AASHTOWare™ BRIDGE DESIGN AND RATING

Technical Note 83

Potentially Incorrect Distribution Factor-Line Girder Analysis Results When Adjacent Lane Vehicle Used

Applies to the following products:

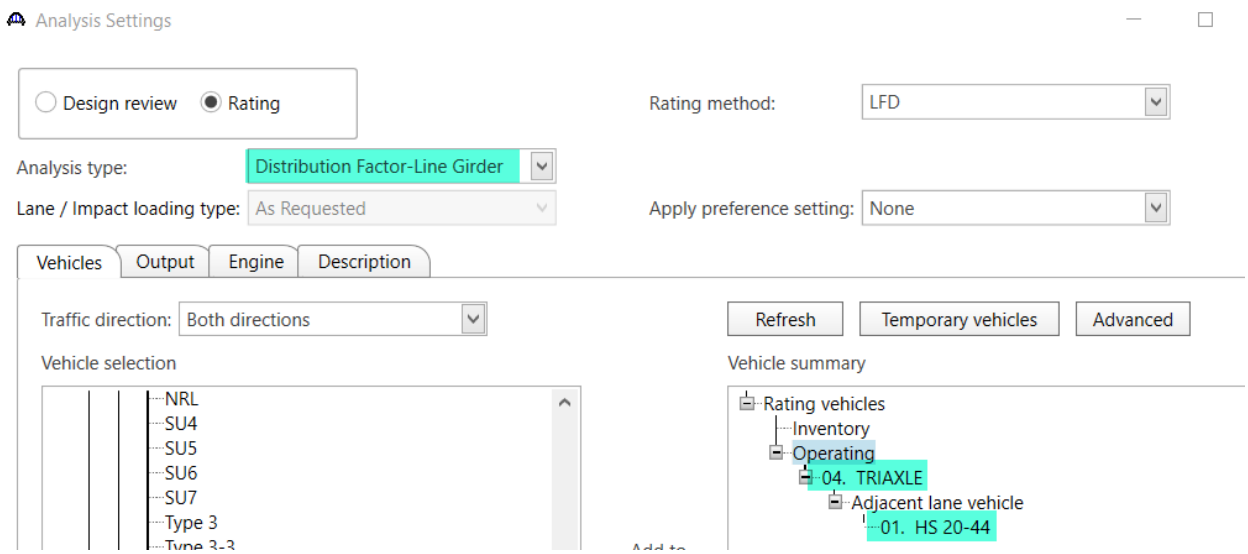
- BrDR, version 7.0 to 7.6
- BrR, version 7.0 to 7.6

Description

For a 'Distribution Factor-Line Girder' (DF-LG) analysis type, if the vehicle name assigned to the 'Adjacent lane vehicle' category is alphanumerically in advance of the primary vehicle name, the adjacent lane vehicle is being used as the primary vehicle and no adjacent vehicle is being considered in the analysis.

Below is an example of the incorrect program behavior using BID 1 'TrainingBridge1'.

A DF-LG analysis is specified with a primary vehicle named '04. TRIAXLE' with the adjacent lane vehicle named '01. HS 20-44'.



In an alphanumerically sequenced listing, the adjacent lane vehicle name '01. HS 20-44' comes before the primary vehicle name '04. TRIAXLE', i.e., in an alphanumeric sort, '01' comes before '04'.

Because of this, the program is incorrectly assigning the adjacent lane vehicle to be the primary vehicle. Furthermore, no adjacent lane vehicle is being considered.

To verify this behavior, the program-generated 'DFAnalysis – Path 1 (Left Edge) Summary.txt' engine output is shown on the next page.

Note that the adjacent lane vehicle ’01. HS 20-44’ appears as the ‘Primary’ vehicle and “No adjacent vehicle specified.” appears as the ‘Adjacent’ vehicle.

DFAnalysis - Path 1 (Left Edge) Summary.txt - Notepad

File Edit Format View Help

Bridge ID: TrainingBridge1 NBI Structure ID: TrainingBridge1
Bridge: Training Bridge 1(LRFD) Bridge Alt: Single Span Bridge
Superstructure: Single Span Structure
User: bridge Date: Thursday, January 16, 2025 12:06 PM

Report Filename: DFAnalysis - Path 1 (Left Edge) Summary.txt

Vehicles:
Primary: 01. HS 20-44
Adjacent: No adjacent vehicle specified.

