AASHTOWare BrDR 7.5.0

Feature Tutorial

Analysis Results Comparison (ARC) Tool Tutorial

ARC1 – ARC Tool

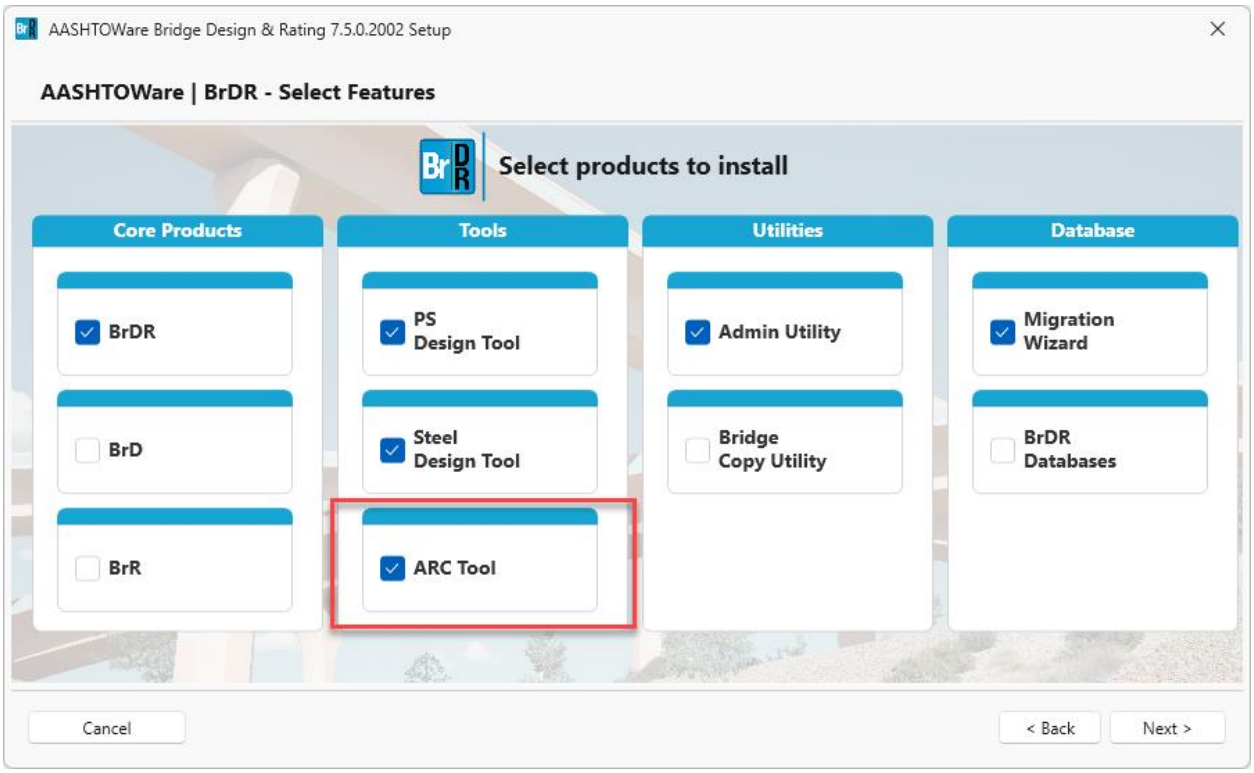
This example describes the use of the Analysis Results Comparison (ARC) Tool feature in BrDR. *Note: The ARC Tool will be included in BrDR for versions 7.1 and later. At the time of this writing, the ARC Tool supports BrDR version 7.0 and later.*

Topics covered:

- Getting started
- Creating and appending to datasets
- Operation of the ARC Tool comparison feature

Getting Started

When installing BrDR, ensure that the ARC Tool is selected as a feature (see below).

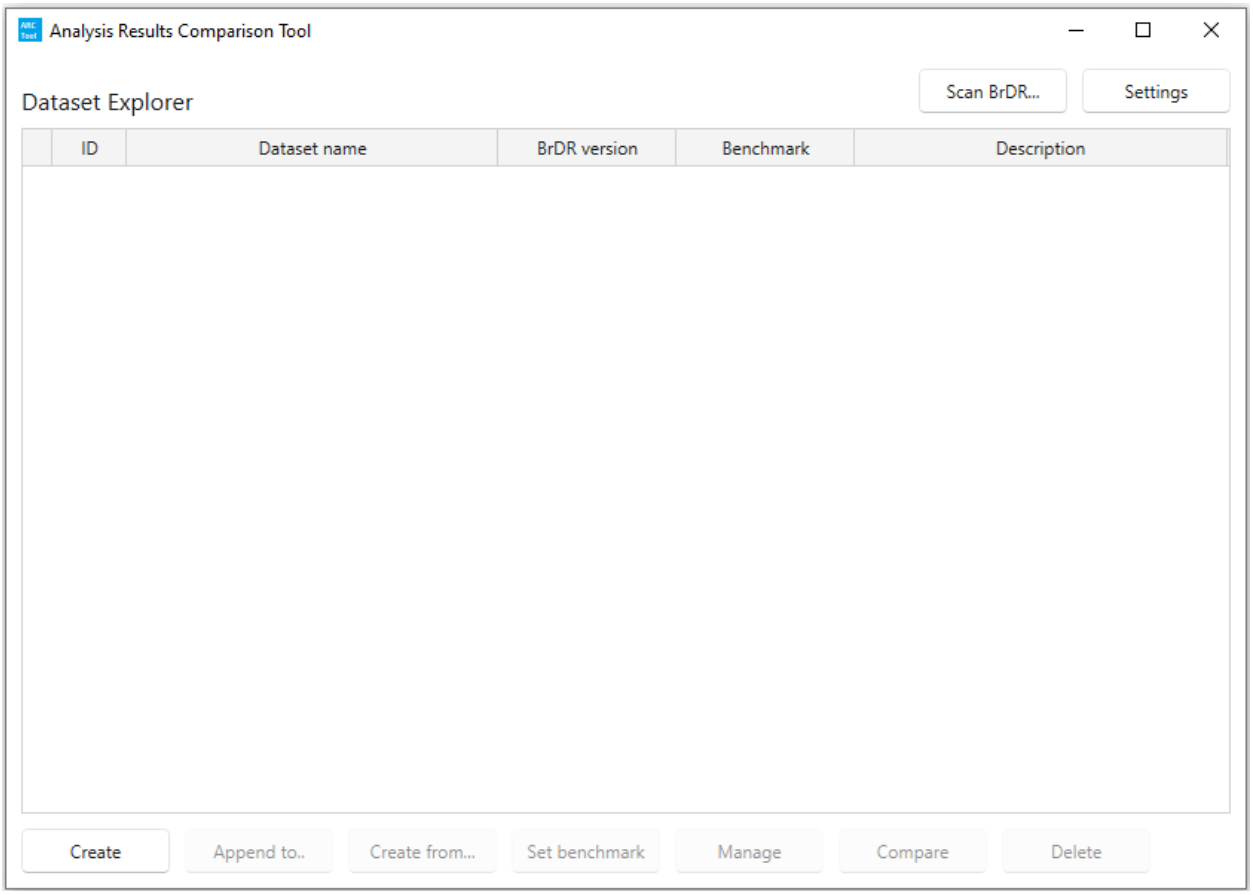


Export Bridge XML Files

The ARC Tool analyzes bridges directly from AASHTOWare BridgeXML files rather than connecting to a database like BrDR. Bridge XML files can be generated by exporting bridges from a particular version of BrDR. Please note, version conversion is available in the ARC Tool for forward compatibility but not backward compatibility. For example, bridges exported from BrDR version 7.0 can be used to generate datasets for versions 7.0 and later, but bridges exported from BrDR version 7.1 cannot be used to generate datasets for BrDR version 7.0.

