

AASHTOWare BrDR 7.5.0

Culvert Tutorial

CVT2 – Corrugated Metal Pipe Culvert Example

CVT2 – Corrugated Metal Pipe Culvert Example

Topics Covered

- Metal Pipe Culvert Alternatives
- LFR Rating
- LRFR Rating
- MBE 2022 approved ballot item specification updates

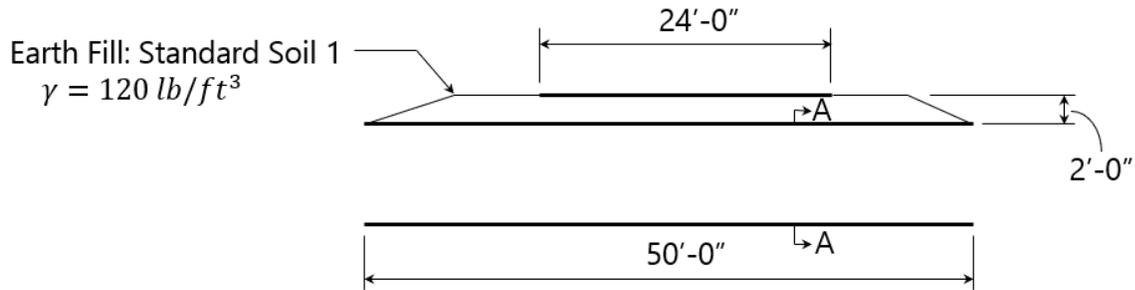
Overview of Metal Pipe Culvert features

- Metal pipe culverts implemented in BrDR version 7.3.0 in September 2022
- Metal pipe culverts support LFR and LRFR rating methods
- Metal pipe culverts can be rated for wall capacity and plastic moment
- Single and multilane loading options available

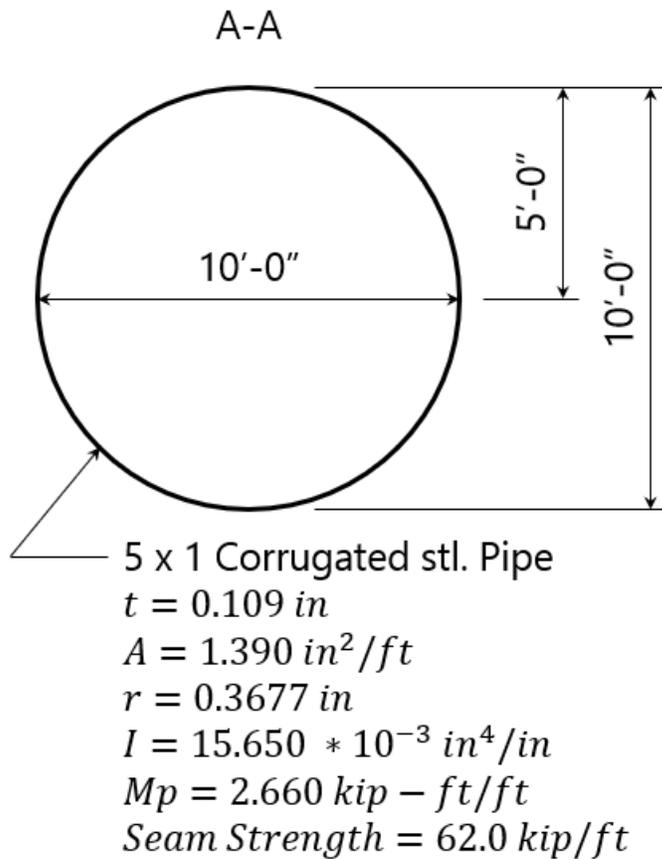
This tutorial describes the data entry for a corrugated metal pipe culvert using the metal pipe culvert alternative in BrDR version 7.5.0.

CVT2 – Corrugated Metal Pipe Culvert Example

Elevation



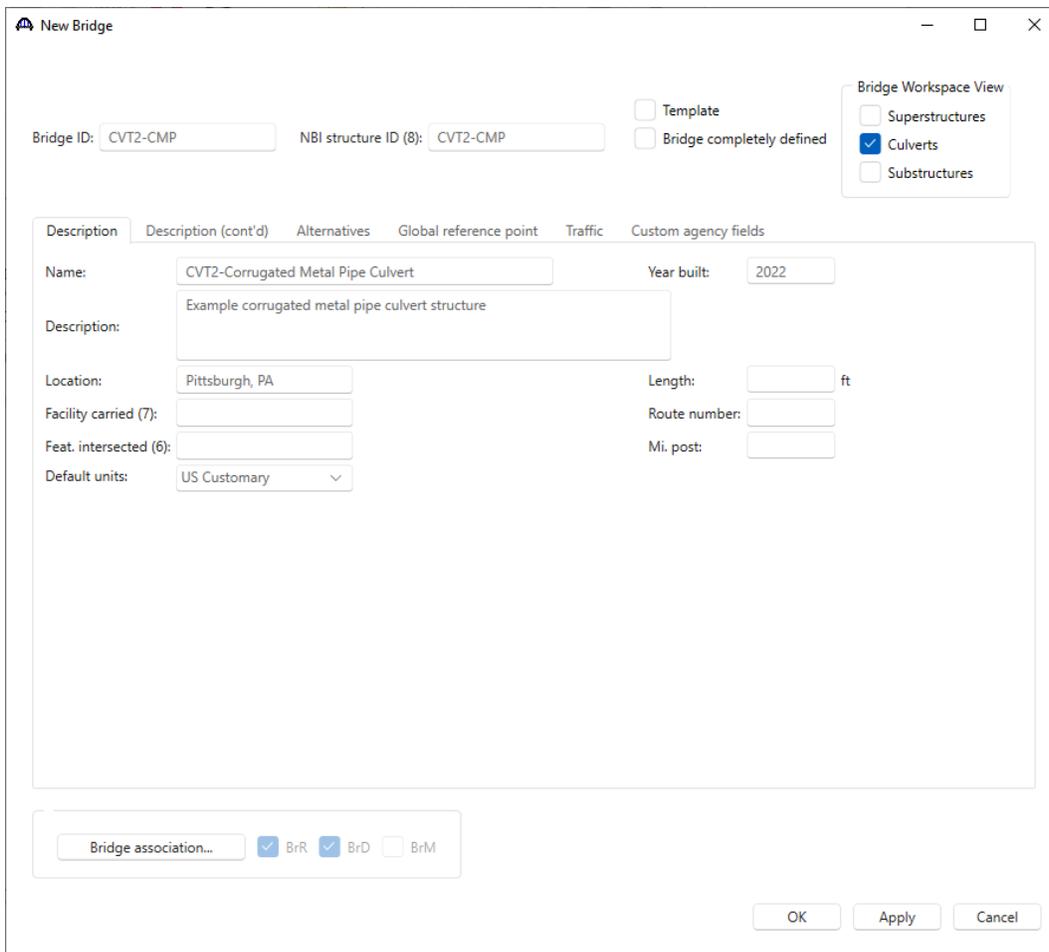
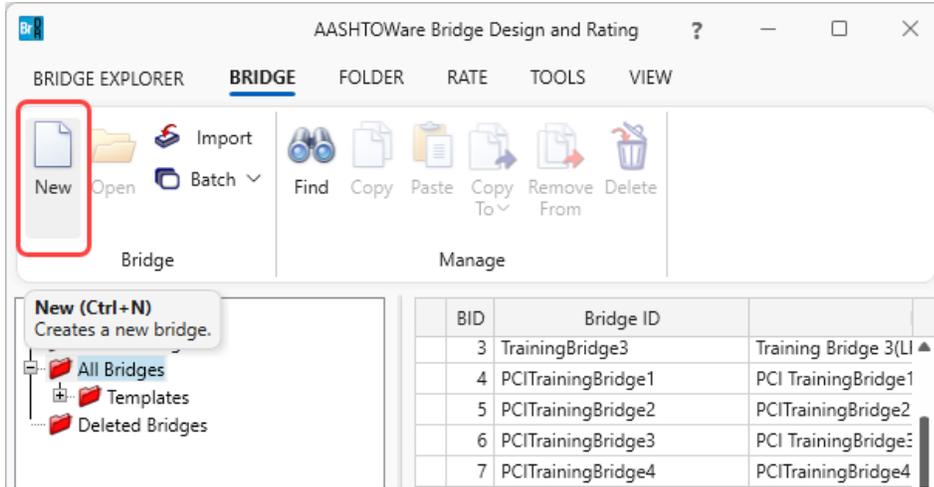
Cross Section



CVT2 – Corrugated Metal Pipe Culvert Example

Corrugated Metal Pipe Data Entry

From the **Bridge Explorer** create a new bridge by clicking on the **New** button in the **Bridge** group of the **BRIDGE** ribbon and enter the description data as shown below.

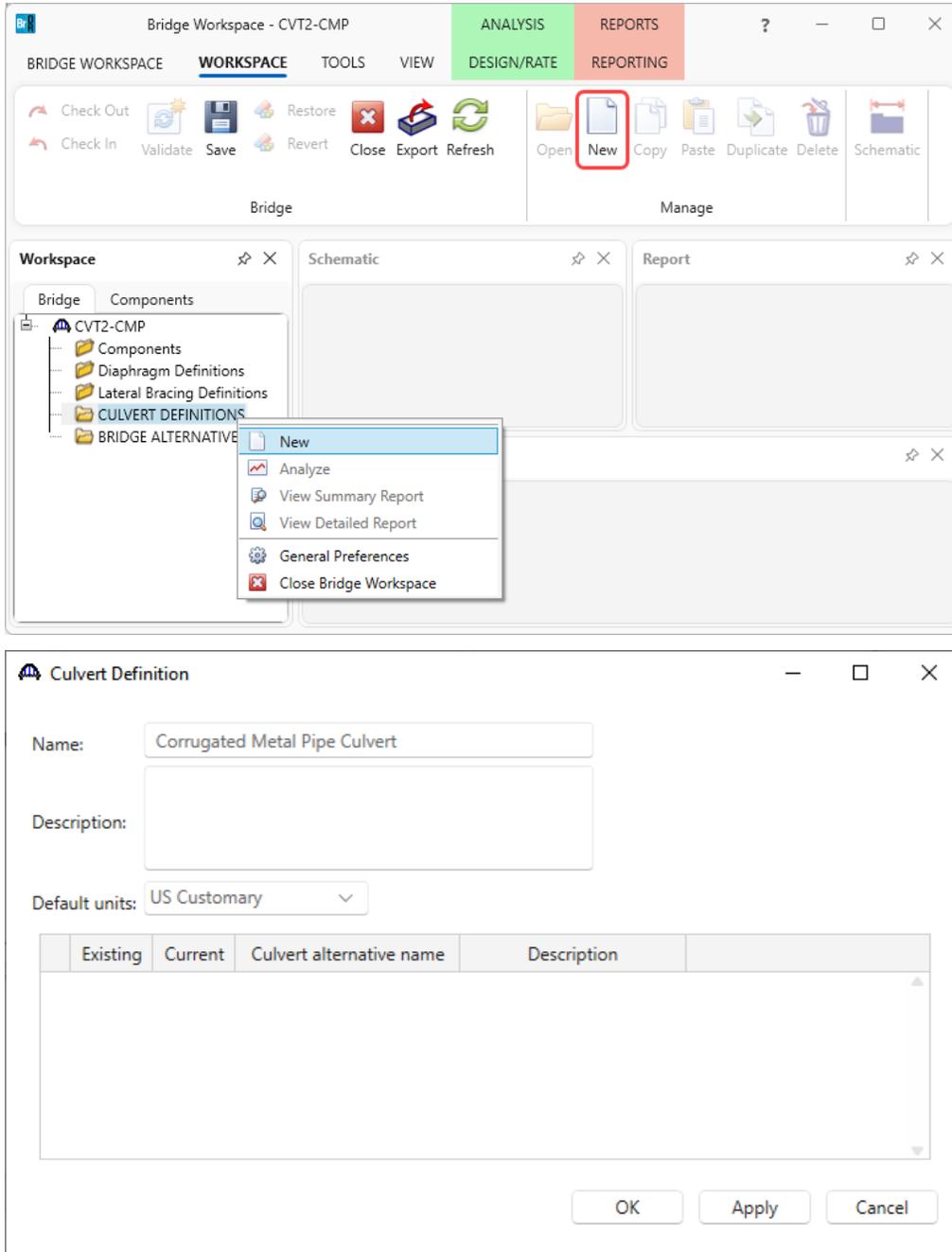


Close the window by clicking **OK**.

