DICKINSON WRIGHT PLLC

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COLUMBUS, OH 43215-3192
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CHRISTINE M.T. PIRIK
CPIRIK@DICKINSONWRIGHT.COM
(614) 591-5461

February 5, 2018

Ms. Barcy F. McNeal, Secretary
Ohio Power Siting Board
Docketing Division
180 East Broad Street, 11th Floor
Columbus, OH 43215

Re: Case No. 13-197-EL-BGN, 16-1687-EL-BGA, and 17-1099-EL-BGA
Trishe Wind Ohio, LLC
Compliance with Condition 6 Substation Issued for Construction Drawings

Dear Ms. McNeal:

Trishe Wind Ohio, LLC ("Applicant") is certified to construct a wind-powered electric generation facility in Paulding County, Ohio ("Project"), in accordance with the December 16, 2013 Opinion, Order, and Certificate ("Certificate") issued by the Ohio Power Siting Board.

Condition 6 of the Certificate requires the Applicant to submit to staff for review and acceptance, one set of detailed engineering drawings of the final project design, including the facility, temporary and permanent access roads, and any crane routes, construction staging areas, and any other associated facilities and access points.

At this time, we are filing the issued for construction drawings for the Project substation in compliance with Condition 6 of the Certificate.

We are available, at your convenience, to answer any questions you may have.

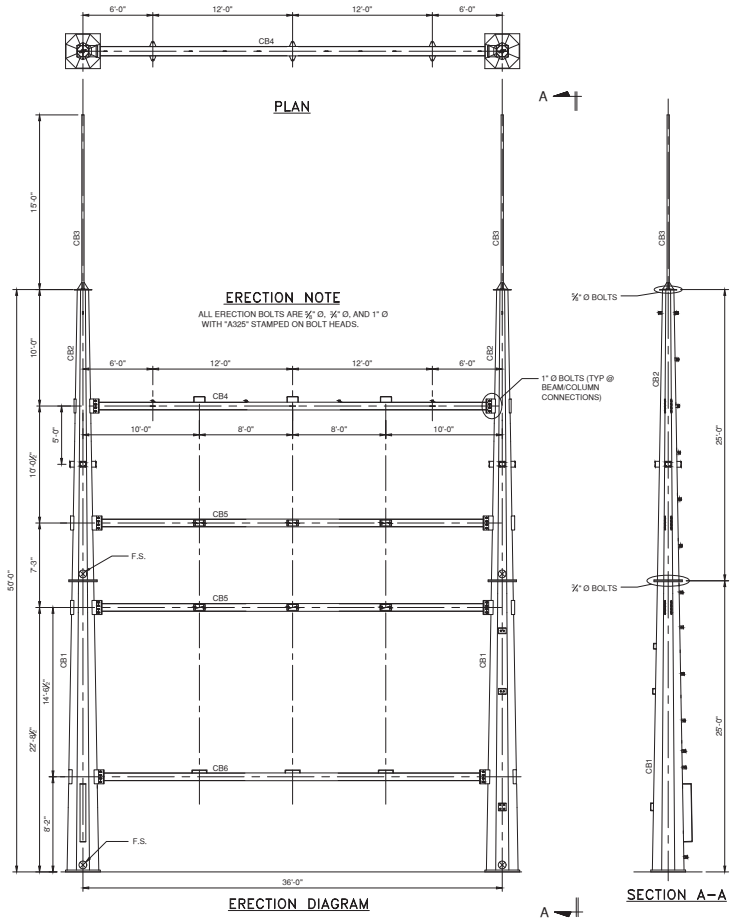
Respectfully submitted,

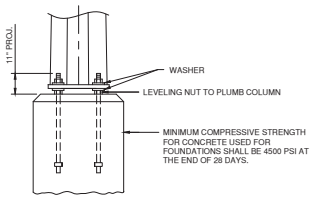
/s/ *Christine M.T. Pirik*
Christine M.T. Pirik (0029759)
Terrence O'Donnell (0074213)
William V. Vorys (0093479)
Dickinson Wright PLLC
150 East Gay Street, Suite 2400
Columbus, Ohio 43215

Attorneys for Trishe Wind Ohio, LLC

Enclosure
CMTP:ap

COLUMBUS 73809-1 83490v3





FOUNDATION DETAIL

NOTES:

1. MATERIAL:
   - W-SHAPES — ASTM A-992
   - HSS-SHAPES — ASTM A-500 Gr B
   - C & L-SHAPES — ASTM A-36
   - CONNECTION PLATES — ASTM A-36
   - BASE PLATES — ASTM A-572 Gr 50
   - STRUCTURAL PLATES — ASTM A-36

   GALVANIZING: ASTM A-123 & A-385
   FABRICATION & INSPECTION: AISC
   ERECTION BOLTS: ASTM A-325
2. ALL HOLES ¾" DIA. UNLESS OTHERWISE NOTED.
3. ALL SEPARATE PIECES ARE TO BE DISTINCTLY MARKED WITH THEIR NUMBERS CORRESPONDING TO THE DRAWINGS. THE NUMBERS ARE TO BE STAMPED INTO THE MATERIAL BEFORE FINISHING WITH STAMPING DIES ⅞" HIGH IN SUCH A MANNER AS TO BE READILY VISIBLE AFTER FINISHING. THE NUMBER SHALL BE STAMPED NEAR THE END OF THE PIECE.
4. ALL LONGITUDINAL WELDS TO HAVE 80% MIN. PENETRATION WITH FULL PENETRATION FOR LAST 6 INCHES ON EACH END.
5. EXTERNAL FACTORED LOADS ON STRUCTURE NOT TO EXCEED 3000 LBS. PER PHASE AND 1500 LBS. PER SHIELD WIRE @ 15° MAX ANGLE AND SHALL MEET NESC MEDIUM LOADING CONDITIONS.

LIST OF MATERIAL

STRUCTURES NUMBER REQUIRED ITEMS SHIPPED	STRUCTURES NUMBER REQUIRED SHOP ASSY	ONE STRUCTURE NUMBER REQUIRED ITEMS SHIPPED	ONE STRUCTURE NUMBER REQUIRED SHOP ASSY	DESCRIPTION	MARK	SHEET	WEIGHT PER PIECE
		2		WELDED ASSEMBLY	CB1	002	
			4	PL ⅜" x 52⅝" x 24'-9" (BENT)	aa		1661
			2	PL 2" x 36" x 3'-0" (A572)	ab		736
			2	PL 1" x 28" x 2'-4"	ac		222
			4	MC6 x 15.1 x 0'-8"	ad		10
			14	PL ¼" x 2½" x 0'-2⅝"	af		1
			2	PL ½" x 8" x 1'-2⅝" (BENT)	ag		16
			4	PL ¾" x 14½" x 2'-6⅛"	bd		94
			4	PL ¾" x 14½" x 3'-0⅛"	bf		111
			2	PL ⅜" x 6" x 6'-2⅛" (BENT)	bg		48
		2		WELDED ASSEMBLY	CB2	003	
			2	PL 1" x 28" x 2'-4"	ac		222
			14	PL ¼" x 2½" x 0'-2⅝"	af		1
			4	PL ⅜" x 36" x 24'-10½" (BENT)	ba		1142
			2	PL ½" x 13" x 1'-6"	bb		33
			4	PL ¾" x 14½" x 2'-0"	bc		74
			4	PL ¾" x 14½" x 2'-6⅛"	bd		94
			8	PL ¼" x 7¼" x 1'-3¾" (BENT)	be		8
		2		WELDED ASSEMBLY	CB3	004	
			2	3½"Ø STD. PIPE x 14'-11¼"	ca		136
			2	PL ½" x 13" x 1'-1"	cb		24
			4	PL ¼" x 4½" x 0'-7" (1 MAKES 2)	cc		2
			2	PL ¼" x 4" x 0'-4"	cd		1
		1		WELDED ASSEMBLY	CB4		
			4	PL ¼" x 2½" x 0'-2⅝"	af		1
			4	PL ¾" x 5" x 1'-2½"	lc		15
			3	PL ¾" x 6" x 1'-9"	ld		27
			2	4" x 10" STEEL SCREEN	lf		1
			2	PL ¾" x 13" x 1'-2⅝"	lg		40
			1	HSS 10 x 10 x ½" x 33'-4½"	ha		1599
			3	PL ½" x 12" x 1'-10½" (BENT)	hc		38
		2		WELDED ASSEMBLY	CB5		
			4	PL ¾" x 11" x 1'-2½"	lb		34
			8	PL ¾" x 5" x 1'-2½"	lc		15
			4	4" x 8" STEEL SCREEN	le		1
			2	HSS 8 x 8 x ½" x 32'-8½"	hb		844
			6	C 12 x 20.7 x 6"	hd		10
		1		WELDED ASSEMBLY	CB6		
			4	PL ¾" x 5" x 1'-2½"	lc		15
			2	4" x 10" STEEL SCREEN	lf		1
			2	PL ¾" x 13" x 1'-2⅝"	lg		40
			1	HSS 10 x 10 x ½" x 32'-2½"	he		1543
			3	PL ½" x 15½" x 1'-8½"	hf		45

NUMBER REQUIRED	NUMBER REQUIRED	GALV. BOLTS & WASHERS	WEIGHT PER HUNDRED	
	10	⅝" Ø x 2" HEX HD. W/ HEX NUT (A325)	37.4	
	40	⅝" Ø x 3" HEX HD. W/ HEX NUT (A325)	70.9	
	75	1" Ø x 3" HEX HD. W/ HEX NUT (A325)	141.0	
	16	½" Ø x 1½" HEX HD. W/ HEX NUT (A307)	11.5	LIGHT MTG.
	12	½" Ø x 2½" HEX HD. W/ HEX NUT (A307)	19.6	SA. MTG.
	15	⅝" Ø x 2¼" HEX HD. W/ HEX NUT (A307)	32.0	SW. MTG.
	15	SQUARE BEVELED WASHER W/ 1 1/16"Ø HOLES	12.0	SW. MTG.
	15	¾" Ø x 2½" HEX HD. W/ HEX NUT (A307)	41.6	CCVT. MTG.

STEEL	21,488#
BOLTS	155#
TOTAL	21,643#

NORTHWEST OHIO WIND PROJECT

PAULDING COUNTY, OHIO

Rev.	Date	Description	By
0A	10/19/17	PRELIMINARY	UEI
0B	1/25/18	ISSUED FOR CONSTRUCTION	UEI

WHITE an MEA company

ISSUED FOR CONSTRUCTION

STATE OF OHIO
MARTIN FELIX PADULA
E-80306
REGISTERED PROFESSIONAL ENGINEER
01-25-2018

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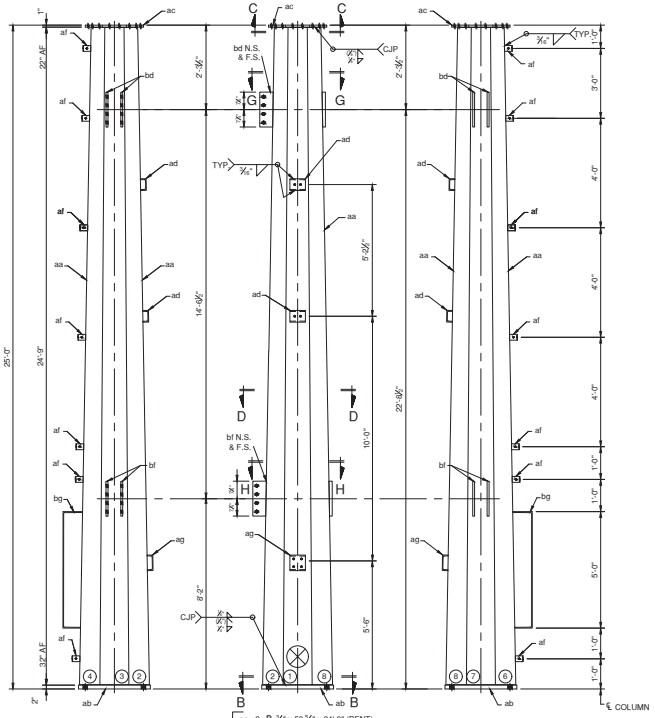
Fargo, North Dakota 58104
Phone: 701.280.8500
Fax: 701.237.3191
www.ulteig.com
We Make Westher
Bismarck - Denver - Detroit Lakes - Fargo - Sioux Falls - St. Paul

Design By: D. WEBER
Drawn By: V. LEE
Approved By: M. PADULA
Project Number: 17.01246

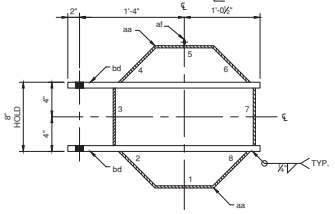
138/34.5KV PROJECT SUBSTATION 138kV DEADEND "CB" STEEL LAYOUT

DWG #: NWO-S1-001
REVISION: 0B

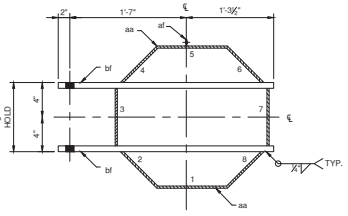


CB1

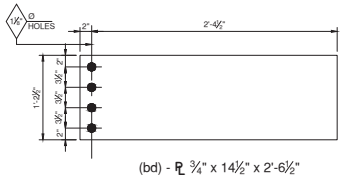
aa - 2 - PL ⅜" x 52'-9½" x 24'-9" (BENT)
ab - 1 - PL 2" x 36" x 3'-0" (A572)
ac - 1 - PL 1" x 28" x 2'-4"
ad - 2 - MC6 x 15.1* x 0'-8"
af - 7 - PL ¼" x 2½" x 0'-2½"
ag - 1 - PL ½" x 8" x 1'-2½" (BENT)
bd - 2 - PL ¾" x 14½" x 2'-6½"
bf - 2 - PL ¾" x 14½" x 3'-0½"
bg - 1 - PL ⅜" x 6" x 6'-2½" (BENT)



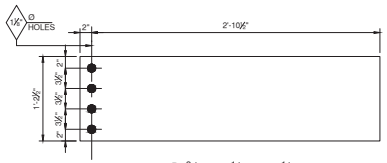
SECTION G-G



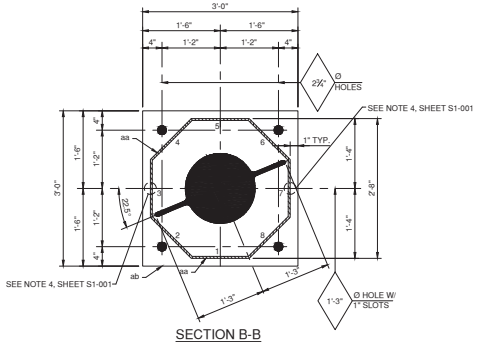
SECTION H-H



(bd) - PL ¾" x 14½" x 2'-6½"



(bf) - PL ¾" x 14½" x 3'-0½"



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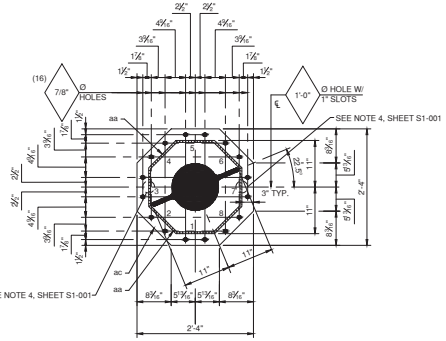

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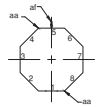

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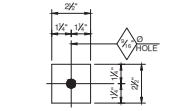
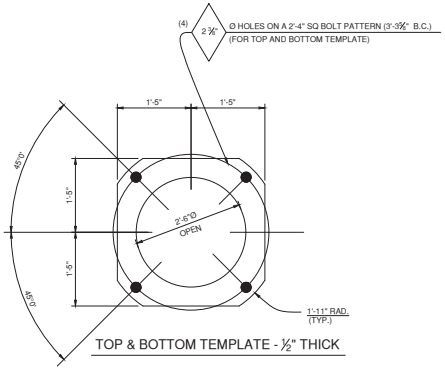
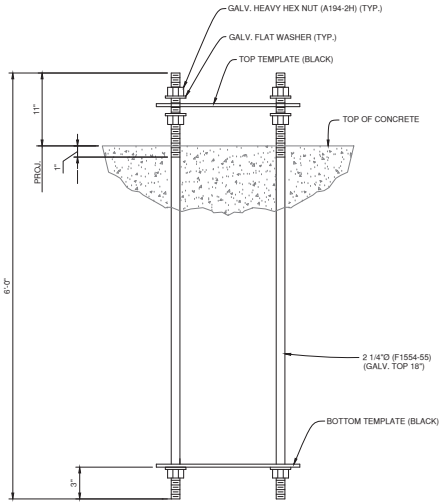
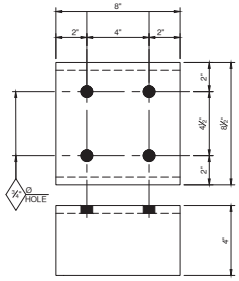


(af) - PL ¼" x 2½" x 0'-2½"

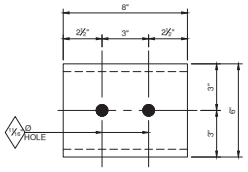


TOP & BOTTOM TEMPLATE - ½" THICK

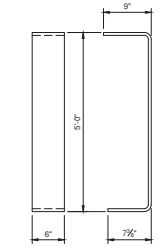




(ag) - PL ½" x 8" x 1'-2½" (BENT)



(ad) - MC6 x 15.1 x 0'-8"



(bg) - PL ⅜" x 6" x 6'-2½" (BENT)

NORTHWEST OHIO
WIND PROJECT

PAULDING COUNTY, OHIO

Rev.	Date	Description	By
0A	10/19/17	PRELIMINARY	UEI
0B	1/25/18	ISSUED FOR CONSTRUCTION	UEI

WHITE
an MEA company

NOTES:

1. ALL HOLES ¾" DIA. UNLESS OTHERWISE NOTED.

ISSUED FOR CONSTRUCTION

STATE OF OHIO
MARTIN FELIX PADULA
E-80306
REGISTERED
PROFESSIONAL ENGINEER
01-25-2018

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Fargo, North Dakota 58104
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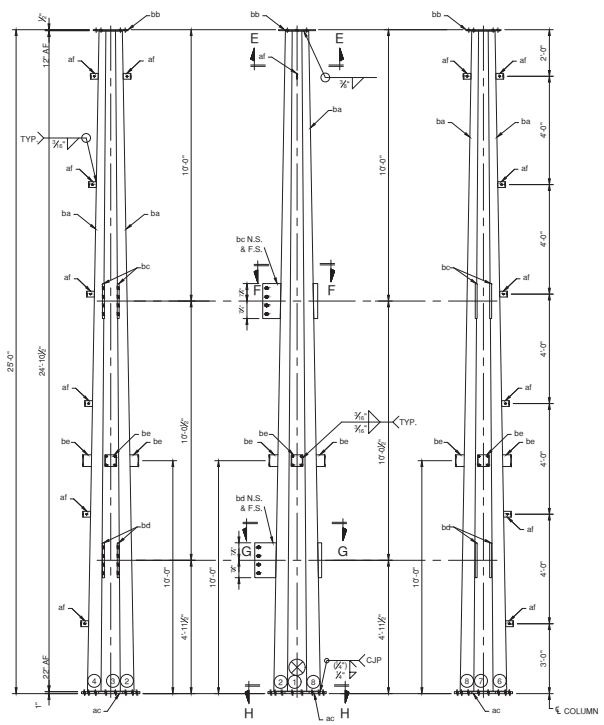
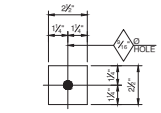
Bismarck - Denver - Detroit Lakes - Fargo - Sioux Falls - St. Paul

Design By: D. WEBER
Drawn By: V. LEE
Approved By: M. PADULA
Project Number: 17.01246

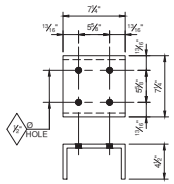
138/34.5KV
PROJECT SUBSTATION
138kV DEADEND "CB"
STEEL DETAILS

DWG #: NWO-S1-002
REVISION: 0B

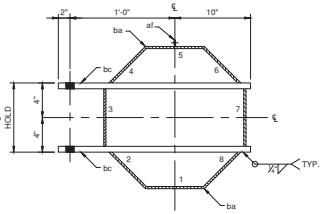




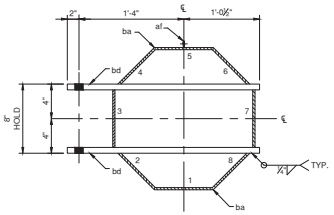
(af) - ℄ ¼" x 2½" x 0'-2½"



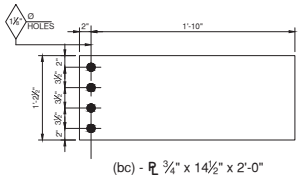
(be) - ℄ ¼" x 7¼" x 1'-3¾" (BENT)



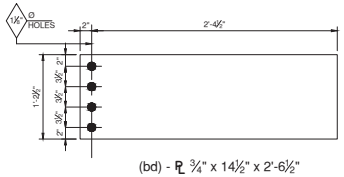
SECTION F-F



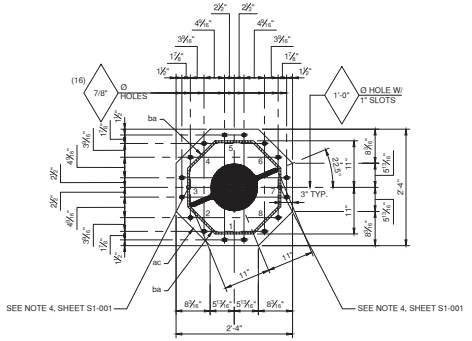
SECTION G-G



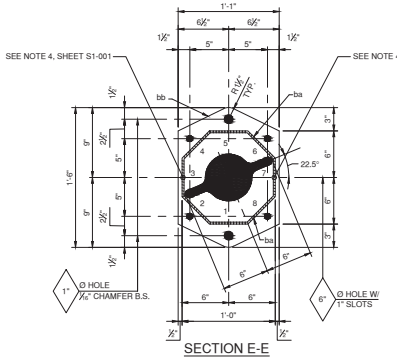
(bc) - ℄ ¾" x 14½" x 2'-0"



(bd) - ℄ ¾" x 14½" x 2'-6½"



SECTION H-H



SECTION E-E

NOTES:

1. ALL HOLES ¾" DIA. UNLESS OTHERWISE NOTED.

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Design By: D. WEBER
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Approved By: M. PADULA
Project Number: 17.01246

NORTHWEST OHIO WIND PROJECT

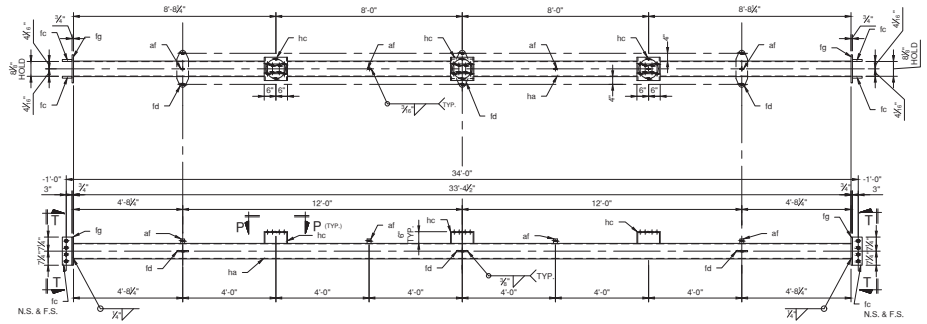
PAULDING COUNTY, OHIO

Rev.	Date	Description	By
0A	10/19/17	PRELIMINARY	UEI
0B	1/25/18	ISSUED FOR CONSTRUCTION	UEI

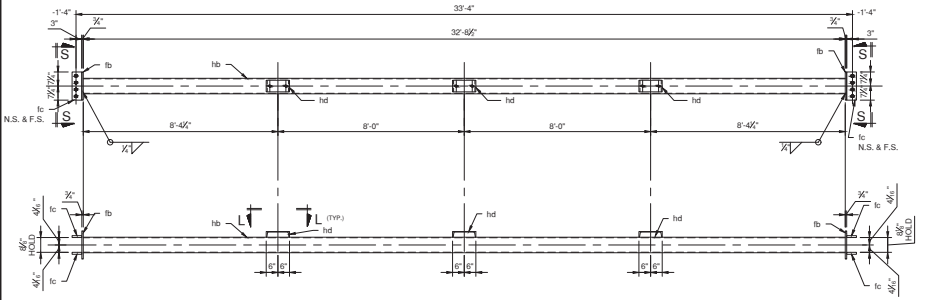
138/34.5KV
PROJECT SUBSTATION
138kV DEADEND "CB"
STEEL DETAILS

DWG #: NWO-S1-003

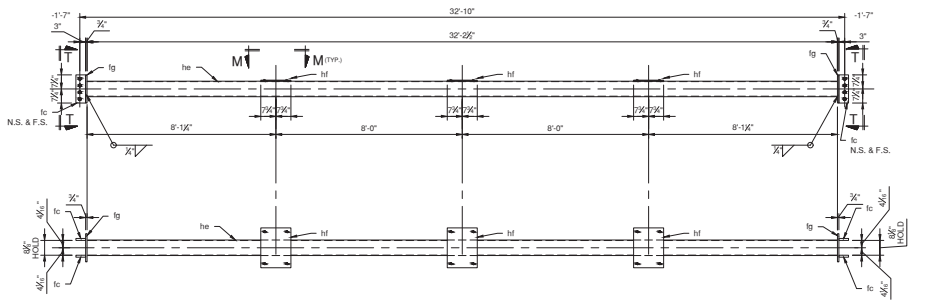
REVISION: 0B



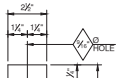
CB4
af - 4 - PL ¼" x 2½" x 0'-2½"
fc - 4 - PL ¾" x 5" x 1'-2½"
fd - 3 - PL ¾" x 6" x 1'-9"
ff - 2 - 4" x 10" STEEL SCREEN
fg - 2 - PL ¼" x 13" x 1'-2½"
ha - 1 - HSS 10 x 10 x ⅜" x 33'-4½"
hc - 3 - PL ½" x 12" x 1'-10½" (BENT)



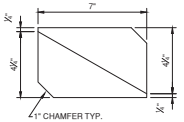
CB5
fb - 2 - PL ¾" x 11" x 1'-2½"
fc - 4 - PL ¾" x 5" x 1'-2½"
fe - 2 - 4" x 8" STEEL SCREEN
hb - 1 - HSS8x8 x ½" x 32'-8½"
hd - 3 - C12x20.7 x 6"



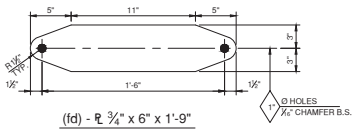
CB6
fc - 4 - PL ¾" x 5" x 1'-2½"
ff - 2 - 4" x 10" STEEL SCREEN
fg - 2 - PL ¼" x 13" x 1'-2½"
he - 1 - HSS 10 x 10 x ½" x 32'-2½"
hf - 3 - PL ½" x 15½" x 1'-6½"



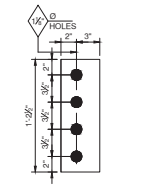
(af) - PL ¼" x 2½" x 0'-2½"



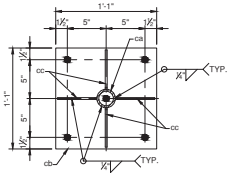
(cc) - PL ¼" x 4½" x 0'-7" (1 MAKES 2)



(fd) - PL ¾" x 6" x 1'-9"



(fc) - PL ¾" x 5" x 1'-2½"



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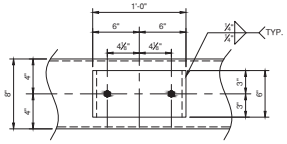

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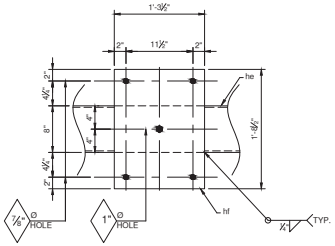

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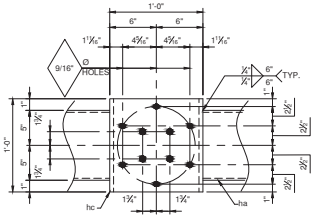

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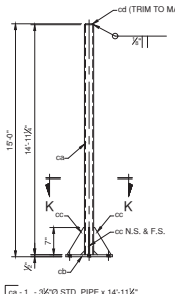
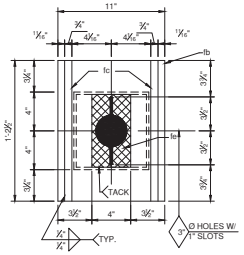
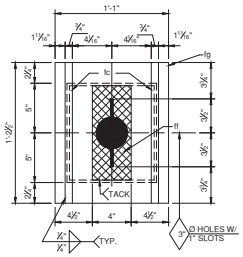


CB3
ca - 1 - ¾"Ø STD. PIPE x 14'-11¼"
cb - 1 - PL ½" x 13" x 1'-1"
cc - 2 - PL ½" x 4½" x 0'-7" (1 MAKES 2)
cd - 1 - PL ½" x 4" x 0'-4"



SECTION S-S



SECTION T-T

NORTHWEST OHIO
WIND PROJECT

PAULDING COUNTY, OHIO

Rev.	Date	Description	By
0A	10/19/17	PRELIMINARY	UEI
0B	1/25/18	ISSUED FOR CONSTRUCTION	UEI

WHITE
an MEA company

NOTES:
1. ALL HOLES ¾" DIA. UNLESS OTHERWISE NOTED.

ISSUED FOR CONSTRUCTION

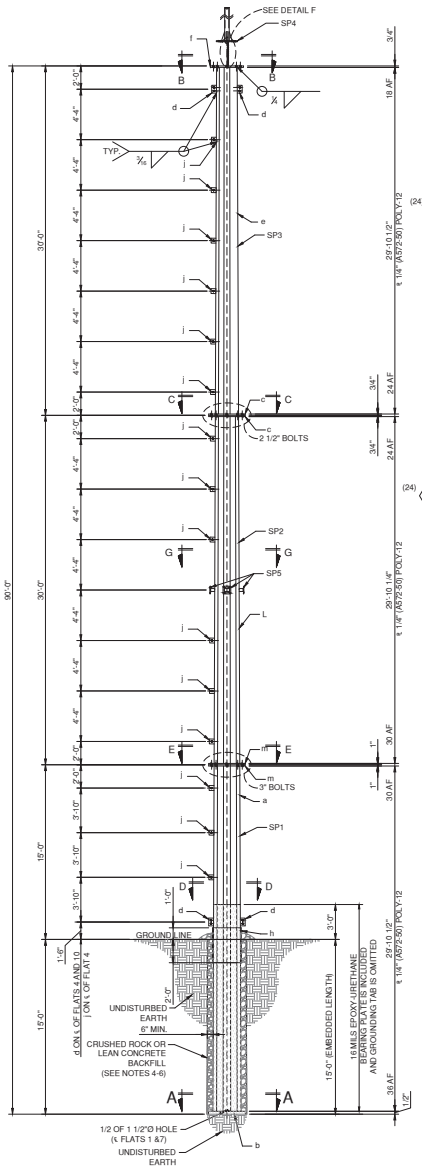
STATE OF OHIO
MARTIN FELIX PADULA
E-80306
REGISTERED
PROFESSIONAL ENGINEER
01-25-2018

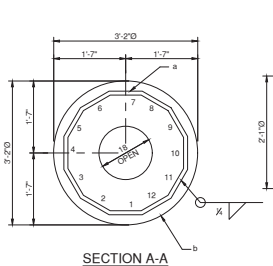
3350 38th Avenue South
Fargo, North Dakota 58104
Phone: 701.280.8500
Fax: 701.237.3191
www.ulteig.com
We Make Westies
Bismarck - Denver - Detroit Lakes - Fargo - Sioux Falls - St. Paul

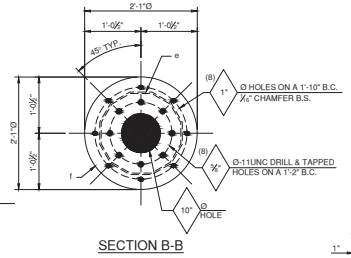
Design By: D. WEBER
Drawn By: V. LEE
Approved By: M. PADULA
Project Number: 17.01246

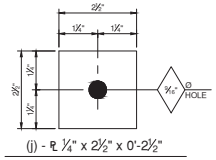
138/34.5KV
PROJECT SUBSTATION
138kV DEADEND "CB"
STEEL DETAILS

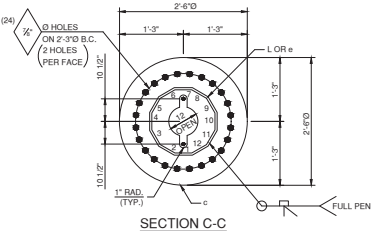
DWG #: NWO-S1-004
REVISION: 0B

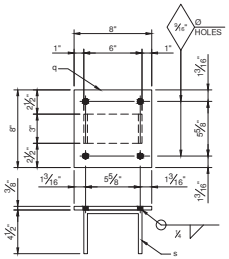


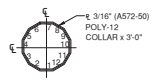


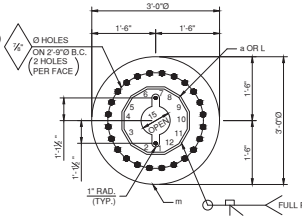


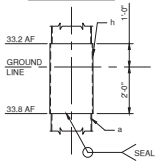


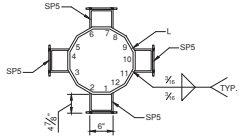


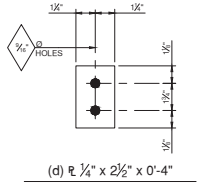


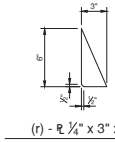


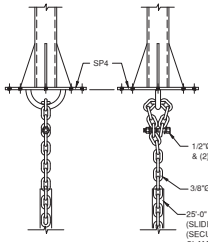


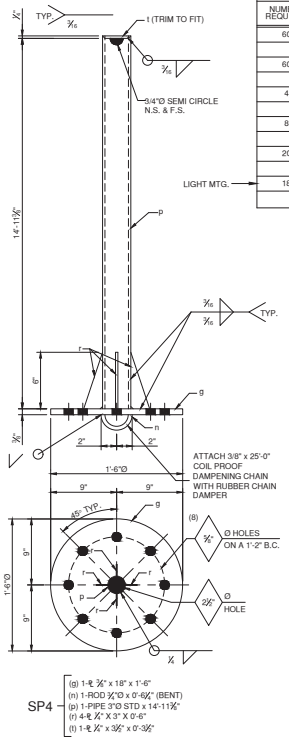












TWO STRUCTURES NUMBER REQUIRED		ONE STRUCTURE NUMBER REQUIRED		MATERIAL LIST DESCRIPTION	MARK	SHEET	WEIGHT PER PIECE
ITEMS SHIPPED	SHOP ASSY	ITEMS SHIPPED	SHOP ASSY				
2		1		WELDED ASSEMBLY	SP1	THIS	
	2		1	℄ ¼" x 114¼" x 29'-10½" (12 SIDED POLYGON)	a		2901
	2		1	℄ ¼" x 38" x 3'-2"	b		205
	2		1	℄ 1" x 36" x 3'-0"	m		368
	4		2	℄ ¼" x 2½" x 0'-4"	d		1
	6		3	℄ ¼" x 2½" x 0'-2½"	j		1
	2		1	℄ ⅜" x 107½" x 3'-0" (12 SIDED POLYGON)	h		206
2		1		WELDED ASSEMBLY	SP2		
	2		1	℄ ¼" x 95" x 29'-10¼" (12 SIDED POLYGON)	L		2411
	2		1	℄ ¾" x 30" x 2'-6"	c		191
	2		1	℄ 1" x 36" x 3'-0"	m		368
	12		6	℄ ¼" x 2½" x 0'-2½"	j		1
2		1		WELDED ASSEMBLY	SP3		
	2		1	℄ ¼" x 75½" x 29'-10½" (12 SIDED POLYGON)	e		1971
	2		1	℄ ¾" x 30" x 2'-6"	c		191
	2		1	℄ ¾" x 25" x 2'-1"	f		133
	4		2	℄ ¼" x 2½" x 0'-4"	d		1
	12		6	℄ ¼" x 2½" x 0'-2½"	j		1
2		1		WELDED ASSEMBLY	SP4		
	2		1	℄ ¾" x 18" x 1'-6"	g		34
	2		1	ROD ¾" Ø x 0'-6¼" (BENT)	n		1
	2		1	℄ ¼" x 3½" x 0'-3½"	t		1
	2		1	PIPE 3" STD x 14'-11½"	p		130
	8		4	℄ ¼" x 3" x 0'-6"	r		1
8		4		WELDED ASSEMBLY	SP5		
	8		4	℄ ¼" x 3" x 1'-2" (BENT)	s		3
	8		4	℄ ¾" x 8" x 0'-8"	q		7
2		1		⅜" x 25'-0" COIL PROOF CHAIN			26
2		1		25'-0" RUBBER HOSE			

NUMBER REQUIRED	NUMBER REQUIRED	GALV. BOLTS & WASHERS	WEIGHT PER HUNDRED
60	30	¾" DIA. x 3" HEX HD. W/ HEX NUT (A325)	70.9
60	30	¾" DIA. x 2½" HEX HD. W/ HEX NUT (A325)	64.7
4	2	½" DIA. x 2½" HEX HD. W/ HEX NUT (A325)	24.7
8	4	WASHER FOR ½" DIA. BOLT	3.0
20	10	½" DIA. x 1¼" CAPSCREW (A707)	23.0
18	9	⅞"Ø x 1½" HEX HD. W/ HEX NUT (A307)	7.1

STEEL	18,400#
BOLTS	89#
TOTAL	18,489#

GENERAL NOTES
1. MATERIAL: ASTM A-572 GRADE 50 (SUITABLE FOR GALVANIZING). GALVANIZING: ASTM A-123 & A-385 FABRICATION & INSPECTION: AISC ERECTION BOLTS: ASTM A-325
2. ALL HOLES 3/4" UNLESS NOTED.
3. ALL SEPARATE PIECES ARE TO BE DISTINCTLY MARKED WITH THEIR NUMBERS CORRESPONDING TO THE DRAWINGS. THE NUMBERS ARE TO BE STAMPED INTO THE MATERIAL BEFORE FINISHING WITH STAMPING DIES 3/4" HIGH IN SUCH A MANNER AS TO BE READILY VISIBLE AFTER FINISHING. THE NUMBER SHALL BE STAMPED NEAR THE END OF THE PIECE.
4. BACKFILL SHALL CONSIST OF CRUSHED ROCK PER SCREEN AS FOLLOWS:
   100% PASSING 1" SCREEN
   85%-95% PASSING 3/4" SCREEN
   15%-25% PASSING 1/2" SCREEN
   5%-10% PASSING 3/8" SCREEN
   0%-10% PASSING NO. 4 SCREEN
5. CRUSHED ROCK SHALL BE THOROUGHLY TAMPED DURING INSTALLATION.
6. LEAN CONCRETE MAY BE SUBSTITUTED FOR CRUSHED ROCK BACKFILL.
7. ALL LONGITUDINAL WELDS SHALL HAVE A MINIMUM OF 50% PENETRATION.

DESIGN NOTES
1. UP TO (2) ⅜" EHS SHIELD WIRES WITHIN A 30 DEGREE PULL OFF ANGLE.
2. TENSION - 1500# NESC HEAVY LOADING.

NORTHWEST OHIO WIND PROJECT

PAULDING COUNTY, OHIO

Rev.	Date	Description	By
0A	1/25/18	ISSUED FOR CONSTRUCTION	UEI

WHITE an MEA company

ISSUED FOR CONSTRUCTION

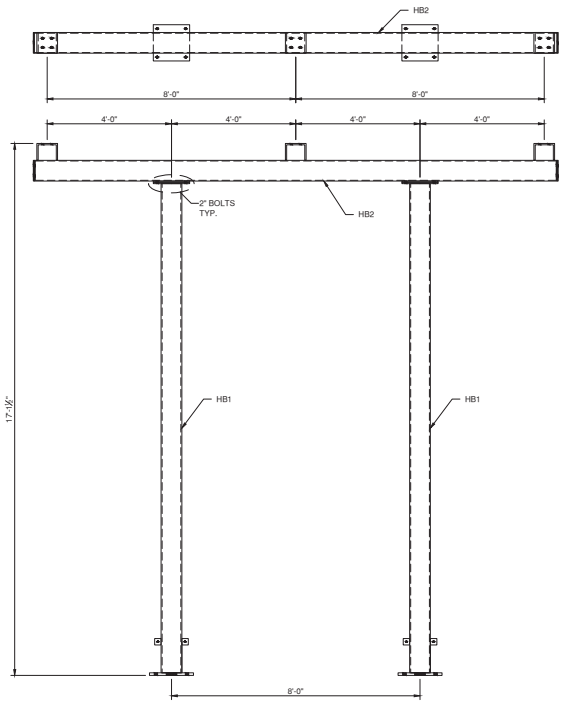
STATE OF OHIO
MARTIN FELIX PADULA
E-80306
REGISTERED
PROFESSIONAL ENGINEER
01-25-2018

Ulteig
3350 38th Avenue South
Fargo, North Dakota 58104
Phone: 701.280.8500
Fax: 701.237.3191
www.ulteig.com
We Make Westsider
Bismarck - Denver - Detroit Lakes - Fargo - Sioux Falls - St. Paul

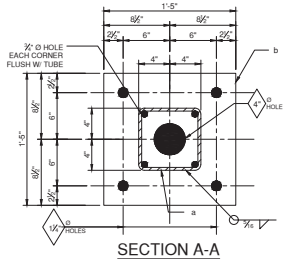
Design By: D. WEBER
Drawn By: V. LEE
Approved By: M. PADULA
Project Number: 17.01246

138/34.5KV
PROJECT SUBSTATION
90' SHIELD POLE
"SP" STEEL DETAILS

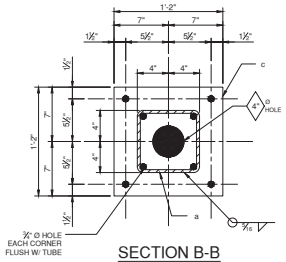
DWG #: NWO-S2-001
REVISION: 0A



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



SECTION A-A



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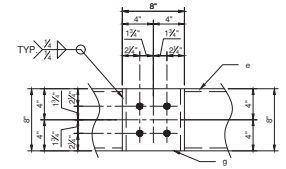
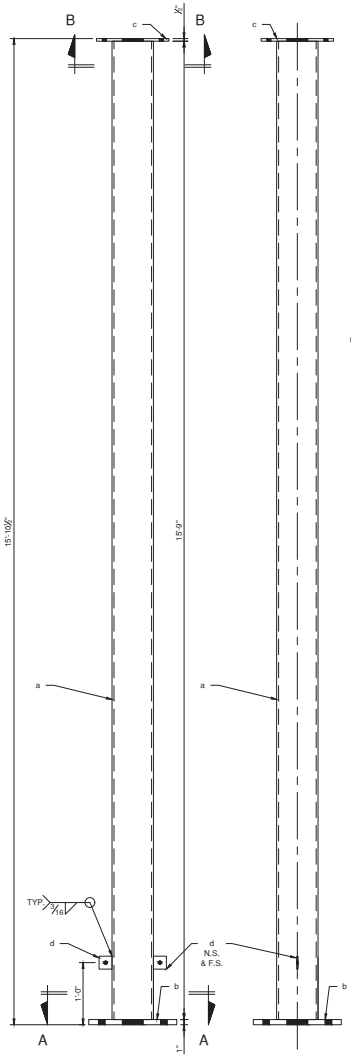


SECTION C-C

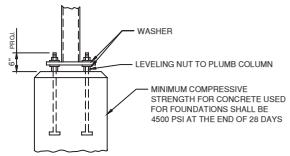


HB1
- (a) - 1 - HSS8 x 8 x ¼" x 15'-9"
- (b) - 1 - ℄ 1" x 17" x 1'-5"
- (c) - 1 - ℄ ½" x 14" x 1'-2"
- (d) - 2 - ℄ ½" x 2½" x 0'- 2½"

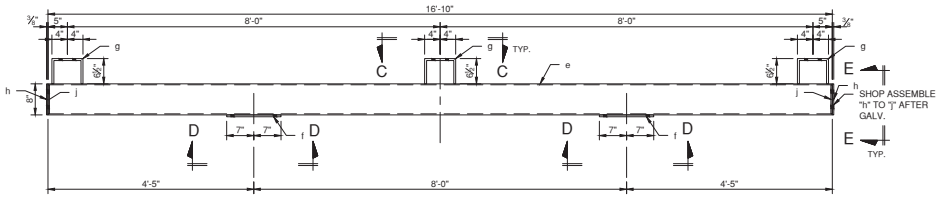
STRUCTURES	ONE STRUCTURE	MATERIAL LIST			
NUMBER REQUIRED (ITEMS SHIPPED)	NUMBER REQUIRED (ITEMS SHIPPED)	DESCRIPTION	MARK	SHEET	WEIGHT PER PIECE
	2	WELDED ASSEMBLY	HB1	THIS	
	2	HSS8x8 x ¼" x 15'-9"	a		594
	2	℄ 1" x 17" x 1'-5"	b		82
	2	℄ ½" x 14" x 1'-2"	c		28
	4	℄ ½" x 2½" x 0'-2½"	d		1
	1	WELDED ASSEMBLY	HB2		
	1	HSS8x8 x ¼" x 16'-10"	e		435
	2	℄ ½" x 14" x 1'-2"	f		28
	3	℄ ½" x 8" x 1'-7½" (BENT)	g		22
	2	℄ ½" x 8" x 0'-8"	h		7
	2	℄ ½" x 2" x 0'-7½"	j		2
	4	½"Ø x 1" CAPSCREW (A307)	k		

NUMBER REQUIRED	NUMBER REQUIRED	GALV. BOLTS & WASHERS		WEIGHT PER HUNDRED
	10	½"Ø x 2" HEX HD. W/ HEX NUT (A325)		37.4
INS. MTG.	15	½"Ø x 1½" CAPSCREW (A307)		16.9

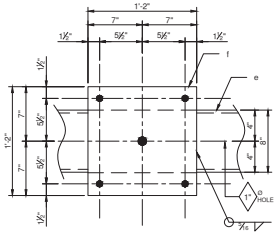
STEEL	1,987#
BOLTS	6#
TOTAL	1,993#



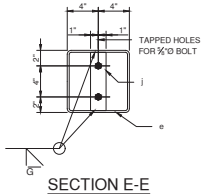
FOUNDATION DETAIL



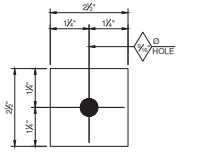
HB2
- (e) - 1 - HSS8 x 8 x ¼" x 16'-10"
- (f) - 1 - ℄ ½" x 14" x 1'-2"
- (g) - 1 - ℄ ½" x 8" x 1'-7½" (BENT)
- (h) - 2 - ℄ ½" x 8" x 0'- 8"
- (j) - 2 - ℄ ½" x 2" x 0'- 7½"
- (k) - 4 - ½"Ø x 1" CAPSCREW (A307)



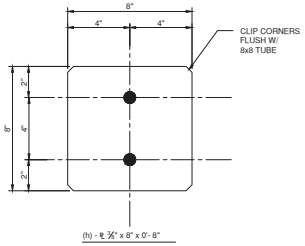
SECTION D-D



SECTION E-E



(d) - ℄ ½" x 2½" x 0'- 2½"



(h) - ℄ ½" x 8" x 0'- 8"

NOTES:

1. MATERIAL:
   - W-SHAPES — ASTM A-992
   - HSS-SHAPES — ASTM A-500 Gr B
   - C & L-SHAPES — ASTM A-36
   - PLATES — ASTM A-36

   GALVANIZING: ASTM A-123 & A-385
   FABRICATION & INSPECTION: AISC
   ERECTION BOLTS: ASTM A-325
2. ALL HOLES ⅞" DIA. UNLESS OTHERWISE NOTED.
3. ALL SEPARATE PIECES ARE TO BE DISTINCTLY MARKED WITH THEIR NUMBERS CORRESPONDING TO THE DRAWINGS. THE NUMBERS ARE TO BE STAMPED INTO THE MATERIAL BEFORE FINISHING WITH STAMPING DIES ¼" HIGH IN SUCH A MANNER AS TO BE READILY VISIBLE AFTER FINISHING. THE NUMBER SHALL BE STAMPED NEAR THE END OF THE PIECE.

ISSUED FOR CONSTRUCTION

STATE OF OHIO
MARTIN FELIX PADULA
E-80306
REGISTERED
PROFESSIONAL ENGINEER
01-25-2018

3350 38th Avenue South
Fargo, North Dakota 58104
Phone: 701.280.8500
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Bismarck - Denver - Detroit Lakes - Fargo - Sioux Falls - St. Paul

Design By: D. WEBER
Drawn By: V. LEE
Approved By: M. PADULA
Project Number: 17.01246

NORTHWEST OHIO WIND PROJECT

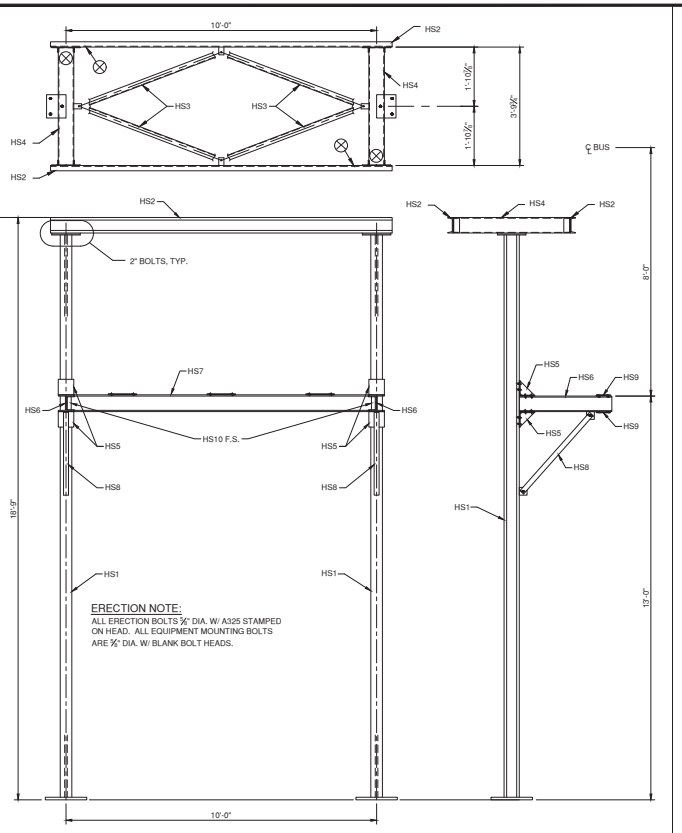
PAULDING COUNTY, OHIO

Rev.	Date	Description	By
0A	10/19/17	PRELIMINARY	UEI
0B	1/25/18	ISSUE FOR CONSTRUCTION	UEI

WHITE an MEA company

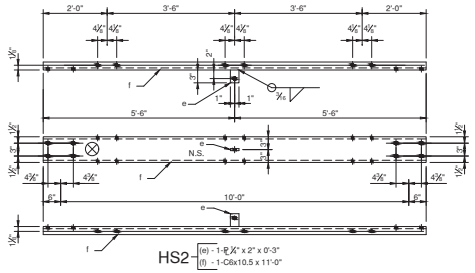
138/34.5KV SUBSTATION
138kV HIGH BUS SUPPORT "HB"

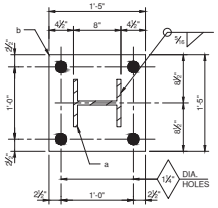
DWG #: NWO-S3-001
REVISION: 0A



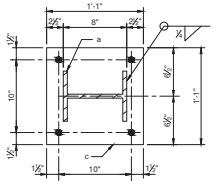
ERECTION DIAGRAM

SCALE: ½"=1'-0"





SECTION A-A



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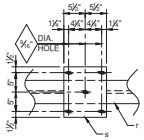
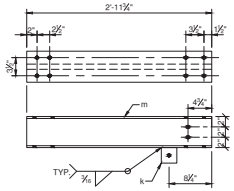
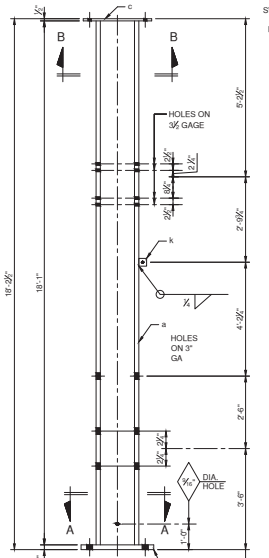
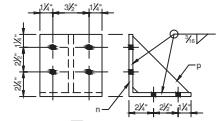
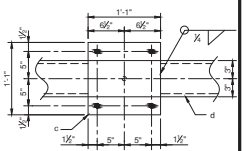


SECTION D-D

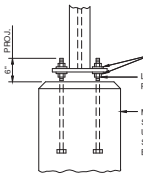




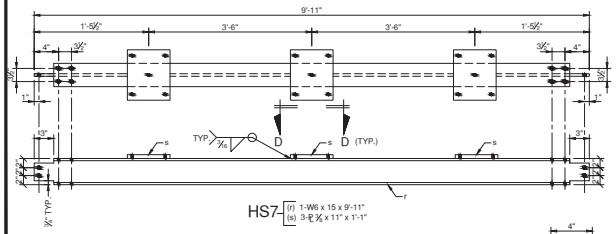


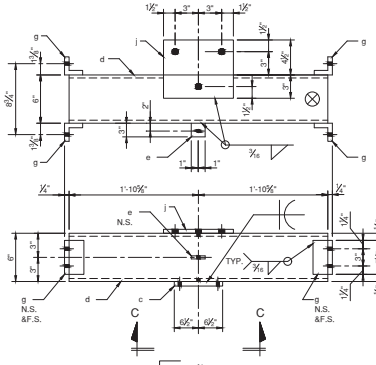


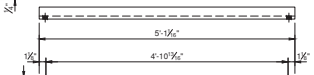
SECTION C-C

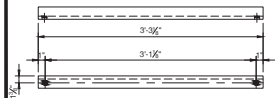


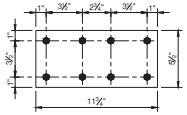
FOUNDATION DETAIL

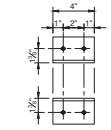












MATERIAL LIST

TWO STRUCTURES NUMBER REQUIRED ITEMS SHIPPED	TWO STRUCTURES NUMBER REQUIRED SHOP ASSY	ONE STRUCTURE NUMBER REQUIRED ITEMS SHIPPED	ONE STRUCTURE NUMBER REQUIRED SHOP ASSY	DESCRIPTION	MARK	SHEET	WEIGHT PER PIECE
			2	WELDED ASSEMBLY	HS1	THIS	
			2	W8x31 x 18'-1"	a		561
			2	PL 1" x 17" x 1'-5"	b		82
			2	PL ¾" x 13" x 1'-1"	c		24
			2	PL ¾" x 3" x 0'-3"	k		1
		2		WELDED ASSEMBLY	HS2		
			2	PL ¾" x 2" x 0'-3"	e		1
			2	C6x10.5 x 11'-0"	f		116
		4		L2 x 2 x ¼" x 5'-1⅛"	HS3		8
		2		WELDED ASSEMBLY	HS4		
			2	HSS6x6 x ¼" x 3'-9½"	d		72
			2	PL ¾" x 2" x 0'-3"	e		1
			8	L2½ x 2½ x ¼" x 0'-5½"	g		2
			2	PL ¾" x 13" x 1'-1"	c		24
			2	PL ¾" x 7½" x 0'-9"	j		7
		4		WELDED ASSEMBLY	HS5		
			4	L6 x 6 x ⅜" x 0'-6"	n		7
			4	PL ⅜" x 5" x 0'-5"	p		3
		2		WELDED ASSEMBLY	HS6		
			2	PL ⅜" x 3" x 0'-3"	k		1
			2	W6 x 15 x 2'-11¾"	m		45
		1		WELDED ASSEMBLY	HS7		
			1	W6 x 15 x 9'-11"	r		149
			3	PL ⅜" x 11" X 1'-1"	s		15
		2		L2½ x 2½ x ⅜ x 3'-3½"	HS8		20
		4		PL ⅜" x 5½" X 0'-11⅞"	HS9		7
		2		L2½ x 2½ x ⅜ x 0'-4"	HS10		6

NUMBER REQUIRED	NUMBER REQUIRED	GALV. BOLTS & WASHERS	WEIGHT PER HUNDRED
	100	⅝"Ø x 1¾" HEX HD. W/HEX NUTS (A325)	35.3
	10	⅝"Ø x 2" HEX HD. W/HEX NUTS (A325)	37.4
	15	⅝"Ø x 2½" HEX HD. W/ HEX NUTS (A307)	31.5
	30	SQUARE BEVELED WASHER W/ 1"Ø HOLE	22.4
	15	⅝"Ø x 1¾" HEX HD. W/ HEX NUTS (A307)	6.3

SWITCH MTG. BOLTS

VT MTG.

STEEL	2,224#
BOLTS	52#
TOTAL	2,276#

NOTES:

1. MATERIAL:
   - W-SHAPES — ASTM A-992
   - HSS-SHAPES — ASTM A-500 Gr B
   - C & L-SHAPES — ASTM A-36
   - PLATES — ASTM A-36

   GALVANIZING: ASTM A-123 & A-385
   FABRICATION & INSPECTION: AISC
   ERECTION BOLTS: ASTM A-325
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NORTHWEST OHIO WIND PROJECT

PAULDING COUNTY, OHIO

Rev.	Date	Description	By
0A	10/19/17	PRELIMINARY	UEI
0B	1/25/18	ISSUED FOR CONSTRUCTION	UEI

WHITE an MEA company

ISSUED FOR CONSTRUCTION

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MARTIN FELIX PADULA
E-80306
REGISTERED
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01-25-2018

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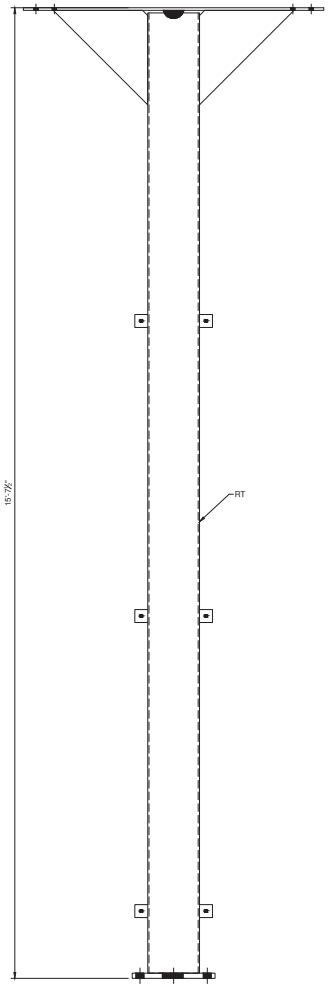
Design By: D. WEBER
Drawn By: V. LEE
Approved By: M. PADULA
Project Number: 17.01246

138/34.5KV SUBSTATION
34.5kV SWITCH STAND
"HS"

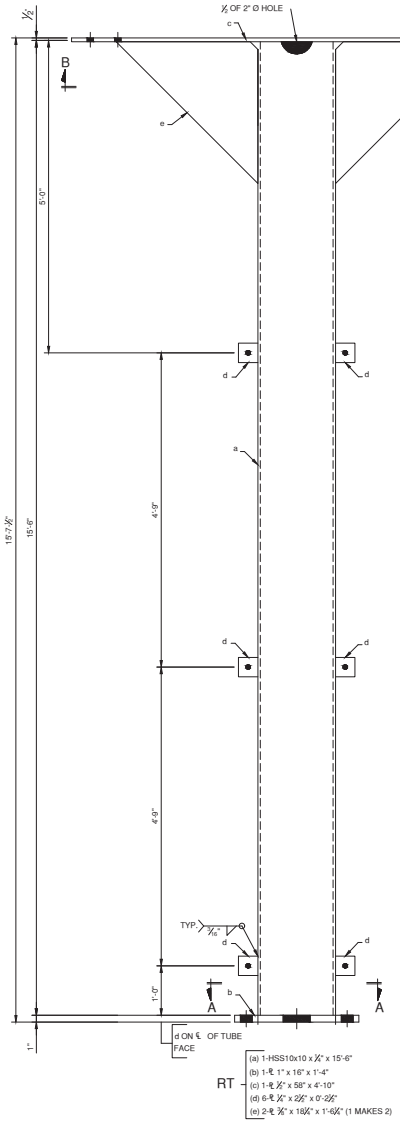
DWG #: NWO-S4-001

REVISION: 0B



ERECTION DIAGRAM

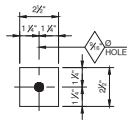
SCALE: 1" = 1'-0"



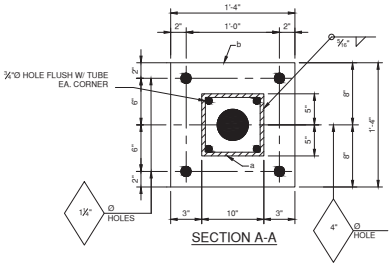
RT

(a) 1-HSS10x10 x ¼" x 15'-6"
(b) 1-PL 1" x 16" x 1'-4"
(c) 1-PL ½" x 58" x 4'-10"
(d) 6-PL ¼" x 2½" x 0'-2½"
(e) 2-PL ⅜" x 18¼" x 1'-6¼" (1 MAKES 2)

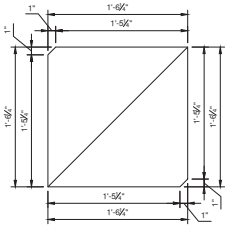
REACTOR MTG.



