CCS Constructors Inc.

Supply & Erect Structural Steel and Precast
Crane Service Rigging Pile Driving Heavy Hauling

Erection Plan for Precast Concrete NEXT BEAMS
Rochester, VT
ER BRF 0162(16)
Bridge 15

July 2, 2014

General Requirements:

The erection shall not be performed during windy or heavy rain conditions. This submittal covers the erection of the four NEXT beams. Erection of the abutments and approach slabs is not within the scope of this submittal and shall be submitted separately.

A Grove **GMK5275** hydraulic truck crane and Demag **AC160-2** hydraulic truck crane will be used for the erection. The **GMK5275** is to be outfitted with 169,700 lbs of manufacturer's supplied counterweights, and the **AC160-2** is to be outfitted with 119,500 lbs of manufacturer's supplied counterweights.

The units shall be picked from the locations and lifting apparatus shown in the J.P. Carrara & Sons Inc. shop drawings, and shall be installed according to the manufacturer's requirements and project specifications . Each Next Beam unit is to be picked from (4) locations. See the attached isometric drawing for rigging sizes, which are minimum; slightly larger rigging is permissible.

The maximum permissible crane radius for unloading and setting the Next Beam units is shown on layout drawing, and shall not be exceeded. The unloading area is to be behind the **GMK5275** crane.

Two W36x230 (ASTM A36 or better) steel beams with diaphragms and skates, termed a "slider system" herein will be used to support one end of each NEXT beam in rolling it across the span. Calderwood Engineering ETC, LLC and Miller Construction designed this system for erecting heavier NEXT beams on another V.A.O.T. project. Design calculations have been reviewed and are sealed herein, for pertaining to this project only. All diaphragms shown in the attached layout drawing shall be connected to the W36x230 beams as shown in the attached diagrams.

The sub-base beneath the tractor, cranes, and slider system shall be 2 feet minimum of compacted structural gravel.

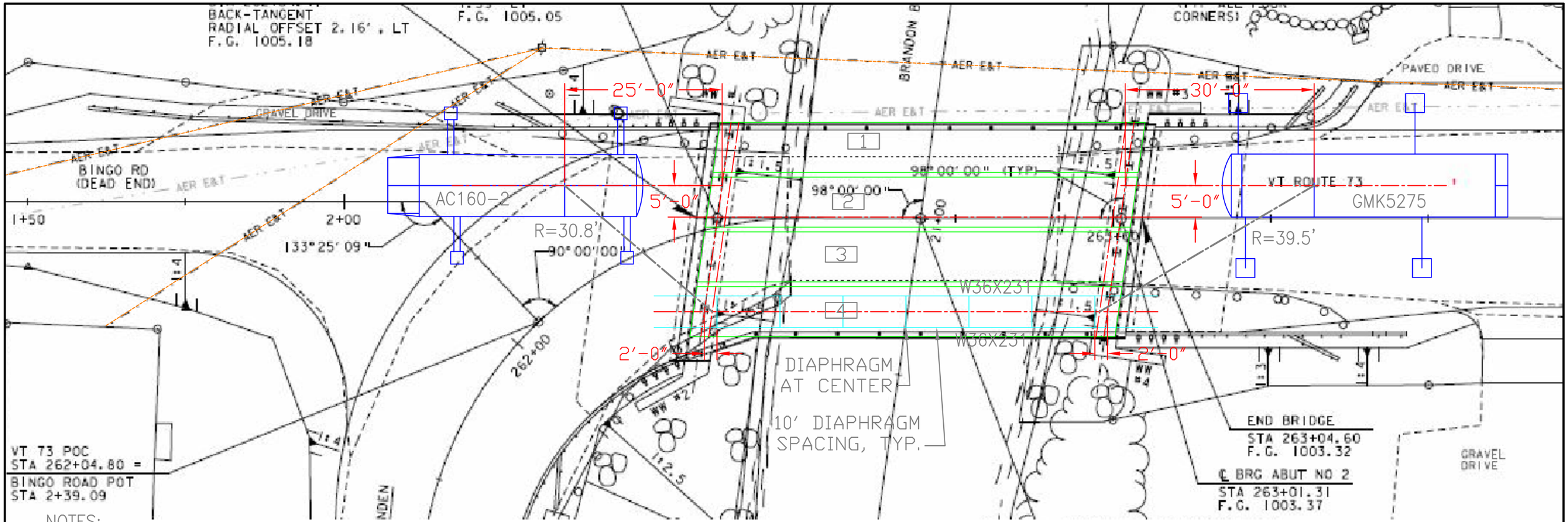
The NEXT BEAMS are to be set from the North, working toward the South.

Sequence:

1. The **GMK5275**is to pick one end of the #1 NEXT beam (as indicated on the attached layout drawing) from the steerable dolly, and remain hooked on. The tractor truck is to remain hooked on.
2. The steerable dolly is to be carefully removed from under the NEXT beam.
3. The **GMK5275** is to set the end of the NEXT beam onto hardwood blocking on the slider system skate, and unhook.
4. The tractor is to slowly back up, pushing the NEXT beam across the span on the slider system. The tractor shall have a straight path to remain parallel to the slider rails for backing up.
5. The **AC160-2** is to hook onto the receiving end of the NEXT beam upon it being within the safe lifting radius and coming to a stop.
6. The **GMK5275** is to hook onto the tractor supported end of the NEXT beam.
7. Both cranes are to simultaneously and gradually pick the NEXT beam and set it into the final position. The NEXT beam is to be kept level during the 2-crane pick.
8. Repeat steps 1-7 for the remaining NEXT beams. However, the last NEXT beam is to be set on 6 rows of hardwood blocking on top of the 2 center NEXT beams since the slider system is its place.
9. Either crane may pick the slider beam system and remove it from the final NEXT beam position. Both cranes are to hook onto the last NEXT beam and set it in the final position.

Andrew D. White, P.E.
July 2, 2014

Digitally signed by Andrew White
Date: 2014.07.02 14:03:18 -04'00'



NOTES:

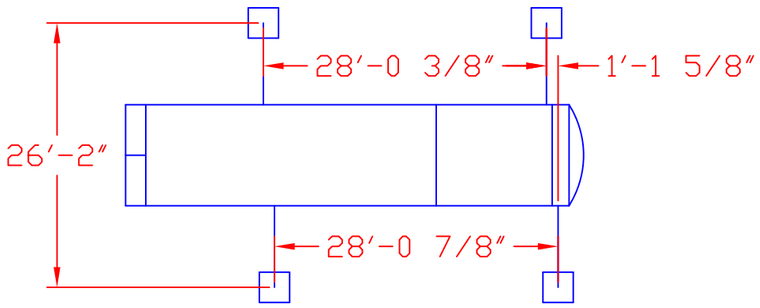
1) CRANE OUTRIGGERS SHALL BEAR ON 1" MIN. THICK STEEL PLATES OR CRANE MATS.

2) PICK WEIGHT INCLUDES 5.0K CRANE BLOCK AND 0.6K LOAD LINE.

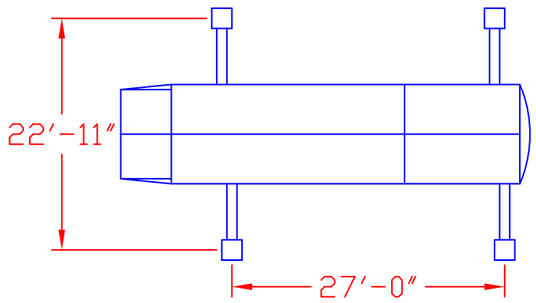
3) CRANE RADII ARE SHOWN NEXT TO BOOM LAYOUTS. DO NOT EXCEED WITHOUT CAPACITY VERIFICATION. SEE NARATIVE FOR ADDITIONAL INFORMATION.

