$(21^2+28^2)^{1/2} = 35$

KOHLI & KALIHER ASSOCIATES, INC.
ENGINEERS AND SURVEYORS
2244 Baton Rouge Ave., Lima, Ohio 45805

Form #2

Calculations For Logan County CR 21-1.00
Load Rating Analysis

Computed By THH Date 2-10-11 Sheet 3 of 8
Checked By DGB Date 7-30-11

1 $L_0 U_1$ (2 Ea) C 10 X 15.3
(1 Ea) $\left(\frac{3/8 \times 15\ 1/8}{144}\right) 490\ \#/ft^3$
$= 19.3\ \#/ft$
$2(15.3) + 19.3 = 49.9\ \#$
use 52.5 See Section Properties sheet
~~49.9~~ $(14^2+21^2)^{1/2} = ~~1259.42~~$ 1325 #

2 $L_1 U_1$ 2 Ea $\left(\frac{1.75}{12}\right)\left(\frac{0.50}{12}\right) + \frac{\pi(0.5)^2}{144}$
$= 0.017\ ft^2$
$0.017\ ft^2 \left(\frac{490\ \#}{ft^3}\right) = 8.55\ \#/ft$
$8.55(21) = 179.60\ \#$

3 $U_1 L_2$ 2 Ea $\left(\frac{2.5}{12}\right)\left(\frac{0.625}{12}\right) 490\ \#/ft^3$
$= 10.63\ \#/ft$
$10.63(14^2+21^2)^{1/2} = 268.29\ \#$

4 $L_2 U_2$ C 6 X 8.2
(2)(8.2) = 16.4 #/ft
use 18.2 See Section Properties sheet
~~16.4~~ (21) = 383 ~~344.4~~ #

5 $U_1 L_3$ 2 Ea $\left(\frac{2.5}{12}\right)\left(\frac{0.625}{12}\right) 490\ \#/ft^3$
$= 10.63\ \#/ft$
~~10.63~~ $(21^2+28^2)^{1/2} = 372.05$ ok

6 $L_3 U_3$ C 5 X 6.7
2(6.7) = 13.4 #/ft
use 17.0 See Sect. Properties sheet
~~13.4~~ (21) = 357 ~~281.4~~

7 $U_2 L_4$ 2 Ea $\left(\frac{2.5}{12}\right)\left(\frac{0.5}{12}\right) 490\ \#/ft^3 =$
$= 8.51\ \#/ft$
$8.51(21^2+28^2)^{1/2} = 297.85$

8 $L_3 U_5$ $\left(\frac{1}{12}\right)^2 490\ \#/ft^3 =$
$= 3.40\ \#/ft$
$3.40(21^2+28^2)^{1/2} = 119.10\ \#$

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Calculations For Logan County CR21-1.00
Load Rating Analysis

Computed By THH Date 2-10-11 Sheet 4 of 8
Checked By DGB Date 7-30-11

9 L_4U_4 C5X6.7 $2(6.7) = 13.4\ \#/ft$ Use 17 See Sec. Properties Sheet ~~13.4~~ #/ft (21') = 357 ~~281.4~~ #

10 ~~L_4U_4~~ U_4L_4 7/8" Dia Bar

$2\left(\frac{7/16}{12}\right)^2 \pi = 1.20\ in^2$

$1.20\left(\frac{490\ \#/ft^3}{144\ in^2/ft^2}\right) = 4.08\ \#/ft$

$(21^2+28^2)^{1/2}(4.08\ \#/ft) = 142.8\ \#$

~~13~~ 11 U_3L_5 $2\ Ea\left(\frac{1.75}{12}\right)\left(\frac{0.5}{12}\right)490\ \#/ft^3$

$= 5.95\ \#/ft$

$5.95(21^2+28^2)^{1/2} = 208.25\ \#$

12 L_5U_5 C5X6.7 $2(6.7) = 13.4\ \#/ft$ Use 17 See Sec. properties sheet ~~13.4~~ #/ft (21') = 357 ~~281.4~~ #

14 ~~L_4U_4~~ U_4L_4 $\left(\frac{1.125}{12}\right)^2(490\ \#/ft^3)$

$= 4.31\ \#/ft$

$4.31\ \#/ft\ (21^2+28^2)^{1/2} = 150.73\ \#$

Tc1 TC (2 Ea) C10X15.3

$1\ Ea\left(\frac{3/8 \times 15\ 1/8}{144}\right)490\ \#/ft^3$

$= 19.3\ \#/ft$

$2(15.3)+19.3 = 49.9\ \#$

Use 52 ~~49~~ (14) = 728 ~~698.6~~ #

BC1
BC2 L_0L_1 & $L_1'L_2$ $1\ Ea\left(\frac{3/4 \times 3}{12 \quad 12}\right)490 = 15.31(14) = 214.38\ \#$

BC3 L_2L_3 $2\ Ea\left(\frac{3/4 \times 3.5}{12 \quad 12}\right)490 = 17.86(14) = 250.04\ \#$

KOHLI & KALIHER ASSOCIATES, INC.
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Calculations For Logan County CR21-100 Load Rating Analysis

Computed By THH Date 2-10-11 Sheet 5 of 8

Checked By DG3 Date 7-30-11

B<4 $L_3\ L_4$ $2\left(\frac{4\frac{1}{4}}{12} \times \frac{7/8}{12}\right) 490\ (14)\ \cancel{22.71}\ 25.31 = \cancel{317.87\#}\ 355\#$

BC5 $L_4\ L_5$ $2\left(\frac{5}{12} \times \frac{1}{12}\right) 490\ (14)\ 34.03 = 476.39\#$

WT. TOP STRUT: $2 - C\ 4 \times 5.4 \Rightarrow (2)\left(5.4\ \frac{LBS}{LF}\right)(16.7') = 179\ LBS$

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ENGINEERS AND SURVEYORS
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Form #2

Calculations For Logan County - CR 21-100
Load Rating Analysis

Computed By THH Date 2-10-11 Sheet 4 of 8
Checked By JGS Date 7-30-11

D_L@L_0 Truss: $\frac{L_0U_1}{2} + \frac{L_0L_1}{2} = \frac{1325}{1259.42} + \frac{214.38}{2} = 770$ ~~736.9~~