Data Explorer Window

Run the ARC Tool executable file to open the **Dataset Explorer** window (this is 'ArcToolUi.exe' located in the folder {BrDR installation folder}\ArcTool) . This is the ARC Tool's main window and can be used to access the features in the ARC Tool. Below is a quick description of the features available for the ARC Tool.



Settings

Opens the Settings Window to allow the user to update connection details for installed versions of BrDR.

Scan BrDR

Scans the user's computer for installed versions of BrDR (7.0.0 and later) and imports analysis setting templates.

Create

Allows the user to generate a new dataset.

Append to

Allows the user to generate new data and add it to an existing dataset.

Create From

Allows the user to generate a new dataset from an existing dataset using a different version of BrDR.

Set benchmark

Sets the selected the dataset as the benchmark. A benchmark is an accepted dataset that will be used to compare to future datasets.

Manage

Allows the user to view and delete the items within the selected dataset.

Compare

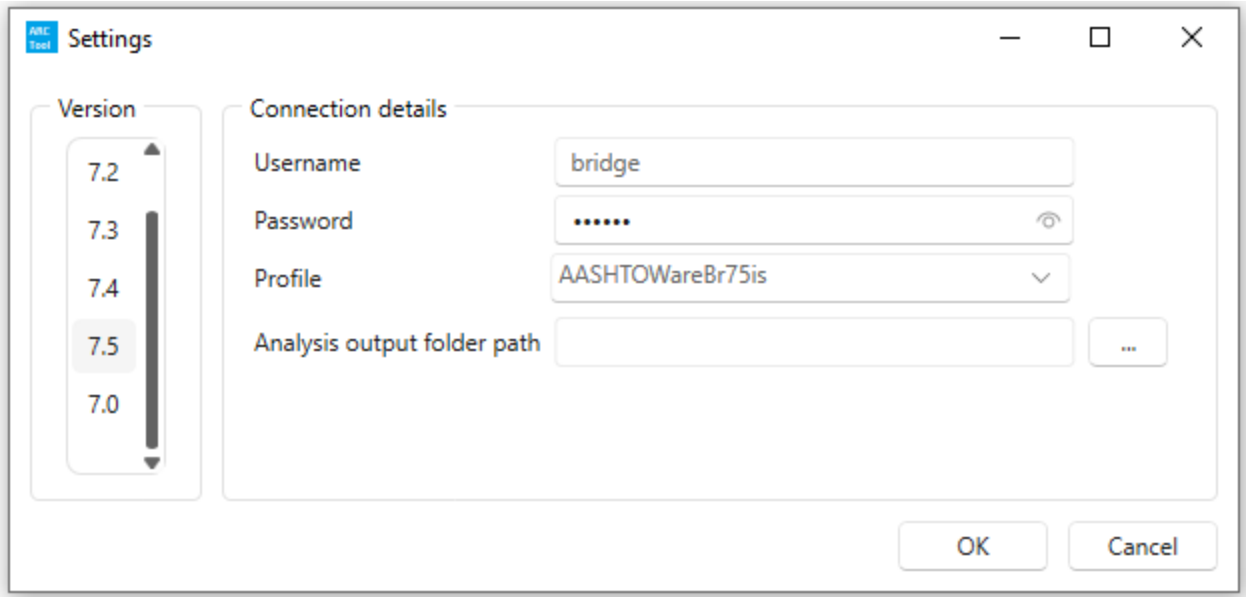
Runs a Level 1 comparison on 2 selected datasets or 1 selected dataset against the benchmark dataset. Level 1 is a comparison of controlling rating factors at the bridge level.

Delete

Deletes the selected dataset(s).

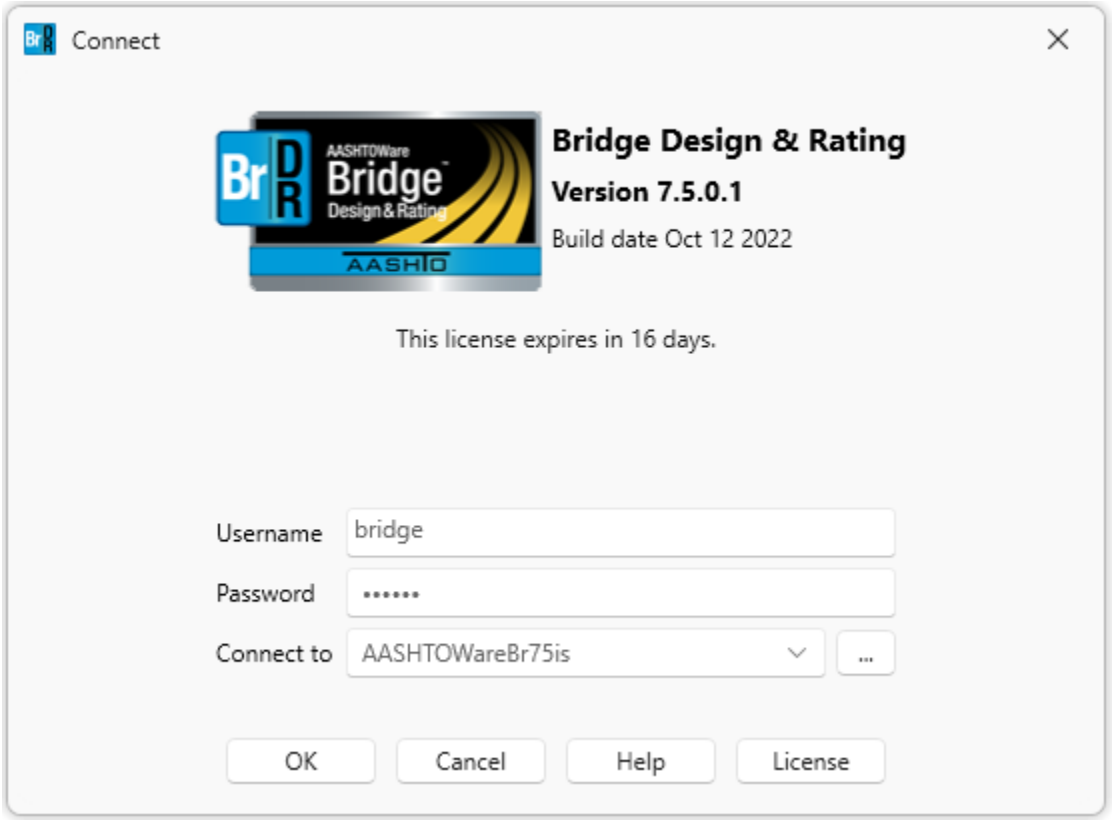
Setup BrDR Connection Details

The first step in using the ARC Tool is to update the BrDR connection details information. Click on Settings in the **Dataset Explorer** window to open the **Settings** Window.

