FORSGREN
Associates Inc.

PROFESSIONAL ENGINEER REGISTERED 9814 7/29/14 STATE OF IDAHO JASON WOLFE

MEMORANDUM

DATE: July 29, 2014

TO: Shanon Murgoito, P.E., ITD

FROM: Jason Wolfe, P.E./S.E.

RE: Bigge Temporary Ramp Deflection and Capacity Calculations

---

Forsgren Associates has completed the temporary ramp deflection and capacity calculations for the Calumet Reactor Bigge (Job #13Q-9199) Rev 1 Truck Configuration. Per our scope of work, we have determined the deflections and moment and shear capacities for the 52-foot long Bigge Jump Bridge (Almas International drawing with the identifier "Old Bridge Reinforced 1988"), as well as for the 60-foot Barge Ramp (BR60-2 and BR60-3).

52-Foot Jump Bridge:

This jump bridge is 8 feet wide, 52 feet long, with a center of bearing to center of bearing length of 48 feet, based on drawings provided by Bigge. Two jump bridges will be used to span across the following structures, each carrying half of the truck load:

- Bridge Key 18525; US-95, 11.7 Miles North of Moscow
- Bridge Key 18705; US-95, 0.1 Mile South of Cocolalla

Please see Appendix A for the following supporting information:

- Bridge Site Drawings
- 52' Jump Bridge Drawings
- Calculations

A model of the temporary jump bridge was developed in LARSA 4D to determine the deflections and loading. The ramp was modeled as a simple span beam constructed of A36 steel. Using the LARSA Section Composer tool, the ramp was modeled using the dimensions of the plates and a tee-shaped element made from half of a W27x146 as shown on the plans provided by Bigge. The web depth varies from 0 inch at the beginning of the ramp to 12 3/8 inches at full depth. One support was assumed as a pinned condition with rotation fixed about the vertical and longitudinal axis, and all translation fixed. The other support was similarly supported, but allowed to move in the longitudinal direction. The jump bridge was assumed to act as a single composite unit, and the capacities of the various welds and connections within the unit were not analyzed as part of this scope.

Since two jump bridges will be utilized for crossing the structures, each jump bridge will carry half of the transport vehicle load. The transport vehicle was modeled as a series of moving point loads representing the individual axle loads, and placed along the centerline of the jump bridge. The spacing and values of the loads are based on the truck configuration provided by Bigge.

Based on the results of the model, the service dead plus live load deflection is 2.02 inches. The plans of the 52-foot jump bridge indicate approximately 1.625 inches thickness of steel plates at each bearing location. A 1-inch thick by 4-foot wide steel plate will be placed beneath each bearing to provide a total of 2.625 inches of clearance between the jump bridge and the roadway surface.

The maximum shears and moments in the ramp bridge are as shown in the table below.

Load Condition	Service Shear (kips)	Service Moment (k-ft)	Load Factor	Factored Shear (kips)	Factored Moment (k-ft)
Live Load + Impact	85.17	888.60	1.75	149.05	1555.05
Dead Load	16.61	217.05	1.25	20.76	271.31
Total	101.78	1105.65		169.81	1826.36

Shear and moment capacities of the jump bridge were determined at several sections, based on how the geometry and cross sections change along the length of the structure. Shear capacities were determined at two sections near the end of the jump bridge; the face of the support with additional web members, as well as at the location just beyond where the additional web members end. Moment capacities were calculated at these two locations, as well as near the ramp top angle point, and at the midspan of the structure.

In all cases, the shear and moment capacities exceed the factored loads applied at the various locations. The bridge is adequate to meet the strength demands of the proposed loading.

60-Foot Barge Ramp:

This jump bridge is 6'-4" wide and 60 feet long, with an assumed center of bearing to center of bearing length of 59.5 feet, based on drawings provided by Bigge. Three adjacent jump bridges will be used to span across the following structure:

- Bridge Key 19080; SH 200B over Strong Creek; in East Hope

Please see Appendix B for the following supporting information:

- Bridge Site Drawings
- 60' Barge Ramp Drawings
- Calculations

Very little information about the existing bridge over Strong Creek is available. Field measurements were obtained on June 26, 2014, and used to prepare the drawings. Calculating the capacities against the surcharge loading to the abutment walls, wing walls, and the extended beam seat walls at the widened portion of the bridge is impractical due to the number of unknowns. The proposed approach limits the amount of influence of the surcharge load on the various walls by maintaining a minimum distance of one-half the estimated height of the walls to any load point, in accordance with ITD policy. As shown on the Jump Bridge Plan in Appendix B, the shaded areas next to the walls indicate the limits where loading is to be avoided. Generally speaking, the jump bridge supports are to be a minimum of 5 feet from the abutment walls, 4 feet from the wing walls, and 2 feet from the extended beam seat walls. In order to meet these criteria, the 60-foot ramp bridges are required at this site.

A model of the temporary ramp bridge was developed in LARSA 4D to determine the deflections and loading. The ramp was modeled as a simple span beam constructed of A992 Grade 50 steel. Using the LARSA Section Composer tool, the ramp was modeled using the dimensions of the adjacent W24x104 beam elements as shown on the plans provided by Bigge. The beam webs are cut at the ramp sections, and the structure depth varies from 10 inch at the beginning of the ramp to 24.06 inches at full depth. One support was assumed as a pinned condition with rotation fixed about the vertical and longitudinal axis, and all translation fixed. The other support was similarly supported, but allowed to move in the longitudinal direction. The adjacent beams are welded together with butt welds in a stitch pattern along the edges of the flanges. The jump bridge was assumed to act as a single composite unit, and the capacities of the flange welds were not analyzed as part of this scope.

In order for the jump bridges to provide the necessary width for the transport vehicle, three jump bridges will be placed side by side over the Strong Creek structure. Based on the geometry of the layout, the two outside jump bridges will carry the majority of the transport vehicle loading. Because of this, the model of the jump bridge is assumed to carry half of the transport vehicle load. The transport vehicle was modeled as a series of moving point load pairs representing the tandem wheel loads, and placed along the centerline of the jump bridge. The spacing and values of the loads are based on the truck configuration provided by Bigge.

Based on the results of the model, the service dead plus live load deflection is 2.26 inches. The jump bridge will be elevated so that 3-inches clear exists from the bottom of the jump bridge to the roadway surface.

The maximum shears and moments in the ramp bridge are as shown in the table below.

Load Condition	Service Shear (kips)	Service Moment (k-ft)	Load Factor	Factored Shear (kips)	Factored Moment (k-ft)
Live Load + Impact	102.38	1347.32	1.75	179.17	2357.81
Dead Load	18.69	290.71	1.25	23.36	363.39
Total	121.07	1638.03		202.53	2721.20

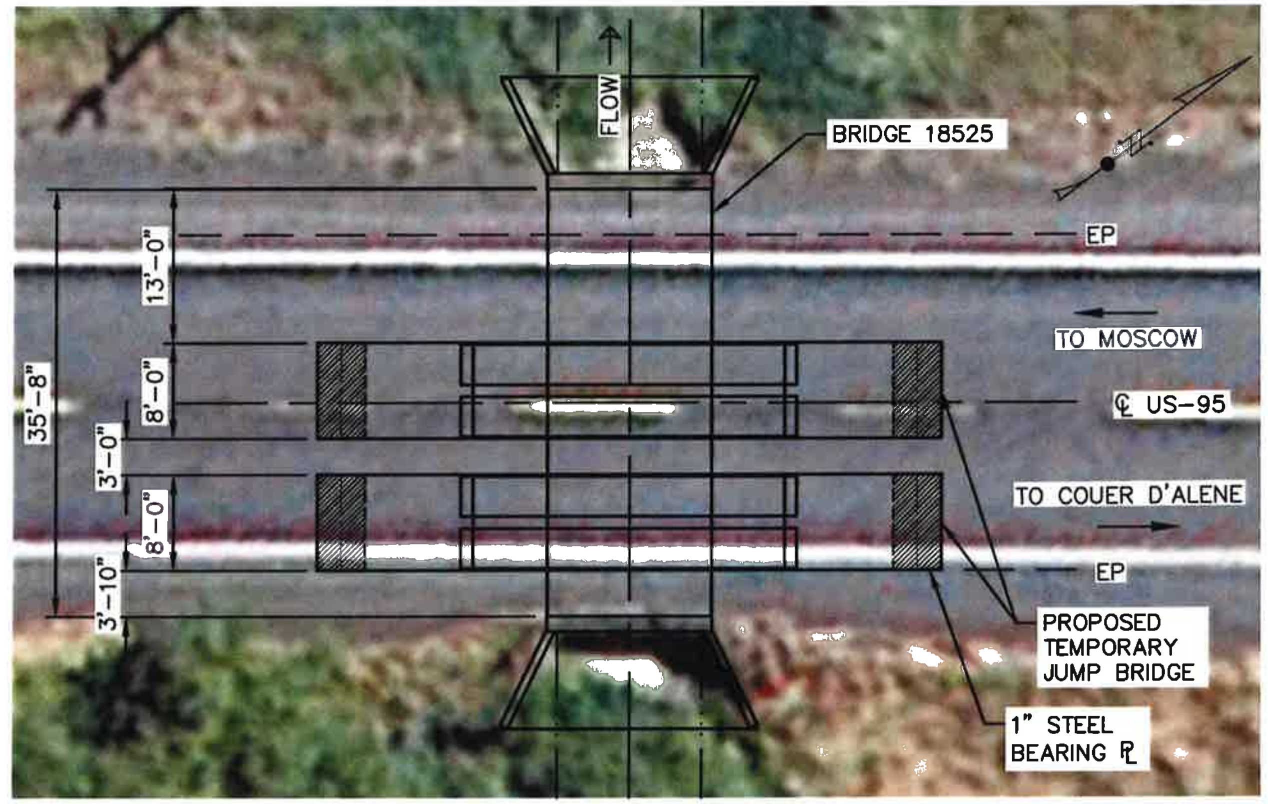
Shear and moment capacities of the jump bridge were determined at several sections, based on how the geometry and cross sections change along the length of the structure. Shear capacities were determined at the ends of the jump bridge. Moment capacities were calculated at the end and midspan of the jump bridge.

In all cases, the shear and moment capacities exceed the factored loads applied at the locations. The bridge is adequate to meet the strength demands of the proposed loading.

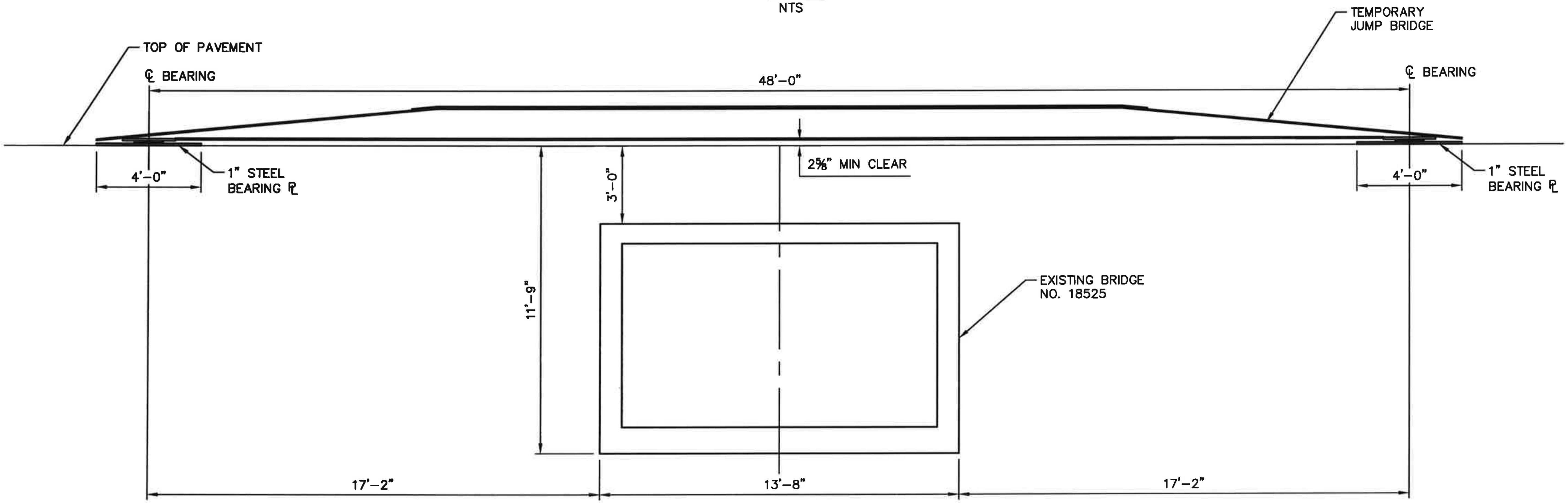
For both jump bridge configurations, at each of the three locations, we recommend that the ends of the bridges be supported on wide, stiff plates to better distribute the reaction loads to the underlying soil, and to limit the bridge from sinking into the supporting pavement and soil. We recommend supporting the jump bridges on 1-inch thick steel plates, with plan dimensions equaling the width of the jump bridge in the transverse direction and four feet longitudinally. This will approximately equal the maximum pressure allowed to be exerted by a dual wheel load onto the pavement.

Appendix A (52-Foot Jump Bridge):

Bridge Site Drawings
52' Jump Bridge Drawings
Calculations



PLAN
NTS



PROFILE
¼"=1'-0"

