AASHTOWare PS Design Tool v7.2

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RADBUG Meeting
August 3, 2022

AASHTOWare Bridge Design & Rating

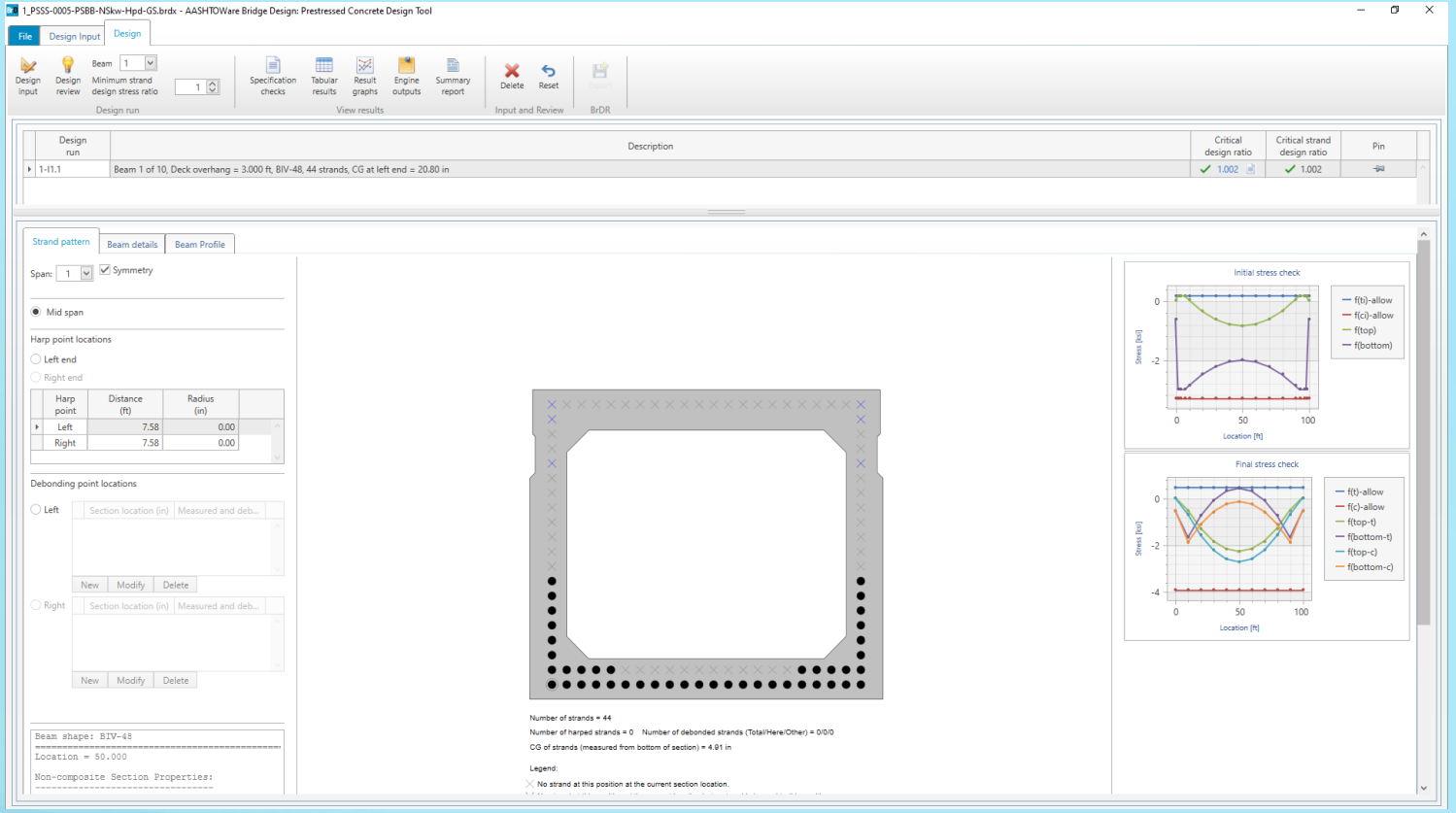
ProMiles

Outline

- PowerPoint Presentation
  - Capabilities and Limitations
  - UI and Features
  - Future Improvements
- Live Demo
  - Enter the project
  - Perform design input run, review, and iterate
  - Perform design review run
  - Import into BrD
- Q & A

PS Design Tool

Analysis and design of prestressed concrete beams with harped and debonded strand patterns



Capabilities and Limitations

- Design Specification
  - AASHTO LRFD, Ed 6'th through 9'th
  - Strength, Service, Fatigue Limit States, and Transport Stability
- Loads
  - Live Load
    - Vehicular: Design, Permit, Fatigue
    - Pedestrian
  - Dead Load
    - Girder, Deck, Wearing Surface, Diaphragms,
    - Appurtenance: Median, Parapet, Railing, Sidewalk, Generic

Capabilities and Limitations

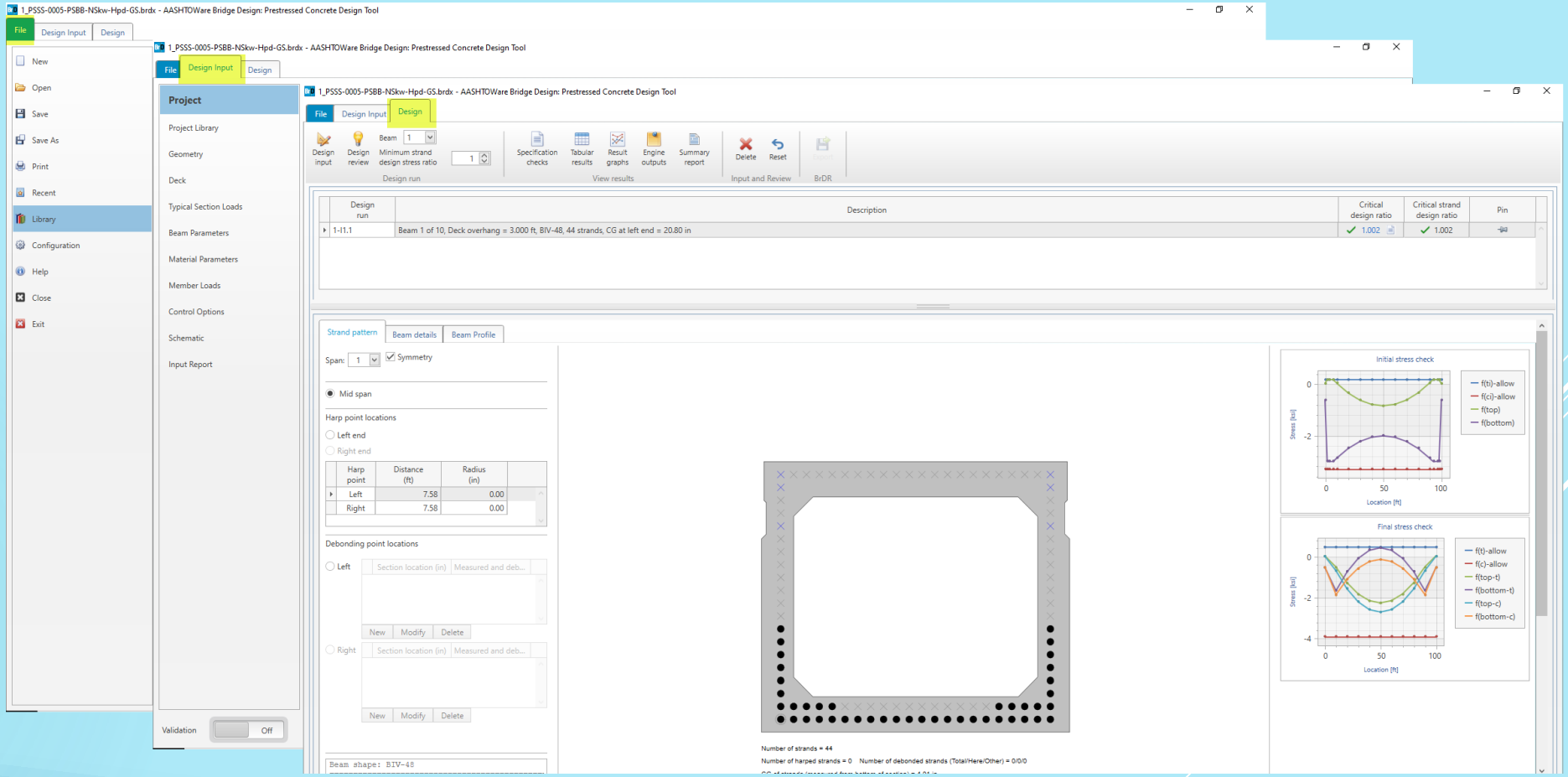
- Structure Definition
  - Girder System (constant girder spacing and one skew)
  - Girder Line
- Shape Types
  - Adjacent and Spread Box Beam
  - Narrow and Wide Top Flange I Beam
  - Tee Beam with 2 or 3 Stems

Capabilities and Limitations

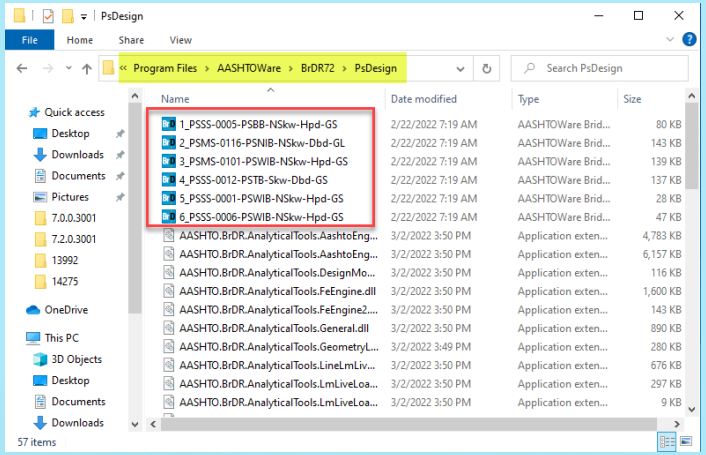
- Strand Configurations
  - Initial Design: Straight, Straight and Debonded, Straight and Harped
  - Final Design: Any Combination of Straight, Debonded, and Harped
- Input
  - Fixed
  - Variable (Parametric)

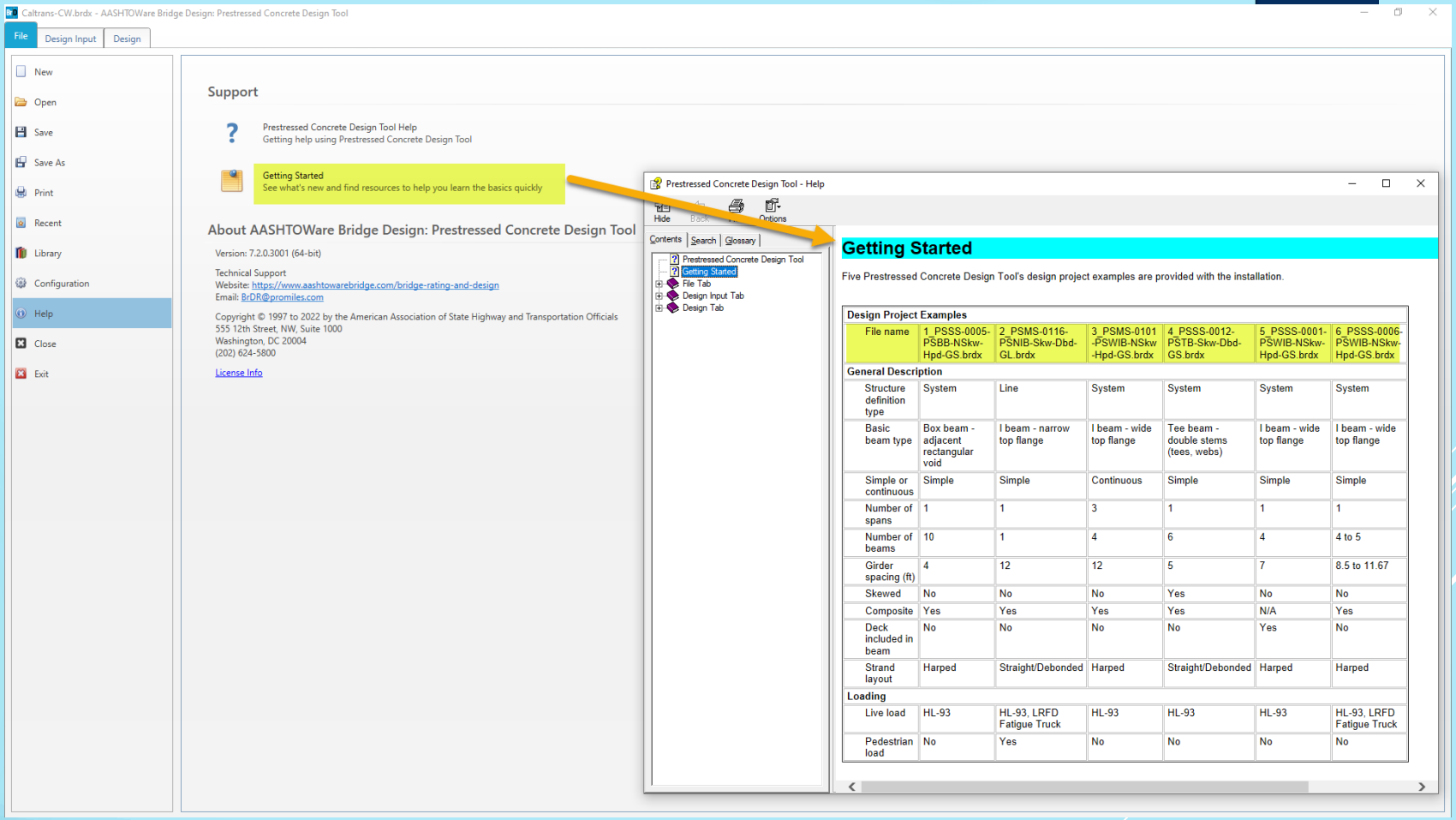
Program Organization

- File: Common and PS Design Tool specific file operations
- Design Input: Data input for initial design
- Design: Results of initial design plus input tweaks and final design results



