Four Span Continuous Haunched Steel Plate Girder Input

October, 2011
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1. Creating a New Bridge File

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:

**Template:** Template bridges serve as templates to help develop other bridges.
FOUR SPAN CONTINUOUS HAUNCHED STEEL PLATE GIRDER INPUT

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: 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.

Bridge ID: 13466
NBI Structure ID (8): 13466

Description:
District (2): Lynchburg
County:
Owner (22): State Highway Agency
Maintainer: State Highway Agency
Admin. Area: Not Applicable
NHS Indicator: 1 On the NHS
Functional Class: 02 Rural Other Prnc

Virtis/Opis computes this value as the Truck PCT * ADT * Directional PCT

Click to accept and close
FOUR SPAN CONTINUOUS HAUNCHED STEEL PLATE GIRDER INPUT

The data to input traffic values can be found on VDOT’s website at:


11000 x (0.01 + 0.01 + 0.01 + 0.12 + 0.01) x 0.50 = 880

**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, and regularly to avoid lost data.
2. Material Properties Input

**Structural Steel**

Copy from Library button: Opens the Library – Materials – Structural Steel window, allowing you to copy a set of structural steel material properties from the library to this window.
FOUR SPAN CONTINUOUS HAUNCHED STEEL PLATE GIRDER INPUT

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
<th>Library</th>
<th>Units</th>
<th>Py</th>
<th>Pu</th>
<th>alpha</th>
<th>Density/Unit Load</th>
<th>Modulus of Elasticity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1105 to 1506</td>
<td>Built 1105 to 1506 - steel unknown</td>
<td>Standard US Customary</td>
<td>38</td>
<td>6000</td>
<td>0.0000000000</td>
<td>0.4000</td>
<td>290000.00</td>
<td></td>
</tr>
<tr>
<td>1105 to 163</td>
<td>Built 1105 to 163 - steel unknown</td>
<td>Standard US Customary</td>
<td>38</td>
<td>6000</td>
<td>0.0000000000</td>
<td>0.4000</td>
<td>290000.00</td>
<td></td>
</tr>
<tr>
<td>AASHTO M90N (1961)</td>
<td>AASHTO M90N (1961) or ASTM A 7(1967)</td>
<td>Standard US Customary</td>
<td>23</td>
<td>6000</td>
<td>0.0000000000</td>
<td>0.4000</td>
<td>290000.00</td>
<td></td>
</tr>
<tr>
<td>AASHTO M96N (1961)</td>
<td>AASHTO M96N (1961) or ASTM A 8(1968)</td>
<td>Standard US Customary</td>
<td>48</td>
<td>7000</td>
<td>0.0000000000</td>
<td>0.4000</td>
<td>290000.00</td>
<td></td>
</tr>
<tr>
<td>AASHTO M96N (1961)</td>
<td>AASHTO M96N (1961) or ASTM A 8(1968)</td>
<td>Standard US Customary</td>
<td>55</td>
<td>8000</td>
<td>0.0000000000</td>
<td>0.4000</td>
<td>290000.00</td>
<td></td>
</tr>
<tr>
<td>AASHTO M1188</td>
<td>AASHTO M1188 or ASTM A 441 - 1/4&quot; to 1&quot; thick, inclusive</td>
<td>Standard US Customary</td>
<td>46</td>
<td>9000</td>
<td>0.0000000000</td>
<td>0.4000</td>
<td>290000.00</td>
<td></td>
</tr>
<tr>
<td>After 1963</td>
<td>Built after 1963 - steel unknown</td>
<td>Standard US Customary</td>
<td>36</td>
<td>6000</td>
<td>0.0000000000</td>
<td>0.4000</td>
<td>290000.00</td>
<td></td>
</tr>
<tr>
<td>ASTM A292 - &lt;= 3/4&quot;</td>
<td>ASTM A 292 - 3/4&quot; thick and under</td>
<td>Standard US Customary</td>
<td>50</td>
<td>7000</td>
<td>0.0000000000</td>
<td>0.4000</td>
<td>290000.00</td>
<td></td>
</tr>
<tr>
<td>ASTM A292 - &lt;= 1 1/2&quot; to 4&quot; incl.</td>
<td>ASTM A 292 - over 1 1/2&quot; to 4&quot; thick, inclusive</td>
<td>Standard US Customary</td>
<td>42</td>
<td>8000</td>
<td>0.0000000000</td>
<td>0.4000</td>
<td>290000.00</td>
<td></td>
</tr>
<tr>
<td>ASTM A441 - 1/4&quot; to 1 1/2&quot; incl.</td>
<td>ASTM A 441 - 1/4&quot; to 1 1/2&quot; thick, inclusive</td>
<td>Standard US Customary</td>
<td>46</td>
<td>9000</td>
<td>0.0000000000</td>
<td>0.4000</td>
<td>290000.00</td>
<td></td>
</tr>
<tr>
<td>ASTM A441 - &lt;= 5/8&quot;</td>
<td>ASTM A 441 - 5/8&quot; thick and under</td>
<td>Standard US Customary</td>
<td>56</td>
<td>10000</td>
<td>0.0000000000</td>
<td>0.4000</td>
<td>290000.00</td>
<td></td>
</tr>
<tr>
<td>ASTM A441 - &lt;= 1 1/2&quot; to 4&quot; incl.</td>
<td>ASTM A 441 - over 1 1/2&quot; to 4&quot; thick, inclusive</td>
<td>Standard US Customary</td>
<td>46</td>
<td>9000</td>
<td>0.0000000000</td>
<td>0.4000</td>
<td>290000.00</td>
<td></td>
</tr>
<tr>
<td>ASTM A441 - &lt;= 3/4&quot;</td>
<td>ASTM A 441 - 3/4&quot; thick and under</td>
<td>Standard US Customary</td>
<td>50</td>
<td>7000</td>
<td>0.0000000000</td>
<td>0.4000</td>
<td>290000.00</td>
<td></td>
</tr>
<tr>
<td>ASTM A441 - &lt;= 1 1/2&quot; to 4&quot; incl.</td>
<td>ASTM A 441 - over 1 1/2&quot; to 4&quot; thick, inclusive</td>
<td>Standard US Customary</td>
<td>46</td>
<td>9000</td>
<td>0.0000000000</td>
<td>0.4000</td>
<td>290000.00</td>
<td></td>
</tr>
<tr>
<td>ASTM A441 - &lt;= 1 1/2&quot; to 4&quot; incl.</td>
<td>ASTM A 441 - over 1 1/2&quot; to 4&quot; thick, inclusive</td>
<td>Standard US Customary</td>
<td>46</td>
<td>9000</td>
<td>0.0000000000</td>
<td>0.4000</td>
<td>290000.00</td>
<td></td>
</tr>
<tr>
<td>ASTM A441 - &lt;= 1 1/2&quot; to 4&quot; incl.</td>
<td>ASTM A 441 - over 1 1/2&quot; to 4&quot; thick, inclusive</td>
<td>Standard US Customary</td>
<td>46</td>
<td>9000</td>
<td>0.0000000000</td>
<td>0.4000</td>
<td>290000.00</td>
<td></td>
</tr>
<tr>
<td>ASTM A441 - &lt;= 1 1/2&quot; to 4&quot; incl.</td>
<td>ASTM A 441 - over 1 1/2&quot; to 4&quot; thick, inclusive</td>
<td>Standard US Customary</td>
<td>46</td>
<td>9000</td>
<td>0.0000000000</td>
<td>0.4000</td>
<td>290000.00</td>
<td></td>
</tr>
</tbody>
</table>

