REPLACEMENT OF BRIDGE NO. 04575
MAIN STREET OVER
TANKERHOOSEN RIVER
VERNON, CONNECTICUT

STATE PROJECT NO. 146-199

ADDENDUM TO PRELIMINARY ENGINEERING REPORT

DECEMBER 22, 2016

Prepared By:
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59 Elm Street, Suite 101
New Haven, CT

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Addendum to Preliminary Engineering Report

FOREWORD

Various technical investigations were conducted during the preliminary engineering phase of this project for the replacement of the Main Street Bridge No. 04575 over the Tankerhoosen River. Subsequent to the submission of the Preliminary Engineering Report and based on a discussion between Dewberry Engineers and Close Jensen and Miller (the Consultant Liaison), one additional alternative has been investigated that should be given consideration as a potential preferred alternative. This Addendum provides specific information regarding the newly developed alternative:

1. PROJECT DESCRIPTION

No Change.

2. GEOMETRIC DETAILS

Geometric details for the new alternative remains the same as included in the Preliminary Engineering Report.

The new Alternative 4 replaces the existing bridge in the same location and alignment as the existing bridge, the geometrics will follow the existing centerline of the road. The roadway profile will be raised by approximately 1 foot to provide for the increased structural depth and additional free board between the new bridge low chord and water surface similar to Alternative 1 and 2 presented in the Preliminary Engineering Report.

3. TRAFFIC CONTROL

Traffic control will follow Option 3 that is discussed in the Preliminary Design Report for the new alternatives.

4. SUBSTRUCTURE AND SUPERSTRUCTURE EVALUATION

Evaluated Alternatives and Bridge Evaluation Methodology is consistent with the discussion presented in the Preliminary Design Report.

Proposed Bridge Replacement

Replacement Alternative 4: One Lane Bridge (On Line)

This alternative proposes the replacement of the existing bridge with a one-lane steel multi-beam bridge constructed above the refurbished historic truss on the existing alignment to carry vehicular and pedestrian traffic.

New, cast-in-place concrete abutments would be constructed behind the existing bridge abutments, therefore maintaining the existing 55.5 ft. wide clear channel opening. The proposed abutment location would require a 71’-9” span bridge (69’-9” between centers of bearings) and would carry one (1) 11’-0” wide travel lane and a 4’-0” wide striped path at grade along the east side. The proposed 11’-0” wide roadway would follow the proposed approach width. The proposed abutments would be constructed as integral abutments on micropiles or drilled in H-Piles rock socketed in gneissic bedrock with a 225 kip factored axial resistance.

The existing historic truss system would be rehabilitated and utilized in its original form without providing any support for traffic or structural load from the superstructure other than its own self-weight. The truss system would be supported on the existing stone walls which would be repaired as needed. The new proposed superstructure would be placed between the trusses and supported by the proposed abutments built behind the existing stone wall abutments. Since there is no pedestrian access on the cantilevered section of the truss floor beams in this alternate, the proposed abutments would be constructed the length of the roadway section only.

A total of four (4) W30x132 rolled beams would support the reinforced concrete deck. The steel beams were designed utilizing Bentley Leap Bridge Steel structural analysis program for the dead loads due to its self-weight and weight of the proposed concrete deck, railing and wearing surface and live loads due to an AASHTO HL-93 design vehicle. A yield stress of 50 ksi was assumed in the analysis based on AASHTO M270 Grade 50 steel typically specified for structural steel. In order to avoid future maintenance associated with painted steel, galvanized steel would be utilized with an option to galvanize and paint the fascia beams.

A standard 8½” thick reinforced concrete deck made composite with the steel beams would be utilized to support the roadway. The 4’-0” wide pedestrian path at grade would be striped between the edge of travel lane and the edge of curb on the east side of the bridge. In order to maintain the existing overtopping conditions, an open rail would be used. A 9” high 1’-10” wide concrete base would support the rail. The low cord elevation for this alternate matches the existing low chord of 207.7 and is located at the east side of the south abutment. Wingwalls would be required to contain the embankments utilizing the existing low rubble stone retaining walls that would be preserved and are extending from the existing stone abutments.

Due to the existence of a previous sidewalk on the cantilevered floor beam section of the existing truss bridge, this study also investigated an additional alternative with a new independent pedestrian bridge constructed above the cantilevered section of the refurbished truss floor beam. However, this alternate was not progressed when it was discovered that the abutment length needed to accommodate the AASHTO and ADA required 5'-0" sidewalk width would encroach into the river. This would require extensive modification to the existing stone walls and the embankment would need to be widened into the river. Therefore, due to hydraulic and permitting issues, a new pedestrian bridge constructed above the cantilevered section of the refurbished truss floor beam was eliminated.

A General-Plan, Elevation and Cross-Section of the proposed bridge configuration is depicted in sketch SK-5 (Appendix F).

The following describes the proposed sequence to accomplish the construction:

- Temporarily shield/relocate aerial utilities and protect/support utilities attached to or near existing structure
- Detour traffic and close the bridge to vehicular and pedestrian traffic
- Install debris shield under the bridge and remove existing bridge superstructure
- Remove existing truss system
- Repair, rehabilitate and repaint truss system including floor beams
- Construct proposed abutments on micropiles or drilled in H-Piles
- Repair existing stone wall abutments
- Reset the rehabilitated truss system on the repaired stone wall abutments
- Erect steel beams on proposed abutment caps
- Construct the continuity diaphragm
- Construct concrete bridge deck and approach slabs
- Place waterproofing membrane and bituminous concrete wearing surface on bridge deck and approach slabs
- Construct rail base and open rail system and stripe pedestrian path at grade
- Complete approach roadway work
- Remove all barriers and open bridge to vehicular and pedestrian traffic

It is anticipated that the proposed construction can be accomplished in one construction season (9 months). The proposed replacement (Year 2017 pricing) is estimated at $1,950,000 in the construction cost estimate (**see Appendix D**).

5. HYDROLOGY, HYDRAULIC AND SCOUR EVALUATIONS

Alternative 4 is the reconstruction of the bridge at its existing location with an 11' lane and a 4' shoulder. Because the existing trusses are retained, along with the transverse floor beams, the proposed low chords in this alternative must match the existing low chords. Since low chords match the existing, and the abutments are kept at the same location, this option is essentially the existing condition. The only change from the existing condition is a slight increase of the vertical profile, which would not have an impact on the model, since none of the design flows overtop the roadway. Therefore, a hydraulic analysis of this alternative is not necessary. The proposed water surface elevations for this alternative are the same as the existing. For a summary of water surface elevations, refer to the Existing Condition columns of data on tables 3 through 8 and tables 24 and 25 of the preliminary hydraulic findings memorandum dated December 15, 2016. Scour for Alternative 4 is anticipated to be very similar to the existing condition. Given the relatively shallow depth of bedrock along with the control provided by the downstream dam, scour is not expected to be an issue.

6. PRELIMINARY FOUNDATION REPORT

The Preliminary Foundation Report Memorandum has been revised to include the new alternative and is being submitted concurrently with this Addendum. The following narrative is a summary of aforementioned report specific to the new alternative only. Please refer to the Preliminary Foundation Report Memorandum and Preliminary Engineering Report for further information.

