AASHTOWare BrDR 6.8.3

Regression Comparison Tool

TestUtilityUser

Introduction

Wikipedia defines regression testing as the following:

> *"**Regression testing** is a type of software testing that seeks to uncover new software bugs, or regressions, in existing functional and non-functional areas of a system after changes such as enhancements, patches or configuration changes, have been made to them."*

The BrDR Regression Comparison Tool allows users to perform regression testing between different sets of BrDR analyses.

Differences between two sets of BrDR analyses can occur for several reasons including the following:

- The software was changed intentionally to address a change in the AASHTO specification – an expected and acceptable change.
- The software was changed intentionally to address a coding defect – an expected and acceptable change.
- The software was changed intentionally to provide a user requested enhancement – an expected and acceptable change.
- The software was inappropriately changed thus introducing a defect – an unexpected and unacceptable change.

Differences between two analytical engines can occur for several reasons including the following:

- Differences can occur when the two engines produce different results because of differing assumptions.
- One engine is more rigorous or refined than the other.
- Differing interpretations of the AASHTO specifications.
- One or both engines have a defect.

When a difference is found as a result of regression testing, the user must investigate to determine the cause. The BrDR Regression Comparison Tool can help a user compare two analyses, identify the cause of the differences, and using the comparisons and a working knowledge of the change/enhancement, determine if the differences are expected and acceptable.

Features – What does the Regression Comparison Tool do?

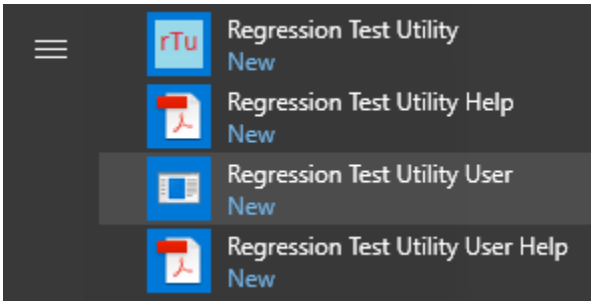
The Regression Comparison Tool allows the user to compare the following results between two different sets of BrDR analyses:

- Text comparison for the specification check articles. This comparison requires the use of a third-party text comparison software such as Beyond Compare or WinMerge.
- Graphical comparisons of dead load and live load actions, including moment, shear, deflection, etc.
- Graphical comparison of computed specification check data.

The AASHTO analytical engines in BrDR store regression data associated with report numbers similar to the NCHRP 12-50 process (*NCHRP Report 485 – Bridge Software – Validation Guidelines and Examples*). If a third-party analytical engine stores regression data with the same report numbers in an RTU file similar to that produced by BrDR, the regression tool can also be used to compare results between the 2 analytical engines.

Graphical User Interface

The Regression Comparison Tool has two interfaces, TestUtilityUser and TestUtilityBatch. TestUtilityUser is a simpler version of TestUtilityBatch that allows the comparison of any two RTU (Regression Testing Utility) and SCA (Specification Check Articles) files. While TestUtilityBatch and TestUtilityUser perform the same file comparison functions, TestUtilityBatch is geared for automated batch testing of multiple test cases. This tutorial will focus only on the usage of TestUtilityUser. Each regression test utility comes with its own Getting Started manual.



<= TestUtilityBatch

<= TestUtilityBatch - Getting Started

<= TestUtilityUser

<= TestUtilityUser - Getting Started

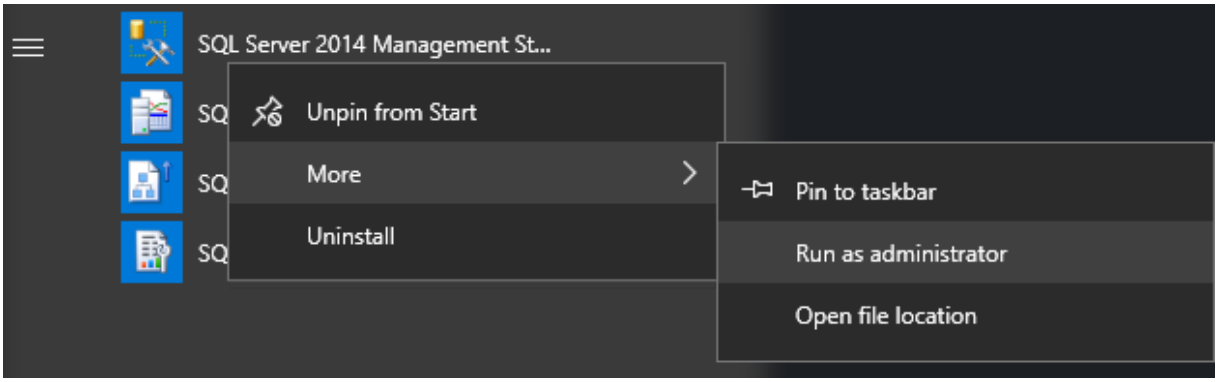
Configuring Database

The regression test utility uses a database to store information. Users will not be able to open the utility if a database with the name AashtoBridgeTestUtility is not created or attached. Both TestUtilityBatch and TestUtilityUser use the same database.

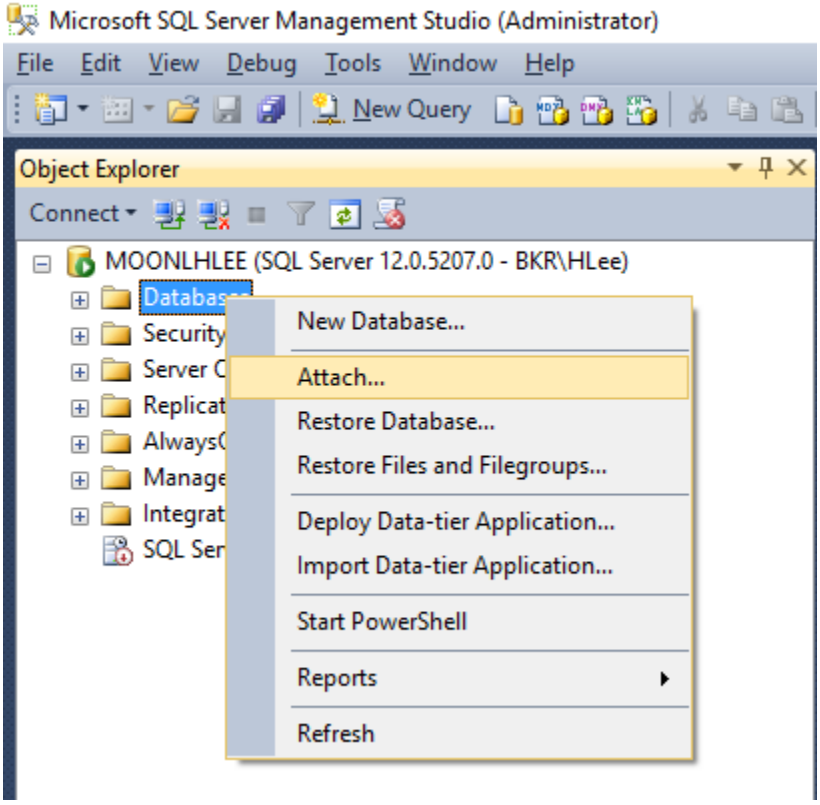
Attaching AashtoBridgeTestUtility 6.8.3 database

The version 6.8.3 database (AashtoBridgeTestUtility.mdf) is included with the utility and must be configured before using the utility. In order to configure/attach the database, it is necessary to have SQL Server 2014 SP2 installed on the user's computer. If users do not have SQL Server 2014 SP2 installed on their computer, they may either install it using the BrDR 6.8.3 installer or download it from https://www.microsoft.com/en-us/download/details.aspx?id=53167.

