

BRIDGE REHABILITATION LOAD RATING

BRIDGE NO. CUY-10-1613 SFN 1801503

CUYAHOGA COUNTY
DISTRICT # 12



July 21, 2016

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Specifications & References

Ohio Department of Transportation 2004 "Bridge Design Manual", Section 900 Bridge Load Rating, July 2015 Update

American Association of State Highway and Transportation Officials (AASHTO), "Standard Specifications for Highway Bridges, 17th Edition", 2002

TranSystems, CUY-10-1613 "Load Rating Report", February 2012

Federal Highway Administration, "Load Rating Guidance and Examples for Bolted and Riveted Gusset Plates in Truss Bridges", February 2009

Note: The Concrete Deck for East Abutment and Approach, Exterior Floorbeam at Panel Point 43, and Rivet Connections at L132 and U1133 for Truss B Member L132-U133 are structural components found to be insufficient in 2012 Load Rating Report by TranSystems. This report shows the load rating of the rehabilitation design for these components and the bridge's new governing rating.



BRIDGE LOAD RATING SUMMARY REPORT

OFFICE OF STRUCTURAL ENGINEERING

OHIO DEPARTMENT OF TRANSPORTATION

SFN		BRIDGE NUMBER		DISTRICT	
1801503		CUY-10-1613		12	
ORIGINAL CONSTRUCTION YEAR	REHABILITATION YEAR	OVERALL STRUCTURE LENGTH	FEATURE INTERSECTION		
1932	1980, 1999	3285 ft	Cuyahoga River, W 3rd St, Scranton Rd, W 17th St		
SPECIAL ASSUMPTIONS & COMMENTS	The Concrete Deck for East Abutment and Approach, Exterior Floorbeam at Panel Point 43, and Rivet Connections at L132 and U1133 for Truss B Member L132-U133 are structural components found to be insufficient in 2012 Load Rating Report by TranSystems. The load rating analysis of the rehabbed components used loads developed by TranSystems for 2012 Load Rating. This BR-100 shows the new governing rating of both load ratings (TranSystems 2012 & Richland Engineering Limited 2016).				

PLEASE SELECT ON RIGHT, WHERE APPROPRIATE, BY USING THE DROP DOWN ARROW BUTTON	
LOAD RATING PURPOSE:	2 - Rehabilitation
LOAD RATING SOFTWARE:	8 - Combination
RATING SOURCE:	1 - Plan information available for load rating analysis (Default)
RATING METHOD:	2 - Load Factor Rating (LFR)
ORIGINAL DESIGN LOADING:	4 - H20

STRUCTURE RATING SUMMARY

OHIO LEGAL				SPECIALIZED HAULING VEHICLES (SHV)			
Loading Type	GVW (Tons)	Rating Factor - RF		Legal Weight (Tons)	Loading Type	GVW (Tons)	Rating Factor-RF
		Inv.	Oper.				Oper.
HS20 Loading	36	1.080	1.400	36.00	NOTIONAL RATING LOAD	40	N/A
Ohio - 2F1	15		1.820	15.00	SU4	27	N/A
Ohio - 3F1	23		1.460	23.00	SU5	31	N/A
Ohio - 4F1	27		1.380	27.00	SU6	34.75	N/A
Ohio - 5C1	40		1.530	40.00	SU7	38.75	N/A

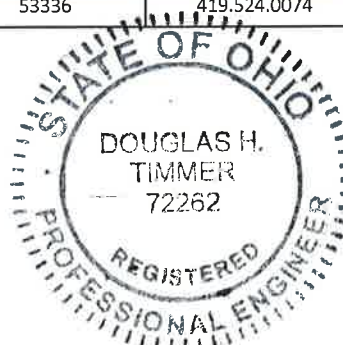
Overall Posting Rating	Sign Posting Recommendation:
140%	
BRIDGE POSTING REQUIRED BY RATING	
No load posting is recommended	

AGENCY/FIRM	Richland Engineering Limited		REPORT DATE:	7/21/2016
RATED BY	PE #	PHONE NUMBER	EMAIL	
Douglas H. Timmer	72262	419.524.0074	dougthimmer@r-e-l.com	
REVIEWED BY	PE #	PHONE NUMBER	EMAIL	
Barry L. Neumann	53336	419.524.0074	bneumann@r-e-l.com	

SFN: 1801503

BRIDGE NUMBER: CUY-10-1613

BR-100_SMS (02/2016)



