

*AASHTOWare BrR 6.8*

---

***Steel Tutorial***

*Simplified Working Stress Rating Example*

## Topics Covered

- Overview of simplified working stress capabilities.
- Identify non-detailed description of steel section properties in BARS data file.
- Import the BARS data file to BrR/BrD database.
- Perform rating for the imported member alternative.

## Overview of simplified working stress capabilities

BARS provides the means for entering non-detailed description of steel cross sections. Non-detailed steel cross sections are cross sections that are defined by the cross sectional area, moment of inertia, and section modulus. These section properties are valid for working stress moment rating analysis only since the BARS data does not include the web areas needed for shear rating analysis.

The BARS import utility in BrR verifies and imports these cross sections into a Steel Non-Detailed member alternative. New Steel Non-Detailed member alternatives and cross sections can only be created for member that was imported from BARS. The default rating method for the member alternative is ASD and BrR Simplified ASD is selected as the analysis module.

When the member alternative is chosen for rating, BrR will export each of these cross sections as an equivalent rectangular section that corresponds to the cross sectional area and moment of inertia imported from BARS. AASHTO engine will be used to perform structural analysis on these equivalent sections and computes moments at points of interest along the member. The working stress moment rating factors will be computed and the critical rating factors will be displayed in the Analysis Results window. An output XML file with all the rating factors will also be created.

## Identify non-detailed description of steel section properties in BARS data file

The following BARS data file describes a 130 ft (2 @ 65 ft) long structural steel (SS) member. The member has three non-detailed cross sections (Card 12). The first section defines the first 55 ft of the first span and the last 55 ft of the second span. The third section defines the last 5 ft of the first span and the first 5 ft of the second span. The second section defines the remaining 5 ft in the first and second spans.

```

0606544 OBRIDGEID S071 06544
AA NEW
01 I.D. HS20HS20 1.18 *7T* POST
9906544
0206544 S07106544 OTHR 40246 130 0 0 26 0 0 2
0806544 G01 2 65 0 0 65 0 0 SS 1.068 X
1006544 G01 01 0 0 0 W 685. 65 0 0
1006544 G01 02 0 0 0 W 685. 65 0 0
1106544 G01 0101 55 0 001
1106544 G01 0102 5 0 002
1106544 G01 0103 5 0 003
1106544 G01 0201 5 0 003
1106544 G01 0202 5 0 002
1106544 G01 0203 55 0 001
1206544 G01 1 34.13 4919. 327.9
1206544 G01 2 48.13 8175. 527.4
1206544 G01 3 57.1310390. 654.5
    
```

Section number

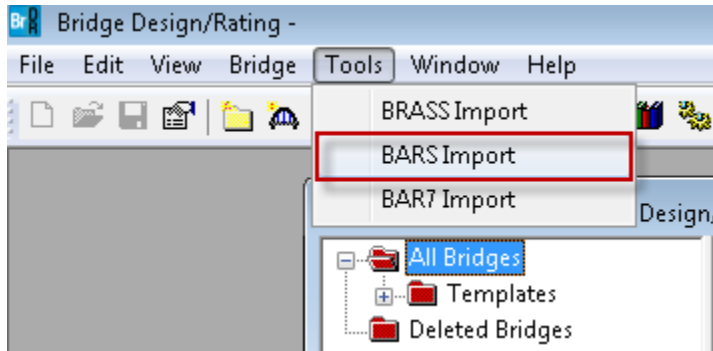
Elastic section modulus ( $S = I/c$ ) of the section, in inches to the third power