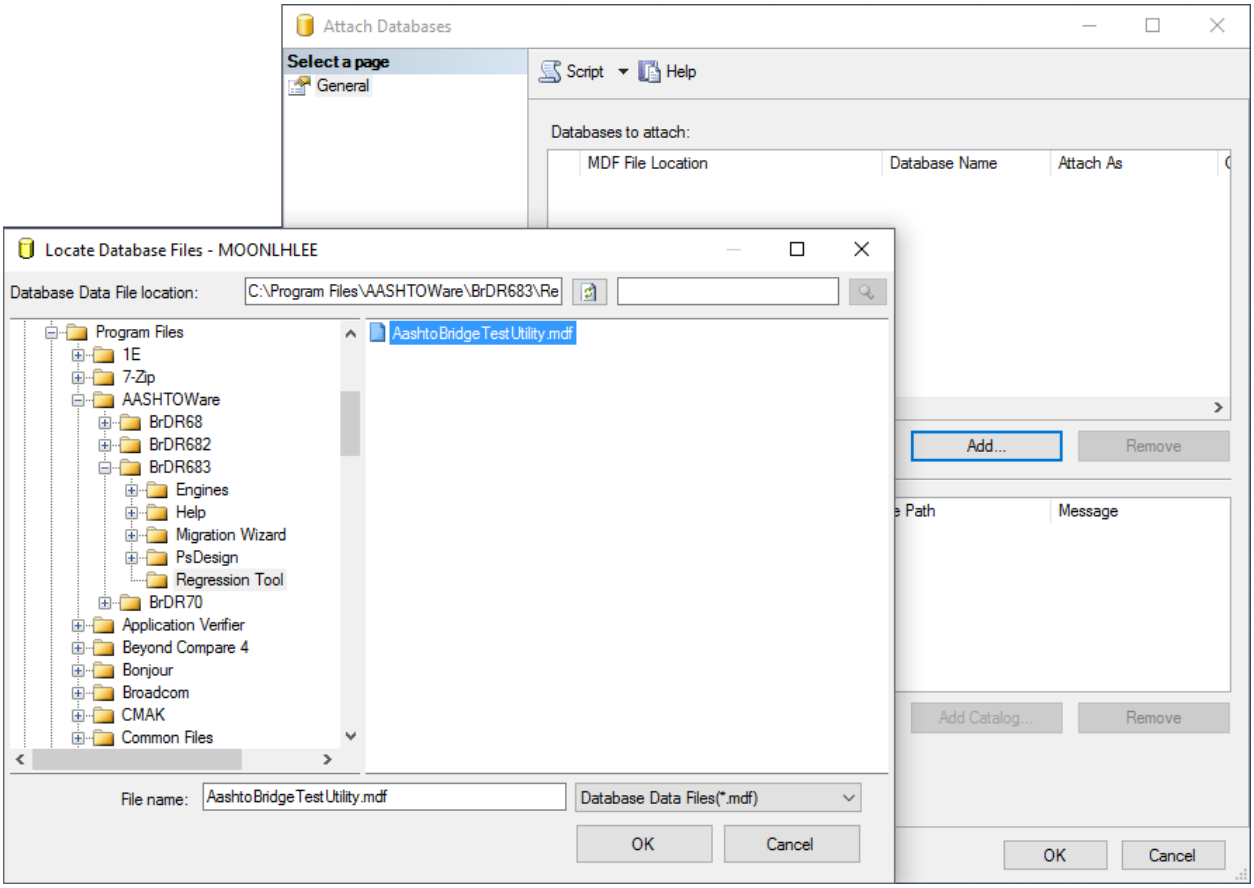
To attach the database, run SQL Server Management Studio as administrator.



When the studio is opened, right click on Database and select Attach.

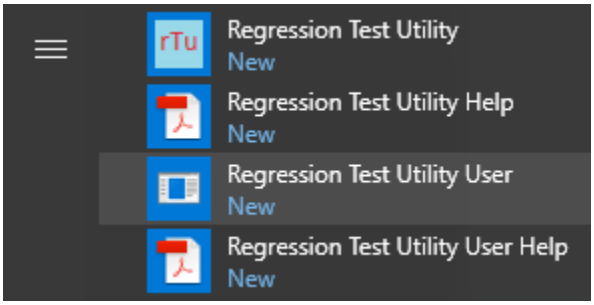


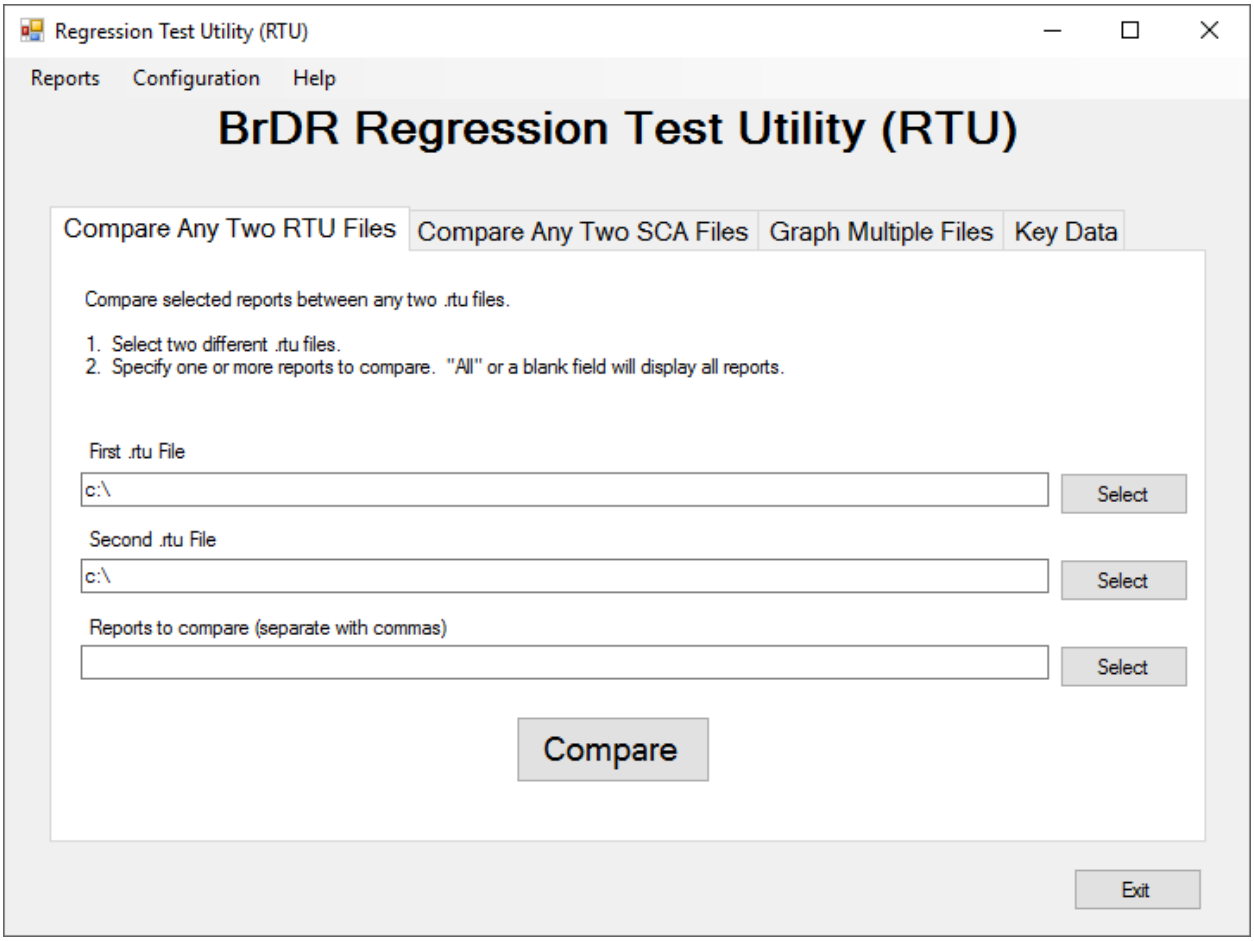
Browse to the location of the MDF file and select the database by clicking on the Add button and browsing to the database file as shown below.