LEGEND

[1] INDICATES SEQUENCE OF SETTING



GROVE GMK5275 TRUCK CRANE



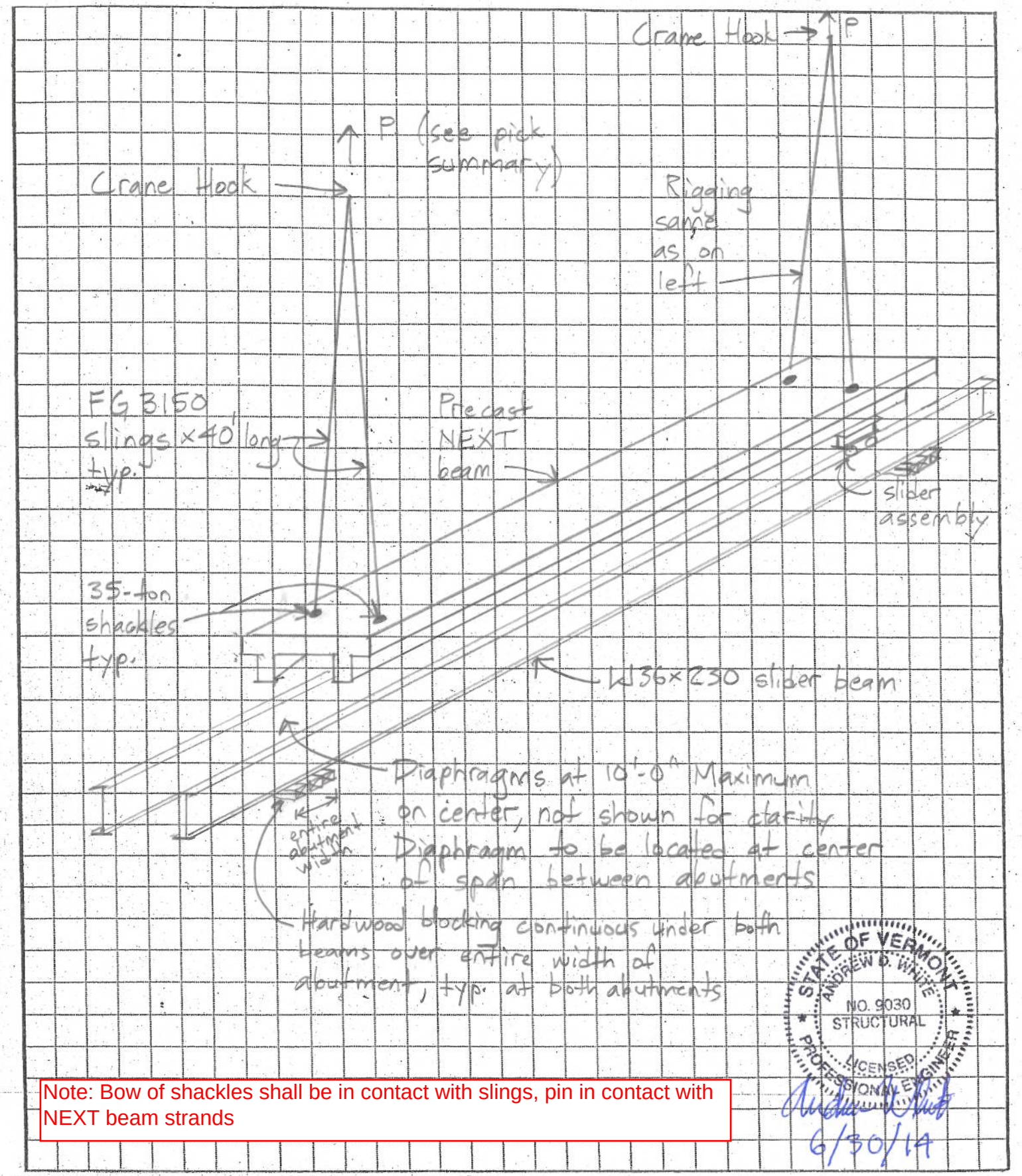
DEMAG AC160-2 TRUCK CRANE

STATE OF VERMONT
ANDREW D. WHITE
NO. 9030
STRUCTURAL
LICENSED
PROFESSIONAL ENGINEER

ANDREW D. WHITE
6/30/14

CCS CONSTRUCTORS, INC
138 MUNSON AVE.
MORRISVILLE, VT 05661
PH. 802-888-7701
FX. 802-888-4746

PROJECT NAME	PROJECT NO.
ROCHESTER, VT BRIDGE 15	BRF 0162(16)
CRANE LAYOUT	DRAWING NO. 1
SCALE 1"=15'	DATE 6/30/14



Note: Bow of shackles shall be in contact with slings, pin in contact with NEXT beam strands

STATE OF VERMONT
ANDREW D. WHITE
NO. 9030
STRUCTURAL
LICENSED
PROFESSIONAL ENGINEER
6/30/14

CCS CONSTRUCTORS, INC. 138 MUNSON AVE. MORRISVILLE, VT 05661 PH. 802-888-7701 FX. 802-888-4746	PROJECT NAME Rochester	PROJECT NO. BRF 0162(16)
	Rigging	DRAWING NO. 2
	SCALE N.T.S. DATE 6/30/14	

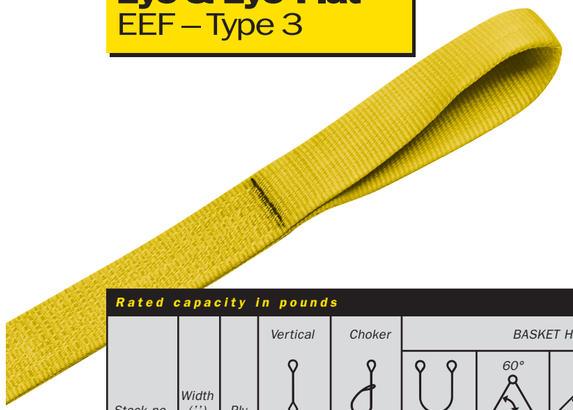
CCS Constructors, Inc.
138 Munson Ave.
Morrisville, VT 05661
802-888-7701

Heaviest Pick, KS-B1:

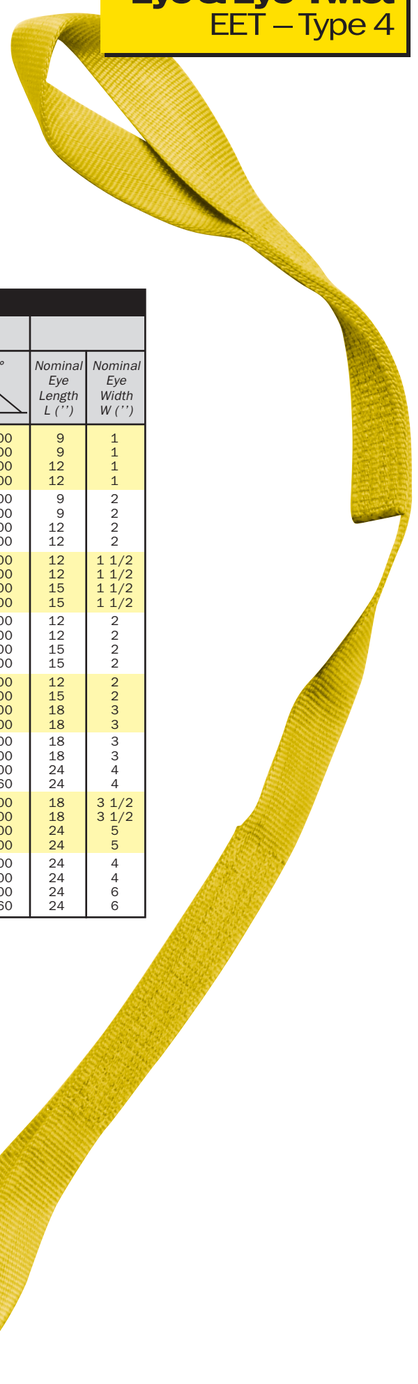
item	quantity	wt each, kips	total wt, kips
precast NEXT beam 1	0.5	138.400	69.200
35-ton shackles at strands	2	0.050	0.100
40' FG3150 slings (1 leg)	2	0.180	0.360
load line	1	0.600	0.600
crane block	1	5.000	5.000
total:			**75.260 kips**