CVT2 – Corrugated Metal Pipe Culvert Example

Culvert Definition

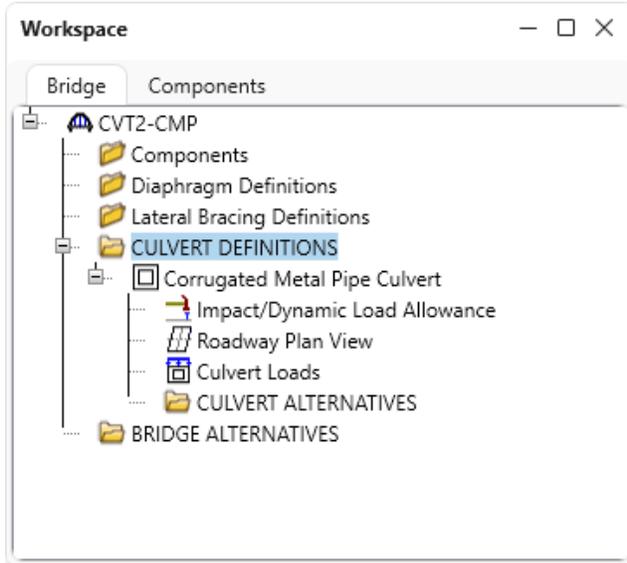
To create a new culvert definition, click on **CULVERT DEFINITIONS** in the **Bridge Workspace** tree and select **New** from the **Manage** group of the **WORKSPACE** ribbon (or double click on the **CULVERT DEFINITION**, or right click and select **New**). Enter the Culvert Definition **Name** as show below.



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

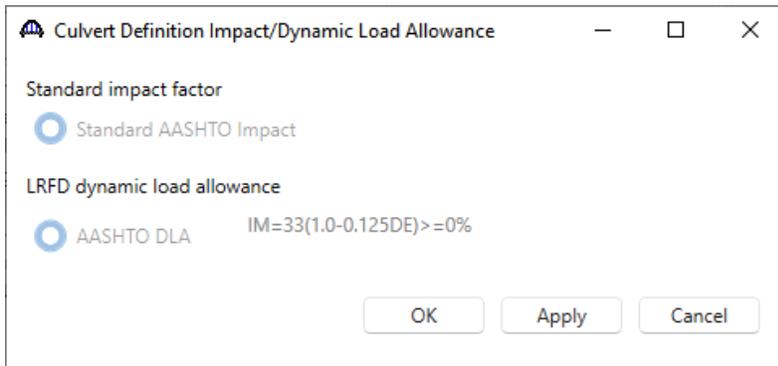
CVT2 – Corrugated Metal Pipe Culvert Example

Expand the tree for the new culvert structure definition as shown below.



Impact/Dynamic Load Allowance

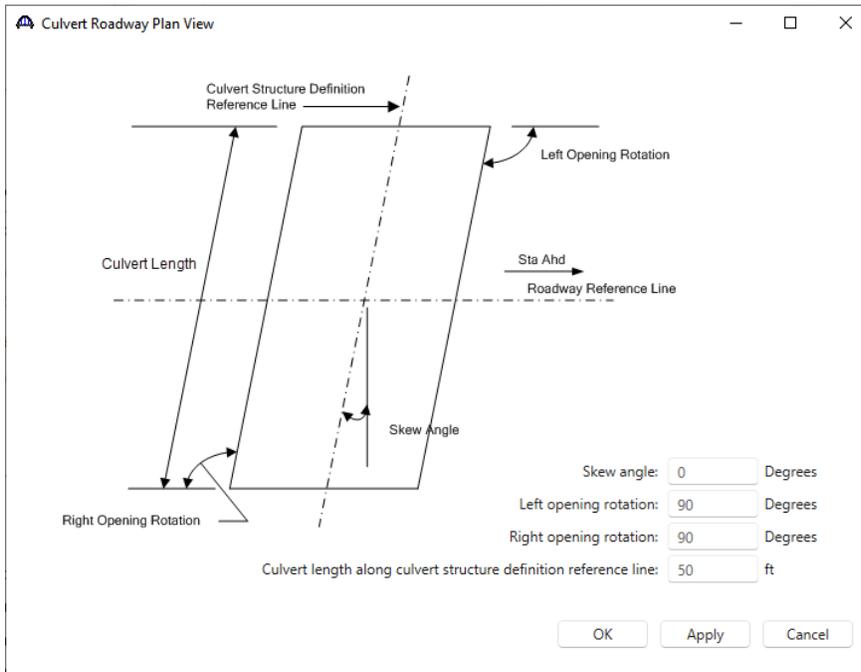
Impact (LFD) and Dynamic Load Allowance (LRFD) cannot be modified for culvert structure definition, therefore, no additional input can be entered on the **Culvert Definition Impact/Dynamic Load Allowance** window.



CVT2 – Corrugated Metal Pipe Culvert Example

Culvert Roadway Plan View

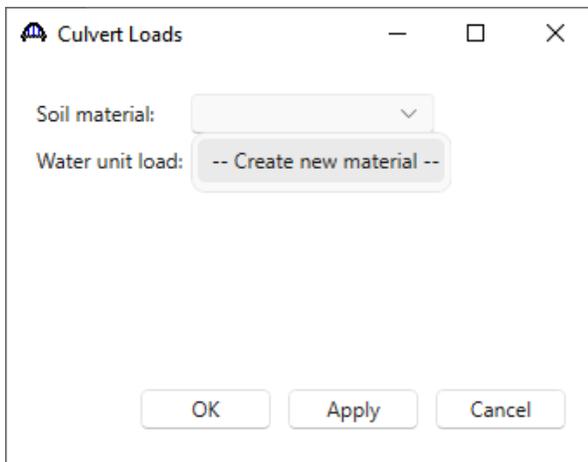
Double click on the **Roadway Plan View** node in the **Bridge Workspace** tree to open the **Culvert Roadway Plan View** window. Enter the culvert orientation details as shown below. The **Culvert length along culvert structure definition reference line** must be input for the live load pressure distribution calculations. The other input items help define the culvert orientation but are not used by the analysis engine at this time.



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

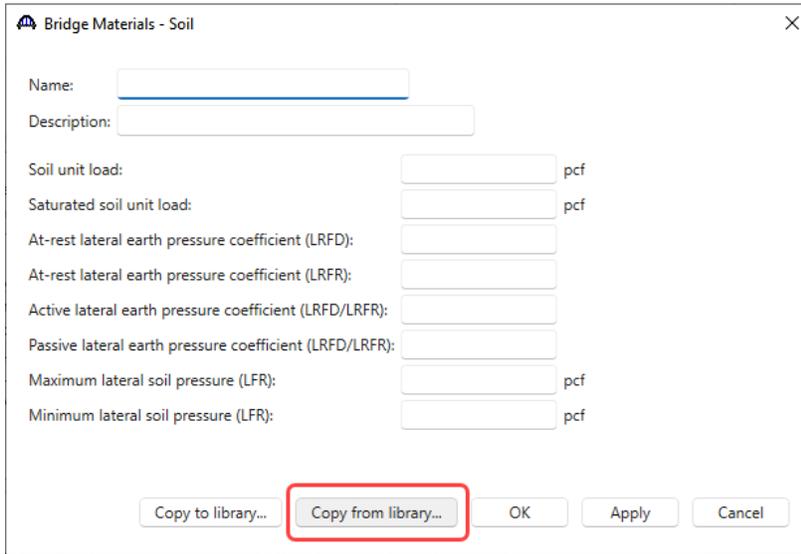
Culvert Loads

Double-click on the **Culvert Loads** node to open the **Culvert Loads** window. Define the water unit load and soil material in the **Culvert Loads** window. If the soil material is already defined within this bridge, it will show up in the dropdown list of **Soil material**. In this case, since a soil material is not defined, use the **Create new material** option to add a new soil material definition as shown below.



CVT2 – Corrugated Metal Pipe Culvert Example

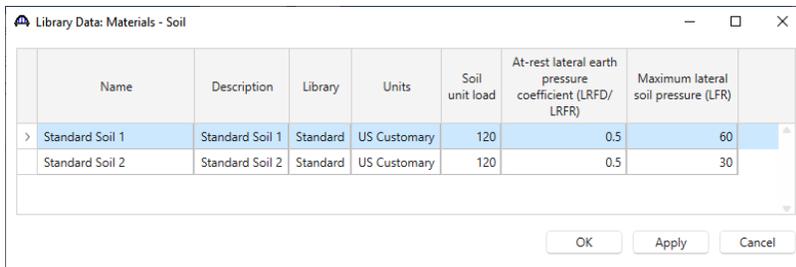
The **Bridge Materials - Soil** window opens as shown below. Select the **Copy from library** button to copy the **Standard Soil 1** definition from the BrDR library.



The dialog box titled "Bridge Materials - Soil" contains several input fields for soil properties. The "Copy from library..." button is highlighted with a red rectangle.

Name:	<input type="text"/>
Description:	<input type="text"/>
Soil unit load:	<input type="text"/> pcf
Saturated soil unit load:	<input type="text"/> pcf
At-rest lateral earth pressure coefficient (LRFD):	<input type="text"/>
At-rest lateral earth pressure coefficient (LRFR):	<input type="text"/>
Active lateral earth pressure coefficient (LRFD/LRFR):	<input type="text"/>
Passive lateral earth pressure coefficient (LRFD/LRFR):	<input type="text"/>
Maximum lateral soil pressure (LFR):	<input type="text"/> pcf
Minimum lateral soil pressure (LFR):	<input type="text"/> pcf

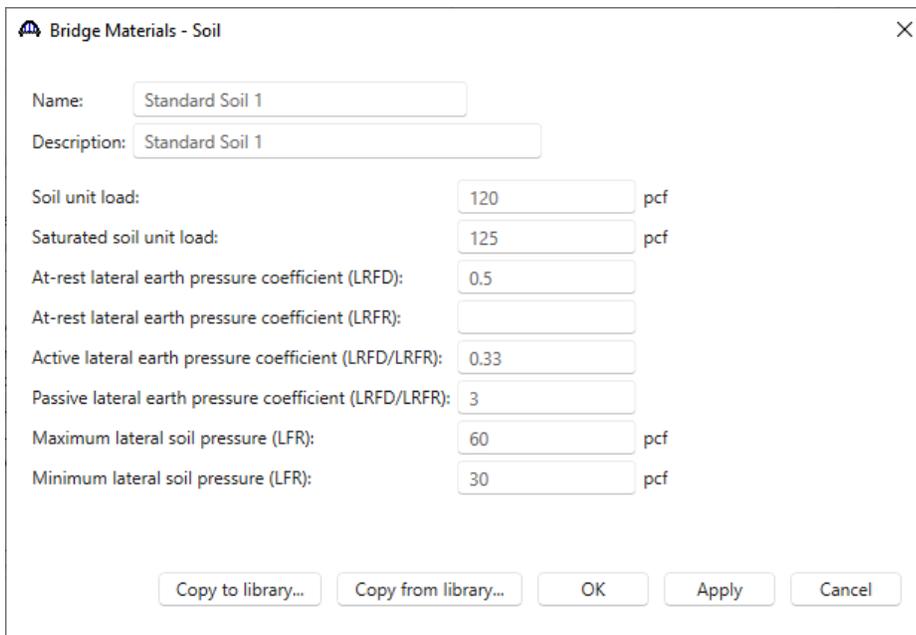
Buttons: Copy to library... Copy from library... OK Apply Cancel



The dialog box titled "Library Data: Materials - Soil" displays a table of soil materials from a library.

