BRIDGE RATING

Prepared For

MASSACHUSETTS DEPARTMENT OF TRANSPORTATION
HIGHWAY DIVISION

PITTSFIELD

HOLMES ROAD

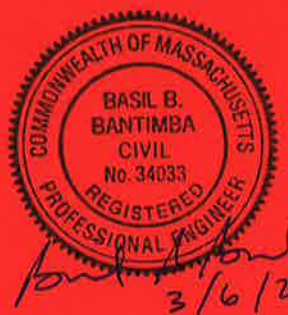
OVER

HOUSATONIC RAILROAD

BRIDGE NO. P-10-002 (0DY)

STRUCTURE NO. P10002-0DY-DOT-634

DATE OF INSPECTION: **MAY 22, 2018**
DATE OF RATING: **MARCH 07, 2019**



PREPARED BY

AI Engineers, Inc.

60 K St., 3rd Floor
Boston, MA 02127

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PITTSFIELD HOLMES ROAD OVER HOUSATONIC RAILROAD BRIDGE NO. P-10-002

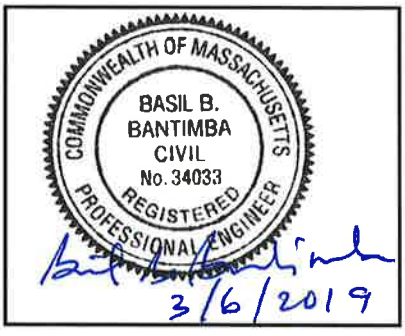
SUMMARY OF BRIDGE RATING

TOWN/CITY:	PITTSFIELD	BRIDGE NO.:	P-10-002
CARRIES:	HOLMES ROAD	OVER:	HOUSATONIC RAILROAD
STRUCTURE NO.:	P10002-0DY-DOT-634	BIN NO.:	0DY

RATINGS (TONS)

LOAD FACTOR RATINGS FOR LOAD POSTING PURPOSES LOAD RATINGS IN ENGLISH TONS		
VEHICLE TYPE	INVENTORY	OPERATING
H20	0.0	0.0
TYPE 3	0.0	0.0
TYPE 3S2	0.0	0.0
HS20	0.0	0.0
SU4	0.0	0.0
SU5	0.0	0.0
SU6	0.0	0.0
SU7	0.0	0.0
EV2	-	0.0
EV3	-	0.0

MS18 LOAD FACTOR RATINGS IN METRIC TONS PROVIDED IN COMPLIANCE WITH THE DECEMBER 1995 FHWA NBIS CODING GUIDE			
INVENTORY		OPERATING	
Item 66	MS Equivalent	Item 64	MS Equivalent
0.0	MS0.0	0.0	MS0.0



A posting recommendation has been made based on the results of this Rating Report. This recommendation is contained in the "Memorandum to the NBIS File" for this bridge, dated _____.

Consultant P.E. Stamp

State Bridge Engineer Date

BREAKDOWN OF BRIDGE RATING

TOWN/CITY:	PITTSFIELD	BRIDGE NO.:	P-10-002
CARRIES:	HOLMES ROAD	OVER:	HOUSATONIC RAILROAD
STRUCTURE NO.:	P10002-0DY-DOT-634	BIN NO.:	0DY

BRIDGE COMPONENT	INVENTORY RATING BY LOAD FACTOR METHOD (ENGLISH TONS)				OPERATING RATING BY LOAD FACTOR METHOD (ENGLISH TONS)			
	H20	TYPE 3	TYPE 3S2	HS20	H20	TYPE 3	TYPE 3S2	HS20
BEAMS B1 FLEXURAL STRENGTH MOMENT AT MID-SPAN	35.2	39.4	52.3	41.8	58.7	65.8	87.4	97.5
BEAMS B1 SHEAR STRENGTH AT CRITICAL SHEAR LOC.	47.3	47.6	70.1	56.1	77.3	79.3	115.5	92.1
BEAMS B1 SERVICEABILITY CONC. TENSION AT MID-SPAN	31.3	35.0	46.9	37.2	-	-	-	-
BEAMS B2 FLEXURAL STRENGTH MOMENT AT MID-SPAN	36.6	41.0	54.4	43.5	61.1	68.4	90.8	72.6
BEAMS B2 SHEAR STRENGTH AT CRITICAL SHEAR LOC.	48.3	48.2	69.6	57.1	79.0	80.4	116.2	94.1
BEAMS B2 SERVICEABILITY CONC. TENSION AT MID-SPAN	33.4	37.4	50.0	39.7	-	-	-	-
BEAMS B3 FLEXURAL STRENGTH MOMENT AT MID-SPAN	32.5	36.4	48.3	38.6	54.2	60.8	80.7	64.5
BEAMS B3 SHEAR STRENGTH AT CRITICAL SHEAR LOC.	48.3	48.2	71.6	57.3	79.0	80.4	117.9	94.1
BEAMS B3 SERVICEABILITY CONC. TENSION AT MID-SPAN	29.2	32.8	43.8	34.8	-	-	-	-

Note:

- Midspan refers to locations from 0.40L to 0.60L
- See Appendix D for locations of critical shear

BREAKDOWN OF BRIDGE RATING (CONTINUED)

TOWN/CITY:	PITTSFIELD	BRIDGE NO.:	P-10-002
CARRIES:	HOLMES ROAD	OVER:	HOUSATONIC RAILROAD
STRUCTURE NO.:	P10002-0DY-DOT-634	BIN NO.:	0DY

BRIDGE COMPONENT	INVENTORY RATING BY LOAD FACTOR METHOD (ENGLISH TONS)				OPERATING RATING BY LOAD FACTOR METHOD (ENGLISH TONS)			
	H20	TYPE 3	TYPE 3S2	HS20	H20	TYPE 3	TYPE 3S2	HS20
BEAMS B4 FLEXURAL STRENGTH MOMENT AT MID-SPAN	26.8	30.0	40.0	31.9	44.8	50.2	66.7	53.2
BEAMS B4 SHEAR STRENGTH AT CRITICAL SHEAR LOC.	48.3	48.2	71.6	57.3	79.0	80.4	117.9	94.1
BEAMS B4 SERVICEABILITY CONC. TENSION AT MID-SPAN	23.5	26.3	35.3	27.9	-	-	-	-
BEAMS B5 FLEXURAL STRENGTH MOMENT AT MID-SPAN	45.4	50.8	68.2	53.9	75.7	84.9	113.9	90.1
BEAMS B5 SHEAR STRENGTH AT CRITICAL SHEAR LOC.	52.3	50.8	74.9	62.0	85.6	84.6	125.1	101.9
BEAMS B5 SERVICEABILITY CONC. TENSION AT MID-SPAN	44.8	50.2	66.7	53.3	-	-	-	-
BEAMS B6 FLEXURAL STRENGTH MOMENT AT MID-SPAN	40.3	45.2	59.9	48.0	67.4	75.5	100.1	80.1
BEAMS B6 SHEAR STRENGTH AT CRITICAL SHEAR LOC.	48.3	48.2	71.6	57.3	78.9	80.4	117.9	94.1
BEAMS B6 SERVICEABILITY CONC. TENSION AT MID-SPAN	30.0	33.6	45.0	35.7	-	-	-	-

Note:

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BREAKDOWN OF BRIDGE RATING (CONTINUED)

TOWN/CITY:	PITTSFIELD	BRIDGE NO.:	P-10-002
CARRIES:	HOLMES ROAD	OVER:	HOUSATONIC RAILROAD
STRUCTURE NO.:	P10002-0DY-DOT-634	BIN NO.:	0DY

BRIDGE COMPONENT	INVENTORY RATING BY LOAD FACTOR METHOD (ENGLISH TONS)				OPERATING RATING BY LOAD FACTOR METHOD (ENGLISH TONS)			
	H20	TYPE 3	TYPE 3S2	HS20	H20	TYPE 3	TYPE 3S2	HS20
BEAMS B7 FLEXURAL STRENGTH MOMENT AT MID-SPAN	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
BEAMS B7 SHEAR STRENGTH AT CRITICAL SHEAR LOC.	48.3	48.2	71.6	57.3	79.0	80.4	117.9	94.1
BEAMS B7 SERVICEABILITY CONC. TENSION AT MID-SPAN	**0.0**	**0.0**	**0.0**	**0.0**	-	-	-	-
BEAMS B8 FLEXURAL STRENGTH MOMENT AT MID-SPAN	45.4	50.8	67.3	53.9	75.7	84.9	112.3	90.1
BEAMS B8 SHEAR STRENGTH AT CRITICAL SHEAR LOC.	52.3	50.8	74.9	62.0	85.6	84.6	125.1	101.9
BEAMS B8 SERVICEABILITY CONC. TENSION AT MID-SPAN	45.3	50.6	66.7	53.5	-	-	-	-
BEAMS B9 FLEXURAL STRENGTH MOMENT AT MID-SPAN	23.7	26.5	35.3	28.1	39.5	44.3	59.0	47.0
BEAMS B9 SHEAR STRENGTH AT CRITICAL SHEAR LOC.	48.3	48.2	71.6	57.3	79.0	80.4	117.9	94.1
BEAMS B9 SERVICEABILITY CONC. TENSION AT MID-SPAN	20.2	22.6	30.4	24.0	-	-	-	-

Note:

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- See Appendix D for locations of critical shear

BREAKDOWN OF BRIDGE RATING (CONTINUED)

TOWN/CITY:	PITTSFIELD	BRIDGE NO.:	P-10-002
CARRIES:	HOLMES ROAD	OVER:	HOUSATONIC RAILROAD
STRUCTURE NO.:	P10002-0DY-DOT-634	BIN NO.:	0DY

BRIDGE COMPONENT	INVENTORY RATING BY LOAD FACTOR METHOD (ENGLISH TONS)				OPERATING RATING BY LOAD FACTOR METHOD (ENGLISH TONS)			
	H20	TYPE 3	TYPE 3S2	HS20	H20	TYPE 3	TYPE 3S2	HS20
BEAMS B10 FLEXURAL STRENGTH MOMENT AT MID-SPAN	57.7	64.6	85.6	58.6	96.3	107.9	143.0	114.6
BEAMS B10 SHEAR STRENGTH AT CRITICAL SHEAR LOC.	73.6	78.4	108.9	87.0	120.5	131.0	179.0	143.3
BEAMS B10 SERVICEABILITY CONC. TENSION AT MID-SPAN	52.4	58.7	78.2	62.3	-	-	-	-

Note:

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BREAKDOWN OF BRIDGE RATING (CONT'D)

TOWN/CITY:	PITTSFIELD	BRIDGE NO.:	P-10-002
CARRIES:	HOLMES ROAD	OVER:	HOUSATONIC RAILROAD
STRUCTURE NO.:	P10002-0DY-DOT-634	BIN NO.:	0DY

BRIDGE COMPONENT	INVENTORY RATING BY LOAD FACTOR METHOD (ENGLISH TONS)				OPERATING RATING BY LOAD FACTOR METHOD (ENGLISH TONS)			
	SU4	SU5	SU6	SU7	SU4	SU5	SU6	SU7
BEAMS B1 FLEXURAL STRENGTH MOMENT AT MID-SPAN	37.8	39.4	39.5	40.4	63.1	65.7	66.0	67.5
BEAMS B1 SHEAR STRENGTH AT CRITICAL SHEAR LOC.	47.1	47.2	54.6	56.6	78.5	78.5	90.2	93.8
BEAMS B1 SERVICEABILITY CONC. TENSION AT MID-SPAN	33.6	35.0	35.2	35.9	-	-	-	-
BEAMS B2 FLEXURAL STRENGTH MOMENT AT MID-SPAN	39.3	40.9	41.1	42.0	65.6	68.4	68.7	70.2
BEAMS B2 SHEAR STRENGTH AT CRITICAL SHEAR LOC.	47.9	48.0	55.8	57.7	79.6	79.9	92.1	95.6
BEAMS B2 SERVICEABILITY CONC. TENSION AT MID-SPAN	35.9	37.4	37.6	38.4	-	-	-	-
BEAMS B3 FLEXURAL STRENGTH MOMENT AT MID-SPAN	34.9	36.4	36.5	37.3	58.3	60.7	61.0	62.3
BEAMS B3 SHEAR STRENGTH AT CRITICAL SHEAR LOC.	47.9	48.0	55.8	57.7	79.6	79.9	92.1	95.6
BEAMS B3 SERVICEABILITY CONC. TENSION AT MID-SPAN	31.4	32.7	32.9	33.6	-	-	-	-

Note:

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BREAKDOWN OF BRIDGE RATING (CONTINUED)

TOWN/CITY:	PITTSFIELD	BRIDGE NO.:	P-10-002
CARRIES:	HOLMES ROAD	OVER:	HOUSATONIC RAILROAD
STRUCTURE NO.:	P10002-0DY-DOT-634	BIN NO.:	0DY

BRIDGE COMPONENT	INVENTORY RATING BY LOAD FACTOR METHOD (ENGLISH TONS)				OPERATING RATING BY LOAD FACTOR METHOD (ENGLISH TONS)			
	SU4	SU5	SU6	SU7	SU4	SU5	SU6	SU7
BEAMS B4 FLEXURAL STRENGTH MOMENT AT MID-SPAN	28.8	30.0	30.1	30.8	48.1	50.1	50.3	51.4
BEAMS B4 SHEAR STRENGTH AT CRITICAL SHEAR LOC.	47.9	48.0	55.8	57.7	97.6	79.9	92.1	95.6
BEAMS B4 SERVICEABILITY CONC. TENSION AT MID-SPAN	25.2	26.3	26.4	26.9	-	-	-	-
BEAMS B5 FLEXURAL STRENGTH MOMENT AT MID-SPAN	48.7	50.8	51.0	52.1	81.4	84.8	85.2	87.0
BEAMS B5 SHEAR STRENGTH AT CRITICAL SHEAR LOC.	50.5	51.2	60.0	61.8	84.0	85.3	99.1	102.5
BEAMS B5 SERVICEABILITY CONC. TENSION AT MID-SPAN	48.1	50.2	50.4	51.5	-	-	-	-
BEAM B6 FLEXURAL STRENGTH MOMENT AT MID-SPAN	43.3	45.1	45.3	46.3	72.4	75.4	75.7	77.4
BEAM B6 SHEAR STRENGTH AT CRITICAL SHEAR LOC.	47.9	48.0	55.8	57.7	79.6	79.9	92.1	95.6
BEAM B6 SERVICEABILITY CONC. TENSION AT MID-SPAN	32.2	33.6	33.7	34.5	-	-	-	-

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BREAKDOWN OF BRIDGE RATING (CONTINUED)

TOWN/CITY:	PITTSFIELD	BRIDGE NO.:	P-10-002
CARRIES:	HOLMES ROAD	OVER:	HOUSATONIC RAILROAD
STRUCTURE NO.:	P10002-0DY-DOT-634	BIN NO.:	0DY

BRIDGE COMPONENT	INVENTORY RATING BY LOAD FACTOR METHOD (ENGLISH TONS)				OPERATING RATING BY LOAD FACTOR METHOD (ENGLISH TONS)			
	SU4	SU5	SU6	SU7	SU4	SU5	SU6	SU7
BEAMS B7 FLEXURAL STRENGTH MOMENT AT MID-SPAN	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
BEAMS B7 SHEAR STRENGTH AT CRITICAL SHEAR LOC.	47.9	48.0	55.8	57.7	79.6	79.9	92.1	95.6
BEAMS B7 SERVICEABILITY CONC. TENSION AT MID-SPAN	**0.0**	**0.0**	**0.0**	**0.0**	-	-	-	-
BEAMS B8 FLEXURAL STRENGTH MOMENT AT MID-SPAN	48.7	50.8	51.0	52.1	81.4	84.8	85.2	87.0
BEAMS B8 SHEAR STRENGTH AT CRITICAL SHEAR LOC.	50.5	51.2	60.0	61.8	84.0	85.3	99.1	102.5
BEAMS B8 SERVICEABILITY CONC. TENSION AT MID-SPAN	48.7	50.5	51.0	52.4	-	-	-	-
BEAM B9 FLEXURAL STRENGTH MOMENT AT MID-SPAN	25.4	26.5	26.6	27.2	42.4	44.2	44.4	45.4
BEAM B9 SHEAR STRENGTH AT CRITICAL SHEAR LOC.	47.9	48.0	55.8	57.7	79.6	79.9	92.1	95.6
BEAM B9 SERVICEABILITY CONC. TENSION AT MID-SPAN	21.7	22.6	22.7	23.2	-	-	-	-

Note:

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BREAKDOWN OF BRIDGE RATING (CONTINUED)

TOWN/CITY: PITTSFIELD BRIDGE NO.: P-10-002

CARRIES: HOLMES ROAD OVER: HOUSATONIC RAILROAD

STRUCTURE NO.: P10002-0DY-DOT-634 BIN NO.: 0DY

BRIDGE COMPONENT	INVENTORY RATING BY LOAD FACTOR METHOD (ENGLISH TONS)				OPERATING RATING BY LOAD FACTOR METHOD (ENGLISH TONS)			
	SU4	SU5	SU6	SU7	SU4	SU5	SU6	SU7
BEAMS B10 FLEXURAL STRENGTH MOMENT AT MID-SPAN	62.0	64.6	64.9	66.3	103.5	107.8	108.3	110.7
BEAMS B10 SHEAR STRENGTH AT CRITICAL SHEAR LOC.	76.3	74.8	84.7	89.2	127.5	124.6	140.2	147.8
BEAMS B10 SERVICEABILITY CONC. TENSION AT MID-SPAN	56.3	58.6	58.9	60.2	-	-	-	-

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BREAKDOWN OF BRIDGE RATING (CONTINUED)

TOWN/CITY: PITTSFIELD BRIDGE NO.: P-10-002

CARRIES: HOLMES ROAD OVER: HOUSATONIC RAILROAD

STRUCTURE NO.: P10002-0DY-DOT-634 BIN NO.: 0DY

BRIDGE COMPONENT	INVENTORY RATING BY LOAD FACTOR METHOD (ENGLISH TONS)		OPERATING RATING BY LOAD FACTOR METHOD (ENGLISH TONS)	
	EV2	EV3	EV2	EV3
BEAMS B1 FLEXURAL STRENGTH MOMENT AT MID-SPAN	-	-	65.9	4.6
BEAMS B1 SHEAR STRENGTH AT CRITICAL SHEAR LOC.	-	-	87.8	87.0
BEAMS B1 SERVICEABILITY CONC. TENSION AT MID-SPAN	-	-	-	-
BEAMS B2 FLEXURAL STRENGTH MOMENT AT MID-SPAN	-	-	68.5	67.2
BEAMS B2 SHEAR STRENGTH AT CRITICAL SHEAR LOC.	-	-	86.6	88.9
BEAMS B2 SERVICEABILITY CONC. TENSION AT MID-SPAN	-	-	-	-
BEAMS B3 FLEXURAL STRENGTH MOMENT AT MID-SPAN	-	-	60.9	59.6
BEAMS B3 SHEAR STRENGTH AT CRITICAL SHEAR LOC.	-	-	86.6	88.9
BEAMS B3 SERVICEABILITY CONC. TENSION AT MID-SPAN	-	-	-	-

Note:

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- See Appendix D for locations of critical shear

BREAKDOWN OF BRIDGE RATING (CONTINUED)

TOWN/CITY: PITTSFIELD BRIDGE NO.: P-10-002

CARRIES: HOLMES ROAD OVER: HOUSATONIC RAILROAD

STRUCTURE NO.: P10002-0DY-DOT-634 BIN NO.: 0DY

BRIDGE COMPONENT	INVENTORY RATING BY LOAD FACTOR METHOD (ENGLISH TONS)		OPERATING RATING BY LOAD FACTOR METHOD (ENGLISH TONS)	
	EV2	EV3	EV2	EV3
BEAMS B4 FLEXURAL STRENGTH MOMENT AT MID-SPAN	-	-	50.3	49.2
BEAMS B4 SHEAR STRENGTH AT CRITICAL SHEAR LOC.	-	-	86.6	88.9
BEAMS B4 SERVICEABILITY CONC. TENSION AT MID-SPAN	-	-	-	-
BEAMS B5 FLEXURAL STRENGTH MOMENT AT MID-SPAN	-	-	85.2	83.3
BEAMS B5 SHEAR STRENGTH AT CRITICAL SHEAR LOC.	-	-	93.8	93.0
BEAMS B5 SERVICEABILITY CONC. TENSION AT MID-SPAN	-	-	-	-
BEAM B6 FLEXURAL STRENGTH MOMENT AT MID-SPAN	-	-	75.5	74.0
BEAM B6 SHEAR STRENGTH AT CRITICAL SHEAR LOC.	-	-	86.6	88.9
BEAM B6 SERVICEABILITY CONC. TENSION AT MID-SPAN	-	-	-	-

Note:

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BREAKDOWN OF BRIDGE RATING (CONTINUED)

TOWN/CITY: PITTSFIELD BRIDGE NO.: P-10-002

CARRIES: HOLMES ROAD OVER: HOUSATONIC RAILROAD

STRUCTURE NO.: P10002-0DY-DOT-634 BIN NO.: 0DY

BRIDGE COMPONENT	INVENTORY RATING BY LOAD FACTOR METHOD (ENGLISH TONS)		OPERATING RATING BY LOAD FACTOR METHOD (ENGLISH TONS)	
	EV2	EV3	EV2	EV3
BEAMS B7 FLEXURAL STRENGTH MOMENT AT MID-SPAN	-	-	**0.0**	**0.0**
BEAMS B7 SHEAR STRENGTH AT CRITICAL SHEAR LOC.	-	-	86.6	88.9
BEAMS B7 SERVICEABILITY CONC. TENSION AT MID-SPAN	-	-	-	-
BEAMS B8 FLEXURAL STRENGTH MOMENT AT MID-SPAN	-	-	84.7	83.3
BEAMS B8 SHEAR STRENGTH AT CRITICAL SHEAR LOC.	-	-	93.8	93.0
BEAMS B8 SERVICEABILITY CONC. TENSION AT MID-SPAN	-	-	-	-
BEAM B9 FLEXURAL STRENGTH MOMENT AT MID-SPAN	-	-	44.4	43.4
BEAM B9 SHEAR STRENGTH AT CRITICAL SHEAR LOC.	-	-	86.6	88.9
BEAM B9 SERVICEABILITY CONC. TENSION AT MID-SPAN	-	-	-	-

Note:

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BREAKDOWN OF BRIDGE RATING (CONTINUED)

TOWN/CITY:	PITTSFIELD	BRIDGE NO.:	P-10-002
CARRIES:	HOLMES ROAD	OVER:	HOUSATONIC RAILROAD
STRUCTURE NO.:	P10002-0DY-DOT-634	BIN NO.:	0DY

BRIDGE COMPONENT	INVENTORY RATING BY LOAD FACTOR METHOD (ENGLISH TONS)		OPERATING RATING BY LOAD FACTOR METHOD (ENGLISH TONS)	
	EV2	EV3	EV2	EV3
BEAMS B10 FLEXURAL STRENGTH MOMENT AT MID-SPAN	-	-	107.9	105.9
BEAMS B10 SHEAR STRENGTH AT CRITICAL SHEAR LOC.	-	-	132.1	135.5
BEAMS B10 SERVICEABILITY CONC. TENSION AT MID-SPAN	-	-	-	-

Note:

- Midspan refers to locations from 0.40L to 0.60L
- See Appendix D for locations of critical shear

BREAKDOWN OF BRIDGE RATING (CONTINUED)

TOWN/CITY: PITTSFIELD BRIDGE NO.: P-10-002

CARRIES: HOLMES ROAD OVER: HOUSATONIC RAILROAD

STRUCTURE NO.: P10002-0DY-DOT-634 BIN NO.: 0DY

BRIDGE COMPONENT	INVENTORY RATING BY LOAD FACTOR METHOD (METRIC TONS)		OPERATING RATING BY LOAD FACTOR METHOD (METRIC TONS)	
	MS18	MS (EQUIV.)	MS18	MS (EQUIV.)
BEAMS B1 FLEXURAL STRENGTH MOMENT AT MID-SPAN	37.6	MS20.9	87.8	MS48.8
BEAMS B1 SHEAR STRENGTH AT CRITICAL SHEAR LOC.	50.5	MS28.1	82.9	MS46.1
BEAMS B1 SERVICEABILITY CONC. TENSION AT MID-SPAN	33.5	MS18.6	-	-
BEAMS B2 FLEXURAL STRENGTH MOMENT AT MID-SPAN	39.2	MS21.8	81.7	MS45.4
BEAMS B2 SHEAR STRENGTH AT CRITICAL SHEAR LOC.	56.2	MS31.2	104.6	MS58.1
BEAMS B2 SERVICEABILITY CONC. TENSION AT MID-SPAN	34.1	MS19.0	-	-
BEAMS B3 FLEXURAL STRENGTH MOMENT AT MID-SPAN	34.7	MS19.3	72.6	MS40.4
BEAMS B3 SHEAR STRENGTH AT CRITICAL SHEAR LOC.	51.6	MS28.7	106.1	MS59.0
BEAMS B3 SERVICEABILITY CONC. TENSION AT MID-SPAN	31.3	MS17.4	-	-

Note:

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BREAKDOWN OF BRIDGE RATING (CONTINUED)

TOWN/CITY: PITTSFIELD BRIDGE NO.: P-10-002

CARRIES: HOLMES ROAD OVER: HOUSATONIC RAILROAD

STRUCTURE NO.: P10002-0DY-DOT-634 BIN NO.: 0DY

BRIDGE COMPONENT	INVENTORY RATING BY LOAD FACTOR METHOD (METRIC TONS)		OPERATING RATING BY LOAD FACTOR METHOD (METRIC TONS)	
	MS18	MS (EQUIV.)	MS18	MS (EQUIV.)
BEAMS B4 FLEXURAL STRENGTH MOMENT AT MID-SPAN	28.7	MS16.0	47.9	MS26.6
BEAMS B4 SHEAR STRENGTH AT CRITICAL SHEAR LOC.	51.6	MS28.7	84.7	MS47.1
BEAMS B4 SERVICEABILITY CONC. TENSION AT MID-SPAN	25.1	MS14.0	-	-
BEAMS B5 FLEXURAL STRENGTH MOMENT AT MID-SPAN	48.5	MS27.0	81.1	MS45.1
BEAMS B5 SHEAR STRENGTH AT CRITICAL SHEAR LOC.	55.8	MS31.0	91.7	MS51.0
BEAMS B5 SERVICEABILITY CONC. TENSION AT MID-SPAN	48.0	MS26.7	-	-
BEAMS B6 FLEXURAL STRENGTH MOMENT AT MID-SPAN	43.2	MS24.0	72.1	MS40.1
BEAMS B6 SHEAR STRENGTH AT CRITICAL SHEAR LOC.	51.6	MS28.7	84.7	MS47.1
BEAMS B6 SERVICEABILITY CONC. TENSION AT MID-SPAN	32.1	MS17.9	-	-

Note:

- Midspan refers to locations from 0.40L to 0.60L
- See Appendix D for locations of critical shear

BREAKDOWN OF BRIDGE RATING (CONTINUED)

TOWN/CITY: PITTSFIELD BRIDGE NO.: P-10-002

CARRIES: HOLMES ROAD OVER: HOUSATONIC RAILROAD

STRUCTURE NO.: P10002-0DY-DOT-634 BIN NO.: 0DY

BRIDGE COMPONENT	INVENTORY RATING BY LOAD FACTOR METHOD (METRIC TONS)		OPERATING RATING BY LOAD FACTOR METHOD (METRIC TONS)	
	MS18	MS (EQUIV.)	MS18	MS (EQUIV.)
BEAMS B7 FLEXURAL STRENGTH MOMENT AT MID-SPAN	**0.0**	**MS.0**	**0.0**	**MS.0**
BEAMS B7 SHEAR STRENGTH AT CRITICAL SHEAR LOC.	51.6	MS28.7	84.7	MS47.1
BEAMS B7 SERVICEABILITY CONC. TENSION AT MID-SPAN	**0.0**	**MS.0**	-	-
BEAMS B8 FLEXURAL STRENGTH MOMENT AT MID-SPAN	48.5	MS27.0	81.1	MS45.1
BEAMS B8 SHEAR STRENGTH AT CRITICAL SHEAR LOC.	55.8	MS31.0	91.7	MS51.0
BEAMS B8 SERVICEABILITY CONC. TENSION AT MID-SPAN	48.2	MS26.8	-	-
BEAMS B9 FLEXURAL STRENGTH MOMENT AT MID-SPAN	25.3	MS14.1	42.3	MS23.5
BEAMS B9 SHEAR STRENGTH AT CRITICAL SHEAR LOC.	51.6	MS28.7	84.7	MS47.1
BEAMS B9 SERVICEABILITY CONC. TENSION AT MID-SPAN	21.6	MS12.0	-	-

