

*Opis 6.1*

*Prestress Bridge*

*Tutorial*

\*\*\*\*\*

*Entering a New Bridge*

*Using Templates*

# Opis 6.1 Tutorial

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## Introduction

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*This tutorial will take you through a simple span prestress beam design using a template bridge. The template was created to expedite the data input. All of the standard materials are already in the tree structure. The template bridge is a single span – four beam bridge. You will need to modify this as necessary. You will not want to use the Superstructure Definition Wizard when you use a template bridge. The template bridge already contains a Superstructure Definition that you can modify to fit your bridge. If you have questions or comments on this tutorial, please send them to Jeff Olsen. I will modify this document as necessary to make entering bridges as easy as possible.*

# Opis 6.1 Tutorial for Prestress Bridge

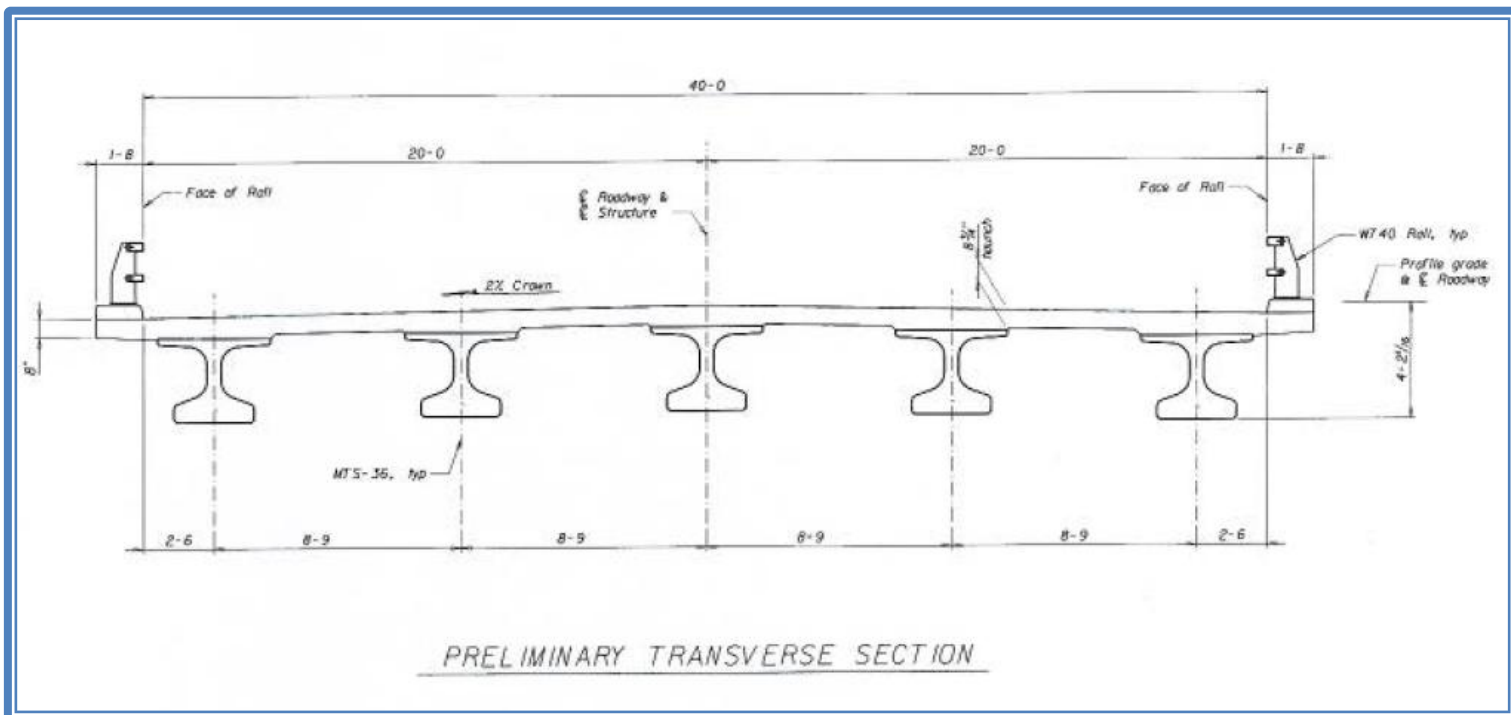
*This example will take you through a complete prestressed beam design.*

## Bridge Data

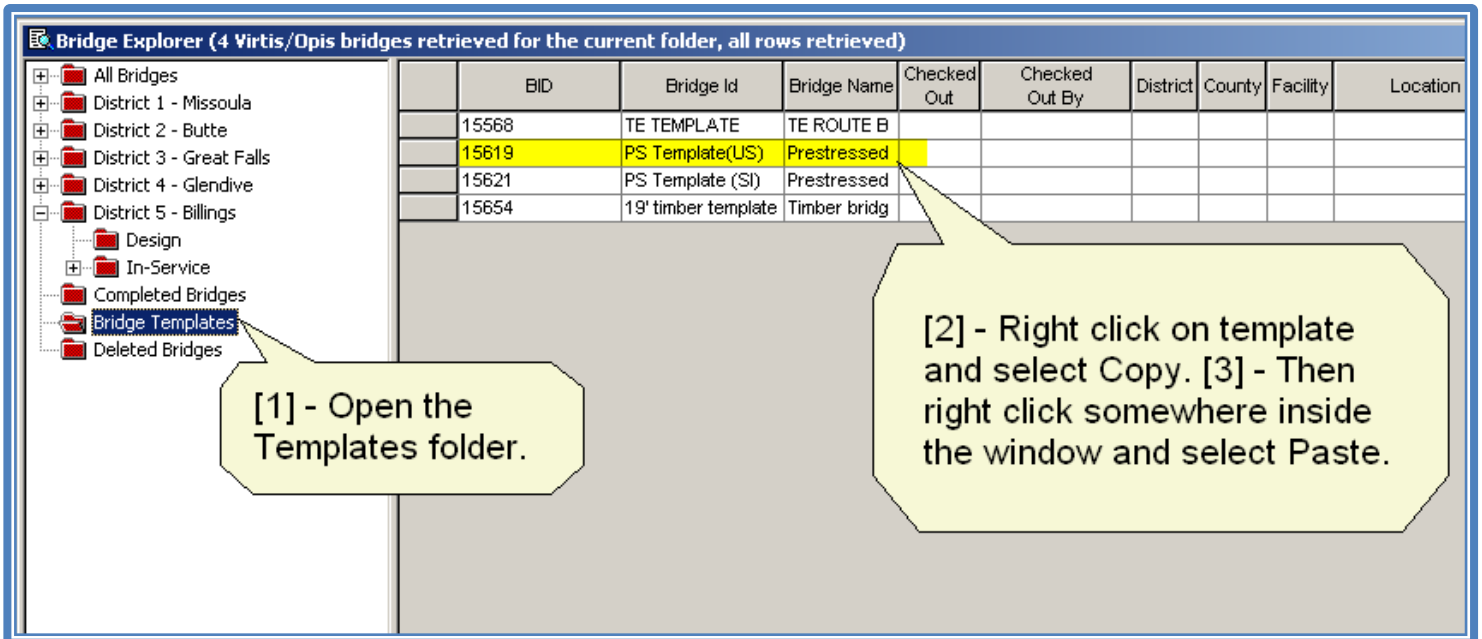
NH 57-3(42)83  
Lewistown-East CN  
4067001

Bridge over Boyd Creek  
NBI P00057084+02521

- Simple Span Prestressed Beam
- Type MTS 36
- 40 ft Roadway Width
- Span Length = 83 ft
- No Skew
- 5 Beam Lines at 9'-8" Spacing
- 8 inch Deck Thickness
- W740 Rail
- Normal Crown
- Assumed 1/2 "wearing surface



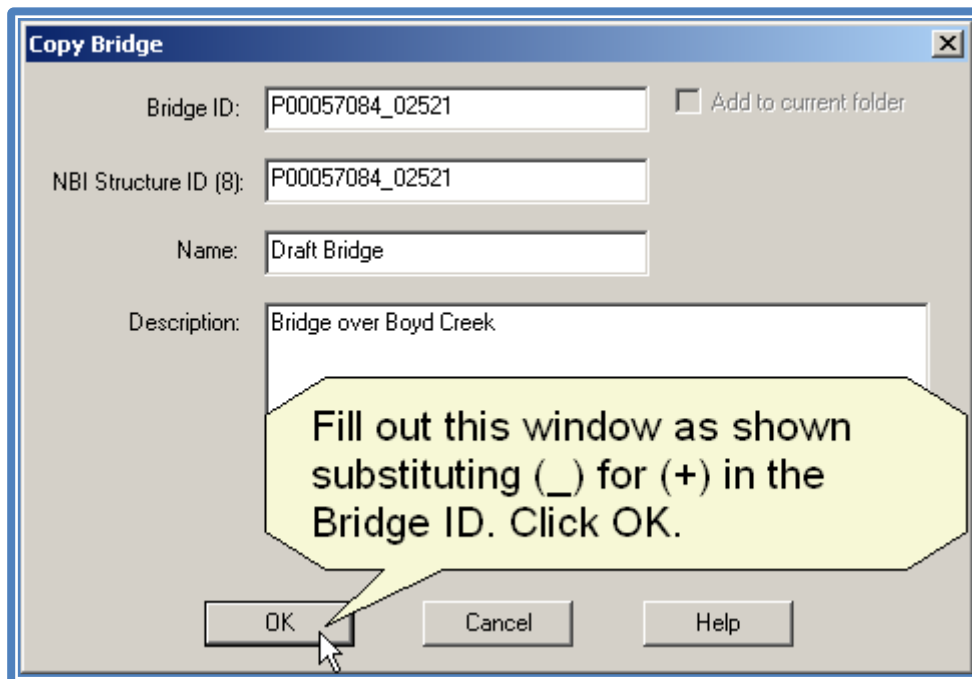
## Starting With a Template



BID	Bridge Id	Bridge Name	Checked Out	Checked Out By	District	County	Facility	Location
15568	TE TEMPLATE	TE ROUTE B						
15619	PS Template(US)	Prestressed						
15621	PS Template (SI)	Prestressed						
15654	19' timber template	Timber bridg						

[1] - Open the Templates folder.

[2] - Right click on template and select Copy. [3] - Then right click somewhere inside the window and select Paste.



Bridge ID: P00057084\_02521  Add to current folder

NBI Structure ID (8): P00057084\_02521

Name: Draft Bridge

Description: Bridge over Boyd Creek

OK Cancel Help

Fill out this window as shown substituting (\_) for (+) in the Bridge ID. Click OK.

## Bridge Description Window – Defining Bridge

**Bridge Explorer (5 Virtis/Opis bridges retrieved for the current folder, all rows retrieved)**

	BID	Bridge Id	Bridge Name	Checked Out	Checked Out By	District	County	Facility	Location	Route
	15568	TE TEMPLATE	TE ROUTE B							1
	15619	PS Template(US)	Prestressed							
	15621	PS Template (SI)	Prestressed							
	15654	19' timber template	Timber bridg							
	15667	P00057084_02521	Draft Bridge		BRIDGEWARE					

**Bridge Workspace - P00057084\_02521**

- Materials
- Beam Shapes
- Appurtenances
  - Impact / Dynamic Load Allowance
- HPF LRFD Multiple Presence Factors
- Factors
  - LRFD Substructure Design Settings
- EC Environmental Conditions
- DP Design Parameters
- SUPERSTRUCTURE DEFINITIONS
  - # Beam - Type ##
- BRIDGE ALTERNATIVES

**Bridge Description Window (P00057084\_02521)**

Template  
 Bridge Complete

Name: Draft Bridge      Year Built:

Description: Bridge over Boyd Creek

Location:

Facility Carried (7):

Feat. Intersected (6):

Default Units: US Customary

BridgeWare Association...  Virtis  Opis  Pontis

**Callout Boxes:**

- [1] - Your bridge will show up in the templates folder and will be checked out to you.
- [2] - double click here to open the bridge.
- [3] - This window will appear. Double click on the Bridge ID to open the Bridge Description window.
- [4] - Uncheck the Template box. This will move the bridge out of the Templates folder.
- [5] - Fill in data fields as shown then open the Description(cont'd) Tab

**Warning:** Keep in mind that you do not have access to check out bridges in the templates folder, you can only copy them. If you check your bridge in before moving it out of the templates folder you will no longer be able to check it out. If this happens to you, see either Jeff or Paul.

# Opis 6.1 Tutorial

The screenshot displays the Opis 6.1 software interface for configuring a bridge. The main window, titled "P00057084\_02521", shows the following fields:

- Bridge ID: P00057084\_02521
- NBI Structure ID (8): P00057084\_02521
- Template:
- Bridge Completely Defined:
- Description: Description (cont'd) | Alternatives | Global Reference Point | Traffic
- District (2): BILLINGS
- County: FERGUS
- Owner (22): 01 State Highway Agency
- Maintainer: 01 State Highway Agency
- Admin. Area: Dist 5
- NHS Indicator: 1 On the NHS
- Functional Class: Not Applicable

Below these fields is a "BridgeWare Association..." button and three checkboxes:  Virtis,  Opis, and  Pontis.

A callout box [6] points to the configuration fields, stating: "[6] - Fill in this information as appropriate. If you're unsure about any of them, use Not Appl. ~~~Make sure you fill in the Admin Area. That is the flag that makes your bridge show up in your district folder.~~~"

A second callout box [7] points to the "BridgeWare Association..." button, stating: "[7] - Click on the BridgeWare Association button and uncheck Virtis in the window below."

The "BridgeWare Association" dialog box is open, showing the following options:

- The selected bridge should be available to:
  - Virtis
  - Opis
- Is there a corresponding Pontis bridge you would like to link to?
  - Yes
  - No
- No link to Pontis bridge requested.

Buttons: Help, OK, Cancel

## Superstructure Definition- Define Bridge Geometry

**[1] - Double click on the Super Definition to open the window.**

**[2] - Fill in the information as shown.**

**Name:** 5 Beam - Type MTS 36

**Description:**

**Default Units:** US Customary

**Number of spans:** 1

**Number of girders:** 5

Span	Length (ft)
1	83.00

**Deck type:** Concrete

Frame Structure Simplified Definition

**For PS only**

**Average humidity:** 65.000 %

**Member Alt. Types**

- Steel
- P/S
- R/C
- Timber

OK Apply Cancel



## Framing Plan – (Define Erection Plan)

The screenshot shows the Bridge Workspace interface. The project tree on the left is expanded to show the 'SUPERSTRUCTURE DEFINITIONS' folder, which contains a sub-folder '5 Beam - Type MTS 36'. The 'Framing Plan Detail' item under this sub-folder is selected and highlighted. A callout box with an arrow points to this item, containing the text: [1] - Expand the tree and double click on the Framing Plan Detail.

The 'Structure Framing Plan Details' dialog box is open. It has two tabs: 'Layout' and 'Diaphragms'. The 'Diaphragms' tab is active. At the top, there are two input fields: 'Number of spans = 1' and 'Number of girders = 5'. Below these, there are two radio buttons for 'Girder Spacing Orientation': 'Perpendicular to girder' (which is selected) and 'Along support'. A callout box with an arrow points to these radio buttons, containing the text: [2] - Enter the Skew and Beam Spacing. [3] - Then click on the Diaphragms tab.

On the left side of the dialog, there is a table with two columns: 'Support' and 'Skew (Degrees)'. It contains two rows of data:

Support	Skew (Degrees)
1	-0.0000
2	-0.0000

On the right side of the dialog, there is another table with three columns: 'Girder Bay', 'Start of Girder', and 'End of Girder'. It contains four rows of data:

Girder Bay	Start of Girder	End of Girder
1	8.75	8.75
2	8.75	8.75
3	8.75	8.75
4	8.75	8.75

At the bottom of the dialog, there are three buttons: 'OK', 'Apply', and 'Cancel'.

# Opis 6.1 Tutorial

Structure Framing Plan Details

Number of spans = 1      Number of girders = 5

Layout    Diaphragms

Girder Bay: 1      Copy Bay To...      Diaphragm Wizard...

Support Number	Start Distance (ft)		Diaphragm Spacing (ft)	Number of Spaces	Length (ft)	End Distance (ft)	
	Left Girder	Right Girder				Left Girder	Right Girder

**Diaphragm Wizard**

Select the desired framing plan system:

[2] - Select the desired pattern and click on Next.

Delete

Cancel

< Back

**Diaphragm Wizard**

Diaphragm Spacing

- Enter number of equal spaces per span
- Enter equal spacing per span
- Enter groups of equal spacing

Support diaphragm load: 0.0000 kip

Interior diaphragm load: 20 kip

Span	Length (ft)	Number of Equal Spaces
1	83.00	3

[3] - Enter the diaphragm information and click on Finish.