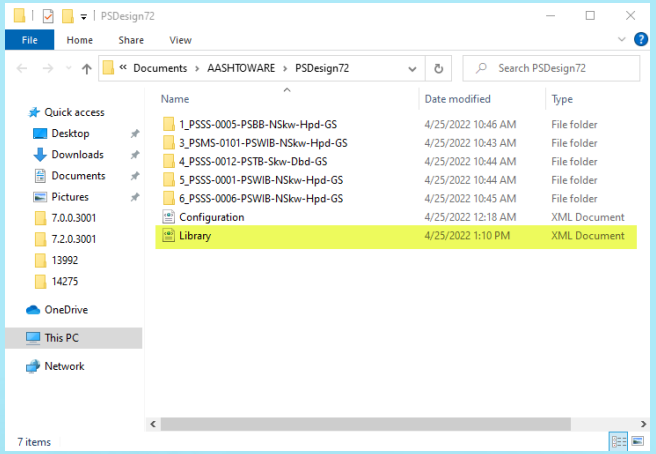
File | Help

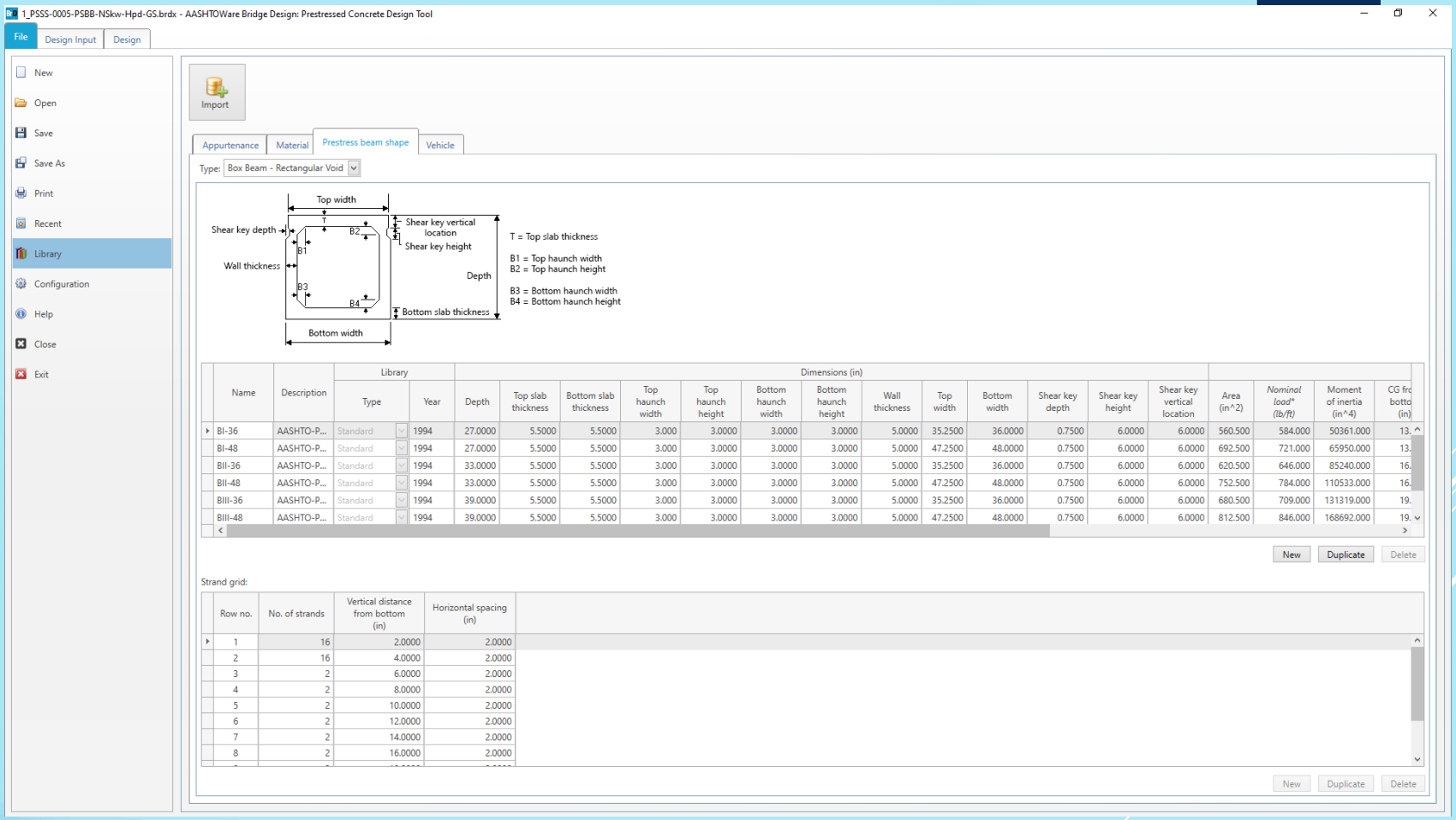




- Program Help
- F1 Button
- Example Input Files Included with Install
- Input Stored in XML Files

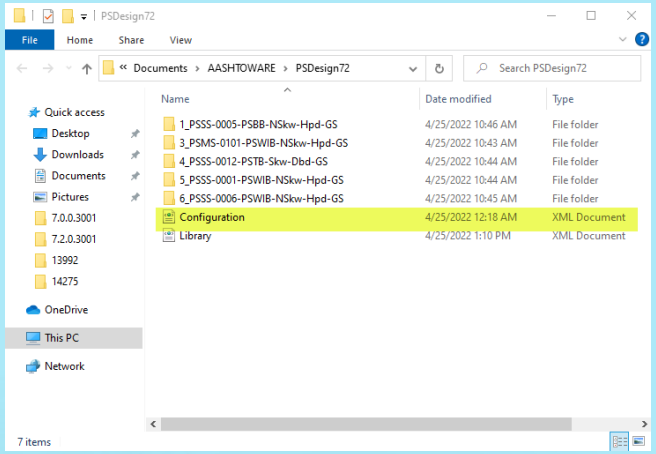
File | Library

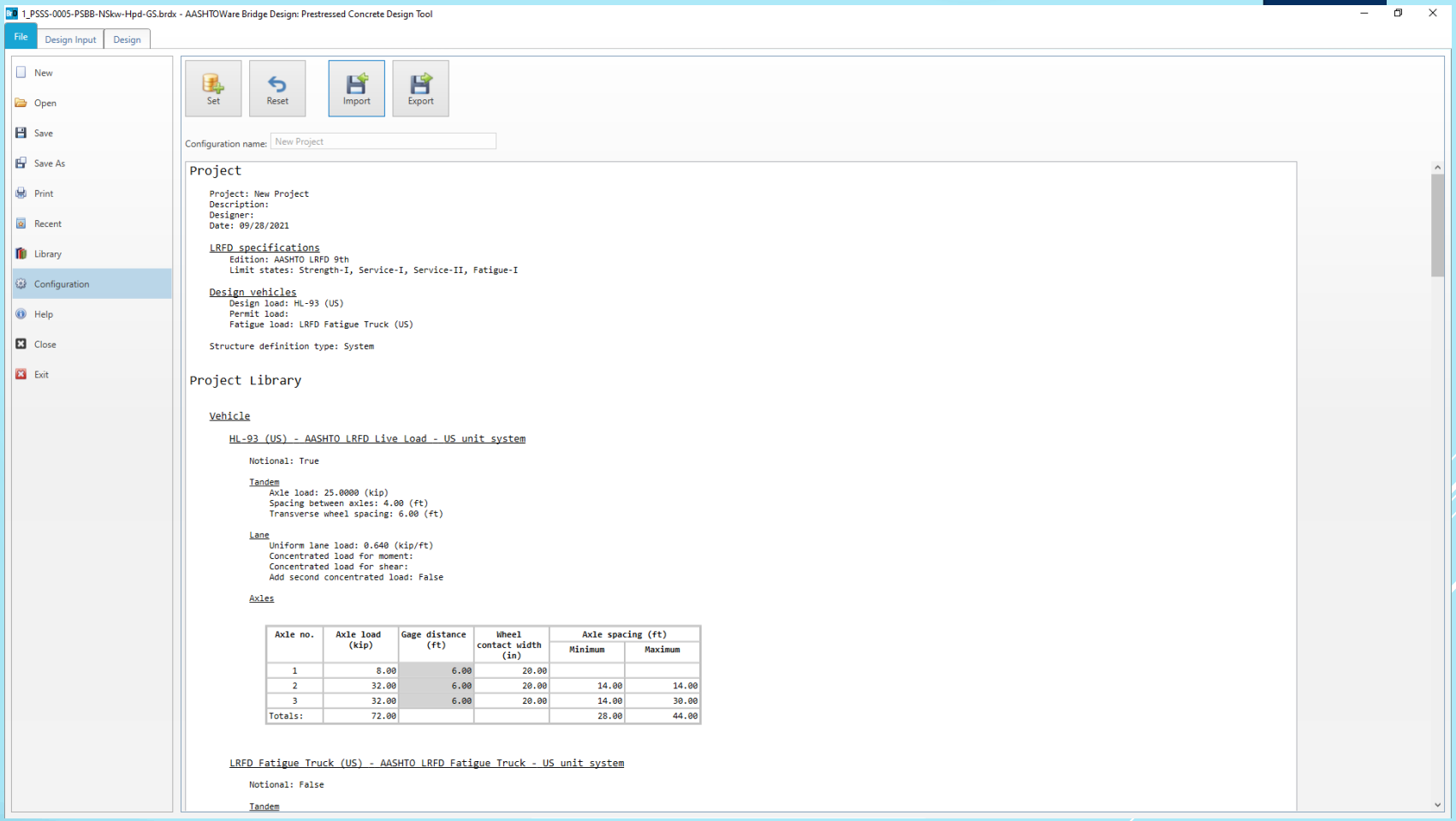




- Data shared between projects
- Can be imported from BrDR
- Stored in XML File

File | Configuration



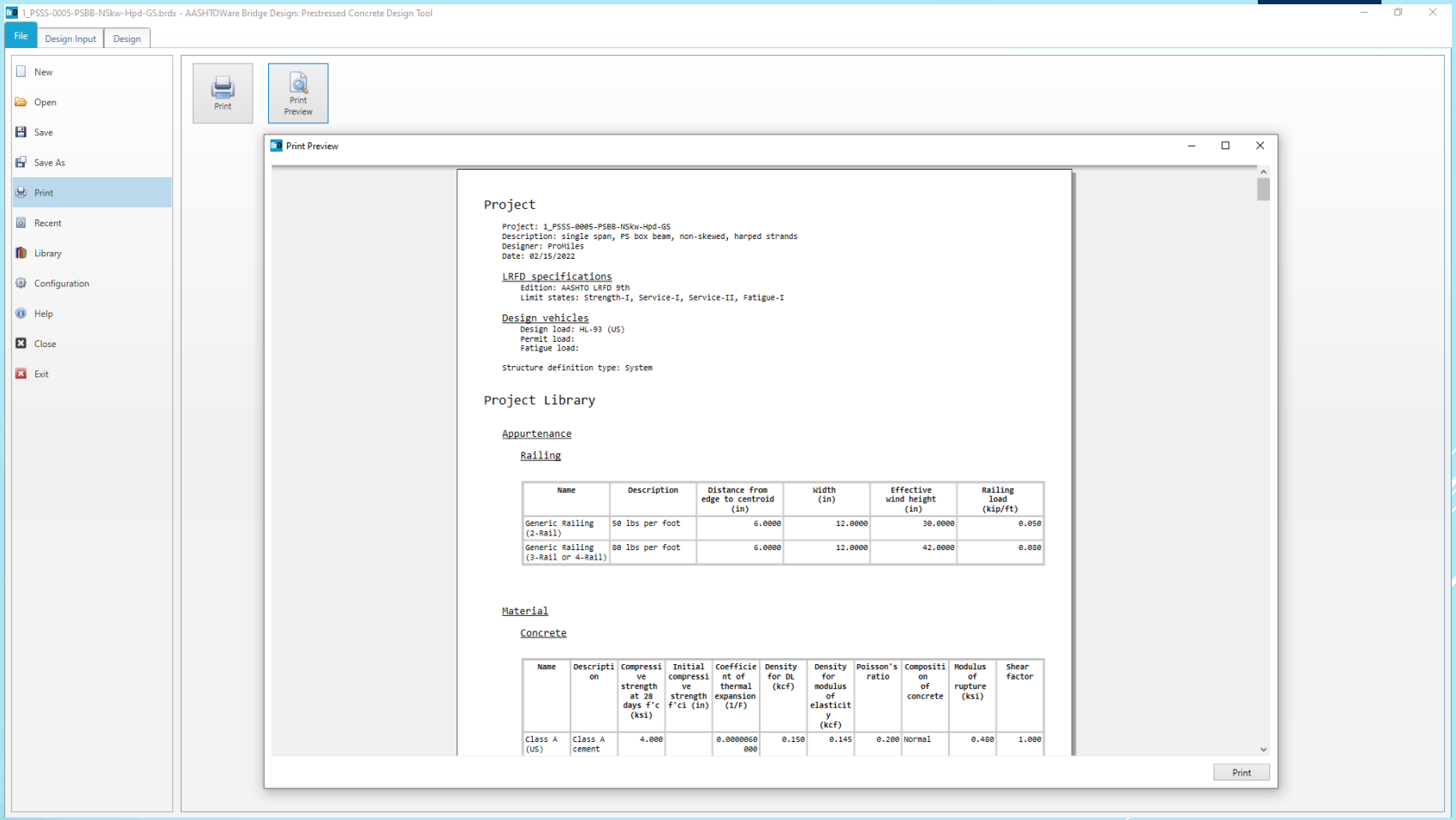


- Template with default entries for new project
- Can be customized by user
- Stored in XML File

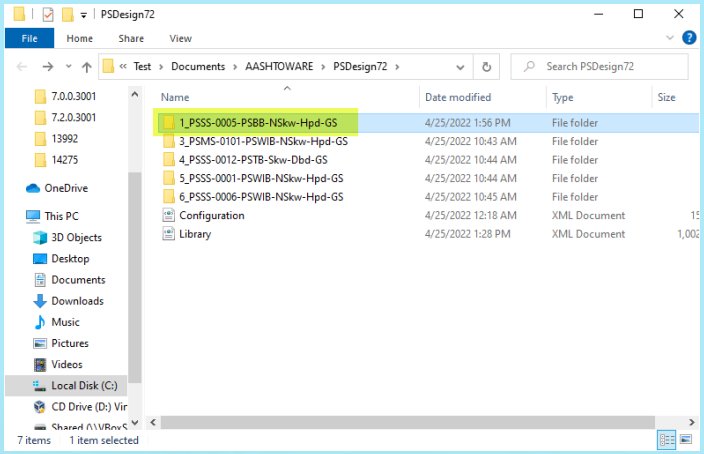
File | Print

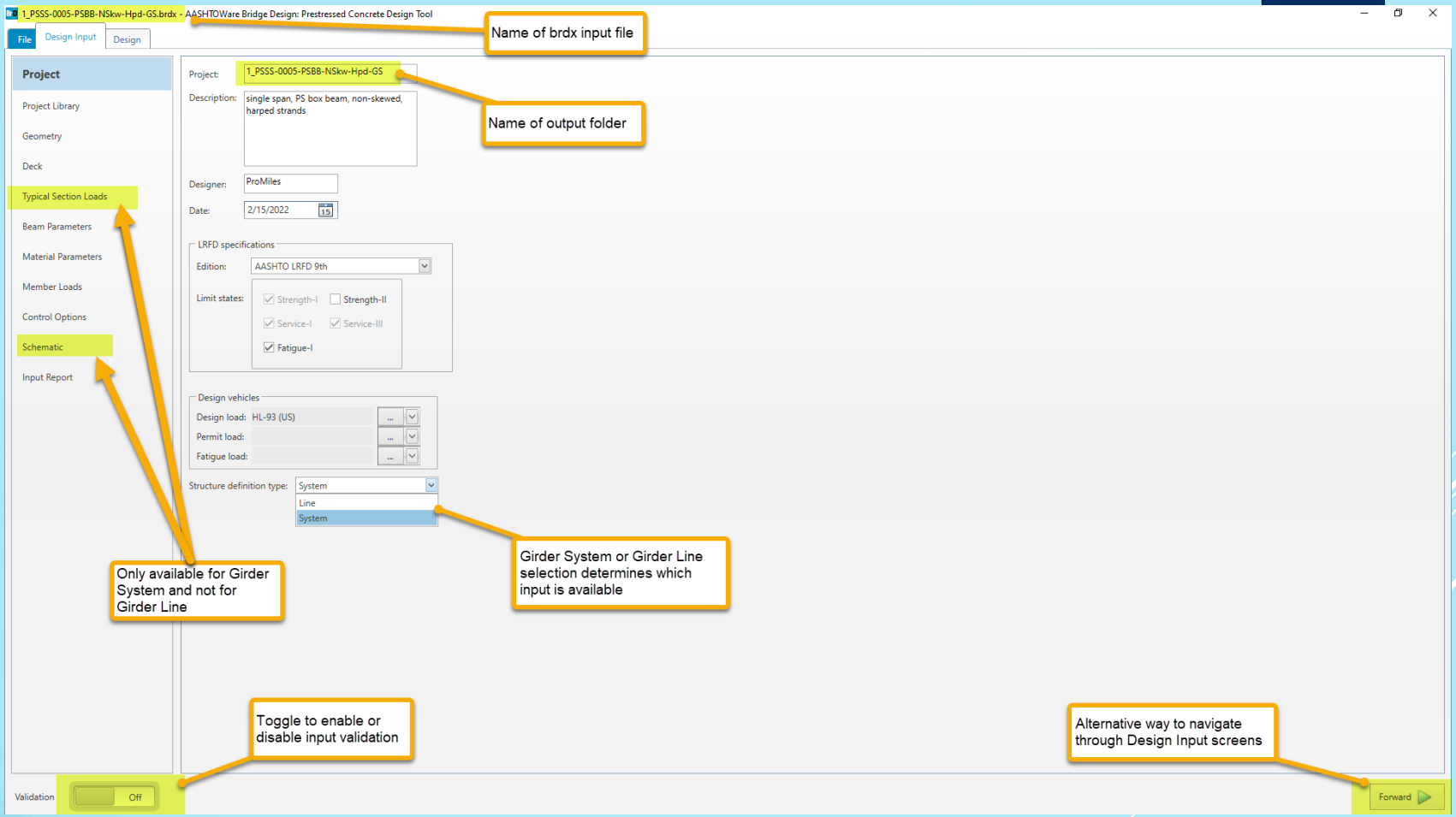
- Print Preview and Print of Input Data

(Output Data printout available in Design | Summary Report)



