AASHTOWare BrD 6.8

Prestress Tutorial

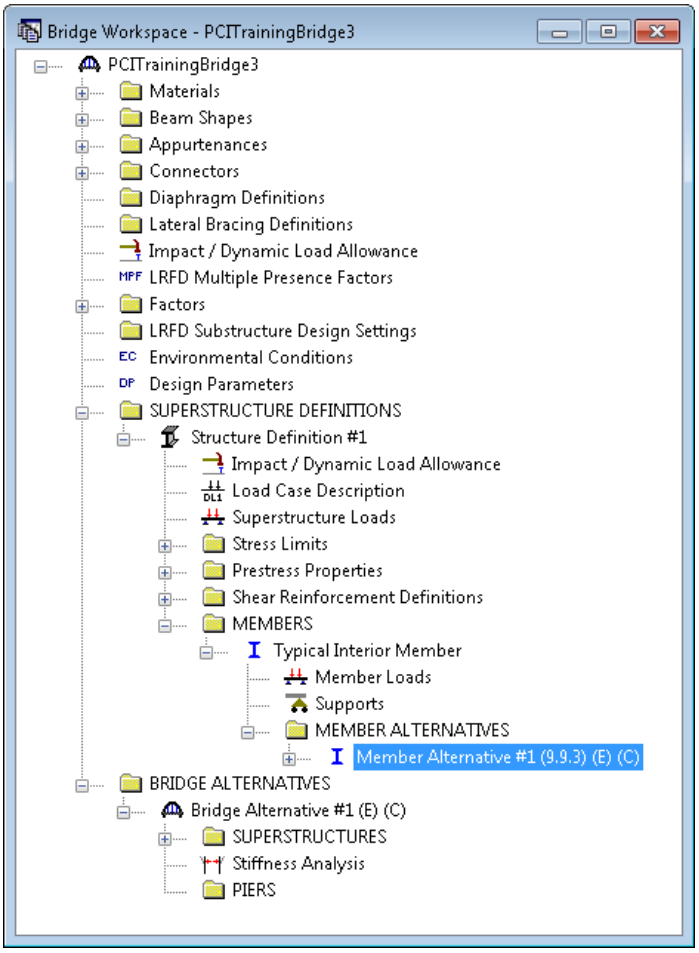
Cut Strand for P/S Beam Example

Topics Covered

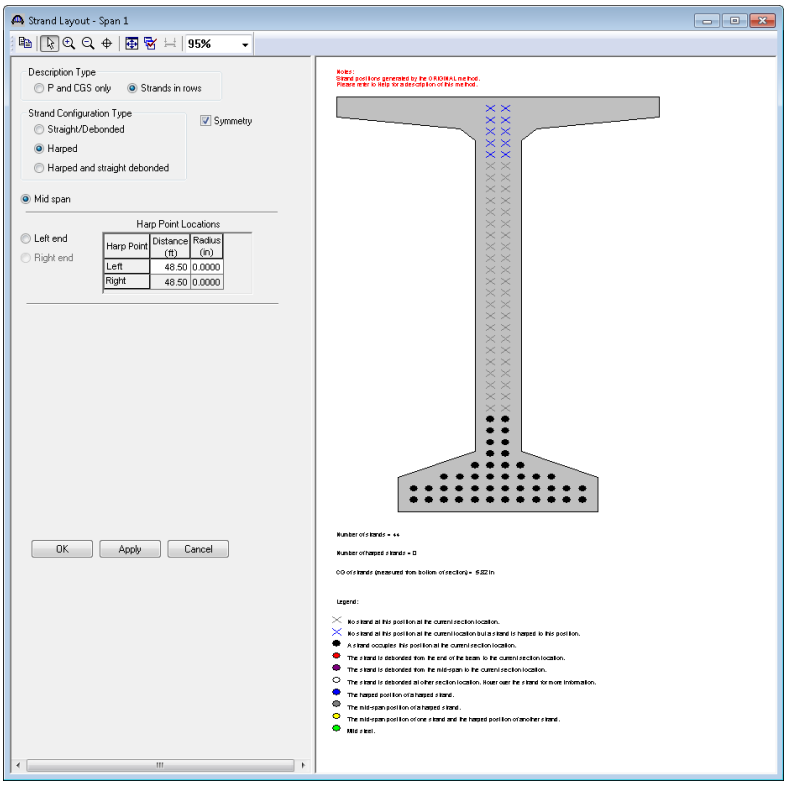
- Definition of a strand layout with top strands that are debonded and cut at the center of the beam to control stresses at release.
- LRFD design review of a prestressed concrete beam with the strand layout described above.