Moment of inertia ( $I$ ) of the section, in inches to the fourth power

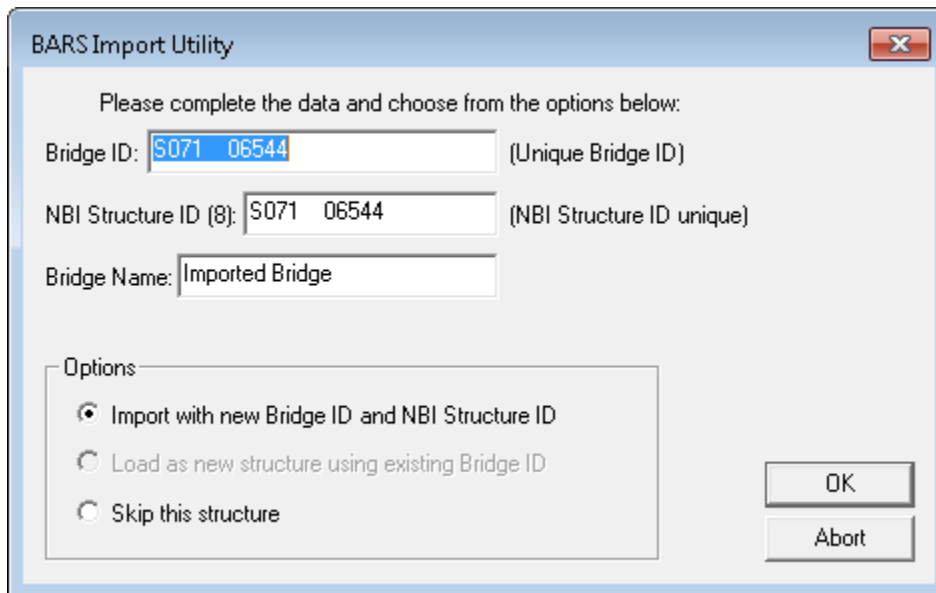
Area ( $A$ ) of the section, in square inches

## Import the BARS data file to BrR/BrD database

To import a BARS data file, use the BARS Import tool under the Tools menu.



In the BARS import window, go to File -> Import and import the SWS Rate - Simplified Working Stress Rating Example.dat file. The following window will appear. Press OK and close the import window to go back to the bridge explorer.





## SWS Rate - Simplified Working Stress Rating Example

Double-click on the “Mbr Alt 1” member alternative. The windows shown below will open. The Girder Type is Steel Non-Detailed and the ASD Analysis Module is Virtis Simplified ASD.

The screenshot shows the "Member Alternative Description" dialog box with the "Description" tab selected. The "Member Alternative" field contains "Mbr Alt 1". The "Girder Type" dropdown is set to "Steel Non-Detailed" and is highlighted with a red box. Other visible fields include "Material Type" (Steel), "Default Units" (US Customary), "End bearing locations" (Left and Right), "Default rating method" (ASD), and "Self Load" (Load case: Engine Assigned).

The screenshot shows the "Member Alternative Description" dialog box with the "Specs" tab selected. A table is displayed with the following data:

Analysis Method Type	Analysis Module	Selection Type	Spec Version
ASD	Virtis Simplified ASD	System Default	

The row containing "ASD", "Virtis Simplified ASD", and "System Default" is highlighted with a red box. The "Member Alternative" field at the top still contains "Mbr Alt 1".

## SWS Rate - Simplified Working Stress Rating Example




The three imported non-detailed cross sections are shown below.

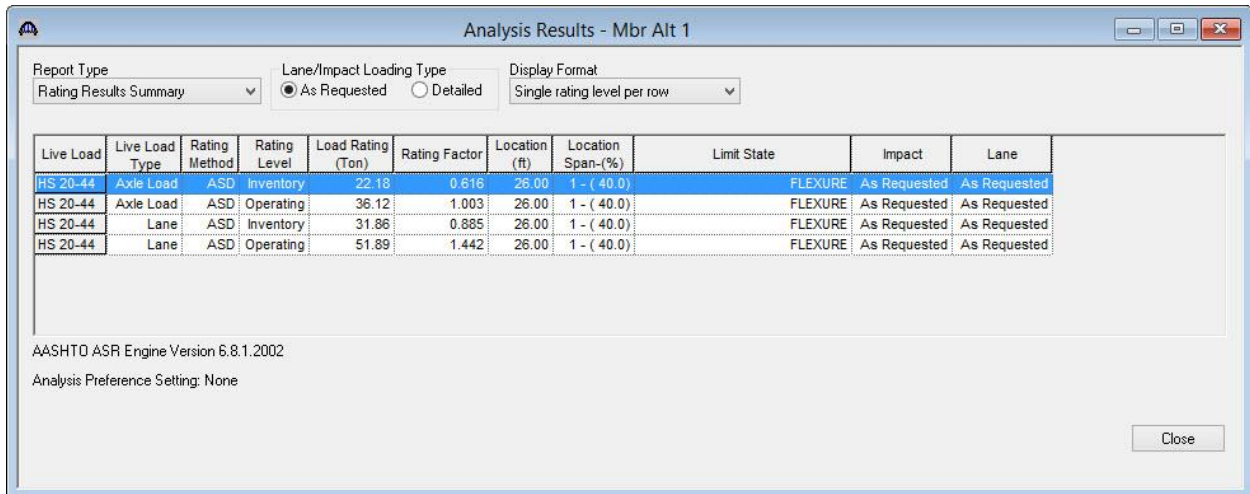
The image displays three overlapping 'Cross Sections' dialog boxes, each showing the properties for a specific non-detailed cross section. The sections are named G0101, G0102, and G0103. Each dialog box contains the following information:

Section Name	Steel Material	Area (in <sup>2</sup> )	Moment of Inertia (in <sup>4</sup> )	Section Modulus (in <sup>3</sup> )
G0101	Fy 33000	34.13	4919	327.9
G0102	Fy 33000	48.13	8175	527.4
G0103	Fy 33000	57.13	10390	654.5

Each dialog box also includes a 'Name' field, a 'Type' dropdown set to 'Non-Detailed', and a 'Section Properties' tab. The bottom dialog box (G0103) features 'OK', 'Apply', and 'Cancel' buttons.

## Perform rating for the imported member alternative

To perform a rating, select the name of the “Mbr Alt 1” member alternative in the Bridge Workspace tree. Click the View Analysis Settings button  on the toolbar. The Analysis Settings window will open. Use the “HS 20 Rating” template. Click OK to close the window. Next click the Analyze button  on the toolbar to perform the rating. When the rating is finished, you can review the critical rating factors by clicking the View Analysis Report button  on the toolbar. The window shown below will open.




Analysis Results - Mbr Alt 1

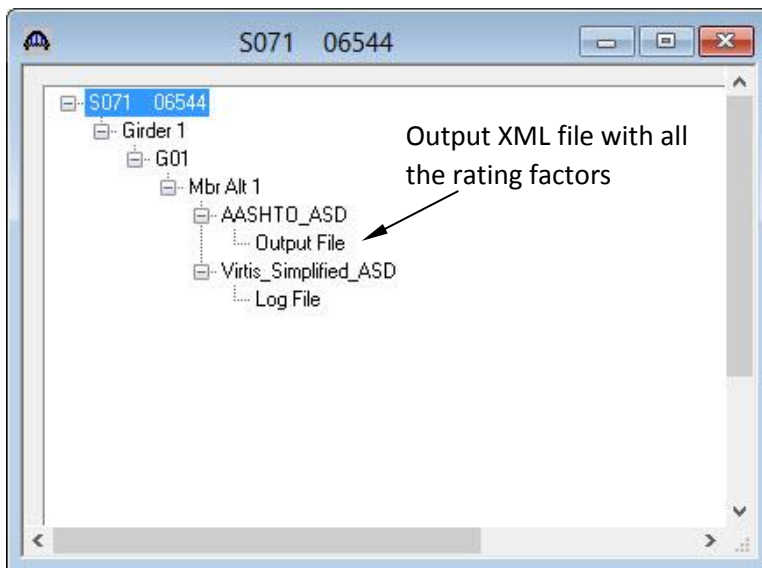
Report Type: Rating Results Summary  
 Lane/Impact Loading Type:  As Requested  Detailed  
 Display Format: Single rating level per row

Live Load	Live Load Type	Rating Method	Rating Level	Load Rating (Ton)	Rating Factor	Location (ft)	Location Span-(%)	Limit State	Impact	Lane
HS 20-44	Axle Load	ASD	Inventory	22.18	0.616	26.00	1 - (40.0)	FLEXURE	As Requested	As Requested
HS 20-44	Axle Load	ASD	Operating	36.12	1.003	26.00	1 - (40.0)	FLEXURE	As Requested	As Requested
HS 20-44	Lane	ASD	Inventory	31.86	0.885	26.00	1 - (40.0)	FLEXURE	As Requested	As Requested
HS 20-44	Lane	ASD	Operating	51.89	1.442	26.00	1 - (40.0)	FLEXURE	As Requested	As Requested

AASHTO ASR Engine Version 6.8.1.2002  
 Analysis Preference Setting: None

Close

Click the View Latest Analysis Output button  on the toolbar. The window shown below will open.



