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TRANSMITTAL

TO: Jennifer Fitch, PE Project Manager Vermont Agency of Transportation	DATE	PROJECT NO.
	7/1/2014	Brookfield BRF FLBR (2)

XX WE ENCLOSE THE FOLLOWING: _____ UNDER SEPARATE COVER WE ARE SENDING THE FOLLOWING

COPIES	NUMBER	DESCRIPTION	CODE
1		Deck Panel Erection Plan	H

CODE:

A FOR INITIAL APPROVAL
B FOR FINAL APPROVAL
C APPROVED AS NOTED-RESUBMISSION REQUIRED
D APPROVED AS NOTED-RESUBMISSION NOT REQUIRED
E DISAPPROVED-RESUBMIT
F QUOTATION REQUESTED
G APPROVED
H FOR APPROVAL
I AS REQUESTED OR REQUIRED
J FOR USE IN ERECTION
K LETTER FOLLOWS
L FOR FIELD CHECK
M FOR YOUR USE

BY: Paul J. Miller

WRIGHT
CONSTRUCTION COMPANY, INC.

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July 1, 2014

Erection Plan for 900.670 Special Provision (Nail Laminated Timber Deck Panel)
Brookfield BRF FLBR(2)
Brookfield, VT

Narrative of the work related to the fabrication, transportation and installation of the deck panels.

See also Engineer's sketches, and calculations.

PANEL FABRICATION

1. Fabrication of the deck panels will be done at our shop location in Mount Holly. Panels will be nailed together per the attached layout drawings.
2. Once fabricated, deck panels will be stored in Mount Holly until they are needed at the project for installation. When ready for installation the panels will be shipped to the job site on a flatbed trailer.

PANEL ERECTION

1. The panels will be installed after the pontoons are in place and connected from abutment to abutment. The glue laminated timbers at the ramps will also already be installed.
2. The deck panels will be lifted into place using a Gradall 534D-9, 9,000 pound capacity forklift. See supporting documentation for how panels will be lifted.
3. The deck panels at the ramp will be installed first starting with Type E, then working across the length of the ramp installing Type D panels and then installing the last Type E panel. All panels will be permanently secured as they are installed per the contract drawings.
4. Once the ramp deck is complete, the first end panel Type A will be moved and lowered into place on the pontoon with sleeper timbers and elastomeric pad attached on the underside. The holes for the inner curb carriage bolt attachment will have been predrilled so that the carriage bolt can be inserted from the underside before the deck panel is set on the pontoon.
5. Holes in the pontoon will be drilled using the predrilled holes in the deck panel for layout locations and the deck panel will be secured to the pontoon per the drawings.
6. Deck panel Type B will then be moved and lowered into place. Deck panel will be secured in the same manner as panel A.
7. Panels will continue to be installed along the pontoon per the plan layout. Installation will always occur in front of the advancing equipment. The forklift will advance across the pontoons and fully installed deck panels until all panels are in place.
8. Once a pontoon has all of the deck panels installed and secured to it the curbing and pedestrian railing for that pontoon can be installed while continuing on to the next pontoon section with the panel installation.

Brookfield Floating Bridge
VTrans Project BRF FLBR(2)

Construction Engineering for
Wright Construction Company
Mt Holly, VT

Prepared by:
David Skidmore, PE
Castleton, VT

6/30/14

6/30/2014

The attached information provides information associated with the erection / placement of the nail laminated wood floor panels of the float bridge and it's approaches. The calculations show that the contractor will use safe and reasonable methods of handling the panels, and will not impose stresses on the panels that might compromise the integrity of the panels, or bridge.

Sequence, generally;

- Fabricate panels in contractor's shop, Mt Holly VT, store and load panels for transport.
- Handling of the panels will be done with a forklift with nominal 6ft forks
- Onsite off loading and stockpiling of panels may be by same forklift methods.
- Setting of the panels requires the use of a lifting device, so that the panels can be handled and set directly into their final location.

