Four-Span PS Concrete Beam AASHTO Type III Simple Spans Input

As-Built Model Only

September, 2011
DETAILED EXAMPLE

FOUR-SPAN PS CONCRETE BEAM AASHTO TYPE III SIMPLE SPANS INPUT

ONLY FOR AS-BUILT MODEL
To create a new bridge right click on the folder where you want to save the bridge and choose New – New Bridge. New window will appear, fill the data as shown below. See bridge plans for bridge information.

**Template:** Template bridges serve as templates to help develop other bridges.

**Bridge Completely Defined:** Check the box if the specified bridge is completely defined within the Virtis/Opis database. Do not check this box if some of the structures making up the bridge are not in the database.

**BridgeWare Association... button:** Opens the BridgeWare Association window allowing you to specify this current bridge as a Virtis, Opis or Virtis/Opis bridge and also to link this current bridge to a bridge in the Pontis database if Pontis is installed.
Enter fields as shown:

The data to input traffic values can usually be found in the road plans for new bridges. For existing bridges, traffic information can be found in VDOT traffic report or bridge RNS/PONTIS.

**OK button:** Saves the bridge description in this window and its tabs to memory and closes the window.

**Apply button:** Saves the bridge description in this window and its tabs to memory and keeps the window open.

**Cancel button:** Closes the window without saving the bridge description in this window and its tabs to memory.

**Note:** It is strongly recommended that the bridge data be saved at this point.

**How to same Virtis Input:**
FOUR-SPAN PS CONCRETE BEAM AASHTO TYPE III SIMPLE SPANS INPUT
BRIDGE INFORMATION

Click to save

Click to save

For Help, press FL
FOUR-SPAN PS CONCRETE BEAM AASHTO TYPE III SIMPLE SPANS INPUT

BEAM SHAPE

4 ksi concrete for deck:

Double click to open

Click to use data from library

Copy from Library button: Opens the Library - Materials - Concrete window, allowing you to copy a set of concrete material properties from the library to this window.

Click to accept
FOUR-SPAN PS CONCRETE BEAM AASHTO TYPE III SIMPLE SPANS INPUT BEAM SHAPE

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
<th>Compressive strength at 28 days (f_c)</th>
<th>Initial compressive strength (f_i,c)</th>
<th>Coefficient of thermal expansion</th>
<th>Density (for dead loads)</th>
<th>Density (for modulus of elasticity)</th>
<th>Modulus of elasticity (E_c)</th>
<th>Initial modulus of elasticity</th>
<th>Poisson’s ratio</th>
<th>Composition of concrete</th>
<th>Modulus of rupture (f_t)</th>
<th>Shear factor</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>5 ksi</td>
<td></td>
<td></td>
<td>0.150</td>
<td>0.145</td>
<td>3644.15</td>
<td>3644.15</td>
<td>0.200</td>
<td>Normal</td>
<td>0.400</td>
<td>1.000</td>
</tr>
</tbody>
</table>

5 ksi concrete for PS Concrete beams:

Click to use data from library
### FOUR-SPAN PS CONCRETE BEAM AASHTO TYPE III SIMPLE SPANS INPUT

**BEAM SHAPE**

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
<th>Library</th>
<th>Units</th>
<th>Fc</th>
<th>PoF</th>
<th>Module of Elasticity (Ec)</th>
<th>Poisson's Ratio</th>
<th>Module of Rupture</th>
</tr>
</thead>
<tbody>
<tr>
<td>A0 Trench</td>
<td>Class A0 Trench Concrete</td>
<td>US</td>
<td>0.100</td>
<td>1500</td>
<td></td>
<td>3300.59</td>
<td>0.000</td>
<td>0.418</td>
</tr>
<tr>
<td>Class A</td>
<td>Class A cement concrete</td>
<td>US</td>
<td>0.150</td>
<td>2400</td>
<td></td>
<td>2220.00</td>
<td>0.200</td>
<td>3.33</td>
</tr>
<tr>
<td>Class A (AE) 3rd</td>
<td>Class A cement concrete</td>
<td>US</td>
<td>0.150</td>
<td>2400</td>
<td></td>
<td>2422.75</td>
<td>0.200</td>
<td>3.33</td>
</tr>
<tr>
<td>Class A (US) 3rd</td>
<td>Class A cement concrete</td>
<td>US</td>
<td>0.150</td>
<td>2400</td>
<td></td>
<td>3844.15</td>
<td>0.200</td>
<td>3.33</td>
</tr>
<tr>
<td>Class B</td>
<td>Class B cement concrete</td>
<td>US</td>
<td>0.150</td>
<td>2400</td>
<td></td>
<td>18911.64</td>
<td>0.200</td>
<td>2.56</td>
</tr>
<tr>
<td>Class B (US) 3rd</td>
<td>Class B cement concrete</td>
<td>US</td>
<td>0.150</td>
<td>2400</td>
<td></td>
<td>2422.75</td>
<td>0.200</td>
<td>3.33</td>
</tr>
<tr>
<td>Class C</td>
<td>Class C cement concrete</td>
<td>US</td>
<td>0.150</td>
<td>2400</td>
<td></td>
<td>3844.15</td>
<td>0.200</td>
<td>3.33</td>
</tr>
<tr>
<td>Class C (US) 3rd</td>
<td>Class C cement concrete</td>
<td>US</td>
<td>0.150</td>
<td>2400</td>
<td></td>
<td>3844.15</td>
<td>0.200</td>
<td>3.33</td>
</tr>
</tbody>
</table>

1. **Click to accept**
2. **Change name to A5**
3. **Change to 5 and push tab**
4. **Select “Yes”**
5. **Ec will be recalculated based on 5 ksi concrete**
6. **Input 4 and push tab**
7. **Select “Yes”**
8. **Click to accept and close**

---

*VDOT VERSION 6.2*
Grade 60 ksi reinforcing steel:

- Double click to open
- Click to use data from library
- Click to accept
# FOUR-SPAN PS CONCRETE BEAM AASHTO TYPE III SIMPLE SPANS INPUT

## BEAM SHAPE

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
<th>Library</th>
<th>Units</th>
<th>$F_y$</th>
<th>$F_u$</th>
<th>Modulus of Elasticity</th>
<th>Loaded per Unit Length</th>
<th>Moment</th>
<th>Transfer Length (Std)</th>
<th>Transfer Length (LIFD)</th>
<th>Strand Type</th>
<th>Epoxy Coated</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.6&quot; (TVW=250) LR</td>
<td>Low relaxation 0.6000/Seven Vlces/Env = 250</td>
<td>Stands</td>
<td>US</td>
<td>225.0</td>
<td>250.0</td>
<td>28500.00</td>
<td>0.737</td>
<td>0.500</td>
<td>0.276</td>
<td>30.0000</td>
<td>Low R</td>
<td>FALSE</td>
</tr>
<tr>
<td>0.6&quot; (TVW=250) SR</td>
<td>Stress relieved 0.6000/Seven Vlces/Env = 250</td>
<td>Stands</td>
<td>US</td>
<td>212.5</td>
<td>250.0</td>
<td>28500.00</td>
<td>0.737</td>
<td>0.500</td>
<td>0.276</td>
<td>30.0000</td>
<td>Low R</td>
<td>FALSE</td>
</tr>
<tr>
<td>0.6&quot; (TVW=270) LR</td>
<td>Low relaxation 0.6000/Seven Vlces/Env = 270</td>
<td>Stands</td>
<td>US</td>
<td>243.0</td>
<td>270.0</td>
<td>28500.00</td>
<td>0.740</td>
<td>0.500</td>
<td>0.257</td>
<td>30.0000</td>
<td>Low R</td>
<td>FALSE</td>
</tr>
<tr>
<td>0.6&quot; (TVW=270) SR</td>
<td>Stress relieved 0.6000/Seven Vlces/Env = 270</td>
<td>Stands</td>
<td>US</td>
<td>229.5</td>
<td>270.0</td>
<td>28500.00</td>
<td>0.740</td>
<td>0.500</td>
<td>0.257</td>
<td>30.0000</td>
<td>Low R</td>
<td>FALSE</td>
</tr>
<tr>
<td>1/2&quot; (TVW=250) LR</td>
<td>Low relaxation 1/2/Seven Vlces/Env = 250</td>
<td>Stands</td>
<td>US</td>
<td>225.0</td>
<td>250.0</td>
<td>28500.00</td>
<td>0.400</td>
<td>0.500</td>
<td>0.144</td>
<td>30.0000</td>
<td>Low R</td>
<td>FALSE</td>
</tr>
<tr>
<td>1/2&quot; (TVW=250) SR</td>
<td>Stress relieved 1/2/Seven Vlces/Env = 250</td>
<td>Stands</td>
<td>US</td>
<td>212.5</td>
<td>250.0</td>
<td>28500.00</td>
<td>0.400</td>
<td>0.500</td>
<td>0.144</td>
<td>30.0000</td>
<td>Low R</td>
<td>FALSE</td>
</tr>
<tr>
<td>1/2&quot; (TVW=270) LR</td>
<td>Low relaxation 1/2/Seven Vlces/Env = 270</td>
<td>Stands</td>
<td>US</td>
<td>243.0</td>
<td>270.0</td>
<td>28500.00</td>
<td>0.520</td>
<td>0.500</td>
<td>0.163</td>
<td>30.0000</td>
<td>Low R</td>
<td>FALSE</td>
</tr>
<tr>
<td>1/2&quot; (TVW=270) SR</td>
<td>Stress relieved 1/2/Seven Vlces/Env = 270</td>
<td>Stands</td>
<td>US</td>
<td>229.5</td>
<td>270.0</td>
<td>28500.00</td>
<td>0.520</td>
<td>0.500</td>
<td>0.163</td>
<td>30.0000</td>
<td>Low R</td>
<td>FALSE</td>
</tr>
<tr>
<td>1/4&quot; (TVW=250) LR</td>
<td>Low relaxation 1/4/Three Vlces/Env = 250</td>
<td>Stands</td>
<td>US</td>
<td>225.0</td>
<td>250.0</td>
<td>28500.00</td>
<td>0.100</td>
<td>0.250</td>
<td>0.036</td>
<td>12.5000</td>
<td>Low R</td>
<td>FALSE</td>
</tr>
<tr>
<td>1/4&quot; (TVW=250) SR</td>
<td>Stress relieved 1/4/Three Vlces/Env = 250</td>
<td>Stands</td>
<td>US</td>
<td>225.0</td>
<td>250.0</td>
<td>28500.00</td>
<td>0.100</td>
<td>0.250</td>
<td>0.036</td>
<td>12.5000</td>
<td>Low R</td>
<td>FALSE</td>
</tr>
<tr>
<td>1/4&quot; (TVW=270) LR</td>
<td>Low relaxation 1/4/Three Vlces/Env = 270</td>
<td>Stands</td>
<td>US</td>
<td>225.0</td>
<td>270.0</td>
<td>28500.00</td>
<td>0.122</td>
<td>0.250</td>
<td>0.036</td>
<td>15.0000</td>
<td>Low R</td>
<td>FALSE</td>
</tr>
<tr>
<td>1/4&quot; (TVW=270) SR</td>
<td>Stress relieved 1/4/Three Vlces/Env = 270</td>
<td>Stands</td>
<td>US</td>
<td>225.0</td>
<td>270.0</td>
<td>28500.00</td>
<td>0.122</td>
<td>0.250</td>
<td>0.036</td>
<td>15.0000</td>
<td>Low R</td>
<td>FALSE</td>
</tr>
<tr>
<td>1/8&quot; (TVW=250) LR</td>
<td>Low relaxation 1/8/Three Vlces/Env = 250</td>
<td>Stands</td>
<td>US</td>
<td>225.0</td>
<td>250.0</td>
<td>28500.00</td>
<td>0.260</td>
<td>0.375</td>
<td>0.075</td>
<td>18.7500</td>
<td>Low R</td>
<td>FALSE</td>
</tr>
<tr>
<td>1/8&quot; (TVW=250) SR</td>
<td>Stress relieved 1/8/Three Vlces/Env = 250</td>
<td>Stands</td>
<td>US</td>
<td>225.0</td>
<td>250.0</td>
<td>28500.00</td>
<td>0.260</td>
<td>0.375</td>
<td>0.075</td>
<td>18.7500</td>
<td>Low R</td>
<td>FALSE</td>
</tr>
<tr>
<td>1/8&quot; (TVW=270) LR</td>
<td>Low relaxation 1/8/Three Vlces/Env = 270</td>
<td>Stands</td>
<td>US</td>
<td>225.0</td>
<td>270.0</td>
<td>28500.00</td>
<td>0.272</td>
<td>0.375</td>
<td>0.080</td>
<td>22.5000</td>
<td>Low R</td>
<td>FALSE</td>
</tr>
<tr>
<td>1/8&quot; (TVW=270) SR</td>
<td>Stress relieved 1/8/Three Vlces/Env = 270</td>
<td>Stands</td>
<td>US</td>
<td>225.0</td>
<td>270.0</td>
<td>28500.00</td>
<td>0.272</td>
<td>0.375</td>
<td>0.080</td>
<td>22.5000</td>
<td>Low R</td>
<td>FALSE</td>
</tr>
</tbody>
</table>