Douglas H. Timmer

CUY - 10 - 1613

SFN 1801503

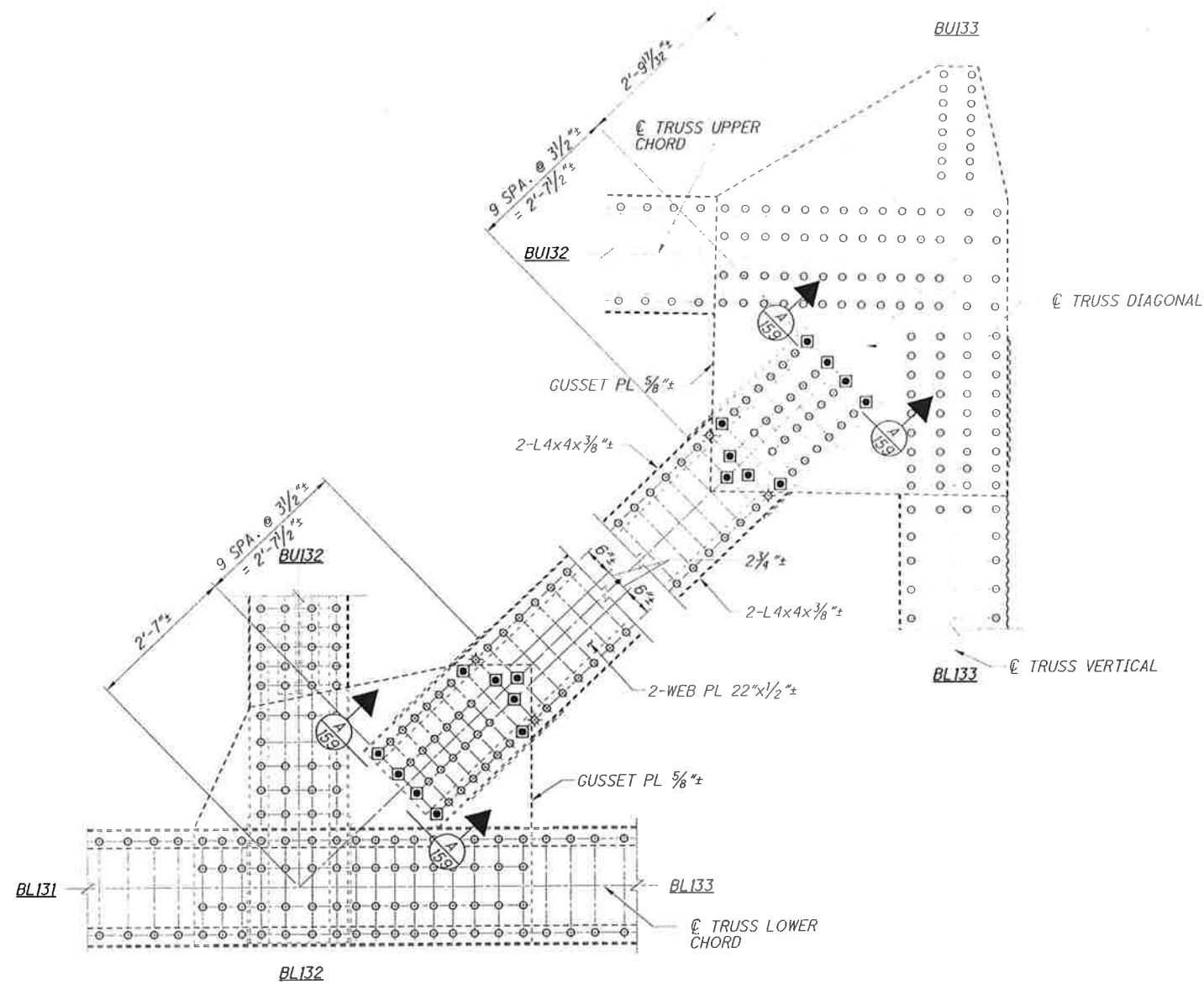
LOAD RATING SUMMARY TABLE

	HS INV	HS OPP	2F1 OPP	3F1 OPP	4F1 OPP	5C1 OPP
EAST ABUT AND APPROACH DECK	1.231	2.055	3.288	3.868	4.697	3.868
TRUSS B L132-U133 CONNECTION	1.127	1.882	4.298	2.862	2.495	2.073
PANEL POINT 43 FLOORBEAM BRACE	1.954	3.261	6.725	4.472	3.913	4.579
CONTROLLING VALUE	1.127	1.882	3.288	2.862	2.495	2.073
OPERATING TONS			15	23	27	40

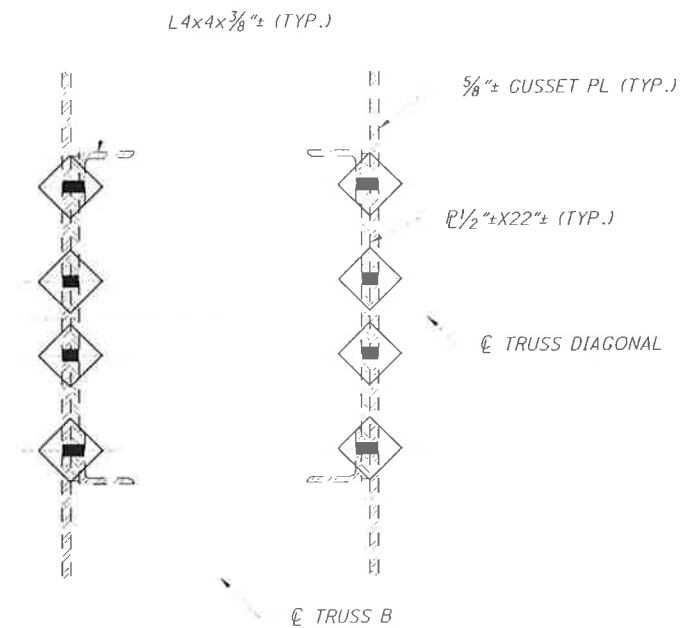


SECTION X-X AND Y-Y: FOR LOCATIONS, SEE SHEET 208233.





SPAN 20, TRUSS B, PANEL BL132 - BUI33 - SOUTH ELEVATION
(LOOKING NORTH)



SECTION A-A

NOTES

MATERIALS SHOWN ARE EXISTING UNLESS OTHERWISE NOTED.

CONNECTION BOLTS SHALL BE ASTM A325, TYPE 1.

EXISTING RIVETS ARE 1"± DIAMETER.

