AASHTOWare Bridge Design and Rating
An Overview

BrDR Fundamentals Training

August 19, 2026

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AASHTOWare™ BRIDGE DESIGN AND RATING

AASHTOWare Bridge Design and Rating
An Overview

Benjamin Flanagan, P.E., ProMiles

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AASHTOWare™ BRIDGE DESIGN AND RATING

Topics

- Product history and background
- Product Overview
- Product Design
- System Information
- Major Software Components
- Capabilities
- Advantages

AASHTOWare Basics

- Development started in the early 1990s under FHWA guidance
- Result of funds invested by States and FHWA
- Cooperative effort of over 40 state/local/federal transportation departments
- Licensed by US DOTs
- Software “owned” by members of AASHTO

Product Organization

- Joint development efforts by AASHTO member agencies
- Pooling knowledge and resources of member agencies
- Products are administrated by AASHTO and managed by a Task Force
- Products are verified and validated by member agencies

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BrDR Task Force Members

- Jennifer Hart, Indiana DOT, Chair
- Scott Westerfield, Mississippi DOT, Vice Chair
- Ruben Boehler, Illinois DOT
- Yihong Gao, Minnesota DOT
- Michael Johnson, Idaho TD
- Robby Tennant, West Virginia DOT

- Ryan Fragapane, AASHTOWare Product Director
- Hannah Vaughn, AASHTOWare Associate Product Manager
- Lubin Gao, FHWA Liaison

AASHTOWare BrDR Overview – Bridge Design and Design Review

- Determine if the design of a bridge is adequate for “Design” vehicles
- Compute Design Ratios (DR):

  DR = Capacity/Demand

- DR ≥ 1.0 is good
- DR < 1.0 is not good (i.e. does not pass the spec-check)
- BrD can be used to check design
- Standalone design tools are also available

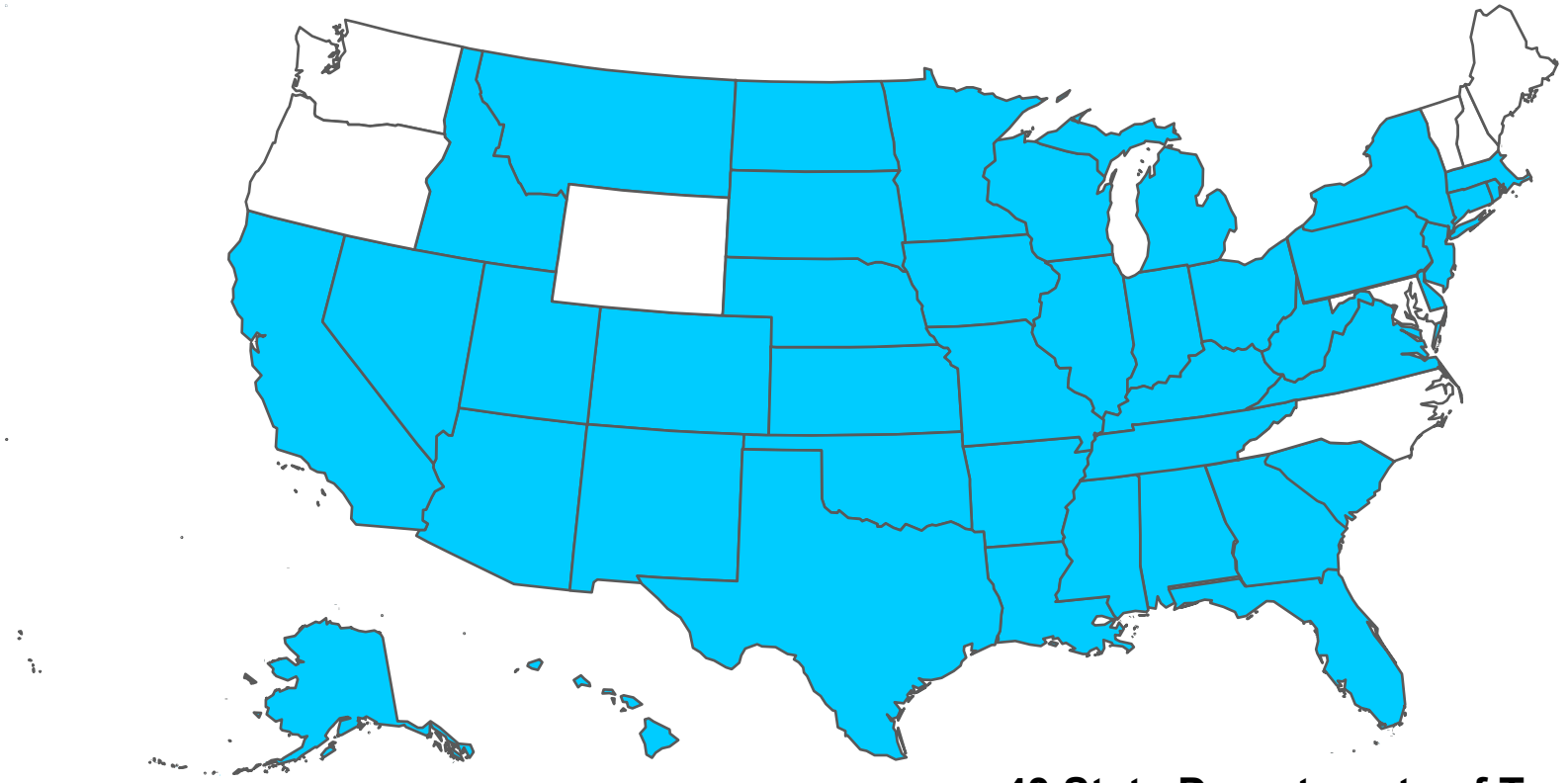
AASHTOWare BrDR Overview – Bridge Load Rating

- Determine the ability of a bridge to carry a specific vehicle
- Compute a Rating Factor (RF):

  RF = (Capacity – Dead Load Action) / (Live Load Action)

- RF ≥ 1.0 is good
- RF < 1.0 is not good

AASHTOWare BrDR – licensees



43 State Departments of Transportation (Maryland is not highlighted above) +

District of Columbia, Puerto Rico & Manitoba

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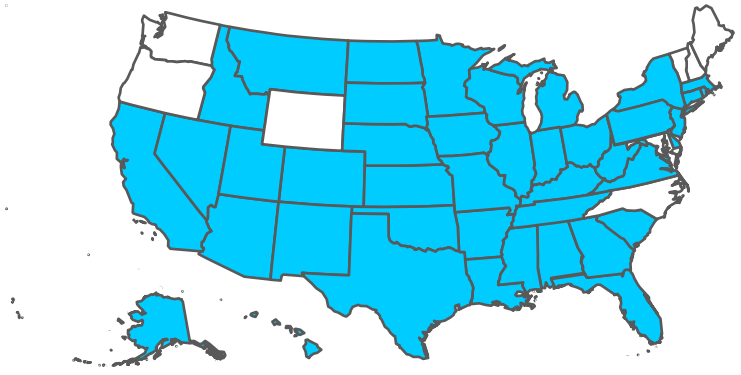