Based on the results of the subsurface investigation, deep foundations such as micropiles or drilled in H-piles socketed into bedrock, will be utilized for Alternative No. 4. It is anticipated that nominal axial pile resistance in excess of 125 tons is feasible.

7. ALTERNATE TRANSPORTATION MODES

No Change.

8. RIGHTS OF WAY

See Preliminary Engineering Report discussions for Alternative 1 as impacts will be the same for the new Alternative 4.

9. NOISE/AIR IMPACTS AND DESIGN FEATURES

No change.

10. DRAINAGE AND PERMITTING

No change.

11. UTILITIES

No change.

12. LANDSCAPING

No change.

13. SUMMARY OF FINDINGS

For Alternative 4, traffic control Option 3 discussed in the Preliminary Engineering Report for maintaining traffic during construction utilizing a temporary driveway access from Route 83 through one of the existing properties to the Main Street cul-de-sac is recommended to be progressed to final design. Temporary easements for the temporary driveway will be required from one property owner and the State of Connecticut for encroachment into the I-84 existing ROW. Therefore the replacement bridge for Alternative 4 can be constructed in the same location as the existing resulting in no permanent ROW acquisition.

The Steel Multi-Beam Bridge construction cost estimate for Alternative 4 has been prepared only utilizing Traffic Control Option 3 and is summarized below and attached in ***Appendix D.***

Alternative 4: One 11’ lane, 4’ shoulder/pedestrian/bike path
Construction Cost: $1,950,000
Construction Duration: 9 months

Hydraulic performance for Alternative 4 is essentially the same as the existing condition; therefore, there will be no increases in water surface elevations for the 2, 10, 25, 50, 100 and 500 year events.

For Alternative 4, the drawings HWY-09 (***Appendix C***) depict the roadway plans. The proposed typical section is depicted on drawing HWY-08 in ***Appendix C***. The profile for the proposed alignment can be found on drawing HWY-10 in ***Appendix C***.

There is no existing sidewalk located along the bridge or roadway on Main Street, and no sidewalk will be proposed at this time on the roadway, however a pedestrian path will be provided across the waterway.

A comparison of existing and proposed roadway design elements with the current Design Standards specified in the CTDOT HDM is tabulated for Alternative 4 in the Design Elements Table in ***Appendix B.***

14. RECOMMENDATION

Alternative No. 4 provides a new bridge that is independent of the existing historic truss superstructure and retaining/channel walls. The new bridge will meet current design requirements and given the low volume of traffic that crosses the river the single lane bridge will adequately service the residents, emergency services and park users. The alternative also rehabilitates the existing truss superstructure and stone walls. We believe that this alternative strikes an appropriate balance between maintaining the historic nature of the original truss bridge and retaining walls in their original configuration while providing a modern, code compliant structure. As this alternative is also the least costly alternative, we recommend that Alternative No. 4 be advanced to final design.

Appendix B

Design Elements Table

Appendix B: Design Elements Table

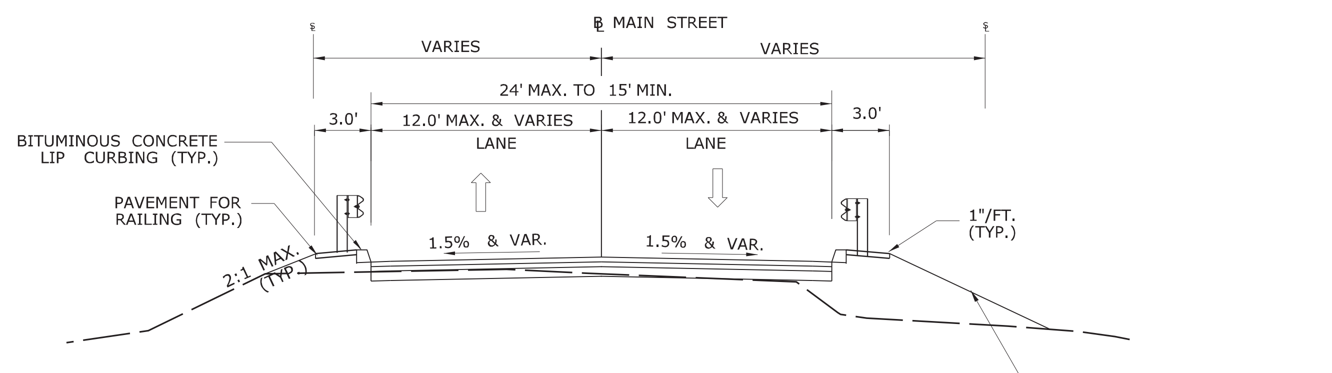
Design Element:	Design Standards	Existing	Proposed Alternative 4 Design
Design Speed	30 mph	30 mph	30 mph
Travel Lane Width	12 ft.		
Approach Road		10.0 -12.0 ft.	11 ft.
Bridge		15.0 ft.	12 ft. (1 Lane Bridge)
Shoulder Width	2-4 ft.	0 ft.	4 ft.
Cross Slope			
Travel Lane	1.5-2.0%	Varies	1.5%
Shoulder	1.5-2.0%	N/A	N/A
Roadside Clear Zone	14 ft.	14 ft.	14 ft.
Minimum Radius of curvature	230 ft.	100 ft.	100 ft.*
Maximum Grade	10%	2.1%	2.1%
Minimum Grade	0.5%	0.2%	0.5%
Vertical Curvature (K value)			
Crest (min.)	19	15	N/A
Sag (min.)	37	26	17**
Stopping Sight Distance (Vertical)	200 ft.	<155ft	<155ft.
Stopping Sight Distance (Horizontal)	200 ft.	100 ft.	100 ft.*

* Design exception will be sought for this criteria on the basis that this is a bridge replacement project and major roadway work is not feasible.

** Design exception will not be sought for this criteria as is occurs at the end of the Cul-de-sac where proposed profile is meeting existing ground and speed of vehicle will be extremely slow.

Appendix C

Roadway Typical Section, Plan and Profile



MAIN STREET

ALTERNATIVE 4
N.T.S.

