

COLORADO DEPARTMENT OF TRANSPORTATION STAFF BRIDGE BRIDGE RATING MANUAL	Section: 13 Effective: April 1, 2002 Supersedes: July 1, 1995
SECTION 13 - TIMBER STRUCTURES	

13-1 INTRODUCTION TO RATING TIMBER BRIDGES

This section covers the rating of timber stringers and decks. All timber members will be rated using the policies and guidelines in Section 1.

All new timber structures shall be rated using the VIRTIS (currently limited to sawn timber stringers with sawn timber decks) program. Timber structures with operating capacity less than 36 tons or structures that require posting/color coding shall be rated using the TIMBER program.

All other types of timber stringers and decks will be rated in compliance with the applicable guidelines within this manual and the AASHTO code. Hand computations will be acceptable (use AASHTO MAINTENANCE MANUAL and MANUAL FOR CONDITION EVALUATION OF BRIDGES, SECOND EDITION).

Examples are presented for the three-stringer types listed below, as well as transverse nail laminated timber decks, and transverse plank timber decks.

Timber structures shall be rated using guidelines in Subsection 1-6.

For rating non-timber decks, see Section 3.

An important aspect of rating timber bridges is that the rating should reflect the actual condition of the members, as reported from field inspections. The guidelines for evaluating and accounting for the condition of timber members are shown in Subsection 13-3.

The types of stringers covered by this section are:

- TS - Timber Stringer - Timber Deck
- TTD - Treated Timber Stringer - Concrete Deck
- TTS - Treated Timber Stringer - Timber Deck

13-2 POLICIES AND GUIDELINES FOR RATING TIMBER STRINGERS

I. General

- A. Allowable stress method shall be used to rate timber structures.
- B. All new timber structures and timber structures constructed after year 1960, with transverse nail laminated timber decks or transverse plank decks, shall be rated using the VIRTIS program. Currently, VIRTIS does not rate sawn timber decks, glulamated decks and girders.

- C. Timber stringers, as well as transverse nail laminated timber decks, and transverse plank timber decks, constructed prior to and including year 1960, shall be rated using the TIMBER program.
- D. When plans are not available, the allowable stress values for Douglas Fir-Larch (species), select structural (commercial grade), beams and stringers (size classification) with modifications as stated elsewhere in this section shall not be exceeded. For guidelines on determining the allowable inventory and operating stresses for timber, see the AASHTO STANDARD SPECIFICATIONS FOR HIGHWAY BRIDGES AND MANUAL FOR CONDITION EVALUATION OF BRIDGES.
- E. The allowable stress value for shear may be increased by a modification factor of 1.33. This factor will always be used for stringers without splits and in good condition. If a beam or stringer is split horizontally, the increase factor is not allowed; see Subsection 13-3.
- F. For structures constructed prior to and including year 1960, the allowable stresses do not need to be modified for the following: 1) Wet service factor, 2) Load duration factor, 3) Size factor, and 4) Form factor.
- G. For structures constructed after year 1960, the allowable stresses shall be modified according to the AASHTO STANDARD SPECIFICATIONS FOR HIGHWAY BRIDGES.
- H. The actual dimensions of timber members shall be used rather than nominal dimensions.
- I. The rater shall evaluate and account for the condition of timber members as specified in Subsection 13-3.

II. Stringers Requiring Rating

- A. Interior Stringers - A rating is required for the critically loaded interior stringer combined with the worst condition. Factors that influence condition are splits, broken, and repaired stringers, and wood condition. More than one interior stringer may require an analysis due to variation in span length, stringer size, stringer spacing, differences in loads or moments, etc.
- B. Exterior Stringers - An exterior stringer shall be rated when the section used is different than the section used for an interior stringer.

III. Dead Loads

- A. When rating timber bridges with timber decks use the maximum asphalt thickness obtained along a transverse cross section taken at midspan, rather than the average thickness, for dead load calculations.

- B. For timber or metal plank decks, dead loads due to railing curbs, and wheel guards shall not be distributed to all stringers, but shall be considered to be carried by the exterior stringer.
- C. The method of applying dead loads due to utilities is left to the rater's discretion.

IV. Rating Reporting/Package Requirements

The rater and checker shall complete the rating documentation as described in Section 1 of this manual. Any variation from the original design assumptions shall be added to the Rating Summary Sheet as applicable. The rating package requirements shall be per Section 1-13 of this manual and as amended herein:

Consultant designed projects - Before finalizing the rating package and when VIRTIS is used as the analysis tool, the Rater shall verify with the Staff Bridge Rating Coordinator that the version number of the program being used is identical to CDOT'S version number. Data files created using a lower version of the program shall be rejected. It is required for the CDOT data archive, since the data base management feature inside the program would not work satisfactorily. After the analysis is completed, the rater shall save the data file. When saving is finalized, the rater shall export the data file in *.bbd format (i.e., 0-18-BY.bbd format; bbd = BRIDGEWare Bridge Data File) on an IBM-compatible 3.5" PC Disk for delivery with the rating package. Also, the version number used during analysis shall be typed on the diskette label. This ensures proper importation of bridge data archive by the Staff Bridge at a later date.

13-3 EVALUATING CONDITION OF TIMBER MEMBERS

I. Broken Stringers

- A. In a broken stringer the wood is completely separated. The separation must extend a distance equal to or greater than one-fourth the depth of the stringer.
- B. For a broken stringer, the rater shall assume that the stringer is not there. Use stringer spacing equal to 1.5 times the actual spacing for dead load and live load distribution calculations.

II. Cracked Stringers

- A. A cracked stringer is similar to a broken stringer. A cracked stringer must be separated completely through the stringer in a lateral or transverse direction (at or nearly at 90 degrees to the longitudinal axis of the stringer); however, the separation must not extend vertically into the stringer more than one-fourth the depth of the stringer.
- B. The rater will evaluate the crack as follows, depending upon its location in the stringer:

1. In the 1/4 span closest to the support the rater shall use the allowable shear stress values given in AASHTO without the shear increase factor from subsection 13-2.

2. In the center-half of the span, the rater shall calculate the effective or reduced section depth, corresponding to the crack location on the beam, in order for the TIMBER computer program to determine the bending moment capacity.

III. Split Stringers

- A. To be a split, it must penetrate completely through the stringer and may or may not extend the full length of the stringer.
- B. A split will not reduce a member's bending capacity.
- C. For stringers that are split the allowable shear stress values given in AASHTO shall be used without the shear increase factor from Subsection 13-2.

IV. Checked Stringers

- A. A check is a separation of the wood along the fiber direction resulting from stresses set up in wood during seasoning, and usually extends across the rings of annual growth.
- B. Checks in a stringer may be on either or both sides.
- C. A check will not be considered to reduce the load carrying capacity of a timber member.

V. Shaked Stringers

- A. A shake is the result of the growth in the tree and may easily be mistaken as a check.
- B. A shake will not be considered to reduce the load carrying capacity of a timber member.

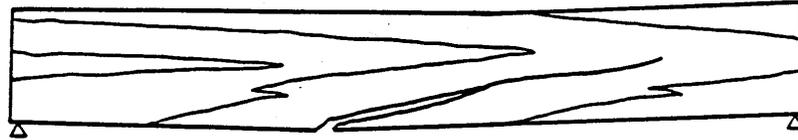
VI. Decay

- A. Decay can reduce a member's load capacity.
- B. A reduced section will be rated for shear or bending strength depending on the location.

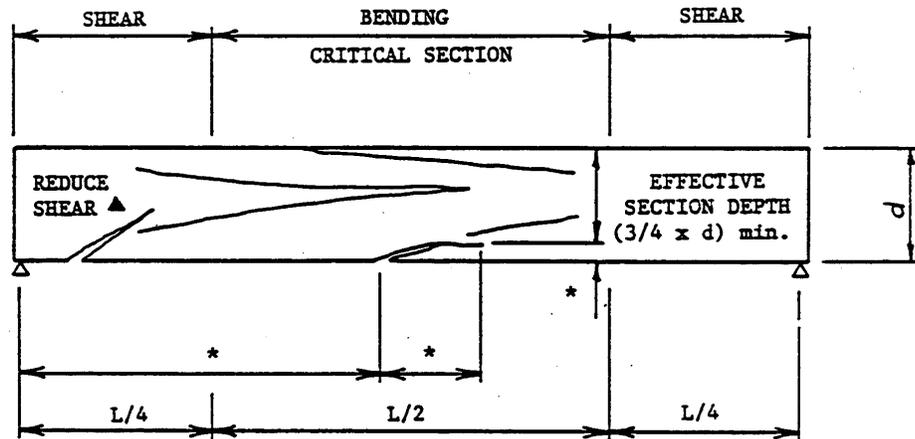
VII. Aging

- A. No adjustment in the allowable stresses for timber is necessary for reasons of aging alone. This is in accordance with ASTM D 245, April 10, 2000.

