

*AASHTOWare BrDR 7.5.0*

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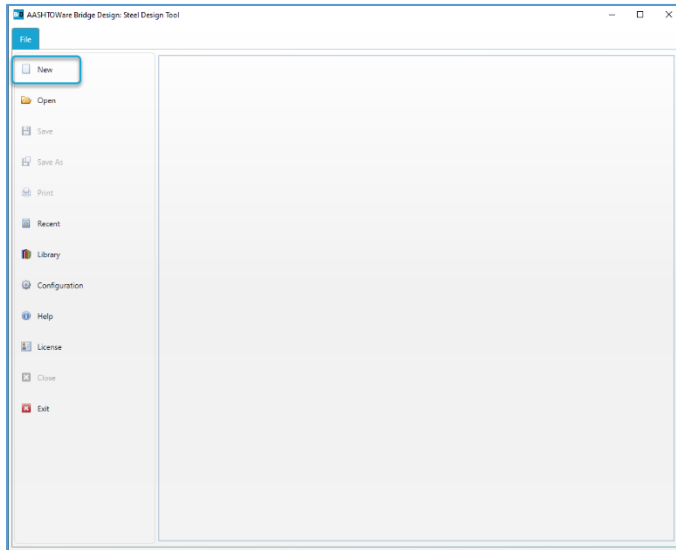
***Steel Design Tool***

*Two Span Girder Design Example*

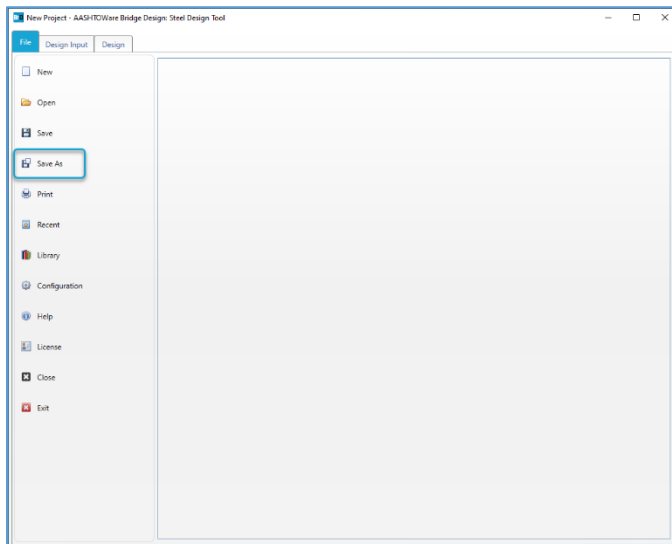
## Two Span Girder Design Example

Start the **Steel Design Tool** program, create a new input file using the **File | New** command. The program will switch from the **File** tab to the **Design Input** tab.

### File | New and File | Save As



Before proceeding with **Design Input** return to the **File** tab and click **Save As** to rename the file from **New Project** to **STL15 Design Example**.



The new file name will appear in the program title bar and the program will again bring up the the **Design Input** with the **Project** input screen. The **Project** property will still say **New Project** and this will be changed in the next step. The **Project** property determines the name of the subfolder in the Documents\AASHTOWare\SteelDesign75\ folder where design run output files will be stored. In the bottom left corner of the program window, there is a

**Validation** button that enables input validation. When validation is enabled, the program will mark sections and input boxes with missing or incorrect information. For the purposes of this example, the **Validation** will be disabled during input and will be enabled after all input is entered to verify that there are no validation errors.

## Design Input | Project

On the Design Input | **Project** input screen, enter the data as shown below.

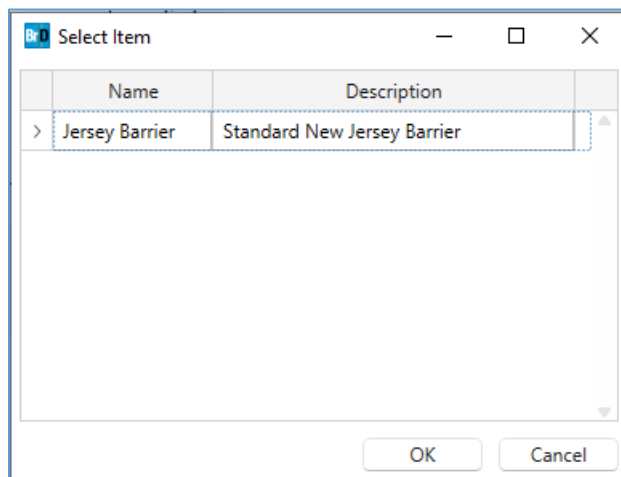
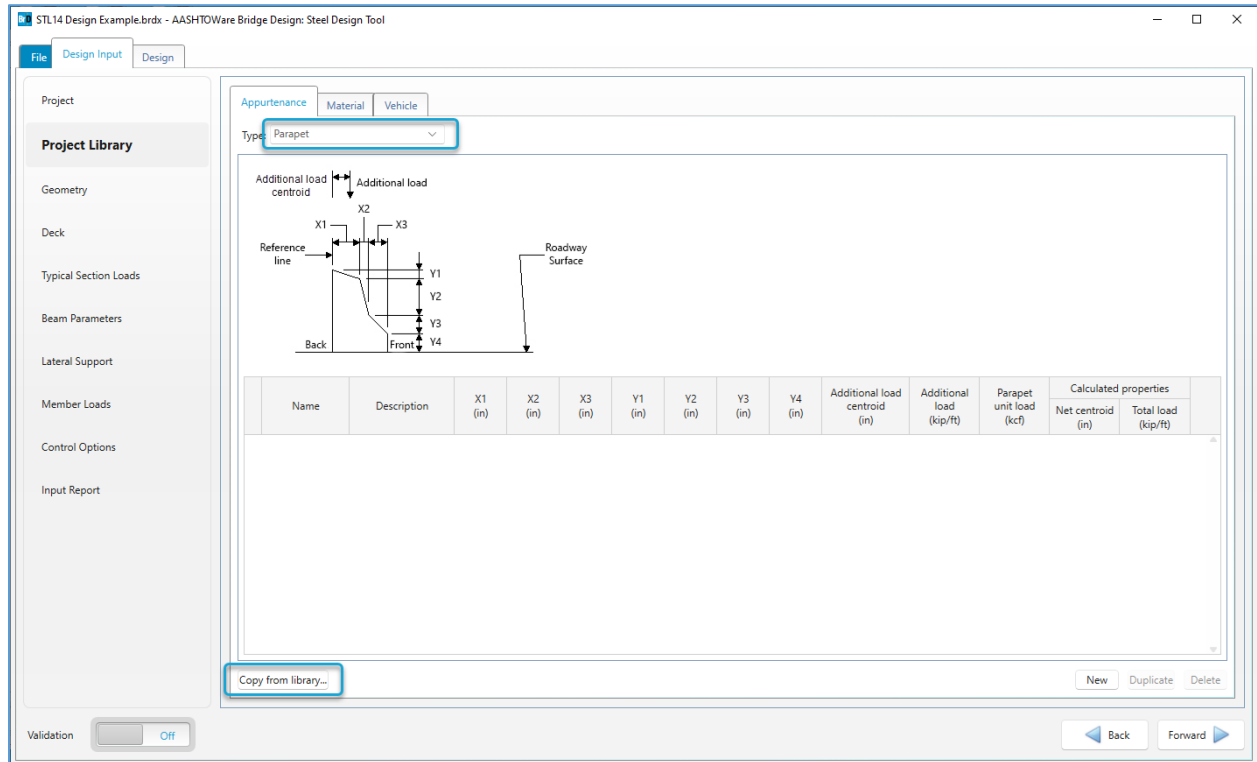
The screenshot displays the 'Project' input screen within the 'AASHTOWare Bridge Design: Steel Design Tool'. The interface includes a sidebar on the left with navigation options: Project, Project Library, Geometry, Deck, Typical Section Loads, Beam Parameters, Lateral Support, Member Loads, Control Options, and Input Report. The 'Project' tab is selected. The main area contains the following fields and sections:

- Project:** A text box containing 'STL14 Design Example'.
- Description:** A text box containing '2 Span 4 Girder Bridge'.
- Designer:** An empty text box.
- Date:** A date picker showing '2/8/2024'.
- LRFD specifications:**
  - Edition:** A dropdown menu set to 'AASHTO LRFD 9th'.
  - Limit states:** A group of checkboxes, all of which are checked: Strength-I, Strength-II, Strength-III, Strength-V, Service-II, Fatigue-I, and Fatigue-II.
- Design vehicles:**
  - Design load:** A text box with a dropdown arrow.
  - Permit load:** A text box with a dropdown arrow.
  - ☐ Single lane permit load
  - Fatigue load:** A text box with a dropdown arrow.
- Design ADTT:** A text box containing '0'.

At the bottom of the window, there is a 'Validation' toggle switch set to 'Off', and 'Back' and 'Forward' navigation buttons.

## Design Input | Project Library | Appurtenance

On the **Appurtenance** tab, select **Parapet** for **Type** from the drop down menu and click the **Copy from library** button to add a new parapet. Select the Jersey Barrier.



## STL15 - Steel Design Tool Example

STL14 Design Example.brdx - AASHTOWare Bridge Design: Steel Design Tool

File
Design Input
Design

Project

Project Library

Geometry

Deck

Typical Section Loads

Beam Parameters

Lateral Support

Member Loads

Control Options

Input Report

Appurtenance
Material
Vehicle

Type: Parapet

Name	Description	X1 (in)	X2 (in)	X3 (in)	Y1 (in)	Y2 (in)	Y3 (in)	Y4 (in)	Additional load centroid (in)	Addition load (kip/ft)	Parapet unit load (kip/ft)	Calculated properties	
												Net centroid (in)	Total load (kip/ft)
Jersey Barrier	Standard New Jersey Barrier	12.0000	2.0000	7.0000	0.0000	19.0000	10.0000	3.0000			0.1500	7.8801	0.505

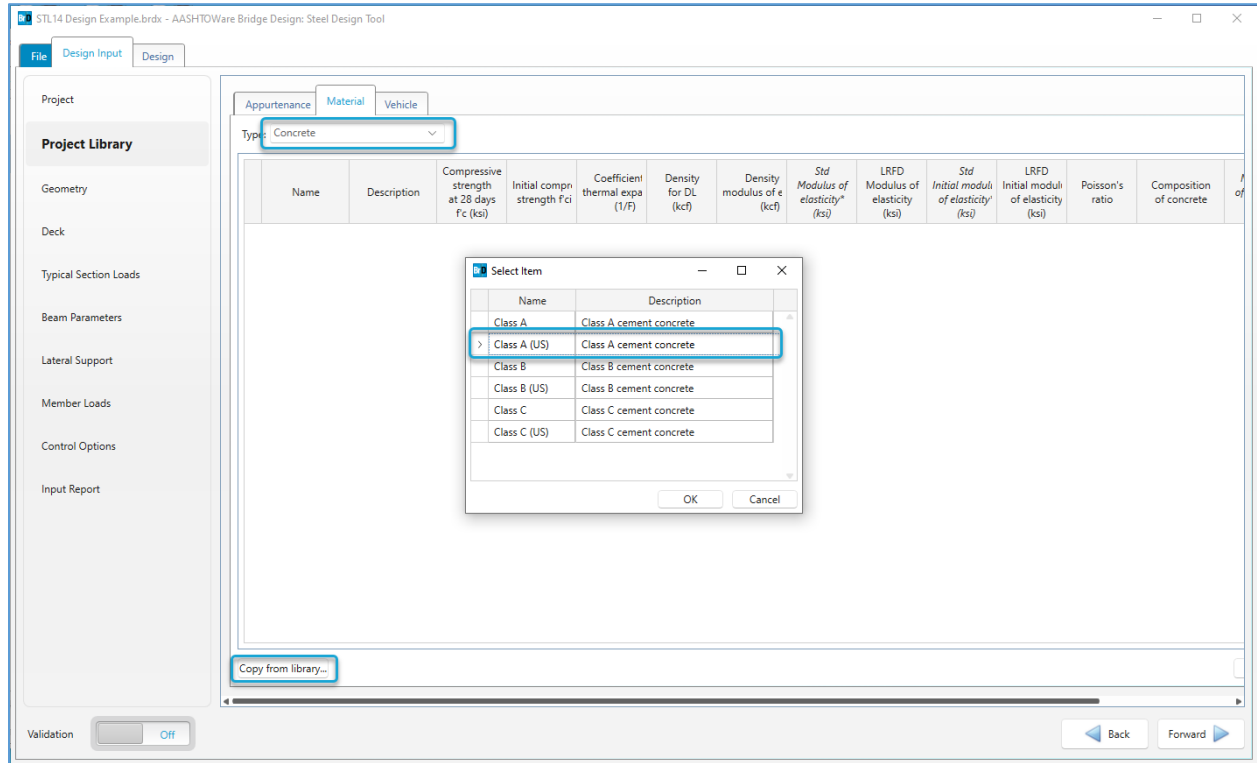
Copy from library...
New
Duplicate
Delete

Validation
Off

Back
Forward

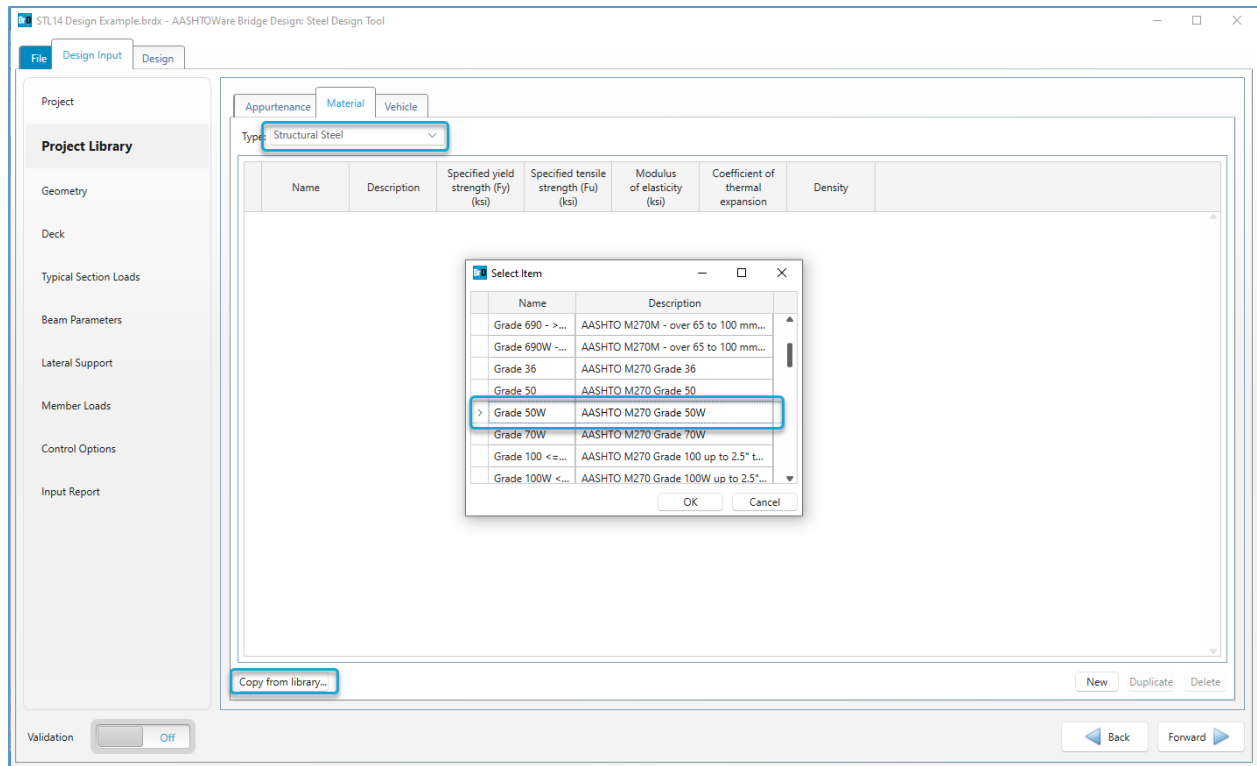
## Design Input | Project Library | Material