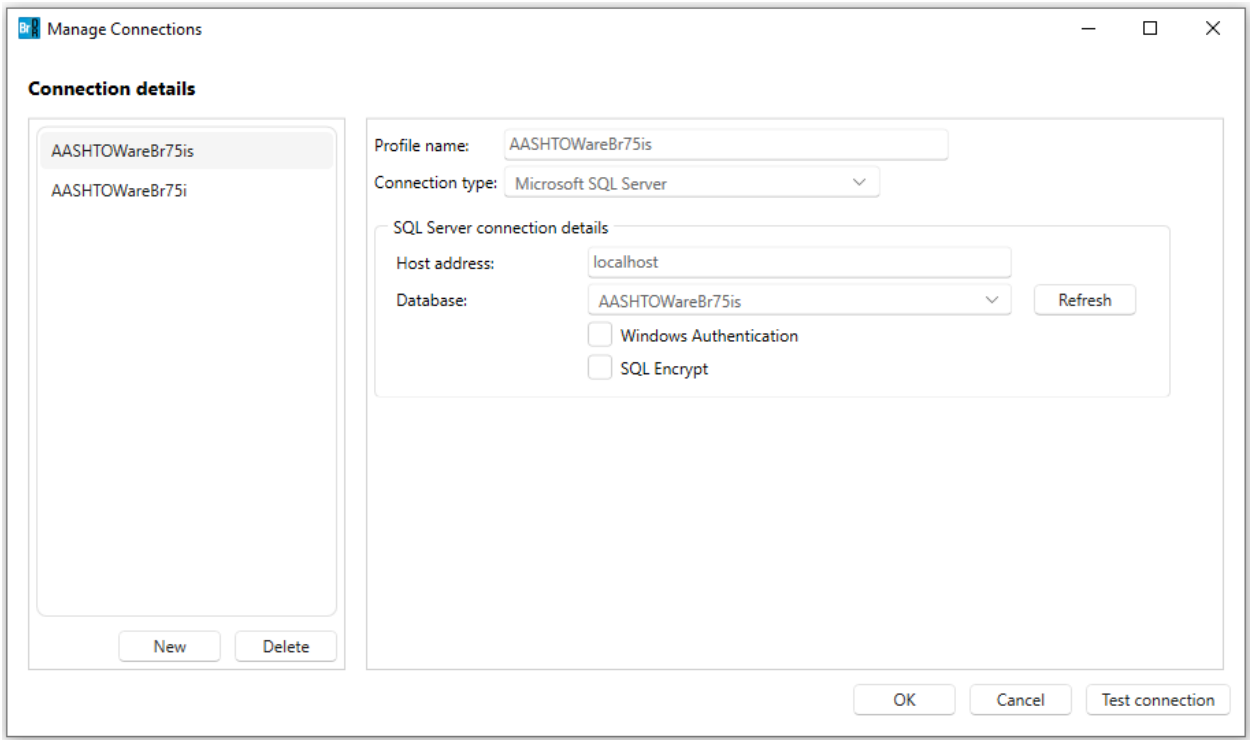


The list on the left will populate automatically with all the versions of BrDR installed on the user's machine. Select a BrDR version from the list and update the connection details with the correct database connection details information. The user can also update the location of the output files from a BrDR analysis by selecting a new folder path for the **Analysis output folder path** field. If nothing is specified, the **Analysis output folder path** will default to the BrDR settings.

The Username, Password, and Profile should be the same login information that is used to access BrDR on the login page:



If the Profiles dropdown is empty, first confirm that the profiles exist by opening BrDR and clicking '…' on the login window to open the **Manage Connections** window:



The Profiles dropdown should contain the connection profiles shown listed on the left side of this window. Also note, a user must login to BrDR at least once before using the ARC Tool to activate the license.

Register Installed Versions of BrDR and Import Analysis Settings Templates

The first step in using the ARC Tool is to register the installed versions of BrDR and import the existing Analysis Settings Templates. Click on Scan BrDR in the Dataset Explorer window to run this process. If any versions of BrDR are installed or uninstalled or if Analysis Settings Templates are created or removed, this step should be repeated.

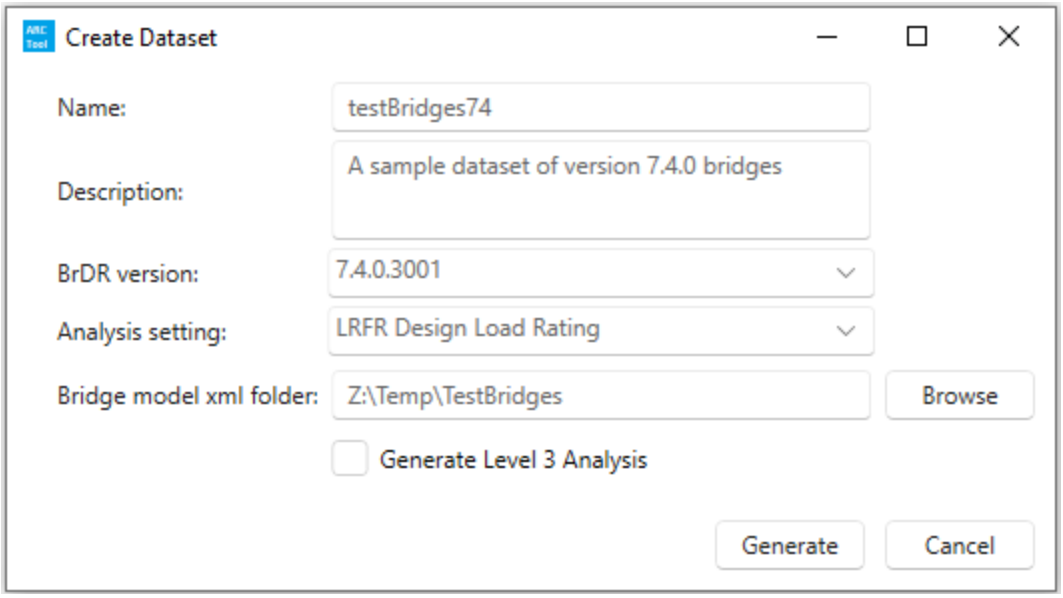
Creating and Appending to a Dataset

The ARC Tool can be used to generate and store rating data for different versions of BrDR in a local ARC Tool database to be used in comparison analyses. This section describes the different ways to create and update rating datasets.

Create a Dataset

The next step in using the ARC Tool is to generate rating data from the different BrDR versions. Click **Create** in the **Dataset Explorer** window to open the **Create Dataset** window. Type in a name and description for the dataset. The BrDR version and Analysis Settings dropdown menus will be automatically populated after running **Scan BrDR** in the previous section. Select a BrDR version and Analysis Settings Template from the dropdown menus. Click **Browse** and select the folder where the exported bridge XML files are stored. To generate analysis data at the point of interest level, select the **Generate Level 3 Analysis** checkbox. Click **Generate** to connect to the selected version of BrDR and generate the new dataset.