PRELIMINARY DESIGN REVIEW

REV.	DATE	REVISION DESCRIPTION	SHEET NO.
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-

Plotted Date: 12/21/2016

DESIGNER/DRAFTER: RBB/LAS
CHECKED BY: A.FULCO
SCALE AS NOTED

TOWN OF VERNON
ENGINEERING DEPARTMENT

Filename: $FILEA$

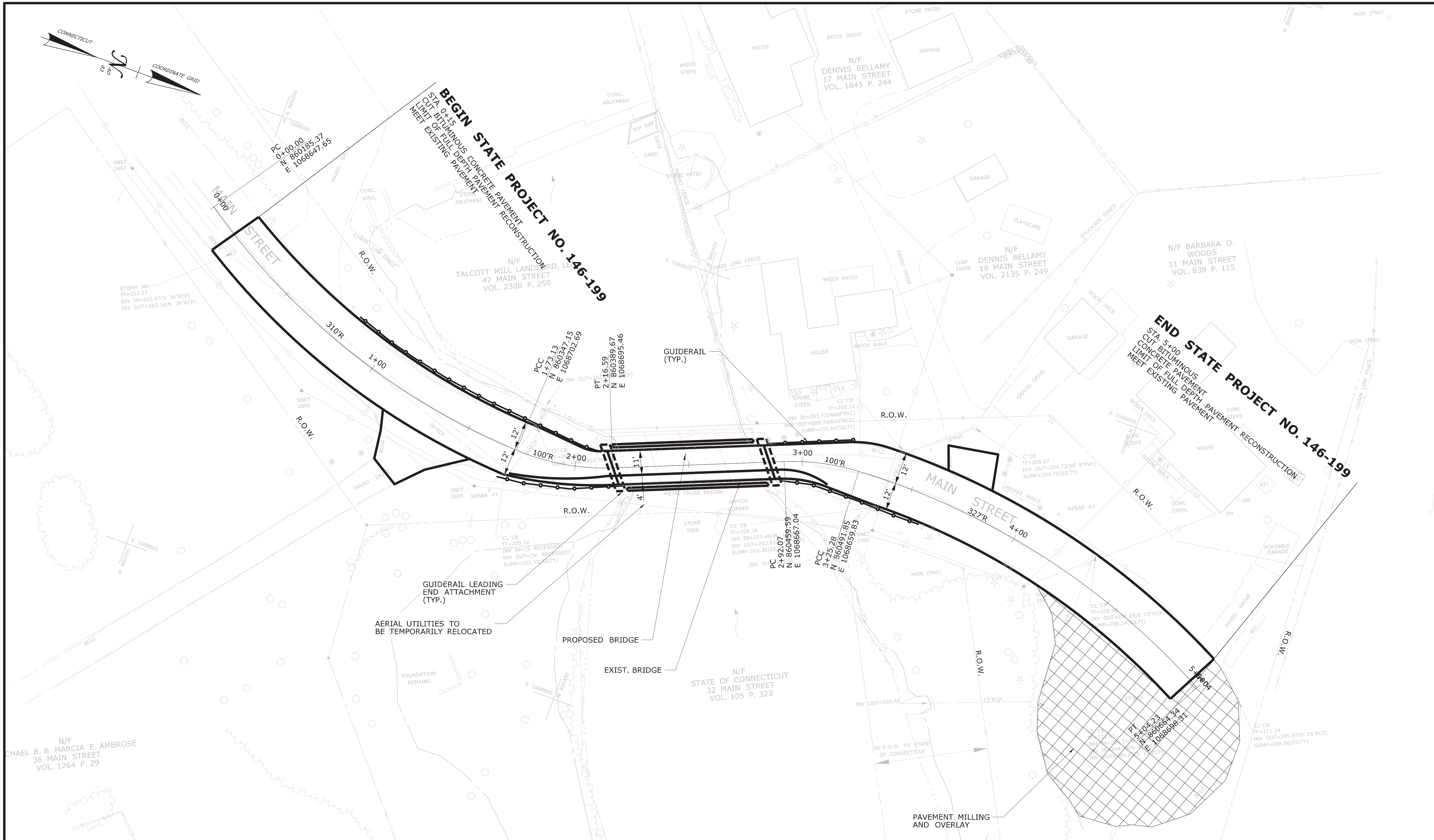
SIGNATURE/ BLOCK:

PROJECT TITLE: REPLACEMENT OF BRIDGE NO. 04575 MAIN STREET OVER TANKERHOOSEN RIVER

TOWN: VERNON

DRAWING TITLE: TYPICAL SECTIONS

PROJECT NO. 146-199
DRAWING NO. HWY-08
SHEET NO.



PRELIMINARY DESIGN REVIEW

REV.	DATE	REVISION DESCRIPTION	SHEET NO.
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-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-

Plotted Date: 12/21/2016

DESIGNER/DRAFTER: RBB/LAS
CHECKED BY: A.FULCO
SCALE AS NOTED

TOWN OF VERNON
ENGINEERING DEPARTMENT

Filename: $FILEA$

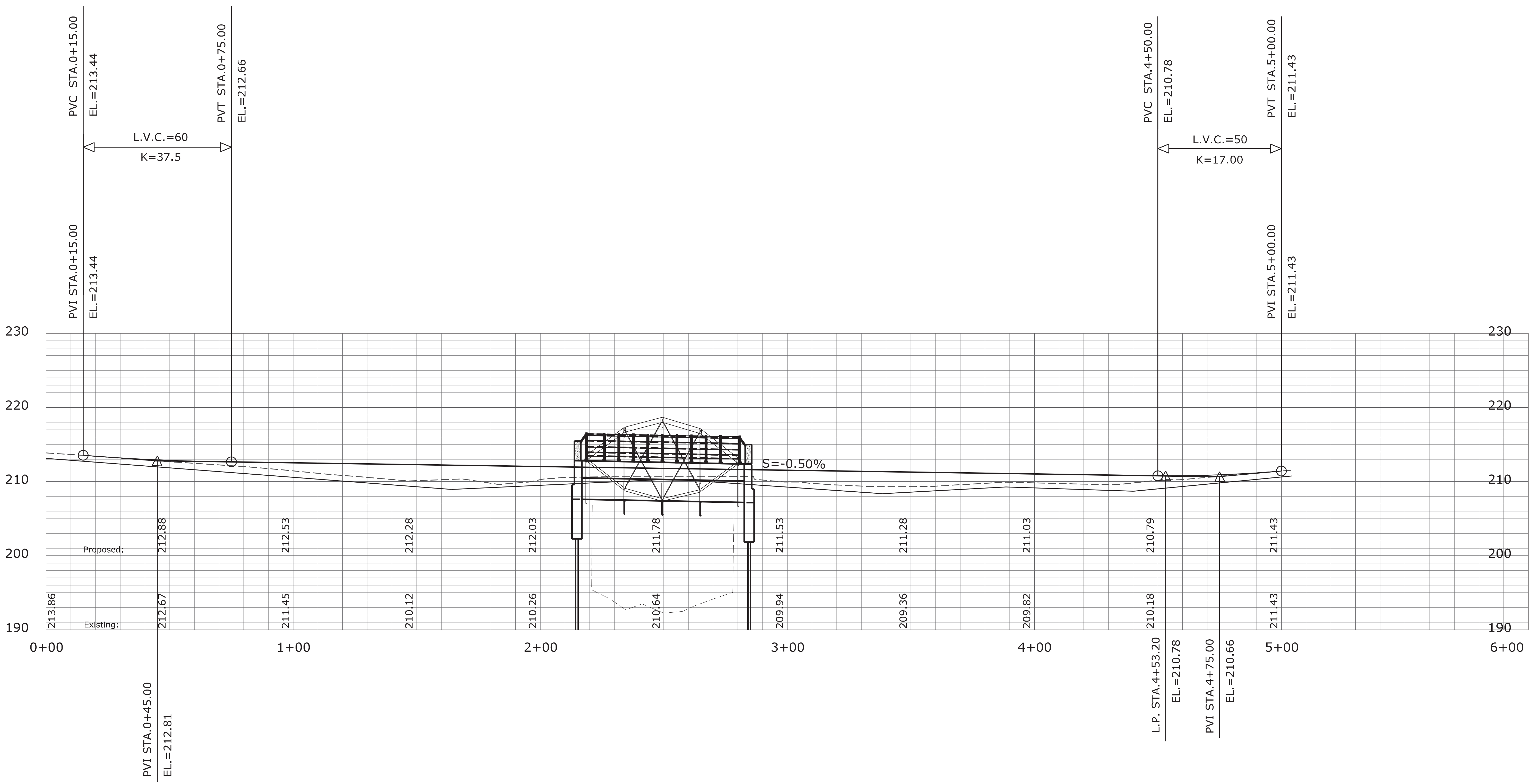
SIGNATURE/BLOCK:

PROJECT TITLE: REPLACEMENT OF BRIDGE NO. 04575 MAIN STREET OVER TANKERHOOSEN RIVER

TOWN: VERNON

DRAWING TITLE: PLAN ALTERNATIVE 4

PROJECT NO. 146-199
DRAWING NO. HWY-09
SHEET NO.



