MONOKO, LLC

1037 Peninsula Avenue
Tarpon Springs, FL 34689-2125 (727) 940-3244
E-mail Address: MonokoLLC@aol.com (727) 279-8795 Fax

Submittal No.: 03a: Containment Plan Calculations sealed by VT PE

Date: June 14, 2016

Vermont Department of Transportation
Southeast Regional Construction Office
Attn: Ann Gammell, P.E., Regional Construction Engineer
PO Box 1873; 61 Depot Street
Wilder, VT 05088-1873
(802) 522-5719; (802) 281-5000; (802) 281-5002 fax
Ann.Gammell@Vermont.gov

Description: Proposal/Contract Number: Windsor-Hartford IM BPNT (13)
Letting Date: 10/09/15; Award Date: 11/02/15
Project Description: Bridge Painting of Eleven Bridges
In the Towns of Windsor & Hartford, Windsor County, VT
Contract Amount: $8,671,323.00; Completion Date: 10/12/18

Contractor: MONOKO, LLC

Reviewed & Approved By: *Keri Monokandilos*
Keri Monokandilos, Manager

Date: **06/14/2016**

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BY: Mark Sargent DATE: 07/01/2016

Engineer: Paul Perry IV, Resident Engineer
PO Box 1873; 61 Depot Street
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Revision:

SUBMITTAL REVIEW

Review is only for general conformity to the contract drawings and specifications and shall not relieve the contractor of his entire responsibility under the contract, including among other things, dimensions to be confirmed and correlated at the job site, and information that pertains to the fabrication processes or to techniques of construction.

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- [ ] MAKE CORRECTIONS NOTED RESUBMITTAL NOT REQUIRED
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PB AMERICAS, INC.
BY: [signature]
DATE: 6/27/16

ABRASIVE BLASTING CONTAINMENT PLANS
ELEVEN BRIDGES ON I-91
BRIDGE NOS. 34N, 34S, 41N, 41S, 41C, 42N, 42S, 44N, 44S, 45N & 45S

Windsor-Hartford

County of Windsor, Vermont

Table of Contents

Prepared for:

Monoko, LLC
037 Peninsula Avenue
Tarpon Springs, FL 34689
(727) 940 - 3244

June, 2016

SUBMITTAL REVIEW

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BY: [signature]

DATE: 6/27/16

STATE OF VERMONT ★ PAUL R. STEIJLEN ★ NO. 107795 ★ CIVIL ★ LICENSED PROFESSIONAL ENGINEER — 6-13-16

A2B Engineering, LLC

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Paul R. Steijlen, P.E.
VT License No. 107795

Appendix A
Structural Impact

SUBMITTAL REVIEW

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A2B ENGINEERING, LLC
CONSULTING ENGINEERS

A2B ENGINEERING, LLC CONSULTING ENGINEERS	Subject: Abrasive Blasting Containment Plans Eleven Bridges on I-91, County of Windsor, Vermont		
	Comp by: MAT Check by: PRS	Date: 02/08/16 Job No: 187-18-1	Sheet Number:

Structural Impact:

The platform containment structure has been analyzed for a live load of 16 psf (Approximately 0.5 in. average depth of steel shot, 1.5" mineral slag abrasive or 1.5" sand abrasive plus uniform worker loading). When the depth of the spent abrasives nears the depths specified, the contractor will cease abrasive blasting operations and vacuum the spent abrasives.

The scaffold structure has been analyzed for approximately 1/4" average depth of steel shot. The configuration of the scaffold was taken to be 32 feet by 28 inches (max) with a 2 person, 500 lb rated scaffold.

Design Loads:

Platform Design Criteria:

Dead Load =	3	psf	(Platform)
Live Load (Uniform) =	12	psf	(0.5 in. steel shot)
Live Load (Uniform) =	4	psf	(2 workers)

Scaffold Design Criteria:

Length =	32	ft	(max per scaffold)
Width =	28	in	(max per scaffold)
Dead Load =	220	lb	(scaffold)
Weight of steel shot =	6	psf	(0.25 in. steel shot)
Live Load (Concentrated) =	250	lb	(per worker)

No more than 2 workers shall be allowed per platform cable or scaffold cable. Limit 500 lb. total weight of workers and abrasive blasting on 500 lb. rated scaffold

Wind Loads:

The containment structure has been analyzed for a maximum wind velocity of 40 mph. If winds nearing or exceeding 40 mph (or a lesser wind is specified in the contract specifications) are predicted, blasting and painting operations shall cease, and the paint containment tarpaulins shall be rolled and secured in place.

Design Variables:

Height to C.G. of Cont. Area = 20 ft

Height and Exposure Factor Kz = 1.0
(ASCE 7-10 Table 17.3-1, z = 50 ft, Exposure C)

Topographic Factor Kzt = 1.0
(ASCE 7-10 Figure 26.8-1)

Wind Directionality Kd = 0.85
(ASCE 7-10 Table 26.6-1, Building C & C)

Wind Velocity V = 40 mph

Wind Pressure $P_z = 0.00256 \cdot K_z \cdot K_{zt} \cdot K_d \cdot V^2$ (psf)

Wind Pressure Pz = 3.48 psf

Design Pressure:

Height of Cont. Area = 50 ft (Conservative)

Wind Pressure = Height*Pz = 175.0 plf

NOTE:

Based on the maximum wind velocity of 40 mph (8 psf wind load per AASHTO), the resulting load transferred to a bridge structure is 175 plf, based on a containment height of 50 ft. from the top of the bridge parapets to grade. Since AASHTO 3.15.1.1.2 specifies a lateral loading of 300 plf minimum, for design of girder bridges and 450 plf for truss bridges, the maximum anticipated load of 175 plf is acceptable. Therefore, wind loading on girder bridges does not govern.

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Appendix B
Platform Design

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PB AMERICAS, INC.

BY: G. Boyington

DATE: 6/27/16

A2B ENGINEERING, LLC
CONSULTING ENGINEERS

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Platform Cable Design Summary (Metal Decking):

Option #	Platform Cable Size (in.)	Platform Support Hanger (in.)	Max. Platform Support Hanger Spacing	Max. Platform Cable Spacing	Platform Cable Load Ratio	Platform Support Hanger Load Ratio	Chain Hanger Load Ratio	Maximum Shackle Load Ratio	Overall Design Check
2	9/16	3/8	25.00	5.25	1.01	1.00	1.89	1.21	OK

Option # 1

Platform Cable Size =	9/16	in.
Minimum Support Hanger Size =	3/8	in.
Maximum Support Hanger Spacing =	25	ft.
Maximum Cable Spacing =	5.25	ft.
Minimum Shackle Size =	1/2	in. (for Platform Support Hangers)
Minimum Shackle Size =	5/8	in. (for Platform Cables)
Design Cable Sag =	18	in.

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Suspended Platform System Design (Metal Decking with 0.5625 in. dia. Platform Cable @ 5.25 ft. spacing):

1 Bridge Structure:	Max. Hanger Spacing	25.00	ft.
2 Worker Loading:	Tributary cable width	5.25	ft. maximum (Conservative)
	No. workers / platform cable	2	(250 lb. ea. OSHA)
	Equiv. worker loading	3.81	psf
3 D+L Loading:	Metal Decking	3.00	psf
	18-oz floor tarpaulins	0.13	psf
	Dead Load =	3.13	psf
	Dead Load (min) =	3.00	psf
	Dead Load =	3.13	psf
	Assume depth of grit =	1/2	in
	Uniform grit loading	12.00	psf 1/2 in. layer
	Equiv. worker loading	4.00	psf 2 workers
	Live Load =	16.00	psf (Grit + Worker Loading)
	Total Design Loading (Service)	19.13	psf
	Total Design Loading (Ultimate)	114.75	psf (Using FS = 6)
4 Platform Cable Analysis: (Longitudinals)	Platform Cable Size	9/16	in. dia.6x19 IWRC, EIP
	Platform Cable Weight	0.59	plf
	Platform Cable strength.	16.80	tons
	Platform Cable strength.	16.30	tons (pre-tensioned with 1000 lbf)

Max. tension at center of cable span, $H = w L^2 / 8 d$

Uniform cable load,	w =	603.0	plf
Max. cable span,	L =	25.00	ft.
Min. req'd deflect,	d =	15.0	in (5% of length and 12 inch min.)
Use =	d =	18.0	in
Tension (center)	H =	15.70	tons

Max. tension at end supports, $T = [H^2 + (w L / 2)^2]^{0.5}$

Design Cable Tension =	16.15	tons
Cable Stress Ratio	1.01	>= 1.0 OK
Use Shackle Size =	5/8	in
Working Load limit =	3.25	tons
Factor of Safety =	6	
Shackle Strength =	19.5	tons
Design Load at supports =	16.15	tons
Shackle Load Ratio =	1.21	
Shackle Check =	Ok	

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5 **Platform Support Hangers Analysis:**

Max. tributary hanger area.	131.3	sq.ft.
Max. hanger load,	15061	lbf
Max. hanger load,	7.53	tons
Platform Support Hangers	3/8	in. dia. 6x19 IWRC, EIP (min)
Platform Support Hangers Weight	0.26	plf
Platform Support Hangers Strength	7.55	tons
Hanger Stress Ratio	1.00	>= 1.0 OK
Min. Chain Working Load	7100	lb (min)
Factor of Safety	4	
Chain Strength	14.2	tons
Design Load at supports =	7.53	tons
Chain Hanger Stress Ratio =	1.89	>= 1.0 OK
Use Shackle Size =	1/2	in
Working Load limit =	2.00	tons
Factor of Safety =	6	
Shackle Strength =	12	tons
Design Load at supports =	7.53	tons
Shackle Load Ratio =	1.59	
Shackle Check =	Ok	

6 **Outrigger Loads:**

Tension (center) =	15.70	tons (Includes F.S. of 6)
Horiz. Distance to 1st Outrigger =	25	ft.
Vertical Distance =	1.79	ft.
Horizontal Distance =	6	ft.
Vertical Angle =	4.10	deg
Horizontal Angle =	13.50	deg
Vertical Force at 1st Outrigger =	0.37	kips (Service Load)
Horizontal Force at 1st Outrigger =	1.22	kips (Service Load)
Tension (center) =	15.70	tons (Includes F.S. of 6)
Horiz. Distance to 2nd Outrigger =	25	ft.
Vertical Distance =	1.79	ft.
Horizontal Distance =	9	ft.
Vertical Angle =	4.10	deg
Horizontal Angle =	19.80	deg
Vertical Force at 2nd Outrigger =	0.87	kips (Service Load)
Horizontal Force at 2nd Outrigger =	1.77	kips (Service Load)

Note: See RAM Elements Analysis for Outrigger Design

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Alternate Support Hanger Analysis:

1. Bridge Configuration:

a. Flange Plate Width, w =	12.00	in.	(Conservative)
b. Flange Plate Thickness, t =	13/16	in.	(Conservative)
c. Fy (A36) =	36	ksi	

2. D+L Loading:

e. Dead Load =	3.13	psf	(min. platform loading)
f. Live Load =	16.00	psf	(Grit + Workers)
g. Total Design Loading =	19.13	psf	(e + f)

3. Hanger Loads:

h. Max Girder Spacing =	7.50	ft	
i. Max Diaphragm Spacing =	25.00	ft	(Conservative)
j. Max. Tributary Hanger Area =	187.50	ft^2	(h * i)
k. (1) Additional Worker at ea. Hanger =	250.00	lb	(conservative)
l. Maximum Hanger Load, P =	3.84	kips	(g * j) + k

4. Analysis:

m. Eccentricity, v =	6.0	in.	
n. Moment, Mmax =	11.51	k-in	(l / 2 * m)
o. Section Modulus, S =	1.32	in^3	(1/6 * 2 * m * b^2)
p. fb = (Mmax) / Sx	8.72	ksi	
q. Fb = 0.66 * Fy =	23.76	ksi	
r. Capacity/Demand Ratio =	2.73		
Check:	Ok		

NOTE:

M = (l / 2 * k)

S = (1/6 * 2 * k * b^2)

M/S = 1.5 * l / b^2 <= 0.66 * Fy

b >= SQRT(1.5 * l / (0.66 * Fy))

r. Flange Plate Thickness =	13/16	in.	(b)
s. Min. Flange Plate Thickness =	0.49	in.	
Check:	Ok		

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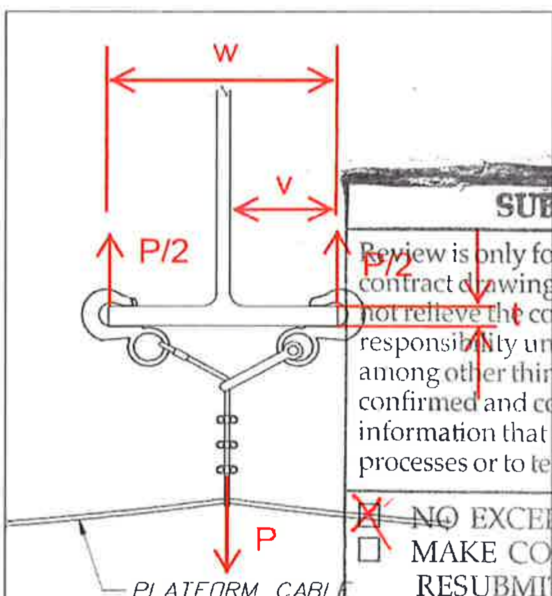

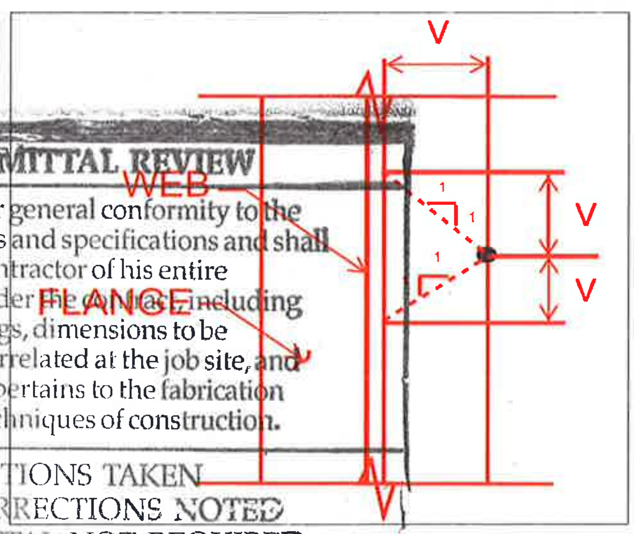

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PB AMERICAS, INC.

BY: SJ Boyington

DATE: 6/27/16

Appendix C
Scaffold Design

SUBMITTAL REVIEW

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A2B ENGINEERING, LLC
CONSULTING ENGINEERS

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1. Scaffold Configuration:

Length =	32	ft.
Width =	28	in.
Weight =	213	lb
Assume Weight =	220	lb

2. Abrasive Cleaning Material:

Assume 0 inch of steel shot will cover the scaffold

Depth =	0	in.
Density of the shot =	280	pcf
Weight of the shot =	0.00	psf

3. Total Loads:

With full workers and no shot

Dead Load =	220.00	lb (see note below)
Live Load ** =	800	lb (see note below)

NOTE: The scaffold cable carries the load from two scaffolds where the length of scaffold exceeds 32 ft.
** Assuming four 200 lb workers (average weight) all at one cable at adjoining ends of the scaffold.

Use 1/2 " dia. 6x19 IWRC, EIP, or better

NOTE: The cable carries the DL from 2 scaffolds + 10% for overlap

Cable diameter =	1/2	in
Cable weight =	0.46	plf
Cable strength =	13.3	tons
Spacing =	25	ft
PickupSpacing =	25	ft
d = 5% of PickupSpacing =	15	in.
d =	15	in.
Use d =	18	in.
Tension at the center =	4.34	kips
Tension at the support =	4.37	kips

FS of the cable = 6.08 >= 6.0 OK

Use Shackle Size =	5/8	in
Working Load limit =	3.25	tons
Working Load at supports	2.19	tons
Shackle Load Ratio =	1.49	

Shackle Check = Ok

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C2

4. Scaffold Support Hanger:

Hanger support load = 1020 lb
Use = 1100 lb

Use 3/8 " dia. 6x19 IWRC, EIP cables

Hanger diameter = 3/8 in
Hanger weight = 0.26 plf
Hanger strength = 7.55 tons

FS of the hanger = 13.73 >= 6.0 OK

Min. Chain working load = 7100 lb (min)
Chain Design Load = 1020 lb
Use = 1100 lb

Chain Hanger Stress Ratio = 6.45 >=1.0 OK

Use Shackle Size = 1/2 in
Working Load limit = 2.00 tons
Working Load at supports = 0.55 tons
Shackle Load Ratio = 3.64

Shackle Check = Ok

5. Optional Suspended Scaffold:

Hanger support load = 910 lb per two rods
Misc. rod loads = 100 lb
3/4" diameter metal rod, Fy = 36 ksi
Total weight on one rod = 505 lb
Area 3/4" Rod = 0.44 in^2
fa = P/A = 1.14 ksi

Metal Rod Check = Ok

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1. Scaffold Configuration:

Length =	32	ft.
Width =	28	in.
Weight =	213	lb
Assume Weight =	220	lb

2. Abrasive Cleaning Material:

Assume 1/4 inch of steel shot will cover the scaffold

Depth =	1/4	in.
Density of the shot =	280	pcf
Weight of the shot =	5.83	psf

3. Total Loads:

With full shot and no workers

Dead Load =	655.56	lb (see note below)
Live Load =	0	lb (see note below)

NOTE: The scaffold cable carries the load from two scaffolds where the length of scaffold exceeds 32 ft.

Use 1/2 " dia. 6x19 IWRC, EIP, or better

Cable diameter =	1/2	in
Cable weight =	0.46	plf
Cable strength =	13.3	tons

NOTE: The cable carries the DL from 2 scaffolds + 10% for overlap

Spacing =	25	ft
PickupSpacing =	20	ft
d = 5% of PickupSpacing =	12	in.
d =	12	in.
Use d =	18	in.
Tension at the center =	2.40	kips
Tension at the support =	2.43	kips

FS of the cable = 10.96 >= 6.0 OK

Use Shackle Size =	5/8	in
Working Load limit =	3.25	tons
Working Load at supports =	1.21	tons
Shackle Load Ratio =	2.68	

Shackle Check = Ok

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4. Scaffold Support Hanger:

Hanger support load = 656 lb

Use = 700 lb

Use 3/8 " dia. 6x19 IWRC, EIP cables

Hanger diameter = 3/8 in

Hanger weight = 0.26 plf

Hanger strength = 7.55 tons

FS of the hanger = 21.57 >= 6.0 OK

Min. Chain working load = 7100 lb (min)

Chain Design Load = 656 lb

Use = 700 lb

Chain Hanger Stress Ratio = 10.14 >=1.0 OK

Use Shackle Size = 1/2 in

Working Load limit = 2.00 tons

Working Load at supports = 0.35 tons

Shackle Load Ratio = 5.71

Shackle Check = Ok

5. Optional Suspended Scaffold:

Hanger support load = 328 lb per two rods

Misc. rod loads = 100 lb

3/4" diameter metal rod, Fy = 36 ksi

Total weight on one rod = 214 lb

Area 3/4" Rod = 0.44 in^2

fa = P/A = 0.48 ksi

Metal Rod Check = Ok

SUBMITTAL REVIEW

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Appendix D
Miscellaneous Hardware

SUBMITTAL REVIEW

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A2B ENGINEERING, LLC
CONSULTING ENGINEERS

A2B ENGINEERING, LLC CONSULTING ENGINEERS	Subject: Abrasive Blasting Containment Plans Eleven Bridges on I-91, County of Windsor, Vermont		
	Comp by: MAT Check by: PRS	Date: 02/08/16 Job No: 187-18-1	Sheet Number:

Cable Anchorage Plate Connection:

Design the cable anchor plate attachment. The cable needs only sufficient tension to reduce the sag and support the cable. The connection must be designed to resist the allowable working load of the cable with a factor of safety of 4 per OSHA.

The members used to construct the paint containment platform will be checked for compliance with OSHA requirements for scaffolding - 29 CFR, Part 1910 Standard Number 1910.28:

1910.28(a)(4): Scaffolds and their components shall be capable of supporting without failure at least four times the maximum intended load.

1910.28.(a)(22): Wire or fiber rope used for scaffold suspension shall be capable of supporting at least six times the intended load.

1. Material Properties:

Nom. Strength of 0.625 " diam. 6 x 19 EIP IWRC cable = 20.6 tons

$RopeWeight_{cable}$ = 0.72 plf

Allowable Strength of cable, $T_{cable.allow}$ = 6.87 kips

Chain link platform analysis, the cable load at the support is (Service Loads):

$P_{anchor.plate.design} = DL + LL_u$ = 19.00 psf

$Weight_{anchor.plate}$ = 100.47 plf

$T_{support.anchor.plate}$ = 5.38 kips

The allowable load in the cable exceeds the service load at the anchor plate. Therefore, use the allowable load in the cable to design the anchor plate.

Structural Steel (A36 steel): F_{y_A36} = 36 ksi

F_{u_A36} = 58 ksi

Weld Metal (E70XX electrodes) F_{u_weld} = 70 ksi

E = 29000 ksi

d = 18 in Lspan = 25 ft

2. Check the anchorage capacity:

3/4" diam. Anchor with a 6 5/8" embedment, $F_{t.u}$ = 10980 lbf

Allowable Tension for a 6 5/8" embedment, $F_{t.allow}$ = 2.75 kips

Number of anchors required for pure tension = 2.50 (Use 4 anchors)

Ult. shear value for a 3/4" diam. Anchor $F_{v.u}$ = 20320 lbf

Allow. Shear (3/4" diam., 6 5/8" embedment) $F_{v.allow}$ = 5.08 kips

No. Anchors required for pure shear = 1.85

From the chain link platform analysis, the longitudinal pickup point spacing is:

Sag = atan [d / (0.5 * Longspan)] 6.84 degrees

Anchor plate connection can accommodate 4 anchors. From the analysis, a minimum of 4 wedge anchors are required. Since the cable angle from the pier cap anchorage to the anchor plate may vary, check the deck anchorage for 0, 5, 10, 15 and 20 degrees.

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No. of anchors assumed:	No. Anchors =	4
For the cable at a 0 degree angle:	Ø =	0 degrees
$f_{t.cable} = T_{cable.allow}(\sin Ø)$	$f_{t.cable}$ =	0 kips
$f_{v.cable} = T_{cable.allow}(\cos Ø)$	$f_{v.cable}$ =	6.87 kips
Combined Stress Ratio	Dem./Capacity CSR =	0.34 < 1.0 OK

No. of anchors assumed:	No. Anchors =	4
For the cable at a 5 degree angle:	Ø =	5 degrees
$f_{t.cable} = T_{cable.allow}(\sin Ø)$	$f_{t.cable}$ =	0.60 kips
$f_{v.cable} = T_{cable.allow}(\cos Ø)$	$f_{v.cable}$ =	6.84 kips
Combined Stress Ratio	Dem./Capacity CSR =	0.39 < 1.0 OK

No. of anchors assumed:	No. Anchors =	4
For the cable at a 10 degree angle:	Ø =	10 degrees
$f_{t.cable} = T_{cable.allow}(\sin Ø)$	$f_{t.cable}$ =	1.19 kips
$f_{v.cable} = T_{cable.allow}(\cos Ø)$	$f_{v.cable}$ =	6.76 kips
Combined Stress Ratio	Dem./Capacity CSR =	0.44 < 1.0 OK

No. of anchors assumed:	No. Anchors =	4
For the cable at a 15 degree angle:	Ø =	15 degrees
$f_{t.cable} = T_{cable.allow}(\sin Ø)$	$f_{t.cable}$ =	1.78 kips
$f_{v.cable} = T_{cable.allow}(\cos Ø)$	$f_{v.cable}$ =	6.63 kips
Combined Stress Ratio	Dem./Capacity CSR =	0.49 < 1.0 OK

No. of anchors assumed:	No. Anchors =	4
For the cable at a 20 degree angle:	Ø =	20 degrees
$f_{t.cable} = T_{cable.allow}(\sin Ø)$	$f_{t.cable}$ =	2.35 kips
$f_{v.cable} = T_{cable.allow}(\cos Ø)$	$f_{v.cable}$ =	6.45 kips
Combined Stress Ratio	Dem./Capacity CSR =	0.53 < 1.0 OK

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3. Weld Design:

Design for a tension load: $T_{design} = T_{cable}$, T_{design} = 41.2 kips

For a 3/4" x 5" x 5" plate, min. weld or strength, t_{weld} = 0.20 in.

Minimum weld size = 3.14 in.

Minimum weld size is 2/16"

Per AASHTO Standard Spacifications, Section 10.23.2.2, the minimum size weld for a 1" plate is 5/16" (0.3857 in.), therefore, specify the minimum weld size.

4. Determine the Minimum Connection Plate Size:

The bearing width of a 0.75 " shackle, b = 0.88 in.

Limit the allowable shear stress through the connection plate to bearing stress in pins to ASCE Manual of Steel Construction, ASD, 9th Ed., Part 5, Section D3:

$F_p = 0.45 * F_{u\_A36}$ 26.1 ksi

The 1 1/4" diam. Hole is at 1 7/8" from the edge, therefore, the minimum edge dist. Is:

$d_{edge.min}$ = 1.25 in.

Shear thru plate, $f_{y.plate}$ = 6.24 ksi

Limit the allowable bearing through the connection plate to bearing stress in pins to ASCE Manual of Steel Construction, ASD 9th Ed. Part 5, Section J8:

$F_p = 0.90 * F_{u\_A36}$ = 52.2 ksi

Required Plate Thickness: th_{plate} = 0.15 in.

