# AASHTOWare Bridge 7.5 Enhancement Highlights

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AASHTOWare RADBUG
August 8, 2023

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# General Enhancement (E)

E1: Advanced Concrete Multicell Box

E2: Report Tool Phase 1

E3: Grid copy and paste

E4: Licensing Mechanism

E5: WiX Installer Phase 2

E6: Capacity Calculator 2.0

E7: ARC Tool Usability Improvements

E8: Update Tutorial

E9: Truss and Gusset Plate Adjacent Vehicle Analysis

E10: Gusset Plate Shear Analysis Improvements

E11: MBE 2023 Interim Update

# User Group Enhancement (UG)

UG1: LFR of Curved Steel Girder Spans > 300’

UG2: LRFR Concrete Moment Redistribution

UG3: Culvert Design Tool Final Iteration

UG4: Precomputed Data Window Filter

UG5: Square Rebar

# Maintenance Work (M)

M1: Database Maintenance

M2: Rating Method Rename

M3: 3D Mesh Generation Improvements

M4: LRFD Maximum Aggregate Size Input

M5: LRFD Modulus of Rupture Input

M6: Variable Axle Spacing for Permit Trucks

M7: Concurrent Moments for Cb Calculation

M8: Net Area Deduction for Truss LRFR

# Service Unit Work (SU)

- SU1: General Preference Additions

# E1: Advanced Concrete Multicell Box

- Define multicell box in multiple segments
- Each segment can have different number of cells

Span lengths | Segment data

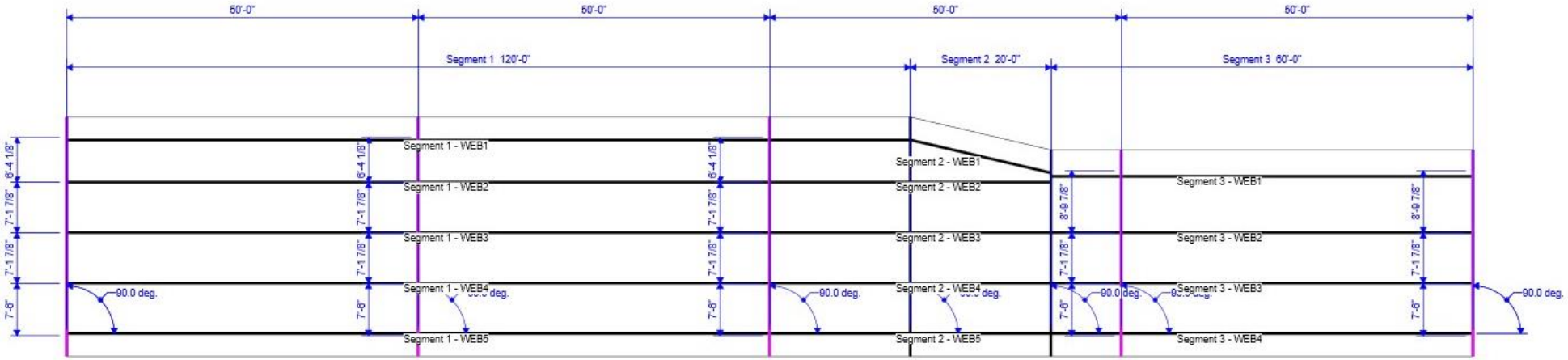
Enter span lengths along the reference line:

| | Span | Length (ft) |
|---|---|---|
| > | 1 | 50.00 |
| | 2 | 50.00 |
| | 3 | 50.00 |
| | 4 | 50.00 |

Span lengths | Segment data

Enter segment lengths along the reference line:

| | Segment | Length (ft) | Number of cells | Include in analysis |
|---|---|---|---|---|
| > | 1 | 120.000 | 4 | ✓ |
| | 2 | 20.000 | 4 | ✓ |
| | 3 | 60.000 | 3 | ✓ |

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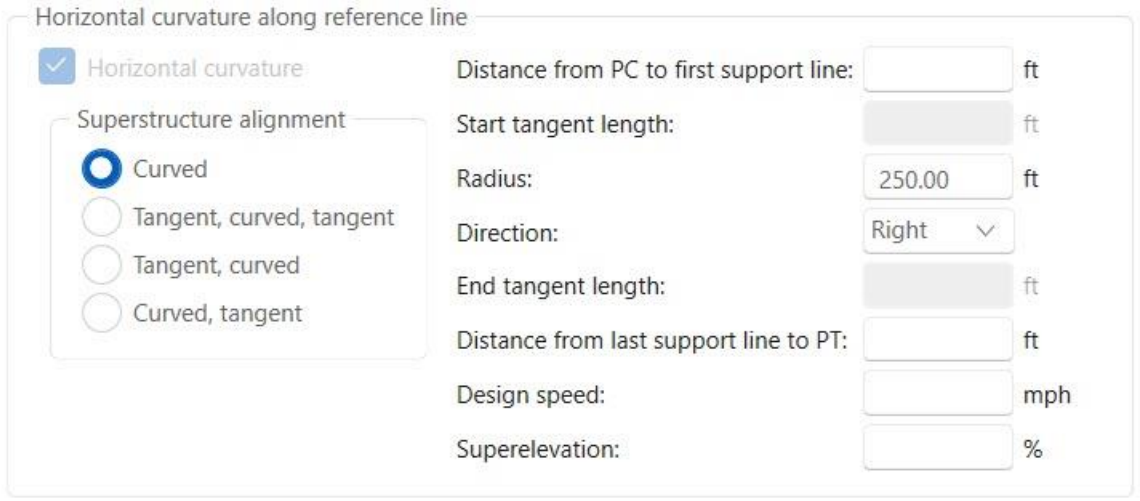
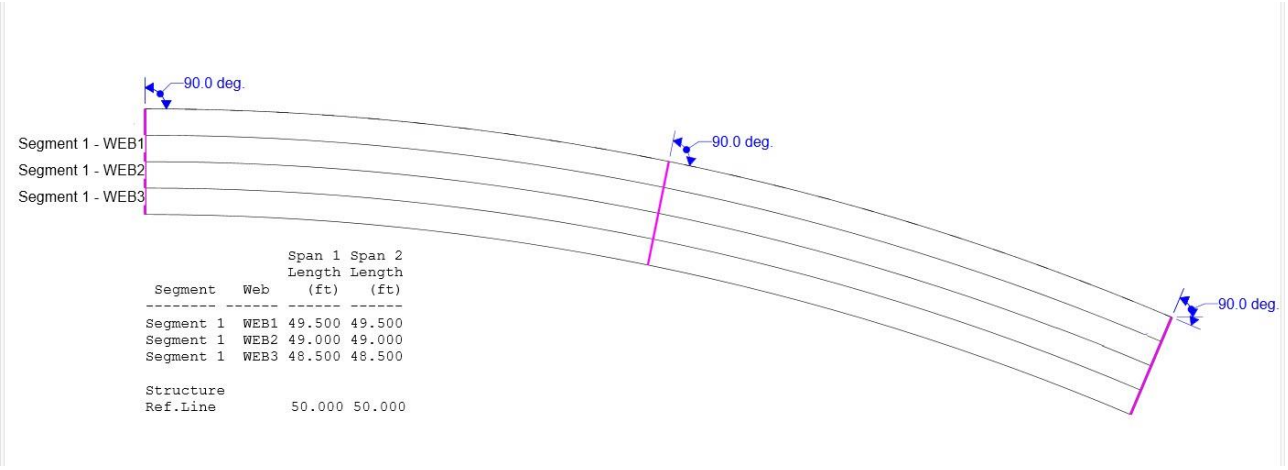
# E1: Advanced Concrete Multicell Box

