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*AASHTOWare BrDR 7.5.0*  
*Prestress Tutorial 9*  
*Cut Strand for PS Beam Example*

## PS9 – Cut Strand for PS Beam Example

BrDR Training

## PS9 – Cut Strand for PS Beam Example

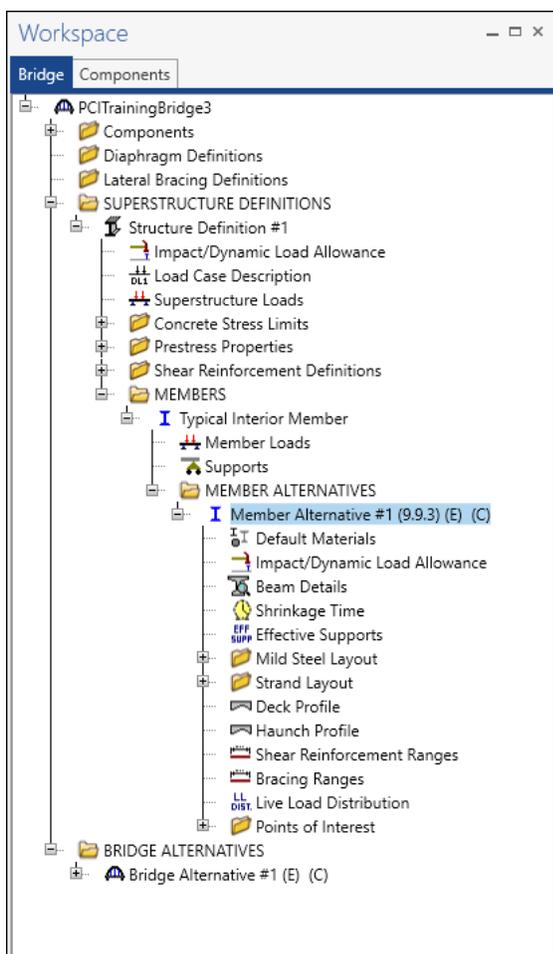
This example describes a design review of a prestressed concrete beam with temporary PS strands.

### 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.

Definition of a strand layout with top strands that are debonded and cut at the center of the beam to control stresses at release.

Open the bridge **PCITrainingBridge3 (BID6)** from the **Bridge Explorer**. A partially expanded **Bridge Workspace** tree is shown below.



## PS9 – Cut Strand for PS Beam Example

Expand the tree under the **Member Alternative #1 (9.9.3)**, expand **Strand Layout** and open the **Span 1** window by double clicking on it. Use the **ZOOM** options on the right side of the window to shrink/expand the schematic of the beam shape so that the entire beam is visible.

### Strand Layout – Span 1

Strand Layout - Span 1
— □ ×

Description type

P and CGS only    Strands in rows

Strand configuration type

Straight/Debonded    Symmetry

Harped

Harped and straight debonded

Mid span

Left end

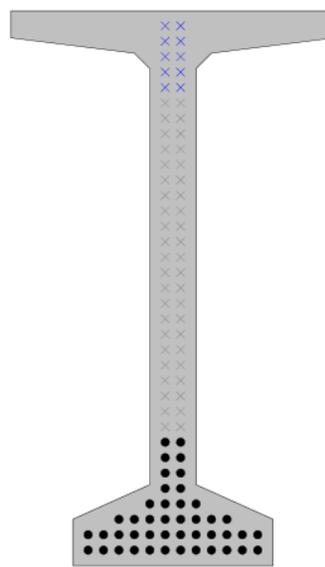
Right end

Harp point locations

Harp point	Distance (ft)	Radius (in)
Left	48.50	0.0000
Right	48.50	0.0000

OK   Apply   Cancel

Notes:  
Strand positions generated by the ORIGINAL method.  
Please refer to Help for a description of the method.



