



BrDR 7.8

Substructure LRFD

Design Review

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ProMiles®

Overview

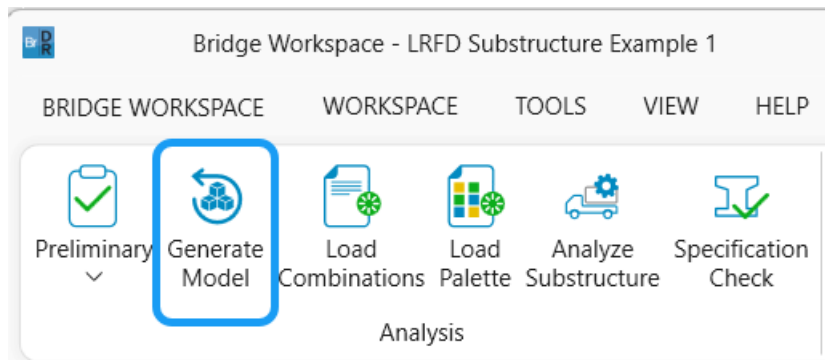
- BWS Changes
- Reinforcement Entry Changes
- Reinforcement Schematic
- Pier Association
- Analysis Control Options
- Analysis: Load Rating or Design Review

BWS Changes

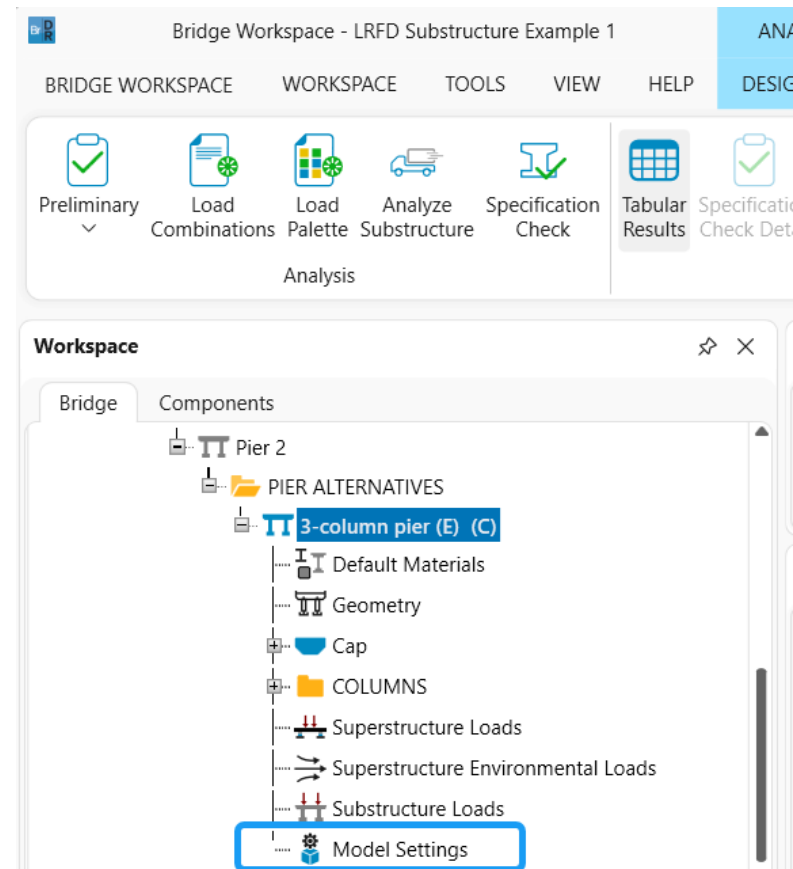
- Model Settings
- Live Load Settings (rating)
- Points of Interest
- Deterioration (rating)

Model Settings

v7.7



v7.8



Live Load Settings (rating)

Superstructure Loads-Pier 2-3-column pier

Back span

Span no.: 1

Superstructure definition: 2 Continuous span

Ahead span

Span no.: 2

Superstructure definition: 2 Continuous span

DL FR LL settings LL-reaction LL-distribution Load rating LL settings BR

Single lane reaction distribution

☒ Consider maximum axle load as P

☐ Consider entire reaction as P

☐ Consider uniform load only

Vehicle single lane reactions will be applied to the deck as shown below:

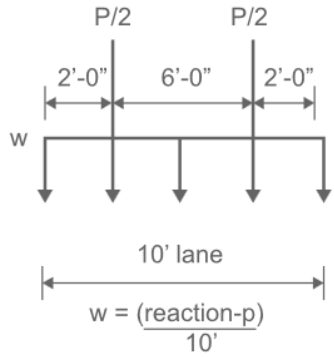


Diagram illustrating the application of vehicle single lane reactions to the deck. The diagram shows a 10' lane with two point loads of $P/2$ separated by 6'-0". The distance from each point load to the lane boundary is 2'-0". A uniform load w is applied across the entire 10' lane. The formula for the uniform load is $w = \frac{\text{reaction-p}}{10'}$.

LRFR dynamic load allowance

Fatigue and fracture limit states: 15.0 %

All other limit states: 33.0 %

Points of Interest

v7.7

Model Settings - 3-column pier

Default parameters Points of interest Member releases

Default nodes are located at beam reaction points, cross-section changes, cap/column interfaces, intersection of cap and column faces, column/footing interfaces, and bottom of foundations.

Cap additional points of interest

Distance from left end of cap (ft)

New Duplicate Delete

Column additional points of interest

Column	Distance from bottom of column (ft)

New Duplicate Delete

v7.8

Cap Point Of Interest - Pier 2 - 3-column pier

Distance from left edge of cap: 0.00 ft or Region: Left C

Shear Development Shear capacity Positive flexu

☐ Override schedule

Shear reinforcement

Material:

Bar size:

of legs:

Area: in²

Spacing: in

LRFD

Com

Sx:

Beta

Ther

LRFD

☐

☐

☐

Consider permit load tensile steel stress

Cap

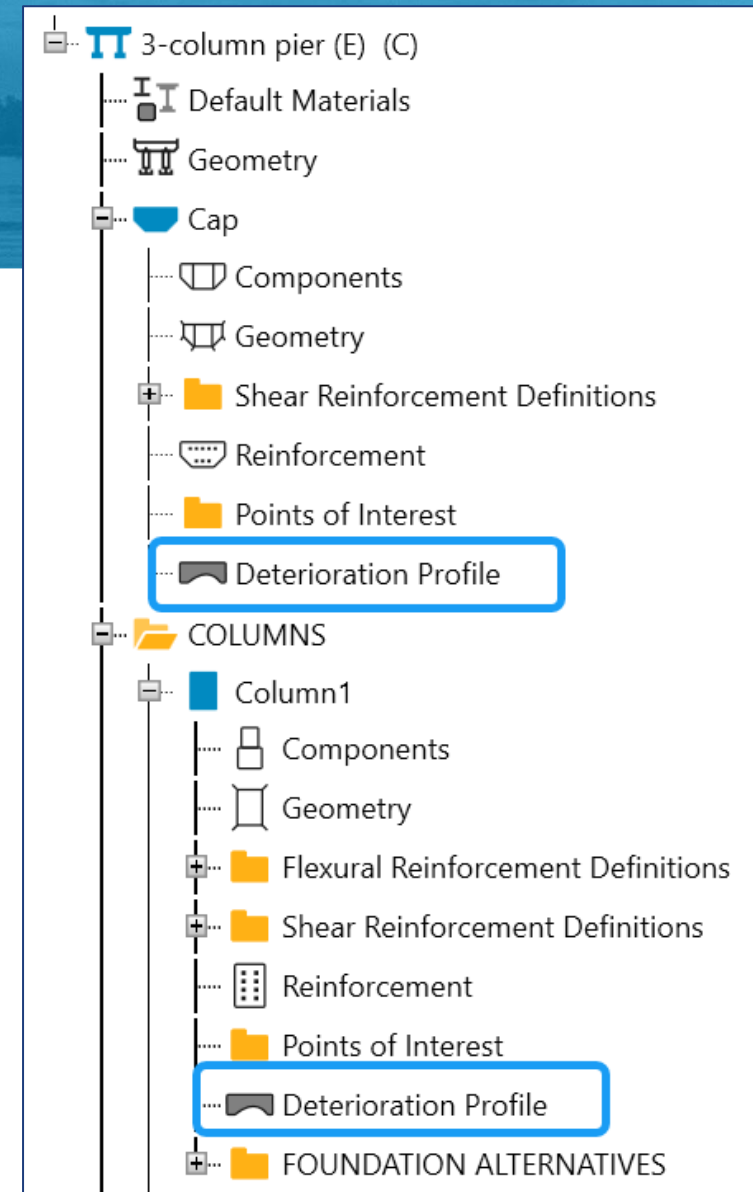
- Components
- Geometry
- Shear Reinforcement Definitions
- Reinforcement
- Points of Interest**
- Deterioration Profile

Column1

- Components
- Geometry
- Flexural Reinforcement Definitions
- Shear Reinforcement Definitions
- Reinforcement
- Points of Interest**
- Deterioration Profile
- FOUNDATION ALTERNATIVES

Deterioration (rating)

- Define concrete section loss and/or mild steel reinforcement loss for cap and column
- Deterioration is ***not considered*** for LRFD Design Review



Reinforcement Entry Changes

- Cap Shear Reinforcement Entry
- Shear Reinforcement Definitions
- Shear Reinforcement Wizards
- Shear Reinforcement Spacing

Cap Shear Reinforcement Entry

v7.7

Cap Reinforcement - Pier 2 - 3-column pier

Flexural **Shear**

	Bar size	Number of legs	Material	Measure from	Direction	Start distance (ft)	Number of spaces	Spacing (in)	Length (ft)	End distance (ft)
>	5	4.000	Grade 60	Left Edge of Cap	Right	0.583	1	0.000	0.000	0.583
	5	4.000	Grade 60	Left Edge of Cap	Right	0.583	10	5.500	4.583	5.166
	5	4.000	Grade 60	Left Edge of Cap	Right	8.333	1	0.000	0.000	8.333
	5	4.000	Grade 60	Left Edge of Cap	Right	8.333	12	5.500	5.500	13.833
	5	4.000	Grade 60	Left Edge of Cap	Right	13.833	6	11.000	5.500	19.333
	5	4.000	Grade 60	Left Edge of Cap	Right	19.333	10	5.500	4.583	23.916
	5	4.000	Grade 60	Left Edge of Cap	Right	27.083	1	0.000	0.000	27.083
	5	4.000	Grade 60	Left Edge of Cap	Right	27.083	10	5.500	4.583	31.666
	5	4.000	Grade 60	Left Edge of Cap	Right	31.666	6	11.000	5.500	37.166
	5	4.000	Grade 60	Left Edge of Cap	Right	37.166	12	5.500	5.500	42.666
	5	4.000	Grade 60	Left Edge of Cap	Right	45.833	1	0.000	0.000	45.833
	5	4.000	Grade 60	Left Edge of Cap	Right	45.833	10	5.500	4.583	50.416

Dup & Mirror New Duplicate Delete

OK Apply Cancel

v7.8

Cap Reinforcement - Pier 2 - 3-column pier

Pier cap length: 51 ft

Flexural **Left cantilever shear** Column bays shear Right cantilever shear

☐ Associate reinforcement with associated pier

Column bay: Bay 1

Left column width/diameter: 3 ft Bay length between column faces: 15.75 ft

Right column width/diameter: 3 ft

	Vertical shear reinforcement	Measure from	Direction	Spacing type	Start distance (ft)	Number of spaces	Spacing (in)	Length (ft)	End distance (ft)
>	Definition 1	Left column CL	Right	Actual	1.583	1	0	0	1.583
	Definition 1	Left column CL	Right	Actual	1.583	12	5.5	5.5	7.083
	Definition 1	Left column CL	Right	Actual	7.083	6	11	5.5	12.583
	Definition 1	Left column CL	Right	Actual	12.583	10	5.5	4.5833333	17.1663333

Copy to bay New Duplicate Delete

Shear wizard

OK Apply Cancel

Shear Reinforcement Definitions

v7.7

Cap Reinforcement - Pier 2 - 3-column pier

Flexural Shear

Bar size	Number of legs	Material	Measure from
5	4.000	Grade 60	Left Edge of Cap
5	4.000	Grade 60	Left Edge of Cap
5	4.000	Grade 60	Left Edge of Cap
5	4.000	Grade 60	Left Edge of Cap
5	4.000	Grade 60	Left Edge of Cap

v7.8

2 Continuous span
BRIDGE ALTERNATIVES
2 span bridge (E) (C)
Continuous span steel bridge
SUPERSTRUCTURES
Stiffness Analysis
PIERS
Pier 2
PIER ALTERNATIVES
3-column pier (E) (C)
Default Materials
Geometry
Cap
Components
Geometry
Shear Reinforcement Definitions
Definition 1
Reinforcement
Points of Interest
Deterioration Profile

