1	**1**	201	239	366	276	231	201	325	303	126	132
	2	226	289	325	249	227	202	333	285	114	118
	3	208	238	345	271	235	205	336	313	123	128
2	**4**	168	169	341	303	245	204	308	331	140	145
	5	190	198	351	285	237	205	329	328	132	143
	6	170	170	327	298	247	208	308	328	145	149
3	**7**	82	88	145	273	285	197	156	153	523	541
	8	84	93	164	277	268	193	157	152	489	520
	9	89	100	171	296	252	183	153	149	492	512
4	**10**	73	73	126	147	379	254	177	184	480	594
	11	72	75	126	150	367	244	179	173	469	587
	12	72	74	125	147	368	250	182	176	480	605
5	**13**	47	47	87	98	185	269	243	189	142	165
	14	45	46	86	95	176	264	243	189	140	161
	15	47	47	89	102	196	258	238	188	157	193
6	**16**	35	34	70	78	129	146	352	282	125	141
	17	42	41	81	90	148	225	309	245	132	152
	18	41	40	79	87	146	226	310	246	136	157
7	**19**	21	23	49	54	89	90	252	325	194	195
	20	21	23	49	53	88	91	238	313	200	194
	21	22	24	50	55	91	94	249	319	187	187
8	**22**	9	13	29	33	57	57	148	197	337	336
	23	11	14	33	37	64	66	158	234	300	290
	24	14	18	39	43	74	75	186	285	251	247
9	**25**	1	4	11	13	24	26	42	43	301	458
	26	0	4	12	15	27	28	47	49	345	476
	27	0	4	12	16	28	29	49	49	376	515
10	**28**	0	2	8	10	19	20	34	35	256	391
	29	0	2	6	9	17	18	31	31	238	268
	30	0	2	7	10	19	20	34	35	266	402
11	**31**	0	0	1	1	6	6	13	13	65	78
	32	0	0	2	3	7	8	15	16	71	89
	33	0	0	2	3	7	8	15	16	70	88

Table 37 BR4333 Maximum Strains of all Strain Gauges for all Test Cases

TEST	Run	C1L1	C1L2	C2L1	C2L2	C3L1	C3L2	C4L1	C4L2	C5L1	C5L2
1	1	58.154	45.773	453.41	528.07	85.181	83.951	359.06	423.82	223.69	178.76
	2	42.854	43.137	447.8	525.66	71.294	69.423	346.71	410.67	223.06	192.81
2	3	23.618	9.2703	79.741	68.244	581.69	430.72	103.01	93.959	524.67	520.39
	4	-3.538	8.8659	70.071	63.357	531.24	425.84	104.48	97.85	501.69	545.92
3	5	33.646	5.7412	59.741	52.971	480.65	525.52	116.96	108.52	290.94	376.51
	6	-2.63	6.3221	63.086	56.332	479.3	511.56	96.713	92.84	311.71	388.96
4	7	-2.842	0.0226	24.862	23.319	25.922	23.919	547.56	478.15	98.808	101.7
	8	-3.051	9.2434	27.597	25.372	27.228	25.989	547.07	485.16	102.21	104.4
5	9	-1.31	0.1539	7.3002	6.8392	23.217	22.299	66.997	53.95	597.19	511.22
	10	6.2019	0.1269	8.9896	8.7049	27.621	25.864	117.98	112.77	484.94	416.22
6	11	23.087	0.4741	6.2064	6.7535	23.731	21.697	55.929	52.638	480.14	545.39
	12	-0.03	1.9328	28.431	24.622	17.51	16.392	53.643	49.426	437.5	526.03
7	13	22.712	1.2647	1.3873	1.4016	23.704	21.472	25.885	25.362	41.641	40.264
	14	6.5747	0.1963	0.392	0.4073	7.1414	6.4929	26.053	25.746	53.385	52.024
8	15	-1.369	0.4885	1.0984	0.7655	-1.459	-1.328	9.9807	10.377	28.779	28.034
	16	-0.519	2.3751	2.5874	1.621	-0.999	-1.148	9.9946	9.9554	27.415	26.875
TEST	**Run**	**C6L1**	**C6L2**	**C7L1**	**C7L2**	**C8L1**	**C8L2**	**C9L1**	**C9L2**	**C10L1**	**C10L2**
1	1	38.379	34.077	12.265	13.042	0.6575	0.3682	0.0908	0.186	0.326	0.2451
	2	39.954	22.113	12.693	14.253	1.061	0.6586	-0.012	0.1359	0.2281	0.3414
2	3	57.852	56.31	22.897	26.302	5.9129	4.3667	0.1029	0.1742	0.1787	0.2925
	4	60.906	35.04	23.952	27.276	6.7504	5.3016	0.0238	0.2262	0.3503	0.5185
3	5	245.09	191.24	33.81	39.023	12.354	9.8631	0.1596	0.278	0.3914	0.5977
	6	232.03	169.59	32.537	37.315	11.571	9.2088	0.0611	0.2296	0.3305	0.4579
4	7	471.79	547.22	56.871	66.296	25.239	19.278	2.5753	4.0826	0.1014	0.2352
	8	473.07	560.13	59.372	68.836	26.494	20.335	2.8768	4.5175	0.3183	0.3999
5	9	59.61	65.567	520.33	584.89	57.75	46.358	17.885	31.203	0.241	0.6346
	10	117.7	127.54	476.03	514.94	61.84	49.084	17.149	29.608	0.1601	0.4382
6	11	105.46	113.51	312.6	433.7	256.21	143.15	20.709	36.582	0.6002	0.8583
	12	106.7	102.74	254.38	380.29	314.31	180.13	25.28	44.011	0.8809	3.6177
7	13	544.99	538.57	63.545	75.421	524.47	454.3	31.88	58.857	5.9722	9.6417
	14	520.72	535.02	98.077	115.21	516.83	471.07	35.919	67.782	8.1764	11.783
8	15	52.864	61.326	540	592.88	83.499	60.89	259.66	616.06	55.87	70.881
	16	80.947	92.302	485.18	526.47	122.41	89.54	252.05	576.42	55.912	70.463