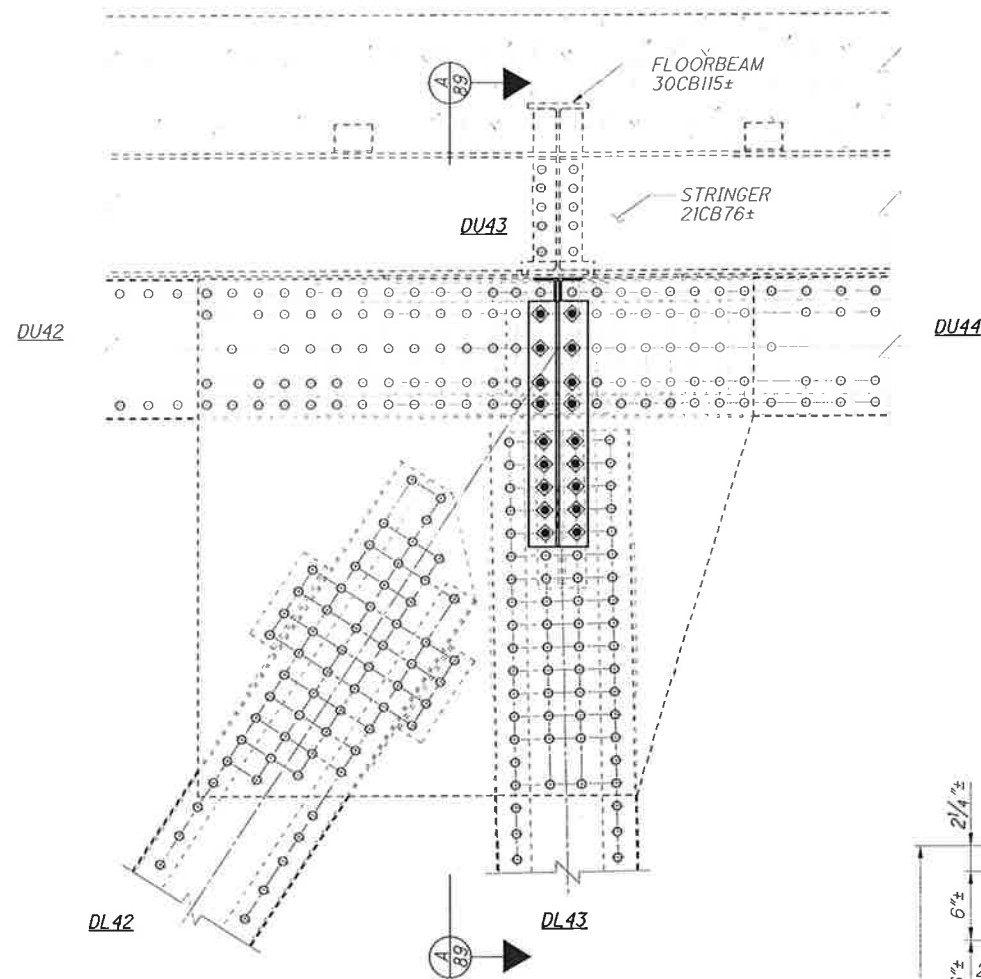
BOLT LEGEND: SEE SHEET 14/23.

RIVET REPLACEMENT SEQUENCE: REPLACE ONE RIVET WITH NEW BOLT AT A TIME IN EACH GUSSET PLATE.

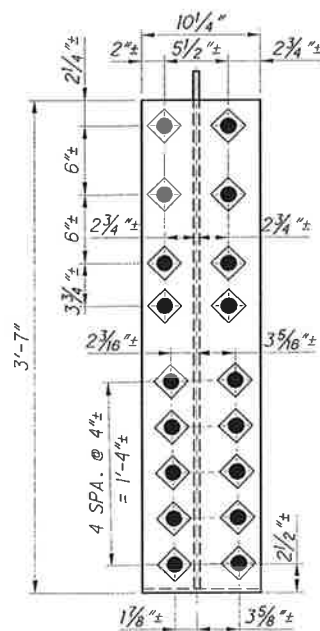
 RICHLAND ENGINEERING LIMITED 29 NORTH PARK STREET MANSFIELD, OHIO 44902	TRUSS DIAGONAL - REPAIR DETAIL - 1				CUY-10-16.13 PID No. 96986
	BRIDGE NO. CUY-10-1613				
	S.R. 10 OVER THE CUYAHOGA RIVER				
DAP	JLS	DLR	7/14/16	1801503	
KAK					