- Define horizontal curvature
- Line girder only – LFR and LRFR
- Update for integral pier modeling

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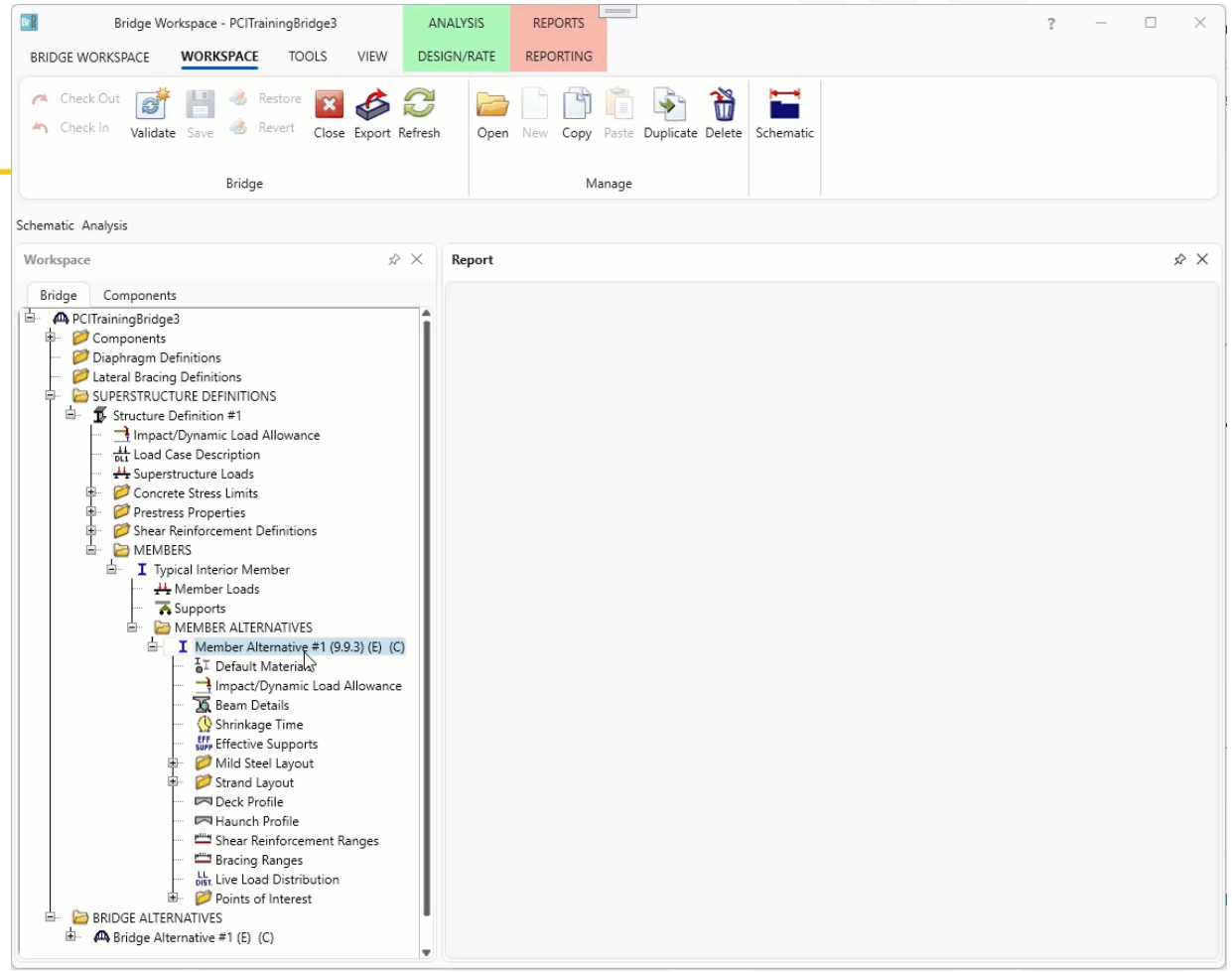
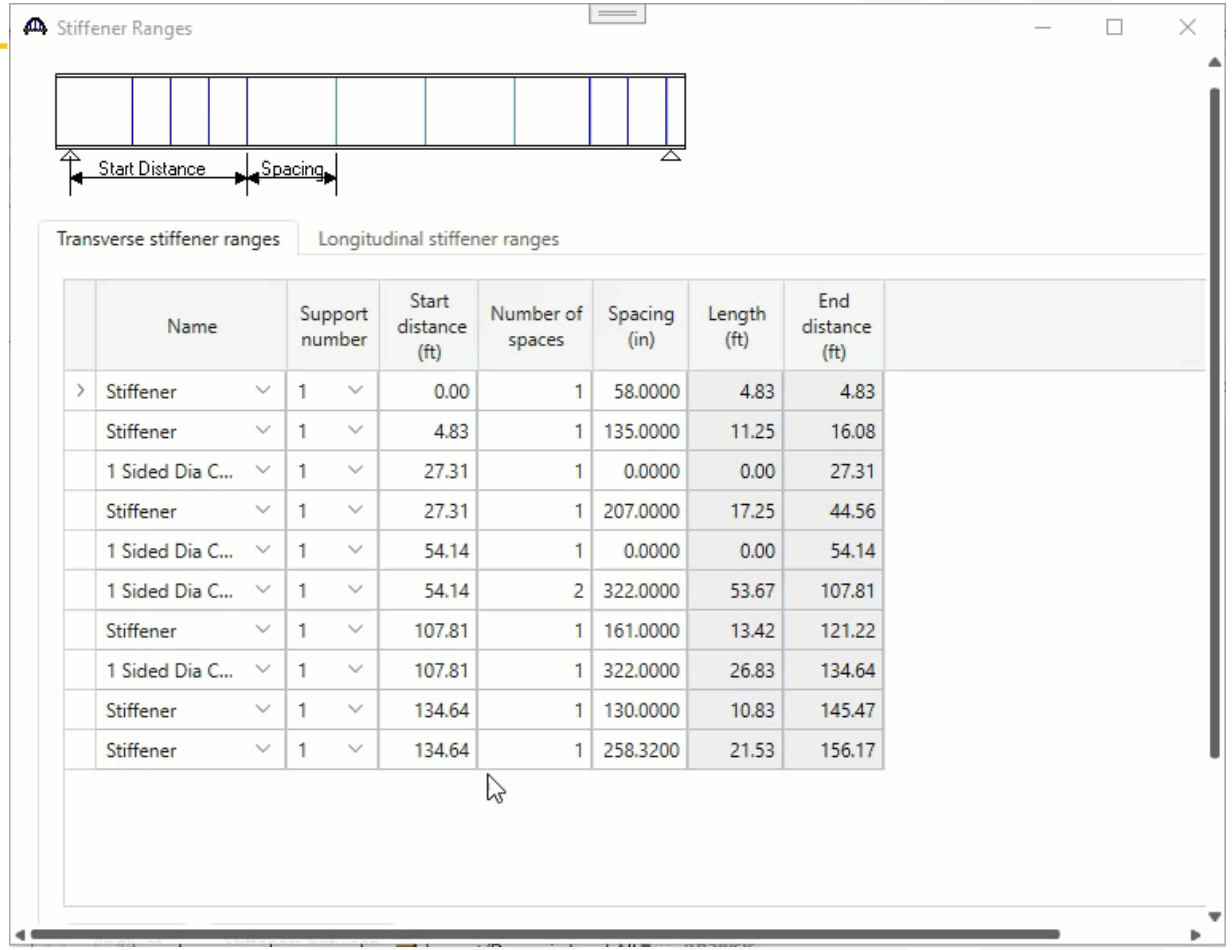
# E2: Report Tool Phase 1

