SR 8 (Ponce De Leon) over Lullwater Creek

Load Rating Report

Serial No: 089-0001-0
Location I.D: 089-00008D-000.76E
County: DeKalb

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1.0 Background Information

The purpose of this report is to outline the approach and results from AECOM's evaluation and load rating of the bridge carrying SR 8 (Ponce De Leon Avenue) over Lullwater Creek (Structure ID 089-0001-0).

In determining the scope of work for this project, GDOT communicated the following issues with the structure:

- The bridge currently has a sufficiency rating of 42.38 and was previously programmed for replacement.
- Because the bridge is located on a roadway that accommodates more than 31,600 vpd, replacement of the bridge would require lane closures, detours and staged construction which would have dramatic impacts to commuters using the corridor.
- Replacement costs for the structure would be high due to staged construction, maintenance of traffic, and limited access.
- The bridge and approach roadway currently accommodate 2 lanes in each direction and sidewalks on both sides. Side streets intersect Ponce De Leon Avenue in both approaches of the bridge.
- GDOT's inspection identified spalling with exposed reinforcement on isolated portions of the bridge. If the structure could be rated and the resulting load capacities determined to be adequate, the cost benefit to repair the bridge may be warranted over full replacement.

The ultimate goal of GDOT's Bridge Maintenance Unit is to obtain a load rating for the structure. Prior to AECOM receiving this project, GDOT had neither the original design plans nor sufficient data on the structure to perform a load rating. GDOT concluded that a load test is the only way to determine the load carrying capacity of the structure. AECOM's scope is to perform the bridge inspection, field measurements, GPR location of existing reinforcement and concrete coring testing to obtain sufficient data to perform a conventional load rating. The results of this material testing could be used for a future load test if the conventional rating was deemed inadequate.

<u>Superstructure</u>

Build in 1922, the existing bridge carries 4 lanes of traffic on Ponce De Leon Avenue over Lullwater Creek. The superstructure is composed of eleven, 7-span continuous, reinforced concrete girders supported by intermediate arch piers and concrete wall abutments. The following is a summary of the bridge superstructure details and dimensions:

- Span Arrangement: 7-span continuous
- Span Lengths: 14.0 ft. center-to-center of bearing
- Overall Bridge Length: 98.0 ft. center-to-center of bearing, 99.5 ft. total length
- Structure Type: Cast-in-place, reinforced concrete, deck girder bridge
- Cross section:
    - Bridge Width: 62.75 ft. out-to-out
    - Roadway: 4 – 10.125 ft. lanes = 40.5 ft.
    - Sidewalk: 9.9167 ft. each side including a 3 ft. grass buffer
    - Parapet: 2.9167 ft. high x 1.208 ft. wide cast-in-place concrete
- Girders:
    - G1 and G11: 2.33 ft. high x 1 ft. wide cast-in-place arched concrete girder.

  - G2 and G10: 2.33 ft. high x 1 ft. wide cast-in-place concrete girder with 6" thick deck
  - G3, G4, G5, G6, G7, G8 and G9: 2.33 ft. high x 1.5 ft wide cast-in-place concrete girder with 6" deck
- Endwalls: Full height, full width concrete
- Inter. diaphragms: None
- Bridge fill:
  - G2 and G10: 28" thick fill with sidewalk slab
  - G3 to G9: 14" thick fill 16" asphalt overlay

The existing roadway has been overlaid to the point where the top of asphalt is approximately 4" below the top of concrete curb. The exterior girders are cast as part of the exterior arch running on the outside of the structure. AECOM's coring work between beams 8 and 9 of the bridge identified 30" from top of roadway to top of the concrete deck.

A full cross section showing existing dimensions is included with the bridge plans in Appendix D.

Substructure

The existing end bents are composed of full height concrete columns with concrete infill walls. The intermediate bents are five column concrete bents with arched bent caps.

Bridge Condition

Prior to beginning work on this project, AECOM reviewed all available information on the bridge structure, including bridge inspection reports. AECOM found that the GDOT's inspection reports are consistent with the existing bridge conditions in the field. AECOM's inspection was focused on determining dimensions of the bridge, determining bridge dead loads, determining bar configurations and identifying defects that could impact the load carrying capacity of the bridge.

Spalls with exposed reinforcement were identified in the following locations:

- Span 1, girders G2, G4, G5, G6, G9 and G10
- Span 4, girder G9
- Span 7, girders G2, G3 and G8
- Bent 2, back face, bay 9
- Bent 2, Column 1
- Bent 4, Column 5

Inspection of the exposed reinforcement at several of the beam spall locations identified No. 6 bars, non-deformed type, in the bottom of the girders. Some of this reinforcement displayed minor section loss. Our inspection also revealed some construction defects related to the placement of reinforcement in the formwork. Bars were shifted laterally across the bottom of the beams rather than being equally spaced. This shift, along with the very close bar spacing in the bottom of the beam, has contributed to some of the beam spalls. In addition, water falling through the catch basin on the right side of the bridge deck has also contributed to the propagation of the beam spall on girder 9 in Span 4.

It is important to note that there were no significant shear cracks identified in the girders.

On the end bents, there are large horizontal cracks in the columns and infill walls. These cracks do not appear to be the result of vehicular overload. They may be the result of foundation settlement, increased lateral loads from pore water pressure buildup in the approach fills, or longitudinal forces transferred from the superstructure.

GDOT Information

When comparing our field measurements with the information currently recorded in GDOT component survey form, AECOM identified some discrepancies, specifically the girder dimensions and spacing as well as the number of columns at the intermediate bents. AECOM recommends these dimensions be updated in accordance with the plans provided in Appendix D.

2.0 Bridge Analysis

All bridge analysis for this project was performed in accordance with AASHTO Standard Specifications for Highway Bridges. Determining a rating for this bridge requires analysis of both the superstructure and intermediate bents. By inspection, the end bents will not control the rating and, thus, were not rated.

2.1 Superstructure Rating

In order to rate the superstructure, AECOM engineers developed computer models using BAR7 and STAAD. The superstructure was modeled as a 7-span continuous bridge.

Critical Girders

There are three girder sizes within the cross section of this bridge:

- Fascia girders G1 and G11
- Sidewalk girders G2 and G10
- Roadway girders G3, G4, G5, G6, G7, G8 and G9

Girders G1 and G11 carry mainly the parapets and fill area below the sidewalk. Girders G2 and G10 are located below the sidewalk area; these girders see little to no live load effects. Based on this configuration, our rating makes the following assumptions:

1. Parapet loads and spandrel walls will be carried only by the fascia girders.
2. Dead loads from sidewalks and fill below sidewalk area will be distributed to the fascias and first interior girders.
3. Live loads will be distributed to girders G3 and G9 by positioning wheels 2 ft. from the curb line and using the lever rule in accordance with AASHTO.
4. AASHTO standard shear and moment distribution for reinforced concrete deck girders will be used for the roadway girders.
5. Distribution of wheel loads through the asphalt paving and fill material will conservatively not be considered.

Based on the dead loads and the distribution of live loads, girder G4 through G8 will control the capacity of the superstructure for this bridge.

Material Testing

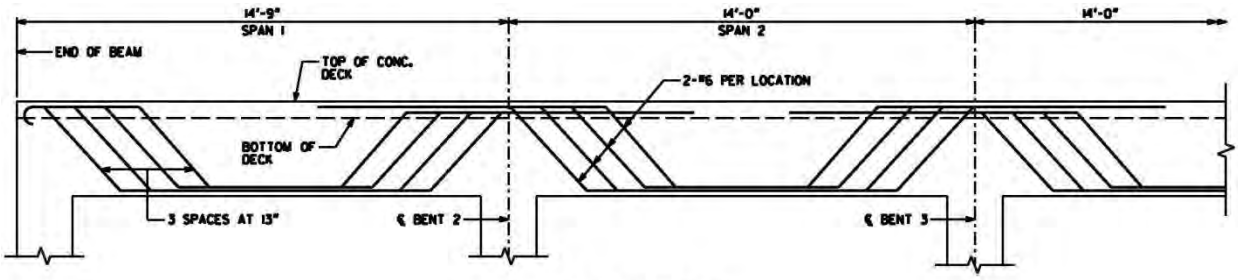
Because there are no existing plans for this bridge, AECOM completed material testing of the superstructure to determine concrete compressive strength and reinforcement configurations. AECOM supplemented this material testing with detailed field measurements and visual inspection. A copy of the testing report is included in Appendix F.

Our cores revealed strengths ranging from 3,000 psi to 3,800 psi. It is not unusual for compressive strengths to increase over time, especially on a 100 year old bridge. Based on bridge plans for a similar

streetcar bridge built around the same time, AECOM assumed the 28-day compressive strength of 2,500 psi for the original bridge condition analysis. Despite the higher field tested strengths, AECOM still limited the concrete strength used in the current girder ratings to 3,000 psi to be conservative.

Visual inspection of exposed reinforcement identified ¾" diameter, non-deformed reinforcement bars were used in the bottom of the girders. Patterns for this reinforcement were enhanced using Ground Penetrating Radar (GPR) scanning of the beams. Typical GPR scans identified 8 bars across the bottom of the beam and was visually confirmed at the spall on girder 9 in Span 4. Because the bars were so closely spaced across the 18" girder, GPR scans could not differentiate the 8 bars. GPR scans of the bottom of beams revealed that none of the bars in the bottom of the girders extend to the ends of the beam. GPR scans also identified a minimum of 2 bars bent up for shear at each angled bar location; there appears to be 4 bent up bar locations near the ends of the beams.

AECOM's rating assumes that all of the bars in the beams are ¾" in diameter. No vertical shear stirrups were identified by the GPR. The shear capacity of the section is developed by the concrete and inclined reinforcement. Examination of plans for other bridges in Atlanta built in the early 1900s revealed that it was common practice to bend steel from the high positive moment regions at a 45 degree angle across the shear plane near the supports and then continue it across the negative moment regions. This appears to be the reinforcement detailing for the girders in this structure. GPR scans identified four sets of diagonal bar locations spaced at approximately 13" on center at the ends of the girder. GPR scans identified 1 or 2 bars at each of these diagonal locations.



BEAM ELEVATION
BEAM 4 SHOWN
SPANS 1 AND 2 SHOWN, OTHER SPANS SIMILAR.

There are limitations to what can be identified with GPR testing for steel reinforcement. For this structure, determining the amount of reinforcement across the negative moment region of these girders is restricted. There is a 16" thick layer of asphalt and 14" of fill over the roadway sections of the bridge respectively; GPR scanning would require removal of a large section of asphalt and fill to complete the scanning. The deck can be scanned from the underside of the deck, but the angle of incidence would not allow reading of the bars located immediately over the stem with an acceptable level of accuracy.

Load Calculation

Non-composite loads were calculated using the girder stem dimensions and the tributary area of the slab over the girders. The superimposed dead load includes the layer of fill and asphalt overlay, which was distributed to the main girders based on tributary area.

AECOM researched the Ponce de Leon corridor and determined that this bridge was originally designed for streetcar loading. For replicating the original design, AECOM used streetcar load diagrams displayed on historic plans from bridges built in Atlanta during the same period.

Live load distribution was computed using Section 3.23 of the AASHTO Standard Specifications for Highway Bridges.

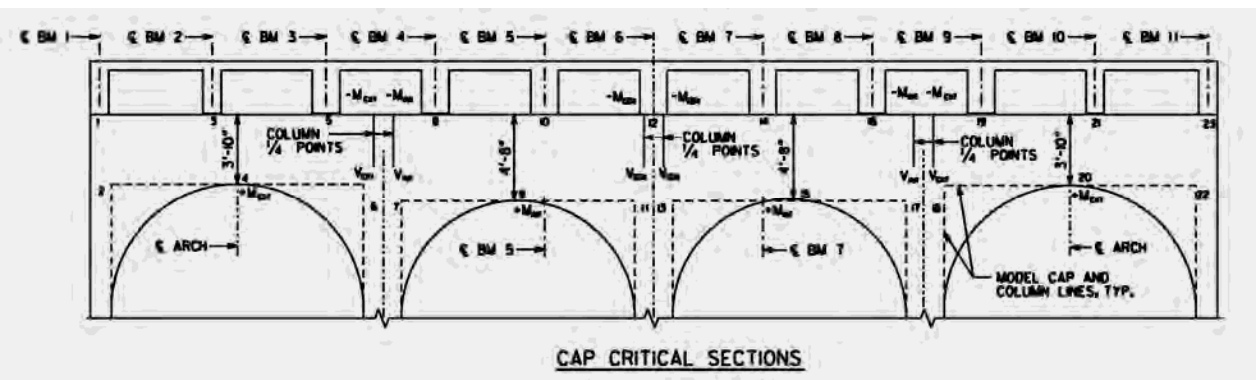
2.2 Intermediate Bent Rating

In order to rate the intermediate bents, AECOM engineers developed a computer models using BRPIER.

Intermediate Bent Model

The existing intermediate bents are composed of 5 columns with concrete arched caps between. Spaced 15.5' from the first interior columns, the outside columns are 1.25' wide x 1.67' deep and reside immediately below the fascia girder and parapet. The interior three columns are 2.167' wide x 1.67' deep and are spaced at 14.83' on center.

The outside bent cap sections are 1.67' wide x 3.83' deep at the arch crown. The interior sections are 1.67' wide x 4.67' deep at the arch crown; the deeper sections are consistent with the higher loads anticipated in these sections. Based on the reinforcement pattern determined by GPR, AECOM idealized the cap sections by neglecting the increased section properties from the arch. These arch sections were added in as dead load to the cap. A schematic of the BAR7 model with critical sections is shown below:



Live load distribution was determined using GDOT's BRLLCA program with these loads going to girders G2 through G10.

Material Testing

Because there are no existing plans for this bridge, AECOM completed material testing of the substructure to determine concrete compressive strength and reinforcement configurations. AECOM supplemented this material testing with detailed field measurements and visual inspection. A copy of the testing report is included in Appendix F.

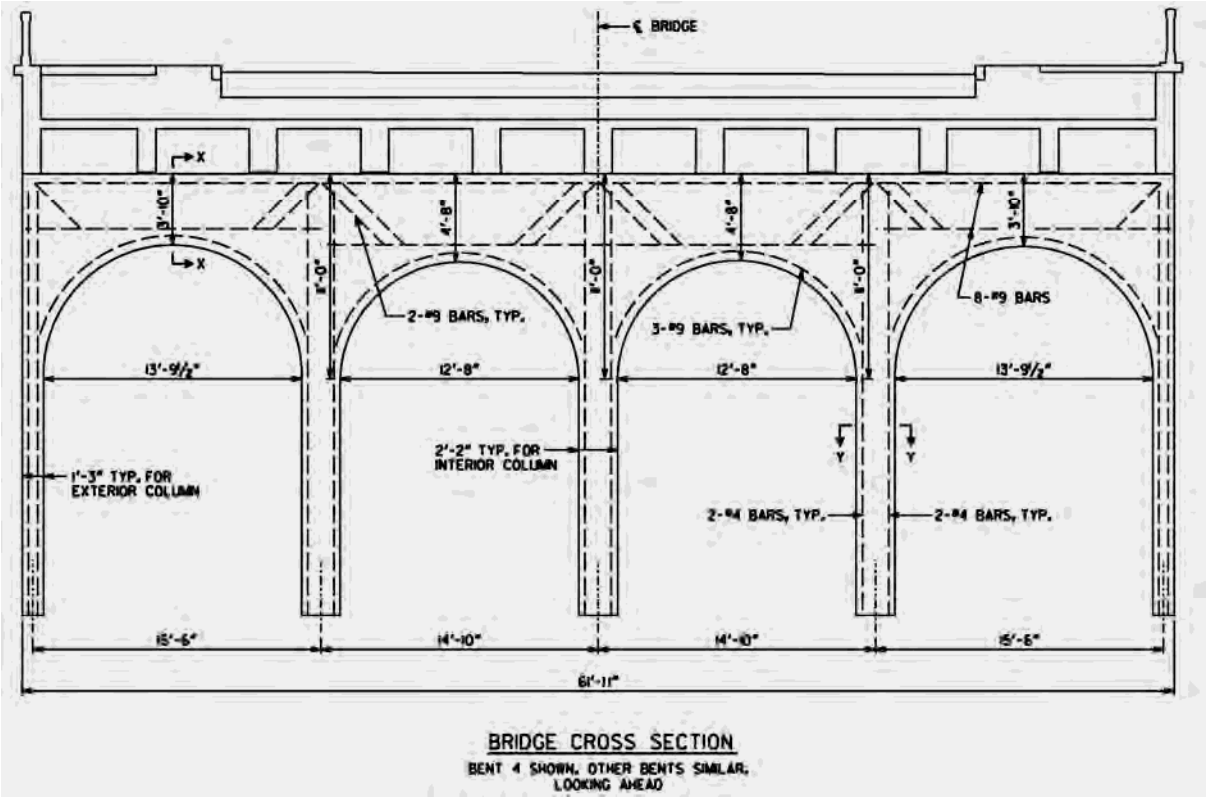
AECOM performed concrete coring to determine compressive strength of the cast-in-place substructure. Our cores for the substructure revealed strengths from 1000 psi to 1900 psi. The cores were taken from the columns in areas where the concrete was deteriorated. For the purposes of the rating, AECOM assumed a concrete strength of 1,500 psi.

Visual inspection of exposed reinforcement in spalled areas identified 1.125" diameter, non-deformed reinforcement bars were used in the top and bottom of caps. Patterns for this reinforcement were enhanced using GPR scanning of the caps and columns. Typical GPR scans identified 8 bars across the top of the bent cap. GPR scans also identified bars bent up for shear at in the areas of the bent caps

adjacent to the columns; there appears to be 2 bent up bar locations near the ends of the caps as shown in the Bridge Cross Section below.

AECOM's rating assumes that all of the bars in the bent caps are 1.125" in diameter. No vertical shear stirrups were identified by the GPR. The shear capacity of the section is developed by the concrete and inclined reinforcement.

The GPR was able to identify three bars running along the profile of the arch. In addition, the GPR identified bars running horizontally across the crown of the arch.



Visual inspection of spalled areas on the columns and GPR identified a ½" diameter bar in the corner of each column. No columns ties were identified.

<u>Load Calculation</u>
Girder dead load reactions were taken from the BAR7 reactions from the superstructure. Live load distribution was computed between curb lines using BRLLCA.

3.0 Load Rating Results

AECOM's approach to Load Rating this structure can be summarized with the following steps:

1. Determine capacity of the critical girders
2. Replicate the original design by computing loads, stresses and rating factors using the Streetcar and impact factors from a structure built during the same period
3. Determine H and HS rating for current conditions
4. Determine rating for remaining GDOT rating vehicles for the superstructure
5. Determine capacity of the bents
6. Compute the dead and live load reactions to the bents and the HS rating for the bent cap
7. Determine rating for remaining GDOT rating vehicles for the substructure

Step 1: AECOM's first step was to determine a capacity for the critical girders in the structure. Moment and shear capacity calculations (Appendix C) were completed for the critical roadway girders (G4 through G8) using material properties, bar locations and dimensions described in Section 3. Capacities were determined using MathCAD calculations and verified with BAR7.

It is important to note that the reinforcement configuration and the resultant capacity of the negative moment regions over the piers are assumed. However, correlations can be made to the capacity based on the anticipated loads. Dead and live load analysis results showed maximum positive moments at mid-span about equal to maximum negative moments over the piers. Engineering judgment and an understanding of construction practices of this era give us a reasonable level of certainty that the negative moment areas will rate at a comparable level as the positive moment regions.

The yield strength of reinforcement bars is assumed to be 33 ksi. This assumption is based on standard load rating practice and *CRSI Engineering Data Report No. 48 Evaluation of Reinforcing Bars in Old Reinforced concrete Structures* (See Appendix F).

Step 2: There are no existing plans for this bridge. The bridge is designed to carry fill and has a spandrel wall over the fascia girders containing this fill. The main girders of this bridge were designed to carry streetcar loading. Using historic streetcar loading for bridges built during this era, AECOM replicated the original design loading to elevate our level of confidence with the reinforcement configurations identified through GPR testing. Calculated steel stresses produced from the streetcar loading were well below allowable limits for 33 ksi steel; this is a solid indicator that the AECOM field identified reinforcement configurations were reasonable.

Step 3: All ratings were completed using Load Factor Method. Dead load calculations were completed based on field measurements of current conditions, live load analysis for the H and HS truck/lane loading, and ratings were completed with BAR7. Based on current bridge loading conditions, the existing condition H and HS ratings for the roadway girders (G4) are as follows:

G4: H20 - Current Condition

Force	Capacity	DL	LL+I	Truck	IR	Tons	OR	Tons
+M	273	45.0	59.4	20	1.66	33.28	2.78	55.56
-M	264	60.2	39.4	20	2.17	43.45	3.63	72.53
V	138	24.9	27.7	20	1.76	35.15	2.93	58.67

G4: HS20 - Current Condition

Force	Capacity	DL	LL+I	Truck	IR	Tons	OR	Tons
+M	273	45.0	61.9	36	1.60	57.49	2.67	95.96
-M	264	60.2	49.2	36	1.74	62.63	2.90	104.54
V	138	24.9	28.2	36	1.73	62.14	2.88	103.73

For the HS20 loading, results show that the shear and moment capacities are relatively close in magnitude to each other, which would be expected in the design of any bridge. The load ratings show that the girder capacity is 60% more than the HS loading. GDOT standard practice for reinforced concrete deck girders offers an interesting comparison. The standard deck girder bridge spanning 40 ft would have girders spaced at 9 ft on center, an 8" deck, and a total girder depth of 2.75 ft. This bridge has a 14 ft span, continuity, 6 ft spacing and approximately the same depth girder. AECOM's research shows that Georgia Power operated a streetcar line along Ponce de Leon in 1924. The short spans and deeper girders suggest that the design load was higher than current loads; the fill would be common on bridges where load distribution and a reduction in impact was intended.

Step 4: In the final step for the superstructure, AECOM completed ratings for the six standard GDOT vehicles: H-Mod, Tandem, Timber, HS-Mod, 3S2, and Piggyback. Detailed load rating calculations are included in Appendix C and summarized in the table below.

GDOT Vehicle Posting (Superstructure)

GDOT Rating Vehicle	OR (Tons)	Limit for Posting	Posting Y/N?
H-20 Mod	81.15	21.5	No
Tandem	83.79	33.0	No
Timber	105.12	37.1	No
HS20-Mod	115.93	30.0	No
3S2	134.30	40.0	No
Piggyback	173.81	40.0	No

Based on the above results for the superstructure, no posting would be required for this bridge.

Step 5: Moment and shear capacity calculations (Appendix C) were completed for the interior and exterior bent cap sections using material properties, bar locations and dimensions described in Section 3. Capacities were determined using MathCAD calculations and verified with BAR7.

Our inspection teams were able to identify the size and quantity of negative moment reinforcement through visual inspection of spalled areas. Reinforcement configuration and the resultant capacity of the positive moment regions over the mid-span of the caps are assumed. However, correlations can be made to the capacity based on comparing the magnitude of forces in each section.

Step 6: BAR7 dead and live load girder analysis results were used to determine maximum reactions for the bent analysis. Analysis of the piers determined that the maximum positive cap moments are below girders G5 and G7. The maximum negative moment region is over column 3. Controlling shear ratings are located adjacent to columns 2 and 4. The detailed load rating calculations are included in Appendix C and summarized in the table below.

Intermediate Bent: HS20 - Existing Condition

Force	Capacity	DL	LL+I	Truck	IR	Tons	OR	Tons
V_{ext}	249	-93.92	-48.86	36	1.20	43.09	2.01	72.52
$+M_{ext}$	758	143.65	28.33	36	9.29	334.57	15.51	558.47
$-M_{ext}$	758	-227.73	-120.87	36	1.76	63.40	2.94	105.84
$-M_{int}$	956	-225.0	-111.50	36	2.74	98.73	4.58	164.80
V_{int}	306	92.22	76.59	36	1.12	40.31	1.87	67.29
$+M_{int}$	956	120.95	166.98	36	2.20	79.36	3.68	132.47
V_{cen}	306	-50.84	-51.62	36	2.14	77.10	3.58	128.70
$-M_{cen}$	956	-133.93	-165.10	36	2.18	78.57	3.64	131.15
$-M_{cen}$	956	-133.93	-165.09	36	2.18	78.57	3.64	131.15
V_{cen}	306	50.38	51.62	36	2.14	77.11	3.58	128.72
$+M_{int}$	956	120.91	136.26	36	2.70	97.25	4.51	162.37
V_{int}	306	-92.23	-76.60	36	1.12	40.31	1.95	70.10
$-M_{int}$	956	-225.09	-111.59	36	2.74	98.63	4.57	164.63
$-M_{ext}$	758	-227.56	-120.80	36	1.76	63.47	2.94	105.95
$+M_{ext}$	758	143.71	30.43	36	8.65	311.44	14.44	519.86
V_{ext}	249	93.91	48.85	36	1.20	43.10	2.00	71.95

Step 7: In the final step for the substructure, AECOM completed ratings for the six standard GDOT vehicles: H-Mod, Tandem, Timber, HS-Mod, 3S2, and Piggyback. Detailed load rating calculations are included in Appendix C and summarized in the table below.

GDOT Vehicle Posting (Substructure)

GDOT Rating Vehicle	OR (Tons)	Limit for Posting	Posting Y/N?
H-20 Mod	58.58	21.5	No
Tandem	57.06	33.0	No
Timber	73.88	37.1	No
HS20-Mod	83.68	30.0	No
3S2	83.16	40.0	No
Piggyback	119.37	40.0	No

Based on the above results for the substructure, no posting would be required for this bridge.

4.0 Conclusions and Recommendations

The purpose of performing the inspection and materials testing of this structure was to obtain enough information for use in a conventional line girder analysis and rating. There are two items that could not be verified through the field inspection and material testing. These items and their associated assumptions for rating are as follows:

1. In the girders, the amount of negative moment reinforcement over the piers could not be determined. AECOM's load analysis showed the moment levels in these areas are comparable to the positive moment regions; therefore, negative moment rating levels would expect to be at the same level as the positive moment regions.

2. In the bent caps, the amount of positive moment reinforcement over the arches could not be determined. AECOM's load analysis showed the moment levels in these areas are comparable to the negative moment regions; therefore, rating levels would expect to be at the same level as the negative regions.

Our analysis shows that the bridge is rating at an H and HS rating equal to 33 tons and 57 tons, respectively. Because there are unknowns associated with the above listed assumptions, there is still a level of uncertainty associated with the capacity of the structure; however, AECOM's replication of the original design loads and steel stresses supports the final rating of this report. The following table shows a summary of the controlling girder load rating:

Superstructure Rating Summary

Live Load	IR	IR (Tons)	OR	OR (Tons)	Posting Y/N?
H20	1.66	33.28	2.78	55.56	-
HS20	1.60	57.49	2.67	95.96	-
H-20 Mod	2.31	48.61	3.86	81.15	No
Tandem	1.52	50.20	2.54	83.79	No
Timber	1.70	62.97	2.84	105.12	No
HS20-Mod	2.31	69.45	3.86	115.93	No
3S2	2.01	80.46	3.36	134.30	No
Piggyback	2.60	104.12	4.35	173.81	No

The substructure ratings shown below are likely conservative because our model ignores additional shear and moment capacity created by the additional section depth created by the arches. The following table shows a summary of the controlling intermediate bent load ratings:

Substructure Rating Summary

Live Load	IR	IR (Tons)	OR	OR (Tons)	Posting Y/N?
H20	1.12	22.39	1.87	37.38	-
HS20	1.12	40.31	1.87	67.29	-
H-20 Mod	1.67	35.09	2.79	58.58	No
Tandem	1.04	34.19	1.73	57.06	No
Timber	1.20	44.26	2.00	73.88	No
HS20-Mod	1.67	50.13	2.79	83.68	No
3S2	1.25	49.82	2.08	83.16	No
Piggyback	1.79	71.51	2.98	119.37	No

4.1 Bridge Condition and Load Capacity

In determining bridge capacity, it is important to identify any defects due to load distress that would significantly lower the capacity of the bridge. For this structure, the presence of significant tension cracks at the girder midspan, spalls at the midspan, and shear cracks at the supports would be a concern.

It should be noted that the bridge is heavily traveled and has no load restrictions, which means there is a high probability that the structure has seen loads that exceed the current legal limits. There are no significant shear or tension cracks on the girders that could be attributed to capacity issues. Most of the defects in the girders are spalls. There are major spalls in girders G3 and G9 adjacent to the deck drains; constant contact with water from the drains has propagated these spalls.

As identified in Section 1.0, some of the girders displayed spalls with exposed reinforcement suffering minor section loss. These areas should be repaired to preserve and extend the life of this structure. In addition, the repairs should consider an alternate deck drain detail that channels water away from the girders.

4.2 What we expect from a Load Test?

A full diagnostic load test is the primary method used to determine the load carry capacity of a structure. As outlined in the NCHRP's *Manual for Bridge Rating Through Nondestructive Load Testing*, there are a number of factors associated with the bridge configuration which may influence the actual load carrying capacity of bridges. On this structure, AECOM has identified the following factors:

1. Asphalt Overlay and fill: Due to the presence of the thick asphalt overlay and fill layer, there would be improved live load distribution and reduced impact on this structure. As an alternative to conventional wheel load distribution on multi-girder bridges, culvert distribution and impact criteria could be applied on this structure.

2. Endwalls: Full height, concrete endwalls, cast monolithic with the deck and longitudinal girders, will create fixed end moments, rather than behaving as a pinned connection as modeled in the conventional load rating. There would be unintended continuity resulting from the endwalls.

Distribution factors for multi-girder bridges are conservative and meant for design purposes. Studies have shown that the two-way stiffness of bridge decks provide improved distribution in the longitudinal and transverse directions.

By neglecting the distribution and impact reduction created by the presence of fill over the deck, AECOM's approach to load distribution used in this analysis is conservative.

Because of the number of factors that would likely increase live load distribution on the structure, AECOM expects that the load rating would increase as a result of a diagnostic load test.

4.3 Recommendations

Even with assumptions made regarding the reinforcement in the negative moment regions of the girders, there is increased certainty with this load rating because of clarity gained from the visual inspection and material testing. The lack of defects commonly associated with shear or tension overstress support the load rating values outlined in the report.

A diagnostic load test would determine a more exact rating for this structure. The presence of unintended continuity details and the multi-girder superstructure configuration have a high probability of producing substantial increases in the current rating if a load test is executed. In our opinion, the conventional rating performed as part of this project is sufficient for the bridge, and the cost to benefit of performing a diagnostic load test is not warranted.

AECOM does recommend maintaining the current inspection frequency for the bridge and perform the following bridge repairs to preserve and extend the life of the structure:

Deck

1. Repair underside deck spalls found throughout the bridge.
2. For improved long term maintenance, remove fill, repair defects in top of deck, and install waterproofing and drainage system in the fill area.

Superstructure

1. Repair spalls at the following locations:
    a) Span 1 Beams 2, 9 and 10
    b) Span 4 Beam 9
    c) Span 7 Beams 2, 3, 8, 9 and 10

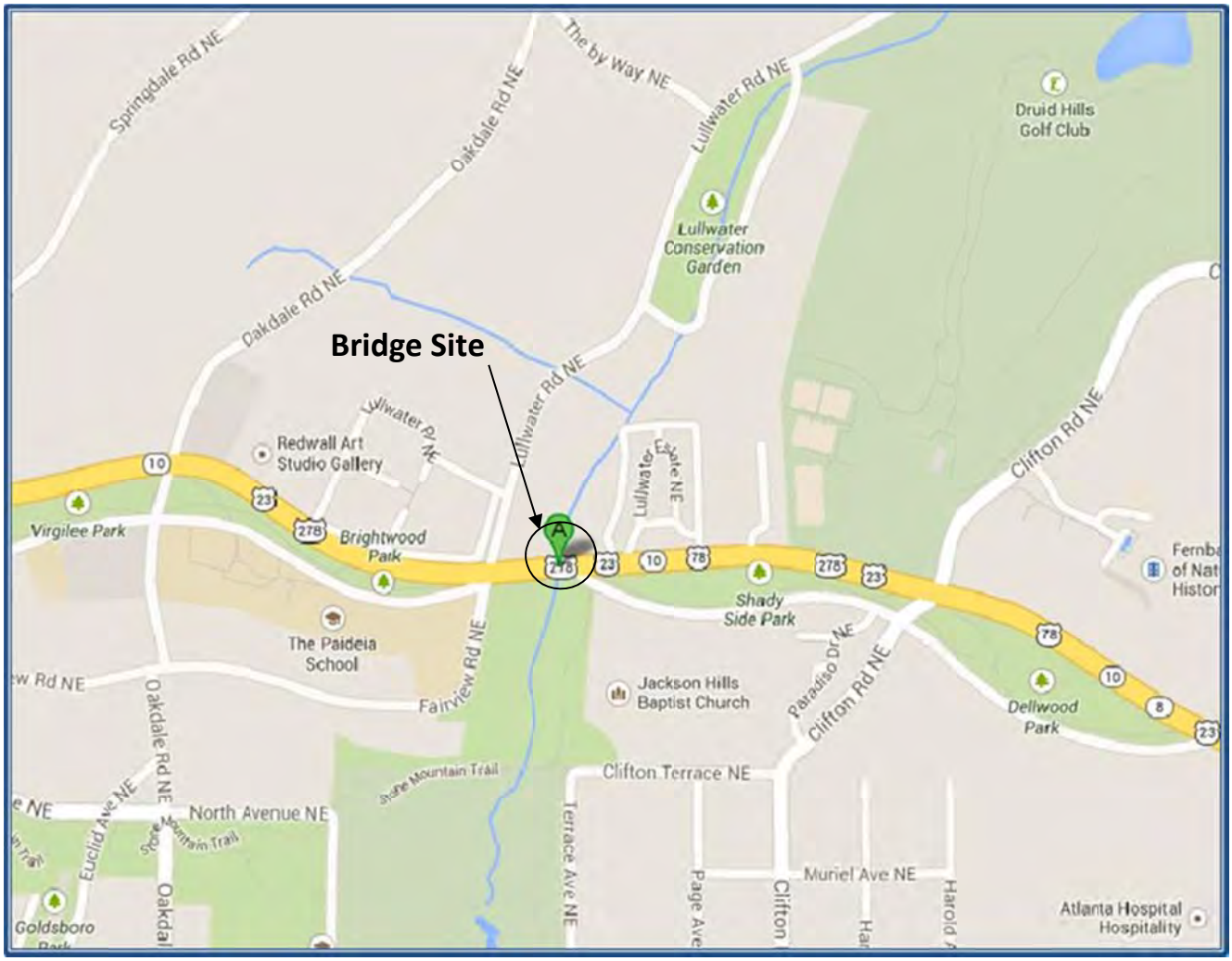
Substructure

1. Repair spalls at the following locations:
    a) Bent 2 Right side backface
    b) Bent 2 Column 1
    c) Bent 4 Column 5
2. Monitor horizontal cracks at abutment walls for future movement. If lateral shifts in the abutment walls are identified, install supplementary lateral support such as tiebacks.

General

1. Install new deck drain system with downspouts directed away from primary members.
2. Remove vegetation in contact with structure.
3. Apply special protective coating to all concrete surfaces.

Appendix A – Location Map



Historical Atlanta Streetcar Map

Appendix B – GDOT Bridge Information

BRIDGE INVENTORY DATA LISTING GEORGIA DEPARTMENT OF TRANSPORTATION

Structure ID: 089-0001-0 **DeKalb** SUFF. RATING 42.38

Location & Geography

*		Structure I.D.No:	089-0001-0
	200	Bridge Information	07
*	6A	Feature Int:	LULLWATER CREEK
*	6B	Critical Bridge:	0
*	7A	Route Number Carried:	SR00008
*	7B	Facility Carried:	PONCE DE LEON
*	9	Location:	2.5 MI W OF DECATUR
	2	DOT District:	7
	207	Year Photo:	2012
*	91	Inspection Frequency:	24 Date: 04/26/2012
	92A	Fract Crit Insp Freq:	00 Date: 02/01/1901
	92B	Underwater Insp Freq:	00 Date: 02/01/1901
	92C	Other Spc. Insp Freq:	00 Date: 02/01/1901
*	4	Place Code:	04000
*	5	Inventory Route (O/U):	1
		Type:	2
		Designation:	1
		Number:	00023
		Direction:	0
*	16	Latitude: 33-46.4377	MMS Prefix: SR
*	17	Longitude: 84-20.1722	MMS Suffix: 00 MP: 0.76
	98	Border Bridge:	000 %Shared: 00
	99	ID Number:	000000000000000
*	100	STRAHNET:	0
	12	Base Highway Network:	1
	13A	LRS Inventory Route:	891000800
	13B	Sub Inventory Route:	0
*	101	Parallel Structure:	N
*	102	Direction of Traffic:	2
*	264	Road Inventory Mile Post:	000.76
*	208	Inspection Area:	07 Initials: JPD
		Engineer's Initial:	sgm

* Location I.D. No.: 089-00008D-000.76E

*	104	Highway System:	0
*	26	Functional Classification:	14
*	204	Federal Route Type:	F No.: 00032
	105	Federal Lands Highway:	0
*	110	Truck Route:	0
	206	School Bus Route:	1
	217	Benchmark Elevation:	0000.00
	218	Datum:	0
*	19	Bypass Length:	02
*	20	Toll:	3
*	21	Maintenance:	01
*	22	Owner:	01
*	31	Design Load:	2
	37	Historical Significance:	2
	205	Congressional District:	05
	27	Year Constructed:	1922
	106	Year Reconstructed:	0000
	33	Bridge Median:	0
	34	Skew:	00
	35	Structure Flared:	0
	38	Navigation Control:	0
	213	Special Steel Design:	0
	267	Type of Paint:	0
*	42	Type of Service on:	5
		Under:	5
	214	Movable Bridge:	0
	203	Type Bridge:	A-O-O-O
	259	Pile Encasement:	3
*	43	Structure Type Main:	2 04
	45	No. Spans Main:	007
	44	Structure Type Appr:	0 00
	46	No. Spans Appr:	0000
	226	Bridge Curve Horz:	0 Vert: 0
	111	Pier Protection:	0
	107	Deck Structure Type:	1
	108	Wearing Surface Type:	6
		Membrance:	1
		Protection:	8

Signs & Attachments

	225	Expansion Joint Type:	00
	242	Deck Drains:	2
	243	Parapet Location:	0
		Height:	0.00
		Width:	0.00
	238	Curb:	0.50 1
	239	Handrail:	1 1
*	240	Median Barrier Rail:	0
	241	Bridge Median Height:	0.00
		Width:	0.00
*	230	Guardrail Loc Dir Rear:	0
		Fwrd:	0
		Oppo Dir Rear:	0
		Fwrd:	0
	244	Approach Slab:	0
	224	Retaining Wall:	1
	233	Posted Speed Limit:	25
	236	Warning Sign:	0
	234	Delineator:	0
	235	Hazard Boards:	0
	237	Utilities Gas:	00
		Water:	00
		Electric:	00
		Telephone:	00
		Sewer:	00
	247	Lighting Street:	0
		Naviagtion:	0
		Aerial:	0
*	248	County Continuity No.:	05

BRIDGE INVENTORY DATA LISTING GEORGIA DEPARTMENT OF TRANSPORTATION

Structure ID: 089-0001-0 **DeKalb** SUFF. RATING 42.38

Programming Data

201 Project No.: SP
202 Plans Available: 0
249 Prop. Proj. No. BRG-0007-00(031)
250 Approval Status: 0000
251 P.I. No.: 0007031
252 Contract Date: 02/01/1901
260 Seismic No.: 00000
75 Type Work: 31 1
94 Bridge Imp. Cost: $ 328
95 Roadway Imp. Cost: $ 126
96 Total Imp Cost: $ 541
76 Imp. Length: 000311
97 Imp. Year: 1990
114 Future ADT: 047475 Year: 3930

Hydraulic Data

215 Waterway Data
Highwater Elev.: 0000.0 Year: 1900
Avg. Streambed Elev.: 0000.0 Freq.: 00
Drainage Area: 00000
Area Of Opening: 000000
113 Scour Critical: U
216 Water Depth: 00.5 Br. Height: 29.3
222 Slope Protection: 0
221 Spur Dikes Rear: 0 Fwrd: 0
219 Fender System: 0
220 Dolphin: 0
223 Culvert Cover: 000
Type: 0
No. Barrels: 0
Width: 0.00 Height: 0.00
Length: 0 Apron: 0
* 265 U/W Insp. Area: 0 Diver: ZZZ

* Location I.D. No.: 089-00008D-000.76E

Measurements

* 29 ADT: 031650 Year: 3910
109 % Trucks: 0
* 28 Lanes On: 04 Under: 00
210 No. Tracks On: 00 Under: 00
* 48 Max. Span Length: 0014
* 49 Structure Length: 98
51 Br. Rwdy. Width: 40.00
52 Deck Width: 62.50
* 47 Tot. Horz. Cl: 40.00
50 Curb/Sdewlk Width: 6.00/6.00
32 Approach Rdwy Width: 040
* 229 Shoulder Width:
Rear Lt: 0.00 Type: 7 Rt: 0.00
Fwrd Lt: 0.00 Type: 7 Rt: 0.00
Pavement Width:
Rear: 40.00 Type: 2
Fwrd: 40.00 Type: 2
Intersection Rear: 1 Fwrd: 1
36 Safety Features Br. Rail: 2
Transition: 0
App. G. Rail: 0
App. Rail End: 0
53 Minimum Cl.Over: 99 ' 99 "
Under: N 00 ' 00 "
* 228 Min. Vertical Cl
Act. Odm Dir: 99 ' 99 "
Oppo. Dir: 99 ' 99 "
Posted Odm. Dir: 00 ' 00 "
Oppo. Dir: 00 ' 00 "
55 Lateral Undercl. Rt: N 0.00
56 Lateral Undercl. Lt: 0.00
* 10 Max Min Vert Cl: 99 ' 99 " Dir: 0
39 Nav Vert Cl: 000 Horz: 0000
116 Nav Vert Cl Closed: 000
245 Deck Thickness Main: 12.00
Deck Thick Approach: 0.00
246 Overlay Thickness: 16.00
212 Year Last Painted: Sup: 0000 Sub: 0000

Ratings

65 Inventory Rating Method: 2
63 Inventory Rating Method: 2
66 Inventory Type: 2 Rating: 36
64 Operating Type: 2 Rating: 52
231 Calculated Loads
H-Modified: 20 0
HS-Modified: 25 0
Type 3: 28 0
Type 3s2: 40 0
Timber: 36 0
Piggyback: 40 0
261 H Inventory Rating: 20
262 H Operating Rating: 29
67 Structural Evaluation: 4
58 Deck Condition: 5
59 Superstructure Condition: 5
* 227 Collision Damage: 0
60A Substructure Condition: 4
60B Scour Condition: 8
60C Underwater Condition: N
71 Waterway Adequacy: 8
61 Channel Protection Cond: 7
68 Deck Geometry: 2
69 UnderClr. Horz/Vert: N
72 Appr. Alignment: 8
62 Culvert: N

Posting Data

70 Bridge Posting Required: 5
41 Struct Open, Posted, Cl: A
* 103 Temporary Structure: 0
232 Posted Loads H-Modified: 00
HS-Modified: 00
Type 3: 00
Type3s2: 00
Timber: 00
Piggyback: 00
253 Notification Date 02/01/1901
253 Fed Notify Date: 02/01/1901 0

GEORGIA DEPARTMENT OF TRANSPORTATION

Bridge Inspection Report

District: 7 **Inspection Date:** 4/26/2012 **Inspection Area:** 07
Bridge Inspector: Jeramy Durrence **Over:** LULLWATER CREEK **Bridge Status:** 07
Location ID: 089-00008D-000.76E **County:** DeKalb
Structure ID: 089-0001-0 **Road Name:** PONCE DE LEON

EVALUATION & DEFICIENCIES

SubStructure: **Year Painted:** 0000

Abutments # 1 & 8 are vertical concrete columns with concrete reinforced back wall. All columns and back walls are cracking.
Bents # 2,3,4,5,6 & 7 are concrete columns and arches

Both caps and back walls at both abutments have cracking and spalling with exposed rebar.

Abutment # 1 has horizontal cracks in columns # 1,3,5,7,8 & 9. The worst cracks are at column # 3, 3.6' below cap and open 1/2".
Column # 7 has two cracks at 1.2' and 7.7' below cap. Cracks at column #7 are 1/2"W.
Column #2 at abutment #1 has a pop out spall with exposed rebar. (see photo)
Note : Columns are 11.5' tall to bottom of cap. and 16.5' to top of cap.
Bent 2 column 1 has corner spall with exposed rebar.
Bent 4 column 5 has spall with exposed rebar.

Rear side of column 5 at bent 4 has a pop out spall with exposed rebar.
Bent # 7 column # 3 has two spalls on corners at the ground line. The exposed steel has 100 % section loss.

Abutment # 8 has horizontal cracks in columns # 3,4,5 & 7. These cracks are from 2.8' below cap to cap connection and are 1/16" to 1/8" open.
Columns are 10.5' high to bottom of cap and 15.5' to top of cap.

Abutment 8 in bay 6 has a 3 SF spall with exposed rebar.

SuperStructure: **Year Painted:** 0000

Seven spans with (11) concrete T - beams and arch design.
Beams 1 and 11 are an arch design, these are the exterior beams.

Beams 1,2,8,9,10, & 11 at abutment 1 have minor cracking and spalling with some exposed rebar. (see photo)
Beam 3 in span 4 has minor cracking and beginning to spall.
Beam 9 in span 4 has a 5'L x 1'H x 3"D spall with exposed rebar. Rebar has minor corrosion. (see photo)
Beams 3 and 9 in span are below a drain hole and are at the edge of the roadway.
Span 4 beam 8 has spall with exposed rebar midspan.

Deck:

12" Concrete deck with 16" asphalt overlay.

Spalls, cracks & exposed rebar throughout on bottom due to age.
Exposed rebar has corrosion and minor section loss.
Bottom side of deck between beams 7 and 8 in span 6 has minor delamination.
Bottom side of deck has transverse cracking with efflorescence.

General:

GEORGIA DEPARTMENT OF TRANSPORTATION

Bridge Inspection Report

District: 7 **Inspection Date:** 4/26/2012 **Inspection Area:** 07
Bridge Inspector: Jeramy Durrence **Over:** LULLWATER CREEK **Bridge Status:** 07
Location ID: 089-00008D-000.76E **County:** DeKalb
Structure ID: 089-0001-0 **Road Name:** PONCE DE LEON

EVALUATION & DEFICIENCIES

Built in 1922. H - 15 design. Project # Unknown.
Bridge is in fair overall condition but has spalls, cracks and exposed steel throughout due to age.
Minor drift on upstream side.
Condition ratings could be upgraded with maintenance.

Structure has a proposed project # BRG-0007-00(031) and PI # 0007031.

Bridge has concrete floor underneath from bent # 2 to bent # 6.

JTE MEET WITH ROOSEVELT WILSON, ASST. DISTRICT BRIDGE MANAGER FOR DISTRICT 7 ABOUT NEEDED MAINTENANCE REPAIRS. LISTED DEFENCIES WILL BE SCHEDULED FOR REPAIR.

Required maintenance: Repair cracking and spalling in beams, caps, and columns.

