Iowa Department of Transportation

Letter of Transmittal

Office of Bridges and Structures
800 Lincoln Way (515)-233-7924
Ames, IA 50010 Fax (515)-239-1978

July 31, 2013

ID No	1209

To: HERBERGER CONSTRUCTION CO.,
2508 WEST 2ND
INDIANOLA, IA 50125

Design No.	113	Station	
File No.	30484	Section	
Job No.			
County	CASS		
Project	BRF-092-2(36)--38-15		
Project	ROLLING BRIDGE (BRIDGE SLIDE)		
Location			

We are sending you

[X] *Attached* [ ] *Under Separate Cover*

[ ] Plans
[ ] Prints
[X] Shop Drawings
[ ] Falsework Plans

Item	Copies	Sheets	Description	1. No Exceptions Taken	2. Make Corrections Noted *	3. Amend and Resubmit	4. Rejected - See Remarks
1	1	65	ENGINEERING ANALYSIS & PRODUCT SHEETS (60)	X			
			PLAN DETAIL SHEETS (5 sheets, S0-S4)				

* No Resubmittal Necessary

Remarks:

Signed *Brett Kloss*
Brett Kloss
Office of Bridges and Structures

Cc:

W. SUNDAY-CONSTRUCTION
HERBERGER CONSTRUCTION CO., INC. (2 COPIES)
OFFICE COPY
S. NIXON-CRESTON RCE (2 COPIES)

REVIEWED BY OFFICE OF BRIDGES AND STRUCTURES
IOWA DEPARTMENT OF TRANSPORTATION

Reviewed in accordance with current policy

July 31, 2013

✓ NO EXCEPTIONS TAKEN
❑ MAKE CORRECTIONS NOTED (NO RESUBMITTAL NEC.)
❑ AMEND AND RESUBMIT

This review is for strength and arrangement of component parts. Any deviation from the plans or specifications not clearly noted by the Contractor has not been reviewed. Review by the Engineer shall not serve to relieve the Contractor of the contractual responsibility or any error or deviation from the contract requirements.

Appendix A
Engineering Analysis

Iowa Department of Transportation
Cass County Rolling Bridge
BRF-092-2(36)--38-15

for:

Herberger Construction
2508 West 2nd Ave.
Indianola, IA 50125

by:

Tometich Engineering, Inc.
10501 Buena Vista Court
Urbandale, Iowa 50322
Phone: (515) 280-8022
Fax (515) 727-9124

e-mail: tph@tometichengineering.com
web site: www.tometichengineering.com

26-Jul-13

Tometich Engineering, Inc.
Urbandale, Iowa 50322
Phone: (515) 280-8022
Fax: (515) 727-9124

Job Name: Iowa Department of p. 1/
Job # U13-135 Date: 1-Jul-13
file: U13-135 calc1.xls

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Iowa Department of Transportation

Design Calculations:

Project : Iowa Department of Transportation
Cass County Rolling Bridge
BRF-092-2(36)--38-15

Submit to: Herberger Construction
2508 West 2nd Ave. Phone: 515-961-5564
Indianola, IA 50125 Fax: 515-962-1496
Attn: Dennis Herberger e-mail:

Design Review:
Theodore P Hoeger P.E.
Tometich Engineering, Inc. Iowa Reg. # 20812

References:
AASHTO LRFD Bridge Construction 3rd Ed. 2010
AISC Manual for Steel Construction , 9th Ed.
AISC Manual for Steel Construction , Load and Resistance Factor Design, 2nd Ed., 1994
American Concrete Institute; ACI 318-05
International Building Code (IBC) - 2009 Edition

Commentary:
This project consists of designing
Temporary construction pier for a new county bridge.

Certification:

I hereby certify that this engineering document was prepared by me or under my direct personal supervision and that I am a duly Licensed Professional Engineer under the laws of the State of Iowa

Signature: Ted Hoeger
Date: 26 July 2013
Registration #: 20812

My Registration Expires December 31, 2014

Reisions to Calculation set sumbitted 07/01/2013

LICENSED PROFESSIONAL ENGINEER
THEODORE HOEGER 20812
IOWA

Tometich Engineering, Inc.
10501 Buena Vista Ct.
Urbandale, IA 50322
(515) 280-8022
Fax: (515) 727-9124

Job Name: Cass Country Rolling Bridge
Job # U13-135
Born on Date:
Version #: 1

Table of Contents

Temporary Pier design/check
- Bridge Loads
- Deck beam - HP12x53 Check
- Cross Beam - HP 10x57 Check
- Girder Beam - W36x135
- Temp deck check
  - Plywood check
  - Wood member Check

Rolling design/check
- Load analysis for roller/jack capacity
- Jacking beam - HP12x53 check
- Cross Beam - HP10x42 check
- Girder Beam - W36x135 check
- Temporary Pile capacity check
- Jack and roller checks (bearing plates)
- HP beams Web checks
- Web Stiffener Design
- Abutment extension design/check
- Roller channel concrete bearing area check

Material Specifications
- Hillaman Rollers
- Enerpac Jacks

Calculation Submittal Notes

1. Temporary pier design does not include the weight of the barrier rails. The barrier rails will be cast after the bridge is rolled into its final position
2. Contractor will provide documentation to certify HP steel shapes are 50ksi steel. The W36x136 is not certified and was analyzed as A36 steel.

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Revisions to calculation set submitted 01-07-2013:

Pg. 11	2x6 spacing reduced to 12" on center.
Added	Pages 11a, 11b, 11c &11d - plywood analysis
Pg. 15	added 3/16" to weld calculation
Pg. 16	compression flange bracing changed to 8 feet on center
Pg. 18	compression flange bracing changed to 8 feet on center
Added	Pages 27a & 27b - W36x135 with jacking loads and required capacity of piles
Added	Pages 30A-30F for analysis of back row of piling
Pg. 32	Revised
Pg. 33, 34 & 35	Corrected for $\Omega = 2$ for web crippling
Pg. 36	Revised to include AISC J10.8
Pg. 37,38 &39	Corrected for 1.2 dead load applied
Pg. 40	Corrected for roller length and applied load

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10501 Buena Vista Court
Urbandale, Iowa 50322
(515) 280-8022
fax: (515) 727-9124
www.tometichengineering.com

PROJECT DOT- Cass Co.
SHEET NUMBER 3 OF 45
CALCULATED BY TPH DATE
CHECKED BY DATE
FILE NUMBER U13-135

Bridge Weight Calcs.

Constructed Bridge Wt = 721 tons = 1,442 Kips.
+ 10% = 800 Tons = 1600 Kips.

Each End Beam Load = 800 Kips.
Beam Length = 47'-2"
Beam Load/ft = 17.02 Kips/ft.
Beam Width = 3'-4"
Beam Load/ft² = 5.11 Kips/ft²

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Beam Reactions.

Beam span = 120 ft
Beam Wt = 87.4K + 3K = 90.4 Kips.

Middle Beams Deck Wt
Beam spacing = 8'-0⅞"
Deck = 8½" thick
Concrete Area = 8.5/12 x 8' = 5.66 ft²
Deck wt/ft = 5.66 (150) = 850 #/ft.
Total Beam Wt w/ Deck = 90.4 + (850)120 ft = 192.4 Kips.
Beam Reaction = 192.4/2 = 96.2 Kips.

Edge Beam
Beam spacing = (½)8'-0⅞" + 3'-6" = 7'-6"
Deck = 8½"
Concrete Area = 7½' x (8½/12) = 5.312 ft²
Deck Wt/ft = (5.312) 150 = 797 #/ft.
Gaurd Rail Wt = [[26.1 cy concrete] + [1.5K + 1.55K + 2.44K steel]]/2 — Barrier to Be Poured After Sliding
= (26.1)(27)150# + 5.52K/2 = 55.6 Kips.
Total Beam Wt w/ Deck & Barrier = 90.4 + .797(120) + 55.6K = 246.6 Kips.
Beam Reaction = 120.82 Kips. — ~~55.6K~~ ~~65.2K~~
− 55.6/2 = 93.0K — Without Barrier Rail

End Beam Wt = 4' x 4' x 150# x 47' = 112,800# = 112 Kips.

Bridge Wt = 192.4(4) + 246.6(2) + 112(2) = 1476.8 Kips = 738.4 Tons ✓ ≈ 721 Tons.

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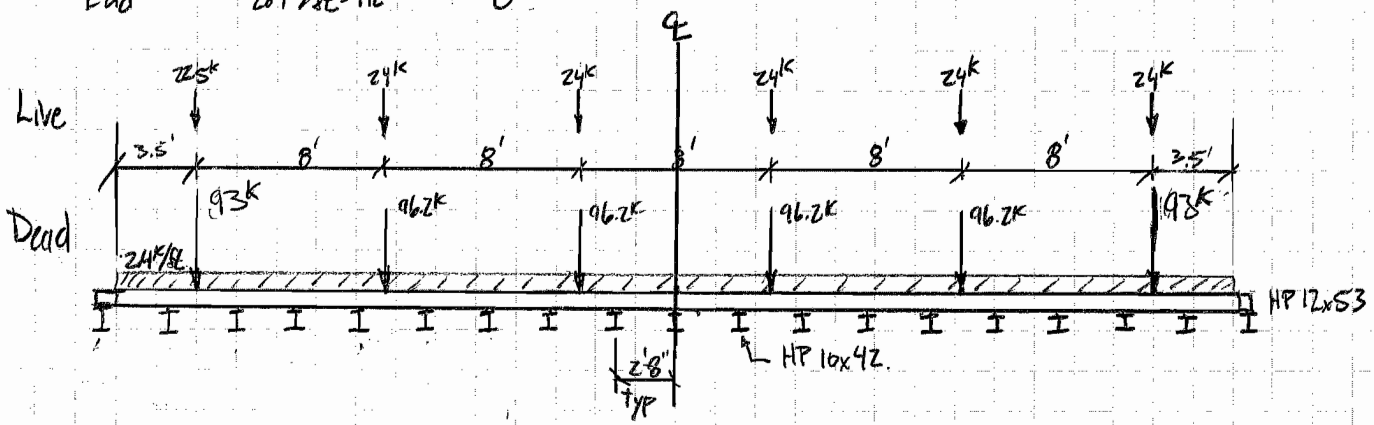
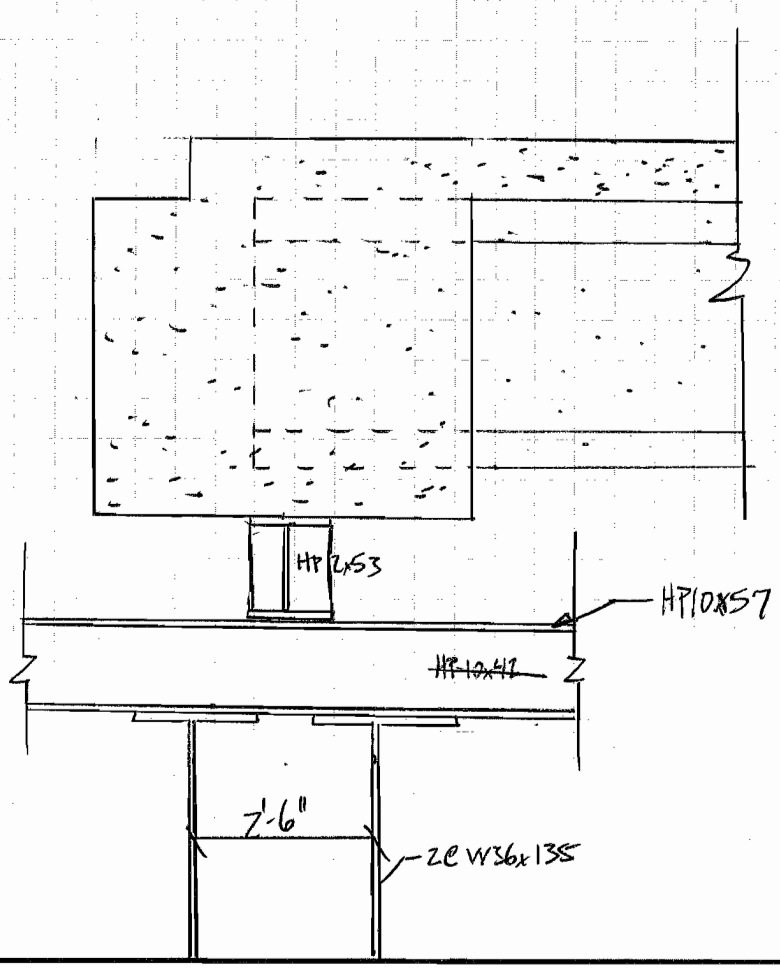
PROJECT DOT Cass Co.
SHEET NUMBER 4 OF 45
CALCULATED BY TPH DATE
CHECKED BY DATE
FILE NUMBER U13-135

Temporary Bent Design.

Beam Reactions =

	Dead	Live
outside	193 Kips	50#/ft = 7½'(120)(50)/2 = 22.5K
Inside	96.2 Kips	50#/ft = 8' x (120)(50)/2 = 24.0K
End	2.4K/ft = 112K	0





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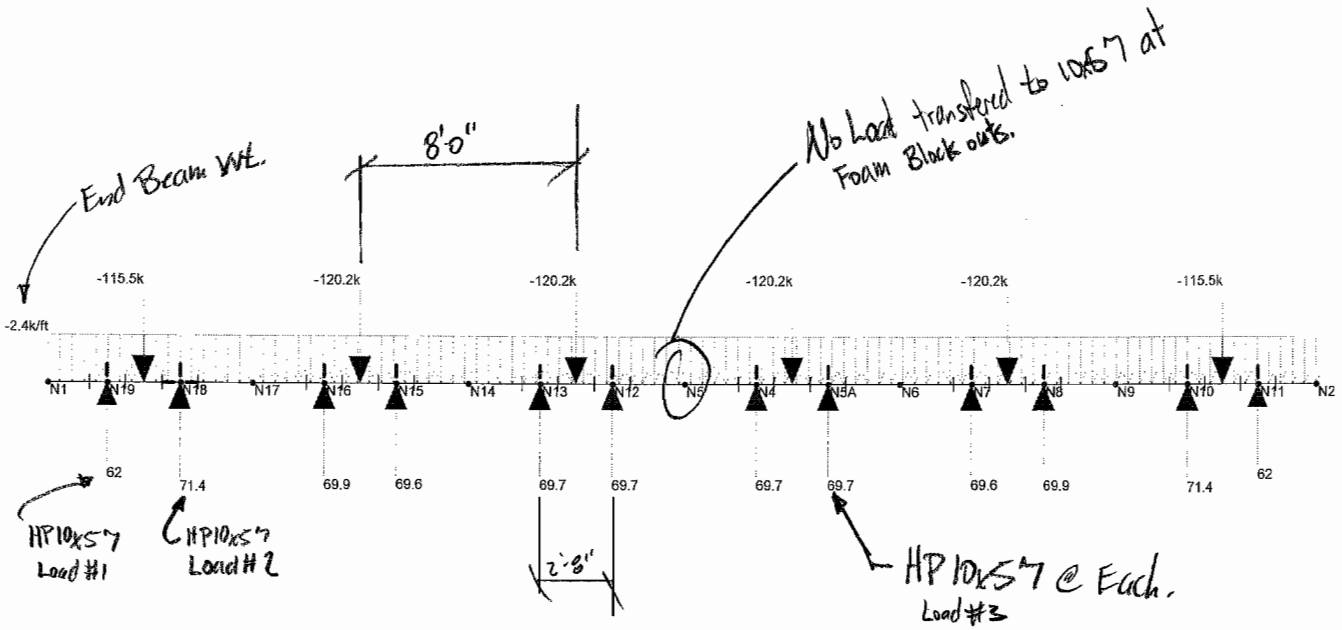
Construction Analysis.

HP 12x53

- Applied Load From Bridge Beam Reactions W/Live Load + End Beam Dead Load.
  - Beam is Braced for Lateral torsion @ Each Reaction Location. w/ Web stiffner and Welded to HP10x57



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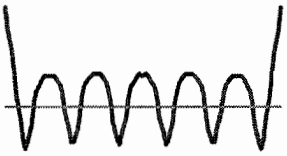
Loads: LC 2, 2. D+H+F+L+T
Results for LC 2, 2. D+H+F+L+T
Y-direction Reaction units are k and k-ft

Tometich Engineering		SK - 1
Ted Hoeger PE	Cass County Sliding bridge	June 25, 2013 at 2:42 PM
U13-135	HP12x53	HP12x53.r3d

Beam: ***M1***

Shape: **HP12x53**
Material: **A992**
Length: **47 ft**
I Joint: **N1**
J Joint: **N2**
LC 2: 2. D+H+F+L+T
Code Check: **0.944 (bending)**
Report Based On 97 Sections

.016 at 47 ft

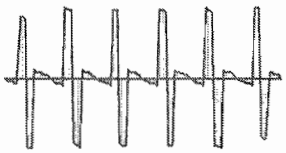
Dy  in

-.007 at 43.573 ft

Dz ———— in

A ———— k

64.122 at 42.594 ft

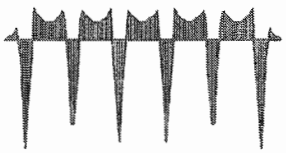
Vy  k

-64.122 at 4.406 ft

Vz ———— k

T ———— k-ft

17.292 at 28.885 ft

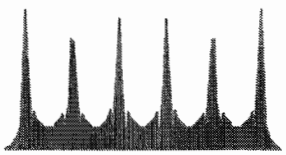
Mz  k-ft

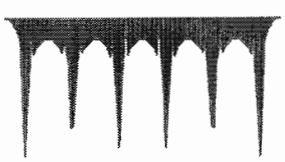
-63.99 at 43.573 ft

My ———— k-ft

fa ———— ksi

11.528 at 43.573 ft

fc  ksi

ft  ksi

-11.528 at 43.573 ft

AISC 14th(360-10): ASD Code Check

Direct Analysis Method

Max Bending Check	**0.944**	Max Shear Check	**0.625 (y)**
Location	**43.573 ft**	Location	**4.406 ft**
Equation	**H1-1b**	Max Defl Ratio	**L/10000**
Bending Flange	**Non-Compact**	Compression Flange	**Slender** **Qs=.991**
Bending Web	**Compact**	Compression Web	**Non-Slender** **Qa=1**

Fy	**50 ksi**
Pnc/om	**60.01 k**
Pnt/om	**464.072 k**
Mny/om	**66.857 k-ft**
Mnz/om	**67.771 k-ft**
Vny/om	**102.66 k**
Vnz/om	**187.545 k**
Cb	**1**

	y-y	z-z
Lb	**47 ft**	**47 ft**
KL/r	**197.035**	**112.008**

L Comp Flange	**47 ft**
Warp Length	**47 ft**
L-torque	**47 ft**
Tau_b	**1**

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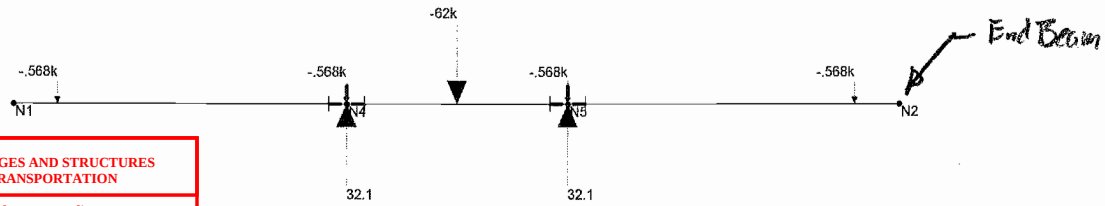
Construction Analysis.

		Area	
Platform Load =	LL = 50ps	2'x2'-8"	266#
	DL = 30psf	2'x2'-8"	160#
HP12x53	Beam = 53pf.	2'-8" Length	142#
			568#

HP 10x57 Check.

#1



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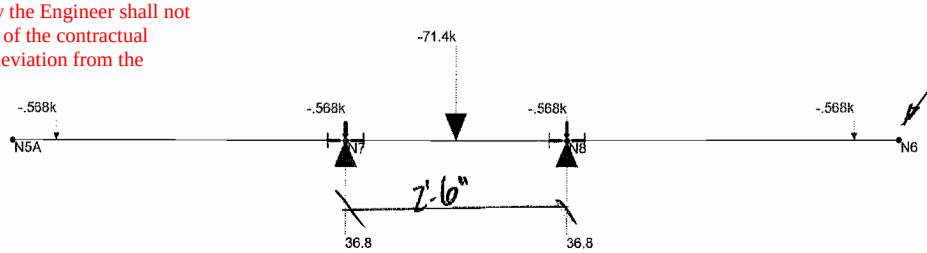
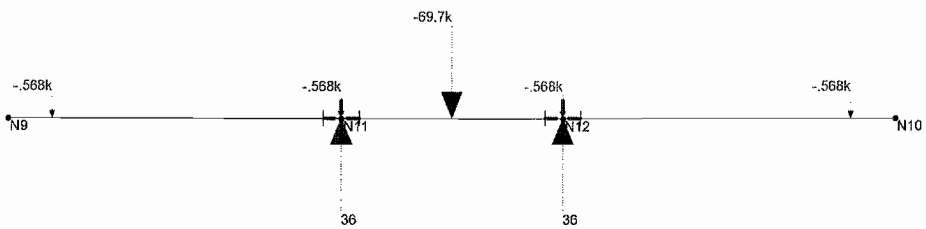
#2



2nd From End.
See Attached Risa Info.
(Governs)

W36x135 Location.

#3



HP10x57 check.

Applied Reactions from HP12x53 with LL+DL of platform.