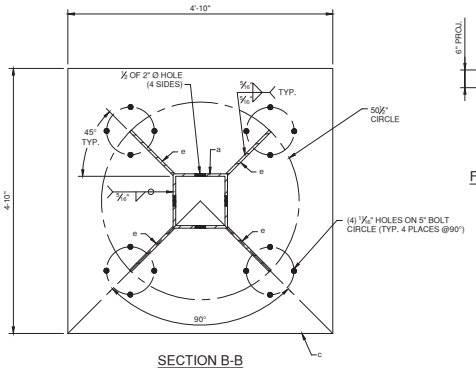
(d) - PL ¼" x 2½" x 0'-2½"



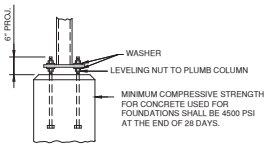
SECTION A-A



(e) - PL ⅜" x 18¼" x 1'-6¼"
(1 MAKES 2)



SECTION B-B



FOUNDATION DETAIL

LIST OF MATERIAL

STRUCTURES NUMBER REQUIRED ITEMS SHIPPED	STRUCTURES NUMBER REQUIRED SHOP ASS'Y	ONE STRUCTURE NUMBER REQUIRED ITEMS SHIPPED	ONE STRUCTURE NUMBER REQUIRED SHOP ASS'Y	DESCRIPTION	MARK	SHEET THIS	WEIGHT PER PEICE
		1		WELDED ASSEMBLY	RT		
			1	HSS10x10 x ¼" x 15'-6"	a		506
			1	PL 1" x 16" x 1'-4"	b		73
			1	PL ½" x 58" x 4'-10"	c		477
			6	PL ¼" x 2½" x 0'-2½"	d		1
			2	PL ⅜" x 18¼" x 1'-6¼" (1 MAKES 2)	e		35

NUMBER REQUIRED	NUMBER REQUIRED	GALV. BOLTS & WASHERS	WEIGHT PER HUNDRED
	20	⅞" Ø x 2" HEX HD. W/ HEX NUT (A307)	29.4

STEEL	1032#
BOLTS	6#
TOTAL	1038#

NOTES:

1. MATERIAL:
   - W-SHAPES — ASTM A-992
   - HSS-SHAPES — ASTM A-500 Gr B
   - C & L-SHAPES — ASTM A-36
   - PLATES — ASTM A-36

   GALVANIZING: ASTM A-123 & A-385
   FABRICATION & INSPECTION: AISC
   ERECTION BOLTS: ASTM A-325
2. ALL HOLES ¾" DIA. UNLESS OTHERWISE NOTED.
3. ALL SEPARATE PIECES ARE TO BE DISTINCTLY MARKED WITH THEIR NUMBERS CORRESPONDING TO THE DRAWINGS. THE NUMBERS ARE TO BE STAMPED INTO THE MATERIAL BEFORE FINISHING WITH STAMPING DIES ½" HIGH IN SUCH A MANNER AS TO BE READILY VISIBLE AFTER FINISHING. THE NUMBER SHALL BE STAMPED NEAR THE END OF THE PIECE.

NORTHWEST OHIO WIND PROJECT

PAULDING COUNTY, OHIO

Rev.	Date	Description	By
0A	10/19/17	PRELIMINARY	UEI
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WHITE an MEA company

ISSUED FOR CONSTRUCTION

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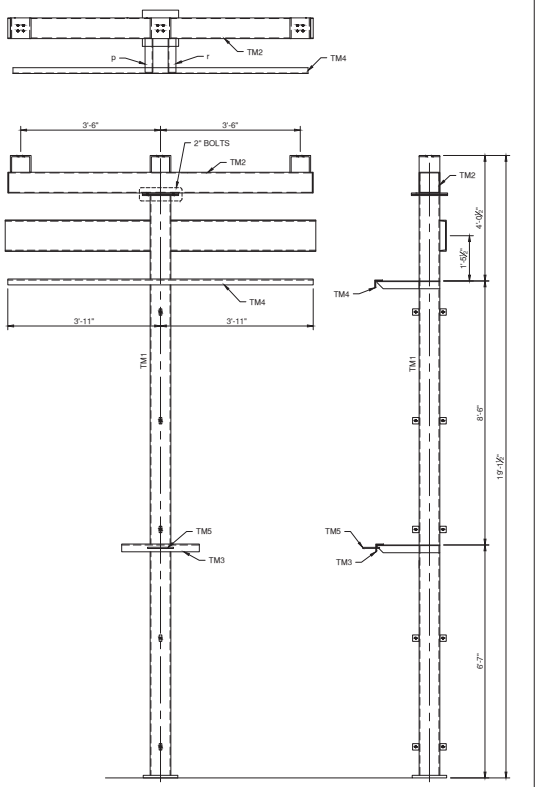
Design By: D. WEBER
Drawn By: V. LEE
Approved By: M. PADULA
Project Number: 17.01246

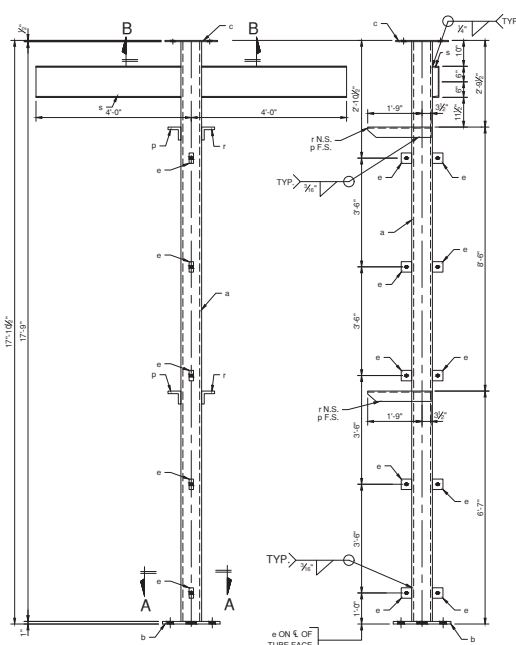
138/34.5KV SUBSTATION
34.5kV NGR SUPPORT "RT"

DWG #: NWO-S5-001
REVISION: 0B



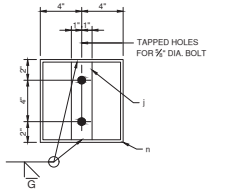
ERECTION DIAGRAM

SCALE: ½" = 1'-0"

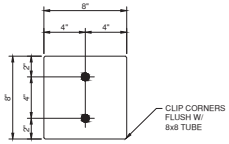


TM1

(a) 1 - HSS8 x 8 x ⅜" x 17'-9"
(b) 1 - PL 1" x 16" x 1'-4"
(c) 1 - PL ½" x 14" x 1'-2"
(e) 10 - PL ¼" x 2½" x 0'-2½"
(p) 2 - L4 x 4 x ⅜ x 2'-0½"
(r) 2 - L4 x 4 x ⅜ x 2'-0½"
(s) 1 - MC 12 x 14.3 x 8'-0"



SECTION D-D

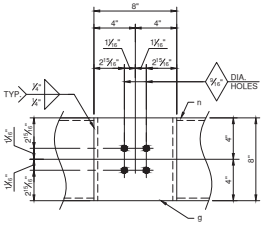


(h) - PL ⅜" x 8" x 0'-8"

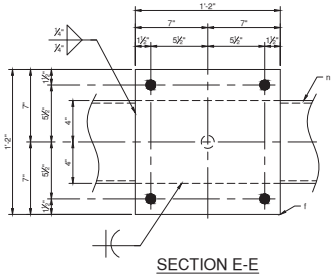
FOUR STRUCTURES NUMBER REQUIRED ITEMS	FOUR STRUCTURES NUMBER REQUIRED SHOP ASS'Y	ONE STRUCTURE NUMBER REQUIRED ITEMS SHIPPED	ONE STRUCTURE NUMBER REQUIRED SHOP ASS'Y	MATERIAL LIST DESCRIPTION	MARK	SHEET	WEIGHT PER PIECE
4		1		WELDED ASSEMBLY	TM1	THIS	
	4		1	HSS8 x 8 x ⅜ x 17'-9"	a		669
	4		1	PL 1" x 16" x 1'-4"	b		73
	4		1	PL ½" x 14" x 1'-2"	c		28
	40		10	PL ¼" x 2½" x 0'-2½"	e		1
	8		2	L4 x 4 x ⅜" x 2'-0½"	p	002	17
	8		2	L4 x 4 x ⅜" x 2'-0½"	r		17
	4		1	MC12 x 14.3 x 8'-0"	s		114
4		1		WELDED ASSEMBLY	TM2	THIS	
	4		1	HSS8 x 8 x ½" x 7'-10"	n		202
	4		1	PL ½" x 14" x 1'-2"	f		28
	12		3	PL ½" x 8" x 1'-7½" (BENT)	g		22
	8		2	PL ½" x 8" x 0'-8"	h		7
	8		2	PL ½" x 2" x 0'-7 ½"	j		2
	16		4	¾"Ø x 1" CAPSCREW (A307)	k		
4		1		L3 x 3 x ¼" x 3'-0"	TM3	002	15
4		1		L3 x 3 x ¼" x 7'-10"	TM4		38
4		1		BAR ½"Ø x 2'-3" (BENT) W/ 2 HEX NUTS	TM5		2

NUMBER REQUIRED	NUMBER REQUIRED	GALV. BOLTS & WASHERS	WEIGHT PER HUNDRED
20	5	⅝"Ø x 1½" HEX HD. W/ HEX NUT (A325)	33.1
20	5	⅝"Ø x 2" HEX HD. W/ HEX NUT (A325)	37.4
32	8	½"Ø x 1½" HEX HD. W/ HEX NUT (A307)	15.1
		CABLE MTG	
48	12	½"Ø x 2¼" HEX HD. W/ HEX NUT (A307)	19.1
		SA. MTG	
		INSUL. MTG	
60	15	½"Ø x 1¼" CAPSCREW (A307)	10.4
60	15	½"Ø LOCK WASHER	1.3

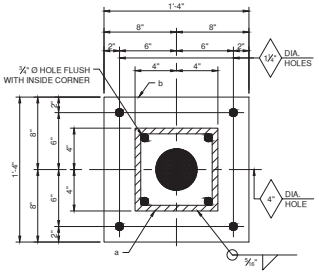
STEEL	5,324#
BOLTS	35#
TOTAL	5,359#



SECTION C-C



SECTION E-E



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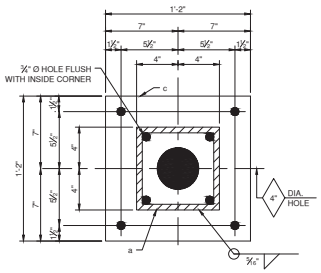

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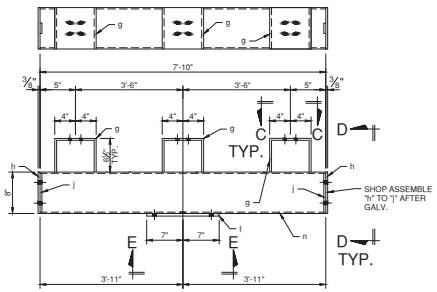
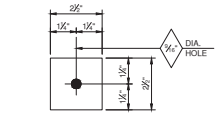
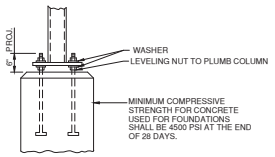


TM2

(m) 1 - HSS8x8 x ½" x 7'-10"
(f) 1 - PL ½" x 14" x 1'-2"
(g) 3 - PL ½" x 8" x 1'-7½" (BENT)
(h) 2 - PL ⅜" x 8" x 0'-8"
(j) 2 - PL ½" x 2" x 0'-7½"
(k) 4 - ⅝" x 1 CAPSCREW (A307)



(e) - PL ¼" x 2½" x 0'-2½"



FOUNDATION DETAIL

NOTES:

1. MATERIAL:
   W-SHAPES ASTM A-992
   HSS-SHAPES ASTM A-500 Gr B
   C & L-SHAPES ASTM A-36
   PLATES ASTM A-36
   GALVANIZING: ASTM A-123 & A-385
   FABRICATION & INSPECTION: AISC
   ERECTION BOLTS: ASTM A-325
2. ALL HOLES ¾" DIA. UNLESS OTHERWISE NOTED.
3. ALL SEPARATE PIECES ARE TO BE DISTINCTLY MARKED WITH THEIR NUMBERS CORRESPONDING TO THE DRAWINGS. THE NUMBERS ARE TO BE STAMPED INTO THE MATERIAL BEFORE FINISHING WITH STAMPING DIES ⅝" HIGH IN SUCH A MANNER AS TO BE READILY VISIBLE AFTER FINISHING. THE NUMBER SHALL BE STAMPED NEAR THE END OF THE PIECE.

NORTHWEST OHIO WIND PROJECT

PAULDING COUNTY, OHIO

Rev.	Date	Description	By
0A	10/19/17	PRELIMINARY	UEI
0B	01/25/18	ISSUED FOR CONSTRUCTION	UEI

WHITE an MEA company

ISSUE FOR CONSTRUCTION

STATE OF OHIO
MARTIN FELIX PADULA
E-80306
REGISTERED
PROFESSIONAL ENGINEER
01-25-2018

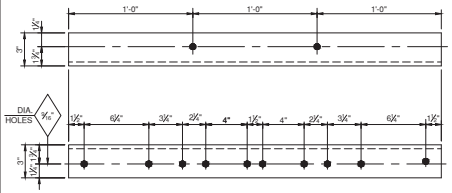
3350 38th Avenue South
Fargo, North Dakota 58104
Phone: 701.280.8500
Fax: 701.237.3191
www.ulteig.com
Bismarck - Denver - Detroit Lakes - Fargo - Sioux Falls - St. Paul

Design By: D. WEBER
Drawn By: V. LEE
Approved By: M. PADULA
Project Number: 17.01246

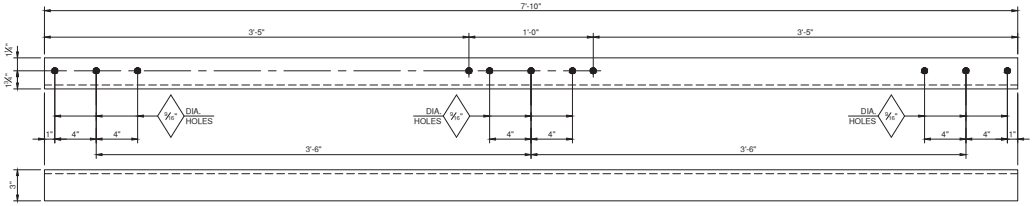
138/34.5KV SUBSTATION
34.5kV CABLE TERMINAL STAND "TM"

DWG #: NWO-S6-001

REVISION: 0A



TM3 – L3 x 3 x ¼" x 3'-0"



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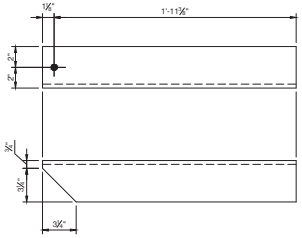
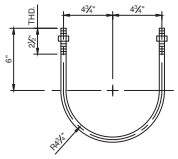
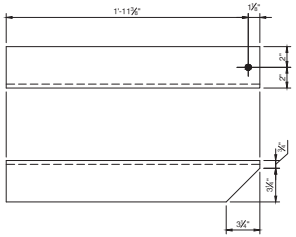


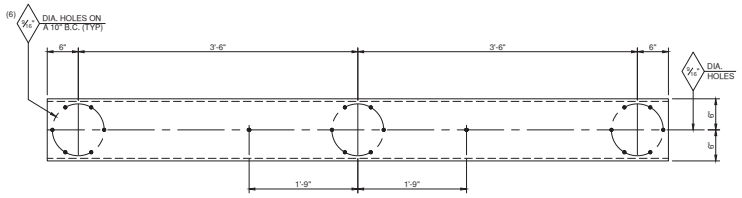
(p) - L4 x 4 x 5/16" x 2'-0½"



TM5 – BAR ⅝" DIA. x 2'-3" (BENT) WITH 2 REG. HEX. NUTS



(r) - L4 x 4 x 5/16" x 2'-0½"



(s) - MC 12 x 14.3 x 8'-0"

NORTHWEST OHIO WIND PROJECT

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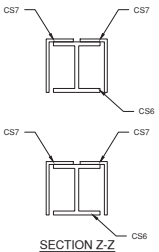
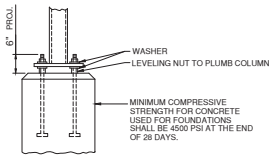
138/34.5KV SUBSTATION
34.5kV CABLE TERMINAL STAND "TM"

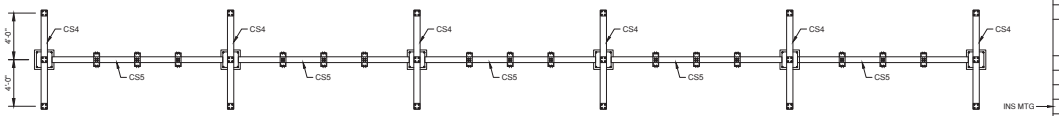
DWG #: NWO-S6-002
REVISION: 0B

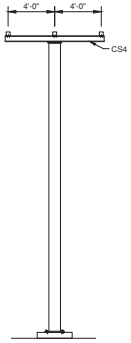


SECTION Z-Z



FOUNDATION DETAIL





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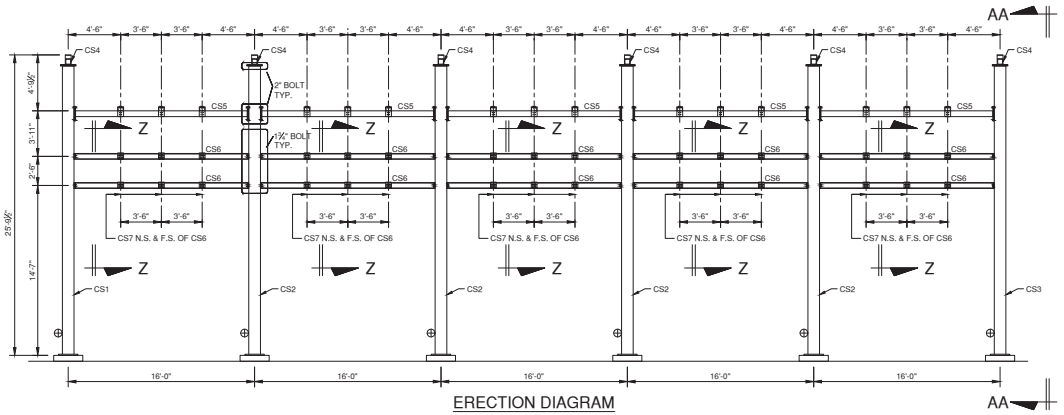

ERECTION DIAGRAM

STRUCTURE NUMBER REQUIRED ITEMS SHIPPED	STRUCTURE NUMBER REQUIRED SHOP ASSY	ONE STRUCTURE NUMBER REQUIRED ITEMS SHIPPED	ONE STRUCTURE NUMBER REQUIRED SHOP ASSY	MATERIAL LIST DESCRIPTION	MARK	SHEET	WEIGHT PER PIECE
		1		WELDED ASSEMBLY	CS1	002	
			1	HSS12 x 12 x ⅜ x 24'-9"	a		1447
			1	PL 1½" x 20" x 1'-8"	b		170
			1	PL ⅝" x 18" x 1'-6"	c		46
			2	PL ⅞" x 2½" x 0'-2½"	d		1
			2	L 2½ x 2½ x ¼ x 0'-4"	e		1
			1	PL ⅝" x 12" x 1'-6"	f		31
		4		WELDED ASSEMBLY	CS2		
			4	HSS12 x 12 x ⅜ x 24'-9"	a		1447
			4	PL 1½" x 20" x 1'-8"	b		170
			4	PL ⅝" x 18" x 1'-6"	c		46
			8	PL ⅞" x 2½" x 0'-2½"	d		1
			16	L 2½ x 2½ x ¼ x 0'-4"	e		1
			8	PL ⅝" x 12" x 1'-6"	f		31
		1		WELDED ASSEMBLY	CS3		
			1	HSS12 x 12 x ⅜ x 24'-9"	a		1447
			1	PL 1½" x 20" x 1'-8"	b		170
			1	PL ⅝" x 18" x 1'-6"	c		46
			2	PL ⅞" x 2½" x 0'-2½"	d		1
			2	L 2½ x 2½ x ¼ x 0'-4"	e		1
			1	PL ⅝" x 12" x 1'-6"	f		31
		6		WELDED ASSEMBLY	CS4	003	
			6	HSS6 x 6 x ¼ x 8'-8"	g		165
			6	PL ⅝" x 18" x 1'-6"	h		46
			18	PL ⅝" x 6" x 1'-0½" (BENT)	s		11
			12	PL ⅜" x 6" x 0'-6"	k		4
			12	PL ⅜" x 2" x 0'-5½"	m		1
			24	⅞" Ø x 1" CAPSCREW	n		
		5		WELDED ASSEMBLY	CS5		
			5	HSS6 x 6 x ¼ x 14'-10"	p		282
			10	PL ⅝" x 12" x 1'-6"	r		31
			45	PL ⅝" x 6" x 1'-0½" (BENT)	s		11
		10		W6 x 15 x 14'-11½"	CS6		224
		60		PL ⅜" x 6" x 0'-10" (BENT)	CS7		7

NUMBER REQUIRED	GALV. BOLTS & WASHERS	WEIGHT PER HUNDRED
75	¾"Ø x 2" HEX HD. W/ HEX NUT (A325)	31.4
175	¾"Ø x 1¾" HEX HD. W/ HEX NUT (A325)	35.3
275	½"Ø x 1" CAPSCREW (A307)	9.2
130	½"Ø x 3" HEX HD. W/HEX NUT (A307)	23.5

STEEL	16,719#
BOLTS	141#
TOTAL	16,860#

NOTES:

1. MATERIAL:
   - W-SHAPES — ASTM A-992
   - HSS-SHAPES — ASTM A-500 Gr B
   - C & L-SHAPES — ASTM A-36
   - PLATES — ASTM A-36

   GALVANIZING: ASTM A-123 & A-385
   FABRICATION & INSPECTION: AISC
   ERECTION BOLTS: ASTM A-325
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3. ALL SEPARATE PIECES ARE TO BE DISTINCTLY MARKED WITH THEIR NUMBERS CORRESPONDING TO THE DRAWINGS. THE NUMBERS ARE TO BE STAMPED INTO THE MATERIAL BEFORE FINISHING WITH STAMPING DIES ½" HIGH IN SUCH A MANNER AS TO BE READILY VISIBLE AFTER FINISHING. THE NUMBER SHALL BE STAMPED NEAR THE END OF THE PIECE.

NORTHWEST OHIO WIND PROJECT

PAULDING COUNTY, OHIO

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0B	1/25/18	ISSUED FOR CONSTRUCTION	UEI

WHITE an MEA company

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MARTIN FELIX PADULA
E-80306
REGISTERED
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01-25-2018

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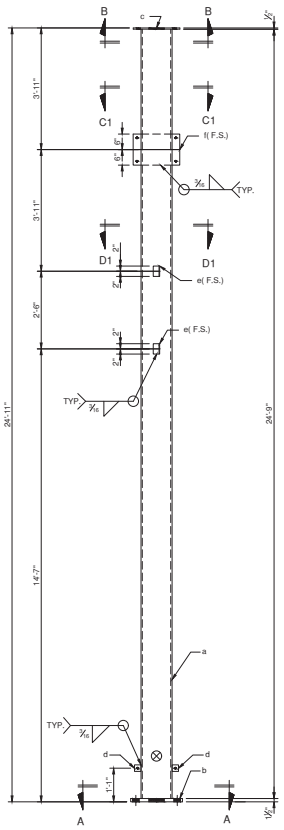
We Know Wonder®
Bismarck - Denver - Detroit Lakes - Fargo - Sioux Falls - St. Paul

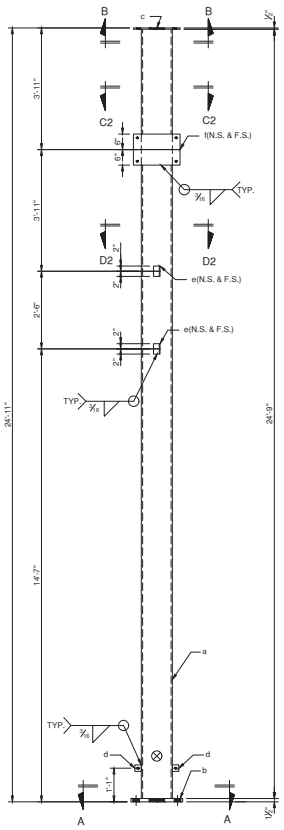
Design By: D. WEBER
Drawn By: V. LEE
Approved By: M. PADULA
Project Number: 17.01246

138/34.5KV SUBSTATION
34.5kV COLLECTION STRUCTURE "CS"

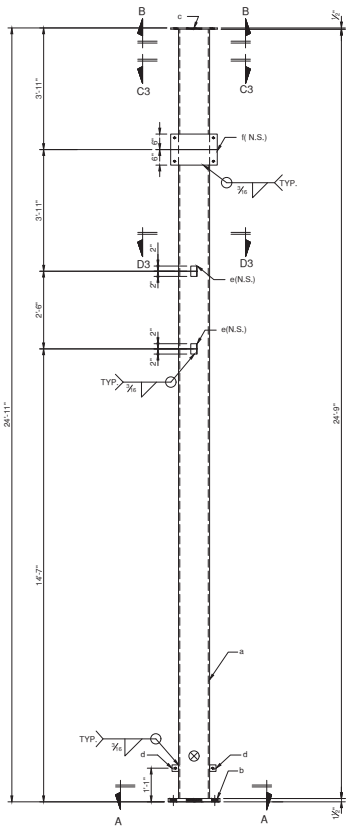
DWG #: NWO-S7-001
REVISION: 0B



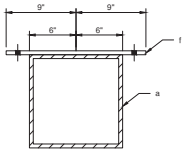
CS1
(a) 1-HSS12 x 12 x 3/8" x 24'-9"
(b) 1-PL 1/2" x 20" x 1'-8"
(c) 1-PL 3/8" x 18" x 1'-6"
(d) 2-PL 1/4" x 2 1/2" x 0'-2 1/2"
(e) 2 -L 2 1/2" x 2 1/2" x 1/4" x 0'-4"
(f) 1-PL 1/2" x 12" x 1'-6"



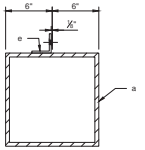
CS2
(a) 1-HSS12 x 12 x 3/8" x 24'-9"
(b) 1-PL 1/2" x 20" x 1'-8"
(c) 1-PL 3/8" x 18" x 1'-6"
(d) 2-PL 1/4" x 2 1/2" x 0'-2 1/2"
(e) 4 -L 2 1/2" x 2 1/2" x 1/4" x 0'-4"
(f) 1-PL 1/2" x 12" x 1'-6"



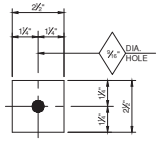
CS3
(a) 1-HSS12 x 12 x 3/8" x 24'-9"
(b) 1-PL 1/2" x 20" x 1'-8"
(c) 1-PL 3/8" x 18" x 1'-6"
(d) 2-PL 1/4" x 2 1/2" x 0'-2 1/2"
(e) 2 -L 2 1/2" x 2 1/2" x 1/4" x 0'-4"
(f) 1-PL 1/2" x 12" x 1'-6"



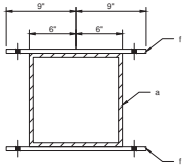
SECTION C1-C1



SECTION D1-D1



(d) - PL 1/4" x 2½" x 0'-2½"



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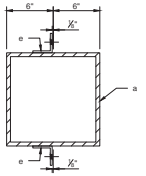

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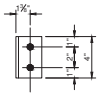
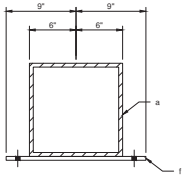


(e) - PL 2½" x 2½" x 1/4" x 0'-4"



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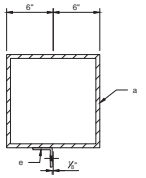

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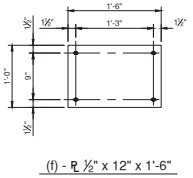
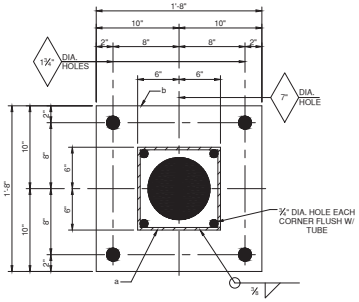
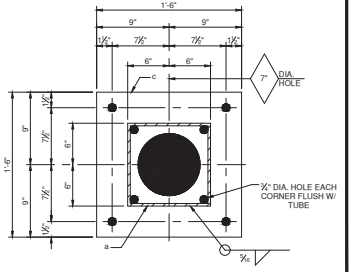


(f) - PL 1/2" x 12" x 1'-6"



SECTION A-A



SECTION B-B

NORTHWEST OHIO WIND PROJECT

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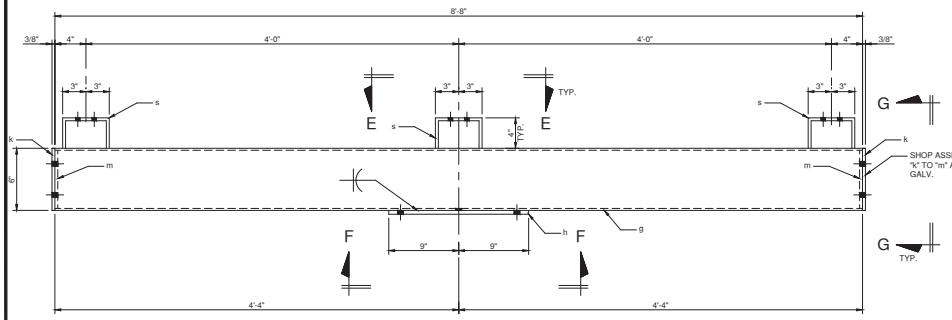
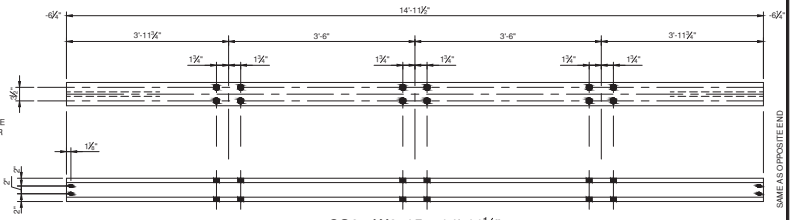
34.5kV COLLECTION STRUCTURE "CS"

DWG #: NWO-S7-002
REVISION: 0B

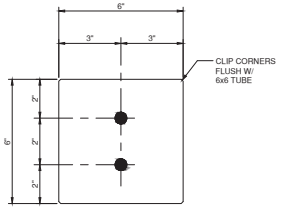


CS4

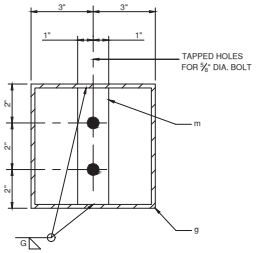
(g) 1 - HSS6 x 6 x ¼" x 8'-8"
(h) 1 - PL ½" x 18" x 1'-6"
(s) 3 - PL ½" x 6" x 1'-0½" (BENT)
(k) 2 - PL ¾" x 6" x 0'-6"
(m) 2 - PL ¾" x 2" x 0'-5½"
(n) 4 - ⅞"Ø x 1" CAPSCREW (A307)



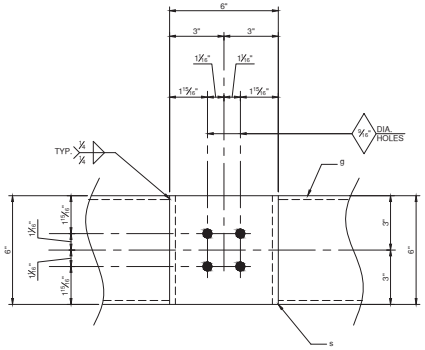
CS6 - W6x15 x 14'-11½"



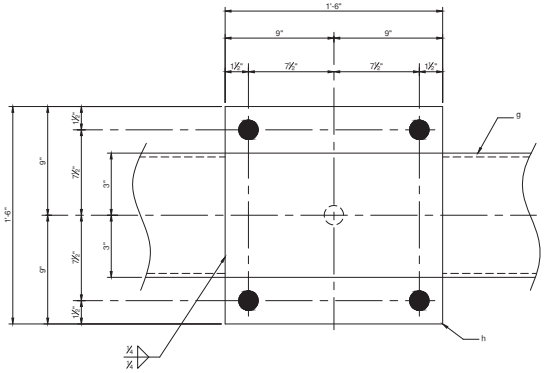
(k) - PL ⅜" x 6 x 0'-6"



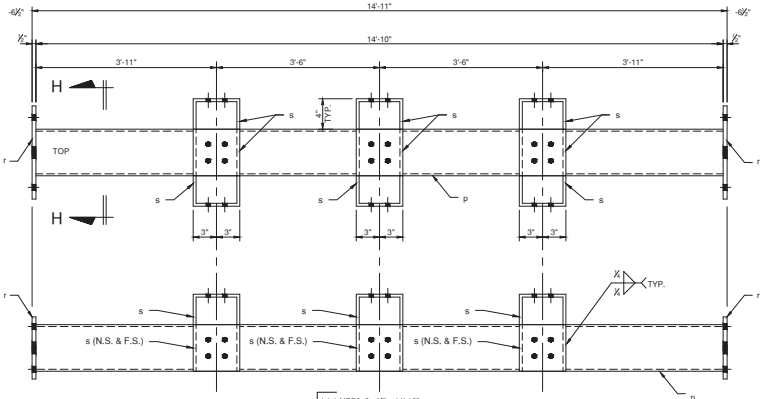
SECTION G-G



SECTION E-E

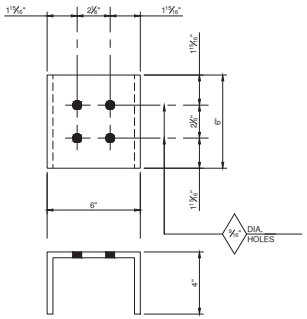


SECTION F-F

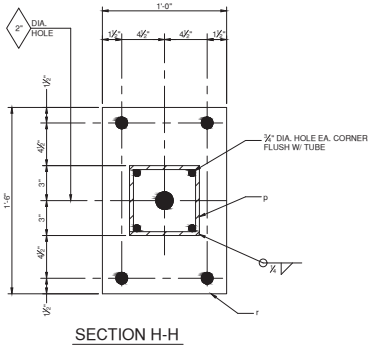


CS5

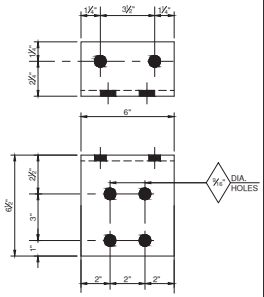
(p) 1-HSS6x6 x ¼" x 14'-10"
(r) 2-PL ½" x 12" x 1'-6"
(s) 9-PL ½" x 6" x 1'-0½" (BENT)



(s) - PL ½" x 6" x 1'-0½" (BENT)



SECTION H-H



CS7 - PL ⅜" x 6" x 0'-10" (BENT)

NORTHWEST OHIO WIND PROJECT

PAULDING COUNTY, OHIO

Rev.	Date	Description	By
0A	10/19/17	PRELIMINARY	UEI
0B	1/25/18	ISSUED FOR CONSTRUCTION	UEI

WHITE an MEA company

ISSUED FOR CONSTRUCTION

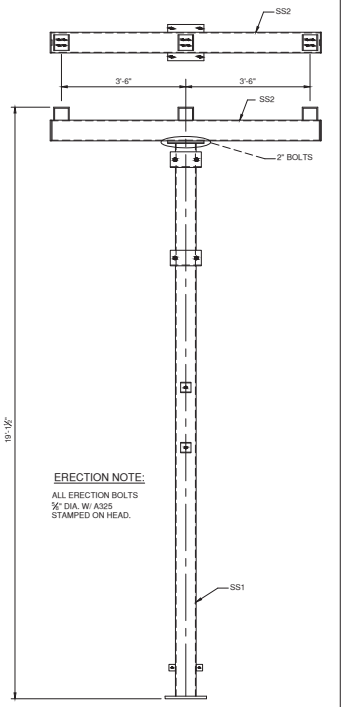
STATE OF OHIO
MARTIN FELIX PADULA
E-80306
REGISTERED
PROFESSIONAL ENGINEER
01-25-2018

3350 38th Avenue South
Fargo, North Dakota 58104
Phone: 701.280.8500
Fax: 701.237.3191
www.ulteig.com
Bismarck - Denver - Detroit Lakes - Fargo - Sioux Falls - St. Paul

Design By: D. WEBER
Drawn By: V. LEE
Approved By: M. PADULA
Project Number: 17.01246

138/34.5KV SUBSTATION
34.5kV COLLECTION STRUCTURE "CS"

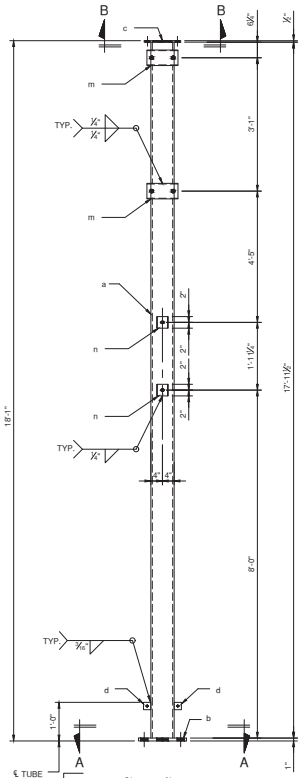
DWG #: NWO-S7-003
REVISION: 0B



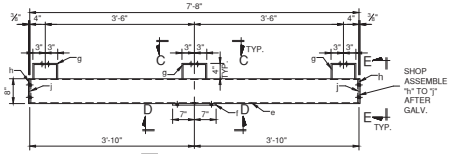
ERECTION NOTE:

ALL ERECTION BOLTS
¾" DIA. W/ A325
STAMPED ON HEAD.

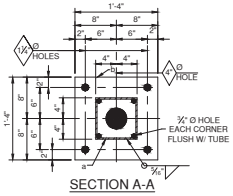
ERECTION DIAGRAM
SCALE: ½" = 1'-0"



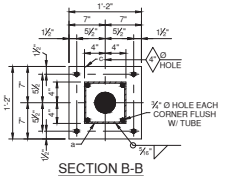
SS1
(a) 1-HSS8x8 x ¼" x 17'-11½"
(b) 1-PL 1" x 16" x 1'-4"
(c) 1-PL ½" x 14" x 1'-2"
(d) 2-PL ¼" x 2½" x 0'-2½"
(m) 2-C6 x 13 x 1'-0"
(n) 2-PL ½" x 4" x 0'-8½" (BENT)



SS2
(e) 1 - HSS8x8 x ¼" x 7'-8"
(f) 1 - PL ½" x 14" x 1'-2"
(g) 3 - PL ½" x 6" x 1'-0½" (BENT)
(h) 2 - PL ⅜" x 8" x 0'-8"
(i) 2 - PL ⅜" x 2" x 0'-7½"
(k) 4 - ⅞"Ø x 1" CAPSCREW (A307)

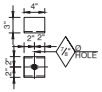


SECTION A-A

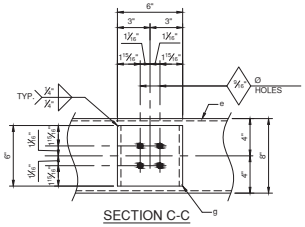


SECTION B-B

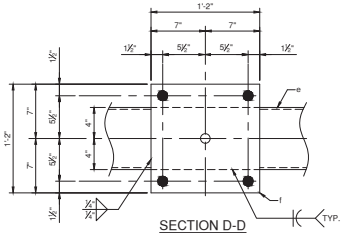
(m) C6 x 13 x 1'-0"



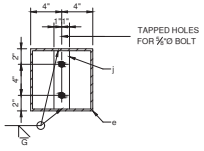
(n) - PL ½" x 4" x 0'-8½" (BENT)



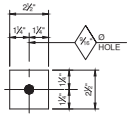
SECTION C-C



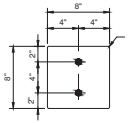
SECTION D-D



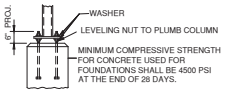
SECTION E-E



(d) - PL ¼" x 2½" x 0'-2½"



(h) - PL ⅜" x 8 x 0'-8"



FOUNDATION DETAIL

LIST OF MATERIAL

STRUCTURES NUMBER REQUIRED		ONE STRUCTURE NUMBER REQUIRED		DESCRIPTION	MARK	SHEET	WEIGHT PER PEICE
ITEMS SHIPPED	SHOP ASSY	ITEMS SHIPPED	SHOP ASSY				
		1		WELDED ASSEMBLY	SS1	THIS	
			1	HSS8x8 x ¼" x 17'-11½"	a		677
			1	PL 1" x 16" x 1'-4"	b		73
			1	PL ½" x 14" x1'-2"	c		28
			2	PL ¼" x 2½" x 0'-2½"	d		1
			2	C6 x 13 x 1'-0"	m		13
			2	PL ½" x 4" x 0'-8½" (BENT)	n		5
		1		WELDED ASSEMBLY	SS2		
			1	HSS8x8 x ¼" x 7'-8"	e		198
			1	PL ½" x 14" x 1'-2"	f		28
			3	PL ½" x 6" x 1'-0½" (BENT)	g		11
			2	PL ⅜" x 8" x 0'-8"	h		17
			2	PL ⅜" x 2" x 0'-7½"	j		4
			4	⅞"Ø x 1" CAPSCREW (A307)	k		

NUMBER REQUIRED	GALV. BOLTS & WASHERS	WEIGHT PER HUNDRED
5	¾" Ø x 2" HEX HD. W/ HEX NUT (A325)	37.4
15	½" Ø x 1¼" CAPSCREW (A307)	10.4
15	½" Ø LOCK WASHER	1.3
5	¾" Ø x 1½" HEX HD. (A307)	27.1

INSUL. MTG.
FUSE MTG.

STEEL	1,117#
BOLTS	5#
TOTAL	1,122#

NOTES:

1. MATERIAL:
   - W-SHAPES — ASTM A-992
   - HSS-SHAPES — ASTM A-500 Gr B
   - C & L-SHAPES — ASTM A-36
   - PLATES — ASTM A-36

   GALVANIZING: ASTM A-123 & A-385
   FABRICATION & INSPECTION: AISC
   ERECTION BOLTS: ASTM A-325
2. ALL HOLES ¾" DIA. UNLESS OTHERWISE NOTED.
3. ALL SEPARATE PIECES ARE TO BE DISTINCTLY MARKED WITH THEIR NUMBERS CORRESPONDING TO THE DRAWINGS. THE NUMBERS ARE TO BE STAMPED INTO THE MATERIAL BEFORE FINISHING WITH STAMPING DIES ¾" HIGH IN SUCH A MANNER AS TO BE READILY VISIBLE AFTER FINISHING. THE NUMBER SHALL BE STAMPED NEAR THE END OF THE PIECE.

NORTHWEST OHIO WIND PROJECT

PAULDING COUNTY, OHIO

Rev.	Date	Description	By
0A	10/19/17	PRELIMINARY	UEI
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WHITE
an MEA company

ISSUED FOR CONSTRUCTION

STATE OF OHIO
MARTIN FELIX PADULA
E-80306
REGISTERED
PROFESSIONAL ENGINEER
01-25-2018

3350 38th Avenue South
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Phone: 701.280.8500
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We Make Westies®
Bismarck - Denver - Detroit Lakes - Fargo - Sioux Falls - St. Paul

Design By: D. WEBER
Drawn By: V. LEE
Approved By: M. PADULA
Project Number: 17.01246

138/34.5KV
SUBSTATION
34.5kV 3Ø BUS & SS
SUPPORT "SS"

DWG #: NWO-S8-001
REVISION: 0B

NORTHWEST OHIO (NWO)
DRAWING AND SPECIFICATION INDEX
SUBSTATION

2/1/2018

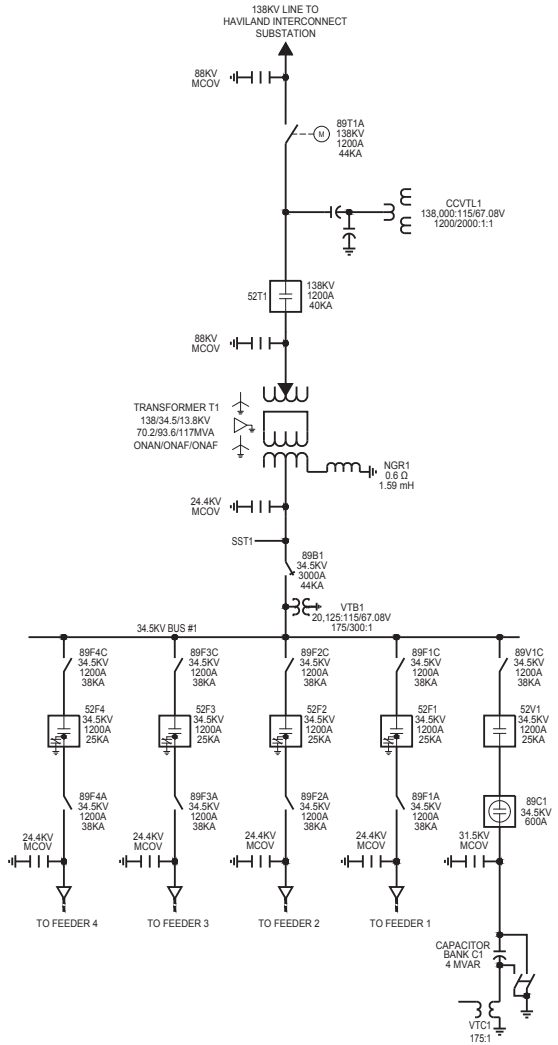
DRAWING NAME	REV	DOCUMENT TITLE	DATE	SUBMITTAL	ATTACHED
DESIGN BASIS	0B	COLLECTOR SUBSTATION DESIGN BASIS	10/19/2017	60% DESIGN	
NWO-0100	0A	MAIN POWER TRANSFORMER SPECIFICATION	06/30/2017	30% DESIGN	
NWO-0201	0A	SF6 BREAKER SPECIFICATION	07/14/2017	30% DESIGN	
NWO-0202	0B	VACUUM CIRCUIT BREAKER SPECIFICATION	10/19/2017	60% DESIGN	
NWO-0204	0A	CAPACITOR SWITCHER SPECIFICATION	10/19/2017	60% DESIGN	
NWO-0302	0B	GOAB SWITCH SPECIFICATION	10/19/2017	60% DESIGN	
NWO-0303	0A	HOOKSTICK SWITCH SPECIFICATION	07/14/2017	30% DESIGN	
NWO-0401	0A	VOLTAGE TRANSFORMER SPECIFICATION	07/14/2017	30% DESIGN	
NWO-0501	0A	NEUTRAL GROUNDING REACTOR SPECIFICATION	08/24/2017	30% DESIGN	
NWO-0502	0A	CAPACITOR BANK SPECIFICATION	10/19/2017	60% DESIGN	
NWO-0600	0B	CONTROL ENCLOSURE SPECIFICATION	10/26/2019	MANUFACTURE	
NWO-AC1-001	0B	AC DISTRIBUTION SYSTEM	01/25/2018	CONSTRUCTION	X
NWO-AC1-002	0D	AC PANEL 1	01/25/2018	CONSTRUCTION	X
NWO-AS1-001	0C	SUBSTATION THREE LINE DIAGRAM	01/25/2018	CONSTRUCTION	X
NWO-AS1-002	0B	SUBSTATION THREE LINE DIAGRAM	01/25/2018	CONSTRUCTION	X
NWO-AS1-003	0B	THREE LINE DIAGRAM FEEDERS 2, 3 & 4	01/25/2018	CONSTRUCTION	X
NWO-AS1-004	0B	THREE LINE DIAGRAM FEEDER 1 & VAR BUS	01/25/2018	CONSTRUCTION	X
NWO-AS2-001	0C	AC SCHEMATICS LINE RELAYS	01/25/2018	CONSTRUCTION	X
NWO-AS2-002	0B	AC SCHEMATIC TRANSFORMER T1 RELAYS	01/25/2018	CONSTRUCTION	X
NWO-AS2-003	0B	AC SCHEMATIC 34.5KV BUS #1 RELAY	01/25/2018	CONSTRUCTION	X
NWO-AS2-004	0B	AC SCHEMATIC FEEDER RELAYS	01/25/2018	CONSTRUCTION	X
NWO-AS2-005	0B	AC SCHEMATIC VAR BUS RELAYS & GE WFMS	01/25/2018	CONSTRUCTION	X
NWO-CC1-001	0C	138/34.5KV SUBSTATION CONDUIT PLAN	01/25/2018	CONSTRUCTION	X
NWO-CC2-001	0B	138/34.5KV SUBSTATION CONDUIT DETAILS	01/25/2018	CONSTRUCTION	X
NWO-CC2-002	0B	138/34.5KV SUBSTATION CONDUIT DETAILS	01/25/2018	CONSTRUCTION	X
NWO-CC3-001	0B	138/34.5KV SUBSTATION CONDUIT SCHEDULE	01/25/2018	CONSTRUCTION	X
NWO-CH1-001	0C	SUBSTATION CONTROL ENCLOSURE TOP PLAN	10/26/2017	MANUFACTURE	
NWO-COM-001	0B	SUBSTATION COMM DIAGRAM	11/21/2017	90% DESIGN	
NWO-COM-002	0A	COMM PORT DIAGRAM	11/21/2017	90% DESIGN	
NWO-COM-003	0A	IRIG-B DIAGRAM	11/21/2017	90% DESIGN	
NWO-COM-004	0A	FIBER PATCH PANEL #1 CONNECTION DIAGRAM	11/21/2017	90% DESIGN	
NWO-COM-005	0A	FIBER PATCH PANEL #2 CONNECTION DIAGRAM	11/21/2017	90% DESIGN	
NWO-COM-006	0A	FIBER PATCH PANEL #2 CONNECTION DIAGRAM	11/21/2017	90% DESIGN	
NWO-COM-007	0A	PERMANENT FIBER CONNECTION DIAGRAM	11/21/2017	90% DESIGN	
NWO-DC1-001	0D	DC PANELS 1 & 2	01/25/2018	CONSTRUCTION	X
NWO-DS1-001	0B	DC SCHEMATIC LINE RELAY 87L1P GE L90	01/25/2018	CONSTRUCTION	X
NWO-DS1-002	0B	DC SCHEMATIC LINE RELAY 87L1S SEL-411L	01/25/2018	CONSTRUCTION	X
NWO-DS1-003	0B	DC SCHEMATIC BREAKER 52T1 RELAY 11T1H SEL-351	01/25/2018	CONSTRUCTION	X
NWO-DS1-004	0B	DC SCHEMATIC LOCKOUT RELAY 86BFT1, 86T1P & 86T1S	01/25/2018	CONSTRUCTION	X
NWO-DS1-005	0B	DC SCHEMATIC TRANSFROMER T1 RELAY 87T1P SEL-387A	01/25/2018	CONSTRUCTION	X
NWO-DS1-006	0B	DC SCHEMATIC TRANSFROMER T1 RELAY 87T1S SEL-387A	01/25/2018	CONSTRUCTION	X
NWO-DS1-007	0B	DC SCHEMATIC 34.5KV BUS 1 RELAY 87B1 SEL-587Z	01/25/2018	CONSTRUCTION	X
NWO-DS1-008	0B	DC SCHEMATICS 34.5KV BUS 1 RELAY 11T1L SEL-351	01/25/2018	CONSTRUCTION	X
NWO-DS1-009	0B	DC SCHEMATIC FEEDER RELAY 11F1 SEL-351	01/25/2018	CONSTRUCTION	X
NWO-DS1-010	0B	DC SCHEMATIC FEEDER RELAY 11F2 SEL-351	01/25/2018	CONSTRUCTION	X
NWO-DS1-011	0B	DC SCHEMATIC FEEDER RELAY 11F3 SEL-351	01/25/2018	CONSTRUCTION	X
NWO-DS1-012	0B	DC SCHEMATIC FEEDER RELAY 11F4 SEL-351	01/25/2018	CONSTRUCTION	X
NWO-DS1-013	0B	DC SCHEMATIC VAR BUS 1 RELAY 11V1 SEL-487V	01/25/2018	CONSTRUCTION	X
NWO-DS1-014	0B	DC SCHEMATIC LOCKOUT RELAY 86C1	01/25/2018	CONSTRUCTION	X
NWO-DS1-100	0B	DC SCHEMATIC MTRL1, ESW1, CLK1, INV1	01/25/2018	CONSTRUCTION	X
NWO-DS1-101	0B	DC SCHEMATIC HMI1 SEL-3355	01/25/2018	CONSTRUCTION	X
NWO-DS1-102	0B	DC SCHEMATIC RTU1 SEL-3530	01/25/2018	CONSTRUCTION	X
NWO-DS1-103	0C	DC SCHEMATIC DPAC1 SEL-2440	01/25/2018	CONSTRUCTION	X
NWO-DS1-104	0B	DC SCHEMATIC DIGITAL FAULT RECORDER DFR1 SHEET 1 OF 3	01/25/2018	CONSTRUCTION	X
NWO-DS1-105	0B	DC SCHEMATIC DIGITAL FAULT RECORDER DFR1 SHEET 2 OF 3	01/25/2018	CONSTRUCTION	X
NWO-DS1-106	0B	DC SCHEMATIC DIGITAL FAULT RECORDER DFR1 SHEET 3 OF 3	01/25/2018	CONSTRUCTION	X
NWO-DS2-001	0B	DC SCHEMATIC LINE MOD 89T1	01/25/2018	CONSTRUCTION	X
NWO-DS2-002	0B	DC SCHEMATIC BREAKER 52T1	01/25/2018	CONSTRUCTION	X
NWO-DS2-003	0B	DC SCHEMATIC TRANSFORMER T1	01/25/2018	CONSTRUCTION	X
NWO-DS2-005	0B	DC SCHEMATIC 34.5KV DISCONNECT SWITCH 89B1	01/25/2018	CONSTRUCTION	X
NWO-DS2-006	0B	DC SCHEMATIC FEEDER BREAKER 52F1	01/25/2018	CONSTRUCTION	X
NWO-DS2-007	0B	DC SCHEMATIC FEEDER BREAKER 52F2	01/25/2018	CONSTRUCTION	X
NWO-DS2-008	0B	DC SCHEMATIC FEEDER BREAKER 52F3	01/25/2018	CONSTRUCTION	X
NWO-DS2-009	0B	DC SCHEMATIC FEEDER BREAKER 52F4	01/25/2018	CONSTRUCTION	X
NWO-DS2-010	0B	DC SCHEMATIC VAR BUS BREAKER 52V1	01/25/2018	CONSTRUCTION	X
NWO-DS2-011	0B	DC SCHEMATIC CAP SWITCHER 89C1	01/25/2018	CONSTRUCTION	X
NWO-EQ1-001	0E	SUBSTATION GENERAL ARRANGEMENT	01/25/2018	CONSTRUCTION	X
NWO-EQ2-001	0B	138KV ELECTRICAL LAYOUT SECTIONS	01/25/2018	CONSTRUCTION	X
NWO-EQ2-002	0B	138KV ELECTRICAL LAYOUT SECTIONS	01/25/2018	CONSTRUCTION	X
NWO-EQ2-003	0B	34.5KV ELECTRICAL LAYOUT SECTIONS	01/25/2018	CONSTRUCTION	X
NWO-EQ2-004	0B	34.5KV ELECTRICAL LAYOUT SECTIONS	01/25/2018	CONSTRUCTION	X
NWO-EQ3-001	0B	138/34.5KV ELECTRICAL DETAILS	01/25/2018	CONSTRUCTION	X
NWO-EQ4-001	0B	138/34.5KV SUBSTATION MATERIAL LIST	01/25/2018	CONSTRUCTION	X
NWO-F1-001	0E	SUBSTATION FOUNDATION PLAN	01/25/2018	CONSTRUCTION	X
NWO-F2-001	0B	138/34.5KV SUBSTATION FOUNDATION DETAIL PIERS P1-P5	01/12/2018	CONSTRUCTION	
NWO-F3-001	0C	138/34.5KV SUBSTATION FOUNDATION DETAILS SLAB S3	01/25/2018	CONSTRUCTION	X
NWO-F4-001	0B	138/34.5KV SUBSTATION FOUNDATION DETAILS XFMR FOUNDATION DETAILS	01/25/2018	CONSTRUCTION	X
NWO-F5-001	0B	138/34.5KV SUBSTATION FOUNDATION DETAILS SLABS S1, S2, S4, S5	01/12/2018	CONSTRUCTION	
NWO-F6-001	0B	138/34.5KV SUBSTATION FOUNDATION DETAILS SLAB S6	01/12/2018	CONSTRUCTION	
NWO-FE-001	0C	SUBSTATION ELEVATION & BOM COMMUNICATION RELAY PANEL 1	01/25/2018	CONSTRUCTION	X