- BWS tree driven reporting
- Report Tool Template Editor
  - Custom BWS Report Templates
  - Drag and drop addition
- Report Tool Viewer
  - BWS tree report preview
  - Select one or more templates
- Only for superstructure with prestressed members



# E3: Grid Copy and Paste

- Extend the copy and paste functionality to all grids for
  - BrDR
  - Design Tools
- Grids have “Excel-Like” behavior
  - Single click to select
  - Double click to edit
  - Click and drag selection




| Name | Support number | Start distance (ft) | Number of spaces | Spacing (in) | Length (ft) | End distance (ft) |
|---|---|---|---|---|---|---|
| Stiffener | 1 | 0.00 | 1 | 58.0000 | 4.83 | 4.83 |
| Stiffener | 1 | 4.83 | 1 | 135.0000 | 11.25 | 16.08 |
| 1 Sided Dia C... | 1 | 27.31 | 1 | 0.0000 | 0.00 | 27.31 |
| Stiffener | 1 | 27.31 | 1 | 207.0000 | 17.25 | 44.56 |
| 1 Sided Dia C... | 1 | 54.14 | 1 | 0.0000 | 0.00 | 54.14 |
| 1 Sided Dia C... | 1 | 54.14 | 2 | 322.0000 | 53.67 | 107.81 |
| Stiffener | 1 | 107.81 | 1 | 161.0000 | 13.42 | 121.22 |
| 1 Sided Dia C... | 1 | 107.81 | 1 | 322.0000 | 26.83 | 134.64 |
| Stiffener | 1 | 134.64 | 1 | 130.0000 | 10.83 | 145.47 |
| Stiffener | 1 | 134.64 | 1 | 258.3200 | 21.53 | 156.17 |

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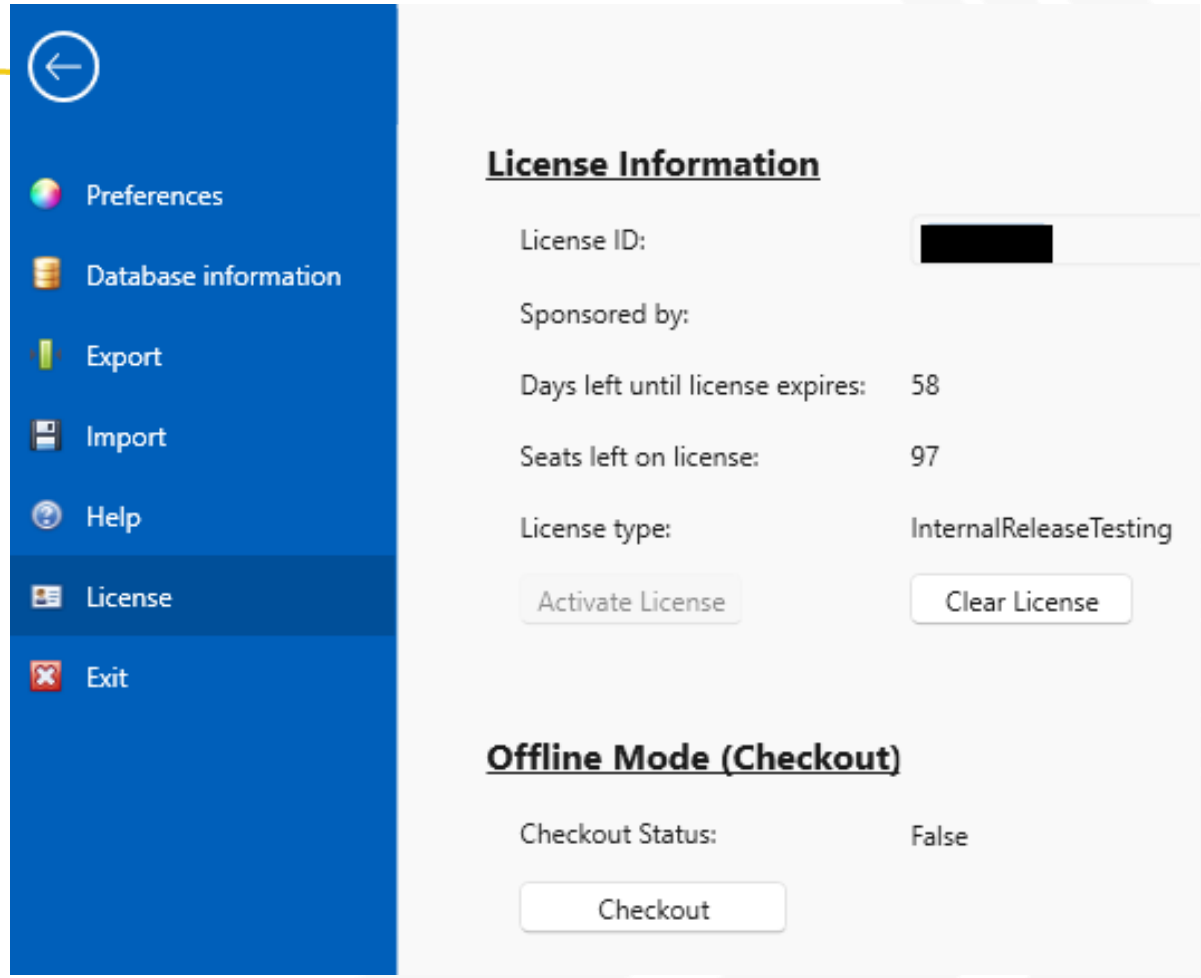
# E4: License Mechanism

- BrDR Desktop Service – BrDR and Design Tools use the same license
- All license types have a single installer
- Secure exported model with cryptographic signature
- Offline use with license checkout mode (Agency Unlimited Only)