Click to accept and close.
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.
FOUR SPAN CONTINUOUS HAUNCHED STEEL PLATE GIRDER INPUT

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
<th>Library</th>
<th>Units</th>
<th>Fo</th>
<th>Fo'</th>
<th>Grade</th>
<th>DL</th>
<th>Density</th>
<th>Modulus of Elasticity</th>
<th>Poisson's Ratio</th>
<th>Modulus of Permeability</th>
</tr>
</thead>
<tbody>
<tr>
<td>A3 Trench</td>
<td>Class A3 Trench Concrete</td>
<td>Agency Defined</td>
<td>US Customary</td>
<td>1.000</td>
<td>0.100</td>
<td>0.100</td>
<td>0.150</td>
<td>0.100</td>
<td>5500.00</td>
<td>0.300</td>
<td>0.448</td>
</tr>
<tr>
<td>Class A</td>
<td>Class A cement concrete</td>
<td>Standard</td>
<td>SI Metric</td>
<td>20.00</td>
<td>0.0000106000</td>
<td>0.0000000000</td>
<td>2400.00</td>
<td>2320.00</td>
<td>25450.00</td>
<td>0.300</td>
<td>3.33</td>
</tr>
<tr>
<td>Class B</td>
<td>Class B cement concrete</td>
<td>Standard</td>
<td>SI Metric</td>
<td>17.00</td>
<td>0.0000106000</td>
<td>0.0000000000</td>
<td>2400.00</td>
<td>2320.00</td>
<td>19811.84</td>
<td>0.300</td>
<td>2.88</td>
</tr>
<tr>
<td>Class C</td>
<td>Class C cement concrete</td>
<td>Standard</td>
<td>SI Metric</td>
<td>20.00</td>
<td>0.0000106000</td>
<td>0.0000000000</td>
<td>2400.00</td>
<td>2320.00</td>
<td>26227.75</td>
<td>0.300</td>
<td>3.97</td>
</tr>
<tr>
<td>Class D</td>
<td>Class D cement concrete</td>
<td>Standard</td>
<td>SI Metric</td>
<td>20.00</td>
<td>0.0000106000</td>
<td>0.0000000000</td>
<td>2400.00</td>
<td>2320.00</td>
<td>25450.00</td>
<td>0.300</td>
<td>3.33</td>
</tr>
<tr>
<td>Class E</td>
<td>Class E cement concrete</td>
<td>Standard</td>
<td>SI Metric</td>
<td>20.00</td>
<td>0.0000106000</td>
<td>0.0000000000</td>
<td>2400.00</td>
<td>2320.00</td>
<td>25450.00</td>
<td>0.300</td>
<td>3.33</td>
</tr>
<tr>
<td>Class F</td>
<td>Class F cement concrete</td>
<td>Standard</td>
<td>SI Metric</td>
<td>20.00</td>
<td>0.0000106000</td>
<td>0.0000000000</td>
<td>2400.00</td>
<td>2320.00</td>
<td>25450.00</td>
<td>0.300</td>
<td>3.33</td>
</tr>
<tr>
<td>PS 6.5 ksi</td>
<td>PS 6.5 ksi (ψc = 6.5 ksi)</td>
<td>Agency Defined</td>
<td>US Customary</td>
<td>6.500</td>
<td>5.500</td>
<td>0.0000000000</td>
<td>0.150</td>
<td>0.150</td>
<td>4607.73</td>
<td>0.300</td>
<td>0.610</td>
</tr>
</tbody>
</table>

**Class A (US)**

Compressive strength at 28 days (f'c) = 4.000 ksi
Initial compressive strength (f'ci) =
Coefficient of thermal expansion = 0.0000000000 1/F
Density (for dead loads) = 0.150 kcf
Density (for modulus of elasticity) = 0.145 kcf
Modulus of elasticity (E_c) = 3644.15 ksi
Initial modulus of elasticity =
Poisson's ratio = 0.200
Composition of concrete = Normal
Modulus of rupture = 0.480 ksi
Shear factor = 1.000

Click to accept
Click to accept and close

Capture Image Library... OK Apply Cancel

VDOT
Version 6.2
11
FOUR SPAN CONTINUOUS HAUNCHED STEEL PLATE GIRDER INPUT

Reinforcing Steel

[Diagram showing tree structure with options for Materials, Concrete, Reinforcing Steel, Beam Shapes, Appurtenances, Impact / Dynamic Load Allowance, Factors, SUPERSTRUCTURE DEFINITIONS, and BRIDGE ALTERNATIVES.]

Copy from Library button: Opens the Library – Materials – Reinforcing Steel window, allowing you to copy a set of reinforcing steel material properties from the library to this window.
## FOUR SPAN CONTINUOUS HAUNCHED STEEL PLATE GIRDER INPUT

<table>
<thead>
<tr>
<th>Grade</th>
<th>Description</th>
<th>Material Property</th>
<th>Units</th>
<th>Fy</th>
<th>Fu</th>
<th>Es</th>
</tr>
</thead>
<tbody>
<tr>
<td>30</td>
<td>30 KN/m^2 reinforcing steel</td>
<td>Standard SI/Metric</td>
<td>300.00</td>
<td>500.00</td>
<td>156948.00</td>
<td></td>
</tr>
<tr>
<td>36</td>
<td>36 KN/m^2 reinforcing steel</td>
<td>Standard SI/Metric</td>
<td>300.00</td>
<td>500.00</td>
<td>156948.00</td>
<td></td>
</tr>
<tr>
<td>42</td>
<td>42 KN/m^2 reinforcing steel</td>
<td>Standard SI/Metric</td>
<td>300.00</td>
<td>500.00</td>
<td>156948.00</td>
<td></td>
</tr>
<tr>
<td>50</td>
<td>50 KN/m^2 reinforcing steel</td>
<td>Standard SI/Metric</td>
<td>50.00</td>
<td>700.00</td>
<td>156948.00</td>
<td></td>
</tr>
<tr>
<td>60</td>
<td>60 KN/m^2 reinforcing steel</td>
<td>Standard SI/Metric</td>
<td>50.00</td>
<td>700.00</td>
<td>156948.00</td>
<td></td>
</tr>
<tr>
<td>75</td>
<td>75 KN/m^2 reinforcing steel</td>
<td>Standard SI/Metric</td>
<td>50.00</td>
<td>700.00</td>
<td>156948.00</td>
<td></td>
</tr>
</tbody>
</table>

**Select Type**
- Plan
- Essay
- Bulletin
- Other

**Click to accept and close**
3. Appurtenances Input

Parapet

Note: The Beam Shapes folder is used for wide flange and rolled beams, and therefore is not applicable for this example.

Enter the parapet dimensions as shown on the As-Built drawings and the unit load.