DRAWING NAME	REV	DOCUMENT TITLE	DATE	SUBMITTAL	ATTACHED
NWO-FE-002	0C	SUBSTATION ELEVATION & BOM LINE RELAYING RELAY PANEL 2	01/25/2018	CONSTRUCTION	X
NWO-FE-003	0C	SUBSTATION ELEVATION & BOM TRANSFORMER T1 RELAY PANEL 3	01/25/2018	CONSTRUCTION	X
NWO-FE-004	0C	SUBSTATION ELEVATION & BOM FEEDER 1, 2, 3 & 4 RELAY PANEL 4	01/25/2018	CONSTRUCTION	X
NWO-FE-005	0C	SUBSTATION ELEVATION & BOM VAR BUS 1 & 34.5KV BUS 1 RELAY PANEL 5	01/25/2018	CONSTRUCTION	X
NWO-FE-006	0C	SUBSTATION ELEVATION & BOM FIBER PATCH PANEL 1	01/25/2018	CONSTRUCTION	X
NWO-FE-007	0C	SUBSTATION ELEVATION & BOM FIBER PATCH PANEL 2	01/25/2018	CONSTRUCTION	X
NWO-FE-008	0C	SUBSTATION ELEVATION & BOM MARSHALLING CABINET MC1 & MC2	01/25/2018	CONSTRUCTION	X
NWO-FP1-001	0B	FENCE PLAN AND DETAILS	01/25/2018	CONSTRUCTION	X
NWO-GD1-001	0D	SUBSTATION GRADING PLAN	01/25/2018	CONSTRUCTION	X
NWO-GD1-002	0B	SUBSTATION GRADING DETAILS	01/25/2018	CONSTRUCTION	X
NWO-GR1-001	0C	138/34.5KV SUBSTATION GROUNDING PLAN	01/25/2018	CONSTRUCTION	X
NWO-GR2-001	0B	138/34.5KV SUBSTATION GROUNDING DETAILS	01/25/2018	CONSTRUCTION	X
NWO-GR2-002	0B	138/34.5KV SUBSTATION GROUNDING DETAILS	10/19/2017	CONSTRUCTION	X
NWO-GR2-003	0B	138/34.5KV SUBSTATION GROUNDING DETAILS	10/19/2017	CONSTRUCTION	X
NWO-GR3-001	0B	138/34.5KV SUBSTATION GROUNDING MATERIAL LIST	10/19/2017	CONSTRUCTION	X
NWO-OL1-001	0F	ONE LINE DIAGRAM	01/25/2018	CONSTRUCTION	X
NWO-S0-001	0B	138/34.5KV SUBSTATION GENERAL ARRANGEMNET STEEL LOCATION PLAN	01/25/2018	CONSTRUCTION	X
NWO-S1-001	0B	138/34.5KV PROJECT SUBSTATION 138KV DEADEND "CB" STEEL LAYOUT	01/25/2018	CONSTRUCTION	X
NWO-S1-002	0B	138/34.5KV PROJECT SUBSTATION 138KV DEADEND "CB" STEEL LAYOUT	01/25/2018	CONSTRUCTION	X
NWO-S1-003	0B	138/34.5KV PROJECT SUBSTATION 138KV DEADEND "CB" STEEL LAYOUT	01/25/2018	CONSTRUCTION	X
NWO-S1-004	0B	138/34.5KV PROJECT SUBSTATION 138KV DEADEND "CB" STEEL LAYOUT	01/25/2018	CONSTRUCTION	X
NWO-S2-001	0B	138/34.5KV PROJECT SUBSTATION 90' SHIELD POLE "SP" STEEL DETAILS	01/25/2018	CONSTRUCTION	X
NWO-S3-001	0B	138/34.5KV SUBSTATION 138KV 1Ø BUS SUPPORT "VS"	01/25/2018	CONSTRUCTION	X
NWO-S4-001	0B	138/34.5KV SUBSTATION 34.5KV SWITCH STAND "HS"	01/25/2018	CONSTRUCTION	X
NWO-S5-001	0B	138/34.5KV SUBSTATION 34.5KV NGR SUPPORT "RT"	01/25/2018	CONSTRUCTION	X
NWO-S6-001	0B	138/34.5KV SUBSTATION 34.5KV CABLE TERMINAL STAND "TM"	01/25/2018	CONSTRUCTION	X
NWO-S6-002	0B	138/34.5KV SUBSTATION 34.5KV CABLE TERMINAL STAND "TM"	01/25/2018	CONSTRUCTION	X
NWO-S7-001	0B	138/34.5KV SUBSTATION 34.5KV COLLECTION STRUCTURE "CS"	01/25/2018	CONSTRUCTION	X
NWO-S7-002	0B	138/34.5KV SUBSTATION 34.5KV COLLECTION STRUCTURE "CS"	01/25/2018	CONSTRUCTION	X
NWO-S7-003	0B	138/34.5KV SUBSTATION 34.5KV COLLECTION STRUCTURE "CS"	01/25/2018	CONSTRUCTION	X
NWO-S8-001	0B	138/34.5KV SUBSTATION 34.5KV 3Ø BUS & SS SUPPORT "SS"	01/25/2018	CONSTRUCTION	X
NWO-S9-001		NO LONGER NEEDED			
NWO-S10-001		NO LONGER NEEDED			
NWO-SW1-001	0E	SWITCHING DIAGRAM AND DEVICE LEGEND	01/25/2018	CONSTRUCTION	X
NWO-WD1-001	0C	WIRING DIAGRAM MARSHALLING CABINET MC1 SHEET 1	01/25/2018	CONSTRUCTION	X
NWO-WD1-002	0C	WIRING DIAGRAM MARSHALLING CABINET MC1 SHEET 2	01/25/2018	CONSTRUCTION	X
NWO-WD2-001	0A	WIRING DIAGRAM LINE MOD 89T1	01/25/2018	CONSTRUCTION	X
NWO-WD2-002	0A	WIRING DIAGRAM CCVTL1 JUNCTION BOX	01/25/2018	CONSTRUCTION	X
NWO-WD2-003	0A	WIRING DIAGRAM BREAKER 52T1	01/25/2018	CONSTRUCTION	X
NWO-WD2-004	0A	WIRING DIAGRAM TRANSFROMER T1	01/25/2018	CONSTRUCTION	X
NWO-WD2-005	0A	WIRING DIAGRAM 34.5KV DISCONNECT SWITCH 89B1	01/25/2018	CONSTRUCTION	X
NWO-WD2-006	0A	WIRING DIAGRAM VTB1 JUNCTION BOX	01/25/2018	CONSTRUCTION	X
NWO-WD2-007	0A	WIRING DIAGRAM FEEDER BREAKER 52F1	01/25/2018	CONSTRUCTION	X
NWO-WD2-008	0A	WIRING DIAGRAM FEEDER BREAKER 52F2	01/25/2018	CONSTRUCTION	X
NWO-WD2-009	0A	WIRING DIAGRAM FEEDER BREAKER 52F3	01/25/2018	CONSTRUCTION	X
NWO-WD2-010	0A	WIRING DIAGRAM FEEDER BREAKER 52F4	01/25/2018	CONSTRUCTION	X
NWO-WD2-012	0A	WIRING DIAGRAM VAR BUS BREAKER 52V1	01/25/2018	CONSTRUCTION	X
NWO-WD2-013	0A	WIRING DIAGRAM CAP SWITCHER 89C1	01/25/2018	CONSTRUCTION	X
NWO-WD2-014	0A	WIRING DIAGRAM VTC1 JUNCTION BOX	01/25/2018	CONSTRUCTION	X

DEVICE LEGEND

- INLINE FUSE
- FUSED DISCONNECT
- FUSED CUT-OUT SWITCH
- MOTOR OPERATED DOUBLE END BREAK DISCONNECT SWITCH
- HOOKSTICK OPERATED DISCONNECT SWITCH
- GROUP OPERATED, MANUALLY OPERATED DISCONNECT SWITCH
- GROUNDING SWITCH
- BUSHING
- BUSHING TYPE CURRENT TRANSFORMER
- SF6 OR VACUUM CIRCUIT BREAKER
- GROUNDING CIRCUIT BREAKER
- REACTIVE SUPPORT SWITCHER
- TERMINATION POINT (UNDERGROUND)
- UNDERGROUND CABLE
- NORMALLY CLOSED (FORM B) CONTACT
- NORMALLY OPEN (FORM A) CONTACT
- SURGE ARRESTER
- AUTOMATIC TRANSFER SWITCH
- NEUTRAL GROUNDING REACTOR
- REACTOR BANK
- CAPACITOR BANK
- VOLTAGE TRANSFORMER
- COUPLING CAPACITOR VOLTAGE TRANSFORMER
- KIRK KEY INTERLOCK
- DFR CURRENT MODULE
- DFR VOLTAGE MODULE
- CHECK METER (PHASOR MEASUREMENT UNIT)
- LOCK-OUT RELAY
- PROTECTIVE RELAY
- OUTDOOR EQUIPMENT CABINET TERMINAL BLOCK
- OUTDOOR EQUIPMENT CABINET SHORTING TERMINAL BLOCK
- TERMINATION CABINET TERMINAL BLOCK
- TERMINATION CABINET SHORTING TERMINAL BLOCK
- RELAY PANEL TERMINAL BLOCK
- RELAY PANEL SHORTING TERMINAL BLOCK

DEVICE FUNCTION NUMBER LIST (ANSI C37.2)			
NO.	FUNCTION AND DEFINITION	NO.	FUNCTION AND DEFINITION
11	MULTIFUNCTION	59L	HOT LINE (SYNCH. CHECK)
21	DISTANCE	59B	HOT BUS (SYNCH. CHECK)
21G	GROUND DISTANCE	62	TIMING RELAY
24	VOLTS PER HERTZ	63	TRANSFORMER PRESSURE RELAY
25	SYNCH. CHECK (HOT LINE/DEAD BUS)	64	GROUND FAULT
26Q	OIL TEMPERATURE THERMOMETER	67P	AC DIRECTIONAL OVERCURRENT
27	UNDERVOLTAGE	67G	GROUND DIRECTIONAL OVERCURRENT
27B	DEAD BUS (SYNCH. CHECK)	71Q	OIL LEVEL INDICATOR DEVICE
46	REVERSE PHASE LOCK-OUT	81	FREQUENCY
49T	TRANSFORMER THERMAL RELAY	86B	BUS LOCK-OUT RELAY
50	INSTANTANEOUS OVERCURRENT	86BF	BREAKER FAILURE LOCK-OUT RELAY
50G	GROUND INSTANTANEOUS OVERCURRENT	86T	TRANSFORMER LOCK-OUT RELAY
50BF	BREAKER FAILURE	87	DIFFERENTIAL
51	AC TIME OVERCURRENT	87L	LINE DIFFERENTIAL
51P	PHASE AC TIME OVERCURRENT	87B	BUS DIFFERENTIAL
51G	GROUND AC TIME OVERCURRENT	87T	TRANSFORMER DIFFERENTIAL
51N	NEUTRAL TIME OVERCURRENT	87N	RESTRICTED EARTH FAULT
52	AC CIRCUIT BREAKER	87V	ZERO SEQ. VOLTAGE DIFFERENTIAL
59	OVERVOLTAGE	89	LINE DISCONNECT SWITCH
59N	NEUTRAL VOLTAGE DISPLACEMENT	90	REGULATING DEVICE



NORTHWEST OHIO WIND PROJECT

PAULDING COUNTY, OHIO

Rev.	Date	Description	By
A	07/21/17	PRELIMINARY	UEI
0B	10/19/17	PRELIMINARY	UEI
0C	11/21/17	90% REVIEW PACKAGE	UEI
0D	01/10/18	90% PACKAGE UPDATES	UEI
0E	01/25/18	ISSUED FOR CONSTRUCTION	UEI

WHITE an IEA company

CONSTRUCTION

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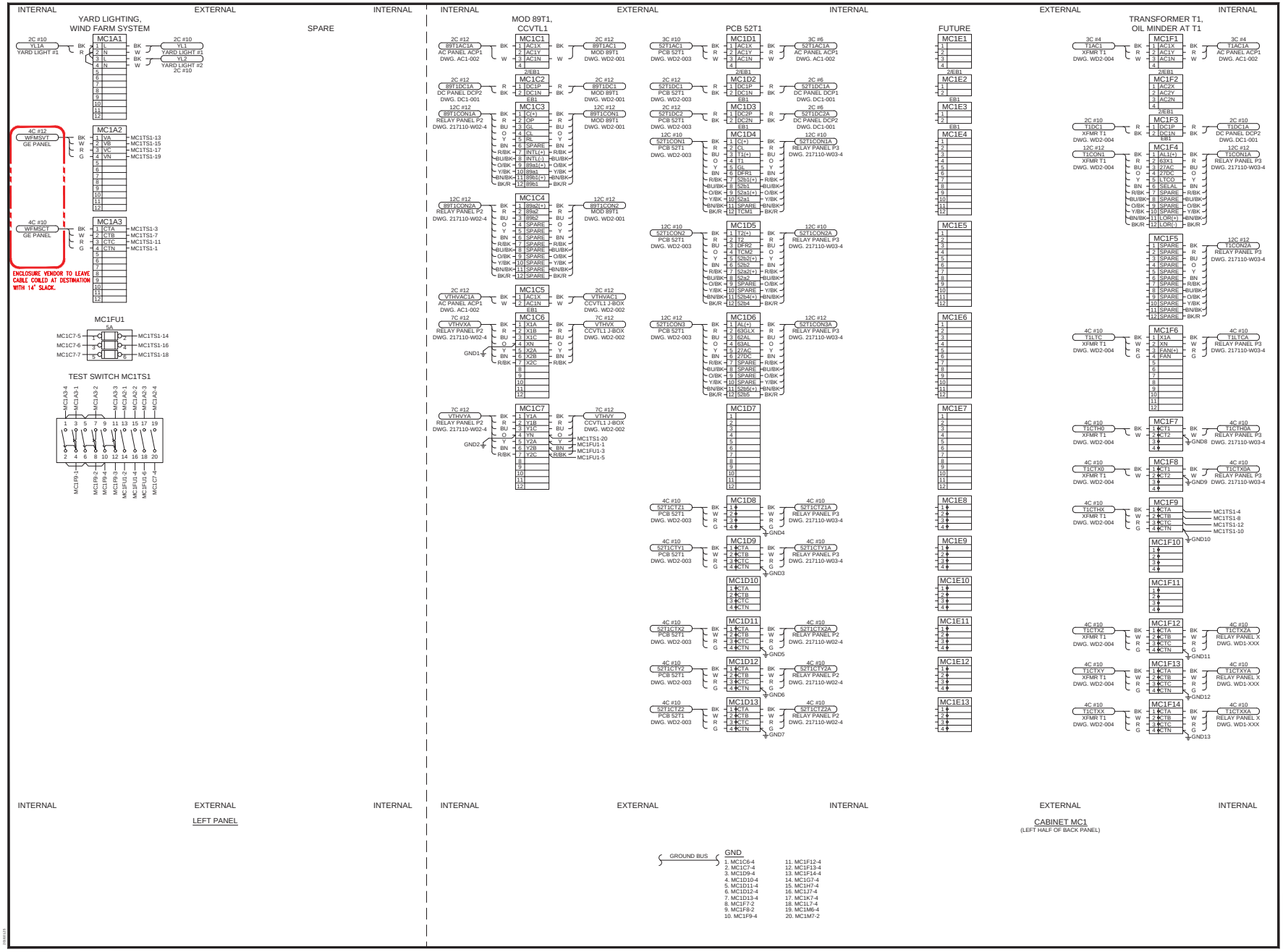
Design By: E. NEUHARDT
Drawn By: E. NEUHARDT
Approved By: J.LIEN
Project Number: 17.01246

SUBSTATION SINGLE LINE DIAGRAM AND DEVICE LEGEND

DWG #: NWO-SW1-001

REVISION: 0E



NORTHWEST OHIO WIND PROJECT

PAULDING COUNTY, OHIO

Rev.	Date	Description	By
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0B	01/10/18	90% PACKAGE UPDATES	UEI
0C	01/25/18	ISSUED FOR CONSTRUCTION	UEI

WHITE an IEA company

NOTES:
1. TERMINAL BLOCKS ARE GE EB25-27 UNLESS OTHERWISE NOTED.
2. ALL CABLE SHIELDS GROUNDED IN MARSHALLING CABINET.
3. TERMINAL BLOCKS SHALL BE LABELED BASED ON THE TERMINAL NUMBER. WIRE LABELS ARE SHOWN INSIDE OF THE TERMINAL BLOCKS FOR EXTERNAL EQUIPMENT CABLES.
4. INTERNAL CABLES FROM MARSHALLING CABINET TO INTERNAL DESTINATION PROVIDED BY ENCLOSURE VENDOR.
5. EXTERNAL CABLES FROM MARSHALLING CABINET TO EXTERNAL DESTINATION PROVIDED BY CONSTRUCTION CONTRACTOR.
6. FINAL CABLE SIZES AND TERMINAL BLOCK LABELS ON HOLD UNTIL FINAL EXTERNAL EQUIPMENT VENDOR DRAWINGS RECEIVED.

INTERNAL NOTES:
1. ALL WIRING TO BE #10 AWG, SIS EXCEPT AS NOTED:
   * - #12 AWG, SIS
   ** - #10 AWG, GREEN SIS FOR GROUNDS
2. AMP NON-INSULATED RING TONGUE TYPE LUGS.
3. DESTINATION TYPE WIRE MARKERS.

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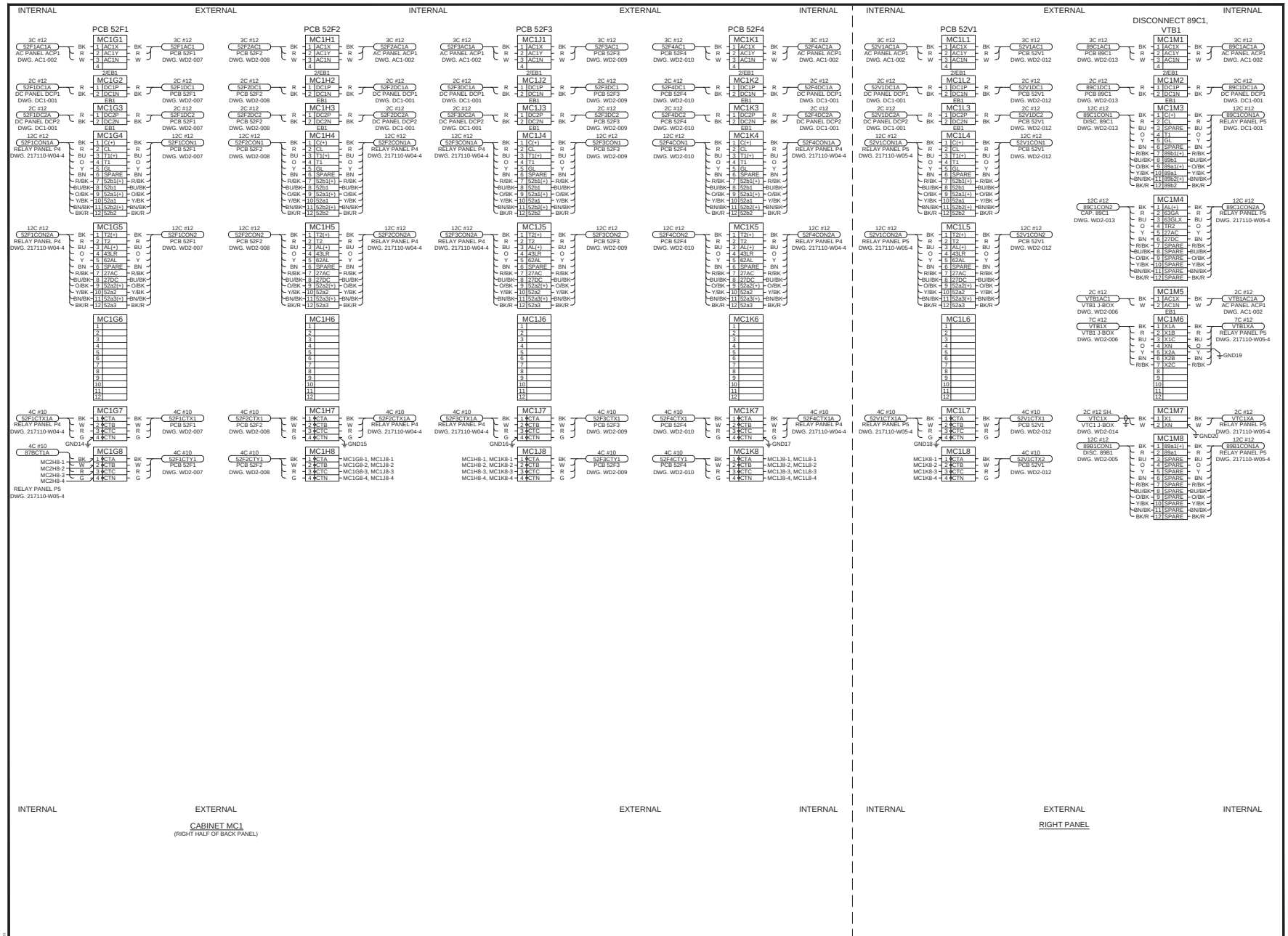
Drawn By: T. ADAMS
Approved By: J. OLSON
Project Number: 17.01246

SUBSTATION WIRING DIAGRAM
MARSHALLING CABINET MC1
SHEET 1

DWG #: NWO-WD1-001
REVISION: 0C



NORTHWEST OHIO WIND PROJECT

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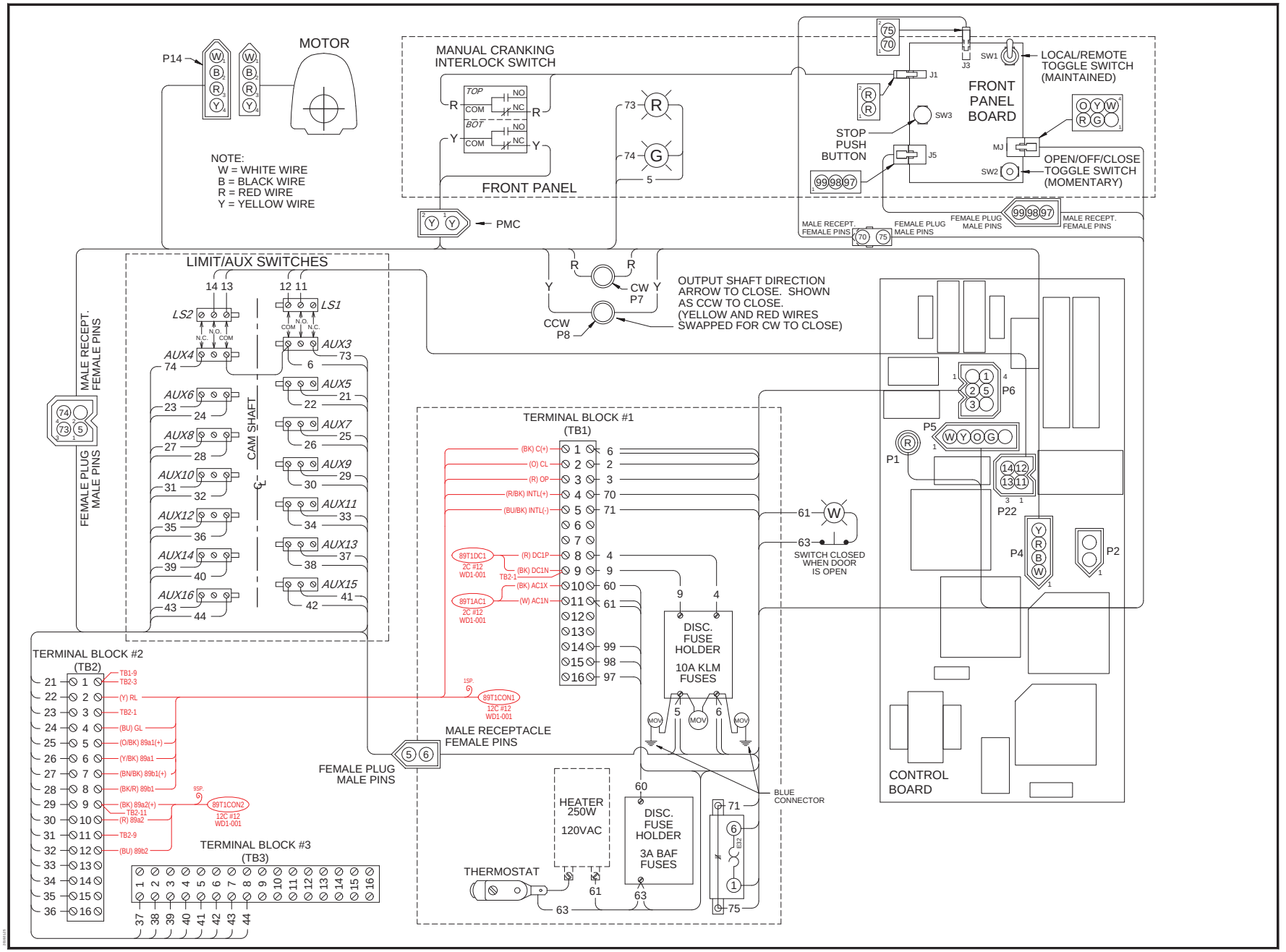
Approved By: J. OLSON
Project Number: 17.01246

SUBSTATION
WIRING DIAGRAM
MARSHALLING CABINET
MC1
SHEET 2

DWG #: NWO-WD1-002

REVISION: 0C



NORTHWEST OHIO
WIND PROJECT

PAULDING COUNTY, OHIO

Rev.	Date	Description	By
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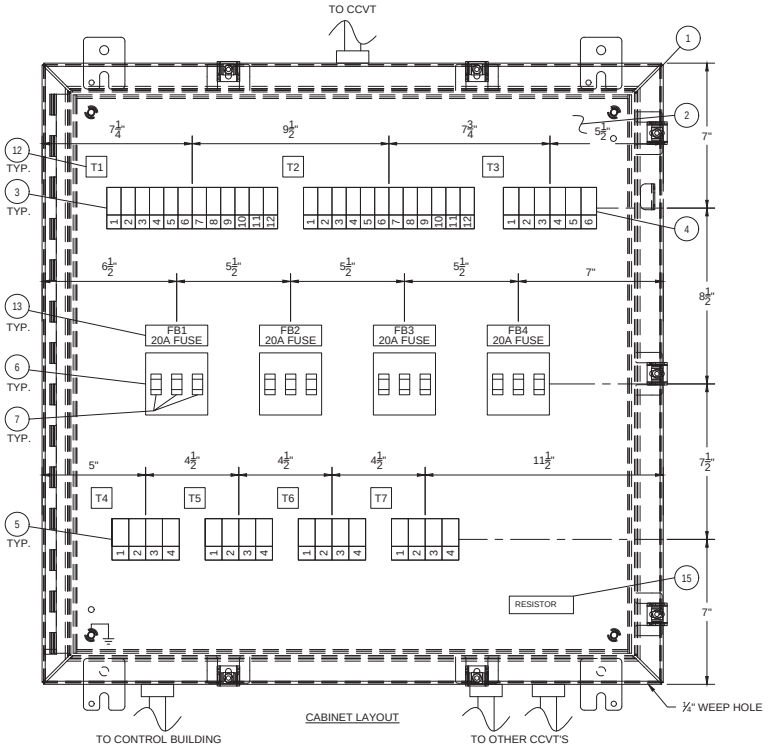
Approved By: J. OLSON
Project Number: 17.01246

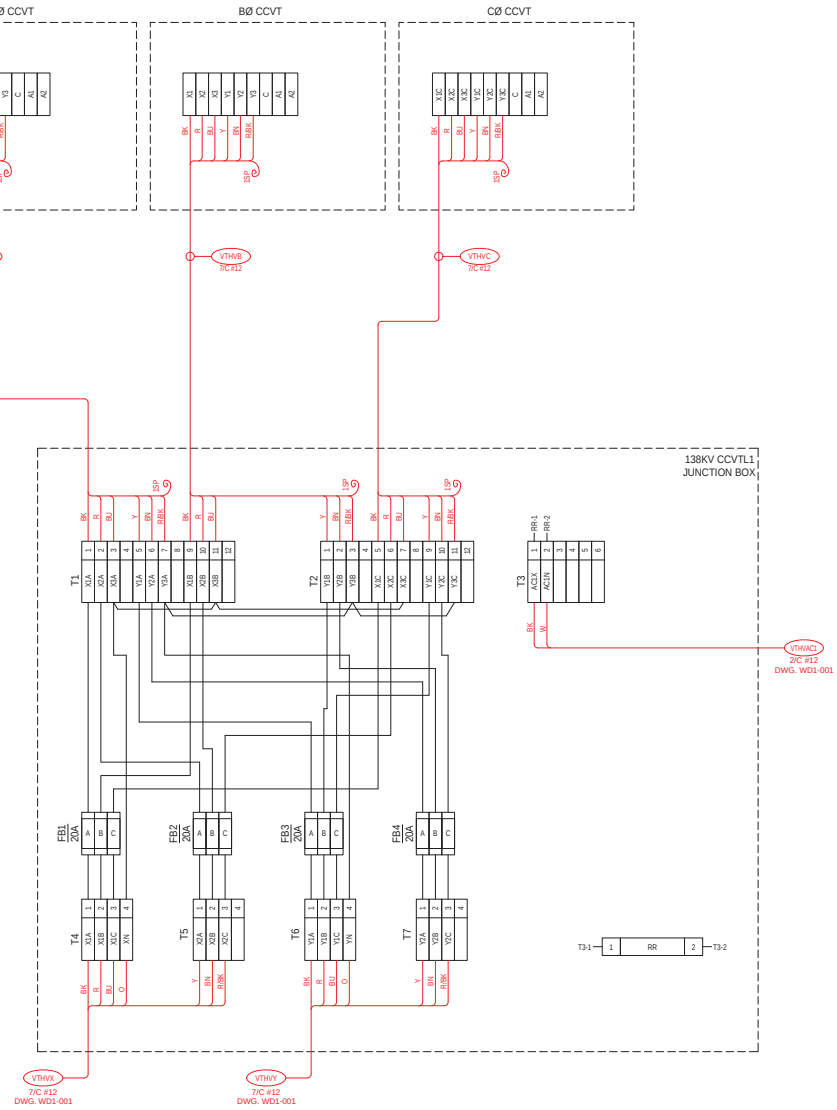
89T1
WIRING DIAGRAM

DWG #: NWO-WD2-001
REVISION: 0A

CABINET MATERIAL LIST		
ITEM	QTY	DESCRIPTION
1	1	NEMA TYPE 4 ENCLOSURE 30" x 30" x 8", GASKETED HOFFMAN ENGINEERING CO., CATALOG # A30H30BLP.
2	1	PANEL FOR ITEM 1. HOFFMAN ENGINEERING CO., CATALOG # A30P30.
3	2	12 POINT TERMINAL BLOCK, GE TYPE EB25B12.
4	1	6 POINT TERMINAL BLOCK, GE TYPE EB25B06.
5	4	4 POINT TERMINAL BLOCK, GE TYPE EB25B04.
6	4	3 POLE CARTRIDGE FUSE HOLDER, 250V, 30A, BUSSMANN CATALOG # RM25030-3QR OR EQUAL.
7	12	20 AMP FUSE FOR USE WITH ITEM 6. 250V, BUSSMANN CATALOG # LPN-RK-20 OR EQUAL.
8	1 LOT	#10 THHN OR SIS WIRE, TINNED AND STRANDED,600V INSULATION.
9	1 LOT	#12 THHN OR SIS WIRE, TINNED AND STRANDED 600V INSULATION.
10	1 LOT	CRIMP TERMINALS, UNISULATED, CORROSION RESISTANT SILVER OR TIN PLATED, RING TONGUE TYPE.
11	1	FRONT OF PANEL, ADHESIVE MOUNTED NAMEPLATE, BLACK PHENOLIC WITH WHITE LETTERS, 1 1/2" x 8". ONE NAMEPLATE WITH THE FOLLOWING ENGRAVING: "CCVT SECONDARY FUSE CABINET"
12	7	ADHESIVE MOUNTED NAMEPLATE, BLACK PHENOLIC WITH WHITE LETTERS, 1" x 1", ONE NAMEPLATE WITH EACH OF THE FOLLOWING ENGRAVING: T1, T2, T3, T4, T5, T6, T7
13	4	ADHESIVE MOUNTED NAMEPLATE, BLACK PHENOLIC WITH WHITE LETTERS, 1" x 3", ONE NAMEPLATE WITH EACH OF THE FOLLOWING ENGRAVING: FB1 20A FUSE, FB2 20A FUSE, FB3 20A FUSE, FB4 20A FUSE
14	4	CABINET MOUNTING BOLTS, 1/2" x 2 1/2" BOLT, NUT, LOCK AND FLAT WASHER.
15	1	RESISTOR 250 OHM, 175 WATT WITH HOLDER. OHMITE CATALOG L175J250E & 6110-P-8 1/2 E



CABINET LAYOUT



CCVTL1

NORTHWEST OHIO WIND PROJECT

PAULDING COUNTY, OHIO

Rev.	Date	Description	By
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NOTES:
1. NAMEPLATES ARE TO BE BLACK PHENOLIC WITH WHITE LETTERING AND ADHESIVE BACKING. TEXT SHALL BE CENTERED ON EACH LINE.
2. JUNCTION BOX TO BE GROUNDED.
3. WIRING AND JUMPERS TO BE INSTALLED BY CONTRACTOR AS SHOWN.
4. CONTROL CABLE SHIELD SHALL BE PULLED BACK AND TAPED.

CONSTRUCTION

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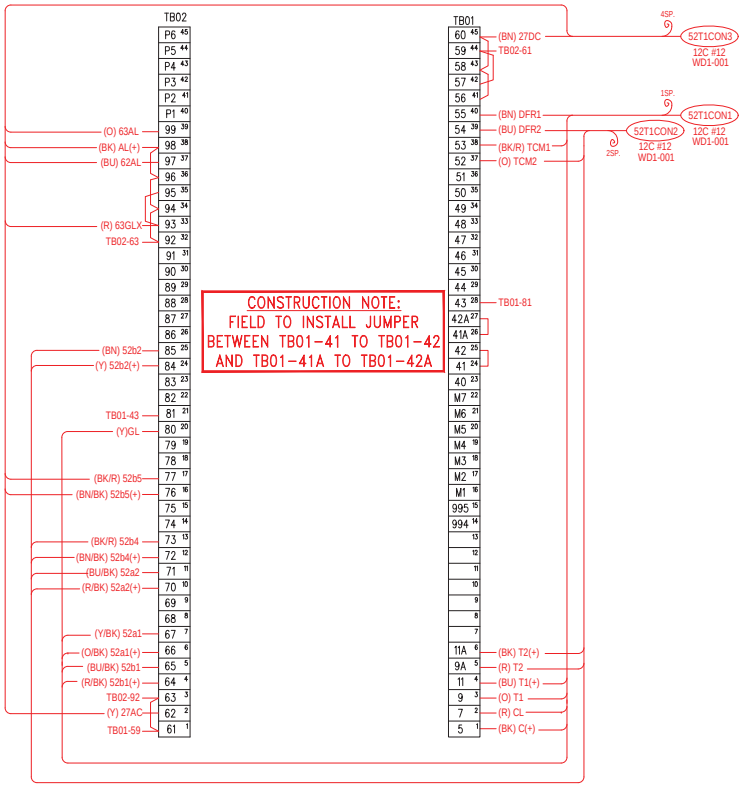
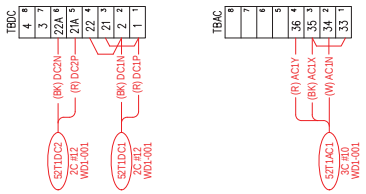
Approved By: J. OLSON
Project Number: 17.01246

WIRING DIAGRAM
CCVTL1 JUNCTION BOX

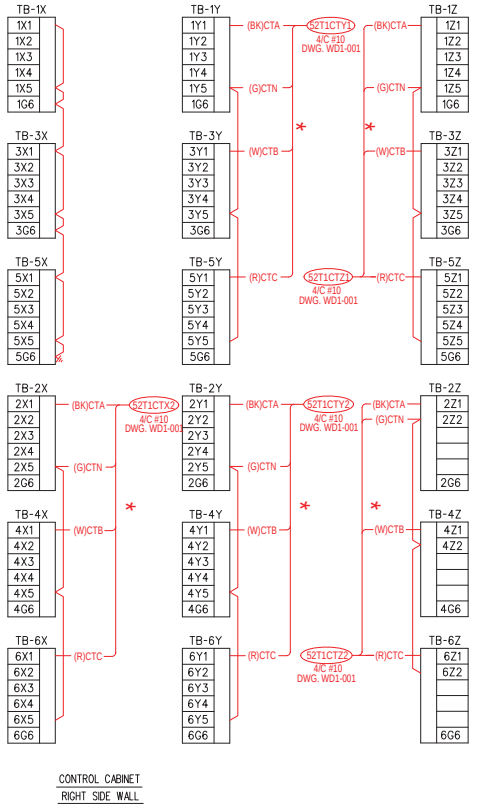
DWG #: NWO-WD2-002
REVISION: 0A





PANEL ASSY

CONSTRUCTION NOTE:
* =FIELD TO
REMOVE SHORTENING
SCREW AND OR
JUMPER



CONTROL CABINET
RIGHT SIDE WALL

NORTHWEST OHIO
WIND PROJECT

PAULDING COUNTY, OHIO

Rev.	Date	Description	By
0A	01/25/18	ISSUED FOR CONSTRUCTION	UEI

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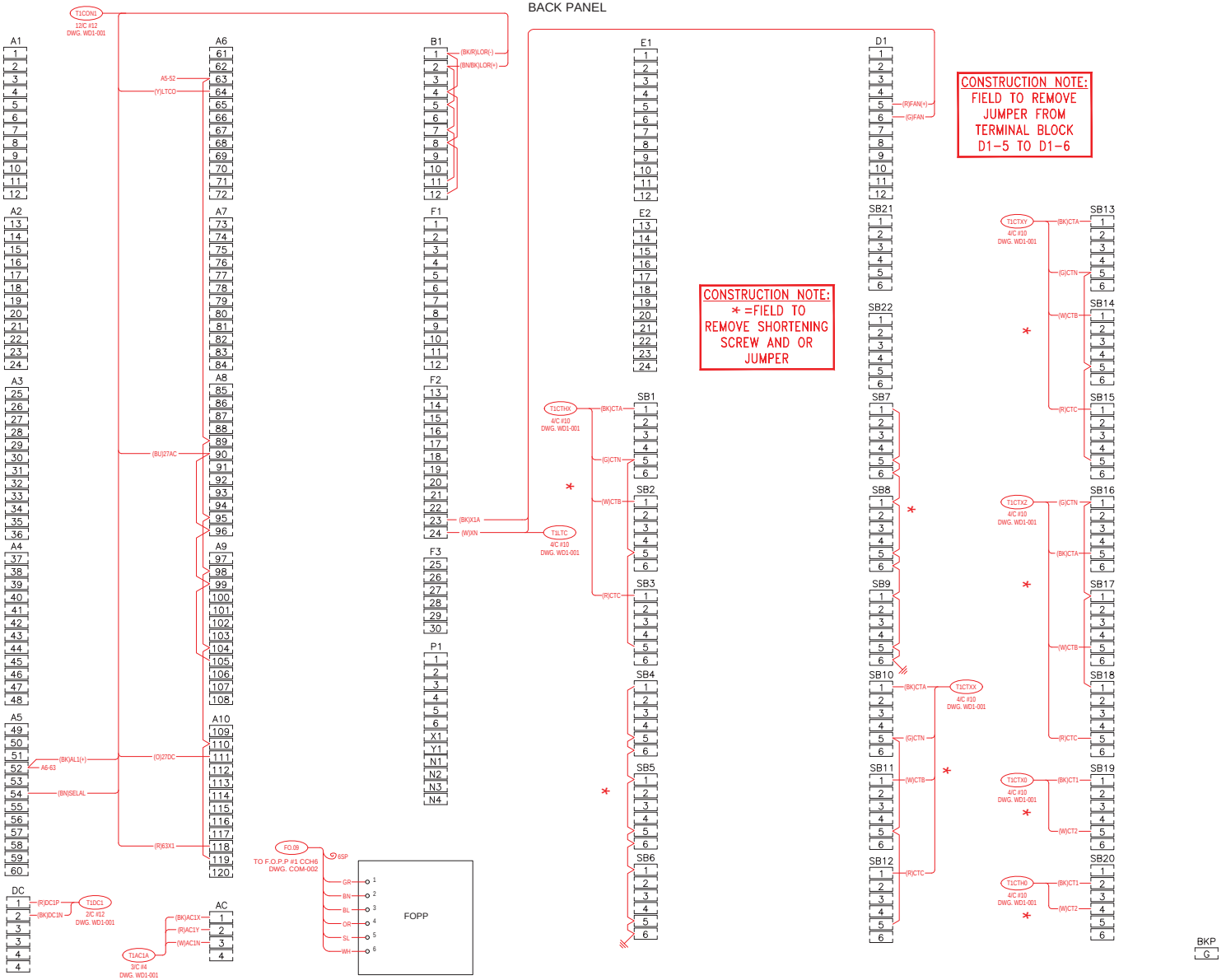
BREAKER 52T1
WIRING DIAGRAM

DWG #: NWO-WD2-003
REVISION: 0A



NORTHWEST OHIO WIND PROJECT

PAULDING COUNTY, OHIO

Rev.	Date	Description	By
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WHITE an IEA company

NOTES:
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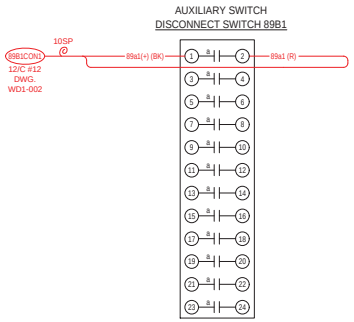
WIRING DIAGRAM
TRANSFORMER T1

DWG #: NWO-WD2-004
REVISION: 0A



NORTHWEST OHIO
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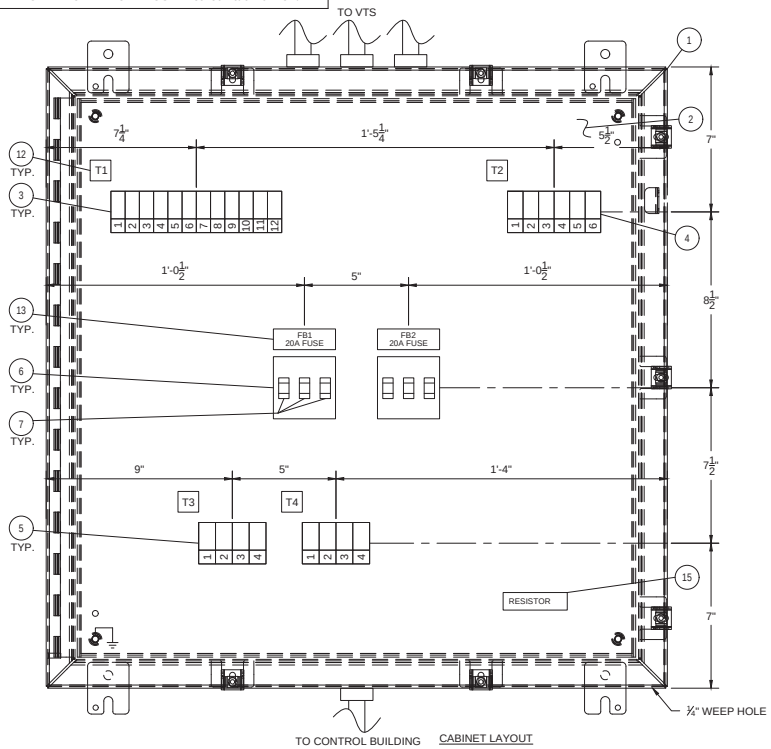
WIRING DIAGRAM
DISCONNECT
SWITCH 89B1

DWG #: NWO-WD2-005
REVISION: 0A

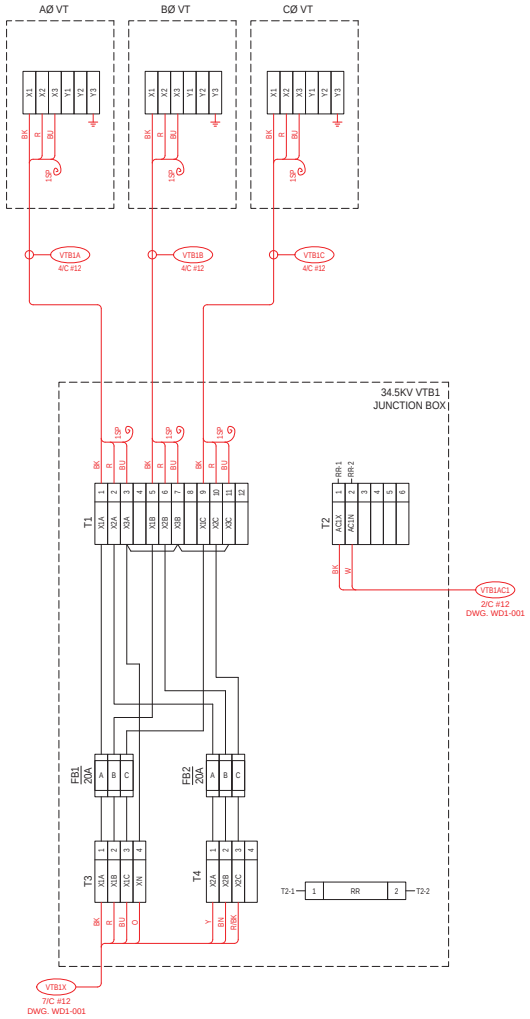
CABINET MATERIAL LIST

ITEM	QTY	DESCRIPTION
1	1	NEMA TYPE 4 ENCLOSURE 30" x 30" x 8", GASKETED HOFFMAN ENGINEERING CO., CATALOG # A30H30BLP.
2	1	PANEL FOR ITEM 1. HOFFMAN ENGINEERING CO., CATALOG # A30P30.
3	1	12 POINT TERMINAL BLOCK, GE TYPE EB25B12.
4	1	6 POINT TERMINAL BLOCK, GE TYPE EB25B06.
5	2	4 POINT TERMINAL BLOCK, GE TYPE EB25B04.
6	2	3 POLE CARTRIDGE FUSE HOLDER, 250V, 30A, BUSSMANN CATALOG # RM25030-3QR OR EQUAL.
7	6	20 AMP FUSE FOR USE WITH ITEM 6. 250V, BUSSMANN CATALOG # LPN-RK-20 OR EQUAL.
8	1 LOT	#10 THHN OR SIS WIRE, TINNED AND STRANDED,600V INSULATION.
9	1 LOT	#12 THHN OR SIS WIRE, TINNED AND STRANDED 600V INSULATION.
10	1 LOT	CRIMP TERMINALS, UNISULATED, CORROSION RESISTANT SILVER OR TIN PLATED, RING TONGUE TYPE.
11	1	FRONT OF PANEL, ADHESIVE MOUNTED NAMEPLATE, BLACK PHENOLIC WITH WHITE LETTERS, 1 1/2" x 8". ONE NAMEPLATE WITH THE FOLLOWING ENGRAVING: "VTB1 34.5KV BUS FUSE CABINET"
12	4	ADHESIVE MOUNTED NAMEPLATE, BLACK PHENOLIC WITH WHITE LETTERS, 1" x 1", ONE NAMEPLATE WITH EACH OF THE FOLLOWING ENGRAVING: T1, T2, T3, T4
13	2	ADHESIVE MOUNTED NAMEPLATE, BLACK PHENOLIC WITH WHITE LETTERS, 1" x 3", ONE NAMEPLATE WITH EACH OF THE FOLLOWING ENGRAVING: FB1 20A FUSE FB2 20A FUSE
14	4	CABINET MOUNTING BOLTS, 1/2" x 2 1/2" BOLT, NUT, LOCK AND FLAT WASHER.
15	1	RESISTOR 250 OHM, 175 WATT WITH HOLDER. OHMITE CATALOG L175J250E & 6110-P-8 1/2 E



CABINET LAYOUT

VTB1



NOTES:
1. NAMEPLATES ARE TO BE BLACK PHENOLIC WITH WHITE LETTERING AND ADHESIVE BACKING. TEXT SHALL BE CENTERED ON EACH LINE.
2. JUNCTION BOX TO BE GROUNDED.
3. WIRING AND JUMPERS TO BE INSTALLED BY CONTRACTOR AS SHOWN.

NORTHWEST OHIO WIND PROJECT

PAULDING COUNTY, OHIO

Rev.	Date	Description	By
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CONSTRUCTION

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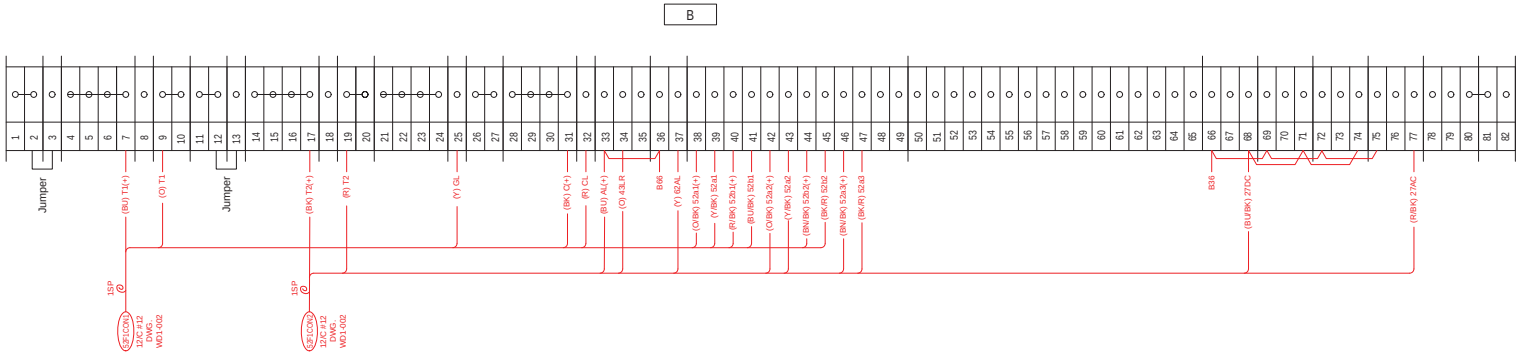
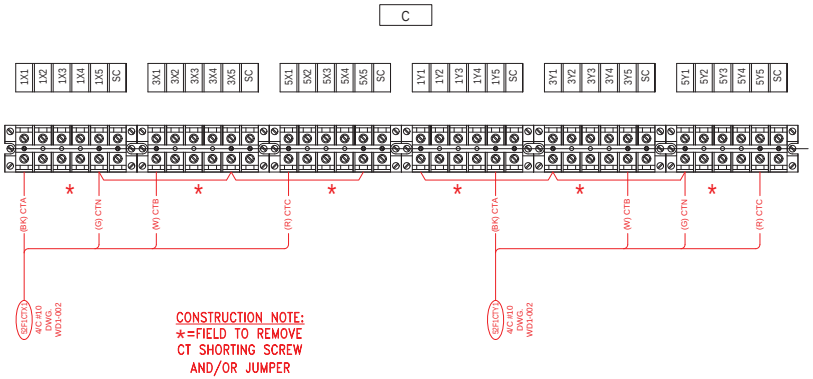
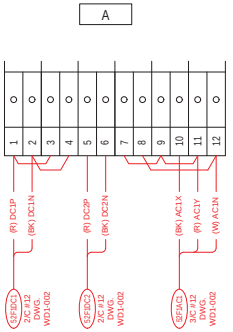
Design By: E. NEUHARDT
Drawn By: T. ADAMS
Approved By: J. OLSON
Project Number: 17.01246

WIRING DIAGRAM
VTB1 JUNCTION BOX

DWG #: NWO-WD2-006
REVISION: 0A







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NOTES:
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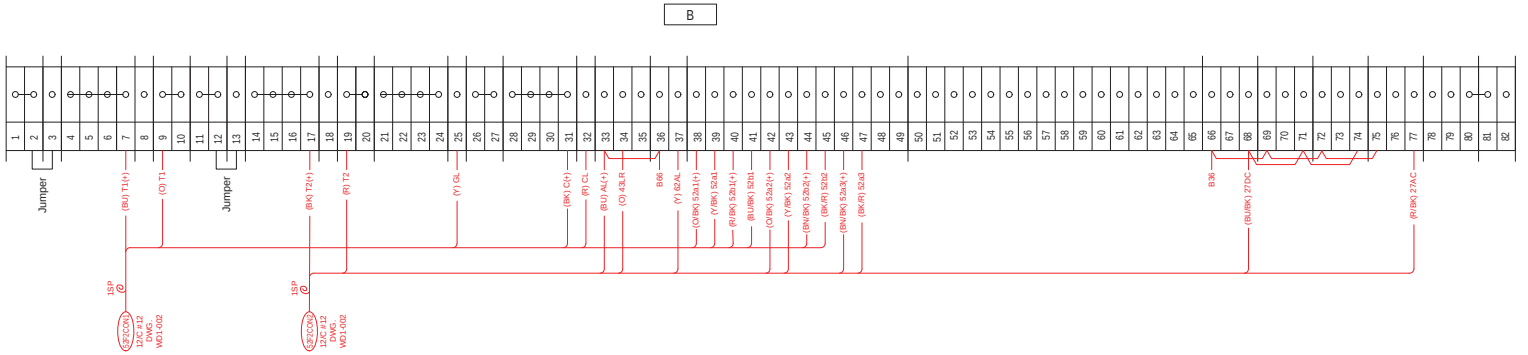
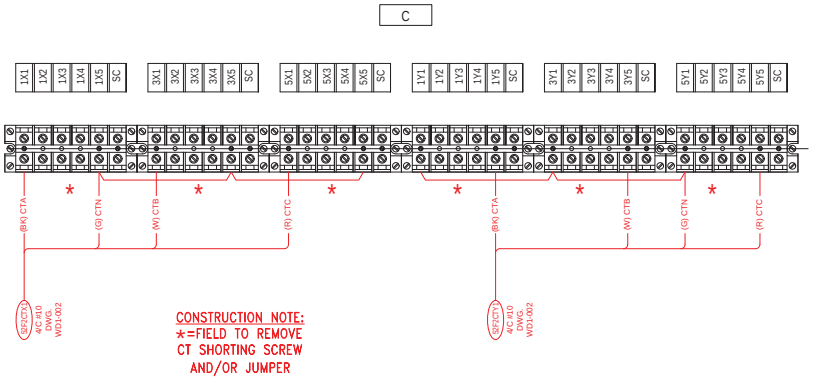
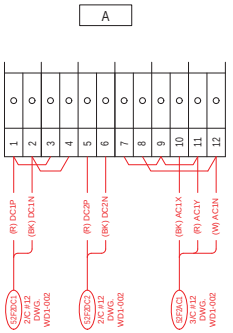
Approved By: J. OLSON
Project Number: 17.01246

WIRING DIAGRAM
FEEDER BREAKER 52F1

DWG #: NWO-WD2-007
REVISION: 0A







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WIND PROJECT

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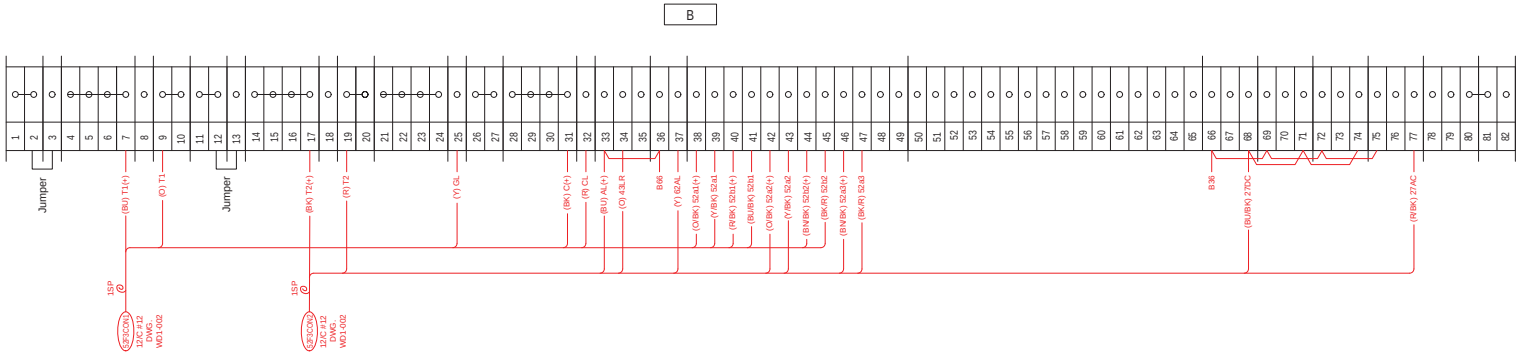
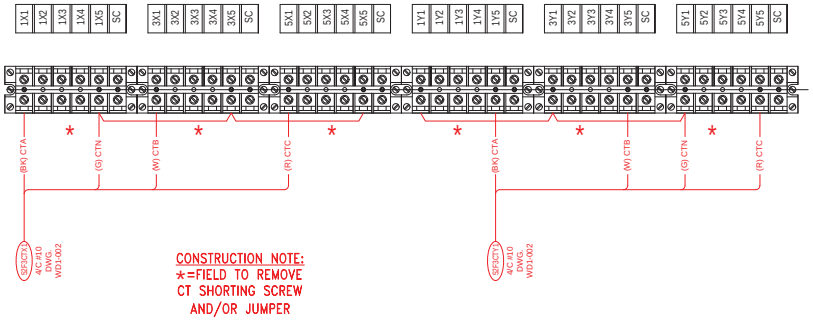
Approved By: J. OLSON
Project Number: 17.01246

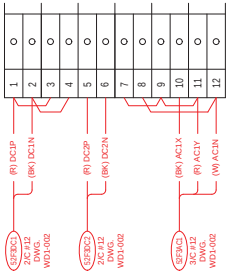
WIRING DIAGRAM
FEEDER BREAKER 52F2

DWG #: NWO-WD2-008
REVISION: 0A





CONSTRUCTION NOTE:
*=FIELD TO REMOVE CT SHORTING SCREW AND/OR JUMPER



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PAULDING COUNTY, OHIO

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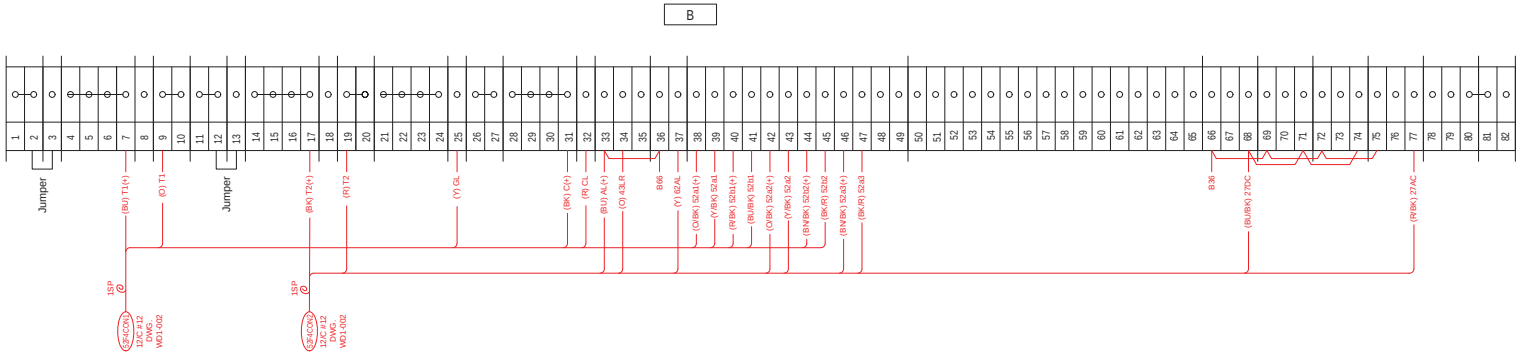
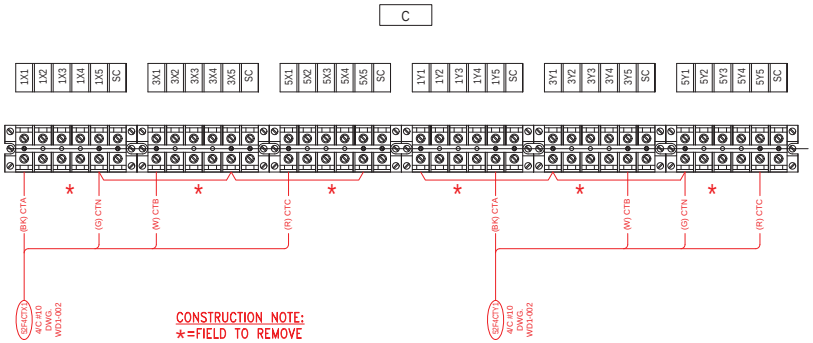
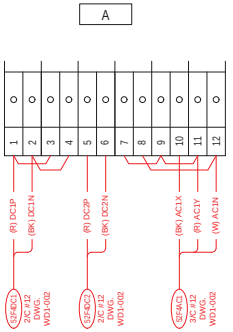
Project Number: 17.01246

WIRING DIAGRAM
FEEDER BREAKER 52F3

DWG #: NWO-WD2-009
REVISION: 0A







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WIND PROJECT

PAULDING COUNTY, OHIO

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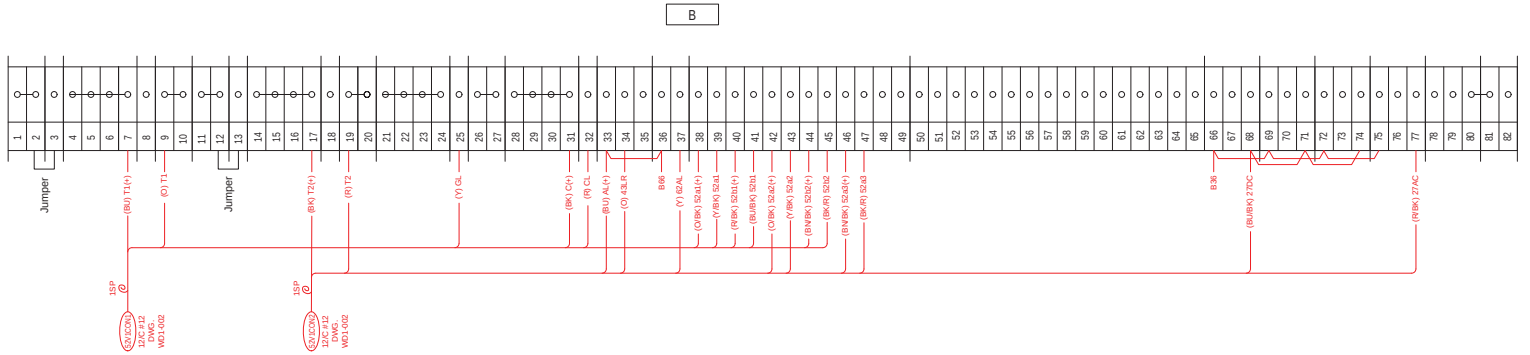
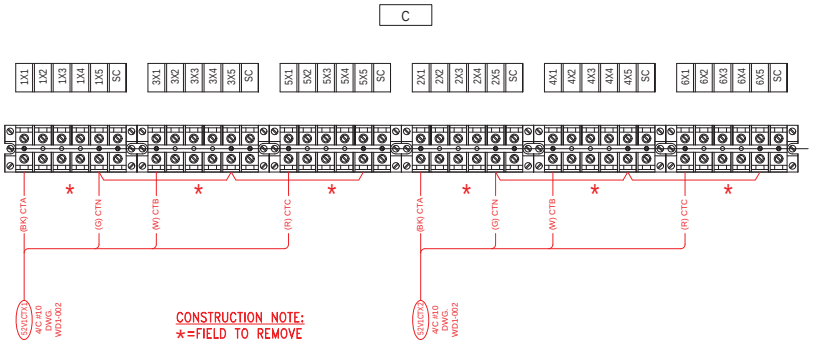
Approved By: J. OLSON
Project Number: 17.01246