Opening TestUtilityUser

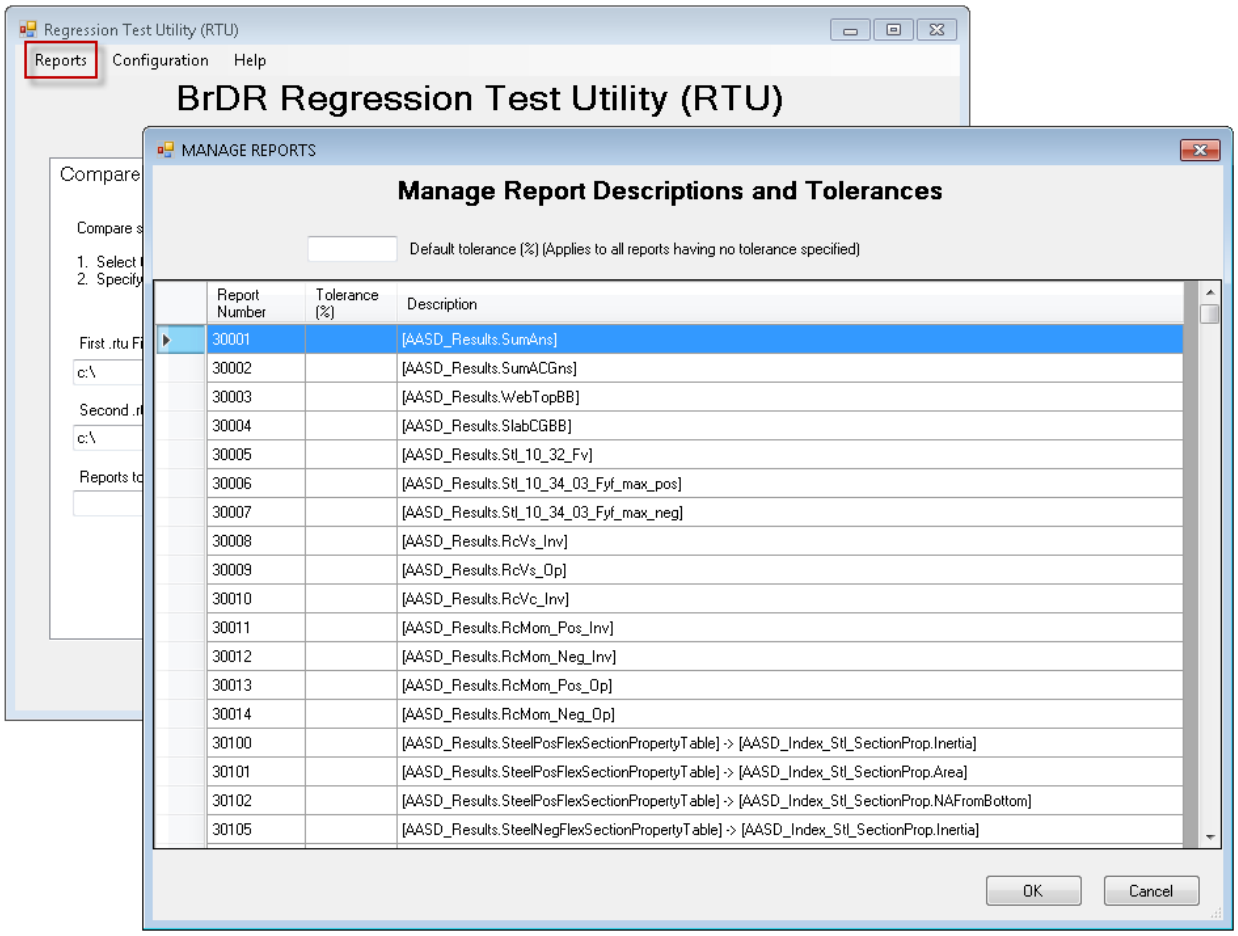
Go to the Start Menu and click on the AASHTOWare's Regression Test Utility User application.





Reports and Configuration windows

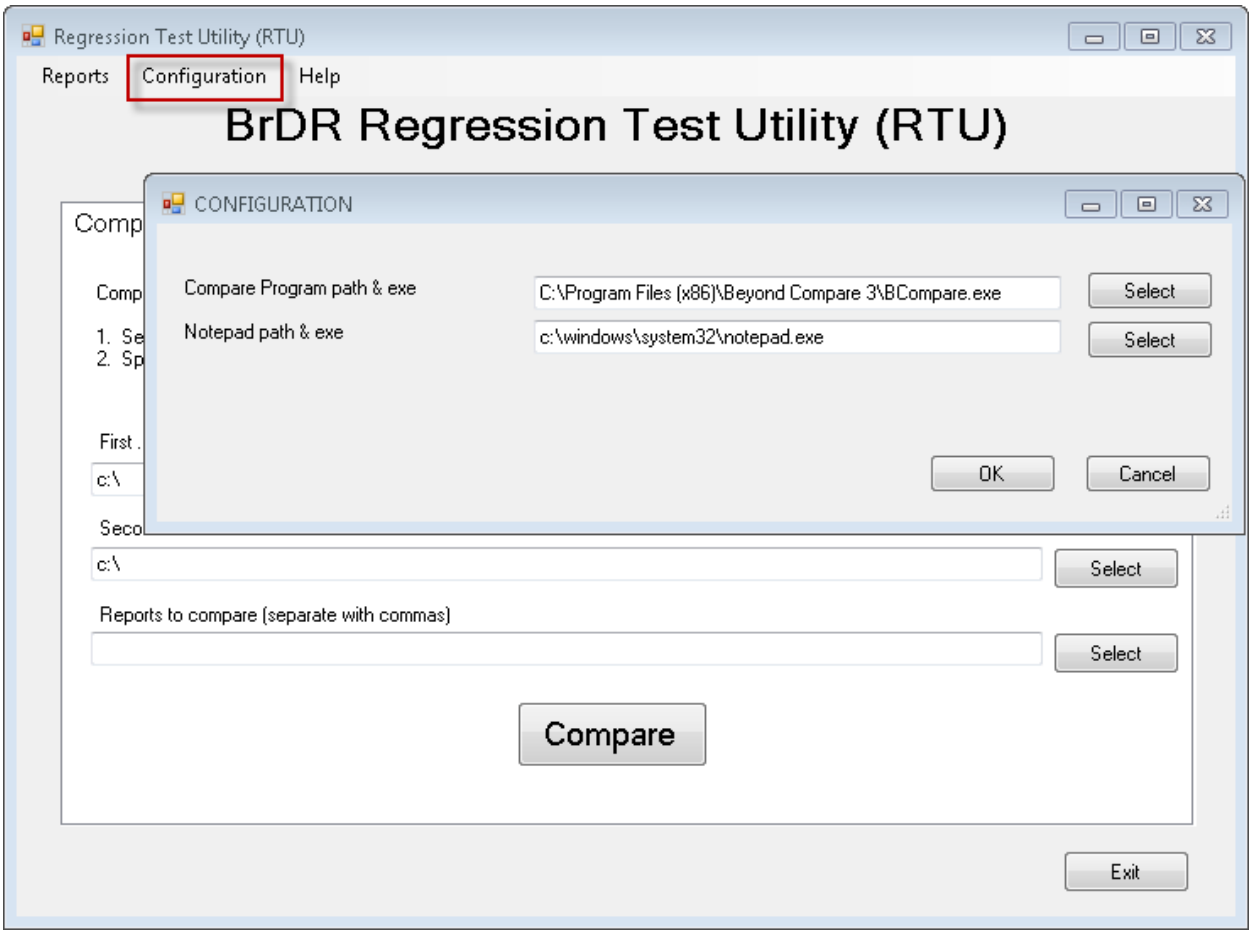
Click on Reports on the menu bar to open the Manage Reports window.



This window contains a table that lists all the available reports that can be output by BrDR (a specific test case will output a subset of these reports), description and tolerances. A "report" is a number assigned to a specific type of value (refer to NCHRP 12-50) produced by a BrDR analysis. For example, NCHRP 12-50 defines report numbers 50042 through 50045 to be shear resistance values Vr, Vn, Vc and Vs. TestUtilityUser graphs these values and calculates differences between two different analyses. These reports are prepopulated from the AashtoBridgeTestUtility database, users are not able to add or delete report from the user interface.