< Back    Finish    Cancel    Help

# Opis 6.1 Tutorial

Structure Framing Plan Details

Number of spans =       Number of girders =

Layout   Diaphragms

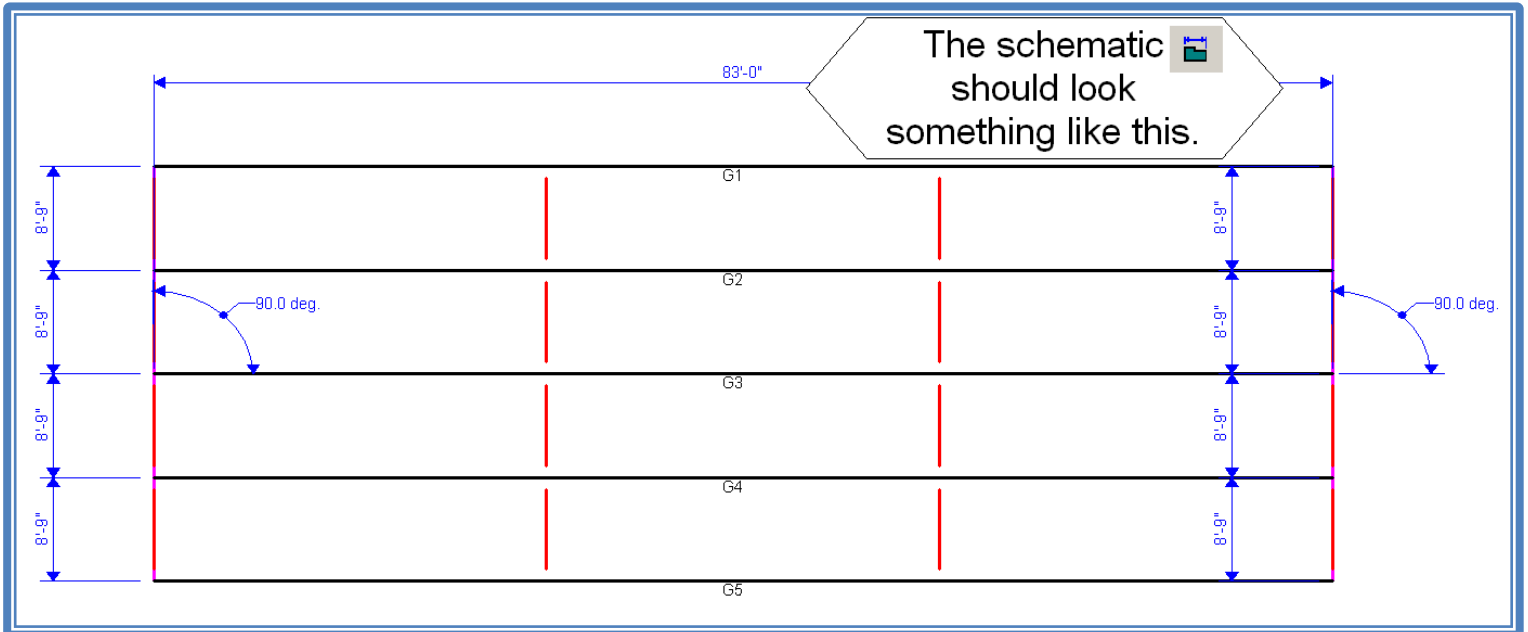
Girder Bay:       Copy Bay To...      Diaphragm Wizard...

Support Number	Start Distance (ft)		Diaphragm Spacing (ft)	Number of Spaces	Length (ft)	End Distance (ft)		Load (kip)
	Left Girder	Right Girder				Left Girder	Right Girder	
1	0.00	0.00	0.00	1	0.00	0.00	0.00	0.0000
1	0.00	0.00	27.67	2	55.33	55.33	55.33	2.0000
1	83.00	83.00	0.00	1	0.00	83.00	83.00	0.0000

The table will populate as shown above.

New   Duplicate   Delete

OK   Apply   Cancel



## Structure Typical Section – (Define Bridge Cross Section)

**Bridge Workspace - P00057084\_02521**

- P00057084\_02521
  - Materials
  - Beam Shapes
  - Appurtenances
  - Impact / Dynamic Load Allowance
  - MFF LRFD Multiple Presence Factors
  - Factors
    - LRFD Substructure Design Settings
  - EC Environmental Conditions
  - DP Design Parameters
  - SUPERSTRUCTURE DEFINITIONS
    - 5 Beam - Type MTS 36
      - Impact / Dynamic Load Allowance
      - Load Case Description
      - Framing Plan Detail
      - Structure Typical Section
      - Superstructure Loads

[1] Open the Structure Typical section window.

[2] Fill in the deck geometry information on the Deck tab.

[3] On the Deck(Cont'd) tab, enter the deck material and thickness. Leave the rest as defaults.

# Opis 6.1 Tutorial

Structure Typical Section

Generic Shape

Back Front

Deck | Deck (Cont'd) | Parapet | Median | Railing | **Generic** | Sidewalk | Lane Position | Wearing Surface

Name	Load Case	Measure To	Edge of Deck Dist. Measured From	Distance At Start (ft)	Distance At End (ft)	Front Face Orientation
w740 Bridge Rail	DC2	Back	Left Edge	0.00	0.00	Right
w740 Bridge Rail	DC2	Back	Right Edge	0.00	0.00	Left

New Duplicate Delete

OK Apply Cancel

[4] Skip ahead to the Generic tab and select the rail type. The remaining fields are defaulted to the standard rail configuration.

Structure Typical Section

Travelway 1 Travelway 2 Superstructure Definition Reference Line

(A) (B)

Deck | Deck (Cont'd) | Parapet | Median | Railing | Generic | Sidewalk | **Lane Position** | Wearing Surface

Travelway Number	Distance From Left Edge of Travelway to Superstructure Definition Reference Line At Start (A) (ft)	Distance From Right Edge of Travelway to Superstructure Definition Reference Line At Start (B) (ft)	Distance From Left Edge of Travelway to Superstructure Definition Reference Line At End (A) (ft)	Distance From Right Edge of Travelway to Superstructure Definition Reference Line At End (B) (ft)
1	-20.00	20.00	-20.00	20.00

LRFD Fatigue  
Lanes available to trucks:   
 Override Truck fraction:

Compute... New Duplicate Delete

OK Apply Cancel

Compute Lane Positions

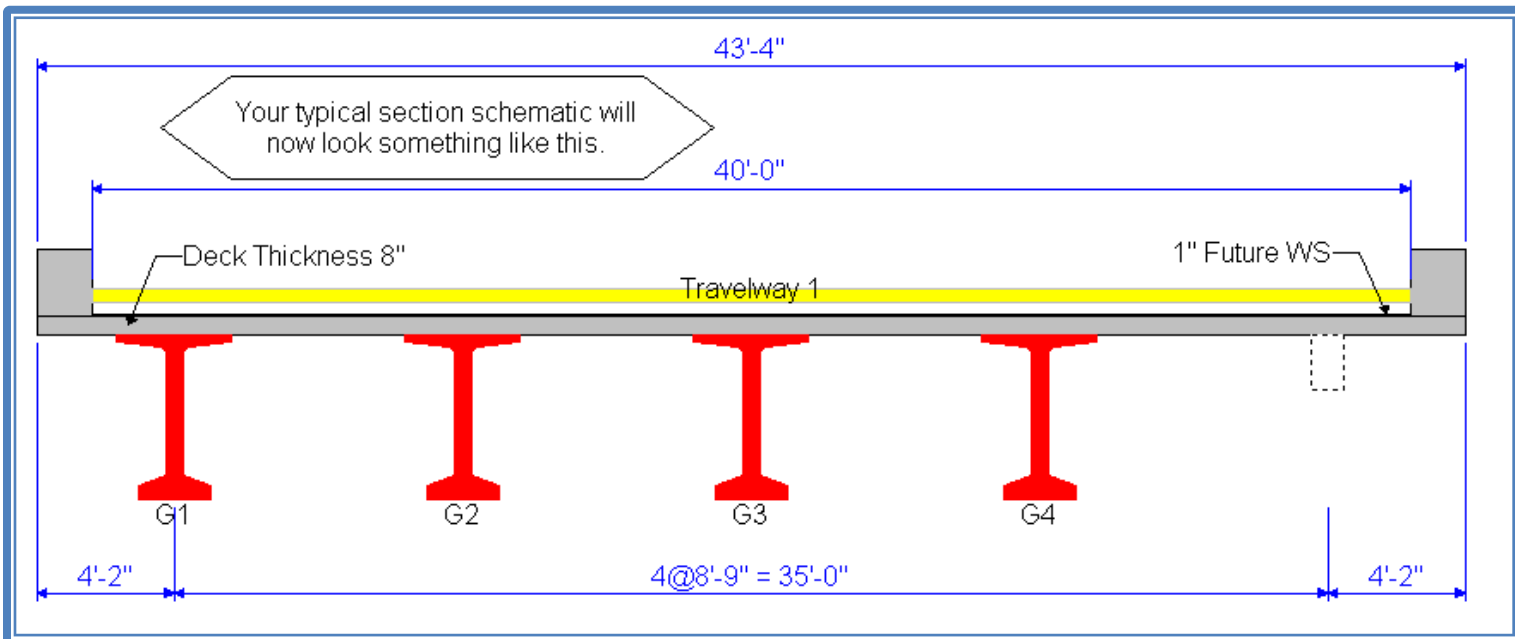
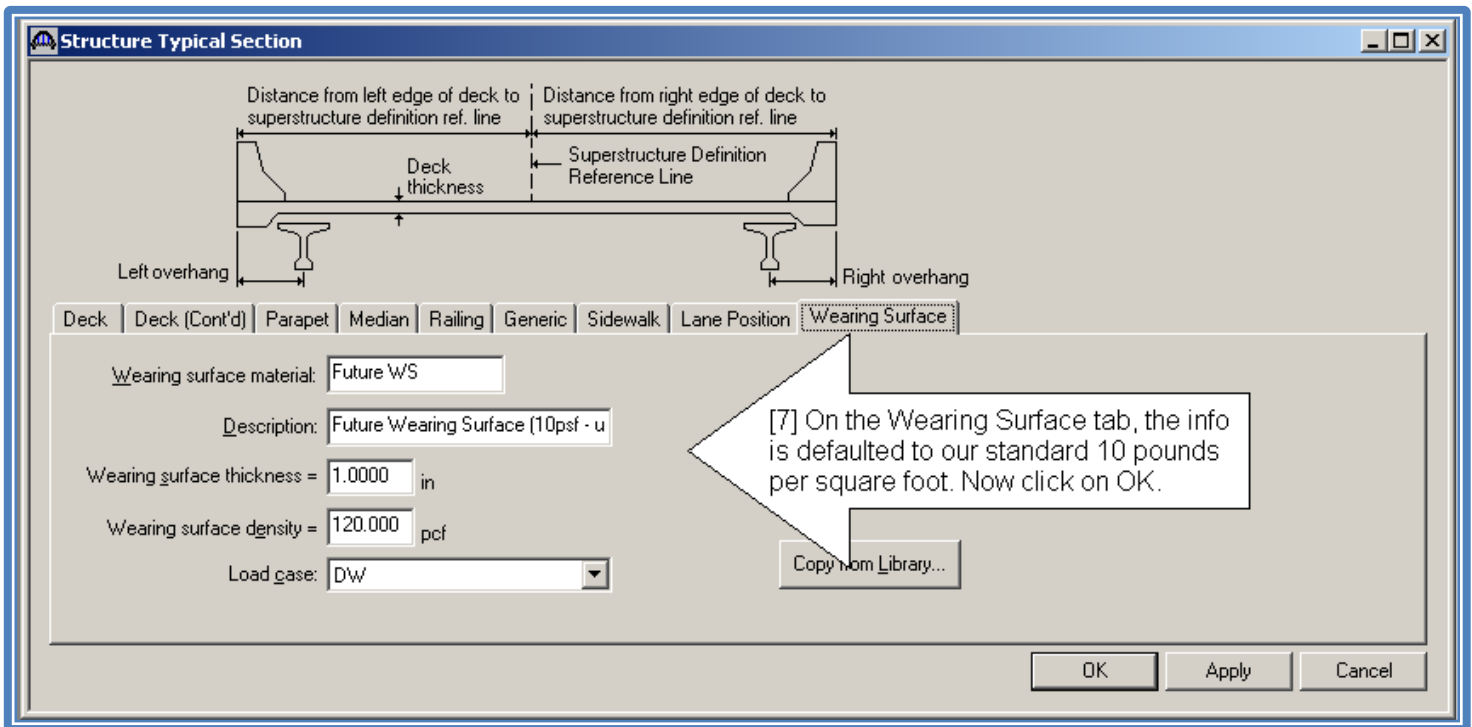
Travelway Number	Distance From Left Edge of Travelway to Superstructure Definition Reference Line At Start (A) (ft)	Distance From Right Edge of Travelway to Superstructure Definition Reference Line At Start (B) (ft)	Distance From Left Edge of Travelway to Superstructure Definition Reference Line At End (A) (ft)	Distance From Right Edge of Travelway to Superstructure Definition Reference Line At End (B) (ft)
1	-20.00	20.00	-20.00	20.00

Apply

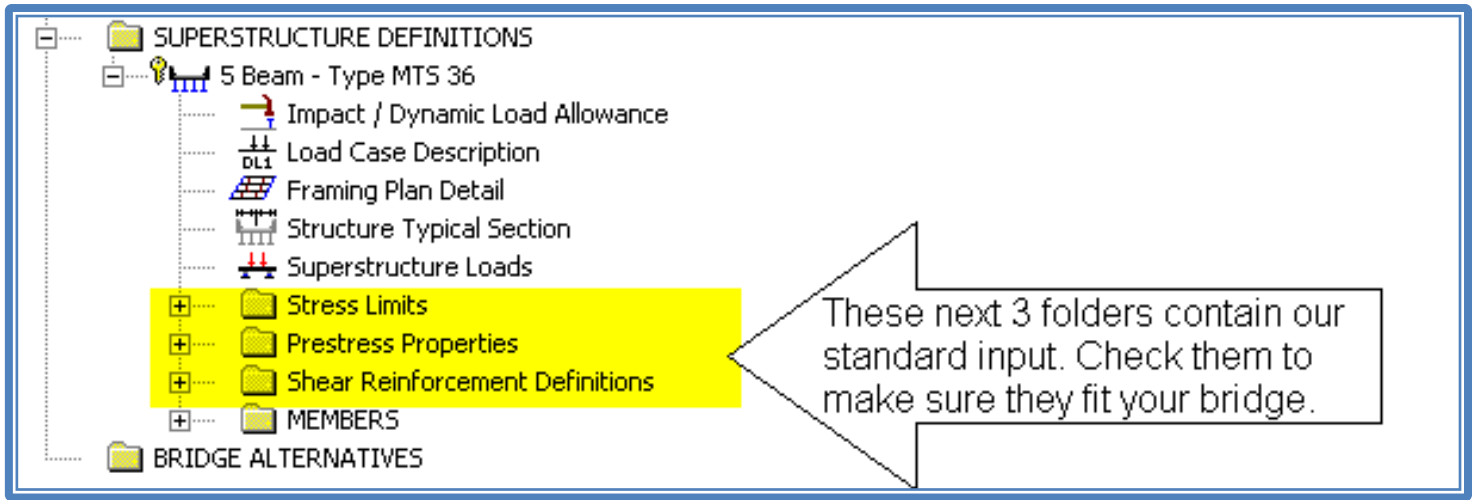
[5] On the Lane Position tab, select the compute button.