Table 38 BR4798 Maximum Strains of all Strain Gauges for all Test Cases

TEST	Run	C1L1	C1L2	C2L1	C2L2	C3L1	C3L2	C4L1	C4L2	C5L1	C5L2
1	1	154.08	152.93	229.07	367.44	229.99	209.39	231.8	289.7	265.61	235.2
	2	144.41	145.39	210.74	356.8	254.47	213.54	232.25	294.68	273.25	244.94
2	3	105.27	96.55	116.42	167.65	392.25	294.01	248.85	262.26	307.37	387.51
	4	105.39	97.674	118.42	175.88	382.2	284.02	246.06	258.64	305.34	374.42
3	5	72.817	68.371	82.443	117.66	251.73	325.32	252.55	219.13	231.44	358.83
	6	74.182	66.417	81.746	116.31	248.62	324.13	252.21	219.34	230.7	364.32
4	7	37.968	38.553	49.172	68.894	114.66	140.26	284.64	242.03	195.15	191.42
	8	40.064	38.443	48.212	69.212	116.58	144.59	270	241.54	195.89	194.15
5	9	24.342	25.266	33.946	48.175	79.933	93.015	155.11	210.8	284.17	282.97
	10	25.489	23.052	30.768	43.361	76.577	88.75	150.45	206.78	276.38	277.82
6	11	17.855	19.504	25.385	38.742	67.446	80.563	132.34	180.64	240.78	366.35
	12	18.525	21.519	27.651	41.567	71.154	83.809	135.25	183.14	244.6	358.14
7	13	1.0701	0.1204	2.579	8.4678	14.315	18.962	33.486	38.965	44.57	54.885
	14	0.2238	4.3957	5.9593	12.354	19.393	24.501	38.485	44.107	48.262	60.617
8	15	0.4964	1.013	0.1751	3.8876	3.6766	8.5227	12.653	17.007	18.142	25.892
	16	0.1804	0.3061	-0.048	2.1022	3.4517	9.0226	15.063	18.615	20.449	28.293
TEST	**Run**	**C6L1**	**C6L2**	**C7L1**	**C7L2**	**C8L1**	**C8L2**	**C9L1**	**C9L2**	**C10L1**	**C10L2**
1	1	44.355	46.03	15.567	6.8281	4.9785	0.9988	-0.309	-0.335	-0.026	0.0216
	2	60.267	58.922	19.232	13.487	12.372	8.4415	7.0898	1.1568	0.3252	-0.079
2	3	83.781	86.217	27.64	22.491	21.887	15.934	3.9356	3.5994	1.2594	-0.025
	4	79.757	79.402	21.312	15.439	13.745	9.4449	2.9297	0.1124	0.0855	0.0973
3	5	287.07	214.06	41.806	33.282	32.086	23.117	13.411	7.0363	0.5704	1.3262
	6	286.58	216.61	44.817	36.264	35.372	25.168	18.141	11.714	1.5236	1.0769
4	7	538.6	543.02	76.374	57.602	53.175	41.7	24.043	16.924	0.8967	0.2221
	8	481.68	500.5	104.27	71.917	63.94	48.361	27.693	20.534	0.6452	1.1396
5	9	136.57	122	310.35	277.55	231.69	162.91	71.367	66.16	4.2386	13.673
	10	149.23	137.48	294.37	270.94	227.74	159.47	72.466	65.792	4.3185	15.475
6	11	132.46	124.05	232.23	282.11	274.91	192.08	70.924	66.471	3.8302	15.06
	12	141.31	134.03	236.5	283.04	270.03	189.59	74.25	69.505	4.4014	13.424
7	13	612.85	538.36	235.31	239.99	289.7	340.25	130.43	109.85	7.4781	23.951
	14	599.48	538.84	217.99	235.2	278.4	334.17	156.98	126.6	9.5176	26.175
8	15	142.57	135.91	339.66	297.33	273.09	228.21	435.38	545.41	29.24	98.371
	16	151.34	148.4	341.84	298.29	281.73	234.85	420.81	531.26	28.884	90.595

Table 39 BR4801 Maximum Strains of all Strain Gauges for all Test Cases

TEST	Run	C1L1	C1L2	C2L1	C2L2	C3L1	C3L2	C4L1	C4L2	C5L1	C5L2
1	1	90.568	39.615	299.11	294.46	271.56	218.24	254.32	305.88	289.73	205.82
	2	91.145	40.351	300.3	293.51	272.8	223.44	256.29	297.97	280.48	209.21
2	3	51.749	26.42	181.97	221.11	375.55	248.57	243.14	198.7	384.08	443.98
	4	57.607	28.953	200.98	267.36	334.48	222.67	226.87	193.72	438.77	393.68
3	5	29.429	16.68	134.86	135.39	255.6	272.49	269.38	205.32	279.36	361.4
	6	37.96	20.607	153.53	156.51	298.4	279.36	254.68	209.91	323.96	445.85
4	7	13.917	8.0912	81.691	78.648	136.61	160.14	259.46	234.6	139.71	165.68
5	9	3.2852	1.9478	38.688	36.82	66.664	74.055	109.69	121.68	376.54	370.13
6	11	1.5961	0.697	34.502	33.179	61.424	67.971	100.78	106.37	346.87	407.28
	12	0.54	-0.195	30.973	30.546	56.483	63.339	94.283	101.53	340.61	411.25
7	13	1.3126	0.1347	5.8448	8.3963	13.793	16.899	24.895	27.303	28.218	40.754
8	15	0.1202	0.045	0.0484	1.6921	3.8615	6.0953	9.9713	11.593	16.689	17.443
TEST	Run	C6L1	C6L2	C7L1	C7L2	C8L1	C8L2	C9L1	C9L2	C10L1	C10L2
1	1	9.575	37.751	16.132	3.312	-3.556	1.9831	0.2869	0.1489	0.241	0.1881
	2	9.6238	36.901	15.605	1.0646	-4.726	1.4861	78.689	58.185	13.248	12.032
2	3	12.66	27.37	23.263	-1.946	-1.925	4.0296	-0.112	-0.065	0.1095	0.4384
	4	12.533	62.067	22.823	40.8	39.644	4.2683	0.5202	0.4295	0.3594	0.5513
3	5	335.97	243.36	45.056	38.26	13.096	16.519	3.1709	0.9396	0.3476	0.3805
	6	211.51	126.44	34.945	-0.87	-11.37	8.8541	-0.014	0.1308	0.3122	0.3161
4	7	458.61	462.56	134.14	75.298	-6.747	34.896	11.237	6.5013	0.4427	0.1713
5	9	133.83	110.37	360.75	446.6	85.615	122.35	30.826	24.829	1.6243	1.4833
6	11	21.349	116.82	268.55	363.37	225.33	183.63	40.906	29.832	6.0469	4.2567
	12	20.883	112.76	256.51	338.5	252.09	203.69	42.155	30.968	6.8343	3.8643
7	13	596.31	510.75	107.32	82.304	379.26	518.68	123.33	90.644	22.48	20.608
8	15	127.16	123.34	391.98	438.55	142.99	164.25	390.86	483.82	147.64	113.94

Table 40 BR4545 Maximum Strains of all Strain Gauges for all Test Cases

Test	Run	C1L1	C1L2	C2L1	C2L2	C3L1	C3L2	C4L1	C4L2	C5L1	C5L2
1	1	771	1038	1483	1232	906	959	942	318	362	425
	2	764	1023	1544	1276	914	976	948	198	359	421
	3	692	895	1579	1327	906	972	945	293	368	430
2	4	335	334	1418	1585	979	912	919	932	719	725
	5	343	351	1465	1645	982	922	930	911	674	706
	6	309	316	1393	1648	1002	914	911	861	770	798
3	7	163	166	583	561	467	1256	976	274	1479	1879
	8	165	166	599	599	434	1252	976	273	1424	1891
	9	153	156	577	548	417	1286	987	272	802	1925
Test	**Run**	**C6L1**	**C6L2**	**C7L1**	**C7L2**	**C8L1**	**C8L2**	**C9L1**	**C9L2**	**C10L1**	**C10L2**
1	1	24	28	24	13	7	5	0	0	0	0
	2	65	76	67	86	52	48	9	10	3	4
	3	25	33	32	26	15	7	6	0	3	0
2	4	77	60	44	42	23	20	6	2	1	0
	5	58	60	46	44	25	20	6	1	1	3
	6	58	61	45	43	23	18	3	0	0	0
3	7	72	116	75	79	47	49	9	6	3	2
	8	75	115	73	77	42	42	3	0	0	0
	9	76	119	74	75	46	43	5	0	0	0

Table 41 BR4803 Maximum Strains of all Strain Gauges for all Test Cases (Channel 1 to Channel 5)