Name	Description	Library	Units	Soil unit load	At-rest lateral earth pressure coefficient (LRFD/LRFR)	Maximum lateral soil pressure (LFR)
Standard Soil 1	Standard Soil 1	Standard	US Customary	120	0.5	60
Standard Soil 2	Standard Soil 2	Standard	US Customary	120	0.5	30

Buttons: OK Apply Cancel



The dialog box titled "Bridge Materials - Soil" now shows the data from the library. The "Copy from library..." button is no longer highlighted.

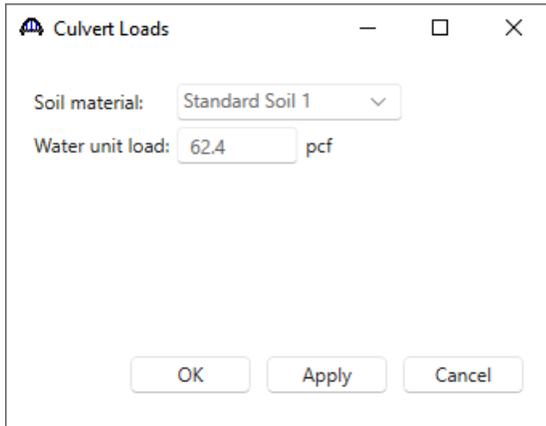
Name:	<input type="text" value="Standard Soil 1"/>
Description:	<input type="text" value="Standard Soil 1"/>
Soil unit load:	<input type="text" value="120"/> pcf
Saturated soil unit load:	<input type="text" value="125"/> pcf
At-rest lateral earth pressure coefficient (LRFD):	<input type="text" value="0.5"/>
At-rest lateral earth pressure coefficient (LRFR):	<input type="text"/>
Active lateral earth pressure coefficient (LRFD/LRFR):	<input type="text" value="0.33"/>
Passive lateral earth pressure coefficient (LRFD/LRFR):	<input type="text" value="3"/>
Maximum lateral soil pressure (LFR):	<input type="text" value="60"/> pcf
Minimum lateral soil pressure (LFR):	<input type="text" value="30"/> pcf

Buttons: Copy to library... Copy from library... OK Apply Cancel

Click **OK** to create and apply this soil material in the Culvert Loads window.

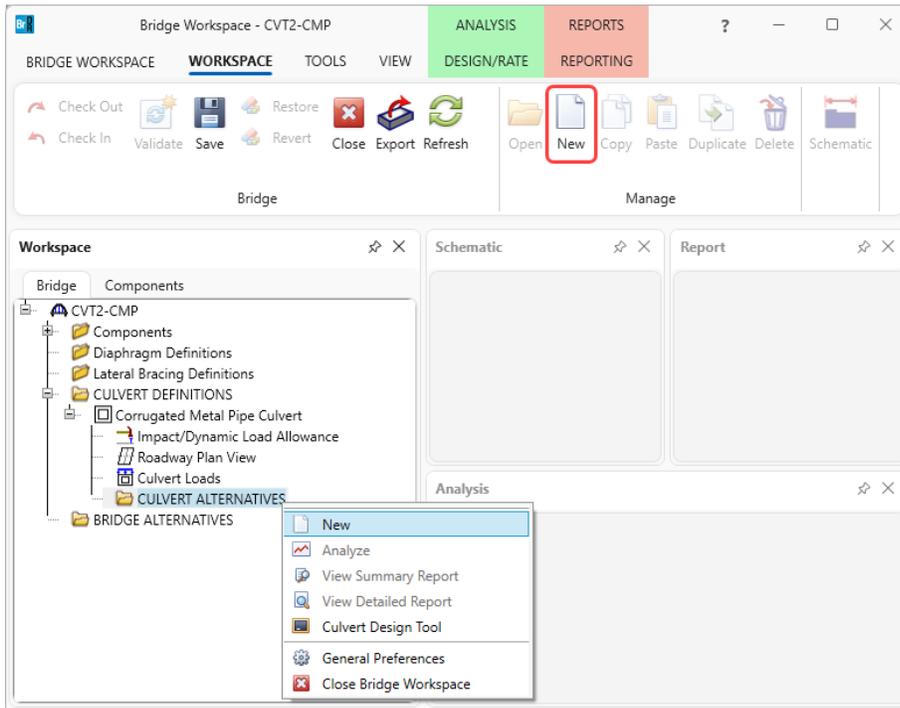
CVT2 – Corrugated Metal Pipe Culvert Example

Save the **Culvert Loads** window with the soil material definition and water unit load. The water unit load will populate by default as 62.4 lb/ft³.



Culvert Alternative

To create a new culvert alternative, click on **CULVERT ALTERNATIVES** in the **Bridge Workspace** tree and select **New** from the **Manage** group of the **WORKSPACE** ribbon (or double click on the **CULVERT ALTERNATIVES**, or right click and select **New**).

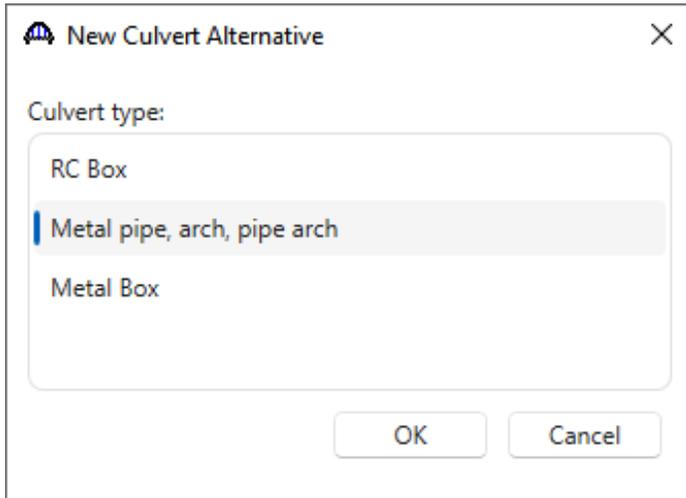


There are three culvert types available in BrDR.

1. Reinforced Concrete Box
2. Metal Pipe, arch, pipe arch
3. Metal box

CVT2 – Corrugated Metal Pipe Culvert Example

For a corrugated metal pipe culvert, select **Metal pipe, arch, pipe arch** from the available options. The culvert type selection cannot be modified after a culvert alternative is created.



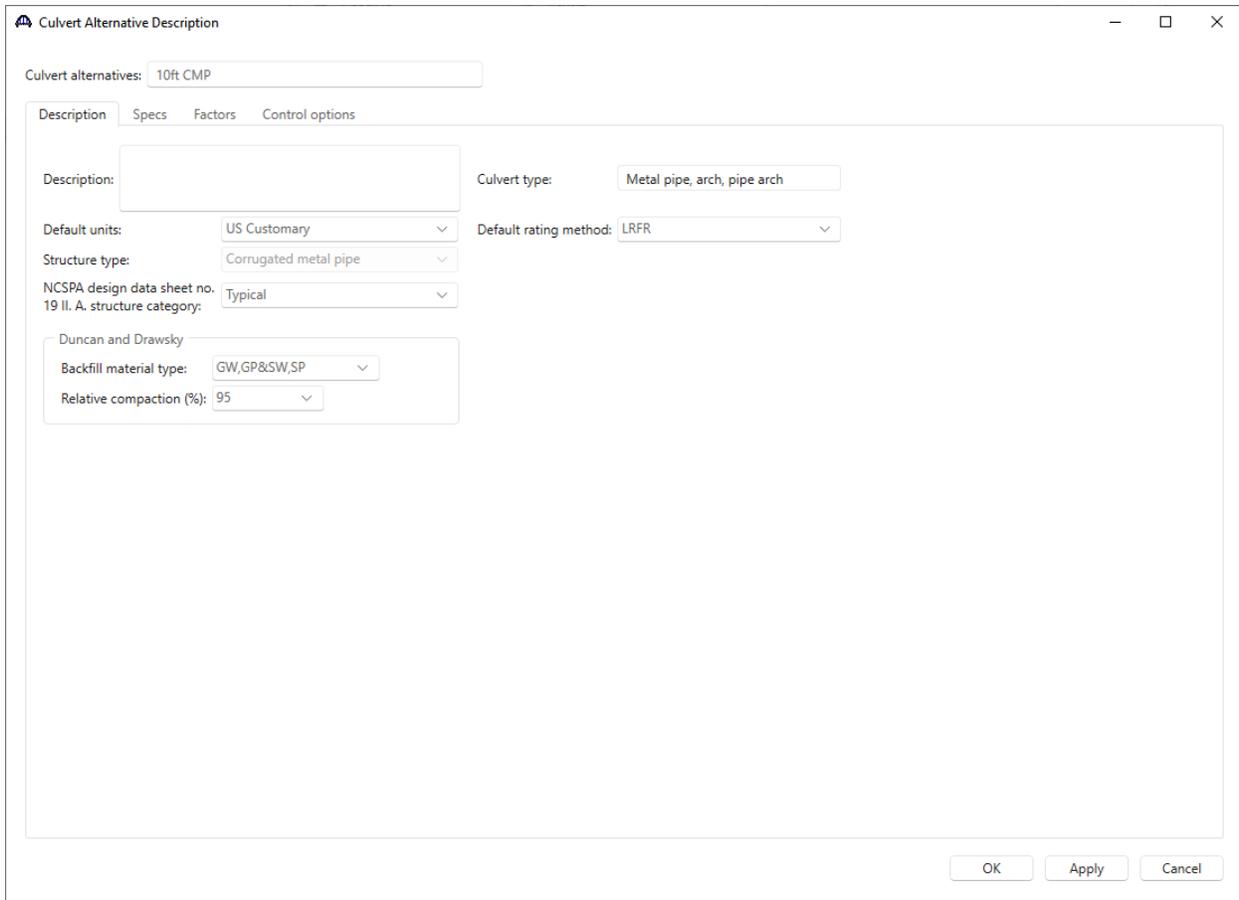
New Culvert Alternative

Culvert type:

- RC Box
- Metal pipe, arch, pipe arch**
- Metal Box

OK Cancel

Enter the culvert alternative description as shown below.