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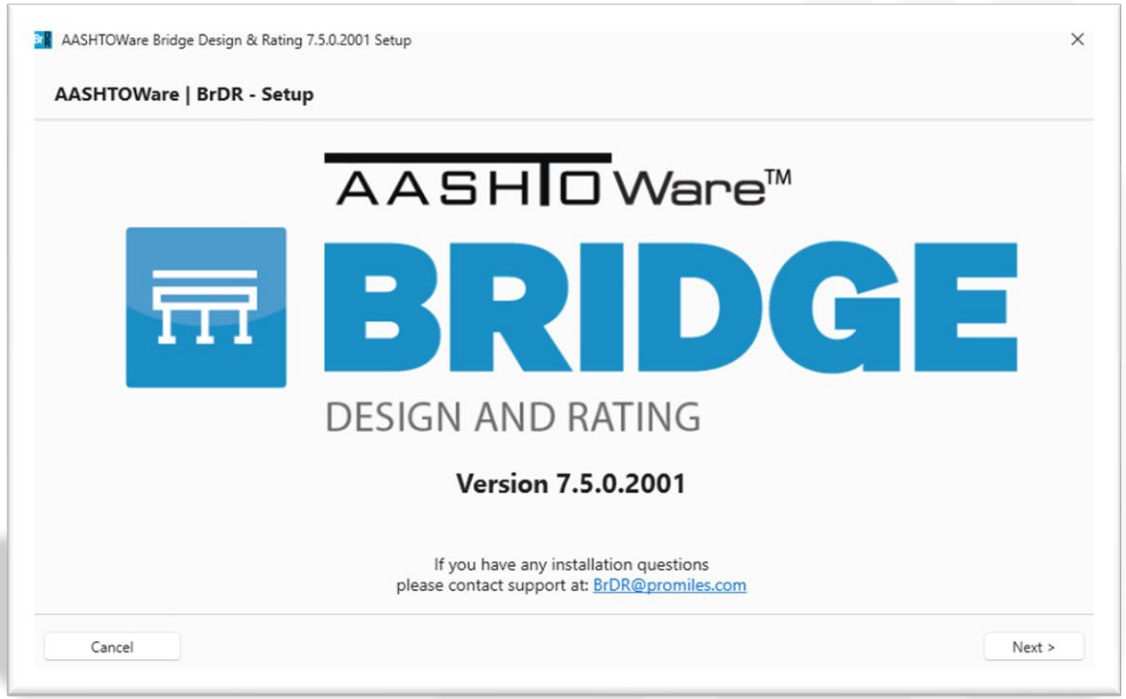
# E5: WiX Installer – Phase 2

- New UI
- Improved error handling and recovery
- Improved silent installation commands
- Improved installer modify capability
- Installer upgrade capabilities
- Upgrade to WiX v4 and .NET 6 support

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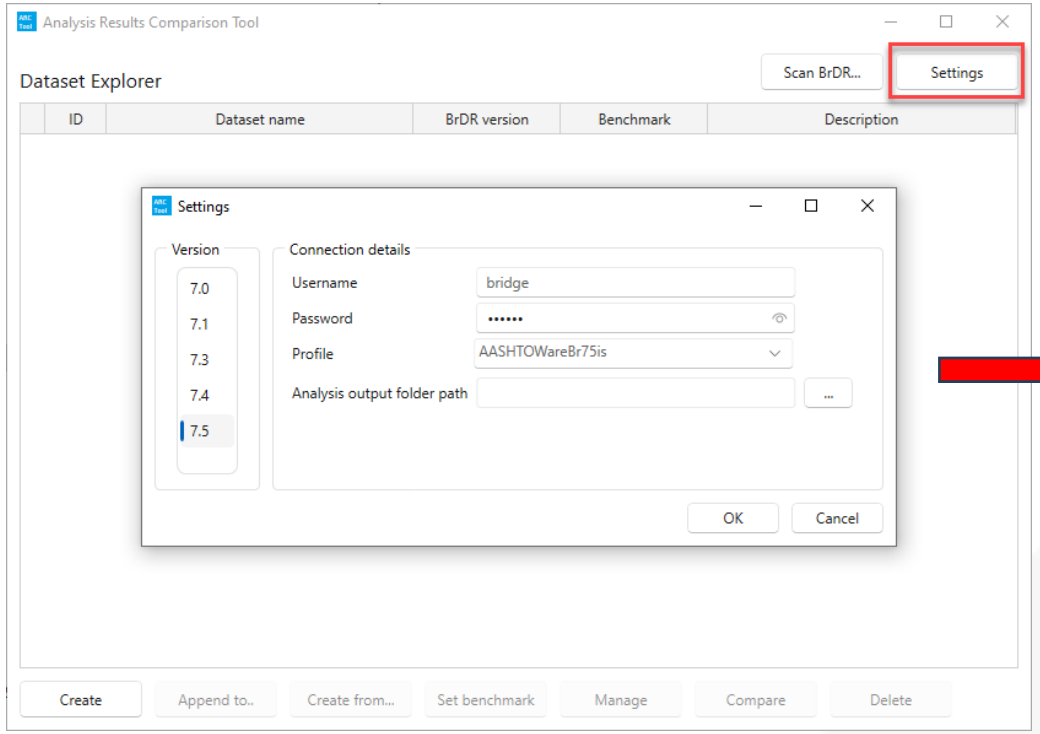
# E6: Capacity Calculator 2.0

- Will be used with Engine 2.0 modules
- Based on Cross Section 2.0

# E7: ARC Tool Usability

- Settings window for connection settings
- Relocate ARC Tool database
- Add additional columns in UI



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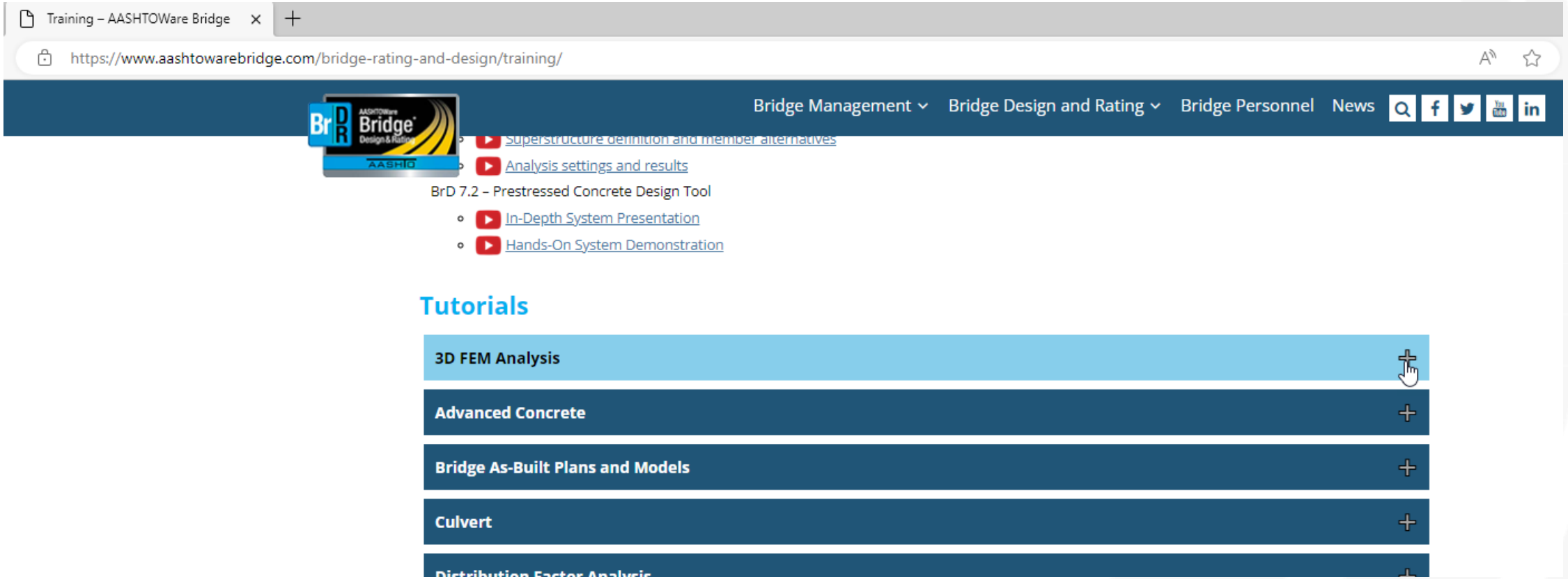
# E8: Update Tutorials

