

ITD BrR Testing Program



BrR 7.2

BrR 7.5.1

PRESENTERS:

MELISSA HENNESSY, ITD
RYAN SHERMAN, FORSGREN
AUSTIN BERRY, FORSGREN

ITD BrR Testing Program

Why Test Upgrades?

- ❖ Agencies conduct different levels of testing for New Releases
- ❖ Objective – To identify how new versions impact ratings
 - ❖ Need to explain Decrease/Increase in Route Capacity
- ❖ Pinpoint the reasons behind rating changes
 - + Change in AASHTO Codes
 - + Bug Fixed from Previous Versions
 - New Bug/Issue



FORSGREN
Associates Inc.



ITD BrR Testing Program

Idaho's History of Testing

- ❖ ITD Used Internal Resources – 2012 to 2016
 - + Compared Results of All Bridges in Database
 - + In-depth Review of a Representative Sample
- ❖ Started Hiring Consultants in 2017
 - + Compared Controlling Ratings for All Bridges
 - + Compared Results of Multiple Vehicles
 - + Developed Procedures for Testing, Upgrading, and Documenting Results



ITD BrR Testing Program

Why Still Using BrR 7.2?

- ❖ ITD Consultant Tested BrR 7.3
 - + AASHTO Timber Engine was new and had some bugs
 - + Would have been only state using BrR 7.3 for Automated Permitting
- ❖ Lack of resources to do full testing on BrR 7.4
- ❖ Avoid potential future issues
- ❖ Can be large effort to upgrade – were understaffed



ITD BrR Testing Program

**SORRY, NOT
SORRY GUYS!**



THANK YOU

**FOR GIVING MY
PRESENTATION
FOR ME!!**

ITD BrR Testing Program

Testing Procedure

- ❖ Phase 1 – Manual Bridge Explorer Analysis
- ❖ Phase 2 – Rating Difference Investigation
- ❖ Phase 3 – ArcTool Verification

AASHTOWare Bridge Design and Rating

BRIDGE EXPLORER BRIDGE FOLDER RATE TOOLS VIEW

Rate Update Ratings Rating Results Recent Rating Results Manage Analysis Events Open Route Precomputed Data Load Rating Tool

Rate BrM Results Results Results Routing Rating Tool

Checked Out	Checked Out By	BID	Bridge ID
		2818	10010
		2777	10015
		2722	10020
		859	10030
		6286	10035
		5783	10040
		1335	10055
		1743	10060
		6014	10061
		1336	10065
		1794	10070
		6527	10081
		6645	10086
		918	10090
		2899	10093
		1337	10095
		1338	10100
		5746	10111
		1339	10115
		3986	10121
		3587	10126
		1340	10131
		5769	10136
		1721	10141
		1413	10145
		1050	10150
		1341	10156
		4193	10161
		4004	10166
		1399	10170
		3415	10176

Rating vehicles

- LRFR
 - Design load rating
 - Inventory
 - Idaho(1) - Type 3
 - Idaho(2) - Type 3S2
 - Idaho(3) - Type 3-3
 - Operating
 - Idaho(1) - Type 3
 - Idaho(2) - Type 3S2
 - Idaho(3) - Type 3-3
 - Fatigue
 - Legal load rating
 - Routine
 - ITD Lane-Type Legal Load
 - Type EV2
 - Type EV3
 - Specialized hauling
 - NRL - Legal
 - Permit load rating
 - 240k Test Truck (Copy for Member Alt)
 - Adjacent vehicle
- LFD/ASD
 - Inventory
 - 240k Test Truck (Do not delete)
 - Idaho(1) - Type 3
 - Idaho(2) - Type 3S2
 - Idaho(3) - Type 3-3
 - Operating
 - 240k Test Truck (Do not delete)
 - Idaho(1) - Type 3
 - Idaho(2) - Type 3S2
 - Idaho(3) - Type 3-3
 - Legal operating
 - Permit inventory
 - Permit operating

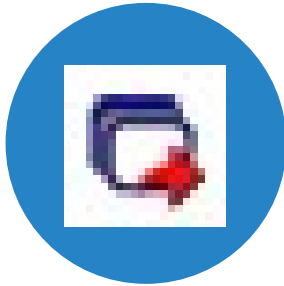
ARC
Tool Analysis Results Comparison Tool

Dataset Explorer

ID	Dataset name	
> 1	7.2 Member Alternative - Group 1	7.2.
2	7.5 Member Alternative - Group 1	7.5.
3	7.2 Member Alternative - Group 2	7.2.
4	7.5 Member Alternative - Group 2	7.5.
5	7.2 Member Alternative - Group 3	7.2.
6	7.5 Member Alternative - Group 3	7.5.

ITD BrR Testing Program

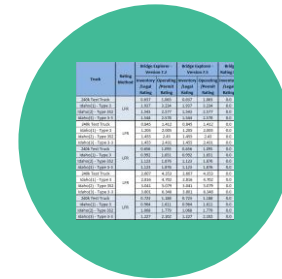
Phase 1 – Manual Bridge Explorer Process



EXPORT XML
FILES



ANALYZE **3,253**
BRIDGES IN 7.2 & 7.5.1



Bridge Number	Bridge Name	Bridge Type	Bridge Length	Bridge Rating	Bridge Status
1001	1001	1001	1001	1001	1001
1002	1002	1002	1002	1002	1002
1003	1003	1003	1003	1003	1003
1004	1004	1004	1004	1004	1004
1005	1005	1005	1005	1005	1005
1006	1006	1006	1006	1006	1006
1007	1007	1007	1007	1007	1007
1008	1008	1008	1008	1008	1008
1009	1009	1009	1009	1009	1009
1010	1010	1010	1010	1010	1010