[6] Click on Apply

# Opis 6.1 Tutorial



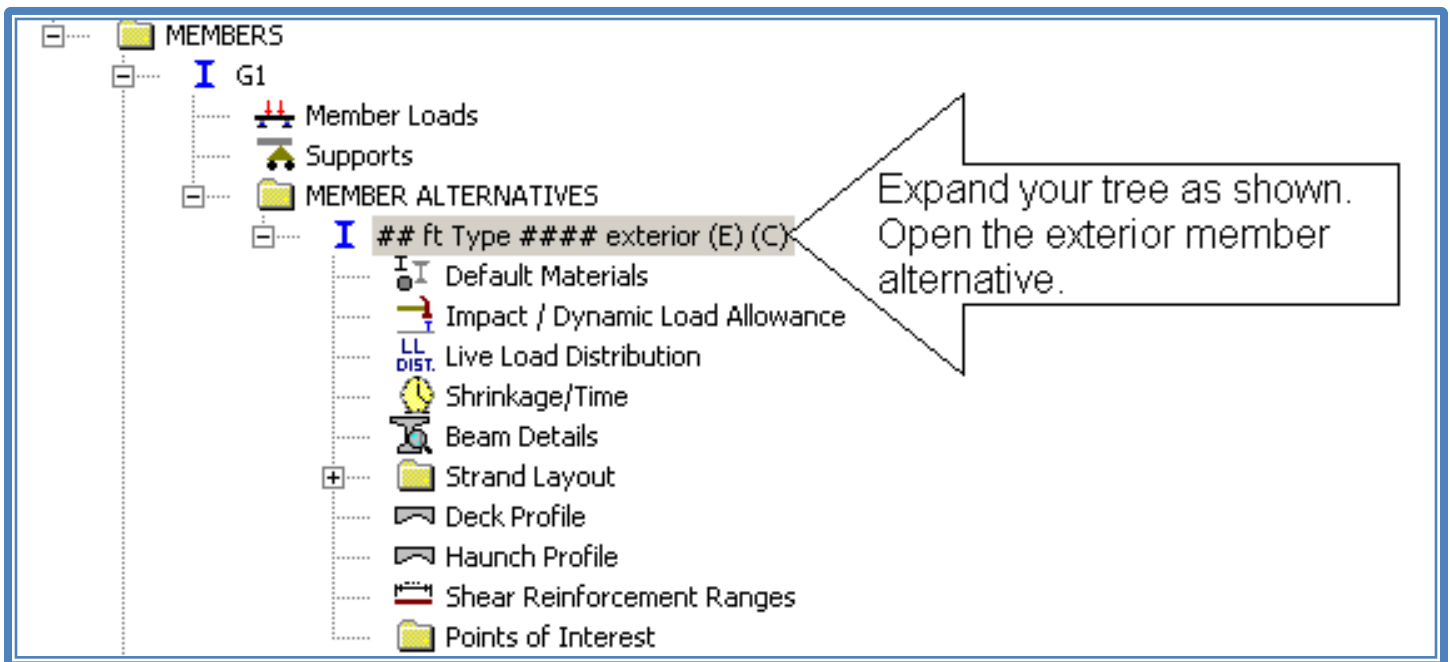
### Stress Limits, Prestressed Properties, Shear Reinforcement Definitions



*In the Prestress Properties window, you select the prestress loss method. Use the Approximate Loss method for the first run. If you need more capacity out of your beam, you can use the refined loss method (with approval of the Bridge Design Engineer). If you use the refined method, you need to use transformed section properties (in the control options tab in the member window—page 99). With the refined method, you can choose if you want to include elastic gains due to shrinkage of deck. See AASHTO 5.9.5.4 for Refined Loss Method.*

### Member Alternative – Defining Individual Beams

*Now it's time to define the members. For each step, enter the data for both the exterior beam and interior beam before moving on the next step.*





# Opis 6.1 Tutorial

Member Alternative Description

Member Alternative: 83 ft Type MTS 36 exterior

Enter the Member Alternative name.

Description Factors Engine Import Control Options

Description:

Girder property input method

Schedule based

Cross-section based

The analysis mode is set to the Virtis/Opis engine.

Material Type: Prestressed (Pretensioned)

Girder Type: PS Precast I

Default Units: US Customary

Analysis Module

ASD: Virtis ASD

LFD: Virtis LFD

LRFD: Opis LRFD

LRFR: Virtis LRFR

Default rating method: LRFR

Additional Self Load

Additional self load =  kip/ft

Additional self load =  %

Crack control parameter (Z)

Top of beam:  kip/in

Bottom of beam:  kip/in

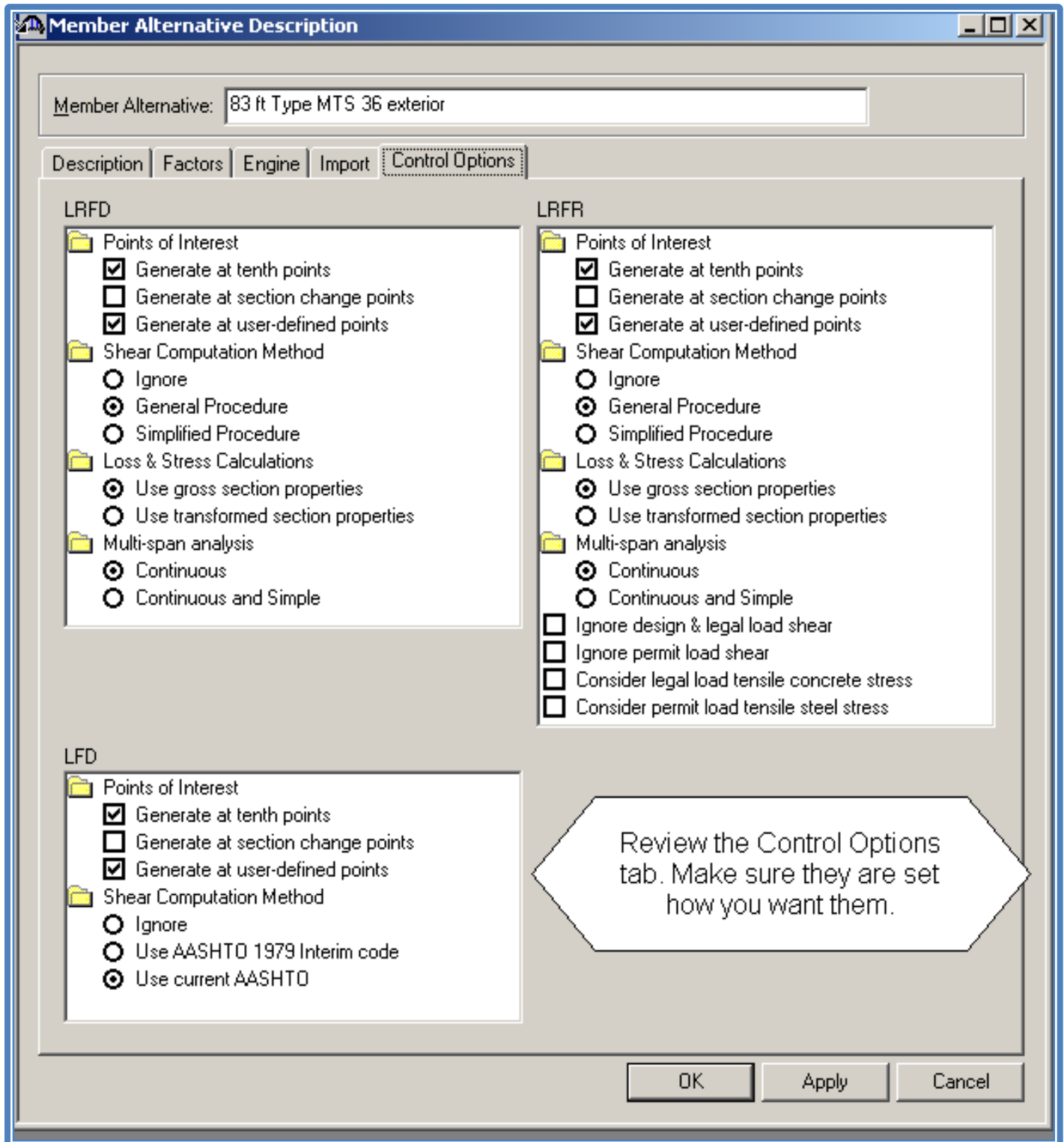
Exposure factor

Top of beam:

Bottom of beam:

OK Apply Cancel

# Opis 6.1 Tutorial



# Explanation of Control Options

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*As a general guideline, I recommend leaving the settings as defaulted in the templates. For special cases, see the discussion below.*

## LRFD

### Points of Interest

- This is available only for a steel, prestressed or reinforced concrete member alternative.
- Include POI's as section change points if you have a flat slab or a steel bridge.

### Shear Computation Method

- This input field is available only for a prestressed or reinforced concrete member alternative.
- Use the **General Procedure** setting.

### Loss & Stress Calculations

- This input field is available only for a prestressed concrete member alternative.
- Select the section properties to be used in the concrete loss and stress computations.
- Initially, use **gross section properties**. If you have a situation where you need to stretch out your beam, you may use **transformed section properties**. If you use transformed section properties, also use the refined loss method for your prestress losses. The loss method control is in the Prestressed Properties window.

### Multi-span analysis

- This input field is available only for a prestressed concrete member alternative.
- The **Continuous** method considers multi-span structures to be simply supported for beam self-weight and uncured deck, and continuously supported for composite dead and live loads. This method takes

advantage of the continuity connection to reduce the maximum positive moment at mid-spans.

- The **Continuous and Simple** method analyzes the structure as simply supported for beam self-weight and uncured deck, and both continuously and simply supported for composite dead and live loads. The maximum effects from the two analyses are then used in the specification checking. This method accounts for the condition where full continuity is not provided at interior supports.

### LRFR

#### Points of Interest

- This is available only for a steel, prestressed or reinforced concrete member alternative.
- Include POI's as section change points if you have a flat slab or a steel bridge.

#### Shear Computation Method

- This input field is available only for a prestressed or reinforced concrete member alternative.
- Use the **General Procedure** setting. If you're having shear issues use the following guidelines:
  - For a new bridge, adjust the shear spacing or hoop size until you satisfy the code.
  - For a rehab, redeck, widening, etc, discuss your issue with Bridge Management Section and the Bridge Design Engineer to see if ignoring the shear rating is appropriate.

#### Loss & Stress Calculations

- This input field is available only for a prestressed concrete member alternative.
- Select the section properties to be used in the concrete loss and stress computations.
- Use the same setting that you used in the LRFD section.

- If you're designing a rehab, redeck, widening, etc, you may sharpen your pencil, if needed, by using transformed section properties and the refined loss method. Discuss this with Bridge Management Section and the Bridge Design Engineer to see if this method is appropriate.

### Multi-span analysis

- Use the same setting that you used in the LRFD section.

### Ignore design & legal load shear

- This input field is available only for a prestressed or reinforced concrete member alternative. Discuss use with BMS.

### Ignore permit load shear

- This input field is available only for a prestressed or reinforced concrete member alternative. Discuss use with BMS.

### Consider legal load tensile concrete stress

- This input field is available only for a prestressed concrete member alternative. Discuss use with BMS.

### Consider permit load tensile steel stress

- Check this box to check LRFR spec article 6.5.4.2.2.2 in an LRFR rating. This input field is available only for a prestressed or reinforced concrete member alternative. Discuss use with BMS.

## LFD

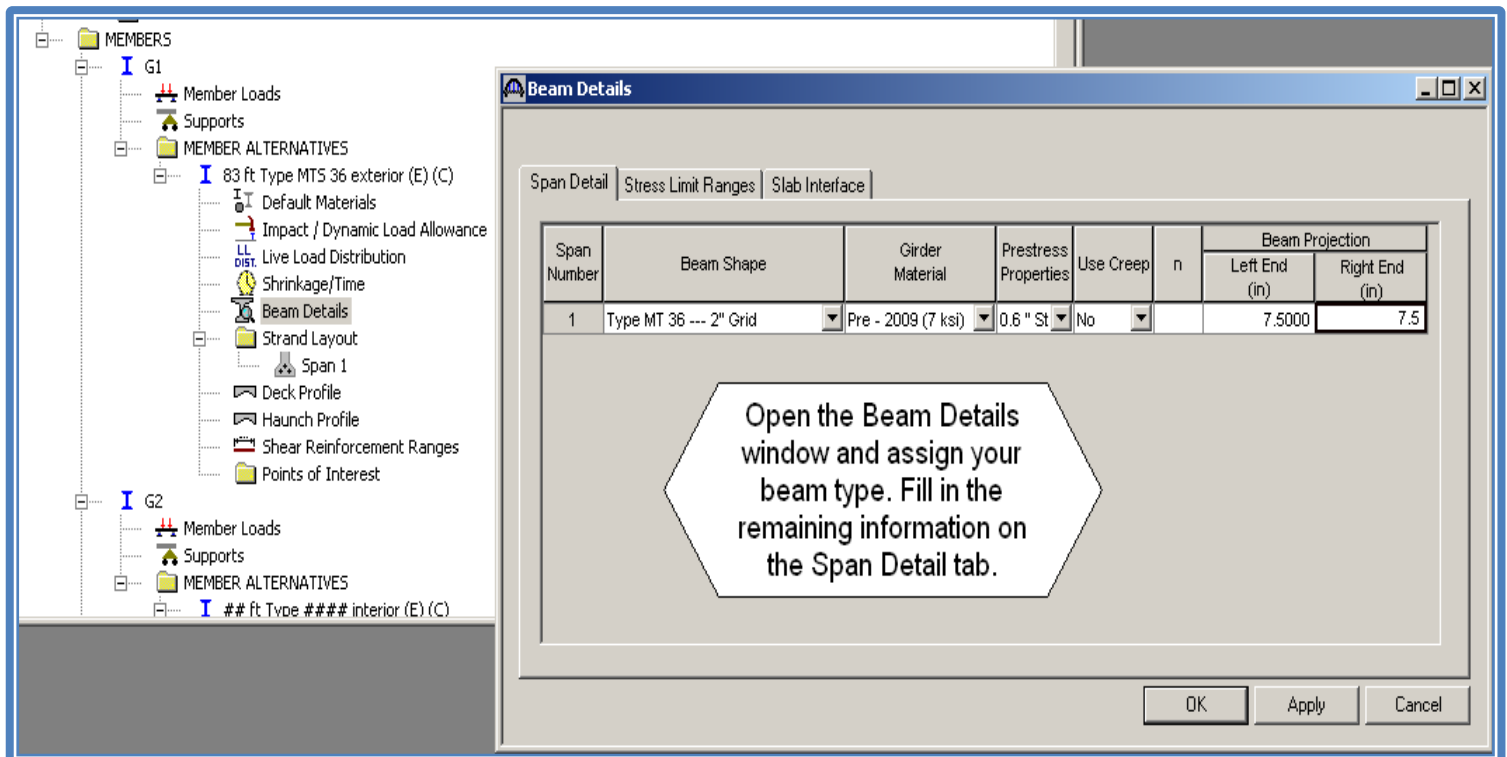
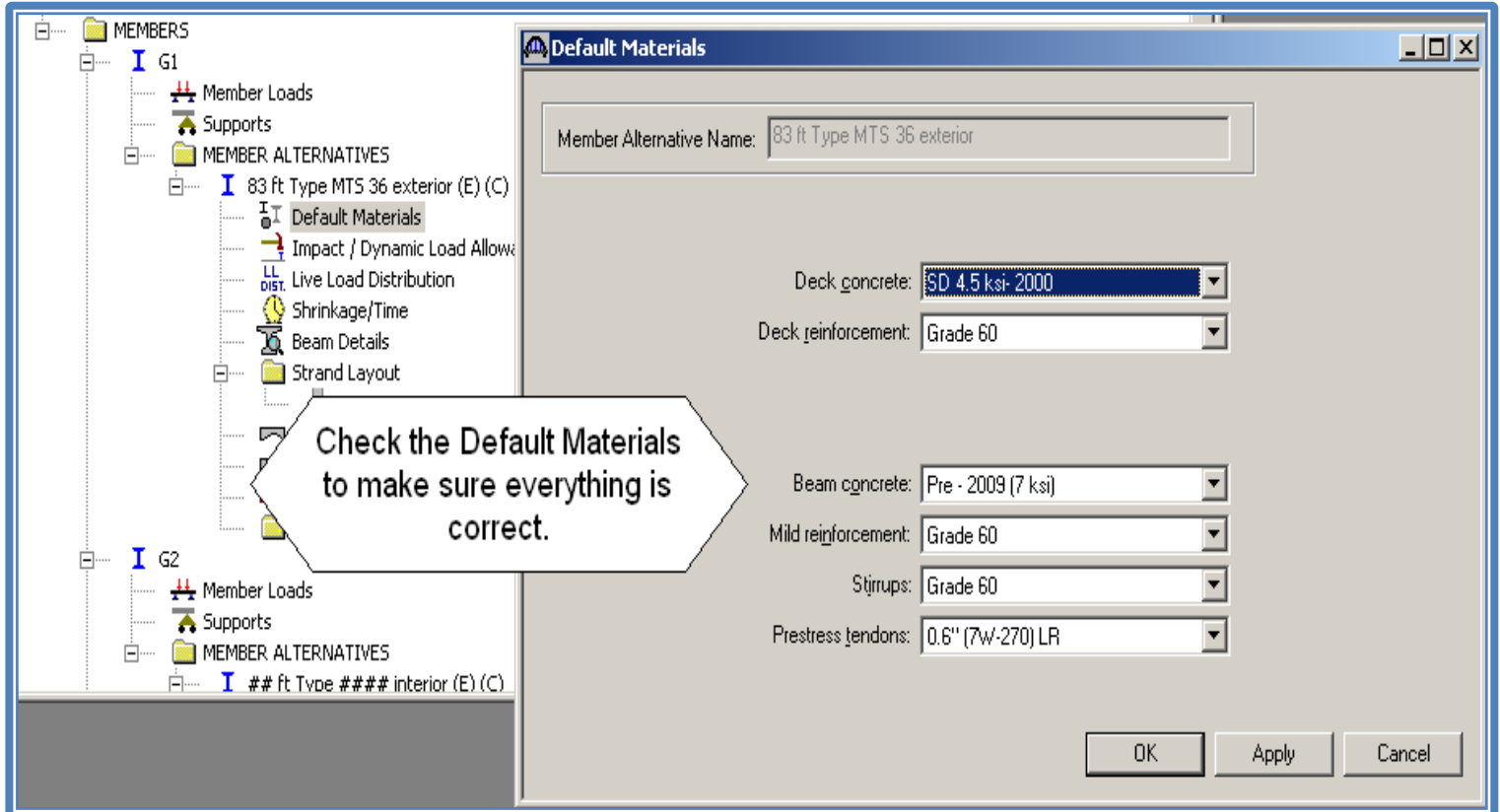
### Points of Interest

- This is available only for a steel, prestressed or reinforced concrete member alternative.
- Include POI's as section change points if you have a flat slab or a steel bridge.

