SIDEWALK FEASIBILITY STUDY REPORT

State Project No. 040-141

Bridges No. 01138

Route 82 over Connecticut River

Town of East Haddam & Town of Haddam

Submitted: November, 2016

Prepared For: **State of Connecticut**

Department of Transportation

Newington, Connecticut

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Executive Summary

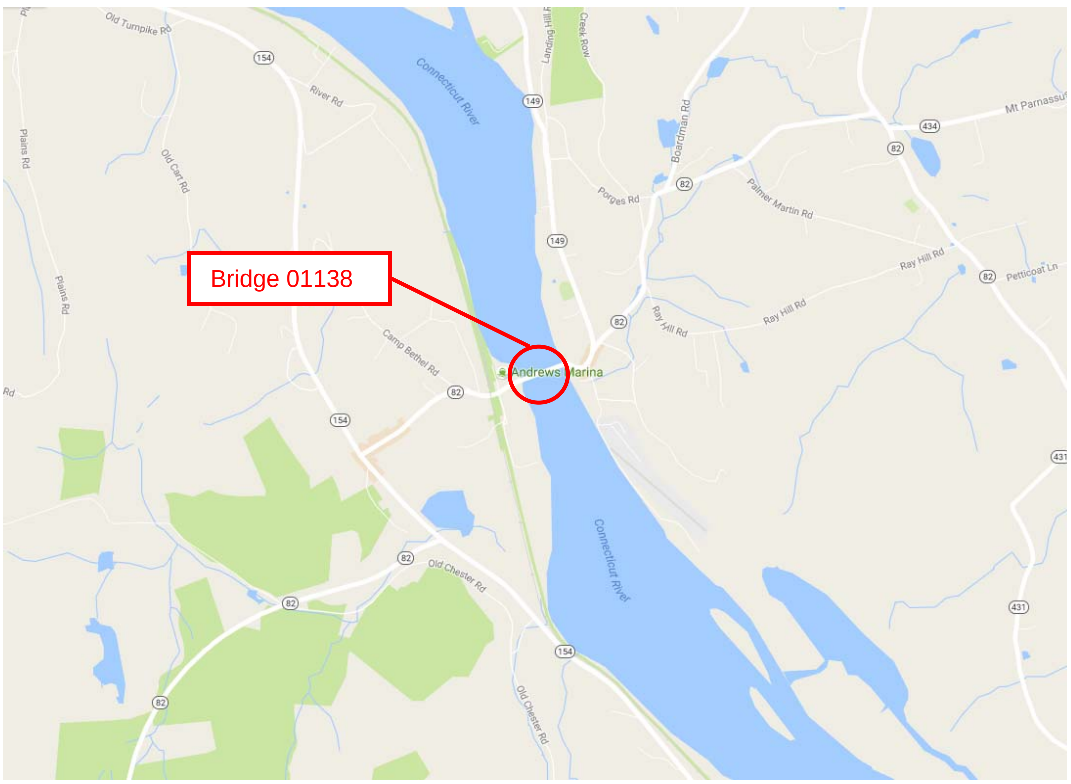
This report presents the feasibility study of providing a new 6' wide sidewalk on the north side of Bridge No. 01138, the East Haddam Swing Bridge. The structure was built in 1913 and carries Route 82 over the Connecticut River. Currently pedestrians using the bridge must cross with vehicular traffic on the 24'-6" wide bridge, rail to rail. Modifications to this bridge are subject to review and approval by the State Historic Preservation Office.

The proposed cantilevered sidewalk consists of a fiber reinforced plastic (FRP) deck supported on steel stringers and floorbeams. Significant strengthening of the existing bridge is required to accommodate the sidewalk on the north side of the bridge. The estimated cost of providing a sidewalk on the bridge is $13.68 million in 2019 dollars, not including approach work or mechanical and electrical upgrades.

A cost benefit analysis considering the addition of a sidewalk on the north side of the bridge, which evaluates the total construction cost versus the benefit to users is beyond the scope of this feasibility study. A cost benefit analysis may better define the needs of the community and assist in the decision making process.

Bridge Description

The East Haddam Swing Bridge was built in 1913 and carries Route 82 over the Connecticut River. The bridge has been rehabilitated several times since its original construction. The bridge has a roadway clear width of 24’-6”, accommodating two lanes of traffic, one in each direction. The bridge consists of four spans and three trusses; a 99’ long deck truss (Span 1), a 326’ long fixed through truss (Span 2) and a 456’ long swing through truss (Spans 3 and 4). The swing spans allow navigational access to the river via the 200’ wide channel between Piers 2 and 3.



Location Map

The deck truss consists of two riveted Warren trusses with vertical posts, see Figure 5. The trusses are spaced at 15’-0”, center-to-center. The top chords of the trusses support nine of the floorbeams at node points. The floorbeams cantilever 5’-0” from the centerline of the truss on each side. The tenth floor beam is supported by Pier 1. The floorbeams support five stringers, which support the concrete filled steel grid deck.

The fixed through truss is an 18 panel riveted Pennsylvania truss, see Figure 6. The trusses are spaced at 27’-0” center-to-center. The 31 floorbeams are supported by the bottom chord of the truss. The floorbeams are evenly spaced, but do not line up with the truss bottom chords at every panel point. The floorbeams support five stringers, supporting the concrete filled steel grid deck.

The swing truss is a 20 panel through truss, see Figure 7. The trusses consist of eye bar members and riveted built-up members, they are spaced at 27’-0”. The 42 floorbeams do not line up with the truss bottom chords at every panel point. The floorbeams support five stringers which support the open steel grid deck. The bridge rotates on a center pivot bearing at Pier 3.

The abutments and piers are reinforced concrete. Piers 2 and 3, located in the river, are stone faced and supported on timber piles.

The existing bridge railing, transitions, approach guiderail and approach guiderail ends do not meet RB-350 safety standards. Additionally, the bridge rail is not suitable to function as a pedestrian railing due to the spacing of the guide rails. All movable bridges must provide a break in the railing, this detail prohibits a tie-in to the transition railings.

Based on the 2015 inspection report, the superstructure is in poor condition, the deck is in fair condition and the substructure is in fair condition. A comprehensive rehabilitation of the superstructure is anticipated, which would include considerable strengthening to meet capacity requirements and achieve load ratings standards

The 2015 inspection report indicates the shoulders on the bridge varying in width from 1.5’ to 2’. The shoulder width is substandard and does not accommodate pedestrians. The current bridge configuration offers no safe access for pedestrian traffic

Sidewalk Feasibility

This study is for the addition of a 6 foot wide sidewalk on the north side of the bridge. The sidewalk is for pedestrian traffic only and would not be a multi-modal path. The sidewalk support would be designed to accommodate snow removal equipment. Detailing of the sidewalk support structure should consider the historic nature of the bridge. Based on information from the State

Historical Preservation Office (SHPO) this should include: limiting new element lines, using similar materials and painting the sidewalk structure to match the bridge.

This Sidewalk Feasibility Study has been prepared to meet the following scope:

1. Develop a preliminary sidewalk support structure
2. Verify structural integrity of the existing superstructure components required to accommodate the sidewalk
3. Determine the extent of swing span balancing required
4. Provide conceptual drawings for the recommended sidewalk and supports
5. Develop a preliminary cost estimate

<u>Sidewalk Support Structure</u>

The proposed sidewalk support structure alternatives are detailed below.

Structural Support from the Existing Bridge Trusses

To minimize visual alterations to the existing structure, only steel was considered for the structural framing of the sidewalk support system. Minimizing the weight of the sidewalk support is critical to limiting the additional stresses on the existing members.

Three structural alternatives were considered for the deck truss (span 1): spliced floorbeam option, cantilevered floorbeam option and prefabricated truss option; the fixed (span 2) and swing through (spans 3 & 4) trusses considered one alternative: cantilevered floorbeams.

Deck Truss – Span 1

The spliced floorbeam option modifies the existing traffic rail post connection and splices a new floorbeam to the existing floorbeam for the deck truss span. The floorbeams support a bolster beam and two stringers which support the deck, see Figure 1. For this option the floorbeams do not introduce new lines to the structure, however, it requires modifications to the existing vehicular rail.

The new cantilevered floorbeam option provides a new floorbeam which is supported by the existing top chord of the deck truss. Similar to the spliced floorbeam option, the new floorbeams support a bolster beam, two stringers and the deck, see Figure 2. This option does not produce additional loads on the existing floorbeams, however, it introduces new element lines to the structure.

Fixed Through Truss – Span 2

The sidewalk on the fixed through truss (span 2) will be supported on a floorbeam cantilevered from the bottom chord. The connection to the top of the bottom chord avoids conflicts with the existing inspection access scaffolding. See Figure 3 for a concept sketch. The floorbeams would support the new stringers and deck. The sidewalk deck end and railing at Pier 3 would need to match the bridge radius to allow for the swing. As the floorbeams would be connected to the existing bottom chord, they should minimize additional lines on the structure.