GMK5275 RADUS= 45', CAPACITY= 106.0 kips, 104.2' BOOM
AC160-2 RADUS= 39', CAPACITY= 81.1 kips, 73.2' BOOM

Eye & Eye-Flat
EEF – Type 3



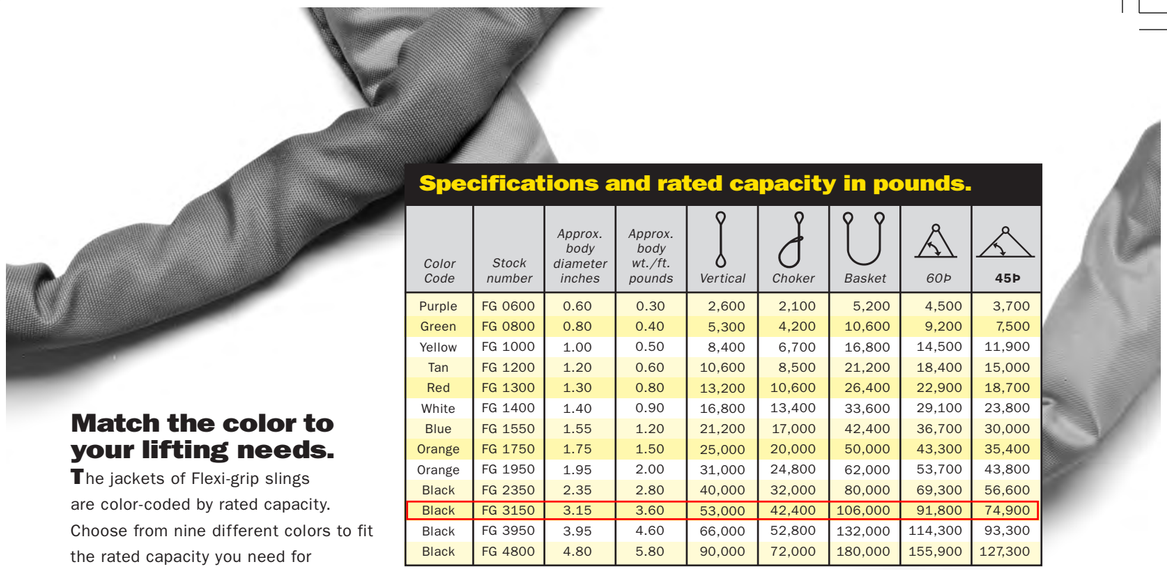
Eye & Eye-Twist
EET – Type 4



Rated capacity in pounds

Stock no.	Width (")	Ply	Vertical	Choker	BASKET HITCH				Nominal Eye Length L (")	Nominal Eye Width W (")
						60°	45	30°		
-1-901	1	1	1,600	1,280	3,200	2,771	2,262	1,600	9	1
-2-901	1	2	3,100	2,480	6,200	5,369	4,383	3,100	9	1
-3-901	1	3	4,100	3,300	8,200	7,052	5,781	4,100	12	1
-4-901	1	4	5,500	4,400	11,000	9,526	7,777	5,500	12	1
-1-902	2	1	3,100	2,480	6,200	5,369	4,383	3,100	9	2
-2-902	2	2	6,200	4,960	12,400	10,738	8,767	6,200	9	2
-3-902	2	3	8,200	6,600	16,400	14,104	11,562	8,200	12	2
-4-902	2	4	11,000	8,800	22,000	19,052	15,554	11,000	12	2
-1-903	3	1	4,700	3,760	9,400	8,140	6,646	4,700	12	1 1/2
-2-903	3	2	8,800	7,040	17,600	15,242	12,443	8,800	12	1 1/2
-3-903	3	3	12,300	9,900	24,600	21,156	17,343	12,300	15	1 1/2
-4-903	3	4	16,400	13,120	32,800	28,405	23,190	16,400	15	1 1/2
-1-904	4	1	6,200	4,960	12,400	10,738	8,767	6,200	12	2
-2-904	4	2	11,000	8,800	22,000	19,052	15,554	11,000	12	2
-3-904	4	3	15,300	12,200	30,600	26,316	21,573	15,300	15	2
-4-904	4	4	20,400	16,320	40,800	35,333	28,846	20,400	15	2
-1-906	6	1	9,300	7,440	18,600	16,108	13,150	9,300	12	2
-2-906	6	2	16,500	13,200	33,000	28,578	23,331	16,500	15	2
-3-906	6	3	22,900	18,300	45,800	39,388	32,289	22,900	18	3
-4-906	6	4	30,600	24,480	61,200	52,999	43,268	30,600	18	3
-1-908	8	1	11,800	9,440	23,600	20,438	16,665	11,800	18	3
-2-908	8	2	22,700	18,160	45,400	39,316	32,098	22,700	18	3
-3-908	8	3	30,700	24,600	61,400	52,804	43,287	30,700	24	4
-4-908	8	4	40,960	32,768	81,920	70,451	57,753	40,960	24	4
-1-910	10	1	14,700	11,760	29,400	25,460	20,786	14,700	18	3 1/2
-2-910	10	2	28,400	22,720	56,800	49,189	40,158	28,400	18	3 1/2
-3-910	10	3	36,000	28,800	72,000	61,920	50,760	36,000	24	5
-4-910	10	4	48,000	38,400	96,000	82,560	67,680	48,000	24	5
-1-912	12	1	17,600	14,080	35,200	30,483	24,886	17,600	24	4
-2-912	12	2	34,100	27,280	68,200	59,061	48,217	34,100	24	4
-3-912	12	3	40,300	32,200	80,600	69,316	56,823	40,300	24	6
-4-912	12	4	53,760	43,008	107,520	92,467	75,801	53,760	24	6

Lighter duty "60" capacities available upon request.
** Insert EEF prefix to indicate Type 3 and EET prefix to indicate Type 4.*
See page 16 to see Types 3 and 4 light-duty slings.
Warning: Horizontal sling angles less than 30° shall not be used.



Specifications and rated capacity in pounds.

Color Code	Stock number	Approx. body diameter inches	Approx. body wt./ft. pounds	Vertical	Choker	Basket	60Þ	45Þ
Purple	FG 0600	0.60	0.30	2,600	2,100	5,200	4,500	3,700
Green	FG 0800	0.80	0.40	5,300	4,200	10,600	9,200	7,500
Yellow	FG 1000	1.00	0.50	8,400	6,700	16,800	14,500	11,900
Tan	FG 1200	1.20	0.60	10,600	8,500	21,200	18,400	15,000
Red	FG 1300	1.30	0.80	13,200	10,600	26,400	22,900	18,700
White	FG 1400	1.40	0.90	16,800	13,400	33,600	29,100	23,800
Blue	FG 1550	1.55	1.20	21,200	17,000	42,400	36,700	30,000
Orange	FG 1750	1.75	1.50	25,000	20,000	50,000	43,300	35,400
Orange	FG 1950	1.95	2.00	31,000	24,800	62,000	53,700	43,800
Black	FG 2350	2.35	2.80	40,000	32,000	80,000	69,300	56,600
Black	FG 3150	3.15	3.60	53,000	42,400	106,000	91,800	74,900
Black	FG 3950	3.95	4.60	66,000	52,800	132,000	114,300	93,300
Black	FG 4800	4.80	5.80	90,000	72,000	180,000	155,900	127,300

Rated capacities are based on current proposal for B30.9-6.
Warning: Horizontal sling angles less than 30° shall not be used.

