

*AASHTOWare BrDR 7.5.0*

---

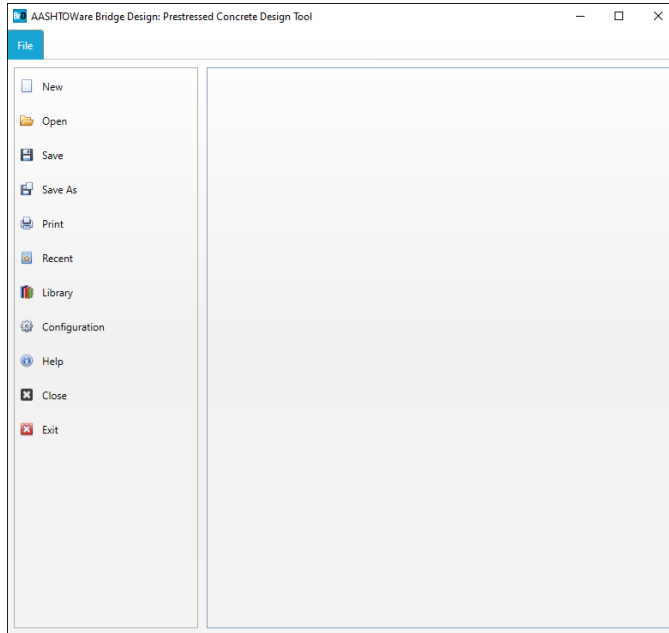
*Prestressed Concrete Design Tool*  
*Three Span Wide Flange PS I Beam Example*

## PS10 – PS Design Tool Example

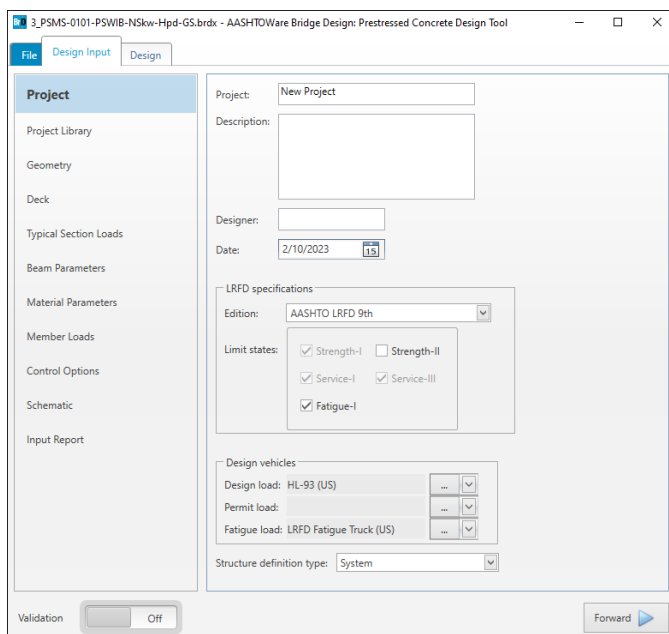
### Three Span Wide Flange PS I Beam Example

Start the **Prestressed 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 **3\_PSMS-0101-PSWIB-NSkw-Hpd-GS** and remove the **LRFD Fatigue Truck (US)** from the **Design vehicles** list.

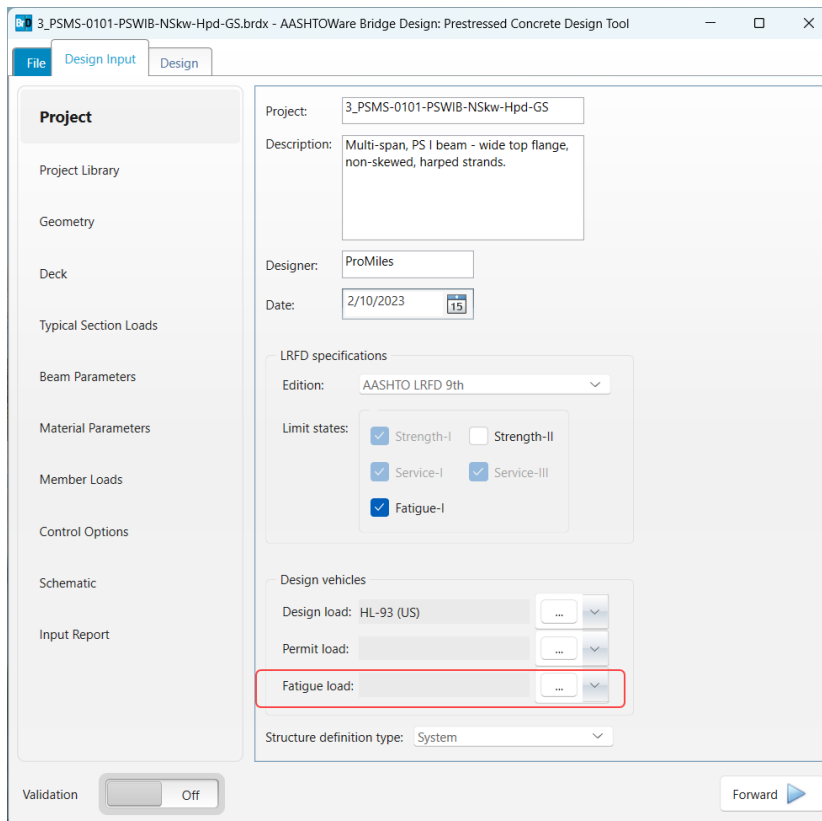


## PS10 – PS Design Tool Example

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 display **New Project** which will be changed in the next step. The **Project** property determines the name of the subfolder in the Documents\AASHTOWare\PSDesign75\ 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. In 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.

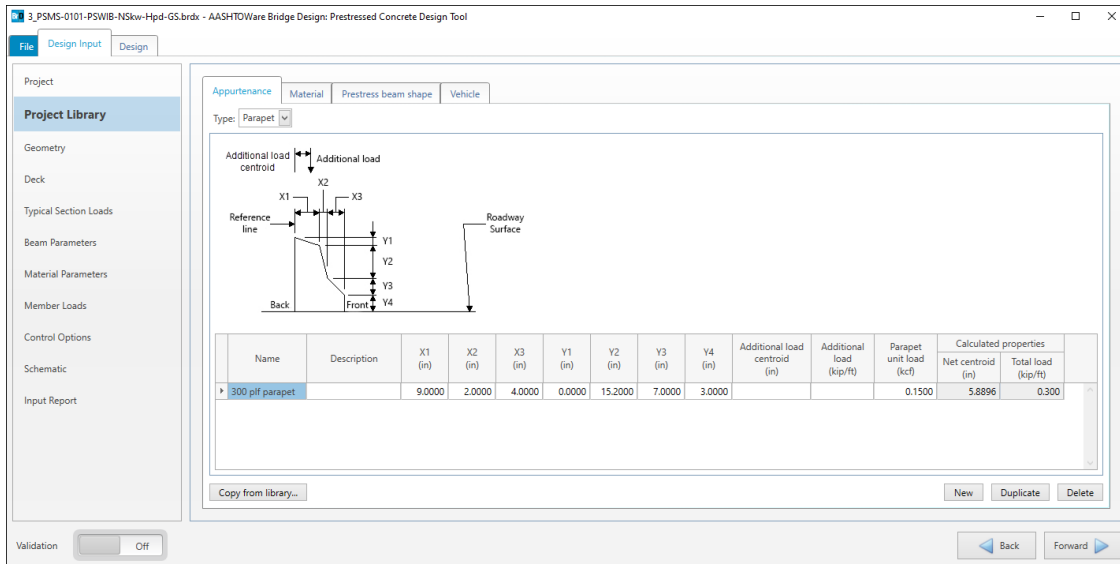


The screenshot shows the 'Project' input screen in the PS Design Tool. The window title is '3\_PSMS-0101-PSWIB-Nskw-Hpd-GS.brdx - AASHTOWare Bridge Design: Prestressed Concrete Design Tool'. The 'Project' property is set to '3\_PSMS-0101-PSWIB-Nskw-Hpd-GS'. The 'Description' is 'Multi-span, PS I beam - wide top flange, non-skewed, harped strands'. The 'Designer' is 'ProMiles' and the 'Date' is '2/10/2023'. Under 'LRFD specifications', the 'Edition' is 'AASHTO LRFD 9th'. The 'Limit states' are: Strength-I (checked), Strength-II (unchecked), Service-I (checked), Service-III (checked), and Fatigue-I (checked). Under 'Design vehicles', the 'Design load' is 'HL-93 (US)', 'Permit load' is empty, and 'Fatigue load' is empty (highlighted with a red box). The 'Structure definition type' is 'System'. At the bottom left, the 'Validation' button is set to 'Off'. At the bottom right, there is a 'Forward' button.