PROFESSIONAL ENGINEER REGISTERED 9814 7/29/14 STATE OF IDAHO JASON WOLFE

PROJECT NO.: 214089

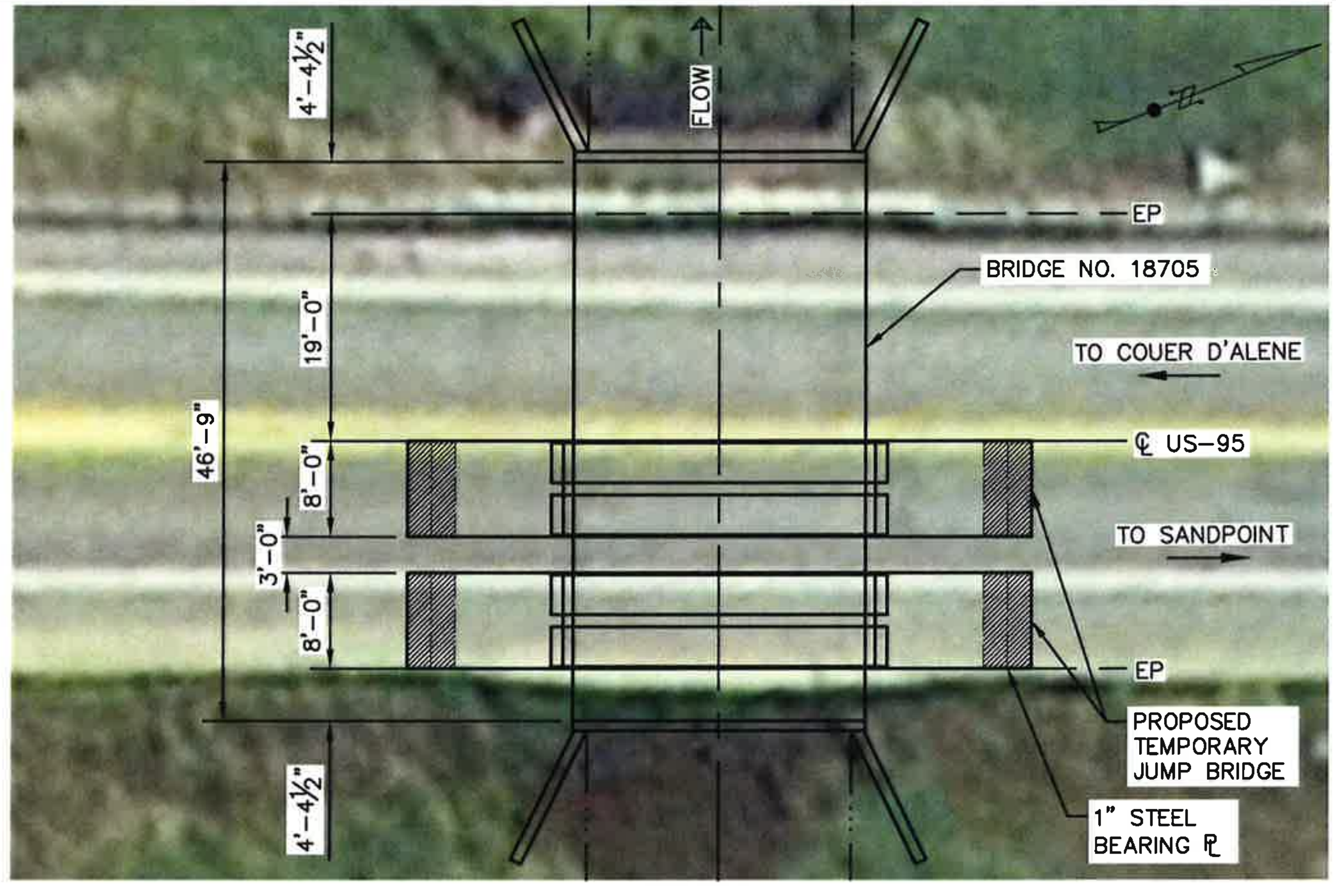
SHEET NO. 1

ITD PERMIT ASSISTANCE - BIGGE CRANE AND RIGGING

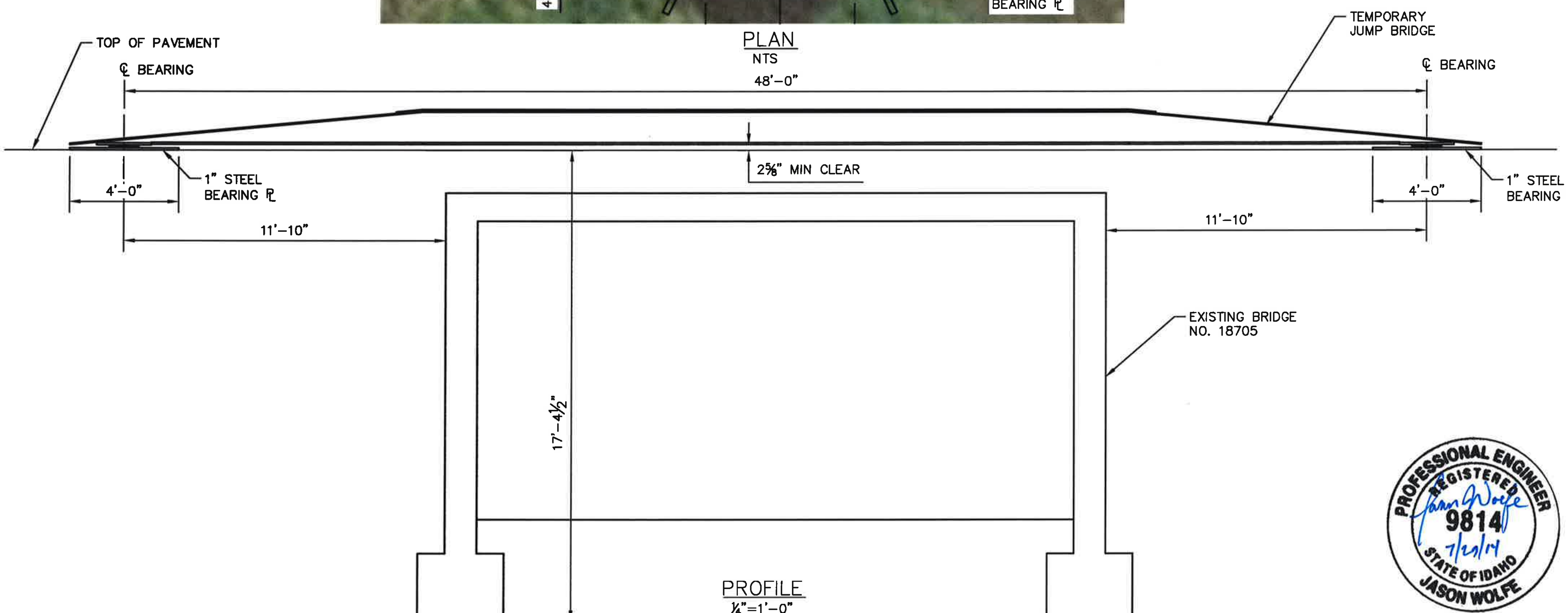
BRIDGE KEY 18525, US 95, 11.7 MILES NORTH OF MOSCOW

FORSGREN Associates Inc.
415 SOUTH 4TH STREET, BOISE, ID 83702
PH: 208.342.3144 FAX: 208.383.0819

P:\214089 - Bigge-Calumet Transport Configuration\CADD\Submittal Drawings\JUMP BRIDGES\18525 PLAN.dwg 7/29/2014 12:01 PM RBLAZICEVICH



PLAN
NTS



PROFILE
¼"=1'-0"

PROJECT NO.: 214089

SHEET NO. 1

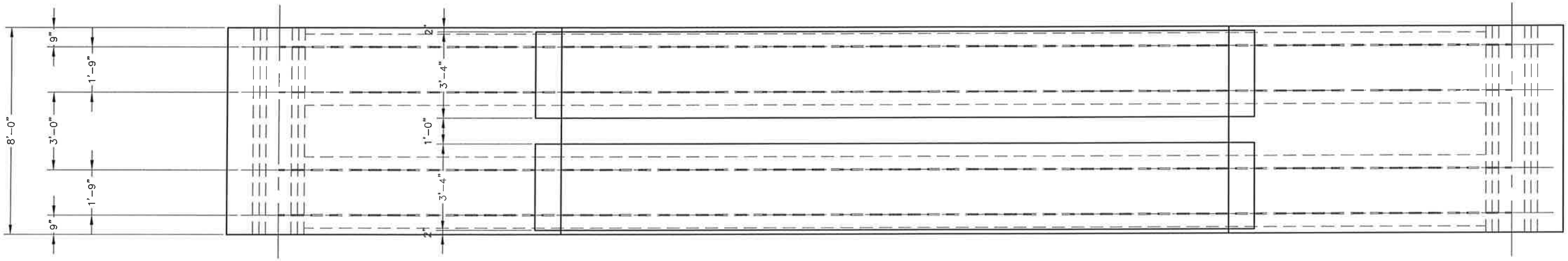
ITD PERMIT ASSISTANCE - BIGGE CRANE AND RIGGING

BRIDGE KEY 18705, US 95, 0.1 MILE SOUTH OF COCOLALLA

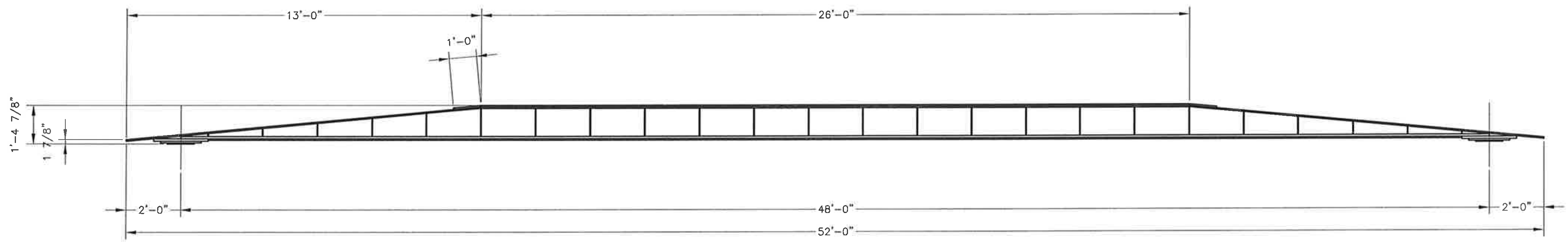
PROFESSIONAL ENGINEER
REGISTERED
9814
7/29/14
STATE OF IDAHO
JASON WOLFE

FORSGREN Associates Inc.
415 SOUTH 4TH STREET, BOISE, ID 83702
PH: 208.342.3144 FAX: 208.383.0819

P:\214089 - Bigge-Calumet Transport Configuration\CADD\Submittal Drawings\JUMP BRIDGES\18705 PLAN.dwg 7/29/2014 11:58 AM RBLAZICEVICH



PLAN



ELEVATION

TRANSPORT BRIDGE

ONE - TBR-1-1

ONE - TBR-1-2

DRAWING REFERENCE:
ALMAS INTERNATIONAL, JUMPER BRIDGE DETAILS
DRAWING NO 8704071, REVISION 3, DATED 4/7/87
ESTIMATED WEIGHT: 38,126 POUNDS

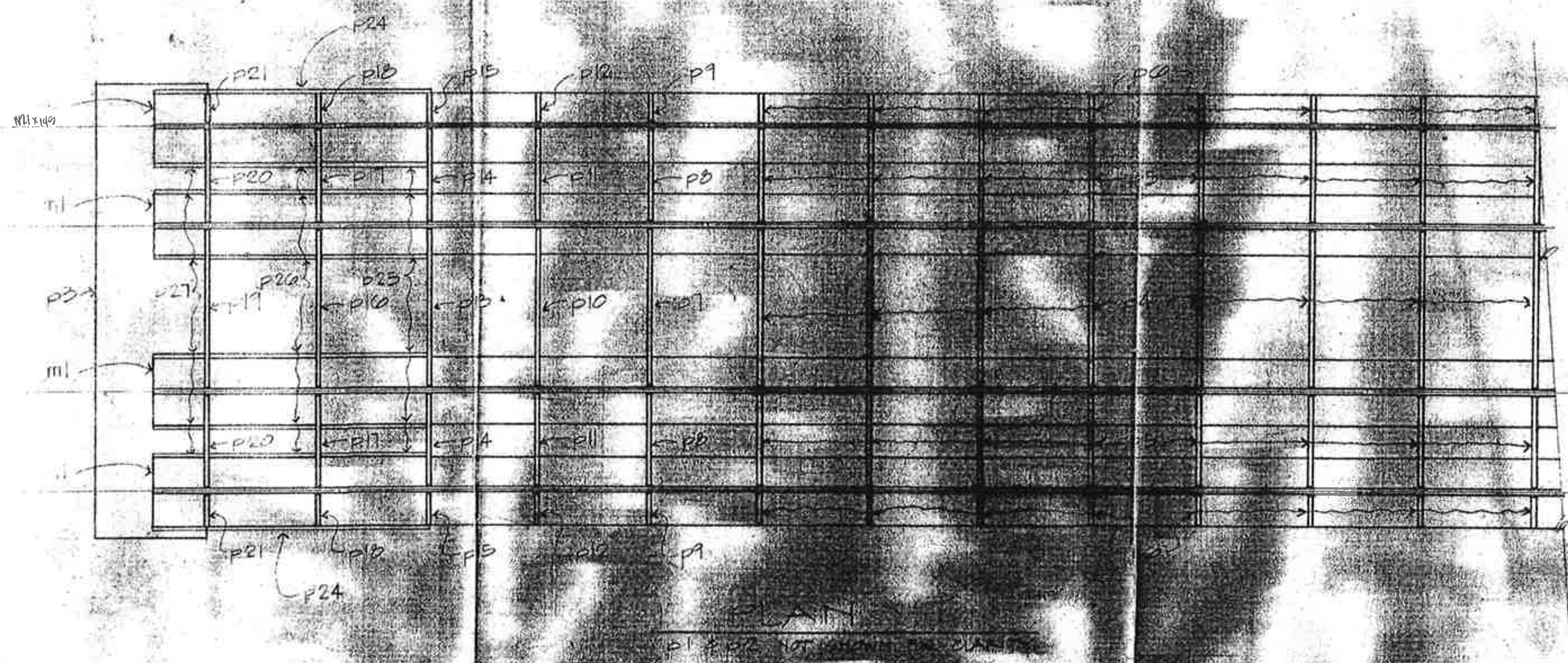
NO.	REVISIONS	DATE	BY	DATE	BY	DATE	BY
0	ORIGINAL RELEASE	3/15/99	GF				
		DRAWN		CHECKED		APPROVED	

BIGGE CRANE and RIGGING CO. Established 1916

TRANSPORT BRIDGE
TBR-1-1, TBR-1-2

SCALE 1/4" =1'-0"	ENGR. No.	DWG. No. TBR-1	SHEET 1 of 1	REV. 0
JOB NO.				

N:\EQUIP\TRANSP\BRIDGES\TBR-1



BILL OF MATERIAL

	Ship Mark	Total No. Req.	No.	Description	Length Ft.	Length In.	Weight Unit	Weight Total	Remarks
				JUMPER BRIDGE				33,126#	
		4	m1	PC W...	48	0	[illegible]	[illegible]	MAKES 2
		1	P1	PL 5/8 × [illegible]	26	0	5538	5538	
		2	P2	PL 5/8 × 90	13	0	2694	5388	
		2	P3	PL 1 × 24	8	0	2093	1396	
		14	P4	PL 1/4 × 12 3/8	2	11 3/8	3	434	CLIP CORNERS
		28	P5	PL 1/4 × 12 3/8	1	8 3/8	18	504	
		28	P6	PL 1/4 × 6 1/2	1	0 3/8	[illegible]	168	
		2	P7	PL 1/4 × 10 1/8	2	11 3/8	25	50	
		4	P8	PL 1/4 × 10 1/8	1	8 3/8	15	60	
		4	P9	PL 1/4 × 6 1/2	0	10 1/8	5	20	
		2	P10	PL 1/4 × 7 7/8	2	11 3/8	20	40	
		4	P11	PL 1/4 × 7 7/8	1	8 3/8	11	44	
		4	P12	PL 1/4 × 6 1/2	0	7 7/8	4	16	
		2	P13	PL 1/4 × 5 5/8	2	11 3/8	14	28	
		4	P14	PL 1/4 × 5 5/8	1	8 3/8	8	32	
		4	P15	PL 1/4 × 5 5/8	0	6 1/2	3	12	
		2	P16	PL 1/4 × 3 3/8	2	11 3/8	9	18	
		4	P17	PL 1/4 × 3 3/8	1	8 3/8	5	20	
		4	P18	PL 1/4 × 3 3/8	0	6 1/2	2	8	
		2	P19	PL 1/4 × 1 1/8	2	11 3/8	3	6	
		4	P20	PL 1/4 × 1 1/8	1	8 3/8	2	8	
		4	P21	PL 1/4 × 1 1/8	0	6 1/2	1	4	
		2	P22	PL 5/8 × 40	28	0	2322	4644	
		2	P23	PL 5/8 × 33	28	0	1965	3930	
		4	P24	PL 1/2 × 5 1/8	5	0	26	102	
		12	P25	PL 1/2 × 5 1/8	1	11 1/2	16	192	
		12	P26	PL 1/2 × 3 3/8	1	11 1/2	8	96	
		12	P27	PL 1/2 × 1 3/8	0	11 1/2	2	24	
		2	P28	PL 3/4 × 13	8	0	308	[illegible]	
		2	P29	PL 1/2 × 12	8	0	163		
		8	P30	PL 5/8 × 12	9	0	244	[illegible]	

ALL MAT'L A-36 PER ASTM SPEC.

ALL MAT'L QUANTITIES ARE FOR ONE BRIDGE

MOMENT OF INERTIA ABT. N.A. = I_{NA} = 10,8... IN⁴

9,071

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Telephone 714 628 8971 TWX 910 581-1471 FAX 714 591 ...

JUMPER BRIDGE DETAIL

3'-0 WIDE

2 REQ

DWN	CHK	ENG	EST. WT.	SCALE	SHEET	DWG. NO
4/7/89			33 126	= 1'-0	OF	87

TEMPORARY JUMP BRIDGE CALCULATIONS

52' STEEL JUMP BRIDGE

ITD PERMIT ASSISTANCE – BIGGE CRANE

PROFESSIONAL ENGINEER
REGISTERED
9814
7/29/14
STATE OF IDAHO
JASON WOLFE

Prepared By:
Jason Wolfe, P.E., S.E.