On the **Material** tab, select **Concrete** for **Type** from the drop down menu and click the **Copy from library** button to copy the **Class A (US)** concrete material definition from **File | Library** to the **Project Library**.



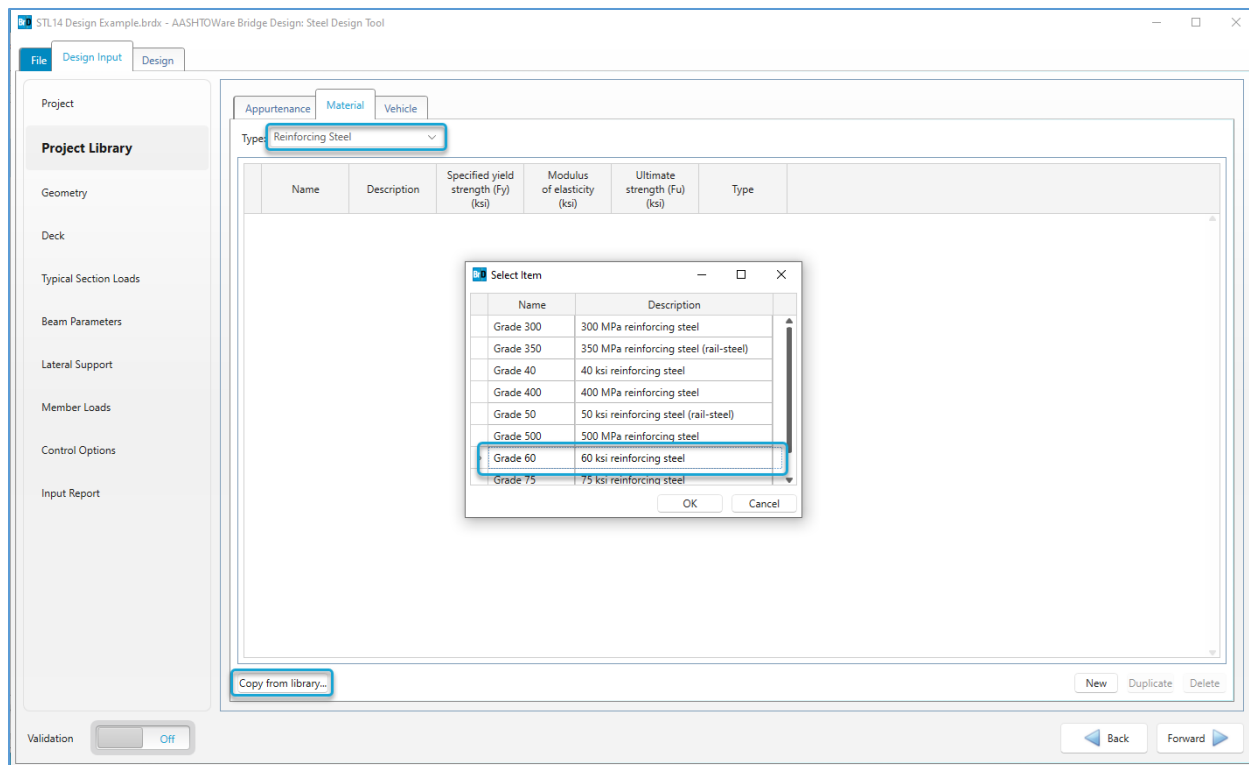
## STL15 - Steel Design Tool Example

On the **Material** tab, select **Structural Steel** for **Type** from the drop down menu and click the **Copy from library** button to copy the **Grade 50W** steel material definition from **File | Library** to the **Project Library**.



## STL15 - Steel Design Tool Example

On the **Material** tab, select **Reinforcing Steel** for **Type** from the drop down menu and click the **Copy from library** button to copy the **Grade 60** reinforcing steel material definition from **File | Library** to the **Project Library**.







## Design Input | Project

Return to the **Project** tab to define the vehicles for the girder design. Click on the ellipsis button to assign the HL-93 (US) vehicle as the design load and the LRFD Fatigue Truck (US) as the fatigue load. Leave the permit load blank.

Define the design average daily truck traffic as 5000.

STL14 Design Example.brdx - AASHTOWare Bridge Design: Steel Design Tool

**File** **Design Input** **Design**

**Project**

Project Library

Geometry

Deck

Typical Section Loads

Beam Parameters

Lateral Support

Member Loads

Control Options

Input Report

Project: STL14 Design Example

Description: 2 Span 4 Girder Bridge

Designer:

Date: 2/8/2024

**LRFD specifications**

Edition: AASHTO LRFD 9th

Limit states:

- ☒ Strength-I
- ☒ Strength-II
- ☒ Strength-III
- ☒ Strength-V
- ☒ Service-II
- ☒ Fatigue-I
- ☒ Fatigue-II

**Design vehicles**

Design load: HL-93 (US)

Permit load:

☐ Single lane permit load

Fatigue load: LRFD Fatigue Truck (US)

Design ADTT: 5000

Validation: ☐ Off

Back Forward

## Design Input | Geometry

On the **Geometry** tab, enter the data as shown below. Depending on your screen resolution, scroll down to enter the **Support** information.

The screenshot shows the 'AASHTOWare Bridge Design: Steel Design Tool' window. The 'Design Input' tab is active, and the 'Geometry' section is selected in the left sidebar. The main area contains the following input fields and tables:

Superstructure definition type: System definition

Number of spans: 2

Number of beams: 4

Girder spacing: 10 ft

Support skew: 0 Degrees

Number of design lanes: 3

Spans:

	Span	Length (ft)
>	1	100.00
	2	100.00

Supports:

	Support	Support type
	1	Pinned
	2	Roller
	3	Roller

End bearing location: Left: 0 in Right: 0 in

Validation: Off

Navigation buttons: Back, Forward



## Design Input | Deck

On the **Deck** tab, enter the data as shown below. The **Splice location gaps** table can be used to input regions where the program should avoid placing shear studs. For this example, leave this table empty.