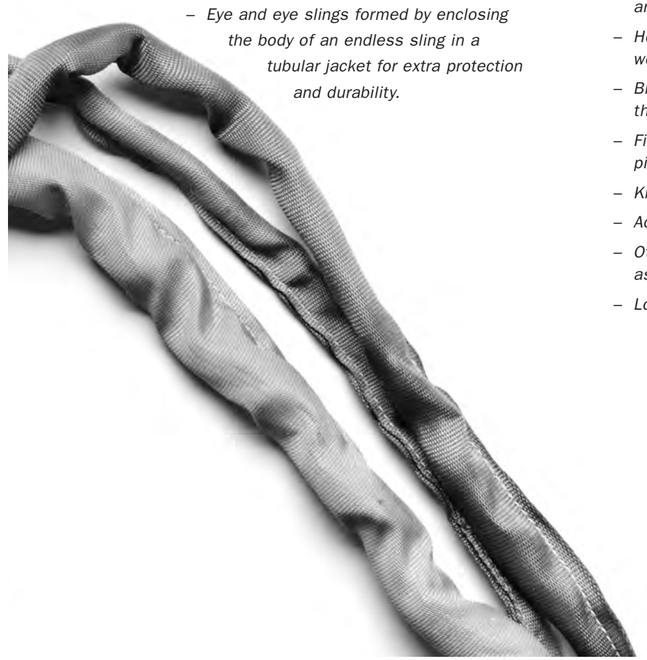
Match the color to your lifting needs.

The jackets of Flexi-grip slings are color-coded by rated capacity. Choose from nine different colors to fit the rated capacity you need for your lift (see chart). Each sling also features a durable identification tag to indicate its size, type and rated capacity for your convenience.

Flexi-grip options.

Flexi-grip slings are also available in three configurations:

- *Endless-type slings that double the lifting legs in every application.*
- *Multi-leg bridles.*
- *Eye and eye slings formed by enclosing the body of an endless sling in a tubular jacket for extra protection and durability.*



Moveable wear pads made with durable polyester buffer or leather are also available to help protect against lifting hooks and corners of loads.

Inspect your slings regularly.

Before each lift, visually inspect your Flexi-grip sling for any damage. Remove sling from service if you see:

- *Missing or illegible identification tag.*
- *Melting, charring or weld spatter on any part of the sling.*
- *Holes, tears, cuts, embedded particles, abrasive wear or snags that expose the sling's core yarns.*
- *Broken or worn stitching in the cover that exposes the core yarns.*
- *Fittings that are damaged, stretched, cracked, pitted or distorted in any way.*
- *Knotting in the sling.*
- *Acid or alkali burns.*
- *Other visible damage that causes doubt as to the sling's strength.*
- *Loading a sling beyond its rated capacity.*