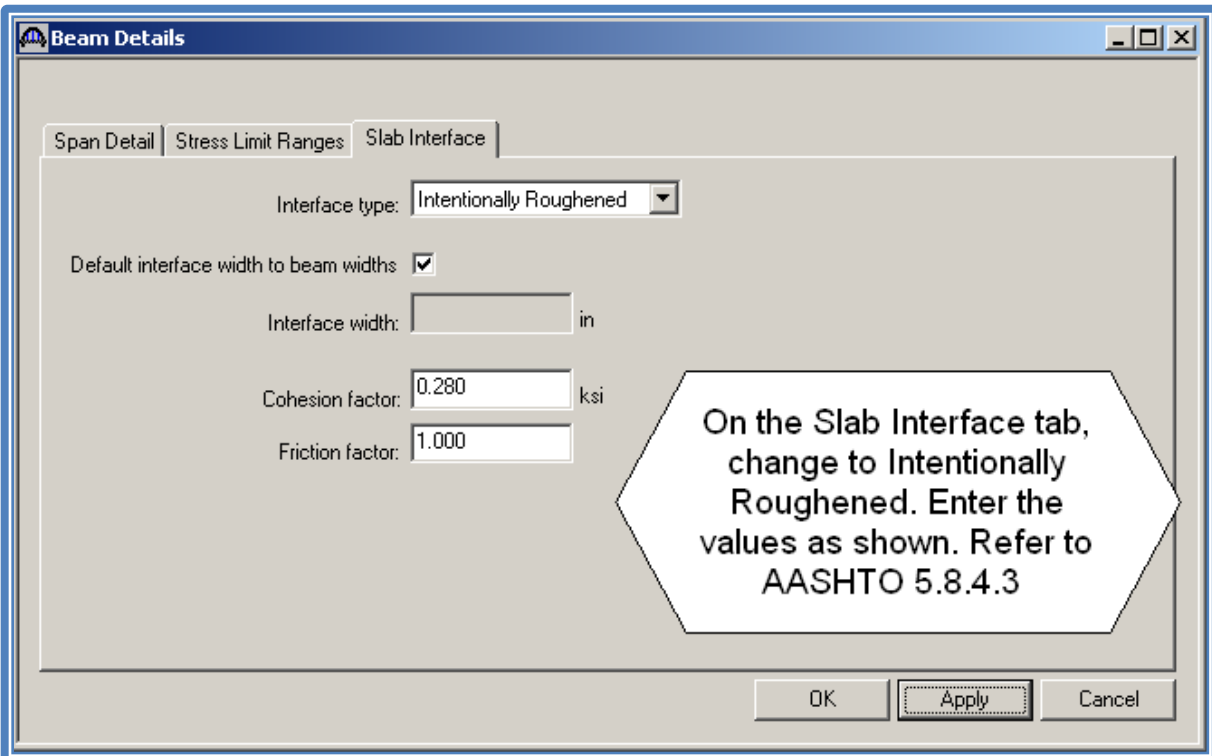
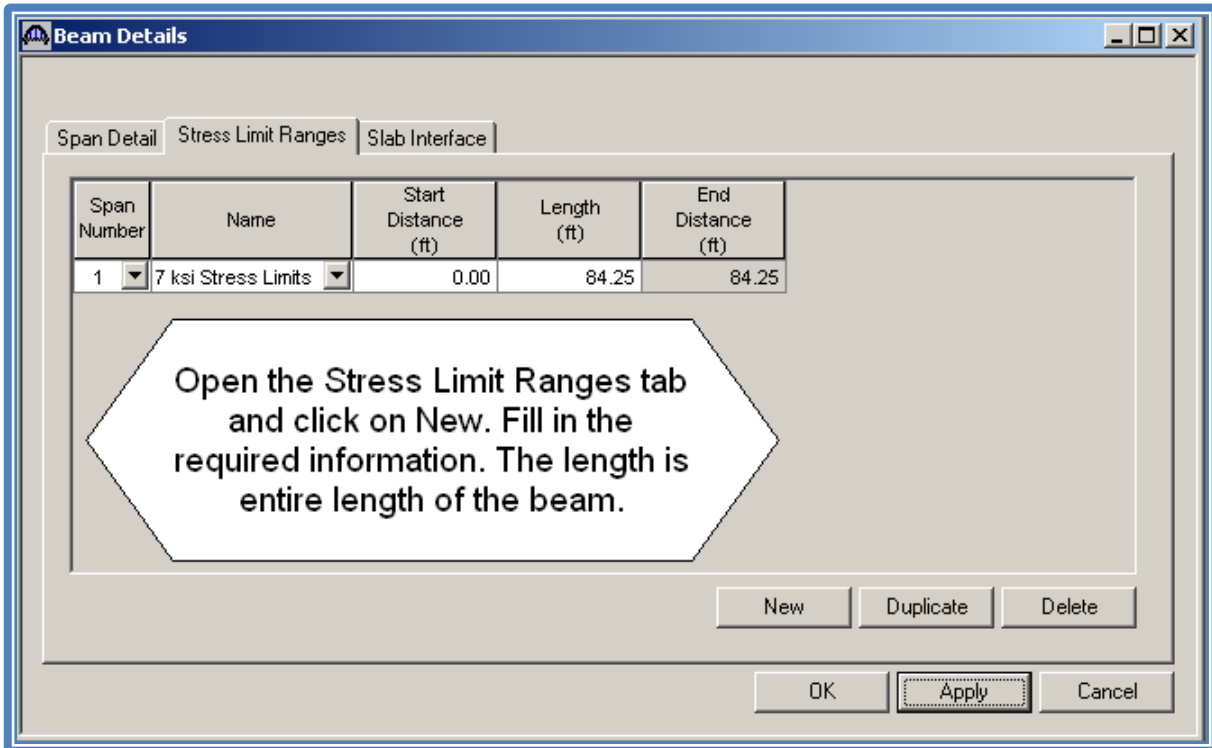
### Shear Computation Method

- This input field is available only for a prestressed member alternative.
- A new option was added to check the shear rating using the AASTHO 1979 Interim Code. If you are rehabbing a bridge that was built prior to 1979 and are having shear issues, discuss this option with BMS and the Bridge Design Engineer.

# Opis 6.1 Tutorial

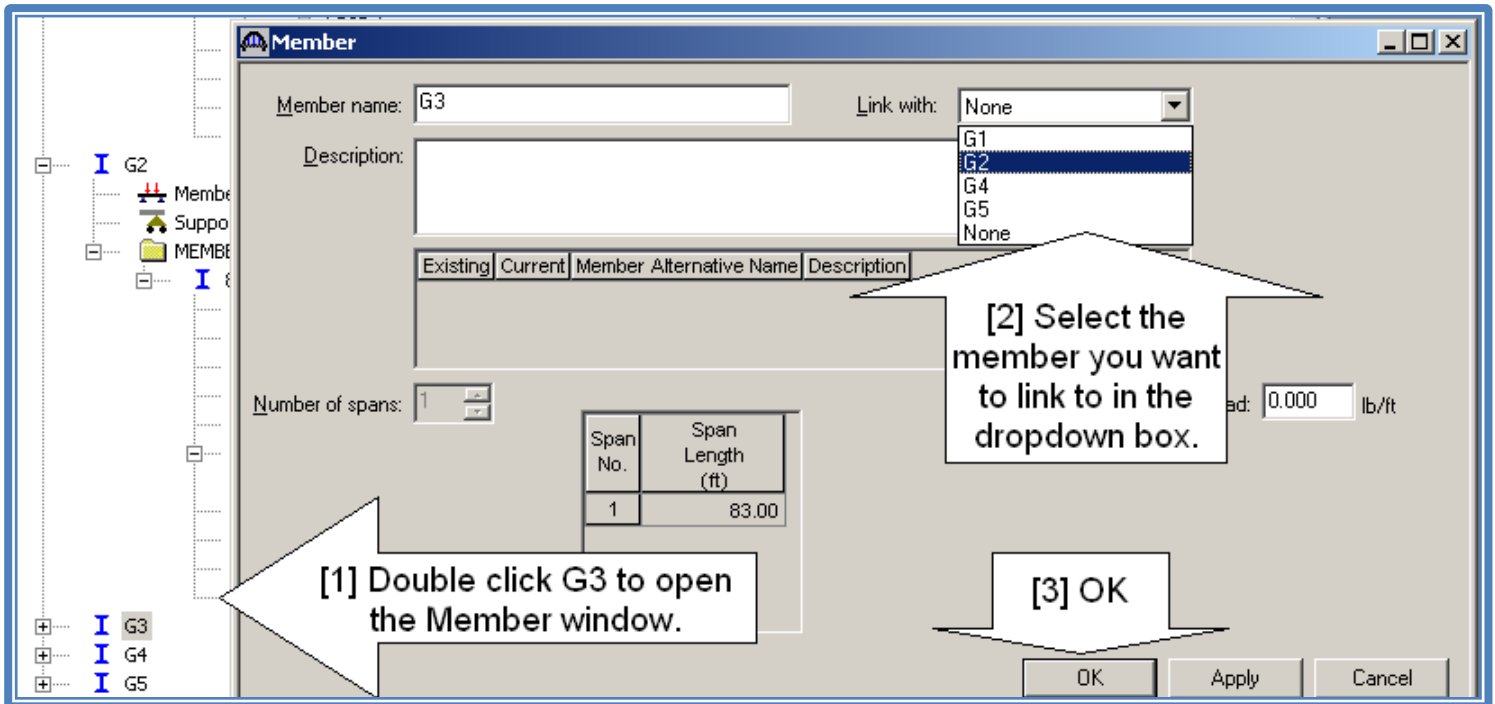


# Opis 6.1 Tutorial



## Opis 6.1 Tutorial

*If you have a symmetrical cross section, you can link beams G3 and G4 to G2, and G5 to G1. To do this, follow the steps below.*



*Repeat this procedure for the remaining beams. If your cross section is not symmetrical, enter the beam data individually.*

*Now go back to page 13 and follow the same steps for G2, the interior beam.*



## Opis 6.1 Tutorial

Now enter the deck information for beams G1 and G2.

[1] Open the Deck Profile window.

Type: PS Precast I

Deck Concrete Reinforcement

Material	Support Number	Start Distance (ft)	Length (ft)	End Distance (ft)	Structural Thickness (in)	Start Effective Flange Width (Std) (in)	End Effective Flange Width (Std) (in)	Start Effective Flange Width (LRFD) (in)	End Effective Flange Width (LRFD) (in)	n
----------	----------------	---------------------	-------------	-------------------	---------------------------	---	---------------------------------------	--	--	---

Compute Deck Profile from Structure Typical Section

Total deck thickness entered on the Structure Typical Section window = 8.0000

Enter a structural thickness to use when computing the effective flange width: 7.5

Compute from Typical Section...

Delete

Cancel

OK

Cancel

[2] Click on the Compute button.

[3] Enter the structural thickness (1/2" less that the deck thickness).

[4] Click OK

# Opis 6.1 Tutorial

Deck Profile

Type: PS Precast I

Exterior Beam

Deck Concrete Reinforcement

Material	Support Number	Start Distance (ft)	Length (ft)	End Distance (ft)	Structural Thickness (in)	Start Effective Flange Width (Std) (in)	End Effective Flange Width (Std) (in)	Start Effective Flange Width (LRFD) (in)	End Effective Flange Width (LRFD) (in)	n
SD	1	0.00	83.00	83.00	7.5000	102.5004	102.5004	102.5004	102.5004	8

The following information will be filled in as shown. There is no need to enter any data in the Reinforcement tab unless you have a continuous-for-live bridge.

Compute from Typical Section... New Duplicate Delete

OK Apply Cancel

Deck Profile

Type: PS Precast I

Interior Beam

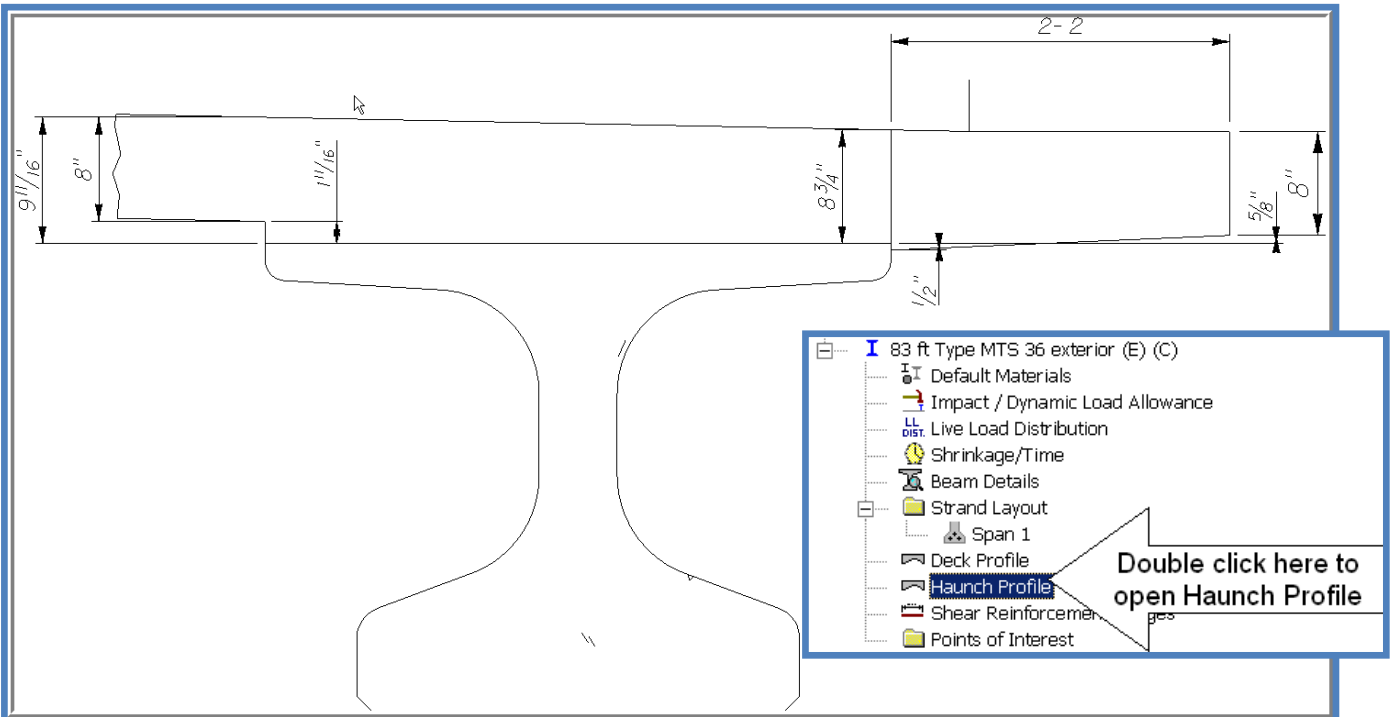
Deck Concrete Reinforcement

Material	Support Number	Start Distance (ft)	Length (ft)	End Distance (ft)	Structural Thickness (in)	Start Effective Flange Width (Std) (in)	End Effective Flange Width (Std) (in)	Start Effective Flange Width (LRFD) (in)	End Effective Flange Width (LRFD) (in)	n
SD	1	0.00	83.00	83.00	7.5000	105.0000	105.0000	105.0000	105.0000	8

Compute from Typical Section... New Duplicate Delete

OK Apply Cancel

# Opis 6.1 Tutorial



**PS Haunch Profile**

[1] Enter haunch data for exterior beam

Support Number	Start Distance (ft)	Length (ft)	End Distance (ft)	Z1 (in)	Z2 (in)	Z3 (in)	Z4 (in)	Y1 (in)	Y2 (in)	Y3 (in)
1	0.00	83.00	83.00	0.0000	0.0000	0.0000	26.0000	1.6875	0.6250	0.5000

**PS Haunch Profile**

[2] Enter haunch data for interior beam

Support Number	Start Distance (ft)	Length (ft)	End Distance (ft)	Z1 (in)	Z2 (in)	Y1 (in)	Y3 (in)
1	0.00	83.00	83.00	0.0000	0.0000	0.7500	0.0000

New Duplicate Delete  
OK Apply Cancel

## Opis 6.1 Tutorial

83 ft Type MTS 36 exterior (E) (C)

- Default Materials
- Impact / Dynamic Load Allowance
- Live Load Distribution
- Shrinkage/Time
- Beam Details
- Strand Layout
  - Span 1
- Deck Profile
- Haunch Profile
- Shear Reinforcement Ranges
- Points of Interest

POI's are automatically generated at the strand transfer locations, critical shear locations and harped locations. So there is generally no need to enter additional POI's.