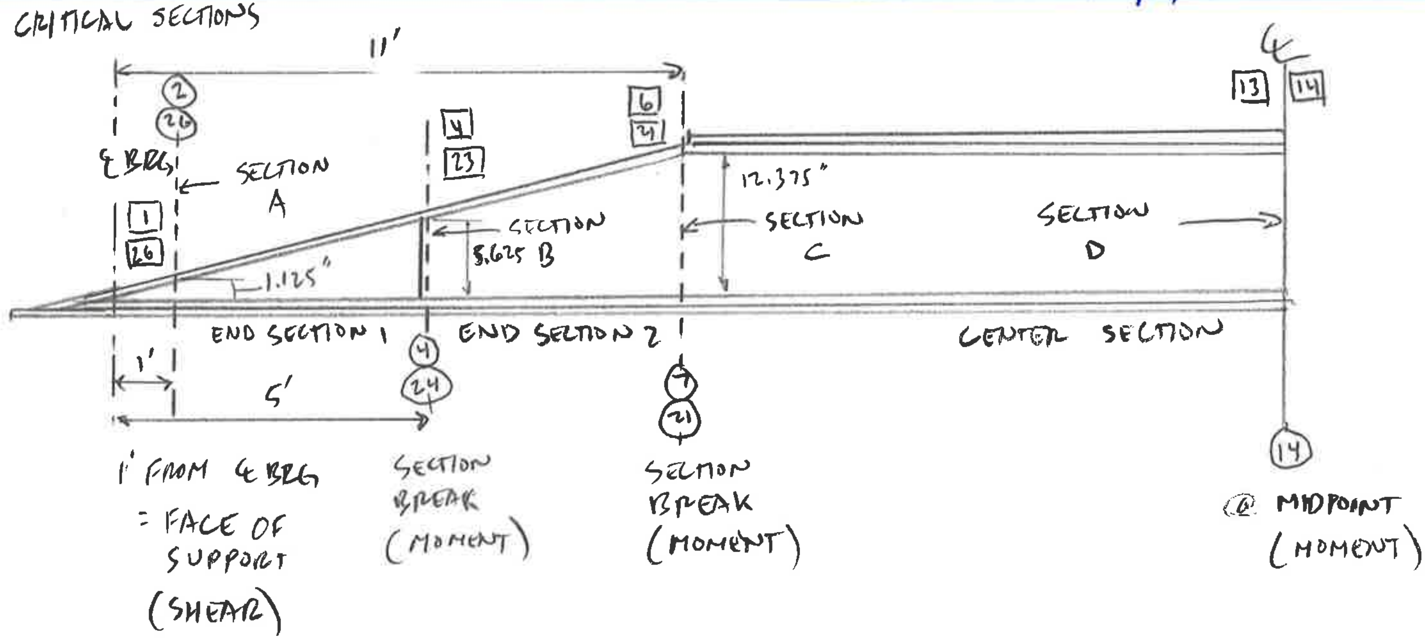
Checked By:
Chris Atkinson, EIT
Barrie Jo Moss, EIT

FORSGREN Associates Inc.

FORSGREN Associates Inc.

OWNER-PROJECT BIGGE / CALUMET	BY	DATE 7/26/14	PROJECT NO.
FEATURE 52' RAMP CAPACITY CALCS	CHK'D BY CMA	DATE 7/29/14	SHT 1 OF 5

CRITICAL SECTIONS



FROM LARSA

JOINT OR MEMBER	SECTION	FACTORED MOMENT	FACTORED SHEAR	SERVICE Δ
1 @ 2	END SECTION 1	163.6 k-ft	163.1 k	—
4 @ 4	END SECTION 2	705.1 k-ft	139.1 k	-0.91"
6 @ 7	END SECTION 2	1277.2 k-ft	105.2 k	-1.51"
13 @ 14	CENTER SECTION	1826.3 k-ft	—	-2.024"
14 @ 14	CENTER SECTION	1825.8 k-ft	—	-2.024"
21 @ 21	END SECTION 2	1276.8 k-ft	105.1 k	-1.51"
23 @ 24	END SECTION 2	704.6 k-ft	139.0 k	-0.91"
26 @ 26	END SECTION 1	163.4 k-ft	163.0 k	—

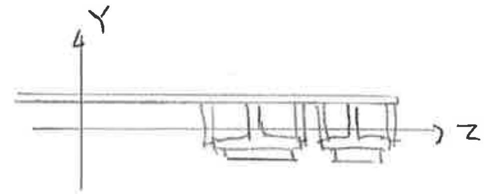
MAX DEFLECTION ~ 2 1/32"

- RECOMMEND SHIMMING/ELEVATING JUMP BRIDGE SO THAT 2 5/8" CLEAR BETWEEN DECK & JUMP BRIDGE

FORSGREN Associates Inc.

OWNER-PROJECT	BY	DATE	PROJECT NO.
BIGGE / CALUMET		7/26/14	
FEATURE 52' JUMP BRIDGE CAPACITY CALC	**CHK'D BY** CMA	**DATE** 7/29/14	**SHT** 2 **OF** 5

SECTION @ CRITICAL SHEAR (SECTION A)



FROM LARSA:

$A = 152.82\ in^2$

$I_{zz} = 192.94\ in^4$

$I_{yy} = 133249.8\ in^4$

$J = 442.06\ in^4$

$S_z = 109.42\ in^3$

$S_y = 2776.04\ in^3$

$R_z = 1.124''$

$R_y = 29.53''$

REFERENCE: AISC LRFD 3rd ed

SHEAR AREA: $(1.125+0.25)(0.5)(8) + (1.125+0.975)(0.605)4 = \underline{\underline{10.582\ in^2}}$

SHEAR CAPACITY $= 0.6(36\ ksi)(10.582\ in^2) = 228.6^k$

$\phi V_n = 0.9(228.6^k) = \underline{\underline{205.7^k}} > V_u = 163^k \therefore$ OK

MOMENT CAPACITY: $F_y S_x = (36\ ksi)(109.42) = 3939.12^{k\text{-}in}$

$= 328.26^{k\text{-}ft}$

$\phi M_n = 0.9(328.26) = \underline{\underline{294.43^{k\text{-}ft}}} > M_u = 163.6^{k\text{-}ft} \therefore$ OK

FORSGREN Associates Inc.

OWNER-PROJECT	BY	DATE	PROJECT NO.
BIGGE. CALUMET	[illegible]	7/26/14	
FEATURE	**CHK'D BY**	**DATE**	
52' JUMP BRIDGE CAPACITY	CMA	7/29/14	SHT 3 OF 5

SECTION B

FROM LARSA: $A = 158.21\ in^2$

$I_{zz} = 1643.40\ in^4$

$I_{yy} = 137{,}933.2\ in^4$

$J = 71.46\ in^4$

$S_z = 394.23\ in^3$

$S_y = 2873.61\ in^3$

$R_z = 3.223''$

$R_y = 29.527''$

$\frac{h}{t_w} = \frac{5.625}{4(0.605)} = 2.32$ ∴ COMPACT

$L_b = 48'$

$L_p = 1.76 r_y \sqrt{E/F_y} = 1.76(29.527)\sqrt{\frac{29{,}000}{36}}$

$L_p = 1474.96'' = 122.9' > L_b$ ∴ $M_n = M_p$

AISC LRFD

SHEAR AREA $= (5.625 + 0.975)(0.605)4 = 15.97\ in^2$

SHEAR CAPACITY $= 0.6(36\ ksi)(15.97\ in^2) = 345^k$

$\phi V_n = 0.9(345^k) = \underline{\underline{310.5^k}} > V_u = 139.1^k$ OK

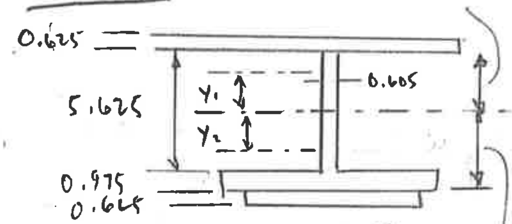
MOMENT CAPACITY $= (36\ ksi)(394.23\ in^3) = 14192.3^{k\text{-}in}$

$M_y = \underline{1182.7}^{k\text{-}ft}$

$\phi M_y = 0.9(1182.7) = \underline{1064.4^{k\text{-}ft}}$

3.5437"

$$\bar{y}_1 = \frac{4(3.5437)(0.605)\left(\frac{3.5437}{2}\right) + 96(0.625)\left(3.5437 + \frac{0.625}{2}\right)}{4(3.5437)(0.605) + 96(0.625)}$$



$\bar{y}_1 = 3.5955''$

$$\bar{y}_2 = \frac{4(2.0813)(0.605)\left(\frac{2.0813}{2}\right) + 4(14)(0.975)\left(3.0563 - \frac{0.975}{2}\right) + 4(12)(0.625)\left(3.0563 + \frac{0.625}{2}\right)}{4(2.0813)(0.605) + 4(14)(0.975) + 4(12)(0.625)}$$

3.0563" FROM LARSA

$\bar{y}_2 = 2.7507''$

$a = \bar{y}_1 + \bar{y}_2 = 6.3462''$

$Z_x = \left(\frac{A}{2}\right)a = \left(\frac{158.21}{2}\right)(6.3462) = 502.01$

$M_p = F_y Z_x = (36\ ksi)(502.01\ in^3) = 18072.5^{k\text{-}in} = 1506^{k\text{-}ft}$

$\phi M_n = 0.9(1506^{k\text{-}ft}) = \underline{\underline{1355.4^{k\text{-}ft}}} > \phi M_y = 1064.4^{k\text{-}ft} > M_u = 705.1^{k\text{-}ft}$

∴ OK

FORSGREN Associates Inc.

OWNER-PROJECT	BY	DATE	PROJECT NO.
BIGGE - CALUMET	TW	7/27/14	
FEATURE: 52' JUMP BRIDGE CAPACITY	CHK'D BY: CMA	DATE: 7/29/14	SHT 4 OF 5

SECTION C

$a = 12.136$

FROM LARSA:

$A = 174.5475$

$I_{zz} = 6807.237$

$I_{yy} = 153{,}002.8$

$J = 72.8352$

$S_z = 856.1592$

$S_y = 3187.558$

$R_z = 6.245$

$R_y = 29.607$

$$\frac{h}{t_w} = \frac{12.375}{4(0.605)} = 5.11 \quad \therefore \text{ COMPACT}$$

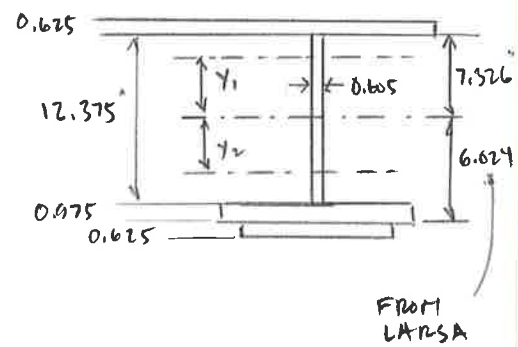
$$L_b = 48'$$

$$L_p = 1.76 r_y \sqrt{\frac{E}{F_y}} = 1.76(29.607)\sqrt{\frac{29{,}000}{36}} = 1470.55'' = 122.5'$$

$$L_b < L_p \Rightarrow M_n = M_p$$

$$M_y = (36 \text{ ksi})(856.1592 \text{ in}^3) = 30821.73 \text{ k-in}$$

$$M_y = 2568.5 \text{ k-ft}$$



$$\bar{y}_1 = \frac{4(7.326)(0.605)\left(\frac{7.326}{2}\right) + 96(0.625)\left(7.326 + \frac{0.625}{2}\right)}{4(7.326)(0.605) + 96(0.625)}$$

$$\bar{y}_1 = 6.732''$$

$$\bar{y}_2 = \frac{4(5.049)(0.605)\left(\frac{5.049}{2}\right) + 4(14)(0.975)\left(6.024 - \frac{0.975}{2}\right) + 4(12)(0.625)\left(6.024 + \frac{0.625}{2}\right)}{4(5.049)(0.605) + 4(14)(0.975) + 4(12)(0.625)}$$

$$\bar{y}_2 = 5.404''$$

$$a = \bar{y}_1 + \bar{y}_2 = 12.136''$$

$$Z_x = \left(\frac{A}{2}\right) a = \left(\frac{174.5475}{2}\right)(12.136'') = 1059.178 \text{ in}^3$$

$$M_p = F_y Z_x = (36 \text{ ksi})(1059.18 \text{ in}^3) = 38130.4 \text{ k-in}$$

$$= 3177.5 \text{ k-ft}$$

$$\phi M_n = 0.9(3177.5 \text{ k-ft}) = 2859.75 \text{ k-ft} > \phi M_y = 2311.65 \text{ k-ft}$$

$$> M_u = 1277.2 \text{ k-ft} \quad \therefore \text{ OK}$$

FORSGREN Associates Inc.

OWNER-PROJECT BIGGE / CALUMET	BY [initials]	DATE 7/27/14	PROJECT NO.
FEATURE 52' JUMP BRIDGE CAPACITY	CHK'D BY CMA	DATE 7/29/14	SHT 5 OF 5

SECTION D

FROM LARSA:

$A = 235.7975\ in^2$

$I_{zz} = 10{,}179.44\ in^4$

$y_z = 7.474''$

$J = 8714.225\ in^4$

$S_z = 1256.876\ in^3$

$R_y = 29.318''$

$\frac{h}{t_w} = \frac{12.375}{4(0.665)} = 5.11$

$L_b = 48' = 576''$

$L_p = 1.76\, r_y \sqrt{E/F_y} = 1.76(29.318)\sqrt{\frac{29000}{36}}$

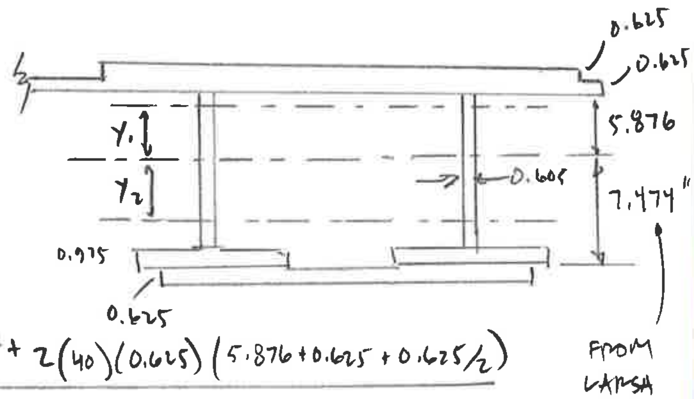
$= 1464.5''$

$= 122' \quad \therefore M_n = M_p$

$M_y = 36ksi\,(1256.876\ in^3)$

$= 45247.5\ ^{k-in}$

$= \underline{\underline{3770.6\ ^{k-ft}}} \qquad \phi M_y = 3393.5\ ^{k-ft}$



$$\bar{y}_1 = \frac{4(0.605)\frac{(5.876)^2}{2} + 96(0.625)(5.876 + 0.625/2) + 2(40)(0.625)(5.876 + 0.625 + 0.625/2)}{4(0.605)(5.876) + 96(0.625) + 2(40)(0.625)}$$

$\bar{y}_1 = 6.068''$

$$\bar{y}_2 = \frac{4(0.605)\left(\frac{6.499^2}{2}\right) + 4(14)(0.975)\left(7.474 - \frac{0.975}{2}\right) + 2(33)(0.625)\left(7.474 + \frac{0.625}{2}\right)}{4(0.605)(6.499) + 4(14)(0.975) + 2(33)(0.625)}$$

$\bar{y}_2 = 6.756''$

$a = \bar{y}_1 + \bar{y}_2 = 12.823''$

$Z_x = \left(\frac{A}{2}\right)(a) = \frac{235.7975}{2}(12.823) = 1511.87\ in^3$

$M_p = F_y Z_x = 36ksi(1511.87\ in^3) = 54427.4\ ^{k-in}$

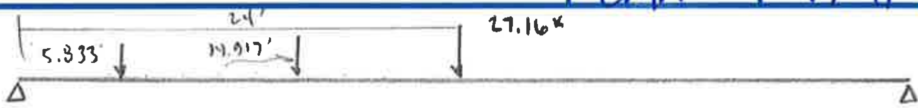
$= 4535.6\ ^{k-ft}$

$\phi M_n = 0.9(4535.6) = \underline{\underline{4082.1\ ^{k-ft}}} > \phi M_y = 3393.5\ ^{k-ft} > M_u = 1826.3\ ^{k-ft}$

$\therefore$ OK

FORSGREN Associates Inc.