Swing Through Truss – Spans 3 & 4

The sidewalk on the swing through truss (spans 3 & 4) would be a floorbeam and stringer system. The floorbeams would be cantilevered from the bottom chord of the truss, see Figure 4. The connection to the top of the bottom chord avoids conflicts with the existing inspection access scaffolding supports. The floorbeams would support the new stringers and the deck. Localized widening of the sidewalk around the existing stairway and other elements at Pier 3 would be required. The sidewalk deck ends and railing would need to match the bridge radius to allow for the swing. The new floorbeams should minimize additional element lines as they are attached to the existing chord.

Sidewalk Deck

The decking concepts considered are FRP deck, FRP planking, aluminum plating or timber decking. The timber deck would create larger loads and may require existing member strengthening. Providing a closed deck surface while minimizing weight are important requirements for the deck therefore the alternatives discussed use a 4" FRP deck. During detailed design eliminating the stringers and using a thicker FRP deck should be considered. A thicker deck may limit the number of FRP manufacturers but would reduce the weight of the overall sidewalk. It is strongly recommended that if the sidewalk is pursued, the lightest system possible be used, regardless of the need for proprietary manufacturers. Steel decking alternatives were not considered due to weight.

Railing

All options use tubular steel rail posts and horizontal railing. A railing height of 42 inches would be provided. The spacing between rails is limited to a maximum of 6 inches in accordance with AASHTO LRFD Bridge Design Specifications. Additional element lines may be required at the railing to meet the safety requirements. The aesthetic treatment of the pedestrian railing should be coordinated with the State Historical Preservation Office during detailed design to minimize the new element lines. Alternative railing types are numerous and include but are not limited to: aluminum railing, mesh panels and vertical rails. As with the deck, it is recommended that the lightest railing available be used to minimize the weight added to the bridge.

Alternate Option - Structural Support from the Bridge Substructure

In the event that the Department was to eliminate the restrictions imposed by the SHPO, an independent simply supported sidewalk could be investigated assuming that modifications to the bridge piers could be performed to support a sidewalk adjacent to the bridge structures. The style of the truss or structural system would need to be coordinated with the State Historical Preservation Office to determine the extent of impact to the historical resource.

At the swing span, this concept would require a cantilever truss or self-anchored cable supported sidewalk bridge structure directly adjacent to the swing span and supported off of a replacement distribution girder or newly designed pivot system. The construction of this type of adjacent structure would require the complete replacement of the distribution girder and center bearing, and the installation of a structural distribution girder system capable of supporting the new sidewalk, counterweight, and the existing truss, which would be placed back upon the new distribution girder system. Such a concept would have an extensive visual impact and is a very significant departure from the goals set forth by the SHPO. Evaluation of this concept is beyond the scope of this report, and could be further studied in future phases. It is anticipated that the length of the swing span, the need for pier modifications, the amount of work required at the pivot girder, and the need to tie the sidewalk span to the swing span would introduce considerable challenges to this alternate option that would need to be overcome.

Structural Integrity and Modifications

This report does not cover the total cost of strengthening required to meet an inventory rating greater than or equal to 1.0 for the bridge without a sidewalk. The goal of this feasibility study is to determine the additional investment that may be necessary to achieve sufficient load capacity to support the sidewalk.

The original design of the Swing Bridge was based on the ARE&MoW design code from 1910. The swing bridge was constructed form structural Open-Hearth Steel, consistent with other bridges of the time period. There are no material records for the bridge itself and evaluation is based on the AASHTO Manual for Bridge Evaluation (MBE), the AASHTO LRFD Movable Highway Bridge Design Specifications (LRFD Movable code), the AASHTO LRFD Bridge Design Specifications, and historical references as appropriate. The bridge structural steel is assumed to be 55-65ksi ultimate (Fu) and ½Fu = 27.5-32.5ksi yield (Fy) steel, consistent with other bridges from the time period.

For the purpose of this feasibility evaluation, computations are based on the mean value of Fy=30ksi, in compliance with the MBE. Previous evaluation of the swing truss bridge assumed a structural steel yield strength of Fy=33ksi.

Previous evaluation of the swing span was performed assuming LFD load cases. For the purpose of this study and the associated load ratings, the use of the LRFR load rating method is required. For the support of highway loads on the movable span, the difference between the LRFR and LFD codes is considerable and results in the Load Rating differences identified below.

Deck Truss – Span 1

The additional load due to the sidewalk does not significantly alter the inventory rating for the deck truss. Minor structural repairs are necessary to achieve increased load ratings at gusset plates, which could be achieved through fastener replacement on a one-for-one basis.

Fixed Through Truss – Span 2

The top chord of the fixed through truss (span 2) includes 8 of 18 members with an inventory load rating less than 1.0 for the as-inspected condition. In the event that the sidewalk were to be added to the bridge, all of the 18 top chord members would subsequently fall below a 1.0 Rating Factor for HL-93 inventory load rating. In all, 8 of the 18 top chord members would rate at or less than 1.0 for HL-93 Operating, were the sidewalks to be added.

The bottom chord of the fixed through truss (span 2) includes 5 of 18 members with an inventory load rating factor less than 1.0 for the as-inspected condition. With the addition of the sidewalk, 14 of the 18 bottom chord members have an inventory rating factor below 1.0 for HL-93 for the as-inspection condition.

Minor structural repairs are necessary to achieve increased load ratings at gusset plates, which could be achieved through fastener replacement on a one-for-one basis.

Swing Through Truss – Spans 3 & 4

Open Position

At the time of prior evaluation, the current LRFR Movable code was unavailable. Comparison between the load cases used for previous evaluation and the load cases required by the current code with the swing span in the open position, result significant decreases to the performance ratios computed for the bridge. Comparing LRFD Factored Load Cases in compliance with Table 2.4.2.3-1, for Swing Bridges, and the previous load combinations reveals the following:

Previous Bridge Open:	1.3x(DL+20%DL)= 1.56 DL (equivalent)
Current Bridge Open (Strength S-1):	1.55x(DL+20%DL)= 1.86 DL (equivalent)

As load combination Strength S-1 governs and is considerably larger than the previous LFD load case, the following comparison is important for understanding the condition of the bridge. For the bridge in the open condition, assuming the decrease in capacity of 10% due to the material property assumptions, and the 19% increase in load, it is apparent that for all other conditions equal, we would expect our current evaluation to result in a performance ratio decrease to approximately 75% of previous values assuming no additional losses or load.

For the bridge open load case, the tower vertical members (U11-L11) have performance ratios (Capacity/Demand) slightly over 1.0 without the sidewalk and below 1.0 with the additional sidewalk deadload. These members provide the vertical reaction to resolve top chord tension forces and function similar to a suspension bridge or cable stayed bridge tower.

For the bridge open load case, without the additional load of a sidewalk, the distribution girder has a performance ratio (Capacity/Demand) of less than 1.0. The additional load from the sidewalk would further decrease the performance ratio. The Distribution Girder is the nonredundant primary load carrying element which refers the entire structure deadload to the center bearing. Load Combination Strength S-1 is a deadload case, as such, this member would need to be significantly strengthened after removal of deadload or replaced during a period where the entire deadload of the bridge supported temporary supports and hydraulic jacks. This major undertaking will need to be considered regardless of whether or not the sidewalk is added.

For the as inspected case in the open position (Load Combination Strength S-1), with the additional load of a sidewalk, the pin bearing at the upper truss node U9, member U9-U10 has a performance ratio (Capacity/Demand) of slightly greater than 1.0.

To comply with the current LRFD Movable code, the distribution girders and the vertical members at Pier 3 would require strengthening to support the sidewalk load. Strengthening of the distribution girder is a significant undertaking. The existing distribution girders have several cover plates and full replacement to meet current load capacity requirements may be the most economical solution.

Seated Position

The swing span, in the seated position has been modeled with end lifts imparting an upwards deflection of 1.5” for the as-built and as-inspected condition. Under these conditions, the bridge is atypical when compared to more traditional center bearing swing bridges with eyebar top chord connections to the tower. With the ends lifted to provide bearings for liveload at the rest piers, the top chord of this truss remains largely in tension. This is the original design intent, given that Members U5 to U11 are eyebar tension members.

The tower vertical members, at least one bottom chord member and two pins have ratings below 1.0 (without the sidewalk) and would require strengthening to support the sidewalk.

Further Swing Span Considerations

A counterweight would need to be added to the south side of the swing truss (spans 3 & 4) to balance the load of the sidewalk. A steel beam could be framed to the existing floorbeams inside of the existing bottom chord to provide the required weight. Locating the beam on the inside of the chord eliminates additional element lines. The additional dead load on the truss from the sidewalk and counterweight reduces the end wedge clearance by 1.2 inches, the end wedge load is increased by 19 kips at each chord and the center bearing load is increased by 230 kips.