159/233

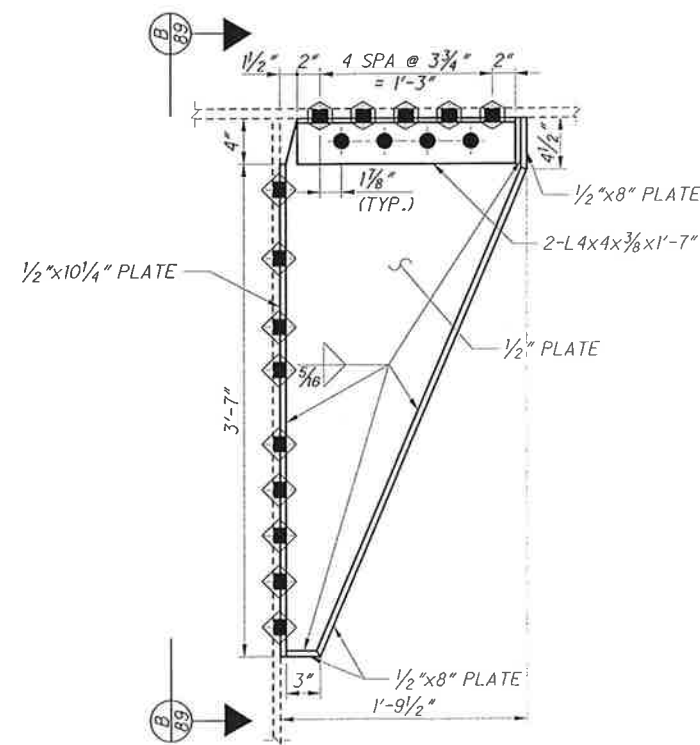
217
301



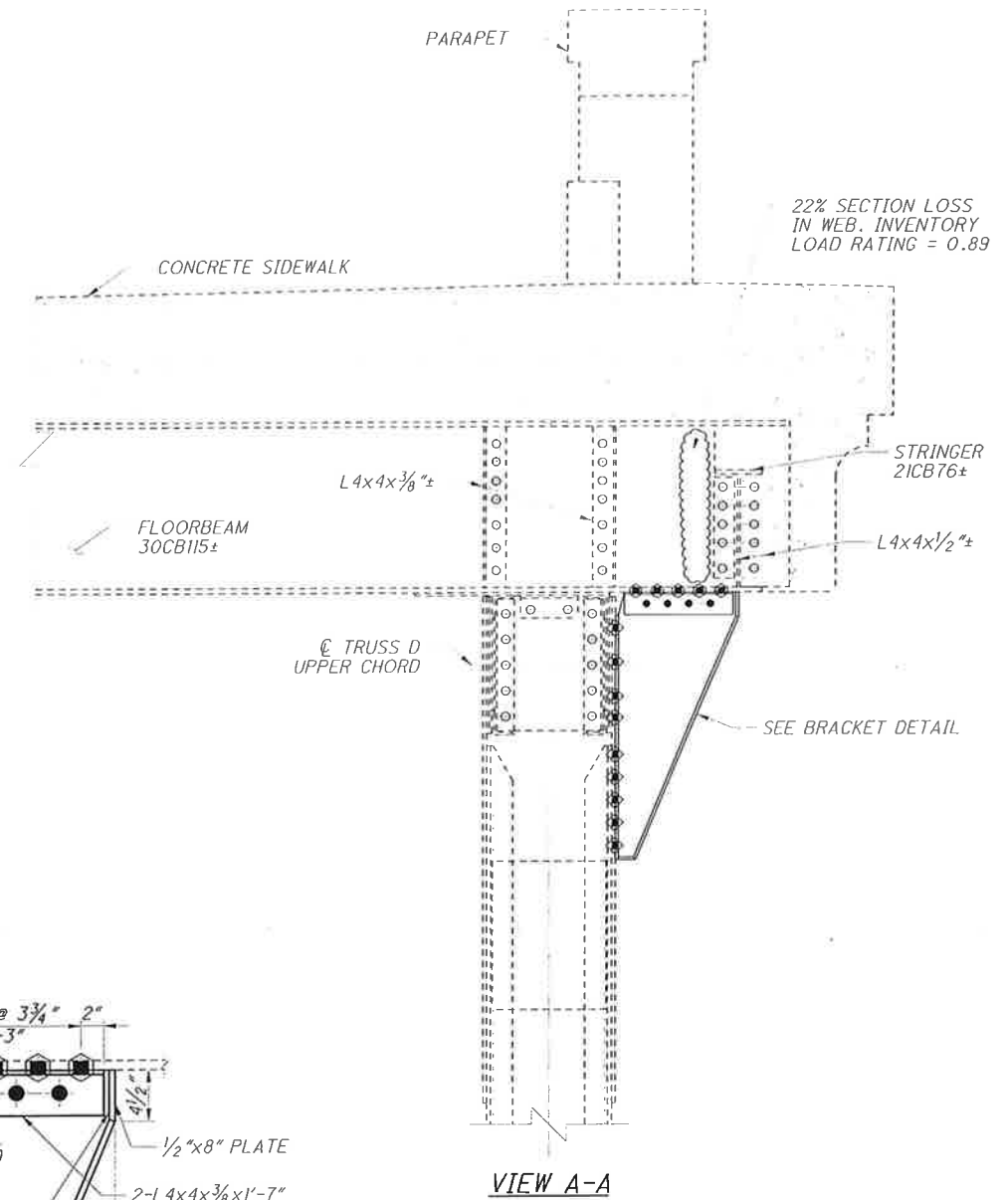
ELEVATION
(CONNECTION TO TRUSS SHOWN)



VIEW B-B



BRACKET DETAIL



NOTES

MATERIALS SHOWN ARE EXISTING UNLESS OTHERWISE NOTED

NEW BOLTS REPLACING EXISTING RIVETS SHALL MATCH THE EXISTING SIZE OF THE CONNECTOR. THE DIAMETER IS ESTIMATED TO BE 1". NEW BOLTS IN DRILLED HOLES WILL BE 1" DIAMETER. BOLTS SHALL BE ASTM A325.

BOLT LEGEND SEE SHEET 14/233

FOR REPAIR LOCATION: SEE SHEET 81/233

CUY - 10 - 1613

SFN 1801503

EAST ABUTMENT AND APPROACH CONCRETE DECK ANALYSIS - EXTERIOR SPAN

DATA:

STRINGER SPACING =	22.875 ft	STEEL STRINGERS:	
FLANGE WIDTH =	1.67 ft	Seff = S - 0.5' =	22.375 ft
MIN FLANGE THK =	0.333 ft	Fig width/thickness =	5,00050005 AASHTO 3.24.1.2
FULL SLAB THICKNESS =	16.00 in.	Seff = S - FW/2	22.04 ft
WEARING SURFACE THK. (Asphalt) =	0.00 in	CONTROLLING Seff.	22.0416667 ft
f _c (CLASS C) =	4500 psi		0.85
f _y =	60000 psi	B1 =	0.85
COFF. =	0.9		
DECK WIDTH =	12 in.		
TOP CLEAR COVER =	2.5 in. (including monolithic wearing surface)		
REBAR DIAMETER:	REBAR SPACING:		
top diameter =	0.75 5 inches	d _{top} = T-clear cover-dia.topdist.-dia.topbar/2 =	12.625 in.
top dist. dia. =	0.5	d _{bot.} = T-1.5-dia.bot.bar/2 =	14.125 in.
bottom diameter =	0.75 5 inches		
bottom dist. dia. =	0.625		

