CONNECTICUT DEPARTMENT OF TRANSPORTATION

CTDOT BrR User Guide

Prepared by the Load Rating Section

Please direct all question and inquiries to DOT.BridgeRating@ct.gov

TABLE OF CONTENTS

ABBREVIATIONS

AASHTO – American Association of State and Highway Transportation Officials

ADTT – Average Daily Truck Traffic

BDS – AASHTO LRFD Bridge Design Specifications

BIR – Bridge Inspection Report

BLRM – CTDOT Bridge Load Rating Manual

CTDOT – Connecticut Department of Transportation

FEA – Finite Element Analysis

FEM – Finite Element Model

LL – Live Load

LLDF – Live Load Distribution Factor

LRE – Load Rating Engineer

LRFD – Load and Resistance Factor Design

LRFR – Load and Resistance Factor Rating

LRS – CTDOT Load Rating Section

NBI – National Bridge Inventory

PS – Prestressed

RC (R/C) – Reinforced Concrete

CHAPTER 1 GENERAL

1.1 Purpose

This manual establishes standards and provides guidance for performing load ratings using BrR. The objective of this Guide is to create models that are

- reproducible,
- consistent,
- meet the Department's policies and preferences,
- able to incorporate changes,
- capable of switching between analysis methods,
- update automatically with the code, and
- functional for permit analysis.

It is understood that some bridges, supported by BrR, may require modifications to these provisions; however, it is stressed that the LRE shall make every effort to comply with the subsequent provisions specified in this Guide.

1.2 Scope

BrR is the Department's software of choice for load rating structures. The requirements set forth in this Guide apply to all CTDOT personnel using BrR. In addition, consultants performing load ratings for CTDOT using BrR are required to follow the guidance contained herein. While this Guide is intended to provide guidance for modeling in BrR, it does not preclude justifiable exemptions, subject to the approval by the LRS.

This Guide shall serve as a supplement to the most recent BLRM. It is not intended to be a stand-alone document for load rating in the state of Connecticut. Rather, this Guide is an extension of the BLRM for load ratings performed using BrR.

This Guide is a living document. Changes will be issued as warranted due to changes in policy, loadings, evaluation, or software versions. The most recent version of this Guide is located at the CTDOT Bridge Load Rating Website.

1.3 Methodology

BrR models shall be modeled to reflect the as-inspected or proposed condition of the structure.

It is the Department's preference that each structure be contained in a single BrR model. If the LRE has reason to develop multiple models for a single structure, the LRE must secure approval from the Department prior to the start of the load rating.

1.4 Bugs, Issues, and Unexpected Behavior

BrR's program support service, Jira, can be used to browse reported issues with BrR. For read-only access to the Jira support service website, contact the LRS at DOT.BridgeRating@ct.gov. The LRE is responsible for reviewing all applicable JIRA tickets to ensure the reported issues do not affect the BrR model. If a Jira ticket affects the BrR model and a workaround for this issue is available or possible, refer to BLRM for reporting.

To submit a ticket reporting an issue in BrR, the LRE shall provide the following minimum information to the DOT.BridgeRating@ct.gov:

- The BrR version that is related to this issue
- The BrR model that is related to this issue
- Documentation describing the issue
- Troubleshooting attempts

1.5 Naming Convention

The naming convention within the BrR model shall be labeled in accordance with the BLRM.

1.5.1 Bridge Name

The Bridge Name field shall be the Structure Identification Number NBI item 8, maintaining all leading zeroes.

1.5.2 Superstructure Definition

The Superstructure Definitions Name shall be as follows: Span ##, where Span ## is the span currently being analyzed.

- Example: Span 02
- Example: Span 02-05

If the bridge being load rated contains two superstructures, each carrying a separate direction of traffic the Superstructure Definitions naming convention shall be as follows: Span ##_XX, where Span ## is the span currently being analyzed, and XX is the applicable travelway direction.

- Example: Span 02_NB
- Example: Span 02-05_WB

1.5.2.1 Member

The Member Name shall be inputted as labeled in the most recent BIR, or for new structures, following the labelling convention specified in the Bridge Inspection Manual.

1.5.2.1.1 Member Alternative

The Member Alternatives Name may be labeled at the discretion of the LRE to create or reuse pre-established naming conventions. In general, naming a Member Alternative 'Copy of X' or 'Wizard X' is not acceptable.

1.5.3 Culvert Definition

If the structure is a culvert enter Cell ##. If the top or bottom slabs are continuous across cells enter the start and end cell delineated by a hyphen.

- Example: Cell 01
- Example: Cell 01-03

1.5.3.1 Culvert Alternative

Repeat the name used for the Culvert Definition.

1.5.3.1.1 Culvert Segment

For Culvert Alternatives with a single Culvert Segment, enter 'Typical Segment'. For Culvert Alternatives with multiple Culvert Segments enter the parameters which distinguish the segments from each other. For example, if two culverts segments vary in fill height:

- Example: Segment 1: Fill 4'
- Example: Segment 2: Fill 6.5'

1.5.4 **Bridge Alternative**

The Bridge Name field shall be the Structure Identification Number NBI item 8, maintaining all leading zeroes.

1.6 Program Structure

For the purposes of discussing BrR components in this Manual, the following terminology is defined in Article 1.6.1 through 1.6.3.
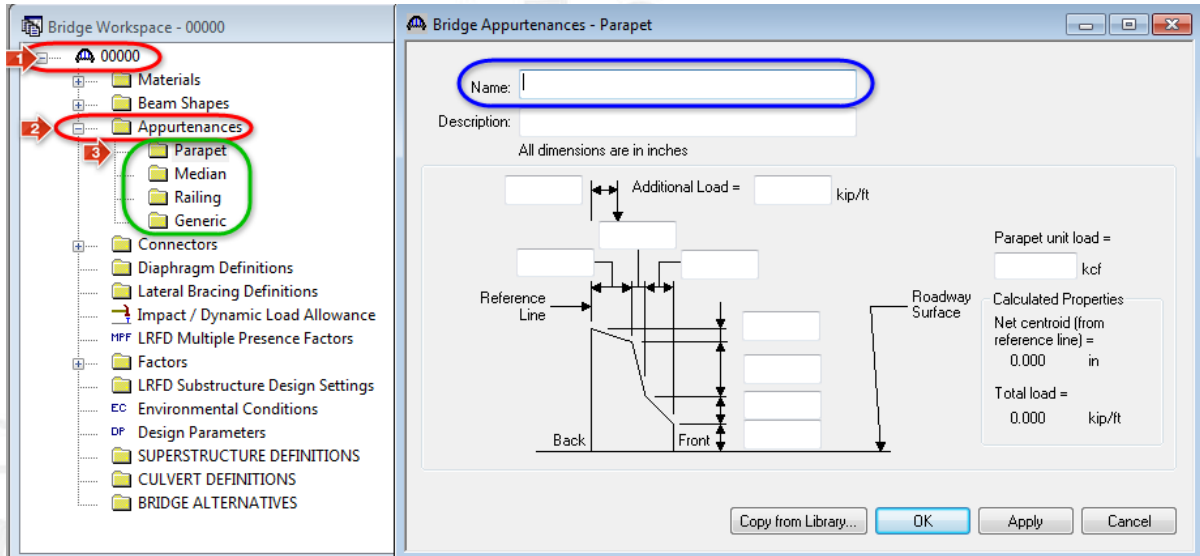

Figure 1.6-1

1.6.1 **Bridge Workspace**

The Bridge Workspace, noted by Arrow 1 in Figure 1.6-1, is generated when a new Bridge is created within BrR. The Bridge Workspace contains modules which are shown by selecting the expand icon, ⊞.

1.6.2 **Modules**

The modules contain information and data, which is used to define structures within the **Superstructure Definition** and **Culvert Definition** modules. Modules referred to within this document are noted by bold text. Modules are accessed by double-clicking the module name, which will open a new window containing input fields. Some modules are contained within folders, which are accessed by selecting the expand icon. For example, in Figure 1.6-1, once the expand icon has been selected for the **Appurtenances** folder, noted by Arrow 2, four modules become available, noted by Arrow 3, including **Parapet**, **Median**, **Railing**, and **Generic**.

1.6.3 **Fields**

Each module contains fields, noted by the blue circle in Figure 1.6-1, used for input data. Input fields referred to within this document are noted by italicized text.

1.7 Configuration Browser

The Configuration Browser provides access to the configuration features and default settings for BrR.
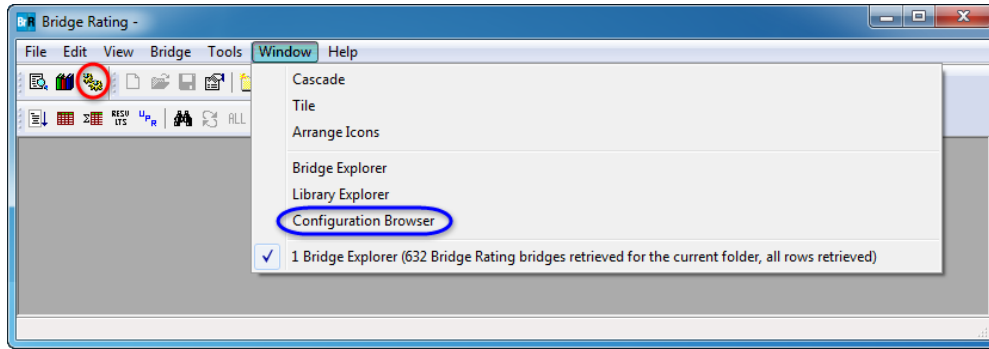

Figure 1.7-1

USER TIP
The Configuration Browser may also be accessed via the shortcut button, circled in red in Figure 1.7-1

1.7.1 **System Defaults**

This folder allows you to specify the system defaults for the Bridge Workspace and the analysis engine.