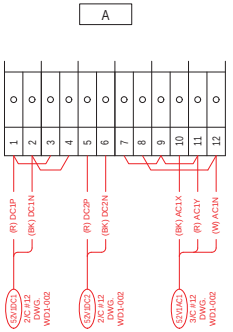
WIRING DIAGRAM
FEEDER BREAKER 52F4

DWG #: NWO-WD2-010
REVISION: 0A





CONSTRUCTION NOTE:
*=FIELD TO REMOVE
CT SHORTING SCREW
AND/OR JUMPER



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WIND PROJECT

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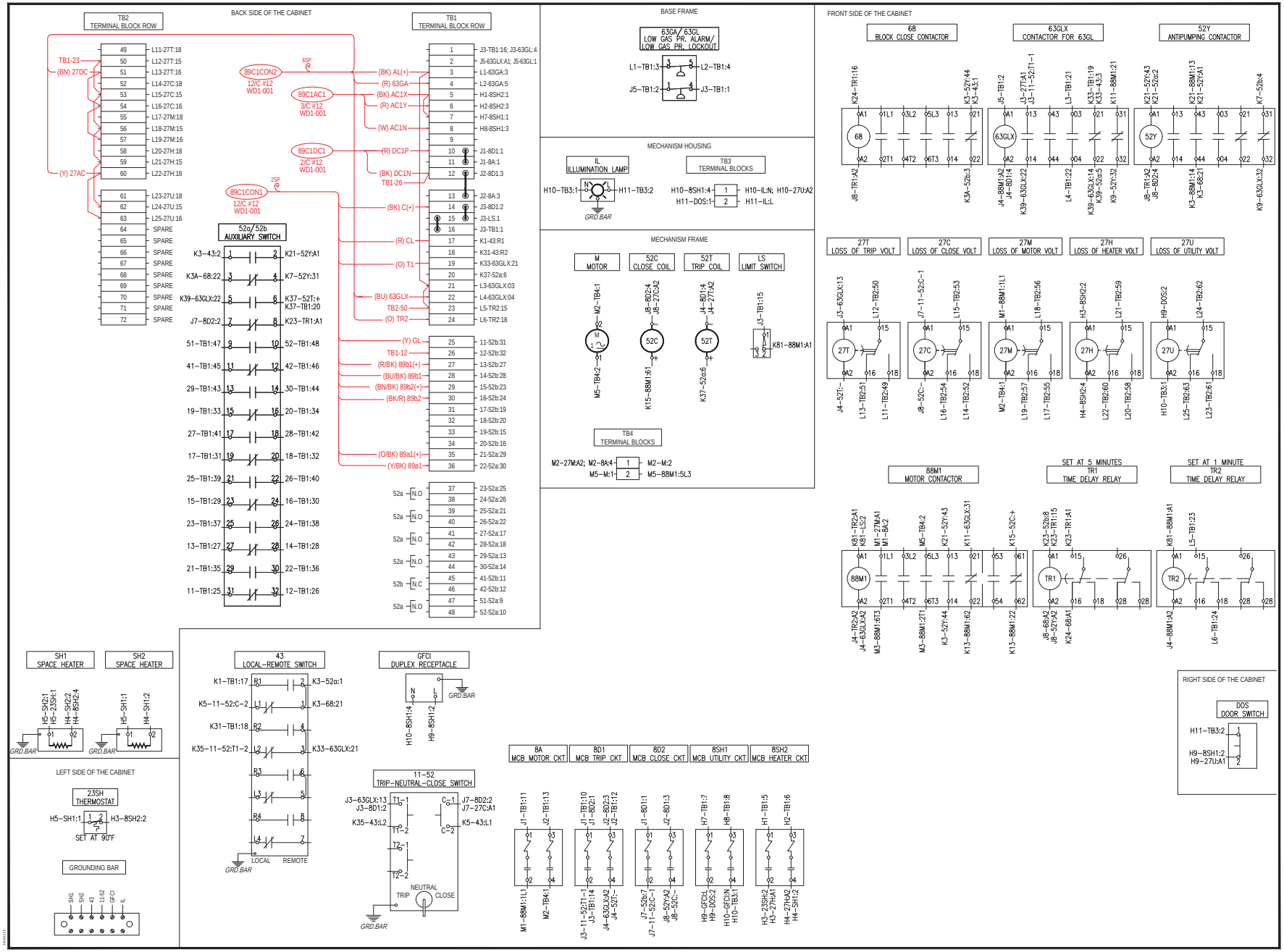
Approved By: J. OLSON
Project Number: 17.01246

WIRING DIAGRAM
BREAKER 52V1

DWG #: NWO-WD2-012
REVISION: 0A



NORTHWEST OHIO
WIND PROJECT

PAULDING COUNTY, OHIO

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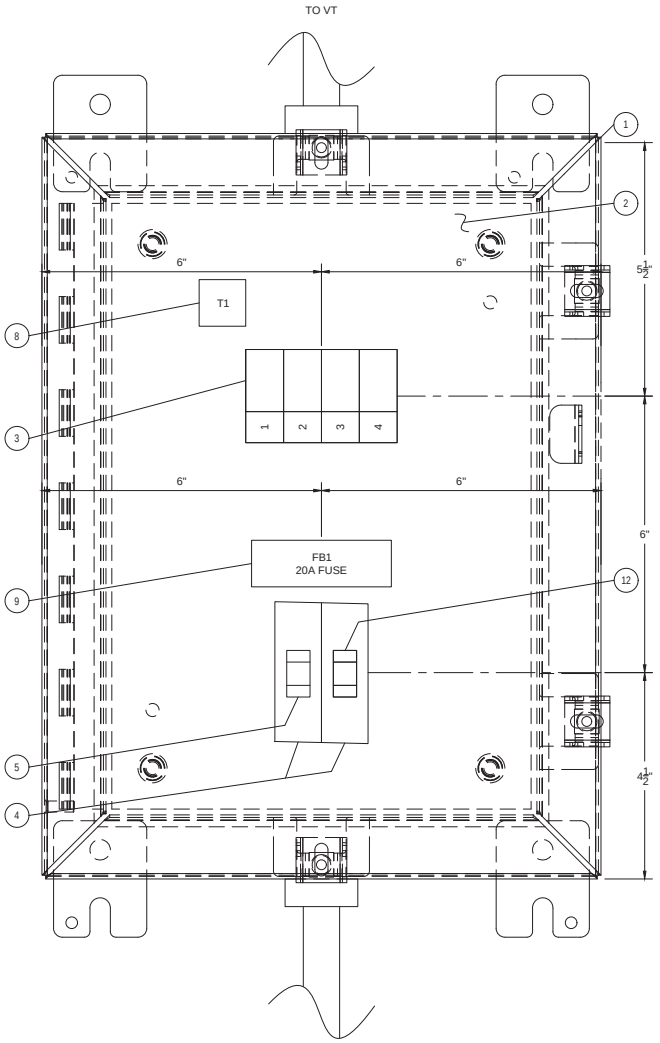
Drawn By: T. ADAMS
Approved By: J. OLSON
Project Number: 17.01246

WIRING DIAGRAM
38KV CAPSWITCHER

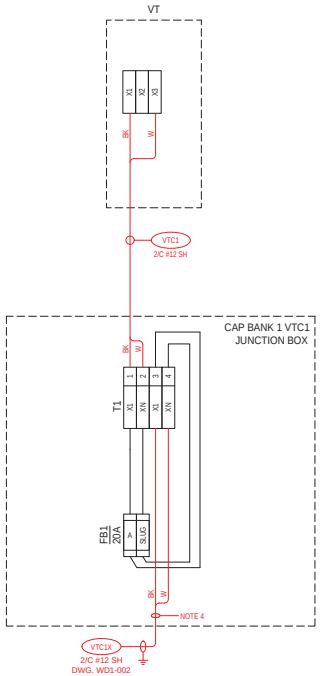
DWG #: NWO-WD2-013
REVISION: 0A



CABINET LAYOUT

VTC1

CABINET MATERIAL LIST		
ITEM	QTY	DESCRIPTION
1	1	NEMA TYPE 4 ENCLOSURE 16" x 12" x 8", GASKETED HOFFMAN ENGINEERING CO., CATALOG # A16H12BLP.
2	1	PANEL FOR ITEM 1. HOFFMAN ENGINEERING CO., CATALOG # A16P12.
3	1	4 POINT TERMINAL BLOCK, GE TYPE EB25B04.
4	2	1 POLE CARTRIDGE FUSE HOLDER, 250V, 30A, BUSSMANN CATALOG # RM25030-1QR OR EQUAL.
5	1	20 AMP FUSE. 250V, BUSMANN CATALOG # LPN-RK-20 OR EQUAL.
6	1 LOT	#12 THHN OR SIS WIRE, TINNED AND STRANDED,600V INSULATION.
7	1	FRONT OF PANEL, ADHESIVE MOUNTED NAMEPLATE, BLACK PHENOLIC WITH WHITE LETTERS, 1 1/2" x 8". ONE NAMEPLATE WITH THE FOLLOWING ENGRAVING: "VTC1 SECONDARY FUSE CABINET"
8	1	ADHESIVE MOUNTED NAMEPLATE, BLACK PHENOLIC WITH WHITE LETTERS, 1" x 1", ONE NAMEPLATE WITH EACH OF THE FOLLOWING ENGRAVING: T1
9	1	ADHESIVE MOUNTED NAMEPLATE, BLACK PHENOLIC WITH WHITE LETTERS, 1" x 3", ONE NAMEPLATE WITH EACH OF THE FOLLOWING ENGRAVING: FB1 20A FUSE
10	1 LOT	CRIMP TERMINALS, UNISULATED, CORROSION RESISTANT SILVER OR TIN PLATED, RING TONGUE TYPE.
11	4	CABINET MOUNTING BOLTS, 1/2" x 2 1/2" BOLT, NUT, LOCK AND FLAT WASHER.
12	1	30A SLUG, 250V, BUSSMANN CATALOG #NTN-R-30



NOTES:
1. NAMEPLATES ARE TO BE BLACK PHENOLIC WITH WHITE LETTERING AND ADHESIVE BACKING. TEXT SHALL BE CENTERED ON EACH LINE.
2. JUNCTION BOX TO BE GROUNDED.
3. WIRING AND JUMPERS TO BE INSTALLED BY CONTRACTOR AS SHOWN.
4. CONTROL CABLE SHIELD SHALL BE PULLED BACK AND TAPED.

NORTHWEST OHIO WIND PROJECT

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Approved By: J. OLSON
Project Number: 17.01246

WIRING DIAGRAM
VTC1 JUNCTION BOX

DWG #: NWO-WD2-014
REVISION: 0A

Drawing Number	Drawing Name
NWO-F1-001	SUBSTATION FOUNDATION PLAN
NWO-F2-001	138/34.5KV SUBSTATION FOUNDATION DETAIL PIERS P1-P5
NWO-F3-001	138/34.5KV SUBSTATION FOUNDATION DETAILS SLABS S3 AND S4
NWO-F4-001	138/34.5KV SUBSTATION FOUNDATION DETAILS SLAB S3 OIL CONTAINMENT
NWO-F5-001	138/34.5KV SUBSTATION FOUNDATION DETAILS SLAB S3 OIL CONTAINMENT
NWO-F6-001	138/34.5KV SUBSTATION FOUNDATION DETAILS SLABS S1, S2, S4
NWO-F7-001	138/34.5KV SUBSTATION FOUNDATION DETAILS SLAB S7
NW0-S0-001	138/34.5KV SUBSTATION GENERAL ARRANGEMENT STEEL LOCATION PLAN
NW0-S1-001	138/34.5KV PROJECT SUBSTATION 138KV DEADEND "CB" STEEL LAYOUT
NW0-S1-002	138/34.5KV PROJECT SUBSTATION 138KV DEADEND "CB" STEEL DETAILS
NW0-S1-003	138/34.5KV PROJECT SUBSTATION 138KV DEADEND "CB" STEEL DETAILS
NW0-S1-004	138/34.5KV PROJECT SUBSTATION 138KV DEADEND "CB" STEEL DETAILS
NW0-S2-001	138/34.5KV PROJECT SUBSTATION 90' SHIELD POLE "SP" STEEL DETAILS
NW0-S3-001	138/34.5KV SUBSTATION 138KV 1Ø BUS SUPPORT "VS"
NW0-S4-001	138/34.5KV SUBSTATION 34.5KV SWITCH STAND "HS"
NW0-S5-001	138/34.5KV SUBSTATION 34.5KV NGR SUPPORT "RT"
NW0-S6-001	138/34.5KV SUBSTATION 34.5KV CABLE TERMINAL STAND "TM"
NW0-S6-002	138/34.5KV SUBSTATION 34.5KV CABLE TERMINAL STAND "TM"
NW0-S7-001	138/34.5KV SUBSTATION 34.5KV COLLECTION STRUCTURE "CS"
NW0-S7-002	138/34.5KV SUBSTATION 34.5KV COLLECTION STRUCTURE "CS"

NW0-S7-003	138/34.5KV SUBSTATION 34.5KV COLLECTION STRUCTURE "CS"
NW0-S8-001	138/34.8KV SUBSTATION 34.5KV 3Ø BUS & SS SUPPORT "SS"
NW0-S9-001	138/34.5KV SUBSTATION OIL CONTAINMENT PLATFORM "P"
NW0-S10-001	138/34.5KV SUBSTATION OIL CONTAINMENT PLATFORM "S"

Client Comment
Match foundation S3 dimensions with the detail on NWO-F4-001.
Calculations not provided with this submittal. Unable to verify that foundation design matches drawings.
Calculations not provided with this submittal. Unable to verify that foundation design matches drawings.
Calculations not provided with this submittal. Unable to verify that foundation design matches drawings.
Calculations not provided with this submittal. Unable to verify that foundation design matches drawings.
Calculations not provided with this submittal. Unable to verify that foundation design matches drawings.
2 dimensions are labled as 1'-5" and should be labeled 1'-4 1/2". Calculations not provided with this submittal. Unable to verify that foundation design matches drawings.
This drawing does not apper to have been reviewed.
Calculations not provided with this submittal. Reccomends providing steel grade for 8-sided polygons.
Calculations not provided with this submittal.
Calculations not provided with this submittal.
Calculations not provided with this submittal. Beam CB6 length is not correct.
Calculations not provided with this submittal.
Calculations not provided with this submittal.
Calculations not provided with this submittal.
Calculations not provided with this submittal. Consider providing caps for ends of member.
Calculations not provided with this submittal.
The spacing between each phase on member TM4 should be 3'-6" instead of 4'-6". Calculations not provided with this submittal.
Item CS7 should have a quantity of 60 instead of 54 in the bill of materials. Calculations not provided with this submittal.
Calculations not provided with this submittal.

Holes on the bottm of member CS6 are not reuqired. Calculations not provided with this submittal.
Bent plates n and g are believed to show the wrong length in the description. Calculations not provided with this submittal.
Update quantity for item e. Calculations not provided with this submittal.
Update quantity for item j. Calculations not provided with this submittal.

Response
The foundation plan has been updated to include the new oil containment, and all foundations match the detail drawings.
Pier P5 has been added. Calculations will be provided.
This drawing number has been renamed 138/34.5KV SUBSTATION DETAILS SLAB S3. This is now the detail sheet showing the Transformer slab and Oil Containment. Calculation will be provided.
This drawing number has been renamed 138/34.5KV SUBSTATION XMFR FOUNDATION DETAILS. It shows details related to the transformer foundation and oil containment. Calculation will be provided.
This drawing number has been renamed 138/34.5KV SUBSTATION FOUNDATION DETAILS SLABS S1, S2, S4, S5. This sheet now shows details for the 34.5 and 138kV breaker slabs and control enclosue stairs. Calculation will be provided.
This drawing has been renamed 138/34.5KV SUBSTATION FOUNDATION DETAILS SLAB S6. It shows the detail for the Cap Bank foundation. Calculation will be provided.
This drawing has been deleted.
N/A
Calculations have been provided.
Calculations have been provided.
Calculations have been provided. Beam CB6 length has been updated to reflect the correct length.
Calculations have been provided.
This steel structure has been updated from a single phase bus support to a 3 phase bus support. The new name of this drawing is 138/34.5KV SUBSTATION 138KV HIGH BUS SUPPORT. Calculations have been provided.
Calculations have been provided.
This structure has been modified, and the arm where the caps needed to be provided has been removed. Calculations have been provided.
Calculations have been provided.
Member TM4 has been updated to reflect the requested change. Calculations have been provided.
The quantity of CS7 has been updated to 60. Calcualtions have been provided.
Calculations have been provided.

The holes on the bottom of member CS6 are there for ease of construction, allowing the beam to be constructed with either side facing up. Calculations have been provided.
The length of bent plate are calculated by adding the inside lenghts of the piece and adding 1/2". The description lengths for both n and g are correct. Calculations have been provided.
This structure has been removed due to the changing of the oil containment from a concrete basin to a geotextile fabric lined, rock-filled pit.
This structure has been removed due to the changing of the oil containment from a concrete basin to a geotextile fabric lined, rock-filled pit.

NORTHWEST OHIO WIND PROJECT

Construction Specification

Prepared By: Ulteig
ISSUED FOR CONSTRUCTION
01/25/2018

ISSUED FOR CONSTRUCTION

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This document has been modified since being signed. It is no longer a valid construction drawing.

THE ORIGINAL VERSION OF THIS DRAWING IS A DIGITALLY SIGNED PDF

Revision 0

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CONSTRUCTION SPECIFICATION

IEA/White Construction

1.0 DESCRIPTION OF WORK

The Northwest Ohio Wind Substation will be located in Paulding County, Ohio.

This project consists of the labor, equipment, and materials necessary to construct a new 138/34.5 kV Collector Substation.

1.01 Points of Demarcation

a. General

Responsibilities include the equipment, labor, and supervision required for the development of the site and construction and commissioning assistance of the substation.

b. 34.5 kV Underground

Four (4) 34.5 kV underground feeder circuits will be terminated at four (4) 34.5 kV riser structures. The underground collection system is designed by others.

c. 138 kV Overhead

Transmission line will consist of a slack span less than 300 feet of phase conductors and shield wires that will interconnect with the AEP Haviland interconnect substation.

2.0 GENERAL PROVISIONS

2.01 Standards

a. All equipment shall be in accordance with the latest modern practice and shall conform to the latest applicable standards of the Electronic Industries Association, Institute of Electrical and Electronics Engineers, American National Standards Institute, and the National Electrical Manufacturer's Association. In the event of conflicting requirements between any of the above stated standards, the terms of this specification shall apply.

b. The installation of all equipment shall be in accordance with local and national codes, including the National Electrical Safety Code and National Electrical Code unless otherwise specified.

3.0 MAJOR EQUIPMENT

All material and bushings shall be clean of oil, dirt, paper, tape and other foreign debris.

See drawing EQ4-001 for a list of major equipment that will be required to complete construction of the substation.

4.0 MATERIALS

Details and catalog numbers for materials will be provided by the Engineer. The Substation Contractor is responsible for determining the quantity for all materials required for complete construction of the project, which includes, but is not limited to, the following:

a. Concrete and all associated materials for protection and curing of concrete, including form lumber, form materials, rebar and coating.

b. All tubular and cable bus and associated compression, bolted, and welded fittings, including ground wire fittings and fittings for equipment termination pads and aluminum tubular bus connections. Aluminum fittings are to be supplied from the following list of suppliers:

Anderson
Dossert Corporation
Homac
DMC
Sefcor
Travis

c. Welding gas, aluminum filler, wire or rods, and other materials for welding bus are to be provided as needed as they are not listed on the substation drawing package material lists.

d. Materials for the complete grounding system including underground, above ground mechanical connectors, and the grounding system, including exothermic or compression connections for below ground bonding, mechanical connectors for above ground copper braids for gates.

e. Surface trench system, including appropriately rated covers, interconnecting wire ways, warning bollards, and chain-link.

f. Galvanized steel conduit, straps, support hardware and conduit fittings (i.e. bushings, locknuts, reducers, nipples, outlet boxes, etc.), including junction boxes and mounting brackets, and other miscellaneous items required for the installation of the conduit system.

g. PVC conduit, elbows, straps, support hardware, and fittings (i.e. couplers, end bells, caps, etc.), cement, cleaning solvent, and other miscellaneous items required for the installation of the conduit system.

h. Low voltage (600 V) wire, control cable, and multi-conductor shielded cable, and materials for termination of conductors, control cables and inter-panel wiring, including compression terminal lugs, plastic ties for wire bundling, cable number tags, and electrical tape, solder, or pressure connectors for joints and splices, heat shrink wire labels, and other items required to install and connect the low voltage electrical system.

i. Miscellaneous items, such as soil sterilizer, screws, bolts, cable pulling compound, compression fitting filler compound, and electrical joint compound.

j. Station luminaries, brackets, lamps, and other miscellaneous items as required to complete the yard lighting system.

5.0 DRAWINGS

a. Construction drawings and specifications will be provided by the Engineer. Authorized record print conditions shall be documented, clearly showing where construction activities differ from the information provided on the drawings. The record prints should be marked with red and green, green shall be used to show items that are removed from the drawings and red shall be used to show items that are added to the drawings. All work will not be considered complete until the record drawings have been received and accepted as accurate. Additional sets of drawings will be furnished as requested at the cost of reproduction and handling.

b. In reading sizes, distances, angles, slopes, and other measurements on maps or drawings, the values used shall be those given in dimensions and figures and shall not be obtained by scaling.

c. See Master Drawing List/Index for a complete list of drawings.

6.0 SITE PREPARATION AND FINISHING

6.01 General

Furnish all materials, labor, tools, and equipment necessary to place and compact crushed rock surfacing material in the substation, and in areas outside the substation fence, as shown on the drawings and as specified herein, and to sterilize the soil within the surfacing area.

a. Extent of Work

The work required includes, but is not limited to erosion control, excavation, backfilling, rough grading, turf establishment and related items necessary to complete the work indicated on the drawings and as specified herein, and generally listed as follows:

6.01.a.1. Implementation of erosion control measures in accordance with Local County and State regulations.

6.01.a.2. Providing and placement of compacted Engineered fill from offsite.

6.01.a.3. Rough grading, finish grading, placement of vegetation retardant and surfacing aggregate on the site as specified on the drawings.

6.01.a.4. Construction and surfacing of access roads.

6.01.a.5. Handling, storage, transportation, and disposal of organic or other unsuitable excavated materials.

6.01.a.6. The Contractor will be responsible for quantity calculations.

6.01.a.7. All work shall comply with the projects Stormwater Pollution Prevention Plan (SWPPP).

b. Standards

Applicable standards shall be the latest revision and supplements to the following ASTM Standard Specifications for Road and Bridge Construction:

6.01.b.1. ASTM C117: Standard Test Method for Materials Finer than No. 200 Sieve in Mineral Aggregates by Washing

6.01.b.2. ASTM C136: Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates

6.01.b.3. ASTM D698: Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort

6.01.b.4. ASTM D5195: Standard Test Method for Density of Soil and Rock In-Place at Depths Below Surface by Nuclear Methods

6.01.b.5. ASTM D1140: Standard Test Methods for Amount of Material in Soils Finer than No. 200 Sieve

6.01.b.6. ASTM D1556: Standard Test Method for Density and Unit Weight of Soil in Place by the Sand Cone Method

6.01.b.7. ASTM D4318: Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soil

6.01.b.8. ASTM D1557: Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort

6.02 Subgrade

All labor, material, and equipment necessary to maintain and restore the subgrade as required for the substation site shall be provided. Preparations of site, area excavation, fill materials, grading, access roads, and turf establishment shall be accomplished as follows:

a. Preparation of Site

6.02.a.1. Location and staking of the site within the property lines shall be accomplished in accordance with these plans and specifications.

6.02.a.2. Location of underground utilities shall be accomplished before any excavation has begun. Scheduling a locating service or locating of utilities is not the responsibility of the Engineer.

6.02.a.3. The area of the site to be graded shall be cleared of rocks, boulders, trees, brush, and other vegetation. Stumps and roots two inches or larger in diameter shall be removed to a depth of not less than 24 inches. Stones and boulders also to a depth of not less than 24 inches below the finished subgrade. Stone and boulders shall be removed from site or buried in an area and manner approved by the Engineer.

6.02.a.4. The site topsoil shall be stripped of vegetation to such depth as may be necessary to remove roots, grass, and other organic matter. Sod or turf stripped from the

site, if suitable may be used on slopes and shoulders of embankments or access roads constructed as part of the work.

6.02.a.5. All debris resulting from site preparation operations, including trees, brush, roots, and sod stripping shall be disposed of under the local rules and regulations. Combustible material may be burned at the site if practical to do so without creating a hazard and only after obtaining the proper permits in accordance with area burning laws.

6.02.a.6. Prior to placement of fill and after rough grading in cut areas, the subgrade shall be proof rolled with a fully loaded tandem-axle dump truck with a minimum gross weight of 25 tons. Unsuitable areas observed shall be improved by compaction or by replacement with a suitable compacted fill.

6.02.a.7. Any unknown water conditions or soil considered being weak and subject to significant displacement under normal equipment wheel application shall require the Engineer to be contacted.

Upon discovery of any unknown water conditions or weak subgrade materials, the Engineer may order additional subcuts or geotextile treatment.

6.02.a.8. No equipment will be allowed to cross rivers or stream beds.

b. Area Excavation

6.02.b.1. Excavation shall be performed by any recognized method of good practice to complete the job in the most expeditious manner.

6.02.b.2. Proper precautions shall be taken to insure there is no damage to existing facilities or equipment.

6.02.b.3. Excavation shall include all materials found within the designated limits for excavation.

c. Fill Materials

6.02.c.1. General

All fill shall consist of material approved by the Geotechnical Engineer and be free of any organic matter or debris. No fill shall be placed on frozen subgrade.

6.02.c.2. Common fill shall consist of low-plasticity cohesive material or granular material. Low-plasticity cohesive fill shall have a liquid limit less than 45% and a plasticity index less than 20%. Common fill shall not contain frozen material or particles with maximum lengths greater than 4". Common fill material shall conform to recommendations presented in the soils report for the project. The Engineer may approve variations from the previous conditions if requested in writing.

6.02.c.3. Select granular fill shall consist of a well graded granular material with less than 5% passing the #200 sieve.

6.02.c.4. Base Rock

The location and depth of base rock shall be as specified in the notes of the Grading and Drainage plans.

If unsuitable fill is encountered in areas being excavated for foundations, backfill with base rock. Base rock shall be sound, hard, durable angular or sub-angular crushed rock, and shall meet the following gradation requirements when tested in accordance with AASHTO T-27:

Use ODOT Item 304 Aggregate base

Sieve Size	Total Percent Passing
2 inch (50 mm)	100
1 inch (25.0 mm)	70 to 100
3/4 inch (19.0 mm)	50 to 90
No. 4 (4.75 mm)	30 to 60
No. 30 (600 µm)	9 to 33
No. 200 (75 µm)	0 to 15[1]

[1] Furnish OH slag that has 0 to 10 percent passing through the No. 200 (75µm) sieve

6.02.c.5. Finish Rock

The location and depth of base rock shall be as specified in the notes of the Grading and Drainage plans.

"Finished Rock" used to surface the substation yard, and an area extending around the perimeter of the fence, shall be sound, hard (abrasion resistant), durable, angular, or subangular crushed rock. The finished rock shall be free of wood, roots, bark, and other extraneous materials. The "Finished Rock" shall have a depth of 6 inches if the electrical resistivity value of the "Finished Rock" is between 3000 and 5000 ohm-meters. The "Finished Rock" shall have a depth of 4 inches if the electrical resistivity of the "Finished Rock" is 5000 ohm-meters or greater. "Finished Rock" with an electrical resistivity value of less than 3000 ohm-meters is unacceptable. When tested by means of laboratory sieves, grain size distribution shall conform to the following requirements.

US Standard Sieve	Percent Passing
2″	100
1 ½″	90-100
1"	20-75
3/4"	5-40

1/2″	0-10
3/8″	0-5

A minimum of 70% material shall have at least one fractured face.

6.02.c.5.1. Soil Sterilization

Only areas to be surfaced with finish rock (including the areas outside the substation fence), shall be treated with a weed eradicator and soil fumigant.

The Herbicide and its application shall follow the following guidelines:

Develop safety protocols for storing, mixing, transporting, handling spills, and disposing of unused herbicides and containers before bringing herbicides on site. Contractor shall provide safety data sheets for all herbicides brought on site."

Follow all federal, state and local regulations regarding herbicide use,

Herbicides may be applied only by TNC (The Nature Conservancy) employees or contractors who have all certificates and licenses required by state and/or county.

Applicators must wear protective gear required on the label of the herbicide they are using.

Extreme care shall be exercised in the application of the soil sterilant where there is danger of contaminating adjacent seeded areas, shrubs, trees, or neighboring property.

d. Material Approval

6.02.d.1. General

All material to be installed shall comply with the drawings and specifications. If material matching the drawings or specifications cannot be obtained, approval will be required.

Approval for finish rock materials at least seven days prior to delivery and placement shall be obtained. Any finish rock delivered to the site of the work which is not approved will be rejected.

The results of gradation (AASHTO T-27) tests shall be sent to the Engineer prior to obtaining approval of rock materials.

e. Placement

6.02.e.1. General

Surfacing material shall not be placed on snow, frozen subgrade, uncompacted fills, or soft mud. Surfacing material shall be placed after all footing and underground work within the substation yard has been completed.

Compaction of base rock shall be done with a wheel or shoe vibratory compacter sized for roadway base compacting. Base rock shall be deposited in horizontal layers having a thickness of not more than 6" before being compacted. Each lift shall be conditioned to optimum moisture content and compacted to a dry density equivalent to at least 95% of the maximum dry density obtainable by the ASTM designation D-1557.

Perform modified proctor test ASTM D-1557 once per fill type and per source with a minimum of one per gradation.

f. Sediment and Erosion

6.02.f.1. General

Temporary and permanent sediment and erosion controls shall be provided. These controls shall be installed and maintained when performing any ground disturbing activities. These controls shall include silt fences, hay bales, earthen dikes, drainage swales, sediment traps, sediment basins, and similar measures or according to the drawings. Sediment escaping the site during construction must be removed on a regular basis to minimize offsite impact. All work will be logged and maintained in accordance with the SWPPP.

7.0 CONCRETE FOOTINGS AND FOUNDATIONS

7.01 Materials

All material required, including all reinforcing steel, bar supports, ties, spacers, inserts, and other concrete accessories shall be provided. All labor, tools, and equipment necessary to excavate for and construct all footings and foundations as described in this specification and as shown on the drawings shall be provided.

a. Codes and Standards

Provisions of the following codes, specifications, and standards shall be followed:

ACI 301 “Specifications for Structural Concrete for Buildings”
Applicable ASTM Specifications identified herein
Concrete Reinforcing Steel Institute, “Manual of Standard Practice”
ACI 318 “Building Code Requirements for Structural Concrete”

b. All furnished materials shall comply with the Contract and shall meet the requirements of the following specifications:

Admixtures	Air-Entraining (Required)	“Standard Specification for Air-Entraining Admixtures for

		Concrete," ASTM C 260
	Water-Reducing (Optional)	"Standard Specification for Chemical Admixtures for Concrete," ASTM C 494
	Plasticizers (Optional)	Applicable ASTM specifications
	Calcium Chloride	Not Allowed
Aggregate	Washed gravel or washed crushed rock and clean, sharp, washed natural sand or washed manufactured sand of uniform gradation. The maximum size shall not exceed 1 inch.	
Anchor Bolts	"Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength" ASTM F 1554. Bolts shall be hot dip galvanized per "Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware" ASTM A 153. Bolt diameter, bolt length, and thread length are as shown on the foundation drawings.	
Cement	ASTM C 150, "Standard Specification for Portland Cement", Type I or II	
Concrete	All concrete shall obtain a minimum 28-day strength of 4500 psi. Concrete shall be proportioned and produced to have a slump of four to six inches unless pouring through a tremie pipe. The slump for tremie concrete shall be between 6 and 8 inches. All concrete shall contain an air entrainment admixture. Total air content by volume, at the time of placement, shall be maintained at 6% plus or minus 1-1/2%. The water-cement ratio at the time of placement shall not exceed 0.45 by weight.	
Fly Ash (Optional)	Reinforced concrete may incorporate the use of fly ash, properly proportioned to maintain the specified minimum compressive strength. All fly ash shall meet, as a minimum, the "Standard Specification for Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete" ASTM C 618, Class F or Class C fly ashes. The amount of Portland cement that can be replaced by fly ash shall not exceed twenty percent (20%) by weight of cement.	
Form Coating	Industrial Lubricants "Nox-Crete Form Coating", L&M "Debond", Protex "Pro-Cote", Richmond "Rich Cote", or approved equivalent	
Form Material	Plywood and fiberboard materials which are free of damage, cracks, weathering, or any defect which would prohibit the formed surface from appearing smooth and uniformly textured.	
Nuts	"Standard Specification for Carbon and Alloy Steel Nuts" ASTM A 563. Nuts shall be hot dip galvanized per ASTM A 153. Nuts shall be tapped out oversize prior to galvanizing (1/32" for 3/4" and larger --- 1/64" for 5/8" and smaller). Ship nuts assembled on anchor bolts to assure finger ease fit.	
Reinforcing Bar Supports	Fabricate from galvanized wire. Plastic coated or tipped for use in contact with forms for exposed surfaces.	

Reinforcing Steel	"Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement", ASTM A 615, Grade 60
Washers	"Standard Specification for Hardened Steel Washers" ASTM F 436, Type I.
Water	Clean and free from mud, oil, organic matter or other deleterious substances

7.02 Installation

Install reinforced concrete footings and foundations in accordance with the following provisions:

a. Prerequisites

7.02.a.1. Construction drawings shall be thoroughly reviewed. The locations of underground facilities shall be noted and marked to avoid damage occurring during foundation construction activities.

7.02.a.2. A site inspection shall take particular note of ground and stormwater conditions and the extent to which they may affect foundation excavation.

7.02.a.3. Baselines, construction stakes, and horizontal and vertical reference points shall be established before excavating for footings and foundations.

b. Excavation

7.02.b.1. Excavate for footings to the depth shown on the drawings, unless greater depth is required to obtain suitable bearing. Excavations shall be kept free of water during placement of forms and concrete, and while working below grade.

7.02.b.2. As required, supply and install temporary sheeting or shoring as set forth in the rules, orders, and regulations of the United States Department of Labor Occupational Health and Safety Administration (OSHA).

7.02.b.3. Side slopes shall be excavated to an acceptable safe angle of repose, consistent with the type of material being excavated.

c. Forms

7.02.c.1. Forms shall be designed to produce hardened concrete having the shape, lines, and dimensions shown on the drawings. Forms shall be constructed and maintained in proper position and accurate alignment.

7.02.c.2. Forms shall not be removed or disturbed until the concrete has attained sufficient strength to safely support all dead and live loads to be imposed thereon.

7.02.c.3. Formwork supporting weight of concrete may not be removed in less than 7 days after concrete is poured in place.

7.02.c.4. Form facing material may be removed two days after placement, if concrete has attained enough strength to support designed loads and if shores and other

vertical supports have been arranged to permit removal of form facing materials without disturbing shores.

7.02.c.5. Do not pry against concrete surface during formwork removal.

d. Embedments

7.02.d.1. Anchor Bolts

7.02.d.1.1. Anchor bolts shall be accurately located to within 1/8" of their design locations prior to placement of concrete.

7.02.d.1.2. Concrete shall be placed so as not to tilt or laterally displace the anchor bolts (i.e. vibrators may be used to consolidate concrete but shall not be used to transport it laterally within the forms).

7.02.d.1.3. Welding shall not be permitted on anchor bolts unless specifically required on the design drawings.

7.02.d.1.4. Enlargement of base plate anchor bolt holes or bending of anchor bolts shall not be permitted, except with prior approval from the Engineer.

e. Voids

Voids in sleeves, inserts, and anchor slots shall be filled temporarily with readily removable material to prevent the entry of concrete into the voids.

f. Reinforcement

7.02.f.1. Reinforcing steel shall be placed as shown on the drawings.

7.02.f.2. Reinforcing steel may be moved as necessary to avoid interference with other reinforcing steel, conduits or embedded items. Maximum steel spacing shall not be exceeded, however.

7.02.f.3. At time of placing, the reinforcing steel shall be free from loose mill scale, flaking rust, mud, oil, grease, or paint.

7.02.f.4. Reinforcing steel deformed bars shall be tied with steel wire to maintain the spacing shown on the drawings.

7.02.f.5. Welding of reinforcement for any purpose, and tack welding in particular, is expressly prohibited.

7.02.f.6. Reinforcing steel lap, hook and embedment lengths shall conform to ACI 318 or as shown on the drawings.

7.02.f.7. Concrete bricks are not acceptable reinforcing steel supports.

g. Concrete Placement

7.02.g.1. All reinforcing steel shall be inspected to confirm that it is free of deleterious rust, oil, dust, mud and other coatings before concrete is placed. All surfaces that

may have become encrusted with dried mortar or concrete from previous placement operations shall be cleaned.

7.02.g.2. Concrete shall be conveyed to the point of deposit by methods that shall prevent the separation or loss of material. Equipment for chuting, pumping, and pneumatically conveying concrete shall allow for a continuous flow of concrete at the delivery end without separation of materials. Ready-mix delivery time shall conform to ACI-304. Batch mixes shall be discharged completely within 90 minutes of addition of water to aggregates.

7.02.g.3. Concrete shall not be placed against or on top of frozen ground, snow, ice, or water. The subgrade shall be sufficiently moist when concrete is placed to eliminate water loss from the concrete.

7.02.g.4. When placing concrete for drilled pier foundations, care should be taken to prevent the wet concrete from hitting the sides of the casing walls, forms, or the reinforcing steel during pouring operations. All pours shall be continuous.

7.02.g.5. Concrete must be thoroughly compacted by suitable means and shall be worked to fill the form completely. Vibrators shall be used and shall be maintained at a vertical position. Care shall be exercised to avoid excessive contact of the vibrating head with surfaces of the forms and embedded items.

7.02.g.6. Unless otherwise specified on the drawings, the minimum concrete protective covering of reinforcement for slabs and footings, if concrete is placed against the ground, shall be 3", and 2" if concrete is placed against formed edges.

h. Weather

7.02.h.1. Cold weather: When the temperature of the surrounding air is expected to be below 40°F during placing or within 24 hours thereafter, concrete shall be placed in accordance with the recommendations of ACI - 306 "Cold Weather Concreting". Adequate equipment shall be provided for heating concrete materials. All concrete materials, reinforcement forms, fills, and ground that the concrete is to come in contact with shall be free from frost. No frozen materials or materials containing ice shall be used. Combustion heaters are not allowed for heating for the first 24 hours after concrete placement unless precautions are taken to prevent exposure of the fresh concrete to combustion gases.

7.02.h.2. Hot weather: During period of hot weather, or when the combination of hot weather, low relative humidity and wind velocity will tend to impair the quality of the concrete, concrete shall be placed and cured in accordance with the recommendations of ACI - 305 "Hot Weather Concreting". No concrete shall be placed when the temperature of the concrete exceeds 90°F prior to placement. Concrete delivered to the job site, which exceeds 90°F shall not be used.

i. Curing

7.02.i.1. Concrete shall be protected from premature drying, excessively hot or cold temperatures, and mechanical injury. Concrete shall be maintained with minimal moisture loss at a relatively constant temperature for at least seven days, except high-early-strength concrete, for which the period shall be at least three days.

7.02.i.2. For concrete surfaces not in contact with forms, one of the following procedures shall be applied immediately after completion of placement and finishing:

7.02.i.2.1. Application of absorptive mats or fabric kept continuously wet.

7.02.i.2.2. Application of waterproof sheet materials, securely anchored to prevent drying of concrete from wind damage.

7.02.i.2.3. Application of a curing compound conforming to "Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete" ASTM C 309. The compound shall be applied in accordance with the manufacturer recommendations immediately after any water sheen that may develop after finishing, has disappeared from the concrete surface.

7.02.i.3. Moisture loss from surfaces placed against wooden forms or metal forms exposed to heating by the sun shall be minimized by keeping the forms wet until they can be safely removed. After form removal, the concrete shall be cured for the balance of the seven days by one of the methods prescribed above.

7.02.i.4. Proper attention shall be given during curing to prevent excessive concrete temperatures, or water evaporation that will impair the required strength or serviceability of the structure.

j. Finish

Slab foundations shall receive a light broom finish. Top surface of piers shall be either screeded and wood floated or receive a light broom finish.

k. Repair of Surface Defects

7.02.k.1. Surface defects, including tie holes, shall be repaired immediately after form removal. All fins shall be completely removed. All honeycombed and other defective concrete shall be removed down to sound concrete. If chipping is necessary, the edges shall be perpendicular to the surface or slightly undercut. No feather edges shall be permitted.

7.02.k.2. The area to be repaired shall be given a coating of bonding grout or approved bonding adhesive prior to placing the patching mixture.

7.02.k.3. The patching mixtures shall be made of the same materials and of approximately the same proportions as used for the concrete, except that the coarse aggregate shall be omitted and the mortar shall consist of not more than one part cement to 2-1/2 parts sand by damp loose volume.

7.02.k.4. The patching mixture used in repair work shall be cured in accordance with the procedures described above under "Curing."

7.02.k.5. All patched areas shall match the adjacent concrete surfaces.

l. Testing

An independent testing laboratory shall be employed to perform concrete testing. One set of concrete tests shall be taken each day concrete is placed. An additional set of tests shall be taken for every 100 cubic yards of concrete poured in one day. A set of concrete tests shall consist of the following paragraphs. If the results are satisfactory the pour and subsequent testing per ASTM procedures may proceed. If the results do not meet these specifications, additional air entrainment additive may be added and the concrete retested for air. Water may be added only if the amount is within the mix design parameters and is not used to refresh concrete that has begun to set.

7.02.l.1. Perform at least one slump test per truck, per "Standard Test Method for Slump of Hydraulic Cement Concrete" ASTM C-143.

7.02.l.2. Conduct at least one entrained air test each day concrete is placed, with an additional test for every 100 cubic yards of concrete placed in one day, per "Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method" ASTM C 231 or "Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method" ASTM C 173.

7.02.l.3. Prepare four compression test cylinders per set. Test cylinders shall be made, cured, and transported to laboratory per "Standard Practice for Making and Curing Concrete Test Specimens in the Field" ASTM C 31. Perform compressive strength tests on test cylinders per "Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens" ASTM C 39 as revised to date. One cylinder shall be broken at seven days and two broken at 28 days with one cylinder held in reserve.

7.02.l.4. Submit test reports for each cylinder tested within three working days to the Engineer.

7.02.l.5. Any concrete work that does not meet the specified strength and quality shall be removed and replaced.

8.0 STRUCTURAL STEEL

8.01 General

Erection of the substation steel structures as detailed on the attached drawings, and as specified herein is required.

8.02 Assembly and Erection

a. All supervision, labor, tools, equipment, and transportation necessary to assemble and erect all steel structures on foundations as shown on the drawings and as specified herein shall be provided.

b. Structures shall be erected true and plumb with all bolts securely tightened. Structures shall be erected by a method that will not overstress structural members or foundations. Adequate time for concrete curing shall be provided before structure erection. Damaged foundations resulting from premature or excessive construction loading shall be replaced. Should any piece be bent, overstressed or otherwise damaged, it shall be replaced.

c. All bolts shall be drawn up so that mating surfaces of connecting members are held tightly together. After all bolts are placed they shall be tightened to snug-tight. The snug-tightened condition is the tightness that is attained with a few impacts of an impact wrench or the full effort of an ironworker using an ordinary spud wrench to bring the connected plies into firm contact. All tools and wrenches shall be of a design that will not damage the steel or galvanizing.

d. Only minor changes will be allowed to the structural steel at the substation site, i.e., reaming of holes, drilling of holes, clipping of angles, and other minor changes as approved by the Engineer. Bare surfaces resulting from site changes of structural steel shall be painted with ZRC (Zinc Rich Coating) as manufactured by Sealtube Company of Wakefield, Massachusetts. Application of paint shall be in accordance with manufacturer's recommendations and in accordance with ASTM A 780 "Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings". Minimum thickness of repaired areas shall comply with American Hot Dip Galvanizers Association's Manu-Spec, specifically, organic zinc rich paint – dry film thickness of 8 mils, zinc-repair solder – 2 mils, and sprayed zinc – 4 mils (minimum of 3 coats).

e. Any steel pieces damaged shall be repaired or replaced.

9.0 CONDUIT

9.01 General

All conduits and manholes are to be provided as shown on the drawings. All material, labor, tools, and equipment necessary to excavate for and install the conduit and duct bank system in the substation as shown on the drawings and as specified herein. The Contractor shall furnish backfill for the conduit trenches and duct banks, along with all PVC cement, cleaning solvent, duct seal, and other miscellaneous items required for the installation of the conduit system. All conduits shall bear the UL Label. Flexible conduit, if required, shall be liquid tight, Sealtite and no longer than three feet in length with "ST" series connectors, or equal.

9.02 Excavation and Backfill

a. Excavation

9.02.a.1. The minimum trench depth for low-voltage power, control and communication equipment conduits shall be 24 inches nominal unless otherwise shown on drawings, and except where reduced burial depths are specifically required due to obstructions, such as existing conduit banks and ground grid conductors.

9.02.a.2. The trench bottom shall be level and relatively smooth undisturbed earth, well-tamped earth or select backfill, and any elevation change shall be gradual so that the conduit is evenly supported along its entire length. Rock spurs or ridges shall not project into the trench.

9.02.a.3. When conduits are installed to cable manholes, they shall be sloped to drain towards the manhole, if the terrain allows. The minimum slope is 4 inches per 100 feet of conduit. The conduits shall be sealed with duct seal where they enter into the manhole.

9.02.a.4. In no case may trench width be less than eight inches wide.

9.02.a.5. Native soil removed during the trenching process may be used as select backfill.

9.02.a.6. If native soil is not suitable as select backfill, medium size sand or sand-silt passed through a No. 10 sieve from may be used. Crushed rock or fractured sand is not acceptable.

9.02.a.7. No material shall be placed when either material placed, or material on which it is placed, is frozen.

9.02.a.8. Fill shall be placed in horizontal layers having a thickness of not more than eight inches before being compacted. Each lift shall be conditioned to near optimum moisture content and compacted to a dry density equivalent to at least 95% of the dry density obtainable by the Modified Proctor ASTM D1557. Conduit Installation and Connections to Equipment

Conduit runs shall be fully assembled at the trench side. After appropriate conduit cement set time, the conduit run shall be lowered into a properly prepared trench, as close to the trench center as possible.

Every effort shall be made to provide a straight conduit run between bends. Conduit shall not "snake" horizontally along the trench bottom. Conduit run shall be as straight as possible before trench backfill is placed.

After conduits have been installed, they shall be capped at both ends to be kept clean and ready for cable installation.

Install a pull line in all conduits along with the cables for future use. The pull line shall be such that it will not rot with age. A pull line shall be pulled with all cables, and left for future use as needed.

All conduit bends shall be made so that the conduit is not flattened and the internal diameter of the conduit is not effectively reduced.

Conduits shall follow contours of foundations and structures for a neat appearance and shall be firmly fastened on steel structures with pipe straps. Holes for pipe strap installation shall be field drilled.

Terminate conduits with locknuts and bushings or as directed on the drawings. Where equipment is provided with tapped conduit entrances, locknuts are not necessary, but terminations shall be made with bushings unless conduit entrance is provided with a rounded-off boss butting against the end of the conduit. Additional holes, if required, shall be punched in the field and unused holes shall be closed with a plate fastened in place by screws. Conduits to be installed to equipment shall be accomplished in such a manner as to fit snugly against footings as they emerge from the ground. They shall be secured to structural members by means of pipe clamps and bolts.

9.03 Manholes

Where manholes are required, either cast in place or precast design shall be used. Manholes shall be provided with a pedestrian rated cover, unless they are located in an area which is subject to vehicle traffic.

9.04 Surface Trench

Where surface trench is specified, installation guidelines provided by the trench manufacturer shall be followed. Open bottom trench designs from either Concast or Trenwa are preferred. Pedestrian rated surface trench shall be used only in areas limited to pedestrian traffic. Road crossings shall be made with the appropriately rated trench. The covers of the trench system shall extend above the surrounding crushed rock surface. The trench system shall employ a minimum of 4" of sand bedding. The trench system shall incorporate cable clips spaced approximately every 5', which shall support a 4/0 AWG copper grounding cable, which shall be tied to the ground grid approximately every 25'. Markers shall be placed to indicate drive and non-drive areas of the trench system.

10.0 GROUNDING

10.01 General

All material, labor, tools, and equipment necessary to construct the grounding system as shown on the drawings and as specified herein shall be provided. Materials required for below and above ground bonding of the ground grid shall also be provided.

Equipment shall be connected to the main ground grid with #4/0 AWG soft drawn copper conductor, as indicated on the drawings. Where it is possible and practicable, ground wire shall be a continuous conductor.

Ground grid connections shall be tested by performing a continuity test of each equipment and structure grounding conductor to the main ground grid.

10.02 Ground System

The grounding system consists of trenching for laying the below ground conductors and connections to the substation grounding grid. The grounding system also includes connections to equipment, junction boxes, switch operating platforms, structures, fences, and shield wires.

10.03 Backfill of Ground Trenches

Excavated materials, removed during trenching, that are free of clay lumps, deleterious materials, or stones larger than one inch in greatest dimension, may be used for fill. Fill material shall be free of rocks or clods larger than one inch, vegetation, pieces of wood or other organic material larger than one-half inch in diameter. No backfill is to be placed when either material placed, or material on which it is placed, is frozen. Fill shall be deposited in layers, leaving a maximum thickness of eight inches before being compacted. Compaction shall be done with mechanical tampers to at least 95% of Modified Proctor ASTM D-1557. The grounding system shall be inspected before the trenches are backfilled.

10.04 Connections

a. Above Ground

Above ground connections of ground cables to steel structures, equipment, and fence shall be securely made with mechanical compression or bolted type connectors. All steel

conduits shall be effectively grounded either by direct grounds or by attachment to metal enclosures that are adequately grounded. Holes necessary for attaching connectors may have to be drilled. Ground leads shall be run up over the footings and up the structures in a neat and workmanlike manner.

In all cases where connections to the ground grid are stubbed out at equipment footings in advance of equipment installation, care shall be taken that a sufficient length of cable plus a reasonable margin is left, so the lead may be trained up along the wall of the footing and made to follow all surfaces closely in routing cable to the point of connections. Avoid disturbing the galvanized finish of structural steel when routing and terminating structure and equipment grounds. Where paint is present, brush the paint off at the point of contact to establish a solid connection, and coat the connection with a galvanizing compound.

b. Below Ground

The ground grid shall be buried below the top of yard finish rock with minimum of 18 inches and maximum of 20 inches in depth unless otherwise shown on the drawings. The ground grid conductors shall be bonded at points of crossover, connections to ground rods, and at all tap points. Bonding shall be accomplished by the method as shown on the drawings.

11.0 BUS AND CONNECTORS

11.01 Tubular and Cable Bus

Provide all tubular and cable bus as well as all labor, tools, and equipment necessary to install all tubular and cable bus, as shown on the drawings.

a. Tubular Bus

Tubular bus shall be cut in the field to the exact lengths required. Tubing shall be cut off square and all burrs removed. Any deformation of the cut edge of the tubing shall be filed off. Special care must be taken on any piece of bus that is part of systems rated 230 kV and above, as to minimize the effects of corona.

Horizontal tubular bus spans shall be installed with a slight upward deflection that will tend to neutralize the deflection (sag) due to the weight of the bus and taps. Finished bus spans shall deflect no more than 1/150th of the span, upon installation.

1/4 inch diameter weep holes shall be drilled at the bottom of tubular bus at points of maximum sag per material supplier's instructions and details.

Field bends shall be made approximately to the radius shown on the drawings and the curvature shall be continuous and uniform with a minimum of flattening or crimping.

b. Cable Bus

Jumpers and vertical cable taps shall be installed of such length and form as to maintain maximum clearance from surrounding objects and to give assurance that such contour will be stable. No splices in overhead cable bus will be allowed.

c. Damaged Material

11.01.c.1. The tubular and wire bus shall be handled in such a manner that no surface damage will occur. The outer surfaces of all installed conductors shall remain smooth and free from scratches, nicks, dents or other surface damage.

11.01.c.2. All damaged material shall be repaired or replaced. Damage shall include all surface defects which can be felt by the fingers and shall include all visible defects. Minor damage to tubular bus may be repaired by filing and smoothing with fine emery cloth to restore the surface so no damage can be felt. Damaged tubular bus shall not be used.

11.01.c.3. All damaged cable bus shall be considered unusable and subsequently be replaced. Splices will not be acceptable.

11.02 Bus Connections

All bus fittings, connectors and all material, labor, tools, and equipment necessary to install bus fittings and connectors, as specified herein and as shown on the drawings shall be provided.

a. Aluminum Tubular Bus

Welded fittings shall be used for aluminum tubular bus. The fittings shall be welded using the inert gas tungsten arc method or metallic arc inert gas shielding method. All welding shall be smooth and done in a good workmanlike manner, and shall be performed by a certified journeyman welder. Aluminum surfaces to be welded shall be thoroughly cleaned with a clean, stainless steel bristled brush. The welder shall make the required number of "passes" over each weld to assure a strong and corona free mechanical connection. Smoothing of welds shall be accomplished only with fine toothed files or fine abrasive materials. Grinding shall not be permitted.

b. Aluminum and Copper Wire

Copper/Bronze Bolted Terminals: All copper wire connectors 2/0 AWG and larger shall be bolted fittings or compression when a 2-hole NEMA pad is specified as the interface. Contact surfaces shall be cleaned down to the bright metal with emery cloth and then covered with corrosion inhibiting compound. The surfaces shall be wire brushed so as to groove the compound on the surface and shall be bolted or clamped in place without removing the compound.

Aluminum Fittings: All aluminum wire connectors shall be welded or compression type fittings unless otherwise noted on the drawings. The manufacturer's recommendations for installation shall be followed on installation of all fittings.

Where compression fittings are connected in a direction that would allow for water ingress, drains holes shall be drilled.

c. Bolted Connections

Bolted connections shall be fastened with stainless steel hardware. Each bolt shall be furnished with one Belleville washer and two flat washers. Stainless steel Belleville washers shall be a minimum of 0.140" thick with a 6000 pound load required to flatten the washer. Stainless steel flat washers shall be a minimum of 0.125" thick.

All aluminum connections shall be prepared as follows:

- Apply oxide inhibiting compound over the connection surface.

- Wire brush the entire surface through compound to remove oxide film.

- Apply another coat of compound.

- Make the connection and remove excess compound.

Oxide inhibiting compound, Alcoa "ALNOX", or equal shall be used.

d. Damaged Fittings

Fittings shall be handled in such a manner that no surface damage will occur. The outer surfaces of all installed fittings shall remain smooth and free from scratches, nicks, dents and other surface damage.

Damaged material shall be repaired or replaced. Damage shall include all surface defects that can be felt by the fingers and shall include all visible defects. Minor damage to fittings may be repaired by filing and smoothing with fine emery cloth to restore the surface so no damage can be felt. Severely damaged fittings shall be replaced.

11.03 Vibration Dampening

a. Supply and install internal dampening cable in all bus lengths of 8 feet or greater. See material list for dampening cable conductor size. Dampening cable conductor shall be cut to length approximately four inches shorter than the tubular bus section. Weld one end of the dampening conductor to the inside of the tube allowing the other end to move freely inside the tubular bus. Dampening cable is intended to prevent Aeolian vibration on the aluminum bus.

12.0 WIRING AND CONTROL CABLE TERMINATIONS

All wire, control cable, terminal lugs, electrical tape, pressure connectors for joints or splices, tie wraps, heat-shrink wire labels as required shall be provided. All labor, tools, and equipment necessary to pull, lay, and make connections of all wires, jumpers, and cables, as shown on the drawings and as specified herein shall be provided. Tests as described herein shall be provided.

12.01 Materials

All furnished materials shall comply with the contract and shall meet the requirements of the following:

a. Equipment connections, junction box connections, termination cabinet connections and connections to AC equipment. Relay and protection panel connections and DC equipment connections if required.

Terminal Lugs	Compression, copper, ring type; AMP or approved equivalent (Wire sizes #14 #10)
Tie Wrap	Plastic ties of appropriate strength for individual wire bundles as manufactured by 3M and Panduit. Must be UV protected.
Cable Labels	Cables shall be labeled per the cable schedule, cable labels shall be tie wrap type. Acceptable material manufacturers are 3M, Raychem, and Brady.
Wire Labels	Wires shall be labeled the name of the cable. Wire labels are to be printed with permanent ink, and shall be slip-on type, heat shrinkable tube. Acceptable material manufacturers are 3M, Raychem, and Brady.
Clamps	Ground clamp for terminating cable shields, Scotchlock #4460 or approved equivalent

b. Control and Power Cable

12.01.b.1. **See attachment labeled "Substation Power and Control Cables" for cable requirements.** Refer to the cable schedule, provided with the drawings for additional cable requirements.

12.02 Terminations

a. Control Cable

12.02.a.1. All control cable using the specified size, type and number of conductors, or such substitute sizes as are authorized shall be installed. Any deviations shall be approved by the Engineer before making the change.

12.02.a.2. Care shall be used in handling cable to prevent damage by sharp bends or excessive pulling strain or abrasion to the sheath from pulling. Cables shall be pulled in one continuous length from termination to termination.

12.02.a.3. Control cables entering equipment external to the control enclosure, shall have the protective sheath removed to the cable entrance point of the equipment. Black shrink-to-fit tubing shall be applied around the cable where the sheath ends.

12.02.a.4. Cables shall be routed within the yard equipment cabinets to avoid obstructing operating devices and terminal boards. Cables shall be secured in such a way that the cable weight does not pull on the terminal blocks, and they shall be

fastened by tie wraps approximately every six inches. Any unused wires shall be left long enough to reach any terminal block in the equipment.

12.02.a.5. Insulation damage occurring during installation shall be repaired with heat shrink tubing.

12.02.a.6. All wiring shall be identified with wire labels or markers at both ends of each wire. The wire label shall be as is indicated above.

b. Switchgear Interconnections (if applicable)

12.02.b.1. Interconnections in the switchgear shall be installed as detailed on the wiring drawings. Cable numbers have been assigned to assist in identification of the circuits. If a wire size is not identified on the drawing, it shall be sized according to usage and as approved by the Engineer.

12.02.b.2. Cable shields shall be terminated as indicated on the wiring diagram drawings.

12.02.b.3. The shield shall remain on the bundle as far as possible. Do not strip all the shields back to a common point.

c. Substation Equipment

12.02.c.1. All control, AC, DC, potential and current circuits for all equipment at the substation shall be terminated. This includes but is not limited to the following equipment (if applicable): substation transformers, circuit breakers, current transformers, potential transformers, motor operators, capacitor or reactor switchers, and equipment inside the switchgear as shown on the drawings. All cables and individual conductors shall be properly terminated and labeled as shown on the wiring diagrams associated with the equipment.

12.02.c.2. All conductors and cables for substation equipment at each end shall be identified properly. Terminal and conductor identification shall correspond to the designation shown on approved drawings.

12.02.c.3. Identification nameplates shall be provided and made of laminated three-ply plastic, equal to Lamicoid. Nameplates shall be a minimum of 1/16 inch thick, with white outer layers on a black, core. Edges shall be chamfered. Nameplates shall be fastened to the equipment by using one blank rounded screw on each end.

12.02.c.4. The equipment at the substation shall be identified using a nameplate, with 1/4 inch high font. **See attachment labeled "Equipment Nameplates and Warning Signs" for nameplate size and additional equipment nameplate identification.**

12.02.c.5. Small Equipment Identification at substation: Lighting fixtures and power receptacles shall be identified similar to Section 12.02.c.4 above except use 1 inch X 3 inch nameplate with 1/4 inch high letters. The identifications shall include the panel and circuit from which it is served, including device number as shown on drawings.

12.02.c.6. Yard Lighting and Receptacles

Install insulated wire, of the type and sizes shown on the drawings, to connect the yard lighting, and yard power receptacles. Wiring splices and joints shall be made only in conduit outlet boxes. Outdoor light fixtures shall be weather tight and shall be provided with neoprene gaskets. All materials for outdoor lighting shall be furnished.

All splices and joints in wiring shall be pressure type solderless connectors. They shall be insulated with shrinkable XLPE tubing or properly capped and taped.

d. Compression Terminal Lugs

A compression tool shall be used on all compression fittings. The compression tool shall be calibrated before each use. When more than one conductor is located on a terminal, the lower terminal shall be reversed (lugs shall be back to back). All terminal lugs shall be installed so that the crimp connection is visible.

e. Cleanup

All cable pulling compound from all cable exposed in equipment, cabinets and the switchgear enclosure shall be removed.

All construction created debris from the electrical equipment enclosure or switchgear enclosure (if applicable) and the substation shall be removed.

12.03 Testing – Panel Wiring and Control Cables

a. Insulation (MEGGER) testing of all installed cables shall be accomplished. The test consists of testing each conductor at 1000 VDC for 10-15 seconds, while being sure to ground all other conductors not under test.

b. Point to point wiring checks of all installed wiring shall be accomplished.

After completion of the wiring installation work, all circuits shall be tested for continuity, grounds, shorts, and all faulty or improperly connected circuits shall be corrected.

13.0 FIBER OPTIC CABLES

13.01 Products

a. The fiber optic cable shall be dual window, single jacket all-dielectric loose tube cable to be placed in an underground duct application. The cable components should be coated with super absorbent polymer (SAP) materials impregnated within the core to prohibit the migration of water. Fiber cable construction shall be loose tube gel-filled color-coding per TIA/EIA 598B standards. The Central Strength member shall contain no metallic conductors. The overall strength member shall be aramid fiber yarn or fiberglass; the jacket will be black UV and moisture resistant PE with sequential meter markings.

b. Patch cords shall be of duplex design, unless otherwise noted on the drawings. Refer to the plans and drawings for specific requirements of fiber optic cabling.