Note:

- Midspan refers to locations from 0.40L to 0.60L
- See Appendix D for locations of critical shear

BREAKDOWN OF BRIDGE RATING (CONTINUED)

TOWN/CITY:	PITTSFIELD	BRIDGE NO.:	P-10-002
CARRIES:	HOLMES ROAD	OVER:	HOUSATONIC RAILROAD
STRUCTURE NO.:	P10002-0DY-DOT-634	BIN NO.:	0DY

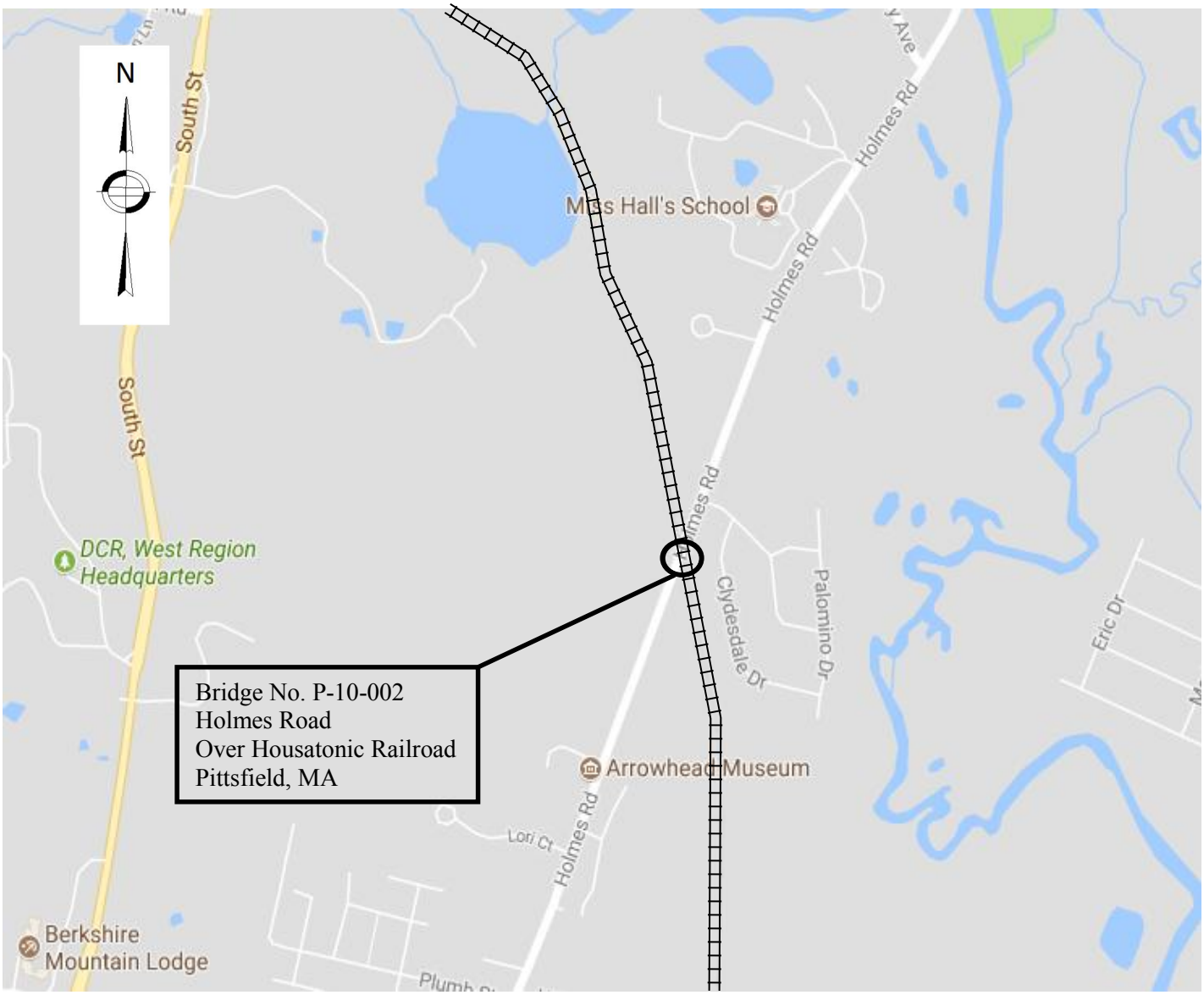
BRIDGE COMPONENT	INVENTORY RATING BY LOAD FACTOR METHOD (METRIC TONNES)		OPERATING RATING BY LOAD FACTOR METHOD (METRIC TONNES)	
	MS18	MS (EQUIV.)	MS18	MS (EQUIV.)
BEAMS B10 FLEXURAL STRENGTH MOMENT AT MID-SPAN	52.7	MS29.3	103.1	MS57.3
BEAMS B10 SHEAR STRENGTH AT CRITICAL SHEAR LOC.	78.3	MS43.5	128.7	MS71.5
BEAMS B10 SERVICEABILITY CONC. TENSION AT MID-SPAN	56.1	MS31.2	N/A	N/A

Note:

- Midspan refers to locations from 0.40L to 0.60L
- See Appendix D for locations of critical shear

LOCATION MAP

PITTSFIELD HOLMES ROAD OVER HOUSATONIC RAILROAD BRIDGE NO. P-10-002



DESCRIPTION OF BRIDGE

PITTSFIELD HOLMES ROAD OVER HOUSATONIC RAILROAD BRIDGE NO. P-10-002

Date of Construction:	1977
Original Design Loading:	H20
Posted Limit:	None
Bridge Type:	Prestressed concrete butted box beams
Skew:	56° - 36' – 00"
Spans:	68’-1 7/16” (center-to-center of bearing)
Width of Bridge Deck:	41’-3” out-to-out
Roadway Width:	32’-9” curb-to-curb
Roadway Surface:	Bituminous concrete wearing surface
Curbs:	Granite curbs (both sides)
Sidewalk/Walkway/Median:	Safety walk (north side) and Sidewalk (south side)
Bridge Railing:	Aluminum bridge rail AL-3 and protective screen (both sides)
Approach Railing:	Steel guardrails (all four corners)
Superstructure:	Prestressed concrete butted box beams
Modifications to Original Superstructure:	None
Utilities:	None
Substructure:	Concrete Abutments
Modifications to Original Substructure:	None

RATING ANALYSIS ASSUMPTIONS AND CRITERIA

PITTSFIELD HOLMES ROAD OVER HOUSATONIC RAILROAD BRIDGE NO. P-10-002

The rating analysis is based on available plans, Inspection Report, and a site visit by AI Engineers, Inc. on July 7, 2017. This revised rating report incorporated the 2018 Routine Inspection Report as well as Section 7.2.10 – "Special Instructions for Deteriorated Prestressed Beam Load Ratings" of Draft 2018 Edition LRFD Bridge Manual, made available by MassDOT. The superstructure is a single span bridge consisting of ten (10) prestressed concrete box beams.

All superimposed dead load was distributed to each beam using Section 7.2.3.4B of the *MassDOT Bridge Manual*.

The live loads used for these ratings were the standard AASHTO H20 loading, HS20 loading, Type 3, Type 3S2, SU4, SU5, SU6, SU7, EV2 and EV3 trucks shown in Figures 7.9, 7.10 and 7.11 of the Draft *MassDOT Bridge Manual*. The statutory loads are 20 tons for H20 trucks, 25 tons for Type 3 trucks, 36 tons for both Type 3S2 and HS20 trucks, 27 tons for SU4 trucks, 31 tons for SU5 trucks, 34.75 tons for SU6 trucks, 38.75 tons for SU7 trucks, 28.75 tons for EV2, and 43 tons for EV3 tons.

The inventory and operating capacities of the bridge were determined in accordance with the relevant provisions of the Seventeenth Edition of the American Association of State Highway and Transportation Officials (AASHTO), *Standard Specifications for Highway Bridges*, the AASHTO Second Edition of the *Manual for Bridge Evaluation* (MBE), and the July 2013 and Draft 2018 editions of the *MassDOT Bridge Manual*, Part I, Chapter 7.

The prestressed concrete beams were modeled as a girder-system using the AASHTOWare Bridge Rating software (Version 6.8.2). The beams have been numbered 1 through 10 from North to South in accordance with the plans and inspection report. The results are presented in the breakdown of the bridge rating.

Per *MassDOT Bridge Manual* guidelines Chapter 7, Section 7.2.4.2B, the rating due to the lane loading was not considered because the span length is less than 200 ft.

Load factor ratings were calculated at both the inventory and operating levels. For the HS20 truck only, in compliance with the requirements of the December 1995 FHWA NBIS Coding Guide, the rating was obtained using the Load Factor Method.As directed by *MassDOT Bridge Manual*, Chapter 7, Section 7.1.7.2B the resulting tonnage English units were converted to metric units using a conversion factor of 0.9.

RATING ANALYSIS ASSUMPTIONS AND CRITERIA (CONTINUED)

PITTSFIELD HOLMES ROAD OVER HOUSATONIC RAILROAD BRIDGE NO. P-10-002

Based on the construction plans and the information provided in AASHTO Manual for Bridge Evaluation (MBE 6B.5.3.3), the following material properties were used:

REINFORCING STEEL,
f_y = 60,000 psi

PRESTRESSED BEAM CONCRETE,
f'_c = 5,000 psi (final)
f'_c = 4,000 psi (at release)
Allowable Tensile Stress = 425 psi $(6\sqrt{f'_c})$
Allowable Compressive Stress (inventory) = $f_c = 0.4f'_c = 2000$ psi
Allowable Compressive Stress (operating) = $f_c = 0.6f'_c = 3000$ psi

PRESTRESSING STEEL,
Ultimate Strength, Fu = 270 ksi (1/2" diameter SR)
Yield Strength, fy = 0.8*Fu f's=216 ksi (inventory)
Yield Strength, fy = 0.9*Fu f's=243 ksi (operating)

RATING ANALYSIS ASSUMPTIONS AND CRITERIA (CONTINUED)

PITTSFIELD HOLMES ROAD OVER HOUSATONIC RAILROAD BRIDGE NO. P-10-002

Analysis Assumptions:

- The inspection report noted that the joints between all beams have evidence of leakage with an as-built condition misalignment between adjacent beams at several locations. The inspection report also noted that the transverse post-tensioning strands had areas of corrosion with delamination that did not produce any strand losses. Since there is no note that specifies the condition or failure of shear keys, the analysis was performed assuming the shear keys as still intact and functioning.

- Standard live load distribution factors were computed by BrR and verified by hand calculations in accordance with AASHTO Standard Specifications for Highway Bridges Section 3.23.4.

- The wearing surface load was calculated based on the field measured average curb reveals (11" on north side and 10.75" on south side) and the maximum thickness (6.5") shown in the plan at the center of roadway (see Appendix C for details).The average thickness of 4.75" was input in BrR under the Typical Section tab as a DW load.

- As shown in the plans, the shear reinforcements around supports were aligned skewed to the beam's longitudinal axis and perpendicular to the beam's longitudinal axis for the rest of the beam length. Thus, the stirrup spacing around supports was taken as the average of the stirrup spacing's at the beam supports. The stirrup size of #4 bars was used throughout the beam length.

- The sidewalk was considered as mountable and the operating condition live load distribution factors for B9 and B10 were calculated by the lever rule.

- Per MassDOT comments, the superimposed dead loads were distributed to each beam in proportion to the tributary moment of inertia.

- The MassDOT Draft 2018 Edition LRFD Manual Section 7.2.10 was used to analyze the areas of deterioration of the prestressed beams. The procedure below was followed to obtain the rating:

    1. Section cuts (A-A to H-H) were created at locations of deficiencies that apply to MassDOT Section 7.2.10 in order to illustrate the extent and range of deterioration.
    2. For each section cut, an equivalent prestressing strand area and center of gravity was calculated based on the guidelines noted in MassDOT Section 7.2.10.

RATING ANALYSIS ASSUMPTIONS AND CRITERIA (CONTINUED)

3. Using the equivalent prestressing strand area, an equivalent jacking force was calculated. Based on the 2018 Routine Inspection Report, field visit and MassDOT Section 7.2.10, the locations and ranges of deficiencies corresponding to each section cut were determined. The mid-span section cuts were analyzed from 0.40L to 0.60L, in 0.05L increments. The end-span section cut was analyzed with respect to the range of deterioration, broken up into quarter points.

4. In BrR, Member Alternatives were created for each deterioration range that corresponds to the section cuts established in step 2. These member alternatives (referred to as "Section Cut Member Alternatives" hereafter) are copies of the original Member Alternatives. In each Section Cut Member Alternative, under the Strand Layout tab, the Force and "P and CGS only" Description Type option was selected and the Force and CGS values calculated in Step 4 were input. Points of Interest were then created at the points noted in Step 3 for both the original Member Alternatives and the Section Cut Member Alternatives.
5. The Section Cut Member Alternatives were then analyzed to view the capacities generated by BrR:
    - For Flexural Strength, a screenshot of the moment capacity at each Point of Interest was taken. Then, at each Point of Interest in the original Member Alternative, the moment capacities were overridden by the capacities shown in the screenshots.
    - For Concrete Tensile Stress, a screenshot of the tensile stress rating at each Point of Interest was taken. The tensile stress cannot be overridden in the Point of Interest tabs. Therefore, the controlling ratings from the screenshots were considered the controlling tensile stress ratings for each beam (with the deterioration ranges taken into account).
    - For Shear Strength, a screenshot of the shear capacity at each Point of Interest was taken. Then, at each Point of Interest in the original Member Alternative, the shear capacity was overridden by the capacities shown in the screenshot.
6. The original Member Alternatives were then analyzed with the override capacity Points of Interest defined in step 6. For the concrete tensile stress rating, the ratings from the Section Cut Member Alternatives were compared with the ratings from the original Member Alternatives and the lowest rating for each beam was considered the controlling rating for the tensile stress limit state.

Since there is deterioration located at and near mid-span and since these critical locations control the rating, *MassDOT Draft 2018 LRFD Bridge Manual Section 7.2.10.6* was not considered because the locations of strand re-development would not control the rating.

EVALUATION OF RATING AND RECOMMENDATIONS

PITTSFIELD HOLMES ROAD OVER HOUSATONIC RAILROAD BRIDGE NO. P-10-002

Interior Beam B7 produces a 0 ton rating for the H20, Type 3, Type 3S2, HS20, SU4, SU5, SU6, SU7, EV2, and EV3 vehicles at both the inventory and operating levels. Beam B3 produces a below statutory rating for the HS20,SU6, and SU7 vehicles at the inventory level. Beam B4 produces a below statutory rating for the Type 3S2, HS20, SU4, SU5, SU6, SU7 vehicles at the inventory level. Beam B6 produces a below statutory rating for the HS20, SU6, SU7 vehicles at the inventory level. Beam B9 produces a below statutory rating for the Type 3, Type 3S2, HS20, SU4, SU5, SU6, SU7 vehicles at the inventory level.

The inventory level ratings by the load factor method are governed by the flexural and concrete tensile capacity of Interior Beam B7 for H20 (0.0 tons), Type 3 (0.0 tons), Type 3S2 (0.0 tons), HS20 (0.0 tons), SU4 (0.0 tons), SU5 (0.0 tons), SU6 (0.0 tons) and SU7 (0.0 tons).

The operating level ratings by the load factor method are governed by flexural capacity of Interior Beam B7 for H20 (0.0 tons), Type 3 (0.0 tons), Type 3S2 (0.0 tons), HS20 (0.0 tons), SU4 (0.0 tons), SU5 (0.0 tons), SU6 (0.0 tons), SU7 (0.0 tons), EV2 (0.0 tons) and EV3 (0.0 tons) vehicles.

The MS18 load factor ratings (inventory and operating) are governed by flexural and concrete tensile capacity of Interior Beam B7. The MS18 ratings (metric tons) are 0.0 (MS 0.0 equivalent) and 0.0 (MS 0.0 equivalent) for the inventory and operating levels, respectively.

Based on the Routine Inspection report dated May 22, 2018 and site visits on July 7, 2017 by AI Engineers, Inc. the structure is in poor condition.

Based on advanced deterioration and resulting prestressing losses at midspan, which were modeled per MassDOT Draft 2018 Bridge Manual Section 7.2.10, several of the beams are rating with severely reduced flexure capacities. Therefore, AI Engineers, Inc. recommends that bridge replacement be considered. In the interim, we recommend monitoring the beam deterioration by more frequent special member inspection.

AVAILABLE PLANS AND INSPECTION REPORTS

PITTSFIELD HOLMES ROAD OVER HOUSATONIC RAILROAD BRIDGE NO. P-10-002

The following field inspection reports and plans were made available to AI Engineers, Inc., for use in determining the live load rating of the bridge:

1. Massachusetts Department of Transportation
   Routine Inspection
   Bridge No. P-10-002 (0DY)
   Structure No. P10002-0DY-DOT-634
   Dated: May 22, 2018

2. Massachusetts Department of Transportation
   Structural Inventory and Appraisal
   Bridge No. P-10-002 (0DY)
   Structure No. P10002-0DY-DOT-634

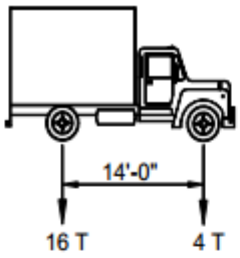
3. The Commonwealth of Massachusetts
   Proposed Bridge in Pittsfield
   Holmes Road Over Conrail R.R.
   May 21, 1977
   Sheets 1 of 14 to 14 of 14

TRUCK LOADINGS

PITTSFIELD HOLMES ROAD OVER HOUSATONIC RAILROAD BRIDGE NO. P-10-002

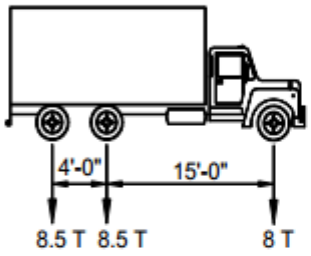
H20 VEHICLE

TOTAL WEIGHT
20 TONS



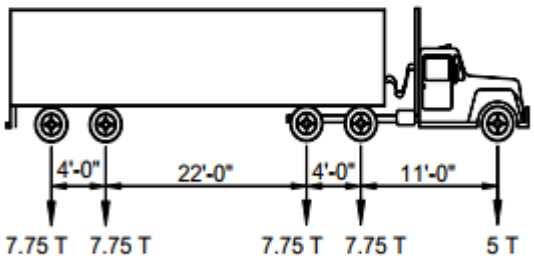
TYPE 3 VEHICLE

TOTAL WEIGHT
25 TONS



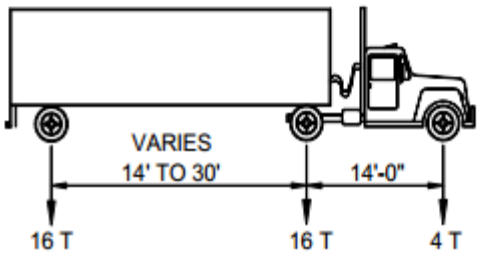
TYPE 3S2 VEHICLE

TOTAL WEIGHT
36 TONS



HS20 VEHICLE

TOTAL WEIGHT
36 TONS

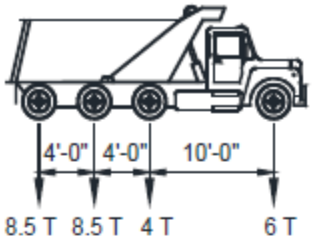


TRUCK LOADINGS

PITTSFIELD HOLMES ROAD OVER HOUSATONIC RAILROAD BRIDGE NO. P-10-002

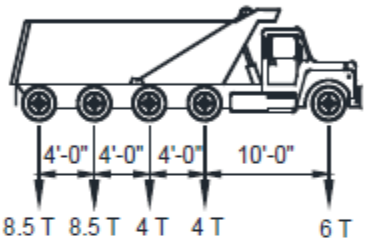
SU4 TRUCK

TOTAL WEIGHT
27 TONS



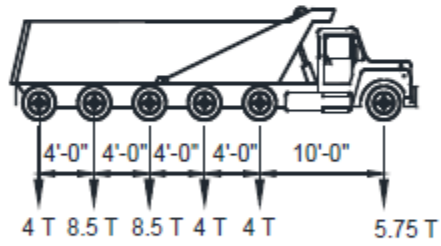
SU5 TRUCK

TOTAL WEIGHT
31 TONS



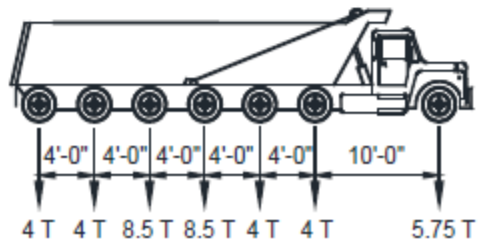
SU6 TRUCK

TOTAL WEIGHT
34.75 TONS



SU7 TRUCK

TOTAL WEIGHT
38.75 TONS

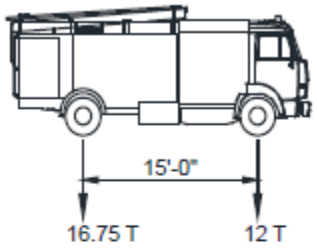


TRUCK LOADINGS

PITTSFIELD HOLMES ROAD OVER HOUSATONIC RAILROAD BRIDGE NO. P-10-002

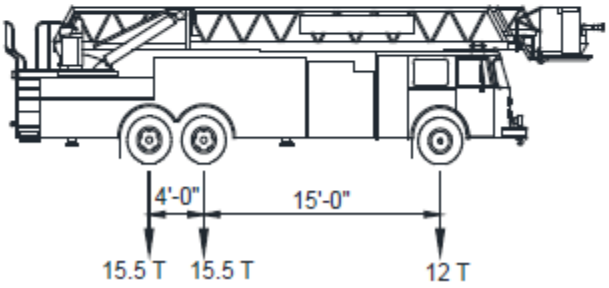
EV2 VEHICLE

TOTAL WEIGHT
28.75 TONS



EV3 VEHICLE

TOTAL WEIGHT
43 TONS



APPENDIX A
INSPECTION REPORTS

APPENDIX B
PHOTOS

INDEX OF PHOTOS

PITTSFIELD HOLMES ROAD OVER HOUSATONIC RAILROAD BRIDGE NO. P-10-002

P-10-002 (0DY)
WEST APPROACH LOOKING EAST

P-10-002 (0DY)
EAST APPROACH LOOKING WEST

P-10-002 (0DY)
NORTH ELEVATION LOOKING SOUTH

P-10-002 (0DY)
UNDERSIDE OVERVIEW

P-10-002 (0DY)
HOUSATONIC RAILROAD LOOKING NORTH

P-10-002 (0DY)
HOUSATONIC RAILROAD LOOKING SOUTH

P-10-002 (0DY)
WEARING SURFACE OVERVIEW

P-10-002 (0DY)
SPALLING AND EXPOSED TENDONS (BEAM 6)

P-10-002 (0DY)
SPALLING AND EXPOSED TENDONS (BEAM 7)

APPENDIX C
COMPUTATIONS

INDEX OF COMPUTATIONS

PITTSFIELD HOLMES ROAD OVER HOUSATONIC RAILROAD BRIDGE NO. P-10-002

PITTSFIELD HOLMES ROAD OVER HOUSATONIC RAILROAD BRIDGE NO. P-10-002

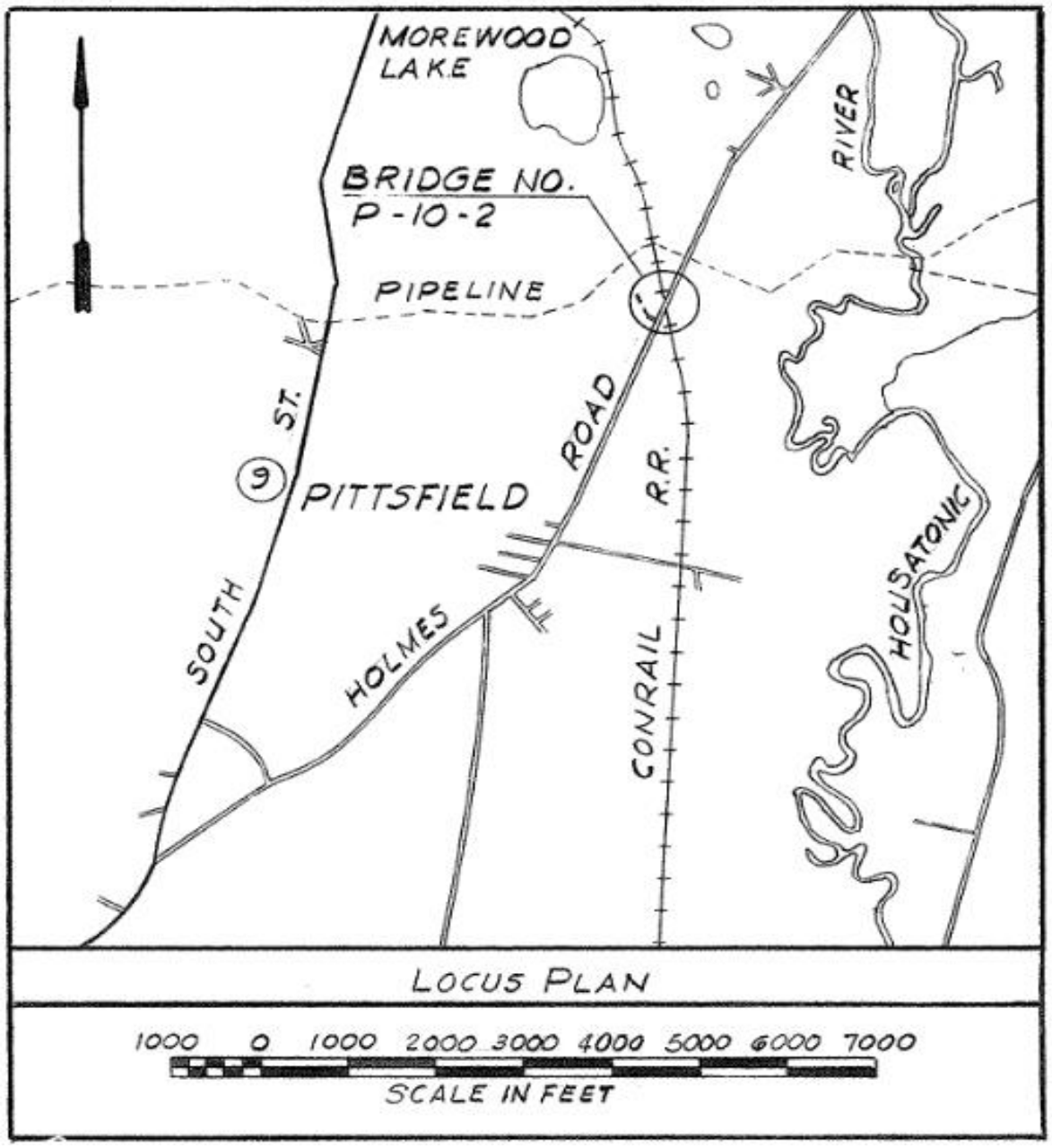
CHECK OF CALCULATIONS SUBMISSION

"I hereby state that I have checked the methods, assumptions, load distributions, computer input files, and all calculations for this rating report for bridge No. P-10-002 (0DY). By signing below, I confirm that I agree with all methods, assumptions, load distributions, and calculations contained in this rating report.