Cap Shear Reinforcement Definition - Pier 2 - 3-column pier

Name: Definition 1

Material: Grade 60

Bar size: 5

Number of legs: 4.00

Inclination (alpha): 90.00 Degrees

Cap Reinforcement - Pier 2 - 3-column pier

Pier cap length: 51.00 ft

Flexural Left cantilever shear Column bays shear Right cantilever shear

☐ Associate reinforcement with associated pier

Cantilever length from column face: 5.25 ft

Column width/diameter: 3.00 ft

Vertical shear reinforcement	Measure from	Direction	Spacing type	Start distance (ft)
Definition	Left edge of cap	Right	Actual	0.583
Definition	Left edge of cap	Right	Actual	0.583

Shear Reinforcement Wizards

Pier Column Shear Reinforcement Wizard

Shear reinforcement type: Ties

Within cap

Top of cap elevation: 76.000 ft Top of column elevation: 71.330 ft

	Shear reinforcement definition	Measure from	Direction	Spacing type	Start distance (ft)	Number of spaces	Spacing (in)	Length (ft)	End distance (ft)
>	#5 Tie	Top of column	Up	Actual	0.250	6	6.0000	3.000	3.250

New Duplicate Delete

Within column

Interior reinforcement

☒ Maximum spacing: 18.0000 in ☐ Number of spaces: Shear reinforcement: #5 Tie

Measured from bottom of column

Start distance: 0.250 ft

	Shear reinforcement definition	Number of spaces	Spacing (in)
>	#5 Tie	6	6.0000

Measured from top of column

Start distance: 0.250 ft

	Shear reinforcement definition	Number of spaces	Spacing (in)
>	#5 Tie	6	6.0000

Shear Reinforcement Spacing

- Enter maximum or actual spacing
- AASHTO engine uses this entered maximum spacing as the spacing in this region