## PS10 – PS Design Tool Example

### Design Input | Project Library | Appurtenance

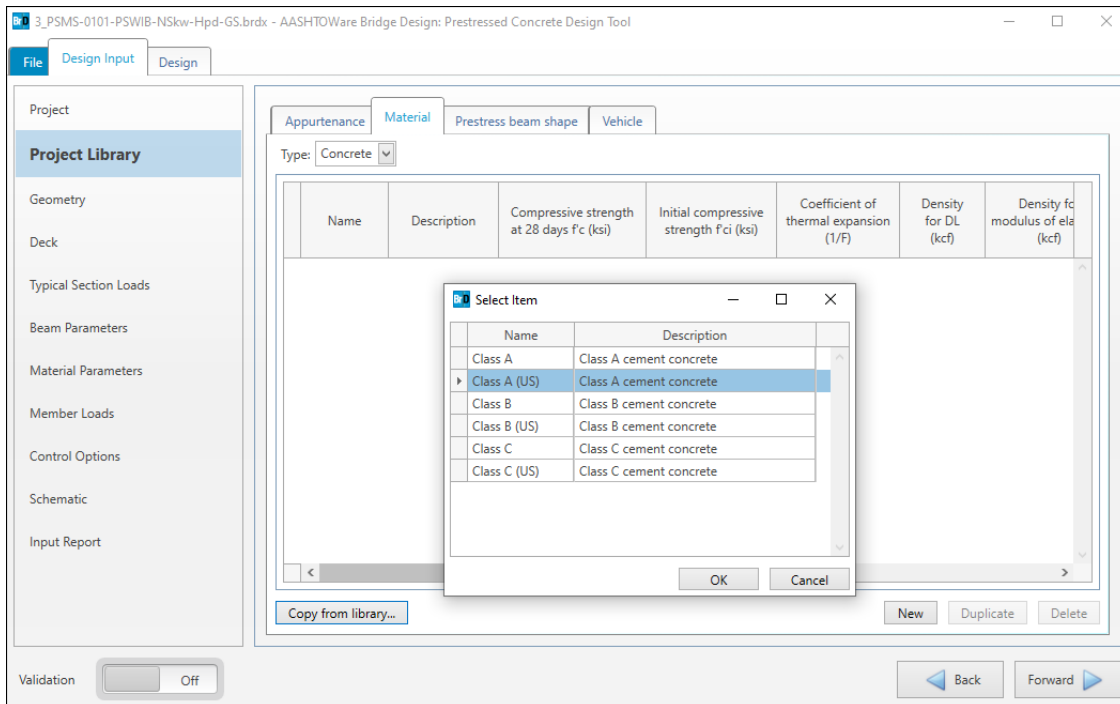
On the **Appurtenance** tab, select **Parapet** for **Type** from the drop down menu and click the **New** button to add a new parapet. Enter the data as shown below.



Name	Description	X1 (in)	X2 (in)	X3 (in)	Y1 (in)	Y2 (in)	Y3 (in)	Y4 (in)	Additional load centroid (in)	Additional load (kip/ft)	Parapet unit load (kcf)	Calculated properties
300 pif parapet		9.0000	2.0000	4.0000	0.0000	15.2000	7.0000	3.0000			0.1500	Net centroid (in): 5.8896 Total load (kip/ft): 0.300

### Design Input | Project Library | Material

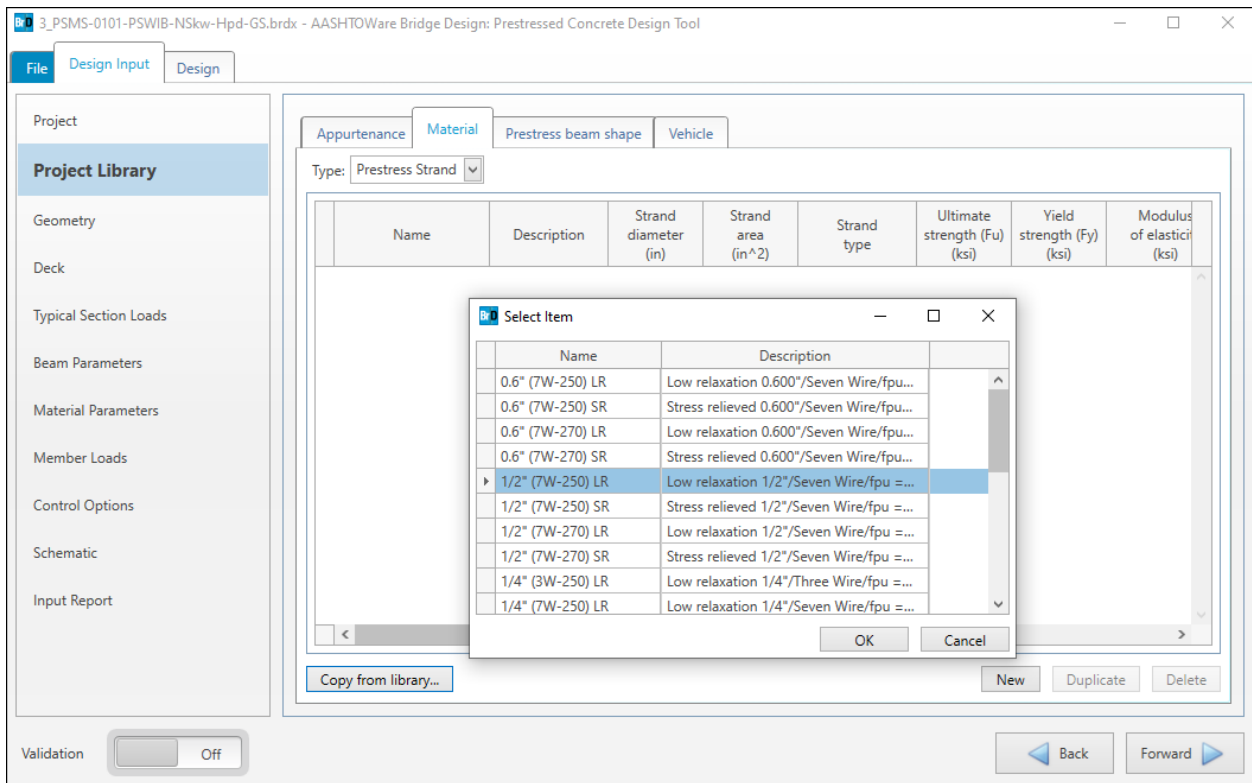
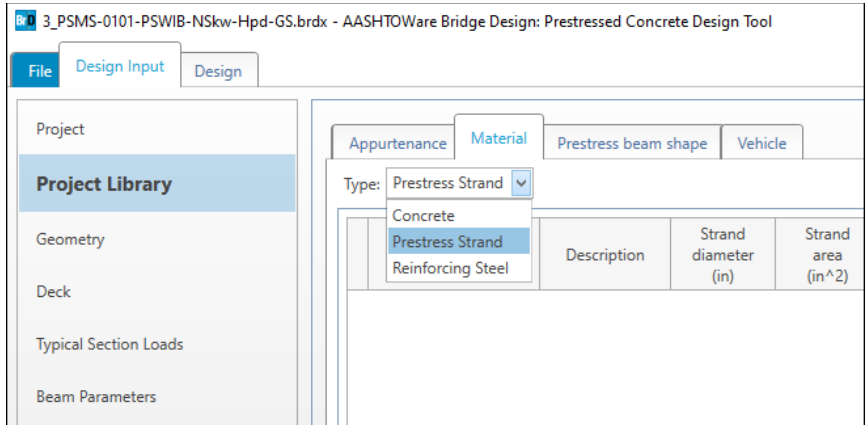
On the **Material** tab, select **Concrete** for **Type** from the drop down menu and click the **Copy from library** button to copy the **Class A (US)** concrete material definition from **File | Library** to the **Project Library**.