A further study is recommended to determine if the mechanical and electrical components are sufficient for the additional dead load. It is imperative that the study consider all of the impacts the additional dead load may cause including: pivot girder deflection, pivot bearing stress, deflection at end wedges and balance wheel and track clearance.

The addition of a sidewalk to the bridge would require the following to be considered in the design phase:

- Increased deflection at swing span ends would require additional balancing, structure reinforcing and mechanical coordination
- Mechanical and electrical work associated with the addition of the sidewalk would require analysis of the existing motors, wedges, roller bearings and pivot bearings; and may require the replacement and design of any or all of the mentioned
- The machinery house would need to be re-framed to allow passage of the sidewalk on the swing span
- The access stairway to the control house would need to be relocated to allow passage of the sidewalk on the swing span
- Additional approach work to include sidewalk

Maintenance and Protection of Traffic

The construction of the sidewalk is anticipated to be completed by closing the westbound lane of traffic and alternating one-way traffic in the eastbound lane. The spliced floorbeam option for the deck truss would require a temporary barrier to protect traffic while the existing railing is modified. Traffic delays and backups can be expected during the sidewalk construction.

The primary Maintenance and Protection of traffic impacts would occur during the periods of truss strengthening associated with improving load rating shortfalls. It is expected that construction of the sidewalk would be a relatively low impact activity that could be combined with the greater project MPT.

Constructability

For the deck truss a crane could be used to construct the structural steel support systems and FRP deck from the ground below the bridge. The fixed through truss and swing through truss would require a barge to construct the steel support system and FRP deck for the sidewalk. The use of a thicker FRP deck would eliminate the steel stringers and therefore reduce the number of crane picks required. Eliminating the stringers would additionally reduce the construction schedule and reduce the road closure time. The thicker FRP deck is a proprietary product and would limit the project to one manufacturer.

The primary constructability constraints would occur during the period where the bridge would remain out of service to address significant shortcomings at the distribution girder. It is expected that at that time all other construction activities would be relatively simple by comparison and could be accomplished without additional significant difficulties.

Approach Work

This report does not cover the approach sidewalk details or costs. However, based on the existing topography on the west approach a retaining wall is required for the approach sidewalk. The east approach would likely require a right-of-way impact and slope work to accommodate the approach sidewalk. Overhead utilities on both approaches would need to be relocated. The traffic control gates on each end of the bridge would need to be relocated to allow for the approach sidewalk.

Preliminary Cost Estimate

The spliced floorbeam deck truss option and the fixed and swing through truss cantilevered floorbeam option including strengthening cost estimate is $13.68 million in 2019 dollars. The estimated cost of the sidewalk and structural strengthening is also $13.68 million in 2019 dollars for the cantilevered floorbeam deck truss option and cantilevered floorbeam fixed and swing through truss option.

The extents of strengthening would depend on the sidewalk load and the efficiency of the rehabilitation method, for this study the strengthening required is based on estimated plate sizes. Concept level engineering was performed to determine an order of magnitude strengthening requirement to meet HL-93 inventory level load rating requirements. The concept level repairs account for inefficient plating that would be effective for the support of new deadload elements and liveload, but would not reduce existing deadload stress. Reducing the sidewalk weight during refined sidewalk design may reduce the number of members requiring strengthening and/or the plate sizes required for strengthening, which could have significant reductions in total cost.

The high cost of rehabilitation is due to the low rating factors computed for the as-built section properties. Such truss members would require strengthening along the length of the member, not just at areas of high stress or advanced section loss.

These estimates do not include for any potential mechanical or electrical upgrades required due to the increased dead load. The estimates include pedestrian gates at each end of the bridge for bridge opening. Details of the estimates can be found in Appendix 1.

Conclusion

The addition of the sidewalk would require strengthening to all the spans and significant strengthening to the fixed through truss and swing truss. The strengthening of the swing truss would require temporary supports at Pier 3.

While the estimated costs for both options are the same, the preferred option for the deck truss is the cantilevered floorbeam option based on eliminating the required railing modifications for the spliced option. The alternatives described in this study minimize the overall additional weight of the sidewalk structure while meeting the requirements of the State Historical Preservation Office.

The use of a FRP deck minimizes future maintenance costs; timber has a shorter design life and steel would require painting that is not necessary for the FRP. The FRP deck could be colored to match the existing steel paint color. The steel structural support system would require routine maintenance and painting to ensure a design life matching that of the adjacent bridge structure. However, steel would match the existing bridge's materials and could be painted the same color.

The overall cost to add the sidewalk to the bridge is approximately $13.68 million in 2019 dollars. The strengthening costs are estimated based on the sidewalk weight. Reductions to the weight would likely reduce the strengthening requirements and therefore the strengthening costs. The estimates included in this study are for the bridge only and do not include any approach work or mechanical and electrical upgrades.

A cost benefit analysis considering the addition of a sidewalk on the north side of the bridge, which evaluates the total construction cost versus the benefit to users is beyond the scope of this feasibility study. A cost benefit analysis may better define the needs of the community and assist in the decision making process.

Appendix 1 – Cost Estimate

Spliced Floorbeam Option

Computations For	East Haddam Bridge	**Made By**	K. Z. Smith	**Date**	10/28/2016	**Job No.**	2887.04
Sidewalk Feasibility Study Estimate		**Checked By**	L. N. Helderman	**Date**	11/1/2016	**Sec. No.**	
Spliced Floorbeam Deck Truss Option		**Back Checked By**		**Date**		**Sheet No.**	

Spliced Floorbeam Deck Truss Option and Cantileverd Floorbeam Fixed & Swing Through Trusses

	Quantity	Unit	Unit Price	Cost
FRP Deck	5290	SF	$ 50	$ 265,000
Structural Steel	68700	LB	$ 10	$ 687,000
Structural Strengthening	120900	LB	$ 30	$ 3,627,000
Steel Railing and Posts	79900	LB	$ 10	$ 799,000
Existing Rail Post Modification	10	EA	$ 1,000	$ 10,000
Pedestrian Traffic Gates	2	EA	$ 10,000	$ 20,000
Rebalancing/Counterweight	139100	LB	$ 10	$ 1,391,000
		Subtotal		$ 6,799,000
		Minor Items	25%	$ 1,699,750
		Subtotal		$ 8,498,750
		Clearing and Grubbing	2%	$ 170,000
		Maintenance and Protection of Traffic	5%	$ 425,000
		Mobilization	10%	$ 850,000
		Construction Staking	1%	$ 85,000
		Subtotal		$ 10,028,750
		Contingency	25%	$ 2,508,000
		Incidentals	25%	$ 2,508,000
		Total (Base Year)		$ 12,536,750
		SAY		**$ 12,540,000**
		Total with Inflation (2019)	2.5%	$ 13,321,000
		SAY		**$ 13,330,000**

Computations For	East Haddam Bridge	**Made By**	K. Z. Smith	**Date**	10/28/2016	**Job No.**	2887.04
Sidewalk Feasibility Study Estimate		**Checked By**	L. N. Helderman	**Date**	11/1/2016	**Sec. No.**	
Spliced Floorbeam Deck Truss Option		**Back Checked By**		**Date**		**Sheet No.**	

Spliced Floorbeam Deck Truss Option and Cantileverd Floorbeam Fixed & Swing Through Trusses

FRP Deck

deck width = 6 ft
deck length = 881 ft

area = 5286 SF

SAY 5290 SF

Railing and Rail Posts

Railing

weight = 5.57 plf
length = 881 ft
number = 14

railing weight = 68700 LB

Rail Post

weight = 14.8 plf
length = 5.5 ft
number = 90

rail post weight = 7326 LB

Subtotal = 76026 LB
Misc. (5%) = 3801 LB

Total weight = 79828 LB

SAY 79900 LB

Existing Rail Post Modification

Rail Posts = 10 EA

SAY 10 EA

Pedestrian Traffic Gate

number = 2 EA

SAY 2 EA

Computations For	East Haddam Bridge	**Made By**	K. Z. Smith	**Date**	10/28/2016	**Job No.**	2887.04
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Spliced Floorbeam Deck Truss Option and Cantileverd Floorbeam Fixed & Swing Through Trusses

Structural Steel

Deck Truss

Stringer

weight =	16	plf	
length =	99	ft	
number =	2		
stringer weight =	3168	LB	
Bolster			
weight =	22	plf	
length =	5.5	ft	
number =	10		
bolster weight =	1210	LB	
Floorbeams			
weight =	66	plf	(match existing beams)
length =	9	ft	
number =	8		
weight =	72	plf	(match existing end beams)
length =	9	ft	
number =	2		
floorbeams weight =	6048	LB	

