AASHTOWare BrDR 7.5.1

LRFR Concrete Moment Redistribution Tutorial

Moment Redistribution in Three Span Spread PS Box Beam

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This example illustrates the effects of moment redistribution for Load and Resistance Factor Rating (LRFR) flexure rating of concrete structures (prestressed, post tensioned, and reinforced). The moment redistribution option is available in BrDR 7.5 for the Manual for Bridge Evaluation (MBE) 3rd edition, with 2022 and 2023 specification interim updates.

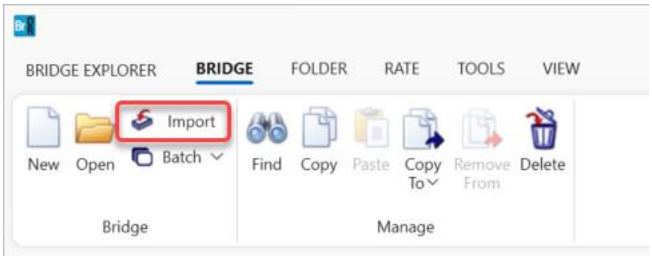
Details, including flowcharts, about moment redistribution in concrete structures can be found in the AASHTO LRFD/LRFR Superstructure Method of Solution Manual accessible from the Help menu in BrDR (search for Concrete Moment Redistribution).

Topics Covered

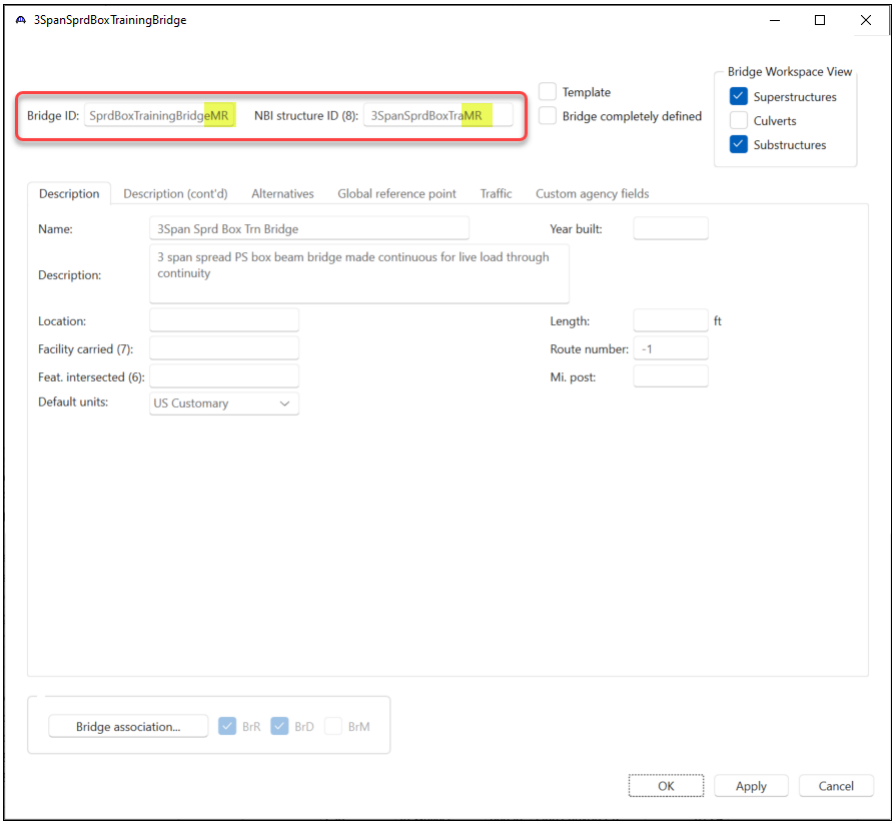
- Bridge Model
- Analysis Settings
- Member Alternative Description – Control options
- LRFR Rating
- Specification Check Detail
- LRFR Rating with Moment Redistribution
- Specification Check Detail with Moment Redistribution
- Moment Redistribution Report

Bridge Model

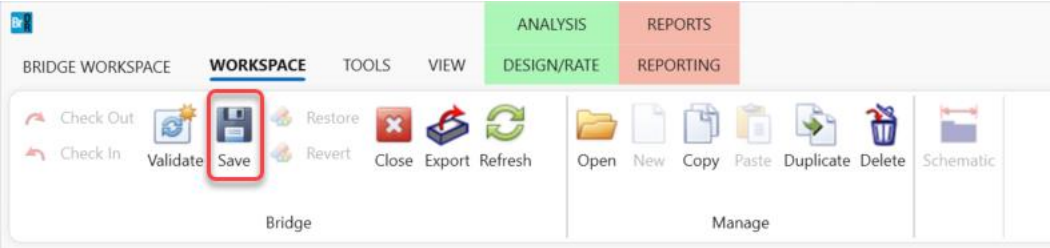
This tutorial uses the bridge created from prestressed concrete structure tutorial PS2 with some minor modifications to satisfy moment redistribution requirements and to illustrate the impact of moment redistribution on rating.
From the **Bridge Explorer** import the bridge given with the PS2 tutorial by selecting the **Import** option as shown below.



If information is displayed about the version of the imported file being different than the current version of the program, confirm by clicking **Yes** to have the imported file migrated to the current version of the program.
In the **Bridge Description** window, which pops up after the bridge is imported, add MR (for Moment Redistribution) to **Bridge ID** and **NBI structure ID** to distinguish this bridge from the PS2 example bridge.

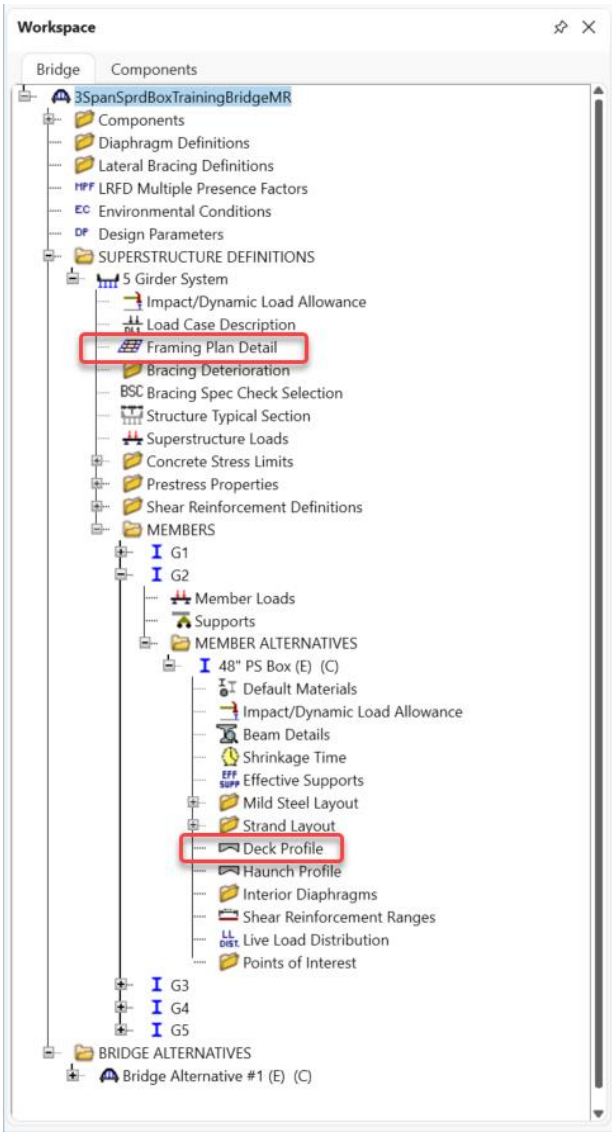


Click **OK** to close the Bridge Description window.

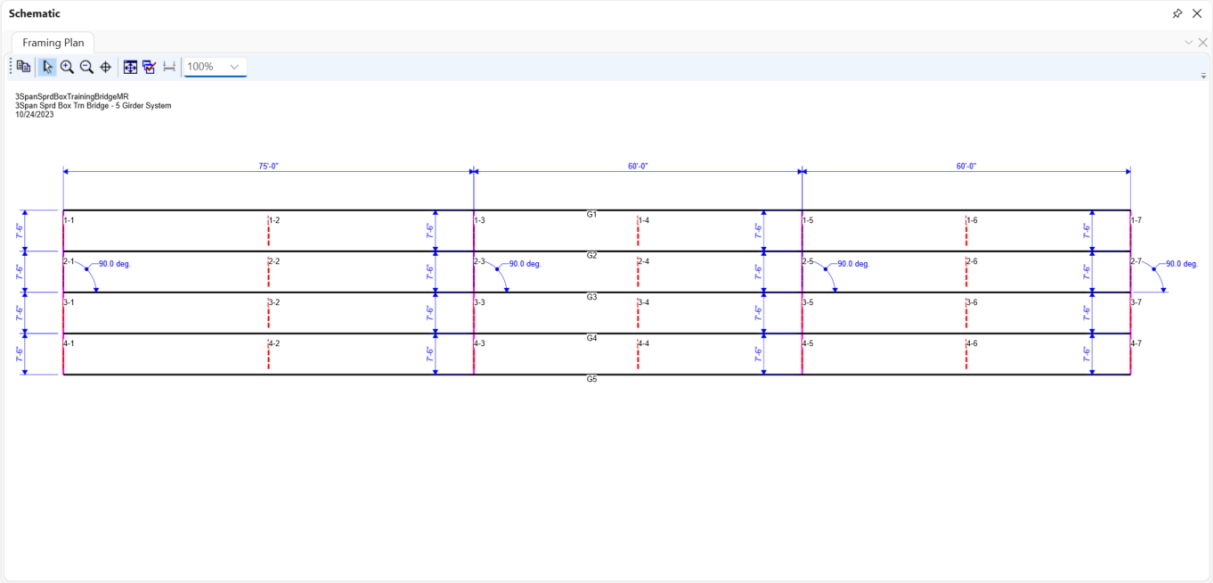


Save the imported bridge to the database using the **Save** button located on the **WORKSPACE** ribbon.

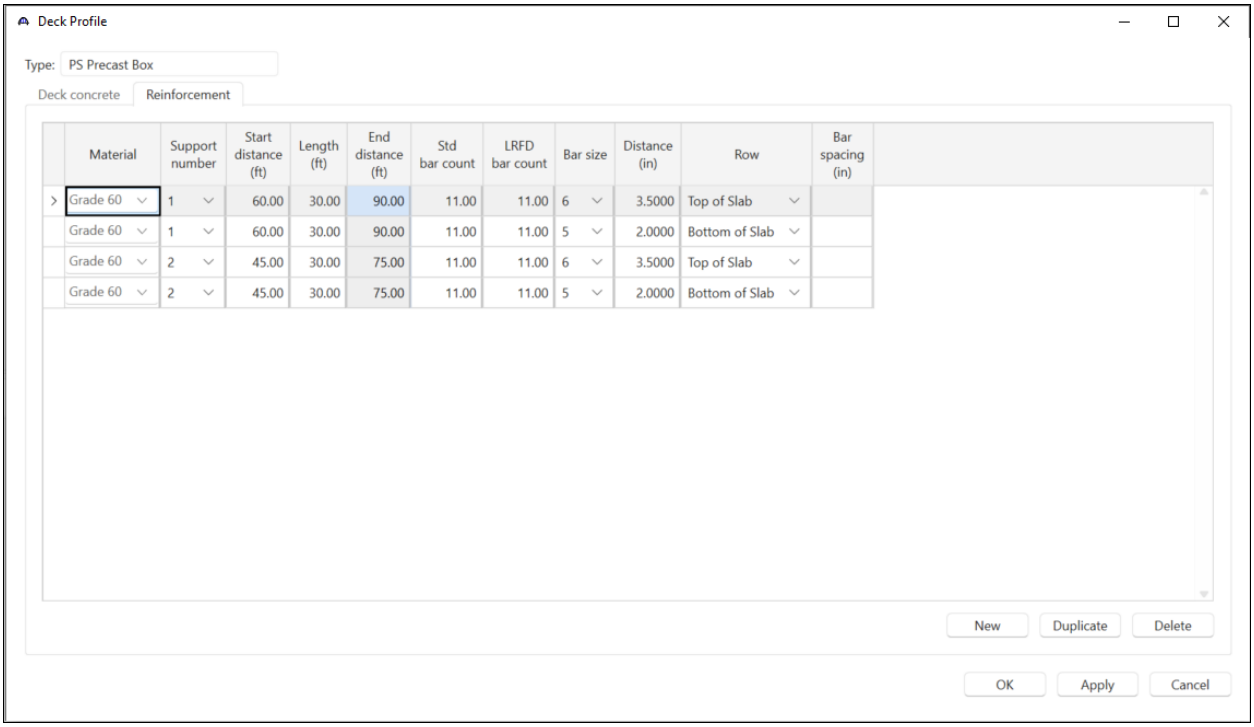
The partially expanded **Bridge Workspace** tree is shown below:



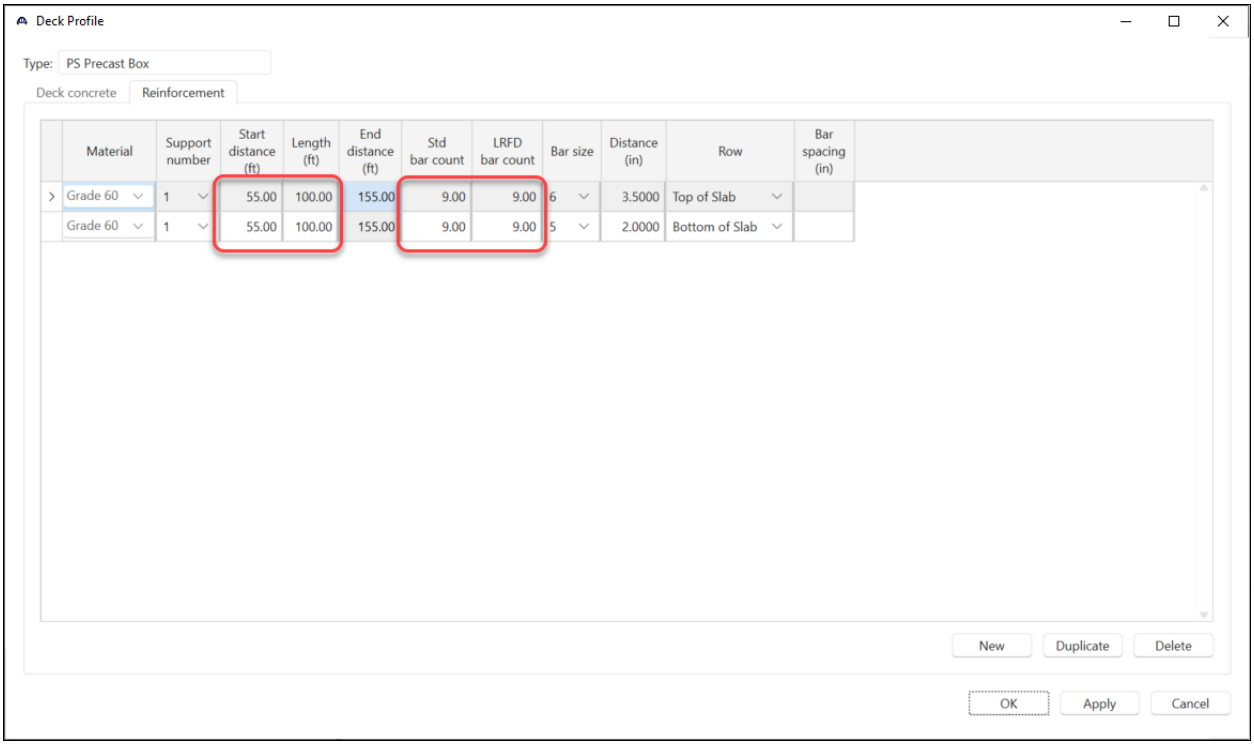
Right-click on the **Framing Plan Detail** and select **Schematic** to display the Framing Plan schematic showing a three span girder system with five girders and span lengths of 75.0, 60.0, and 60.0 ft.