COLLECT
RATINGS



DOCUMENT
ERRORS

ITD BrR Testing Program

Phase 2 – Rating Difference Investigation



COMPARE COLLECTED
RATINGS



RATINGS WITHIN 5%
TOLERANCE = MATCH



INVESTIGATE LARGER
DIFFERENCES



DOCUMENT
FINDING

ITD BrR Testing Program

Phase 3 – ArcTool Verification



REMOVE NON-
APPLICABLE BRIDGES



CREATE DATASET &
RUN ANALYSIS



COMPARE TO BRIDGE
EXPLORER RESULTS



DOCUMENT
FINDING

ITD BrR Testing Program

Procedure With ArcTool

- ❖ Create Result File in ArcTool for Both Versions
- ❖ Make sure same template is selected

The screenshot shows the ArcTool interface. The 'Dataset Explorer' window displays a table of datasets. The 'Create Dataset' dialog box is open, showing the 'Analysis setting' dropdown menu set to '_TEST_MemberAlt'. A blue arrow points to this dropdown. Another blue arrow points to the 'Browse' button in the 'Bridge model xml folder' field. A third blue arrow points to the 'ArcTool_XML' folder in the 'Select Folder' dialog box, which is open over the 'BrDR_Testing' folder.

ID	Dataset name	BrDR version	Benchmark	Description
1	7.2 Member Alternative - Group 1	7.2.0.3001	<input type="checkbox"/>	Group 1 Bridg
2	7.5 Member Alternative - Group 1	7.5.0.3001	<input type="checkbox"/>	
3	7.2 Member Alternative - Group 2	7.2.0.3001	<input type="checkbox"/>	Group 2 Bridg
4	7.5 Men			
5	7.2 Men			
6	7.5 Men			
7	7.2 LRFF			
8	7.2 LFR			
9	7.5 LFR			
10	7.2 Men			
11	7.5 Men			
12	7.2 LRFF			
13	7.5 LRFF			
14	7.2 LFR - test Levels	7.2.0.3001	<input type="checkbox"/>	

ITD BrR Testing Program

Procedure With ArcTool

- ❖ Select Datasets to Compare
- ❖ Verify Analysis Settings are the same
- ❖ Set Desired Tolerance

The screenshot shows the ArcTool interface. On the left is the 'Dataset Explorer' window with a table of datasets. A blue box highlights the first two rows, and a blue arrow points from this box to the 'Dataset Comparison Setting' dialog on the right. The dialog has two columns for 'Dataset 1' and 'Dataset 2'. The 'Analysis settings' field in both columns is highlighted with a blue box and contains the text '_TEST_MemberAlt'. At the bottom of the dialog, a blue box highlights the tolerance settings: Capacity tolerance (%): 5.0, DL tolerance (%): 5.0, LL tolerance (%): 5.0, and RF or DR tolerance (%): 5.0. The 'Run level 1 compare' button is visible at the bottom right of the dialog.

ID	Dataset name	BrDR version	Benchmark	
1	7.2 Member Alternative - Group 1	7.2.0.3001	<input type="checkbox"/>	Group 1 Bridges
2	7.5 Member Alternative - Group 1	7.5.0.3001	<input type="checkbox"/>	
3	7.2 Member Alternative - Group 2	7.2.0.3001	<input type="checkbox"/>	Group 2 Bridges
4	7.5 Member Alternative - Group 2	7.5.0.3001	<input type="checkbox"/>	Group 2 Bridges
5	7.2 Member Alternative - Group 3	7.2.0.3001	<input type="checkbox"/>	Group 3 Bridges
6	7.5 Member Alternative - Group 3	7.5.0.3001	<input type="checkbox"/>	Group 3 Bridges
7	7.2 LRFR - Test Level 1	7.2.0.3001	<input type="checkbox"/>	
8	7.2 LRFR - Test Level 1	7.2.0.3001	<input type="checkbox"/>	
9	7.5 LRFR - Test Level 1	7.5.0.3001	<input type="checkbox"/>	
10	7.2 Member Alternative - Test Level 3	7.2.0.3001	<input type="checkbox"/>	Bridges that had
11	7.5 Member Alternative - Test Level 3	7.5.0.3001	<input type="checkbox"/>	
12	7.2 LRFR - Test Level 3	7.2.0.3001	<input type="checkbox"/>	
13	7.5 LRFR - Test Level 3	7.5.0.3001	<input type="checkbox"/>	
14	7.2 LRFR - Test Level 3	7.2.0.3001	<input type="checkbox"/>	