Condition Rating

Component	Material	Rating
Substructure	Concrete	4
Superstructure	Concrete	5
Deck	Concrete	5

Temp Shored: **No**

Truck Type	Gross/H-Mod	HSMod	Tand	3-S-2	Log	Piggy
Calculated Posting	20	25	28	40	36	40
Posting Required	No	No	No	No	No	No
Existing Posting	00	00	00	00	00	00

*****School Bus Route.******

Structure Does Not Require Posting

GEORGIA DEPARTMENT OF TRANSPORTATION

Deficiency Report

District: 7 **Inspection Date:** 4/26/2012 **Inspection Area:** 07
Bridge Inspector: Jeramy Durrence **Over:** LULLWATER CREEK
Location ID: 089-00008D-000.76E **County:** DeKalb
Structure ID: 089-0001-0 **Asst. District Engineer:** Shun Pringle

EVALUATION & DEFICIENCIES

PONCE DE LEON Over LULLWATER CREEK-------2.5 MI W OF DECATUR

Item	Units	Work	P	Date Reported	Location	Date Completed	Complete
845	HOURS	48	B	3/22/2000		1/31/2005	1,776.00
830	HOURS	168	B	3/13/2002		1/31/2005	1,055.00
830	HOURS	192	B	3/14/2002		1/31/2005	1,054.00
810	SQ. FT.	25	B	9/24/2008	see comments		***
830	HOURS	100	B	9/24/2008	see comments		***

Comments:

810 - repair numerous spalls with exposed rebar on underside of deck throughout.
830 - repair numerous spalls with exposed rebar on superstructure and substructure elements throughout.

GEORGIA DEPARTMENT OF TRANSPORTATION

Waterway Report

District: 7 **Inspection Date:** 4/26/2012 **Inspection Area:** 07

Bridge Inspector: Jeramy Durrence **Over:** LULLWATER CREEK

Location ID: 089-00008D-000.76E **County:** DeKalb **Skew:** 00

Structure ID: 089-0001-0 **Road Name:** PONCE DE LEON

Span #:	1	2	3	4	5	6	7
Length:	**14.0**	**14.0**	**14.0**	**14.0**	**14.0**	**14.0**	**14.0**

Upstream -

Upstream +		1	2	3	4	5	6	7	8
10/01/1998	DAS		0.00	27.30	26.10	0.00	0.00	0.00	0.00
		0.00	0.00	27.30	24.30	0.00	0.00	0.00	
03/22/2000	DAS,LEU		19.30	26.30	25.10	24.50	17.80	17.20	15.90
		18.50	22.20	26.30	24.30	21.70	17.30	16.10	
03/13/2002	DAS,GKK		25.90	29.10	29.20	24.40	20.30	20.00	18.50
		21.00	22.10	28.10	29.80	27.90	20.40	20.10	
05/14/2004	DAS,GKK		26.00	26.30	29.20	24.40	20.30	20.00	18.50
		21.00	22.20	28.10	29.80	27.80	20.40	20.00	
06/08/2006	DAS,GKK		26.00	26.30	29.20	24.40	20.30	20.00	18.50
		21.00	22.20	28.00	29.80	27.80	20.40	20.00	
09/24/2008	JTE/BRL		24.30	28.00	29.80	28.00	23.50	20.50	19.50
		22.30	26.70	29.00	28.70	26.70	20.80	20.00	
06/30/2010	JPD,LJM		24.30	28.00	29.80	28.00	23.70	20.60	19.50
		22.30	26.70	29.00	28.70	26.70	20.90	20.00	
04/26/2012	JPD,LJM		24.30	28.00	29.80	28.00	23.70	20.60	19.50
		22.30	26.70	29.00	28.70	26.70	20.90	20.00	

Downstream -

Downstream +		1	2	3	4	5	6	7	8
10/01/1998	DAS		0.00	27.10	27.10	0.00	0.00	0.00	0.00
		0.00	0.00	27.60	24.30	0.00	0.00	0.00	
03/22/2000	DAS,LEU		21.90	26.10	26.10	25.00	19.10	17.60	16.80
		19.30	22.70	26.60	26.00	23.60	18.30	17.10	
03/13/2002	DAS,GKK		25.20	29.70	31.10	31.00	23.80	20.90	19.80
		22.20	27.80	30.60	30.70	27.30	21.40	20.30	
05/14/2004	DAS,GKK		25.20	29.70	31.10	31.00	23.80	20.90	19.80
		22.20	27.80	30.50	30.60	27.30	21.40	20.30	
06/08/2006	DAS,GKK		25.20	29.70	31.10	31.00	23.70	20.80	19.80
		22.20	27.80	30.50	30.60	27.30	21.40	20.20	

GEORGIA DEPARTMENT OF TRANSPORTATION

Waterway Report

District: 7 **Inspection Date:** 4/26/2012 **Inspection Area:** 07

Bridge Inspector: Jeramy Durrence **Over:** LULLWATER CREEK

Location ID: 089-00008D-000.76E **County:** DeKalb **Skew:** 00

Structure ID: 089-0001-0 **Road Name:** PONCE DE LEON

		1	2	3	4	5	6	7	8
09/24/2008	JTE/BRL		20.30	26.60	29.20	27.40	20.70	20.00	18.40
		20.50	26.30	28.60	28.10	24.00	19.30	19.50	
06/30/2010	JPD,LJM		20.50	26.60	29.10	27.20	20.70	20.00	18.40
		20.50	26.30	28.90	28.10	24.00	19.60	19.50	
04/26/2012	JPD,LJM		20.50	26.60	29.10	27.20	20.70	20.00	18.40
		20.50	26.30	28.90	28.10	24.00	19.60	19.50	

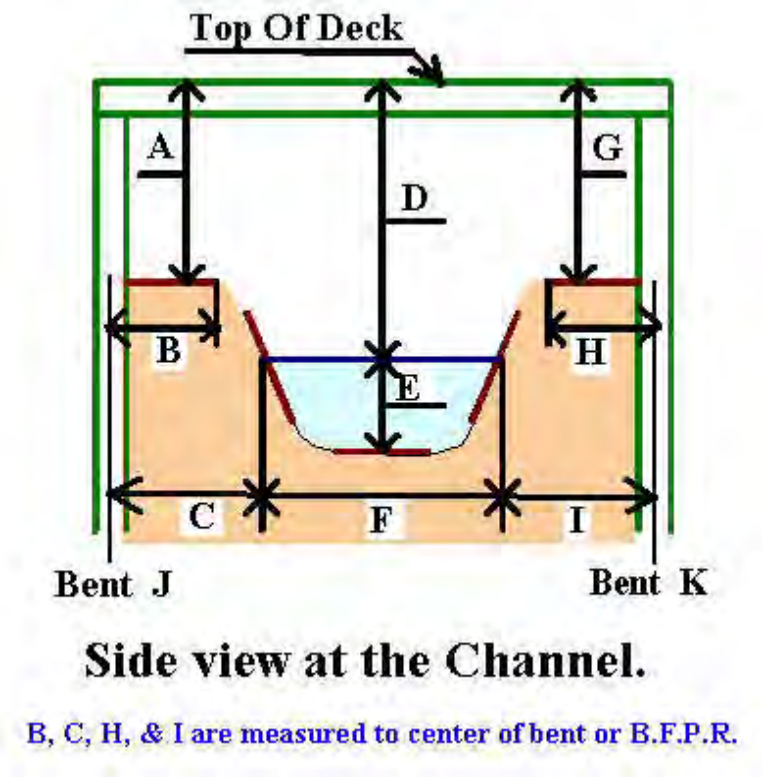
GEORGIA DEPARTMENT OF TRANSPORTATION

Waterway Report

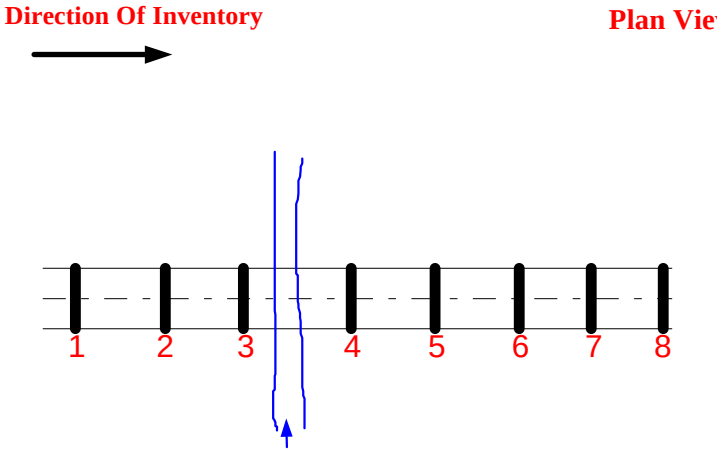
District: 7
Bridge Inspector: Jeramy Durrence
Location ID: 089-00008D-000.76E
Structure ID: 089-0001-0

Inspection Date: 4/26/2012
Over: LULLWATER CREEK
County: DeKalb
Road Name: PONCE DE LEON

Inspection Area: 07
Skew: 00



A:	0
B:	0
C:	8
D:	29.3
E:	00.5
F:	3
G:	0
H:	0
I:	3
J:	3
K:	4



Location of Bridge Height 5' rear Bent 4

Scour Condition: 8 **Waterway Adequacy:** 8 **Channel Protection:** 7

0 = **SubStructure**
0 = **Channel Skew**

0 = **Stream Angle**

Comments:
Bridge has concrete paving under from bent # 2 to bent # 6.
Soundings were taken just off of edge of channel paving at bents # 3 & 4.

GEORGIA DEPARTMENT OF TRANSPORTATION

Pontis Report

District: 7 **Inspection Date:** 4/26/2012 **Inspection Area:** 07

Bridge Inspector: Jeramy Durrence **Over:** LULLWATER CREEK

Location ID: 089-00008D-000.76E **County:** DeKalb **Skew:** 00

Structure ID: 089-0001-0 **Road Name:** PONCE DE LEON

Element	Quantity	Environment	State1	State2	State3	State4	State5
12	3,920	2	392	0	0	0	0
110	1,078	2	105	20	10	0	1
205	48	2	40	0	8	0	0
215	125	2	100	10	15	0	0
234	500	2	400	50	10	0	0
331	200	2	100	0	0	0	0
359	1	2	0	0	0	1	0

GEORGIA DEPARTMENT OF TRANSPORTATION

Bridge Component Report

District: 7
Bridge Inspector: Jeramy Durrence
Location ID: 089-00008D-000.76E
Structure ID: 089-0001-0

Inspection Date: 4/26/2012
Over: LULLWATER CREEK
County: DeKalb
Road Name: PONCE DE LEON

Inspection Area: 07

SubStructure Data

Bent#	Type	Foundation	Col	#Cols	Piling	#Piles	Sway	CAP	Remarks
1	A	SF		0		0		C	Vertical wall
2	B	SF	C	6		0		C	Arch type
3	B	SF	C	6		0		C	Arch type
4	B	SF	C	6		0		C	Arch type
5	B	SF	C	6		0		C	Arch type
6	B	SF	C	6		0		C	Arch type
7	B	SF	C	6		0		C	Arch type
8	A	SF		0		0		C	Vertical wall

SuperStructure Data

Span#	Beam Type	Spacing	Length	#Beams	Remarks
1	Concrete "T" Beam	6.00	14.00	11	28"HX18"W
2	Concrete "T" Beam	6.00	14.00	11	28"HX18"W
3	Concrete "T" Beam	6.00	14.00	11	28"HX18"W
4	Concrete "T" Beam	6.00	14.00	11	28"HX18"W
5	Concrete "T" Beam	6.00	14.00	11	28"HX18"W
6	Concrete "T" Beam	6.00	14.00	11	28"HX18"W
7	Concrete "T" Beam	6.00	14.00	11	28"HX18"W

Bearing Data

Span#	Rear Type Bearing	FWD Type Bearing	Remarks
1	08 - Beam on Cap	08 - Beam on Cap	
2	08 - Beam on Cap	08 - Beam on Cap	
3	08 - Beam on Cap	08 - Beam on Cap	
4	08 - Beam on Cap	08 - Beam on Cap	
5	08 - Beam on Cap	08 - Beam on Cap	
6	08 - Beam on Cap	08 - Beam on Cap	

GEORGIA DEPARTMENT OF TRANSPORTATION

Bridge Component Report

District: 7
Bridge Inspector: Jeramy Durrence
Location ID: 089-00008D-000.76E
Structure ID: 089-0001-0

Inspection Date: 4/26/2012
Over: LULLWATER CREEK
County: DeKalb
Road Name: PONCE DE LEON

Inspection Area: 07

7	08 - Beam on Cap	08 - Beam on Cap

Appendix C – Load Rating Calculations

1. Superstructure Calculations
    a. Original Condition
        i. Girder Capacity and Stress
        ii. Girder Dead and Live Loads
    b. Current Condition
        i. Girder Capacity
        ii. Girder Dead and Live Loads
2. Intermediate Bent Cap Calculations

Input Loads - BEAM 4

Bridge Geometry:

$Span := 14ft$ $\qquad$ $Beam_spacing := 6.0ft$

$T_{slab} := 6.0in$ $\qquad$ $No_beams := 11$ $\qquad$ $No_rdwybeams := 7$

$W_{conc} := 0.150\frac{kip}{ft^3}$ $\qquad$ $W_{asphalt} := 0.140\frac{kip}{ft^3}$ $\qquad$ $W_{clay} := 0.120\frac{kip}{ft^3}$

Beam Data: **Concrete T-Beam**

$B_f := 18in$ $\qquad$ $Bm_ht := 28in$ $\qquad$ Stem only

$Bm_wt := B_f \cdot Bm_ht \cdot W_{conc} = 0.525 \cdot \frac{kip}{ft}$ $\qquad$ Nominal weight per foot per beam

- **Existing Condition: (Roadway Beam)**

Noncomposite Dead Loads (DL1):

$DeckSelfWgt := T_{slab} \cdot Beam_spacing \cdot W_{conc} = 0.450 \cdot \frac{kip}{ft}$

$DL1_{exist} := DeckSelfWgt + Bm_wt = 0.975 \cdot \frac{kip}{ft}$

Composite Dead Loads (DL2):

$T_{asphalt} := 16in$

$Asphalt := T_{asphalt} \cdot Beam_spacing \cdot W_{asphalt} = 1.12 \cdot \frac{kip}{ft}$

$T_{clay} := 14in$

$Clay := T_{clay} \cdot Beam_spacing \cdot W_{clay} = 0.84 \cdot \frac{kip}{ft}$

$Overlay := Asphalt + Clay = 1.96 \cdot \frac{kip}{ft}$

$DL2_{exist} := Overlay = 1.96 \cdot \frac{kip}{ft}$

Distribution Factors:

$RoadwayWidth := 40.5ft$ $\qquad$ Width of roadway from curb to curb in feet.

$BmSpacLft := 6.0ft$ $\qquad$ $BmSpacRgt := 6.0ft$

$$OHorSpacing := \frac{(BmSpacLft + BmSpacRgt)}{2} = 6 \cdot ft$$

$$NLanes := trunc\left(\frac{RoadwayWidth}{12ft}\right) = 3$$ Number of Lanes

$$RedFact := if(NLanes \le 2, 1.0, if(NLanes \le 3, 0.9, 0.75)) = 0.9$$ Live Load Reduction Factor AASHTO 3.12.1

AASHTO Specifications refer to this distribution as the faction of a wheel load. The axle (lane) load distribution factor is equal to 1/2 of the wheel load distribution factor:

$$DFShear := \frac{1}{2} \cdot \left(\frac{BmSpacLft - 6ft}{BmSpacLft} + \frac{BmSpacRgt - 4ft}{BmSpacRgt} + 1\right)$$ $DFShear = 0.667$ Lever Rule

$$DFMoment := \frac{1}{2} \cdot \frac{OHorSpacing}{6.0ft}$$ $DFMoment = 0.5$ AASHTO Table 3.23.1

$$DFDeflect := \frac{NLanes \cdot RedFact}{No_rdwybeams}$$ $DFDeflect = 0.386$ Distribution Factor for live load deflections according to Chapter 5 of Bar7 Users Manual.

$$Impact := min\left(\frac{50ft}{Span + 125ft} + 1, 1.3\right) = 1.3$$

- **Original Condition: (Roadway/Streetcar Beam)**

Noncomposite Dead Loads (DL1):

$$DeckSelfWgt := T_{slab} \cdot Beam_spacing \cdot W_{conc} = 0.450 \cdot \frac{kip}{ft}$$

$$DL1_{orig} := DeckSelfWgt + Bm_wt = 0.975 \cdot \frac{kip}{ft}$$ ✓

Composite Dead Loads (DL2):

$T_{asphalt} := 12in$ Thickness based off the assumption of original curb height of 9"

$$Asphalt := T_{asphalt} \cdot Beam_spacing \cdot W_{asphalt} = 0.84 \cdot \frac{kip}{ft}$$

$$T_{clay} := 14in$$

$$Clay := T_{clay} \cdot Beam_spacing \cdot W_{clay} = 0.84 \cdot \frac{kip}{ft}$$

$$Overlay := Asphalt + Clay = 1.68 \cdot \frac{kip}{ft}$$ ✓

$DL2_{orig} := Overlay = 1.68 \cdot \frac{kip}{ft}$

Distribution Factors: (Streetcar - original condition

$RoadwayWidth := 40.5ft$ Width of roadway from curb to curb in feet.

$BmSpacLft := 6.0ft$ $BmSpacRgt := 6.0ft$

$$OHorSpacing := \frac{(BmSpacLft + BmSpacRgt)}{2} = 6 \cdot ft$$

$$NLanes := trunc\left(\frac{RoadwayWidth}{12ft}\right) = 3$$ Number of Lanes

$$RedFact := if(NLanes \le 2, 1.0, if(NLanes \le 3, 0.9, 0.75)) = 0.9$$ Live Load Reduction Factor AASHTO 3.12.1

AASHTO Specifications refer to this distribution as the faction of a wheel load. The axle (lane) load distribution factor is equal to 1/2 of the wheel load distribution factor:

$$DFShear := \frac{1}{2} \cdot \left(\frac{BmSpacLft - 5ft}{BmSpacLft} + \frac{BmSpacRgt - 4ft}{BmSpacRgt} + 1\right)$$ $DFShear = 0.75$ Lever Rule

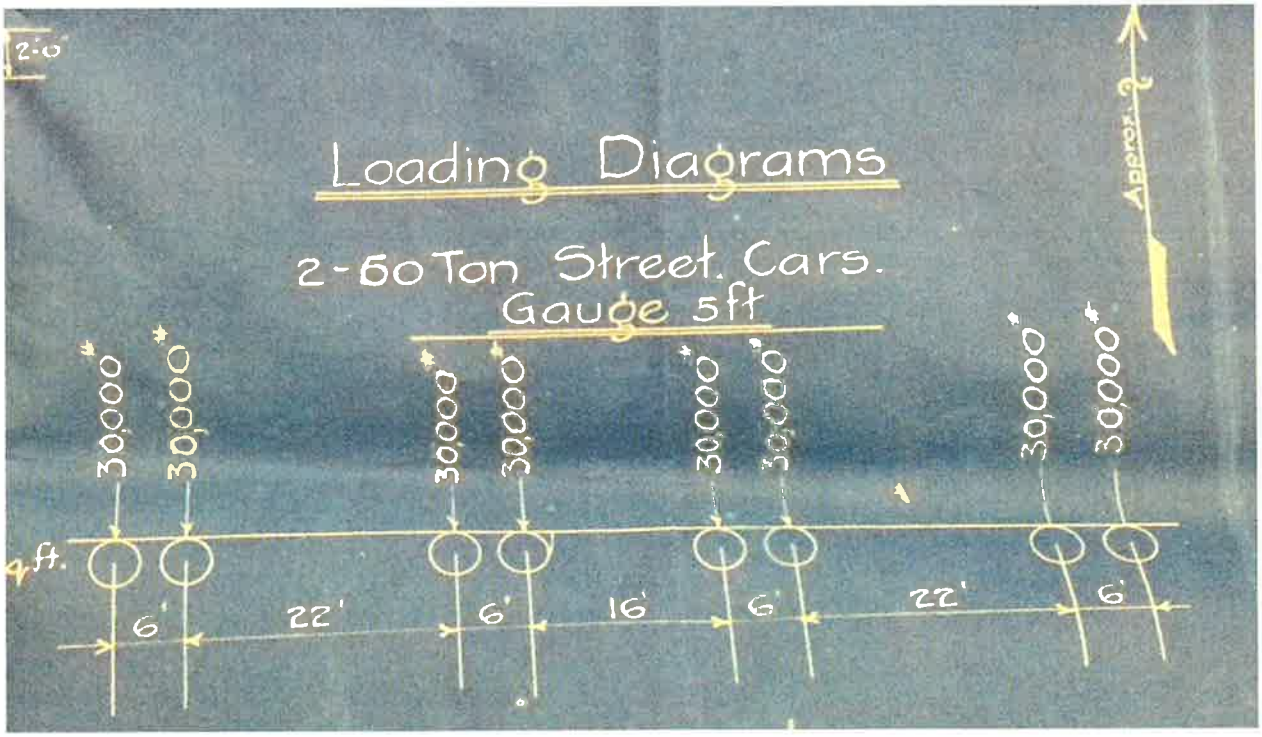
For Streetcar

$$DFMoment := \frac{1}{2} \cdot \frac{OHorSpacing}{6.0ft}$$ $DFMoment = 0.5$ AASHTO Table 3.23.1

$$DFDeflect := \frac{NLanes \cdot RedFact}{No_rdwybeams}$$ $DFDeflect = 0.386$ Distribution Factor for live load deflections according to Chapter 5 of Bar7 Users Manual.

$$Impact := min\left(\frac{50ft}{Span + 125ft} + 1, 1.3\right) = 1.3$$

✓ Note: Impact factor of 1.15 originally applied to a bridge with similar streetcar loading built around the same time. Use 1.15 for original condtion for roadway girders.


2-6
Loading Diagrams
2-60 Ton Street Cars.
Gauge 5ft
Approx. ?
30,000#
30,000#
30,000#
30,000#
30,000#
30,000#
30,000#
30,000#
4 ft.
6'
22'
6'
16'
6'
22'
6'

1. Superstructure Calculations
    a. Original Condition
        i. Girder Capacity and Stress
        ii. Girder Dead and Live Loads

ORIGINAL CONDITION

General:

$f'_c := 2500\ psi$ Compressive Strength of Concrete

$f_y := 33000psi$

$\Phi_{flexure} := 0.90$

$\Phi_{shear} := 0.85$

Positive Moment Capacity:

$h := 2.333ft + 6.0in = 34 \cdot in$ Min. Beam Depth + Average Slab Height

$b := 6.0ft = 72 \cdot in$ Slab Tributary Width

$Cover := 2.0in$ Concrete cover

$\phi_{shear} := 0.75in$ Shear Reinforcement Diameter (#6 Bar)
Inclided 45 degrees in shear zone

$\phi_{tension} := 0.75in$ Tension Reinforcement Diameter (#6 Bar)

$A_{tension} := 0.44in^2$ Tension Reinforcement Area (#6 Bar)

Row 1:

$$d_1 := h - Cover - \frac{(\phi_{tension})}{2} = 31.62 \cdot in$$

$No_bars_1 := 8$ Assumed # of bars in row 1 of positive moment region

$A_1 := No_bars_1 \cdot A_{tension} = 3.52 \cdot in^2$

$A_t := A_1 = 3.52 \cdot in^2$ Total Area of Steel

$Axd := A_1 \cdot d_1 = 111.31 \cdot in^3$

$$d_{pos} := \frac{Axd}{A_t} = 31.62 \cdot in$$

$$a := \frac{A_t \cdot f_y}{0.85(f'_c \cdot psi) \cdot b} \qquad a = 0.76 \cdot in$$

$$\Phi M_{n.pos} := \Phi_{flexure} \cdot \left[A_t \cdot f_y \cdot \left(d_{pos} - \frac{a}{2}\right)\right] \qquad \Phi M_{n.pos} = 272 \cdot kip \cdot ft$$

Positive Moment Capacity

Negative Moment Capacity:

$h = 34 \cdot in$ Min. Beam Depth + Slab Height

$b := 18in$ Slab Tributary Width

$Cover := 2.0in$ Assumed Concrete Cover

$\phi_{tension} := 0.75in$ Assumed Tension Reinforcement Diameter (#6 Bar)

$A_{tension} := 0.44in^2$ Assumed Tension Reinforcement Area (#6 Bar)

Row 1:

$$d_1 := h - Cover - \frac{(\phi_{tension})}{2} = 31.62 \cdot in$$

$No_bars_1 := 8$ Assumed # of bars in row 1 of negative moment region

$A_1 := No_bars_1 \cdot A_{tension} = 3.52 \cdot in^2$ Based on bars bending from the positive moment region

$A_t := A_1 = 3.52 \cdot in^2$ Total Area of Steel

$Axd := A_1 \cdot d_1 = 111.31 \cdot in^3$

$$d_{neg} := \frac{Axd}{A_t} = 31.62 \cdot in$$

$$a := \frac{A_t \cdot f_y}{0.85(f'_c \cdot psi) \cdot b} \qquad a = 3.04 \cdot in$$

$$\Phi M_{n.neg} := \Phi_{flexure} \cdot \left[A_t \cdot f_y \cdot \left(d_{neg} - \frac{a}{2}\right)\right] \qquad \Phi M_{n.neg} = 262 \cdot kip \cdot ft$$

Negative Moment Capacity

Shear Capacity:

$b_w := 18in$

$\phi_{shear} := 0.75in$ Shear Reinforcement Diameter (#6 Bar)

$A_{shear} := 0.44in^2$ Shear Reinforcement Area (#6 Bar)

$d := \min(d_{pos}, d_{neg}) = 31.62 \cdot in$

$$V_c := 2 \cdot \sqrt{f'_c psi} \cdot b_w \cdot d \qquad V_c = 56.918 \cdot kip$$

$No_bars := 2$ Minimum No. of shear bars from GPR

$A_v := No_bars \cdot A_{shear} = 0.88 \cdot in^2$ Area of shear steel based on field measurements

$s := 13in$ Largest Stirrup Spacing. Conservative

$\alpha := 45deg$

$V_s := \frac{A_v \cdot f_y \cdot (\sin(\alpha) + \cos(\alpha)) \cdot d}{s}$ $V_s = 99.9 \cdot kip$

$\Phi V_n := \Phi_{shear} \cdot (V_c + V_s)$ $\Phi V_n = 133.291 \cdot kip$ Shear Capacity

ORIGINAL CONDITION

General:

$f'_c := 2500 \quad psi$

$h := 34in$ — Min. Beam Depth + Slab Height

$b := 18in$ — Slab Tributary Width

$Cover := 2.0in$ — Assumed Concrete Cover

$\phi_{tension} := 0.75in$ — Assumed Tension Reinforcement Diameter (#6 Bar)

$A_{tension} := 0.44in^2$ — Assumed Tension Reinforcement Area (#6 Bar)

$E_c := 57000 \cdot \sqrt{f'_c} \cdot psi \qquad E_c = 2850 \cdot ksi$

$E_s := 29000ksi$

$n := \frac{E_s}{E_c} \qquad n = 10.175$

Negative Moment Stress:

Row 1:

$d_1 := h - Cover - \frac{(\phi_{tension})}{2} = 31.63 \cdot in$

$No_bars_1 := 8$ — Assumed # of bars in row 1 of negative moment region

$A_1 := No_bars_1 \cdot A_{tension} = 3.52 \cdot in^2$ — Based on bars bending from the positive moment region

Row 2:

$gap := 0in$ — Approximate center to center gap between 1st and 2rd row of reinforcing

$d_2 := h - Cover - \frac{(\phi_{tension})}{2} - gap = 31.63 \cdot in$

$No_bars_2 := 0$ — Assumed # of bars in row 2 of negative moment region

$A_2 := No_bars_2 \cdot A_{tension} = 0 \cdot in^2$ — Based on bars bending from the positive moment region

$A_t := A_1 + A_2 = 3.52 \cdot in^2$ — Total Area of Steel

$Axd := A_1 \cdot d_1 + A_2 \cdot d_2 = 111.32 \cdot in^3$

$d_{neg} := \frac{Axd}{A_t} = 31.63 \cdot in$

$\rho := \frac{A_t}{b \cdot d_{neg}} \qquad \rho = 0.0062$

$\rho n := \rho \cdot n \qquad \rho n = 0.063$

$k := \sqrt{2 \cdot \rho n + \rho n^2} - \rho n$ $\quad k = 0.297$

$j := 1 - \frac{k}{3}$ $\quad j = 0.901$

$M_{s.neg} := 54.4kip \cdot ft + 35.6kip \cdot ft$ $\quad M_{s.neg} = 90 \cdot kip \cdot ft$

$f_s := \frac{M_{s.neg}}{A_t \cdot j \cdot d_{neg}}$ $\quad f_s = 10.769 \cdot ksi$ $\quad < 16\ ksi$ ok

Positive Moment Stress:

$M_{s.pos} := 40.7kip \cdot ft + 62.2kip \cdot ft$ $\quad M_{s.pos} = 102.9 \cdot kip \cdot ft$

$b := 72in$

$b_w := 18in$

$t_{slab} := 6.0in$

$h_{beam} := h - t_{slab} = 28 \cdot in$

Row 1:

$d_1 := h - Cover - \frac{(\phi_{tension})}{2} = 31.63 \cdot in$

$No_bars_1 := 8$ No. of bars in row 1 of positive moment region

$A_1 := No_bars_1 \cdot A_{tension} = 3.52 \cdot in^2$

Row 2:

$gap := 0in$ Approximate center to center gap between 1st and 2rd row of reinforcing

$d_2 := h - Cover - \frac{(\phi_{tension})}{2} - gap = 31.63 \cdot in$

$No_bars_2 := 0$ Assumed # of bars in row 2 of positive moment region

$A_2 := No_bars_2 \cdot A_{tension} = 0 \cdot in^2$

$A_t := A_1 + A_2 = 3.52 \cdot in^2$ Total Area of Steel

$Axd := A_1 \cdot d_1 + A_2 \cdot d_2 = 111.32 \cdot in^3$

$d_{pos} := \frac{Axd}{A_t} = 31.63 \cdot in$

$\rho := \frac{A_t}{b \cdot d_{pos}}$ $\quad \rho = 0.0015$

$\rho n := \rho \cdot n$ $\quad \rho n = 0.016$

$k := \sqrt{2 \cdot \rho n + \rho n^2} - \rho n$ $\quad k = 0.162$

$j := 1 - \frac{k}{3}$ $\quad j = 0.946$

$c := \begin{cases} k \cdot d_{pos} & \text{if } k \cdot d_{pos} < t_{slab} \\ \text{"Greater than slab"} & \text{otherwise} \end{cases}$ $\quad c = 0.13\,m$

$nA_s := n \cdot A_t$ $\quad nA_s = 35.818 \cdot in^2$

Part	Area (in^2)	y (in)	A*y (in^3)
Compression Zone	18c	c/2	$9c^2$
Top Steel	$(n-1) \cdot A_t = 32.298 \cdot in^2$	c - (h - d_{neg}) = c - 5.17	65.237c -337.275
Bottom Steel	$nA_s = 35.818 \cdot in^2$	c - d_{pos} = c - 57.33	72.347c - 4149.2

$X_1(c^2) + X_2(c) + X_3 = 0$

$X_1 := 9$

$X_2 := 65.237 + 72.347 = 137.584$

$X_3 := 337.275 + 4149.2 = 4486.475$

$c_1 := \frac{-X_2 + \sqrt{X_2^2 + 4 \cdot X_1 \cdot X_3}}{2 \cdot X_1}$ $\quad c_1 = 15.956$

$c_2 := \frac{-X_2 - \sqrt{X_2^2 + 4 \cdot X_1 \cdot X_3}}{2 \cdot X_1}$ $\quad c_2 = -31.243$

$c := \max(c_1, c_2) \cdot in$ $\quad c = 15.956 \cdot in$

$k := \frac{c}{d_{pos}} = 0.505$

$j := 1 - \frac{k}{3}$ $\quad j = 0.832$

$f_s := \frac{M_{s.pos}}{A_t \cdot j \cdot d_{pos}}$ $\quad f_s = 13.335 \cdot ksi$ < 16 ksi

Bar7 Method of Solution

$t := 6.5in$ $\quad b_w := 18in$ $\quad n := 10$

$E_s := \min(72in, 12 \cdot t + b_w, 0.25 \cdot 14ft) = 42 \cdot in$

$A'_s := 0in^2$ $\quad d' := 0in$

$A_s := 3.52in^2$ $\quad d := 31.63in$

$$x_i := \frac{\frac{1}{2} \cdot E_s \cdot t^2 + (2 \cdot n - 1) \cdot A'_s \cdot d' + n \cdot A_s \cdot d}{E_s \cdot t + (2 \cdot n - 1) \cdot A'_s + n \cdot A_s} \qquad x_i = 6.491 \cdot in$$

$$\frac{1}{2} E_s \cdot x^2 + \left[(2 \cdot n - 1) \cdot A'_s + n \cdot A_s\right] x - (2 \cdot n - 1) \cdot A'_s \cdot d' - n \cdot A_s \cdot d := 0$$

$$a := \frac{1}{2} \cdot E_s \cdot \frac{1}{in} \qquad a = 21$$

$$b := \left[(2 \cdot n - 1) \cdot A'_s + n \cdot A_s\right] \cdot \frac{1}{in^2} \qquad b = 35.2$$

$$c := \left[(2 \cdot n - 1) \cdot A'_s \cdot d' + n \cdot A_s \cdot d\right] \cdot \frac{1}{in^3} \qquad c = 1113.376$$

$$x_1 := \frac{-b + \sqrt{b^2 + 4 \cdot a \cdot c}}{2 \cdot a} \qquad x_1 = 6.491$$

$$x_2 := \frac{-b - \sqrt{b^2 + 4 \cdot a \cdot c}}{2 \cdot a} \qquad x_2 = -8.168$$

$$x := \max(x_1, x_2) \cdot in \qquad x = 6.491 \cdot in$$

$$I_c := \frac{1}{12} \cdot E_s \cdot t^3 + E_s \cdot t \cdot \left(x - \frac{t}{2}\right)^2 + \frac{1}{3} \cdot b_w \cdot (x - t)^3 + (2 \cdot n - 1) \cdot A'_s \cdot (x - d')^2 + n \cdot A_s \cdot (d - x)^2$$

$$I_c = 26074.122 \cdot in^4$$ ok

$$S_c := \frac{I_c}{x} \qquad S_c = 4016.768 \cdot in^3 \qquad f_{s.c} := \frac{M_{s.pos}}{S_c} = 0.307 \cdot ksi$$

$$S_s := \frac{I_c}{n \cdot (d - x)} \qquad S_s = 103.721 \cdot in^3 \text{ ok} \qquad f_{s.s} := \frac{M_{s.pos}}{S_s} = 11.905 \cdot ksi$$

$$S_{sc} := \frac{I_c}{2 \cdot n \cdot (x - d')} \qquad S_{sc} = 200.838 \cdot in^3 \qquad f_{s.sc} := \frac{M_{s.pos}}{S_{sc}} = 6.148 \cdot ksi$$

ORIGINAL CONDITION – Streetcar Load

10-28-13

STRUCTURE ID - 00008900010000 - PONCE DE LEON - BM4

PROJECT IDENTIFICATION

BRG TYPE	SLC LEV	LIVE LANES	OUT- LOAD	PUT	IMP FACT	GAGE DIST	PASS DIST	FAT- IGUE	CONC DECK	SPEC	RE- DIST	DIR	S OVER FACTOR	END PAN
GGG			1	0	1.15	5.0	0.0						0.00	

SKEW
CORR
HYB FACTOR
0.000

BRIDGE CROSS SECTION AND LOADING

DECK WIDTH	OVERHANG OR SPACING	CL OF GIRDER OR TRUSS TO CURB	ROADWAY WIDTH	DISTRIBUTION FACTORS SHEAR	MOMENT	DEFLECT
0.00	6.00	0.00	0.00	0.750	0.500	0.386

SLAB THICKNESS	HAUNCH	DEAD LOADS DL1	DL2	F'C	N	SYMMETRY
0.00	0.00	0.975	1.680	2.500	10.	

STRINGER DL1	FLOORBEAM DL1	UNIT WEIGHT DECK CONCRETE
0.000	0.000	0.

SPAN LENGTHS (CONTINUOUS)

SPAN #	1	2	3	4	5	6	7
LENGTH	14.00	14.00	14.00	14.00	14.00	14.00	14.00

SPECIAL LIVE LOADING 1 (Streetcar)

NUMBER OF AXLES	3% INCR	UNIFORM LANE LOAD	CONC LOAD MOMENT	CONC LOAD SHEAR	GAGE DISTANCE	PASSING DISTANCE	VARY LAST	MAX AXLE DIST
8		0.000	0.000	0.000	5.0	4.0		0.0