Number of strands = 44  
Number of harped strands = 0  
CG of strands (measured from bottom of section) = 5.82 in

Legend:

- × No strand at this position at the current section location.
- × No strand at this position at the current location but a strand is harped to this position.
- A strand occupies this position at the current section location.
- The strand is debonded from the end of the beam to the current section location.
- The strand is debonded from the mid-span to the current section location.
- The strand is debonded at other section locations. Hover over the strand for more information.
- The harped position of a harped strand.
- The mid-span position of a harped strand.
- The mid-span position of one strand and the harped position of another strand.
- Mid steel.

## PS9 – Cut Strand for PS Beam Example

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

**Strand Layout - Span 1**

Description type  
 P and CGS only  Strands in rows

Strand configuration type  
 Straight/Debonded  
 Harped  
 Harped and straight debonded

Symmetry

Mid span

Debonding

Left

Section location (in)	Measured and debonded from
-----------------------	----------------------------

New Modify Delete

Right

Section location (in)	Measured and debonded from
-----------------------	----------------------------

New Modify Delete

OK Apply Cancel

Number of strands = 48  
Number of debonded strands (Steel/Inert/Other) = 0/0/0  
CG of strands (measured from bottom of section) = 6.35 in

Legend:

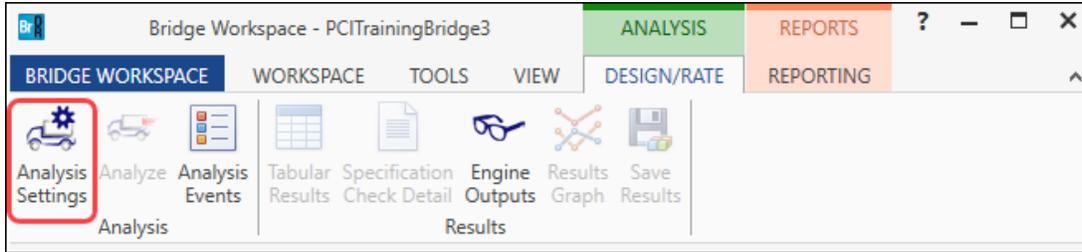
- × No strand at this position at the current section location.
- × No strand at this position at the current location but a strand is harped to this position.
- A strand occupies this position at the current section location.
- The strand is debonded from the end of the beam to the current section location.
- The strand is debonded from the mid-span to the current section location.
- The strand is debonded at other section location. Hover over the strand for more information.
- The harped position of a harped strand.
- The mid-span position of a harped strand.
- The mid-span position of one strand and the harped position of another strand.
- Mid steel.

Click **OK** to apply the changes and close the window.

## PS9 – Cut Strand for PS Beam Example

LRFD Design review of a prestressed concrete beam with the strand layout described above