ITD BrR Testing Program

Procedure With ArcTool

- ❖ Level 1
 - ❖ Overall Bridge Controlling Load Rating

Level 1 Comparison

RF or DR Tolerance(%): 5.0

View comparison setting Export to CSV

ID	Bridge ID	Vehicle	Rating or design	Dataset 1 RF or DR	Dataset 2 RF or DR	Percent change (%)	Location same?	Limit state same?	Dataset 1 Run Tim...	Dataset 2 Run Tim...
1	10035	240k Test Truck (D...	Inventory	0.599	0.599	0.000	Yes	Yes	61.7	66.0
2	10035	240k Test Truck (D...	Operating	1.000	1.000	0.000	Yes	Yes	61.7	66.0
3	10035	Idaho(1) - Type 3	Inventory	1.091	1.091	0.000	Yes	Yes	61.7	66.0
4	10035	Idaho(1) - Type 3	Operating	1.822	1.822	0.000	Yes	Yes	61.7	66.0
5	10035	Idaho(2) - Type 3S2	Inventory	1.160	1.160	0.000	Yes	Yes	61.7	66.0
6	10035	Idaho(2) - Type 3S2	Operating	1.937	1.937	0.000	Yes	Yes	61.7	66.0
7	10035	Idaho(3) - Type 3-3	Inventory	1.110	1.110	0.000	Yes	Yes	61.7	66.0
8	10035	Idaho(3) - Type 3-3	Operating	1.854	1.854	0.000	Yes	Yes	61.7	66.0
9	10560	240k Test Truck (D...	Inventory	0.167	0.167	0.000	Yes	Yes	44.4	41.4
10	10560	240k Test Truck (D...	Operating	0.279	0.279	0.000	Yes	Yes	44.4	41.4
11	10560	Idaho(1) - Type 3	Inventory	0.380	0.380	0.000	Yes	Yes	44.4	41.4
12	10560	Idaho(1) - Type 3	Operating	0.634	0.634	0.000	Yes	Yes	44.4	41.4
13	10560	Idaho(2) - Type 3S2	Inventory	0.308	0.308	0.000	Yes	Yes	44.4	41.4
14	10560	Idaho(2) - Type 3S2	Operating	0.514	0.514	0.000	Yes	Yes	44.4	41.4
15	10560	Idaho(3) - Type 3-3	Inventory	0.305	0.305	0.000	Yes	Yes	44.4	41.4
16	10560	Idaho(3) - Type 3-3	Operating	0.510	0.510	0.000	Yes	Yes	44.4	41.4

Comparison summary:

Acceptable row data = 3833 of 3867 (99%)
Unacceptable row data = 22 of 3867 (1%)
Comparison failures = 12 of 3867 (0%)

Show all within tolerance Show all outside tolerance Show comparison failure Show all

Run level 2 compare Close



ITD BrR Testing Program

Procedure With ArcTool

❖ Level 2

❖ Bridge Member Controlling Load Rating

Level 2 Comparison

RF or DR Tolerance(%): 5.0

View comparison setting Export to CSV

ID	Bridge ID	Super structure def...	Member	Vehicle	Rating or design	Dataset 1 RF or DR	Dataset 2 RF or DR	Percent change (%)	Location same?	Limit state same?
248 / 196 / 0		Negative Moment...	Negative Moment...	Idaho(3) - Type 3-3	Inventory	5.281	5.281	0.000	Yes	Yes
2488	19670	Negative Moment...	Negative Moment...	Idaho(3) - Type 3-3	Operating	5.479	5.479	0.000	Yes	Yes
2489	19670	Positive Moment R...	Positive Moment R...	240k Test Truck (D...	Inventory	1.768	1.768	0.000	Yes	Yes
2490	19670	Positive Moment R...	Positive Moment R...	240k Test Truck (D...	Operating	2.952	2.952	0.000	Yes	Yes
2491	19670	Positive Moment R...	Positive Moment R...	Idaho(1) - Type 3	Inventory	2.334	2.334	0.000	Yes	Yes
2492	19670	Positive Moment R...	Positive Moment R...	Idaho(1) - Type 3	Operating	3.897	3.897	0.000	Yes	Yes
2493	19670	Positive Moment R...	Positive Moment R...	Idaho(2) - Type 3S2	Inventory	2.554	2.554	0.000	Yes	Yes
2494	19670	Positive Moment R...	Positive Moment R...	Idaho(2) - Type 3S2	Operating	4.264	4.264	0.000	Yes	Yes
2495	19670	Positive Moment R...	Positive Moment R...	Idaho(3) - Type 3-3	Inventory	3.192	3.192	0.000	Yes	Yes
2496	19670	Positive Moment R...	Positive Moment R...	Idaho(3) - Type 3-3	Operating	5.330	5.330	0.000	Yes	Yes
2497	19696	1 Span RCF over P...	RCF	240k Test Truck (D...	Inventory	0.545	0.583	7.086	Yes	Yes
2498	19696	1 Span RCF over P...	RCF	240k Test Truck (D...	Operating	0.909	0.974	7.086	Yes	Yes
2499	19696	1 Span RCF over P...	RCF	Idaho(1) - Type 3	Inventory	0.711	0.761	7.086	Yes	Yes
2500	19696	1 Span RCF over P...	RCF	Idaho(1) - Type 3	Operating	1.188	1.272	7.086	Yes	Yes
2501	19696	1 Span RCF over P...	RCF	Idaho(2) - Type 3S2	Inventory	0.790	0.846	7.086	Yes	Yes
2502	19696	1 Span RCF over P...	RCF	Idaho(2) - Type 3S2	Operating	1.319	1.413	7.086	Yes	Yes
2503	19696	1 Span RCF over P...	RCF	Idaho(3) - Type 3-3	Inventory	0.987	1.057	7.086	Yes	Yes

Comparison summary:

Acceptable row data = 14746 of 14796 (100%)
Unacceptable row data = 18 of 14796 (0%)
Comparison failures = 32 of 14796 (0%)

Show all within tolerance Show all outside tolerance Show comparison failure Show all

Run level 3 compare Close

ITD BrR Testing Program

Procedure With ArcTool

- ❖ Level 3
 - ❖ Dead Load, Live Load, and Capacity Comparison
 - ❖ Used to help identify the cause of the difference

Level 3 Comparison

Capacity Tolerance(%): 5.0 DL Tolerance(%): 5.0 LL Tolerance(%): 5.0 RF or DR Tolerance(%): 5.0