How to order: Page 26

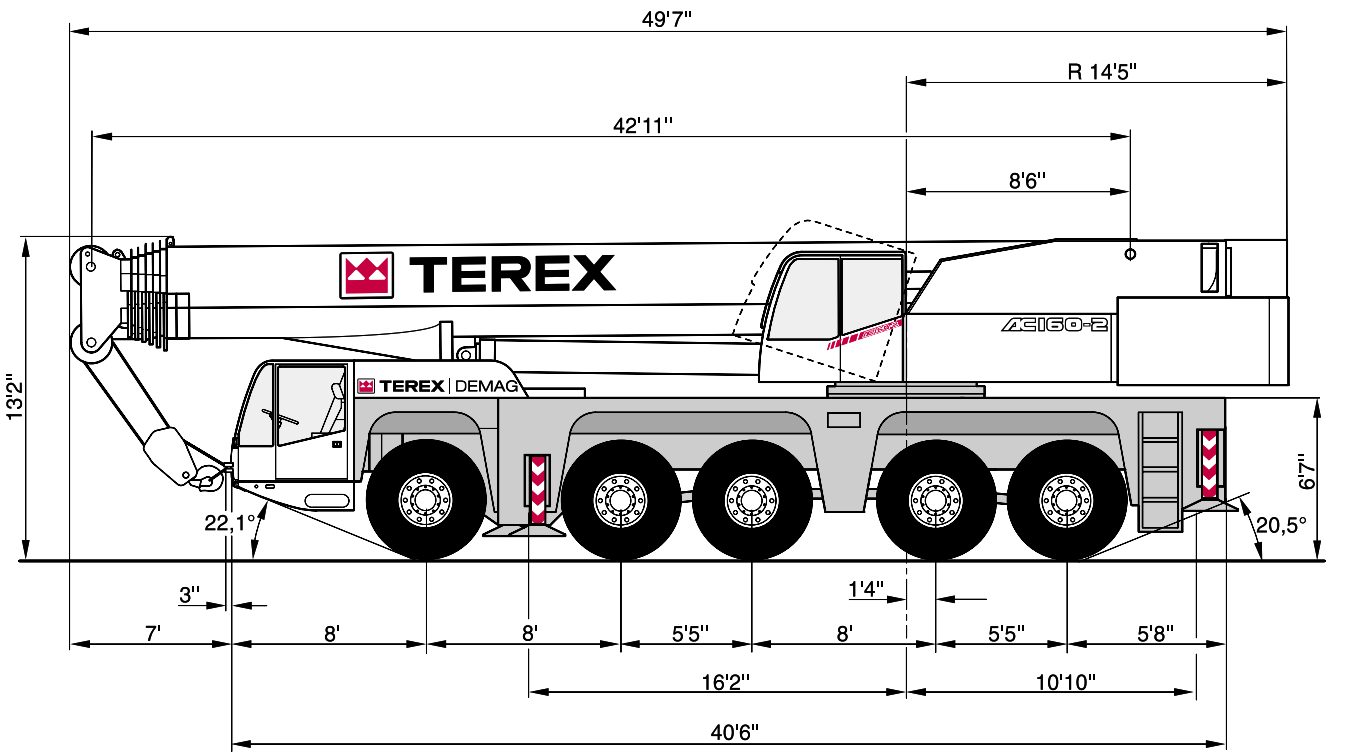
GMK5275

Main Boom
169,700 lb. Counterweight
Outriggers Fully Extended
360°

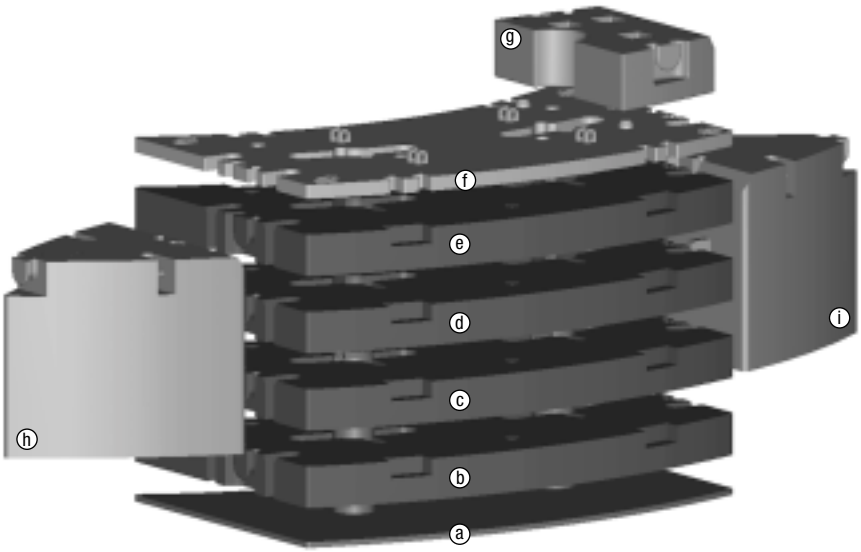
Radius	Boom Length													Radius
	43.7'	59.1'	74.3'	89.3'	104.2'	119.1'	133.4'	148.8'	164.0'	179.0'	193.9'	208.7'	223.1'	
	x 1000 lb.													
8	*550.0													8
10	346.0	332.0	312.0	244.0										10
15	272.0	270.0	260.0	242.0	185.0									15
20	220.0	222.0	215.0	212.0	182.0	144.0	106.0							20
25	184.0	185.0	181.0	181.0	166.0	140.0	106.0	86.0						25
30	152.0	157.0	157.0	155.0	151.0	129.0	105.0	86.0	69.0	55.0	45.0			30
35		136.0	136.0	135.0	136.0	118.0	96.0	86.0	69.0	55.0	45.0	36.4		35
40		121.0	119.0	118.0	120.0	108.0	88.0	82.0	69.0	55.0	45.0	36.4	30.8	40
45		99.0	106.0	104.0	106.0	99.0	81.0	75.0	68.0	55.0	45.0	36.4	30.8	45
50			95.0	93.0	95.0	92.0	76.0	70.0	63.0	55.0	45.0	36.4	30.8	50
55			83.0	84.0	85.0	85.0	72.0	64.0	59.0	52.0	45.0	36.4	30.8	55
60				76.0	77.0	79.0	67.0	59.0	54.0	49.0	44.0	36.4	30.8	60
65				70.0	70.0	72.0	63.0	54.0	50.0	46.0	41.2	36.4	30.8	65
70				63.0	64.0	66.0	60.0	50.0	47.0	43.4	39.0	36.0	30.8	70
75				50.0	58.0	61.0	57.0	46.0	43.0	40.4	36.8	34.4	30.8	75
80					53.0	55.0	54.0	42.8	39.6	37.6	34.8	32.6	30.4	80
85					49.0	51.0	51.0	40.2	37.2	35.2	33.0	31.0	29.2	85
90					39.2	46.0	48.0	37.6	34.6	32.8	31.2	29.4	28.0	90
95						42.4	44.0	35.2	32.4	30.8	29.4	28.0	26.8	95
100						38.2	40.8	33.2	30.4	28.8	27.8	26.4	25.6	100
105							37.6	31.4	28.8	27.2	26.4	24.8	24.4	105
110							34.8	29.6	27.0	25.6	24.8	23.0	23.2	110
115							30.4	28.0	25.2	23.8	23.0	21.4	22.0	115
120								26.6	23.2	21.8	21.2	20.4	20.8	120
125								25.2	21.4	20.0	19.4	19.4	19.4	125
130								24.4	20.2	19.0	18.4	18.4	18.0	130
135									19.2	18.0	17.4	17.4	17.2	135
140									18.2	17.0	16.4	16.6	16.4	140
145									17.2	16.0	15.6	15.8	15.6	145
150									12.8	15.4	14.8	15.0	15.0	150
155										14.8	14.0	14.2	14.2	155
160										14.4	13.2	13.4	13.6	160
165											12.6	12.8	13.0	165
170											11.8	12.2	12.4	170
175											11.4	11.6	11.8	175
180												11.0	11.2	180
185												10.6	10.6	185
190												9.6	10.2	190
195													9.6	195
200													9.2	200

* Over the rear with special equipment
Loads greater than 297,000 lb. can only be lifted with additional equipment
Loads greater than 335,000 lb. can only be lifted with special equipment

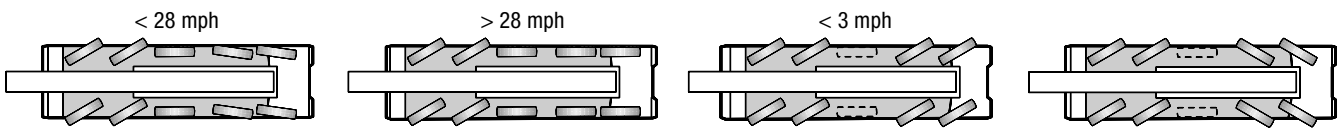
DIMENSIONS

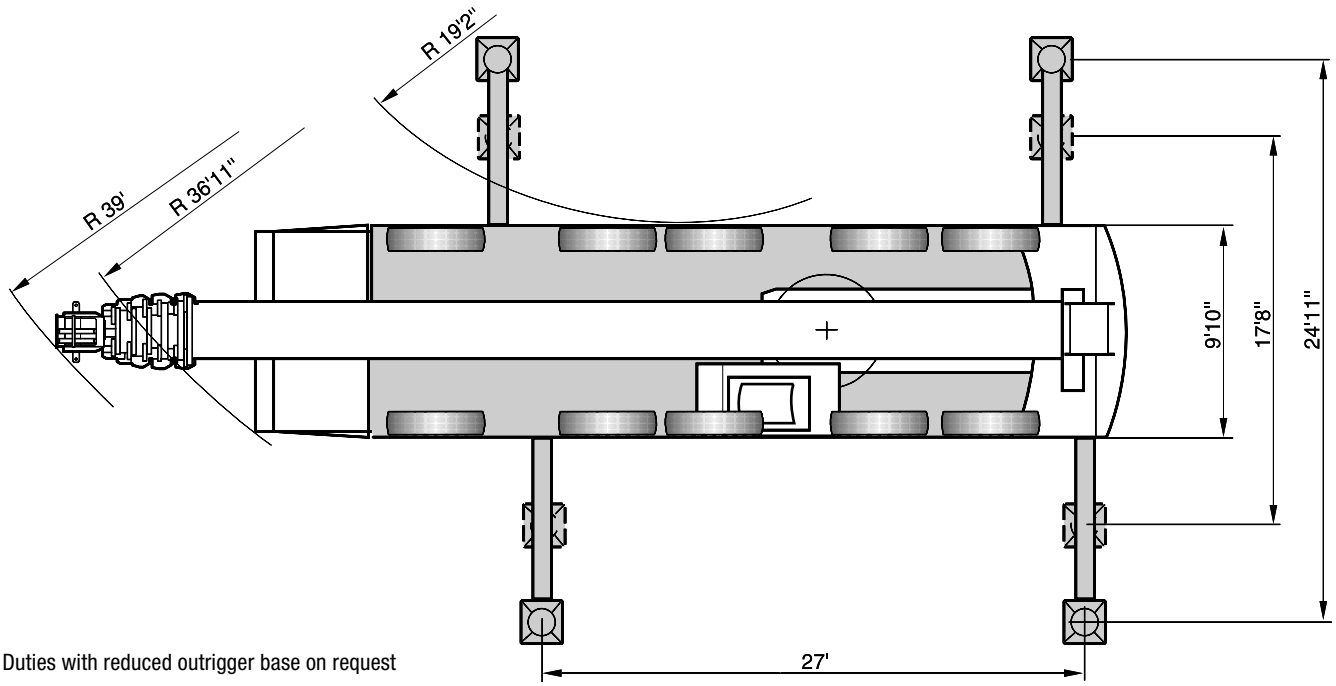

49'7"
R 14'5"
42'11"
8'6"
13'2"
TEREX
AC160-2
TEREX | DEMAG
6'7"
22,1°
20,5°
3"
1'4"
7'
8'
8'
5'5"
8'
5'5"
5'8"
16'2"
10'10"
40'6"

DIMENSIONS



	ⓐ 4,630 lb	ⓑ 17,415 lb	ⓒ 17,415 lb	ⓓ 17,415 lb	ⓔ 17,415 lb	ⓕ 6,835 lb	ⓖ 4,850 lb	ⓗ 16,755 lb	ⓘ 16,755 lb
0 lb									
4,850 lb							X		
9,480 lb	X						X		
16,315 lb	X					X	X		
33,730 lb	X	X				X	X		
44,535 lb	X	X	X				X		
68,565 lb	X	X	X	X		X	X		
85,980 lb	X	X	X	X	X	X	X		
119,490 lb	X	X	X	X	X	X	X	X	X