OWNER-PROJECT	BY	DATE	PROJECT NO.
BIGGE / CALUMET	[signature]	7/27/14	
FEATURE	CHK'D BY	DATE	
GUT CHECK	CMA	7/29/14	SHT 1 OF 1



$\Delta_D = \frac{5wl^4}{384EI} = \frac{5(0.69/12)(48\times12)^4}{384(29{,}000)(10179.44)} = \underline{0.279''}$

$DL \approx 0.69\ ^k/ft$

$I_{min} = 10{,}179.44\ in^4$

$\Delta_{L_1} = \frac{Pl^3}{48EI} = \frac{27.16^k(48\times12)^3}{48(29000)(10179.44)} = \underline{0.366''}$

$\Delta_{L_2} = \frac{Pa}{24EI}(3l^2 - 4a^2) = \frac{27.16(14.917)(12)}{24(29{,}000)(10179.44)}\left(3(48\times12)^2 - 4(14.917\times12)^2\right) = \underline{0.595''}$

$\Delta_{L_3} = \frac{27.16(5.833\times12)}{24(29000)(10179.44)}\left(3(48\times12)^2 - 4(5.833\times12)^2\right) = \underline{0.262}$

FROM LARSA

TOTAL	$\Delta_L = 1.223''$	$\Delta_L = 1.6275''$
	$\Delta_D = 0.279''$	$\Delta_D = 0.3965$
	$\Delta_T = 1.502''$	$\Delta_T = 2.024''$

$M_D = \frac{(0.69)(48)^2}{8} = 198.72^{k\text{-}ft}$

$M_{L_1} = \frac{(27.16^k)(48')}{4} = 325.92^{k\text{-}ft}$

$M_{L_2} = 27.16(14.917') = 405.15^{k\text{-}ft}$

$M_{L_3} = 27.16(5.833') = 158.42^{k\text{-}ft}$

TOTAL	$M_L = 889.49^{k\text{-}ft}$	$M_L = 888.60$
	$M_D = 198.72^{k\text{-}ft}$	$M_D = 217.05^{k\text{-}ft}$
	$M_T = 1088.21^{k\text{-}ft}$	$M_T = 1105.65^{k\text{-}ft}$

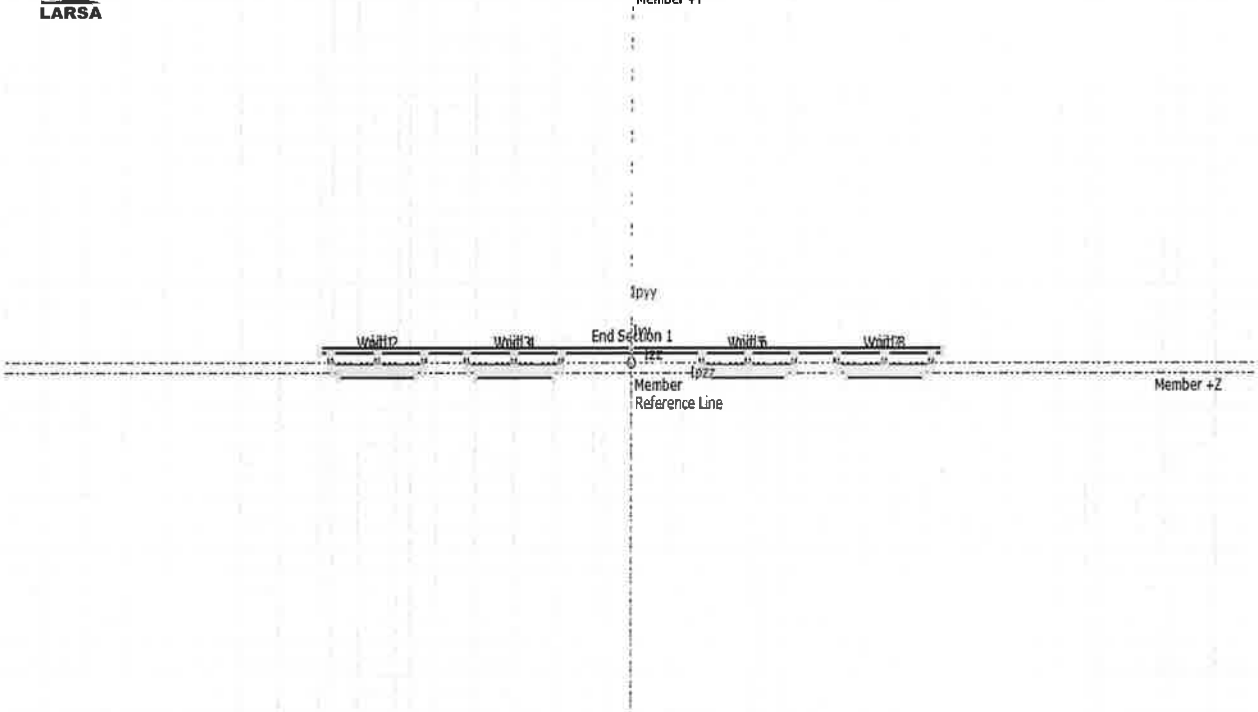
$V_D = \frac{(0.69)(48)}{2} = 16.56^k$

$V_L = \frac{(27.16^k)(6)}{2} = 81.48^k$

TOTAL	$V_L = 81.48^k$	$V_L = 85.17^k$
	$V_D = 16.56$	$V_D = 16.61^k$
	$V_T = 98.04^k$	$V_T = 101.78^k$

LARSA

End Section 1



Section Calculations (in)

Area:	152.82
zc:	0.0000
yc:	1.1382
Izz:	192.94
Iyy:	1.332e5
Izy:	0.0000
Ipzz:	192.94
Ipyy:	1.332e5
Ipa:	0.0000
J:	442.06
Cw:	N/C
Perimeter:	340.21
Sz:	109.42
Sy:	2,776.0
Rz:	1.1236
Ry:	29.528
Qz:	79.425
Qy:	2,042.7
WeightArea:	152.82
CIz:	48.000
Cty:	1.5868
Shear Area Factor Y:	1.0000
Shear Area Factor Z:	1.0000

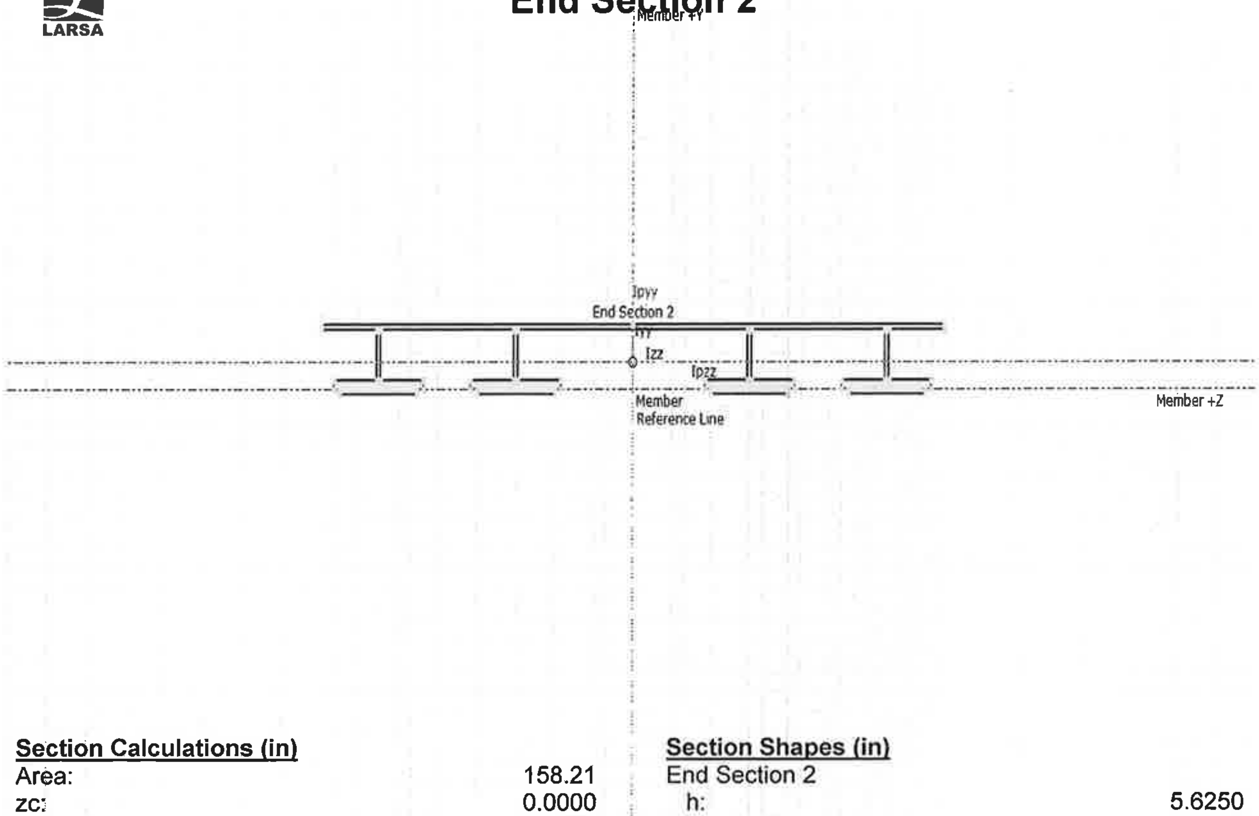
Section Shapes (in)

End Section 1

tf:	0.9750
tbp:	0.6250
ttp:	0.6250
h:	1.1250

Forsgren Associates
415 S. 4th St.
Boise, ID 83702
Tel: 208-342-3144
Fax: 208-383-0819

End Section 2



Section Calculations (in)

Area:	158.21
zc:	0.0000
yc:	3.0563
Izz:	1,643.4
Iyy:	1.379e5
Izy:	1.7e-10
Ipzz:	1,643.4
Ipyy:	1.379e5
Ipa:	0.0000
J:	N/C
Cw:	N/C
Perimeter:	358.21
Sz:	394.23
Sy:	2,873.6
Rz:	3.2229
Ry:	29.527
Qz:	246.56
Qy:	2,119.5
WeightArea:	158.21
Clz:	48.000
Cty:	4.1687
Shear Area Factor Y:	1.0000
Shear Area Factor Z:	1.0000

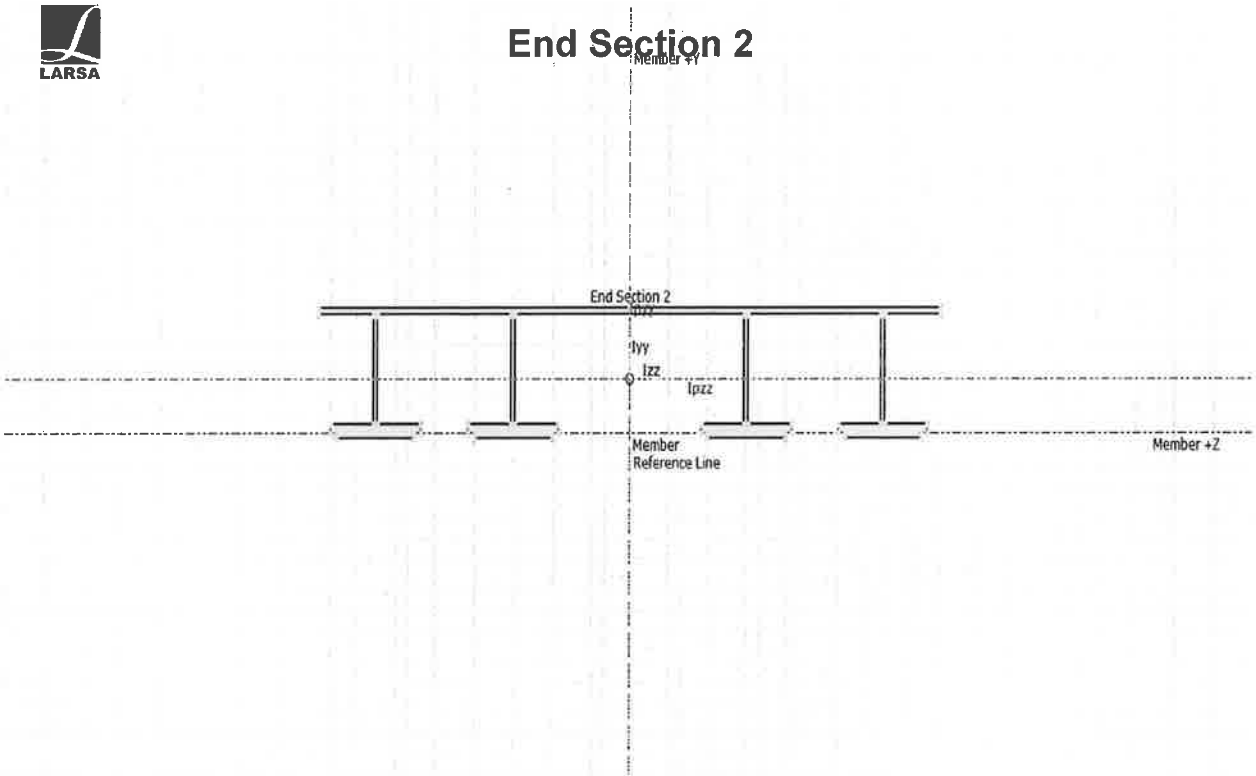
Section Shapes (in)