Documents enclosed:

Calculations:

Panel Weight	1 pg
Panel Handling with Forklift	3 pgs
Panel Handling with Lifting Device	2 pgs
Lifting Device	4 pgs
Panel Handling with Lift Device	1 pg

Drawings:

Floor Panel Lifting Device	
Overall Elevation	1 of 3
Detail A Elevation	2 of 3
Detail B End Elevation	3 of 3

Reference is made to the Project Design Drawings by State of Vermont and T Y Lin International for details of the intended finished structure and components. And to the Contractors schedule for detailed sequencing.

BROOKFIELD BRIDGE
FLOOR PANEL HANDLING

PANEL WEIGHT

SOUTHERN PINE < 35 PCF

		CF
PANEL	$5\frac{1}{2}" \times 6' \times 23'-4"$ =	64.15
SHIPLAP	$2 \times 1\frac{1}{2}" \times 2\frac{3}{4} \times 23'-4"$	1.34
10" SLEEPERS	$2 \times 1\frac{1}{2} \times 9\frac{1}{4} \times 6'$	1.16
6" SLEEPERS	$3 \times 1\frac{1}{2} \times 5\frac{1}{2} \times 6'$	1.03
		67.69 CF

67.69 CF x 35 pcf = 2369 lbs
+ 10% + 237
2606 lbs TOTAL WRIGHT

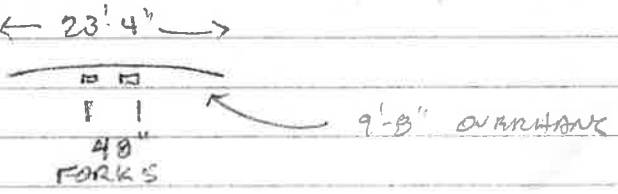
ALLOW FOR SLINGS etc 200 lbs

2800 lbs LOAD TO FORKLIFT

GRADALL 534D RATED FOR 3500 lbs
TO 20' (BEYOND FRONT OF UNIT)

BROOKFIELD FLOAT BRIDGE 1 of 3

PANEL HANDLING w/ FORKLIFT



BENDING AT EACH OF FORKS

TOTAL PANEL WEIGHT 2600 lbs

PANEL PER FOOT 2600/23.33' = 111 PLF

$M = 111 \times 9.67 \times \frac{9.67}{2} = 5190$ FT lbs / PANEL

- CONSIDER PANELS MADE OF 16 SETS OF THREE LAMINATIONS OF BUTT JOINTED 2x6".
- BUTT JOINT CANNOT TRANSFER LOAD / STRESSES
- ANALYSE STRESSES PER SET (3 LAMS / 4½" WIDE)
- LAM WITH JOINT AT CENTER WILL NOT CONTRIBUTE SIGNIFICANT CAPACITY
- ALL BENDING WILL BE TAKEN BY AN 11 FOOT LAP OF 2. 2x6's WITH NAILS 12" OC

MOMENT (PER SET) $\frac{5190}{16} = 324$ FT lbs / SET

WEIGHT (PER FOOT PER SET) $\frac{111}{16} = 6.94$ PLF (use 7)

DEFLECTION

w = 7 plf → .6 lbs/inch

l = 9'-8" → 116"

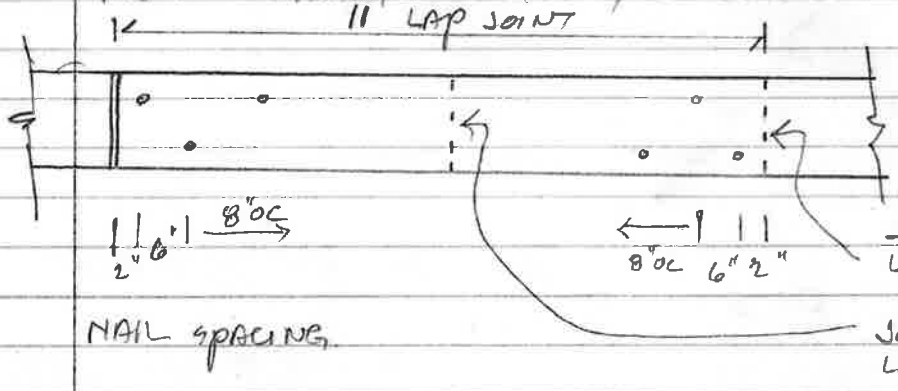
CONSIDER ONLY 1 2x6 'EFFECTIVE' $I = \frac{1\frac{1}{2} \times 5\frac{1}{2}^3}{12} = 20.8\ in^3$

$\Delta = \frac{wl^4}{8ET} = \frac{7 \cdot 116^4}{8\ 1.7\ 10^6\ 20.8} = .38"$

ACTUAL Δ WILL BE GREATER MAYBE 2 TO 3 TIMES THIS BUT 1" MAX DEFLECTION NOT OF CONCERN.