Design Input | Project

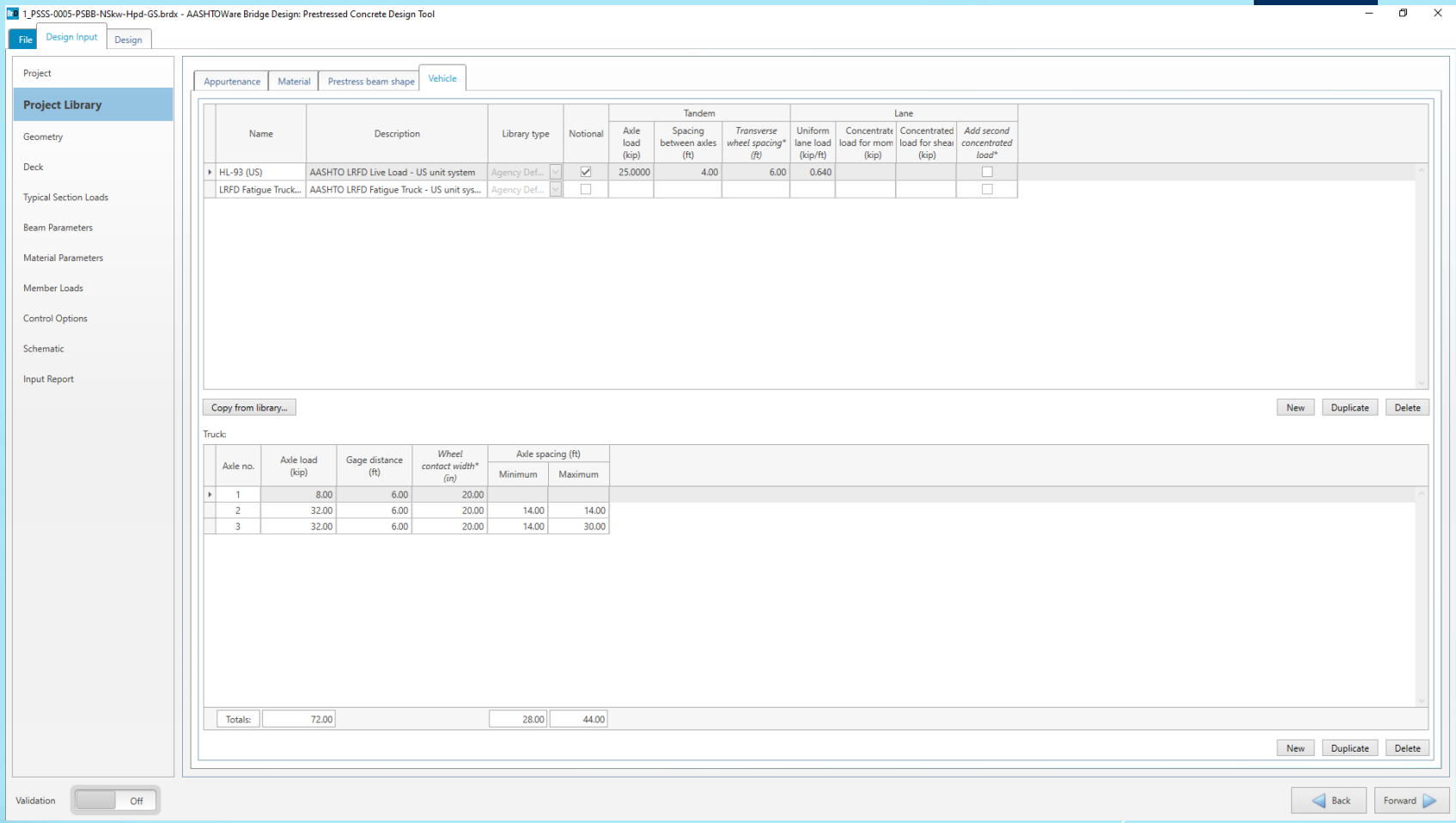




- General Info
- Design Specs
- Which input is available
- Where output is stored

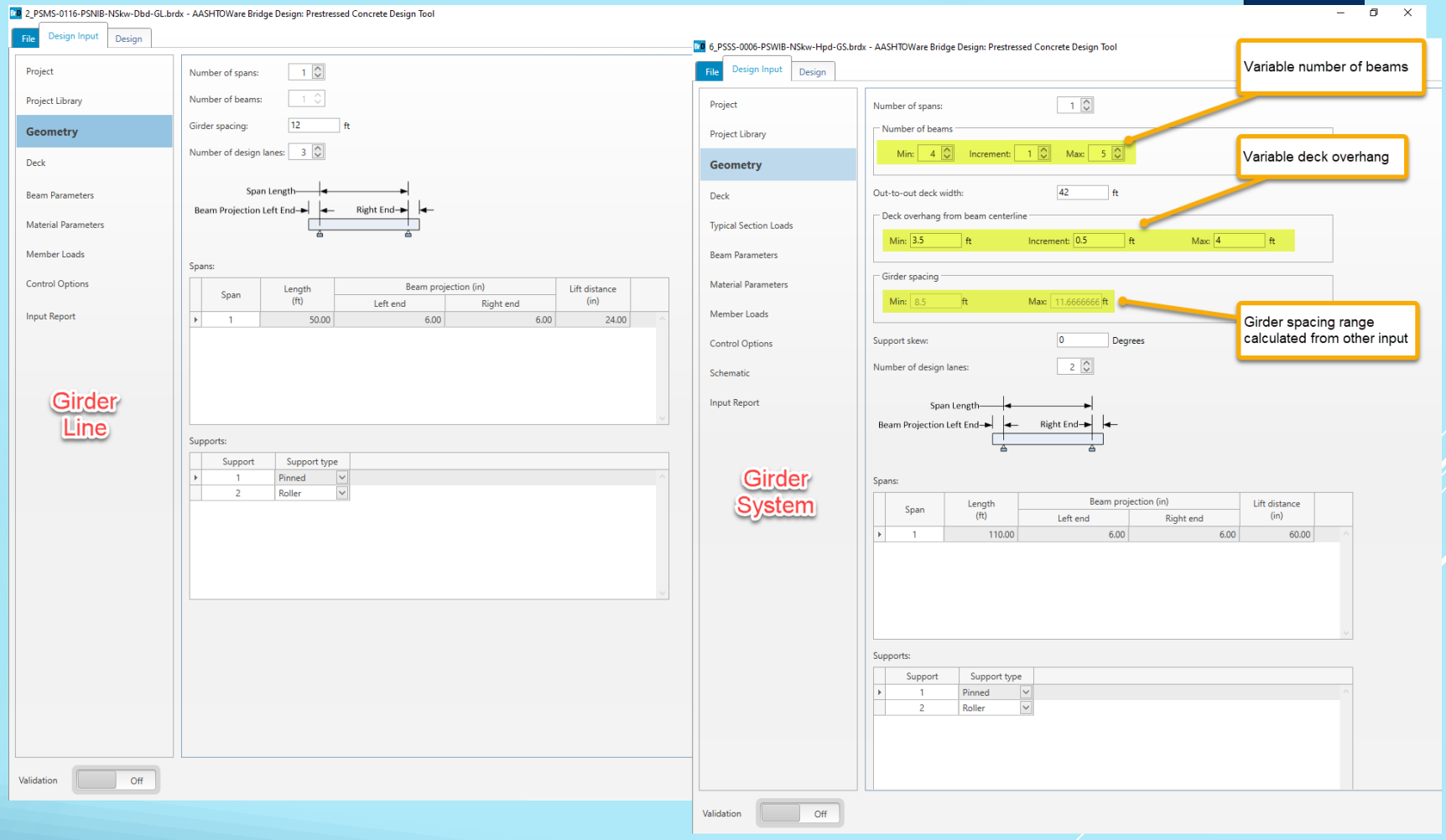
Design Input | Project Library

- Pre-defined Data to Use in the Project
- Created or Copied from File | Library
- Includes:
  - Appurtenances
  - Materials
  - PS Beam Shapes
  - Vehicles



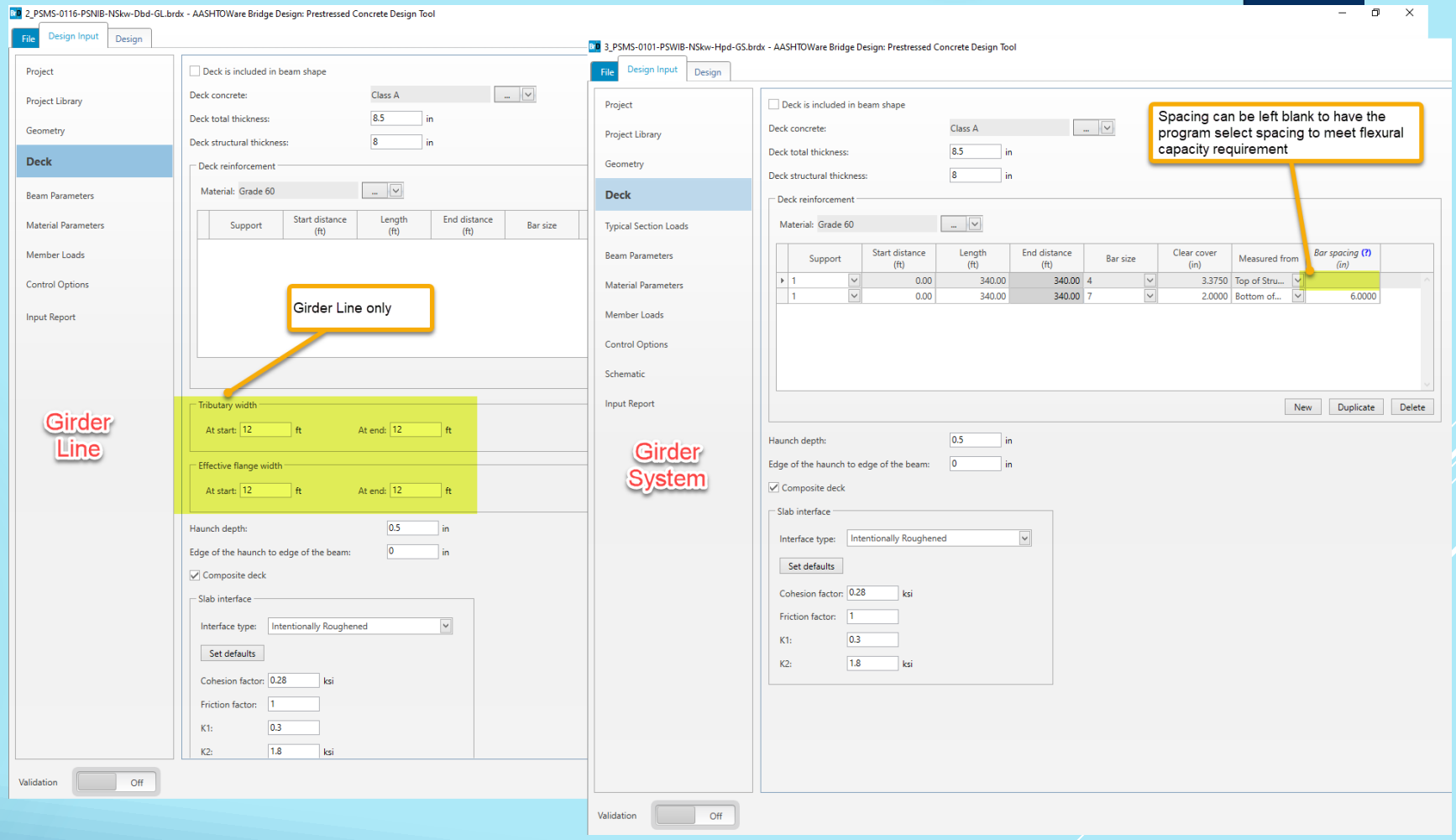
Design Input | Geometry

- Different Input for Girder Line and Girder System
- Girder System allows variable (parametric) input in range form defined by Min/Increment/Max values



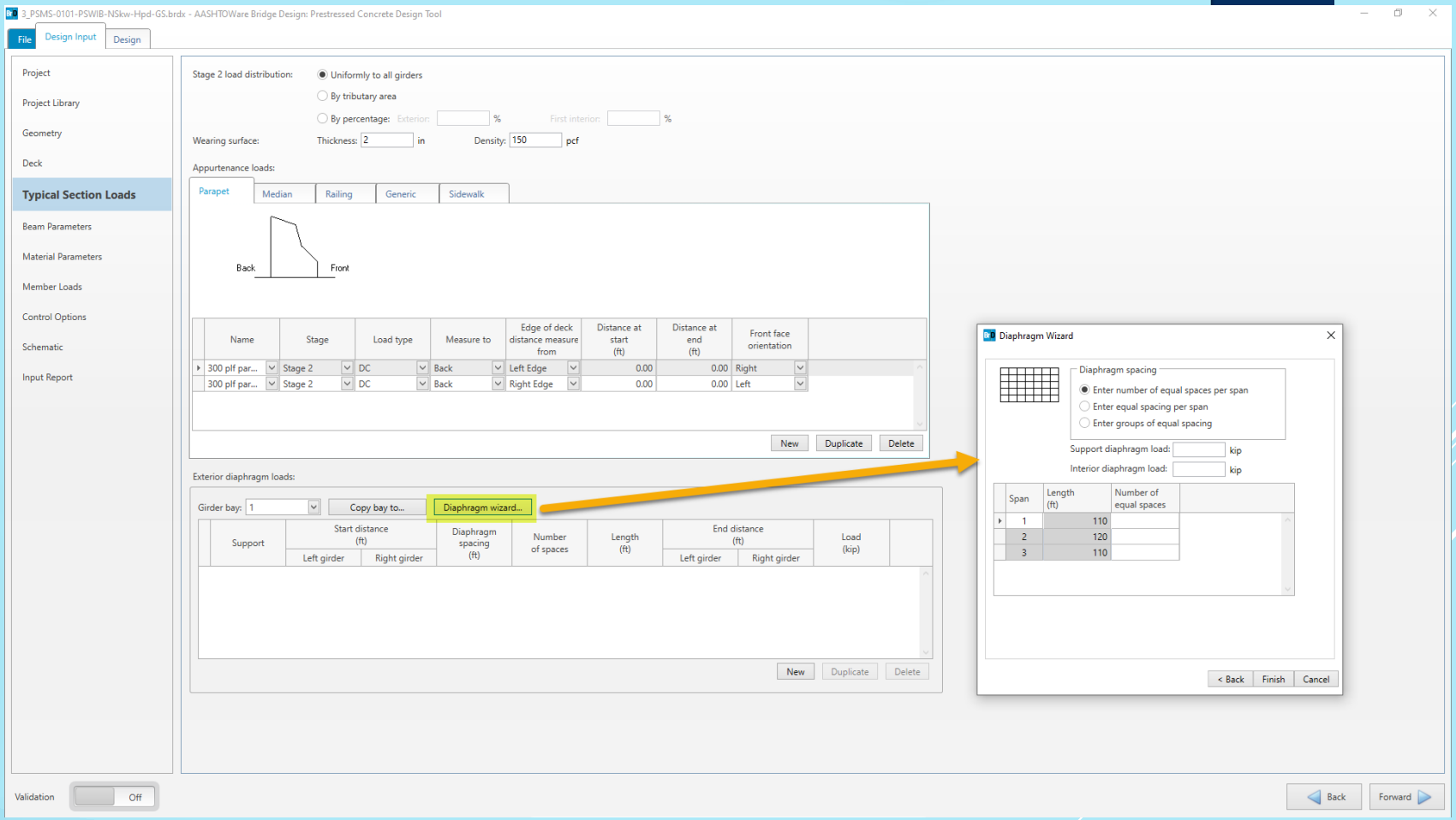
Design Input | Deck

- Different Input for Girder Line and Girder System
- Girder Line needs Tributary Width and Effective Flange Width
- Bar Spacing for deck reinforcement can be left empty to be automatically calculated