Basil B Bantimba 3/6/2019

BASIL BANTIMBA, P.E. DATE

AI Engineers, Inc.	BRIDGE	P-10-002	PREPARED BY	SS
			DATE	6/2017
	SUBJECT	Locus Plan	CHECKED BY	ST
			DATE	7/2017



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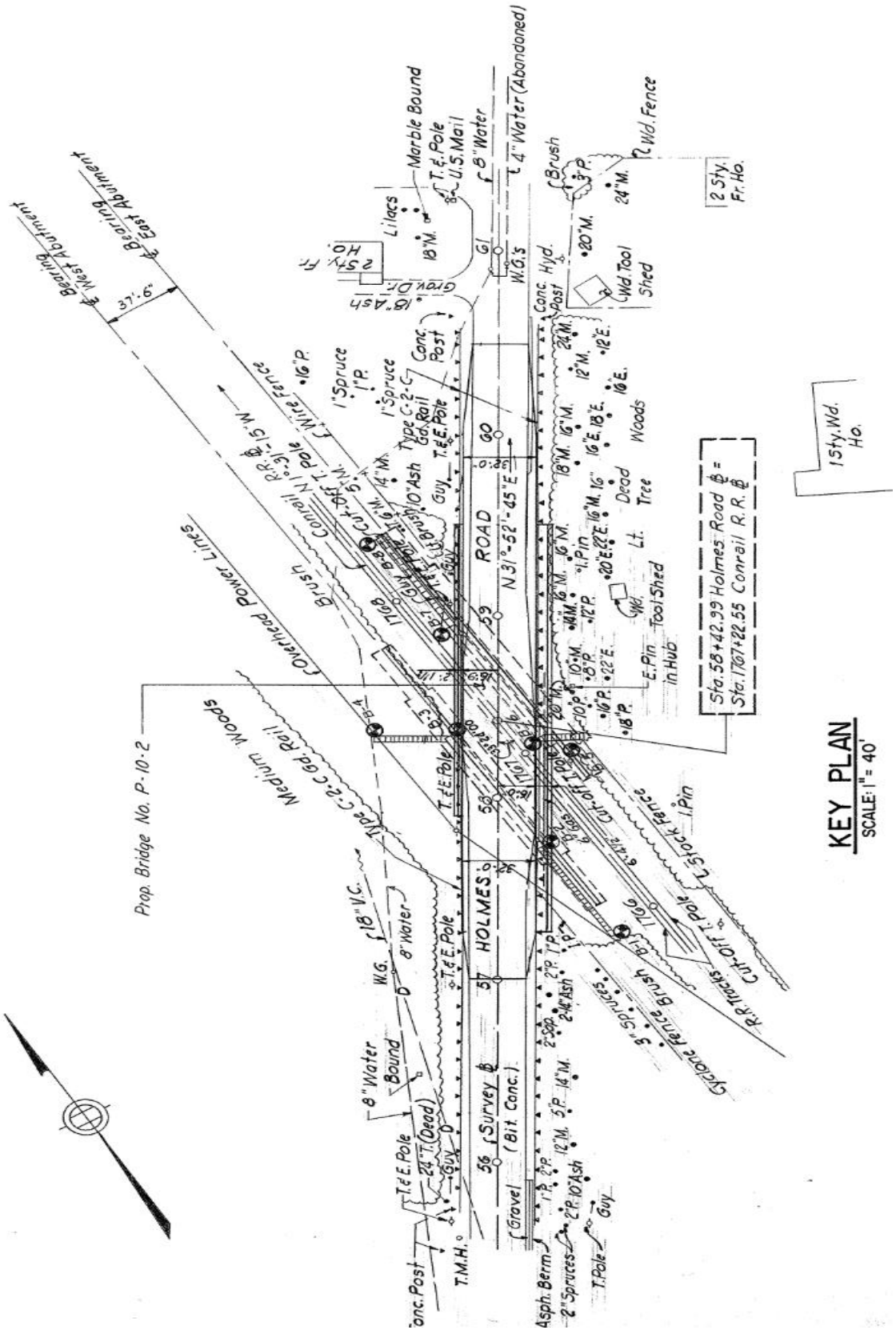
			DATE	6/2017
	SUBJECT	Key Plan	CHECKED BY	ST
			DATE	7/2017



AI Engineers, Inc.	BRIDGE	P-10-002	PREPARED BY	SS
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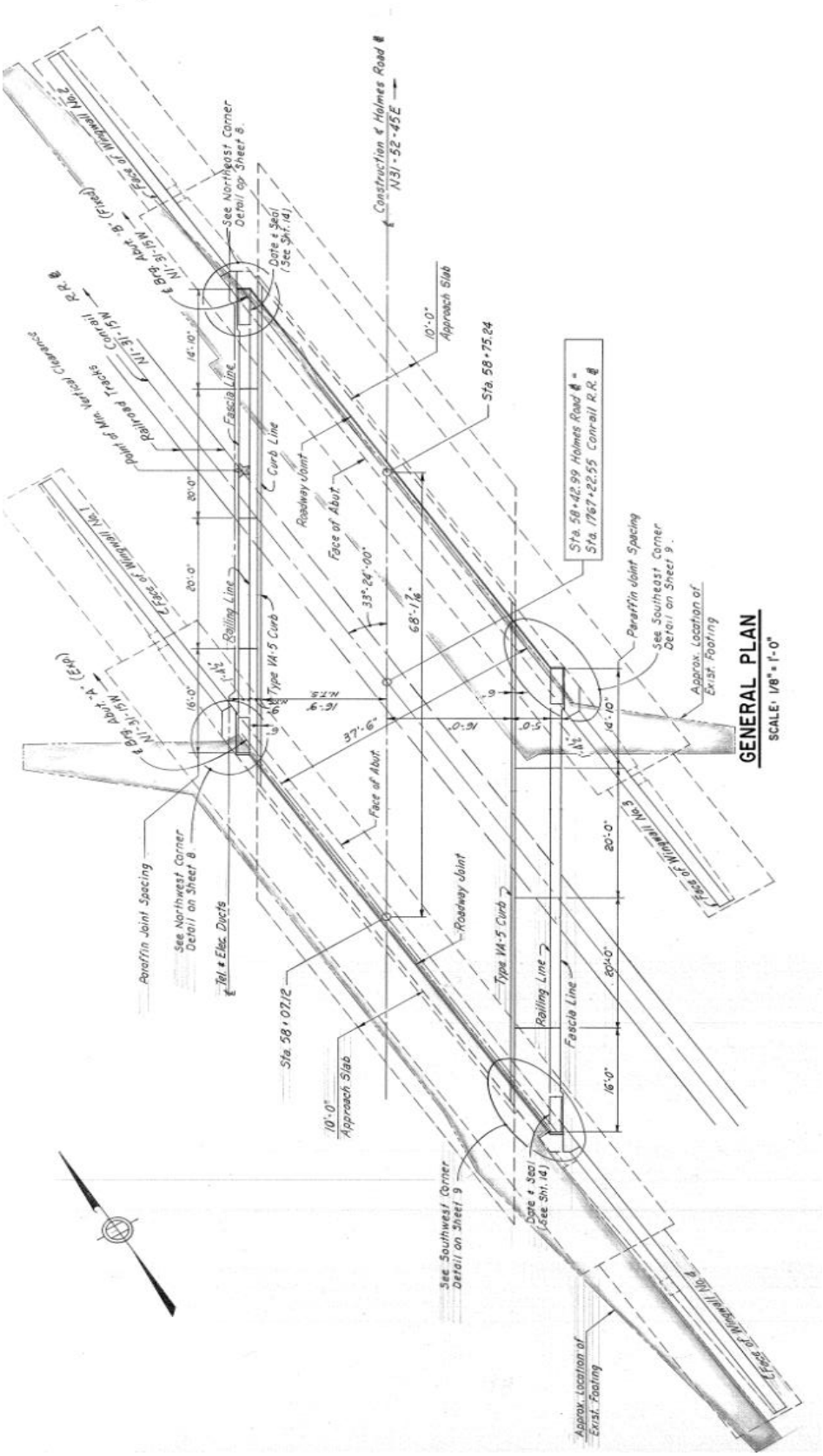
	SUBJECT	General Plan	CHECKED BY	ST
			DATE	7/2017



AI Engineers, Inc.	BRIDGE	P-10-002	PREPARED BY	SS
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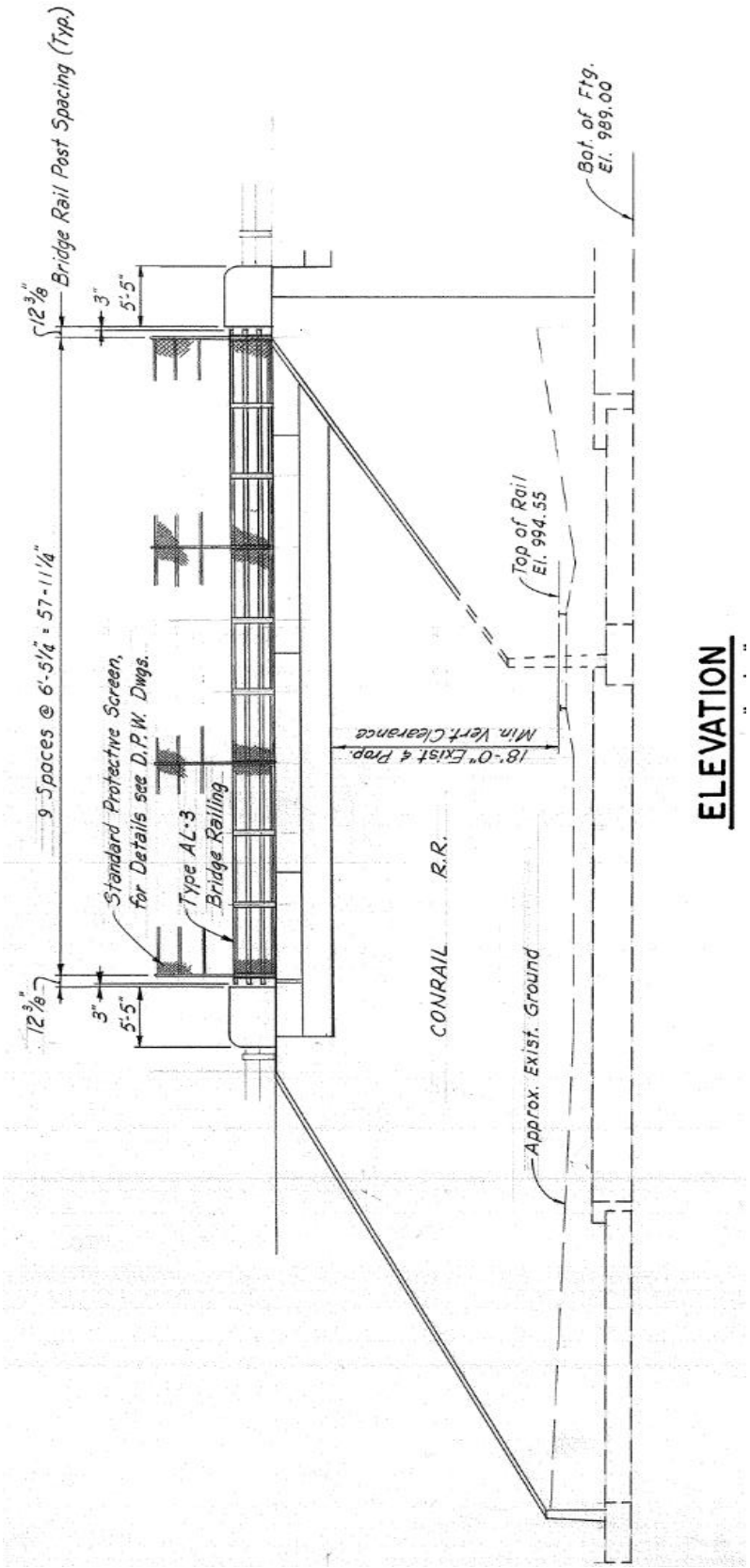
	SUBJECT	Bridge Elevation	CHECKED BY	ST
			DATE	7/2017



AI Engineers, Inc.	BRIDGE	P-10-002	PREPARED BY	SS
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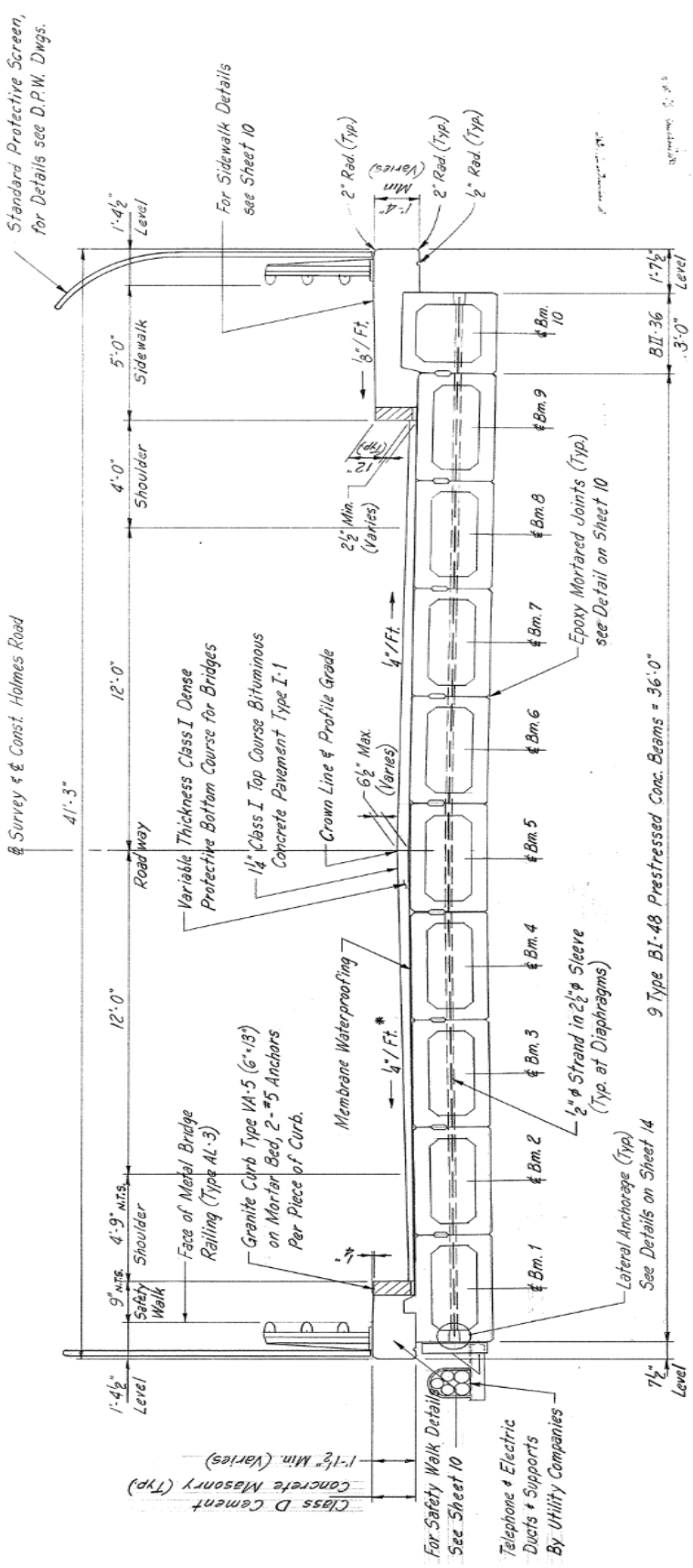
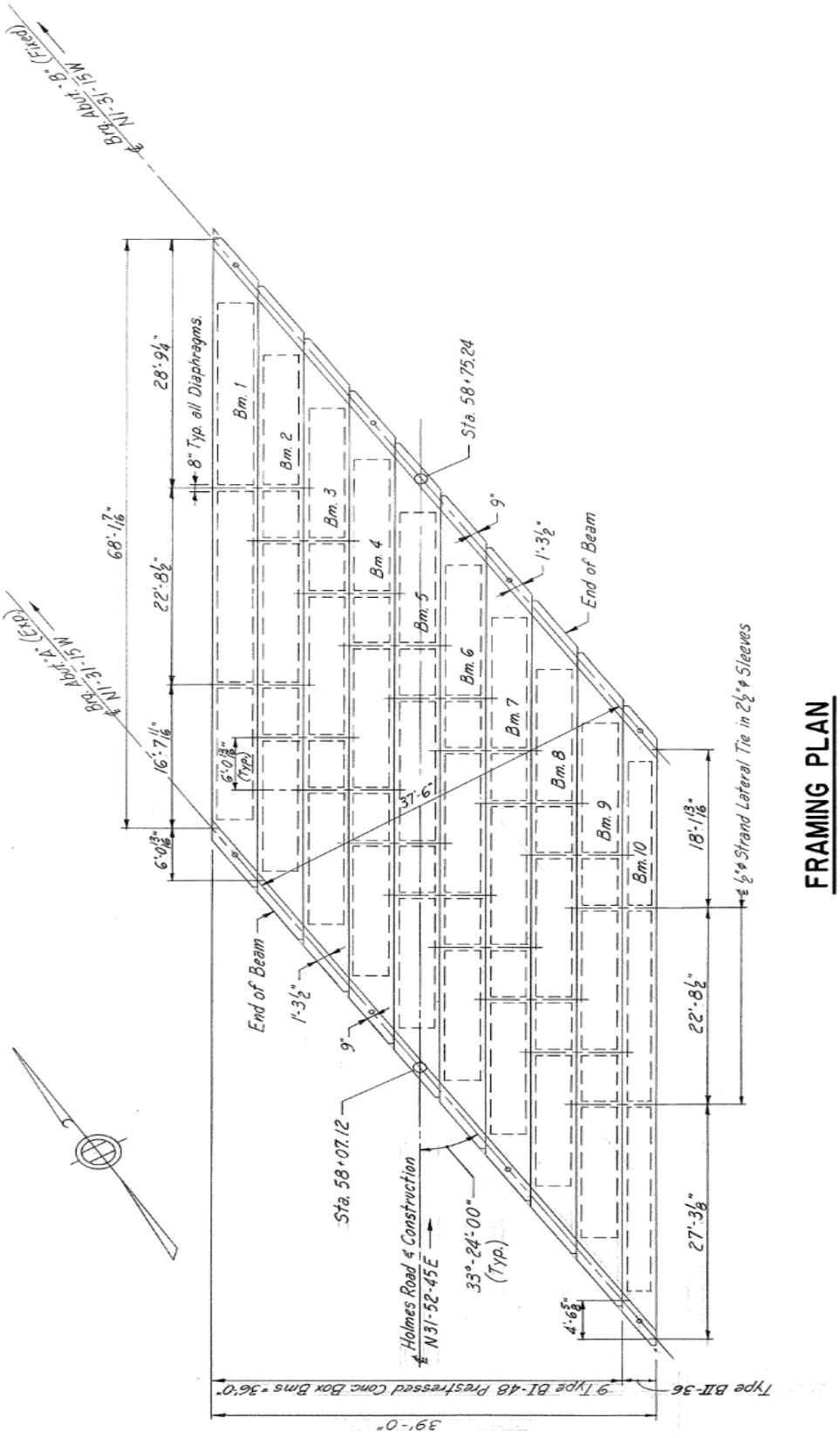
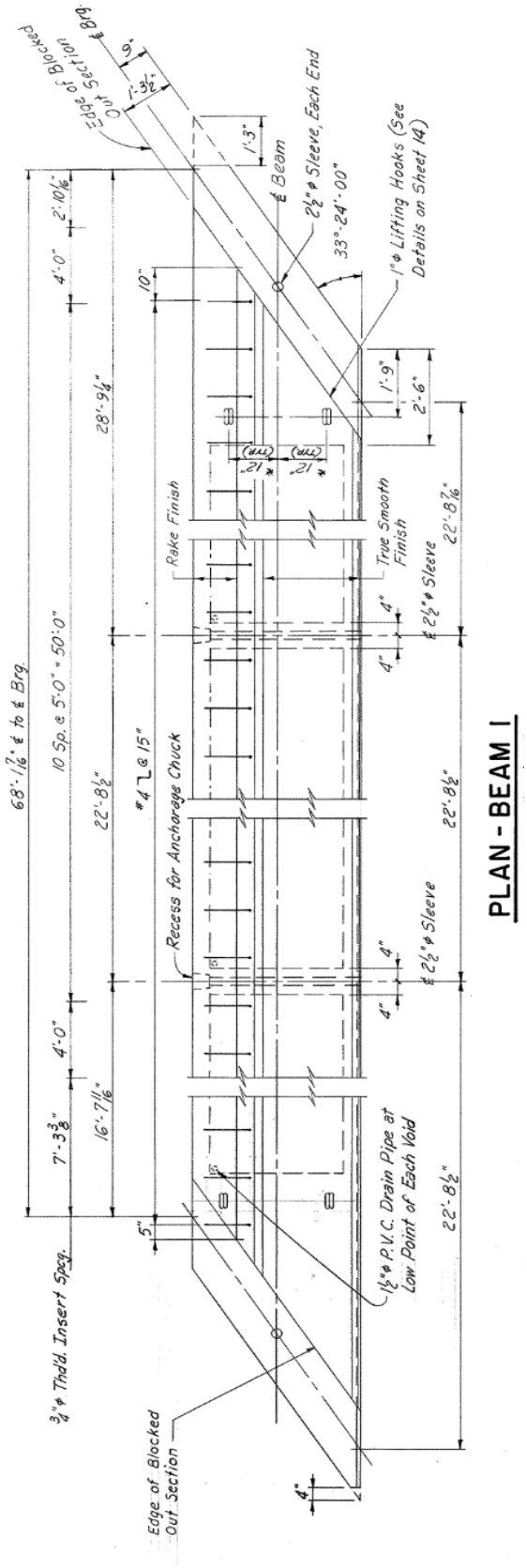
	SUBJECT	Transverse Section	CHECKED BY	ST
			DATE	7/2017

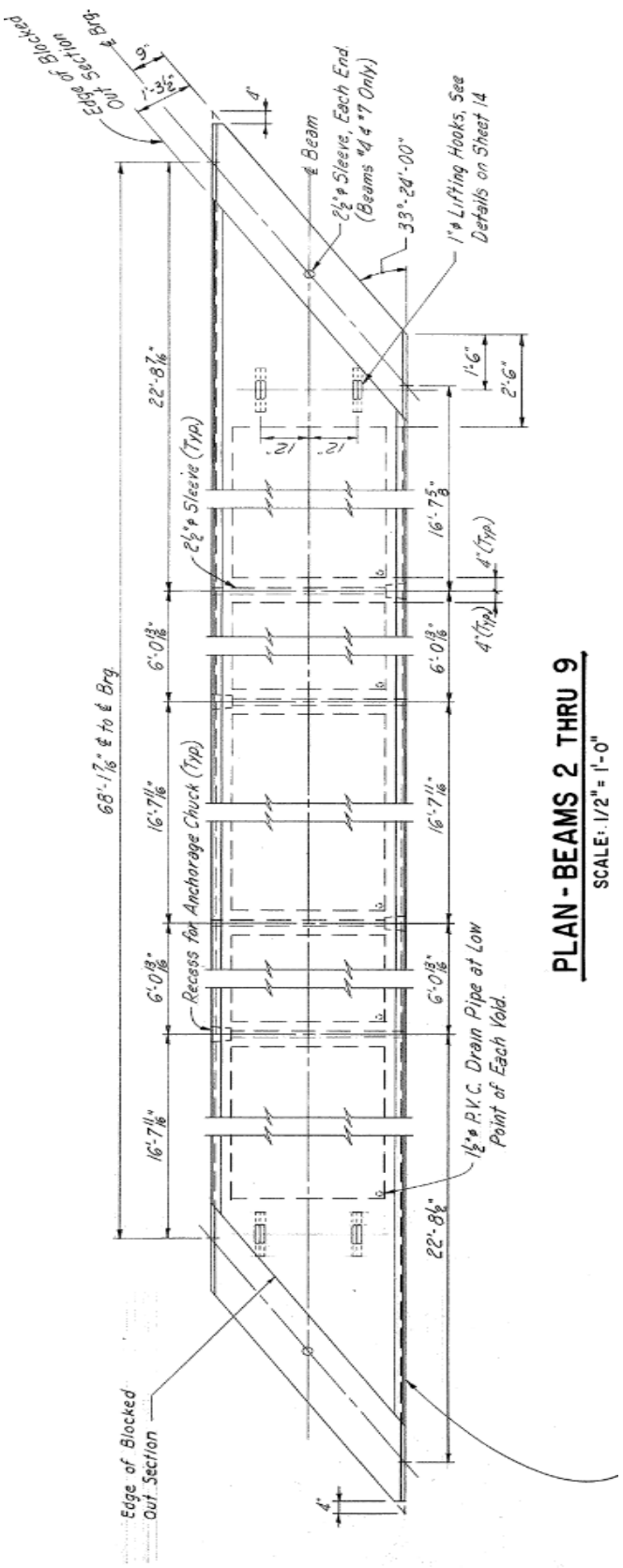



FRAMING PLAN
Bm. 1
Bm. 2
Bm. 3
Bm. 4
Bm. 5
Bm. 6
Bm. 7
Bm. 8
Bm. 9
Bm. 10
8" Typ. all Diaphragms.
Sta. 58+75.24
Sta. 58+07.12
End of Beam
End of Beam
9"
1'-3½"
9"
1'-3½"
37'-6"
6'-0⅛" (Typ.)
6'-0⅛"
68'-1⅞"
28'-9¼"
22'-8½"
16'-7⅛"
18'-1⅜"
22'-8½"
27'-3⅝"
4'-6⅝"
½" ϕ Strand Lateral Tie in 2½" ϕ Sleeves
℄ Holmes Road & Construction
N31-52-45E
33°-24'-00" (Typ.)
9 Type BI-48 Prestressed Conc. Box Bms = 36'-0"
Type BII-36
39'-0"
N31-31-15W (Typ.)
N31-31-15W (Typ.)