ALTERNATIVE 4

PRELIMINARY DESIGN REVIEW

REV.	DATE	REVISION DESCRIPTION	SHEET NO.
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-	-	-	-
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Plotted Date: 12/21/2016

DESIGNER/DRAFTER: SA/KH

CHECKED BY: A.FULCO

SCALE AS NOTED

TOWN OF VERNON
ENGINEERING DEPARTMENT

Filename: $FILEA$

SIGNATURE/ BLOCK:

PROJECT TITLE: REPLACEMENT OF BRIDGE NO. 04575 MAIN STREET OVER TANKERHOOSEN RIVER

TOWN: VERNON

DRAWING TITLE: PROFILE

PROJECT NO. 146-199

DRAWING NO. HWY-10

SHEET NO.

Appendix D

Cost Estimate

PRELIMINARY ENGINEERING ESTIMATE

Replacement of Bridge No. 04575
Main Street over Tankerhoosen River
Vernon, Connecticut

State Project No. 146-199

Alternative 4: 15' Wide Steel Multi-Beam Bridge with Pedestrian Path, Existing Alignment

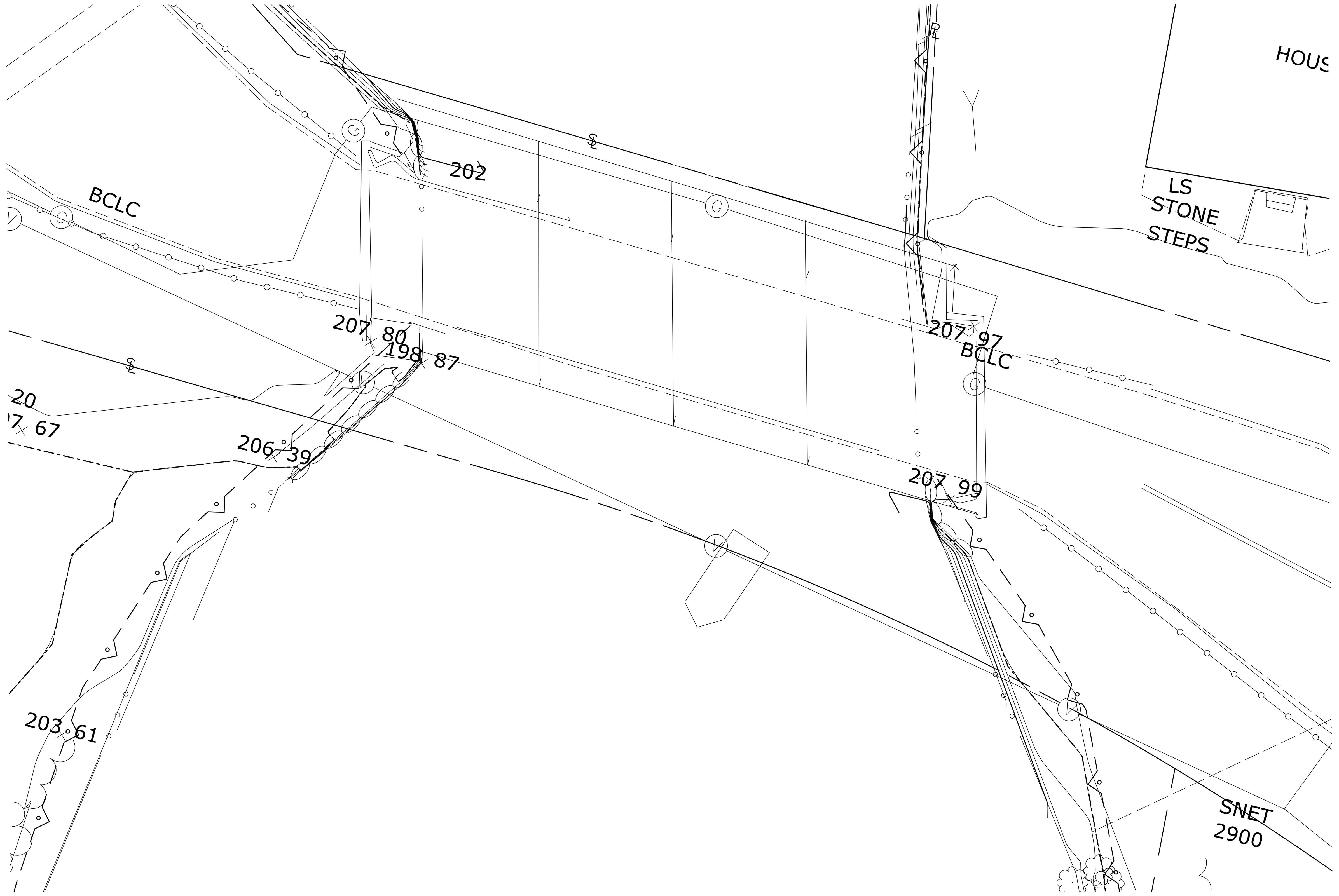
ITEM	QUANTITY	UNIT	UNIT PRICE	AMOUNT
A. Roadway Items				
Earth Excavation	195	CY	$22.00	$4,290
Cut Bituminous Concrete Pavement	175	LF	$6.00	$1,050
Borrow	150	CY	$17.50	$2,625
Formation of Subgrade	1,150	SY	$5.00	$5,750
Sedimentation Control System	775	LF	$8.00	$6,200
Milling	700	SY	$8.00	$5,600
Processed Aggregate Base	280	CY	$45.00	$12,600
HMA S0.5	140	TON	$160.00	$22,400
HMA S0.375	225	TON	$140.00	$31,500
Material for Tack Coat	210	GAL.	$25.00	$5,250
Metal Beam Rail (Type R-B 350)	295	LF	$25.00	$7,375
R-B 350 Bridge Attachment - Vertical Shaped Parapet	4	EA	$2,600.00	$10,400
R-B End Anchorage - Type II	4	EA	$1,250.00	$5,000
Furnishing and Placing Top Soil	850	SY	$7.25	$6,163
Turf Establishment	850	SY	$3.00	$2,550
Pavement Markings	1,050	LF	$6.00	$6,300
Construction Field Office, Small	10	MO	$2,500.00	$25,000
Bituminous Concrete Driveway	125	SY	$40.00	$5,000
			Sub Total	**$165,053**
B. Structure Items				
Structure Excavation - Earth	68	CY	$20.00	$1,360
Removal of Existing Superstructure	1,104	SF	$70.00	$77,280
Structural Steel	43,700	LBS	$5.00	$218,500
Galvanize Structural Steel	43,700	LBS	$0.60	$26,220
Class F Concrete (Superstructure)	76	CY	$1,150.00	$87,400
Class A Concrete (Substructure)	23	CY	$800.00	$18,400
Deformed Steel Bars (Epoxy Coated)	15,200	LBS	$1.65	$25,080
Deformed Steel Bars	3,100	LBS	$1.40	$4,340
Steel Laminated Elastomeric Bearings	8	EA.	$800.00	$6,400
Pervious Structure Backfill	17	CY	$56.00	$952
Micropiles at 225k Factored Resistance	220	LF	$180.00	$39,600
Membrane Waterproofing (Woven Glass Fabric)	137	SY	$115.00	$15,755
HMA Wearing Surface	28	TON	$210.00	$5,880
Open Bridge Rail (Pedestrian Rail)	132	LF	$320.00	$42,304
Remove, Clean, Repair, Coat, Store & Reinstall Hist. Trusses & Floorbeams	1	LS	$275,000.00	$275,000
Repair (Repointing) Existing Stone Masonry Walls	1,080	SF	$50.00	$54,000
Asphaltic Plug Expansion Joints	36	LF	$110.00	$3,960
			Sub Total	**$902,431**
C. Environmental Compliance Items				
Estimated Cost		EST	$40,000.00	**$40,000**
D. Traffic Items				
Traffic Person (Municipal Police Officer)	40	HR	$100.00	$4,000
Construction Signing	250	SF	$12.00	$3,000
Temporary Access Driveway	1	LS	$25,000.00	$25,000
Temporary Precast Concrete Barrier Curb	100	LF	$56.00	$5,600
Construction Barricade - Type III	4	EA	$140.00	$560
			Sub Total	**$38,160**
E. Minor Items (5% of Roadway, Structure and Traffic Items)		5%		**$55,282**
F. Lump Sum Items (Based on percentages of A-E)				
Cleaning & Grubbing		2%		**$24,019**
Mobilization		6.5%		**$78,060**
M&PT		2%		**$24,019**
Construction Staking		1%		**$12,009**
	CONSTRUCTION TOTAL			**$1,339,032**
			SAY	**$1,340,000**
G. Incidentals (25%) & Contingencies (20%)		45%		**$602,564**