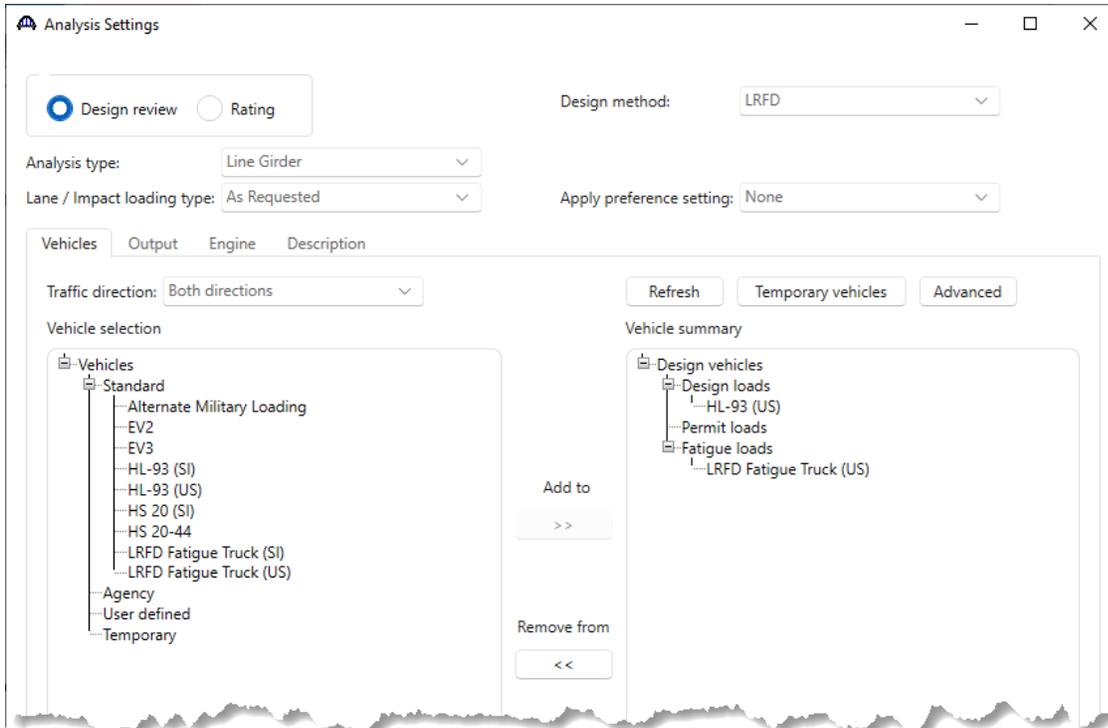
To run an LRFD design review, select the **Analysis Settings** button on the **Analysis** group of the **DESIGN/RATE** ribbon. The window shown below opens.



Click the **Open Template** button and select the **HL 93 Design Review** to be used in the analysis and click **Open**.



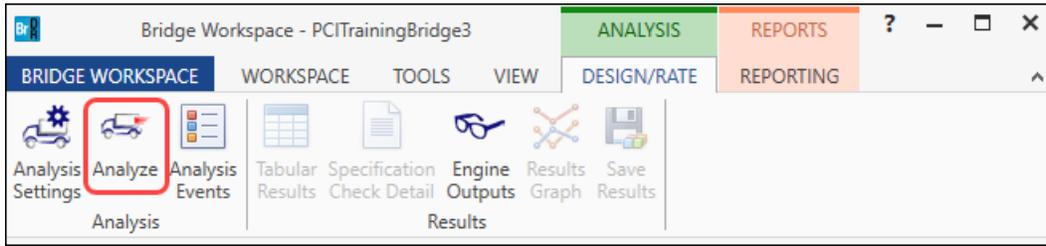
The **Analysis Settings** window will be populated as shown below.



Click **OK** to apply the settings and close the window.

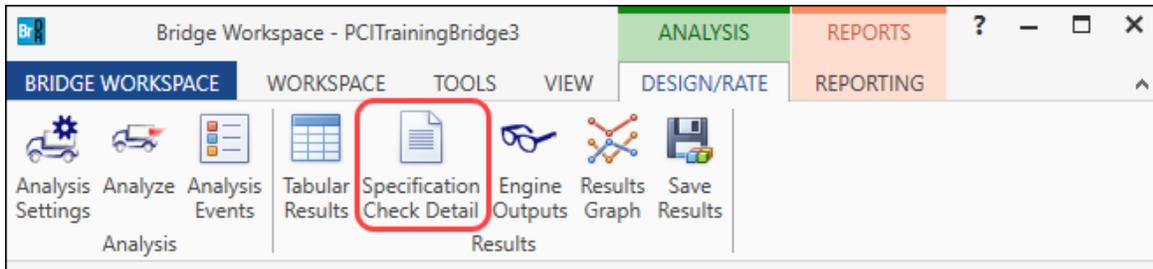
## PS9 – Cut Strand for PS Beam Example

Run the LRFD design review on the **Member Alternative #1 (9.9.3)** by clicking on the **Analyze** button on the **Analysis** group of the **DESIGN/RATE** ribbon.