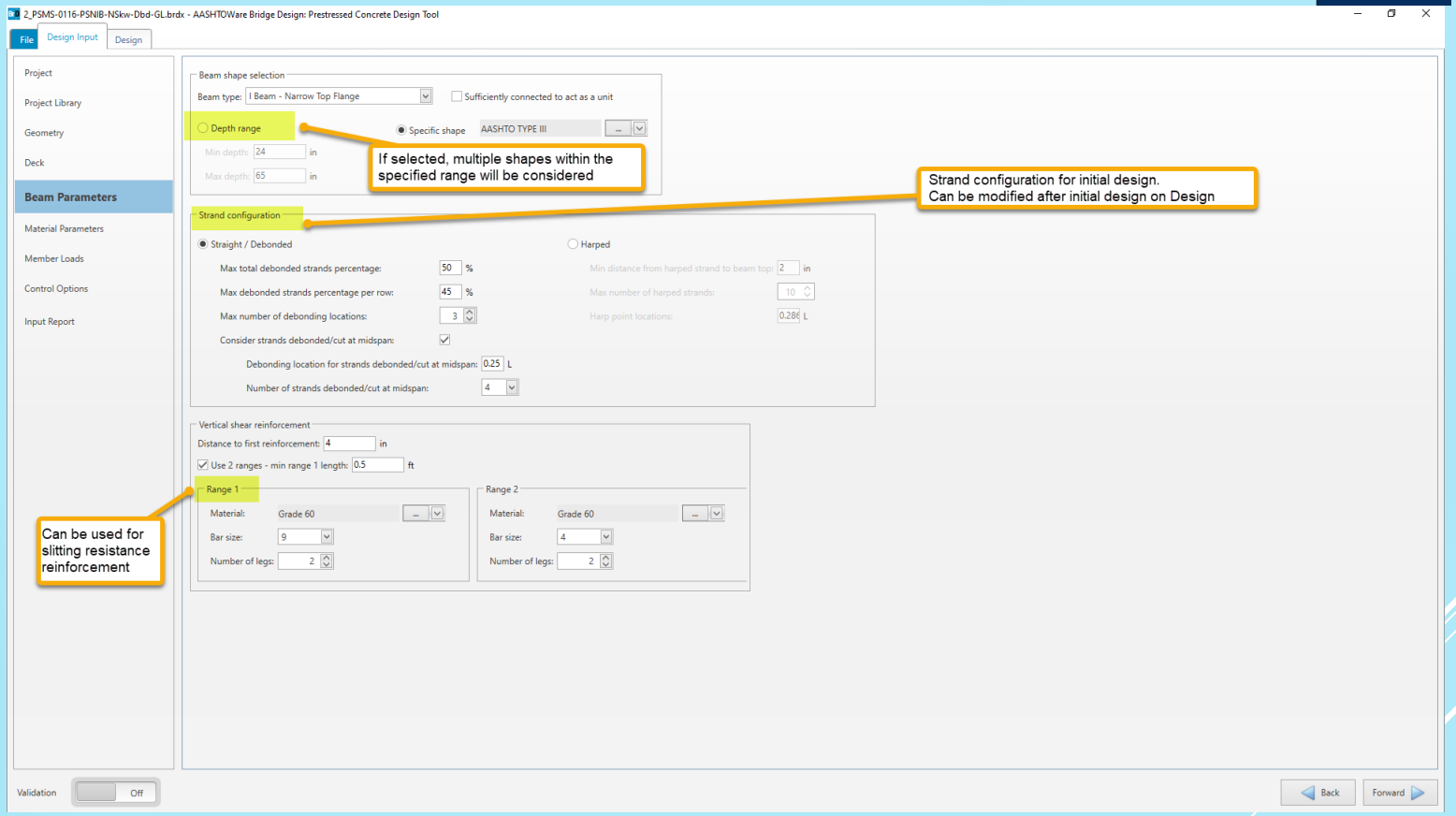
Design Input | Typical Section Loads

- Girder System Only
- Stage 2 Load Distribution
  - Uniform, by area, or by percentage
- Load Types:
  - Wearing Surface
  - Appurtenances
  - Exterior Diaphragms
    - Diaphragm Wizard available only if geometry is fixed



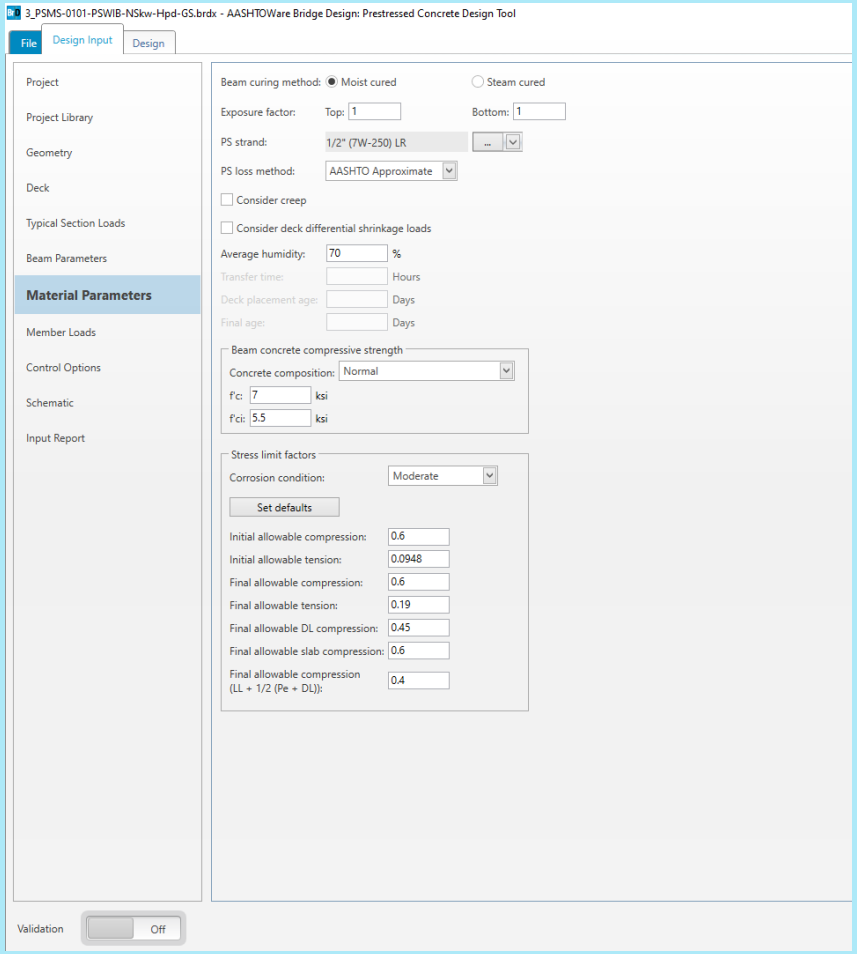
Design Input | Beam Parameters

- Same Input for Girder Line and Girder System
- Parameters for
  - Beam Shape Selection
  - Initial Strand Configuration
  - Vertical Shear (and Splitting) Reinforcement



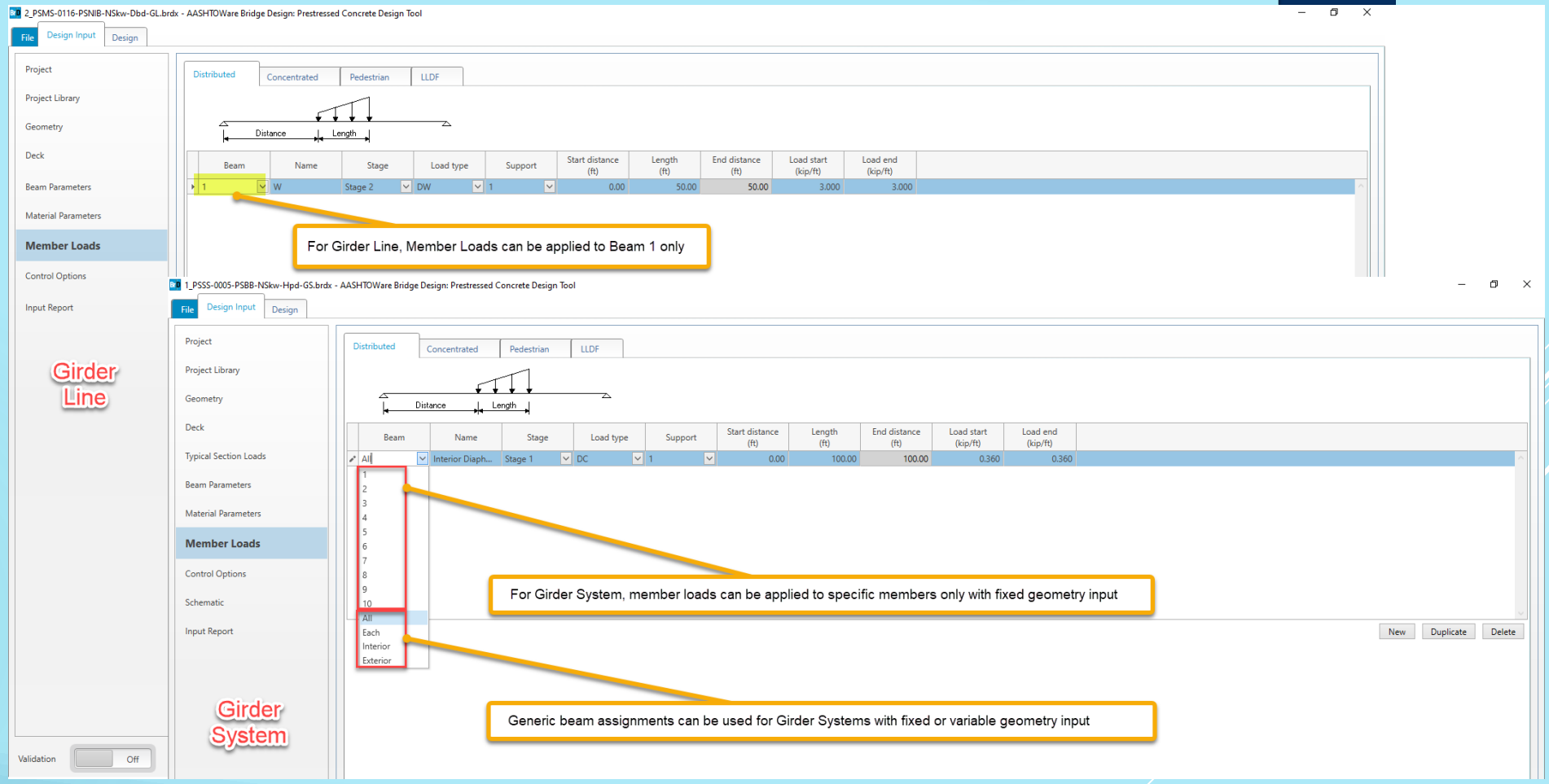
Design Input | Material Properties

- Same Input for Girder Line and Girder System
- Input Data for:
  - PS Loss Calculations
  - Beam Concrete Strength
  - Stress Limit Factors



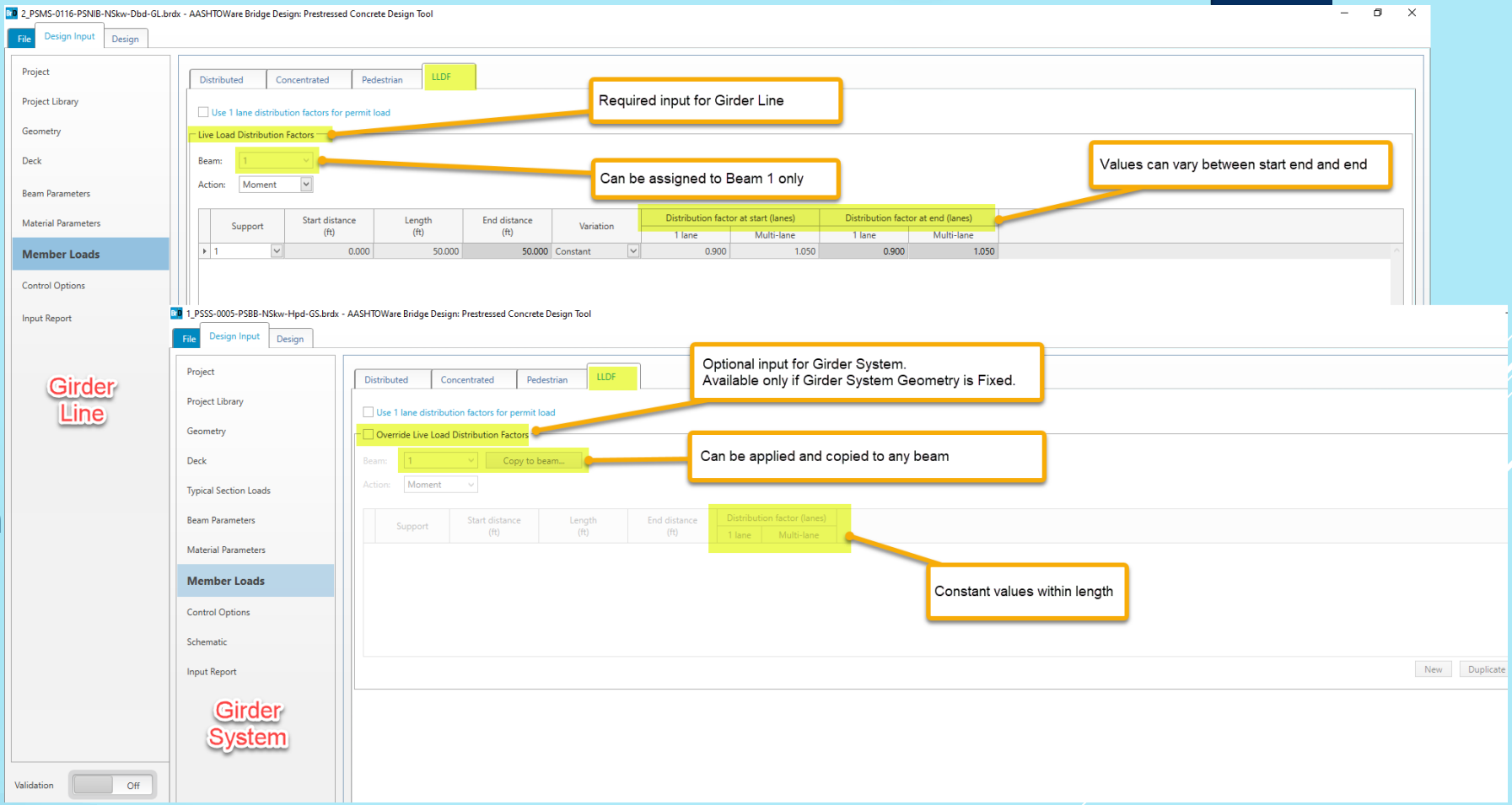
Design Input | Member Loads

- Same Input for Girder Line and Girder System but with Different Beam Assignments
- Load Types:
  - Distributed
  - Concentrated
  - Pedestrian