This example describes design review of a prestressed concrete beam with temporary PS strands using AASHTOWare BrD V680.

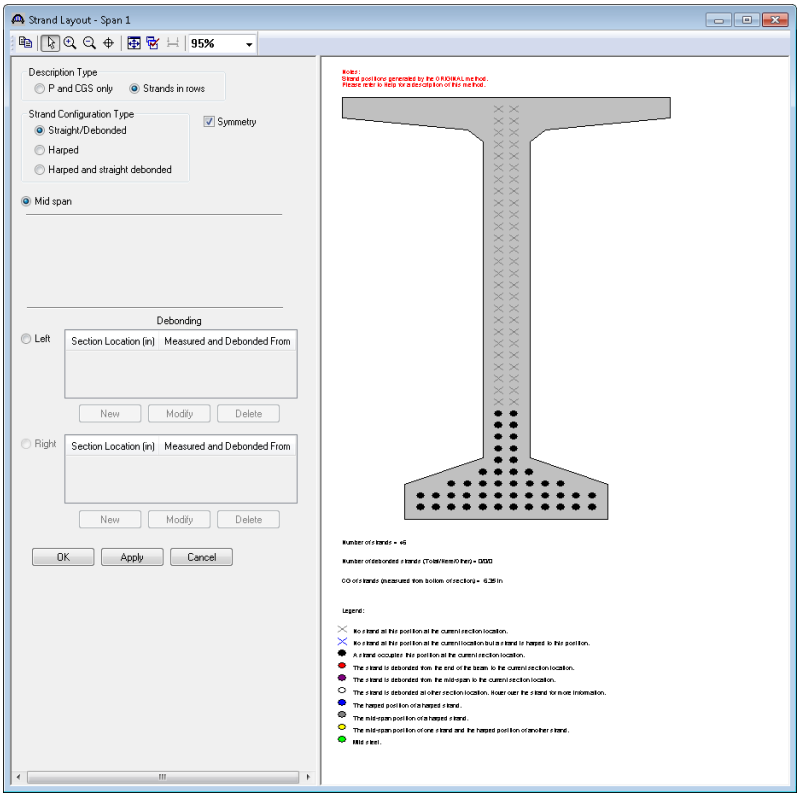
Open the bridge BID6 “PCITrainingBridge3” in the sample database. A partially expanded Bridge Workspace is shown below.



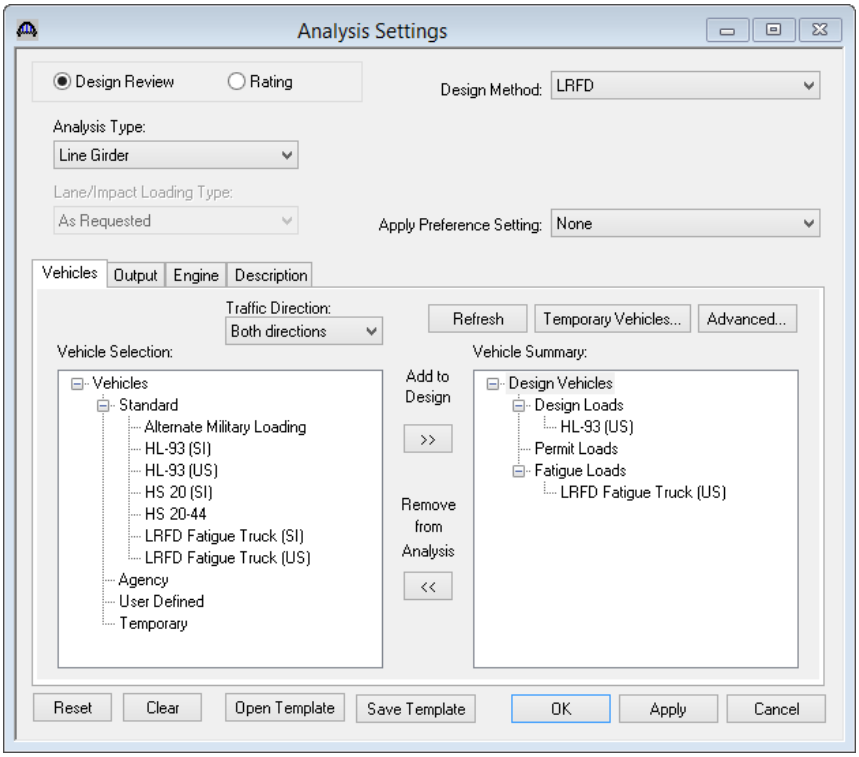
Expand the tree under the Member Alternative #1 (9.9.3), expand the tree under the Strand Layout, and open the Span 1 window. Place the cursor in the schematic view on the right side of the screen. The toolbar buttons in this window will become active. Select the Zoom button to shrink the schematic of the beam shape so that the entire beam is visible.