TRUCK LOAD

AXLE NO.	LOAD	DIST	AXLE NO.	LOAD	DIST	AXLE NO.	LOAD	DIST	AXLE NO.	LOAD	DIST
1	30.00	6.00	2	30.00	22.00	3	30.00	6.00	4	30.00	22.00
5	30.00	6.00	6	30.00	22.00	7	30.00	6.00	8	30.00	0.00

```
*********************************
*  GIRDER  -  LIVE LOAD  SP-1   *
*********************************
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MAXIMUM REACTIONS

SUPPORT	DL1	DL2	+(LL+I)	-(LL+I)	REACTIONS +I.F.	REACTIONS -I.F.	MOMENTS +I.F.	MOMENTS -I.F.
1	5.4	9.3	34.5	-2.2	1.15	1.15		
2	15.5	26.6	30.7	-3.1	1.15	1.15	1.15	1.15
3	13.2	22.7	38.4	-4.1	1.15	1.15	1.15	1.15
4	13.8	23.7	38.5	-3.4	1.15	1.15	1.15	1.15
5	13.8	23.7	38.5	-3.4	1.15	1.15	1.15	1.15
6	13.2	22.7	38.4	-4.1	1.15	1.15	1.15	1.15
7	15.5	26.6	30.7	-3.1	1.15	1.15	1.15	1.15
8	5.4	9.3	34.5	-2.2	1.15	1.15		

Assume for typical shelter loading

NOTE: ALL SUPPORT REACTIONS AND END SHEARS IN EACH SPAN DUE TO A LIVE LOAD ARE CALCULATED BASED ON AASHTO ARTICLE 3.23.1 AS INTERPRETED IN SOL 431-93-05.

UNFACTORED MOMENTS AND SHEARS

SPAN 1 - LIVE LOAD IMPACT FACTORS : POS MOM 1.15 NEG MOM 1.15

X	DL1 MOMENT	DL2 MOMENT	+(LL+I) MOMENT	-(LL+I) MOMENT		DL1 SHEAR	DL2 SHEAR	+(LL+I) SHEAR	-(LL+I) SHEAR	I.F.
0.00	0.0	0.0	0.0	0.0	S	5.4	9.3	34.5	-2.2	1.15
	SIMULT	SHEAR	0.0	0.0		SIMULT	MOM	0.0	0.0	
1.40	6.6	11.4	30.8	-3.1		4.0	6.9	22.0	-3.0	1.15
	SIMULT	SHEAR	22.0	-2.2		SIMULT	MOM	30.8	20.0	
2.80	11.3	19.5	50.9	-6.3		2.7	4.6	18.2	-4.7	1.15
	SIMULT	SHEAR	18.2	-2.2		SIMULT	MOM	50.9	35.2	
4.20	14.1	24.2	61.0	-9.4		1.3	2.2	14.5	-6.4	1.15
	SIMULT	SHEAR	14.5	-2.2		SIMULT	MOM	61.0	45.4	
5.60	15.0	25.7	62.2	-12.6		-0.1	-0.1	11.1	-8.5	1.15
	SIMULT	SHEAR	11.1	-2.2		SIMULT	MOM	62.2	49.3	
7.00	13.9	23.9	58.1	-15.7		-1.4	-2.5	8.0	-11.9	1.15
	SIMULT	SHEAR	-11.4	-2.2		SIMULT	MOM	55.8	54.6	
8.40	11.0	18.9	58.2	-18.9		-2.8	-4.8	5.2	-15.8	1.15
	SIMULT	SHEAR	-15.3	-2.2		SIMULT	MOM	43.9	53.2	
9.80	6.1	10.5	48.8	-22.0		-4.2	-7.2	2.9	-19.6	1.15
	SIMULT	SHEAR	-19.0	-2.2		SIMULT	MOM	28.5	42.9	
11.20	-0.7	-1.2	31.3	-25.2		-5.5	-9.5	1.0	-23.0	1.15
	SIMULT	SHEAR	-22.5	-2.2		SIMULT	MOM	11.5	25.2	
12.60	-9.4	-16.2	7.6	-28.3		-6.9	-11.9	0.5	-26.1	1.15
	SIMULT	SHEAR	-25.7	-2.2		SIMULT	MOM	6.6	2.0	
14.00	-20.0	-34.4	7.3	-35.6	S	-8.3	-14.2	0.6	-37.5	1.15
	SIMULT	SHEAR	0.5	-15.8		SIMULT	MOM	8.3	-24.7	

Maximum pos Moment

SPAN 2 - LIVE LOAD IMPACT FACTORS : POS MOM 1.15 NEG MOM 1.15

X	DL1 MOMENT	DL2 MOMENT	+(LL+I) MOMENT	-(LL+I) MOMENT		DL1 SHEAR	DL2 SHEAR	+(LL+I) SHEAR	-(LL+I) SHEAR	I.F.
0.00	-20.0	-34.4	7.3	-35.6	S	7.2	12.4	36.3	-2.6	1.15
	SIMULT	SHEAR	-2.6	3.2		SIMULT	MOM	-20.1	7.3	
1.40	-10.9	-18.7	7.0	-31.0		5.9	10.1	24.6	-2.6	1.15
	SIMULT	SHEAR	23.8	3.2		SIMULT	MOM	6.0	3.7	
2.80	-3.6	-6.3	27.3	-29.4		4.5	7.7	21.0	-2.6	1.15
	SIMULT	SHEAR	20.2	0.6		SIMULT	MOM	27.3	0.0	
4.20	1.7	2.9	41.9	-28.6		3.1	5.4	17.3	-3.6	1.15

	SIMULT	SHEAR	17.3	0.6		SIMULT	MOM	41.9	25.8	
5.60	5.1	8.8	48.7	-27.7		1.7	3.0	13.6	-6.4	1.15
	SIMULT	SHEAR	13.6	0.6		SIMULT	MOM	48.7	38.3	
7.00	6.6	11.3	48.5	-26.9		0.4	0.7	9.9	-9.7	1.15
	SIMULT	SHEAR	-9.0	0.6		SIMULT	MOM	47.9	45.6	
8.40	6.2	10.6	50.7	-26.1		-1.0	-1.7	6.8	-13.2	1.15
	SIMULT	SHEAR	-12.5	0.6		SIMULT	MOM	39.8	46.3	
9.80	3.8	6.6	45.2	-25.3		-2.4	-4.0	4.5	-16.9	1.15
	SIMULT	SHEAR	-16.1	0.4		SIMULT	MOM	26.6	39.6	
11.20	-0.4	-0.7	31.7	-24.8		-3.7	-6.4	3.2	-20.6	1.15
	SIMULT	SHEAR	-19.9	0.4		SIMULT	MOM	0.5	25.6	
12.60	-6.6	-11.4	10.8	-25.6		-5.1	-8.8	3.2	-24.2	1.15
	SIMULT	SHEAR	-23.6	-2.6		SIMULT	MOM	5.0	5.0	
14.00	-14.7	-25.3	9.5	-29.3	S	-6.5	-11.1	3.2	-36.1	1.15
	SIMULT	SHEAR	3.2	-2.6		SIMULT	MOM	9.5	-20.4	

SPAN 3 - LIVE LOAD IMPACT FACTORS : POS MOM 1.15 NEG MOM 1.15

X	DL1 MOMENT	DL2 MOMENT	+(LL+I) MOMENT	-(LL+I) MOMENT		DL1 SHEAR	DL2 SHEAR	+(LL+I) SHEAR	-(LL+I) SHEAR	I.F.
0.00	-14.7	-25.3	9.5	-29.3	S	6.7	11.6	36.5	-2.6	1.15
	SIMULT	SHEAR	-0.9	13.8		SIMULT	MOM	-21.6	7.8	
1.40	-6.2	-10.7	12.6	-24.3		5.4	9.2	24.8	-2.6	1.15
	SIMULT	SHEAR	23.3	2.5		SIMULT	MOM	4.2	4.1	
2.80	0.4	0.6	33.1	-23.4		4.0	6.9	21.3	-2.6	1.15
	SIMULT	SHEAR	19.5	0.2		SIMULT	MOM	25.6	0.4	
4.20	5.0	8.6	47.1	-23.4		2.6	4.5	17.5	-4.0	1.15
	SIMULT	SHEAR	16.6	-0.1		SIMULT	MOM	40.5	28.7	
5.60	7.8	13.3	52.8	-23.6		1.3	2.2	13.8	-6.9	1.15
	SIMULT	SHEAR	12.8	-0.1		SIMULT	MOM	47.8	40.7	
7.00	8.6	14.8	50.6	-23.8		-0.1	-0.2	10.1	-10.2	1.15
	SIMULT	SHEAR	-9.5	-0.1		SIMULT	MOM	47.3	47.8	
8.40	7.5	12.9	52.6	-24.0		-1.5	-2.5	6.7	-13.9	1.15
	SIMULT	SHEAR	-13.1	-0.1		SIMULT	MOM	40.0	48.1	
9.80	4.5	7.7	46.2	-24.3		-2.8	-4.9	3.8	-17.7	1.15
	SIMULT	SHEAR	-16.9	-0.3		SIMULT	MOM	27.5	40.6	
11.20	-0.4	-0.7	31.8	-24.8		-4.2	-7.2	2.5	-21.4	1.15
	SIMULT	SHEAR	-19.7	-0.3		SIMULT	MOM	0.4	25.5	
12.60	-7.3	-12.5	11.2	-25.6		-5.6	-9.6	2.5	-24.9	1.15
	SIMULT	SHEAR	-23.4	-2.6		SIMULT	MOM	3.9	3.9	
14.00	-16.0	-27.5	8.0	-29.9	S	-6.9	-11.9	2.5	-36.6	1.15
	SIMULT	SHEAR	0.7	-13.9		SIMULT	MOM	7.5	-21.9	

SPAN 4 - LIVE LOAD IMPACT FACTORS : POS MOM 1.15 NEG MOM 1.15

X	DL1 MOMENT	DL2 MOMENT	+(LL+I) MOMENT	-(LL+I) MOMENT		DL1 SHEAR	DL2 SHEAR	+(LL+I) SHEAR	-(LL+I) SHEAR	I.F.
0.00	-16.0	-27.5	8.0	-29.9	S	6.8	11.8	36.4	-2.7	1.15
	SIMULT	SHEAR	-2.7	2.7		SIMULT	MOM	-21.6	8.0	
1.40	-7.4	-12.7	10.8	-26.1		5.5	9.4	24.7	-2.7	1.15
	SIMULT	SHEAR	23.4	2.7		SIMULT	MOM	4.2	4.2	
2.80	-0.7	-1.2	31.4	-25.2		4.1	7.1	21.2	-2.7	1.15
	SIMULT	SHEAR	19.7	0.4		SIMULT	MOM	25.5	0.4	
4.20	4.1	7.0	45.6	-24.8		2.7	4.7	17.5	-3.8	1.15
	SIMULT	SHEAR	16.7	0.0		SIMULT	MOM	40.3	27.3	
5.60	7.0	12.0	51.7	-24.8		1.4	2.4	13.7	-6.7	1.15
	SIMULT	SHEAR	13.0	0.0		SIMULT	MOM	47.6	39.8	
7.00	7.9	13.6	49.8	-24.8		0.0	0.0	10.1	-10.1	1.15
	SIMULT	SHEAR	-9.4	0.0		SIMULT	MOM	47.1	47.1	
8.40	7.0	12.0	51.7	-24.8		-1.4	-2.4	6.7	-13.7	1.15
	SIMULT	SHEAR	-13.0	0.0		SIMULT	MOM	39.8	47.6	
9.80	4.1	7.0	45.6	-24.8		-2.7	-4.7	3.8	-17.5	1.15
	SIMULT	SHEAR	-16.7	0.0		SIMULT	MOM	27.3	40.3	

11.20	-0.7	-1.2	31.4	-25.2		-4.1	-7.1	2.7	-21.2	1.15
	SIMULT	SHEAR	-19.7	-0.4		SIMULT	MOM	0.4	25.5	
12.60	-7.4	-12.7	10.8	-26.1		-5.5	-9.4	2.7	-24.7	1.15
	SIMULT	SHEAR	-23.4	-2.7		SIMULT	MOM	4.2	4.2	
14.00	-16.0	-27.5	8.0	-29.9	S	-6.8	-11.8	2.7	-36.4	1.15
	SIMULT	SHEAR	2.7	-2.7		SIMULT	MOM	8.0	-21.6	

SPAN 5 - LIVE LOAD IMPACT FACTORS : POS MOM 1.15 NEG MOM 1.15

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X	DL1 MOMENT	DL2 MOMENT	+(LL+I) MOMENT	-(LL+I) MOMENT		DL1 SHEAR	DL2 SHEAR	+(LL+I) SHEAR	-(LL+I) SHEAR	I.F.
0.00	-16.0	-27.5	8.0	-29.9	S	6.9	11.9	36.6	-2.5	1.15
	SIMULT	SHEAR	-0.7	13.9		SIMULT	MOM	-21.9	7.5	
1.40	-7.3	-12.5	11.2	-25.6		5.6	9.6	24.9	-2.5	1.15
	SIMULT	SHEAR	23.4	2.6		SIMULT	MOM	3.9	3.9	
2.80	-0.4	-0.7	31.8	-24.8		4.2	7.2	21.4	-2.5	1.15
	SIMULT	SHEAR	19.7	0.3		SIMULT	MOM	25.5	0.4	
4.20	4.5	7.7	46.2	-24.3		2.8	4.9	17.7	-3.8	1.15
	SIMULT	SHEAR	16.9	0.3		SIMULT	MOM	40.6	27.5	
5.60	7.5	12.9	52.6	-24.0		1.5	2.5	13.9	-6.7	1.15
	SIMULT	SHEAR	13.1	0.1		SIMULT	MOM	48.1	40.0	
7.00	8.6	14.8	50.6	-23.8		0.1	0.2	10.2	-10.1	1.15
	SIMULT	SHEAR	9.5	0.1		SIMULT	MOM	47.8	47.3	
8.40	7.8	13.3	52.8	-23.6		-1.3	-2.2	6.9	-13.8	1.15
	SIMULT	SHEAR	-12.8	0.1		SIMULT	MOM	40.7	47.8	
9.80	5.0	8.6	47.1	-23.4		-2.6	-4.5	4.0	-17.5	1.15
	SIMULT	SHEAR	-16.6	0.1		SIMULT	MOM	28.7	40.5	
11.20	0.4	0.6	33.1	-23.4		-4.0	-6.9	2.6	-21.3	1.15
	SIMULT	SHEAR	-19.5	-0.2		SIMULT	MOM	0.4	25.6	
12.60	-6.2	-10.7	12.6	-24.3		-5.4	-9.2	2.6	-24.8	1.15
	SIMULT	SHEAR	-23.3	-2.5		SIMULT	MOM	4.1	4.2	
14.00	-14.7	-25.3	9.5	-29.3	S	-6.7	-11.6	2.6	-36.5	1.15
	SIMULT	SHEAR	0.9	-13.8		SIMULT	MOM	7.8	-21.6	

SPAN 6 - LIVE LOAD IMPACT FACTORS : POS MOM 1.15 NEG MOM 1.15

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X	DL1 MOMENT	DL2 MOMENT	+(LL+I) MOMENT	-(LL+I) MOMENT		DL1 SHEAR	DL2 SHEAR	+(LL+I) SHEAR	-(LL+I) SHEAR	I.F.
0.00	-14.7	-25.3	9.5	-29.3	S	6.5	11.1	36.1	-3.2	1.15
	SIMULT	SHEAR	-3.2	2.6		SIMULT	MOM	-20.4	9.5	
1.40	-6.6	-11.4	10.8	-25.6		5.1	8.8	24.2	-3.2	1.15
	SIMULT	SHEAR	23.6	2.6		SIMULT	MOM	5.0	5.0	
2.80	-0.4	-0.7	31.7	-24.8		3.7	6.4	20.6	-3.2	1.15
	SIMULT	SHEAR	19.9	-0.4		SIMULT	MOM	25.6	0.5	
4.20	3.8	6.6	45.2	-25.3		2.4	4.0	16.9	-4.5	1.15
	SIMULT	SHEAR	16.1	-0.4		SIMULT	MOM	39.6	26.6	
5.60	6.2	10.6	50.7	-26.1		1.0	1.7	13.2	-6.8	1.15
	SIMULT	SHEAR	12.5	-0.6		SIMULT	MOM	46.3	39.8	
7.00	6.6	11.3	48.5	-26.9		-0.4	-0.7	9.7	-9.9	1.15
	SIMULT	SHEAR	9.0	-0.6		SIMULT	MOM	45.6	47.9	
8.40	5.1	8.8	48.7	-27.7		-1.7	-3.0	6.4	-13.6	1.15
	SIMULT	SHEAR	-13.6	-0.6		SIMULT	MOM	38.3	48.7	
9.80	1.7	2.9	41.9	-28.6		-3.1	-5.4	3.6	-17.3	1.15
	SIMULT	SHEAR	-17.3	-0.6		SIMULT	MOM	25.8	41.9	
11.20	-3.6	-6.3	27.3	-26.5		-4.5	-7.7	2.6	-21.0	1.15
	SIMULT	SHEAR	-21.0	-0.3		SIMULT	MOM	0.0	27.3	
12.60	-10.9	-18.7	7.0	-31.0		-5.9	-10.1	2.6	-24.6	1.15
	SIMULT	SHEAR	-23.8	-3.2		SIMULT	MOM	3.7	6.0	
14.00	-20.0	-34.4	7.3	-35.6	S	-7.2	-12.4	2.6	-36.3	1.15
	SIMULT	SHEAR	2.6	-3.2		SIMULT	MOM	7.3	-20.1	

SPAN 7 - LIVE LOAD IMPACT FACTORS : POS MOM 1.15 NEG MOM 1.15

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X	DL1 MOMENT	DL2 MOMENT	+(LL+I) MOMENT	-(LL+I) MOMENT		DL1 SHEAR	DL2 SHEAR	+(LL+I) SHEAR	-(LL+I) SHEAR	I.F.
0.00	-20.0	-34.4	7.3	-35.6	S	8.3	14.2	37.5	-0.6	1.15
	SIMULT	SHEAR	-0.5	15.8		SIMULT	MOM	-24.7	8.3	
1.40	-9.4	-16.2	7.6	-28.3		6.9	11.9	26.1	-0.5	1.15
	SIMULT	SHEAR	25.7	2.2		SIMULT	MOM	2.0	6.6	
2.80	-0.7	-1.2	31.3	-25.2		5.5	9.5	23.0	-1.0	1.15
	SIMULT	SHEAR	22.5	2.2		SIMULT	MOM	25.2	11.5	
4.20	6.1	10.5	48.8	-22.0		4.2	7.2	19.6	-2.9	1.15
	SIMULT	SHEAR	19.0	2.2		SIMULT	MOM	42.9	28.5	
5.60	11.0	18.9	58.2	-18.9		2.8	4.8	15.8	-5.2	1.15
	SIMULT	SHEAR	15.3	2.2		SIMULT	MOM	53.2	43.9	
7.00	13.9	23.9	58.1	-15.7		1.4	2.5	11.9	-8.0	1.15
	SIMULT	SHEAR	11.4	2.2		SIMULT	MOM	54.6	55.8	
8.40	15.0	25.7	62.2	-12.6		0.1	0.1	8.5	-11.1	1.15
	SIMULT	SHEAR	-11.1	2.2		SIMULT	MOM	49.3	62.2	
9.80	14.1	24.2	61.0	-9.4		-1.3	-2.2	6.4	-14.5	1.15
	SIMULT	SHEAR	-14.5	2.2		SIMULT	MOM	45.4	61.0	
11.20	11.3	19.5	50.9	-6.3		-2.7	-4.6	4.7	-18.2	1.15
	SIMULT	SHEAR	-18.2	2.2		SIMULT	MOM	35.2	50.9	
12.60	6.6	11.4	30.8	-3.1		-4.0	-6.9	3.0	-22.0	1.15
	SIMULT	SHEAR	-22.0	2.2		SIMULT	MOM	20.0	30.8	
14.00	0.0	0.0	0.0	0.0	S	-5.4	-9.3	2.2	-34.5	1.15
	SIMULT	SHEAR	0.0	0.0		SIMULT	MOM	0.0	0.0	

BEAM 4 - ORIGINAL STREETCAR

TCC 10-28-13

Special Live Load Case 1 - Streetcar

Critical Values	Capacity (kip-ft, kip)	Max. DL (kip-ft, kip)	Max. LL+I (kip-ft, kip)	Vehicle Weight	IR	IR (Tons)	OR	OR (Tons)
Positive Moment	272	40.7	62.2	120	1.62	194.78	2.71	325.14
Negative Moment	262	54.4	35.6	120	2.48	297.13	4.13	495.97
Shear	133	22.5	37.5	120	1.27	153.00	2.13	255.38

controls

Note: Run used to correlate the original streetcar load to GPR testing of rebar.

1. Superstructure Calculations

   b. Current Condition

      i. Girder Capacity

      ii. Girder Dead and Live Loads

CURRENT CONDITION

General:

$f'_c := 3000\ psi$ Compressive Strength of Concrete

$f_y := 33000psi$

$\Phi_{flexure} := 0.90$

$\Phi_{shear} := 0.85$

Positive Moment Capacity:

$h := 2.333ft + 6.0in = 34 \cdot in$ Min. Beam Depth + Average Slab Height

$b := 6.0ft = 72 \cdot in$ Slab Tributary Width

$Cover := 2.0in$ Concrete cover

$\phi_{shear} := 0.75in$ Shear Reinforcement Diameter (#6 Bar)
Inclided 45 degrees in shear zone

$\phi_{tension} := 0.75in$ Tension Reinforcement Diameter (#6 Bar)

$A_{tension} := 0.44in^2$ Tension Reinforcement Area (#6 Bar)

Row 1:

$$d_1 := h - Cover - \frac{(\phi_{tension})}{2} = 31.62 \cdot in$$

$No_bars_1 := 8$ Assumed # of bars in row 1 of positive moment region

$A_1 := No_bars_1 \cdot A_{tension} = 3.52 \cdot in^2$

$A_t := A_1 = 3.52 \cdot in^2$ Total Area of Steel

$Axd := A_1 \cdot d_1 = 111.31 \cdot in^3$

$$d_{pos} := \frac{Axd}{A_t} = 31.62 \cdot in$$

$$a := \frac{A_t \cdot f_y}{0.85(f'_c \cdot psi) \cdot b} \qquad a = 0.63 \cdot in$$

$$\Phi M_{n.pos} := \Phi_{flexure} \cdot \left[A_t \cdot f_y \cdot \left(d_{pos} - \frac{a}{2}\right)\right] \qquad \Phi M_{n.pos} = 273 \cdot kip \cdot ft$$

Positive Moment Capacity

Negative Moment Capacity:

$h = 34 \cdot in$ Min. Beam Depth + Slab Height

$b := 18in$ Slab Tributary Width

$Cover := 2.0in$ Assumed Concrete Cover

$\phi_{tension} := 0.75in$ Assumed Tension Reinforcement Diameter (#6 Bar)

$A_{tension} := 0.44in^2$ Assumed Tension Reinforcement Area (#6 Bar)

Row 1:

$$d_1 := h - Cover - \frac{(\phi_{tension})}{2} = 31.62 \cdot in$$

$No_bars_1 := 8$ Assumed # of bars in row 1 of negative moment region

$A_1 := No_bars_1 \cdot A_{tension} = 3.52 \cdot in^2$ Based on bars bending from the positive moment region

$A_t := A_1 = 3.52 \cdot in^2$ Total Area of Steel

$Axd := A_1 \cdot d_1 = 111.31 \cdot in^3$

$$d_{neg} := \frac{Axd}{A_t} = 31.62 \cdot in$$

$$a := \frac{A_t \cdot f_y}{0.85(f'_c \cdot psi) \cdot b} \qquad a = 2.53 \cdot in$$

$$\Phi M_{n.neg} := \Phi_{flexure} \cdot \left[A_t \cdot f_y \cdot \left(d_{neg} - \frac{a}{2}\right)\right] \qquad \Phi M_{n.neg} = 264 \cdot kip \cdot ft$$

Negative Moment Capacity

Shear Capacity:

$b_w := 18in$

$\phi_{shear} := 0.75in$ Shear Reinforcement Diameter (#6 Bar)

$A_{shear} := 0.44in^2$ Shear Reinforcement Area (#6 Bar)

$d := \min(d_{pos}, d_{neg}) = 31.62 \cdot in$

$$V_c := 2 \cdot \sqrt{f'_c psi} \cdot b_w \cdot d \qquad V_c = 62.35 \cdot kip$$

$No_bars := 2$ Minimum No. of shear bars from GPR

$A_v := No_bars \cdot A_{shear} = 0.88 \cdot in^2$ Area of shear steel based on field measurements

$s := 13in$ Largest Stirrup Spacing. Conservative

$\alpha := 45deg$

$V_s := \frac{A_v \cdot f_y \cdot (\sin(\alpha) + \cos(\alpha)) \cdot d}{s}$ $V_s = 99.9 \cdot kip$

$\Phi V_n := \Phi_{shear} \cdot (V_c + V_s)$ $\Phi V_n = 137.909 \cdot kip$ Shear Capacity

BEAM 4 - CURRENT CONDITION

GLE 9-23-13

STRUCTURE ID - 00008900010000 - PONCE DE LEON - BM4

PROJECT IDENTIFICATION

BRG TYPE	SLC LEV	LANES	LIVE LOAD	OUT-PUT	IMP FACT	GAGE DIST	PASS DIST	FAT-IGUE	CONC DECK	SPEC	RE-DIST	DIR	S OVER FACTOR	END PAN
GGG			8	0	0.00	0.0	0.0						0.00	

HYB	SKEW CORR FACTOR
	0.000

BRIDGE CROSS SECTION AND LOADING

DECK WIDTH	OVERHANG OR SPACING	CL OF GIRDER OR TRUSS TO CURB	ROADWAY WIDTH	DISTRIBUTION FACTORS SHEAR	MOMENT	DEFLECT
0.00	6.00	0.00	0.00	0.667	0.500	0.386

SLAB THICKNESS	HAUNCH	DEAD LOADS DL1	DL2	F'C	N	SYMMETRY
0.00	0.00	0.975	1.960	3.000	9.	

STRINGER DL1	FLOORBEAM DL1	UNIT WEIGHT DECK CONCRETE
0.000	0.000	0.

SPAN LENGTHS (CONTINUOUS)

SPAN #	1	2	3	4	5	6	7
LENGTH	14.00	14.00	14.00	14.00	14.00	14.00	14.00

SPECIAL LIVE LOADING 1 (H20)

LANE LOADING

NUMBER OF AXLES	3% INCR	UNIFORM LANE LOAD	CONC LOAD MOMENT	CONC LOAD SHEAR	GAGE DISTANCE	PASSING DISTANCE	VARY LAST	MAX AXLE DIST
2		0.640	18.000	26.000	6.0	4.0		0.0

TRUCK LOAD

AXLE NO.	LOAD	DIST	AXLE NO.	LOAD	DIST	AXLE NO.	LOAD	DIST	AXLE NO.	LOAD	DIST
1	8.00	14.00	2	32.00	0.00						

SPECIAL LIVE LOADING 2 (HS20)

LANE LOADING

NUMBER OF AXLES	3% INCR	UNIFORM LANE LOAD	CONC LOAD MOMENT	CONC LOAD SHEAR	GAGE DISTANCE	PASSING DISTANCE	VARY LAST	MAX AXLE DIST
3		0.640	18.000	26.000	6.0	4.0	Y	30.0

TRUCK LOAD

AXLE NO.	LOAD	DIST	AXLE NO.	LOAD	DIST	AXLE NO.	LOAD	DIST	AXLE NO.	LOAD	DIST
1	8.00	14.00	2	32.00	14.00	3	32.00	0.00			

SPECIAL LIVE LOADING 3 (H-Mod)

LANE LOADING

NUMBER OF AXLES	3% INCR	UNIFORM LANE LOAD	CONC LOAD MOMENT	CONC LOAD SHEAR	GAGE DISTANCE	PASSING DISTANCE	VARY LAST	MAX AXLE DIST
5		0.000	0.000	0.000	6.0	4.0		0.0

TRUCK LOAD

AXLE NO.	LOAD	DIST	AXLE NO.	LOAD	DIST	AXLE NO.	LOAD	DIST	AXLE NO.	LOAD	DIST
1	20.00	14.00	2	23.00	0.00	3	0.00	0.00	4	0.00	0.00
5	0.00	0.00									

SPECIAL LIVE LOADING 4 (Type 3/Tandem)

LANE LOADING

NUMBER OF AXLES	3% INCR	UNIFORM LANE LOAD	CONC LOAD MOMENT	CONC LOAD SHEAR	GAGE DISTANCE	PASSING DISTANCE	VARY LAST	MAX AXLE DIST
5		0.000	0.000	0.000	6.0	4.0		0.0

TRUCK LOAD

AXLE NO.	LOAD	DIST	AXLE NO.	LOAD	DIST	AXLE NO.	LOAD	DIST	AXLE NO.	LOAD	DIST
1	20.00	15.00	2	23.00	4.00	3	23.00	0.00	4	0.00	0.00
5	0.00	0.00									

SPECIAL LIVE LOADING 5 (Timber)

LANE LOADING

NUMBER OF AXLES	3% INCR	UNIFORM LANE LOAD	CONC LOAD MOMENT	CONC LOAD SHEAR	GAGE DISTANCE	PASSING DISTANCE	VARY LAST	MAX AXLE DIST
5		0.000	0.000	0.000	6.0	4.0		0.0

TRUCK LOAD

AXLE NO.	LOAD	DIST	AXLE NO.	LOAD	DIST	AXLE NO.	LOAD	DIST	AXLE NO.	LOAD	DIST
1	11.00	10.00	2	23.00	21.80	3	23.00	4.20	4	17.20	0.00
5	0.00	0.00									

SPECIAL LIVE LOADING 6 (HS-Mod)

LANE LOADING

NUMBER OF AXLES	3% INCR	UNIFORM LANE LOAD	CONC LOAD MOMENT	CONC LOAD SHEAR	GAGE DISTANCE	PASSING DISTANCE	VARY LAST	MAX AXLE DIST
5		0.000	0.000	0.000	6.0	4.0		0.0

TRUCK LOAD

AXLE NO.	LOAD	DIST	AXLE NO.	LOAD	DIST	AXLE NO.	LOAD	DIST	AXLE NO.	LOAD	DIST
1	14.00	14.00	2	23.00	14.00	3	23.00	0.00	4	0.00	0.00
5	0.00	0.00									

SPECIAL LIVE LOADING 7 (3s2)

LANE LOADING

NUMBER OF AXLES	3% INCR	UNIFORM LANE LOAD	CONC LOAD MOMENT	CONC LOAD SHEAR	GAGE DISTANCE	PASSING DISTANCE	VARY LAST	MAX AXLE DIST
5		0.000	0.000	0.000	6.0	4.0		0.0

TRUCK LOAD

AXLE NO.	LOAD	DIST	AXLE NO.	LOAD	DIST	AXLE NO.	LOAD	DIST	AXLE NO.	LOAD	DIST
1	11.20	11.00	2	17.20	4.00	3	17.20	32.00	4	17.20	4.00
5	17.20	0.00									

SPECIAL LIVE LOADING 8 (Piggyback)

LANE LOADING

NUMBER OF AXLES	3% INCR	UNIFORM LANE LOAD	CONC LOAD MOMENT	CONC LOAD SHEAR	GAGE DISTANCE	PASSING DISTANCE	VARY LAST	MAX AXLE DIST
5		0.000	0.000	0.000	6.0	4.0		0.0

TRUCK LOAD

AXLE NO.	LOAD	DIST	AXLE NO.	LOAD	DIST	AXLE NO.	LOAD	DIST	AXLE NO.	LOAD	DIST
1	12.00	14.00	2	17.00	28.00	3	17.00	10.00	4	17.00	28.00
5	17.00	0.00									

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*  GIRDER  -  LIVE LOAD  SP-1   *
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MAXIMUM REACTIONS

SUPPORT	DL1	DL2	+(LL+I)	-(LL+I)	REACTIONS +I.F.	REACTIONS -I.F.	MOMENTS +I.F.	MOMENTS -I.F.
1	5.4	10.8	27.7	-1.6 L	1.30	1.30		
2	15.5	31.1	29.7 L	-2.6 L	1.30	1.30	1.30	1.30
3	13.2	26.5	29.3 L	-3.9 L	1.30	1.30	1.30	1.30

4	13.8	27.6	29.4 L	-3.4 L	1.30	1.30	1.30	1.30
5	13.8	27.6	29.4 L	-3.4 L	1.30	1.30	1.30	1.30
6	13.2	26.5	29.3 L	-3.9 L	1.30	1.30	1.30	1.30
7	15.5	31.1	29.7 L	-2.6 L	1.30	1.30	1.30	1.30
8	5.4	10.8	27.7	-1.6 L	1.30	1.30		

NOTE: ALL SUPPORT REACTIONS AND END SHEARS IN EACH SPAN DUE TO A LIVE LOAD ARE CALCULATED BASED ON AASHTO ARTICLE 3.23.1 AS INTERPRETED IN SOL 431-93-05.

UNFACTORED MOMENTS AND SHEARS

SPAN 1 - LIVE LOAD IMPACT FACTORS : POS MOM 1.30 NEG MOM 1.30

X	DL1 MOMENT	DL2 MOMENT	+(LL+I) MOMENT	-(LL+I) MOMENT	DL1 SHEAR	DL2 SHEAR	+(LL+I) SHEAR	-(LL+I) SHEAR	I.F.
0.00	0.0	0.0	0.0	0.0 S	5.4	10.8	27.7	-1.6L	1.30
	SIMULT	SHEAR	0.0	0.0	SIMULT	MOM	0.0	0.0	
1.40	6.6	13.3	25.4	-2.1	4.0	8.1	18.2	-2.8	1.30
	SIMULT	SHEAR	18.2	-1.5	SIMULT	MOM	25.4	25.2	
2.80	11.3	22.7	43.6	-4.3	2.7	5.4	15.6	-5.6	1.30
	SIMULT	SHEAR	15.6	-1.5	SIMULT	MOM	43.6	42.7	
4.20	14.1	28.3	54.8	-6.4	1.3	2.6	13.0	-8.2	1.30
	SIMULT	SHEAR	13.0	-1.5	SIMULT	MOM	54.8	53.1	
5.60	15.0	30.0	59.4	-8.6	-0.1	-0.1	10.6	-10.6	1.30
	SIMULT	SHEAR	10.6	-1.5	SIMULT	MOM	59.4	57.1	
7.00	13.9	27.9	58.2	-10.7	-1.4	-2.9	8.3	-12.9	1.30
	SIMULT	SHEAR	-12.5	-1.5	SIMULT	MOM	58.2	55.5	
8.40	11.0	22.0	51.9	-12.8	-2.8	-5.6	6.2	-14.9	1.30
	SIMULT	SHEAR	-14.6	-1.5	SIMULT	MOM	51.9	49.2	
9.80	6.1	12.2	41.7	-15.0	-4.2	-8.4	4.3	-16.8	1.30
	SIMULT	SHEAR	-16.5	-1.5	SIMULT	MOM	41.7	39.2	
11.20	-0.7	-1.4	28.6	-17.8	-5.5	-11.1	2.6	-18.4	1.30
	SIMULT	SHEAR	-18.2	-4.2	SIMULT	MOM	28.6	26.8	
12.60	-9.4	-18.9	14.2	-23.8L	-6.9	-13.8	1.1	-19.7	1.30
	SIMULT	SHEAR	-19.7	-9.0	SIMULT	MOM	14.2	13.3	
14.00	-20.0	-40.2	5.7	-39.4LS	-8.3	-16.6	0.4L	-27.7	1.30
	SIMULT	SHEAR	0.4	-12.7	SIMULT	MOM	6.1	0.0	

SPAN 2 - LIVE LOAD IMPACT FACTORS : POS MOM 1.30 NEG MOM 1.30

X	DL1 MOMENT	DL2 MOMENT	+(LL+I) MOMENT	-(LL+I) MOMENT	DL1 SHEAR	DL2 SHEAR	+(LL+I) SHEAR	-(LL+I) SHEAR	I.F.
0.00	-20.0	-40.2	5.7	-39.4LS	7.2	14.5	27.7	-2.2L	1.30
	SIMULT	SHEAR	-2.0	12.1	SIMULT	MOM	0.0	6.1	
1.40	-10.9	-21.8	16.0	-28.0	5.9	11.7	19.4	-2.2L	1.30
	SIMULT	SHEAR	18.9	4.7	SIMULT	MOM	13.9	3.3	
2.80	-3.6	-7.3	29.8	-22.4	4.5	9.0	17.6	-4.0	1.30
	SIMULT	SHEAR	16.8	2.7	SIMULT	MOM	27.0	29.8	
4.20	1.7	3.4	40.3	-18.6	3.1	6.3	15.5	-6.3	1.30
	SIMULT	SHEAR	14.5	2.7	SIMULT	MOM	37.7	40.3	
5.60	5.1	10.2	46.6	-15.6L	1.7	3.5	13.3	-8.7	1.30
	SIMULT	SHEAR	12.1	0.4	SIMULT	MOM	44.9	46.6	
7.00	6.6	13.2	48.2	-15.0L	0.4	0.8	10.9	-11.1	1.30
	SIMULT	SHEAR	-11.1	0.4	SIMULT	MOM	47.7	48.2	
8.40	6.2	12.4	45.8	-14.5L	-1.0	-2.0	8.5	-13.4	1.30
	SIMULT	SHEAR	-12.3	0.4	SIMULT	MOM	45.8	45.1	
9.80	3.8	7.7	39.3	-14.3	-2.4	-4.7	6.1	-15.6	1.30
	SIMULT	SHEAR	-14.7	-2.0	SIMULT	MOM	39.3	37.8	
11.20	-0.4	-0.9	28.8	-17.8	-3.7	-7.5	3.9	-17.6	1.30
	SIMULT	SHEAR	-16.9	-4.2	SIMULT	MOM	28.8	26.9	

12.60	-6.6	-13.2	15.3	-23.7	-5.1	-10.2	2.8L	-19.4	1.30
	SIMULT	SHEAR	-19.0	-4.2	SIMULT	MOM	5.5	13.8	
14.00	-14.7	-29.5	8.0	-36.9LS	-6.5	-13.0	2.8L	-27.7	1.30
	SIMULT	SHEAR	2.7	-11.9	SIMULT	MOM	9.2	0.0	

SPAN 3 - LIVE LOAD IMPACT FACTORS : POS MOM 1.30 NEG MOM 1.30

X	DL1 MOMENT	DL2 MOMENT	+(LL+I) MOMENT	-(LL+I) MOMENT	DL1 SHEAR	DL2 SHEAR	+(LL+I) SHEAR	-(LL+I) SHEAR	I.F.
0.00	-14.7	-29.5	8.0	-36.9LS	6.7	13.5	27.7	-2.4L	1.30
	SIMULT	SHEAR	-0.7	11.9	SIMULT	MOM	0.0	8.0	
1.40	-6.2	-12.4	15.3	-24.0	5.4	10.8	19.4	-2.4L	1.30
	SIMULT	SHEAR	19.0	4.3	SIMULT	MOM	13.9	4.9	
2.80	0.4	0.7	28.9	-18.0	4.0	8.0	17.6	-3.9	1.30
	SIMULT	SHEAR	16.9	4.3	SIMULT	MOM	27.0	28.9	
4.20	5.0	10.1	39.4	-14.3	2.6	5.3	15.5	-6.2	1.30
	SIMULT	SHEAR	14.6	2.1	SIMULT	MOM	37.7	39.4	
5.60	7.8	15.6	45.8	-13.5L	1.3	2.6	13.3	-8.5	1.30
	SIMULT	SHEAR	12.3	0.0	SIMULT	MOM	44.8	45.8	
7.00	8.6	17.2	47.7	-13.5L	-0.1	-0.2	10.9	-10.9	1.30
	SIMULT	SHEAR	-10.9	0.0	SIMULT	MOM	47.6	47.7	
8.40	7.5	15.0	45.7	-13.5L	-1.5	-2.9	8.5	-13.3	1.30
	SIMULT	SHEAR	-12.3	0.0	SIMULT	MOM	45.7	44.8	
9.80	4.5	9.0	39.3	-14.3	-2.8	-5.7	6.1	-15.5	1.30
	SIMULT	SHEAR	-14.7	-2.1	SIMULT	MOM	39.3	37.7	
11.20	-0.4	-0.9	28.8	-17.8	-4.2	-8.4	3.9	-17.6	1.30
	SIMULT	SHEAR	-16.9	-4.2	SIMULT	MOM	28.8	27.0	
12.60	-7.3	-14.6	15.3	-23.7	-5.6	-11.2	2.4L	-19.4	1.30
	SIMULT	SHEAR	-19.0	-4.2	SIMULT	MOM	4.8	13.9	
14.00	-16.0	-32.1	6.2L	-37.0LS	-6.9	-13.9	2.4L	-27.7	1.30
	SIMULT	SHEAR	1.8	-11.9	SIMULT	MOM	7.9	0.0	

SPAN 4 - LIVE LOAD IMPACT FACTORS : POS MOM 1.30 NEG MOM 1.30

X	DL1 MOMENT	DL2 MOMENT	+(LL+I) MOMENT	-(LL+I) MOMENT	DL1 SHEAR	DL2 SHEAR	+(LL+I) SHEAR	-(LL+I) SHEAR	I.F.
0.00	-16.0	-32.1	6.2L	-37.0LS	6.8	13.7	27.7	-2.3L	1.30
	SIMULT	SHEAR	-0.9	11.9	SIMULT	MOM	0.0	7.8	
1.40	-7.4	-14.9	15.3	-23.7	5.5	11.0	19.4	-2.4L	1.30
	SIMULT	SHEAR	19.0	4.2	SIMULT	MOM	13.9	4.7	
2.80	-0.7	-1.4	28.8	-17.8	4.1	8.2	17.6	-3.9	1.30
	SIMULT	SHEAR	16.9	4.2	SIMULT	MOM	27.0	28.8	
4.20	4.1	8.2	39.3	-14.3	2.7	5.5	15.5	-6.1	1.30
	SIMULT	SHEAR	14.7	2.1	SIMULT	MOM	37.7	39.3	
5.60	7.0	14.0	45.7	-13.6L	1.4	2.7	13.3	-8.5	1.30
	SIMULT	SHEAR	12.3	0.0	SIMULT	MOM	44.8	45.7	
7.00	7.9	15.9	47.6	-13.6L	0.0	0.0	10.9	-10.9	1.30
	SIMULT	SHEAR	-10.9	0.0	SIMULT	MOM	47.6	47.6	
8.40	7.0	14.0	45.7	-13.6L	-1.4	-2.7	8.5	-13.3	1.30
	SIMULT	SHEAR	-12.3	0.0	SIMULT	MOM	45.7	44.8	
9.80	4.1	8.2	39.3	-14.3	-2.7	-5.5	6.1	-15.5	1.30
	SIMULT	SHEAR	-14.7	-2.1	SIMULT	MOM	39.3	37.7	
11.20	-0.7	-1.4	28.8	-17.8	-4.1	-8.2	3.9	-17.6	1.30
	SIMULT	SHEAR	-16.9	-4.2	SIMULT	MOM	28.8	27.0	
12.60	-7.4	-14.9	15.3	-23.7	-5.5	-11.0	2.4L	-19.4	1.30
	SIMULT	SHEAR	-19.0	-4.2	SIMULT	MOM	4.7	13.9	
14.00	-16.0	-32.1	6.2L	-37.0LS	-6.8	-13.7	2.3L	-27.7	1.30
	SIMULT	SHEAR	0.9	-11.9	SIMULT	MOM	7.8	0.0	

SPAN 5 - LIVE LOAD IMPACT FACTORS : POS MOM 1.30 NEG MOM 1.30

X	DL1 MOMENT	DL2 MOMENT	+(LL+I) MOMENT	-(LL+I) MOMENT	DL1 SHEAR	DL2 SHEAR	+(LL+I) SHEAR	-(LL+I) SHEAR	I.F.

0.00	-16.0	-32.1	6.2L	-37.0LS	6.9	13.9	27.7	-2.4L	1.30
	SIMULT	SHEAR	-1.8	11.9	SIMULT	MOM	0.0	7.9	
1.40	-7.3	-14.6	15.3	-23.7	5.6	11.2	19.4	-2.4L	1.30
	SIMULT	SHEAR	19.0	4.2	SIMULT	MOM	13.9	4.8	
2.80	-0.4	-0.9	28.8	-17.8	4.2	8.4	17.6	-3.9	1.30
	SIMULT	SHEAR	16.9	4.2	SIMULT	MOM	27.0	28.8	
4.20	4.5	9.0	39.3	-14.3	2.8	5.7	15.5	-6.1	1.30
	SIMULT	SHEAR	14.7	2.1	SIMULT	MOM	37.7	39.3	
5.60	7.5	15.0	45.7	-13.5L	1.5	2.9	13.3	-8.5	1.30
	SIMULT	SHEAR	12.3	0.0	SIMULT	MOM	44.8	45.7	
7.00	8.6	17.2	47.7	-13.5L	0.1	0.2	10.9	-10.9	1.30
	SIMULT	SHEAR	10.9	0.0	SIMULT	MOM	47.7	47.6	
8.40	7.8	15.6	45.8	-13.5L	-1.3	-2.6	8.5	-13.3	1.30
	SIMULT	SHEAR	-12.3	0.0	SIMULT	MOM	45.8	44.8	
9.80	5.0	10.1	39.4	-14.3	-2.6	-5.3	6.2	-15.5	1.30
	SIMULT	SHEAR	-14.6	-2.1	SIMULT	MOM	39.4	37.7	
11.20	0.4	0.7	28.9	-18.0	-4.0	-8.0	3.9	-17.6	1.30
	SIMULT	SHEAR	-16.9	-4.3	SIMULT	MOM	28.9	27.0	
12.60	-6.2	-12.4	15.3	-24.0	-5.4	-10.8	2.4L	-19.4	1.30
	SIMULT	SHEAR	-19.0	-4.3	SIMULT	MOM	4.9	13.9	
14.00	-14.7	-29.5	8.0	-36.9LS	-6.7	-13.5	2.4L	-27.7	1.30
	SIMULT	SHEAR	0.7	-11.9	SIMULT	MOM	8.0	0.0	

SPAN 6 - LIVE LOAD IMPACT FACTORS : POS MOM 1.30 NEG MOM 1.30

X	DL1 MOMENT	DL2 MOMENT	+(LL+I) MOMENT	-(LL+I) MOMENT	DL1 SHEAR	DL2 SHEAR	+(LL+I) SHEAR	-(LL+I) SHEAR	I.F.
0.00	-14.7	-29.5	8.0	-36.9LS	6.5	13.0	27.7	-2.8L	1.30
	SIMULT	SHEAR	-2.7	11.9	SIMULT	MOM	0.0	9.2	
1.40	-6.6	-13.2	15.3	-23.7	5.1	10.2	19.4	-2.8L	1.30
	SIMULT	SHEAR	19.0	4.2	SIMULT	MOM	13.8	5.5	
2.80	-0.4	-0.9	28.8	-17.8	3.7	7.5	17.6	-3.9	1.30
	SIMULT	SHEAR	16.9	4.2	SIMULT	MOM	26.9	28.8	
4.20	3.8	7.7	39.3	-14.3	2.4	4.7	15.6	-6.1	1.30
	SIMULT	SHEAR	14.7	2.0	SIMULT	MOM	37.8	39.3	
5.60	6.2	12.4	45.8	-14.5L	1.0	2.0	13.4	-8.5	1.30
	SIMULT	SHEAR	12.3	-0.4	SIMULT	MOM	45.1	45.8	
7.00	6.6	13.2	48.2	-15.0L	-0.4	-0.8	11.1	-10.9	1.30
	SIMULT	SHEAR	11.1	-0.4	SIMULT	MOM	48.2	47.7	
8.40	5.1	10.2	46.6	-15.6L	-1.7	-3.5	8.7	-13.3	1.30
	SIMULT	SHEAR	-12.1	-0.4	SIMULT	MOM	46.6	44.9	
9.80	1.7	3.4	40.3	-18.6	-3.1	-6.3	6.3	-15.5	1.30
	SIMULT	SHEAR	-14.5	-2.7	SIMULT	MOM	40.3	37.7	
11.20	-3.6	-7.3	29.8	-22.4	-4.5	-9.0	4.0	-17.6	1.30
	SIMULT	SHEAR	-16.8	-2.7	SIMULT	MOM	29.8	27.0	
12.60	-10.9	-21.8	16.0	-28.0	-5.9	-11.7	2.2L	-19.4	1.30
	SIMULT	SHEAR	-18.9	-4.7	SIMULT	MOM	3.3	13.9	
14.00	-20.0	-40.2	5.7	-39.4LS	-7.2	-14.5	2.2L	-27.7	1.30
	SIMULT	SHEAR	2.0	-12.1	SIMULT	MOM	6.1	0.0	

SPAN 7 - LIVE LOAD IMPACT FACTORS : POS MOM 1.30 NEG MOM 1.30

X	DL1 MOMENT	DL2 MOMENT	+(LL+I) MOMENT	-(LL+I) MOMENT	DL1 SHEAR	DL2 SHEAR	+(LL+I) SHEAR	-(LL+I) SHEAR	I.F.