BROOKFIELD FLOAT BRIDGE

TANK HANDLING w/ FORKLIFT



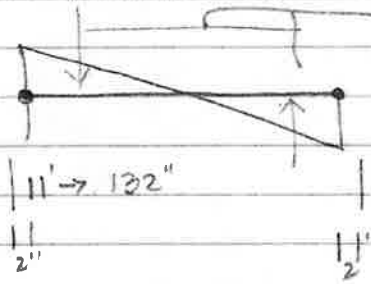
NAIL SPACING.

NAILS MIN 4" LONG MIN .19" ROOT DIAMETER

ALLOWABLE LATERAL LOAD ON 20d NAIL = 139 lbs/NAIL
GROUP II (SP) 11 DIAMETER PENETRATION (2.11")
PENETRATION 4" - 1½" = 2½" ok
NORMAL LOAD DURATION.

CAN NAILED JOINT SAFELY TAKE BENDING?

JOINT MOMENT



NAILS ARE 8" OC TYPICAL → $\frac{139}{8}$ = 17.3 lbs/INCH MAX NAIL CAPACITY.

TOTAL FORCE $\frac{17.3 \times \left(\frac{132 - 4}{2}\right)}{2}$ = 553.6 lbs

MOMENT CAPACITY $\frac{553.1 \text{ lbs} \times 85.3"}{12}$ = 3917 FT lbs

MOMENT/FOOT (pg 1) 324 FT lbs NAIL JOINT OK

BROOKFIELD FLOAT BRIDGE

PANEL HANDLING w/ FORKLIFT

BENDING IN WOOD - CONSIDER ONLY ONE 2x6 IN EACH SET "EFFECTIVE"

$M_{(SET)}$ pg. 324 FT lbs/SET

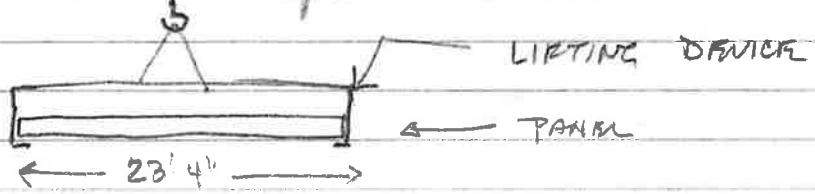
S_x SINGLE 2x6 $\frac{1\frac{1}{2} \times 5\frac{1}{2}^2}{6} = 7.56$

$f_b = \frac{324 \times 12}{7.56} = 514$ psi $F_{b\,allow}$ 1450 psi OK

OK TO HANDLE PANELS WITH FORKLIFT
w NOMINAL 6' LONG FORKS, SPREAD 48" o/o MIN
FORK CAPACITY MIN 2 TON

BROOKFIELD BRIDGE - 1 of 2

PANEL HANDLING W/ LIFTING DEVICE
FOR SETTING PANELS ON FLOATS



PANEL SUPPORTED AT ENDS DURING SETTING.

DESIGN HAS PANEL OVERHANGING FLOATS MAX 2"
DEVICE TO SUPPORT PANEL ON END 1½"