Fixed Through Truss

Stringer

weight =	16	plf
length =	326	ft
number =	2	
stringer weight =	10432	LB
Floorbeams		
weight =	40	plf
length =	9.25	ft
number =	34	
floorbeams weight =	12580	LB

Computations For East Haddam Bridge	**Made By** K. Z. Smith	**Date**	10/28/2016	**Job No.**	2887.04
Sidewalk Feasibility Study Estimate	**Checked By** L. N. Helderman	**Date**	11/1/2016	**Sec. No.**	
Spliced Floorbeam Deck Truss Option	**Back Checked By**	**Date**		**Sheet No.**	

Spliced Floorbeam Deck Truss Option and Cantileverd Floorbeam Fixed & Swing Through Trusses

Structural Steel Continued

Swing Through Truss

Stringer

weight =	16	plf
length =	456	ft
number =	2	
stringer weight =	14592	LB

Floorbeams

weight =	40	plf
length =	9.25	ft
number =	47	
floorbeams weight =	17390	LB
Subtotal =	65420	LB
Misc. (5%) =	3271	LB
Total weight =	68691	LB

SAY 68700 LB

Rebalance/Counterweight

Beam

weight =	305	plf
length =	456	ft
number =	1	
beam weight =	139080	LB
Total weight =	139080	LB

SAY 139100 LB

Computations For	East Haddam Bridge	Made By	K. Z. Smith	Date	10/28/2016	Job No.	2887.04
Sidewalk Feasibility Study Estimate		Checked By	L. N. Helderman	Date	11/1/2016	Sec. No.	
Spliced Floorbeam Deck Truss Option		Back Checked By		Date		Sheet No.	

Spliced Floorbeam Deck Truss Option and Cantileverd Floorbeam Fixed & Swing Through Trusses

Structural Strengthening

Fixed Through Truss

L0-U1 North

area =	7.5	in^2	
length =	31	ft	
number =	2		(top and bottom)
weight =	1591	LB	

U1-U2, U4-U5, U13-U14 & U16-U17 North

area =	6.75	in^2	
length =	80	ft	
number =	2		(top and bottom)
weight =	3690	LB	

U2-U3 & U15-U16 North

area =	12	in^2	
length =	28	ft	
number =	2		(top and bottom)
weight =	2300	LB	

U3-U4 North

area =	19.5	in^2	
length =	14	ft	
number =	2		(top and bottom)
weight =	1869	LB	

U5-U6 & U12-U13 North

area =	9	in^2	
length =	33	ft	
number =	2		(top and bottom)
weight =	2001	LB	

U6-U7 & U11-U12 North

area =	6	in^2	
length =	38	ft	
number =	2		(top and bottom)
weight =	1552	LB	

U7-U8, U8-U9, U9-U10 & U10-U11 North

area =	4.5	in^2	
length =	82	ft	
number =	2		(top and bottom)
weight =	2511	LB	

U14-U15 North

area =	18	in^2	
length =	14	ft	
number =	2		(top and bottom)
weight =	1725	LB	

Computations For East Haddam Bridge	**Made By**	K. Z. Smith	**Date**	10/28/2016	**Job No.** 2887.04
Sidewalk Feasibility Study Estimate	**Checked By**	L. N. Helderman	**Date**	11/1/2016	**Sec. No.**
Spliced Floorbeam Deck Truss Option	**Back Checked By**		**Date**		**Sheet No.**

Spliced Floorbeam Deck Truss Option and Cantileverd Floorbeam Fixed & Swing Through Trusses

U17-U18 North

area =	21	in^2	
length =	31	ft	
number =	2		(top and bottom)
weight =	4454	LB	

L0-L1 North

area =	42	in^2	
length =	22	ft	
number =	1		
weight =	3144	LB	

L1-L2, L2-L3, L4-L5, L6-L7, L7-L8, L10-L11, L11-L12, L13-L14 & L15-L16 North

area =	9	in^2	
length =	157	ft	
number =	2		(top and bottom)
weight =	9616	LB	

L8-L9 & L16-L17 North

area =	12	in^2	
length =	66	ft	
number =	2		(top and bottom)
weight =	5390	LB	

L9-L10 North

area =	15	in^2	
length =	44	ft	
number =	2		(top and bottom)
weight =	4492	LB	

L17-L18 North

area =		in^2	
length =	22	ft	
number =	2		(top and bottom)
weight =	0	LB	

North Subtotal =	44335	LB	
South Subtotal =	22168	LB	(assume repair thicknesses are half of the north side)

Computations For	East Haddam Bridge	**Made By**	K. Z. Smith	**Date**	10/28/2016	**Job No.**	2887.04
Sidewalk Feasibility Study Estimate		**Checked By**	L. N. Helderman	**Date**	11/1/2016	**Sec. No.**	
Spliced Floorbeam Deck Truss Option		**Back Checked By**		**Date**		**Sheet No.**	

Spliced Floorbeam Deck Truss Option and Cantileverd Floorbeam Fixed & Swing Through Trusses

Swing Truss

Distribution Girder (assume full replacement)

area =	150	in^2
length =	33.5	ft
number =	2	
weight =	34198	LB

Verticals (additional plates)

area =	10	in^2
length =	67.5	ft
number =	4	
weight =	9188	LB
Subtotal =	43385	LB

Subtotal weight =	109889	LB
Misc. (10%) =	10989	LB
Total weight =	120877	LB

SAY 120900 LB

Cantilevered Floorbeam Option

Computations For	East Haddam Bridge	Made By	K. Z. Smith	Date	10/28/2016	Job No.	2887.04
Sidewalk Feasibility Study Estimate		Checked By	L. N. Helderman	Date	11/1/2016	Sec. No.	
Cantilever Floorbeam Deck Truss Option		Back Checked By		Date		Sheet No.	

Cantilever Floorbeam Deck Truss Option and Cantilevered Floorbeam Fixed & Swing Through Trusses

	Quantity	Unit	Unit Price	Cost
FRP Deck	5290	SF	$ 50	$ 265,000
Structural Steel	69600	LB	$ 10	$ 696,000
Structural Strengthening	126900	LB	$ 30	$ 3,807,000
Steel Railing and Posts	79900	LB	$ 10	$ 799,000
Pedestrian Traffic Gates	2	EA	$ 10,000	$ 20,000
Rebalancing/Counterweight	139100	LB	$ 10	$ 1,391,000
		Subtotal		$ 6,978,000
		Minor Items	25%	$ 1,745,000
		Subtotal		$ 8,723,000
		Clearing and Grubbing	2%	$ 175,000
		Maintenance and Protection of Traffic	5%	$ 437,000
		Mobilization	10%	$ 873,000
		Construction Staking	1%	$ 88,000
		Subtotal		$ 10,296,000
		Contingency	25%	$ 2,574,000
		Incidentals	25%	$ 2,574,000
		Total (Base Year)		$ 12,870,000
		SAY		**$ 12,870,000**
		Total with Inflation (2019)	2.5%	$ 13,675,000
		SAY		**$ 13,680,000**

Computations For	East Haddam Bridge	**Made By**	K. Z. Smith	**Date**	10/28/2016	**Job No.**	2887.04
Sidewalk Feasibility Study Estimate		**Checked By**	L. N. Helderman	**Date**	11/1/2016	**Sec. No.**	
Cantilever Floorbeam Deck Truss Option		**Back Checked By**		**Date**		**Sheet No.**	

Cantilever Floorbeam Deck Truss Option and Cantilevered Floorbeam Fixed & Swing Through Trusses

FRP Deck

deck width = 6 ft
deck length = 881 ft

area = 5286 SF

SAY 5290 SF

Railing and Rail Posts

Railing
weight = 5.57 plf
length = 881 ft
number = 14

railing weight = 68700 LB

Rail Post
weight = 14.8 plf
length = 5.5 ft
number = 90

rail post weight = 7326 LB

Subtotal = 76026 LB
Misc. (5%) = 3801 LB

Total weight = 79828 LB

SAY 79900 LB

Pedestrian Traffic Gate

number = 2 EA

SAY 2 EA

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Cantilever Floorbeam Deck Truss Option		**Back Checked By**		**Date**		**Sheet No.**	

Cantilever Floorbeam Deck Truss Option and Cantilevered Floorbeam Fixed & Swing Through Trusses

Structural Steel

Deck Truss

Stringer

weight =	16	plf
length =	99	ft
number =	2	
stringer weight =	3168	LB

Bolster

weight =	22	plf
length =	5.5	ft
number =	10	
bolster weight =	1210	LB

Floorbeams

weight =	46	plf
length =	15	ft
number =	10	
floorbeams weight =	6900	LB

Fixed Through Truss

Stringer

weight =	16	plf
length =	326	ft
number =	2	
stringer weight =	10432	LB

Floorbeams

weight =	40	plf
length =	9.25	ft
number =	34	
floorbeams weight =	12580	LB

Cantilever Floorbeam Deck Truss Option and Cantilevered Floorbeam Fixed & Swing Through Trusses