DEAD LOAD:

SLAB =	0.200 k/ft
RAILING AND SIDEWALK =	0.173 k/ft
WEARING SURF. =	0 k/ft
DL total =	0.373 k/ft

SLAB MOMENTS:

		Mu = 1.3[DL]	INVENTORY Mu = 1.3[1.67(LL)]	OPERATING Mu = 1.3[1.0(LL)]
DLM = 0.125*W*S ² *0.8 =	18.10 ft-k	23.53 ft-k	-	-
(HS20) LLM = (S+2)*16*1.3*0.8/32 =	12.50 ft-k	23.53 ft-k	27.14 ft-k	16.25 ft-k
(2F1) LLM = (S+2)*10*1.3*0.8/32 =	7.81 ft-k	23.53 ft-k	-	10.16 ft-k
(3F1/5C1) LLM = (S+2)*8.5*1.3*0.8/32 =	6.64 ft-k	23.53 ft-k	-	8.63 ft-k
(4F1) LLM = (S+2)*7*1.3*0.8/32 =	5.47 ft-k	23.53 ft-k	-	7.11 ft-k

TOP REINFORCEMENT RESISTING MOMENT [Mr (k-ft)]

#6 @ 5"
1.060 in²/ft

56.93 k-ft

BOTTOM REINFORCEMENT RESISTING MOMENT [Mr (k-ft)]

Bottom slab reinforcing = #6 @ 5"
 As slab (top) = 1.060 in²/ft
 Mr = .9Mn = **64.09 k-ft**

DECK RATINGS	
HS20 (INV)	1.231
HS20 (OPP)	2.055
OHIO LEGAL 2F1 (OPP)	3.288
OHIO LEGAL 3F1 (OPP)	3.868
OHIO LEGAL 4F1 (OPP)	4.697
OHIO LEGAL 5C1 (OPP)	3.868



RICHLAND ENGINEERING LIMITED

CALCULATION SHEET

JOB NO. 114059-1 SHEET NO. 8 OF 15
 SUBJECT CUY - 10 - 1613
 CALCULATED BY dht DATE 7/11/16
 CHECKED BY bln DATE 7/19/16

CUY - 10 - 1613

SFN 1801503

EAST ABUTMENT AND APPROACH CONCRETE DECK ANALYSIS - INTERIOR SPAN

DATA:

STRINGER SPACING = 16.750 ft.
 FLANGE WIDTH = 1.50 ft.
 MIN FLANGE THK = 0.333 ft.
 FULL SLAB THICKNESS = 16.00 in.
 WEARING SURFACE THK. (Asphalt) = 0.00 in.

STEEL STRINGERS:
 Seff = S - 0.5' = 16.25 ft.
 Flg width/thickness = 4.500/45005
 Seff = S - FW/2 = 16.00 ft.
CONTROLLING Seff. = 16 ft.

AASHTO 3.24.1.2

f_c (CLASS C) = 4500 psi
 f_y = 60000 psi
 COFF. = 0.9
 DECK WIDTH = 12 in.
 TOP CLEAR COVER = 2.5 in. (including monolithic wearing surface)

REBAR DIAMETER:
 top diameter = 0.75
 top dist. dia. = 0.5
 bottom diameter = 0.75
 bottom dist. dia. = 0.625

REBAR SPACING:
 5 inches
 5 inches

d_{top} = T-clear cover-dia. top dist.-dia. top bar/2 = 12.625 in.
 d_{bot} = T-1,5-dia. bot. bar/2 = 14.125 in.

DEAD LOAD:

SLAB = 0.200 k/ft
 RAILING AND SIDEWALK = 0.000 k/ft
 WEARING SURF. = 0 k/ft
DL total = 0.200 k/ft

SLAB MOMENTS:

		Mu = 1.3[DL] ft-k	INVENTORY Mu = 1.3[1.67(LL)] ft-k	OPERATING Mu = 1.3[1.0(LL)] ft-k
DLM = 0.125*W*S ² *1.0 =	6.40 ft-k	8.32 ft-k	-	-
(HS20) LLM = (S+2)*16*1.3*1.0/32 =	11.70 ft-k	8.32 ft-k	25.40 ft-k	15.21 ft-k
(2F1) LLM = (S+2)*10*1.3*1.0/32 =	7.31 ft-k	8.32 ft-k	-	9.51 ft-k
(3F1/5C1) LLM = (S+2)*8.5*1.3*1.0/32 =	6.22 ft-k	8.32 ft-k	-	8.08 ft-k
(4F1) LLM = (S+2)*7*1.3*1.0/32 =	5.12 ft-k	8.32 ft-k	-	6.65 ft-k

TOP REINFORCEMENT RESISTING MOMENT [Mr (k-ft)]

#6 @ 5"
 1.060 in²/ft

56.93 k-ft

BOTTOM REINFORCEMENT RESISTING MOMENT [Mr (k-ft)]

Bottom slab reinforcing = #6 @ 5"
 As slab (top) = 1.060 in²/ft
 Mr = .9Mn = **64.09 k-ft**

DECK RATINGS	
HS20 (INV)	1.914
HS20 (OPP)	3.196
OHIO LEGAL 2F1 (OPP)	5.114
OHIO LEGAL 3F1 (OPP)	6.016
OHIO LEGAL 4F1 (OPP)	7.305
OHIO LEGAL 5C1 (OPP)	6.016