Duties with reduced outrigger base on request

LIFTING CAPACITIES MAIN BOOM

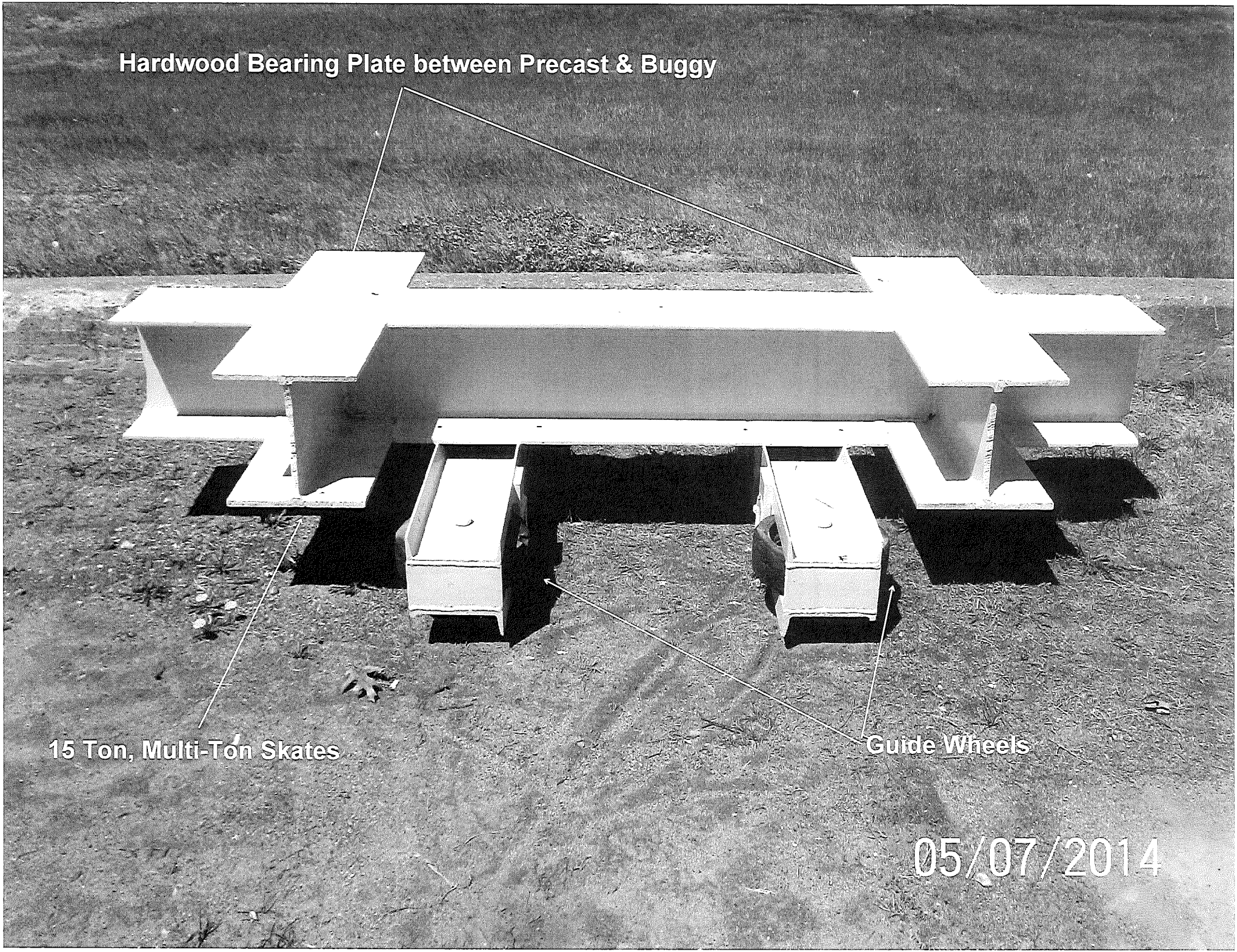
119,500 lb | 360° | 85 %

Radius	ft	Main boom													Radius
		43.0*	43.0	58.1	73.2	88.3	103.3	118.4	133.5	148.6	163.7	178.8	193.9	209.6	
ft		1,000 lb													ft
		360.0**	-	-	-	-	-	-	-	-	-	-	-	-	
10		286.6	286.6	284.4	265.7	-	-	-	-	-	-	-	-	-	10
12		282.2	273.4	269.0	249.1	-	-	-	-	-	-	-	-	-	12
13		262.4	252.4	251.3	234.8	221.6	-	-	-	-	-	-	-	-	13
15		244.7	232.6	232.6	222.7	211.2	-	-	-	-	-	-	-	-	15
16		229.3	216.7	216.3	213.0	200.6	164.9	-	-	-	-	-	-	-	16
20		201.1	188.9	188.5	187.0	181.2	153.0	116.8	-	-	-	-	-	-	20
23		172.2	166.9	166.7	165.1	166.0	140.2	112.0	88.0	-	-	-	-	-	23
26		150.1	149.3	150.1	147.5	148.4	128.5	106.3	80.5	67.0	-	-	-	-	26
30		132.7	132.7	133.4	130.3	131.4	120.6	100.5	74.7	63.9	-	-	-	-	30
33		108.5	108.5	118.4	117.5	116.0	112.4	95.2	69.2	60.6	51.6	-	-	-	33
39		-	-	95.5	94.6	93.0	94.6	85.3	60.4	53.1	46.1	39.0	33.1	-	39
46		-	-	79.4	76.7	77.6	76.7	75.4	53.4	47.2	41.4	35.5	31.7	24.3	46
53		-	-	-	65.0	63.9	63.3	64.4	46.5	42.3	37.5	32.2	29.3	24.3	53
59		-	-	-	54.5	53.6	55.3	53.8	43.0	37.5	34.0	29.5	26.9	23.1	59
66		-	-	-	22.7	46.5	47.4	45.9	39.9	34.0	30.6	27.3	24.9	21.8	66
72		-	-	-	-	42.1	41.0	39.5	36.8	31.1	27.6	25.1	23.1	20.7	72
79		-	-	-	-	21.6	35.9	34.4	34.2	28.2	25.6	22.9	21.4	19.4	79
85		-	-	-	-	-	31.7	30.2	31.5	25.4	23.4	21.4	19.6	18.1	85
92		-	-	-	-	-	28.4	28.0	28.0	23.1	21.4	19.8	18.5	16.8	92
98		-	-	-	-	-	-	26.5	25.1	21.8	19.4	18.3	17.4	15.7	98
105		-	-	-	-	-	-	24.0	22.5	20.5	18.1	16.8	16.1	14.6	105
112		-	-	-	-	-	-	13.2	20.3	19.2	16.8	15.4	15.0	13.7	112
125		-	-	-	-	-	-	-	9.0	17.0	14.1	13.4	13.0	11.9	125
131		-	-	-	-	-	-	-	-	15.2	13.4	12.3	12.1	11.0	131
138		-	-	-	-	-	-	-	-	9.0	13.0	11.2	11.5	10.1	138
144		-	-	-	-	-	-	-	-	8.6	12.3	10.4	10.6	9.5	144
151		-	-	-	-	-	-	-	-	-	6.6	9.9	9.7	9.0	151
158		-	-	-	-	-	-	-	-	-	6.2	9.3	8.6	8.4	158
164		-	-	-	-	-	-	-	-	-	-	8.6	7.7	7.5	164
177		-	-	-	-	-	-	-	-	-	-	5.7	6.0	6.0	177
190		-	-	-	-	-	-	-	-	-	-	-	-	4.4	190
203		-	-	-	-	-	-	-	-	-	-	-	-	-	203

Remarks

* over rear

** with special attachment


Hardwood Bearing Plate between Precast & Buggy
15 Ton, Multi-Ton Skates
Guide Wheels
05/07/2014

CALDERWOOD ENGINEERING ETC, LLC
222 RIVER ROAD
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JOB BARNARD ER BRF 0291 (39)
SHEET NO. 1 OF 9
CALCULATED BY PJH DATE 2/14
CHECKED BY ETC DATE 4/14
SCALE

MAX. LOAD EXTERION NEXT BEAM

= 73.38 TONS = 146.760 KIPS

℄ BRG TO ℄ BRG = 85 Ft

EXISTING STEEL GRADE ASSUME GRADE 33 KSI

SAY DOLLY WEIGHT = 500 lbs +/-

EXISTING STEEL = W36 x 231

USE AISC 13TH EDITION ASD DESIGN

$\Omega_{BENDING}$ = 1.67 (ASD)