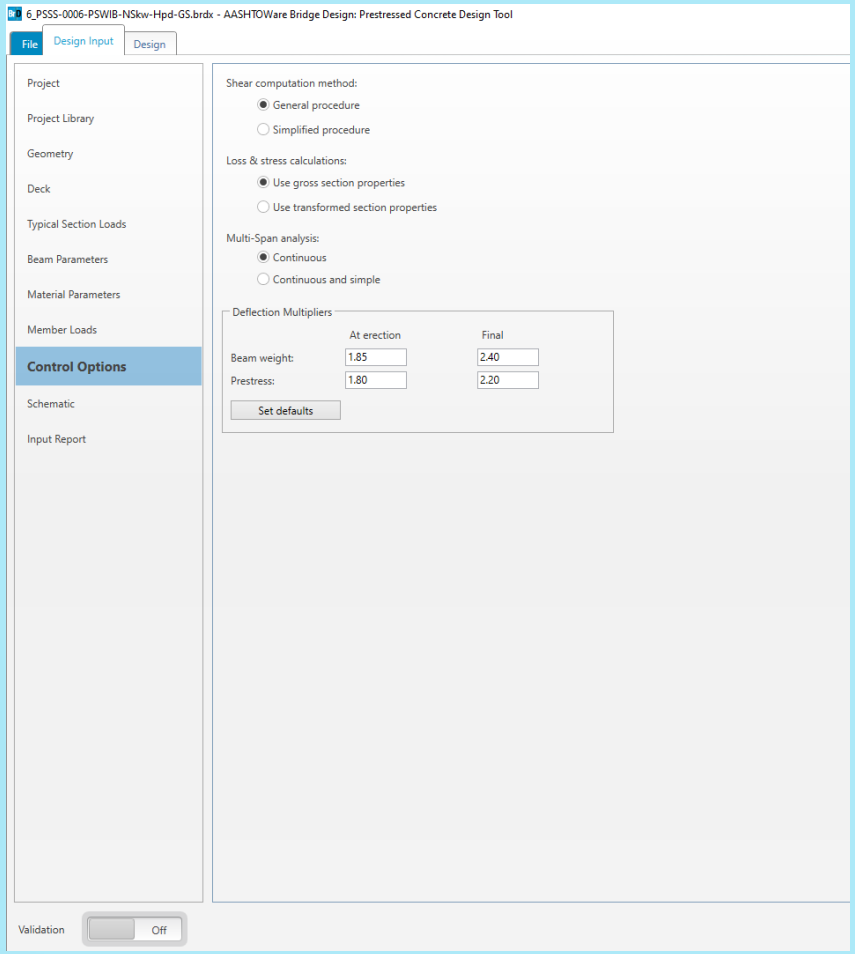
Design Input | Member Loads | LLDFs

- Different Input for Girder Line and Girder System
- Girder Line:
  - Required
  - Allows Variation with within range
- Girder System
  - Calculated by program
  - Can be overridden by user
  - Constant within range



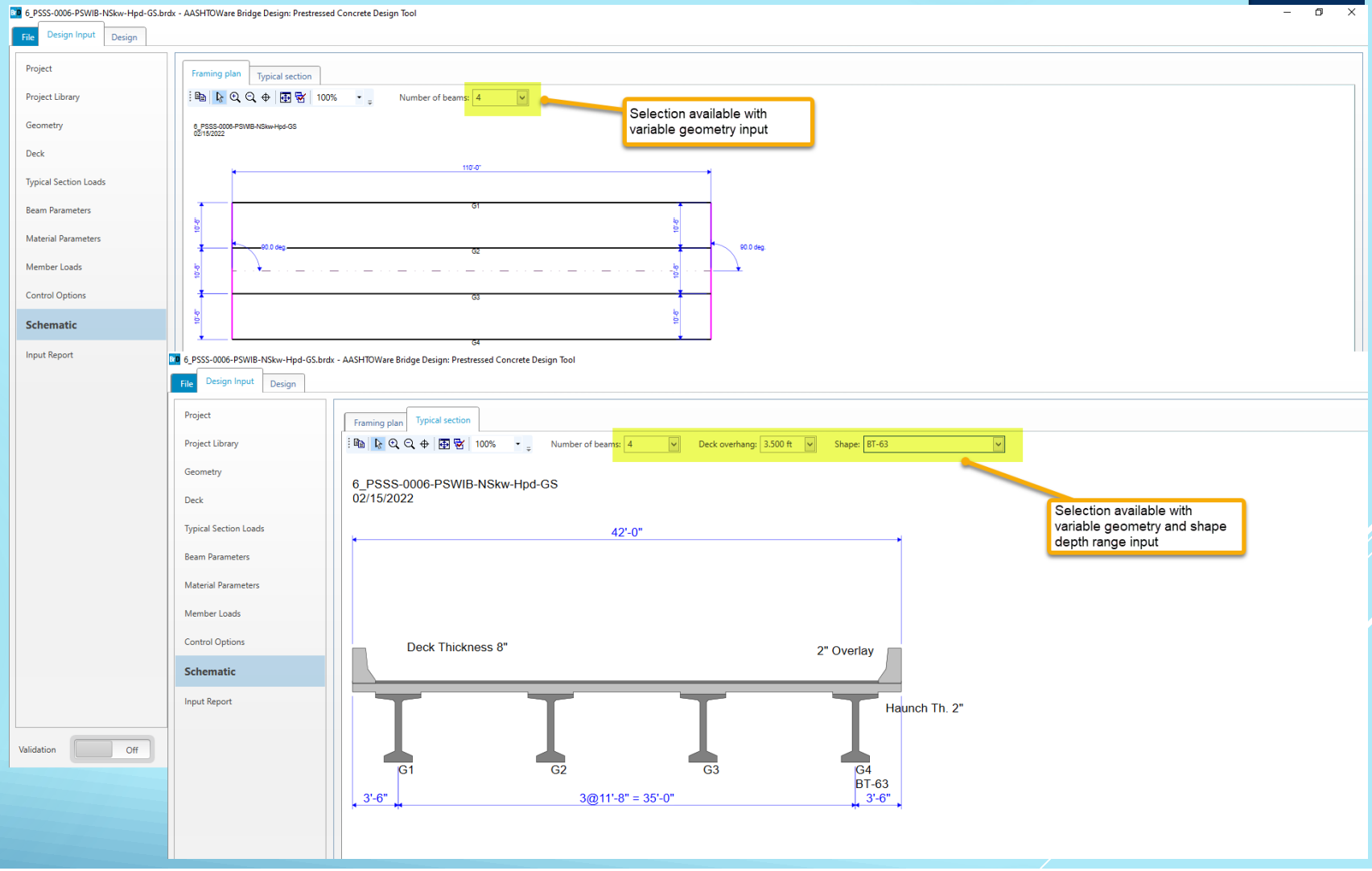
Design Input | Control Options

- Same Input for Girder Line and Girder System
- Defines:
  - Shear Computation Method
  - Gross or Transformed Section Properties for PS Loss Calculations
  - Stage 2 and 3 Analysis for Multi-span bridges
  - Deflection Multipliers



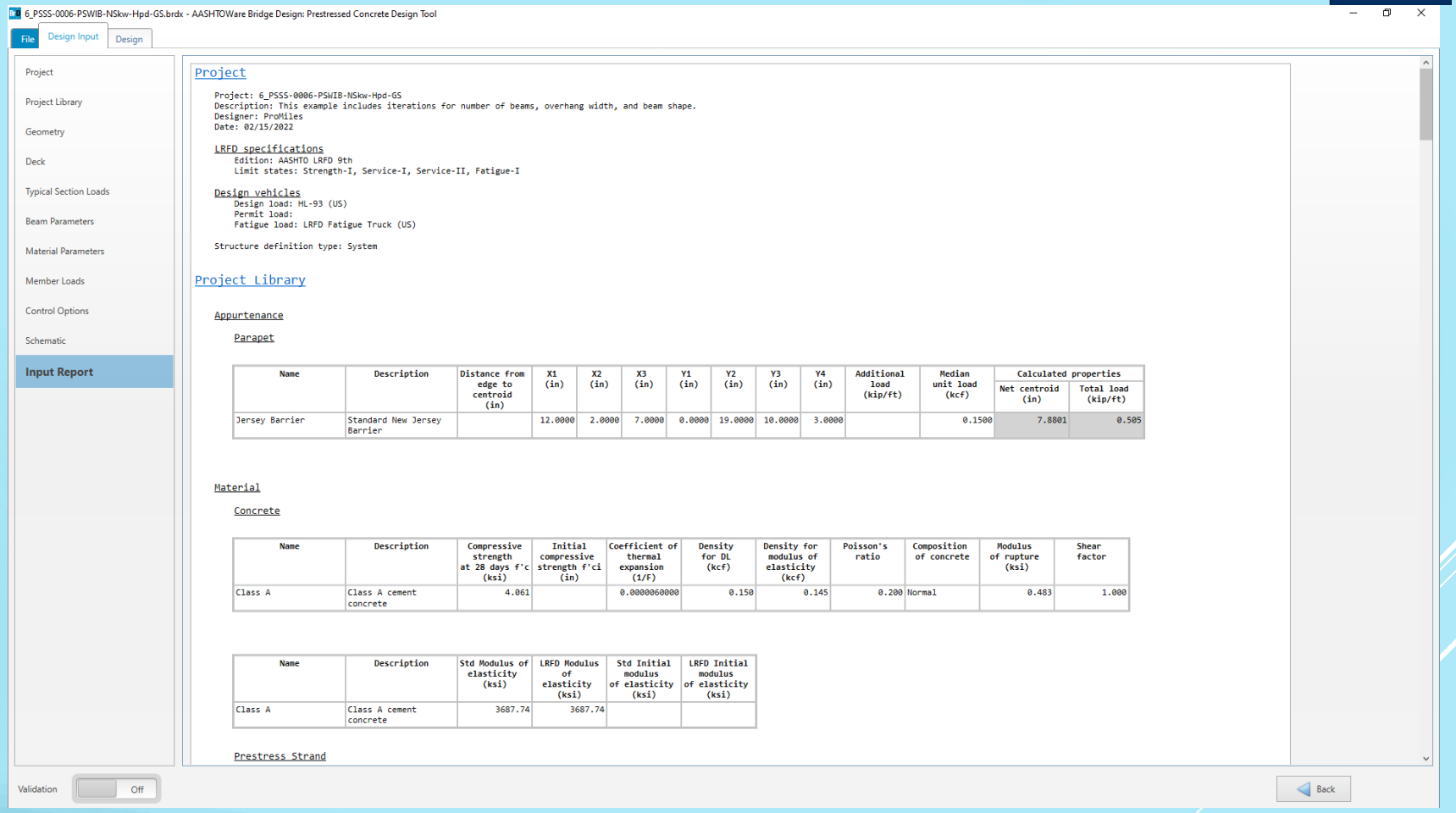
Design Input | Schematic

- Girder System Only
- Displays:
  - Framing Plan
  - Typical Section
- Specific values can be selected when variable geometry and beam depth range input is used



Design Input | Input Report

- Available for Girder Line and Girder System
- Summary of Input Data



Project

Project: 6_PSSS-0006-PSWIB-NSkw-Hpd-GS
Description: This example includes iterations for number of beams, overhang width, and beam shape.
Designer: ProMiles
Date: 02/15/2022

LRFD specifications
Edition: AASHTO LRFD 9th
Limit states: Strength-I, Service-I, Service-II, Fatigue-I

Design vehicles
Design load: HL-93 (US)
Permit load:
Fatigue load: LRFD Fatigue Truck (US)

Structure definition type: System

Project Library

Appurtenance

Parapet

Name	Description	Distance from edge to centroid (in)	X1 (in)	X2 (in)	X3 (in)	Y1 (in)	Y2 (in)	Y3 (in)	Y4 (in)	Additional load (kip/ft)	Median unit load (kcf)	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

Material

Concrete

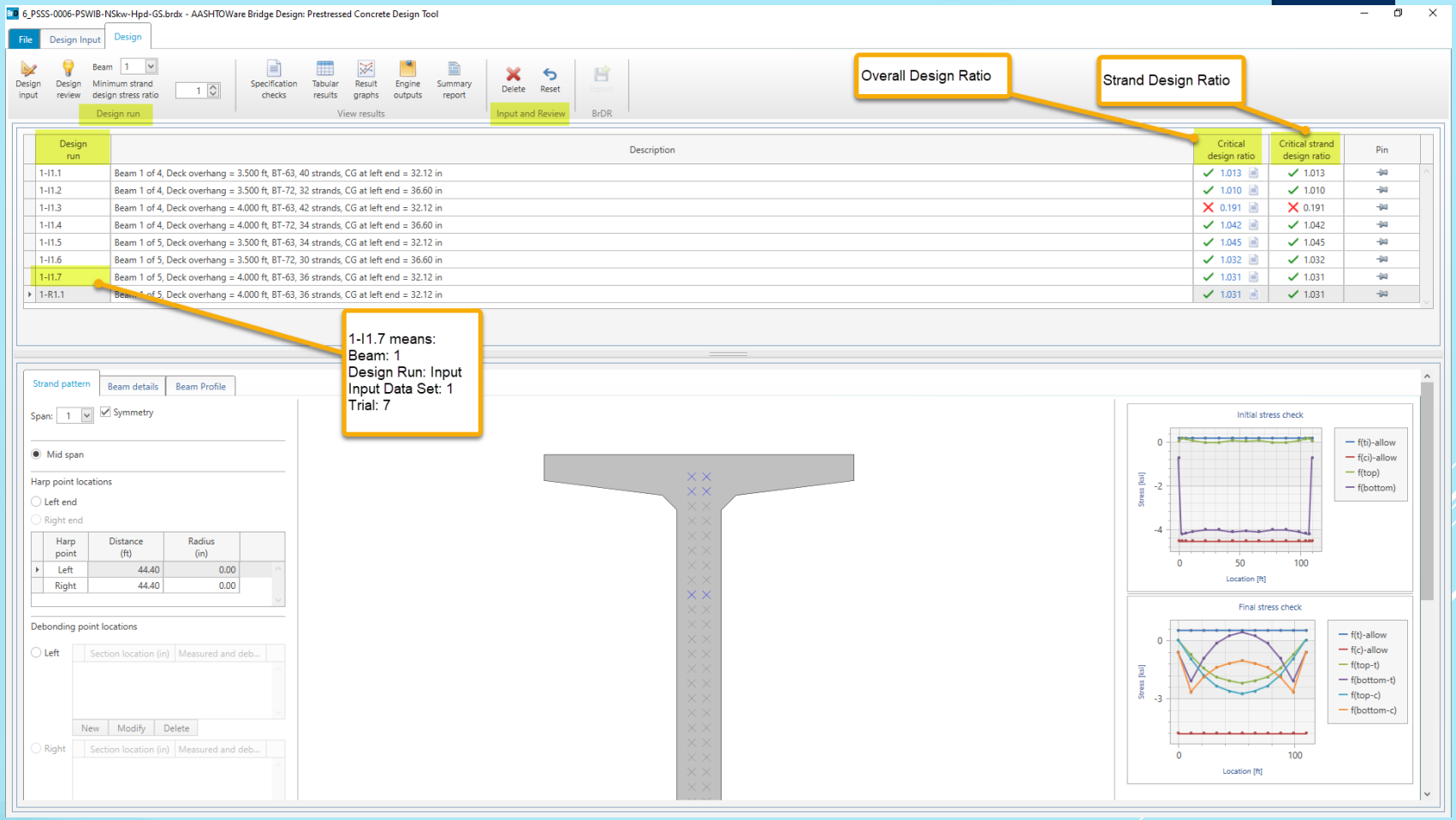
Name	Description	Compressive strength at 28 days f'c (ksi)	Initial compressive strength f'ci (in)	Coefficient of thermal expansion (1/F)	Density for DL (kcf)	Density for modulus of elasticity (kcf)	Poisson's ratio	Composition of concrete	Modulus of rupture (ksi)	Shear factor
Class A	Class A cement concrete	4.061		0.0000060000	0.150	0.145	0.200	Normal	0.483	1.000

Name	Description	Std Modulus of elasticity (ksi)	LRFD Modulus of elasticity (ksi)	Std Initial modulus of elasticity (ksi)	LRFD Initial modulus of elasticity (ksi)
Class A	Class A cement concrete	3687.74	3687.74		