Importance of BrDR

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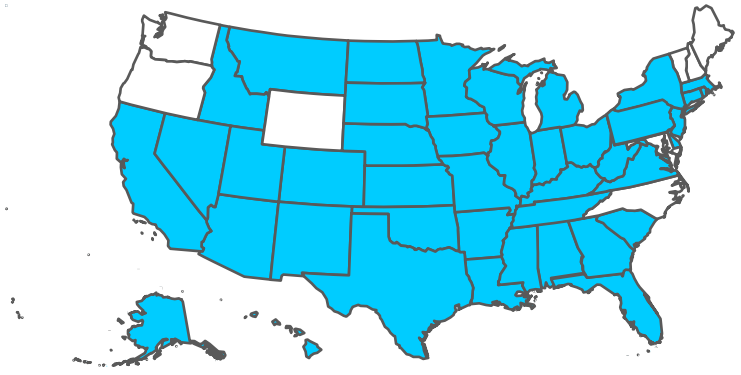

Importance of BrDR

National Bridge Inventory (NBI)

"The National Bridge Inventory is a database, compiled by the Federal Highway Administration, with information on all bridges and tunnels in the United States that have roads passing above or below them."

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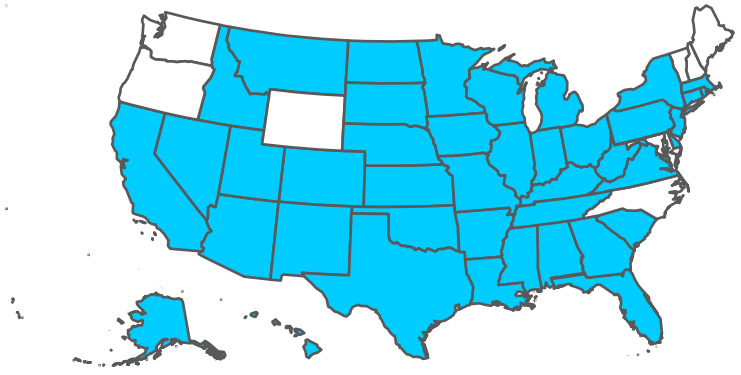

Importance of BrDR

National Bridge Inventory (NBI)

- Structure Type/Material
- Location
- Condition
- Ratings

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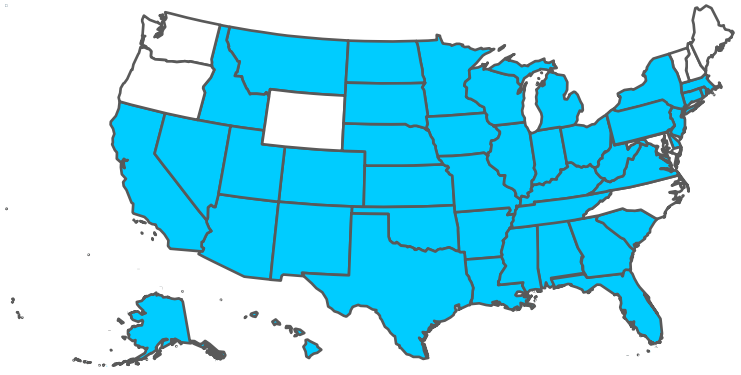

Importance of BrDR

National Bridge Inventory (NBI)

- ~ 620,000+ bridges
- ~ 580,000 can be analyzed in BrR
- ~94% of all Bridges
- Ohio has 26,713 bridges in the NBI

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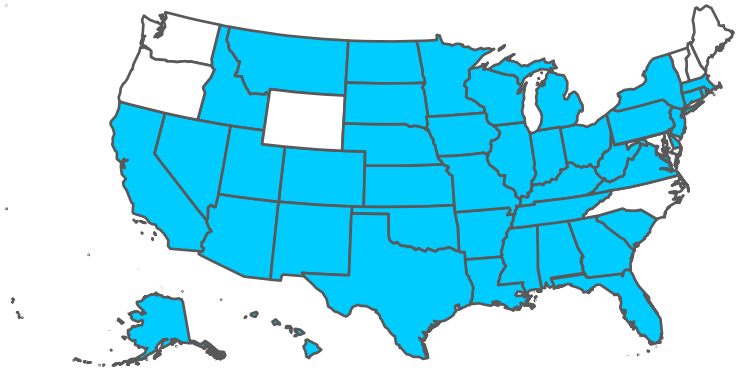

Importance of BrDR

National Bridge Inventory (NBI)

- Of the 40+ agencies there are
- 150,000+ bridges input into BrR
- Roughly one quarter of all bridges in the NBI

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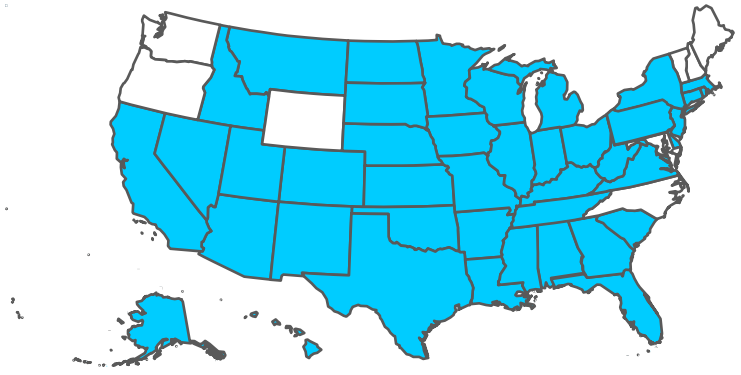

Importance of BrDR

Preservation of Data

- Once input-Lifetime of rating
- Migration of data
- New bridge specs
- New analysis techniques
- Use for permit routing on a daily basis