Name	Description	Compressive strength at 28 days f'c (ksi)	Initial compressive strength f'ci (ksi)	Coefficient of thermal expansion (1/F)	Density for DL (kcf)	Density f'c modulus of elasticity (kcf)
Class A	Class A cement concrete					
Class A (US)	Class A cement concrete					
Class B	Class B cement concrete					
Class B (US)	Class B cement concrete					
Class C	Class C cement concrete					
Class C (US)	Class C cement concrete					

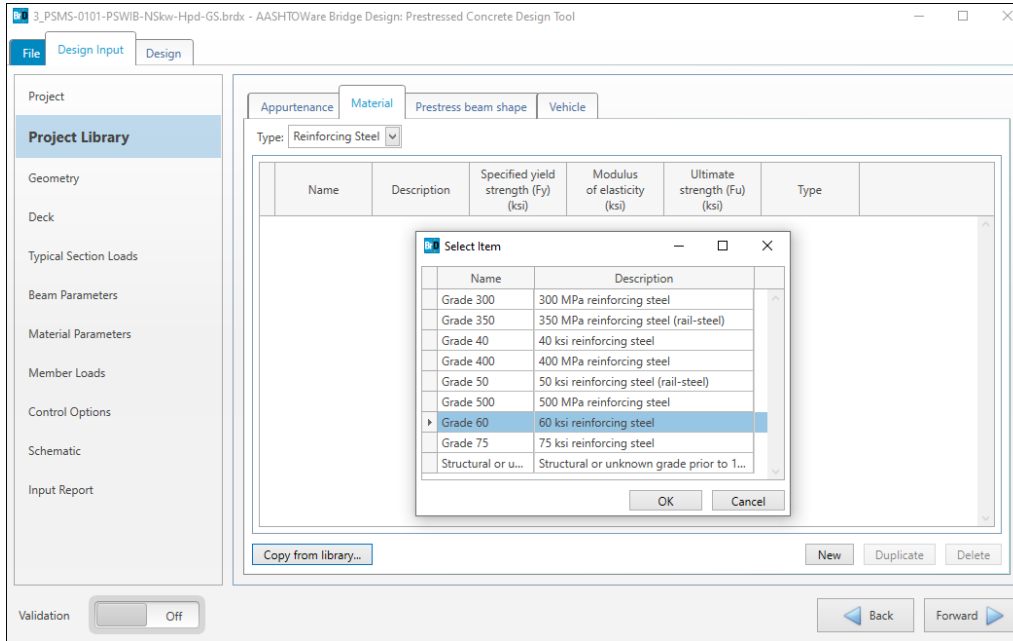
# PS10 – PS Design Tool Example

On the **Material** tab, select **Prestress Strand** for **Type** from the drop down menu and click the **Copy from library** button to copy the 1/2" (7W-250) LR prestressing strand material definition from **File | Library** to the **Project Library**.



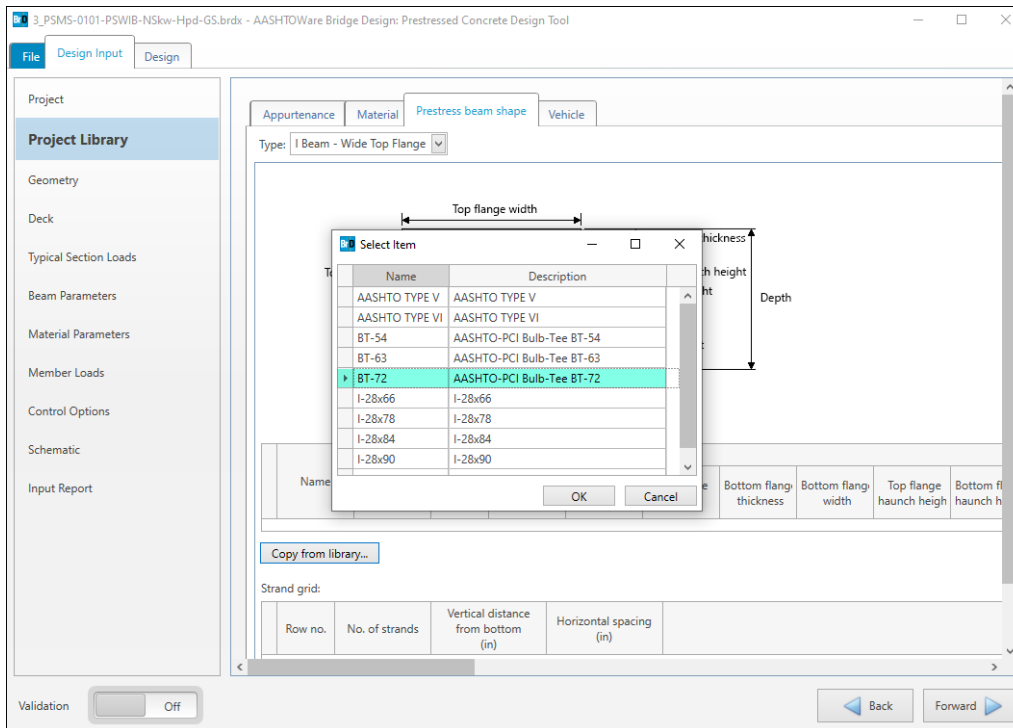
## PS10 – PS Design Tool Example

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 Library | Prestress Beam Shape

On the **Prestressed beam shape** tab, select **I Beam – Wide Top Flange** for **Type** from the drop down menu and click the **Copy from library** button to copy the **BT-72** shape definition from **File | Library** to the **Project Library**.



# PS10 – PS Design Tool Example

## Design Input | Project Library | Vehicle

On the **Vehicle** tab, make sure that only the HL-93 (US) vehicle is present in the table. If not, copy it from the library. If there are any vehicles other than HL-93 (US) in the **Project Library**, remove them using the **Delete** button.

The screenshot shows the 'Vehicle' tab in the software. The main table contains the following data:

Name	Description	Library type	Notional	Tandem			Uniform lane load (kip/ft)
				Axle load (kip)	Spacing between axles (ft)	Transverse wheel spacing* (ft)	
HL-93 (US)	AASHTO LRFD Live Load - US unit system	Agency Def...	<input checked="" type="checkbox"/>	25.0000	4.00	6.00	0.64

Below the main table is a 'Truck' table:

Axle no.	Axle load (kip)	Gage distance (ft)	Wheel contact width* (in)	Axle spacing (ft)	
				Minimum	Maximum
1	8.00	6.00	20.00		
2	32.00	6.00	20.00	14.00	14.00
3	32.00	6.00	20.00	14.00	30.00
Totals:		72.00		28.00	44.00

# PS10 – PS Design Tool Example

## Design Input | Geometry

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

The screenshot shows the 'Geometry' tab of the AASHTOWare Bridge Design: Prestressed Concrete Design Tool. The interface includes a sidebar with navigation options and a main workspace with various input fields and a table.

**Geometry Input Fields:**

- Number of spans: 3
- Number of beams: Min: 4, Increment: 0, Max: 4
- Out-to-out deck width: 44.5 ft
- Deck overhang from beam centerline: Min: 4.25 ft, Increment: 0 ft, Max: 4.25 ft
- Girder spacing: Min: 12 ft, Max: 12 ft
- Support skew: 0 Degrees
- Number of design lanes: 3

**Spans Table:**

Span	Length (ft)	Beam projection (in)		Lift distance (in)
		Left end	Right end	
1	110.00	6.00	6.00	24.00
2	120.00	6.00	6.00	24.00
3	110.00	6.00	6.00	24.00

**Supports Table:**

Support	Support type	Support distance (in)	
		On left	On right
1	Pinned		
2	Roller	12.0	12.0
3	Roller	12.0	12.0
4	Roller		



# PS10 – PS Design Tool Example

## Design Input | Deck

On the **Deck** tab, enter the data as shown below. Leaving the **Bar Spacing** input empty in the first row instructs the program to look during the **Design Input** run for the bar spacing that will satisfy the flexural reinforcement requirement. The bar spacing can be adjusted in **Design Review** runs after the Design Input is performed.