Click to accept and close.
FOUR-SPAN PS CONCRETE BEAM AASHTO TYPE III SIMPLE SPANS INPUT

BEAM SHAPE

I-beam section:

Double click to open

Select narrow flange

Click to use data from library

Click to accept

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
<th>Library</th>
<th>Units</th>
<th>Depth</th>
<th>Top Flange Thickness</th>
<th>Top Flange Width</th>
<th>Bottom Flange Thickness</th>
<th>Bottom Flange Width</th>
<th>Top Haunch Height</th>
<th>Bottom Haunch Height</th>
</tr>
</thead>
<tbody>
<tr>
<td>AASHTO TYPE I</td>
<td>AASHTO TYPE I</td>
<td>Standard</td>
<td>US Customary</td>
<td>28.00</td>
<td>4.0000</td>
<td>12.0000</td>
<td>5.0000</td>
<td>16.0000</td>
<td>3.0000</td>
<td>6.0000</td>
</tr>
<tr>
<td>AASHTO TYPE II</td>
<td>AASHTO TYPE II</td>
<td>Standard</td>
<td>US Customary</td>
<td>26.00</td>
<td>3.0000</td>
<td>10.0000</td>
<td>4.0000</td>
<td>14.0000</td>
<td>2.0000</td>
<td>5.0000</td>
</tr>
<tr>
<td>AASHTO TYPE III</td>
<td>AASHTO TYPE III</td>
<td>Standard</td>
<td>US Customary</td>
<td>45.00</td>
<td>7.0000</td>
<td>18.0000</td>
<td>7.0000</td>
<td>22.0000</td>
<td>4.5000</td>
<td>9.0000</td>
</tr>
<tr>
<td>AASHTO TYPE IV</td>
<td>AASHTO TYPE IV</td>
<td>Standard</td>
<td>US Customary</td>
<td>54.00</td>
<td>6.0000</td>
<td>20.0000</td>
<td>8.0000</td>
<td>26.0000</td>
<td>6.0000</td>
<td>12.0000</td>
</tr>
</tbody>
</table>
FOUR-SPAN PS CONCRETE BEAM AASHTO TYPE III SIMPLE SPANS INPUT
BEAM SHAPE

Strand pattern can be modified using this tab

Click to accept and close
Since there are 11 beams in the superstructure, parapet unit weight inputted as zero in this screen. Parapet load will be applied only to 3 exterior girders in later steps.
FOUR-SPAN PS CONCRETE BEAM AASHTO TYPE III SIMPLE SPANS INPUT IMPACT AND FACTORS

Impact/Dynamic Load Allowance:

- Materials
  - Structural Steel
  - Concrete
    - Class A (US)
    - Class AS (US)
  - Reinforcing Steel
  - Prestress Strand
    - 3/8" (9.53 mm) SR
  - Timber
- Beam Shapes
  - Prestressed Beam Shapes
    - Box Beams
    - I Beams
    - AASHTO TYPE III
  - Tilt Beams
    - U Beams
  - Steel Beam Shapes
  - Timber Beam Shapes
- Appurtenances
  - Parapet
  - VDOT 2-8" Parapet
  - Median
  - Railing
  - Guardrail
- Impact/Dynamic Load Allowance
- Factors
- SUPERSTRUCTURE DEFINITIONS
- BRIDGE ALTERNATIVES

Standard Impact Factor
For structural components where impact is to be included per AASHTO 5.8.1, choose the impact factor to be used:

- Standard AASHTO impact: $I = \frac{L}{L + 125}$
- Modified impact: $I = n \times \text{AASHTO impact}$
- Constant impact override: $I = \%$

LRFD Dynamic Load Allowance
Fatigue and fracture limit states: $15.0$
All other limit states: $3.3$

AASHTO LRFD Default
Click to accept and close

Factors:

Double click to open
FOUR-SPAN PS CONCRETE BEAM AASHTO TYPE III SIMPLE SPANS INPUT

You can open to review the factors for different materials. No modification is needed.