Culvert Alternative Description

Culvert alternatives: 10ft CMP

Description Specs Factors Control options

Description:

Culvert type: Metal pipe, arch, pipe arch

Default units: US Customary

Structure type: Corrugated metal pipe

NCSA design data sheet no. 19 II. A. structure category: Typical

Duncan and Drawsky

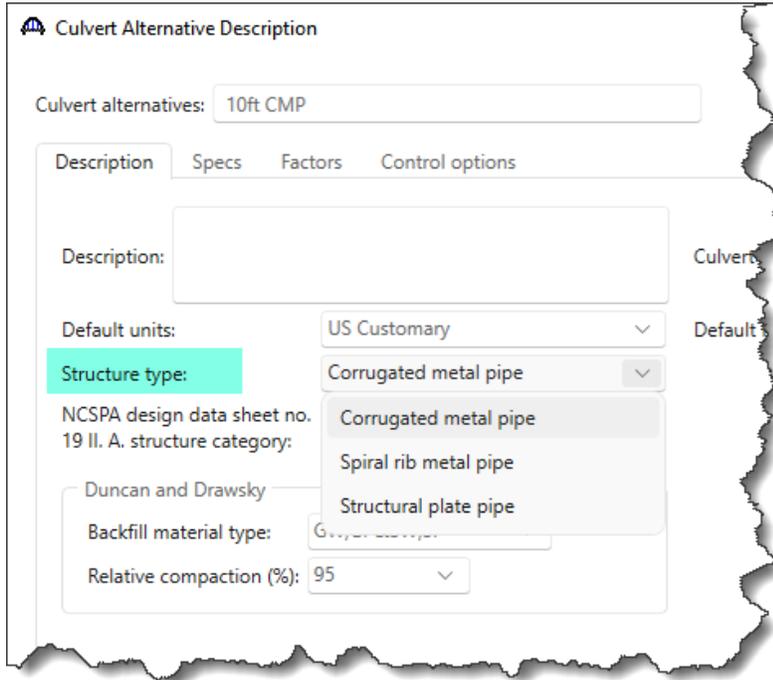
Backfill material type: GW,GP&SW,SP

Relative compaction (%): 95

OK Apply Cancel

CVT2 – Corrugated Metal Pipe Culvert Example

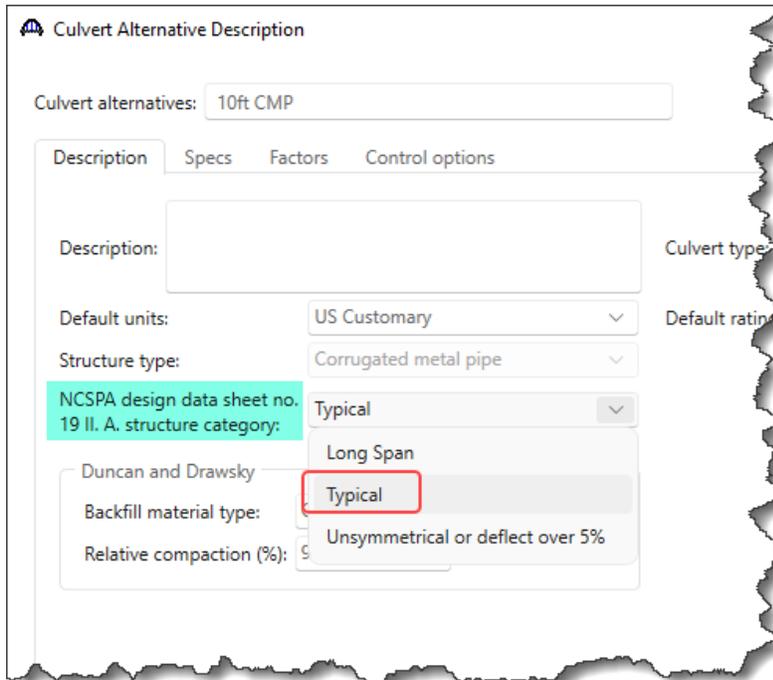
Metal pipe culverts have three available **Structure types**. The type must be selected when creating a new metal pipe culvert alternative and cannot be modified after the alternative is created.



The screenshot shows the 'Culvert Alternative Description' form with the following fields and values:

- Culvert alternatives: 10ft CMP
- Description: [Empty]
- Default units: US Customary
- Structure type: Corrugated metal pipe (dropdown menu is open showing options: Corrugated metal pipe, Spiral rib metal pipe, Structural plate pipe)
- NCSA design data sheet no. 19 II. A. structure category: [Empty]
- Duncan and Drawsky: [Empty]
- Backfill material type: [Empty]
- Relative compaction (%): 95

Select **Typical** under the NCSA design data sheet no. 19 II. A structure category.



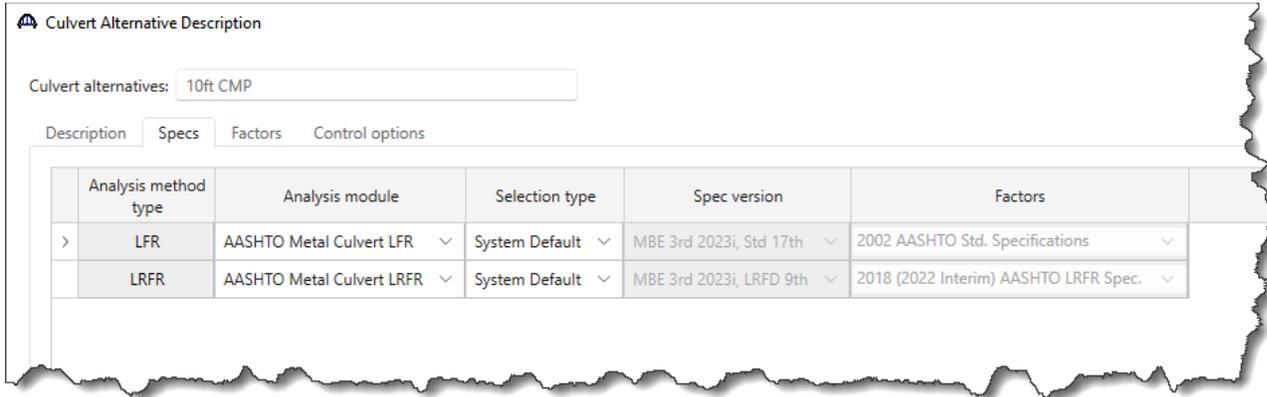
The screenshot shows the 'Culvert Alternative Description' form with the following fields and values:

- Culvert alternatives: 10ft CMP
- Description: [Empty]
- Default units: US Customary
- Structure type: Corrugated metal pipe
- NCSA design data sheet no. 19 II. A. structure category: Typical (dropdown menu is open showing options: Typical, Long Span, Unsymmetrical or deflect over 5%)
- Duncan and Drawsky: [Empty]
- Backfill material type: [Empty]
- Relative compaction (%): [Empty]

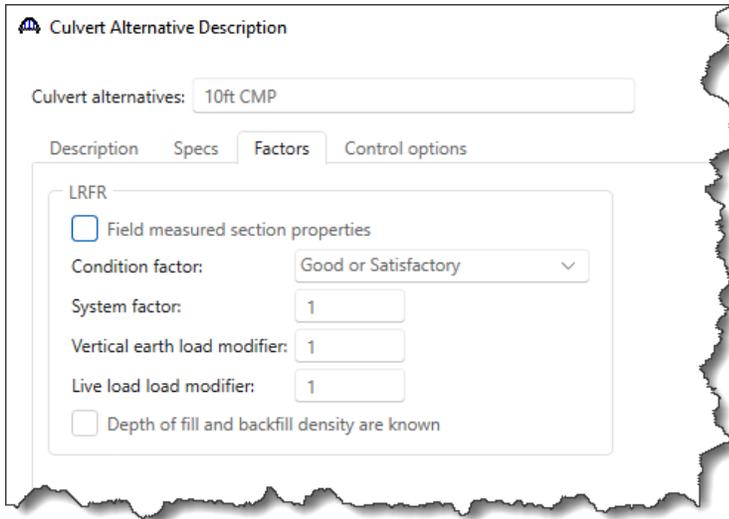
CVT2 – Corrugated Metal Pipe Culvert Example

Review the information in each of the tabs of the **Culvert Alternative Description** window.

The **Specs** tab shows the analysis modules and specification versions for each analysis method type. The AASHTO metal culvert engine supports LFR and LRFR analysis method types. For both LFR and LRFR, only the MBE 3rd edition 2022 approved ballot items and newer specification versions will be available. Leave the selection set to **System Default** to use the default specification version.

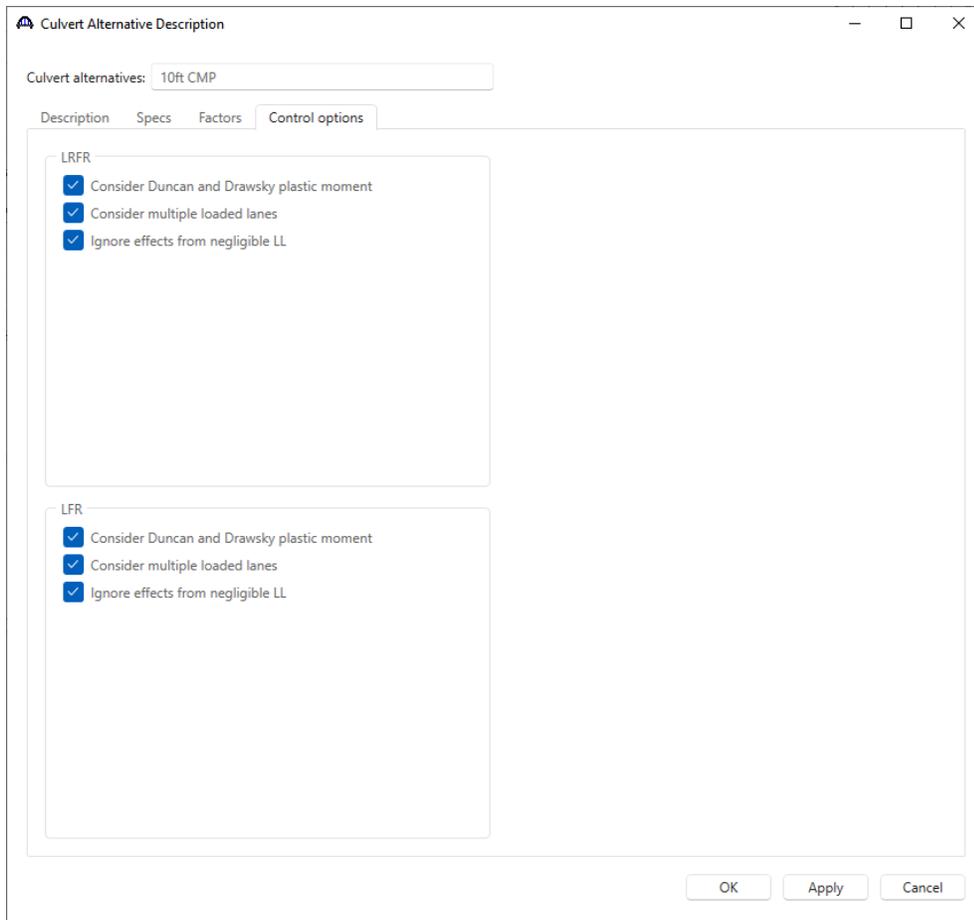


The **Factors** tab provides input to modify the **LRFR** factors. The default options are reasonable to use for this example.



The **Control options** tab has advanced analysis options for LFR and LRFR analysis methods. By default, none of the options are selected. For this example, select all the control options.