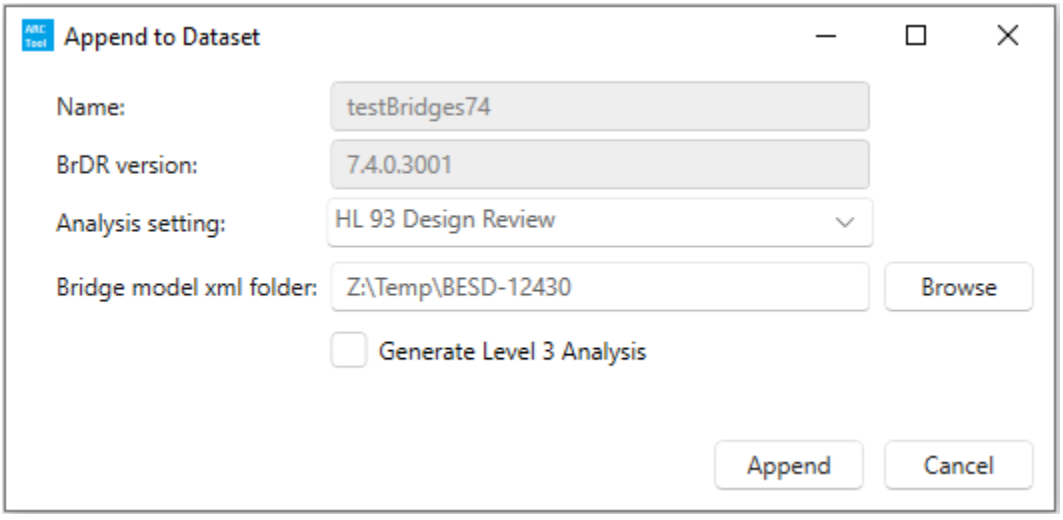
*Note: **Generate Level 3 Analysis** is not selected by default because it will produce large amounts of data. The database has an upper limit of 4gb. The tool will not function if the database is filled to the maximum amount. It is recommended that for large datasets, users run the tool without generating level 3 data. If a discrepancy is found in the level 1 or level 2 data, a new dataset can be created to generate level 3 data for only the bridges of interest.*



Append to a Dataset

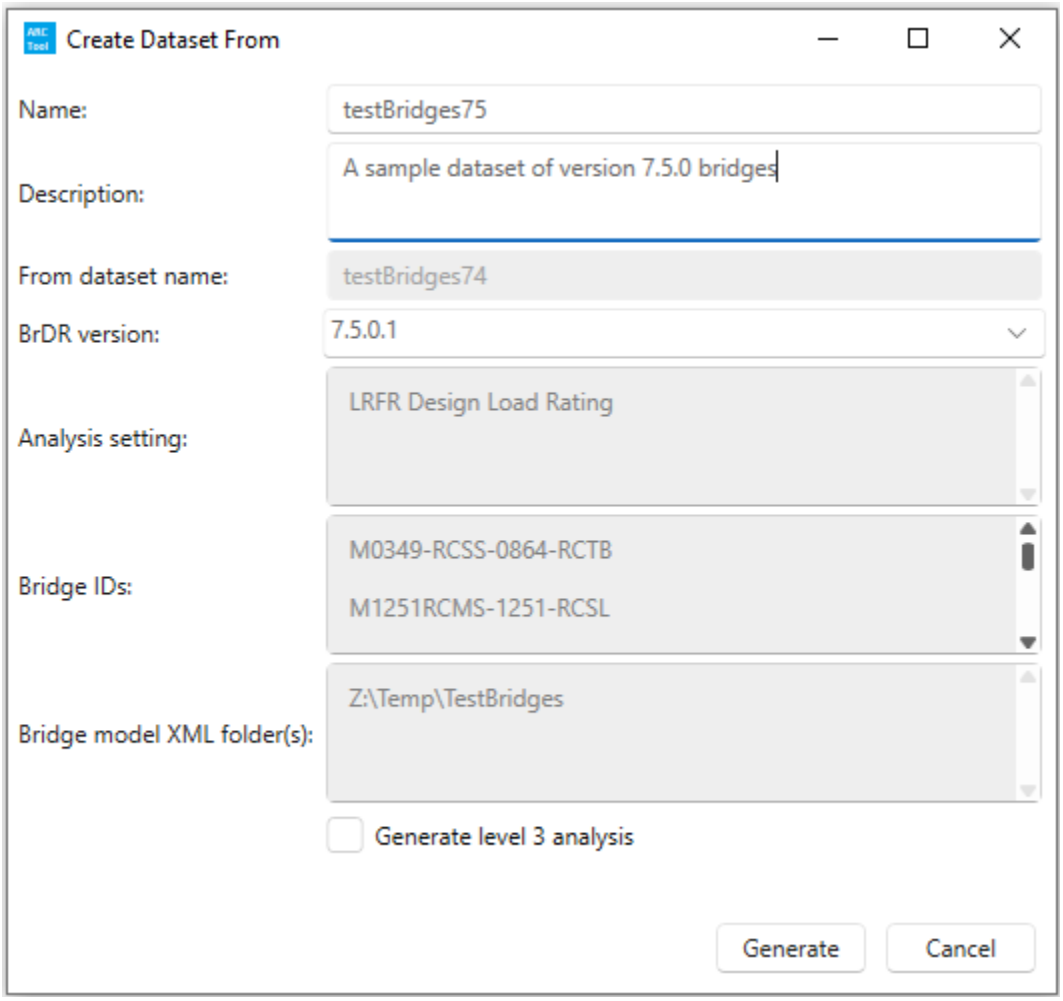
New data can also be added to an existing dataset by using the **Append to** option. Select the dataset to be updated and click **Append to** in the **Dataset Explorer** window to open the **Append to Dataset** window. The name and BrDR version will be read-only and are automatically populated with the information from the existing dataset. Select an analysis setting template from the dropdown menu. Click **Browse** and select the folder where the exported bridge XML files are stored. To generate analysis data at the point of interest level, select the **Generate Level 3 Analysis** checkbox. Click **Append** to generate new data for the selected bridge models and append it to the specified dataset.

*Note: **Generate Level 3 Analysis** is not selected by default because it will produce large amounts of data. The database has an upper limit of 4gb. The tool will not function if the database is filled to the maximum amount. It is recommended that for large datasets, users run the tool without generating level 3 data. If a discrepancy is found in the level 1 or level 2 data, a new dataset can be created to generate level 3 data for only the bridges of interest.*



Create Dataset From

A new dataset can also be created for another version of BrDR using the same inputs as an existing dataset. Select a dataset in the **Dataset Explorer** window and click **Create From** to open the **Create Dataset From** window. Enter the name and description of the new dataset and select the version of BrDR to use. To generate analysis data at the Point of Interest level, select the **Generate Level 3 Analysis** checkbox. Click **Generate** to create the new dataset. *Note: **Generate Level 3 Analysis** is not selected by default because it will produce large amounts of data. The database has an upper limit of 4gb. The tool will not function if the database is filled to the maximum amount. It is recommended that for large datasets, users run the tool without generating level 3 data. If a discrepancy is found in the level 1 or level 2 data, a new dataset can be created to generate level 3 data for only the bridges of interest.*