Click to use data from library

Click to accept

Click to accept and close

Note: It is strongly recommended that the bridge data be saved at this point.
Superstructure Definition:

A girder system defines a set of girders within a cross section, including each girder’s relationship to the others.

In this example, all spans are identical, so one simple span was defined and assigned for Spans 1 to 4.

For PS Concrete Bridges, some of the lengths are defined based on CL to CL of bearings (full model) and some of the lengths are defined based on end to end of the PS beams (beam model). For further clarification, following is the instruction from Virtis Manual:
FOUR-SPAN PS CONCRETE BEAM AASHTO TYPE III SIMPLE SPANS INPUT SUPERSTRUCTURE DEFINITION

Prestressed Member Modeling Methods

Some data for simple span, prestressed beams made continuous for live load must be defined over the full length of the structure, including the regions at the interior supports, and other data should only be defined for the actual precast beam length. The modeling methods for these two methods of input are described below.

Full Model
The Full Model is the name given to the modeling method that defines data over the full length of the structure as illustrated below:

---

Data is defined between the centerlines of final supports in this method.

Beam Model
The Beam Model is the name given to the modeling method that defines data between the ends of the precast beam. This model is illustrated below:

---

Data is defined along the length of the precast beam, including any projections past the centerline of bearings.

The following table lists which model to use when inputting prestressed concrete beam data:

<table>
<thead>
<tr>
<th>Item</th>
<th>Full Model</th>
<th>Beam Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exterior Diaphragms</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Member Loads</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Live Load Distribution Factors</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Stress Limit Ranges</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Deck Profile</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Haunch Profile</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Shear Reinforcement Ranges</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Interior Diaphragms</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Points of interest</td>
<td>X</td>
<td></td>
</tr>
</tbody>
</table>
Factor override: Allows you to override the System Defaults library factors with a set of factors that have been entered for this bridge only. Factor overrides will remain when files are imported into future versions of Virtis. Unless factors specific to the bridge are required, overrides are not recommended as they can prevent updates to System Defaults in future versions (e.g., legal load SHV factors in the MBE). **Do not check the LRFR Factor Override which is shown checked above for illustration purposes only.**

**Consider structural slab thickness for rating:** Check this box if the structural slab thickness should be used to compute section properties for rating. If this box is not checked, the rating will use section properties computed from the total deck thickness.

**Consider wearing surface for rating:** Check this box if the wearing surface loads should be included for rating.
Add Default Load Case Descriptions button: Adds four default load cases to the load case description table as shown above. The default load cases include dead load (DC) acting on non-composite section, dead load (DC) acting on long term composite section, dead load (DW) acting on long term composite section and stay-in-place forms acting on non-composite section. These default load cases can be edited and modified as desired.

Framing Plan Detail:
**Girder spacing orientation**: Specify the girder spacing orientation for the girder spacing table as either perpendicular to girder or along support. If the girder spacing vary along the length of the bridge (that is, if the girders are not parallel to one another), then you must specify the girder spacing orientation as along support. Note that there is a limitation on using flared beams in girder system in Virtis.
FOUR-SPAN PS CONCRETE BEAM AASHTO TYPE III SIMPLE SPANS INPUT
SUPERSTRUCTURE DEFINITION

<table>
<thead>
<tr>
<th>Support Number</th>
<th>Start Distance (ft)</th>
<th>Diaphragm Spacing (ft)</th>
<th>Number of Spans</th>
<th>Length (ft)</th>
<th>End Distance (ft)</th>
<th>Load (kgs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Left Girders</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Right Girders</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Number of spans = [1]  Number of girders = [11]

[Image of Diaphragm Wizard window]

Select the desired framing plan system:

- [Image of framing plan options]

Diaphragm Wizard

[Image of Diaphragm Wizard window]

Diaphragm Spacing:
- [Option to enter number of equal spaces per span]
- [Option to enter equal spacing per span]

Support diaphragm load: [1,400]
Interior diaphragm load: [1,340]

See MathCAD calculations on page 90
In this example, diaphragms were generated using “Diaphragm Wizard”. For more complex geometry, diaphragms can be input manually.

**Structure Typical Section:**

Enter fields as shown:

[Diagram of Structure Typical Section]

- Click to accept and close
- Double click to open
- Click to apply the changes
FOUR-SPAN PS CONCRETE BEAM AASHTO TYPE III SIMPLE SPANS INPUT
SUPERSTRUCTURE DEFINITION

Compute button: Opens the Compute Lane Positions window, which presents the computed values in the lane position table based on information that you have entered using the other tabs of the Structure Typical Section window.

Apply button will populate the computed values for Lane Position.

This example does not have wearing surface.

Note that unit is lbs. per cubic foot.
FOUR-SPAN PS CONCRETE BEAM AASHTO TYPE III SIMPLE SPANS INPUT
SUPERSTRUCTURE DEFINITION

Note: It is strongly recommended that the bridge data be saved at this point.

To access the Structure Typical Section view, your structure typical section must be highlighted in the Bridge Workspace tree. Once structure typical section is highlighted, schematic view can be accessed by selecting “View Schematic”. This option is also available in toolbar under “Bridge Menu” or by right clicking on “Structure Typical Section”.

Review and verify bridge typical section.
FOUR-SPAN PS CONCRETE BEAM AASHTO TYPE III SIMPLE SPANS INPUT
SUPERSTRUCTURE DEFINITION

To access the Framing Plan view, your framing plan detail must be highlighted in the Bridge Workspace tree. Once framing plan detail is highlighted, schematic view can be accessed by selecting "View Schematic". This option is also available in toolbar under "Bridge Menu" or by right clicking on "Framing Plan Detail".