1.7.1.1 Bridge Workspace

a)   The Default Average Humidity field shall equal '80%'.
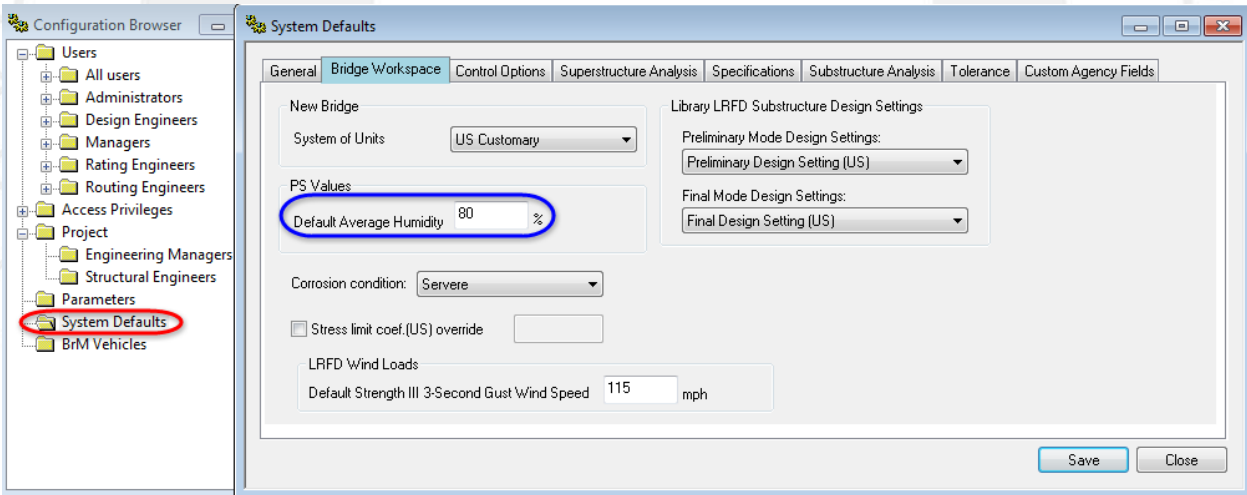

Figure 1.7-2

1.7.1.2 Tolerance

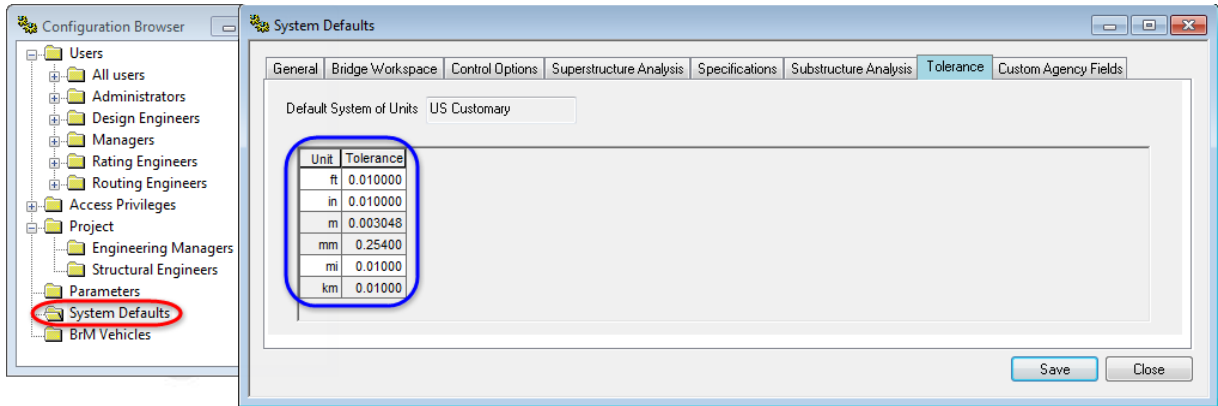The Tolerance fields shall be in accordance with the values in Figure 1.7-3.

Figure 1.7-3

CHAPTER 2 BRIDGE WORKSPACE

2.1 Bridge Workspace

The **Bridge Workspace** module is opened by double-clicking the bridge icon, .

2.1.1 Description

a) The *Facility Carried* shall be inputted in accordance with NBI item 7.

b) The *Featured Intersected* shall be inputted in accordance with NBI item 6A.

2.1.2 Traffic

The *Design ADTT* shall be populated using the same value inputted for the *Recent ADTT*.

2.2 Beam Shapes

2.2.1 Prestressed Beam Shapes

2.2.1.1 Properties

a) If 'Use entered section properties' box is checked, the entered section properties will be used for the FEA and dead load computations only. The spec-checking will be done based on computed dimensions entered on the Dimensions tab.

b) If 'Use entered section properties' box is not checked, the analysis will consider the section properties based on the dimensions entered on the Dimensions tab.

2.2.1.2 Strand Grid

Define the strand grid of the beam to be used for defining the strand layout, discussed further in Article 3.

2.2.2 Steel Beam Shapes

Refer to Chapter 7 for guidance on importing the BrR historical shape database into the Beam Shapes library.

2.3 Appurtenances

Uniform line loads, such as parapets, for conventional construction of the deck should be inputted as an appurtenance with the correct dimensions and density.

2.3.1 Parapet

The weight of a bridge rail or fence may be included using the *Additional Load* field within the **Parapet** module, rather than creating an additional load via the **Railing** module. Either method is acceptable; however, the appropriate method shall be utilized based on the complexity and number of the dead load attachments on the structure. The *Description* shall provide an explanation of the load inputted in the *Additional Load* field.

2.4 Connectors

Connector definitions shall only be defined if these definitions are used within the model.

2.5 Diaphragm Definitions

Diaphragm definitions need only be created if they are used by the analysis type. Defining diaphragm definitions and locating the diaphragms vertically is required for FEA.

USER TIP
If diaphragm definitions are for identification purposes only and not functional for a 3D FEM analysis, note them as such in the Methodology section of the load rating report.

CHAPTER 3 SYSTEM SUPERSTRUCTURE DEFINITIONS

3.1 General

'Girder System Superstructure' shall be used for all structures to analyze a span or series of spans in continuity. If BrR is not capable of modeling the framing, contact the LRS with an alternative procedure for analyzing the structure prior to modeling.

3.1.1 Definition

a) The *Default Units* field shall be selected based on the appropriate system of units used to model the structure, in accordance with the BLRM.

b) The *Average Humidity* field shall equal 80%, in the absence of site specific information.

3.1.2 Analysis

a) The 'Consider structural slab thickness for rating' box shall be checked for all rating analyses.

b) The 'Consider wearing surface for rating' box shall be checked for all rating analyses.

c) The *Default Analysis Type* field shall be selected based on the applicable analysis considered for the structure.

3.1.3 Specs

The *Selection Type* field for LRFR shall be set to 'System Default', unless circumstances dictate an intentional specification override.
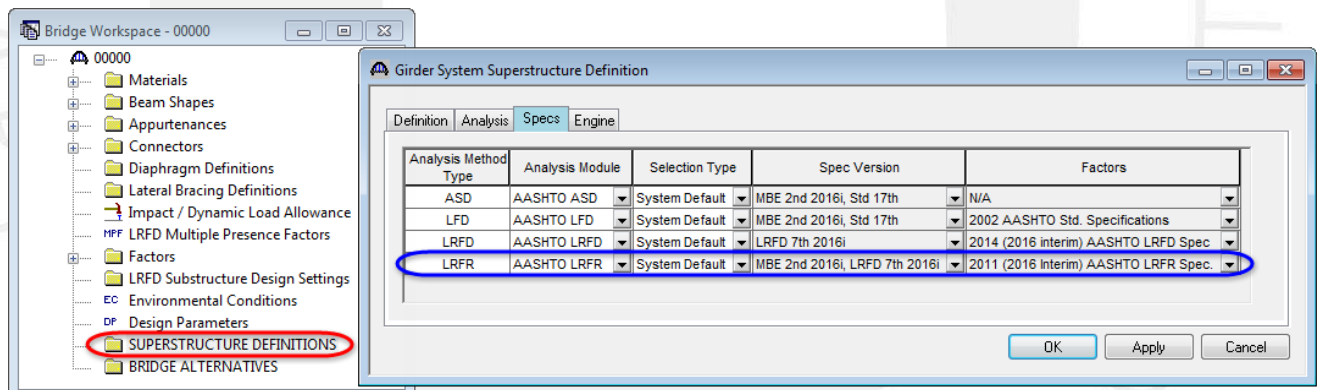

Figure 3.1-1

3.2 Load Case Description

Generic load cases may be defined by using the 'Add Default Load Case Descriptions' button. These generic load cases may be used for loads defined within the **Structure Typical Section** module, if appropriate.

If additional loads are required within the BrR model, the LRE shall create a new, descriptive *Load Case Name*. Note additional loads may not be combined into a generic load case. The purpose for separating each load into a descriptive load case is to provide easily modifiable member loads for future load rating analysis. For example, if a structure consists of multiple utilities, such as a water main and a sewer main, the LRE shall create two distinct load cases for each utility load, as shown in Figure 3.2-1.
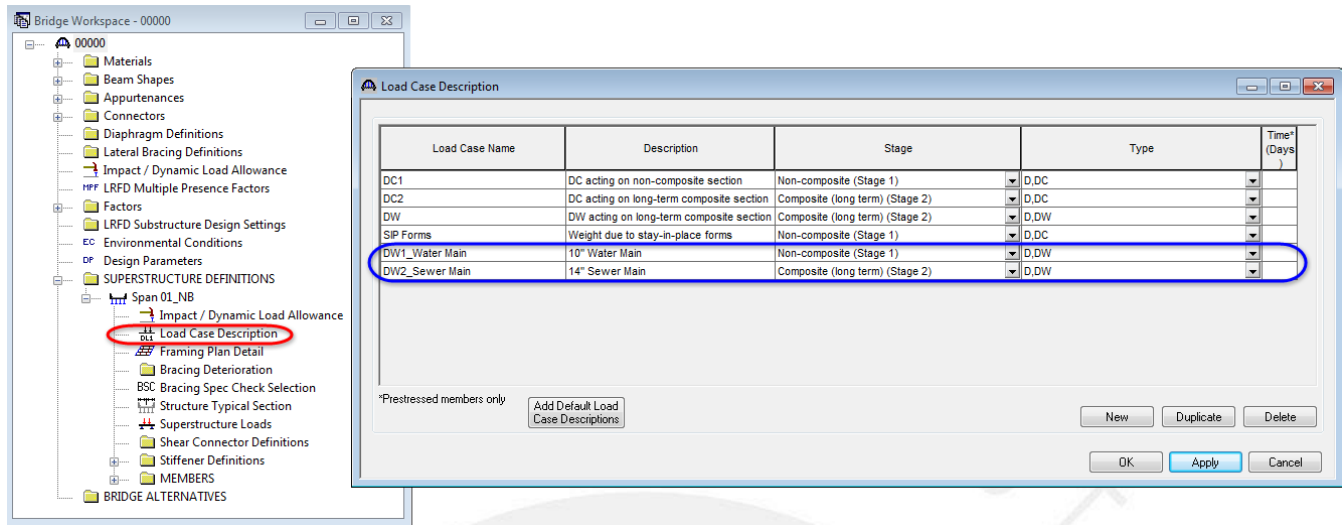
Figure 3.2-1

3.3 Framing Plan Detail

Diaphragms and cross-frames shall be inputted in accordance with the details provided in the plans and with the externally obtained weights assigned to the *Load* field in the Diaphragms tab.

3.4 Bracing Spec Check

When performing a 3D FEA, select all diaphragms required for evaluation.

3.5 Structure Typical Section

3.5.1 Lane Position

If the curb is considered mountable, the travelway must be manually inputted to account for the increased travelway width. Note that when the travelway is extended over the mountable structure, the wearing surface will be superimposed as well. If this process produces rating factors less than 1.0, then the LRE shall apply an uplift load to counteract the additional load applied to the members from the extended wearing surface.

USER TIP
It may be less time consuming to initially model the uplift load to counteract the additional load due to the extended wearing surface.

3.5.2 Wearing Surface

Input the wearing surface thickness, unit weight, and load case in the **Structure Typical Section** module for each Superstructure Definition. If the distribution of the wearing surface cannot be properly handled by BrR, the wearing surface load may be applied as Member Loads.