The screenshot shows the 'Deck' tab in the PS Design Tool. The interface includes a sidebar with navigation options like Project, Geometry, and Deck. The main area contains several input sections:

- Deck concrete:** Class A (US)
- Deck total thickness:** 8.5 in
- Deck structural thickness:** 8 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	0.00	340.00	340.00	4	3.3750	Top of Structural Thickness	
1	0.00	340.00	340.00	7	2.0000	Bottom of Deck	6.0000

Additional inputs include:

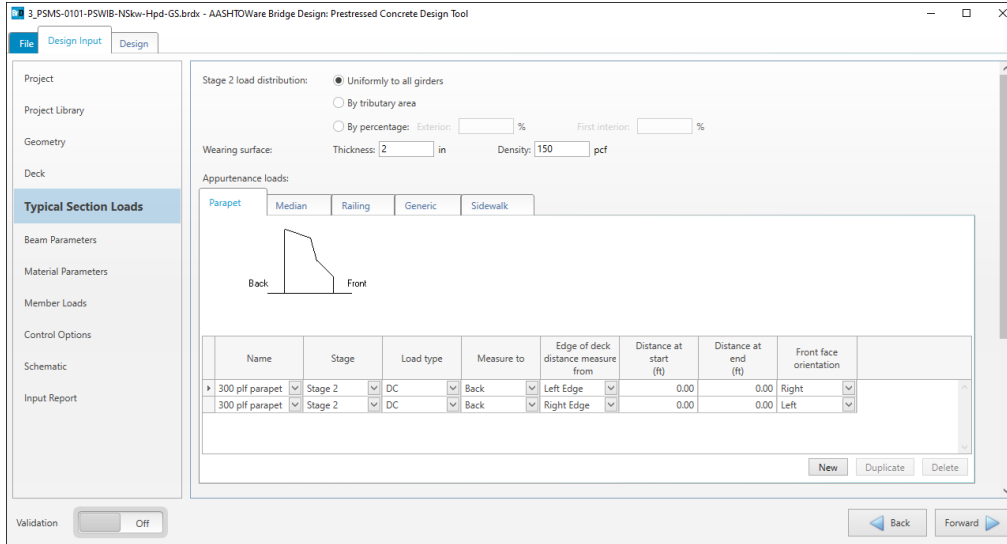
- Haunch depth:** 0.5 in
- Edge of the haunch to edge of the beam:** 0 in
- Composite deck:**
- Slab interface:** Interface type: Intentionally Roughened
- Cohesion factor:** 0.28 ksi
- Friction factor:** 1
- K1:** 0.3
- K2:** 1.8 ksi

Buttons for 'New', 'Duplicate', and 'Delete' are located below the table. At the bottom, there is a 'Validation' toggle set to 'Off' and 'Back'/'Forward' navigation buttons.

# PS10 – PS Design Tool Example

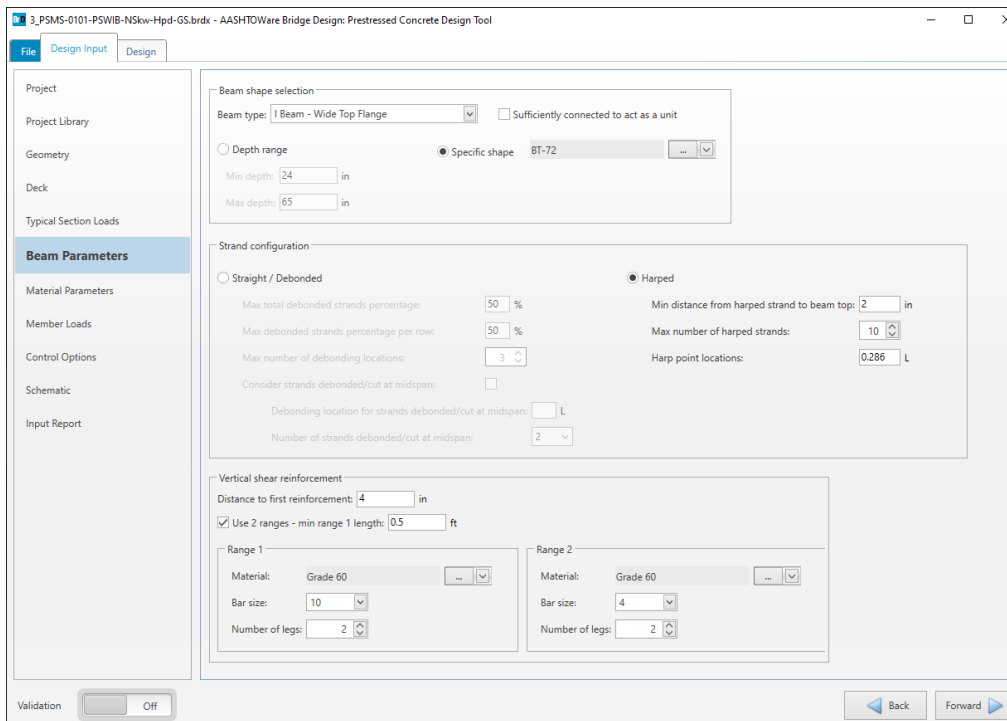
## Design Input | Typical Section Load | Parapet

On the **Parapet** tab in **Typical Section Loads**, enter the data as shown below. In this example, the generic parapet is the only typical section load.



## Design Input | Beam Parameters

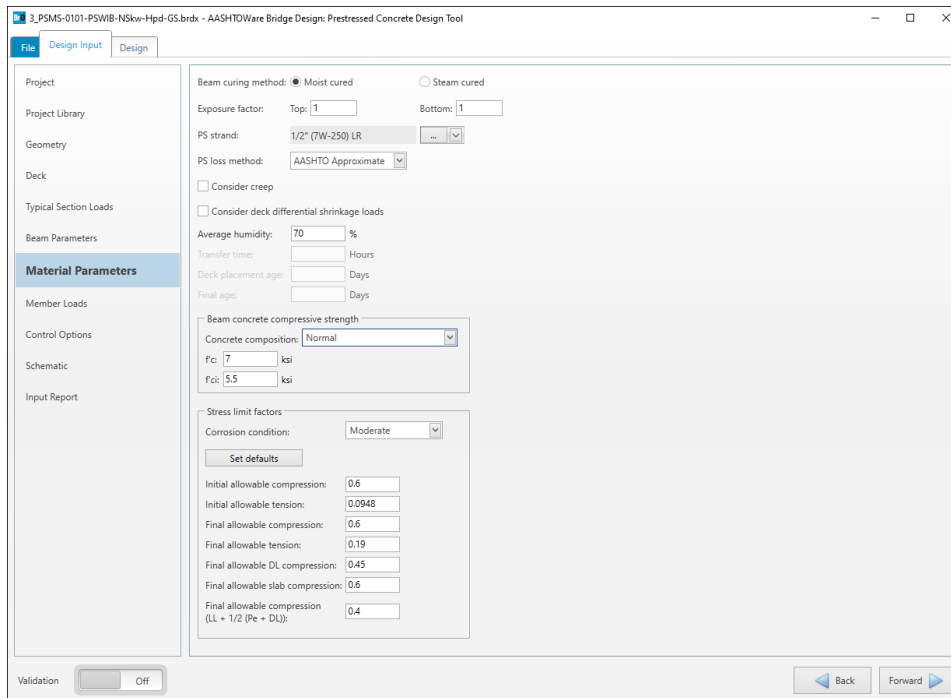
In the **Beam Parameters** input section, enter the data as shown below. Harp point location is equal to 0.286 L. In this example, Range 1 of the vertical shear reinforcement is used to satisfy the splitting resistance requirement which is the reason why a large (#10) bar size and the short 0.5 ft Range 1 length are used.



# PS10 – PS Design Tool Example

## Design Input | Material Properties

In the **Material Parameters** input section, enter the data as shown below.



## Design Input | Member Loads

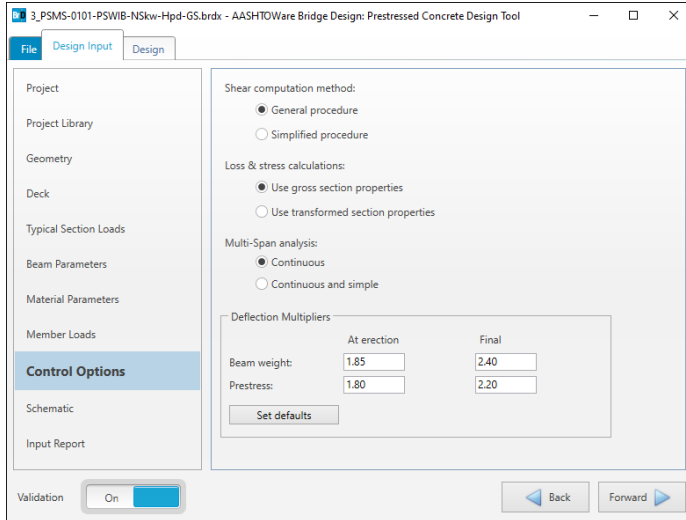
There are no member loads assigned in this example.