Guardrail: 7.9 (14.0/2) = 55.3

~~792.2~~
825.3

D_L@U_1

$\frac{L_0U_1}{2} + \frac{U_1L_2}{2} + \frac{U_1L_3}{2} + \frac{U_1U_2}{2} + U_1L_1$ (+ ½ Top Strut)

R on

$\frac{1325}{1259.42} + \frac{286.29}{2} + \frac{372.05}{2} + \frac{698.6}{2} + \frac{150 + 150}{2} = 1611$ ~~1308.18~~ #

D_L@L_1

$\frac{L_0L_1}{2} + \frac{L_1L_2}{2} + $ ~~L_1U_1~~

$\frac{214.38}{2} + \frac{214.38}{2} +$ ~~179.60~~ = 215 ~~393.98~~ #

Guard Rail = 7.9 #/ft (14) = 110.6
Asphalt = ~~580 #/ft~~ (650) ½ (14) = ~~4,060~~ 4550
Timber Deck = (330 #/ft) ½ (14) = 2,310
Floor Beam = 1018.81/2 = 509.41
Stringer = (146.88 #/ft) ½ (14) = 1028.16

~~8018.17~~
8509
215
~~+393.98~~
~~8412.15~~ #
8724 #

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Form #2

Calculations For Logan County CR21-100
Load Rating Analysis

Computed By THH Date 2-10-11 Sheet 7 of 8
Checked By DGB Date 7-30-11

D_L @ L_2

GR + Asphalt + Deck + Floor Beam + Stringer = ~~8018.17~~ 8509

Truss: $\frac{L_1L_2}{2} + \frac{L_2L_3}{2} + \frac{U_1L_2}{2} + L_2U_2$

$\frac{214.38}{2} \quad \frac{250.04}{2} \quad \frac{268.29}{2} + ~~344.4~~ 383 = ~~710.76~~ 750\#$

~~8728.93~~ 9259

D_L @ U_2

$\frac{U_1U_2}{2} + \frac{U_2U_3}{2} + \frac{U_2L_4}{2} + \frac{1}{2}$ TOP STRUT

$\frac{~~698.6~~ 728}{2} + \frac{~~698.6~~ 728}{2} + \frac{297.85}{2} + \frac{180}{2} = ~~847.53~~ 967\#$

D_L @ U_3

$\frac{U_2U_3}{2} + \frac{U_3U_4}{2} + \frac{U_3L_5}{2} + \frac{1}{2}$ TOP STRUT

$\frac{~~698.6~~ 728}{2} + \frac{~~698.6~~ 728}{2} + \frac{208.25}{2} + \frac{180}{2} = ~~802.73~~ 922\#$

D_L @ L_3

GR + Asphalt + Deck + Floor Beam + Stringers = ~~8018.17~~ 8509

Truss: $\frac{L_2L_3}{2} + \frac{L_3L_4}{2} + \frac{U_1L_3}{2} + \frac{L_3U_5}{2} + L_3U_3 =$

$\frac{250.04}{2} + \frac{~~317.87~~ 355}{2} + \frac{372.05}{2} + \frac{119.10}{2} + ~~281.4~~ 357 = ~~810.93~~ 905\#$

~~8829.1~~ 9414

D_L @ L_4

GR + Asphalt + Deck + Floor Beam + Stringers = ~~8018.17~~ 8509

Truss: $\frac{L_3L_4}{2} + \frac{L_4L_5}{2} + \frac{U_2L_4}{2} + \frac{L_4U_6}{2} + L_4U_4 =$

$\frac{~~317.87~~ 355}{2} + \frac{476.39}{2} + \frac{297.85}{2} + \frac{~~142.8~~ 151}{2} + ~~281.4~~ 357 = ~~645.60~~ 798\#$

~~8663.77~~ 9507

KOHLI & KALIHER ASSOCIATES, INC.
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Calculations For Logan County CR21-1.00
Load Rating Analysis

Computed By THH Date 2-10-11 Sheet 8 of 8
Checked By DGB Date 2-30-11

DL @ U4

$$\frac{U_3U_4}{2} + \frac{U_4U_5}{2} + \frac{U_4L_6}{2} + \tfrac{1}{2}\text{TYP STRUT} =$$

$$\frac{728}{\cancel{698.6}} + \frac{728}{\cancel{698.6}} + \frac{143}{\cancel{150.73}} + \frac{150}{2} = \cancel{773.97}\ \ 890\ \#$$

DL @ U5

$$\frac{U_4U_5}{2} + \frac{U_5U_6}{2} + \frac{L_3U_5}{2} + \frac{U_5L_7}{2} + \tfrac{1}{2}\text{TYP STRUT} =$$

$$\frac{728}{698.6} + \frac{728}{\cancel{698.6}} + \frac{119.0}{2} + \frac{119.0}{2} + \frac{150}{2} = \cancel{817.6}\ \ 937\ \#$$

DL @ L5

$$\frac{L_4L_5}{2} + \frac{L_5L_6}{2} + \frac{U_3L_5}{2} + \frac{L_5U_7}{2} + L_5U_5 =$$

$$\frac{476.39}{2} + \frac{476.39}{2} + \frac{208.25}{2} + \frac{208.25}{2} + \cancel{281.4}\ \ 357 = \cancel{966.04}\ \ 1042$$

GR + Asphalt + Deck + Floor Beam + Stringers = $\cancel{8018.17}$ $\cancel{8984.21}$ $\cancel{8569}$ 9531

FLOOR BEAM TO TRUSS CONNECTION ANALYSIS

KOHLI & KALIHER ASSOCIATES, INC.
ENGINEERS AND SURVEYORS
2244 Baton Rouge Ave., Lima, Ohio 45805

Calculations For LOGAN CO.; PLEASANT TWP.; CR21-1.00 OVER MIAMI RIVER
LOAD RATING ANALYSIS - FLOOR BEAM TO TRUSS CONNECTION

Computed By JGJ Date 6-6-11 Sheet 1 of 1
Checked By _____ Date _____

FLOOR BEAM TO TRUSS U BOLT CONNECTION:

CAPACITY 1"x1" SQ. HANGER BOLT:

ϕ INV. RATING $= (0.55)(26\text{ KSI})(1\text{ IN}^2)(2) = 28.6^k$

ϕ OPP RATING $= (0.75)(26\text{ KSI})(1\text{ IN}^2)(2) = 39.0^k$

$LR = \frac{\phi - DL}{LL+I}$

2FI INV. RATING $= \frac{28.6^k - 8.7^k}{20.0} = 0.995 \Rightarrow 14.9$ TON (19.9")