Standard LRFD

Action: Deflection

Support Number	Start Distance (ft)	Length (ft)	End Distance (ft)	Distribution Factor (Lanes)	
				1 Lane	Multi-Lane
1	0.00	83.00	83.00	0.240	0.510

Compute from Typical Section... View Calcs Delete

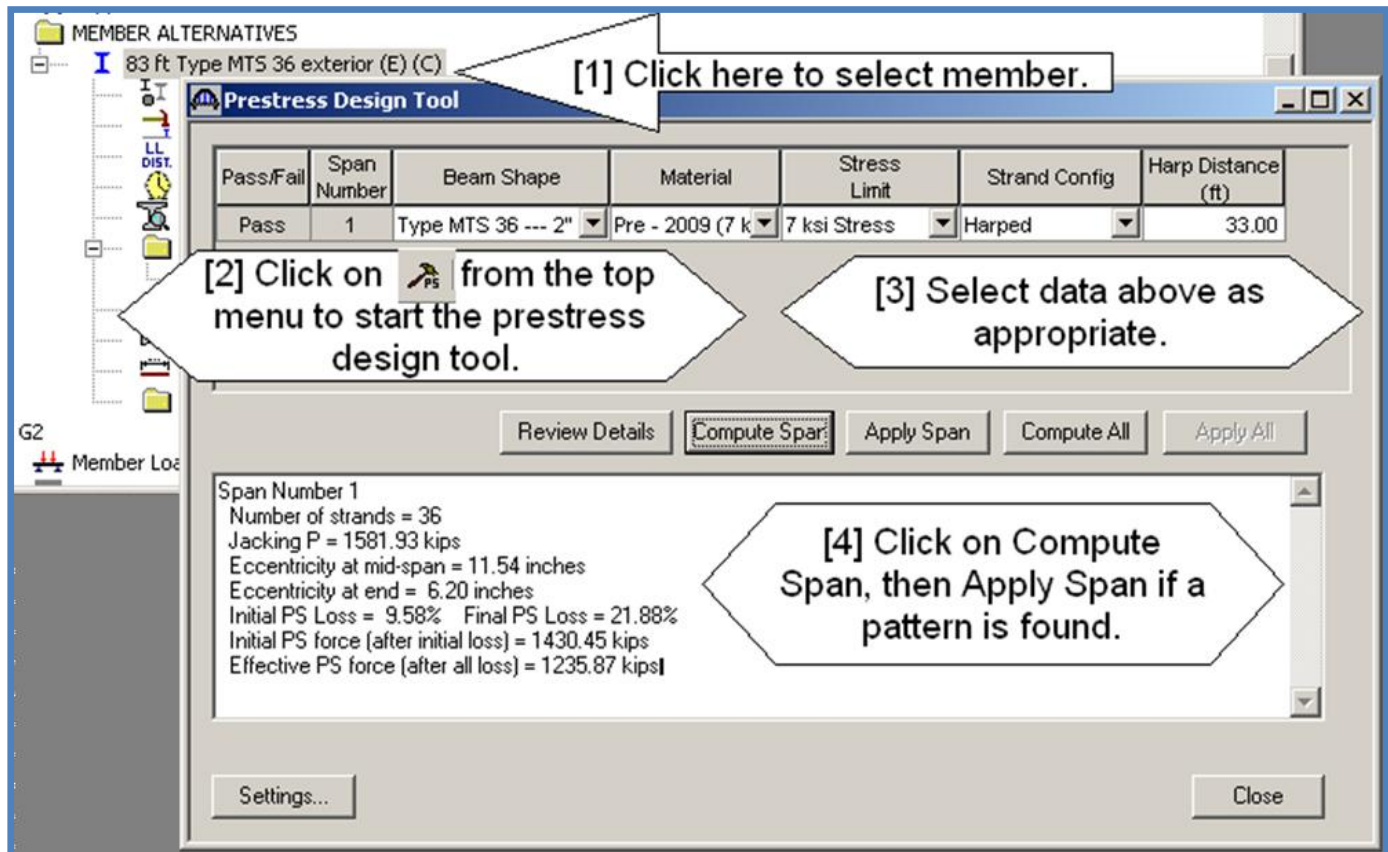
OK Apply Cancel

[1] These fields will now be populated.

[2] You can view the calculations by clicking this button or by opening the Spy Glasses.


[3] Repeat for Interior Beam. You can also compute the standard dist. factors if you wish, but it is not necessary.

## Prestressed Design Tool



*The Prestress Design Tool will calculate both a strand pattern and a shear steel design (if no shear steel has been defined yet). If no strand pattern is found, it doesn't mean that there is not one that will work. You will need to enter one and check it. A good starting point is to fill the bottom two rows, add a few harped strands, and then analyze the beam. See Appendix B for a procedure for designing from scratch. If a strand pattern is found, it is likely to be under designed. You will need to analyze the beam to check for failures and adjust the pattern accordingly. The shear pattern will likely be OK, but will not match our standard spacing. Concentrate on the strand pattern first, then move on to the shear design.*

## Analyze Beam

[1] Click on  from the top menu open the Analysis Settings window.

[2] Click here to open the template window.

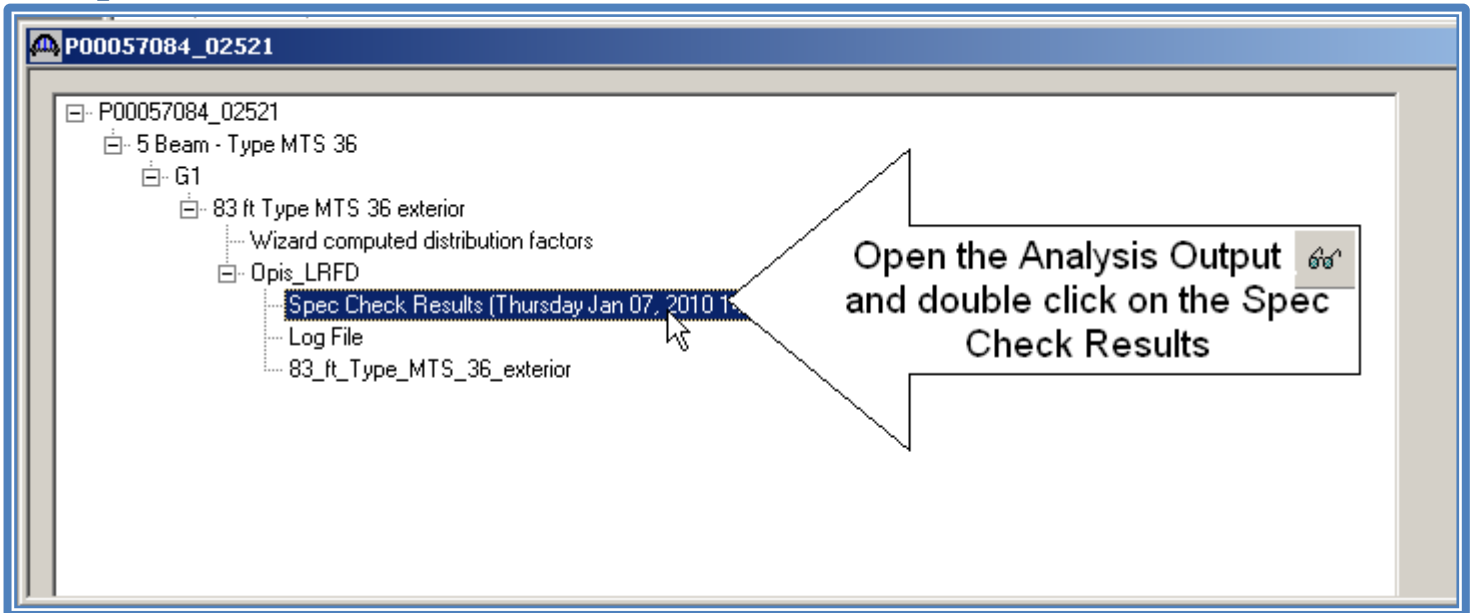
[3] Select a template, then click on Open.

Templates	Description	Analysis	Owner	Public/Private
Default Design Review - SI...	Design Review	Design-Review		Public
Default Design Review - US...	Design Review	Design-Review		Public
ENERGY TRANSPORT	Design Review	Rating	OPS\$U14...	Private
goat	Design Review	Design-Review	OPS\$U50...	Private
Goat R	Virtis/Opis' new analysis event	Rating	OPS\$U50...	Private
LRFR R	Virtis/Opis' new analysis event	Rating		Public
rating	Virtis/Opis' new analysis event	Rating		Public
er alt	Virtis/Opis' new analysis event	Rating		Public

[4] Right click here and select Analyze.

MEMBER ALTERNATIVES
83 ft Type MTS 36 exterior (E) (C)
Default Materials
Impact / Dynamic Load Allow
Live Load Distribution
Shrinkage/Time
Beam Details
Strand Layout
Span 1
Deck Profile
Haunch Profile
Shear Reinforcement Range
Points of Interest

## Spec Check Results



*This gives you a summary of the Specification Results and a table for each of the articles checked. The next page shows a sample of this report. You can easily zero in on failure locations and adjust the strand pattern accordingly. You can also open the Spec Checker for in depth calculations.*

Specification Checks for 83 ft Type MTS 36 exterior - 21 of 614

Specification Reference	Limit State	Flex. Se...	Pass/Fail
✓ 2.5.2.6.2 Criteria for Deflection		N/A	Passed
5.11.4.2 Bonded Strand		N/A	General Comp.
5.4.2.5 Poisson's Ratio		N/A	General Comp.
5.4.2.6 Modulus of Rupture		N/A	General Comp.
5.7.2.2 Rectangular Stress Distribution		N/A	General Comp.
✓ 5.7.3.2 Flexural Resistance (Prestressed Concrete)		N/A	Passed
✓ 5.7.3.3.2 Minimum Reinforcement		N/A	Passed
✓ 5.8.2.5 Minimum Transverse Reinforcement		N/A	Passed
✓ 5.8.2.7 Maximum Spacing of Transverse Reinforcement		N/A	Passed
✓ 5.8.3.3 Nominal Shear Resistance		N/A	Passed
5.8.3.4 Procedures for Determining Shear Resistance		N/A	General Comp.
✗ 5.8.3.5 Longitudinal Reinforcement		N/A	Failed
NA 5.8.4 Interface Shear Transfer		N/A	Not Required
NA 5.8.4.4 Minimum Area of Interface Shear Reinforcement		N/A	Not Required
✓ 5.9.4.2.1 Compression Stresses		N/A	Passed
✓ 5.9.4.2.2 Tension Stresses		N/A	Passed
Computation of Vp		N/A	General Comp.
Cracked_Moment_of_Inertia Section Property Calculations		Positive ...	General Comp.
Cracked_Moment_of_Inertia Section Property Calculations		Negative...	General Comp.
PS_Basic_Properties Calculation		N/A	General Comp.
PS_Gross_Composite_Section_Properties PS Gross Comp...		N/A	General Comp.

**KEY:**  
 [Folder Icon] Code Calculation  
 ✓ Code Check - Pass  
 ✗ Code Check - Fail  
 NA Code Section N/A

All code checks are contained inside the appropriate folder.



## Opis 6.1 Tutorial

### Specification Check Summary

Article	Status
Initial Stress at Transfer (5.9.4.1.1, 5.9.4.1.2)	Pass
Final Stress due to Permanent and Transient Loads (5.9.4.2.1, 5.9.4.2.2)	Fail
Flexure (5.7.3.2, 5.7.3.3.2)	Pass
Shear (5.8.3.3, 5.8.2.5, 5.8.2.7, 5.8.3.5)	Pass
Deflection (5.7.3.6.2)	Pass

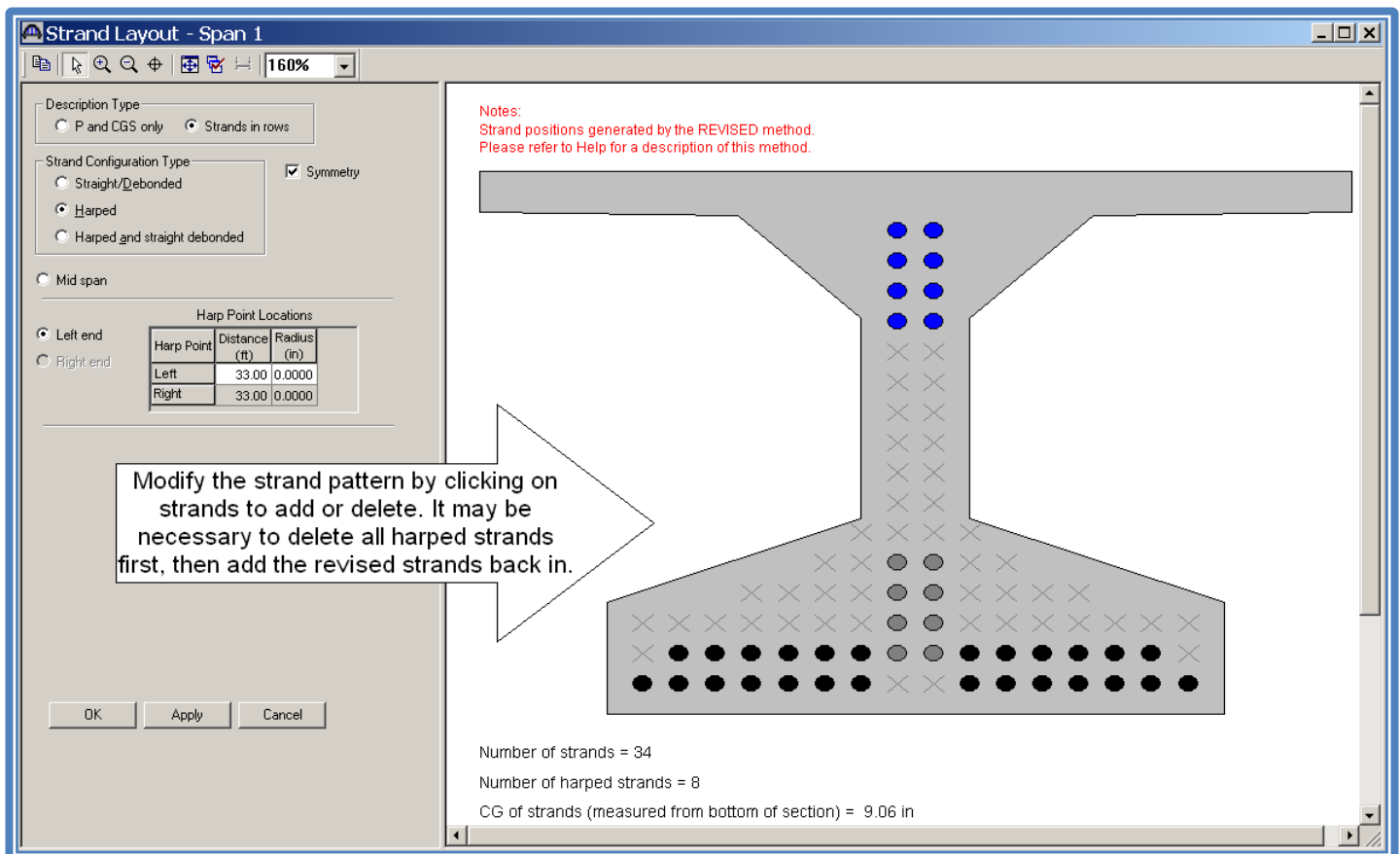
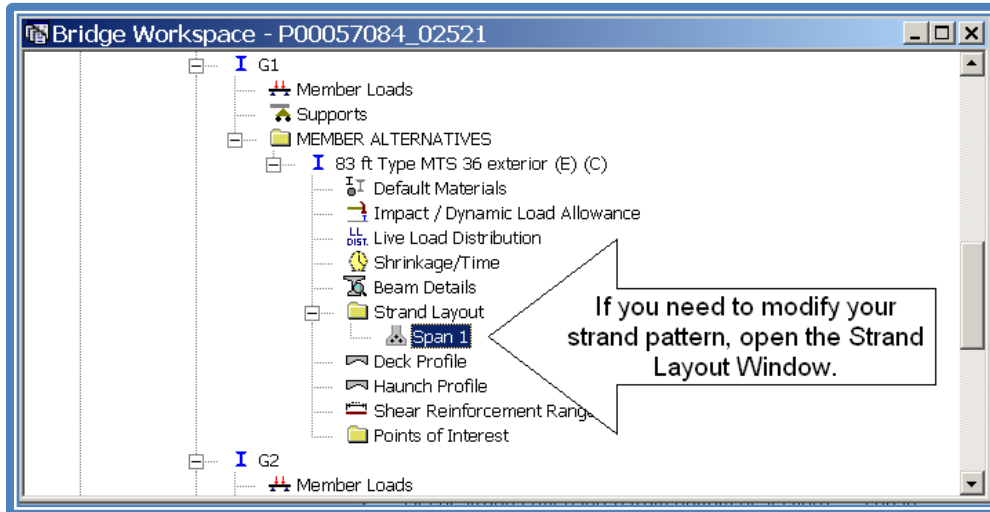
### Final Tension Stress due to Permanent and Transient Loads