End Section 2

h:	5.6250
ttp:	0.6250
tbp:	0.6250
tf:	0.9750

415 S. 4th St.
Boise, ID 83702
Tel: 208-342-3144
Fax: 208-383-0819

End Section 2



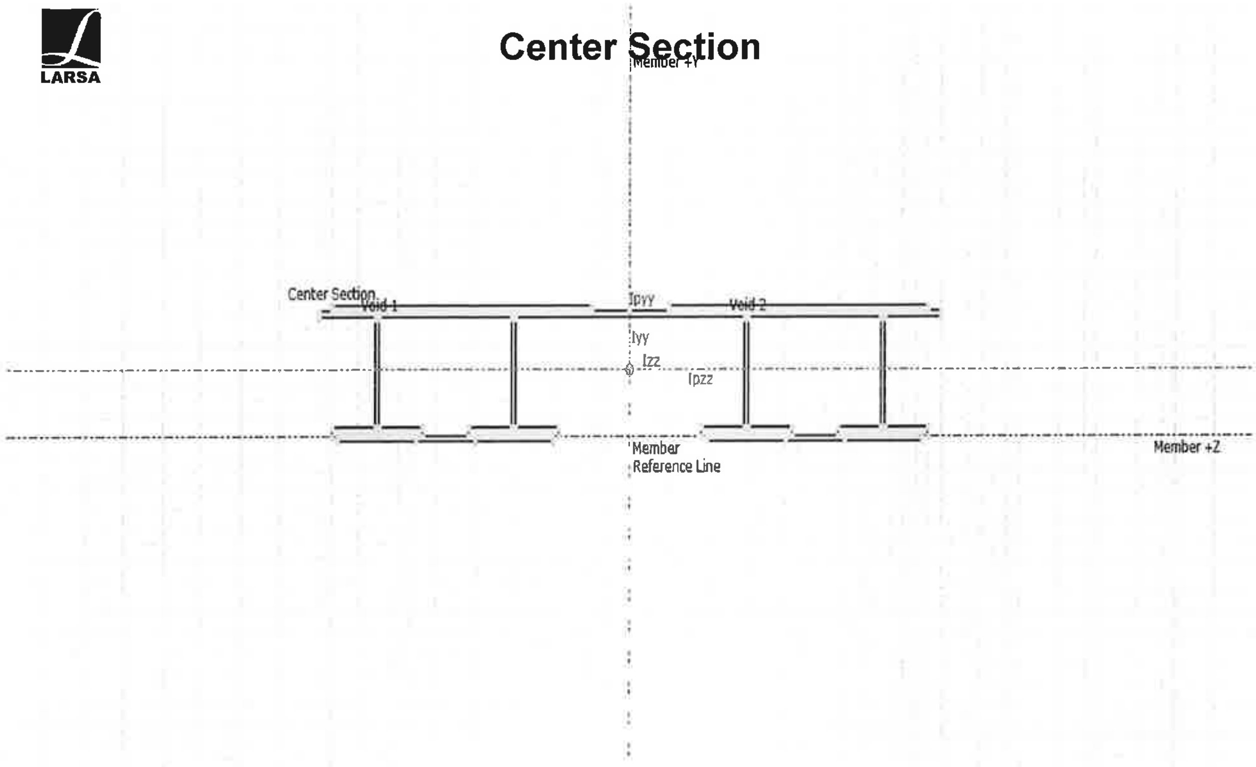
Section Calculations (in)	
Area:	174.55
zc:	0.0000
yc:	6.0241
Izz:	6,807.2
Iyy:	1.530e5
Izy:	1.7e-10
Ipzz:	6,807.2
Ipyy:	1.530e5
Ipa:	0.0000
J:	72.835
Cw:	N/C
Perimeter:	412.21
Sz:	856.16
Sy:	3,187.6
Rz:	6.2449
Ry:	29.607
Qz:	523.24
Qy:	2,352.3
WeightArea:	174.55
Clz:	48.000
Cty:	7.9509
Shear Area Factor Y:	1.0000
Shear Area Factor Z:	1.0000

Section Shapes (in)	
End Section 2	
h:	12.375
ttp:	0.6250
tbp:	0.6250
tf:	0.9750

Forsgren Associates

415 S. 4th St.
Boise, ID 83702
Tel: 208-342-3144
Fax: 208-383-0819

Center Section



Section Calculations (in)

Area:	235.80
zc:	0.0000
yc:	7.4740
Izz:	10,179.
Iyy:	2.027e5
Izy:	0.0000
Ipzz:	10,179.
Ipyy:	2.027e5
Ipa:	0.0000
J:	8,714.2
Cw:	N/C
Perimeter:	440.21
Sz:	1,256.9
Sy:	4,222.6
Rz:	6.5704
Ry:	29.318
Qz:	753.76
Qy:	3,162.6
WeightArea:	235.80
Clz:	48.000
Cty:	7.1260
Shear Area Factor Y:	1.0000
Shear Area Factor Z:	1.0000

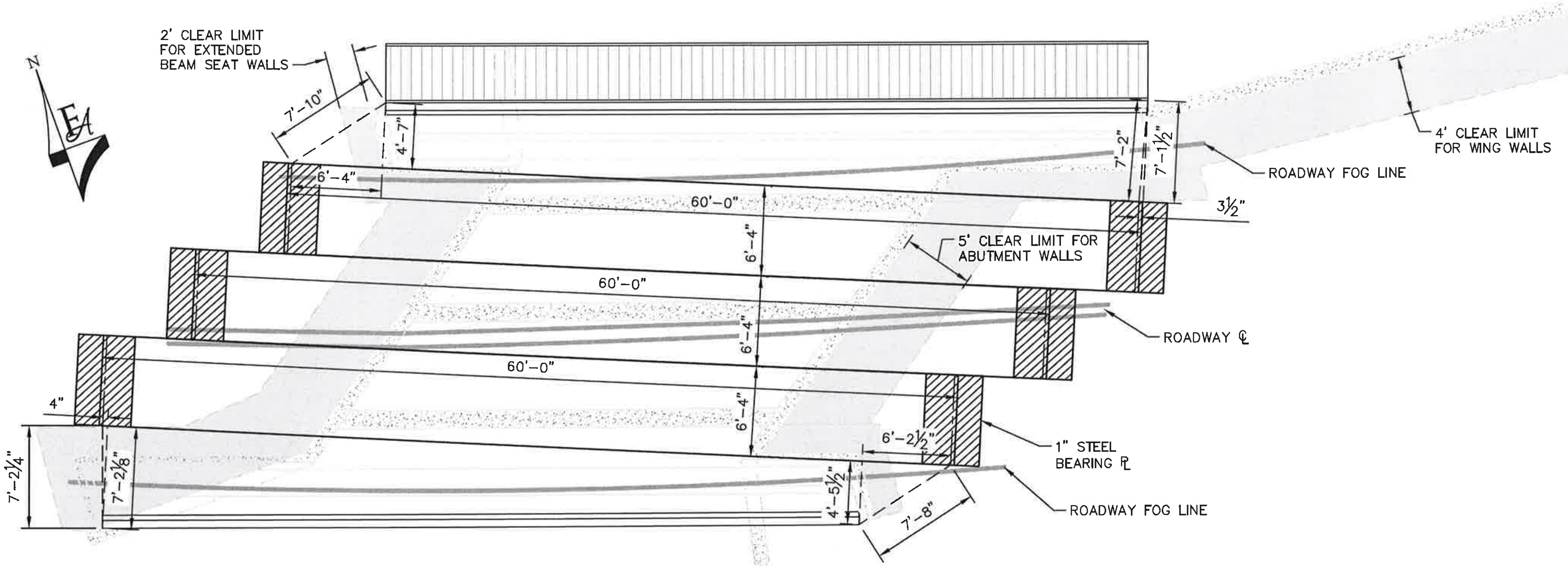
Section Shapes (in)

Center Section

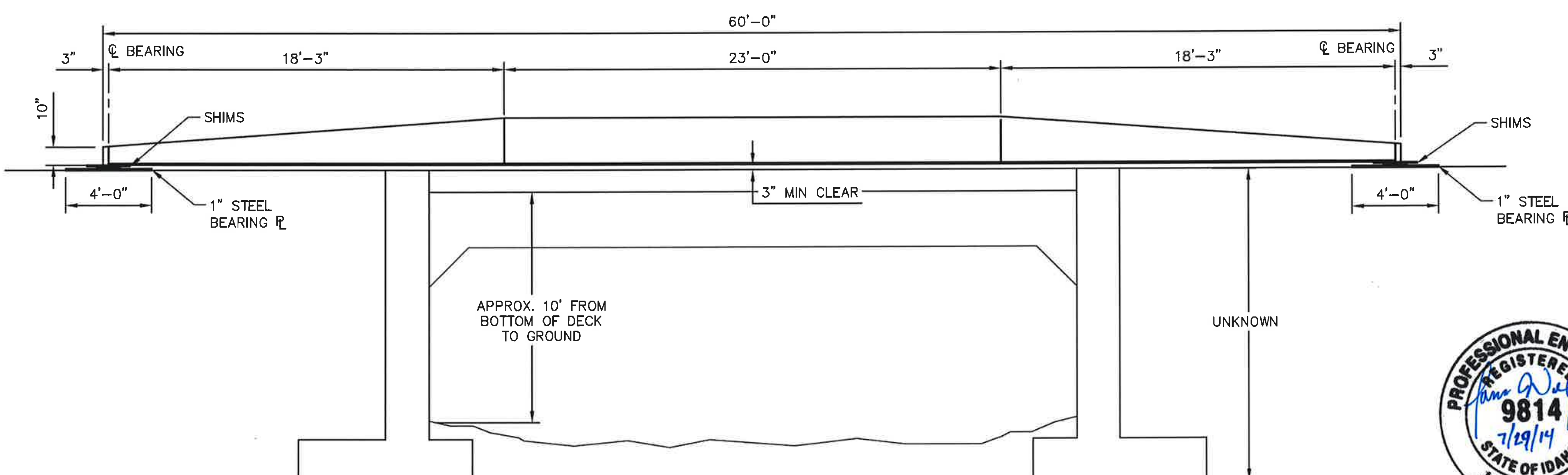
415 S. 4th St.
Boise, ID 83702
Tel: 208-342-3144
Fax: 208-383-0819

Appendix B (60-Foot Barge Ramp):

Bridge Site Drawings
60' Barge Ramp Drawings
Calculations



PLAN
⅛"=1'-0"



PROFILE
3⁄16"=1'-0"

PROFESSIONAL ENGINEER
REGISTERED
9814
7/29/14
STATE OF IDAHO
JASON WOLFE

PROJECT NO.: 214089

SHEET NO.

ITD PERMIT ASSISTANCE - BIGGE

STRONG CREEK JUMP BRIDGE PLAN

FORSGREN Associates Inc.
415 SOUTH 4TH STREET, BOISE, ID 83702
PH: 208.342.3144 FAX: 208.383.0819

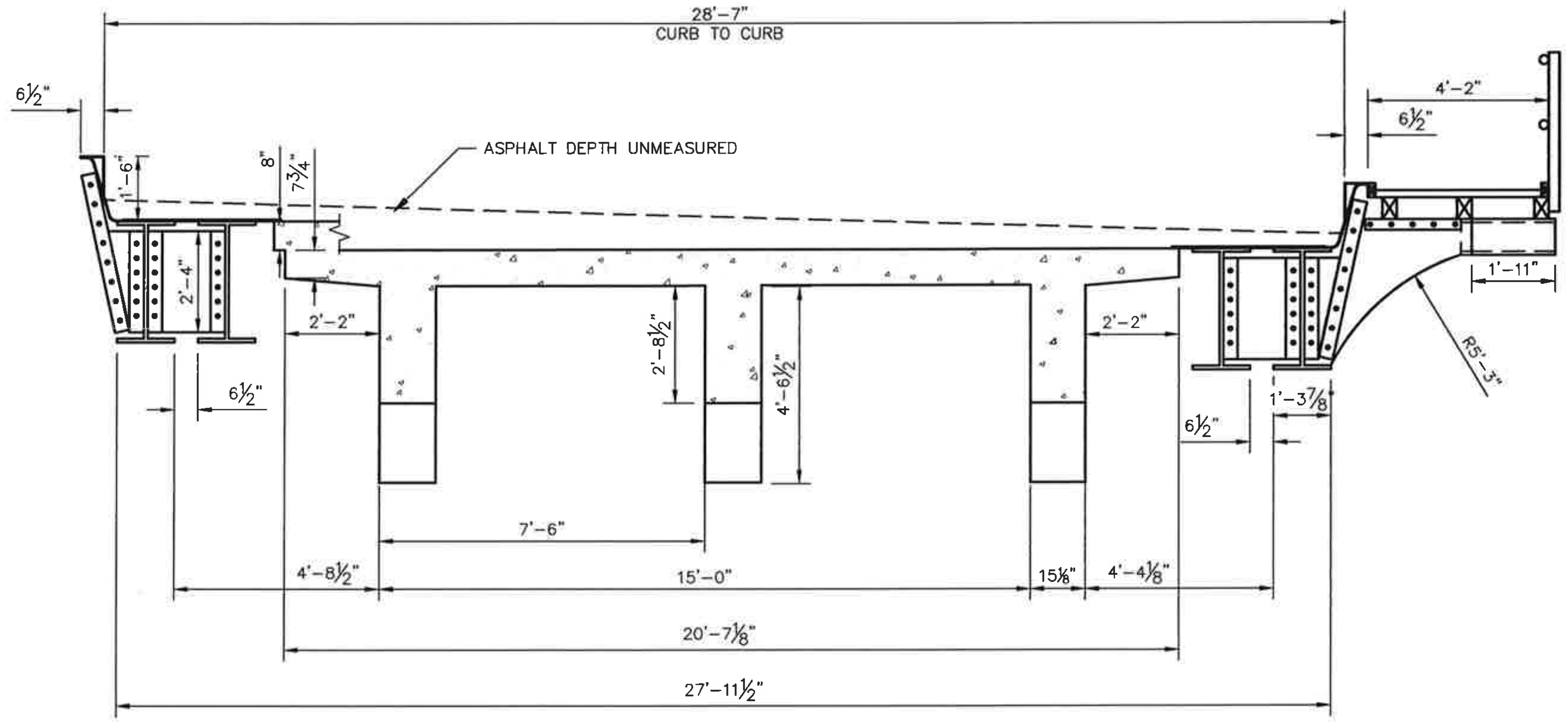
P:\214089 - Bigge-Calumet Transport Configuration\CADD\Submitted Drawings\JUMP BRIDGES\19080 BIGGE PLAN.dwg 7/29/2014 2:52 PM RBLAZICEVICH

P:\214089 – Bigge–Calumet Transport Configuration\CADD\Submittal Drawings\JUMP BRIDGES\19080 BIGGE PLAN.dwg 7/29/2014 1:31 PM RBLAZICEVICH

PLAN
1"=20'

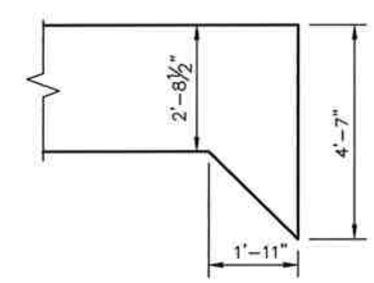
PROFESSIONAL ENGINEER
REGISTERED
9814
7/29/14
STATE OF IDAHO
JASON WOLFE

FORSGREN Associates Inc. 415 SOUTH 4TH STREET, BOISE, ID 83702 PH: 208.342.3144 FAX: 208.383.0819	ITD PERMIT ASSISTANCE - BIGGE	PROJECT NO.: 214089
	STRONG CREEK JUMP BRIDGE VICINITY	SHEET NO.



BRIDGE SECTION
¼"=1'-0"

BRIDGE 19080



CONCRETE GIRDER AT ABUTMENT
¼"=1'-0"

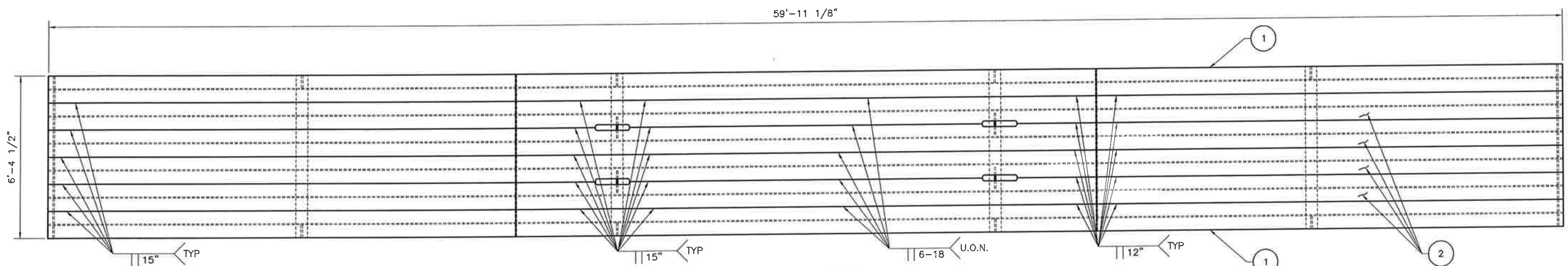
PROFESSIONAL ENGINEER
REGISTERED
9814
7/29/14
STATE OF IDAHO
JASON WOLFE

PROJECT NO.: 214089
SHEET NO.