OPP RATING $\frac{39^k - 8.7^k}{20} = 1.51 \Rightarrow 22.7$ TON (30.3")

3FI INV RATING $= \frac{19.9^k}{28.7^k} = 0.70 \Rightarrow 16$ TON

OPP RATING $= \frac{30.3^k}{28.7^k} = 1.06 \Rightarrow 24.4$ TON

4FI INV RATING $= \frac{19.9^k}{29.8^k} = 0.67 \Rightarrow 18$ TON

OPP RATING $= \frac{30.3^k}{29.8^k} = 1.01 \Rightarrow 27.4$ TON

5C1 INV. RATING $= \frac{19.9^k}{27^k} = 0.73 \Rightarrow 29.5$ TON

OPP RATING $= \frac{30.3^k}{27^k} = 1.12 \Rightarrow 44.9$ TON

L7520 INV RATING $= \frac{19.9^k}{30.6^k} = 0.65 \Rightarrow 23.4$ TON

OPP RATING $= \frac{30.3^k}{30.6^k} = 0.99 \Rightarrow 35.6$ TON

DOES NOT CONTROL LOAD RATING

TIMBER DECK
LOAD RATING ANALYSIS

Timber Decking Load Rating

LOGAN CO PLEASANT TWP CR 21 OVER MIAMI RIVER

Decking			b (thickness)	d (depth)	A (in^2)	S (in^3)	I (in^4)		
Actual Board Width (in):	2.5	3X4 BOARDS USED			0	0	0	Stringer top flange width (in):	5.75
Span Length 'L' (ft):	2.75	3x6 Boards Used:	2.5	5.5	13.75	12.6041667	34.6614583		

Loading Type	Heavy Axle Load (kips)	Wheel Load (k)	Tire Contact Area (in^2)	Tire Distribution Parallel to Traffic (in)	Tire Distribution Transverse to traffic (in)	Number of boards tire rests on	Effective Wheel Load 'P' per board (k)	Mmax due to L.L. (k*ft)	Live Load Bending Stress, fb (psi) (using...) 3X4'S	Live Load Bending Stress, fb (psi) (using...) 3x6's	Live Load Compression Stress, fc perp. (psi) (using...) 3X4'S	Live Load Compression Stress, fc perp. (psi) (using...) 3x6's
H15-44	24	12	225	15	15	6	2	0.94270833	#DIV/0!	897.5	#DIV/0!	139.1
HS20-44	32	16	300	15	20	6	2.666666667	1.11805556	#DIV/0!	1064.5	#DIV/0!	185.5
School Bus	15.25	7.625	207.15	15	13.81	6	1.270833333	0.61476563	#DIV/0!	585.3	#DIV/0!	88.4
OH 2F1	20	10	237.15	15	15.81	6	1.666666667	0.77152778	#DIV/0!	734.5	#DIV/0!	115.9
OH 3F1	17	8.5	218.7	15	14.58	6	1.416666667	0.67394965	#DIV/0!	641.6	#DIV/0!	98.6
OH 4F1	14	7	198.45	15	13.23	6	1.166666667	0.57142361	#DIV/0!	544.0	#DIV/0!	81.2
OH 5C1	17	8.5	218.7	15	14.58	6	1.416666667	0.67394965	#DIV/0!	641.6	#DIV/0!	98.6
				AASHTO 3.25& 3.30	AASHTO 3.25& 3.30							

Allowable Stress for Dense Commercial No. 65 Southern Yellow Pine

	Design Value (psi)	Multipliers											F' values (psi)
		Cd	CM	Ct	CL	CF	CV	Cfu	Cr	Cc	Cf	Cb	
Fb'	1650												1650
Fc'perp.	440												440

Rating Factors

Loading Type	Bending Stress Rating Factor= (Allowable-DL(negligible))/(Live Load)		Compression Stress perp. to grain = (Allow.-DL(Neg.))/(Live Load Stress)	
	3X4'S	3x6's	2X3's	3x6's
H15-44	#DIV/0!	1.84	#DIV/0!	3.16
HS20-44	#DIV/0!	1.55	#DIV/0!	2.37
School Bus	#DIV/0!	2.82	#DIV/0!	4.98
OH 2F1	#DIV/0!	2.25	#DIV/0!	3.80
OH 3F1	#DIV/0!	2.57	#DIV/0!	4.46
OH 4F1	#DIV/0!	3.03	#DIV/0!	5.42
OH 5C1	#DIV/0!	2.57	#DIV/0!	4.46

DOES NOT CONTROL LOAD RATING

Loading Type	Vehicle Gross Load (Tons)	Bending Stress Allowable Gross Load (tons)= rating factor*Gross veh. Weight		Compression Stress perp. to grain = Rating factor* Gross Veh. Weight	
		3X4'S	3x6's	3X4'S	3x6's
H15-44	15	#DIV/0!	27.58	#DIV/0!	47.44
HS20-44	36	#DIV/0!	55.80	#DIV/0!	85.39
School Bus	13	#DIV/0!	36.65	#DIV/0!	64.70
OH 2F1	15	#DIV/0!	33.69	#DIV/0!	56.93
OH 3F1	23	#DIV/0!	59.14	#DIV/0!	102.69
OH 4F1	27	#DIV/0!	81.89	#DIV/0!	146.38
OH 5C1	40	#DIV/0!	102.86	#DIV/0!	178.59

DOES 5-C-11

TURN BUCKLE WELD TO DIAGONAL LOAD RATING ANALYSIS

KOHLI & KALIHER ASSOCIATES, INC.
ENGINEERS AND SURVEYORS
2244 Baton Rouge Ave., Lima, Ohio 45805

Calculations For LOGAN CO.; PLEASANT TWP; C21-1.00 OVER MIAMI RIVER
TURNBUCKLE WELD ANALYSIS

Computed By DGB Date 8-12-11 Sheet 1 of 3
Checked By _____ Date _____

LOOK AT TURNBUCKLE TO WELDED TO DIAG. REPAIRS:

U1L1 - SOUTH TRUSS FROM SOUTH

U1L1 => 2 - 1 3/4 x 1/2" BARS

12.5" ONE BAR

$F_{BAR\ INV} = (2)(1.75)(.5)(.55)(26\ KSI) = 25^K$ TWO BARS

$F_{BAR\ OPP} = (2)(1.75)(.5)(.75)(26\ KSI) = 34.1^K$ TWO BARS

17 K ONE BAR

F STRENGTH 7/8" ϕ BAR - F_y = 32 KSI

$F_{BAR\ INV} = (0.6\ in^2)(.55)(32) = 11.9^K$ ONE BAR

$F_{BAR\ OPP} = (0.6\ in^2)(.75)(32) = 14.2^K$ ONE BAR

STRENGTH OF WELD:

SAY E70 WELD:

$F_{INV.} = (\frac{1}{4})(.707)(18\ KSI) = 0.795^K/_{in}\ (2) = 1.59^K/_{in}$ 1/4 WELD

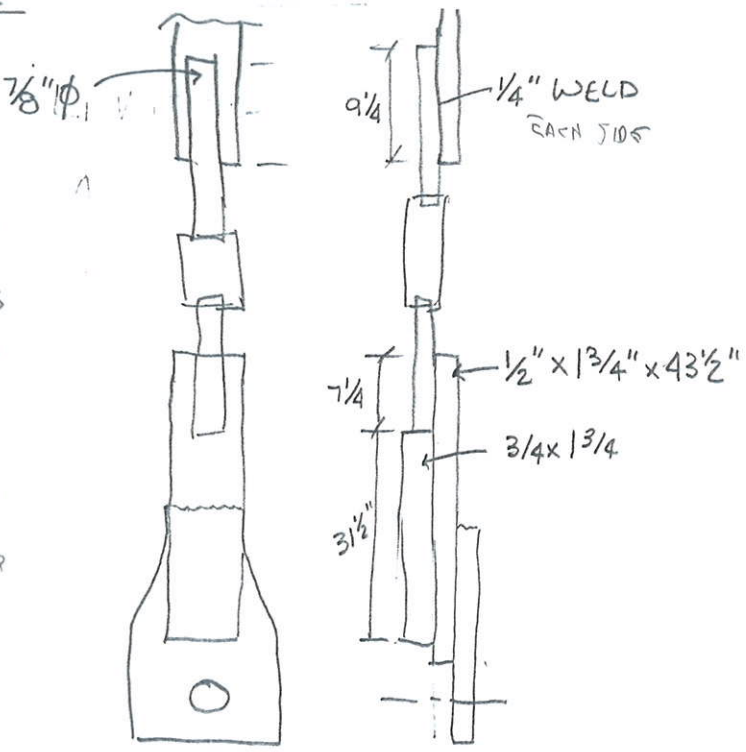
$F_{OPP} = (\frac{.75}{.55})(1.59) = 2.16^K/_{in}$ - 1/4" WELD

$F_{WELD\ INV} = (8.25)(1.59)(2) = \underline{29.4^K} > 12.5^K$

$F_{WELD\ OPP} = (8.25)(2.16)(2) = \underline{40^K} > 17^K$

WELD IS STRONGER THAN 1 3/4 x 1/2" BAR F_y = 20 KSI

BUT 7/8" ϕ Rod - 32 KSI IS NOT STRONGER THUS ADJUST U1L1 LOAD RATING.



L1 SOUTH TRUSS
FROM WEST

KOHLI & KALIHER ASSOCIATES, INC.
ENGINEERS AND SURVEYORS
2244 Baton Rouge Ave., Lima, Ohio 45805

Calculations For LOGAN CO.; PLEASANT TWP; C21-1.00 OVER MIAMI RIVER TURN BUCKLE WELD ANALYSIS

Computed By _____ Date _____ Sheet 2 of 3

Checked By _____ Date _____

U1L1 LOAD RATING ADJUSTMENT DUE TO 7/8" ϕ BAR SPLICE

U1L1	DL	LL+I
2F1	8.7"	20"
3F1	↓	28.5"
4F1		29.8"
5C1		27"
HS20	8.7"	30.6"

ORIGINAL MEM

2F1 R_{INV} $\frac{\text{<- DL}}{\text{LL+I}} = \frac{(12.5" + 11.9") - 8.7"}{20"} = \frac{15.7}{20} = 0.78\,(15\text{ Ton}) = \underline{11.7\text{ Ton}}$ VS $(.81)(15) = 12.1\text{ Ton}$

2F1 R_{OPP} $= \frac{(17 + 14.2) - 8.7}{20"} = \frac{24.5}{20} = 1.22\,(15) = \underline{18.3\text{ Ton}}$ VS $(1.27)(15) = 19\text{ Ton}$

3F1 $R_{INV} = \left(\frac{15.7}{28.5}\right) = 0.55\,(23) = \underline{12.6\text{ Ton}}$ VS $(.57)(23) = 13.1\text{ Ton}$

3F1 $R_{OPP} = \frac{24.5}{28.5} = (0.85)(23) = \underline{19.7\text{ Ton}}$ VS $(.89)(23) = 20.5\text{ Ton}$

ORIGINAL MEM

4F1 $R_{INV} = \frac{15.7}{29.8} = (0.52)(27) = \underline{14.2\text{ Ton}}$ VS $(.547)(27) = 14.7\text{ Ton}$

4F1 $R_{OPP} = \frac{24.5}{29.8} = (0.82)(27) = \underline{22.2\text{ Ton}}$ VS $(.853)(27) = 23\text{ Ton}$

5C1 $R_{INV} = \frac{15.7}{27} = (0.58)(40) = \underline{23.2\text{ Ton}}$ VS $(0.603)(40) = 24.1\text{ Ton}$

5C1 $R_{OPP} = \frac{24.5}{27} = (0.91)(40) = \underline{36.3\text{ Ton}}$ VS $(0.94)(40) = 37.6\text{ Ton}$

HS20 $R_{INV} = \frac{15.7}{30.6} = (0.51)(36) = \underline{18.4\text{ Ton}}$ VS $(.532)(36) = 19.1\text{ Ton}$

HS20 $R_{OPP} = \frac{24.5}{30.6} = (0.80)(36) = \underline{28.8\text{ Ton}}$ VS $(.83)(36) = 29.9\text{ Ton}$

KOHLI & KALIHER ASSOCIATES, INC.
ENGINEERS AND SURVEYORS
2244 Baton Rouge Ave., Lima, Ohio 45805

Calculations For LOGAN Co.; PLEASANT Twp; C 21-1.00 OVER MIAMI RIVER
TURN BUCKLE WELD

Computed By DEJ Date 8-12-11 Sheet 3 of 3
Checked By 3 Date

LOOK AT SPLICE AT L5:

$1\frac{3}{4} \times \frac{1}{2}$"
MEM L5 U7 => SAME FORCES AS U3 L5

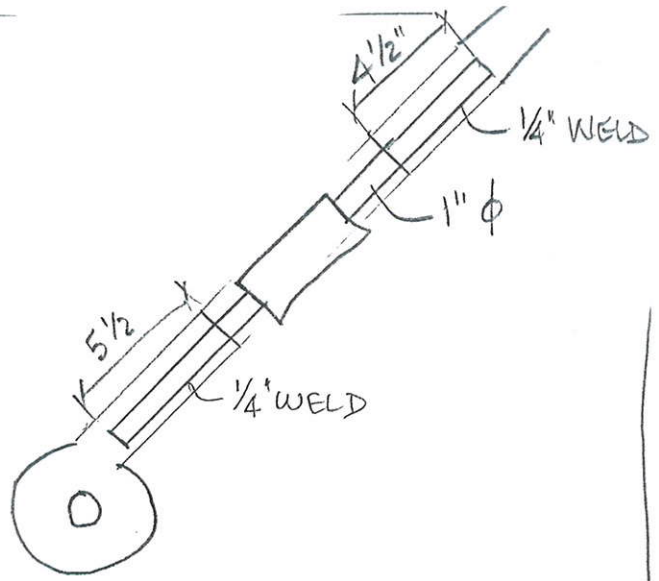
F BAR INV = (2)(1.75)(.5)(.55)(24 KSI) = 25 K TWO BARS

F BAR OPP = (2)(1.75)(.5)(.75)(24 KSI) = 34.1 K TWO BARS

F STRENGTH 1"φ BAR Fy = 36 KSI

F BAR INV = π(.5)²(.55)(36) = 15.55 K > ORIG BAR OK

F BAR OPP = π .5² (.75)(36) = 21.2 K > ORIG BAR OK



L5 INSIDE DIAG BAR
SOUTH TRUSS FROM WEST

CH WELD STRENGTH:

SAY E60 WELD

F INV = $(\frac{1}{16})(.707)(18\ KSI)(2)$ = 1.59 K/IN 1/4" WELD

F OPP = $(\frac{.75}{.55})$ 1.59 K/IN = 2.17 K/IN 1/4 WELD

F WELD INV = (4.5)(2)(1.59) = 14.3 K > 12.5 K ORIGINAL BAR

F WELD OPP = (4.5)(2)(2.17) = 19.53 K > 17 K ORIGINAL BAR

REPAIR IS OK - USE ORIGINAL BAR RATING

TRUSS GEOMETRY AND JOINT/MEMBER DESIGNATION FOR ANALYSIS

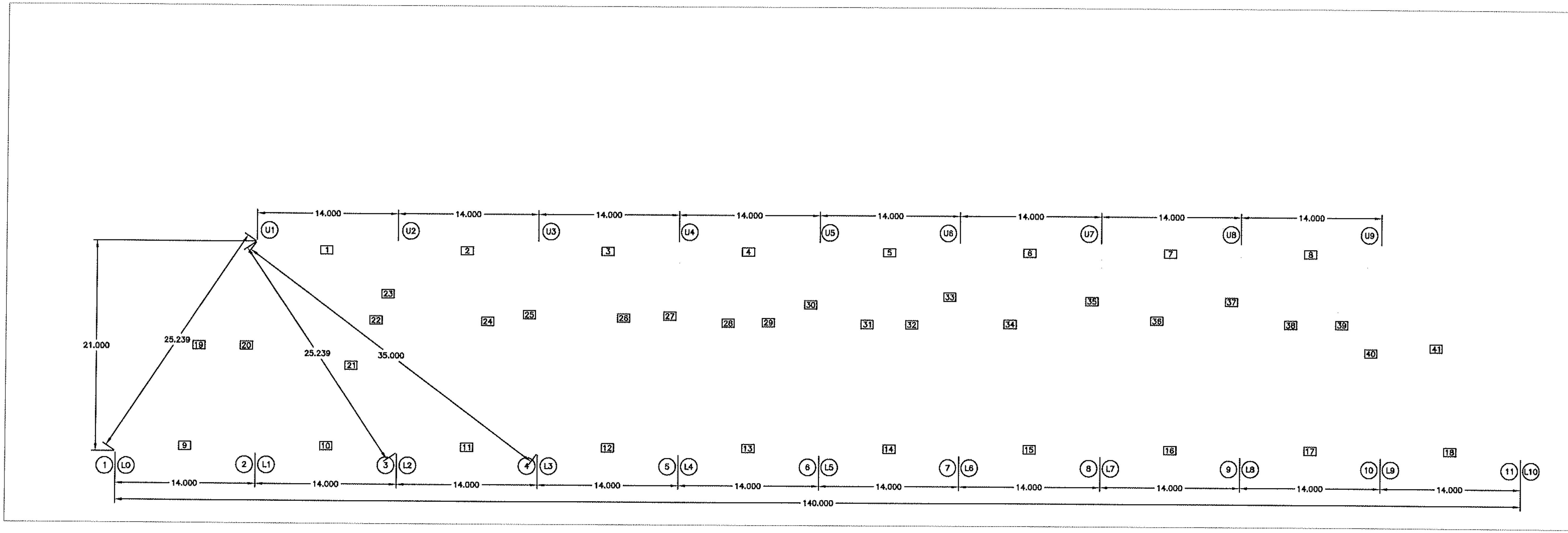
KOHLI & KALIHER ASSOCIATES, INC.
ENGINEERS AND SURVEYORS
2244 Baton Rouge Avenue, Lima, Ohio 45805
419-227-1135

STRUCTURE FILE NUMBER: 4631838

INVENTORY FILE NUMBER: LOG T-21

JOINT NUMBER: TRUSS ELEV

DATE: 08-09-11 DRAWN BY: JRH



PIN CONNECTION DETAILS AND ANALYSIS

KOHLI & KALIHER ASSOCIATES, INC.
ENGINEERS AND SURVEYORS
2244 Baton Rouge Ave., Lima, Ohio 45805