Location (ft)	Allowable Stress (ksi)	Actual Stress Top of Beam (ksi)	Actual Stress Bot of Beam (ksi)	Ratio	Code
0.000	0.50	-0.10	-0.61	99.00	Pass
2.375	0.50	-0.78	-2.47	99.00	Pass
8.300	0.50	-1.44	-1.50	99.00	Pass
16.600	0.50	-2.14	-0.47	99.00	Pass
24.900	0.50	-2.56	0.18	2.75	Pass
32.375	0.50	-2.70	0.46	1.09	Pass
33.200	0.50	-2.73	0.50	1.01	Pass
41.500	0.50	-2.86	0.66	0.77	Fail
49.800	0.50	-2.73	0.50	1.01	Pass
50.625	0.50	-2.70	0.46	1.09	Pass
58.100	0.50	-2.56	0.18	2.75	Pass
66.400	0.50	-2.14	-0.47	99.00	Pass
74.700	0.50	-1.44	-1.50	99.00	Pass
80.625	0.50	-0.78	-2.47	99.00	Pass
83.000	0.50	-0.10	-0.61	99.00	Pass



## Opis 6.1 Tutorial

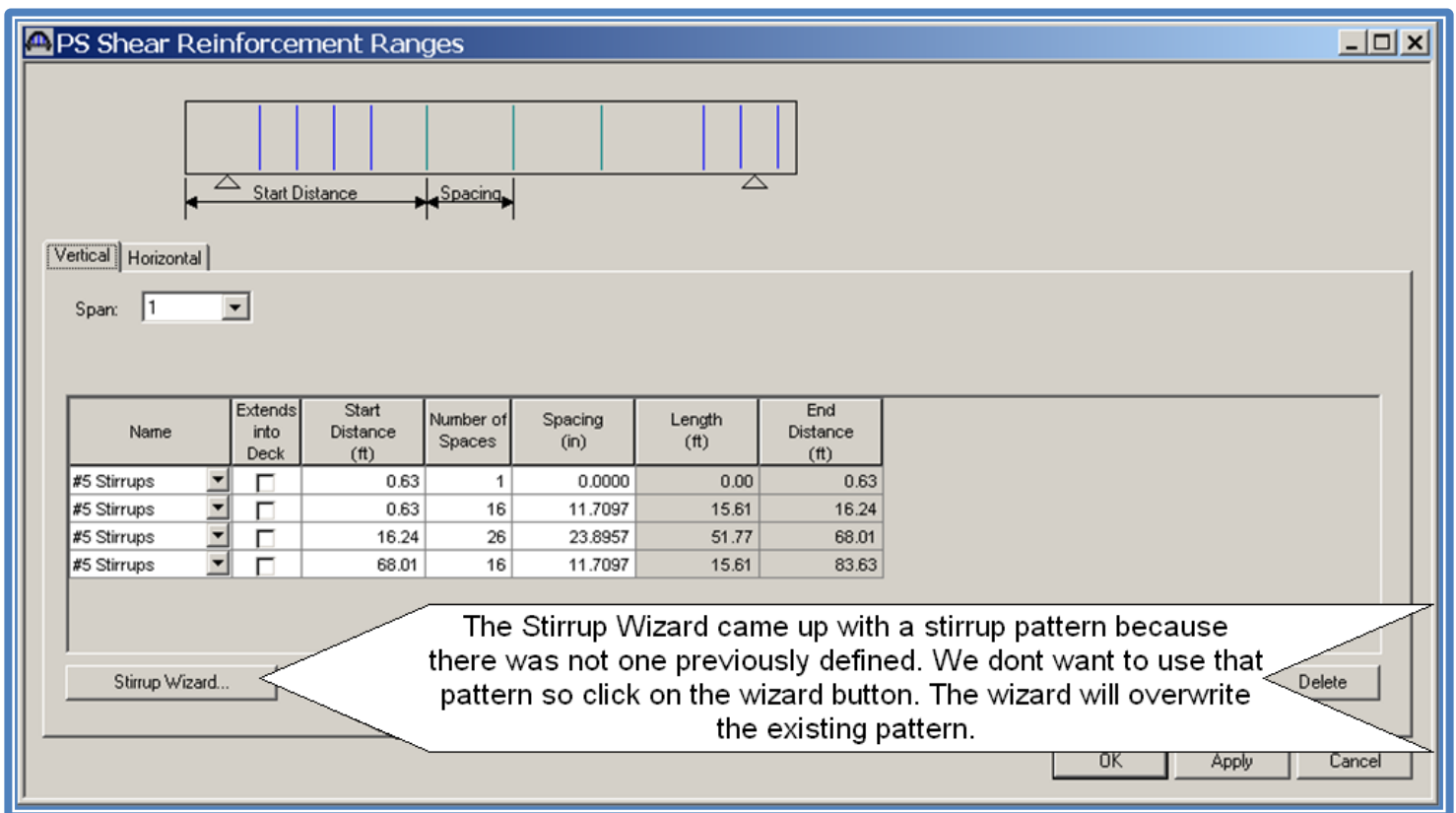
*If you have failures, open the strand layout and modify the strand pattern. Then re-analyze. Repeat this until you have a strand pattern that works all beams.*



*Within a couple iterations, I found a pattern that worked for all stresses and flexure. Next, add this same pattern to the interior beam and analyze it. After doing that, I found it to be satisfactory.*

*Now I need to add our standard shear reinforcing and analyze it. Since we don't have a standard for the Super Girder shapes yet, I will start with the pattern for the MT-28 and modify as I go.*

## Shear Reinforcement Ranges



Name	Extends into Deck	Start Distance (ft)	Number of Spaces	Spacing (in)	Length (ft)	End Distance (ft)
#5 Stirrups	<input type="checkbox"/>	0.63	1	0.0000	0.00	0.63
#5 Stirrups	<input type="checkbox"/>	0.63	16	11.7097	15.61	16.24
#5 Stirrups	<input type="checkbox"/>	16.24	26	23.8957	51.77	68.01
#5 Stirrups	<input type="checkbox"/>	68.01	16	11.7097	15.61	83.63

The Stirrup Wizard came up with a stirrup pattern because there was not one previously defined. We dont want to use that pattern so click on the wizard button. The wizard will overwrite the existing pattern.

## Opis 6.1 Tutorial

The screenshot shows the "Stirrup Wizard" dialog box. At the top, there are fields for "Span:" (set to 1) and "Start distance:" (set to 0.17 ft), along with a checked "Extends to deck" checkbox. Below this is a table with three columns: "Reinf. Name", "Number of Spaces", and "Spacing (in)". The table contains five rows of "#5 Stirrups" with varying numbers of spaces and spacings. Below the table are buttons for "New", "Duplicate", and "Delete". At the bottom left, there is a "Symmetry" section with a checked "Finish by symmetry" checkbox and two radio buttons: "Even number spaces" (unselected) and "Odd number spaces" (selected). At the bottom center is an "Apply" button. Four callout boxes with arrows point to specific elements: [1] points to the "Start distance" field and "Extends to deck" checkbox; [2] points to the "Spacing (in)" column of the table; [3] points to the "Finish by symmetry" checkbox and the "Odd number spaces" radio button; [4] points to the "Apply" button.

**Stirrup Wizard**

Span: 1 Start distance: 0.17 ft  Extends to deck

Reinf. Name	Number of Spaces	Spacing (in)
#5 Stirrups	2	6.0000
#5 Stirrups	8	6.0000
#5 Stirrups	4	12.0000
#5 Stirrups	1	18.0000
#5 Stirrups	15	24.0000

New Duplicate Delete

Symmetry

Finish by symmetry

Even number spaces

Odd number spaces

Apply

[1] Enter the start distance as 0.17'(2") and check Extends Into Deck


[2] Enter the stirrup spacing for the left half of the beam ending just short of midspan.

[3] Check the Finish By Symmetry and the Odd Number Spaces buttons. Do not use Even Spaces unless your spacing gets you to the exact center.

[4] Click Apply and it will mirror your pattern about the center of the beam.

## Opis 6.1 Tutorial

PS Shear Reinforcement Ranges



Vertical | Horizontal

Span: 1

[1] Uncheck the stirrups that do not extend into the deck.

Name	Extends into Deck	Start Distance (ft)	Number of Spaces	Spacing (in)	Length (ft)	End Distance (ft)
#5 Stirrups	<input type="checkbox"/>	0.170000	1	0.000000	0.00	0.17
#5 Stirrups	<input type="checkbox"/>	0.170000	2	6.000000	1.00	1.17
#5 Stirrups	<input checked="" type="checkbox"/>	1.170000	8	6.000000	4.00	5.17
#5 Stirrups	<input checked="" type="checkbox"/>	5.170000	4	12.000000	4.00	9.17
#5 Stirrups	<input checked="" type="checkbox"/>	9.170000	1	18.000000	1.50	10.67
#5 Stirrups	<input checked="" type="checkbox"/>	10.670000	15	24.000000	30.00	40.67
#5 Stirrups	<input checked="" type="checkbox"/>	40.670000	1	34.920000	2.91	43.58
#5 Stirrups	<input checked="" type="checkbox"/>	43.580000	15	24.000000	30.00	73.58
#5 Stirrups	<input checked="" type="checkbox"/>	73.580000	1	18.000000	1.50	75.08
#5 Stirrups	<input checked="" type="checkbox"/>	75.080000	4	12.000000	4.00	79.08
#5 Stirrups	<input checked="" type="checkbox"/>	79.080000	8	6.000000	4.00	83.08
#5 Stirrups	<input type="checkbox"/>	83.080000	2	6.000000	1.00	84.08

[2] Since this spacing exceeds 24 inches, divide it into two equal spaces. Use 2 spaces at 17.46 inches.

Stirrup Wizard... New Duplicate Delete

OK Apply Cancel

*Now re-analyze the exterior beam and check the shear specs.*

*Keep tweaking the reinforcement until you are able to satisfy shear requirements. If you still have longitudinal reinforcement failures in the mid span region, they can be ignored if they meet AASHTO 5.8.3.5, pg 5-83.*


**AASHTO 5.8.3.5**

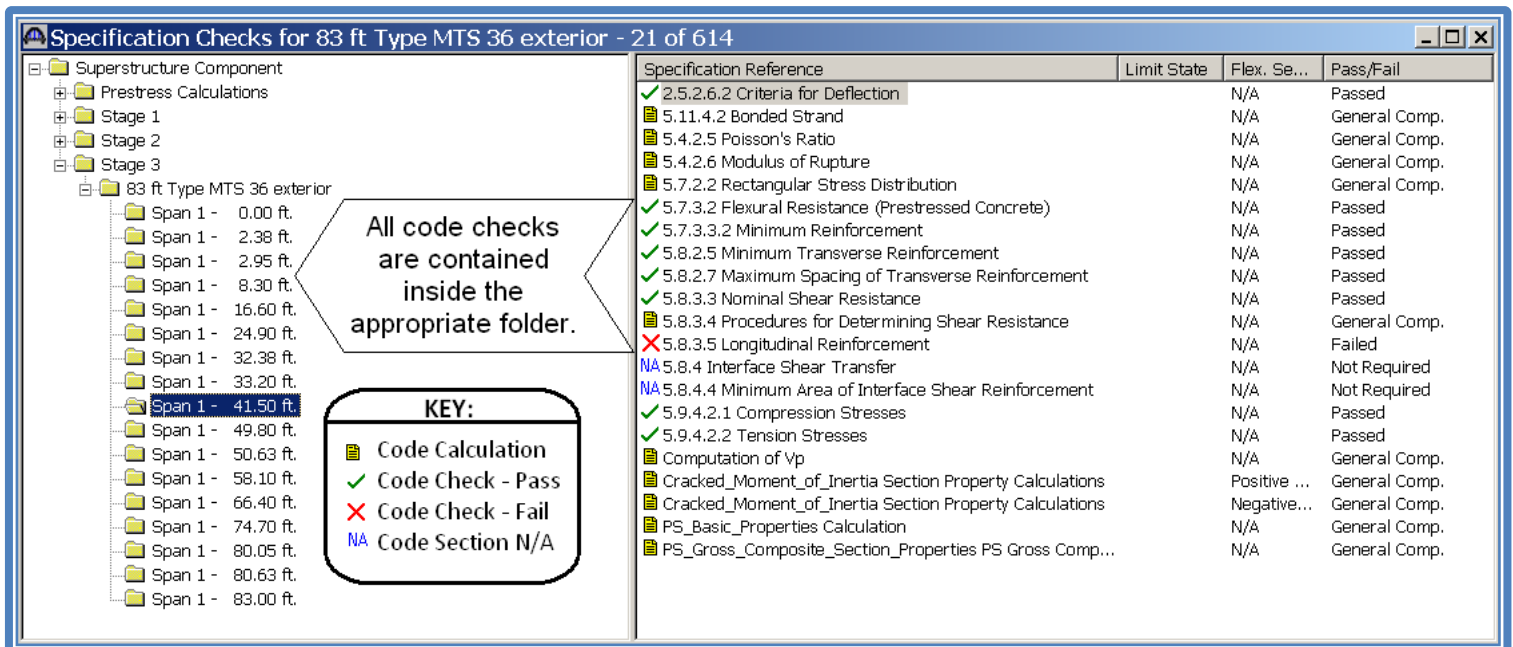
**Page 5-83**

The area of longitudinal reinforcement on the flexural tension side of the member need not exceed the area required to resist the maximum moment acting alone. This provision applies where the reaction force or the load introduces direct compression into the flexural compression face of the member.

