AASHTOWare Bridge Rating/Design Training

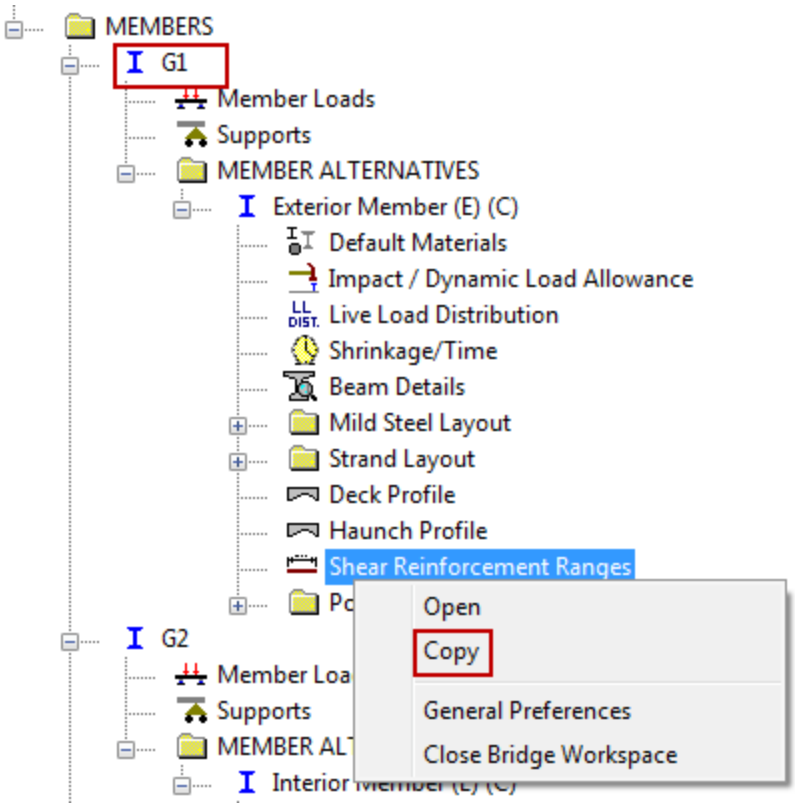
2015 User Requested Enhancements (BrDR 6.7)

Topics Covered

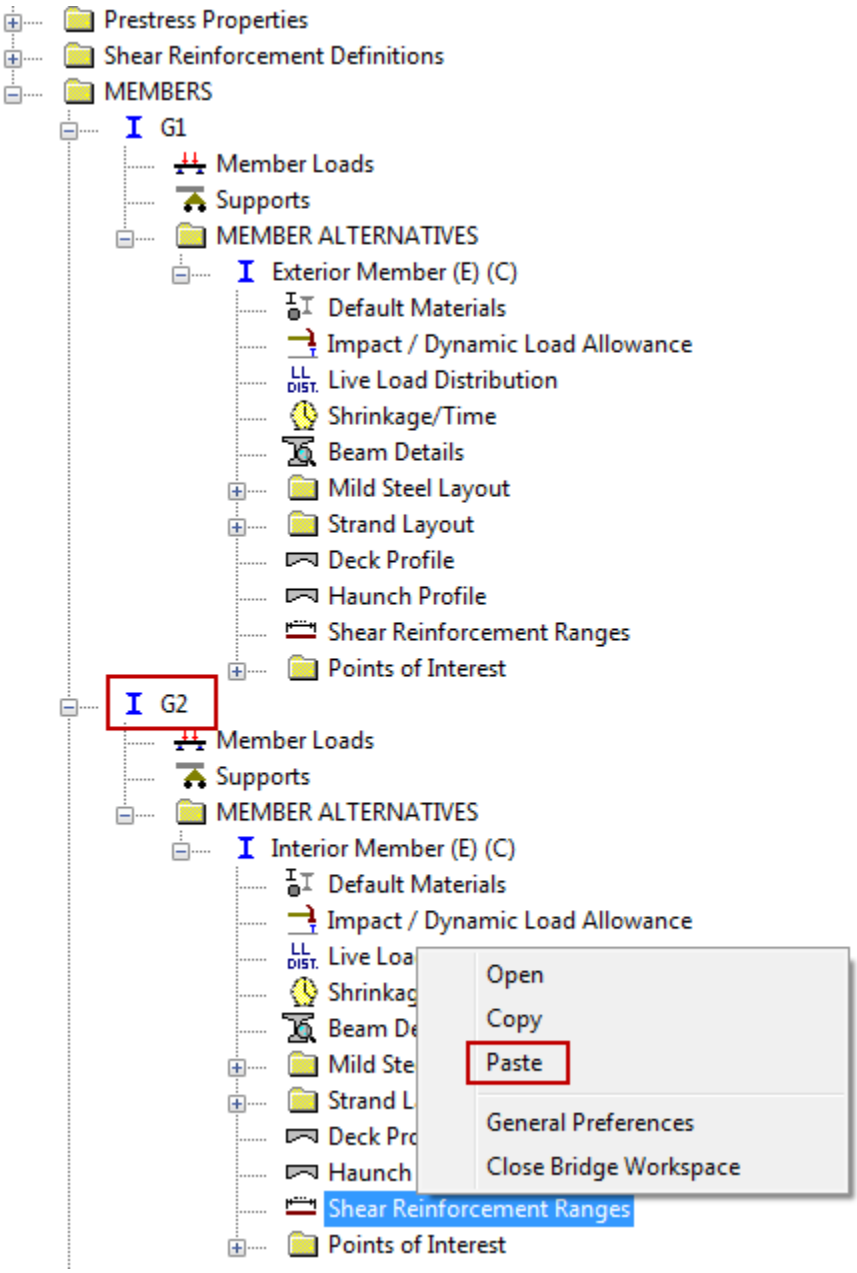
- Copy and paste shear reinforcement ranges
- Control option to consider sloped portion of bent longitudinal reinforcement in bending and shear capacities
- Option to perform 3D FEM analysis for dead load and/or live load only
- Revise culvert LFD LL distribution computation
- Control option to consider development length of deck reinforcements
- Option to specify dead load distribution by percentage
- Computation of live load distribution factors and effective flange widths for girder system superstructure with varying girder spacing
- Allow negative Epsilon (net longitudinal tensile steel strain) in General Procedure shear computation method
- Report dead load actions for both left and right sides of an analysis point
- Review of how to use General Preferences to apply new control options

Copy and paste shear reinforcement ranges

Copy "Shear Reinforcement Ranges" for girder G1 member alternative with a right-click as shown below:

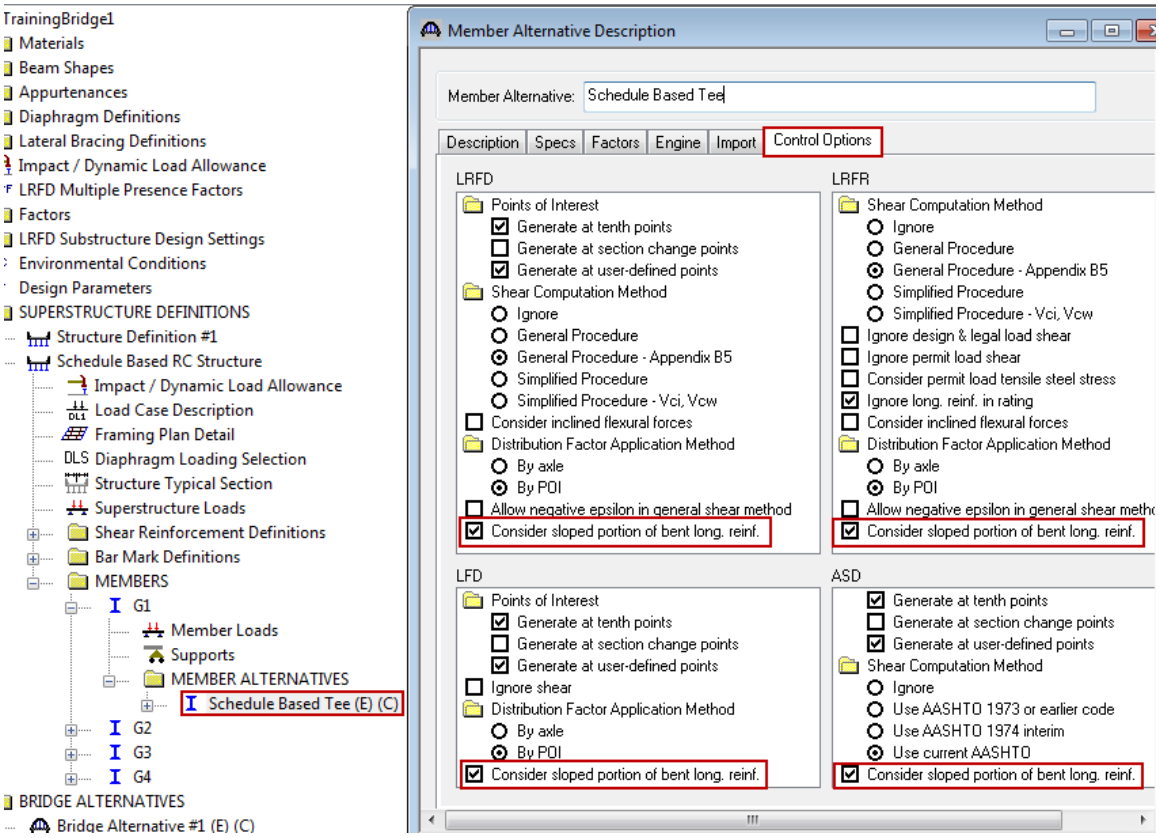


Paste "Shear Reinforcement Ranges" for PS girder G1 member alternative on G2 member alternative with a right-click as shown below:



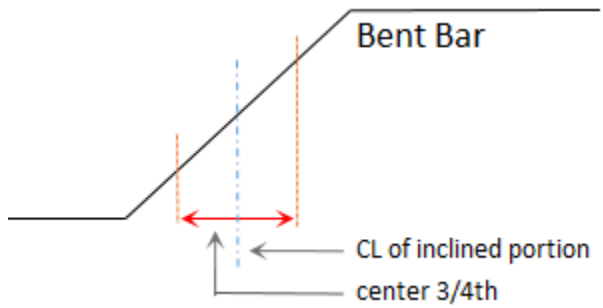
Control option to consider sloped portion of bent longitudinal reinforcement in bending and shear capacities

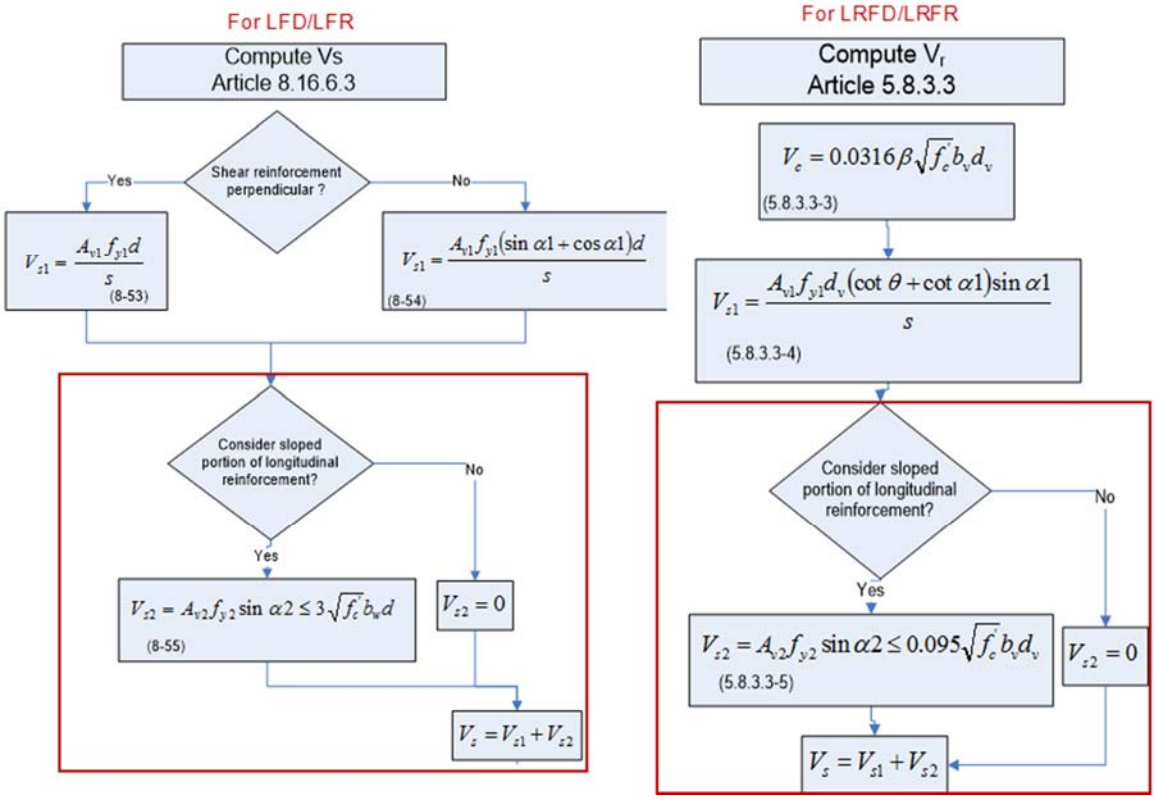
For scheduled based RC member alternative, navigate to member alternative->Control Options and check “Consider sloped portion of bent long. reinf.” for LRFD/LRFR/LFD/ASD as shown below:



Influence of sloped portion of bent longitudinal reinforcement for flexure capacity can be determined by exporting cross section area of the sloped portion of the rebar for analysis.

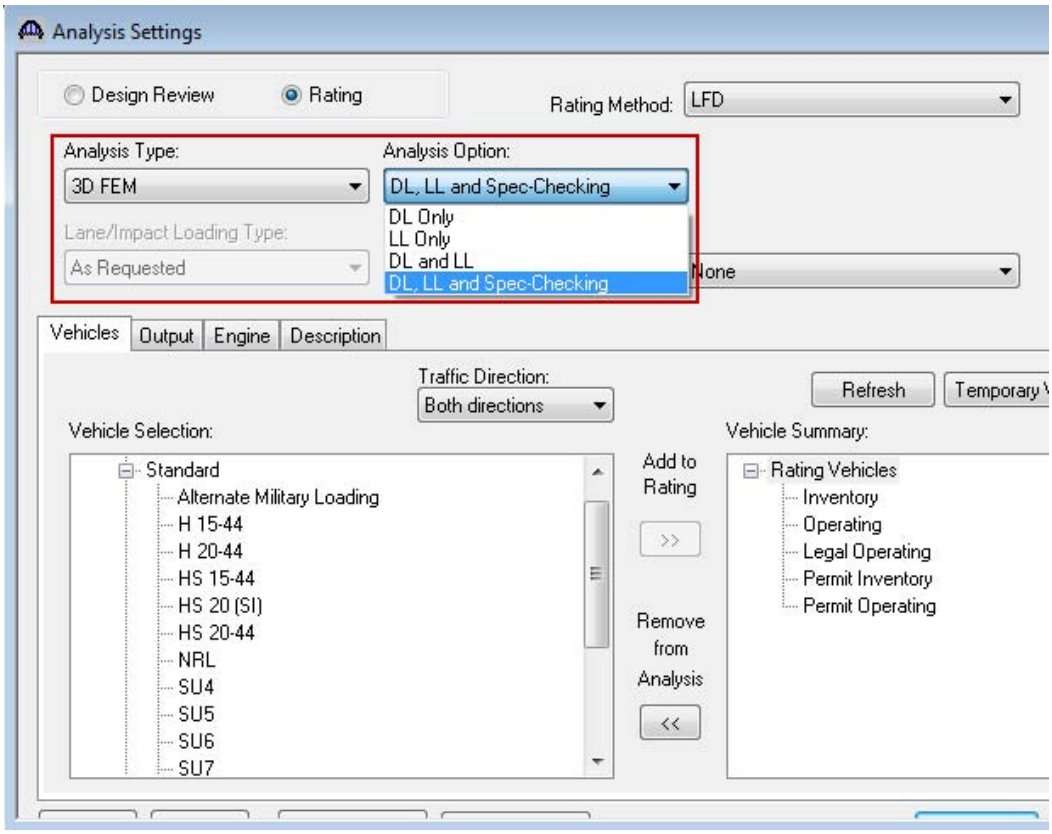
Influence of center 3/4th of the inclined portion (diagram shown below) of bent longitudinal reinforcement for shear capacity for LRFD/LRFR and LFD/LFR are highlighted below:





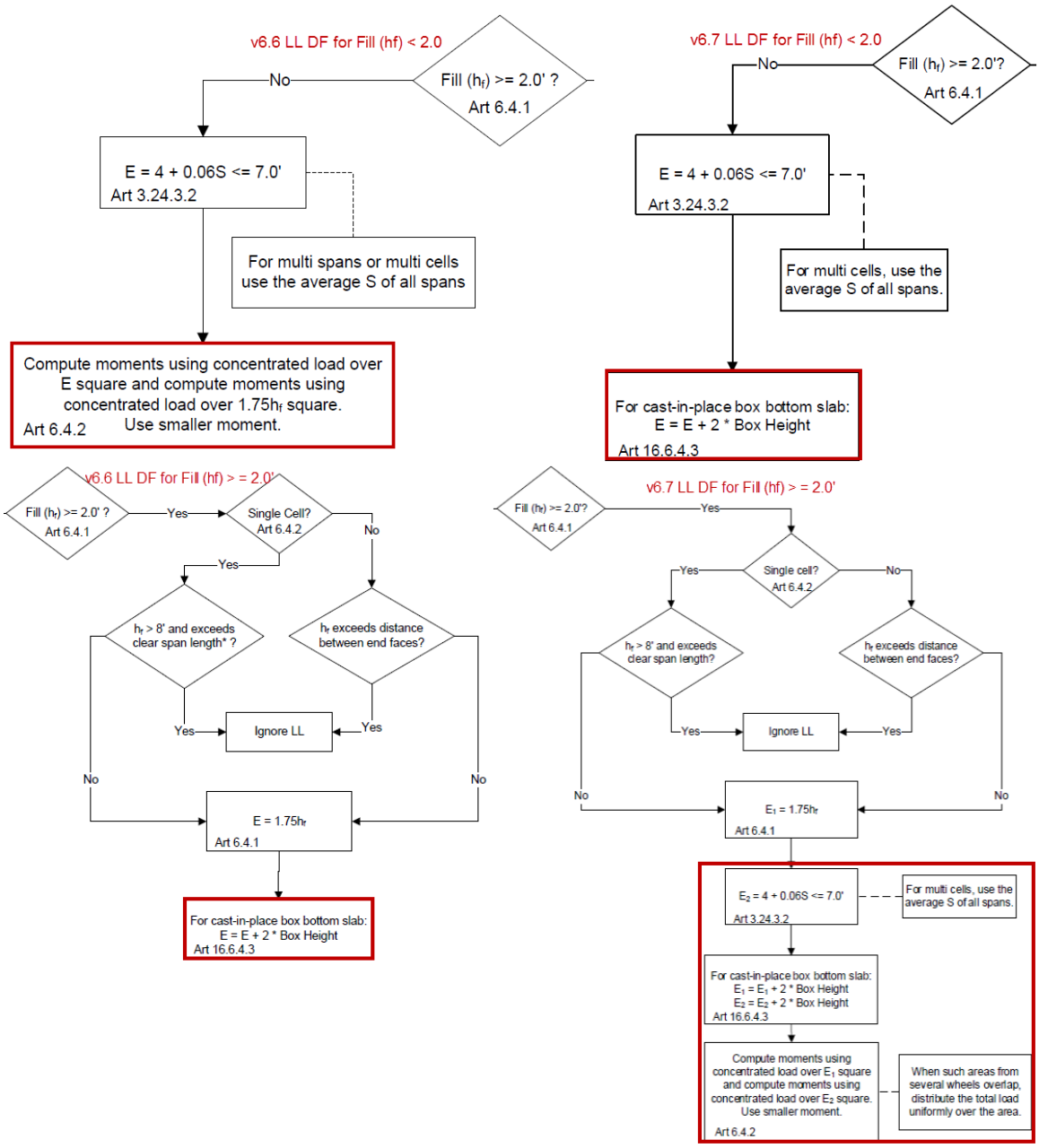
Option to perform 3D FEM analysis for dead load and/or live load only

Open Analysis Settings window by clicking on View analysis settings and change Analysis Type to "3D FEM" or "3D FEM-Vehicle Path". The following Analysis Options will be available as shown below:



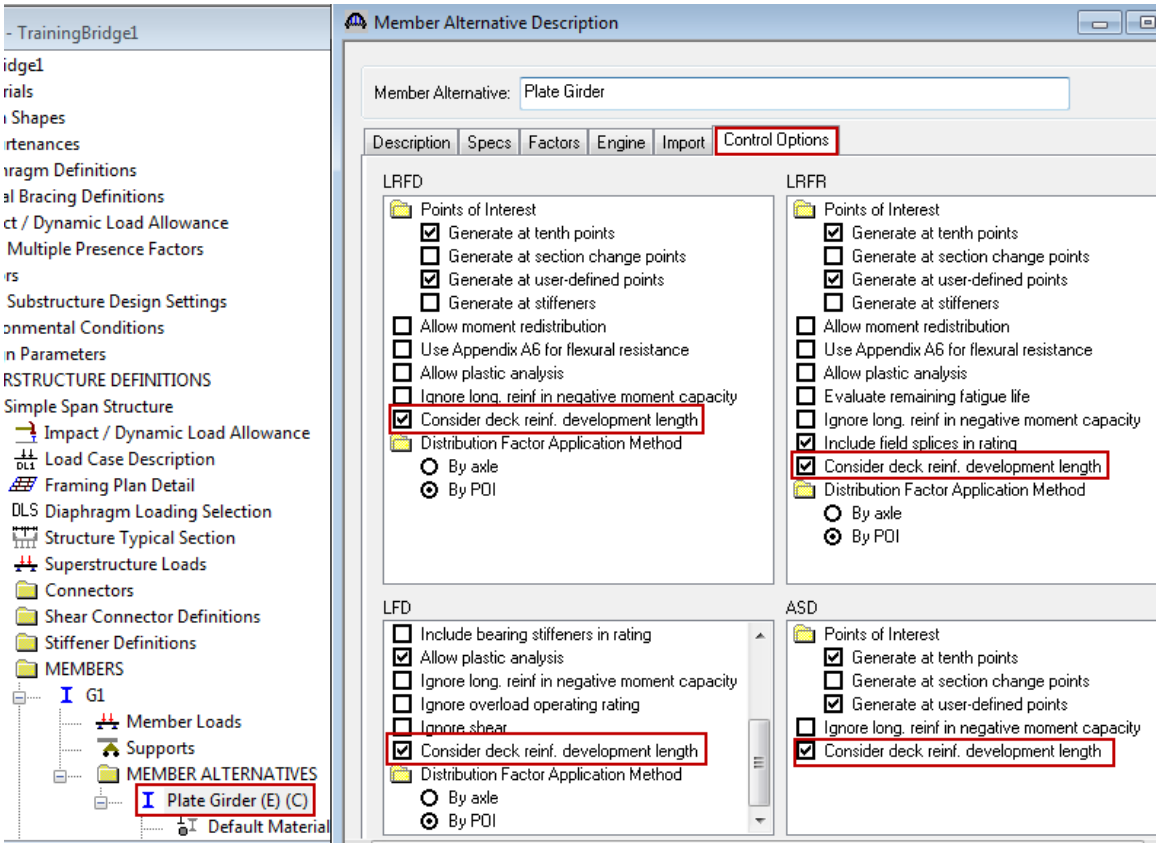
Revise culvert LFD LL distribution computation