Run	C1L1	C1L2	C2L1	C2L2	C3L1	C3L2	C4L1	C4L2	C5L1	C5L2
1	0	4	5	8	6	9	34	45	44	48
2	30	0	2	3	3	1	26	37	46	51
3	14	0	0	0	0	0	24	36	45	48
4	1	0	0	2	0	1	24	29	40	40
5	2	5	4	5	7	9	33	47	75	78
6	0	0	0	0	3	6	32	41	73	75
7	5	2	6	9	30	32	78	89	358	466
8	9	3	9	14	40	44	79	92	325	431
9	4	1	4	7	34	34	85	94	348	460
10	15	7	24	30	11	12	85	96	370	466
11	4	1	7	12	44	43	87	98	865	1100
12	1	0	10	18	30	28	92	104	345	415
13	17	8	31	40	48	49	140	176	2216	2141
14	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
15	6	0	25	33	55	54	141	188	2227	2289
16	13	4	36	42	49	48	267	359	2048	1749
17	14	5	29	38	65	63	377	530	1873	1657
18	9	0	25	32	60	58	521	759	1347	1253
19	22	7	53	58	100	103	1731	1998	647	707
20	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
21	20	4	67	69	129	142	1644	2045	642	695
22	25	7	79	80	372	462	1092	985	500	630
23	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
24	22	4	78	80	389	497	1130	942	482	626
25	104	55	285	391	857	865	150	190	1822	2538
26	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
27	106	59	304	444	863	848	150	191	2015	2543
28	163	112	507	728	779	668	174	238	2489	2347
29	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
30	140	84	439	604	812	715	157	213	2277	2308
31	512	358	980	1403	170	156	1758	2525	412	338
32	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
33	523	371	943	1664	210	199	1697	2676	443	359

Table 42 BR4803 Maximum Strains of all Strain Gauges for all Test Cases (Channel 6 to Channel 10)

Run	C6L1	C6L2	C7L1	C7L2	C8L1	C8L2	C9L1	C9L2	C10L1	C10L2
1	311	358	1751	1704	636	324	1322	1770	147	193
2	337	401	1758	877	673	341	1320	1894	167	216
3	335	392	1751	792	657	333	1326	2056	166	216
4	458	510	1774	1615	690	347	1645	1816	148	188
5	413	451	1763	1805	661	326	1474	1823	165	212
6	449	487	1756	1633	646	293	1497	1820	165	205
7	1468	1692	323	403	3786	841	152	127	66	84
8	1484	1742	295	362	3822	1964	278	229	56	70
9	1521	1611	299	361	3864	1968	274	236	54	70
10	1457	1555	300	373	4035	2075	242	213	49	60
11	841	710	473	502	3776	1952	163	138	36	44
12	1432	1564	327	397	4080	2005	270	229	46	57
13	749	716	2157	2314	378	209	110	93	9	14
14	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
15	795	782	1153	2572	400	230	112	103	14	16
16	615	647	1077	2193	227	110	107	86	9	15
17	580	633	1096	2205	280	153	111	100	13	16
18	511	574	1070	2120	250	139	100	86	10	14
19	1614	2189	158	232	59	43	17	14	11	16
20	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
21	1483	2126	222	297	74	54	50	43	9	11
22	1560	1753	177	217	71	55	42	36	8	10
23	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
24	1556	1756	191	228	67	50	37	30	5	9
25	588	443	82	83	47	34	20	15	3	3
26	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
27	601	473	72	76	45	34	19	14	3	2
28	568	444	61	68	40	28	22	14	0	0
29	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
30	573	462	74	77	33	25	19	12	0	0
31	59	58	41	39	7	7	15	12	2	2
32	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
33	83	80	41	38	9	7	7	6	2	0