Double-click on the **Deck Profile** tree item of the G2 member alternative – 48" PS Box, to open the **Deck Profile** window and go to the **Reinforcement** tab. The reinforcement data imported from the PS2 example consists of two sets of top and bottom reinforcement that extend 15 ft in each direction over each interior support as shown here:



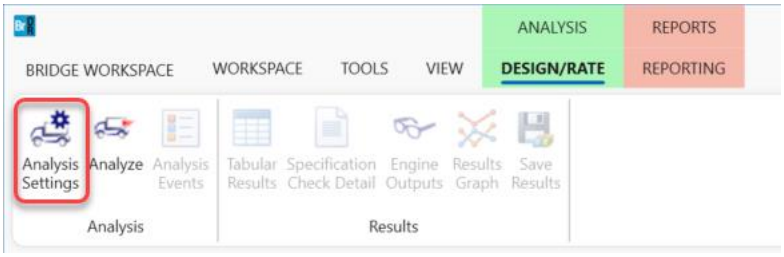
Delete the last two rows and modify start distance, length, and bar counts in the first two rows as shown below:



Deleting the last two rows and changing the start distance and length simplifies the reinforcement layout from two separate sets of top and bottom reinforcement over each internal support to one set of top and bottom reinforcement. The modified reinforcement now starts 20 ft before the first internal support in Span 1 and continues to pass over to Span 2 and then 20 ft after the second internal support into Span 3. This change is required to satisfy the moment redistribution requirements for reinforcement extension and termination which will be discussed later in the tutorial. The purpose of reducing bar counts is to decrease the flexure rating factors over interior supports and to examine whether applying moment redistribution helps to offset the reduction.

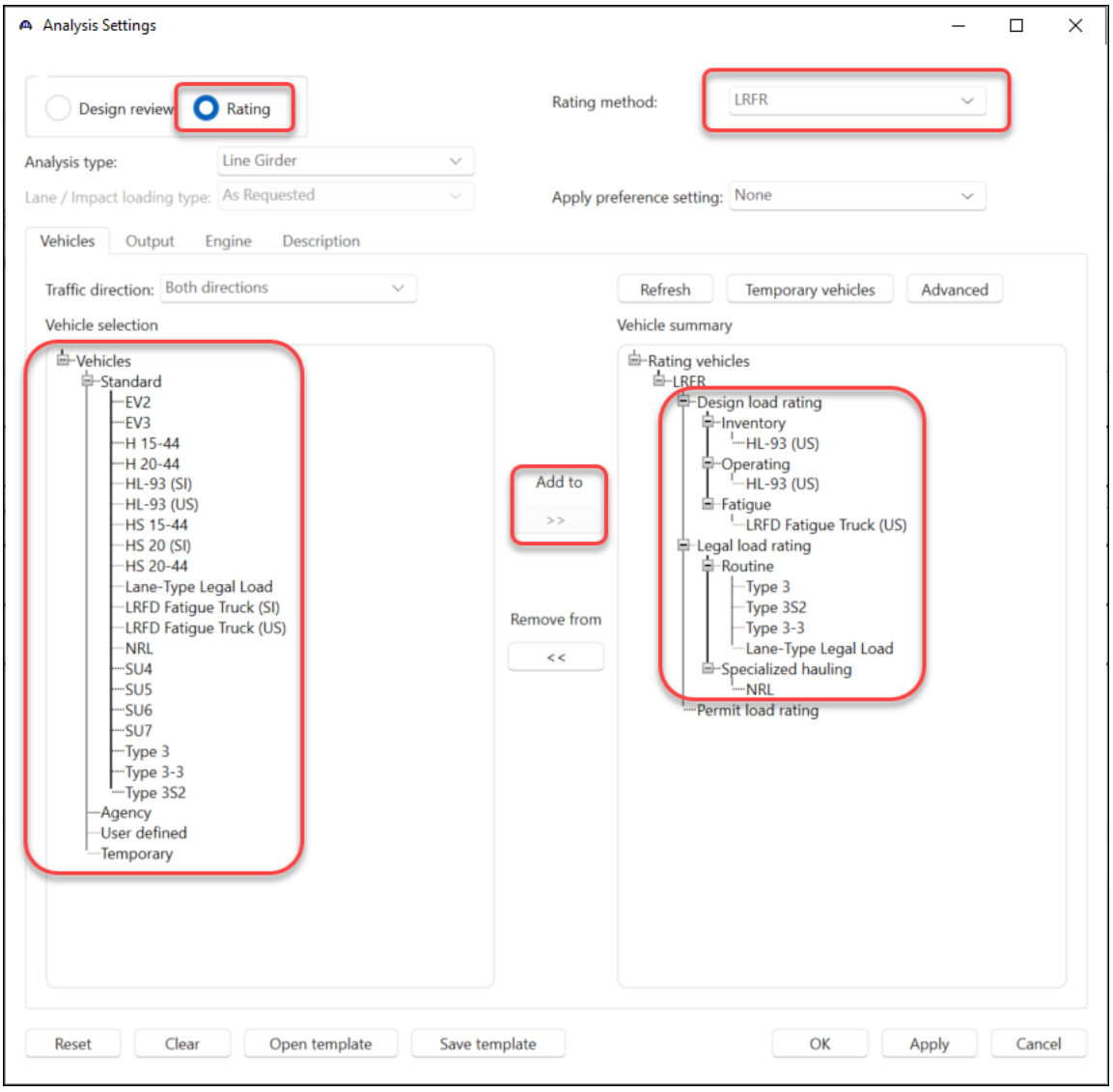
Analysis Settings

To select rating vehicles and rating levels, open the **Analysis Settings** window by clicking the **Analysis Settings** button on the **Analysis** group of the **DESIGN/RATE** ribbon.



In the **Analysis Settings** window, select **Rating** and **LRFR** as the **Rating Method**. Then assign vehicles from the **Vehicle selection** tree on the left to the rating levels under the **Vehicle summary** tree on the right as shown in the screenshot below. The assignment is done in three steps. First clicking on a rating level, next by clicking on a vehicle,

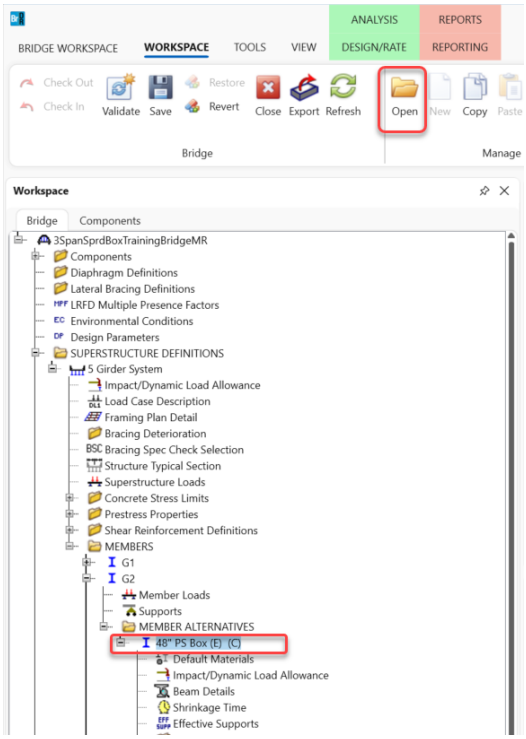
and then by clicking on the **Add to** button. To assign multiple vehicles to the same level, only the last two steps need to be repeated. Also, double-clicking on a vehicle has the same effect as the last two steps.



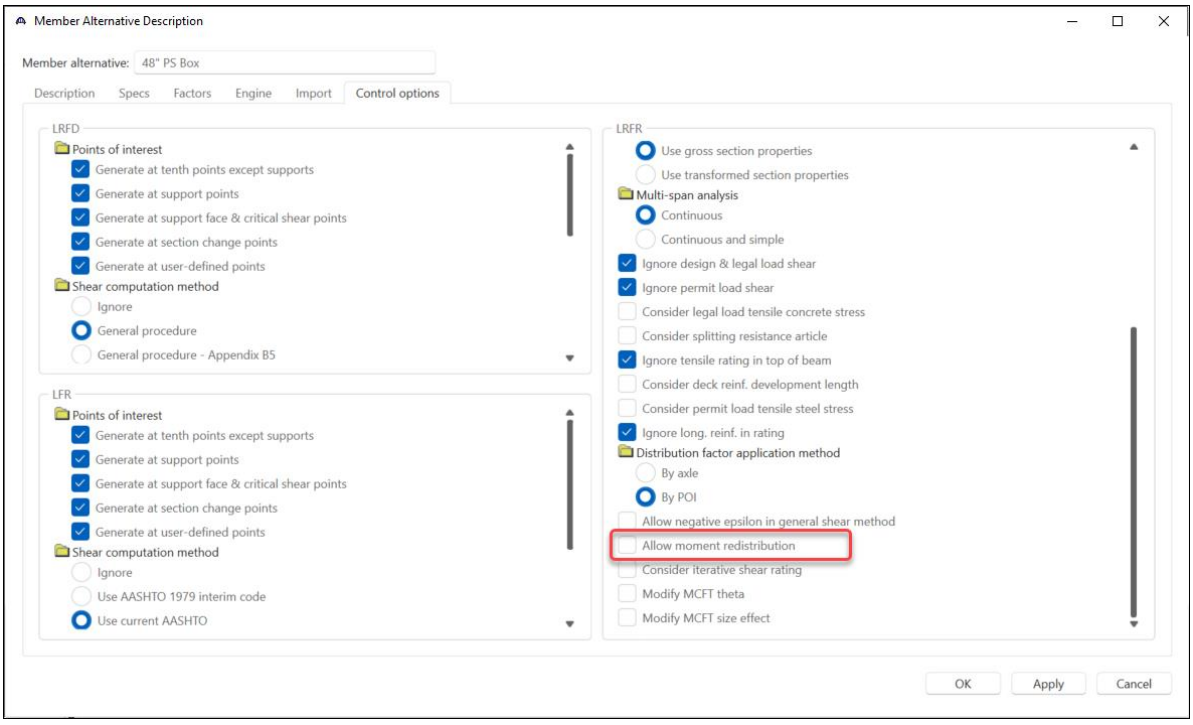
Click **OK** to apply the settings and close the window.

Member Alternative Description – Control options

Navigate to the **48" PS Box Member Alternative** of member **G2**, double click on it (or click the **Open** button from the **WORKSPACE** ribbon) to open its **Member Alternative Description** window.



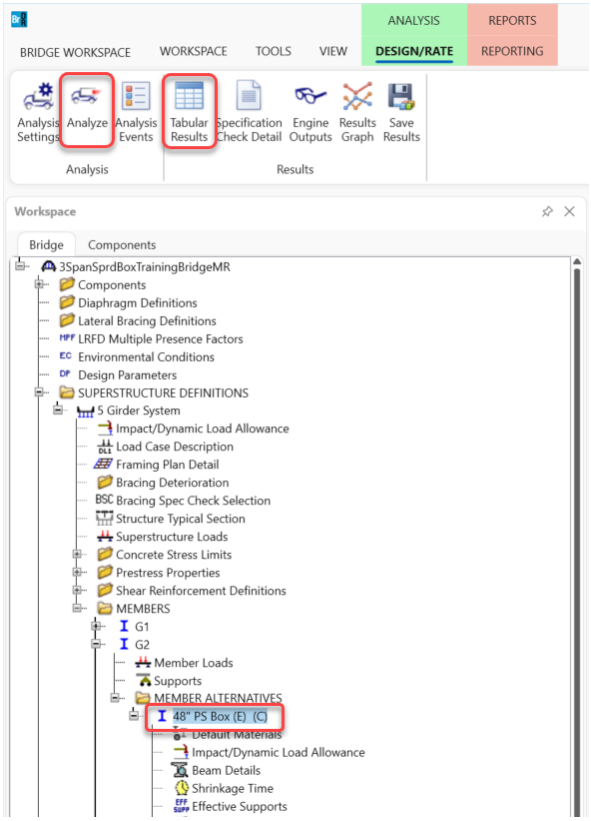
Navigate to the **Control options** tab where the option to allow moment redistribution is located as shown below.



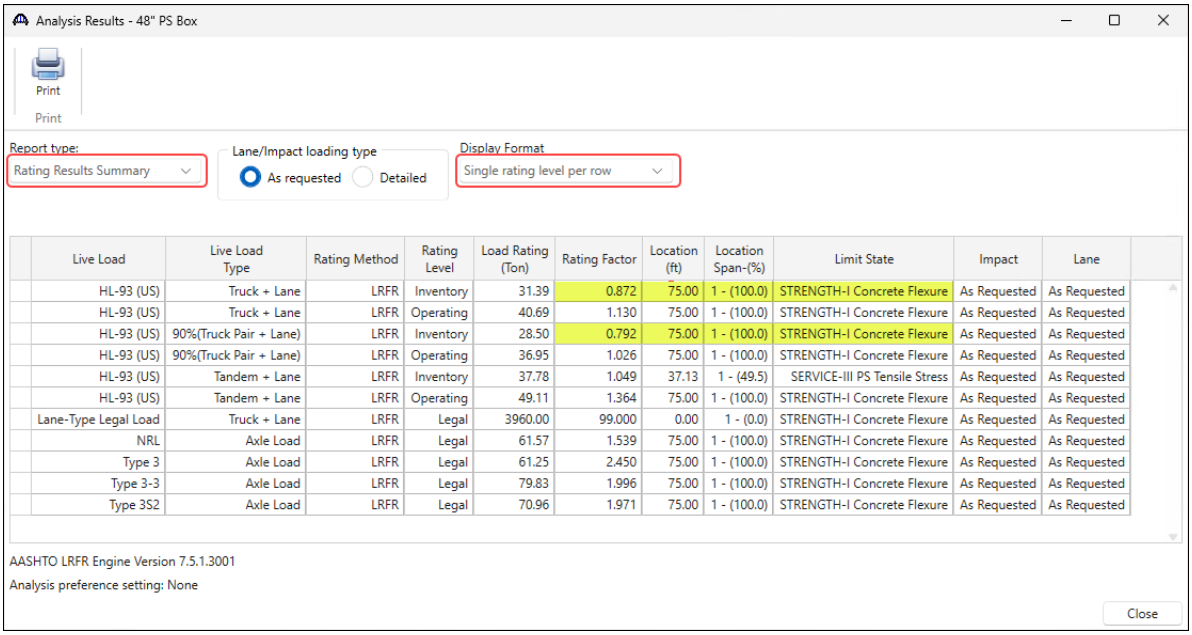
This option will be toggled to compare ratings without and with moment redistribution. The first analysis will be without moment redistribution so make sure the option is unchecked and click the **OK** button to apply the data and close the window.

LRFR Rating

To perform the rating select the **48" PS Box** member alternative in **Bridge Workspace** tree and click the **Analyze** button on the **Analysis** group of the **DESIGN/RATE** ribbon.



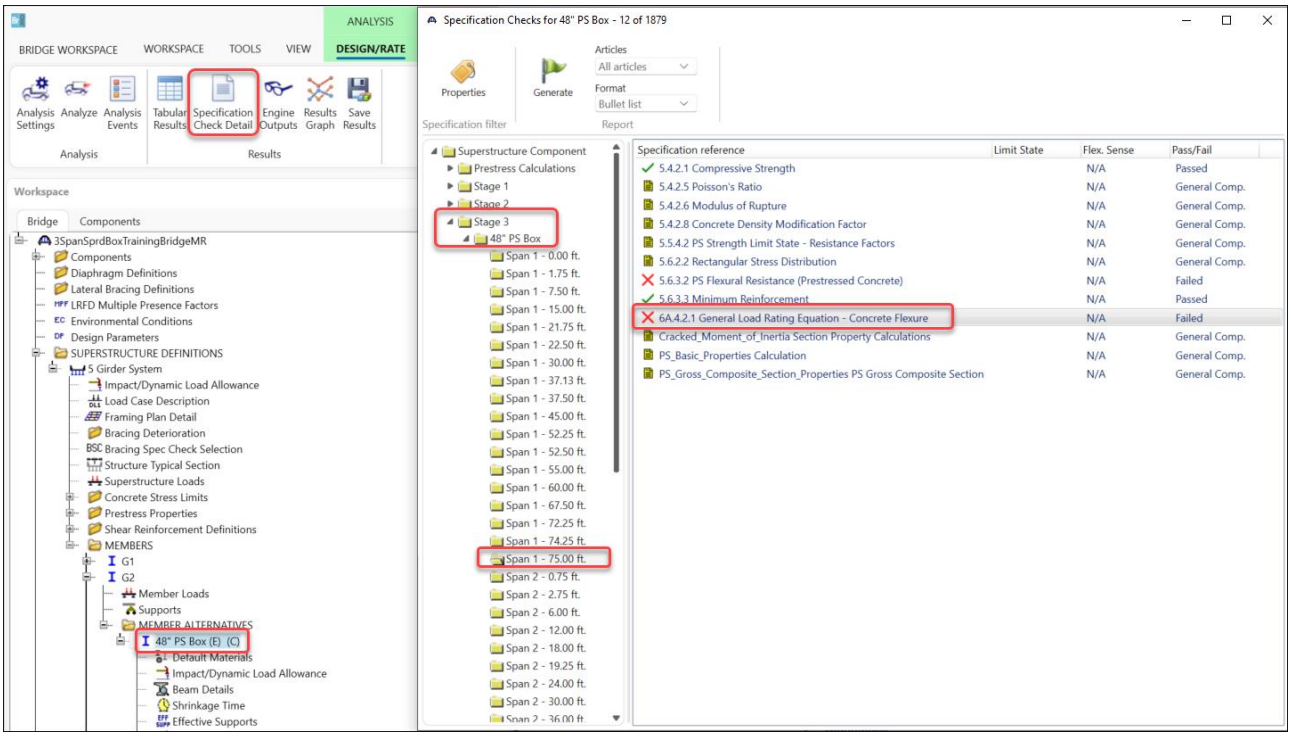
After the analysis is complete, click the **Tabular Results** button to display the ratings. Select **Rating Results Summary** as the **Report Type** and **Single rating level per row** as the **Display Format** option to have the ratings arranged as shown below. Notice there are two ratings less than 1.0 and they both happen due to flexure at the first interior support location at 75.00 ft for the STRENGTH-I limit state.