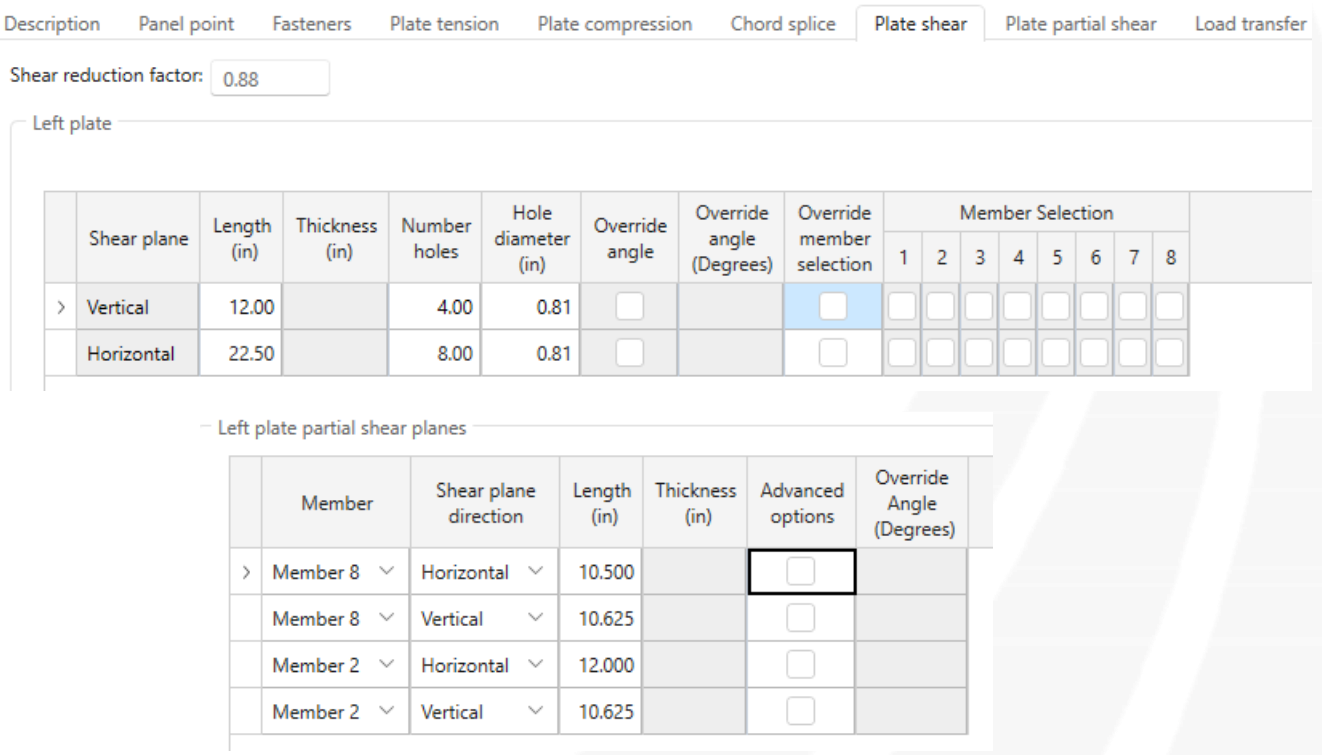


# E9: Truss and Gusset Plate Adjacent Vehicle Analysis

- For LFR
  - Truss LFR already supported
  - Gusset plate LFR will be supported
- For LRFR
  - Truss LRFR will be supported
  - Gusset plate LRFR will be supported

# E10: Gusset Plate Shear Analysis Improvements

- Consider members for shear plane ignored by AASHTO engine.
- Consider shear plane other than horizontal
- Override partial shear plane angle for partial shear plane along a non-truss member

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# E11: MBE 2023 Interim Update

- Consider concurrent actions for load rating related to shear
- New control option “Consider iterative shear rating”
  - 6A.4.2.1 Shear rating
  - 6A.5.8 Longitudinal reinforcement rating for shear
- New control option “Modify MCFT theta”
- New control option “Modify MCFT size effect”

For the purposes of load rating and application of MCFT it is permissible to modify the LRFD Article 5.7.3.4.2 as follows:

1. In areas of low strain where the section remains uncracked, that is $M_u < M_{cr}$, the strain $\varepsilon_s$ may be assumed to be zero regardless of values of $M_u$ and $V_u$; therefore, θ can be taken as 29 degrees.

2. For reinforced concrete members with web reinforcement $Av < Av.min$, the beta should be adjusted by applying the size effect. For prestressed concrete beams, if $fpc/f'c$ is greater than or equal to 0.02, regardless of the amount of shear reinforcement, the size effect may be neglected.

$\beta$ can be taken as shown below-

$$\beta = \frac{4.8}{(1 + 750\varepsilon_s)}$$

---

# UG1: LFR of Curved Steel Girder Spans > 300’

- AASHTO Guide Specifications for Horizontally Curved Steel Girder Highway Bridges 2003 applies to spans up to 300’
- History of construction problems with spans > 300’
- Ignore span limit for rating with warning

# UG2: LRFR Concrete Moment Redistribution

- New LRFR control option “Allow moment redistribution”
- General process
  - Adjust percent of moment redistribution at each pier (up to 20%)
  - Evaluate controlling rating factor to achieve
    - Critical positive flexure RF = Critical negative flexure RF

**5.6.3.4—Moment Redistribution**

In lieu of more refined analysis, where bonded reinforcement that satisfies the provisions of Article 5.10.8 is provided at the internal supports of continuous spans, negative moments determined by elastic theory at strength limit states may be increased or decreased by not more than $1000\varepsilon_t$ percent, with a maximum of 20 percent. Redistribution of negative moments shall be made only where $\varepsilon_t$ is equal to or greater than $1.5\varepsilon_{tl}$ at the section at which moment is reduced, where $\varepsilon_{tl}$ is the tension-controlled strain limit specified in Article 5.6.2.1.

Positive moments shall be adjusted to account for the changes in negative moments to maintain equilibrium of loads and force effects.