EVALUATING CONDITION OF TIMBER MEMBERS

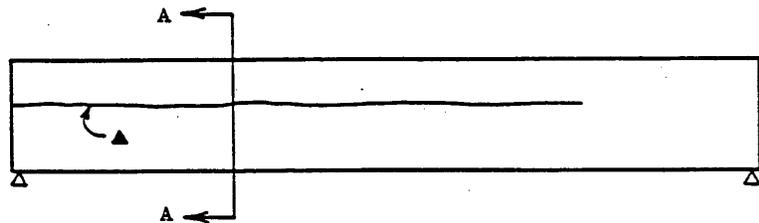


BROKEN STRINGER



* REQUIRES DIMENSION

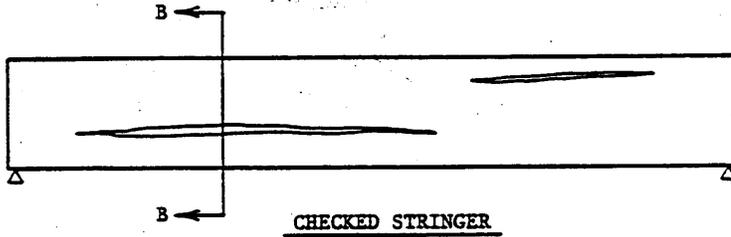
CRACKED STRINGER



SPLIT STRINGER

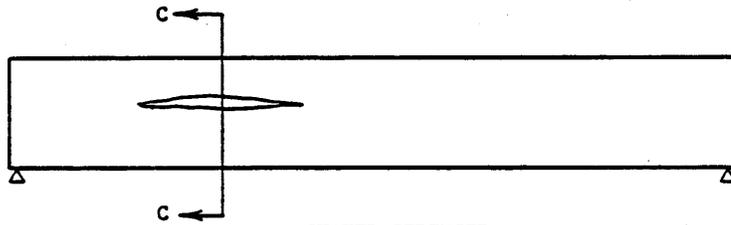
▲ Use allowable shear value (F_v) without 1.33 increase in these areas.

EVALUATING CONDITION OF TIMBER MEMBERS



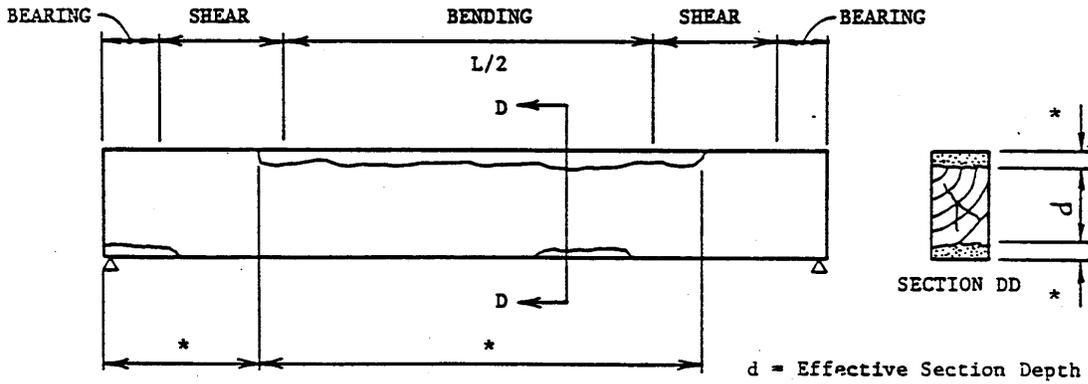
CHECKED STRINGER

SECTION BB



SHAKED STRINGER

SECTION CC



* REQUIRES DIMENSION

d = Effective Section Depth

DECAYED STRINGER

SECTION DD

13-4 GUIDELINES FOR USING THE VIRTIS RATING PROGRAM

The VIRTIS computer program performs the analysis and rating of simple span timber bridges. Virtis uses the Madero ASD analysis engine. This program was developed in accordance with the AASHTO STANDARD SPECIFICATIONS and the AASHTO MANUAL FOR CONDITION EVALUATION OF BRIDGES.

The program will not rate sawn timber decks, glue laminated stringers, glue laminated flooring, flooring placed longitudinally, splined or doweled flooring, multiple layered decks, nor nontimber decks. For required modification to the allowable stresses, see Subsection 13-2 and 13-3.

The library explorer can be used to save commonly used items (beam shapes, non standard vehicles, materials, appurtenances etc.) and this eliminates the need for all users to define the same items repeatedly throughout the program. Once a new girder shape is defined or copied from the library, Virtis automatically computes the required section properties and beam constants.

The program does consider uniform dead loads other than those caused by the stringers, deck, and overlay. In the case where other dead loads are present that would substantially affect the rating, they shall be accounted for during the analysis.

In the Live Load Distribution Factor window, when the compute button is used to calculate the DF's automatically by the program, Virtis users shall verify that these numbers are accurate and matches their calculated numbers.

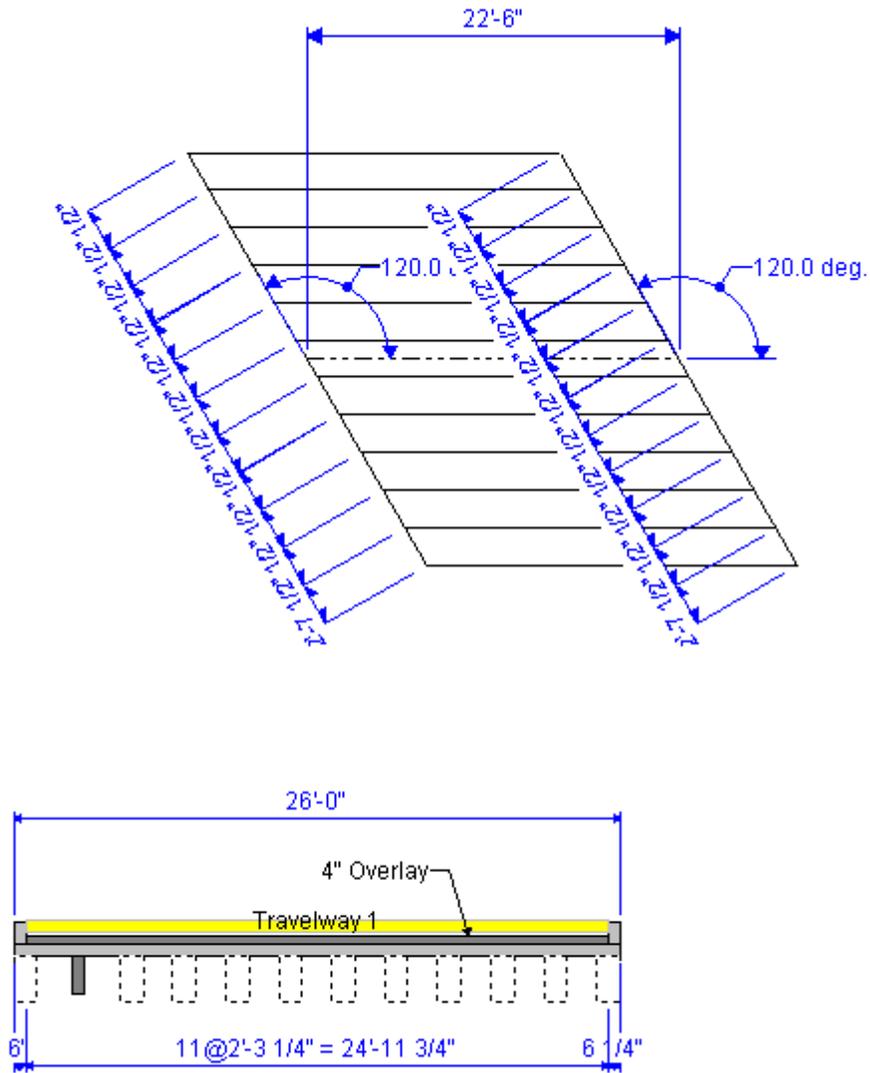
The configuration browser provides access to the configuration features of Virtis. It may be employed to provide specific access privileges, i.e. read, write, delete etc., to the users. This feature is extremely powerful, since Virtis/Opis uses and shares the bridge data from one common source. Therefore, it is required that users of this program create a folder from the bridge explorer window (**EXAMPLE: MY FOLDER OR YOUR LAST NAME**) before creating the model for a new structure.

One example is presented for structure D-22-C, a nine span bridge having treated timber stringers with timber decks. For simplicity, only one span has been modeled using the most critical condition of the members as reported in the field inspection report. A maximum of five spans can be modeled using the Virtis.

13-5 VIRTIS BRIDGE RATING EXAMPLE

TIMBER STRUCTURE EXAMPLE, STRUCTURE NO. D-22-C

Virtis/Opis - [Schematics: Framing Plan View]



From the bridge explorer, create a new bridge and enter the following information.