BEARING: TOTAL PANEL WEIGHT 2600 lbs
REACTION 1300 lbs

DEVICE 68" LONG

BEARING AREA $68 \times 1.5" = 102$ IN²

BEARING STRESS $\frac{1300}{102} = 12.7$ psi ok

PANEL BENDING. TOTAL PANEL . SIMPLE SPAN

$\frac{WL}{8} = \frac{2600 \times 23.33}{8} = 7582$ FT lbs

BENDING PER 'SET' $\frac{7582}{16} = 474$ FT lbs/SET

BECAUSE OF JOINTS IN 2x6's CONSIDER 1 of 3 2x6 LAMS 'EFFECTIVE' ∴

$f_b = \frac{474 \times 12}{7.56} = 752$ psi $\quad F_b = 1450$ psi 2x6 ok

NAILED LAP JOINT (AS CALC FOR FORKLIFT HANDLING pg 2 of 3) $M_{CAP} = 3917$ FT lbs/JNT

IS GREATER THAN 474 FT lbs/JNT

NAIL JOINT OK

TOWNSFIELD CORRIDOR

PANEL HANDLING W/ LIFT DEVICE

CHECK DEFLECTION SIMPLE SPAN

$\Delta = \frac{5 w l^4}{384 E I}$

CONSIDER PANEL 'SAT' ONE 2x6 'EFFECTIVE'

w 7 PLF → .6 lbs/INCH

l 23'4" → 280"

E 1.7×10^6

I 20.8 IN^4

$\frac{5 \cdot .6 \cdot 280^4}{384 \cdot 1.7 \cdot 10^6 \cdot 20.8}$

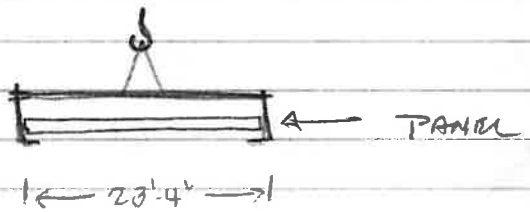
$\Delta = 1.35"$

THAT'S 1/207

WITH POSITIVE CAMBER FABRICATED IN Δ BELOW STRAIGHT LINE WILL BE MINIMAL (~ .6 OR 1/460)

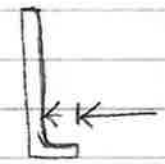
ok

BROOKFIELD BRIDGE
PANEL LIFTING DEVICE

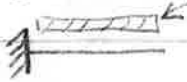


PANEL WEIGHT 2600
LIFT DEVICE SF x 1.25
DESIGN WEIGHT 3250 lbs REACTIONS 1625 lbs

END SUPPORTS
6 8" LONG



BENDING IF SUPPORTED AT CENTER AND LOAD SPREAD OVER 74"



$\frac{1625 \text{ lbs}}{\frac{2}{74"}} \rightarrow 22 \text{ lbs/inch}$

$M = 22 \times \frac{74}{2} \times \frac{\frac{74}{2}}{2} = 15031 \text{ IN lbs}$

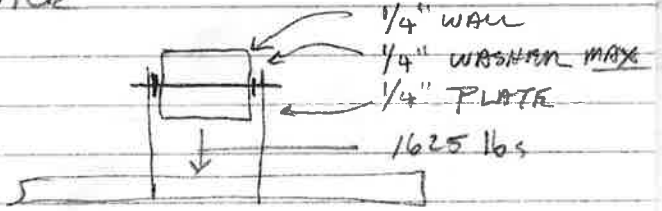
STEEL ANGLE CONSIDER ONLY VERTICAL PLATE
AND F_b 10,000 psi S_x req'd = 1.5 in^3

MIN THICKNESS 6" VERTICAL PLATE = $\frac{6 S_x}{h^2} = b = \frac{6 \cdot 1.5}{6^2} = .25"$

MIN THICKNESS 5" VERTICAL PLATE: $\frac{6 \cdot 1.5}{5^2} = .36"$ (3/8")

BROOFIELD BRIDGE
PANEL LIFTING DEVICE

ROD - BENDING -



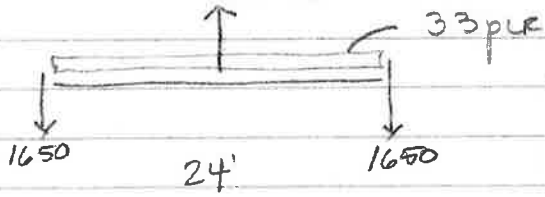
3/4"φ ROD/BOLT IN BENDING

$M = \frac{1625}{2} \times 1/2" = 406$ IN lbs

S_x 3/4"φ $= \frac{\pi d^3}{32} = \frac{\pi \, 3/4^3}{32} = .041 \text{ IN}^3$

$f_b = \frac{406}{.041} = 9900$ psi OK 3/4"φ A307

LIFTING 'BEAM'