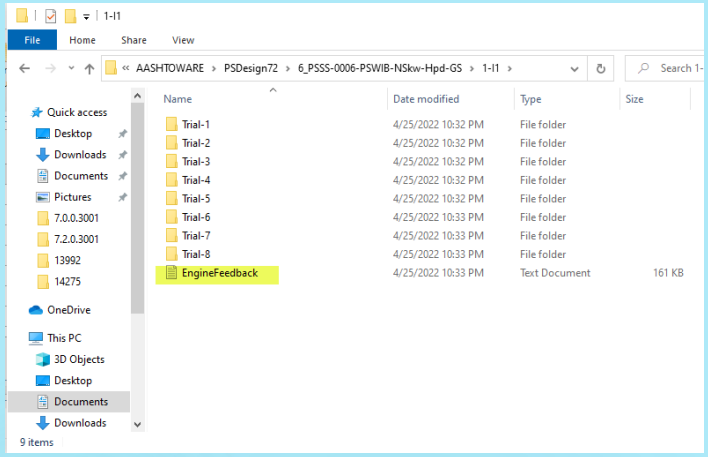
Prestress Strand

Design | Design Run

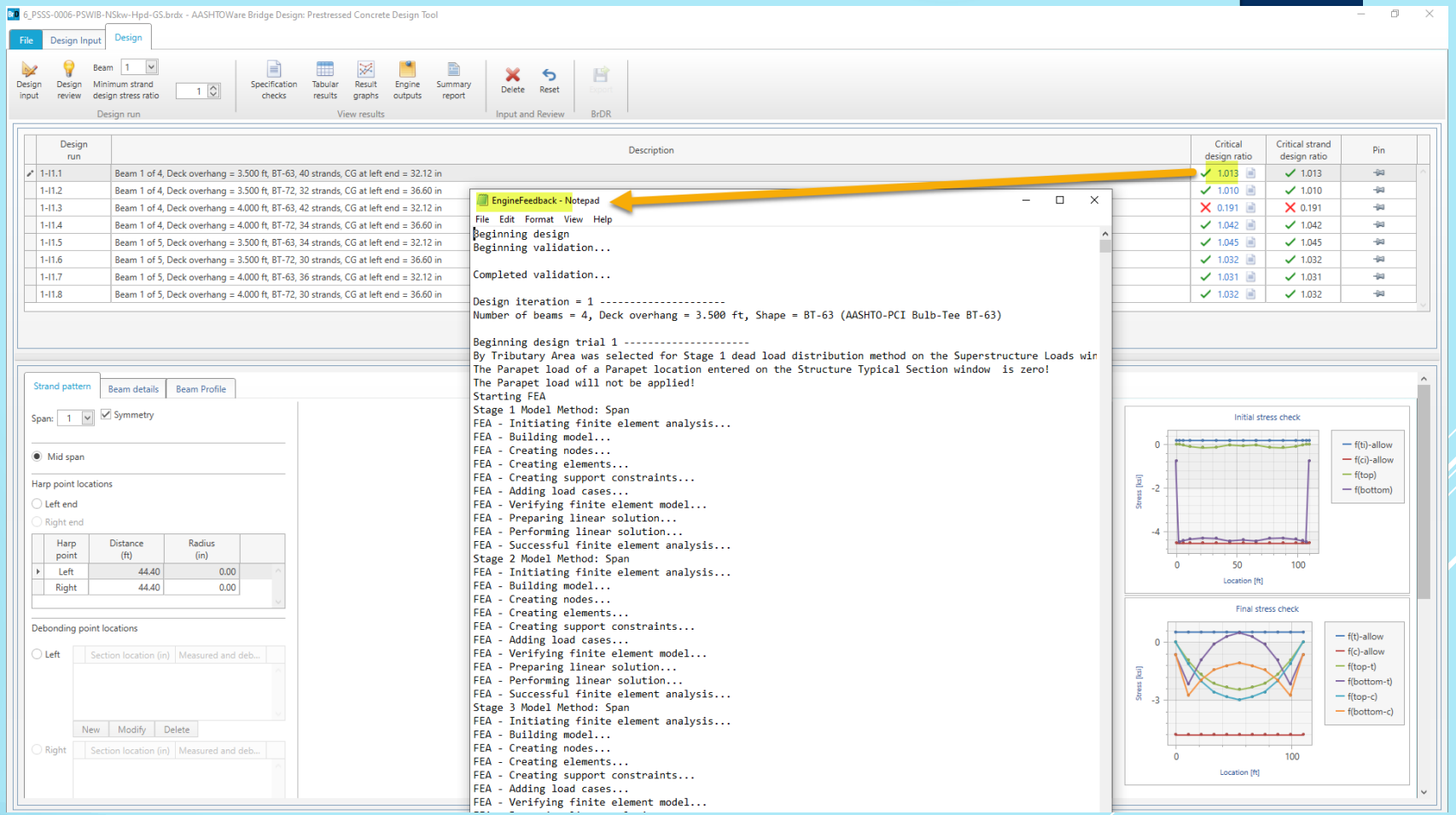
- Design Input Run (I)
  - Initial Design
  - Based on Design Input Data
- Design Review Run (R)
  - Based on Design Input and User's Tweaks of Initial Design



Design | Engine Feedback

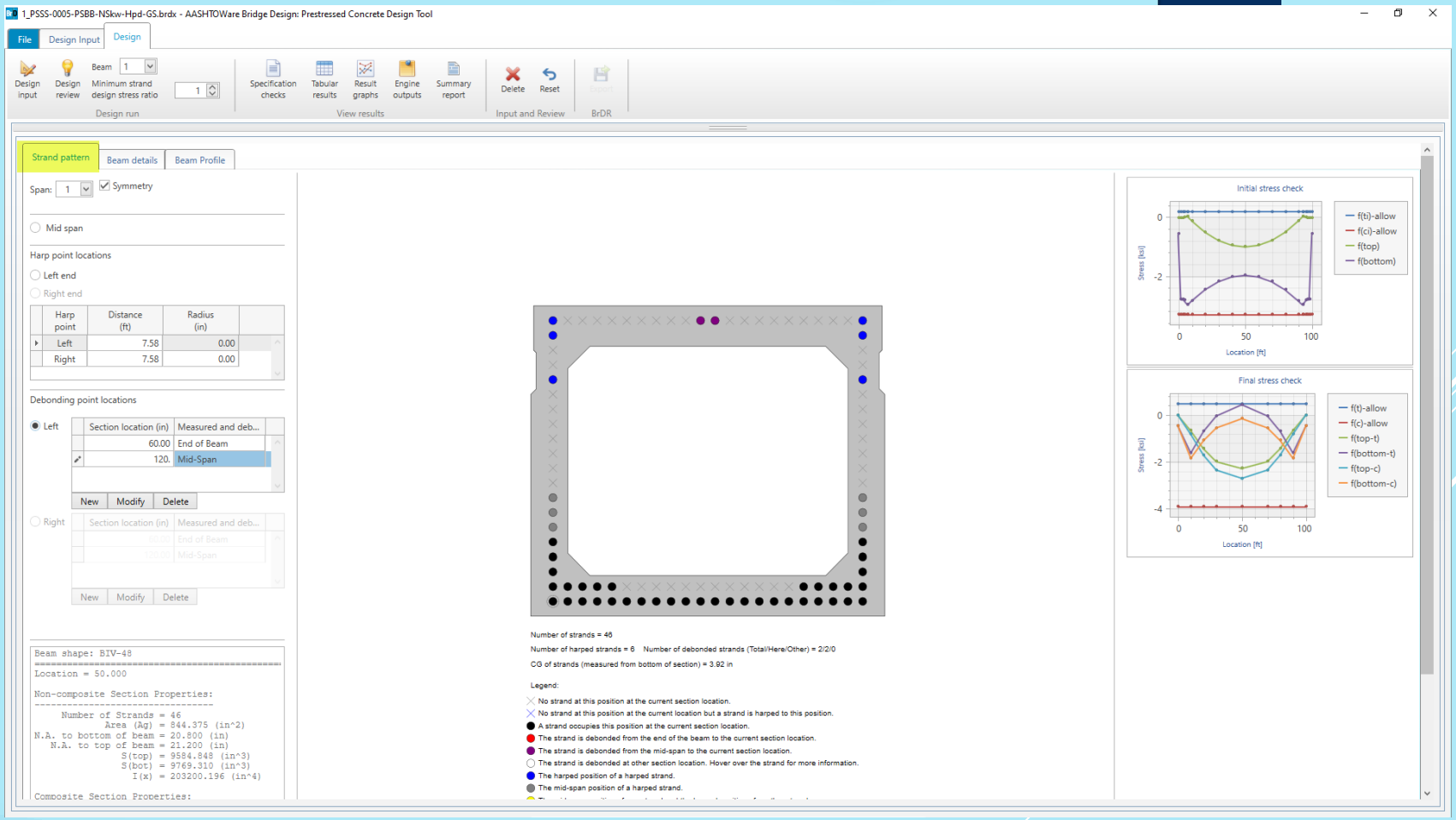


- Log of Engine Progress
- Contains Warnings and Error Messages



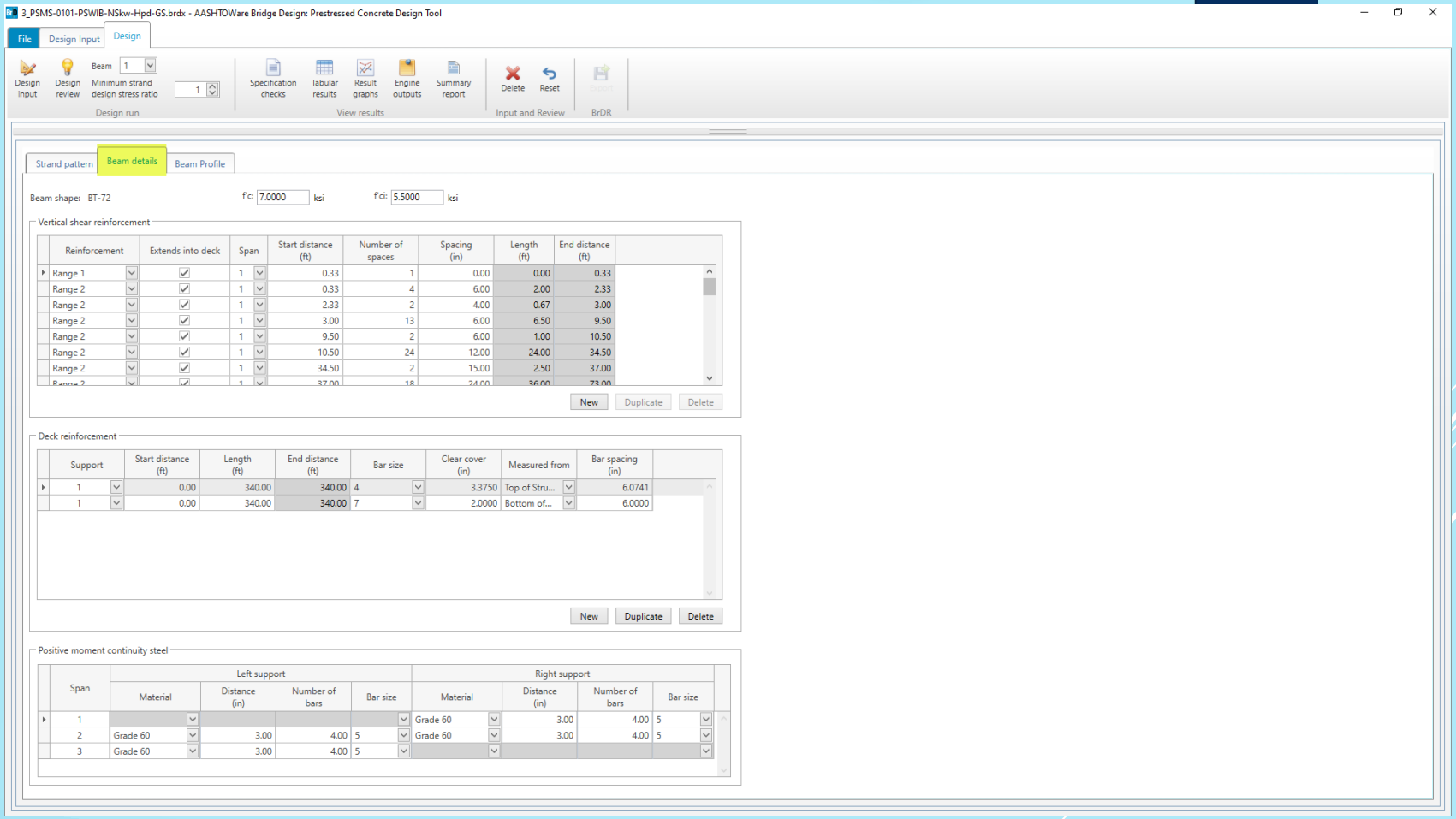
Design | Strand Pattern

- Displays Strand Pattern as Initially Designed at
  - Mid-Span
  - Harp Points
  - Debonding Points
- Displays Initial and Final Concrete Stress Diagrams
- Allows Modification of Strand Patterns
- Modified Patterns can be Design Reviewed



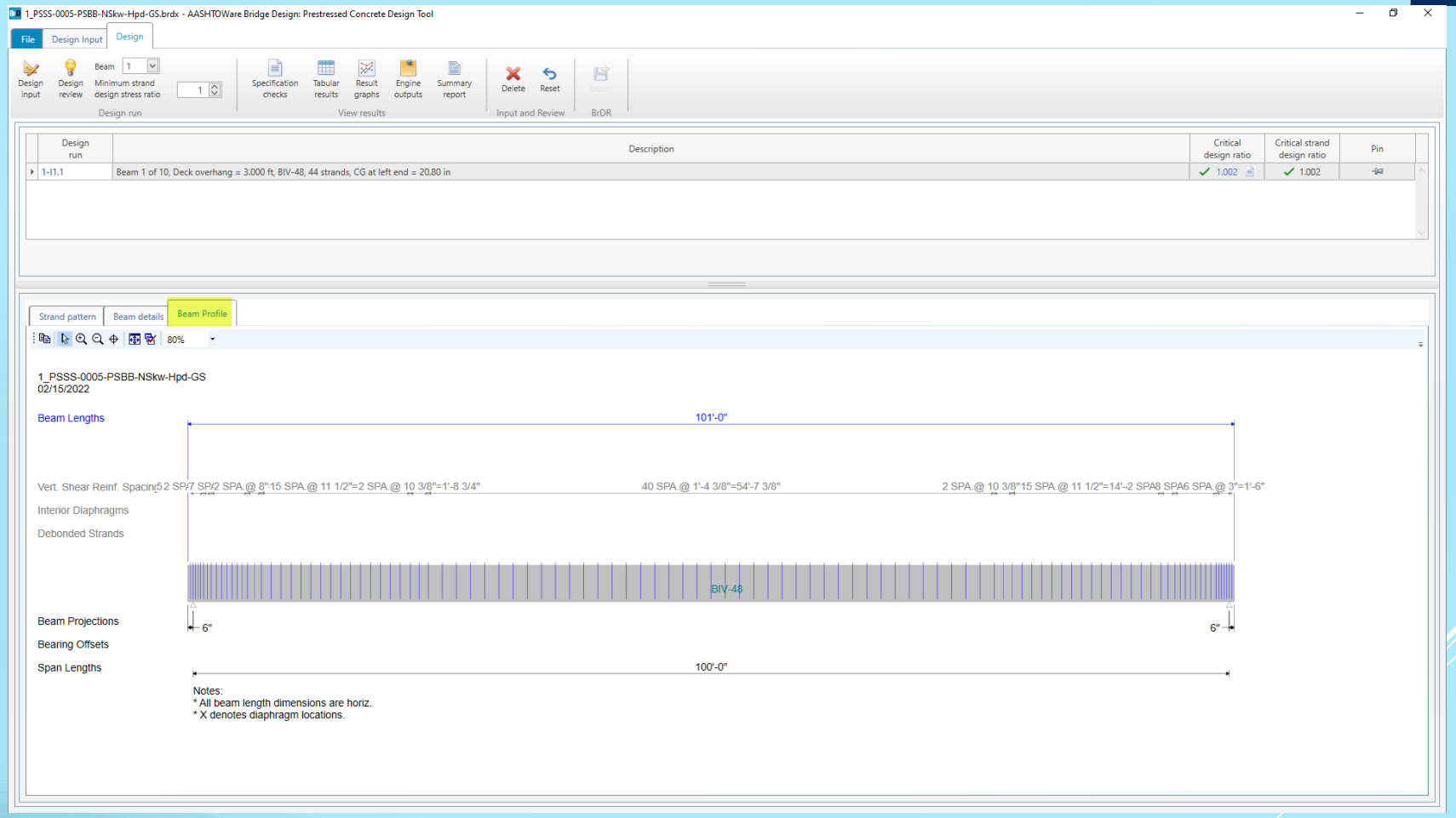
Design | Beam Details

- Displays Concrete Strength and Initial Design of:
  - Vertical Shear Reinforcement
  - Deck reinforcement
  - Positive Moment Continuity Reinforcement
- Allows Modification of Strength & Reinforcement
- Run Design Review to Evaluate Modifications