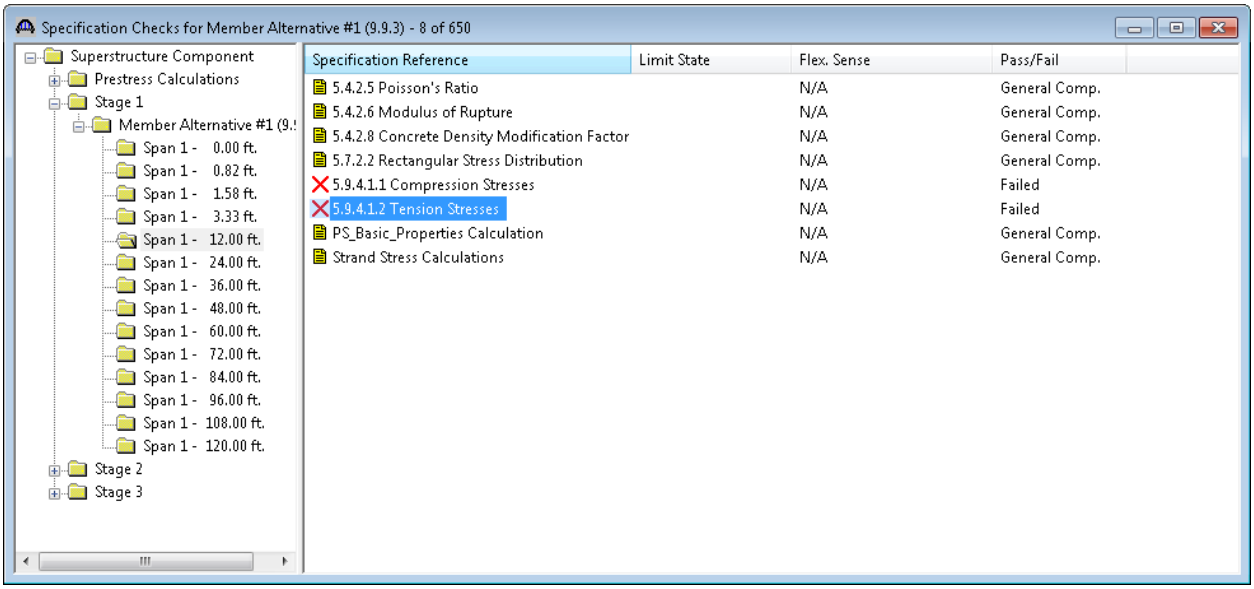
Adjust the strand pattern as follows to produce a strand pattern that results in too large top tensile stresses at release.