3.6 Shear Connector Definition

When considering fatigue, shear connectors need only be modeled if the top of the top flange is on the tension side of the short-term elastic neutral axis. Only a 'Generic' Connector Type is required within the **Shear Connector Definition** module. Consider the provisions of Article 4.6.2 prior to creating a Shear Connector Definition.
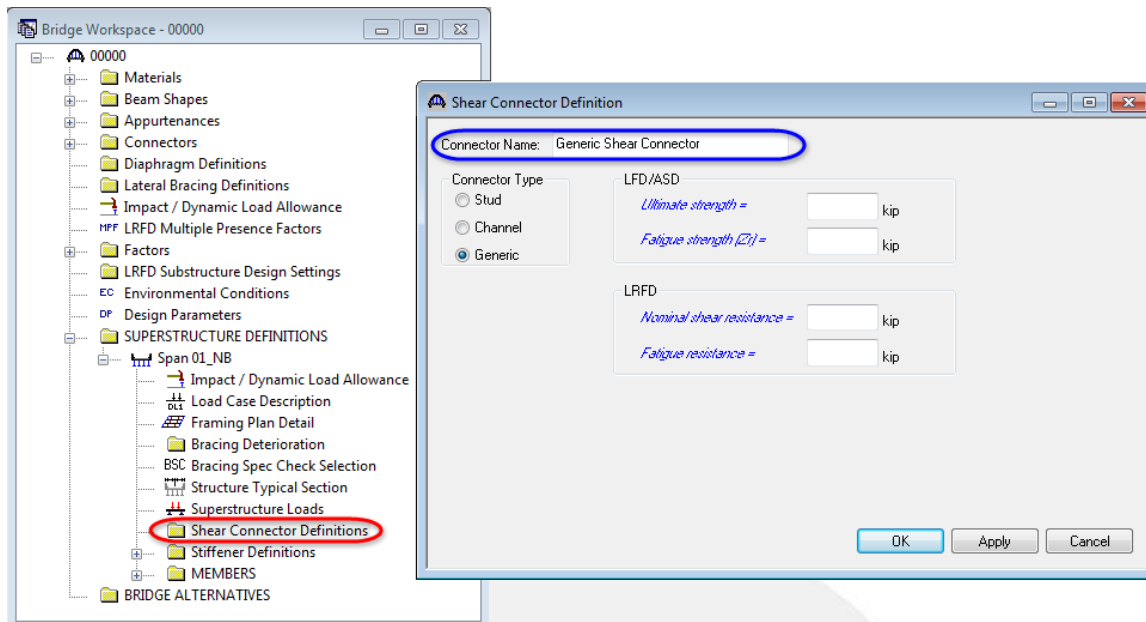
Figure 3.6-1

3.7 Stiffener Definitions

Stiffener properties and dimensions shall be inputted in accordance with the details provided in the structure plans.

USER TIP
BrR does not include the weight of the stiffeners during analysis. Refer to Article 4.1.1 for how to account for the weight of stiffeners.

3.7.1 Bearing

It should be noted that BrR only allows bearing stiffeners to be defined as a pair. Therefore, all single-sided bearing stiffeners shall be inputted in the **Transverse** module.

3.8 Prestress Properties

When using the 'P and CG Only' method for strand layout input, the *Jacking stress ratio* field must be modified per Equation 3.9-1 for BrR to produce the correct area. This input is required because BrR computes the area of prestressing by dividing the jacking force by the product of the prestressed strand tensile strength and the 'Stress Limitations for Prestressing Tendons' factor, f_{pbt}, per *BDS Table 5.9.3-1*.

$$n_{pj} = \frac{F_j}{A_{ps} * F_u}$$

Equation 3.8-1

Where:

$$
\begin{aligned}
n_{pj} &= \text{Jacking stress ratio} \\
F_j &= \text{Jacking force per strand (kip)} \\
A_{ps} &= \text{Area of prestressed strand (in}^2\text{)} \\
F_u &= \text{Ultimate tensile strength (ksi)}
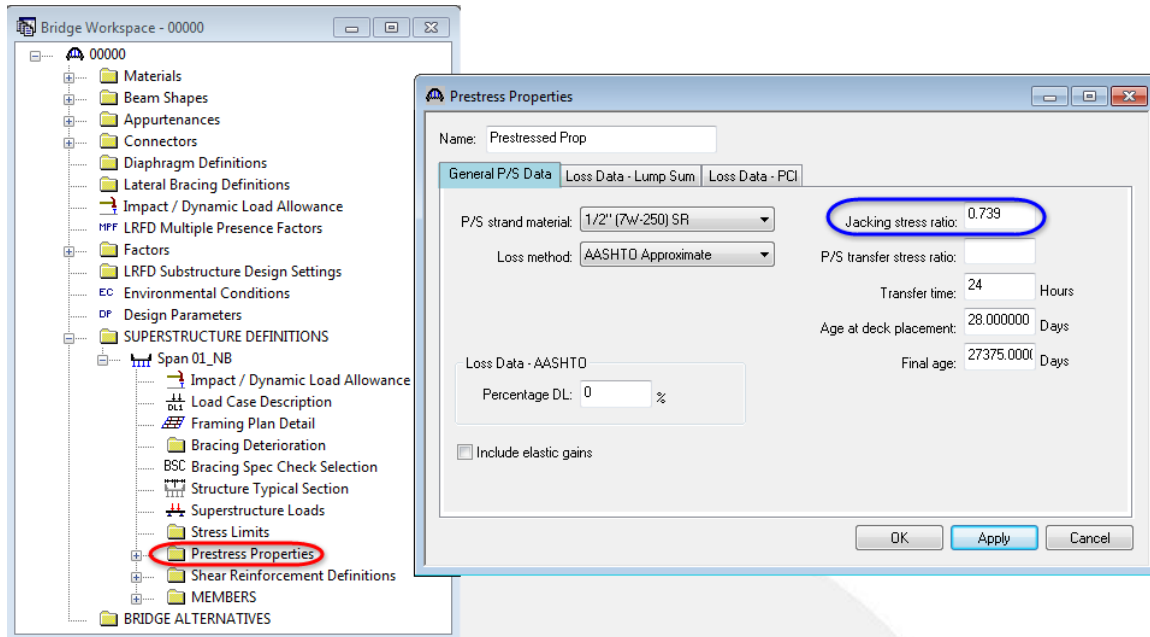\end{aligned}
$$

Figure 3.8-1

CHAPTER 4 MEMBERS

4.1 General

In the **Members** module, members may only be linked for line girder analysis and if the members have the exact same geometry, support conditions, applied loads, LLDFs, and member properties.

4.1.1 Member Loads

All additional loads shall be inputted in accordance with the provisions of Article 3.2.

4.1.1.1 Pedestrian Load

For structures requiring pedestrian LL analysis, the pedestrian load may be inputted in the *Pedestrian Load* field, for all applicable members, if supported by the structure type.

4.1.1.2 Uniform

Transverse stiffener weights, not already accounted for in the weight of the diaphragms, may be inputted as a uniform load along each applicable member.

USER TIP
To consider the weight due to the variable spacing of transverse stiffeners, the LRE may input the transverse stiffener weights as incremental ranges of distributed loads along the member, similar to the procedure discussed in Article 4.1.1.3.

4.1.1.3 Distributed

Longitudinal stiffener weights shall be inputted as incremental ranges along the member.

4.2 Member Alternative Description

'Schedule based' inputs shall be used for modeling, rather than 'Cross-section based' inputs, if the functionality exists for the structure.
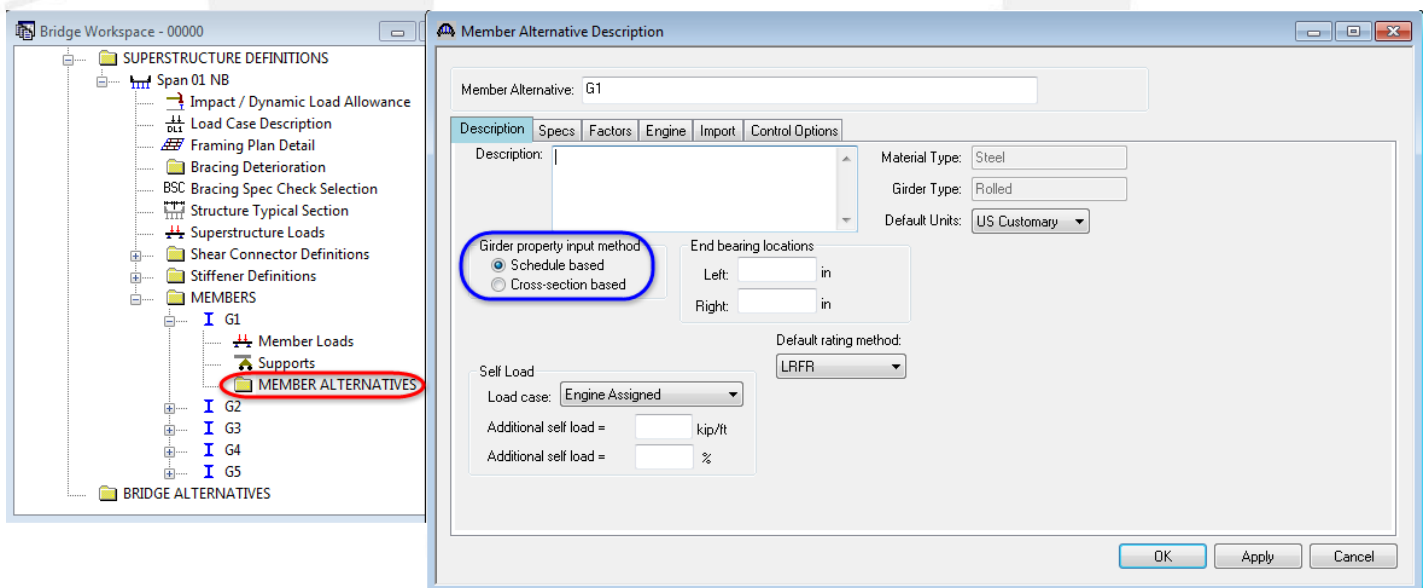

Figure 4.2-1

USER TIP
The options for the *Girder property input method* field are only available when a Member Alternative is initially created and may not be modified once the Member Alternative is created.

4.2.2 Specs

The *Selection Type* field shall be set to 'System Default' to ensure the current specifications are applied during analysis of the structure, unless overrides are required, e.g. to accommodate non-composite for Strength and composite for Service and Fatigue, and workarounds for bugs, etc.
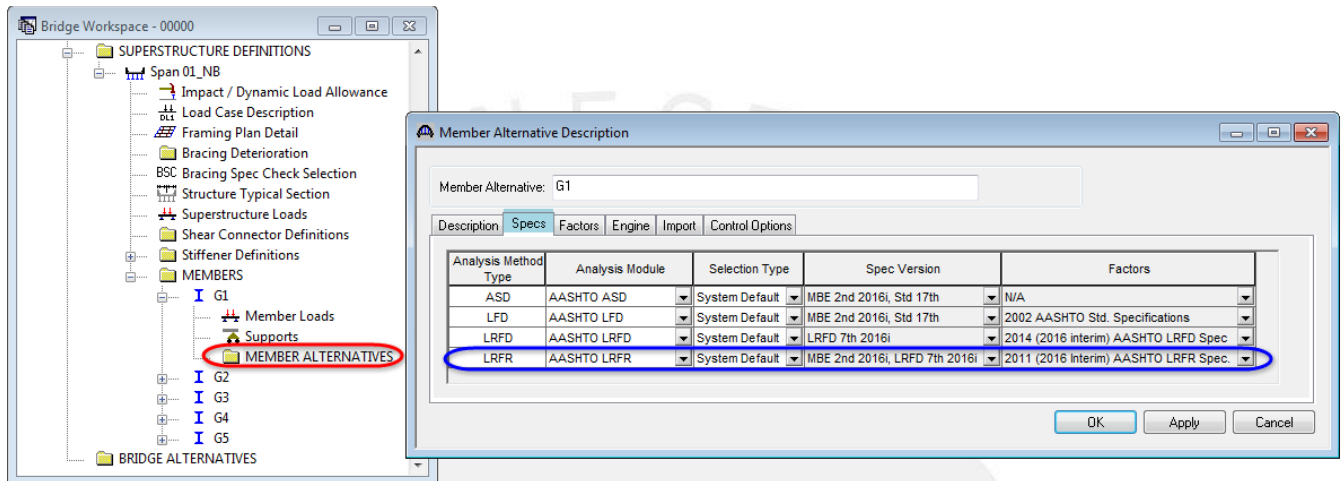