A report can have a tolerance assigned to it. The tolerance is used to determine whether the results of two analyses are considered acceptable or not. Generally, regression testing is looking for zero change. However, there are some useful exceptions. For example, when results from two different programs are being compared or when BrDR's values change slightly due to a bug fix or other planned modification.

Click on Configuration on the menu bar to open the Configuration window.



The Configuration window points to helper programs on your computer. The first path "Compare Program path & exe" points to a comparison software such as Beyond Compare. This is needed to compare two text files (specification check articles) side by side. There are free text comparison software online like WinMerge and ExamDiff that users may download. Users may also use online tool such as Diff Checker and Text Compare. The second path "Notepad path & exe" points to a text editor such as Notepad or Wordpad. The default is c:\windows\system32\notepad.exe as Notepad is generally used, however the utility tool may open any text editor including Microsoft Word.

To continue this tutorial, download and install a comparison software if you don't have one in your computer. Select the path to the comparison software executable file. Click OK to save the configuration and close the window.

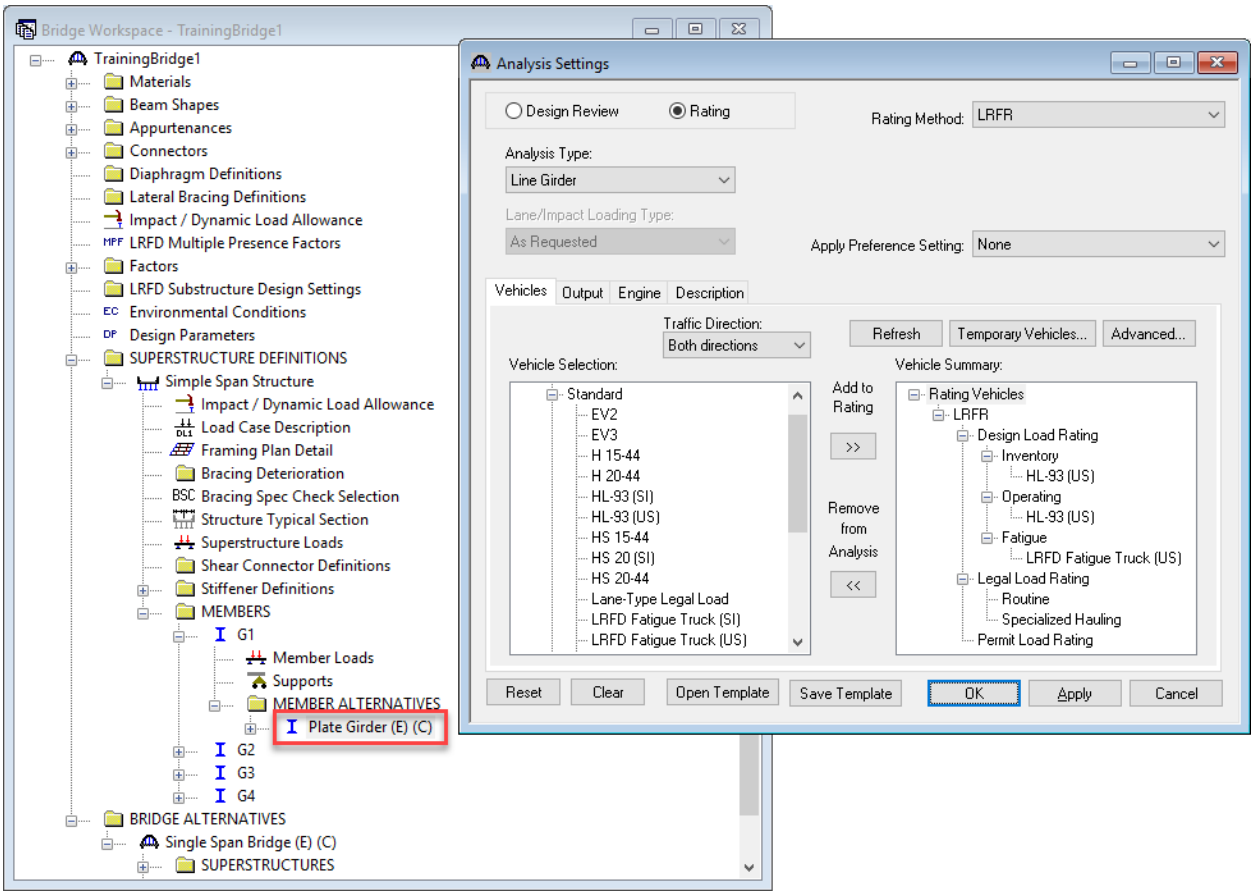
Producing RTU and SCA files

An RTU (regression testing utility) file contains dead load, live load, and other values calculated during spec checking. Report numbers are assigned to different types of values. A SCA (specification check article) file contains the text output from each specification article as it appears in BrDR. One RTU and one SCA file is generated for each member alternative.

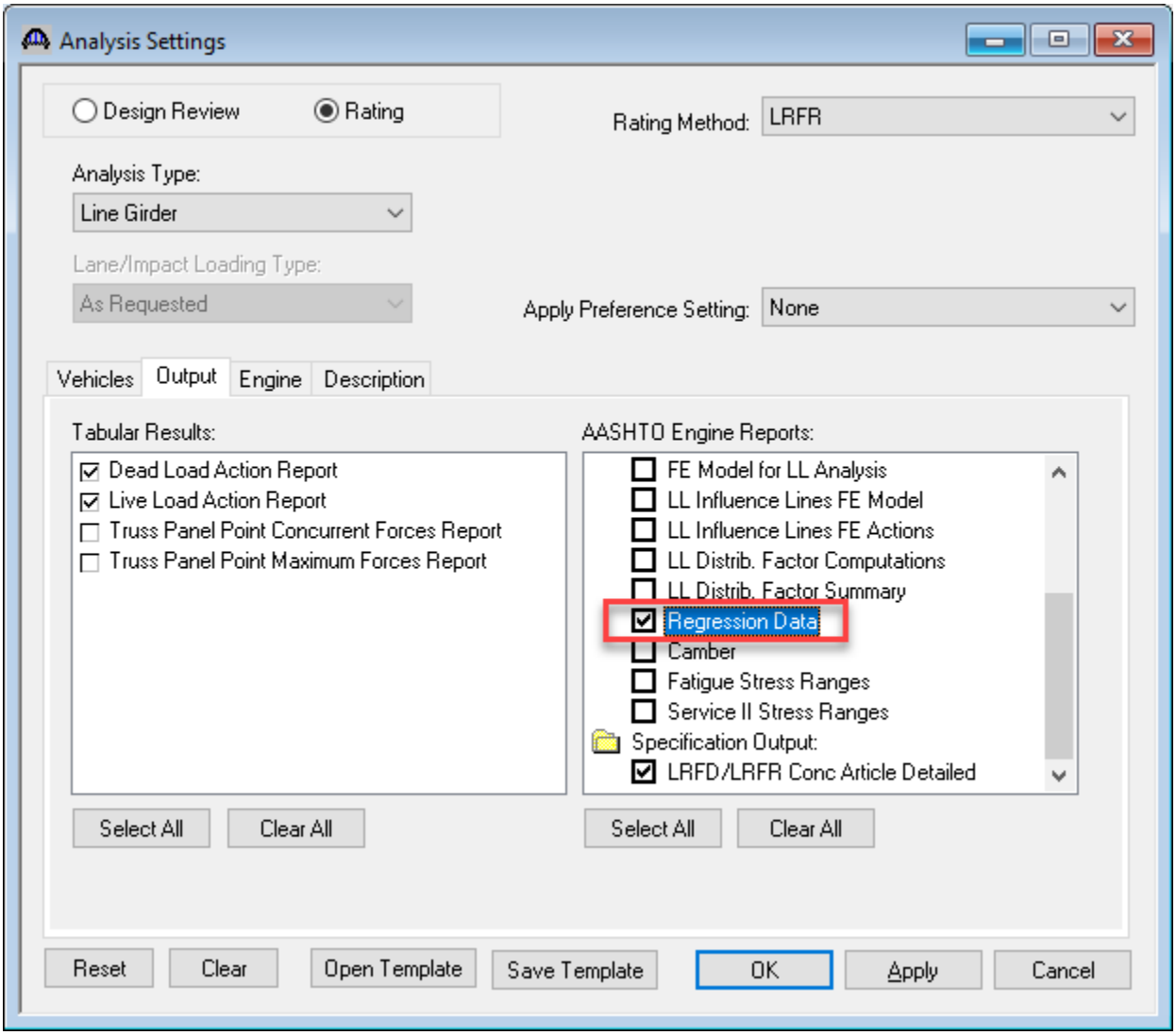
To use this utility, you will need two RTU or SCA files. This section of the tutorial will show you how to produce RTU and SCA files in BrDR and manually compare them in the regression utility.