13.02 Duct Specifications

a. The duct shall be a high density polyethylene (HDPE) conduit. Orange in color equipped with a pull tape. The size shall be a minimum two inch, with a minimum wall thickness of 0.151 inches, or as specified on the drawings. The pull tape shall be rated for 1250 lb.

13.03 Execution

a. All construction and installation work shall be done in a thorough and workmanlike manner in accordance with the Plans and Specifications.

b. All material to be used in construction of the Project shall be stored so as to be protected for deteriorating effects of the elements.

c. All fiber optic cable used in the construction of the Project shall be handled with care. Each reel shall be inspected for damage prior to installation.

d. The latest revision of the National Electrical Safety Code and the National Electrical Code shall be followed in every case except where local regulations are more stringent, in which case local regulations shall govern.

e. Fiber optic cable insulation shall have a maximum tensile load of 600 lbs. for installation and 200 lbs. for in-service load. The minimum bend radius shall be 20xOD for installation and 10xOD for in-service.

f. Deviations from the Plans, Specifications and Construction Sheets shall not be permitted except upon written permission of the Engineer. The fiber optic cable shall only be spliced in the locations indicated on the construction sheets deviations will only be permitted except upon written permission of the Engineer.

13.04 Cable Splicing

a. All splicing for the fiber optic cable shall be by the fusion method and splices placed in a splice tray.

13.05 Fiber Optic Cable Testing

a. All single-mode fiber optic cable testing shall be done with an OTDR in both directions of the strands. For single-mode fiber, test both directions at 1310 nm and 1550 nm.

b. All multi-mode fiber optic cable testing shall have a functional test performed.

c. When testing is completed all test reports shall be submitted for acceptance within ten days after testing is complete.

d. All test reports will have both electronic records of the results and printed copies of the test results will be made and delivered.

e. Testing will be completed on each fiber-optic cable and each strand on every fiber run from termination to termination.

f. Any cable that is tested with negative performance characteristics will be replaced or adjusted as necessary. All cable segments that were corrected shall be re-tested.

13.06 Handling of Cable

a. Cables or duct shall be carefully inspected and tested by the Contractor during placement operation to be certain that the fiber optic cable and duct are free from damage before placement.

b. Bends of small radii and twists that might damage cable shall be avoided. During the placement operation, fiber optic cable shall not be bent in a radius less than 20 times the outside diameter of the cable.

c. For lengths longer than 50 feet, pulling lubricant will always be used when pulling fiber-optic cable. Pulling lubricant shall be used as needed. The pulling lubricant type shall be as required by the pulling equipment manufacturer.

d. Care is to be exercised during the placing operation. Equipment and construction methods shall be such as to assure compliance with this requirement. Competent supervision shall be provided at all times at the site of cable placing operations to assure compliance with this requirement.

e. Every instance of damaged cable observed at any time whether prior to installation, occurring during construction, or discovered by test of observation subsequent to installation at site, shall be repaired or corrected. The method of repair or correction of such damage shall be in accordance with the written instructions of the fiber-optic cable manufacturer. Minor damage to the outer jacket of the cable observed prior to or occurring during construction shall be repaired in accordance with RUS Splicing Standard Bulletin 1753F-401 (PC-2).

13.07 Patch Panel Labeling

a. If the cable manufacturer has not included identification of the individual strands then the cables will be labeled with sequential numbers. Each label should have two digits. The first strand would be labeled '01'. Each strand should have the same label as it has at the other end. If the cable manufacturer has marked each strand by a different colored jacket, then a chart will be created referencing that color to a number. Every cable will have the same color and number relationship. This chart will be documented at each termination point.

b. The label on the cable will be placed as close to the end of the cable before where the sheathing has been stripped away. It will be placed in a location easily viewable after the cable has been mounted.

c. Each patch panel and splice box will be labeled with its unique identifying label. The label will be placed on the outside of the front of the panel or box.

d. Additional labeling will be used as required to enable fast and reliable assembly and maintenance of network.

14.0 SIGNS AND SAFETY MARKERS

14.01 General

Install warning signs, danger signs, equipment signs, phase identification signs, and safety markers or guard posts as specified in **attachment labeled "Equipment Nameplates and Warning Signs"**.

15.0 TESTING AND COMMISSIONING

The substation shall be inspected to ensure that it is electrically, mechanically, and structurally complete, prior to commissioning.

ELECTRICAL EQUIPMENT
AND MATERIAL SPECIFICATION

Substation Power and Control Cables Attachment

1.0 SCOPE

1.1 This specification defines the requirements for substation control and power cables.

1.2 It will be assumed that the supplier is quoting in strict conformance with these specifications unless the quotation includes a statement and description of the proposed exceptions.

2.0 CODES AND STANDARDS

2.1 The substation control and power cables furnished under this specification shall be designed in compliance with the latest published standards of ANSI, IEEE, NEMA, NEC, NESC, ASTM, UL and ICEA, unless otherwise noted. If any of the requirements of this specification are in conflict with these standards, the Supplier shall notify the Engineer immediately.

3.0 CONDUCTORS

3.1 Conductors shall be annealed copper per ASTM B-33, Class B Stranding per ASTM B-8.

4.0 CABLE TYPES

4.1 **Single Conductor – Service Entrance Rated Power Cable**

4.1.1 Power cable shall be 600V Type USE with EPR insulation and stranded copper conductor per ASTM B-8. The cable is to be installed for AC and DC service to outdoor and indoor power apparatus via, direct burial, conduit, cable trench, cable tray as required. See cable list for conductor size. (Note: Cables are to be used only for service from transformer to fused disconnect.)

4.2 **Single Conductor –Tray Rated Power Cable**

4.2.1 Power cable shall be 600V single conductor, Type TC with an RHW insulated stranded copper conductor and Neoprene jacket. See cable list for conductor size. (Note: Cables to be used to interconnect fused disconnects, automatic transfer switch and AC panels for AC distribution system).

4.3 **Multi-Conductor Lighting and Power Cable**

4.3.1 Cables shall be 600V, type TC with RHW insulated stranded copper conductors and Neoprene jacket suitable for direct burial. Color code shall be per ICEA Method 1, Table E1, for AC power cables and ICEA Method 1, Table E2, for DC power cables. See cable list for size and number of conductors.

4.4 **Multi-Conductor Control Cable**

4.4.1 Cables shall be 600V, type TC with an XLPE insulated stranded copper conductors and CPE overall jacket suitable for direct burial. Color code shall be per ICEA Method 1, Table E2. All control cables shall be shielded. Shield shall be longitudinally 5 mil annealed corrugated copper tape with a drain wire that directly contacts the shield the entire length of the cable. See cable list for size and number of conductors.

5.0 INSULATION

5.1 The insulation thickness shall be in accordance with UL standard 1277.

6.0 OVERALL JACKET

6.1 The jacket shall be moisture, sunlight-resistant and flame-retardant, low smoke zero halogen polyolefin per UL standards.

6.2 Thickness shall be in accordance with UL standard 1277.

7.0 SURFACE MARKING

7.1 Cables shall be identified by means of surface ink printing indicated manufacturer, number of conductors, size, voltage rating and required UL information.

8.0 INSPECTION

8.1 All cable shall be inspected and free from defects.

Substation Equipment Nameplates and Warning Signs Attachment

EQUIPMENT NAMEPLATES AND WARNING SIGNS

Note: Line 3 of the nameplate where equipment names/numbers are separated by a comma represents each individual nameplate. Nameplates should only be labeled with one equipment name/number on line 3. The equipment nameplates shall be printed with black letters on a white background. Signs shall be printed on a weather and UV resistant laminated plastic.

5" x 8" NAMEPLATES

Plate 1:	**1 Required**
Line 1-	138 KV
Line 2-	BREAKER
Line 3-	52T1
Plate 2:	**4 Required**
Line 1-	34.5 KV
Line 2-	BREAKER
Line 3-	52F# (#=1, 2, 3, 4)
Plate 3:	**1 Required**
Line 1-	34.5 KV
Line 2-	BREAKER
Line 3-	52V1
Plate 4:	**1 Required**
Line 1-	138/34.5/13.8 KV
Line 2-	70.2/93.6/117 MVA
Line 3-	TRANSFORMER T1
Plate 5:	**1 Required**
Line 1-	138 KV
Line 2-	DISC SWITCH
Line 3-	89T1
Plate 6:	**1 Required**
Line 1-	34.5 KV
Line 2-	DISC SWITCH
Line 3-	89B1
Plate 7:	**4 Required**
Line 1-	34.5 KV
Line 2-	DISC SWITCH

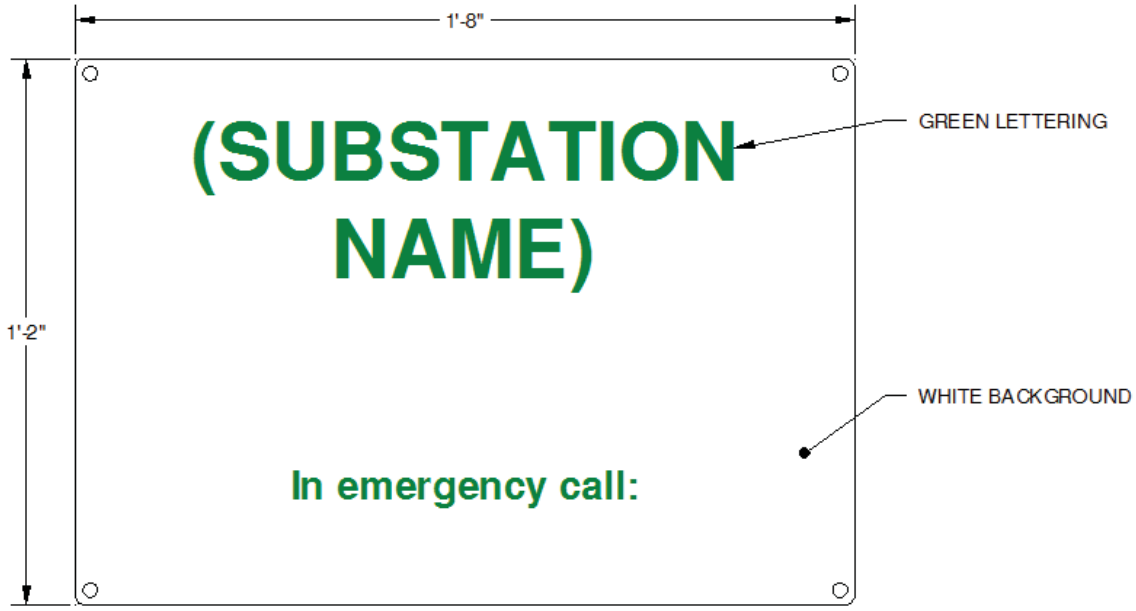
Line 3-	89F#C - (#=1, 2, 3, 4)
Plate 8:	**4 Required**
Line 1-	34.5 KV
Line 2-	DISC SWITCH
Line 3-	89F#A - (#=1, 2, 3, 4)
Plate 9:	**1 Required**
Line 1-	34.5 KV
Line 2-	DISC SWITCH
Line 3-	89V1C
Plate 10:	**1 Required**
Line 1-	75 KVA
Line 2-	STATION AUX
Line 3-	19,920-120/240V
Plate 11:	**1 Required**
Line 1-	34.5 KV
Line 2-	SWITCHER
Line 3-	89C1
Plate 12:	**1 Required**
Line 1-	34.5 KV
Line 2-	CAPACITOR BANK
Line 3-	C1
Plate 13:	**3 Required**
Line 1-	138 KV
Line 2-	CCVTL1
Line 3-	A PHASE, B PHASE, C PHASE
Plate 14:	**1 Required**
Line 1-	34.5 KV
Line 2-	VOLTAGE XFMR
Line 3-	VTB1
Plate 15:	**1 Required**
Line 1-	34.5 KV
Line 2-	0.6 OHM
Line 3-	NEUTRAL GROUNDING REACTOR

WARNING SIGNS

Warning signs are to be placed every 35 feet around the perimeter of the fence as well as on each fence gate. The warning sign shall be printed as shown below or an approved equivalent. Signs shall be printed using the ANSI Z535 color code on a weather and UV resistant laminated plastic.

SUBSTATION INFORMATION SIGN

A substation information sign shall be placed on each substation fence gate and include the substation name and contact information. Sign below is an example of typical sign layout that can be used with the required substation specific information filled in. Signs shall be printed on a weather and UV resistant laminated plastic.



Substation Ground Grid Report

Project Name: NW Ohio Wind Project

Ulteig Project Number: 17.01246

Sector: Energy Services

Market: Substation

Prepared By:

Document Owner(s)	Project/Organization Role
Ulteig Engineers, Inc.	Engineer

Prepared For:

Document Owner(s)	Project/Organization Role
White Construction, Inc.	BOP

Revision History

Revision	Date	Description
A	10/19/2017	60% Package – Issued for Review
0	1/25/2018	ISSUED FOR CONSTRUCTION

Prepared By:	Reviewed By:	Approved By:
Micah Tengesdal	Eric Swenson	Jonathan Olson, PE
Ulteig	Ulteig	Ulteig

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2 STUDY CRITERIA 4
2.1 Study Purpose 4
2.2 Software Used 4
2.3 Study Procedure 4
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4 CONCLUSIONS 6
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6 APPENDIX 2: Figures 10

1 EXECUTIVE SUMMARY

The purpose of the study is to analyze the grounding system to assure that any persons in the vicinity of the grounded facility would not be exposed to a critical electrical shock. The grounding system meets IEEE Std. 80-2013 safety requirements. The ground grid shall be installed as designed and tested after completion.

2 STUDY CRITERIA

2.1 Study Purpose

The purpose of the assessment is to verify that the proposed grounding design meets IEEE Std 80 (2013 Edition) safety requirements and client standards. The touch voltages are computed over any area within three feet of any object that can be touched within the area occupied by the grounding system. The step voltages are computed over the entire area occupied by the grounding system. The maximum touch and step voltages are compared with the maximum permissible levels as specified by IEEE Std. 80-2013. The results are summarized in Appendix 1 as well as in the figures in Appendix 2.

2.2 Software Used

The grounding analysis was performed using Safe Engineering Services (SES) CDEGS software, hereafter CDEGS. CDEGS evaluates the performance of a grounding system based on ANSI/IEEE Standard 80-2013. The RESAP module analyzes soil resistivity and interprets soil structures. RESAP is used to determine equivalent earth structure models based on measured soil resistivity data. Given the field data, RESAP automatically produces a soil model which most closely matches the data. CDEGS also has imbedded modules which compute the ground potential rise of every independent system of the grounding network, earth leakage current distribution along every conductor segment, and potentials at each specified point in the earth or at the earth's surface. The fundamental device model allows the user to represent complex grounding systems in detail and evaluate their performance by comparing maximum touch and step voltages to permissible values set by the IEEE Std. 80-2013.

2.3 Study Procedure

CDEGS was utilized to create a grounding system model to simulate the results of the worst-case fault condition. The soil resistivity measurements were analyzed using the RESAP module, which is utilized to determine electrical resistivity, depth, and number of layers that most accurately reflects the characteristics of the soil. RESAP is capable of simulating multilayer soil models. The grounding system model was created using the MALZ module. A current source is placed in the model at the worst-case fault location. The maximum touch and step voltages are computed based on the grounding system design, soil resistivity, ground fault current, and safety criteria. Safety criteria include fault clearing time, body weight, and presence of insulating surface material. The results are summarized in Appendix 1 as well as in the figures in Appendix 2.

3 RESULTS

The purpose of the safety assessment is to verify the proposed grounding design meets IEEE Std 80-2013 requirements and client standards. The touch voltages are computed over any area within three feet of any object that can be touched within the area occupied by the grounding system. The step voltages are computed over the entire area occupied by the grounding system. The maximum touch and step voltages are compared with the maximum permissible levels as specified by IEEE Std. 80-2013. The results are summarized in Appendix 1.

4 CONCLUSIONS

Per IEEE Std. 80-2013, the maximum touch and step voltages are within acceptable limits.

5 APPENDIX 1: Study Information and Results

Project Name:	Northwest Ohio Wind Project
Project Location:	Paulding County, Ohio
STUDY INFORMATION	
Fault Clearing Time (sec)	0.25
Ground Fault Current (kA)	15
X/R Ratio	0.48
Split Factor (%)	52.85
Body Weight (kg)	50
Insulating Surface Layer Depth (inches)	4
Insulating Surface Layer Resistivity (ohm-m)	3000
Soil Resistivity Method	Four Pin (Wenner) Method
Soil Resistivity Tester	Barr Engineering
Soil Resistivity Date	October 28, 2014
Grid Conductor Size	4/0 AWG
Grid Conductor Type	Copper, annealed soft-drawn
Grid Conductor Depth (inches below subgrade)	18
Ground Rod length (feet)	10
Ground Rod Diameter (inches)	3/4
Ground Rod Burial Depth – Top of Rod (inches)	18
RESULTS	
Soil Layer 1 Resistivity (ohm-m)	26.42859
Soil Layer 1 Thickness (feet)	18.94574
Soil Layer 2 Resistivity (ohm-m)	480.6825
Soil Layer 2 Thickness (feet)	Infinite
Permissible Touch Voltage over Native Soil (volts)	241.000
Permissible Touch Voltage over Surface Layer (volts)	979.700
Maximum Touch Voltage (volts)	120.689
Permissible Step Voltage over Native Soil (volts)	269.600
Permissible Step Voltage over Surface Layer (volts)	3224.500
Maximum Step Voltage (volts)	353.370
Ground Resistance of Substation Site (ohms)	1.208252
Maximum Ground Potential Rise (GPR) (volts peak)	13565.10

SPECIAL CONSIDERATIONS AND CLARIFICATION

1. A two-layer soil model is based on the pre-construction soil resistivity measurements (see Appendix 2: Figures 1-2 and the Geotechnical Report [3]). The site should require limited cut and fill, indicating the soil resistivity measurements should be accurate after grading. Electrical Resistivity measurements were taken in the vicinity of the substation. Only the higher of the two sets of the measurements was considered at each pin spacing.

2. The grounding system resistance is computed based on the electrical resistivity of the soil, the amount of copper, and the shape of the ground grid. The ground grid design and resistance calculation are shown in Appendix 2: Figure 3. The ground grid model matches the CAD file of the Substation Grounding Plan [4].

3. The protection scheme is designed to clear a fault in 0.5 seconds or less. The surface material to be installed and maintained at the substation is a 4-inch layer of 3,000 ohm-meter crushed rock. Appendix 2: Figures 4 and 5 show the safety criteria with and without crushed rock.

4. Touch voltages have been analyzed within 3 feet of any equipment or fence (see Appendix 2: Figure 6).

5. Step voltages have been analyzed inside the fence and up to 20 feet outside the fence (see Appendix 2: Figures 7-8).

6. The worst case ground fault results in less than 15kA ground fault current (see Short Circuit Study [5]). This includes a safety margin for future projections.

7. Ground Potential Rise (GPR) has been analyzed and indicates the area in which the GPR could reach levels above 300V (see Appendix 2: Figure 9). The results can be utilized to determine the type of insulation required for conductors in the area, such as communication circuits and metallic pipelines. If these conductors are not properly insulated and isolated, dangerous conditions for equipment and personnel may exist. All dielectric (AD) fiber optic cable or isolation equipment should be used to isolate personnel and communication equipment.

REFERENCES

[1] Institute of Electrical and Electronics Engineers, ***IEEE Guide for Safety in AC Substation Grounding, IEEE Std 80-2013*****, IEEE, Piscataway, NJ**

[2] Current Distribution Electromagnetic Interference Grounding and Soil Structure Analysis, CDEGS Application: ***NW Ohio Wind Project Substation Grounding System Analysis*****, October, 2017**

[3] Barr Engineering Company – Geotechnical Report Document (NW Ohio Wind Project Geotechnical Report-Final), page 201, ***December 10, 2014***

[4] Ulteig Engineers, Inc.: ***NW Ohio Wind Project – Grounding Plan (Drawing NWO-GR1-001)*****, October, 2017**

[5] Westwood Professional Services – Short Circuit Study (20170928_NW_OH_Wind Short Circuit Study_R1), page 5, ***September 28, 2017***

6 APPENDIX 2: Figures

Project Name: Northwest Ohio Wind Project
Project Location: Paulding County, Ohio

FIGURES

Figure 1 Soil Resistivity Measurements 11
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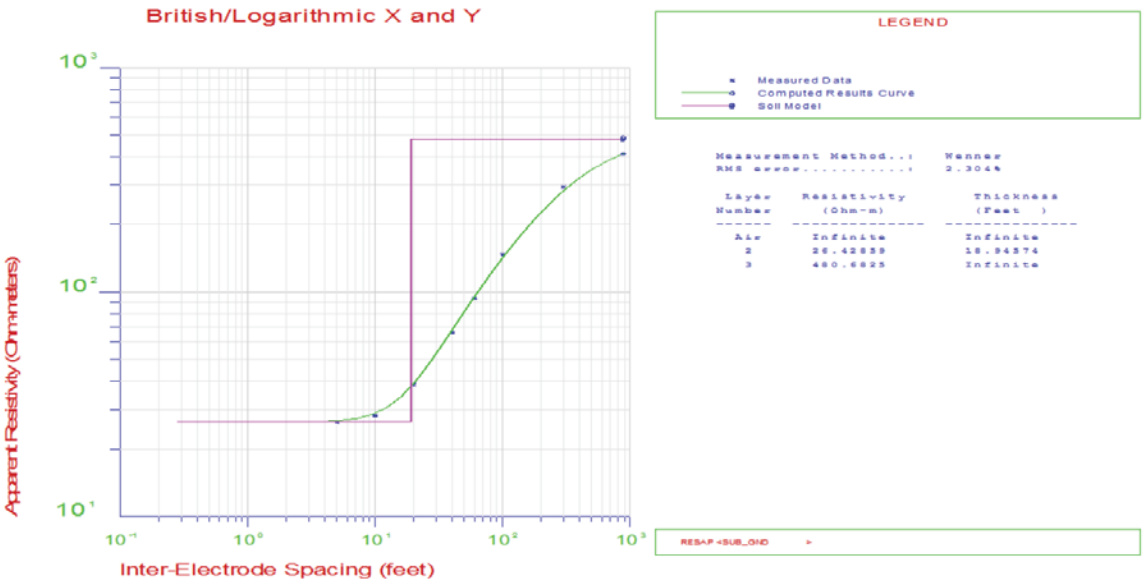
Figure 1 Soil Resistivity Measurements

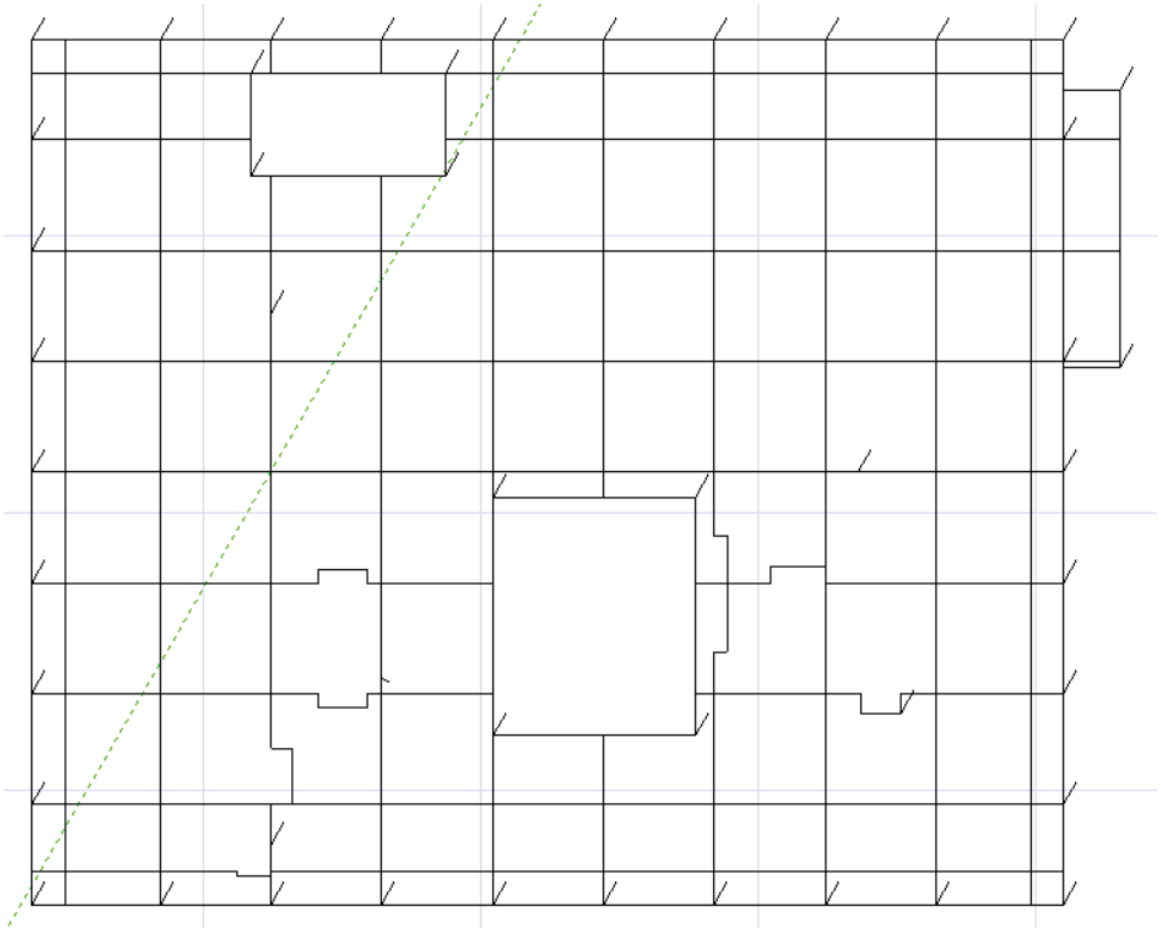
Electrode Spacing "a"	Resistance V/I	Geometric Factor K=2πa	Apparent Resistivity ρ_a=K(V/I)	Apparent Resistivity ρ_a=K(V/I)
feet	Ohms	feet	Ohm-feet	Ohm-cm
N/S Orientation				
5	2.734	31.42	85.89	2618.6
10	1.464	62.83	91.99	2804.5
20	1.013	125.66	127.30	3881.0
40	0.861	251.33	216.39	6597.4
60	0.821	376.99	309.51	9436.3
100	0.764	628.32	480.04	14635.3
300	0.503	1884.96	948.13	28906.6
E/W Orientation				
5	2.760	31.42	86.71	2643.5
10	1.473	62.83	92.55	2821.7
20	0.997	125.66	125.29	3819.7
40	0.862	251.33	216.64	6605.0
60	0.819	376.99	308.76	9413.3
100	0.723	628.32	454.28	13849.9
300	0.511	1884.96	963.21	29366.3

Figure 2 Soil Resistivity – Soil Model



<--- LAYER CHARACTERISTICS -->			Reflection	Resistivity
Layer Number	Resistivity (ohm-m)	Thickness (Feet)	Coefficient (p.u.)	Contrast Ratio
1	Infinite	Infinite	0.0	1.0
2	26.42859	18.94574	-1.0000	0.26429E-18
3	480.6825	Infinite	0.89577	18.188

Figure 3 Grounding System, Resistance, and Ground Potential Rise



```
GPR of Reference Source Bus (#  1)....Magn..:     13566.10     Volts
Impedance of Grounding System.........Magn..:     1.208252     Ohms
```

Figure 4 Safety Assessment – Safety Criteria with crushed rock

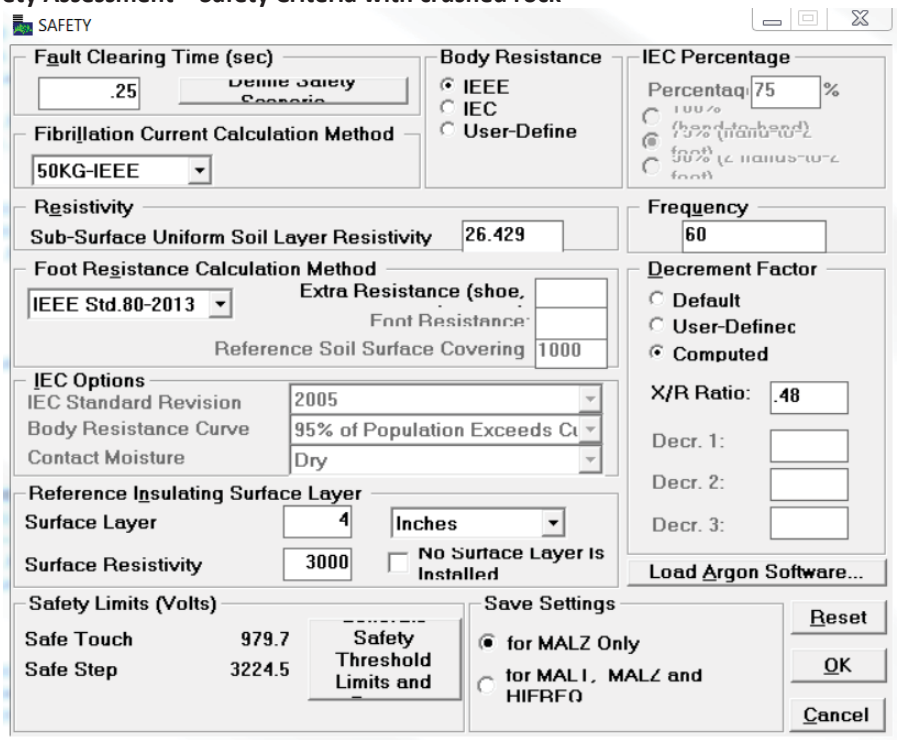


Figure 5 Safety Assessment – Safety Criteria without crushed rock

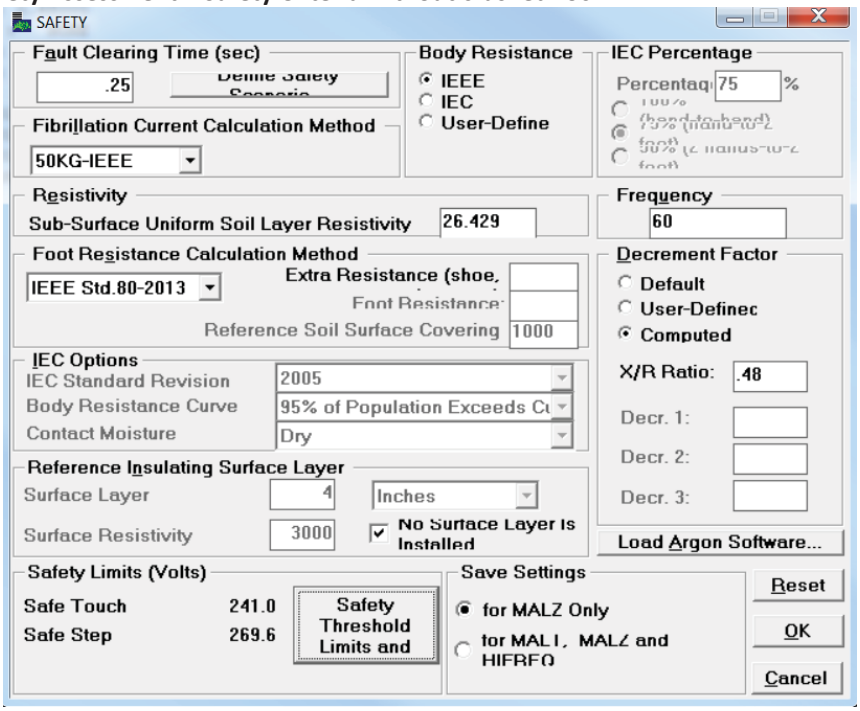
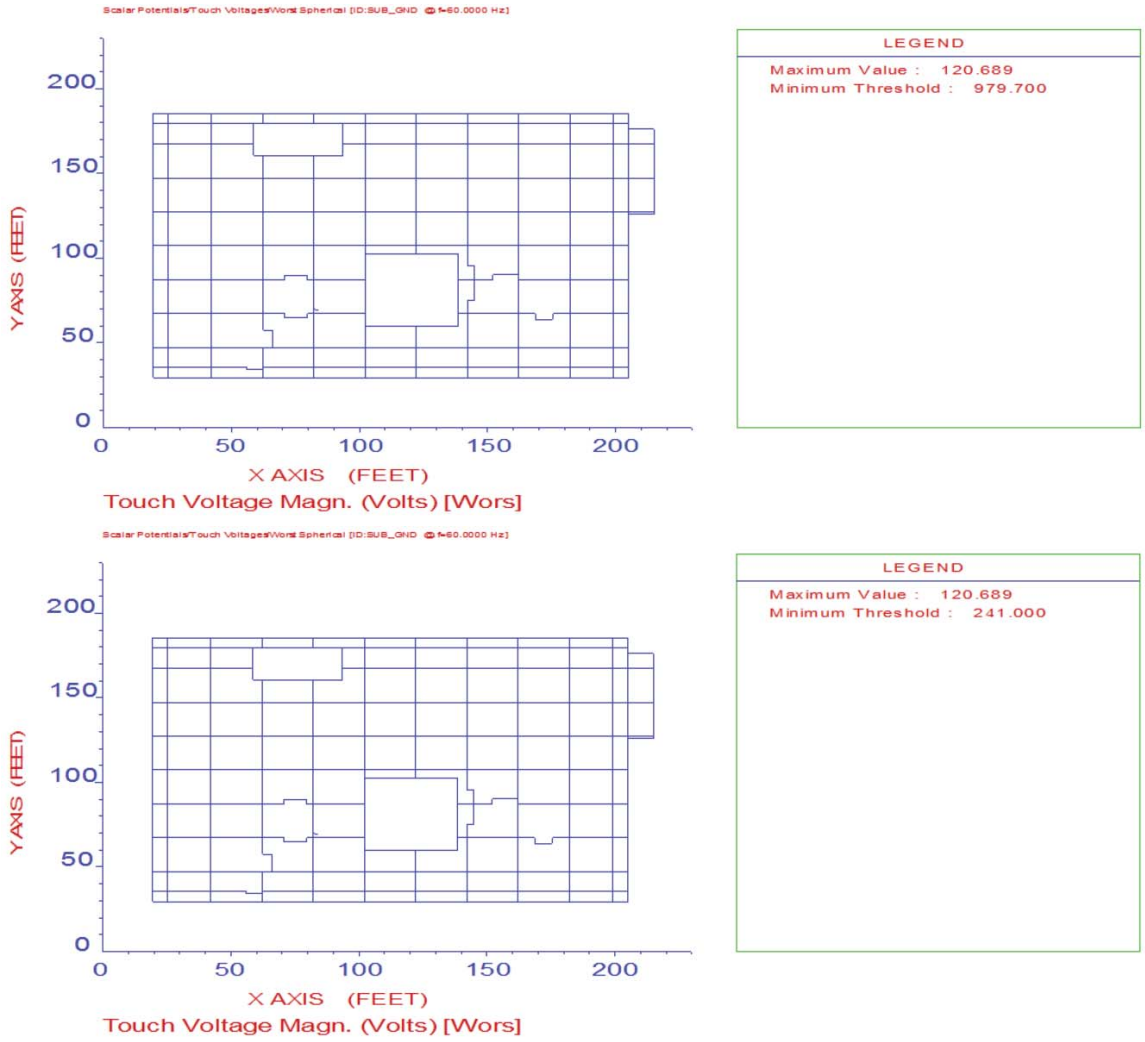
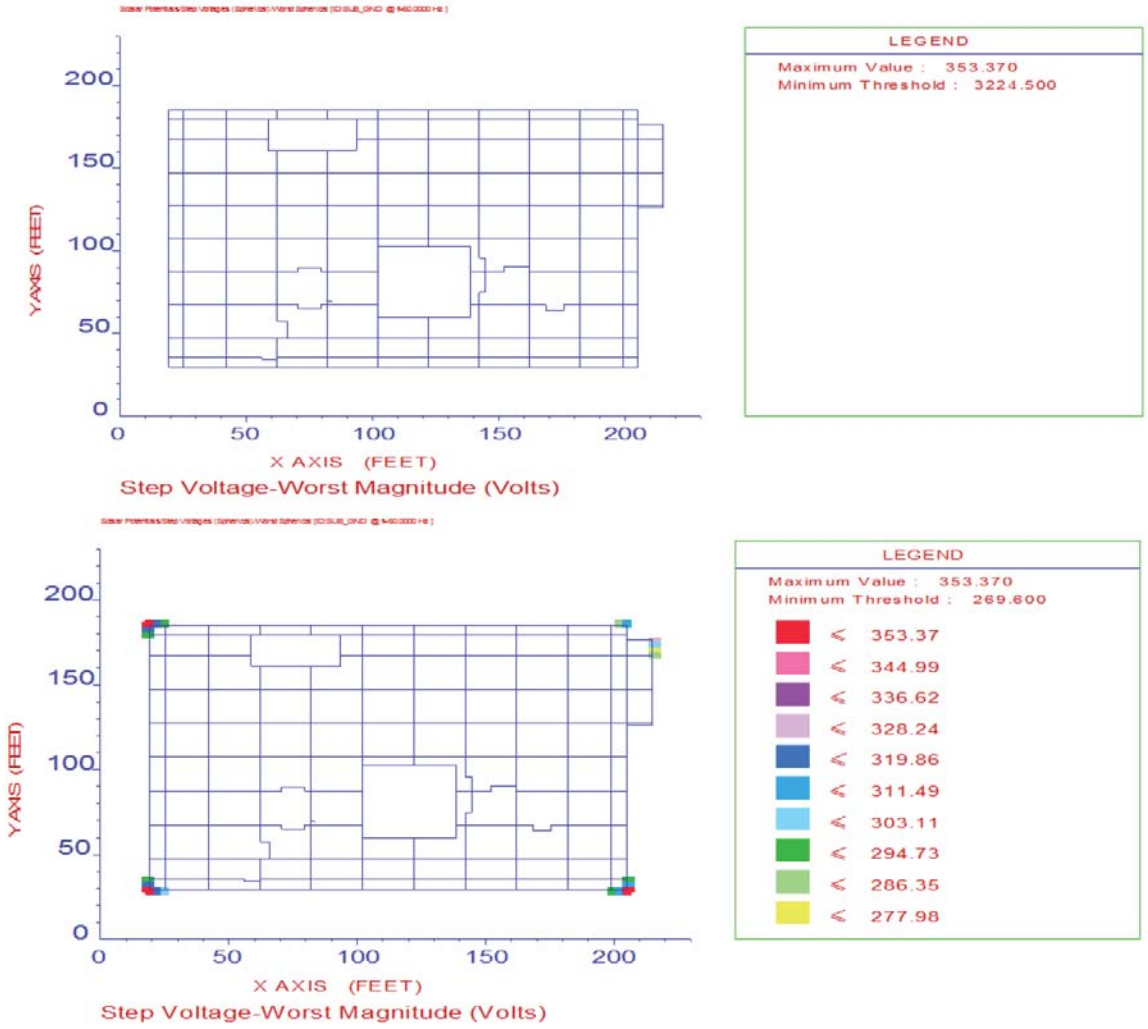


Figure 6 Safety Assessment – Touch Voltage Distribution



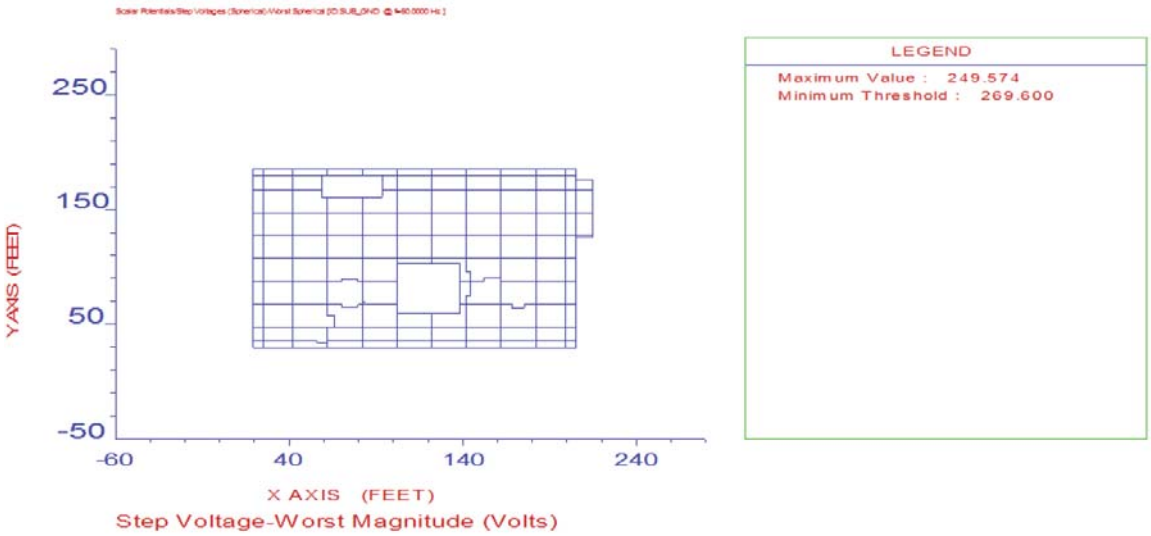
The maximum touch voltage level expected is 120.689V, which is safely below the touch threshold of 979.700V (with crushed rock), and below the threshold of 241.000V (without crushed rock).

Figure 7 Safety Assessment – Step Voltage Distribution Inside Crushed Rock



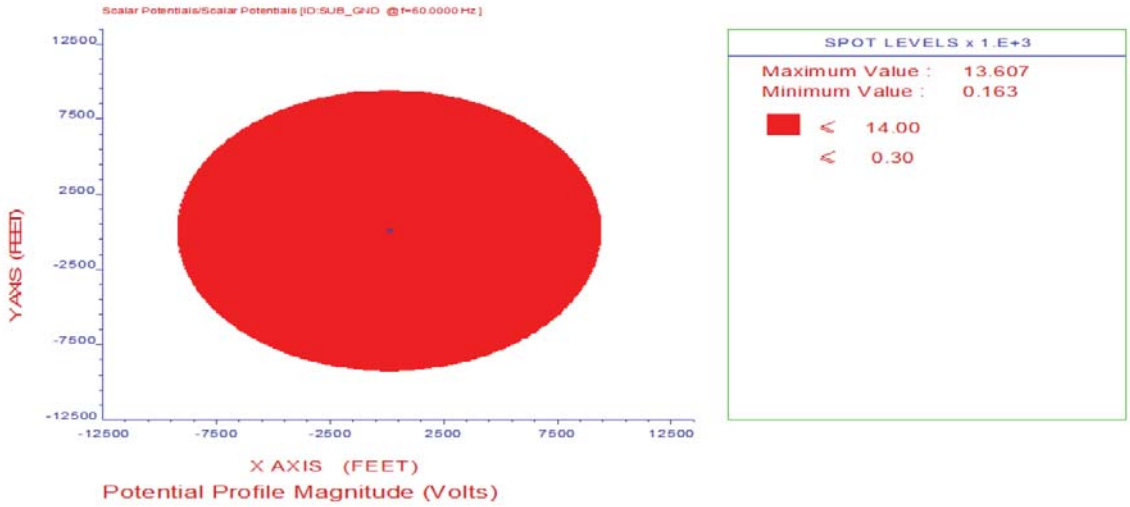
The maximum step voltage level expected is 353.370V, which is safely below the step threshold of 3224.500V (with crushed rock), but not below the threshold of 269.600V (without crushed rock). Therefore, it is imperative at least 4" of crushed rock be installed and maintained at the site.

Figure 8 Safety Assessment – Step Voltage Distribution Outside of Crushed Rock



The maximum step voltage level expected up to 20 feet outside of the substation fence is 249.574V, which is safely below the step threshold of 269.600V.

Figure 9 Safety Assessment – Earth Voltage Distribution



The maximum GPR is 13566.10V peak. GPR remains above 300Vpeak for approximately 10000 feet from the edge of the substation.

General telephone cable may be susceptible to failure at voltages that exceed 300 V peak. Since the fault current used in the touch and step voltage computations is an RMS value, this value has been converted to the peak value at the onset of the fault. Therefore, the 300 volt line accounts for peak fault current and maximum DC offset, using an X/R of 0.4828. The conversion has been made using the following equation:

$$I_{peak} = I_{rms} * \sqrt{2} * (1 + e^{-\pi/(\frac{X}{R})})$$

Using this equation, the peak current is 1.41632 times higher than the RMS current. This scale factor has been applied in the grounding model.

Figure 10 Split Factor Calculation

Ulteig

Modified: 10/19/2017 (MDT)

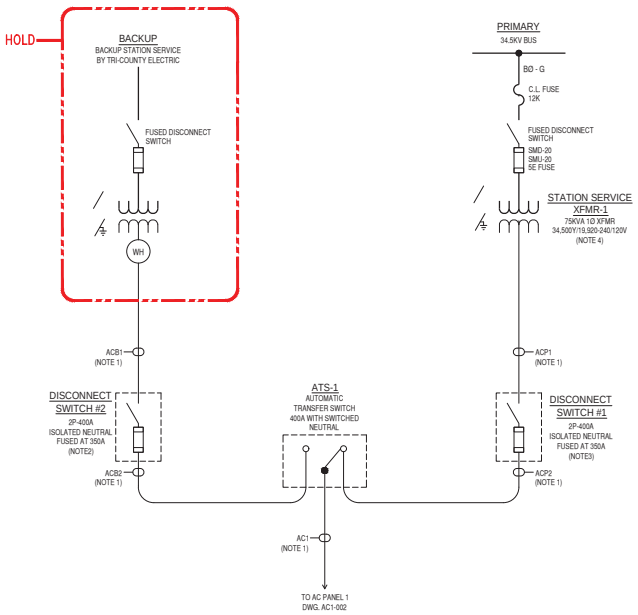
GROUNDING SYSTEM ANALYSIS
SPLIT FACTOR CALCULATION - 34.5 KV FAULT

Project Name: NW Ohio
Project Location: Paulding County, Ohio

Input Data		**Description**
Transmission Lines	1	Number of transmission lines with shield wires continuous and grounded at both ends
Distribution Neutrals	4	Number of distribution lines with neutral wires continuous and grounded at both ends
Rtg < 15?	no	Is the transmission line ground resistance less than 15 ohms?
and Rdg < 25?		and is the distribution line ground resistance less than 25 ohms?
Ground Resistance (ohms)	1.208252	The ground resistance of the ground grid (from grounding study)
Fault Current (amps)	15,000	Maximum fault current

Output Results

Equivalent Resistance (ohms)	1.32
Equivalent Reactance (ohms)	0.244
Equivalent Impedance (ohms)	1.32+0.244i
Split Factor (%)	**52.85%**
Earth Current (amps)	**7,927**



NORTHWEST OHIO
WIND PROJECT

PAULDING COUNTY, OHIO

Rev.	Date	Description	By
0A	11/21/17	90% REVIEW PACKAGE	UEI
0B	01/25/18	ISSUED FOR CONSTRUCTION	UEI

WHITE
an IEA company

NOTES:

1. 1- 1/C 500KCMIL CU (PER PHASE AND NEUTRAL)
   1- 4/0 AWG CU (GROUND)
2. BOND NEUTRAL TO GROUND AT BACKUP (EMERGENCY) FUSED DISCONNECT SWITCH.
3. BOND NEUTRAL TO GROUND AT PRIMARY (NORMAL) FUSED DISCONNECT SWITCH.
4. BOND NEUTRAL TO GROUND AT TRANSFORMER.

CONSTRUCTION

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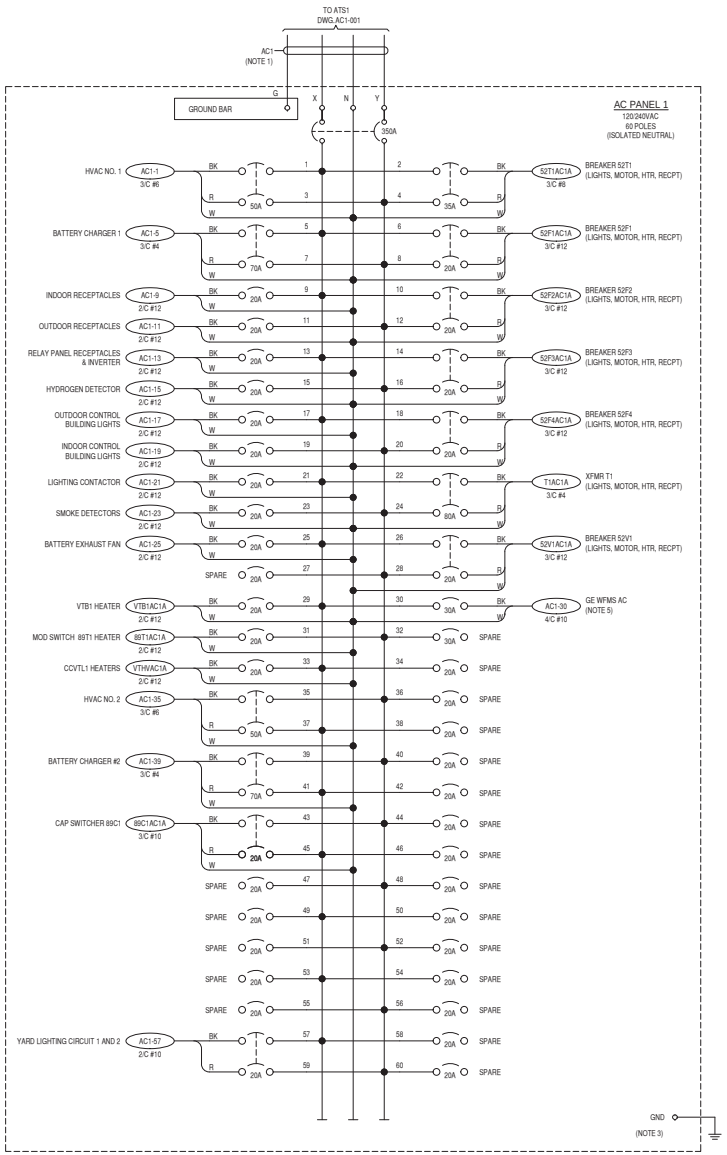
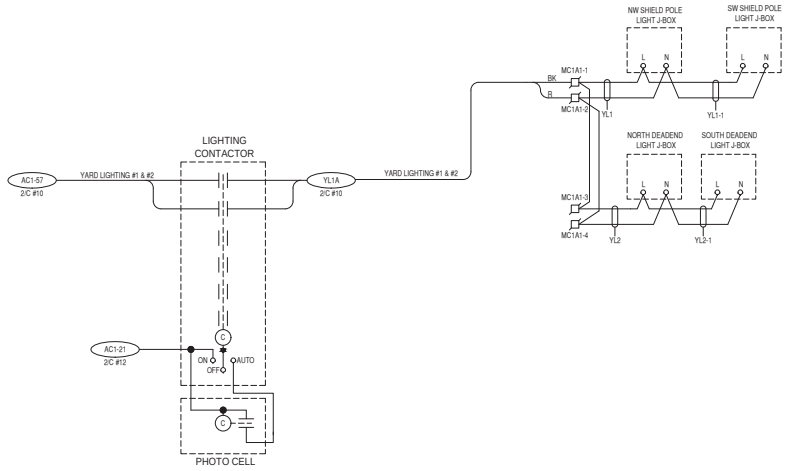
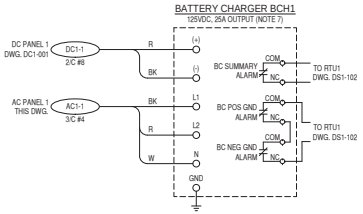
Design By: E. NEUHARDT
Drawn By: E. NEUHARDT
Approved By: J. OLSON
Project Number: 17.01246

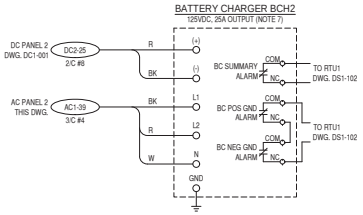
AC DISTRIBUTION SYSTEM

DWG #: NWO-AC1-001
REVISION: 0B









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WIND PROJECT

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Rev.	Date	Description	By
0A	10/19/17	PRELIMINARY	UEI
0B	11/21/17	90% REVIEW PACKAGE	UEI
0C	01/10/18	90% PACKAGE UPDATES	UEI
0D	01/25/18	ISSUED FOR CONSTRUCTION	UEI

WHITE
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NOTES:
1. 1- 1/C 500 KCMIL CU (PER LINE AND NEUTRAL), 1- 4/0 AWG CU (GROUND).
2. DO NOT BOND NEUTRAL TO GROUND IN AC PANEL.
3. BUILDING VENDOR TO UPDATE BUILDING BREAKER AND CABLE SIZES AS NEEDED.
4. BLACK TO 'HOT'
WHITE TO 'NEUTRAL'
GREEN TO 'GROUND'
RED IS TAPED SPARE

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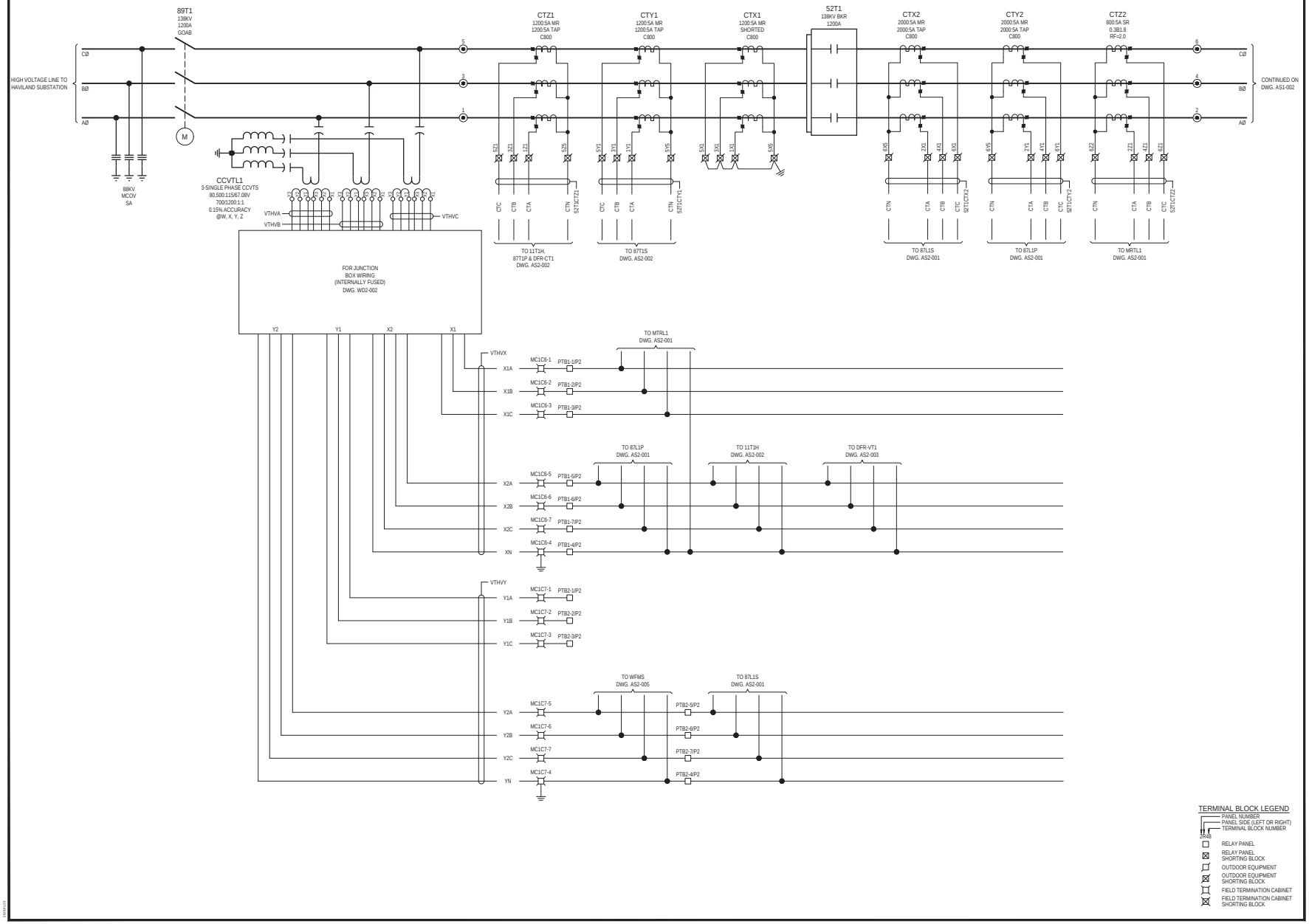
Design By: E. NEUHARDT
Drawn By: E. NEUHARDT
Approved By: J. OLSON
Project Number: 17.01246

AC PANEL 1

DWG #: NWO-AC1-002
REVISION: 0D



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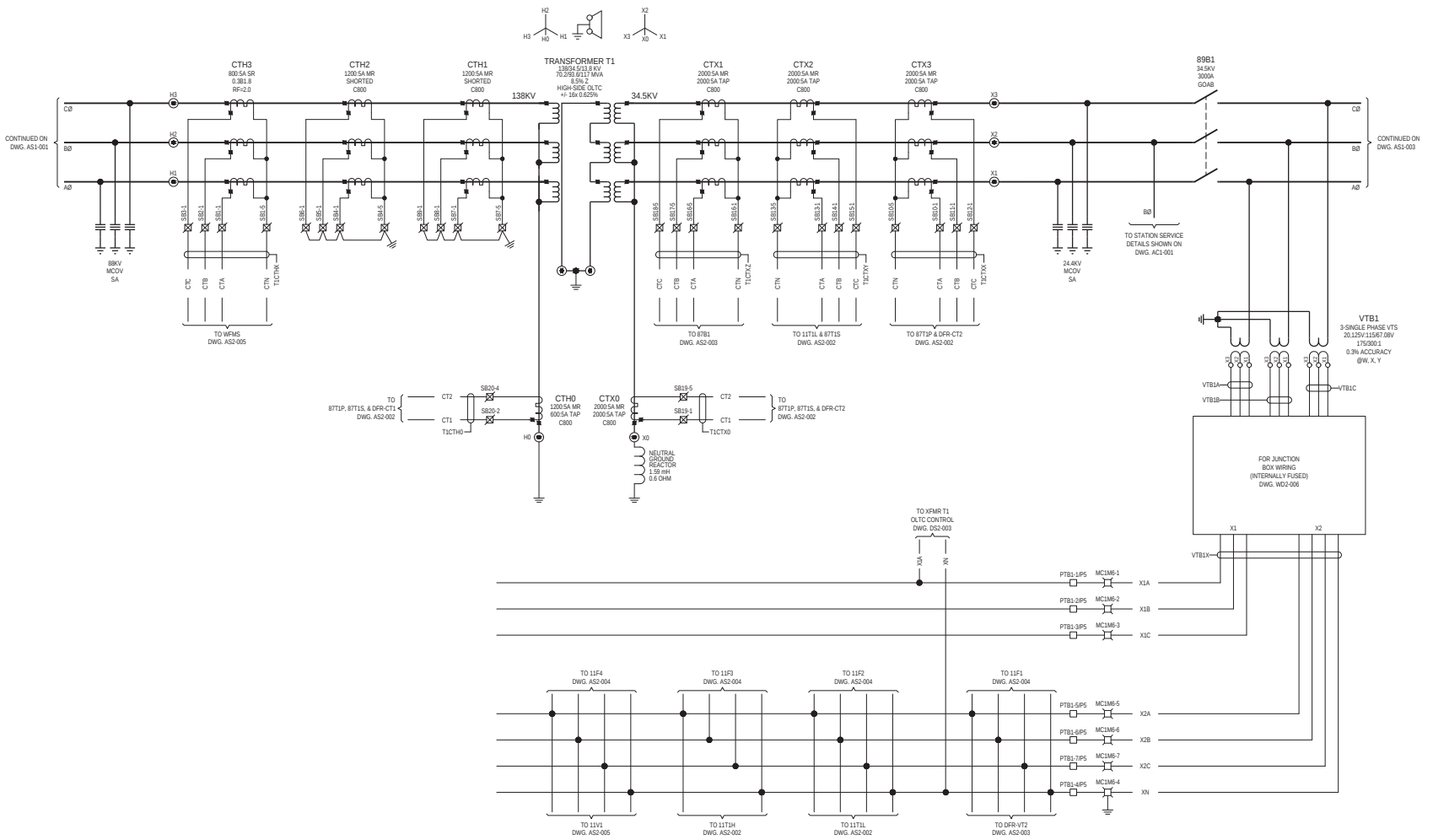
Drawn By: T. ADAMS
Approved By: J. OLSON
Project Number: 17.01246