Figure 4.2-2

4.2.3 Factors

Select the appropriate condition factor, from the drop down, for the member. The *Field measured section properties* box should be checked if the deterioration analyzed is in accordance with the BLRM.
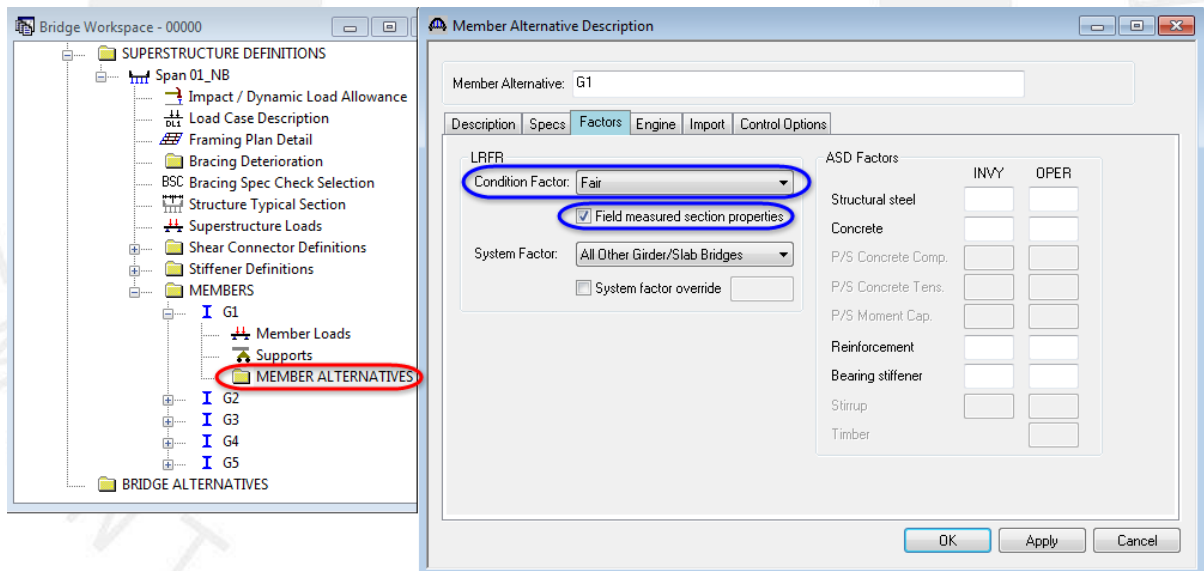

Figure 4.2-3

4.2.4 **Control Options**

4.2.4.1 Steel Member Alternative

```
LRFR
📁 Points of Interest
    ☑ Generate at tenth points
    ☑ Generate at section change points
    ☑ Generate at user-defined points
    ☑ Generate at stiffener
☑ Allow moment redistribution
☑ Use Appendix A6 for flexural resistance
☑ Allow plastic analysis
☑ Evaluate remaining fatigue life
☐ Ignore long. reinf in negative moment capacity
☐ Include field splices in rating
☑ Consider deck reinf. development length
📁 Distribution Factor Application Method
    ⊙ By axle
    ○ By POI
```

Figure 4.2-4

4.2.4.2 Prestressed Concrete Member Alternative

```
LRFR
📁 Points of Interest
    ☑ Generate at tenth points except supports
    ☑ Generate at support points
    ☑ Generate at support face & critical shear points
    ☑ Generate at section change points
    ☑ Generate at user-defined points
📁 Shear Computation Method
    ○ Ignore
    ⊙ General Procedure
    ○ General Procedure - Appendix B5
    ○ Simplified Procedure
    ○ Simplified Procedure - Vci, Vcw
📁 Loss & Stress Calculations
    ⊙ Use gross section properties
    ○ Use transformed section properties
📁 Multi-span analysis
    ⊙ Continuous
    ○ Continuous and Simple
☐ Ignore design & legal load shear
☐ Ignore permit load shear
☑ Consider legal load tensile concrete stress
☐ Consider splitting resistance article
☐ Ignore tensile rating in top of beam
☑ Consider deck reinf. development length
☑ Consider permit load tensile steel stress
☑ Ignore long. reinf. in rating
📁 Distribution Factor Application Method
    ⊙ By axle
    ○ By POI
☑ Allow negative epsilon in general shear method
```

Figure 4.2-5

4.2.4.3 Reinforced Concrete Slab

```
LRFR
  📁 Points of Interest
       ☑ Generate at tenth points except supports
       ☑ Generate at support points
       ☑ Generate at support face & critical shear points
       ☑ Generate at section change points
       ☑ Generate at user-defined points
  📁 Shear Computation Method
       ○ Ignore
       ⦿ General Procedure
       ○ General Procedure - Appendix B5
       ○ Simplified Procedure
       ○ Simplified Procedure - Vci, Vcw
  ☐ Ignore design & legal load shear
  ☐ Ignore permit load shear
  ☑ Consider permit load tensile steel stress
  ☑ Ignore long. reinf. in rating
  ☑ Consider inclined flexural forces
  📁 Distribution Factor Application Method
       ⦿ By axle
       ○ By POI
  ☑ Consider skew reduction factor
  ☑ Allow negative epsilon in general shear method
  ☑ Consider sloped portion of bent long. reinf.
```

Figure 4.2-6

4.3 Live Load Distribution

a) In the <u>LRFD</u> tab, the LLDFs should be left blank so BrR computes the LLDFs during the analysis, and for future analyses, BrR will re-compute the LLDFs with the current version of BrR at that time.

b) If LLDFs overrides are required, ensure all *Actions*, including deflection, moments, and shear, are fully defined, otherwise BrR will override all LLDFs *Actions* at run time.

4.4 Girder Profile

4.4.1 **Bottom Flange Cover Plate**

Currently, BrR does not account for the terminal development of a cover plate, in accordance with BLRM. To ensure an accurate cover plate fatigue analysis, perform the following steps:

1. In the **Weld Definition** module, create a 'Dummy Cover Plate Weld' with a Fatigue Category A.
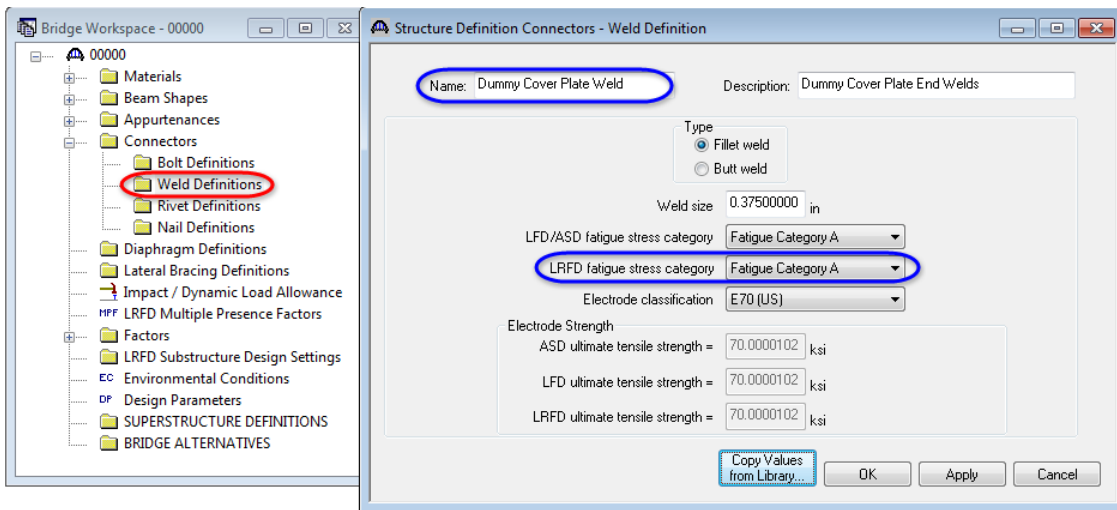
Figure 4.4-1

2. In the Bottom Cover Plate tab, apply the 'Dummy Cover Plate Weld', to the *End Weld at Right*. If this step is not performed, BrR will automatically apply the cover plate termination weld based on the girder properties.
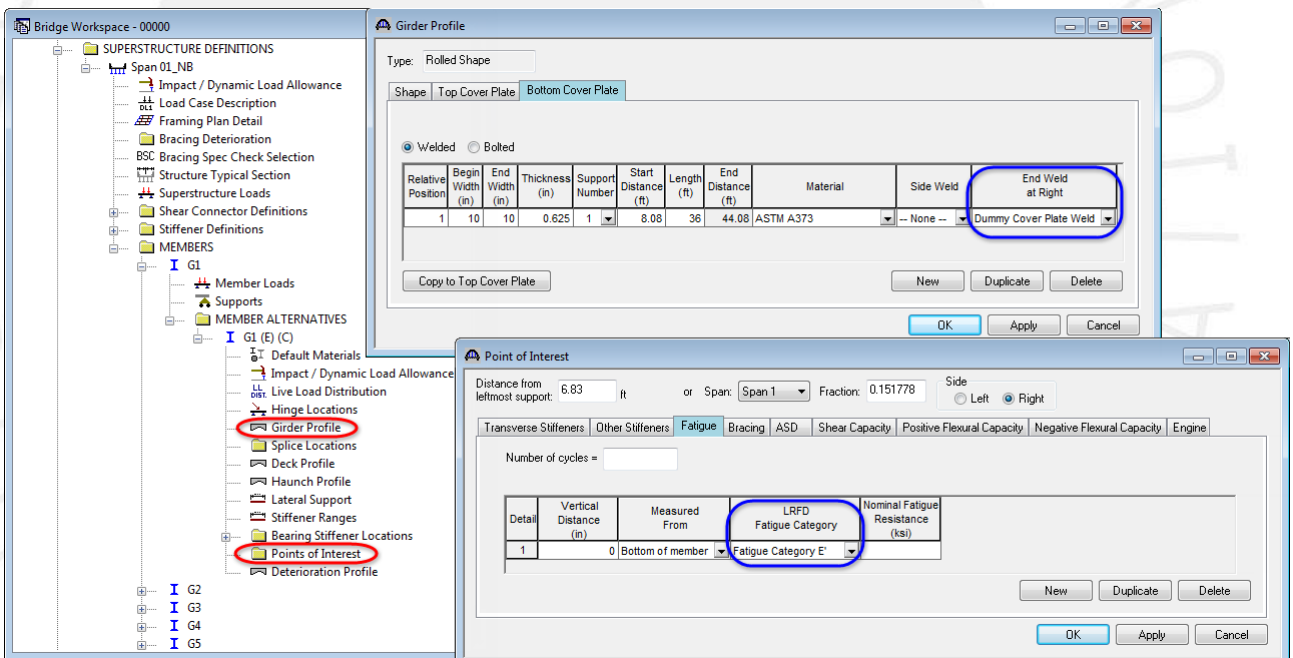
Figure 4.4-2

3. In the **Point of Interest** module, define points of interest for the fatigue details at the actual ends of the cover plate. See Figure 4.4-2 above.