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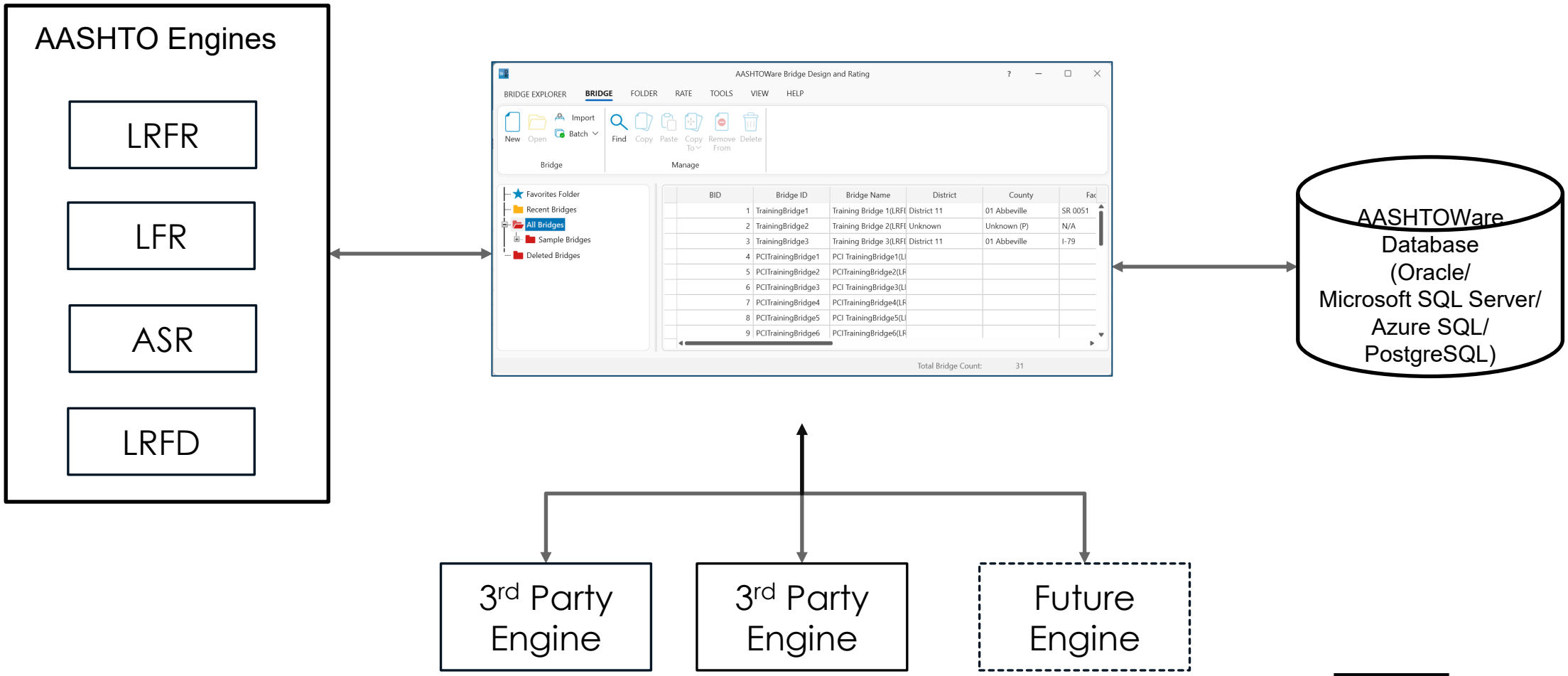
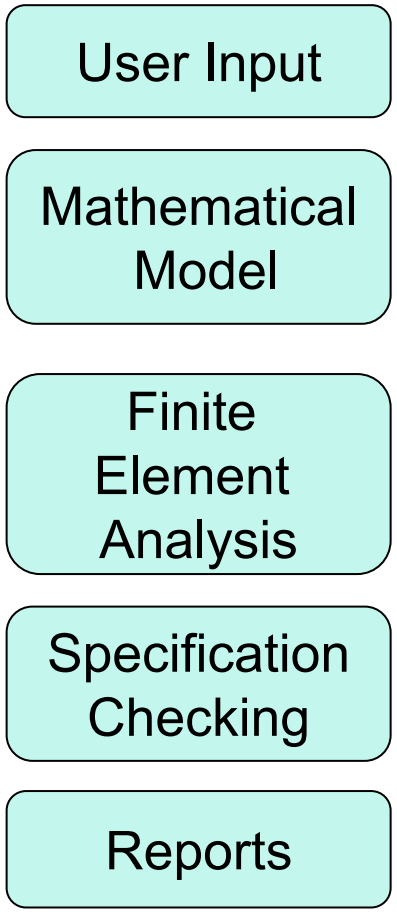
Product design



Product Design

Analysis Process



Product Design

User Input

Mathematical Model

Finite Element Analysis

Specification Checking

Reports

Analysis Process

1. **User describes the physical model**
2. User initiates an analysis – software generates a mathematical model
3. Finite element engine calculates the forces
4. The specification check module calculates the capacity and compares the capacity to the forces
5. Results are reported

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5. **Results are reported**

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AASHTOWare™ BRIDGE DESIGN AND RATING

Development Cycle

- Requirement gathering and task force approval
- Creating design document and mockup
- TAG approval of design
- Agile development and Alpha testing
- Beta testing by Testing TAG (users)
- Acceptance and Release

System Information

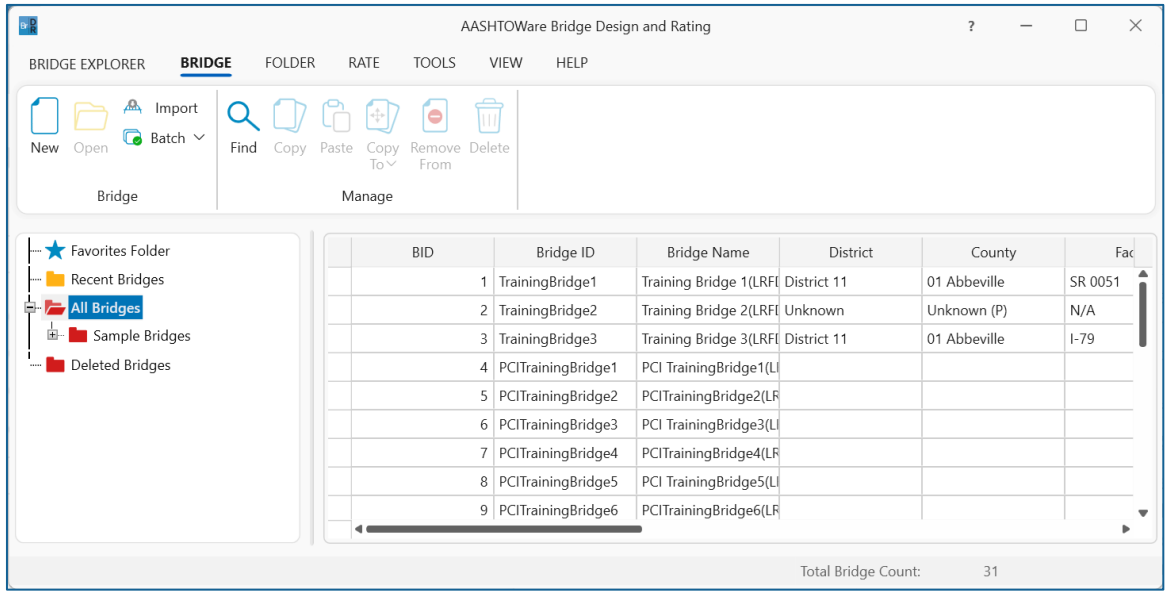
- Supported Databases
  - **Microsoft SQL Server**
  - **Oracle**
  - **Azure SQL**
  - **PostgreSQL**
- Development platform
  - **.NET**
- Language used
  - **C#**
- Statistics
  - **800+ database tables**
  - **1000+ windows**