Appendix B: Alternative Truck Load Paths

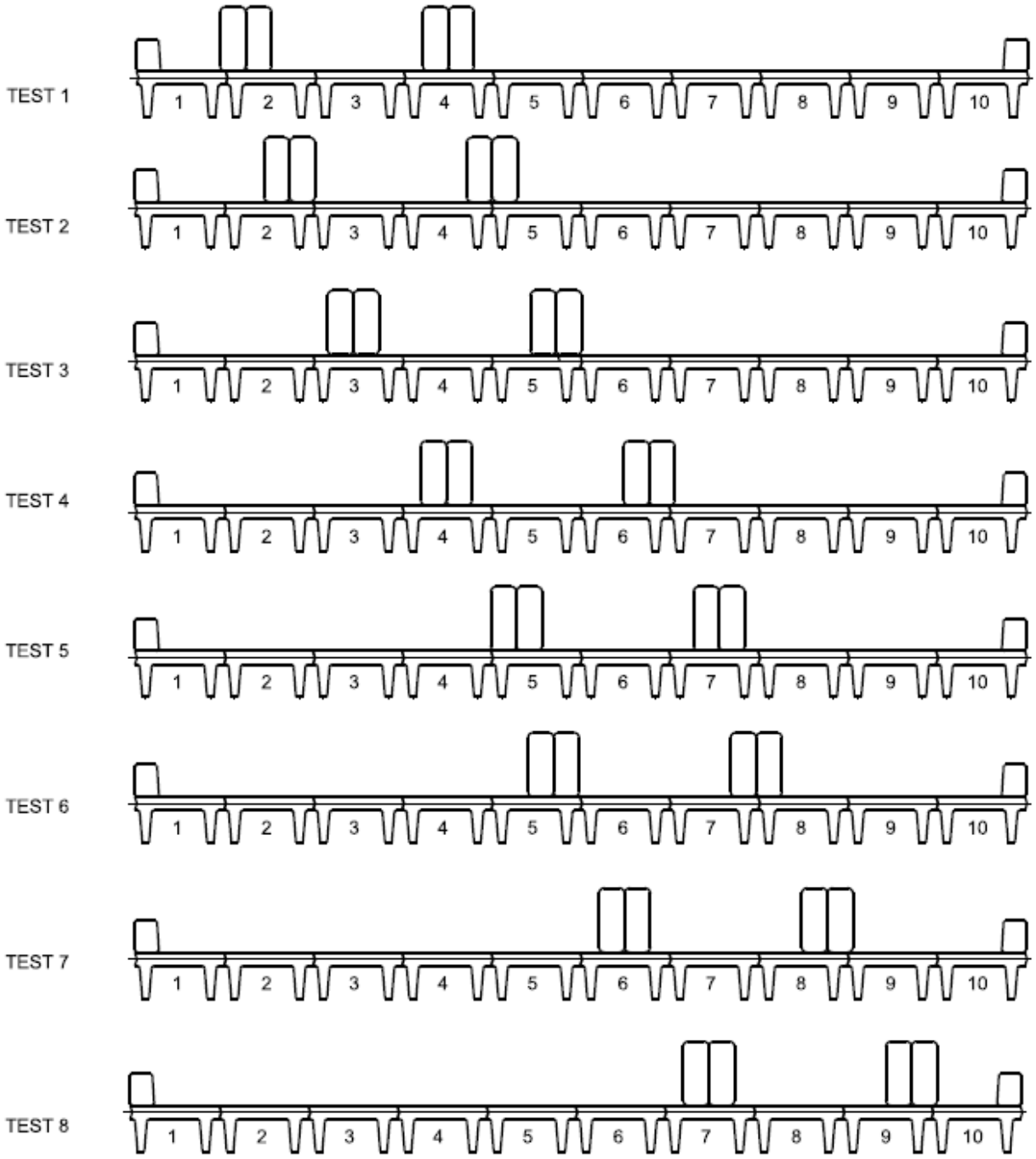


Figure 68: Load Test Wheel Path Scenario-2

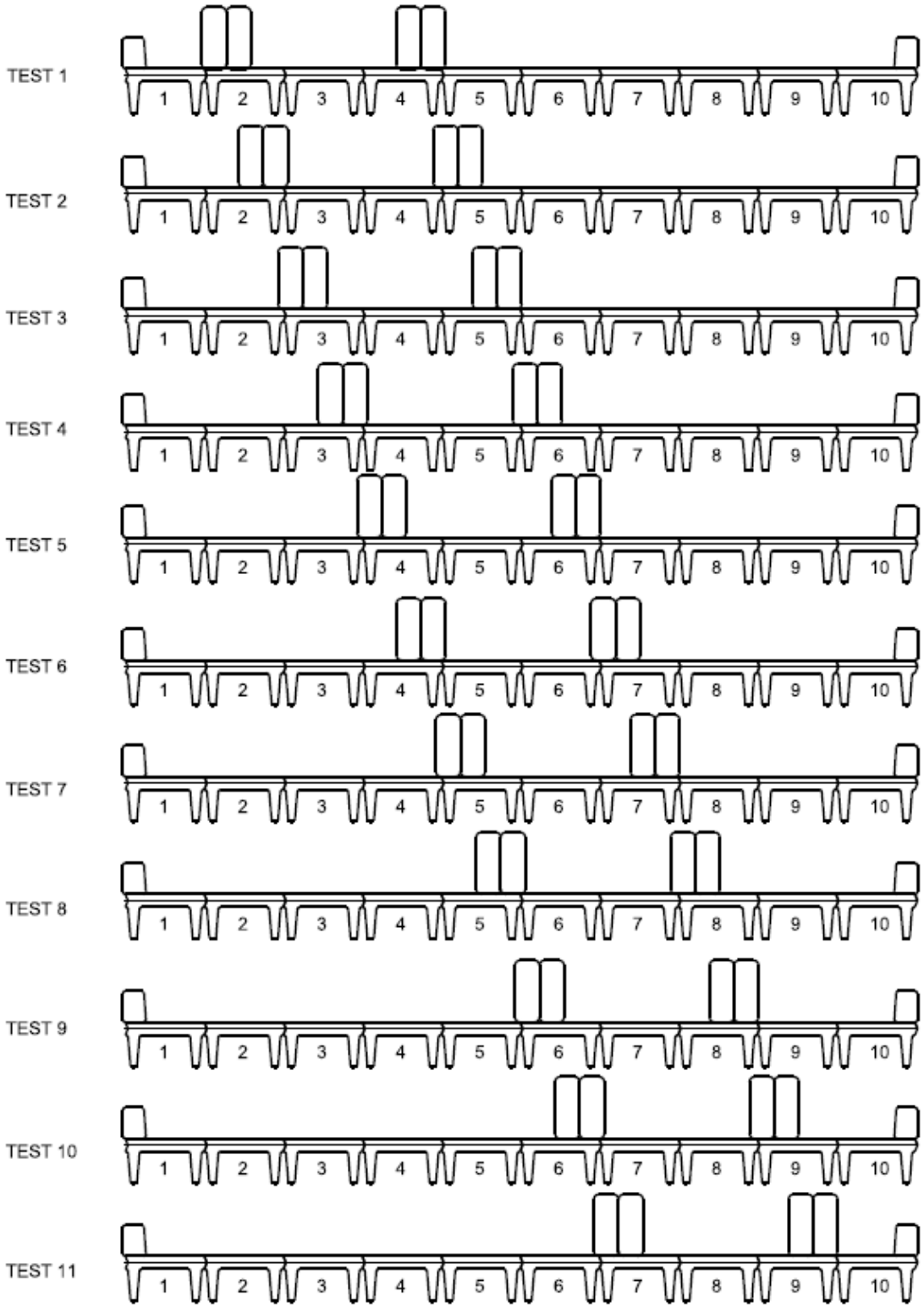


Figure 69: Load Test Wheel Path Scenario-3

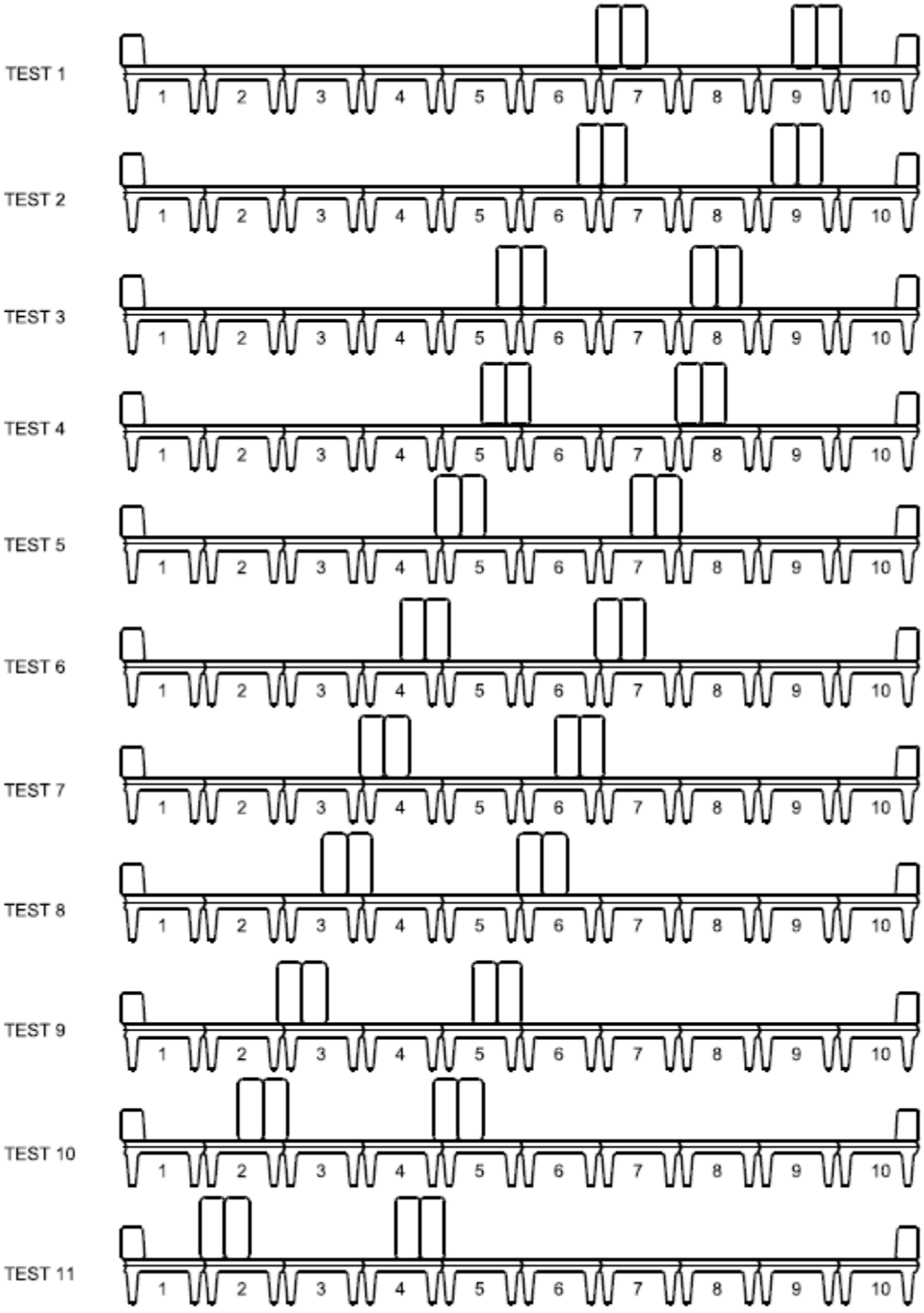


Figure 70: Load Test Wheel Path Schenario-4

Appendix C: AASHTO Distribution Factor Calculations And Postings

AASHTO LRFD 8th Live Load Moment Distribution Factor: H10 Channel Bridge

```
---------------------------------------------------------------
Live Load Distribution Factor for Moment in Interior Beams
(Article 4.6.2.2.2b Interior Beams with Concrete Decks)
---------------------------------------------------------------
Cross section type: Type I connected only enough to prevent displacement from Table 4.6.2.2.1-1


Check Range of Applicability
----------------------------
Cross section type: Type I connected only enough to prevent displacement from Table 4.6.2.2.1-1

Input:
Theta  =    0.00(Deg)            Theta <= 45.0:  PASSED
NL     =    2                        NL <= 6.0:  PASSED


Compute Moment Distribution Factors
-----------------------------------
Input:
Poisson's ratio =         0.20
I               =      4872.63(in^4)
J               =      3138.90(in^4)
W               =        25.50(ft)
L               =        29.29(ft)
NL              =         2
S               =         2.54(ft)

K = SQRT( (1 + Poisson)*I/J ) =  1.365

C = K(W/L) <= K =  1.188

D = 11.5 - NL + 1.4NL(1 - 0.2C)^2 = 11.127

One Design Lane Loaded:
DF = S/D =    0.228 Lanes

Two or More Design Lanes Loaded:
DF = S/D =    0.228 Lanes
```

```
====================================
    Moment Distribution Factors
====================================


---------------------------------------
            Region 1
---------------------------------------
Start Distance:         0.00(ft)
End Distance:          29.29(ft)
Moment Type:        Positive
Properties at:         14.65(ft)
Theta:                  0.00(Deg)


-------------------------------------------------------------------------------
Live Load Distribution Factor for Moment in Exterior Longitudinal Beams
(Article 4.6.2.2.2d Exterior Beams)
-------------------------------------------------------------------------------
Cross section type: Type I connected only enough to prevent displacement from Table 4.6.2.2.1-1


Compute Moment Distribution Factors
-----------------------------------

One Design Lane Loaded:
Lever Rule DF =     0.261 Lanes

Two or More Design Lanes Loaded:
Lever Rule DF =     0.217 Lanes
```

LRFR RATING FACTOR FOR LEGAL VEHICLES

Rating Vehicle:	LRFR Legal Rating Level (SEV III included)					
	H10			H15		
	DF=BrR (0.228)	DF=0.35	DF=0.5	DF=BrR (0.229)	DF=0.35	DF=0.5
Type 3-3	0.957	0.624	0.437	0.958	0.627	0.439
Modified AASHTO SC - Type 3	0.757	0.494	0.346	0.758	0.496	0.347
Modified AASHTO SC - Type 3S2	0.761	0.497	0.348	0.762	0.499	0.349
EV2	0.641	0.419	0.293	0.642	0.42	0.294
EV3	0.432	0.282	0.197	0.433	0.283	0.198
SU4	0.645	0.421	0.295	0.645	0.423	0.296
SU5	0.613	0.4	0.28	0.614	0.402	0.281
SU6	0.561	0.366	0.256	0.562	0.368	0.258