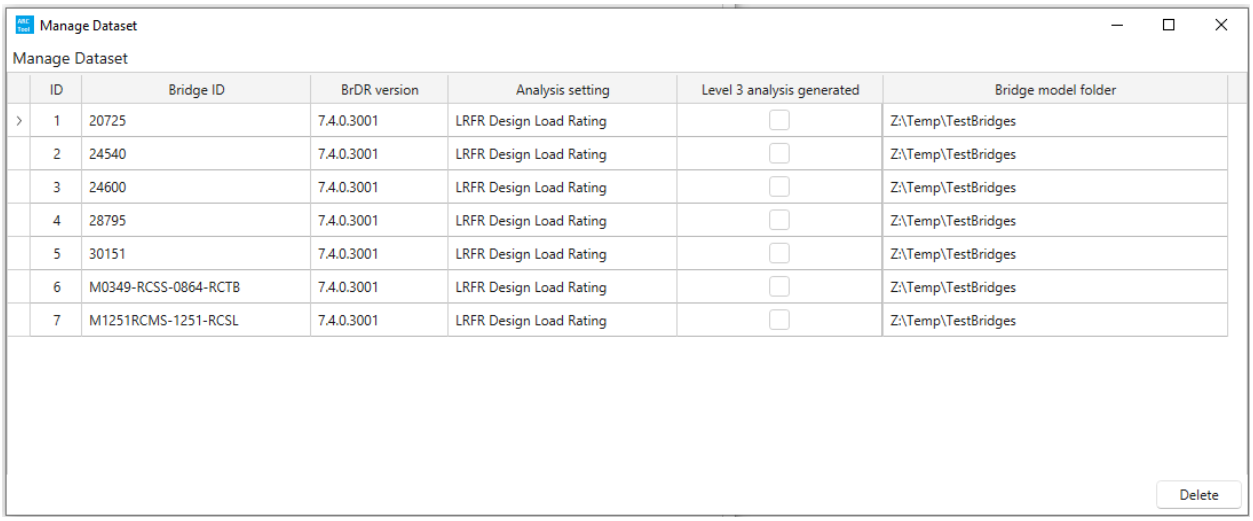


Set Benchmark

To set or change the existing Benchmark dataset, select a row, and click **Set Benchmark**. The Benchmark will be the default comparison dataset when only one dataset is selected in the **Dataset Explorer** window.

Manage Datasets

To view the bridge data within a dataset, select a row and click **Manage**. This will open the **Manage Dataset** window which displays a list of all the data items within a dataset by Bridge ID, BrDR version, and Analysis setting. Items can be deleted from a dataset by selecting rows and clicking **Delete**.



ID	Bridge ID	BrDR version	Analysis setting	Level 3 analysis generated	Bridge model folder
1	20725	7.4.0.3001	LRFR Design Load Rating		Z:\Temp\TestBridges
2	24540	7.4.0.3001	LRFR Design Load Rating		Z:\Temp\TestBridges
3	24600	7.4.0.3001	LRFR Design Load Rating		Z:\Temp\TestBridges
4	28795	7.4.0.3001	LRFR Design Load Rating		Z:\Temp\TestBridges
5	30151	7.4.0.3001	LRFR Design Load Rating		Z:\Temp\TestBridges
6	M0349-RCSS-0864-RCTB	7.4.0.3001	LRFR Design Load Rating		Z:\Temp\TestBridges
7	M1251RCMS-1251-RCSL	7.4.0.3001	LRFR Design Load Rating		Z:\Temp\TestBridges

Delete

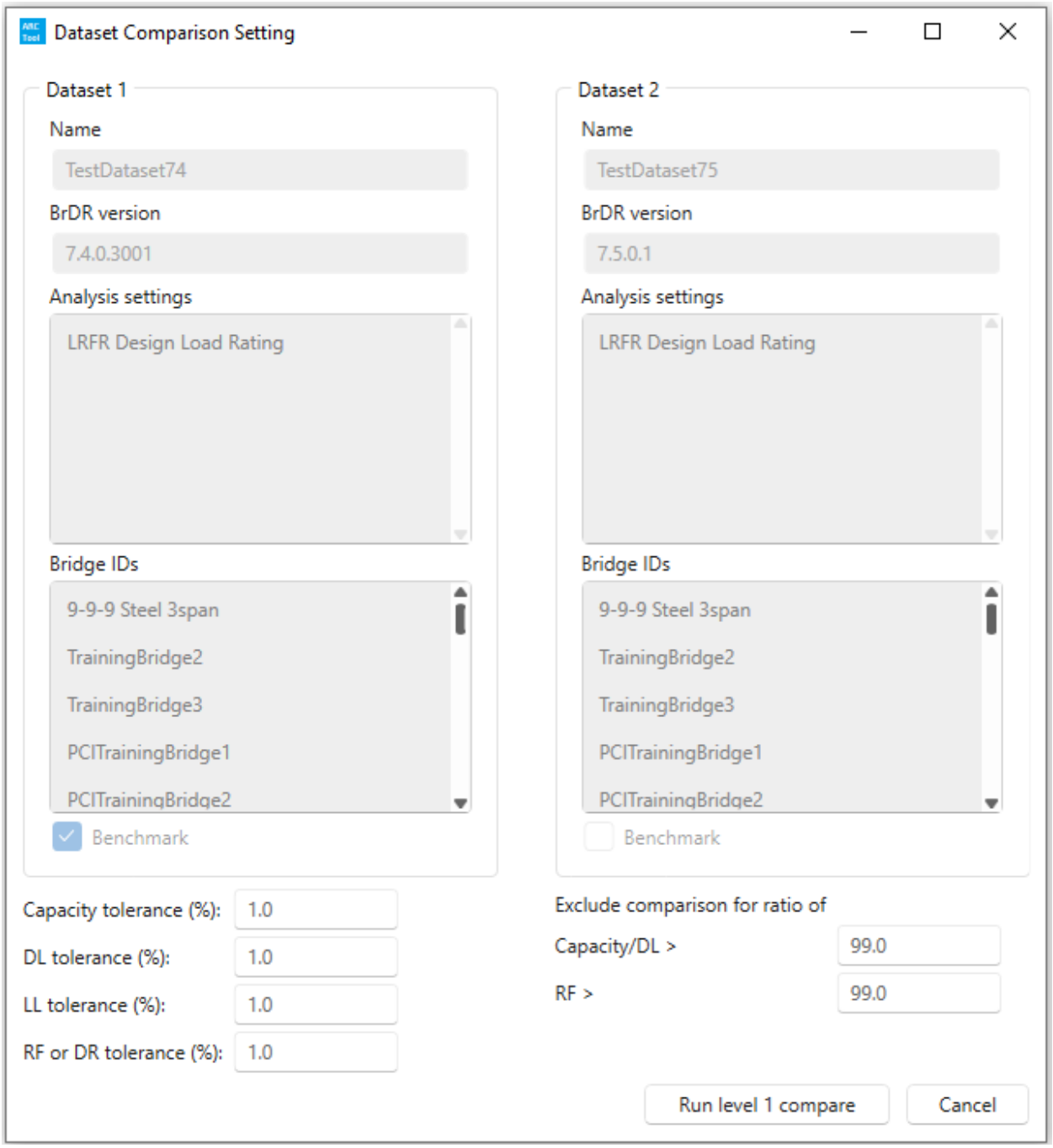
The user can delete entire datasets from the ARC Tool by selecting rows in the **Dataset Explorer** window and clicking **Delete**.

Operation of the ARC Tool Comparison Feature

Once at least 2 rating datasets have been generated in the ARC tool, the user can run dataset comparison analyses. The following section describes how to generate comparison data in the ARC tool.

Compare Datasets

To compare two datasets, select the two rows in the **Dataset Explorer** window or to compare one dataset against the benchmark, select one row in the **Dataset Explorer** window. Click **Compare** to open the **Dataset Comparison Setting** window. The **Dataset Comparison Setting** window will display the name, BrDR version, analysis settings template, and Bridge IDs for the datasets to be compared. The display tolerances and exclude comparison ratios can also be updated in this window. Please note, only the RF or DR tolerance is used for level 1 and level 2 comparisons. The capacity, dead load, and live load percent changes are only shown for level 3 comparisons.