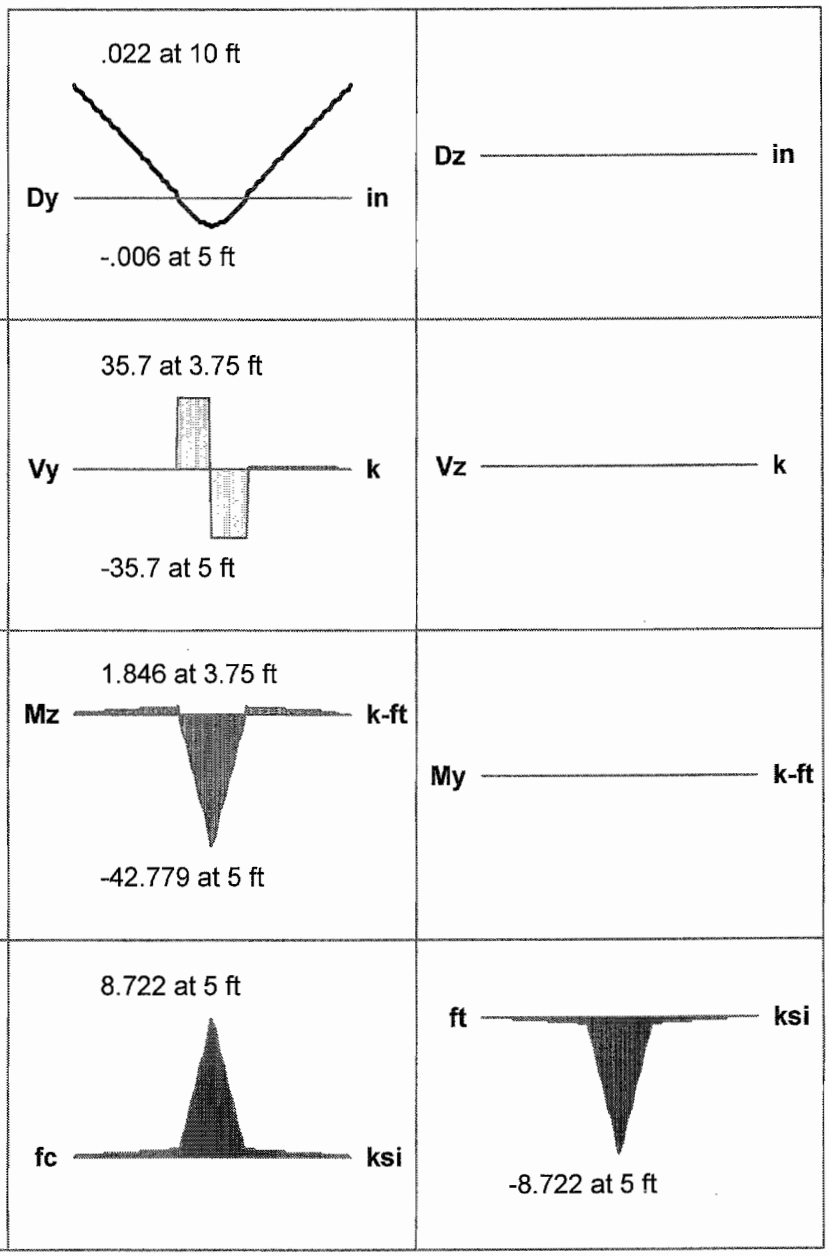
Loads: LC 2, 2. D+H+F+L+T
Results for LC 1, 1. D+F
Y-direction Reaction units are k and k-ft

Tometich Engineering		SK - 1
Ted Hoeger PE	Cass County Sliding bridge	June 27, 2013 at 9:28 AM
U13-135	HP10x57	HP10x57.r3d

Beam #2 Results

Beam: ***M2***

Shape: **HP10x57**
Material: **A992**
Length: **10 ft**
I Joint: **N5A**
J Joint: **N6**
LC 1: 1. D+F
Code Check: **0.316 (shear)**
Report Based On 97 Sections



AISC 14th(360-10): ASD Code Check

Direct Analysis Method

Max Bending Check	**0.263**	Max Shear Check	**0.316 (y)**
Location	**5 ft**	Location	**3.75 ft**
Equation	**H1-1b**	Max Defl Ratio	**L/4391**
Bending Flange	**Compact**	Compression Flange	**Non-Slender**
Bending Web	**Compact**	Compression Web	**Non-Slender**

Fy	**50 ksi**
Pnc/om	**420.11 k**
Pnt/om	**500 k**
Mny/om	**75.599 k-ft**
Mnz/om	**162.749 k-ft**
Vny/om	**112.887 k**
Vnz/om	**207.054 k**
Cb	**1**

	y-y	z-z
Lb	**10 ft**	**10 ft**
KL/r	**48.795**	**28.6**

L Comp Flange	**10 ft**
Warp Length	**10 ft**
L-torque	**10 ft**
Tau_b	**1**

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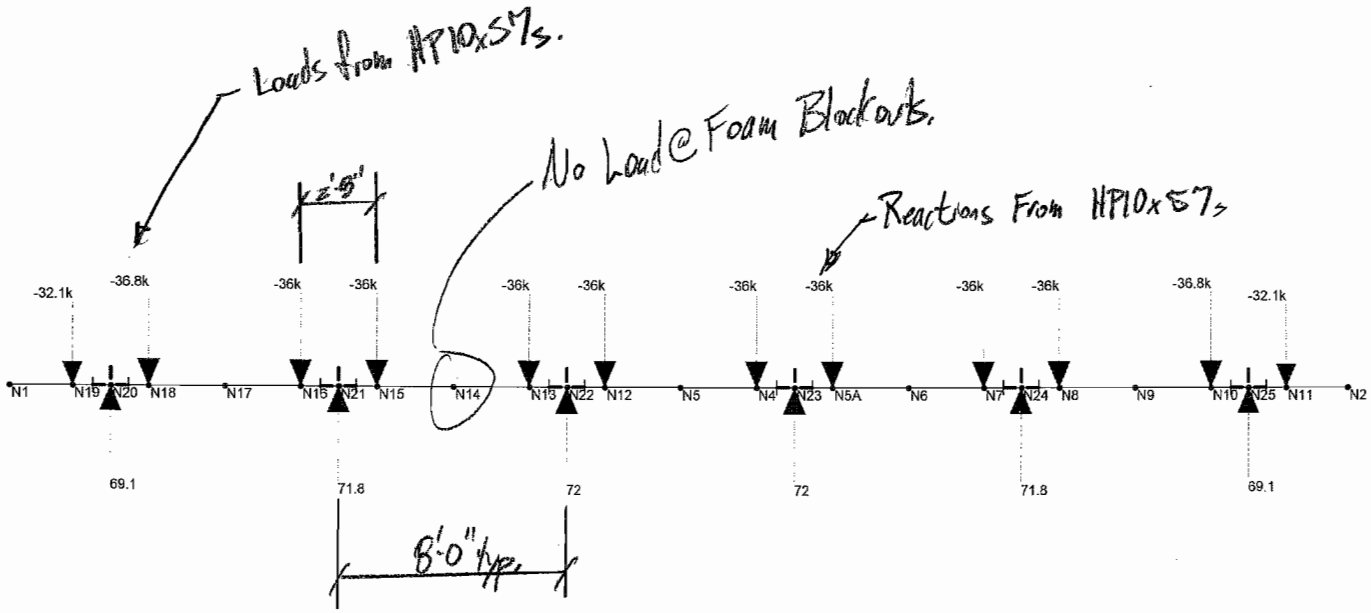
Construction Analysis.

Check (1) Single W36x135 Girder Beam.



Pile Load = 72 Kips = 36 TONS.

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Loads: BLC 1, D-Dead
Results for LC 1, 1. D+F
Y-direction Reaction units are k and k-ft

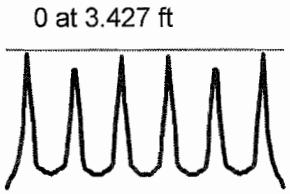
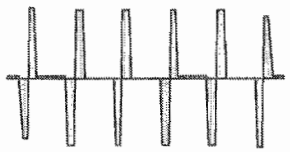
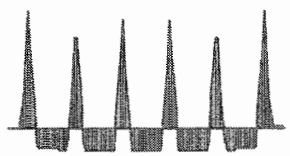
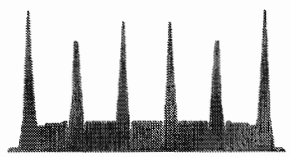
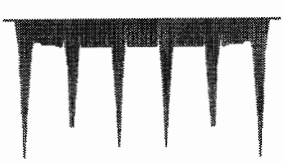
Tometich Engineering		SK - 1
Ted Hoeger PE	Cass County Sliding bridge	June 27, 2013 at 9:37 AM
U13-135	W36x135	W36x135.r3d

9/45

Beam: ***M1***

Shape: **W36x135**
Material: **A36 Gr.36**
Length: **47 ft**
I Joint: **N1**
J Joint: **N2**
LC 1: 1. D+F
Code Check: **0.155 (bending)**
Report Based On 97 Sections

	Dy: 0 at 3.427 ft; -.003 at 47 ft (in)	Dz (in)
A: .532 at 19.583 ft; -.532 at 27.417 ft (k)	Vy: 37.024 at 3.917 ft; -37.024 at 42.594 ft (k)	Vz (k)
T (k-ft)	Mz: 40.458 at 43.573 ft; -8.049 at 13.219 ft (k-ft)	My (k-ft)
fa: .013 at 19.583 ft; -.013 at 27.417 ft (ksi)	fc: 1.108 at 43.573 ft (ksi)	ft: -1.108 at 43.573 ft (ksi)

AISC 14th(360-10): ASD Code Check
Direct Analysis Method

Max Bending Check	**0.155**	Max Shear Check	**0.120 (y)**
Location	**43.573 ft**	Location	**3.917 ft**
Equation	**H1-1b**	Max Defl Ratio	**L/10000**
Bending Flange	**Compact**	Compression Flange	**Non-Slender Qs=1**
Bending Web	**Compact**	Compression Web	**Slender Qa=1**

No Cert. →

			y-y	z-z
Fy	**36 ksi**			
Pnc/om	**106.318 k**	Lb	**47 ft**	**47 ft**
Pnt/om	**860.12 k**	KL/r	**237.506**	**40.338**
Mny/om	**107.246 k-ft**			
Mnz/om	**265.071 k-ft**			
Vny/om	**307.584 k**	L Comp Flange	**47 ft**	
Vnz/om	**245.231 k**	Warp Length	**47 ft**	
→ Cb	**1**	L-torque	**47 ft**	
		Tau_b	**1**	

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IOWA DEPARTMENT OF TRANSPORTATION

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July 31, 2013

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Tometich Engineering, Inc.
Urbandale, Ia.

(515) 280-8022
Fax: (515) 727-9124

Job Name: Cass County Rolling Bridge
Job # U13-135
Born on Date: 10-May-05
Version #: 2.0

Page:
Date: 27-Jun-13

NDS Simple Span Joist/Beam

Location: Work Platform

Load

Unfactored		
Live	50	psf
Dead	20	psf
Spacing o.c.	1.5	ft
Live Load	75.0	plf
Dead Load	30.0	plf
Total Load	105.0	plf
Span	3.000	ft
Reaction	157.50	lb
Moment	118.13	lb*ft

Wood Properties (psi)				
	Fb	Fv	E	Emin
Doug Fir-Larch #2	900	180	1600000	580000
SPF South #2	775	135	1100000	400000
Southern Pine #2	975	175	1600000	580000

Beam Material	SPF South #2		
Size	2x6		
Fb	775	psi	
Fv	135	psi	
E	1100000	psi	
Number of Plys	1		
Width	5.50	in	
Depth	1.50	in	
Area	8.25	in^2	
Sx	2.1	in^3	
Ix	1.5	in^4	
F'b	1178.7	psi	
fb	687.3	psi	Bending OK!
F'v	155.3	psi	
fv	28.6	psi	Shear OK!
E'	1100000.0	psi	
L /360	0.10	in	
L /240	0.15	in	
Live Deflection	0.08	in	Deflection ok!
Total Deflection	0.11	in	Deflection ok!

CD	1.15	Load Duration Factor (1.6 involving wind/seismic)
CF	1.15	Size Factor for Bending, Table 4A
Ct	1.00	Temperature Factor, Table 2.3.3
Cr	1.15	Repetitive Member Factor: NDS 4.3.9
CM	1.00	Wet Service Factor for Compression, Table 4A
Ci	1.00	Incising Factor NDS 4.3.8
CL	1.00	Beam Stability Factor NDS 3.3.3

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Job Name: Cass County Rolling Bridge
Job # U13-135
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Version #: 2.0

Page:
Date: 27-Jun-13

NDS Simple Span Joist/Beam

Location: Under Beam concrete

Load

Unfactored		
Live	600	psf
Dead	10	psf
Spacing o.c.	1.5	ft
Live Load	900.0	plf
Dead Load	15.0	plf
Total Load	915.0	plf
Cantilever Length	0.600	ft
Reaction	274.50	lb
Moment	164.70	lb*ft

164.7

Wood Properties (psi)				
	Fb	Fv	E	Emin
Doug Fir-Larch #2	900	180	1600000	580000
SPF South #2	775	135	1100000	400000
Southern Pine #2	975	175	1600000	580000

Beam Material	SPF South #2		CD	1.15	Load Duration Factor (1.6 involving wind/seismic)
Size	2x6		CF	1.15	Size Factor for Bending, Table 4A
Fb	775	psi	Ct	1.00	Temperature Factor, Table 2.3.3
Fv	135	psi	Cr	1.15	Repetitive Member Factor: NDS 4.3.9
E	1100000	psi	CM	1.00	Wet Service Factor for Compression, Table 4A
Number of Plys	1		Ci	1.00	Incising Factor NDS 4.3.8
Width	5.50	in	CL	1.00	Beam Stability Factor NDS 3.3.3
Depth	1.50	in			
Area	8.25	in^2			
Sx	2.1	in^3			
Ix	1.5	in^4			
F'b	1178.7	psi			
fb	958.3	psi	Bending OK!		
F'v	155.3	psi			
fv	49.9	psi	Shear OK!		
E'	1100000.0	psi			
L /360	0.02	in			
L /240	0.03	in			
Live Deflection	0.00	in	Deflection ok!		
Total Deflection	0.00	in	Deflection ok!		

$W_b = \frac{120(1930)(.455)}{12^2}(1.25) = 994 > 610$ ok.

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Plywood check.

$F_b = 1450$, 3/4" plywood $S_x = 1.125 in^3$ per Foot.

$f_b = \frac{M}{S_x} \Rightarrow$ allowable $M = F_b S_x / 12 = ft\text{-}\# = 1450(1.125)/12 = 135.9$ ft-#

$M_{max} = 135$ ft-# $= \frac{wl^2}{10} \Rightarrow$ Max span $= \sqrt{M_{max}(10)/w} = \sqrt{135(10)/610} = 1.48$ ft $= 1'-5''$

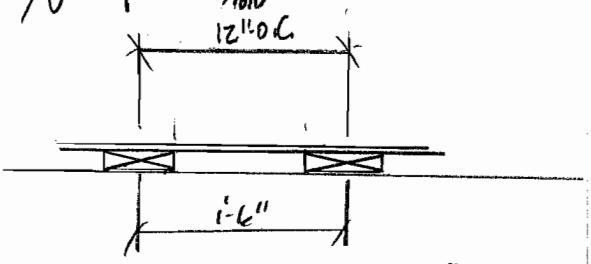
Reaction $= 1.1\,wl = 1.1(610)1.48' = 993^{\#}$

$f_v = \frac{3}{2}\frac{V}{bd} = \frac{3}{2}\left(\frac{993}{3/4(12)}\right) = 165.5$ psi > 120 psi. N.G.

Max allowable $V = 120(\frac{2}{3})(.75)(12) = 720^{\#}$

Max span $= 720/1.1(610) = 1.07$ ft $= 1'-1'' = 13''$

Use 2x6@ 12"-O.C.



Max spacing: 1'-6" O.C.

11a/45

2008 Interim Revisions to

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Construction Handbook for Bridge Temporary Works

First Edition/1995

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Published by the
American Association of State Highway and Transportation Officials

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116/45

Table 7. Grade-use guide for Plyform sheathing.[20]

Use these terms when specifying plywood[a]	Description	Typical trademarks	Veneer grade		
			Faces	Inner piles	Backs
APA B-B PLYFORM Class I & II[a]	Specifically manufactured for concrete forms. Many reuses. Smooth, solid surfaces. Mill-oiled unless otherwise specified.	APA PLYFORM B-B CLASS I EXTERIOR 000 PS 1-83	B	C	B
APA High Density Overlaid PLYFORM Class I & II[b]	Hard, semi-opaque resin-fiber overlay, heat-fused to panel faces. Smooth surface resists abrasion. Up to 200 reuses. Light oiling recommended between pours.	HDO PLYFORM I EXT APA 000 PS 1-83	B	C-Plugged	B
APA STRUCTURAL I PLYFORM[b]	Especially designed for engineered applications. All Group 1 species. Stronger and stiffer than PLYFORM Class I and II. Recommended for high pressures where face grain is parallel to supports. Also available with High Density Overlay faces.	APA STRUCTURAL I PLYFORM B-B CLASS I EXTERIOR 000 PS 1-83	B	C or C-Plugged	B
Special Overlays, proprietary panels, and Medium Density Overlaid plywood specifically designed for concrete forming.[b]	Produces a smooth uniform concrete surface. Generally mill-treated with form release agent.	No standard grading; for details of proprietary versions, see manufacturers' specifications.			
APA B-C EXT	Sanded panel often used for concrete forming where only on smooth, solid side is required.	APA B-C GROUP 1 EXTERIOR 000 PS 1-83	B	C	C

Notes:
(a) Commonly available in 19/32-in (15.1-mm), 5/8-in (15.9-mm), 23/32-in (18.3-mm), and ¾-in (19.1-mm) panel thickness [4-ft by 8-ft (1.2-m by 2.4-m) size].
(b) Check dealer for availability in your area.

Plywood manufactured in the United States is built up of an odd number of layers, with the grain of adjacent layers perpendicular. Alternating the grain direction of adjoining layers minimizes shrinkage and warping. In determining the flexural strength, shear strength, and stiffness of a panel, only those layers having their grain perpendicular to the supporting stud are assumed to be stressed. The safe span of plywood is therefore dependent not only on the type of plywood, but also on whether it is used in the weak direction (the face grain runs parallel to the supports) or in the strong direction (the face grain runs perpendicular to the supports).

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Interim 2003

11/45

Formulas for calculating the maximum allowable pressures for plywood members based on stress and deflection are given in table 8. Table 9 summarizes section properties for Plyform Class I and Class II, and Structural I Plyform. Design stresses and moduli of elasticity for these plywood classes are given in table 10. Due to the nature of plywood, the moment of inertia cannot simply be divided by half of the plywood thickness to get the section modulus. Therefore, the moment of inertia, I, is to be used to calculate deflection and the section modulus, KS, to calculate bending stress.

The design stresses in table 10 are given for Plyform used in wet conditions such as concrete forming. Bending stress and rolling stress may each be increased by 25 percent under loads of short duration, though this applies only when the number of reuses is limited. Since the limit on the number of reuses is not well defined, the designer must decide whether to use this factor. Also, the design stresses may be higher if special conditions exist, such as if the Plyform is well sealed against moisture so that the moisture content always remains below 16 percent. In addition to plywood strength, the designer must consider the effect of reuse on the permanent set or deflection of the plywood.

spts. @18" ⟹ $W_b = \frac{12 (1930 \text{ Psi})(.455)}{12^2} \times 1.25 = 914.$ $P_{sf} < 610 P_{sf}$

ok

Table 8. Formulas for stress and deflection calculations for plywood.[20]

	2 spans	3 spans
Maximum allowable pressure, w_b (lbf/ft²) based on bending stress	$w_b = \frac{96F_bKS}{l_1^2}$	$w_b = \frac{120F_bKS}{l_1^2}$
Maximum allowable pressure, w_s (lbf/ft²) based shear stress	$w_s = \frac{19.2F_s(lb/Q)}{l_2}$	$w_s = \frac{20F_s(lb/Q)}{l_2}$
Bending deflection, Δ_b (in)	$\Delta_b = \frac{wl_3^4}{2220EI}$	$\Delta_b = \frac{wl_3^4}{1743EI}$
Shear deflection, Δ_s (in)	$\Delta_s = \frac{Cwt^2l_3^1}{127E_cI}$	

To calculate the maximum allowable pressure based on maximum allowable deflection, $\Delta_{all.}$, calculate Δ_b and Δ_s with w = 1.0 lbf/ft². Then the maximum allowable pressure based on deflection, w_Δ (in lbf/ft²) is calculated as follows:

$$w_\Delta = \frac{\Delta_{all.}}{\Delta_s + \Delta_b}$$

Conversion: 1 lbf/ft² = 47.9 N/m²; 1,000 lbf/in² = 6.89 N/mm²; 1 in = 25.4 mm; 1 ft = 0.305 m.

W = uniform load, lbf/ft²
F_b = bending stress, lbf/in²
F_s = rolling shear stress, lbf/in²
lb/Q = rolling shear constant, in²/ft
KS = effective section modulus, in³/ft
I = moment of inertia, in⁴/ft
E = modulus of elasticity, adjusted, lb/in²
E_c = modulus of elasticity, unadjusted, lb/in²

l_1 = span, center-to-center of supports, in
l_2 = clear span, (in)
l_3 = clear span + ¼ in for 2-in framing, or clear span + 3/8 in for 4-in framing, in
Δ = deflection, in
C = constant = 120 parallel, 60 perpendicular
t = plywood thickness, in

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face grain ⊥ to supports

11d/45

Table 9. Section properties for Plyform Class I and Class II, and Structural I Plyform.[20]

Thickness (in)	Approximate weight (lbf/ft²)	Properties for stress applied parallel with face grain			Properties for stress applied perpendicular with grain		
		Moment of inertia I (in⁴/ft)	Effective section modulus KS (in³/ft)	Rolling shear constant lb/Q (in²/ft)	Moment of inertia I (in⁴/ft)	Effective section modulus KS (in³/ft)	Rolling shear constant lb/Q (in²/ft)
Class I							
15/32	1.4	0.066	0.244	4.743	0.018	0.107	2.419
1/2	1.5	0.077	0.268	5.153	0.024	0.130	2.739
19/32	1.7	0.115	0.335	5.438	0.029	0.146	2.834
5/8	1.8	0.130	0.358	5.717	0.038	0.175	3.094
23/32	2.1	0.180	0.430	7.009	0.072	0.247	3.798
3/4	2.2	0.199	0.455	7.187	0.092	0.306	4.063
7/8	2.6	0.296	0.584	8.555	0.151	0.422	6.028
1	3.0	0.427	0.737	9.374	0.270	0.634	7.014
1 1/8	3.3	0.554	0.849	10.430	0.398	0.799	8.419
Class II							
15/32	1.4	0.063	0.243	4.499	0.015	0.138	2.434
1/2	1.5	0.075	0.267	4.891	0.020	0.167	2.727
19/32	1.7	0.115	0.334	5.326	0.025	0.188	2.812
5/8	1.8	0.130	0.357	5.593	0.032	0.225	3.074
23/32	2.1	0.180	0.430	6.504	0.060	0.317	3.781
3/4	2.2	0.198	0.454	6.631	0.075	0.392	4.049
7/8	2.6	0.300	0.591	7.990	0.123	0.542	5.997
1	3.0	0.421	0.754	8.614	0.220	0.812	6.987
1 1/8	3.3	0.566	0.869	9.571	0.323	1.023	8.388
Structural I							
15/32	1.4	0.067	0.246	4.503	0.021	0.147	2.405
1/2	1.5	0.078	0.271	4.908	0.029	0.178	2.725
19/32	1.7	0.116	0.338	5.018	0.034	0.199	2.811
5/8	1.8	0.131	0.361	5.258	0.045	0.238	3.073
13/32	2.1	0.183	0.439	6.109	0.085	0.338	3.780
3/4	2.2	0.202	0.464	6.189	0.108	0.418	4.047
7/8	2.6	0.317	0.626	7.539	0.179	0.579	5.991
1	3.0	0.479	0.827	7.978	0.321	0.870	6.981
1 1/8	3.3	0.623	0.955	8.841	0.474	1.098	8.377

Notes:
(a) All properties adjusted to account for reduced effectiveness of plies with grain perpendicular to applied stress.
(b) Conversion: 1 in = 25.4 mm; 1 ft = 0.305 ft; 1 lbf/ft² = 47.9 N/m².

Table 10. Design stresses for Plyform.[20]

	Plyform Class I	Plyform Class II	Structural I Plyform
Modulus of elasticity – E (lbf/in², adjusted, use for bending deflection calculation)	1,650,000	1,430,000	1,650,000
Modulus of elasticity – E_e (lbf/in², unadjusted, use for shear deflection calculation)	1,500,000	1,300,000	1,500,000
Bending stress – F_b (lbf/in²)	1,930	1,330	1,930
Rolling shear stress – F_s (lbf/in²)	72	72	102

Table 10 has been increased by 25% for short duration loads.
Conversion: 1,000 lbf/in² = 6.89 N/mm²

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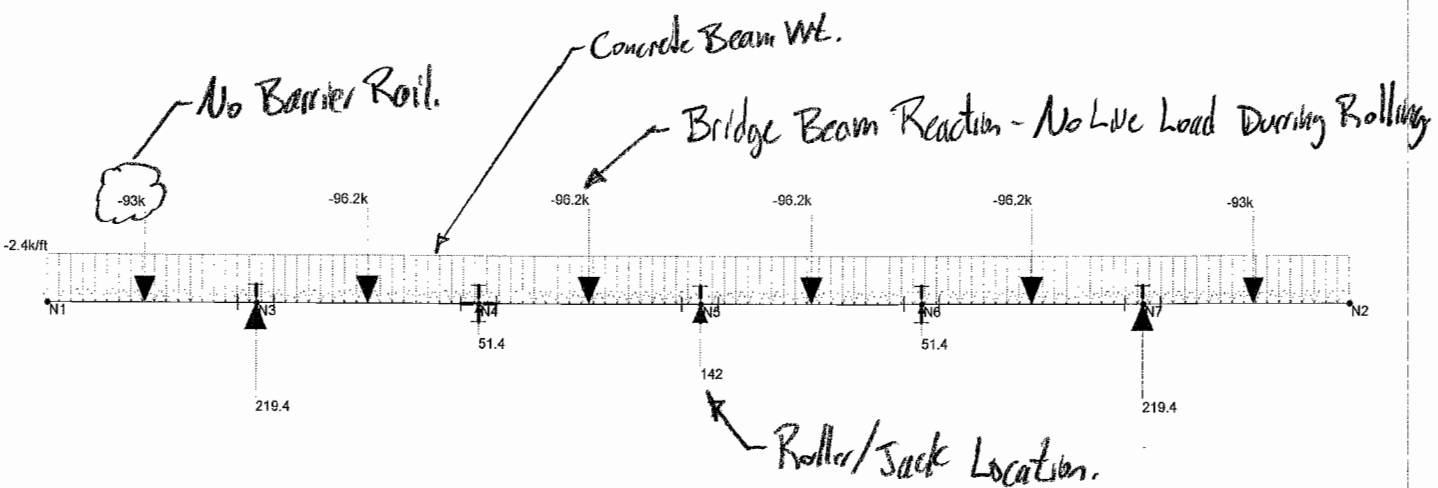
Interim 2008

Jack/Roll Loads.

Check Temporary Pier For Rolling Loads.

Load Analysis of Concrete Bridge Beam to Find Roller/Jack Reactions.



Roller Capacity: 100 Metric tons = 220^k > 219.4 ✓ok.