0.00	-20.0	-40.2	5.7	-39.4LS	8.3	16.6	27.7	-0.4L	1.30
	SIMULT	SHEAR	-0.4	12.7	SIMULT	MOM	0.0	6.1	
1.40	-9.4	-18.9	14.2	-23.8L	6.9	13.8	19.7	-1.1	1.30
	SIMULT	SHEAR	19.7	9.0	SIMULT	MOM	13.3	14.2	
2.80	-0.7	-1.4	28.6	-17.8	5.5	11.1	18.4	-2.6	1.30
	SIMULT	SHEAR	18.2	4.2	SIMULT	MOM	26.8	28.6	
4.20	6.1	12.2	41.7	-15.0	4.2	8.4	16.8	-4.3	1.30
	SIMULT	SHEAR	16.5	1.5	SIMULT	MOM	39.2	41.7	
5.60	11.0	22.0	51.9	-12.8	2.8	5.6	14.9	-6.2	1.30

	SIMULT	SHEAR	14.6	1.5	SIMULT	MOM	49.2	51.9	
7.00	13.9	27.9	58.2	-10.7	1.4	2.9	12.9	-8.3	1.30
	SIMULT	SHEAR	12.5	1.5	SIMULT	MOM	55.5	58.2	
8.40	15.0	30.0	59.4	-8.6	0.1	0.1	10.6	-10.6	1.30
	SIMULT	SHEAR	-10.6	1.5	SIMULT	MOM	57.1	59.4	
9.80	14.1	28.3	54.8	-6.4	-1.3	-2.6	8.2	-13.0	1.30
	SIMULT	SHEAR	-13.0	1.5	SIMULT	MOM	53.1	54.8	
11.20	11.3	22.7	43.6	-4.3	-2.7	-5.4	5.6	-15.6	1.30
	SIMULT	SHEAR	-15.6	1.5	SIMULT	MOM	42.7	43.6	
12.60	6.6	13.3	25.4	-2.1	-4.0	-8.1	2.8	-18.2	1.30
	SIMULT	SHEAR	-18.2	1.5	SIMULT	MOM	25.2	25.4	
14.00	0.0	0.0	0.0	0.0 S	-5.4	-10.8	1.6L	-27.7	1.30
	SIMULT	SHEAR	0.0	0.0	SIMULT	MOM	0.0	0.0	

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*  GIRDER  -  LIVE LOAD  SP-2   *
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MAXIMUM REACTIONS

SUPPORT	DL1	DL2	+(LL+I)	-(LL+I)	REACTIONS +I.F.	REACTIONS -I.F.	MOMENTS +I.F.	MOMENTS -I.F.
1	5.4	10.8	28.0	-1.7	1.30	1.30		
2	15.5	31.1	29.7 L	-2.8	1.30	1.30	1.30	1.30
3	13.2	26.5	29.3 L	-3.9 L	1.30	1.30	1.30	1.30
4	13.8	27.6	29.4 L	-3.4 L	1.30	1.30	1.30	1.30
5	13.8	27.6	29.4 L	-3.4 L	1.30	1.30	1.30	1.30
6	13.2	26.5	29.3 L	-3.9 L	1.30	1.30	1.30	1.30
7	15.5	31.1	29.7 L	-2.8	1.30	1.30	1.30	1.30
8	5.4	10.8	28.0	-1.7	1.30	1.30		

NOTE: ALL SUPPORT REACTIONS AND END SHEARS IN EACH SPAN DUE TO A LIVE LOAD ARE CALCULATED BASED ON AASHTO ARTICLE 3.23.1 AS INTERPRETED IN SOL 431-93-05.

UNFACTORED MOMENTS AND SHEARS

SPAN 1 - LIVE LOAD IMPACT FACTORS : POS MOM 1.30 NEG MOM 1.30

X	DL1 MOMENT	DL2 MOMENT	+(LL+I) MOMENT	-(LL+I) MOMENT	DL1 SHEAR	DL2 SHEAR	+(LL+I) SHEAR	-(LL+I) SHEAR	I.F.
0.00	0.0	0.0	0.0	0.0 S	5.4	10.8	28.0	-1.7	1.30
	SIMULT	SHEAR	0.0	0.0	SIMULT	MOM	0.0	0.0	
1.40	6.6	13.3	26.0	-2.4	4.0	8.1	18.6	-4.3	1.30
	SIMULT	SHEAR	18.6	-1.7	SIMULT	MOM	26.0	23.2	
2.80	11.3	22.7	44.8	-4.9	2.7	5.4	16.0	-6.9	1.30
	SIMULT	SHEAR	16.0	-1.7	SIMULT	MOM	44.8	39.0	
4.20	14.1	28.3	56.6	-7.3	1.3	2.6	13.5	-9.4	1.30
	SIMULT	SHEAR	13.5	-1.7	SIMULT	MOM	56.6	47.9	
5.60	15.0	30.0	61.9	-9.8	-0.1	-0.1	11.0	-11.8	1.30
	SIMULT	SHEAR	11.0	-1.7	SIMULT	MOM	61.9	50.2	
7.00	13.9	27.9	61.2	-12.2	-1.4	-2.9	8.7	-14.0	1.30
	SIMULT	SHEAR	-12.1	-1.7	SIMULT	MOM	61.2	47.5	
8.40	11.0	22.0	55.6	-14.7	-2.8	-5.6	6.6	-15.9	1.30
	SIMULT	SHEAR	-14.2	-1.7	SIMULT	MOM	55.6	41.0	
9.80	6.1	12.2	45.9	-17.1	-4.2	-8.4	4.7	-17.5	1.30
	SIMULT	SHEAR	-16.1	-1.7	SIMULT	MOM	45.9	32.0	
11.20	-0.7	-1.4	33.5	-19.6	-5.5	-11.1	3.0	-18.9	1.30
	SIMULT	SHEAR	-17.8	-1.7	SIMULT	MOM	33.5	21.4	
12.60	-9.4	-18.9	19.7	-32.6	-6.9	-13.8	1.6	-20.0	1.30
	SIMULT	SHEAR	-19.2	-11.8	SIMULT	MOM	19.7	10.5	

14.00	-20.0	-40.2	6.6	-49.2	S	-8.3	-16.6	0.5	-27.8	1.30
	SIMULT SHEAR		0.5	-11.8		SIMULT MOM		6.6	-1.0	

SPAN 2 - LIVE LOAD IMPACT FACTORS : POS MOM 1.30 NEG MOM 1.30
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X	DL1 MOMENT	DL2 MOMENT	+(LL+I) MOMENT	-(LL+I) MOMENT		DL1 SHEAR	DL2 SHEAR	+(LL+I) SHEAR	-(LL+I) SHEAR	I.F.
0.00	-20.0	-40.2	6.6	-49.2	S	7.2	14.5	28.1	-2.3	1.30
	SIMULT SHEAR		-2.3	15.1		SIMULT MOM		-1.0	6.6	
1.40	-10.9	-21.8	18.4	-33.4		5.9	11.7	19.9	-3.3	1.30
	SIMULT SHEAR		17.2	10.5		SIMULT MOM		8.8	14.0	
2.80	-3.6	-7.3	29.8	-22.4		4.5	9.0	18.6	-5.6	1.30
	SIMULT SHEAR		15.6	2.7		SIMULT MOM		18.6	29.8	
4.20	1.7	3.4	41.8	-21.6		3.1	6.3	17.0	-7.8	1.30
	SIMULT SHEAR		15.6	0.5		SIMULT MOM		27.8	38.2	
5.60	5.1	10.2	49.6	-20.9		1.7	3.5	15.1	-10.2	1.30
	SIMULT SHEAR		13.2	0.5		SIMULT MOM		35.2	42.4	
7.00	6.6	13.2	52.6	-20.1		0.4	0.8	12.9	-12.5	1.30
	SIMULT SHEAR		10.8	0.5		SIMULT MOM		39.6	42.3	
8.40	6.2	12.4	50.6	-19.4		-1.0	-2.0	10.5	-14.6	1.30
	SIMULT SHEAR		-12.4	0.5		SIMULT MOM		40.4	38.5	
9.80	3.8	7.7	43.9	-18.7		-2.4	-4.7	8.2	-16.5	1.30
	SIMULT SHEAR		-14.8	0.5		SIMULT MOM		36.7	31.4	
11.20	-0.4	-0.9	33.7	-19.7		-3.7	-7.5	6.1	-18.2	1.30
	SIMULT SHEAR		-16.3	-2.3		SIMULT MOM		29.2	22.0	
12.60	-6.6	-13.2	21.0	-29.3		-5.1	-10.2	3.9	-19.7	1.30
	SIMULT SHEAR		-18.4	-9.7		SIMULT MOM		15.8	11.2	
14.00	-14.7	-29.5	8.0	-43.3	S	-6.5	-13.0	2.8L	-27.8	1.30
	SIMULT SHEAR		2.7	-14.6		SIMULT MOM		9.2	-1.1	

SPAN 3 - LIVE LOAD IMPACT FACTORS : POS MOM 1.30 NEG MOM 1.30
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X	DL1 MOMENT	DL2 MOMENT	+(LL+I) MOMENT	-(LL+I) MOMENT		DL1 SHEAR	DL2 SHEAR	+(LL+I) SHEAR	-(LL+I) SHEAR	I.F.
0.00	-14.7	-29.5	8.0	-43.3	S	6.7	13.5	28.1	-2.4	1.30
	SIMULT SHEAR		-0.7	9.8		SIMULT MOM		-1.1	7.0	
1.40	-6.2	-12.4	22.3	-29.6		5.4	10.8	19.9	-3.4	1.30
	SIMULT SHEAR		18.3	9.8		SIMULT MOM		13.0	14.3	
2.80	0.4	0.7	34.9	-18.9		4.0	8.0	18.2	-5.5	1.30
	SIMULT SHEAR		16.2	4.0		SIMULT MOM		22.1	29.1	
4.20	5.0	10.1	45.0	-18.1		2.6	5.3	16.5	-7.7	1.30
	SIMULT SHEAR		14.5	0.2		SIMULT MOM		31.4	37.5	
5.60	7.8	15.6	51.2	-17.9		1.3	2.6	14.5	-10.1	1.30
	SIMULT SHEAR		12.1	0.2		SIMULT MOM		38.3	41.8	
7.00	8.6	17.2	52.7	-17.6		-0.1	-0.2	12.3	-12.4	1.30
	SIMULT SHEAR		-11.1	0.2		SIMULT MOM		41.9	41.9	
8.40	7.5	15.0	50.3	-17.7		-1.5	-2.9	10.0	-14.5	1.30
	SIMULT SHEAR		-12.3	-0.2		SIMULT MOM		41.7	38.2	
9.80	4.5	9.0	43.8	-17.9		-2.8	-5.7	7.7	-16.5	1.30
	SIMULT SHEAR		-14.7	-0.2		SIMULT MOM		37.4	31.4	
11.20	-0.4	-0.9	33.7	-19.7		-4.2	-8.4	5.5	-18.3	1.30
	SIMULT SHEAR		-16.3	-2.4		SIMULT MOM		29.1	26.8	
12.60	-7.3	-14.6	21.0	-29.3		-5.6	-11.2	3.4	-20.0	1.30
	SIMULT SHEAR		-18.4	-9.7		SIMULT MOM		14.4	12.9	
14.00	-16.0	-32.1	7.2	-43.0	S	-6.9	-13.9	2.4L	-28.2	1.30
	SIMULT SHEAR		0.7	-14.5		SIMULT MOM		7.9	-1.2	

SPAN 4 - LIVE LOAD IMPACT FACTORS : POS MOM 1.30 NEG MOM 1.30
=======

X	DL1 MOMENT	DL2 MOMENT	+(LL+I) MOMENT	-(LL+I) MOMENT		DL1 SHEAR	DL2 SHEAR	+(LL+I) SHEAR	-(LL+I) SHEAR	I.F.
0.00	-16.0	-32.1	7.2	-43.0	S	6.8	13.7	28.1	-2.4	1.30
	SIMULT SHEAR		-2.4	9.8		SIMULT MOM		-1.1	7.2	

1.40	-7.4	-14.9	21.1	-29.4		5.5	11.0	19.9	-3.4	1.30
	SIMULT	SHEAR	18.4	9.8		SIMULT	MOM	13.0	14.4	
2.80	-0.7	-1.4	33.8	-20.1		4.1	8.2	18.2	-5.5	1.30
	SIMULT	SHEAR	16.3	2.4		SIMULT	MOM	22.0	29.1	
4.20	4.1	8.2	43.8	-17.9		2.7	5.5	16.5	-7.7	1.30
	SIMULT	SHEAR	14.6	0.2		SIMULT	MOM	31.4	37.4	
5.60	7.0	14.0	50.3	-17.7		1.4	2.7	14.5	-10.0	1.30
	SIMULT	SHEAR	12.3	0.2		SIMULT	MOM	38.2	41.7	
7.00	7.9	15.9	52.0	-17.5		0.0	0.0	12.4	-12.3	1.30
	SIMULT	SHEAR	11.0	0.2		SIMULT	MOM	41.8	41.8	
8.40	7.0	14.0	50.3	-17.7		-1.4	-2.7	10.0	-14.5	1.30
	SIMULT	SHEAR	-12.3	-0.2		SIMULT	MOM	41.7	38.2	
9.80	4.1	8.2	43.8	-17.9		-2.7	-5.5	7.7	-16.5	1.30
	SIMULT	SHEAR	-14.6	-0.2		SIMULT	MOM	37.4	31.4	
11.20	-0.7	-1.4	33.8	-20.1		-4.1	-8.2	5.5	-18.2	1.30
	SIMULT	SHEAR	-16.3	-2.4		SIMULT	MOM	29.1	22.0	
12.60	-7.4	-14.9	21.1	-29.4		-5.5	-11.0	3.4	-19.9	1.30
	SIMULT	SHEAR	-18.4	-9.8		SIMULT	MOM	14.4	13.0	
14.00	-16.0	-32.1	7.2	-43.0	S	-6.8	-13.7	2.4	-28.1	1.30
	SIMULT	SHEAR	2.4	-9.8		SIMULT	MOM	7.2	-1.1	

SPAN 5 - LIVE LOAD IMPACT FACTORS : POS MOM 1.30 NEG MOM 1.30

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X	DL1 MOMENT	DL2 MOMENT	+(LL+I) MOMENT	-(LL+I) MOMENT		DL1 SHEAR	DL2 SHEAR	+(LL+I) SHEAR	-(LL+I) SHEAR	I.F.
0.00	-16.0	-32.1	7.2	-43.0	S	6.9	13.9	28.2	-2.4L	1.30
	SIMULT	SHEAR	-0.7	14.5		SIMULT	MOM	-1.2	7.9	
1.40	-7.3	-14.6	21.0	-29.3		5.6	11.2	20.0	-3.4	1.30
	SIMULT	SHEAR	18.4	9.7		SIMULT	MOM	12.9	14.4	
2.80	-0.4	-0.9	33.7	-19.7		4.2	8.4	18.3	-5.5	1.30
	SIMULT	SHEAR	16.3	2.4		SIMULT	MOM	26.8	29.1	
4.20	4.5	9.0	43.8	-17.9		2.8	5.7	16.5	-7.7	1.30
	SIMULT	SHEAR	14.7	0.2		SIMULT	MOM	31.4	37.4	
5.60	7.5	15.0	50.3	-17.7		1.5	2.9	14.5	-10.0	1.30
	SIMULT	SHEAR	12.3	0.2		SIMULT	MOM	38.2	41.7	
7.00	8.6	17.2	52.7	-17.6		0.1	0.2	12.4	-12.3	1.30
	SIMULT	SHEAR	11.1	-0.2		SIMULT	MOM	41.9	41.9	
8.40	7.8	15.6	51.2	-17.9		-1.3	-2.6	10.1	-14.5	1.30
	SIMULT	SHEAR	-12.1	-0.2		SIMULT	MOM	41.8	38.3	
9.80	5.0	10.1	45.0	-18.1		-2.6	-5.3	7.7	-16.5	1.30
	SIMULT	SHEAR	-14.5	-0.2		SIMULT	MOM	37.5	31.4	
11.20	0.4	0.7	34.9	-18.9		-4.0	-8.0	5.5	-18.2	1.30
	SIMULT	SHEAR	-16.2	-4.0		SIMULT	MOM	29.1	22.1	
12.60	-6.2	-12.4	22.3	-29.6		-5.4	-10.8	3.4	-19.9	1.30
	SIMULT	SHEAR	-18.3	-9.8		SIMULT	MOM	14.3	13.0	
14.00	-14.7	-29.5	8.0	-43.3	S	-6.7	-13.5	2.4	-28.1	1.30
	SIMULT	SHEAR	0.7	-9.8		SIMULT	MOM	7.0	-1.1	

SPAN 6 - LIVE LOAD IMPACT FACTORS : POS MOM 1.30 NEG MOM 1.30

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X	DL1 MOMENT	DL2 MOMENT	+(LL+I) MOMENT	-(LL+I) MOMENT		DL1 SHEAR	DL2 SHEAR	+(LL+I) SHEAR	-(LL+I) SHEAR	I.F.
0.00	-14.7	-29.5	8.0	-43.3	S	6.5	13.0	27.8	-2.8L	1.30
	SIMULT	SHEAR	-2.7	14.6		SIMULT	MOM	-1.1	9.2	
1.40	-6.6	-13.2	21.0	-29.3		5.1	10.2	19.7	-3.9	1.30
	SIMULT	SHEAR	18.4	9.7		SIMULT	MOM	11.2	15.8	
2.80	-0.4	-0.9	33.7	-19.7		3.7	7.5	18.2	-6.1	1.30
	SIMULT	SHEAR	16.3	2.3		SIMULT	MOM	22.0	29.2	
4.20	3.8	7.7	43.9	-18.7		2.4	4.7	16.5	-8.2	1.30
	SIMULT	SHEAR	14.8	-0.5		SIMULT	MOM	31.4	36.7	
5.60	6.2	12.4	50.6	-19.4		1.0	2.0	14.6	-10.5	1.30
	SIMULT	SHEAR	12.4	-0.5		SIMULT	MOM	38.5	40.4	
7.00	6.6	13.2	52.6	-20.1		-0.4	-0.8	12.5	-12.9	1.30

	SIMULT	SHEAR	-10.8	-0.5		SIMULT	MOM	42.3	39.6	
8.40	5.1	10.2	49.6	-20.9		-1.7	-3.5	10.2	-15.1	1.30
	SIMULT	SHEAR	-13.2	-0.5		SIMULT	MOM	42.4	35.2	
9.80	1.7	3.4	41.8	-21.6		-3.1	-6.3	7.8	-17.0	1.30
	SIMULT	SHEAR	-15.6	-0.5		SIMULT	MOM	38.2	27.8	
11.20	-3.6	-7.3	29.8	-22.4		-4.5	-9.0	5.6	-18.6	1.30
	SIMULT	SHEAR	-15.6	-2.7		SIMULT	MOM	29.8	18.6	
12.60	-10.9	-21.8	18.4	-33.4		-5.9	-11.7	3.3	-19.9	1.30
	SIMULT	SHEAR	-17.2	-10.5		SIMULT	MOM	14.0	8.8	
14.00	-20.0	-40.2	6.6	-49.2	S	-7.2	-14.5	2.3	-28.1	1.30
	SIMULT	SHEAR	2.3	-15.1		SIMULT	MOM	6.6	-1.0	

SPAN 7 - LIVE LOAD IMPACT FACTORS : POS MOM 1.30 NEG MOM 1.30

X	DL1 MOMENT	DL2 MOMENT	+(LL+I) MOMENT	-(LL+I) MOMENT		DL1 SHEAR	DL2 SHEAR	+(LL+I) SHEAR	-(LL+I) SHEAR	I.F.
0.00	-20.0	-40.2	6.6	-49.2	S	8.3	16.6	27.8	-0.5	1.30
	SIMULT	SHEAR	-0.5	11.8		SIMULT	MOM	-1.0	6.6	
1.40	-9.4	-18.9	19.7	-32.6		6.9	13.8	20.0	-1.6	1.30
	SIMULT	SHEAR	19.2	11.8		SIMULT	MOM	10.5	19.7	
2.80	-0.7	-1.4	33.5	-19.6		5.5	11.1	18.9	-3.0	1.30
	SIMULT	SHEAR	17.8	1.7		SIMULT	MOM	21.4	33.5	
4.20	6.1	12.2	45.9	-17.1		4.2	8.4	17.5	-4.7	1.30
	SIMULT	SHEAR	16.1	1.7		SIMULT	MOM	32.0	45.9	
5.60	11.0	22.0	55.6	-14.7		2.8	5.6	15.9	-6.6	1.30
	SIMULT	SHEAR	14.2	1.7		SIMULT	MOM	41.0	55.6	
7.00	13.9	27.9	61.2	-12.2		1.4	2.9	14.0	-8.7	1.30
	SIMULT	SHEAR	12.1	1.7		SIMULT	MOM	47.5	61.2	
8.40	15.0	30.0	61.9	-9.8		0.1	0.1	11.8	-11.0	1.30
	SIMULT	SHEAR	-11.0	1.7		SIMULT	MOM	50.2	61.9	
9.80	14.1	28.3	56.6	-7.3		-1.3	-2.6	9.4	-13.5	1.30
	SIMULT	SHEAR	-13.5	1.7		SIMULT	MOM	47.9	56.6	
11.20	11.3	22.7	44.8	-4.9		-2.7	-5.4	6.9	-16.0	1.30
	SIMULT	SHEAR	-16.0	1.7		SIMULT	MOM	39.0	44.8	
12.60	6.6	13.3	26.0	-2.4		-4.0	-8.1	4.3	-18.6	1.30
	SIMULT	SHEAR	-18.6	1.7		SIMULT	MOM	23.2	26.0	
14.00	0.0	0.0	0.0	0.0	S	-5.4	-10.8	1.7	-28.0	1.30
	SIMULT	SHEAR	0.0	0.0		SIMULT	MOM	0.0	0.0	

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*  GIRDER  -  LIVE LOAD  SP-3  *
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MAXIMUM REACTIONS

SUPPORT	DL1	DL2	+(LL+I)	-(LL+I)	REACTIONS +I.F.	REACTIONS -I.F.	MOMENTS +I.F.	MOMENTS -I.F.
1	5.4	10.8	19.9	-0.9	1.30	1.30		
2	15.5	31.1	18.2	-1.5	1.30	1.30	1.30	1.30
3	13.2	26.5	19.9	-2.5	1.30	1.30	1.30	1.30
4	13.8	27.6	19.9	-1.6	1.30	1.30	1.30	1.30
5	13.8	27.6	19.9	-1.6	1.30	1.30	1.30	1.30
6	13.2	26.5	19.9	-2.5	1.30	1.30	1.30	1.30
7	15.5	31.1	18.2	-1.5	1.30	1.30	1.30	1.30
8	5.4	10.8	19.9	-0.9	1.30	1.30		

NOTE: ALL SUPPORT REACTIONS AND END SHEARS IN EACH SPAN DUE TO A LIVE LOAD ARE CALCULATED BASED ON AASHTO ARTICLE 3.23.1 AS INTERPRETED IN SOL 431-93-05.

UNFACTORED MOMENTS AND SHEARS

SPAN 1 - LIVE LOAD IMPACT FACTORS : POS MOM 1.30 NEG MOM 1.30

X	DL1 MOMENT	DL2 MOMENT	+(LL+I) MOMENT	-(LL+I) MOMENT		DL1 SHEAR	DL2 SHEAR	+(LL+I) SHEAR	-(LL+I) SHEAR	I.F.
0.00	0.0	0.0	0.0	0.0	S	5.4	10.8	19.9	-0.9	1.30
	SIMULT SHEAR		0.0	0.0		SIMULT MOM		0.0	0.0	
1.40	6.6	13.3	18.3	-1.3		4.0	8.1	13.1	-2.4	1.30
	SIMULT SHEAR		13.1	-0.9		SIMULT MOM		18.3	17.6	
2.80	11.3	22.7	31.3	-2.5		2.7	5.4	11.2	-4.6	1.30
	SIMULT SHEAR		11.2	-0.9		SIMULT MOM		31.3	29.0	
4.20	14.1	28.3	39.4	-3.8		1.3	2.6	9.4	-6.6	1.30
	SIMULT SHEAR		9.4	-0.9		SIMULT MOM		39.4	35.2	
5.60	15.0	30.0	42.7	-5.1		-0.1	-0.1	7.6	-8.3	1.30
	SIMULT SHEAR		7.6	-0.9		SIMULT MOM		42.7	37.0	
7.00	13.9	27.9	41.8	-6.3		-1.4	-2.9	6.0	-9.9	1.30
	SIMULT SHEAR		-9.0	-0.9		SIMULT MOM		41.8	35.1	
8.40	11.0	22.0	37.3	-7.6		-2.8	-5.6	4.4	-11.3	1.30
	SIMULT SHEAR		-10.5	-0.9		SIMULT MOM		37.3	30.5	
9.80	6.1	12.2	29.9	-8.9		-4.2	-8.4	3.1	-12.5	1.30
	SIMULT SHEAR		-11.9	-0.9		SIMULT MOM		29.9	23.9	
11.20	-0.7	-1.4	20.6	-11.9		-5.5	-11.1	1.8	-13.5	1.30
	SIMULT SHEAR		-13.1	-5.4		SIMULT MOM		20.6	16.1	
12.60	-9.4	-18.9	10.2	-22.3		-6.9	-13.8	0.8	-14.3	1.30
	SIMULT SHEAR		-14.1	-7.5		SIMULT MOM		10.2	7.9	
14.00	-20.0	-40.2	3.4	-33.9	S	-8.3	-16.6	0.2	-19.9	1.30
	SIMULT SHEAR		0.2	-10.4		SIMULT MOM		3.4	0.0	

SPAN 2 - LIVE LOAD IMPACT FACTORS : POS MOM 1.30 NEG MOM 1.30

X	DL1 MOMENT	DL2 MOMENT	+(LL+I) MOMENT	-(LL+I) MOMENT		DL1 SHEAR	DL2 SHEAR	+(LL+I) SHEAR	-(LL+I) SHEAR	I.F.
0.00	-20.0	-40.2	3.4	-33.9	S	7.2	14.5	19.9	-1.2	1.30
	SIMULT SHEAR		-1.2	7.8		SIMULT MOM		0.0	3.4	
1.40	-10.9	-21.8	12.2	-23.3		5.9	11.7	14.2	-1.6	1.30
	SIMULT SHEAR		13.1	6.8		SIMULT MOM		7.0	10.3	
2.80	-3.6	-7.3	21.4	-16.1		4.5	9.0	13.2	-3.7	1.30
	SIMULT SHEAR		11.3	2.0		SIMULT MOM		14.4	21.4	
4.20	1.7	3.4	27.6	-13.3		3.1	6.3	12.0	-5.5	1.30
	SIMULT SHEAR		9.5	2.0		SIMULT MOM		21.2	27.6	
5.60	5.1	10.2	30.7	-10.6		1.7	3.5	10.6	-7.2	1.30
	SIMULT SHEAR		7.7	2.0		SIMULT MOM		26.5	30.7	
7.00	6.6	13.2	30.8	-7.9		0.4	0.8	9.0	-8.9	1.30
	SIMULT SHEAR		-8.9	2.0		SIMULT MOM		29.5	30.8	
8.40	6.2	12.4	29.7	-6.8		-1.0	-2.0	7.3	-10.4	1.30
	SIMULT SHEAR		-7.6	-1.2		SIMULT MOM		29.7	28.1	
9.80	3.8	7.7	26.9	-8.5		-2.4	-4.7	5.5	-11.8	1.30
	SIMULT SHEAR		-9.4	-1.2		SIMULT MOM		26.9	23.0	
11.20	-0.4	-0.9	20.9	-11.8		-3.7	-7.5	3.7	-13.1	1.30
	SIMULT SHEAR		-11.3	-4.6		SIMULT MOM		20.9	16.2	
12.60	-6.6	-13.2	11.8	-20.9		-5.1	-10.2	2.0	-14.1	1.30
	SIMULT SHEAR		-13.1	-6.6		SIMULT MOM		3.0	8.2	
14.00	-14.7	-29.5	5.8	-30.9	S	-6.5	-13.0	2.0	-19.9	1.30
	SIMULT SHEAR		2.0	-9.4		SIMULT MOM		5.8	0.0	

SPAN 3 - LIVE LOAD IMPACT FACTORS : POS MOM 1.30 NEG MOM 1.30

X	DL1 MOMENT	DL2 MOMENT	+(LL+I) MOMENT	-(LL+I) MOMENT		DL1 SHEAR	DL2 SHEAR	+(LL+I) SHEAR	-(LL+I) SHEAR	I.F.
0.00	-14.7	-29.5	5.8	-30.9	S	6.7	13.5	19.9	-1.2	1.30
	SIMULT SHEAR		-0.5	7.5		SIMULT MOM		0.0	3.6	
1.40	-6.2	-12.4	11.8	-21.0		5.4	10.8	14.1	-1.5	1.30
	SIMULT SHEAR		13.2	6.6		SIMULT MOM		8.1	10.0	

2.80	0.4	0.7	20.9	-11.9		4.0	8.0	13.0	-3.6	1.30
	SIMULT	SHEAR	11.4	4.5		SIMULT	MOM	16.0	20.9	
4.20	5.0	10.1	27.1	-8.1		2.6	5.3	11.8	-5.4	1.30
	SIMULT	SHEAR	9.6	1.2		SIMULT	MOM	22.8	27.1	
5.60	7.8	15.6	30.3	-6.4		1.3	2.6	10.4	-7.1	1.30
	SIMULT	SHEAR	7.8	1.2		SIMULT	MOM	27.8	30.3	
7.00	8.6	17.2	30.5	-5.0		-0.1	-0.2	8.8	-8.8	1.30
	SIMULT	SHEAR	-8.8	-1.2		SIMULT	MOM	30.4	30.5	
8.40	7.5	15.0	30.2	-6.7		-1.5	-2.9	7.1	-10.3	1.30
	SIMULT	SHEAR	-7.8	-1.2		SIMULT	MOM	30.2	27.9	
9.80	4.5	9.0	27.0	-8.4		-2.8	-5.7	5.4	-11.8	1.30
	SIMULT	SHEAR	-9.6	-1.2		SIMULT	MOM	27.0	23.0	
11.20	-0.4	-0.9	20.8	-11.8		-4.2	-8.4	3.6	-13.0	1.30
	SIMULT	SHEAR	-11.4	-4.5		SIMULT	MOM	20.8	16.2	
12.60	-7.3	-14.6	11.7	-20.8		-5.6	-11.2	1.5	-14.1	1.30
	SIMULT	SHEAR	-13.2	-6.6		SIMULT	MOM	10.0	8.2	
14.00	-16.0	-32.1	3.6	-30.7	S	-6.9	-13.9	1.2	-19.9	1.30
	SIMULT	SHEAR	0.3	-9.3		SIMULT	MOM	3.5	0.0	

SPAN 4 - LIVE LOAD IMPACT FACTORS : POS MOM 1.30 NEG MOM 1.30
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X	DL1 MOMENT	DL2 MOMENT	+(LL+I) MOMENT	-(LL+I) MOMENT		DL1 SHEAR	DL2 SHEAR	+(LL+I) SHEAR	-(LL+I) SHEAR	I.F.
0.00	-16.0	-32.1	3.6	-30.7	S	6.8	13.7	19.9	-1.2	1.30
	SIMULT	SHEAR	-1.2	7.5		SIMULT	MOM	0.0	3.6	
1.40	-7.4	-14.9	11.7	-20.8		5.5	11.0	14.1	-1.5	1.30
	SIMULT	SHEAR	13.2	6.6		SIMULT	MOM	8.2	10.0	
2.80	-0.7	-1.4	20.8	-11.8		4.1	8.2	13.0	-3.6	1.30
	SIMULT	SHEAR	11.4	4.5		SIMULT	MOM	16.2	20.8	
4.20	4.1	8.2	27.1	-8.4		2.7	5.5	11.8	-5.4	1.30
	SIMULT	SHEAR	9.6	1.2		SIMULT	MOM	23.0	27.1	
5.60	7.0	14.0	30.2	-6.7		1.4	2.7	10.3	-7.1	1.30
	SIMULT	SHEAR	7.8	1.2		SIMULT	MOM	27.9	30.2	
7.00	7.9	15.9	30.5	-5.0		0.0	0.0	8.8	-8.8	1.30
	SIMULT	SHEAR	-8.8	-1.2		SIMULT	MOM	30.5	30.5	
8.40	7.0	14.0	30.2	-6.7		-1.4	-2.7	7.1	-10.3	1.30
	SIMULT	SHEAR	-7.8	-1.2		SIMULT	MOM	30.2	27.9	
9.80	4.1	8.2	27.1	-8.4		-2.7	-5.5	5.4	-11.8	1.30
	SIMULT	SHEAR	-9.6	-1.2		SIMULT	MOM	27.1	23.0	
11.20	-0.7	-1.4	20.8	-11.8		-4.1	-8.2	3.6	-13.0	1.30
	SIMULT	SHEAR	-11.4	-4.5		SIMULT	MOM	20.8	16.2	
12.60	-7.4	-14.9	11.7	-20.8		-5.5	-11.0	1.5	-14.1	1.30
	SIMULT	SHEAR	-13.2	-6.6		SIMULT	MOM	10.0	8.2	
14.00	-16.0	-32.1	3.6	-30.7	S	-6.8	-13.7	1.2	-19.9	1.30
	SIMULT	SHEAR	1.2	-7.5		SIMULT	MOM	3.6	0.0	

SPAN 5 - LIVE LOAD IMPACT FACTORS : POS MOM 1.30 NEG MOM 1.30
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X	DL1 MOMENT	DL2 MOMENT	+(LL+I) MOMENT	-(LL+I) MOMENT		DL1 SHEAR	DL2 SHEAR	+(LL+I) SHEAR	-(LL+I) SHEAR	I.F.
0.00	-16.0	-32.1	3.6	-30.7	S	6.9	13.9	19.9	-1.2	1.30
	SIMULT	SHEAR	-0.3	9.3		SIMULT	MOM	0.0	3.5	
1.40	-7.3	-14.6	11.7	-20.8		5.6	11.2	14.1	-1.5	1.30
	SIMULT	SHEAR	13.2	6.6		SIMULT	MOM	8.2	10.0	
2.80	-0.4	-0.9	20.8	-11.8		4.2	8.4	13.0	-3.6	1.30
	SIMULT	SHEAR	11.4	4.5		SIMULT	MOM	16.2	20.8	
4.20	4.5	9.0	27.0	-8.4		2.8	5.7	11.8	-5.4	1.30
	SIMULT	SHEAR	9.6	1.2		SIMULT	MOM	23.0	27.0	
5.60	7.5	15.0	30.2	-6.7		1.5	2.9	10.3	-7.1	1.30
	SIMULT	SHEAR	7.8	1.2		SIMULT	MOM	27.9	30.2	
7.00	8.6	17.2	30.5	-5.0		0.1	0.2	8.8	-8.8	1.30
	SIMULT	SHEAR	8.8	1.2		SIMULT	MOM	30.5	30.4	
8.40	7.8	15.6	30.3	-6.4		-1.3	-2.6	7.1	-10.4	1.30

	SIMULT	SHEAR	-7.8	-1.2		SIMULT	MOM	30.3	27.8	
9.80	5.0	10.1	27.1	-8.1		-2.6	-5.3	5.4	-11.8	1.30
	SIMULT	SHEAR	-9.6	-1.2		SIMULT	MOM	27.1	22.8	
11.20	0.4	0.7	20.9	-11.9		-4.0	-8.0	3.6	-13.0	1.30
	SIMULT	SHEAR	-11.4	-4.5		SIMULT	MOM	20.9	16.0	
12.60	-6.2	-12.4	11.8	-21.0		-5.4	-10.8	1.5	-14.1	1.30
	SIMULT	SHEAR	-13.2	-6.6		SIMULT	MOM	10.0	8.1	
14.00	-14.7	-29.5	5.8	-30.9	S	-6.7	-13.5	1.2	-19.9	1.30
	SIMULT	SHEAR	0.5	-7.5		SIMULT	MOM	3.6	0.0	

SPAN 6 - LIVE LOAD IMPACT FACTORS : POS MOM 1.30 NEG MOM 1.30

X	DL1 MOMENT	DL2 MOMENT	+(LL+I) MOMENT	-(LL+I) MOMENT		DL1 SHEAR	DL2 SHEAR	+(LL+I) SHEAR	-(LL+I) SHEAR	I.F.
0.00	-14.7	-29.5	5.8	-30.9	S	6.5	13.0	19.9	-2.0	1.30
	SIMULT	SHEAR	-2.0	9.4		SIMULT	MOM	0.0	5.8	
1.40	-6.6	-13.2	11.8	-20.9		5.1	10.2	14.1	-2.0	1.30
	SIMULT	SHEAR	13.1	6.6		SIMULT	MOM	8.2	3.0	
2.80	-0.4	-0.9	20.9	-11.8		3.7	7.5	13.1	-3.7	1.30
	SIMULT	SHEAR	11.3	4.6		SIMULT	MOM	16.2	20.9	
4.20	3.8	7.7	26.9	-8.5		2.4	4.7	11.8	-5.5	1.30
	SIMULT	SHEAR	9.4	1.2		SIMULT	MOM	23.0	26.9	
5.60	6.2	12.4	29.7	-6.8		1.0	2.0	10.4	-7.3	1.30
	SIMULT	SHEAR	7.6	1.2		SIMULT	MOM	28.1	29.7	
7.00	6.6	13.2	30.8	-7.9		-0.4	-0.8	8.9	-9.0	1.30
	SIMULT	SHEAR	8.9	-2.0		SIMULT	MOM	30.8	29.5	
8.40	5.1	10.2	30.7	-10.6		-1.7	-3.5	7.2	-10.6	1.30
	SIMULT	SHEAR	-7.7	-2.0		SIMULT	MOM	30.7	26.5	
9.80	1.7	3.4	27.6	-13.3		-3.1	-6.3	5.5	-12.0	1.30
	SIMULT	SHEAR	-9.5	-2.0		SIMULT	MOM	27.6	21.2	
11.20	-3.6	-7.3	21.4	-16.1		-4.5	-9.0	3.7	-13.2	1.30
	SIMULT	SHEAR	-11.3	-2.0		SIMULT	MOM	21.4	14.4	
12.60	-10.9	-21.8	12.2	-23.3		-5.9	-11.7	1.6	-14.2	1.30
	SIMULT	SHEAR	-13.1	-6.8		SIMULT	MOM	10.3	7.0	
14.00	-20.0	-40.2	3.4	-33.9	S	-7.2	-14.5	1.2	-19.9	1.30
	SIMULT	SHEAR	1.2	-7.8		SIMULT	MOM	3.4	0.0	

SPAN 7 - LIVE LOAD IMPACT FACTORS : POS MOM 1.30 NEG MOM 1.30

X	DL1 MOMENT	DL2 MOMENT	+(LL+I) MOMENT	-(LL+I) MOMENT		DL1 SHEAR	DL2 SHEAR	+(LL+I) SHEAR	-(LL+I) SHEAR	I.F.
0.00	-20.0	-40.2	3.4	-33.9	S	8.3	16.6	19.9	-0.2	1.30
	SIMULT	SHEAR	-0.2	10.4		SIMULT	MOM	0.0	3.4	
1.40	-9.4	-18.9	10.2	-22.3		6.9	13.8	14.3	-0.8	1.30
	SIMULT	SHEAR	14.1	7.5		SIMULT	MOM	7.9	10.2	
2.80	-0.7	-1.4	20.6	-11.9		5.5	11.1	13.5	-1.8	1.30
	SIMULT	SHEAR	13.1	5.4		SIMULT	MOM	16.1	20.6	
4.20	6.1	12.2	29.9	-8.9		4.2	8.4	12.5	-3.1	1.30
	SIMULT	SHEAR	11.9	0.9		SIMULT	MOM	23.9	29.9	
5.60	11.0	22.0	37.3	-7.6		2.8	5.6	11.3	-4.4	1.30
	SIMULT	SHEAR	10.5	0.9		SIMULT	MOM	30.5	37.3	
7.00	13.9	27.9	41.8	-6.3		1.4	2.9	9.9	-6.0	1.30
	SIMULT	SHEAR	9.0	0.9		SIMULT	MOM	35.1	41.8	
8.40	15.0	30.0	42.7	-5.1		0.1	0.1	8.3	-7.6	1.30
	SIMULT	SHEAR	-7.6	0.9		SIMULT	MOM	37.0	42.7	
9.80	14.1	28.3	39.4	-3.8		-1.3	-2.6	6.6	-9.4	1.30
	SIMULT	SHEAR	-9.4	0.9		SIMULT	MOM	35.2	39.4	
11.20	11.3	22.7	31.3	-2.5		-2.7	-5.4	4.6	-11.2	1.30
	SIMULT	SHEAR	-11.2	0.9		SIMULT	MOM	29.0	31.3	
12.60	6.6	13.3	18.3	-1.3		-4.0	-8.1	2.4	-13.1	1.30
	SIMULT	SHEAR	-13.1	0.9		SIMULT	MOM	17.6	18.3	
14.00	0.0	0.0	0.0	0.0	S	-5.4	-10.8	0.9	-19.9	1.30
	SIMULT	SHEAR	0.0	0.0		SIMULT	MOM	0.0	0.0	

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*  GIRDER  -  LIVE LOAD  SP-4  *
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MAXIMUM REACTIONS

SUPPORT	DL1	DL2	+(LL+I)	-(LL+I)	REACTIONS +I.F.	REACTIONS -I.F.	MOMENTS +I.F.	MOMENTS -I.F.
1	5.4	10.8	29.6	-1.8	1.30	1.30		
2	15.5	31.1	28.5	-2.9	1.30	1.30	1.30	1.30
3	13.2	26.5	32.1	-4.3	1.30	1.30	1.30	1.30
4	13.8	27.6	32.0	-3.1	1.30	1.30	1.30	1.30
5	13.8	27.6	32.0	-3.1	1.30	1.30	1.30	1.30
6	13.2	26.5	32.1	-4.3	1.30	1.30	1.30	1.30
7	15.5	31.1	28.5	-2.9	1.30	1.30	1.30	1.30
8	5.4	10.8	29.6	-1.8	1.30	1.30		

NOTE: ALL SUPPORT REACTIONS AND END SHEARS IN EACH SPAN DUE TO A LIVE LOAD
ARE CALCULATED BASED ON AASHTO ARTICLE 3.23.1
AS INTERPRETED IN SOL 431-93-05.

UNFACTORED MOMENTS AND SHEARS

SPAN 1 - LIVE LOAD IMPACT FACTORS : POS MOM 1.30 NEG MOM 1.30

X	DL1 MOMENT	DL2 MOMENT	+(LL+I) MOMENT	-(LL+I) MOMENT		DL1 SHEAR	DL2 SHEAR	+(LL+I) SHEAR	-(LL+I) SHEAR	I.F.
0.00	0.0	0.0	0.0	0.0	S	5.4	10.8	29.6	-1.8	1.30
	SIMULT	SHEAR	0.0	0.0		SIMULT	MOM	0.0	0.0	
1.40	6.6	13.3	29.3	-2.5		4.0	8.1	20.9	-3.6	1.30
	SIMULT	SHEAR	20.9	-1.8		SIMULT	MOM	29.3	13.1	
2.80	11.3	22.7	48.7	-5.0		2.7	5.4	17.4	-5.4	1.30
	SIMULT	SHEAR	17.4	-1.8		SIMULT	MOM	48.7	21.4	
4.20	14.1	28.3	58.9	-7.5		1.3	2.6	14.0	-6.9	1.30
	SIMULT	SHEAR	14.0	-1.8		SIMULT	MOM	58.9	37.0	
5.60	15.0	30.0	60.9	-10.0		-0.1	-0.1	10.9	-10.5	1.30
	SIMULT	SHEAR	10.9	-1.8		SIMULT	MOM	60.9	49.1	
7.00	13.9	27.9	58.5	-12.5		-1.4	-2.9	8.0	-13.8	1.30
	SIMULT	SHEAR	-13.0	-1.8		SIMULT	MOM	55.9	52.6	
8.40	11.0	22.0	54.1	-15.0		-2.8	-5.6	5.4	-17.0	1.30
	SIMULT	SHEAR	-16.3	-1.8		SIMULT	MOM	45.3	48.5	
9.80	6.1	12.2	42.5	-17.5		-4.2	-8.4	3.2	-19.9	1.30
	SIMULT	SHEAR	-19.5	-1.8		SIMULT	MOM	31.8	38.0	
11.20	-0.7	-1.4	25.2	-20.9		-5.5	-11.1	1.6	-22.6	1.30
	SIMULT	SHEAR	-22.3	-7.2		SIMULT	MOM	17.9	22.5	
12.60	-9.4	-18.9	11.7	-31.0		-6.9	-13.8	0.9	-24.9	1.30
	SIMULT	SHEAR	-12.1	-7.2		SIMULT	MOM	11.7	3.2	
14.00	-20.0	-40.2	6.7	-46.8	S	-8.3	-16.6	0.5	-32.0	1.30
	SIMULT	SHEAR	0.5	-17.0		SIMULT	MOM	6.7	-19.5	

SPAN 2 - LIVE LOAD IMPACT FACTORS : POS MOM 1.30 NEG MOM 1.30

X	DL1 MOMENT	DL2 MOMENT	+(LL+I) MOMENT	-(LL+I) MOMENT		DL1 SHEAR	DL2 SHEAR	+(LL+I) SHEAR	-(LL+I) SHEAR	I.F.
0.00	-20.0	-40.2	6.7	-46.8	S	7.2	14.5	31.0	-2.4	1.30
	SIMULT	SHEAR	-2.4	7.2		SIMULT	MOM	-15.5	6.7	
1.40	-10.9	-21.8	13.4	-36.6		5.9	11.7	23.3	-2.9	1.30
	SIMULT	SHEAR	9.3	7.2		SIMULT	MOM	6.7	7.6	
2.80	-3.6	-7.3	27.2	-27.9		4.5	9.0	20.6	-5.0	1.30
	SIMULT	SHEAR	18.8	3.4		SIMULT	MOM	22.6	18.6	
4.20	1.7	3.4	39.4	-23.1		3.1	6.3	17.6	-6.2	1.30

	SIMULT	SHEAR	15.7	3.4		SIMULT	MOM	34.3	21.9	
5.60	5.1	10.2	45.8	-18.4		1.7	3.5	14.6	-8.5	1.30
	SIMULT	SHEAR	12.7	3.4		SIMULT	MOM	40.7	38.4	
7.00	6.6	13.2	46.1	-13.7		0.4	0.8	11.5	-11.5	1.30
	SIMULT	SHEAR	9.6	3.4		SIMULT	MOM	41.5	43.1	
8.40	6.2	12.4	44.5	-13.4		-1.0	-2.0	8.6	-14.6	1.30
	SIMULT	SHEAR	-12.7	-2.4		SIMULT	MOM	37.0	42.1	
9.80	3.8	7.7	37.9	-16.8		-2.4	-4.7	6.9	-17.7	1.30
	SIMULT	SHEAR	-15.8	-2.4		SIMULT	MOM	20.8	35.3	
11.20	-0.4	-0.9	25.8	-20.8		-3.7	-7.5	5.6	-20.7	1.30
	SIMULT	SHEAR	-18.8	-6.6		SIMULT	MOM	18.5	22.7	
12.60	-6.6	-13.2	14.3	-30.0		-5.1	-10.2	3.4	-23.5	1.30
	SIMULT	SHEAR	-8.8	-6.6		SIMULT	MOM	5.3	5.4	
14.00	-14.7	-29.5	10.0	-39.7	S	-6.5	-13.0	3.4	-31.0	1.30
	SIMULT	SHEAR	3.4	-14.6		SIMULT	MOM	10.0	-15.5	

SPAN 3 - LIVE LOAD IMPACT FACTORS : POS MOM 1.30 NEG MOM 1.30

X	DL1 MOMENT	DL2 MOMENT	+(LL+I) MOMENT	-(LL+I) MOMENT		DL1 SHEAR	DL2 SHEAR	+(LL+I) SHEAR	-(LL+I) SHEAR	I.F.
0.00	-14.7	-29.5	10.0	-39.7	S	6.7	13.5	30.9	-2.4	1.30
	SIMULT	SHEAR	-0.9	6.6		SIMULT	MOM	-15.1	7.2	
1.40	-6.2	-12.4	13.5	-30.4		5.4	10.8	23.4	-2.9	1.30
	SIMULT	SHEAR	9.3	6.6		SIMULT	MOM	5.6	7.8	
2.80	0.4	0.7	25.8	-21.2		4.0	8.0	20.5	-5.0	1.30
	SIMULT	SHEAR	19.0	6.6		SIMULT	MOM	22.8	18.4	
4.20	5.0	10.1	38.3	-16.6		2.6	5.3	17.5	-6.2	1.30
	SIMULT	SHEAR	15.9	2.9		SIMULT	MOM	35.0	21.7	
5.60	7.8	15.6	44.9	-13.1		1.3	2.6	14.4	-8.4	1.30
	SIMULT	SHEAR	12.8	2.4		SIMULT	MOM	41.6	37.6	
7.00	8.6	17.2	45.6	-9.9		-0.1	-0.2	11.3	-11.3	1.30
	SIMULT	SHEAR	9.8	-2.4		SIMULT	MOM	42.3	42.4	
8.40	7.5	15.0	44.8	-13.3		-1.5	-2.9	8.4	-14.4	1.30
	SIMULT	SHEAR	-12.8	-2.4		SIMULT	MOM	37.5	41.7	
9.80	4.5	9.0	38.2	-16.7		-2.8	-5.7	6.2	-17.5	1.30
	SIMULT	SHEAR	-15.9	-2.4		SIMULT	MOM	21.6	35.1	
11.20	-0.4	-0.9	25.7	-20.8		-4.2	-8.4	5.0	-20.6	1.30
	SIMULT	SHEAR	-19.0	-6.5		SIMULT	MOM	18.4	22.8	
12.60	-7.3	-14.6	13.5	-30.0		-5.6	-11.2	2.9	-23.4	1.30
	SIMULT	SHEAR	-9.3	-6.5		SIMULT	MOM	7.9	5.5	
14.00	-16.0	-32.1	7.2	-39.2	S	-6.9	-13.9	2.4	-31.0	1.30
	SIMULT	SHEAR	0.7	-14.4		SIMULT	MOM	7.1	-15.3	

SPAN 4 - LIVE LOAD IMPACT FACTORS : POS MOM 1.30 NEG MOM 1.30

X	DL1 MOMENT	DL2 MOMENT	+(LL+I) MOMENT	-(LL+I) MOMENT		DL1 SHEAR	DL2 SHEAR	+(LL+I) SHEAR	-(LL+I) SHEAR	I.F.
0.00	-16.0	-32.1	7.2	-39.2	S	6.8	13.7	31.0	-2.4	1.30
	SIMULT	SHEAR	-2.4	6.5		SIMULT	MOM	-15.3	7.2	
1.40	-7.4	-14.9	13.5	-30.0		5.5	11.0	23.4	-2.9	1.30
	SIMULT	SHEAR	9.3	6.5		SIMULT	MOM	5.6	7.8	