CVT2 – Corrugated Metal Pipe Culvert Example



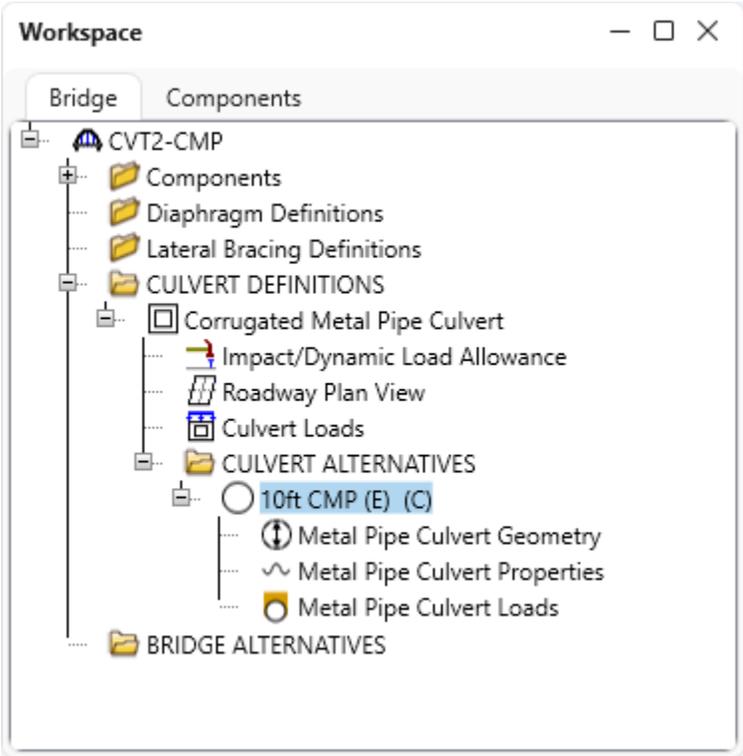
Description of Metal Pipe Culvert Alternative control options:

1. Consider Duncan and Drawsky plastic moment – Select this option to load rate a culvert alternative using the plastic moment capacity in addition to the wall capacity. The plastic moment capacity is computed according to the method described in *Design Procedures for Flexible Metal Culvert Structures* by J. M. Duncan and R. H. Drawsky (1983).
2. Consider multiple loaded lanes – This option considers multiple loaded lanes in the live load pressure calculations.
3. Ignore effects from negligible live load – Use this control option to skip the rating when live load pressure at the depth of the culvert is less than 10% of the total pressure at the depth of the culvert.

Click **OK** to create a new culvert alternative and close the window.

CVT2 – Corrugated Metal Pipe Culvert Example

Expand the tree for the new culvert alternative as shown below.



CVT2 – Corrugated Metal Pipe Culvert Example

Metal Pipe Culvert Geometry

Double click on the **Metal Pipe Culvert Geometry** node in the **Bridge Workspace** tree to open the **Metal Pipe Culvert Geometry** window to enter the culvert geometry. Refer to the diagrams included in the window for the dimensions of the specific metal pipe culvert structure you are entering. For the corrugated metal pipe in this example, the dimensions correspond to the circular pipe diagram. This example is a **Typical** structure category type, but when **Long span**, or **Unsymmetrical or Deflect over 5%** are selected under the **NCSPA design data sheet no. 19 II. A structure category** in the **Culvert Alternative Description - Description** window, the actual top radius must also be input.

The screenshot shows the "Metal Pipe Culvert Geometry" window. It contains three diagrams illustrating different culvert types: "Circular", "Arch", and "Pipe Arch". Each diagram shows the span length (S), rise (R), and rise above haunch (RA). The "Circular" diagram shows a circle with diameter S and radius R, with RA being the height from the haunch to the top. The "Arch" diagram shows a semi-circular arch with span S and rise R, where R = RA. The "Pipe Arch" diagram shows a pipe arch with span S, rise R, and rise above haunch RA.

Below the diagrams are input fields for the following parameters:

- Span length (S): 10 ft
- Rise (R): 10 ft
- Rise above haunch (RA): 5 ft

There is also a section for "Actual top radius" with two radio buttons: "Design Plans" (selected) and "Field measurement". Below these are input fields for "Straight edge length (C):" and "Mid-ordinate (M):", both currently empty. An "Actual top radius:" field is also present, currently empty. A "Compute" button is located below the "Actual top radius" field.

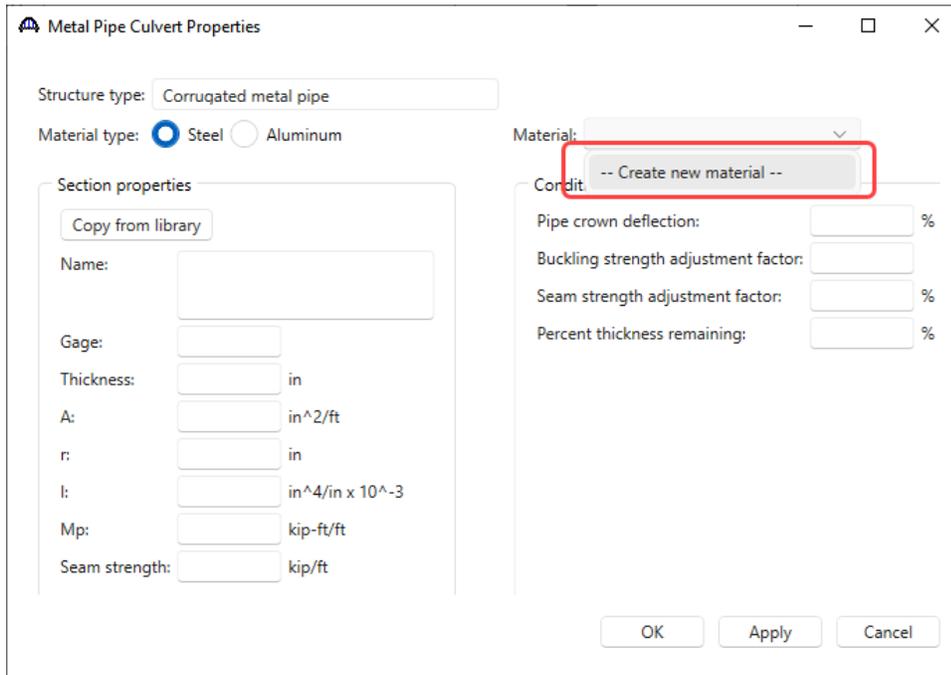
At the bottom of the window are three buttons: "OK", "Apply", and "Cancel".

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

CVT2 – Corrugated Metal Pipe Culvert Example

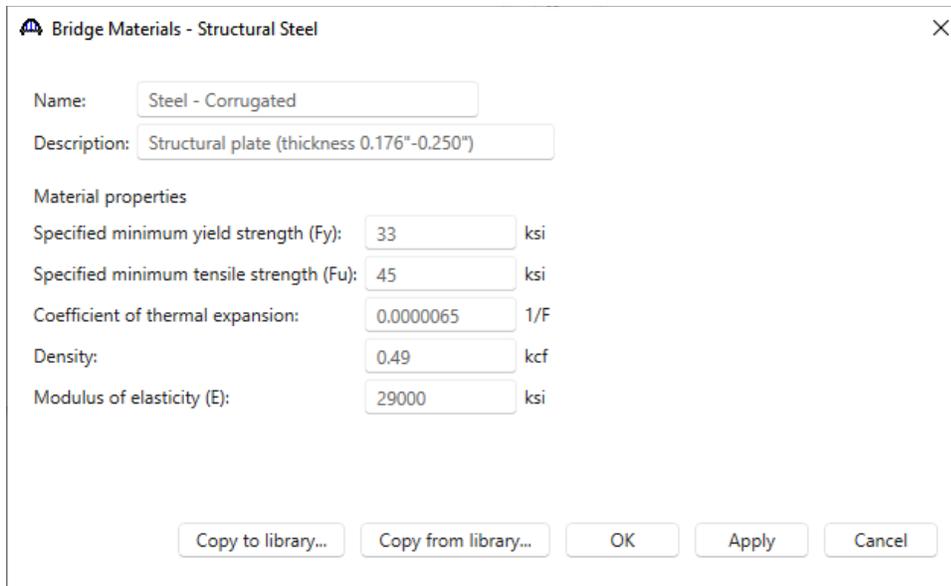
Metal Pipe Culvert Properties

Double-click on the **Metal Pipe Culvert Properties** node in the **Bridge Workspace** tree to enter the pipe culvert section properties, material, and culvert condition. Both steel and aluminum materials are available for the metal pipe culverts. First, select **Steel** and use the **Create new material** option from the material dropdown list to define a steel material.



The screenshot shows the "Metal Pipe Culvert Properties" dialog box. The "Structure type" is set to "Corrugated metal pipe". The "Material type" is set to "Steel". The "Material" dropdown menu is open, and the option "-- Create new material --" is highlighted with a red box. The "Section properties" section includes a "Copy from library" button and fields for Name, Gage, Thickness, A, r, I, Mp, and Seam strength. The "Condition" section includes fields for Pipe crown deflection, Buckling strength adjustment factor, Seam strength adjustment factor, and Percent thickness remaining. The "OK", "Apply", and "Cancel" buttons are at the bottom.

Use the **Copy from library...** option to copy the **Steel - Corrugated** structural steel material definition. Select **OK** to save the new steel material.



The screenshot shows the "Bridge Materials - Structural Steel" dialog box. The "Name" field is "Steel - Corrugated" and the "Description" is "Structural plate (thickness 0.176"-0.250)". The "Material properties" section includes fields for Specified minimum yield strength (Fy), Specified minimum tensile strength (Fu), Coefficient of thermal expansion, Density, and Modulus of elasticity (E). The "Copy to library...", "Copy from library...", "OK", "Apply", and "Cancel" buttons are at the bottom.

CVT2 – Corrugated Metal Pipe Culvert Example

Input the section properties and condition for the corrugated steel pipe as shown below.

Metal Pipe Culvert Properties

Structure type:

Material type: Steel Aluminum

Material:

Section properties

Name:

Gage:

Thickness: in

A: in²/ft

r: in

I: in⁴/in x 10⁻³

Mp: kip-ft/ft

Seam strength: kip/ft

Condition

Pipe crown deflection: %

Buckling strength adjustment factor:

Seam strength adjustment factor: %

Percent thickness remaining: %

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

CVT2 – Corrugated Metal Pipe Culvert Example

Metal Pipe Culvert Loads

Double-click on the **Metal Pipe Culvert Loads** node in the **Bridge Workspace** tree to enter details about the metal pipe culvert loads in the **Metal Pipe Culvert Loads** window. Since the control option for **Consider multiple loaded lanes** is selected, the **Clear roadway width** input will be used to determine the number of lanes. The **Pavement reduction factor** is an input item introduced in the 2022 approved ballot item specification revisions. If applying the **Pavement reduction factor**, enter the factor as a percent by which you want to reduce the live load pressure. If the input is left blank, the AASHTO Metal Culvert Engine will apply a factor of 100%, or in other words 100% of the live load pressure will be applied to the culvert.