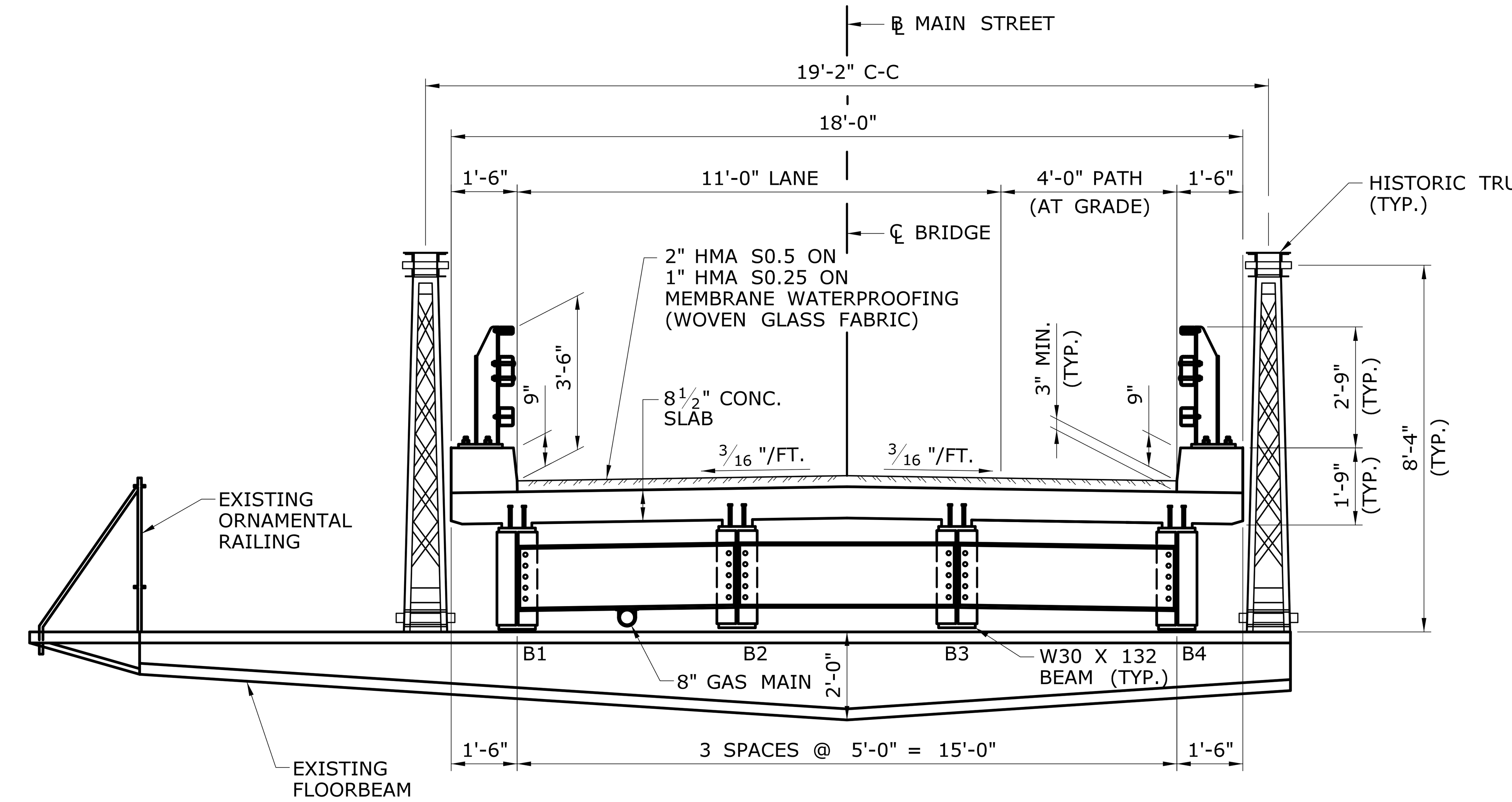
TOTAL ESTIMATED COST (Year 2017) **$1,941,597**

Say **$1,950,000**

Appendix F

Bridge Alternative General-Plan, Elevation and Cross-Section





CROSS SECTION - STEEL ALTERNATIVE 4

SCALE: 3/8" = 1'-0"

Appendix I

Preliminary Structural Calculations

Bridge 1

Superstructure

Member Definition

Member Group: Group01

Member 01:

Std Section	No.	Ref. Span	Start (ft)	Length (ft)	Material	Section			
	1	1	0.0000	69.7500	Grade 50	W30X132			