Specify a 3/4" plate

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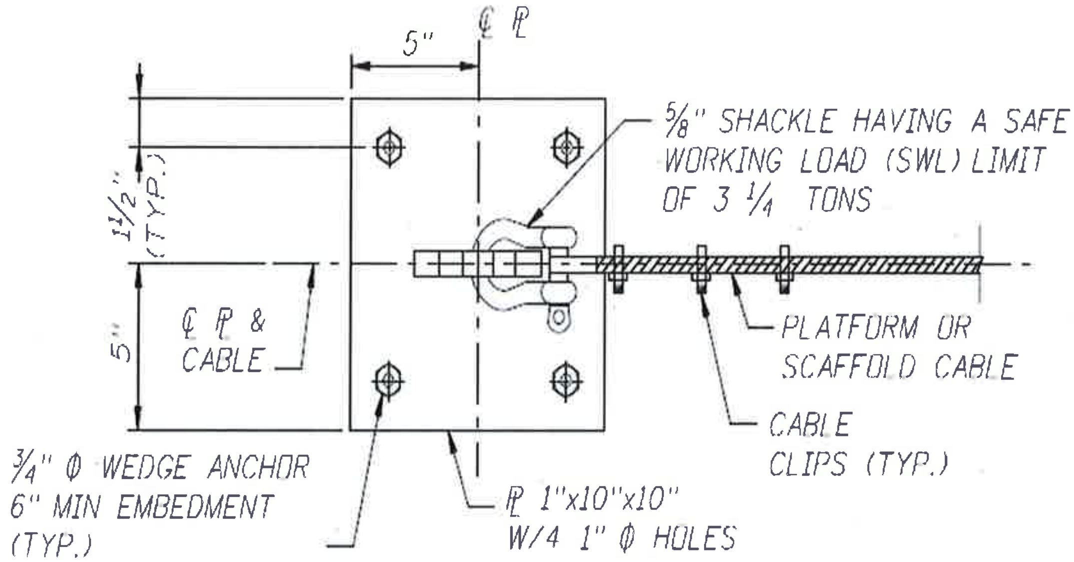

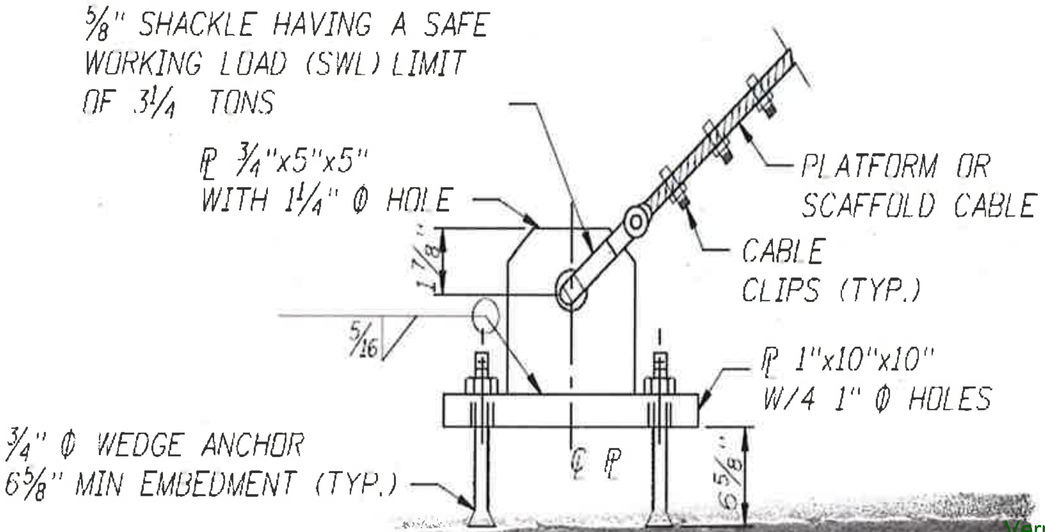

OPTIONAL ANCHOR PLATE ATTACHMENT

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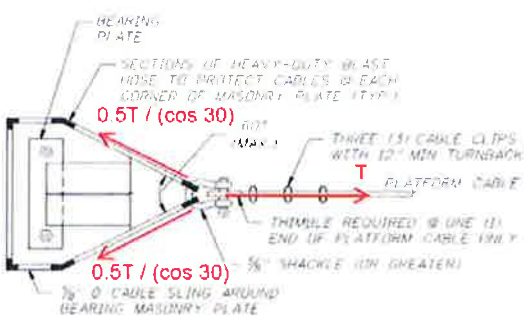
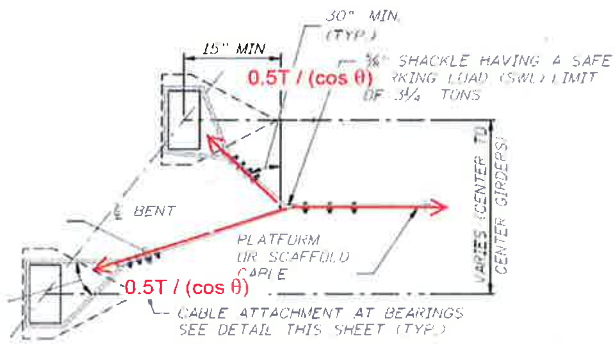
	Comp by: MAT Check by: PRS	Date: 02/08/16 Job No: 187-18-1	Sheet Number:

The following calculations are based on a worst-case-scenario, where 5/8" cables are tensioned.

Cable Attachment at Bearings:



Mid Bay Cable Attachments:



Max. Tension on 5/8" Platform Cable, T =	20.6	tons
0.5 T / (cos (max. angle/2)) = T		
Angle =	30.0	deg
Specify a Maximum Angle of =	**30.0**	**deg**

Max. Tension on 5/8" Platform Cable, T =	20.6	tons
T / cos(angle) = 2T (2 cables)		
Angle =	30.0	deg
Specify a Maximum Angle of =	**30.0**	**deg**

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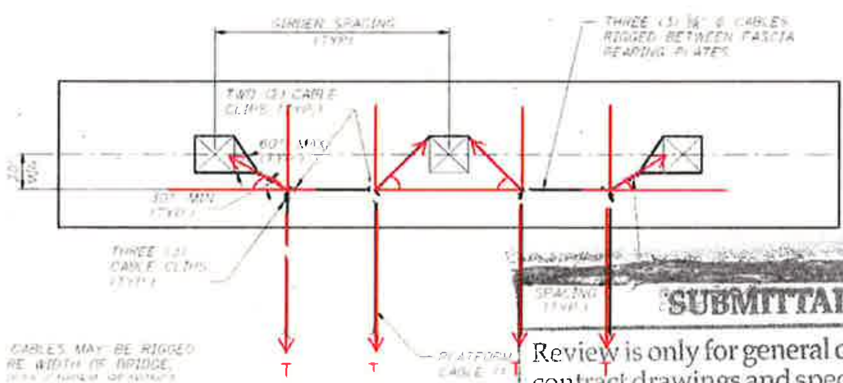
Transverse Cable Attachment:



Max. Tension on 5/8" Platform Cable, T =	20.6	tons
T / cos(angle) = 3T (3 cables)		
Angle =	19.5	deg
Specify a Maximum Angle of =	**30.0**	**deg**

Max. Tension on 5/8" Platform Cable, T =	20.6	tons
T / cos(angle) = 2T (2 cables)		
Angle =	30.0	deg
Specify a Maximum Angle of =	**30.0**	**deg**

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PB AMERICAS, INC.

BY: G. Bayington

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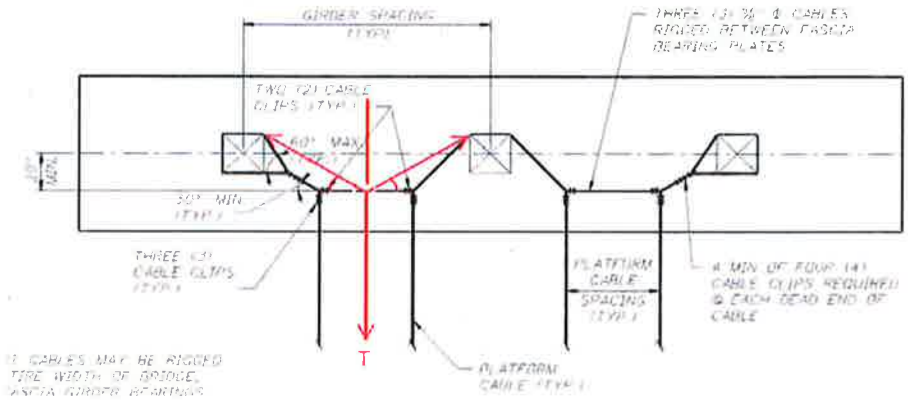
	Comp by: MAT	Date: 02/08/16	Sheet Number:
	Check by: PRS	Job No: 187-18-1	

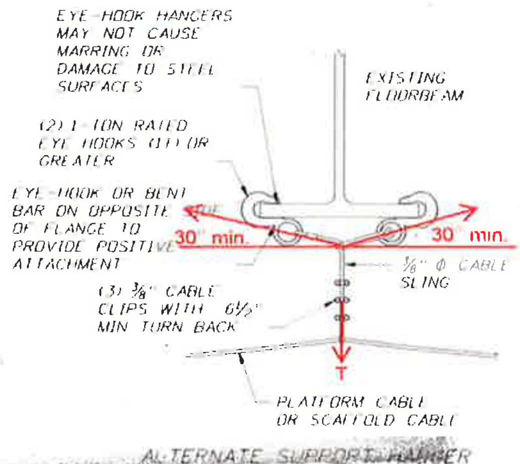
Alternate Transverse Cable Attachment:



Max. Tension on 5/8" Platform Cable, T =	20.6	tons
0.5T / cos(angle) = 3T		
Angle =	9.6	deg
Specify a Maximum Angle of =	**30.0**	**deg**

Alternate Support Hanger:

1/2" Platform Support Cable:		
Max. Tension, T =	13.3	tons
0.5T /sin(angle) = T		
Angle =	30.0	deg
Specify a Minimum Angle of =	**30.0**	**deg**
(2) 1-Ton Rated Eye Hooks =	2	tons
Max. Hanger Load (Ult.) =	7.48	tons
Factor of Safety =	6	
Max. Hanger Load (Service) =	1.25	tons
Eye Hook Check:	**Ok**	



ALTERNATE SUPPORT HANGER

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	Comp by:	MAT	Date:	02/08/16	Sheet Number:
	Check by:	PRS	Job No:	187-18-1	

Intermediate Containment Support Analysis:

Use a TS 4x4x1/4 supported on the bridge beams bottom flanges for the intermediate pickup point supports.

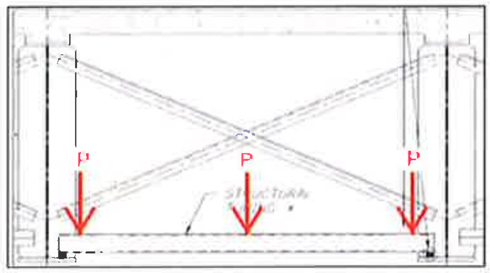
TS 4 x 4 x 1/4:

DL_{TS} =	12.21	plf	I_{TS} =	7.8	in^4
A_{TS} =	3.37	in^2	T_{ts} =	0.233	in
B_{ts} =	4	in	b_Tts =	14.2	-
S_{TS} =	3.9	in^3	h_T_{ts} =	14.2	-
h_{TS} =	4	in	F_{yHSS} =	46	KSI

(ASTM A-500, Grade B)

Check Shear:

Tributary Cable Width =	5.25	ft
Max. Hanger Spacing =	25	ft
Dead Load =	3.00	psf
Live Load =	16.00	psf
Support Load on the TS 4 x 4 x 1/4 =	2493.75	lbf
fv =	3.01	ksi
$0.33*F_{yHSS}$ =	15.18	ksi
Capacity/Demand Ratio =	5.04	



Conservative to use 3 loads P on tubing

TS Check for Shear: Ok

Bending Analysis:

Check the max. bending moment in the TS with the cable load centered between two girders.

Reference AISC Beam Equation 7

Max. Girder Spacing =	9.5	ft
M_{max} =	5.92	kip-ft (M = PL/4)
$fy = M_{max}/S_{TS}$ =	18.22	ksi
$0.6*F_{yHSS}$ =	27.60	ksi
Capacity/Demand Ratio =	1.51	

TS Check for Bending: Ok

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Check the max. bending moment in the TS with two cable loads centered between two girders.

Reference AISC 9th edition Beam Equation 41

Mmax =	6.20	kip-ft
fy = Mmax/STS =	19.09	ksi
$0.6*F_{yHSS}$ =	27.60	ksi
Capacity/Demand Ratio =	1.45	

TS Check for Bending: Ok

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PB AMERICAS, INC.

BY: S. Boyington

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	Comp by: MAT Check by: PRS	Date: 02/08/16 Job No: 187-18-1	Sheet Number:	

Intermediate Containment Support Analysis:

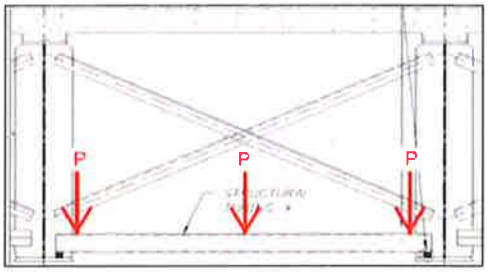
Use a TS 4x4x3/8 supported on the bridge beams bottom flanges for the intermediate pickup point supports.

TS 4 x 4 x 3/8:

DL_{TS} =	17.2	plf	I_{TS} =	10.3	in^4	
A_{TS} =	4.78	in^2	T_{ts} =	0.349	in	
B_{ts} =	4	in	b_Tts =	8.46	-	
S_{TS} =	5.13	in^3	h_T_{ts} =	8.46	-	
h_{TS} =	4	in	F_{yHSS} =	46	KSI	(ASTM A-500, Grade B)

Check Shear:

Tributary Cable Width =	5.25	ft
Max. Hanger Spacing =	25	ft
Dead Load =	3.00	psf
Live Load =	16.00	psf
Support Load on the TS 4 x 4 x 3/8=	2493.75	lbf
fv =	2.01	ksi
$0.33*F_{yHSS}$ =	15.18	ksi
Capacity/Demand Ratio =	7.55	



Conservative to use 3 loads P on tubing

TS Check for Shear: Ok

Bending Analysis:

Check the max. bending moment in the TS with the cable load centered between two girders.

Reference AISC Beam Equation 7

Max. Girder Spacing =	11	ft
M_{max} =	6.86	kip-ft (M = PL/4)
$fy = M_{max}/S_{TS}$ =	16.04	ksi
$0.6*F_{yHSS}$ =	27.60	ksi
Capacity/Demand Ratio =	1.72	

TS Check for Bending: Ok

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Check the max. bending moment in the TS with two cable loads centered between two girders.

Reference AISC 9th edition Beam Equation 41

Mmax =	7.95	kip-ft
fy = Mmax/STS =	18.60	ksi
$0.6*F_{yHSS}$ =	27.60	ksi
Capacity/Demand Ratio =	1.48	

TS Check for Bending: Ok

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PB AMERICAS, INC.

BY: S. Boyington D8

DATE: 6/27/16

A2B ENGINEERING, LLC CONSULTING ENGINEERS	Subject: Abrasive Blasting Containment Plans Eleven Bridges on I-91, County of Windsor, Vermont		
	Comp by: MAT Check by: PRS	Date: 02/08/16 Job No: 187-18-1	Sheet Number:

Support Hanger Analysis: (Type 1)

A. Design Loads:

Girder Spacing =	7.50	ft.	(Conservative)
Width of Platform =	6.00	ft.	
Number of Hangers =	2		(per Girder)
Tributary Area =	22.50	$ft.^2$	(per Hanger)
No. Workers per Platform =	2		
Weight of 1 Worker =	250	lb	
Assume Depth of Grit =	1/2	in	
Density of Steel Grit =	280	pcf	
Self Weight 4x2x1/8 Tubing =	4.75	plf	
Tributary Length of Tubing =	7.50	ft.	
Tarpaulin Weight =	0.13	psf	
Metal Decking Weight =	3.00	psf	(Conservative)
Tubing Load =	35.6	lb.	
18-oz Tarpaulin Load =	2.8	lb.	
Steel Grit Load =	262.5	lb.	
Metal Deck Load =	67.5	lb.	
Worker Load =	500.0	lb.	
Total Load per Hanger =	868.4	lb.	
Load per Hanger Hook =	434.2	lb.	

* Conservatively, use Load per Hanger Hook = 1000 lb. (2000 lb. Total)
* See RAM Element Analysis (bracket is designed for 1000 lb per hanger hook).

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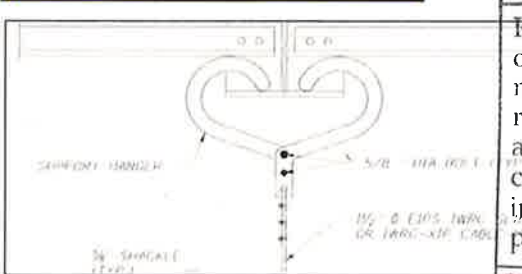
B. Bolt Analysis

Bolt Size =	5/8	in.	
Vertical Reaction =	0.50	kips/bolt	(RAM Elements Output)
Horizontal Reaction =	2.80	kips/bolt	(RAM Elements Output)
Ultimate Shear, Ru =	2.84	kips/bolt	
Two (2) Hooks =	5.69	kips/bolt	
Shear Capacity, ΦRn =	6.23	kips/bolt	(AISC 14th Ed. Table 7-1)
Capacity/Demand Ratio =	1.10		

Bolt Shear Check: OK



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BY: S.H. Boyington
DATE: 6/27/16

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A2B ENGINEERING, LLC CONSULTING ENGINEERS	Subject: Abrasive Blasting Containment Plans Eleven Bridges on I-91, County of Windsor, Vermont		
	Comp by: MAT Check by: PRS	Date: 02/08/16 Job No: 187-18-1	Sheet Number:

Total Reaction =	5.69	kips
Slip Critical Shear Strength, ΦRn =	6.44	kips/bolt (AISC 14th Ed. Table 7-3)
Capacity/Demand Ratio =	1.13	

Bolt Slip-Critical Check: OK

Available Bearing Strength at Bolt Holes =	51.10	kips/in (AISC 14th Ed. Table 7-4)
Plate Thickness =	0.500	in.
Total Reaction =	5.69	kips
Bearing Strength =	25.55	kips/bolt
Capacity/Demand Ratio =	4.49	

Bolt Bearing Strength Check: OK

Structural Tubing Analysis:

Tributary Length of Tubing =	7.50	ft.
Tubing Load =	35.6	lb.
18-oz Tarpaulin Load =	2.8	lb.
Steel Grit Load =	262.5	lb.
Metal Deck Load =	67.5	lb.
Worker Load =	500.0	lb.
Load on Tubing, P =	868.4	lb.
Max. Moment on Tubing, Mmax =	19.54	kip-in (Conservative to use PL/4)
HSS 4x2x1/8, Sx =	1.32	in^3
Yield Strength, Fy =	46	ksi
Bending Stress, fb =	14.80	ksi
Allowable Bending Stress, Fb =	30.36	ksi
Capacity/Demand Ratio =	2.05	

Bending Stress Check: OK

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Metal Decking Analysis (From Table- Single Span, 20-Gauge):

Span Length =	6.00	ft. (Conservative)
Span Condition =	Single Span	
Uniform Dead Load =	16.38	psf
Design Live Load =	50	psf (Minimum Construction Load)
Total Uniform Design Load =	66.38	psf
Allowable Uniform Load =	69.00	psf (6 ft. spacing is conservative)
Capacity/Demand Ratio =	1.04	

Metal Decking Check: OK

SUBMITTAL REVIEW

Revi[illegible]neral conformity to the contract drawings and specifications and shall not relieve the contractor of his entire responsibility under the contract, including among other things, dimensions to be confirmed and correlated at the job site, and information that pertains to the fabrication processes or to techniques of construction.

- [X] NO EXCEPTIONS TAKEN
- [ ] MAKE CORRECTIONS NOTED RESUBMITTAL NOT REQUIRED
- [ ] AMEND AND RESUBMIT
- [ ] REJECTED - SEE REMARKS

PB AMERICAS, INC.

BY: SJ Boyington

DATE: 6/27/16

D10

Bentley

Units system: English

Geometry data

GLOSSARY

Cb22, Cb33	: Moment gradient coefficients
Cm22, Cm33	: Coefficients applied to bending term in interaction formula
d0	: Tapered member section depth at J end of member
DJX	: Rigid end offset distance measured from J node in axis X
DJY	: Rigid end offset distance measured from J node in axis Y
DJZ	: Rigid end offset distance measured from J node in axis Z
DKX	: Rigid end offset distance measured from K node in axis X
DKY	: Rigid end offset distance measured from K node in axis Y
DKZ	: Rigid end offset distance measured from K node in axis Z
dL	: Tapered member section depth at K end of member
Ig factor	: Inertia reduction factor (Effective Inertia/Gross Inertia) for reinforced concrete members
K22	: Effective length factor about axis 2
K33	: Effective length factor about axis 3
L22	: Member length for calculation of axial capacity
L33	: Member length for calculation of axial capacity
LB pos	: Lateral unbraced length of the compression flange in the positive side of local axis 2
LB neg	: Lateral unbraced length of the compression flange in the negative side of local axis 2
RX	: Rotation about X
RY	: Rotation about Y
RZ	: Rotation about Z
TO	: 1 = Tension only member 0 = Normal member
TX	: Translation in X
TY	: Translation in Y
TZ	: Translation in Z

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Nodes

Node	X [ft]	Y [ft]	Z [ft]	Rigid Floor
1	0.00	0.00	0.00	0
2	0.00	0.125	0.00	0
3	0.00	0.2917	0.00	0
4	0.00	0.4167	0.00	0
5	-0.375	0.60	0.00	0
6	-0.7583	0.75	0.00	0
7	-0.9167	0.8667	0.00	0
8	-0.9667	1.0833	0.00	0
9	-0.95	1.25	0.00	0
10	-0.8083	1.4167	0.00	0
11	-0.5833	1.50	0.00	0
12	-0.35	1.4167	0.00	0
13	-0.2333	1.2917	0.00	0
14	-0.2333	1.1667	0.00	0

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PB AMERICAS, INC.
BY: S. Boyington
DATE: 6/27/16
D11

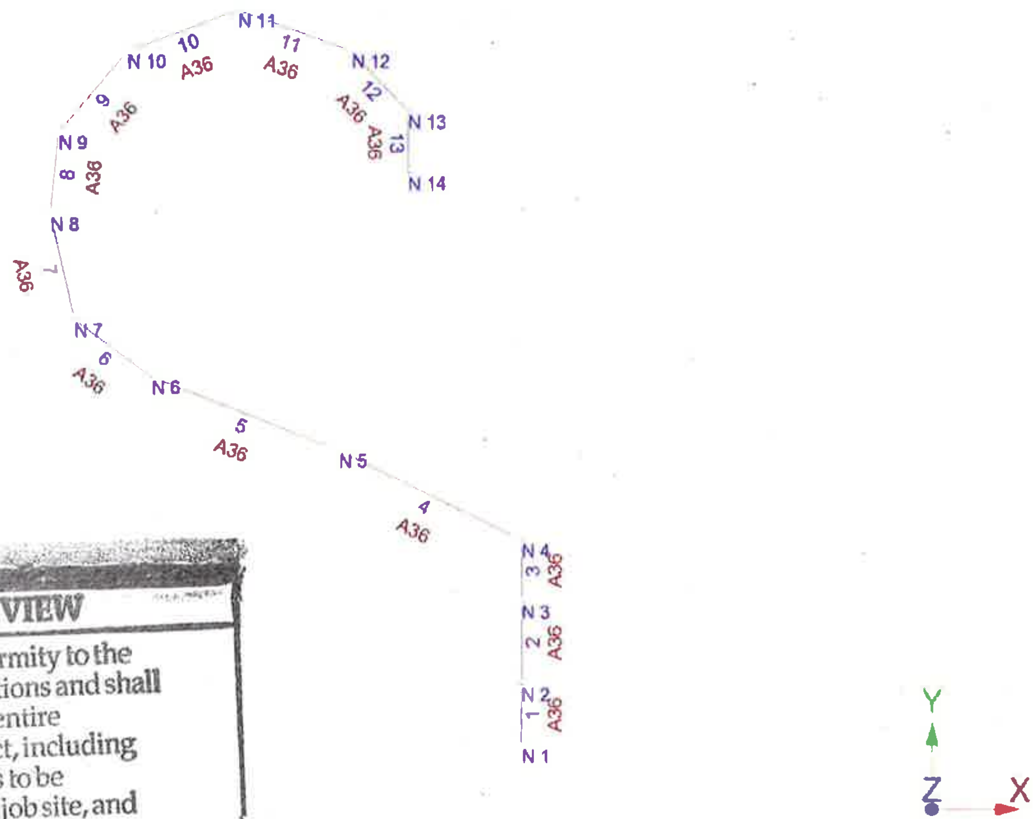
Restraints

Node	TX	TY	TZ	RX	RY	RZ
3	1	0	1	0	1	0
4	1	0	1	0	0	0
14	0	1	0	0	0	0

Members

Member	NJ	NK	Description	Section	Material	d0 [in]	dL [in]	Ig factor
1	1	2		PL 1/2x2	A36	0.00	0.00	0.00
2	2	3		PL 1/2x2	A36	0.00	0.00	0.00
3	3	4		PL 1/2x2	A36	0.00	0.00	0.00
4	4	5		PL 1/2x2	A36	0.00	0.00	0.00
5	5	6		PL 1/2x2	A36	0.00	0.00	0.00
6	6	7		PL 1/2x2	A36	0.00	0.00	0.00
7	7	8		PL 1/2x2	A36	0.00	0.00	0.00
8	8	9		PL 1/2x2	A36	0.00	0.00	0.00
9	9	10		PL 1/2x2	A36	0.00	0.00	0.00
10	10	11		PL 1/2x2	A36	0.00	0.00	0.00
11	11	12		PL 1/2x2	A36	0.00	0.00	0.00
12	12	13		PL 1/2x2	A36	0.00	0.00	0.00
13	13	14		PL 1/2x2	A36	0.00	0.00	0.00

Units system: English



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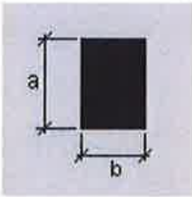
Units system: English

Section information

Section name: PL 1/2x2 **(US)**

Dimensions



a	=	2.000	[in]	Height
b	=	0.500	[in]	Width

Properties

Ag	:	1.000	[in2]	Gross area of the section.
I 33	:	0.333	[in4]	Moment of inertia about local axis 3.
I 22	:	0.021	[in4]	Moment of inertia about local axis 2.
I 23	:	0.000	[in4]	Product of inertia.
Ang 3' to 3	:	0.000	--	Angle to the principal axis. (°)
I 33'	:	0.333	[in4]	Moment of inertia about principal axis 3.
I 22'	:	0.021	[in4]	Moment of inertia about principal axis 2.
Dist. to cg 3	:	0.000	[in]	Distance from the geometric center to the gravity center of the section in the axis 3 direction.
Dist. to cg 2	:	0.000	[in]	Distance from the geometric center to the gravity center of the section in the axis 2 direction.
J	:	0.070	[in4]	Saint-Venant torsion constant.
Xsc'	:	0.000	[in]	Distance from the c.g. to the shear center with reference to the principal axis 3.
Ysc'	:	0.000	[in]	Distance from the c.g. to the shear center with reference to the principal axis 2.
Cw	:	0.000	[in6]	Section warping constant.
ro	:	0.595	[in]	Polar radius of gyration.
J 33'	:	0.000	[in]	Property to consider torsional – flexural buckling about principal axis 3.
J 22'	:	0.000	[in]	Property to consider torsional – flexural buckling about principal axis 2.
S 33 top	:	0.333	[in3]	Top elastic section modulus about local axis 3.
S 33 bot	:	0.333	[in3]	Bottom elastic section modulus about local axis 3.
S 22 top	:	0.083	[in3]	Top elastic section modulus about local axis 2.
S 22 bot	:	0.083	[in3]	Bottom elastic section modulus about local axis 2.
S 33' top	:	0.333	[in3]	Top elastic section modulus about principal axis 3.
S 33' bot	:	0.333	[in3]	Bottom elastic section modulus about principal axis 3.
S 22' top	:	0.083	[in3]	Top elastic section modulus about principal axis 2.
S 22' bot	:	0.083	[in3]	Bottom elastic section modulus about principal axis 2.
Z 33	:	0.500	[in3]	Plastic section modulus about local axis 3.
Z 22	:	0.125	[in3]	Plastic section modulus about local axis 2.
Z 33'	:	0.500	[in3]	Plastic section modulus about principal axis 3.
Z 22'	:	0.125	[in3]	Plastic section modulus about principal axis 2.
Max 3	:	0.250	[in]	Coordinate of the farthest positive extremity of the section in relation to local axis 3.
Min 3	:	-0.250	[in]	Coordinate of the farthest negative extremity of the section in relation to local axis 3.
Max 2	:	1.000	[in]	Coordinate of the farthest positive extremity of the section in relation to local axis 2.
Min 2	:	-1.000	[in]	Coordinate of the farthest negative extremity of the section in relation to local axis 2.
Aw3	:	1.000	[in2]	Flange area for shear.
Aw2	:	1.000	[in2]	Web area for shear.
C	:	0.595	[in3]	Torsional constant.
Qmod2'	:	2.49E+05	[in3]	Shear modulus for principal axis 2.
Qmod3'	:	2.49E+05	[in3]	Shear modulus for principal axis 3.