AI Engineers, Inc.	BRIDGE	P-10-002	PREPARED BY	SS
			DATE	6/2017
	SUBJECT	Beam Plans	CHECKED BY	ST
			DATE	7/2017

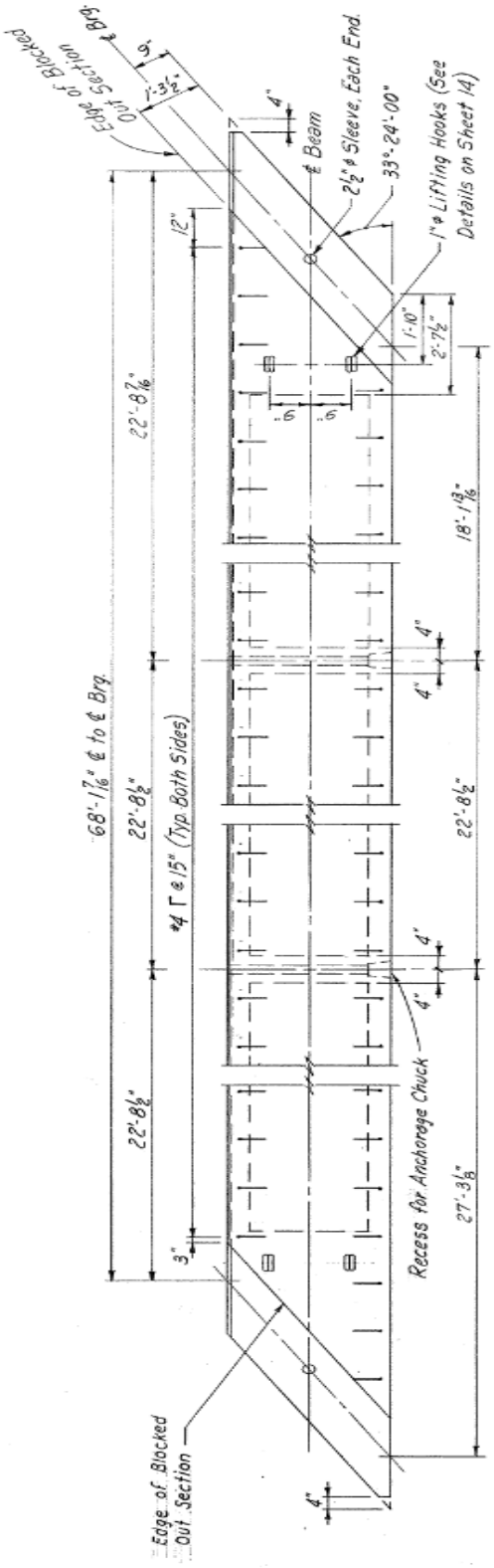


PLAN - BEAM I

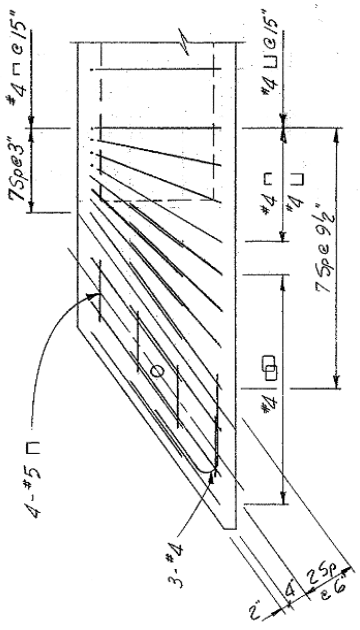


PLAN - BEAMS 2 THRU 9

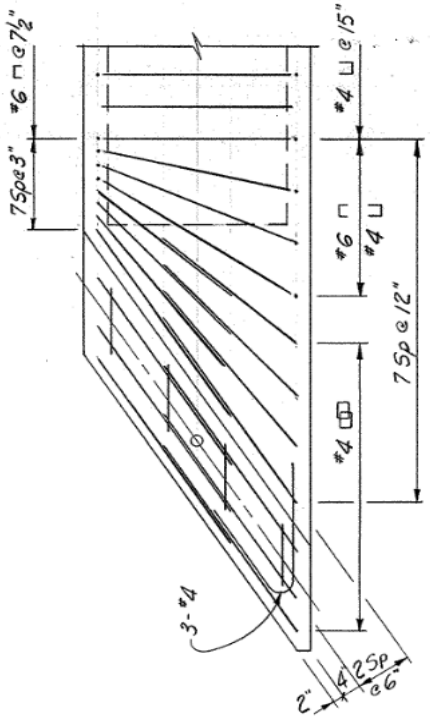
SCALE: 1/2" = 1'-0"



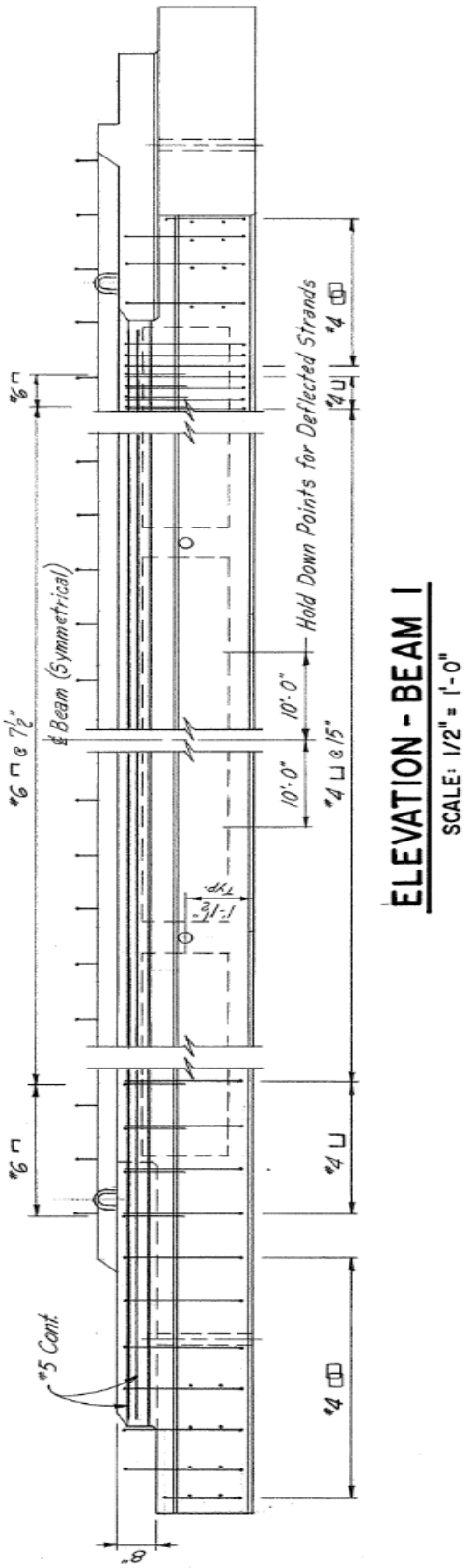
PLAN - BEAM 10
SCALE: 1/2" = 1'-0"



PLAN - END OF BEAM 10
N.T.S.

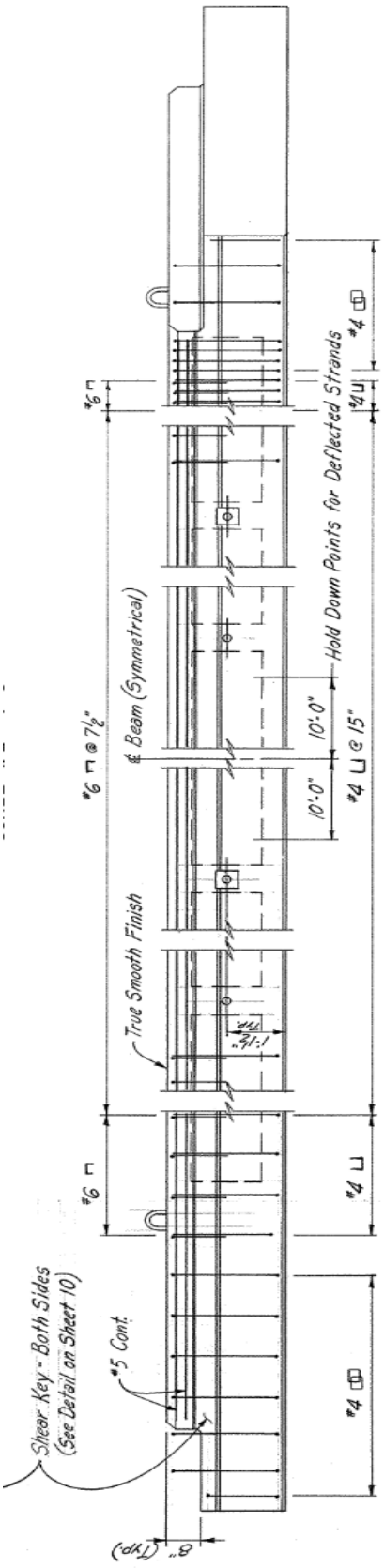


PLAN - END OF BEAMS 1 THRU 9
SCALE: 1/2" = 1'-0"



ELEVATION - BEAM 1

SCALE: 1/2" = 1'-0"



ELEVATION - BEAMS 2 THRU 9

SCALE: 1/2" = 1'-0"

AI Engineers, Inc.	BRIDGE	P-10-002	PREPARED BY	SS
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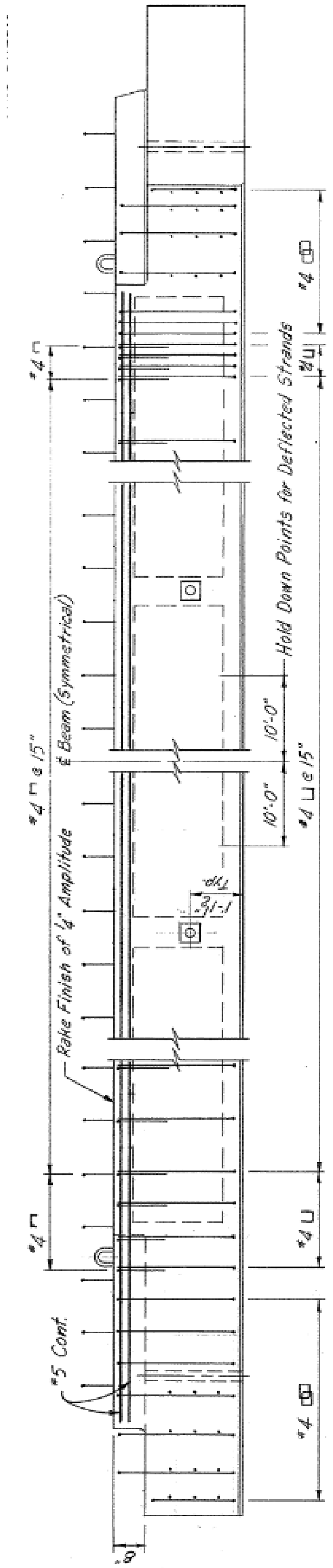
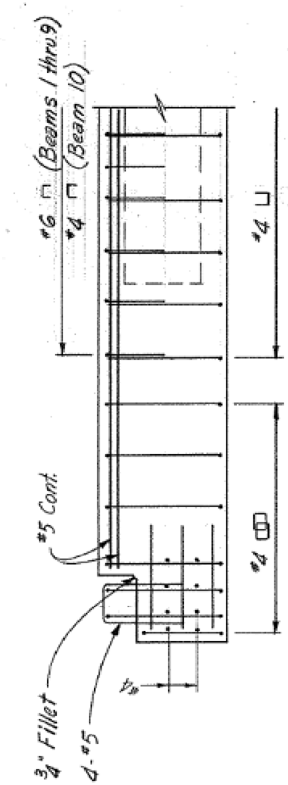
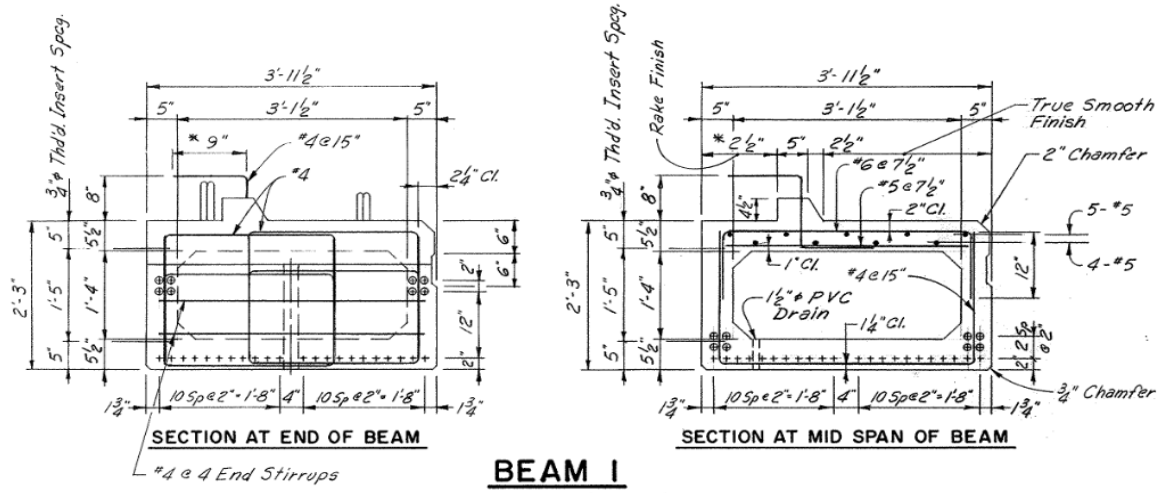
			DATE	7/2017



ELEVATION - BEAM 10
SCALE: 1/2" = 1'-0"

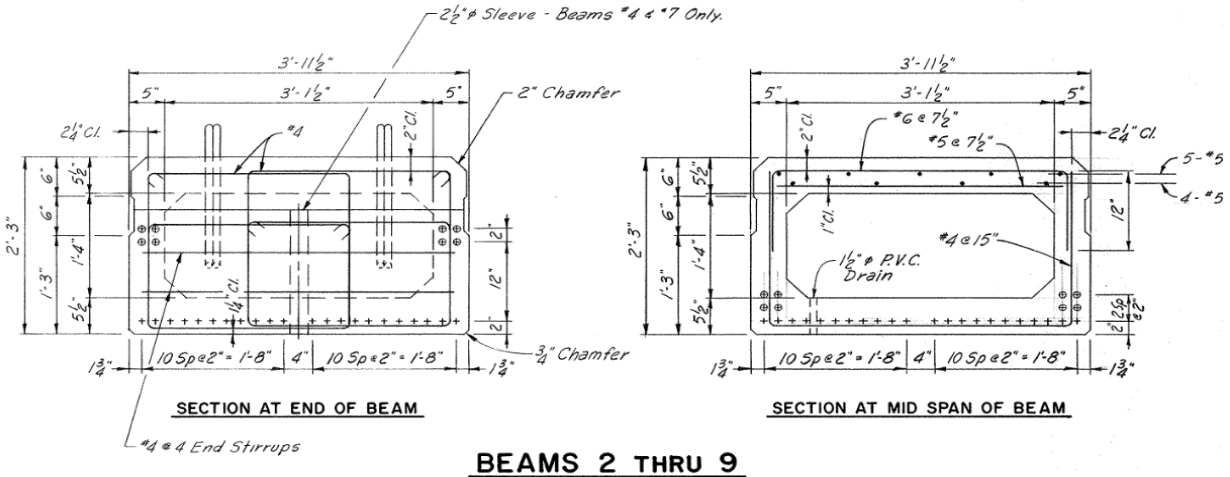


ELEVATION - END OF BEAMS
SCALE: 1/2" = 1'-0"



BEAM 1

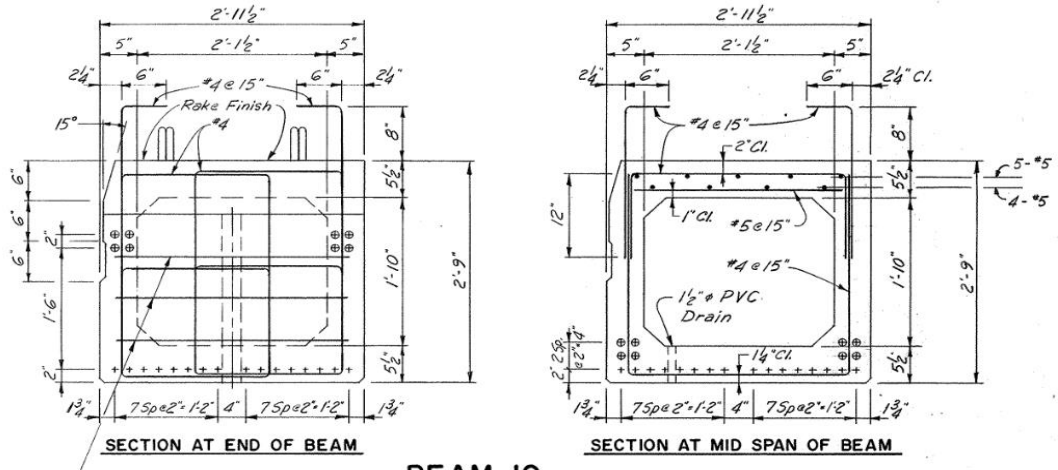
SCALE: 3/4" = 1'-0"



BEAMS 2 THRU 9

SCALE: 1" = 1'-0"

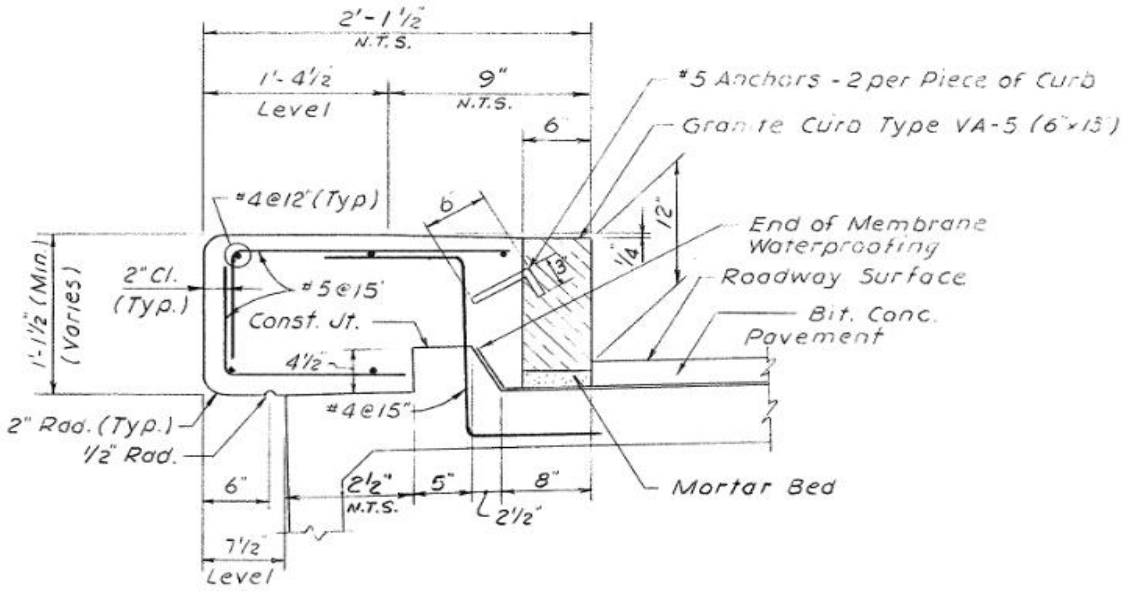
⊕ Denotes Deflected Strands
\+ Denotes Straight Strands
All Strands are ½" ø (270K)



BEAM 10

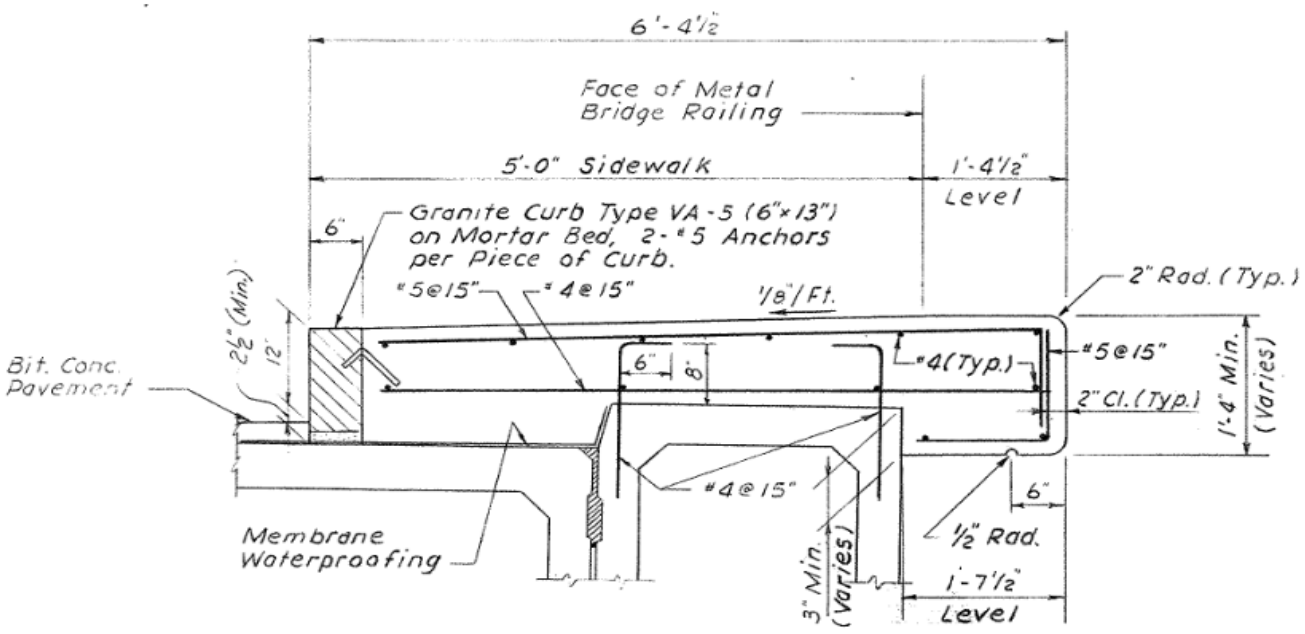
SCALE: 1" = 1'-0"

⊕ Denotes Deflected Strands
\+ Denotes Straight Strands
All Strands ½" ø (270K)



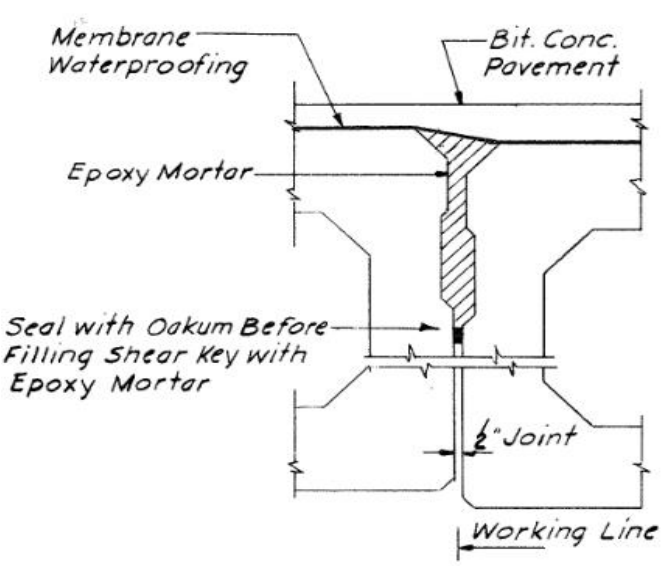
SAFETY WALK DETAILS

SCALE: 1" = 1'-0"



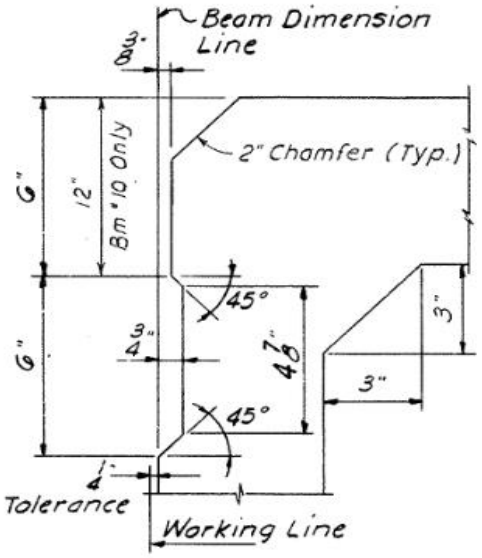
SIDEWALK DETAILS

SCALE: 3/4" = 1'-0"



TYPICAL JOINT DETAIL

SCALE: 1 1/2" = 1'-0"

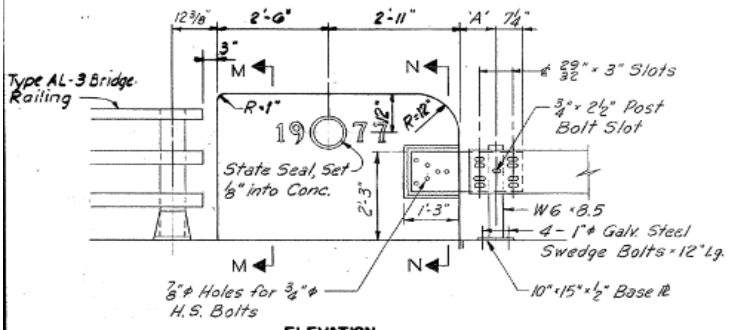


SHEAR KEY DETAIL

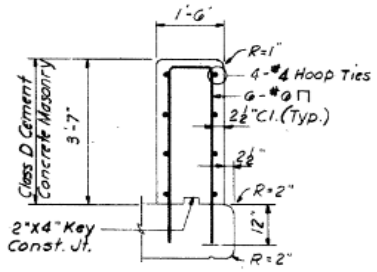
SCALE: 3" = 1'-0"

Date and Seal on Northeast and Southwest End Post Only.

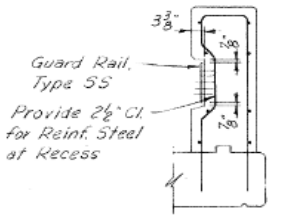
'A': 9 3/4" at Northeast & Southwest Corners
3'-0" at Northwest & Southeast Corners



ELEVATION



SECTION M-M

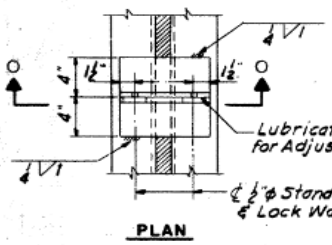


SECTION N-N

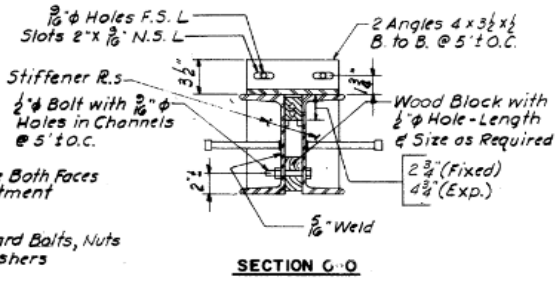
END POST AND GUARD RAIL ATTACHMENT DETAILS

SCALE: 1/2" = 1'-0"

NOTE: Galvanizing Shall Conform to ASTM A153
Bolts & Washers Shall Conform to ASTM A307



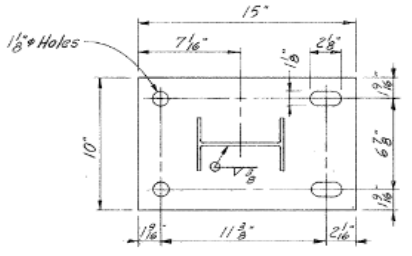
PLAN



SECTION G-O

SHIPPING DEVICE FOR ROADWAY ARMORED JOINT

SCALE: 1 1/2" = 1'-0"



BASE PLATE DETAIL

N.T.S.