Live Load	Live Load Type	Rating Method	Rating Level	Load Rating (Ton)	Rating Factor	Location (ft)	Location Span-(%)	Limit State	Impact	Lane
HL-93 (US)	Truck + Lane	LRFR	Inventory	31.39	0.872	75.00	1 - (100.0)	STRENGTH-I Concrete Flexure	As Requested	As Requested
HL-93 (US)	Truck + Lane	LRFR	Operating	40.69	1.130	75.00	1 - (100.0)	STRENGTH-I Concrete Flexure	As Requested	As Requested
HL-93 (US)	90%(Truck Pair + Lane)	LRFR	Inventory	28.50	0.792	75.00	1 - (100.0)	STRENGTH-I Concrete Flexure	As Requested	As Requested
HL-93 (US)	90%(Truck Pair + Lane)	LRFR	Operating	36.95	1.026	75.00	1 - (100.0)	STRENGTH-I Concrete Flexure	As Requested	As Requested
HL-93 (US)	Tandem + Lane	LRFR	Inventory	37.78	1.049	37.13	1 - (49.5)	SERVICE-III PS Tensile Stress	As Requested	As Requested
HL-93 (US)	Tandem + Lane	LRFR	Operating	49.11	1.364	75.00	1 - (100.0)	STRENGTH-I Concrete Flexure	As Requested	As Requested
Lane-Type Legal Load	Truck + Lane	LRFR	Legal	3960.00	99.000	0.00	1 - (0.0)	STRENGTH-I Concrete Flexure	As Requested	As Requested
NRL	Axle Load	LRFR	Legal	61.57	1.539	75.00	1 - (100.0)	STRENGTH-I Concrete Flexure	As Requested	As Requested
Type 3	Axle Load	LRFR	Legal	61.25	2.450	75.00	1 - (100.0)	STRENGTH-I Concrete Flexure	As Requested	As Requested
Type 3-3	Axle Load	LRFR	Legal	79.83	1.996	75.00	1 - (100.0)	STRENGTH-I Concrete Flexure	As Requested	As Requested
Type 3S2	Axle Load	LRFR	Legal	70.96	1.971	75.00	1 - (100.0)	STRENGTH-I Concrete Flexure	As Requested	As Requested

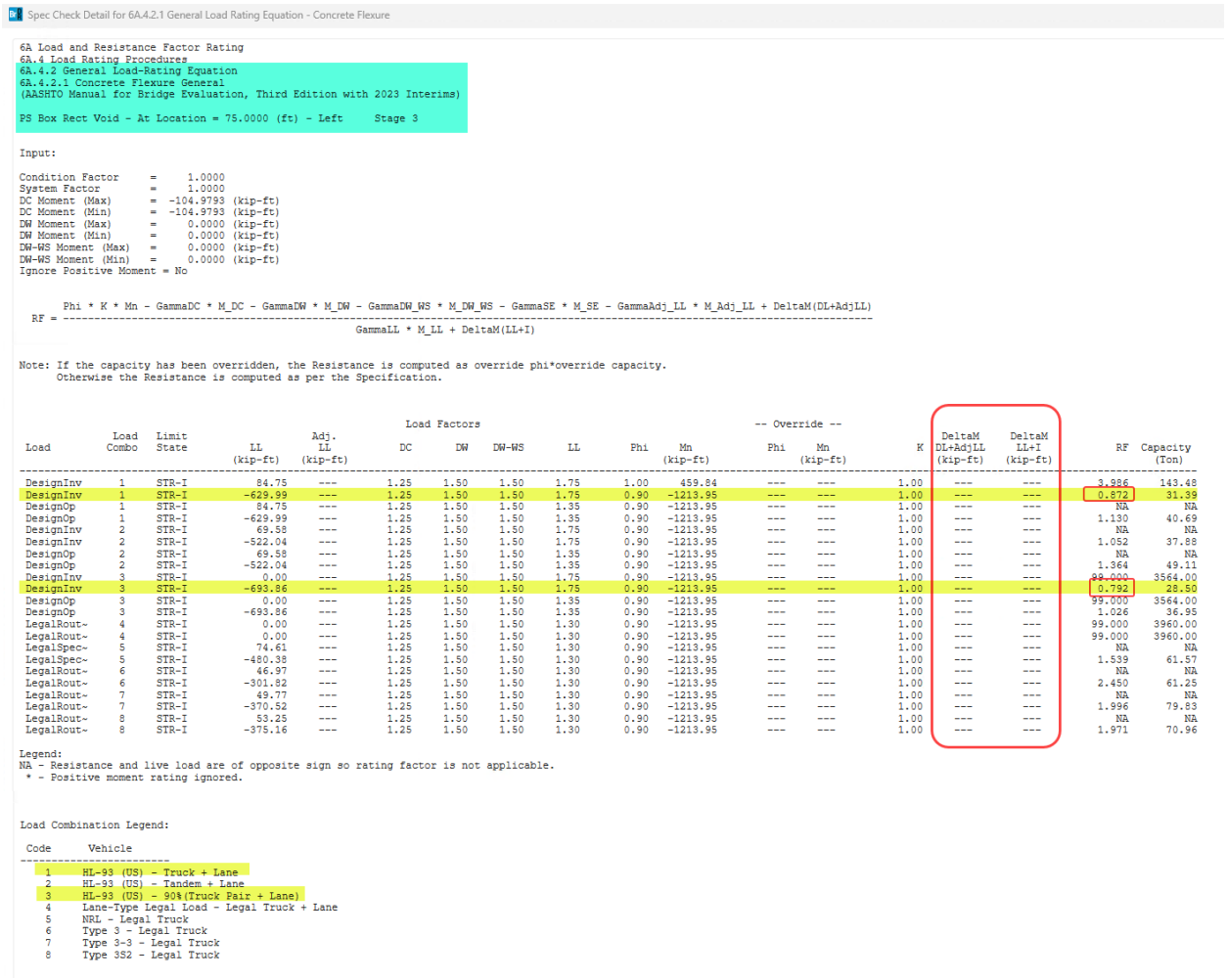
Specification Check Detail

The ratings displayed in the **Rating Results Summary** come from the rating specification articles that are processed during analysis. All specification check articles can be reviewed by clicking the **Specification Check Detail** button on the **Results** group of the **DESIGN/RATE** ribbon which opens the **Specification Check** window as shown below.



To review the flexure ratings at the 75.0 ft location, navigate to the **Stage 3** specification check detail for the analyzed member alternative, select the **Span 1 – 75.00 ft** point of interest, and then double-click on article **6A.4.2.1**

General Load Rating Equation – Concrete Flexure. This opens the **Spec Check Detail** window (see Figure 1) which shows the details of how the ratings were calculated. It is worth noting that since moment redistribution was not considered, the moment increments (DeltaM) for dead plus adjacent vehicle load (DL+AdjLL) and primary vehicle with impact (LL+I) are not available and they do not affect the rating factors (RF).



Spec Check Detail for 6A.4.2.1 General Load Rating Equation - Concrete Flexure

6A Load and Resistance Factor Rating
6A.4 Load Rating Procedures
6A.4.2 General Load-Rating Equation
6A.4.2.1 Concrete Flexure General
(AASHTO Manual for Bridge Evaluation, Third Edition with 2023 Interims)

PS Box Rect Void - At Location = 75.0000 (ft) - Left Stage 3

Input:

Condition Factor = 1.0000
System Factor = 1.0000
DC Moment (Max) = -104.9793 (kip-ft)
DC Moment (Min) = -104.9793 (kip-ft)
DW Moment (Max) = 0.0000 (kip-ft)
DW Moment (Min) = 0.0000 (kip-ft)
DW-WS Moment (Max) = 0.0000 (kip-ft)
DW-WS Moment (Min) = 0.0000 (kip-ft)
Ignore Positive Moment = No

$$RF = \frac{Phi * K * Mn - GammaDC * M\_DC - GammaDW * M\_DW - GammaDW\_WS * M\_DW\_WS - GammaSE * M\_SE - GammaAdj\_LL * M\_Adj\_LL + DeltaM(DL+AdjLL)}{GammaLL * M\_LL + DeltaM(LL+I)}$$

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.

					Load Factors						-- Override --						
Load	Load Combo	Limit State	LL (kip-ft)	Adj. LL (kip-ft)	DC	DW	DW-WS	LL	Phi	Mn (kip-ft)	Phi	Mn (kip-ft)	K	DeltaM DL+AdjLL (kip-ft)	DeltaM LL+I (kip-ft)	RF	Capacity (Ton)
DesignInv	1	STR-I	84.75	---	1.25	1.50	1.50	1.75	1.00	459.84	---	---	1.00	---	---	3.986	143.48
DesignInv	1	STR-I	-629.99	---	1.25	1.50	1.50	1.75	0.90	-1213.95	---	---	1.00	---	---	0.872	31.39
DesignOp	1	STR-I	84.75	---	1.25	1.50	1.50	1.35	0.90	-1213.95	---	---	1.00	---	---	NA	NA
DesignOp	1	STR-I	-629.99	---	1.25	1.50	1.50	1.35	0.90	-1213.95	---	---	1.00	---	---	1.130	40.69
DesignInv	2	STR-I	69.58	---	1.25	1.50	1.50	1.75	0.90	-1213.95	---	---	1.00	---	---	NA	NA
DesignInv	2	STR-I	-522.04	---	1.25	1.50	1.50	1.75	0.90	-1213.95	---	---	1.00	---	---	1.052	37.88
DesignOp	2	STR-I	69.58	---	1.25	1.50	1.50	1.35	0.90	-1213.95	---	---	1.00	---	---	NA	NA
DesignOp	2	STR-I	-522.04	---	1.25	1.50	1.50	1.35	0.90	-1213.95	---	---	1.00	---	---	1.364	49.11
DesignInv	3	STR-I	0.00	---	1.25	1.50	1.50	1.75	0.90	-1213.95	---	---	1.00	---	---	99.000	3564.00
DesignInv	3	STR-I	-693.86	---	1.25	1.50	1.50	1.75	0.90	-1213.95	---	---	1.00	---	---	0.792	28.50
DesignOp	3	STR-I	0.00	---	1.25	1.50	1.50	1.35	0.90	-1213.95	---	---	1.00	---	---	99.000	3564.00
DesignOp	3	STR-I	-693.86	---	1.25	1.50	1.50	1.35	0.90	-1213.95	---	---	1.00	---	---	1.026	36.95
LegalRout~	4	STR-I	0.00	---	1.25	1.50	1.50	1.30	0.90	-1213.95	---	---	1.00	---	---	99.000	3960.00
LegalRout~	4	STR-I	0.00	---	1.25	1.50	1.50	1.30	0.90	-1213.95	---	---	1.00	---	---	99.000	3960.00
LegalSpec~	5	STR-I	74.61	---	1.25	1.50	1.50	1.30	0.90	-1213.95	---	---	1.00	---	---	NA	NA
LegalSpec~	5	STR-I	-480.38	---	1.25	1.50	1.50	1.30	0.90	-1213.95	---	---	1.00	---	---	1.539	61.57
LegalRout~	6	STR-I	46.97	---	1.25	1.50	1.50	1.30	0.90	-1213.95	---	---	1.00	---	---	NA	NA
LegalRout~	6	STR-I	-301.82	---	1.25	1.50	1.50	1.30	0.90	-1213.95	---	---	1.00	---	---	2.450	61.25
LegalRout~	7	STR-I	49.77	---	1.25	1.50	1.50	1.30	0.90	-1213.95	---	---	1.00	---	---	NA	NA
LegalRout~	7	STR-I	-370.52	---	1.25	1.50	1.50	1.30	0.90	-1213.95	---	---	1.00	---	---	1.996	79.83
LegalRout~	8	STR-I	53.25	---	1.25	1.50	1.50	1.30	0.90	-1213.95	---	---	1.00	---	---	NA	NA
LegalRout~	8	STR-I	-375.16	---	1.25	1.50	1.50	1.30	0.90	-1213.95	---	---	1.00	---	---	1.971	70.96

Legend:
NA - Resistance and live load are of opposite sign so rating factor is not applicable.
* - Positive moment rating ignored.

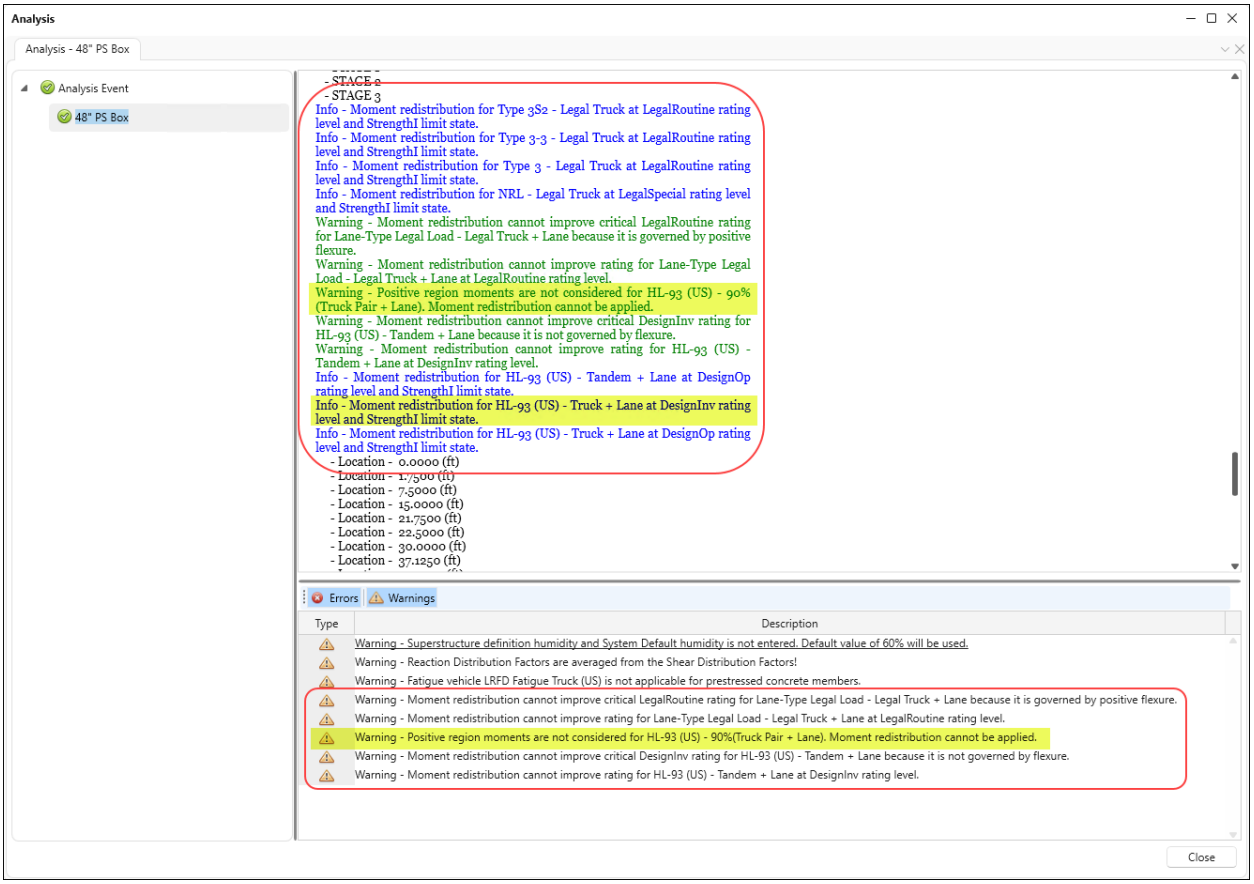
Load Combination Legend:

Code	Vehicle
1	HL-93 (US) - Truck + Lane
2	HL-93 (US) - Tandem + Lane
3	HL-93 (US) - 90%(Truck Pair + Lane)
4	Lane-Type Legal Load - Legal Truck + Lane
5	NRL - Legal Truck
6	Type 3 - Legal Truck
7	Type 3-3 - Legal Truck
8	Type 3S2 - Legal Truck

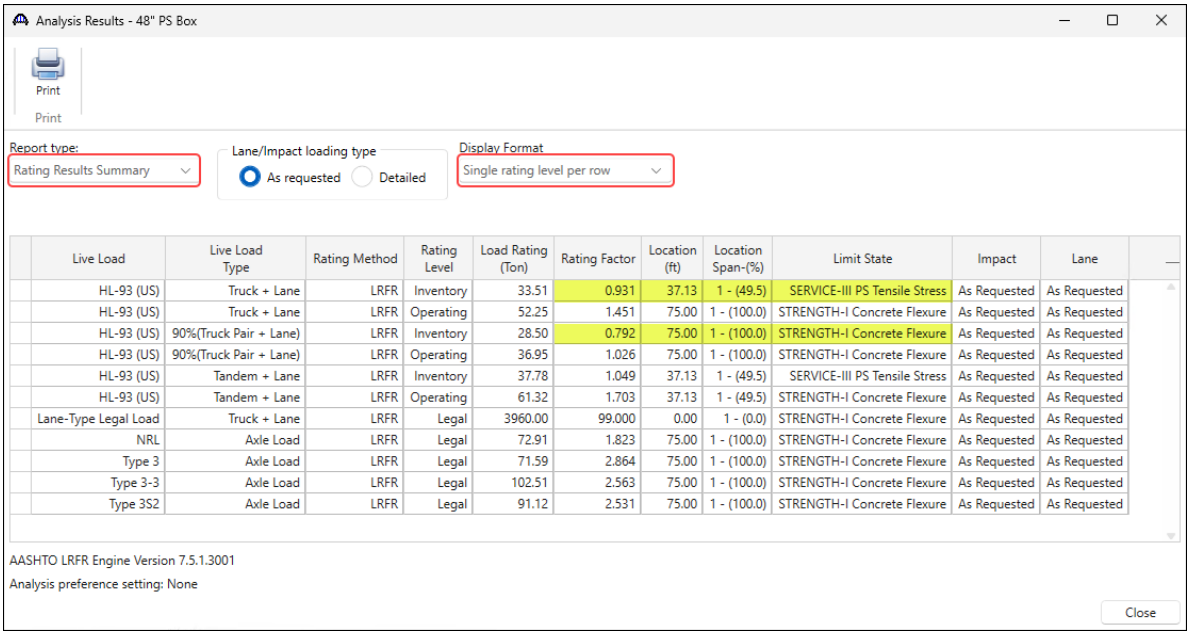
Figure 1 – 6A.4.2.1 Concrete Flexure General

LRFR Rating with Moment Redistribution

Select the control option to allow moment redistribution as shown in Member Alternative Description – Control options and rerun the analysis as shown in LRFR Rating. During analysis with the moment redistribution allowed, the program displays information and warnings about applying moment redistribution to the bending moments for the considered live load types. As shown in the screenshot below, moment redistribution was applied to the HL-93 – Truck + Lane vehicular load and the load rating for this load may improve. For the HL-93 – 90% (Truck Pair + Lane) load, however, moment redistribution could not be applied which means load rating for this load will not improve.



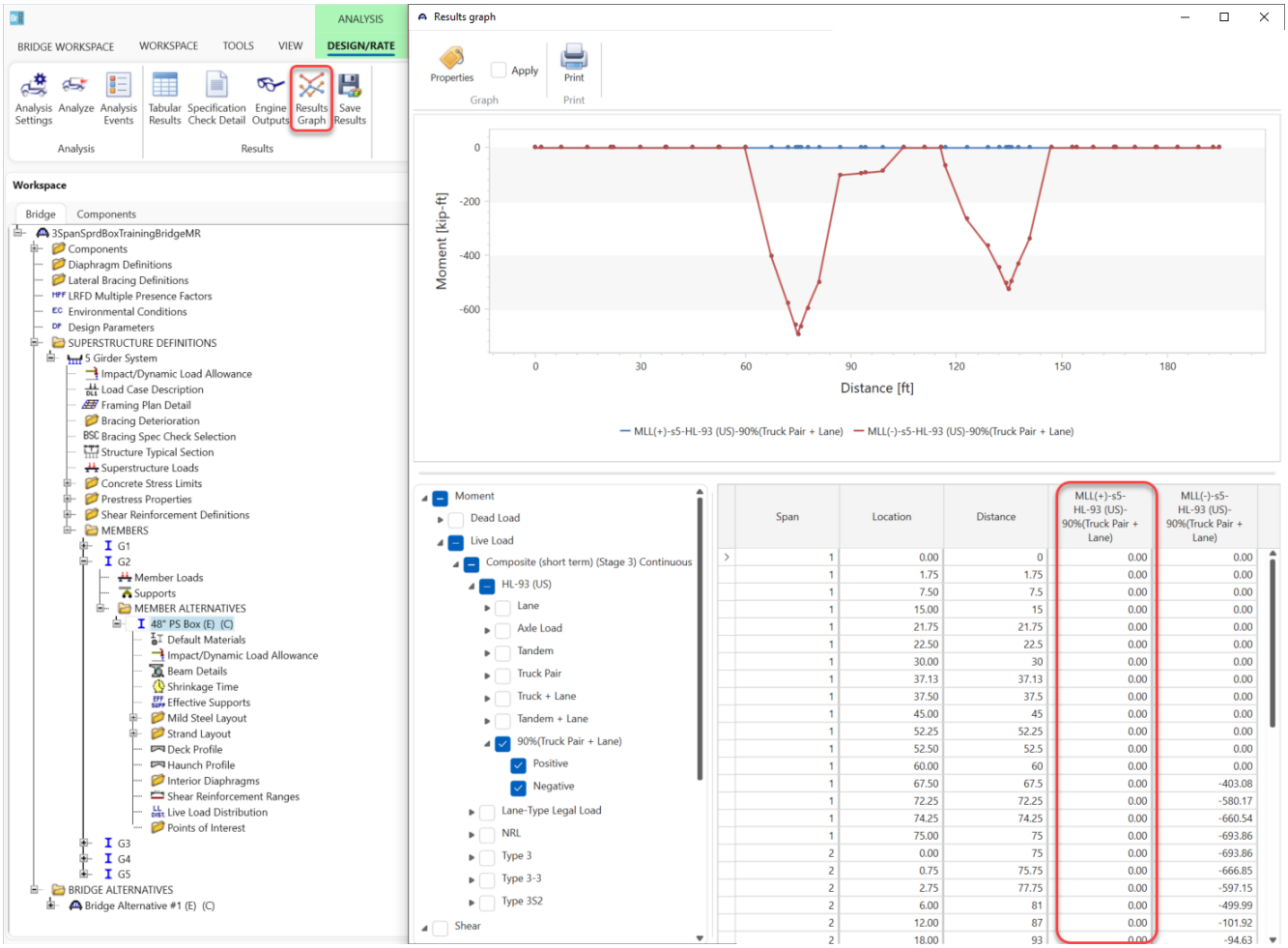
The new **Rating Results Summary** with moment redistribution allowed is as shown below and it can be observed that the critical rating factor for the HL-93 Truck + Lane load at inventory level increased with moment redistribution to 0.913 from 0.872 without moment redistribution. However, the new factor is now at a different location and due to SERVICE-III PS Tensile Stress and not due to STRENGTH-I Concrete Flexure. This means that tensile stress now controls for this load combination and the rating factor due to flexure is even higher which will be verified by reviewing the flexure rating article in Specification Check Detail with Moment Redistribution.



Live Load	Live Load Type	Rating Method	Rating Level	Load Rating (Ton)	Rating Factor	Location (ft)	Location Span-(%)	Limit State	Impact	Lane
HL-93 (US)	Truck + Lane	LRFR	Inventory	33.51	0.931	37.13	1 - (49.5)	SERVICE-III PS Tensile Stress	As Requested	As Requested
HL-93 (US)	Truck + Lane	LRFR	Operating	52.25	1.451	75.00	1 - (100.0)	STRENGTH-I Concrete Flexure	As Requested	As Requested
HL-93 (US)	90%(Truck Pair + Lane)	LRFR	Inventory	28.50	0.792	75.00	1 - (100.0)	STRENGTH-I Concrete Flexure	As Requested	As Requested
HL-93 (US)	90%(Truck Pair + Lane)	LRFR	Operating	36.95	1.026	75.00	1 - (100.0)	STRENGTH-I Concrete Flexure	As Requested	As Requested
HL-93 (US)	Tandem + Lane	LRFR	Inventory	37.78	1.049	37.13	1 - (49.5)	SERVICE-III PS Tensile Stress	As Requested	As Requested
HL-93 (US)	Tandem + Lane	LRFR	Operating	61.32	1.703	37.13	1 - (49.5)	STRENGTH-I Concrete Flexure	As Requested	As Requested
Lane-Type Legal Load	Truck + Lane	LRFR	Legal	3960.00	99.000	0.00	1 - (0.0)	STRENGTH-I Concrete Flexure	As Requested	As Requested
NRL	Axle Load	LRFR	Legal	72.91	1.823	75.00	1 - (100.0)	STRENGTH-I Concrete Flexure	As Requested	As Requested
Type 3	Axle Load	LRFR	Legal	71.59	2.864	75.00	1 - (100.0)	STRENGTH-I Concrete Flexure	As Requested	As Requested
Type 3-3	Axle Load	LRFR	Legal	102.51	2.563	75.00	1 - (100.0)	STRENGTH-I Concrete Flexure	As Requested	As Requested
Type 3S2	Axle Load	LRFR	Legal	91.12	2.531	75.00	1 - (100.0)	STRENGTH-I Concrete Flexure	As Requested	As Requested

For the HL-93 – 90% (Truck Pair + Lane) load at the inventory level, moment redistribution could not be applied, and the rating remained the same at 0.792. This is because moment redistribution reduces negative moments over supports at the expense of increasing positive midspan moments. Since vehicular loads consisting of truck pair and lane load are only considered for negative bending moments, it is not possible to determine the increase of positive midspan moments and moment redistribution cannot be applied.

To confirm that only negative moments are considered for the HL-93 – 90% (Truck Pair + Lane) load, display the bending moment diagram using the **Results Graph** window as shown below.


ANALYSIS
BRIDGE WORKSPACE
WORKSPACE
TOOLS
VIEW
DESIGN/RATE
Analysis Settings
Analyze
Analysis Events
Tabular Results
Specification Check Detail
Engine Outputs
Results Graph
Save Results
Analysis
Results
Workspace
Bridge
Components
3SpanSprdBoxTrainingBridgeMR
Components
Diaphragm Definitions
Lateral Bracing Definitions
LRFD Multiple Presence Factors
Environmental Conditions
Design Parameters
SUPERSTRUCTURE DEFINITIONS
5 Girder System
Impact/Dynamic Load Allowance
Load Case Description
Framing Plan Detail
Bracing Deterioration
Bracing Spec Check Selection
Structure Typical Section
Superstructure Loads
Concrete Stress Limits
Prestress Properties
Shear Reinforcement Definitions
MEMBERS
G1
G2
Member Loads
Supports
MEMBER ALTERNATIVES
48" PS Box (E) (C)
Default Materials
Impact/Dynamic Load Allowance
Beam Details
Shrinkage Time
Effective Supports
Mild Steel Layout
Strand Layout
Deck Profile
Haunch Profile
Interior Diaphragms
Shear Reinforcement Ranges
Live Load Distribution
Points of Interest
G3
G4
G5
BRIDGE ALTERNATIVES
Bridge Alternative #1 (E) (C)
Results graph
Properties
Apply
Print
Graph
Print
Moment [kip-ft]
0
-200
-400
-600
0
30
60
90
120
150
180
Distance [ft]
MLL(+)-s5-HL-93 (US)-90%(Truck Pair + Lane)
MLL(-)-s5-HL-93 (US)-90%(Truck Pair + Lane)
Moment
Dead Load
Live Load
Composite (short term) (Stage 3) Continuous
HL-93 (US)
Lane
Axle Load
Tandem
Truck Pair
Truck + Lane
Tandem + Lane
90%(Truck Pair + Lane)
Positive
Negative
Lane-Type Legal Load
NRL
Type 3
Type 3-3
Type 3S2
Shear
Span
Location
Distance
MLL(+)-s5-HL-93 (US)-90%(Truck Pair + Lane)
MLL(-)-s5-HL-93 (US)-90%(Truck Pair + Lane)
1 0.00 0 0.00 0.00
1 1.75 1.75 0.00 0.00
1 7.50 7.5 0.00 0.00
1 15.00 15 0.00 0.00
1 21.75 21.75 0.00 0.00
1 22.50 22.5 0.00 0.00
1 30.00 30 0.00 0.00
1 37.13 37.13 0.00 0.00
1 37.50 37.5 0.00 0.00
1 45.00 45 0.00 0.00
1 52.25 52.25 0.00 0.00
1 52.50 52.5 0.00 0.00
1 60.00 60 0.00 0.00
1 67.50 67.5 0.00 -403.08
1 72.25 72.25 0.00 -580.17
1 74.25 74.25 0.00 -660.54
1 75.00 75 0.00 -693.86
2 0.00 75 0.00 -693.86
2 0.75 75.75 0.00 -666.85
2 2.75 77.75 0.00 -597.15
2 6.00 81 0.00 -499.99
2 12.00 87 0.00 -101.92
2 18.00 93 0.00 -94.63

Specification Check Detail with Moment Redistribution

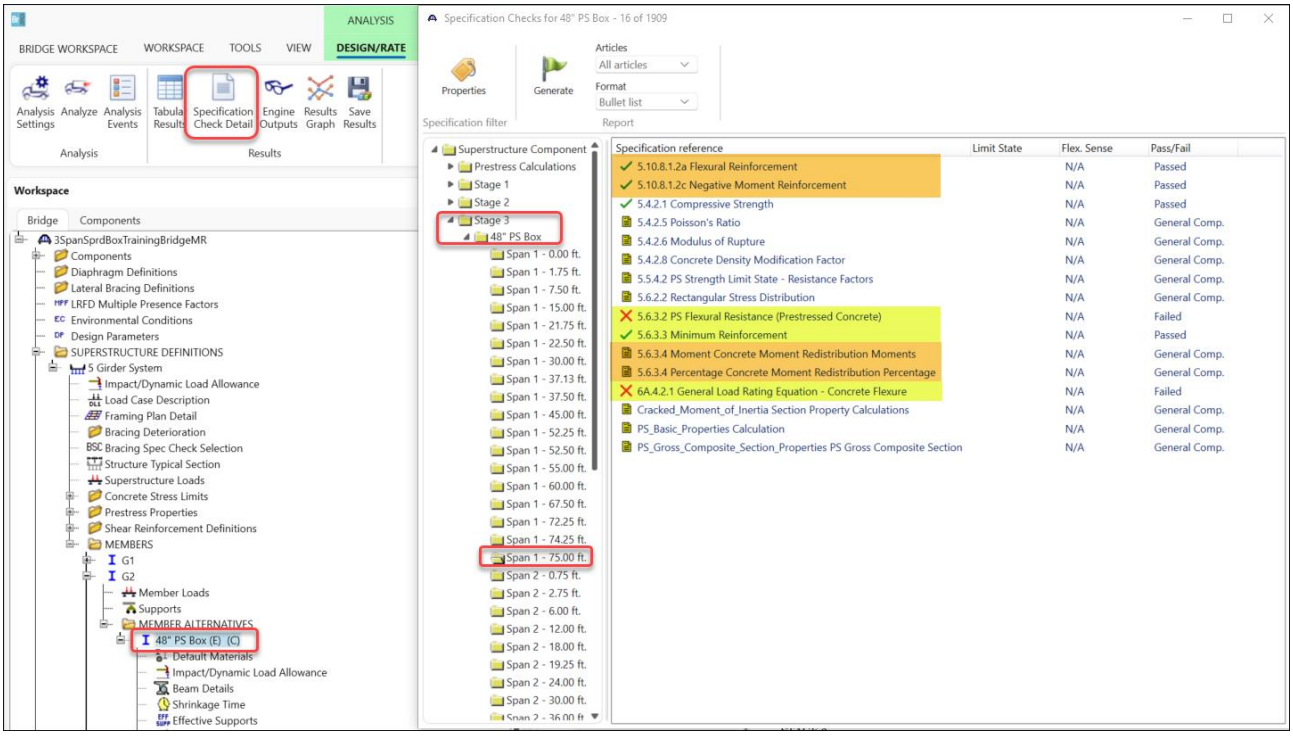
When the control option to allow moment redistribution is selected by the user, the program processes the following additional specification check articles during analysis:

- 5.10.8.1.2a Flexural Reinforcement (in negative moment regions)
- 5.10.8.1.2c Negative Moment Reinforcement (at support locations)
- 5.6.3.4 Moment Redistribution Percentage (at support locations)
- 5.6.3.4 Maximum Allowable Moment Redistribution Moments (at support locations)

As described in AASHTO LRFD/LRFR Superstructure Method of Solution Manual, these articles (highlighted in orange in the screenshot below) check if requirements for applying moment redistribution are satisfied and determine the maximum value of moment redistribution that can occur at support locations. Based on the support values and the redistribution optimization procedure, moment increments (denoted DeltaM) are interpolated at each POI between supports and applied to bending moments in the following specification check articles (highlighted in yellow in the screenshot below):

- 5.6.3.2 Flexural Resistance
- 5.6.3.3 Minimum Reinforcement
- 6A.4.2.1 General Load-Rating Equation – Concrete Flexure

Open each of the highlighted articles and review their contents.



To verify that the flexure load rating factor increased for HL-93 Truck + Lane load at inventory level, open the article titled **6A.4.2.1 General Load-Rating Equation – Concrete Flexure** (see Figure 2). On the second row in

the table, the rating factor is now 1.120 which is an increase of 0.248 (28%) from the initial value of 0.872. This increase is due to the DeltaM moment increments which are the result of moment redistribution.

Since moment redistribution does not apply to the HL-93 – 90% (Truck Pair + Lane) vehicle, the DeltaM values for that vehicle are not calculated and its rating factor at the inventory level stayed the same at 0.792 with and without moment redistribution.

Spec Check Detail for 6A.4.2.1 General Load Rating Equation - Concrete Flexure

6A Load and Resistance Factor Rating
6A.4 Load Rating Procedures
6A.4.2 General Load-Rating Equation
6A.4.2.1 Concrete Flexure General
(AASHTO Manual for Bridge Evaluation, Third Edition with 2023 Interims)

PS Box Rect Void - At Location = 75.0000 (ft) - Left Stage 3

Input:

Condition Factor = 1.0000
System Factor = 1.0000
DC Moment (Max) = -104.9793 (kip-ft)
DC Moment (Min) = -104.9793 (kip-ft)
DW Moment (Max) = 0.0000 (kip-ft)
DW Moment (Min) = 0.0000 (kip-ft)
DW-WS Moment (Max) = 0.0000 (kip-ft)
DW-WS Moment (Min) = 0.0000 (kip-ft)
Ignore Positive Moment = No

$$RF = \frac{Phi * K * Mn - GammaDC * M\_DC - GammaDW * M\_DW - GammaDW\_WS * M\_DW\_WS - GammaSE * M\_SE - GammaAdj\_LL * M\_Adj\_LL + DeltaM(DL+AdjLL)}{GammaLL * M\_LL + DeltaM(LL+I)}$$

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.

			Load Factors							-- Override --						
Load	Load Combo	Limit State	LL (kip-ft)	Adj. LL (kip-ft)	DC	DW	DW-WS	LL	Phi	Mn (kip-ft)	Phi	Mn (kip-ft)	K	DeltaM DL+AdjLL (kip-ft)	DeltaM LL+I (kip-ft)	RF	Capacity (Ton)
DesignInv	1	STR-I	84.75	---	1.25	1.50	1.50	1.75	1.00	459.84	---	---	1.00	26.24	220.50	1.532	55.13
DesignInv	1	STR-I	-629.99	---	1.25	1.50	1.50	1.75	0.90	-1213.95	---	---	1.00	26.24	220.50	1.120	40.31
DesignOp	1	STR-I	84.75	---	1.25	1.50	1.50	1.35	1.00	459.84	---	---	1.00	26.24	170.10	1.985	71.47
DesignOp	1	STR-I	-629.99	---	1.25	1.50	1.50	1.35	0.90	-1213.95	---	---	1.00	26.24	170.10	1.451	52.25
DesignInv	2	STR-I	69.58	---	1.25	1.50	1.50	1.75	0.90	-1213.95	---	---	1.00	---	---	NA	NA
DesignInv	2	STR-I	-522.04	---	1.25	1.50	1.50	1.75	0.90	-1213.95	---	---	1.00	---	---	1.052	37.88
DesignOp	2	STR-I	69.58	---	1.25	1.50	1.50	1.35	1.00	459.84	---	---	1.00	23.58	126.64	2.573	92.62
DesignOp	2	STR-I	-522.04	---	1.25	1.50	1.50	1.35	0.90	-1213.95	---	---	1.00	23.58	126.64	1.704	61.33
DesignInv	3	STR-I	0.00	---	1.25	1.50	1.50	1.75	0.90	-1213.95	---	---	1.00	---	---	99.000	3564.00
DesignInv	3	STR-I	-693.86	---	1.25	1.50	1.50	1.75	0.90	-1213.95	---	---	1.00	---	---	0.792	28.50
DesignOp	3	STR-I	0.00	---	1.25	1.50	1.50	1.35	0.90	-1213.95	---	---	1.00	---	---	99.000	3564.00
DesignOp	3	STR-I	-693.86	---	1.25	1.50	1.50	1.35	0.90	-1213.95	---	---	1.00	---	---	1.026	36.95
LegalRout~	4	STR-I	0.00	---	1.25	1.50	1.50	1.30	0.90	-1213.95	---	---	1.00	---	---	99.000	3960.00
LegalRout~	4	STR-I	0.00	---	1.25	1.50	1.50	1.30	0.90	-1213.95	---	---	1.00	---	---	99.000	3960.00
LegalSpec~	5	STR-I	74.61	---	1.25	1.50	1.50	1.30	1.00	459.84	---	---	1.00	18.30	87.09	3.112	124.46
LegalSpec~	5	STR-I	-480.38	---	1.25	1.50	1.50	1.30	0.90	-1213.95	---	---	1.00	18.30	87.09	1.823	72.91
LegalRout~	6	STR-I	46.97	---	1.25	1.50	1.50	1.30	0.90	-1213.95	---	---	1.00	16.97	50.73	NA	NA
LegalRout~	6	STR-I	-301.82	---	1.25	1.50	1.50	1.30	0.90	-1213.95	---	---	1.00	16.97	50.73	2.864	71.59
LegalRout~	7	STR-I	49.77	---	1.25	1.50	1.50	1.30	1.00	459.84	---	---	1.00	26.24	96.34	3.507	140.29
LegalRout~	7	STR-I	-370.52	---	1.25	1.50	1.50	1.30	0.90	-1213.95	---	---	1.00	26.24	96.34	2.563	102.51
LegalRout~	8	STR-I	53.25	---	1.25	1.50	1.50	1.30	1.00	459.84	---	---	1.00	26.24	97.54	3.387	121.93
LegalRout~	8	STR-I	-375.16	---	1.25	1.50	1.50	1.30	0.90	-1213.95	---	---	1.00	26.24	97.54	2.531	91.12

Legend:
NA - Resistance and live load are of opposite sign so rating factor is not applicable.
* - Positive moment rating ignored.

Load Combination Legend:

Code	Vehicle
1	HL-93 (US) - Truck + Lane
2	HL-93 (US) - Tandem + Lane
3	HL-93 (US) - 90%(Truck Pair + Lane)
4	Lane-Type Legal Load - Legal Truck + Lane
5	NRL - Legal Truck
6	Type 3 - Legal Truck
7	Type 3-3 - Legal Truck
8	Type 3S2 - Legal Truck

Figure 2 – 6A.4.2.1 General Load-Rating Equation – Concrete Flexure

The flexural resistance article (see Figure 3) is also affected by moment redistribution through moment increments DeltaMu. For HL-93 Truck + Lane load at inventory level, the Mr/Mu ratio with moment redistribution is equal to:

$$\frac{M_r}{M_u} = \frac{-1092.55}{-1233.71 + 246.74} = 1.107$$

which is an increase from the ratio without moment redistribution that is equal to:

$$\frac{M_r}{M_u} = \frac{-1092.55}{-1233.71} = 0.886$$

In negative moment regions, moment redistribution can potentially increase flexure rating factor and design ratios, but it is worth remembering that in positive moment regions the rating factors and design ratios may decrease due to moment redistribution as the moment increments DeltaM will increase the positive moments.

The design ratios for the HL-93 – 90% (Truck Pair + Lane) vehicle are unchanged as moment redistribution does not apply to this vehicle and DeltaMu increments are not calculated.

The increments are also not calculated for any load combination under the SER-III limit state because moment redistribution applies only to the strength limit states.

Spec Check Detail for 5.6.3.2 PS Flexural Resistance (Prestressed Concrete)

```
5.6 Design for Flexural and Axial Effects - B Regions
5.6.3 Flexural Members
5.6.3.2 Flexural Resistance
(AASHTO LRFD Bridge Design Specifications, Ninth Edition)

PS Box Rect Void - At Location = 75.0000 (ft) - Left     Stage 3

                    Cross Section Properties
------------------------------------------------------------------
Name: BII-48
Girder f'c = 6.00(ksi)     Girder f'ci = 5.10(ksi)
Slab f'c   = 4.00(ksi)

Effective Slab Width       =     90.00(in)
Effective Slab Thickness   =      7.50(in)
Haunch Width               =     47.25(in)
Haunch Thickness           =      0.50(in)
Beam Height                =     33.00(in)

Total Aps  =   0.00(in^2)
Total CGS  =   0.00(in)

Eff Aps    =   0.00(in^2)
Eff CGS    =   0.00(in)


Flexural Reinforcement
----------------------
   As     Dist. From
            Bottom
 (in^2)      (in)
  1.86       3.00
  3.96      37.50
  2.79      35.50

Allow Moment Redistribution Control Option: Yes
Moment Redistribution Qualified: Yes, redistribution did occur.

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.
```

Limit State	Load Combination	Mu kip-ft	DeltaMu kip-ft	Phi	Mn kip-ft	-- Override -- Phi	Mn kip-ft	Mr= Phi * Mn kip-ft	Mr/Mu	NA Depth in	Ac in^2	Max Conc Stress ksi	Max Rebar Stress ksi	Tensi Capac ki
STR-I	1, DesInv	17.08	246.74	1.000	459.84	---	---	459.84	1.743	2.15	423.00	0.00	60.00	
STR-I	1, DesInv	-1233.71	246.74	0.900	-1213.95	---	---	-1092.55	1.107	2.42	902.44	0.00	60.00	
STR-I	1, DesOp	-16.82	196.34	1.000	459.84	---	---	459.84	2.561	2.15	423.00	0.00	60.00	
STR-I	1, DesOp	-981.72	196.34	0.900	-1213.95	---	---	-1092.55	1.391	2.42	902.44	0.00	60.00	
STR-I	2, DesInv	-9.46	---	0.900	-1213.95	---	---	-1092.55	99.000	2.42	902.44	0.00	60.00	
STR-I	2, DesInv	-1044.80	---	0.900	-1213.95	---	---	-1092.55	1.046	2.42	902.44	0.00	60.00	
STR-I	2, DesOp	-37.29	150.22	1.000	459.84	---	---	459.84	4.072	2.15	423.00	0.00	60.00	
STR-I	2, DesOp	-835.98	150.22	0.900	-1213.95	---	---	-1092.55	1.593	2.42	902.44	0.00	60.00	
STR-I	3, DesInv	-131.22	---	0.900	-1213.95	---	---	-1092.55	8.326	2.42	902.44	0.00	60.00	
STR-I	3, DesInv	-1345.48	---	0.900	-1213.95	---	---	-1092.55	0.812	2.42	902.44	0.00	60.00	
STR-I	3, DesOp	-131.22	---	0.900	-1213.95	---	---	-1092.55	8.326	2.42	902.44	0.00	60.00	
STR-I	3, DesOp	-1067.94	---	0.900	-1213.95	---	---	-1092.55	1.023	2.42	902.44	0.00	60.00	
STR-I	4, LegalRout	-131.22	---	0.900	-1213.95	---	---	-1092.55	8.326	2.42	902.44	0.00	60.00	
STR-I	4, LegalRout	-131.22	---	0.900	-1213.95	---	---	-1092.55	8.326	2.42	902.44	0.00	60.00	
STR-I	5, LegalSpec	-34.24	105.39	1.000	459.84	---	---	459.84	6.463	2.15	423.00	0.00	60.00	
STR-I	5, LegalSpec	-755.72	105.39	0.900	-1213.95	---	---	-1092.55	1.680	2.42	902.44	0.00	60.00	
STR-I	6, LegalRout	-70.16	67.70	0.900	-1213.95	---	---	-1092.55	99.000	2.42	902.44	0.00	60.00	
STR-I	6, LegalRout	-523.59	67.70	0.900	-1213.95	---	---	-1092.55	2.397	2.42	902.44	0.00	60.00	
STR-I	7, LegalRout	-66.52	122.58	1.000	459.84	---	---	459.84	8.202	2.15	423.00	0.00	60.00	
STR-I	7, LegalRout	-612.90	122.58	0.900	-1213.95	---	---	-1092.55	2.228	2.42	902.44	0.00	60.00	
STR-I	8, LegalRout	-62.00	123.79	1.000	459.84	---	---	459.84	7.442	2.15	423.00	0.00	60.00	
STR-I	8, LegalRout	-618.93	123.79	0.900	-1213.95	---	---	-1092.55	2.207	2.42	902.44	0.00	60.00	
SER-III	1, DesInv	-37.18	---	0.900	-1213.95	---	---	-1092.55	29.383	2.42	902.44	0.00	60.00	

```
Load Combination Legend:

 Code      Vehicle
-------------------------
    1      HL-93 (US) - Truck + Lane
    2      HL-93 (US) - Tandem + Lane
    3      HL-93 (US) - 90%(Truck Pair + Lane)
    4      Lane-Type Legal Load - Legal Truck + Lane
    5      NRL - Legal Truck
    6      Type 3 - Legal Truck
    7      Type 3-3 - Legal Truck
    8      Type 3S2 - Legal Truck
```

Figure 3 – 5.6.3.2 Flexural Resistance

One more specification check article affected by moment redistribution is the minimum reinforcement article (see Figure 4). When moment redistribution is applied to Mu through the DeltaMu increment, the Mr/MrMin ratio may change if MrMin is governed by Mr2 which in turn is equal to 1.33 Mu.