SUBMITTAL REVIEW

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- [ ] REJECTED - SEE REMARKS

PB AMERICAS, INC.

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D14

Bentley

Units system: English

Load data

GLOSSARY

Comb : Indicates if load condition is a load combination

Load conditions

Condition	Description	Comb.	Category
DL	Dead Load	No	DL
LC1	1.5DL	Yes	

Load on nodes

Condition	Node	FX [Kip]	FY [Kip]	FZ [Kip]	MX [Kip*ft]	MY [Kip*ft]	MZ [Kip*ft]
DL	2	0.00	-1.00	0.00	0.00	0.00	0.00

Self weight multipliers for load conditions

Condition	Description	Comb.	Self weight multiplier MultX	MultY	MultZ
DL	Dead Load	No	0.00	-1.00	0.00
LC1	1.5DL	Yes	0.00	0.00	0.00

Earthquake (Dynamic analysis only)

Condition	a/g	Ang. [Deg]	Damp. [%]
DL	0.00	0.00	0.00
LC1	0.00	0.00	0.00

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PB AMERICAS, INC.
BY: [signature]
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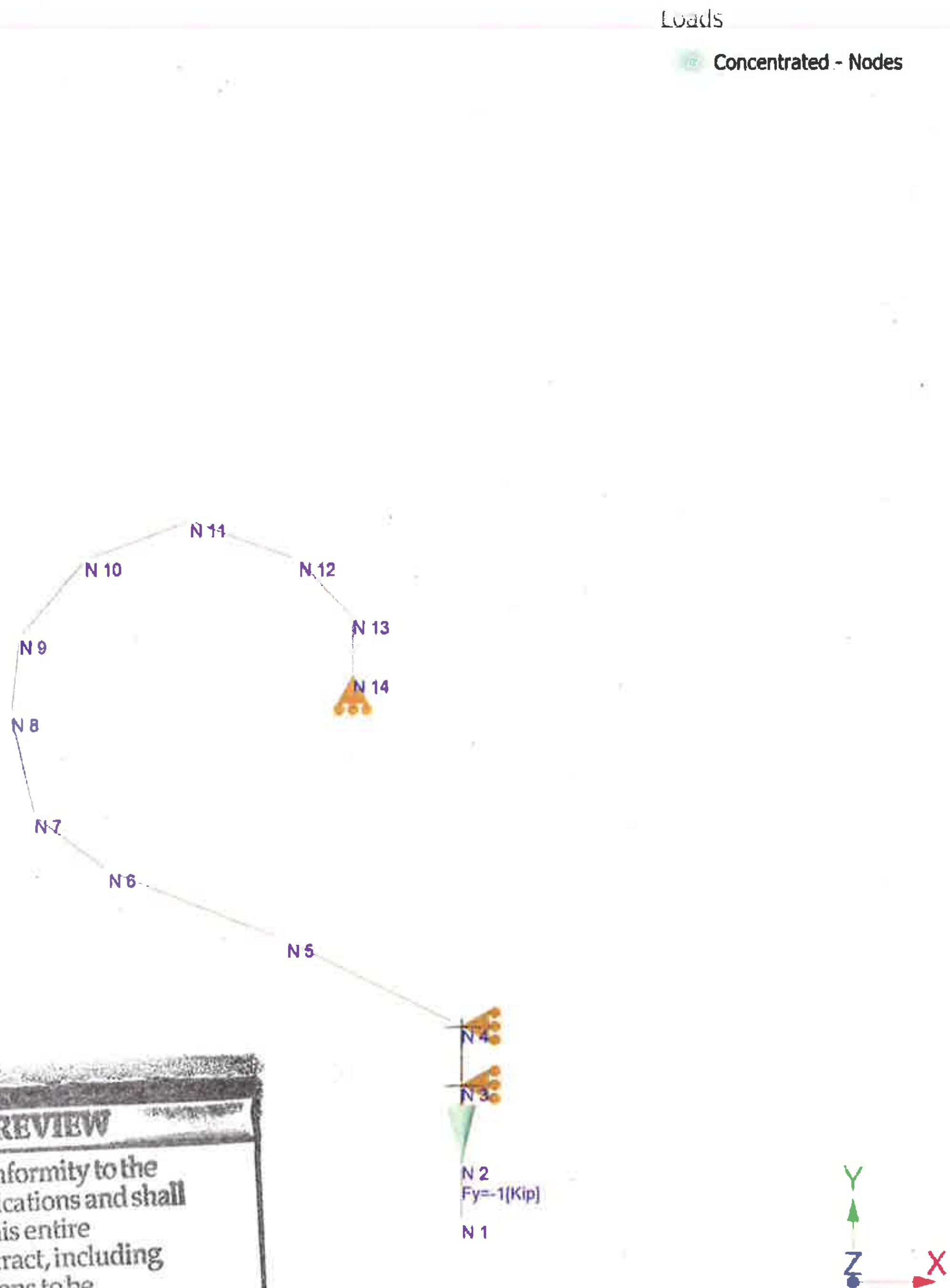
D15

Bentley

Units system: English

Load condition: DL=Dead Load



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PB AMERICAS, INC.

BY: SL Boyington

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Bentley

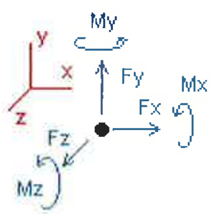
Units system: English

Analysis result

Translations

Node	Translations [in] TX	TY	TZ	Rotations [Rad] RX	RY	RZ
Condition **LC1=1.5DL**						
1	-0.00064	-0.13718	0.00000	0.00000	0.00000	-0.00018
2	-0.00036	-0.13718	0.00000	0.00000	0.00000	-0.00018
3	0.00000	-0.13707	0.00000	0.00000	0.00000	-0.00018
4	0.00000	-0.13699	0.00000	0.00000	0.00000	-0.00051
5	0.00241	-0.13181	0.00000	0.00000	0.00000	-0.00091
6	0.00197	-0.13266	0.00000	0.00000	0.00000	0.00218
7	-0.00275	-0.13896	0.00000	0.00000	0.00000	0.00486
8	-0.01987	-0.14277	0.00000	0.00000	0.00000	0.00840
9	-0.03945	-0.14071	0.00000	0.00000	0.00000	0.01115
10	-0.06519	-0.11869	0.00000	0.00000	0.00000	0.01435
11	-0.08100	-0.07586	0.00000	0.00000	0.00000	0.01687
12	-0.06325	-0.02600	0.00000	0.00000	0.00000	0.01821
13	-0.03559	-0.00008	0.00000	0.00000	0.00000	0.01845
14	-0.00791	0.00000	0.00000	0.00000	0.00000	0.01845

Reactions



Direction of positive forces and moments

Node	Forces [Kip] FX	FY	FZ	Moments [Kip*ft] MX	MY	MZ
Condition **LC1=1.5DL**						
3	2.77620	0.00000	0.00000	0.00000	0.00000	0.00000
4	-2.77578	0.00000	0.00000	0.00000	0.00000	0.00000
14	0.00000	1.51417	0.00000	0.00000	0.00000	0.00000
SUM	0.00042	1.51417	0.00000	0.00000	0.00000	0.00000

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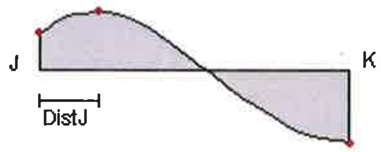
PB AMERICAS, INC.
BY: SHBoyington
DATE: 6/27/16

D17

Points of interest in members



Considered points

Resisted by 2 bolts.

CONDITION : **LC1=1.5DL**

Station	Dist to J [ft]	Axial [Kip]	Shear V2 [Kip]	M33 [Kip*ft]	Shear V3 [Kip]	M22 [Kip*ft]	Torsion [Kip*ft]
			Plane 1-2		Plane 1-3		
MEMBER 1							
0%	0.000	0.000	0.000	0.000	0.000	0.000	0.000
100%	0.125	0.000	0.000	0.000	0.000	0.000	0.000
MEMBER 2							
0%	0.000	1.500	0.000	0.000	0.000	0.000	0.000
100%	0.167	1.501	0.000	0.000	0.000	0.000	0.000
MEMBER 3							
0%	0.000	1.501	-2.776	0.000	0.000	0.000	0.000
100%	0.125	1.502	-2.776	-0.347	0.000	0.000	0.000
MEMBER 4							
0%	0.000	0.659	-1.350	0.347	0.000	0.000	0.000
100%	0.417	0.660	-1.351	-0.216	0.000	0.000	0.000
MEMBER 5							
0%	0.000	0.548	-1.401	-0.216	0.000	0.000	0.000
100%	0.412	0.549	-1.403	-0.793	0.000	0.000	0.000
MEMBER 6							
0%	0.000	0.893	-1.213	-0.793	0.000	0.000	0.000
100%	0.197	0.894	-1.214	-1.032	0.000	0.000	0.000
MEMBER 7							
0%	0.000	1.468	-0.339	-1.032	0.000	0.000	0.000
100%	0.222	1.469	-0.339	-1.110	0.000	0.000	0.000
MEMBER 8							
0%	0.000	1.501	-0.150	1.110	0.000	0.000	0.000
100%	0.167	1.501	-0.150	1.087	0.000	0.000	0.000
MEMBER 9							
0%	0.000	1.150	-0.978	1.087	0.000	0.000	0.000
100%	0.219	1.150	-0.978	0.877	0.000	0.000	0.000
MEMBER 10							
0%	0.000	0.524	-1.416	0.877	0.000	0.000	0.000
100%	0.240	0.525	-1.418	0.539	0.000	0.000	0.000
MEMBER 11							
0%	0.000	-0.508	-1.424	0.539	0.000	0.000	0.000
100%	0.248	-0.509	-1.425	0.184	0.000	0.000	0.000
MEMBER 12							
0%	0.000	-1.106	-1.032	0.184	0.000	0.000	0.000
100%	0.171	-1.106	-1.033	0.003	0.000	0.000	0.000
MEMBER 13							
0%	0.000	-1.514	0.000	0.003	0.000	0.000	0.000
100%	0.125	-1.514	0.000	0.000	0.000	0.000	0.000

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- [ ] REJECTED - SEE REMARKS

PB AMERICAS, INC.
BY: G.L. Boynton
DATE: 6/25/16

Bentley

Units system: English

Steel Code Check

Report: **Summary - Group by section**

Load conditions to be included in design :

LC1=1.5DL

Description	Section	Member	Ctrl Eq.	Ratio	Status	Reference
	PL 1/2x2	8	LC1 at 0.00%	0.91	OK	Eq. H1-1b

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PB AMERICAS, INC.

BY: S. L. Boyington

DATE: 6/27/16

Bentley

Units system: English

Steel Code Check

Report: Concise

Members: Hot-rolled
Design code: AISC 360-2010 LRFD

Member	:	**8**
Design status	:	**OK**

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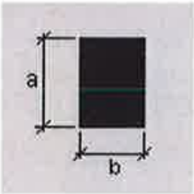
PB AMERICAS, INC.
BY: SL Boyington
DATE: 6/27/16

Section information

Section name: PL 1/2x2 **(US)**

Dimensions



a	=	2.000	[in]	Height
b	=	0.500	[in]	Width

Properties

Section properties	**Unit**	**Major axis**	**Minor axis**
Gross area of the section. (Ag)	[in2]	1.000	
Moment of Inertia (local axes) (I)	[in4]	0.333	0.021
Moment of Inertia (principal axes) (I')	[in4]	0.333	0.021
Bending constant for moments (principal axis) (J')	[in]	0.000	0.000
Radius of gyration (local axes) (r)	[in]	0.577	0.144
Radius of gyration (principal axes) (r')	[in]	0.577	0.144
Saint-Venant torsion constant. (J)	[in4]	0.070	
Section warping constant. (Cw)	[in6]	0.000	
Distance from centroid to shear center (principal axis) (xo,yo)	[in]	0.000	0.000
Top elastic section modulus of the section (local axis) (Ssup)	[in3]	0.333	0.083
Bottom elastic section modulus of the section (local axis) (Sinf)	[in3]	0.333	0.083
Top elastic section modulus of the section (principal axis) (S'sup)	[in3]	0.333	0.083
Bottom elastic section modulus of the section (principal axis) (S'inf)	[in3]	0.333	0.083
Plastic section modulus (local axis) (Z)	[in3]	0.500	0.125
Plastic section modulus (principal axis) (Z')	[in3]	0.500	0.125
Polar radius of gyration. (ro)	[in]	0.595	
Area for shear (Aw)	[in2]	1.000	1.000
Torsional constant. (C)	[in3]	0.595	

Material : A36

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BY: Mark Sargent DATE: 07/01/2016

D20

Properties	Unit	Value
Yield stress (Fy):	[Kip/in2]	36.00
Tensile strength (Fu):	[Kip/in2]	58.00
Elasticity Modulus (E):	[Kip/in2]	29000.00
Shear modulus for steel (G):	[Kip/in2]	11507.94

DESIGN CRITERIA

Description	Unit	Value
Length for tension slenderness ratio (L)	[ft]	0.17

Distance between member lateral bracing points

Length (Lb) [ft]	
Top	Bottom
4.00	4.00

Laterally unbraced length

Length [ft]			Effective length factor		
Major axis(L33)	Minor axis(L22)	Torsional axis(Lt)	Major axis(K33)	Minor axis(K22)	Torsional axis(Kt)
0.17	0.17	0.17	1.0	1.0	1.0

Additional assumptions	
Continuous lateral torsional restraint	No
Tension field action	No
Continuous flexural torsional restraint	No
Effective length factor value type	None
Major axis frame type	Sway
Minor axis frame type	Sway

DESIGN CHECKS

AXIAL TENSION DESIGN ✔

Axial tension

Ratio :	0.05		
Capacity :	32.40 [Kip]	Reference :	Eq. D2-1
Demand :	1.50 [Kip]	Ctrl Eq. :	LC1 at 100.00%

Intermediate results	Unit	Value	Reference
Factored axial tension capacity(ϕPn)	[Kip]	32.40	Eq. D2-1

AXIAL COMPRESSION DESIGN ✔

Compression in the major axis 33

Ratio :	0.00		
Capacity :	32.38 [Kip]	Reference :	Sec. E1
Demand :	0.00 [Kip]	Ctrl Eq. :	LC1 at 0.00%

Intermediate results	Unit	Value	Reference
Section classification			
Factored flexural buckling strength(ϕP_{n33})	[Kip]	32.38	Sec. E1

Compression in the minor axis 22

Ratio	:	0.00			
Capacity	:	32.07 [Kip]	Reference	:	Sec. E1
Demand	:	0.00 [Kip]	Ctrl Eq.	:	LC1 at 0.00%

Intermediate results	Unit	Value	Reference
Section classification			
Factored flexural buckling strength(ϕP_{n22})	[Kip]	32.07	Sec. E1

FLEXURAL DESIGN ✓

Bending about major axis, M33

Ratio	:	0.89			
Capacity	:	1.25 [Kip*ft]	Reference	:	Sec. F1
Demand	:	1.11 [Kip*ft]	Ctrl Eq.	:	LC1 at 0.00%

Intermediate results	Unit	Value	Reference
Section classification			
Factored lateral-torsional buckling strength(ϕM_n)	[Kip*ft]	1.25	Sec. F1

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Bending about minor axis, M22

Ratio	:	0.00			
Capacity	:	0.34 [Kip*ft]	Reference	:	Sec. F1
Demand	:	0.00 [Kip*ft]	Ctrl Eq.	:	LC1 at 0.00%

Intermediate results	Unit	Value	Reference
Section classification			
Factored yielding strength(ϕM_n)	[Kip*ft]	0.34	Sec. F1

DESIGN FOR SHEAR ✓

Shear in major axis 33

Ratio	:	0.00			
Capacity	:	19.44 [Kip]			
Demand	:	0.00 [Kip]	Ctrl Eq.	:	LC1 at 0.00%

Intermediate results	Unit	Value	Reference
Factored shear capacity(ϕV_n)	[Kip]	19.44	

Shear in minor axis 22

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- [X] NO EXCEPTIONS TAKEN
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PB AMERICAS, INC.

BY: SJ Bayington

DATE: 6/27/16

D22

Ratio	: 0.01			
Capacity	: 19.44 [Kip]			
Demand	: -0.15 [Kip]	Ctrl Eq.	: LC1 at 100.00%	

Intermediate results	Unit	Value	Reference
Factored shear capacity(ϕVn)	[Kip]	19.44	

TORSION DESIGN ✔

Torsion

Ratio	: 0.00		
Capacity	: 0.23 [Kip*ft]		
Demand	: 0.00 [Kip*ft]	Ctrl Eq.	: LC1 at 0.00%

Intermediate results	Unit	Value	Reference
Factored torsion capacity(ϕTn)	[Kip*ft]	0.23	

COMBINED ACTIONS DESIGN ✔

Combined flexure and axial compression

Ratio	: 0.89		
Ctrl Eq.	: LC1 at 0.00%	Reference	: Eq. H1-1b

Intermediate results	Unit	Value	Reference
Interaction of flexure and axial force	--	0.89	Eq. H1-1b

Combined flexure and axial tension

Ratio	: 0.91		
Ctrl Eq.	: LC1 at 0.00%	Reference	: Eq. H1-1b

Intermediate results	Unit	Value	Reference

Combined flexure and axial compression about local axis

Ratio	: N/A	
Ctrl Eq.	: --	Reference

Combined flexure and axial tension about local axis

Ratio	: N/A	
Ctrl Eq.	: --	Reference

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BY: SL Boyington

DATE: 6/27/16

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Combined torsion, flexure, shear and axial compression

Ratio	: N/A		
Ctrl Eq.	: --	Reference	:

Combined torsion, flexure, shear and axial tension

Ratio	: N/A		
Ctrl Eq.	: --	Reference	:

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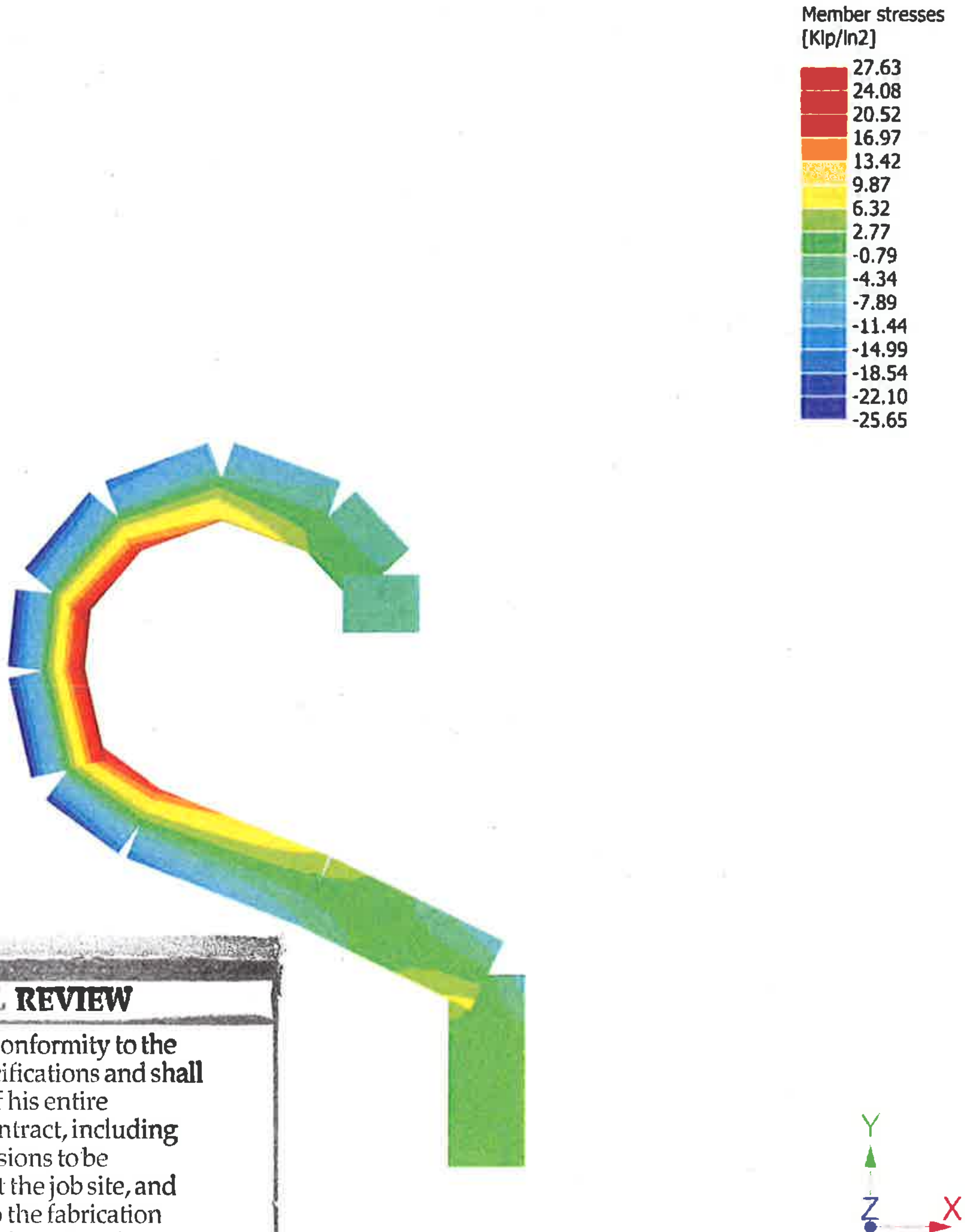
BY: G. Boyington
DATE: 6/27/16

Bentley

Units system: English

Load condition: DL=Dead Load



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Support Hanger Analysis: (Type 2)

A. Design Loads:

Girder Spacing =	7.50	ft.	(Conservative)
Width of Platform =	6.00	ft.	
Number of Hangers =	2		(per Girder)
Tributary Area =	22.50	$ft.^2$	(per Hanger)
No. Workers per Platform =	2		
Weight of 1 Worker =	250	lb	
Assume Depth of Grit =	1/2	in	
Density of Steel Grit =	280	pcf	
Self Weight 4x2x1/8 Tubing =	4.75	plf	
Tributary Length of Tubing =	7.50	ft.	
Tarpaulin Weight =	0.13	psf	
Metal Decking Weight =	3.00	psf	(Conservative)
Tubing Load =	35.6	lb.	
18-oz Tarpaulin Load =	2.8	lb.	
Steel Grit Load =	262.5	lb.	
Metal Deck Load =	67.5	lb.	
Worker Load =	500.0	lb.	
Total Load per Hanger =	868.4	lb.	
Load per Hanger Hook =	434.2	lb.	

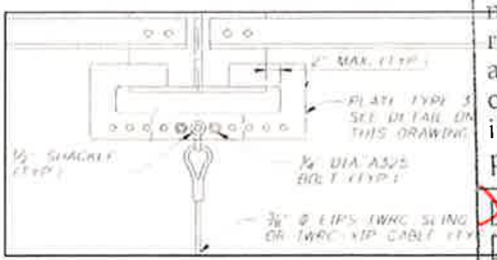
* Conservatively, use Load per Hanger Hook = 1000 lb. (2000 lb. Total)

* See RAM Element Analysis (bracket is designed for 1000 lb per hanger hook, resulting in 89% demand/capacity ratio)

B. Bolt Analysis

Bolt Size =	3/4	in.
Vertical Reaction =	3.86	kips/bolt (RAM Elements Output)
Horizontal Reaction =	1.75	kips/bolt (RAM Elements Output)
Ultimate Shear, Ru =	4.24	kips/bolt
Number of Bolts =	2	
Two (2) Hooks =	8.48	kips
Shear Capacity, ΦRn =	12.4	kips/bolt (AISC 14th Ed. Table 7-1)
Capacity/Demand Ratio =	1.46	

Bolt Shear Check: OK



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PB AMERICAS, INC.