Show data at:
 Bridge level Superstructure def. level Member level

ID	Bridge ID	Super structure def...	Member	Vehicle	Rating or design	Span - % of span/e...	Action - unit	Unfact. DL change...	Unfact. LL change (...)	Unfact. capacity ch...	RF or DR change (%)
169	30645	Continuous 2 Span...	Continuous 2 Span...	240k Test Truck (D...	Operating	1-0.0%	Shear	0.000	0.000	-0.036	-0.038
170	30645	Continuous 2 Span...	Continuous 2 Span...	240k Test Truck (D...	Operating	1-2.1%	Shear	0.000	0.000	-0.066	-0.086
171	30645	Continuous 2 Span...	Continuous 2 Span...	240k Test Truck (D...	Operating	1-4.5%	Shear	0.000	0.000	-0.067	-0.087
172	30645	Continuous 2 Span...	Continuous 2 Span...	240k Test Truck (D...	Operating	1-10.0%	Shear	0.000	0.000	-0.070	-0.086
173	30645	Continuous 2 Span...	Continuous 2 Span...	240k Test Truck (D...	Operating	1-20.0%	Shear	0.000	0.000	2.892	5.350
174	30645	Continuous 2 Span...	Continuous 2 Span...	240k Test Truck (D...	Operating	1-30.0%	Shear	0.000	0.000	5.222	9.604
175	30645	Continuous 2 Span...	Continuous 2 Span...	240k Test Truck (D...	Operating	1-40.0%	Shear	0.000	0.000	0.000	-0.014
176	30645	Continuous 2 Span...	Continuous 2 Span...	240k Test Truck (D...	Operating	1-50.0%	Shear	0.000	0.000	4.722	-8.284
177	30645	Continuous 2 Span...	Continuous 2 Span...	240k Test Truck (D...	Operating	1-60.0%	Shear	0.000	0.000	3.777	-7.294
178	30645	Continuous 2 Span...	Continuous 2 Span...	240k Test Truck (D...	Operating	1-70.0%	Shear	0.000	0.000	0.042	-0.070
179	30645	Continuous 2 Span...	Continuous 2 Span...	240k Test Truck (D...	Operating	1-80.0%	Shear	0.000	0.000	0.026	-0.044
180	30645	Continuous 2 Span...	Continuous 2 Span...	240k Test Truck (D...	Operating	1-90.0%	Shear	0.000	0.000	0.021	-0.039
181	30645	Continuous 2 Span...	Continuous 2 Span...	240k Test Truck (D...	Operating	1-95.9%	Shear	0.000	0.000	0.019	-0.038
182	30645	Continuous 2 Span...	Continuous 2 Span...	240k Test Truck (D...	Operating	1-98.3%	Shear	0.000	0.000	0.012	-0.026
183	30645	Continuous 2 Span...	Continuous 2 Span...	240k Test Truck (D...	Operating	2-1.5%	Shear	0.000	0.000	-0.016	-0.030
184	30645	Continuous 2 Span...	Continuous 2 Span...	240k Test Truck (D...	Operating	2-3.8%	Shear	0.000	0.000	-0.015	-0.028
185	30645	Continuous 2 Span...	Continuous 2 Span...	240k Test Truck (D...	Operating	2-10.0%	Shear	0.000	0.000	-0.013	-0.021
186	30645	Continuous 2 Span...	Continuous 2 Span...	240k Test Truck (D...	Operating	2-20.0%	Shear	0.000	0.000	-0.009	-0.015
187	30645	Continuous 2 Span...	Continuous 2 Span...	240k Test Truck (D...	Operating	2-30.0%	Shear	0.000	0.000	-0.009	-0.015

Comparison summary:
Acceptable row data = 1368 of 1680 (81%)
Unacceptable row data = 312 of 1680 (19%)
Comparison failures = 0 of 1680 (0%)