CUY - 10 - 1613

SFN 1801503

TRUSS B L132-U133 CONNECTION ANALYSIS
Loads (from TranSystems 2012 Load Rating)

DL = 537.71 kips
HS 20 LL+I = 193.92 kips
2F1 LL+I = 84.89 kips
3F1 LL+I = 127.48 kips
4F1 LL+I = 146.24 kips
5C1 LL+I = 176.03 kips

Capacity:

Diameter of Rivets or Bolts = 1.000 inches
Number of Rivets = 48
Number of Bolts = 18

Rivet Strength = 18.0 ksi (pg 11 FHWA Load Rating Guidance for Bolted and Riveted Gusset Plates in Truss Bridges)
Bolt Strength = 35.0 ksi (AASHTO Table 10.56A)

Connection Capacity = 1173.4 kips

Inventory Rating = (Capacity - 1.3DL) / (2.17LL+I)

Operating Rating = (Capacity - 1.3DL) / (1.3LL+I)

	Inventory Rating	Operating Rating				
	HS 20	HS 20	2F1	3F1	4F1	5C1
Truss B L132-U133 Connection Rating	1.127	1.882	4.298	2.862	2.495	2.073

Truss Member Loads with Proposed Sidewalk from TranSystems 2012 Load Rating

Assumption: Pick maximum load values for each member from the truss analysis output at the considered truss joint and assume these loads are acting simultaneously.