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Loads: BLC 1, D-Dead
Results for LC 1, 1. D+F
Y-direction Reaction units are k and k-ft

Tometich Engineering		SK - 2
Ted Hoeger PE	Cass County Sliding bridge	June 18, 2013 at 1:32 PM
U13-135	Roller/Jack Reactions	Bridge on Rollers 1 w no barrier.r3d

WARNING: Detail Report Based On Less Than 10 Sections!

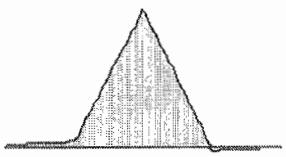
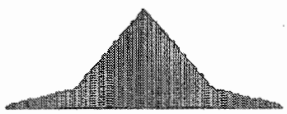
13/45

Beam: ***M1***

Shape:	**CRECT48X48**	Concrete Stress Block:	**Rectangular**
Material:	**Conc4000NW**	Cracked Sections Used:	**Yes**
Length:	**47 ft**	Cracked 'I' Factor:	**.35**
I Joint:	**N1**	Effective 'I':	**154828.8 in^4**
J Joint:	**N2**		

Code Check: **0.673 (bending)**
Report Based On 5 Sections

Moment + shear Value of End Beam For DOT USE.

A ——— **k**	70.994 at 23.5 ft **Vy**  **k** -2.005 at 35.25 ft	**Vz** ——— **k**
T ——— **k-ft**	140.216 at 23.5 ft **Mz**  **k-ft**	**My** ——— **k-ft**

Beam Design does not consider any 'T' & 'My' Moments, nor 'A' & 'Vz' Forces.

Warning: No design for spans which qualify as 'Deep Beams'

ACI 318-11 Code Check

Top Bending Check	**0.673**	Bot Bending Check	**0.318**	Shear Check	**0.493 (y)**
Location	**7.344 ft**	Location	**27.417 ft**	Location	**43.083 ft**
Gov Muz Top	**422.186 k-ft**	Gov Muz Bot	**-119.436 k-ft**	Gov Vuy	**102.4 k**
phi*Mnz Top	**627.019 k-ft**	phi*Mnz Bot	**375.649 k-ft**	phi*Vny	**207.762 k**
Tension Bar Fy	**60 ksi**	Concrete Weight	**.145 k/ft^3**	Top Cover	**1.5 in**
Shear Bar Fy	**60 ksi**	λ	**1**	Bottom Cover	**1.5 in**
F'c	**4 ksi**	E_Concrete	**3644 ksi**	Side Cover	**1.5 in**
Flex. Rebar Set	**ASTM A615**	Min 1 Bar Dia Spac.	**No**	Legs/Stirrup	**2**
Shear Rebar Set	**ASTM A615**				

Span Information

Span	Span Length (ft)	I-Face Dist. (in)	J-Face Dist. (in)
1	**0 - 7.5**	**0**	**0**
2	**7.5 - 15.5**	**0**	**0**
3	**15.5 - 23.5**	**0**	**0**
4	**23.5 - 31.5**	**0**	**0**
5	**31.5 - 39.5**	**0**	**0**
6	**39.5 - 47**	**0**	**0**

REVIEWED BY OFFICE OF BRIDGES AND STRUCTURES
IOWA DEPARTMENT OF TRANSPORTATION

Reviewed in accordance with current policy

July 31, 2013

✓ NO EXCEPTIONS TAKEN
☐ MAKE CORRECTIONS NOTED (NO RESUBMITTAL NEC.)
☐ AMEND AND RESUBMIT

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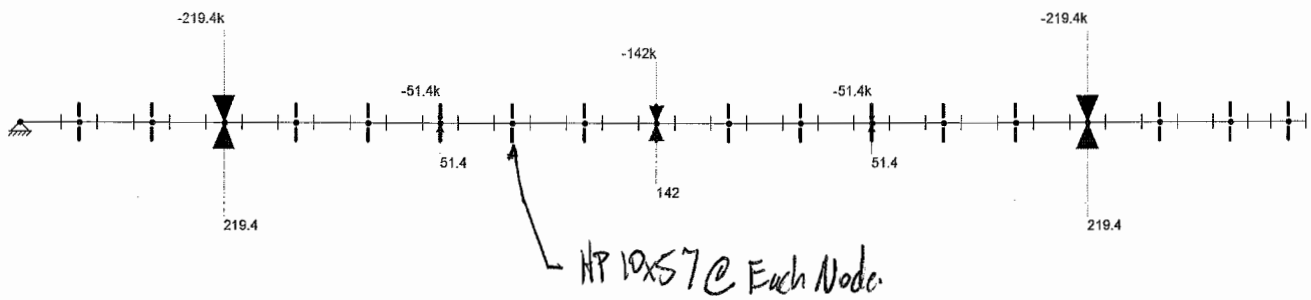
Jack/Roll Analysis.

HP12x53 - Load case #1 - Rollers over HP10x57s.



Direct Load path - No Loads on HP12x53 - Check Flange Buckling.

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Loads: BLC 1, D-Dead
Results for LC 1, 1. D+F
Y-direction Reaction units are k and k-ft

Tometich Engineering		SK - 1
Ted Hoeger PE	Cass County Sliding bridge	June 18, 2013 at 2:04 PM
U13-135	HP12x53 with rollers over HP10x57s	HP12x53.r3d

Jack/Roll Analysis

HP12x53 Load Case #2 - Rollers Between HP10x57s

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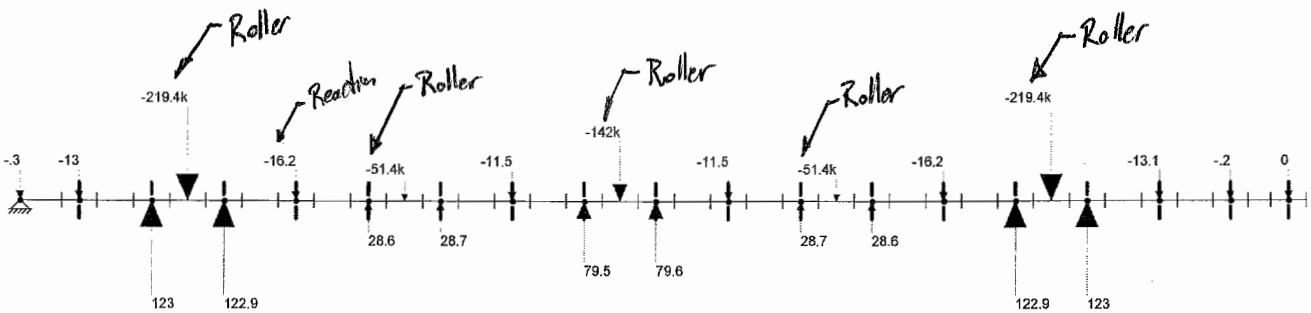


Loads @ Mid Span of HP12x53 Between HP10x57s,

Max uplift Reaction = 16.2 kips.

Uplift Resisted through Welding Beam Down.

Weld Length Req = 16.2/.4(50) sin(45°)(3/16) = 1.14" of Weld

Drawings show 3" Min Weld.

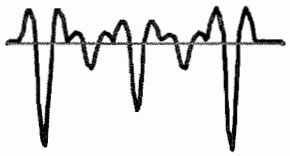
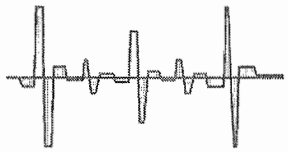
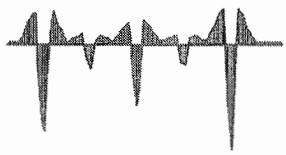
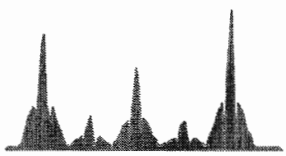
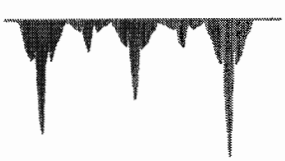
Loads: BLC 1, D-Dead
Results for LC 1, 1. D+F
Y-direction Reaction units are k and k-ft

Tometich Engineering		SK - 2
Ted Hoeger PE	Cass County Sliding bridge	June 18, 2013 at 2:07 PM
U13-135	HP12x53 with loads between HP10x57s	HP12x53.r3d

16/45.

Beam: ***M1***

Shape: **HP12x53**
Material: **A992**
Length: **47 ft**
I Joint: **N1**
J Joint: **N2**
LC 1: 1. D+F
Code Check: **1.069 (shear)**
Report Based On 97 Sections

	.003 at 35.74 ft Dy  in -.01 at 38.188 ft	Dz ——— in
A ——— k	109.721 at 4.896 ft Vy  k -109.737 at 38.677 ft	Vz ——— k
T ——— k-ft	34.487 at 36.719 ft Mz  k-ft -107.983 at 38.188 ft	My ——— k-ft
fa ——— ksi	19.453 at 38.188 ft fc  ksi	ft  ksi -19.453 at 38.188 ft

AISC 14th(360-10): ASD Code Check

Direct Analysis Method

Max Bending Check	**0.661**	Max Shear Check	**1.069 (y)**
Location	**38.188 ft**	Location	**38.677 ft**
Equation	**H1-1b**	Max Defl Ratio	**L/10000**
Bending Flange	**Non-Compact**	Compression Flange	**Slender** **Qs=.991**
Bending Web	**Compact**	Compression Web	**Non-Slender** **Qa=1**

Fy	**50 ksi**
Pnc/om	**185.297 k**
Pnt/om	**464.072 k**
Mny/om	**66.857 k-ft**
Mnz/om	**163.401 k-ft**
Vny/om	**102.66 k**
Vnz/om	**187.545 k**
Cb	**1**

	y-y	z-z
Lb	**8 ft**	**47 ft**
KL/r	**33.538**	**112.008**

L Comp Flange	**8 ft**
Warp Length	**47 ft**
L-torque	**47 ft**
Tau_b	**1**

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IOWA DEPARTMENT OF TRANSPORTATION

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July 31, 2013

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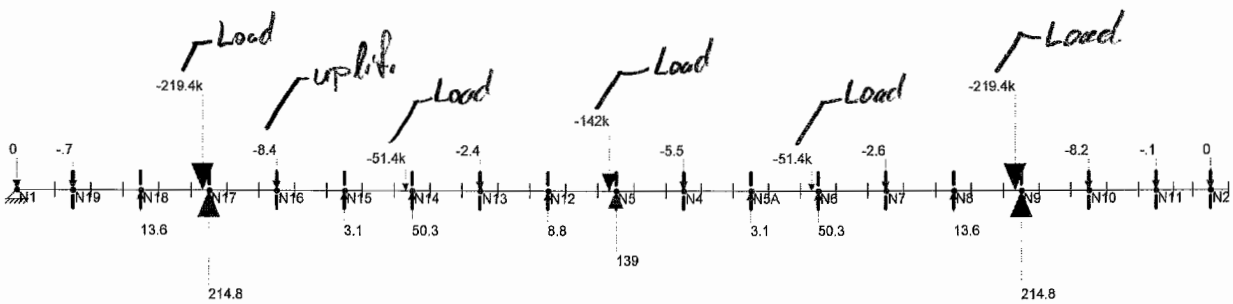
Jack/Roller Analysis

HP12x53 - Load case #3

Loads to side of HP10x57s (6")

(Check shear capacity)



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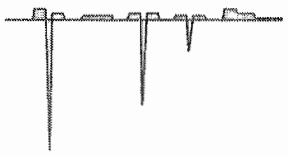
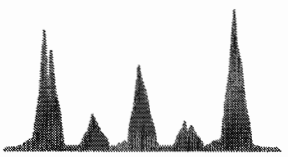
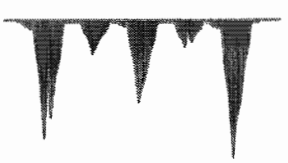
Loads: BLC 1, D-Dead
Results for LC 1, 1. D+F
Y-direction Reaction units are k and k-ft

Tometich Engineering		SK - 1
Ted Hoeger PE	Cass County Sliding bridge	July 1, 2013 at 4:44 PM
U13-135	HP12x53 with load to side of HP10x57	HP12x53 loads at side of 10x47s.r...

See Attached Page For shear Analysis

Beam: ***M1***

Shape: **HP12x53**
Material: **A992**
Length: **47 ft**
I Joint: **N1**
J Joint: **N2**
LC 1: 1. D+F
Code Check: **2.012 (shear)**
Report Based On 97 Sections

	.002 at 40.635 ft Dy in -.003 at 6.365 ft	Dz ——— in
A ——— k	12.884 at 4.896 ft Vy  k -206.516 at 7.344 ft	Vz ——— k
T ——— k-ft	21.188 at 39.656 ft Mz k-ft -28.063 at 39.167 ft	My ——— k-ft
fa ——— ksi	5.056 at 39.167 ft fc  ksi	ft  ksi -5.056 at 39.167 ft

AISC 14th(360-10): ASD Code Check

Direct Analysis Method

Max Bending Check	**0.172**	Max Shear Check	**2.012 (y)**	
Location	**39.167 ft**	Location	**7.344 ft**	
Equation	**H1-1b**	Max Defl Ratio	**L/10000**	
Bending Flange	**Non-Compact**	Compression Flange	**Slender**	**Qs=.991**
Bending Web	**Compact**	Compression Web	**Non-Slender**	**Qa=1**

Fy	**50 ksi**
Pnc/om	**185.297 k**
Pnt/om	**464.072 k**
Mny/om	**66.857 k-ft**
Mnz/om	**163.401 k-ft**
Vny/om	**102.66 k**
Vnz/om	**187.545 k**
Cb	**1**

	y-y	z-z
Lb	**8 ft**	**47 ft**
KL/r	**33.538**	**112.008**

L Comp Flange	**8 ft**
Warp Length	**47 ft**
L-torque	**47 ft**
Tau_b	**1**

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Tometich Engineering, Inc.
10501 Buena Vista Court
Urbandale, Iowa 50322
(515) 280-8022
fax: (515) 727-9124
www.tometichengineering.com

PROJECT DOT- Cas Co.
SHEET NUMBER 14 OF 45
CALCULATED BY TPH DATE
CHECKED BY DATE
FILE NUMBER U13-135

Shear Capacity of HP12x53

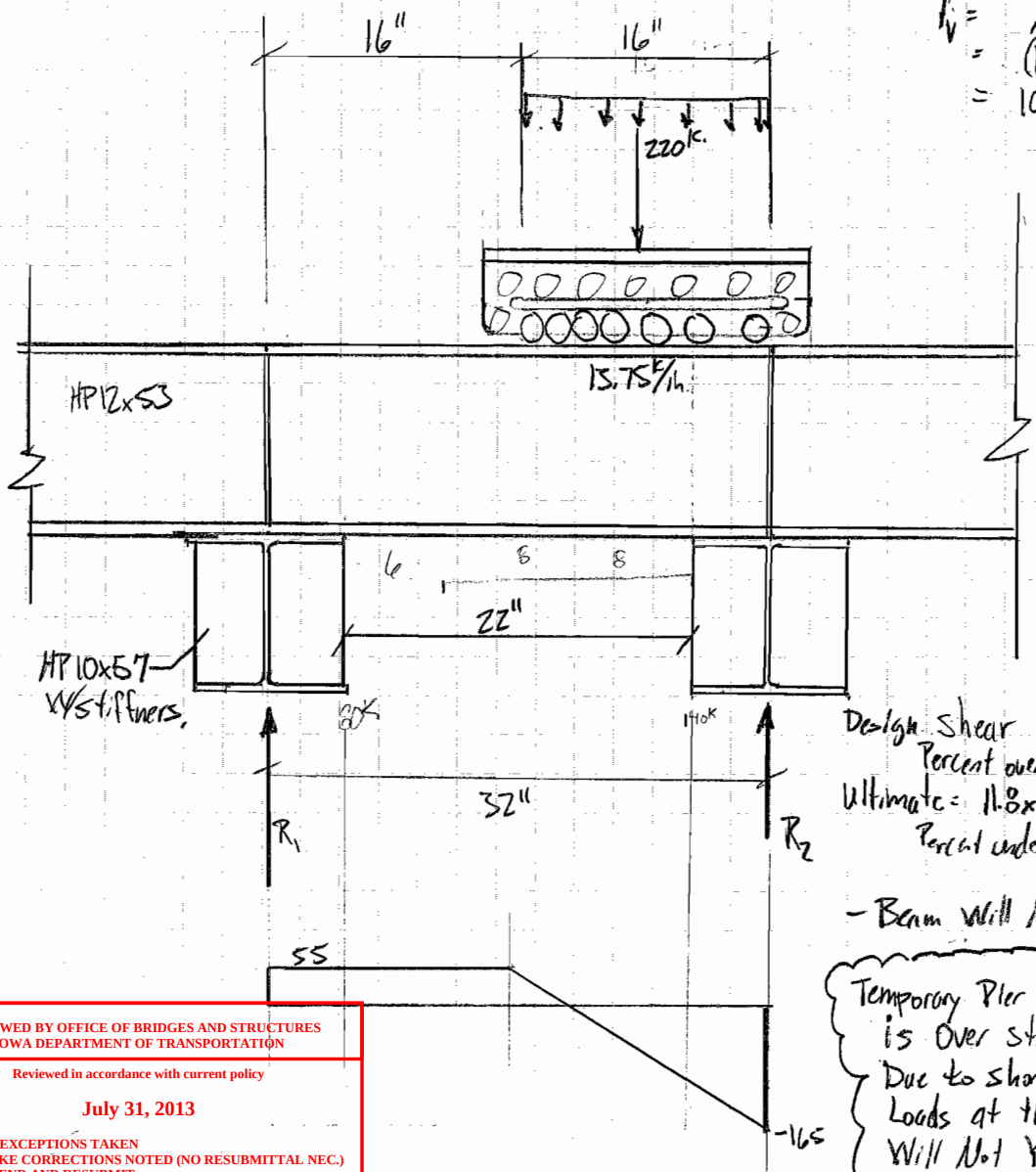
Find Max shear IF Load is seen As distributed across the rollers.
- Simple Span approach

= Load/inch of Roller

$R_1 = 13.75 \times 16 \times 8/32 = 55^K$
$R_2 = 13.75 \times 16 \times 24/32 = 165^K$

HP12x53
D=11.8
t_w=.435
A=15.5

$F_v = A_w \cdot .6 F_y \phi$ (1.5)
$= (11.8)(.435)(.6)50/1.5$
$= 102.66$ Kips.
← Matches Risa.



Design Shear Capacity = 102.66K.
Percent over Design = 1.60%
Ultimate = 11.8 x .435 x 50ksi = 256.K
Percent under ultimate = .64% ← OK.

- Beam Will Not Yield. -

Temporary Pier FOR Accepts this Beam is Over stressed By Design standards. Due to short term Load and only 2 Loads at this Stress this Beam Will Not Yield or Fail.

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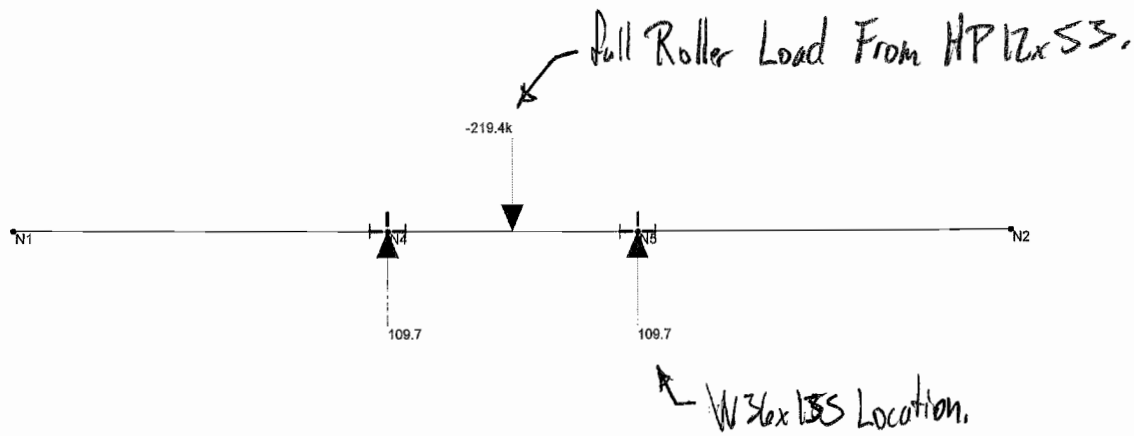
Roller/Jack Analysis.



HP 10x57 check w/ Roller Load.

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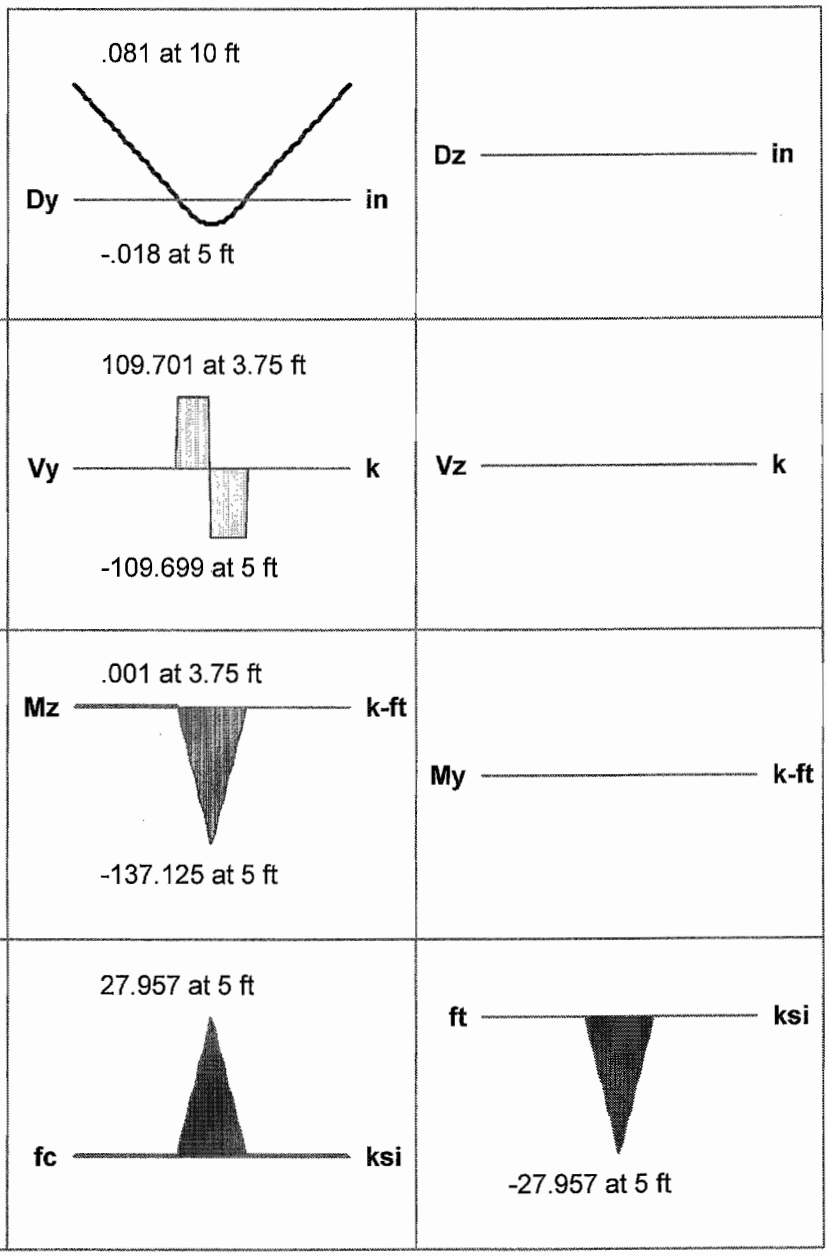
Loads: BLC 1, D-Dead
Results for LC 1, 1. D+F
Y-direction Reaction units are k and k-ft

Tometich Engineering		SK - 1
Ted Hoeger PE	Cass County Sliding bridge	June 18, 2013 at 2:36 PM
U13-135	HP10x57 with roller above	HP10x42.r3d

Beam: ***M1***

Shape: **HP10x57**
Material: **A992**
Length: **10 ft**
I Joint: **N1**
J Joint: **N2**
LC 1: 1. D+F
Code Check: **0.972 (shear)**
Report Based On 97 Sections



AISC 14th(360-10): ASD Code Check

Direct Analysis Method

Max Bending Check	**0.843**	Max Shear Check	**0.972 (y)**
Location	**5 ft**	Location	**3.75 ft**
Equation	**H1-1b**	Max Defl Ratio	**L/1206**
Bending Flange	**Compact**	Compression Flange	**Non-Slender**
Bending Web	**Compact**	Compression Web	**Non-Slender**

Fy	**50 ksi**
Pnc/om	**420.11 k**
Pnt/om	**500 k**
Mny/om	**75.599 k-ft**
Mnz/om	**162.749 k-ft**
Vny/om	**112.887 k**
Vnz/om	**207.054 k**
Cb	**1**

	y-y	z-z
Lb	**10 ft**	**10 ft**
KL/r	**48.795**	**28.6**

L Comp Flange	**10 ft**
Warp Length	**10 ft**
L-torque	**10 ft**
Tau_b	**1**

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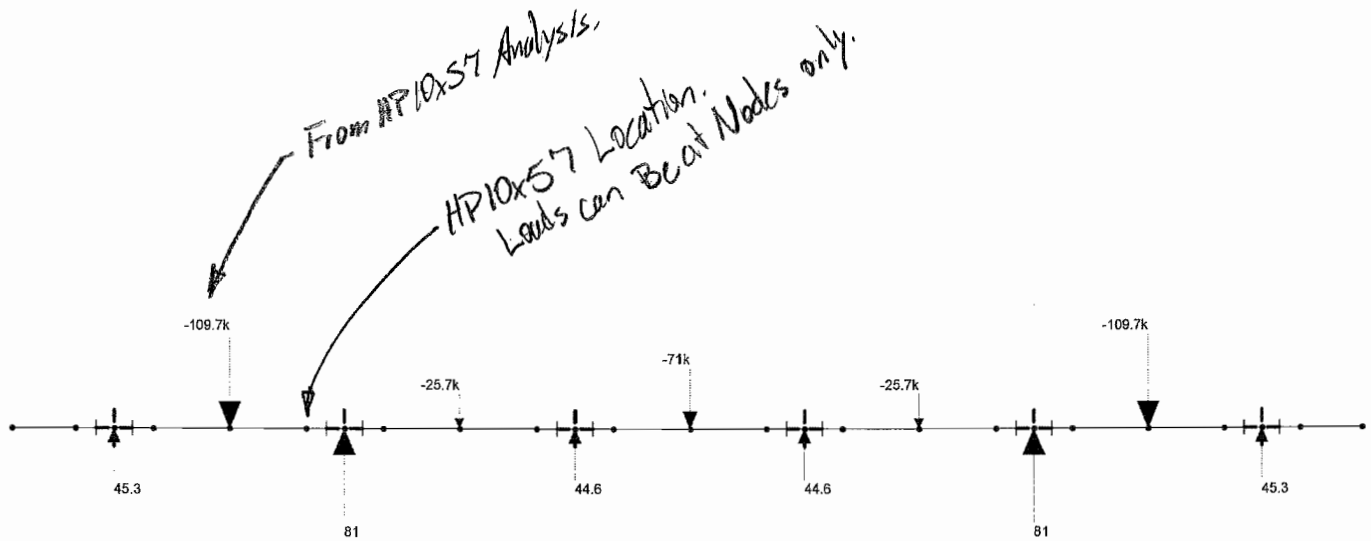
Roller/Jack Analysis.