The following example demonstrates the tool's features by comparing the results between the Legacy AASHO LRFR Engine and the Modernized AASHTO LRFR Engine.

Launch BrDR 6.8.3 from the Start Menu and connect to the AASHTOWareBr683s database. Open BID1 TrainingBridge1 Bridge Workspace. Expand the Simple Span Structure superstructure definition and select the G1 member's Plate Girder member alternative in the Bridge Workspace tree. Open the Analysis Settings window and select the LRFR Design Load Rating template.

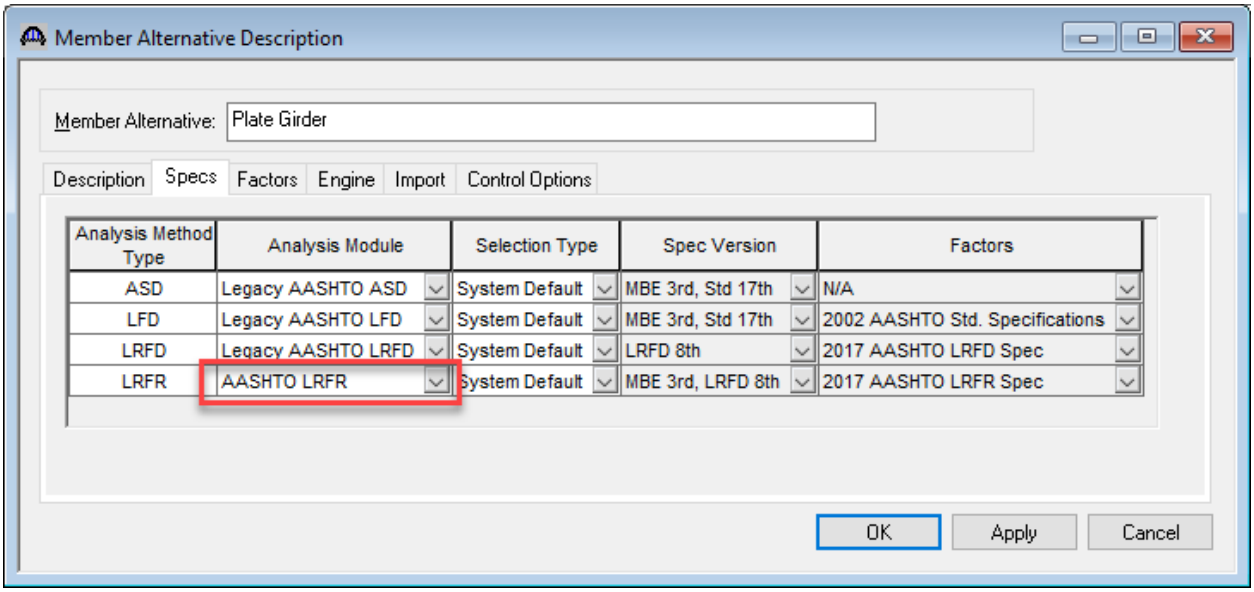


Switch to the Output tab and select the AASHTO Engine Reports' Regression Data option. These AASHTO Engine Reports are stored in the user's analysis output folder. Click OK to save the analysis settings and close the window.

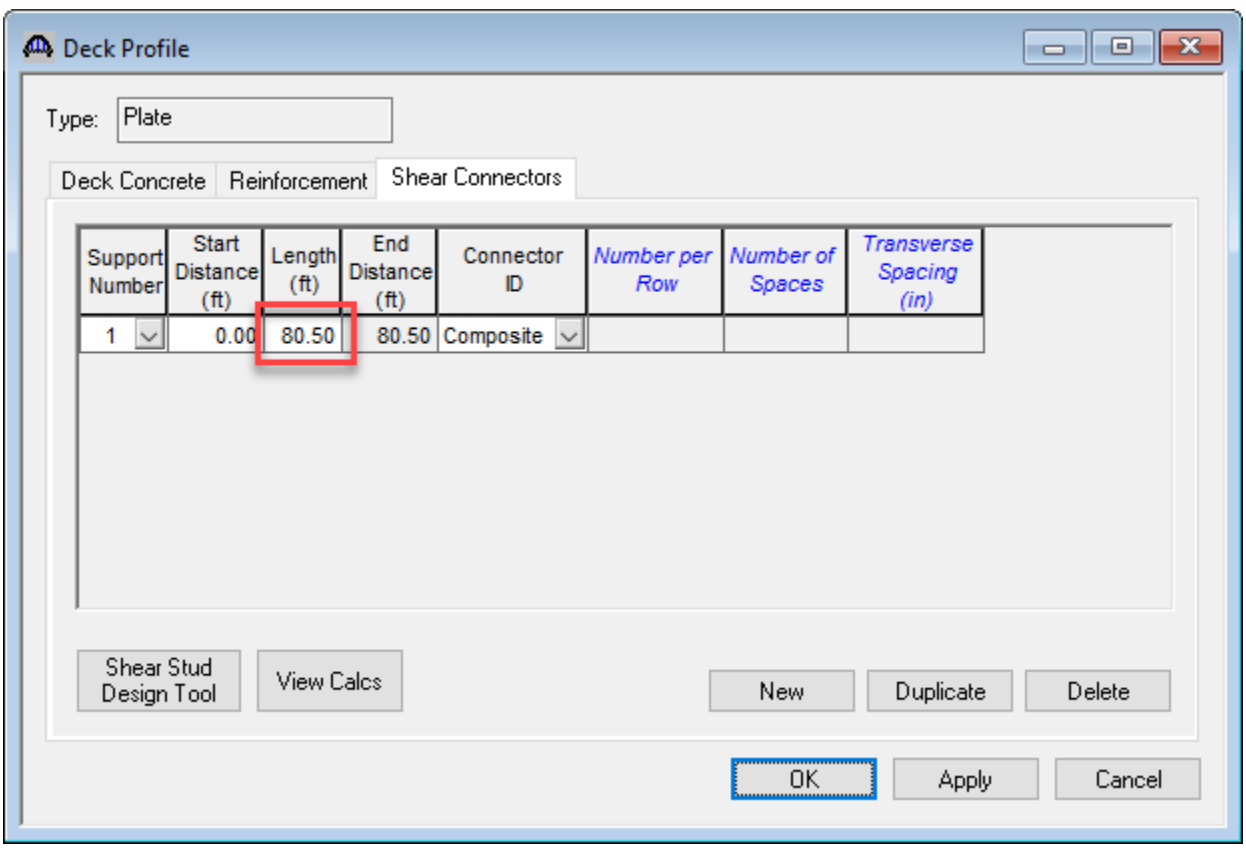


Click on the Analyze button on the toolbar to perform the LRFR analysis. Since the Legacy AASHTO LRFR Engine is selected for LRFR analysis on the Member Alternative window's Specs tab, the generated regression data is for the Legacy AASHTO LRFR Engine. Click OK to close the Analysis Progress window.

Open the G1 member's Plate Girder Member Alternative window. Switch to the Specs tab and select the Modernized AASHTO LRFR Engine. Click OK to close the Member Alternative window.