Note: In this load rating example an additional load of 0.030 kip/ft is required to account for the aluminum railing on top of the parapet.
FOUR SPAN CONTINUOUS HAUNCHED STEEL PLATE GIRDER INPUT

Impact / Dynamic Load Allowance Input

- Materials
- Beam Shapes
- Appurtenances
  - Parapet
  - Median
  - Railing
  - Generic
- Impact / Dynamic Load Allowance
- Factors
- SUPERSTRUCTURE DEFINITIONS
- BRIDGE ALTERNATIVES

AASHTO LRFD default

Double click to open

Click to accept and close
4. Factors Input

**LRFR**

- Materials
- Beam Shapes
- Appurtenances
  - Parapet
  - Median
  - Railing
  - Generic
- Impact / Dynamic Load Allowance
- Factors
  - LFD
  - LRFD
- SUPERSTRUCTURE DEFINITIONS
- BRIDGE ALTERNATIVES

**Factors Input:** Allows you to enter factors that are specific for this bridge only. These factors can be selected to override the System Default library factors. These bridge specific factors can then be used by selecting on the analysis tab of factor overrides in the Girder System Superstructure Definitions window as discussed later in this example. However, 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).
FOUR SPAN CONTINUOUS HAUNCHED STEEL PLATE GIRDER INPUT

5. Superstructure Definitions Input

- Materials
- Beam Shapes
- Appurtenances
- Impact / Dynamic Load Allowance
- Factors
- SUPERSTRUCTURE DEFINITIONS
- BRIDGE ALTERNATIVES

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

Enter the number of spans, number of girders in each span, and the length of each span as shown on the as-built drawings. Also check the box for the appropriate material.
**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).

**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.
**Load Case Description**

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 varies 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 the support.

Note: In this example there is no skew, however, a clockwise rotation is positive.
Enter diaphragm spacing as depicted on the As-Built plans. The Duplicate button is used to copy an existing row in the diaphragms table, and the new button adds a new blank row. The input format shown above ensures that diaphragms will be placed exactly at girder supports by not spacing to a support location (thus avoiding rounding errors).

Note that input was entered to 3 decimal places, but Virtis displays only 2 decimal places.

**Copy Bay To button:** Allows you to copy diaphragm information from this girder bay to another. After you have entered all diaphragm information in this tab for the selected girder bay, click this button and then select the number of the girder bay to which you want this diaphragm information to be copied.

Note: In this example, copy the diaphragm spacing from Girder Bay 1 to Bays 2, 3, and 4. Each time a message will appear asking whether to save the data before copying to another bay. Left click yes each time.
**FOUR SPAN CONTINUOUS HAUNCHED STEEL PLATE GIRDER INPUT**

**Diaphragm Wizard:** If you have uniform diaphragm spacing throughout the bridge, then you can use the diaphragm wizard to generate the diaphragm table.

To access the framing schematic view, right click on Framing Plan Detail, and select Schematic. Or highlight Framing Plan Detail in the Bridge Workspace tree and click the View Schematic icon on the toolbar.
FOUR SPAN CONTINUOUS HAUNCHED STEEL PLATE GIRDER INPUT

Structure Typical Section

Enter the deck dimensions as shown on the typical section from the as-built plans.
Select the previously defined deck concrete and enter the Total deck thickness shown.

Under the Parapet Tab, enter the location of the previously defined parapets as shown.
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.

The Apply button will populate the computed values for Lane Position.
To access the structure typical section schematic, right click on Structure Typical Section, and select Schematic. Or highlight Structure Typical Section in the Bridge Workspace tree and click the View Schematic icon on the toolbar.
FOUR SPAN CONTINUOUS HAUNCHED STEEL PLATE GIRDER INPUT

13466
13466 - AS- BUILT SPANS A-D

Deck Thickness 8 5/8"
Travely 1

42'-0"  38'-0"
4@9'-0" = 36'-0"
3'-6"

Stiffener Definitions

- Materials
- Beam Shapes
- Appurtenances
  - Impact / Dynamic Load Allowance
  - Factors
- SUPERSTRUCTURE DEFINITIONS
  - As Built Span 1 (Span A)
    - Impact / Dynamic Load Allowance
    - Load Case Description
    - Framing Plan Detail
    - Structure Typical Section
    - Superstructure Loads
- Connectors
- Shear Connector Definitions
- Stiffener Definitions
  - Transverse
    - Bearing
- MEMBERS
- BRIDGE ALTERNATIVES

Double click to open

New Transverse Stiffener Definition

Stiffener Type:
- Trans. Plate Stiffener
- Trans. Plate Stiffener
- Trans. Angle Stiffener

OK Cancel

Select Trans. Plate Stiffener and click OK.
FOUR SPAN CONTINUOUS HAUNCHED STEEL PLATE GIRDER INPUT

Repeat the steps above for each transverse stiffener shown on the as-built plans starting each time by double clicking on the Transverse folder.
FOUR SPAN CONTINUOUS HAUNCHED STEEL PLATE GIRDER INPUT

Select Plate Stiffener and click OK.
Repeat the steps above for the other bearing stiffener from the as-built plans starting by double clicking on the Bearing folder.

Note: It is a good idea to save the project regularly by selecting Save in the file pull down menu.
6. Member Inputs

Member Loads

Note: For this particular bridge, a 10 plf DC1 uniform member load will be applied to girders G1 & G2 to account for the lateral bracing in bay 1.
Click New to enter a new row and enter the Uniform Load shown for DC1. Expand G2 and repeat the steps for G2.
FOUR SPAN CONTINUOUS HAUNCHED STEEL PLATE GIRDER INPUT

Supports

- 13466
  - Materials
  - Beam Shapes
  - Appurtenances
    - Impact / Dynamic Load Allowance
  - Factors
  - SUPERSTRUCTURE DEFINITIONS
    - AS-BUILT SPANS A-D
      - Impact / Dynamic Load Allowance
      - Load Case Description
      - Framing Plan Detail
      - Structure Typical Section
      - Superstructure Loads
    - Connectors
    - Shear Connector Definitions
    - Stiffener Definitions
    - MEMBERS
      - G1
        - Member Loads
      - G2
      - G3
      - G4
      - G5
  - BRIDGE ALTERNATIVES
Support Type: Select the support type 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.

For G1, change the default support types so that Support Number 3 is Pinned and the remaining are Roller. Expand G2 and G3 and repeat steps for both. Note that G4 will be linked to G2 and G5 will be linked to G1 later in this example.
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. The ASD rating method is displayed as read only if the member alternative is a non-detailed section since the LFD and LRFD rating methods require actual beam dimensions that are not available in a non-detailed section.

Girder property input method: Cross-section based input describes the member alternative in terms of a section cut through the member at a specific location. The selection of girder property input method affects which windows are provided for defining the member alternative.