W36x135 Analysis- Load Case #1

Roller on HP12x53 center above HP10x57 @ Center of W36x135 span.



Pile Load = 81K

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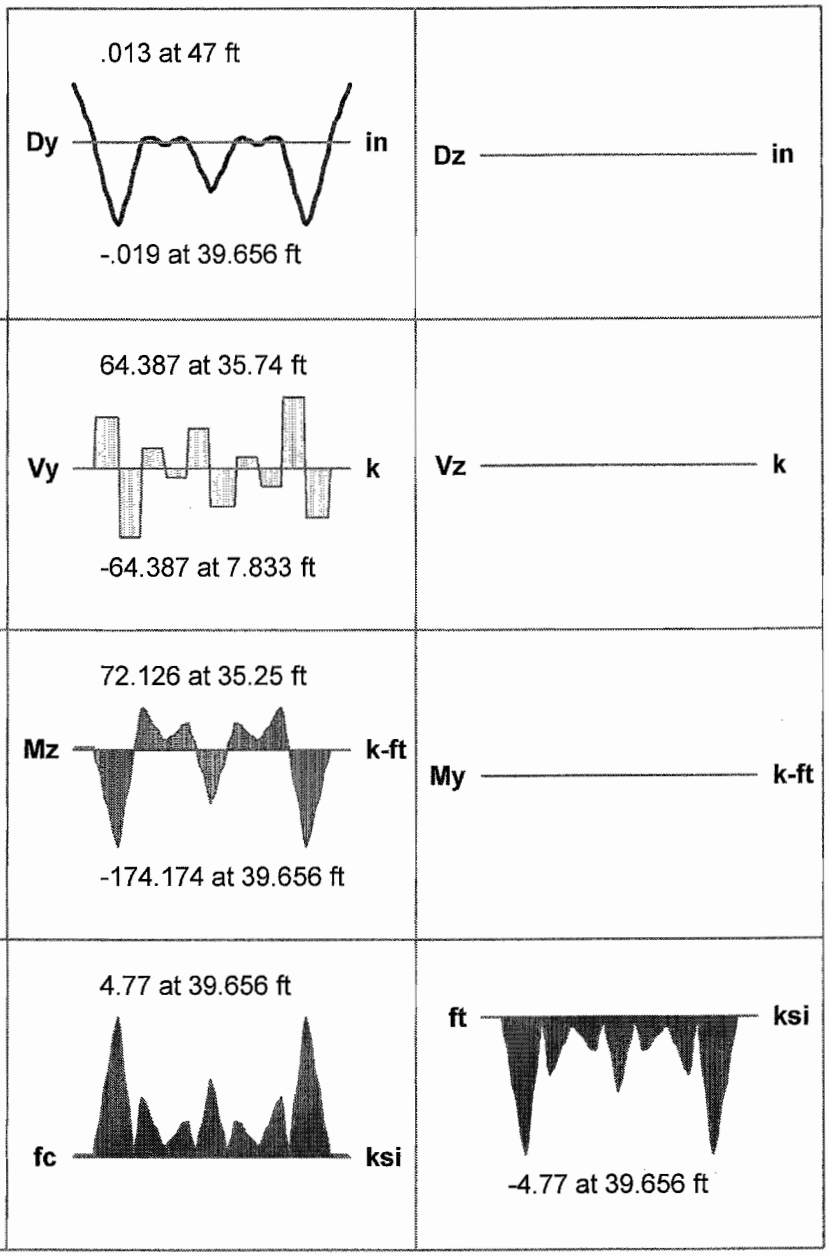
Loads: BLC 1, D-Dead
Results for LC 1, 1. D+F
Y-direction Reaction units are k and k-ft

Tometich Engineering		SK - 1
Ted Hoeger PE	Cass County Sliding bridge	June 27, 2013 at 3:06 PM
U13-135	W36x135 with roller loads from HP10x57s	W36x135 at start (center loads).r3d

Beam: ***M1***

Shape: **W36x135**
Material: **A36 Gr.36**
Length: **47 ft**
I Joint: **N1**
J Joint: **N2**
LC 1: 1. D+F
Code Check: **0.657 (bending)**
Report Based On 97 Sections



AISC 14th(360-10): ASD Code Check

Direct Analysis Method

Max Bending Check	**0.657**	Max Shear Check	**0.209 (y)**	
Location	**7.344 ft**	Location	**35.74 ft**	
Equation	**H1-1b**	Max Defl Ratio	**L/10000**	
Bending Flange	**Compact**	Compression Flange	**Non-Slender**	**Qs=1**
Bending Web	**Compact**	Compression Web	**Slender**	**Qa=1**

Fy	**36 ksi**
Pnc/om	**106.318 k**
Pnt/om	**860.12 k**
Mny/om	**107.246 k-ft**
Mnz/om	**265.071 k-ft**
Vny/om	**307.584 k**
Vnz/om	**245.231 k**
Cb	**1**

	y-y	z-z
Lb	**47 ft**	**47 ft**
KL/r	**237.506**	**40.338**

L Comp Flange	**47 ft**
Warp Length	**47 ft**
L-torque	**47 ft**
Tau_b	**1**

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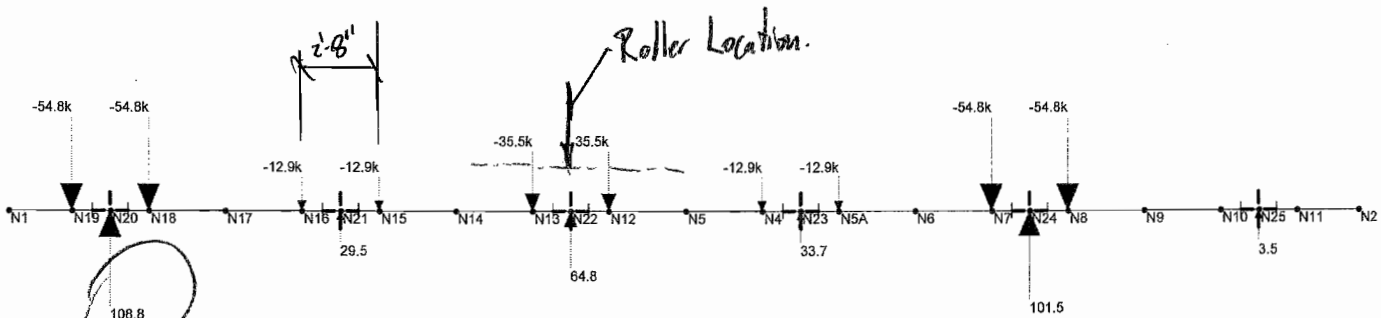
Jack/Roller Analysis

W36x135 Load case #2 - Roller on HP12x53 above Pile Location

HP12x53 Loads (2) HP10x57s on each side of Pile Location.



= Max Pile Capacity Required = 108.8k

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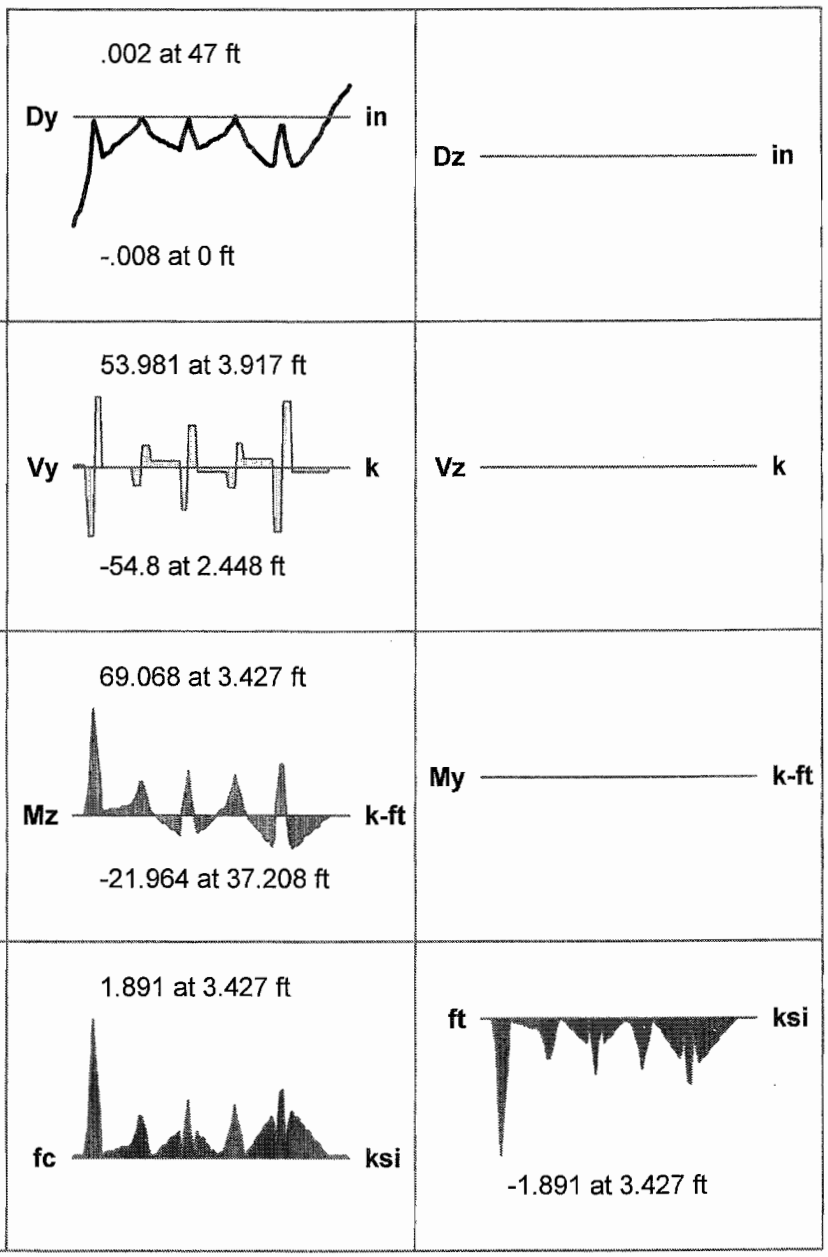
Loads: BLC 1, D-Dead
Results for LC 1, 1. D+F
Y-direction Reaction units are k and k-ft

Tometich Engineering		SK - 2
Ted Hoeger PE	Cass County Sliding bridge	June 27, 2013 at 3:11 PM
U13-135	W36x135 with roller loads from HP10x57s over piles	W36x135 at start (over piles).r3d

Beam: ***M1***

Shape: **W36x135**
Material: **A36 Gr.36**
Length: **47 ft**
I Joint: **N1**
J Joint: **N2**
LC 1: 1. D+F
Code Check: **0.261 (bending)**
Report Based On 97 Sections



AISC 14th(360-10): ASD Code Check

Direct Analysis Method

Max Bending Check	**0.261**	Max Shear Check	**0.178 (y)**	
Location	**3.427 ft**	Location	**2.448 ft**	
Equation	**H1-1b**	Max Defl Ratio	**L/10000**	
Bending Flange	**Compact**	Compression Flange	**Non-Slender**	**Qs=1**
Bending Web	**Compact**	Compression Web	**Slender**	**Qa=1**

No Cal. →

Fy	**36 ksi**
Pnc/om	**106.318 k**
Pnt/om	**860.12 k**
Mny/om	**107.246 k-ft**
Mnz/om	**265.071 k-ft**
Vny/om	**307.584 k**
Vnz/om	**245.231 k**
Cb	**1**

	y-y	z-z
Lb	**47 ft**	**47 ft**
KL/r	**237.506**	**40.338**

L Comp Flange	**47 ft**
Warp Length	**47 ft**
L-torque	**47 ft**
Tau_b	**1**

REVIEWED BY OFFICE OF BRIDGES AND STRUCTURES
IOWA DEPARTMENT OF TRANSPORTATION

Reviewed in accordance with current policy

July 31, 2013

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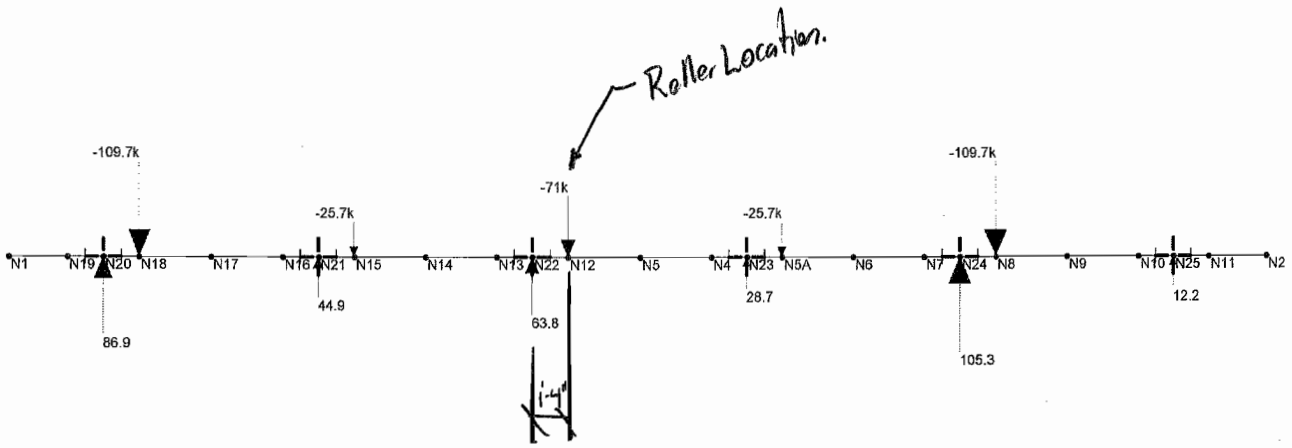
Jack/Rolling Analysis

W36x135 Load Case #3 - Roller on HP12x53 directly over HP10x57 @ Side of Pile Location,



Max Pile Load: 105.3k

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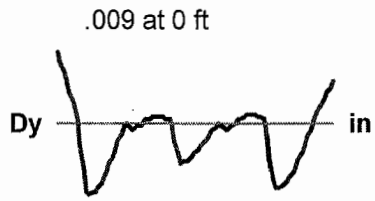
Loads: BLC 1, D-Dead
Results for LC 1, 1. D+F
Y-direction Reaction units are k and k-ft

Tometich Engineering		SK - 1
Ted Hoeger PE	Cass County Sliding bridge	June 27, 2013 at 3:17 PM
U13-135	W36x135 with roller loads from HP10x57 beside piles	W36x135 at start (side of piles).r3d

27/45

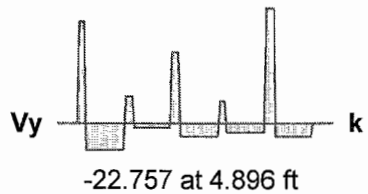
Beam: ***M1***

Shape: **W36x135**
Material: **A36 Gr.36**
Length: **47 ft**
I Joint: **N1**
J Joint: **N2**
LC 1: 1. D+F
Code Check: **0.434 (bending)**
Report Based On 97 Sections



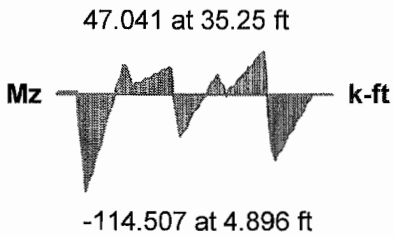
Dz — in

A: .532 at 19.583 ft / -.532 at 27.417 ft — k



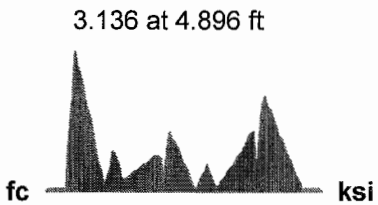
Vz — k

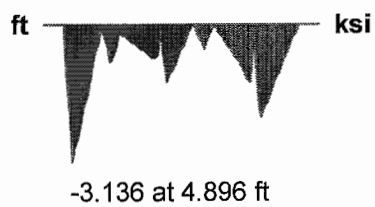
T — k-ft



My — k-ft

fa: .013 at 19.583 ft / -.013 at 27.417 ft — ksi





AISC 14th(360-10): ASD Code Check

Direct Analysis Method

Max Bending Check	**0.434**	Max Shear Check	**0.317 (y)**
Location	**4.896 ft**	Location	**35.74 ft**
Equation	**H1-1b**	Max Defl Ratio	**L/10000**
Bending Flange	**Compact**	Compression Flange	**Non-Slender Qs=1**
Bending Web	**Compact**	Compression Web	**Slender Qa=1**

No Cat. →

Fy	**36 ksi**
Pnc/om	**106.318 k**
Pnt/om	**860.12 k**
Mny/om	**107.246 k-ft**
Mnz/om	**265.071 k-ft**
Vny/om	**307.584 k**
Vnz/om	**245.231 k**
Cb	**1**

	y-y	z-z
Lb	**47 ft**	**47 ft**
KL/r	**237.506**	**40.338**

L Comp Flange	**47 ft**
Warp Length	**47 ft**
L-torque	**47 ft**
Tau_b	**1**

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IOWA DEPARTMENT OF TRANSPORTATION

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July 31, 2013

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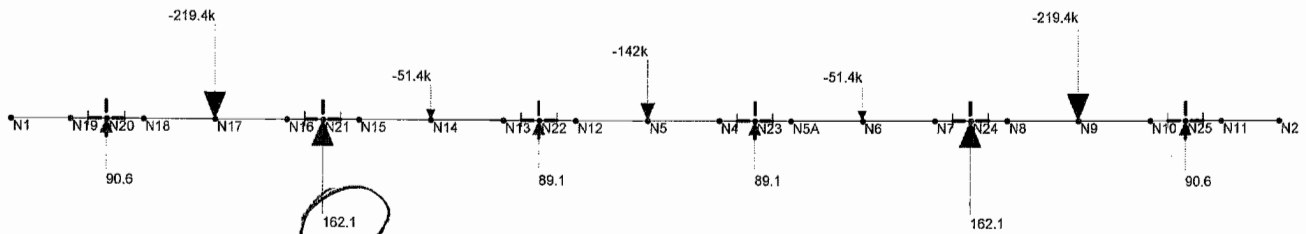
27A/45

W36x135 w/ Jacking Loads



Max Pile Load: 162.1K.

81 Tons

Design Capacity = 162.1 x 1.15 = 186.4K ultimate Capacity Req.

HP10x57 Area = 16.8 186.4/16.8 = 11 ksi ok

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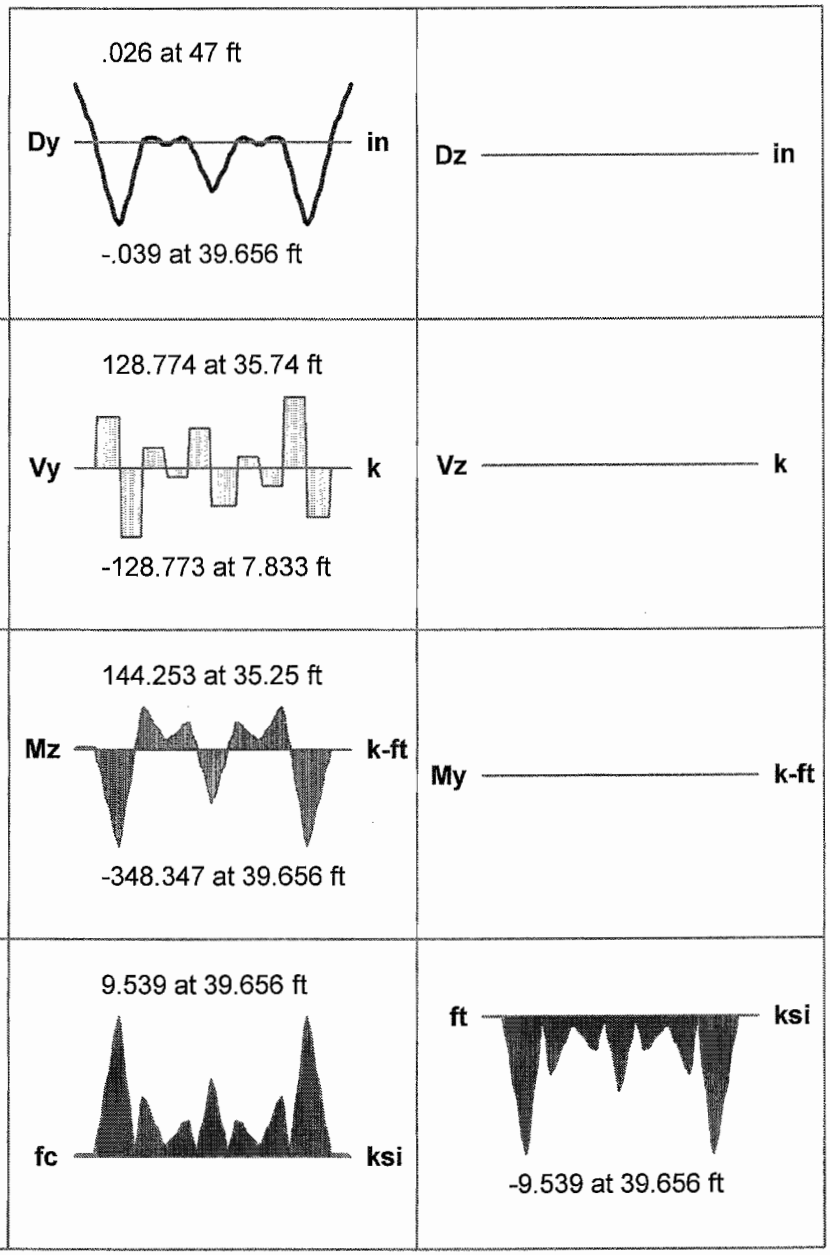
Loads: BLC 1, D-Dead
Results for LC 1, 1. D+F
Y-direction Reaction units are k and k-ft

Tometich Engineering		SK - 1
Ted Hoeger PE	Cass County Sliding bridge	July 23, 2013 at 10:05 AM
U13-135	W36x135 with Jacking Loads	W36x135 Jacking Loads.r3d

2TB/45.