Level 1 Comparison

Click **Run level 1 compare** in the **Dataset Comparison Setting** window to run a level 1 comparison on the selected datasets. This will open the **Level 1 Comparison** window which displays the results of the comparison by the controlling rating factor for each bridge. If the location or limit state is different between the two datasets, the value for that column will be shown in red. If the rating/design factor percent change between the two datasets is greater

than the RF or DR tolerance specified in the **Dataset Comparison Setting** window, the value for that column will be shown in red.

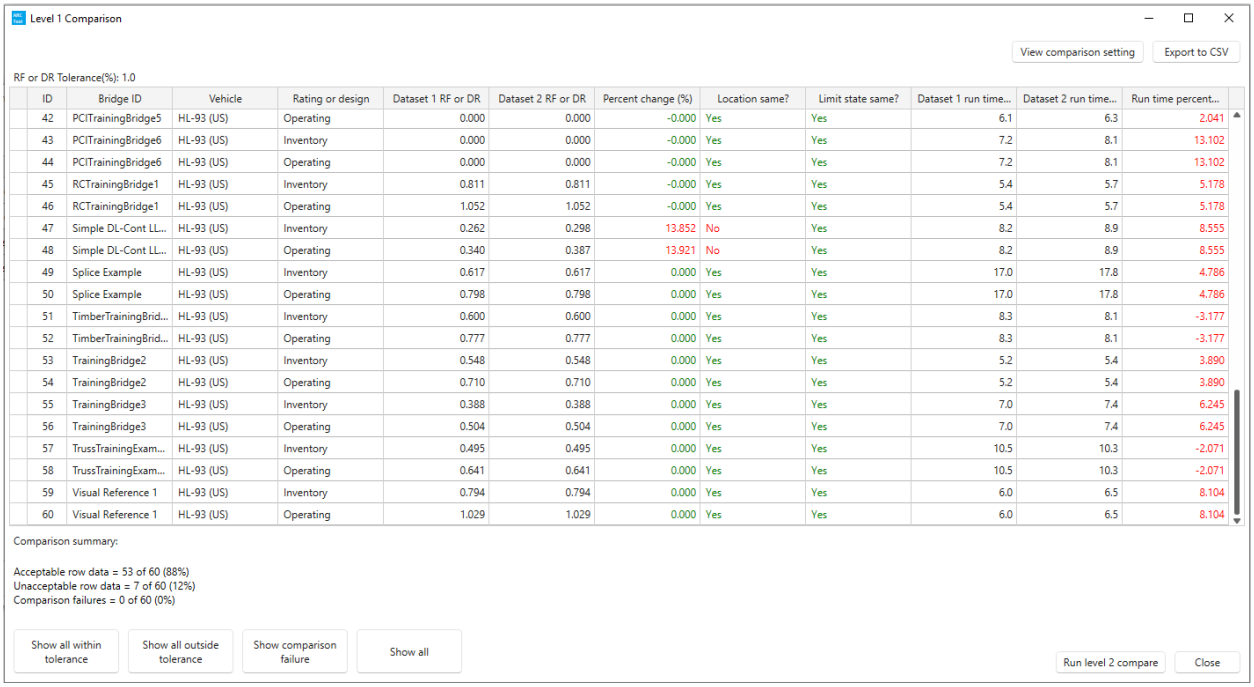
The **Level 1 Comparison** window also includes the Dataset 1 and Dataset 2 runtimes and a percent change between the two values. The runtimes are the total time in seconds it takes to run the analysis in BrDR.

To view the settings for this comparison, click **View comparison setting** in the top right corner of the window. This will open the **Dataset Comparison Setting** window in read-only mode.

To export the results to a CSV file, click **Export to CSV** and select a location to save the file.

The **Comparison Summary** shown at the bottom left of the window provides a summary of the level 1 results. If either dataset 1 or dataset 2 does not have a rating/design factor, the comparison will be counted as a failure. If the limit state or controlling location are different between dataset 1 and dataset 2 or the rating/design factor percent change is not within the specified tolerance, the comparison will be counted as unacceptable. If the limit state and location are both the same and the rating/design factor percent change is within the specified tolerance, the comparison will be counted as acceptable.

The **Show all within tolerance**, **Show all outside tolerance**, **Show comparison failure**, and **Show all** buttons at the bottom of the **Level 1 Comparison** window can be used to filter the data grid by rating/design factor percent change tolerance.



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 time...	Dataset 2 run time...	Run time percent...
42	PCITrainingBridge5	HL-93 (US)	Operating	0.000	0.000	-0.000	Yes	Yes	6.1	6.3	2.041
43	PCITrainingBridge6	HL-93 (US)	Inventory	0.000	0.000	-0.000	Yes	Yes	7.2	8.1	13.102
44	PCITrainingBridge6	HL-93 (US)	Operating	0.000	0.000	-0.000	Yes	Yes	7.2	8.1	13.102
45	RCTrainingBridge1	HL-93 (US)	Inventory	0.811	0.811	-0.000	Yes	Yes	5.4	5.7	5.178
46	RCTrainingBridge1	HL-93 (US)	Operating	1.052	1.052	-0.000	Yes	Yes	5.4	5.7	5.178
47	Simple DL-Cont LL...	HL-93 (US)	Inventory	0.262	0.298	13.852	No	Yes	8.2	8.9	8.555
48	Simple DL-Cont LL...	HL-93 (US)	Operating	0.340	0.387	13.921	No	Yes	8.2	8.9	8.555
49	Splice Example	HL-93 (US)	Inventory	0.617	0.617	0.000	Yes	Yes	17.0	17.8	4.786
50	Splice Example	HL-93 (US)	Operating	0.798	0.798	0.000	Yes	Yes	17.0	17.8	4.786
51	TimberTrainingBrid...	HL-93 (US)	Inventory	0.600	0.600	0.000	Yes	Yes	8.3	8.1	-3.177
52	TimberTrainingBrid...	HL-93 (US)	Operating	0.777	0.777	0.000	Yes	Yes	8.3	8.1	-3.177
53	TrainingBridge2	HL-93 (US)	Inventory	0.548	0.548	0.000	Yes	Yes	5.2	5.4	3.890
54	TrainingBridge2	HL-93 (US)	Operating	0.710	0.710	0.000	Yes	Yes	5.2	5.4	3.890
55	TrainingBridge3	HL-93 (US)	Inventory	0.388	0.388	0.000	Yes	Yes	7.0	7.4	6.245
56	TrainingBridge3	HL-93 (US)	Operating	0.504	0.504	0.000	Yes	Yes	7.0	7.4	6.245
57	TrussTrainingExam...	HL-93 (US)	Inventory	0.495	0.495	0.000	Yes	Yes	10.5	10.3	-2.071
58	TrussTrainingExam...	HL-93 (US)	Operating	0.641	0.641	0.000	Yes	Yes	10.5	10.3	-2.071
59	Visual Reference 1	HL-93 (US)	Inventory	0.794	0.794	0.000	Yes	Yes	6.0	6.5	8.104
60	Visual Reference 1	HL-93 (US)	Operating	1.029	1.029	0.000	Yes	Yes	6.0	6.5	8.104

Level 2 Comparison

Click **Run level 2 compare** in the **Level 1 Comparison** window to run a level 2 comparison on the selected bridges. This will open the **Level 2 Comparison** window which displays the results of the comparison at the controlling location of each member in a bridge. If the controlling location or limit state is different between the two datasets, the value for that column will be shown in red. If the rating/design factor percent change between the two datasets is