Member 02:

Std Section	No.	Ref. Span	Start (ft)	Length (ft)	Material	Section			
	1	1	0.0000	69.7500	Grade 50	W30X132			

Member 03:

Std Section	No.	Ref. Span	Start (ft)	Length (ft)	Material	Section			
	1	1	0.0000	69.7500	Grade 50	W30X132			

Member 04:

Std Section	No.	Ref. Span	Start (ft)	Length (ft)	Material	Section			
	1	1	0.0000	69.7500	Grade 50	W30X132			

Date:	12/21/2016	Main Street Alt_4.lbs	
Time:	5:26 PM	Bentley LEAP Bridge Steel [AASHTO LRFD Specifications]	v16.01.00.05

Code Checker Results

Group01 Member 01

POI Location: 34.875 ft (1.50) Mid Bracing Point:

Strength Limit State (Article 6.10.6)

Final Default Strength I | Strength I | Final

Article	Equation	Parameter	Value	Perf. Ratio	Result
6.10.6.2 – Flexure					
6.10.6.2.2 – Composite Sections in Positive Flexure					
	Is Compact?				Compact
	Straight Bridge?				Straight
	6.10.6.2.2 $Flange\ F_y \le 70ksi$	*Fyt*	50.000	0.7143	True
		Fyb	50.000		
	6.10.2.1.1-1 $\frac{D}{t_w} \le 150$	*D*	28.300	0.3068	True
		tw	0.615		
	6.10.6.2.2-1 $\frac{2D_{cp}}{t_w} \le 3.76\sqrt{\frac{E}{F_{yc}}}$	*Dcp*	0.000	0.0000	True
6.10.7.1 – Compact Sections					
	6.10.7.1.1-1 $M_u + \frac{1}{3} f_l S_{xt} \le \phi_f M_n$	*Mu*	2226.617	0.9025	Passed
		fl	14.607		
		Sxt	487.611		
		Φf Mn	2686.352		
	6.10.7.1.2-1 $M_n = M_p$	*Mp*	2995.066		
	6.10.7.1.2-2 $M_n = M_p\left(1.07 - \frac{0.7D_p}{D_t}\right)$	*Mn*	2686.352		
		Mp	2995.066		
		Dp	9.779		
		Dt	39.550		
	6.10.7.1.2-3 $M_n \le 1.3R_h M_y$	*1.3RhMy*	2641.226		
		My	2031.712		
6.10.7.3 – Ductility					
	6.10.7.3-1 $D_p \le 0.42D_t$	*Dp*	9.779	0.5887	Passed
		0.42 Dt	16.611		
6.10.6.3 – Shear					

6.10.9.1 – General					
6.10.9.1-1	$V_u \le \phi_v V_n$	Vu	20.991	0.0416	Passed
		ΦVn	504.730		
6.10.9.2 – Unstiffened Webs					
	$d_0 \le 1.5D$	d0	---	---	---
		D	---		
	$d_0 \le 3.0D$	d0	167.400	1.972	Unstiffened
		D	28.300		
6.10.9.2-1	$V_n = V_{cr} = CV_p$	Vn	504.730		
6.10.9.2-2	$V_p = 0.58F_{yw}Dt_w$	Vp	504.730		
6.10.9.3.2-4	$C = 1.0$	C	1.000		
6.10.9.3.2-5	$C = \frac{1.12}{\frac{D}{t_w}}\sqrt{\frac{Ek}{F_{yw}}}$	C	---		
6.10.9.3.2-6	$C = \frac{1.57}{\left(\frac{D}{t_w}\right)^2}\left(\frac{Ek}{F_{yw}}\right)$	C	---		
	$k = 5$	k	5.000		

Service Limit State (Article 6.10.4)

Final Default Service II   Service II   Final

Article	Equation	Parameter	Value	Perf. Ratio	Result
6.10.4.2 – Permanent Deformations					
6.10.4.2.1 – General					
	Slab Effective Negative?				True
	Continuous Shear Connectors?				True
	$f_{slab} < 0.9 f_r$	fslab	---	---	---
		0.9 fr	---		
	Is 6.10.1.7 met?				True
	$f_{slab} < 2 f_r$	fslab	---	---	---
		2 fr	---		
6.10.1.6 – Lateral Flange Stress Considerations					
6.10.1.6-2	$L_b \le 1.2L_p\sqrt{\frac{C_b R_b}{f_{bu} / F_{yc}}}$	Lb	167.400		
			133.983		

	6.10.1.6-4	$f_l = \left(\frac{0.85}{1-\frac{f_{bu}}{F_{cr}}}\right) f_{l1} \geq f_{l1}$	*fl1*	8.991		
			fl	9.896		
	6.10.1.6-1	$f_l \leq 0.6F_{yf}$	*Fyf*	50.000	0.3299	
			fl	9.896		
6.10.4.2.2 – Flexure						
		Is Section Composite?				True
		Is Flexure Negative?				False
	6.10.4.2.2-1	$f_f \leq 0.95R_hF_{yf}$	*ff*	18.259	0.3844	Passed
			*0.95Rh*Fyf*	47.500		
	6.10.4.2.2-2	$f_f + \frac{f_l}{2} \leq 0.95R_hF_{yf}$	*ff*	40.382	0.9543	Passed
			fl	9.896		
			*0.95Rh*Fyf*	47.500		
Top Flange	6.10.4.2.2-3	$f_f + \frac{f_l}{2} \leq 0.80R_hF_{yf}$	*ff*	18.259	---	---
			fl	0.000		
			*0.8*Rh*Fyf*	---		
Bottom Flange	6.10.4.2.2-3	$f_f + \frac{f_l}{2} \leq 0.80R_hF_{yf}$	*ff*	40.382	---	---
			fl	9.896		
			*0.8*Rh*Fyf*	---		
	6.10.4.2.2-4	$f_c \leq F_{crw}$	*fc*	---	---	---
			Fcrw	---		

Group01 Member 02

POI Location: 34.875 ft (1.50) Mid Bracing Point:

Strength Limit State (Article 6.10.6)

Final Default Strength I Strength I Final

Article		Equation	Parameter	Value	Perf. Ratio	Result
6.10.6.2 – Flexure						
6.10.6.2.2 – Composite Sections in Positive Flexure						
		Is Compact?				Compact
		Straight Bridge?				Straight
	6.10.6.2.2	Flange $F_y \leq 70ksi$	*Fyt*	50.000	0.7143	True
			Fyb	50.000		