Structural Steel Continued

Swing Through Truss

Stringer

weight =	16	plf
length =	456	ft
number =	2	
stringer weight =	14592	LB

Floorbeams

weight =	40	plf
length =	9.25	ft
number =	47	
floorbeams weight =	17390	LB
Subtotal =	66272	LB
Misc. (5%) =	3314	LB
Total weight =	69586	LB

SAY 69600 LB

Rebalance/Counterweight

Beam

weight =	305	plf
length =	456	ft
number =	1	
beam weight =	139080	LB
Total weight =	139080	LB

SAY 139100 LB

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Cantilever Floorbeam Deck Truss Option		**Back Checked By**		**Date**		**Sheet No.**	

Cantilever Floorbeam Deck Truss Option and Cantilevered Floorbeam Fixed & Swing Through Trusses

Structural Strengthening

Fixed Through Truss

L0-U1 North

area =	7.5	in^2	
length =	31	ft	
number =	2		(top and bottom)
weight =	1591	LB	

U1-U2, U4-U5, U13-U14 & U16-U17 North

area =	6.75	in^2	
length =	80	ft	
number =	2		(top and bottom)
weight =	3690	LB	

U2-U3 & U15-U16 North

area =	12	in^2	
length =	28	ft	
number =	2		(top and bottom)
weight =	2300	LB	

U3-U4 North

area =	19.5	in^2	
length =	14	ft	
number =	2		(top and bottom)
weight =	1869	LB	

U5-U6 & U12-U13 North

area =	9	in^2	
length =	33	ft	
number =	2		(top and bottom)
weight =	2001	LB	

U6-U7 & U11-U12 North

area =	6	in^2	
length =	38	ft	
number =	2		(top and bottom)
weight =	1552	LB	

U7-U8, U8-U9, U9-U10 & U10-U11 North

area =	4.5	in^2	
length =	82	ft	
number =	2		(top and bottom)
weight =	2511	LB	

U14-U15 North

area =	18	in^2	
length =	14	ft	
number =	2		(top and bottom)
weight =	1725	LB	

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Cantilever Floorbeam Deck Truss Option		**Back Checked By**		**Date**		**Sheet No.**	

Cantilever Floorbeam Deck Truss Option and Cantilevered Floorbeam Fixed & Swing Through Trusses

U17-U18 North

area =	21	in^2	
length =	31	ft	
number =	2		(top and bottom)
weight =	4454	LB	

L0-L1 North

area =	42	in^2
length =	22	ft
number =	1	
weight =	3144	LB

L1-L2, L2-L3, L4-L5, L6-L7, L7-L8, L10-L11, L11-L12, L13-L14 & L15-L16 North

area =	9	in^2	
length =	157	ft	
number =	2		(top and bottom)
weight =	9616	LB	

L8-L9 & L16-L17 North

area =	12	in^2	
length =	66	ft	
number =	2		(top and bottom)
weight =	5390	LB	

L9-L10 North

area =	15	in^2	
length =	44	ft	
number =	2		(top and bottom)
weight =	4492	LB	

L17-L18 North

area =	24	in^2	
length =	22	ft	
number =	2		(top and bottom)
weight =	3593	LB	

North Subtotal =	47929	LB	
South Subtotal =	23964	LB	(assume repair thicknesses are half of the north side)

Computations For	East Haddam Bridge	**Made By**	K. Z. Smith	**Date**	10/28/2016	**Job No.**	2887.04
Sidewalk Feasibility Study Estimate		**Checked By**	L. N. Helderman	**Date**	11/1/2016	**Sec. No.**	
Cantilever Floorbeam Deck Truss Option		**Back Checked By**		**Date**		**Sheet No.**	

Cantilever Floorbeam Deck Truss Option and Cantilevered Floorbeam Fixed & Swing Through Trusses

Swing Truss

Distribution Girder (assume full replacement)

area =	150	in^2
length =	33.5	ft
number =	2	
weight =	34198	LB

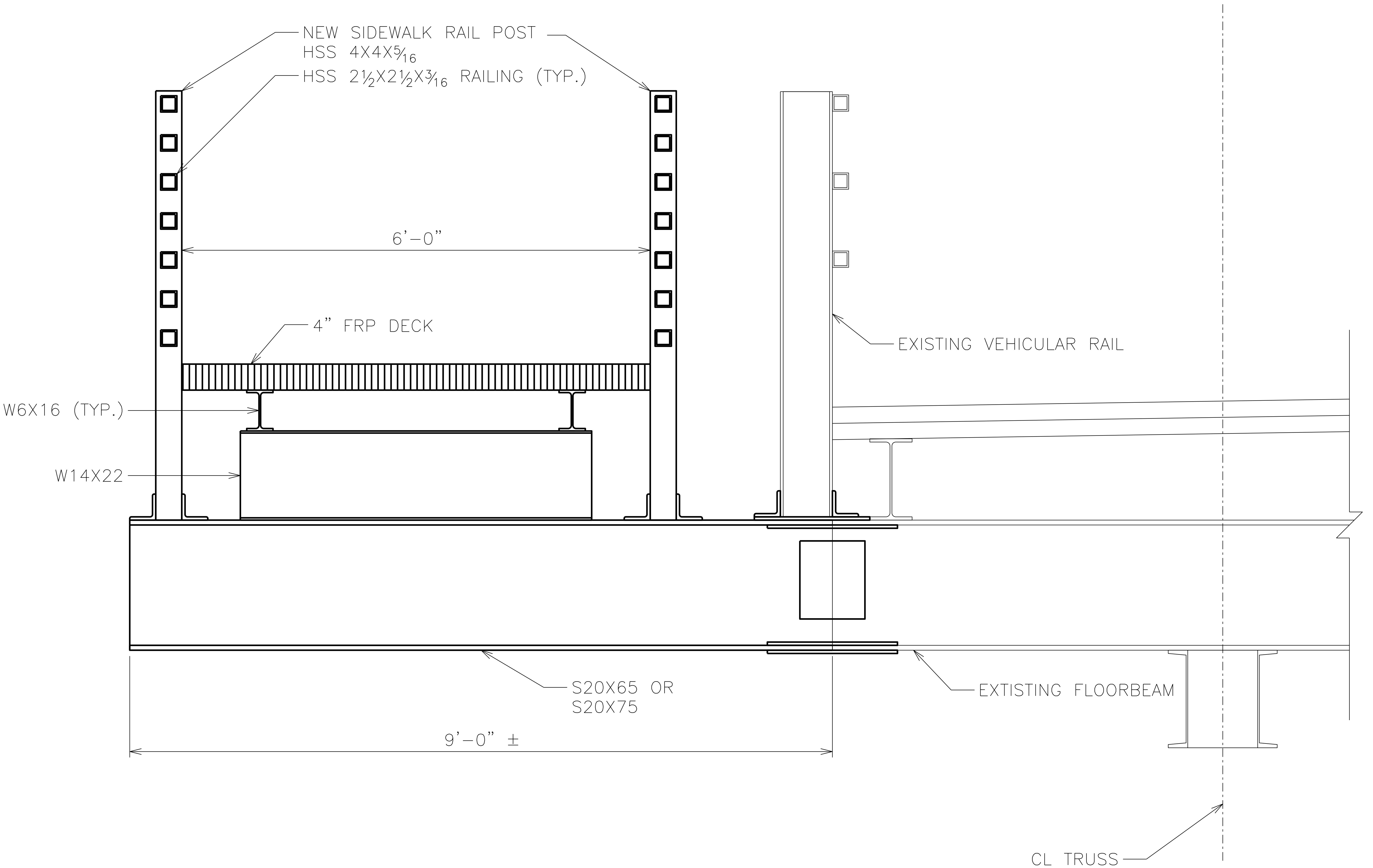
Verticals (additional plates)