## Opis 6.1 Tutorial


*When your shear requirements are met, enter the same shear data for the remaining beams. The easiest way to do this is to open both shear windows side-by-side and transfer the data. Then analyze the remaining beams. Be aware that in the spec check summary shear table, the failures are not colored red as they are in the other tables. This is a bug and has been reported.*

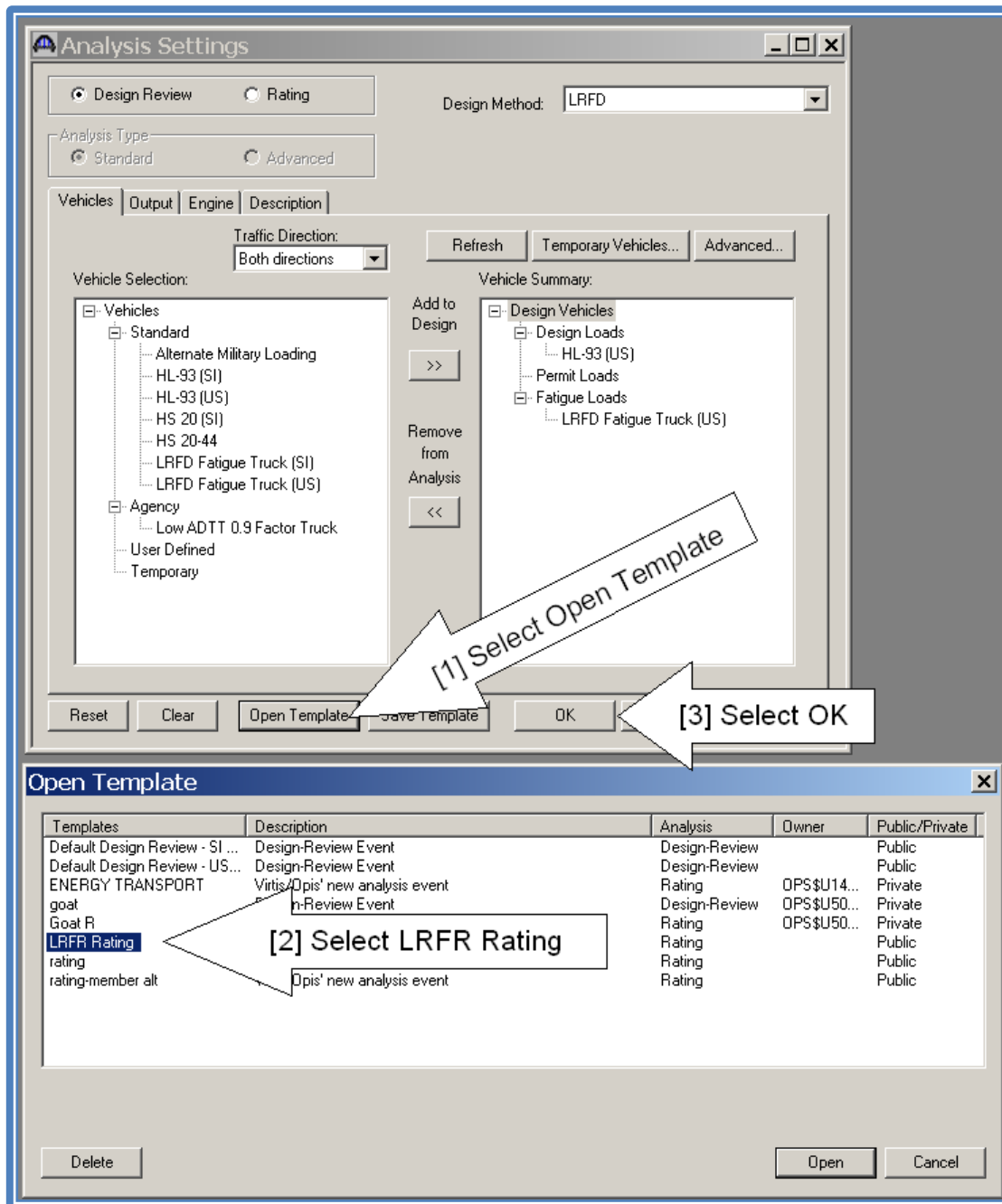
*You can also check the actual Spec Checker  for more information on values of variables and code equations.*



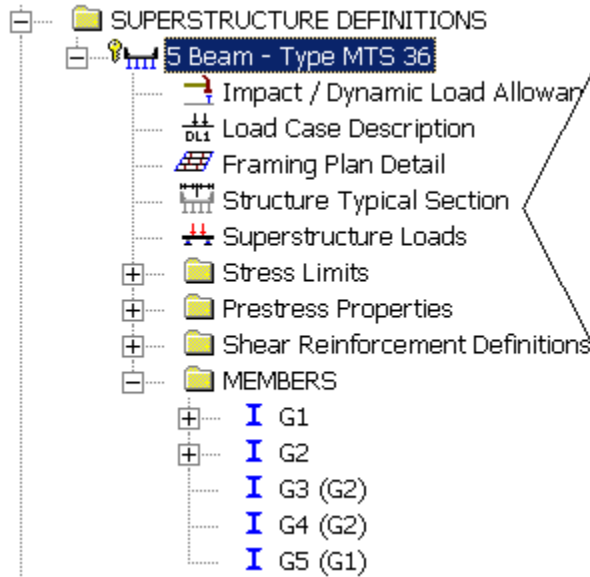
Specification Reference	Limit State	Flex. Se...	Pass/Fail
✓ 2.5.2.6.2 Criteria for Deflection		N/A	Passed
5.11.4.2 Bonded Strand		N/A	General Comp.
5.4.2.5 Poisson's Ratio		N/A	General Comp.
5.4.2.6 Modulus of Rupture		N/A	General Comp.
5.7.2.2 Rectangular Stress Distribution		N/A	General Comp.
✓ 5.7.3.2 Flexural Resistance (Prestressed Concrete)		N/A	Passed
✓ 5.7.3.3.2 Minimum Reinforcement		N/A	Passed
✓ 5.8.2.5 Minimum Transverse Reinforcement		N/A	Passed
✓ 5.8.2.7 Maximum Spacing of Transverse Reinforcement		N/A	Passed
✓ 5.8.3.3 Nominal Shear Resistance		N/A	Passed
5.8.3.4 Procedures for Determining Shear Resistance		N/A	General Comp.
✗ 5.8.3.5 Longitudinal Reinforcement		N/A	Failed
NA 5.8.4 Interface Shear Transfer		N/A	Not Required
NA 5.8.4.4 Minimum Area of Interface Shear Reinforcement		N/A	Not Required
✓ 5.9.4.2.1 Compression Stresses		N/A	Passed
✓ 5.9.4.2.2 Tension Stresses		N/A	Passed
Computation of $V_p$		N/A	General Comp.
Cracked_Moment_of_Inertia Section Property Calculations		Positive ...	General Comp.
Cracked_Moment_of_Inertia Section Property Calculations		Negative...	General Comp.
PS_Basic_Properties Calculation		N/A	General Comp.
PS_Gross_Composite_Section_Properties PS Gross Comp...		N/A	General Comp.


## Bridge Rating

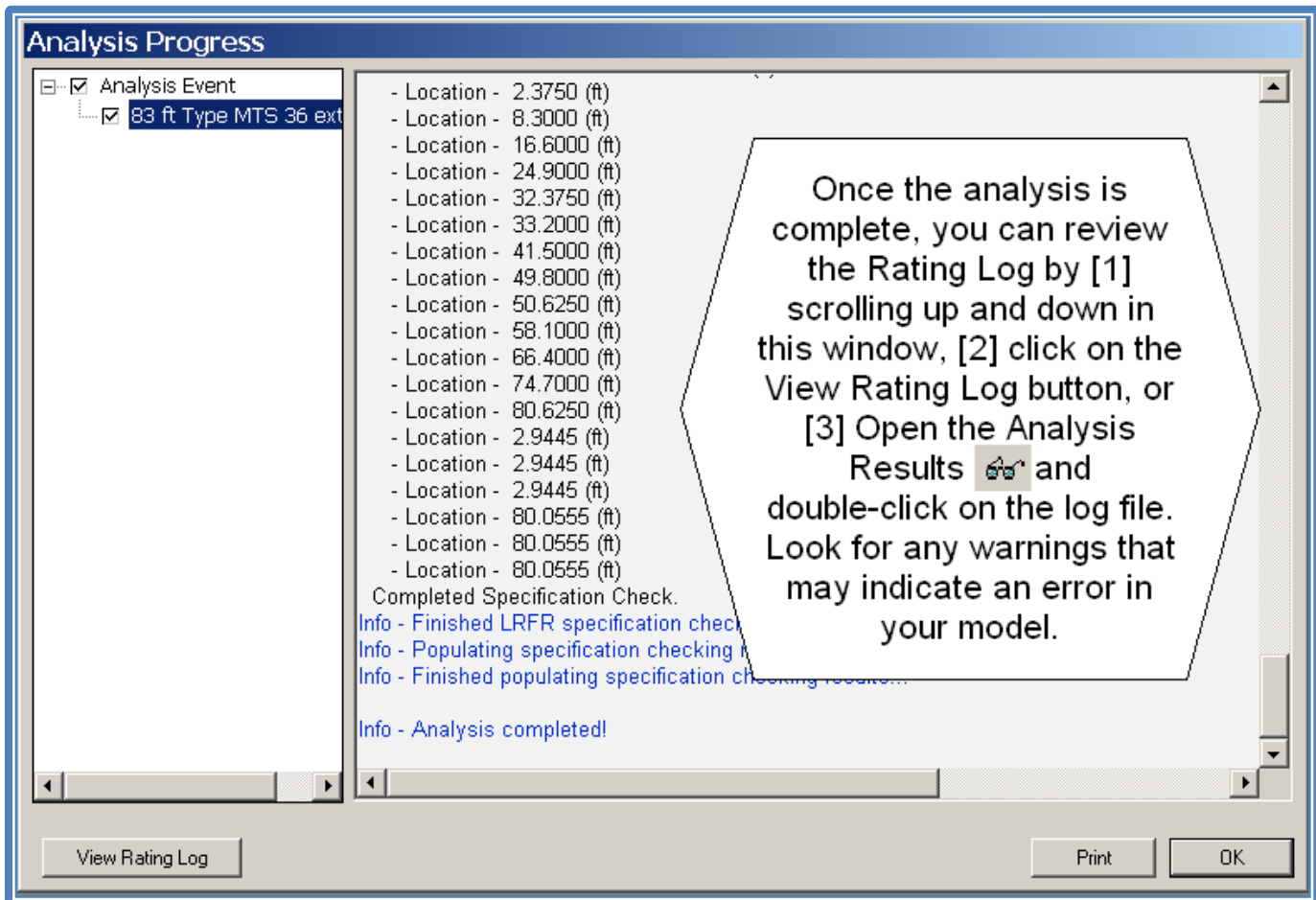
When you are satisfied with the design, check the rating. Open the analysis settings  and select the LRFR Rating. Then run the Analysis for the entire structure definition.




# Opis 6.1 Tutorial




[4] Click on the superstructure definition, [5] Then the Analyze button 



Once the analysis is complete, you can review the Rating Log by [1] scrolling up and down in this window, [2] click on the View Rating Log button, or [3] Open the Analysis Results  and double-click on the log file. Look for any warnings that may indicate an error in your model.


## Opis 6.1 Tutorial

To view the rating results, click on the member in the Member Alternatives folder that you want to view, then the View Analysis Report  button will activate. Click the button and the following window will appear. You can only view the rating for one member at a time.

Analysis Results - 83 ft Type MTS 36 exterior

Report Type: Rating Results Summary | Lane/Impact Loading Type:  As Requested  Detailed | Display Format: Single rating level per row

Live Load	Live Load Type	Rating Method	Rating Level	Load Rating (Ton)	Rating Factor	Location (ft)	Location Span-(%)	Limit State	Impact	Lane
HL-93 (US)	Truck + Lan	LRFR	Inventory	36.12	1.003	41.50	1 - ( 50.0)	SERVICE-III Tensile Stress	As Requested	As Requested
HL-93 (US)	Truck + Lane	LRFR	Operating	55.44	1.540	8.30	1 - ( 10.0)	STRENGTH-I Concrete Shear	As Requested	As Requested
Type 3	Axle Load	LRFR	Inventory	46.23	1.849	41.50	1 - ( 50.0)	SERVICE-III Tensile Stress	As Requested	As Requested
Type 3	Axle Load	LRFR	Operating	71.44	2.858	41.50	1 - ( 50.0)	STRENGTH-I Concrete Flexure	As Requested	As Requested
Type 3S2	Axle Load	LRFR	Inventory	57.88	1.608	41.50	1 - ( 50.0)	SERVICE-III Tensile Stress	As Requested	As Requested
Type 3S2	Axle Load	LRFR	Operating	89.45	2.485	41.50	1 - ( 50.0)	STRENGTH-I Concrete Flexure	As Requested	As Requested
Type 3-3	Axle Load	LRFR	Inventory	65.34	1.634	41.50	1 - ( 50.0)	SERVICE-III Tensile Stress	As Requested	As Requested
Type 3-3	Axle Load	LRFR	Operating	100.98	2.525	41.50	1 - ( 50.0)	STRENGTH-I Concrete Flexure	As Requested	As Requested

To review the rating summary, click on the View Analysis Reports. 

Virtis LRFR Engine Version 6.1.0.3001

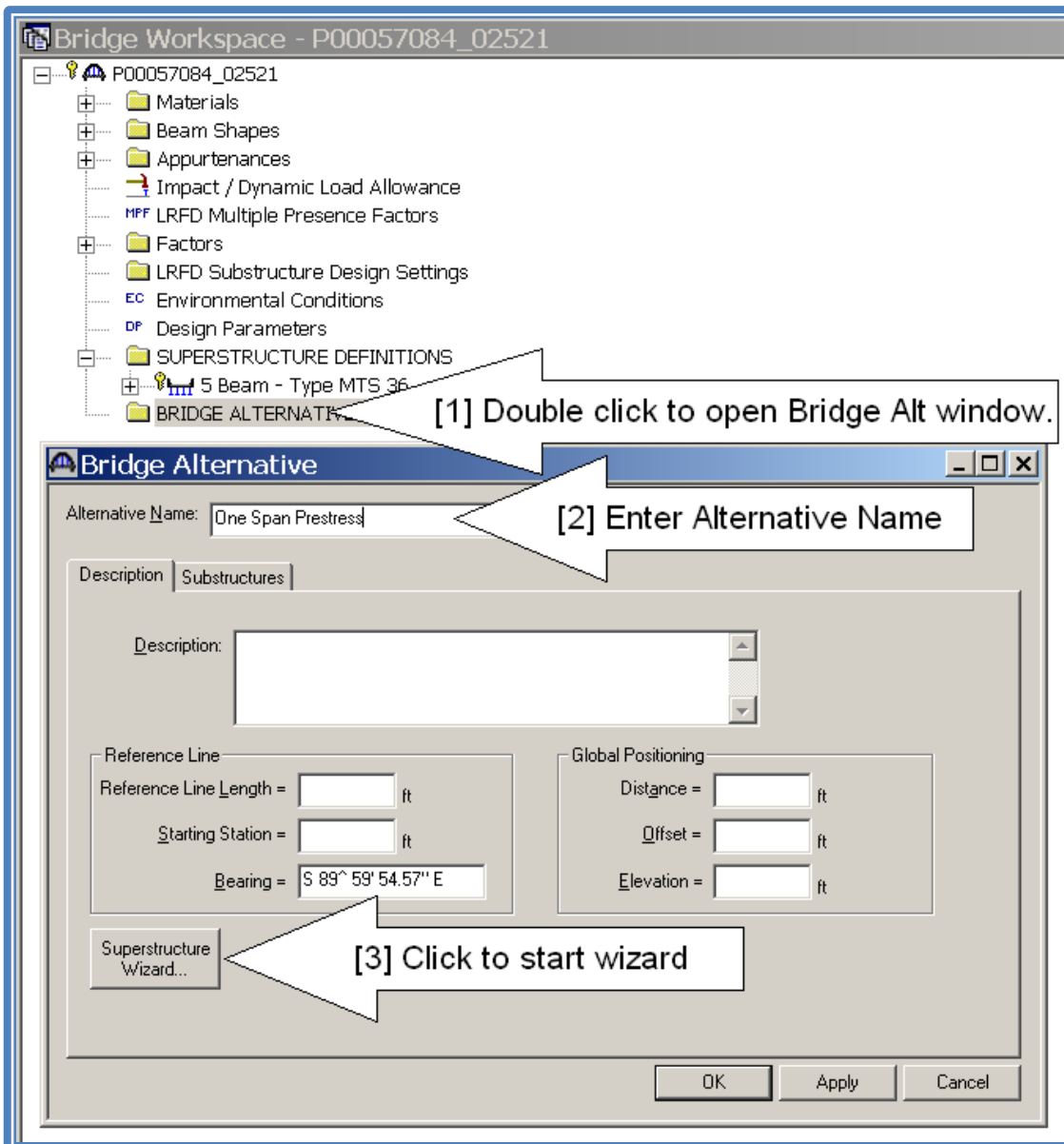
Close

The rating factor needs to be greater than 1.0. You can change the display format to "Single Rating Level per Row" to make the table easier to read. The Location and Limit State columns tell you where and what is controlling the rating.