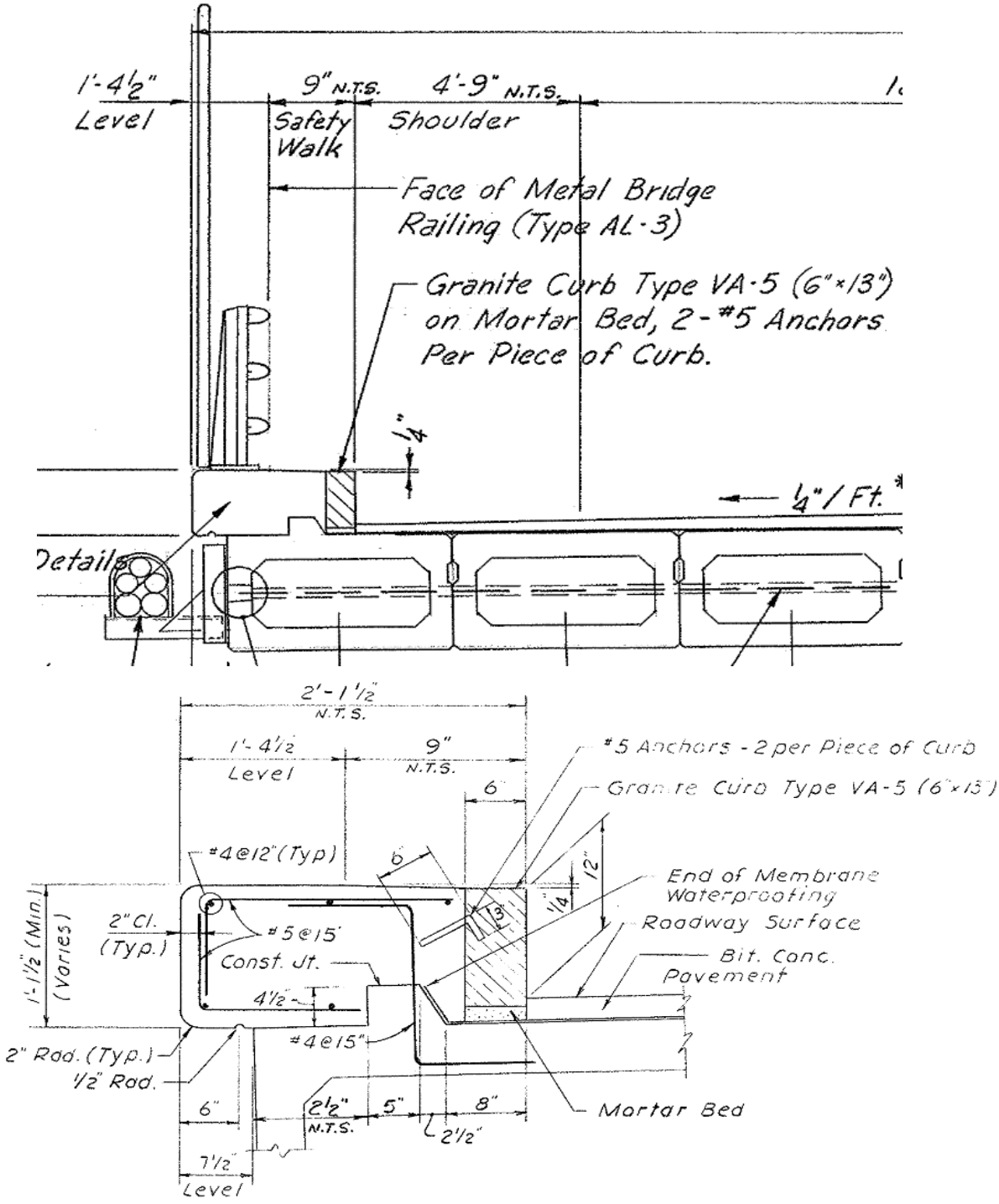
NOTES:

1. Initial Prestress Force ($\frac{1}{2}$"ϕ Strands, ASTM Grade 270K)
   Beam 1: 30 × 28,910 = 867,300 Lbs.
   Beam 10: 24 × 28,910 = 693,840 Lbs.
2. Minimum 28 Day Cylinder Strength of Conc. = 5000 p.s.i.
3. Minimum Strength of Conc. at Prestress = 4000 p.s.i.
4. Initial Tensioning Per $\frac{1}{2}$"ϕ Strand = 28,910 Lbs.
5. Dimensions Shown with an Asterisk (*) are Not to Scale.

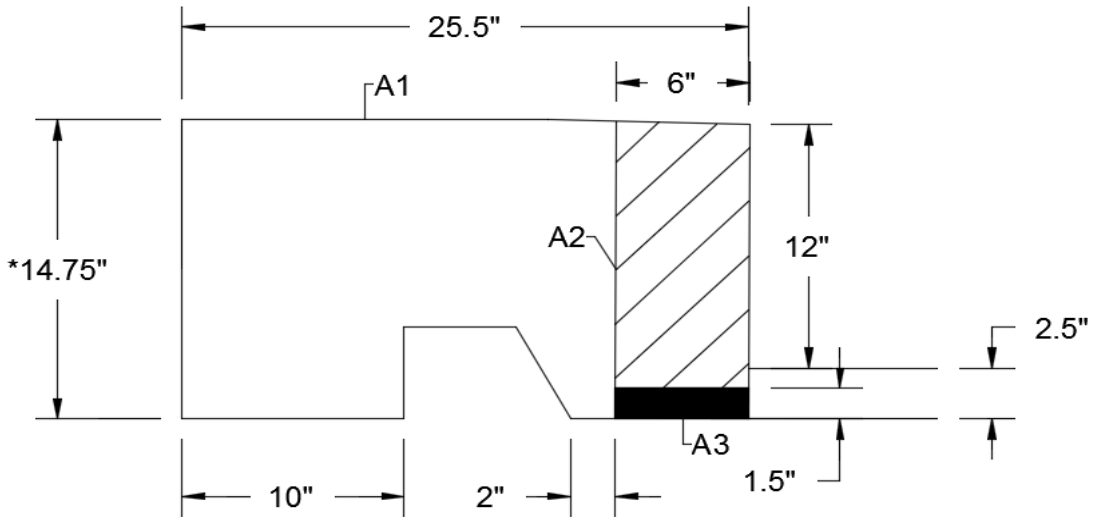
REINFORCEMENT

ALL BARS SHALL CONFORM TO A.S.T.M. SPECIFICATIONS FOR A615 GRADE 60. UNLESS OTHERWISE SHOWN ON THE PLANS ALL NO.4 BARS SHALL BE LAPPED 20" AND ALL NO.5 BARS SHALL BE LAPPED 26". FOR HORIZONTAL BARS WITH 12" OR MORE OF CONCRETE BELOW THE BAR THE LAP LENGTHS SHALL BE 29" FOR NO.4 BARS AND 36" FOR NO.5 BARS. IF THE ABOVE BARS ARE SPACED 6" OR MORE ON CENTER, THE LAP LENGTH SHALL BE 80% OF THE LAP LENGTH GIVEN ABOVE. ALL OTHER BARS SHALL BE LAPPED AS SHOWN ON THE PLANS.

North Side - Safety Walk Dead Load



Note: Plan shows utility is attached to exterior face of Beam 1. Since no utility was observed during field visit by AI, utility load was not considered.



*Safety walk height varies; therefore, the height shown on the safety walk detail plans was used.

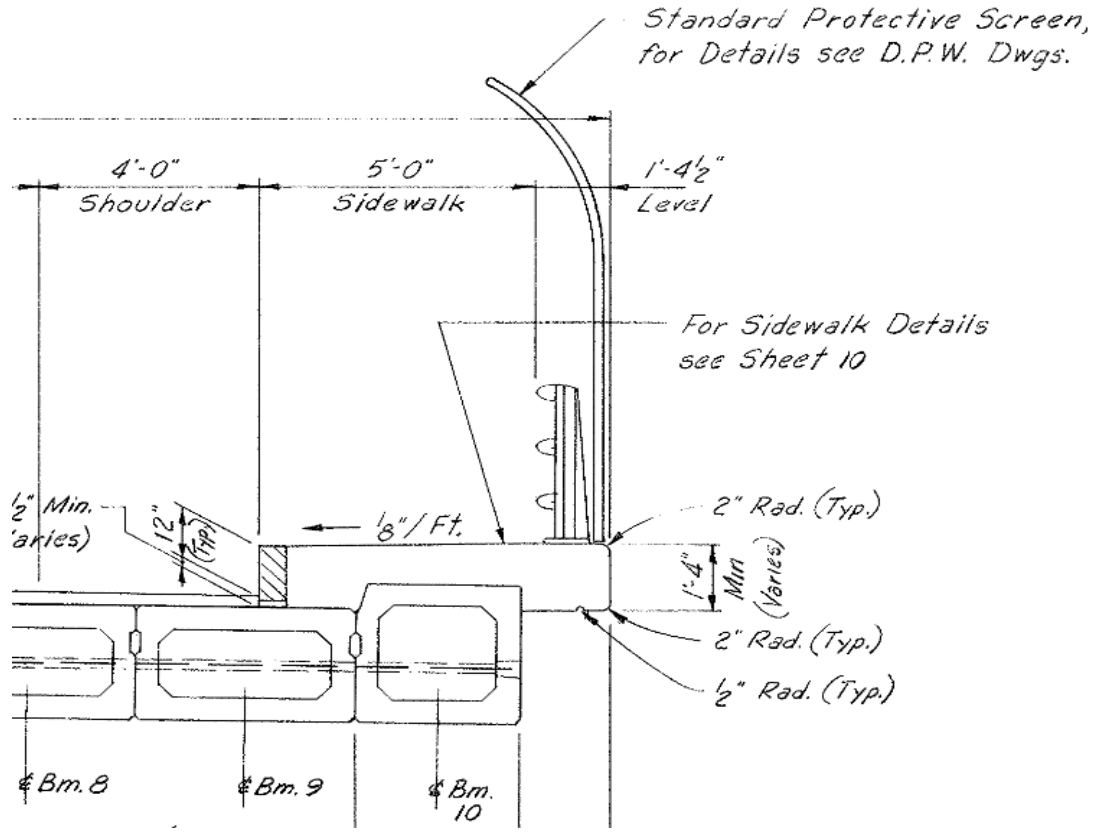
Concrete Safety Walk Area = 259.4 in^2

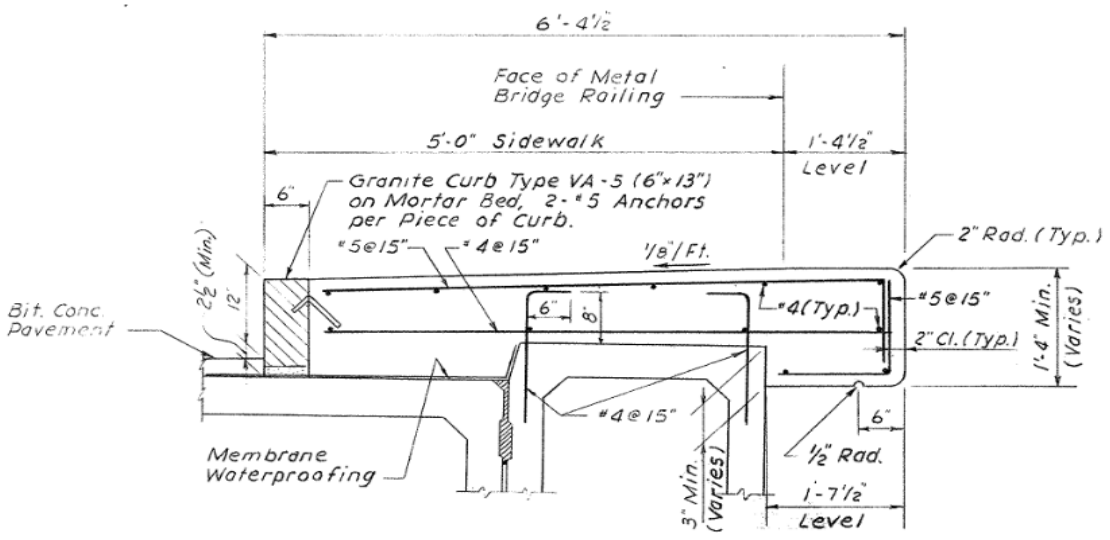
Granite Curb Area = 78.5 in^2

Mortar Area = 9.0 in^2

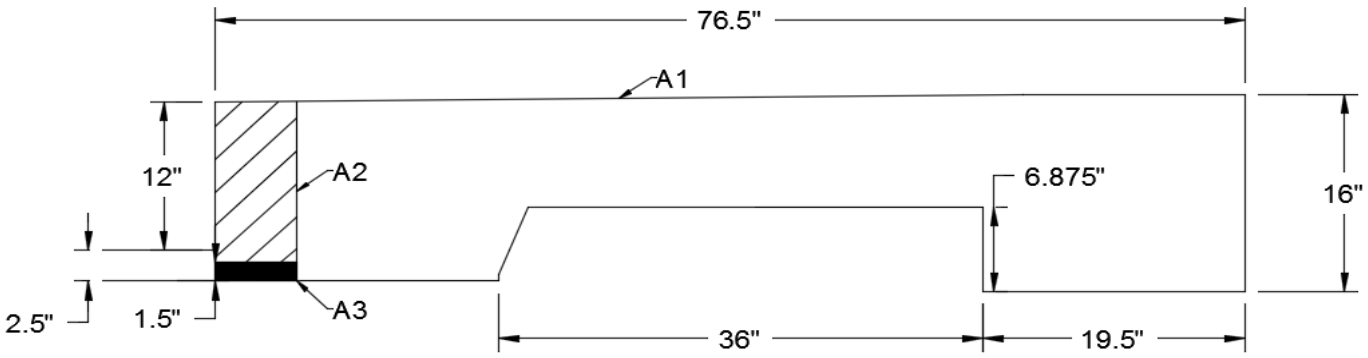
Safety Walk Area, A1 =	259.4	in^2	(from AutoCAD)
Granite Curb Area, A2 =	78.5	in^2	(from AutoCAD)
Mortar Area, A3 =	9.0	in^2	(from AutoCAD)
Concrete Unit Weight =	150	lb/ft^3	
Granite Unit Weight =	170	lb/ft^3	
Mortar Unit Weight =	130	lb/ft^3	
Safety Walk Load =	0.270	k/ft	
Granite Curb Load =	0.093	k/ft	
Mortar Load =	0.008	k/ft	
Pedestrian Fence Load =	0.025	k/ft	(from VDOT Pedestrian Fence Details Plan)
Aluminum Rail and Post Load =	0.030	k/ft	(assumed)
Total North Side Load =	**0.426**	**k/ft**	

South Side - Sidewalk





SIDEWALK DETAILS



Concrete Sidewalk Area = 858.4 in^2

Granite Curb Area = 78.2 in^2

Mortar Area = 9.0 in^2

Sidewalk Area, A1 =	858.4	in^2	(from AutoCAD)
Granite Curb Area, A2 =	78.2	in^2	(from AutoCAD)
Mortar Area, A3 =	9.0	in^2	(from AutoCAD)
Concrete Unit Weight =	150	lb/ft^3	
Granite Unit Weight =	170	lb/ft^3	
Mortar Unit Weight =	130	lb/ft^3	
Sidewalk Load =	0.894	k/ft	
Granite Curb Load =	0.092	k/ft	
Mortar Load =	0.008	k/ft	
Pedestrian Fence Load =	0.030	k/ft	(from VDOT Pedestrian Fence Details Plan)
Aluminum Rail Load =	0.030	k/ft	(assumed)
Total South Side Load =	**1.055**	**k/ft**	

AI Engineers, Inc.	BRIDGE	P-10-002	PREPARED BY	SS
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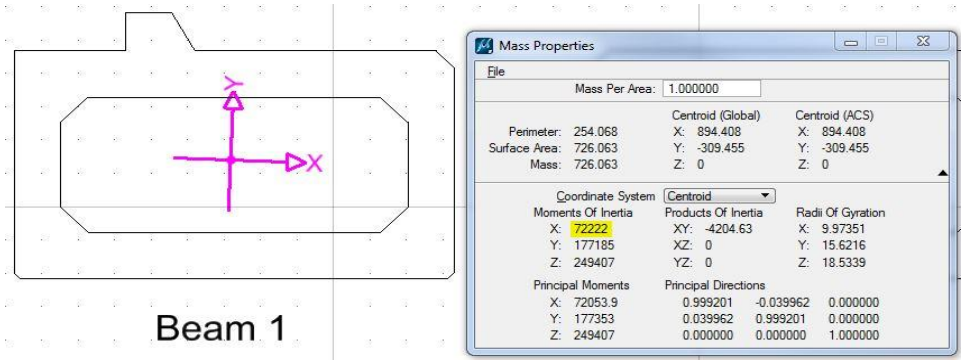
			UPDATED BY	JMA
			DATE	12/2018

MassDOT 3.8.2.5

$$L.D.F._k = \frac{I_k}{\sum_{i=1}^{n} I_i}$$

Beam	I_k (in^4)	I_i (in^4)
1	72222	
2-9	66225.67	
10	85959.74	
		687987.1



Note: I values taken from CAD for Beam 1 and from BrR for Beams 2-10.

Superimposed Dead Load Distribution Factors

Beam	$L.D.F._k$
1	0.105
2-9	0.096
10	0.125

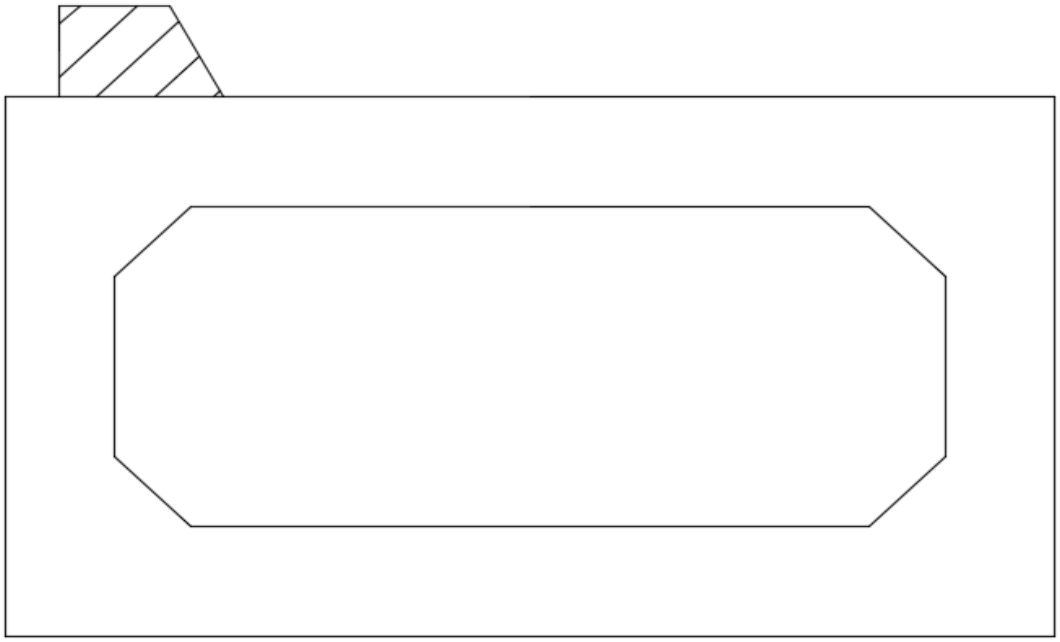
Superimposed Dead Load Summary

Beam	Superimposed Dead Load Due to		Total Superimposed Dead Load (k/ft)
	Q1 (k/ft)	Q2 (k/ft)	
1	0.045	0.111	0.155
2-9	0.041	0.102	0.143
10	0.053	0.132	0.185

Notes:

1. Q1 is for north side and Q2 is for south side.

Beam 1 Additional Dead Load



Additional Concrete Area = 28.13 in^2

Additional Concrete Area =	28.13	in^2	(from AutoCAD)
Concrete Unit Weight =	150	lb/ft^3	
Additional Self Load =	**0.029**	**k/ft**	**(applied as self load to B1)**

AI Engineers, Inc.	BRIDGE	P-10-002	PREPARED BY	SS
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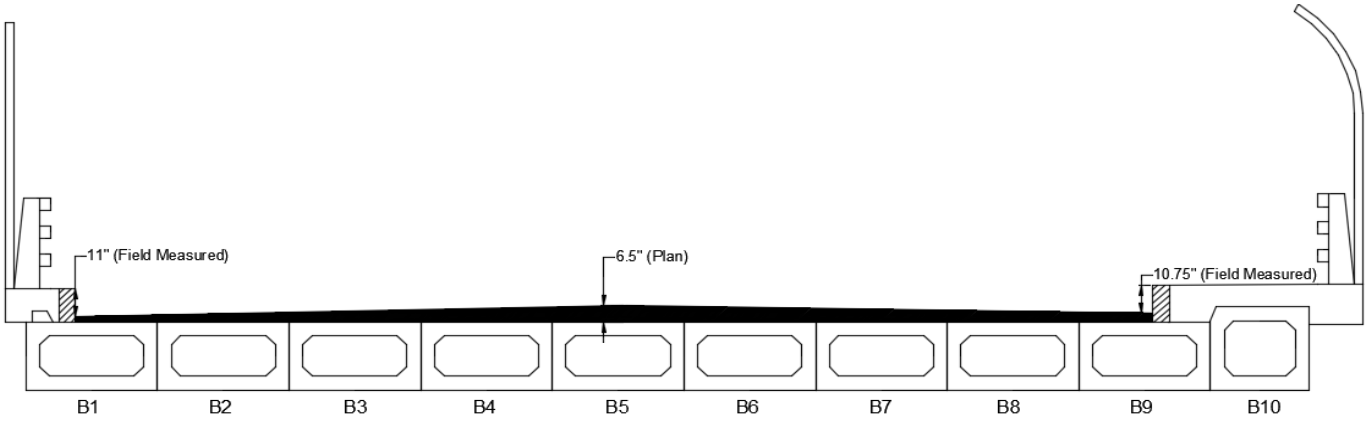
			DATE	7/2017



Wearing Surface Area =	1863.375	in^2
Travelway =	32.75	ft
Average Thickness =	4.75	in
Unit Weight =	0.15	k/ft^3
Wearing Surface Load =	1.941	k/ft (total)
Number of Girders =	10	

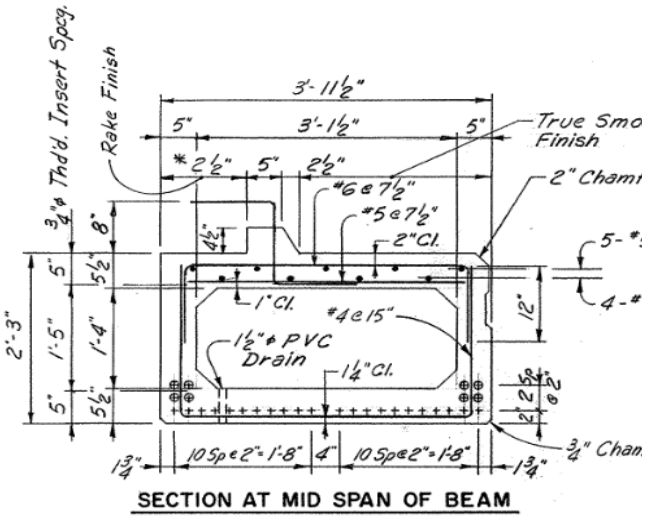
Wearing Surface is distributed equally to all beams per MassDOT Section 7.2.3.5.B

Wearing Surface Load =	0.194	k/ft (per girder)

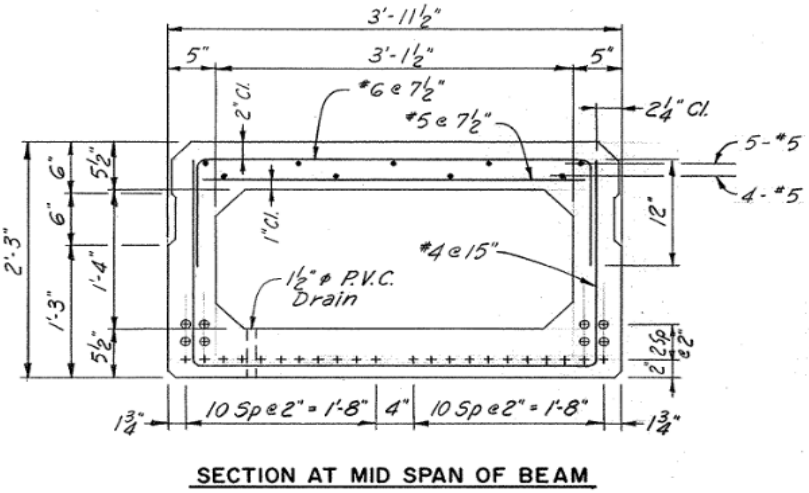
Note: Wearing surface load was input into BrR under the "Structural Typical Section" using a 4.75" average thickness and a unit weight of 0.15 k/ft^3.

BI-48 Void Area (B1 to B9)

Box Width =	48	in
Skew =	33.4	degrees
Unit Weight =	150	lb/ft^3



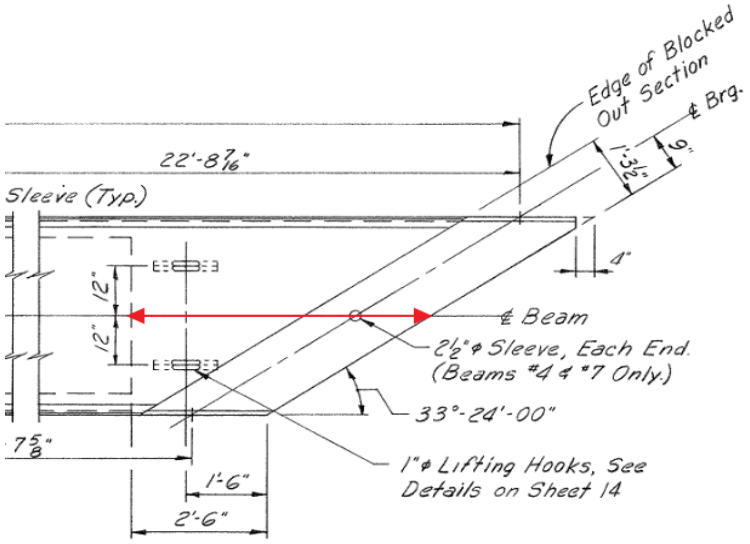
BEAM 1



BEAMS 2 THRU 9

Void Height =	16	in
Void Width =	38	in
Void Chamfer =	3	in
Void Area =	590	in^2

End Diaphragm



Average End Diaphragm Length = 66.40 in

End Diaphragm Load = 3.40 k

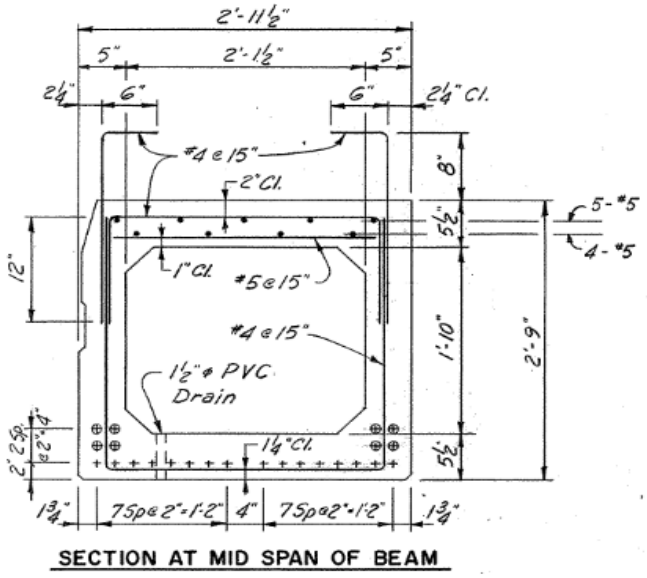
Interior Diaphragm

Interior Diaphragm Length = 8.00 in

Interior Diaphragm Load = 0.41 k

BII-36 Void Area (B10)

Box Width =	36	in
Skew =	33.4	degrees
Unit Weight =	150	lb/ft^3

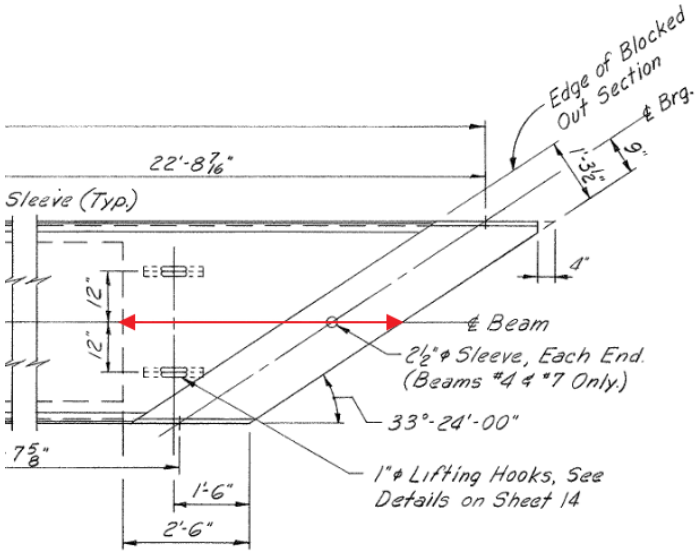


SECTION AT MID SPAN OF BEAM

BEAM IO

Void Height =	22	in
Void Width =	26	in
Void Chamfer =	3	in
Void Area =	554	in^2

End Diaphragm



Average End Diaphragm Length = 58.80 in

End Diaphragm Load = 2.83 k

Interior Diaphragm

Interior Diaphragm Length = 8.00 in

Interior Diaphragm Load = 0.38 k

Live Load Distribution Factor - Beams 1-9

AASHTO Standard 3.23.4

Load Fraction = S/D

S = 4 ft

D = $(5.75 - 0.5N_L) + 0.7N_L (1 - 0.2C)^2$ = 5.920

Where;