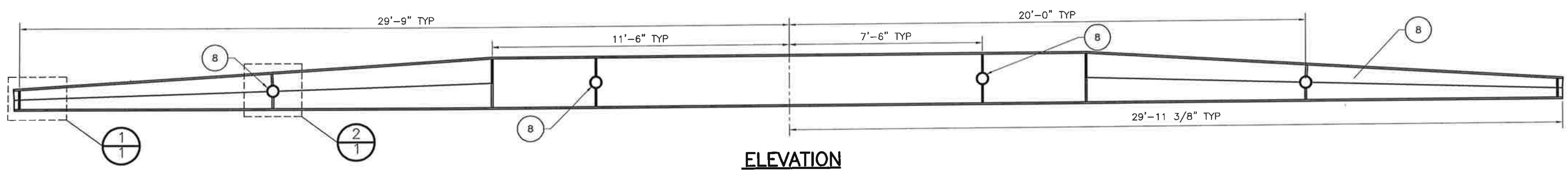
ITD PERMIT ASSISTANCE - BIGGE
BRIDGE KEY 19080 - SECTION & DETAIL

FORSGREN Associates Inc.
415 SOUTH 4TH STREET, BOISE, ID 83702
PH: 208.342.3144 FAX: 208.383.0819

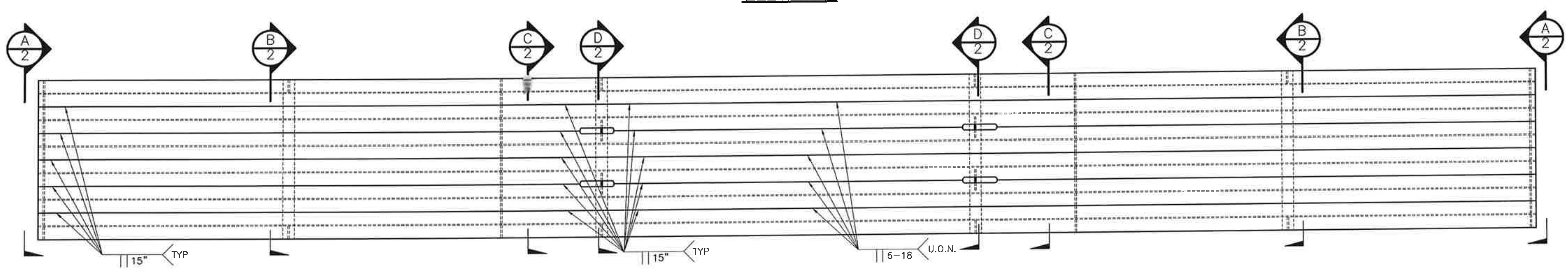
P:\214089 – Bigge-calumet Transport Configuration\cadd\submittal Drawings\Jump Bridges\19080 PLAN.dwg 7/11/2014 3:24 PM RBLAZICEVICH



TOP VIEW



ELEVATION

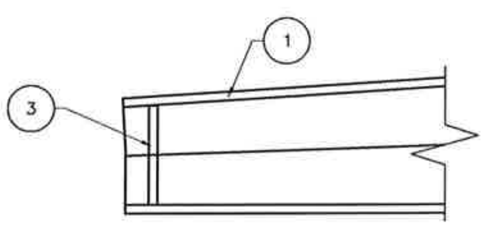


BOTTOM VIEW

60 FT BARGE RAMP – BR60-2 & BR60-3

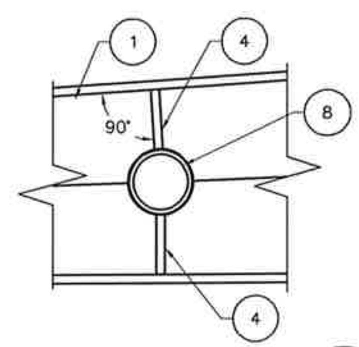
2 REQUIRED AS SHOWN

APPROX. WEIGHT EACH = 37.250 LBS.



DETAIL 1/1

END DETAIL



DETAIL 2/1

STIFFENER DETAIL

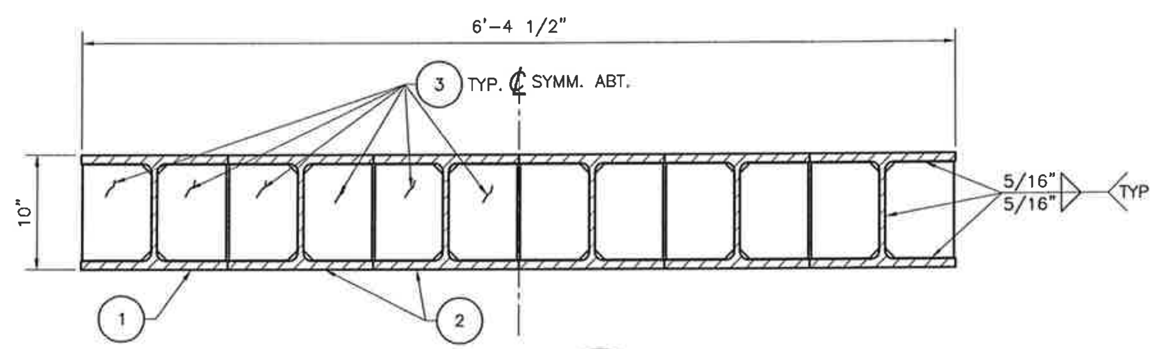
APPROVED FOR CONSTRUCTION

NO.	REVISIONS	DATE	BY	DATE	BY	DATE	BY
1	REVISED TITLE BLOCK	5/27/08	JTC				
0	APPROVED FOR CONSTRUCTION	5/20/08	ANP	5/21/08	JTC	5/21/08	JTC
		DRAWN		CHECKED		APPROVED	

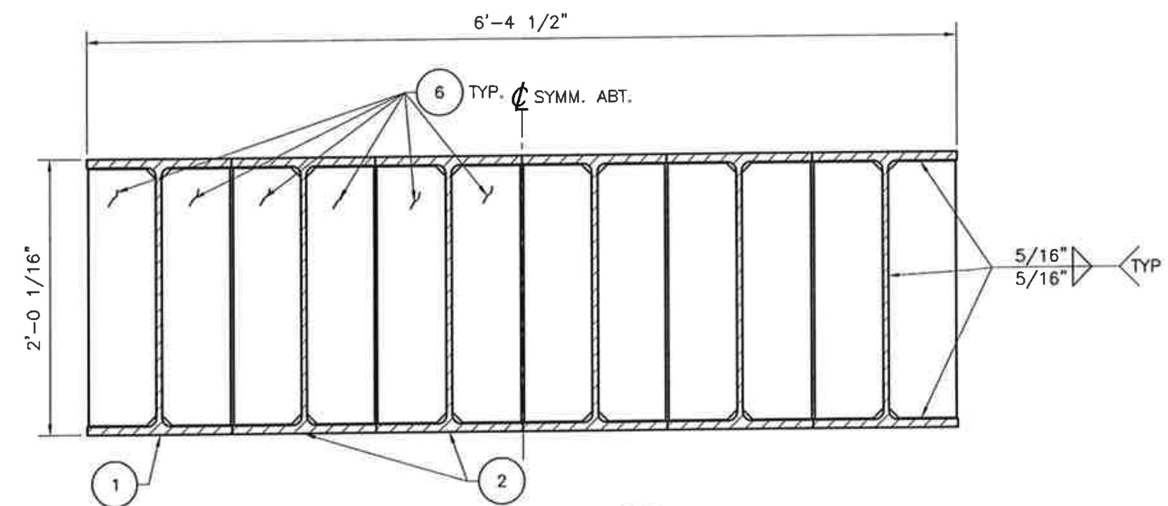
BIGGE CRANE and RIGGING CO. Established 1916

GENERAL ARRANGEMENT
60 FT BARGE RAMP – BR60-2 AND BR60-3 ⚠1

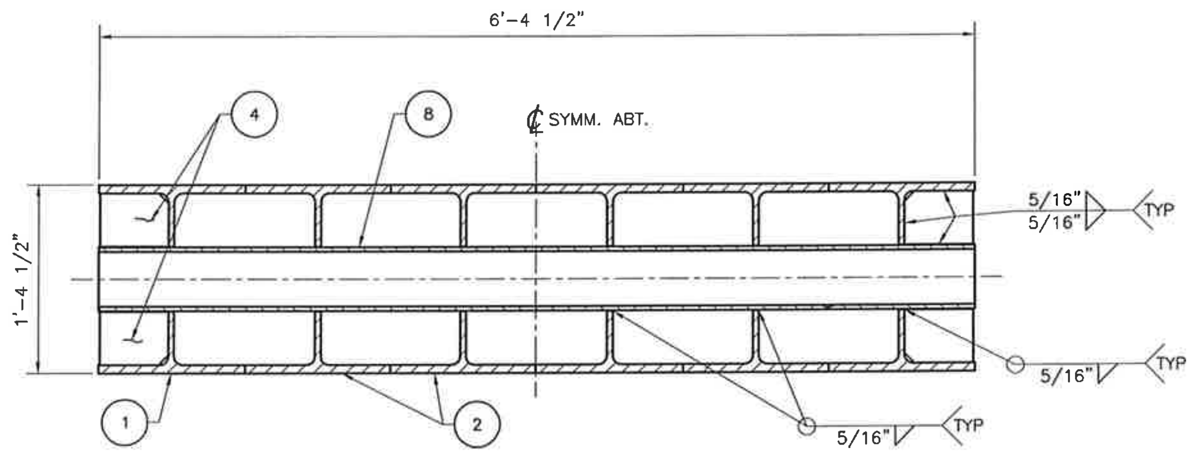
SCALE:	JOB No.	DWG. No.	SHEET	REV.
NOTED = 1'-0"		BR60	1 of 4	1



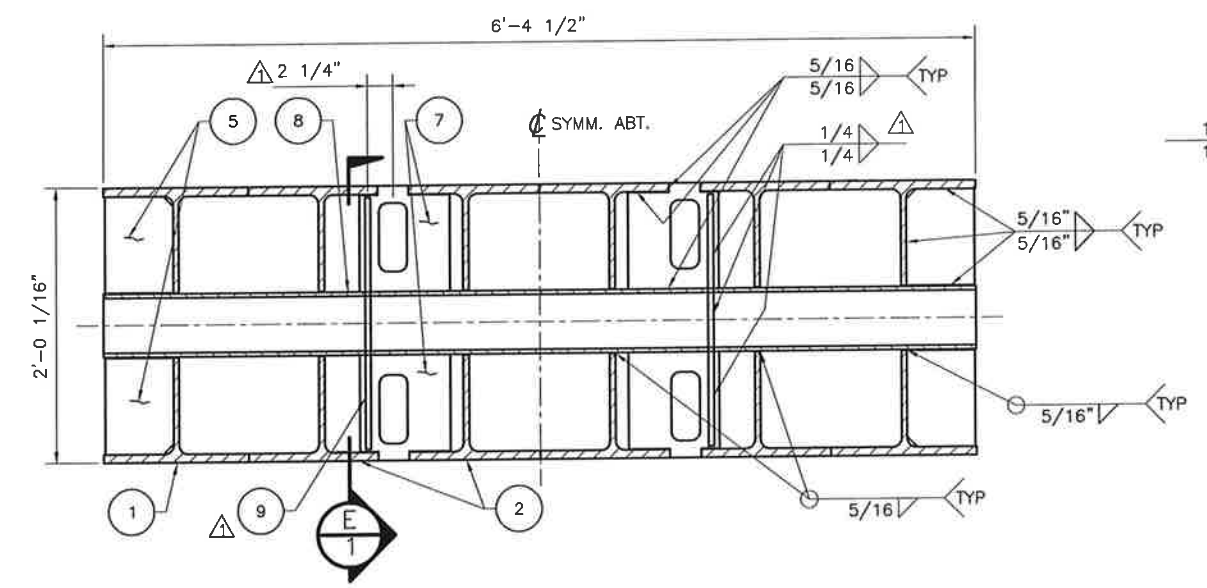
SECTION A/1



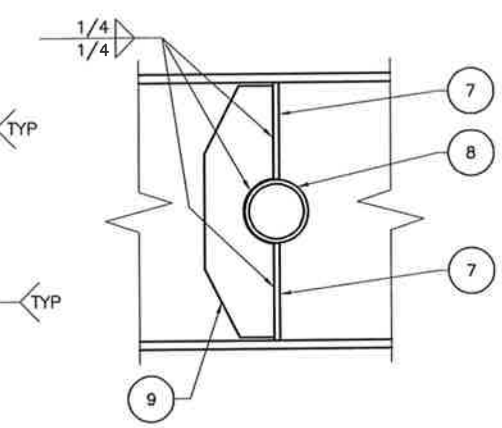
SECTION C/1



SECTION B/1



SECTION D/1



1 SECTION E/1

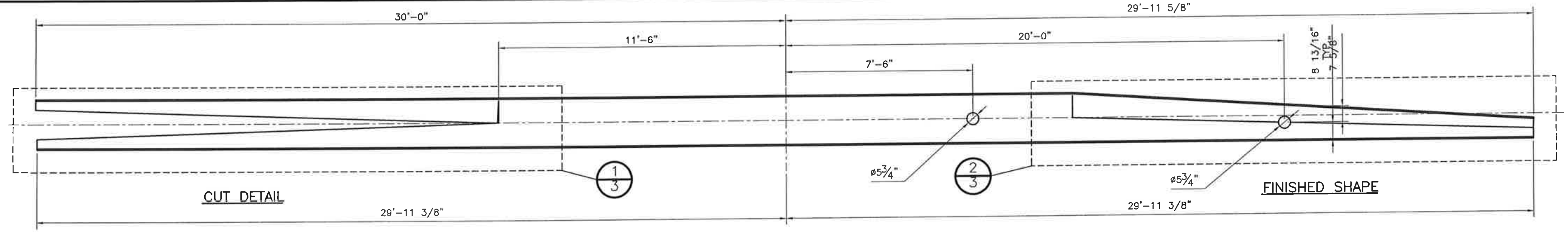
NO.	REVISIONS	DRAWN DATE	DRAWN BY	CHECKED DATE	CHECKED BY	APPROVED DATE	APPROVED BY
1	REVISED TITLE BLOCK; ADDED SECTION E	5/27/08	JTC				
0	APPROVED FOR CONSTRUCTION	5/20/08	ANP	5/21/08	JTC	5/21/08	JTC

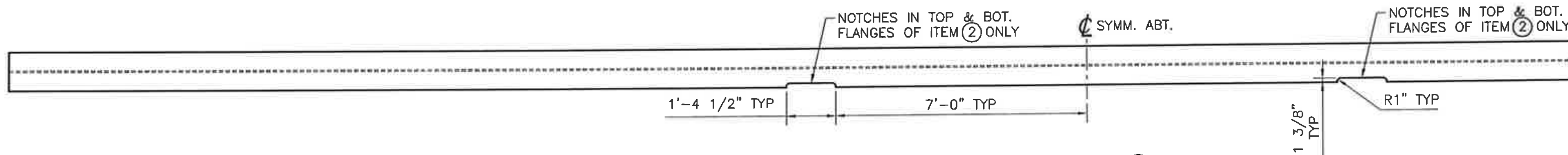
BIGGE CRANE and RIGGING CO. Established 1916