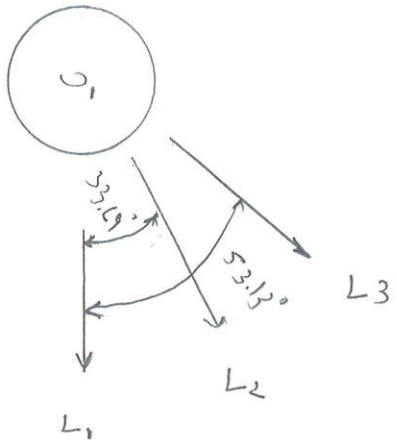
Calculations For LOGAN COUNTY; PLEASANT TWP.; C21-1.00 OVER MIAMI RIVER
PIN CONNECTION ANALYSIS

Computed By JCG Date 8-11-11 Sheet 1 of 8

Checked By _____ Date _____

CK PIN CONNECTION @ U1:

U1L1	DL	LL+I
2F1	8.7"	20"
3F1	8.7"	28.5"
4F1	8.7"	29.8"
5C1	8.7"	27.0"
HS20	8.7"	30.6"



U1L2	DL	LL+I	DL ↓	DL →	LL+I ↓	LL+I →
2F1	43.5"	22.6"	36.19	24.13	18.8"	10.42"
3F1	43.5"	34.1"			28.37"	15.74"
4F1	43.5"	39.3"			32.7"	18.14"
5C1	43.5"	48.7"			40.52"	22.48"
HS20	43.5"	51.3"	36.19	24.13	42.68"	23.67

U1L3	DL	LL+I	DL ↓	DL →	LL+I ↓	LL+I →
2F1	43.27	27.6"	25.96"	34.62"	16.56"	22.1"
3F1		41.4"			24.9"	33.2"
4F1		47.7"			28.6"	38.2"
5C1		57.27"			34.4"	45.8"
HS20	43.27	61.98"	25.96"	34.62"	37.2"	49.6"

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Calculations For LOGAN CO.; PLEASANT TWP; C21-1.00 OVER MIAMI RIVER
PIN CONNECTION ANALYSIS

Computed By JCG Date 8-11-11 Sheet 2 of 8
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CH PIN CONNECTION U1 CONT.:

NOTE: USE DL FOR MEMBERS U1L1+U1L2 AND U1L3 ⇒ MAX PIN DL SHEAR

USE MAX LL+I FOR MEMBERS U1L1 AND U1L2 ⇒ MAX PIN LL+I SHEAR
TRUCKS ARE NOT LONG ENOUGH TO CREATE MAX LL IN ALL THREE MEM AT SAME TIME.

MAX DL↓ = $5.7^k + 36.19 + 25.96^k = 70.9^k \downarrow$

MAX DL→ = $24.13^k + 34.62^k = 58.75^k \rightarrow$

$R_{MAX\,DL} = [70.9^2 + 58.75^2]^{1/2} = \underline{92.07^k}$ ↘

MAX LL+I:

2F1 = $\{(20^k + 18.8^k)^2 + (10.42)^2\}^{1/2} = \underline{40.2^k}$ ↓

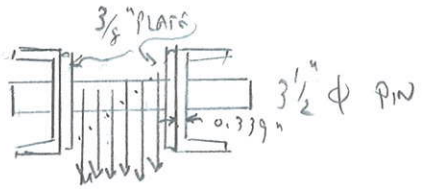
3F1 = $\{(28.5 + 28.37)^2 + 15.74^2\}^{1/2} = \underline{59.0^k}$ ↘

4F1 = $\{(29.8 + 32.7)^2 + 18.14^2\}^{1/2} = \underline{65.1^k}$ ↘

5C1 = $\{(27 + 40.5)^2 + 22.48^2\}^{1/2} = \underline{71.1^k}$ ↓

1+S2D = $\{(30.6 + 42.68)^2 + 23.67^2\}^{1/2} = \underline{77.0^k}$ ↘

CHECK PIN SHEAR + PLATE TOP CHORD



INV ALLOW PIN SHEAR = $\pi R^2 F_{INV} = (\pi (1.75)^2 1.4)(22\,ksi) = \underline{100^k}$ / SHEAR PLANE

OPP ALLOW PIN SHEAR = $\pi R^2 F_{OPP} = \pi (1.75)^2 (1.33)(22\,ksi) = \underline{137.6^k}$ / SHEAR PLANE

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Calculations For LOGAN CO.; PLEASANT TWP; C21-1.06 OVER MIAMI RIVER
PIN CONNECTIONS ANALYSIS

Computed By DGJ Date 5-11-11 Sheet 3 of 8

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CH PIN SHEAR @ FACE TOP CHORD CONT:

2 FI R_{INV} Pin Shear = $\frac{(100^{\#})(2)^{(2\text{ Shear Planes})} - 92.07^{\#}}{40.2} = 2.68\ (15) = 40.2$ Ton

2 FI R_{OPP} " = $\frac{(137.6)(2) - 92.07}{40.2} = 4.55\ (15) = 68$ Ton

3 FI R_{INV} Pin Shear = $\frac{107.93^{\#}}{59^{\#}} = (1.82)(23) = 42$ Ton

3 FI R_{OPP} " = $\frac{183.1}{59} = (3.1)(23) = 71$ Ton

4 FI R_{INV} Shear = $\frac{107.93}{65.1} = (1.67)(27) = 44.7$ Ton

4 FI R_{OPP} Shear = $\frac{183.1}{65.1} = (2.81)(27) = 75.9$ Ton

5 CI R_{INV} " = $\frac{107.93}{71.1} = (1.51)(40) = 60$ Ton

5 CI R_{OPP} " = $\frac{183.1}{71.1} = (2.57)(40) = 103$ Ton

H520 R_{INV} = $\frac{107.93}{77.0} = (1.40)(36) = 50.4$ Ton

H520 R_{OPP} Pin Shear = $\frac{183.1}{77} = (2.38)(36) = 85.6$ Ton

U1 PIN SHEAR DOES NOT CONTROL LOAD RATING

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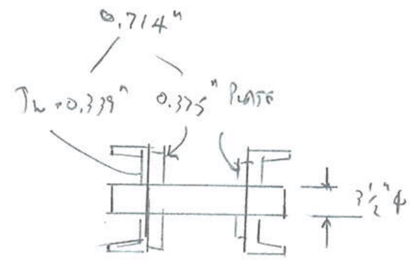
Form #2

Calculations For: LOGAN Co.; PLEASANT TWP; C 21-1.00 OVER MIAMI RIVER

Computed By: DGB   Date: 8-11-11   Sheet 4 of 8
Checked By: ______   Date: ______