Ω_{SHEAR} = 1.50 (ASD)

ϕ_b = 0.9 (LRFD)

ϕ_v = 1.0 (LRFD)

PROVIDE BRACING @ 10 Ft CENTERS

L_b = 120 INCHES

W36x230 BEAM IS COMPACT BY DEFINITION

STATE OF VERMONT
ANDREW D. WHITE
NO. 9030
STRUCTURAL
LICENSED
PROFESSIONAL ENGINEER

July 2, 2014,
9 sheets of
calculations

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JOB BARNARD
SHEET NO. 2 OF 9
CALCULATED BY PJH DATE 2/14
CHECKED BY ETC DATE 4/14
SCALE

$L_p = 1.76\, r_y \sqrt{E/F_y}$ (F2-5 AISC 13TH)

$L_p = 1.76\,(3.71)\sqrt{29000/33} = 193.57$ IN

$L_b = 120$ IN $\leq L_p$ ∴ LATERAL TORSIONAL BUCKLING IS NOT AN ISSUE

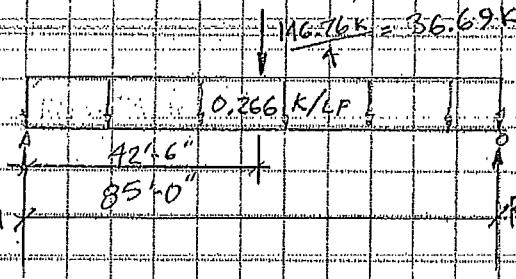
& $M_n = M_p = F_y Z_x$

$M_n = 33$ KSI $* 963$ IN$^3 = 31,779$ K-IN

$M_A = \frac{M_n}{\Omega} = \frac{(31,779\ \text{K-IN})}{1.67} = 19,029.3$ K-IN

$= 1585.8$ K-FT

1/4 NEXT BM CARRIED BY EACH BEAM (1/2 CARRIED BY TRUCK ASSEMBLY, HALF BY SLIDING BEAM)



$\omega = 0.231$ K/FT $* 1.15 = 0.266$ K/LF

$R_1 = R_2 = \frac{36.69\text{K} + 0.266 * 85'}{2}$

$= 29.65$ KIPS

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JOB BARNARD
SHEET NO. 3 OF 9
CALCULATED BY PJH DATE 2/14
CHECKED BY ETC DATE 4/14
SCALE

$M_u = \frac{29.65\text{K} + 29.65\text{K} - 42.5 * 0.266\text{ KLF}}{2} * 42.5\text{ ft} = 1019.9\text{ K-ft}$

M_u (SVC LOAD) $= 1019.9$ K-FT

M_n (ASD) $= 1585.8$ K-FT

$M_R \geq M_u$ $\therefore$ O.K.

$V_u = 36.69\text{K} + 0.266 * 85.5\text{ft}/2 = 47.995$ KIPS
(WITH SLIDING SLED @ ℄ BRG EITHER END)

$V_n = 0.6\, F_y\, A_w\, C_v$ (G2-1)

$h/t_w = 36.5\text{in} / 0.76\text{in} = 48.03$

$2.24\sqrt{E/F_y} = 2.24 * \sqrt{29000/33} = 66.4$

$66.4 > 48.03$ $\therefore$ $C_v = 1.0$

$V_n = 0.60\,(33\text{ k-s.i.}) * (36.5\text{ in}) * (0.76\text{ in}) * 1.0 = 549.25$ KIPS

V_u (SVC) $<<$ $V_A = \frac{549.25\text{ K}}{1.5} = 366.2$ KIPS $\therefore$ O.K.

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JOB BARNARD
SHEET NO. 4 OF 9
CALCULATED BY PJH DATE 2/14
CHECKED BY ETC DATE 4/14
SCALE

✓ WEB LOCAL YIELDING (J10-3) J-2

STAY N = K

$R_N = (2.5K + N)(F_{yw})(t_w)$

K = 2.21 in ∴ $R_N = (2.5(2.21\text{in}) + 2.21\text{in})(33\text{ksi})(0.76\text{in})$

R_N = 193.99 kips $\Omega = 1.5$

∴ $R_A = 193.99\text{K} / 1.5 = 129.33$ kips

R_u = 48 kips << R_A ∴ LOCAL WEB YIELDING OK

✓ WEB CRIPPLING (J10-4) J-3

USE N = K = 2.21 in

$$R_N \text{ (@ END OF MEMBER)} = 0.4 t_w^2 \left[1 + 3\left(\frac{N}{d}\right)\left(\frac{t_w}{t_f}\right)^{1.5}\right]\sqrt{\frac{E F_{yw} t_f}{t_w}}$$

$$R_N = 0.4(0.76\text{in})^2\left[1 + 3*\left[\frac{2.21\text{in}}{36.5\text{in}} * \left(\frac{0.760\text{in}}{1.26\text{in}}\right)^{1.5}\right]\right]\sqrt{\frac{29000 * 33\text{ksi} * 1.26\text{in}}{0.76\text{in}}}$$

R_N = 293.496 kips $R_A = R_N/\Omega$ $\Omega = 2.00$

R_A = 293.5K / 2.0 = 146.7 kips >> R_u ∴ OK

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JOB BARNARD
SHEET NO. 5 OF 9
CALCULATED BY PJH DATE 2/14
CHECKED BY ETC DATE 4/14
SCALE

✓ SIDESWAY WEB BUCKLING J-4

$h/t_w = (36.5\,in - 2.21\,in * 2) / 0.76\,in = 32.08$

$l/b_{fc} = 120\,in / 16.5\,in = 7.27$

$(h/t_w)/(l/b_{fc}) = 32.08/7.27 = 4.41$

COMPRESSION FLANGE IS NOT RESTRAINED AGAINST ROTATION

$(h/t_w)/(l/b_{fc}) = 4.41 \geq 1.7$ ∴ SIDESWAY WEB BUCKLING IS NOT A CONCERN

✓ BRACING FORCE REQ'D

RULE OF THUMB: 2% FORCE IN COMPRESSION FLANGE

APPENDIX D (C-A-6-46)

$P_{br} = 0.01 * M_u (C_t) C_d / h_o = 0.01 * (1019.9\,k\text{-}ft * 12\,in/ft)(2.0)(2.0)/36.5\,in$

$C_t = 2.0 \quad C_d = 2.0$

$P_{br} = 13.91$ KIPS

AVE STRESS IN COMP. FLANGE $= \left[\frac{1019.9\,(12\,in/ft)}{85\,in^3}, \frac{1019.9\,(12)*16.99\,in}{15600\,in^4}\right] * 1/2$

$= 13.83\,ksi$ $\quad 2\%\,P_u = 0.02 * 13.83\,ksi * 1.26\,in * 16.5\,in = 5.75\,k$