End Bearing Locations: Enter the end bearing locations as shown on the as-built plans.
FOUR SPAN CONTINUOUS HAUNCHED STEEL PLATE GIRDER INPUT

Member Alternative: Exterior Girder G1

LRFD Points of Interest
- Generate at tenth points
- Generate at section change points
- Generate at user-defined points
- Allow moment redistribution
- Use Appendix A6 for flexural resistance
- Allow plastic analysis
- Ignore long. reinf in negative moment capacity

Distribution Factor Application Method
- By axle
- By PDI

LRFR Points of Interest
- Generate at tenth points
- Generate at section change points
- Generate at user-defined points
- Allow moment redistribution
- Use Appendix A6 for flexural resistance
- Allow plastic analysis
- Evaluate remaining fatigue life
- Ignore long. reinf in negative moment capacity

Distribution Factor Application Method
- By axle
- By PDI

LFD Points of Interest
- Generate at tenth points
- Generate at section change points
- Generate at user-defined points
- Allow moment redistribution
- Include bearing stiffeners in rating

Distribution Factor Application Method
- By axle
- By PDI

ASD Points of Interest
- Generate at tenth points
- Generate at section change points
- Generate at user-defined points

Note: No changes were made to the default Control Options in this example.
Once the Member Alternative has been created, you can double click on the member, and the alternative will be listed as shown below.

**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 a 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.
Splice Locations
Enter the Splice locations as depicted on the as-built drawings.
FOUR SPAN CONTINUOUS HAUNCHED STEEL PLATE GIRDER INPUT

Girder Profile

- SUPERSTRUCTURE DEFINITIONS
  - AS-BUILT SPANS A-D
    - Impact / Dynamic Load Allowance
    - Load Case Description
    - Framing Plan Detail
    - Structure Typical Section
    - Superstructure Loads
  - Connectors
  - Shear Connector Definitions
  - Stiffener Definitions
  - MEMBERS
    - G1
      - Member Loads
      - Supports
  - MEMBER ALTERNATIVES
    - Exterior Girder G1 (E) (C)
      - Default Materials
      - Impact / Dynamic Load Allowance
      - Live Load Distribution
      - Hinge Locations
      - Splice Locations
    - Girder Profile
      - Deck Profile
      - Haunch Profile
      - Lateral Support
      - Stiffener Ranges
    - Bearing Stiffener Locations
    - Points of Interest
    - Deterioration Profile
  - G2
  - G3
  - G4
  - G5

BRIDGE ALTERNATIVES
Enter the dimensions of the web per the as-built drawings.
Enter the dimensions of the top flange per the as-built drawings.

**Four Span Continuous Haunched Steel Plate Girder Input**

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<thead>
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<th>End Width (in)</th>
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<th>Start Distance (ft)</th>
<th>Length (ft)</th>
<th>End Distance (ft)</th>
<th>Material</th>
<th>Weld</th>
<th>Weld at Right</th>
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**Enter the dimensions of the bottom flange per the as-built drawings.**

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<th>Thickness (in)</th>
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<th>Length (ft)</th>
<th>End Distance (ft)</th>
<th>Material</th>
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Click to accept and close.
FOUR SPAN CONTINUOUS HAUNCHED STEEL PLATE GIRDER INPUT

Deck Profile

- SUPERSTRUCTURE DEFINITIONS
  - AS-BUILT SPANS A-D
    - Impact / Dynamic Load Allowance
    - Load Case Description
    - Framing Plan Detail
    - Structure Typical Section
    - Superstructure Loads
  - Connectors
  - Shear Connector Definitions
  - Stiffener Definitions
  - MEMBERS
    - G1
      - Member Loads
      - Supports
  - MEMEER ALTERNATIVES
    - Exterior Girder G1 (E) (C)
      - Default Materials
      - Impact / Dynamic Load Allowance
      - Live Load Distribution
      - Hinge Locations
      - Splice Locations
      - Girder Profile
      - Haunch Profile
      - Lateral Support
      - Stiffener Ranges
      - Bearing Stiffener Locations
      - Points of Interest
      - Deterioration Profile
    - G2
    - G3
    - G4
    - G5

- BRIDGE ALTERNATIVES
When asked whether the computation should proceed assuming the entire length of girder is composite, click yes.
FOUR SPAN CONTINUOUS HAUNCHED STEEL PLATE GIRDER INPUT

Type: Plate
Deck Concrete Reinforcement Shear Connectors

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<th>End Effective Flange Width (Std) (in)</th>
<th>Start Effective Flange Width (L-FRD) (in)</th>
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<td>78.00</td>
<td>150.00</td>
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</table>

Note: By selecting Composite under the Connector ID pull down the Stud Dimensions under the Shear Connector Definitions become irrelevant since the deck is treated as a composite structure.
Enter the dimensions of the haunch per the as-built drawings. Note that the third Haunch Type is selected for this example.
FOUR SPAN CONTINUOUS HAUNCHED STEEL PLATE GIRDER INPUT

Lateral Support

- SUPERSTRUCTURE DEFINITIONS
  - AS-BUILT SPANS A-D
    - Impact / Dynamic Load Allowance
    - Load Case Description
    - Framing Plan Detail
    - Structure Typical Section
    - Superstructure Loads
  - Connectors
  - Shear Connector Definitions
  - Stiffener Definitions
  - MEMBERS
    - G1
      - Member Loads
      - Supports
    - MEMBER ALTERNATIVES
      - Exterior Girder G1 (E) (C)
        - Default Materials
        - Impact / Dynamic Load Allowance
        - Live Load Distribution
        - Hinge Locations
        - Splice Locations
        - Girder Profile
        - Deck Profile
        - Haunch Profile
        - Lateral Support
        - Stiffener Ranges
      - Bearing Stiffener Locations
      - Points of Interest
      - Deterioration Profile

- BRIDGE ALTERNATIVES

Double click to open
Regions where the slab is considered to provide lateral support for the top flange are defined using the lateral support window.
Apply at Diaphragms button: Stiffener ranges corresponding to diaphragm locations are added. A dialog will open prompting for the bearing stiffener and transverse stiffener definitions to be used. The Computed stiffener locations are added to the list of ranges.
Bearing Stiffener: Select a bearing stiffener definition to place at the end diaphragms and diaphragms located at piers. If no bearing stiffener definitions exist, “None defined” will appear in this list box.

Transverse Stiffener: Select a transverse stiffener definition to place at the interior diaphragm locations. If no transverse stiffener definitions exist, “None defined” will appear in this list box.

Apply button: Creates the stiffener locations and closes this window.
Enter the other stiffener locations as depicted on the as-built drawings. Note that five screenshots have been copied here to display the complete input. Bearing stiffeners do not appear in Transverse Stiffener Ranges. Virtis will set the bearing stiffener definition selected in the previous screenshot as the default definition for each support in the Bearing Stiffener Locations folder shown later in this example.