N_L = 2

C = K(W/L) for W/L < 1
C = K for W/L ≥ 1 C = 0.430

Where;

W = 39 ft

L = 68.12 ft

K = ((1+u)I/J)1/2 = 0.751

Where;

I = 66226 in^4 (from BrR)

J = 141061 in^4 (from BrR)

u = 0.2

Load Fraction = 0.676

Live Load Distribution Factor - Beams 10

AASHTO Standard 3.23.4

Load Fraction = S/D

S = 3 ft

D = $(5.75 - 0.5N_L) + 0.7N_L (1 - 0.2C)^2$ = 5.879

Where;

N_L = 2

C = K(W/L) for W/L < 1

C = K for W/L $\geq$ 1

C = 0.509

Where;

W = 39 ft

L = 68.12 ft

K = ((1+u)I/J)1/2 = 0.889

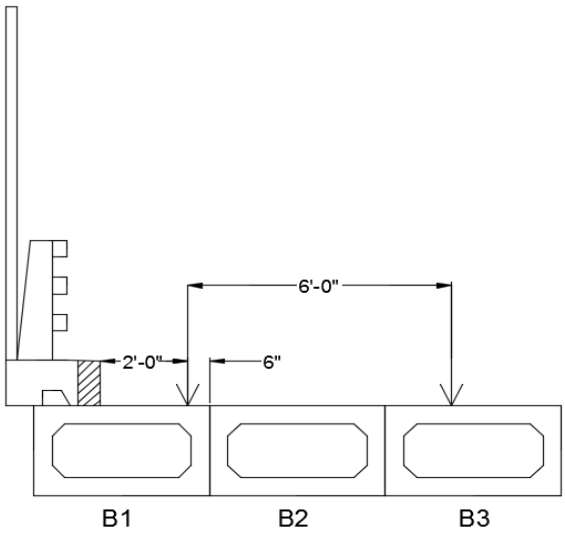
Where;

I = 85960 in^4 (from BrR)

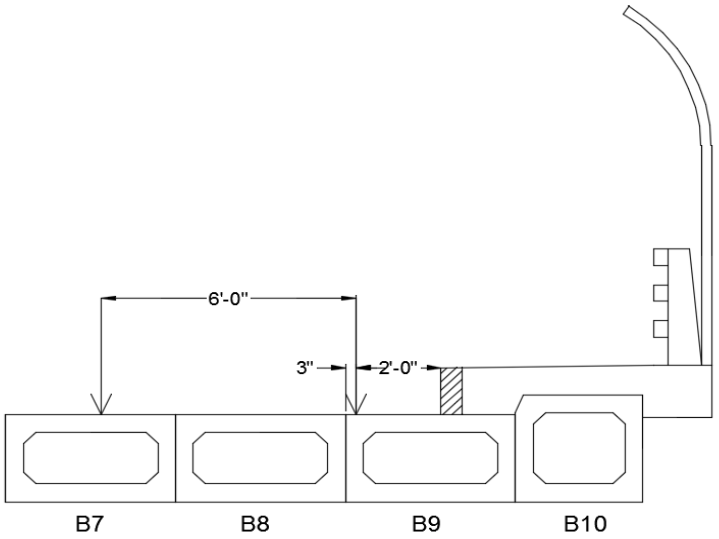
J = 130519 in^4 (from BrR)

u = 0.2

Load Fraction = 0.510

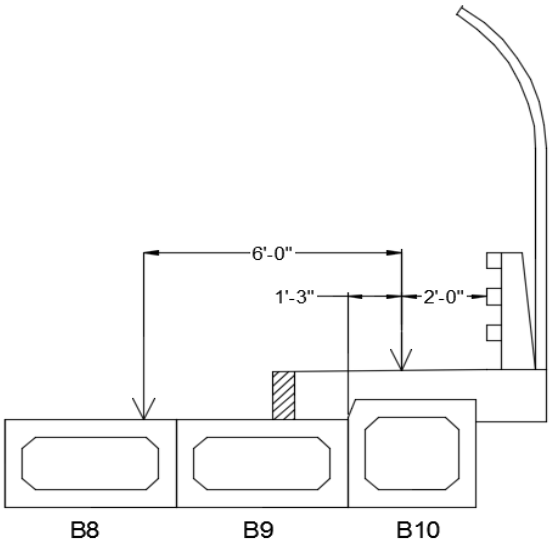


Inventory B1 LLDF = 0.625
Operating B1 LLDF = 0.625



Inventory B9 LLDF = 0.563
Inventory B10 LLDF = 0.000

Mountable Sidewalk Case



Operating B9 LLDF = 1.000
Operating B10 LLDF = 0.929

The shear at supports live load distribution factor for Beams 2-8 is 1.000.

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			DATE	7/2017
			UPDATED BY	JMA
			DATE	12/2018

Superimposed Dead Loads

Beam #	Post & Rail (k/ft)	Wearing Surface (k/ft)	Additional Load (k/ft)
1	0.155	0.194	0.029
2	0.143	0.194	0.000
3	0.143	0.194	0.000
4	0.143	0.194	0.000
5	0.143	0.194	0.000
6	0.143	0.194	0.000
7	0.143	0.194	0.000
8	0.143	0.194	0.000
9	0.143	0.194	0.000
10	0.185	0.194	0.000

Diaphragm Loads

Beam #	End Diaphragm Load (k)	Int. Diaphragm Load (k)
1-9	3.401	0.410
10	2.828	0.385

Live Load Distribution Factors

Beam #	LLDF (Inv.)	LLDF (Oper.)
1-9	0.676	0.676
10	0.510	0.929

AI Engineers, Inc.	BRIDGE	P-10-002	PREPARED BY	SS
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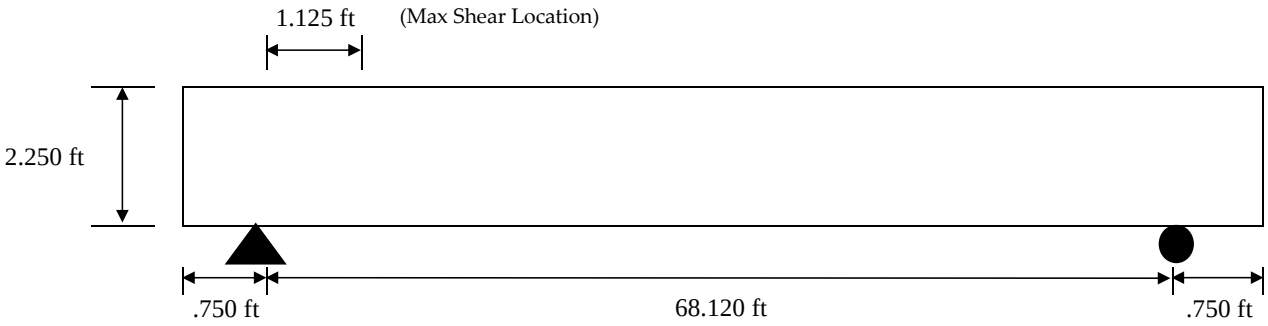
	SUBJECT	Beam 1 Input Summary	CHECKED BY	ST
			DATE	7/2017



Span Length =	68.120	ft
Beam Projection =	0.750	ft
Beam Height =	2.250	ft
Max Shear Location =	1.125	ft (H/2)

Properties

Concrete

f'c =	5000	psi
f'ci =	4000	psi
n =	6	

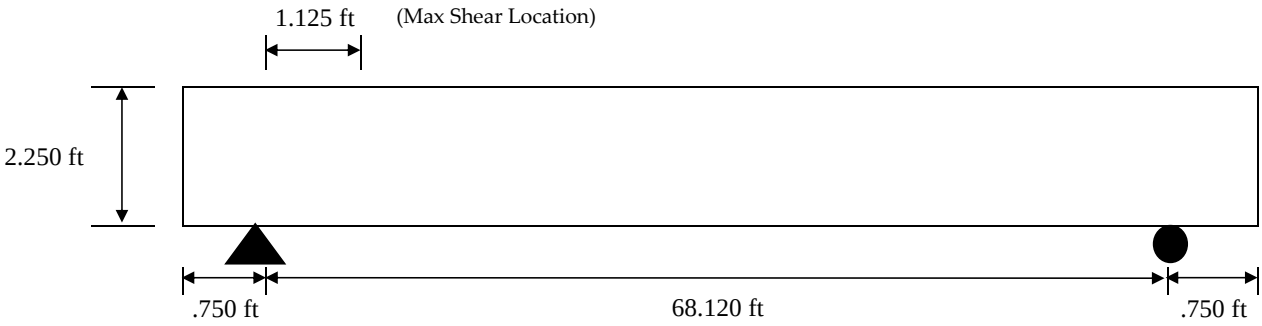
Prestressing Steel

Strand Type =	1/2" (7W-270) SR	
Strand Diameter =	0.500	in
Fu =	270	ksi
Transfer Length =	25	in

Reinforcing Steel

Fy =	60	ksi

AI Engineers, Inc.	BRIDGE	P-10-002	PREPARED BY	SS
			DATE	6/2017
	SUBJECT	Beam 2 Input Summary	CHECKED BY	ST
			DATE	7/2017



Span Length =	68.120	ft
Beam Projection =	0.750	ft
Beam Height =	2.250	ft
Max Shear Location =	1.125	ft (H/2)

Properties

Concrete

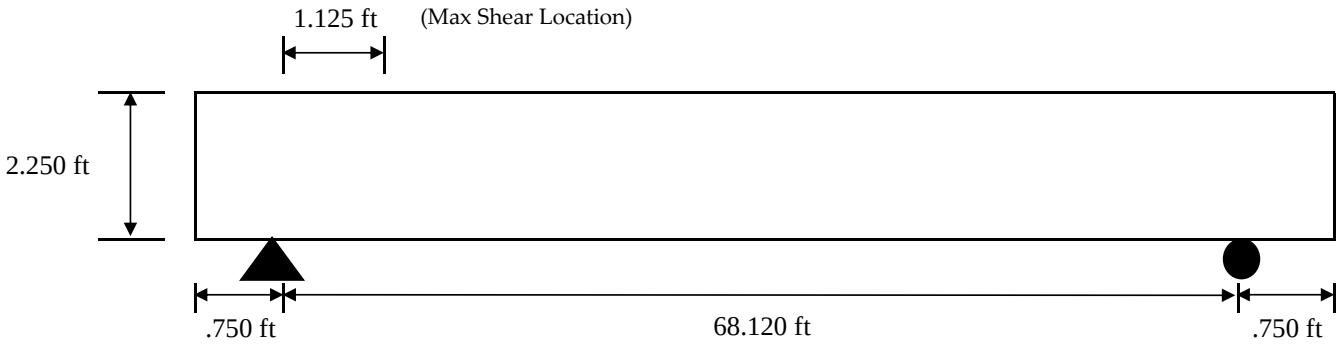
f'c =	5000	psi
f'ci =	4000	psi
n =	6	

Prestressing Steel

Strand Type =	1/2" (7W-270) SR	
Strand Diameter =	0.500	in
Fu =	270	ksi
Transfer Length =	25	in

Reinforcing Steel

Fy =	60	ksi



Span Length =	68.120	ft
Beam Projection =	0.750	ft
Beam Height =	2.250	ft
Max Shear Location =	1.125	ft (H/2)

Properties

Concrete

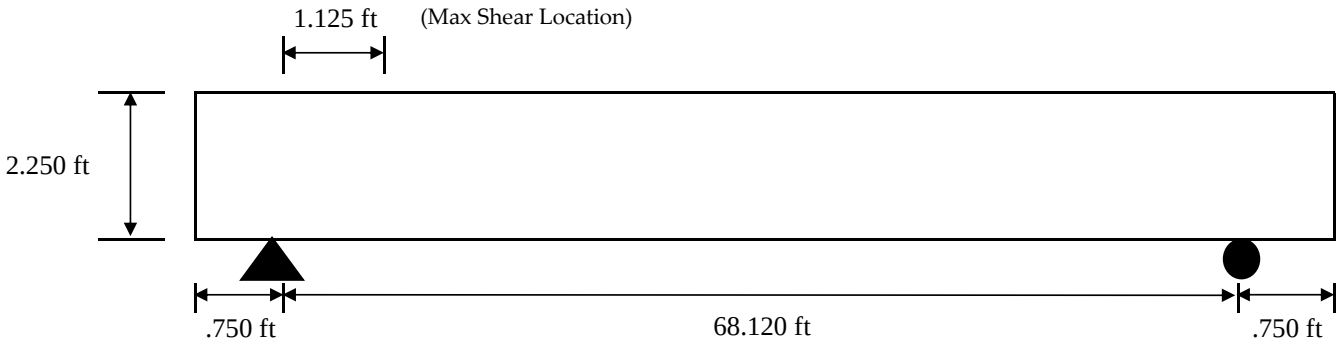
f'c =	5000	psi
f'ci =	4000	psi
n =	6	

Prestressing Steel

Strand Type =	1/2" (7W-270) SR	
Strand Diameter =	0.500	in
Fu =	270	ksi
Transfer Length =	25	in

Reinforcing Steel

Fy =	60	ksi



Span Length =	68.120	ft
Beam Projection =	0.750	ft
Beam Height =	2.250	ft
Max Shear Location =	1.125	ft (H/2)

Properties

Concrete

f'c =	5000	psi
f'ci =	4000	psi
n =	6	

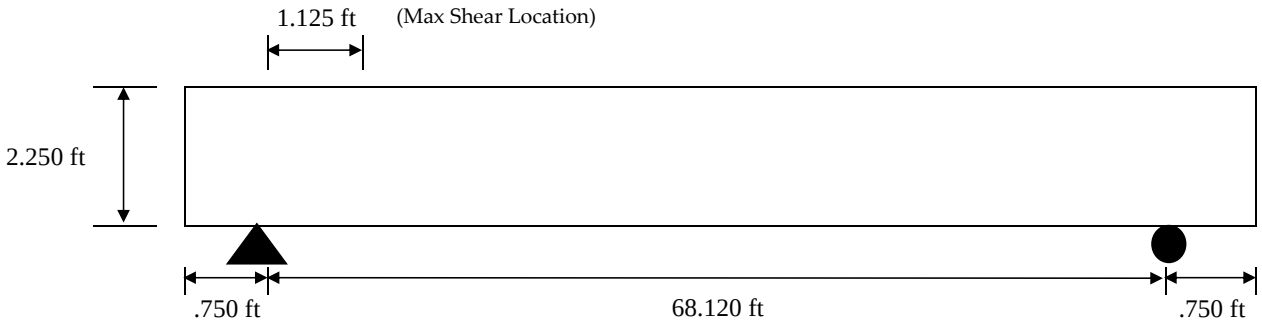
Prestressing Steel

Strand Type =	1/2" (7W-270) SR	
Strand Diameter =	0.500	in
Fu =	270	ksi
Transfer Length =	25	in

Reinforcing Steel

Fy =	60	ksi

AI Engineers, Inc.	BRIDGE	P-10-002	PREPARED BY	SS
			DATE	6/2017
	SUBJECT	Beam 6 Input Summary	CHECKED BY	ST
			DATE	7/2017



Span Length =	68.120	ft
Beam Projection =	0.750	ft
Beam Height =	2.250	ft
Max Shear Location =	1.125	ft (H/2)

Properties

Concrete

f'c =	5000	psi
f'ci =	4000	psi
n =	6	

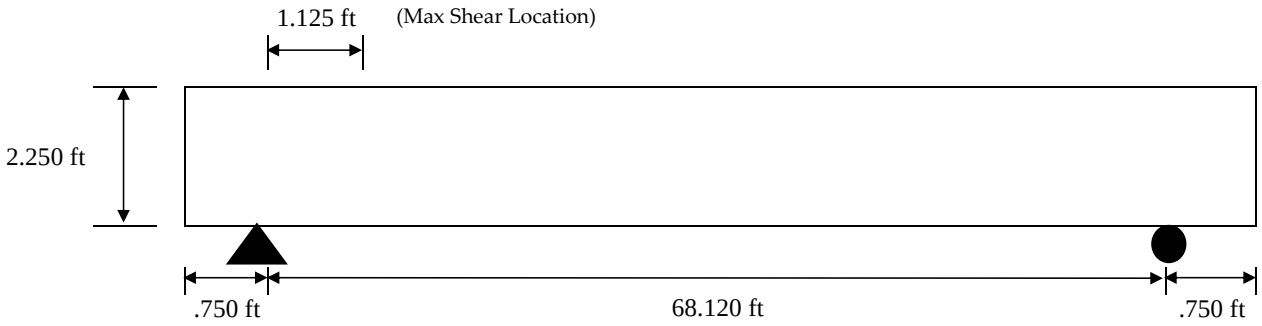
Prestressing Steel

Strand Type =	1/2" (7W-270) SR	
Strand Diameter =	0.500	in
Fu =	270	ksi
Transfer Length =	25	in

Reinforcing Steel

Fy =	60	ksi

AI Engineers, Inc.	BRIDGE	P-10-002	PREPARED BY	SS
			DATE	6/2017
	SUBJECT	Beam 7 Input Summary	CHECKED BY	ST
			DATE	7/2017



Span Length =	68.120	ft
Beam Projection =	0.750	ft
Beam Height =	2.250	ft
Max Shear Location =	1.125	ft (H/2)

Properties

Concrete

f'c =	5000	psi
f'ci =	4000	psi
n =	6	

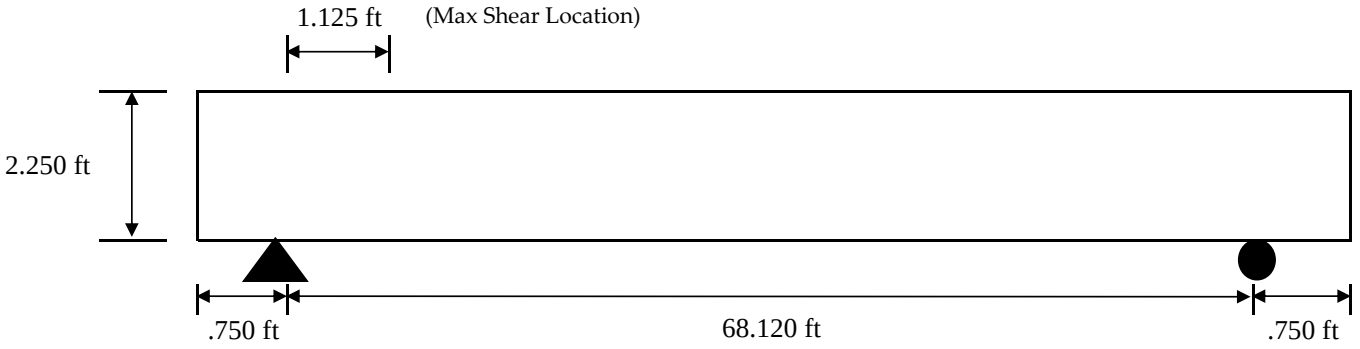
Prestressing Steel

Strand Type =	1/2" (7W-270) SR	
Strand Diameter =	0.500	in
Fu =	270	ksi
Transfer Length =	25	in

Reinforcing Steel

Fy =	60	ksi

AI Engineers, Inc.	BRIDGE	P-10-002	PREPARED BY	SS
			DATE	6/2017
	SUBJECT	Beam 9 Input Summary	CHECKED BY	ST
			DATE	7/2017



Span Length =	68.120	ft
Beam Projection =	0.750	ft
Beam Height =	2.250	ft
Max Shear Location =	1.125	ft (H/2)

Properties

Concrete

f'c =	5000	psi
f'ci =	4000	psi
n =	6	

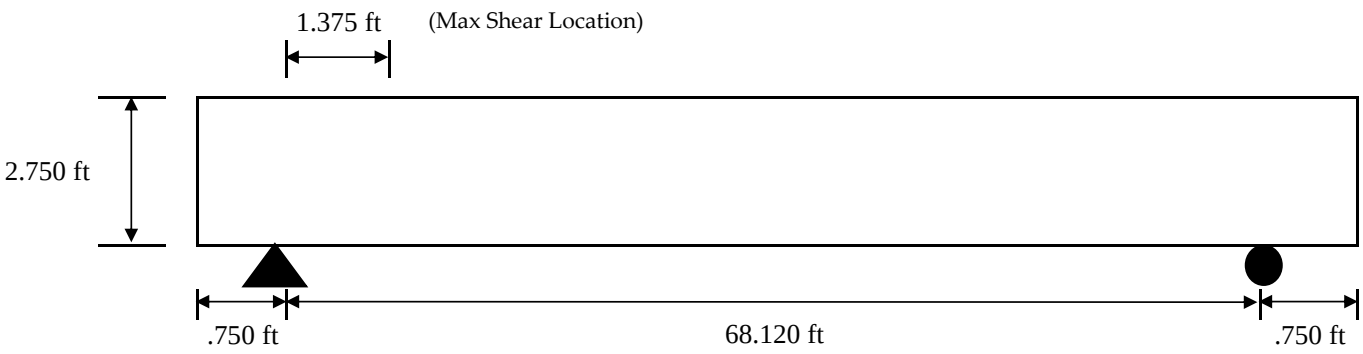
Prestressing Steel

Strand Type =	1/2" (7W-270) SR	
Strand Diameter =	0.500	in
Fu =	270	ksi
Transfer Length =	25	in

Reinforcing Steel

Fy =	60	ksi

AI Engineers, Inc.	BRIDGE	P-10-002	PREPARED BY	SS
			DATE	6/2017
	SUBJECT	Beam 10 Input Summary	CHECKED BY	ST
			DATE	7/2017



Span Length =	68.120	ft
Beam Projection =	0.750	ft
Beam Height =	2.750	ft
Max Shear Location =	1.375	ft (H/2)

Properties

Concrete

f'c =	5000	psi
f'ci =	4000	psi
n =	6	

Prestressing Steel

Strand Type =	1/2" (7W-270) SR	
Strand Diameter =	0.500	in
Fu =	270	ksi
Transfer Length =	25	in

Reinforcing Steel

Fy =	60	ksi

AI Engineers, Inc.	BRIDGE	P-10-002 (0DY)	PREPARED BY	JMA
			DATE	12/2018
	SUBJECT	Detail Legend + Strand Loss Info	CHECKED BY	SS
			DATE	2/2018

Legend:

= Spall

= Delamination

= Exposed strand (removed in BrR)

= Strand with no section loss

= Strand with 10% section loss

= Strand with 25% section loss

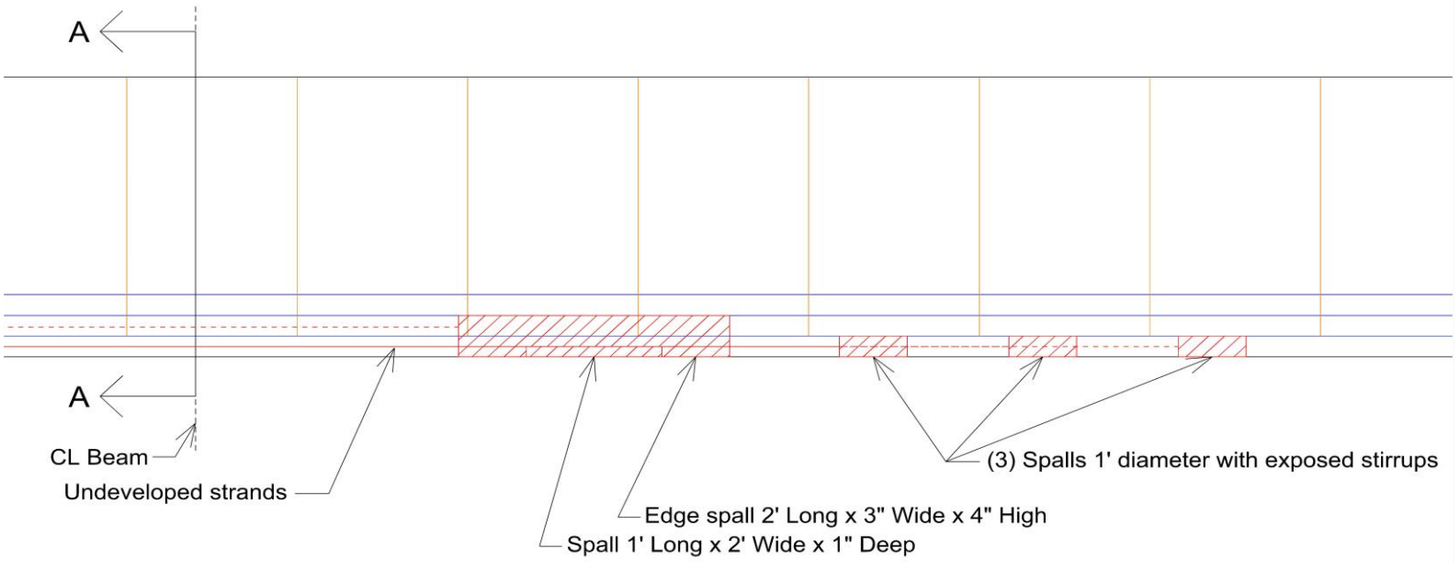
= Strand with 50% section loss

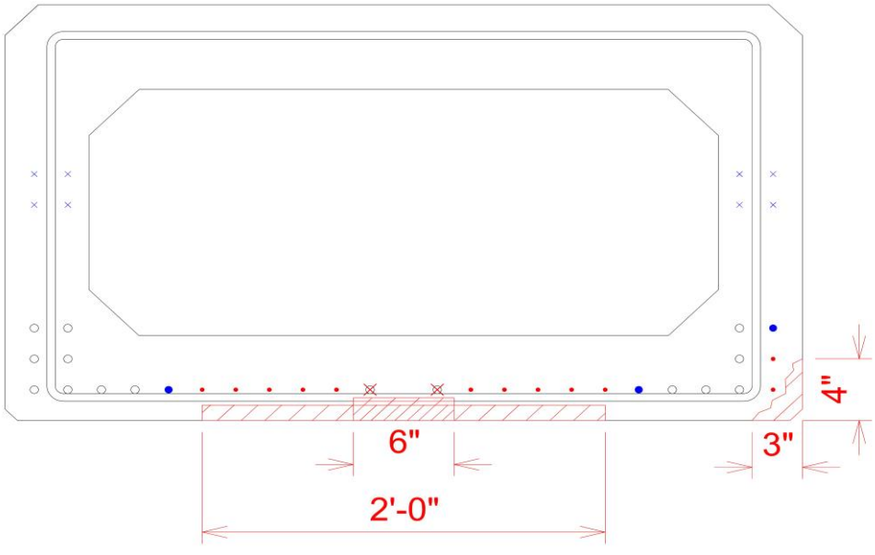
Notes:

1. Losses taken from 2018 Routine Inspection Report.
2. Losses shown in details based on DRAFT MassDOT 2018 Edition LRFR Bridge Manual - Part I Section 7.2.10 - Special Instructions for Deteriorated Prestressed Beam Load Ratings, Dated 11/14/2018.