Major Components

- Bridge Explorer
- Library
- Configuration
- Bridge Workspace

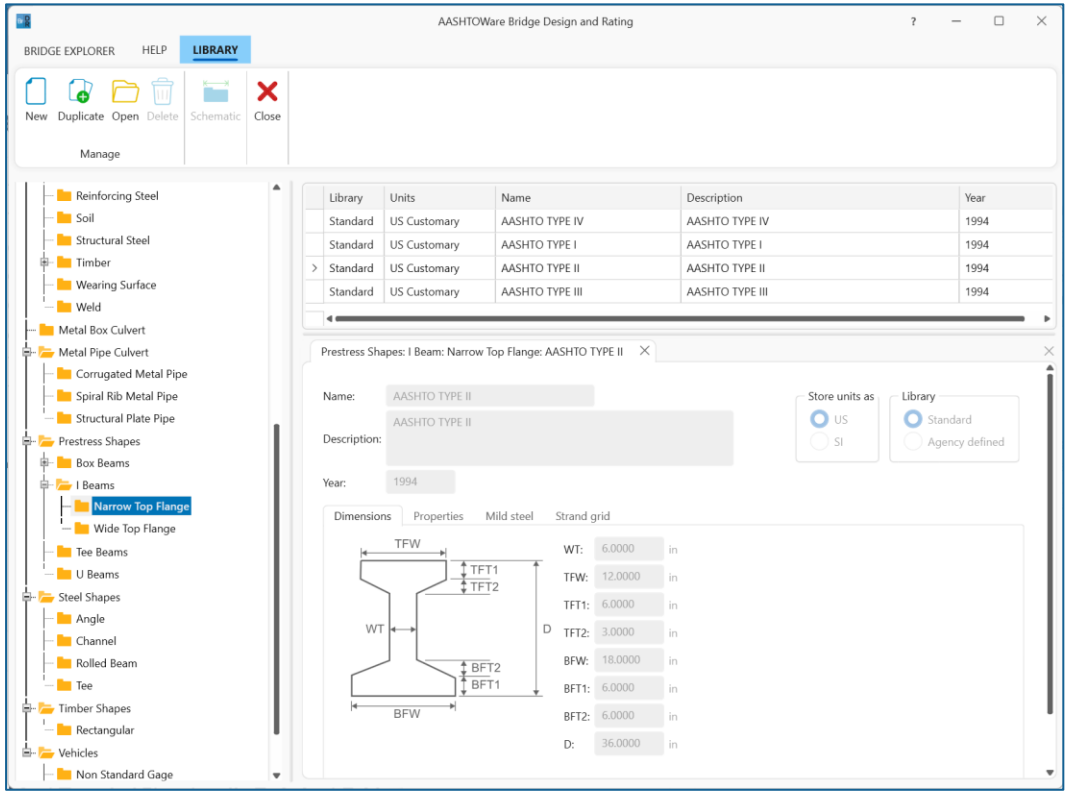
Bridge Explorer

- Displays a list of bridges organized into folders
- Provides tools for finding a bridge based on criteria
- Rating of groups of bridges
- Rating based on a routing file
- Bridge Exchange – Importing and Exporting bridges
- Check-in, Checkout



Library

- Beam shapes
- Materials
- Appurtenances
- Connectors
- Vehicles
- Factors



Configuration

- User Administration

  Adding users and groups

- Access Privileges

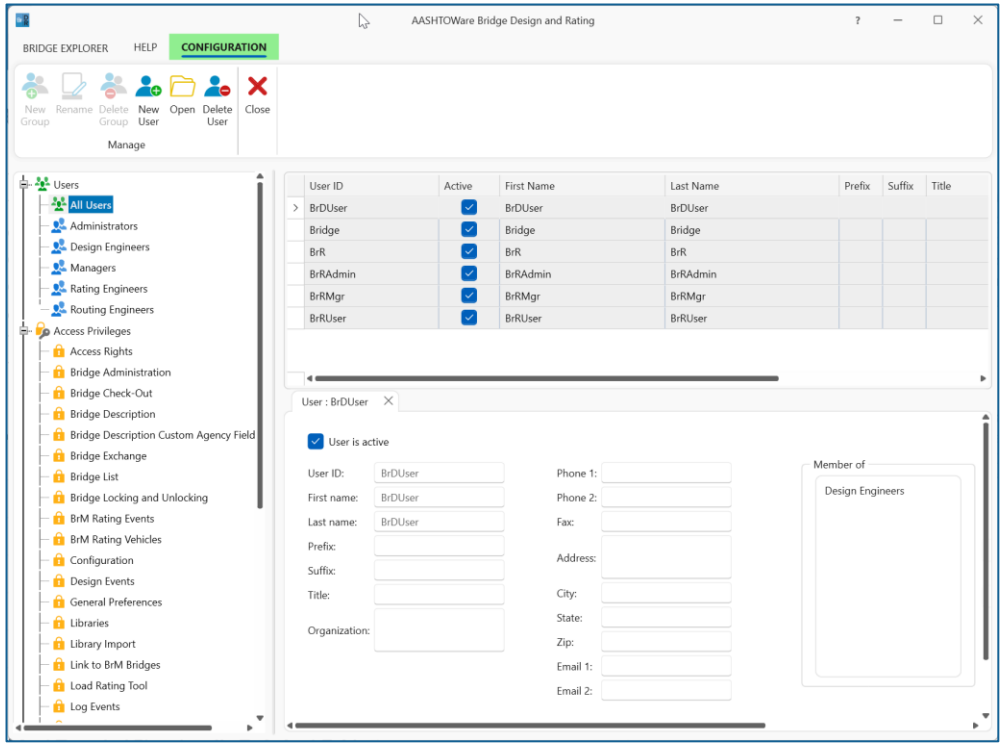
  Controlling access

- Parameters

  Editing names of counties, districts, etc.