Girder G1 - Plate Girder

Distance (ft)	3D Positive Moment (kip-ft)	2D Positive Moment (kip-ft)	Positive Moment DF	3D Negative Moment (kip-ft)	2D Negative Moment (kip-ft)	Negative Moment DF	3D Positive Shear (kip)	2D Positive Shear (kip)	Positive Shear DF	3D Negative Shear (kip)	2D Negative Shear (kip)	Negative Shear DF
0.00	0.00	0.00	0.000	0.00	0.00	0.000	0.00	0.00	0.000	-49.16	-67.83	0.725
16.10	634.06	976.08	0.650	0.00	0.00	0.000	2.79	3.62	0.772	-38.24	-60.63	0.631
32.20	1069.69	1720.32	0.622	0.00	0.00	0.000	8.45	10.23	0.826	-34.35	-53.43	0.643
36.67	1169.00	1885.72	0.620	0.00	0.00	0.000	9.54	12.22	0.780	-33.92	-51.43	0.659
48.30	1364.83	2232.72	0.611	0.00	0.00	0.000	13.35	17.43	0.766	-30.65	-46.23	0.663
64.40	1555.59	2535.68	0.613	0.00	0.00	0.000	17.26	24.63	0.701	-27.24	-39.03	0.698
80.50	1628.90	2618.00	0.622	0.00	0.00	0.000	20.95	31.83	0.658	-23.61	-31.83	0.742
96.60	1596.35	2535.68	0.630	0.00	0.00	0.000	24.83	39.03	0.636	-19.49	-24.63	0.791
112.70	1443.23	2232.72	0.646	0.00	0.00	0.000	29.24	46.23	0.632	-14.60	-17.43	0.838
124.33	1249.27	1885.71	0.662	0.00	0.00	0.000	33.35	51.43	0.648	-9.91	-12.22	0.810
128.80	1152.95	1720.32	0.670	0.00	0.00	0.000	34.34	53.43	0.643	-8.60	-10.23	0.841
144.90	686.09	976.08	0.703	0.00	0.00	0.000	40.88	60.63	0.674	-2.30	-3.62	0.637
161.00	0.00	0.00	0.000	0.00	0.00	0.000	48.51	67.83	0.715	0.00	0.00	0.000

Girder G2 - Plate Girder

Distance (ft)	3D Positive Moment (kip-ft)	2D Positive Moment (kip-ft)	Positive Moment DF	3D Negative Moment (kip-ft)	2D Negative Moment (kip-ft)	Negative Moment DF	3D Positive Shear (kip)	2D Positive Shear (kip)	Positive Shear DF	3D Negative Shear (kip)	2D Negative Shear (kip)	Negative Shear DF
0.00	0.00	0.00	0.000	0.00	0.00	0.000	0.00	0.00	0.000	-29.62	-67.83	0.437
16.10	370.50	976.08	0.380	0.00	0.00	0.000	0.00	3.62	0.000	-19.18	-60.63	0.316
32.20	618.87	1720.32	0.360	0.00	0.00	0.000	1.01	10.23	0.098	-15.36	-53.43	0.287
36.67	673.53	1885.72	0.357	0.00	0.00	0.000	1.36	12.22	0.111	-14.91	-51.43	0.290
48.30	781.45	2232.72	0.350	0.00	0.00	0.000	3.78	17.43	0.217	-12.09	-46.23	0.262
64.40	856.96	2535.68	0.338	0.00	0.00	0.000	6.91	24.63	0.280	-8.87	-39.03	0.227
80.50	849.08	2618.00	0.324	0.00	0.00	0.000	9.96	31.83	0.313	-5.94	-31.83	0.187
96.60	768.77	2535.68	0.303	0.00	0.00	0.000	12.77	39.03	0.327	-3.48	-24.63	0.141
112.70	622.72	2232.72	0.279	0.00	0.00	0.000	15.10	46.23	0.327	-1.86	-17.43	0.107
124.33	477.57	1885.71	0.253	0.00	0.00	0.000	16.52	51.43	0.321	-1.20	-12.22	0.098
128.80	416.13	1720.32	0.242	0.00	0.00	0.000	16.46	53.43	0.308	-1.39	-10.23	0.136
144.90	196.43	976.08	0.201	0.00	0.00	0.000	15.56	60.63	0.257	-1.25	-3.62	0.346
161.00	0.00	0.00	0.000	0.00	0.00	0.000	14.98	67.83	0.221	-1.12	0.00	0.000

Reviewing the ‘6B.4 Steel Flexure Overload’ spec report at the mid-span POI (80.50 ft), the live load moment is reported to be 2,069.6 kip-ft.

Spec Check Detail for 6B.4 Steel Flexure Overload

Top flange continuously supported. Top flange lateral stresses are set to zero.

Note: If the capacity has been overridden, the Resistance is computed as override phi*override capacity.
Otherwise the Resistance is computed as per the Specification.