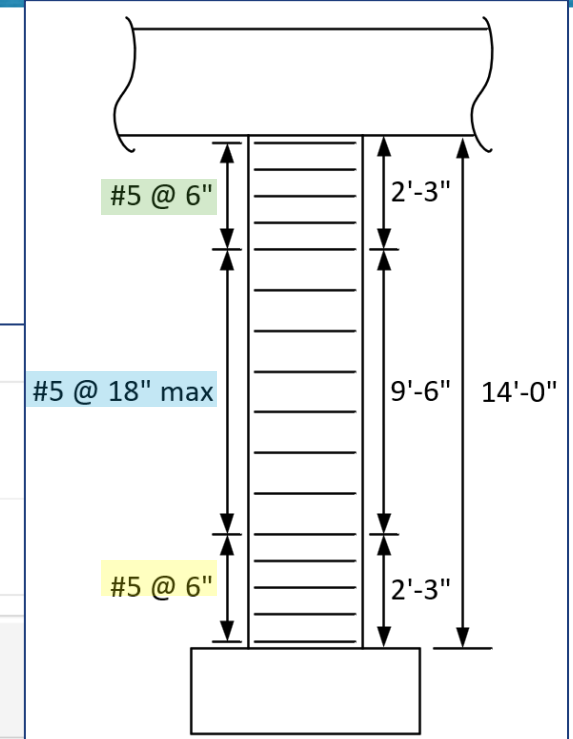
Flexural | **Shear**

☐ Associate reinforcement with associated pier

Shear reinforcement type

☒ Ties ☐ Spirals ☐ Spirals designed as ties ☐ Hoops ☐ Hoops with lap splice

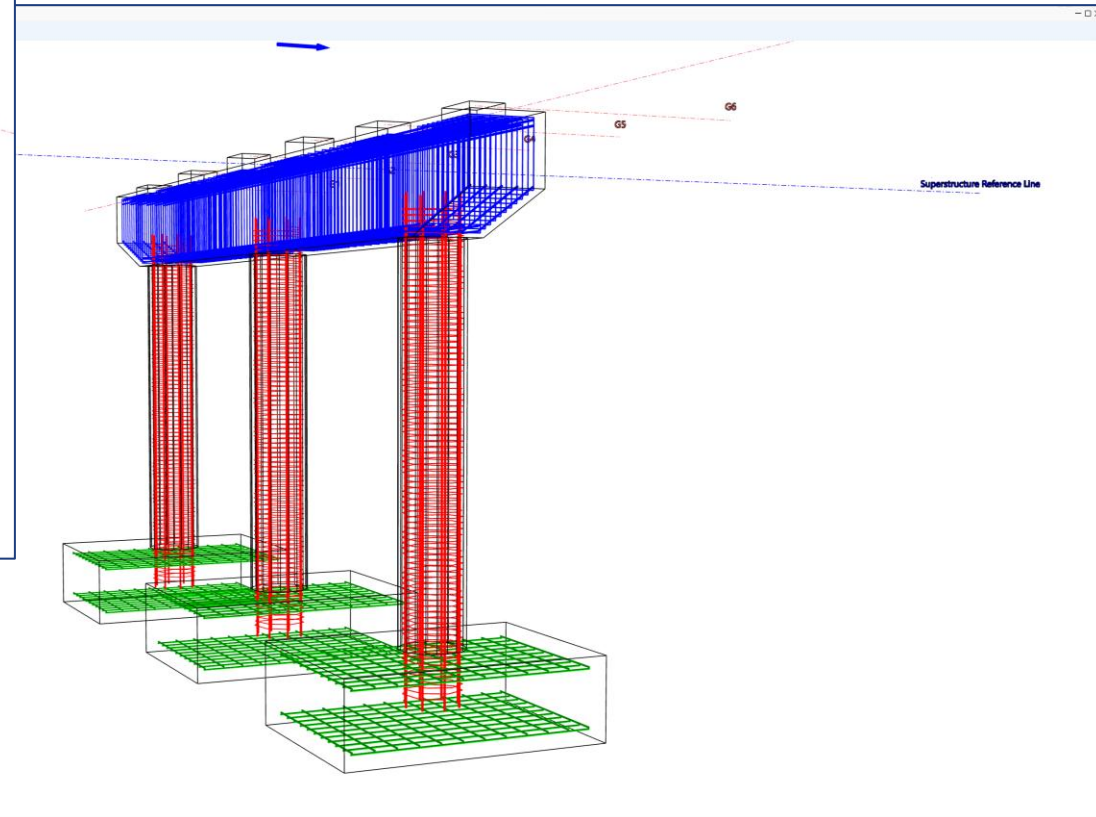
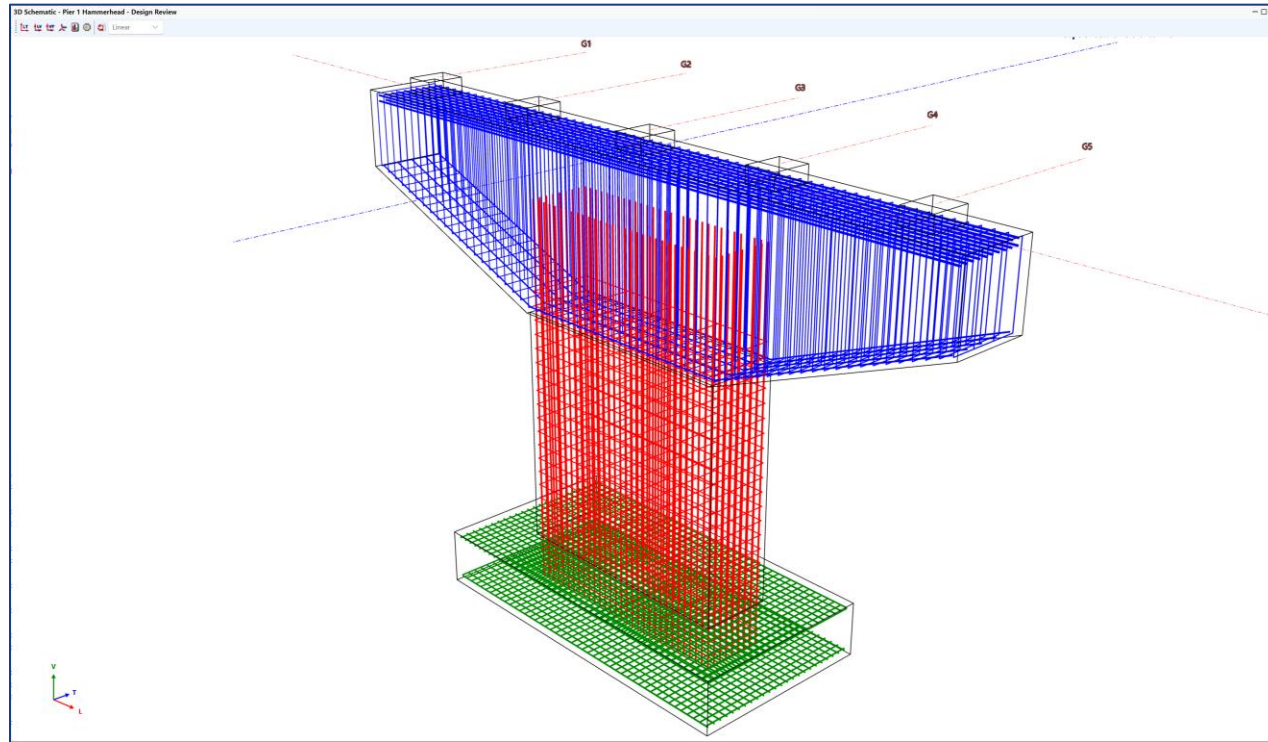
Range	Shear reinforcement definition	Measure from	Direction	Spacing type	Start distance (ft)	Number of spaces	Spacing (in)	Length (ft)	End distance (ft)
1	Column 1 Tie Definition	Bottom of column	Up	Actual	0.250	4	6.0000	2.000	2.250
2	Column 1 Tie Definition	Bottom of column	Up	Maximum	2.250		18.0000	9.500	11.750
3	Column 1 Tie Definition	Bottom of column	Up	Actual	11.750	4	6.0000	2.000	13.750