# PS10 – PS Design Tool Example

## Design Input | Control Options

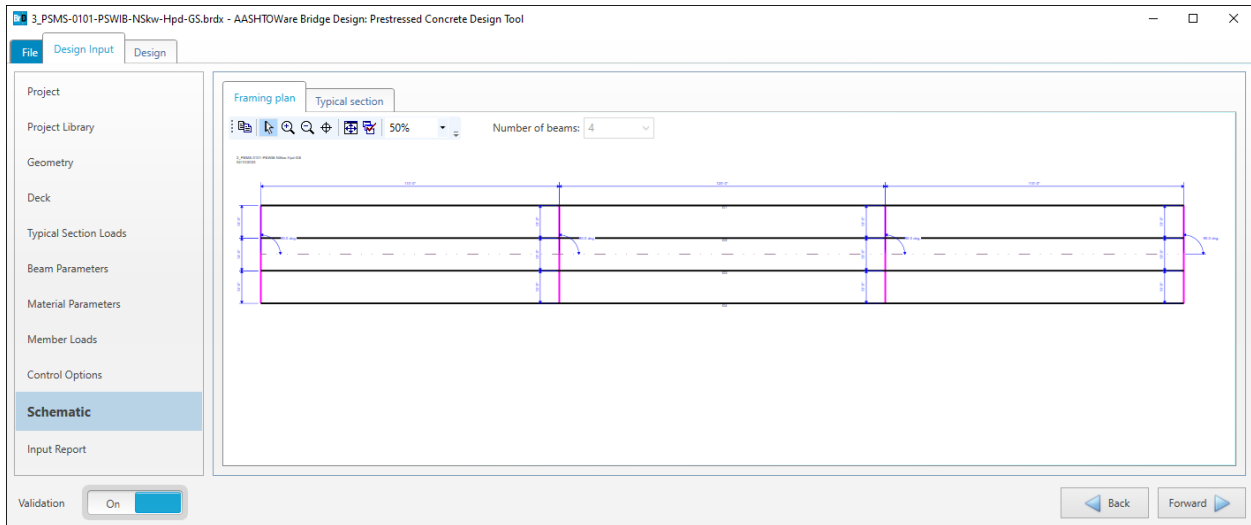
In the **Control Options** input section, enter the data as shown in the screenshot below.

Once the data is entered, turn **Validation** back 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 | Schematic | Framing Plan

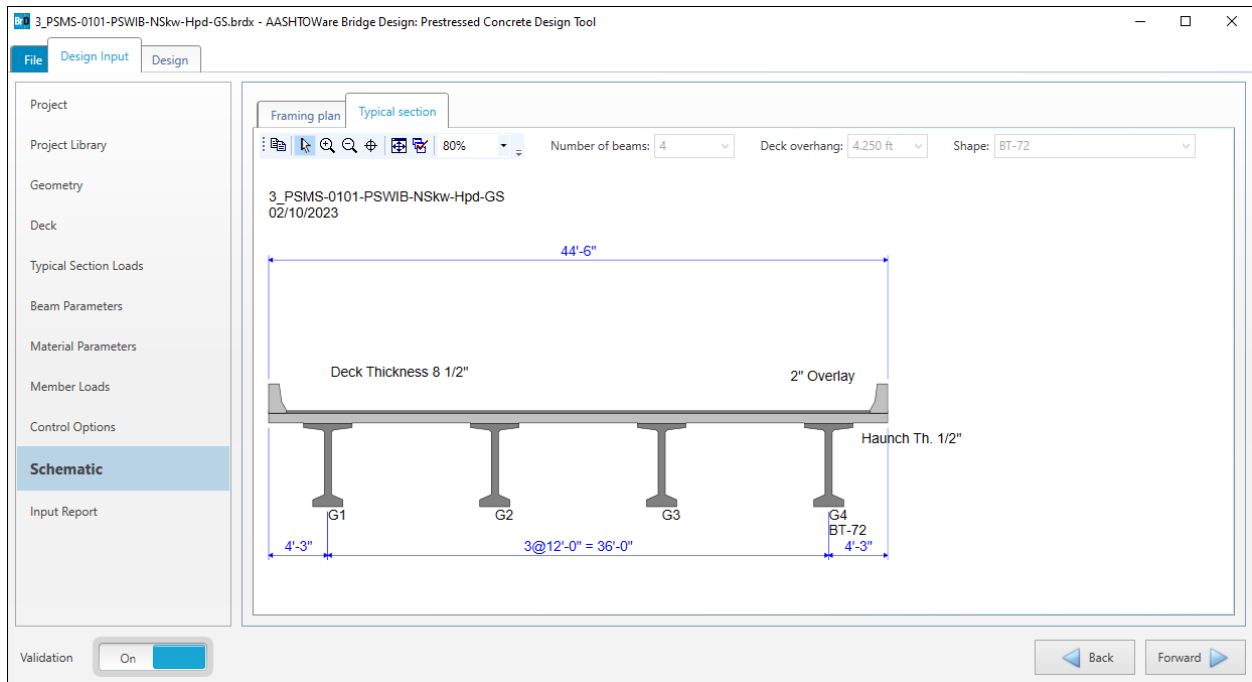
To verify the input data, review the **Framing Plan** view in the **Schematic** section.



# PS10 – PS Design Tool Example

## Design Input | Schematic | Typical Section

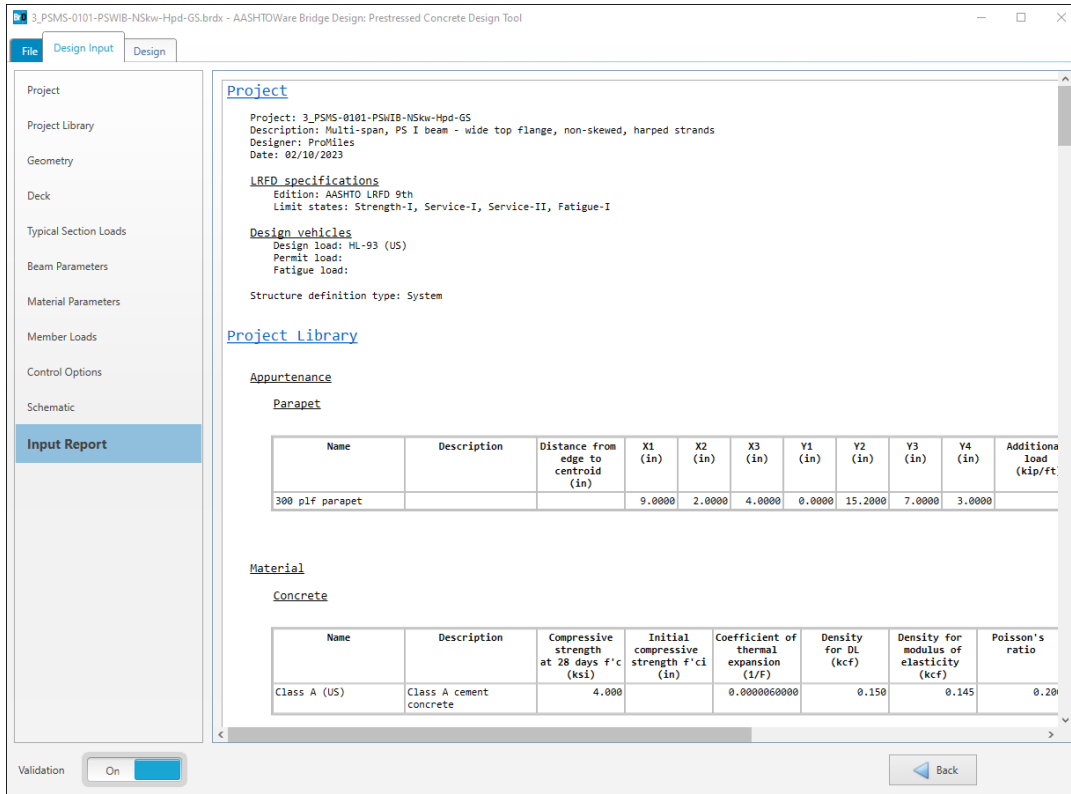
To verify the input data, review the **Typical Section** view in the **Schematic** section.