Show all within tolerance Show all outside tolerance Show all Close



ITD BrR Testing Program



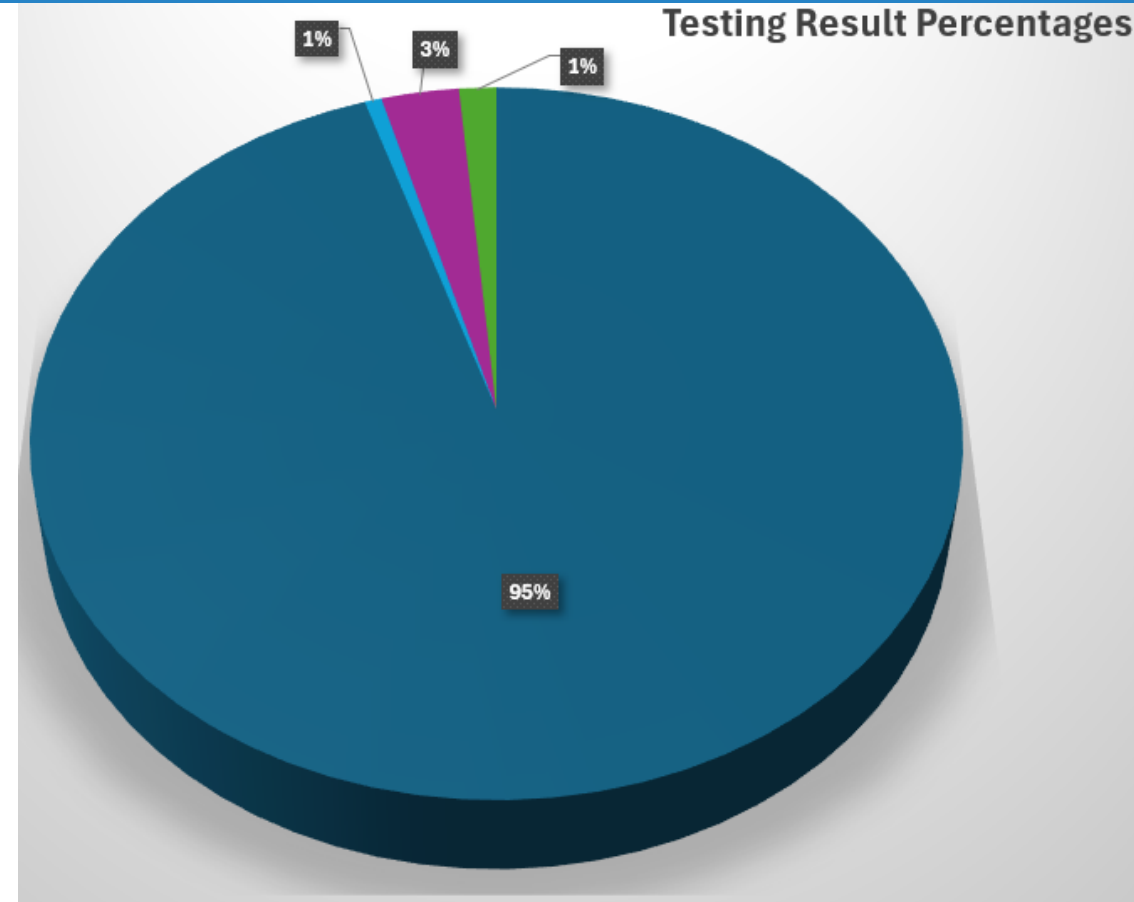
ArcTool Pros/Cons

❖ Reduce Time in Collecting/Sorting Data
❖ Reduce Potential Human Error in Copying Data
❖ Provides More Than Level 1 Results
❖ Assists in Finding Location and Reason for Difference
❖ Easier to Find Issues That Don't Impact Overall Load Rating
❖ Decreases Time to Test/Upgrade Sooner
❖ Creates Large Amounts of Temporary Files
❖ Member Alternative Naming Matters
❖ Does Not Rate all Bridge Types (254 bridges did not run)
❖ Does Not Tell You if Superstructures or Members Didn't Run

ITD BrR Testing Program

Testing Results Overview

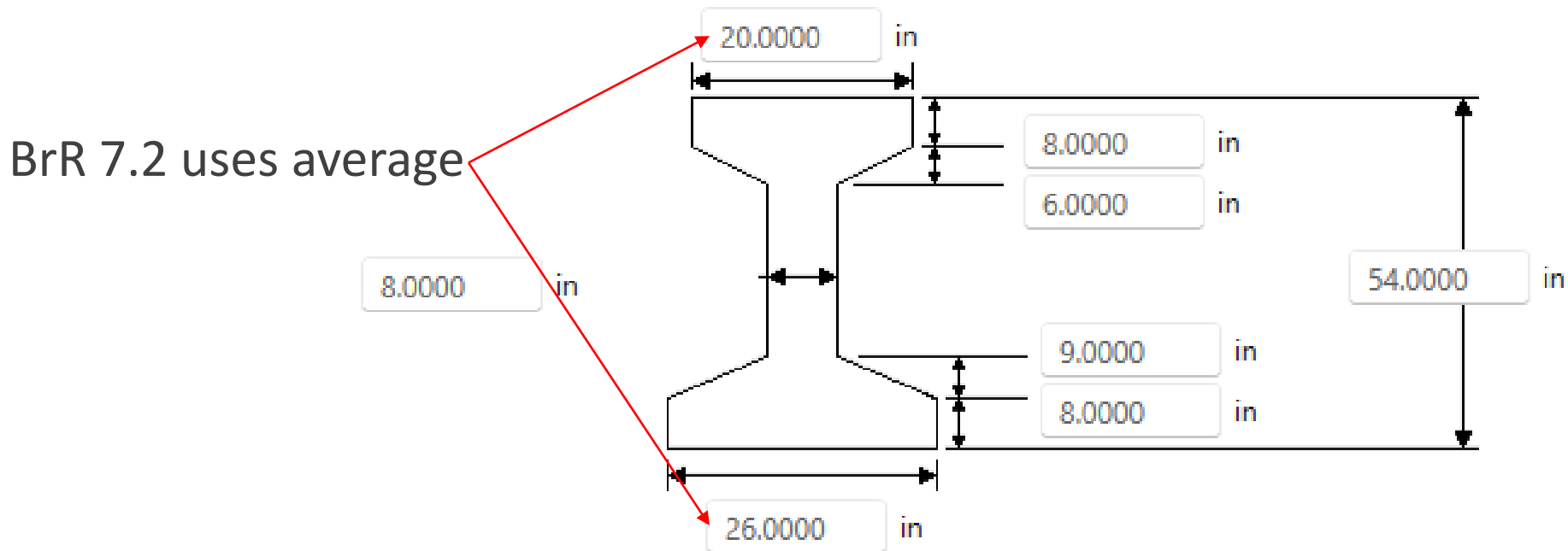
- 95% Considered a Match (3,090 out of 3,253)
- 1% Results are >5% due to current 7.5.1 Bugs (21 out of 3,253)
- 3% Results are >5% due to previous bug fixes (96 out of 3,253)
- 1% Multi-cell boxes will have varied results (46 out of 3,253)



ITD BrR Testing Program

Major Difference Summary btwn 7.2 & 7.5.1

- ❖ Ticket BSSD-3925 – Fix in 7.5.1 to use the correct compression flange width for f^*su (36 bridges)



ITD BrR Testing Program

Major Difference Summary btwn 7.2 & 7.5.1

- ❖ **Ticket BSSD-1611** – Fix in 7.3 to correct depth 'd' to consider the centroid of the negative moment reinforcing (15 bridges)