Review and verify bridge framing plan.
Stress Limits:

Double click to open

Select Class A5 for PS Beams

Program calculates stress limits

Click to accept and close
FOUR-SPAN PS CONCRETE BEAM AASHTO TYPE III SIMPLE SPANS INPUT SUPERSTRUCTURE DEFINITION

Prestress Properties:

<table>
<thead>
<tr>
<th>Name</th>
<th>PS Beams</th>
</tr>
</thead>
</table>

**General P/S Data**

<table>
<thead>
<tr>
<th>P/S strand material</th>
<th>1/2&quot; (TW-270)LR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Loss method</td>
<td>AASHTO Approximate</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Jacking stress ratio</th>
<th>0.750</th>
</tr>
</thead>
<tbody>
<tr>
<td>P/S transfer stress ratio</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Transfer time</th>
<th>24.0 Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age of deck placement</td>
<td>60.00 Days</td>
</tr>
<tr>
<td>Final age</td>
<td>3125.00 Days</td>
</tr>
</tbody>
</table>

| Include elastic gains | No |

Double click to open

Select P/S strand

Click to accept and close
FOUR-SPAN PS CONCRETE BEAM AASHTO TYPE III SIMPLE SPANS INPUT
SUPERSTRUCTURE DEFINITION

Shear Reinforcement:

Double click to open

Click to accept and close
FOUR-SPAN PS CONCRETE BEAM AASHTO TYPE III SIMPLE SPANS INPUT
G1 INPUT

Members:

Existing: Check the box next to the name of the member alternative that represents the existing member. The existing member alternative is selected for analysis during a batch analysis process.

Current: Check the box next to the name of the member alternative that represents the current alternative being modified or reviewed.

Span Length: This input is disabled for girder system since the span lengths are computed based on the data entered in the Structure Framing Plan Details and Structure Typical Section windows.

Pedestrian Load: Enter the pedestrian live load acting on the member, in units of force per length of member.
Select DC2 to add parapet weight

Click to add load

Input parapet load (1/3 of parapet weight, see MathCAD calcs.)

Click to apply the load

Select SIP Forms to add SIP weight

Click to add load
Load for G2 to G11: Repeat the same steps and input DC1, DC2 and SIP Form loads for all other beams. See MathCAD calculations for interior and exterior loads. Self-weight for deck and PS concrete beams will be calculated by program. Concrete diaphragm weight was input previously in framing plan.

Note: It is strongly recommended that the bridge data be saved at this point.

Supports:
Support Type: Select the support types as either pinned, roller, fixed, free, or other. Check marks will automatically appear in the appropriate boxes for translation and rotation constraints to correspond with the selected support type.

Support Type for G2 to G11: Repeat the same step and input support type for all other beams.

Member Alternatives: Note that the following steps provide input for G1. Later, Member Alternative contents will be copied to G2 and G4 and modified. The remaining girders will be linked to either G1, G2 or G4.
Material Type: Select the material type. Virtis/Opis currently limits floorbeam and stringer definitions to steel beams.

Girder Type: Select the girder type. The girder types available are dependent upon the selected material type.

Default rating method: Select the default rating method to be used for the member alternative.

For PS beam, only option is schedule based
Default Materials:

- Based on AASHTO MBE 6A.5.9, shear should be evaluated for permit loads.

Click to accept and close

Double click to open
**FOUR-SPAN PS CONCRETE BEAM AASHTO TYPE III SIMPLE SPANS INPUT**

G1 INPUT

<table>
<thead>
<tr>
<th>Member Alternative Name</th>
<th>G1</th>
</tr>
</thead>
</table>

**Deck concrete**
- Class A: S5

**Deck reinforcement**
- Grade 60

**Beam concrete**
- Class A5: S5

**Mid reinforcement**
- Grade 60

**Shells**
- Grade 60

**Precast tendon**
- 12” TF-27HR

**Live Load Distribution:**

Virtis does not have the beam information to generate Live Load Distribution at this stage. Skip this item for now.

Click to accept and close.
FOUR-SPAN PS CONCRETE BEAM AASHTO TYPE III SIMPLE SPANS INPUT
G1 INPUT

Shrinkage/Time:

Double click to open

Click to apply the changes
FOUR-SPAN PS CONCRETE BEAM AASHTO TYPE III SIMPLE SPANS INPUT

G1 INPUT

<table>
<thead>
<tr>
<th>Span Number</th>
<th>Beam Shape</th>
<th>Grade Material</th>
<th>Prestress Properties</th>
<th>Use Stress</th>
<th>%</th>
<th>Right End (ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>AASHTO TYPE III</td>
<td>Class AG (USA)</td>
<td>PS Beams</td>
<td>10</td>
<td>10.5000</td>
<td>10.0000</td>
</tr>
</tbody>
</table>

- Click to apply the changes
- End of the beam to CL bearings
- See MathCAD calculations
FOUR-SPAN PS CONCRETE BEAM AASHTO TYPE III SIMPLE SPANS INPUT

G1 INPUT

<table>
<thead>
<tr>
<th>Interface type</th>
<th>Eventually Roughened</th>
</tr>
</thead>
<tbody>
<tr>
<td>Default interface</td>
<td>0.5</td>
</tr>
<tr>
<td>Cohesion factor</td>
<td>0.000</td>
</tr>
<tr>
<td>Friction factor</td>
<td>0.000</td>
</tr>
<tr>
<td>Interface width</td>
<td>0.000</td>
</tr>
</tbody>
</table>

Virtis computes for intentionally roughened

Click to accept and close

Strand Layout:

Double click to open

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FOUR-SPAN PS CONCRETE BEAM AASHTO TYPE III SIMPLE SPANS INPUT

G1 INPUT

By clicking on each location, select strands at mid-span based on PS concrete beam.

Length from end of the beam to harp point.

Verify total number of strands.

Strands pattern at mid-span.