Double-click on the “Output File” will open the XML file in Internet Explorer. The content of the XML file is shown below.



SWS Rate - Simplified Working Stress Rating Example

**Bridge Name:** Imported Bridge  
**NBI Structure ID:** S071 06544  
**Bridge ID:** S071 06544

**Analyzed By:** Bridge  
**Analyze Date:** Friday, September 16, 2016 09:49:23  
**Analysis Engine:** AASHTO ASR Engine Version 6.8.1.2002

**Structure Definition Name:** Girder 1  
**Member Name:** G01  
**Member Alternative Name:** Mbr Alt 1

Working Stress Rating Summary								
Live Load		Vehicle	Rating	Controls	Capacity	Span	Location	Percent
		Type	Factor		(Ton)		(ft)	
HS 20-44	Inventory	Axle	0.616	FLEXURE	22.18	1	26.00	40.0
	Operating	Axle	1.003	FLEXURE	36.12	1	26.00	40.0

Note:  
 "N/A" indicates not applicable  
 "\*\*\*" indicates not available

**Moments**  
**Live Load HS 20-44**

**Span 1**

Location		Stage 1 DL	+(LL+I)	-(LL+I)	+Impact	-Impact
(ft)	Percent	(kip-ft)	(kip-ft)	(kip-ft)	Factor (%)	Factor (%)
0.00	0.0	0.00	0.00(L)	0.00(L)	**	**
6.50	10.0	103.04	218.96(T)	-32.09(T)	**	**
13.00	20.0	172.24	362.25(T)	-64.18(T)	**	**
19.50	30.0	207.59	435.88(T)	-96.27(T)	**	**
26.00	40.0	209.09	465.67(T)	-128.36(T)	**	**
32.50	50.0	176.74	450.76(T)	-160.45(T)	**	**
39.00	60.0	110.54	399.04(T)	-192.54(T)	**	**
45.50	70.0	10.50	301.03(T)	-224.63(T)	**	**
52.00	80.0	-123.39	170.48(T)	-256.73(T)	**	**
55.00	84.6	-196.61	101.78(T)	-271.54(T)	**	**
58.50	90.0	-291.42	48.00(L)	-288.82(T)	**	**
60.00	92.3	-335.24	35.41(L)	-316.51(L)	**	**
65.00	100.0	-495.49	0.00(L)	-441.41(L)	**	**

**Span 2**

Location		Stage 1 DL	+(LL+I)	-(LL+I)	+Impact	-Impact
(ft)	Percent	(kip-ft)	(kip-ft)	(kip-ft)	Factor (%)	Factor (%)
0.00	0.0	-495.49	0.00(L)	-441.41(L)	**	**
5.00	7.7	-335.24	35.41(L)	-316.51(L)	**	**

SWS Rate - Simplified Working Stress Rating Example

6.50	10.0	-291.42	48.00(L)	-288.82(T)	**	**
10.00	15.4	-196.61	101.78(T)	-271.54(T)	**	**
13.00	20.0	-123.39	170.48(T)	-256.73(T)	**	**
19.50	30.0	10.50	301.03(T)	-224.63(T)	**	**
26.00	40.0	110.54	399.04(T)	-192.54(T)	**	**
32.50	50.0	176.74	450.76(T)	-160.45(T)	**	**
39.00	60.0	209.09	465.67(T)	-128.36(T)	**	**
45.50	70.0	207.59	435.88(T)	-96.27(T)	**	**
52.00	80.0	172.24	362.25(T)	-64.18(T)	**	**
58.50	90.0	103.04	218.96(T)	-32.09(T)	**	**
65.00	100.0	0.00	0.00(L)	0.00(L)	**	**

Note:

"N/A" indicates not applicable

"\*\*" indicates not available

LL Codes:

(T) Truck load controls

(L) Lane load controls

Note:

Impact and distribution factors included in above live load moments.