Metal Pipe Culvert Loads

Clear roadway width

ELEVATION

Flexible Pavement

Base Course

Subbase

H

H_{min}

Flexible Pipe

Rigid Pavement

Base Course

Subbase

H = H_{min}

Flexible Pipe

Average depth of fill (H): 2 ft

Minimum cover depth (H_{min}): 2 ft

Water height: 0 ft

Clear roadway width: 24 ft

Pavement reduction factor: %

Wearing surface density: 0 pcf

Wearing surface thickness: 0 in

Thickness field measured (DW = 1.25 if checked)

Comment:

OK Apply Cancel

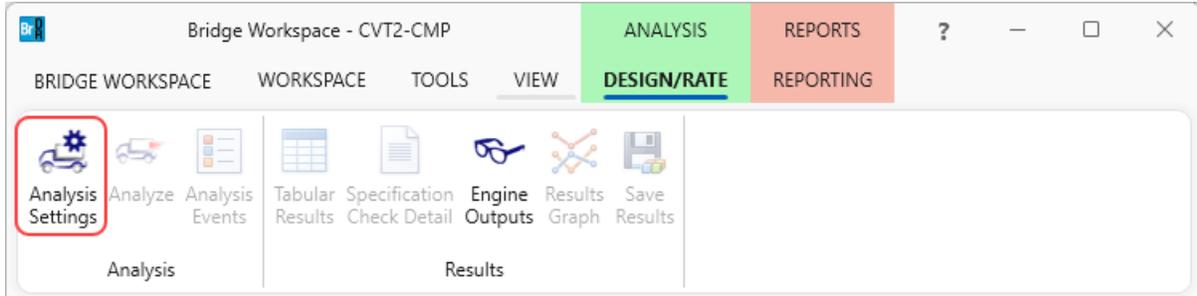
This completes the data entry for the corrugated metal pipe culvert structure.

CVT2 – Corrugated Metal Pipe Culvert Example

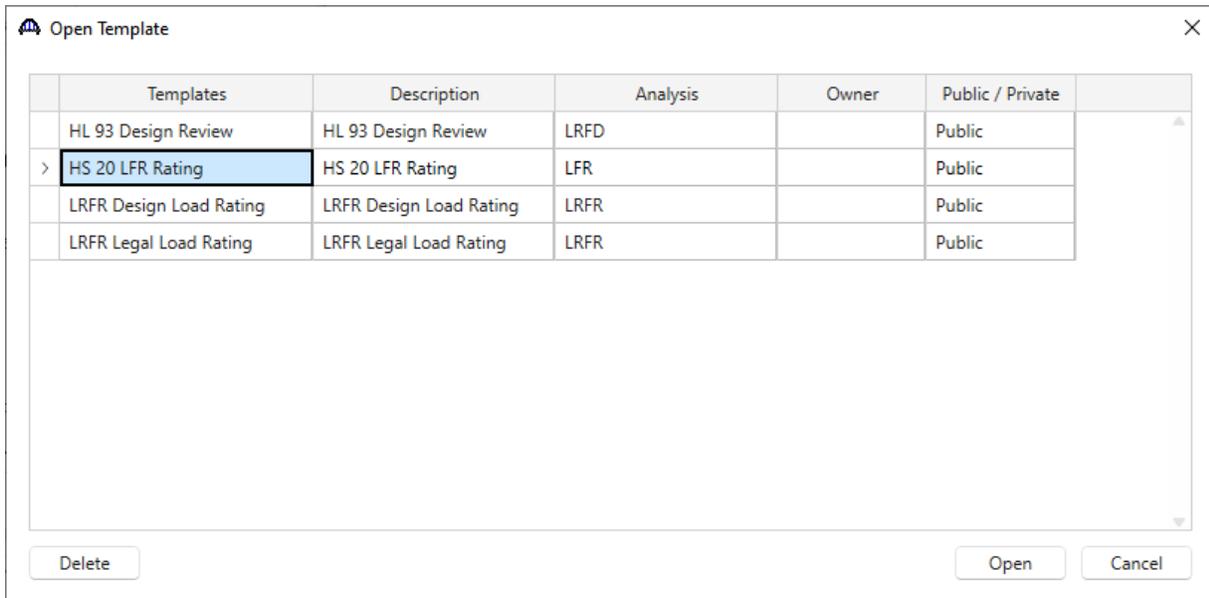
Corrugated Metal Pipe Culvert LFR Analysis.

LFR Analysis

To perform an LFR Rating, select the **10ft CMP** alternative in the **Bridge Workspace** tree and click the **Analysis Settings** button from the **Analysis** group of the **DESIGN/RATE** ribbon.



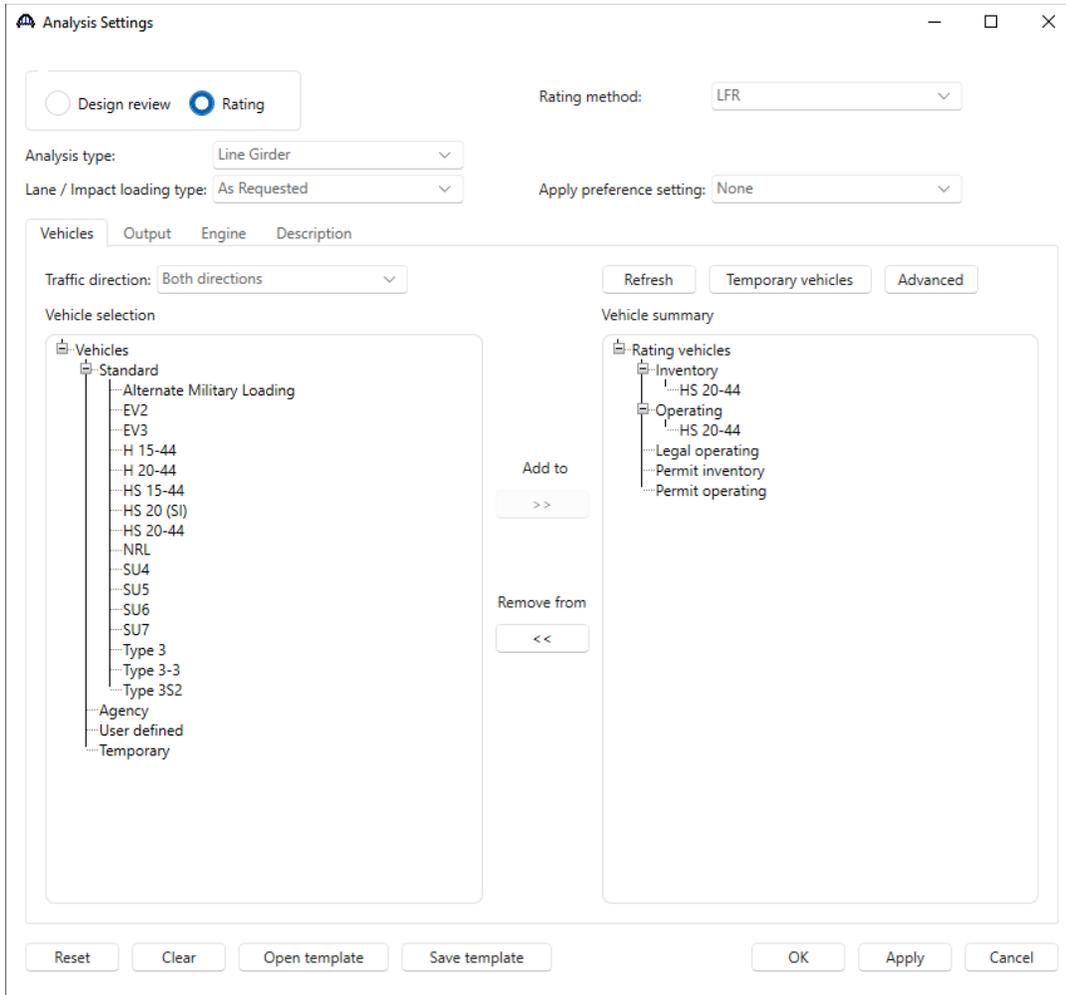
The **Analysis Settings** window will open. Click the **Open template** button and select the **HS 20 LFR Rating** to be used in the rating and click **Open**.



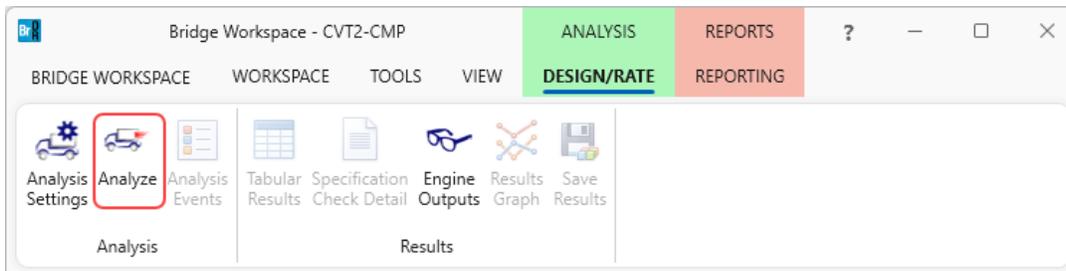
Click **OK** to apply the data and close the window.

CVT2 – Corrugated Metal Pipe Culvert Example

The **Analysis Settings** window will be populated as shown below. Click **OK** to apply the data and close the window.



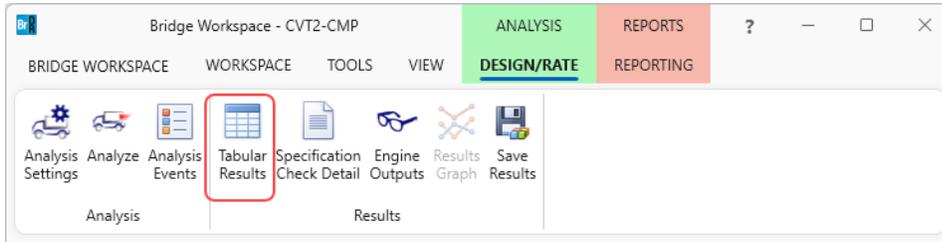
Click the **Analyze** button from the **Analysis** group of the **DESIGN/RATE** ribbon to start the rating process.



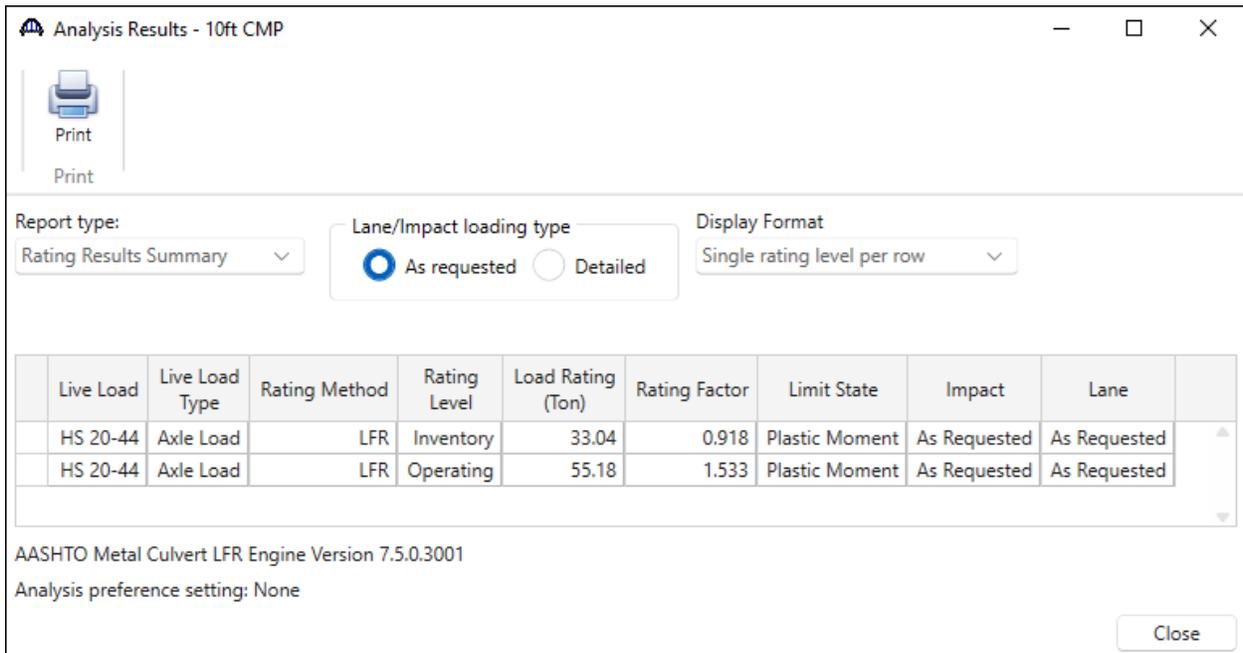
CVT2 – Corrugated Metal Pipe Culvert Example

Tabular Results

When the rating is completed, results can be reviewed by clicking the **Tabular Results** button from the **Results** group of the **DESIGN/RATE** ribbon.