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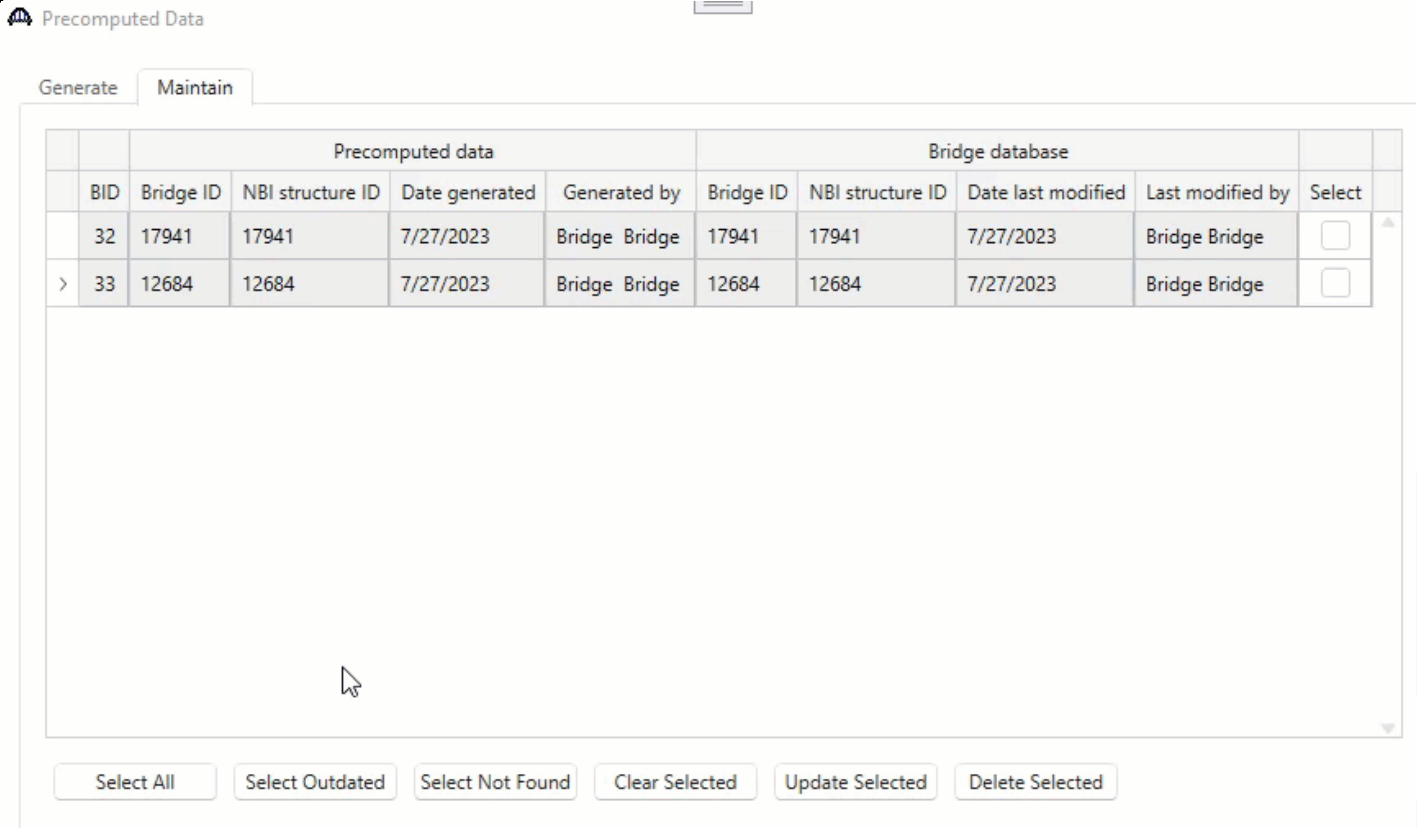
# UG3: Culvert Design Tool Final Iteration

- Depth of fill not adjusted based on top slab design
- Reinforcement development handling
- Consider cutoff bars for final design
- Consider horizontal joint for design
- Horizontal leg of interior wall consideration for top slab

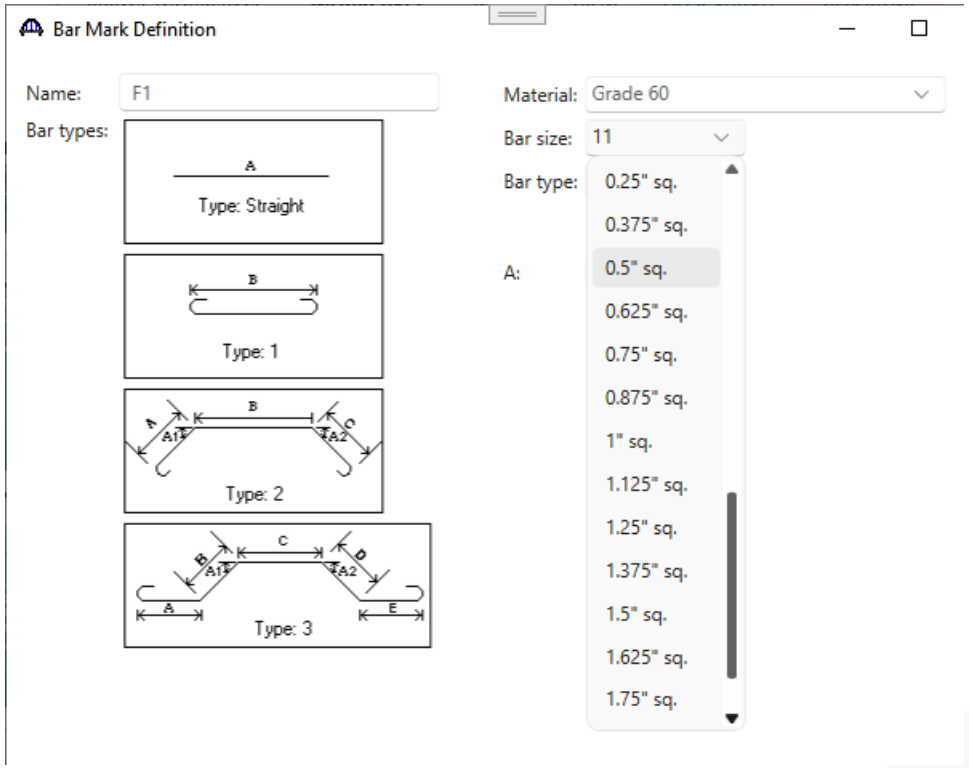
# UG4: Precomputed Data Window Filter

- Filtering option in all columns of the Maintain tab



# UG5: Square Rebars

- Consider square rebars with nominal diameter

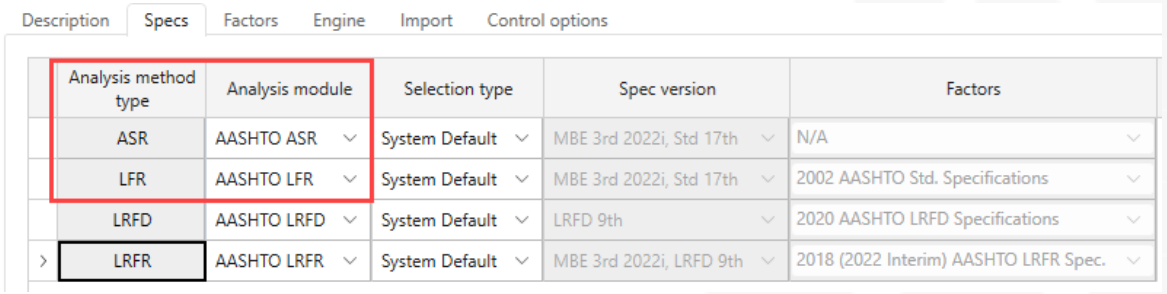


# M1: BrDR Database Maintenance

- Database connection pooling
- Reconnect to database automatically
- Encrypt database connection
- Additional Azure connection type
  - Azure MFA
  - Azure Integrated Active Directory