SUBSTATION THREE LINE DIAGRAM

DWG #: NWO-AS1-001

REVISION: 0C



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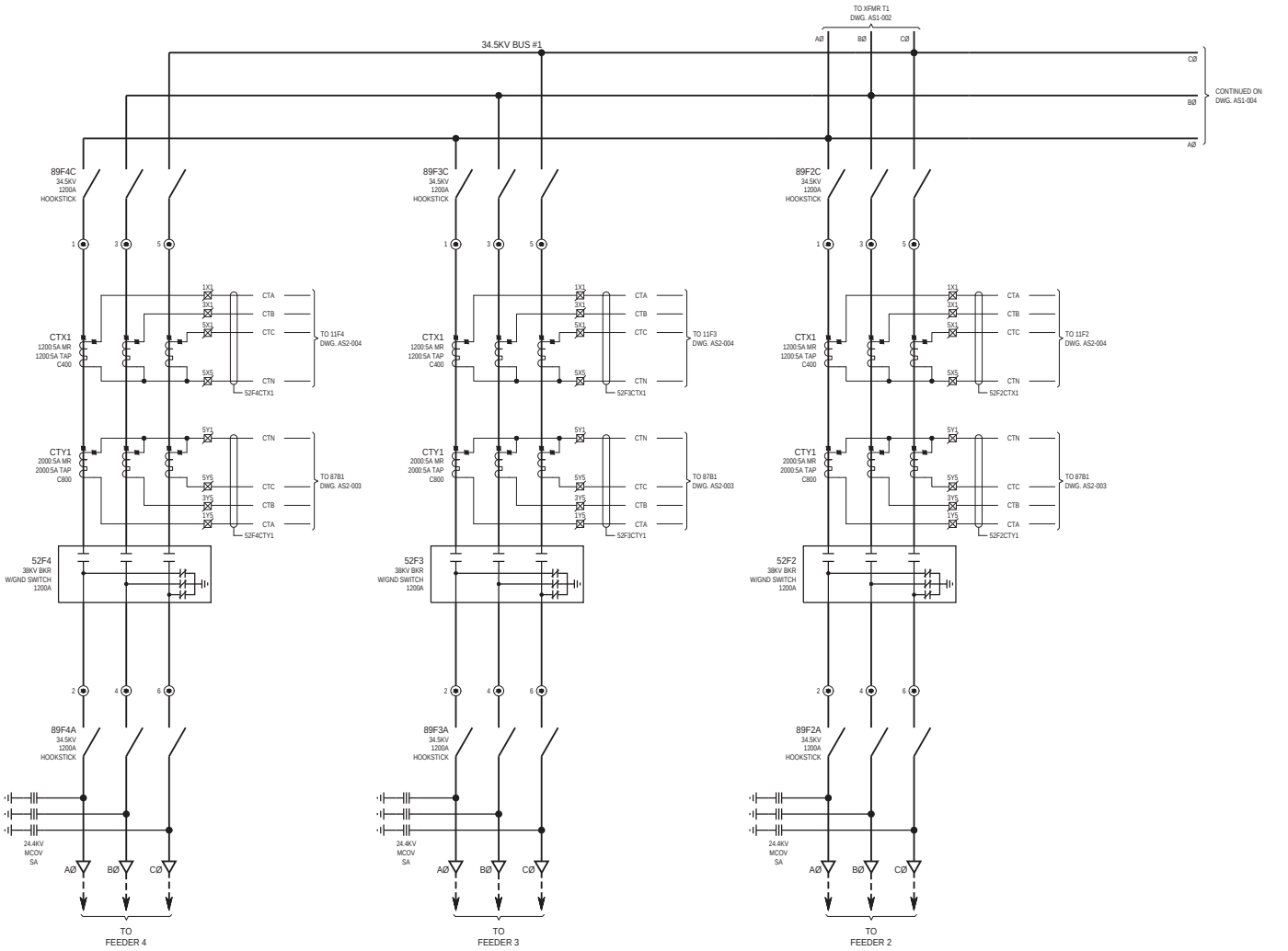
Project Number: 17.01246

SUBSTATION THREE LINE DIAGRAM

DWG #: NWO-AS1-002

REVISION: 0B



TERMINAL BLOCK LEGEND

- PANEL NUMBER
- PANEL SIDE (LEFT OR RIGHT)
- TERMINAL BLOCK NUMBER
- 2B4B
- RELAY PANEL
- RELAY PANEL SHORTING BLOCK
- OUTDOOR EQUIPMENT
- OUTDOOR EQUIPMENT SHORTING BLOCK
- FIELD TERMINATION CABINET
- FIELD TERMINATION CABINET SHORTING BLOCK

NORTHWEST OHIO WIND PROJECT

PAULDING COUNTY, OHIO

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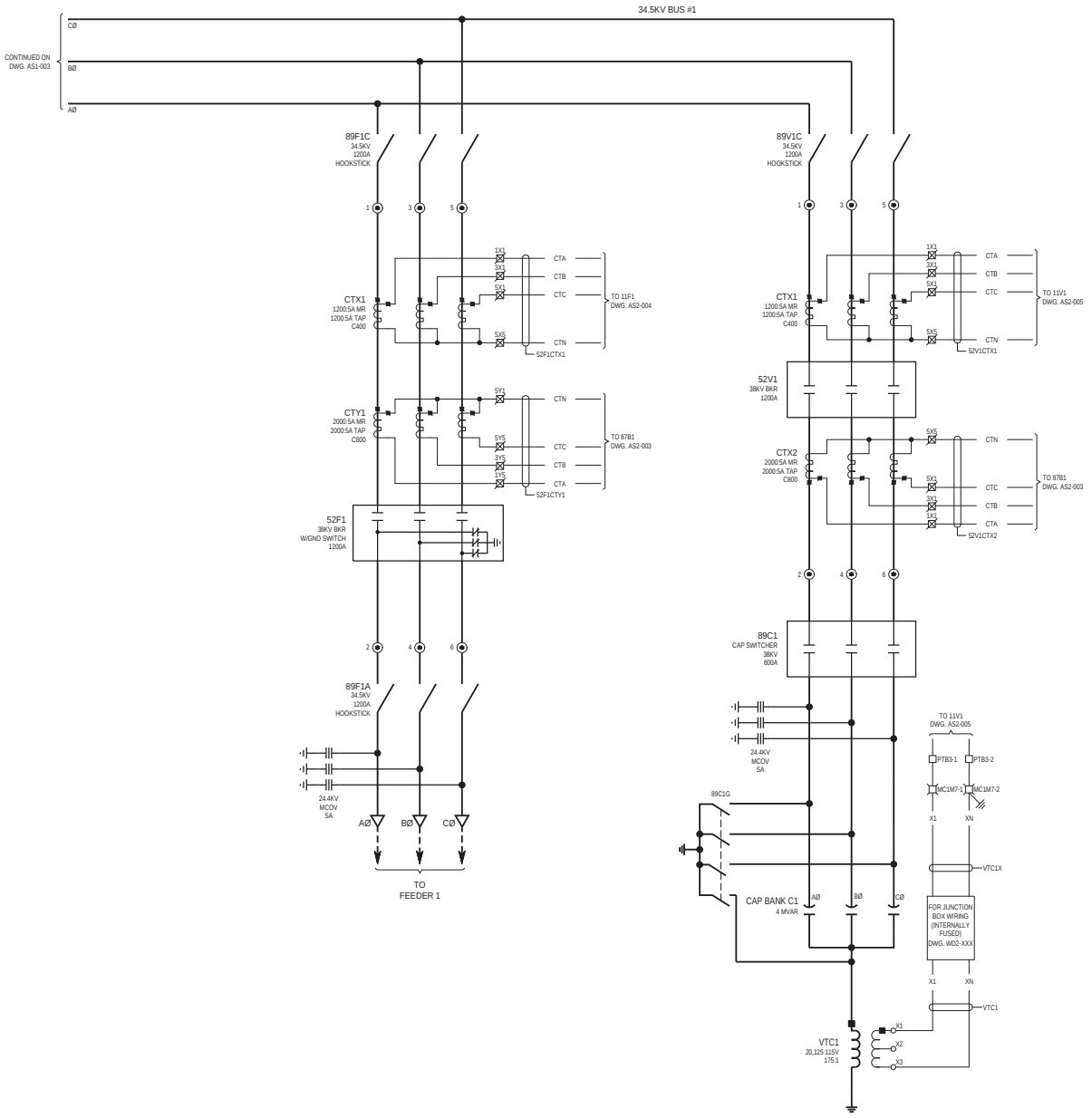
Design By: E. NEUHARDT
Drawn By: T. ADAMS
Approved By: J. OLSON
Project Number: 17.01246

SUBSTATION THREE LINE DIAGRAM FEEDERS 2, 3, & 4

DWG #: NWO-AS1-003

REVISION: 0B



TERMINAL BLOCK LEGEND

- PANEL NUMBER
- PANEL SIDE (LEFT OR RIGHT)
- TERMINAL BLOCK NUMBER
- 29AB
- RELAY PANEL
- RELAY PANEL SHORTING BLOCK
- OUTDOOR EQUIPMENT
- OUTDOOR EQUIPMENT SHORTING BLOCK
- FIELD TERMINATION CABINET
- FIELD TERMINATION CABINET SHORTING BLOCK

NORTHWEST OHIO WIND PROJECT

PAULDING COUNTY, OHIO

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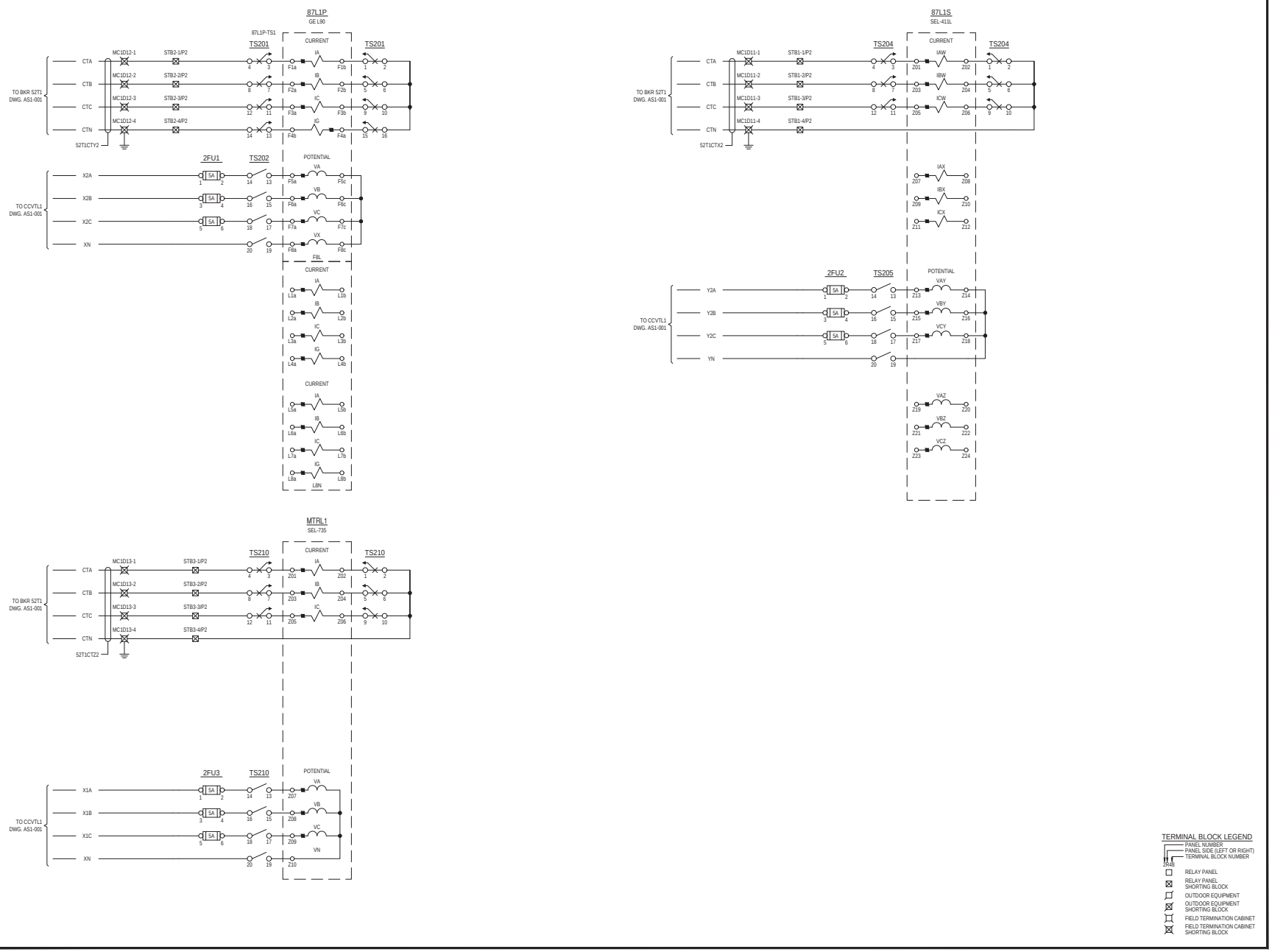
Design By: E. NEUHARDT
Drawn By: T. ADAMS
Approved By: J. OLSON
Project Number: 17.01246

SUBSTATION THREE LINE DIAGRAM FEEDER 1 & VAR BUS

DWG #: NWO-AS1-004

REVISION: 0B



TERMINAL BLOCK LEGEND

PANEL NUMBER
PANEL SIDE (LEFT OR RIGHT)
TERMINAL BLOCK NUMBER
2R4B

- RELAY PANEL
- RELAY PANEL SHORTING BLOCK
- OUTDOOR EQUIPMENT
- OUTDOOR EQUIPMENT SHORTING BLOCK
- FIELD TERMINATION CABINET
- FIELD TERMINATION CABINET SHORTING BLOCK

NORTHWEST OHIO
WIND PROJECT

PAULDING COUNTY, OHIO

Rev.	Date	Description	By
0A	11/21/17	90% REVIEW PACKAGE	UEI
0B	01/10/18	90% PACKAGE REVIEW	UEI
0C	01/25/18	ISSUED FOR CONSTRUCTION	UEI

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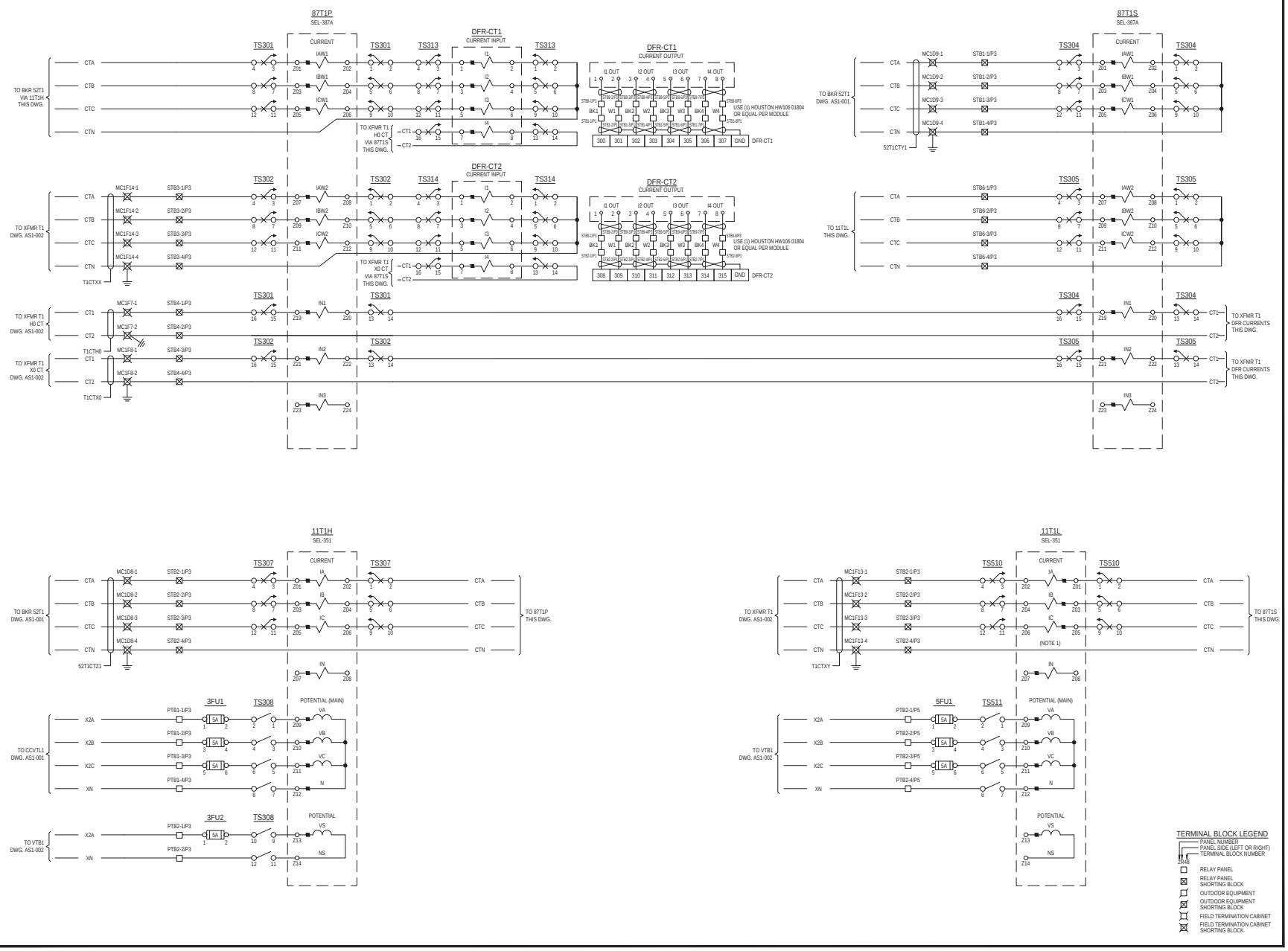
SUBSTATION
AC SCHEMATIC
LINE RELAYS

DWG #: NWO-AS2-001
REVISION: 0C



NORTHWEST OHIO WIND PROJECT

PAULDING COUNTY, OHIO

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1. 11T1L IS WIRED IN REVERSE POLARITY.

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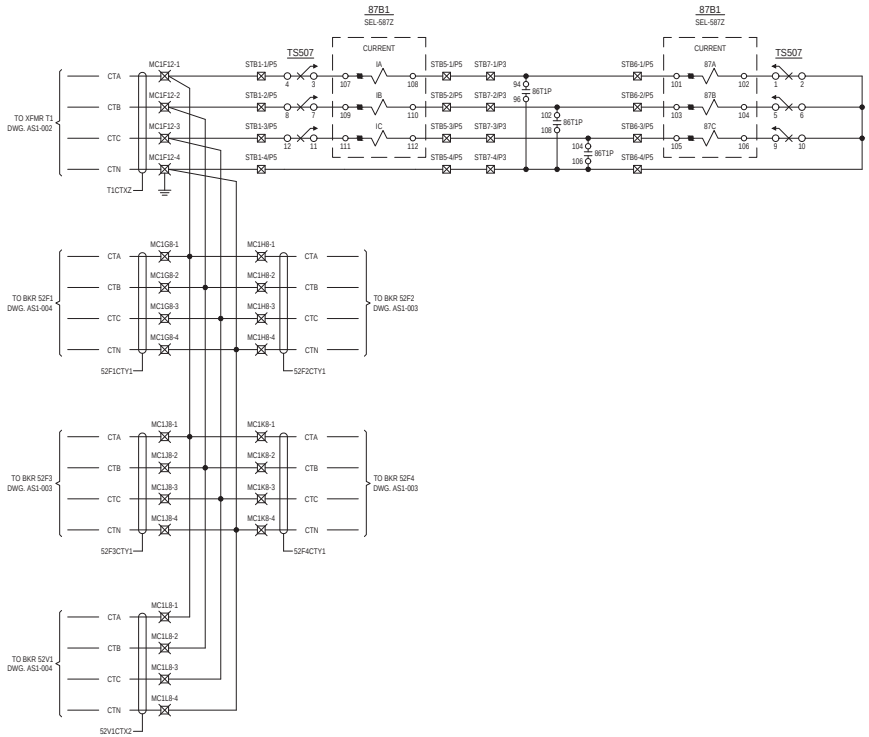
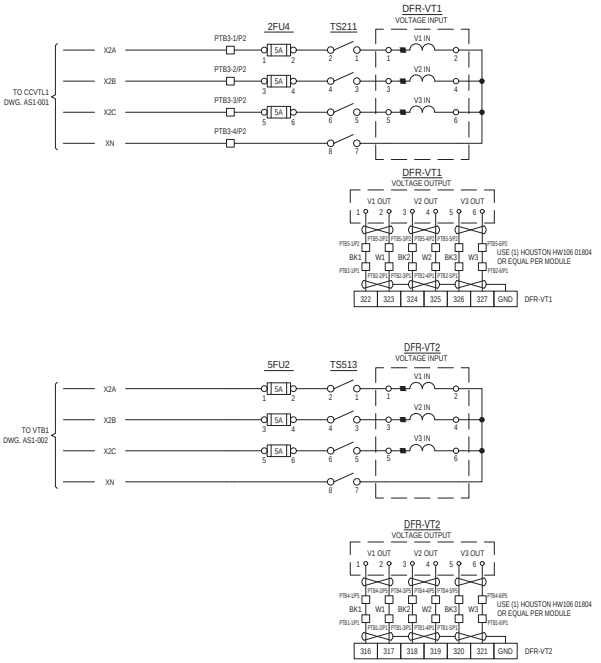
SUBSTATION AC SCHEMATIC TRANSFORMER T1 RELAYS

DWG #: NWO-AS2-002

REVISION: 0B





TERMINAL BLOCK LEGEND

- PANEL NUMBER
- PANEL SIDE (LEFT OR RIGHT)
- TERMINAL BLOCK NUMBER

2RAB

- RELAY PANEL
- RELAY PANEL SHORTING BLOCK
- OUTDOOR EQUIPMENT
- OUTDOOR EQUIPMENT SHORTING BLOCK
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- FIELD TERMINATION CABINET SHORTING BLOCK

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WIND PROJECT

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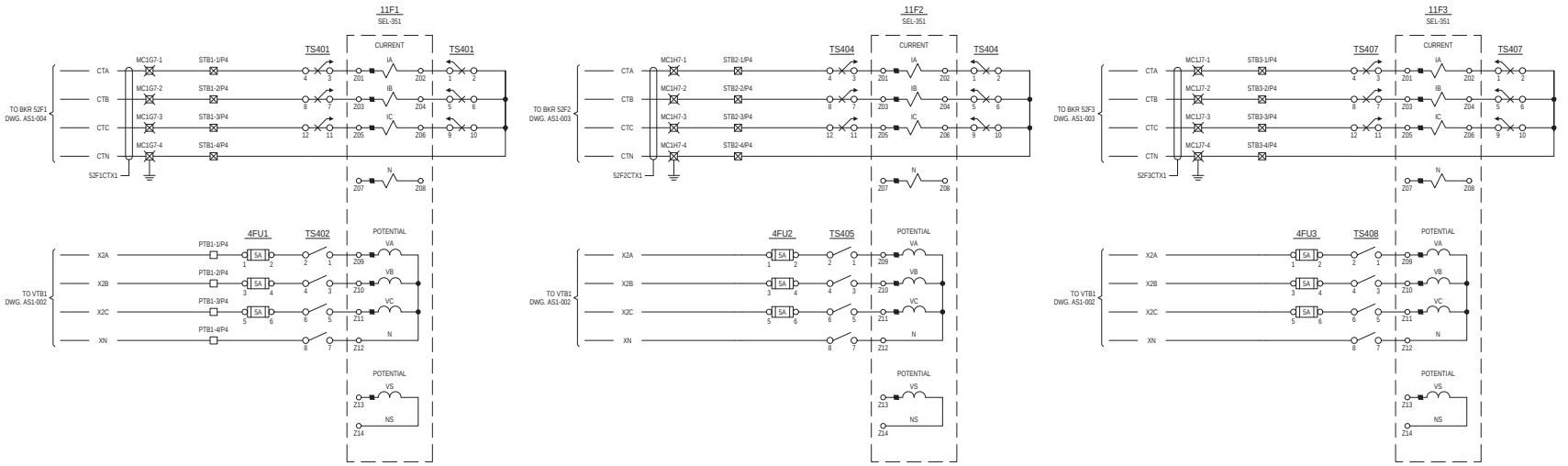
SUBSTATION
AC SCHEMATIC
34.5KV BUS #1 RELAY

DWG #: NWO-AS2-003
REVISION: 0B



TERMINAL BLOCK LEGEND

- PANEL NUMBER
- PANEL SIDE (LEFT OR RIGHT)
- TERMINAL BLOCK NUMBER
- 2B4B
- RELAY PANEL
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- FIELD TERMINATION CABINET SHORTING BLOCK

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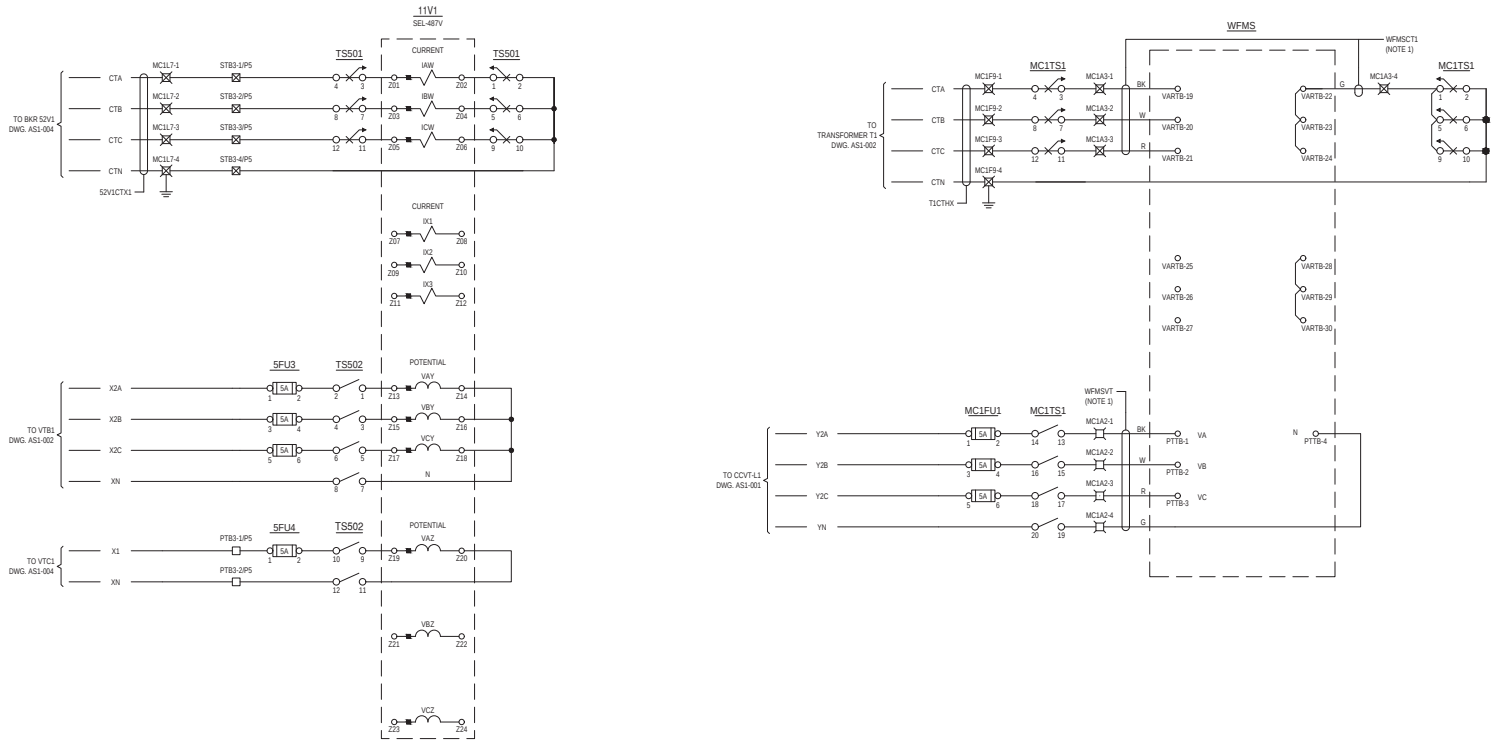
SUBSTATION
AC SCHEMATIC
FEEDER RELAYS

DWG #: NWO-AS2-004
REVISION: 0B



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NORTHWEST OHIO
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NOTES:
1. ENCLOSURE VENDOR TO LEAVE CABLE COILED AT DESTINATION WITH 14' SLACK.

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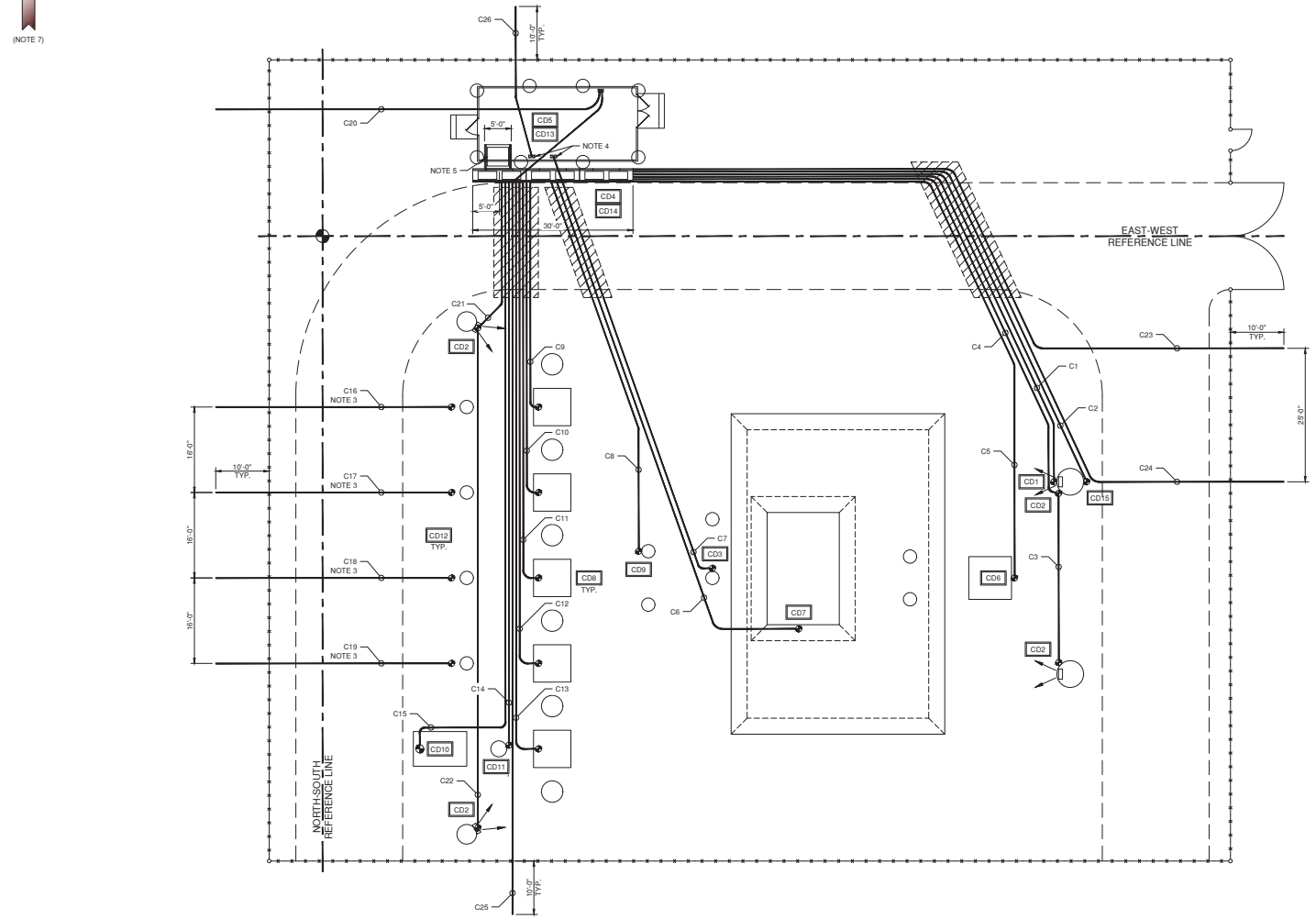
SUBSTATION
AC SCHEMATIC
VAR BUS RELAY &
GE WFMS

DWG #: NWO-AS2-005
REVISION: 0B



NORTHWEST OHIO WIND PROJECT

PAULDING COUNTY, OHIO

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NOTES:

1. ALL CONDUITS CARRYING FIBER CABLES ARE REQUIRED TO USE SWEEPS ON 90° TRANSITIONS TO PREVENT DAMAGE TO FIBERS.
2. FEEDER AND POWER CONDUITS SHALL TERMINATE 10' OUTSIDE OF THE SUBSTATION FENCE.
3. ALL FEEDER CONDUITS SHALL BE BURIED 48" BELOW SUBGRADE.
4. STATION SERVICE CABLES SHALL BE ROUTED DIRECTLY TO FUSED DISCONNECT SWITCH.
5. PROVIDE A SECTION OF CABLE TRENCH BELOW ENCLOSURE WITH DIMENSIONS AS SHOWN TO ROUTE CABLES UP INTO TERMINATION CABINET.
6. SEE CABLE MANUFACTURER'S RECOMMENDATIONS FOR CABLE BENDING RADIUS WHEN WHEN SELECTING THE RADIUS FOR ANY ELBOW SWEEP ALONG A CONDUIT RUN FOR WHICH THE CABLE IS INSTALLED.
7. SEE GRADING PLAN FOR INDICATION OF TRUE NORTH.

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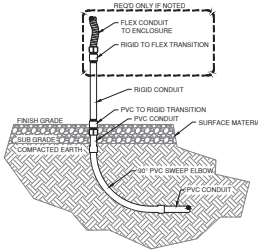
Project Number: 17.01246

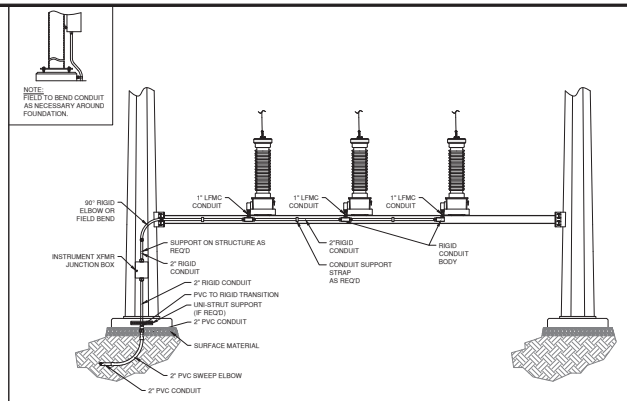
138/34.5KV SUBSTATION CONDUIT PLAN

DWG #: NWO-CC1-001

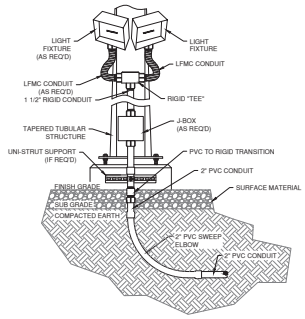
REVISION: 0C



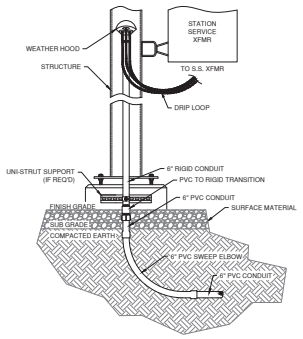
TYPICAL CONDUIT RISER
SCALE: NONE



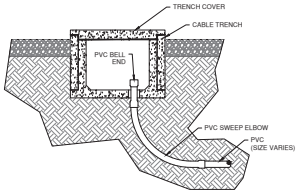
DETAIL CD1: 138KV INSTRUMENT TRANSFORMER - THREE PHASE
SCALE: NONE



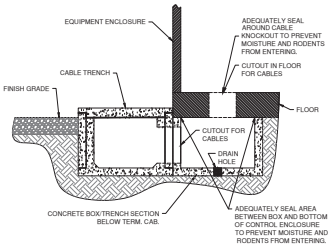
DETAIL CD2: DEAD-END/STATIC MAST LIGHTING
SCALE: NONE



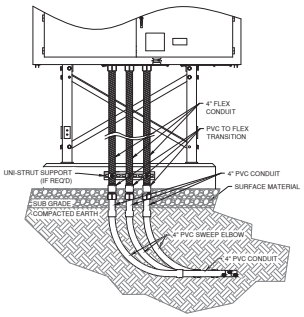
DETAIL CD3: STATION SERVICE XFMR
SCALE: NONE



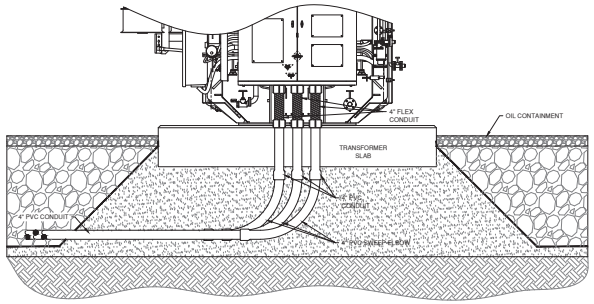
DETAIL CD4: CABLE TRENCH EXIT/ENTRANCE
SCALE: NONE



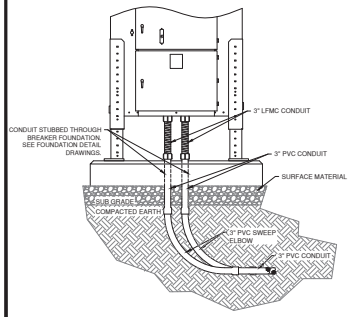
DETAIL CD5: EQUIPMENT ENCLOSURE
SCALE: NONE



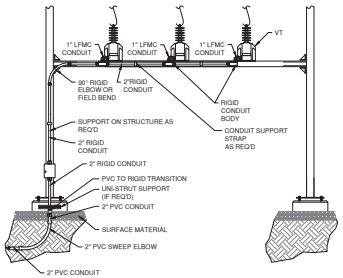
DETAIL CD6: 138KV BREAKER
SCALE: NONE



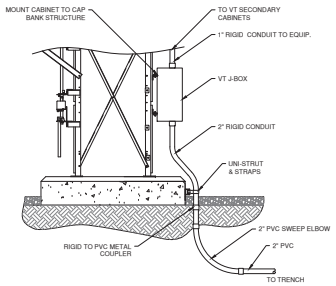
DETAIL CD7: TRANSFORMER CONDUIT
SCALE: NONE



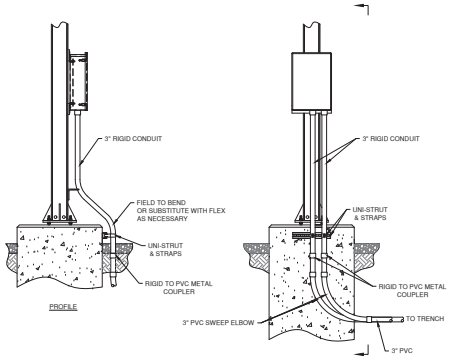
DETAIL CD8: 34.5KV BREAKER
SCALE: NONE



DETAIL CD9: VOLTAGE TRANSFORMER - THREE PHASE
SCALE: NONE



DETAIL CD10: 34.5 CAP BANK & J-BOX
SCALE: NONE



DETAIL CD11: CIRCUIT SWITCHER
SCALE: NONE

NORTHWEST OHIO WIND PROJECT

PAULDING COUNTY, OHIO

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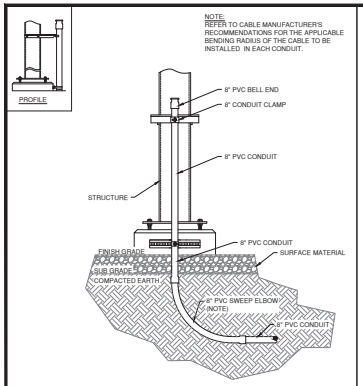
Approved By: J. OLSON
Project Number: 17.01246

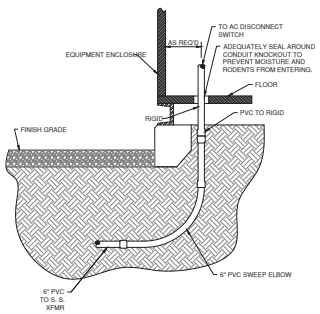
138/34.5KV SUBSTATION CONDUIT DETAILS

DWG #: NWO-CC2-001

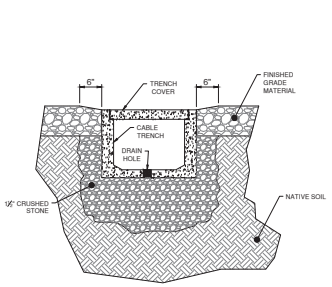
REVISION: 0B



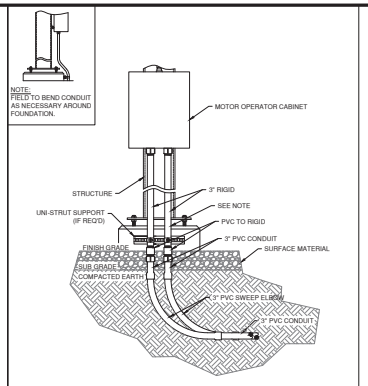
DETAIL CD12: CONDUIT RISER
SCALE: NONE



DETAIL CD13: EQUIPMENT ENCLOSURE
SCALE: NONE



DETAIL CD14: CABLE TRENCH DRAIN TILE
SCALE: NONE



DETAIL CD15: SWITCH MOTOR OPERATOR
SCALE: NONE

NORTHWEST OHIO WIND PROJECT

PAULDING COUNTY, OHIO

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138/34.5KV SUBSTATION CONDUIT DETAILS

DWG #: NWO-CC2-002
REVISION: 0B

CONDUIT SCHEDULE				
RUN NO.		CONDUIT SIZE	FROM	TO
C1	-	2"	138V CCVTL1 J-BOX	CABLE TRENCH
C2	1	3"	138KV MOD 89T1	CABLE TRENCH
	2	3"		
C3	-	2"	SOUTH DEADEND LIGHT J-BOX	NORTH DEADEND LIGHT J-BOX
C4	-	2"	NORTH DEADEND LIGHT J-BOX	CABLE TRENCH
C5	1	4"	138KV BREAKER 52T1	CABLE TRENCH
	2	4"		
	3	4"		
C6	1	4"	138KV/34.5KV XFMR T1	CABLE TRENCH
	2	4"		
	3	4"		
C7	-	6"	PRIMARY STATION SERVICE	PRIMARY AC FUSED DISCONNECT
C8	-	2"	34.5KV VTB1	CABLE TRENCH
C9	1	3"	34.5KV FEEDER BREAKER 52F4	CABLE TRENCH
	2	3"		
C10	1	3"	34.5KV FEEDER BREAKER 52F3	CABLE TRENCH
	2	3"		
C11	1	3"	34.5KV FEEDER BREAKER 52F2	CABLE TRENCH
	2	3"		
C12	1	3"	34.5KV FEEDER BREAKER 52F1	CABLE TRENCH
	2	3"		
C13	1	3"	34.5KV VAR BREAKER 52V1	CABLE TRENCH
	2	3"		
C14	1	3"	34.5KV CAP SWITCHER 89C1	CABLE TRENCH
	2	3"		
C15	-	2"	34.5KV CAPACITOR VTC1	CABLE TRENCH
C16	-	8"	34.5KV COLLLECTOR FEEDER 4	10' OUTSIDE FENCE
C17	-	8"	34.5KV COLLLECTOR FEEDER 3	10' OUTSIDE FENCE
C18	-	8"	34.5KV COLLLECTOR FEEDER 2	10' OUTSIDE FENCE
C19	-	8"	34.5KV COLLLECTOR FEEDER 1	10' OUTSIDE FENCE
C20	-	6"	FIBER PATCH PANEL	10' OUTSIDE FENCE (FEEDER FIBER)
C21	-	2"	NORTH-WEST SHIELD POLE LIGHT	CABLE TRENCH
C22	-	2"	SOUTH-WEST SHIELD POLE LIGHT	NORTH-WEST SHIELD POLE LIGHT
C23	-	2"	CABLE TRENCH	10' OUTSIDE FENCE (FIBER TO HAVILAND INTERCONNECT SUBSTATION)
C24	-	2"	CABLE TRENCH	10' OUTSIDE FENCE (FIBER TO HAVILAND INTERCONNECT SUBSTATION)
C25	-	2"	FIBER PATCH PANEL	10' OUTSIDE FENCE (O&M BUILDING)
C26	-	6"	SECONDARY AC FUSED DISCONNECT	10' OUTSIDE FENCE

NORTHWEST OHIO WIND PROJECT

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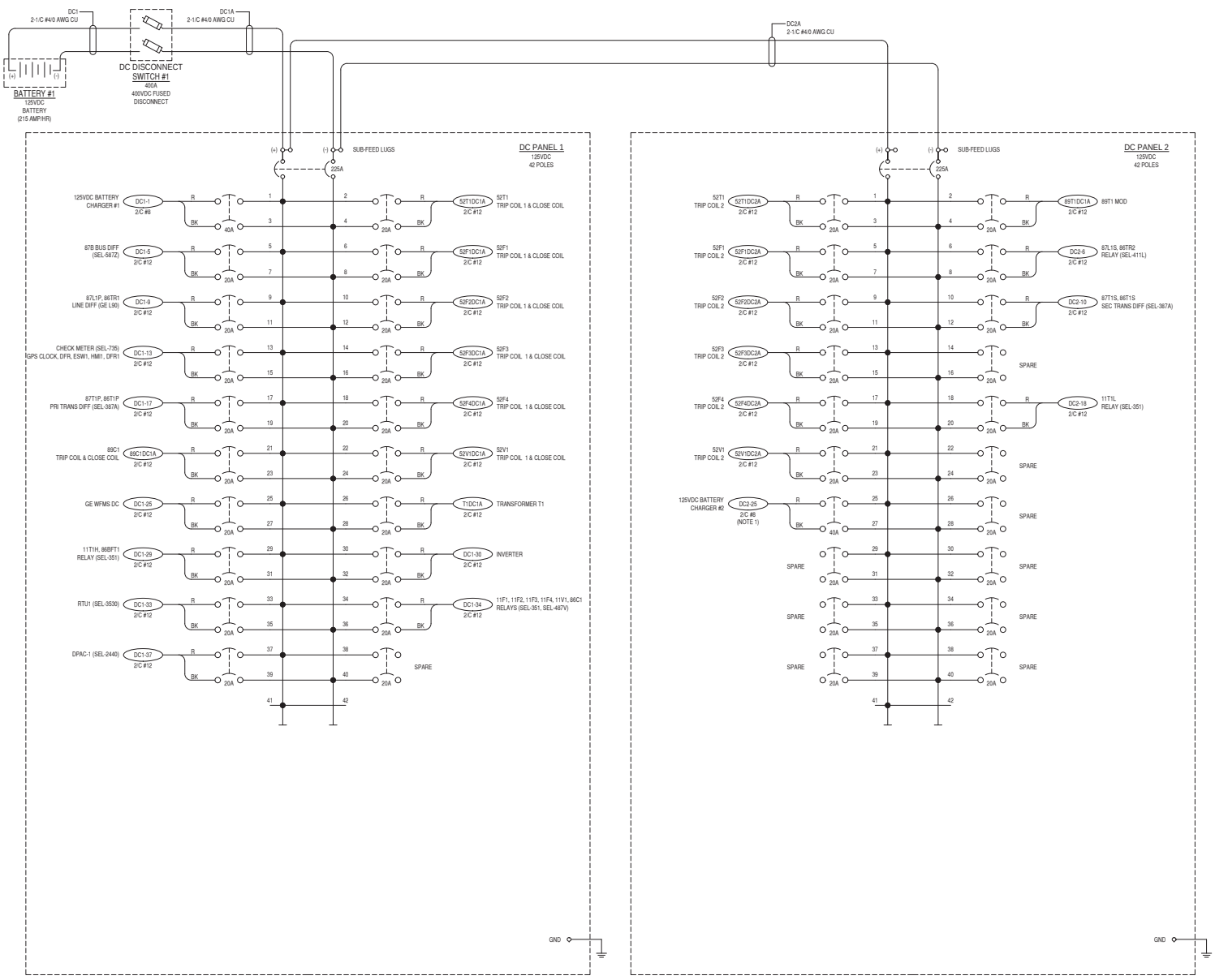
Approved By: J. OLSON
Project Number: 17.01246

138/34.5KV SUBSTATION CONDUIT SCHEDULE

DWG #: NWO-CC3-001

REVISION: 0B

20161133



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WIND PROJECT

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0C	01/10/18	90% PACKAGE UPDATES	UEI
0D	01/25/18	ISSUED FOR CONSTRUCTION	UEI

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NOTES:

1. BUILDING VENDOR TO UPDATE BUILDING BREAKER AND CABLE SIZES AS NEEDED.

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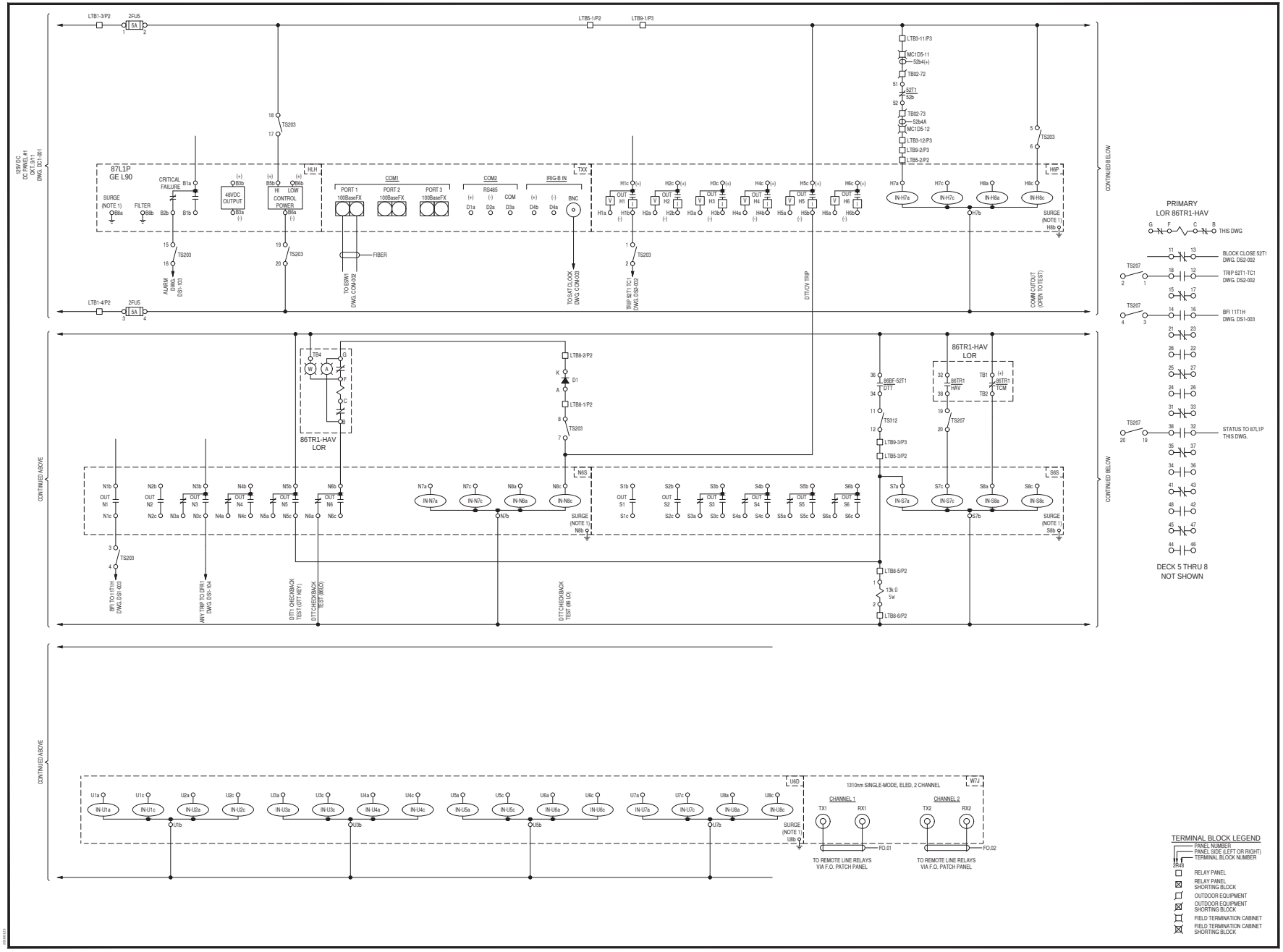
Design By: E. NEUHARDT
Drawn By: E. NEUHARDT
Approved By: J. OLSON
Project Number: 17.01246

DC PANELS 1 & 2

DWG #: NWO-DC1-001
REVISION: 0D



NORTHWEST OHIO
WIND PROJECT

PAULDING COUNTY, OHIO

Rev.	Date	Description	By
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NOTES:

1. RELAY SURGE CONNECTOR TO BE #10AWG OR LARGER.

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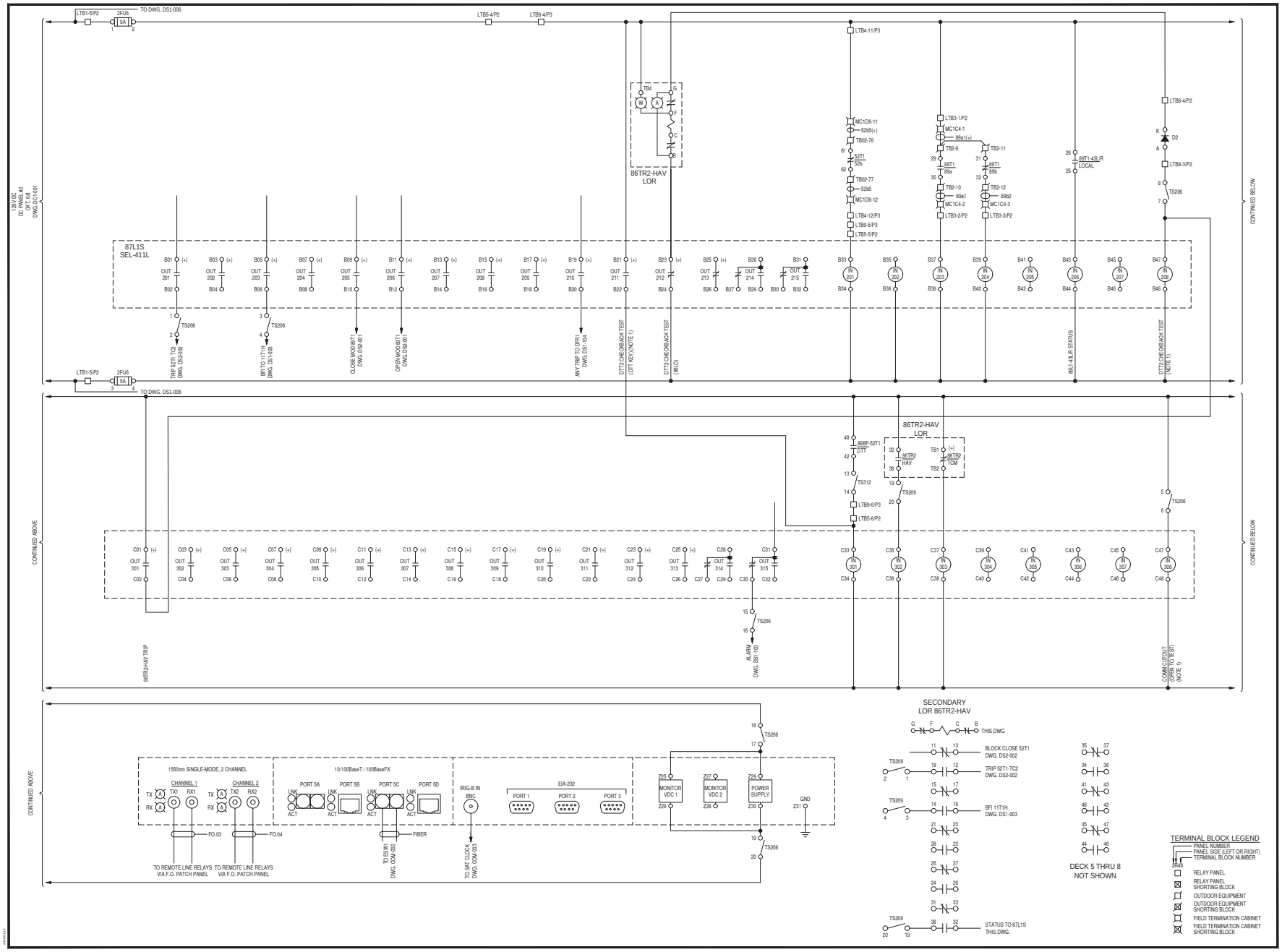
Design By: E. NEUHARDT
Drawn By: T. ADAMS
Approved By: J. OLSON
Project Number: 17.01246

SUBSTATION DC SCHEMATIC LINE RELAY 87L1P GE L90

DWG #: NWO-DS1-001

REVISION: 0B



NORTHWEST OHIO
WIND PROJECT

PAULDING COUNTY, OHIO

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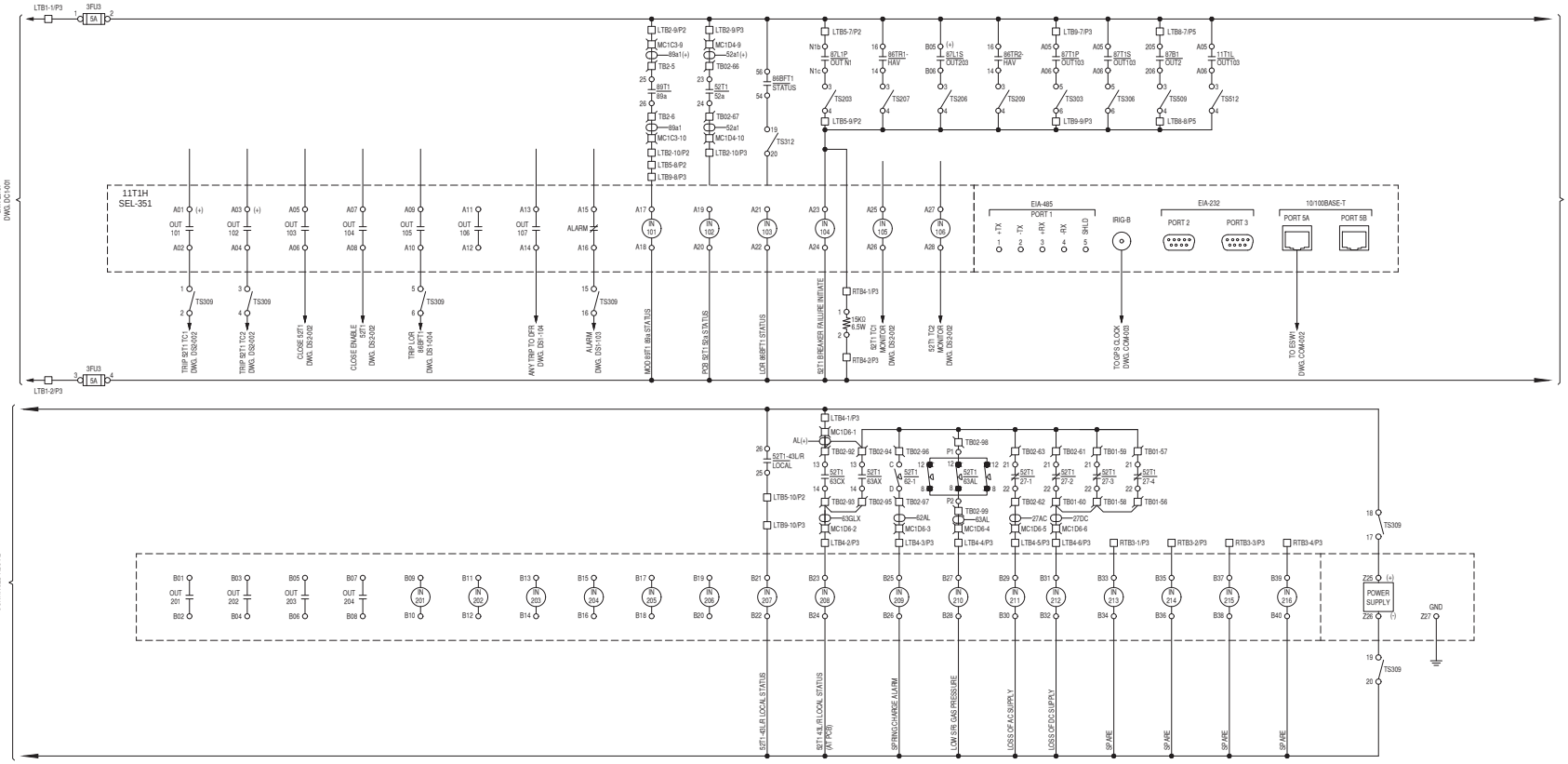
Design By: E. NEUHARDT
Drawn By: T. ADAMS
Approved By: J. OLSON
Project Number: 17.01246

SUBSTATION DC SCHEMATIC LINE RELAY 87L1S SEL-411L

DWG #: NWO-DS1-002
REVISION: 0B



TERMINAL BLOCK LEGEND

PANEL NUMBER
PANEL SIDE (LEFT OR RIGHT)
TERMINAL BLOCK NUMBER
2R40

- RELAY PANEL
- RELAY PANEL SHORTING BLOCK
- OUTDOOR EQUIPMENT
- OUTDOOR EQUIPMENT SHORTING BLOCK
- FIELD TERMINATION CABINET
- FIELD TERMINATION CABINET SHORTING BLOCK