Spec Check Detail for 5.6.3.3 Minimum Reinforcement

```
5 Concrete Structures
5.6 Design for Flexural and Axial Effects - B Regions
5.6.3 Flexural Members
5.6.3.3 Minimum Reinforcement
(AASHTO LRFD Bridge Design Specifications, Ninth Edition)

PS Box Rect Void - At Location = 75.0000 (ft) - Left     Stage 3

Cross Section Properties for Prestress box beam with Rectangular void
------------------------------------------------------------
Name: BII-48   Girder f'c = 6.00(ksi)     Girder f'ci = 5.10(ksi)

Beam Height             =   33.00(in)     Side Wall Thickness      =    5.00(in)
Top Slab Width          =   47.25(in)
Top Slab Thick          =    5.50(in)
Bottom Slab Width       =   48.00(in)
Bottom Slab Thick       =    5.50(in)
Shear Key Top           =    6.00(in)
Shear Key Height        =    6.00(in)
Shear Key Depth         =    0.75(in)
B1                      =    3.00(in)
B2                      =    3.00(in)
B3                      =    3.00(in)
B4                      =    3.00(in)

Slab f'c                =      4.00(ksi)
Effective Slab Width    =     90.00(in)        Haunch Width             =     47.25(in)
Effective Slab Thickness =     7.50(in)        Haunch Thickness         =      0.50(in)


Flexural Reinforcement
----------------------
   As     Dist. From
          Bottom
 (in^2)      (in)
  1.86       3.00
  3.96      37.50
  2.79      35.50


Cross section is located in the region over the pier between the simple span bearings.
Section will be analyzed as a reinforced concrete section.

Input:
fr beam =        0.59 (ksi)             fr deck =        0.48 (ksi)
Inertia =   253622.51 (in^4)            STop    =  -19754.87 (in^3)
yBot    =       25.29 (in)              SBot    =   10027.05 (in^3)

Gamma3 = Fy/Fu.

Gamma1 =  1.60
Gamma2 =  1.10
Gamma3 =  0.67

Mcr = Gamma3 * [( gamma1*fr + Gamma2*fcpe)*Sc - Mdnc * (Sc/Snc - 1)]      (5.6.3.3-1)

(Note:  For reinforced concrete members Sc = Snc)


Mr1 = Mcr           Article 5.6.3.3
Mr2 = 1.33 * Mu     Article 5.6.3.3

MrMin = Min(Mr1, Mr2)     Article 5.6.3.3


Allow Moment Redistribution Control Option: Yes
Moment Redistribution Qualified: Yes, redistribution did occur.

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.
```

Limit State	Load Comb	Mu (kip-ft)	DeltaMu (kip-ft)	Sc (in^3)	Mcr (kip-ft)	Mr1 (kip-ft)	Mr2 (kip-ft)	MrMin (kip-ft)	--- Override --- Phi	Mnr (kip-ft)	Mr (kip-ft)	DR = Mr/MrMin	
STR-I	1, DesInv	17.08	246.74	10027.05	523.97	523.97	350.88	350.88	---	---	459.84	1.311	Pass
STR-I	1, DesInv	-1233.71	246.74	-19754.87	-842.87	-842.87	-1312.67	-842.87	---	---	-1092.55	1.296	Pass
STR-I	1, DesOp	-16.82	196.34	10027.05	523.97	523.97	238.77	238.77	---	---	459.84	1.926	Pass
STR-I	1, DesOp	-981.72	196.34	-19754.87	-842.87	-842.87	-1044.54	-842.87	---	---	-1092.55	1.296	Pass
STR-I	2, DesInv	-9.46	---	-19754.87	-842.87	-842.87	-12.58	-12.58	---	---	-1092.55	86.856	Pass
STR-I	2, DesInv	-1044.80	---	-19754.87	-842.87	-842.87	-1389.59	-842.87	---	---	-1092.55	1.296	Pass
STR-I	2, DesOp	-37.29	150.22	10027.05	523.97	523.97	150.19	150.19	---	---	459.84	3.062	Pass
STR-I	2, DesOp	-835.98	150.22	-19754.87	-842.87	-842.87	-912.07	-842.87	---	---	-1092.55	1.296	Pass
STR-I	3, DesInv	-131.22	---	-19754.87	-842.87	-842.87	-174.53	-174.53	---	---	-1092.55	6.260	Pass
STR-I	3, DesInv	-1345.48	---	-19754.87	-842.87	-842.87	-1789.49	-842.87	---	---	-1092.55	1.296	Pass
STR-I	3, DesOp	-131.22	---	-19754.87	-842.87	-842.87	-174.53	-174.53	---	---	-1092.55	6.260	Pass
STR-I	3, DesOp	-1067.94	---	-19754.87	-842.87	-842.87	-1420.36	-842.87	---	---	-1092.55	1.296	Pass
STR-I	4, LegalRout	-131.22	---	-19754.87	-842.87	-842.87	-174.53	-174.53	---	---	-1092.55	6.260	Pass
STR-I	4, LegalRout	-131.22	---	-19754.87	-842.87	-842.87	-174.53	-174.53	---	---	-1092.55	6.260	Pass
STR-I	5, LegalSpec	-34.24	105.39	10027.05	523.97	523.97	94.63	94.63	---	---	459.84	4.859	Pass
STR-I	5, LegalSpec	-755.72	105.39	-19754.87	-842.87	-842.87	-864.95	-842.87	---	---	-1092.55	1.296	Pass
STR-I	6, LegalRout	-70.16	67.70	-19754.87	-842.87	-842.87	-3.28	-3.28	---	---	-1092.55	333.283	Pass
STR-I	6, LegalRout	-523.59	67.70	-19754.87	-842.87	-842.87	-606.34	-606.34	---	---	-1092.55	1.802	Pass
STR-I	7, LegalRout	-66.52	122.58	10027.05	523.97	523.97	74.56	74.56	---	---	459.84	6.167	Pass
STR-I	7, LegalRout	-612.90	122.58	-19754.87	-842.87	-842.87	-652.13	-652.13	---	---	-1092.55	1.675	Pass
STR-I	8, LegalRout	-62.00	123.79	10027.05	523.97	523.97	82.18	82.18	---	---	459.84	5.596	Pass
STR-I	8, LegalRout	-618.93	123.79	-19754.87	-842.87	-842.87	-658.55	-658.55	---	---	-1092.55	1.659	Pass
SER-III	1, DesInv	-37.18	---	-19754.87	-842.87	-842.87	-49.45	-49.45	---	---	-1092.55	22.093	Pass
SER-III	1, DesInv	-608.97	---	-19754.87	-842.87	-842.87	-809.94	-809.94	---	---	-1092.55	1.349	Pass
SER-III	2, DesInv	-49.31	---	-19754.87	-842.87	-842.87	-65.59	-65.59	---	---	-1092.55	16.658	Pass
SER-III	2, DesInv	-522.61	---	-19754.87	-842.87	-842.87	-695.08	-695.08	---	---	-1092.55	1.572	Pass
SER-III	3, DesInv	-104.98	---	-19754.87	-842.87	-842.87	-139.62	-139.62	---	---	-1092.55	7.825	Pass
SER-III	3, DesInv	-660.07	---	-19754.87	-842.87	-842.87	-877.89	-842.87	---	---	-1092.55	1.296	Pass
SER-III	4, LegalRout	-104.98	---	-19754.87	-842.87	-842.87	-139.62	-139.62	---	---	-1092.55	7.825	Pass
SER-III	4, LegalRout	-104.98	---	-19754.87	-842.87	-842.87	-139.62	-139.62	---	---	-1092.55	7.825	Pass
SER-III	5, LegalSpec	-30.37	---	-19754.87	-842.87	-842.87	-40.40	-40.40	---	---	-1092.55	27.045	Pass
SER-III	5, LegalSpec	-585.36	---	-19754.87	-842.87	-842.87	-778.53	-778.53	---	---	-1092.55	1.403	Pass
SER-III	6, LegalRout	-58.01	---	-19754.87	-842.87	-842.87	-77.15	-77.15	---	---	-1092.55	14.161	Pass
SER-III	6, LegalRout	-406.80	---	-19754.87	-842.87	-842.87	-541.04	-541.04	---	---	-1092.55	2.019	Pass
SER-III	7, LegalRout	-55.21	---	-19754.87	-842.87	-842.87	-73.42	-73.42	---	---	-1092.55	14.880	Pass
SER-III	7, LegalRout	-475.50	---	-19754.87	-842.87	-842.87	-632.42	-632.42	---	---	-1092.55	1.728	Pass
SER-III	8, LegalRout	-51.73	---	-19754.87	-842.87	-842.87	-68.80	-68.80	---	---	-1092.55	15.880	Pass
SER-III	8, LegalRout	-480.14	---	-19754.87	-842.87	-842.87	-638.59	-638.59	---	---	-1092.55	1.711	Pass

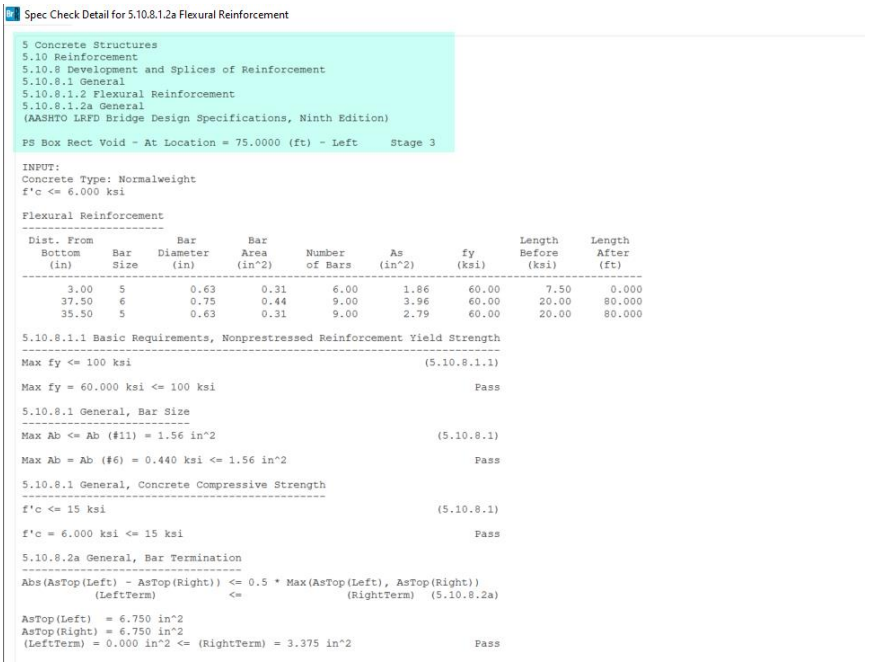
```
Load Combination Legend:

 Code      Vehicle
-----------------------
    1     HL-93 (US) - Truck + Lane
    2     HL-93 (US) - Tandem + Lane
    3     HL-93 (US) - 90%(Truck Pair + Lane)
    4     Lane-Type Legal Load - Legal Truck + Lane
    5     NRL - Legal Truck
    6     Type 3 - Legal Truck
    7     Type 3-3 - Legal Truck
    8     Type 3S2 - Legal Truck


-----------------------------------------------------------------------------------------------------------------
```

Figure 4 – 5.6.3.3 Minimum Reinforcement

All specification check articles affected by moment redistribution are related to flexure only because moment redistribution does not apply to shear effects. In the bridge model considered in this tutorial, shear effects are

ignored, and no shear related articles are shown but even if shear was not ignored and shear articles were processed, they would not be affected by moment redistribution.

The additional specification check articles processed only when the moment redistribution is allowed by the user are shown in Figure 5 through Figure 8. Open each article and review its contents.

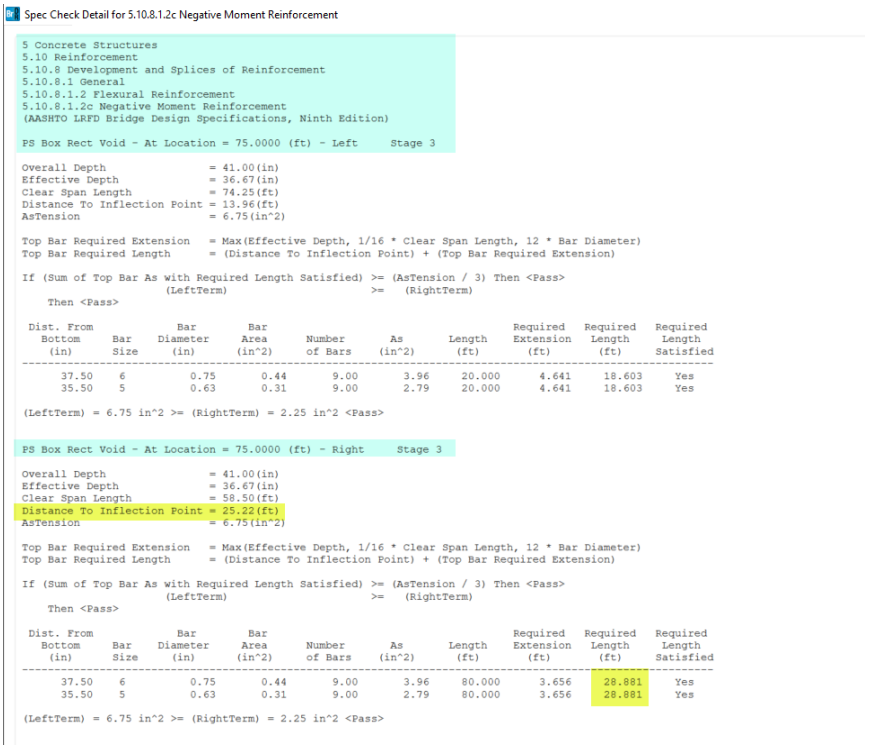


Spec Check Detail for 5.10.8.1.2a Flexural Reinforcement

```
5 Concrete Structures
5.10 Reinforcement
5.10.8 Development and Splices of Reinforcement
5.10.8.1 General
5.10.8.1.2 Flexural Reinforcement
5.10.8.1.2a General
(AASHTO LRFD Bridge Design Specifications, Ninth Edition)

PS Box Rect Void - At Location = 75.0000 (ft) - Left     Stage 3

INPUT:
Concrete Type: Normalweight
f'c <= 6.000 ksi

Flexural Reinforcement
----------------------
 Dist. From              Bar        Bar                                      Length     Length
   Bottom      Bar     Diameter     Area      Number       As         fy      Before      After
     (in)      Size      (in)     (in^2)     of Bars    (in^2)      (ksi)      (ksi)       (ft)
-------------------------------------------------------------------------------------------------
     3.00     5          0.63       0.31       6.00       1.86      60.00       7.50      0.000
    37.50     6          0.75       0.44       9.00       3.96      60.00      20.00     80.000
    35.50     5          0.63       0.31       9.00       2.79      60.00      20.00     80.000

5.10.8.1.1 Basic Requirements, Nonprestressed Reinforcement Yield Strength
--------------------------------------------------------------------------
Max fy <= 100 ksi                                                (5.10.8.1.1)

Max fy = 60.000 ksi <= 100 ksi                                           Pass

5.10.8.1 General, Bar Size
--------------------------
Max Ab <= Ab (#11) = 1.56 in^2                                    (5.10.8.1)

Max Ab = Ab (#6) = 0.440 ksi <= 1.56 in^2                                Pass

5.10.8.1 General, Concrete Compressive Strength
-----------------------------------------------
f'c <= 15 ksi                                                     (5.10.8.1)

f'c = 6.000 ksi <= 15 ksi                                                Pass

5.10.8.2a General, Bar Termination
----------------------------------
Abs(AsTop(Left) - AsTop(Right)) <= 0.5 * Max(AsTop(Left), AsTop(Right))
          (LeftTerm)            <=                (RightTerm)   (5.10.8.2a)

AsTop(Left)  = 6.750 in^2
AsTop(Right) = 6.750 in^2
(LeftTerm) = 0.000 in^2 <= (RightTerm) = 3.375 in^2                      Pass
```

Figure 5 – 5.10.8.1.2a Flexural Reinforcement

The articles shown in Figure 5 and Figure 6 check several reinforcement requirements that must pass for moment redistribution to be applied. For instance, in the negative moment reinforcement article (Figure 6), the required length of the reinforcement on the right side of the first interior support is calculated to be 28.881 ft which is almost half of the 60.0 ft span between interior supports. Since the reinforcement in the original imported bridge model extended only 15.0 ft from the support, the reinforcement length had to be adjusted. Otherwise, the length check would fail, and redistribution would not be applied at all.