Original Strand Area =	0.153	in^2	
Original Equiv Strand Diameter =	0.441	in	
10% Loss Strand Area =	0.138	in^2	
10% Equiv Strand Diameter =	0.419	in	
25% Loss Strand Area =	0.115	in^2	
25% Equiv Strand Diameter =	0.383	in	
50% Loss Strand Area =	0.077	in^2	
50% Equiv Strand Diameter =	0.313	in	
C.G.S. Row 1 =	2.000	in	
C.G.S. Row 2 =	4.000	in	At midspan points only
C.G.S. Row 3 =	6.000	in	At midspan points only

B9


A
A
CL Beam
Undeveloped strands
(3) Spalls 1' diameter with exposed stirrups
Edge spall 2' Long x 3" Wide x 4" High
Spall 1' Long x 2' Wide x 1" Deep


4"
6"
3"
2'-0"

Detail A-A

No. of Row 1 Strands w/no loss =	7	No. of Row 2 Strands w/no loss =	3
No. of Row 1 Strands w/10% loss =	2	No. of Row 2 Strands w/10% loss =	0
No. of Row 1 Strands w/25% loss =	0	No. of Row 2 Strands w/25% loss =	0
No. of Row 1 Strands w/50% loss =	11	No. of Row 2 Strands w/50% loss =	1
No. of Row 1 Strands w/100% loss =	2	No. of Row 2 Strands w/100% loss =	0

No. of Row 3 Strands w/no loss =	3
No. of Row 3 Strands w/10% loss =	1
No. of Row 3 Strands w/25% loss =	0
No. of Row 3 Strands w/50% loss =	0
No. of Row 3 Strands w/100% loss =	0

Jacking Stress Ratio =	0.7	(Stress Relieved)	
Ultimate Strength, F_u =	270	ksi	
Total Adjusted Area of Strands =	3.327	in^2	
Jacking Force =	629	k	(input into BrR)
C.G. of Strands =	3.040	in	(input into BrR)

POIs (Distance from left support)

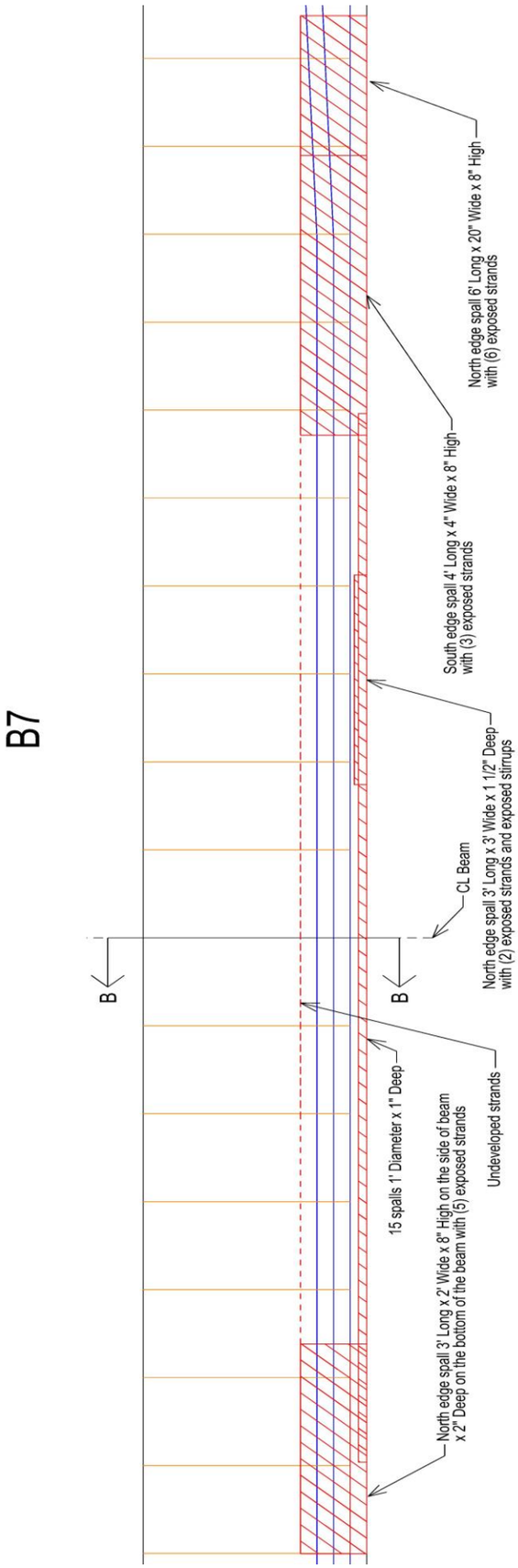
27.248	ft	0.4L
30.654	ft	0.45L
34.060	ft	0.5L
37.466	ft	0.55L
40.872	ft	0.6L

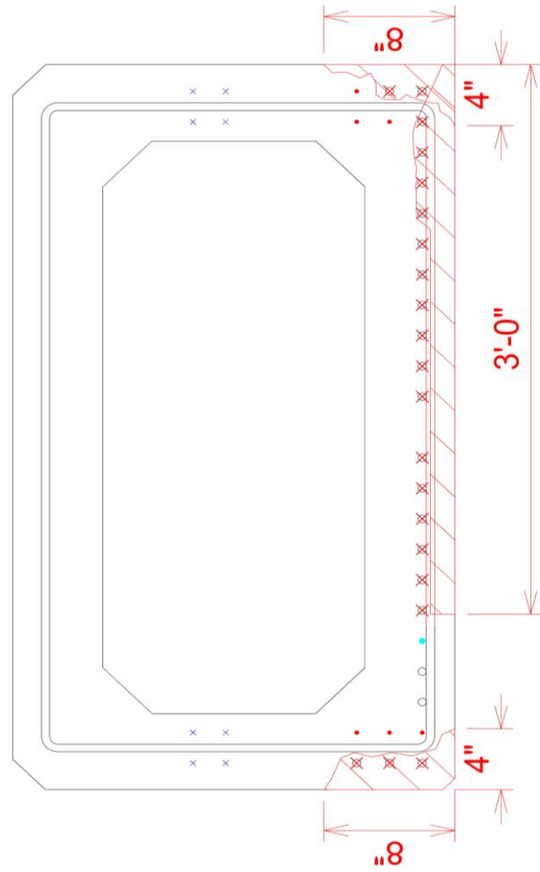
Flexure Capacity - 34.0599'

Spec Check Detail for 6B.5.3.3 PS Moment Capacity

```
Part B - ALLOWABLE STRESS RATING AND LOAD FACTOR RATING
6B.5 NOMINAL CAPACITY: C
6B.5.3 Load Factor Method
6B.5.3.3 Prestressed Concrete Capacity
(AASHTO Manual for Bridge Evaluation, Third Edition - 2017)

PS Box Rect Void - At Location = 34.0599 (ft) - Left     Stage 3


INPUT:

Adjust Moment Capacity for Min Reinforcement Requirements:No

SUMMARY:

Therefore the k adjustment factor will not be considered.
Nominal Moment Capacity  = Phi * Mn


  Load       Load
 Group       Comb              Phi*Mn    Phi*Mn < 1.2Mcr      Mu          k       Capacity
                              (kip-ft)                     (kip-ft)               (kip-ft)
-------------------------------------------------------------------------------------------
 Inventory  3, INV, MAX        1517.25        ---            ---         ---       1517.25
```

AI Engineers, Inc.	BRIDGE	P-10-002 (0DY)	PREPARED BY	JMA
			DATE	12/2018
	SUBJECT	Beam 7 Prestressing Loss Calculation	CHECKED BY	SS
			DATE	2/2018





Detail B-B

Note: all strand losses shown in elevation do not re-develop at midspan. Therefore these strand losses were considered at midspan.

No. of Row 1 Strands w/no loss =	2	No. of Row 2 Strands w/no loss =	0
No. of Row 1 Strands w/10% loss =	0	No. of Row 2 Strands w/10% loss =	0
No. of Row 1 Strands w/25% loss =	1	No. of Row 2 Strands w/25% loss =	0
No. of Row 1 Strands w/50% loss =	1	No. of Row 2 Strands w/50% loss =	2
No. of Row 1 Strands w/100% loss =	18	No. of Row 2 Strands w/100% loss =	2

No. of Row 3 Strands w/no loss =	0
No. of Row 3 Strands w/10% loss =	0
No. of Row 3 Strands w/25% loss =	0
No. of Row 3 Strands w/50% loss =	3
No. of Row 3 Strands w/100% loss =	1

Jacking Stress Ratio =	0.7	(Stress Relieved)	
Ultimate Strength, F_u =	270	ksi	
Total Adjusted Area of Strands =	0.883	in^2	
Jacking Force =	167	k	(input into BrR)
C.G. of Strands =	3.395	in	(input into BrR)

POIs (Distance from left support)

27.248	ft	0.4L
30.654	ft	0.45L
34.060	ft	0.5L
37.466	ft	0.55L
40.872	ft	0.6L

Notes:

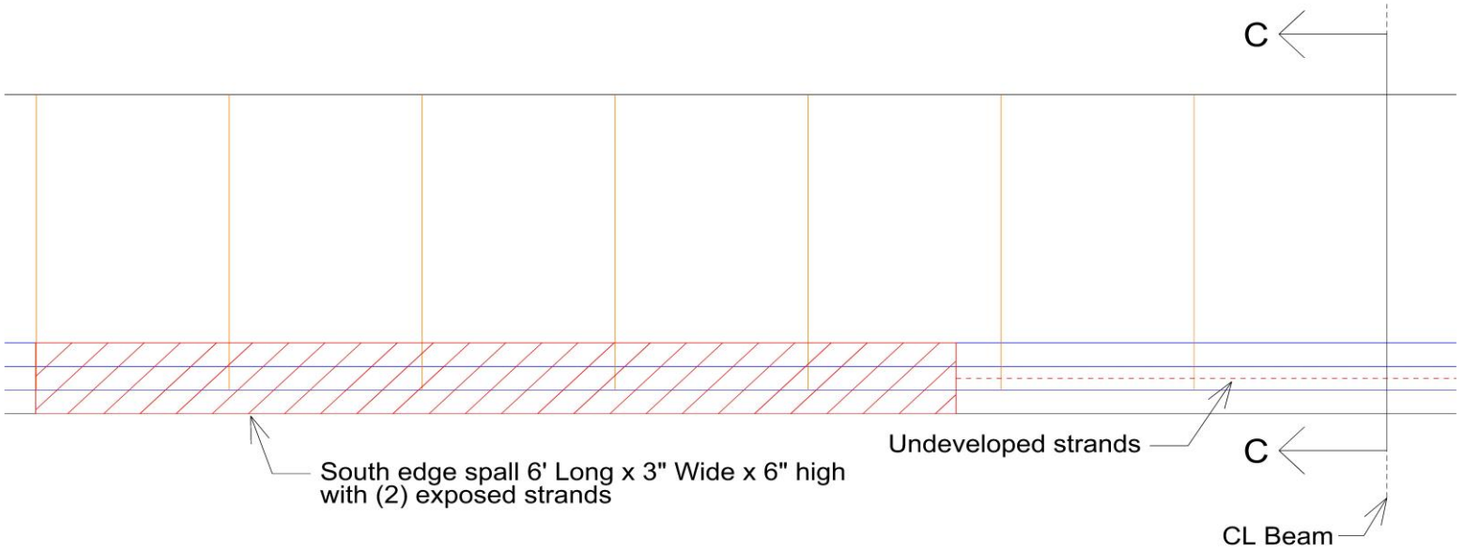
1. Points of interest defined at 1/4th points along the input deterioration range and mid-span (if applicable).

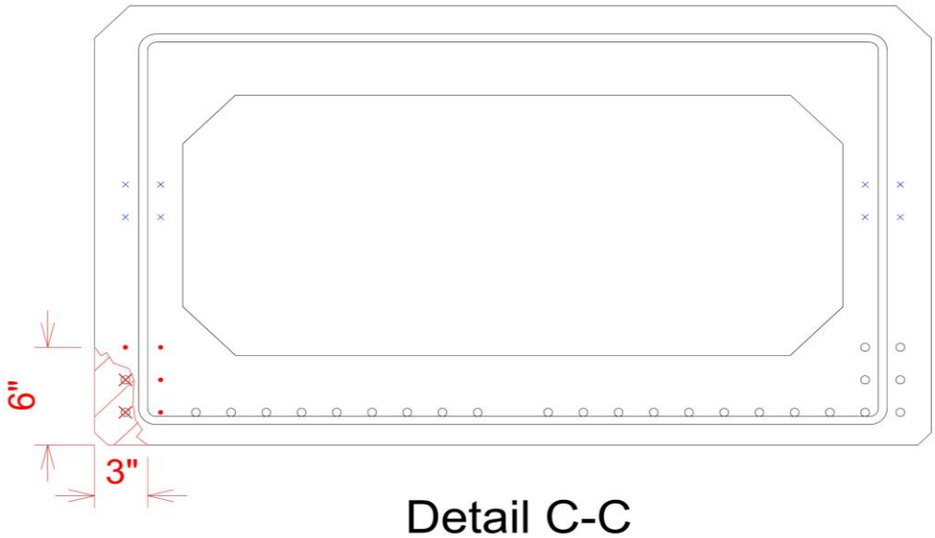
Flexure Capacity - 34.0599'

Spec Check Detail for 6B.5.3.3 PS Moment Capacity

```
Part B - ALLOWABLE STRESS RATING AND LOAD FACTOR RATING
6B.5 NOMINAL CAPACITY: C
6B.5.3 Load Factor Method
6B.5.3.3 Prestressed Concrete Capacity
(AASHTO Manual for Bridge Evaluation, Third Edition - 2017)

PS Box Rect Void - At Location = 34.0599 (ft) - Left     Stage 3


INPUT:

Adjust Moment Capacity for Min Reinforcement Requirements:No

SUMMARY:

Therefore the k adjustment factor will not be considered.
Nominal Moment Capacity  = Phi * Mn


  Load      Load
 Group      Comb             Phi*Mn   Phi*Mn < 1.2Mcr     Mu          k      Capacity
                            (kip-ft)                   (kip-ft)              (kip-ft)
-------------------------------------------------------------------------------------
 Inventory  3, INV, MAX        459.42       ---           ---         ---        459.42
```

B6





Detail C-C

Note: strand losses shown near midspan in elevation do not re-develop at midspan.
Therefore these strand losses were considered at midspan.

No. of Row 1 Strands w/no loss =	20	No. of Row 2 Strands w/no loss =	2
No. of Row 1 Strands w/10% loss =	0	No. of Row 2 Strands w/10% loss =	0
No. of Row 1 Strands w/25% loss =	0	No. of Row 2 Strands w/25% loss =	0
No. of Row 1 Strands w/50% loss =	1	No. of Row 2 Strands w/50% loss =	1
No. of Row 1 Strands w/100% loss =	1	No. of Row 2 Strands w/100% loss =	1

No. of Row 3 Strands w/no loss =	2	
No. of Row 3 Strands w/10% loss =	0	
No. of Row 3 Strands w/25% loss =	0	
No. of Row 3 Strands w/50% loss =	2	
No. of Row 3 Strands w/100% loss =	0	

Jacking Stress Ratio =	0.7	(Stress Relieved)	
Ultimate Strength, F_u =	270	ksi	
Total Adjusted Area of Strands =	3.980	in^2	
Jacking Force =	752	k	(input into BrR)
C.G. of Strands =	2.655	in	(input into BrR)

POIs (Distance from left support)

27.248	ft	0.4L
30.654	ft	0.45L
34.060	ft	0.5L
37.466	ft	0.55L
40.872	ft	0.6L

Notes:
1. Points of interest defined at 1/4th points along the input deterioration range and mid-span (if applicable).

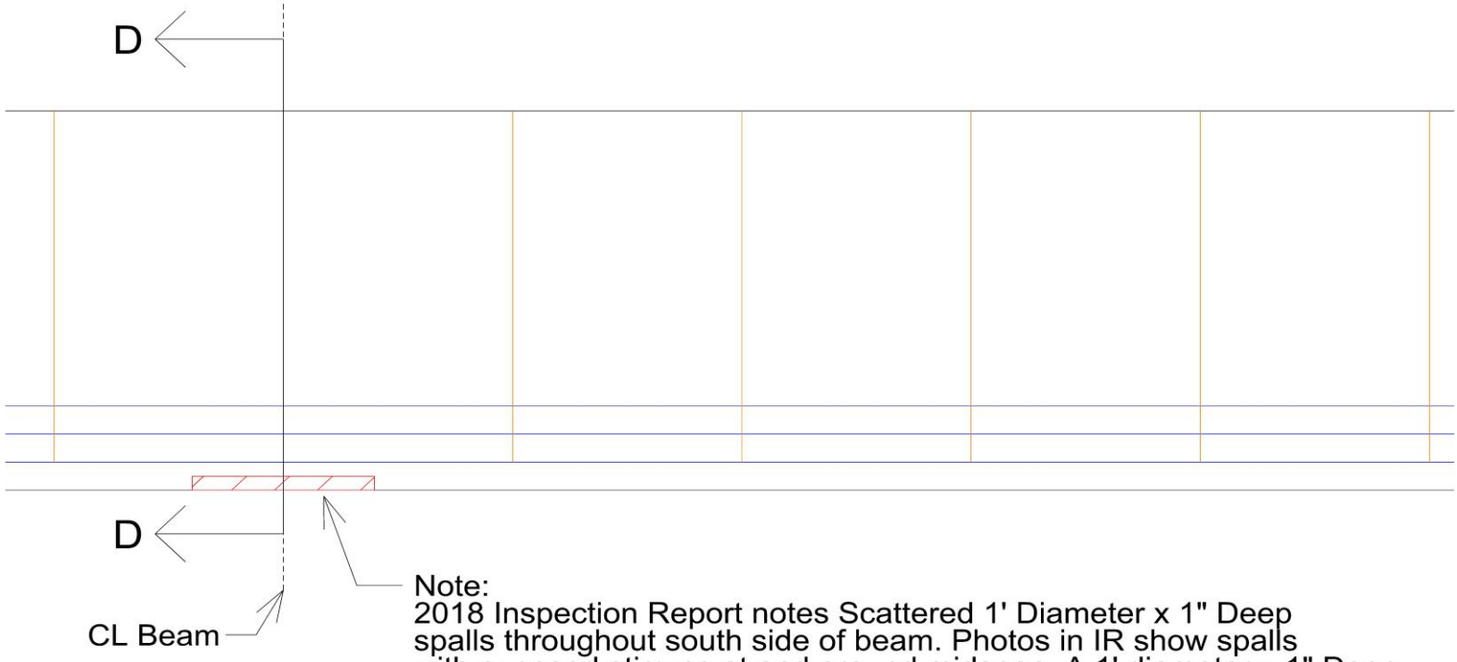
Flexure Capacity - 34.0599'

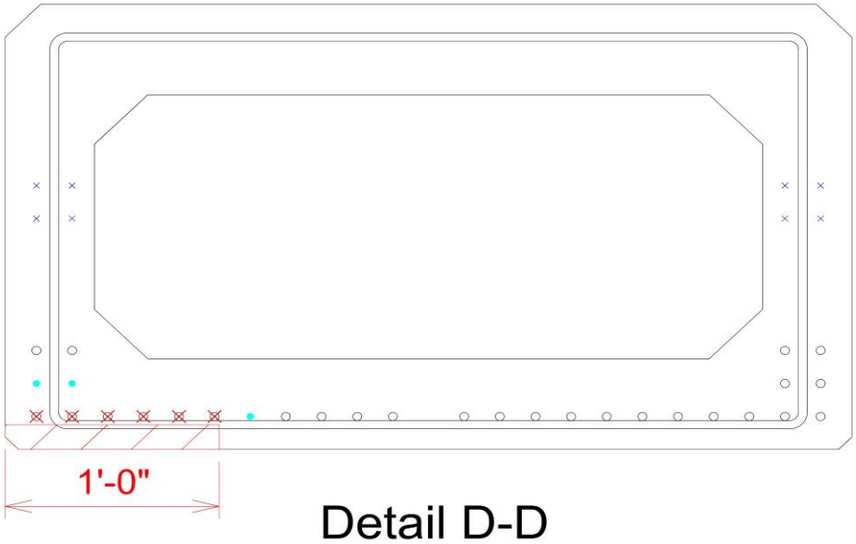
Spec Check Detail for 6B.5.3.3 PS Moment Capacity

```
Part B - ALLOWABLE STRESS RATING AND LOAD FACTOR RATING
6B.5 NOMINAL CAPACITY: C
6B.5.3 Load Factor Method
6B.5.3.3 Prestressed Concrete Capacity
(AASHTO Manual for Bridge Evaluation, Third Edition - 2017)

PS Box Rect Void - At Location = 34.0599 (ft) - Left     Stage 3


INPUT:

Adjust Moment Capacity for Min Reinforcement Requirements:No

SUMMARY:

Therefore the k adjustment factor will not be considered.
Nominal Moment Capacity  = Phi * Mn


  Load      Load
 Group      Comb            Phi*Mn   Phi*Mn < 1.2Mcr     Mu          k      Capacity
                           (kip-ft)                   (kip-ft)             (kip-ft)
-------------------------------------------------------------------------------------
 Inventory  3, INV, MAX      1794.18       ---           ---         ---      1794.18
```

AI Engineers, Inc.	BRIDGE	P-10-002 (0DY)	PREPARED BY	JMA
			DATE	12/2018
	SUBJECT	Beam 4 Prestressing Loss Calculation	CHECKED BY	SS
			DATE	2/2018

B4





Detail D-D

No. of Row 1 Strands w/no loss =	15	No. of Row 2 Strands w/no loss =	2
No. of Row 1 Strands w/10% loss =	0	No. of Row 2 Strands w/10% loss =	0
No. of Row 1 Strands w/25% loss =	1	No. of Row 2 Strands w/25% loss =	2
No. of Row 1 Strands w/50% loss =	0	No. of Row 2 Strands w/50% loss =	0
No. of Row 1 Strands w/100% loss =	6	No. of Row 2 Strands w/100% loss =	0

No. of Row 3 Strands w/no loss =	4
No. of Row 3 Strands w/10% loss =	0
No. of Row 3 Strands w/25% loss =	0
No. of Row 3 Strands w/50% loss =	0
No. of Row 3 Strands w/100% loss =	0

Jacking Stress Ratio =	0.7	(Stress Relieved)	
Ultimate Strength, F_u =	270	ksi	
Total Adjusted Area of Strands =	3.558	in^2	
Jacking Force =	672	k	(input into BrR)
C.G. of Strands =	2.989	in	(input into BrR)

POIs (Distance from left support)

27.248	ft	0.4L
30.654	ft	0.45L
34.060	ft	0.5L
37.466	ft	0.55L
40.872	ft	0.6L

Notes:

1. Points of interest defined at 1/4th points along the input deterioration range and mid-span (if applicable).

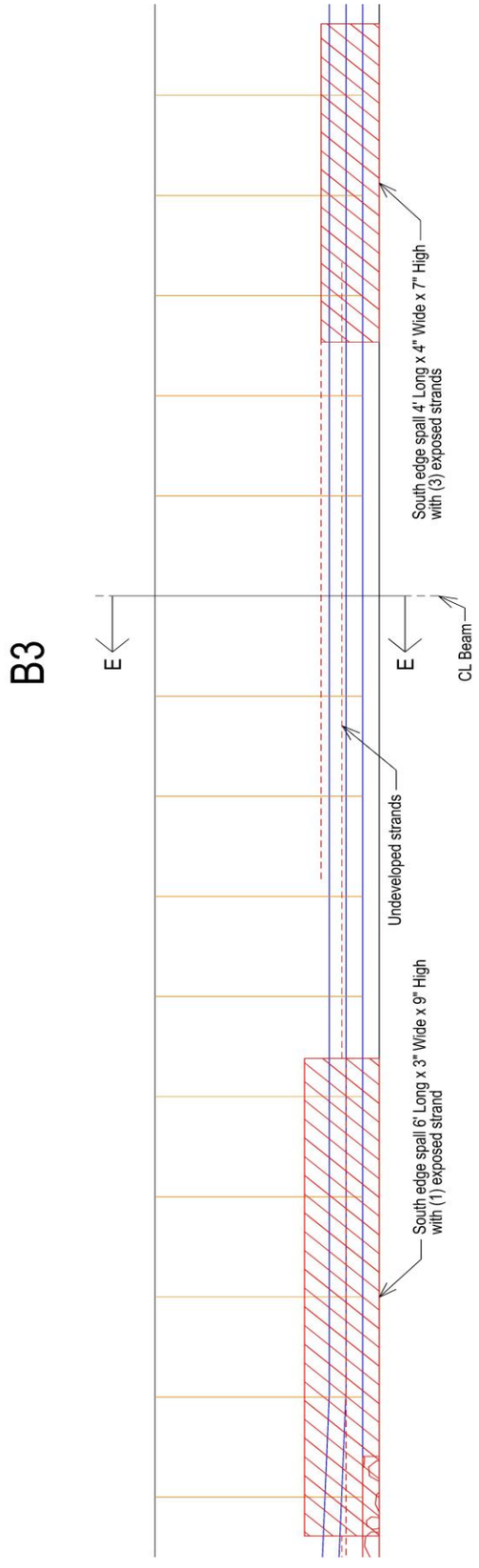
Flexure Capacity - 34.0599'

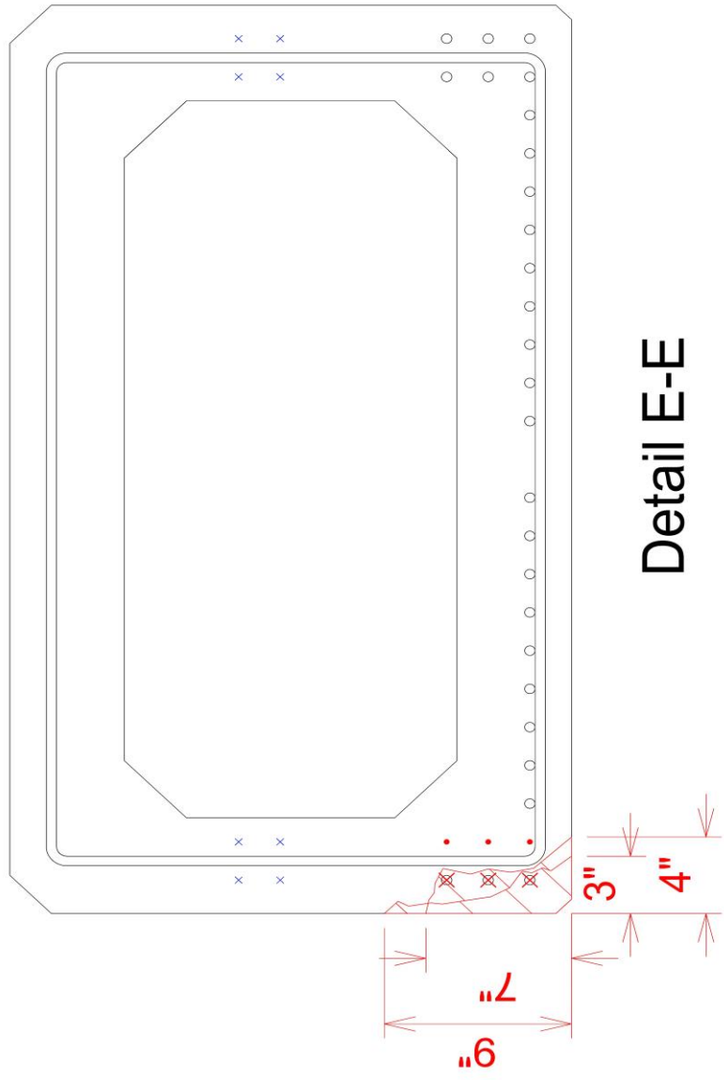
Spec Check Detail for 6B.5.3.3 PS Moment Capacity

```
Part B - ALLOWABLE STRESS RATING AND LOAD FACTOR RATING
6B.5 NOMINAL CAPACITY: C
6B.5.3 Load Factor Method
6B.5.3.3 Prestressed Concrete Capacity
(AASHTO Manual for Bridge Evaluation, Third Edition - 2017)

PS Box Rect Void - At Location = 34.0599 (ft) - Left     Stage 3


INPUT:

Adjust Moment Capacity for Min Reinforcement Requirements:No

SUMMARY:

Therefore the k adjustment factor will not be considered.
Nominal Moment Capacity  = Phi * Mn
```

Load Group	Load Comb	Phi*Mn (kip-ft)	Phi*Mn < 1.2Mcr	Mu (kip-ft)	k	Capacity (kip-ft)
Inventory	3, INV, MAX	1608.05	---	---	---	1608.05

AI Engineers, Inc.	BRIDGE	P-10-002 (0DY)	PREPARED BY	JMA
			DATE	12/2018
	SUBJECT	Beam 3 Prestressing Loss Calculation	CHECKED BY	SS
			DATE	2/2018





Notes:

1. Strand losses shown do not have adequate length to re-develop at midspan and were therefore considered at midspan.

AI Engineers, Inc.	BRIDGE	P-10-002 (0DY)	PREPARED BY	JMA
			DATE	12/2018
	SUBJECT	Beam 3 Prestressing Loss Calculation	CHECKED BY	SS
			DATE	2/2018