area =	10	in^2
length =	67.5	ft
number =	4	
weight =	9188	LB

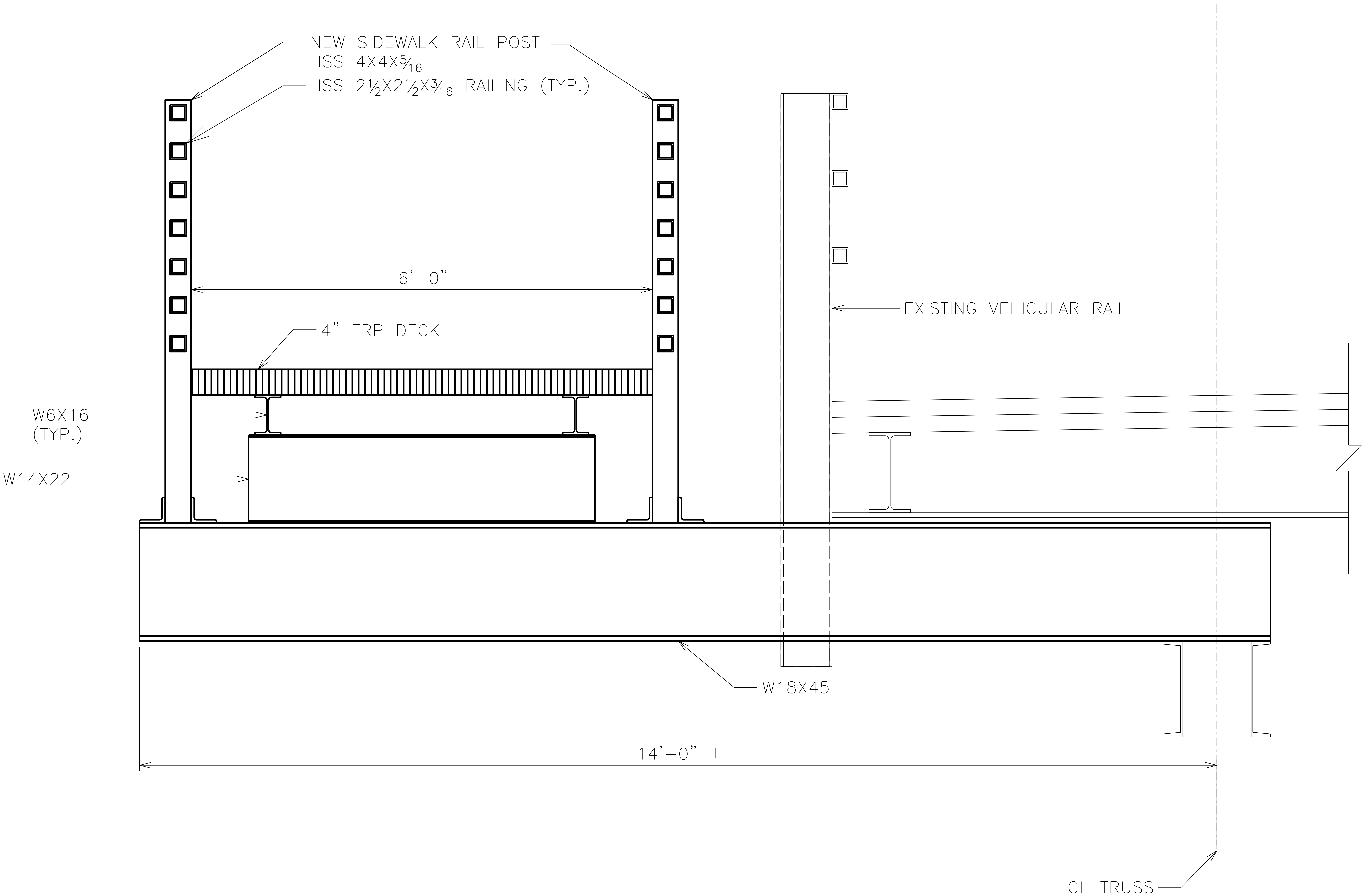
Subtotal =	43385	LB
Subtotal weight =	115279	LB
Misc. (10%) =	11528	LB
Total weight =	126806	LB

SAY 126900 LB

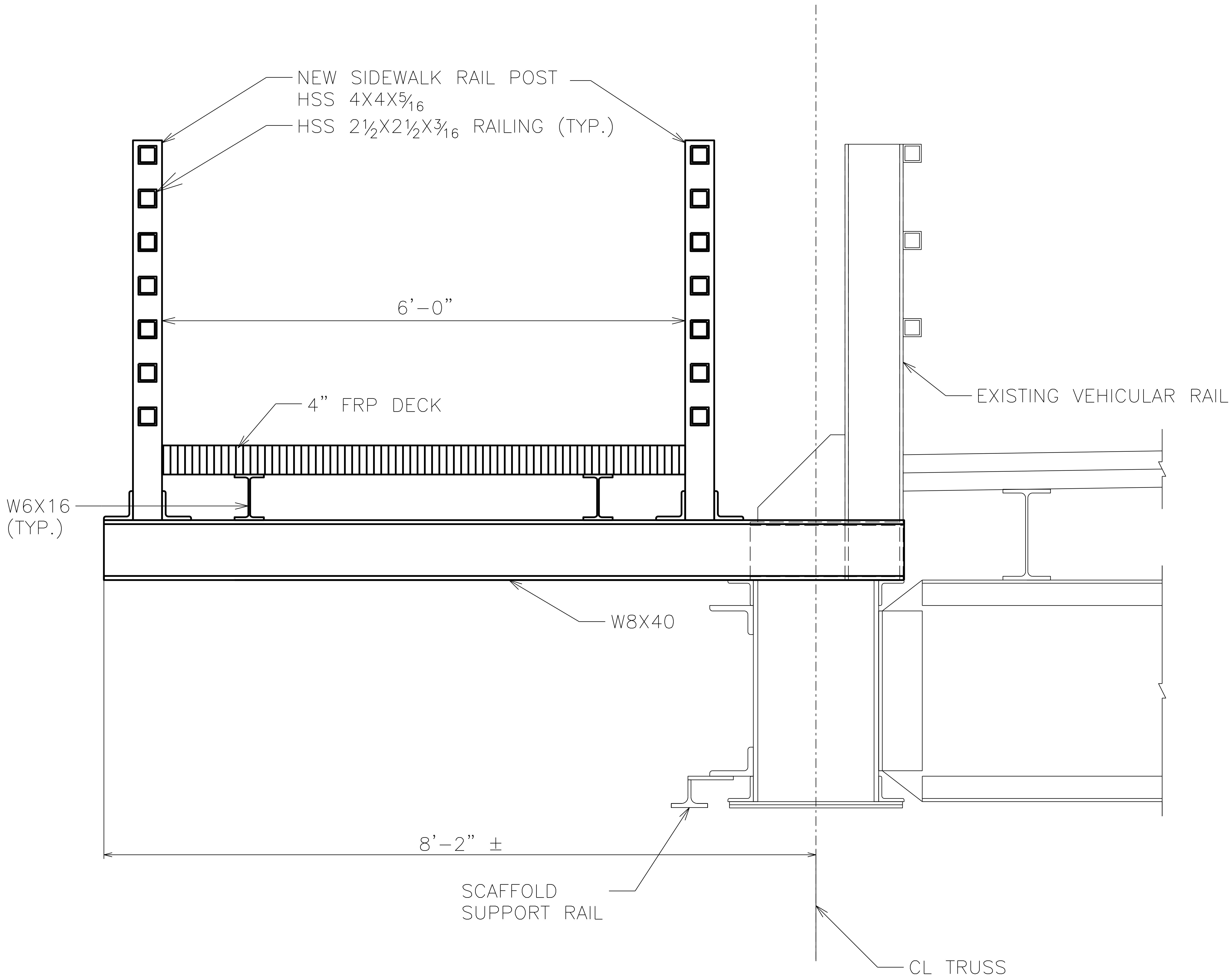
Appendix 2 – Sidewalk Feasibility Conceptual Sketches