Distribution factor computations were revised for both fill depth >= 2.0’ and fill depth < 2.0’. The changes in BrDR 6.7 with respect to earlier version of BrDR 6.6 are highlighted below:

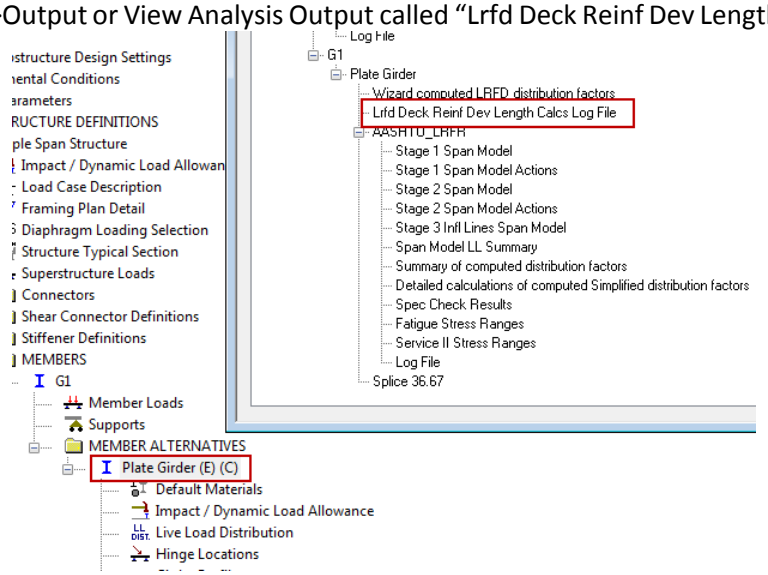


Control option to consider development length of deck reinforcements

For scheduled based member/member alternative with a Deck Profile, navigate to Control Options and check ”Consider deck reinf. development length” under LRFD/LRFR/LFD/ASD as shown below:



Following snippet shows development length calculations for LRFD in an output file available in Menu->Bridge->Output or View Analysis Output called “Lrfd Deck Reinf Dev Length Calcs Log File”.



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Spec: AASHTO LRFD Bridge Design Specifications
Edition: Seventh
Year: 2014

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Reinf. Set #: 1                 Bar Mark Def:                   Bar Start Distance: 10.000   ft

INPUT:
Distance:    10.000 ft          Reinf. Set #: N/A               Bar Mark Def: DeckReinforcement
Bar Size: 3                     Bar Dia:   0.375 in             Bar Area:   0.11 in^2
Bar Clr Cover:   1.813 in       Bar Clr Spacing:  59.438 in     Bar Side Cover:
Bar C/C Spacing: 59.813 in      Bar Fy:   60,000 psi            Epoxy: TRUE
Hooked Bar: FALSE               Hook At End of Mbr: FALSE       Stirrup Spacing: Not applicable
Concrete f'c: 4,500 psi         Concrete Composition: Normal    Top Bar: FALSE
Consider Fully Developed Start Ind: FALSE
Consider Fully Developed End Ind: FALSE

OUTPUT:
Article 5.11.2.1.1:     Basic Dev. Length = 9.00 in
Article 5.11.2.1.2      Epoxy reinf. factor: 1.2
Article 5.11.2.1.1:     Dev. length shall not be less than 12 inches
Article 5.11.2:         Computed Dev. Length = 12.00 in

Bar     developed at:   11.000  ft

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Reinf. Set #: 1                 Bar Mark Def:                   Bar End Distance:       160.000  ft

INPUT:
Distance:   160.000 ft          Reinf. Set #: N/A               Bar Mark Def: DeckReinforcement
Bar Size: 3                     Bar Dia:   0.375 in             Bar Area:   0.11 in^2
Bar Clr Cover:   1.813 in       Bar Clr Spacing:  59.438 in     Bar Side Cover:
Bar C/C Spacing: 59.813 in      Bar Fy:   60,000 psi            Epoxy: TRUE
Hooked Bar: FALSE               Hook At End of Mbr: FALSE       Stirrup Spacing: Not applicable
Concrete f'c: 4,500 psi         Concrete Composition: Normal    Top Bar: FALSE
Consider Fully Developed Start Ind: FALSE
Consider Fully Developed End Ind: FALSE

OUTPUT:
Article 5.11.2.1.1:     Basic Dev. Length = 9.00 in
Article 5.11.2.1.2      Epoxy reinf. factor: 1.2
Article 5.11.2.1.1:     Dev. length shall not be less than 12 inches
Article 5.11.2:         Computed Dev. Length = 12.00 in