2.80	-0.7	-1.4	25.7	-20.8		4.1	8.2	20.5	-5.0	1.30
	SIMULT	SHEAR	19.0	6.5		SIMULT	MOM	22.8	18.4	
4.20	4.1	8.2	38.2	-16.7		2.7	5.5	17.5	-6.2	1.30
	SIMULT	SHEAR	15.9	2.4		SIMULT	MOM	35.0	21.6	
5.60	7.0	14.0	44.9	-13.3		1.4	2.7	14.4	-8.3	1.30
	SIMULT	SHEAR	12.8	2.4		SIMULT	MOM	41.6	37.6	
7.00	7.9	15.9	45.5	-9.9		0.0	0.0	11.3	-11.3	1.30
	SIMULT	SHEAR	9.8	-2.4		SIMULT	MOM	42.4	42.4	
8.40	7.0	14.0	44.9	-13.3		-1.4	-2.7	8.3	-14.4	1.30
	SIMULT	SHEAR	-12.8	-2.4		SIMULT	MOM	37.6	41.6	
9.80	4.1	8.2	38.2	-16.7		-2.7	-5.5	6.2	-17.5	1.30
	SIMULT	SHEAR	-15.9	-2.4		SIMULT	MOM	21.6	35.0	

11.20	-0.7	-1.4	25.7	-20.8	-4.1	-8.2	5.0	-20.5	1.30
	SIMULT	SHEAR	-19.0	-6.5	SIMULT	MOM	18.4	22.8	
12.60	-7.4	-14.9	13.5	-30.0	-5.5	-11.0	2.9	-23.4	1.30
	SIMULT	SHEAR	-9.3	-6.5	SIMULT	MOM	7.8	5.6	
14.00	-16.0	-32.1	7.2	-39.2 S	-6.8	-13.7	2.4	-31.0	1.30
	SIMULT	SHEAR	2.4	-6.5	SIMULT	MOM	7.2	-15.3	

SPAN 5 - LIVE LOAD IMPACT FACTORS : POS MOM 1.30 NEG MOM 1.30

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X	DL1 MOMENT	DL2 MOMENT	+(LL+I) MOMENT	-(LL+I) MOMENT	DL1 SHEAR	DL2 SHEAR	+(LL+I) SHEAR	-(LL+I) SHEAR	I.F.
0.00	-16.0	-32.1	7.2	-39.2 S	6.9	13.9	31.0	-2.4	1.30
	SIMULT	SHEAR	-0.7	14.4	SIMULT	MOM	-15.3	7.1	
1.40	-7.3	-14.6	13.5	-30.0	5.6	11.2	23.4	-2.9	1.30
	SIMULT	SHEAR	9.3	6.5	SIMULT	MOM	5.5	7.9	
2.80	-0.4	-0.9	25.7	-20.8	4.2	8.4	20.6	-5.0	1.30
	SIMULT	SHEAR	19.0	6.5	SIMULT	MOM	22.8	18.4	
4.20	4.5	9.0	38.2	-16.7	2.8	5.7	17.5	-6.2	1.30
	SIMULT	SHEAR	15.9	2.4	SIMULT	MOM	35.1	21.6	
5.60	7.5	15.0	44.8	-13.3	1.5	2.9	14.4	-8.4	1.30
	SIMULT	SHEAR	12.8	2.4	SIMULT	MOM	41.7	37.5	
7.00	8.6	17.2	45.6	-9.9	0.1	0.2	11.3	-11.3	1.30
	SIMULT	SHEAR	-9.8	2.4	SIMULT	MOM	42.4	42.3	
8.40	7.8	15.6	44.9	-13.1	-1.3	-2.6	8.4	-14.4	1.30
	SIMULT	SHEAR	-12.8	-2.4	SIMULT	MOM	37.6	41.6	
9.80	5.0	10.1	38.3	-16.6	-2.6	-5.3	6.2	-17.5	1.30
	SIMULT	SHEAR	-15.9	-2.9	SIMULT	MOM	21.7	35.0	
11.20	0.4	0.7	25.8	-21.2	-4.0	-8.0	5.0	-20.5	1.30
	SIMULT	SHEAR	-19.0	-6.6	SIMULT	MOM	18.4	22.8	
12.60	-6.2	-12.4	13.5	-30.4	-5.4	-10.8	2.9	-23.4	1.30
	SIMULT	SHEAR	-9.3	-6.6	SIMULT	MOM	7.8	5.6	
14.00	-14.7	-29.5	10.0	-39.7 S	-6.7	-13.5	2.4	-30.9	1.30
	SIMULT	SHEAR	0.9	-6.6	SIMULT	MOM	7.2	-15.1	

SPAN 6 - LIVE LOAD IMPACT FACTORS : POS MOM 1.30 NEG MOM 1.30

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X	DL1 MOMENT	DL2 MOMENT	+(LL+I) MOMENT	-(LL+I) MOMENT	DL1 SHEAR	DL2 SHEAR	+(LL+I) SHEAR	-(LL+I) SHEAR	I.F.
0.00	-14.7	-29.5	10.0	-39.7 S	6.5	13.0	31.0	-3.4	1.30
	SIMULT	SHEAR	-3.4	14.6	SIMULT	MOM	-15.5	10.0	
1.40	-6.6	-13.2	14.3	-30.0	5.1	10.2	23.5	-3.4	1.30
	SIMULT	SHEAR	8.8	6.6	SIMULT	MOM	5.4	5.3	
2.80	-0.4	-0.9	25.8	-20.8	3.7	7.5	20.7	-5.6	1.30
	SIMULT	SHEAR	18.8	6.6	SIMULT	MOM	22.7	18.5	
4.20	3.8	7.7	37.9	-16.8	2.4	4.7	17.7	-6.9	1.30
	SIMULT	SHEAR	15.8	2.4	SIMULT	MOM	35.3	20.8	
5.60	6.2	12.4	44.5	-13.4	1.0	2.0	14.6	-8.6	1.30
	SIMULT	SHEAR	12.7	2.4	SIMULT	MOM	42.1	37.0	
7.00	6.6	13.2	46.1	-13.7	-0.4	-0.8	11.5	-11.5	1.30
	SIMULT	SHEAR	-9.6	-3.4	SIMULT	MOM	43.1	41.5	
8.40	5.1	10.2	45.8	-18.4	-1.7	-3.5	8.5	-14.6	1.30
	SIMULT	SHEAR	-12.7	-3.4	SIMULT	MOM	38.4	40.7	
9.80	1.7	3.4	39.4	-23.1	-3.1	-6.3	6.2	-17.6	1.30
	SIMULT	SHEAR	-15.7	-3.4	SIMULT	MOM	21.9	34.3	
11.20	-3.6	-7.3	27.2	-27.9	-4.5	-9.0	5.0	-20.6	1.30
	SIMULT	SHEAR	-18.8	-3.4	SIMULT	MOM	18.6	22.6	
12.60	-10.9	-21.8	13.4	-36.6	-5.9	-11.7	2.9	-23.3	1.30
	SIMULT	SHEAR	-9.3	-7.2	SIMULT	MOM	7.6	6.7	
14.00	-20.0	-40.2	6.7	-46.8 S	-7.2	-14.5	2.4	-31.0	1.30
	SIMULT	SHEAR	2.4	-7.2	SIMULT	MOM	6.7	-15.5	

SPAN 7 - LIVE LOAD IMPACT FACTORS : POS MOM 1.30 NEG MOM 1.30

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X	DL1 MOMENT	DL2 MOMENT	+(LL+I) MOMENT	-(LL+I) MOMENT		DL1 SHEAR	DL2 SHEAR	+(LL+I) SHEAR	-(LL+I) SHEAR	I.F.
0.00	-20.0	-40.2	6.7	-46.8	S	8.3	16.6	32.0	-0.5	1.30
	SIMULT	SHEAR	-0.5	17.0		SIMULT	MOM	-19.5	6.7	
1.40	-9.4	-18.9	11.7	-31.0		6.9	13.8	24.9	-0.9	1.30
	SIMULT	SHEAR	12.1	7.2		SIMULT	MOM	3.2	11.7	
2.80	-0.7	-1.4	25.2	-20.9		5.5	11.1	22.6	-1.6	1.30
	SIMULT	SHEAR	22.3	7.2		SIMULT	MOM	22.5	17.9	
4.20	6.1	12.2	42.5	-17.5		4.2	8.4	19.9	-3.2	1.30
	SIMULT	SHEAR	19.5	1.8		SIMULT	MOM	38.0	31.8	
5.60	11.0	22.0	54.1	-15.0		2.8	5.6	17.0	-5.4	1.30
	SIMULT	SHEAR	16.3	1.8		SIMULT	MOM	48.5	45.3	
7.00	13.9	27.9	58.5	-12.5		1.4	2.9	13.8	-8.0	1.30
	SIMULT	SHEAR	13.0	1.8		SIMULT	MOM	52.6	55.9	
8.40	15.0	30.0	60.9	-10.0		0.1	0.1	10.5	-10.9	1.30
	SIMULT	SHEAR	-10.9	1.8		SIMULT	MOM	49.1	60.9	
9.80	14.1	28.3	58.9	-7.5		-1.3	-2.6	6.9	-14.0	1.30
	SIMULT	SHEAR	-14.0	1.8		SIMULT	MOM	37.0	58.9	
11.20	11.3	22.7	48.7	-5.0		-2.7	-5.4	5.4	-17.4	1.30
	SIMULT	SHEAR	-17.4	1.8		SIMULT	MOM	21.4	48.7	
12.60	6.6	13.3	29.3	-2.5		-4.0	-8.1	3.6	-20.9	1.30
	SIMULT	SHEAR	-20.9	1.8		SIMULT	MOM	13.1	29.3	
14.00	0.0	0.0	0.0	0.0	S	-5.4	-10.8	1.8	-29.6	1.30
	SIMULT	SHEAR	0.0	0.0		SIMULT	MOM	0.0	0.0	

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*  GIRDER  -  LIVE LOAD  SP-5  *
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MAXIMUM REACTIONS

SUPPORT	DL1	DL2	+(LL+I)	-(LL+I)	REACTIONS +I.F.	REACTIONS -I.F.	MOMENTS +I.F.	MOMENTS -I.F.
1	5.4	10.8	27.0	-1.8	1.30	1.30		
2	15.5	31.1	25.0	-2.8	1.30	1.30	1.30	1.30
3	13.2	26.5	27.8	-3.6	1.30	1.30	1.30	1.30
4	13.8	27.6	27.8	-3.0	1.30	1.30	1.30	1.30
5	13.8	27.6	27.8	-3.0	1.30	1.30	1.30	1.30
6	13.2	26.5	27.8	-3.6	1.30	1.30	1.30	1.30
7	15.5	31.1	25.0	-2.8	1.30	1.30	1.30	1.30
8	5.4	10.8	27.0	-1.8	1.30	1.30		

NOTE: ALL SUPPORT REACTIONS AND END SHEARS IN EACH SPAN DUE TO A LIVE LOAD
ARE CALCULATED BASED ON AASHTO ARTICLE 3.23.1
AS INTERPRETED IN SOL 431-93-05.

UNFACTORED MOMENTS AND SHEARS

SPAN 1 - LIVE LOAD IMPACT FACTORS : POS MOM 1.30 NEG MOM 1.30

X	DL1 MOMENT	DL2 MOMENT	+(LL+I) MOMENT	-(LL+I) MOMENT		DL1 SHEAR	DL2 SHEAR	+(LL+I) SHEAR	-(LL+I) SHEAR	I.F.
0.00	0.0	0.0	0.0	0.0	S	5.4	10.8	27.0	-1.8	1.30
	SIMULT	SHEAR	0.0	0.0		SIMULT	MOM	0.0	0.0	
1.40	6.6	13.3	26.3	-2.5		4.0	8.1	18.8	-2.8	1.30
	SIMULT	SHEAR	18.8	-1.8		SIMULT	MOM	26.3	17.1	
2.80	11.3	22.7	43.8	-5.0		2.7	5.4	15.7	-4.3	1.30
	SIMULT	SHEAR	15.7	-1.8		SIMULT	MOM	43.8	29.9	
4.20	14.1	28.3	53.3	-7.6		1.3	2.6	12.7	-5.8	1.30
	SIMULT	SHEAR	12.7	-1.8		SIMULT	MOM	53.3	38.5	
5.60	15.0	30.0	55.5	-10.1		-0.1	-0.1	9.9	-8.7	1.30

	SIMULT	SHEAR	9.9	-1.8		SIMULT	MOM	55.5	50.5	
7.00	13.9	27.9	54.5	-12.6		-1.4	-2.9	7.3	-11.6	1.30
	SIMULT	SHEAR	-11.6	-1.8		SIMULT	MOM	51.4	54.5	
8.40	11.0	22.0	51.3	-15.3		-2.8	-5.6	5.0	-14.4	1.30
	SIMULT	SHEAR	-14.4	-1.8		SIMULT	MOM	42.4	51.3	
9.80	6.1	12.2	41.7	-17.7		-4.2	-8.4	3.5	-17.1	1.30
	SIMULT	SHEAR	-17.1	-1.8		SIMULT	MOM	34.7	41.7	
11.20	-0.7	-1.4	27.0	-19.7		-5.5	-11.1	1.5	-19.5	1.30
	SIMULT	SHEAR	-19.5	-1.8		SIMULT	MOM	25.8	27.0	
12.60	-9.4	-18.9	13.0	-22.2		-6.9	-13.8	0.4	-21.7	1.30
	SIMULT	SHEAR	-15.4	-1.8		SIMULT	MOM	5.6	8.6	
14.00	-20.0	-40.2	6.3	-31.4	S	-8.3	-16.6	0.4	-28.6	1.30
	SIMULT	SHEAR	0.4	-13.4		SIMULT	MOM	6.3	-11.7	

SPAN 2 - LIVE LOAD IMPACT FACTORS : POS MOM 1.30 NEG MOM 1.30

X	DL1 MOMENT	DL2 MOMENT	+(LL+I) MOMENT	-(LL+I) MOMENT		DL1 SHEAR	DL2 SHEAR	+(LL+I) SHEAR	-(LL+I) SHEAR	I.F.
0.00	-20.0	-40.2	6.3	-31.4	S	7.2	14.5	28.0	-2.2	1.30
	SIMULT	SHEAR	-2.2	2.8		SIMULT	MOM	-11.9	6.3	
1.40	-10.9	-21.8	9.9	-27.4		5.9	11.7	20.6	-2.2	1.30
	SIMULT	SHEAR	14.9	2.8		SIMULT	MOM	8.4	3.1	
2.80	-3.6	-7.3	25.3	-24.6		4.5	9.0	17.9	-2.5	1.30
	SIMULT	SHEAR	17.9	1.5		SIMULT	MOM	25.3	16.1	
4.20	1.7	3.4	37.4	-22.7		3.1	6.3	15.0	-4.4	1.30
	SIMULT	SHEAR	15.0	1.6		SIMULT	MOM	37.4	29.1	
5.60	5.1	10.2	43.7	-20.9		1.7	3.5	12.1	-6.7	1.30
	SIMULT	SHEAR	12.1	1.6		SIMULT	MOM	43.7	39.3	
7.00	6.6	13.2	45.1	-18.4		0.4	0.8	9.2	-9.3	1.30
	SIMULT	SHEAR	-9.3	1.5		SIMULT	MOM	44.0	45.1	
8.40	6.2	12.4	45.1	-18.3		-1.0	-2.0	6.7	-12.1	1.30
	SIMULT	SHEAR	-12.1	-0.7		SIMULT	MOM	36.3	45.1	
9.80	3.8	7.7	39.1	-19.2		-2.4	-4.7	4.7	-15.0	1.30
	SIMULT	SHEAR	-15.0	-0.6		SIMULT	MOM	33.3	39.1	
11.20	-0.4	-0.9	27.2	-19.8		-3.7	-7.5	3.0	-17.8	1.30
	SIMULT	SHEAR	-17.8	-2.4		SIMULT	MOM	16.0	27.2	
12.60	-6.6	-13.2	14.5	-23.1		-5.1	-10.2	2.8	-20.5	1.30
	SIMULT	SHEAR	-14.4	-2.4		SIMULT	MOM	4.4	10.5	
14.00	-14.7	-29.5	8.4	-26.5	S	-6.5	-13.0	2.8	-27.9	1.30
	SIMULT	SHEAR	2.8	-6.8		SIMULT	MOM	8.4	-9.5	

SPAN 3 - LIVE LOAD IMPACT FACTORS : POS MOM 1.30 NEG MOM 1.30

X	DL1 MOMENT	DL2 MOMENT	+(LL+I) MOMENT	-(LL+I) MOMENT		DL1 SHEAR	DL2 SHEAR	+(LL+I) SHEAR	-(LL+I) SHEAR	I.F.
0.00	-14.7	-29.5	8.4	-26.5	S	6.7	13.5	27.6	-2.3	1.30
	SIMULT	SHEAR	-0.8	10.1		SIMULT	MOM	-7.5	6.7	
1.40	-6.2	-12.4	16.4	-22.7		5.4	10.8	20.2	-2.3	1.30
	SIMULT	SHEAR	14.2	2.4		SIMULT	MOM	12.1	3.5	
2.80	0.4	0.7	28.2	-20.1		4.0	8.0	17.6	-2.8	1.30
	SIMULT	SHEAR	17.6	1.0		SIMULT	MOM	28.2	27.4	
4.20	5.0	10.1	39.4	-19.0		2.6	5.3	14.7	-4.9	1.30
	SIMULT	SHEAR	14.7	1.0		SIMULT	MOM	39.4	34.2	
5.60	7.8	15.6	45.1	-17.8		1.3	2.6	11.8	-6.8	1.30
	SIMULT	SHEAR	11.8	1.1		SIMULT	MOM	45.1	36.8	
7.00	8.6	17.2	44.6	-16.3		-0.1	-0.2	9.0	-9.1	1.30
	SIMULT	SHEAR	9.0	1.0		SIMULT	MOM	44.6	44.4	
8.40	7.5	15.0	44.7	-17.6		-1.5	-2.9	6.7	-11.9	1.30
	SIMULT	SHEAR	-11.9	-1.0		SIMULT	MOM	36.1	44.7	
9.80	4.5	9.0	38.9	-18.8		-2.8	-5.7	4.7	-14.8	1.30
	SIMULT	SHEAR	-14.8	-0.9		SIMULT	MOM	33.2	38.9	
11.20	-0.4	-0.9	27.3	-19.8		-4.2	-8.4	2.7	-17.7	1.30
	SIMULT	SHEAR	-17.7	-2.4		SIMULT	MOM	25.9	27.3	

12.60	-7.3	-14.6	14.6	-23.2		-5.6	-11.2	2.2	-20.4	1.30
	SIMULT	SHEAR	-14.4	-2.4		SIMULT	MOM	3.5	10.7	
14.00	-16.0	-32.1	6.8	-26.8	S	-6.9	-13.9	2.2	-27.8	1.30
	SIMULT	SHEAR	0.6	-12.9		SIMULT	MOM	6.6	-9.3	

SPAN 4 - LIVE LOAD IMPACT FACTORS : POS MOM 1.30 NEG MOM 1.30
=======

X	DL1 MOMENT	DL2 MOMENT	+(LL+I) MOMENT	-(LL+I) MOMENT		DL1 SHEAR	DL2 SHEAR	+(LL+I) SHEAR	-(LL+I) SHEAR	I.F.
0.00	-16.0	-32.1	6.8	-26.8	S	6.8	13.7	27.8	-2.3	1.30
	SIMULT	SHEAR	-2.3	2.4		SIMULT	MOM	-9.3	6.8	
1.40	-7.4	-14.9	14.7	-23.4		5.5	11.0	20.4	-2.3	1.30
	SIMULT	SHEAR	14.4	2.4		SIMULT	MOM	10.7	3.6	
2.80	-0.7	-1.4	27.3	-20.0		4.1	8.2	17.7	-2.7	1.30
	SIMULT	SHEAR	17.7	2.4		SIMULT	MOM	27.3	26.0	
4.20	4.1	8.2	38.9	-18.8		2.7	5.5	14.8	-4.8	1.30
	SIMULT	SHEAR	14.8	0.9		SIMULT	MOM	38.9	33.3	
5.60	7.0	14.0	44.7	-17.6		1.4	2.7	11.9	-6.7	1.30
	SIMULT	SHEAR	11.9	1.0		SIMULT	MOM	44.7	36.2	
7.00	7.9	15.9	44.3	-16.2		0.0	0.0	9.1	-9.1	1.30
	SIMULT	SHEAR	-9.1	0.9		SIMULT	MOM	44.3	44.3	
8.40	7.0	14.0	44.7	-17.6		-1.4	-2.7	6.7	-11.9	1.30
	SIMULT	SHEAR	-11.9	-1.0		SIMULT	MOM	36.2	44.7	
9.80	4.1	8.2	38.9	-18.8		-2.7	-5.5	4.8	-14.8	1.30
	SIMULT	SHEAR	-14.8	-0.9		SIMULT	MOM	33.3	38.9	
11.20	-0.7	-1.4	27.3	-20.0		-4.1	-8.2	2.7	-17.7	1.30
	SIMULT	SHEAR	-17.7	-2.4		SIMULT	MOM	26.0	27.3	
12.60	-7.4	-14.9	14.7	-23.4		-5.5	-11.0	2.3	-20.4	1.30
	SIMULT	SHEAR	-14.4	-2.4		SIMULT	MOM	3.6	10.7	
14.00	-16.0	-32.1	6.8	-26.8	S	-6.8	-13.7	2.3	-27.8	1.30
	SIMULT	SHEAR	2.3	-2.4		SIMULT	MOM	6.8	-9.3	

SPAN 5 - LIVE LOAD IMPACT FACTORS : POS MOM 1.30 NEG MOM 1.30
=======

X	DL1 MOMENT	DL2 MOMENT	+(LL+I) MOMENT	-(LL+I) MOMENT		DL1 SHEAR	DL2 SHEAR	+(LL+I) SHEAR	-(LL+I) SHEAR	I.F.
0.00	-16.0	-32.1	6.8	-26.8	S	6.9	13.9	27.8	-2.2	1.30
	SIMULT	SHEAR	-0.6	12.9		SIMULT	MOM	-9.3	6.6	
1.40	-7.3	-14.6	14.6	-23.2		5.6	11.2	20.4	-2.2	1.30
	SIMULT	SHEAR	14.4	2.4		SIMULT	MOM	10.7	3.5	
2.80	-0.4	-0.9	27.3	-19.8		4.2	8.4	17.7	-2.7	1.30
	SIMULT	SHEAR	17.7	2.4		SIMULT	MOM	27.3	25.9	
4.20	4.5	9.0	38.9	-18.8		2.8	5.7	14.8	-4.7	1.30
	SIMULT	SHEAR	14.8	0.9		SIMULT	MOM	38.9	33.2	
5.60	7.5	15.0	44.7	-17.6		1.5	2.9	11.9	-6.7	1.30
	SIMULT	SHEAR	11.9	1.0		SIMULT	MOM	44.7	36.1	
7.00	8.6	17.2	44.6	-16.3		0.1	0.2	9.1	-9.0	1.30
	SIMULT	SHEAR	-9.0	-1.0		SIMULT	MOM	44.4	44.6	
8.40	7.8	15.6	45.1	-17.8		-1.3	-2.6	6.8	-11.8	1.30
	SIMULT	SHEAR	-11.8	-1.1		SIMULT	MOM	36.8	45.1	
9.80	5.0	10.1	39.4	-19.0		-2.6	-5.3	4.9	-14.7	1.30
	SIMULT	SHEAR	-14.7	-1.0		SIMULT	MOM	34.2	39.4	
11.20	0.4	0.7	28.2	-20.1		-4.0	-8.0	2.8	-17.6	1.30
	SIMULT	SHEAR	-17.6	-1.0		SIMULT	MOM	27.4	28.2	
12.60	-6.2	-12.4	16.4	-22.7		-5.4	-10.8	2.3	-20.2	1.30
	SIMULT	SHEAR	-14.2	-2.4		SIMULT	MOM	3.5	12.1	
14.00	-14.7	-29.5	8.4	-26.5	S	-6.7	-13.5	2.3	-27.6	1.30
	SIMULT	SHEAR	0.8	-10.1		SIMULT	MOM	6.7	-7.5	

SPAN 6 - LIVE LOAD IMPACT FACTORS : POS MOM 1.30 NEG MOM 1.30
=======

X	DL1 MOMENT	DL2 MOMENT	+(LL+I) MOMENT	-(LL+I) MOMENT	DL1 SHEAR	DL2 SHEAR	+(LL+I) SHEAR	-(LL+I) SHEAR	I.F.

0.00	-14.7	-29.5	8.4	-26.5	S	6.5	13.0	27.9	-2.8	1.30
	SIMULT	SHEAR	-2.8	6.8		SIMULT	MOM	-9.5	8.4	
1.40	-6.6	-13.2	14.5	-23.1		5.1	10.2	20.5	-2.8	1.30
	SIMULT	SHEAR	14.4	2.4		SIMULT	MOM	10.5	4.4	
2.80	-0.4	-0.9	27.2	-19.8		3.7	7.5	17.8	-3.0	1.30
	SIMULT	SHEAR	17.8	2.4		SIMULT	MOM	27.2	16.0	
4.20	3.8	7.7	39.1	-19.2		2.4	4.7	15.0	-4.7	1.30
	SIMULT	SHEAR	15.0	0.6		SIMULT	MOM	39.1	33.3	
5.60	6.2	12.4	45.1	-18.3		1.0	2.0	12.1	-6.7	1.30
	SIMULT	SHEAR	12.1	0.7		SIMULT	MOM	45.1	36.3	
7.00	6.6	13.2	45.1	-18.4		-0.4	-0.8	9.3	-9.2	1.30
	SIMULT	SHEAR	9.3	-1.5		SIMULT	MOM	45.1	44.0	
8.40	5.1	10.2	43.7	-20.9		-1.7	-3.5	6.7	-12.1	1.30
	SIMULT	SHEAR	-12.1	-1.6		SIMULT	MOM	39.3	43.7	
9.80	1.7	3.4	37.4	-22.7		-3.1	-6.3	4.4	-15.0	1.30
	SIMULT	SHEAR	-15.0	-1.6		SIMULT	MOM	29.1	37.4	
11.20	-3.6	-7.3	25.3	-24.6		-4.5	-9.0	2.5	-17.9	1.30
	SIMULT	SHEAR	-17.9	-1.7		SIMULT	MOM	16.1	25.3	
12.60	-10.9	-21.8	9.9	-27.4		-5.9	-11.7	2.2	-20.6	1.30
	SIMULT	SHEAR	-14.9	-2.8		SIMULT	MOM	3.1	8.4	
14.00	-20.0	-40.2	6.3	-31.4	S	-7.2	-14.5	2.2	-28.0	1.30
	SIMULT	SHEAR	2.2	-2.8		SIMULT	MOM	6.3	-11.9	

SPAN 7 - LIVE LOAD IMPACT FACTORS : POS MOM 1.30 NEG MOM 1.30

X	DL1 MOMENT	DL2 MOMENT	+(LL+I) MOMENT	-(LL+I) MOMENT		DL1 SHEAR	DL2 SHEAR	+(LL+I) SHEAR	-(LL+I) SHEAR	I.F.
0.00	-20.0	-40.2	6.3	-31.4	S	8.3	16.6	28.6	-0.4	1.30
	SIMULT	SHEAR	-0.4	13.4		SIMULT	MOM	-11.7	6.3	
1.40	-9.4	-18.9	13.0	-22.2		6.9	13.8	21.7	-0.4	1.30
	SIMULT	SHEAR	15.4	1.8		SIMULT	MOM	8.6	5.6	
2.80	-0.7	-1.4	27.0	-19.7		5.5	11.1	19.5	-1.5	1.30
	SIMULT	SHEAR	19.5	1.8		SIMULT	MOM	27.0	25.8	
4.20	6.1	12.2	41.7	-17.7		4.2	8.4	17.1	-3.5	1.30
	SIMULT	SHEAR	17.1	1.8		SIMULT	MOM	41.7	34.7	
5.60	11.0	22.0	51.3	-15.3		2.8	5.6	14.4	-5.0	1.30
	SIMULT	SHEAR	14.4	1.8		SIMULT	MOM	51.3	42.4	
7.00	13.9	27.9	54.5	-12.6		1.4	2.9	11.6	-7.3	1.30
	SIMULT	SHEAR	11.6	1.8		SIMULT	MOM	54.5	51.4	
8.40	15.0	30.0	55.5	-10.1		0.1	0.1	8.7	-9.9	1.30
	SIMULT	SHEAR	-9.9	1.8		SIMULT	MOM	50.5	55.5	
9.80	14.1	28.3	53.3	-7.6		-1.3	-2.6	5.8	-12.7	1.30
	SIMULT	SHEAR	-12.7	1.8		SIMULT	MOM	38.5	53.3	
11.20	11.3	22.7	43.8	-5.0		-2.7	-5.4	4.3	-15.7	1.30
	SIMULT	SHEAR	-15.7	1.8		SIMULT	MOM	29.9	43.8	
12.60	6.6	13.3	26.3	-2.5		-4.0	-8.1	2.8	-18.8	1.30
	SIMULT	SHEAR	-18.8	1.8		SIMULT	MOM	17.1	26.3	
14.00	0.0	0.0	0.0	0.0	S	-5.4	-10.8	1.8	-27.0	1.30
	SIMULT	SHEAR	0.0	0.0		SIMULT	MOM	0.0	0.0	

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*  GIRDER  -  LIVE LOAD  SP-6  *
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MAXIMUM REACTIONS

SUPPORT	DL1	DL2	+(LL+I)	-(LL+I)	REACTIONS +I.F.	REACTIONS -I.F.	MOMENTS +I.F.	MOMENTS -I.F.
1	5.4	10.8	19.9	-0.9	1.30	1.30		
2	15.5	31.1	18.2	-1.5	1.30	1.30	1.30	1.30
3	13.2	26.5	19.9	-2.5	1.30	1.30	1.30	1.30
4	13.8	27.6	19.9	-1.6	1.30	1.30	1.30	1.30
5	13.8	27.6	19.9	-1.6	1.30	1.30	1.30	1.30

6	13.2	26.5	19.9	-2.5	1.30	1.30	1.30	1.30
7	15.5	31.1	18.2	-1.5	1.30	1.30	1.30	1.30
8	5.4	10.8	19.9	-0.9	1.30	1.30		

NOTE: ALL SUPPORT REACTIONS AND END SHEARS IN EACH SPAN DUE TO A LIVE LOAD ARE CALCULATED BASED ON AASHTO ARTICLE 3.23.1 AS INTERPRETED IN SOL 431-93-05.

UNFACTORED MOMENTS AND SHEARS

SPAN 1 - LIVE LOAD IMPACT FACTORS : POS MOM 1.30 NEG MOM 1.30

X	DL1 MOMENT	DL2 MOMENT	+(LL+I) MOMENT	-(LL+I) MOMENT		DL1 SHEAR	DL2 SHEAR	+(LL+I) SHEAR	-(LL+I) SHEAR	I.F.
0.00	0.0	0.0	0.0	0.0	S	5.4	10.8	19.9	-0.9	1.30
	SIMULT	SHEAR	0.0	0.0		SIMULT	MOM	0.0	0.0	
1.40	6.6	13.3	18.3	-1.3		4.0	8.1	13.1	-2.5	1.30
	SIMULT	SHEAR	13.1	-0.9		SIMULT	MOM	18.3	17.5	
2.80	11.3	22.7	31.3	-2.6		2.7	5.4	11.2	-4.7	1.30
	SIMULT	SHEAR	11.2	-0.9		SIMULT	MOM	31.3	28.7	
4.20	14.1	28.3	39.4	-3.8		1.3	2.6	9.4	-6.7	1.30
	SIMULT	SHEAR	9.4	-0.9		SIMULT	MOM	39.4	34.6	
5.60	15.0	30.0	42.7	-5.1		-0.1	-0.1	7.6	-8.5	1.30
	SIMULT	SHEAR	7.6	-0.9		SIMULT	MOM	42.7	36.1	
7.00	13.9	27.9	41.8	-6.4		-1.4	-2.9	6.0	-10.1	1.30
	SIMULT	SHEAR	-9.0	-0.9		SIMULT	MOM	41.8	34.1	
8.40	11.0	22.0	37.3	-7.7		-2.8	-5.6	4.4	-11.4	1.30
	SIMULT	SHEAR	-10.5	-0.9		SIMULT	MOM	37.3	29.5	
9.80	6.1	12.2	29.9	-9.0		-4.2	-8.4	3.1	-12.6	1.30
	SIMULT	SHEAR	-11.9	-0.9		SIMULT	MOM	29.9	23.0	
11.20	-0.7	-1.4	20.6	-11.5		-5.5	-11.1	1.8	-13.6	1.30
	SIMULT	SHEAR	-13.1	-8.5		SIMULT	MOM	20.6	15.4	
12.60	-9.4	-18.9	10.2	-23.4		-6.9	-13.8	0.8	-14.4	1.30
	SIMULT	SHEAR	-14.1	-8.5		SIMULT	MOM	10.2	7.5	
14.00	-20.0	-40.2	3.4	-35.9	S	-8.3	-16.6	0.2	-19.9	1.30
	SIMULT	SHEAR	0.2	-9.3		SIMULT	MOM	3.4	0.0	

SPAN 2 - LIVE LOAD IMPACT FACTORS : POS MOM 1.30 NEG MOM 1.30

X	DL1 MOMENT	DL2 MOMENT	+(LL+I) MOMENT	-(LL+I) MOMENT		DL1 SHEAR	DL2 SHEAR	+(LL+I) SHEAR	-(LL+I) SHEAR	I.F.
0.00	-20.0	-40.2	3.4	-35.9	S	7.2	14.5	19.9	-1.2	1.30
	SIMULT	SHEAR	-1.2	10.0		SIMULT	MOM	0.0	3.4	
1.40	-10.9	-21.8	12.1	-24.0		5.9	11.7	14.3	-1.2	1.30
	SIMULT	SHEAR	13.1	7.6		SIMULT	MOM	6.4	1.7	
2.80	-3.6	-7.3	21.4	-16.1		4.5	9.0	13.4	-3.6	1.30
	SIMULT	SHEAR	11.3	2.0		SIMULT	MOM	13.4	21.4	
4.20	1.7	3.4	27.7	-13.3		3.1	6.3	12.2	-5.4	1.30
	SIMULT	SHEAR	9.5	2.0		SIMULT	MOM	20.0	27.7	
5.60	5.1	10.2	30.9	-10.6		1.7	3.5	10.8	-7.2	1.30
	SIMULT	SHEAR	7.8	2.0		SIMULT	MOM	25.3	30.9	
7.00	6.6	13.2	31.0	-7.9		0.4	0.8	9.3	-8.8	1.30
	SIMULT	SHEAR	-8.8	2.0		SIMULT	MOM	28.5	31.0	
8.40	6.2	12.4	29.0	-6.9		-1.0	-2.0	7.6	-10.4	1.30
	SIMULT	SHEAR	7.6	-1.2		SIMULT	MOM	29.0	28.3	
9.80	3.8	7.7	26.6	-8.6		-2.4	-4.7	5.8	-11.8	1.30
	SIMULT	SHEAR	-9.2	-1.2		SIMULT	MOM	26.6	23.2	
11.20	-0.4	-0.9	20.9	-11.2		-3.7	-7.5	3.9	-13.0	1.30
	SIMULT	SHEAR	-11.1	-6.4		SIMULT	MOM	20.9	16.3	
12.60	-6.6	-13.2	12.0	-20.1		-5.1	-10.2	2.0	-14.1	1.30
	SIMULT	SHEAR	-13.0	-6.4		SIMULT	MOM	3.0	8.3	

14.00	-14.7	-29.5	5.8	-30.2	S	-6.5	-13.0	2.0	-19.9	1.30
	SIMULT	SHEAR	2.0	-9.6		SIMULT	MOM	5.8	0.0	

SPAN 3 - LIVE LOAD IMPACT FACTORS : POS MOM 1.30 NEG MOM 1.30

X	DL1 MOMENT	DL2 MOMENT	+(LL+I) MOMENT	-(LL+I) MOMENT		DL1 SHEAR	DL2 SHEAR	+(LL+I) SHEAR	-(LL+I) SHEAR	I.F.
0.00	-14.7	-29.5	5.8	-30.2	S	6.7	13.5	19.9	-1.2	1.30
	SIMULT	SHEAR	-0.5	7.3		SIMULT	MOM	0.0	3.7	
1.40	-6.2	-12.4	11.7	-20.6		5.4	10.8	14.1	-1.2	1.30
	SIMULT	SHEAR	13.2	6.6		SIMULT	MOM	8.5	1.9	
2.80	0.4	0.7	20.9	-11.4		4.0	8.0	13.0	-3.6	1.30
	SIMULT	SHEAR	11.4	6.6		SIMULT	MOM	16.6	20.9	
4.20	5.0	10.1	27.2	-7.6		2.6	5.3	11.7	-5.3	1.30
	SIMULT	SHEAR	9.6	1.1		SIMULT	MOM	23.5	27.2	
5.60	7.8	15.6	30.4	-6.0		1.3	2.6	10.3	-7.1	1.30
	SIMULT	SHEAR	7.9	1.1		SIMULT	MOM	28.4	30.4	
7.00	8.6	17.2	30.8	-5.1		-0.1	-0.2	8.7	-8.7	1.30
	SIMULT	SHEAR	8.7	-1.2		SIMULT	MOM	30.8	30.7	
8.40	7.5	15.0	30.5	-6.8		-1.5	-2.9	7.0	-10.3	1.30
	SIMULT	SHEAR	-7.9	-1.2		SIMULT	MOM	30.5	28.1	
9.80	4.5	9.0	27.2	-8.5		-2.8	-5.7	5.3	-11.7	1.30
	SIMULT	SHEAR	-9.7	-1.2		SIMULT	MOM	27.2	23.2	
11.20	-0.4	-0.9	20.8	-11.2		-4.2	-8.4	3.5	-13.0	1.30
	SIMULT	SHEAR	-11.4	-6.5		SIMULT	MOM	20.8	16.3	
12.60	-7.3	-14.6	11.7	-20.4		-5.6	-11.2	1.1	-14.1	1.30
	SIMULT	SHEAR	-13.2	-6.5		SIMULT	MOM	1.7	8.3	
14.00	-16.0	-32.1	3.7	-30.0	S	-6.9	-13.9	1.1	-19.9	1.30
	SIMULT	SHEAR	0.3	-9.5		SIMULT	MOM	3.3	0.0	

SPAN 4 - LIVE LOAD IMPACT FACTORS : POS MOM 1.30 NEG MOM 1.30

X	DL1 MOMENT	DL2 MOMENT	+(LL+I) MOMENT	-(LL+I) MOMENT		DL1 SHEAR	DL2 SHEAR	+(LL+I) SHEAR	-(LL+I) SHEAR	I.F.
0.00	-16.0	-32.1	3.7	-30.0	S	6.8	13.7	19.9	-1.3	1.30
	SIMULT	SHEAR	-1.3	7.3		SIMULT	MOM	0.0	3.7	
1.40	-7.4	-14.9	11.7	-20.4		5.5	11.0	14.1	-1.3	1.30
	SIMULT	SHEAR	13.2	6.5		SIMULT	MOM	8.3	2.0	
2.80	-0.7	-1.4	20.8	-11.2		4.1	8.2	13.0	-3.5	1.30
	SIMULT	SHEAR	11.4	6.5		SIMULT	MOM	16.4	20.8	
4.20	4.1	8.2	27.1	-8.6		2.7	5.5	11.7	-5.3	1.30
	SIMULT	SHEAR	9.6	1.3		SIMULT	MOM	23.2	27.1	
5.60	7.0	14.0	30.4	-6.8		1.4	2.7	10.3	-7.1	1.30
	SIMULT	SHEAR	7.9	1.3		SIMULT	MOM	28.2	30.4	
7.00	7.9	15.9	30.7	-5.1		0.0	0.0	8.7	-8.7	1.30
	SIMULT	SHEAR	-8.7	-1.3		SIMULT	MOM	30.7	30.7	
8.40	7.0	14.0	30.4	-6.8		-1.4	-2.7	7.1	-10.3	1.30
	SIMULT	SHEAR	-7.9	-1.3		SIMULT	MOM	30.4	28.2	
9.80	4.1	8.2	27.1	-8.6		-2.7	-5.5	5.3	-11.7	1.30
	SIMULT	SHEAR	-9.6	-1.3		SIMULT	MOM	27.1	23.2	
11.20	-0.7	-1.4	20.8	-11.2		-4.1	-8.2	3.5	-13.0	1.30
	SIMULT	SHEAR	-11.4	-6.5		SIMULT	MOM	20.8	16.4	
12.60	-7.4	-14.9	11.7	-20.4		-5.5	-11.0	1.3	-14.1	1.30
	SIMULT	SHEAR	-13.2	-6.5		SIMULT	MOM	2.0	8.3	
14.00	-16.0	-32.1	3.7	-30.0	S	-6.8	-13.7	1.3	-19.9	1.30
	SIMULT	SHEAR	1.3	-7.3		SIMULT	MOM	3.7	0.0	

SPAN 5 - LIVE LOAD IMPACT FACTORS : POS MOM 1.30 NEG MOM 1.30

X	DL1 MOMENT	DL2 MOMENT	+(LL+I) MOMENT	-(LL+I) MOMENT		DL1 SHEAR	DL2 SHEAR	+(LL+I) SHEAR	-(LL+I) SHEAR	I.F.
0.00	-16.0	-32.1	3.7	-30.0	S	6.9	13.9	19.9	-1.1	1.30
	SIMULT	SHEAR	-0.3	9.5		SIMULT	MOM	0.0	3.3	

1.40	-7.3	-14.6	11.7	-20.4		5.6	11.2	14.1	-1.1	1.30
	SIMULT	SHEAR	13.2	6.5		SIMULT	MOM	8.3	1.7	
2.80	-0.4	-0.9	20.8	-11.2		4.2	8.4	13.0	-3.5	1.30
	SIMULT	SHEAR	11.4	6.5		SIMULT	MOM	16.3	20.8	
4.20	4.5	9.0	27.2	-8.5		2.8	5.7	11.7	-5.3	1.30
	SIMULT	SHEAR	9.7	1.2		SIMULT	MOM	23.2	27.2	
5.60	7.5	15.0	30.5	-6.8		1.5	2.9	10.3	-7.0	1.30
	SIMULT	SHEAR	7.9	1.2		SIMULT	MOM	28.1	30.5	
7.00	8.6	17.2	30.8	-5.1		0.1	0.2	8.7	-8.7	1.30
	SIMULT	SHEAR	-8.7	1.2		SIMULT	MOM	30.7	30.8	
8.40	7.8	15.6	30.4	-6.0		-1.3	-2.6	7.1	-10.3	1.30
	SIMULT	SHEAR	-7.9	-1.1		SIMULT	MOM	30.4	28.4	
9.80	5.0	10.1	27.2	-7.6		-2.6	-5.3	5.3	-11.7	1.30
	SIMULT	SHEAR	-9.6	-1.1		SIMULT	MOM	27.2	23.5	
11.20	0.4	0.7	20.9	-11.4		-4.0	-8.0	3.6	-13.0	1.30
	SIMULT	SHEAR	-11.4	-6.6		SIMULT	MOM	20.9	16.6	
12.60	-6.2	-12.4	11.7	-20.6		-5.4	-10.8	1.2	-14.1	1.30
	SIMULT	SHEAR	-13.2	-6.6		SIMULT	MOM	1.9	8.5	
14.00	-14.7	-29.5	5.8	-30.2	S	-6.7	-13.5	1.2	-19.9	1.30
	SIMULT	SHEAR	0.5	-7.3		SIMULT	MOM	3.7	0.0	

SPAN 6 - LIVE LOAD IMPACT FACTORS : POS MOM 1.30 NEG MOM 1.30

X	DL1 MOMENT	DL2 MOMENT	+(LL+I) MOMENT	-(LL+I) MOMENT		DL1 SHEAR	DL2 SHEAR	+(LL+I) SHEAR	-(LL+I) SHEAR	I.F.
0.00	-14.7	-29.5	5.8	-30.2	S	6.5	13.0	19.9	-2.0	1.30
	SIMULT	SHEAR	-2.0	9.6		SIMULT	MOM	0.0	5.8	
1.40	-6.6	-13.2	12.0	-20.1		5.1	10.2	14.1	-2.0	1.30
	SIMULT	SHEAR	13.0	6.4		SIMULT	MOM	8.3	3.0	
2.80	-0.4	-0.9	20.9	-11.2		3.7	7.5	13.0	-3.9	1.30
	SIMULT	SHEAR	11.1	6.4		SIMULT	MOM	16.3	20.9	
4.20	3.8	7.7	26.6	-8.6		2.4	4.7	11.8	-5.8	1.30
	SIMULT	SHEAR	9.2	1.2		SIMULT	MOM	23.2	26.6	
5.60	6.2	12.4	29.0	-6.9		1.0	2.0	10.4	-7.6	1.30
	SIMULT	SHEAR	-7.6	1.2		SIMULT	MOM	28.3	29.0	
7.00	6.6	13.2	31.0	-7.9		-0.4	-0.8	8.8	-9.3	1.30
	SIMULT	SHEAR	8.8	-2.0		SIMULT	MOM	31.0	28.5	
8.40	5.1	10.2	30.9	-10.6		-1.7	-3.5	7.2	-10.8	1.30
	SIMULT	SHEAR	-7.8	-2.0		SIMULT	MOM	30.9	25.3	
9.80	1.7	3.4	27.7	-13.3		-3.1	-6.3	5.4	-12.2	1.30
	SIMULT	SHEAR	-9.5	-2.0		SIMULT	MOM	27.7	20.0	
11.20	-3.6	-7.3	21.4	-16.1		-4.5	-9.0	3.6	-13.4	1.30
	SIMULT	SHEAR	-11.3	-2.0		SIMULT	MOM	21.4	13.4	
12.60	-10.9	-21.8	12.1	-24.0		-5.9	-11.7	1.2	-14.3	1.30
	SIMULT	SHEAR	-13.1	-7.6		SIMULT	MOM	1.7	6.4	
14.00	-20.0	-40.2	3.4	-35.9	S	-7.2	-14.5	1.2	-19.9	1.30
	SIMULT	SHEAR	1.2	-10.0		SIMULT	MOM	3.4	0.0	

SPAN 7 - LIVE LOAD IMPACT FACTORS : POS MOM 1.30 NEG MOM 1.30

X	DL1 MOMENT	DL2 MOMENT	+(LL+I) MOMENT	-(LL+I) MOMENT		DL1 SHEAR	DL2 SHEAR	+(LL+I) SHEAR	-(LL+I) SHEAR	I.F.
0.00	-20.0	-40.2	3.4	-35.9	S	8.3	16.6	19.9	-0.2	1.30
	SIMULT	SHEAR	-0.2	9.3		SIMULT	MOM	0.0	3.4	
1.40	-9.4	-18.9	10.2	-23.4		6.9	13.8	14.4	-0.8	1.30
	SIMULT	SHEAR	14.1	8.5		SIMULT	MOM	7.5	10.2	
2.80	-0.7	-1.4	20.6	-11.5		5.5	11.1	13.6	-1.8	1.30
	SIMULT	SHEAR	13.1	8.5		SIMULT	MOM	15.4	20.6	
4.20	6.1	12.2	29.9	-9.0		4.2	8.4	12.6	-3.1	1.30
	SIMULT	SHEAR	11.9	0.9		SIMULT	MOM	23.0	29.9	
5.60	11.0	22.0	37.3	-7.7		2.8	5.6	11.4	-4.4	1.30
	SIMULT	SHEAR	10.5	0.9		SIMULT	MOM	29.5	37.3	
7.00	13.9	27.9	41.8	-6.4		1.4	2.9	10.1	-6.0	1.30

	SIMULT	SHEAR	9.0	0.9		SIMULT	MOM	34.1	41.8	
8.40	15.0	30.0	42.7	-5.1		0.1	0.1	8.5	-7.6	1.30
	SIMULT	SHEAR	-7.6	0.9		SIMULT	MOM	36.1	42.7	
9.80	14.1	28.3	39.4	-3.8		-1.3	-2.6	6.7	-9.4	1.30
	SIMULT	SHEAR	-9.4	0.9		SIMULT	MOM	34.6	39.4	
11.20	11.3	22.7	31.3	-2.6		-2.7	-5.4	4.7	-11.2	1.30
	SIMULT	SHEAR	-11.2	0.9		SIMULT	MOM	28.7	31.3	
12.60	6.6	13.3	18.3	-1.3		-4.0	-8.1	2.5	-13.1	1.30
	SIMULT	SHEAR	-13.1	0.9		SIMULT	MOM	17.5	18.3	
14.00	0.0	0.0	0.0	0.0	S	-5.4	-10.8	0.9	-19.9	1.30
	SIMULT	SHEAR	0.0	0.0		SIMULT	MOM	0.0	0.0	

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*  GIRDER  -  LIVE LOAD  SP-7   *
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MAXIMUM REACTIONS

SUPPORT	DL1	DL2	+(LL+I)	-(LL+I)	REACTIONS +I.F.	REACTIONS -I.F.	MOMENTS +I.F.	MOMENTS -I.F.
1	5.4	10.8	22.4	-1.4	1.30	1.30		
2	15.5	31.1	23.2	-2.3	1.30	1.30	1.30	1.30
3	13.2	26.5	26.5	-5.4	1.30	1.30	1.30	1.30
4	13.8	27.6	26.7	-4.7	1.30	1.30	1.30	1.30
5	13.8	27.6	26.7	-4.7	1.30	1.30	1.30	1.30
6	13.2	26.5	26.5	-5.4	1.30	1.30	1.30	1.30
7	15.5	31.1	23.2	-2.3	1.30	1.30	1.30	1.30
8	5.4	10.8	22.4	-1.4	1.30	1.30		

NOTE: ALL SUPPORT REACTIONS AND END SHEARS IN EACH SPAN DUE TO A LIVE LOAD
ARE CALCULATED BASED ON AASHTO ARTICLE 3.23.1
AS INTERPRETED IN SOL 431-93-05.

UNFACTORED MOMENTS AND SHEARS

SPAN 1 - LIVE LOAD IMPACT FACTORS : POS MOM 1.30 NEG MOM 1.30

X	DL1 MOMENT	DL2 MOMENT	+(LL+I) MOMENT	-(LL+I) MOMENT		DL1 SHEAR	DL2 SHEAR	+(LL+I) SHEAR	-(LL+I) SHEAR	I.F.
0.00	0.0	0.0	0.0	0.0	S	5.4	10.8	22.4	-1.4	1.30
	SIMULT	SHEAR	0.0	0.0		SIMULT	MOM	0.0	0.0	
1.40	6.6	13.3	22.2	-2.0		4.0	8.1	15.8	-1.4	1.30
	SIMULT	SHEAR	15.8	-1.4		SIMULT	MOM	22.2	-2.0	
2.80	11.3	22.7	36.7	-4.0		2.7	5.4	13.1	-2.8	1.30
	SIMULT	SHEAR	13.1	-1.4		SIMULT	MOM	36.7	23.4	
4.20	14.1	28.3	44.1	-6.0		1.3	2.6	10.5	-4.6	1.30
	SIMULT	SHEAR	10.5	-1.4		SIMULT	MOM	44.1	29.8	
5.60	15.0	30.0	45.6	-8.0		-0.1	-0.1	8.1	-7.5	1.30
	SIMULT	SHEAR	8.1	-1.4		SIMULT	MOM	45.6	38.3	
7.00	13.9	27.9	44.3	-10.1		-1.4	-2.9	6.0	-10.3	1.30
	SIMULT	SHEAR	-9.6	-1.4		SIMULT	MOM	41.8	40.0	
8.40	11.0	22.0	40.5	-12.1		-2.8	-5.6	4.0	-12.8	1.30
	SIMULT	SHEAR	-12.2	-1.4		SIMULT	MOM	33.9	35.7	
9.80	6.1	12.2	31.8	-14.1		-4.2	-8.4	2.4	-15.1	1.30
	SIMULT	SHEAR	-14.6	-1.4		SIMULT	MOM	23.2	26.5	
11.20	-0.7	-1.4	18.9	-16.1		-5.5	-11.1	1.0	-17.1	1.30