BY: [signature]

DATE: 6/27/16

A2B ENGINEERING, LLC CONSULTING ENGINEERS	Subject: Abrasive Blasting Containment Plans Eleven Bridges on I-91, County of Windsor, Vermont		
	Comp by: MAT Check by: PRS	Date: 02/08/16 Job No: 187-18-1	Sheet Number:

Total Reaction =	8.48	kips
Slip Critical Shear Strength, ΦRn =	9.49	kips/bolt (AISC 14th Ed. Table 7-3)
Capacity/Demand Ratio =	1.12	

Bolt Slip-Critical Check: OK

Available Bearing Strength at Bolt Holes =	62.00	kips/in (AISC 14th Ed. Table 7-4)
Plate Thickness =	0.375	in.
Total Reaction =	8.48	kips
Bearing Strength =	23.25	kips/bolt
Capacity/Demand Ratio =	2.74	

Bolt Bearing Strength Check: OK

Structural Tubing Analysis:

Tributary Length of Tubing =	7.50	ft.	
Tubing Load =	35.6	lb.	
18-oz Tarpaulin Load =	2.8	lb.	
Steel Grit Load =	262.5	lb.	
Metal Deck Load =	67.5	lb.	
Worker Load =	500.0	lb.	
Load on Tubing, P =	868.4	lb.	
Max. Moment on Tubing, Mmax =	19.54	kip-in	(Conservative to use PL/4)
HSS 4x2x1/8, Sx =	1.32	in^3	
Yield Strength, Fy =	46	ksi	
Bending Stress, fb =	14.80	ksi	
Allowable Bending Stress, Fb =	30.36	ksi	
Capacity/Demand Ratio =	2.05		

Bending Stress Check: OK

Metal Decking Analysis (From Table- Single Span, 20-Gauge):

Span Length =	6.00	ft.	(Conservative)
Span Condition =	Single Span		
Uniform Dead Load =	16.38	psf	
Design Live Load =	50	psf	(Minimum Construction Load)
Total Uniform Design Load =	66.38	psf	
Allowable Uniform Load =	69	psf	(6 ft. spacing is conservative)
Capacity/Demand Ratio =	1.04		

Metal Decking Check: OK

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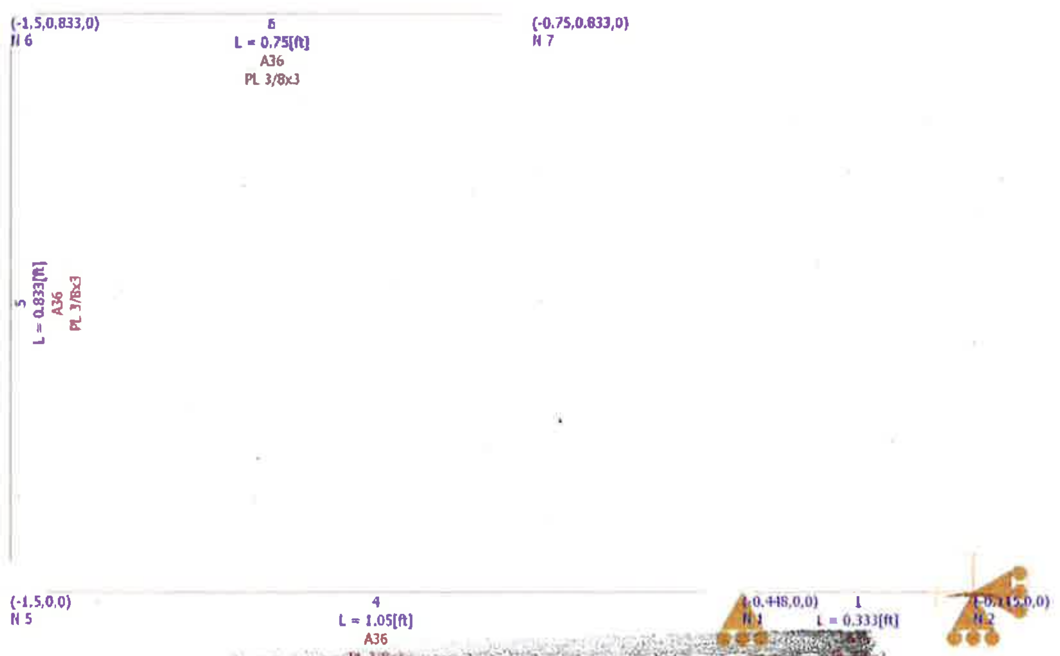
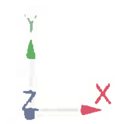
BY: [signature]
DATE: 6/27/16

D27

Units system: English





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PB AMERICAS, INC.

BY: SLBayington

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BY: Mark Sargent DATE: 07/01/2016

Bentley

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Geometry data

GLOSSARY

Cb22, Cb33	: Moment gradient coefficients
Cm22, Cm33	: Coefficients applied to bending term in interaction formula
d0	: Tapered member section depth at J end of member
DJX	: Rigid end offset distance measured from J node in axis X
DJY	: Rigid end offset distance measured from J node in axis Y
DJZ	: Rigid end offset distance measured from J node in axis Z
DKX	: Rigid end offset distance measured from K node in axis X
DKY	: Rigid end offset distance measured from K node in axis Y
DKZ	: Rigid end offset distance measured from K node in axis Z
dL	: Tapered member section depth at K end of member
Ig factor	: Inertia reduction factor (Effective Inertia/Gross Inertia) for reinforced concrete members
K22	: Effective length factor about axis 2
K33	: Effective length factor about axis 3
L22	: Member length for calculation of axial capacity
L33	: Member length for calculation of axial capacity
LB pos	: Lateral unbraced length of the compression flange in the positive side of local axis 2
LB neg	: Lateral unbraced length of the compression flange in the negative side of local axis 2
RX	: Rotation about X
RY	: Rotation about Y
RZ	: Rotation about Z
TO	: 1 = Tension only member 0 = Normal member
TX	: Translation in X
TY	: Translation in Y
TZ	: Translation in Z

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Nodes

Node	X [ft]	Y [ft]	Z [ft]	Rigid Floor
1	-0.448	0.00	0.00	0
2	-0.115	0.00	0.00	0
5	-1.50	0.00	0.00	0
6	-1.50	0.833	0.00	0
7	-0.75	0.833	0.00	0

Restraints

Node	TX	TY	TZ	RX	RY	RZ
1	0	1	0	0	0	0
2	1	1	1	1	1	0

Members

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PB AMERICAS, INC.

BY: SKBoyington

DATE: 6/27/16

Member	NJ	NK	Description	Section	Material	d0 [in]	dL [in]	Ig factor
1	1	2		PL 3/8x3	A36	0.00	0.00	0.00
4	1	5		PL 3/8x3	A36	0.00	0.00	0.00
5	5	6		PL 3/8x3	A36	0.00	0.00	0.00
6	6	7		PL 3/8x3	A36	0.00	0.00	0.00

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BY: D. Boyington

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Bentley

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Section information

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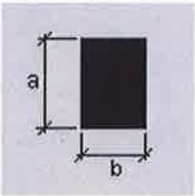
BY: S Boyington

DATE: 6/27/16

Section name: PL 3/8x3 (US)

Dimensions



a	=	3.000	[in]	Height
b	=	0.375	[in]	Width

Properties

Ag	:	1.125	[in2]	Gross area of the section.
I 33	:	0.844	[in4]	Moment of inertia about local axis 3.
I 22	:	0.013	[in4]	Moment of inertia about local axis 2.
I 23	:	0.000	[in4]	Product of inertia.
Ang 3' to 3	:	0.000	--	Angle to the principal axis. (°)
I 33'	:	0.844	[in4]	Moment of inertia about principal axis 3.
I 22'	:	0.013	[in4]	Moment of inertia about principal axis 2.
Dist. to cg 3	:	0.000	[in]	Distance from the geometric center to the gravity center of the section in the axis 3 direction.
Dist. to cg 2	:	0.000	[in]	Distance from the geometric center to the gravity center of the section in the axis 2 direction.
J	:	0.049	[in4]	Saint-Venant torsion constant.
Xsc'	:	0.000	[in]	Distance from the c.g. to the shear center with reference to the principal axis 3.
Ysc'	:	0.000	[in]	Distance from the c.g. to the shear center with reference to the principal axis 2.
Cw	:	0.000	[in6]	Section warping constant.
ro	:	0.873	[in]	Polar radius of gyration.
J 33'	:	0.000	[in]	Property to consider torsional – flexural buckling about principal axis 3.
J 22'	:	0.000	[in]	Property to consider torsional – flexural buckling about principal axis 2.
S 33 top	:	0.563	[in3]	Top elastic section modulus about local axis 3.
S 33 bot	:	0.563	[in3]	Bottom elastic section modulus about local axis 3.
S 22 top	:	0.070	[in3]	Top elastic section modulus about local axis 2.
S 22 bot	:	0.070	[in3]	Bottom elastic section modulus about local axis 2.
S 33' top	:	0.563	[in3]	Top elastic section modulus about principal axis 3.
S 33' bot	:	0.563	[in3]	Bottom elastic section modulus about principal axis 3.
S 22' top	:	0.070	[in3]	Top elastic section modulus about principal axis 2.
S 22' bot	:	0.070	[in3]	Bottom elastic section modulus about principal axis 2.
Z 33	:	0.844	[in3]	Plastic section modulus about local axis 3.
Z 22	:	0.105	[in3]	Plastic section modulus about local axis 2.
Z 33'	:	0.844	[in3]	Plastic section modulus about principal axis 3.
Z 22'	:	0.105	[in3]	Plastic section modulus about principal axis 2.
Max 3	:	0.188	[in]	Coordinate of the farthest positive extremity of the section in relation to local axis 3.
Min 3	:	-0.188	[in]	Coordinate of the farthest negative extremity of the section in relation to local axis 3.
Max 2	:	1.500	[in]	Coordinate of the farthest positive extremity of the section in relation to local axis 2.
Min 2	:	-1.500	[in]	Coordinate of the farthest negative extremity of the section in relation to local axis 2.
Aw3	:	1.125	[in2]	Flange area for shear.
Aw2	:	1.125	[in2]	Web area for shear.
C	:	0.982	[in3]	Torsional constant.
Qmod2'	:	2.21E+05	[in3]	Shear modulus for principal axis 2.
Qmod3'	:	2.21E+05	[in3]	Shear modulus for principal axis 3.

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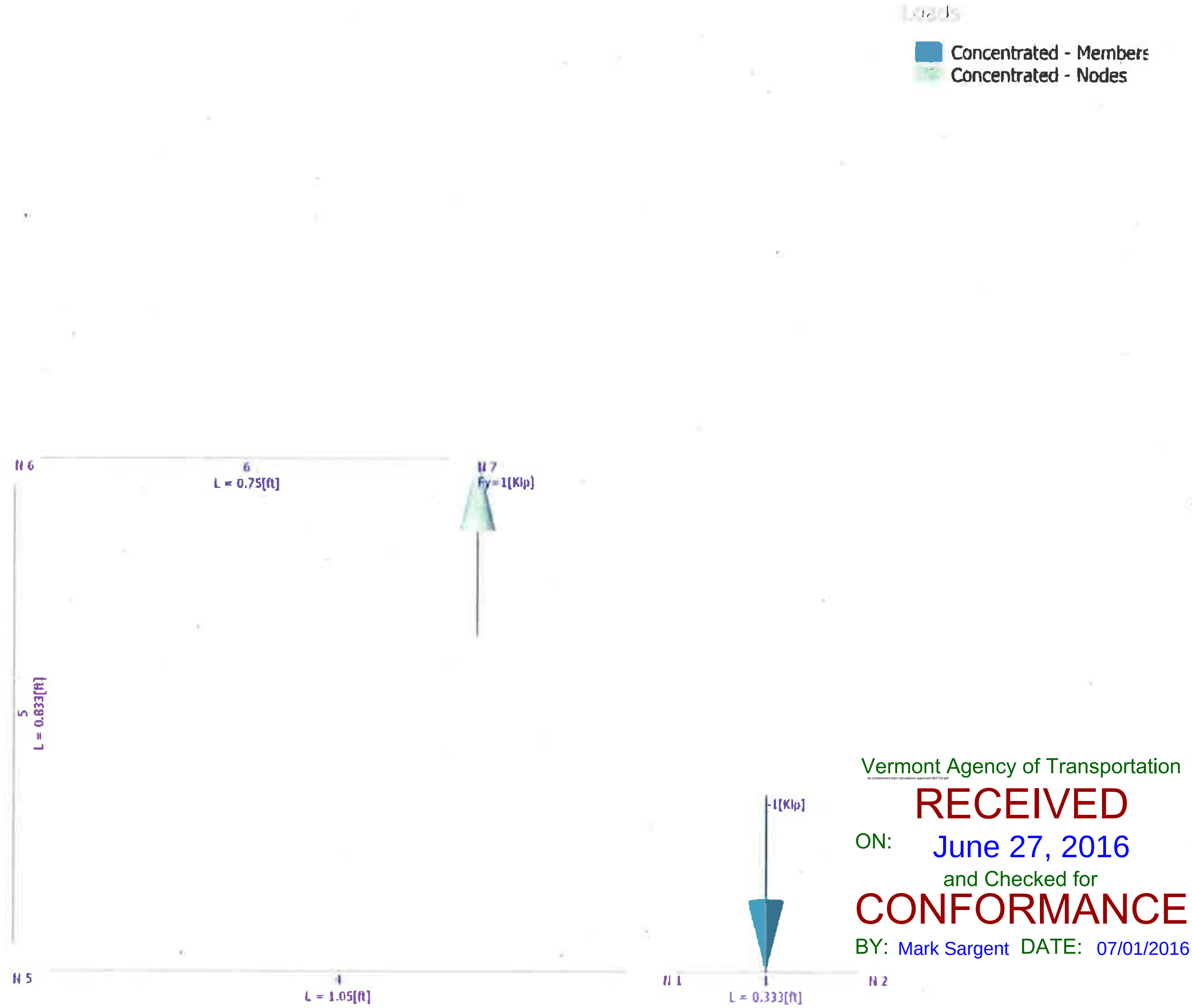
Load condition: LL1=Live Load Case 1



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BY: S L Bayington

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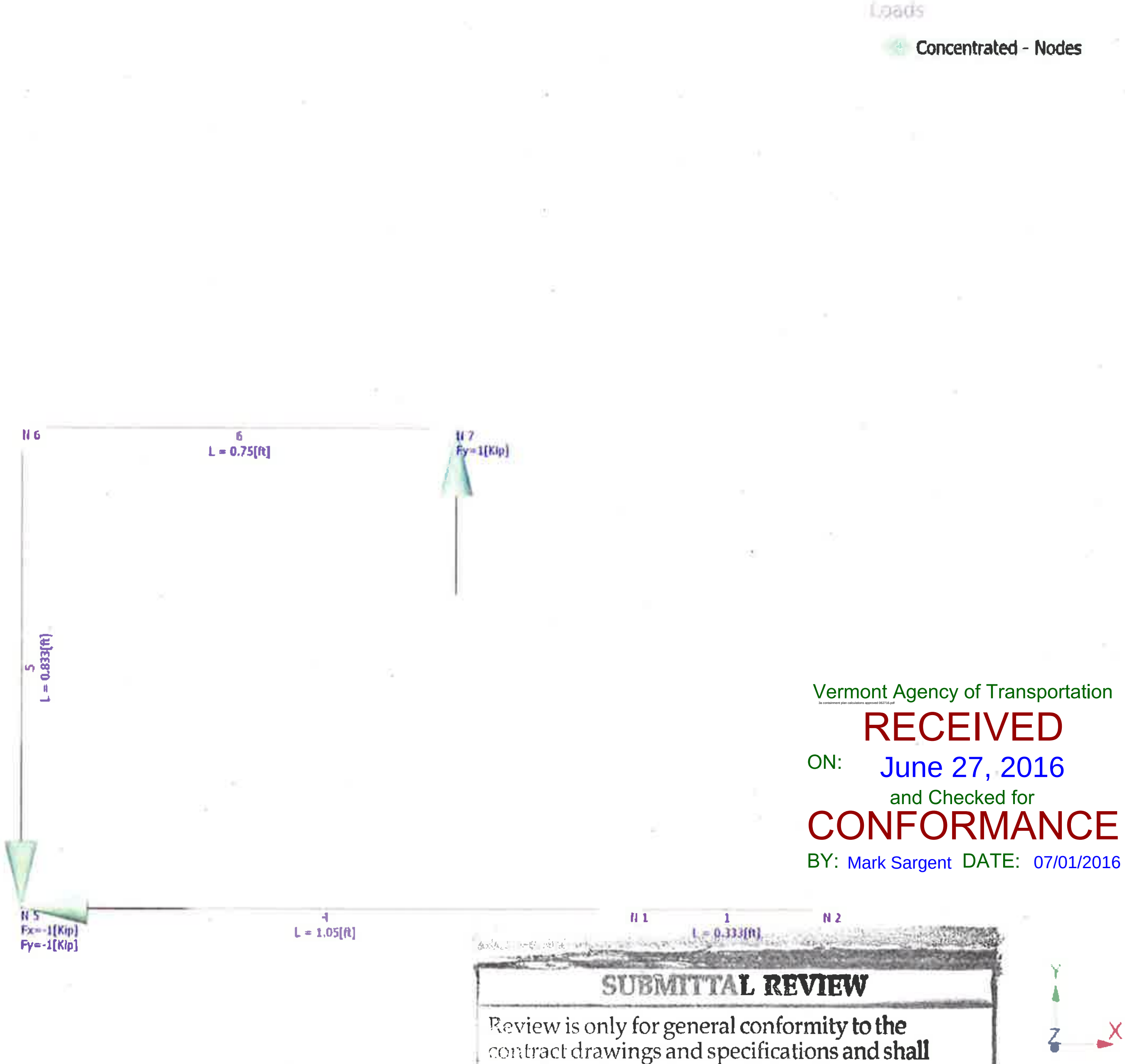
Units system: English

Load condition: LL2=Live Load Case 2



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BY: S E Bayington

DATE: 6/27/16

Bentley

Units system: English

Load data

GLOSSARY

Comb : Indicates if load condition is a load combination

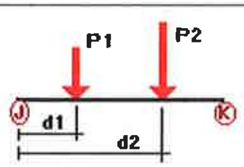
Load conditions

Condition	Description	Comb.	Category
LL1	Live Load Case 1	No	LL
LL2	Live Load Case 2	No	LL
DL	Dead Load	No	DL
LC1	1.75LL1+DL	Yes	
LC2	1.75LL2+DL	Yes	

Load on nodes

Condition	Node	FX [Kip]	FY [Kip]	FZ [Kip]	MX [Kip*ft]	MY [Kip*ft]	MZ [Kip*ft]
LL1	7	0.00	1.00	0.00	0.00	0.00	0.00
LL2	5	-1.00	-1.00	0.00	0.00	0.00	0.00
	7	0.00	1.00	0.00	0.00	0.00	0.00

Concentrated forces on members



Condition	Member	Dir1	Value1 [Kip]	Dist1 [ft]	%
LL1	1	Y	-1.00	50.00	Yes

Self weight multipliers for load conditions

D34

Condition	Description	Self weight multiplier Comb.	MultX	MultY	MultZ
LL1	Live Load Case 1	No	0.00	0.00	0.00
LL2	Live Load Case 2	No	0.00	0.00	0.00
DL	Dead Load	No	0.00	0.00	0.00
LC1	1.75LL1+DL	Yes	0.00	0.00	0.00
LC2	1.75LL2+DL	Yes	0.00	0.00	0.00

Earthquake (Dynamic analysis only)

Condition	a/g	Ang. [Deg]	Damp. [%]
LL1	0.00	0.00	0.00
LL2	0.00	0.00	0.00
DL	0.00	0.00	0.00
LC1	0.00	0.00	0.00
LC2	0.00	0.00	0.00

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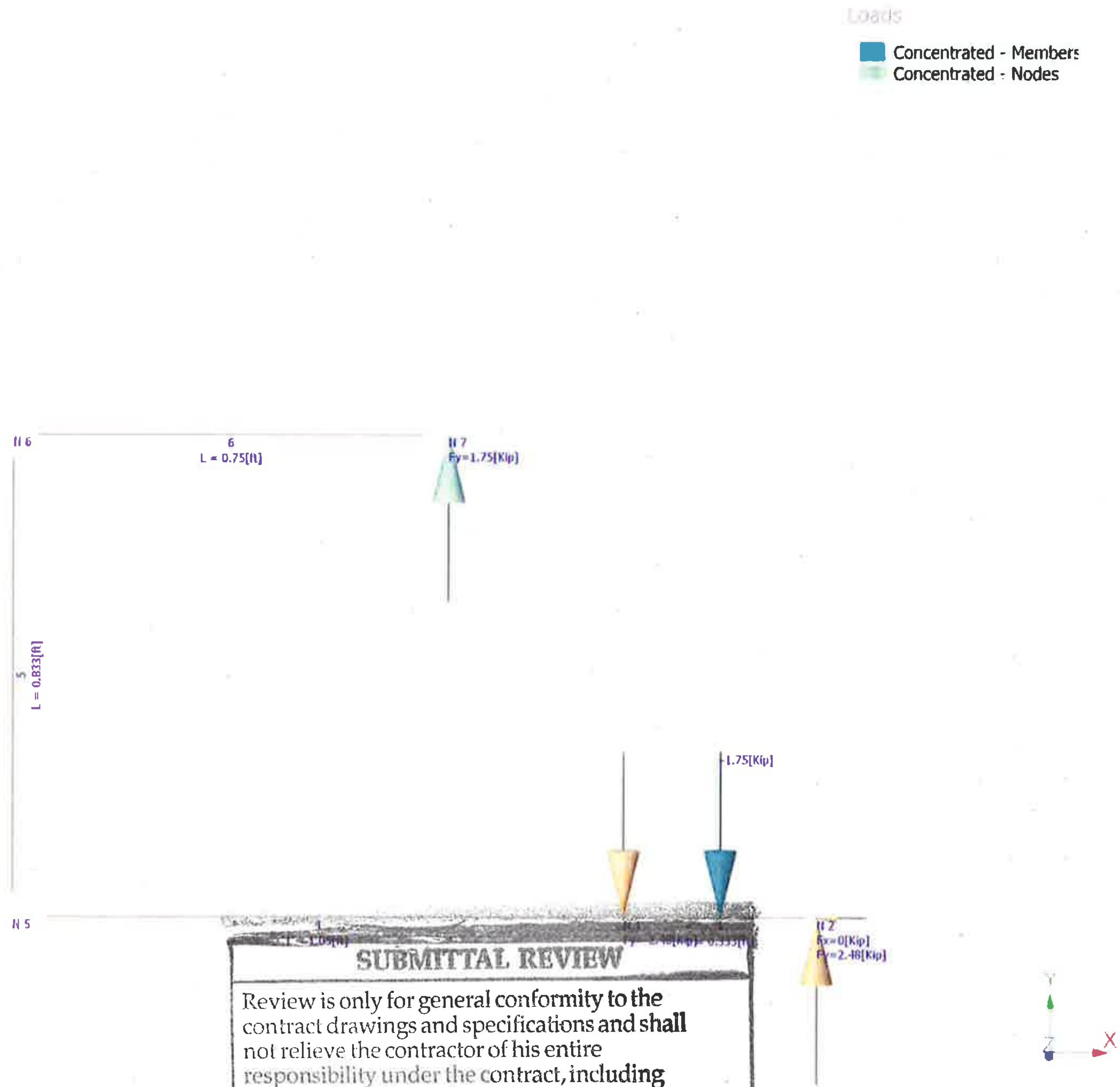
Load condition: LC1=1.75LL1+DL



SUBMITTAL REVIEW

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- [ ] MAKE CORRECTIONS NOTED RESUBMITTAL NOT REQUIRED
- [ ] AMEND AND RESUBMIT
- [ ] REJECTED - SEE REMARKS

PB AMERICAS, INC.

BY: S Bayington

DATE: 6/24/16

Vermont Agency of Transportation

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BY: Mark Sargent DATE: 07/01/2016

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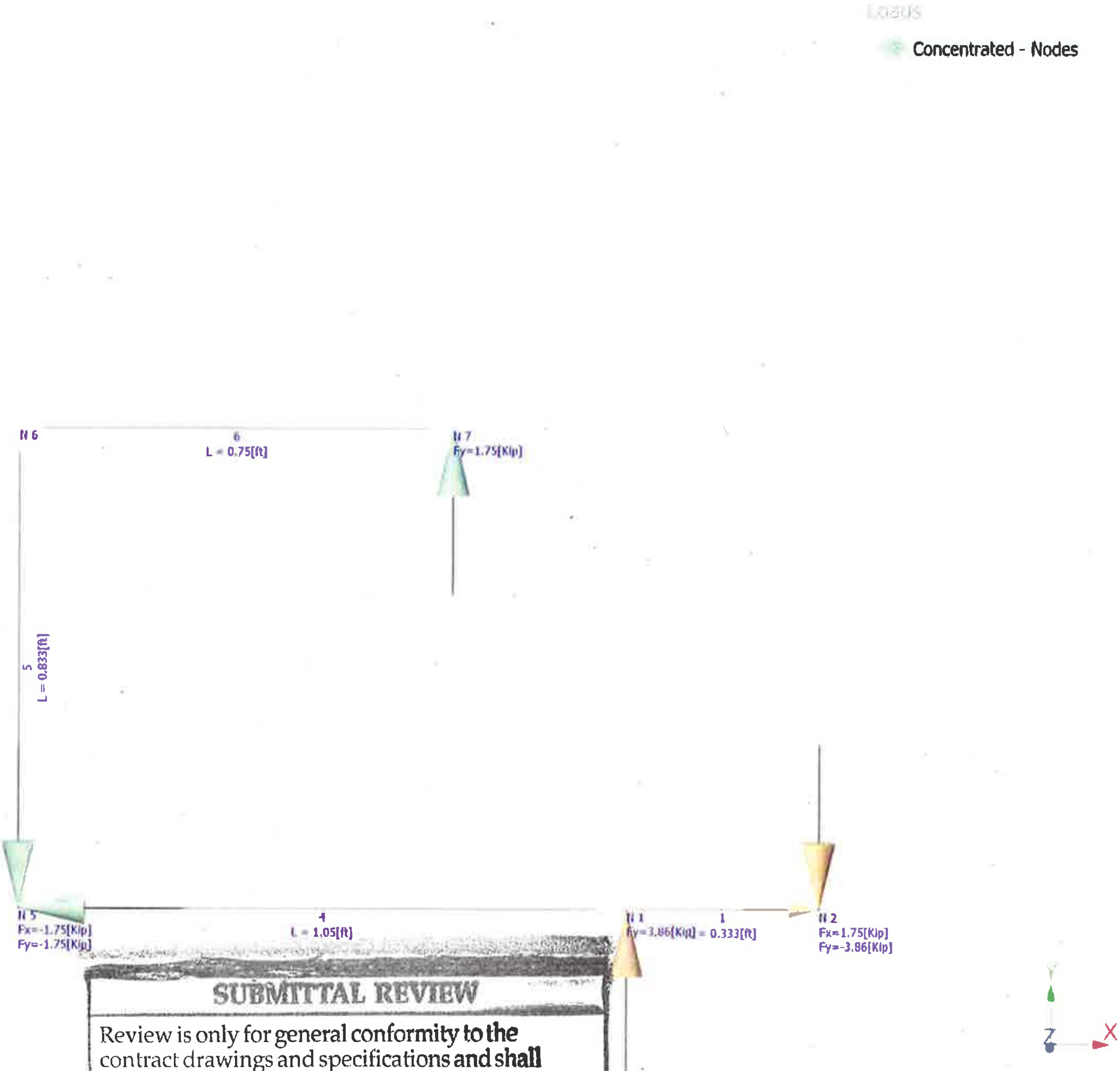
Units system: English

Load condition: LC2=1.75LL2+DL



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PB AMERICAS, INC.

BY: S.Y. Boyington

DATE: 6/27/16

Vermont Agency of Transportation

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BY: Mark Sargent DATE: 07/01/2016

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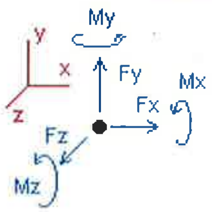
Units system: English

Analysis result

Reactions



Direction of positive forces and moments

Node	Forces [Kip] FX	FY	FZ	Moments [Kip*ft] MX	MY	MZ
Condition **LC1=1.75LL1+DL**						
1	0.00000	-2.48403	0.00000	0.00000	0.00000	0.00000
2	0.00000	2.48403	0.00000	0.00000	0.00000	0.00000
SUM	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Condition **LC2=1.75LL2+DL**						
1	0.00000	3.85871	0.00000	0.00000	0.00000	0.00000
2	1.75000	-3.85871	0.00000	0.00000	0.00000	0.00000
SUM	1.75000	0.00000	0.00000	0.00000	0.00000	0.00000

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PB AMERICAS, INC.