Beam: ***M1***

Shape: **W36x135**
Material: **A36 Gr.36**
Length: **47 ft**
I Joint: **N1**
J Joint: **N2**
LC 1: 1. D+F
Code Check: **0.545 (bending)**
Report Based On 97 Sections



AISC 14th(360-10): ASD Code Check

Direct Analysis Method

Max Bending Check	**0.545**	Max Shear Check	**0.419 (y)**	
Location	**11.75 ft**	Location	**35.74 ft**	
Equation	**H1-1b**	Max Defl Ratio	**L/8704**	
Bending Flange	**Compact**	Compression Flange	**Non-Slender**	**Qs=1**
Bending Web	**Compact**	Compression Web	**Slender**	**Qa=.919**

Fy	**36 ksi**
Pnc/om	**698.294 k**
Pnt/om	**860.12 k**
Mny/om	**107.246 k-ft**
Mnz/om	**265.071 k-ft**
Vny/om	**307.584 k**
Vnz/om	**245.231 k**
Cb	**1**

	y-y	z-z
Lb	**10 ft**	**47 ft**
KL/r	**50.533**	**40.338**

L Comp Flange	**47 ft**
Warp Length	**47 ft**
L-torque	**47 ft**
Tau_b	**1**

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Tometich Engineering, Inc.
10501 Buena Vista Court
Urbandale, Iowa 50322
(515) 280-8022
fax: (515) 727-9124
www.tometichengineering.com

PROJECT DOT- Cass Co.
SHEET NUMBER 28 OF 45
CALCULATED BY TPH DATE
CHECKED BY DATE
FILE NUMBER U13-135

REVIEWED BY OFFICE OF BRIDGES AND STRUCTURES
IOWA DEPARTMENT OF TRANSPORTATION
Reviewed in accordance with current policy
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Temporary Pier Pile Capacity

Notes 1. Pile Capacity Factor of Safety (FS) of 1.5 used for construction Loads. These loads are short in duration. Bridge Construction should Be Less than 3 Months. Full Loading of Piles Will require Completed Bridge with Full Live Load of 50psf. (Not likely). Plus Completed Bridge will Not Be in place More than 1 Month.
∴ DOT Charts Will Not Apply

2. Pile Capacity FS of 1.25 used for Rolling Loads. These Loads should Be Very short Less than 2 Weeks. ∴ Full Safety factor Not Needed. ∴ Dot charts Do Not Apply. No settlement Calculation are Required Because of this short term Load. Consolidation is a time Required Process.

3. Soils Design Info Provided on DOT Drawings do not provide Soils Information Below 30 ft. New Qu Value estimated from Blow Counts on soil Borings.

4. Contractor is instructed to drive to Design Bearing Capacity. Calculations for Length are for Contractor reference only

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PROJECT DOT - Coss Co.
SHEET NUMBER 29 OF 45
CALCULATED BY TPH DATE
CHECKED BY DATE
FILE NUMBER U13-135

Temporary Pier Pile Capacity.

Loads: Construction = 72^k per pile
Rolling = 115^k per pile } = Req Capacity.

Factor of safety for Construction = 1.5 ⇒ 72 x 1.5 = 108^k Capacity.

Factor of Safety for Rolling = 1.25 ⇒ 108^k x 1.25 = 135^k ⇒ Due to Short Duration 1.25 SF is Acceptable.

Design Bearing Capacity Per Pile: 135^k

Pile = HP10x42
A = 12.4
d = 9.7
b_f = 10.1
t_f = .420
T = 7½

Friction Area/ft = $b_f(4) + T(2)$ = 10.1(4) + 7½(2) = 55.4 = 4.616 ft²

End Bearing - (Assume Clay Plug) = (10.1 x 9.7) = 97.9 in² = .680 ft²

Pile Length = 60 ft ⇒ 5 ft @ grade ⇒ 55 ft of Embedment.

Top of Pile Elevation = 1209.8
Bottom of Pile = 1209.8 - 60 = 1149.8

DOT Provided Soil Properties: } Does Not Represent Soils Below 30 ft.
cohesion = 250 #/ft²

Pile Capacity/Design: Assume Full 60 ft (55 ft embed)

top 30 ft. S_u = 250 #/ft.
Below 25' ft Q_u = 3000 psf ⇒ 1500 #/ft² = S_u

$Q_{ult} = \Sigma f(A_{surf}) + (q\,A_{tip})$

$f = \alpha C$

C = 250, α = 1 @ first 30' of pile
C = 1500, α = .65 @ Last 25' of pile.

Adhesion = 250(1)(4.616)(30') + 1500(.65)(4.616)25' = 147.135^k + End Bearing.

55 ft Embedment ok✓

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30/45

23

GENERAL NOTES

DRILLING AND SAMPLING

The borings were conducted with either a truck or all-terrain rotary drill rig using the drilling methods indicated on each Boring Log. Soil sampling and/or in-situ testing such as Shelby Tube (ST), split-spoon (SS), drive cone (DC), or core (C) was conducted at depth intervals which were selected in consideration of the characteristics of the proposed construction. Generally undisturbed soil samples are taken at 5 foot depth intervals or change in soil types. Disturbed soil samples from the auger, either jar size or bulk size samples, may be taken at intermediate intervals for the purpose of soil classification or laboratory testing. Borings conducted for soil classification only, will show no designation of sampling although disturbed sampling is performed. Soil samples obtained in the field were identified and sealed for transportation to the laboratory for performance of pertinent physical testing and engineering classification.

DRILLING METHODS

CFA - Continuous flight auger (ASTM D-1452)
HSA - Hollow stem auger
HA - Hand auger

SAMPLE TYPES

ST - Shelby tube (ASTM D-1587)
SS - Split spoon (ASTM D-1586)
DC - Drive cone
BS - Bulk sample
C - Core (ASTM D-2113)

DRILLING PROCEDURES

Standard Penetration Test: Number of blows required to drive sampler (split spoon or drive cone) into the soil with a 140-pound weight dropping a distance of 30-inches (ASTM D-1586), number of blows recorded for each 6-inch interval in an 18-inch (or more) penetration depth, values shown are for each 6-inch interval (if series of number sets are shown) or a total of the last two 6-inch intervals (if only one number is shown) which is commonly referred to as "N" in blows per foot. High resistance is indicated by a high number of blows for a lesser penetration depth listed in inches.

Cone Penetration Test: Quasi-static in-place testing of soils using a 60 degree cone and friction sleeve which are steadily pushed into the soil and measure skin friction and end bearing (ASTM D-3441).

WATER LEVEL MEASUREMENTS

Water levels indicated on the Boring Logs are the levels measured in the borings at the times indicated. In pervious soils, the indicated levels may reflect the location of groundwater. In low permeability soils, the accurate determination of groundwater levels is not possible with short term observations.

SOIL PROPERTIES AND DESCRIPTIONS

Soil descriptions are based on the Unified Soil Classifications System (USCS) as outlined in ASTM Designations D-2487 and D2488. The USCS group symbol shown on the boring logs corresponds to the group names listed below. The description includes soil constituents, moisture conditions, color and any other appropriate descriptive terms. This classification is primarily based upon visual and apparent physical soil characteristics, comparison with other soil samples, and our experience with the soil.

GROUP SYMBOL	GROUP NAME	GROUP SYMBOL	GROUP NAME
GW	Well graded gravel	CL	Lean clay
GP	Poorly graded gravel	ML	Silt
GM	Silty gravel	OL	Organic clay
GC	Clayey gravel	CH	Fat Clay
SW	Well graded sand	MH	Elastic silt
SP	Poorly graded gravel	OH	Organic silt
SM	Silty sand	PT	Peat
SC	Clayey sand	CL/CH	Lean to fat clay

GRAIN SIZE TERMINOLOGY

Particle	*Size Range*	
Clay	< 0.002 mm	(< 0.002 mm)
Silt	< #200 sieve	(0.075 to 0.002 mm)
Sand	#4 to #200 sieve	(4.75 to 0.075 mm)
Gravel	3 in. to #4 sieve	(75 mm to 4.75 mm)
Cobbles	12 in. to 3 in.	(300 mm to 75 mm)
Boulders	> 12 in.	(> 300 mm)

RELATIVE PROPORTIONS

Description	*Sand and Gravel % of Dry Weight*	*Fines % of Dry Weight*
Trace	< 15	< 5
With	15 to 29	5 – 12
Modifier	> 30	> 12

COHESIVE SOIL PLASTICITY

Description	*Liquid Limit (%)*
Lean	< 45
Lean to fat	45 to 49
Fat	≥ 50

RELATIVE CONSISTENCY OF COHESIVE SOILS

Consistency	*Unconfined Compressive Strength (UCS), Q_u (psf)*	*SPT (bpf)*
Very soft	< 500	0 – 2
Soft	500 – 1,000	2 – 4
Medium	1,000 – 2,000	4 – 8
Stiff	2,000 – 4,000	8 – 15
Very stiff	4,000 – 8,000	15 – 30
Hard	8,000 – 16,000	30 – 100
Very hard	> 16,000	> 100

RELATIVE DENSITY OF COHESIONLESS SOILS

Relative Density	*SPT (bpf)*
Very loose	0 – 3
Loose	4 – 9
Medium dense	10 – 29
Dense	30 – 49
Very dense	≥ 50

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IOWA DEPARTMENT OF TRANSPORTATION
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PROJECT DOT- Cass Co.
SHEET NUMBER 30A OF 45
CALCULATED BY TPH DATE 26 July 2013
CHECKED BY _____ DATE _____
FILE NUMBER U13-135

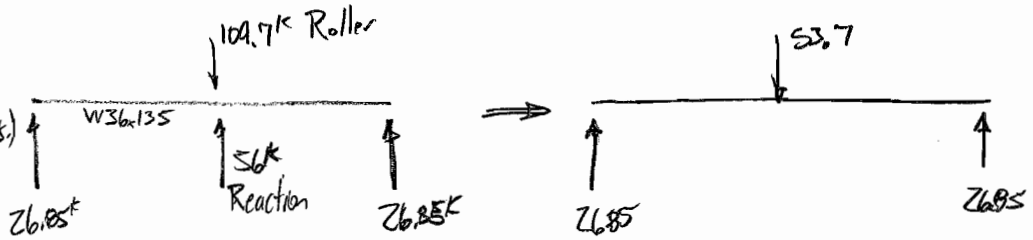
Pile Capacity/Design for Back Row - (Non-Jacking)

- Max Load at Rolling Loads.
- Piles spaced at 4 ft on Center
- Max Capacity = 35 tons. = 70K ⇒ Design Capacity = 56 Kips

- Rolling Loads Will Happen only once ∴ slight Deflection of Pile Can Be Acceptable. When Pile under Load Deflects the W36x135 will Distribute Load to adjacent Piles.

For Analysis to Find Pile Loads - Assume the Pile Directly Below a Roller is Loaded to Full Design Capacity + Starts to Deflect.

End Roller:
(Simple span Analysis)



$56 + 26.8 + 26.8 = 109.7^K$

Find Δ of W36x135 for Reactions @ 8'-0 o.c. + Load = 53.7^K $I_x = 7800 in^4$

$$\Delta = \frac{Pl^3}{48EI} \Rightarrow \frac{53.7(96)^3}{48(29000)7800} = 0.0043'' \leftarrow \Delta = \underline{4/1000 \text{ of an inch}}$$

On Attached Risa Analysis Pages a 56^K upward Load is Applied to Reaction Locations that exceed 56^K total.

28 Tons.

11 Piles With 56 Kip Design Capacity Are Adequate when Load distribution is Applied

HP 10x42s

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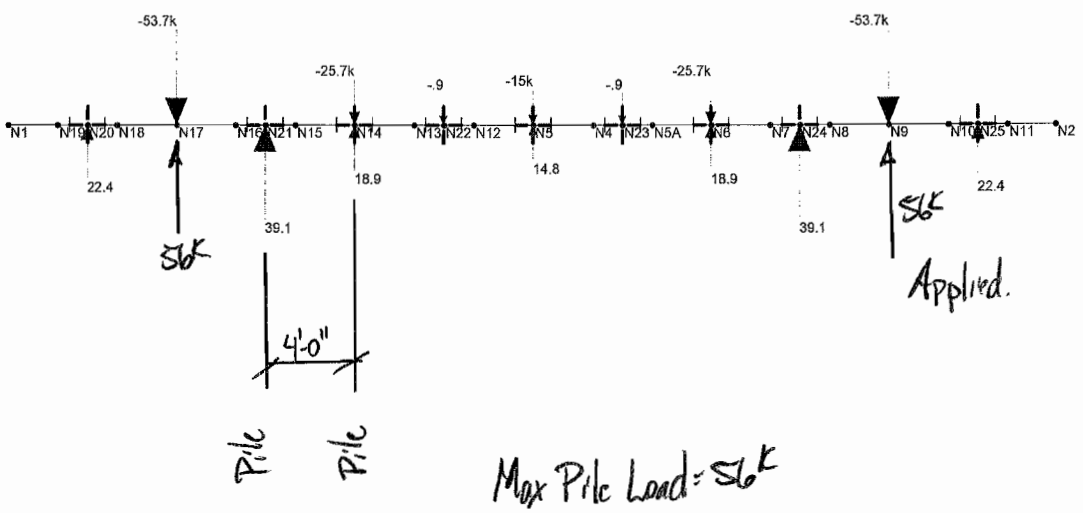
30B/45

Back Row - W36x135.

Load Case - Loads over Pile Location.

53.7 + 56 = 109.7k.



Max Pile Load = 56k

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Loads: BLC 1, D-Dead
Results for LC 1, 1. D+F
Y-direction Reaction units are k and k-ft

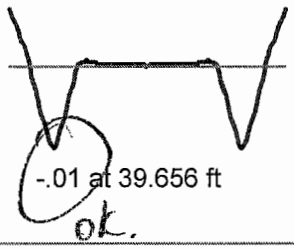
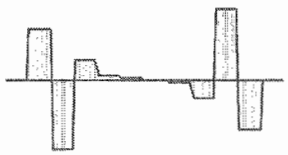
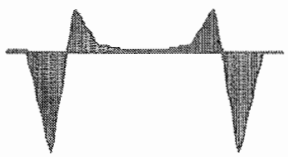
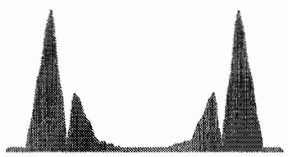
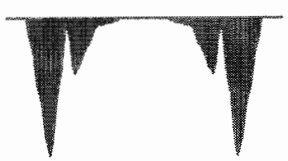
Tometich Engineering		SK - 1
Ted Hoeger PE	Cass County Sliding bridge	July 26, 2013 at 8:33 AM
U13-135	Back Row W36x135	W36x135 REAR at start (center loa...

304/45

Beam: ***M1***

Shape: **W36x135**
Material: **A36 Gr.36**
Length: **47 ft**
I Joint: **N1**
J Joint: **N2**
LC 1: 1. D+F
Code Check: **0.324 (bending)**
Report Based On 97 Sections

ok.

	.006 at 47 ft **Dy**  **in** -.01 at 39.656 ft ok.	**Dz** ——— **in**
.511 at 35.74 ft **A** ——— **k** -.511 at 11.26 ft	31.346 at 35.74 ft **Vy**  **k** -31.346 at 7.833 ft	**Vz** ——— **k**
T ——— **k-ft**	34.017 at 35.25 ft **Mz**  **k-ft** -85.924 at 39.656 ft	**My** ——— **k-ft**
.013 at 35.74 ft **fa** ——— **ksi** -.013 at 11.26 ft	2.353 at 39.656 ft **fc**  **ksi**	**ft**  **ksi** -2.353 at 39.656 ft

AISC 14th(360-10): ASD Code Check

Direct Analysis Method

Max Bending Check	**0.324**	Max Shear Check	**0.102 (y)**
Location	**7.344 ft**	Location	**35.74 ft**
Equation	**H1-1b**	Max Defl Ratio	**L/10000**
Bending Flange	**Compact**	Compression Flange	**Non-Slender Qs=1**
Bending Web	**Compact**	Compression Web	**Slender Qa=1**

Fy	**36 ksi**
Pnc/om	**106.318 k**
Pnt/om	**860.12 k**
Mny/om	**107.246 k-ft**
Mnz/om	**265.071 k-ft**
Vny/om	**307.584 k**
Vnz/om	**245.231 k**
Cb	**1**

	y-y	z-z
Lb	**47 ft**	**47 ft**
KL/r	**237.506**	**40.338**

L Comp Flange	**47 ft**
Warp Length	**47 ft**
L-torque	**47 ft**
Tau_b	**1**

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IOWA DEPARTMENT OF TRANSPORTATION

Reviewed in accordance with current policy

July 31, 2013

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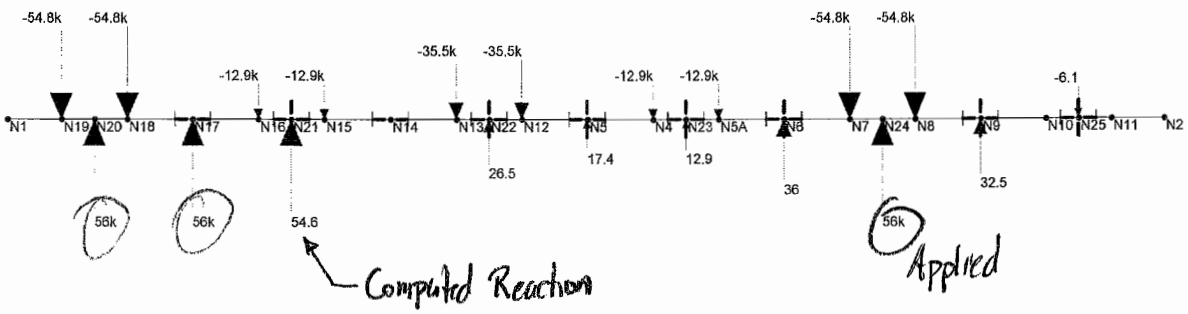
30D/45

Back Row - W36x135

Load Case - Loads over Piles.



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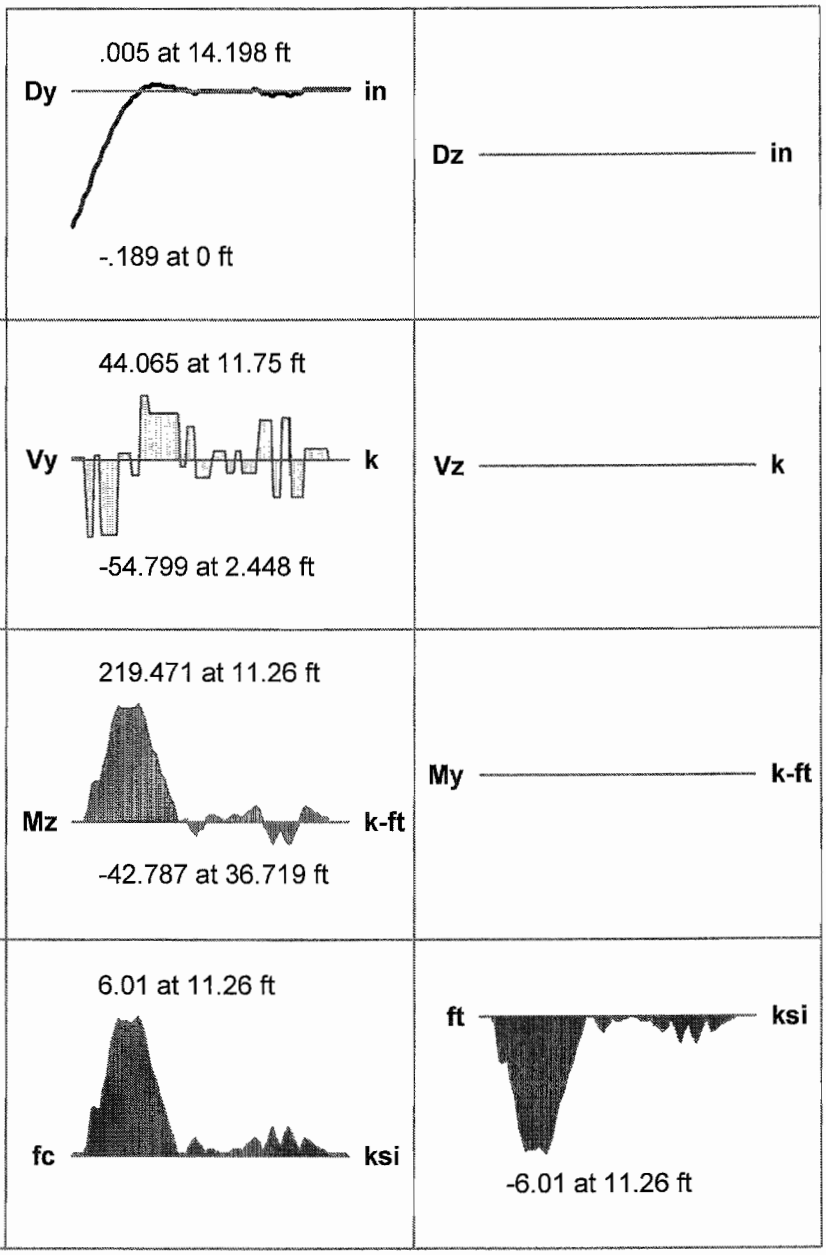
Loads: BLC 1, D-Dead
Results for LC 1, 1. D+F
Y-direction Reaction units are k and k-ft

Tometich Engineering		SK - 4
Ted Hoeger PE	Cass County Sliding bridge	July 26, 2013 at 8:50 AM
U13-135	Back Row W36x135	W36x135 Rear at start (over piles)....

30E/45

Beam: ***M1***

Shape: **W36x135**
Material: **A36 Gr.36**
Length: **47 ft**
I Joint: **N1**
J Joint: **N2**
LC 1: 1. D+F
Code Check: **0.241 (bending)**
Report Based On 97 Sections



AISC 14th(360-10): ASD Code Check

Direct Analysis Method

Max Bending Check	**0.241**	Max Shear Check	**0.178 (y)**	
Location	**11.26 ft**	Location	**2.448 ft**	
Equation	**H1-1b**	Max Defl Ratio	**L/2979**	
Bending Flange	**Compact**	Compression Flange	**Non-Slender**	**Qs=1**
Bending Web	**Compact**	Compression Web	**Slender**	**Qa=1**

Fy	**36 ksi**
Pnc/om	**106.318 k**
Pnt/om	**860.12 k**
Mny/om	**107.246 k-ft**
Mnz/om	**912.232 k-ft**
Vny/om	**307.584 k**
Vnz/om	**245.231 k**
Cb	**1**

	y-y	z-z
Lb	**47 ft**	**47 ft**
KL/r	**237.506**	**40.338**

L Comp Flange	**10 ft**
Warp Length	**47 ft**
L-torque	**47 ft**
Tau_b	**1**

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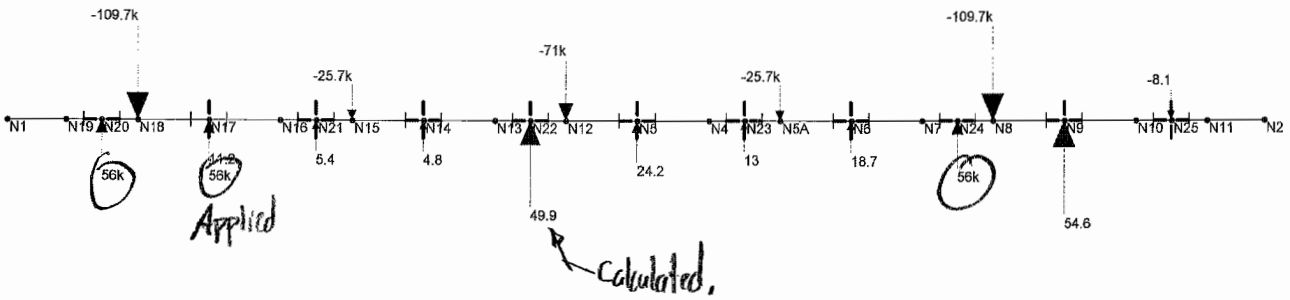
Back Row - W36x135

Load case - Load at W10x57 Beside Piles



Max Δ of W36 = 0.014" ✓ok.