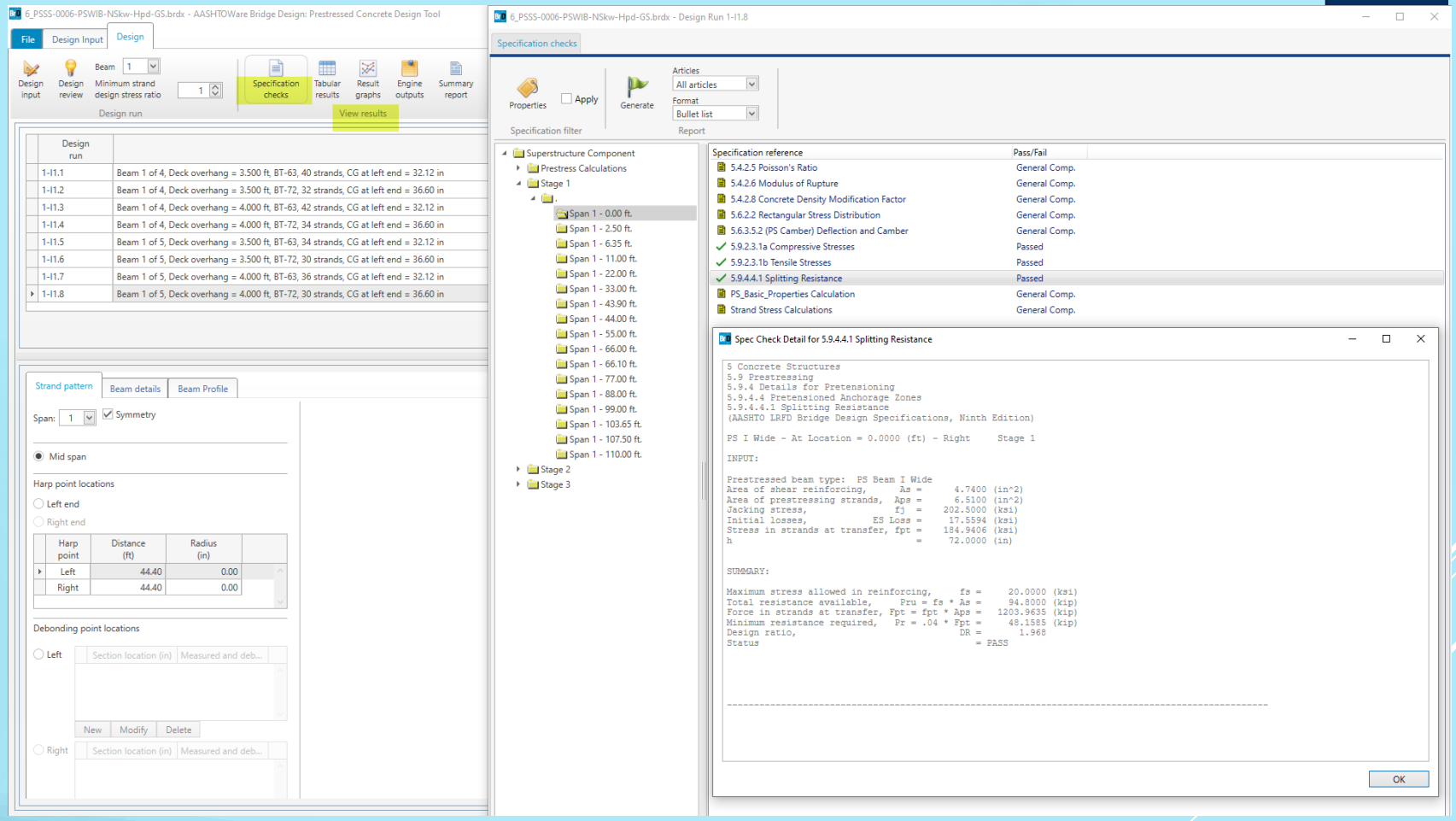
Design | Beam Profile

- Displays Beam Schematic with Dimensions and Annotations



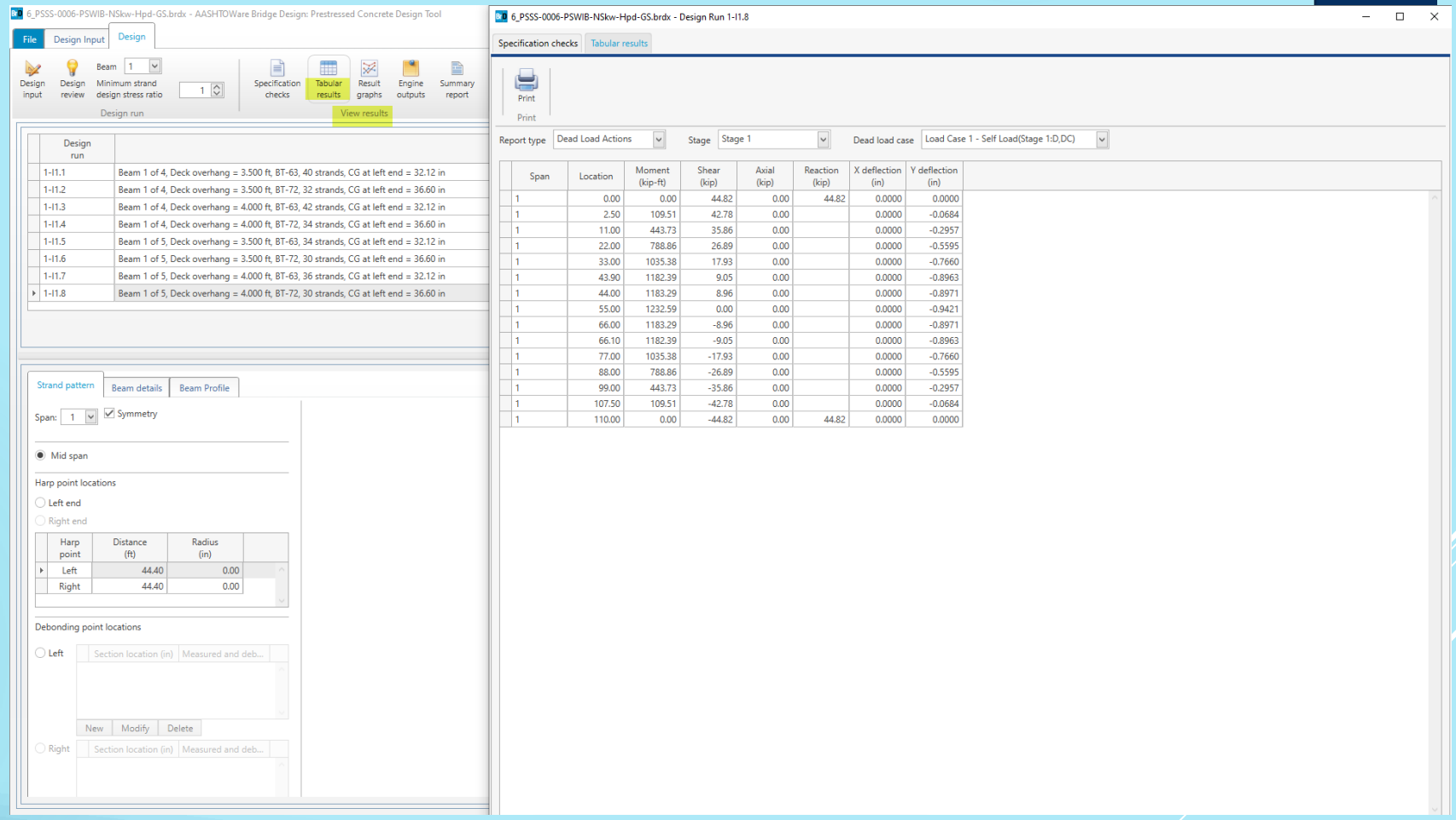
Design | View Results | Specification Checks

- Detailed Spec Check Output at:
  - Each Stage
  - Each POI
  - Each Article



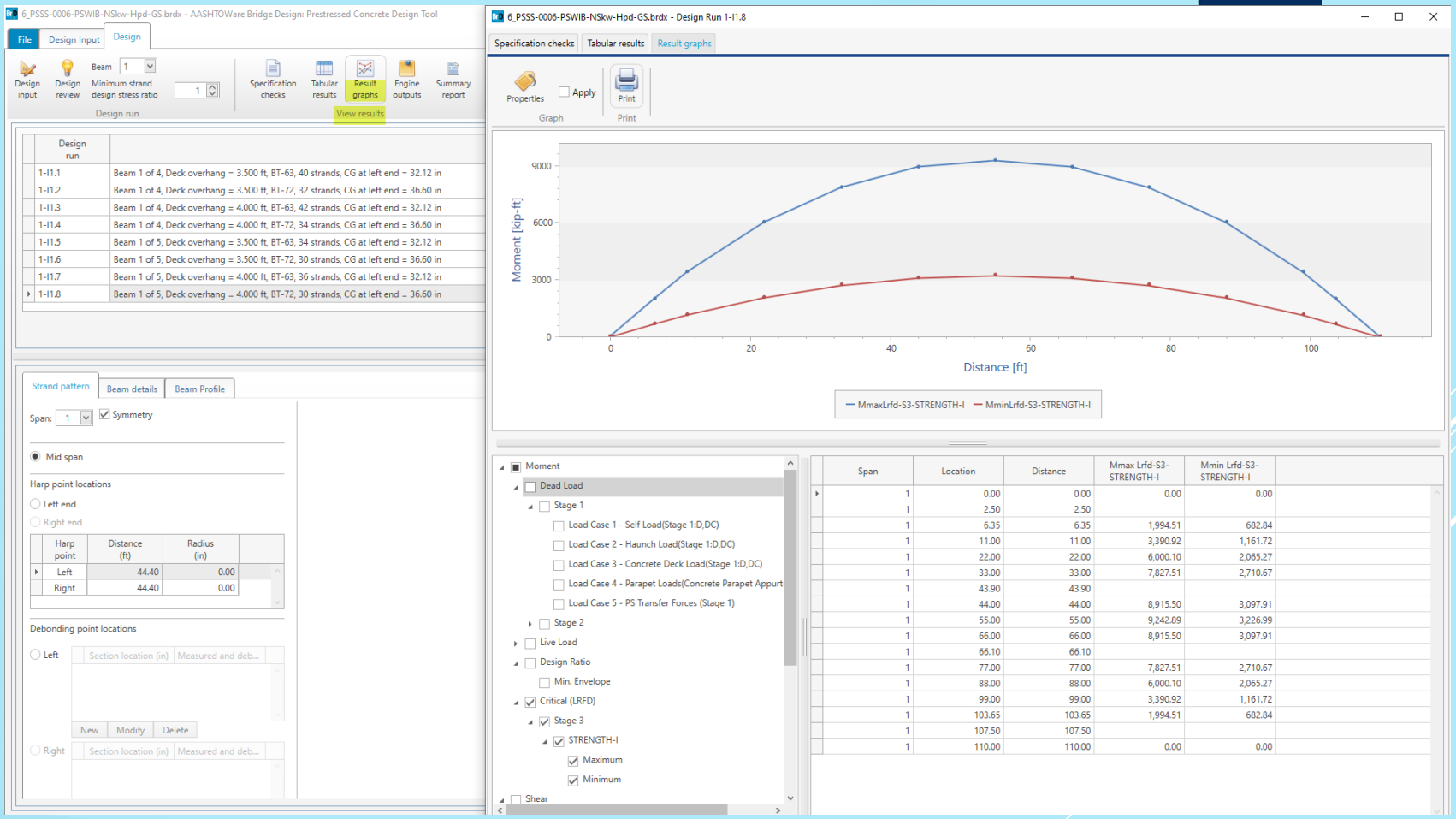
Design | View Results | Tabular Results

- Detailed Tabular Results:
  - Dead and Live Load Actions
  - Each Stage
  - Each Load Case
  - Each POI
- Can be viewed and printed



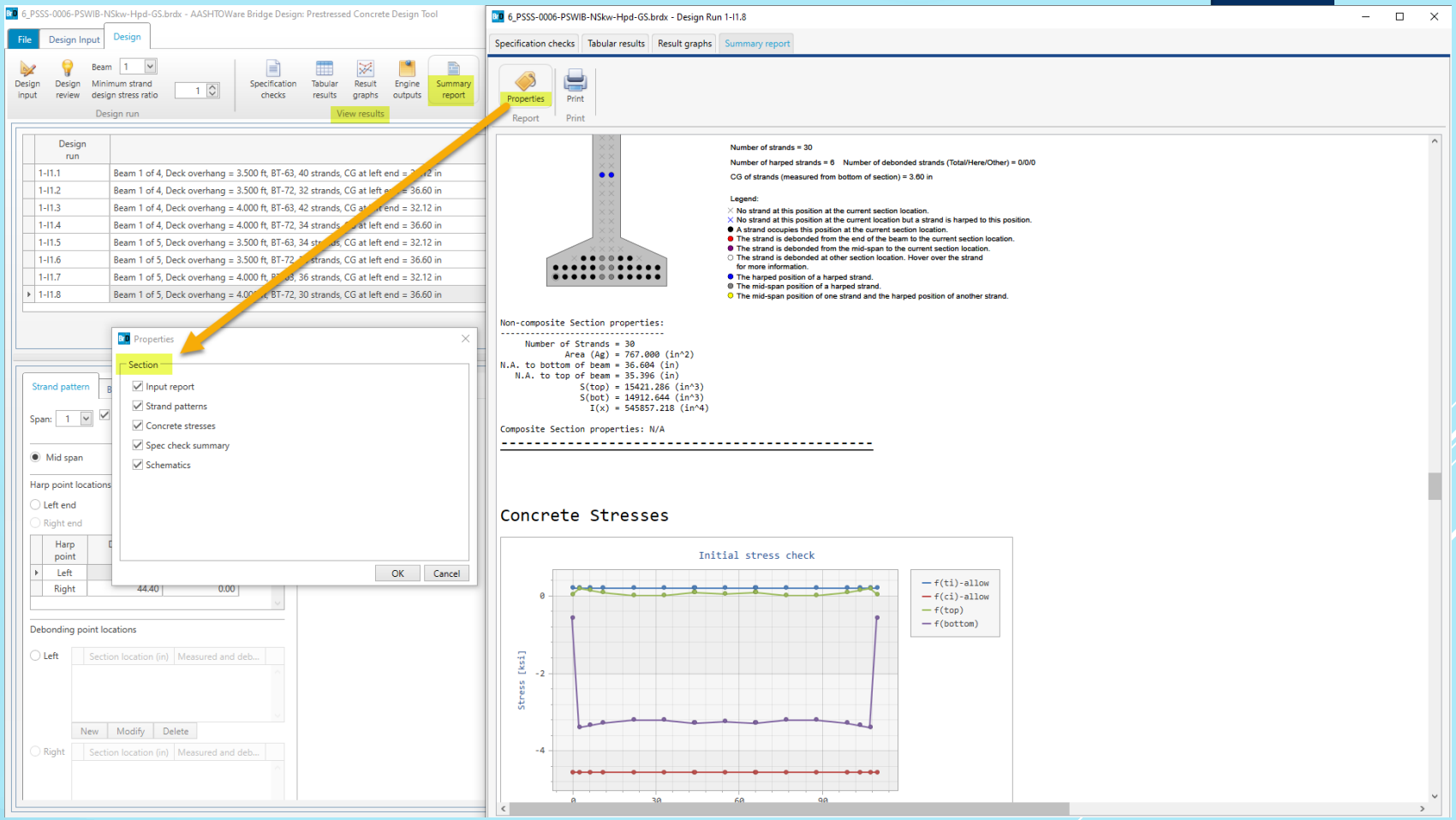
Design | View Results | Results Graphs

- Results Graphs with Corresponding Tabular Results:
  - Dead and Live Load Actions and Deflections
  - Each Stage
  - Each Load Case
  - Each POI
  - Design Ratios
  - Envelopes
- Can be viewed and printed