The screenshot shows a software window titled "D-22-C" with a red title bar. The window contains the following fields and controls:

- Bridge ID:
- NBI Structure ID (8):
- Template
- Design Only
- Tabbed interface with "Description" selected.
- Name: Year Built:
- Description:
- Location:
- Length: ft
- Facility Carried (7):
- Route Number:
- Feat. Intersected (6):
- Mi. Post:
- Units:
- Recent ADTT:
- Buttons:

Click OK. This saves the data to memory and closes the window.

NOTE: Since Virtis uses a common/shared database; it is required that users of this program create a folder from the bridge explorer window (**EXAMPLE: MY FOLDER OR YOUR LAST NAME**) before creating the model for a new structure.

To add a new timber material, click on Materials, Timber, and Sawn in the tree and select File/New from the menu (or right click on Sawn and select New). Click the Copy from Library button and select the Colorado Douglas Fir Beams Stringers from the library. Click OK and the following window will open. The ASD Tabulated Design Values in this window are based on dry conditions and do not include any adjustment factors based on usage conditions. Make necessary corrections to the allowable bending and shear stress values. Click OK to save this timber material to memory and close the window.

Bridge Materials - Timber - Sawn

Name: Colorado Douglas Fir BeamsStringers Description: No Splits, Commercial Grade

Grading method: Visual

Species: Douglas Fir-Larch

Commercial grade: Select Structural

Size classification: Beams and Stringers

Grading rules agency: Unknown

Density: 0.05 kcf

Modulus of elasticity: 1600.00 ksi

ASD Tabulated Design Values	
Bending:	1.600 ksi
Tension (parallel):	0.950 ksi
Shear (parallel):	0.113 ksi
Compr. (perp.):	0.625 ksi
Compr. (parallel):	1.100 ksi

Copy from Library... OK Apply Cancel

Follow the same procedure to copy from the Materials library. Change the name of material and size classification. Click OK to save this timber deck material to memory and close the window.

Bridge Materials - Timber - Sawn

Name: Colorado Douglas Fir Deck Description: No Splits, Commercial Grade

Grading method: Visual

Species: Douglas Fir-Larch

Commercial grade: Select Structural

Size classification: 2" - 4" thick, 5" - 6" wide

Grading rules agency: Unknown

Density: 0.05 kcf

Modulus of elasticity: 1600.00 ksi

ASD Tabulated Design Values

Bending:	1.600	ksi
Tension (parallel):	0.950	ksi
Shear (parallel):	0.113	ksi
Compr. (perp.):	0.625	ksi
Compr. (parallel):	1.100	ksi

Copy from Library... OK Apply Cancel

Add a new timber beam shape by clicking on Beam Shapes, Timber, and Rectangular in the tree and selecting File/New from the menu (or double clicking on Rectangular). Enter the actual beam dimensions to be used to calculate section properties on the dimensions tab. Dressed dimensions shall not be used. Click OK to save the data to memory and close the window.

Timber Beam - Rectangular

Name:

Description:

Dimensions | Properties

6.0000 in

20.0000 in

Copy from Library... OK Apply Cancel

Click the Properties tab, and then Compute. Click OK to save the data to memory and close the window.

Timber Beam - Rectangular

Name: 6x20 Beam

Description: 6

Dimensions Properties

Area: 120.00 in²

Nominal weight: lb/ft

Moment of inertia: 4000.0 in⁴

CG from bottom: 10.0000 in

Section modulus, top: 400.0 in³

Section modulus, bottom: 400.0 in³

Nominal width: 6.00 in

Nominal depth: 20.0000 in

Compute

Copy from Library... OK Apply Cancel

Expand the tree labeled Appurtenances to enter the bridge appurtenances information to be used in the analysis. To define a generic railing, double click on Generic in the tree and input the generic railing dimensions. Click OK to save data to memory and close the window.

Bridge Appurtenances - Generic

Name:

Description:

All dimensions are in inches

Distance from edge to centroid =

Reference Line →

Barrier weight = kip/ft

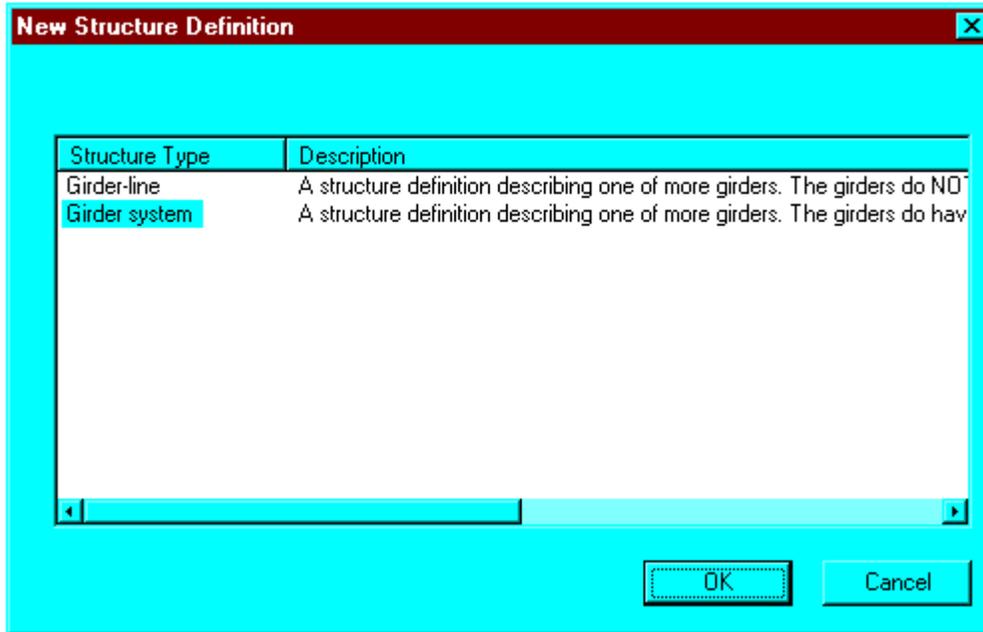
Width =

Effective wind height =

Back ← → Front

Generic Shape

Double click on STRUCTURE DEFINITION (or click on STRUCTURE DEFINITION and select File/New from the menu or right mouse click on STRUCTURE DEFINITION and select New from the popup menu) to create a new structure definition. The following dialog box will appear.



Select Girder System and the following Structure Definition window will open. Enter the appropriate data as shown below.

Girder System Structure Definition

Definition | Analysis | Engine

Name: Structure Definition # 1

Description:

Units: US Customary

Number of spans: 1

Number of girders: 12

Deck type: Timber

Enter Span Lengths Along the Reference Line:

Span	Length (ft)
1	22.50

For PS only

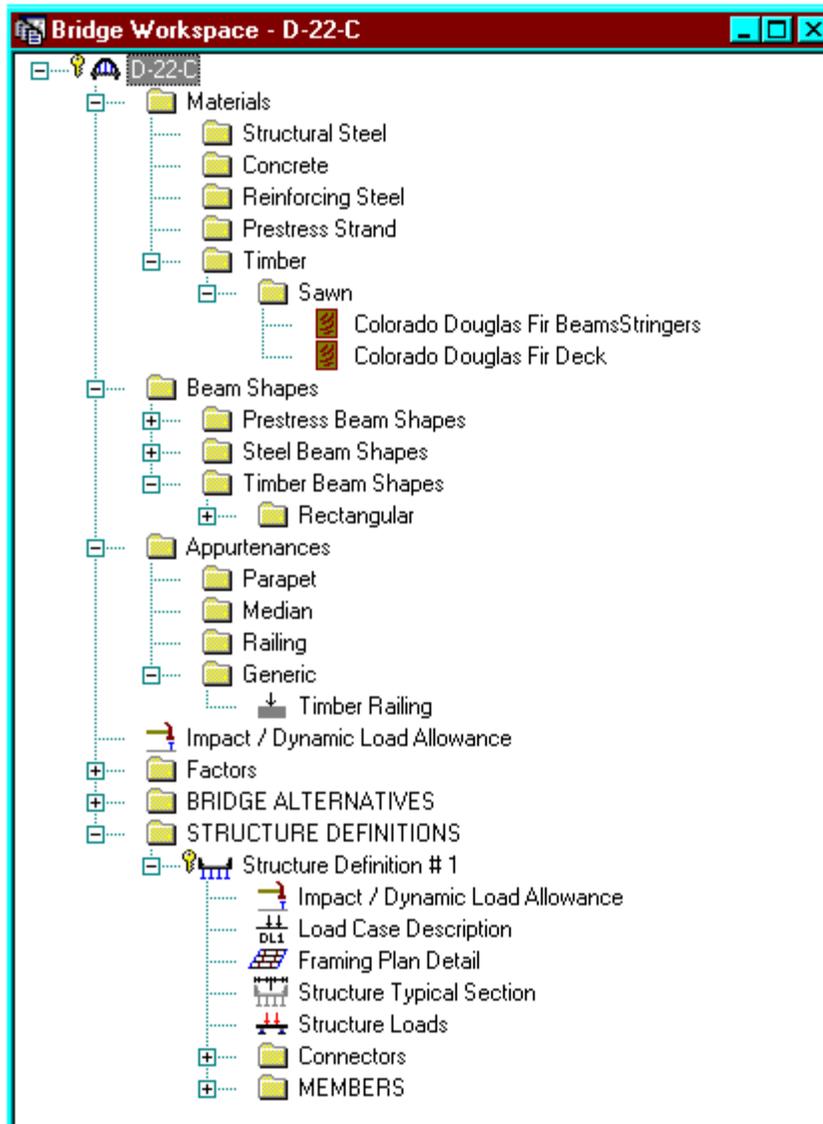
Average humidity: %

Member Alt. Types

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

OK Apply Cancel

Following is the partially expanded Bridge Workspace tree:



Click Load Case Description to define the dead load cases. The load types are presented in a single row separated by a comma. The first type applies to LFD design and the second type applies to LRFD design and it corresponds with the load types presented in the AASHTO Specifications. The completed Load Case Description window is shown below.

Load Case Name	Description	Stage	Type	Time* (Days)
HBP DL		Non-composite (Stage 1)	D,DW	
Rail DL		Non-composite (Stage 1)	D,DC	

*Prestressed members only

New Duplicate Delete

OK Apply Cancel

Double click on Framing Plan Detail to describe the framing plan. Enter the appropriate data to describe the framing plan. If the bridge has diaphragms, switch to the Diaphragms tab and enter the appropriate data. Click OK to save to memory and close the window.

Structure Framing Plan Details

Number of spans = 1 Number of girders = 12

Layout Diaphragms

Support	Skew (Degrees)
1	-30.0000
2	-30.0000

Girder Spacing Orientation

Perpendicular to girder

Along support

Girder Bay	Girder Spacing (ft)	
	Start of Girder	End of Girder
1	2.27	2.2
2	2.27	2.2
3	2.27	2.2
4	2.27	2.2
5	2.27	2.2

OK Apply Cancel

Double click on Structure Typical Section in the Bridge Workspace tree to define the structure typical section. Input the data describing the typical section as shown below.

Structure Typical Section

Distance from left edge of deck to structure definition reference line

Distance from right edge of deck to structure definition reference line

Deck thickness

Structure Definition Reference Line

Left overhang

Right overhang

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

Structure definition reference line is the bridge deck.

	Start	End
Distance from left edge of deck to structure definition reference line =	13.00 ft	13.00 ft
Distance from right edge of deck to structure definition reference line =	13.00 ft	13.00 ft
Left overhang =	0.50 ft	0.50 ft
Computed right overhang =	0.52 ft	0.52 ft

OK Apply Cancel

The Deck (cont'd) tab is used to enter information about the deck. Virtis/Opis only supports transverse timber decks. Select the type of deck as Nail-Laminated. The timber material to be used for the deck is selected from the list of bridge materials described above. A Nail definition has not been created yet, so leave the field blank for now. The Deck LL distribution width in the direction normal to the flooring span shall be per AASHTO Standard Specifications, Article 3.25.1.1. For this structure, this value is equal to 21.0 inches (15 inches plus thickness of floor).

Structure Typical Section

Distance from left edge of deck to structure definition reference line | Distance from right edge of deck to structure definition reference line

Deck thickness | Structure Definition Reference Line

Left overhang | Right overhang

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

Timber deck type:

Timber material:

Total deck thickness: in | Nominal thick.: in

Lamination width: in | Nominal width: in

Deck LL distribution width: in

Nail:

OK | Apply | Cancel

The Generic tab is used to enter information about the appurtenances. Click New to add a row to the table. Enter the following data.

Structure Typical Section

Generic Shape

Back Front

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

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

New Duplicate Delete

OK Apply Cancel

Select the Lane Position tab. Enter the values shown below or click the Compute...button to automatically compute the lane positions. A dialog box showing the results of the computation opens. Click the apply button to apply the computed values.

Travelway Number	Distance From Left Edge of Travelway to Structure Definition Reference Line At Start (A) (ft)	Distance From Right Edge of Travelway to Structure Definition Reference Line At Start (B) (ft)	Distance From Left Edge of Travelway to Structure Definition Reference Line At End (A) (ft)	Distance From Right Edge of Travelway to Structure Definition Reference Line At End (B) (ft)
1	-12.50	12.50	-12.50	

Buttons: Compute... New Duplicate Delete OK Apply Cancel

Enter the following wearing surface information and click OK to save to memory and close the window.

Structure Typical Section

Distance from left edge of deck to structure definition reference line

Distance from right edge of deck to structure definition reference line

Deck thickness

Structure Definition Reference Line

Left overhang

Right overhang

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

Wearing surface material: 4" HBP

Description: Hot Bituminous

Wearing surface thickness = 4.0000 in

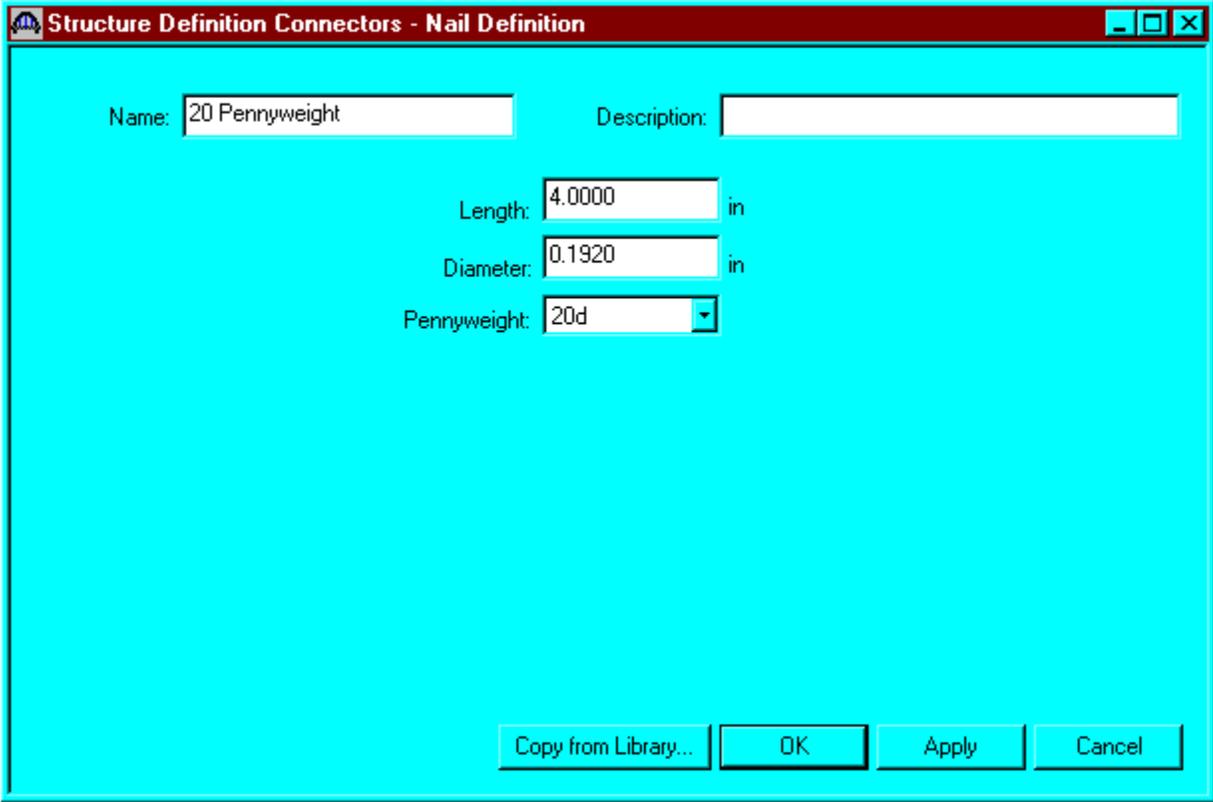
Wearing surface density = 144.000 pcf

Load case: HBP DL

Copy from Library...

OK Apply Cancel

Expand the Connectors tree item to create a nail definition. Double click on Nail. Define the nail and click OK to save to memory.



Structure Definition Connectors - Nail Definition

Name: 20 Pennyweight Description:

Length: 4.0000 in

Diameter: 0.1920 in

Pennyweight: 20d

Copy from Library... OK Apply Cancel

Now that we have created a nail definition, this can be applied to nails in the deck. Reopen the Structure Typical Section: Deck (cont'd) tab. Select the 20 Pennyweight nail definition as the nail on that tab. Click OK to save to memory and close the window.