CK PIN CONNECTION @ U1 CONT.:

CK PIN BEARING ON TOP CHORD:



BRG σ_B ALLOW INV = (0.8)(26) = 20.8 KSI

BRG σ_B ALLOW OPP = (.9)(26) = 23.4 KSI

2F1 R INV BRG = $\dfrac{(2)(0.714")(3.5")(20.8\ KSI) - 90.07^k}{40.2^k}$ = (0.35)(15) = **5.2 TON** (circled: 104^k, 14^k)

2F1 R opp BRG = $\dfrac{(2)(0.714)(3.5")\ 23.4\ KSI - 90.07}{40.2^k}$ = (0.67)(15) = **10 TON** (circled: 117^k, 27^k)

3F1 R INV BRG = $\dfrac{14}{59}$ = (0.24)(23) = **5.5 TON**

3F1 R OPP BRG = $\dfrac{27}{59}$ = (.457)(23) = **10.5 TON**

4F1 R INV BRG = $\dfrac{14}{65.1}$ = (.215)(27) = **5.8 TON**

4F1 R opp BRG = $\dfrac{27}{65.1}$ = (.415)(27) = **11.2 TON**

5G1 R INV BRG = $\dfrac{14}{71.1}$ = (.197)(40) = **7.9 TON**

5G1 R opp BRG = $\dfrac{27}{71.1}$ = (.38)(40) = **15.2 TON**

H 520 R INV BRG = $\dfrac{14}{77}$ = (.182)(36) = **6.5 TON**

H 520 R opp BRG = $\dfrac{27}{77}$ = (.351)(36) = **12.6 TON**

PIN CONNECTION @ U1 DOES NOT CONTROL LOAD RATING - BUT IT IS CLOSE TO CONTROLLING.

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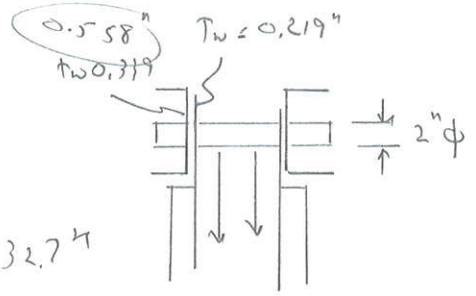
Calculations For LOGAN Co.; PLEASANT TWP; C21-1.00 OVER MIAMI RIVER
PIN CONNECTION ANALYSIS

Computed By JGB Date 8-12-11 Sheet 5 of 8
Checked By _____ Date _____

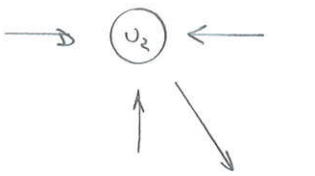


CH PIN CONNECTION @ U2:

CH PIN SHEAR:

INV ALLOW PIN SHEAR = $(\pi)(1^2)(.4)(27\text{KSI}) = 32.7^K$

OPP ALLOW PIN SHEAR = $\pi 1^2 (.5)(27\text{KSI}) = 44.9^K$



2F1 R_{INV} Pin Shear = $\frac{(32.7)(2) - 26.1}{23.7} = (1.07)(15) = 24.8$ Ton (39.3)

2F1 R_{OPP} = $\frac{(44.9^K)(2) - 26}{23.7} = (2.09)(15) = 40.4$ Ton (63.8)

U2L4	DL	LL+I
2F1	26.1K	23.7K
3F1	26.1K	35.6K
4F1	26.1K	40.77K
SC1	26.1K	47K
HS20	26.1K	52.8K

3F1 $R_{INV} = \left(\frac{39.3}{35.6}\right) = (1.1)(23) = 25.3$ Ton

3F1 $R_{OPP} = \left(\frac{63.8}{35.6}\right) = (1.79)(23) = 41.2$ Ton

4F1 $R_{INV} = \left(\frac{39.3}{40.77}\right) = (0.96)(27) = 26$ Ton

4F1 $R_{OPP} = \frac{63.8}{40.77} = (1.56)(27) = 42.2$ Ton

SC1 INV = $\frac{39.3}{47} = (0.83)(40) = 33.4$ Ton

SC1 OPP = $\frac{63.8}{47} = (1.35)(40) = 54.3$ Ton

HS20 INV = $\frac{39.3}{52.8} = (0.74)(36) = 26.8$ Ton

HS20 OPP = $\frac{63.8}{52.8} = (1.20)(36) = 43.5$ Ton

U2 PIN BRG CONT.:

3F1 INV = $\frac{20.32}{35.6} = (0.57)(23) = 13.1$ Ton

3F1 OPP = $\frac{26.1}{35.6} = (0.73)(23) = 16.9$ Ton

4F1 INV = $20.32/40.77 = 0.5(27) = 13.4$ Ton

4F1 OPP = $26.1/40.77 = (0.64)(27) = 17.3$ Ton

SC1 INV $20.32/47 = (0.43)(40) = 17.3$ Ton

SC1 OPP $26.1/47 = (0.52)(40) = 22.2$ Ton

HS20 INV $20.32/52.8 = (0.38)(36) = 13.8$ Ton

HS20 OPP $26.1/52.8 = (.49)(36) = 17.8$ Ton

CH PIN BRG ON TOP CHORD: (20.32) (46.42)

2F1 $R_{INV} = \frac{(2)(29)(.558^{in})(20.8\text{KSI}) - 26.1}{23.7} = (0.86)(15) = 12.9$ Ton

2F1 $R_{OPP} = \frac{(2)(2)(.558)(23.4\text{KSI}) - 26.1}{23.7}$ (26.1K) $= (1.10)(15) = 16.5$ Ton

PIN U2 CONNECTION DOES NOT CONTROL LOAD RATING

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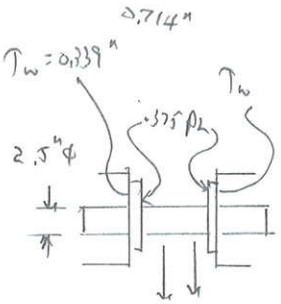
Calculations For LOGAN CO. ; PLEASANT TWP; C21-1.00 OVER MIAMI RIVER
PIN CONNECTION ANALYSIS

Computed By DCG Date 8-12-11 Sheet 6 of 8

Checked By _____ Date _____

NOTE: PINS U3, U4 AND U5 DO NOT CONTROL THE LOAD BY INSPECTION AS THE FORCES ARE LESS AND THE PIN & END BEARING AREA ARE THE SAME AS U2.