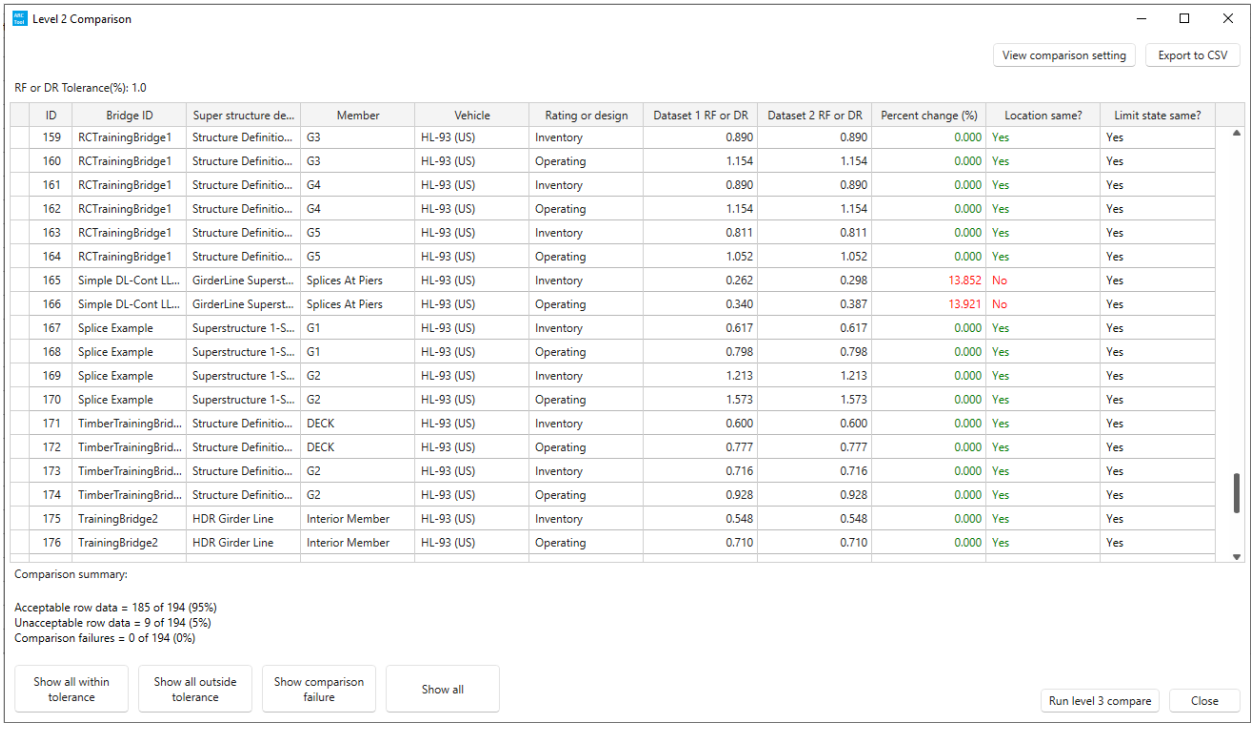
greater than the RF/DR tolerance specified in the **Dataset Comparison Setting** window, the value for that column will be shown in red.

To view the settings for this comparison, click the **View comparison setting** button in the top right corner of the window. This will open the **Dataset Comparison Setting** window in read-only mode.

To export the results to a CSV file, click the **Export to CSV** button and select a location to save the file.

The **Comparison Summary** located at in the bottom left of the window shows a summary of the level 2 results. If either dataset 1 or dataset 2 does not have a rating/design factor, the comparison will be counted as a failure. If the limit state or controlling location are different between dataset 1 and dataset 2 or the rating/design factor percent change is not within the specified tolerance, the comparison will be counted as unacceptable. If the limit state and location are both the same and the rating/design factor percent change is within the specified tolerance, the comparison will be counted as acceptable.

The **Show all within tolerance**, **Show all outside tolerance**, **Show comparison failure**, and **Show all** buttons at the bottom of the **Level 2 Comparison** window can be used to filter the data grid by rating/design factor percent change tolerance.



ID	Bridge ID	Super structure de...	Member	Vehicle	Rating or design	Dataset 1 RF or DR	Dataset 2 RF or DR	Percent change (%)	Location same?	Limit state same?
159	RCTrainingBridge1	Structure Definitio...	G3	HL-93 (US)	Inventory	0.890	0.890	0.000	Yes	Yes
160	RCTrainingBridge1	Structure Definitio...	G3	HL-93 (US)	Operating	1.154	1.154	0.000	Yes	Yes
161	RCTrainingBridge1	Structure Definitio...	G4	HL-93 (US)	Inventory	0.890	0.890	0.000	Yes	Yes
162	RCTrainingBridge1	Structure Definitio...	G4	HL-93 (US)	Operating	1.154	1.154	0.000	Yes	Yes
163	RCTrainingBridge1	Structure Definitio...	G5	HL-93 (US)	Inventory	0.811	0.811	0.000	Yes	Yes
164	RCTrainingBridge1	Structure Definitio...	G5	HL-93 (US)	Operating	1.052	1.052	0.000	Yes	Yes
165	Simple DL-Cont LL...	GirderLine Superst...	Splices At Piers	HL-93 (US)	Inventory	0.262	0.298	13.852	No	Yes
166	Simple DL-Cont LL...	GirderLine Superst...	Splices At Piers	HL-93 (US)	Operating	0.340	0.387	13.921	No	Yes
167	Splice Example	Superstructure 1-S...	G1	HL-93 (US)	Inventory	0.617	0.617	0.000	Yes	Yes
168	Splice Example	Superstructure 1-S...	G1	HL-93 (US)	Operating	0.798	0.798	0.000	Yes	Yes
169	Splice Example	Superstructure 1-S...	G2	HL-93 (US)	Inventory	1.213	1.213	0.000	Yes	Yes
170	Splice Example	Superstructure 1-S...	G2	HL-93 (US)	Operating	1.573	1.573	0.000	Yes	Yes
171	TimberTrainingBrid...	Structure Definitio...	DECK	HL-93 (US)	Inventory	0.600	0.600	0.000	Yes	Yes
172	TimberTrainingBrid...	Structure Definitio...	DECK	HL-93 (US)	Operating	0.777	0.777	0.000	Yes	Yes
173	TimberTrainingBrid...	Structure Definitio...	G2	HL-93 (US)	Inventory	0.716	0.716	0.000	Yes	Yes
174	TimberTrainingBrid...	Structure Definitio...	G2	HL-93 (US)	Operating	0.928	0.928	0.000	Yes	Yes
175	TrainingBridge2	HDR Girder Line	Interior Member	HL-93 (US)	Inventory	0.548	0.548	0.000	Yes	Yes
176	TrainingBridge2	HDR Girder Line	Interior Member	HL-93 (US)	Operating	0.710	0.710	0.000	Yes	Yes

Level 3 Comparison

If the **Generate Level 3 Analysis** checkbox was selected for both dataset 1 and dataset 2, a level 3 comparison can be generated. Click **Run level 3 compare** in the **Level 2 Comparison** window to run a level 3 comparison on the selected members. This will open the **Level 3 Comparison** window which displays the results of the comparison at the point of interest level. If the capacity, dead load, live load, or rating/design factor percent change between

dataset 1 and dataset 2 are greater than the respective tolerances specified in the **Dataset Comparison Setting** window, the value for that column will be shown in red.