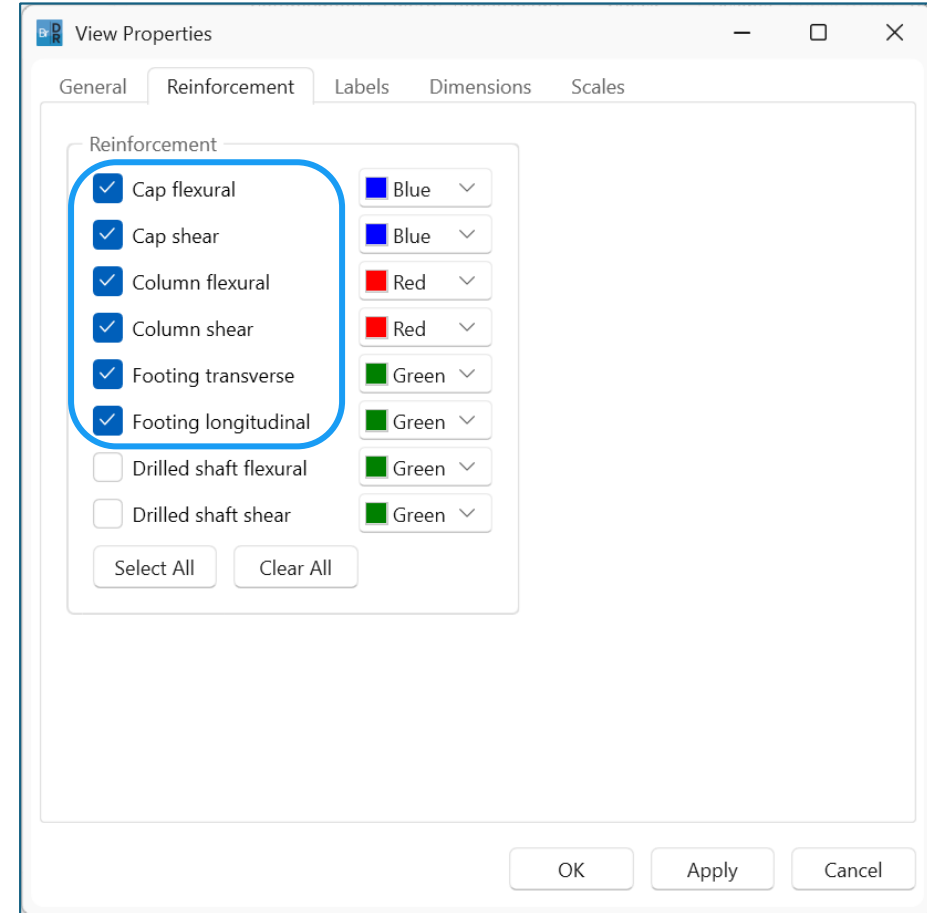
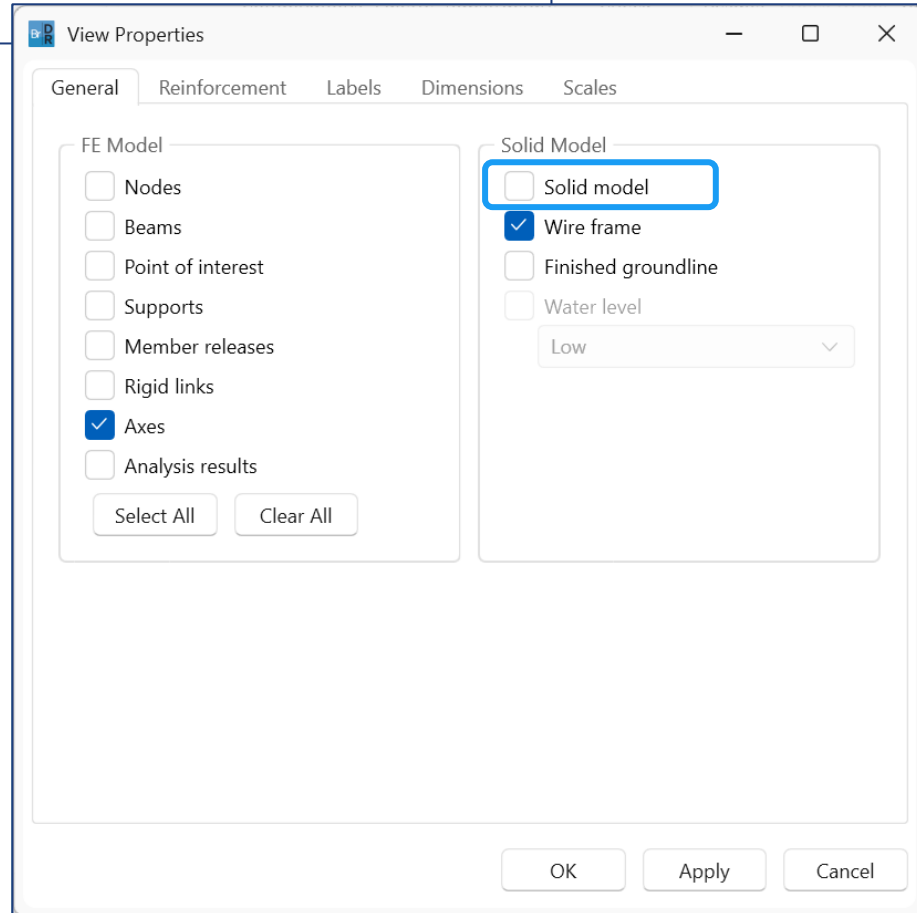
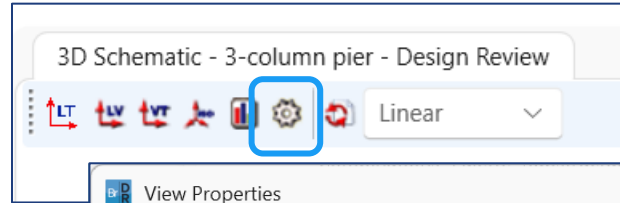
Reinforcement Schematic