Describing a member:

The member window shows the data that was generated when the structure definition was created. No changes are required at this time. The first Member Alternative that we create will automatically be assigned as the Existing and Current Member alternative for this member.

Member name: Link with:

Description:

Existing	Current	Member Alternative Name	Description
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Timber Beam Interior	

Number of spans:

Span No.	Span Length (ft)
1	22.50

Pedestrian load: lb/ft

OK Apply Cancel

Defining a Member Alternative: Double click MEMBER ALTERNATIVES in the tree to create a new alternative. The New Member Alternative dialog will open. Select Timber for the Material Type and Rectangular Sawn Timber for the Girder Type. Only Timber is available for the Material Type since a timber deck type was selected on the Structure Definition window. Timber decks are limited to timber beams in Virtis/Opis.

New Member Alternative

Material Type:

Girder Type:

OK Cancel

Enter the following data for the Member Alternative. Click OK to save to memory and close the window.

Member Alternative Description

Member Alternative:

Description | Factors | Engine | Import

Description:

Material Type:

Girder Type:

Member units:

Girder property input method

Schedule based

Cross-section based

Analysis Module

ASD:

Additional Self Weight

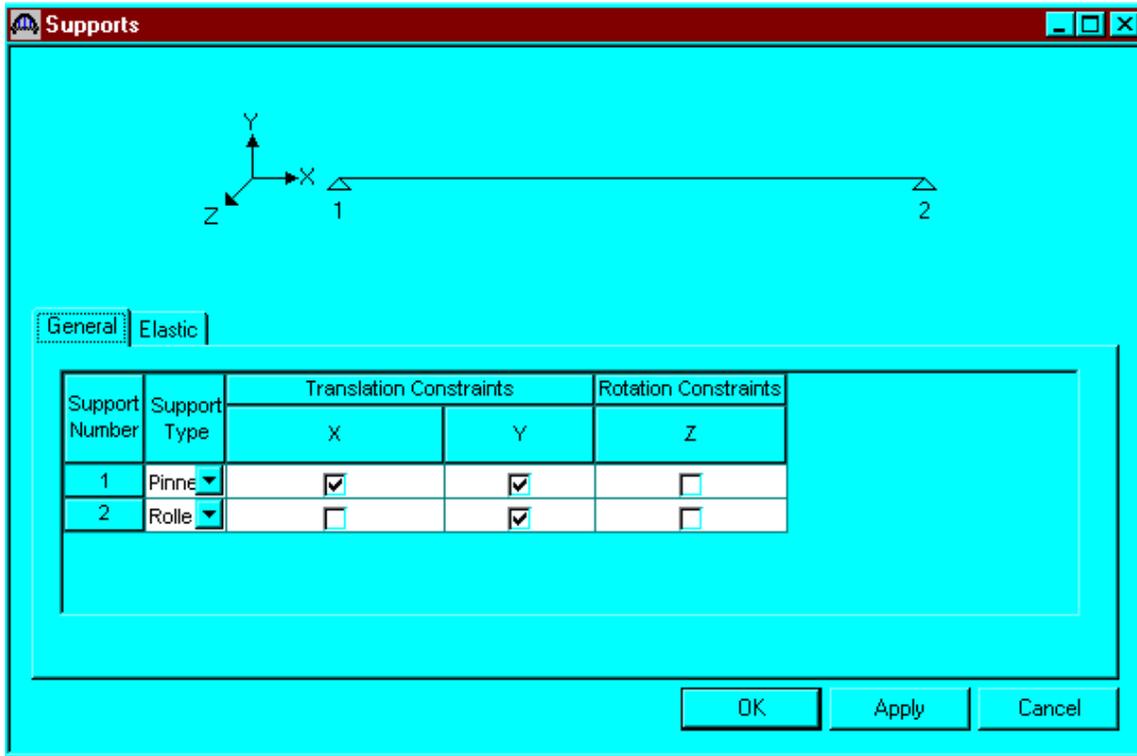
Additional self weight = kip/ft

Additional self weight = %

Default rating method:

OK Apply Cancel

Support constraints were generated when the structure definition was created and are shown below.



Use the Compute from Typical Section button to compute the live load distribution factors. Refer to AASHTO Table 3.23.1, Article 3.23.1.2 and Article 13.6.5.2.

Standard | LRFD

Lanes Loaded	Distribution Factor (Wheels)			
	Shear	Shear at Supports	Moment	Deflection
1 Lane	0.527	1.000	0.454	0.167
Multi-Lane	0.567	1.000	0.534	0.333

Compute from Typical Section

OK Apply Cancel

Open the Beam Details window by double clicking on Beam Details in the Bridge Workspace tree. The Beam Details window is shown below.

Beam Details

General | Adjustment Factors | Support Lengths

Beam shape: 6x20 Beam

Material: Colorado Douglas Fir Beam

Beam projection

Left: 0.0000 in Right: 0.0000 in

OK Apply Cancel

The Adjustment Factors tab of the Beam Details window allows you to enter adjustment factors to modify the tabulated design values entered on the Bridge Materials - Timber - Sawn window. The tabulated design values modified by these adjustment factors produce the design allowable stresses. In Colorado, dry moisture condition is used. Enter 1.0 for all adjustment factors. See Section 13-2(F).

The screenshot shows the 'Beam Details' window with the 'Adjustment Factors' tab selected. The window has a title bar with a red background and a small icon on the left. Below the title bar are three tabs: 'General', 'Adjustment Factors', and 'Support Lengths'. The 'Adjustment Factors' tab is active and contains the following fields:

Moisture condition for shear/flexure:	Dry
Moisture condition for bearing:	Dry
Moisture condition for modulus:	Dry
Shear factor:	1.000
Flat use factor:	1.00
Wet service (flexure):	1.000
Repetitive use factor:	1.00
Wet service (shear):	1.000
Load duration factor:	1.000
Wet service (bearing):	1.00
Wet service (modulus):	1.000
Size factor (flexure):	1.000

At the bottom right of the adjustment factors section is a 'Compute' button. At the bottom of the window are three buttons: 'OK', 'Apply', and 'Cancel'.

Enter the following data for the Support Lengths tab. Click OK to save to memory and close the window.

The screenshot shows a software window titled "Beam Details" with three tabs: "General", "Adjustment Factors", and "Support Lengths". The "Support Lengths" tab is active and contains a table with the following data:

Support Number	Bearing Length (in)	Bearing Width (in)
1	8.0000	6.0000
2	8.0000	6.0000

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

Open the Deck Details window by double clicking on Deck Details in the tree. Enter 1.0 for all adjustment factors. See Section 13-2(F) and the Adjustment Factors tab of the Beam Details window.

The screenshot shows a software window titled "Deck Details" with a red title bar. Inside the window, there is a tab labeled "Adjustment Factors". The window contains several input fields and dropdown menus. The "Moisture condition for shear/flexure", "Moisture condition for bearing", and "Moisture condition for modulus" are all set to "Dry". The "Shear factor", "Wet service (flexure)", "Wet service (shear)", "Wet service (bearing)", "Wet service (modulus)", "Size factor (flexure)", "Flat use factor", "Repetitive use factor", and "Load duration factor" are all set to "1.00". There is a "Compute" button on the right side of the adjustment factors section. At the bottom of the window, there are three buttons: "OK", "Apply", and "Cancel".

Parameter	Value
Moisture condition for shear/flexure	Dry
Moisture condition for bearing	Dry
Moisture condition for modulus	Dry
Shear factor	1.00
Wet service (flexure)	1.00
Wet service (shear)	1.00
Wet service (bearing)	1.00
Wet service (modulus)	1.00
Size factor (flexure)	1.00
Flat use factor	1.00
Repetitive use factor	1.00
Load duration factor	1.00

Open the Point of Interest window by double clicking on the Points of Interest tree. It enables you to enter points of interest, in addition to those that are automatically generated by the program.