Component: Top Flange

Rating Level	Vehicle	Flexure Type	LL (kip-ft)	Adj. LL (kip-ft)	A1	A2	fDLz (ksi)	fDLl (ksi)	fLLIz (ksi)	fLLl (ksi)	Adj. fLLIz (ksi)	fR (ksi)	Override Phi	Override fR (ksi)	RF	Capacity (Ton)	Note
Operating	1	Pos	2069.6	---	1.00	1.00	-32.76	0.00	-1.47	0.00	---	-47.50	---	---	10.019	375.69	
Operating	1	Pos	0.0	---	1.00	1.00	-32.76	0.00	0.00	0.00	---	-47.50	---	---	99.000	3712.50	

Component: Bot Flange

Rating Level	Vehicle	Flexure Type	LL (kip-ft)	Adj. LL (kip-ft)	A1	A2	fDLz (ksi)	fDLl (ksi)	fLLIz (ksi)	fLLl (ksi)	Adj. fLLIz (ksi)	fR (ksi)	Override Phi	Override fR (ksi)	RF	Capacity (Ton)	Note
Operating	1	Pos	2069.6	---	1.00	1.00	27.51	0.00	6.11	0.00	---	47.50	---	---	3.272	122.70	
Operating	1	Pos	0.0	---	1.00	1.00	27.51	0.00	0.00	0.00	---	47.50	---	---	99.000	3712.50	

Load Combination Legend:

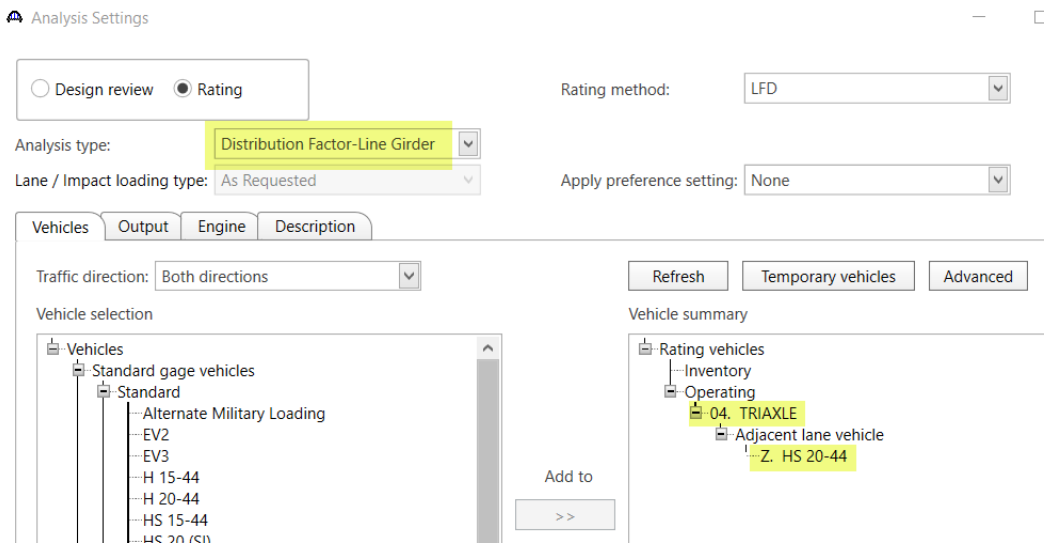
Code	Vehicle
1	04. TRIAXLE - Truck

Incorrect -- results are being reported based on '01. HS 20-44' vehicle

Workaround

The workaround is to use a vehicle name for the 'Adjacent lane vehicle' that alphanumerically **follows** the 'Primary' vehicle name.

In the 'Analysis Settings' window below, the name of the adjacent lane '01. HS 20-44' vehicle has been changed to 'Z. HS 20-44' ('Z' will follow every other character in an alphanumeric listing).



In reviewing the 'DFAnalysis – Path 1 (Left Edge) Summary.txt' engine output report,'04. TRIAXLE' is now correctly shown as the 'Primary' vehicle and 'Z. HS 20-44' as the 'Adjacent' vehicle.