	6.10.2.1.1-1	$\frac{D}{t_w} \le 150$	D	28.300	0.3068	True
			tw	0.615		
	6.10.6.2.2-1	$\frac{2D_{cp}}{t_w} \le 3.76\sqrt{\frac{E}{F_{yc}}}$	Dcp	0.000	0.0000	True
6.10.7.1 – Compact Sections						
	6.10.7.1.1-1	$M_u + \frac{1}{3} f_l S_{st} \le \phi_f M_n$	Mu	2224.763	0.8108	Passed
			fl	4.820		
			Sxt	494.210		
			Φf Mn	2825.401		
	6.10.7.1.2-1	$M_n = M_p$	Mp	3132.480		
	6.10.7.1.2-2	$M_n = M_p\left(1.07 - \frac{0.7D_p}{D_t}\right)$	Mn	2825.401		
			Mp	3132.480		
			Dp	9.494		
			Dt	39.550		
	6.10.7.1.2-3	$M_n \le 1.3R_n M_y$	1.3RhMy	2676.968		
			My	2059.206		
6.10.7.3 – Ductility						
	6.10.7.3-1	$D_p \le 0.42D_t$	Dp	9.494	0.5715	Passed
			0.42 Dt	16.611		
6.10.6.3 – Shear 6.10.9.1 – General						
	6.10.9.1-1	$V_u \le \phi_v V_n$	Vu	55.001	0.1090	Passed
			ΦVn	504.730		
6.10.9.2 – Unstiffened Webs						
		$d_0 \le 1.5D$	d0	---	---	---
			D	---		
		$d_0 \le 3.0D$	d0	167.400	1.972	Unstiffened
			D	28.300		
	6.10.9.2-1	$V_n = V_{cr} = CV_p$	Vn	504.730		
	6.10.9.2-2	$V_p = 0.58F_{yw}Dt_w$	Vp	504.730		
	6.10.9.3.2-4	$C = 1.0$	C	1.000		
	6.10.9.3.2-5	$C = \frac{1.12}{\frac{D}{t_w}}\sqrt{\frac{Ek}{F_{yw}}}$	C	---		

	6.10.9.3.2-6 $C = \frac{1.57}{\left(\frac{D}{t_w}\right)^2}\left(\frac{Ek}{F_{yw}}\right)$	C	---		
	$k = 5$	k	5.000		

Service Limit State (Article 6.10.4)

Final Default Service II — Service II — Final

Article	Equation	Parameter	Value	Perf. Ratio	Result
6.10.4.2 – Permanent Deformations					
6.10.4.2.1 – General					
	Slab Effective Negative?				True
	Continuous Shear Connectors?				True
	$f_{slab} < 0.9 f_r$	fslab	---	---	---
		0.9 fr	---		
	Is 6.10.1.7 met?				True
	$f_{slab} < 2 f_r$	fslab	---	---	---
		2 fr	---		
6.10.1.6 – Lateral Flange Stress Considerations					
	6.10.1.6-2 $L_b \le 1.2 L_p \sqrt{\frac{C_b R_b}{f_{bu} / F_{yc}}}$	Lb	167.400		
			138.837		
	6.10.1.6-4 $f_l = \left(\frac{0.85}{1 - \frac{f_{bu}}{F_{cr}}}\right) f_{l1} \ge f_{l1}$	fl1	3.050		
		fl	3.291		
	6.10.1.6-1 $f_l \le 0.6 F_{yf}$	Fyf	50.000	0.1097	
		fl	3.291		
6.10.4.2.2 – Flexure					
	Is Section Composite?				True
	Is Flexure Negative?				False
	6.10.4.2.2-1 $f_f \le 0.95 R_h F_{yf}$	ff	17.121	0.3604	Passed
		0.95Rh*Fyf	47.500		
	6.10.4.2.2-2 $f_f + \frac{f_l}{2} \le 0.95 R_h F_{yf}$	ff	39.848	0.8735	Passed
		fl	3.291		
		0.95Rh*Fyf	47.500		

Top Flange	6.10.4.2.2-3	$f_f + \frac{f_l}{2} \le 0.80 R_h F_{yf}$	*ff*	17.121	---	---
			fl	0.000		
			*0.8*Rh*Fyf*	---		
Bottom Flange	6.10.4.2.2-3	$f_f + \frac{f_l}{2} \le 0.80 R_h F_{yf}$	*ff*	39.848	---	---
			fl	3.291		
			*0.8*Rh*Fyf*	---		
	6.10.4.2.2-4	$f_c \le F_{crw}$	*fc*	---	---	---
			Fcrw	---		

Group01 Member 03

POI Location: 34.875 ft (1.50) Mid Bracing Point:

Strength Limit State (Article 6.10.6)

Final Default Strength I Strength I Final

Article	Equation		Parameter	Value	Perf. Ratio	Result
6.10.6.2 – Flexure						
6.10.6.2.2 – Composite Sections in Positive Flexure						
		Is Compact?				Compact
		Straight Bridge?				Straight
	6.10.6.2.2	*Flange* $F_y \le 70ksi$	*Fyt*	50.000	0.7143	True
			Fyb	50.000		
	6.10.2.1.1-1	$\frac{D}{t_w} \le 150$	*D*	28.300	0.3068	True
			tw	0.615		
	6.10.6.2.2-1	$\frac{2D_{cp}}{t_w} \le 3.76\sqrt{\frac{E}{F_{yc}}}$	*Dcp*	0.000	0.0000	True
6.10.7.1 – Compact Sections						
	6.10.7.1.1-1	$M_u + \frac{1}{3} f_l S_{xt} \le \phi_f M_n$	*Mu*	2224.404	0.8103	Passed
			fl	4.734		
			Sxt	494.210		
			Φf Mn	2825.401		
	6.10.7.1.2-1	$M_n = M_p$	*Mp*	3132.480		
	6.10.7.1.2-2	$M_n = M_p\left(1.07 - \frac{0.7D_p}{D_t}\right)$	*Mn*	2825.401		
			Mp	3132.480		
			Dp	9.494		
			Dt	39.550		

	6.10.7.1.2-3	$M_n \le 1.3 R_h M_y$	*1.3RhMy*	2676.968		
			My	2059.206		
6.10.7.3 – Ductility						
	6.10.7.3-1	$D_p \le 0.42 D_t$	*Dp*	9.494	0.5715	Passed
			0.42 Dt	16.611		
6.10.6.3 – Shear 6.10.9.1 – General						
	6.10.9.1-1	$V_u \le \phi_v V_n$	*Vu*	53.920	0.1068	Passed
			ΦVn	504.730		
6.10.9.2 – Unstiffened Webs						
		$d_0 \le 1.5D$	*d0*	---	---	---
			D	---		
		$d_0 \le 3.0D$	*d0*	167.400	1.972	Unstiffened
			D	28.300		
	6.10.9.2-1	$V_n = V_{cr} = CV_p$	*Vn*	504.730		
	6.10.9.2-2	$V_p = 0.58 F_{yw} D t_w$	*Vp*	504.730		
	6.10.9.3.2-4	$C = 1.0$	*C*	1.000		
	6.10.9.3.2-5	$C = \frac{1.12}{\frac{D}{t_w}} \sqrt{\frac{Ek}{F_{yw}}}$	*C*	---		
	6.10.9.3.2-6	$C = \frac{1.57}{\left(\frac{D}{t_w}\right)^2} \left(\frac{Ek}{F_{yw}}\right)$	*C*	---		
		$k = 5$	*k*	5.000		

Service Limit State (Article 6.10.4)

Final Default Service II — Service II — Final

Article	Equation	Parameter	Value	Perf. Ratio	Result
6.10.4.2 – Permanent Deformations 6.10.4.2.1 – General					
	Slab Effective Negative?				True
	Continuous Shear Connectors?				True
	$f_{slab} < 0.9 f_r$	*fslab*	---	---	---
		0.9 fr	---		
	Is 6.10.1.7 met?				True