Number of strands = 8
Number of harped strands = 2
C/D of strands (measured from bottom of section) = 8.00 in

Legend:
- □ strand at mid span at the current section location
- □ strand at mid span at the current section location but a strand is harped to the position
- □ strand connecting this position at the current section location
- □ strand is harped at the current section location
- □ strand is harped at the current section location but a strand is harped to the position
- □ the harped position of a harped strand
- □ the harped position of another harped strand.
FOUR-SPAN PS CONCRETE BEAM AASHTO TYPE III SIMPLE SPANS INPUT
G1 INPUT

Note: Since G2 (interior girder) is not inputted yet, Virtis cannot generate deck profile for G1 at this point. Deck profile for G1 will be generated in next steps, after inputting G2.
FOUR-SPAN PS CONCRETE BEAM AASHTO TYPE III SIMPLE SPANS INPUT
G1 INPUT

Haunch Profile:

Double click to open

Click to add a line
FOUR-SPAN PS CONCRETE BEAM AASHTO TYPE III SIMPLE SPANS INPUT
G1 INPUT

Shear Reinforcement Ranges:

Click to accept and close

Double click to open

Click to add a line or duplicate
The ranges of Shear Reinforcement must be defined in this tab over the entire the length of the PS Concrete Beam.

At this point beam information for G1 is completed and Virtis will be able to generate Standard Live Load Distribution Factors.
**Live Load Distribution:**

- **Double click to open**

**Compute from Typical Section button:** Computes the live load distribution factors per wheel based on the values that you entered in the Structure Typical Section window and the Structure Framing Plan Details window. The computed distribution factors are then displayed on this tab.
Note: Standard Distribution Factors for LFR were created. However, since G2 (interior girder) is not input yet, Virtis cannot generate LRFD Live Load Distribution Factors for G1 at this point. LRFD Live Load Distribution Factors for G1 will be generated after inputting G2.

Note: It is strongly recommended that the bridge data be saved at this point.

<table>
<thead>
<tr>
<th>Lanes Located</th>
<th>Distribution Factor (Normalized)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Shear</td>
</tr>
<tr>
<td>1 Lane</td>
<td>0.867542</td>
</tr>
<tr>
<td>Multi Lane</td>
<td>0.867542</td>
</tr>
</tbody>
</table>
Link with: Select the member to which this member is to be linked. If two members are linked, they share the same definition and any revisions to one member affect the other member. If the applied loads acting on the two members are different (due to different tributary width, different arrangements of parapets, medians, sidewalk, the railings, and different lane positions), then they should not be linked with one another. If you do not want to link this member with any other member, select “None”. This input field is available for girder system only.

G11 is identical to G1 so it can be linked to G1 as shown below:

If a warning box pops up, click to confirm.
G3, G9 and G10 are identical to G2 so they can be linked to G2 as follow:
Repeat same steps to link G9 and G10 to G2.

G5, G6, G7 and G8 are identical to G4 so they can be linked to G4 (see linking G3 to G2 instruction).

Note: It is strongly recommended that the bridge data be saved at this point.
Copy Properties:

Since most girder detail and properties are similar between interior and exterior girders of this bridge, you can copy properties of one girder to another as shown below:

Right click on G1 and choose Copy.
Right click on Member Alternative for G2 and paste. You will notice that a copy of G1 is placed under G2 Member Alternative. Double click to open it.

After copying and pasting exterior beam to interior, the following items need to be updated in interior beam:
- Live Load Distribution Factors (Standard and LRFD)
- Deck Profile
- Haunch Profile
- Beam details and strand layout (if interior and exterior beams are different) – In this case, they are identical.

Click to accept and close

Double click to open
FOUR-SPAN PS CONCRETE BEAM AASHTO TYPE III SIMPLE SPANS INPUT

G2 INPUT

Virtis generates Live Load Distribution Factors

Click here to review deflection, moment and shear distribution factors

Click to accept and close
FOUR-SPAN PS CONCRETE BEAM AASHTO TYPE III SIMPLE SPANS INPUT

G2 INPUT

Type: PS Precast I

Click to compute

Double click to open

½" deck thickness considered non-structural
FOUR-SPAN PS CONCRETE BEAM AASHTO TYPE III SIMPLE SPANS INPUT

G2 INPUT

Since interior and exterior beams are identical in this bridge, no other modification is necessary for G2.
At this point, G2 is inputted and Virtis can generate LRFD Live Load Distribution for G1:
FOUR-SPAN PS CONCRETE BEAM AASHTO TYPE III SIMPLE SPANS INPUT
G2 INPUT

Virtis generates Live Load Distribution Factors

Click here to review deflection, moment and shear distribution factors

Click to accept and close
At this point, G2 is input and Virtis can generate Deck Profile for G1:

Double click to open

Click to compute
Next step Copy G2 to G4 (similar to copying G1 to G2). When you copy a beam, the following items may need to be updated:

- Live Load Distribution Factors (Standard and LRFD)
- Deck Profile
- Haunch Profile
- Beam details and strand layout (if interior and exterior beams are different)

In this example, since G2 and G4 are identical, no update is needed.

**Note:** It is strongly recommended that the bridge data be saved at this point.
FOUR-SPAN PS CONCRETE BEAM AASHTO TYPE III SIMPLE SPANS INPUT BRIDGE ALTERNATIVE

A bridge can have several unique bridge alternatives. Each bridge alternative must include the entire bridge but can consist of different layout of superstructures. The number of spans, the span lengths, and the pier locations are defined within the bridge alternative (and its accompanying windows). Entering different alternatives can be useful when comparing various alternatives for a preliminary study.

The Description tab of bridge Alternative window allows you to describe the orientation of the bridge alternative reference line with respect to the bridge global reference point. You can generate the bridge alternative using the Superstructure wizard or manually enter the require information. This data is more for information purpose than for calculations. In this example, Superstructure wizard was used as shown below:

Double click to open

Click here
FOUR-SPAN PS CONCRETE BEAM AASHTO TYPE III SIMPLE SPANS INPUT BRIDGE ALTERNATIVE

1. Input number of spans.
2. Click to generate.
3. Verify correct superstructure definition is selected.
4. Click to finish.