	SIMULT	SHEAR	-16.7	-1.4		SIMULT	MOM	11.2	13.6	
12.60	-9.4	-18.9	4.8	-23.9		-6.9	-13.8	0.4	-18.9	1.30
	SIMULT	SHEAR	0.4	-5.9		SIMULT	MOM	4.8	-1.7	
14.00	-20.0	-40.2	5.3	-36.2	S	-8.3	-16.6	0.4	-24.2	1.30
	SIMULT	SHEAR	0.4	-13.1		SIMULT	MOM	5.3	-17.9	

SPAN 2 - LIVE LOAD IMPACT FACTORS : POS MOM 1.30 NEG MOM 1.30

X	DL1 MOMENT	DL2 MOMENT	+(LL+I) MOMENT	-(LL+I) MOMENT		DL1 SHEAR	DL2 SHEAR	+(LL+I) SHEAR	-(LL+I) SHEAR	I.F.
0.00	-20.0	-40.2	5.3	-36.2	S	7.2	14.5	24.0	-1.9	1.30
	SIMULT	SHEAR	-1.9	7.0		SIMULT	MOM	-18.2	5.3	
1.40	-10.9	-21.8	6.7	-26.3		5.9	11.7	18.2	-1.9	1.30
	SIMULT	SHEAR	16.8	5.2		SIMULT	MOM	-1.1	2.7	
2.80	-3.6	-7.3	20.3	-21.6		4.5	9.0	15.9	-2.3	1.30
	SIMULT	SHEAR	14.3	2.8		SIMULT	MOM	13.4	10.4	
4.20	1.7	3.4	30.5	-17.7		3.1	6.3	13.4	-3.7	1.30
	SIMULT	SHEAR	12.5	2.8		SIMULT	MOM	24.1	11.9	
5.60	5.1	10.2	35.6	-13.8		1.7	3.5	10.8	-6.0	1.30
	SIMULT	SHEAR	10.0	2.5		SIMULT	MOM	30.4	29.8	
7.00	6.6	13.2	36.2	-10.3		0.4	0.8	8.2	-8.5	1.30
	SIMULT	SHEAR	-7.7	2.5		SIMULT	MOM	31.7	32.8	
8.40	6.2	12.4	35.3	-11.9		-1.0	-2.0	5.7	-11.0	1.30
	SIMULT	SHEAR	-10.2	-1.5		SIMULT	MOM	28.4	31.0	
9.80	3.8	7.7	29.6	-14.0		-2.4	-4.7	3.9	-13.5	1.30
	SIMULT	SHEAR	-12.8	-1.5		SIMULT	MOM	11.6	24.5	
11.20	-0.4	-0.9	19.1	-16.1		-3.7	-7.5	2.9	-15.9	1.30
	SIMULT	SHEAR	-15.2	-1.5		SIMULT	MOM	2.8	13.8	
12.60	-6.6	-13.2	8.6	-23.7		-5.1	-10.2	3.0	-18.0	1.30
	SIMULT	SHEAR	2.7	-5.8		SIMULT	MOM	8.0	-0.2	
14.00	-14.7	-29.5	12.6	-32.0	S	-6.5	-13.0	2.9	-23.6	1.30
	SIMULT	SHEAR	2.9	-13.9		SIMULT	MOM	12.6	-16.3	

SPAN 3 - LIVE LOAD IMPACT FACTORS : POS MOM 1.30 NEG MOM 1.30

X	DL1 MOMENT	DL2 MOMENT	+(LL+I) MOMENT	-(LL+I) MOMENT		DL1 SHEAR	DL2 SHEAR	+(LL+I) SHEAR	-(LL+I) SHEAR	I.F.
0.00	-14.7	-29.5	12.6	-32.0	S	6.7	13.5	23.9	-2.6	1.30
	SIMULT	SHEAR	-2.5	5.8		SIMULT	MOM	-17.3	12.4	
1.40	-6.2	-12.4	9.1	-23.9		5.4	10.8	18.2	-2.6	1.30
	SIMULT	SHEAR	-2.5	5.8		SIMULT	MOM	-0.5	8.7	
2.80	0.4	0.7	19.3	-16.9		4.0	8.0	15.9	-2.6	1.30
	SIMULT	SHEAR	14.4	2.5		SIMULT	MOM	13.8	5.1	
4.20	5.0	10.1	29.6	-13.7		2.6	5.3	13.4	-3.7	1.30
	SIMULT	SHEAR	12.6	2.0		SIMULT	MOM	24.4	11.8	
5.60	7.8	15.6	35.6	-10.9		1.3	2.6	10.8	-5.8	1.30
	SIMULT	SHEAR	10.0	2.0		SIMULT	MOM	30.5	29.2	
7.00	8.6	17.2	36.1	-8.1		-0.1	-0.2	8.2	-8.3	1.30
	SIMULT	SHEAR	7.4	2.0		SIMULT	MOM	31.7	32.3	
8.40	7.5	15.0	35.0	-10.6		-1.5	-2.9	5.7	-10.9	1.30
	SIMULT	SHEAR	-10.1	-2.0		SIMULT	MOM	28.4	30.7	
9.80	4.5	9.0	29.6	-13.4		-2.8	-5.7	3.7	-13.5	1.30
	SIMULT	SHEAR	-12.8	-2.0		SIMULT	MOM	11.9	24.5	
11.20	-0.4	-0.9	19.1	-16.2		-4.2	-8.4	2.5	-16.0	1.30
	SIMULT	SHEAR	-15.3	-2.0		SIMULT	MOM	4.1	13.8	
12.60	-7.3	-14.6	7.9	-23.7		-5.6	-11.2	2.5	-18.3	1.30
	SIMULT	SHEAR	2.2	-5.8		SIMULT	MOM	7.5	-0.6	
14.00	-16.0	-32.1	11.0	-32.1	S	-6.9	-13.9	2.5	-24.1	1.30
	SIMULT	SHEAR	2.5	-14.0		SIMULT	MOM	11.0	-17.6	

SPAN 4 - LIVE LOAD IMPACT FACTORS : POS MOM 1.30 NEG MOM 1.30

X	DL1 MOMENT	DL2 MOMENT	+(LL+I) MOMENT	-(LL+I) MOMENT		DL1 SHEAR	DL2 SHEAR	+(LL+I) SHEAR	-(LL+I) SHEAR	I.F.
0.00	-16.0	-32.1	11.0	-32.1	S	6.8	13.7	23.9	-2.5	1.30
	SIMULT	SHEAR	-2.2	5.8		SIMULT	MOM	-17.2	11.0	
1.40	-7.4	-14.9	7.9	-24.0		5.5	11.0	18.2	-2.5	1.30
	SIMULT	SHEAR	-2.2	5.8		SIMULT	MOM	-0.5	7.5	

2.80	-0.7	-1.4	19.1	-16.3	4.1	8.2	15.9	-2.5	1.30
	SIMULT	SHEAR	15.2	2.0	SIMULT	MOM	13.8	4.1	
4.20	4.1	8.2	29.4	-13.5	2.7	5.5	13.4	-3.8	1.30
	SIMULT	SHEAR	12.6	2.0	SIMULT	MOM	24.4	11.8	
5.60	7.0	14.0	34.9	-10.7	1.4	2.7	10.8	-5.7	1.30
	SIMULT	SHEAR	10.1	2.0	SIMULT	MOM	30.4	28.2	
7.00	7.9	15.9	35.5	-8.0	0.0	0.0	8.2	-8.2	1.30
	SIMULT	SHEAR	-7.5	-2.0	SIMULT	MOM	31.7	31.7	
8.40	7.0	14.0	34.9	-10.7	-1.4	-2.7	5.7	-10.8	1.30
	SIMULT	SHEAR	-10.1	-2.0	SIMULT	MOM	28.2	30.4	
9.80	4.1	8.2	29.4	-13.5	-2.7	-5.5	3.8	-13.4	1.30
	SIMULT	SHEAR	-12.6	-2.0	SIMULT	MOM	11.8	24.4	
11.20	-0.7	-1.4	19.1	-16.3	-4.1	-8.2	2.5	-15.9	1.30
	SIMULT	SHEAR	-15.2	-2.0	SIMULT	MOM	4.1	13.8	
12.60	-7.4	-14.9	7.9	-24.0	-5.5	-11.0	2.5	-18.2	1.30
	SIMULT	SHEAR	2.2	-5.8	SIMULT	MOM	7.5	-0.5	
14.00	-16.0	-32.1	11.0	-32.1 S	-6.8	-13.7	2.5	-23.9	1.30
	SIMULT	SHEAR	2.2	-5.8	SIMULT	MOM	11.0	-17.2	

SPAN 5 - LIVE LOAD IMPACT FACTORS : POS MOM 1.30 NEG MOM 1.30

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X	DL1 MOMENT	DL2 MOMENT	+(LL+I) MOMENT	-(LL+I) MOMENT	DL1 SHEAR	DL2 SHEAR	+(LL+I) SHEAR	-(LL+I) SHEAR	I.F.
0.00	-16.0	-32.1	11.0	-32.1 S	6.9	13.9	24.1	-2.5	1.30
	SIMULT	SHEAR	-2.5	14.0	SIMULT	MOM	-17.6	11.0	
1.40	-7.3	-14.6	7.9	-23.7	5.6	11.2	18.3	-2.5	1.30
	SIMULT	SHEAR	-2.2	5.7	SIMULT	MOM	-0.6	7.5	
2.80	-0.4	-0.9	19.1	-16.2	4.2	8.4	16.0	-2.5	1.30
	SIMULT	SHEAR	15.3	2.0	SIMULT	MOM	13.8	4.1	
4.20	4.5	9.0	29.6	-13.4	2.8	5.7	13.5	-3.7	1.30
	SIMULT	SHEAR	12.8	2.0	SIMULT	MOM	24.5	11.9	
5.60	7.5	15.0	35.0	-10.6	1.5	2.9	10.9	-5.7	1.30
	SIMULT	SHEAR	10.1	2.0	SIMULT	MOM	30.7	28.4	
7.00	8.6	17.2	36.1	-8.1	0.1	0.2	8.3	-8.2	1.30
	SIMULT	SHEAR	-7.4	-2.0	SIMULT	MOM	32.3	31.7	
8.40	7.8	15.6	35.6	-10.9	-1.3	-2.6	5.8	-10.8	1.30
	SIMULT	SHEAR	-10.0	-2.0	SIMULT	MOM	29.2	30.5	
9.80	5.0	10.1	29.6	-13.7	-2.6	-5.3	3.7	-13.4	1.30
	SIMULT	SHEAR	-12.6	-2.0	SIMULT	MOM	11.8	24.4	
11.20	0.4	0.7	19.3	-16.9	-4.0	-8.0	2.6	-15.9	1.30
	SIMULT	SHEAR	-14.4	-2.5	SIMULT	MOM	5.1	13.8	
12.60	-6.2	-12.4	9.1	-23.9	-5.4	-10.8	2.6	-18.2	1.30
	SIMULT	SHEAR	2.5	-5.8	SIMULT	MOM	8.7	-0.5	
14.00	-14.7	-29.5	12.6	-32.0 S	-6.7	-13.5	2.6	-23.9	1.30
	SIMULT	SHEAR	2.5	-5.8	SIMULT	MOM	12.4	-17.3	

SPAN 6 - LIVE LOAD IMPACT FACTORS : POS MOM 1.30 NEG MOM 1.30

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X	DL1 MOMENT	DL2 MOMENT	+(LL+I) MOMENT	-(LL+I) MOMENT	DL1 SHEAR	DL2 SHEAR	+(LL+I) SHEAR	-(LL+I) SHEAR	I.F.
0.00	-14.7	-29.5	12.6	-32.0 S	6.5	13.0	23.6	-2.9	1.30
	SIMULT	SHEAR	-2.9	13.9	SIMULT	MOM	-16.3	12.6	
1.40	-6.6	-13.2	8.6	-23.7	5.1	10.2	18.0	-3.0	1.30
	SIMULT	SHEAR	-2.7	5.8	SIMULT	MOM	-0.2	8.0	
2.80	-0.4	-0.9	19.1	-16.1	3.7	7.5	15.9	-2.9	1.30
	SIMULT	SHEAR	15.2	1.5	SIMULT	MOM	13.8	2.8	
4.20	3.8	7.7	29.6	-14.0	2.4	4.7	13.5	-3.9	1.30
	SIMULT	SHEAR	12.8	1.5	SIMULT	MOM	24.5	11.6	
5.60	6.2	12.4	35.3	-11.9	1.0	2.0	11.0	-5.7	1.30
	SIMULT	SHEAR	10.2	1.5	SIMULT	MOM	31.0	28.4	
7.00	6.6	13.2	36.2	-10.3	-0.4	-0.8	8.5	-8.2	1.30
	SIMULT	SHEAR	7.7	-2.5	SIMULT	MOM	32.8	31.7	
8.40	5.1	10.2	35.6	-13.8	-1.7	-3.5	6.0	-10.8	1.30

	SIMULT	SHEAR	-10.0	-2.5		SIMULT	MOM	29.8	30.4	
9.80	1.7	3.4	30.5	-17.7		-3.1	-6.3	3.7	-13.4	1.30
	SIMULT	SHEAR	-12.5	-2.8		SIMULT	MOM	11.9	24.1	
11.20	-3.6	-7.3	20.3	-20.8		-4.5	-9.0	2.3	-15.9	1.30
	SIMULT	SHEAR	-15.0	-2.5		SIMULT	MOM	10.4	13.4	
12.60	-10.9	-21.8	6.7	-26.3		-5.9	-11.7	1.9	-18.2	1.30
	SIMULT	SHEAR	-16.8	-5.2		SIMULT	MOM	2.7	-1.1	
14.00	-20.0	-40.2	5.3	-36.2	S	-7.2	-14.5	1.9	-24.0	1.30
	SIMULT	SHEAR	1.9	-7.0		SIMULT	MOM	5.3	-18.2	

SPAN 7 - LIVE LOAD IMPACT FACTORS : POS MOM 1.30 NEG MOM 1.30

X	DL1 MOMENT	DL2 MOMENT	+(LL+I) MOMENT	-(LL+I) MOMENT		DL1 SHEAR	DL2 SHEAR	+(LL+I) SHEAR	-(LL+I) SHEAR	I.F.
0.00	-20.0	-40.2	5.3	-36.2	S	8.3	16.6	24.2	-0.4	1.30
	SIMULT	SHEAR	-0.4	13.1		SIMULT	MOM	-17.9	5.3	
1.40	-9.4	-18.9	4.8	-23.9		6.9	13.8	18.9	-0.4	1.30
	SIMULT	SHEAR	-0.4	5.9		SIMULT	MOM	-1.7	4.8	
2.80	-0.7	-1.4	18.9	-16.1		5.5	11.1	17.1	-1.0	1.30
	SIMULT	SHEAR	16.7	1.4		SIMULT	MOM	13.6	11.2	
4.20	6.1	12.2	31.8	-14.1		4.2	8.4	15.1	-2.4	1.30
	SIMULT	SHEAR	14.6	1.4		SIMULT	MOM	26.5	23.2	
5.60	11.0	22.0	40.5	-12.1		2.8	5.6	12.8	-4.0	1.30
	SIMULT	SHEAR	12.2	1.4		SIMULT	MOM	35.7	33.9	
7.00	13.9	27.9	44.3	-10.1		1.4	2.9	10.3	-6.0	1.30
	SIMULT	SHEAR	9.6	1.4		SIMULT	MOM	40.0	41.8	
8.40	15.0	30.0	45.6	-8.0		0.1	0.1	7.5	-8.1	1.30
	SIMULT	SHEAR	-8.1	1.4		SIMULT	MOM	38.3	45.6	
9.80	14.1	28.3	44.1	-6.0		-1.3	-2.6	4.6	-10.5	1.30
	SIMULT	SHEAR	-10.5	1.4		SIMULT	MOM	29.8	44.1	
11.20	11.3	22.7	36.7	-4.0		-2.7	-5.4	2.8	-13.1	1.30
	SIMULT	SHEAR	-13.1	1.4		SIMULT	MOM	23.4	36.7	
12.60	6.6	13.3	22.2	-2.0		-4.0	-8.1	1.4	-15.8	1.30
	SIMULT	SHEAR	-15.8	1.4		SIMULT	MOM	-2.0	22.2	
14.00	0.0	0.0	0.0	0.0	S	-5.4	-10.8	1.4	-22.4	1.30
	SIMULT	SHEAR	0.0	0.0		SIMULT	MOM	0.0	0.0	

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* GIRDER - LIVE LOAD SP-8 *
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MAXIMUM REACTIONS

SUPPORT	DL1	DL2	+(LL+I)	-(LL+I)	REACTIONS +I.F.	REACTIONS -I.F.	MOMENTS +I.F.	MOMENTS -I.F.
1	5.4	10.8	17.0	-0.9	1.30	1.30		
2	15.5	31.1	18.0	-1.5	1.30	1.30	1.30	1.30
3	13.2	26.5	18.4	-1.8	1.30	1.30	1.30	1.30
4	13.8	27.6	18.6	-1.6	1.30	1.30	1.30	1.30
5	13.8	27.6	18.6	-1.6	1.30	1.30	1.30	1.30
6	13.2	26.5	18.4	-1.8	1.30	1.30	1.30	1.30
7	15.5	31.1	18.0	-1.5	1.30	1.30	1.30	1.30
8	5.4	10.8	17.0	-0.9	1.30	1.30		

NOTE: ALL SUPPORT REACTIONS AND END SHEARS IN EACH SPAN DUE TO A LIVE LOAD ARE CALCULATED BASED ON AASHTO ARTICLE 3.23.1 AS INTERPRETED IN SOL 431-93-05.

UNFACTORED MOMENTS AND SHEARS

SPAN 1 - LIVE LOAD IMPACT FACTORS : POS MOM 1.30 NEG MOM 1.30

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X	DL1 MOMENT	DL2 MOMENT	+(LL+I) MOMENT	-(LL+I) MOMENT		DL1 SHEAR	DL2 SHEAR	+(LL+I) SHEAR	-(LL+I) SHEAR	I.F.
0.00	0.0	0.0	0.0	0.0	S	5.4	10.8	17.0	-0.9	1.30
	SIMULT	SHEAR	0.0	0.0		SIMULT	MOM	0.0	0.0	
1.40	6.6	13.3	15.4	-1.3		4.0	8.1	11.0	-1.7	1.30
	SIMULT	SHEAR	11.0	-0.9		SIMULT	MOM	15.4	13.1	
2.80	11.3	22.7	24.7	-2.6		2.7	5.4	8.8	-3.3	1.30
	SIMULT	SHEAR	8.8	-0.9		SIMULT	MOM	24.7	21.8	
4.20	14.1	28.3	30.0	-3.9		1.3	2.6	7.2	-4.7	1.30
	SIMULT	SHEAR	7.2	-0.9		SIMULT	MOM	30.0	26.6	
5.60	15.0	30.0	32.9	-5.2		-0.1	-0.1	5.9	-6.0	1.30
	SIMULT	SHEAR	5.9	-0.9		SIMULT	MOM	32.9	28.1	
7.00	13.9	27.9	32.4	-6.5		-1.4	-2.9	4.6	-7.4	1.30
	SIMULT	SHEAR	-6.4	-0.9		SIMULT	MOM	32.4	25.5	
8.40	11.0	22.0	29.1	-7.8		-2.8	-5.6	3.5	-8.7	1.30
	SIMULT	SHEAR	-7.6	-0.9		SIMULT	MOM	29.1	20.0	
9.80	6.1	12.2	23.5	-9.0		-4.2	-8.4	2.4	-9.7	1.30
	SIMULT	SHEAR	-8.7	-0.9		SIMULT	MOM	23.5	13.1	
11.20	-0.7	-1.4	16.1	-10.3		-5.5	-11.1	1.4	-10.8	1.30
	SIMULT	SHEAR	-10.8	-0.9		SIMULT	MOM	15.5	15.9	
12.60	-9.4	-18.9	7.5	-16.4		-6.9	-13.8	0.6	-13.0	1.30
	SIMULT	SHEAR	-10.5	-8.5		SIMULT	MOM	7.5	4.2	
14.00	-20.0	-40.2	3.5	-28.6	S	-8.3	-16.6	0.2	-18.7	1.30
	SIMULT	SHEAR	0.2	-8.7		SIMULT	MOM	3.5	-10.8	

SPAN 2 - LIVE LOAD IMPACT FACTORS : POS MOM 1.30 NEG MOM 1.30

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X	DL1 MOMENT	DL2 MOMENT	+(LL+I) MOMENT	-(LL+I) MOMENT		DL1 SHEAR	DL2 SHEAR	+(LL+I) SHEAR	-(LL+I) SHEAR	I.F.
0.00	-20.0	-40.2	3.5	-28.6	S	7.2	14.5	17.7	-1.2	1.30
	SIMULT	SHEAR	-1.2	9.6		SIMULT	MOM	-7.5	3.5	
1.40	-10.9	-21.8	8.8	-16.6		5.9	11.7	12.0	-1.2	1.30
	SIMULT	SHEAR	9.8	4.4		SIMULT	MOM	6.0	1.7	
2.80	-3.6	-7.3	15.9	-11.9		4.5	9.0	10.8	-2.6	1.30
	SIMULT	SHEAR	9.9	0.7		SIMULT	MOM	4.4	15.8	
4.20	1.7	3.4	22.2	-11.2		3.1	6.3	9.7	-3.9	1.30
	SIMULT	SHEAR	8.3	0.5		SIMULT	MOM	12.4	20.7	
5.60	5.1	10.2	26.3	-10.4		1.7	3.5	8.4	-5.1	1.30
	SIMULT	SHEAR	7.0	0.5		SIMULT	MOM	19.1	23.2	
7.00	6.6	13.2	27.6	-10.0		0.4	0.8	6.9	-6.6	1.30
	SIMULT	SHEAR	5.7	0.1		SIMULT	MOM	23.4	22.4	
8.40	6.2	12.4	26.2	-9.9		-1.0	-2.0	5.3	-8.1	1.30
	SIMULT	SHEAR	-6.7	0.1		SIMULT	MOM	23.5	18.5	
9.80	3.8	7.7	22.5	-9.7		-2.4	-4.7	4.0	-9.4	1.30
	SIMULT	SHEAR	-7.8	0.1		SIMULT	MOM	20.8	12.6	
11.20	-0.4	-0.9	16.2	-10.4		-3.7	-7.5	2.6	-10.4	1.30
	SIMULT	SHEAR	-9.9	-1.2		SIMULT	MOM	15.7	5.7	
12.60	-6.6	-13.2	8.4	-15.5		-5.1	-10.2	1.4	-11.9	1.30
	SIMULT	SHEAR	-9.8	-7.9		SIMULT	MOM	2.2	5.8	
14.00	-14.7	-29.5	4.3	-26.9	S	-6.5	-13.0	1.4	-17.6	1.30
	SIMULT	SHEAR	1.4	-8.1		SIMULT	MOM	4.3	-7.8	

SPAN 3 - LIVE LOAD IMPACT FACTORS : POS MOM 1.30 NEG MOM 1.30

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X	DL1 MOMENT	DL2 MOMENT	+(LL+I) MOMENT	-(LL+I) MOMENT		DL1 SHEAR	DL2 SHEAR	+(LL+I) SHEAR	-(LL+I) SHEAR	I.F.
0.00	-14.7	-29.5	4.3	-26.9	S	6.7	13.5	17.7	-1.3	1.30
	SIMULT	SHEAR	-0.4	9.4		SIMULT	MOM	-8.0	3.7	
1.40	-6.2	-12.4	9.5	-15.3		5.4	10.8	11.9	-1.3	1.30
	SIMULT	SHEAR	9.7	8.1		SIMULT	MOM	6.3	2.0	
2.80	0.4	0.7	17.0	-9.9		4.0	8.0	10.6	-2.7	1.30
	SIMULT	SHEAR	8.4	1.2		SIMULT	MOM	6.1	17.0	

4.20	5.0	10.1	23.2	-9.0		2.6	5.3	9.6	-4.1	1.30
	SIMULT	SHEAR	7.8	0.6		SIMULT	MOM	13.5	22.1	
5.60	7.8	15.6	27.0	-8.2		1.3	2.6	8.3	-5.4	1.30
	SIMULT	SHEAR	6.5	0.6		SIMULT	MOM	19.6	24.7	
7.00	8.6	17.2	28.0	-8.0		-0.1	-0.2	6.8	-7.0	1.30
	SIMULT	SHEAR	-5.9	0.0		SIMULT	MOM	23.6	23.7	
8.40	7.5	15.0	26.1	-8.1		-1.5	-2.9	5.2	-8.5	1.30
	SIMULT	SHEAR	-7.2	-0.6		SIMULT	MOM	23.8	19.4	
9.80	4.5	9.0	22.5	-8.9		-2.8	-5.7	3.9	-9.7	1.30
	SIMULT	SHEAR	-7.8	-0.6		SIMULT	MOM	21.0	13.0	
11.20	-0.4	-0.9	16.2	-10.4		-4.2	-8.4	2.5	-10.7	1.30
	SIMULT	SHEAR	-9.9	-1.3		SIMULT	MOM	15.8	5.6	
12.60	-7.3	-14.6	8.4	-16.0		-5.6	-11.2	1.2	-12.1	1.30
	SIMULT	SHEAR	-9.8	-8.2		SIMULT	MOM	1.9	5.7	
14.00	-16.0	-32.1	3.8	-27.9	S	-6.9	-13.9	1.2	-17.8	1.30
	SIMULT	SHEAR	0.3	-8.5		SIMULT	MOM	3.6	-8.3	

SPAN 4 - LIVE LOAD IMPACT FACTORS : POS MOM 1.30 NEG MOM 1.30

X	DL1 MOMENT	DL2 MOMENT	+(LL+I) MOMENT	-(LL+I) MOMENT		DL1 SHEAR	DL2 SHEAR	+(LL+I) SHEAR	-(LL+I) SHEAR	I.F.
0.00	-16.0	-32.1	3.8	-27.9	S	6.8	13.7	17.7	-1.3	1.30
	SIMULT	SHEAR	-1.3	9.5		SIMULT	MOM	-8.1	3.8	
1.40	-7.4	-14.9	8.3	-16.2		5.5	11.0	12.0	-1.3	1.30
	SIMULT	SHEAR	9.9	8.2		SIMULT	MOM	5.7	2.0	
2.80	-0.7	-1.4	16.3	-10.7		4.1	8.2	10.7	-2.5	1.30
	SIMULT	SHEAR	9.8	1.3		SIMULT	MOM	5.5	15.6	
4.20	4.1	8.2	22.5	-8.9		2.7	5.5	9.7	-3.9	1.30
	SIMULT	SHEAR	7.8	0.6		SIMULT	MOM	12.9	20.9	
5.60	7.0	14.0	26.0	-8.1		1.4	2.7	8.4	-5.2	1.30
	SIMULT	SHEAR	6.7	0.6		SIMULT	MOM	19.1	23.7	
7.00	7.9	15.9	27.3	-7.9		0.0	0.0	6.9	-6.9	1.30
	SIMULT	SHEAR	5.7	-0.1		SIMULT	MOM	23.3	23.3	
8.40	7.0	14.0	26.0	-8.1		-1.4	-2.7	5.2	-8.4	1.30
	SIMULT	SHEAR	-6.7	-0.6		SIMULT	MOM	23.7	19.1	
9.80	4.1	8.2	22.5	-8.9		-2.7	-5.5	3.9	-9.7	1.30
	SIMULT	SHEAR	-7.8	-0.6		SIMULT	MOM	20.9	12.9	
11.20	-0.7	-1.4	16.3	-10.7		-4.1	-8.2	2.5	-10.7	1.30
	SIMULT	SHEAR	-9.8	-1.3		SIMULT	MOM	15.6	5.5	
12.60	-7.4	-14.9	8.3	-16.2		-5.5	-11.0	1.3	-12.0	1.30
	SIMULT	SHEAR	-9.9	-8.2		SIMULT	MOM	2.0	5.7	
14.00	-16.0	-32.1	3.8	-27.9	S	-6.8	-13.7	1.3	-17.7	1.30
	SIMULT	SHEAR	1.3	-9.5		SIMULT	MOM	3.8	-8.1	

SPAN 5 - LIVE LOAD IMPACT FACTORS : POS MOM 1.30 NEG MOM 1.30

X	DL1 MOMENT	DL2 MOMENT	+(LL+I) MOMENT	-(LL+I) MOMENT		DL1 SHEAR	DL2 SHEAR	+(LL+I) SHEAR	-(LL+I) SHEAR	I.F.
0.00	-16.0	-32.1	3.8	-27.9	S	6.9	13.9	17.8	-1.2	1.30
	SIMULT	SHEAR	-0.3	8.5		SIMULT	MOM	-8.3	3.6	
1.40	-7.3	-14.6	8.4	-16.0		5.6	11.2	12.1	-1.2	1.30
	SIMULT	SHEAR	9.8	8.2		SIMULT	MOM	5.7	1.9	
2.80	-0.4	-0.9	16.2	-10.4		4.2	8.4	10.7	-2.5	1.30
	SIMULT	SHEAR	9.9	1.3		SIMULT	MOM	5.6	15.8	
4.20	4.5	9.0	22.5	-8.9		2.8	5.7	9.7	-3.9	1.30
	SIMULT	SHEAR	7.8	0.6		SIMULT	MOM	13.0	21.0	
5.60	7.5	15.0	26.1	-8.1		1.5	2.9	8.5	-5.2	1.30
	SIMULT	SHEAR	7.2	0.6		SIMULT	MOM	19.4	23.8	
7.00	8.6	17.2	28.0	-8.0		0.1	0.2	7.0	-6.8	1.30
	SIMULT	SHEAR	5.9	0.0		SIMULT	MOM	23.7	23.6	
8.40	7.8	15.6	27.0	-8.2		-1.3	-2.6	5.4	-8.3	1.30
	SIMULT	SHEAR	-6.5	-0.6		SIMULT	MOM	24.7	19.6	
9.80	5.0	10.1	23.2	-9.0		-2.6	-5.3	4.1	-9.6	1.30

	SIMULT	SHEAR	-7.8	-0.6		SIMULT	MOM	22.1	13.5	
11.20	0.4	0.7	17.0	-9.9		-4.0	-8.0	2.7	-10.6	1.30
	SIMULT	SHEAR	-8.4	-1.2		SIMULT	MOM	17.0	6.1	
12.60	-6.2	-12.4	9.5	-15.3		-5.4	-10.8	1.3	-11.9	1.30
	SIMULT	SHEAR	-9.7	-8.1		SIMULT	MOM	2.0	6.3	
14.00	-14.7	-29.5	4.3	-26.9	S	-6.7	-13.5	1.3	-17.7	1.30
	SIMULT	SHEAR	0.4	-9.4		SIMULT	MOM	3.7	-8.0	

SPAN 6 - LIVE LOAD IMPACT FACTORS : POS MOM 1.30 NEG MOM 1.30

X	DL1 MOMENT	DL2 MOMENT	+(LL+I) MOMENT	-(LL+I) MOMENT		DL1 SHEAR	DL2 SHEAR	+(LL+I) SHEAR	-(LL+I) SHEAR	I.F.
0.00	-14.7	-29.5	4.3	-26.9	S	6.5	13.0	17.6	-1.4	1.30
	SIMULT	SHEAR	-1.4	8.1		SIMULT	MOM	-7.8	4.3	
1.40	-6.6	-13.2	8.4	-15.5		5.1	10.2	11.9	-1.4	1.30
	SIMULT	SHEAR	9.8	7.9		SIMULT	MOM	5.8	2.2	
2.80	-0.4	-0.9	16.2	-10.4		3.7	7.5	10.4	-2.6	1.30
	SIMULT	SHEAR	9.9	1.2		SIMULT	MOM	5.7	15.7	
4.20	3.8	7.7	22.5	-9.7		2.4	4.7	9.4	-4.0	1.30
	SIMULT	SHEAR	7.8	-0.1		SIMULT	MOM	12.6	20.8	
5.60	6.2	12.4	26.2	-9.9		1.0	2.0	8.1	-5.3	1.30
	SIMULT	SHEAR	6.7	-0.1		SIMULT	MOM	18.5	23.5	
7.00	6.6	13.2	27.6	-10.0		-0.4	-0.8	6.6	-6.9	1.30
	SIMULT	SHEAR	-5.7	-0.1		SIMULT	MOM	22.4	23.4	
8.40	5.1	10.2	26.3	-10.4		-1.7	-3.5	5.1	-8.4	1.30
	SIMULT	SHEAR	-7.0	-0.5		SIMULT	MOM	23.2	19.1	
9.80	1.7	3.4	22.2	-11.2		-3.1	-6.3	3.9	-9.7	1.30
	SIMULT	SHEAR	-8.3	-0.5		SIMULT	MOM	20.7	12.4	
11.20	-3.6	-7.3	15.9	-11.9		-4.5	-9.0	2.6	-10.8	1.30
	SIMULT	SHEAR	-9.9	-0.8		SIMULT	MOM	15.8	4.4	
12.60	-10.9	-21.8	8.8	-16.6		-5.9	-11.7	1.2	-12.0	1.30
	SIMULT	SHEAR	-9.8	-4.4		SIMULT	MOM	1.7	6.0	
14.00	-20.0	-40.2	3.5	-28.6	S	-7.2	-14.5	1.2	-17.7	1.30
	SIMULT	SHEAR	1.2	-9.6		SIMULT	MOM	3.5	-7.5	

SPAN 7 - LIVE LOAD IMPACT FACTORS : POS MOM 1.30 NEG MOM 1.30

X	DL1 MOMENT	DL2 MOMENT	+(LL+I) MOMENT	-(LL+I) MOMENT		DL1 SHEAR	DL2 SHEAR	+(LL+I) SHEAR	-(LL+I) SHEAR	I.F.
0.00	-20.0	-40.2	3.5	-28.6	S	8.3	16.6	18.7	-0.2	1.30
	SIMULT	SHEAR	-0.2	8.7		SIMULT	MOM	-10.8	3.5	
1.40	-9.4	-18.9	7.5	-16.4		6.9	13.8	13.0	-0.6	1.30
	SIMULT	SHEAR	10.5	8.5		SIMULT	MOM	4.2	7.5	
2.80	-0.7	-1.4	16.1	-10.3		5.5	11.1	10.8	-1.4	1.30
	SIMULT	SHEAR	10.8	0.9		SIMULT	MOM	15.9	15.5	
4.20	6.1	12.2	23.5	-9.0		4.2	8.4	9.7	-2.4	1.30
	SIMULT	SHEAR	8.7	0.9		SIMULT	MOM	13.1	23.5	
5.60	11.0	22.0	29.1	-7.8		2.8	5.6	8.7	-3.5	1.30
	SIMULT	SHEAR	7.6	0.9		SIMULT	MOM	20.0	29.1	
7.00	13.9	27.9	32.4	-6.5		1.4	2.9	7.4	-4.6	1.30
	SIMULT	SHEAR	6.4	0.9		SIMULT	MOM	25.5	32.4	
8.40	15.0	30.0	32.9	-5.2		0.1	0.1	6.0	-5.9	1.30
	SIMULT	SHEAR	-5.9	0.9		SIMULT	MOM	28.1	32.9	
9.80	14.1	28.3	30.0	-3.9		-1.3	-2.6	4.7	-7.2	1.30
	SIMULT	SHEAR	-7.2	0.9		SIMULT	MOM	26.6	30.0	
11.20	11.3	22.7	24.7	-2.6		-2.7	-5.4	3.3	-8.8	1.30
	SIMULT	SHEAR	-8.8	0.9		SIMULT	MOM	21.8	24.7	
12.60	6.6	13.3	15.4	-1.3		-4.0	-8.1	1.7	-11.0	1.30
	SIMULT	SHEAR	-11.0	0.9		SIMULT	MOM	13.1	15.4	
14.00	0.0	0.0	0.0	0.0	S	-5.4	-10.8	0.9	-17.0	1.30
	SIMULT	SHEAR	0.0	0.0		SIMULT	MOM	0.0	0.0	

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BEAM 4 - CURRENT LOAD CASE

Special Live Load Case 1 - H20

Critical Values	Capacity (kip-ft, kip)	Max. DL (kip-ft, kip)	Max. LL+I (kip-ft, kip)	Vehicle Weight	IR	IR (Tons)	OR	OR (Tons)
Positive Moment	273	45.0	59.4	20	1.66	33.28	2.78	55.56
Negative Moment	264	60.2	39.4	20	2.17	43.45	3.63	72.53
Shear	138	24.9	27.7	20	1.76	35.15	2.93	58.67

Special Live Load Case 2 - HS20

Critical Values	Capacity (kip-ft, kip)	Max. DL (kip-ft, kip)	Max. LL+I (kip-ft, kip)	Vehicle Weight	IR	IR (Tons)	OR	OR (Tons)
Positive Moment	273	45.0	61.9	36	1.60	57.49	2.67	95.96
Negative Moment	264	60.2	49.2	36	1.74	62.63	2.90	104.54
Shear	138	24.9	28.2	36	1.73	62.14	2.88	103.73

Special Live Load Case 3 - H-Mod

Critical Values	Capacity (kip-ft, kip)	Max. DL (kip-ft, kip)	Max. LL+I (kip-ft, kip)	Vehicle Weight	IR	IR (Tons)	OR	OR (Tons)
Positive Moment	273	45.0	42.7	21	2.31	48.61	3.86	81.15
Negative Moment	264	60.2	33.9	21	2.52	53.02	4.21	88.51
Shear	138	24.9	19.9	21	2.45	51.37	4.08	85.75

Special Live Load Case 4 - Type 3 (Tandem)

Critical Values	Capacity (kip-ft, kip)	Max. DL (kip-ft, kip)	Max. LL+I (kip-ft, kip)	Vehicle Weight	IR	IR (Tons)	OR	OR (Tons)
Positive Moment	273	45.0	60.9	33	1.62	53.56	2.71	89.41
Negative Moment	264	60.2	46.8	33	1.83	60.36	3.05	100.75
Shear	138	24.9	32.0	33	1.52	50.20	2.54	83.79

Special Live Load Case 5 - Timber

Critical Values	Capacity (kip-ft, kip)	Max. DL (kip-ft, kip)	Max. LL+I (kip-ft, kip)	Vehicle Weight	IR	IR (Tons)	OR	OR (Tons)
Positive Moment	273	45.0	55.5	37	1.78	65.90	2.97	110.00
Negative Moment	264	60.2	31.4	37	2.73	100.86	4.55	168.36
Shear	138	24.9	28.6	37	1.70	62.97	2.84	105.12

Special Live Load Case 6 - HS-Mod

Critical Values	Capacity (kip-ft, kip)	Max. DL (kip-ft, kip)	Max. LL+I (kip-ft, kip)	Vehicle Weight	IR	IR (Tons)	OR	OR (Tons)
Positive Moment	273	45.0	42.7	30	2.31	69.45	3.86	115.93
Negative Moment	264	60.2	35.9	30	2.38	71.53	3.98	119.40
Shear	138	24.9	19.9	30	2.45	73.38	4.08	122.49

Special Live Load Case 7 - Type 3s2

Critical Values	Capacity (kip-ft, kip)	Max. DL (kip-ft, kip)	Max. LL+I (kip-ft, kip)	Vehicle Weight	IR	IR (Tons)	OR	OR (Tons)
Positive Moment	273	45.0	45.6	40	2.17	86.71	3.62	144.74
Negative Moment	264	60.2	36.2	40	2.36	94.58	3.95	157.88
Shear	138	24.9	24.2	40	2.01	80.46	3.36	134.30

Special Live Load Case 8 - Piggyback

Critical Values	Capacity (kip-ft, kip)	Max. DL (kip-ft, kip)	Max. LL+I (kip-ft, kip)	Vehicle Weight	IR	IR (Tons)	OR	OR (Tons)
Positive Moment	273	45.0	32.9	40	3.00	120.18	5.02	200.61
Negative Moment	264	60.2	28.6	40	2.99	119.71	5.00	199.83
Shear	138	24.9	18.7	40	2.60	104.12	4.35	173.81

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Beam 4 Rating Summary

Live Load	IR	IR (Tons)	OR	OR (Tons)
H20	1.66	33.28	2.78	55.56
HS20	1.60	57.49	2.67	95.96
H20-Mod	2.31	48.61	3.86	81.15
Tandem	1.52	50.20	2.54	83.79
Timber	1.70	62.97	2.84	105.12
HS20-Mod	2.31	69.45	3.86	115.93
3s2	2.01	80.46	3.36	134.30
Piggyback	2.60	104.12	4.35	173.81

2. Intermediate Bent Cap Calculations

General:

$f'_c := 1500\ psi$ Compressive Strength of Concrete

$f_y := 33000psi$

$\Phi_{flexure} := 0.90$

$\Phi_{shear} := 0.85$

Positive Moment Capacity (Exterior Cap):

$h := 3ft + 10in = 46 \cdot in$ Cap Height

$b := 20in$ Slab Tributary Width

$Cover := 2.0in$ Concrete cover

$\phi_{tension} := 1.128in$ Tension Reinforcement Diameter (#9 Bar)

$A_{tension} := 1.0in^2$ Tension Reinforcement Area (#9 Bar)

Row 1:

$$d_1 := h - Cover - \frac{(\phi_{tension})}{2} = 43.44 \cdot in$$

$No_bars_1 := 8$ Assumed # of bars in row 1 of positive moment region based on bars found in negative moment region

$$A_1 := No_bars_1 \cdot A_{tension} = 8 \cdot in^2$$

$A_t := A_1 = 8 \cdot in^2$ Total Area of Steel

$$Axd := A_1 \cdot d_1 = 347.49 \cdot in^3$$

$$d_{pos} := \frac{Axd}{A_t} = 43.44 \cdot in$$

$$a := \frac{A_t \cdot f_y}{0.85(f'_c \cdot psi) \cdot b} \qquad a = 10.35 \cdot in$$

$$\Phi M_{n.pos} := \Phi_{flexure} \cdot \left[A_t \cdot f_y \cdot \left(d_{pos} - \frac{a}{2}\right)\right] \qquad \Phi M_{n.pos} = 758 \cdot kip \cdot ft$$

Positive Moment Capacity

Negative Moment Capacity (Exterior Cap):

$h = 46 \cdot in$ Cap Height

$b := 20in$ Slab Tributary Width

$Cover := 2.0in$ Assumed Concrete Cover

$\phi_{tension} := 1.128in$ Assumed Tension Reinforcement Diameter (#9 Bar)

$A_{tension} := 1.0in^2$ Assumed Tension Reinforcement Area (#9 Bar)

Row 1:

$d_1 := h - Cover - \frac{(\phi_{tension})}{2} = 43.44 \cdot in$

$No_bars_1 := 8$ Assumed # of bars in row 1 of negative moment region

$A_1 := No_bars_1 \cdot A_{tension} = 8 \cdot in^2$

$A_t := A_1 = 8 \cdot in^2$ Total Area of Steel

$Axd := A_1 \cdot d_1 = 347.49 \cdot in^3$

$d_{neg} := \frac{Axd}{A_t} = 43.44 \cdot in$

$a := \frac{A_t \cdot f_y}{0.85(f'_c \cdot psi) \cdot b}$ $a = 10.35 \cdot in$

$\Phi M_{n.neg} := \Phi_{flexure} \cdot \left[A_t \cdot f_y \cdot \left(d_{neg} - \frac{a}{2}\right)\right]$ $\Phi M_{n.neg} = 758 \cdot kip \cdot ft$ Negative Moment Capacity

Shear Capacity (Exterior Cap):

$b_w := 20in$

$\phi_{shear} := 1.128in$ Shear Reinforcement Diameter (#9 Bar)

$A_{shear} := 1.0in^2$ Shear Reinforcement Area (#9 Bar)

$d := \min(d_{pos}, d_{neg}) = 43.44 \cdot in$

$V_c := 2 \cdot \sqrt{f'_c psi} \cdot b_w \cdot d$ $V_c = 67.291 \cdot kip$

$No_bars := 2$ Minimum No. of shear bars from GPR

$A_v := No_bars \cdot A_{shear} = 2 \cdot in^2$ Area of shear steel based on field measurements

$s := 18in$ Conservative assumption for inclined bar spacing

$\alpha := 45deg$

$V_s := \frac{A_v \cdot f_y \cdot (\sin(\alpha) + \cos(\alpha)) \cdot d}{s}$ $\quad V_s = 225.24 \cdot kip$

$\Phi V_n := \Phi_{shear} \cdot (V_c + V_s)$ $\quad \Phi V_n = 248.647 \cdot kip$ Shear Capacity

Positive Moment Capacity (Interior Cap):

$h := 4ft + 8in = 56 \cdot in$ Cap Height

$b := 20in$ Slab Tributary Width

$Cover := 2.0in$ Concrete cover

$\phi_{tension} := 1.128in$ Tension Reinforcement Diameter (#9 Bar)

$A_{tension} := 1.0in^2$ Tension Reinforcement Area (#9 Bar)

Row 1:

$d_1 := h - Cover - \frac{(\phi_{tension})}{2} = 53.44 \cdot in$

$No_bars_1 := 8$ Assumed # of bars in row 1 of positive moment region based on bars found in negative moment region

$A_1 := No_bars_1 \cdot A_{tension} = 8 \cdot in^2$

$A_t := A_1 = 8 \cdot in^2$ Total Area of Steel

$Axd := A_1 \cdot d_1 = 427.49 \cdot in^3$

$d_{pos2} := \frac{Axd}{A_t} = 53.44 \cdot in$

$a := \frac{A_t \cdot f_y}{0.85(f'_c \cdot psi) \cdot b}$ $\quad a = 10.35 \cdot in$

$\Phi M_{n.pos} := \Phi_{flexure} \cdot \left[A_t \cdot f_y \cdot \left(d_{pos2} - \frac{a}{2}\right)\right]$ $\quad \Phi M_{n.pos} = 956 \cdot kip \cdot ft$ Positive Moment Capacity

Negative Moment Capacity (Interior Cap):

$h = 56 \cdot in$ Cap Height

$b := 20in$ Slab Tributary Width

$Cover := 2.0in$ Assumed Concrete Cover

$\phi_{tension} := 1.128in$ Assumed Tension Reinforcement Diameter (#9 Bar)

$A_{tension} := 1.0in^2$ Assumed Tension Reinforcement Area (#9 Bar)

Row 1:

$d_1 := h - Cover - \frac{(\phi_{tension})}{2} = 53.44 \cdot in$

$No_bars_1 := 8$ Assumed # of bars in row 1 of negative moment region

$A_1 := No_bars_1 \cdot A_{tension} = 8 \cdot in^2$

$A_t := A_1 = 8 \cdot in^2$ Total Area of Steel

$Axd := A_1 \cdot d_1 = 427.49 \cdot in^3$

$d_{neg2} := \frac{Axd}{A_t} = 53.44 \cdot in$

$a := \frac{A_t \cdot f_y}{0.85(f'_c \cdot psi) \cdot b}$ $a = 10.35 \cdot in$

$\Phi M_{n.neg} := \Phi_{flexure} \cdot \left[A_t \cdot f_y \cdot \left(d_{neg2} - \frac{a}{2}\right)\right]$ $\Phi M_{n.neg} = 956 \cdot kip \cdot ft$ Negative Moment Capacity

Shear Capacity (Interior Cap):

$b_w := 20in$

$\phi_{shear} := 1.128in$ Shear Reinforcement Diameter (#9 Bar)

$A_{shear} := 1.0in^2$ Shear Reinforcement Area (#9 Bar)

$d := \min(d_{pos2}, d_{neg2}) = 53.44 \cdot in$

$V_c := 2 \cdot \sqrt{f'_c psi} \cdot b_w \cdot d$ $V_c = 82.783 \cdot kip$

$No_bars := 2$ Minimum No. of shear bars from GPR

$A_v := No_bars \cdot A_{shear} = 2 \cdot in^2$ Area of shear steel based on field measurements

$s := 18in$ Conservative assumption for inclined bar spacing