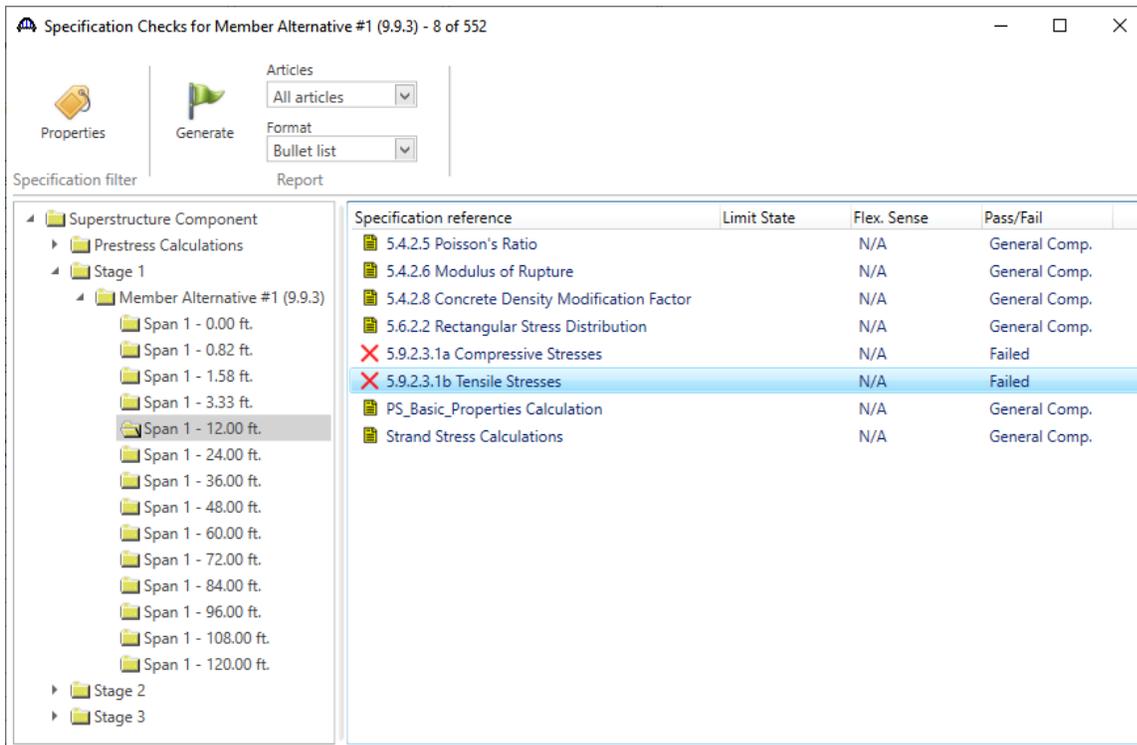


### Specification Check Detail

After the analysis, open the **Specification Checks** window by clicking on the **Specification Check Detail** button from the **Results** group of the **DESIGN/RATE** ribbon.



Go to **Superstructure component, Stage 1, Member Alternative #1 (9.9.3), Span 1 – 12 ft.**



## PS9 – Cut Strand for PS Beam Example

Open the **5.9.2.3.1b Tensile Stresses** article. The tension in the top of the beam at release shows a design ratio of 0.445.