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FOUR-SPAN PS CONCRETE BEAM AASHTO TYPE III SIMPLE SPANS INPUT BRIDGE ALTERNATIVE

Alternative Name: As Built

Reference Line Length = 272.00 ft
Starting Station = ft
Heading = N 30° 00' 00" E

Global Positioning:
Distance = ft
Offset = ft
Elevation = ft

Superelevation:

Click to accept and close

Right click on Bridge Alternatives and select Expand Branch

Bridge alternative for 4 simple spans (spans are identical)
Before continuing, save your work and check the input.
FOUR-SPAN PS CONCRETE BEAM AASHTO TYPE III SIMPLE SPANS INPUT
BRIDGE ALTERNATIVE

To export the XML file to hard drive or server, click on file\export.
Rating the bridge, reviewing the results and output:

Click on "View analysis setting" to select vehicles for ratings.

Notice the changes under Vehicle Selection and Vehicle Summary after Rating Method is changed from LFD to LRFR shown in the screenshot on the following page. Note, if using the current VDOT library, VA Semi was changed to VA Type 3S2 and VA Single was changed to VA Type 3.
Select the following trucks for “simple span” bridge rating. Since span lengths are less than 200’, Legal Lane Load is not required for rating.
Click on Advanced

Click to apply the changes

Make sure permit loads are set with unlimited crossing mixed with traffic
FOUR-SPAN PS CONCRETE BEAM AASHTO TYPE III SIMPLE SPANS INPUT
RATING BRIDGE AND REVIEW THE OUTPUT

To review the reactions and specification checks, make sure all items are checked in output menu.

Click on Analyze button to start the analysis to rate individual girders in “Bridge Workspace”:

Select to analyze all girders

Click to accept and close
Analysis can be done from the top for the whole structures as shown above or from the member folder for each individual girder as shown below. Simply select and click Analyze button to start.
FOUR-SPAN PS CONCRETE BEAM AASHTO TYPE III SIMPLE SPANS INPUT RATING BRIDGE AND REVIEW THE OUTPUT

To review the result, select the girder and click on View analysis report icon.

Step 1: Select one girder

Step 2: Click to review results

Indicates controlling Location and Limit State
Rate entire bridge in “Bridge Explorer”:

Step 1: Select Bridge Explorer

Step 2: Click on the bridge in explorer

Step 3: Click on Rate

Click to close model

Rate entire bridge in “Bridge Explorer”:

Select the bridge in “Bridge Explorer” and click “Rate”.

Step 1: Select Bridge Explorer

Step 2: Click on the bridge in explorer

Step 3: Click on Rate

Click to close model
When using this method to rate the entire bridge, a screenshot for the lowest ratings will show on the screen.

Reviewing Output in Virtis. To review the output, calculations and specification checks, open the bridge and run all girders or one individual girder as shown in the previous steps. In this example G1 is analyzed.
FOUR-SPAN PS CONCRETE BEAM AASHTO TYPE III SIMPLE SPANS INPUT RATING BRIDGE AND REVIEW THE OUTPUT

To review the reactions and specification checks, make sure all items are checked in output menu.

Click to apply the changes

Click to accept and close
Click on Analyze button to start the analysis.
FOUR-SPAN PS CONCRETE BEAM AASHTO TYPE III SIMPLE SPANS INPUT RATING BRIDGE AND REVIEW THE OUTPUT

To review analysis charts, select girder and click on view analysis charts icon.

Click on view analysis charts to see moment, shear and deflection.

You can select all or some of the vehicles and review moment, shear, axial and deflection.
FOUR-SPAN PS CONCRETE BEAM AASHTO TYPE III SIMPLE SPANS INPUT RATING BRIDGE AND REVIEW THE OUTPUT

To review specification check, select girder and click on view spec check icon. Click on Specification Reference column header to sort the column.

<table>
<thead>
<tr>
<th>Specification Name</th>
<th>Unit State</th>
<th>Rev. Status</th>
<th>Pass/Fail</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.4.6.4.1.2.2.1.1</td>
<td>N/A</td>
<td>General</td>
<td></td>
</tr>
<tr>
<td>5.4.6.4.1.2.2.1.2</td>
<td>N/A</td>
<td>General</td>
<td></td>
</tr>
<tr>
<td>5.4.6.4.1.2.2.1.3</td>
<td>N/A</td>
<td>General</td>
<td></td>
</tr>
<tr>
<td>5.4.6.4.1.2.2.1.4</td>
<td>N/A</td>
<td>General</td>
<td></td>
</tr>
<tr>
<td>5.4.6.4.1.2.2.1.5</td>
<td>N/A</td>
<td>General</td>
<td></td>
</tr>
<tr>
<td>5.4.6.4.1.2.2.1.6</td>
<td>N/A</td>
<td>General</td>
<td></td>
</tr>
<tr>
<td>5.4.6.4.1.2.2.1.7</td>
<td>N/A</td>
<td>General</td>
<td></td>
</tr>
<tr>
<td>5.4.6.4.1.2.2.1.8</td>
<td>N/A</td>
<td>General</td>
<td></td>
</tr>
<tr>
<td>5.4.6.4.1.2.2.1.9</td>
<td>N/A</td>
<td>General</td>
<td></td>
</tr>
<tr>
<td>5.4.6.4.1.2.2.1.10</td>
<td>N/A</td>
<td>General</td>
<td></td>
</tr>
</tbody>
</table>

Click on View Spec Check to see calculation details.

Click on each column to sort the results.