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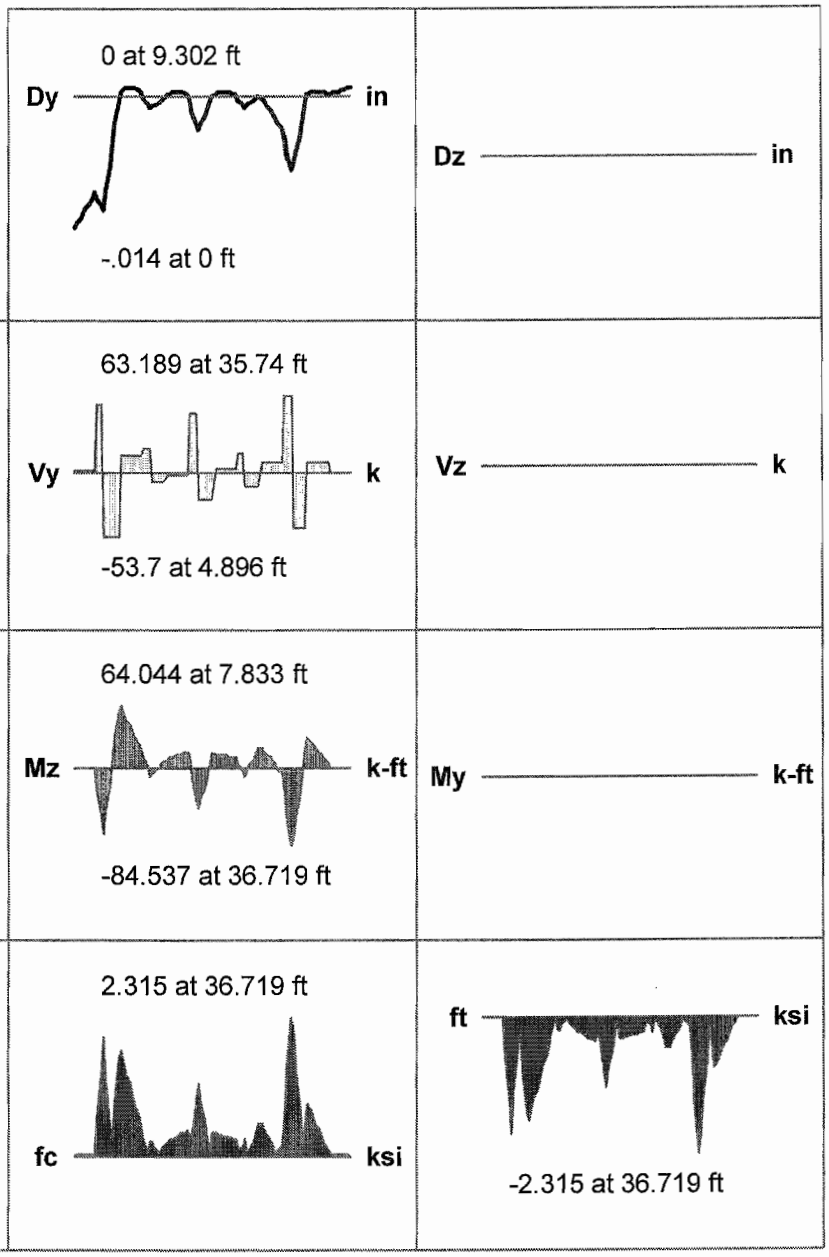
Loads: BLC 1, D-Dead
Results for LC 1, 1. D+F
Y-direction Reaction units are k and k-ft

Tometich Engineering		SK - 5
Ted Hoeger PE	Cass County Sliding bridge	July 26, 2013 at 8:56 AM
U13-135	Back Row W36x135	W36x135 REAR at start (side of pil...

Beam: ***M1***

Shape: **W36x135**
Material: **A36 Gr.36**
Length: **47 ft**
I Joint: **N1**
J Joint: **N2**
LC 1: 1. D+F
Code Check: **0.205 (shear)**
Report Based On 97 Sections



AISC 14th(360-10): ASD Code Check

Direct Analysis Method

Max Bending Check	**0.093**	Max Shear Check	**0.205 (y)**	
Location	**36.719 ft**	Location	**35.74 ft**	
Equation	**H1-1b**	Max Defl Ratio	**L/10000**	
Bending Flange	**Compact**	Compression Flange	**Non-Slender**	**Qs=1**
Bending Web	**Compact**	Compression Web	**Slender**	**Qa=1**

Fy	**36 ksi**
Pnc/om	**106.318 k**
Pnt/om	**860.12 k**
Mny/om	**107.246 k-ft**
Mnz/om	**912.232 k-ft**
Vny/om	**307.584 k**
Vnz/om	**245.231 k**
Cb	**1**

	y-y	z-z
Lb	**47 ft**	**47 ft**
KL/r	**237.506**	**40.338**

L Comp Flange	**10 ft**
Warp Length	**47 ft**
L-torque	**47 ft**
Tau_b	**1**

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PROJECT DOT Cass Co.
SHEET NUMBER 31 OF 45
CALCULATED BY TPH DATE
CHECKED BY DATE
FILE NUMBER U13-135

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Jacking / Rolling Load Checks.

Jacking - use 5 Jacks in Jacking Pockets.
see Attached Risa Analysis for Jack / Roller Loads.

Max Load: 220 Kips. @ End ⇒ Jack: ENERPAC 160ton ✓ok
= 142K Kips @ Center. ⇒ Jack: ENERPAC 100 ton ✓ok.

Rollers: 100 Metric ton = 220K > 219.4 *✓ok.

*Note - The Barrier Rail is Not Included For this Analysis.
Rails Will Be Placed After Rolling.

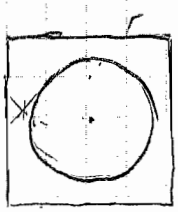
Find Bearing Area Req

Center Load: 142 K
allowable = 2500 Psi on Concrete

142K / 2.5 = 56.8 in² ⇒ 57"² opt: 7½" □ = 56.25 ≈ 2524 # psi.

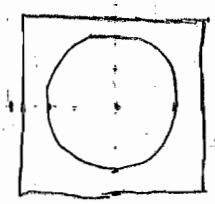
Jack: ENERPAC - CLP-1002
Capacity = 100 Tons
stroke = 1.97"
Area = 22.75 in²
colapsed Ht = 5.39"
Saddle Diameter = 4.96" ⇒ πr² = Area = 19.32"²

7½" □ plate above + Below Jack.



End Load = 220K
req Area @ 2500 psi Bearing = 88 in² ⇒ 9½" Plate □ = Bearing Pressure = 2.438K

Jack: 160 Ton ENERPAC CLP-1602
capacity = 160 tons
stroke = 1.77 inches.
Area = 25.85
clapsed Ht = 5.83"
saddle Diameter = 6.30" ⇒ πr² = 31.17 in²



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PROJECT DOT Cass Co.
SHEET NUMBER 32 OF 45
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Bearing Plate above & Below Jack

$t_m = l\sqrt{\frac{3.33 P_a}{F_y B N}}$ l = smallest of m, n, n' or λ

$m = \frac{N - 0.95d}{2}$ $n = \frac{B - 0.8b_f}{2}$ $n' = \frac{\sqrt{db_f}}{4}$ $\lambda = 1$

100 Ton Jack – $P = 142^k$
$\phi = 4.96" = d = b_f$
$B = 7\frac{1}{2}"$
$N = 7\frac{1}{2}"$

$m = \frac{7\frac{1}{2} - 0.95(4.95)}{2} = 1.398"$

$n = \frac{7\frac{1}{2} - 0.8(4.95)}{2} = 1.077"$

$t_m = 1.875\sqrt{\frac{3.33(142)}{36(7\frac{1}{2})(7\frac{1}{2})}} = .906"$

$n' = \frac{\sqrt{7\frac{1}{2}^2}}{4} = 1.875"$ ← Use

Use 1" Plate above small Jacks.

160 ton Jack – $P = 220^k$
$\phi = 5.83"$
$B = 9\frac{1}{2}$
$N = 9\frac{1}{2}$

$m = \frac{9\frac{1}{2} - 0.95(5.83)}{2} = 1.980"$

$n = \frac{9\frac{1}{2} - 0.8(5.83)}{2} = 2.418"$ ← Use

$t_m = 2.418\sqrt{\frac{3.33(220)}{36(9\frac{1}{2})(9\frac{1}{2})}} = 1.14"$

$n' = \frac{\sqrt{9\frac{1}{2}^2}}{4} = 2.375"$

Use 1¼" Plate above Large Jack

Top of Roller $14" \times 21" = 294"^2$ Bearing Pressure $= 220^k/294 = 748^{\#}/in^2$ Ok.

Top Roller Plate is Reinforced w/ Vertical Members.

$n = \frac{14 - (.8)(7\frac{7}{8})}{2} = 3.85$

$t_m = 3.85\sqrt{\frac{3.33(220)}{36(14)(21)}} = 1.013" = 1"$ Provided on Roller Ok.

No Added plate on Roller Req.

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PROJECT DOT- Cass Co.
SHEET NUMBER 33 OF 45
CALCULATED BY TPH DATE
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FILE NUMBER U15-135

check Web Loading.

HP 12x53
$A = 15.5 in^2$
$d = 11.8$ in
$t_w = .435$ in
$b_f = 12$ in
$t_f = .435$ in
$K = 1.125$ in.

End Jack = 8.66" Ø
Interior Jack = 6.89" Ø
Roller = 16" Long x 3.63" Wide.
HP 10x57 Below = 10.7" = b_f.

End Jack. (220k) N=8.66	Interior Jack. (142k) N=6.89	Roller (220k) N=16"

Web Yeilding. $R_n = (5K+N) F_y w t_w$

End Jack:
$R_n = (5(1.125)+8.66)(50)0.435$
$= 310.69^k$
$\Omega R_n = 207.13^k$
Stiffner Req for (12.86k)

Interior Jack:
$R_n = (5(1.125)+6.89)50(.435)$
$= 272^k$
$\Omega R_n = 181.46^k$ ✓ok.

Roller:
$R_n = (5(1.125)+16)50(.435)$
$= 470^k$
$\Omega R_n = 313.56^k$ ✓ok.

@ End of HP 12x53
$R_n = (2.5(K)+N) F_y t_w$
$R_n = 409^k$
$\Omega R_n = 272.7^k$ ✓ok.

Web Crippling. $R_n = 0.8 t_w^2 \left[1+3\left(\frac{N}{d}\right)\left(\frac{t_w}{t_f}\right)^{1.5}\right]\sqrt{\frac{E F_y t_f}{t_w}}$

End Jack:
$R_n = .8(.435)^2\left[1+3\left(\frac{8.66}{11.8}\right)(1)^{1.5}\right]\sqrt{29000(50)}$
$= 583.6^k \Rightarrow \Omega R_n = 291.5^k$ ✓ok.

Interior Jack:
$R_n = 0.8(.435)^2\left[1+3\left(\frac{6.89}{11.8}\right)(1)^{1.5}\right]\sqrt{29000(50)}$
$= 501.59^k$ $\Omega R_n = 250.79^k$ ✓ok.

Roller:
$R_n = 0.8(.435)^2\left[1+3\left(\frac{16}{11.8}\right)1^{1.5}\right]\sqrt{29000(50)}$
$= 932.7^k \Rightarrow \Omega R_n = 466.85^k$

@ End of Beam $d/2 = 5.9"$

See Next Page.

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PROJECT Dot - Cass Co.
SHEET NUMBER 34 OF 45
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Check HP12x53 Web Loading

Roller Load @ End of Beam - Web Crippling.

For $N/d \le 0.2$ Max N distance = $d(.2) = 11.8(.2) = 2.36''$

Load - Roller = 16" Long $\Rightarrow$ $220^k/16'' = 13.75^k/in \Rightarrow 2.36'' \times 13.75 = 32.45^k$

$$R_n = 0.4t_w^2\left[1+3\left(\frac{N}{d}\right)\left(\frac{t_w}{t_f}\right)^{1.5}\right]\sqrt{\frac{EF_y t_f}{t_w}}$$

$$R_n = 0.4(.435)^2\left[1+3\left(\frac{2.36}{11.8}\right)\right]\sqrt{29000(50)} = 145.8^k$$

$$\phi R_n = 72.9^k > 32.45 \checkmark \text{ok.}$$

For $N/d > .2$ With Load at $\le d/2$

Load Location = @ $d/2 = 11.8/2 = 5.9''$ From End.

$N = 5.9 \times 2 = 11.8''$, Load = $11.8(13.75) = 162.25^k$

$$R_n = 0.4t_w^2\left[1+\left(\frac{4N}{d}-0.2\right)\left(\frac{t_f}{t_w}\right)^{1.5}\right]\sqrt{\frac{EF_y t_w}{t_f}}$$

$$R_n = 0.4(.435^2)\left[1+\left(\frac{(4)11.8}{11.8}-.2\right)\right]\sqrt{29000(50)} = 437.4^k$$

$$\phi R_n = 218.7^k > 162.25^k > 220^k \checkmark \text{ok.}$$

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PROJECT DOT- Cass- Co.
SHEET NUMBER 35 OF 45
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FILE NUMBER 413-135

check HP10x57 Web Loading

Max Load = 220^k from HP12x53 During Rolling + Jacking.

Length of Bearing = Width of HP12x53 = 12" = N

HP10x57
A = 16.8 in^2
d = 9.99"
t_w = .565"
b_f = 10.2"
t_f = .565"
K = 1.25"

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Web Yeilding

$R_n = (5K + N) F_y t_w$

$R_n = (5(1.25) + (12))\, 50\, (.565) = 515.56$

$\phi R_n = 343.7^{kips} > 220^k$ ✓ok.

Web Crippling.

$R_n = .8 t_w^2 \left[1 + 3\left(\frac{N}{d}\right)\left(\frac{t_f}{t_w}\right)^{1.5}\right]\sqrt{\frac{E F_y t_f}{t_w}}$ (=1, =1)

$R_n = .8(.565)^2 \left[1 + 3\left(\frac{12}{9.99}\right)\right]\sqrt{29000(50)} = 1415.69^k$

$\phi R_n = 707.84^k > 220^k$ ✓ok.

No stiffners Req.

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PROJECT DOT - Cass County
SHEET NUMBER 36 OF 45
CALCULATED BY TPH DATE 23 July-2013
CHECKED BY _____ DATE _____
FILE NUMBER U13-135

Web Stiffener Design. for HP12x53 @ Jack Location,

Per AISC J4.4

HP12x53
$A = 15.5$
$d = 11.8''$
$t_w = 0.435$
$b_f = 12$
$t_f = 0.435$

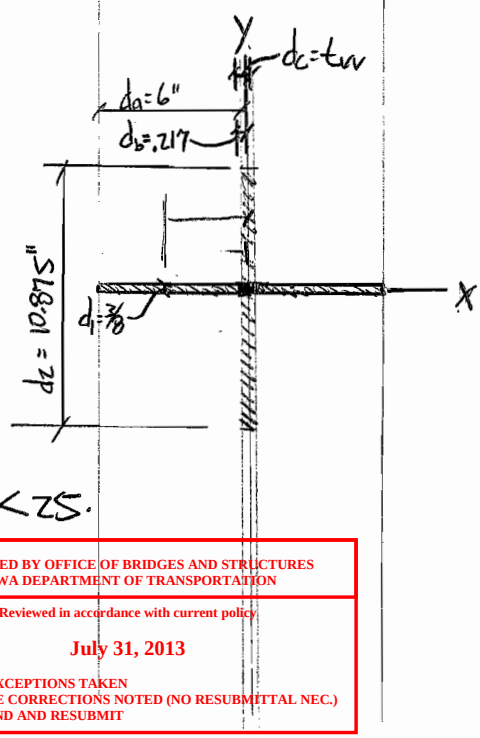
Web stiffner thickness = 3/8"

$h = 11.8'' - .435(2) = 10.93$

k - Ends Welded to Flanges = Fixed Bending
$k = 0.65$

l effective $H_t = .75h = .75(10.93) = 8.1975''$

effective Web length $= 25t_w = 10.875''$



Find r_x + r_y of effective steel. $I = \Sigma(I_o + ad^2)$ $r = \sqrt{\frac{I}{A}}$

Component	a	dy	I_x ($\frac{bh^3}{12}$)	dx	$(a)dx^2$	I_y
3/8 stiffner	2.168	0	.02	3.10	20.83	6.09
3/8 stiffner	2.168	0	.02	3.10	20.83	6.09
Web	4.073	0	44.78	0	0	.07
Total	9.066		$I_x = 44.82''$		41.66	12.25

$I_y = 53.91$

$r_x = \sqrt{\frac{44.82}{9.066}} = 2.22in$

$r_y = \sqrt{\frac{53.91}{9.066}} = 2.43in$

$\frac{kl}{r_x} = \frac{.65(8.1975)}{2.22} = 2.4 < 25.$

$P_n = 36^{ksi}(3/8)(12) = 162^k$
$\Omega P_n = 97^k > 12.86^k$ Req ✓ok

Use 3/8" Web stiffner.

REVIEWED BY OFFICE OF BRIDGES AND STRUCTURES
IOWA DEPARTMENT OF TRANSPORTATION
Reviewed in accordance with current policy
July 31, 2013
✓ NO EXCEPTIONS TAKEN
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☐ AMEND AND RESUBMIT

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Weld strength of 3/16 filled Weld = $3/16(\sin 45)(.6)36(1'') = 2.86^k$/inch.

Weld Length Req = 12.86^k/2 stiffners / 2.86^k = 2.24" of Weld.

Use 3" of 3/16 Filled Weld

Tometich Engineering, Inc.
10501 Buena Vista Court
Urbandale, Iowa 50322
(515) 280-8022
fax: (515) 727-9124
www.tometichengineering.com

PROJECT DOT-Coss-Co
SHEET NUMBER 37 OF 45
CALCULATED BY TPH DATE
CHECKED BY DATE
FILE NUMBER C13-155

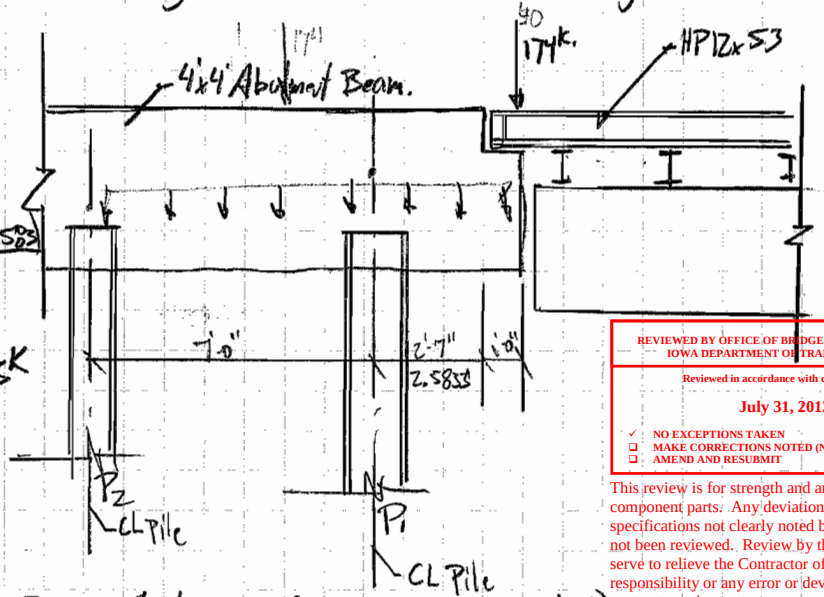
Abutment Beam Analysis.

· extend Abutment Beam 1'-0" for Bearing of HP12x53 Doris Roling.

Beam Wt = 2.4 k/ft. x 1.2 = 2.88 k/ft.
Roller = 220 k x 1.2 = 264 k

$M_{max} = Pa + \frac{wa^2}{2} = 264(3.5833) + \frac{2.88(3.5833)^2}{2}$
$= 964.46$ k-ft.

$V_{max} = 264 + 2.88(3.5833) = 274.3$ k



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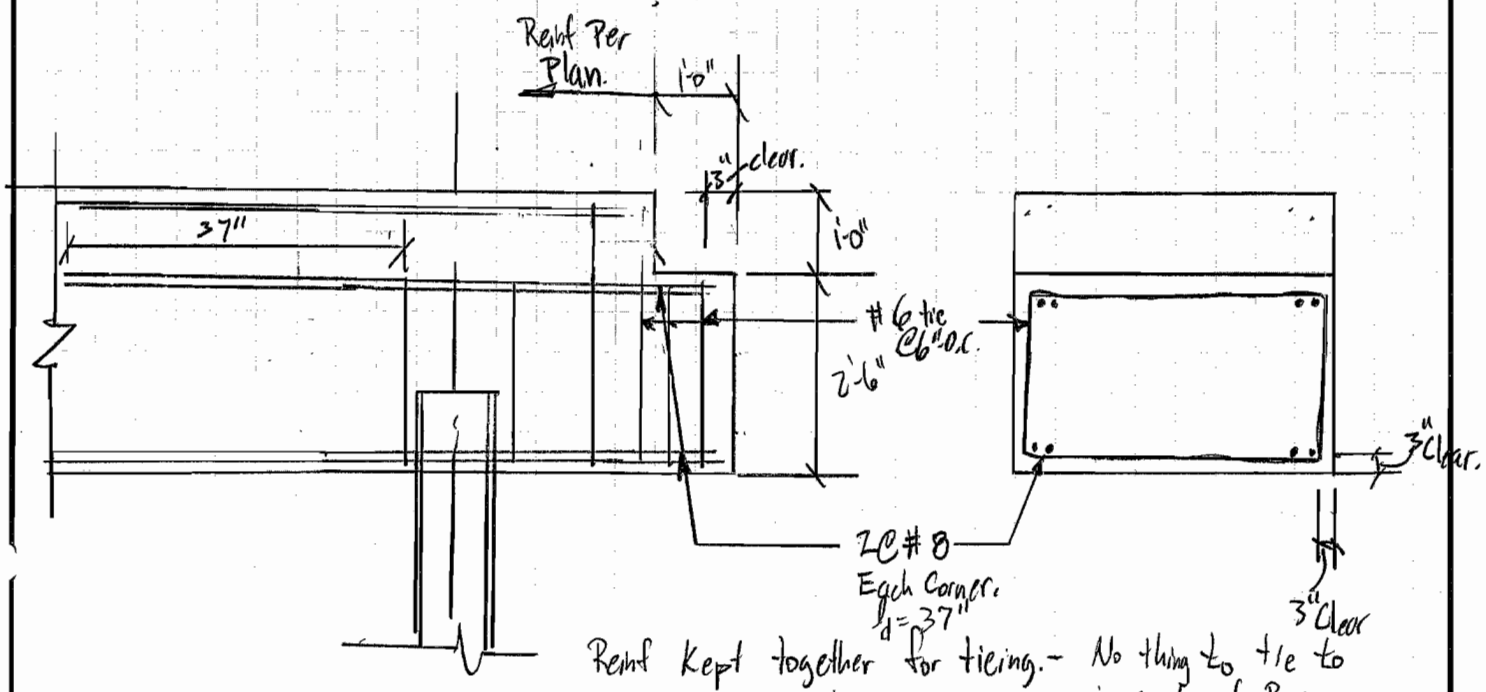
See Attached Excel Concrete Beam Analysis (No Mid Height steel)

$M_{max} = 1276$ k-ft. > 803.75 k applied.
#5 stirrups at @ 228.6 k placed 15" o.c > 1'-0" shown ✓ shear Reinf OK



Reinf Kept together for tieing. - No thing to tie to in center of Beam.

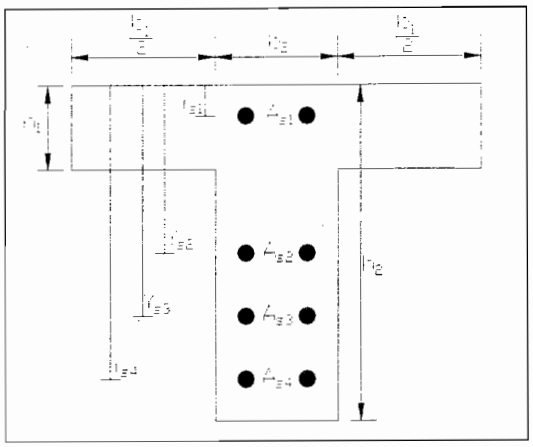
38/45

Tometich Engineering, Inc.
Urbandale, Ia.
10501 Buena Vista Court
(515) 280-8022
Fax: (515) 727-9124

Job Name: Cass County Rollling Bridge
Job # U13-135
Born on Date 10-May-05
Version # 1.0

Page:
Date: 23-Jul-13

Conc. Beam Design - ACI 318-02



Units are in kips and inches

Concrete:

Overhangs	b_1	0	h1	0
Web	b_2	48	h2	42

For rectangular section analysis, set h1 = 0, h1 = any value

Materials:

f'_c	4
f_y	60
e_{cu}	0.003

Steel:

A_{s1}	7.9	y_{s1}	5.125	
A_{s2}	0	y_{s2}	0	
A_{s3}	0	y_{s3}	0	
A_{s4}	7.9	y_{s4}	36.875	*Must have steel at As4*

ys4 = d (steel depth)

Solution

b_1 0.85 **Iterate:** a 3.6792835
c 4.32856883

	strain	stress	Depth	Force	Moment
concrete1		-3.4	0	0	0
concrete2		-3.4	3.6792835	-600.4591	-1104.63
steel1	0.000551982	16.007488		126.45915	648.10315
steel2	-0.003	-60		0	0
steel3	-0.003	-60		0	0
steel4	0.022556946	60		474	17478.75
			SUM=	8.377E-05	17022.224

ϕ 0.9 **ϕM_n** **15320 kip-in.** **1276.6668 kip-ft**

e_t **0.022556946** **Min. Code e_t =** **0.004** ok!