Point of Interest

Distance from leftmost support: ft or Span: Fraction: Side: Left Right

ASD Design Values | Adjustment Factors | Operating Stress Percentage | Bracing | Engine

Override deck design values

Tabulated design values:

Bending: ksi

Tension parallel to grain: ksi

Shear parallel to grain: ksi

Compr. perp. to grain: ksi

Compr. parallel to grain: ksi

Override beam design values

Tabulated design values:

Bending: ksi

Tension parallel to grain: ksi

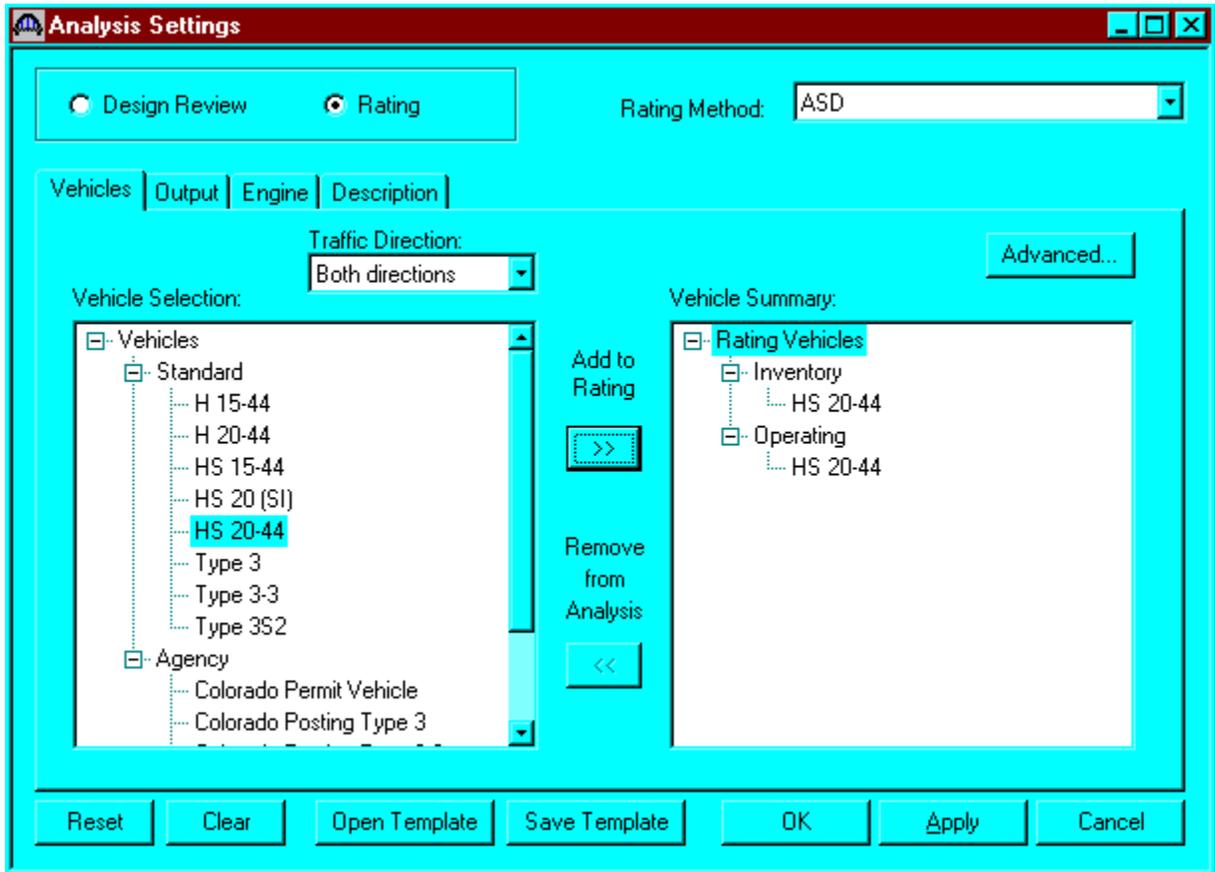
Shear parallel to grain: ksi

Compr. perp. to grain: ksi

Compr. parallel to grain: ksi

OK Apply Cancel

To perform a rating analysis, select the Bridge Analysis Settings button on the toolbar to open the window shown below. Select ASD as the Rating Method, select HS 20-44 vehicle or other vehicles to be used in the rating and click OK.



Select the output tab of the Analysis Settings window. Check specific boxes next to the desired output report and click the Engine tab.

Analysis Settings

Design Review Rating Rating Method: ASD

Vehicles **Output** Engine Description

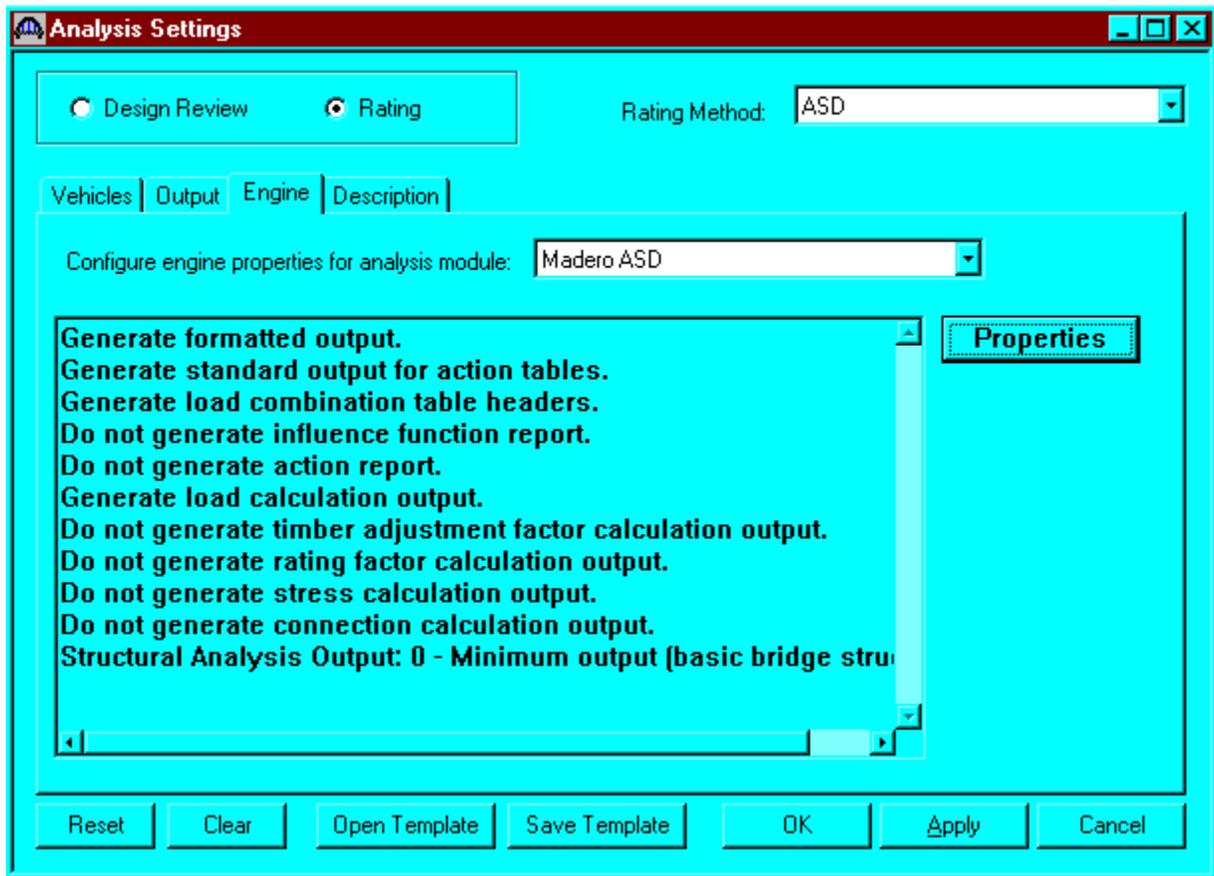
Output:

- ASD Critical Loads Report
- ASD Critical Stresses Report
- Dead Load Action Report
- Live Load Action Report
- Rating Report

Select All Clear All

Reset Clear Open Template Save Template OK Apply Cancel

Select the analysis engine and click the Properties tab.



Select the desired Output Options and click OK.

Madero ASD - Analysis Event Properties

Output Options

Format:

- Formatted Output
- Abbreviated Action Tables
- Load Combination Table Headers

Calculations:

- Load Calculations
- Timber Adjustment Factor Calculations
- Rating Factor Calculations
- Stress Calculations
- Connection Calculations

Reports:

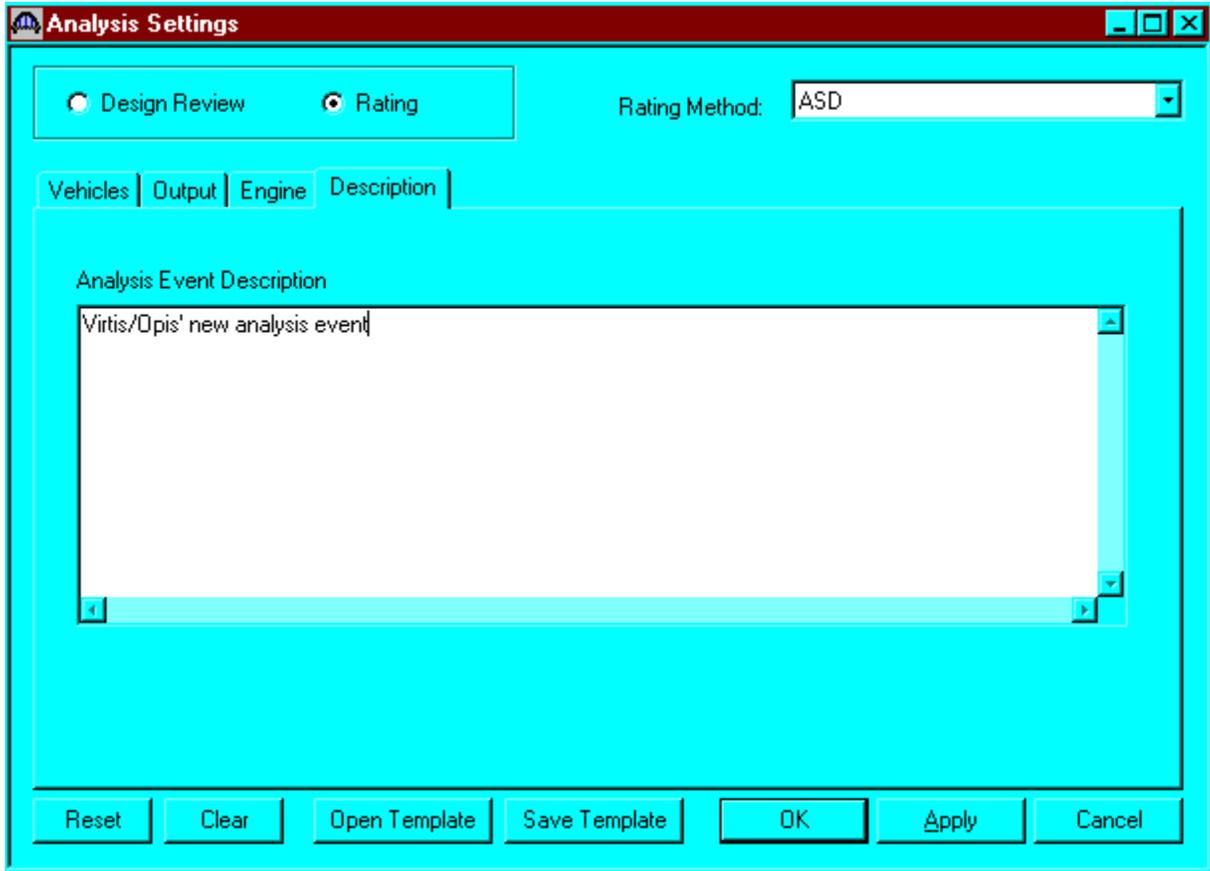
- Influence Function Report
- Action Report

Structural Analysis Output: 0 - Minimum output (basic bridge structure)

OK

Cancel

Click the Description tab. Provide a general narrative description of the analysis event and click OK.



The results of the ASD analysis are as follows:

Analysis Results - Timber Beam Interior

Report Type: Rating Results Summary

Live Load	Live Load Type	Design Method	Inventory Load Rating Ton	Operating Load Rating Ton	Inventory Rating Factor	Operating Rating Factor	Inventory Location ft	Inventory Location Span-(%)	Operating Location ft	Operating Location Span-(%)	Inv. Limi
HS 20-44	Axle	ASD	29.98	42.67	0.833	1.165	22.50	1 - (100.	22.50	1 - (100.	SI
HS 20-44	Lane	ASD	36.42	51.82	1.012	1.439	22.50	1 - (100.	22.50	1 - (100.	SI

Madero(ASD/LRFD) - Version 1.00.00 - Dec. 20, 2000

Close

13-6 TIMBER RATING PROGRAM DESCRIPTION

The TIMBER computer program performs the complete analysis and rating of simple span timber bridges. The program was developed in accordance with the AASHTO STANDARD SPECIFICATIONS and the AASHTO MANUAL FOR CONDITION EVALUATION OF BRIDGES.

The program will not rate glue laminated stringers, glue laminated flooring, flooring placed longitudinally, splined or doweled flooring, multiple layered decks, nor nontimber decks. In accordance with subsection 13-2, the program does not modify the user input values for allowable stresses.

The program does not consider dead loads other than those caused by the stringers, deck, and overlay. In the case where other dead loads are present that would substantially affect the rating, they shall be accounted for during the analysis.

The asphalt overlay depth is used to compute the dead load, using the asphalt unit weight of 144 pcf. When the timber bridge has gravel overlay (unit weight = 120 pcf) the depth entered should be the equivalent depth of asphalt to gravel. This is done by taking the actual depth of gravel, dividing it by 1.2, and entering the result into the required depth column. The actual depth of gravel shall be shown on the Rating Summary Sheet.

The following information appears as output from the program.

I. Stringer

- A. Total dead load moment and shear for the stringer being rated.
- B. Live load moment and shear due to HS 20 truck.
- C. Stringer rating for bending and shear for Inventory and Operating stress levels.
- D. Live load moment and shear due to all three Colorado posting trucks.
- E. Posting ratings for bending and shear for all three Colorado posting trucks. If all posting rating values are greater than the respective posting truck weights, and the operating rating is greater than or equal to 36 tons, then the posting ratings are not printed.
- F. The Overload Color Code Rating for the stringer being rated is based on either shear or bending, depending on which controls.

II. Decking

- A. Deck rating for nail laminated and plank floors at Inventory and Operating stress levels.
- B. Posting ratings for all three Colorado posting trucks.
- C. The Overload Color Code Rating is not a function of the deck rating.

13-7 TIMBER BRIDGE RATING EXAMPLES

Timber Rating Program Input

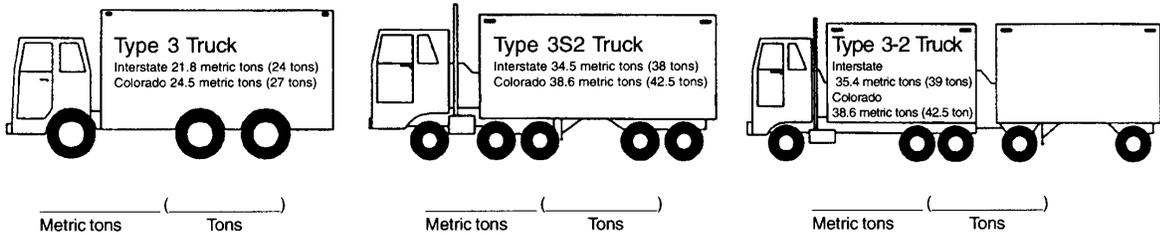
Timber Data			
Description Data			
Structure Number:	D-22-C	Rater:	MAN
Batch ID:	A75153	No. of Lanes:	2
Hwy. Number:	71		
Deadload			
Asphalt Overlay (in):	4		
Structure Data			
Deck Type:	Laminated	Deck Thickness (in):	6
Plank Width (in):			
Stringer Width (in):	6	Stringer Depth (in):	20
Stringer Spacing (ft):	2.271	Effective Span Length (ft):	22.5
Material Properties			
Inv. Bending Stress (PSI):	1600	Inv. Shear Stress (PSI):	113
OK	Cancel	Apply	Write to File

COLORADO DEPARTMENT OF TRANSPORTATION TIMBER RATING SUMMARY	Structure # D-22-C
	State highway # 71
Rated using Asphalt thickness: <u>124</u> mm (<u>4</u> in.) <input checked="" type="checkbox"/> Colorado legal loads <input type="checkbox"/> Interstate legal loads	Batch I.D. A75153
	Structure type TTS
	Parallel structure #

Structural member	STRINGER	DECK	
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Metric tons (Tons)				
Inventory	27.3	(30.1)	102.7	(113)
Operating	39.3	(43.3)	137.0	(151)

Type 3 truck	()	()	()	()
Type 3S2 truck	()	()	()	()
Type 3-2 truck	()	()	()	()
Permit truck	()	()	()	()



Comments Stringer: Allowable bending stress = 1600 psi Allowable shear stress = 113 psi Bending controlled - Color Code: White Timber Deck Rated. Project No: S0021(1)			
Rated by	Date	Checked by	Date

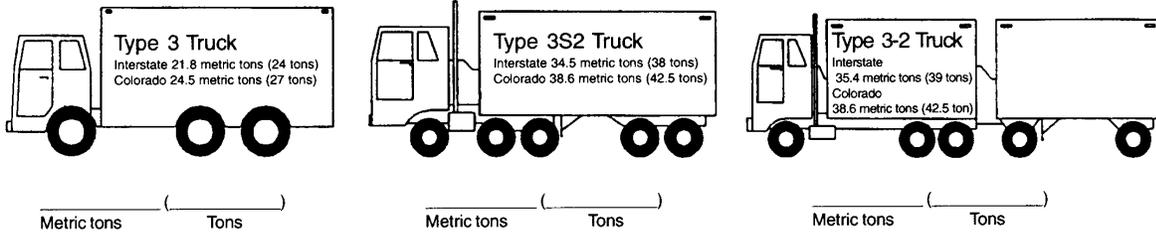
Timber Rating Program Input

Timber Data			
Description Data			
Structure Number:	H-01-C	Rater:	MH
Batch ID:	C75202	No. of Lanes:	2
Hwy. Number:	6		
Deadload			
Asphalt Overlay (in):	3.5		
Structure Data			
Deck Type:	Laminated	Deck Thickness (in):	6
Plank Width (in):			
Stringer Width (in):	5.75	Stringer Depth (in):	19.5
Stringer Spacing (ft):	2.083	Effective Span Length (ft):	23
Material Properties			
Inv. Bending Stress (PSI):	1600	Inv. Shear Stress (PSI):	85
OK	Cancel	Apply	Write to File