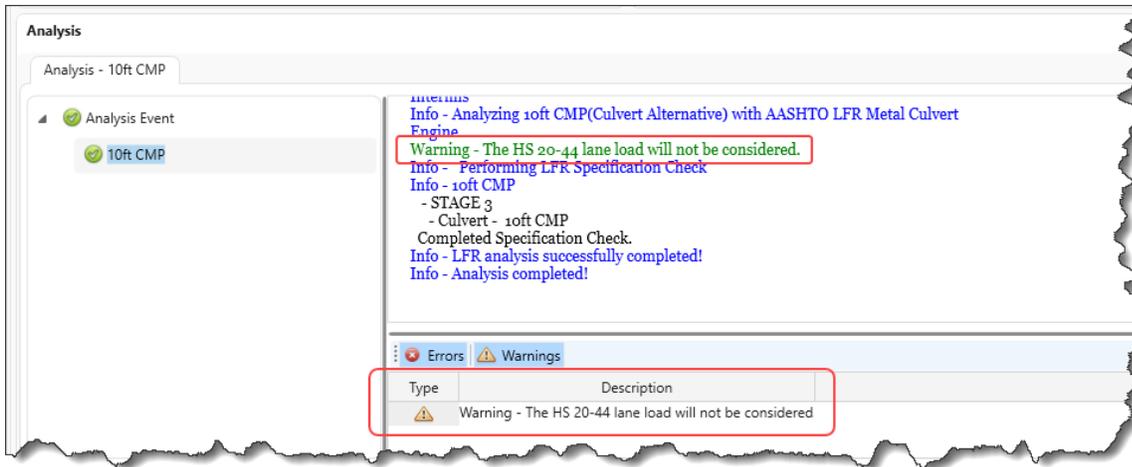


The window shown below will open. Select **Single rating level per row** as the display format to display the output in single rows as shown below. The **Rating Results Summary** is the only report type available following a metal culvert analysis.



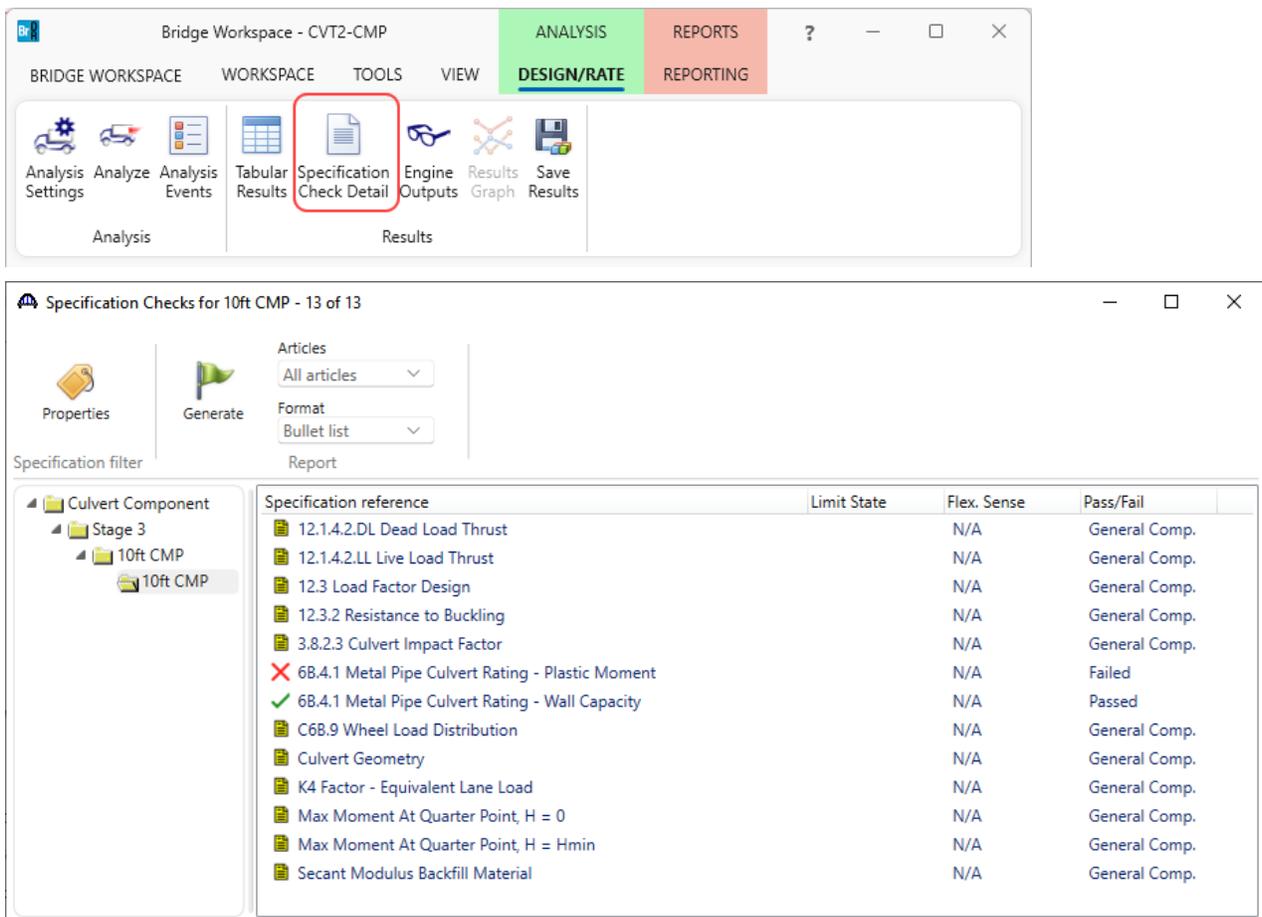
Review the **Analysis Progress** log shown below. The warning shown informs that the lane load portion of the HS 20-44 vehicle is not considered for the metal culvert analysis. Some advanced vehicle loading options are not applicable to the metal culvert analysis including lane loads, adjacent vehicles, fatigue trucks, and tandem trains.

CVT2 – Corrugated Metal Pipe Culvert Example



Specification Check Detail

To review detailed rating results at the controlling location, use the **Specification Check Detail** button in the ribbon to open the **Specification** window. Note that the metal culvert only has one POI for specification checking. The 6B.4.1 Metal Pipe Culvert Rating – Plastic Moment rating article and the last four calculation articles listed are included because the LFR control option for Duncan and Drawsky plastic moment was selected.



CVT2 – Corrugated Metal Pipe Culvert Example

Open the **C6B.9 Wheel Load Distribution** specification article to display detailed calculations for the LFR vehicle live loading. This article includes calculations for each vehicle and each analysis category. The live load pressure calculations are shown below for the HS 20-44 truck in the operating analysis category.

Spec Check Detail for C6B.9 Wheel Load Distribution

Vehicle: HS 20-44 - Truck - Operating

Impact Factor (IM) = 20.0%

Wheel Load Distribution to Critical Axle Group

Axle No.	Total Axle Load (kip)	Axle Spacing (ft)	lw (ft)	Pressure (kip/ft)
1	8.00	---	0.83	1.85
2	32.00	14.00	0.83	7.38
3	32.00	14.00	0.83	7.38

WD Wheel = wt + LLDF * H
 WD Axle = Min(WD Wheel * 2, wt + sw + LLDF * H)

Axle No.	Total Axle Load (kip)	Axle Spacing (ft)	wt (ft)	sw (ft)	WD Wheel (ft)	WD Axle (ft)
2	32.00	---	1.67	6.00	5.17	10.33

Single Lane Results:

Total area at depth H (A_LL) = 22.39 (ft²)
 Live load patch length at depth (lw) = 4.33 (ft)
 Total live load for all interacting wheels (P) = 16.00 (kip)

Reduction in Load Intensity (RLI) (Article 3.12)

$$\text{Live Load Vertical Crown Pressure (Pl)} = \frac{P * (1 + IM / 100) * RLI}{A_LL}$$

No. Lanes	RLI	Required Depth For Interaction (ft)	Total Width At Depth (ft)	Load From All Interacting Wheels (kip)	Live Load Area (ft ²)	Live Load Pressure (ksf)
1	1.00	---	5.17	16.00	22.39	0.86
2	1.00	1.33	19.17	32.00	40.42	0.95