BrR 7.2

```
INPUT:
f'c =      5.0000 (ksi)
d   =     43.4810 (in)
b'  =      8.0000 (in)
fpe =     0.4429 (ksi)
Md  =    -123.2600 (kip-ft)
I   =   679839.9406 (in^4)

where  d >= 0.8 * h
       Mmax = Mu - Md
       Vi = Simult. Vu - Vd

use d = 49.2000 (in)
```

BrR 7.5.1

d (in)
49.20
57.60
57.60
57.60
57.60
57.60
57.60
57.60
57.60
49.20
57.60
57.60
57.60
49.20
57.60
57.60
57.60

ITD BrR Testing Program

Major Difference Summary btwn 7.2 & 7.5.1

❖ **Ticket BSSD-4079 & BSSD-3518** – Fix in 7.3 for the corrugated deck analysis & change in 7.5 to add analysis point locations to the corrugated deck analysis (17 bridges)

BrR 7.2

- CorrugatedDeck
 - Span 1 - 0.00 ft.
 - Span 1 - 0.75 ft.
 - Span 1 - 1.50 ft.
 - Span 2 - 1.50 ft.
 - Span 2 - 3.00 ft.
 - Span 2 - 4.50 ft.
 - Span 3 - 1.50 ft.
 - Span 3 - 3.00 ft.
 - Span 3 - 4.50 ft.
 - Span 4 - 1.50 ft.
 - Span 4 - 3.00 ft.
 - Span 4 - 4.50 ft.
 - Span 5 - 0.75 ft.
 - Span 5 - 1.50 ft.

BrR 7.5.1

- CorrugatedDeck
 - Span 1 - 0.00 ft.
 - Span 1 - 0.75 ft.
 - Span 1 - 1.50 ft.
 - Span 2 - 1.13 ft.
 - Span 2 - 2.25 ft.
 - Span 2 - 3.38 ft.
 - Span 2 - 4.50 ft.
 - Span 3 - 1.13 ft.
 - Span 3 - 2.25 ft.
 - Span 3 - 3.38 ft.
 - Span 3 - 4.50 ft.
 - Span 4 - 1.13 ft.
 - Span 4 - 2.25 ft.
 - Span 4 - 3.38 ft.
 - Span 4 - 4.50 ft.
 - Span 5 - 0.75 ft.
 - Span 5 - 1.50 ft.

ITD BrR Testing Program

Major Difference Summary btwn 7.2 & 7.5.1

- ❖ **Multi-cell Box Bridges** – Several tickets & enhancements affect these bridges along with previous version workarounds now creating loads that are inaccurate (46 bridges)

BrR 7.2

Strand Stress Calculations

Jacking Stress = 195.17 (ksi)
ES losses = 4.55 (ksi)
Total losses = 27.74 (ksi)

BrR 7.5.1

Strand Stress Calculations

Jacking Stress = 195.17 (ksi)
ES losses = 4.55 (ksi)
FR losses = 5.83 (ksi)
Total losses = 33.57 (ksi)

ITD BrR Testing Program

Major Difference Summary btwn 7.2 & 7.5.1

❖ **Madero** Engine vs **AASHTO** Timber ASR Engine (discussed further in the following slides)

Analysis method type	Analysis module
ASR	Madero ASR <input type="text"/>



Analysis method type	Analysis module
ASR	AASHTO Timber ASR <input type="text"/>

ITD BrR Testing Program

Timber Modifications

202 Timber/Timber Component Bridges

❖ Convert – Madero Engine to AASHTO Timber ASR Engine (202 bridges)

ITD BrR Testing Program

Timber Modifications Cont.

- ❖ Revise standard ITD truck templates (all bridges with a timber deck)

Vehicle: Standard Gage: Idaho(1) - Type 3 ×

Name:

Description:

Truck Tandem Lane

Axle no.	Axle load (kip)	Gage dist. (ft)	Wheel contact width (in)	Axle spacing (ft)	
				Minimum	Maximum
1	16.20	6.00			
2	18.90	6.00		10.00	10.00
3	18.90	6.00		4.00	4.00

Will need to be entered in BrR 7.5.1

ITD BrR Testing Program

Timber Modifications Cont.

- ❖ Beam Stability Factor, C_L – Hard enter correct value in BrR 7.5.1 (121 bridges)

Beam Details **BrR 7.2 Input**

General Adjustment factors Support lengths

Moisture condition for shear/flexure: Wet

Moisture condition for bearing: Wet

Moisture condition for modulus: Wet

Shear factor: 1.000 Flat use factor: 1.00

Wet service (flexure): 1.000 Repetitive use factor: 1.00

Wet service (shear): 1.000 Load duration factor: 1.150

Wet service (bearing): 0.67

Wet service (modulus): 1.000

Size factor (flexure): 0.947

Compute

Beam Details **BrR 7.5.1 Input**

General Adjustment factors Support lengths

Moisture condition for shear/flexure: Wet

Moisture condition for bearing: Wet

Moisture condition for modulus: Wet

Compute

ASD

Wet service (flexure) (C_M): 1.000

Wet service (shear) (C_M): 1.000

Wet service (bearing) (C_M): 0.670

Wet service (modulus) (C_M): 1.000

Shear (C_H): 1.000

Flat use (C_{Fu}): 1.000

Repetitive use (C_r): 1.000

Load duration (C_D): 1.150

Size (C_F): 0.947

Bearing (C_b):

Beam stability (C_L):

LRFD

Wet service (flexure) (C_M):

Wet service (shear) (C_M):

Wet service (bearing) (C_M):

Wet service (modulus) (C_M):

Format conversion (C_{KF}):

Format conversion (bearing) (C_{KF}):

Size (flexure) (C_F):

Size (modulus) (C_F):

Flat use (C_{Fu}):

Incising (flexure, shear) (C_i):

Incising (bearing) (C_i):

Incising (modulus) (C_i):

Bearing (C_b):

Time effects (STRENGTH - I) (C_t):

Time effects (STRENGTH - II) (C_t):

Beam stability (C_L):

When left blank, 7.5.1 appears to use the unbraced length solely between the diaphragms and does not consider the bracing action of the deck being nailed to the girders.