		$f_{slab} < 2f_r$	fslab	---	---	---
			2 fr	---		
6.10.1.6 – Lateral Flange Stress Considerations						
	6.10.1.6-2	$L_b \le 1.2L_p\sqrt{\frac{C_bR_b}{f_{bu}/F_{yc}}}$	Lb	167.400		
				138.838		
	6.10.1.6-4	$f_l = \left(\frac{0.85}{1-\frac{f_{bu}}{F_{cr}}}\right) f_{l1} \ge f_{l1}$	fl1	2.995		
			fl	3.231		
	6.10.1.6-1	$f_l \le 0.6F_{yf}$	Fyf	50.000	0.1077	
			fl	3.231		
6.10.4.2.2 – Flexure						
		Is Section Composite?				True
		Is Flexure Negative?				False
	6.10.4.2.2-1	$f_f \le 0.95R_hF_{yf}$	ff	17.120	0.3604	Passed
			0.95Rh*Fyf	47.500		
	6.10.4.2.2-2	$f_f + \frac{f_l}{2} \le 0.95R_hF_{yf}$	ff	39.842	0.8728	Passed
			fl	3.231		
			0.95Rh*Fyf	47.500		
Top Flange	6.10.4.2.2-3	$f_f + \frac{f_l}{2} \le 0.80R_hF_{yf}$	ff	17.120	---	---
			fl	0.000		
			0.8*Rh*Fyf	---		
Bottom Flange	6.10.4.2.2-3	$f_f + \frac{f_l}{2} \le 0.80R_hF_{yf}$	ff	39.842	---	---
			fl	3.231		
			0.8*Rh*Fyf	---		
	6.10.4.2.2-4	$f_c \le F_{crw}$	fc	---	---	---
			Fcrw	---		

Group01 Member 04

POI Location: 34.875 ft (1.50) Mid Bracing Point:

Strength Limit State (Article 6.10.6)

Final Default Strength I — Strength I — Final

Article	Equation	Parameter	Value	Perf. Ratio	Result
6.10.6.2 – Flexure					
6.10.6.2.2 – Composite Sections in Positive Flexure					

		Is Compact?				Compact
		Straight Bridge?				Straight
	6.10.6.2.2	$Flange\ F_y \leq 70ksi$	*Fyt*	50.000	0.7143	True
			Fyb	50.000		
	6.10.2.1.1-1	$\frac{D}{t_w} \leq 150$	*D*	28.300	0.3068	True
			tw	0.615		
	6.10.6.2.2-1	$\frac{2D_{cp}}{t_w} \leq 3.76\sqrt{\frac{E}{F_{yc}}}$	*Dcp*	0.000	0.0000	True
6.10.7.1 – Compact Sections						
	6.10.7.1.1-1	$M_u + \frac{1}{3} f_l S_{xt} \leq \phi_f M_n$	*Mu*	2227.247	0.9029	Passed
			fl	14.630		
			Sxt	487.611		
			Φf Mn	2686.352		
	6.10.7.1.2-1	$M_n = M_p$	*Mp*	2995.066		
	6.10.7.1.2-2	$M_n = M_p\left(1.07 - \frac{0.7D_p}{D_t}\right)$	*Mn*	2686.352		
			Mp	2995.066		
			Dp	9.779		
			Dt	39.550		
	6.10.7.1.2-3	$M_n \leq 1.3R_h M_y$	*1.3RhMy*	2641.226		
			My	2031.712		
6.10.7.3 – Ductility						
	6.10.7.3-1	$D_p \leq 0.42D_t$	*Dp*	9.779	0.5887	Passed
			0.42 Dt	16.611		
6.10.6.3 – Shear 6.10.9.1 – General						
	6.10.9.1-1	$V_u \leq \phi_v V_n$	*Vu*	21.079	0.0418	Passed
			ΦVn	504.730		
6.10.9.2 – Unstiffened Webs						
		$d_0 \leq 1.5D$	*d0*	---	---	---
			D	---		
		$d_0 \leq 3.0D$	*d0*	167.400	1.972	Unstiffened
			D	28.300		
	6.10.9.2-1	$V_n = V_{cr} = CV_p$	*Vn*	504.730		
	6.10.9.2-2	$V_p = 0.58F_{yw}Dt_w$	*Vp*	504.730		
	6.10.9.3.2-4	$C = 1.0$	*C*	1.000		

	6.10.9.3.2-5 $C=\frac{1.12}{\frac{D}{t_w}}\sqrt{\frac{Ek}{F_{yw}}}$	C	---		
	6.10.9.3.2-6 $C=\frac{1.57}{\left(\frac{D}{t_w}\right)^2}\left(\frac{Ek}{F_{yw}}\right)$	C	---		
	$k=5$	k	5.000		

Service Limit State (Article 6.10.4)

Final Default Service II — Service II — Final

Article	Equation	Parameter	Value	Perf. Ratio	Result
6.10.4.2 – Permanent Deformations					
6.10.4.2.1 – General					
	Slab Effective Negative?				True
	Continuous Shear Connectors?				True
	$f_{slab}<0.9f_r$	*fslab*	---	---	---
		0.9 fr	---		
	Is 6.10.1.7 *met?*				True
	$f_{slab}<2f_r$	*fslab*	---	---	---
		2 fr	---		
6.10.1.6 – Lateral Flange Stress Considerations					
	6.10.1.6-2 $L_b\le 1.2L_p\sqrt{\frac{C_bR_b}{f_{bu}/F_{yc}}}$	*Lb*	167.400		
			133.980		
	6.10.1.6-4 $f_l=\left(\frac{0.85}{1-\frac{f_{bu}}{F_{cr}}}\right)f_{l1}\ge f_{l1}$	*fl1*	9.005		
		fl	9.912		
	6.10.1.6-1 $f_l\le 0.6F_{yf}$	*Fyf*	50.000	0.3304	
		fl	9.912		
6.10.4.2.2 – Flexure					
	Is Section Composite?				True
	Is Flexure Negative?				False
	6.10.4.2.2-1 $f_f\le 0.95R_hF_{yf}$	*ff*	18.260	0.3844	Passed
		*0.95Rh*Fyf*	47.500		

Top Flange	6.10.4.2.2-2	$f_f + \frac{f_l}{2} \leq 0.95 R_h F_{yf}$	*ff*	40.392	0.9547	Passed
			fl	9.912		
			*0.95Rh*Fyf*	47.500		
	6.10.4.2.2-3	$f_f + \frac{f_l}{2} \leq 0.80 R_h F_{yf}$	*ff*	18.260	---	---
			fl	0.000		
			*0.8*Rh*Fyf*	---		
Bottom Flange	6.10.4.2.2-3	$f_f + \frac{f_l}{2} \leq 0.80 R_h F_{yf}$	*ff*	40.392	---	---
			fl	9.912		
			*0.8*Rh*Fyf*	---		
	6.10.4.2.2-4	$f_c \leq F_{crw}$	*fc*	---	---	---
			Fcrw	---		