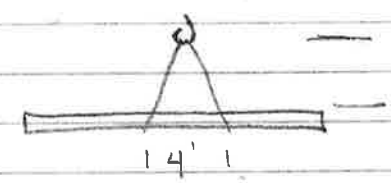


ASSUME 10x10x1/4"
32.6 PLF
S_x 30.1

M LOAD 1650 x 12 19800
M BEAM 33x12x12/2 2376
22176 FT lbs

$f_b = \frac{22176 \times 12}{30.1} = 8840$ psi $F_{b\,allow}$ 42 x .66 → 27.7 KSI
OK

ACTUAL SLINGS



LIMIT LENGTH SO AS TO LIMIT BOOM HEIGHT OF FORKLIFT.

TOTAL LOAD 3250 LOAD + 33x25 DEVICE + 200 MISC = 4275 lbs

OR CHOKER 8' LONG 1/2" 3200 lb cap x 2
BASKET 12' LONG 5/16"φ 3000 lb cap x 2

BROOKFIELD BRIDGE
PANEL LIFTING DEVICE

BENDING IN OUTSTANDING LEG OF END SUPPORT

$M = 1625 \times 1.75 = 2845$ in lbs

$S_{x\ MIN\ 10,000} = .28$ in^3 MIN

SOLVE FOR THICKNESS $\sqrt{\frac{6\ S_x}{b}} = h$

$\sqrt{\frac{6 \cdot .28}{68}} = h = .157"$ THICK

THIS IS LESS THAN REQUIRED FOR VERTICAL PLATE

VERIFY 3/4" ϕ A307 ROD (OR BOLT) WILL SUPPORT REACTION

DOUBLE SHEAR BOLT CAPACITY TABLE 11.9K

BEARING ϕR_N ϕ .75

.75 6.75 $R_N = F_y dt$

= 5 K / SURFACE 36 3/4 1/4

X 2 SURFACES $R_N = 6.75$

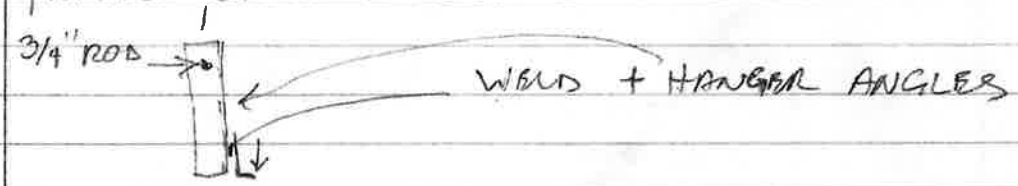
10K CAPACITY

HANGER LOAD IS REACTION OF 1625 lbs

3/4" ϕ A307 BOLT OR ROD OK IN 1/4" METAL

BROOKFIELD BRIDGE

PANEL LIFTING DEVICE



LOAD 1625 1/4" MIN METAL
3/16" FILLET WELD

WITH 700 lbs / 1/16 / INCH FOR FILLET WELD

MINIMUM WELD TOTAL $\frac{1625}{3 \times 700} = 1"$

MINIMUM WELD SIZE 1 1/2"