BY: [signature]

DATE: 6/27/16

Bentley

Units system: English

Steel Code Check

Report: Summary - Group by member

Load conditions to be included in design :

LC1=1.75LL1+DL
LC2=1.75LL2+DL

Description	Section	Member	Ctrl Eq.	Ratio	Status	Reference
	PL 3/8x3	1	LC2 at 0.00%	0.59	OK	Eq. H1-1b
		4	LC2 at 100.00%	0.88	OK	Eq. H1-1b
		5	LC1 at 100.00%	**0.89**	**OK**	Eq. H1-1b
		6	LC1 at 0.00%	0.87	OK	Sec. F1

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PB AMERICAS, INC.
BY: [signature]
DATE: 6/21/16

Tubular Steel Outriggers

A. Load on Outrigger:

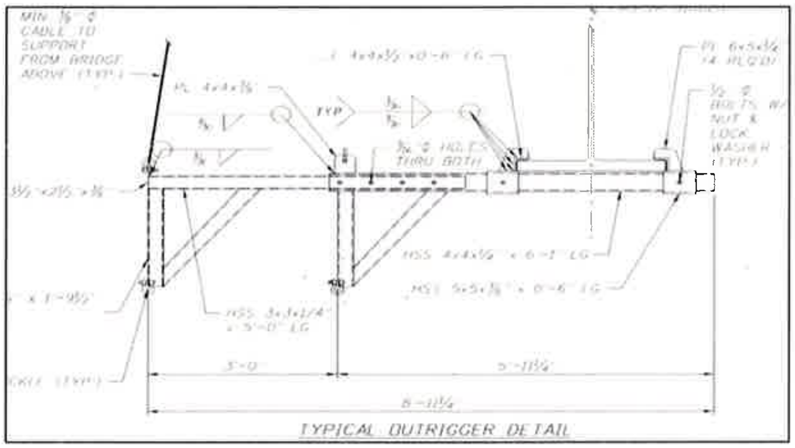
Dead Load = 3.13 psf
Live Load = 16.00 psf
Anticipated Uniform Load = **19.13 psf**

B. For a maximum 25.00 -ft. outrigger spacing, an estimated platform dead & live loading of 19.13 psf and 1 worker at the end of the outrigger, the max. anticipated load for which the outrigger is to be designed is:

Max. Cable Spacing = 5.25 ft.
Tributary Width = 5.25 ft. (Conservative)

P = (25.00)x(5.25)x(19.1) + 250 lbs = **2,760 lbs.**

SPACING WIDTH DL + LL WORKER



TYPICAL OUTRIGGER DETAIL

C. Maximum moment, Mmax = **3.51** kip-ft (From RAM Elements Analysis)

D. Analyzing a TS 4x4X1/4 outrigger arm, S_x = 3.90 in^3

Fy = 36 ksi

fy = 3.51 k-ft x (12) / 3.90 in³ = **10.8 ksi < 21.6 ksi OK**

fv = 2.76 kip / (2 x 3 in x 0.25 in.) = **1.84 ksi < 11.88 ksi OK**

Note: Each outrigger is to be supported from the bridge parapets or guide railing posts above to eliminate the cantilever bending within the outrigger arm.

SUBMITTAL REVIEW

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PB AMERICAS, INC.

BY: S J Bayington

DATE: 6/27/16

Vermont Agency of Transportation

RECEIVED

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BY: Mark Sargent DATE: 07/01/2016

A2B ENGINEERING, LLC CONSULTING ENGINEERS	Subject:	Abrasive Blasting Containment Plans Eleven Bridges on I-91, County of Windsor, Vermont		
	Comp by: MAT Check by: PRS	Date: 06/08/16 Job No: 187-18-1	Sheet Number:	

Typical Outrigger Connection Calculations:

A. Plate Check:

Plate Width, b =	3	in.
Plate Thickness, h =	0.5	in.
Section Modulus, S =	0.125	$in.^3$
Minimum Yield Stress, F_y =	36	ksi
Flange Width, b_f =	12	in.
Reaction =	1.12	kips
Moment Arm, a =	0.75	in.
Moment on Plate, M_{pl}=	0.84	kip-in
Bending Stress, f_b =	6.72	ksi
Allow. Bending Stress, F_b =	21.6	ksi
Capacity/Demand Ratio =	3.21	

(Conservative)
(From RAM Elements Analysis)

Plate Check: OK

SUBMITTAL REVIEW

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☒ NO EXCEPTIONS TAKEN
☐ MAKE CORRECTIONS NOTED
RESUBMITTAL NOT REQUIRED
☐ AMEND AND RESUBMIT
☐ REJECTED - SEE REMARKS

PB AMERICAS, INC.

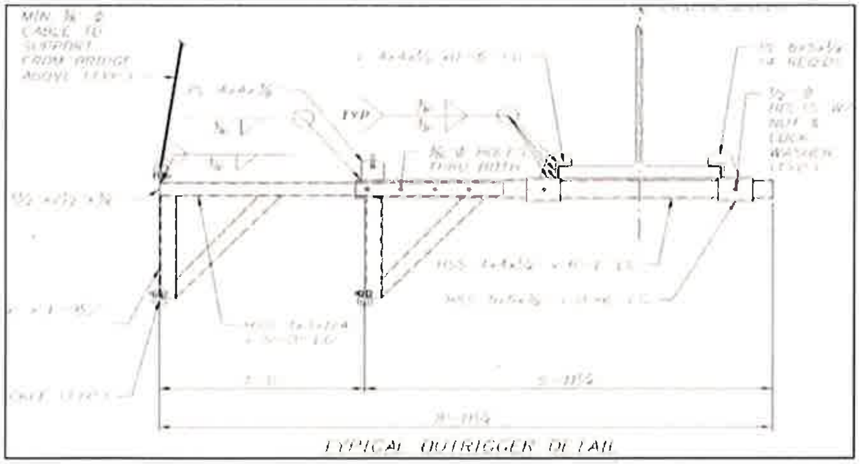
BY: S. Boyington
DATE: 6/27/16

===>> Support each outrigger from the bridge parapets or guide railing posts above to eliminate the cantilever bending within the outrigger arm.

B. Weld Check:

Weld Size =	3/16	in.	
Filler Metal Strength =	70	ksi	
Weld Effective Area, A_e =	0.80	$in.^2$	
Nom. Stress Weld Metal, F_{nw} =	42	ksi	(AISC 14th Ed.- Table J2.5)
Reaction =	1.12	kips	(From RAM Elements Analysis)
Weld Design Strength, R_n =	33.41	kips	(AISC 14th Ed.- Eqn. J2-3)
Capacity/Demand Ratio =	29.83		

Weld Check: OK



TYPICAL OUTRIGGER DETAIL

Vermont Agency of Transportation
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BY: Mark Sargent DATE: 07/01/2016

A2B ENGINEERING, LLC CONSULTING ENGINEERS	Subject:	Abrasive Blasting Containment Plans		
		Eleven Bridges on I-91, County of Windsor, Vermont		
	Comp by: MAT	Date: 06/08/16	Sheet Number:	
	Check by: PRS	Job No: 187-18-1		

Available Shear Strength on Bolts:

Available Shear, 5/8" Bolt =	16.60	kips	(From Table 7-1, AISC 14th Ed.)
5/8" Bolt Area =	0.31	in.^{2}	
1/2" Bolt Area =	0.20	in.^{2}	
Available Shear, 1/2" Bolt =	10.62	kips	
Service Design Cable Tension =	5.38	kips	
Cable Angle =	20	deg	
ASD Shear Load on Bolts =	1.84	kips/cable	
Number of Cables on Outrigger =	3		
Total ASD Shear Load =	5.52	kips	
Capacity/Demand Ratio =	1.92		

Bolt Shear Check: OK

Available Axial Compression on HSS 4x4x1/4:

Legnth, L =	9.00	ft.	
Effective Length Factor, K =	1.00		(Pinned-Pinned Connection)
Effective Length Factor, K =	2.00		(Cantilever with Fixed End)
Effective Length, KL =	18.00	ft.	(Conservative)
Pn/Ω Axial Comp., HSS 4x4x1/4 =	25.10	kips	(From Table 4-4, AISC 14th Ed.)
Total ASD Shear Load =	5.52	kips	
Capacity/Demand Ratio =	4.54		

Axial Comp. Check: OK

SUBMITTAL REVIEW

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PB AMERICAS, INC.

BY: SJ Boyington

DATE: 6/27/16

D42

Vermont Agency of Transportation

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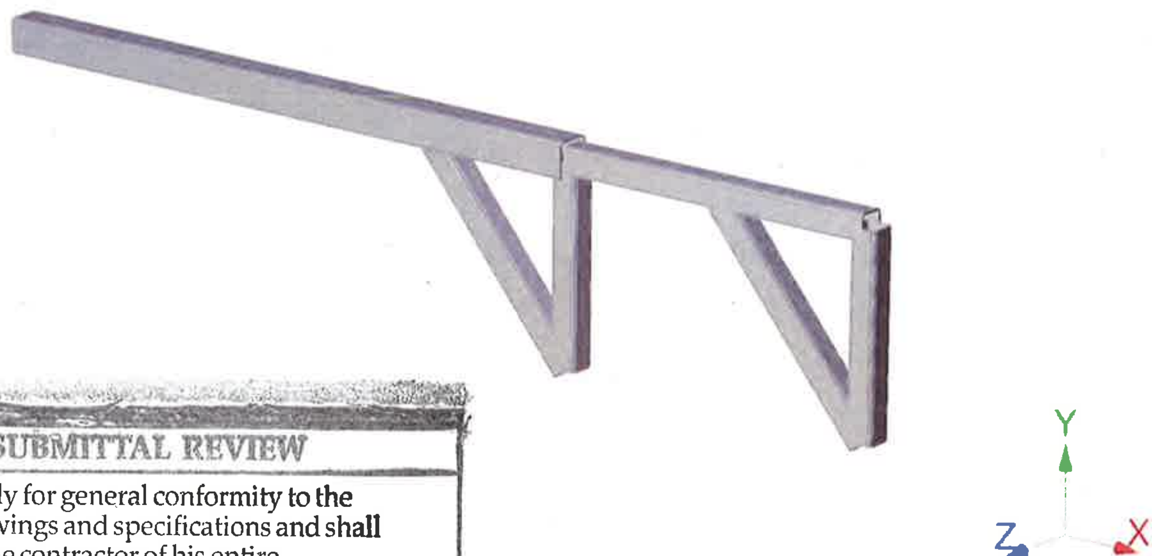

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PB AMERICAS, INC.

BY: S. Boyington

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Geometry data

GLOSSARY

Cb22, Cb33	: Moment gradient coefficients
Cm22, Cm33	: Coefficients applied to bending term in interaction formula
d0	: Tapered member section depth at J end of member
DJX	: Rigid end offset distance measured from J node in axis X
DJY	: Rigid end offset distance measured from J node in axis Y
DJZ	: Rigid end offset distance measured from J node in axis Z
DKX	: Rigid end offset distance measured from K node in axis X
DKY	: Rigid end offset distance measured from K node in axis Y
DKZ	: Rigid end offset distance measured from K node in axis Z
dL	: Tapered member section depth at K end of member
Ig factor	: Inertia reduction factor (Effective Inertia/Gross Inertia) for reinforced concrete members
K22	: Effective length factor about axis 2
K33	: Effective length factor about axis 3
L22	: Member length for calculation of axial capacity
L33	: Member length for calculation of axial capacity
LB pos	: Lateral unbraced length of the compression flange in the positive side of local axis 2
LB neg	: Lateral unbraced length of the compression flange in the negative side of local axis 2
RX	: Rotation about X
RY	: Rotation about Y
RZ	: Rotation about Z
TO	: 1 = Tension only member 0 = Normal member
TX	: Translation in X
TY	: Translation in Y
TZ	: Translation in Z

SUBMITTAL REVIEW

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PB AMERICAS, INC.
BY: SY Bryington
DATE: 6/21/16

Nodes

Node	X [ft]	Y [ft]	Z [ft]	Rigid Floor
1	0.00	0.00	0.00	0
2	9.00	0.00	0.00	0
3	1.50	0.00	0.00	0
4	4.50	0.00	0.00	0
5	6.00	0.00	0.00	0
6	7.50	0.00	0.00	0
7	9.00	-1.79	0.00	0
8	6.00	-1.79	0.00	0

Restraints

Node	TX	TY	TZ	RX	RY	RZ
1	1	1	1	1	0	0
3	0	1	1	0	0	0

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BY: Mark Sargent DATE: 07/01/2016

D44

Members

Member	NJ	NK	Description	Section	Material	d0 [in]	dL [in]	lg factor
1	1	3	Horiz. 4x4	HSS_SQR 4X4X1_4	A36	0.00	0.00	0.00
2	3	4	Horiz. 4x4	HSS_SQR 4X4X1_4	A36	0.00	0.00	0.00
3	4	5	Horiz. 4x4	HSS_SQR 4X4X1_4	A36	0.00	0.00	0.00
4	5	6	Horiz. 3x3	HSS_SQR 3X3X1_4	A36	0.00	0.00	0.00
5	6	2	Horiz. 3x3	HSS_SQR 3X3X1_4	A36	0.00	0.00	0.00
6	5	8	Vert. 3x3	HSS_SQR 3X3X1_4	A36	0.00	0.00	0.00
7	2	7	Vert. 3x3	HSS_SQR 3X3X1_4	A36	0.00	0.00	0.00
8	8	4	Diag. 3x3	HSS_SQR 3X3X1_4	A36	0.00	0.00	0.00
9	7	6	Diag. 3x3	HSS_SQR 3X3X1_4	A36	0.00	0.00	0.00

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PB AMERICAS, INC.

BY: [signature]

DATE: 6/7/16

Vermont Agency of Transportation

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Units system: English
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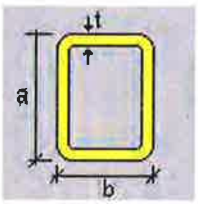
Section information

Section name: HSS_SQR 4X4X1_4 **(US)**

Dimensions



a	=	4.000	[in]	Height
b	=	4.000	[in]	Width
T	=	0.233	[in]	Thickness

Properties

Ag	:	3.370	[in2]	Gross area of the section.
I 33	:	7.800	[in4]	Moment of inertia about local axis 3.
I 22	:	7.800	[in4]	Moment of inertia about local axis 2.
I 23	:	0.000	[in4]	Product of inertia.
Ang 3' to 3	:	0.000	--	Angle to the principal axis. (°)
I 33'	:	7.800	[in4]	Moment of inertia about principal axis 3.
I 22'	:	7.800	[in4]	Moment of inertia about principal axis 2.
Dist. to cg 3	:	0.000	[in]	Distance from the geometric center to the gravity center of the section in the axis 3 direction.
Dist. to cg 2	:	0.000	[in]	Distance from the geometric center to the gravity center of the section in the axis 2 direction.
J	:	12.800	[in4]	Saint-Venant torsion constant.
Xsc'	:	0.000	[in]	Distance from the c.g. to the shear center with reference to the principal axis 3.
Ysc'	:	0.000	[in]	Distance from the c.g. to the shear center with reference to the principal axis 2.
Cw	:	0.000	[in6]	Section warping constant.
ro	:	2.150	[in]	Polar radius of gyration.
J 33'	:	0.000	[in]	Property to consider torsional – flexural buckling about principal axis 3.
J 22'	:	0.000	[in]	Property to consider torsional – flexural buckling about principal axis 2.
S 33 top	:	3.900	[in3]	Top elastic section modulus about local axis 3.
S 33 bot	:	3.900	[in3]	Bottom elastic section modulus about local axis 3.
S 22 top	:	3.900	[in3]	Top elastic section modulus about local axis 2.
S 22 bot	:	3.900	[in3]	Bottom elastic section modulus about local axis 2.
S 33' top	:	3.900	[in3]	Top elastic section modulus about principal axis 3.
S 33' bot	:	3.900	[in3]	Bottom elastic section modulus about principal axis 3.
S 22' top	:	3.900	[in3]	Top elastic section modulus about principal axis 2.
S 22' bot	:	3.900	[in3]	Bottom elastic section modulus about principal axis 2.
Z 33	:	4.700	[in3]	Plastic section modulus about local axis 3.
Z 22	:	4.700	[in3]	Plastic section modulus about local axis 2.
Z 33'	:	4.700	[in3]	Plastic section modulus about principal axis 3.
Z 22'	:	4.700	[in3]	Plastic section modulus about principal axis 2.
Max 3	:	2.000	[in]	Coordinate of the farthest positive extremity of the section in relation to local axis 3.
Min 3	:	-2.000	[in]	Coordinate of the farthest negative extremity of the section in relation to local axis 3.
Max 2	:	2.000	[in]	Coordinate of the farthest positive extremity of the section in relation to local axis 2.
Min 2	:	-2.000	[in]	Coordinate of the farthest negative extremity of the section in relation to local axis 2.
Aw3	:	1.538	[in2]	Flange area for shear.
Aw2	:	1.538	[in2]	Web area for shear.
C	:	6.563	[in3]	Torsional constant.
Qmod2'	:	1.74E+05	[in3]	Shear modulus for principal axis 2.
Qmod3'	:	1.74E+05	[in3]	Shear modulus for principal axis 3.

SUBMITTAL REVIEW

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PB AMERICAS, INC.
BY: S. Bayington
DATE: 6/27/16

Vermont Agency of Transportation
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ON: June 27, 2016
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BY: Mark Sargent DATE: 07/01/2016

D46

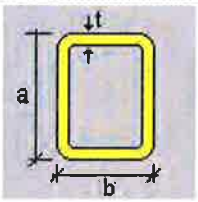
Bentley

Current Date: 6/10/2016 10:39 AM
Units system: English
File name: C:\Users\Laptop1\Desktop\Monoko\RAM R1.etz\

Section information

Section name: HSS_SQR 3X3X1_4 **(US)**

Dimensions



a	=	3.000	[in]	Height
b	=	3.000	[in]	Width
T	=	0.233	[in]	Thickness

Properties

Ag	2.440	[in2]	Gross area of the section.
I 33	3.000	[in4]	Moment of inertia about local axis 3.
I 22	3.000	[in4]	Moment of inertia about local axis 2.
I 23	0.000	[in4]	Product of inertia.
Ang 3' to 3	0.000	--	Angle to the principal axis. (°)
I 33'	3.000	[in4]	Moment of inertia about principal axis 3.
I 22'	3.000	[in4]	Moment of inertia about principal axis 2.
Dist. to cg 3	0.000	[in]	Distance from the geometric center to the gravity center of the section in the axis 3 direction.
Dist. to cg 2	0.000	[in]	Distance from the geometric center to the gravity center of the section in the axis 2 direction.
J	5.080	[in4]	Saint-Venant torsion constant.
Xsc'	0.000	[in]	Distance from the c.g. to the shear center with reference to the principal axis 3.
Ysc'	0.000	[in]	Distance from the c.g. to the shear center with reference to the principal axis 2.
Cw	0.000	[in6]	Section warping constant.
ro	1.571	[in]	Polar radius of gyration.
J 33'	0.000	[in]	Property to consider torsional – flexural buckling about principal axis 3.
J 22'	0.000	[in]	Property to consider torsional – flexural buckling about principal axis 2.
S 33 top	2.000	[in3]	Top elastic section modulus about local axis 3.
S 33 bot	2.000	[in3]	Bottom elastic section modulus about local axis 3.
S 22 top	2.000	[in3]	Top elastic section modulus about local axis 2.
S 22 bot	2.000	[in3]	Bottom elastic section modulus about local axis 2.
S 33' top	2.000	[in3]	Top elastic section modulus about principal axis 3.
S 33' bot	2.000	[in3]	Bottom elastic section modulus about principal axis 3.
S 22' top	2.000	[in3]	Top elastic section modulus about principal axis 2.
S 22' bot	2.000	[in3]	Bottom elastic section modulus about principal axis 2.
Z 33	2.500	[in3]	Plastic section modulus about local axis 3.
Z 22	2.500	[in3]	Plastic section modulus about local axis 2.
Z 33'	2.500	[in3]	Plastic section modulus about principal axis 3.
Z 22'	2.500	[in3]	Plastic section modulus about principal axis 2.
Max 3	1.500	[in]	Coordinate of the farthest positive extremity of the section in relation to local axis 3.
Min 3	-1.500	[in]	Coordinate of the farthest negative extremity of the section in relation to local axis 3.
Max 2	1.500	[in]	Coordinate of the farthest positive extremity of the section in relation to local axis 2.
Min 2	-1.500	[in]	Coordinate of the farthest negative extremity of the section in relation to local axis 2.
Aw3	1.072	[in2]	Flange area for shear.
Aw2	1.072	[in2]	Web area for shear.
C	3.518	[in3]	Torsional constant.
Qmod2'	2.36E+05	[in3]	Shear modulus for principal axis 2.
Qmod3'	2.36E+05	[in3]	Shear modulus for principal axis 3.

SUBMITTAL REVIEW

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PB AMERICAS, INC.
BY: S Bayington
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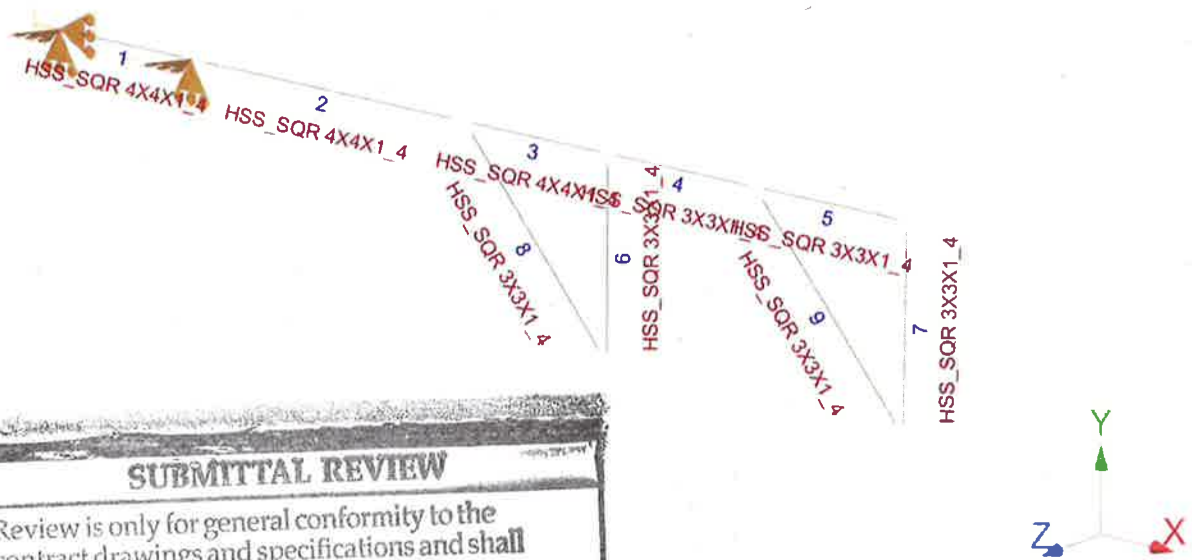
D47

Bentley

Current Date: 6/10/2016 10:40 AM
Units system: English
File name: C:\Users\Laptop1\Desktop\Monoko\RAM R1.etz\



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PB AMERICAS, INC.