Bar     developed at:  159.000  ft
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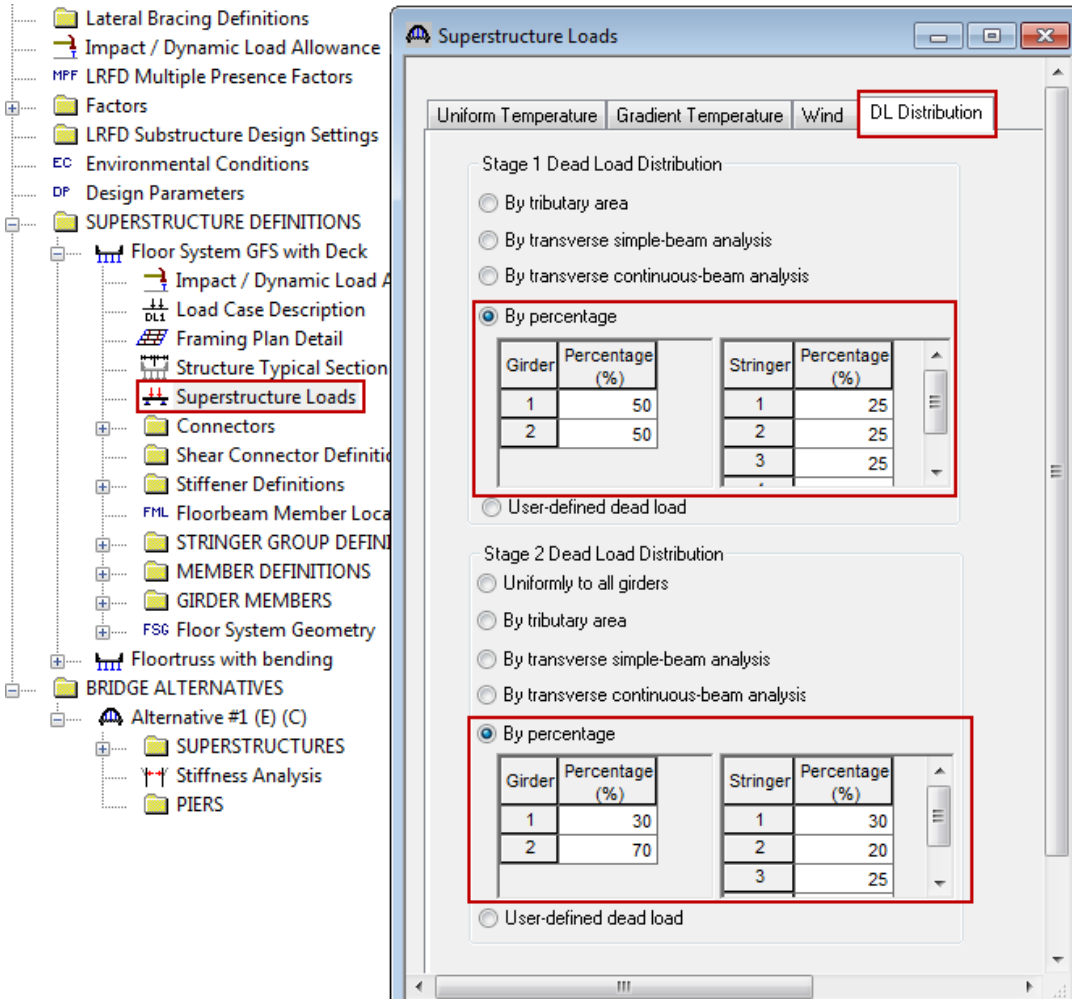
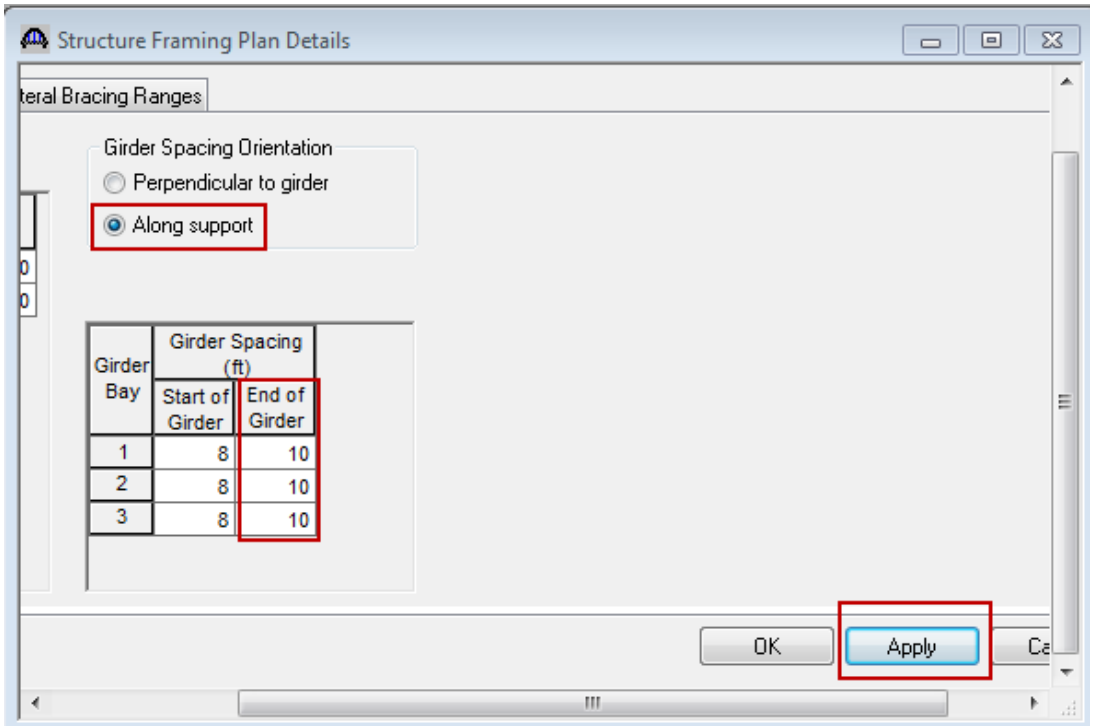
Option to specify dead load distribution by percentage

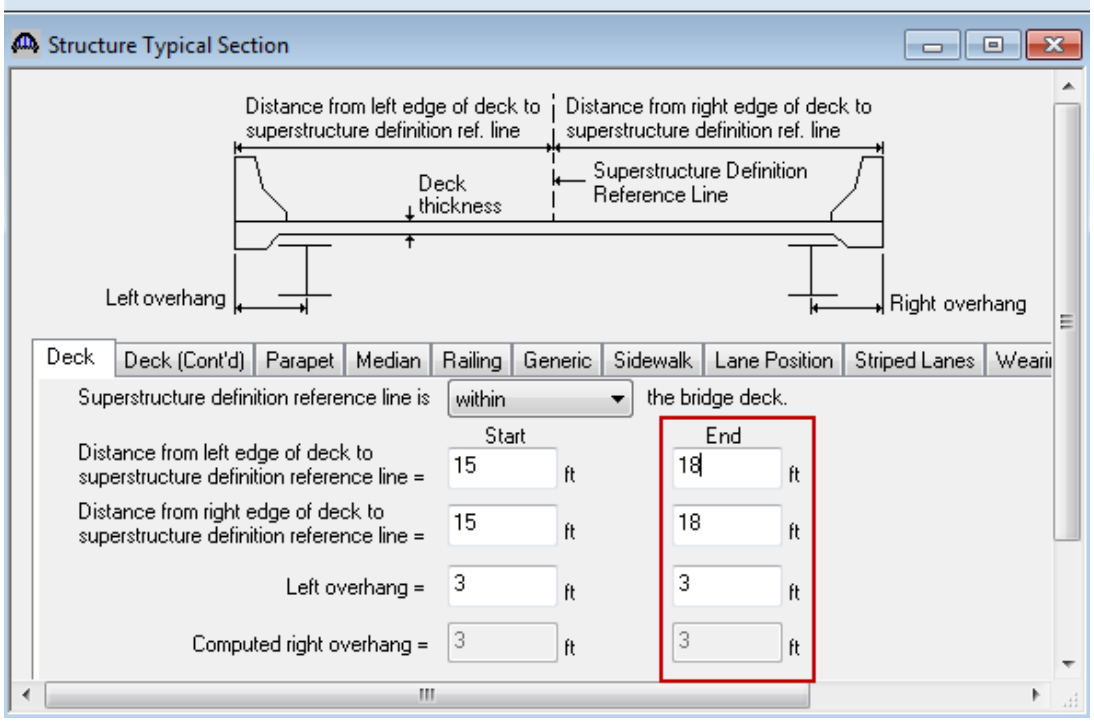
Open Superstructure Loads window->DL Distribution tab and set “Stage 1 Dead Load Distribution” and “Stage 2 Dead Load Distribution” to “By percentage”. Enter the percentage distribution for each girder/stringer/floorbeam/truss in the grid provided as shown below:



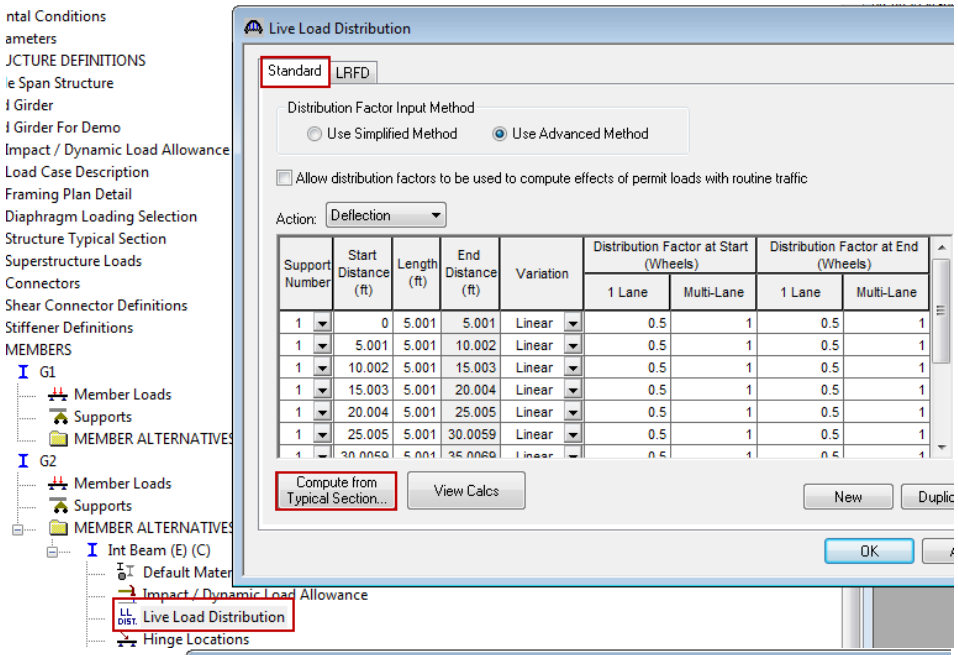
Computation of live load distribution factors and effective flange widths for girder system superstructure with varying girder spacing