NORTHWEST OHIO
WIND PROJECT

PAULDING COUNTY, OHIO

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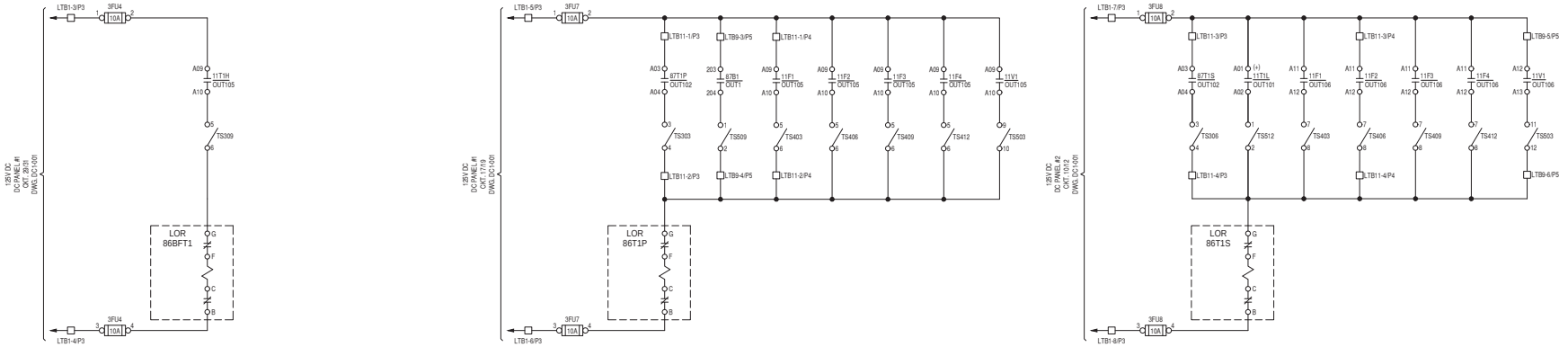
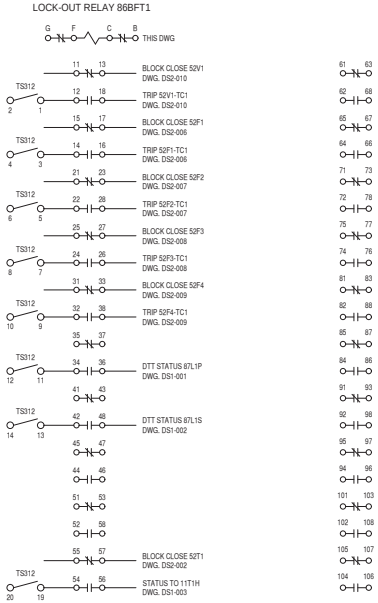
Drawn By: T. ADAMS
Approved By: J. OLSON
Project Number: 17.01246

SUBSTATION
DC SCHEMATIC
BREAKER 52T1
RELAY 11T1H
SEL-351

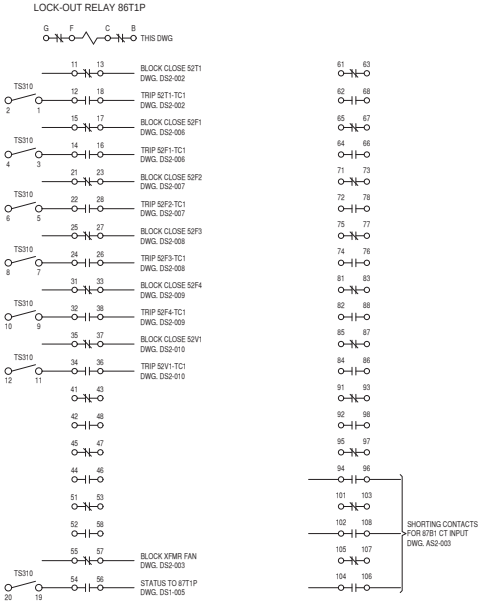
DWG #: NWO-DS1-003
REVISION: 0B



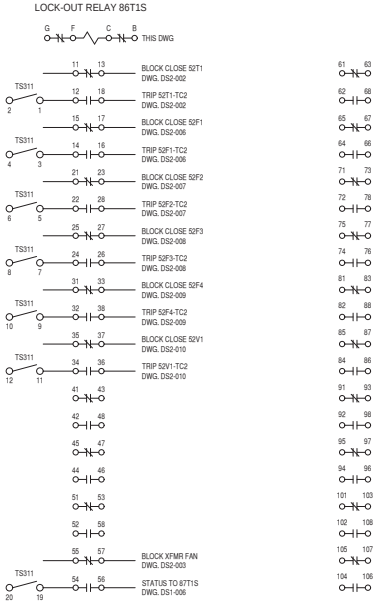
LOCK-OUT RELAY 86BFT1



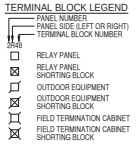
LOCK-OUT RELAY 86T1P



LOCK-OUT RELAY 86T1S



TERMINAL BLOCK LEGEND



NORTHWEST OHIO
WIND PROJECT

PAULDING COUNTY, OHIO

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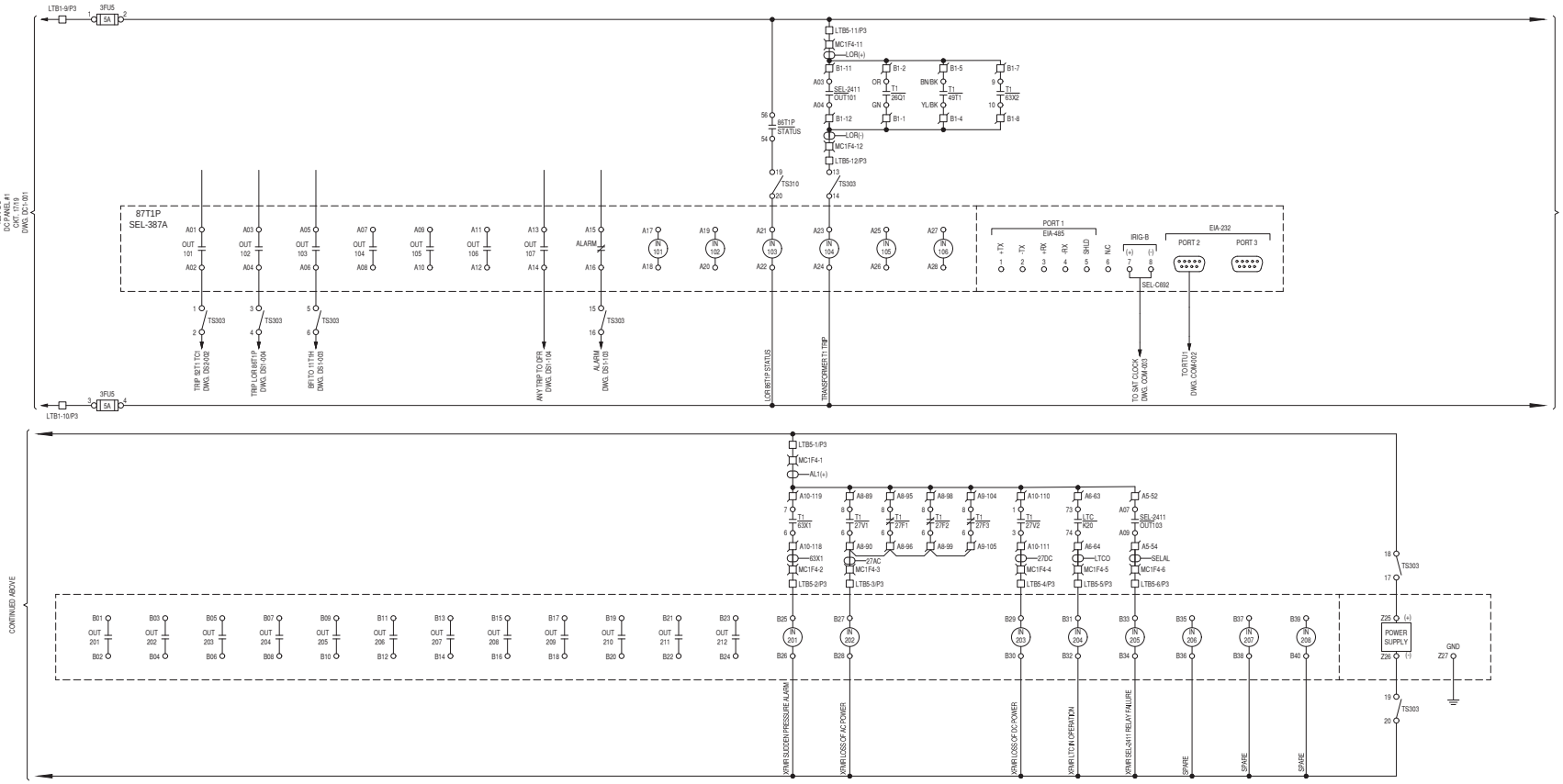
Design By: E. NEUHARDT
Drawn By: T. ADAMS
Approved By: J. OLSON
Project Number: 17.01246

SUBSTATION DC SCHEMATIC LOCK-OUT RELAY 86BFT1, 86T1P & 86T1S

DWG #: NWO-DS1-004

REVISION: 0B



TERMINAL BLOCK LEGEND

PANEL NUMBER
PANEL SIDE (LEFT OR RIGHT)
TERMINAL BLOCK NUMBER
2R40

- RELAY PANEL
- RELAY PANEL SHORTING BLOCK
- OUTDOOR EQUIPMENT
- OUTDOOR EQUIPMENT SHORTING BLOCK
- FIELD TERMINATION CABINET
- FIELD TERMINATION CABINET SHORTING BLOCK

NORTHWEST OHIO
WIND PROJECT

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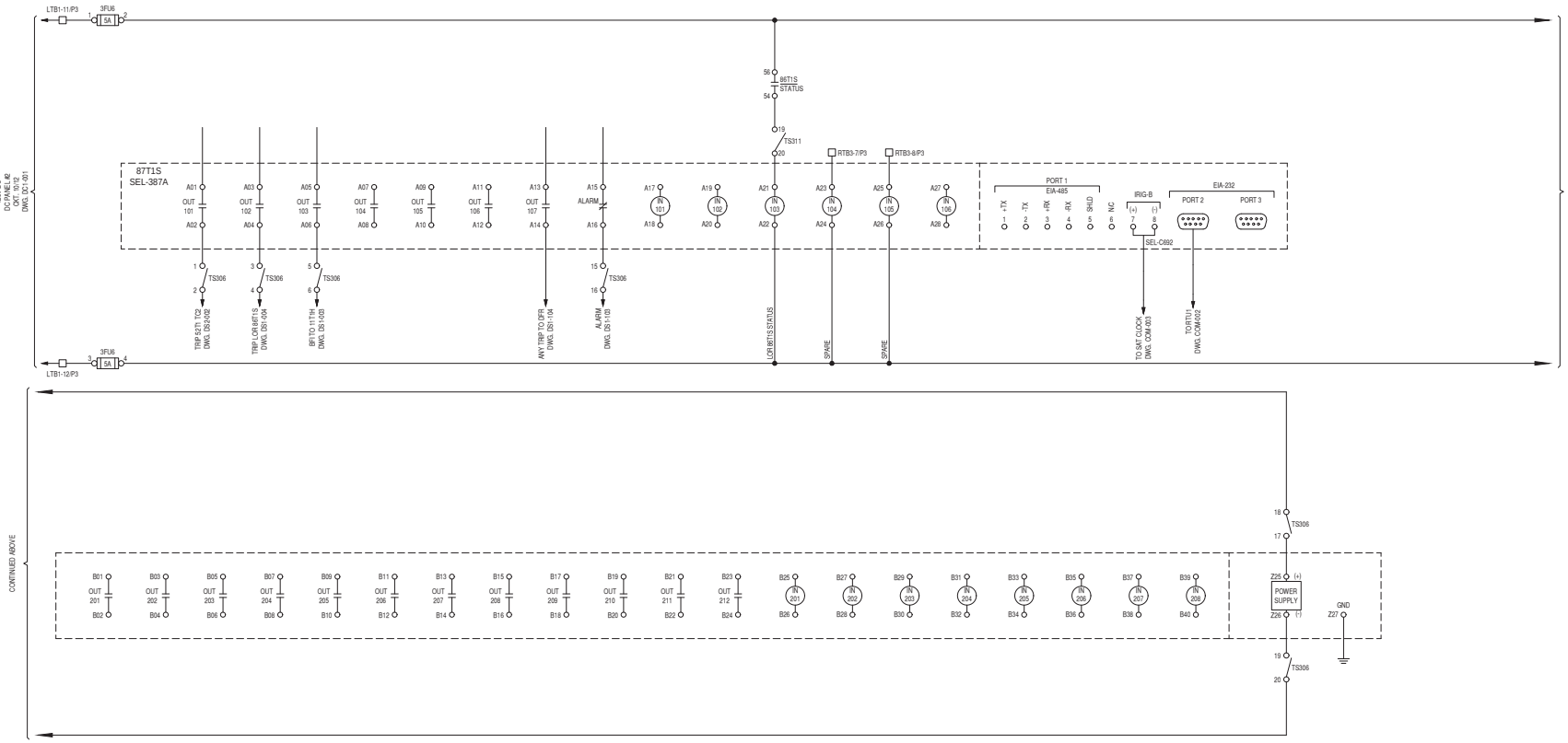
Design By: E. NEUHARDT
Drawn By: T. ADAMS
Approved By: J. OLSON
Project Number: 17.01246

SUBSTATION
DC SCHEMATIC
TRANSFORMER T1
RELAY 87T1P
SEL-387A

DWG #: NWO-DS1-005
REVISION: 0B



TERMINAL BLOCK LEGEND

PANEL NUMBER
PANEL SIDE (LEFT OR RIGHT)
TERMINAL BLOCK NUMBER
2R40

- RELAY PANEL
- RELAY PANEL SHORTING BLOCK
- OUTDOOR EQUIPMENT
- OUTDOOR EQUIPMENT SHORTING BLOCK
- FIELD TERMINATION CABINET
- FIELD TERMINATION CABINET SHORTING BLOCK

NORTHWEST OHIO WIND PROJECT

PAULDING COUNTY, OHIO

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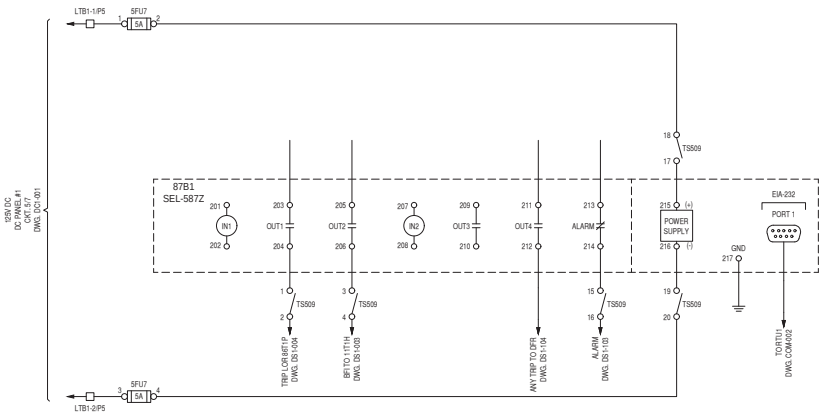
Design By: E. NEUHARDT
Drawn By: T. ADAMS
Approved By: J. OLSON
Project Number: 17.01246

SUBSTATION
DC SCHEMATIC
TRANSFORMER T1
RELAY 87T1S
SEL-387A

DWG #: NWO-DS1-006
REVISION: 0B



TERMINAL BLOCK LEGEND

PANEL NUMBER
PANEL SIDE (LEFT OR RIGHT)
TERMINAL BLOCK NUMBER
2R43

- RELAY PANEL
- RELAY PANEL SHORTING BLOCK
- OUTDOOR EQUIPMENT
- OUTDOOR EQUIPMENT SHORTING BLOCK
- FIELD TERMINATION CABINET
- FIELD TERMINATION CABINET SHORTING BLOCK

NORTHWEST OHIO
WIND PROJECT

PAULDING COUNTY, OHIO

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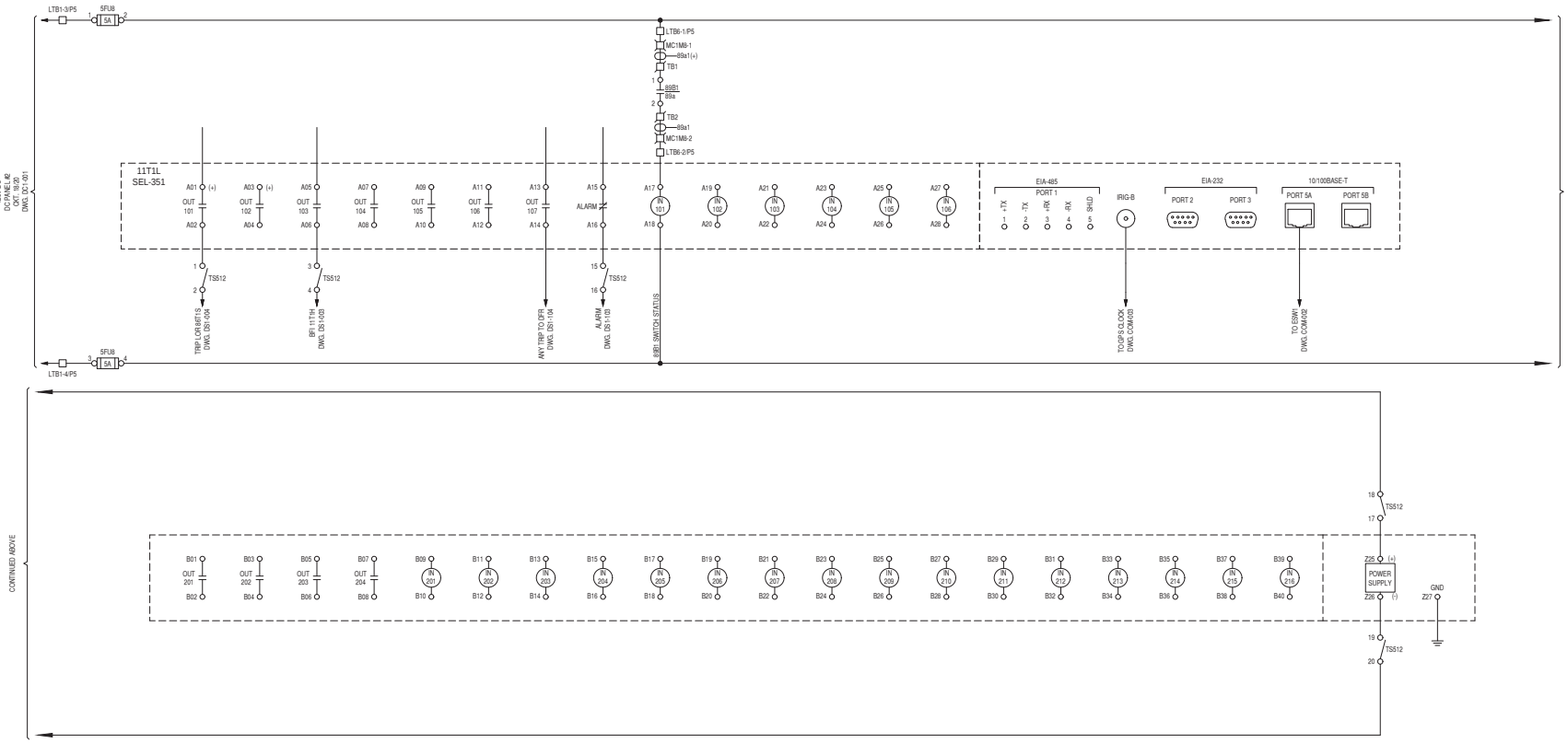
Drawn By: T. ADAMS
Approved By: J. OLSON
Project Number: 17.01246

SUBSTATION
DC SCHEMATIC
34.5KV BUS 1 RELAY 87B1
SEL-587Z

DWG #: NWO-DS1-007
REVISION: 0B



TERMINAL BLOCK LEGEND

PANEL NUMBER
PANEL SIDE (LEFT OR RIGHT)
TERMINAL BLOCK NUMBER
2R40

- RELAY PANEL
- RELAY PANEL SHORTING BLOCK
- OUTDOOR EQUIPMENT
- OUTDOOR EQUIPMENT SHORTING BLOCK
- FIELD TERMINATION CABINET
- FIELD TERMINATION CABINET SHORTING BLOCK

NORTHWEST OHIO WIND PROJECT

PAULDING COUNTY, OHIO

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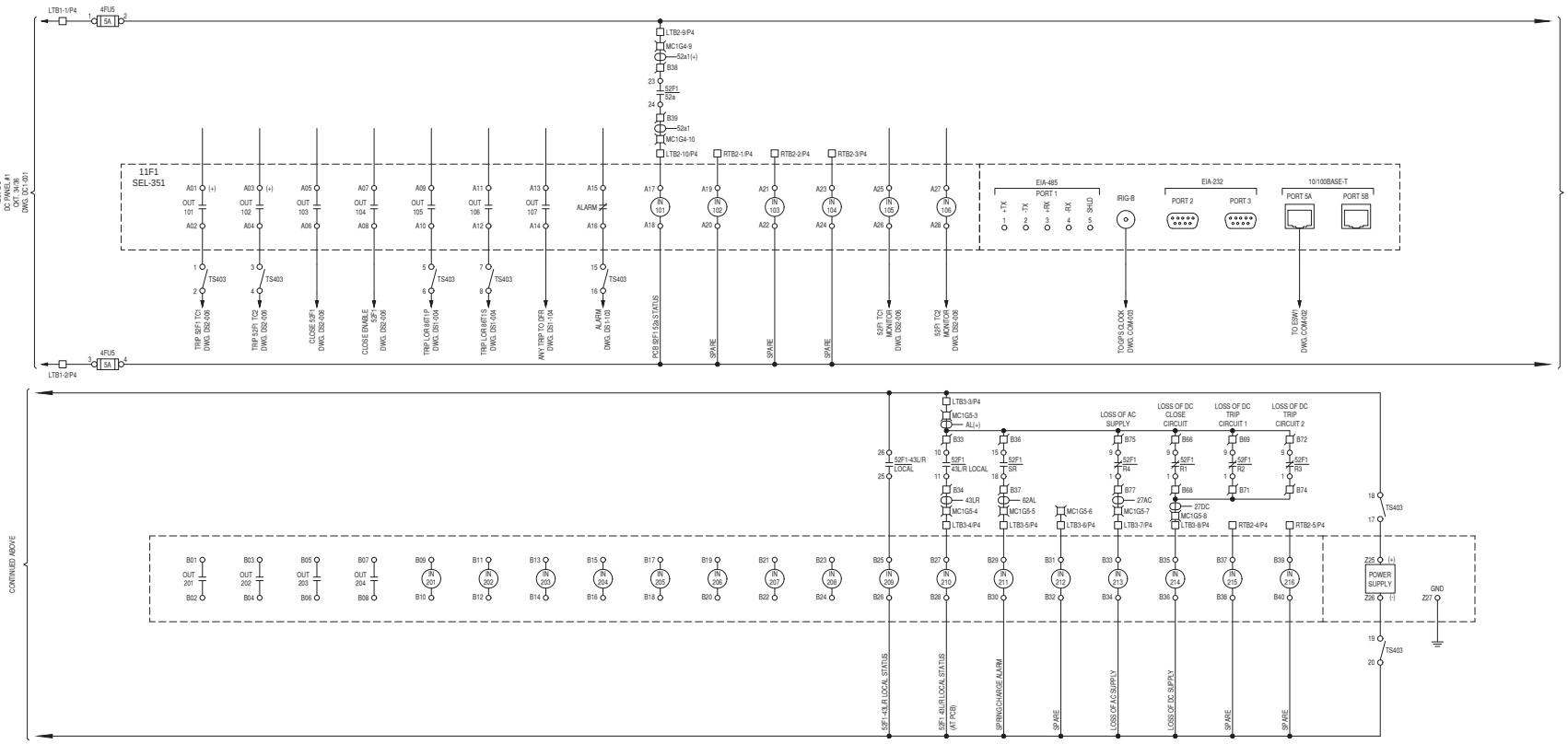
Design By: E. NEUHARDT
Drawn By: J.QUINTANILLA
Approved By: J. OLSON
Project Number: 17.01246

SUBSTATION
DC SCHEMATIC
34.5KV BUS 1 RELAY 11T1L
SEL-351

DWG #: NWO-DS1-008
REVISION: 0B



TERMINAL BLOCK LEGEND

PANEL NUMBER
PANEL SIDE (LEFT OR RIGHT)
TERMINAL BLOCK NUMBER
2R40

- RELAY PANEL
- RELAY PANEL SHORTING BLOCK
- OUTDOOR EQUIPMENT
- OUTDOOR EQUIPMENT SHORTING BLOCK
- FIELD TERMINATION CABINET
- FIELD TERMINATION CABINET SHORTING BLOCK

NORTHWEST OHIO
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PAULDING COUNTY, OHIO

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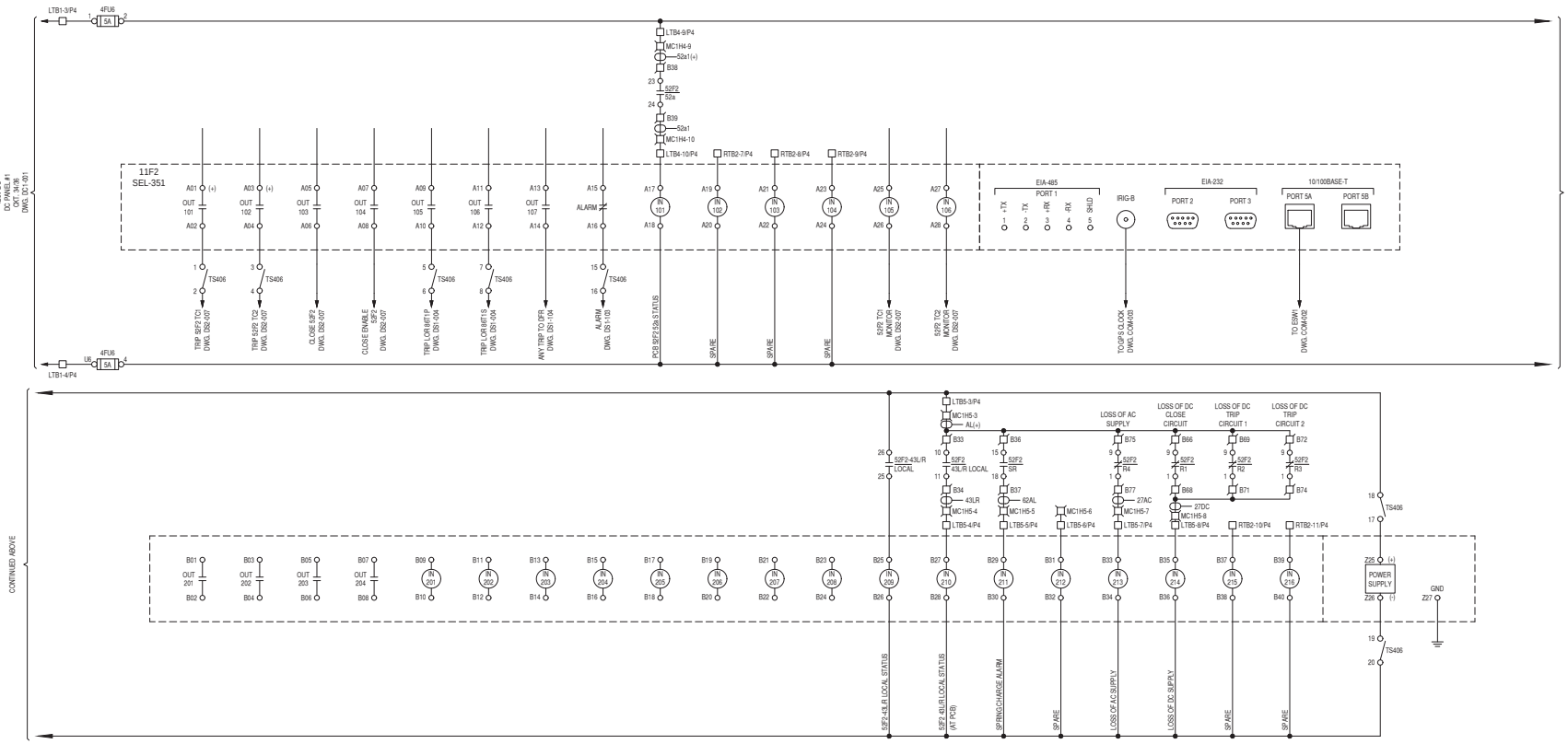
Design By: E. NEUHARDT
Drawn By: T. ADAMS
Approved By: J. OLSON
Project Number: 17.01246

SUBSTATION
DC SCHEMATIC
FEEDER RELAY 11F1
SEL-351

DWG #: NWO-DS1-009
REVISION: 0B



NORTHWEST OHIO
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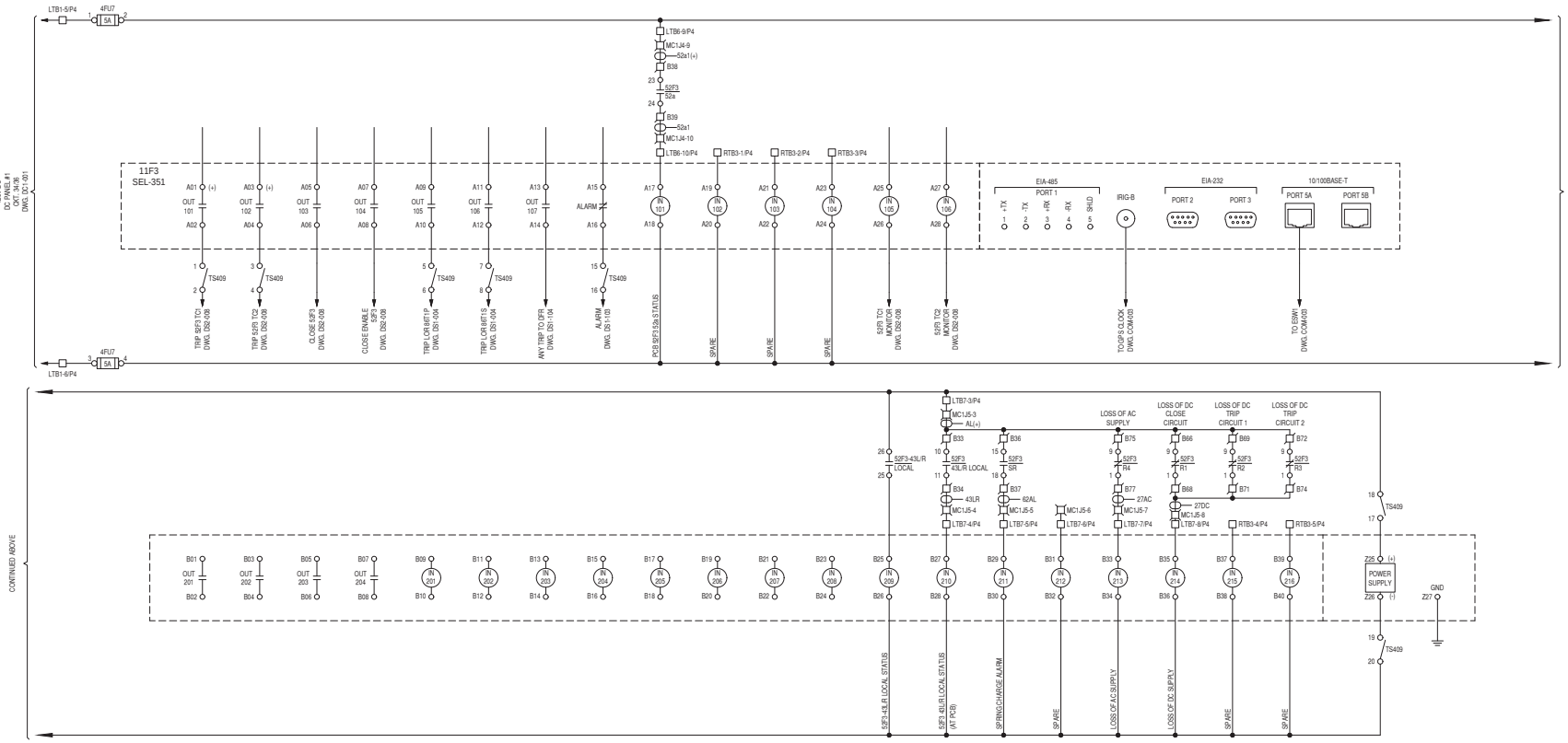
Design By: E. NEUHARDT
Drawn By: T. ADAMS
Approved By: J. OLSON
Project Number: 17.01246

SUBSTATION
DC SCHEMATIC
FEEDER RELAY 11F2
SEL-351

DWG #: NWO-DS1-010
REVISION: 0B



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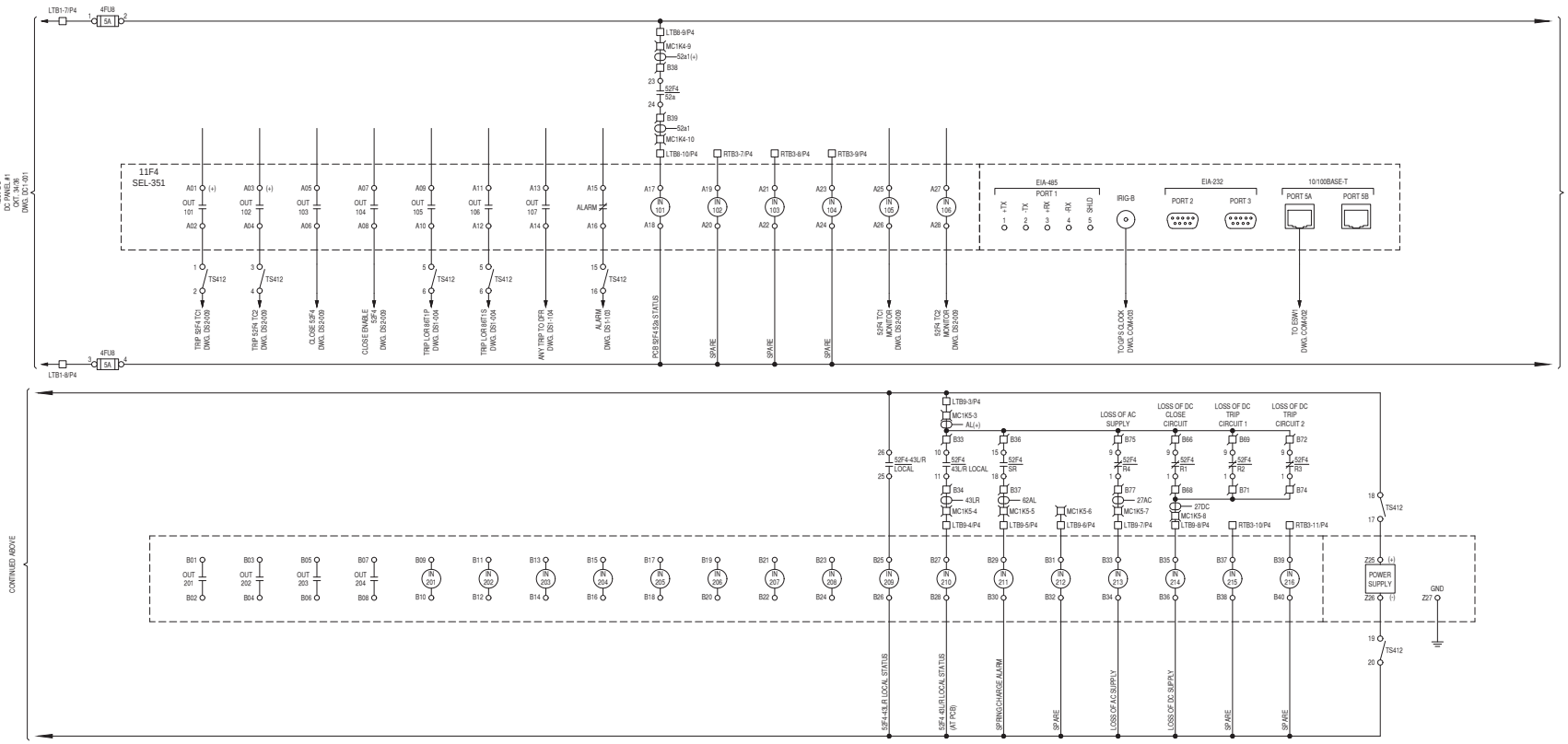
Design By: E. NEUHARDT
Drawn By: T. ADAMS
Approved By: J. OLSON
Project Number: 17.01246

SUBSTATION
DC SCHEMATIC
FEEDER RELAY 11F3
SEL-351

DWG #: NWO-DS1-011
REVISION: 0B



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Approved By: J. OLSON
Project Number: 17.01246

SUBSTATION DC SCHEMATIC FEEDER RELAY 11F4 SEL-351

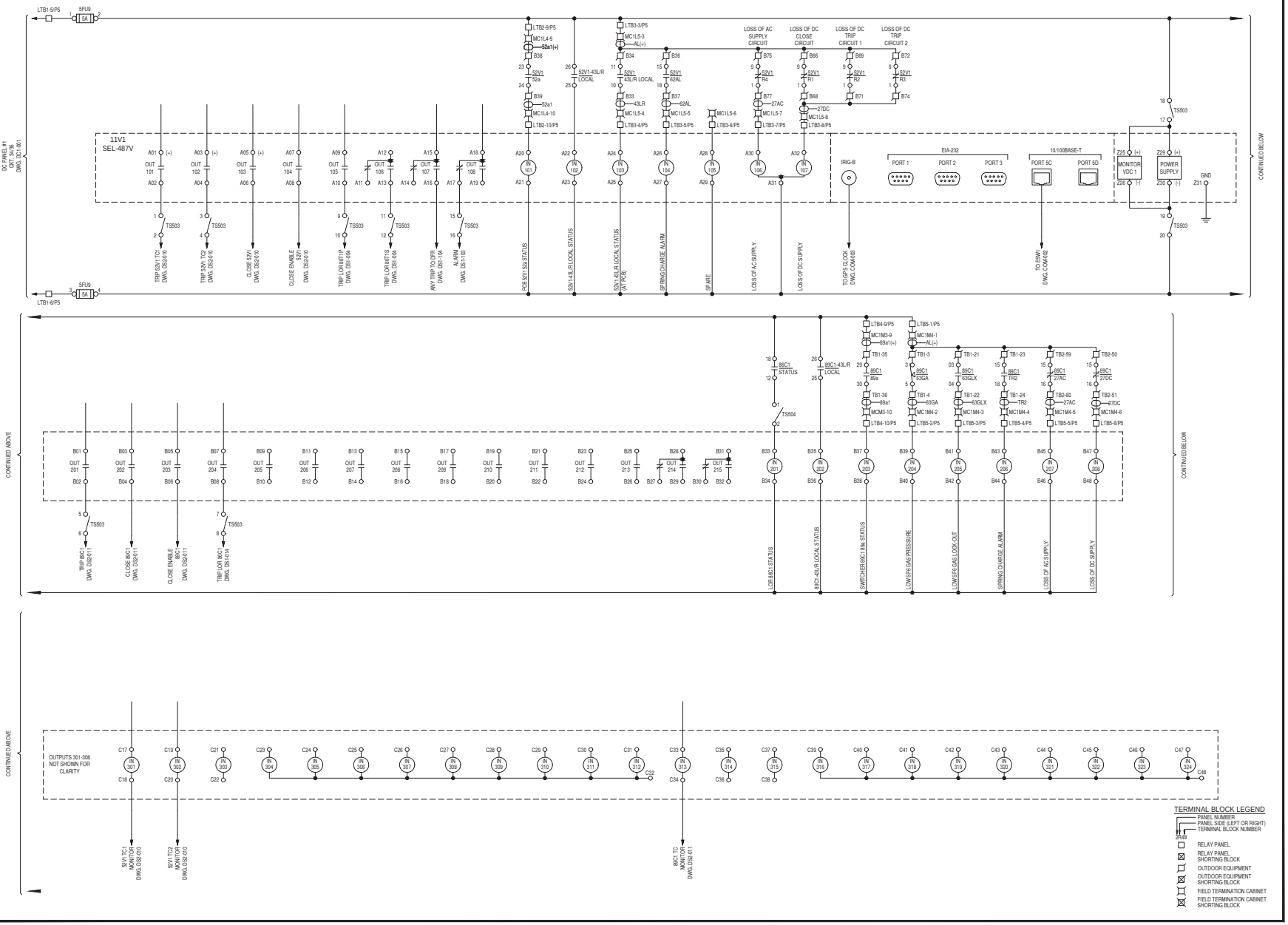
DWG #: NWO-DS1-012

REVISION: 0B

TERMINAL BLOCK LEGEND

PANEL NUMBER
PANEL SIDE (LEFT OR RIGHT)
TERMINAL BLOCK NUMBER
2R40

- RELAY PANEL
- RELAY PANEL SHORTING BLOCK
- OUTDOOR EQUIPMENT
- OUTDOOR EQUIPMENT SHORTING BLOCK
- FIELD TERMINATION CABINET
- FIELD TERMINATION CABINET SHORTING BLOCK



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PAULDING COUNTY, OHIO

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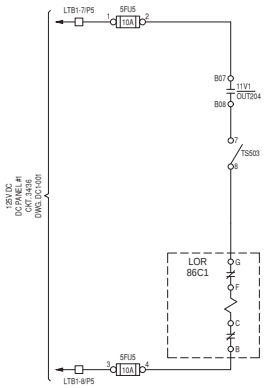
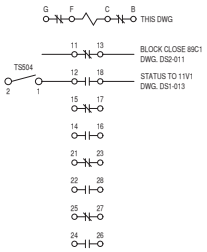
Approved By: J. OLSON
Project Number: 17.01246

SUBSTATION
DC SCHEMATIC
VAR BUS 1 RELAY 11V1
SEL-487V

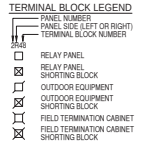
DWG #: NWO-DS1-013
REVISION: 0B



LOCK-OUT RELAY 86C1



TERMINAL BLOCK LEGEND



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WIND PROJECT

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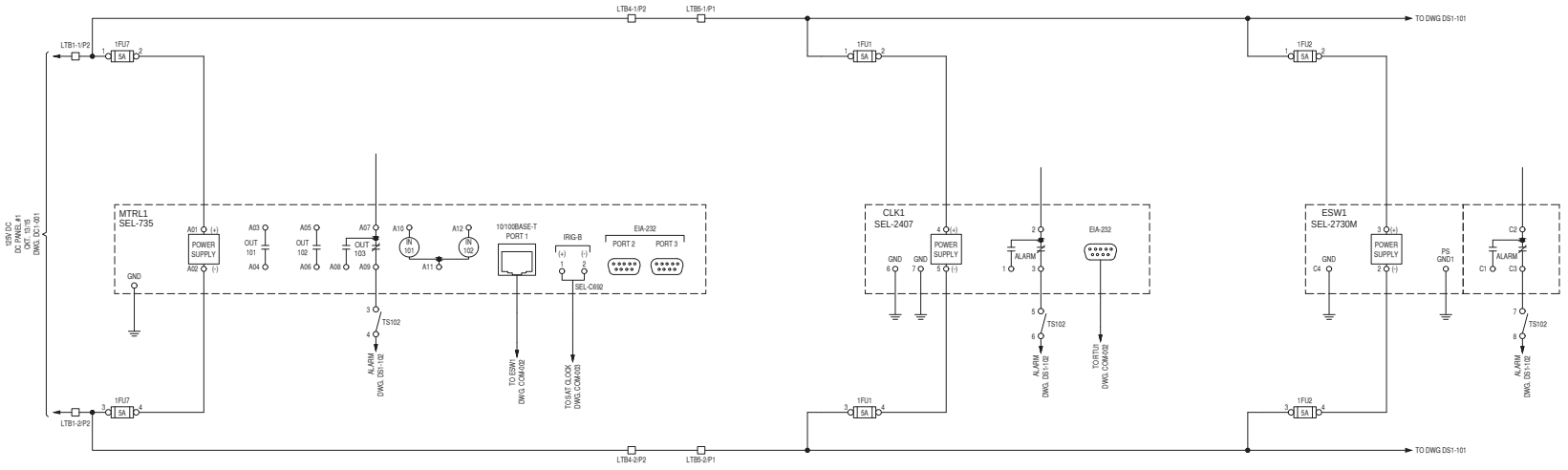
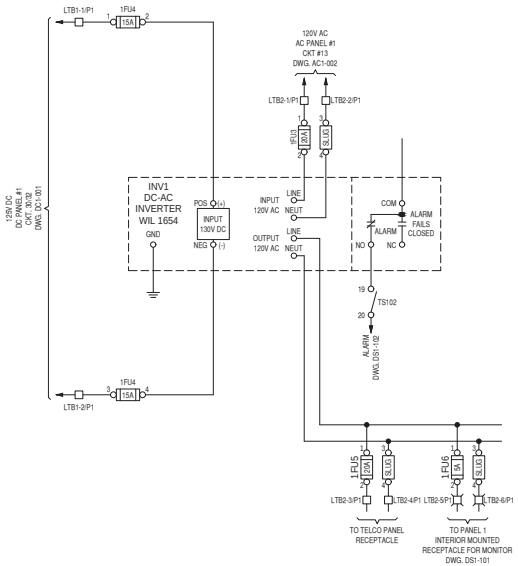
Drawn By: T. ADAMS
Approved By: J. OLSON
Project Number: 17.01246

SUBSTATION
DC SCHEMATIC
LOCK-OUT RELAY
86C1

DWG #: NWO-DS1-014
REVISION: 0B





TERMINAL BLOCK LEGEND

- PANEL NUMBER
- PANEL SIDE (LEFT OR RIGHT)
- TERMINAL BLOCK NUMBER
- 2R43
- RELAY PANEL
- RELAY PANEL SHORTING BLOCK
- OUTDOOR EQUIPMENT
- OUTDOOR EQUIPMENT SHORTING BLOCK
- FIELD TERMINATION CABINET
- FIELD TERMINATION CABINET SHORTING BLOCK

NORTHWEST OHIO WIND PROJECT

PAULDING COUNTY, OHIO

Rev.	Date	Description	By
0A	11/21/17	90% REVIEW PACKAGE	UEI
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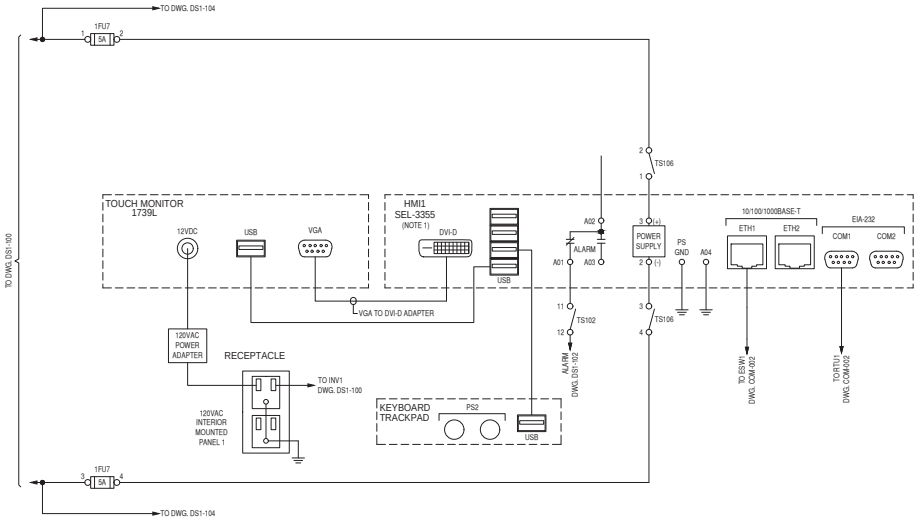
Design By: E. NEUHARDT
Drawn By: T. ADAMS
Approved By: J. OLSON
Project Number: 17.01246

SUBSTATION DC SCHEMATIC MTRL1, ESW1, CLK1, INV1

DWG #: NWO-DS1-100

REVISION: 0B



TERMINAL BLOCK LEGEND

PANEL NUMBER
PANEL SIDE (LEFT OR RIGHT)
TERMINAL BLOCK NUMBER
2R43

- RELAY PANEL
- RELAY PANEL SHORTING BLOCK
- OUTDOOR EQUIPMENT
- OUTDOOR EQUIPMENT SHORTING BLOCK
- FIELD TERMINATION CABINET
- FIELD TERMINATION CABINET SHORTING BLOCK

NORTHWEST OHIO
WIND PROJECT

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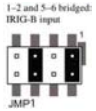
NOTES:
1. THE COM 1 JUMPERS, LABELED JMP1 ON THE SEL-3355 MAIN BOARD, SHALL BE CONFIGURED BY CONTROL ENCLOSURE VENDOR FOR IRIG-B INPUT FOR TIME SYNCHRONIZATION. FOR IRIG-B INPUT: 1-2 BRIDGED AND 5-6 BRIDGED.



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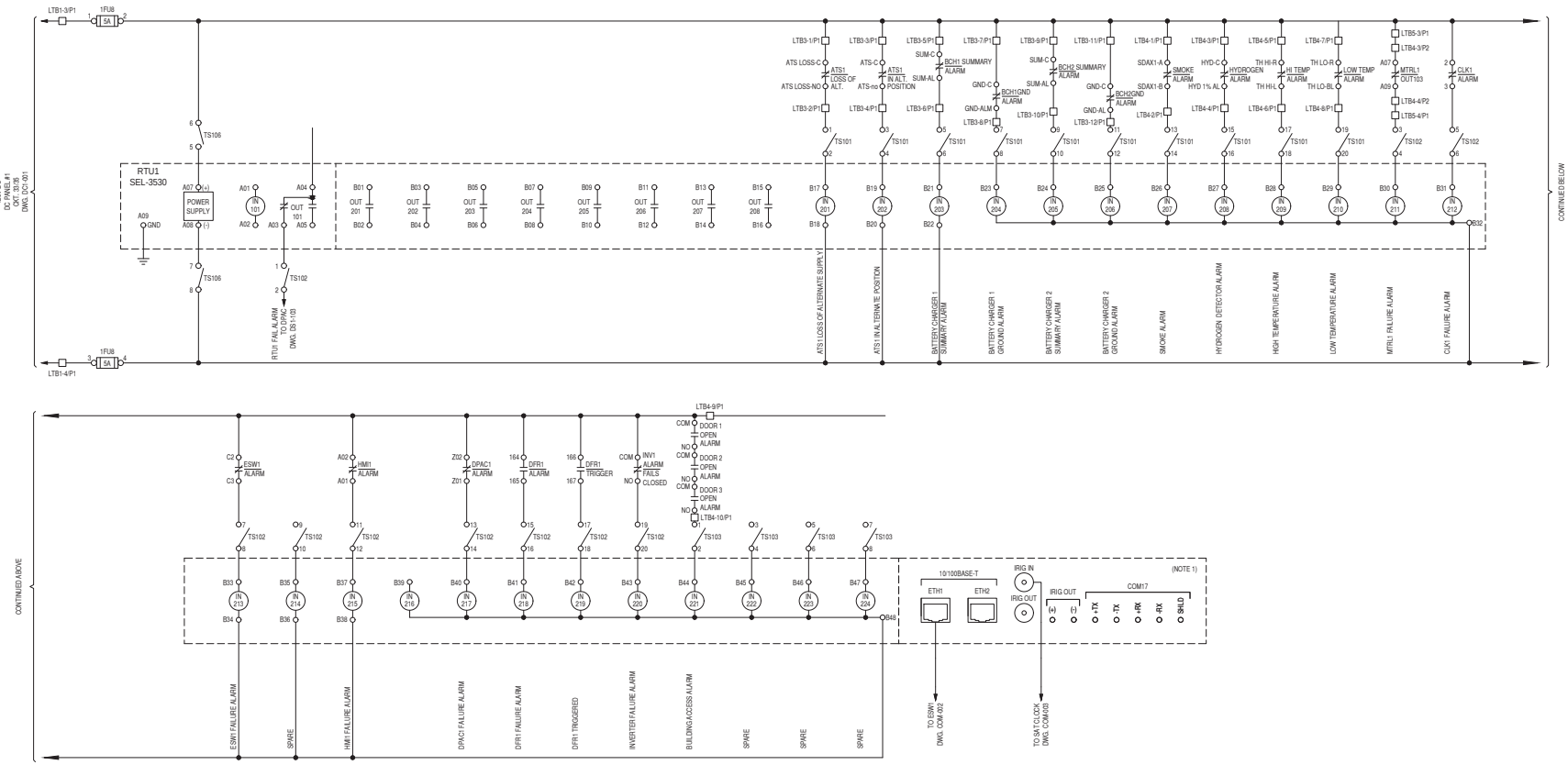
SUBSTATION
DC SCHEMATIC
HMI1
SEL-3355

DWG #: NWO-DS1-101
REVISION: 0B



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PANEL NUMBER
PANEL SIDE (LEFT OR RIGHT)
TERMINAL BLOCK NUMBER
2R43

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- RELAY PANEL SHORTING BLOCK
- OUTDOOR EQUIPMENT
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- FIELD TERMINATION CABINET
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NOTES:
1. SERIAL CONNECTIONS SHOWN ON DWG COM-002.