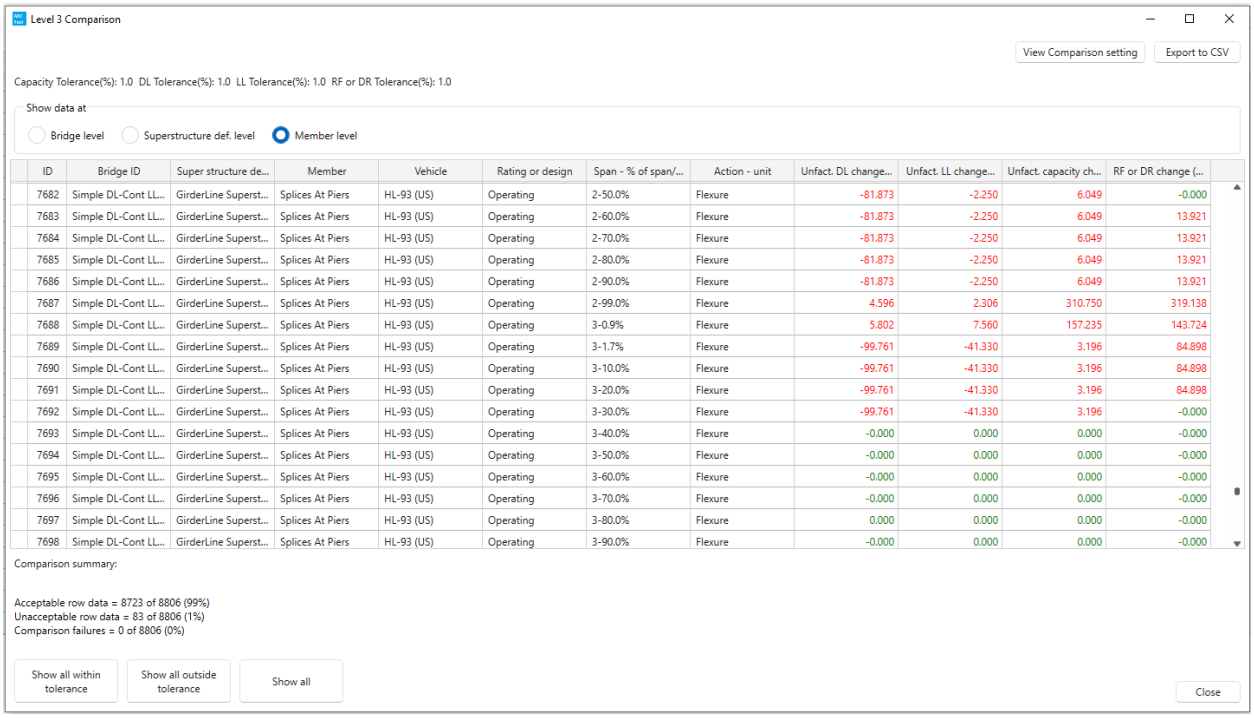
To view the settings for this comparison, click the **View comparison setting** button in the top right corner of the window. This will open the **Dataset Comparison Setting** window in read-only mode.

To export the results to a CSV file, click the **Export to CSV** button and select a location to save the file.

The **Show data at** radio buttons can be used to toggle the level 3 data to show comparisons of the controlling rating/design factor of the bridge, superstructure def. or member.

The **Comparison Summary** located at the bottom left of the window shows a summary of the level 3 results. If either dataset 1 or dataset 2 does not have a rating/design factor, the comparison will be counted as a failure. If the rating/design factor percent change is not within the specified tolerance, the comparison will be counted as unacceptable. If the rating/design factor percent change is within the specified tolerance, the comparison will be counted as acceptable.

The **Show all within tolerance**, **Show comparison failure**, and **Show all** buttons at the bottom of the Level 3 Comparison window can be used to filter the data grid by rating/design factor percent change tolerance.



ID	Bridge ID	Super structure de...	Member	Vehicle	Rating or design	Span - % of span/...	Action - unit	Unfact. DL change...	Unfact. LL change...	Unfact. capacity ch...	RF or DR change (...
7682	Simple DL-Cont LL...	GirderLine Superst...	Splices At Piers	HL-93 (US)	Operating	2-50.0%	Flexure	-81.873	-2.250	6.049	-0.000
7683	Simple DL-Cont LL...	GirderLine Superst...	Splices At Piers	HL-93 (US)	Operating	2-60.0%	Flexure	-81.873	-2.250	6.049	13.921
7684	Simple DL-Cont LL...	GirderLine Superst...	Splices At Piers	HL-93 (US)	Operating	2-70.0%	Flexure	-81.873	-2.250	6.049	13.921
7685	Simple DL-Cont LL...	GirderLine Superst...	Splices At Piers	HL-93 (US)	Operating	2-80.0%	Flexure	-81.873	-2.250	6.049	13.921
7686	Simple DL-Cont LL...	GirderLine Superst...	Splices At Piers	HL-93 (US)	Operating	2-90.0%	Flexure	-81.873	-2.250	6.049	13.921
7687	Simple DL-Cont LL...	GirderLine Superst...	Splices At Piers	HL-93 (US)	Operating	2-99.0%	Flexure	4.596	2.306	310.750	319.138
7688	Simple DL-Cont LL...	GirderLine Superst...	Splices At Piers	HL-93 (US)	Operating	3-0.9%	Flexure	5.802	7.560	157.235	143.724
7689	Simple DL-Cont LL...	GirderLine Superst...	Splices At Piers	HL-93 (US)	Operating	3-1.7%	Flexure	-99.761	-41.330	3.196	84.898
7690	Simple DL-Cont LL...	GirderLine Superst...	Splices At Piers	HL-93 (US)	Operating	3-10.0%	Flexure	-99.761	-41.330	3.196	84.898
7691	Simple DL-Cont LL...	GirderLine Superst...	Splices At Piers	HL-93 (US)	Operating	3-20.0%	Flexure	-99.761	-41.330	3.196	84.898
7692	Simple DL-Cont LL...	GirderLine Superst...	Splices At Piers	HL-93 (US)	Operating	3-30.0%	Flexure	-99.761	-41.330	3.196	-0.000
7693	Simple DL-Cont LL...	GirderLine Superst...	Splices At Piers	HL-93 (US)	Operating	3-40.0%	Flexure	-0.000	0.000	0.000	-0.000
7694	Simple DL-Cont LL...	GirderLine Superst...	Splices At Piers	HL-93 (US)	Operating	3-50.0%	Flexure	-0.000	0.000	0.000	-0.000
7695	Simple DL-Cont LL...	GirderLine Superst...	Splices At Piers	HL-93 (US)	Operating	3-60.0%	Flexure	-0.000	0.000	0.000	-0.000
7696	Simple DL-Cont LL...	GirderLine Superst...	Splices At Piers	HL-93 (US)	Operating	3-70.0%	Flexure	-0.000	0.000	0.000	-0.000
7697	Simple DL-Cont LL...	GirderLine Superst...	Splices At Piers	HL-93 (US)	Operating	3-80.0%	Flexure	0.000	0.000	0.000	-0.000
7698	Simple DL-Cont LL...	GirderLine Superst...	Splices At Piers	HL-93 (US)	Operating	3-90.0%	Flexure	-0.000	0.000	0.000	-0.000