GENERAL ARRANGEMENT
60 FT BARGE RAMP – BR60-2 AND BR60-3 1

APPROVED FOR CONSTRUCTION

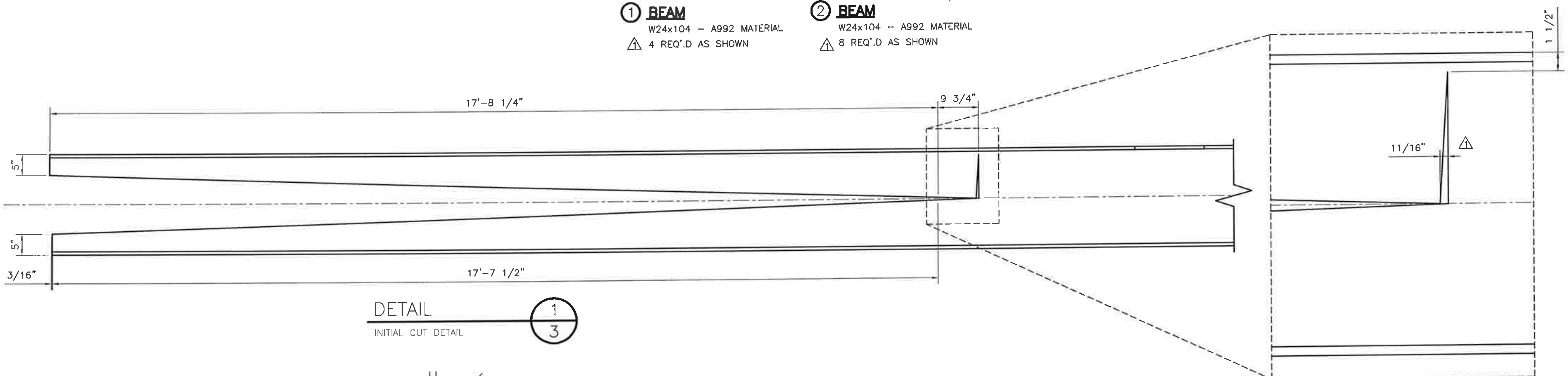
SCALE:	JOB No.	DWG. No.	SHEET	REV.
NOTED = 1'-0"		BR60	2 of 4	1



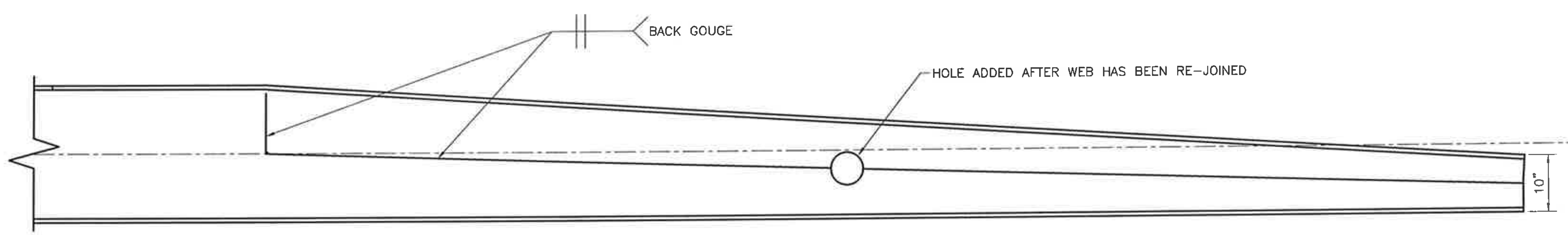


① **BEAM**
W24x104 – A992 MATERIAL
⚠ 4 REQ'.D AS SHOWN

② **BEAM**
W24x104 – A992 MATERIAL
⚠ 8 REQ'.D AS SHOWN



DETAIL 1/3
INITIAL CUT DETAIL



DETAIL 2/3
FINAL SHAPE DETAIL

APPROVED FOR CONSTRUCTION

NO.	REVISIONS	DRAWN DATE	DRAWN BY	CHECKED DATE	CHECKED BY	APPROVED DATE	APPROVED BY
1	REVISED WEB CUT, TITLE BLOCK	5/27/08	JTC				
0	APPROVED FOR CONSTRUCTION	5/20/08	ANP	5/21/08	JTC	5/21/08	JTC

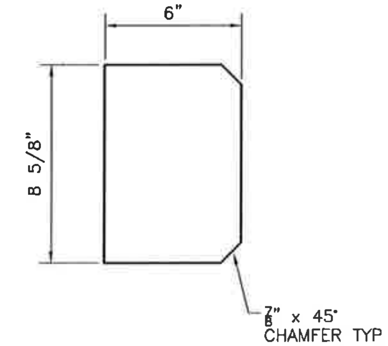
BIGGE CRANE and RIGGING CO. Established 1916

BEAM FABRICATION DETAILS
60 FT BARGE RAMP – BR60-2 AND BR60-3 ⚠

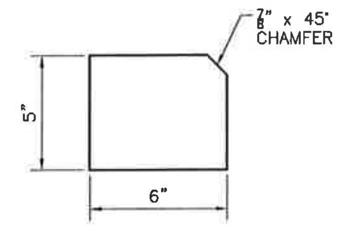
SCALE:	JOB No.	DWG. No.	SHEET	REV.
NOTED = 1'-0"		BR60	3 of 4	1

BILL OF MATERIALS

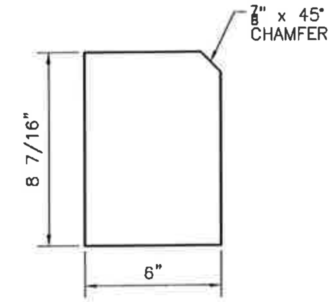
MK.	QTY	DESCRIPTION		TOTAL WEIGHT	MTL.	REMARK
1	4	W24x104 x 60'-0" LG	(5,990#/EA)	23,960	A992	Gr 50
2	8	W24x104 x 60'-0" LG	(5,990#/EA)	47,920	A992	Gr 50
3	48	PL 1/2"x6" x 8 5/8"	(7#/EA)	350	A36	
4	16	PL 1/2"x5" x 6"	(4#/EA)	64	A36	
5	16	PL 1/2"x6" x 8 7/16"	(3#/EA)	46	A36	
6	48	PL 1/2"x6" x 1'-10 3/8"	(19#/EA)	914	A36	
7	16	PL 1/2"x9 1/4" x 10"	(10#/EA)	164	A36	
8	8	5" SC 80 PIPE x 6'-4 1/2"	(133#/EA)	1,064	A53F	
9	8	PL 1/2"x6" x 1'-10"	(15#/EA)	120	A36	



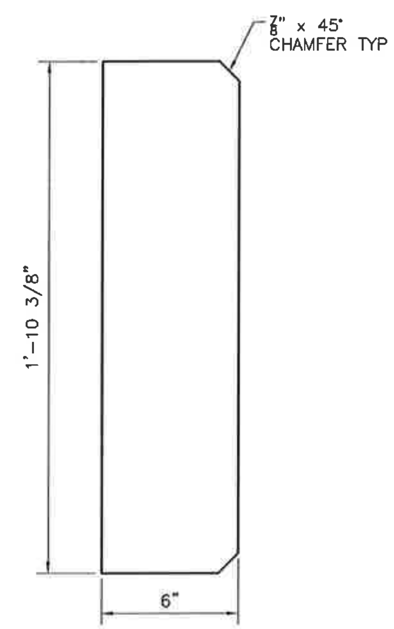
③ **PLATE**
1/2" THK A36 MATERIAL
48 REQ'.D AS SHOWN



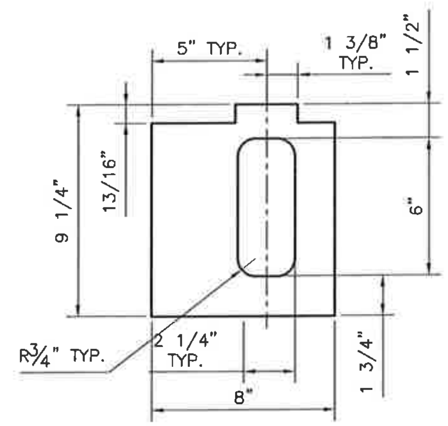
④ **PLATE**
1/2" THK A36 MATERIAL
16 REQ'.D AS SHOWN



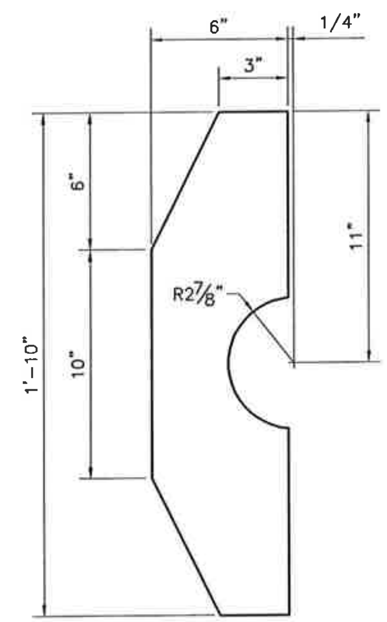
⑤ **PLATE**
1/2" THK A36 MATERIAL
16 REQ'.D AS SHOWN



⑥ **PLATE**
1/2" THK A36 MATERIAL
48 REQ'.D AS SHOWN



⑦ **PLATE**
1/2" THK A36 MATERIAL
16 REQ'.D AS SHOWN



⑨ **PLATE**
1/2" THK A36 MATERIAL
8 REQ'.D AS SHOWN

APPROVED FOR CONSTRUCTION

NO.	REVISIONS	DRAWN DATE	BY	CHECKED DATE	BY	APPROVED DATE	BY
1	REVISED MATERIAL QTY, TITLE BLOCK	5/27/08	JTC				
0	APPROVED FOR CONSTRUCTION	5/20/08	ANP	5/21/08	JTC	5/21/08	JTC

BIGGE CRANE and RIGGING CO. Established 1916

PART DETAILS AND BILL OF MATERIALS
60 FT BARGE RAMP – BR60-2 AND BR60-3

SCALE:	JOB No.	DWG. No.	SHEET	REV.
NOTED = 1'-0"		BR60	4 of 4	1

TEMPORARY JUMP BRIDGE CALCULATIONS

60' BARGE RAMP BRIDGE

ITD PERMIT ASSISTANCE – BIGGE CRANE

PROFESSIONAL ENGINEER
REGISTERED
9814
7/29/14
STATE OF IDAHO
JASON WOLFE

Prepared By:
Jason Wolfe, P.E., S.E.

Checked By:
Chris Atkinson, EIT
Barrie Jo Moss, EIT

FORSGREN Associates Inc.

FORSGREN Associates Inc.

OWNER-PROJECT	BY	DATE	PROJECT NO.
BIGGE – CALUMET REACTOR	[signature]	7/24/14	
FEATURE	**CHK'D BY**	**DATE**	
CAPACITY CALCS FOR 60' JUMP BRIDGE	CMA	7/29/14	SHT 1 OF 6

REFERENCE:
AISC LRFD MANUAL 2nd ed
AASHTO LRFD

60' RAMP MOMENT CAPACITY (MIDSPAN)

$M_y = F_y S_x$

$S_x = 1534.78 \text{ in}^3$ (MIDSPAN) (LARSA)

$M_y = (50 \text{ ksi})(1534.78 \text{ in}^3) = 76{,}739 \text{ k-in}$

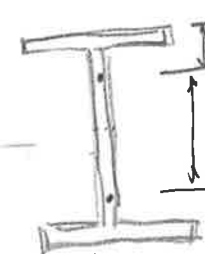
$= \underline{\underline{6395 \text{ k-ft}}}$

$\phi M_y = 0.9(6395) = 5755 \text{ k-ft}$

$Z_x = \left(\frac{A}{2}\right)a$

$Z_x = \left(\frac{30.6}{2}\right)(18.88")$

$= 288.86 \text{ in}^3$ (FOR 1)



$A_{TOTAL} = (30.6 \text{ in}^2)(6) = 183.6 \text{ in}^2$

$Z_{x\,total} = \left(\frac{183.6}{2}\right)(18.88 \text{ in})$

$= 1733.18 \text{ in}^3$

$M_p = F_y Z_x$

$= 50 \text{ ksi}(1733.18 \text{ in}^3)$

$M_p = 86659.2 \text{ k-in}$

$= \underline{\underline{7221.6 \text{ k-ft}}}$

$\frac{Z_x}{S_x} = \frac{1733.18}{1534.78} = 1.13 < 1.5 \therefore \text{ok}$

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OWNER-PROJECT	BY	DATE	PROJECT NO.
CALUMET REACTOR		7/24/14	
FEATURE	**CHK'D BY**	**DATE**	
60' RAMP CAPACITY	CMA	7/29/14	SHT 2 OF 6

$$\frac{h}{t_w} = \frac{24.06 - 2(0.75)}{6(0.5)} = \frac{22.56}{3} = \underline{\underline{7.52}}$$

DETERMINE IF ACTS AS BEAM OR PLATE GIRDER PER AISC.

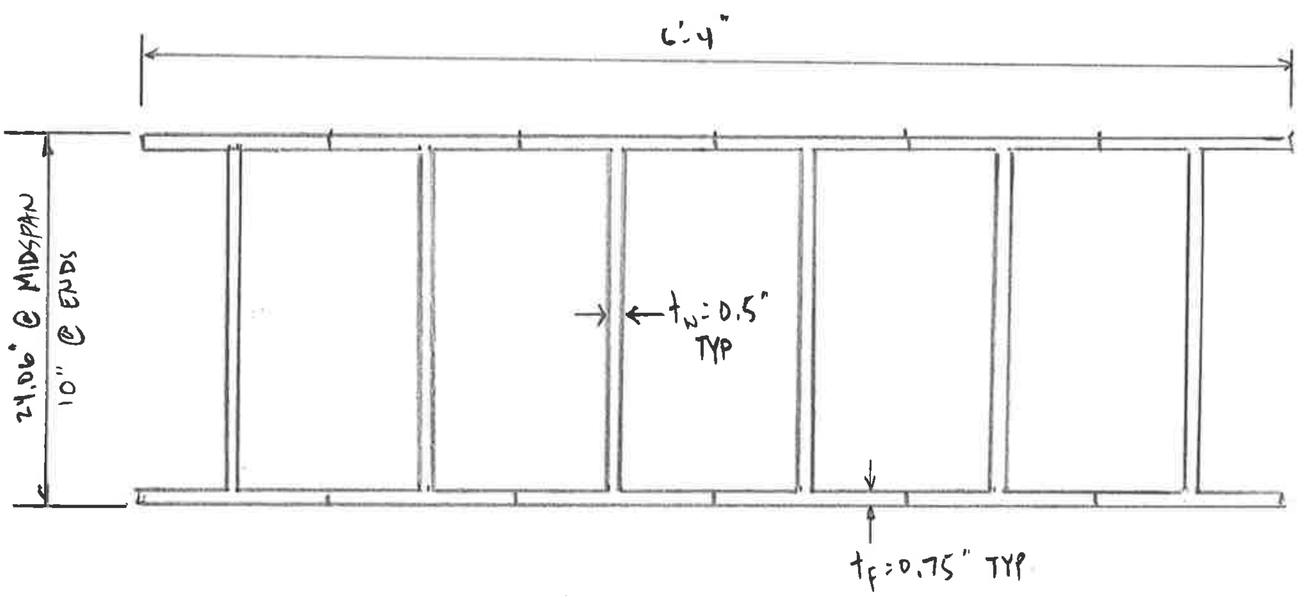
IF $\frac{h}{t_w} > \lambda_r \Rightarrow$ PLATE GIRDER; USE APP G

$\leq \lambda_r \Rightarrow$ BEAM; USE Ch. F & APP F

$\frac{h}{t_w} < \lambda_p = 3.76\sqrt{E/F_y}$ COMPACT $= 90.5$ ✓

$< \lambda_r = 5.7\sqrt{E/F_y}$ NONCOMPACT $= 137.3$ ✓

ACTS AS BEAM - USE AISC Ch. F



6 W24×104

SECTION

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OWNER-PROJECT	BY	DATE	PROJECT NO.
CALUMET - BIGGE	JW	7/24/14	
FEATURE	CHK'D BY	DATE	
JUMP BRIDGE - 60' - CAPACITY	CMA	7/29/14	SHT 3 OF 6

MIDSPAN

CONSIDER BEAM TO ACT AS BOX SECTION

$L_b = 60' = 720''$

$$L_p = \frac{0.13\, r_y E}{M_p}\sqrt{JA}$$

FROM LARSA

$$= \frac{0.13(21.97\text{ in})(29{,}000\text{ ksi})}{86659.2^{k\text{-in}}}\sqrt{(36509.7)(183.6\text{ in}^2)}$$