SU7	0.529	0.346	0.242	0.53	0.347	0.243
SC - SU2	0.925	0.604	0.423	0.926	0.606	0.425
SC Representative School Bus	1.032	0.674	0.472	1.033	0.677	0.474
SC SHV1A	0.504	0.329	0.23	0.505	0.331	0.231
SC SHV1B	0.485	0.317	0.222	0.486	0.318	0.223
SC SHV2A	0.511	0.334	0.234	0.512	0.335	0.235
SC SHV2B	0.451	0.294	0.206	0.451	0.295	0.207
SC SHV3A	0.678	0.443	0.31	0.679	0.445	0.311
SC SHV3B	0.643	0.42	0.294	0.644	0.422	0.295

Rating Vehicle:	LRFR Legal Rating Level (SEV III excluded)					
	H10			H15		
	DF=BrR (0.228)	DF=0.35	DF=0.5	DF=BrR (0.229)	DF=0.35	DF=0.5
Type 3-3	2.116	1.381	0.967	2.124	1.391	0.974
Modified AASHTO SC - Type 3	1.674	1.093	0.765	1.681	1.101	0.77
Modified AASHTO SC - Type 3S2	1.683	1.099	0.769	1.69	1.106	0.775
EV2	1.418	0.926	0.648	1.424	0.932	0.653
EV3	0.956	0.624	0.437	0.959	0.628	0.44
SU4	1.426	0.931	0.652	1.432	0.937	0.656
SU5	1.356	0.885	0.619	1.361	0.891	0.624
SU6	1.241	0.81	0.567	1.246	0.816	0.571
SU7	1.171	0.764	0.535	1.176	0.77	0.539
SC - SU2	2.046	1.335	0.935	2.054	1.345	0.942
SC Representative School Bus	2.283	1.49	1.043	2.292	1.501	1.05
SC SHV1A	1.115	0.728	0.51	1.12	0.733	0.513
SC SHV1B	1.073	0.7	0.49	1.077	0.705	0.494
SC SHV2A	1.131	0.738	0.517	1.135	0.743	0.52
SC SHV2B	0.997	0.65	0.455	1	0.655	0.459
SC SHV3A	1.5	0.979	0.686	1.506	0.986	0.69
SC SHV3B	1.422	0.928	0.65	1.428	0.935	0.655

Rating Vehicle:	LFR Operating Rating Level					
	H10			H15		
	DF=BrR (0.494)	DF=0.7	DF=1	DF=BrR (0.458)	DF=0.7	DF=1
Type 3-3	1.981	1.398	0.979	2.152	1.409	0.986
Modified AASHTO SC - Type 3	1.567	1.106	0.775	1.703	1.115	0.78
Modified AASHTO SC - Type 3S2	1.575	1.112	0.779	1.712	1.121	0.785
EV2	1.327	0.937	0.656	1.443	0.945	0.661
EV3	0.894	0.632	0.442	0.972	0.636	0.445
SU4	1.335	0.942	0.66	1.45	0.95	0.665
SU5	1.269	0.896	0.627	1.379	0.903	0.632
SU6	1.162	0.82	0.574	1.262	0.827	0.579
SU7	1.096	0.774	0.542	1.191	0.78	0.546
SC - SU2	1.915	1.352	0.947	2.081	1.363	0.954
SC Representive School Bus	2.136	1.509	1.056	2.322	1.52	1.064
SC SHV1A	1.044	0.737	0.516	1.134	0.743	0.52
SC SHV1B	1.004	0.709	0.496	1.091	0.714	0.5
SC SHV2A	1.058	0.747	0.523	1.15	0.753	0.527
SC SHV2B	0.933	0.659	0.461	1.014	0.664	0.465
SC SHV3A	1.404	0.991	0.694	1.526	0.999	0.699
SC SHV3B	1.331	0.94	0.658	1.447	0.947	0.663
SC Crane #527568	1.028	0.726	0.508	1.117	0.732	0.512
SC Crane #544726	1.018	0.719	0.503	1.106	0.724	0.507
SC - 100k Permit	1.172	0.828	0.579	1.274	0.834	0.584
SC - 120k Permit	1.011	0.714	0.5	1.098	0.719	0.503
SC - 130k Permit	0.97	0.685	0.479	1.054	0.69	0.483
H 20-44 Axle Load	1.461	1.032	0.722	1.588	1.04	0.728
HS 20-44 Axle Load	1.276	0.901	0.631	1.387	0.908	0.636
H 20-44 Lane	1.795	1.268	0.887	1.951	1.277	0.894
H 20-44 Lane	1.795	1.268	0.887	1.951	1.277	0.894
Alternate Military Loading	1.155	0.816	0.571	1.255	0.822	0.575

The following are the corresponding anticipated bridge load posting (LFR) based on the distribution factor guidance provided here. The individual K factors have not been applied to these load postings. The K factors obtained from our testing varied from 1.2 to 1.7 with an average of 1.41. A potential increase on average of 41% in the posting may be obtained thru this process.