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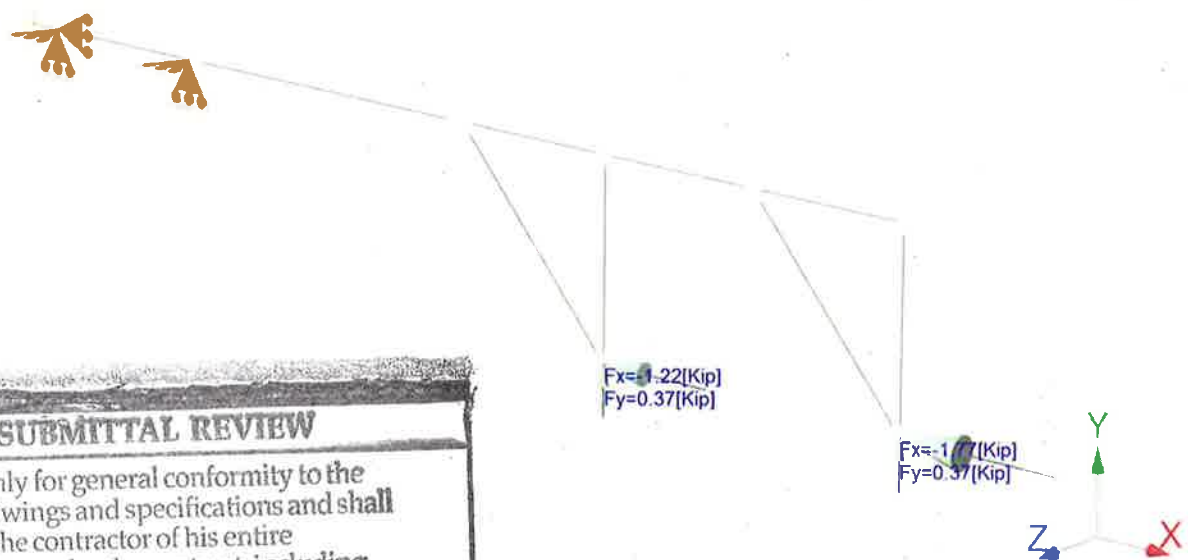
Load condition: DL=Dead Load

Loads

- Bending moments
- Concentrated - Nodes



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Load data

GLOSSARY

Comb : Indicates if load condition is a load combination

Load conditions

Condition	Description	Comb.	Category
DL	Dead Load	No	DL
S1	DL	Yes	
D1	DL	Yes	

Load on nodes

Condition	Node	FX [Kip]	FY [Kip]	FZ [Kip]	MX [Kip*ft]	MY [Kip*ft]	MZ [Kip*ft]
DL	7	-1.77	0.37	0.00	0.00	0.00	0.00
	8	-1.22	0.37	0.00	0.00	0.00	0.00

Self weight multipliers for load conditions

Condition	Description	Comb.	Self weight multiplier MultX	MultY	MultZ
DL	Dead Load	No	0.00	-1.00	0.00
S1	DL	Yes	0.00	0.00	0.00
D1	DL	Yes	0.00	0.00	0.00

Earthquake (Dynamic analysis only)

Condition	a/g	Ang. [Deg]	Damp. [%]
DL	0.00	0.00	0.00
S1	0.00	0.00	0.00
D1	0.00	0.00	0.00

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Steel Code Check

Report: Summary - Group by member

Load conditions to be included in design :
D1=DL

Description	Section	Member	Ctrl Eq.	Ratio	Status	Reference
Diag. 3x3	*HSS_SQR 3X3X1_4*	8	D1 at 100.00%	0.17	OK	Eq. H1-1b
		9	D1 at 100.00%	0.19	OK	Eq. H1-1b
Horiz. 3x3		4	D1 at 100.00%	**0.41**	**OK**	Eq. H1-1b
		5	D1 at 0.00%	0.23	OK	Eq. H1-1b
Horiz. 4x4	*HSS_SQR 4X4X1_4*	1	D1 at 100.00%	0.15	OK	Eq. H1-1b
		2	D1 at 100.00%	**0.29**	**OK**	Eq. H1-1b
		3	D1 at 0.00%	0.20	OK	Eq. H1-1b
Vert. 3x3	*HSS_SQR 3X3X1_4*	6	D1 at 0.00%	**0.14**	**OK**	Eq. H1-1b
		7	D1 at 100.00%	0.06	OK	Eq. H1-1b

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PB AMERICAS, INC.
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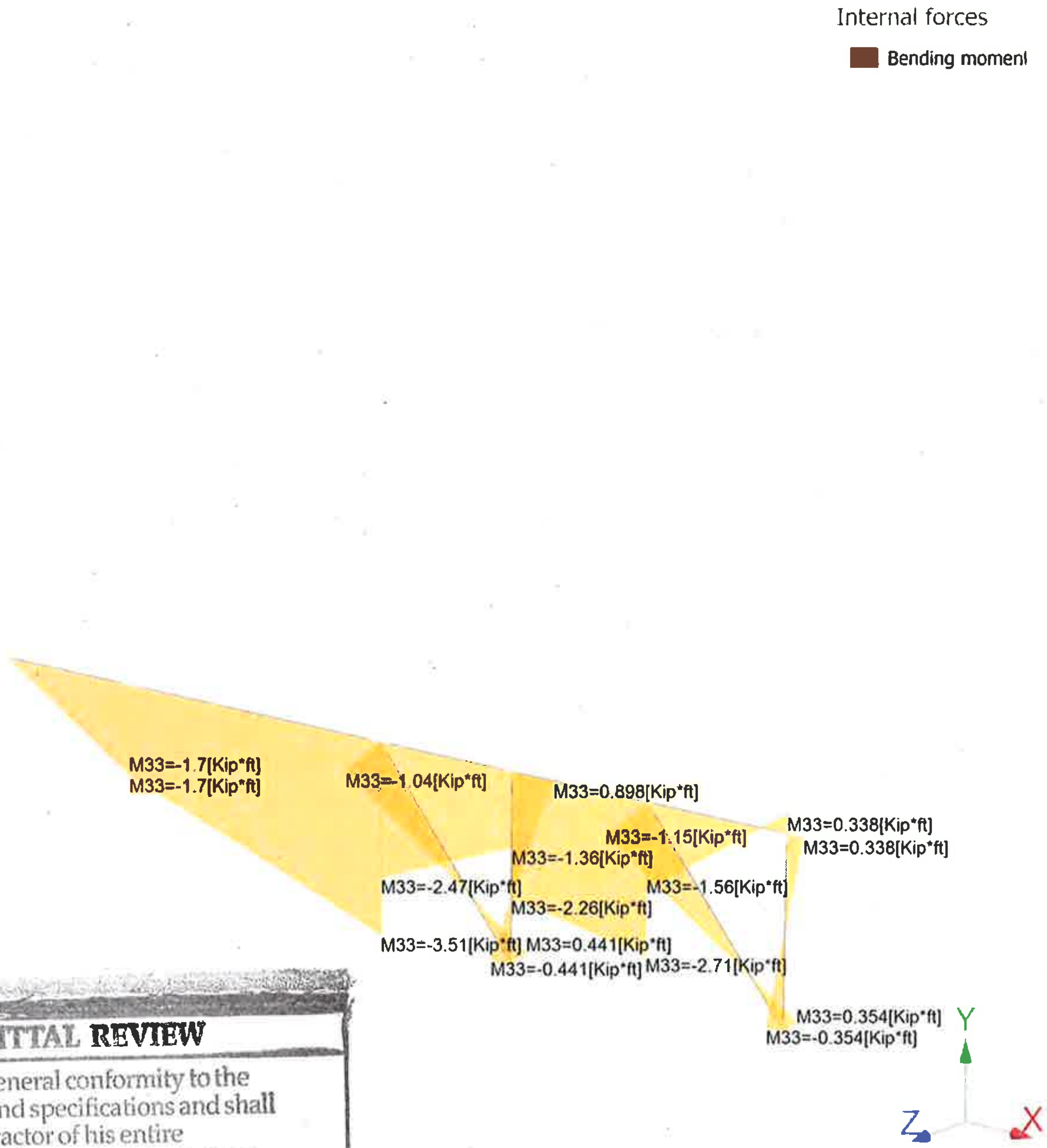
File name: C:\Users\Laptop1\Desktop\Monoko\RAM R1.etz\
Load condition: DL=Dead Load



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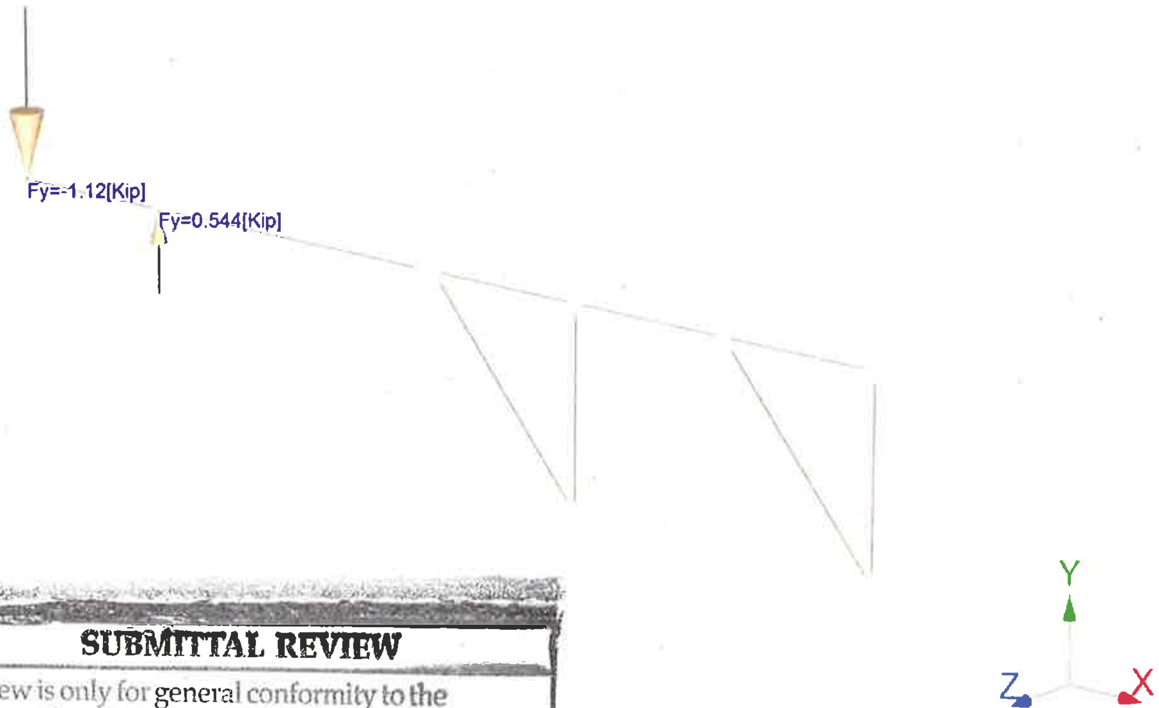
Load condition: DL=Dead Load



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PB AMERICAS, INC.
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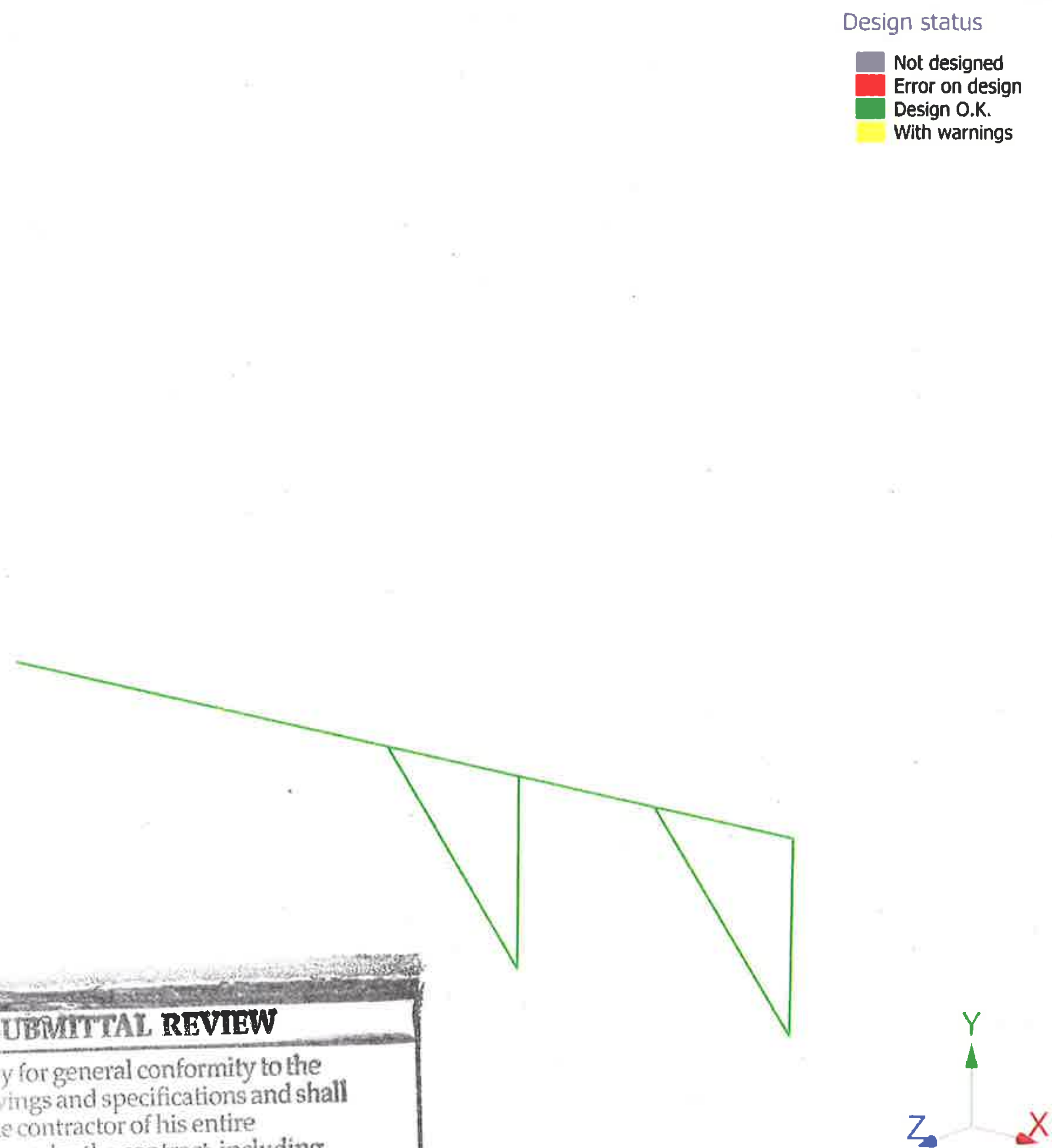
File name: C:\Users\Laptop1\Desktop\Monoko\RAM R1.etz\
Load condition: D1=DL



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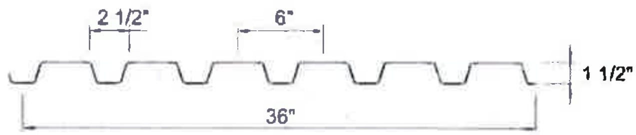
B, BA, BV DECK



Height	1 1/2 in.
Fy (minimum)	33 ksi
Modulus of Elasticity	29500 ksi

SECTION PROPERTIES

Gage	Fy (ksi)	Coverage (in)	Thickness (in)	Weight (psf)	I (in^4/ft)	Sp (in^3/ft)	Sn (in^3/ft)
22	33	36	0.0295	1.63	0.177	0.189	0.198
20	33	36	0.0358	1.96	0.213	0.238	0.247
18	33	36	0.0474	2.57	0.290	0.315	0.316

ALLOWABLE UNIFORM LOADS

Span Condition	Gage	Allowable Total (Dead + Live) Uniform Load (psf) Center to Center Span (ft. - in.) 5 - 0	5 - 6	6 - 0	6 - 6	7 - 0	7 - 6	8 - 0	8 - 6	9 - 0	9 - 6	Max. Constr. Span (ctr. to ctr.)
Single	22	91	71	57	47	40	34	30	27	24	22	5 - 8
	20	111	86	69	56	47	40	35	30	27	25	6 - 7
	18	156	119	94	76	63	53	46	40	35	31	8 - 2
Double	22	107	88	74	63	54	47	42	37	33	30	6 - 8
	20	133	110	92	79	68	59	52	46	41	37	7 - 10
	18	170	140	118	101	87	76	66	59	53	47	9 - 6
Triple	22	133	110	93	79	68	59	50	44	38	34	6 - 9
	20	166	137	115	98	84	70	59	51	45	39	7 - 11
	18	213	176	146	125	107	93	78	67	58	51	9 - 8

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BY: [signature] 6/27/16

Notes

1. Section properties are calculated using the AISI Cold Formed Steel Design Specifications, 1996 Edition.
2. Loads and maximum construction spans are based on the SDI Design Manual for Composite Decks, Form Decks and Roof Decks, Publication No. 30.
3. Maximum cantilever spans are based on SDI criteria and are sensitive to adjacent spans. For this table, adjacent span is assumed to be at least 1.5 times longer than the cantilever span.
4. Minimum end bearing length shall be 1 1/2".
5. Loads shown in RED are governed by the live load deflection not in excess of 1/240 of span. 10 psf dead load has been included.
6. Perforations which are placed in the vertical ribs of type BA deck reduce the strength less than 5%.

FACTORY MUTUAL SPANS

Gage	Max. Ctr. to Ctr. Span (ft.-in.)
22	6 - 0
20	6 - 6
18	7 - 5

CANTILEVER SPANS

Gage	Maximum Cantilever Span (ft.-in.)
22	2 - 0
20	2 - 4
18	2 - 8

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3a containment plan calculations approved 062716.pdf
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- Type B deck provides the best balance of strength and economy of all the 1 1/2" deep roof decks. 1" (minimum) rigid roofing insulation is required to be used with type B deck.
- Available with nested side laps only.
- Available as an acoustic deck. Type BA deck is manufactured with perforations in the vertical ribs, having a NRC rating of 0.60 with 1 1/2" (minimum) rigid roofing insulation.
- Available as a vented deck. Type BV deck is manufactured with slot vents in the bottom flutes. The openings equal 0.5% of total surface. Type BV deck is to be specified when venting is required for cementitious insulation fills. Type BV deck is manufactured at our Lake City, FL facility only.
- Type B deck is Factory Mutual approved. Type BA and BV decks are not Factory Mutual approved.
- Type B, BA and BV decks are manufactured from steel conforming to ASTM A1008-00 Grades C, D or E or from A653/A653M-00 structural quality grade SQ33 or higher. The minimum yield strength used by NMBS is 33 KSI.
- Minimum attachment to supporting structural members requires connections at all side lap ribs plus a sufficient number of interior ribs to limit the spacing between connections to 18". Side laps are to be fastened together between supports, at a maximum spacing of 36" o.c. whenever the deck span exceeds 5'-0". Connections can be made either by welding using a minimum 5/8" diameter puddle weld or properly designed mechanical fasteners.

NEW MILLENNIUM BUILDING SYSTEMS

RED HEAD
CONCRETE ANCHORING SPECIALISTS

or go to the Advance Search

Trubolt Wedge Type Anchor

Performance Data (2 pages)

Product Information: Suggested Specifications
Selection and Order Information (2 pages)
Installation Instructions :Approvals and Listing

PERFORMANCE TABLE

Trubolt Wedge Anchors				*Ultimate Tension and Shear Values (Lbs/kN) in Concrete**					
ANCHOR DIA In. (mm)	INSTALLATION TORQUE Ft. Lbs (Nm)	EMBEDMENT DEPTH In. (mm)	ANCHOR TYPE	f'c = 2000 PSI (13.8 MPa)		f'c = 4000 PSI (27.6 MPa)		f'c = 6000 PSI (41.4 MPa)	
				TENSION Lbs. (kN)	SHEAR Lbs. (kN)	TENSION Lbs. (kN)	SHEAR Lbs. (kN)	TENSION Lbs. (kN)	SHEAR Lbs. (kN)
1/4 (6.4)	4 (5.4)	1-1/8 (28.6) 1-15/16 (49.2) 2-1/8 (54.0)	WS-Carbon or WS-G Hol-Dipped Galvanized or WW-304 S.S. or SWW-316 S.S.	1,180 (5.2) 2,100 (9.3) 2,260 (10.1)	1,400 (6.2) 1,680 (7.5) 1,680 (7.5)	1,780 (7.9) 3,300 (14.7) 3,300 (14.7)	1,400 (6.2) 1,680 (7.5) 1,680 (7.5)	1,900 (8.5) 3,300 (14.7) 3,300 (14.7)	1,400 (6.2) 1,680 (7.5) 1,680 (7.5)
3/8 (9.5)	25 (33.9)	1-1/2 (38.1) 3 (76.2) 4 (101.6)		1,680 (7.5) 3,480 (15.5) 4,800 (21.4)	2,320 (10.3) 4,000 (17.8) 4,000 (17.8)	2,240 (10.0) 5,940 (26.4) 5,940 (26.4)	2,620 (10.3) 4,140 (18.4) 4,140 (18.4)	2,840 (12.6) 6,120 (27.2) 6,120 (27.2)	3,160 (14.1) 4,500 (20.0) 4,500 (20.0)
1/2 (12.7)	55 (74.6)	2-1/4 (57.2) 4-1/8 (104.8) 6 (152.4)		4,660 (20.7) 4,660 (20.7) 5,340 (23.8)	4,760 (21.2) 7,240 (32.2) 7,240 (32.2)	5,100 (22.7) 9,640 (42.9) 9,640 (42.9)	4,760 (21.2) [illegible] 7,240 (32.2)	7,040 (31.3) 10,820 (48.1) 10,820 (48.1)	7,040 (31.3) 8,160 (36.3) 8,160 (36.3)
5/8 (15.9)	90 (122.0)	2-3/4 (69.9) 5-1/8 (130.2) 7-1/2 (190.5)		6,580 (29.3) 6,580 (29.3) 7,060 (31.4)	7,120 (31.7) 9,600 (42.7) 9,600 (42.7)	7,180 (31.9) 14,920 (66.4) 15,020 (66.8)	7,120 (31.7) 11,900 (52.9) 11,900 (52.9)	9,720 (43.2) 16,380 (72.9) 16,380 (72.9)	9,616 (42.8) [illegible] 12,520 (55.7)
3/4 (19.1)	110 (149.2)	3-1/4 (82.6) 6-5/8 (168.3) 10 (254.0)		7,120 (31.7) 10,980 (48.8) 10,980 (48.8)	10,120 (45.0) 20,320 (90.4) 20,320 (90.4)	10,840 (48.2) 17,700 (78.7) 17,880 (79.5)	13,720 (61.0) 23,740 (105.6) 23,740 (105.6)	13,300 (59.2) 20,260 (90.1) 23,580 (104.9)	15,980 (71.1) 23,740 (105.6) 23,740 (105.6)
7/8 (22.2)	250 (339.0)	3-3/4 (95.3) 6-1/4 (158.8) 8 (203.2)		9,520 (42.3) 14,660 (65.2) 14,660 (65.2)	13,160 (58.5) 20,880 (92.9) 20,880 (92.9)	14,740 (65.6) 20,940 (93.1) 20,940 (93.1)	16,580 (73.8) 28,800 (128.1) 28,800 (128.1)	17,420 (77.5) 24,360 (108.4) 24,360 (108.4)	19,160 (85.2) 28,800 (128.1) [illegible]
1 (25.4)	300 (406.7)	4-1/2 (114.3) 7-3/8 (187.3) 9-1/2 (241.3)		13,940 (62.0) 14,600 (64.9) 18,700 (83.2)	16,080 (71.5) 28,680 (127.6) 28,680 (127.6)	20,180 (89.8) 23,980 (106.7) 26,540 (118.1)	[illegible] 37,940 (168.8) [illegible]	21,180 (94.2) 33,260 (148.0) 33,260 (148.0)	[illegible] 38,080 (169.4) [illegible]

* Allowable values are based upon a 4 to 1 safety factor. Divide by 4 for allowable load values.
* For Tie-Wire Wedge Anchor, TW-1400, use tension data from 1/4" diameter with 1-1/8" embedment.

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TB AMERICAS, INC.
BY: S. Bonington
DATE: 6/23/16

PERFORMANCE TABLE

Trubolt Wedge Anchors				*Ultimate Tension and Shear Values (Lbs/kN) in Lightweight Concrete**			
ANCHOR DIA In. (mm)	INSTALLATION TORQUE Ft. Lbs (Nm)	EMBEDMENT DEPTH In. (mm)	ANCHOR TYPE	LIGHTWEIGHT CONCRETE f'c = 3000 PSI 20.7 MPa)		LOWER FLUTE OF STEEL DECK WITH LIGHTWEIGHT CONCRETE FILL f'c = 2000 PSI (13.8 MPa)	
				TENSION Lbs. (kN)	SHEAR Lbs. (kN)	TENSION Lbs. (kN)	SHEAR Lbs. (kN)
3/8 (9.5)	25 (33.9)	1-1/2 (38.1) 3 (76.2)	WS-Carbon or WS-G Hol-Dipped Galvanized or WW-304 S.S. or SWW-316 S.S.	1,175 (5.2) 2,825 (12.6)	1,480 (6.6) 2,440 (10.9)	1,900 (8.5) 2,840 (12.6)	3,160 (14.1) 4,000 (17.8)
1/2 (12.7)	55 (74.6)	2-1/4 (57.2) 3 (76.2) 4 (101.6)		2,925 (13.0) 3,470 (15.4) 4,290 (19.1)	2,855 (12.7) 3,450 (15.3) 3,450 (15.3)	3,400 (15.1) 4,480 (19.9) 4,800 (21.4)	5,380 (23.9) 6,620 (29.4) 6,440 (28.6)
5/8 (15.9)	90 (122.0)	3 (76.2) 5 (127.0)		4,375 (19.5) 6,350 (28.2)	4,360 (19.4) 6,335 (28.2)	4,720 (21.0) 6,580 (29.3)	5,500 (24.5) 9,140 (40.7)
3/4 (19.1)	110 (149.2)	3-1/4 (82.6) 5-1/4 (133.4)		5,390 (24.0) 7,295 (32.5)	7,150 (31.8) 10,750 (47.8)	5,840 (26.0) 7,040 (31.3)	8,880 (39.5) ----

* Allowable values are based upon a 4 to 1 safety factor. Divide by 4 for allowable load values.

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D56

Forged Wire Rope Clips

SEE APPLICATION AND WARNING INFORMATION
Para Español: www.thecrosbygroup.com
On Page 56

G-450

- Each base has a Product Identification Code (PIC) for material traceability, the name CROSBY or CG, and a size forged into it.
- Based on the catalog breaking strength of wire rope, Crosby wire rope clips have an efficiency rating of 80% for 1/8" - 7/8" sizes, and 90% for sizes 1" through 3-1/2".
- Entire Clip-Galvanized to resist corrosive and rusting action.
- Sizes 1/8" through 2-1/2" and 3" have forged bases.
- All Clips are individually bagged or tagged with proper application instructions and warning information.
- Clip sizes up through 1-1/2" have rolled threads.
- Meets or exceeds all requirements of ASME B30.26 including identification, ductility, design factor, proof load and temperature requirements. Importantly, these wire rope clips meet other critical performance requirements including fatigue life, impact properties and material traceability, not addressed by ASME B30.26.
- Look for the Red-U-Bolt®, your assurance of Genuine Crosby Clips.

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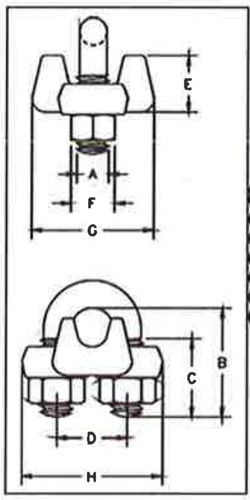
PB AMERICAS, INC.
BY:
DATE:

Crosby Clips, all sizes 1/4" and larger, meet the performance requirements of Federal Specification FF-C-450 TYPE 1 CLASS 1, except for those provisions required of the contractor. For additional information, see page 444.

G-450 Crosby® Clips



Rope Size (in.)	Rope Size (mm)	G-450 Stock No.	Std. Package Qty.	Weight Per 100 (lbs.)	A	B	C	D	E	F	G	H
1/8	3-4*	1010015	100	6	.22	.72	.44	.47	.37	.38	.81	.99
3/16*	5*	1010033	100	10	.25	.97	.56	.59	.50	.44	.94	1.18
1/4	6-7	1010051	100	19	.31	1.03	.50	.75	.66	.56	1.19	1.43
5/16	8	1010079	100	28	.38	1.38	.75	.88	.73	.69	1.31	1.66
3/8	9-10	1010097	100	48	.44	1.50	.75	1.00	.91	.75	1.63	1.94
7/16	11	1010113	50	78	.50	1.88	1.00	1.19	1.13	.88	1.91	2.28
1/2	12-13	1010131	50	80	.50	1.88	1.00	1.19	1.13	.88	1.91	2.28
9/16	14-15	1010159	50	109	.56	2.25	1.25	1.31	1.34	.94	2.06	2.50
5/8	16	1010177	50	110	.56	2.25	1.25	1.31	1.34	.94	2.06	2.50
3/4	18-20	1010195	25	142	.62	2.75	1.44	1.50	1.39	1.06	2.25	2.84
7/8	22	1010211	25	212	.75	3.12	1.62	1.75	1.58	1.25	2.44	3.16
1	24-26	1010239	10	252	.75	3.50	1.81	1.88	1.77	1.25	2.63	3.47
1-1/8	28-30	1010257	10	283	.75	3.88	2.00	2.00	1.91	1.25	2.81	3.59
1-1/4	32-34	1010275	10	438	.88	4.44	2.22	2.34	2.17	1.44	3.13	4.13
1-3/8	36	1010293	10	442	.88	4.44	2.22	2.34	2.31	1.44	3.13	4.19
1-1/2	38	1010319	10	544	.88	4.94	2.38	2.59	2.44	1.44	3.41	4.44
1-5/8	41-42	1010337	Bulk	704	1.00	5.31	2.62	2.75	2.66	1.63	3.63	4.75
1-3/4	44-46	1010355	Bulk	934	1.13	5.75	2.75	3.06	2.92	1.81	3.81	5.24
2	48-52	1010373	Bulk	1300	1.25	6.44	3.00	3.38	3.03	2.00	4.44	5.88
2-1/4	56-58	1010391	Bulk	1600	1.25	7.13	3.19	3.88	3.19	2.00	4.56	6.38
2-1/2	62-65	1010417	Bulk	1900	1.25	7.69	3.44	4.13	3.69	2.00	4.69	6.63
** 2-3/4	** 68-72	1010435	Bulk	2300	1.25	8.31	3.56	4.38	4.88	2.00	5.00	6.88
3	75-78	1010453	Bulk	3100	1.50	9.19	3.88	4.75	4.44	2.38	5.31	7.61
** 3-1/2	** 85-90	1010426	Bulk	4000	1.50	10.75	4.50	5.50	6.00	2.38	6.19	8.38

* Electro-plated U-Bolt and Nuts. ** 2-3/4" and 3-1/2" base is made of cast steel.