# PS10 – PS Design Tool Example

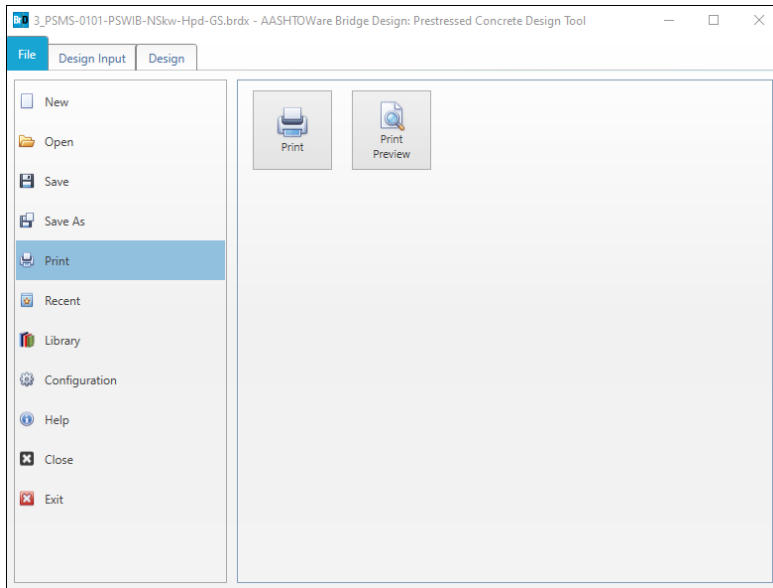
## Design Input | Input Report

The **Input Report** section provides a complete echo of the input data in tabular and graphical format.



## File | Print

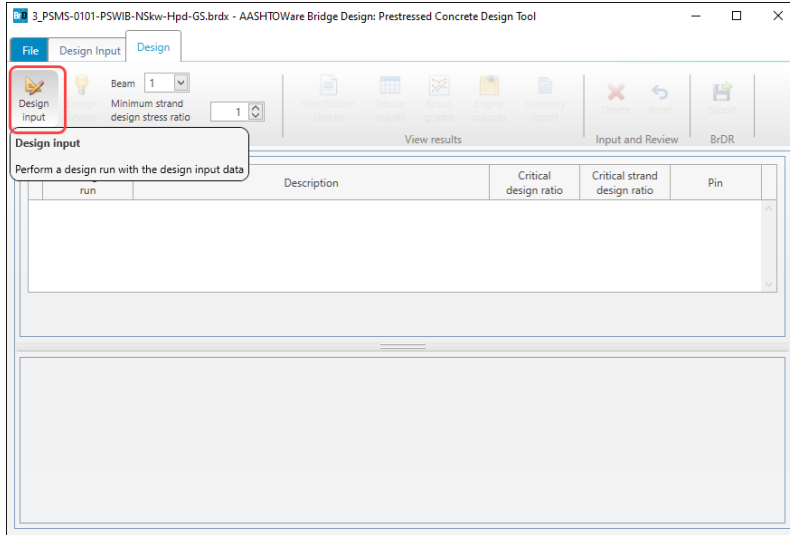
The **Print** and **Print Preview** buttons in the **File | Print** section apply to the **Input Report**.



# PS10 – PS Design Tool Example

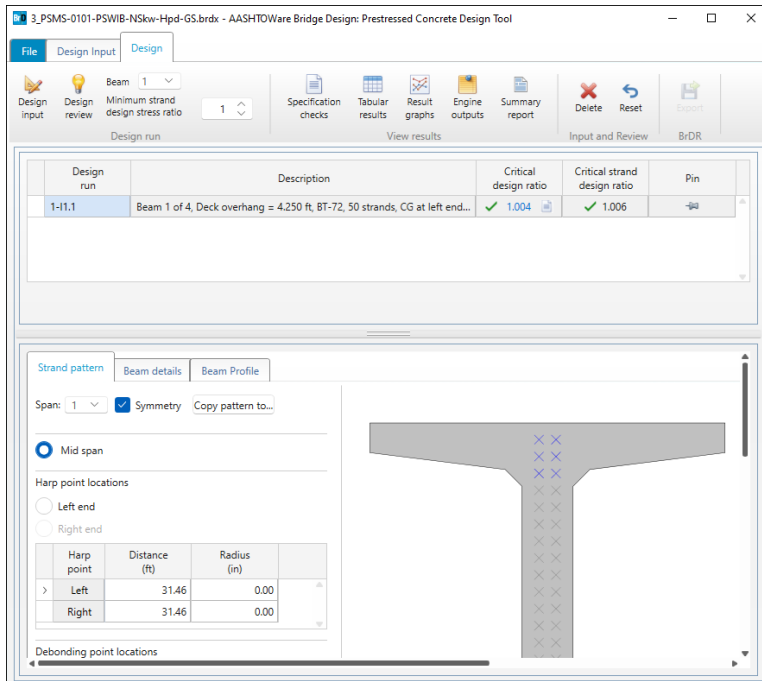
## Design | Design Input

After the input data is entered and reviewed, a **Design Input** can be performed by clicking on the **Design Input** button located on the **Design ribbon**. The **Design Input** option is based on the input data and produces a design that is displayed in the **Design Run** grid with a brief description and values of the critical design ratios. The **Design Input** option can be further adjusted by modifying the data displayed on the **Strand Pattern** and **Beam Details** tabs.



## Design | Strand Pattern

The **Strand Pattern** tab displays the strand pattern calculated by the program together with the corresponding initial and final concrete stresses. The strand pattern can also be modified by the user. Harping and debonding configurations can be applied simultaneously (to different strands.)



# PS10 – PS Design Tool Example

## Design | Beam Details

The **Beam Details** tab displays concrete strength and reinforcement data. Depending on the screen resolution, scrolling down to view the **Positive moment continuity steel** table may be necessary. Note that the bar spacing in the first row of the deck reinforcement table that was blank in the **Design Input | Deck** has been calculated by the program and is now displayed. It came close to the 6 in. spacing provided in the input in the second row. The calculated value will later be adjusted to be exactly 6 in. and a design review will be run to check if it is sufficient.

**Design Run Summary**

Design run	Description	Critical design ratio	Critical strand design ratio	Pin
1-11.1	Beam 1 of 4, Deck overhang = 4.250 ft, BT-72, 50 strands, CG at left end = 36.60 in	✓ 1.004	✓ 1.006	

**Beam Details**

Beam shape: BT-72      f'c: 7.0000 ksi      f'ci: 5.5000 ksi

Vertical shear reinforcement

Reinforcement	Extends into deck	Span	Start distance (ft)	Number of spaces	Spacing (in)	Length (ft)	End distance (ft)
Range 1	✓	1	0.33	1	0.00	0.00	0.33
Range 2	✓	1	0.33	4	6.00	2.00	2.33
Range 2	✓	1	2.33	2	4.00	0.67	3.00
Range 2	✓	1	3.00	12	6.00	6.00	9.00
Range 2	✓	1	9.00	2	6.75	1.13	10.13
Range 2	✓	1	10.13	35	8.50	24.79	34.92
Range 2	✓	1	34.92	2	12.50	2.08	37.00
Range 2	✓	1	37.00	18	24.00	36.00	73.00

Deck reinforcement

Support	Start distance (ft)	Length (ft)	End distance (ft)	Bar size	Clear cover (in)	Measured from	Bar spacing (in)
1	0.00	340.00	340.00	4	3.3750	Top of Stru...	6.0741
1	0.00	340.00	340.00	7	2.0000	Bottom of...	6.0000