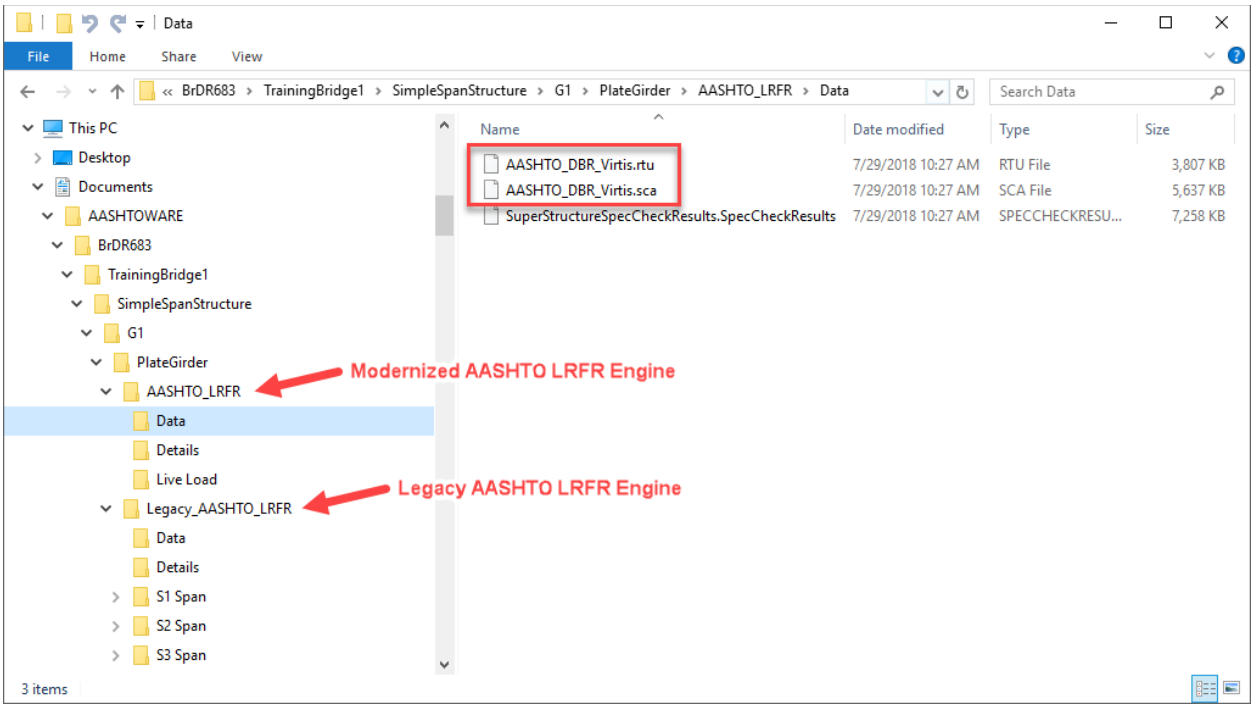


To illustrate the tool's comparison features, expand the Plate Girder member alternative in the Bridge Workspace tree. Open the Deck Profile window and decrease the length of the shear connector range from 161 ft to 80.5 ft.



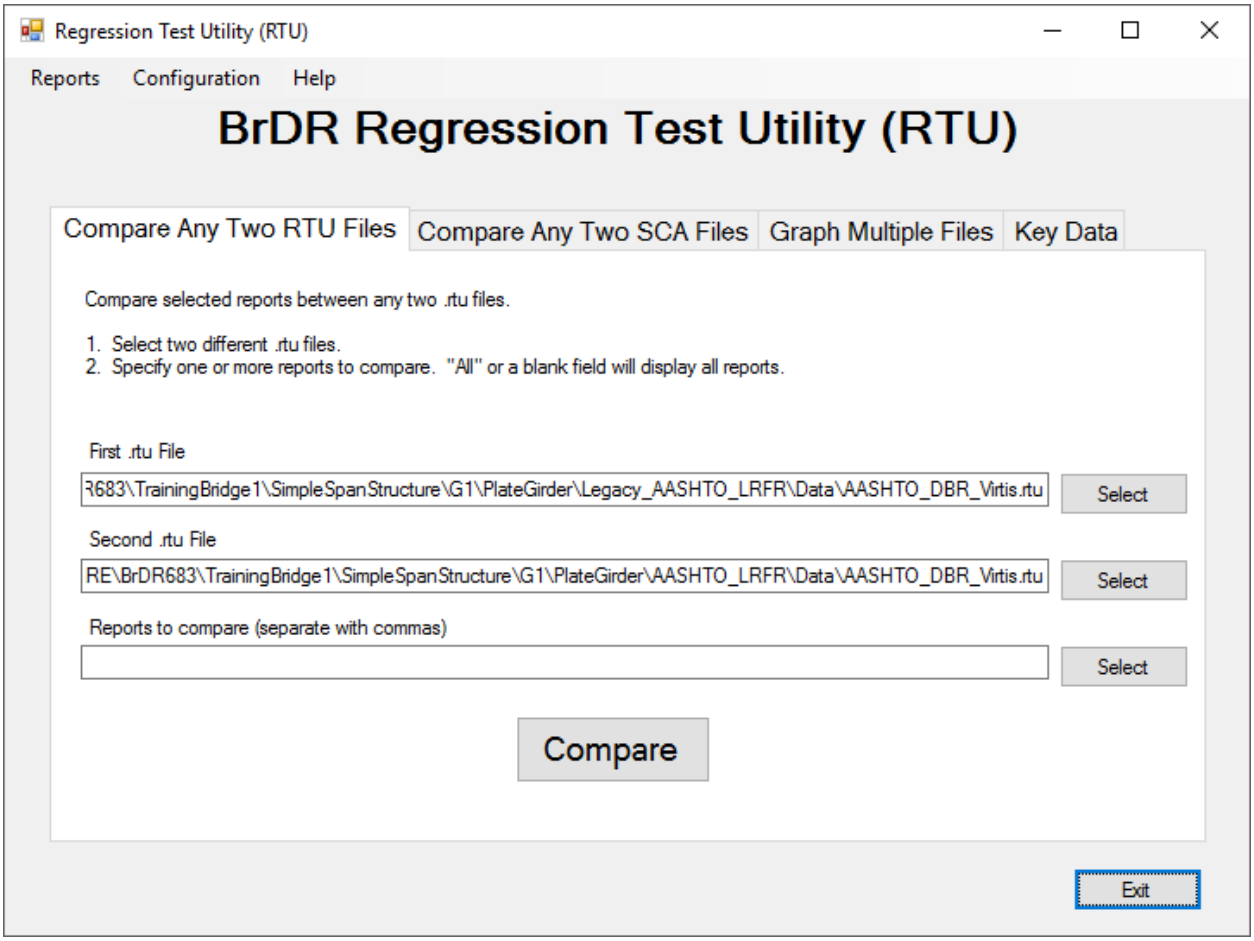
Select the G1 member's Plate Girder member alternative in the Bridge Workspace tree. Click on the Analyze button on the toolbar to perform the LRFR analysis using the Modernized AASHTO LRFR Engine. Click OK to close the Analysis Progress window.

The regression data is stored in the user's analysis output folder. The default analysis output folder is the My Documents folder. The AASHTO Engine stores the RTU (regression testing utility) files and SCA (specification check article) files inside the Data folder.