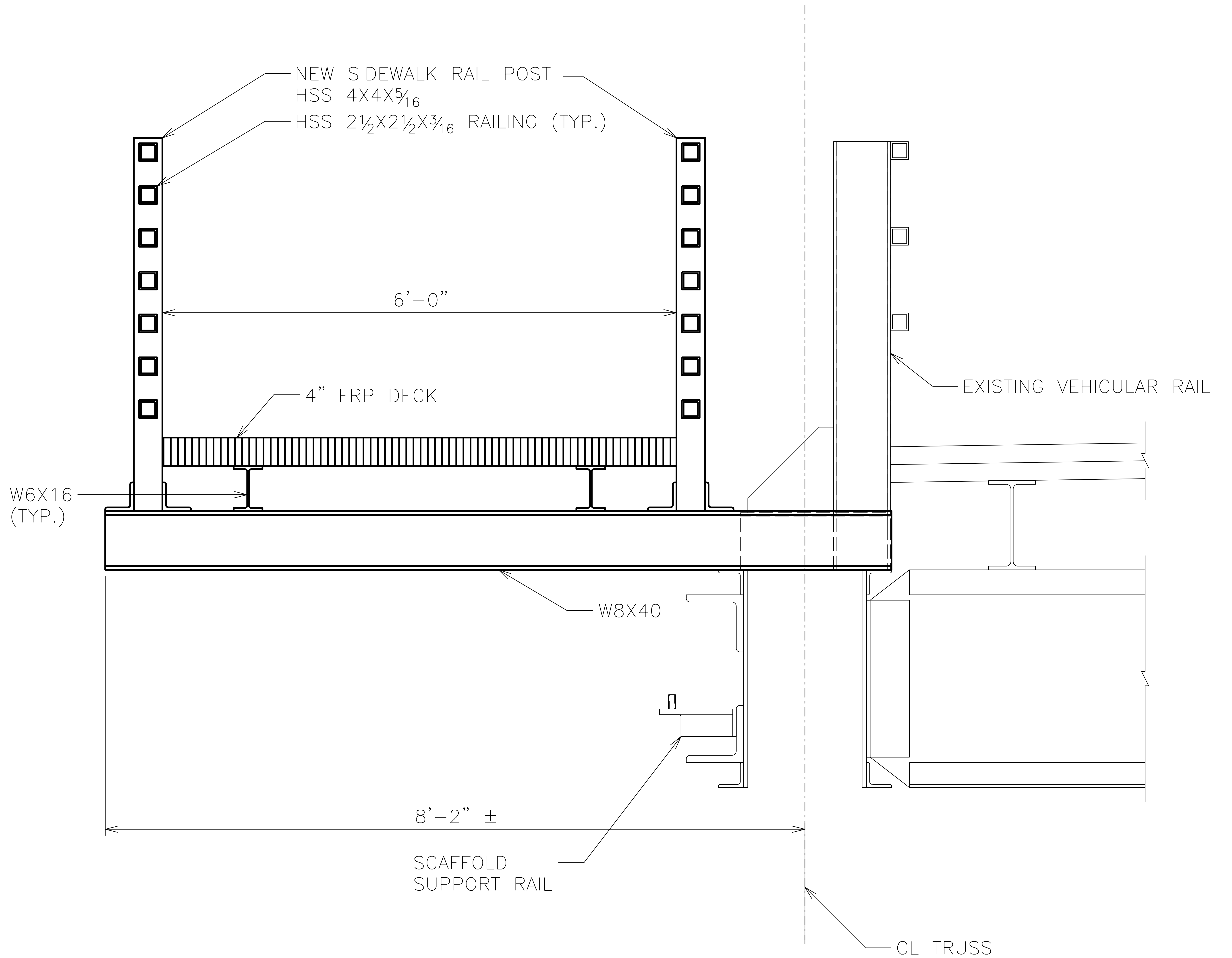
DECK TRUSS SPLICE OPTION Figure 1	Drawn By LN HELDERMAN Checked By KZ SMITH	Project # 2887.04 East Haddam Bridge Br. No. 01138	Hardesty & Hanover



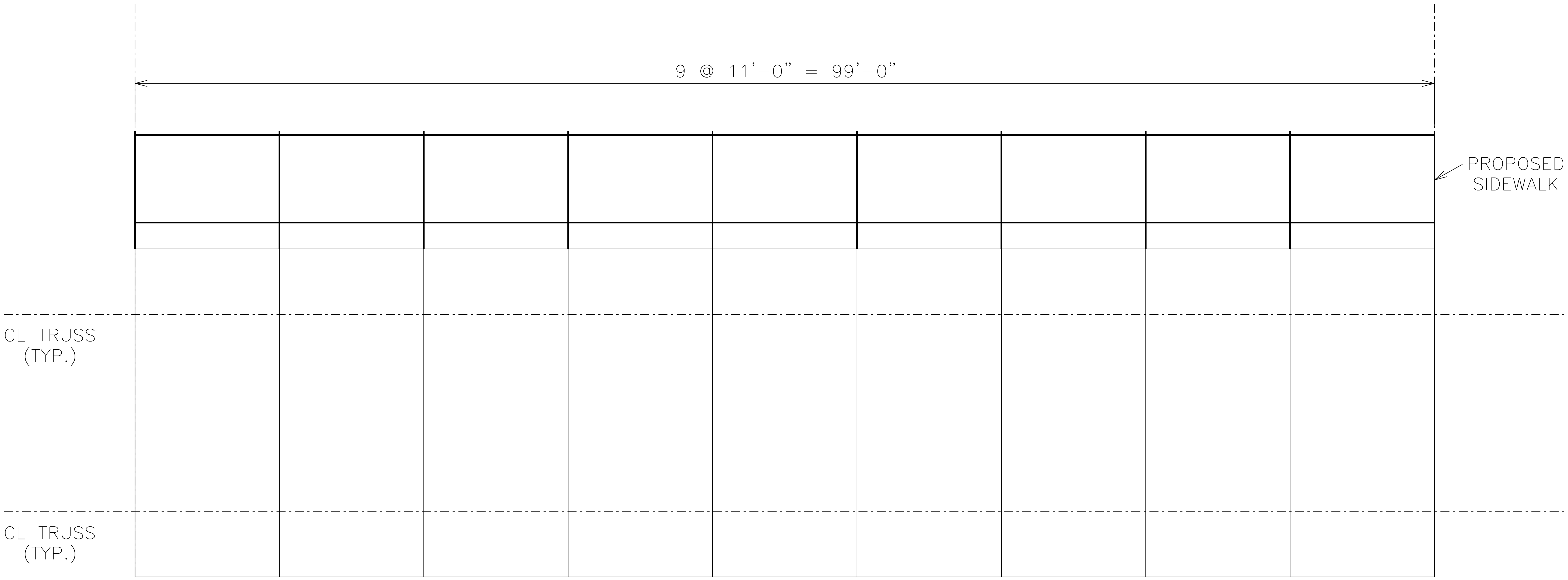
DECK TRUSS CANTILEVER OPTION Figure 2	Drawn By LN HELDERMAN Checked By KZ SMITH	Project # 2887.04 East Haddam Bridge Br. No. 01138	Hardesty &Hanover



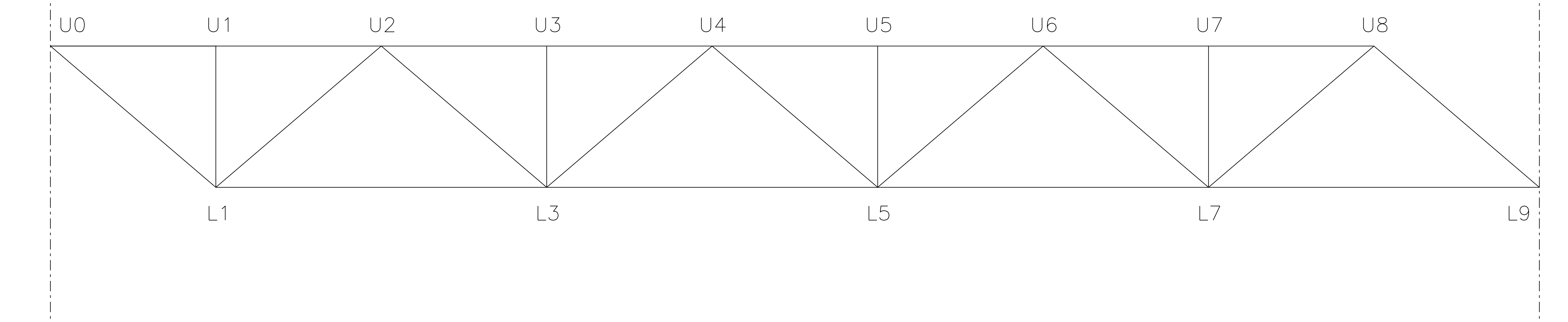
FIXED THROUGH TRUSS Figure 3	Drawn By LN HELDERMAN Checked By KZ SMITH	Project # 2887.04 East Haddam Bridge Br. No. 01138	Hardesty & Hanover



SWING TRUSS Figure 4	Drawn By LN HELDERMAN Checked By KZ SMITH	Project # 2887.04 East Haddam Bridge Br. No. 01138	Hardesty & Hanover