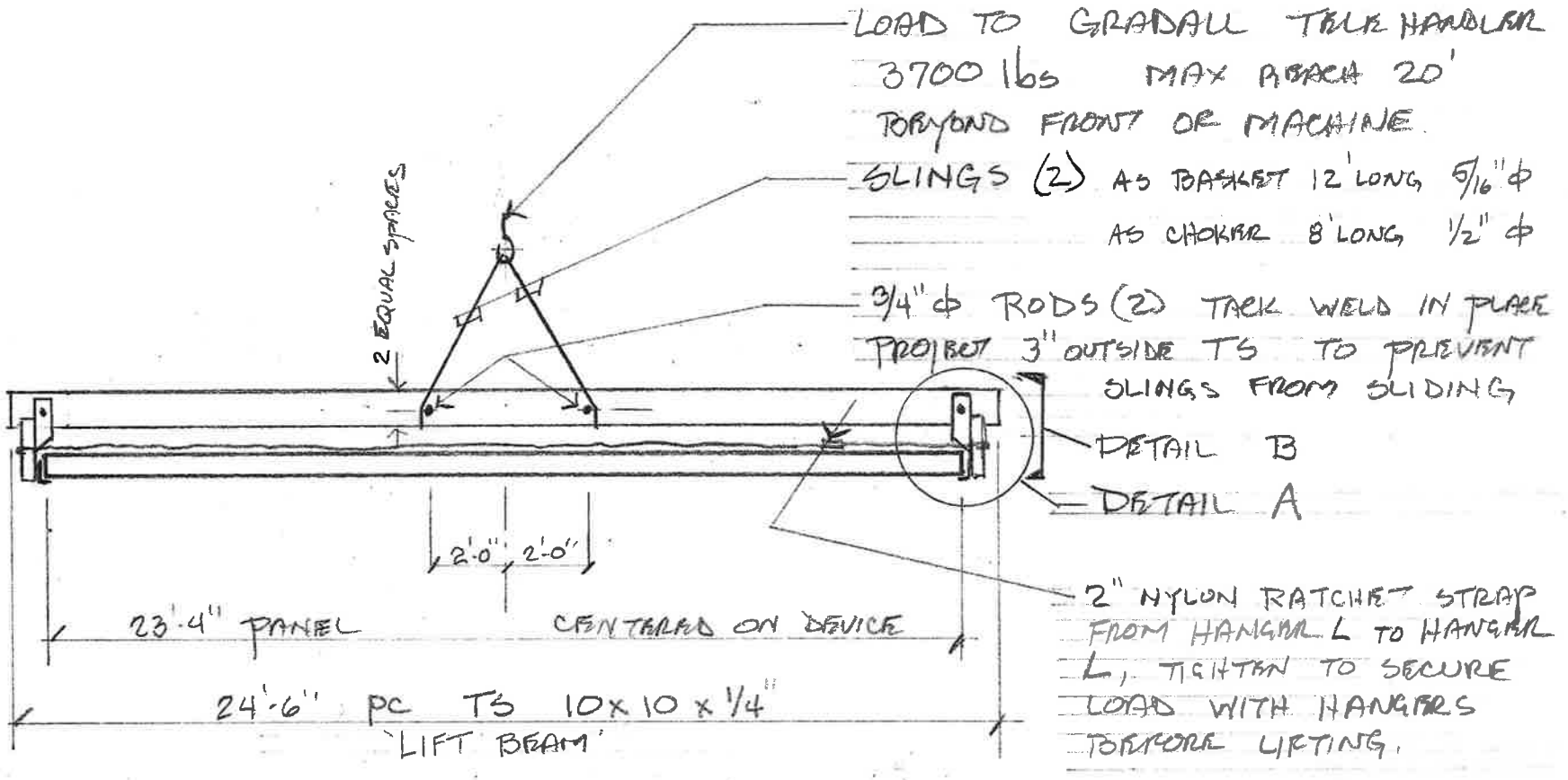
HANGER 4's MIN 3 x 3 x 1/4" BY INSPECTION

BROOKFIELD BRIDGE 1 pg
PANEL HANDLING w/ DEVICE.

LOAD:	PANEL	2600	lbs
	DEVICE FOAM 33x25	825	lbs
	MISC ANGLES + SLINGS	275	lbs est
TOTAL LOAD		3700	lbs