4.5 Strand Layout

The Left CGS and Right CGS inputs refer to the left end of the beam and right end of the beam, respectively, rather than the centerline of bearing. It is the Department preference that the 'Strand in Rows' method be used for inputting strand patterns for PS members.
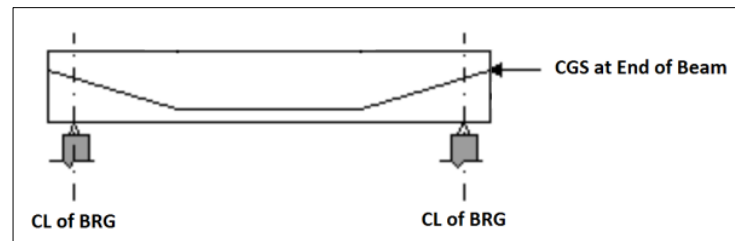
Figure 4.5-1

USER TIP
For harped or draped strands, the LRE may be required to determine the vertical distance from the bottom of the beam to the CGS at the end of the beam if the CGS at the centerline of bearing is shown on the plans.

4.5.1 P and CG Only

The 'P and CG Only' input method shall be used to model the strand layout if the section meets all of the following requirements:

- No strands are debonded
- No available record of the strand layout and the strand layout cannot be deduced from exiting records

If either of the above requirements are not met, the 'Strand in Rows' input method shall be used.

The *Force* should be the jacking force of the effective prestressing strands in the beam. Refer to Article 3.8 for additional considerations required for the 'P and CG Only' method.

USER TIP
For members with deteriorated strands, it may be less time consuming to use the 'Strand in Rows' input method.

4.5.2 Strand in Rows

Refer to Article 2.2.1.2 for creating the strand grid for possible strand locations.

4.6 Deck Profile

4.6.1 Reinforcement

The longitudinal deck reinforcement shall be inputted for all structures with reinforced concrete decks.

4.6.2 Shear Connectors

For the purposes of evaluating fatigue, apply a Shear Connector Definition in the *Connector ID* field as opposed to 'Composite'. Shear connectors need only be modeled for composite steel girders if the connector to top flange weld is on the tension side of the short-term elastic neutral axis. Shear connector configuration and spacing may be omitted. This provision shall apply to both simply supported and continuous members.
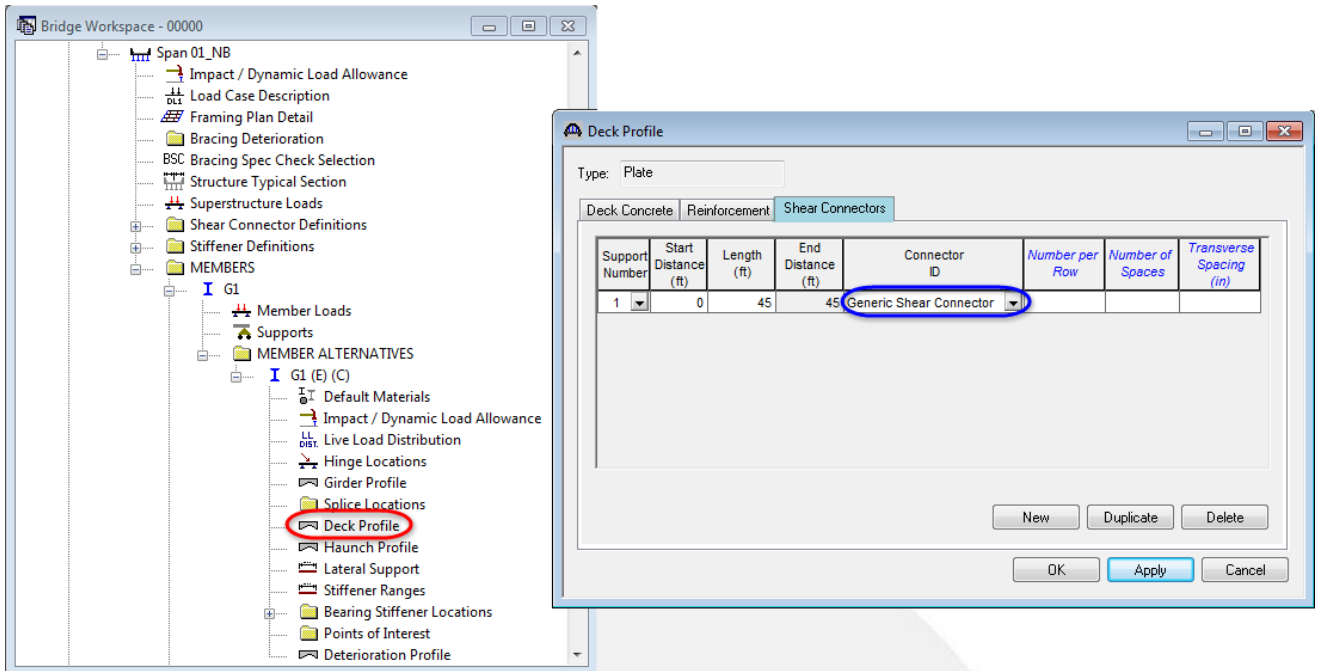
Figure 4.6-1

USER TIP
It is often less time consuming to model 'generic' shear connectors initially, as opposed to, applying the 'Composite' property and checking the short-term elastic neutral axis for each member section. Refer to Article 3.6 for defining generic shear connectors.

CHAPTER 5 CURVED DECK ON STRAIGHT GIRDERS

5.1 General

The effects of a curved deck on straight members shall be considered when modeling a structure. Currently, BrR lacks the ability to model a curved deck on straight members. The purpose of the procedure defined in Article 5.2, is to consider the following characteristics for each fascia member:

- Variable concrete deck load
- Variable effective flange widths
- Maximize LL effects

These attributes will affect the overall capacity of the section and force effects for these members.

5.2 Line Girder Analysis Method

The following method is acceptable to approximate the force effects of a curved deck on the exterior, straight members when performing a line girder analysis.

1. In the Deck tab of the **Structure Typical Section** module, enter the maximum structure width, based on the combined maximum left and right overhangs, as shown in Figure 5.2-1 and Figure 5.3-2. This Step will allow BrR to compute the LLDFs for the exterior members based on the maximum overhangs.
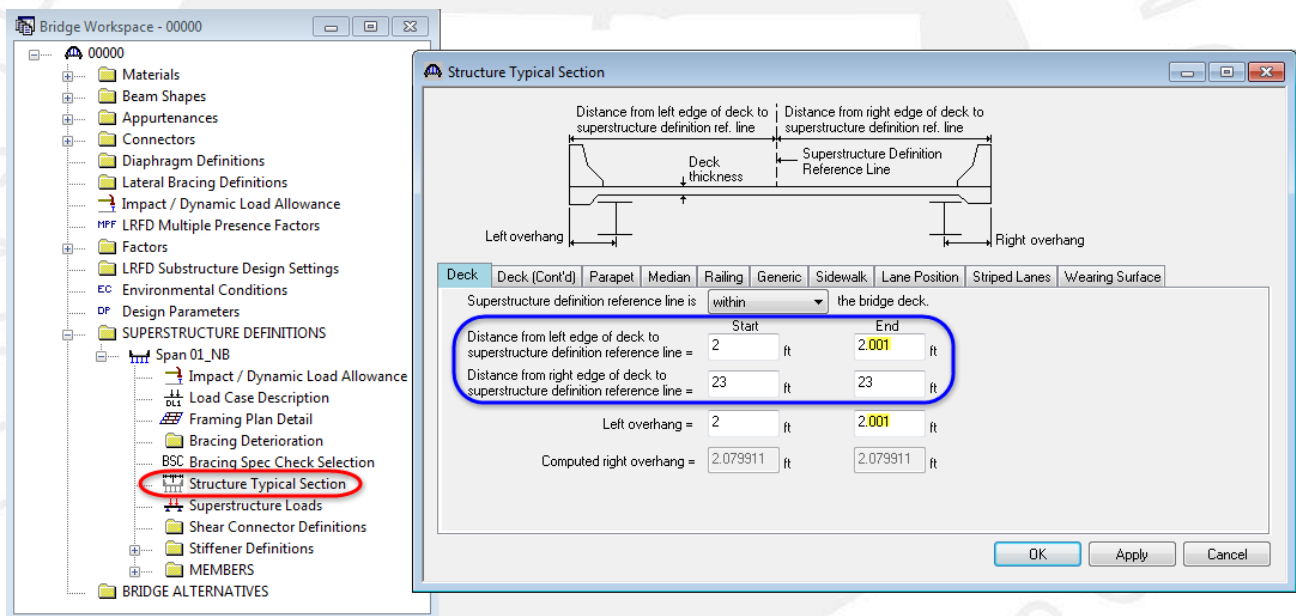

Figure 5.2-1

USER TIP
If the LRE or the Department determines this simplification to be overly conservative, the LLDFs shall be calculated independently and applied, within the **Live Load Distribution Factor** module, in incremental ranges along the member.

2. In the Deck tab of the **Structure Typical Section** module, add an additional 0.001 ft to the *Distance from left edge of deck to superstructure definition reference line-End* field, as highlighted in yellow in the Figure 5.2-1. This step should be skipped if the start and end values are originally not equal, or the girders are flared. This Step enables the 'advanced range input method' within the **Deck Profile** module, which allows the LRE to input distinct 'Start' and 'End' effective flange widths, further discussed in Step 6.

3. Determine the excess dead load caused by using the maximum overhangs in the model and convert the excess loads into distributed loads, as illustrated in Figure 5.3-4.

4. In the Distributed tab of the **Member Loads** module, input the distributed loads, as determined in Step 3. Using an approximate linearly varying load is acceptable provided the approximate load removed does not exceed the actual load that should be removed.
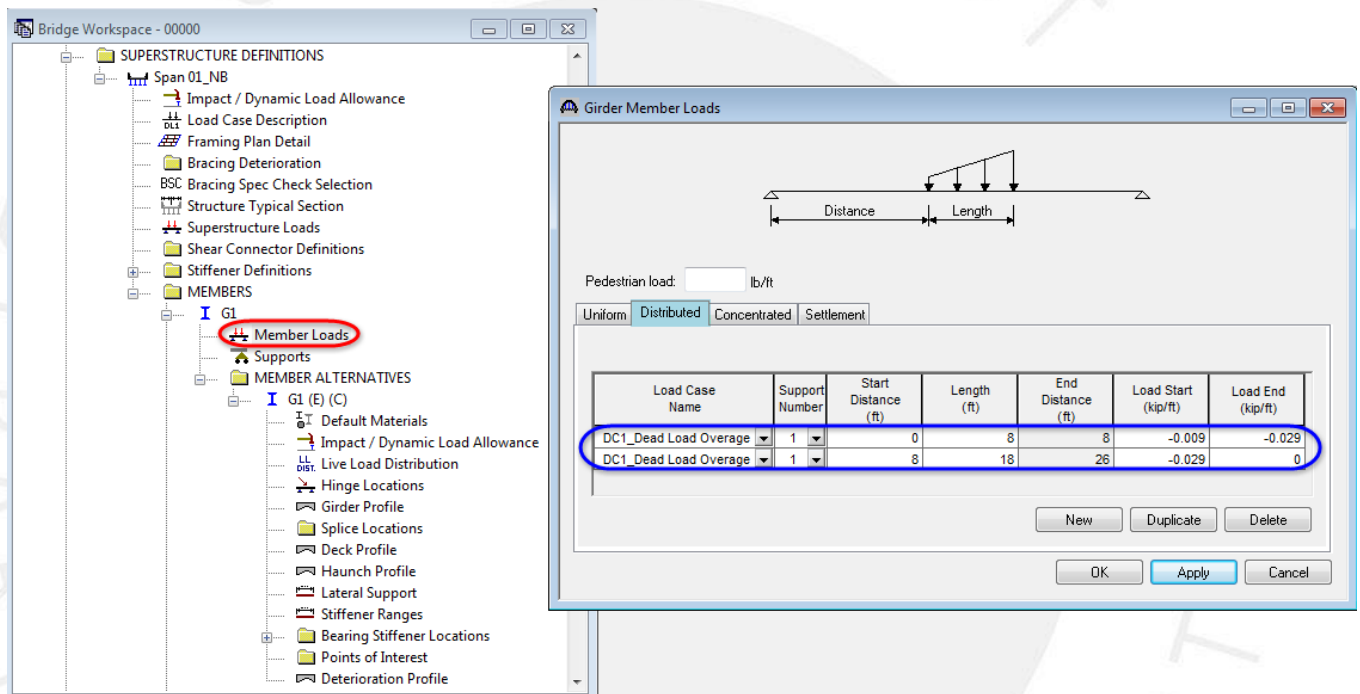

Figure 5.2-2

5. Identify and determine regions to vary the effective flange width. Generally ranges will linearly vary between the ends of the span and the maximum/minimum effective flange point. See Figure 5.3-3 for an illustration.