The screenshot shows the 'Deck' tab in the 'Steel Design Tool' interface. The left sidebar contains a list of tabs: Project, Project Library, Geometry, **Deck**, Typical Section Loads, Beam Parameters, Lateral Support, Member Loads, Control Options, and Input Report. The main area contains the following inputs and tables:

Deck concrete: Class A (US)

Deck total thickness: 10 in

Deck structural thickness: 9 in

Deck reinforcement

Material: Grade 60

Support	Start distance (ft)	Length (ft)	End distance (ft)	Bar size	Clear cover (in)	Measured from	Bar spacing (in)
> 1	80.00	40.00	120.00	6	2.0000	Top of Str...	4.0000

Buttons: New, Duplicate, Delete

Deck overhang: 3 ft

Haunch depth: 2 in

Edge of haunch to edge of beam: 0 in

☒ Composite deck

Shear connectors

Stud diameter: 0.5 in

☒ Provide shear studs in negative flexure regions

Splice location gaps

Support	Splice location		Left gap (ft)	Right gap (ft)
	Left or right	Distance		

Validation: ☐ Off

Buttons: Back, Forward

Design Input | Typical Section Loads

On the **Parapet** tab in **Typical Section Loads**, enter the data as shown below.

STL14 Design Example.brdx - AASHTOWare Bridge Design: Steel Design Tool

File Design Input Design

Project

Project Library

Geometry

Deck

**Typical Section Loads**

Beam Parameters

Lateral Support

Member Loads

Control Options

Input Report

Validation ☐ Off

Stage 2 load distribution: ☒ Uniformly to all girders  
☐ By tributary area  
☐ By percentage: Exterior:  % First interior:  %

Wearing surface: Thickness:  in Density:  pcf

Appurtenance loads:

Parapet Median Railing Generic Sidewalk

Back Front

Name	Stage	Load type	Measure to	Edge of deck distance measun from	Distance at start (ft)	Distance at end (ft)	Front face orientation
> Jersey Bar...	Stage 1	DC	Back	Left Edge	0.00	0.00	Left
Jersey Bar...	Stage 1	DC	Back	Right Edge	0.00	0.00	Right

New Duplicate Delete

Diaphragm loads:

Girder bay: 1 Copy bay to...

Support	Start distance (ft)		Diaphragm spacing (ft)	Number of spaces	Length (ft)	End distance (ft)		Load (kip)
	Left girder	Right girder				Left girder	Right girder	
1	0.00	0.00	0.00	1	0.00	0.00	0.00	1.000
1	0.00	0.00	25.00	8	200.00	200.00	200.00	1.000

New Duplicate Delete

Back Forward

Make sure to scroll to the bottom of the page to define the diaphragm loads. Input the diaphragm loads as shown for Girder Bay 1 and use the **Copy bay to...** button to copy the loads to Girder Bay 2 and Girder Bay 3.

Control Options

Input Report

Diaphragm loads:

Girder bay: 1 Copy bay to...

Copy diaphragm to bay(s)

Select the new bay(s):

Bay 2

Bay 3

OK Cancel

Support	Start distance (ft)		Diaphragm spacing (ft)	Number of spaces	Length (ft)	End distance (ft)		Load (kip)
	Left girder	Right girder				Left girder	Right girder	
1	0.00	0.00	0.00	1	0.00	0.00	0.00	1.000
1	0.00	0.00	25.00	8	200.00	200.00	200.00	1.000

New Duplicate Delete

Back Forward

## Design Input | Beam Parameters

In the **Beam Parameters** input section, enter the data as shown below. All of the plate dimensions except for the web depth can be designed. Providing a larger range of values for any given parameter can help the design tool converge on a solution. The program will design transverse stiffeners for shear resistance if the **Use transverse stiffeners** button is selected. This example does not use this option.

The screenshot displays the 'Beam Parameters' section of the 'STL14 Design Example.brdx - AASHTOWare Bridge Design: Steel Design Tool' software. The interface includes a sidebar on the left with navigation options: Project, Project Library, Geometry, Deck, Typical Section Loads, **Beam Parameters** (selected), Lateral Support, Member Loads, Control Options, and Input Report. The main area is titled 'Section configuration' and contains several input fields and tables.

**Section configuration**

Web	Min	Max	Increment
Depth	60 in	60 in	
Thickness	0.3750	0.7500	1/8"

Top flange	Min	Max	Increment
Width	12 in	20 in	2 in
Thickness	0.5000	2.0000	1/4"

Bottom flange	Min	Max	Increment
Width	12 in	20 in	2 in
Thickness	0.5000	2.0000	1/4"

☐ Use transverse stiffeners

Beam	One sided	Max spacing (in)
> Exterior	<input type="checkbox"/>	
Interior	<input type="checkbox"/>	

**Structural steel materials**

Web: Grade 50W

Top flange: Grade 50W

Bottom flange: Grade 50W

Transverse stiffener: Grade 50W

Bearing stiffener: Grade 50W

Validation:

Navigation:

Design Input | Lateral Support

In the **Lateral Support** input section, enter the data as shown below. Top flange lateral support ranges are regions where the top flange is continuously laterally supported and top flange lateral support locations are discrete points of lateral support.

Top Flange Lateral Support:

Ranges

Locations

	Support	Start distance (ft)	Length (ft)	End distance (ft)	
▶ 1	▼	0.00	200.00	200.00	

New Duplicate Delete

Top Flange Lateral Support:

Ranges

Locations

	Support	Start distance (ft)	Spacing (ft)	Number of spaces	Length (ft)	End distance (ft)	
▶ 1	▼	0.00	0.00	1	0.00	0.00	
1	▼	0.00	25.00	8	200.00	200.00	