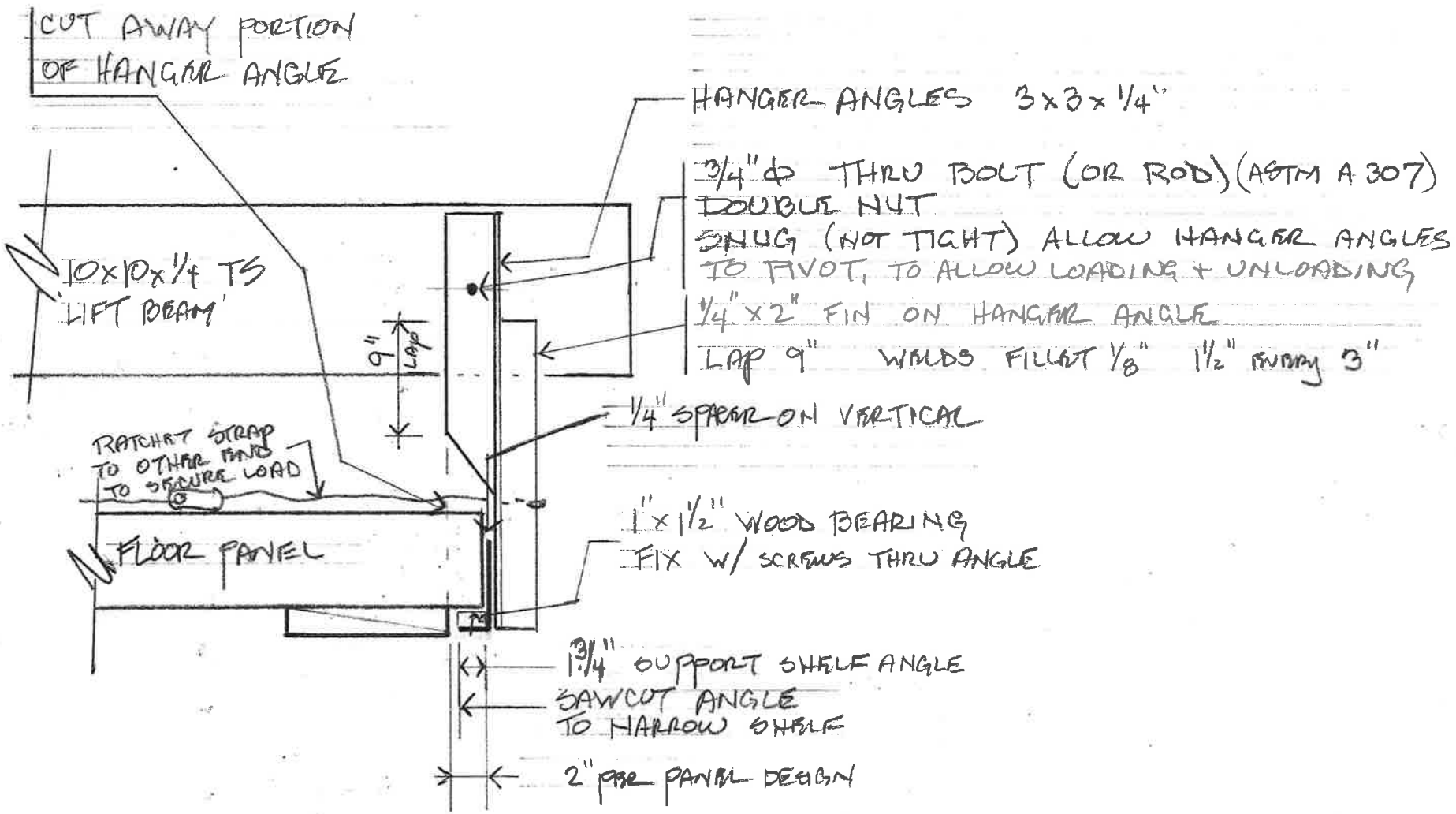
GRADAL TELEHANDLER 534D9-45
RATED FOR 4000 lbs TO
ABOUT 20' IN FRONT OF MACHINE

THAT MEANS MACHINE CAN
REACH OVER 2 FULL PANELS AND
SET 3RD PANEL AT ~15' REACH
SAFELY.