All Connector Single PL 6” x 1/2” definitions in the screenshots were created with the Apply at Diaphragms button. All Intermediate Single PL 6” x 3/8” definitions were added by clicking the New button for each line of input.
### Four Span Continuous Haunched Steel Plate Girder Input

#### Transverse Stiffener Ranges

<table>
<thead>
<tr>
<th>Name</th>
<th>Support Number</th>
<th>Start Distance (ft)</th>
<th>Number of Spaces</th>
<th>Spacing (in)</th>
<th>Length (ft)</th>
<th>End Distance (ft)</th>
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<tbody>
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<td>4.33</td>
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#### Longitudinal Stiffener Ranges
### Transverse Stiffener Ranges

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<th>Spacing (in)</th>
<th>Length (ft)</th>
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<tr>
<td>Intermediate Single PL 6&quot;x3/8&quot;</td>
<td>✔️ ✔️</td>
<td>116.00</td>
<td>2</td>
<td>42.6250</td>
<td>7.10</td>
<td>123.10</td>
</tr>
<tr>
<td>Intermediate Single PL 6&quot;x3/8&quot;</td>
<td>✔️ ✔️</td>
<td>126.67</td>
<td>2</td>
<td>52.0000</td>
<td>8.67</td>
<td>135.33</td>
</tr>
<tr>
<td>Intermediate Single PL 6&quot;x3/8&quot;</td>
<td>✔️ ✔️</td>
<td>135.33</td>
<td>2</td>
<td>48.0000</td>
<td>8.00</td>
<td>143.33</td>
</tr>
<tr>
<td>Intermediate Single PL 6&quot;x3/8&quot;</td>
<td>✔️ ✔️</td>
<td>143.33</td>
<td>1</td>
<td>28.0000</td>
<td>2.33</td>
<td>145.67</td>
</tr>
</tbody>
</table>

### Longitudinal Stiffener Ranges

- Apply Diaphragms...
- Stiffeners between Diaphragms...
- New
- Duplicate
- Delete

**OK**  **Apply**  **Cancel**
Enter the Longitudinal Stiffeners as depicted on the as-built plans.
Bearing Stiffener Locations

Ensure that the bearing stiffeners are set to Bearing Abut. for supports 1 & 5, and set to Bearing Pier for supports 2, 3, & 4.
Bearing Stiffener Location - Support 1

Pairs of bearing stiffeners at this support = 1

\[ X = 8.0000 \text{ in} \]

<table>
<thead>
<tr>
<th>Stiffener Pair</th>
<th>Name</th>
<th>Offset (in)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Bearing Abut. PL 8&quot;x3/4&quot;</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

* Negative offset to left of CL bearing

Click to accept and close

Save: It is a good idea to save the project regularly by selecting Save in the file pull down menu.
COPYING A MEMBER

Member Loads and Supports were previously defined for G2. Copy properties from G1 to G2 as shown in the following steps.

Right click on Girder 1 and choose Copy.
Right click on the Member Alternative for G2 and click paste. You will notice that a copy of Girder 1 is placed under G2 Member Alternatives.
Rename the girder as an interior girder, and check the Factors tab and Control Options tab as done for G1 previously.

G2 has a couple differences from G1 since it is an interior girder.
First, the deck profile will need to be updated using the Compute from Typical Section button as was done for G1, because the effective flange width is different for the interior girder.

Note that the screenshot above is shown for the re-computed values.
Secondly, the Haunch Profile is automatically updated for an interior beam; however the dimensions should be checked to make sure they are correct.
Finally, the Stiffener Ranges need to be updated to represent the fact that they are pair stiffeners for the interior girders instead of single for the exterior girders. There is also no longitudinal stiffeners on the interior girders for this bridge.
Update all the ranges to the appropriate stiffener pair by changing the Name selection. Under the Longitudinal Stiffener Ranges tab, delete the two lines of input by clicking the delete button twice. Click OK to accept and close.

Member G3 can be copied and renamed from G2 as was done previously. These are both interior girders, and the only difference is that the additional member load was not entered for G3 because bays 2 and 3 do not support any lateral bracing. Double click the copied Member Alternative under G3 and rename the alternative “Interior Girder G3.” No additional changes are required. Click OK to accept and close.
Linking a Member

To complete the bridge typical you may link previously defined girders to similarly (symmetrically) placed girders elsewhere in the bridge typical. In this example, G4 can be linked to G2 and G5 can be linked to G1 since it is a symmetrical bridge section.

A warning message will appear. Click continue to continue and OK to accept and close.

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 widths, different
arrangements of parapets, medians, sidewalks, and 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 a girder system only.

Repeat the same steps to link G5 to G1.

G4 is linked to G2
FOUR SPAN CONTINUOUS HAUNCHED STEEL PLATE GIRDER INPUT

Once all the girders are defined and linked, verify that the entered data is correct by viewing the bridge schematics. Right-click on the Structure Typical Section from the Bridge Workspace and select Schematic from the popup menu.

13466
13460 - A3-BUILT SPANS A-D
09/1 6/1

To view the girder elevation for G1 right-click on the “Exterior Girder G1” member alternative from the Bridge Workspace and select Schematic from the popup menu.
Live Load Distribution

Once all the data for the girders and the schematics have been checked for accuracy, the live load distributions can be computed for each girder.
FOUR SPAN CONTINUOUS HAUNCHED STEEL PLATE GIRDER INPUT

**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. A LRFD Distribution Factor Progress window will appear. Click OK when complete. The computed distribution factors are then displayed on this tab. Computed factors for Moment and Shear can be viewed by changing the Action selection. Click OK to accept and close.

Repeat the same steps for G2 and G3.
7. Creating Additional Superstructure Definitions

Once the as-built model is created, it can be copied and reused to rate the bridge in the current condition in accordance with the latest inspection report. Simply right click on As Built Span A-D and select copy and then right click on superstructure definitions and hit paste as shown below.
FOUR SPAN CONTINUOUS HAUNCHED STEEL PLATE GIRDER INPUT

Rename the span using the date of the latest inspection report.

Save: It is a good idea to save the project regularly by selecting Save in the file pull down menu.
As shown in the Bridge Deck Rehabilitation Plans dated September 17, 1997, the concrete deck has been milled and a 1¼” thick latex concrete overlay was installed. After scarifying ½” there is a net increase to the deck of ¾”. Therefore the Structure Typical Section needs to be updated to reflect this change in the IR 102009 Model.
8. Bridge Alternatives

**Bridge Alternatives**

A bridge can have several unique bridge alternatives. Each bridge alternative must include the entire bridge but can consist of a 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 bridge alternatives can be useful when comparing various alternatives for a preliminary study.

The Description tab of the Bridge Alternative window allows you to describe the orientation of the bridge alternative reference line with respect to the bridge global reference point. Enter the required information and click another tab or the OK button. This data is more for informational purposes than for calculations.
FOUR SPAN CONTINUOUS HAUNCHED STEEL PLATE GIRDER INPUT

Superstructures

- 13466
- Materials
- Beam Shapes
- Appurtenances
- Impact / Dynamic Load Allowance
- Factors
- SUPERSTRUCTURE DEFINITIONS
- AS-BUILT SPANS A-D
- JR 102009 SPANS A-D
- BRIDGE ALTERNATIVES
- AS-BUILT (E) (C)
  - SUPERSTRUCTURES

Double click to open

Superstructure Name: AS-BUILT SPANS A-D

<table>
<thead>
<tr>
<th>Description</th>
<th>Alternatives</th>
<th>Vehicle Path</th>
<th>Engine</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description:</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Reference Line

- Distance = 
- Offset = 
- Angle = 0.00 Degrees
- Starting Station = 

Click to accept and close

OK  Apply  Cancel
Superstructure Alternatives

- 13466
  - Materials
  - Beam Shapes
  - Appurtenances
    - Impact / Dynamic Load Allowance
  - Factors
  - SUPERSTRUCTURE DEFINITIONS
    - AS-BUILT SPANS A-D
    - IR 102009 SPANS A-D
  - BRIDGE ALTERNATIVES
    - AS-BUILT (E) (C)
      - SUPERSTRUCTURES
        - AS-BUILT SPANS A-D
          - SUPERSTRUCTURE ALTERNATIVES

Alternative Name: AS-BUILT SPANS A-D

Description:

Superstructure Definition: None

Select definition from dropdown

Click to accept and close

Double click to open

Superstructure definition: Select the superstructure definition assigned to the superstructure alternative. A definition named “None” is available to allow you to create a superstructure alternative as a placeholder for a superstructure definition that is not defined within Virtis/Opis. The name of the superstructure definition assigned to the alternative displays in the Bridge Workspace tree following the alternative name.
After the Superstructure Definition is defined, the spans’ lengths will appear.