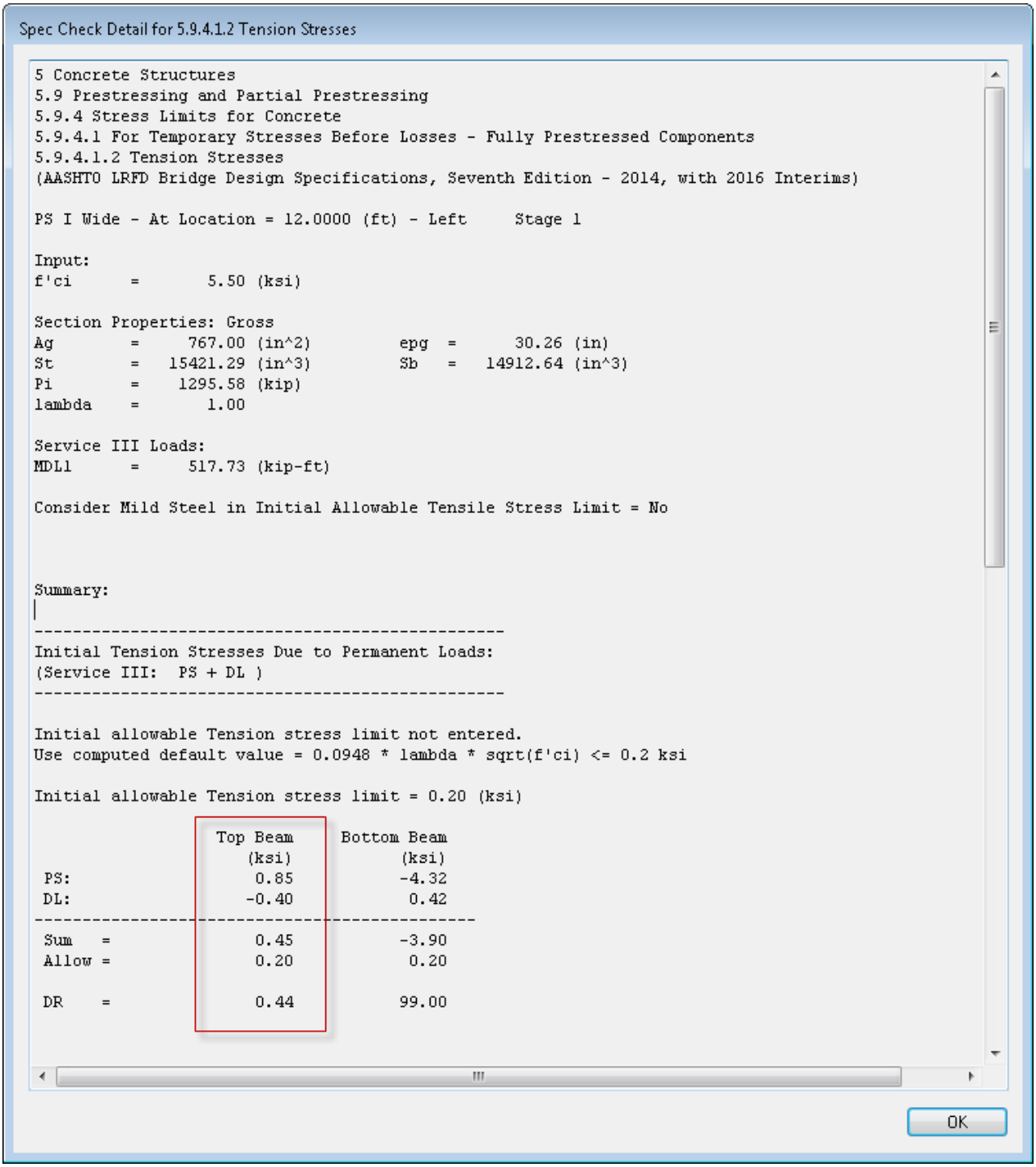
Open the Analysis Settings window and select the HL-93 Design Review template as shown below.