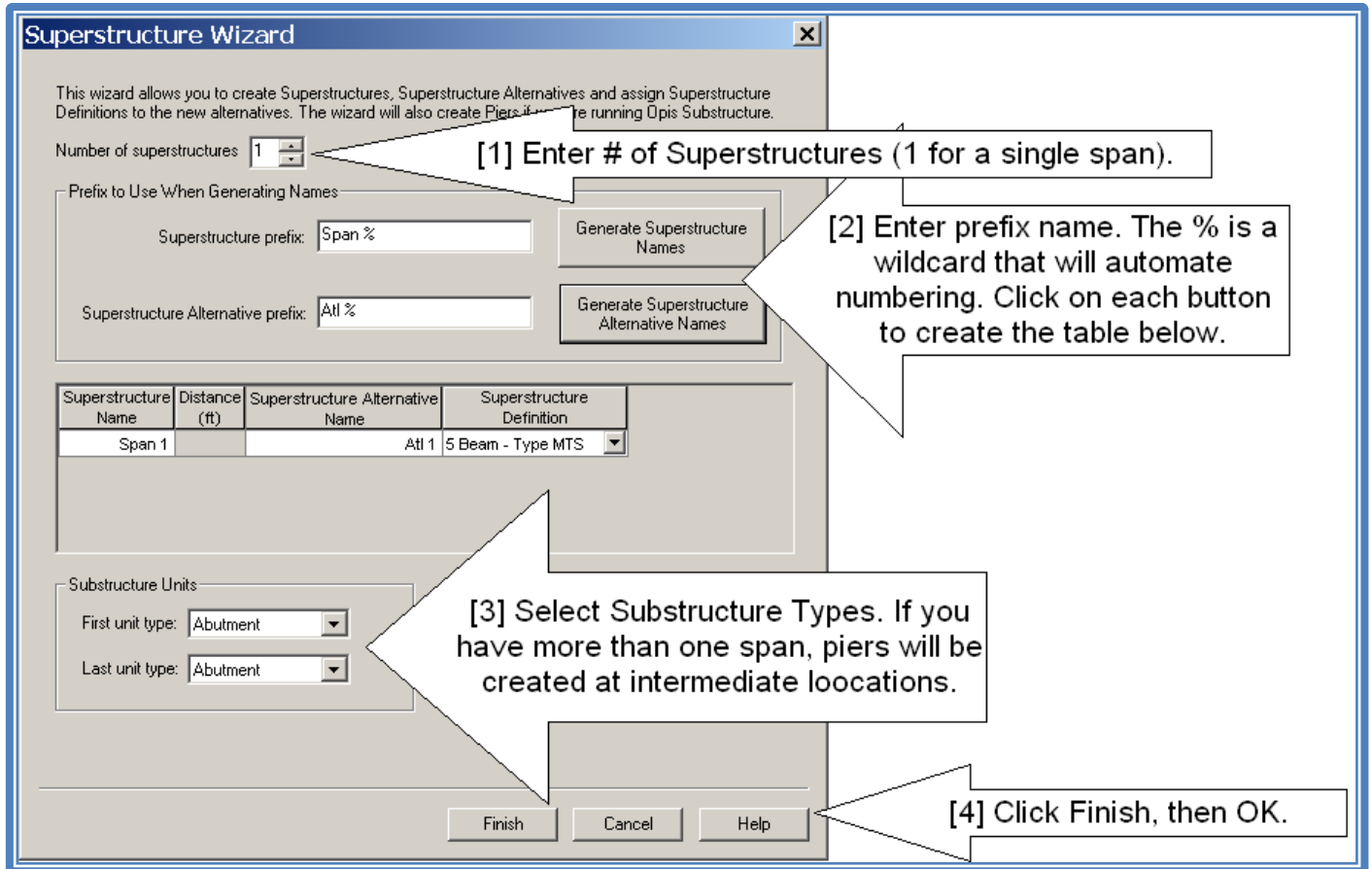


## Building the Bridge Alternative Model

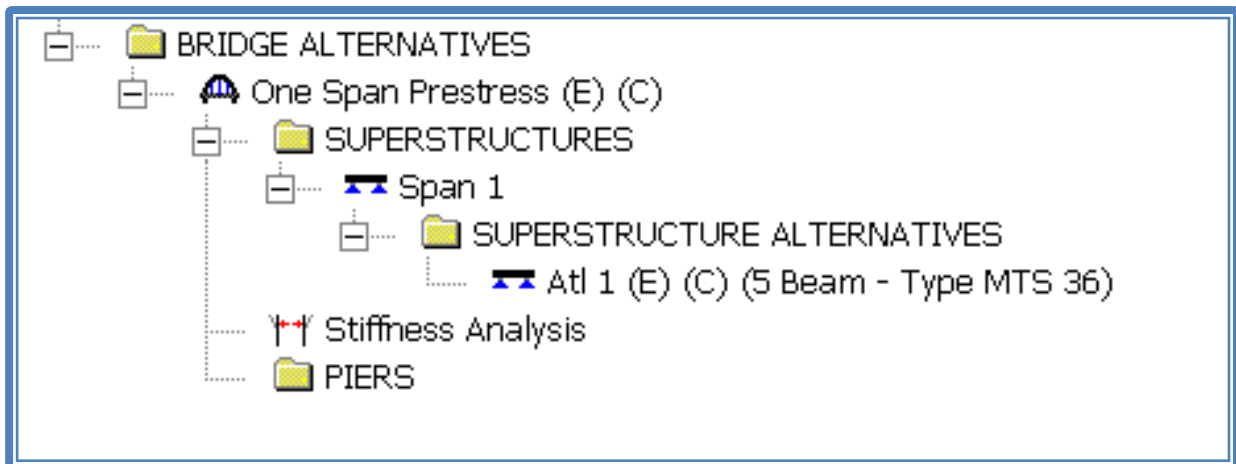
*The last step in creating the model is to build the Bridge Alternative Tree. This is where you put all the superstructure pieces together to define your complete bridge. This particular example is a single span bridge so there is only one superstructure. Opis 6.1 introduced a wizard to assist in building the tree.*



## Opis 6.1 Tutorial

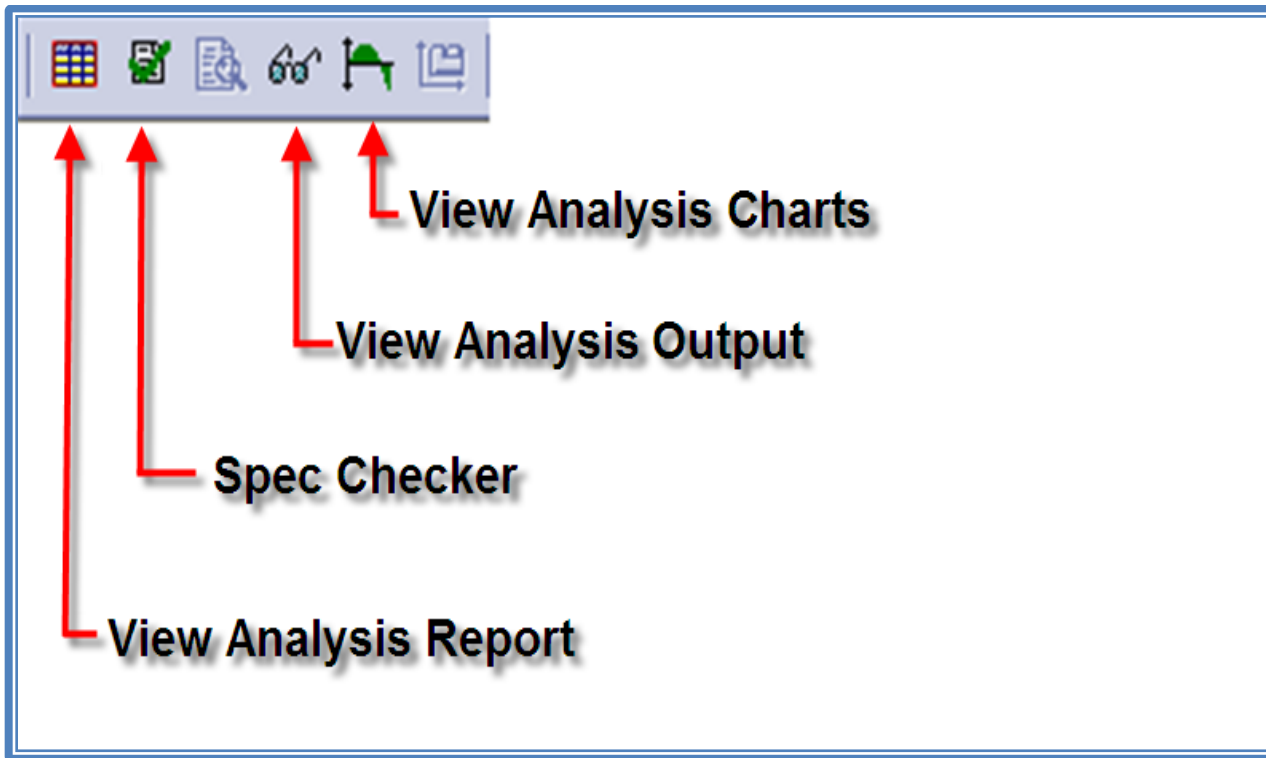


The following tree is created:



*When your design is complete and you are satisfied with the design and rating for all beams, open the Bridge Description window (top line in the tree). Change the name from "Draft Bridge" to "Design Complete".*

## APPENDIX A - Reports



### **View Analysis Report**

***Opis:** This contains tabular results of all dead and live load actions for all load stages. The actions include Moments, Shears, Axial Loads, Reactions and Deflections. They can be printed or copied and pasted into another document such as Excel.*

***Virtis:** The report contains the rating summary along with the action tables as listed above. The rating factors are found in this table.*



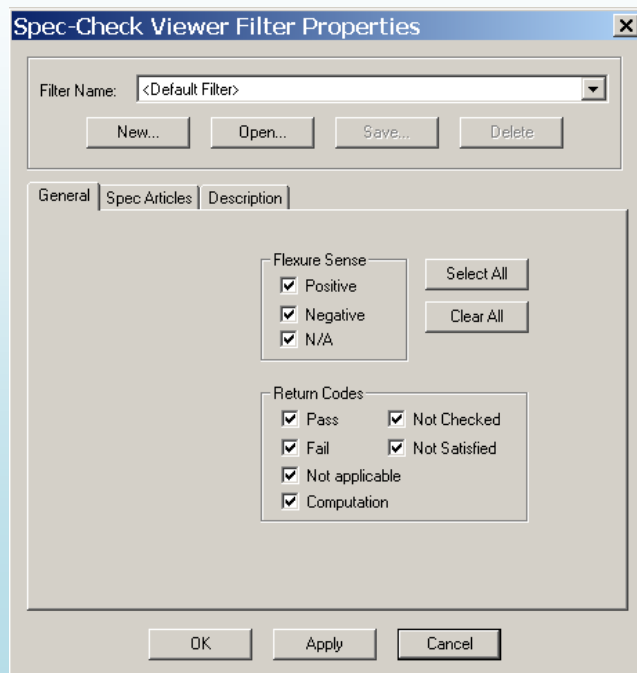
## Spec Checker

*Opis: This report contains all of the LRFD specification check calculations. They are organized in a logical tree structure. The checks and calculations can be found in the appropriate folder. Any or all of the calculations can be printed using the Reports Tool.*

*Virtis: This report contains all of the LRFR specification check calculations. They are organized in a tree structure as described above.*

## Filter

*The filter can be used to refine Spec Check Output. You can turn off certain checks and codes. You can also save the filter for later use.*





## **View Analysis Output**

Opis: This is a customizable report. You can set the reports that you want created in the Analysis Settings Output Tab. The customizable reports are more information than you generally need but they are turned on in the analysis settings templates in case you really want to dig in. **The most useful report here is the Spec Check Summary Report.** It puts all the spec checks into a very convenient table. You can use it to quickly find deficiencies in your beam.

Virtis: This is also a customizable report again with probably way more information than you will need.



## **Report Tool**

Opis: The report tool has many functions.

1. Select a BWS (bridge workspace or input file) report from the dropdown box then select either a pre-built report with the “open” button or create your own with the “new” button.
2. Select an Analysis Output report from the dropdown box, then click “Generate”.
3. You can use it to print select articles from inside the Spec Checker. Highlight the articles you want, then click on the Report Tool. Check the “selected articles” button and click “OK”.

Virtis: This tool functions same in Virtis.



## **View Analysis Charts**

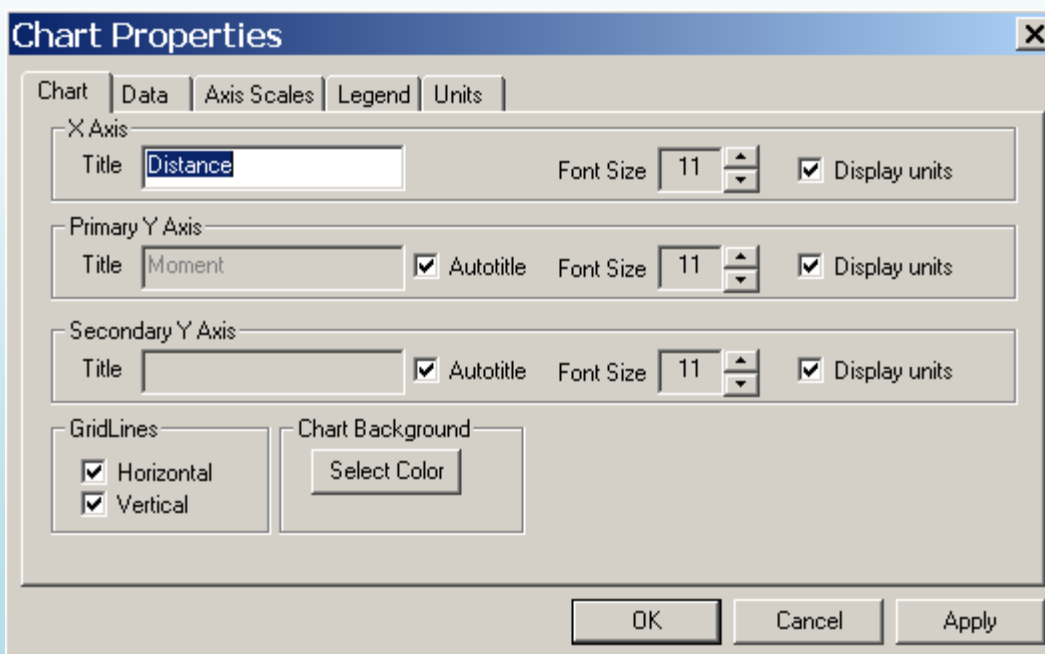
***Opis:** This is a handy tool that allows you to plot many different graphs. It uses a tree structure to select the graph data. It also includes a table of data that is plotted in the graph. You can print either the graph or the data directly from the file menu.*

***Virtis:** Same as Opis.*



## **Chart Settings**

*If you click somewhere inside the graph, the chart setting icon will become active. This allows you to customize the graph.*





### **View Schematic**

*This tool allows you to view a number of different drawings by highlighting the item in the tree then clicking on the view icon.*

- 1. Framing Plan Detail*
- 2. Structure Typical Section*
- 3. Member Alternative Profile*



### **Validate Model**

*This tool allows you to check your model at any time. It will give you warnings and errors in your model. Highlight the member you want to check, then click the “validate” icon.*

# Where Do I Find Results ???

Summary			Detailed Table	
Data	Report Type	Report Name	Report Type	Report Name
Section Properties - Stage 1	----	----	----	----
Section Properties - Stage 2	----	----	----	----
Section Properties - Stage 3	----	----	----	----
Dead Load Actions	View Analysis Report	Dead Load Actions		
Live Load Actions	View Analysis Report	Live Load Actions		
Distribution Factors	Bridge Description Tree	LRFD Dist. Factors		
Moment Calcs	Eye Glasses	Spec Check Summary	View Analysis Charts	Moment Tree
Shear Calcs	Eye Glasses	Spec Check Summary	View Analysis Charts	Shear Tree
Prestress Losses	----	----	----	----
Initial Stresses	Eye Glasses	Spec Check Summary	View Analysis Charts	Concrete Stress Tree
Final Stresses	Eye Glasses	Spec Check Summary	View Analysis Charts	Concrete Stress Tree
Ultimate Moment Capacity	Eye Glasses	Spec Check Summary	Report Tool	Flexure Analysis Summary
Shear Capacity	Eye Glasses	Spec Check Summary	Report Tool	Shear Analysis Summary
Camber and Deflections	Eye Glasses	Spec Check Summary	View Analysis Charts	Deflection Tree

Detailed Calculation	
Data	Calculation
Section Properties - Stage 1	Spec Checker- Pres. Properties Stage 1
Section Properties - Stage 2	Spec Checker- Pres. Properties Stage 2
Section Properties - Stage 3	Spec Checker- Pres. Properties Stage 3
Dead Load Actions	Basic PS Beam Property Calculations
Live Load Actions	PS Gross Composite Section Properties
Distribution Factors	PS Gross Composite Section Properties
Moment Calcs	Wizard Computed Dist. Factors
Shear Calcs	Instantaneous and Long Term Losses
Prestress Losses	Tension and Compression Stresses
Initial Stresses	Tension and Compression Stresses
Final Stresses	Beam Capacity Detail
Ultimate Moment Capacity	Procedures for Determining Shear Resistance, and Nominal Shear Resistance
Shear Capacity	Criteria for Deflection
Camber and Deflections	

Report Type	Report Type
Eye Glasses	Eye Glasses
View Analysis Report	View Analysis Report
View Analysis Charts	View Analysis Charts
Report Tool	Report Tool
Spec Checker	Spec Checker
Member Alt. Tree	Member Alt. Tree



## APPENDIX B - Strand Design Procedure

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### Procedure for Strand Layout

1. *Fill bottom two rows with strands.*
2. *Analyze beam.*
3. *Check the Spec Check Summary for Final Tension Stresses at center span. You want the design ratio should be just over 1.0. Ignore all other stresses at this point.*
4. *Open the strand layout window again and adjust the number of strands until you achieve a design ratio of just over 1.0.*
5. *Now look for other areas of failure in the Spec Check Summary. You are likely to have compression failures near the end of the beam at release.*
6. *Add harping or debonding to reduce the compression in the bottom of the beam end as necessary. Re-analyze after each adjustment and check the Spec Check Summary.*
7. *If you can't find a pattern that works, talk to your Area Engineer and the Bridge Design Engineer about using the refined prestress loss method or using a continuous for live load design. This may be more economical than adding a beam line or using a deeper beam. You can also contact Jeff for assistance in finding a pattern that works.*

# APPENDIX C - Flow Chart

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*(Still Under Construction)*