$\alpha := 45deg$

$V_s := \frac{A_v \cdot f_y \cdot (\sin(\alpha) + \cos(\alpha)) \cdot d}{s}$ $V_s = 277.09 \cdot kip$

$\Phi V_n := \Phi_{shear} \cdot (V_c + V_s)$ $\Phi V_n = 305.892 \cdot kip$ Shear Capacity

GLE 10-28-13

GEORGIA DEPARTMENT OF TRANSPORTATION
PRECONSTUCTION DIVISION - OFFICE OF BRIDGE & STRUCTURAL DESIGN
LIVE LOAD CASE PROGRAM
REVISED: JUNE 26, 2008

PROB. NO.

PONCE DE LEON OVER LULLWATER CREEK

BRIDGE WIDTH	X1	X2	CENTER LINE DISTANCE	# OF BEAMS	REACTION FORCE	MAXIMUM # OF TRUCKS	# OF COLUMNS	COLUMN WIDTH	SKEW ANGLE
62.750	13.125	13.125	31.375	11	22.300	4	0	0.000	0

D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15	D16	D17	D18	D19	D20
0.927	6.198	6.250	6.000	6.000	6.000	6.000	6.000	6.000	6.250	6.198									

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GEORGIA DEPARTMENT OF TRANSPORTATION
PRECONSTUCTION DIVISION - OFFICE OF BRIDGE & STRUCTURAL DESIGN
SUMMARY OF THE LIVE LOAD CASE PROGRAM
REVISED: JUNE 26, 2008

PROB. NO.

PONCE DE LEON OVER LULLWATER CREEK

BRIDGE WIDTH	X1	X2	CENTER LINE DISTANCE	# OF BEAMS	REACTION FORCE	MAXIMUM # OF TRUCKS	# OF COLUMNS	COLUMN WIDTH	SKEW ANGLE
62.750	13.125	13.125	31.375	11	22.300	4	0	0.000	0

D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15	D16	D17	D18	D19	D20
0.927	6.198	6.250	6.000	6.000	6.000	6.000	6.000	6.000	6.250	6.198									

		NO. OF TRUCKS	BEAM 1	BEAM 2	BEAM 3	BEAM 4	BEAM 5	BEAM 6	BEAM 7	BEAM 8	BEAM 9	BEAM 10
			BEAM 11	BEAM 12	BEAM 13	BEAM 14	BEAM 15	BEAM 16	BEAM 17	BEAM 18	BEAM 19	BEAM 20
LL CASE	1	1	0.000	0.892	22.337	21.371	0.000	0.000	0.000	0.000	0.000	0.000
			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
LL CASE	2	2	0.000	0.892	22.337	29.733	22.300	13.938	0.000	0.000	0.000	0.000
			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
LL CASE	3	3	0.000	0.892	22.337	29.733	22.300	29.733	22.300	6.504	0.000	0.000
			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
LL CASE	4	4	0.000	0.892	22.337	29.733	22.300	29.733	23.229	28.804	21.371	0.000
			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
LL CASE	5	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	21.371	22.337	0.892
			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
LL CASE	6	2	0.000	0.000	0.000	0.000	0.000	13.937	22.300	29.733	22.337	0.892
			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
LL CASE	7	3	0.000	0.000	0.000	6.504	22.300	29.733	22.300	29.733	22.337	0.892
			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
LL CASE	8	4	0.000	0.000	21.371	28.804	23.229	29.733	22.300	29.733	22.337	0.892
			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
LL CASE	9	1	0.000	0.000	0.000	0.000	11.150	22.300	11.150	0.000	0.000	0.000
			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
LL CASE	10	2	0.000	0.000	3.717	22.300	29.733	22.300	11.150	0.000	0.000	0.000
			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
LL CASE	11	3	0.000	0.000	3.717	22.300	29.733	22.300	29.733	22.300	3.717	0.000
			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
LL CASE	12	2	0.000	0.000	0.000	7.433	22.300	29.733	22.300	7.433	0.000	0.000
			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
LL CASE	13	3	0.000	0.000	22.300	29.733	22.300	29.733	22.300	7.433	0.000	0.000
			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
LL CASE	14	4	0.000	0.000	22.300	29.733	22.300	29.733	22.300	29.733	22.300	0.000
			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
LL CASE	15	2	0.000	0.892	22.337	21.371	0.000	0.000	0.000	21.371	22.337	0.892
			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
LL CASE	16	3	0.000	0.892	22.337	29.733	22.300	13.938	0.000	21.371	22.337	0.892
			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
LL CASE	17	4	0.000	0.892	22.337	29.733	22.300	27.875	22.300	29.733	22.337	0.892
			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Input Loads - BEAM 4

Bridge Geometry:

$Span := 14ft$ $\quad$ $Beam_spacing := 6.0ft$

$T_{slab} := 6.0in$ $\quad$ $No_beams := 11$ $\quad$ $No_rdwybeams := 7$

$W_{conc} := 0.150\frac{kip}{ft^3}$ $\quad$ $W_{asphalt} := 0.140\frac{kip}{ft^3}$ $\quad$ $W_{clay} := 0.120\frac{kip}{ft^3}$

Additional Dead Load from Arches:

$Width := 20in$ Cap/Column Width

$Area_1 := 17.8ft^2$ Arch area at columns 1 and 5 (from Microstation)

$Area_2 := 33.4ft^2$ Arch area at columns 2 and 4 (from Microstation)

$Area_3 := 30.2ft^2$ Arch area at column 3 (from Microstation)

$Total := (Area_1 + Area_2 + Area_3)\cdot Width\cdot W_{conc} = 20.35\cdot kip$

$CapArch := \frac{Total}{No_beams}$ $\quad$ $CapArch = 1.85\cdot kip$ $\quad$ Additional Load per beam

Beam Data: Concrete T-Beam

$B_f := 18in$ $\quad$ $Bm_ht := 28in$ $\quad$ Stem only

$Bm_wt := B_f\cdot Bm_ht\cdot W_{conc} = 0.525\cdot\frac{kip}{ft}$ $\quad$ Nominal weight per foot per beam

Interior Beam:

Noncomposite Dead Loads (DL1):

$DeckSelfWgt := T_{slab}\cdot Beam_spacing\cdot W_{conc} = 0.450\cdot\frac{kip}{ft}$

$DL1 := (DeckSelfWgt + Bm_wt)\cdot Span = 13.65\cdot kip$

Composite Dead Loads (DL2):

$T_{asphalt} := 16in$

$Asphalt := T_{asphalt}\cdot Beam_spacing\cdot W_{asphalt} = 1.12\cdot\frac{kip}{ft}$

$T_{clay} := 14in$

$Clay := T_{clay} \cdot Beam_spacing \cdot W_{clay} = 0.84 \cdot \frac{kip}{ft}$

$Overlay := Asphalt + Clay = 1.96 \cdot \frac{kip}{ft}$

$DL2 := Span \cdot Overlay = 27.44 \cdot kip$

$InteriorBeam := DL1 + DL2 + CapArch = 42.94 \cdot kip$ **Use 47 kips**

Exterior Beam:

Beam Data: Concrete T-Beam

$B_f := 12in$ $Bm_ht := 28in$ Stem only

$Bm_wt := B_f \cdot Bm_ht \cdot W_{conc} = 0.35 \cdot \frac{kip}{ft}$ Nominal weight per foot per beam

$Beam_spacing := 3.333ft$

Noncomposite Dead Loads (DL1):

$DeckSelfWgt := T_{slab} \cdot Beam_spacing \cdot W_{conc} = 0.250 \cdot \frac{kip}{ft}$

$DL1 := (DeckSelfWgt + Bm_wt) \cdot Span = 8.4 \cdot kip$

Composite Dead Loads (DL2):

$T_{clay} := 29in$

$Clay := T_{clay} \cdot Beam_spacing \cdot W_{clay} = 0.967 \cdot \frac{kip}{ft}$

$Overlay := Clay = 0.967 \cdot \frac{kip}{ft}$

$Barrier_weight := 250 \cdot \frac{lbf}{ft}$ $Barrier_weight = 0.25 \cdot \frac{kip}{ft}$

$Sidewalk := (5.75in \cdot 6.4167ft) \cdot W_{conc} = 0.461 \cdot \frac{kip}{ft}$

$DL2 := Span \cdot (Overlay + Barrier_weight + Sidewalk) = 23.489 \cdot kip$

$ExteriorBeam := DL1 + DL2 + CapArch = 33.738 \cdot kip$ **Use 36 kips**

GLE 10-28-13

PROB. NO.

GEORGIA DEPARTMENT OF TRANSPORTATION
PRECONSTUCTION DIVISION - OFFICE OF BRIDGE & STRUCTURAL DESIGN
THE ANALYSIS AND DESIGN OF PIERS FOR BRIDGES - V 4.2.07 - AASHTO SPECS 1984 INTERIM
REVISED: JUNE 30, 2008
PONCE DE LEON OVER LULLWATER CREEK (CAP ONLY)

DESIGN DATA

DESIGN OPTIONS	NO. CAN	NO. COL	NO. LLC	SKEW ANG D M S	F'C PSI	FC PSI	N	FY PSI	FS PSI	EC KSI	ES KSI	CONC. STRAIN	Z FACT	* * * CAP REINFORCING STEEL * * * MAIN SIZE	STR SIZ	MAX TOP	MAX BOT	MIN SIZE	MIN NO.	TOP CL.	MIN S.SP	CAP DEPTH INCR.	BOT CL.
D	L 0	5	17	90-00-00	1000.	400.	16.	33000.	18150.	1822.	29000.	0.0030	170.	9	4	8	8	9	8	2.00	3.00	3.00	2.00

COLUMN REINFORCING STEEL MIN.P	MAX.P	CL.SP.	CLEAR	R MODE	KL COEF	OC	OF	CM	BD1	BD2	IMPACT %	SOIL WT KCF	ALL.S.P. KSF	MIN PL SP	MAX PL SP	EDGE DIST	PILE DEPTH	REBAR CLEAR	ALL.PILE CAPACITY	ALL.PILE UPLIFT	I P
1.00	8.00	2.25	2.500	2	2.00	0.00	0.90	0.00	1.00	0.00	0.00	0.110	0.000	2.50	5.00	1.250	1.000	3.000	0.000	0.000	

CAP DATA

CN	C	L	A	DE	BC	BE	DH	LH	XB1	XB2	XB3	XB4	XB5	XB6	XB7	XB8
11	C	15.625	0.000	3.833	1.667		0.000	0.000	0.001	0.313	5.896	1.381	4.869	2.625		
12	C	14.833	0.000	4.667	1.667		0.000	0.000	0.542	2.292	4.550	1.450	5.458	0.540		
13	C	14.833	0.000	4.667	1.667		0.000	0.000	0.542	5.458	1.450	4.550	2.292			
14	C	15.625	0.000	3.833	1.667		0.000	0.000	0.542	2.625	4.869	1.381	5.896	0.311		

COLUMN DATA

CN	P	I	T	S	HT	A	DT	BT	DB	BB	DL	FLEX	ND	NB	SZ	ND	NB	SZ	ND	NB	SZ	ND	NB	SZ	SLOPE	EP	AP
21	0	C	T		19.833	0.000	1.250	1.667	0.000	0.000	1.917	0.000	0	4	5	0	0	0	0	4	5	0	0	0	0.000	0.000	0.000
22	0	C	T		19.833	0.000	2.167	1.667	0.000	0.000	2.333	0.000	0	4	5	0	0	0	0	4	5	0	0	0	0.000	0.000	0.000
23	0	C	T		19.833	0.000	2.167	1.667	0.000	0.000	2.333	0.000	0	4	5	0	0	0	0	4	5	0	0	0	0.000	0.000	0.000
24	0	C	T		19.833	0.000	2.167	1.667	0.000	0.000	2.333	0.000	0	4	5	0	0	0	0	4	5	0	0	0	0.000	0.000	0.000
25	0	C	T		19.833	0.000	1.250	1.667	0.000	0.000	1.917	0.000	0	4	5	0	0	0	0	4	5	0	0	0	0.000	0.000	0.000

GROUP II WIND

SUPERSTRUCTURE AREA* TRANS.	LONG.	STD. WIND	WIND ON SUPERSTRUCTURE INTENSITIES FT1	FL1	FT2	FL2	FT3	FL3	FT4	FL4	FT5	FL5	* WIND FORCE ARM APT	APL	* WIND ON PIER PT	PL
119.	119.	1	50	0	44	6	41	12	33	16	17	19	7.083	7.083	0.692	13.463

GROUP III WIND

STD. * WIND	WIND ON SUPERSTRUCTURE INTENSITIES FT1	FL1	FT2	FL2	FT3	FL3	FT4	FL4	FT5	FL5	* STD. * WIND	WIND ON LIVE LOAD INTENSITIES FT1	FL1	FT2	FL2	FT3	FL3	FT4	FL4	FT5	FL5	* LENGTHS OF LL TRANS.	LONGI.	* WIND ON LL ARMS APT	APL
1	50	0	44	6	41	12	33	16	17	19	1	100	0	88	12	82	24	66	32	34	38	14.0	14.0	14.667	14.667

MISCELLANEOUS FORCES

CENTRI. FT	TRACTION FORCE AND ARMS FL	APT	APL	EXPANSION COEFFICIENT	SHRINKAGE COEFFICIENT	STREAM FLOW PT	PL
0.000	0.280	14.667	14.667	0.00018000	0.00042000	0.000	0.000

GCE 10-08-13

DEAD LOAD SUPERSTRUCTURE AND LIVE LOAD CASES

I.D.	NL	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12
D.L.	0	36.000	0.000	36.000	0.000	47.000	0.000	0.000	47.000	0.000	47.000	0.000	47.000
		0.000	47.000	0.000	47.000	0.000	0.000	47.000	0.000	36.000	0.000	36.000	
LL 1	1	0.000	0.000	0.892	0.000	22.337	0.000	0.000	21.371	0.000	0.000	0.000	0.000
		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
LL 2	2	0.000	0.000	0.892	0.000	22.337	0.000	0.000	29.733	0.000	22.300	0.000	13.938
		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
LL 3	3	0.000	0.000	0.892	0.000	22.337	0.000	0.000	29.733	0.000	22.300	0.000	29.733
		0.000	22.300	0.000	6.504	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
LL 4	4	0.000	0.000	0.892	0.000	22.337	0.000	0.000	29.733	0.000	22.300	0.000	29.733
		0.000	23.229	0.000	28.804	0.000	0.000	21.371	0.000	0.000	0.000	0.000	
LL 5	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
		0.000	0.000	0.000	21.371	0.000	0.000	22.337	0.000	0.892	0.000	0.000	
LL 6	2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	13.937
		0.000	22.300	0.000	29.733	0.000	0.000	22.337	0.000	0.892	0.000	0.000	
LL 7	3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	6.504	0.000	22.300	0.000	29.733
		0.000	22.300	0.000	29.733	0.000	0.000	22.337	0.000	0.892	0.000	0.000	
LL 8	4	0.000	0.000	0.000	0.000	21.371	0.000	0.000	28.804	0.000	23.229	0.000	29.733
		0.000	22.300	0.000	29.733	0.000	0.000	22.337	0.000	0.892	0.000	0.000	
LL 9	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	11.150	0.000	22.300
		0.000	11.150	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
LL10	2	0.000	0.000	0.000	0.000	3.717	0.000	0.000	22.300	0.000	29.733	0.000	22.300
		0.000	11.150	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
LL11	3	0.000	0.000	0.000	0.000	3.717	0.000	0.000	22.300	0.000	29.733	0.000	22.300
		0.000	29.733	0.000	22.300	0.000	0.000	3.717	0.000	0.000	0.000	0.000	
LL12	2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	7.433	0.000	22.300	0.000	29.733
		0.000	22.300	0.000	7.433	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
LL13	3	0.000	0.000	0.000	0.000	22.300	0.000	0.000	29.733	0.000	22.300	0.000	29.733
		0.000	22.300	0.000	7.433	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
LL14	4	0.000	0.000	0.000	0.000	22.300	0.000	0.000	29.733	0.000	22.300	0.000	29.733
		0.000	22.300	0.000	29.733	0.000	0.000	22.300	0.000	0.000	0.000	0.000	
LL15	2	0.000	0.000	0.892	0.000	22.337	0.000	0.000	21.371	0.000	0.000	0.000	0.000
		0.000	0.000	0.000	21.371	0.000	0.000	22.337	0.000	0.892	0.000	0.000	
LL16	3	0.000	0.000	0.892	0.000	22.337	0.000	0.000	29.733	0.000	22.300	0.000	13.938
		0.000	0.000	0.000	21.371	0.000	0.000	22.337	0.000	0.892	0.000	0.000	
LL17	4	0.000	0.000	0.892	0.000	22.337	0.000	0.000	29.733	0.000	22.300	0.000	27.875
		0.000	22.300	0.000	29.733	0.000	0.000	22.337	0.000	0.892	0.000	0.000	

CAP ANALYSIS AND DESIGN DATA

CAP MOMENTS AND SHEARS

POINT	MOMENTS (KIP-FEET) D.L.TOT.	G1 MAX.+	G1 MAX.-	G2 MAX.+	G2 MAX.-	G3 MAX.+	G3 MAX.-	** SHEARS (KIPS) DL T.LT	DL T.RT	G1 + LT	G1 + RT	G1 - LT	G1 - RT
C 1R	-4.633	-3.598	-5.561	-4.119	-5.147	-2.545	-6.648		79.571		83.775		76.353
P 1	-4.553	-3.522	-5.477	-4.040	-5.067	-2.467	-6.565	79.570	32.770	83.774	36.974	76.352	29.552
P 2	5.643	6.051	5.563	6.130	5.156	7.383	4.065	32.380	32.380	36.584	36.584	29.162	29.162
P 3	174.900	200.095	155.946	174.920	174.879	190.046	163.491	25.034	-21.766	29.238	-19.499	21.815	-24.985
P 4	143.653	171.979	120.255	143.792	143.513	161.014	129.242	-23.487	-23.487	-21.219	-21.219	-26.705	-26.705
P 5	14.526	53.893	-24.543	15.085	13.967	39.697	-10.466	-29.553	-90.653	-27.286	-89.847	-32.772	-139.509
P 6	-227.732	-215.856	-348.602	-226.946	-228.517	-218.376	-302.353	-93.924	-93.924	-93.118	-93.118	-142.780	-142.780
C 2L	-278.632	-266.321	-425.885	-277.801	-279.464	-268.884	-369.185	-94.597		-93.791		-143.453	
C 2R	-275.206	-260.955	-428.213	-273.451	-276.962	-261.655	-371.845		93.044		169.634		87.042
P 7	-224.999	-214.001	-336.494	-223.356	-226.642	-213.718	-296.458	92.222	92.222	168.812	168.812	86.220	86.220
P 8	-17.611	71.679	-20.370	-16.444	-18.778	39.191	-22.598	88.745	27.645	165.335	40.593	82.743	21.643
P 9	92.470	240.674	62.402	92.691	92.248	181.848	73.831	20.742	20.742	33.690	33.690	14.740	14.740
P10	120.951	287.930	82.180	121.031	120.871	221.166	97.507	18.542	-42.558	31.491	-42.558	12.540	-94.177
P11	-133.925	-133.925	-299.025	-132.712	-135.138	-133.548	-236.599	-50.838	-50.838	-50.838	-50.838	-102.458	-102.458
P12	-161.599	-161.599	-354.573	-160.273	-162.924	-161.422	-281.316	-51.657	-112.757	-51.657	-112.757	-103.277	-216.767
C 3L	-161.711	-161.711	-354.781	-160.386	-163.037	-161.535	-281.487	-112.759		-112.759		-216.768	
C 3R	-161.707	-161.707	-354.775	-160.382	-163.033	-161.540	-281.481		51.654		103.270		51.654
P13	-133.934	-133.934	-299.025	-132.721	-135.147	-133.548	-236.602	50.832	50.832	102.448	102.448	50.832	50.832
P14	120.909	257.173	82.119	120.989	120.830	202.731	97.455	42.552	-18.548	94.168	-11.306	42.552	-30.596
P15	92.419	211.214	62.338	92.641	92.197	164.188	73.772	-20.748	-20.748	-13.505	-13.505	-32.796	-32.796
P16	-17.689	60.066	-20.443	-16.522	-18.856	32.537	-22.674	-27.651	-88.751	-20.408	-82.745	-39.699	-165.349
P17	-225.090	-214.080	-336.675	-223.447	-226.734	-213.801	-296.604	-92.228	-92.228	-86.222	-86.222	-168.826	-168.826
C 4L	-275.208	-260.948	-428.232	-273.452	-276.963	-261.651	-371.857	-93.049		-87.043		-169.647	
C 4R	-278.639	-266.320	-425.914	-277.807	-279.471	-268.886	-369.204		94.583		143.434		93.777
P18	-227.558	-215.676	-348.355	-226.773	-228.343	-218.200	-302.135	93.908	93.908	142.759	142.759	93.101	93.101
P19	14.658	58.365	-11.929	15.217	14.099	42.586	-3.018	90.637	29.537	139.488	31.720	89.831	26.810
P20	143.707	174.133	127.747	143.846	143.567	162.365	133.712	23.471	23.471	25.654	25.654	20.743	20.743
P21	174.932	201.592	161.987	174.952	174.911	190.961	167.115	21.750	-25.050	23.933	-22.867	19.023	-29.520
P22	5.581	5.981	5.440	6.068	5.094	7.315	4.005	-32.396	-32.396	-30.213	-30.213	-36.867	-36.867
P23	-4.555	-3.952	-5.643	-4.041	-5.069	-2.579	-6.821	-32.784	-79.584	-30.601	-77.401	-37.254	-84.054
C 5L	-4.634	-4.029	-5.727	-4.121	-5.148	-2.658	-6.903	-79.585		-77.402		-84.055	

✓ GLE 10-28-13

LIVE LOAD REACTION FOR BRLLCA INPUT

Vehicle	BAR 7 R_{LL+I}	Distribution	Axle Reaction	P_{LL+I}
H20	29.7	0.667	44.5	22.3
HS20	29.7	0.667	44.5	22.3
H-20 Mod	19.9	0.667	29.8	14.9
Tandem	32.1	0.667	48.1	24.1
Timber	27.8	0.667	41.7	20.8
HS20-Mod	19.9	0.667	29.8	14.9
3S2	26.7	0.667	40.0	20.0
Piggyback	18.6	0.667	27.9	13.9

/CLE
11-28-13

RATINGS FROM BRPIER RESULTS

			H20			P-Load =	22.3	kips	HS20			P-Load =	22.3	kips
Force	Capacity	DL	LL+I	Truck	IR	Tons	OR	Tons	LL+I	Truck	IR	Tons	OR	Tons
V_{ext}	249	-93.92	-48.86	20	1.20	23.94	2.00	39.96	-48.86	36	1.20	43.09	2.01	72.52
$+M_{ext}$	758	143.65	28.33	20	9.29	185.87	15.51	310.26	28.33	36	9.29	334.57	15.51	558.47
$-M_{ext}$	758	-227.73	-120.87	20	1.76	35.22	2.94	58.80	-120.87	36	1.76	63.40	2.94	105.84
$-M_{int}$	956	-225.00	-111.50	20	2.74	54.85	4.58	91.55	-111.50	36	2.74	98.73	4.58	164.80
V_{int}	306	92.22	76.59	20	1.12	22.40	1.87	37.38	76.59	36	1.12	40.31	1.87	67.29
$+M_{int}$	956	120.95	166.98	20	2.20	44.09	3.68	73.59	166.98	36	2.20	79.36	3.68	132.47
V_{int}	306	-50.84	-51.62	20	2.14	42.84	3.58	71.50	-51.62	36	2.14	77.10	3.58	128.70
$-M_{cen}$	956	-133.93	-165.10	20	2.18	43.65	3.64	72.86	-165.10	36	2.18	78.57	3.64	131.15
$-M_{cen}$	956	-133.93	-165.09	20	2.18	43.65	3.64	72.86	-165.09	36	2.18	78.57	3.64	131.15
V_{int}	306	50.83	51.62	20	2.14	42.84	3.58	71.51	51.62	36	2.14	77.11	3.58	128.72
$+M_{int}$	956	120.91	136.26	20	2.70	54.03	4.51	90.19	136.26	36	2.70	97.25	4.51	162.34
V_{int}	306	-92.23	-76.60	20	1.12	22.39	1.87	37.38	-76.60	36	1.12	40.31	1.95	70.10
$-M_{int}$	956	-225.09	-111.59	20	2.74	54.79	4.57	91.46	-111.59	36	2.74	98.63	4.57	164.63
$-M_{ext}$	758	-227.56	-120.80	20	1.76	35.26	2.94	58.86	-120.80	36	1.76	63.47	2.94	105.95
$+M_{ext}$	758	143.71	30.43	20	8.65	173.02	14.44	288.81	30.43	36	8.65	311.44	14.44	519.86
V_{ext}	249	93.91	48.85	20	1.20	23.95	2.00	39.97	48.85	36	1.20	43.10	2.00	71.95
				Controlling	1.12	22.39	1.87	37.38		Controlling	1.12	40.31	1.87	67.29

GLE 10-28-13

RATINGS FROM BRPIER RESULTS

			H-20 Mod				P-Load = 14.9 kips		Tandem				P-Load = 24.1 kips	
Force	Capacity	DL	LL+I	Truck	IR	Tons	OR	Tons	LL+I	Truck	IR	Tons	OR	Tons
Vext	249	-93.92	-32.74	21	1.79	37.51	2.98	62.62	-52.80	33	1.11	36.55	1.85	61.00
+Mext	758	143.65	18.98	21	13.87	291.28	23.15	486.21	30.61	33	8.60	283.76	14.35	473.66
-Mext	758	-227.73	-80.99	21	2.63	55.20	4.39	92.14	-130.64	33	1.63	53.78	2.72	89.76
-Mint	956	-225.00	-74.71	21	4.09	85.95	6.83	143.47	-120.50	33	2.54	83.73	4.24	139.77
Vint	306	92.22	51.32	21	1.67	35.10	2.79	58.58	82.78	33	1.04	34.19	1.73	57.07
+Mint	956	120.95	111.88	21	3.29	69.09	5.49	115.33	180.47	33	2.04	67.31	3.40	112.35
Vint	306	-50.84	-34.59	21	3.20	67.13	5.34	112.05	-55.79	33	1.98	65.39	3.31	109.16
-Mcen	956	-133.93	-110.62	21	3.26	68.40	5.44	114.18	-178.44	33	2.02	66.64	3.37	111.23
-Mcen	956	-133.93	-110.62	21	3.26	68.40	5.44	114.18	-178.43	33	2.02	66.64	3.37	111.24
Vint	306	50.83	34.58	21	3.20	67.13	5.34	112.06	55.79	33	1.98	65.40	3.31	109.17
+Mint	956	120.91	91.30	21	4.03	84.67	6.73	141.33	147.28	33	2.50	82.48	4.17	137.69
Vint	306	-92.23	-51.32	21	1.67	35.09	2.79	58.58	-82.79	33	1.04	34.19	1.73	57.06
-Mint	956	-225.09	-74.77	21	4.09	85.87	6.83	143.33	-120.60	33	2.53	83.65	4.23	139.63
-Mext	758	-227.56	-80.94	21	2.63	55.26	4.39	92.24	-130.56	33	1.63	53.83	2.72	89.86
+Mext	758	143.71	20.39	21	12.91	271.14	21.55	452.59	32.88	33	8.00	264.14	13.36	440.91
Vext	249	93.91	32.73	21	1.79	37.52	2.98	62.64	52.80	33	1.11	36.56	1.85	61.02
				Controlling	1.67	35.09	2.79	58.58		Controlling	1.04	34.19	1.73	57.06

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RATINGS FROM BRPIER RESULTS

			Timber			P-Load =	20.8	kips	HS20-Mod			P-Load =	14.9	kips
Force	Capacity	DL	LL+I	Truck	IR	Tons	OR	Tons	LL+I	Truck	IR	Tons	OR	Tons
Vext	249	-93.92	-45.73	37	1.28	47.31	2.13	78.98	-32.74	30	1.79	53.59	2.98	89.46
+Mext	758	143.65	26.51	37	9.93	367.36	16.57	613.21	18.98	30	13.87	416.11	23.15	694.58
-Mext	758	-227.73	-113.14	37	1.88	69.62	3.14	116.21	-80.99	30	2.63	78.86	4.39	131.63
-Mint	956	-225.00	-104.36	37	2.93	108.40	4.89	180.95	-74.71	30	4.09	122.79	6.83	204.96
Vint	306	92.22	71.69	37	1.20	44.26	2.00	73.89	51.32	30	1.67	50.14	2.79	83.69
+Mint	956	120.95	156.30	37	2.36	87.14	3.93	145.45	111.88	30	3.29	98.70	5.49	164.75
Vint	306	-50.84	-48.32	37	2.29	84.66	3.82	141.32	-34.59	30	3.20	95.90	5.34	160.07
-Mcen	956	-133.93	-154.54	37	2.33	86.27	3.89	144.00	-110.62	30	3.26	97.72	5.44	163.11
-Mcen	956	-133.93	-154.53	37	2.33	86.27	3.89	144.01	-110.62	30	3.26	97.72	5.44	163.12
Vint	306	50.83	48.31	37	2.29	84.67	3.82	141.33	34.58	30	3.20	95.91	5.34	160.09
+Mint	956	120.91	127.55	37	2.89	106.79	4.82	178.25	91.30	30	4.03	120.96	6.73	201.91
Vint	306	-92.23	-71.70	37	1.20	44.26	2.00	73.88	-51.32	30	1.67	50.13	2.79	83.68
-Mint	956	-225.09	-104.45	37	2.93	108.30	4.89	180.77	-74.77	30	4.09	122.67	6.83	204.76
-Mext	758	-227.56	-113.07	37	1.88	69.70	3.14	116.34	-80.94	30	2.63	78.94	4.39	131.77
+Mext	758	143.71	28.48	37	9.24	341.97	15.43	570.82	20.39	30	12.91	387.34	21.55	646.56
Vext	249	93.91	45.73	37	1.28	47.33	2.14	79.00	32.73	30	1.79	53.61	2.98	89.48
				Controlling	1.20	44.26	2.00	73.88		Controlling	1.67	50.13	2.79	83.68

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RATINGS FROM BRPIER RESULTS

			3S2			P-Load =	20.0	kips	Piggyback			P-Load =	13.9	kips
Force	Capacity	DL	LL+I	Truck	IR	Tons	OR	Tons	LL+I	Truck	IR	Tons	OR	Tons
Vext	249	-93.92	-43.92	40	1.33	53.26	2.22	88.90	-30.60	40	1.91	76.45	3.19	127.61
+Mext	758	143.65	25.46	40	10.34	413.51	17.26	690.25	17.74	40	14.84	593.59	24.77	990.84
-Mext	758	-227.73	-108.66	40	1.96	78.36	3.27	130.81	-75.70	40	2.81	112.49	4.69	187.77
-Mint	956	-225.00	-100.23	40	3.05	122.02	5.09	203.68	-69.83	40	4.38	175.16	7.31	292.38
Vint	306	92.22	68.85	40	1.25	49.82	2.08	83.17	47.97	40	1.79	71.52	2.98	119.39
+Mint	956	120.95	150.11	40	2.45	98.08	4.09	163.73	104.57	40	3.52	140.80	5.88	235.03
Vint	306	-50.84	-46.41	40	2.38	95.30	3.98	159.07	-32.33	40	3.42	136.80	5.71	228.35
-Mcen	956	-133.93	-148.42	40	2.43	97.11	4.05	162.09	-103.40	40	3.48	139.39	5.82	232.68
-Mcen	956	-133.93	-148.42	40	2.43	97.11	4.05	162.10	-103.39	40	3.49	139.40	5.82	232.69
Vint	306	50.83	46.40	40	2.38	95.31	3.98	159.09	32.33	40	3.42	136.81	5.71	228.37
+Mint	956	120.91	122.50	40	3.01	120.20	5.02	200.65	85.34	40	4.31	172.55	7.20	288.02
Vint	306	-92.23	-68.86	40	1.25	49.82	2.08	83.16	-47.97	40	1.79	71.51	2.98	119.37
-Mint	956	-225.09	-100.31	40	3.05	121.90	5.09	203.48	-69.88	40	4.37	174.99	7.30	292.09
-Mext	758	-227.56	-108.60	40	1.96	78.45	3.27	130.95	-75.65	40	2.82	112.61	4.70	187.98
+Mext	758	143.71	27.35	40	9.62	384.92	16.06	642.53	19.05	40	13.81	552.55	23.06	922.34
Vext	249	93.91	43.92	40	1.33	53.27	2.22	88.92	30.59	40	1.91	76.47	3.19	127.65
				Controlling	1.25	49.82	2.08	83.16		Controlling	1.79	71.51	2.98	119.37

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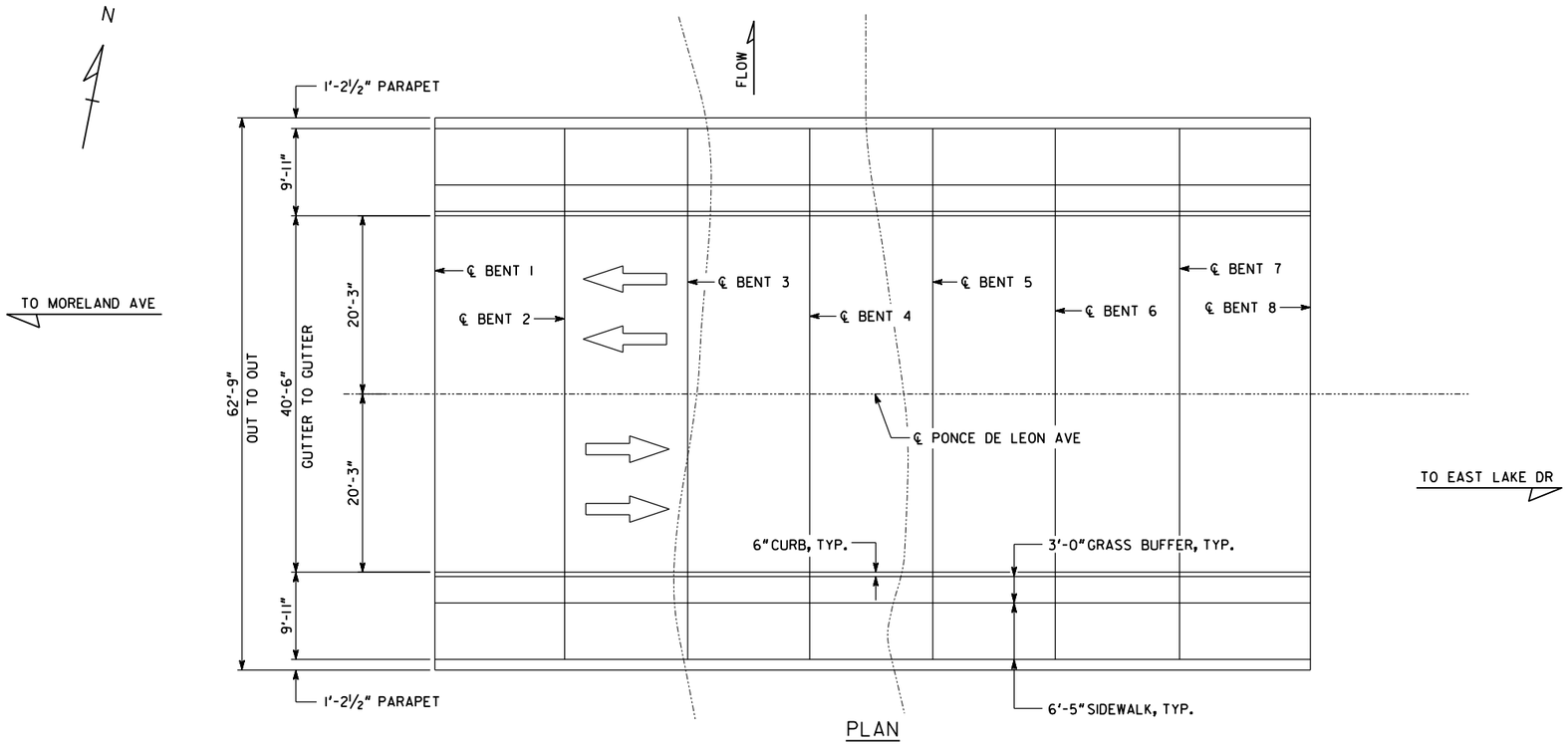
INTERMEDIATE BENT RATING SUMMARY

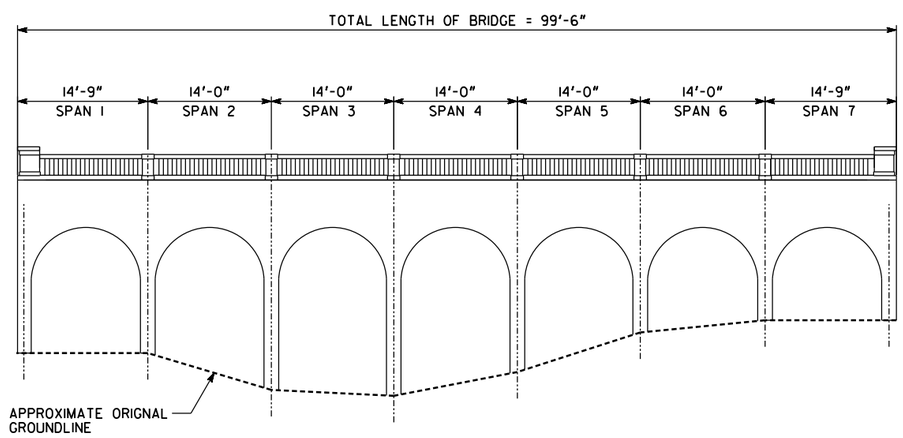
Live Load	IR	IR (Tons)	OR	OR (Tons)
H20	1.12	22.39	1.87	37.38
HS20	1.12	40.31	1.87	67.29
H20-Mod	1.67	35.09	2.79	58.58
Tandem	1.04	34.19	1.73	57.06
Timber	1.20	44.26	2.00	73.88
HS20-Mod	1.67	50.13	2.79	83.68
3s2	1.25	49.82	2.08	83.16
Piggyback	1.79	71.51	2.98	119.37

Appendix D – AECOM Bridge Plans

STATE	PROJECT NUMBER	SHEET NO.	TOTAL SHEETS
GA.			



PLAN



ELEVATION

BRIDGE SERIAL NO. 089-0001-0

AECOM

GEORGIA
DEPARTMENT OF TRANSPORTATION
PRECONSTRUCTION DIVISION-OFFICE OF BRIDGE DESIGN

PLAN AND ELEVATION
PONCE DE LEON OVER LULLWATER CREEK
DEKALB COUNTY P.I. 0007032

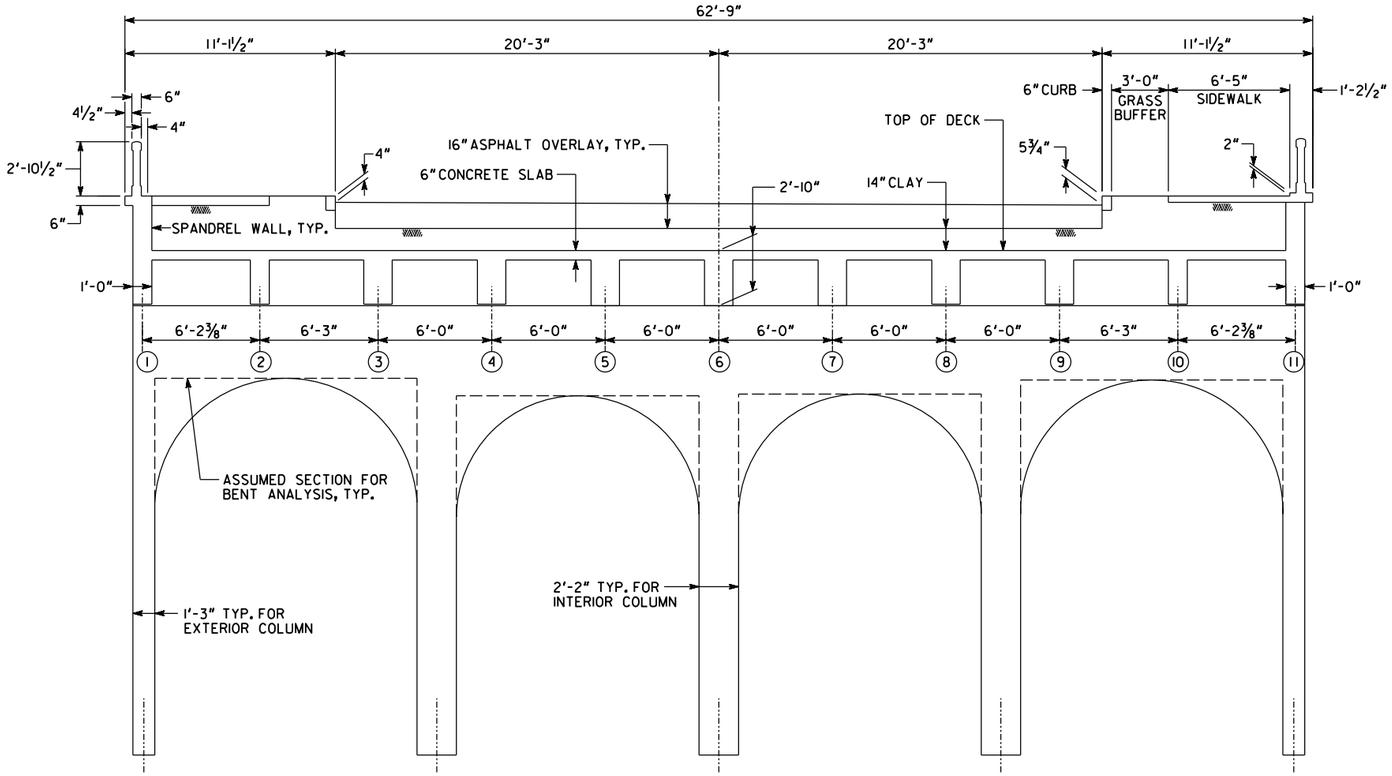
SCALE: 1/8" = 1'-0" SEPTEMBER 2013

DATE	REVISIONS	BY

DRAWING NO. 35-
BRIDGE SHEET 1 OF 3

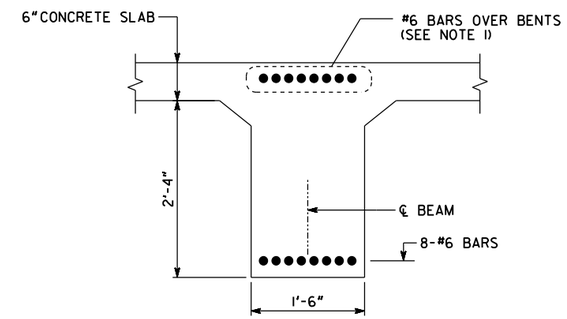
DESIGNED KPE CHECKED GLE REVIEWED X
DRAWN KPE DESIGN GROUP X APPROVED X

STATE	PROJECT NUMBER	SHEET NO.	TOTAL SHEETS
GA.			



BRIDGE CROSS SECTION

BENT 4 SHOWN. OTHER BENTS SIMILAR.
LOOKING AHEAD

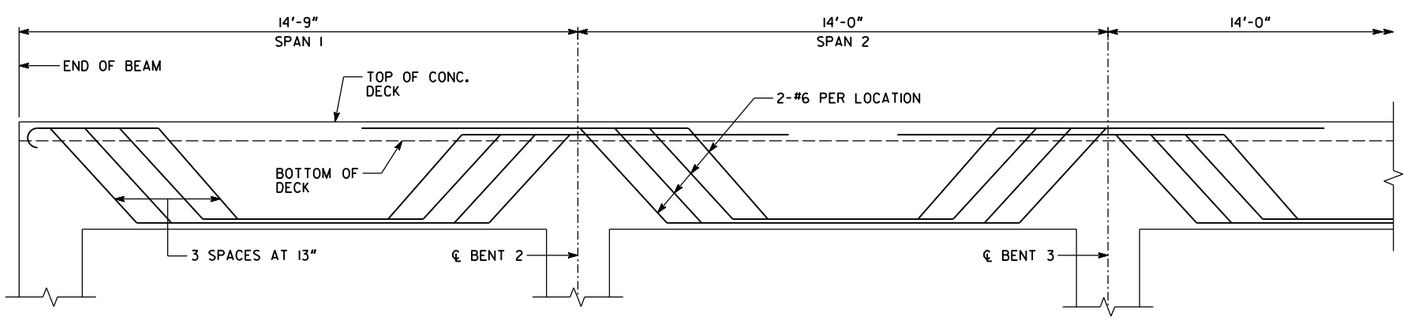


CROSS SECTION

BEAMS 3-9

NOTES:

1. BAR CONFIGURATION OVER BENT 2, 3, 4, 5, 6 AND 7 IS ASSUMED.
2. BAR CONFIGURATION AT MIDSPAN, BEAM ENDS AND BENT CAPS DERIVED FROM GPR SCANNING.
3. DECK, OVERLAY AND FILL THICKNESS VERIFIED WITH CORING.



BEAM ELEVATION

BEAM 4 SHOWN
SPANS 1 AND 2 SHOWN. OTHER SPANS SIMILAR.

BRIDGE SERIAL NO. 089-0001-0

AECOM

GEORGIA
DEPARTMENT OF TRANSPORTATION
PRECONSTRUCTION DIVISION-OFFICE OF BRIDGE DESIGN

CROSS SECTION AND BEAM ELEVATIONS
PONCE DE LEON OVER LULLWATER CREEK
DEKALB COUNTY P.I. 0007032

SCALE: ¼" = 1'-0" SEPTEMBER 2013

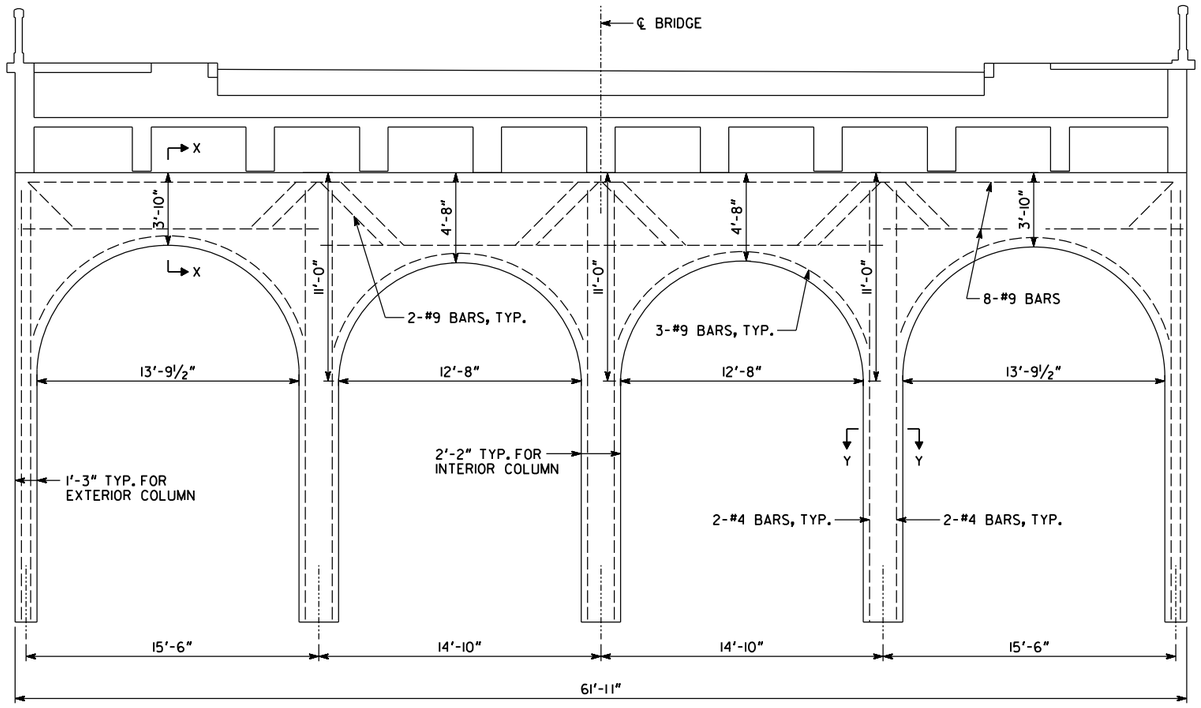
DRAWING NO. 35-

BRIDGE SHEET 2 OF 3

REVISIONS | DATE | BY

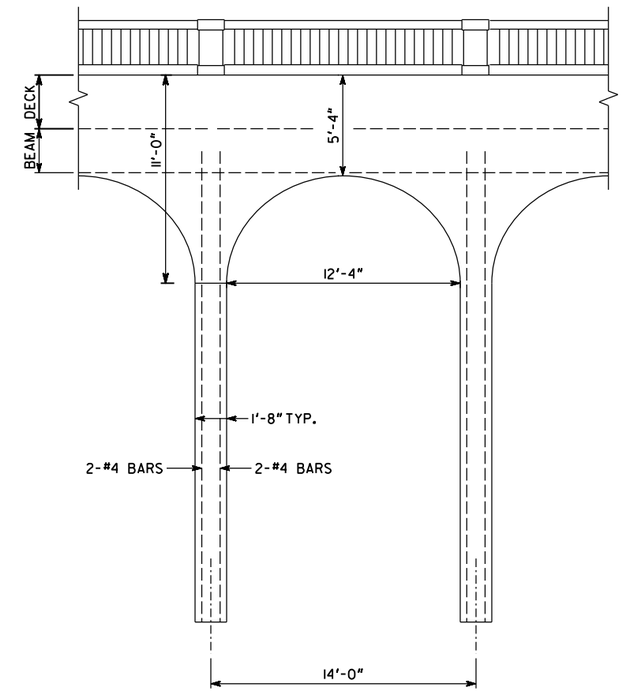
DESIGNED KPE | CHECKED GLE | REVIEWED X
DRAWN KPE | DESIGN GROUP X | APPROVED X

STATE	PROJECT NUMBER	SHEET NO.	TOTAL SHEETS
GA.			



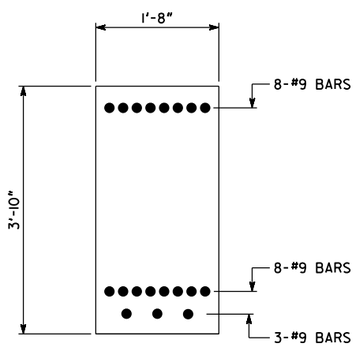
BRIDGE CROSS SECTION

BENT 4 SHOWN. OTHER BENTS SIMILAR.
LOOKING AHEAD

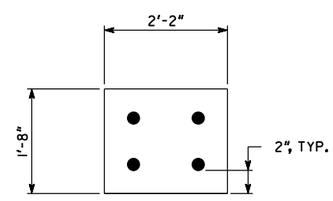


BRIDGE PARTIAL ELEVATION

SPAN 4 SHOWN. OTHER BENTS SIMILAR.



SECTION X-X



SECTION Y-Y

BRIDGE SERIAL NO. 089-0001-0

AECOM

GEORGIA
DEPARTMENT OF TRANSPORTATION
PRECONSTRUCTION DIVISION-OFFICE OF BRIDGE DESIGN

SUBSTRUCTURE DETAILS

PONCE DE LEON OVER LULLWATER CREEK

DEKALB COUNTY P.I. 0007032

SCALE: ¼" = 1'-0" SEPTEMBER 2013

DESIGNED KPE CHECKED GLE REVIEWED X
DRAWN KPE DESIGN GROUP X APPROVED X

REVISIONS	BY	DATE

DRAWING NO. 35-

BRIDGE SHEET 3 OF 3

Appendix E – Photos

Photo 1 South Elevation

Photo 2 Looking East

Photo 3 Sidewalk, grass buffer and concrete balustrade.

Photo 4 Looking West under Bridge

Photo 5 Looking South along typical bent

Photo 6 Looking at the underside of deck and bent arch

Photo 7 Fascia Arch

Photo 8 Typical Underside of Deck

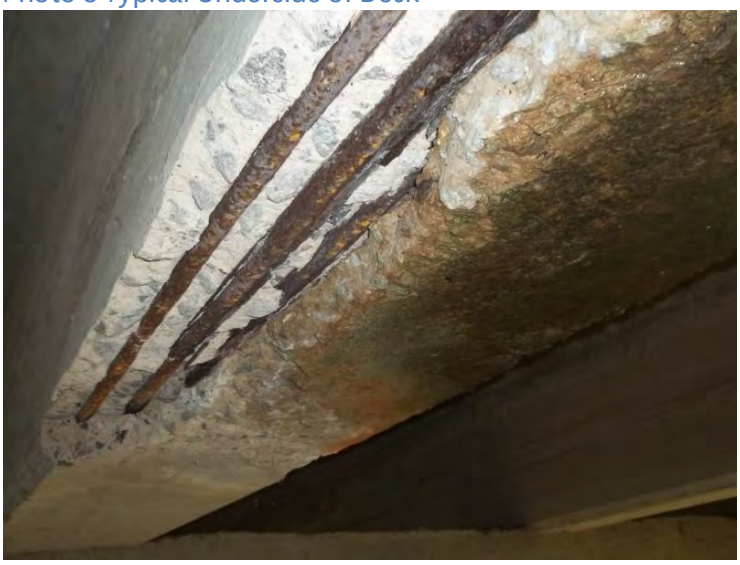


Photo 9 Typical Spalling on Beams

Photo 10 Exposed Beam Reinforcement

Photo 11 Deck Drain with Spalling on Beam with Exposed Rebar

Photo 12 Spalling on the Fascia Arch column with Exposed Rebar

Photo 13 Concrete Coring of a Column

Photo 14 Typical Column concrete Core

Photo 15 Coring the Deck

Photo 16 Typical Deck Core Hole

Photo 17 Typical Deck Drain