New Duplicate Delete

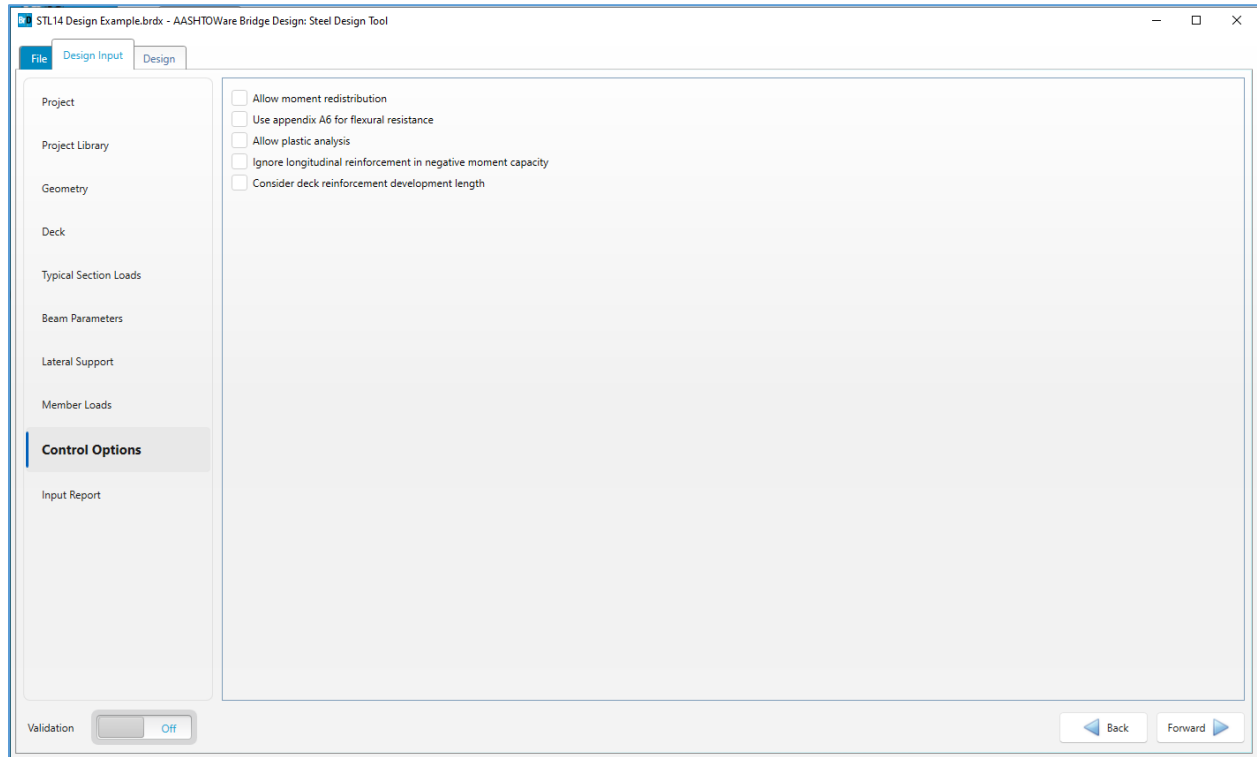
Design Input | Member Loads

There are no member loads assigned in this example. Member concentrated loads, member distributed loads and pedestrian loads could be assigned here.

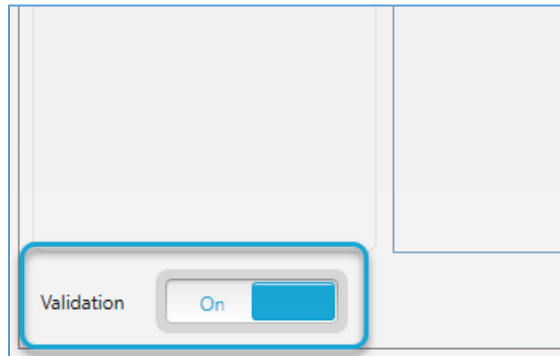


### Design Input | Control Options

The **Control Options** input section provides options for analysis and design. For this example, leave the options as is.

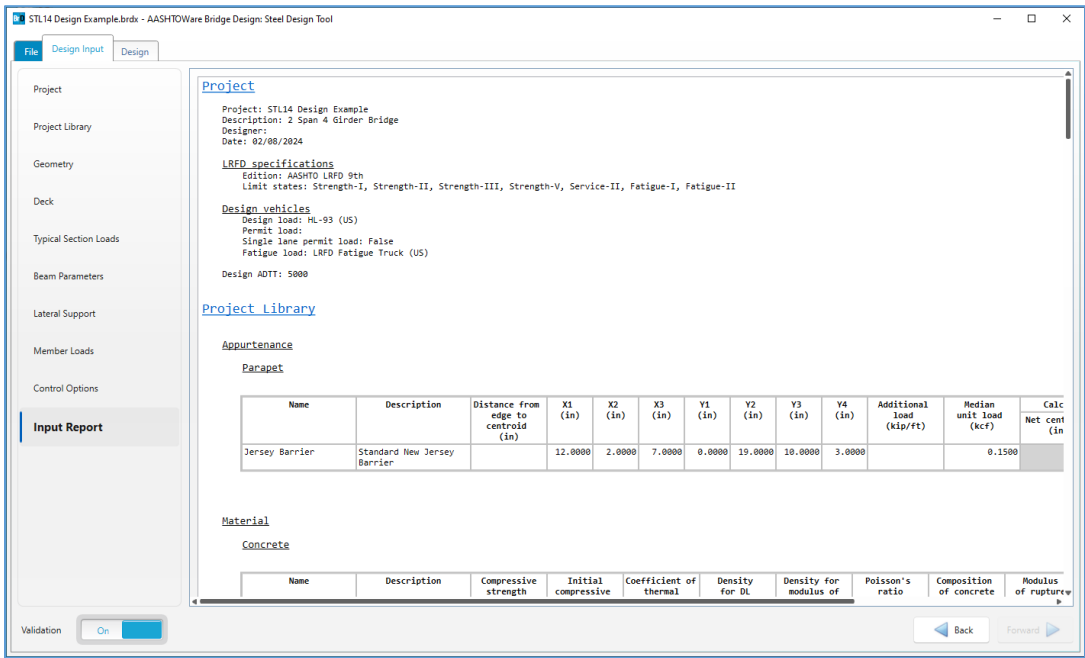


At this point, all design data has been defined. Turn **Validation** on and ensure that there are no validation error marks displayed next to the input section. Otherwise, go back to these sections and resolve the errors.



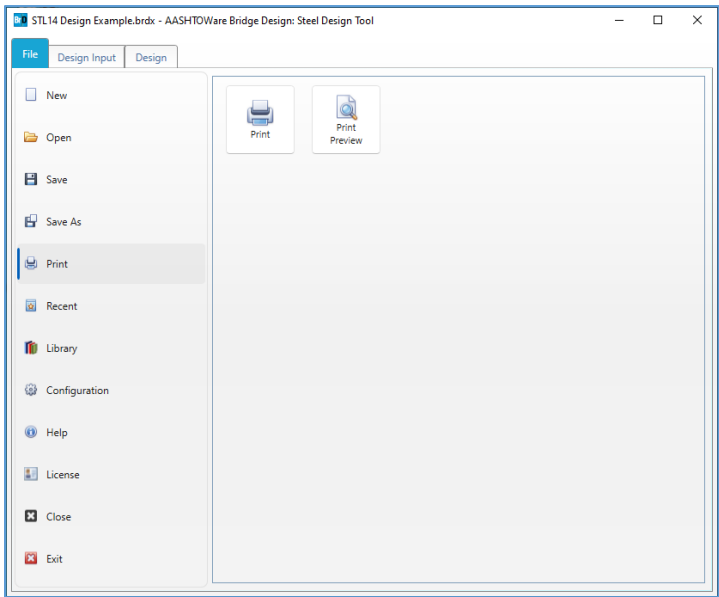
Design Input | Input Report

The **Input Report** section provides a detailed report of the input data.



File | Print

The **Print** and **Print Preview** buttons in the **File | Print** section apply to the **Input Report**.

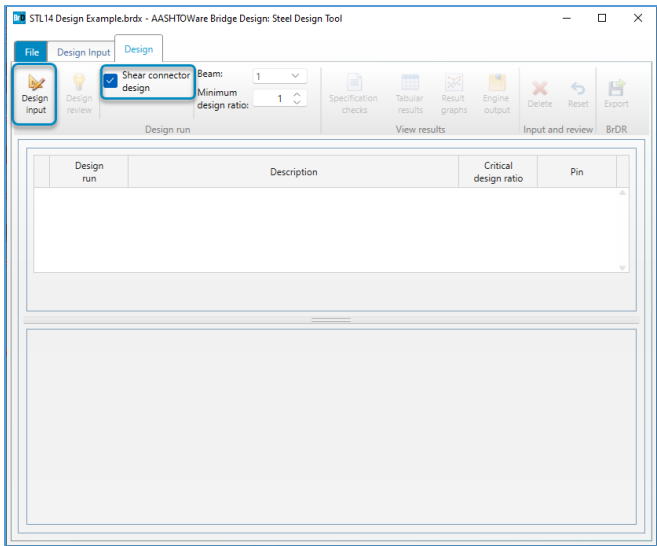


Design | Design Input

After the input data is entered and reviewed, **Design Input** run can be performed by clicking on the **Design Input** button located on the **Design ribbon**. **Design Input** run is based on the input data and produces a design that is