Positive moment continuity steel

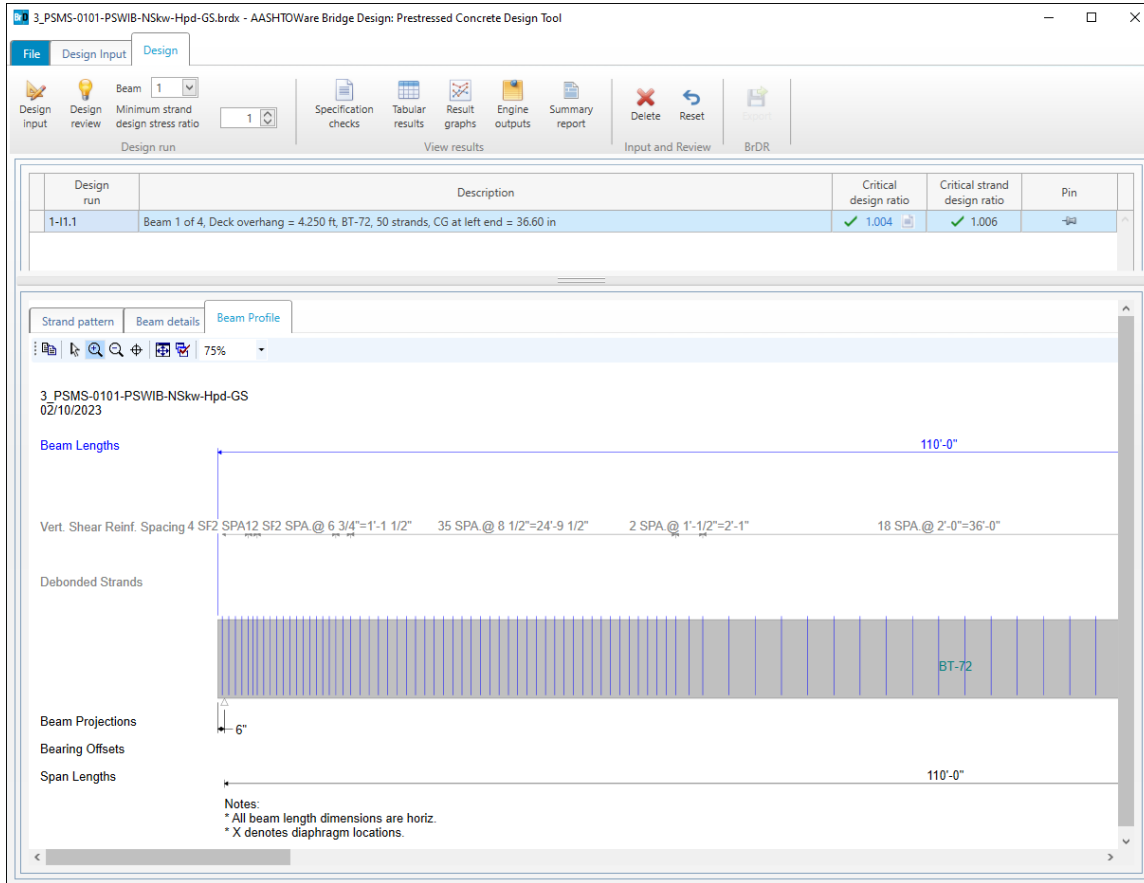
Span	Left support				Right support			
	Material	Distance (in)	Number of bars	Bar size	Material	Distance (in)	Number of bars	Bar size
1					Grade 60	3.00	8.00	5
2	Grade 60	3.00	8.00	5	Grade 60	3.00	8.00	5
3	Grade 60	3.00	8.00	5				



# PS10 – PS Design Tool Example

## Design | Beam Profile

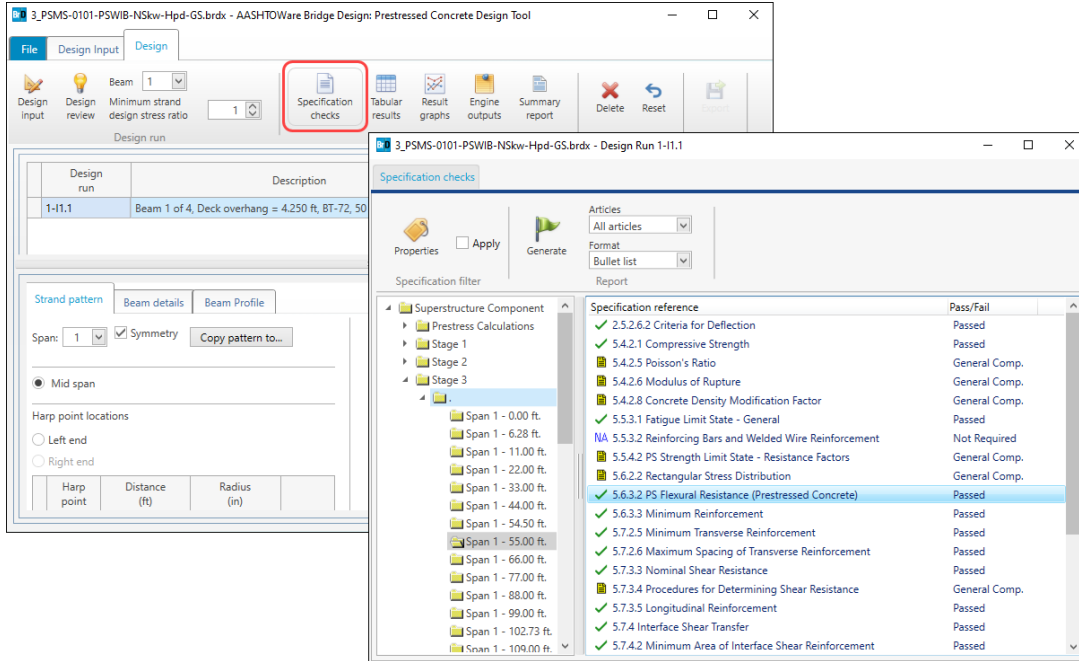
The **Beam Profile** tab shows an elevation view of the beam together with dimension and reinforcement information.



# PS10 – PS Design Tool Example

## Design | Specification Check

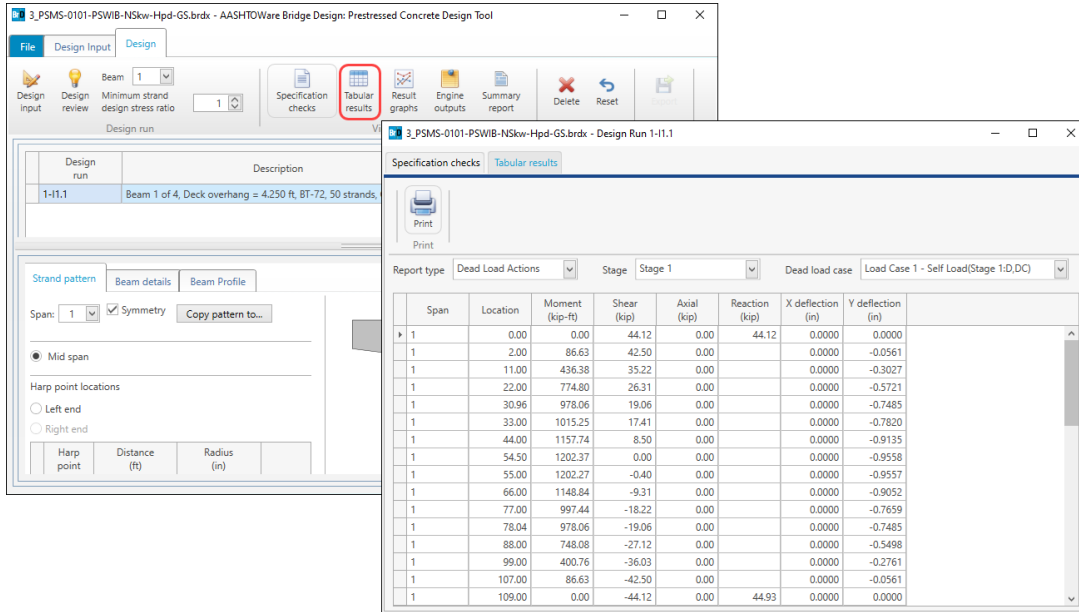
To view the specification check results, click on the **Specification checks** button from the **View results** group of the **Design** ribbon.



# PS10 – PS Design Tool Example

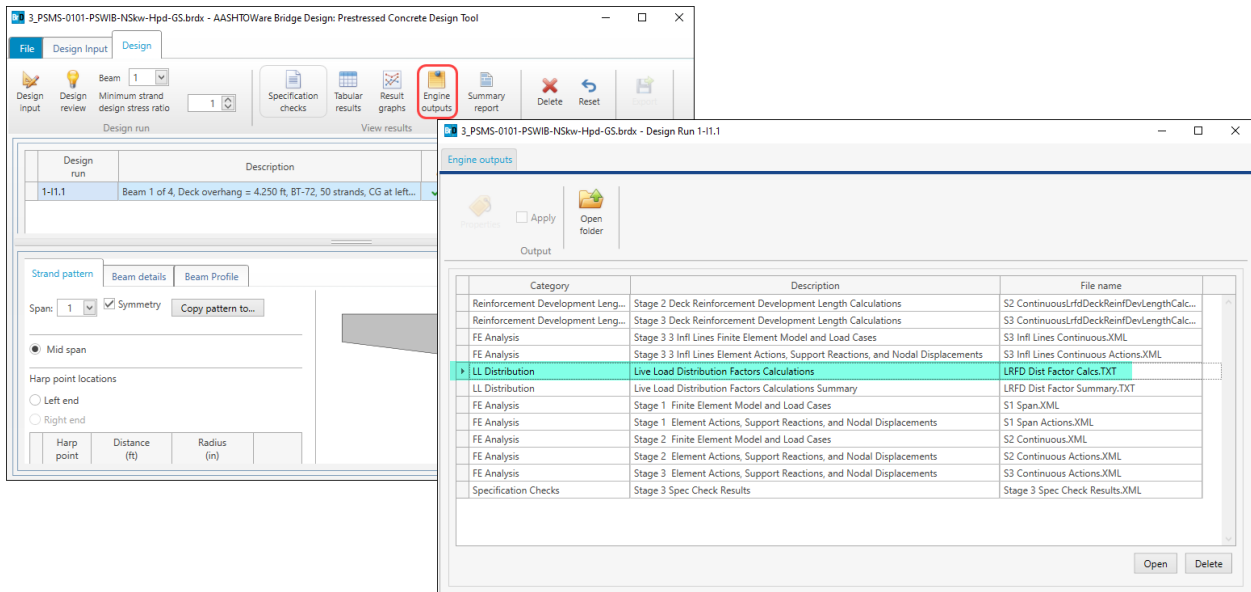
## Design | Tabular Results

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.