- Pier 3D Schematic
- Schematic Settings

Reinforcement Schematic



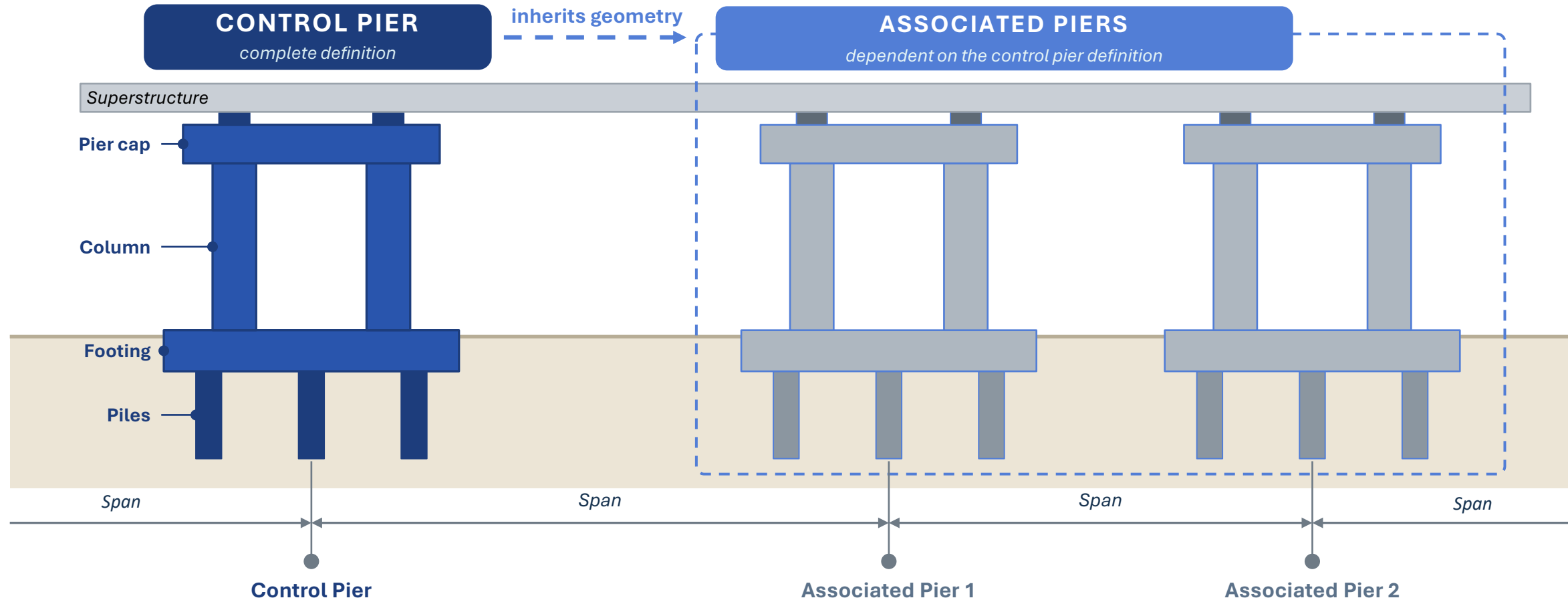
Reinforcement Schematic



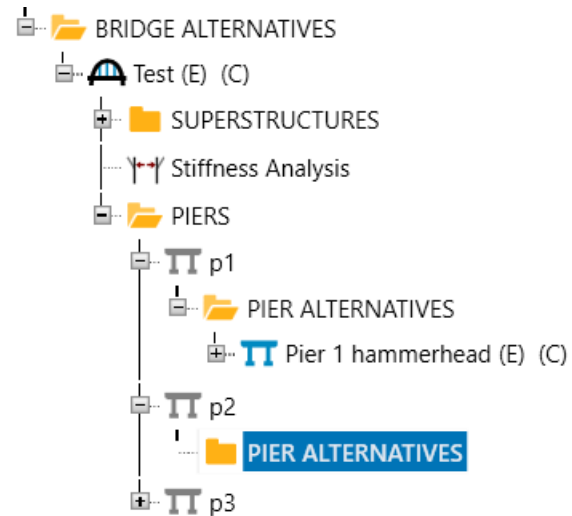
Pier Association

- Association concept
- Dependent data
- Reinforcement association

Pier Association



Pier Association



Pier Alternative - p2 - Pier 2 (assoc Pier 1 hammerhead)

Name: Pier 2 Type: RC SolidShaft Pier

Associate with: p1 - Pier 1 hammerhead

Description Specs Factors Control options Stiffness LRFD reports

Description:

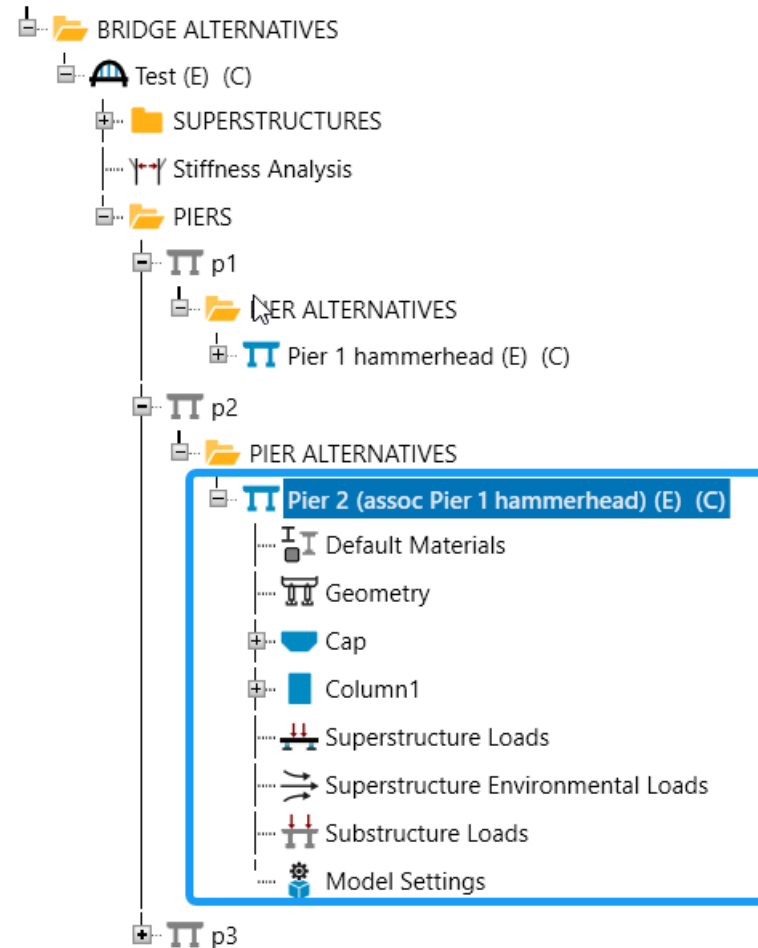
Units: US Customary

Default rating method: LRFR

LRFD substructure design settings

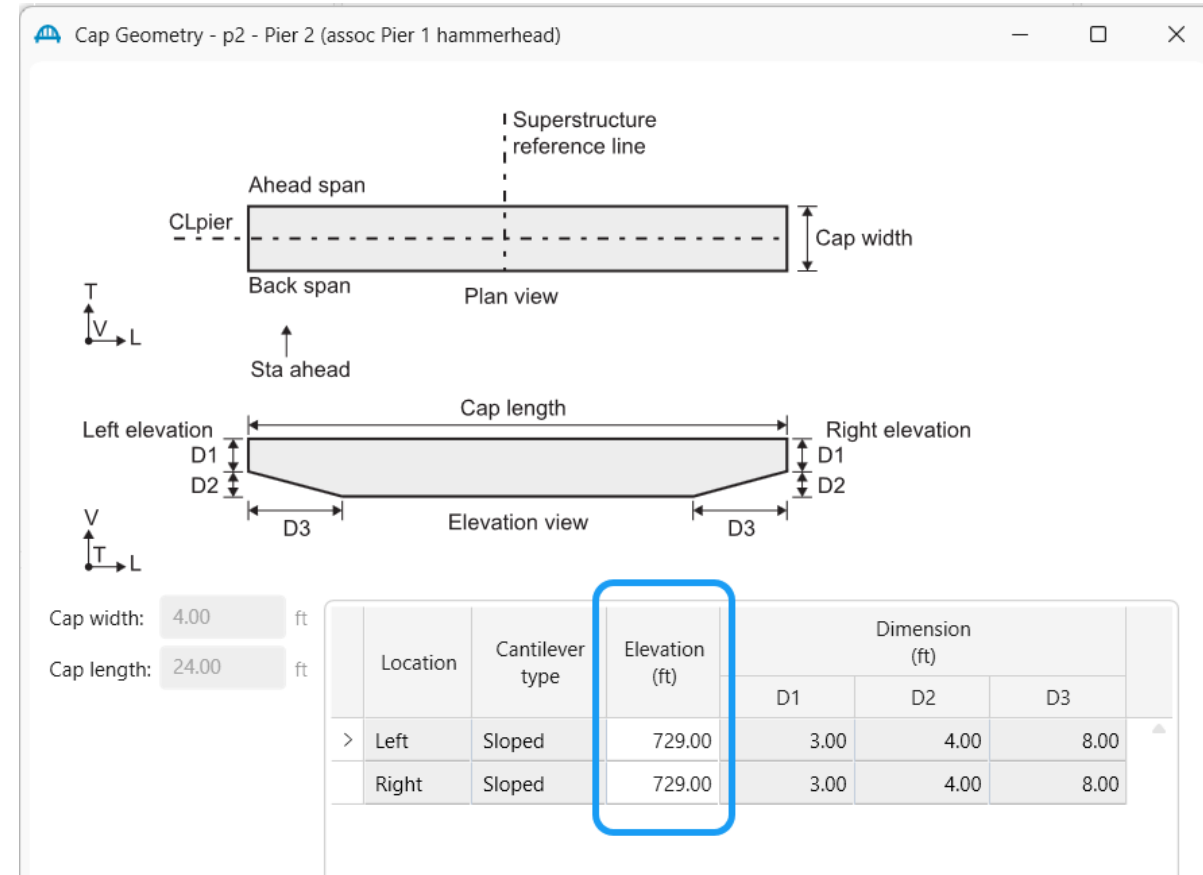
Preliminary mode

Pier Association



Pier Association

- If a change is made to the gross geometry/reinforcement in the control pier, the change is reflected in the dependent pier
- Only elevation data can be modified in the dependent pier
- Loads are not associated



Pier Association

- Un-associate reinforcement in the dependent pier to modify it

Cap Reinforcement - p2 - Pier 2 (assoc Pier 1 hammerhead)

Pier cap length: 24 ft

Flexural Left cantilever shear Right cantilever shear

☒ Associate reinforcement with associated pier

Longitudinal skin

Bar size: 4 Bar spacing: 8 in Bar material: Grade 60 Stirrup clear cover: 2 in

Primary flexural

Reinforcement input method
☒ Simplified ☐ Advanced ☒ Reinforcement follows cap profile Full length bar edge distance: ft

	Set	Measure from cap	Clear cover (in)	Bar size	Number	Material	Measure from	Start distance (ft)	Straight length (ft)	End distance (ft)	Hook at start	Hook at end	Developed at start	Developed at end	Head at start	Head at end
	1	Top	3	10	10	Grade 60	Full length	0	24	24	☐	☐	☐	☐	☐	☐
>	2	Bottom	3	10	10	Grade 60	Full length	0	24	24	☐	☐	☐	☐	☐	☐

New Duplicate Delete

OK Apply Cancel

Control Options

v7.8 introduces the *Control options* tab to the pier alternative window.

Pier Alternative - Pier 2 - 3-column pier

Name: 3-column pier Type: RC Frame Pier

Associate with: -- None --

Description Specs Factors **Control options** Stiffness LRFD reports

LRFD

Points of interest

- ☒ Generate at tenth points except supports
- ☐ Generate at support points
- ☒ Generate at support face & critical shear points
- ☐ Generate at section change points
- ☒ Generate at user-defined points
- ☒ Generate at beam reaction points

Shear computation method

☐ Ignore

☒ General procedure

☐ General procedure - Appendix B5

☐ Simplified procedure

☐ Consider inclined flexural forces

☐ Allow negative epsilon in general shear method

LRFR

Points of interest

- ☒ Generate at tenth points except supports
- ☐ Generate at support points
- ☒ Generate at support face & critical shear points
- ☐ Generate at section change points
- ☒ Generate at user-defined points
- ☒ Generate at beam reaction points