Click to select.
Scroll down to 5.7.3.2 Flexural Resistance to review moment capacity.
FOUR-SPAN PS CONCRETE BEAM AASHTO TYPE III SIMPLE SPANS INPUT RATING BRIDGE AND REVIEW THE OUTPUT

Click OK to close.
FOUR-SPAN PS CONCRETE BEAM AASHTO TYPE III SIMPLE SPANS INPUT RATING BRIDGE AND REVIEW THE OUTPUT

Rating factor for Flexure (scroll down to 6.4.2.1 concrete flexure general load rating equation)

---

Click to select

---

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FOUR-SPAN PS CONCRETE BEAM AASHTO TYPE III SIMPLE SPANS INPUT

Rating factor for PS Tensile Stress:

### Rating factor for PS Tensile Stress:

<table>
<thead>
<tr>
<th>Component</th>
<th>Rating Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prestress Calculations</td>
<td></td>
</tr>
<tr>
<td>Stage 1</td>
<td></td>
</tr>
<tr>
<td>Stage 2</td>
<td></td>
</tr>
<tr>
<td>Stage 3</td>
<td></td>
</tr>
</tbody>
</table>

### Load and Resistance Factor Rating

**Load Rating:**

1. **Design Load Rating Process:**
   - Stage 1:
     - Prestress Calculations
       - Stage 1
     - Stage 2
     - Stage 3

2. **Load Rating Process:**
   - Stage 1:
     - Prestress Calculations
       - Stage 1
     - Stage 2
     - Stage 3

### Calculation Details

**Stage 1:**

- Prestress Calculations
  - Stage 1
  - Stage 2
  - Stage 3

**Stage 2:**

- Prestress Calculations
  - Stage 1
  - Stage 2
  - Stage 3

**Stage 3:**

- Prestress Calculations
  - Stage 1
  - Stage 2
  - Stage 3

### Rating Factor for PS Tensile Stress

- **Rating factor for PS Tensile Stress:**
  - Stage 1
  - Stage 2
  - Stage 3

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- **Version:** 6.2
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**VDOT**

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FOUR-SPAN PS CONCRETE BEAM AASHTO TYPE III SIMPLE SPANS INPUT RATING BRIDGE AND REVIEW THE OUTPUT

To review the shear, scroll down to 5.8.3.3 Shear Resistance.

[Image of a computer screen showing a software interface with a highlighted area indicating where to select.]
FOUR-SPAN PS CONCRETE BEAM AASHTO TYPE III SIMPLE SPANS INPUT RATING BRIDGE AND REVIEW THE OUTPUT

Rating factor for Shear: Scroll down to 6.4.2.1 concrete shear general load rating equation.
Subject: Calculations for Bridge Load Rating Using Virtis

Structure ID: 21953  
State Bridge No: 131-2551

Superstructure Definition (As-Built Spans 1, 2, 3 or 4):

Framing Plan:
Skew := DMS(10,21,15) = 10.354 deg

Structure Typical Section:
Spacing_{Bay1to10} := 5ft + 8in = 5.667 ft
Overhang := 2ft

Member Alternatives:
kips := 1000lb
\[
\begin{align*}
28500 \text{kips} & \quad \text{in}^2 \\
4074.28 \text{kips} & \quad \text{in}^2 \\
\implies n := \frac{28500}{4074.28} \text{kips} & = 6.995 \quad \text{Use 7}
\end{align*}
\]

Member Loads:
SIP Form Weight:
\[
\begin{align*}
w_{SIP} := 20 \text{lb} & \quad \text{ft}^2 \\
w_{SIP_{\text{Ext}}} := w_{SIP} \frac{\text{Spacing}_{Bay1to10}}{2} & = 0.057 \frac{\text{kips}}{\text{ft}} \quad \text{On G1 & G11} \\
w_{SIP_{\text{Int}}} := w_{SIP} \text{Spacing}_{Bay1to10} & = 0.113 \frac{\text{kips}}{\text{ft}} \quad \text{On G2 to G10}
\end{align*}
\]

Additional deck overhang weight:
\[
\begin{align*}
\gamma_c := 150 \text{lb} & \quad \text{ft}^3 \\
w_{OH} := \gamma_c \left[3\text{in} \cdot 2.5\text{in} + (2\text{ft} + 11\text{in} - 8\text{in} - 3\text{in}) \frac{2.5\text{in}}{2}\right] & = 0.039 \frac{\text{kips}}{\text{ft}} \quad \text{Apply to G1 and G11}
\end{align*}
\]
Parapet weight:

\[
A := (2\text{ft} + 8\text{in}) \left(6\text{in} + \frac{5\text{in}}{2}\right) + 3\text{in} \cdot 9\text{in} + \frac{7\text{in}}{2} \cdot 10\text{in} + 2\text{in} \cdot 19\text{in}
\]

\[A = 2.583 \text{ ft}^2\]

\[w_{\text{parapet}} := A \cdot \gamma_c\]

\[w_{\text{parapet}} = 0.39 \frac{\text{kips}}{\text{ft}}\]

\[w_{\text{parapet\_per\_beam}} := \frac{w_{\text{parapet}}}{3}\]

\[w_{\text{parapet\_per\_beam}} = 0.13 \frac{\text{kips}}{\text{ft}}\]  
Apply to three exterior beams
Diaphragm Weight (Intermediate):

\[ A_{\text{diaphragm}} := 13.4417 \text{ft}^2 \]
\[ t_{\text{diaphragm}} := 8 \text{in} \]

\[ W_{\text{diaph}} := A_{\text{diaphragm}} \cdot t_{\text{diaphragm}} \cdot \gamma_c = 1.34 \text{ kips} \]

Diaphragm Weight (End):

\[ A_{\text{diaphragm}} := 9.908 \text{ft}^2 \]
\[ t_{\text{diaphragm}} := 12 \text{in} \]

\[ W_{\text{diaph}} := A_{\text{diaphragm}} \cdot t_{\text{diaphragm}} \cdot \gamma_c = 1.49 \text{ kips} \]