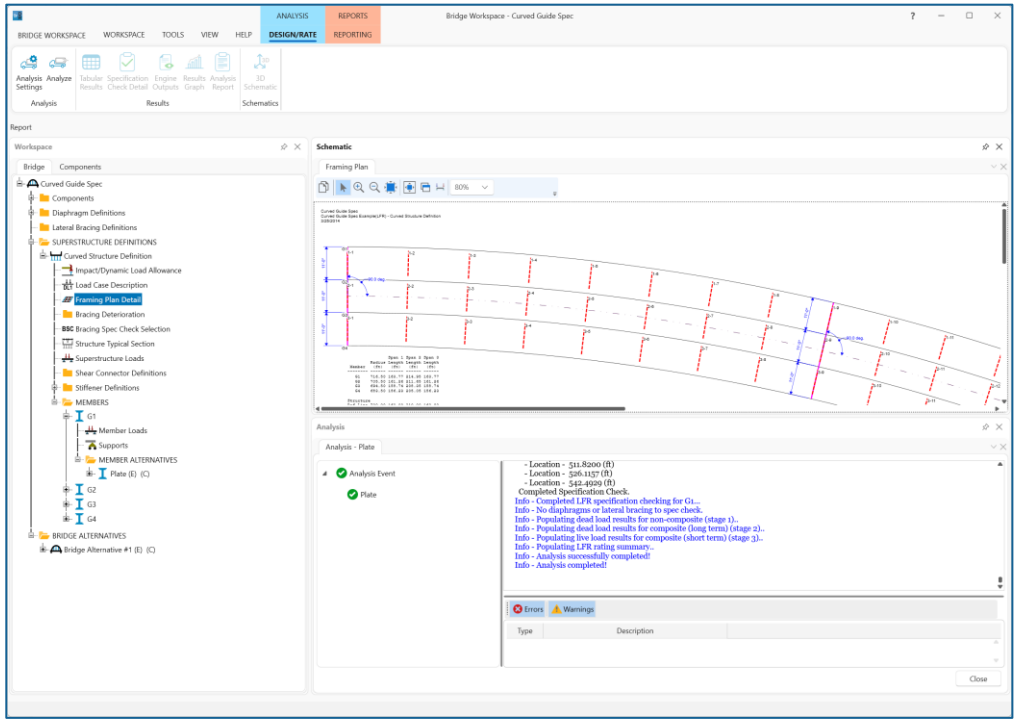
- System Defaults

  Default factors, settings, analysis engines, tolerances

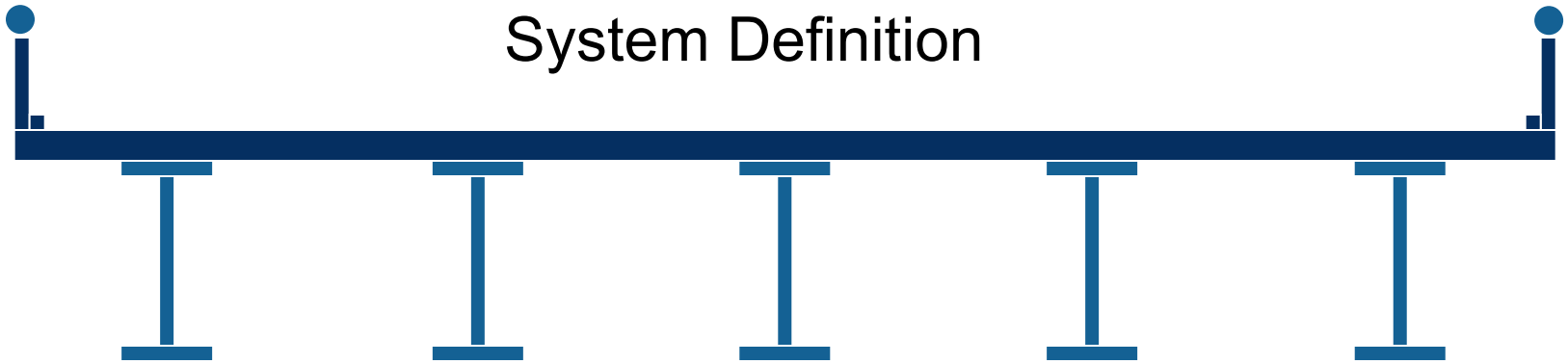


Bridge Workspace

- Bridge components used in the bridge model
- Detailed description of bridge or culvert geometry and other analysis components
- Analyze individual members of a bridge or culvert