H10 – AASHTO DF	H10- DF 0.35x2	H10- DF 0.50x2
Minor reflective Cracking	**Moderate reflective cracking**	**Major reflective Cracking**

Posting Signs
R-12-6-48

BRIDGE WEIGHT LIMIT - TONS		
SINGLE VEHICLE		
2 OR 3 AXLES	35 T	
4 OR MORE AXLES	37 T	
COMBINATIONS	45 T	

EMERGENCY VEHICLE WEIGHT LIMITS	
SINGLE AXLE	16 T
TANDEM	27 T
GROSS	38 T

Posting Signs
R-12-6-48

BRIDGE WEIGHT LIMIT - TONS		
SINGLE VEHICLE		
2 OR 3 AXLES	23 T	
4 OR MORE AXLES	24 T	
COMBINATIONS	42 T	

EMERGENCY VEHICLE WEIGHT LIMITS	
SINGLE AXLE	15 T
TANDEM	19 T
GROSS	26 T

Posting Signs
R-12-6-48

BRIDGE WEIGHT LIMIT - TONS		
SINGLE VEHICLE		
2 OR 3 AXLES	16 T	
4 OR MORE AXLES	17 T	
COMBINATIONS	28 T	

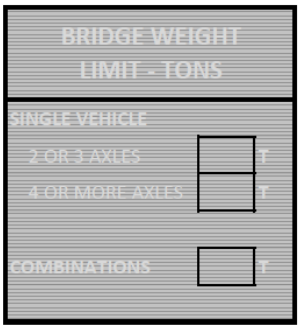
EMERGENCY VEHICLE WEIGHT LIMITS	
SINGLE AXLE	10 T
TANDEM	13 T
GROSS	18 T

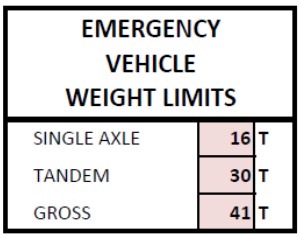
H15 – AASHTO DF

Minor reflective Cracking

Posting Signs

R-12-6-48



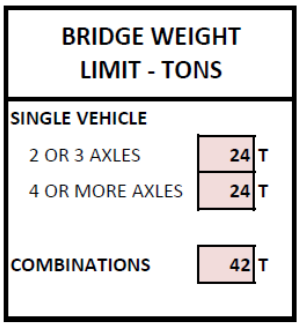


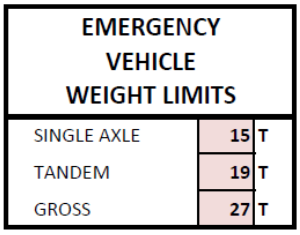
H15- DF 0.35x2

Moderate reflective cracking

Posting Signs

R-12-6-48



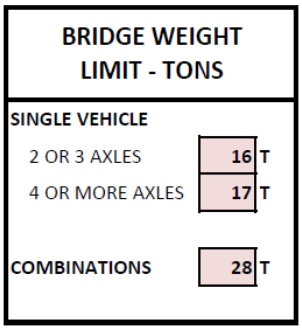


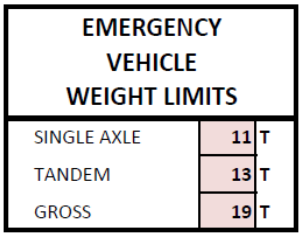
H15- DF 0.50x2

Major reflective Cracking

Posting Signs

R-12-6-48





Appendix D: Theoretical Maximum Strain Calculation at Mid-span

Theoretical Maximum Strain under Bucket Truck (Example: H10 Channel)

Theoretical Maximum Strain on One Girder (Skinny Leg Channel Bridge, H10)

girderlength := 30ft bearingoffset := 5.5in

$Span := girderlength - bearingoffset \cdot 2 = 29.083 \cdot ft$ CL-CL of bearing

Section Properties based on BrR (H10)

$I := 4872.634 in^4$

$y_b := 11.7912 in$

$S := \frac{I}{y_b} = 413.243 \cdot in^3$

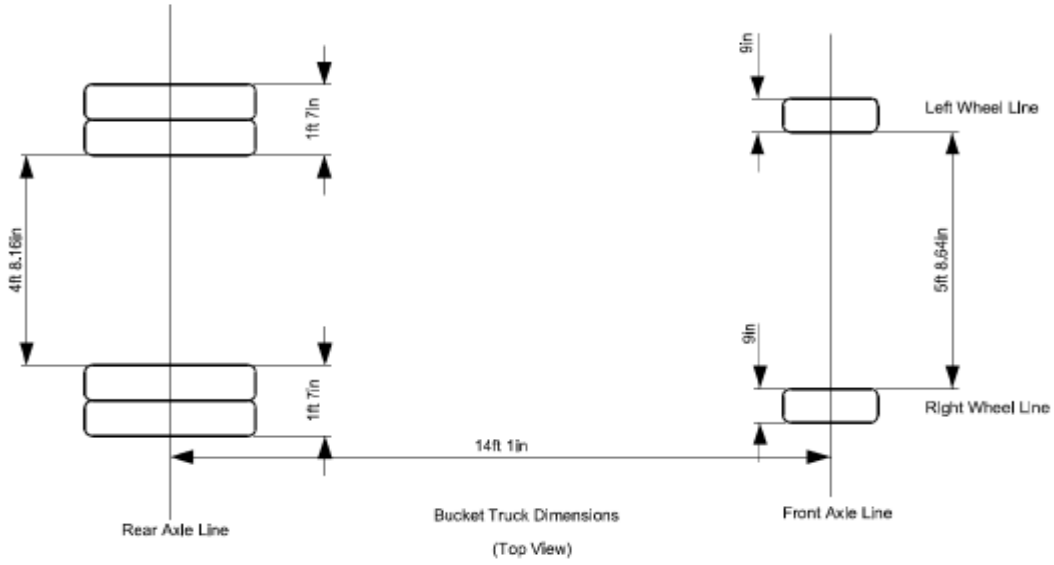
Material Properties

$f_c := 5 ksi$

$\gamma_c := 0.145 \ kcf$

$E_c := 120000 \cdot \gamma_c^2 \cdot \left(\frac{f_c}{ksi}\right)^{0.33} ksi = 4.291 \times 10^3 \cdot ksi$ *AASHTO LRFD 8th 5.4.2.4-1*

Wheel Loads (Bucket Truck Loaded)



	Measured Wheel Load (lbs.)	
	Front Axle	*Rear Axle*
Right Wheel Line	2580	5980
Left Wheel Line	3040	5960

1. Calculation based on Left Wheel Load:

Maximum Moment Calcualtion:

Left Side Wheel Load:

$P_{front.left} := 3.04kip \qquad P_{rear.left} := 5.96kip \qquad Axle_{spacing} := 14ft + 1in = 14.083 \cdot ft$

Case I: second axle was offset from mid-span

Rear axle offset from mid-span:

$$offset\_rear := \frac{1}{2}\frac{P_{front.left} \cdot Axle_{spacing}}{P_{front.left} + P_{rear.left}} = 2.379 \cdot ft$$

Front axel distance from mid-span:

$$offset\_front := Axle_{spacing} - offset\_rear = 11.705 \cdot ft$$

Mid-span moment due to rear axle:

$$M_{rear} := \frac{P_{rear.left} \cdot Span}{4} \cdot \frac{\left(\frac{Span}{2} - offset\_rear\right)}{\frac{Span}{2}} = 36.246 \cdot kip \cdot ft$$