# M2: Rating Method Rename

- Rename ASD rating to ASR rating, LFD rating to LFR rating
  - AASHTO engine names
  - Manual for Bridge Evaluation UI notations
  - Method of Solution names
  - Domain API property and method names
  - Analysis API - System type constants
- Does not impact UI notations from ASD or LFD Spec

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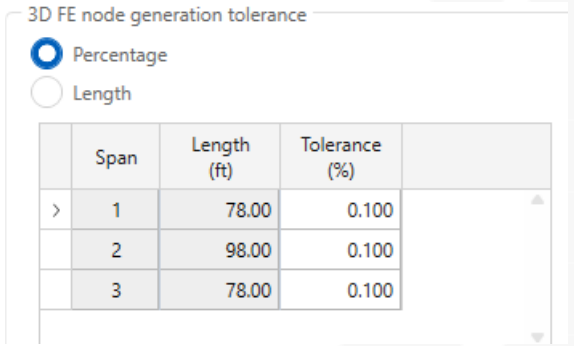
# M3: 3D Mesh Generation Improvements

- Limit small elements
- Node merging percentage or length tolerance by span instead of hardcoded 0.1% for all spans

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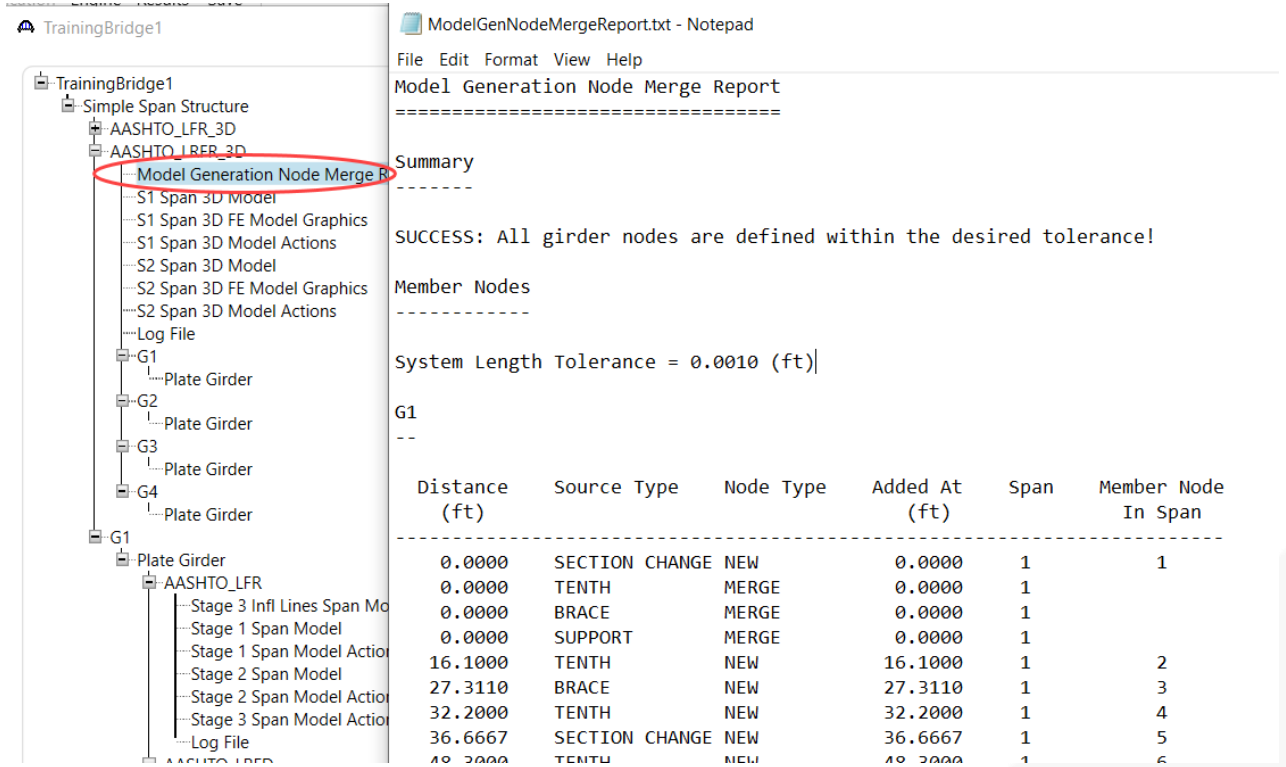
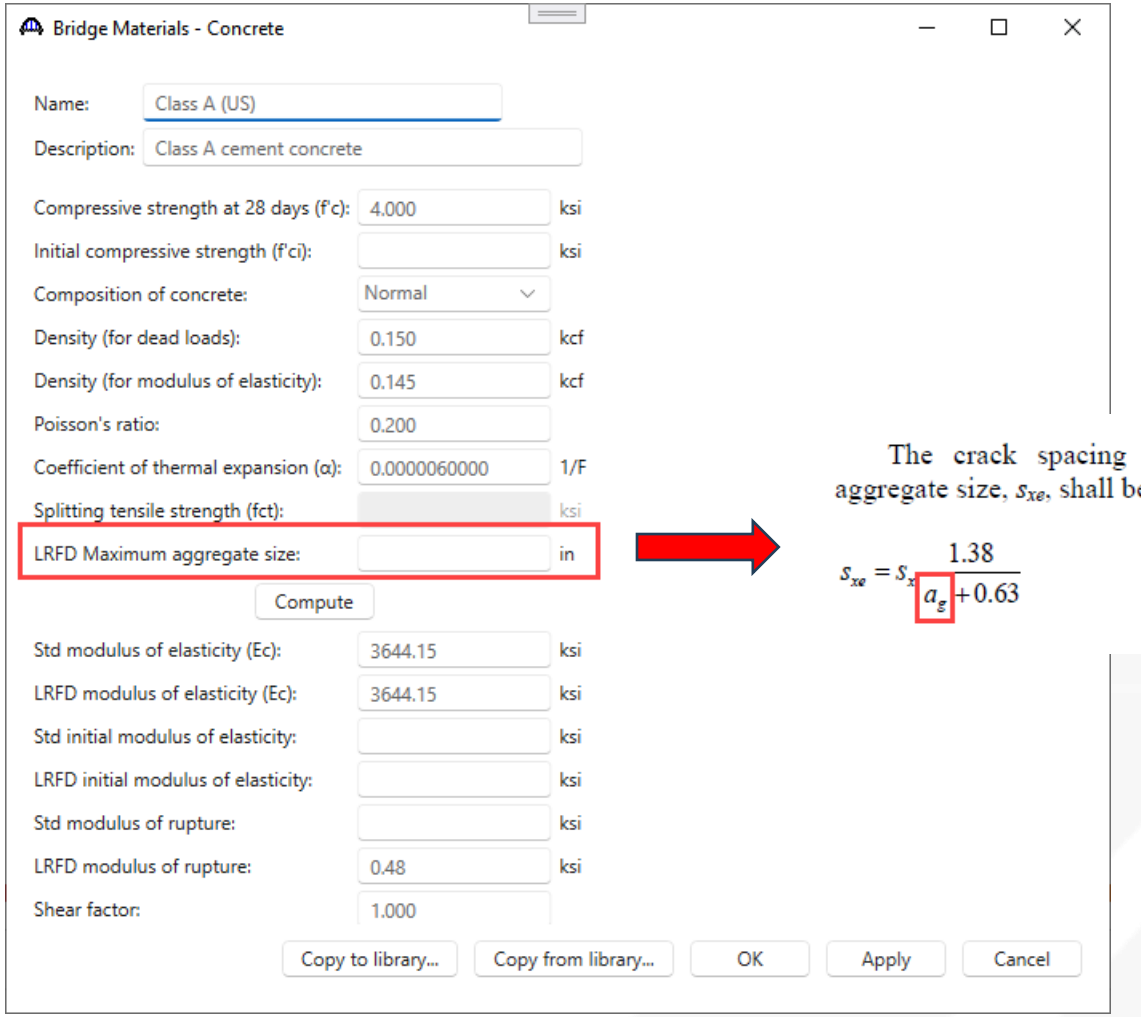
# M3: 3D Mesh Generation Improvements