Spec Check Detail for 5.10.8.1.2c Negative Moment Reinforcement

5 Concrete Structures
5.10 Reinforcement
5.10.8 Development and Splices of Reinforcement
5.10.8.1 General
5.10.8.1.2 Flexural Reinforcement
5.10.8.1.2c Negative Moment Reinforcement
(AASHTO LRFD Bridge Design Specifications, Ninth Edition)

PS Box Rect Void - At Location = 75.0000 (ft) - Left Stage 3

Overall Depth = 41.00(in)
Effective Depth = 36.67(in)
Clear Span Length = 74.25(ft)
Distance To Inflection Point = 13.96(ft)
AsTension = 6.75(in^2)

Top Bar Required Extension = Max(Effective Depth, 1/16 * Clear Span Length, 12 * Bar Diameter)
Top Bar Required Length = (Distance To Inflection Point) + (Top Bar Required Extension)

If (Sum of Top Bar As with Required Length Satisfied) >= (AsTension / 3) Then <Pass>
(LeftTerm) >= (RightTerm)
Then <Pass>

Dist. From Bottom (in)	Bar Size	Bar Diameter (in)	Bar Area (in^2)	Number of Bars	As (in^2)	Length (ft)	Required Extension (ft)	Required Length (ft)	Required Length Satisfied
37.50	6	0.75	0.44	9.00	3.96	20.000	4.641	18.603	Yes
35.50	5	0.63	0.31	9.00	2.79	20.000	4.641	18.603	Yes

(LeftTerm) = 6.75 in^2 >= (RightTerm) = 2.25 in^2 <Pass>

PS Box Rect Void - At Location = 75.0000 (ft) - Right Stage 3

Overall Depth = 41.00(in)
Effective Depth = 36.67(in)
Clear Span Length = 58.50(ft)
Distance To Inflection Point = 25.22(ft)
AsTension = 6.75(in^2)

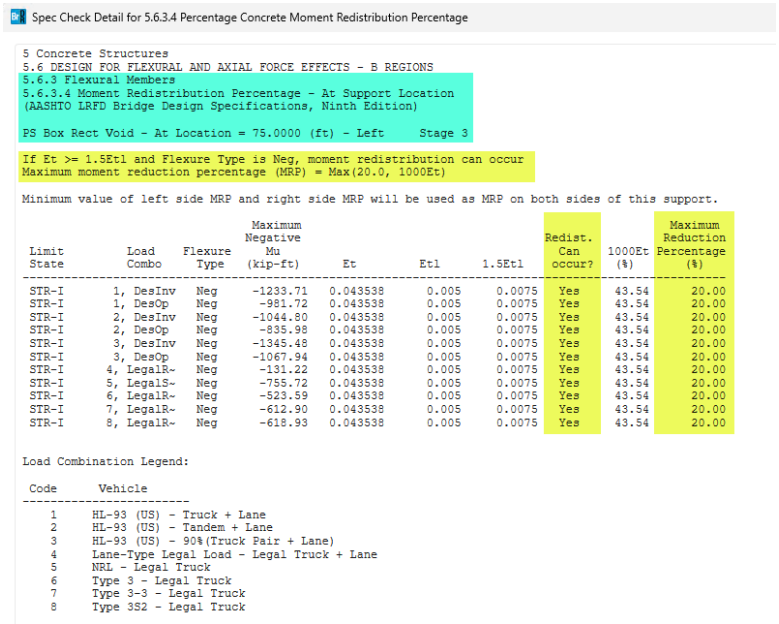
Top Bar Required Extension = Max(Effective Depth, 1/16 * Clear Span Length, 12 * Bar Diameter)
Top Bar Required Length = (Distance To Inflection Point) + (Top Bar Required Extension)

If (Sum of Top Bar As with Required Length Satisfied) >= (AsTension / 3) Then <Pass>
(LeftTerm) >= (RightTerm)
Then <Pass>

Dist. From Bottom (in)	Bar Size	Bar Diameter (in)	Bar Area (in^2)	Number of Bars	As (in^2)	Length (ft)	Required Extension (ft)	Required Length (ft)	Required Length Satisfied
37.50	6	0.75	0.44	9.00	3.96	80.000	3.656	28.881	Yes
35.50	5	0.63	0.31	9.00	2.79	80.000	3.656	28.881	Yes

(LeftTerm) = 6.75 in^2 >= (RightTerm) = 2.25 in^2 <Pass>

Figure 6 – 5.10.8.1.2c Negative Moment Reinforcement



Spec Check Detail for 5.6.3.4 Percentage Concrete Moment Redistribution Percentage

5 Concrete Structures
5.6 DESIGN FOR FLEXURAL AND AXIAL FORCE EFFECTS - B REGIONS
5.6.3 Flexural Members
5.6.3.4 Moment Redistribution Percentage - At Support Location
(AASHTO LRFD Bridge Design Specifications, Ninth Edition)

PS Box Rect Void - At Location = 75.0000 (ft) - Left Stage 3

If Et >= 1.5Etl and Flexure Type is Neg, moment redistribution can occur
Maximum moment reduction percentage (MRP) = Max(20.0, 1000Et)

Minimum value of left side MRP and right side MRP will be used as MRP on both sides of this support.

Limit State	Load Combo	Flexure Type	Maximum Negative Mu (kip-ft)	Et	Etl	1.5Etl	Redist. Can occur?	1000Et (%)	Maximum Reduction Percentage (%)
STR-I	1, DesInv	Neg	-1233.71	0.043538	0.005	0.0075	Yes	43.54	20.00
STR-I	1, DesOp	Neg	-981.72	0.043538	0.005	0.0075	Yes	43.54	20.00
STR-I	2, DesInv	Neg	-1044.80	0.043538	0.005	0.0075	Yes	43.54	20.00
STR-I	2, DesOp	Neg	-835.98	0.043538	0.005	0.0075	Yes	43.54	20.00
STR-I	3, DesInv	Neg	-1345.48	0.043538	0.005	0.0075	Yes	43.54	20.00
STR-I	3, DesOp	Neg	-1067.94	0.043538	0.005	0.0075	Yes	43.54	20.00
STR-I	4, LegalR~	Neg	-131.22	0.043538	0.005	0.0075	Yes	43.54	20.00
STR-I	5, LegalS~	Neg	-755.72	0.043538	0.005	0.0075	Yes	43.54	20.00
STR-I	6, LegalR~	Neg	-523.59	0.043538	0.005	0.0075	Yes	43.54	20.00
STR-I	7, LegalR~	Neg	-612.90	0.043538	0.005	0.0075	Yes	43.54	20.00
STR-I	8, LegalR~	Neg	-618.93	0.043538	0.005	0.0075	Yes	43.54	20.00

Load Combination Legend:

Code	Vehicle
1	HL-93 (US) - Truck + Lane
2	HL-93 (US) - Tandem + Lane
3	HL-93 (US) - 90%(Truck Pair + Lane)
4	Lane-Type Legal Load - Legal Truck + Lane
5	NRL - Legal Truck
6	Type 3 - Legal Truck
7	Type 3-3 - Legal Truck
8	Type 3S2 - Legal Truck

Figure 7 – 5.6.3.4 Moment Redistribution Percentage

In the moment redistribution percentage article (Figure 7), strain requirements are checked to determine if moment redistribution can be applied. Also, the maximum percentages of moment reduction at supports are calculated. Based on the percentages, the maximum moment increments (DeltaM) at supports are calculated in the maximum allowable moment redistribution moments article (Figure 8).

Spec Check Detail for 5.6.3.4 Moment Concrete Moment Redistribution Moments

5 Concrete Structures
5.6 DESIGN FOR FLEXURAL AND AXIAL FORCE EFFECTS - B REGIONS
5.6.3 Flexural Members
5.6.3.4 Maximum Allowable Moment Redistribution Moments - At Support Location
(AASHTO LRFD Bridge Design Specifications, Ninth Edition)

PS Box Rect Void - At Location = 75.0000 (ft) - Left Stage 3

Input:
M_DC = -104.98 kip-ft
M_DW = 0.00 kip-ft
M_DW-WS = 0.00 kip-ft
M_PT = 0.00 kip-ft
M_SE = 0.00 kip-ft

Limit State	Load Combo	Flexure Type	MRP (%)	M_LL (kip-ft)	M_AdjLL (kip-ft)
STR-I	1, DesInv	Neg	20.00	-629.99	0.00
STR-I	1, DesOp	Neg	20.00	-629.99	0.00
STR-I	2, DesInv	Neg	20.00	-522.04	0.00
STR-I	2, DesOp	Neg	20.00	-522.04	0.00
STR-I	3, DesInv	Neg	20.00	-693.86	0.00
STR-I	3, DesOp	Neg	20.00	-693.86	0.00
STR-I	4, LegalR~	Neg	20.00	0.00	0.00
STR-I	5, LegalS~	Neg	20.00	-480.38	0.00
STR-I	6, LegalR~	Neg	20.00	-301.82	0.00
STR-I	7, LegalR~	Neg	20.00	-370.52	0.00
STR-I	8, LegalR~	Neg	20.00	-375.16	0.00

		Load Factors						
Limit State	Load Combo	DC	DW	DW-WS	SE	PT	LL	AdjLL
STR-I	1	1.25	1.50	1.50	0.00	0.00	1.75	0.00
STR-I	1	1.25	1.50	1.50	0.00	0.00	1.35	0.00
STR-I	2	1.25	1.50	1.50	0.00	0.00	1.75	0.00
STR-I	2	1.25	1.50	1.50	0.00	0.00	1.35	0.00
STR-I	3	1.25	1.50	1.50	0.00	0.00	1.75	0.00
STR-I	3	1.25	1.50	1.50	0.00	0.00	1.35	0.00
STR-I	4	1.25	1.50	1.50	0.00	0.00	1.30	0.00
STR-I	5	1.25	1.50	1.50	0.00	0.00	1.30	0.00
STR-I	6	1.25	1.50	1.50	0.00	0.00	1.30	0.00
STR-I	7	1.25	1.50	1.50	0.00	0.00	1.30	0.00
STR-I	8	1.25	1.50	1.50	0.00	0.00	1.30	0.00
SER-III	1	1.00	1.00	1.00	0.00	0.00	0.80	0.00
SER-III	2	1.00	1.00	1.00	0.00	0.00	0.80	0.00
SER-III	3	1.00	1.00	1.00	0.00	0.00	0.80	0.00
SER-III	4	1.00	1.00	1.00	0.00	0.00	1.00	0.00
SER-III	5	1.00	1.00	1.00	0.00	0.00	1.00	0.00
SER-III	6	1.00	1.00	1.00	0.00	0.00	1.00	0.00
SER-III	7	1.00	1.00	1.00	0.00	0.00	1.00	0.00
SER-III	8	1.00	1.00	1.00	0.00	0.00	1.00	0.00

Maximum Allowable Moment Redistribution Moments:
Max_Delta_M = -MRP * M

where:
MRP = maximum reduction percentage
M = elastic moment due to applied load

				Unfactored Max_Delta_M							Factored Max_Delta_M	
Limit State	Load Combo	Flexure Type	MRP (%)	DC (kip-ft)	DW (kip-ft)	DW-WS (kip-ft)	SE (kip-ft)	PT (kip-ft)	LL (kip-ft)	AdjLL (kip-ft)	DL+AdjLL (kip-ft)	LL+I (kip-ft)
STR-I	1, DesInv	Neg	20.00	21.00	0.00	0.00	0.00	0.00	126.00	0.00	26.24	220.50
STR-I	1, DesOp	Neg	20.00	21.00	0.00	0.00	0.00	0.00	126.00	0.00	26.24	170.10
STR-I	2, DesInv	Neg	20.00	21.00	0.00	0.00	0.00	0.00	104.41	0.00	26.24	182.72
STR-I	2, DesOp	Neg	20.00	21.00	0.00	0.00	0.00	0.00	104.41	0.00	26.24	140.95
STR-I	3, DesInv	Neg	20.00	21.00	0.00	0.00	0.00	0.00	138.77	0.00	26.24	242.85
STR-I	3, DesOp	Neg	20.00	21.00	0.00	0.00	0.00	0.00	138.77	0.00	26.24	187.34
STR-I	4, LegalR~	Neg	20.00	21.00	0.00	0.00	0.00	0.00	0.00	0.00	26.24	0.00
STR-I	5, LegalS~	Neg	20.00	21.00	0.00	0.00	0.00	0.00	96.08	0.00	26.24	124.90
STR-I	6, LegalR~	Neg	20.00	21.00	0.00	0.00	0.00	0.00	60.36	0.00	26.24	78.47
STR-I	7, LegalR~	Neg	20.00	21.00	0.00	0.00	0.00	0.00	74.10	0.00	26.24	96.34
STR-I	8, LegalR~	Neg	20.00	21.00	0.00	0.00	0.00	0.00	75.03	0.00	26.24	97.54

Load Combination Legend:

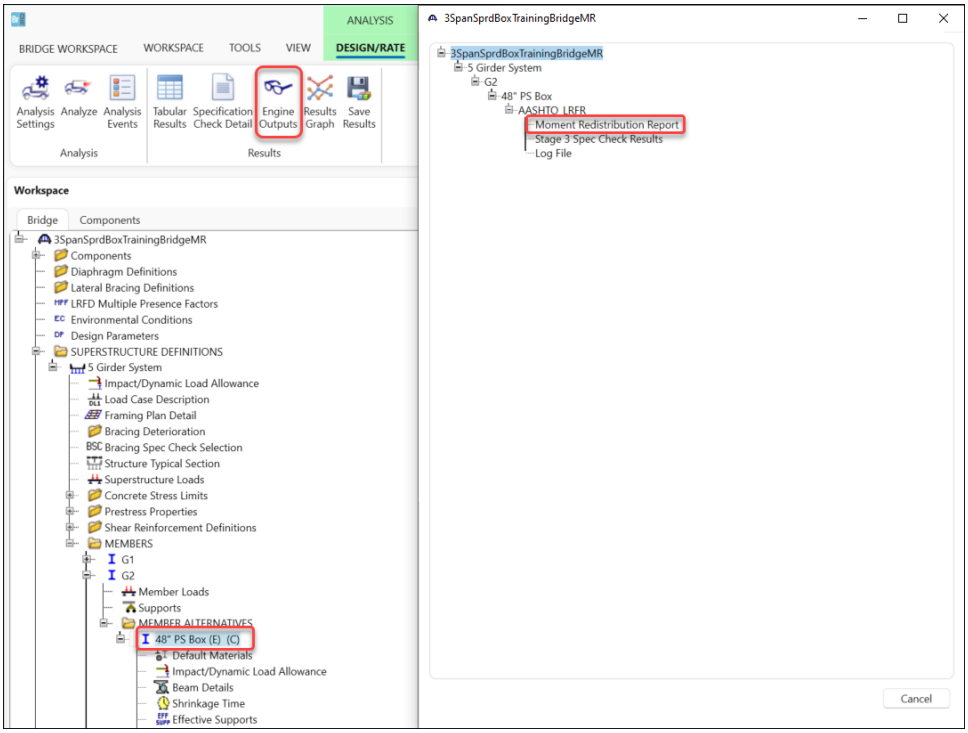
Code	Vehicle
1	HL-93 (US) - Truck + Lane
2	HL-93 (US) - Tandem + Lane
3	HL-93 (US) - 90%(Truck Pair + Lane)
4	Lane-Type Legal Load - Legal Truck + Lane
5	NRL - Legal Truck
6	Type 3 - Legal Truck
7	Type 3-3 - Legal Truck
8	Type 3S2 - Legal Truck

Figure 8 – 5.6.3.4 Maximum Allowable Moment Redistribution Moments

The actual amount of moment redistribution applied for each vehicle is reported in the **Moment Redistribution Report** discussed in the next section.

Moment Redistribution Report

Detailed information about the amount of moment redistribution applied for each vehicle at each location and how moment redistribution affects the flexure rating factors is available in the **Moment Redistribution Report**. To view the report, click on the **Engine Output** button located on the **Results** group of the **DESIGN/RATE** ribbon and then double-click on the **Moment Redistribution Report** item in the tree showing the available engine output files as shown in the screenshot below.



The report is a text file, and it will be open in the default text viewer. The format of the report file is shown in Figure 9 and Figure 10 which include locations from the first span for selected vehicles. Highlighted in the figures are the controlling rating factors before and after moment redistribution, and the percentages of applied moment redistribution at the first interior supports.

For the HL-93 Truck + Lane vehicle (Figure 9), the applied redistribution percentage at Support 2 (first interior support) is 20% which is equal to the maximum redistribution percentage. This is because even when the maximum redistribution percentage is applied, the minimum negative flexure rating factor is still smaller than the positive flexure rating factor, so it is beneficial overall to apply as much redistribution as allowed.