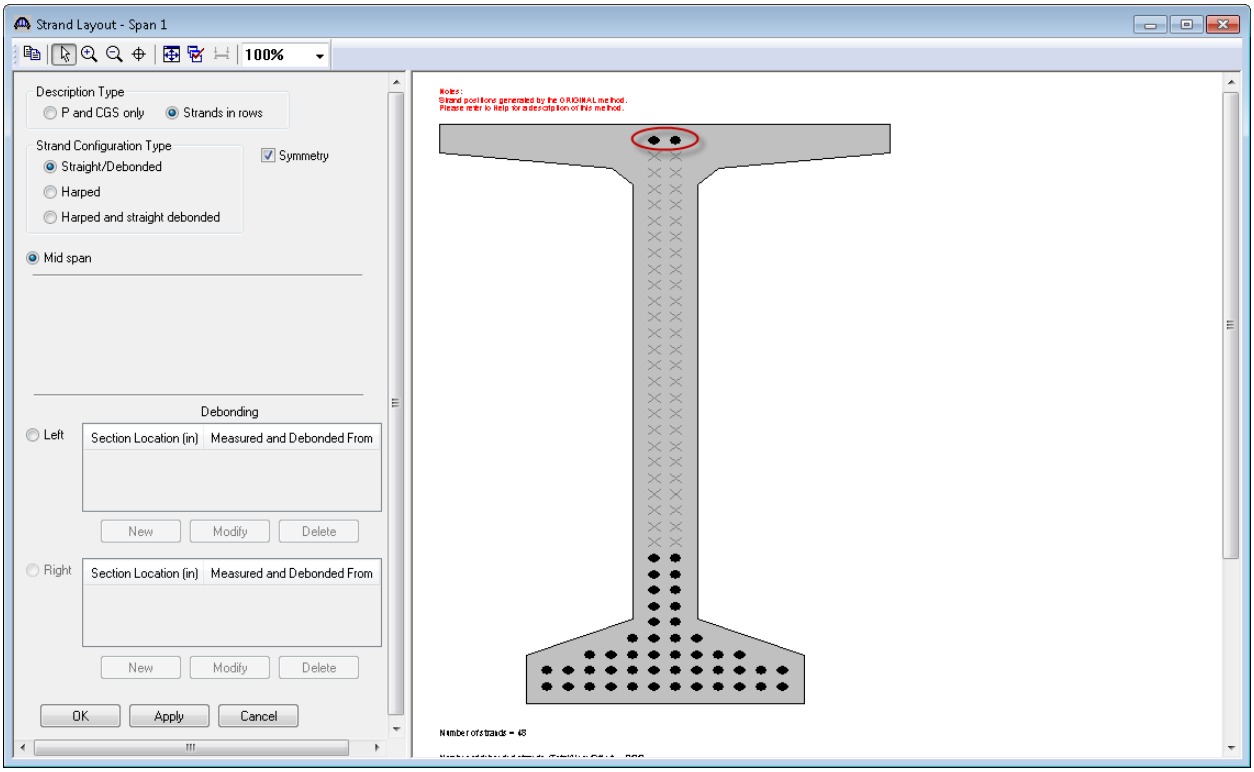
Run the LRFD design review on the Member Alternative #1 (9.9.3). View the specification checks by selecting the View Spec Check button,  , from the toolbar. Go to Superstructure Component → Stage 1 → Member Alternative #1 (9.9.3) → Span 1 – 12 ft.



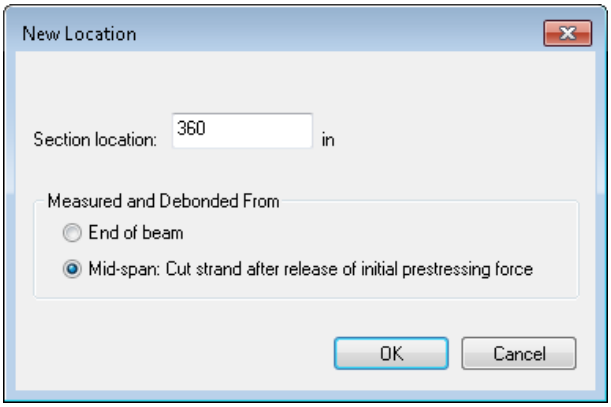
Open the 5.9.4.1.2 article details. The tension in the top of the beam at release shows a design ratio of 0.44:



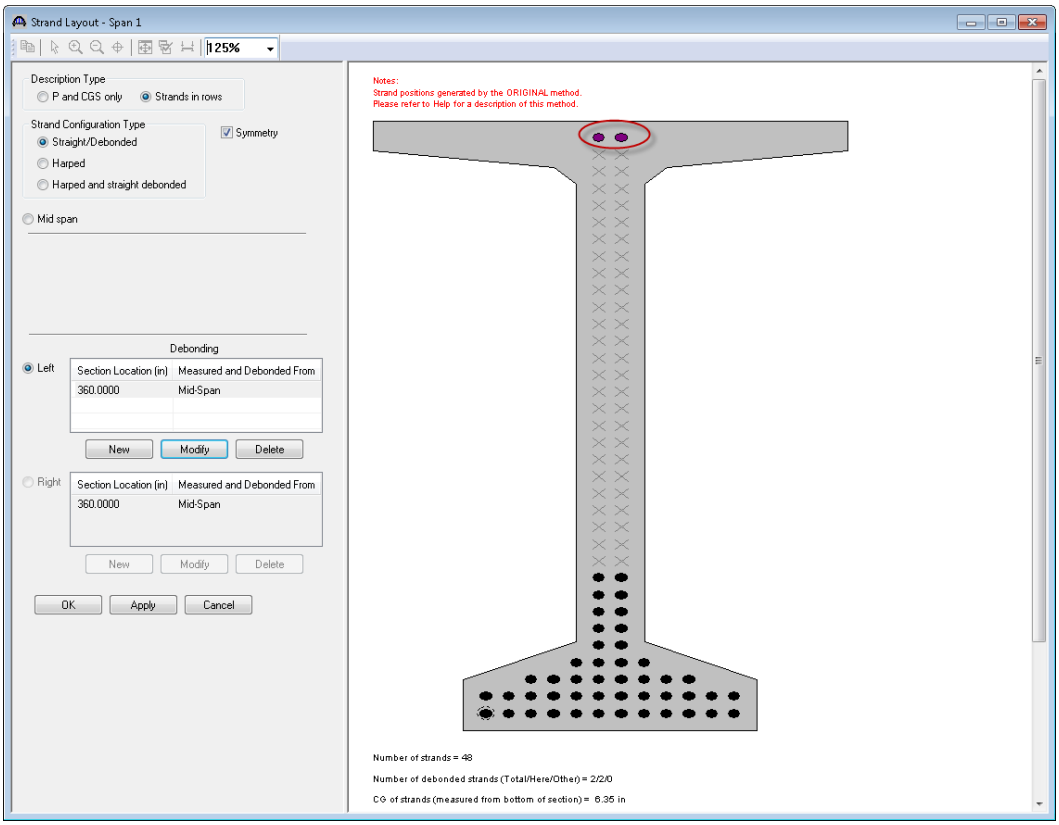
Re-open the Strand Layout window. Add 2 strands to the top of the beam at midspan.



Select the Left radio button, click New to open the following dialog. We are going to debond these top strands over a length equal to ½ the beam length. The beam length is 120' so we debonding 60' with 30' going to the left of midspan and 30' to the right of midspan.