Shear computation method

☐ Ignore

☒ General procedure

☐ General procedure - Appendix B5

☐ Simplified procedure

☐ Ignore design & legal load shear

☐ Ignore permit load shear

☐ Ignore tension in long. reinf. due to shear

☐ Consider permit load tensile steel stress

☐ Consider inclined flexural forces

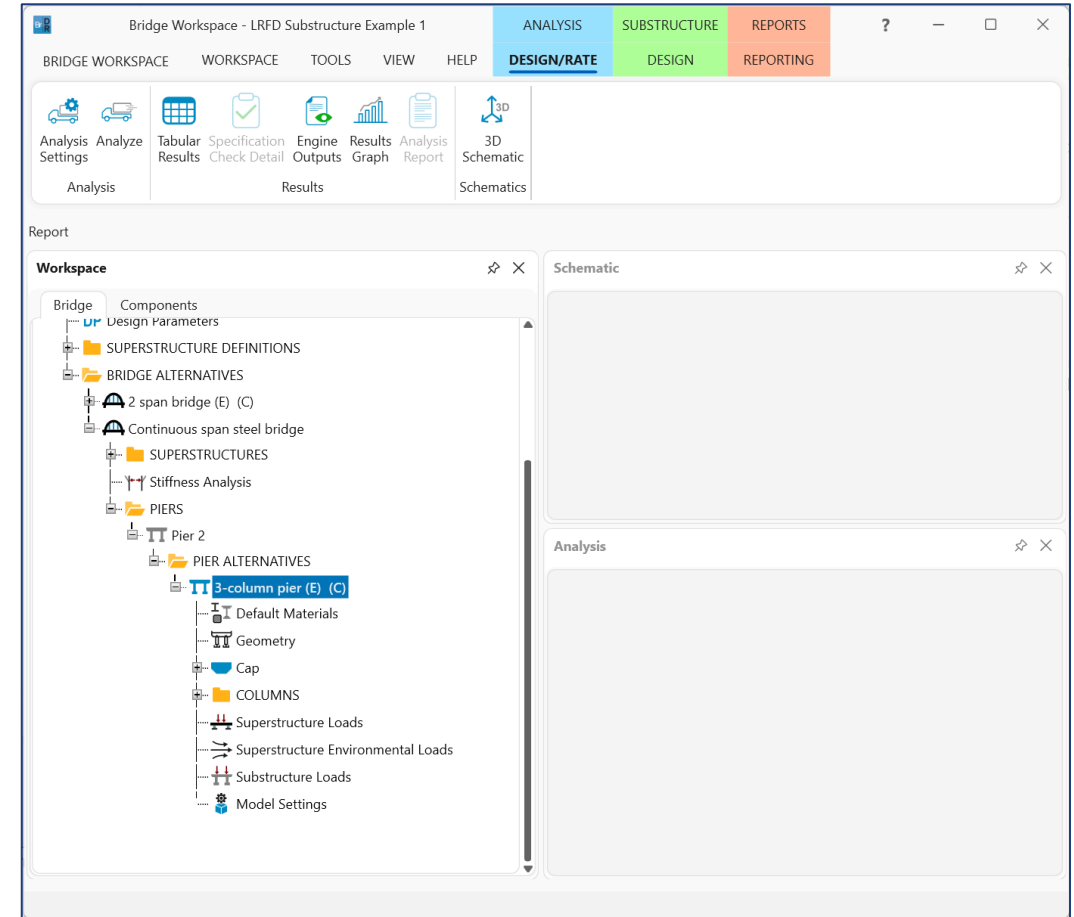
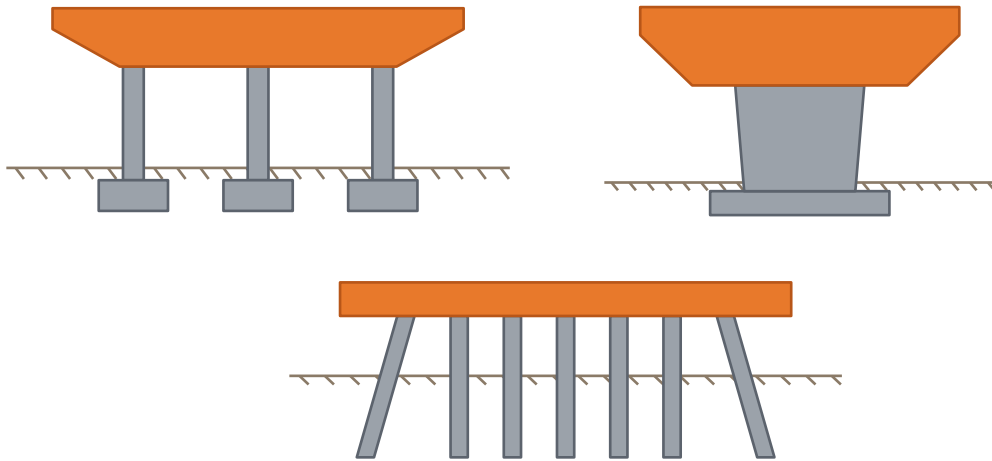
☐ Allow negative epsilon in general shear method

OK Apply Cancel

Analysis: Load Rating

ANALYSIS: DESIGN/RATE

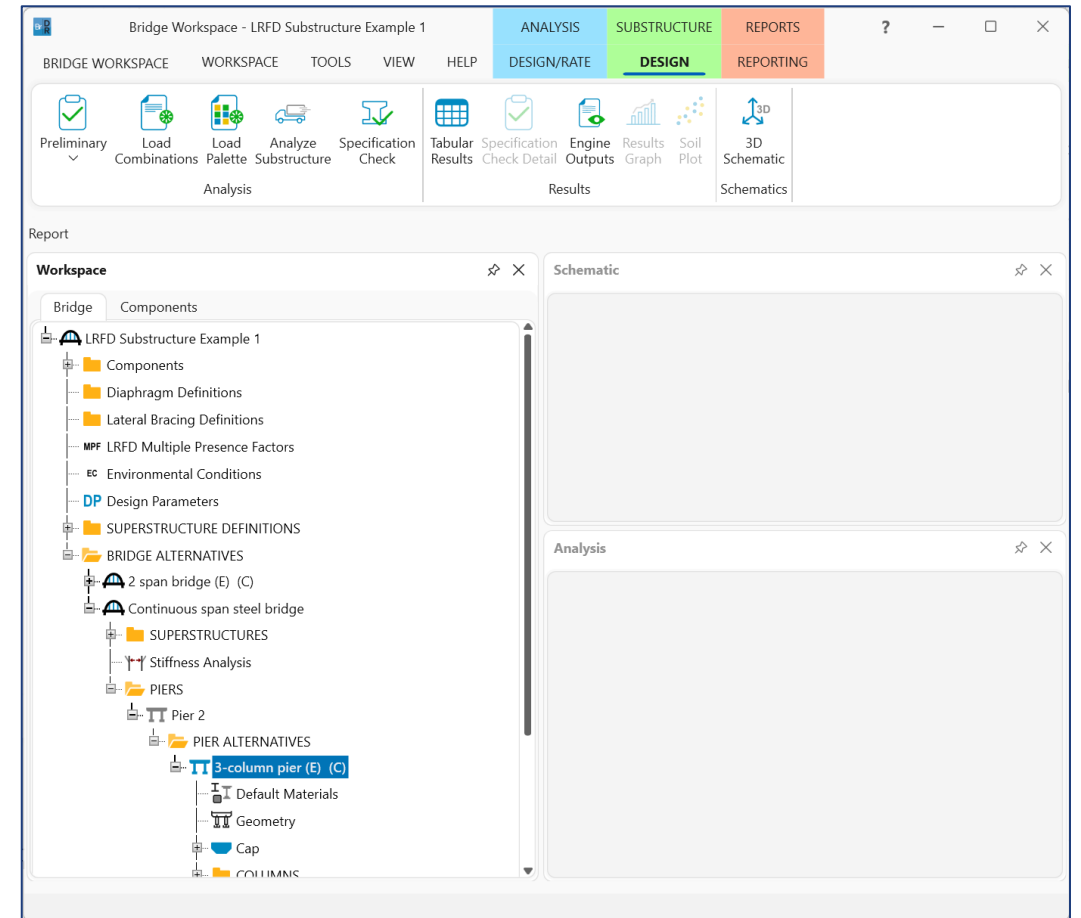
Define analysis settings, vehicles, and substructure loading options in the *Analysis Settings* window.



Analysis: Design Review

SUBSTRUCTURE: **DESIGN**

Define limit states and vehicles in the substructure design settings.





Thank you!

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