$= 2474.5$ in

$= \underline{\underline{206.2'}}$

$L_b < L_p \;\therefore\; \phi M_n = \phi M_p$

$$L_r = \frac{2 r_y E \sqrt{JA}}{M_r}$$

$M_r = F_y S_x = (50\text{ ksi})(1534.78\text{ in}^3)$

$= \underline{76739^{k\text{-in}}}$

$$= \frac{2(21.97\text{ in})(29{,}000)}{76739}\sqrt{(36509.7)(183.6)}$$

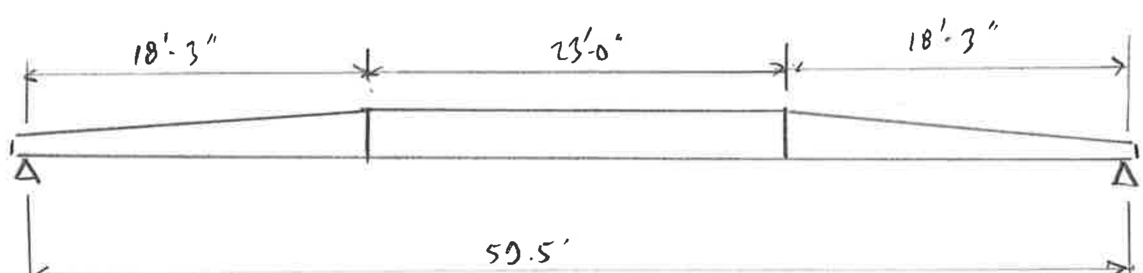
FROM LARSA

$= 42991.5$ in

$= \underline{3582.6'}$

$\phi M_n = \phi M_p = 0.9(7221.6^{k\text{-ft}}) = \underline{\underline{6499^{k\text{-ft}}}}$

MAX MOMENT $\underline{\underline{M_u = 2721.24^{k\text{-ft}}}}$



MOMENT CAPACITY @ END

$M_y = F_y S_x$

$S_x = 522.7\ in^3$ (END) FROM LARSA

$M_y = (50\ ksi)(522.7\ in^3) = 26135\ ^{k\text{-}in}$

$= \underline{\underline{2177.9\ ^{k\text{-}ft}}}$

$Z_x = \left(\frac{A}{2}\right)(a)$

$= \frac{141.42\ in^2}{2}(8.35\ in)$

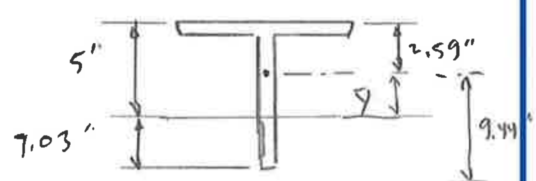
$Z_x = 590.43\ in^3$

$M_p = F_y Z_x = (50\ ksi)(590.43\ in^3)$

$M_p = 29521.425\ ^{k\text{-}in}$

$= \underline{\underline{2460.1\ ^{k\text{-}ft}}}$

$\frac{Z_x}{S_x} = \frac{590.43}{522.7} = 1.13 < 1.5$ ✓



$\bar{y}_1 = \frac{(15.3\ in^2)(9.44") - (0.5")(7.03")\left(\frac{7.03"}{2}\right)}{15.3\ in^2 - (0.5")(7.03")}$

$\bar{y}_1 = 11.207"$

$\bar{y} = (11.207" - 7.03") = 4.177$

$a = 2(4.177") = 8.35"$

$A = 30.6\ in^2 - 14.06"(0.5")$

$A = 23.57\ in^2\ (6) = \underline{141.42\ in^2}$

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OWNER-PROJECT	BY	DATE	PROJECT NO.
CALUMET - BIGGE	[signature]	7/25/14	
FEATURE	CHK'D BY	DATE	
60' JUMP BRIDGE CAPACITY	CMA	7/29/14	SHT 5 OF 6

$$\frac{h}{t_w} = \frac{10'' - 2(0.75'')}{6(0.5'')} = \frac{8.5}{3} = 2.83$$ ACTS AS BEAM $\left(< 3.76\sqrt{E/F_y}\right)$

CONSIDER BEAM TO ACT AS BOX SECTION

$$L_p = \frac{0.13\, r_y E}{M_p}\sqrt{JA}$$ (AISC LRFD)

FROM LARSA

$$= \frac{0.13(22.03)(29{,}000)}{29521.425}\sqrt{(6986.7)(141.42\,in^2)}$$

$L_p = 2796.5$ in

$= 233'$

$L_b < L_p \quad \therefore \quad \phi M_n = \phi M_p$

$\phi M_p = 0.9(2460.1\ k\text{-}ft) = \underline{\underline{2214.1\ k\text{-}ft}}$

FORSGREN Associates Inc.

OWNER-PROJECT	BY	DATE	PROJECT NO.
CALUMET / BIGGE	[signature]	7/25/14	
FEATURE	**CHK'D BY**	**DATE**	
60' JUMP BRIDGE CAPACITY	CMA	7/29/14	SHT 6 OF 6

SHEAR CAPACITY @ END

$$\frac{h}{t_w} < 2.45\sqrt{\frac{E}{F_y}} = 2.45\sqrt{\frac{29000}{50}} = 59$$ (AISC LRFD 3rd)

$V_n = 0.6\, F_y\, A_w$ $\qquad$ $A_w = 6(10'')(0.5'') = 30\ in^2$

$V_n = 0.6(50\ ksi)(30\ in^2) = \underline{\underline{900^k}}$

$\phi V_n = 0.9(900^k) = \underline{\underline{810^k}}$

MAX FACTORED SHEAR = $\underline{\underline{202.5^k}}$ FROM LARSA

DEFLECTION

MAX DEFLECTION (SERVICE) = 2.26" FROM LARSA

RECOMMEND SHIMMING/ELEVATING JUMP BRIDGE

SO THAT 3" CLEAR BETWEEN DECK & JUMP BRIDGE

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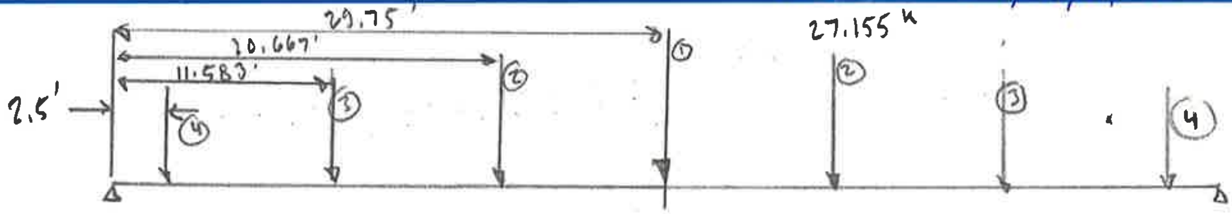
OWNER-PROJECT	BY	DATE	PROJECT NO.
CALUMET / BIGBE	[signature]	7/25/14	
FEATURE	**CHK'D BY**	**DATE**	
GUT CHECK ON Δ, M, V - 60' JUMP BRIDGE	CMA	7/29/14	SHT 1 OF 1



$\Delta_D = \frac{5wl^4}{384EI} = \frac{5(0.629\ k/ft \div 12)(59.5 \times 12)^4}{384(29{,}000)(18463.41)}$

$\Delta_D = 0.33''$

DL = 0.629 k/ft

I @ MIDPOINT : 18463.41 in^4

I @ END = 2613.484

$\Delta_{L_1} = \frac{Pl^3}{48EI} = \frac{27.155(59.5')^3}{48EI} = \underline{0.385''}$

$\Delta_{L_2} = \frac{Pa}{24EI}(3l^2 - 4a^2) = \frac{27.155(20.667')}{24EI}\left(3(59.5)^2 - 4(20.667)^2\right) = \underline{0.673''}$

$\Delta_{L_3} = \frac{27.155(11.583')}{24EI}\left(3(59.5')^2 - 4(11.583')^2\right) = \underline{0.427''}$

$\Delta_{L_4} = \frac{27.155(2.5')}{24EI}\left(3(59.5')^2 - 4(2.5')^2\right) = \underline{0.097''}$

LARSA VALUES IN GREEN

		Calc	LARSA
TOTAL	Δ_L =	1.582''	1.855''
	Δ_D =	0.331	0.403
	COMBINED Δ =	1.913	2.258

$M_D = \frac{(0.629\ k/ft)(59.5')^2}{8} = \underline{278.35\ k\text{-}ft}$

$M_{L_1} = \frac{Pl}{4} = \frac{27.155(59.5')}{4} = \underline{403.93\ k\text{-}ft}$

$M_{L_2} = Pa = 27.155^k(20.667) = \underline{561.20\ k\text{-}ft}$

$M_{L_3} = 27.155(11.583') = \underline{314.54\ k\text{-}ft}$

$M_{L_4} = 27.155^k(2.5') = \underline{67.89\ k\text{-}ft}$

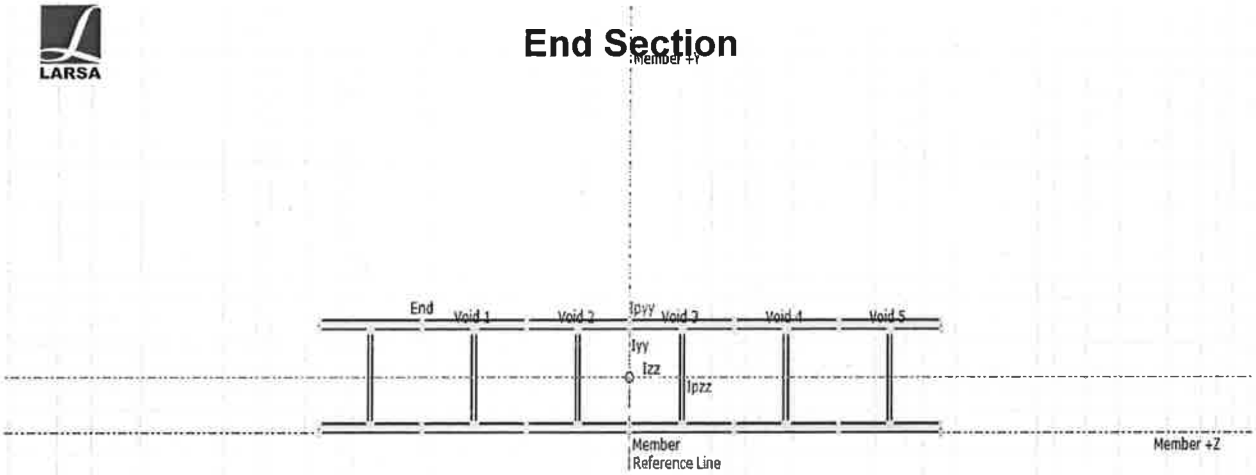
		Calc	LARSA
TOTAL	M_L =	1347.56 k-ft	1347.34
	M_D =	278.35	290.71
	M_T =	1625.91 k-ft	1638.05

$V_D = \frac{wl}{2} = \frac{0.629(59.5')}{2} = \underline{18.71^k}$

$V_L = \frac{7(27.155)}{2} = \underline{95.04^k}$

		Calc	LARSA
TOTAL	V_L =	95.04 k	102.38 k
	V_D =	18.71 k	18.69 k
	V_T =	113.76 k	121.07

End Section



Section Calculations (in)	
Area:	140.25
zc:	0.0000
yc:	5.0000
Izz:	2,613.5
Iyy:	68,053.
Izy:	0.0000
Ipzz:	2,613.5
Ipyy:	68,053.
Ipa:	0.0000
J:	6,986.7
Cw:	N/C
Perimeter:	405.00
Sz:	522.70
Sy:	1,779.2
Rz:	4.3168
Ry:	22.028
Qz:	292.45
Qy:	1,341.1
WeightArea:	140.25
Clz:	38.250
Cty:	5.0000
Shear Area Factor Y:	1.0000
Shear Area Factor Z:	1.0000

Section Shapes (in)	
End	
D:	10.000 to 24.060
tf:	0.7500

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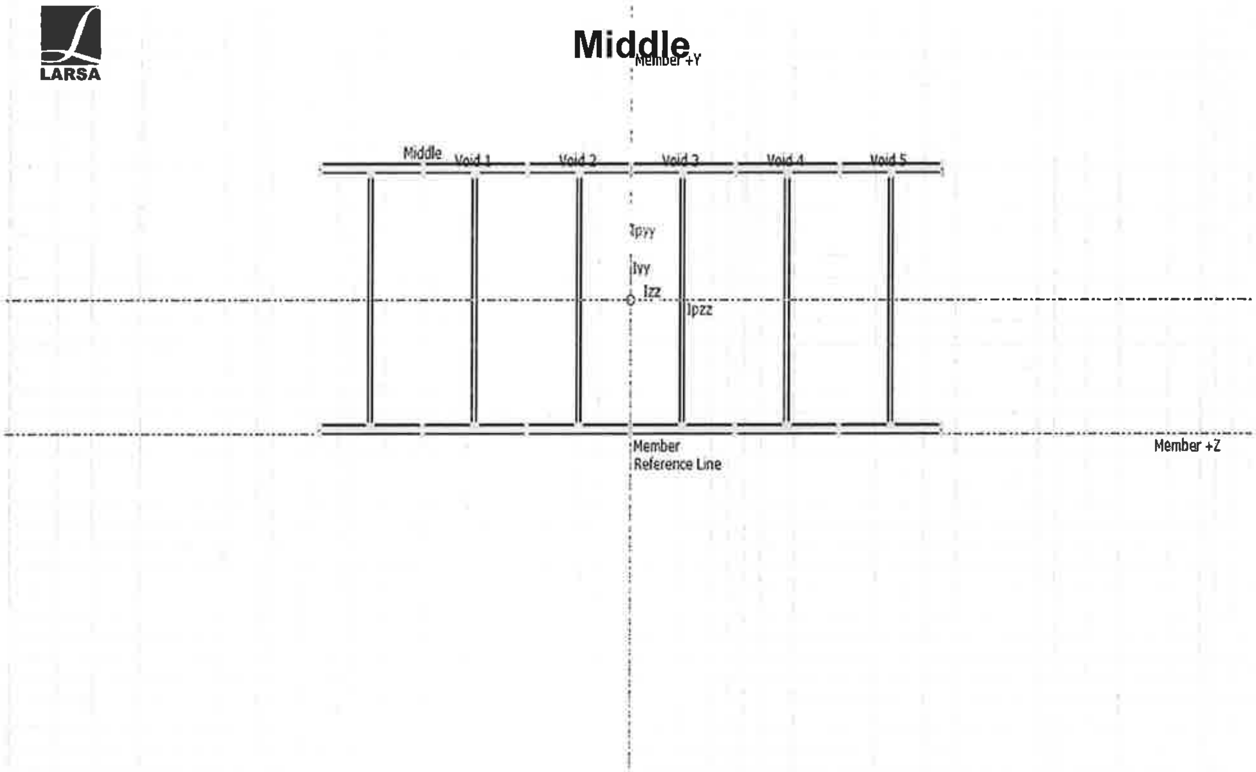
Middle



Section Calculations (in)	
Area:	182.43
zc:	0.0000
yc:	12.030
Izz:	18,463.
Iyy:	88,053.
Izy:	0.0000
Ipzz:	18,463.
Ipyy:	88,053.
Ipa:	0.0000
J:	36,510.
Cw:	N/C
Perimeter:	573.72
Sz:	1,534.8
Sy:	2,302.0
Rz:	10.060
Ry:	21.970
Qz:	859.56
Qy:	1,744.5
WeightArea:	182.43
CIz:	38.250
Cty:	12.030
Shear Area Factor Y:	1.0000
Shear Area Factor Z:	1.0000

Section Shapes (in)	
Middle	
D:	24.060
tf:	0.7500

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