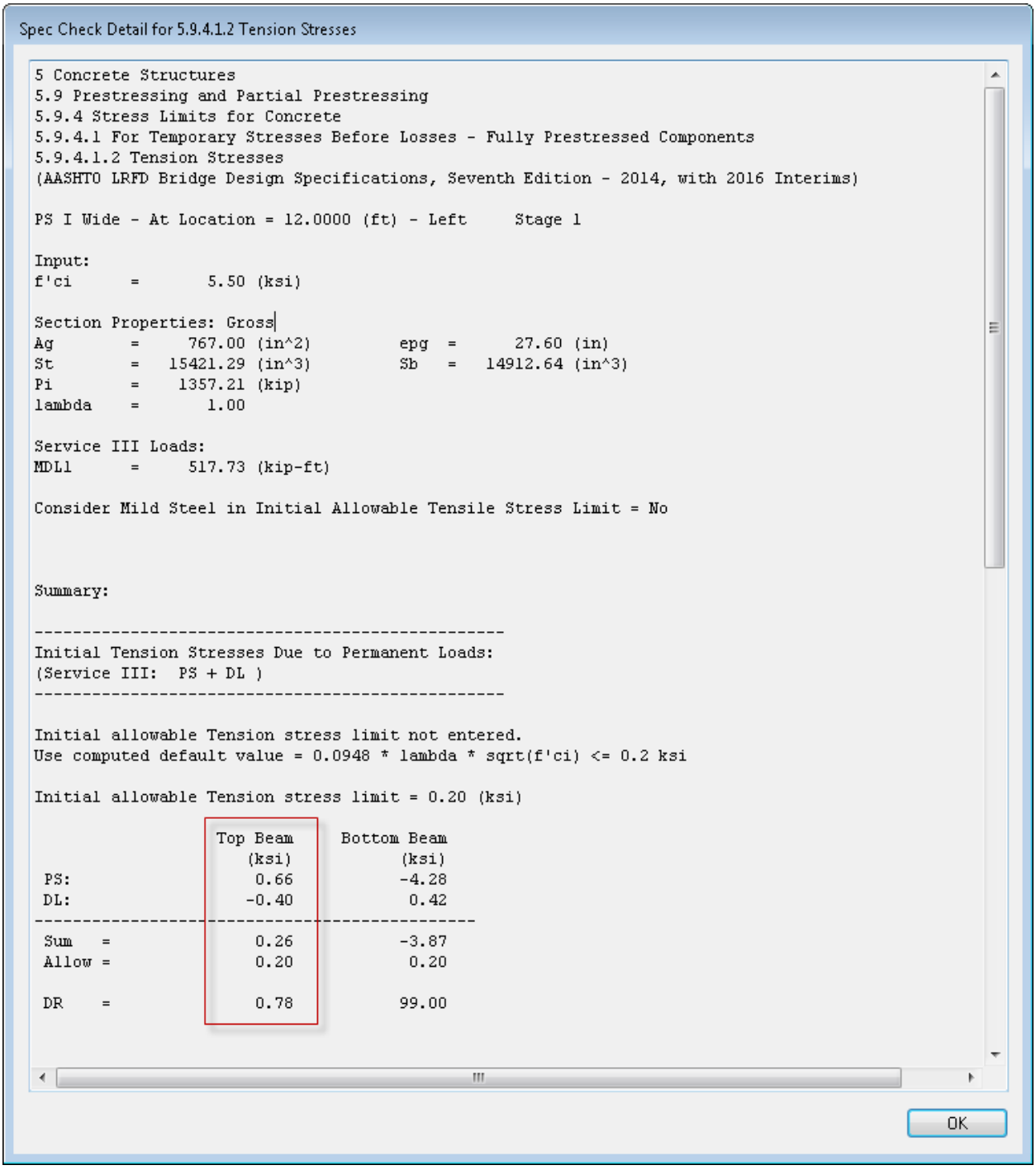


Click OK to close the dialog and then select the top 2 strands as being debonded and cut. These 2 strands will then appear as purple strands. Click OK to close the Strand Layout window.



Adding these pretensioned top strands adds compression to the top of the beam at the ends of the beam to counteract the high tension in the top of the beam. Debonding and cutting them at midspan removes the compression in this region for the final construction stage.

Re-run the HL-93 design review of this member alternative. Re-open the details for Article 5.9.4.1.2 and see that the design ratio has improved. The top strands contribute compression in this region which counteracts the high tension in the top flange.


Spec Check Detail for 5.9.4.1.2 Tension Stresses
5 Concrete Structures
5.9 Prestressing and Partial Prestressing
5.9.4 Stress Limits for Concrete
5.9.4.1 For Temporary Stresses Before Losses - Fully Prestressed Components
5.9.4.1.2 Tension Stresses
(AASHTO LRFD Bridge Design Specifications, Seventh Edition - 2014, with 2016 Interims)
PS I Wide - At Location = 12.0000 (ft) - Left Stage 1
Input:
f'ci = 5.50 (ksi)
Section Properties: Gross
Ag = 767.00 (in^2) epg = 27.60 (in)
St = 15421.29 (in^3) Sb = 14912.64 (in^3)
Pi = 1357.21 (kip)
lambda = 1.00
Service III Loads:
MDL1 = 517.73 (kip-ft)
Consider Mild Steel in Initial Allowable Tensile Stress Limit = No
Summary:
Initial Tension Stresses Due to Permanent Loads:
(Service III: PS + DL)
Initial allowable Tension stress limit not entered.
Use computed default value = 0.0948 * lambda * sqrt(f'ci) <= 0.2 ksi
Initial allowable Tension stress limit = 0.20 (ksi)
Top Beam (ksi)
Bottom Beam (ksi)
PS: 0.66 -4.28
DL: -0.40 0.42
Sum = 0.26 -3.87
Allow = 0.20 0.20
DR = 0.78 99.00
OK