6. In the Deck Concrete tab of the **Deck Profile** module, the deck properties may be inputted as a range along the length of the member. Each range length will have an effective flange width that varies linearly from 'Start' to 'End', based on the information determined in Step 5.

   This linearly variable effective flange width shall not exceed the actual effective flange width at any location along the member.
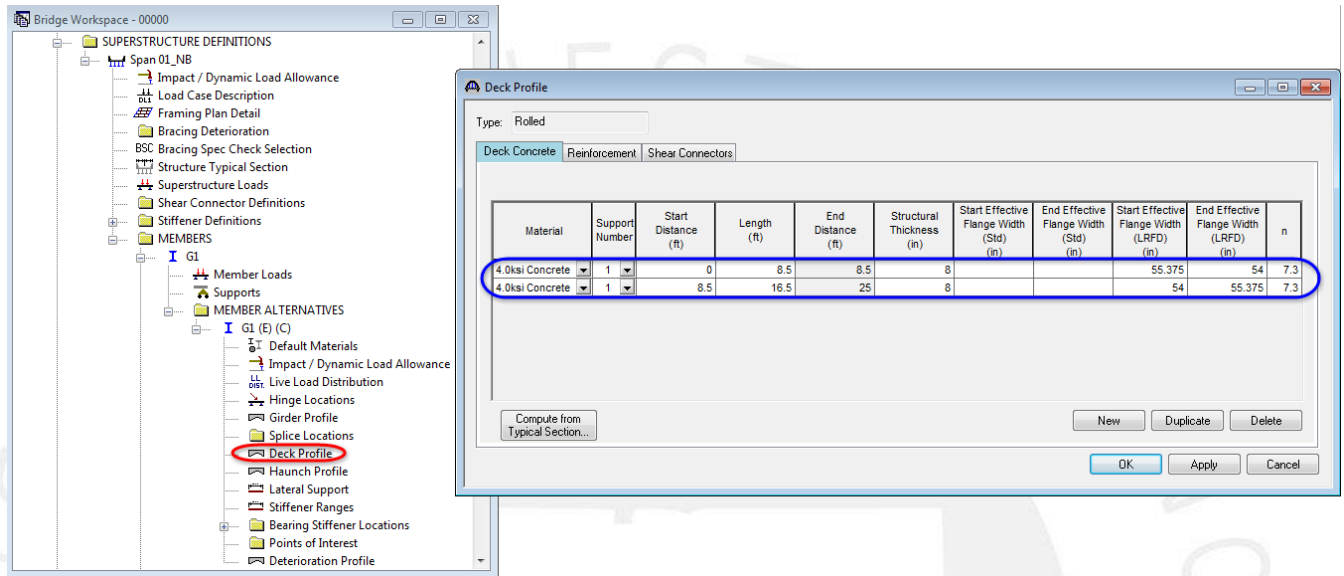