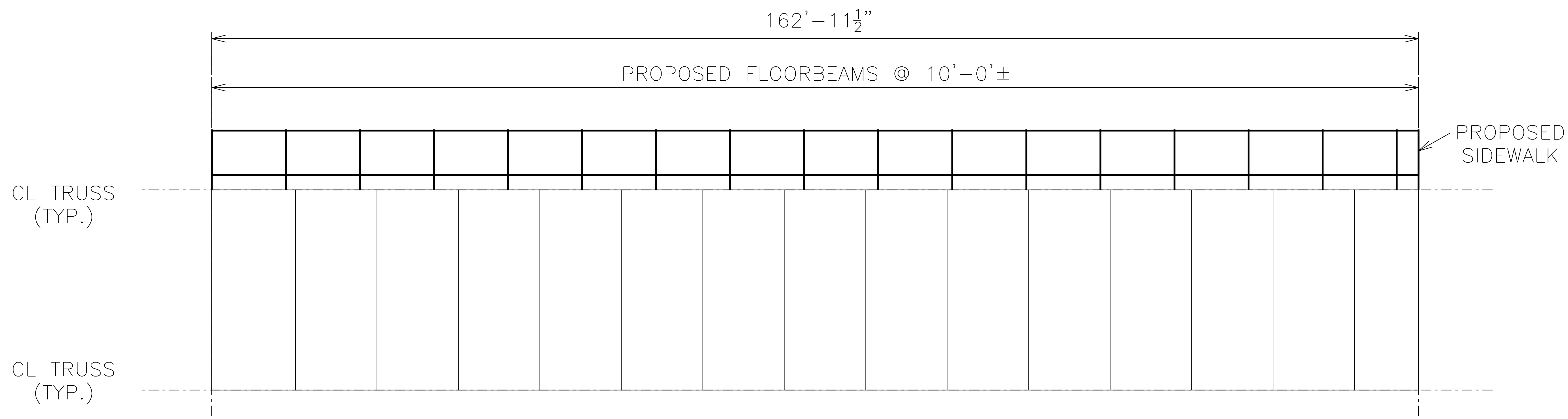


FRAMING PLAN

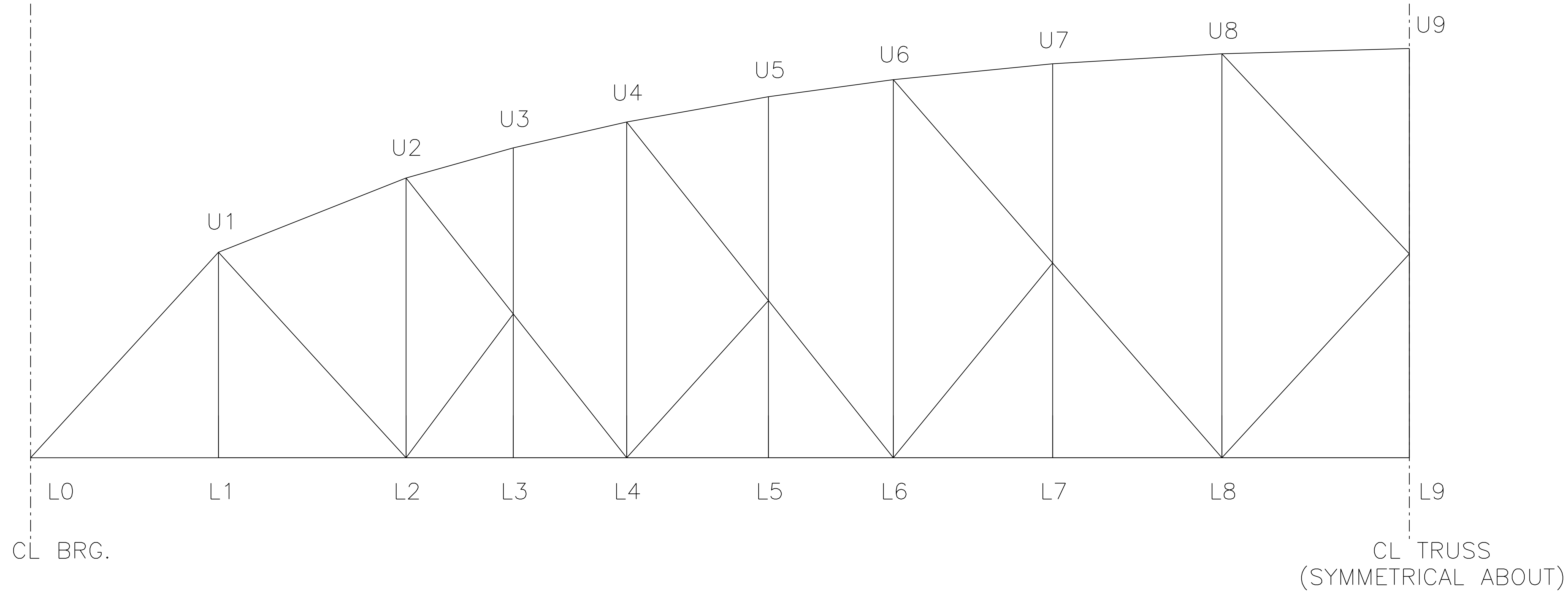


ELEVATION

DECK TRUSS FIGURE 5	DRAWN BY LN HELDERMAN CHECKED BY KZ SMITH	PROJECT # 2887.04 East Haddam Bridge Br. No. 01138	Hardesty & Hanover

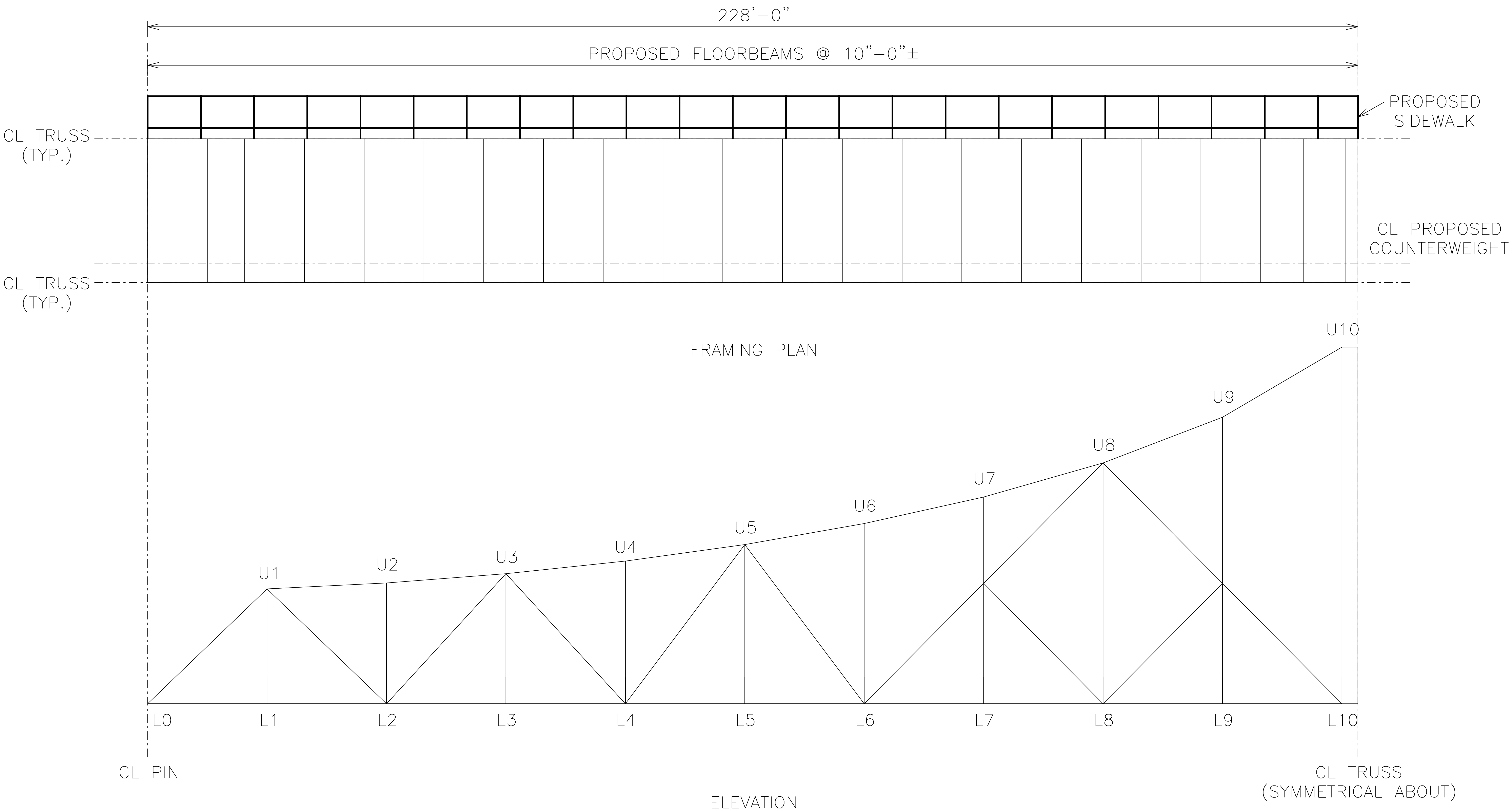


FRAMING PLAN



ELEVATION

FIXED THROUGH TRUSS FIGURE 6	DRAWN BY LN HELDERMAN CHECKED BY KZ SMITH	PROJECT # 2887.04 East Haddam Bridge Br. No. 01138	Hardesty &Hanover



SWING THROUGH TRUSS FIGURE 7	DRAWN BY LN HELDERMAN CHECKED BY KZ SMITH	PROJECT # 2887.04 East Haddam Bridge Br. No. 01138	Hardesty & Hanover