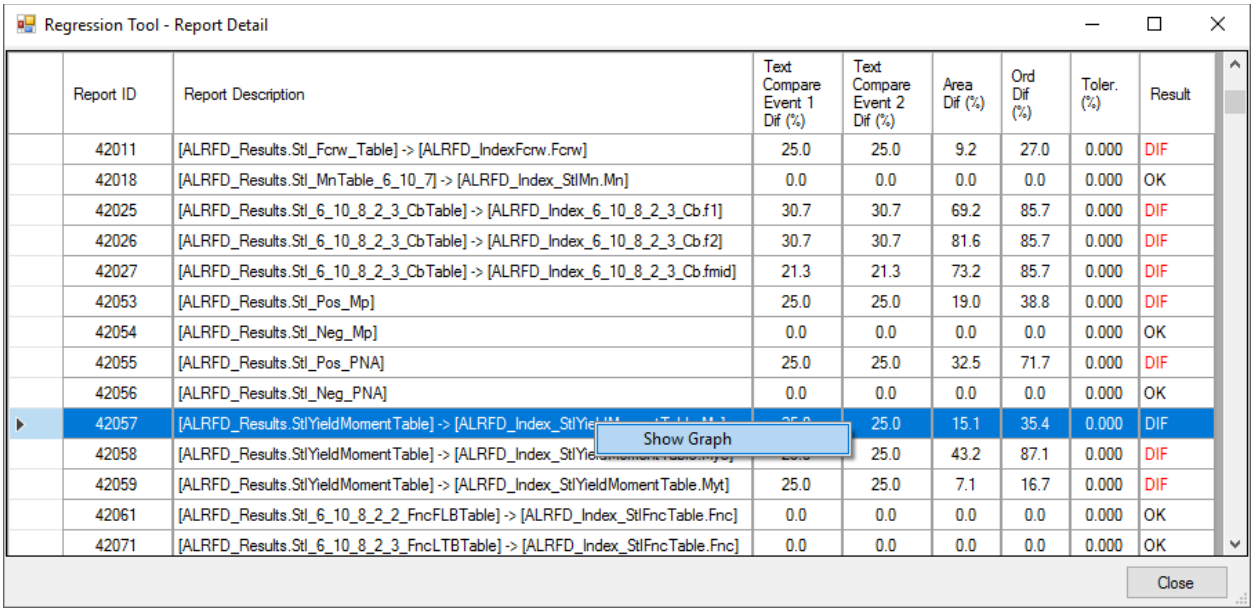


Comparing RTU and SCA files

In the testing utility, select the two RTU files to compare. You can also limit the set of reports presented in the Report Detail window by specifying the report numbers to compare. Click Compare to start the RTU comparison.

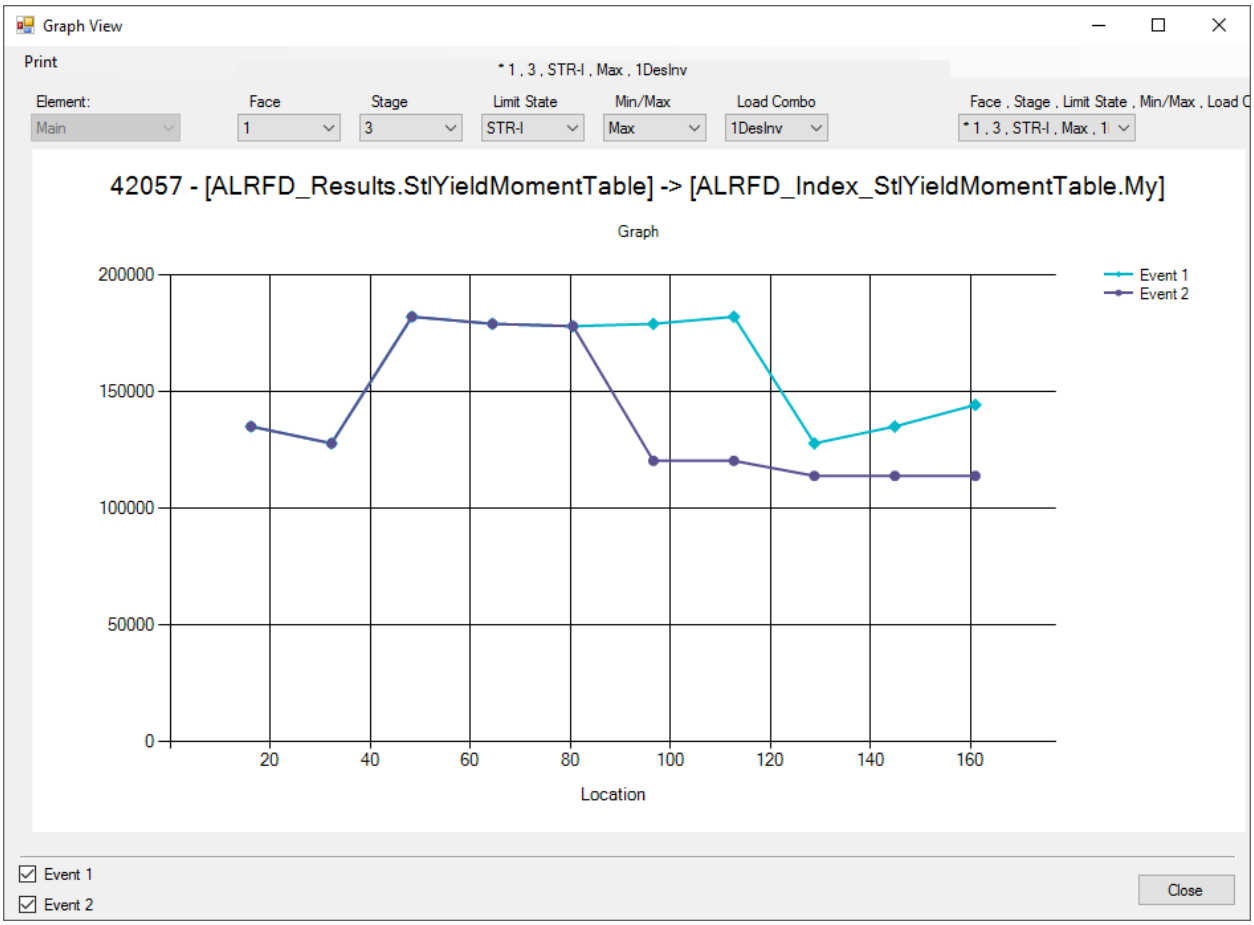


The Report Detail window presents the comparison results in tabular form.



Report ID	Report Description	Text Compare Event 1 Dif (%)	Text Compare Event 2 Dif (%)	Area Dif (%)	Ord Dif (%)	Toler. (%)	Result
42011	[ALRFD_Results.Stl_Fcrw_Table] -> [ALRFD_IndexFcrw.Fcrw]	25.0	25.0	9.2	27.0	0.000	DIF
42018	[ALRFD_Results.Stl_MnTable_6_10_7] -> [ALRFD_Index_StlMn.Mn]	0.0	0.0	0.0	0.0	0.000	OK
42025	[ALRFD_Results.Stl_6_10_8_2_3_CbTable] -> [ALRFD_Index_6_10_8_2_3_Cb.f1]	30.7	30.7	69.2	85.7	0.000	DIF
42026	[ALRFD_Results.Stl_6_10_8_2_3_CbTable] -> [ALRFD_Index_6_10_8_2_3_Cb.f2]	30.7	30.7	81.6	85.7	0.000	DIF
42027	[ALRFD_Results.Stl_6_10_8_2_3_CbTable] -> [ALRFD_Index_6_10_8_2_3_Cb.fmid]	21.3	21.3	73.2	85.7	0.000	DIF
42053	[ALRFD_Results.Stl_Pos_Mp]	25.0	25.0	19.0	38.8	0.000	DIF
42054	[ALRFD_Results.Stl_Neg_Mp]	0.0	0.0	0.0	0.0	0.000	OK
42055	[ALRFD_Results.Stl_Pos_PNA]	25.0	25.0	32.5	71.7	0.000	DIF
42056	[ALRFD_Results.Stl_Neg_PNA]	0.0	0.0	0.0	0.0	0.000	OK
42057	[ALRFD_Results.StlYieldMomentTable] -> [ALRFD_Index_StlYie		25.0	15.1	35.4	0.000	DIF
42058	[ALRFD_Results.StlYieldMomentTable] -> [ALRFD_Index_StlYie		25.0	43.2	87.1	0.000	DIF
42059	[ALRFD_Results.StlYieldMomentTable] -> [ALRFD_Index_StlYieldMomentTable.Myt]	25.0	25.0	7.1	16.7	0.000	DIF
42061	[ALRFD_Results.Stl_6_10_8_2_2_FncFLBTable] -> [ALRFD_Index_StlFncTable.Fnc]	0.0	0.0	0.0	0.0	0.000	OK
42071	[ALRFD_Results.Stl_6_10_8_2_3_FncLTBTable] -> [ALRFD_Index_StlFncTable.Fnc]	0.0	0.0	0.0	0.0	0.000	OK

Select report number 42057. Right click on report number 42057 and select Show Graph to present the results for this report in graphical form.