Mid-span moment due to front axle:

$$M_{front} := \frac{P_{front.left} \cdot Span}{4} \cdot \frac{\left(\frac{Span}{2} - offset\_front\right)}{\frac{Span}{2}} = 4.312 \cdot kip \cdot ft$$

Maximum mid-span moment due to both axles:

$$M_{max.case1} := M_{rear} + M_{front} = 40.558 \cdot kip \cdot ft$$

Case II: second axle was in mid-span

Rear axle offset from mid-span:

$$offset\_rear := 0ft$$

Front axel distance from mid-span:

$$offset\_front := Axle_{spacing} - offset\_rear = 14.083 \cdot ft$$

Mid-span moment due to rear axle:

$$M_{rear} := \frac{P_{rear.left} \cdot Span}{4} = 43.334 \cdot kip \cdot ft$$

Mid-span moment due to front axle:

$$M_{front} := \frac{P_{front.left} \cdot Span}{4} \cdot \frac{\left(\frac{Span}{2} - offset\_front\right)}{\frac{Span}{2}} = 0.697 \cdot kip \cdot ft$$

Maximum mid-span moment due to both axles:

$$M_{max.case2} := M_{rear} + M_{front} = 44.031 \cdot kip \cdot ft$$

Maximum mid-span moment due to both axles:

$$M_{max} := \max\left(M_{max.case1}, M_{max.case2}\right) = 44.031 \cdot kip \cdot ft$$

Assume one wheel line is on a girder and no load sharing (no distribution)

$$M_{max.girder} := M_{max} = 44.031 \cdot kip \cdot ft$$

Maximum strain in the mid-span

$$\epsilon_{max} := \frac{M_{max.girder}}{S \cdot E_c} = 2.98 \times 10^{-4}$$

2. Calculation based on Right Wheel Load:

Maximum Moment Calcualtion:

Right Side Wheel Load:

$P_{front.right} := 2.58kip \quad P_{rear.right} := 5.98kip \quad Axle_{spacing} := 14ft + 1in = 14.083 \cdot ft$

Maximum Moment at Mid-Span:

Case I: second axle was offset from mid-span

Rear axle offset from mid-span:

$$offset\_rear := \frac{1}{2}\frac{P_{front.right} \cdot Axle_{spacing}}{P_{front.right} + P_{rear.right}} = 2.122 \cdot ft$$

Front axel distance from mid-span:

$$offset\_front := Axle_{spacing} - offset\_rear = 11.961 \cdot ft$$

Mid-span moment due to rear axle:

$$M_{rear} := \frac{P_{rear.right} \cdot Span}{4} \cdot \frac{\left(\frac{Span}{2} - offset\_rear\right)}{\frac{Span}{2}} = 37.134 \cdot kip \cdot ft$$

Mid-span moment due to front axle:

$$M_{front} := \frac{P_{front.right} \cdot Span}{4} \cdot \frac{\left(\frac{Span}{2} - offset\_front\right)}{\frac{Span}{2}} = 3.329 \cdot kip \cdot ft$$

Maximum mid-span moment due to both axles:

$$M_{max.case1} := M_{rear} + M_{front} = 40.463 \cdot kip \cdot ft$$

Case II: second axle was on the mid-span

Rear axle offset from mid-span:

$$offset\_rear := 0ft$$

Front axel distance from mid-span:

$$offset\_front := Axle_{spacing} - offset\_rear = 14.083 \cdot ft$$

Mid-span moment due to rear axle:

$$M_{rear} := \frac{P_{rear.right} \cdot Span}{4} = 43.48 \cdot kip \cdot ft$$

Mid-span moment due to front axle:

$$M_{front} := \frac{P_{front.right} \cdot Span}{4} \cdot \frac{\left(\frac{Span}{2} - offset\_front\right)}{\frac{Span}{2}} = 0.591 \cdot kip \cdot ft$$

Maximum mid-span moment due to both axles:

$$M_{max.case2} := M_{rear} + M_{front} = 44.071 \cdot kip \cdot ft$$

Maximum mid-span moment due to both axles:

$$M_{max} := \max\left(M_{max.case1}, M_{max.case2}\right) = 44.071 \cdot kip \cdot ft$$

Assume one wheel line is on a girder and no load sharing (no distribution)

$$M_{max.girder} := M_{max} = 44.071 \cdot kip \cdot ft$$

Maximum strain in the mid-span

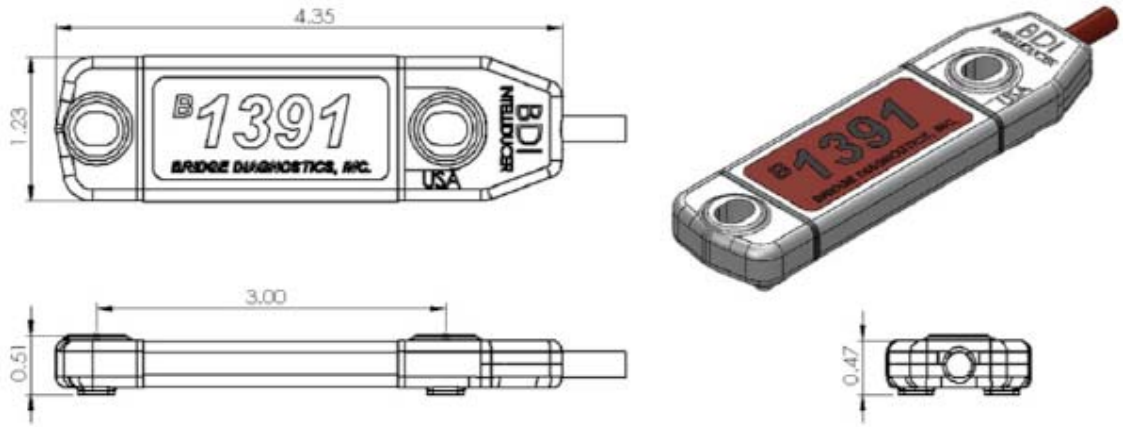
$$\varepsilon_{max} := \frac{M_{max.girder}}{S \cdot E_c} = 2.98229 \times 10^{-4}$$

Actual maximum strain in the mid-span corresponding to the measured strain
(Ex:BR04548)

$$DF_{test} := 0.25$$

$$\varepsilon_T := \frac{DF_{test}}{0.5} \cdot 298.229 = 149.114$$

Appendix E: General Specifications of ST350 Strain Transducers (BDI)



Model	ST350
Range (Resistance)	350 Ω
Excitation Voltage	+1.0 to +10.0 Vdc (output is ratiometric)
Power Rating **Max:** **Typical:** **Intelliducer:**	 300 mW 72 mW @ +5.0 Vdc 13 mW @ +5.0 Vdc*
Circuit	Full Wheatstone bridge with four active 350Ω foil gages
Strain Range	±4000με (Calibrated to ±2000με)
Force required for 1000με	~17lbs. (~76N)
Typical Sensitivity	~500 με/mV/V (individually calibrated to N.I.S.T. standards)

Accuracy	< ±1%
Effective Gage Length	3.0 in (76.2 mm) [Extensions available for use with R/C structures]
Cable Length	IC-02-187 (0.187 in diameter, 22awg, 2 pair, shielded with drain wire, red PVC jacket) or IC-02-250 (0.250 in diameter, 22awg, 2 pair, shielded with drain wire, blue PVC jacket)
Housing	6061-Aluminum
Weather Proofing	IP67 Rated (waterproof to 70 meters available)
Operating Temperature	-58°F to +185°F (-50°C to +85°C)
Weight	3 oz. (85 grams)
Mounting	BDI mounting Tab and adhesive, mechanical connection