Figure 5.2-3

5.3 Visual Aids

ACTUAL SLAB PLAN

Figure 5.3-1

LIVE LOAD DISTRIBUTION

A = DISTANCE FROM LEFT EDGE OF DECK TO SUPERSTRUCTURE DEFINITION REFERENCE LINE AT START OF STRUCTURE

B = DISTANCE FROM RIGHT EDGE OF DECK TO SUPERSTRUCTURE DEFINITION REFERENCE LINE AT START OF STRUCTURE

C = DISTANCE FROM LEFT EDGE OF DECK TO SUPERSTRUCTURE DEFINITION REFERENCE LINE AT END OF STRUCTURE

D = DISTANCE FROM RIGHT EDGE OF DECK TO SUPERSTRUCTURE DEFINITION REFERENCE LINE AT END OF STRUCTURE

Figure 5.3-2

EFFECTIVE FLANGE WIDTH

EF LENGTH

EF LENGTH

EFW

EFW

G1

EFW

EFW

EFW

G5

EFW

EF LENGTH

EF LENGTH

EF LENGTH

— — EFFECTIVE FLANGE WIDTH LIMITS

EF = EFFECTIVE FLANGE
EFW = EFFECTIVE FLANGE WIDTH

THE EFFECTIVE FLANGE WIDTH SHALL NOT EXCEED THE ACTUAL
EFFECTIVE FLANGE WIDTH AT ANY LOCATION ALONG THE MEMBER

NOTE: SOME OF THE DIAPHRAGMS WERE REMOVED FOR CLARITY

Figure 5.3-3

SLAB WEIGHT CORRECTION

OV LENGTH   OV LENGTH

OV LENGTH   OV LENGTH

AREA OF OVERAGE

OV = OVERAGE

THE AREA OF OVERAGE SHALL NOT EXCEED THE ACTUAL AREA THAT SHOULD BE REMOVED.
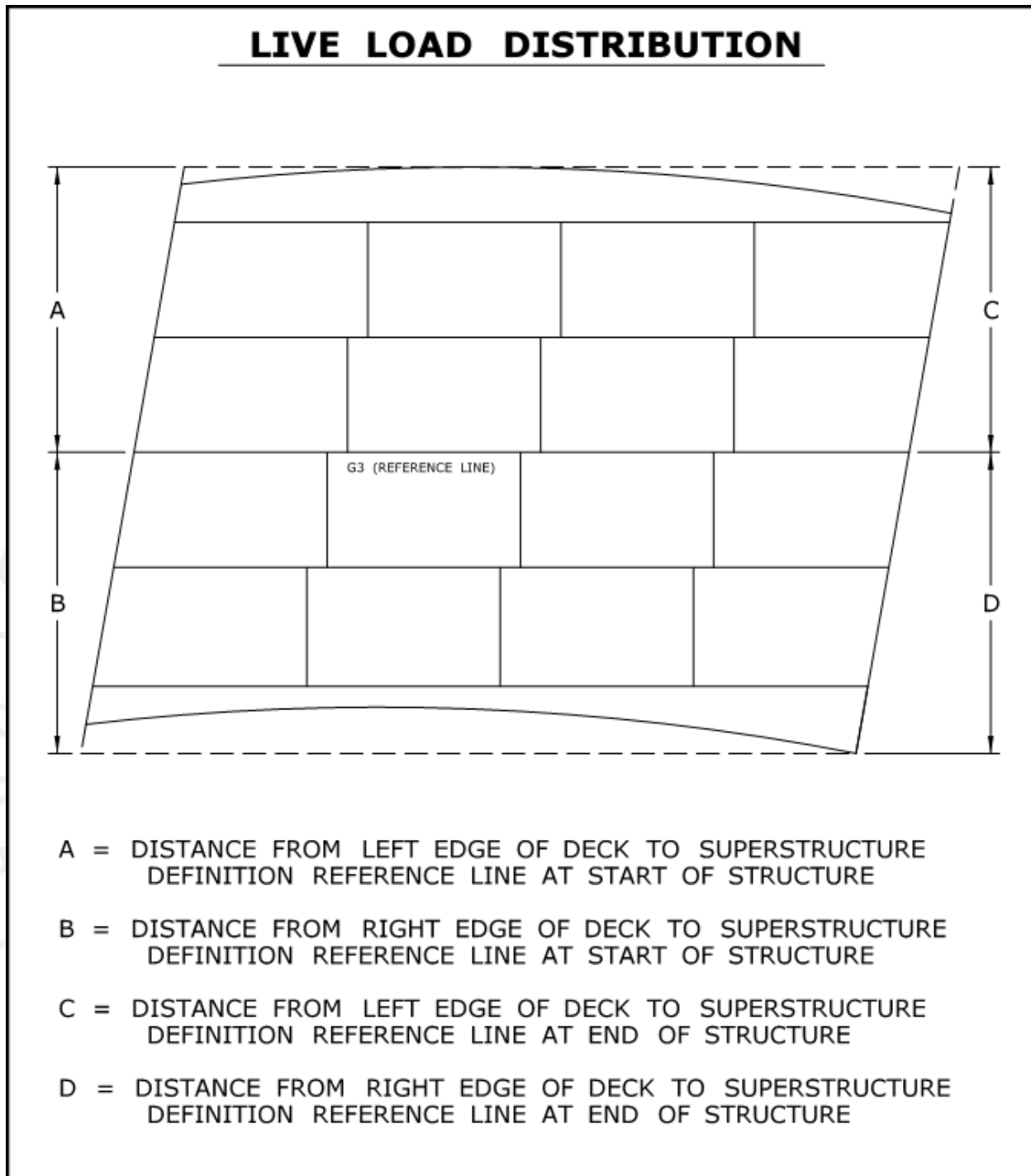
NOTE: THE MINIMUM AND MAXIMUM OVERHANGS ARE NOT ALWAYS AT 0.5L.
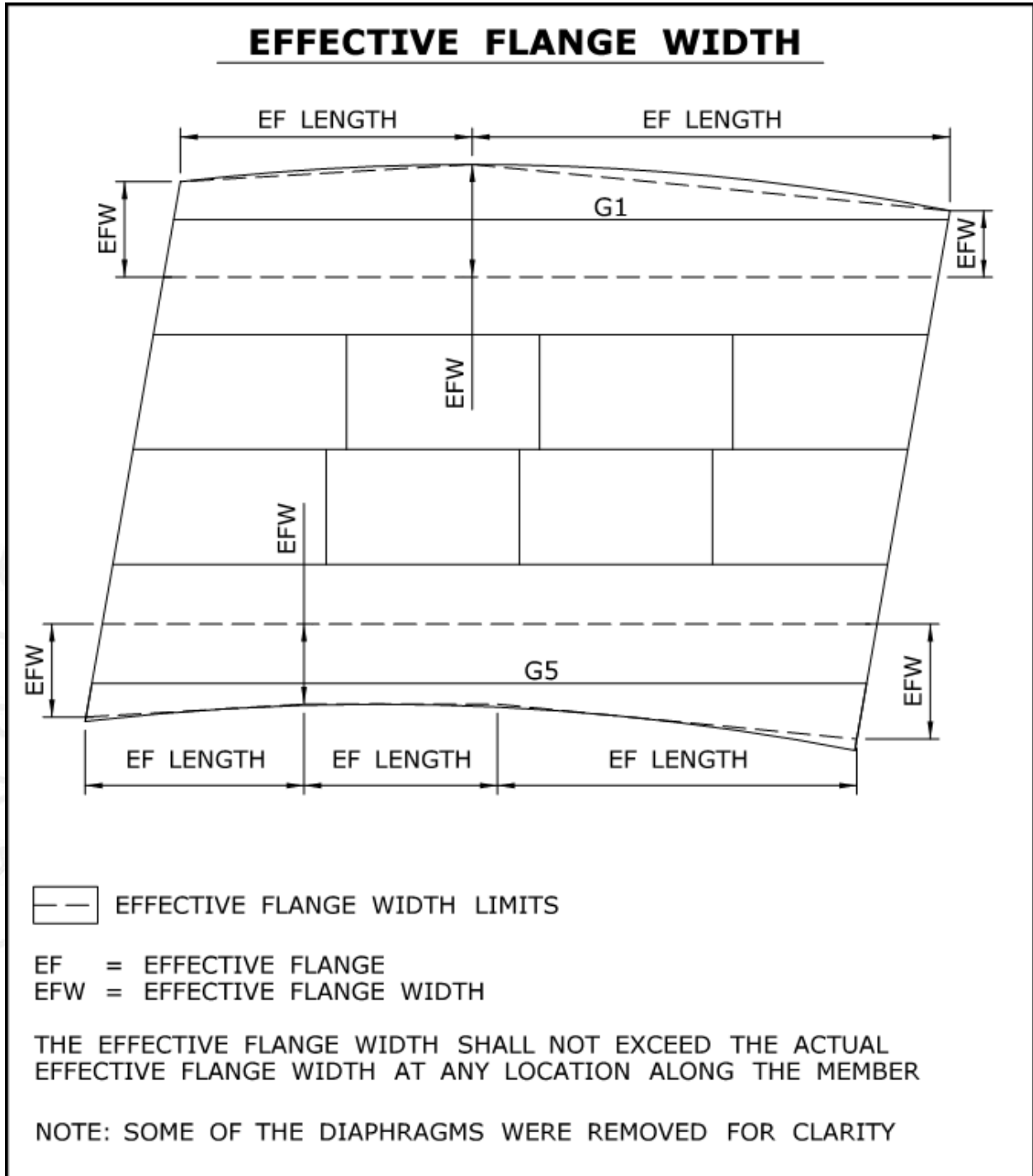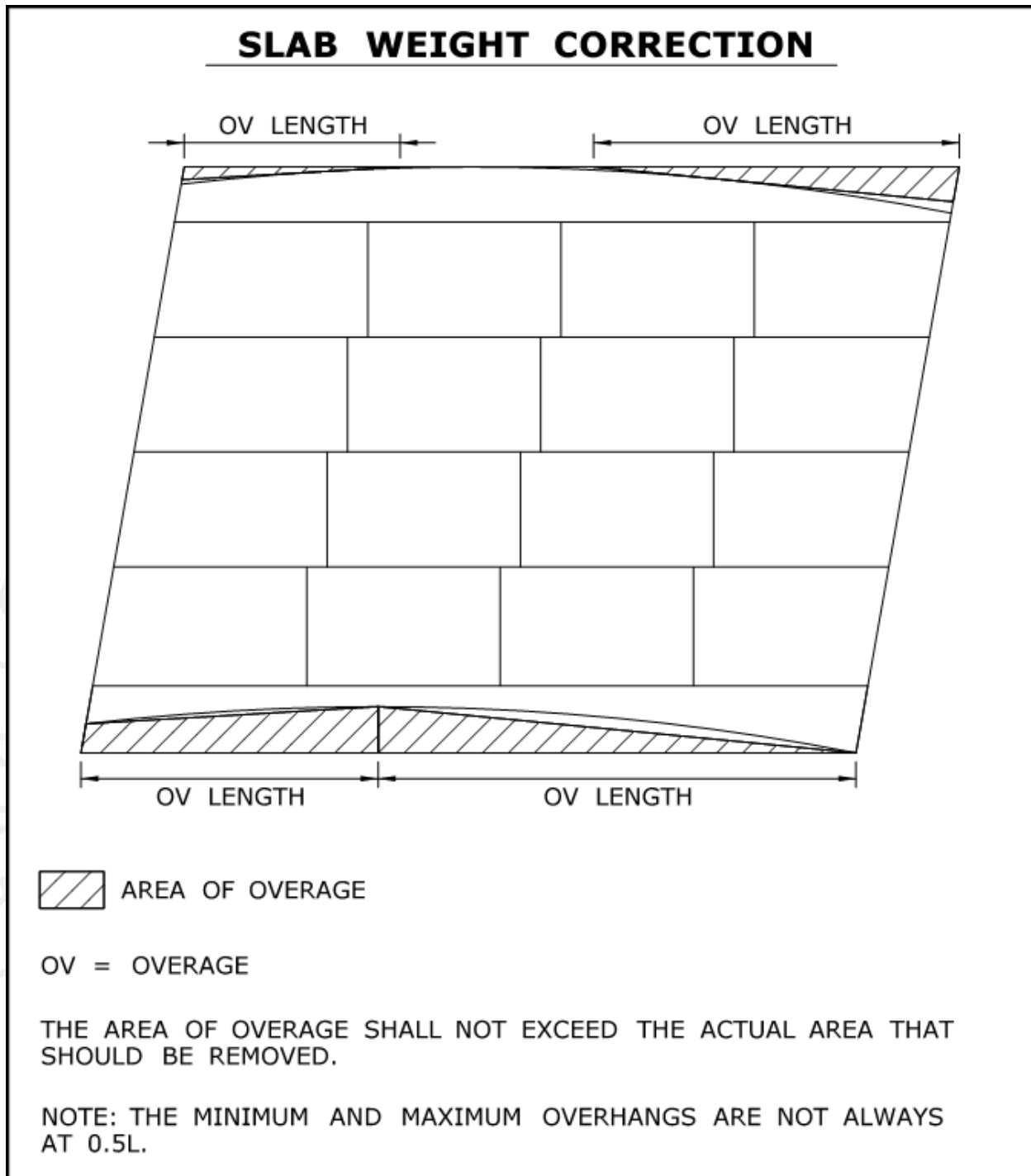
Figure 5.3-4

CHAPTER 6 CULVERTS

6.1 General

The guidance provided within this Chapter is applicable to only buried RC box culverts.

6.2 Culvert Alternatives

6.2.1 **Control Options**

The Control Options, shown in Figure 6.2-1, shall be applied to the BrR model for the load rating analysis.

```
LRFR
📁 Points of Interest
    ☑ Generate at tenth points
    ☑ Generate at section change
       points
    ☑ Generate at user-defined points
📁 Shear Computation Method
    ○ Ignore
    ◉ General Procedure
    ○ Simplified Procedure
☐ Exclude bottom slab
☑ Include haunch stiffness in FE
   model
```
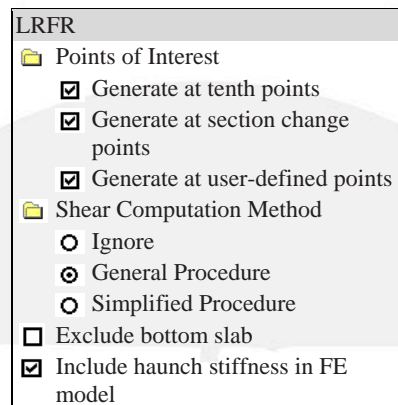
Figure 6.2-1

6.2.2 **Bar Mark Definitions**

The following *Bar Types* are recommended when modeling reinforcement:
- Straight
- Hook
- Corner
- Welded Wire Reinforcement

Other bar mark definition types have shown in the past to not behave as expected. The above mentioned *Bar Types* should be used to simulate Bent and C-bar types, as practical.

6.3 Culverts Segments

6.3.1 **R/C Box Culvert Loads**

To consider additional line loads through fill, the unit weight of the wearing surface should be increased by the term:

$$\gamma_\Delta = \frac{u * 12}{B * t_w}$$

Equation 6.3.1-1

Where:

γ_Δ = Increase to unit weight (pcf)

u = Linear loading (plf)

t_w = Wearing surface thickness (in)

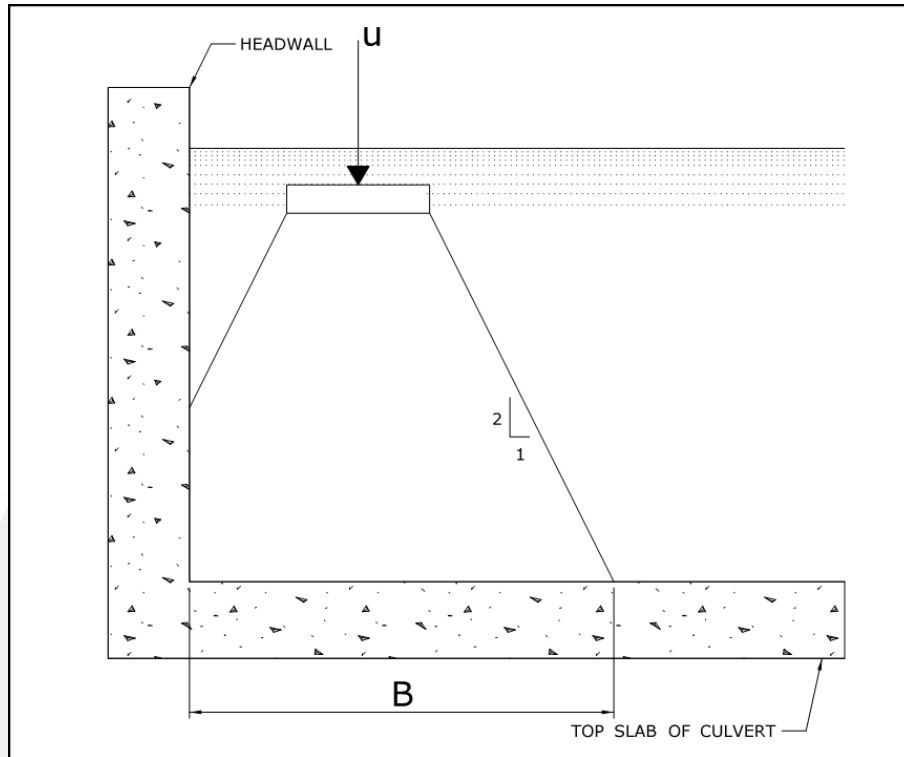B = Width of stress at crown assuming a 2V:1H distribution, as shown in Figure 6.3-1 (ft)

Figure 6.3-1

CHAPTER 7 HISTORIC STEEL SHAPES DATABASE

7.1 Importing Database

BrR provides a historical steel shape database that is not initially installed in the Steel Shapes Library but may be imported after the initial installation. Below are instructions to install and use these historic shapes.