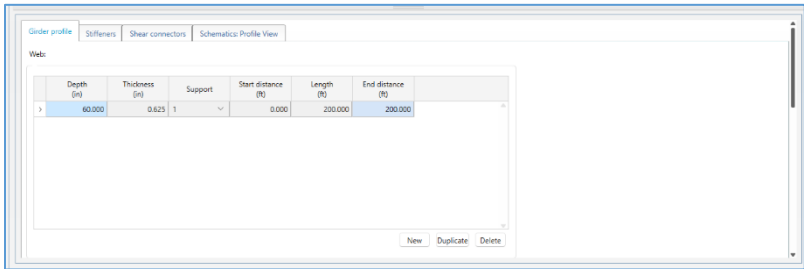
STL15 - Steel Design Tool Example

displayed in the **Design Run** grid with a brief description and values of the critical design ratios. Select the checkbox for **Shear connector design** to design the shear connectors along with the girder in the composite regions. The beam dropdown is the selection for which girder the program will design and the input for minimum design ratio defines the target design ratio for which the girder will be designed.



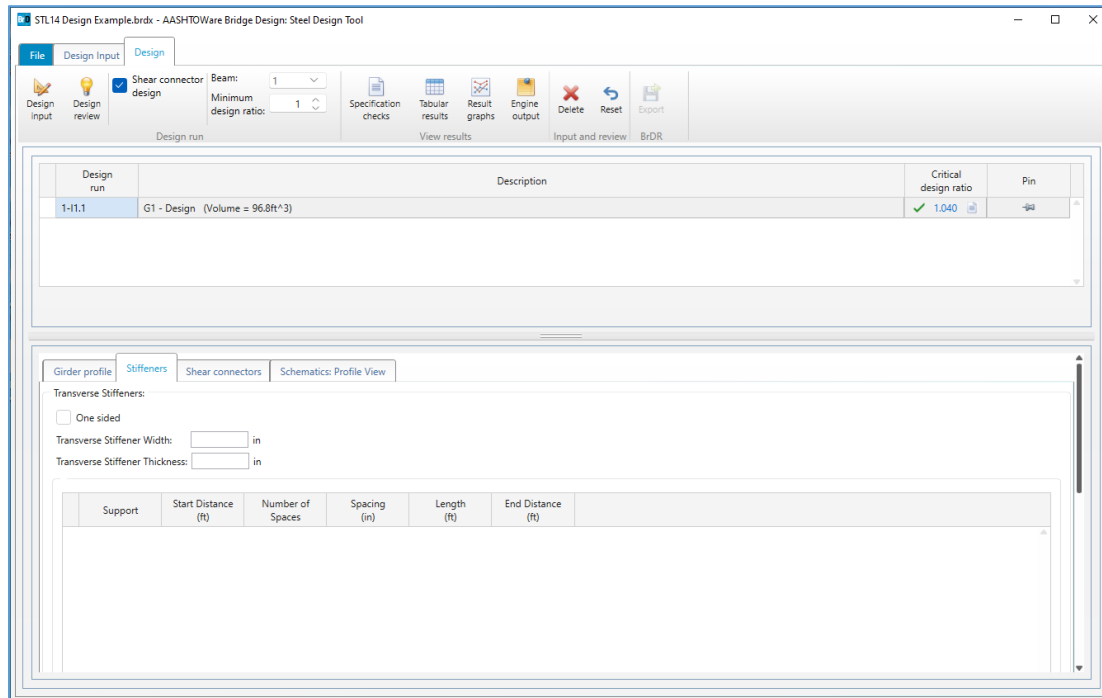
Design | Girder Profile

The **Girder Profile** tab displays the ranges for steel plates along the web and flanges. After a design input run is completed, these tables will display the program computed ranges. The user may modify these ranges and reanalyze the member using the **Design Review** option.



## Design | Stiffeners

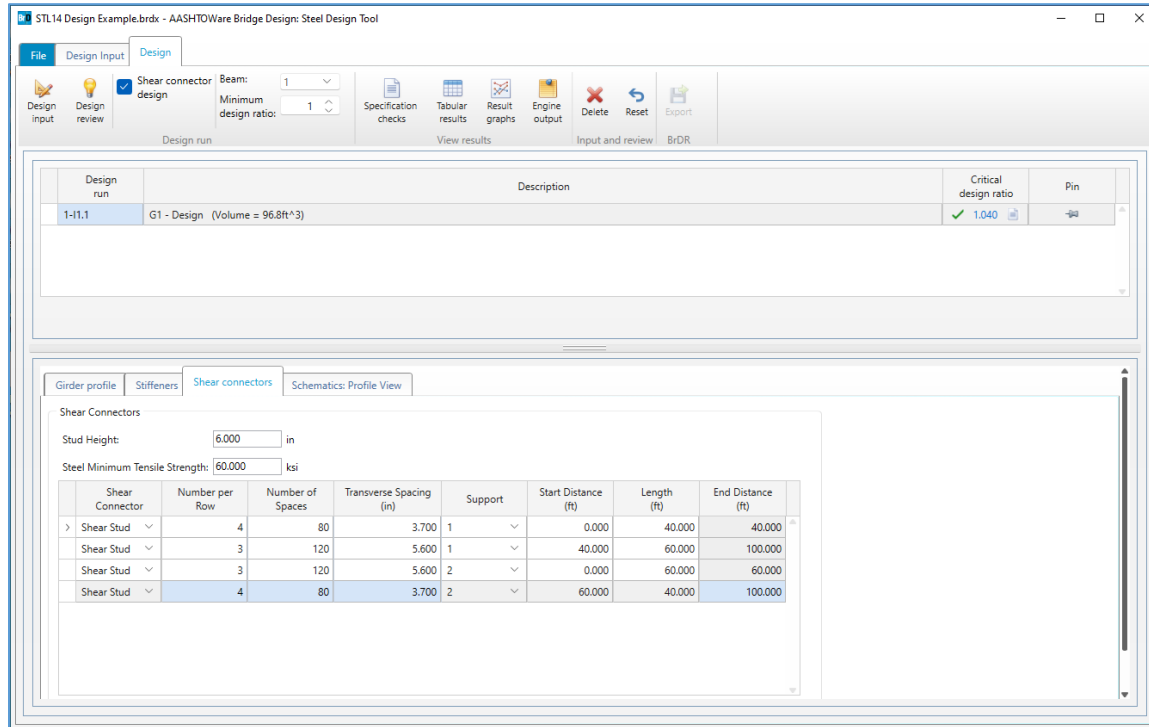
The **Stiffeners** tab displays the results of the stiffener design. This includes transverse stiffeners and bearing stiffeners. The transverse stiffeners will only be designed when the design input option to **Use Transverse Stiffeners** in the **Design Input | Beam Parameters** window is selected.