Vermont Agency of Transportation
RECEIVED
ON: June 27, 2016
and Checked for
CONFORMANCE
BY: Mark Sargent DATE: 07/01/2016

- Each base has a Product Identification Code (PIC) for material traceability, the name CROSBY or "CG", and a size forged into it.
- Entire clip is made from 316 Stainless Steel to resist corrosive and rusting action.
- All components are Electro-Polished.
- All Clips are individually bagged or tagged with proper application instructions and warning information.

SS-450

SS-450 Stainless Steel Wire Rope Clips

Rope Size (in.)	Rope Size (mm)	SS-450 Stock No.	Std. Package Qty.	Weight Per 100 (lbs.)	A	B	C	D	E	F	G	H
1/8	3-4	1011250	Bulk	6	.22	.72	.44	.47	.41	.38	.81	.94
3/16	5	1011261	Bulk	10	.25	.97	.56	.59	.50	.44	.94	1.16
1/4	6-7	1011272	Bulk	20	.31	1.03	.50	.75	.66	.56	1.19	1.44
3/8	9-10	1011283	Bulk	47	.44	1.50	.75	1.00	.91	.75	1.63	1.94
1/2	12-13	1011305	Bulk	77	.50	1.88	1.00	1.19	1.13	.88	1.91	2.28
5/8	16	1011327	Bulk	106	.56	2.38	1.25	1.31	1.34	.94	2.06	2.50

Include 4 cable clips

CROSBY® CLIPS WARNINGS AND APPLICATION INSTRUCTIONS

G-450
(Red-U-Bolt®)

SS-450
(316 Stainless Steel)

⚠WARNING

- **Failure to read, understand, and follow these instructions may cause death or serious injury.**
- **Read and understand these instructions before using clips.**
- **Match the same size clip to the same size wire rope.**
- **Prepare wire rope end termination only as instructed.**
- **Do not use with plastic coated wire rope.**
- **Apply first load to test the assembly. This load should be of equal or greater weight than loads expected in use. Next, check and retighten nuts to recommended torque (See Table 1).**

Efficiency ratings for wire rope end terminations are based upon the minumum breaking force of wire rope. The efficiency rating of a properly prepared loop or thimble-eye termination for clip sizes 32 mm through 22mm is 80%, and for sizes 25.5 mm through 88.9 mm is 90%.

The number of clips shown (see Table 1) is based upon using RRL or RLL wire rope, 6 x 19 or 6 x 36 Class, FC or IWRC; IPS or XIP, XXIP. If Seale construction or similar large outer wire type construction in the 6 x 19 Class is to be used for sizes 1 inch and larger, add one additional clip. If a pulley (sheave) is used for turning back the wire rope, add one additional clip.

The number of clips shown also applies to rotation-resistant RRL wire rope, 8 x 19 Class, IPS, XIP, XXIP sizes 1-1/2 inch and smaller; and to rotation-resistant RRL wire rope, 19 x 7 Class, IPS, XIP, XXIP sizes 1-3/4 inch and smaller.

For other classes of wire rope not mentioned above, we recommend contacting Crosby Engineering to ensure the desired efficiency rating.

For elevator, personnel hoist, and scaffold applications, refer to ANSI A17.1 and ANSI A10.4. These standards do not recommend U-Bolt style wire rope clip terminations. The style wire rope termination used for any application is the obligation of the user.

For OSHA (Construction) applications, see OSHA 1926.251.

1. Refer to Table 1 in following these instructions. Turn back specified amount of rope from thimble or loop. Apply first clip one base width from dead end of rope. Apply U-Bolt over dead end of wire rope – live end rests in saddle (Never saddle a dead horse!). Use torque wrench to tighten nuts evenly, alternate from one nut to the other until reaching the recommended torque. (See Figure 1)

Figure 1

2. When two clips are required, apply the second clip as near the loop or thimble as possible. Use torque wrench to tighten nuts evenly, alternating until reaching the recommended torque. When more than two clips are required, apply the second clip as near the loop or thimble as possible, turn nuts on second clip firmly, but do not tighten. (See Figure 2)

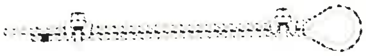


Figure 2

3. When three or more clips are required, space additional clips equally between first two – take up rope slack – use torque wrench to tighten nuts on each U-Bolt evenly, alternating from one nut to the other until reaching recommended torque. (See Figure 3)

Figure 3

4. If a pulley (sheave) is used in place of a thimble, add one additional clip. Clip spacing should be as shown. (See Figure 4)

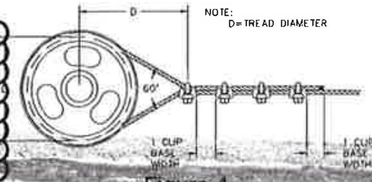


Figure 4

5. WIRE ROPE SPLICING PROCEDURES:

The preferred method of splicing two wire ropes together is to use inter-locking turnback eyes with thimbles using the recommended number of clips on each eye (See Figure 5).

An alternate method is to use twice the number of clips as used for a turnback termination. The rope ends are placed parallel to each other, overlapping by twice the turnback amount shown in the application instructions. The minimum number of clips should be installed on each dead end (See Figure 6). Spacing, installation torque, and other instructions still apply.

Figure 6

6. IMPORTANT

Apply first load to test the assembly. This load should be of equal or greater weight than loads expected in use. Next, check and use torque wrench to retighten nuts to recommended torque. In accordance with good rigging and maintenance practices, the wire rope end termination should be inspected periodically for wear, abuse, and general adequacy.

Table 1				
Clip Size (in.)	Rope Size (mm)	Minimum No. of Clips	Amount of Rope to Turn Back in mm	*Torque in Nm
1/8	3-4	2	85	6.1
3/16	5	2	95	10.2
1/4	6-7	2	120	20.3
5/16	8	2	133	40.7
3/8	9-10	2	165	61.0
7/16	11-12	2	178	68
1/2	13	3	292	88
9/16	14-15	3	305	129
5/8	16	3	305	129
3/4	18-20	4	460	176
7/8	22	4	480	305
1	24-25	5	660	305
1-1/8	28-30	6	860	305
1-1/4	33-34	7	1120	488
1-3/8	36	7	1120	488
1-1/2	38-40	8	1370	488
1-5/8	41-42	8	1470	583
1-3/4	44-46	8	1550	800
2	48-52	8	1800	1017
2-1/4	56-58	8	1850	1017
2-1/2	62-65	9	2130	1017
2-3/4	68-72	10	2540	1017
3	75-78	10	2690	1627
3-1/2	85-90	12	3780	1627

If a pulley (sheave) is used for turning back the wire rope, add one additional clip. See Figure 4.

If a greater number of clips are used than shown in the table, the amount of turnback should be increased proportionately.

*The tightening torque values shown are based upon the threads being clean, dry, and free of lubrication.

rev. 2

Crosby® Round Pin Shackles

Load Rated | Fatigue Rated | QT | QUIC-CHECK® | MAXTOUGH®

ROUND PIN ANCHOR SHACKLES

G-213 S-213

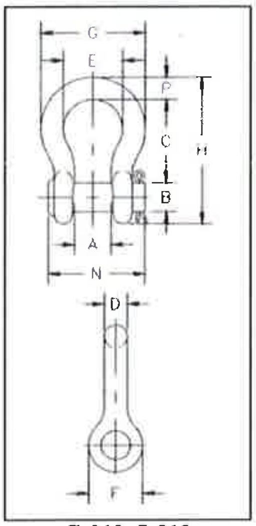
Round pin anchor shackles meet the performance requirements of Federal Specification RR-C-271D Type IVA, Grade A, Class 1, except for those provisions required of the contractor.

- Capacities 1/2 thru 35 metric tons.
- Forged - Quenched and Tempered, with alloy pins.
- Working Load Limit permanently shown on every shackle.
- Hot Dip galvanized or Self Colored.
- Fatigue rated.
- Shackles 25t and larger are **RFID EQUIPPED**.
- Shackles can be furnished proof tested with certificates to designated standards, such as ABS, DNV, Lloyds, or other certification. Charges for proof testing and certification available when requested at the time of order.
- Shackles are Quenched and Tempered and can meet DNV impact requirements of 42 joules at -20 degree C.
- Look for the Red Pin® . . . the mark of genuine Crosby quality.

ROUND PIN CHAIN SHACKLES

G-215 S-215

Round pin chain shackles meet the performance requirements of Federal Specification RR-C-271D Type IVB, Grade A, Class 1, except for those provisions required of the contractor.

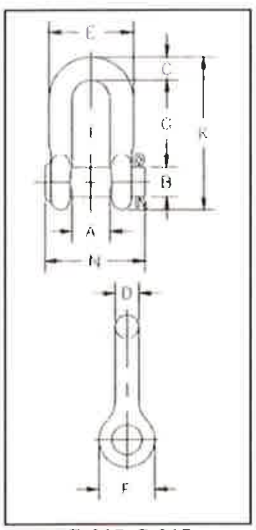


G-213 S-213

Nominal Size (In.)	Working Load Limit (t)*	Stock No. G-213	Stock No. S-213	Weight Each (lbs.)	Dimensions (in.) A	B	C	D	E	F	G	H	N	P	Tolerance +/- C	Tolerance +/- A
1/4	1/2	1018017	1018026	.13	.47	.31	1.13	.25	.78	.61	1.28	1.84	1.34	.25	.06	.06
5/16	3/4	1018035	1018044	.18	.53	.38	1.22	.31	.84	.75	1.47	2.09	1.59	.31	.06	.06
3/8	1	1018053	1018062	.29	.66	.44	1.44	.38	1.03	.91	1.78	2.49	1.86	.38	.13	.06
7/16	1-1/2	1018071	1018080	.38	.75	.50	1.69	.44	1.16	1.06	2.03	2.91	2.13	.44	.13	.06
1/2	2	1018099	1018106	.71	.81	.63	1.88	.50	1.31	1.19	2.31	3.28	2.38	.50	.13	.06
5/8	3-1/4	1018115	1018124	1.50	1.06	.75	2.38	.63	1.69	1.50	2.94	4.19	2.91	.69	.13	.06
3/4	4-3/4	1018133	1018142	2.32	1.25	.88	2.81	.75	2.00	1.81	3.50	4.97	3.44	.81	.25	.06
7/8	6-1/2	1018151	1018160	3.49	1.44	1.00	3.31	.88	2.28	2.09	4.03	5.83	3.81	.97	.25	.06
1	8-1/2	1018179	1018188	5.00	1.69	1.13	3.75	1.00	2.69	2.38	4.69	6.56	4.53	1.06	.25	.06
1-1/8	9-1/2	1018197	1018204	6.97	1.81	1.25	4.25	1.13	2.91	2.69	5.16	7.47	5.13	1.25	.25	.06
1-1/4	12	1018213	1018222	9.75	2.03	1.38	4.69	1.29	3.25	3.00	5.75	8.25	5.50	1.38	.25	.06
1-3/8	13-1/2	1018231	1018240	13.25	2.25	1.50	5.25	1.42	3.63	3.31	6.38	9.16	6.13	1.50	.25	.13
1-1/2	17	1018259	1018268	17.25	2.38	1.63	5.75	1.54	3.88	3.63	6.88	10.00	6.50	1.62	.25	.13
1-3/4	25	1018277	1018286	29.46	2.88	2.00	7.00	1.84	5.00	4.19	8.86	12.34	7.75	2.25	.25	.13
2	35	1018295	1018302	45.75	3.25	2.25	7.75	2.08	5.75	4.81	9.97	13.68	8.75	2.40	.25	.13

* NOTE: Maximum Proof Load is 2.0 times the Working Load Limit. Minimum Ultimate Strength is 6 times the Working Load Limit.

☒ NO EXCEPTIONS TAKEN
☐ MAKE CORRECTIONS NOTED
RESUBMITTAL NOT REQUIRED
☐ AMEND AND RESUBMIT
☐ REJECTED - SEE REMARKS
BY:
DATE: 6/27/16



G-215 S-215

Nominal Size (In.)	Working Load Limit (t)*	Stock No. G-215	Stock No. S-215	Weight Each (lbs.)	Dimensions (in.) A	B	C	D	E	F	G	K	N	Tolerance +/- C	Tolerance +/- A
1/4	1/2	1018810	1018829	.10	.47	.31	.25	.25	.97	.62	.91	1.59	1.34	.06	.06
5/16	3/4	1018838	1018847	.18	.53	.38	.31	.31	1.16	.75	1.07	1.91	1.63	.06	.06
3/8	1	1018856	1018865	.25	.66	.44	.38	.38	1.42	.92	1.28	2.31	1.86	.13	.06
7/16	1-1/2	1018874	1018883	.40	.75	.50	.44	.44	1.63	1.06	1.48	2.67	2.13	.13	.06
1/2	2	1018892	1018909	.50	.81	.63	.50	.50	1.81	1.18	1.66	3.03	2.38	.13	.06
5/8	3-1/4	1018918	1018927	1.21	1.06	.75	.63	.63	2.32	1.50	2.04	3.76	2.91	.13	.06
3/4	4-3/4	1018936	1018945	2.00	1.25	.88	.81	.75	2.76	1.81	2.40	4.53	3.44	.25	.06
7/8	6-1/2	1018954	1018963	3.28	1.44	1.00	.97	.88	3.20	2.10	2.86	5.33	3.81	.25	.06
1	8-1/2	1018972	1018981	4.75	1.69	1.13	1.00	1.00	3.69	2.38	3.24	5.94	4.53	.25	.06
1-1/8	9-1/2	1018990	1019007	6.30	1.81	1.25	1.25	1.13	4.07	2.68	3.61	6.78	5.13	.25	.06
1-1/4	12	1019016	1019025	9.00	2.03	1.38	1.38	1.25	4.53	3.00	3.97	7.50	5.50	.25	.13
1-3/8	13-1/2	1019034	1019043	12.00	2.25	1.50	1.50	1.38	5.01	3.31	4.43	8.28	6.13	.25	.13
1-1/2	17	1019052	1019061	16.15	2.38	1.63	1.62	1.50	5.38	3.62	4.87	9.05	6.50	.25	.13
1-3/4	25	1019070	1019089	29.96	2.88	2.00	2.12	1.75	6.38	4.19	5.82	10.97	7.75	.25	.13
2	35	1019098	1019105	43.25	3.25	2.25	2.36	2.10	7.25	5.00	6.82	12.74	8.75	.25	.13

* NOTE: Maximum Proof Load is 2.0 times the Working Load Limit. Minimum Ultimate Strength is 6 times the Working Load Limit.

Vermont Agency of Transportation
RECEIVED
ON: June 27, 2016
and Checked for
CONFORMANCE
BY: Mark Sargent DATE: 07/01/2016

Crosby® Eye Hooks

Load Rated Fatigue Rated "QT" QUENCHED & TEMPERED QUIC-CHECK® "TA" TYPE APPROVED

SEE APPLICATION AND WARNING INFORMATION
Para Español: www.thecrosbygroup.com
On Pages 140-141

S-320 & S-320N EYE HOOKS

Use 1-ton rated (min.)

All Crosby 320 Eye Hoist Hooks incorporate the following features:

- The most complete line of Eye hoist hooks.
- Available in carbon steel and alloy steel.
- Designed with a 5:1 Design Factor for (Carbon Steel); 4.5:1 Design Factor for 30t - 60t (Alloy Steel).
- Eye hooks are load rated.
- Proper design, careful forging and precision controlled quenched and tempering give maximum strength without excessive weight and bulk.
- Every Crosby Eye Hook has a pre-drilled cam which can be equipped with a latch. Even years after purchase of the original hook, latch assemblies can be added. (See pages 119 - 121)
- Chemical analysis and tensile tests performed on each PIC to verify chemistry and mechanical properties.
- Type Approval and certification in accordance with ABS 2007 Steel Vessel Rules 1-1-17.7, and ABS Guide for Certification of Cranes.
- Hoist hooks incorporate two types of strategically placed markings forged into the product which address two (2) QUIC-CHECK® features:
  - Deformation Indicators and Angle Indicators (see following page for detailed definition).

The following additional features have been incorporated in the new Crosby S-320N Eye Hoist Hooks. (Sizes 3/4 metric ton Carbon through 22 metric ton Alloy)

- Metric Rated at 5:1 Design Factor for (Carbon Steel); 5:1 Design Factor for 1t - 22t (Alloy Steel).
- Can be proof tested to 2 times the working Load Limit.
- Low profile hook tip.
- New integrated latch (S-4320) meets the World class standard for lifting.
  - Heavy duty stamped latch interlocks with the hook tip.
  - High cycle, long life spring.
  - When secured with proper cotter pin through the hole in the tip of hook, meets the intent of OSHA Rule 1926.1431(g) and 1926.1501(g) for personnel hoisting.
- Fatigue rated at 1-1/2 times the Working Load Limit at 20,000 cycles.

SUBMITTAL REVIEW
Review is only for general conformity to the design concept of the project and shall not relieve the contractor of his entire responsibility, including quantities, dimensions to be confirmed and correlated at the jobsite, and information that pertains to the fabrication processes or to techniques of construction.
☒ NO EXCEPTIONS TAKEN
☐ MAKE CORRECTIONS NOTED RESUBMITTAL NOT REQUIRED
☐ AMEND AND RESUBMIT
☐ REJECTED - SEE REMARKS
PB AMERICAS, INC.
BY: [signature] DATE: 6/27/16

Working Load Limit (t)		Hook ID Code	Eye Hook Stock No.			Weight Each (kg.)	Replacement Latch Kits		
Carbon	Alloy		Carbon S-320C S-320CN S.C.	Carbon G-320CN Galv.	Alloy S-320A S-320AN S.C.		S-4320 Stock No.	PL Stock No.	SS-4055 Stock No.
.75	1.25	†D	1022200	1022208	1022375	.28	1096325	-	-
1	1.6	†F	1022211	1022219	1022386	.40	1096374	-	-
1.6	2.5	†G	1022222	1022230	1022397	.65	1096421	-	-
2	3.2	†H	1022233	1022241	1022406	.94	1096468	-	-
3.2	5.4	†I	1022244	1022249	1022419	1.95	1096515	1092000	-
5	8	†J	1022255	1022262	1022430	3.76	1096562	1092001	-
7.5	11.5	†K	1022264	1022274	1022441	6.80	1096609	1092002	-
10	16	†L	1022277	1022285	1022452	9.42	1096657	1092003	-
15	22	†N	1022288	1022296	1022465	17.9	1096704	1092004	-
20	31.5	O	1023289	-	1023546	27.2	-	1093716	1090161
25	37	P	1023305	-	1023564	47.6	-	1093717	1090189
30	45	S	1023323	-	1023582	67	-	1093718	1090189
40	60	T	1023341	-	1023608	103	-	1093719	1090205

*Eye Hooks (3/4 TC - 22TA), Proof load is 2 times Working Load Limit. Eye Hooks (20 TC - 60TA). All carbon hooks-average straightening load (ultimate load) is 5 times Working Load Limit. Alloy eye hooks 1 ton through 22 ton-average straightening load (ultimate load) is 5 times Working Load Limit. Alloy eye hooks 30 tons through 60 tons-average straightening load (ultimate load) is 4.5 times Working Load Limit.

† New 320N style hook.

Vermont Agency of Transportation
RECEIVED
ON: June 27, 2016
and Checked for
CONFORMANCE
BY: Mark Sargent DATE: 07/01/2016

Grade 80 Alloy Chain

SPECTRUM 8®
ALLOY CHAIN

- Alloy Steel.
- Heat Treated.
- Finish – Black rust preventative coating.
- Permanently embossed with CG (Crosby Group) and 8 (Grade).
- Proof Tested at 2 times the Working Load Limit with certification.

Minimum chain working load for Grade 80 is 7100 lb

Grade 80 Alloy Chain recommended for overhead lifting applications.

Chain Size (In.)	Spec. 8 Drum Stock No.	Feet Per Drum	Material Size (In.)	Working Load Limit (lbs.)*	Maximum Inside Length (In.)	Maximum Inside Width (In.)	Maximum Length 100 Links (In.)	Weight Per 100 Feet (lbs.)
9/32 (1/4)	273527	500	.276	3500	.87	.42	90	72
5/16	273536	500	.343	4500	1.01	.49	100	114
3/8	273545	500	.394	7100	1.23	.58	125	148
1/2	273554	300	.512	12000	1.57	.77	164	243
5/8	273563	200	.630	18100	1.93	.90	202	351
3/4	273572	100	.787	28300	2.42	1.14	252	584
7/8	273581	100	.866	34200	2.66	1.26	277	705
1	273590	75	1.024	47700	3.28	1.54	328	1041
1-1/4	273599	66	1.260	72300	4.03	1.89	403	1478

* Proof loaded at 2 times Working Load Limit. Ultimate Load is 4 times the Working Load Limit.

Crosby provides two methods of attaching Spectrum 8® chain to Crosby fittings.

A-1337
LOK-A-LOY®
Connecting Link
Refer to Page 202

S-1325
Grade 100
Coupler Link
Refer to Page 211

SUBMITTAL REVIEW

Review is only for general conformity to the contract drawings and specifications and shall not relieve the contractor of his entire responsibility under the contract, including among other things, dimensions to be confirmed and correlated at the job site, and information that pertains to the fabrication processes or to techniques of construction.

- [x] NO EXCEPTIONS TAKEN
- [ ] MAKE CORRECTIONS NOTED RESUBMITTAL NOT REQUIRED
- [ ] AMEND AND RESUBMIT
- [ ] REJECTED - SEE REMARKS

PB AMERICAS, INC.

BY:

DATE: 6/27/16

Vermont Agency of Transportation

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BY: Mark Sargent DATE: 07/01/2016

General Purpose Tarps

Teri Tarps, protecting the construction, agricultural, recreational, and transportation industries against the weather.

TERI GENERAL PURPOSE TARPS are rugged, water and mildew resistant canvas tarpaulins available in both regular and flame retardant materials.

TERI GENERAL PURPOSE TARPS, constructed from strong and flexible canvas, are completely dependable in any weather and for almost any purpose. They are available in many popular styles: OD, water and mildew resistant and OD Flame, water and mildew resistant, specially treated for applications requiring a flame retardant material.

Material

TERI OD: Rated 10 ounce canvas untreated; 18 ounce per sq. yd. treated. This Olive Drab canvas is the "old stand-by", proven in thousands of applications. Completely water and mildew-resistant.

TERI OD Flame: flame retardant, this material is very popular in the construction industry. 1 0 ounce canvas untreated, 18 ounce after treatment. Water and mildew resistant.

Assumed Tarp DL

Available

10 oz. per sq. yd.

12oz. per sq. yd.

14.90 oz. per sq. yd.

Stock Sizes

15'x20'

20'x20'

20'x30'

All sizes are cut sizes before finishing. A 15' x 20' tarp will measure 1 4'4" x 1 9'6" minimum. Tarps are constructed of 6' material; allow for extra seams (2" per seam) on larger tarps.

*Special sizes available in request.

SUBMITTAL REVIEW

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- [x] NO EXCEPTIONS TAKEN
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PB AMERICAS, INC.

BY: S. Lybarger

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Appendix E
Standard Wire Rope

SUBMITTAL REVIEW

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PB AMERICAS, INC.

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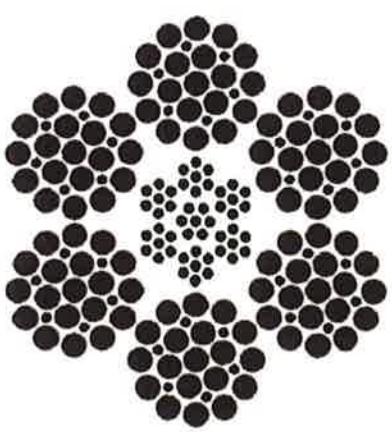
A2B ENGINEERING, LLC
CONSULTING ENGINEERS

6x19 Class Wire Rope

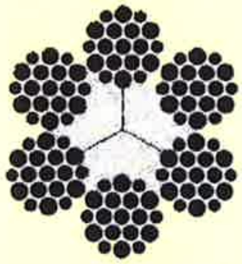
Strands: 6
Wires per strand: 19 to 26
Core: IWRC or fiber core
Standard Grade: Purple Plus
Lay: Regular or Lang
Finish: Bright or galvanized

The 6x19 Classification of wire rope is the most widely used. With its good combination of flexibility and wear resistance, rope in this class can be suited to the specific needs of diverse kinds of machinery and equipment.

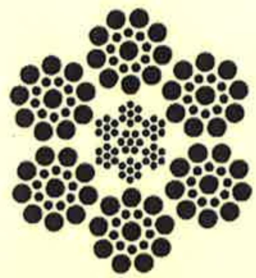
The 6x19 Seale construction, with its large outer wires, provides great ruggedness and resistance to abrasion and crushing. However, its resistance to fatigue is somewhat less than that offered by a 6x25 construction. The 6x25 possesses the best combination of flexibility and wear resistance in the 6x19 Class due to the filler wires providing support and imparting stability to the strand. The 6x26 Warrington Seale construction has a high resistance to crushing. This construction is a good choice where the end user needs the wear resistance of a 6x19 Class Rope and the flexibility midway between a 6x19 Class and 6x37 Class rope.



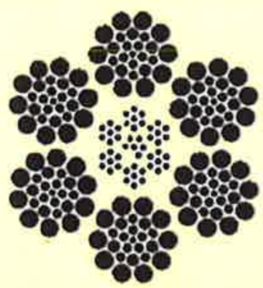
6x25 Filler Wire with IWRC



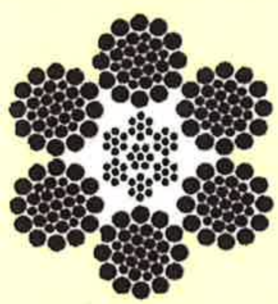
6x19 Warrington with fiber core



6x19 Seale with IWRC



6x26 Warrington Seale with IWRC



6x31 Warrington Seale with IWRC

6x49 Filler Wire Seale with IWRC

6x36 Class Wire Rope

Strands: 6
Wires per strand: 27 to 49
Core: IWRC or fiber core
Standard Grade: Purple Plus
Lay: Regular or Lang
Finish: Bright or galvanized

The 6x36 Class of wire rope is characterized by the relatively large number of wires used in each strand. Ropes of this class are among the most flexible available due to the greater number of wires per strand, however their resistance to abrasion is less than ropes in the 6x19 Class.

The designation 6x36 is only nominal, as in the case with the 6x19 Class. Improvements in wire rope design, as well as changing machine designs, have resulted in the use of strands with widely varying numbers of wires and a smaller number of available constructions. Typical 6x37 Class constructions include 6x33 for diameters under 1/2", 6x36 Warrington Seale (the most common 6x37 Class construction) offered in diameters 1/2" through 1-5/8", and 6x49 Filler Wire Seale over 1-3/4" diameter.