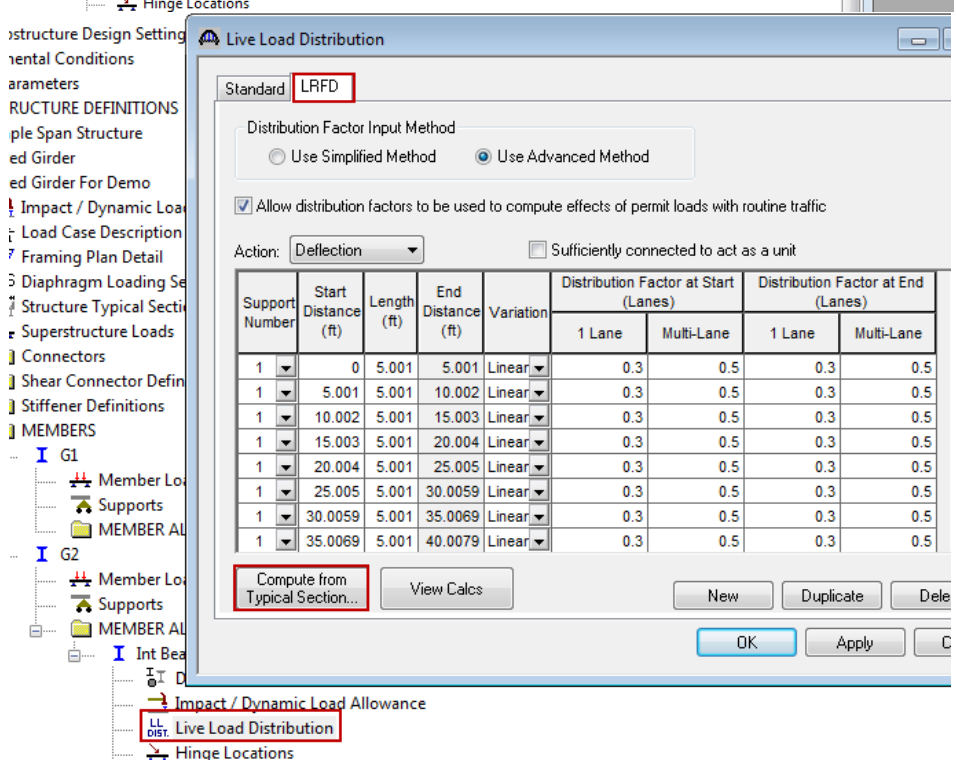
Varying girder spacing can be defined in Framing Plan Detail window and then change the relative location of the superstructure definition reference line in Structure Typical Section->Deck tab as shown below:



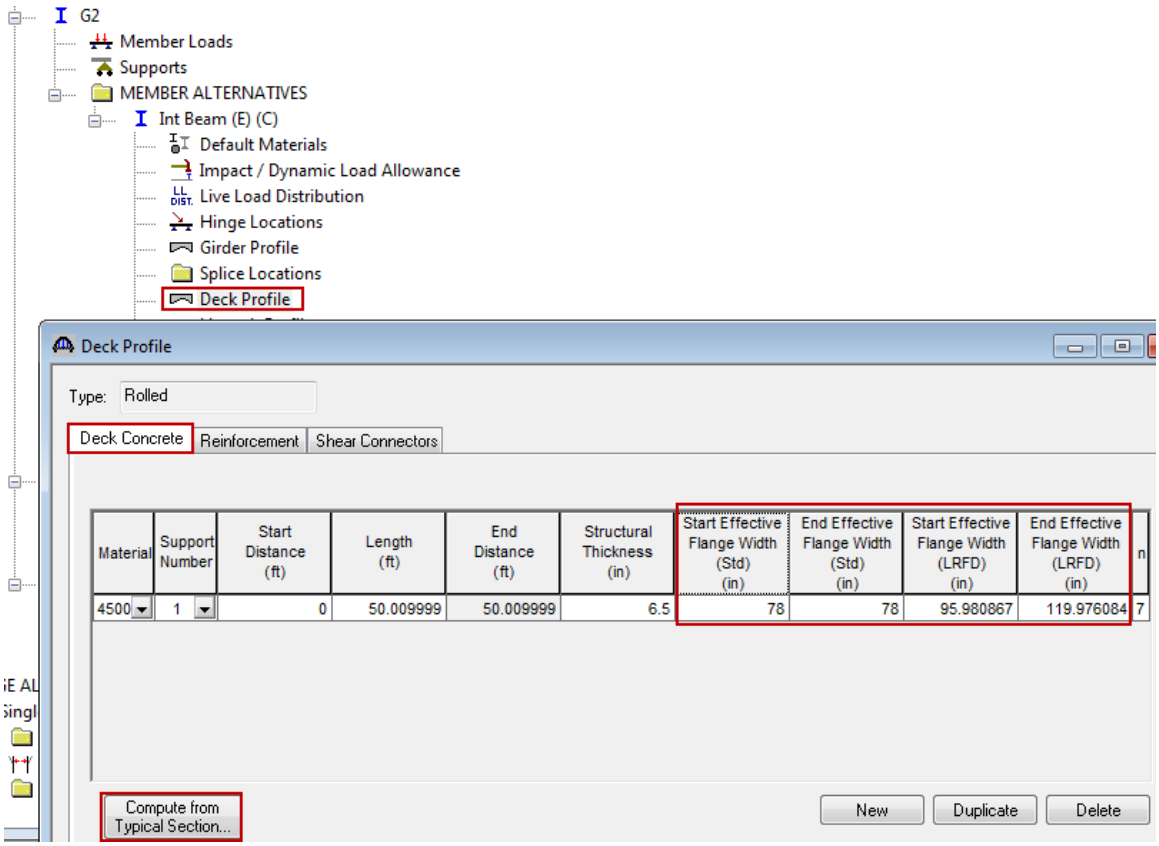


LL Distribution factors can be computed for Standard and LRFD specifications as shown below:



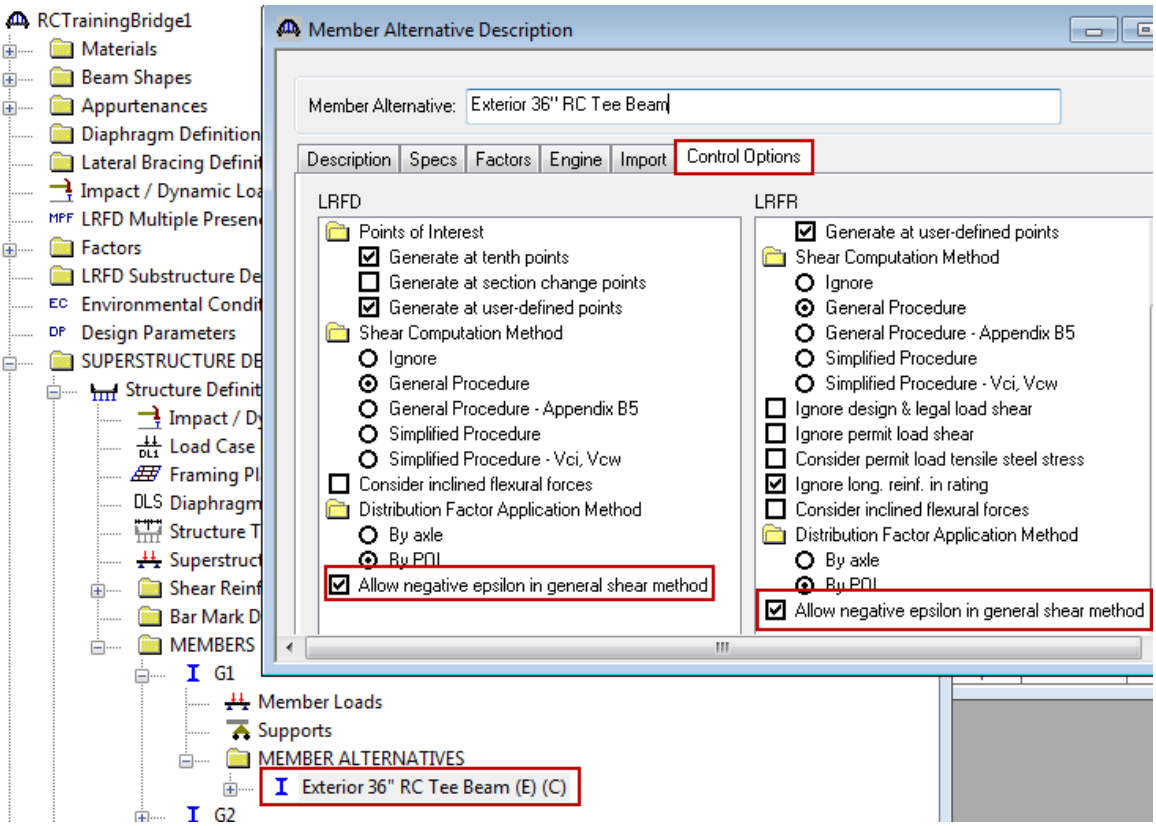


Effective flange width for Standard and LRFD specifications for flared girder can be computed as shown below:



Allow negative Epsilon (net longitudinal tensile steel strain) in General Procedure shear computation method

For PS or RC girder member alternative, the above control option for LRFD and LRFR can be accessed through Member Alternative->Control Options->"Allow negative epsilon in general shear method" as shown below:



Epsilon is computed based on the following equation and specification, shown below:

$$\varepsilon_s = \frac{\left(\frac{|M_u|}{d_v} + 0.5N_u + |V_u - V_p| - A_{ps}f_{po}\right)}{E_sA_s + E_pA_{ps}} \qquad (5.8.3.4.2\text{-}4)$$

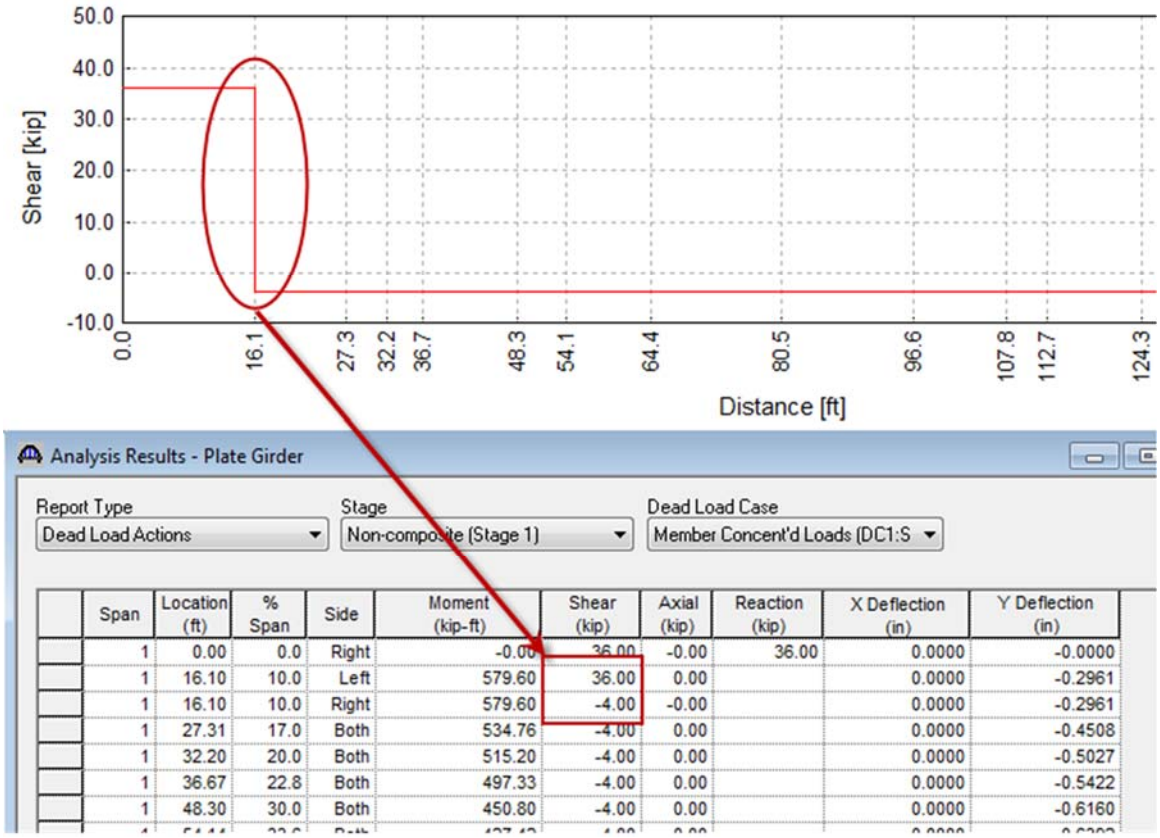
If the value of ε_s calculated from Eq. 5.8.3.4.2-4 is negative, it should be taken as zero or the value should be recalculated with the denominator of Eq. 5.8.3.4.2-4 replaced by $(E_sA_s + E_pA_{ps} + E_cA_{ct})$. However, ε_s should not be taken as less than -0.40×10^{-3}.

When the "Allow negative epsilon in general shear method" is not selected, epsilon is taken as zero if it is computed as a negative value. When this control option is selected and epsilon is computed as a negative value, then epsilon is recalculated with the replaced denominator shown above and restricted to not less than the limit shown.

Report dead load actions for both left and right sides of an analysis point

Run an analysis through Bridge Workspace on a member alternative and open View Analysis Report or Menu Bridge->Tabular Report and select Report Type as “Dead Load Actions”. As shown below, if any of the reported actions are different between left and right of a point of interest, the point is reported for “Left” and “Right” of that point. If the actions on either side for all reported actions are same, then it is reported as “Both”.

The example below shows a shear force diagram for 161’ simple span bridge with concentrated load at 16.1’. The tabular results shows the difference in shear value between left and right of 16.1’.