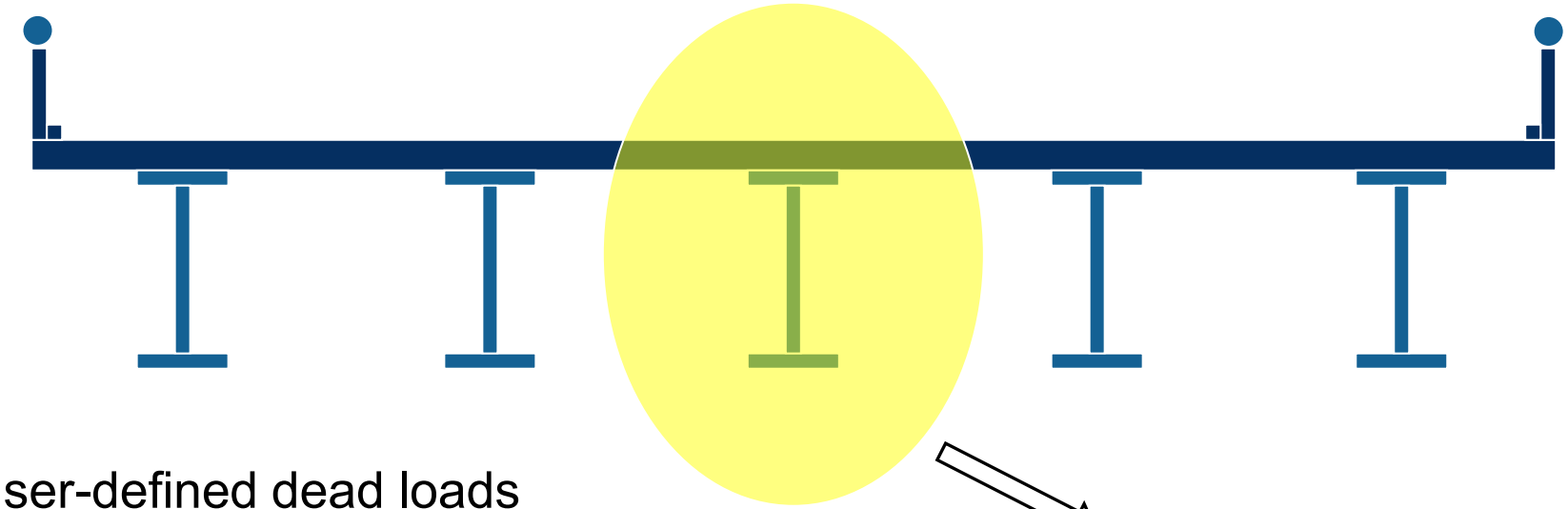


Model Definition – System definition



- System computed dead loads
- System computed live load distribution factors

Model Definition – Line definition

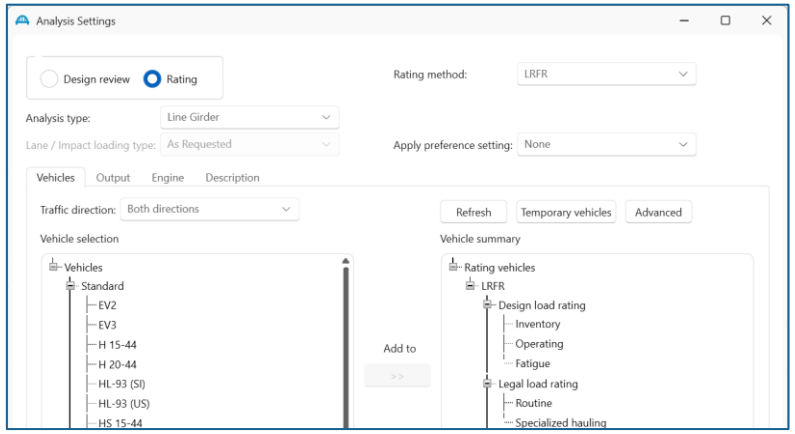


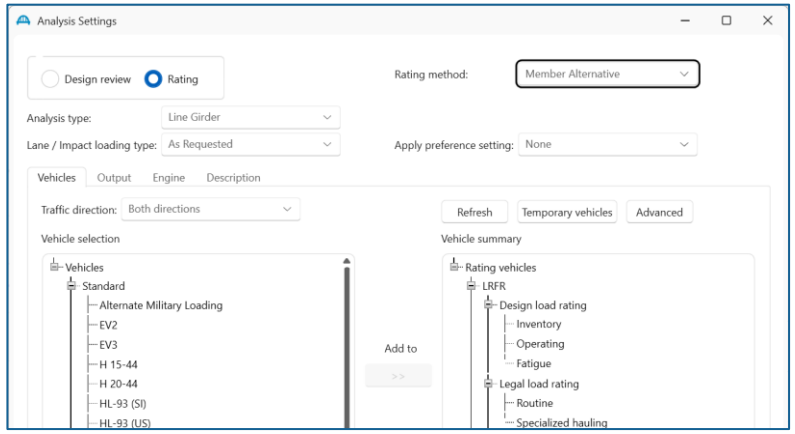
- User-defined dead loads
- User-defined live load distribution factors

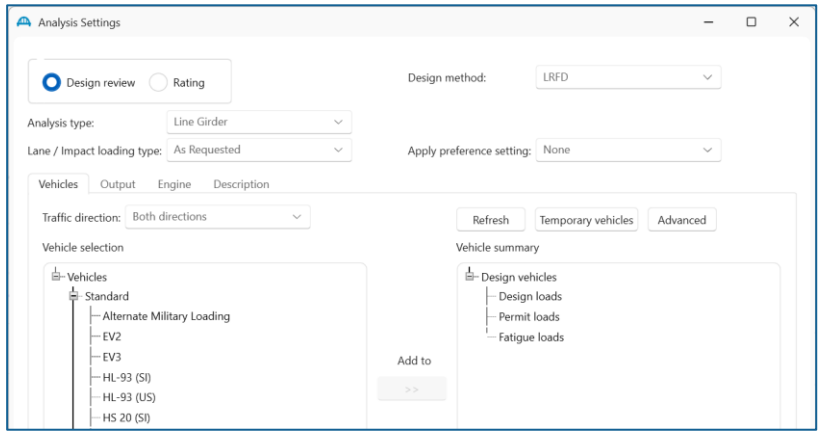
Line Definition

Capabilities – Analysis

- LRFD
- LRFR
- LFR/LFD
- ASR/ASD
- Member Alternative







Capabilities – Bridge Types

- Steel girder superstructures
  - **Rolled shapes**
  - **Welded plate girder**
  - **Built-up I shapes**

Capabilities – Bridge Types

- P/S concrete superstructures
  - **I beam**
  - **Box beam**
  - **Multi-stem tee**
  - **U beam**

Capabilities – Bridge Types

- Reinforced concrete superstructures
  - **Tee beam**
  - **I beam**
  - **Slab**
  - **Advanced shape (reinforced and post-tensioned)**

Capabilities – Bridge Types

- Reinforced concrete slab system superstructures
  - **User defined strip width**
  - **Solid and voided section**
  - **Integral with pier**

Capabilities – Bridge Types

- Reinforced concrete multi-celled box superstructure LRFD/LRFR/LFR
  - **Line girder analysis, web-lines or full box**
  - **User defined box cross sections**
  - **Integral with pier**
  - **Straight or curved**

Capabilities – Bridge Types

- Post-tensioned multi-celled box superstructure (LRFR/LFR)
  - **Line girder analysis, full box including web-lines**
  - **User defined box cross section**
  - **Integral with pier**
  - **Straight or curved**

Capabilities – Bridge Types

- Floor system/Floor line (LRFR/LFR/ASR)
  - **Girder-Floorbeam-Stringer**
  - **Truss-Floorbeam-Stringer**
  - **Girder-Floorbeam**
  - **Truss-Floorbeam**
  - **Floorbeam-Stringer**

Capabilities – Bridge Types

- Floor system
  - **Floor trusses (LFR only)**

Capabilities – Bridge Types

- Steel trusses (LRFR/LFR)
  - **Continuous span**
  - **Suspended span**
  - **Counters**
  - **Deck truss**
  - **Through truss**

Capabilities – Bridge Types

- Timber Superstructures (ASR and LRFR)
  - **Sawn deck**
  - **Sawn beam**
  - **Glulam beam**

Capabilities – Bridge Types

- Reinforced concrete box culverts (LRFD/LRFR/LFR)
  - **Sloping fill**
  - **Multiple cells**
  - **Optional bottom slab**
  - **Optional haunches**