No. of Row 1 Strands w/no loss =	20	No. of Row 2 Strands w/no loss =	2
No. of Row 1 Strands w/10% loss =	0	No. of Row 2 Strands w/10% loss =	0
No. of Row 1 Strands w/25% loss =	0	No. of Row 2 Strands w/25% loss =	0
No. of Row 1 Strands w/50% loss =	1	No. of Row 2 Strands w/50% loss =	1
No. of Row 1 Strands w/100% loss =	1	No. of Row 2 Strands w/100% loss =	1

No. of Row 3 Strands w/no loss =	2
No. of Row 3 Strands w/10% loss =	0
No. of Row 3 Strands w/25% loss =	0
No. of Row 3 Strands w/50% loss =	1
No. of Row 3 Strands w/100% loss =	1

Jacking Stress Ratio =	0.7	(Stress Relieved)	
Ultimate Strength, F_u =	270	ksi	
Total Adjusted Area of Strands =	3.903	in^2	
Jacking Force =	738	k	(input into BrR)
C.G. of Strands =	2.589	in	(input into BrR)

POIs (Distance from left support)

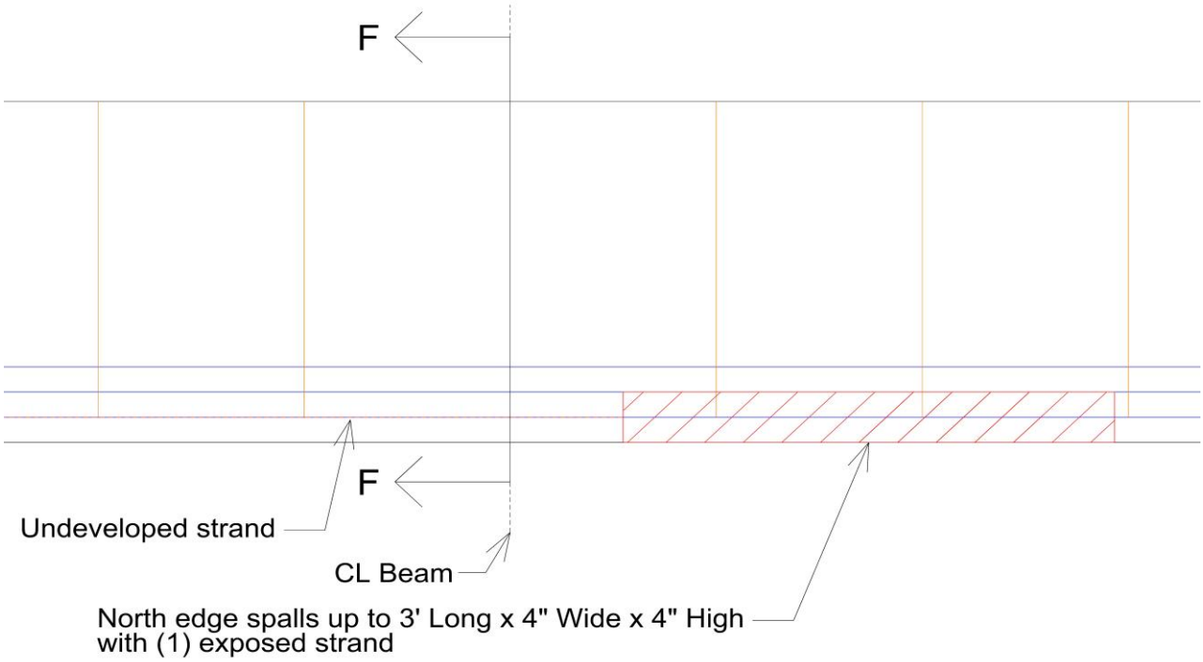
27.248	ft	0.4L
30.654	ft	0.45L
34.060	ft	0.5L
37.466	ft	0.55L
40.872	ft	0.6L

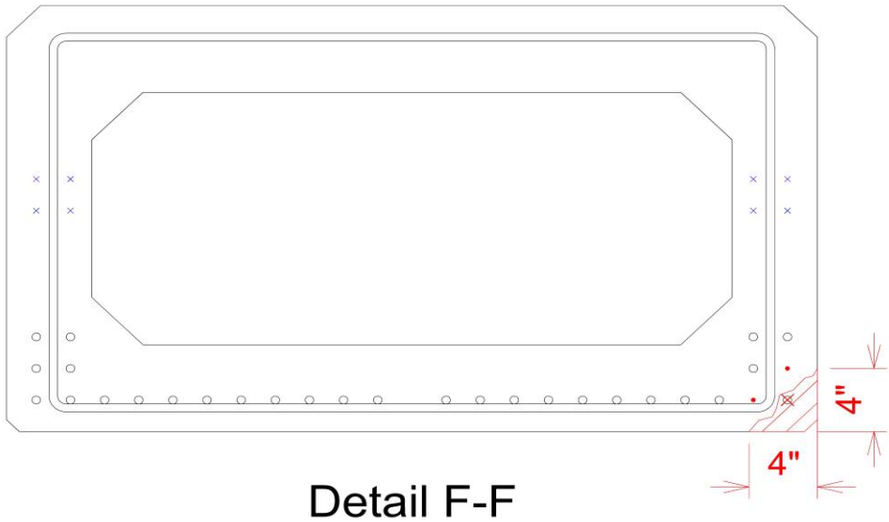
Flexure Capacity - 34.0599'

Spec Check Detail for 6B.5.3.3 PS Moment Capacity

```
Part B - ALLOWABLE STRESS RATING AND LOAD FACTOR RATING
6B.5 NOMINAL CAPACITY: C
6B.5.3 Load Factor Method
6B.5.3.3 Prestressed Concrete Capacity
(AASHTO Manual for Bridge Evaluation, Third Edition - 2017)

PS Box Rect Void - At Location = 34.0599 (ft) - Left     Stage 3


INPUT:

Adjust Moment Capacity for Min Reinforcement Requirements:No

SUMMARY:

Therefore the k adjustment factor will not be considered.
Nominal Moment Capacity  = Phi * Mn


  Load       Load
 Group       Comb              Phi*Mn    Phi*Mn < 1.2Mcr      Mu          k       Capacity
                              (kip-ft)                     (kip-ft)               (kip-ft)
-------------------------------------------------------------------------------------------
 Inventory  3, INV, MAX        1772.00        ---            ---         ---        1772.00
```

B2


F
F
Undeveloped strand
CL Beam
North edge spalls up to 3' Long x 4" Wide x 4" High
with (1) exposed strand


4"
4"

Detail F-F

AI Engineers, Inc.	BRIDGE	P-10-002 (0DY)	PREPARED BY	JMA
			DATE	12/2018
	SUBJECT	Beam 2 Prestressing Loss Calculation	CHECKED BY	SS
			DATE	2/2018

No. of Row 1 Strands w/no loss =	20	No. of Row 2 Strands w/no loss =	3
No. of Row 1 Strands w/10% loss =	0	No. of Row 2 Strands w/10% loss =	0
No. of Row 1 Strands w/25% loss =	0	No. of Row 2 Strands w/25% loss =	0
No. of Row 1 Strands w/50% loss =	1	No. of Row 2 Strands w/50% loss =	1
No. of Row 1 Strands w/100% loss =	1	No. of Row 2 Strands w/100% loss =	0

No. of Row 3 Strands w/no loss =	4
No. of Row 3 Strands w/10% loss =	0
No. of Row 3 Strands w/25% loss =	0
No. of Row 3 Strands w/50% loss =	0
No. of Row 3 Strands w/100% loss =	0

Jacking Stress Ratio =	0.7	(Stress Relieved)	
Ultimate Strength, F_u =	270	ksi	
Total Adjusted Area of Strands =	4.285	in^2	
Jacking Force =	810	k	(input into BrR)
C.G. of Strands =	2.821	in	(input into BrR)

POIs (Distance from left support)

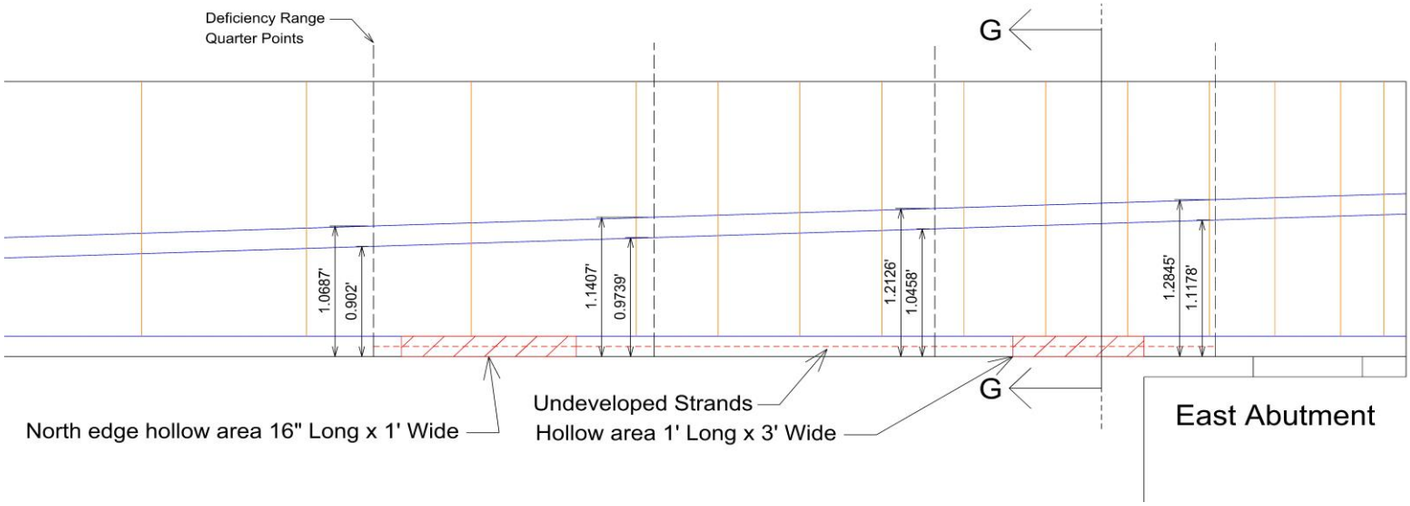
27.248	ft	0.4L
30.654	ft	0.45L
34.060	ft	0.5L
37.466	ft	0.55L
40.872	ft	0.6L

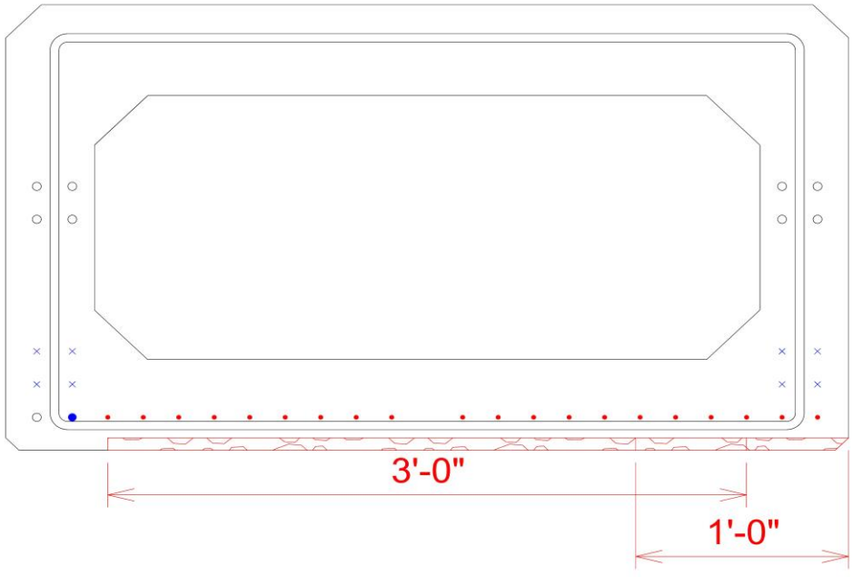
Flexure Capacity - 34.0599'

Spec Check Detail for 6B.5.3.3 PS Moment Capacity

```
Part B - ALLOWABLE STRESS RATING AND LOAD FACTOR RATING
6B.5 NOMINAL CAPACITY: C
6B.5.3 Load Factor Method
6B.5.3.3 Prestressed Concrete Capacity
(AASHTO Manual for Bridge Evaluation, Third Edition - 2017)

PS Box Rect Void - At Location = 34.0599 (ft) - Left     Stage 3


INPUT:

Adjust Moment Capacity for Min Reinforcement Requirements:No

SUMMARY:

Therefore the k adjustment factor will not be considered.
Nominal Moment Capacity  = Phi * Mn


  Load       Load
 Group       Comb              Phi*Mn    Phi*Mn < 1.2Mcr      Mu          k       Capacity
                              (kip-ft)                     (kip-ft)               (kip-ft)
-------------------------------------------------------------------------------------------
 Inventory  3, INV, MAX        1890.12        ---            ---         ---       1890.12
```

B2


Deficiency Range
Quarter Points
G
1.0687'
0.902'
1.1407'
0.9739'
1.2126'
1.0458'
1.2845'
1.1178'
North edge hollow area 16" Long x 1' Wide
Undeveloped Strands
Hollow area 1' Long x 3' Wide
G
East Abutment


3'-0"
1'-0"

Detail G-G

AI Engineers, Inc.	BRIDGE	P-10-002 (0DY)	PREPARED BY	JMA
			DATE	12/2018
	SUBJECT	Beam 2 Prestressing Loss Calculation	CHECKED BY	SS
			DATE	2/2018

No. of Row 1 Strands w/no loss =	1	No. of Row 2 Strands w/no loss =	4
No. of Row 1 Strands w/10% loss =	1	No. of Row 2 Strands w/10% loss =	0
No. of Row 1 Strands w/25% loss =	0	No. of Row 2 Strands w/25% loss =	0
No. of Row 1 Strands w/50% loss =	20	No. of Row 2 Strands w/50% loss =	0
No. of Row 1 Strands w/100% loss =	0	No. of Row 2 Strands w/100% loss =	0

No. of Row 3 Strands w/no loss =	4
No. of Row 3 Strands w/10% loss =	0
No. of Row 3 Strands w/25% loss =	0
No. of Row 3 Strands w/50% loss =	0
No. of Row 3 Strands w/100% loss =	0

Notes:

1. Rows 2 and 3 are harped at these locations.

Jacking Stress Ratio =	0.7	(Stress Relieved)
Ultimate Strength, F_u =	270	ksi
Total Adjusted Area of Strands =	3.055	in^2

POI	Row 2 C.G. (ft)	Row 3 C.G. (ft)	C.G. of Strands (in)
60.991	0.902	1.069	5.937
63.132	0.974	1.141	6.283
65.274	1.046	1.213	6.629
67.416	1.118	1.285	6.975

Jacking Force = 577 k (input into BrR)

POIs (Distance from left support)

60.9908	ft
63.1324	ft
65.2740	ft
67.4155	ft

Flexure Capacity - 60.9908

Spec Check Detail for 6B.5.3.3 PS Moment Capacity

```
Part B - ALLOWABLE STRESS RATING AND LOAD FACTOR RATING
6B.5 NOMINAL CAPACITY: C
6B.5.3 Load Factor Method
6B.5.3.3 Prestressed Concrete Capacity
(AASHTO Manual for Bridge Evaluation, Third Edition - 2017)

PS Box Rect Void - At Location = 60.9908 (ft) - Left     Stage 3


INPUT:

Adjust Moment Capacity for Min Reinforcement Requirements:No

SUMMARY:

Therefore the k adjustment factor will not be considered.
Nominal Moment Capacity  = Phi * Mn


  Load      Load
 Group      Comb              Phi*Mn    Phi*Mn < 1.2Mcr     Mu          k      Capacity
                             (kip-ft)                    (kip-ft)              (kip-ft)
-------------------------------------------------------------------------------------
 Inventory  3, INV, MAX       1125.67       ---            ---         ---      1125.67
```

Shear Capacity - 60.9908

Spec Check Detail for 9.20.1.3 Nominal Shear Capacity

```
9 Prestressed Concrete
9.20 Shear
9.20.1 General
9.20.1.3
(AASHTO Standard Specifications for Highway Bridges, Seventeenth Edition - 2002)

PS Box Rect Void - At Location = 60.9908 (ft) - Left     Stage 3

INPUT:
Phi =    0.9000
Vs  =   34.3392 (kip)

Vn = Phi * (Vc + Vs)


  Load      Load
 Group      Comb               Vc        Vn
                             (kip)     (kip)
-------------------------------------------
 Inventory  3, INV, MAX       97.70    118.83
```

Flexure Capacity - 63.1324

Spec Check Detail for 6B.5.3.3 PS Moment Capacity

```
Part B - ALLOWABLE STRESS RATING AND LOAD FACTOR RATING
6B.5 NOMINAL CAPACITY: C
6B.5.3 Load Factor Method
6B.5.3.3 Prestressed Concrete Capacity
(AASHTO Manual for Bridge Evaluation, Third Edition - 2017)

PS Box Rect Void - At Location = 63.1324 (ft) - Left     Stage 3


INPUT:

Adjust Moment Capacity for Min Reinforcement Requirements:No

SUMMARY:

Therefore the k adjustment factor will not be considered.
Nominal Moment Capacity  = Phi * Mn


  Load      Load
 Group      Comb              Phi*Mn    Phi*Mn < 1.2Mcr     Mu          k      Capacity
                             (kip-ft)                    (kip-ft)              (kip-ft)
-------------------------------------------------------------------------------------
 Inventory  3, INV, MAX       1000.63       ---           ---         ---       1000.63
```

Shear Capacity - 63.1324

Spec Check Detail for 9.20.1.3 Nominal Shear Capacity

```
9 Prestressed Concrete
9.20 Shear
9.20.1 General
9.20.1.3
(AASHTO Standard Specifications for Highway Bridges, Seventeenth Edition - 2002)

PS Box Rect Void - At Location = 63.1324 (ft) - Left     Stage 3

INPUT:
Phi =    0.9000
Vs  =   69.1200 (kip)

Vn = Phi * (Vc + Vs)


  Load      Load
 Group      Comb              Vc        Vn
                             (kip)     (kip)
-----------------------------------------------
 Inventory  3, INV, MAX       97.72     150.16
```

Flexure Capacity - 65.2740

Spec Check Detail for 6B.5.3.3 PS Moment Capacity

```
Part B - ALLOWABLE STRESS RATING AND LOAD FACTOR RATING
6B.5 NOMINAL CAPACITY: C
6B.5.3 Load Factor Method
6B.5.3.3 Prestressed Concrete Capacity
(AASHTO Manual for Bridge Evaluation, Third Edition - 2017)

PS Box Rect Void - At Location = 65.2740 (ft) - Left     Stage 3


INPUT:

Adjust Moment Capacity for Min Reinforcement Requirements:No

SUMMARY:

Therefore the k adjustment factor will not be considered.
Nominal Moment Capacity  = Phi * Mn


  Load      Load
 Group      Comb              Phi*Mn    Phi*Mn < 1.2Mcr     Mu          k      Capacity
                             (kip-ft)                    (kip-ft)              (kip-ft)
-------------------------------------------------------------------------------------
 Inventory  3, INV, MAX       861.59        ---           ---         ---       861.59
```

Shear Capacity - 65.2740

Spec Check Detail for 9.20.1.3 Nominal Shear Capacity

```
9 Prestressed Concrete
9.20 Shear
9.20.1 General
9.20.1.3
(AASHTO Standard Specifications for Highway Bridges, Seventeenth Edition - 2002)

PS Box Rect Void - At Location = 65.2740 (ft) - Left     Stage 3

INPUT:
Phi =    0.9000
Vs  =   69.1200 (kip)

Vn = Phi * (Vc + Vs)


  Load      Load
 Group      Comb              Vc        Vn
                             (kip)     (kip)
-----------------------------------------------
 Inventory  3, INV, MAX       97.74     150.18
```

Flexure Capacity - 67.4155

Spec Check Detail for 6B.5.3.3 PS Moment Capacity

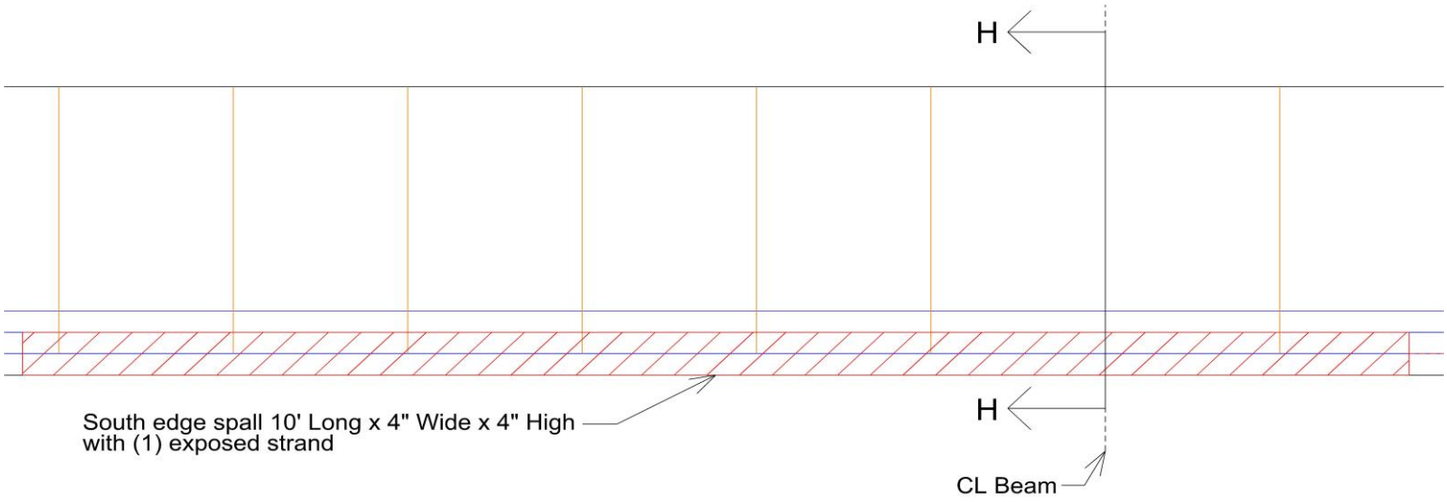
```
Part B - ALLOWABLE STRESS RATING AND LOAD FACTOR RATING
6B.5 NOMINAL CAPACITY: C
6B.5.3 Load Factor Method
6B.5.3.3 Prestressed Concrete Capacity
(AASHTO Manual for Bridge Evaluation, Third Edition - 2017)

PS Box Rect Void - At Location = 67.4155 (ft) - Left     Stage 3


INPUT:

Adjust Moment Capacity for Min Reinforcement Requirements:No

SUMMARY:

Therefore the k adjustment factor will not be considered.
Nominal Moment Capacity  = Phi * Mn


  Load      Load
 Group      Comb              Phi*Mn    Phi*Mn < 1.2Mcr     Mu          k      Capacity
                             (kip-ft)                    (kip-ft)              (kip-ft)
-------------------------------------------------------------------------------------
 Inventory  3, INV, MAX       558.83        ---           ---         ---       558.83
```

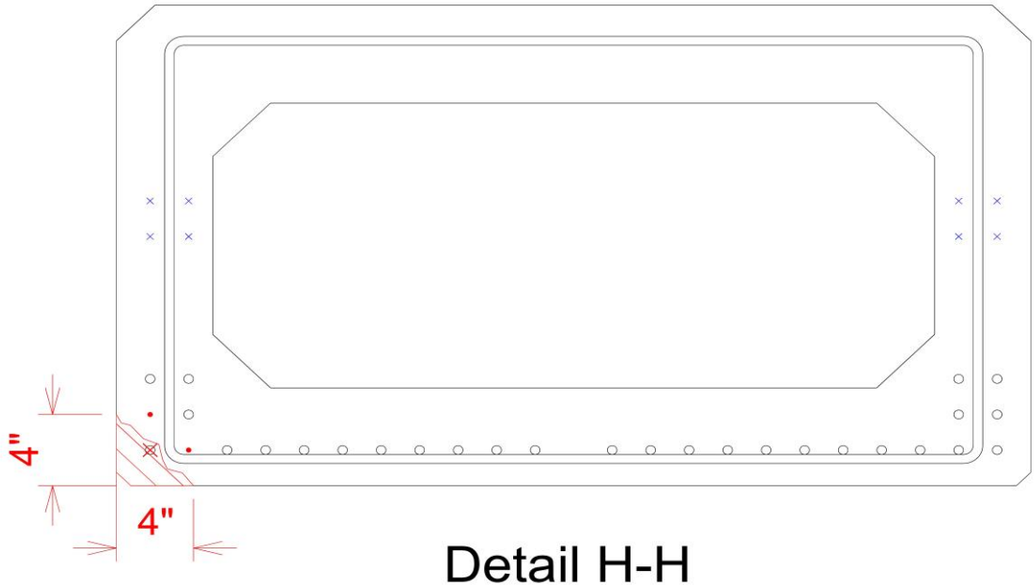
Shear Capacity - 67.4155

Spec Check Detail for 9.20.1.3 Nominal Shear Capacity

```
9 Prestressed Concrete
9.20 Shear
9.20.1 General
9.20.1.3
(AASHTO Standard Specifications for Highway Bridges, Seventeenth Edition - 2002)

PS Box Rect Void - At Location = 67.4155 (ft) - Left     Stage 3

INPUT:
Phi =    0.9000
Vs  =  122.1881 (kip)

Vn = Phi * (Vc + Vs)


  Load      Load
 Group      Comb              Vc        Vn
                             (kip)     (kip)
-----------------------------------------------
 Inventory  3, INV, MAX       84.38     185.91
```

B1


H
H
South edge spall 10' Long x 4" Wide x 4" High
with (1) exposed strand
CL Beam


4"
4"

Detail H-H

No. of Row 1 Strands w/no loss =	20	No. of Row 2 Strands w/no loss =	3
No. of Row 1 Strands w/10% loss =	0	No. of Row 2 Strands w/10% loss =	0
No. of Row 1 Strands w/25% loss =	0	No. of Row 2 Strands w/25% loss =	0
No. of Row 1 Strands w/50% loss =	1	No. of Row 2 Strands w/50% loss =	1
No. of Row 1 Strands w/100% loss =	1	No. of Row 2 Strands w/100% loss =	0

No. of Row 3 Strands w/no loss =	4
No. of Row 3 Strands w/10% loss =	0
No. of Row 3 Strands w/25% loss =	0
No. of Row 3 Strands w/50% loss =	0
No. of Row 3 Strands w/100% loss =	0

Jacking Stress Ratio =	0.7	(Stress Relieved)	
Ultimate Strength, F_u =	270	ksi	
Total Adjusted Area of Strands =	4.285	in^2	
Jacking Force =	810	k	(input into BrR)
C.G. of Strands =	2.821	in	(input into BrR)

POIs (Distance from left support)

27.248	ft	0.4L
30.654	ft	0.45L
34.060	ft	0.5L
37.466	ft	0.55L
40.872	ft	0.6L

Flexure Capacity - 34.0599'

Spec Check Detail for 6B.5.3.3 PS Moment Capacity

```
Part B - ALLOWABLE STRESS RATING AND LOAD FACTOR RATING
6B.5 NOMINAL CAPACITY: C
6B.5.3 Load Factor Method
6B.5.3.3 Prestressed Concrete Capacity
(AASHTO Manual for Bridge Evaluation, Third Edition - 2017)

PS Box Rect Void - At Location = 34.0599 (ft) - Left     Stage 3


INPUT:

Adjust Moment Capacity for Min Reinforcement Requirements:No

SUMMARY:

Therefore the k adjustment factor will not be considered.
Nominal Moment Capacity  = Phi * Mn


  Load      Load
 Group      Comb             Phi*Mn   Phi*Mn < 1.2Mcr     Mu          k      Capacity
                           (kip-ft)                   (kip-ft)              (kip-ft)
-------------------------------------------------------------------------------------
 Inventory  3, INV, MAX       1890.12       ---           ---         ---       1890.12
```

APPENDIX D
COMPUTER INPUT AND OUTPUT