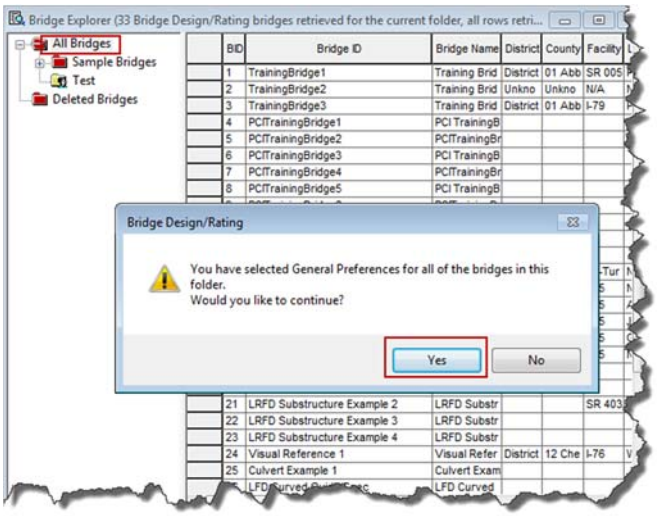
Span	Location (ft)	% Span	Side	Moment (kip-ft)	Shear (kip)	Axial (kip)	Reaction (kip)	X Deflection (in)	Y Deflection (in)
1	0.00	0.0	Right	-0.00	36.00	-0.00	36.00	0.0000	-0.0000
1	16.10	10.0	Left	579.60	36.00	0.00		0.0000	-0.2961
1	16.10	10.0	Right	579.60	-4.00	-0.00		0.0000	-0.2961
1	27.31	17.0	Both	534.76	-4.00	0.00		0.0000	-0.4508
1	32.20	20.0	Both	515.20	-4.00	0.00		0.0000	-0.5027
1	36.67	22.8	Both	497.33	-4.00	0.00		0.0000	-0.5422
1	48.30	30.0	Both	450.80	-4.00	0.00		0.0000	-0.6160

Review of using General Preferences to edit control options for a group of bridges

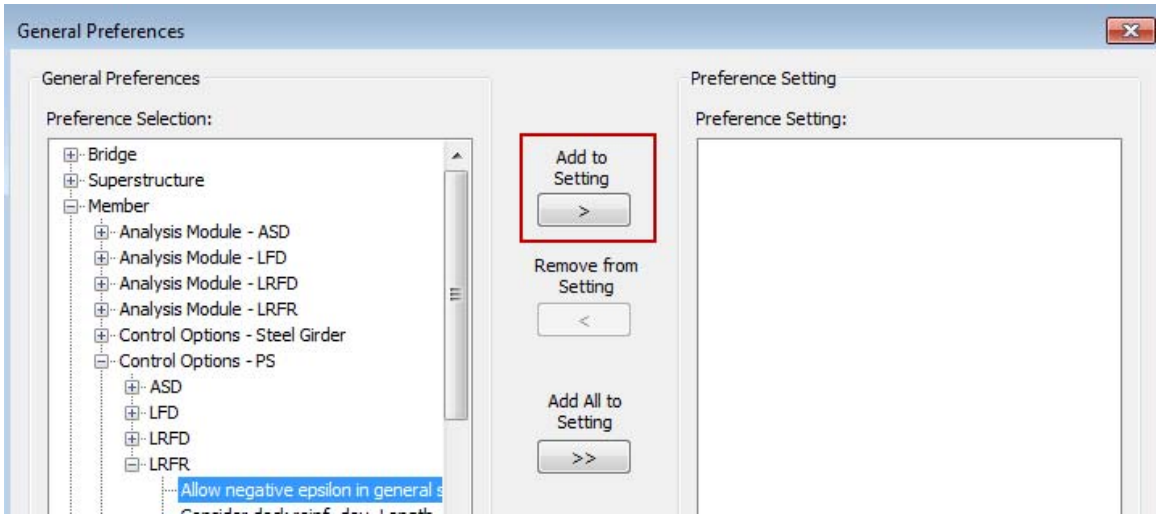
General Preferences are not new to BrDR 6.7. This is just a review of using this feature to apply control options to a group of bridges.

On Bridge Explorer, click on All Bridges folder and open Menu Bridge->General Preferences or click on General Preferences icon as shown below:

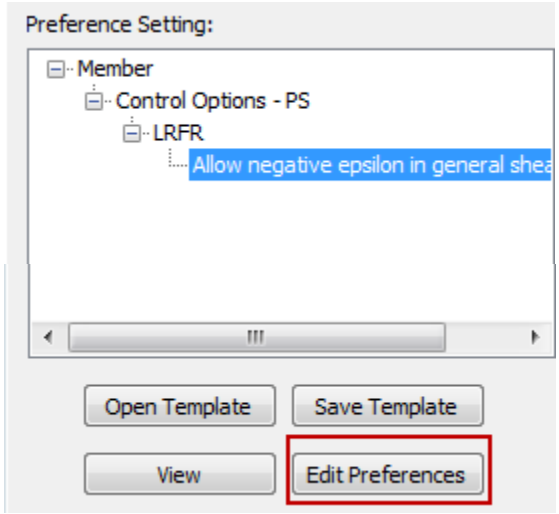
The following message will pop-up, click "Yes"



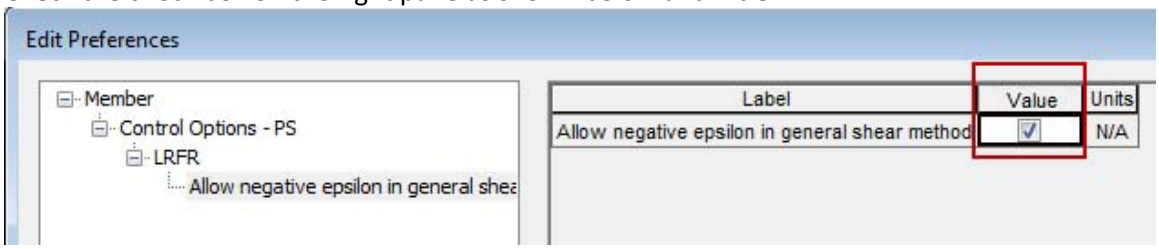
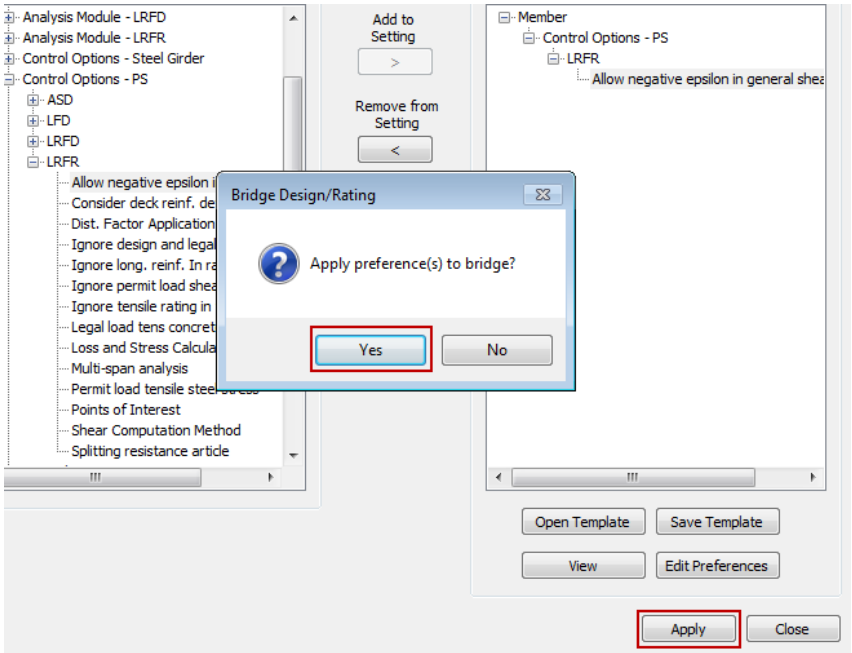
To consider "Allow negative epsilon in general shear method" for all members in the above highlighted bridges, navigate to Preference Selection: Member->Control Options-PS->LRFR and click on "Allow negative epsilon in general shear method" and click Add to Setting as shown below:



Select “Allow negative epsilon in general shear method” under Preference Setting and select “Edit Preference”.



Check the check box on the right pane as shown below and hit Ok.



Click Apply on the General Preference window, which will ask Apply preference(s) to bridge? Click “Yes”.