USE 13.91 KIPS BRACING FORCE REQ'D

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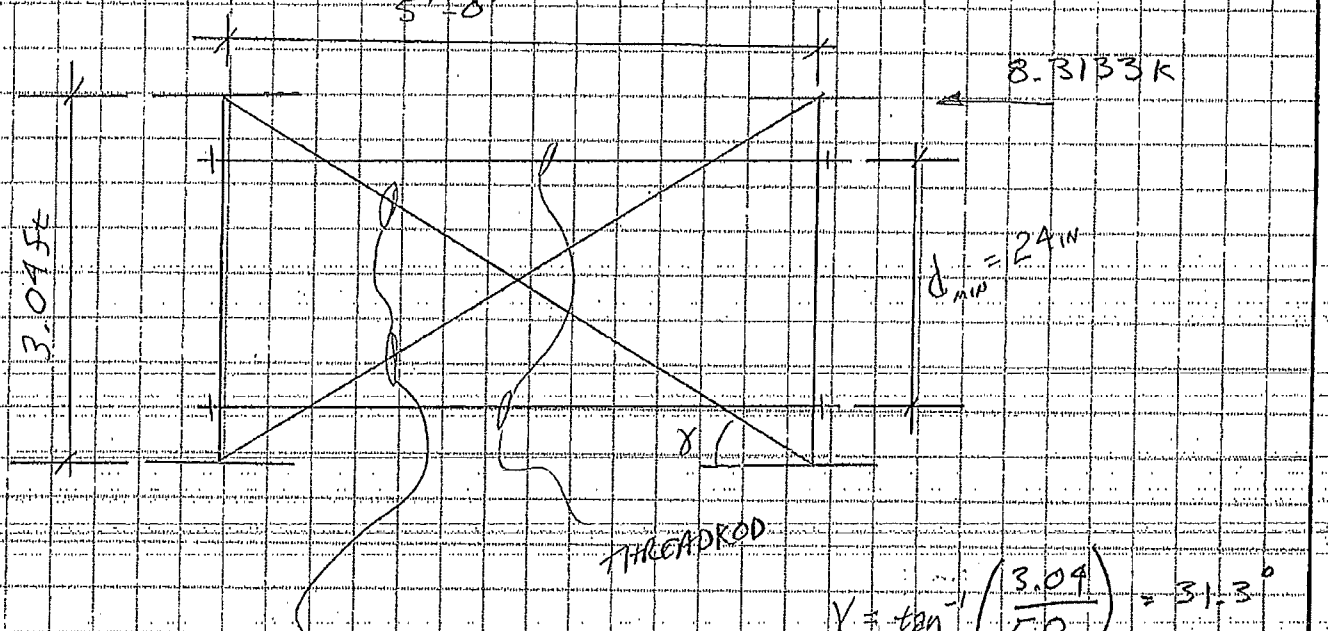
JOB BARNARD
SHEET NO. 6 OF 9
CALCULATED BY RJH DATE 2/14
CHECKED BY ETC DATE 4/14
SCALE

L_B REQ'D = 193.57 IN
L_B PROV = 120 IN
} BRACING FORCE MAY BE REDUCED TO ACCOUNT FOR CLOSER SPACING PROVIDED.

∴ BRACING FORCE REQ'D @ 120 IN

= 13.41 KIPS * 120 IN / 193.57 IN = 8.3133 K / X-FRAME

SPACING OF GIRDERS = SPACING OF STEMS OF NEXT BM = 5'-0"



$\gamma = \tan^{-1}\left(\frac{3.04}{5.0}\right) = 31.3°$

4x6 TIMBER BRACES (SPF #2 KD HT)

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JOB BARNARD
SHEET NO. 7 OF 9
CALCULATED BY PJH DATE 2/14
CHECKED BY ETC DATE 4/19
SCALE

P_u IN BRACING = 8,313.3 lbs * 1 / cos 31.3° = 9,730 lbs

$F_{c\perp} = 9730 \text{ lbs} / (4 \text{ in} * 6 \text{ in}) = 405.4 \text{ psi}$

$l_e = \sqrt{(3.04)^2 + (5)^2} = 5.852 \text{ ft} = 70.22 \text{ in}$

$F_{c\perp} = 1000 \text{ psi}$ (NDS - ASD 2005)

$C_F = 1.1$ $C_D = 1.0$ (FOR CONSERVATISM)

$C_M = 0.80$

$F'_c = 1000 \text{ psi} * 1.1 * 0.80 * 1.0 = 880 \text{ psi}$

$l_e/d = 70.22 \text{ in} / 4 \text{ in} = 17.56$

$F_{cE} = \frac{0.822 E_{min}}{(l_e/d)^2} = \frac{0.822 * 400{,}000 \text{ psi}}{(17.56)^2} = 1066 \text{ psi}$

$c = 0.80$ FOR SAWN LUMBER

$\frac{1 + F_{cE}/F_c^*}{2c} = 1.3821$ $\sqrt{\left(\frac{1 + F_{cE}/F_c^*}{2c}\right)^2 - \frac{F_{cE}/F_c^*}{c}} = 1.5142$

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JOB BARNARD
SHEET NO. 8 OF 9
CALCULATED BY PJH DATE 2/14
CHECKED BY EJC DATE 4/14
SCALE

$$C_P = \frac{1 + F_{cE}/F_c^*}{2c} - \sqrt{\left(\frac{1 + F_{cE}/F_c^*}{2c}\right)^2 - \frac{F_{cE}/F_c^*}{c}} \qquad (3.7-1)$$

$$C_P = 1.3821 - \sqrt{(1.3821)^2 - 1.5142} = 0.7528$$

$$F'_{c\perp} = C_P F_c^* = 0.7528 * 680 psi = 662.5 psi$$

$$P_{ALLOWABLE} = 662.5 * 4 in * 6 in = 15,900 lbs$$

$15,900 lbs \geq 9,730 lbs \quad \therefore 0.K.$

THREADROD MUST BE CAPABLE OF RESISTING $8,313.3 lbs * \frac{36.5 - 6.25 in}{24 in} = 10,251.35 lbs$

$P_{T\,ALL} \geq 10.25 KIPS$

$\Omega_t = 1.67$ (YIELD) $P_1 = F_y A_g$ $P_1 = \frac{F_y A_g}{1.67}$

USING A36 THREADROD 7/8" ϕ $A_g = 0.60 in^2$

$P_{ALL} = \frac{36 ksi * 0.60 in^2}{1.67} = 12.96 KIPS$

✓ RUPTURE $F_u = 58 ksi$ $A_c = 0.129 in^2$ (UNC THREADS)

$\Omega_t = 2.00$ (FOR RUPTURE)

$P_{ALL} = \frac{58 ksi * 0.129 in^2}{2.0} = 12.491 KIPS$ (GOVERNS)

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JOB BARNARD
SHEET NO. 9 OF 9
CALCULATED BY PJW DATE 2/14
CHECKED BY ETC DATE 4/14
SCALE

12.44 KIPS ≥ 10.25 KIPS ∴ O.K.

√ CONCRETE BEARING STRESS f'_c = 5,000 psi

USE 12 x 18 PL

MAX REACTION = 48 K / (12 x 18) = 0.222 ksi

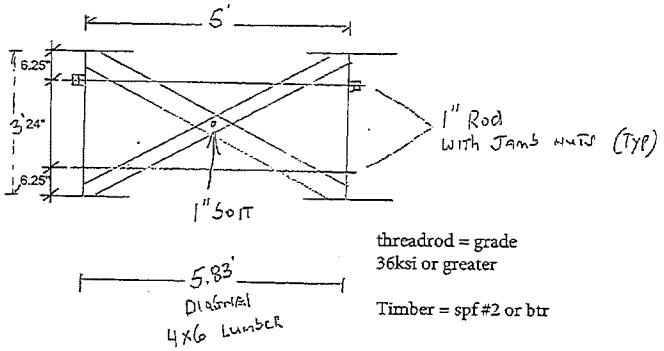
= 222 psi

ALLOWABLE BEARING PRESSURE ON CONCRETE

PER AASHTO 17TH EDITION ASD

= 0.3 f'_c = 0.3 * 5,000 psi = 1500 psi ALLOWED

222 psi << 1500 psi ∴ O.K.



threadrod = grade
36ksi or greater

Timber = spf #2 or btr

20 - 1" FLAT WASHERS (EXTRAS)
65 - 1" NUTS (EXTRAS)
20 - 1"x6" THREADED ROD (EXTRAS)
20 - 4"x6"x6" FOR DIAG BRACING (EXTRAS)
10 - 1"x12" BOLTS/NUTS (EXTRAS)

GIRDER WT: 19,780 EA +-

July 1, 2014

STATE OF VERMONT
ANDREW D. WHITE
NO. 9030
STRUCTURAL
LICENSED
PROFESSIONAL ENGINEER