COLORADO DEPARTMENT OF TRANSPORTATION TIMBER RATING SUMMARY	Structure # H-01-C
	State highway # 6
Rated using Asphalt thickness: <u>89</u> mm (<u>3.5</u> in.) <input checked="" type="checkbox"/> Colorado legal loads <input type="checkbox"/> Interstate legal loads	Batch I.D. C75202
	Structure type TTS
	Parallel structure #

Structural member	STRINGER	DECK	
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	Metric tons (Tons)			
Inventory	20.0 (22.1)	121.0 (133)	()	()
Operating	28.1 (31.0)	161.0 (177)	()	()
Type 3 truck	22.9 (25.3)	()	()	()
Type 3S2 truck	35.3 (38.9)	()	()	()
Type 3-2 truck	36.6 (40.3)	()	()	()
Permit truck	()	()	()	()



Comments

Stringer:
 Allowable bending stress = 1600 psi
 Allowable shear stress = 85 psi (Split Stringer)
 Shear controlled - Color Code: Black

Timber Deck Rated.
 Project No: FAP 242-E

Rated by	Date	Checked by	Date
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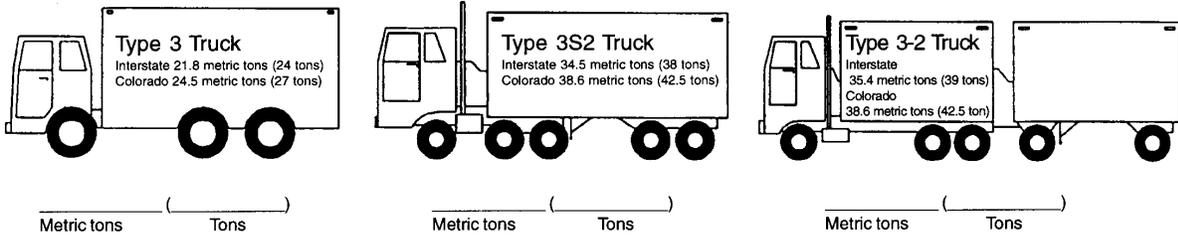
Timber Rating Program Input

Timber Data			
Description Data			
Structure Number:	C-18-BE	Rater:	MH
Batch ID:	C75211	No. of Lanes:	2
Hwy. Number:	37		
Deadload			
Asphalt Overlay (in):	6.5		
Structure Data			
Deck Type:	Plank	Deck Thickness (in):	4
Plank Width (in):	14		
Stringer Width (in):	4	Stringer Depth (in):	18
Stringer Spacing (ft):	1.167	Effective Span Length (ft):	25.75
Material Properties			
Inv. Bending Stress (PSI):	1600	Inv. Shear Stress (PSI):	113
OK	Cancel	Apply	Write to File

COLORADO DEPARTMENT OF TRANSPORTATION TIMBER RATING SUMMARY		Structure #	C-18-BE
		State highway #	37
Rated using Asphalt thickness: <u>165</u> mm (<u>6.5</u> in.) <input checked="" type="checkbox"/> Colorado legal loads <input type="checkbox"/> Interstate legal loads		Batch I.D.	C75211
		Structure type	TS
		Parallel structure #	

Structural member	STRINGER	DECK	
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	Metric tons (Tons)			
Inventory	16.9 (18.6)	169.0 (186)	()	()
Operating	24.6 (27.1)	224.0 (247)	()	()
Type 3 truck	19.4 (21.4)	()	()	()
Type 3S2 truck	30.0 (33.1)	()	()	()
Type 3-2 truck	30.7 (33.8)	()	()	()
Permit truck	()	()	()	()



Comments

Stringer:
 Allowable bending stress = 1600 psi
 Allowable shear stress = 113 psi
 Bending controlled Inventory & Posting Rating - Color Code: Black
 Shear controlled Operating Rating

Timber Deck Rated.
 Project No: Bridge surveyed in 1962

Rated by	Date	Checked by	Date
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Timber Rating Program Input

Timber Data			
Description Data			
Structure Number:	A-17-D	Rater:	MNord
Batch ID:	A75149	No. of Lanes:	2
Hwy. Number:	85		
Deadload			
Asphalt Overlay (in):	8.5		
Structure Data			
Deck Type:	Concrete	Deck Thickness (in):	6
Plank Width (in):	0		
Stringer Width (in):	6	Stringer Depth (in):	20
Stringer Spacing (ft):	2.229	Effective Span Length (ft):	23
Material Properties			
Inv. Bending Stress (PSI):	1600	Inv. Shear Stress (PSI):	113
OK	Cancel	Apply	Write to File

Timber Rating Program Output

Batch: A75149 Timber Bridge Rating Date: 8/24/2001
 Rater: MNord Structure Number: A-17-D State Highway: 85

Number of Lanes: 2
 Floor Type: Concrete
 Effective Span Length: 23.000 ft.
 Stringer Spacing: 2.229 ft.
 Stringer Width: 6.000 in.
 Stringer Depth: 20.00 in.
 Floor Thickness: 6.00 in.
 Bituminous Overlay Thickness: 5.00 in.
 Allow. Stress in Bending: 1600.0 PSI
 Allow. Shear Stress: 113.0 PSI

HS-20 Truck (Gross Wt. 36 Tons)

NOTE: Concrete slab is not rated.

Deadload Moment: 22.65 KIP-ft.
 Liveload Moment: 41.01 KIP-ft.
 Deadload Shear: 2.23 KIPS
 Liveload Shear: 8.00 KIPS

	Inventory Rating	Operating Rating
Stringer		
Bending	26.9 Tons	42.4 Tons
Shear	30.6 Tons	44.1 Tons
Moment Capacity	53.33 KIP-ft	70.93 KIP-ft
Shear Capacity	9.04 KIPS	12.02 KIPS

```

+ + + Overload Information + + +
+                                     +
+   Color Code = White               +
+                                     +
+   1-Axle (KIPS) = 45.203           +
+   2-Axles (4-0) = 54.224           +
+   3-Axles (4-0) = 58.850           +
+   4-Axles (4-0) = 68.518           +
+                                     +
+   These Loads Assume 1-Lane        +
+   Distribution Factor                +
+ + + + + + + + + + + + + + + + + +
  
```

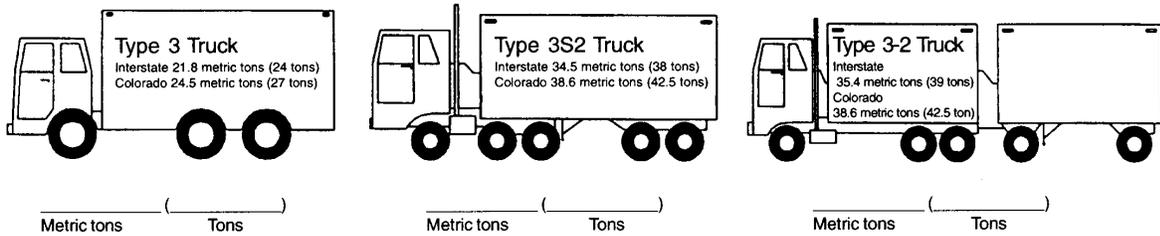
COLORADO DEPARTMENT OF TRANSPORTATION TIMBER RATING SUMMARY	Structure # A-17-D
	State highway # 85
Rated using Asphalt thickness: <u>127</u> mm (<u>5</u> in.) <input checked="" type="checkbox"/> Colorado legal loads <input type="checkbox"/> Interstate legal loads	Batch I.D. A75149
	Structure type TTD
	Parallel structure #

Structural member	STRINGER	CONC. SLAB	
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Metric tons (Tons)

Inventory	24.4 (26.9)	* ()	()
Operating	38.5 (42.4)	* ()	()

Type 3 truck	()	()	()
Type 3S2 truck	()	()	()
Type 3-2 truck	()	()	()
Permit truck	()	()	()



Comments

Stringer:
 Allowable bending stress = 1600 psi
 Allowable shear stress = 113 psi
 Bending controlled - Color Code: White

* Concrete Deck not Rated, no information available.
 Project No: F006-1(3)

Rated by	Date	Checked by	Date
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