5 Concrete Structures  
5.9 Prestressing  
5.9.2 Stress Limitations  
5.9.2.3 Stress Limits for Concrete  
5.9.2.3.1 For Temporary Stresses before Losses  
5.9.2.3.1b Tensile Stresses  
(AASHTO LRFD Bridge Design Specifications, Ninth Edition)

PS I Wide - At Location = 12.0000 (ft) - Left Stage 1

Input:  
f'ci = 5.50 (ksi)

Section Properties: Gross  
Ag = 767.00 (in<sup>2</sup>) epg = 30.26 (in)  
St = 15421.29 (in<sup>3</sup>) Sb = 14912.64 (in<sup>3</sup>)  
Pi = 1295.58 (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 )  
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Initial allowable Tension stress limit not entered.  
Use computed default value = 0.0948 \* lambda \* SQRT(f'ci) <= 0.2 ksi

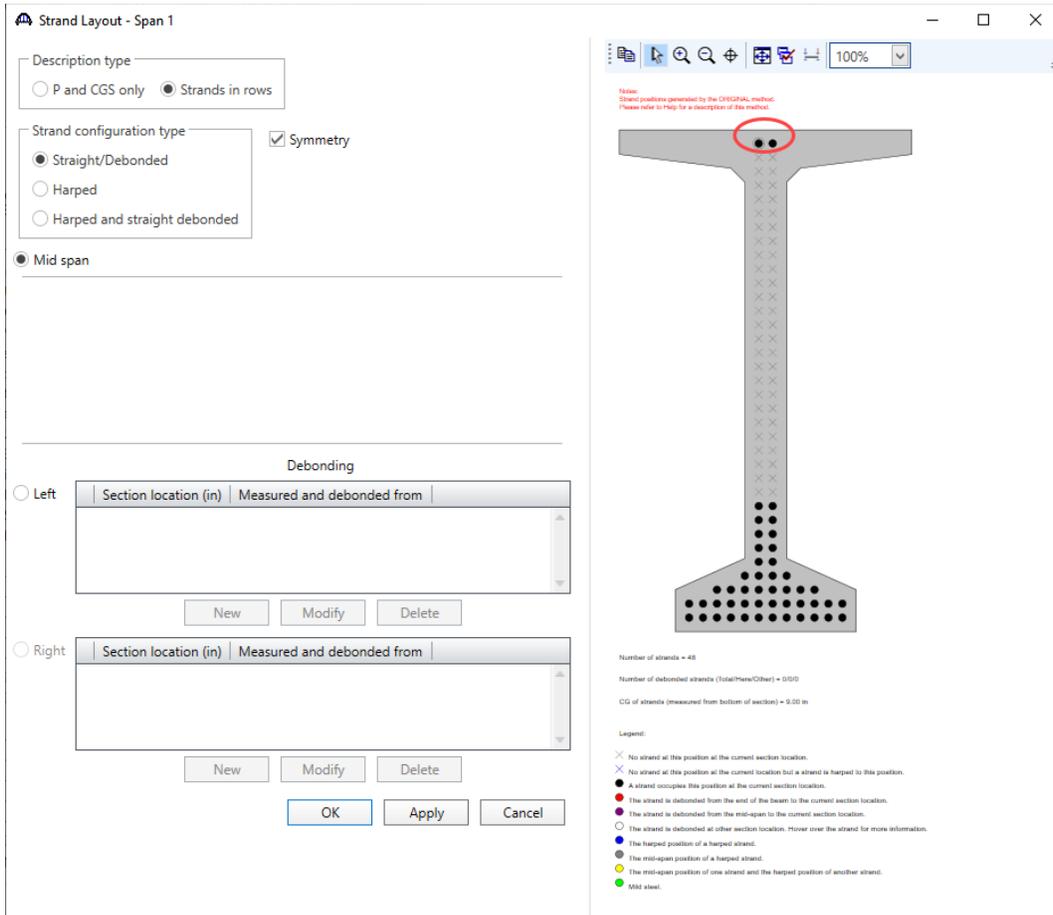
Initial allowable Tension stress limit = 0.20 (ksi)

	Top Beam (ksi)	Bottom Beam (ksi)
PS:	0.853	-4.318
DL:	-0.403	0.417
Sum =	0.450	-3.901
Allow =	0.200	0.200
DR =	0.445	99.000