DFAnalysis - Path 1 (Left Edge) Summary.txt - Notepad

File Edit Format View Help

Bridge ID: TrainingBridge1 NBI Structure ID: TrainingBridge1
Bridge: Training Bridge 1(LRFD) Bridge Alt: Single Span Bridge
Superstructure: Single Span Structure
User: bridge Date: Thursday, January 16, 2025 11:57 AM

Report Filename: DFAnalysis - Path 1 (Left Edge) Summary.txt

Vehicles:
Primary: 04. TRIAXLE
Adjacent: Z. HS 20-44

Girder G1 - Plate Girder

Distance (ft)	3D Positive Moment (kip-ft)	2D Positive Moment (kip-ft)	Positive Moment DF	3D Negative Moment (kip-ft)	2D Negative Moment (kip-ft)	Negative Moment DF	3D Positive Shear (kip)	2D Positive Shear (kip)	Positive Shear DF	3D Negative Shear (kip)	2D Negative Shear (kip)	Negative Shear DF
0.00	0.00	0.00	0.000	0.00	0.00	0.000	0.00	0.00	0.000	-55.41	-71.93	0.770
16.10	778.02	1037.25	0.750	0.00	0.00	0.000	4.59	4.70	0.978	-47.76	-64.43	0.741
32.20	1507.50	1833.00	0.822	0.00	0.00	0.000	10.48	11.93	0.879	-44.98	-56.93	0.790
36.67	1680.93	2010.97	0.836	0.00	0.00	0.000	11.46	14.01	0.818	-44.01	-54.84	0.803
48.30	2075.73	2387.25	0.870	0.00	0.00	0.000	15.42	19.43	0.794	-39.45	-49.43	0.798
64.40	2432.29	2730.00	0.891	0.00	0.00	0.000	19.36	26.93	0.719	-33.34	-41.93	0.795
80.50	2599.85	2831.25	0.918	0.00	0.00	0.000	23.15	34.43	0.673	-27.19	-34.43	0.790
96.60	2542.72	2730.00	0.931	0.00	0.00	0.000	30.01	41.93	0.716	-20.84	-26.93	0.774
112.70	2249.82	2387.25	0.942	0.00	0.00	0.000	37.85	49.43	0.766	-15.75	-19.43	0.811
124.33	1906.24	2010.97	0.948	0.00	0.00	0.000	44.66	54.84	0.814	-11.35	-14.01	0.810
128.80	1737.20	1833.00	0.948	0.00	0.00	0.000	46.30	56.93	0.813	-9.63	-11.93	0.808
144.90	968.95	1037.25	0.934	0.00	0.00	0.000	55.37	64.43	0.859	-2.75	-4.70	0.585
161.00	0.00	0.00	0.000	0.00	0.00	0.000	61.05	71.93	0.849	0.00	0.00	0.000

Girder G2 - Plate Girder

Distance (ft)	3D Positive Moment (kip-ft)	2D Positive Moment (kip-ft)	Positive Moment DF	3D Negative Moment (kip-ft)	2D Negative Moment (kip-ft)	Negative Moment DF	3D Positive Shear (kip)	2D Positive Shear (kip)	Positive Shear DF	3D Negative Shear (kip)	2D Negative Shear (kip)	Negative Shear DF

Reviewing the ‘6B.4 Steel Flexure Overload’ spec report at the mid-span POI (80.50 ft), the live load moment now correctly reports out a larger value of 3,054.4 kip-ft correctly reflecting the ’04. TRIAXLE’ vehicle in the primary lane with ‘Z. HS-20 44’ in the adjacent lane.

Spec Check Detail for 6B.4 Steel Flexure Overload

Top flange continuously supported. Top flange lateral stresses are set to zero.

Note: If the capacity has been overridden, the Resistance is computed as override phi*override capacity.
Otherwise the Resistance is computed as per the Specification.

Component: Top Flange

Rating Level	Vehicle	Flexure Type	LL (kip-ft)	Adj. LL (kip-ft)	A1	A2	fDLz (ksi)	fDLl (ksi)	fLLIz (ksi)	fLLl (ksi)	Adj. fLLIz (ksi)	fR (ksi)	Override Phi	Override fR (ksi)	RF	Capacity (Ton)	Note
Operating	1	Pos	3054.4	---	1.00	1.00	-32.76	0.00	-2.17	0.00	---	-47.50	---	---	6.788	254.56	
Operating	1	Pos	0.0	---	1.00	1.00	-32.76	0.00	0.00	0.00	---	-47.50	---	---	99.000	3712.50	

Component: Bot Flange

Rating Level	Vehicle	Flexure Type	LL (kip-ft)	Adj. LL (kip-ft)	A1	A2	fDLz (ksi)	fDLl (ksi)	fLLIz (ksi)	fLLl (ksi)	Adj. fLLIz (ksi)	fR (ksi)	Override Phi	Override fR (ksi)	RF	Capacity (Ton)	Note
Operating	1	Pos	3054.4	---	1.00	1.00	27.51	0.00	9.01	0.00	---	47.50	---	---	2.217	83.14	
Operating	1	Pos	0.0	---	1.00	1.00	27.51	0.00	0.00	0.00	---	47.50	---	---	99.000	3712.50	

Load Combination Legend:

Code	Vehicle
1	04. TRIAXLE - Truck

Long-term Resolution

This issue will be corrected in v7.7.