Repeat this process to create a Bridge Alternative for IR102009 Spans A-D starting by double clicking on the BRIDGE ALTERNATIVES folder.
FOUR SPAN CONTINUOUS HAUNCHED STEEL PLATE GIRDER INPUT

Once each bridge alternative has been created, double click on the bridge to open the bridge information window.

Double click to open

- Materials
- Beam Shapes
- Appurtenances
  - Impact / Dynamic Load Allowance
- Factors
- SUPERSTRUCTURE DEFINITIONS
  - AS-BUILT SPANS A-D
  - IR 102009 SPANS A-D
- BRIDGE ALTERNATIVES
  - AS-BUILT
    - SUPERSTRUCTURES
      - AS-BUILT SPANS A-D
        - SUPERSTRUCTURE ALTERNATIVES
          - AS-BUILT SPANS A-D (E) (C) (AS-BUILT SPANS A-D)
  - IR 102009 (F) (C)
    - SUPERSTRUCTURES
      - IR 102009 SPANS A-D
        - SUPERSTRUCTURE ALTERNATIVES
          - IR 102009 SPANS A-D (E) (C) (IR 102009 SPANS A-D)
FOUR SPAN CONTINUOUS HAUNCHED STEEL PLATE GIRDER INPUT

Under the Alternatives tab, the Existing and Current boxes should be checked for the IR 102009 model. By selecting the existing and current check boxes, the user can control which bridge alternative Virtis will model.

Before continuing, save your work and check the input.
FOUR SPAN CONTINUOUS HAUNCHED STEEL PLATE GIRDER INPUT

Bridge Validation

Total Number of Messages: 64
Number of Information Messages: 52
Number of Warning Messages: 12
Number of Error Messages: 0

Bridge: 13466
Existing bridge alternative: IR 102009
Current bridge alternative: IR 102009
AS-BUILT (Bridge Alternative)
  AS-BUILT SPANS A-D (Superstructure)
    Existing superstructure alternative: AS-BUILT SPANS A-D
    Current superstructure alternative: AS-BUILT SPANS A-D
    AS-BUILT SPANS A-D (Superstructure Alternative)
      AS-BUILT SPANS A-D (Superstructure Definition)
      No errors or warnings.

IR 102009 (Bridge Alternative)
  IR 102009 SPANS A-D (Superstructure)
    Existing superstructure alternative: IR 102009 SPANS A-D
    Current superstructure alternative: IR 102009 SPANS A-D
    IR 102009 SPANS A-D (Superstructure Alternative)
      IR 102009 SPANS A-D (Superstructure Definition)
      No errors or warnings.

AS-BUILT SPANS A-D (Girder System Superstructure Definition)
  Girder Members
    G1 (Girder Member)
      Existing member alternative: Exterior Girder G1
      Current member alternative: Exterior Girder G1
      Exterior Girder G1 (Member Alternative)
      Warning: Deck reinforcement ranges not defined.
      Warning: No points of interest defined.
    G2 (Girder Member)
      Existing member alternative: Interior Girder G2
      Current member alternative: Interior Girder G2
      Interior Girder G2 (Member Alternative)
      Warning: Deck reinforcement ranges not defined.
      Warning: No points of interest defined.
    G3 (Girder Member)
      Existing member alternative: Interior Girder G3
      Current member alternative: Interior Girder G3
      Interior Girder G3 (Member Alternative)
      Warning: Deck reinforcement ranges not defined.
      Warning: No points of interest defined.
    G4 (Girder Member)
      Linked to G2.
    G5 (Girder Member)
      Linked to G1.

IR 102009 SPANS A-D (Girder System Superstructure Definition)

Click to Save

Review
Errors and
Warnings

Continue saving
Cancel Save operation
9. Rating the Structure

To run the analysis from the Bridge Explorer, exit to back to main page with the list of bridges. Right click on the bridge you want to rate and select rate.
Design Load Ratings

Select the vehicles to be rated and click the Add to Rating button to include them. A template of vehicles to be rated can be saved and reused as well. A typical template might include design load trucks, legal load trucks, permit load trucks, and special hauling vehicles. In this case, due to the amount of memory required to run the rating, it has been split into four separate ratings. One will be run for the inventory design loads, one for the operating design loads, one for the legal loads and one for the permit loads.

Inventory Load Ratings

As shown here the vehicles included in the inventory rating are the HL-93, HS 20-44, and HS-20-Tandem.

Once you click OK the analysis will start automatically.
FOUR SPAN CONTINUOUS HAUNCHED STEEL PLATE GIRDER INPUT

Analysis Progress

- Location - 234.1700 (ft)
- Location - 240.4000 (ft)
- Location - 254.3000 (ft)
- Location - 259.0000 (ft)
- Location - 270.0000 (ft)
- Location - 271.0000 (ft)
- Location - 284.8000 (ft)
- Location - 285.6000 (ft)
- Location - 298.6000 (ft)
- Location - 300.0000 (ft)
- Location - 314.4000 (ft)
- Location - 329.3000 (ft)
- Location - 344.0000 (ft)
- Location - 358.8000 (ft)
- Location - 372.6000 (ft)
- Location - 380.0000 (ft)
- Location - 382.1700 (ft)
- Location - 390.4000 (ft)
- Location - 403.2000 (ft)
- Location - 417.0000 (ft)
- Location - 418.0000 (ft)
- Location - 419.0000 (ft)
- Location - 430.2000 (ft)
- Location - 442.4000 (ft)
- Location - 453.8900 (ft)
- Location - 454.6000 (ft)
- Location - 456.6000 (ft)
- Location - 456.8000 (ft)
- Location - 470.0000 (ft)
- Location - 481.2000 (ft)
- Location - 503.4000 (ft)
- Location - 516.6000 (ft)
- Location - 522.0000 (ft)
- Location - 527.8000 (ft)
- Location - 540.0000 (ft)

Completed Specification Check.

- Analysis completed
Once you close the Analysis Progress window the Bridge Rating Results window will automatically open as shown below.