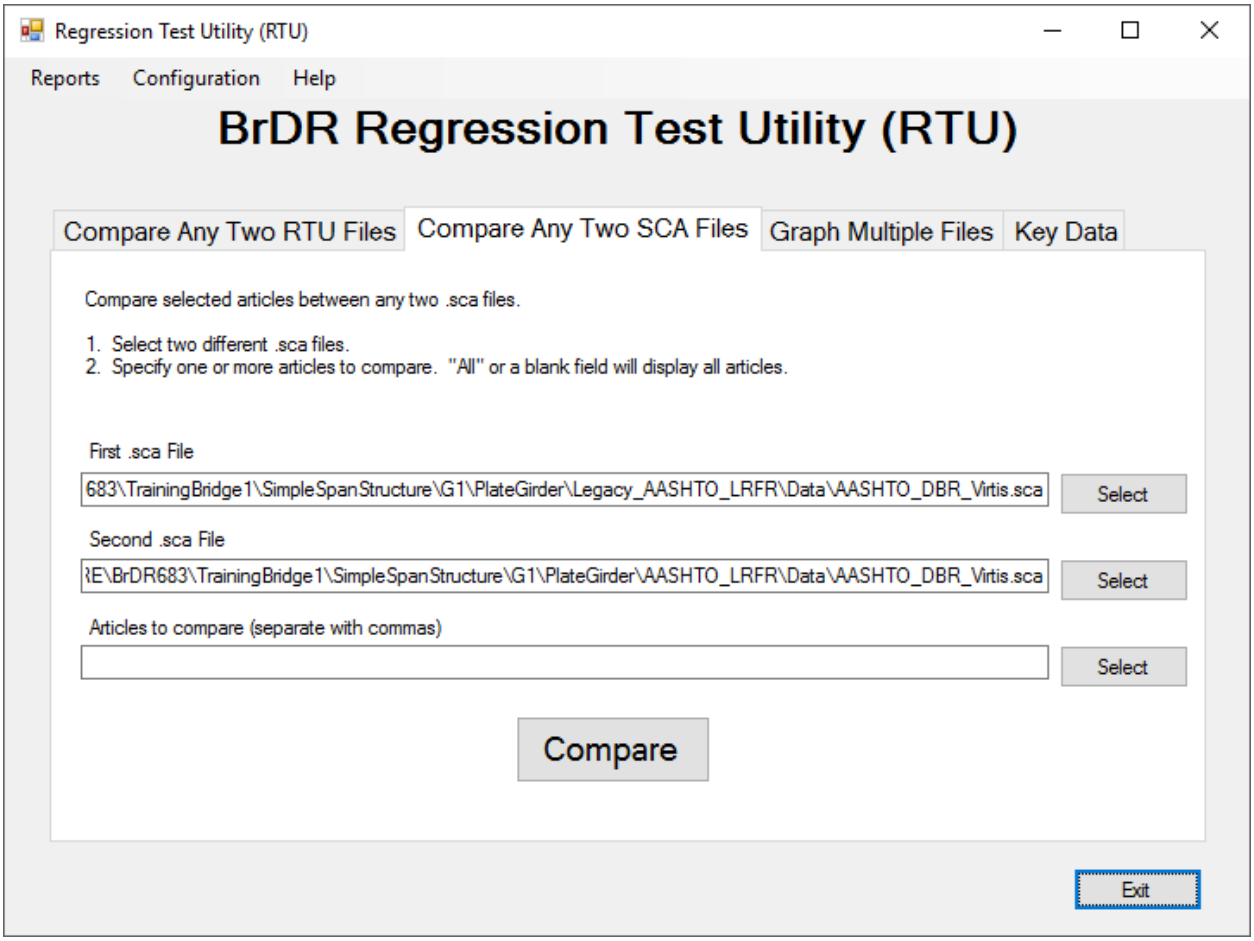
For this report number, results are presented along the length of the girder for each combination of Face, Stage, Limit State, Min/Max and Load Combo. The drop-down list on the top right of the graph allows you to quickly scroll through each combination. A combination marked with an * indicates differences found. Event 1 represents the report number in the first RTU file and Event 2 represents the report number in the second RTU file.

The % differences in results shown on the Report Detail window represent the following.

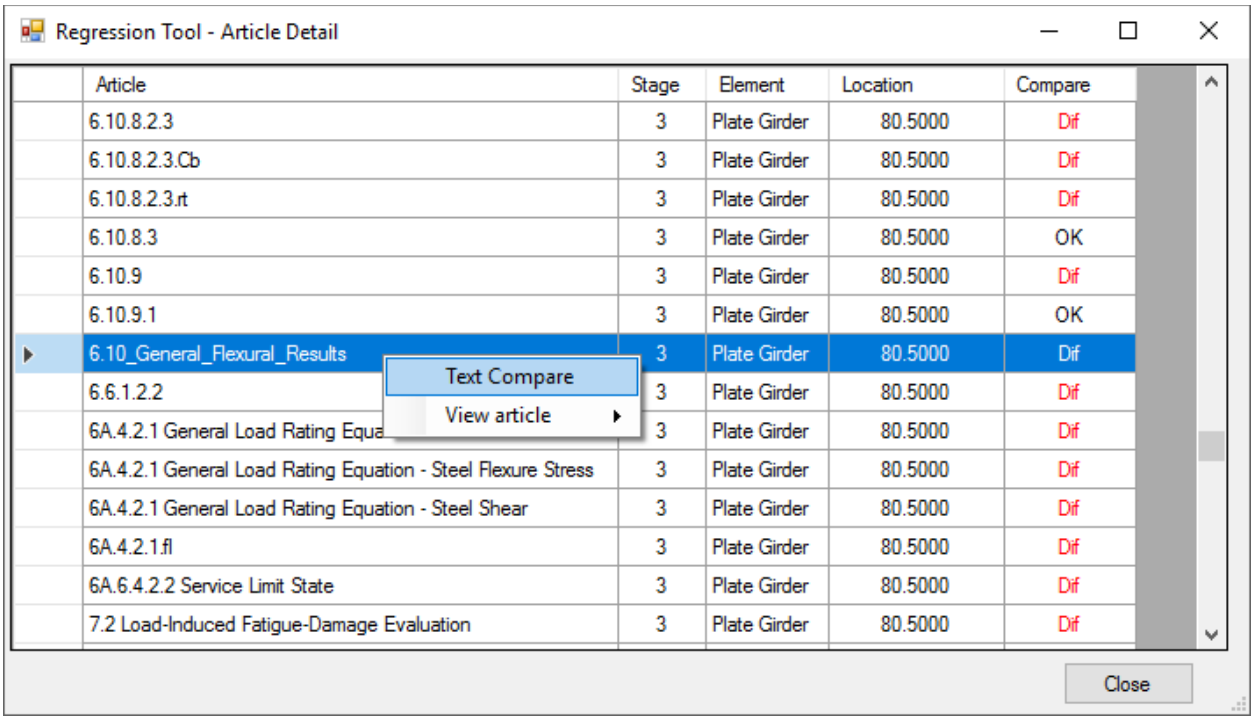
- Percent difference in the areas between the two graphs. Areas are calculated using the trapezoids under each point with vertical lines projected to the axis origin below. The percentage is (larger area – smaller area) * 100 / (larger area).
- Percent difference in ordinate values between the two graphs. The percentage is (difference in ordinate values) * 100 / (largest ordinate value).

Review the RTU differences for other report numbers. Close the Graph View window and the Report Detail window.

Switch to the Compare Any Two SCA Files tab and select the two SCA files to compare. Click Compare to start the SCA comparison.



The Article Detail window presents the comparison results. The comparison of the SCA files is provided for every article at different stages and locations. The Compare column indicates if the SCA files are different for that particular article, stage and location.



Right click on an article and select Text Compare will open the comparison software that you configured. View article allows you to open individual articles in the text editor software that was configured. Event1 article is the article in the first SCA file and Event2 article is the article in the second SCA file.

Review the SCA differences for other articles, stages and locations.