**Rating Factors  
Live Load HS 20-44  
Vehicle Type Axle**

**Span 1**

Location		Section	Inventory	Operating
(ft)	Percent	Modulus (in <sup>3</sup> )	Rating Factor	Rating Factor
0.00R	0.0	327.900	N/A	N/A
6.50	10.0	327.900	1.794	2.618
13.00	20.0	327.900	0.894	1.391
19.50	30.0	327.900	0.662	1.075
26.00	40.0	327.900	0.616	1.003
32.50	50.0	327.900	0.708	1.108
39.00	60.0	327.900	0.966	1.418
45.50	70.0	327.900	1.613	2.212
52.00	80.0	327.900	1.451	2.154
55.00L	84.6	327.900	1.102	1.767
55.00R	84.6	527.400	2.214	3.282
58.50	90.0	527.400	1.753	2.757
60.00L	92.3	527.400	1.561	2.540
60.00R	92.3	654.500	2.210	3.425
65.00L	100.0	654.500	1.541	2.663

**Span 2**

SWS Rate - Simplified Working Stress Rating Example

Location		Section	Inventory	Operating
(ft)	Percent	Modulus (in <sup>3</sup> )	Rating Factor	Rating Factor
0.00R	0.0	654.500	1.541	2.663
5.00L	7.7	654.500	2.210	3.425
5.00R	7.7	527.400	1.561	2.540
6.50	10.0	527.400	1.753	2.757
10.00L	15.4	527.400	2.214	3.282
10.00R	15.4	327.900	1.102	1.767
13.00	20.0	327.900	1.451	2.154
19.50	30.0	327.900	1.613	2.212
26.00	40.0	327.900	0.966	1.418
32.50	50.0	327.900	0.708	1.108
39.00	60.0	327.900	0.616	1.003
45.50	70.0	327.900	0.662	1.075
52.00	80.0	327.900	0.894	1.391
58.50	90.0	327.900	1.794	2.618
65.00L	100.0	327.900	N/A	N/A

Note:

"N/A" indicates not applicable

"\*\*" indicates not available

**Rating Factors  
Live Load HS 20-44  
Vehicle Type Lane**

**Span 1**

Location		Section	Inventory	Operating
(ft)	Percent	Modulus (in <sup>3</sup> )	Rating Factor	Rating Factor
0.00R	0.0	327.900	N/A	N/A
6.50	10.0	327.900	2.856	4.166
13.00	20.0	327.900	1.367	2.129
19.50	30.0	327.900	0.966	1.570
26.00	40.0	327.900	0.885	1.442
32.50	50.0	327.900	1.011	1.582
39.00	60.0	327.900	1.397	2.051
45.50	70.0	327.900	2.336	3.204
52.00	80.0	327.900	2.029	3.010
55.00L	84.6	327.900	1.353	2.168
55.00R	84.6	527.400	2.716	4.027
58.50	90.0	527.400	1.784	2.806
60.00L	92.3	527.400	1.461	2.378
60.00R	92.3	654.500	2.068	3.206
65.00L	100.0	654.500	1.120	1.936

SWS Rate - Simplified Working Stress Rating Example

**Span 2**

<b>Location</b>		<b>Section</b>	<b>Inventory</b>	<b>Operating</b>
<b>(ft)</b>	<b>Percent</b>	<b>Modulus</b>	<b>Rating</b>	<b>Rating</b>
		<b>(in<sup>3</sup>)</b>	<b>Factor</b>	<b>Factor</b>
0.00R	0.0	654.500	1.120	1.936
5.00L	7.7	654.500	2.068	3.206
5.00R	7.7	527.400	1.461	2.378
6.50	10.0	527.400	1.784	2.806
10.00L	15.4	527.400	2.716	4.027
10.00R	15.4	327.900	1.353	2.168
13.00	20.0	327.900	2.029	3.010
19.50	30.0	327.900	2.336	3.204
26.00	40.0	327.900	1.397	2.051
32.50	50.0	327.900	1.011	1.582
39.00	60.0	327.900	0.885	1.442
45.50	70.0	327.900	0.966	1.570
52.00	80.0	327.900	1.367	2.129
58.50	90.0	327.900	2.856	4.166
65.00L	100.0	327.900	N/A	N/A

Note:

"N/A" indicates not applicable

"\*\*" indicates not available