## STL15 - Steel Design Tool Example

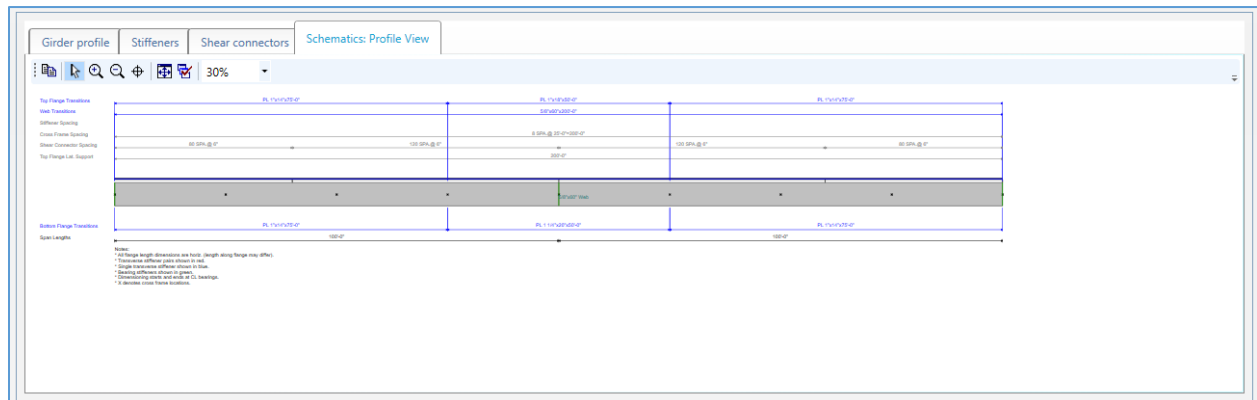
### Design | Shear connectors

The **Shear connectors** tab shows the results of the shear connector design if enabled and if the member has composite regions.



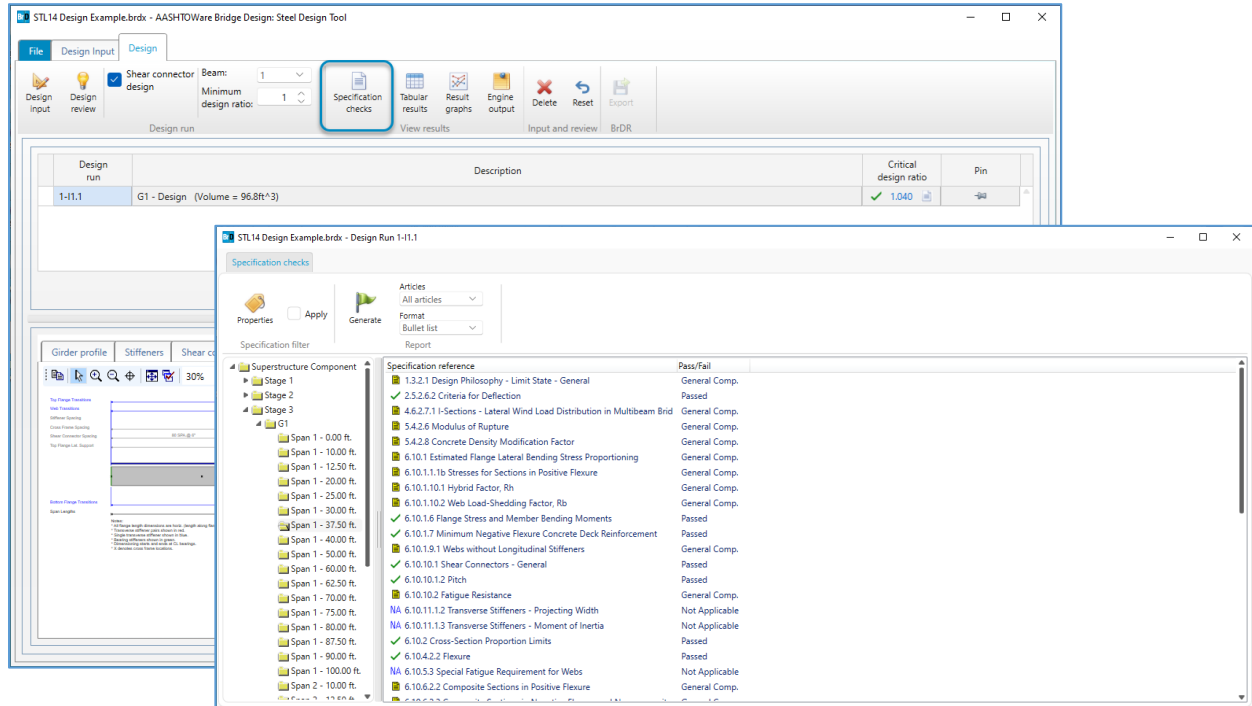
### Design | Schematics: Profile View

The **Schematics: Profile View** tab shows a schematic of the girder design.



## Design | Specification Check

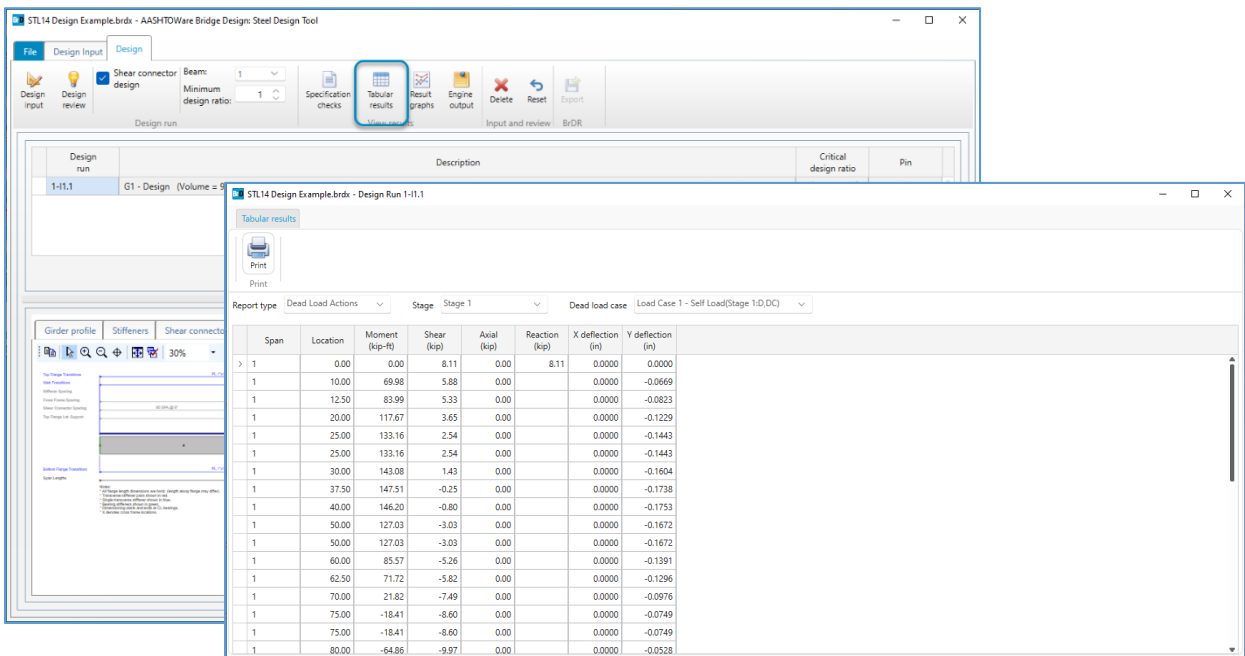
To view the specification check results, click on the **Specification checks** button from the **View results** group of the **Design** ribbon.