@ PIN LO SHEAR:

INV ALLOW PIN SHEAR = $\pi(1.25")^2(1.4)(22 ksi) = 51.0^k$ / SHEAR PLANE

OPP " " " = $\pi(1.25")^2(.55)(22 ksi) = 20.2^k$ / SHEAR PLANE

	DL	LLAT
2F1	31"	14.1"
3F1	31"	21.2"
4F1	31"	24.5"
5C1	31"	31"
HS20	31"	32"

2F1 $R_{INV} = \frac{(51.0)(2)-31}{14.1} = 5.0(1.5) = \underline{\underline{7.5 \text{ TON}}}$

HS20 $R_{INV} = \frac{(51)(2)-31}{32} = (2.2)(16) = \underline{\underline{50 \text{ TON}}}$

PIN SHEAR @ LO DOES NOT CONTROL LOAD RATING

@ PIN LO - BRG ON END POST:

INV. PIN BRG = $(1.8)(24)(.714")(2.5")(2) = 74.2^k$ / PIN

OPP PIN BRG = $(1.9)(24)(.714")(2.5")(2) = 83.5^k$ / PIN

2F1 $R_{INV} = \frac{74.2-31}{14.1} = (3.06)(15) = \underline{\underline{45.9 \text{ TON}}}$

2F1 $R_{OPP} = \frac{83.5-31}{14.1} = (3.72)(15) = \underline{\underline{55.8 \text{ TON}}}$

HS20 $R_{INV} = \frac{72.4-31}{32} = (1.29)(32) = \underline{\underline{46.6 \text{ TON}}}$

HS20 $R_{OPP} = \frac{83.5-31}{32} = (1.64)(32) = \underline{\underline{59 \text{ TON}}}$

PIN BRG @ LO DOES NOT CONTROL LOAD RATING

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Calculations For LOGAN Co ; PLEASANT Twp ; S21-1.00 OVER MIAMI RIVER
PIN CONNECTION ANALYSIS

Computed By DG Date 5-11-11 Sheet 7 of 8

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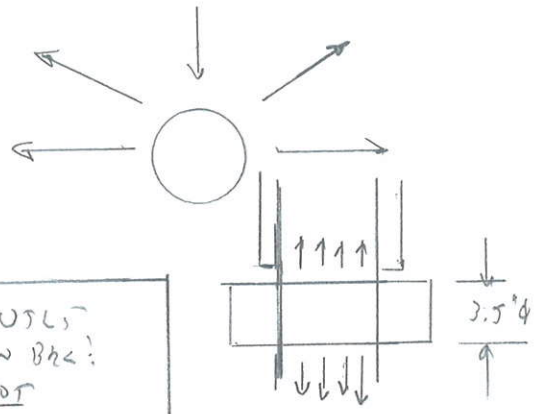
<n PIN SHEAR @ L5 U



NOTE; EACH DIAG AND LC MUST SHEAR TWO PLANES.

U5

U5 L5	DL	LL+I
2F1	-0.9"	-3.8"
3F1	-0.9"	-8.1"
4F1	-0.9"	-9.9"
5C1	-0.9"	-9.3"
H520	-0.9"	-14"

FORCES FROM U5 L5 ARE LOW - PIN SHEAR DO NOT CONTROL LOAD RATING

U3

L4 L5

U3 L5	DL	LL+I
2F1	8.74"	19.8"
3F1	↓	29.7"
4F1		33.7"
5C1		36.3"
H520	8.74"	43.4"

FB REACTION

L4 L5	DL	LL+I
2F1	82.9"	36.9"
3F1	↓	55.3"
4F1		64.4"
5C1		79.4"
H520	82.9	82.8"

FLOOR BEAM REACTION

	DL	LL+I
2F1	8.7"	20"
3F1	↓	28.5"
4F1		29.8"
5C1		27"
H520	8.7"	30.6"

ALLOW PIN SHEAR 3½" ϕ PN
INV = 100"/ SHEAR PLANE
OPP = 137"/ SHEAR PLANE
} SEE PG 2

$$R_{INV\ H520} = \frac{(100)(2) - (82.9/2)}{82.8/2} = 3.8\ (36) = 137\ Tons$$

$$R_{OPP\ H520} = \frac{(137)(2) - 82.9/2}{(82.8/2)} = (5.41)(36) = 202\ Tons$$

PIN SHEAR @ L5 DOES NOT CONTROL LOAD RATING

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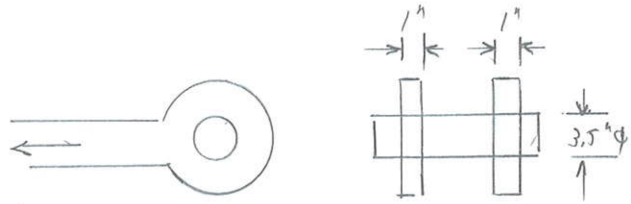
Form #2

Calculations For: LOGAN CO.; PLEASANT TWP; C21-1.00 OVER MIAMI RIVER
PIN CONNECTION ANALYSIS

Computed By: DEB Date: 8-11-11 Sheet 8 of 8
Checked By: ______ Date: ______

CK PIN BRG LT:



See Pg 4

$$2F1\ R\ INV\ BRG = \frac{20.8^{KSI}(1)(3.5) - (82.9/2)}{36.9^{K}/2} = (1.7)(15) = \underline{25.5\ TON}$$

(72.8 − 41.45 = 31.35; 36.9/2 = 18.45)

$$2F1\ R\ OPP\ BRG = \frac{(23.4\ KSI)(1)(3.5) - 41.45}{18.45} = (2.19)(15) = \underline{32.9\ TON}$$

(40.45)

$$HS20\ R\ INV\ BRG = \frac{31.35}{(82.8/2)} = (0.76)(36) = \underline{27.4\ TON}$$

$$HS20\ R\ OPP\ BRG = \frac{40.45}{82.8/2} = (0.97)(36) = \underline{35.2\ TON}$$

PIN LT BRG DOES <u>NOT</u> CONTROL STRUCT LOAD RATING

HAND CALCULATIONS FOR RATING OF WHIPPLE DIAGONALS U1L3; U2L4; U3L5; U4L6; L3U5; AND L4U6 USING BARS 7 ANALYSIS RESULTS