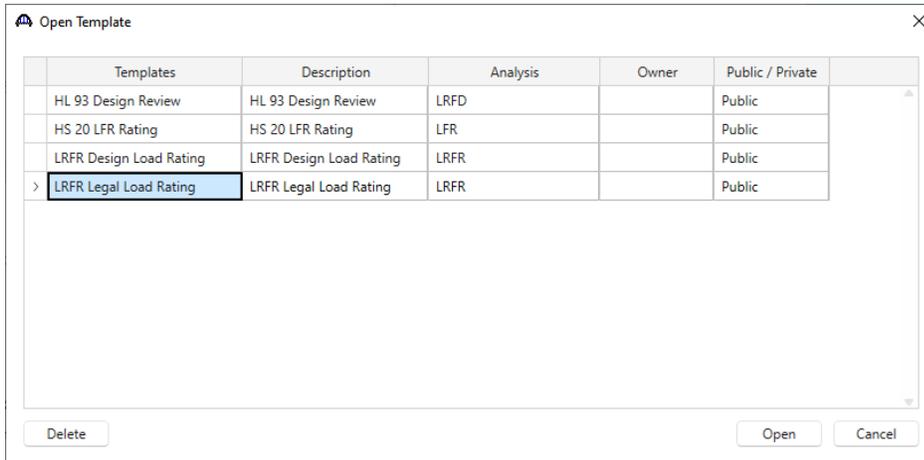
OK

CVT2 – Corrugated Metal Pipe Culvert Example

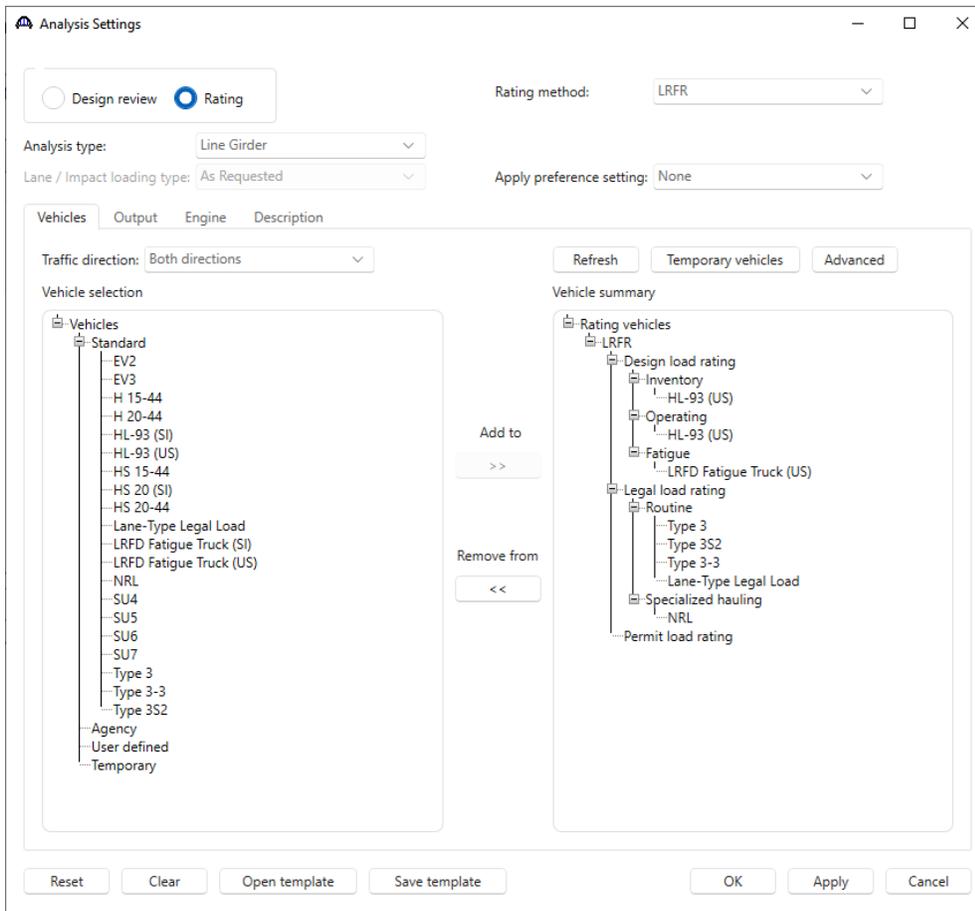
Corrugated Metal Pipe Culvert LRFR Analysis.

LRFR Analysis

Close the spec check window and reopen the **Analysis Settings** window to test an **LRFR** analysis. Click the **Open template button** and select the **LRFR Legal Load Rating** to be used in the rating and click **Open**.



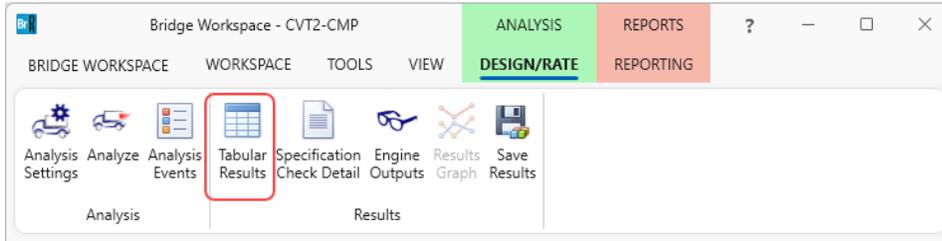
The **Analysis Settings** window will be populated as shown below.



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

CVT2 – Corrugated Metal Pipe Culvert Example

Click **Analyze** on the ribbon to launch the rating. When the rating analysis is complete, review the results by clicking the **Tabular Results** button on the ribbon.



The window shown below will open. Select **Single rating level per row** as the display format to display the output in single rows as shown below. The **Rating Results Summary** is the only report type available following a metal culvert analysis.

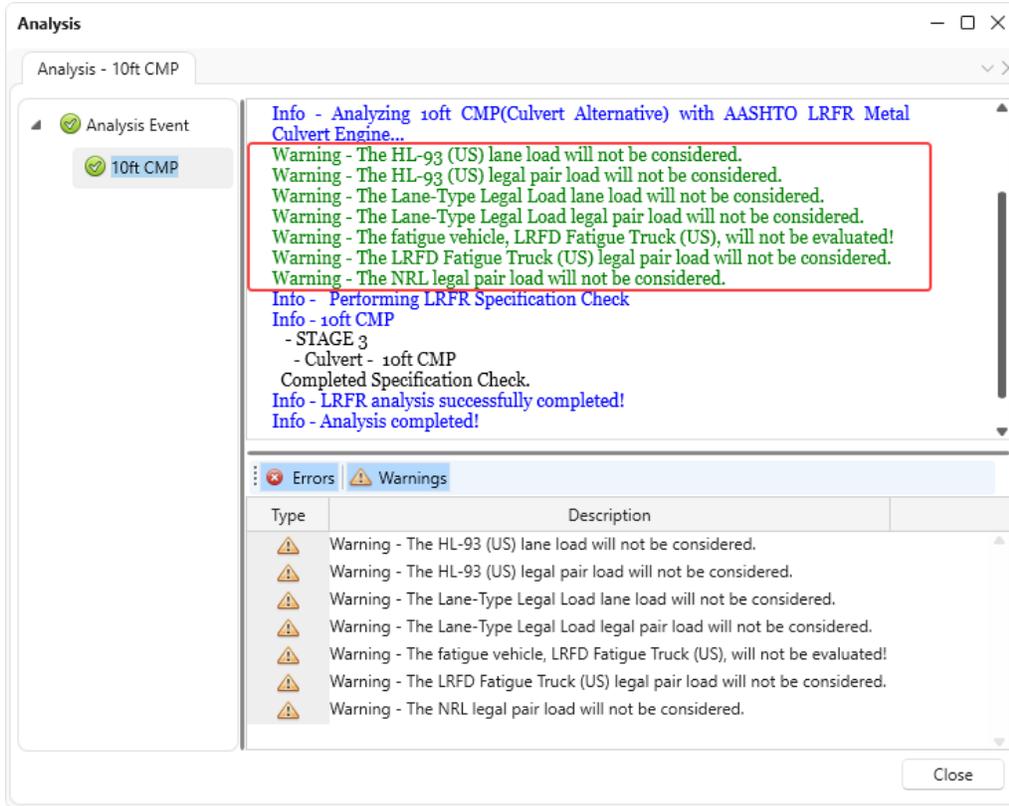
The screenshot shows the 'Analysis Results - 10ft CMP' window. The 'Report type' is 'Rating Results Summary'. The 'Lane/Impact loading type' is 'As requested'. The 'Display Format' is 'Single rating level per row'. The table below shows the results for various live loads.

Live Load	Live Load Type	Rating Method	Rating Level	Load Rating (Ton)	Rating Factor	Limit State	Impact	Lane
HL-93 (US)	Axle Load	LRFR	Inventory	39.43	1.095	STRENGTH-I Plastic Moment	As Requested	As Requested
HL-93 (US)	Axle Load	LRFR	Operating	51.11	1.420	STRENGTH-I Plastic Moment	As Requested	As Requested
HL-93 (US)	Tandem	LRFR	Inventory	50.47	1.402	STRENGTH-I Plastic Moment	As Requested	As Requested
HL-93 (US)	Tandem	LRFR	Operating	65.42	1.817	STRENGTH-I Plastic Moment	As Requested	As Requested
Lane-Type Legal Load	Axle Load	LRFR	Legal	76.66	2.555	STRENGTH-I Plastic Moment	As Requested	As Requested
NRL	Axle Load	LRFR	Legal	72.15	1.804	STRENGTH-I Plastic Moment	As Requested	As Requested
Type 3	Axle Load	LRFR	Legal	45.10	1.804	STRENGTH-I Plastic Moment	As Requested	As Requested
Type 3-3	Axle Load	LRFR	Legal	76.66	1.917	STRENGTH-I Plastic Moment	As Requested	As Requested
Type 3S2	Axle Load	LRFR	Legal	71.22	1.978	STRENGTH-I Plastic Moment	As Requested	As Requested

AASHTO Metal Culvert LRFR Engine Version 7.5.0.3001
Analysis preference setting: None

Review the **Analysis Progress** log . As with the LFR analysis, the warnings shown informs that some of the selected loads are not applicable to metal culverts. See sample below.

CVT2 – Corrugated Metal Pipe Culvert Example



Specification Check Detail

To review detailed rating results at the controlling location, click on the **Specification Check Detail** button in the ribbon to open the **Specification Checks** window. Note that the metal culvert only has one POI for specification checking. The **6A.10.4 Culvert Load Rating Equation – Duncan and Drawsky Plastic Moment** rating article and the last four calculation articles listed are included because the LRFR control option for Duncan and Drawsky plastic moment as selected.

The 'Specification Checks for 10ft CMP - 13 of 13' window displays the following table:

Specification reference	Limit State	Flex. Sense	Pass/Fail
12.7.2 Safety Against Structural Failure		N/A	General Comp.
12.7.2.2.DL Dead Load Thrust		N/A	General Comp.
12.7.2.2.LL Live Load Thrust		N/A	General Comp.
12.7.2.4 Resistance to Buckling		N/A	General Comp.
3.6.2.2 Culvert Dynamic Load Allowance		N/A	General Comp.
6A.10.10.3a Wheel Load Distribution		N/A	General Comp.
6A.10.4 Culvert Load Rating Equation - Duncan and Drawsky Plastic M		N/A	Passed
6A.10.4 Culvert Load Rating Equation - Wall Capacity		N/A	Passed
Culvert Geometry		N/A	General Comp.
K4 Factor - Equivalent Lane Load		N/A	General Comp.
Max Moment At Quarter Point, H = 0		N/A	General Comp.
Max Moment At Quarter Point, H = Hmin		N/A	General Comp.
Secant Modulus Backfill Material		N/A	General Comp.

CVT2 – Corrugated Metal Pipe Culvert Example

Open the **6A.10.10.3a Wheel Load Distribution** specification article for detailed calculations for the LRFR vehicle live loading. This article includes calculations for each vehicle and each analysis category. The live load pressure calculations are shown below for the HL-93 truck in the operating analysis category.

Spec Check Detail for 6A.10.10.3a Wheel Load Distribution

Vehicle: HL-93 (US) - Truck - DesignOp - STR-I

Tire Patch Length (lt) = 10.00 (in) for HL-93 loading

Wheel Load Distribution to Critical Axle Group

Average Depth of Fill (H) = 2.00 (ft)
 Span Length (S) = 10.00 (ft)

Sa-crit = H*LLDF + lt = 3.13 (ft)

Axle No.	Total Axle Load (kip)	Axle Spacing (ft)	Pressure (kip/ft)
1	8.00	---	2.55
2	32.00	14.00	10.21
3	32.00	14.00	10.21

Axle No.	Total Axle Load (kip)	Axle Spacing (ft)	wt (ft)	sw (ft)	Ww (ft)
2	32.00	---	1.67	6.00	4.57

Single Lane Results:

Total area at depth H (A_LL) = 14.31 (ft^2)
 Live load patch length at depth (lw) = 3.13 (ft)
 Total live load for all interacting wheels (P) = 16.00 (kip)

$$\text{Live Load Vertical Crown Pressure (Pl)} = \frac{P * (1 + IM / 100) * MPF}{A_LL} \quad (3.6.1.2.6b-7)$$

No. Lanes	MPF	Required Depth For Interaction (ft)	Total Width At Depth (ft)	Load From All Interacting Wheels (kip)	Live Load Area (ft^2)	Live Load Pressure (ksf)
1	1.20	---	4.57	16.00	14.31	1.67

OK