ITD BrR Testing Program

Timber Modifications Cont.

- ❖ Ticket BSSD-4875 – Bearing calculations use the incorrect LLDF's in 7.5.1 (20 bridges)

Live Load Distribution

Standard | LRFD

Distribution factor input method

Use simplified method Use advanced method Use advanced method with 1994 guide specs

Allow distribution factors to be used to compute effects of permit loads with routine traffic

Lanes loaded	Distribution factor (wheels)			
	Shear	Shear at supports	Moment	Deflection
> 1 Lane	0.633	1.000	0.667	0.500
Multi-lane	0.633	1.000	0.667	0.500

BrR 7.5.1 is currently using the Shear LLDF's instead of the Shear at Supports

ITD BrR Testing Program

Timber Modifications Cont.

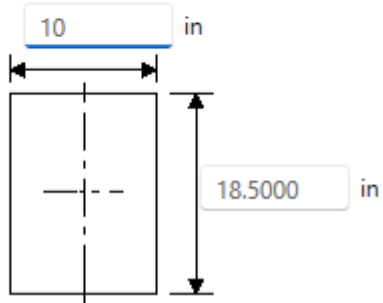
❖ Section Properties – BrR 7.2 recalculates, BrR 7.5.1 uses entered values (2 bridges)

Timber Shape - Rectangular

Name: 10in Solid Sawn

Description: Beam Section

Dimensions Properties



BrR 7.2

Dimensions Properties

Area:	210	in ²
Nominal load:	91.00	lb/ft
Moment of inertia:	7717.5	in ⁴
CG from bottom:	10.5000	in
Section modulus, top:	735.0	in ³
Section modulus, bottom:	735.0	in ³
Nominal width:	10.00	in
Nominal depth:	21.0000	in

Manually fix

BrR 7.5.1

Dimensions Properties

Area:	185	in ²
Nominal load:	91.00	lb/ft
Moment of inertia:	5276.4	in ⁴
CG from bottom:	9.2500	in
Section modulus, top:	570.4	in ³
Section modulus, bottom:	570.4	in ³
Nominal width:	10.00	in
Nominal depth:	21.0000	in

Recompute

Compute

ITD BrR Testing Program

Timber Modifications Cont.

- ❖ Tributary Area – BrR 7.2 calcs automatically, BrR 7.5.1 uses selected method (6 bridges)

BrR 7.2

Stage 2 dead load distribution

- Uniformly to all girders
- By tributary area
- By transverse simple-beam analysis
- By transverse continuous-beam analysis
- By percentage

BrR 7.5.1

Has to be selected in order to analyze correctly

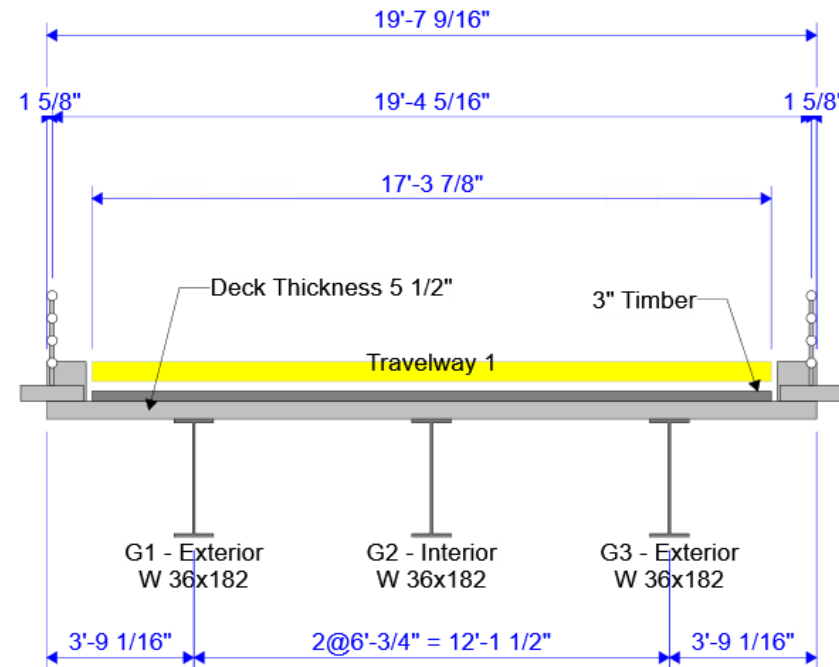
Stage 2 dead load distribution

- Uniformly to all girders
- By tributary area
- By transverse simple-beam analysis
- By transverse continuous-beam analysis
- By percentage

ITD BrR Testing Program

Timber Modifications Cont.