Dead Load					2F1					3F1					4F1					5C1					(HS20-44)				
Member	Comp./Tens. (kips)	Member	Comp. (kips)	Tens. (kips)	Member	Comp. (kips)	Tens. (kips)	Member	Comp. (kips)	Tens. (kips)	Member	Comp. (kips)	Tens. (kips)	Member	Comp. (kips)	Tens. (kips)	Member	Comp. (kips)	Tens. (kips)	Member	Comp. (kips)	Tens. (kips)	Member	Comp. (kips)	Tens. (kips)				
211301	-549.46	211301	-95.74	0.21	211301	-144.80	0.18	211301	-167.48	0.14	211301	-198.94	0.18	211301	-214.02	0.33	211301	-214.02	0.33	211301	-214.02	0.33	211301	-214.02	0.33				
211302	None	211302	None	None	211302	None	None	211302	None	None	211302	None	None	211302	None	None	211302	None	None	211302	None	None	211302	None	None				
211303	-121.65	211303	-58.11	0.01	211303	-85.62	0.01	211303	-94.89	0.01	211303	-94.89	0.01	211303	-94.89	0.01	211303	-94.89	0.01	211303	-94.89	0.01	211303	-94.89	0.01				
211304	None	211304	None	None	211304	None	None	211304	None	None	211304	None	None	211304	None	None	211304	None	None	211304	None	None	211304	None	None				
211305	-549.48	211305	-95.69	0.20	211305	-144.72	0.17	211305	-167.39	0.13	211305	-167.39	0.13	211305	-167.39	0.13	211305	-167.39	0.13	211305	-167.39	0.13	211305	-167.39	0.13				
211311	-549.48	211311	-95.69	0.20	211311	-144.72	0.17	211311	-167.39	0.13	211311	-167.39	0.13	211311	-167.39	0.13	211311	-167.39	0.13	211311	-167.39	0.13	211311	-167.39	0.13				
211312	-8.32	211312	-33.16	42.82	211312	-49.00	63.51	211312	-54.96	72.11	211312	-54.96	72.11	211312	-54.96	72.11	211312	-54.96	72.11	211312	-54.96	72.11	211312	-54.96	72.11				
211313	-153.43	211313	-43.85	11.29	211313	-65.60	15.85	211313	-74.92	16.50	211313	-74.92	16.50	211313	-74.92	16.50	211313	-74.92	16.50	211313	-74.92	16.50	211313	-74.92	16.50				
211314	None	211314	None	None	211314	None	None	211314	None	None	211314	None	None	211314	None	None	211314	None	None	211314	None	None	211314	None	None				
211315	-554.88	211315	-91.11	0.14	211315	-136.93	0.12	211315	-158.75	0.09	211315	-158.75	0.09	211315	-158.75	0.09	211315	-158.75	0.09	211315	-158.75	0.09	211315	-158.75	0.09				
211321	-554.88	211321	-91.11	0.14	211321	-136.93	0.12	211321	-158.75	0.09	211321	-158.75	0.09	211321	-158.75	0.09	211321	-158.75	0.09	211321	-158.75	0.09	211321	-158.75	0.09				
211322	236.32	211322	-16.12	62.70	211322	-22.63	93.78	211322	-23.55	107.10	211322	-23.55	107.10	211322	-23.55	107.10	211322	-23.55	107.10	211322	-23.55	107.10	211322	-23.55	107.10				
211323	-359.32	211323	-58.74	0.07	211323	-88.21	0.06	211323	-101.20	0.05	211323	-101.20	0.05	211323	-101.20	0.05	211323	-101.20	0.05	211323	-101.20	0.05	211323	-101.20	0.05				
211324	None	211324	None	None	211324	None	None	211324	None	None	211324	None	None	211324	None	None	211324	None	None	211324	None	None	211324	None	None				
211325	-387.15	211325	-61.18	0.08	211325	-91.88	0.06	211325	-105.39	0.05	211325	-105.39	0.05	211325	-105.39	0.05	211325	-105.39	0.05	211325	-105.39	0.05	211325	-105.39	0.05				
211331	-387.15	211331	-61.18	0.08	211331	-91.88	0.06	211331	-105.39	0.05	211331	-105.39	0.05	211331	-105.39	0.05	211331	-105.39	0.05	211331	-105.39	0.05	211331	-105.39	0.05				
211332	537.71	211332	-0.08	84.89	211332	-0.06	127.48	211332	-0.04	146.24	211332	-0.04	146.24	211332	-0.06	176.03	211332	-0.06	176.03	211332	-0.06	176.03	211332	-0.06	176.03				
211333	-498.61	211333	-76.26	0.07	211333	-114.52	0.06	211333	-131.69	0.05	211333	-131.69	0.05	211333	-131.69	0.05	211333	-131.69	0.05	211333	-131.69	0.05	211333	-131.69	0.05				
211334	None	211334	None	None	211334	None	None	211334	None	None	211334	None	None	211334	None	None	211334	None	None	211334	None	None	211334	None	None				
211335	None	211335	None	None	211335	None	None	211335	None	None	211335	None	None	211335	None	None	211335	None	None	211335	None	None	211335	None	None				
221301	396.59	221301	0.00	54.38	221301	0.00	81.59	221301	0.00	94.28	221301	0.00	94.28	221301	0.00	109.68	221301	0.00	109.68	221301	0.00	109.68	221301	0.00	109.68				
221302	194.20	221302	-25.42	48.43	221302	-37.31	72.31	221302	-41.60	82.62	221302	-41.60	82.62	221302	-41.60	82.62	221302	-41.60	82.62	221302	-41.60	82.62	221302	-41.60	82.62				
221303	-121.65	221303	-58.11	0.01	221303	-85.62	0.01	221303	-94.89	0.01	221303	-94.89	0.01	221303	-94.89	0.01	221303	-94.89	0.01	221303	-94.89	0.01	221303	-94.89	0.01				
221304	-8.32	221304	-33.16	42.82	221304	-49.00	63.51	221304	-54.96	72.11	221304	-54.96	72.11	221304	-54.96	72.11	221304	-54.96	72.11	221304	-54.96	72.11	221304	-54.96	72.11				
221305	522.32	221305	0.01	66.26	221305	0.01	99.57	221305	0.01	114.95	221305	0.01	114.95	221305	0.01	132.83	221305	0.01	132.83	221305	0.01	132.83	221305	0.01	132.83				
221311	522.32	221311	0.01	66.26	221311	0.01	99.57	221311	0.01	114.95	221311	0.01	114.95	221311	0.01	132.83	221311	0.01	132.83	221311	0.01	132.83	221311	0.01	132.83				
221312	None	221312	None	None	221312	None	None	221312	None	None	221312	None	None	221312	None	None	221312	None	None	221312	None	None	221312	None	None				
221313	-153.43	221313	-43.85	11.29	221313	-65.60	15.85	221313	-74.92	16.50	221313	-74.92	16.50	221313	-74.92	16.50	221313	-74.92	16.50	221313	-74.92	16.50	221313	-74.92	16.50				
221314	236.32	221314	-16.12	62.70	221314	-22.63	93.78	221314	-23.55	107.10	221314	-23.55	107.10	221314	-23.55	107.10	221314	-23.55	107.10	221314	-23.55	107.10	221314	-23.55	107.10				
221315	358.19	221315	0.01	47.64	221315	0.01	70.80	221315	0.01	80.47	221315	0.01	80.47	221315	0.01	92.38	221315	0.01	92.38	221315	0.01	92.38	221315	0.01	92.38				
221321	358.19	221321	0.01	47.64	221321	0.01	70.80	221321	0.01	80.47	221321	0.01	80.47	221321	0.01	92.38	221321	0.01	92.38	221321	0.01	92.38	221321	0.01	92.38				
221322	None	221322	None	None	221322	None	None	221322	None	None	221322	None	None	221322	None	None	221322	None	None	221322	None	None	221322	None	None				
221323	-359.32	221323	-58.74	0.07	221323	-88.21	0.06	221323	-101.20	0.05	221323	-101.20	0.05	221323	-101.20	0.05	221323	-101.20	0.05	221323	-101.20	0.05	221323	-101.20	0.05				
221324	537.71	221324	-0.08	84.89	221324	-0.06	127.48	221324	-0.04	146.24	221324	-0.04	146.24	221324	-0.06	176.03	221324	-0.06	176.03	221324	-0.06	176.03	221324	-0.06	176.03				
221325	1.83	221325	-4.94	0.04	221325	-7.51	0.06	221325	-8.75	0.05	221325	-8.75	0.05	221325	-8.75	0.05	221325	-8.75	0.05	221325	-8.75	0.05	221325	-8.75	0.05				
221331	1.83	221331	-4.94	0.04	221331	-7.51	0.06	221331	-8.75	0.05	221331	-8.75	0.05	221331	-8.75	0.05	221331	-8.75	0.05	221331	-8.75	0.05	221331	-8.75	0.05				
221332	None	221332	None	None	221332	None	None	221332	None	None	221332	None	None	221332	None	None	221332	None	None	221332	None	None	221332	None	None				
221333	-498.61	221333	-76.26	0.07	221333	-114.52	0.06	221333	-131.69	0.05	221333	-131.69	0.05	221333	-131.69	0.05	221333	-131.69	0.05	221333	-131.69	0.05	221333	-131.69	0.05				
221334	None	221334	None	None	221334	None	None	221334	None	None	221334	None	None	221334	None	None	221334	None	None	221334	None	None	221334	None	None				
221335	None	221335	None	None	221335	None	None	221335	None	None	221335	None	None	221335	None	None	221335	None	None	221335	None	None	221335	None	None				

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Part – B: Gusset Plate Resistance in Accordance with the Load Factor Rating Method (LFR)

1. General

Gusset connections of non-load-path-redundant steel truss bridges shall be evaluated during a bridge load rating analysis. Non-load-path-redundant bridges are those with no alternate load paths and whose failure of a main component is expected to result in the collapse of the bridge.