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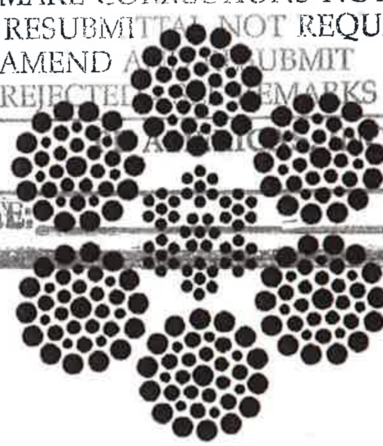

6x36 Warrington Seale IWRC

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6x19 and 6x36 Classes Technical Data

Rope Diameter		Approx. Weight (lb./ft.)		Nominal Strength, tons (bright or drawn galvanized**)		
				Royal Purple	Purple Plus	
Inches	mm.	Fiber Core	IWRC	IWRC	Fiber Core	IWRC
1/4	6.5	0.11	0.12	3.74	3.01	3.40
5/16	8.0	0.16	0.18	5.80	4.69	5.27
3/8	9.5	0.24	0.26	8.30	6.71	7.55
7/16	11.0	0.32	0.35	11.2	9.10	10.2
1/2	13.0	0.42	0.46	14.6	11.8	13.3
9/16	14.5	0.53	0.58	18.5	14.9	16.8
5/8	16.0	0.66	0.72	22.7	18.4	20.6
[illegible]	19.0	0.95	1.04	32.4	26.2	[illegible]
7/8	22.0	1.29	1.41	43.8	35.4	39.8
1	26.0	1.68	1.85	56.9	46.0	51.7
1-1/8	29.0	2.13	2.34	71.5	57.9	65.0
1-1/4	32.0	2.63	2.89	87.9	71.1	79.9
1-3/8	35.0	3.18	3.49	106	85.5	96
1-1/2	38.0	3.78	4.16	125	101	114
1-5/8	42.0	4.44	4.88	146	118	132
1-3/4	45.0	5.15	5.66	169	136	153
1-7/8	48.0	5.91	6.49	192	155	174
2	52.0	6.73	7.39	217	176	198
2-1/8	54.0	7.60	8.34	[illegible]	[illegible]	[illegible]
2-1/4	58.0	[illegible]	[illegible]	[illegible]	220	[illegible]
2-3/8	60.0	9.49	[illegible]	[illegible]	[illegible]	[illegible]
2-1/2	[illegible]	[illegible]	[illegible]	[illegible]	269	[illegible]
2-3/4	70.0	12.7	14.0	[illegible]	[illegible]	[illegible]

**Galvanized – [illegible] deduct 10% from the nominal strength shown.

Technical data for the above listed constructions are the same and are detailed in the table. For further information on additional constructions and diameters, contact WW's customer service department.

SUBMITTAL REVIEW

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PB AMERICAS, INC.

BY: S Boynton

DATE: 6/27/16

6x19 Class

6x19 Seale
6x19 Warrington
6x21 Filler Wire Type U
6x21 Seale
6x25 Filler Wire Type W
6x25 Seale
6x26 Warrington Seale

6x36 Class

6x31 Warrington Seale
6x33
6x36 Warrington Seale
6x41 Warrington Seale
6x43 Filler Wire Seale
6x49 Filler Wire Seale

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Appendix F
Scaffold Platform

SUBMITTAL REVIEW

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PB AMERICAS, INC.

BY: S. Babington

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A2B ENGINEERING, LLC
CONSULTING ENGINEERS

**BETH-ALLEN
LADDER & EQUIPMENT Inc.**

2124 West Broad Street Bethlehem, Pennsylvania 18018

1-800-835-4242 Email Us 610-866-4242
FAX: 610-866-3328

SUBMITTAL REVIEW

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PB AMERICAS, INC.
BY: [signature]
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WERNER

Aluminum Staging
Task-Master® Stages

Ideal for the Jack applications, Swing stages, or catwalks

Decorator Planks * Scaffold Planks * Stage Platforms * Guard Rail Systems

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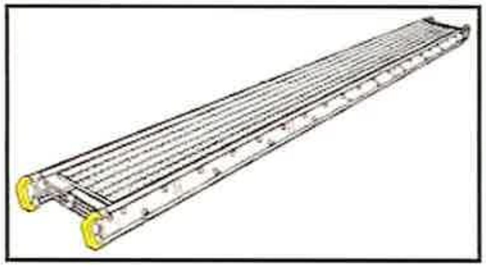

- Twist-Proof® Stage Design
- Individual slip-resistant decking minimizes paint or material build up.
- Double end rung provides extra rigidity on stages 20' or longer-standard on stages with 5" or 6" rails.
- Vinyl-coated end caps serve as hand grips and protect from sharp edges and surfaces marks.

DECORATOR PLANKS **1 Person 250 lbs. Rated**

Model	Width	Side Rail Length	Side Rail Depth	Side Rail Flange	Ship Wt. lbs.
2008	12"	8'	4"	1-3/8"	25
2012	12"	12'	4"	1-3/8"	36
2016	12"	16'	4"	1-3/8"	48
2020	12"	20'	5"	1-3/8"	65
2024	12"	24'	5"	1-3/8"	78

SCAFFOLD PLANKS **2 Person - 500Lbs. Rated**

Model	Width	Side Rail Length	Side Rail Depth	Side Rail Flange	Ship Wt. lbs.
2316	12"	16'	4"	1-3/8"	48
2320	12"	20'	6"	1-3/8"	79
2324	12"	24'	6" HvyDty	1-3/8"	112
2328	12"	28'	6" HvyDty	1-3/8"	131
2330	12"	30'	6" HvyDty	1-3/8"	140
2332	12"	32'	6" HvyDty	1-3/8"	149
2408	14"	8'	4"	1-3/8"	27
2412	14"	12'	4"	1-3/8"	40
2416	14"	16'	5"	1-3/8"	58
2420	14"	20'	6"	1-3/8"	85
2424	14"	24'	6"	1-3/8"	109
2428	14"	28'	6"	2"	127
2430	14"	30'	6" HvyDty	2"	171
2432	14"	32'	6" HvyDty	2"	182

SUBMITTAL REVIEW
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PB AMERICAS, INC.
BY: [signature]
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STAGE PLATFORMS **2 Persons - 500 Lbs. Rated**

Model	Width	Side Rail length	Side Rail Depth	Side Rail flange	Ship Wt. lbs.
2508	20"	8'	4"	1-3/8"	33.0
2512	20"	12'	4"	1-3/8"	48.0
2516	20"	16'	5"	1-3/8"	70.0
*2520	20"	20'	6"	1-3/8"	102.0
*2524	20"	24'	6"	1-3/8"	121.0
*2528	20"	28'	6"	2"	157.0
*2530	20"	30'	6"	2"	168.0
*2532	20"	32'	6"	2"	179.0
*2536	20"	36'	6"Hvy Dty	2"	243.0

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*2539	20"	39'	6" Hvy Dty	2"	264.0

STAGE PLATFORMS 2 Persons - 500 Lbs. Rated

2608	24"	8'	4"	1-3/8"	38.0
2612	24"	12'	4"	1-3/8"	56.0
2616	24"	16'	5"	1-3/8"	81.0
*2620	24"	20'	6"	1-3/8"	115.0
*2624	24"	24'	6"	1-3/8"	138.0
*2628	24"	28'	6"	2"	168.0
*2630	24"	30'	6"	2"	180.0
*2632	24"	32'	6"	2"	191.0
2708	28"	8'	4"	1-3/8"	41.0
2712	28"	12'	4"	1-3/8"	60.0
2716	28"	16'	5"	1-3/8"	87.0
*2720	28"	20'	6"	1-3/8"	124.0
*2724	28"	24'	6"	1-3/8"	147.0
*2728	28"	28'	6"	2"	187.0
*2732	28"	32'	6"	2"	213.0

SUBMITTAL REVIEW

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FB AMERICAS, INC.

BY: SL Boyington

DATE: 6/21/16

STAGE PLATFORMS 3 Person - 750 lbs. Rated

3112	24"	12'	4"	2"	64.0
3116	24"	16'	5"	2"	92.0
*3120	24"	20'	6"	2"	115.0
*3124	24"	24'	6"Hvy Dty	2"	145.0
*3128	24"	28'	6"Hvy Dty	2"	204.0
*3132	24"	32'	6" Hvy Dty	2"	236.0
*3136	24"	36'	6" Hvy Dty	2"	323.0
*3139	24"	39'	6" Hvy Dty	2"	365.0

STAGE PLATFORMS 3 Person - 750 lbs. Rated

3208	28"	8'	4"	2"	48.0

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Appendix G

Ventilation System

SUBMITTAL REVIEW

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PB AMERICAS, INC.

BY: BJ Boyington

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BY: Mark Sargent DATE: 07/01/2016

A2B ENGINEERING, LLC
CONSULTING ENGINEERS

A2B ENGINEERING, LLC CONSULTING ENGINEERS	Subject:	Abrasive Blasting Containment Plans Eleven Bridges on I-91, County of Windsor, Vermont			
	Comp by: MAT Check by: PRS		Date: 02/08/16 Job No: 187-18-1		Sheet Number:

Dust Collector/Fan Ventilation System :

The contractor shall provide mechanical exhaust ventilation for the abrasive blasting containment structures using one or more mobile dust collectors. The contractor proposes to use one (1) 45,000 cfm at 13" W.G. mobile dust collector manufactured by Advanced Recycling Sytems, Inc. The dust collector has an assumed dust exhaust capacity based on the number of ducts provided.

Using an itterative process and estimated friction loss for 20" diameter ducts from friction loss curves, use:

4 - 20 inch diameter ducts

Max. Exhaust capacity =	48000	cfm total, or 12000 cfm per duct
Total Estimated system static pressure =	9.46	inch water gage (from fan curve)
Friction loss per 100 ft of duct =	2.0	Inch W.G. (from friction loss curve for 20" ducts)
Maximum number of elbows =	3	Each (46 equivalent linear feet per elbow)
loss thru containment =	1.20	inch water gage (typical)
loss thru fabric filters =	4.00	inch water gage (typical)
loss thru elbows =	2.76	inch water gage (calculated)
loss thru duct =	1.50	inch water gage (remaining)
Maximum Length of Duct =	75.0	ft (max allowed for system)

3 - 20 inch diameter ducts

Max. Exhaust capacity =	45000	cfm total, or 15000 cfm per duct
Total Estimated system static pressure =	12.25	inch water gage (from fan curve)
Friction loss per 100 ft of duct =	2.8	Inch W.G. (from friction loss curve for 20" ducts)
Maximum number of elbows =	3	Each (46 equivalent linear feet per elbow)
loss thru containment =	1.20	inch water gage (typical)
loss thru fabric filters =	4.00	inch water gage (typical)
loss thru elbows =	3.86	inch water gage (calculated)
loss thru duct =	3.19	inch water gage (remaining)
Maximum Length of Duct =	113.8	ft (max allowed for system)

2 - 20 inch diameter ducts

Max. Exhaust capacity =	40000	cfm total, or 20000 cfm per duct
Total Estimated system static pressure =	16.00	inch water gage (from fan curve)
Friction loss per 100 ft of duct =	4.5	Inch W.G. (from friction loss curve for 20" ducts)
Maximum number of elbows =	3	Each (46 equivalent linear feet per elbow)
loss thru containment =	1.20	inch water gage (typical)
loss thru fabric filters =	4.00	inch water gage (typical)
loss thru elbows =	6.21	inch water gage (calculated)
loss thru duct =	4.59	inch water gage (remaining)
Maximum Length of Duct =	102.0	ft (max allowed for system)

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1 - 20 inch diameter ducts

Max. Exhaust capacity =	24000	cfm total, or 24000 cfm per duct
Total Estimated system static pressure =	17.50	inch water gage (from fan curve)
Friction loss per 100 ft of duct =	5.5	Inch W.G. (from friction loss curve for 20" ducts)
Maximum number of elbows =	3	Each (46 equivalent linear feet per elbow)
loss thru containment =	1.20	inch water gage (typical)
loss thru fabric filters =	4.00	inch water gage (typical)
loss thru elbows =	7.59	inch water gage (calculated)
loss thru duct =	4.71	inch water gage (remaining)
Maximum Length of Duct =	85.6	ft (max allowed for system)

If the cross sectional area is exceeded in the shop drawings or required air flow is not achieved, contractor shall provide additional dust collectors and exhaust ducts or reduce the size of the active paint containment enclosure by installing internal tarpaulin walls.

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PB AMERICAS, INC.
BY: S. Boyington
DATE: 6/25/16

A2B ENGINEERING, LLC CONSULTING ENGINEERS	Subject: Abrasive Blasting Containment Plans Eleven Bridges on I-91, County of Windsor, Vermont		
	Comp by: MAT Check by: PRS	Date: 02/08/16 Job No: 187-18-1	Sheet Number:

Containment Design Parameters:

Provide a minimum cross-draft ventilation of 100 - 300 ft/min (Coating Structural Steel- Containment System 561.10-3)
Provide a minimum down-draft ventilation of 60 ft/min
Size the inlets to provide air flow velocity of 700 - 1,000 ft/min

Ventilation System Cross-Draft:

20" diam. Ducts, No. Required =	4	3	2	1	
Volume Q =	48,000	45,000	24,000	20,000	cfm
Max. Containment Area (V = 100 ft/min)	480.0	450.0	240.0	200.0	ft^2
Min. Containment Area (V = 300 ft/min)	160.0	150.0	80.0	66.7	ft^2
Max. Inlet Area (V = 700 ft/min)	68.6	64.3	34.3	28.6	ft^2
Min. Inlet Area (V = 1000 ft/min)	48.0	45.0	24.0	20.0	ft^2

Sample Calculation:

Max. Containment Area = Q/V = 48000 cfm / 100 ft/min = 480.0 ft^2

Min. Containment Area = Q/V = 48000 cfm / 300 ft/min = 160.0 ft^2

Max. Inlet Area = Q/V = 48000 cfm / 700 ft/min = 68.6 ft^2

Min. Inlet Area = Q/V = 48000 cfm / 1000 ft/min = 48.0 ft^2

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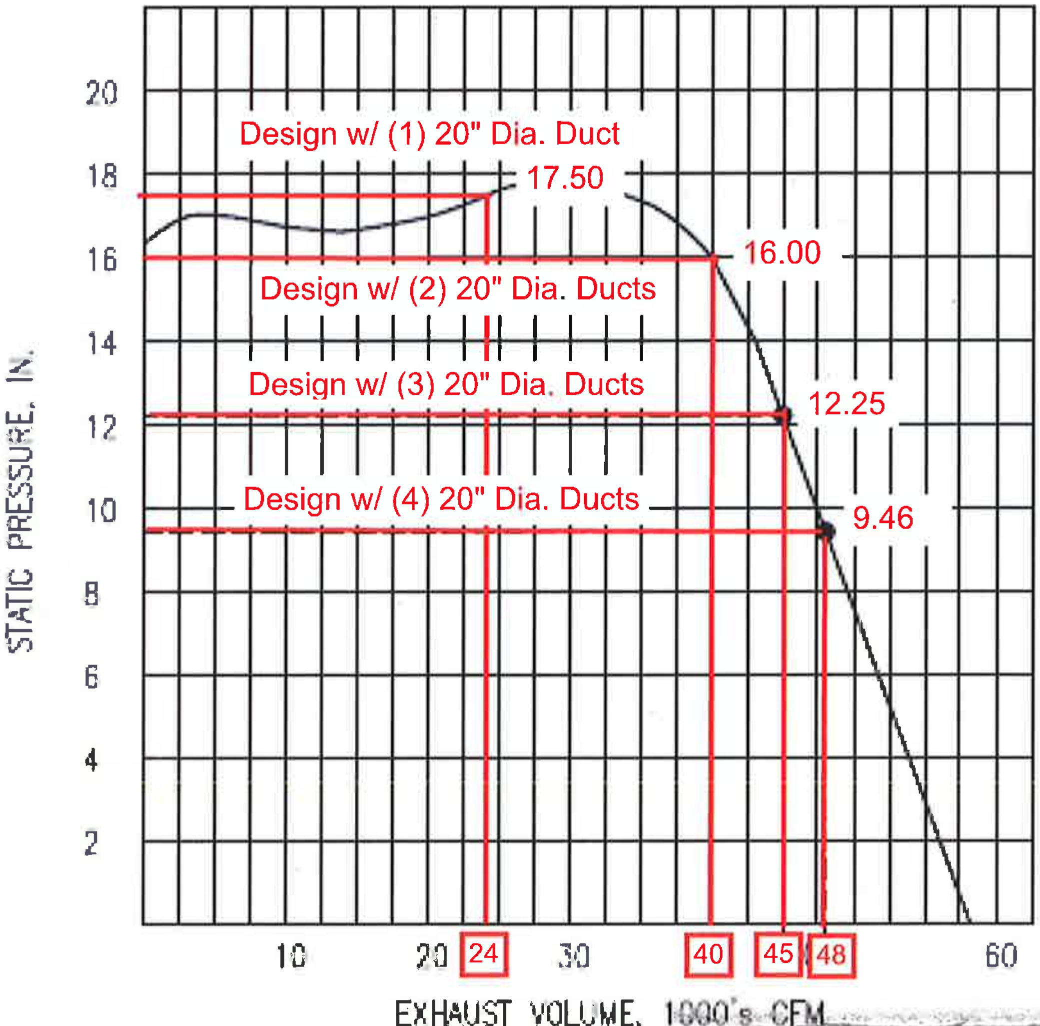
PB AMERICAS, INC.
BY: SY Boyington
DATE: 6/27/16

ADVANCED RECYCLE SYSTEMS, INC.
MODEL ARS-45 MOBILE DUST COLLECTOR



DUST COLLECTOR FAN CURVE

Vermont Agency of Transportation
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ON: June 27, 2016
and Checked for
CONFORMANCE
BY: Mark Sargent DATE: 07/01/2016

SUBMITTAL REVIEW

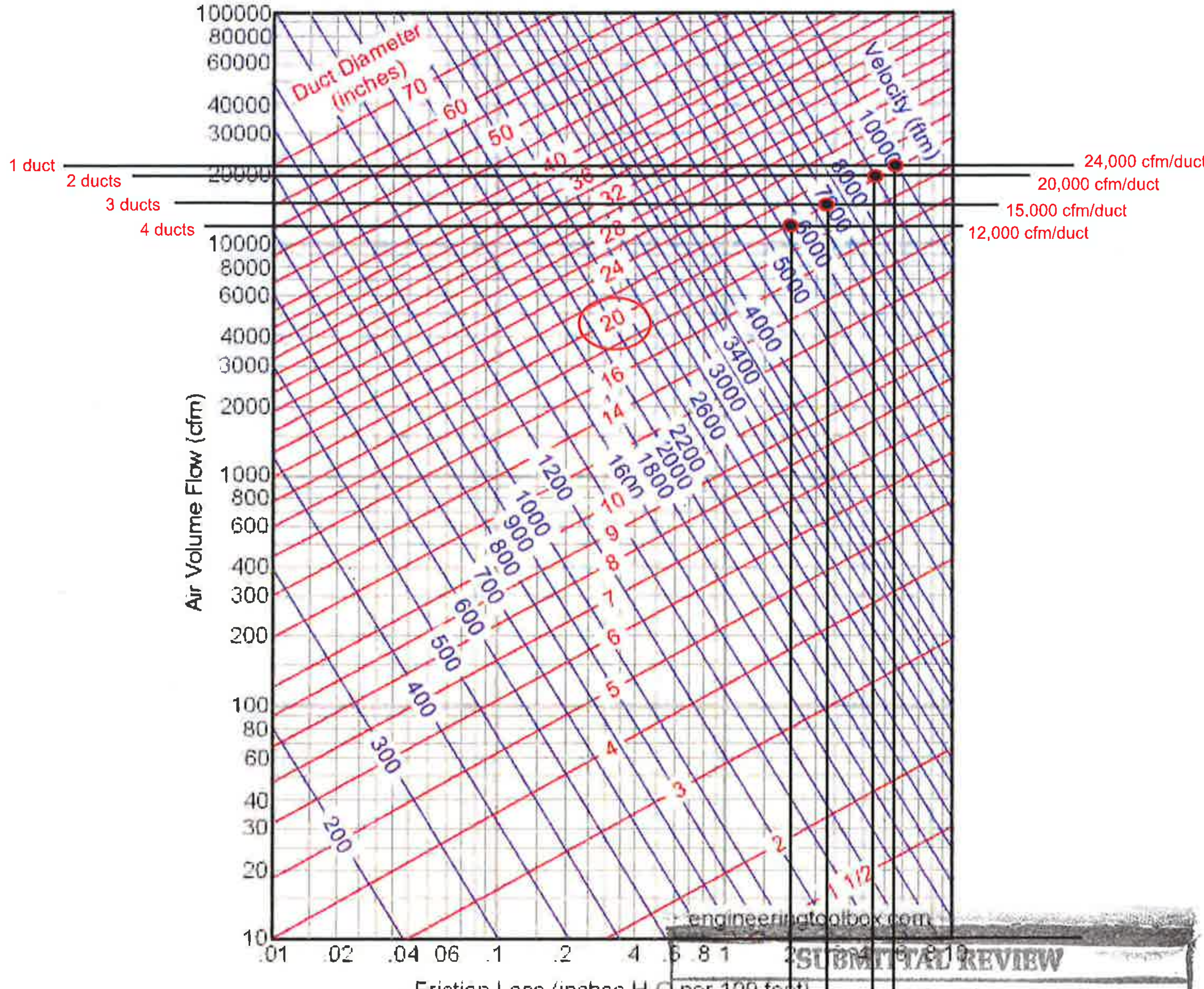
Review is only for general conformity to the contract drawings and specifications and shall not relieve the contractor of his entire responsibility under the contract, including among other things, dimensions to be confirmed and correlated at the job site, and information that pertains to the fabrication processes or to techniques of construction.

- [x] NO EXCEPTIONS TAKEN
- [ ] MAKE CORRECTIONS NOTED RESUBMITTAL NOT REQUIRED
- [ ] AMEND AND RESUBMIT
- [ ] REJECTED - SEE REMARKS

PB AMERICAS, INC.
BY: S. Byington
DATE: 6/27/16

MAX. AVAILABLE EXHAUST CAPACITY W/4 DUCTS	48,000 CFM
MAX. AVAILABLE EXHAUST CAPACITY W/3 DUCTS	45,000 CFM
MAX. AVAILABLE EXHAUST CAPACITY W/2 DUCTS	40,000 CFM
MAX. AVAILABLE EXHAUST CAPACITY W/1 DUCT	24,000 CFM

Estimated Friction Loss for
20" diameter exhaust ducts



2.0 2.8 4.5 5.5

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Advanced Recycling Systems, Inc.

Designers and Builders of Mobile Blasting Systems

1089 N. HUBBARD ROAD • LOWELLVILLE, OHIO 44436-9737 • Tel. (330) 534-3330 • FAX (330) 534-9249

45,000 CFM Dust Collector at 13" Wg.

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- ***Hydraulic Auger***
- ***Only 28 ft. long***
- ***Long Life Filter Cartridges***

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Low Drag-High Airflow Design

Advanced Recycling Systems, Inc.

Designers and Builders of Mobile Blasting Systems

1089 N. HUBBARD ROAD • LOWELLVILLE, OHIO 44436-9737 • Tel. (330) 534-3330 • FAX (330) 534-9249

45,000 CFM Dust Collector

SPECIFICATIONS	
AIR RATE PER UNIT	45,000 CFM @ 13 Wg. 40,000 CFM @ 16 Wg.
CARTRIDGE EFFICIENCY	99.9% @ 0.5 microns
ARRANGEMENT OF ELEMENTS	Vertical
CARTRIDGE CLEANING	Ram Injection, Pulse Type
NUMBER OF CARTRIDGES	84
FILTER MEDIA AREA	12,600 sq. ft.
AIR-TO-CLOTH RATIO	3.5 TO 1 @ 45,000 CFM 3.1 TO 1 @ 40,000 CFM
DUCTING CONNECTIONS	4 @ 20" Dia.
FAN	Class IV Non-overloading Type "C" Spark Resistant
DRIVE	Banded V-Belt with clutch
TYPE OF ENGINE	165 H.P. Diesel
FUEL TANK	90 Gallon
AUGER DRIVE	Hydraulic
TRAILER	28'L x 8'W x 12'3"H
BRAKES	Electric
OPTIONS:	Dual Rear Inlets

Specifications are subject to change without notice so that improvements can be affected as quickly as possible.

Nothing contained in this brochure is intended to extend any warranty or representation, expressed or implied, regarding the products described herein.

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COATING EXISTING STRUCTURAL STEEL – CONTAINMENT SYSTEM. (REV 11-16-11)

SUBARTICLE 561-10.3 (of the Supplemental Specifications) is deleted and the following substituted:

561-10.3 Containment System: Submit a written containment system design plan in accordance with this section and the contract documents at the pre-construction conference or as directed by the Engineer which clearly describes the proposed containment system applicable to the intended removal method and in accordance with the requirements outlined herein and SSPC Guide 6, Guide for Containing Debris Generated During Paint Removal Activities. Ensure the plan includes, but is not limited to, removal method; methods for collecting debris; and containment enclosure components. Use fire retardant materials. Provide containment drawings, calculations, assumptions, ventilation criteria if applicable, and a structural analysis that verifies the existing structure can withstand the additional dead, live and wind loads imposed by the containment system, signed and sealed by a Specialty Engineer. However, for more complex structures incorporating cables stayed, suspension, or truss designs, the analysis must be performed by the Contractor's Engineer of Record qualified in Type Work Category 4.3, Complex Bridge Design. Provide a contingency plan addressing natural weather events such as tropical storms and hurricanes. Ensure the lighting inside the containment is in accordance with SSPC Guide 12, Guide for Illumination of Industrial Painting Projects. Provide lighting to a minimum intensity of 10 ft-cd for general, 20 ft-cd for work, and 50 ft-cd for inspection. All drawings and calculations must be submitted and accepted before any work begins. Include a clear description of the ventilation system components and information including the fan curve and design point on the proposed dust collector. Design to provide ventilation according to the notes provided in SSPC Guide 6: 100 feet per minute for cross draft and 50-60 feet per minute for downdraft.

Isolate the immediate area of the structure to ensure compliance with current and permit requirements for air, water, soil, and pollution prevention. Protect the containment system from vehicular and pedestrian traffic. Ensure paint, paint chips, or other debris will not fall outside of the containment area under any circumstances. Repair any damage created by fastening, bracing, or handling the scaffolding and staging. If a suspended platform is constructed, use rigid or flexible materials as needed to create an air and dust impenetrable enclosure. Verify that the platform and its components are designed and constructed to support at least four times its maximum intended load without failure, with wire cables capable of supporting at least six times their maximum intended load without failure. Strictly comply with all applicable OSHA regulations regarding scaffolding. The category and class of containment shall be as required in the Contract Documents.

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