- Model Generation Node Merge Report



# M4: LRFD Maximum Aggregate Size Input

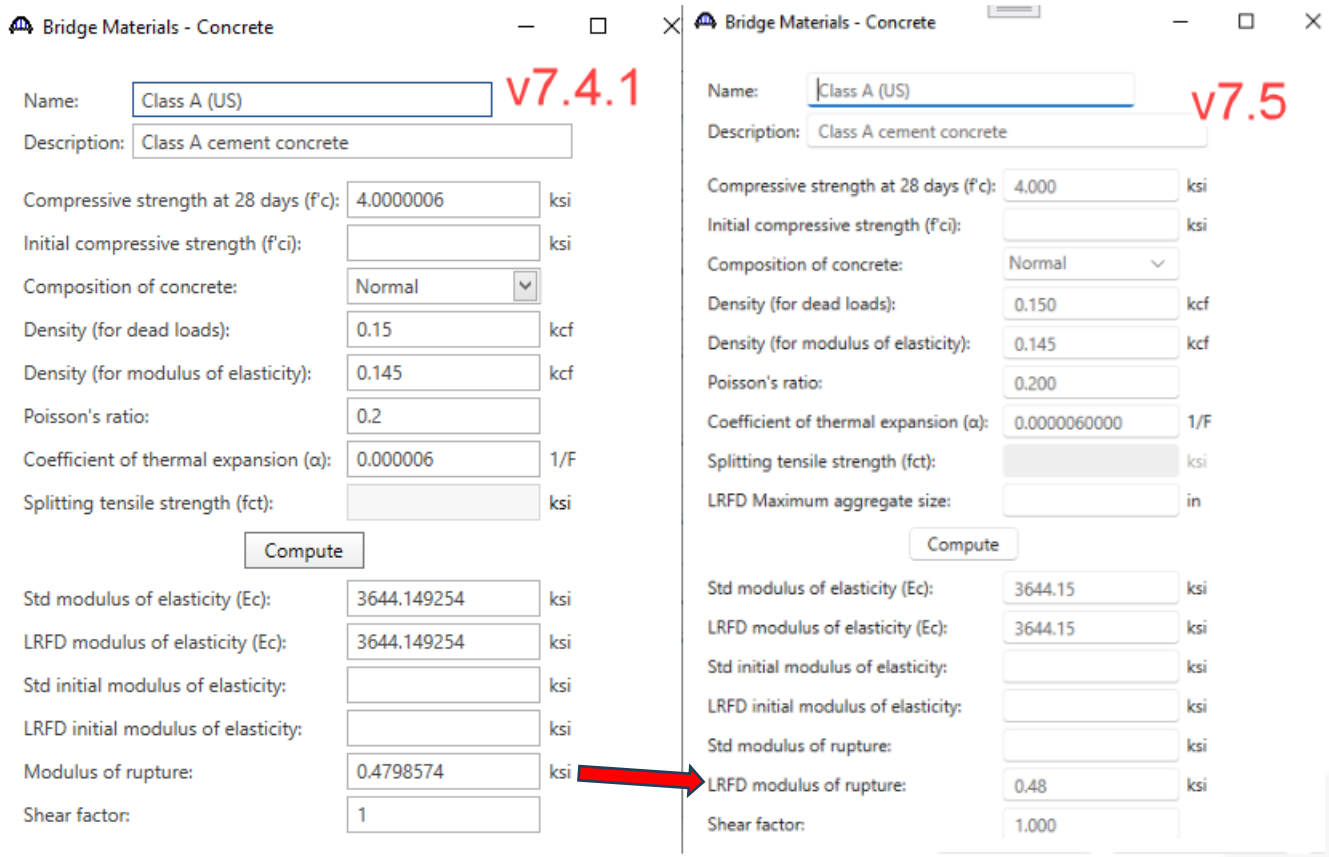
- Default value is 1.0




The crack spacing parameter as influenced by aggregate size, $s_{xe}$, shall be determined as:

$$s_{xe} = s_x \frac{1.38}{a_g + 0.63} \qquad (5.7.3.4.2\text{-}7)$$

# M5: LRFD Modulus of Rupture Input

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# M6: Variable Axle Spacing for Permit Trucks

- Evaluate variable axle spacing for permit trucks
- Applicable to both LFR and LRFR
- LRFR permit live load factor based on maximum axle spacing

# M7: Use Concurrent Moments in Cb Calculations

- New LRFR and LRFD control options "Consider concurrent moments in Cb calculation"
- Use concurrent moments along unbraced length
- Based on LRFD C6.10.8.2.3

Strict application of the $C_b$ provisions would require the consideration of the concurrent moments along the unbraced length. This would necessitate the calculation of:

(1) the maximum possible value of $f_2$ at the brace point with the higher compressive stress using the critical moment envelope value, along with calculation of $f_{mid}$ and $f_0$ using the concurrent moments, and

(2) the maximum possible compressive value of $f_{mid}$ using the critical moment envelope value, along with the calculation of $f_0$ and $f_2$ using the concurrent moments.

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# M8: Net Area Deduction for Truss LRFR

- Add new input for truss net area deduction
- For existing models
  - Use LFR effective area deduction with a warning

# SU1: General Preference Additions

- LRFR Condition Factor
- LRFR System Factor
- Additional self load
  - As load per unit length
  - As percentage

Questions?

Thank you!