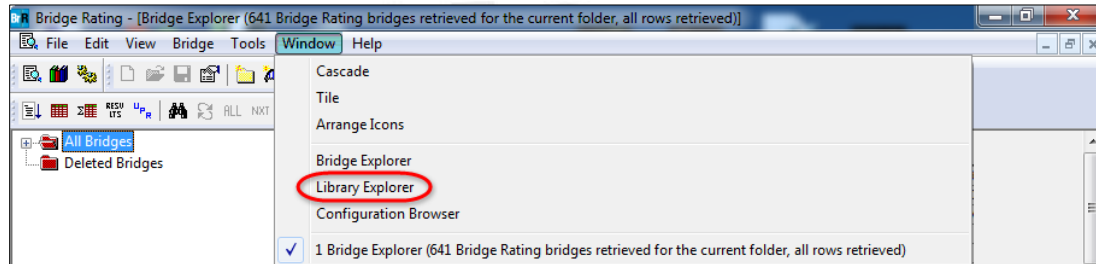1. Once logged in to BrR, go to the Window dropdown and click on 'Library Explorer'

Figure 7.1-1

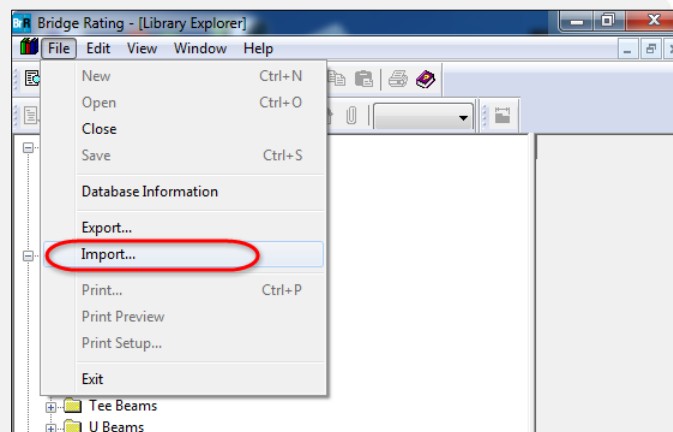2. Go to the File dropdown and click "Import…"

Figure 7.1-2

3. Select the 'old rolled shapes.xml' file and click the 'Open' button. The default location for this file is: C:\Program Files\AASHTOWare\BrR68
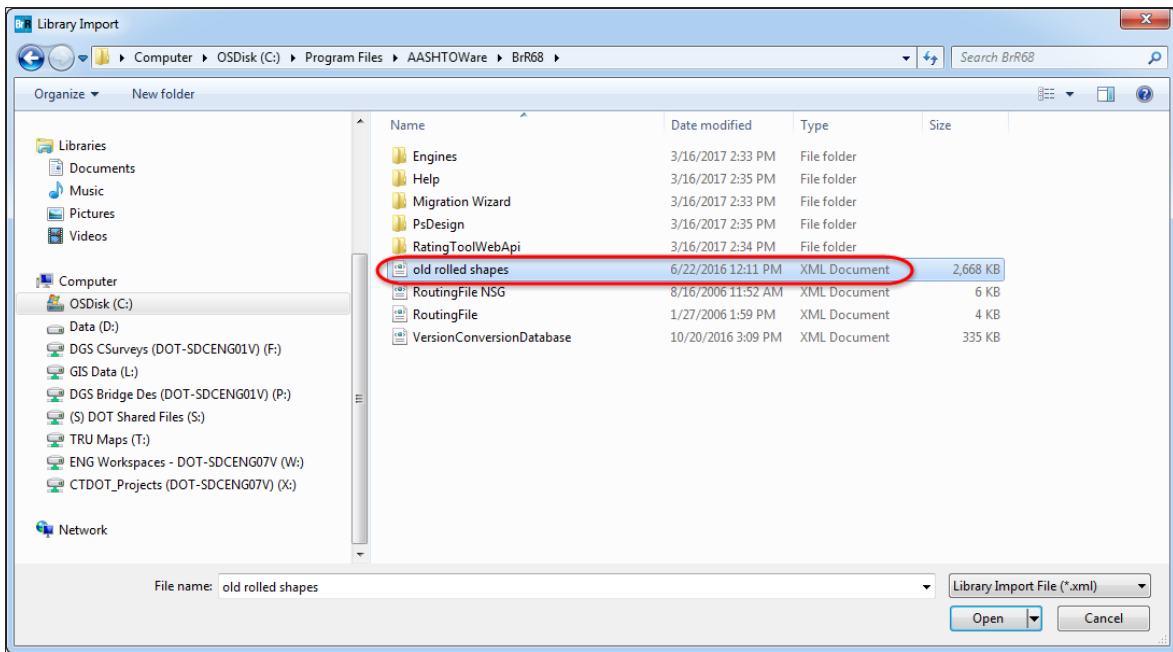
Figure 7.1-3

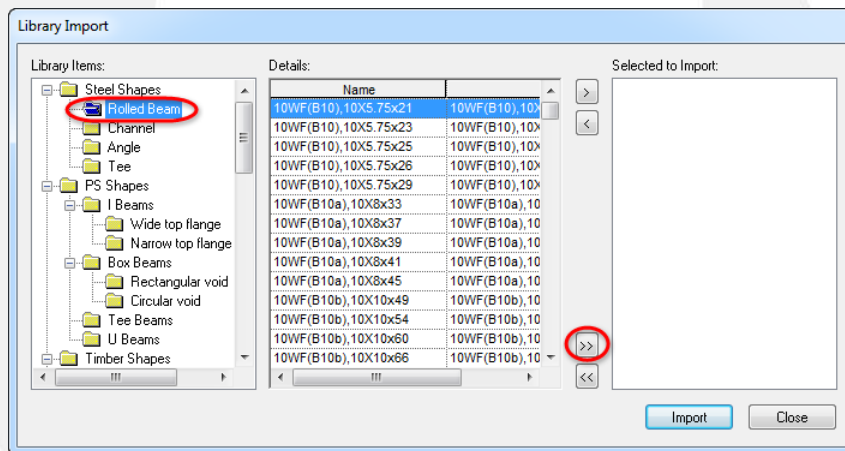4. Select the 'Rolled Beam' folder, as shown in Figure 7.1-4, in the Library Items box.

Figure 7.1-4

5. Click the '>>' button, as shown in Figure 7.1-4, which will move all of the shapes listed in the *Details* box to the *Selected to Import* box.

6. Click the 'Import' button, as shown in Figure 7.1-5, to complete the import of the historic shapes database.
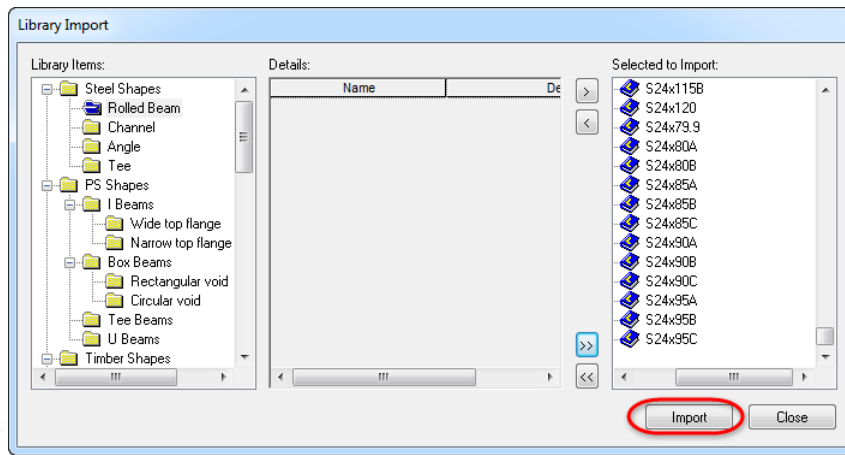
Figure 7.1-5

7. The historic shapes can be found by selecting the "Agency Defined" library. The most important step to note when looking for a historic shape is to delete any inputs in the "Shape Designation" field, which will provide the complete list of steel shapes, starting with the historic sections.

   For example, if the user wishes to search for a historic shape, type a size and then the shape designation into the Shape Designation field. For example, searching the designation "WF" will yield no results but searching the designation "10WF" will provide a list of historic shapes, as shown in the image below.
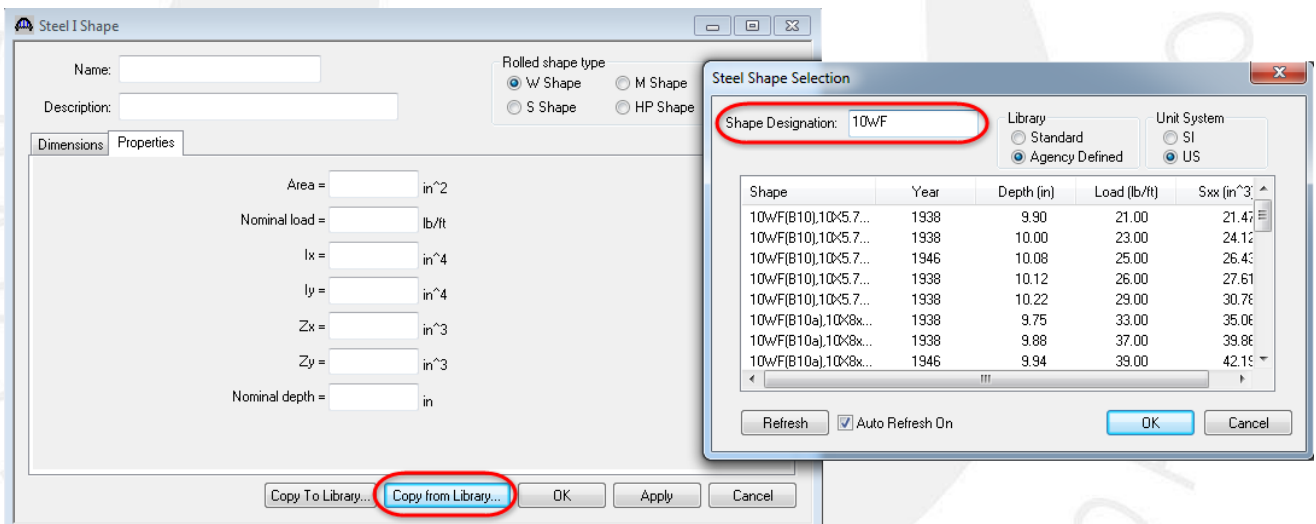

Figure 7.1-6

CHAPTER 8 LOAD RATING SECTION STAFF ONLY

8.1 General

The purpose of this Chapter is to document the procedures performed by the LRS to maintain the production database of BrR models.

8.2 Vehicle Templates

The LRS shall maintain a library of CTDOT analysis vehicles.

8.3 Analysis Templates

The LRS shall maintain analysis templates to perform load ratings in accordance with the BLRM.

8.4 Model Import

BrR models may only be imported and associated to the AASHTOWare Database once the LRS reviews and determines the model conforms to the BLRM.

8.4.1 **Bridge Completely Defined**

After the LRS reviews and determines the model conforms to the BLRM, the LRS will import the model and check the 'Bridge Completely Defined' box.

8.4.2 **Custom Agency Fields**

The Custom Agency Fields will provide additional information in the Bridge Explorer that may be used to sort and filter models.

8.4.2.1 Batch Analysis

Value	Definition
0	The model is incomplete and is not functional for batch analysis
1	The model is complete and functional for batch analysis
2	The model is complete and requires post-processing to obtain valid rating results

8.4.2.2 Continuous or > 200'

Value	Definition
0	The model does not contain a continuous span or a span greater than 200 feet
1	The model does contain a continuous span or a span greater than 200 feet

8.4.2.3 Default Analysis Type

Value	Definition
0	Line Girder
1	Finite Element Analysis

8.4.2.4 Structure Type

Value	Definition
0	Steel
1	PS Concrete
2	RC
3	Culvert
4	Concrete Multi-Cell Box
5	Truss

8.4.2.6 Deck Type

Value	Definition
0	Concrete
1	Corrugated
2	Generic
3	Timber