STL15 - Steel Design Tool Example

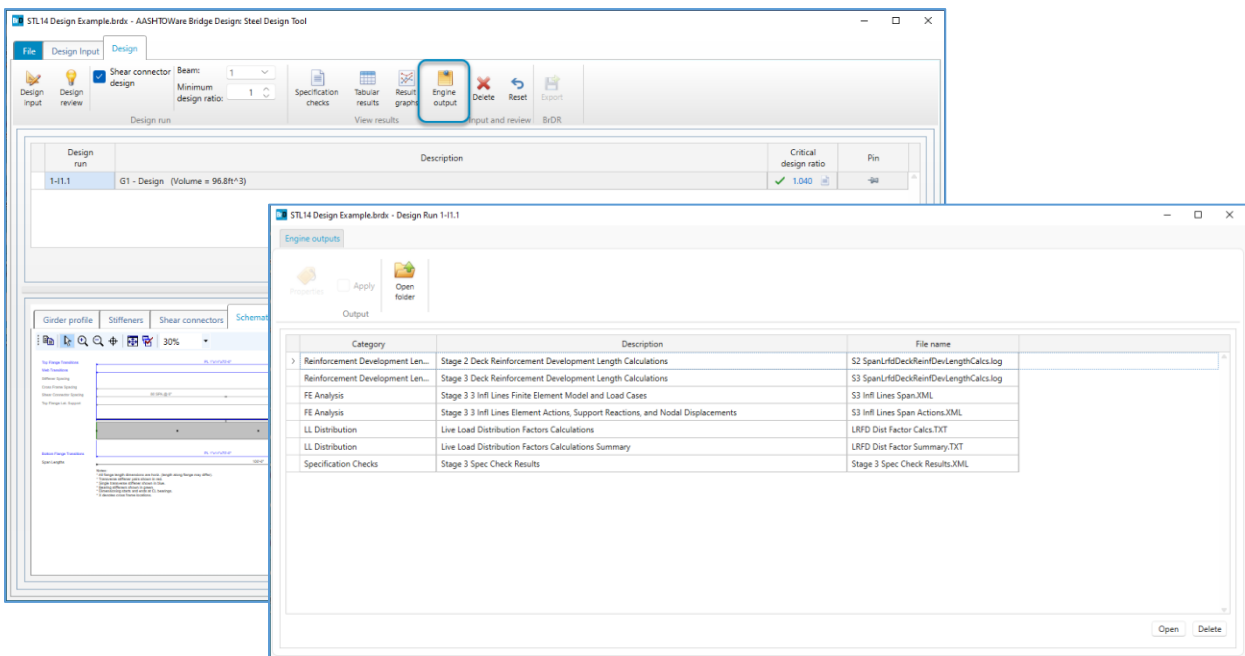
Design | Tabular Results

To view the tabular results, click on the **Tabular results** button from the **View results** group of the **Design** ribbon.



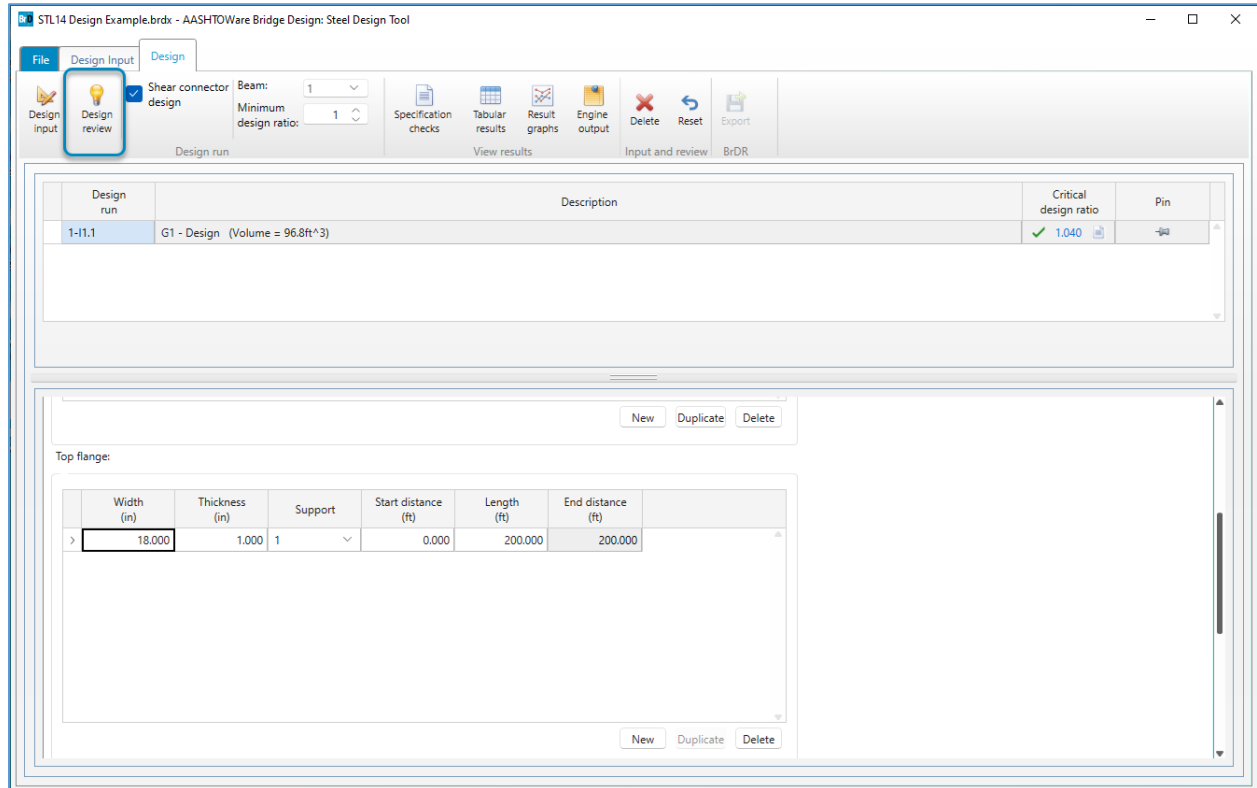
Design | Engine Outputs

To view the contents of the engine output files, click on the **Engine outputs** button from the **View results** group of the **Design** ribbon, and then double-click on the row corresponding to the required file.



## Design | Design Review

To illustrate the ability of the program to adjust results of the **Design Input** run, modify the **Top flange** table to define a top flange with a constant 18 inch width along the entire 200 ft length of the girder. Select **Design Review** to analyze this modified design.





## STL15 - Steel Design Tool Example

After the program finishes performing the design review, it will add another row to the design run grid. The design review runs are indicated with an **R** displayed in the **Design run** column in contrast to an **I** shown in that column for design input runs. The results for the **Design review** runs are displayed and can be reviewed or further modified the same way as design input runs. Additional design input runs can be performed by modifying the input on the **Design Input** tab. Each of the design runs, either input or review, stores a copy of its design input data that is reloaded every time the design input run is selected in the design run grid.

The screenshot displays the 'STL14 Design Example.brdrx - AASHTOWare Bridge Design: Steel Design Tool' interface. The 'Design' tab is active, showing a toolbar with icons for Design input, Design review, Shear connector design, Specification checks, Tabular results, Result graphs, Engine output, Delete, Reset, and Export. The design run grid shows two rows: '1-I1.1 G1 - Design (Volume = 96.8ft^3)' and '1-R1.1 G1 - Design Review'. The '1-R1.1' row is selected, and its 'Critical design ratio' is 1.049. Below the grid, the 'Top flange' section contains a table with dimensions:

	Width (in)	Thickness (in)	Support	Start distance (ft)	Length (ft)	End distance (ft)
>	18.000	1.000	1	0.000	200.000	200.000