### Bridge Rating Results

<table>
<thead>
<tr>
<th>Bridge Id</th>
<th>Vehicle</th>
<th>Rating Level</th>
<th>Rating Factor</th>
<th>Time Stamp</th>
<th>Rated By</th>
<th>Impact</th>
<th>Load</th>
<th>Up To Date</th>
<th>Ctrl Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>13468</td>
<td>HL-30X(US)</td>
<td>Inventory</td>
<td>1.000</td>
<td>72.00</td>
<td>As Requested</td>
<td>As Requested</td>
<td>✔</td>
<td>✔</td>
<td></td>
</tr>
<tr>
<td>13469</td>
<td>HS-30-44</td>
<td>Inventory</td>
<td>1.567</td>
<td>89.03</td>
<td>As Requested</td>
<td>As Requested</td>
<td>✔</td>
<td>✔</td>
<td></td>
</tr>
<tr>
<td>15468</td>
<td>HS-30-Tandem</td>
<td>Inventory</td>
<td>2.216</td>
<td>53.16</td>
<td>As Requested</td>
<td>As Requested</td>
<td>✔</td>
<td>✔</td>
<td></td>
</tr>
</tbody>
</table>
Operating Load Ratings

As shown here the vehicles included in the operating rating are the HL-93, HS 20-44, and HS-20-Tandem.
FOUR SPAN CONTINUOUS HANCHED STEEL PLATE GIRDER INPUT
Legal Load Ratings

As shown here the vehicles included in the legal rating are the Lane-Type Legal Load, NRL, SU4, SU5, SU6, SU7, VA Semi, and VA Single trucks.

Once all vehicles for the LRFR Simple Span template have been entered, left click the Advanced button above the right column.
### Structure Rating Results

<table>
<thead>
<tr>
<th>BridgeId</th>
<th>Structure</th>
<th>Vehicle</th>
<th>Rating Level</th>
<th>Rating Factor</th>
<th>Capacity (Ton)</th>
<th>Time Stamp</th>
<th>Rating Method</th>
<th>Impact</th>
<th>Load</th>
<th>Up To Date</th>
<th>DB</th>
<th>Vehicle Path</th>
</tr>
</thead>
<tbody>
<tr>
<td>13458</td>
<td>IR102000 SPA</td>
<td>VA Semi</td>
<td>Legal</td>
<td></td>
<td>2.016</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Member Rating Results

<table>
<thead>
<tr>
<th>Unique Id</th>
<th>Structure</th>
<th>Member</th>
<th>Vehicle</th>
<th>Rating Level</th>
<th>Rating Factor</th>
<th>Capacity (Ton)</th>
<th>Location (Y)</th>
<th>Rating Method</th>
<th>Time Stamp</th>
<th>Impact</th>
<th>Load</th>
<th>Vehicle Path</th>
<th>Distribution Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>13455</td>
<td>IR102000 SPA</td>
<td>01</td>
<td>VA Semi</td>
<td>Legal</td>
<td>2.016</td>
<td>0.84</td>
<td>48.00 UMPR</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13456</td>
<td>IR102000 SPA</td>
<td>02</td>
<td>VA Semi</td>
<td>Legal</td>
<td>2.000</td>
<td>0.20</td>
<td>48.00 UMPR</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13457</td>
<td>IR102000 SPA</td>
<td>03</td>
<td>VA Semi</td>
<td>Legal</td>
<td>2.000</td>
<td>0.20</td>
<td>48.00 UMPR</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
FOUR SPAN CONTINUOUS HAUNCHED STEEL PLATE GIRDER INPUT

**Permit Load Ratings**

The permit ratings are done using the Blanket Permit 115 and the Blanket Permit 90 vehicles.

<table>
<thead>
<tr>
<th>Vehicles</th>
<th>Output</th>
<th>Engine</th>
<th>Description</th>
</tr>
</thead>
</table>

**Rating Method:** LRFR

**Set Rating Method to LRFR**

**Click to open**

<table>
<thead>
<tr>
<th>Traffic Direction: Down miles post</th>
</tr>
</thead>
</table>

**Refresh** | **Temporary Vehicles...** | **Advanced...**

**Vehicle Selection:**

- Standard
  - H 15-44
  - H 20-44
  - HL-33 (SI)
  - HL-93 (US)
  - HS 15-44
  - HS 20 (SI)
  - HS 20-44
  - Lane-Type Legal Load
  - LRFD Fatigue Truck (SI)
  - LRFD Fatigue Truck (US)
  - Type 3
  - Type 3-3
  - Type 3S2
  - Agency

**Add to Permit** | **Remove from Analysis** |

**Vehicle Summary:**

<table>
<thead>
<tr>
<th>Rating Vehicles</th>
</tr>
</thead>
<tbody>
<tr>
<td>LRFR</td>
</tr>
<tr>
<td>Design Load Rating</td>
</tr>
<tr>
<td>Inventory</td>
</tr>
<tr>
<td>Operating</td>
</tr>
<tr>
<td>Fatigue</td>
</tr>
<tr>
<td>Legal Load Rating</td>
</tr>
<tr>
<td>Permit Load Rating</td>
</tr>
<tr>
<td>Blanket Permit 115</td>
</tr>
<tr>
<td>Blanket Permit 90</td>
</tr>
</tbody>
</table>

**Set Rating Method to LRFR**

**Click to open**
For the two Blanket Permit vehicles, change the Frequency to Unlimited Crossings.
FOUR SPAN CONTINUOUS HAUNCHED STEEL PLATE GIRDER INPUT

Rating Method: LRFR

Save Analysis Results

Vehicles

Traffic Direction:
Down mile post

Add to Permit

Remove from Analysis

Rating Vehicles

Design Load Rating
Inventory
Operational
Fatigue
Legal Load Rating
Permit Load Rating
Blanket Permit 115
Blanket Permit 90

Click to accept and close

OK

Bridge Rating Results

View Structure Rating Results

VDOT Version 6.2
As demonstrated by the rating results, the controlling member is G1 in the inventory rating, which produced a rating factor of 1.00 for the HL-93 loading.
Once the controlling member has been identified, an analysis can be run on the individual girder. As shown below, this can be done by highlighting the girder and clicking the analyze icon, or by right clicking and selecting analyze. After the analysis is run, you can click the view analysis report icon shown below to view the results.
FOUR SPAN CONTINUOUS HAUNCHED STEEL PLATE GIRDER INPUT

Click the View Analysis Report Icon to see the report.
Once the structure has been rated, and the results have been checked for accuracy a summary form is usually generated to display the pertinent results along with any assumptions or comments which would be relevant to someone reviewing the rating. A sample summary form has been provided in Appendix C. Note that the controlling limit state for the summary form is located in the screenshot shown above.
RTE 29 OVER ROANOKE RIVER AND NORFOLK & WESTERN RAILWAY

ALUMINUM RAILING

R. D. 02-03

Scale: As Ruled

225:14

2020-02-10
Each Terminal Wall shall be cast as one piece.

Plan

Elevation

Sections B-B

[Diagram showing details of terminal walls, including dimensions, labels, and construction notes.]

NOTE: On permanent expansion joint alternate in color, see Sheet 7-B for Terminal Wall modification.

Terminal walls are detailed to take guard rail attachment GR-4A.