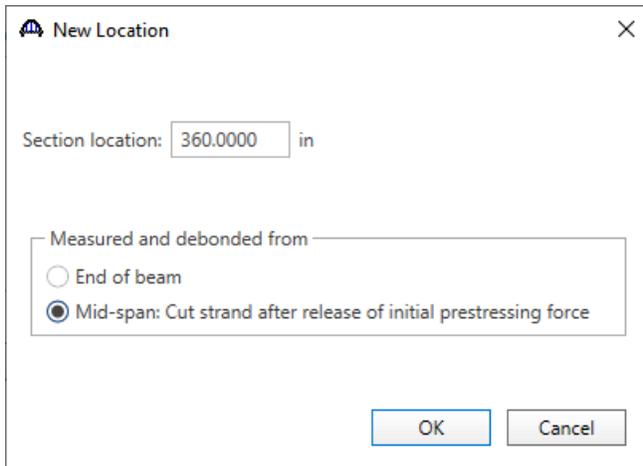
OK

# PS9 – Cut Strand for PS Beam Example

Reopen the **Strand Layout – Span 1** window. Add 2 strands to the top of the beam at midspan.



Select the **Left** radio button, click **New** to open the following window. Debond the newly added top strands over a length equal to  $\frac{1}{2}$  the beam length. The beam length is 120' so debond 60' with 30' going to the left of midspan and 30' to the right of midspan. When measuring from mid-span, the strand will be cut after release of the initial prestressing.



Click **OK** to close the window.

## PS9 – Cut Strand for PS Beam Example

Select the top 2 strands as being debonded and cut. These 2 strands will then appear as purple strands. Click **OK** to close the window.

**Strand Layout - Span 1**

Description type  
 P and CGS only  Strands in rows

Strand configuration type  
 Straight/Debonded  
 Harped  
 Harped and straight debonded

Symmetry

Mid span

Debonding

Left

Section location (in)	Measured and debonded from
360.0000	Mid-Span

New Modify Delete

Right

Section location (in)	Measured and debonded from
360.0000	Mid-Span

New Modify Delete

OK Apply Cancel

Number of strands = 40  
Number of debonded strands (Total/Here/Other) = 2/2/0  
CG of strands (measured from bottom of section) = 8.35 in

Legend:

- × No strand at this position at the current section location.
- × No strand at this position at the current location but a strand is harped to this position.
- A strand occupies this position at the current section location.
- The strand is debonded from the end of the beam to the current section location.
- The strand is debonded from the mid-span to the current section location.
- The strand is debonded at other section location. Hover over the strand for more information.
- The harped position of a harped strand.
- The mid-span position of a harped strand.
- The mid-span position of one strand and the harped position of another strand.
- Mid steel.

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 removed the compression in this region for the final construction stage.

## PS9 – Cut Strand for PS Beam Example

Re-run the **HL-93 design review** of this member alternative. Reopen the details for article **5.9.2.3.1b Tensile Stresses** and see that the design ratio has improved. The top strands contribute to compression in this region and counteracts the high tension in the top flange.

5 Concrete Structures  
5.9 Prestressing  
5.9.2 Stress Limitations  
5.9.2.3 Stress Limits for Concrete  
5.9.2.3.1 For Temporary Stresses before Losses  
5.9.2.3.1b Tensile Stresses  
(AASHTO LRFD Bridge Design Specifications, Ninth Edition)

PS I Wide - At Location = 12.0000 (ft) - Left Stage 1

Input:  
f'ci = 5.50 (ksi)

Section Properties: Gross  
Ag = 767.00 (in<sup>2</sup>) epg = 27.60 (in)  
St = 15421.29 (in<sup>3</sup>) Sb = 14912.64 (in<sup>3</sup>)  
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:	0.660	-4.282
DL:	-0.403	0.417
Sum =	0.257	-3.865
Allow =	0.200	0.200
DR =	0.778	99.000

OK