Floor Panel Lifting Device
Overall Elevation
Scale 1/4" = 1' 0" +-
For: Wright Construction Company
Mount Holly VT 802 259 2094

Brookfield Floating Bridge Project
DWG 1 of 3
6/30/13
By: David Skidmore PE
Castleton VT 802 353 4120



Floor Panel Lifting Device
Detail A Elevation
Scale 1 1/2" = 1' 0" +-
For: Wright Construction Company
Mount Holly VT 802 259 2094

Brookfield Floating Bridge Project
DWG 2 of 3
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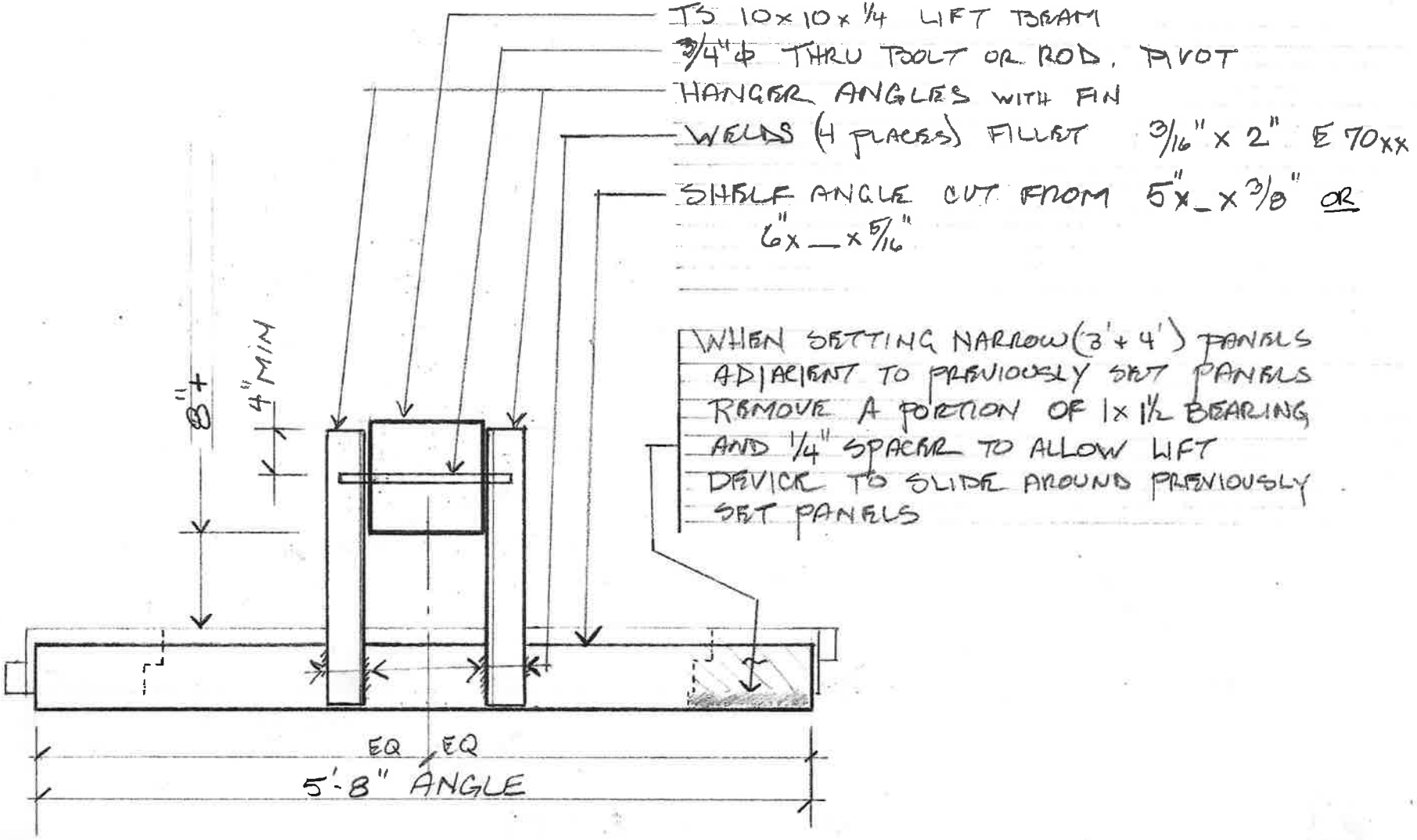

Floor Panel Lifting Device
Detail B End Elevation
Scale 1" = 1' 0" +-
For: Wright Construction Company
Mount Holly VT 802 259 2094

Brookfield Floating Bridge Project
DWG 3 of 3
6/30/13
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