RTE. 29 OVER ROANOKE RIVER AND
NORFOLK & WESTERN RAILWAY
TERMINAL WALLS

Scale As Noted

VDOT Version 6.2
### End Diaphragm at Abutment

<table>
<thead>
<tr>
<th>Girder Spacing, $S$</th>
<th>w, lb</th>
<th>L, ft</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>8.75 ft</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Top channel weight=</td>
<td>296.63 lb</td>
<td>C 15x33.9</td>
<td>33.9</td>
</tr>
<tr>
<td>Bottom angle weight=</td>
<td>107.63 lb</td>
<td>L 6x4x3/8</td>
<td>12.3</td>
</tr>
<tr>
<td>Two inclined angle weight=</td>
<td>119.55 lb</td>
<td>L 5x3x3/8</td>
<td>9.8</td>
</tr>
<tr>
<td></td>
<td>523.80 lb</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Skew</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>523.80</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>539.51</td>
<td></td>
<td>(3% Misc.)</td>
</tr>
</tbody>
</table>

**USE** 540.00 lb
### Intermediate Diaphragm

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Girder Spacing, S</td>
<td>8.75 ft</td>
</tr>
<tr>
<td>Top angle weight</td>
<td>63.00 lb</td>
</tr>
<tr>
<td>Top angle thickness, L</td>
<td>7.2</td>
</tr>
<tr>
<td>Top angle length, L</td>
<td>8.75</td>
</tr>
<tr>
<td>Top angle angle, n</td>
<td>1</td>
</tr>
<tr>
<td>Bottom angle weight</td>
<td>63.00 lb</td>
</tr>
<tr>
<td>Bottom angle thickness, L</td>
<td>7.2</td>
</tr>
<tr>
<td>Bottom angle length, L</td>
<td>8.75</td>
</tr>
<tr>
<td>Bottom angle angle, n</td>
<td>1</td>
</tr>
<tr>
<td>Two inclined angle weight</td>
<td>128.40 lb</td>
</tr>
<tr>
<td>Two inclined angle thickness, L</td>
<td>6.6</td>
</tr>
<tr>
<td>Two inclined angle length, L</td>
<td>9.73</td>
</tr>
<tr>
<td>Two inclined angle angle, n</td>
<td>2</td>
</tr>
<tr>
<td>Skew</td>
<td>0</td>
</tr>
<tr>
<td>USE</td>
<td>270.00 lb</td>
</tr>
</tbody>
</table>

(5% Misc.)
### Pier Diaphragm

<table>
<thead>
<tr>
<th>Girder Spacing, S=</th>
<th>8.75 ft</th>
<th>w, lb</th>
<th>L, ft</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Top angle weight=</td>
<td>141.75 lb</td>
<td>L 6x4x1/2</td>
<td>16.2</td>
<td>8.75</td>
</tr>
<tr>
<td>Bottom angle weight=</td>
<td>141.75 lb</td>
<td>L 6x4x1/2</td>
<td>16.2</td>
<td>8.75</td>
</tr>
<tr>
<td>Two inclined angle weight=</td>
<td>313.46 lb</td>
<td>L 5x3.5x1/2</td>
<td>13.6</td>
<td>11.52</td>
</tr>
</tbody>
</table>

\[ \text{Skew} \quad \text{596.96 lb} \]

\[ \text{USE} \quad 630.00 \text{ lb} \]
### APPENDIX C: SAMPLE LOAD RATING SUMMARY FORM FOR BRIDGES

**Route:** Route 29 SBL  
**Over:** Roanoke River & Norfolk Southern Railway  
**VA Str. No.:** 1903  
**FED. ID:** 13466  
**County:** Pittsylvania  
**District:** Lynchburg  
**Rated By:** CC  
**Date:** March, 2011  
**Checked By:** EWB  
**Date:** April, 2011  
**Calculation Tools/Method Used:** Virtis 6.1  
**Basis for Rating:** Conversion to LRFR  

<table>
<thead>
<tr>
<th>GVW (TONS)</th>
<th>RATING</th>
<th>CONTROLLING MEMBERS</th>
<th>CONTROLLING LOCATION</th>
<th>CONTROLLING FORCE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DESIGN LOAD</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HL-93 (INV)</td>
<td>N/A</td>
<td>1.000</td>
<td>Exterior Girders – Span A</td>
<td>0.4L</td>
</tr>
<tr>
<td>HL-93 (OPR)</td>
<td>N/A</td>
<td>1.296</td>
<td>Exterior Girders – Span A</td>
<td>0.4L</td>
</tr>
<tr>
<td><strong>LEGAL LOAD</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HS-20 (INV)</td>
<td>36</td>
<td>60.0</td>
<td>Exterior Girders – Span A</td>
<td>0.4L</td>
</tr>
<tr>
<td>HS-20 (OPR)</td>
<td>36</td>
<td>77.8</td>
<td>Exterior Girders – Span A</td>
<td>0.4L</td>
</tr>
<tr>
<td><strong>PERMIT LOAD</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BP-90</td>
<td>45</td>
<td>75.8</td>
<td>Exterior Girders – Span A</td>
<td>0.4L</td>
</tr>
<tr>
<td>BP-115</td>
<td>57.5</td>
<td>98.5</td>
<td>Exterior Girders – Span D</td>
<td>0.6L</td>
</tr>
<tr>
<td><strong>SH VEHICLES</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NRL</td>
<td>40</td>
<td>63.6</td>
<td>Exterior Girders – Span D</td>
<td>0.6L</td>
</tr>
<tr>
<td>SU4</td>
<td>27</td>
<td>61.3</td>
<td>Exterior Girders – Span A</td>
<td>0.4L</td>
</tr>
<tr>
<td>SU5</td>
<td>31</td>
<td>62.6</td>
<td>Exterior Girders – Span D</td>
<td>0.6L</td>
</tr>
<tr>
<td>SU6</td>
<td>34.75</td>
<td>63.0</td>
<td>Exterior Girders – Span D</td>
<td>0.6L</td>
</tr>
<tr>
<td>SU7</td>
<td>38.75</td>
<td>64.1</td>
<td>Exterior Girders – Span D</td>
<td>0.6L</td>
</tr>
</tbody>
</table>

* Not applicable for simple span less than 200 feet.
ASSUMPTIONS/COMMENTS BY LOAD RATING ENGINEER:

Comments:

1. HS-20 Truck is the controlling HS-20 load case.
2. The controlling Design Loads (Inventory) and Legal Limit States are Strength I.
3. The controlling Design Loads (Operating) and Permit Limit States are Strength II.

Assumptions:

Bridge No: 13466 – 4-Span Continuous Composite Steel Plate Girder Multi-Girder Bridge.

1. Material properties not noted in the plans are based on the year of construction. Materials used for the analysis are Structural Steel, ASTM A36, Fy=36ksi, Cast-In-Place Concrete, Class A4, f’c =4.0 ksi, Reinforcing steel, Grade 40, Fy=40 ksi.

2. The slab thickness was reduced by 0.5” per VDOT, IIM-S&B-80 for composite properties.

3. The LRFD effective slab width used for composite properties was the full tributary width as outlined in Section 4.6.2.6 of the AASHTO LRFD Bridge Design Specifications (2008 Interims).

4. Superimposed dead load was distributed uniformly to all girders. An additional load of 30 plf was applied to the concrete parapet to account for the aluminum railing.

5. LRFD Live load distribution factors were computed by Virtis.

6. A typical 1” thick haunch has been input for composite beam properties and dead load.

7. A 10 plf DC1 member load was applied to girders G1 & G2 to account for the lateral bracing in bay 1.

8. The IR and rehabilitation plans noted that the concrete deck has been milled and a 1¼” thick latex concrete overlay was installed. After scarifying ½” there is a net increase to the deck of ¾”.

9. Per IR, Condition factor for the bridge superstructure was listed as Satisfactory (Superstructure Rating= 6); φc=1.0.