Capabilities – Bridge Types

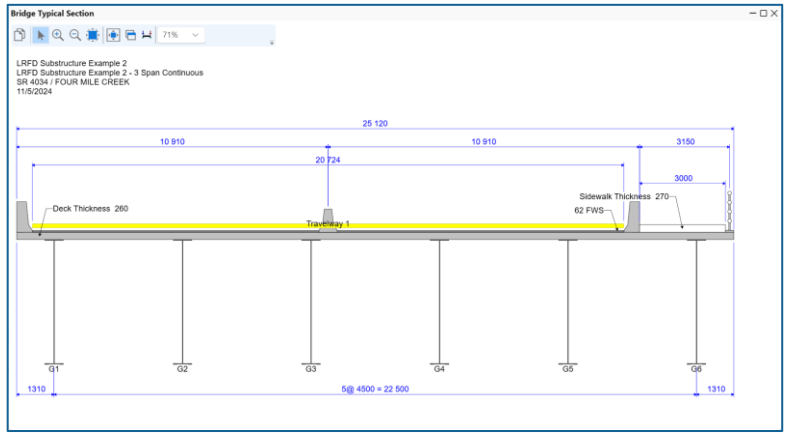
- Metal culvert (LFR/LRFR)
  - **Metal pipe, arch, pipe arch**
  - **Metal box**

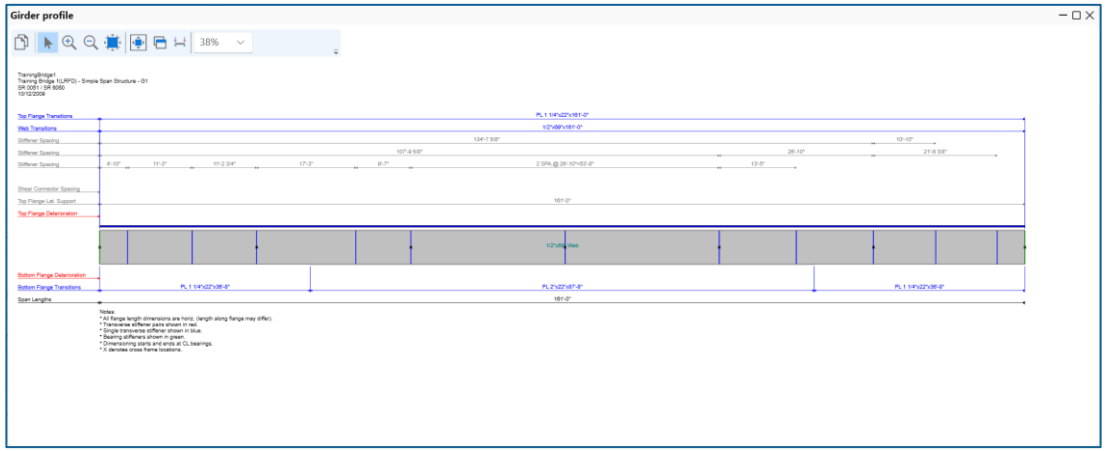
Capabilities – Substructure

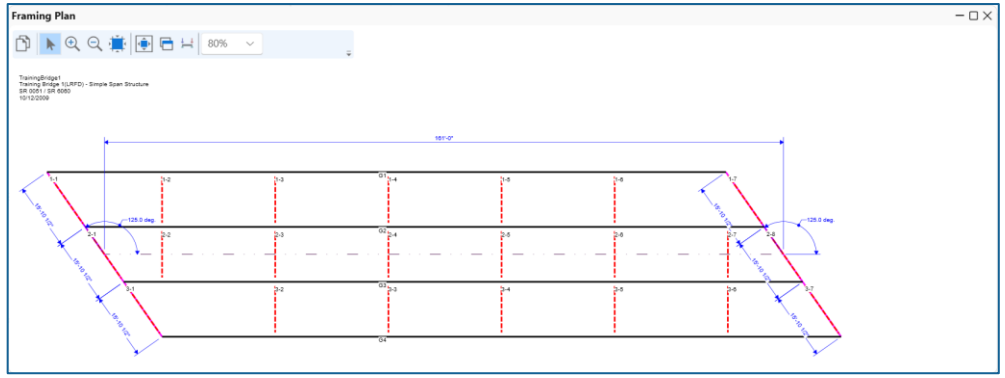
LRFD, LRFR (Pier cap)

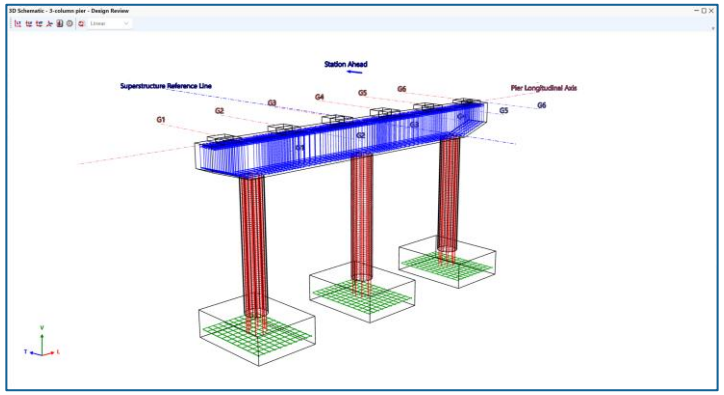
- Pier types
  - **Multi-column frame**
  - **Solid shaft**
  - **Pile bent**
  - **Wall**
- Foundation types
  - **Spread**
  - **Single drilled shaft**
  - **Pile**