Shear Design - ACI 318-02

	Vu (kips)	274.3	
Eq 11-3	ϕ Vc (kips)	168	
	Vu -ϕ Vc (kips)	106	Section Ok!
	Vs	106	
11.5.4.1	Max spacing	18.4375	
	Stirrup Bar #	6	
	Av (in^2)	0.9	
Eq 11-15	Req'd Spacing	14	inches

Spacing Based on Min Shear Reinforcing

11.5.5.3		23	
11.5.5.3		22	
	Max Spacing	14	inches

Use #	6	Stirrups @	14	inches

Abutment Beam
No Mid Height steel.

REVIEWED BY OFFICE OF BRIDGES AND STRUCTURES
IOWA DEPARTMENT OF TRANSPORTATION

Reviewed in accordance with current policy

July 31, 2013

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Urbandale, Ia.
10501 Buena Vista Court
(515) 280-8022
Fax: (515) 727-9124

Job Name: Cass County Rollling Bridge
Job #: U13-135
Born on Date: 10-May-05
Version # 1.0

Date: 23-Jul-13

Conc. Beam Design - ACI 318-02

Depth Reduced 12"

Units are in kips and inches

Concrete:

Overhangs	b_1	0	h1	0	*For rectangular section analysis,*
Web	b_2	48	h2	30	*set b1 = 0, h1 = any value*

Materials:

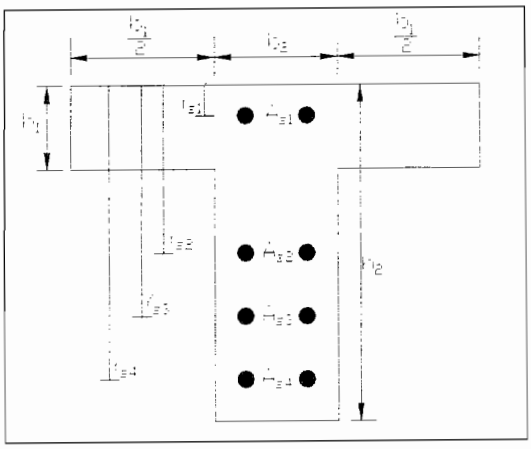
f'_c	4
f_y	60
e_{cu}	0.003

Steel:

A_{s1}	3.16	y_{s1}	5.125	
A_{s2}	0	y_{s2}	0	
A_{s3}	0	y_{s3}	0	
A_{s4}	3.16	y_{s4}	24.875	*Must have steel at As4*

ys4 = d (steel depth)

(4)#8 Bars Top & Bottom.



Solution

b_1	0.85	**Iterate:** a	2.3235294
c	2.733564014		

	strain	stress	Depth	Force	Moment
concrete1		-3.4	0	0	0
concrete2		-3.4	2.3235294	-379.2	-440.5412
steel1	0.002624525	60		189.6	971.7
steel2	-0.003	-60		0	0
steel3	-0.003	-60		0	0
steel4	0.024299525	60		189.6	4716.3
			SUM=	0	5247.4588

ϕ	0.9	ϕM_n	**4723 kip-in.**	**393.55941 kip-ft**

e_t	**0.024299525**	**Min. Code e_t =**	**0.004**	ok!

Shear Design - ACI 318-02

	Vu (kips)	274.3	
Eq 11-3	ϕ Vc (kips)	113	
	Vu -ϕ Vc (kips)	161	Section Ok!
	Vs	161	
11.5.4.1	Max spacing	12.4375	
	Stirrup Bar #	6	
	Av (in^2)	0.9	
Eq 11-15	Req'd Spacing	6	inches

Spacing Based on Min Shear Reinforcing

11.5.5.3		23	
11.5.5.3		22	
	Max Spacing	6	inches

Use #	6	Stirrups @	6	inches	

$$l_d = \left[\frac{3}{40} \frac{f_y}{\sqrt{f'_c}} \cdot \frac{\psi_t \psi_e \psi_s \lambda}{\frac{c_b + K_{tr}}{d_b}} \right] d_b$$

71.2

$\psi_t = 1.3$
$\psi_e = 1.2$
$\psi_s = 1$
$\lambda = 1$
$c_b = 3$
$K_{tr} = 0$

$$l_d = \left[71.2 \frac{(1.3)(1.2)(1)(1)}{3/1} \right]$$

$l_d = 37.0''$

extend 37" past Pile Location.

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IOWA DEPARTMENT OF TRANSPORTATION

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PROJECT DOT-Cass-Co
SHEET NUMBER 40 OF 45
CALCULATED BY TPH DATE
CHECKED BY DATE
FILE NUMBER 413-135

Channel Bearing Area on Concrete Abutment

Roller Contact Area = 16" x 3 5/8" = 58 in²
Load = 220k
allowable Psi = 2500

Required Area = 220k/2.5 = 88 in².

Roller channel = C10x 15.3,

Assume Full Width of channel Bearing ⇒ Area = 16x10" = 160 in²

PSI = 220/160 = 1.375 k/sq.

Any channel Wider than C10 = ok ✓

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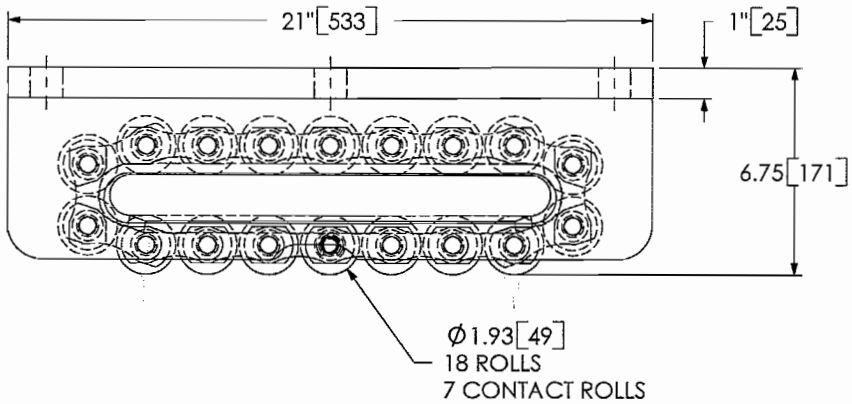

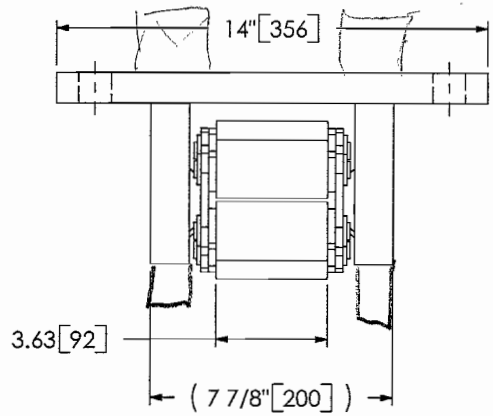

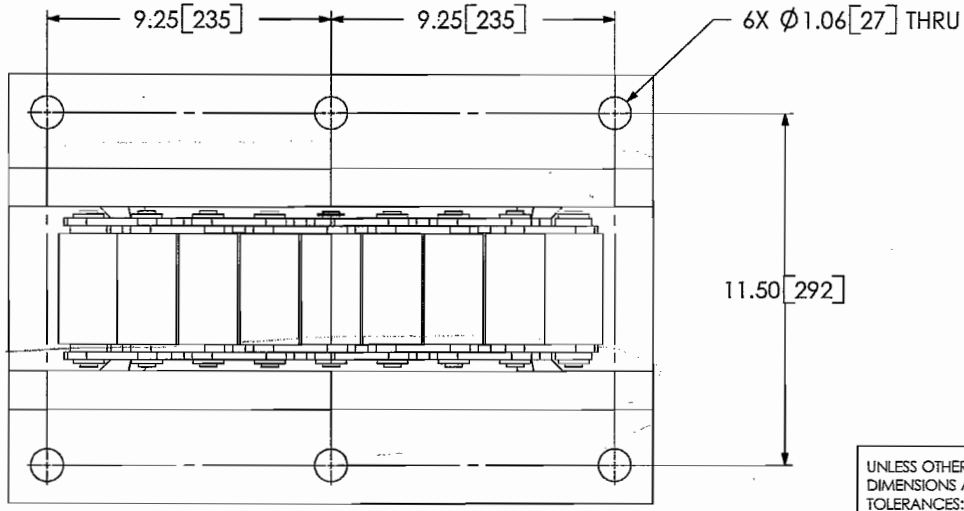

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Interior Rollers

NOTE:
1. DIMENSIONS IN INCHES [MILLIMETERS]
2. CAPACITY: 100 METRIC TONS

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UNLESS OTHERWISE NOTED
DIMENSIONS ARE IN INCHES
TOLERANCES:
FRACTIONAL: ±1/8
ANGULAR: ±.5°
ONE PLACE DECIMAL: ±.03
TWO PLACE DECIMAL: ±.015
THREE PLACE DECIMAL: ±.005

THIRD ANGLE PROJECTION

	NAME	DATE
DRAWN	NS	05/26/94
CHECKED	DF	
ENG APPR.	KZ	
SALES APPR.		
CUST APPR.		

COMMENTS:

HILMAN INC.
12 TIMBER LANE, MARLBORO, NJ 07746 USA

STANDARD 100-XOT ROLLER
HILMAN INCORPORATED

SIZE	DWG. NO.	REV.
A	100-XOT	

SCALE:1:6 | WEIGHT: 250 lb / 113 kg | SHEET 1 OF 1

4/45

NOTES:

SOME DIMENSIONS ON THIS DRAWING ARE SUBJECT TO FABRICATION TOLERANCES AND ARE SHOWN FOR REFERENCE. IF YOUR APPLICATION REQUIRES SPECIFIC DIMENSIONS, PLEASE CONSULT WITH HILMAN'S SALES DEPARTMENT.

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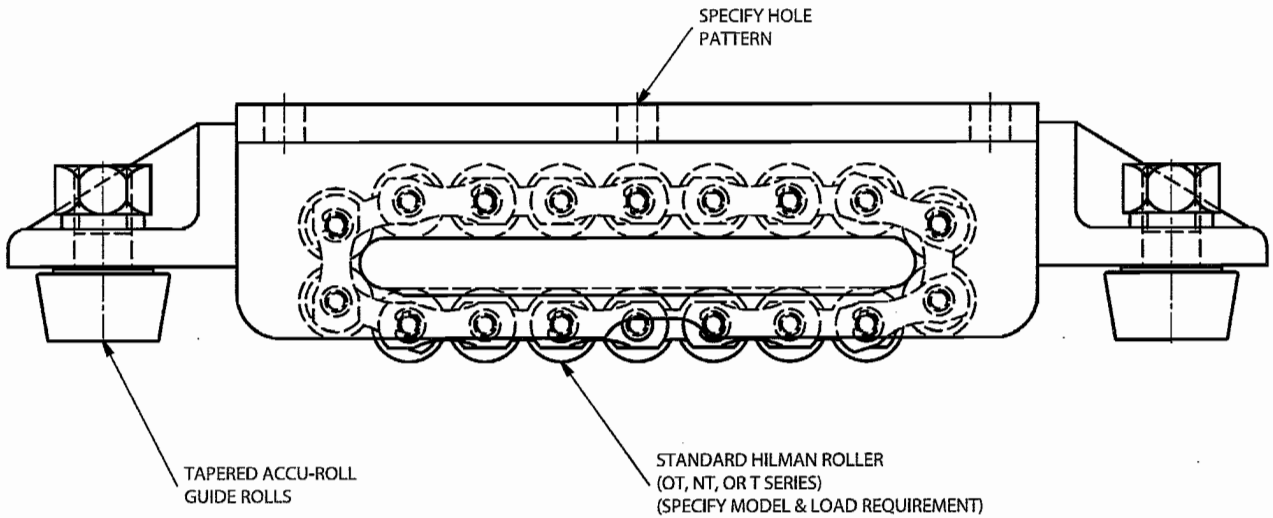
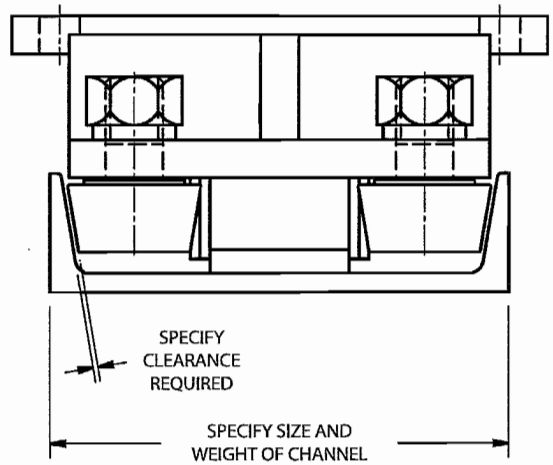
DATE	REV	REVISION RECORD	DR	CK





Istt Last Rollers.

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IOWA DEPARTMENT OF TRANSPORTATION

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APPROVALS		DATE
DRAWN	EJM	10/08/98
CHECKED		
ENGINEER		
CUSTOMER		

HILMAN, INC.

12 TIMBER LANE, MARLBORO, NEW JERSEY 07746 USA

TITLE
TAPERED ACCU-ROLL C SYSTEM, CHANNEL
HILMAN INCORPORATED

SIZE	DWG NO.	REV
C	C-102	
SCALE	REF.	SHEET 1

42/45

43/45

ENERPAC®

POWERFUL SOLUTIONS. GLOBAL FORCE.

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IOWA DEPARTMENT OF TRANSPORTATION

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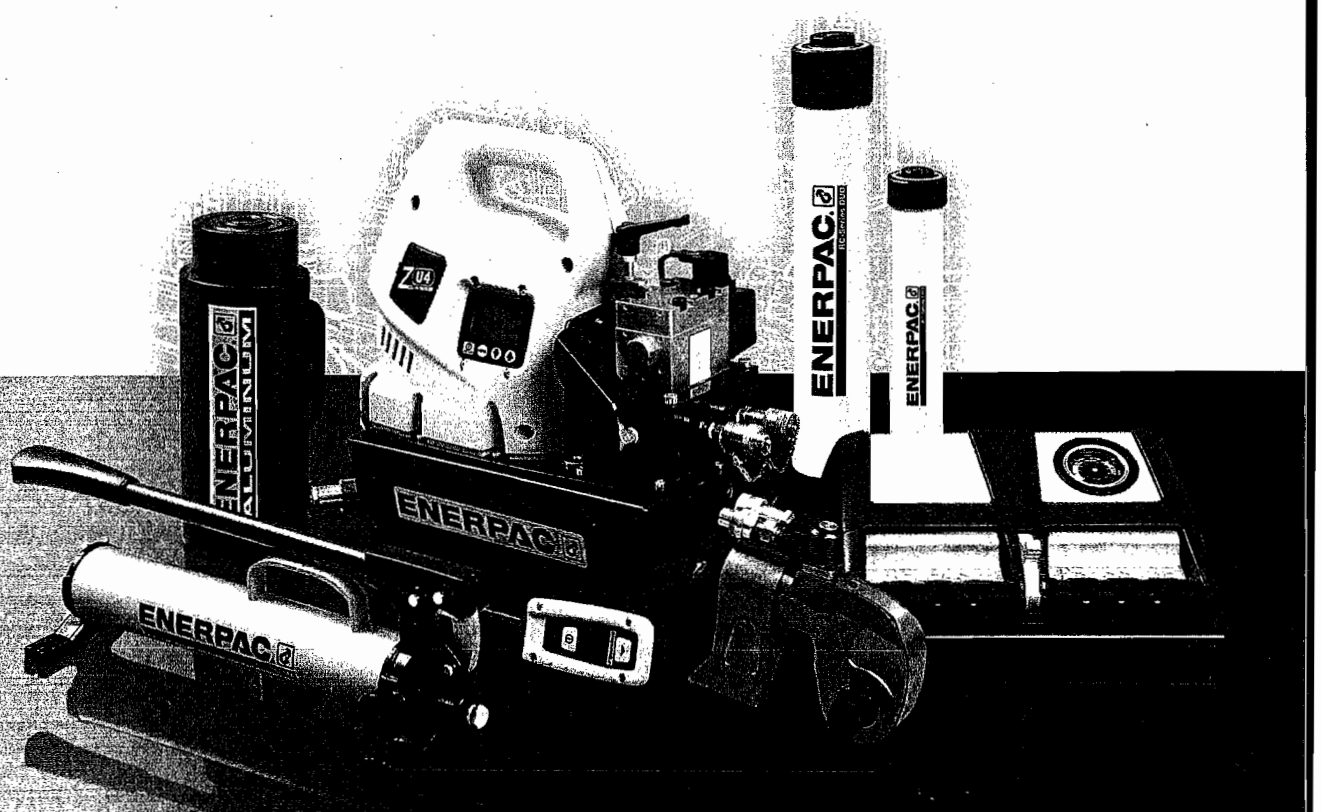


E327 US

INDUSTRIAL TOOLS

44/45

▼ Shown from left to right: **CLP-2002, CLP-5002**

The Shortest Power Lifter

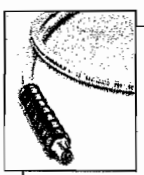
Saddles

All CLP-Series cylinders include integral tilt saddles with maximum tilt angles up to 5°.

Gauges

Minimize the risk of overloading and ensure long, dependable service from your equipment. Refer to the System Components section for a full range of gauges.

Page: 113



Hoses

Enerpac offers a complete line of high-quality hydraulic hoses. To ensure the integrity of your system, specify only Enerpac hydraulic hoses.

Page: 114

- **Flat design for use in confined areas**
- **Safety lock nut for mechanical load holding**
- **Single-acting load return**
- **Special bearing design resists sideload forces**
- **Overflow port functions as a stroke limiter**
- **CR-400 coupler and dust cap included on all models**

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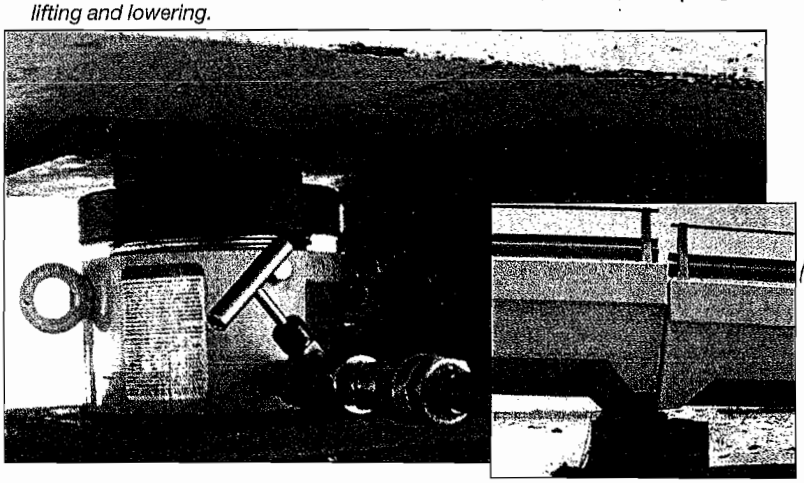
▼ *Only the extreme low height CLP-cylinder fits in this confined area to lift the construction. The V-82 needle valve is used to control cylinder speed during lifting and lowering.*



Cylinder Capacity (ton) [maximum]	Stroke (in)	Model Number	Cylinder Effective Area (in^2)	Oil Capacity (in^3)
60 [67.1]	1.97	**CLP-602**	13.42	26.42
100 [113.7]	1.97	**CLP-1002**	22.75	44.78
160 [179.2]	1.77	**CLP-1602**	35.85	63.51
200 [221.3]	1.77	**CLP-2002**	44.27	78.43
250 [284.2]	1.77	**CLP-2502**	56.85	100.72
400 [433.6]	1.77	**CLP-4002**	86.72	153.64
500 [566.2]	1.77	**CLP-5002**	113.25	200.63

Single-Acting, Pancake Lock Nut Cylinders

45/45

Speed Chart

See the Enerpac Cylinder Speed Chart in our "Yellow Pages" to determine your approximate cylinder speed.

Page: 251

Longer Stroke Lock Nut Cylinders

For lock nut applications that require longer stroke lengths, see **CLL-Series** cylinders.

Page: 44

REVIEWED BY OFFICE OF BRIDGES AND STRUCTURES
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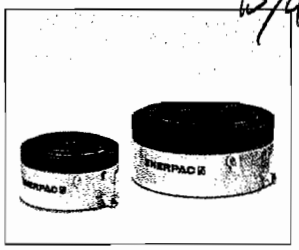
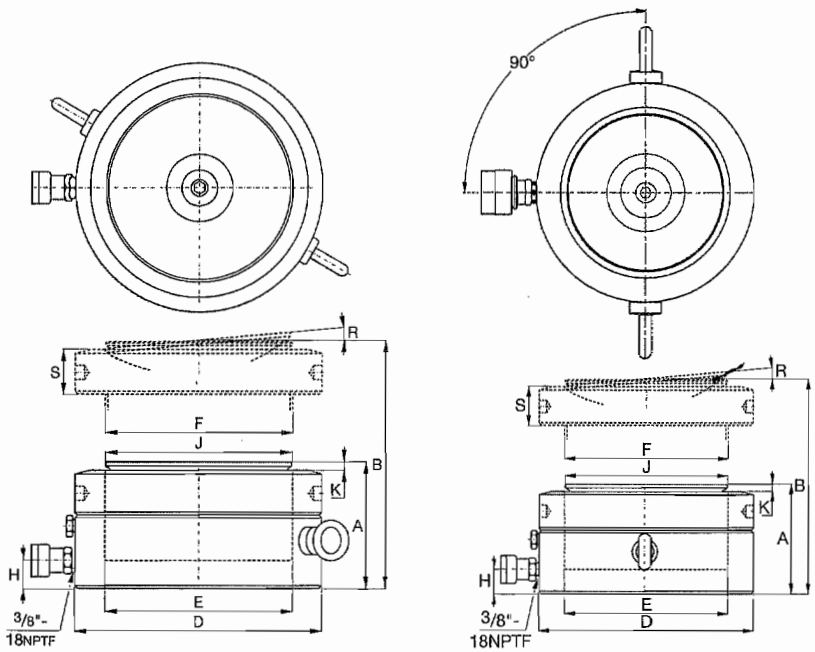
CLP Series



Capacity:
60-500 tons

Stroke:
1.77-1.97 inches

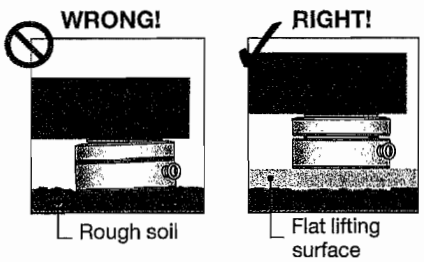
Maximum Operating Pressure:
10,000 psi



8" sq plate or +or

All CLP-series cylinders require a solid lifting surface for correct support.

Use of pancake cylinders on surfaces such as sand, mud or dirt may result in cylinder damage!



For more safety instructions see our "Yellow Pages".