On the other hand, for the Type 3 Legal Truck vehicle (Figure 10), the applied redistribution percentage at Support 2 (first interior support) is 12.93% which is smaller than the maximum redistribution percentage of 20%. This is because if the maximum redistribution percentage was applied the minimum positive flexure rating factor would become smaller than the negative flexure rating factor. In other words, too much redistribution would be applied and the detrimental effect of moment redistribution in the positive flexure would exceed the beneficial effect in negative flexure. In such cases, the program attempts to optimize the amount of applied moment redistribution by reducing

the applied redistribution percentages at supports so that the rating factors in positive and negative flexure after moment redistribution are equal. Reducing the applied redistribution percentage to 12.93% achieves this goal and both positive and negative flexure rating factors after moment redistribution are equal to 2.864 which is an increase of 0.414 (16.9%) from the controlling negative flexure rating factor before moment redistribution of 2.450.

MomentRedistributionReport.txt - Notepad

File Edit Format View Help

Moment redistribution for HL-93 (US) - Truck + Lane at Design Inventory rating level and StrengthI limit state.

Before moment redistribution:
  Minimum positive flexure rating factor = 1.252 @ 37.125 ft
  Minimum negative flexure rating factor = 0.872 @ 75.000 ft
After moment redistribution:
  Minimum positive flexure rating factor = 1.151 @ 37.125 ft
  Minimum negative flexure rating factor = 1.120 @ 75.000 ft

Location (ft)	Support	Side	Span	Location in Span (ft)	Percent in Span (%)	DL+AdjLL (kip-ft)	LL+I (kip-ft)	Max Redistribution Percentage (%)	Applied Redistribution Percentage (%)
0.000	1	Right	1	0.000	0.000	0.00	0.00	0.000	0.000
75.000	2	Left	1	75.000	100.000	-131.22	-1102.49	20.000	20.000
75.000	2	Right	2	0.000	0.000	-131.22	-1102.49	20.000	20.000
135.000	3	Left	2	60.000	100.000	-80.87	-807.27	20.000	20.000
135.000	3	Right	3	0.000	0.000	-80.87	-807.27	20.000	20.000
195.000	4	Left	3	60.000	100.000	0.00	0.00	0.000	0.000

Location (ft)	Side	Span	Location in Span (ft)	Percent in Span (%)	Positive Flexure Capacity (kip-ft)	Negative Flexure Capacity (kip-ft)	Initial Flexure Capacity (kip-ft)	Initial DL+AdjLL (kip-ft)	Initial LL+I (kip-ft)	Initial Controlling Flexure RF	Max Delta DL+AdjLL (kip-ft)	Max Delta LL+I (kip-ft)	Applied Delta DL+AdjLL (kip-ft)	Applied Delta LL+I (kip-ft)	Positive Flexure RF	Negative Flexure RF
0.000	Right	1	0.000	0.000	596.96	-87.16	596.96	0.00	0.00	99.000	0.00	0.00	0.00	0.00	99.000	99.000
1.750	Left	1	1.750	2.333	1931.13	-231.92	1931.13	138.81	165.56	10.826	0.61	5.14	0.61	5.14	10.496	99.000
1.750	Right	1	1.750	2.333	1931.13	-231.92	1931.13	138.81	165.56	10.826	0.61	5.14	0.61	5.14	10.496	99.000
7.500	Left	1	7.500	10.000	2764.96	-234.38	2764.96	547.41	629.93	3.520	2.62	22.05	2.62	22.05	3.397	99.000
7.500	Right	1	7.500	10.000	2764.96	-234.38	2764.96	547.41	629.93	3.520	2.62	22.05	2.62	22.05	3.397	99.000
15.000	Left	1	15.000	20.000	3095.55	-142.67	3095.55	970.89	1057.44	2.009	5.25	44.10	5.25	44.10	1.924	99.000
15.000	Right	1	15.000	20.000	3095.55	-142.67	3095.55	970.89	1057.44	2.009	5.25	44.10	5.25	44.10	1.924	99.000
21.750	Left	1	21.750	29.000	3202.96	-54.32	3202.96	1246.07	1278.76	1.530	7.61	63.94	7.61	63.94	1.452	99.000
21.750	Right	1	21.750	29.000	3202.96	0.00	3202.96	1246.07	1278.76	1.530	7.61	63.94	7.61	63.94	1.452	99.000
22.500	Left	1	22.500	30.000	3202.96	0.00	3202.96	1270.45	1296.81	1.490	7.87	66.15	7.87	66.15	1.412	99.000
22.500	Right	1	22.500	30.000	3202.96	0.00	3202.96	1270.45	1296.81	1.490	7.87	66.15	7.87	66.15	1.412	99.000
30.000	Left	1	30.000	40.000	3202.96	0.00	3202.96	1446.09	1395.08	1.259	10.50	88.20	10.50	88.20	1.177	99.000
30.000	Right	1	30.000	40.000	3202.96	0.00	3202.96	1446.09	1395.08	1.259	10.50	88.20	10.50	88.20	1.177	99.000
37.125	Left	1	37.125	49.500	3202.96	0.00	3202.96	1498.15	1361.17	1.252	12.99	109.15	12.99	109.15	1.151	99.000
37.125	Right	1	37.125	49.500	3202.96	0.00	3202.96	1498.15	1361.17	1.252	12.99	109.15	12.99	109.15	1.151	99.000
37.500	Left	1	37.500	50.000	3202.96	0.00	3202.96	1497.79	1357.21	1.256	13.12	110.25	13.12	110.25	1.153	99.000
37.500	Right	1	37.500	50.000	3202.96	0.00	3202.96	1497.79	1357.21	1.256	13.12	110.25	13.12	110.25	1.153	99.000
45.000	Left	1	45.000	60.000	3202.96	0.00	3202.96	1408.70	1195.36	1.501	15.75	132.30	15.75	132.30	1.340	99.000
45.000	Right	1	45.000	60.000	3202.96	0.00	3202.96	1408.70	1195.36	1.501	15.75	132.30	15.75	132.30	1.340	99.000
52.250	Left	1	52.250	69.667	3202.96	0.00	3202.96	1204.78	908.51	2.199	18.28	153.61	18.28	153.61	1.864	99.000
52.250	Right	1	52.250	69.667	3202.96	-54.32	3202.96	1204.78	908.51	2.199	18.28	153.61	18.28	153.61	1.864	99.000
52.500	Left	1	52.500	70.000	3198.98	-56.97	3198.98	1195.68	896.81	2.234	18.37	154.35	18.37	154.35	1.888	99.000
52.500	Right	1	52.500	70.000	3198.98	-56.97	3198.98	1195.68	896.81	2.234	18.37	154.35	18.37	154.35	1.888	99.000
55.000	Left	1	55.000	73.333	3159.20	-87.73	3159.20	1083.36	762.75	2.722	19.25	161.70	19.25	161.70	2.225	99.000
55.000	Right	1	55.000	73.333	3170.05	-1105.95	3170.05	1083.36	762.75	2.736	19.25	161.70	19.25	161.70	2.236	99.000
60.000	Left	1	60.000	80.000	3091.18	-1172.08	3091.18	858.73	494.63	4.513	21.00	176.40	21.00	176.40	3.296	99.000
60.000	Right	1	60.000	80.000	3091.18	-1172.08	3091.18	858.73	494.63	4.513	21.00	176.40	21.00	176.40	3.296	99.000
67.500	Left	1	67.500	90.000	2631.54	-1259.15	-1259.15	397.86	-497.68	3.329	23.62	198.45	23.62	198.45	99.000	5.617
67.500	Right	1	67.500	90.000	2944.68	-1261.62	-1261.62	397.86	-497.68	3.334	23.62	198.45	23.62	198.45	99.000	5.625
72.250	Left	1	72.250	96.333	2265.85	-1267.13	-1267.13	41.88	-861.37	1.520	25.28	212.41	25.28	212.41	99.000	2.056
72.250	Right	1	72.250	96.333	2265.85	-1267.13	-1267.13	41.88	-861.37	1.520	25.28	212.41	25.28	212.41	99.000	2.056
74.250	Left	1	74.250	99.000	826.20	-1133.46	-1133.46	-122.88	-1035.74	0.976	25.98	218.29	25.98	218.29	99.000	1.268
75.000	Left	1	75.000	100.000	459.84	-1092.55	-1092.55	-131.22	-1102.49	0.872	26.24	220.50	26.24	220.50	99.000	1.120
75.000	Right	2	0.000	0.000	459.84	-1092.55	-1092.55	-131.22	-1102.49	0.872	26.24	220.50	26.24	220.50	99.000	1.120

Figure 9 – Moment redistribution for HL-93 (US) - Truck + Lane at Design Inventory rating level and Strength I limit state

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Moment redistribution for Type 3 - Legal Truck at Legal Routine rating level and StrengthI limit state.

Before moment redistribution:
  Minimum positive flexure rating factor = 3.005 @ 37.125 ft
  Minimum negative flexure rating factor = 2.450 @ 75.000 ft
After moment redistribution:
  Minimum positive flexure rating factor = 2.864 @ 37.125 ft
  Minimum negative flexure rating factor = 2.864 @ 75.000 ft

Location (ft)	Support	Side	Span	Location in Span (ft)	Percent in Span (%)	DL+AdjLL (kip-ft)	LL+I (kip-ft)	Max Redistribution Percentage (%)	Applied Redistribution Percentage (%)
0.000	1	Right	1	0.000	0.000	0.00	0.00	0.000	0.000
75.000	2	Left	1	75.000	100.000	-131.22	-392.37	20.000	12.930
75.000	2	Right	2	0.000	0.000	-131.22	-392.37	20.000	12.930
135.000	3	Left	2	60.000	100.000	-80.87	-282.98	20.000	20.000
135.000	3	Right	3	0.000	0.000	-80.87	-282.98	20.000	20.000
195.000	4	Left	3	60.000	100.000	0.00	0.00	0.000	0.000

Location (ft)	Side	Span	Location in Span (ft)	Percent in Span (%)	Positive Flexure Capacity (kip-ft)	Negative Flexure Capacity (kip-ft)	Initial Flexure Capacity (kip-ft)	Initial DL+AdjLL (kip-ft)	Initial LL+I (kip-ft)	Initial Controlling Flexure RF	Max Delta DL+AdjLL (kip-ft)	Max Delta LL+I (kip-ft)	Applied Delta DL+AdjLL (kip-ft)	Applied Delta LL+I (kip-ft)	Positive Flexure RF	Negative Flexure RF
0.000	Right	1	0.000	0.000	596.96	-87.16	596.96	0.00	0.00	99.000	0.00	0.00	0.00	0.00	99.000	99.000
1.750	Left	1	1.750	2.333	1931.13	-231.92	1931.13	138.81	70.29	25.499	0.61	1.83	0.40	1.18	25.071	99.000
1.750	Right	1	1.750	2.333	1931.13	-231.92	1931.13	138.81	70.29	25.499	0.61	1.83	0.40	1.18	25.071	99.000
7.500	Left	1	7.500	10.000	2764.96	-234.38	2764.96	547.41	266.82	8.311	2.62	7.85	1.70	5.07	8.150	99.000
7.500	Right	1	7.500	10.000	2764.96	-234.38	2764.96	547.41	266.82	8.311	2.62	7.85	1.70	5.07	8.150	99.000
15.000	Left	1	15.000	20.000	3095.55	-142.67	3095.55	970.89	445.96	4.764	5.25	15.69	3.39	10.15	4.651	99.000
15.000	Right	1	15.000	20.000	3095.55	-142.67	3095.55	970.89	445.96	4.764	5.25	15.69	3.39	10.15	4.651	99.000
21.750	Left	1	21.750	29.000	3202.96	-54.32	3202.96	1246.07	537.01	3.644	7.61	22.76	4.92	14.71	3.538	99.000
21.750	Right	1	21.750	29.000	3202.96	0.00	3202.96	1246.07	537.01	3.644	7.61	22.76	4.92	14.71	3.538	99.000
22.500	Left	1	22.500	30.000	3202.96	0.00	3202.96	1270.45	544.31	3.550	7.87	23.54	5.09	15.22	3.445	99.000
22.500	Right	1	22.500	30.000	3202.96	0.00	3202.96	1270.45	544.31	3.550	7.87	23.54	5.09	15.22	3.445	99.000
30.000	Left	1	30.000	40.000	3202.96	0.00	3202.96	1446.09	583.96	3.009	10.50	31.39	6.79	20.29	2.896	99.000
30.000	Right	1	30.000	40.000	3202.96	0.00	3202.96	1446.09	583.96	3.009	10.50	31.39	6.79	20.29	2.896	99.000
37.125	Left	1	37.125	49.500	3202.96	0.00	3202.96	1498.15	567.28	3.005	12.99	38.84	8.40	25.11	2.864	99.000
37.125	Right	1	37.125	49.500	3202.96	0.00	3202.96	1498.15	567.28	3.005	12.99	38.84	8.40	25.11	2.864	99.000
37.500	Left	1	37.500	50.000	3202.96	0.00	3202.96	1497.79	565.46	3.016	13.12	39.24	8.48	25.37	2.872	99.000
37.500	Right	1	37.500	50.000	3202.96	0.00	3202.96	1497.79	565.46	3.016	13.12	39.24	8.48	25.37	2.872	99.000
45.000	Left	1	45.000	60.000	3202.96	0.00	3202.96	1408.70	497.47	3.607	15.75	47.08	10.18	30.44	3.379	99.000
45.000	Right	1	45.000	60.000	3202.96	0.00	3202.96	1408.70	497.47	3.607	15.75	47.08	10.18	30.44	3.379	99.000
52.250	Left	1	52.250	69.667	3202.96	0.00	3202.96	1204.78	383.16	5.215	18.28	54.67	11.82	35.34	4.746	99.000
52.250	Right	1	52.250	69.667	3202.96	-54.32	3202.96	1204.78	383.16	5.215	18.28	54.67	11.82	35.34	4.746	99.000
52.500	Left	1	52.500	70.000	3198.98	-56.97	3198.98	1195.68	378.52	5.292	18.37	54.93	11.88	35.51	4.810	99.000
52.500	Right	1	52.500	70.000	3198.98	-56.97	3198.98	1195.68	378.52	5.292	18.37	54.93	11.88	35.51	4.810	99.000
55.000	Left	1	55.000	73.333	3159.20	-87.73	3159.20	1083.36	326.97	6.349	19.25	57.55	12.44	37.20	5.666	99.000
55.000	Right	1	55.000	73.333	3170.05	-1105.95	3170.05	1083.36	326.97	6.382	19.25	57.55	12.44	37.20	5.696	99.000
60.000	Left	1	60.000	80.000	3091.18	-1172.08	3091.18	858.73	223.88	9.972	21.00	62.78	13.57	40.59	8.390	99.000
60.000	Right	1	60.000	80.000	3091.18	-1172.08	3091.18	858.73	223.88	9.972	21.00	62.78	13.57	40.59	8.390	99.000
67.500	Left	1	67.500	90.000	2631.54	-1259.15	2631.54	397.86	54.95	40.646	23.62	70.63	15.27	45.66	22.049	99.000
67.500	Right	1	67.500	90.000	2944.68	-1261.62	2944.68	397.86	54.95	46.344	23.62	70.63	15.27	45.66	25.161	99.000
72.250	Left	1	72.250	96.333	2265.85	-1267.13	-1267.13	41.88	-303.03	4.320	25.28	75.60	16.34	48.87	99.000	5.215
72.250	Right	1	72.250	96.333	2265.85	-1267.13	-1267.13	41.88	-303.03	4.320	25.28	75.60	16.34	48.87	99.000	5.215
74.250	Left	1	74.250	99.000	826.20	-1133.46	-1133.46	-122.88	-368.13	2.745	25.98	77.69	16.80	50.22	99.000	3.232
75.000	Left	1	75.000	100.000	459.84	-1092.55	-1092.55	-131.22	-392.37	2.450	26.24	78.47	16.97	50.73	99.000	2.864
75.000	Right	2	0.000	0.000	459.84	-1092.55	-1092.55	-131.22	-392.37	2.450	26.24	78.47	16.97	50.73	99.000	2.864

Figure 10 – Moment redistribution for Type 3 - Legal Truck at Legal Routine rating level and Strength I limit state