Capabilities – Graphics



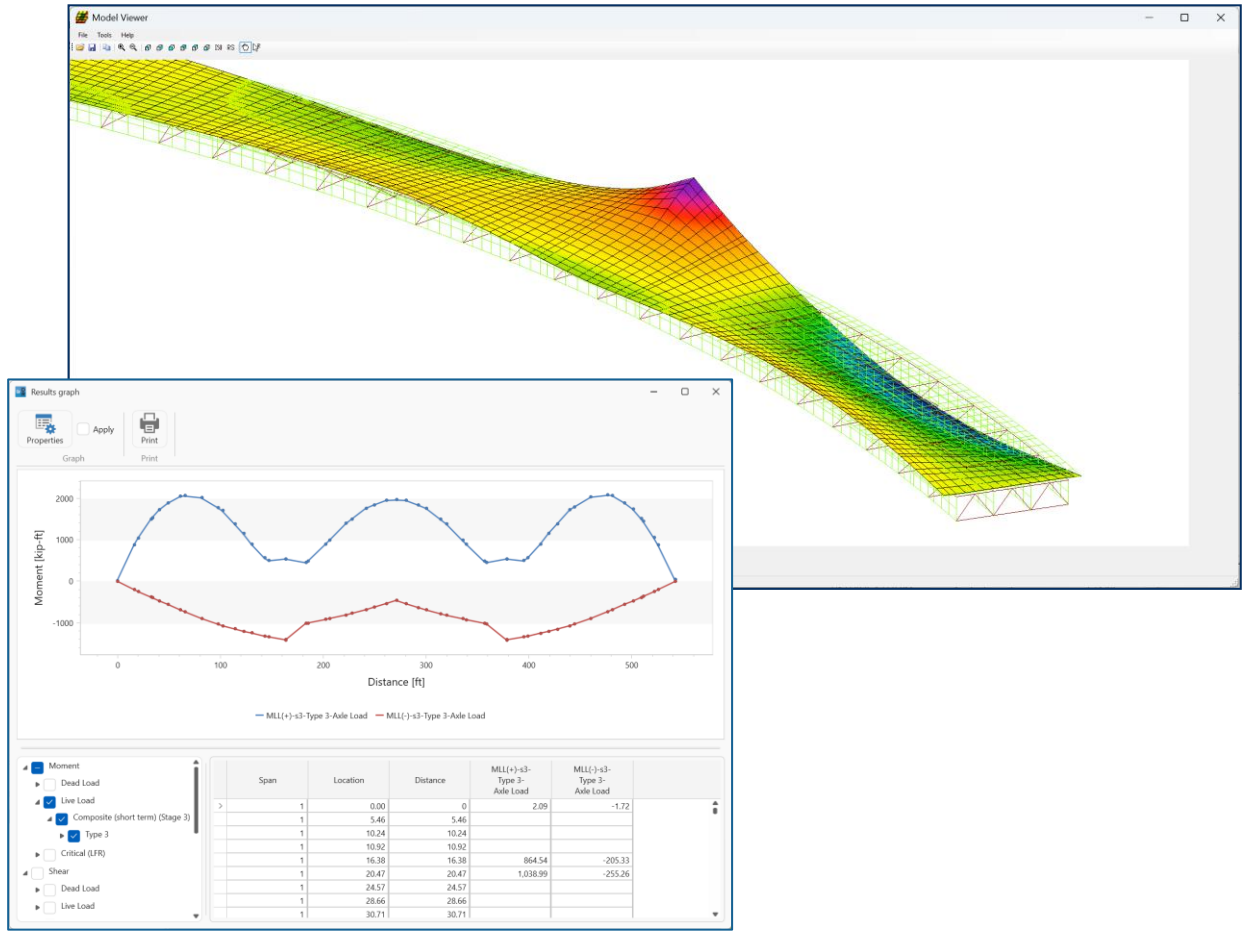






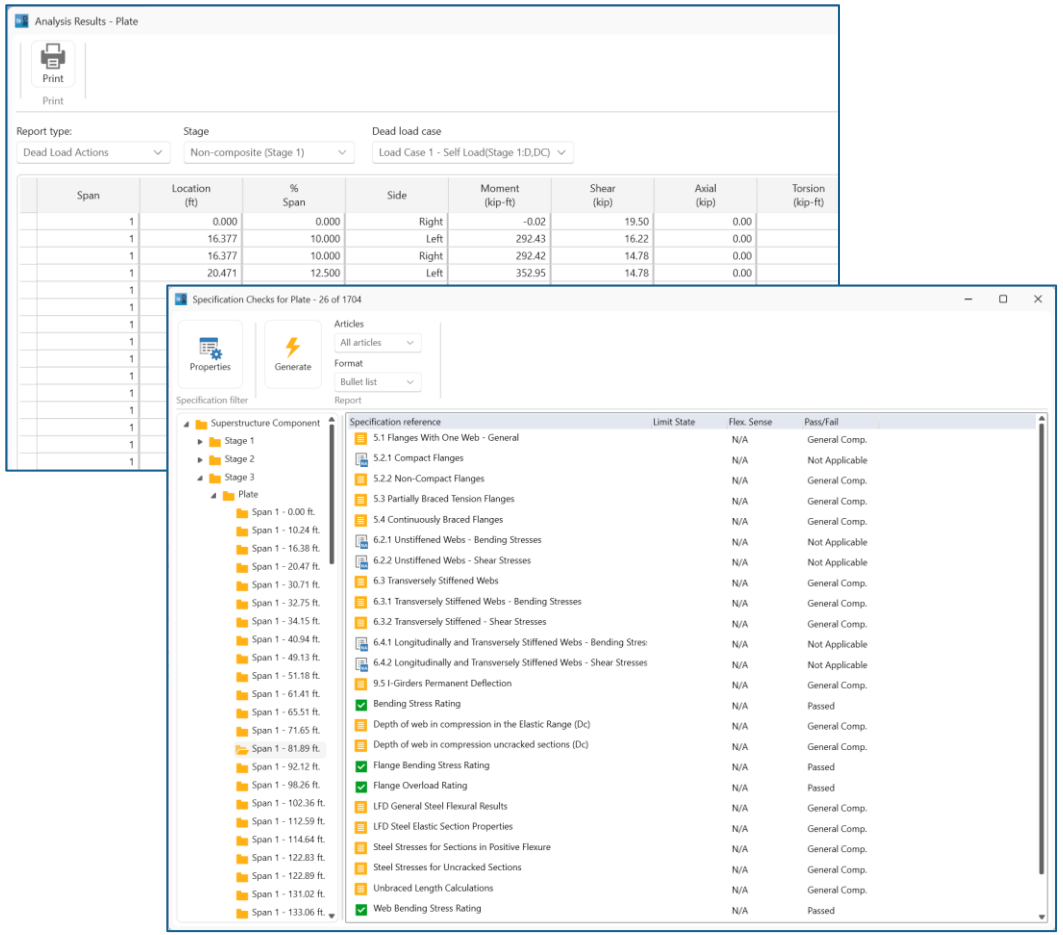
Capabilities – Analysis and Result Plots

- Analysis methods:
  - **Line girder (1D)**
  - **3D straight and curved girders**
  - **Automatic mesh generation**
  - **Transverse live load analysis or user-defined vehicle loading path**
  - **Dead load and live load analysis**



Capabilities – Analysis Results and Specification Evaluation

- Actions for analyzed point in tabular format
- Specification checking based on control options for LRFD, LRFR, LFR/LFD and ASR/ASD



Advantages – BrDR

- Design review and load rating in one user interface:
  - **Improved productivity by learning one user interface**
  - **Consistency across many bridge types**
- Database for storing bridge descriptions
  - **Integrity**
  - **Backups**
- Simplified administration of one product

Advantages – BrDR

- General 3D description not specific to:
  - **A particular edition of the AASHTO specification**
  - **An analysis method**
  - **An analysis engine**
- Data input does not need changed with specification updates
- Enter data once and compare between different specifications or 3D vs line girder

Advantages – BrDR

- Research – Evaluate specification changes before they are adopted for production use
- Agency Service Units
  - **Agencies can request features**
  - **Users vote on features**
  - **Technical Advisory Groups – advise how features should be implemented**

Advantages – BrDR

- 3rd party analysis engines through engine API
- 3rd party applications using domain API
- Permit routing support through analysis API

Thank You