# PS10 – PS Design Tool Example

```
LRFD Dist Factor Calcs - Notepad
File Edit Format View Help

=====
== Detailed Calculations ==
=====

=====
Lever Rule Distribution
(Article 4.6.2.2)
=====

Compute Lever Rule Deck Distribution Factors
-----

Number Lanes Loaded = 1

Truck Wheel Positions from Left Edge of Deck
Truck   Left Wheel   Right Wheel
        (ft)       (ft)
-----
1       3.25        9.25

Lever Rule Reaction, R = 0.833

Lever DF = MPF * R = 1.20 * 0.833 = 1.000 Lanes

Compute Lever Rule Deck Distribution Factors
-----

Number Lanes Loaded = 2

Truck Wheel Positions from Left Edge of Deck
Truck   Left Wheel   Right Wheel
        (ft)       (ft)
-----
1       3.25        9.25
2       15.25       21.25

Lever Rule Reaction, R = 0.875

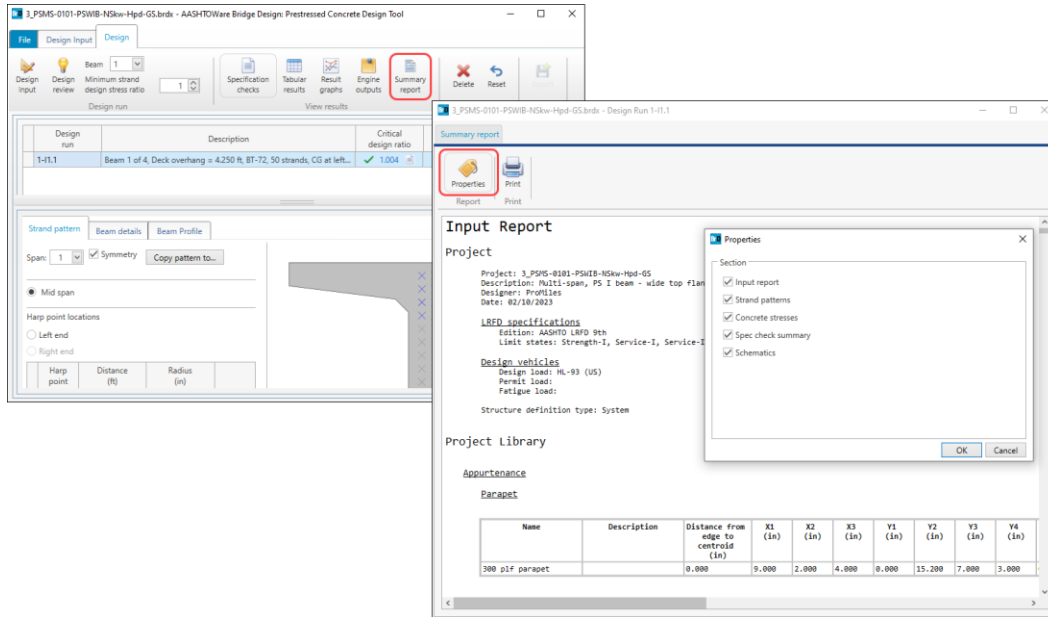
Lever DF = MPF * R = 1.00 * 0.875 = 0.875 Lanes

Ln 1, Col 1 | 100% | Windows (CRLF) | UTF-8
```

# PS10 – PS Design Tool Example

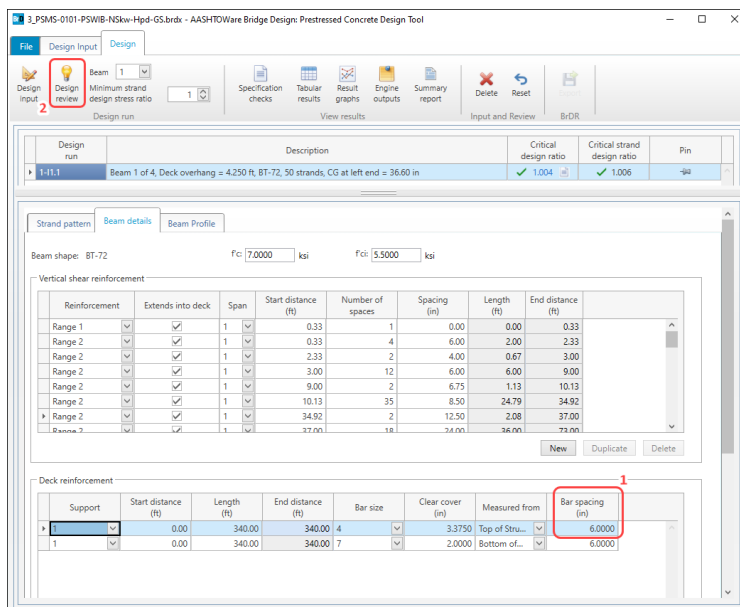
## Design | Summary Report

To view the summary report, click on the **Summary Report** button from the **View results** group of the **Design** ribbon. The summary report is composed of several sections. The sections included in the report can be selected by clicking on the **Properties** button in the **Summary Report** window and checking or unchecking the corresponding sections.



## Design | Design Review

To illustrate the ability of the program to adjust results of the **Design Input** run, modify the **Bar spacing** in the first row of the **Deck reinforcement** table to be exactly 6.0 in. Then, click the **Design Review** run button on the **Design** ribbon.



## PS10 – PS 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 AASHTOWare Bridge Design: Prestressed Concrete Design Tool interface. The main window shows the 'Design' tab with a toolbar and a 'Design run' grid. The grid contains two rows: '1-I1.1' and '1-R1.1'. The '1-R1.1' row is highlighted with a red box. Below the grid, the 'Beam details' tab is active, showing 'Beam shape: BT-72', 'f'c: 7.0000 ksi, and 'f'ci: 5.5000 ksi. The 'Vertical shear reinforcement' table is visible, showing columns for Reinforcement, Extends into deck, Span, Start distance (ft), Number of spaces, Spacing (in), Length (ft), and End distance (ft). The 'Deck reinforcement' table is also visible, showing columns for Support, Start distance (ft), Length (ft), End distance (ft), Bar size, Clear cover (in), Measured from, and Bar spacing (in).

Design run	Description	Critical design ratio	Critical strand design ratio	Pin
1-I1.1	Beam 1 of 4, Deck overhang = 4.250 ft, BT-72, 50 strands, CG at left end = 36.60 in	✓ 1.004	✓ 1.006	→
1-R1.1	Beam 1 of 4, Deck overhang = 4.250 ft, BT-72, 50 strands, CG at left end = 36.60 in	✓ 1.008	✓ 1.009	→

Reinforcement	Extends into deck	Span	Start distance (ft)	Number of spaces	Spacing (in)	Length (ft)	End distance (ft)
Range 1	✓	1	0.33	1	0.00	0.00	0.33
Range 2	✓	1	0.33	4	6.00	2.00	2.33
Range 2	✓	1	2.33	2	4.00	0.67	3.00
Range 2	✓	1	3.00	12	6.00	6.00	9.00
Range 2	✓	1	9.00	2	6.75	1.13	10.13
Range 2	✓	1	10.13	35	8.50	24.79	34.92
Range 2	✓	1	34.92	2	12.50	2.08	37.00
Range 2	✓	1	37.00	18	21.00	36.00	72.00

Support	Start distance (ft)	Length (ft)	End distance (ft)	Bar size	Clear cover (in)	Measured from	Bar spacing (in)
1	0.00	340.00	340.00	4	3.3750	Top of Stru...	6.0000
1	0.00	340.00	340.00	7	2.0000	Bottom of...	6.0000