Page: 241

Collapsed Height A (in)	Extended Height B (in)	Outside Diameter D (in)	Cyl. Bore Diameter E (in)	Plunger Diameter F (mm)	Base to Advance Port H (in)	Saddle Diameter J (in)	Saddle Protrusion from Plngr. K (in)	Saddle Max. Tilt Angle R	Lock Nut Height S (in)	Weight (lbs)	Model Number
4.92	6.89	5.51	4.13	Tr 104 x 4	.75	3.78	.24	5°	1.10	33	**CLP-602**
5.39	7.36	6.89	5.38	Tr 136 x 6	.83	4.96	.31	5°	1.22	57	**CLP-1002**
5.83	7.60	8.66	6.76	Tr 171 x 6	1.06	6.30	.35	5°	1.57	97	**CLP-1602**
6.10	7.87	9.65	7.51	Tr 190 x 6	1.18	7.09	.39	5°	1.69	125	**CLP-2002**
6.26	8.03	10.83	8.51	Tr 216 x 6	1.26	7.87	.43	5°	1.73	163	**CLP-2502**
7.01	8.78	13.78	10.51	Tr 266 x 6	1.54	9.84	.43	4°	2.17	295	**CLP-4002**
7.56	9.33	15.75	12.01	Tr 305 x 6	1.89	11.42	.39	3°	2.44	416	**CLP-5002**

TEMPORARY BRIDGE PIER
HWY 92 - CASS CO. IOWA
D.O.T.# BRF-092-2(36)--38-15

ALL STRUCTURAL STEEL REQUIRING Fy=50ksi, HP12x53 JACKING BEAM AND HP10x57 CROSS BEAM, SHALL MEET STANDARD SPECIFICATION 4152 AND CERTIFICATION REQUIREMENTS OF IM562

SEE APPENDIX 'A' FOR TEMPORARY PIER CALCULATIONS

LICENSED PROFESSIONAL ENGINEER THEODORE HOEGER 20812 IOWA

I HEREBY CERTIFY THAT THIS ENGINEERING DOCUMENT WAS PREPARED BY ME OR UNDER MY DIRECT PERSONAL SUPERVISION AND THAT I AM A DULY REGISTERED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF IOWA.

THIS NOTICE COVERS DRAWINGS S0-S4

SIGNATURE: Ted Hoeger

NAME: THEODORE HOEGER, P.E.

DATE: 26 July 2013 20812

MY REGISTRATION EXPIRES ON 31-DECEMBER-2013

REVIEWED BY OFFICE OF BRIDGES AND STRUCTURES
IOWA DEPARTMENT OF TRANSPORTATION

Reviewed in accordance with current policy

July 31, 2013

- ✓ NO EXCEPTIONS TAKEN
- ☐ MAKE CORRECTIONS NOTED (NO RESUBMITTAL NEC.)
- ☐ AMEND AND RESUBMIT

This review is for strength and arrangement of component parts. Any deviation from the plans or specifications not clearly noted by the Contractor has not been reviewed. Review by the Engineer shall not serve to relieve the Contractor of the contractual responsibility or any error or deviation from the contract requirements.

DRAWING INDEX:

S0: GENERAL NOTES
S1: BRIDGE PLAN AND SECTION
S2: BRIDGE SECTION AND TEMPORARY BENT FRAMING PLAN
S3: DETAILS
S4: DETAILS

TOMETICH ENGINEERING, INC.
10501 Buena Vista Court Urbandale, IA 50322
(p) 515.280.8022 (f) 515.727.9124
http://www.tometichengineering.com

IDOT PROJ. # BRF-092-2(36)--38-15
BRIDGE SLIDING PLAN
CASS CO. IOWA

ISSUE / REVISION

No.	Description	Date
	ORIGINAL ISSUE	7-1-13
	REVISED	7-25-13

GENERAL NOTES

DATE: 7-25-13
FILE: U13-135
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S0

THE FALSEWORK DESIGN IS BASED ON NO BARRIER RAIL LOAD ON THE DECK. BARRIER RAIL TO BE CAST ON THE BRIDGE AFTER THE BRIDGE SUPERSTRUCTURE HAS BEEN LATERALLY MOVED.

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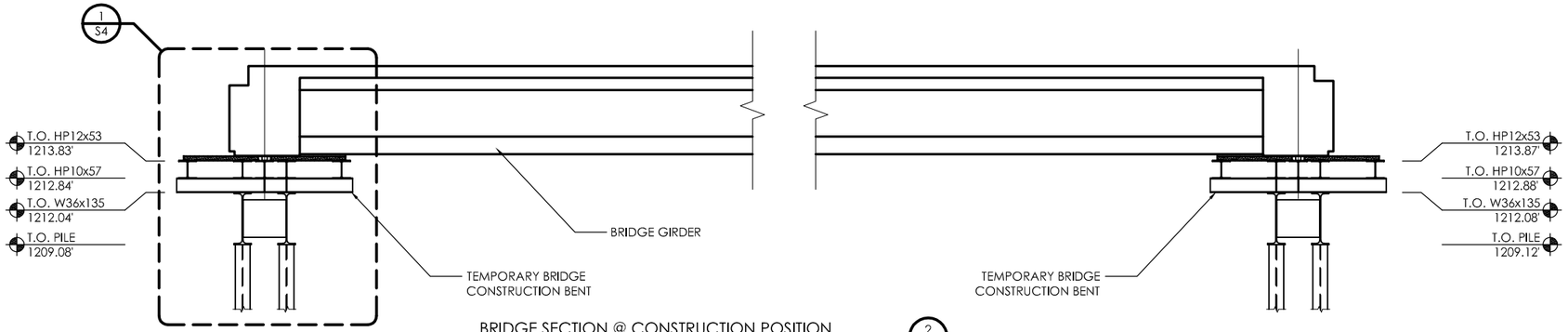
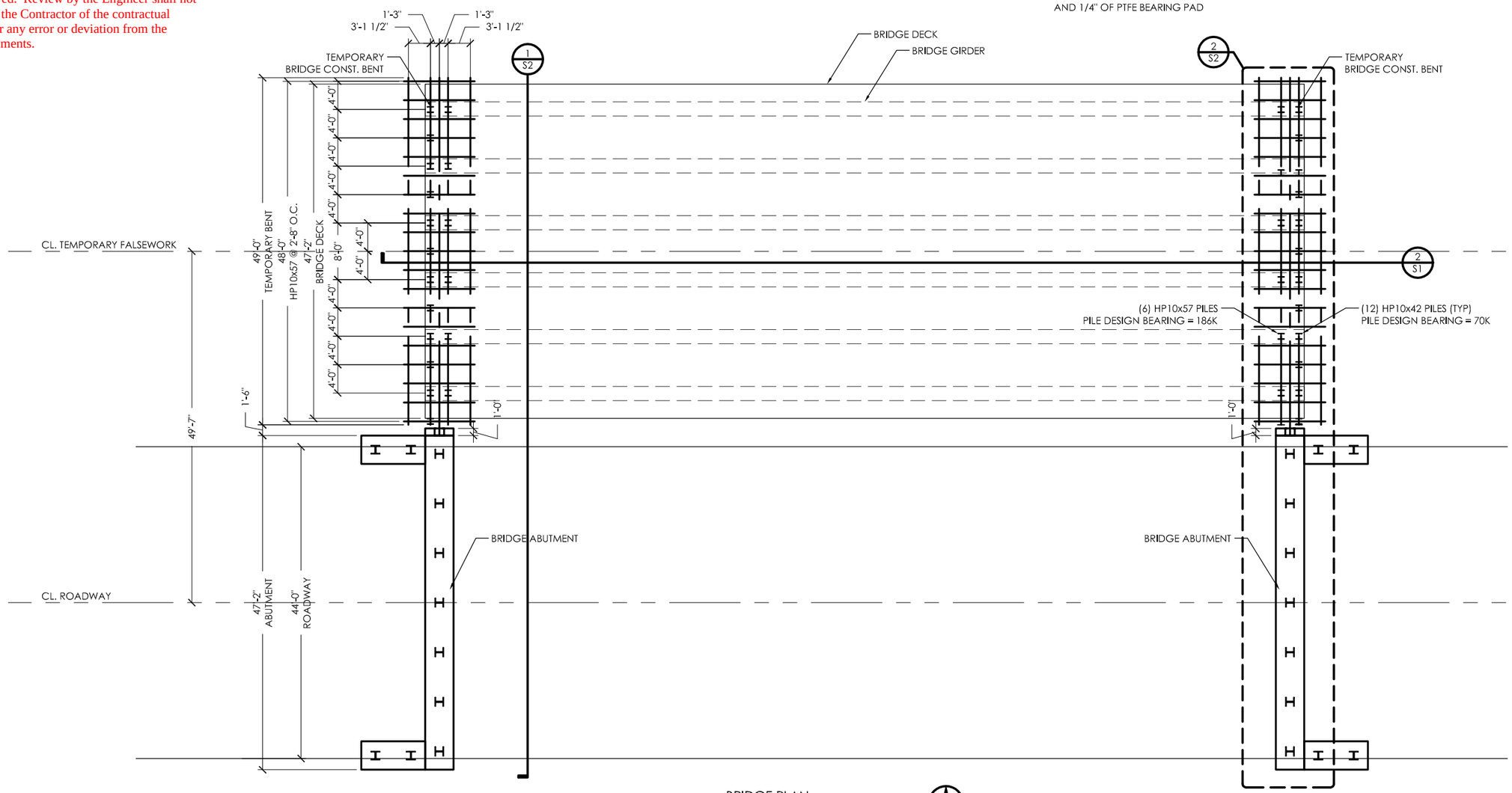


BRIDGE SECTION @ CONSTRUCTION POSITION (2 / S1)

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

NOTE:
PERMANENT BRIDGE ABUTMENTS WILL BE 1/2" HIGHER THAN SHOWN IN D.O.T. DRAWING TO MAKE UP FOR REMOVAL OF 1/4" SLIDE PLATE AND 1/4" OF PTFE BEARING PAD



BRIDGE PLAN

SCALE: 1/16" = 1'-0"

N

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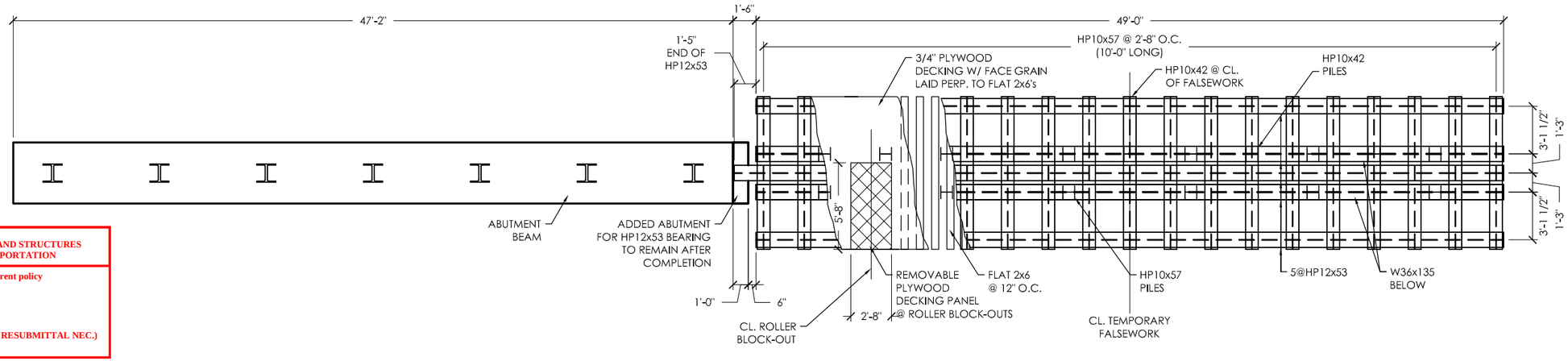
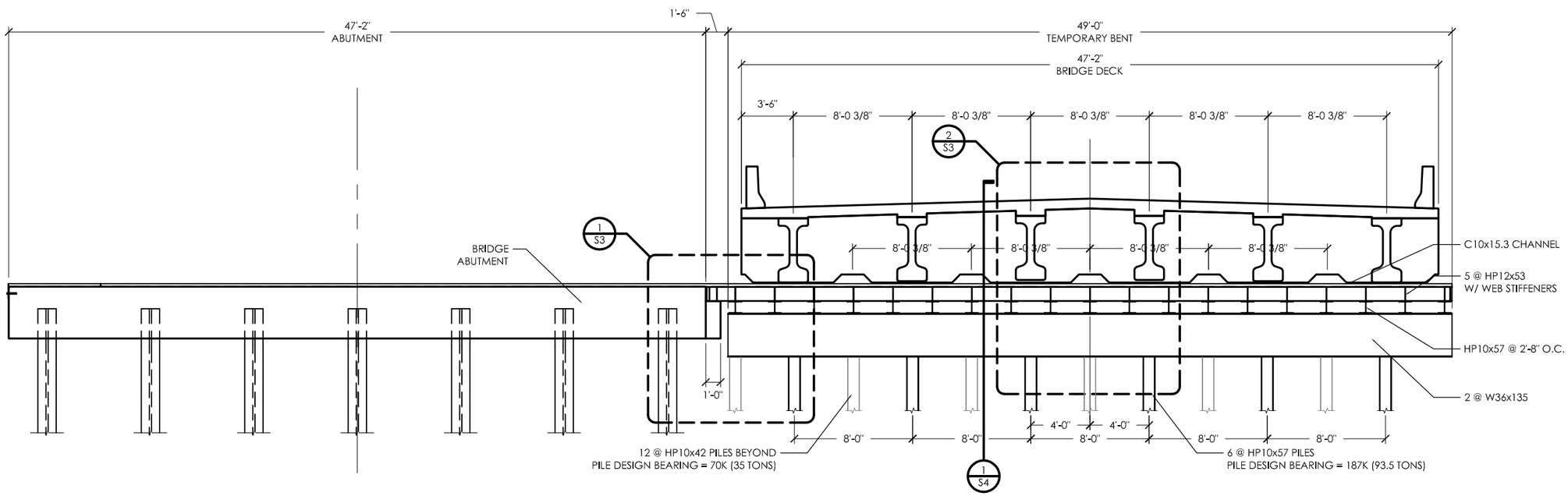
S1



TEMPORARY BENT FRAMING (2/S2)

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



BRIDGE
SECTION @ CONSTRUCTION POSITION (1/S2)

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

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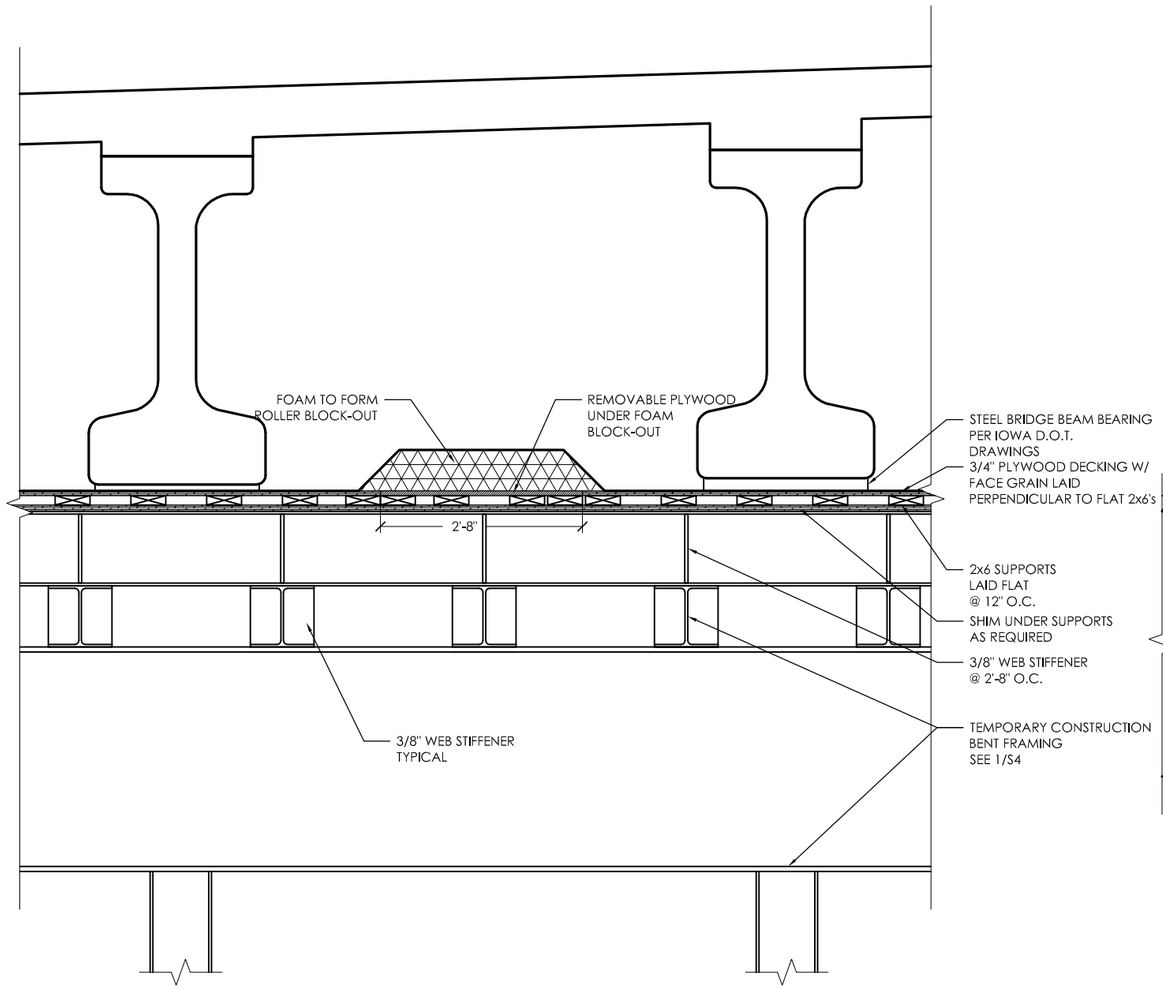
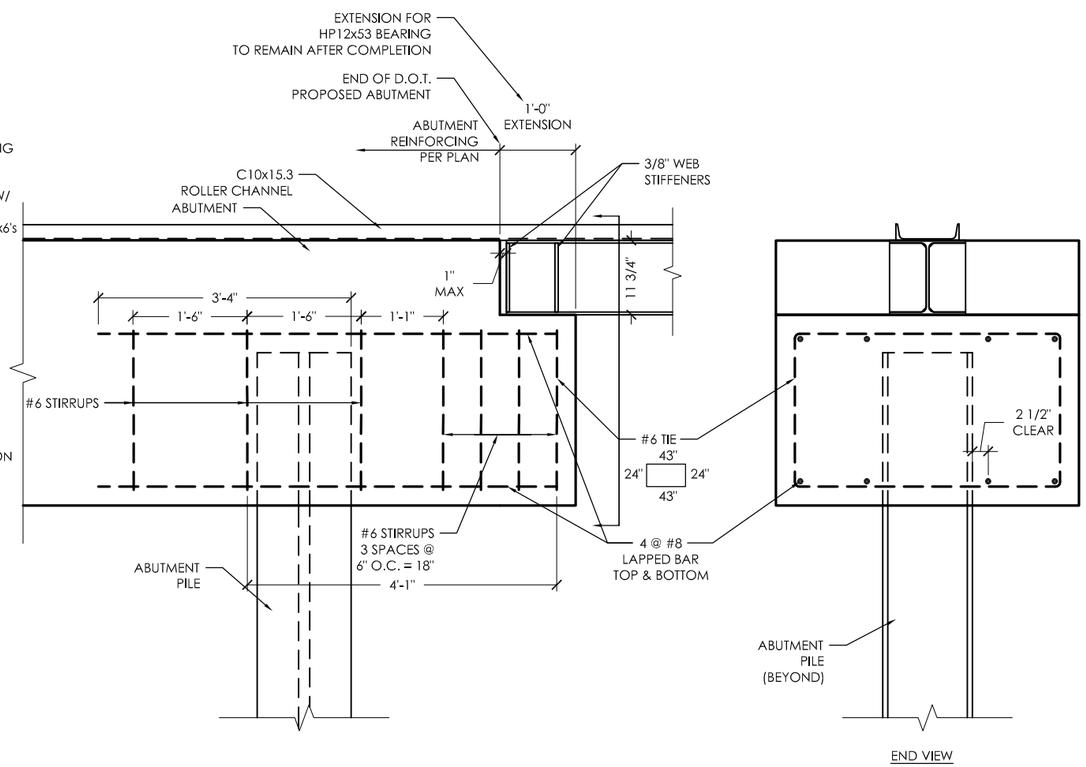


PLYWOOD FORM-WORK SECTION (2/S3)

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



NOTE:
REINFORCING TO BE EPOXY COATED

PLYWOOD FORM-WORK PLAN (1/S3)

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

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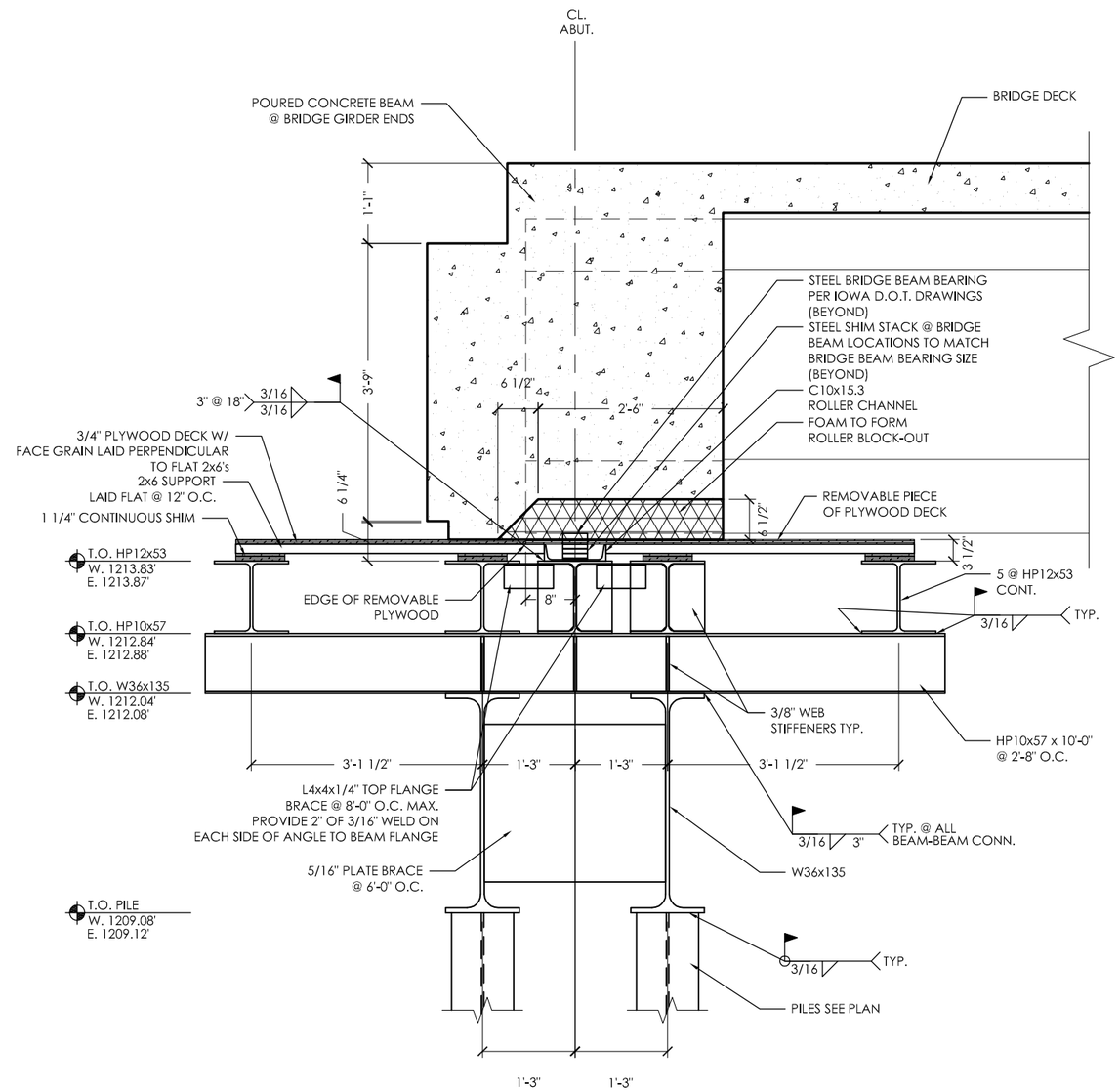
S3



TEMPORARY PIER SECTION/CONSTRUCTION (1 / S4)

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

NOTES:

1. PERMANENT BRIDGE ABUTMENTS WILL BE 1/2" HIGHER THAN SHOWN IN D.O.T. DRAWING TO MAKE UP FOR REMOVAL OF 1/4" SLIDE PLATE AND 1/4" OF PTFE BEARING PAD
2. E. = EAST ABUTMENT
   W. = WEST ABUTMENT
3. BEARING PLATES FOR SUPER STRUCTURE MOVE WILL BE SHOWN ON "MOVE" SUBMITTAL

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