The evaluation of gusset connections shall include the evaluation of the connecting plates and fasteners. The capacity (referred to as the resistance in this Guidance) of a gusset connection is determined as the smaller resistance of the fasteners or gusset plates.

The following guidance is intended to provide for life safety and thus the resistance of the connection is required to be checked at maximum loads only. The maximum loads are the loadings specified in AASHTO Article 10.47. Owners may require that connections be checked for other loading levels such as overload to minimize serviceability concerns.

2. Resistance of Fasteners

For concentrically loaded bolted and riveted gusset connections, the maximum axial load in each connected member may be assumed to be distributed equally to all fasteners.

At maximum loads, the fasteners in bolted and riveted gusset connections shall be evaluated to prevent fastener shear and plate bearing failures. The provisions of AASHTO Article 10.56.1.3.2 shall apply for determining the resistance of fasteners to prevent fastener shear and plate bearing failures.

For unknown rivet types, the shear resistance of one rivet shall be taken as:

$$\phi R = \phi F m A_r \quad (1)$$

where:

ϕF = shear strength of one rivet. The values in Table 1 may be used for ϕF based on the year of construction:

Table 1

Year of Construction	ϕF ksi
Constructed prior to 1936 or of unknown origin	18
Constructed after 1936 but of unknown origin	21

m = the number of shear planes

A_r = cross-sectional area of the rivet before driving

The shear resistance of a rivet in connections greater than 50.0 in. in length shall be taken as 0.80 times the value given in Eq. 1. The length of the connection is measured between the extreme fasteners on one side of the connection.

3. Resistance of Gusset Plates

The resistance of a gusset plate shall be determined as the least resistance of the plate in compression, shear, and tension including block shear.

3.1. Gusset Plates in Tension

Gusset plates subjected to axial tension shall be investigated for two conditions:

- Yield on the effective gross section, and
- Block shear rupture

The resistance for gusset plates in tension, R_r , shall be taken as the least of the values given by either yielding on the effective area or the block shear rupture resistance.

3.1.1. Effective Gross Section Yielding

$$R_r = A_e F_y \quad (2)$$

where:

A_e = effective gross cross-sectional area taking into account the possibility of net section fracture.

$$A_e = A_n + \beta A_g \leq A_g \quad (3)$$

A_n = net cross-sectional area of the plates as specified in AASHTO Article 10.16.14.

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SFN 1801503

PANEL POINT 43 FLOORBEAM BRACE ANALYSIS
Loads (from TranSystems 2012 Load Rating)

DL = 96.78 kips
HS 20 LL+I = 82.36 kips
2F1 LL+I = 39.94 kips
3F1 LL+I = 60.07 kips
4F1 LL+I = 68.64 kips
5C1 LL+I = 58.66 kips

Connection Capacity:

Diameter of One Bolt = 1 inches
Number of Bolts = 18

Bolt Strength = 35.0 ksi (AASHTO Table 10.56A)

Connection Capacity = 494.8 kips

Plate Capacity:

Web Thickness = 0.500 inches
Shortest Web Length = 19.000 inches

Yield Strength = 50 ksi

Capacity = $F_y \times A_g$ = 475.0 kips

Inventory Rating = $(\text{Capacity} - 1.3\text{DL}) / (2.17\text{LL}+I)$

Operating Rating = $(\text{Capacity} - 1.3\text{DL}) / (1.3\text{LL}+I)$

	Inventory Rating	Operating Rating				
	HS 20	HS 20	2F1	3F1	4F1	5C1
Brace Connection Rating	2.065	3.446	7.107	4.725	4.135	4.839
Brace Plate Rating	1.954	3.261	6.725	4.472	3.913	4.579
Panel Point 43 Floorbeam Brace Rating	1.954	3.261	6.725	4.472	3.913	4.579

Tran Systems

Made By: BRC
 Checked By: CIG
 2.8.11 BRC
 CIG

Date: 12/30/11
 Date: 1/4/12
 2/1/12
 2/2/12

Job No: P402 10 0069
 Sheet No: 13A/16

UPDATED RATING FACTORSMAIN SPAN - ORIGINAL

BEAM 30 CB 115 SHOP DRAWINGS "FB 5" EXTERIOR AT PP 43

ADDITIONAL LOAD IS 1.77 K/ft (BRIDGE 4)

AT PP43 SPACING IS 23' 11" \rightarrow 42.3 K / width bridge30 CB 115 EXT HAS $\frac{23'}{2 \times 23' + 27'} = 0.315$ OR 31.5% OF 42.3 K

ADDITIONAL 13.3 K ON 30 CB 115.

SINCE SHARE AT THE R26 CONTROLS $\frac{13.3 K}{2} = 6.7 K / DL BEAM$ $V_{DL\ orig} = 90.08 K$ $V_u = 275.44 K$ (SHEET 386) $V_{DL\ new} = 96.78 K$

LL + I (SHT 36)	
HS 20	82.36 K
2FI	39.94 K
3FI	60.07 K
4FI	68.64 K
5CI	58.66 K

	INV	OPER
HS 20	0.84	1.40
2FI	—	2.88
3FI	—	1.92
4FI	—	1.68
5CI	—	1.96

 $V_{AND} = 7.09 K$ $V_{TOT} = V_{LL+I} + V_{AND}$

	INV	OPER
HS 20	1.03	1.29
2FI	—	2.45
3FI	—	1.71
4FI	—	1.52
5CI	—	1.75

ELECTRONIC FILES OF ALL SPREADSHEET CALCULATIONS

BRIDGE NO. CUY-10-1613
SFN 1801503

NOTE: SPREADSHEETS ARE IN MICROSOFT EXCEL