- ❖ Ticket BSSD-4111 – Pre-existing bug in the Madero Engine (1 bridge)

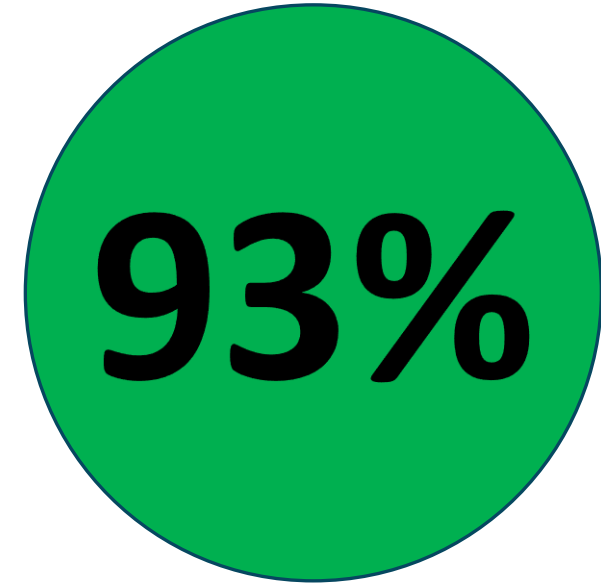


ITD BrR Testing Program

Timber Summary

After Revisions or Future Bug Fixes:







- ❖ 187 Bridges Considered a Match
- ❖ 15 Bridges > 5% due to Madero vs AASHTO differences

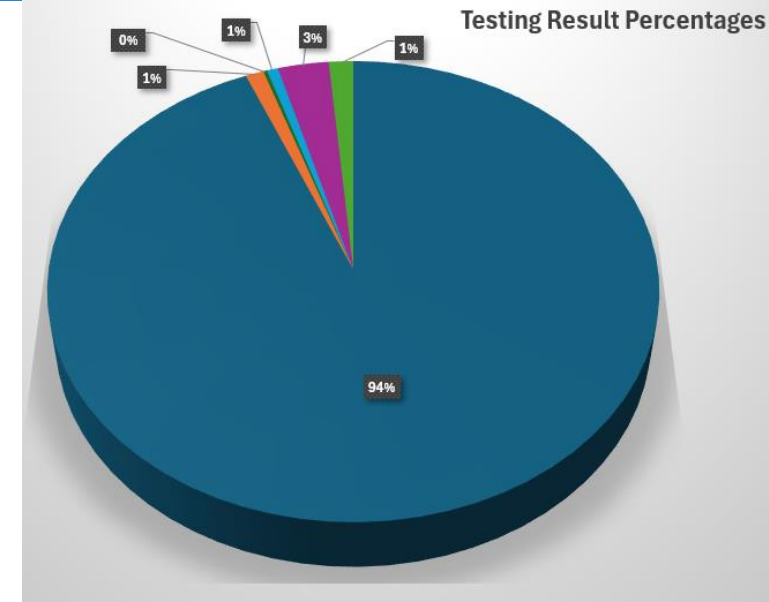


ITD BrR Testing Program

Testing Results

Tested 3,253 Bridges





- ❖ 3,049 – Results Matched (93.7%) 
- ❖ 34 – Require Minor BrR 7.5.1 Modifications to Match (1.0%) 
- ❖ 7 – Require ITD Modifications to Truck Template to Match (0.2%) 
- ❖ 21 – Results are >5% due to current 7.5.1 Bugs (0.6%) 
- ❖ 96 – Results are >5% due to Bug Fixes or Enhancements between 7.2 & 7.5.1 (3.0%) 
- ❖ 46 – Multi-cell boxes are >5% due to various reasons (1.4%) 

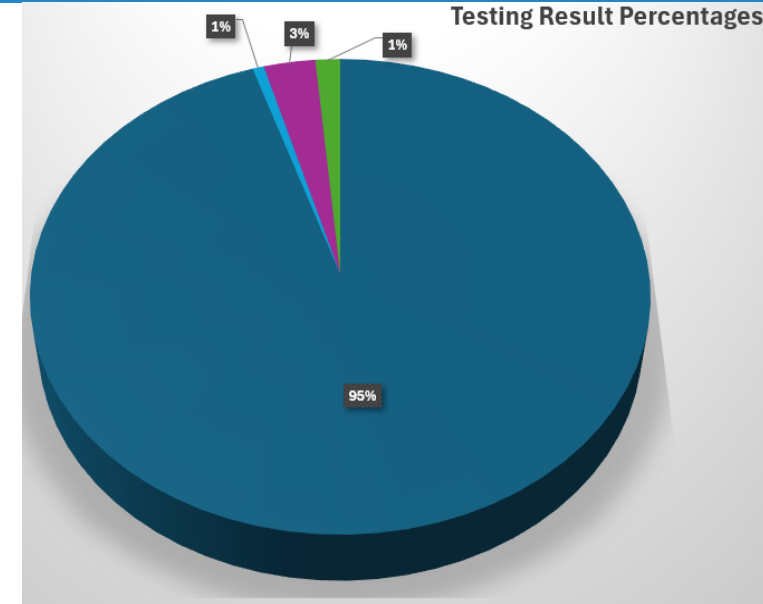


ITD BrR Testing Program

Testing Results Cont.

After Revisions:

- ❖ 3,090 – Considered a Match (95%) 
- ❖ 21 – Results are >5% due to current 7.5.1 Bugs (0.6%) 
- ❖ 96 – Results are >5% but now considered correct (3.0%) 
- ❖ 46 – Multi-cell boxes will have varied results depending on corrections (1.4%) 



ITD BrR Testing Program

Results of BrR 7.5.1 Testing



Thank you!

Contact Information & Questions



Melissa Hennessy, P.E.
melissa.hennessy@itd.idaho.gov



Kayla Jacobsen, P.E.
[kjacobson@forsgren.com](mailto:kjacobsen@forsgren.com)

Phone: (208) 342-3144
Website: Forsgren.com



Ryan Sherman, P.E., S.E.
rsherman@forsgren.com