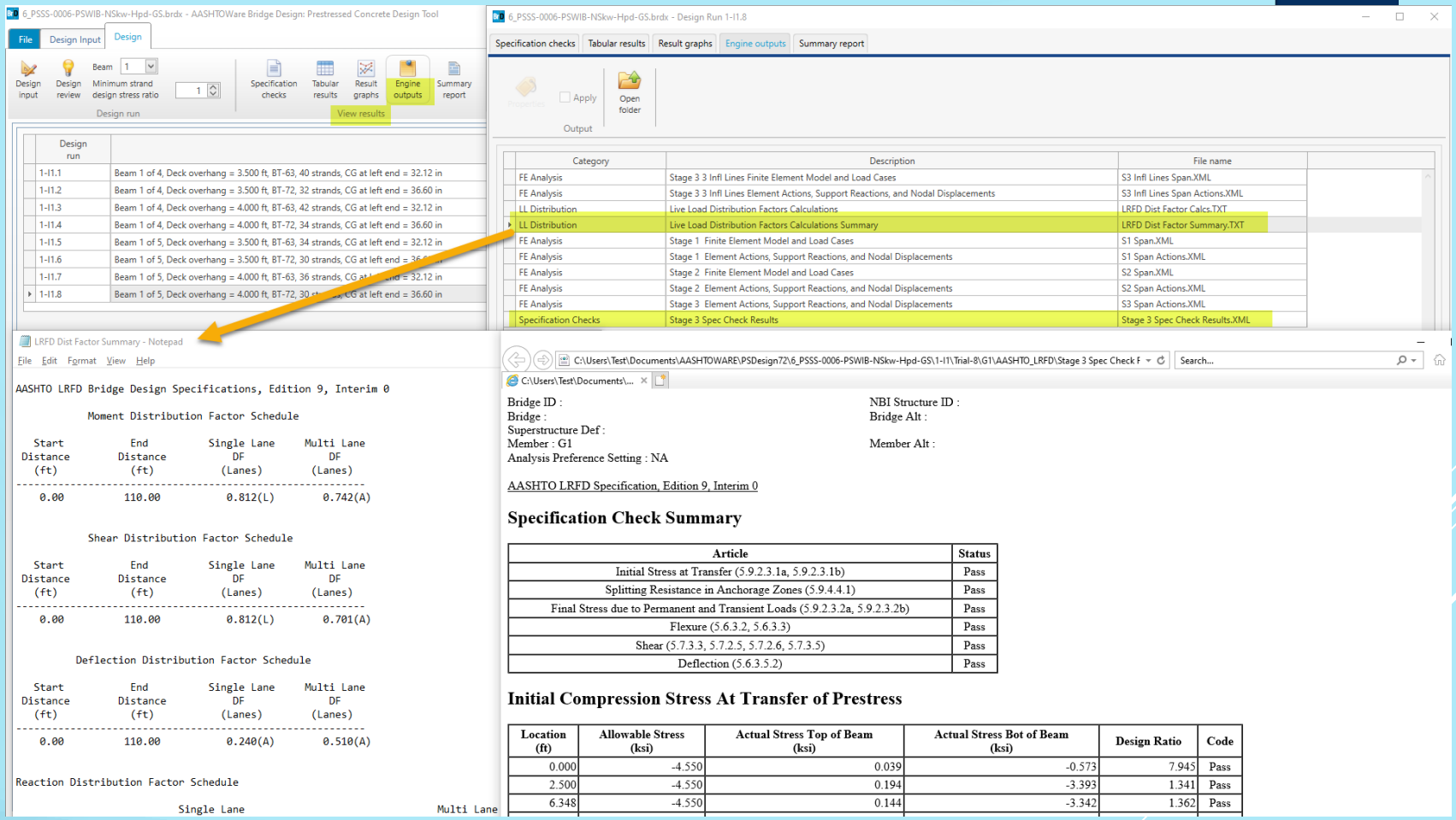
Design | View Results | Summary Report

- Combines Multiple Section of Output
- Sections are selectable by User
- Can be viewed and printed



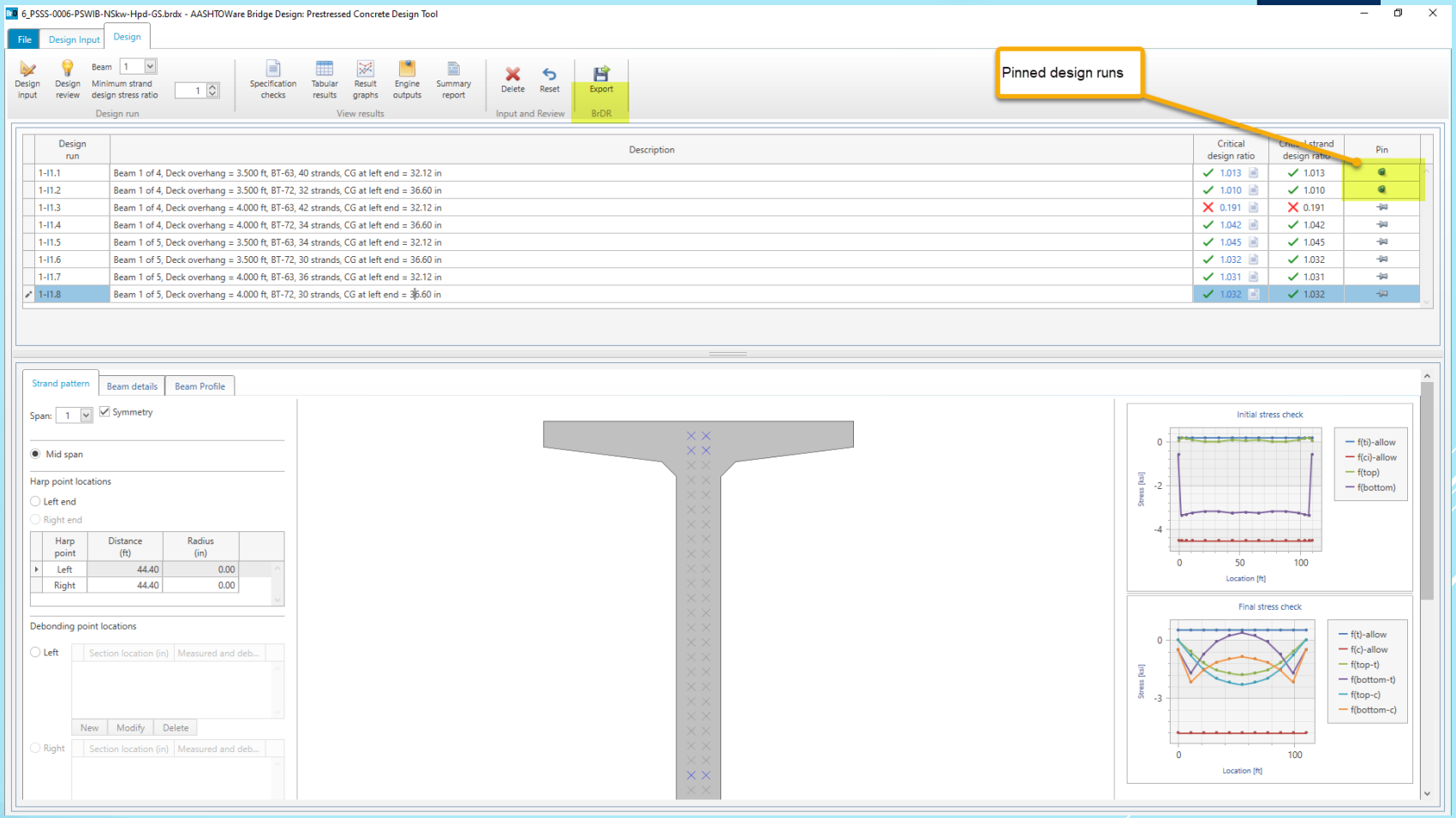
Design | View Results | Engine Outputs

- Various Output Files from Engine:
  - Finite Element Analysis Models and Results
  - Live Load Distribution Calculations
  - Specification Check Summary



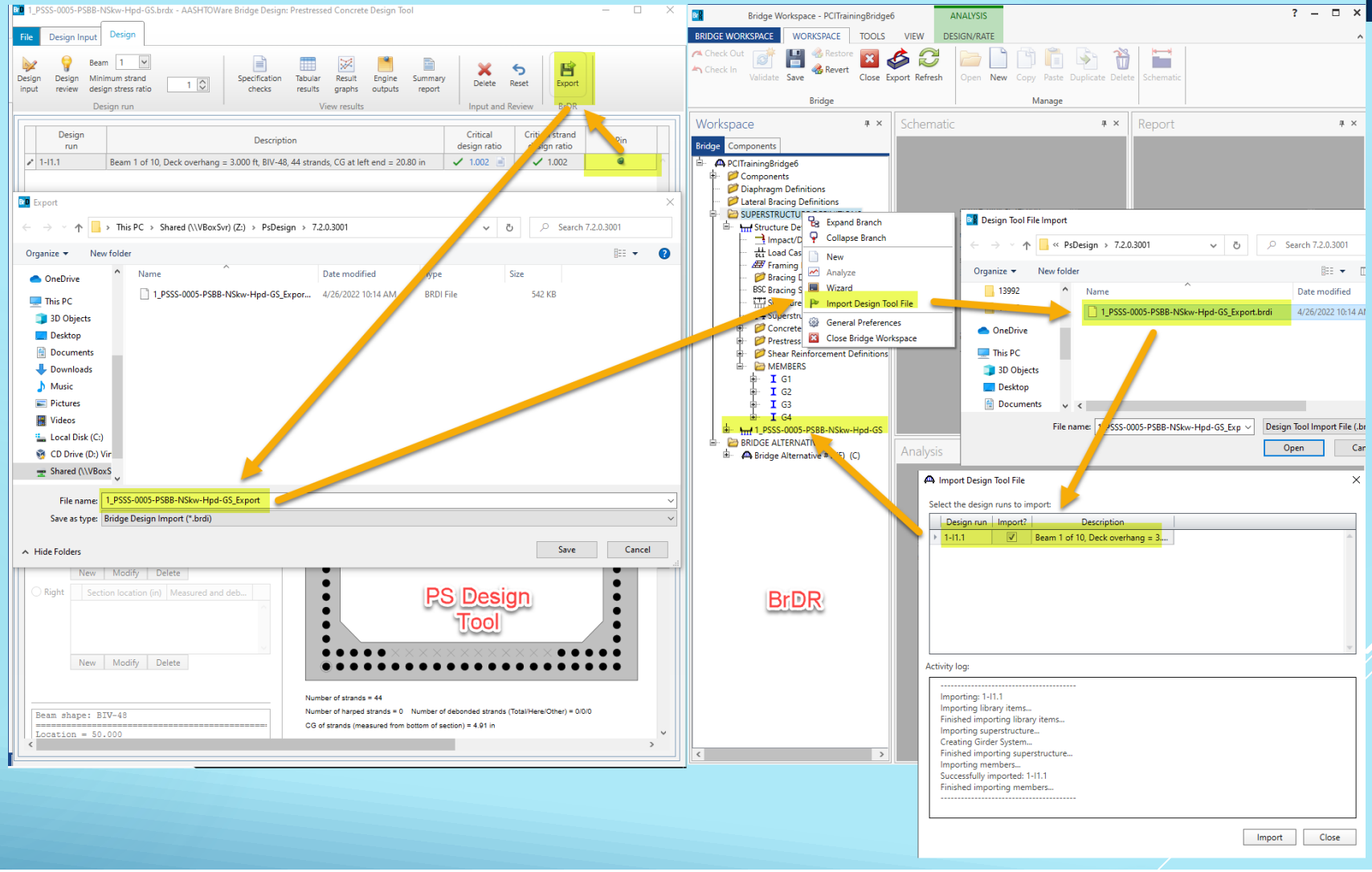
Design | Design Run Pinning

- Pinned Design Runs:
  - Can be exported to BrDR
  - Are saved in input file and will be reanalyzed when input file is reopened



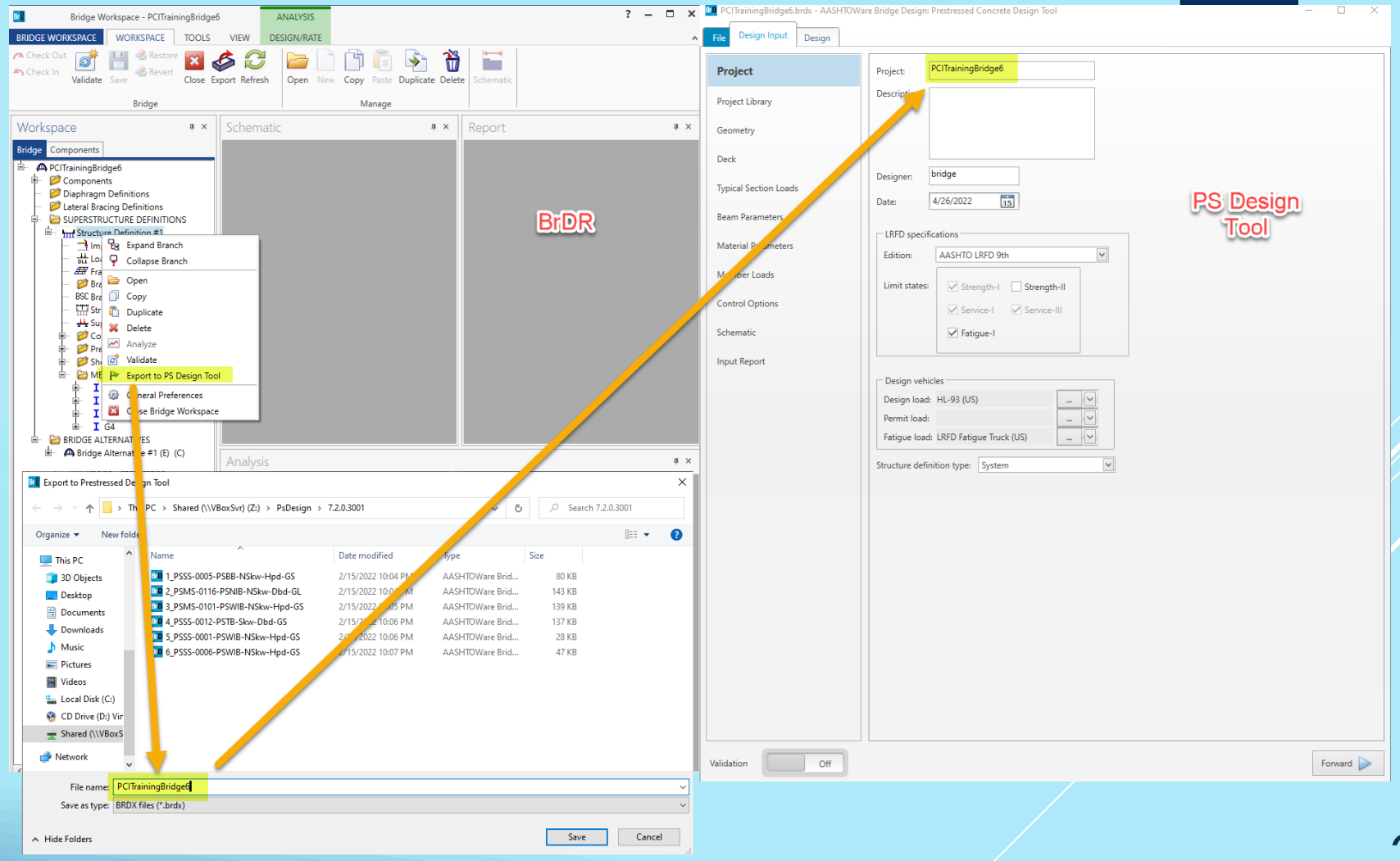
Design | BrDR Export/Import

- From PS Design Tool to BrDR



Design | BrDR Export/Import

- From
- BrDR
  to
  PS Design Tool
  (starts automatically)



Future Improvements

- We welcome feedback!
- Some ideas for improvement from TAG Beta Testing
  - Strand design algorithm to envelope designs for multiple trials and girders
  - Strand editing in tabular format
  - Strand and beam Visualization
  - Design algorithm for mild steel in girder
  - Dedicated stirrup range for splitting resistance
  - Import girders from PS Design Tool into one superstructure in BrDR
- More ideas will be appreciated…

Hands-on Example

- Enter the project
- Perform design input run
- Perform design review run

Any Questions?