Photo 18 Horizontal crack in abutment wall

Appendix F – Materials Testing Results

METALS & MATERIALS ENGINEERS

August 15th 2013

Mr. Garrick L. Edwards, P.E.
Project Director, AECOM
1360 Peachtree Street NE, Suite 500
Atlanta, Georgia 30309

Subject: Proposal for Inspection and Testing Services for GDOT Task Order # 2
SR # 8 and Lullwater Creek (Structure ID: 089-0001-0)
DeKalb County, Georgia

Dear Mr. Edwards,

Metals & Materials Engineers (MME) appreciates the opportunity to work on the Ground Penetrating Radar (GPR) evaluation and coring & testing for the subject bridge. This draft report briefly describes the evaluation procedure and summarizes the results captured.

GPR Evaluation:

Selected beams were scanned vertically and horizontally to determine the configuration of reinforcement steel. Two (2) inner beams (Beams 4 and 5) and one (1) outer beam (Beam 2) were evaluated between Bent 6 and Bent 7 on the Northern half of the bridge. The position and depth of metal inclusions in the structure were marked on the surfaces.

The span chosen for the GPR inspection was between Bent 6 and Bent 7. Also, the beams were inspected on all available surfaces with the following GPR limitations:

- Several of the beams had an angled section of concrete at the interface with the deck. The geometry of these areas prohibited GPR inspection.
- The wavelength of the RADAR could not differentiate between individual reinforcing bars that were less than two inches apart.
- The wavelength of the RADAR required estimation of concrete cover that was less than two inches.
- The top of the interior beams had an angled section of concrete that was prohibited GPR inspection.

Results:

Five drawings are submitted that detail the information gleaned from the inspection. Those images are given in Figures 1 thru 5. The reinforcement pattern was found to be similar in all the structures examined.

Coring & Testing:

Two full depth concrete & asphalt cores were obtained from roadway section and two concrete cores were obtained from the columns to determine the thickness, compressive strength of concrete cores and bulk specific gravity of asphalt cores. Based on the condition of the cores four concrete cores were tested for the compressive strength and two asphalt cores were tested for bulk specific gravity. Tables 1 and 2 summarize the results and Figures 6 thru 9 shows the cross section of the roadway and bridge deck & columns.

Table 1: Compressive Strength Results of concrete cores

Core ID	Diameter (in)	Length (in)	Area (in^2)	L/D Ratio	Correction Factor	Load (lb)	Compressive Strength (psi)
Ponce #1 (Roadway)	3.50	4.75	9.62	1.36	0.94	36590	3810
Ponce #2 (Roadway)	3.49	6.02	9.56	1.72	0.98	29310	3070
Ponce #3 (Columns)	3.51	7.00	9.67	1.99	1.00	9800	1010
Ponce #4 (Columns)	3.51	6.98	9.67	1.99	1.00	18450	1910

Table 2: Bulk Density Results of asphalt cores

Core ID	Thickness (in)	Bulk Specific Gravity	Density (pcf)	Comments
Ponce #1 (Roadway)	1.5	2.1806	135.6	topping layer
Ponce #2 (Roadway)	1.5	2.2746	141.5	topping layer

Metals & Materials Engineers appreciates the opportunity to submit this report. Should you have any questions or comments, please feel free to contact us at your convenience.

The data collection and interpretation methodologies used in this investigation are standard practices applied in similar surveys. The correlation of geophysical responses with probable subsurface features is based on past results of similar investigations and it is possible that some variations could exist at this site. Due to the indirect nature of geophysical data, no guarantees can be made or are implied regarding identification of features, and the presence or absence of additional objects or targets beyond those identified.

Bentley Thompson Director GPR Services	Scott Lowrie, PE Principal Engineer	Vissu Dokka Project Manager

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Figure 1

Span 6, Beam 2 (North Face)

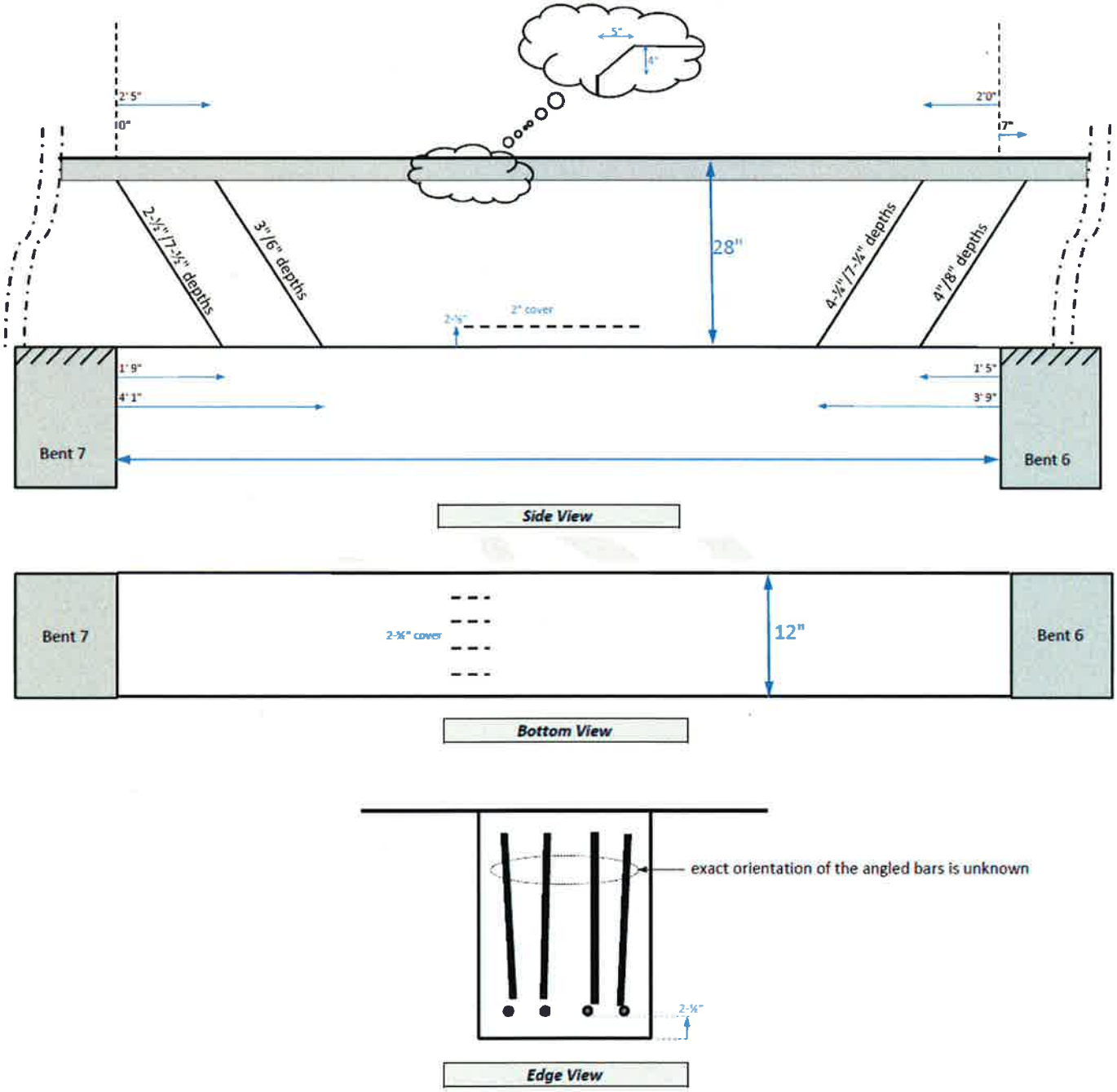

Figure 2

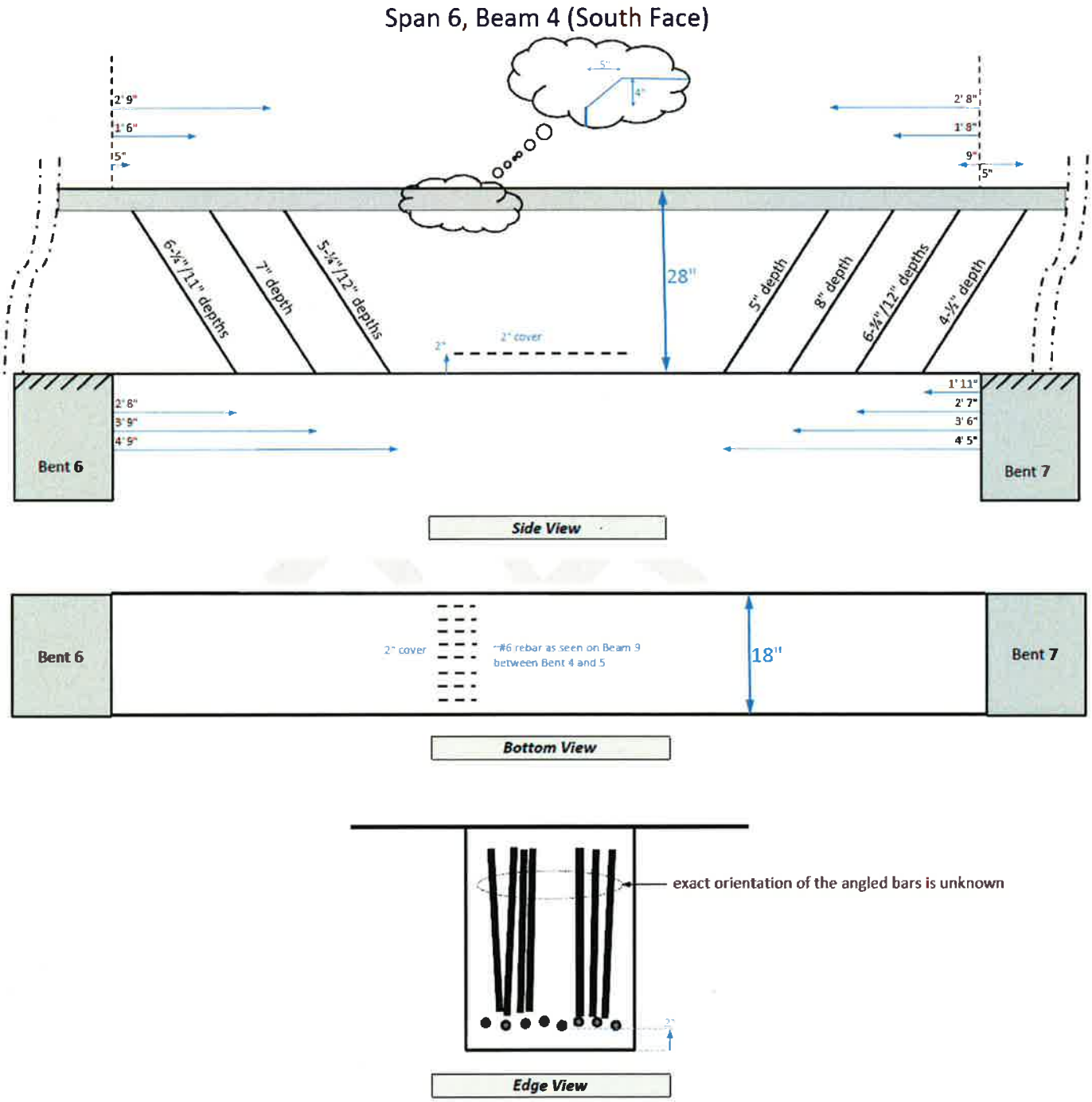
Span 6, Beam 4 (South Face)
5"
4"
2' 9"
1' 6"
5"
2' 8"
1' 8"
9"
5"
6-¼"/11" depths
7" depth
5-¼"/12" depths
28"
5" depth
8" depth
6-¾"/12" depths
4-½" depth
2"
2" cover
2' 8"
3' 9"
4' 9"
1' 11"
2' 7"
3' 6"
4' 5"
Bent 6
Bent 7
Side View
Bent 6
2" cover
#6 rebar as seen on Beam 9 between Bent 4 and 5
18"
Bent 7
Bottom View
exact orientation of the angled bars is unknown
2"
Edge View

Figure 3

Span 6, Beam 5 (North Face)

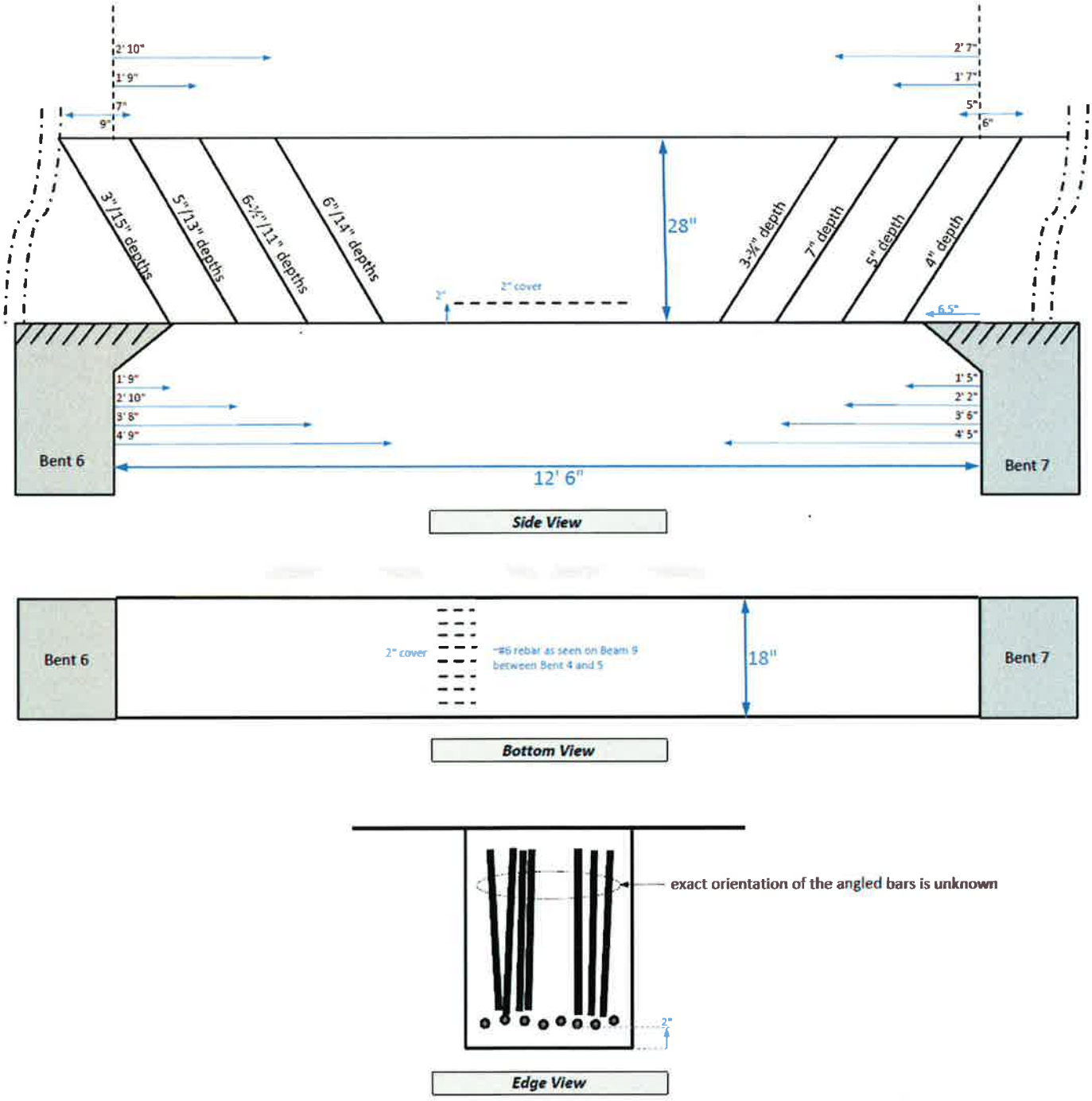

Figure 4 (Bent 6 at Beams 4-6)

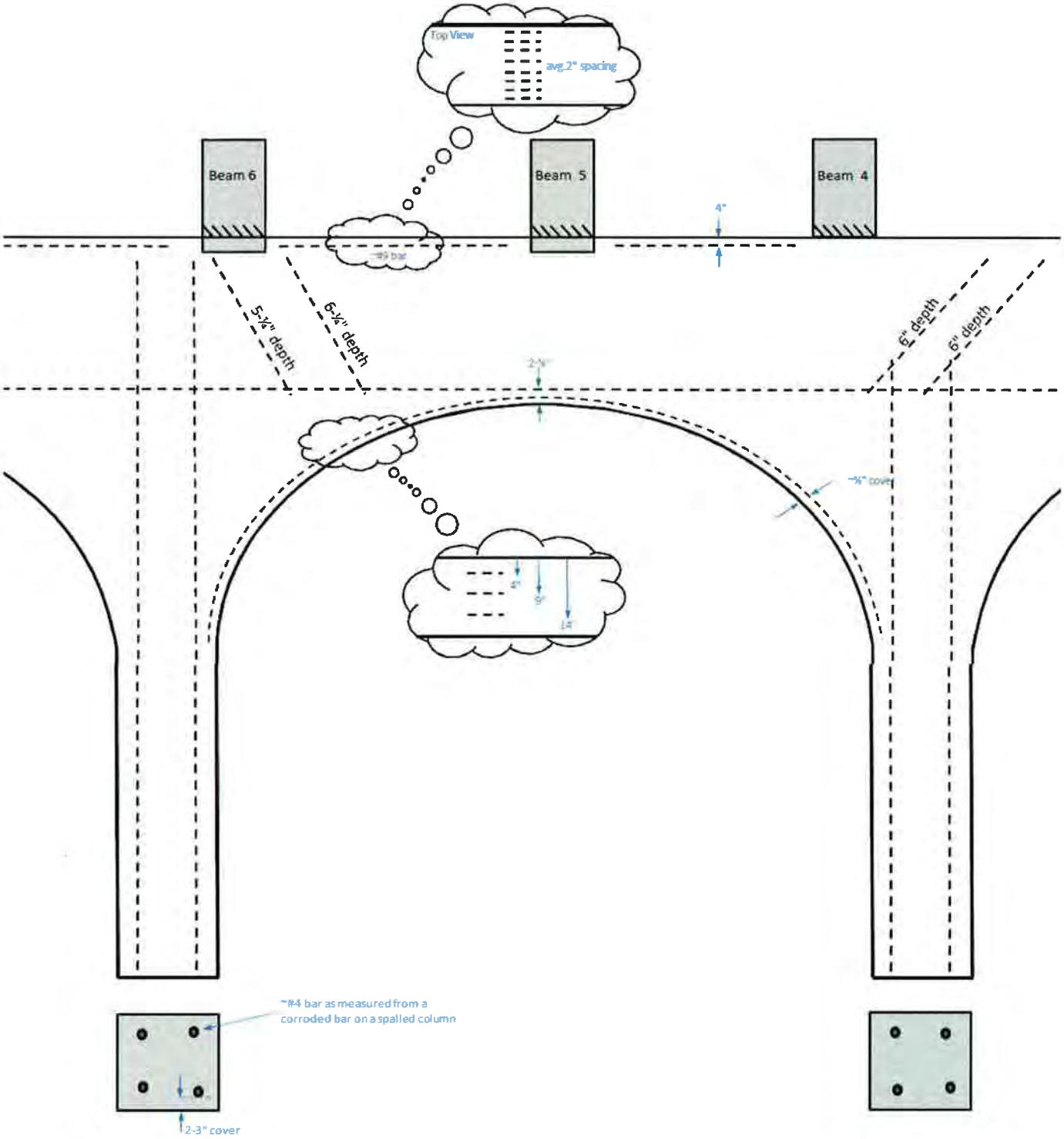

Figure 5 (Bent 6 at Beams 1-3)

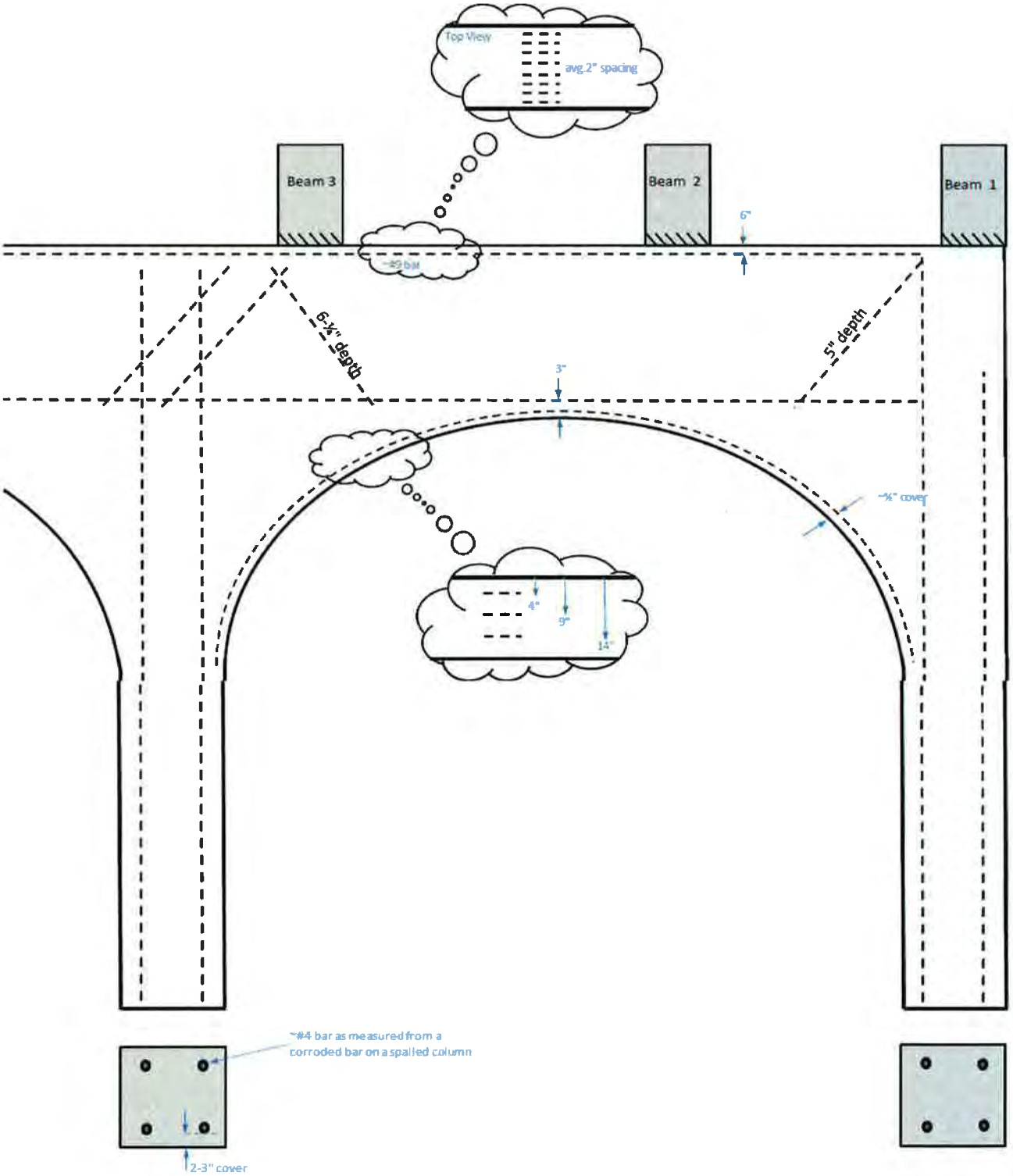

Figure 6

Figure 7

Cores from East bound South Lane of Ponce de Leon

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Figure 8

Cores from Bent 6 Column 4

Figure 9

Cores from Bent 2 Column 3

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ENGINEERING
DATA REPORT
NUMBER 48

EVALUATION OF REINFORCING BARS IN OLD REINFORCED CONCRETE STRUCTURES

A SERVICE OF THE CONCRETE REINFORCING STEEL INSTITUTE

INTRODUCTION

Most practicing structural engineers sooner or later face the task of evaluating old structures. This task is always an interesting challenge, because it is never a routine application of the current practice in design. Owners commonly require re-evaluation when planning a change in building usage, restoration, additional stories, or lateral additions in any combination. Frequently, the original contract documents, the "as-built" revisions, and so on, cannot be found.

The structural engineering challenge is two-fold. First, the material properties must be determined for the concrete. The concrete can and usually does gain 25 percent or more strength than it had at 28 days, but the concrete can also have deteriorated under fire or chemical exposures. The second challenge concerns the reinforcing bars — determining the yield strength, the bar sizes and their cross-sectional areas, the locations of the bars, effective depths of structural members, the bending and cut-off details of the bars, and development lengths (bond and anchorage).

Where documentation is lacking for the existing structure, the following abbreviated history of reinforcing bars may be a useful starting point.

Reference 1 is an excellent presentation on the history of reinforced concrete. Included in the article are illustrations of a variety of patented reinforcing bars, and an extensive list of references regarding codes, design and construction, and reports on landmark tests.

REINFORCING BARS — SPECIFICATIONS, BAR SIZES AND ALLOWABLE STRESSES

Specifications. Reinforcing bars, as we know them today, came about in 1900. Specifications were first developed by the Association of American Steel Manufacturers in 1910. The American Society for Testing and Materials (ASTM) adopted standard specification A15 for billet-steel concrete reinforcing bars in 1911. Reinforcing bars were plain and deformed in structural, intermediate and hard grades (minimum yield strengths), or deformed, cold-twisted. Structural grade (minimum f_y = 33,000 psi) was normally used, unless otherwise specified. The specified minimum yield strengths of structural, intermediate, and hard grades were 33,000, 40,000, and 50,000 psi, respectively. The minimum yield strength of cold twisted bars was specified at 55,000 psi.

ASTM also issued similar specifications for rail-steel (A16) and axle-steel (A160) reinforcing bars. The minimum yield strength for rail-steel bars was 50,000 psi, and for axle-steel bars the same as for billet steel bars.

Table 1 summarizes the ASTM specifications for reinforcing bars from 1911 to the present.

Bar Sizes. Table 2 shows the standard reinforcing bar sizes recommended by the Joint Committee on Standard Specifications for Concrete and Reinforced Concrete in its 1924 Report (Reference 2).

Allowable Stresses. Some early authorities stated that allowable stresses in tension in the reinforcement higher than 12,000 psi show "very little to be gained in economy" and recommended a maximum of 14,000 psi (Reference 3). Recommended allowable stresses in tension in the 1924 Joint Committee Report (Reference 2) were:

- 16,000 psi for structural grade and rail-steel bars
- 18,000 psi for intermediate and hard grade bars and twisted bars.

In its 1940 Report, the Joint Committee increased its recommended allowable stresses to:

Tension

- 18,000 psi for structural grade bars
- 20,000 psi for intermediate and hard grades or rail-steel bars
- 16,000 psi for all web reinforcement

Compression

- 16,000 psi for intermediate grade bars
- 20,000 psi for hard grade or rail-steel bars

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Table 1—Reinforcing Bars 1911 to Present; ASTM Specifications; Minimum Yield and Tensile Strengths in psi

ASTM Spec	Years		Steel Type	Grade 33 (Structural)		Grade 40 (Intermediate)		Grade 50 (Hard)		Grade 60		Grade 75	
	Start	End		Min. Yield	Min. Tensile	Min. Yield	Min. Tensile	Min. Yield	Min. Tensile	Min. Yield	Min. Tensile	Min. Yield	Min. Tensile
A15	1911	1966	Billet	33,000	55,000	40,000	70,000	50,000	80,000				
A408	1957	1966	Billet	33,000	55,000	40,000	70,000	50,000	80,000				
A432	1959	1966	Billet							60,000	90,000		
A431	1959	1966	Billet									75,000	100,000
A615	1968	1972	Billet			40,000	70,000			60,000	90,000	75,000	100,000
A615	1974	1986	Billet			40,000	70,000			60,000	90,000		
A615	1987	Present	Billet			40,000	70,000			60,000	90,000	75,000	100,000
A16	1913	1966	Rail					50,000	80,000				
A61	1963	1966	Rail							60,000	90,000		
A616	1968	1999	Rail					50,000	80,000	60,000	90,000		
A160	1936	1964	Axle	33,000	55,000	40,000	70,000	50,000	80,000				
A160	1965	1966	Axle	33,000	55,000	40,000	70,000	50,000	80,000	60,000	90,000		
A617	1968	1999	Axle			40,000	70,000			60,000	90,000		
A996	2000	Present	Rail, Axle			40,000	70,000	50,000	80,000	60,000	90,000		
A706	1974	Present	Low-Alloy							60,000	80,000		
A955M	1996	Present	Stainless			40,000	70,000			60,000	90,000	75,000	100,000

BOND AND ANCHORAGE

After establishing the yield strength of the reinforcing bars, the next important property required for evaluation of old structures concerns bond and anchorage. Steel mills in the USA completed conversion of their production to "high-bond" deformations about 1947, which continue virtually unchanged to the present day. In 1947, ASTM issued a specification, designated as A305, which prescribed requirements for deformations on reinforcing bars. The A305 specification existed from 1947 to 1968. In 1968, the requirements for deformations were merged into the specifications for reinforcing bars—A615 (billet-steel), A616 (rail-steel), and A617 (axle-steel).

For older structures, it is prudent to consider all varieties of reinforcing bars—plain round, old-style deformed, twisted square, and so on—conservatively and simply as 50 percent as effective in bond and anchorage as current bars. In other words, the tension development lengths, ℓ_d, for the old bars would be twice (double) the ℓ_d required for modern reinforcing bars. Since most strength design reviews for flexure will be based on a yield strength, f_y = 33,000 psi instead of today's 60,000 psi, the tension development lengths for the old bars can be determined by adding 10 percent to any current table of tension development lengths, ℓ_d, for modern reinforcing bars. The main deficiencies encountered in old structures will be in tension lap splice lengths provided for bars larger than #6, and typical details with top bars larger than #6 cut off at 0.25 times clear span.

Standard end hooks, 90° or usually 180°, on old-style bars in earlier codes were considered to develop half the allowable tension stress. Under today's strength design method, this value would approximate $\phi f_y/2 = (0.90)(33{,}000 \text{ psi})/2 \approx 15{,}000$ psi.

DETAILS OF REINFORCING BARS

Flexural Members. For structures built during the period 1900 to 1940, design standards and accompanying typical details of reinforcing bars evolved gradually, beginning with a bewildering variety of patented systems. Where design drawings or project specifications are not available, and no clue remains to the system used, caution is particularly prudent. Many of the older patented systems would be considered much less effective today—some were theoretically sound and went out of style because of high costs, but others were based upon theory not acceptable today. In two-way slabs, do ***not*** assume that there was only two-way reinforcement. Especially, if the topmost layer is disappointingly light, it may be part of a *four-way* system, with four layers instead of two. Look for diagonal bands of bars.

Where original design drawings are not available, typical details for reinforcing bars as shown in ACI Detailing Manuals (Reference 4) were commonly used since 1947. These typical details can be assumed and used for initial calculations if original service loads are known. In any case, these calculations should be confirmed or modified as soon as data on bar sizes, bar spacings, and effective depths of structural members can be checked in the field.

Particularly for flexural members, load tests are especially convincing when used to check calculated capacity based upon material tests and reconstituted

placing drawings. In particular, even non-destructive load tests can thus be used to validate calculated deflections before and after cracking. (Reference 5).

Columns. Non-destructive surface tests should be employed at numerous locations to evaluate the concrete. If it is necessary, column concrete cover can be removed to observe vertical bar sizes, splice details, ties or spirals, etc., and replaced with little or no impairment of the structural capacity. Load tests on columns are generally not feasible, and so evaluation of column strength must be analytical. Even cutting out sample test cores to determine concrete strength is not generally advisable, since vertical reinforcing bars may be damaged and replacing removed concrete is not likely to be effective.

Under present codes, the contribution of spiral reinforcement to column capacity is considerably less than under old codes. In a present day evaluation, therefore, spiral columns, especially square or rectangular, are more likely to limit the total capacity than tied columns.

Locating Reinforcing Bars. Instruments now available permit the user to locate and follow individual reinforcing bars inside concrete slabs or beams. Some give accurate indications for the depth of concrete cover and even relative size of bar. Again, it is desirable to calibrate such readings by exposing the bars at some non-critical locations. These readings are particularly valuable in re-constructing the design details—bend points, cut-off points, and bar spacings—at least for the outside layers of bars.

CONCRETE PROPERTIES

The present day concrete properties in place should be determined by tests. Even if original project specifications are available, the specified concrete compressive strength, f_c', is not a reliable value years later. Evaluation of present in-place concrete strength may be demonstrated by several more or less non-destructive methods. The ASTM standard test methods are:

(a) Test of cast-in-place cylinders, ASTM C873 (limited to use in slabs)

(b) Pulse velocity testing, ASTM C597

(c) Rebound number, ASTM C805

(d) Penetration resistance, ASTM C803

(e) Pullout strength, ASTM C900

It should be noted that all these methods require correlation with strength tests on drilled cores. The measurements of these various properties of concrete are ***related*** to compressive strength, tensile strength, or modulus of elasticity which can be converted to compressive strength of standard cylinders for design strength. Even instruments purporting to read "psi" or with "conversions provided" must be calibrated with the tests on cores from the actual concrete in question.

Table 2—Standard* Reinforcing Bar Sizes (1924)

Size, in.	Area, in.^{2}	
	Round	Square
	**	†
3/8	0.11	–
1/2	0.20	0.25
5/8	0.31	–
3/4	0.44	–
7/8	0.60	–
1	0.79	1.00
1-1/8	–	1.27
1-1/4	–	1.56

* Recommended by the Joint Committee on Standard Specifications for Concrete and Reinforced Concrete in its 1924 Report.

** Most suppliers offered a ¼-inch round bar, as well as the recommended standard sizes.

† The ¼-inch square bar was used, but to a lesser extent. Square bars were usually deformed, or if plain in structural grade, twisted to enhance bond and yield strength properties.

1. Round bars were plain or deformed.
2. A number of producers offered additional sizes, in 1/16-inch increments, prior to adoption of this reduced list of standard sizes.

SELECTED REFERENCES

1. "Reinforced Concrete at the Turn of the Century", by Robert E. Loov, *ACI Concrete International*, December 1991, pp. 67-73.

2. "Recommended Practice and Standard Specifications for Concrete and Reinforced Concrete" by Joint Committee on Standard Specifications for Concrete and Reinforced Concrete; the committee was composed of representatives of ACI, AIA, AREA, ASCE, ASTM and PCA. Reports were published in 1916, 1924 and 1940.

3. *Principles of Reinforced Concrete Construction*, by F. E. Turneaure and E. R. Maurer, John Wiley & Sons, New York, 1908.

4. ACI Detailing Manual for Buildings, 1947, ACI Committee 315, and Detailing Manual, 1957, 1965, 1974, 1980 . . .

5. "Full-Scale Load Testing of Structures", STP-702, ASTM, 1980 (Symposium Collection).

OTHER RESOURCES

ACI Building Codes, 1928, 1936, 1941, 1947, 1951, 1956, 1963, 1971, 1977 . . .

"Strength Evaluation of Existing Structures", Chapter 20, ACI 318-77, ACI 318-83, ACI 318-89 . . .

"Application of ACI 318 Load Test Requirements", by R. C. Elstner, D. P. Gustafson, J. M. Hanson and P. F. Rice, CRSI *Professional Members' Bulletin*, No. 16, 1987, CRSI, 11 pp.

"Strength Evaluation of Existing Concrete Buildings (ACI 437R-91)", by ACI Committee 437, 24 pp.

This report No. 48 replaces EDR No. 11.

SOFT METRIC REINFORCING BARS

While the focus of this report is on the past, it is important for readers of this document to be aware of current industry practice regarding soft metric reinforcing bars. The term "soft metric" is used in the context of bar sizes and bar size designations. "Soft metric conversion" means describing the nominal dimensions of inch-pound reinforcing bars in terms of metric units, but not physically changing the bar sizes. In 1997, producers of reinforcing bars (the steel mills) began to phase in the production of soft metric bars. Within a few years, the shift to exclusive production of soft metric reinforcing bars was essentially achieved. Virtually all reinforcing bars currently produced in the USA are soft metric. The steel mills' initiative of soft metric conversion enables the industry to furnish the same reinforcing bars to inch-pound construction projects as well as to metric construction projects, and eliminates the need for the steel mills and fabricators to maintain a dual inventory. Thus, USA-produced reinforcing bars furnished to any construction project most likely will be soft metric.

Designations of Bar Sizes. The sizes of soft metric reinforcing bars are physically the same as the corresponding sizes of inch-pound bars. Soft metric bar sizes, which are designated #10, #13, #16, and so on, correspond to inch-pound bar sizes #3, #4, #5, and so on. The metric bar designations are simply a re-labeling of the inch-pound bar designations. The following table shows the one-to-one correspondence of the soft metric bar sizes to the inch-pound bar sizes.

Soft Metric Bar Sizes vs. Inch-Pound Bar Sizes

Soft Metric Bar Size Designation	Inch-Pound Bar Size Designation
#10	#3
#13	#4
#16	#5
#19	#6
#22	#7
#25	#8
#29	#9
#32	#10
#36	#11
#43	#14
#57	#18

Minimum Yield Strengths or Grades. Virtually all steel mills in the USA are currently producing reinforcing bars to meet the metric requirements for tensile properties in the ASTM specifications. Minimum yield strengths in metric units are 300, 350, 420 and 520 MPa (megapascals), which are equivalent to 40,000, 50,000, 60,000 and 75,000 psi, respectively. Metric Grade 420 is the counterpart of standard Grade 60.

Bar Marking. Soft metric reinforcing bars are required to be identified with the Producer's mill designation, bar size, type of steel, and minimum yield strength or grade. For example, consider the marking requirements for a #25, Grade 420 metric bar, which is the counterpart of an inch-pound #8, Grade 60 bar. Regarding the bar size and grade, the ASTM specifications require the number "25" to be rolled onto the surface of the metric bar to indicate its size. For identifying or designating the yield strength or grade, the ASTM specifications provide an option. A mill can choose to roll a "4" (the first digit in the grade number) onto the bar, or roll an additional longitudinal rib or grade line to indicate Grade 420.

The 27th Edition of the CRSI *Manual of Standard Practice* was published in March 2001. Chapter 1 in the Manual includes a detailed presentation of the inch-pound and metric requirements in the ASTM specifications for reinforcing bars. Appendix A in the Manual shows the bar marks used by USA producers to identify Grade 420 soft metric bars.

More information about soft metric reinforcing bars is also provided in Engineering Data Report No. 42, "Using Soft Metric Reinforcing Bars in Non-Metric Construction Projects". EDR No. 42 can be found on CRSI's Website at **www.crsi.org**.

Readers of this report are also encouraged to visit the CRSI Website for:

- Descriptions of CRSI publications and software, and ordering information
- Institute documents available for downloading
- Technical information on epoxy-coated reinforcing bars
- Technical information on continuously reinforced concrete pavement
- Membership in CRSI and member web links
- General information on the CRSI Foundation
- Information on the CRSI Design Awards competition

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Appendix G – GDOT Comments and Responses

AECOM Responses

- Denotes AECOM response

1. For both reports: Include any repair recommendations found during the investigation.
    - Repair recommendations included at the end of 4.0 Conclusions and Recommendations
2. Section 3.0 Load Rating Reports:
    - Step 5: change it from 8 to 6. We check 8 vehicles but 2 of them were rated in step 4.
        - Step 3 shows H and HS ratings. Step 4 shows the 6 GDOT Rating vehicles.
3. Appendix C – Load Rating Calculations
    - Explain the methodology of using a BAR7 run for a simple span bridge, to check capacities, and then again for use BAR7 for continuous girder, to develop loads and then using hand calculations to develop the actually ratings.
        - We removed the simple span BAR7 capacity checks and we'll rely on our MathCAD capacity calculations.
        - BAR7 was run as a continuous girder to obtain the 8 standard live load vehicle loads.
        - Ratings were performed by combining MathCAD capacities and BAR7 dead and live load results.
4. In conclusion section can they provide a summary table of the Inventory and Operating rating factors and tons for each of the three beams and then an overall summary
    - Inventory and Operating rating factor and tonnage added to Appendix C. Overall summary of controlling girder inserted into 4.0 Conclusions and Recommendations.

GDOT Comments from October 09, 2013

From: Bennett, Clayton [mailto:clbennett@dot.ga.gov]
Sent: Thursday, October 10, 2013 1:28 PM
To: Edwards, Garrick
Subject: FW: Peachtree Road and Ponce de Leon Bridges

Garrick,

Please see the comments below.

Clayton

From: Schwartz, Kevin
Sent: Wednesday, October 09, 2013 3:58 PM
To: Bennett, Clayton
Subject: RE: Peachtree Road and Ponce de Leon Bridges

Clayton,

I have the following comments.
For both reports: Include any repair recommendations found during the investigation.
Peachtree Road report:

- Section 3.0 Load Rating Reports:
    - Step 5: change it from 8 to 6. We check 8 vehicles but 2 of them were rated in step 4.
- Appendix C – Load Rating Calculations
    - Explain the methodology of using a BAR7 run for a simple span bridge, to check capacities, and then again for use BAR7 for continuous girder, to develop loads and then using hand calculations to develop the actually ratings.
- Page 2 of the plan sheet shows an 18" sewer line but on second page of section 1.0 – Background information it shows 18" water line.
- In conclusion section can they provide a summary table of the Inventory and Operating rating factors and tons for each of the three beams and then an overall summary

Ponce de Leon report:

- Section 3.0 Load Rating Reports:
    - Step 5: change it from 8 to 6. We check 8 vehicles but 2 of them were rated in step 4.
- Appendix C – Load Rating Calculations
    - Explain the methodology of using a BAR7 run for a simple span bridge, to check capacities, and then again for use BAR7 for continuous girder, to develop loads and then using hand calculations to develop the actually ratings.
- In conclusion section can they provide a summary table of the Inventory and Operating rating factors and tons for each of the three beams and then an overall summary

Kevin