Appendix F: Bucket Truck Details used in Diagnostic Load Tests

EVERYTHING YOU NEED TO GET THE JOB DONE

1-800-252-0043

Equipment Rentals, Parts and Service

www.nescorentals.com

NESCO RENTALS

A0119728 - 45' 2014 VERSALIFT SST-40; 2014 RAM RAM 5500 4X4

Warehouse: O11 - OR - TEREX - PHOENIX AZ

CHASSIS SPECIFICATIONS

VIN:	3C7WRNBL4EG208926	
Engine Make / HP:	6.7L CUMMINS / 305	
Transmission:	AISIN 6-SPEED	
Brakes:	HYDRAULIC	
Hitch:	COMBO PINTLE/BALL	
Winch Location:	N/A	**Capacity:** N/A
Drive Type: ALL WHEEL DRIVE	**Fuel Type:** DIESEL	**Rail Gear:** N
Rail Gear Type:		

EQUIPMENT SPECIFICATIONS

Serial Number:	EH140070	
Working Height:	45'	
Bucket:	24X30X42 1-MAN	**Capacity:** 350 LBS
Certified Kv:	46KV CAT C	
Rotation:	CONTINUOUS	
Outrigger(s):	TORSION BAR	
Mount:	BEHIND CAB	
Tool Circuit:	HYD AT PLATFORM	
Controls:	SINGLE STICK	
Body:	UTILITY LINE	
Winch/Jib:	N/A	**Capacity:** N/A
Additional:	N/A	
Over Center: N	**Telescoping:** Y	**Upper Controls:** Y
Rotator: Y	**Material Handler:** N	**Insulated Boom:** Y

DIMENSIONS / MILES / HOURS / WEIGHTS

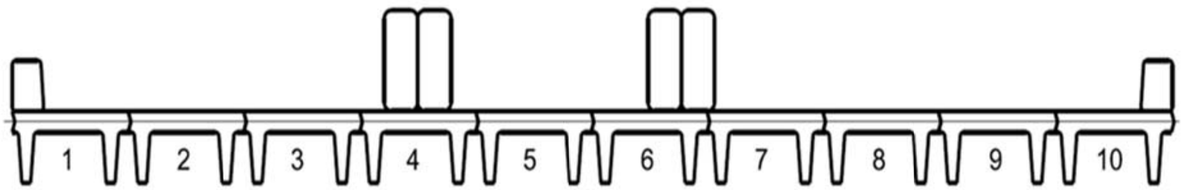
Height: 10'2	**Length:** 23'5	**Width:** 7'9
GVWR: 19,500	**Unladen:** 14,840LBS	**Tow Capacity:**
Axle Capacity:	7,000LBS front / 12,500LBS rear	
Wheelbase:	WB / CA	**Tire Size:** 225/70R19.5G
Tread Front/Rear:	100%	**Tread Updated:** 6/2014
PTO Hours:	973	
Engine Hours:	5,483	**Hours Updated:** 06/03/2019
Miles:	79,919	**Miles Updated:** 06/03/2019

Additional Specs:

45' 14 VERS SST40-EIH, 14 RAM 5500 4X4 A0119728 EQUIP DESC: EMERGENCY STOP CONTROL, FULL PRESSURE TURRET MOUNTED LOWER CONTROLS, OPEN CENTER HYDRAULIC SYSTEM, FIBERGLASS COMPENSATION, 12 INSULATION GAP, FIBERGLASS INNER BOOM, ELECTROGARD, 15-GAL HYD OIL RESERVOIR, BUCKET LINER AND COVER, HYD LEVELING W/UPPER CONTROL, NON-LUBE BEARINGS AT ALL PIVOT POINTS, MULTI-LINK HOSE CARRIER SYSTEM, BOOM CRADLE AND RATCHET STRAP, ENGINE START/STOP, TWO SPEED ENGINE THROTTLE CONTROL FOR HYD TOOL POWER, EMERGENCY 12V DC HYD SYSTEM, INVERTOR, LADDER RACK ADDED TRUCK DESC: HEAVY DUTY FRONT SUSPENSION GROUP, 4.44 LIMITED SLIP AXLE, AC, COLD WEATHER GROUP INCLUDING ENGINE BLOCK HEATER, RADIO: UCONNECT 3.0 AM/FM, HD VINYL 40/20/40 SLIT BENCH SEAT, PARKVIEW REAR BACKUP CAMERA, AMBULANCE PREP PKG W/220 AMP ALTERNATOR, TRANSFER CASE SKID PLATE SHIELD

Appendix G: Sample Distribution Factor Calculation from Load Test Data

BR 04398: Max Strain Runs (Test 4)



Channel No.	G1		G2		G3		G4		G5		G6		G7		G8		G9		G10		Σ Strains
Leg	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	
Sensor Label	B3189	B3188	B3310	B4491	B4501	B4499	B4494	B3456	B3313	B4493	B4486	B4488	B3460	B3458	B3184	B3461	B4490	B3187	B3193	B3190	(10^{-6})
Run 7	16.12	15.79	68.16	65.58	123.29	166.84	227.55	210.76	190.66	151.54	373.25	495.79	87.02	82.55	56.84	62.09	25.05	29.82	2.25	3.11	2454.07
Run 7	15.83	15.51	67.34	64.76	122.43	166.07	228.26	211.62	189.73	150.71	380.10	505.20	85.19	81.28	56.01	61.31	24.25	29.04	1.97	2.80	2459.41
Run 8	19.71	18.00	73.62	71.92	128.37	174.33	238.91	215.80	193.87	154.19	395.10	516.50	90.45	85.90	60.79	65.93	26.90	31.18	4.36	5.58	2571.41
Run 8	18.43	16.79	70.41	68.54	123.80	168.28	230.10	208.42	185.80	147.62	387.08	497.94	83.12	80.39	57.06	62.26	24.78	28.92	3.69	4.76	2468.20
Avg.	**17.53**	**16.52**	**69.88**	**67.70**	**124.47**	**168.88**	**231.20**	**211.65**	**190.01**	**151.02**	**383.88**	**503.86**	**86.45**	**82.53**	**57.68**	**62.90**	**25.24**	**29.74**	**3.07**	**4.06**	**2488.27**

Distribution Factors for Right and Left Legs (Test 4)

Channel No.	G1		G2		G3		G4		G5		G6		G7		G8		G9		G10	
Run 7	0.01	0.01	0.03	0.03	0.05	0.07	0.09	0.09	0.08	0.06	0.15	0.20	0.04	0.03	0.02	0.03	0.01	0.01	0.00	0.00
Run 7	0.01	0.01	0.03	0.03	0.05	0.07	0.09	0.09	0.08	0.06	0.15	0.21	0.03	0.03	0.02	0.02	0.01	0.01	0.00	0.00
Run 8	0.01	0.01	0.03	0.03	0.05	0.07	0.09	0.08	0.08	0.06	0.15	0.20	0.04	0.03	0.02	0.03	0.01	0.01	0.00	0.00
Run 8	0.01	0.01	0.03	0.03	0.05	0.07	0.09	0.08	0.08	0.06	0.16	0.20	0.03	0.03	0.02	0.03	0.01	0.01	0.00	0.00
Avg.	**0.01**	**0.01**	**0.03**	**0.03**	**0.05**	**0.07**	**0.09**	**0.09**	**0.08**	**0.06**	**0.15**	**0.20**	**0.03**	**0.03**	**0.02**	**0.03**	**0.01**	**0.01**	**0.00**	**0.00**

Distribution Factors per Girder/Channel Test 4)

Channel No.	G1	G2	G3	G4	G5	G6	G7	G8	G9	G10
Run 7 & 8	0.01	0.06	0.12	0.18	0.14	0.36	0.07	0.05	0.02	0.00