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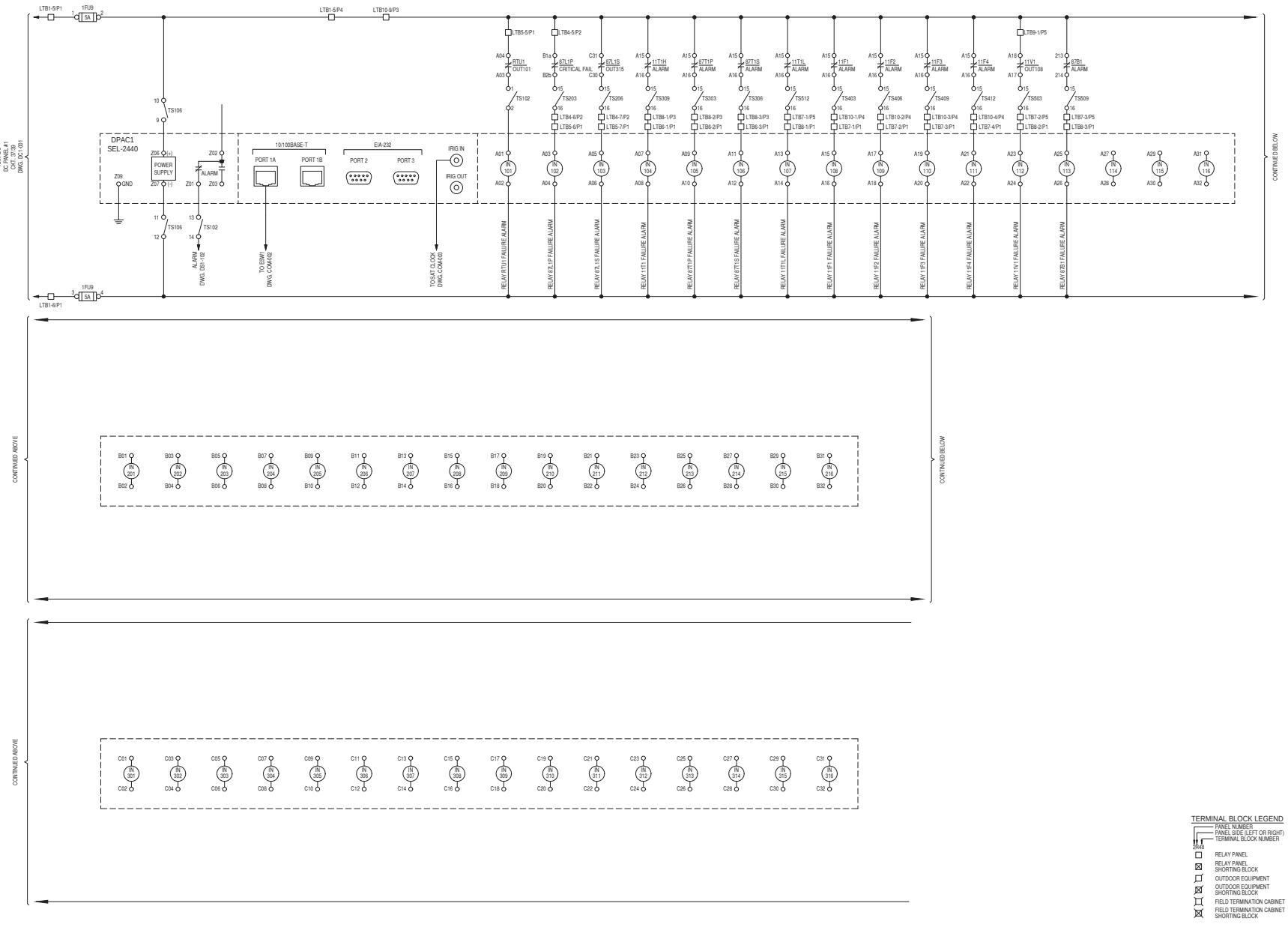
SUBSTATION
DC SCHEMATIC
RTU1
SEL-3530

DWG #: NWO-DS1-102
REVISION: 0B



NORTHWEST OHIO WIND PROJECT

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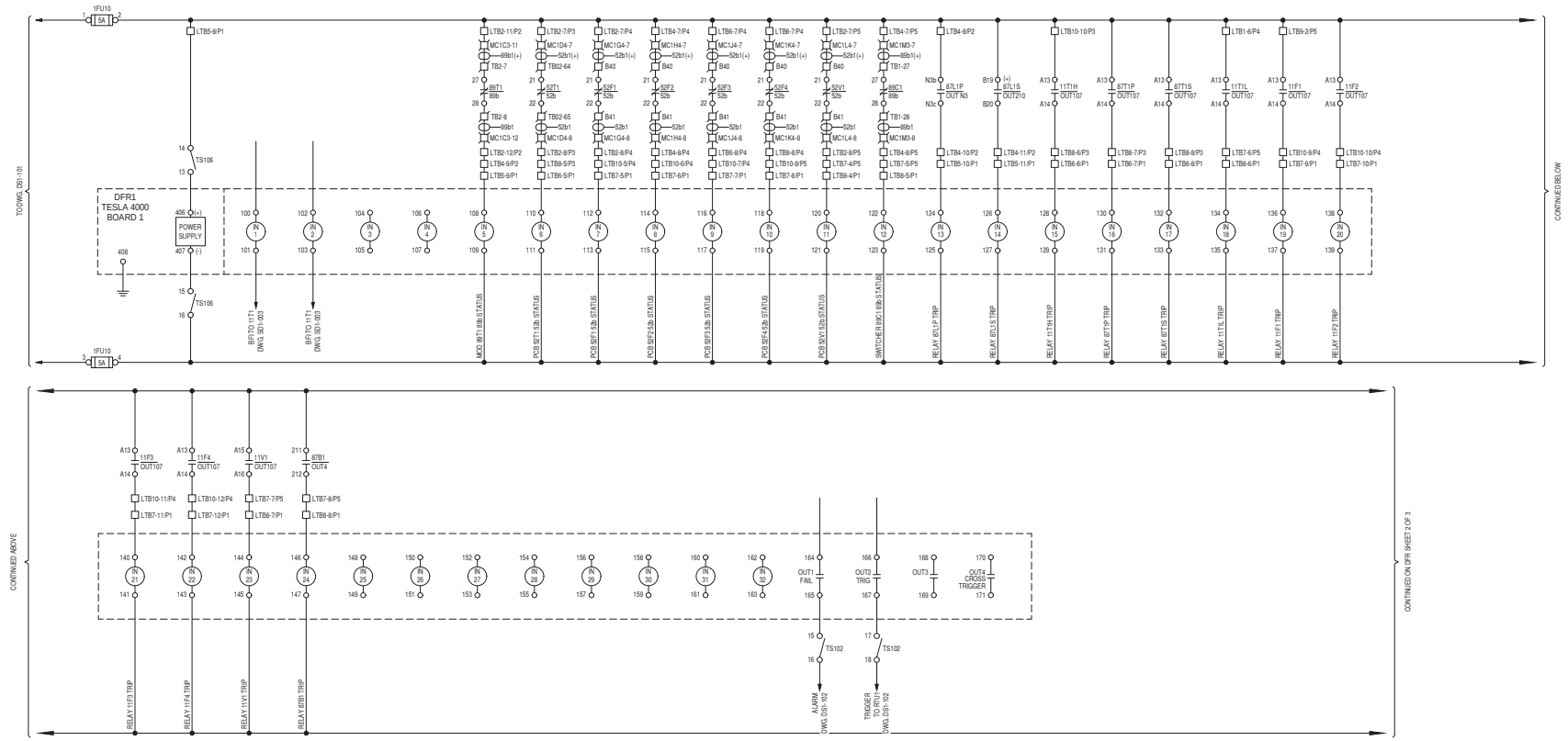
Project Number: 17.01246

SUBSTATION
DC SCHEMATIC
DPAC1
SEL-2440

DWG #: NWO-DS1-103
REVISION: 0C



TERMINAL BLOCK LEGEND

PANEL NUMBER
PANEL SIDE (LEFT OR RIGHT)
TERMINAL BLOCK NUMBER
2R40

- RELAY PANEL
- RELAY PANEL SHORTING BLOCK
- OUTDOOR EQUIPMENT
- OUTDOOR EQUIPMENT SHORTING BLOCK
- FIELD TERMINATION CABINET
- FIELD TERMINATION CABINET SHORTING BLOCK

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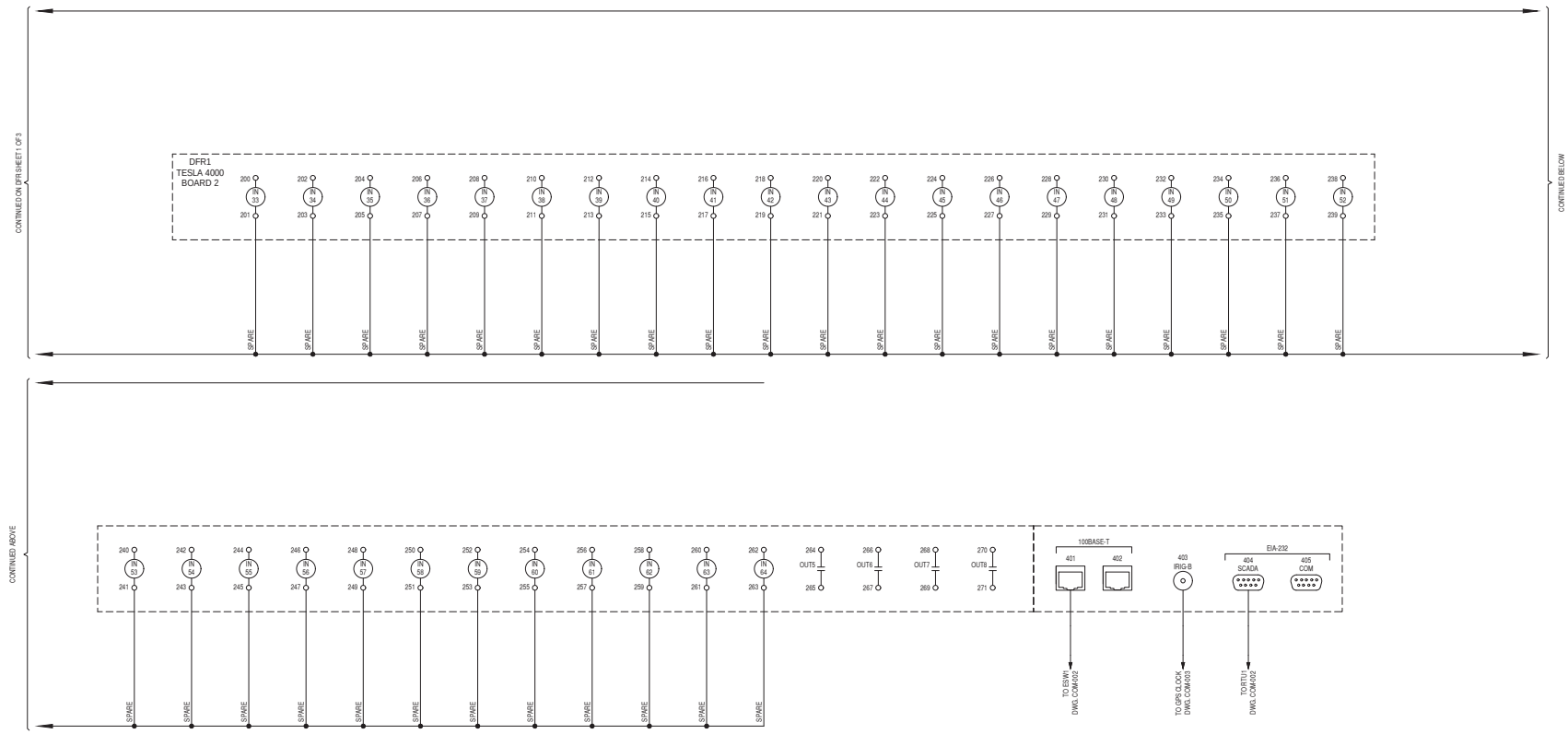
SUBSTATION
DC SCHEMATIC
DIGITAL FAULT
RECORDER DFR1
SHEET 1 OF 3

DWG #: NWO-DS1-104
REVISION: 0B



TERMINAL BLOCK LEGEND

- PANEL NUMBER
- PANEL SIDE (LEFT OR RIGHT)
- TERMINAL BLOCK NUMBER
- 2R40
- RELAY PANEL
- RELAY PANEL SHORTING BLOCK
- OUTDOOR EQUIPMENT
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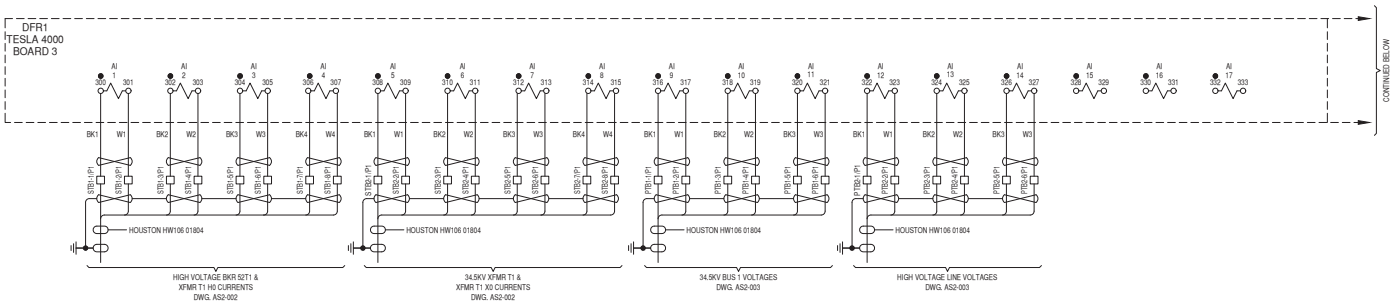
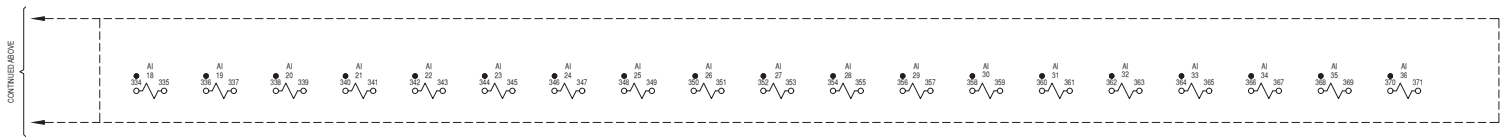
SUBSTATION
DC SCHEMATIC
DIGITAL FAULT
RECORDER DFR1
SHEET 2 OF 3

DWG #: NWO-DS1-105
REVISION: 0B





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PANEL NUMBER
PANEL SIDE (LEFT OR RIGHT)
TERMINAL BLOCK NUMBER
2R43

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Drawn By: T. ADAMS
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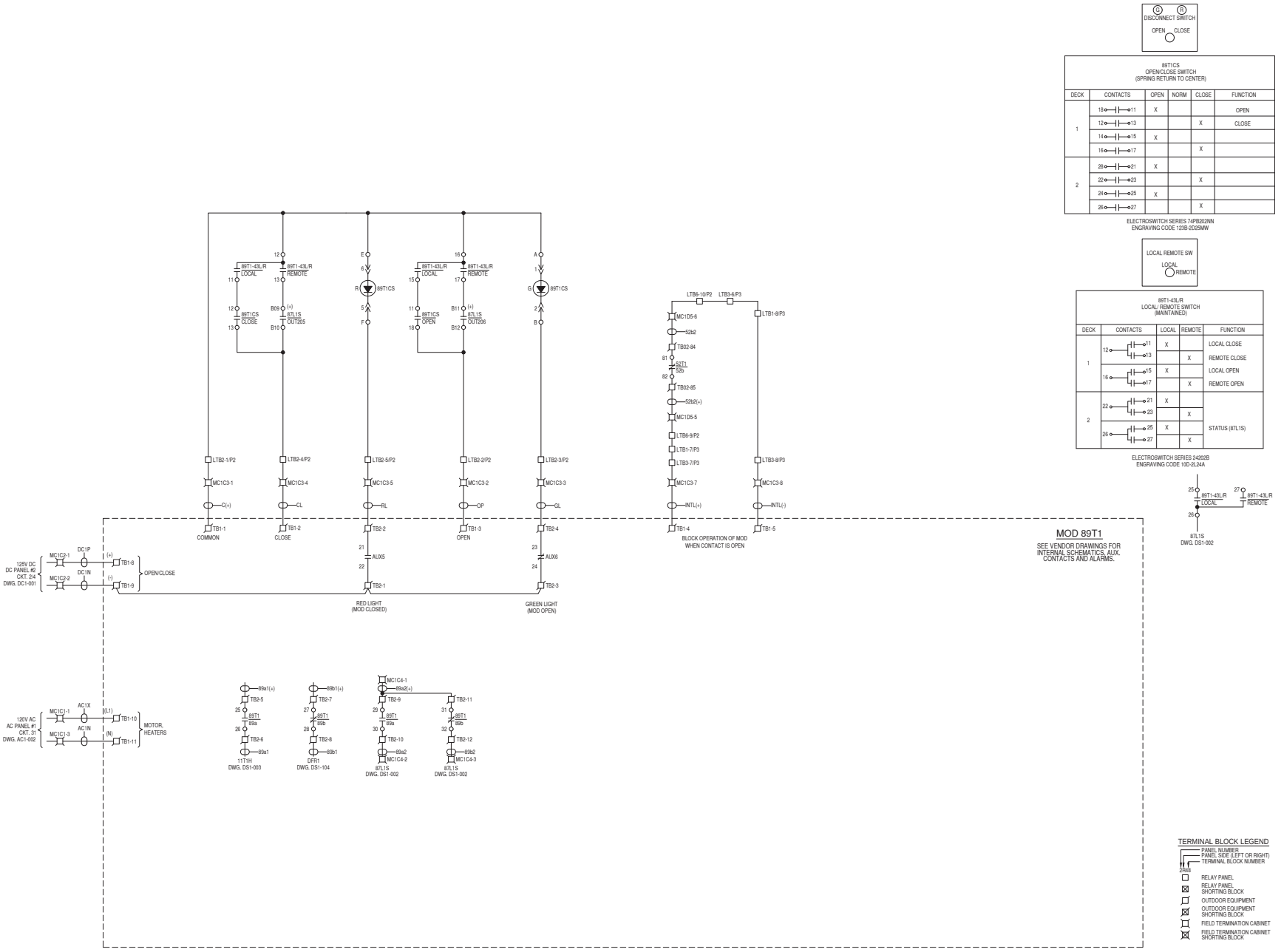
Project Number: 17.01246

SUBSTATION
DC SCHEMATIC
DIGITAL FAULT
RECORDER DFR1
SHEET 3 OF 3

DWG #: NWO-DS1-106
REVISION: 0B



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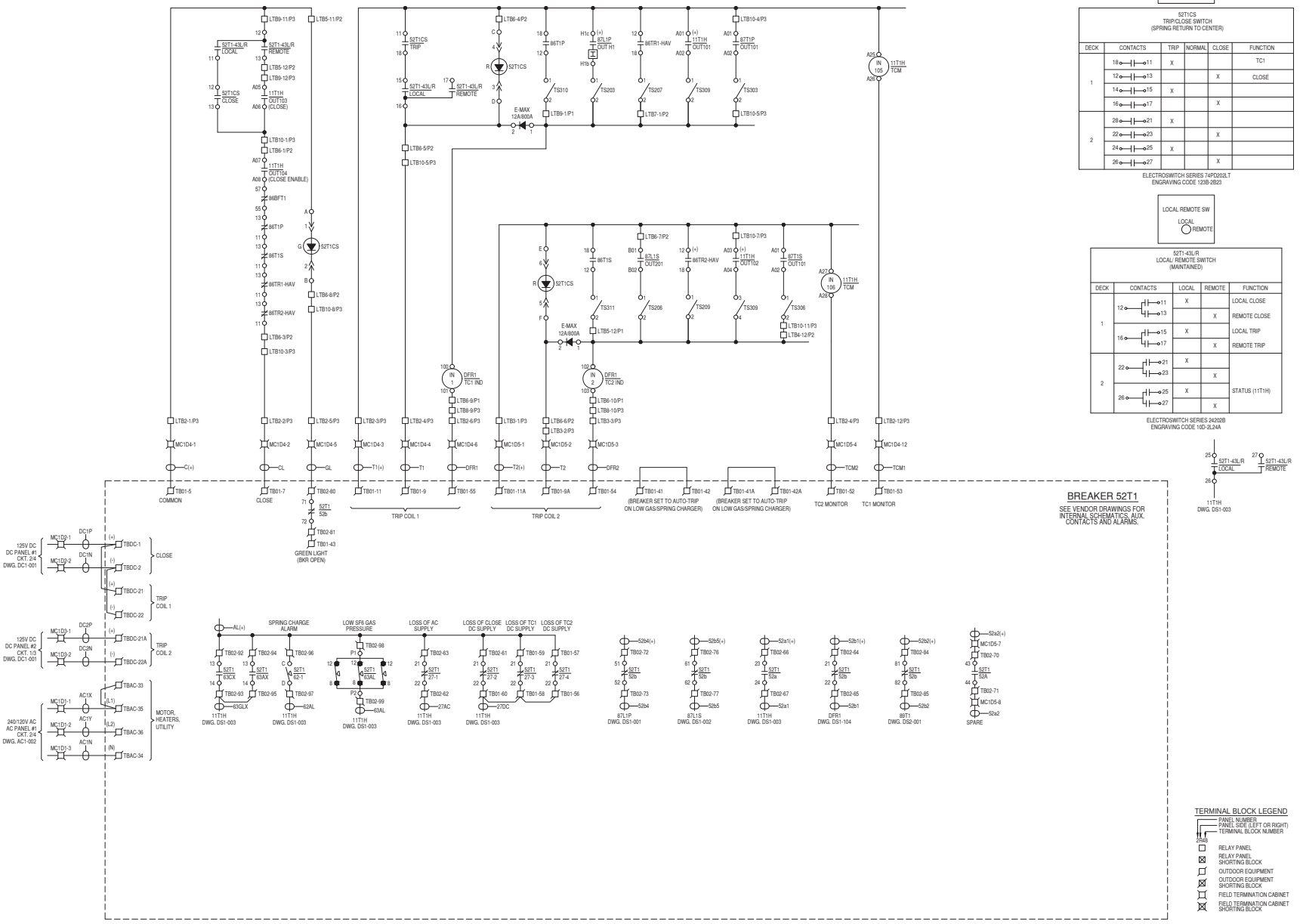
Project Number: 17.01246

SUBSTATION DC SCHEMATIC LINE MOD 89T1

DWG #: NWO-DS2-001

REVISION: 0B



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Drawn By: T. ADAMS
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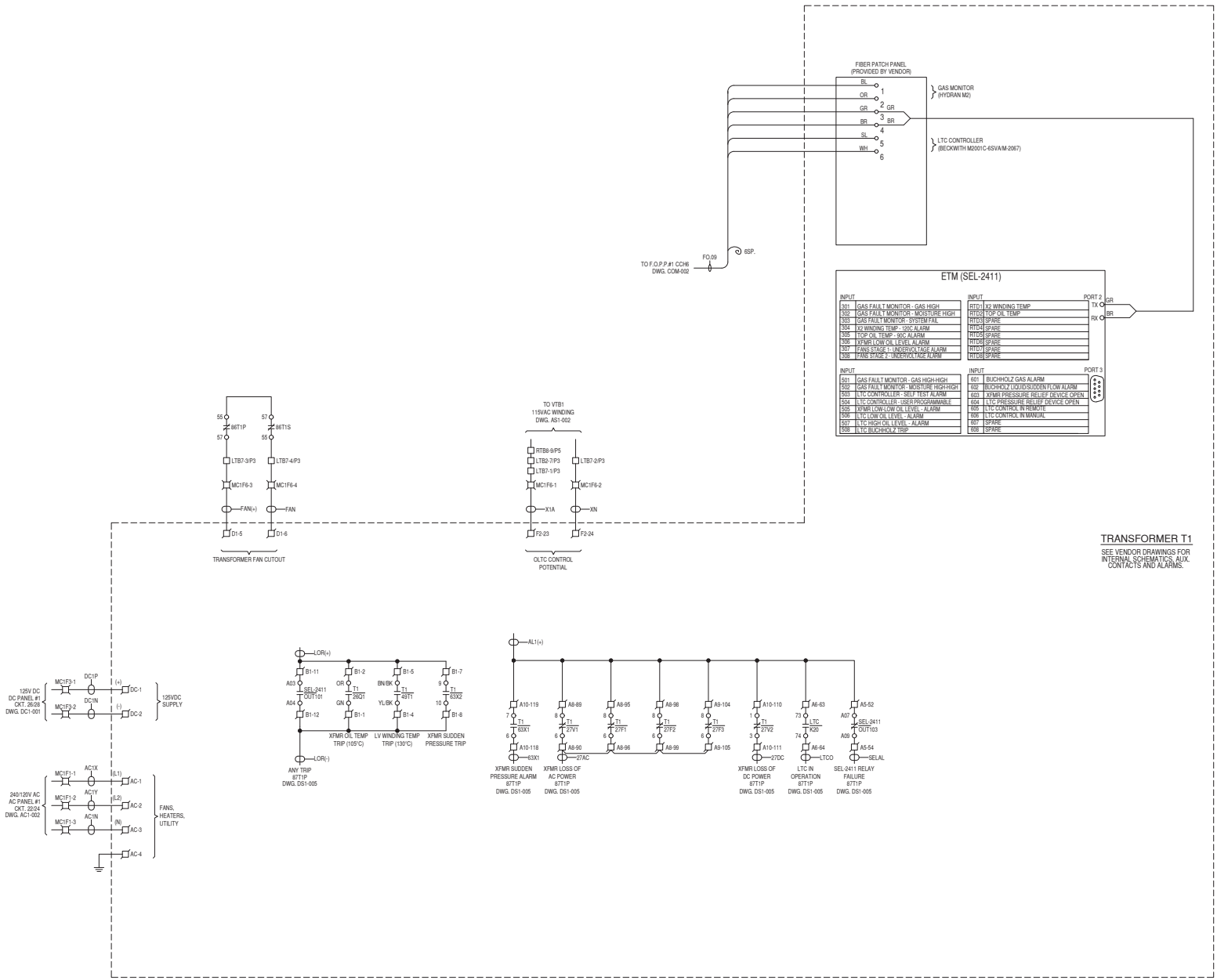
Project Number: 17.01246

SUBSTATION
DC SCHEMATIC
BREAKER 52T1

DWG #: NWO-DS2-002
REVISION: 0B



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Approved By: J. OLSON
Project Number: 17.01246

SUBSTATION
DC SCHEMATIC
TRANSFORMER T1

DWG #: NWO-DS2-003
REVISION: 0B

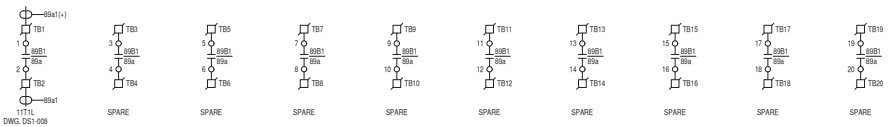
NOTE:

1. 89a CONTACT OPEN AND 89b CONTACT CLOSED WHEN DISCONNECT SWITCH IS OPEN.

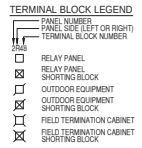
2. 89b CONTACTS MUST BE FIELD CONVERTED FROM 89a CONTACTS PER MANUFACTURERS INSTRUCTIONS.

MAIN SWITCH 89B1

SEE VENDOR DRAWINGS FOR INTERNAL SCHEMATICS, AUX. CONTACTS AND ALARMS.



TERMINAL BLOCK LEGEND



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Approved By: J. OLSON
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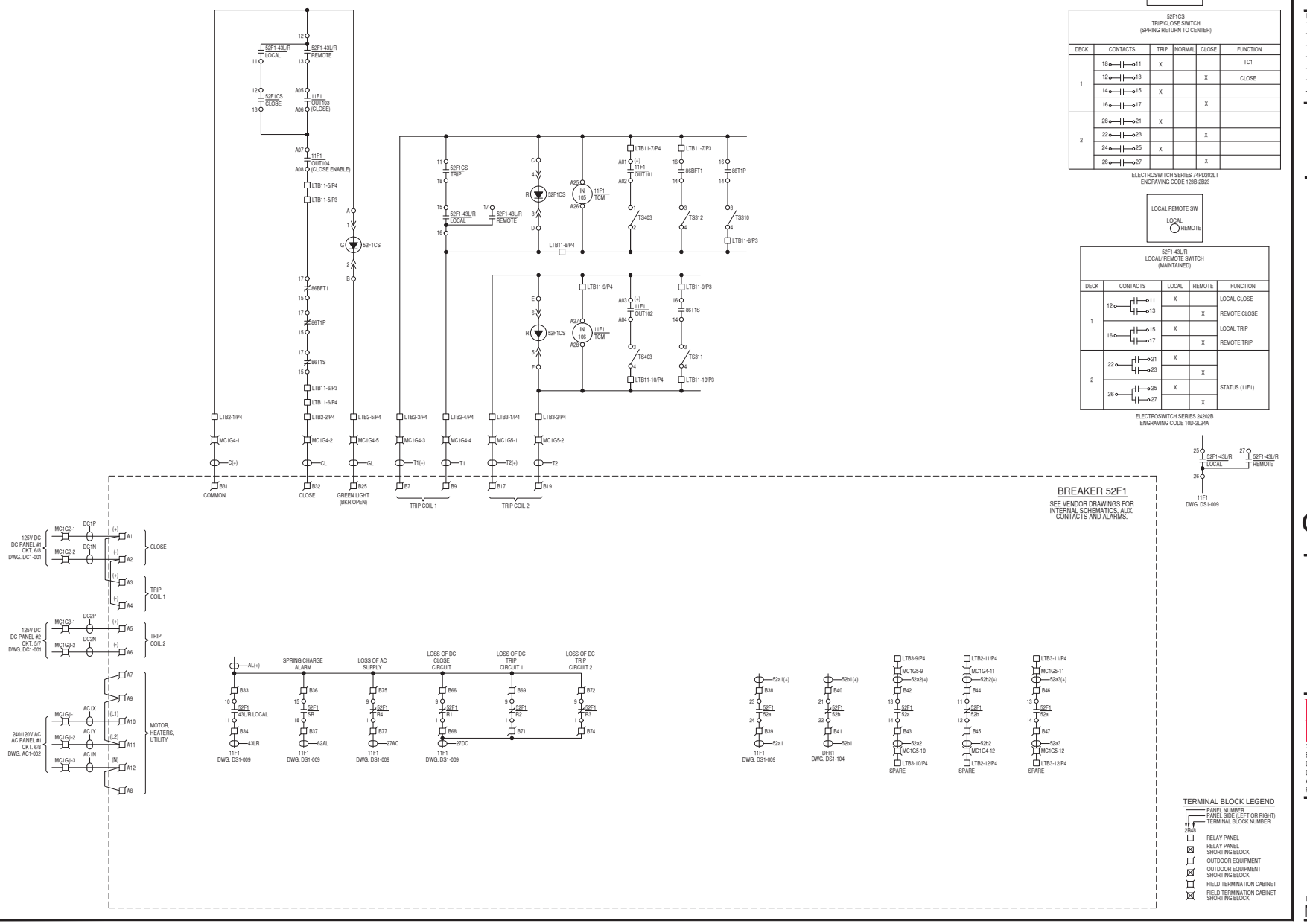
SUBSTATION
DC SCHEMATIC
34.5KV DISCONNECT
SWITCH 89B1

DWG #: NWO-DS2-005
REVISION: 0B



DECK	CONTACTS	TRIP	NORMAL	CLOSE	FUNCTION
1	10–11	X			TC1
	12–13			X	CLOSE
	14–15	X			
	16–17			X	
2	20–21	X			
	22–23			X	
	24–25	X			
	26–27			X	

52F1CS TRIP/CLOSE SWITCH (SPRING RETURN TO CENTER)

DECK	CONTACTS	LOCAL	REMOTE	FUNCTION
1	12–11	X		LOCAL CLOSE
	12–13		X	REMOTE CLOSE
	16–15	X		LOCAL TRIP
	16–17		X	REMOTE TRIP
2	22–21	X		STATUS (11F1)
	22–23		X	
	26–25	X		
	26–27		X	

52F1-43L/R LOCAL/ REMOTE SWITCH (MAINTAINED)

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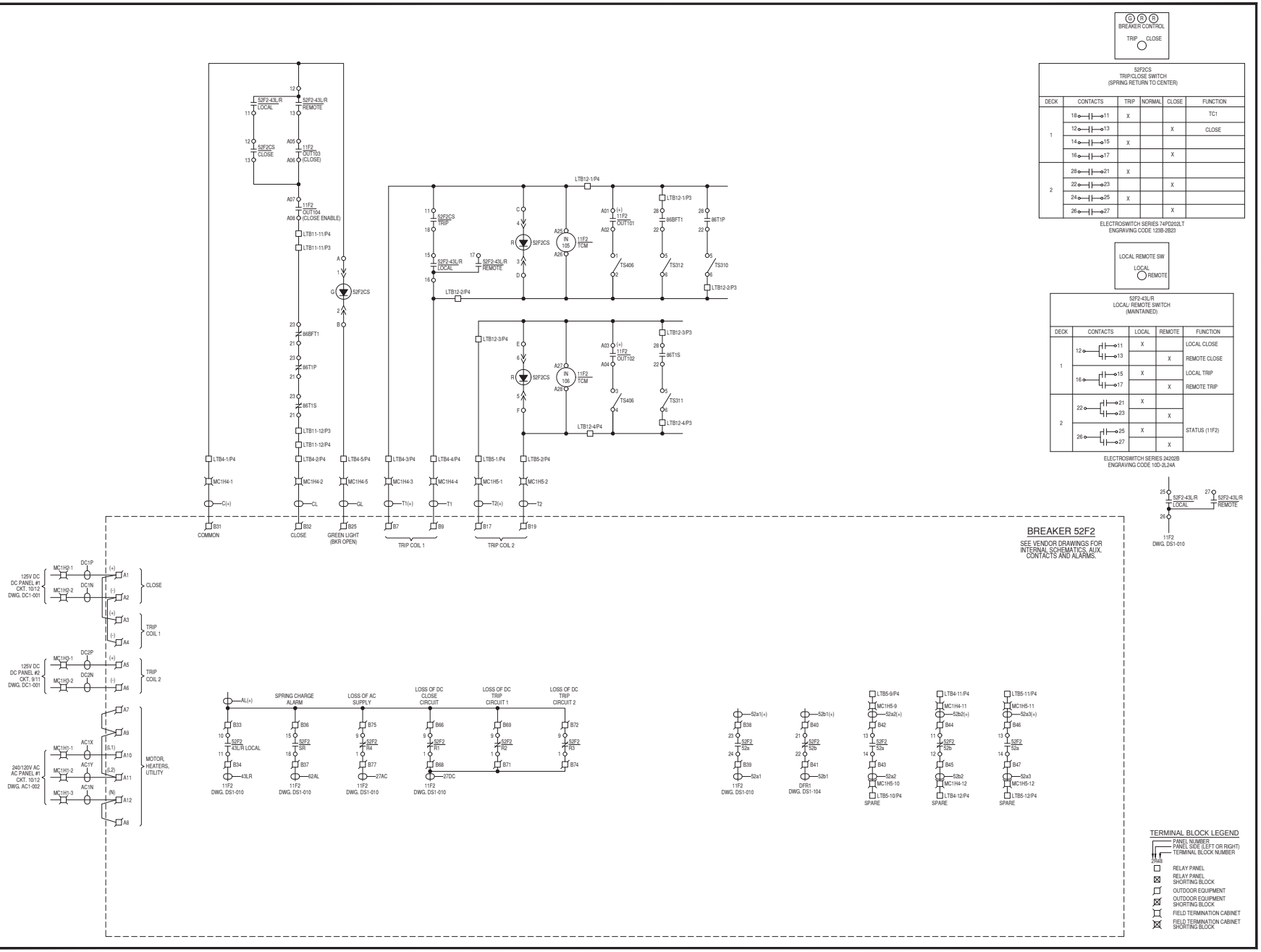
Drawn By: T. ADAMS
Approved By: J. OLSON
Project Number: 17.01246

SUBSTATION DC SCHEMATIC FEEDER BREAKER 52F1

DWG #: NWO-DS2-006

REVISION: 0B



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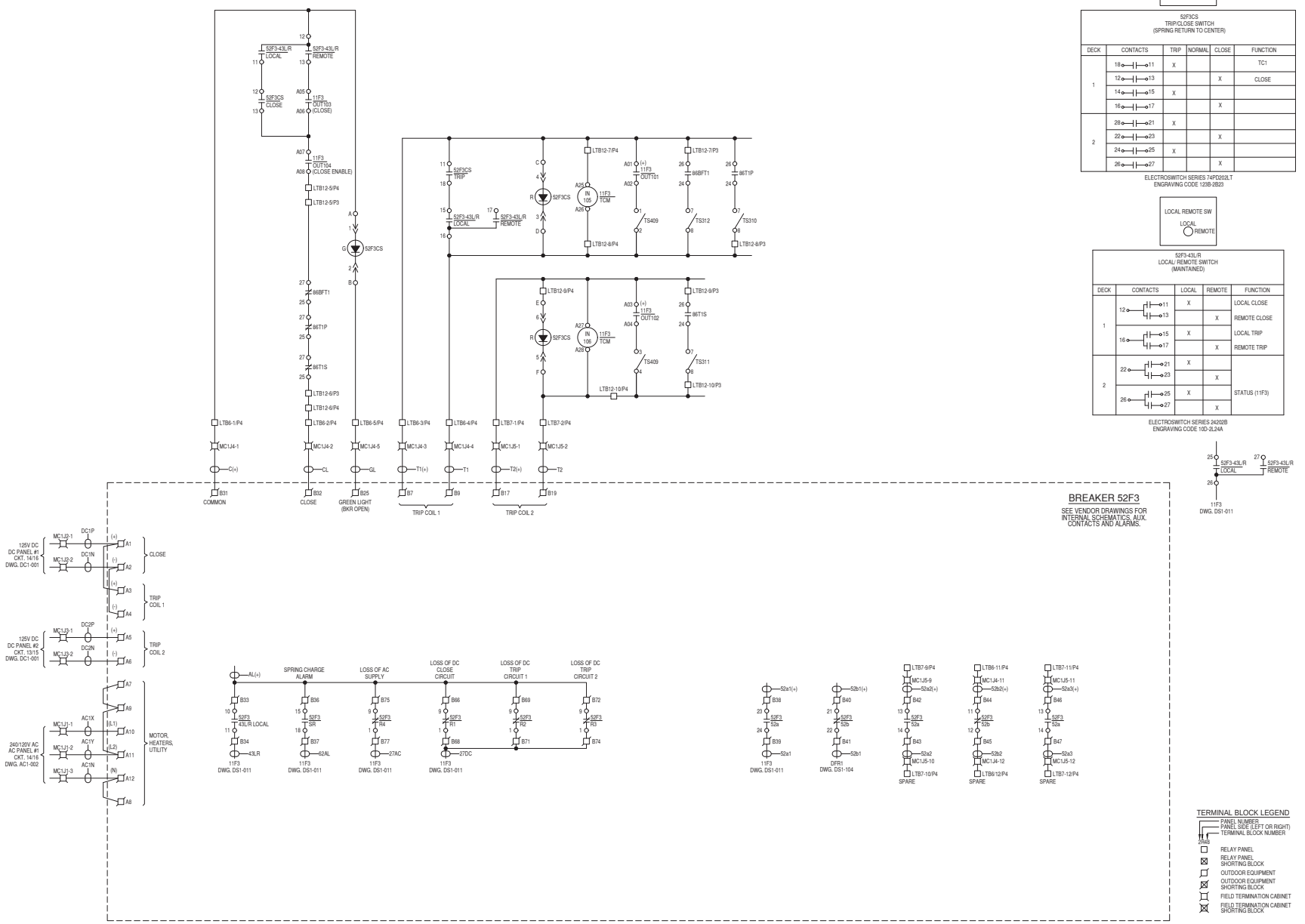
Design By: E. NEUHARDT
Drawn By: T. ADAMS
Approved By: J. OLSON
Project Number: 17.01246

SUBSTATION DC SCHEMATIC FEEDER BREAKER 52F2

DWG #: NWO-DS2-007

REVISION: 0B



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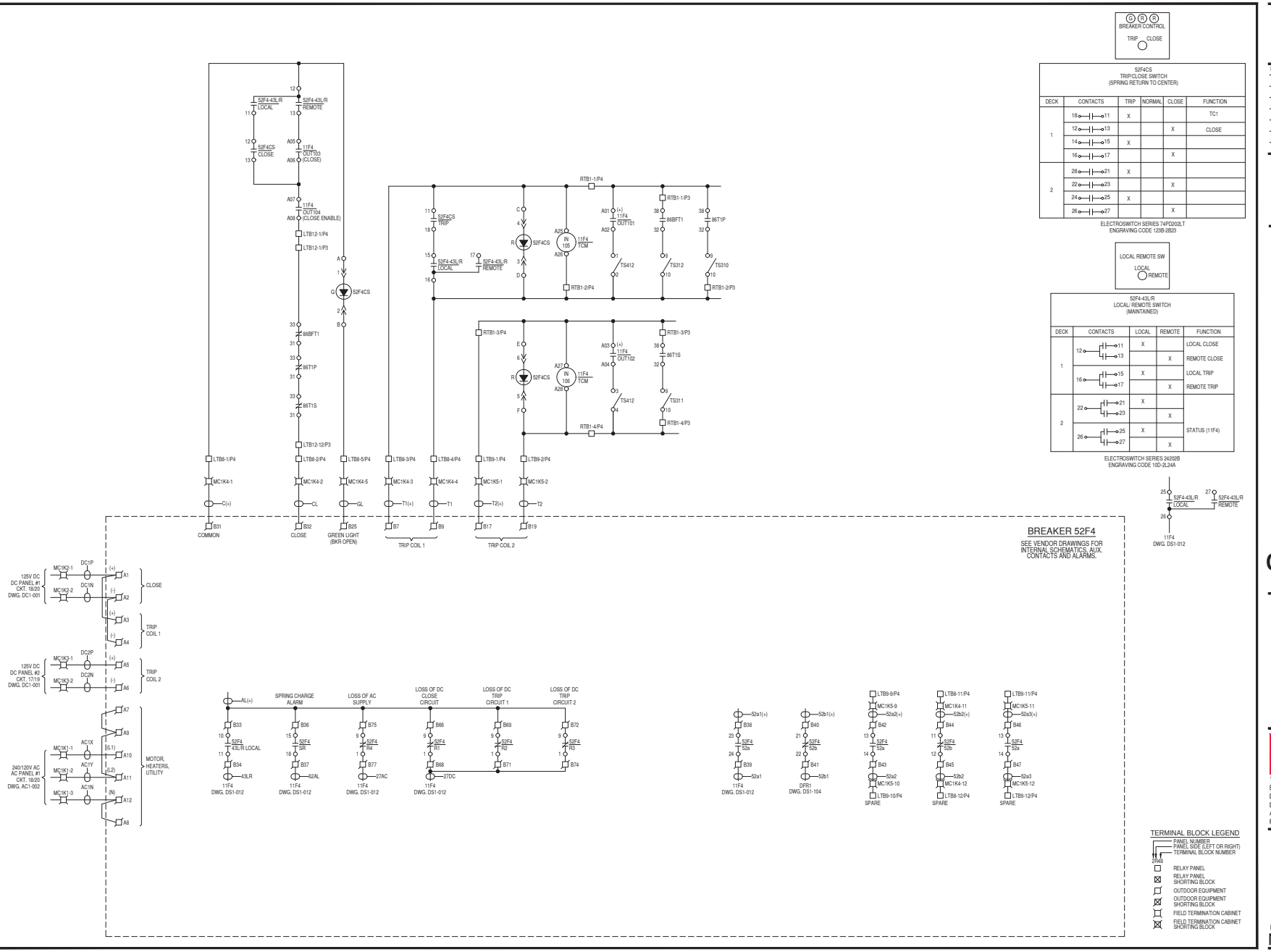
Drawn By: T. ADAMS
Approved By: J. OLSON
Project Number: 17.01246

SUBSTATION DC SCHEMATIC FEEDER BREAKER 52F3

DWG #: NWO-DS2-008

REVISION: 0B



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WIND PROJECT

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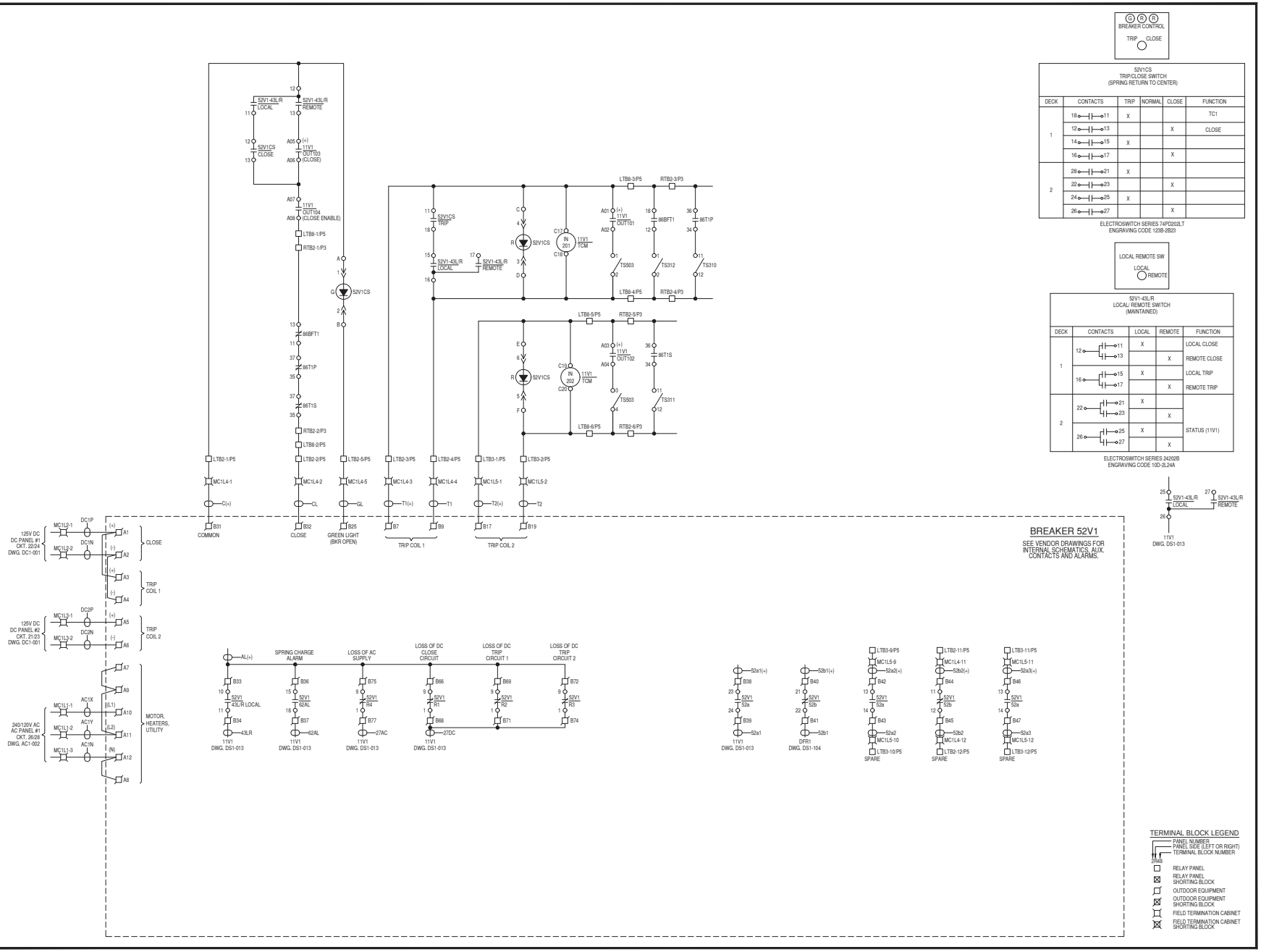
Drawn By: T. ADAMS
Approved By: J. OLSON
Project Number: 17.01246

SUBSTATION
DC SCHEMATIC
FEEDER BREAKER 52F4

DWG #: NWO-DS2-009
REVISION: 0B



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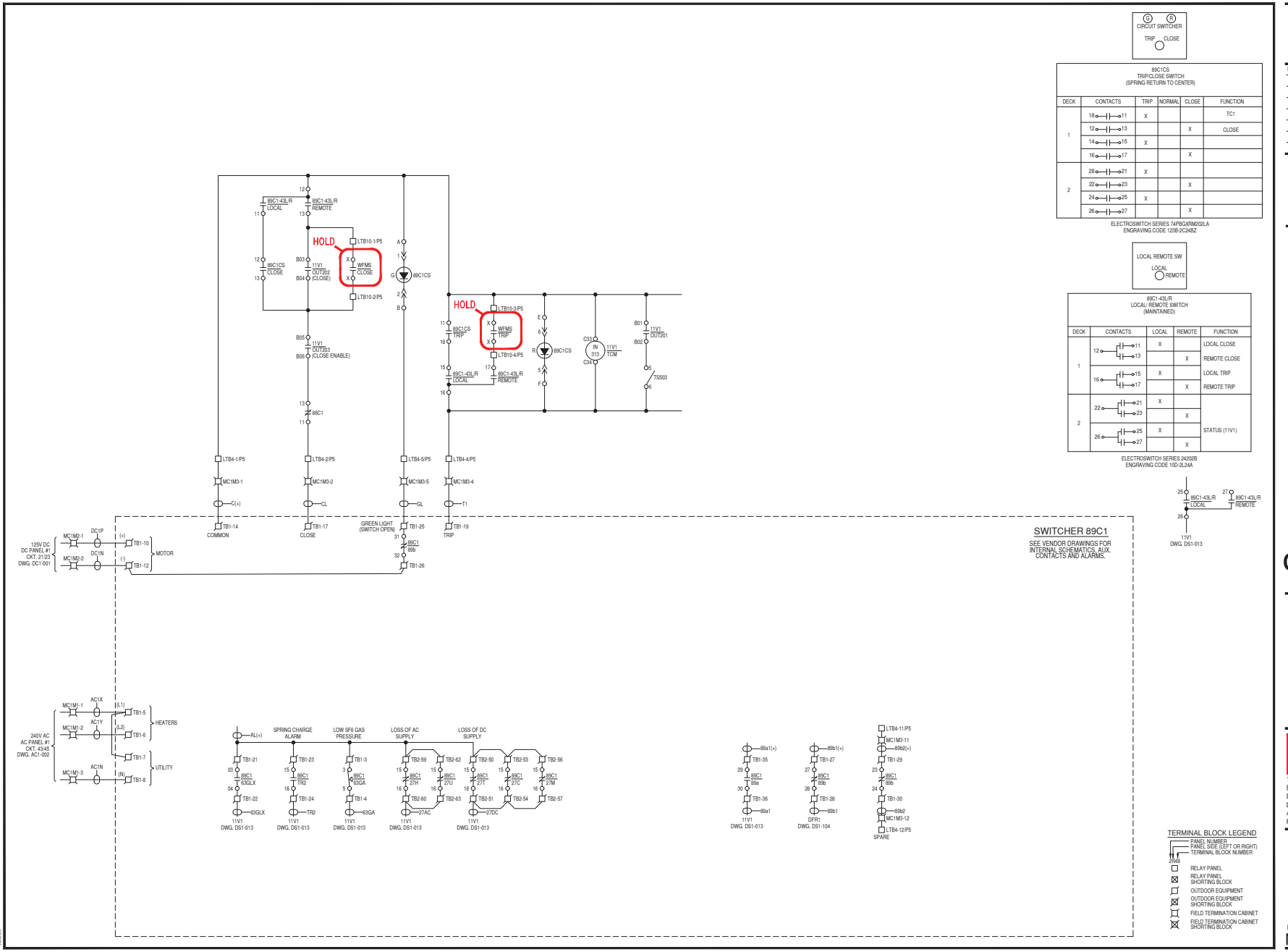
Drawn By: T. ADAMS
Approved By: J. OLSON
Project Number: 17.01246

SUBSTATION
DC SCHEMATIC
CAP BREAKER 52V1

DWG #: NWO-DS2-010

REVISION: 0B



NORTHWEST OHIO WIND PROJECT

PAULDING COUNTY, OHIO

Rev.	Date	Description	By
0A	11/21/17	90% REVIEW PACKAGE	UEI
0B	01/25/18	ISSUED FOR CONSTRUCTION	UEI

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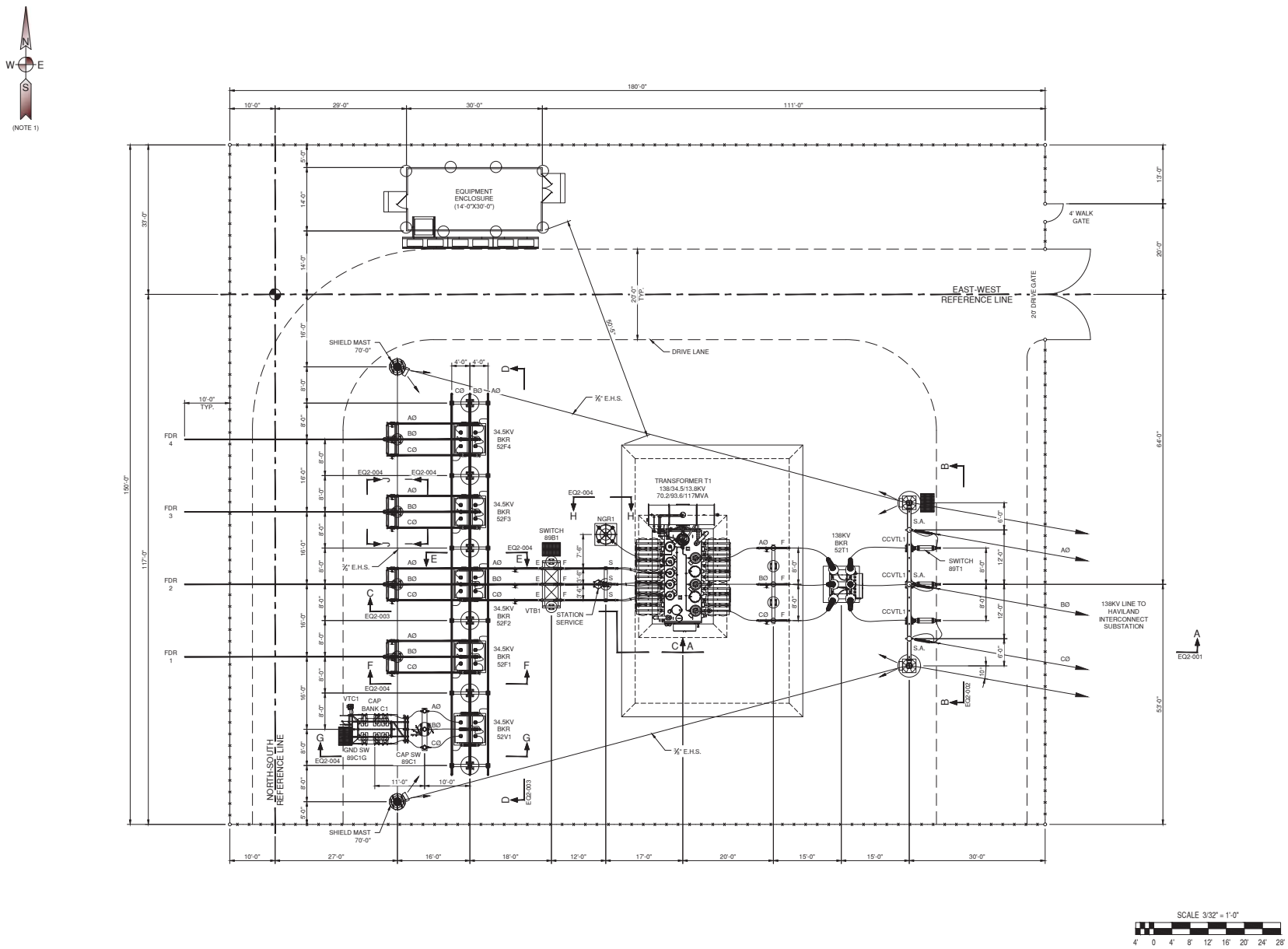
Design By: E. NEUHARDT
Drawn By: T. ADAMS
Approved By: J. OLSON
Project Number: 17.01246

SUBSTATION
DC SCHEMATIC
CAP SWITCHER 89C1

DWG #: NWO-DS2-011

REVISION: 0B



NORTHWEST OHIO WIND PROJECT

PAULDING COUNTY, OHIO

Rev.	Date	Description	By
0A	07/20/17	PRELIMINARY	UEI
0B	09/06/17	PRELIMINARY	UEI
0C	10/19/17	PRELIMINARY	UEI
0D	11/21/17	90% DESIGN PACKAGE	UEI
0E	1/25/18	ISSUED FOR CONSTRUCTION	UEI

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NOTES:

1. SEE GRADING PLAN FOR INDICATION OF TRUE NORTH.

LEGEND:

- F — FIXED FITTING
- S — SLIP FITTING
- E — EXPANSION FITTING
- OPERATOR PLATFORM
- INDICATES SECTION VIEW
- X-XXX — DRAWING ON WHICH SECTION APPEARS
- CABLE TRENCH
- AREA LIGHT
- BASE LINE INTERSECTION
- FENCE w/ BARBS

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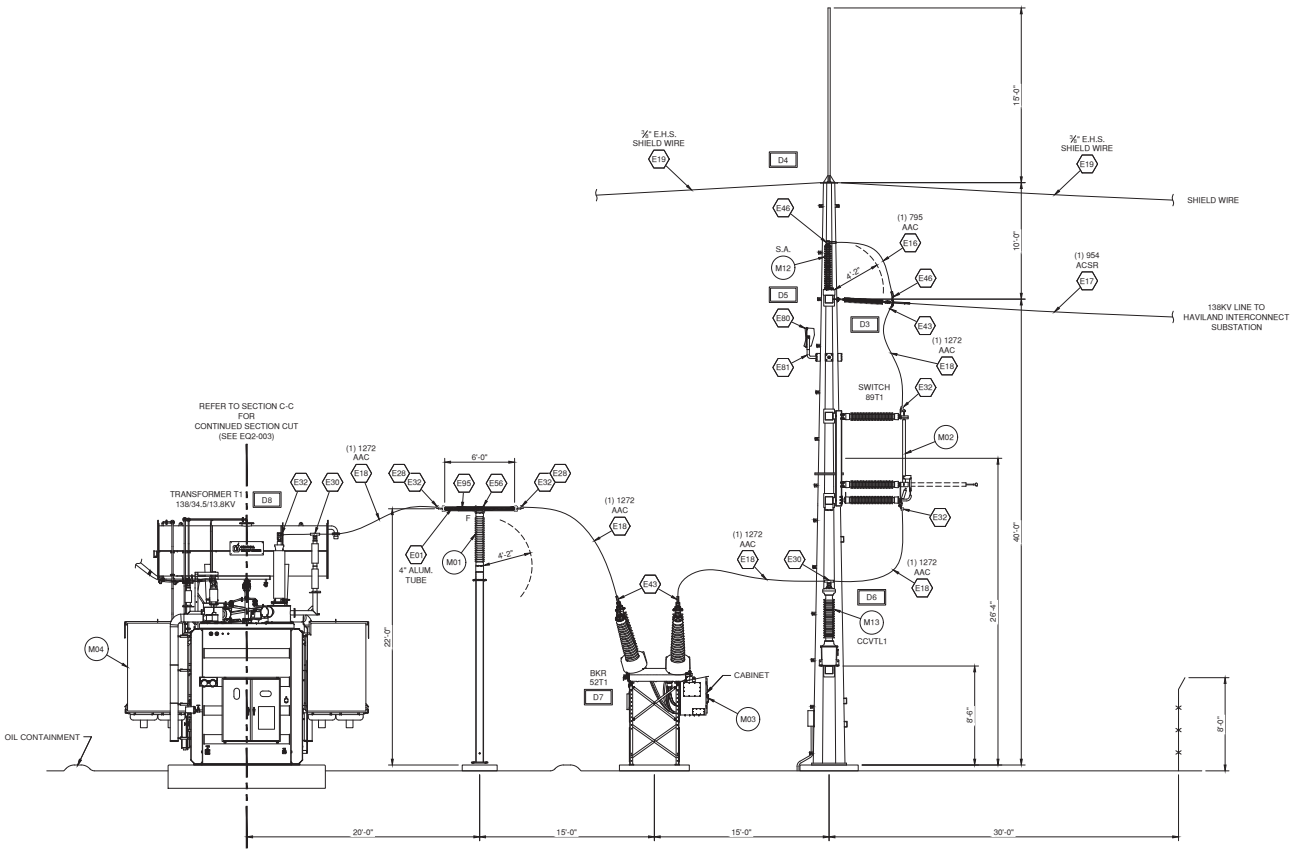
Design By: T. SEVERANCE
Drawn By: P. IWUCHUKWU
Approved By: J. OLSON
Project Number: 17.01246

SUBSTATION GENERAL ARRANGEMENT

DWG #: NWO-EQ1-001

REVISION: 0E



SECTION A-A

SCALE 3/16" = 1'-0"

2' 0 2' 4' 6' 8' 10' 12' 14'

LEGEND:

F	FIXED FITTING
S	SLIP FITTING
E	EXPANSION FITTING
N.S.	NEAR SIDE
F.S.	FAR SIDE
M#	MAJOR MATERIAL SEE DWG. EQ4-001
E#	MINOR MATERIAL SEE DWG. EQ4-001
D#	DETAIL, SEE DWG. EQ3-001

NORTHWEST OHIO WIND PROJECT

PAULDING COUNTY, OHIO

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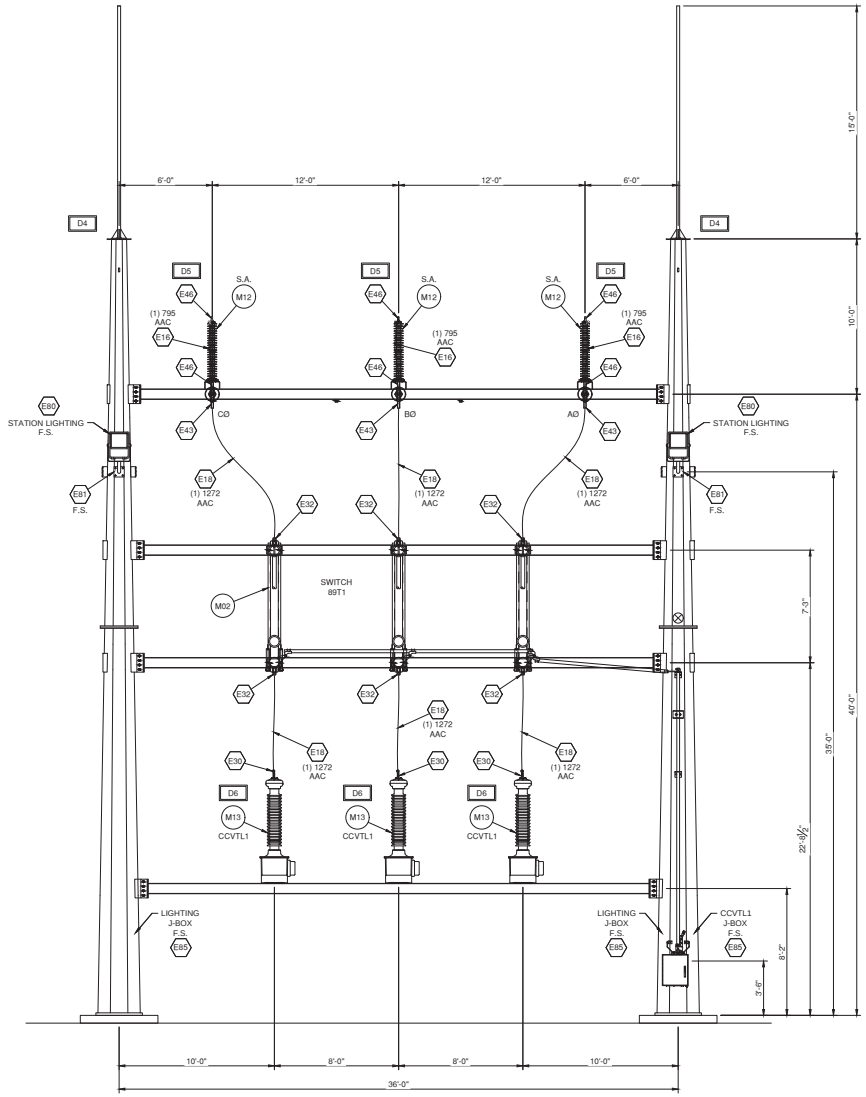
Approved By: J. OLSON
Project Number: 17.01246

138KV ELECTRICAL LAYOUT SECTIONS

DWG #: NWO-EQ2-001

REVISION: 0B



SECTION B-B

SCALE 1/4" = 1'-0"

2' 0 2' 4' 6' 8' 10'

NORTHWEST OHIO WIND PROJECT

PAULDING COUNTY, OHIO

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LEGEND:

F	FIXED FITTING
S	SLIP FITTING
E	EXPANSION FITTING
N.S.	NEAR SIDE
F.S.	FAR SIDE
M#	MAJOR MATERIAL SEE DWG. EQ4-001
E#	MINOR MATERIAL SEE DWG. EQ4-001
D#	DETAIL, SEE DWG. EQ3-001

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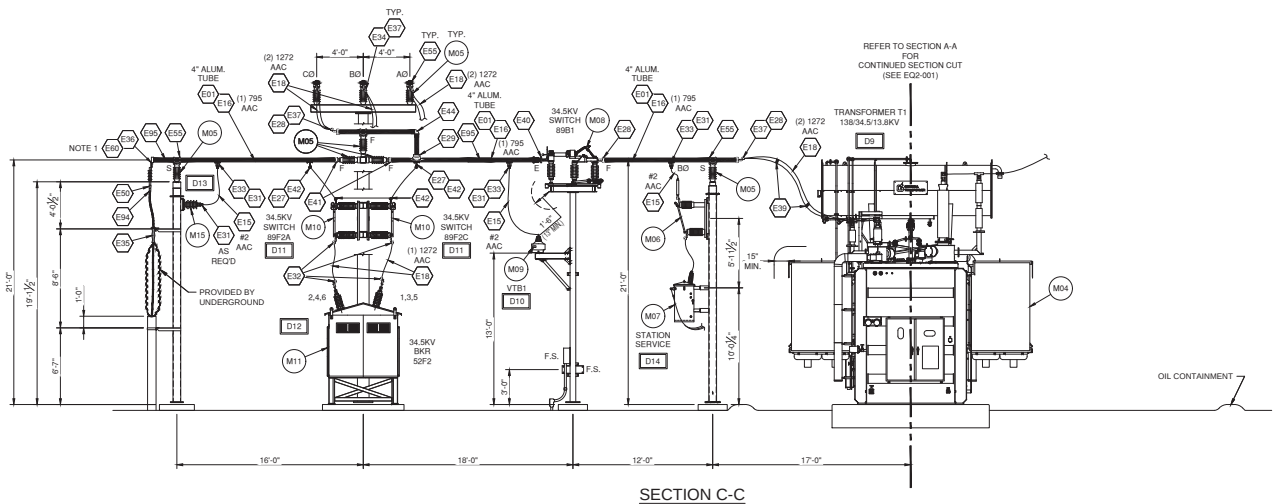
Project Number: 17.01246

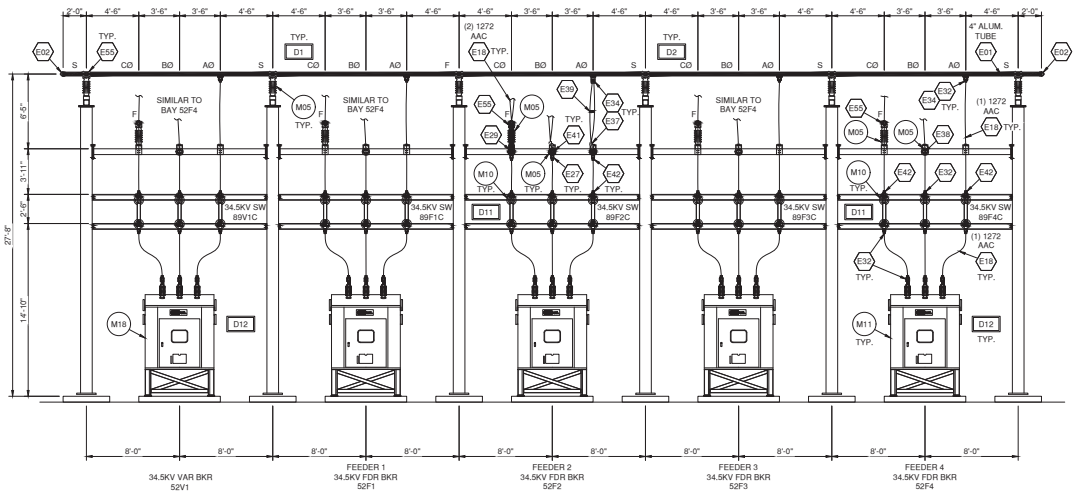
138KV ELECTRICAL LAYOUT SECTIONS

DWG #: NWO-EQ2-002

REVISION: 0B



SECTION C-C



SECTION D-D

SCALE 3/16" = 1'-0"

2' 0 2' 4' 6' 8' 10' 12' 14'

NORTHWEST OHIO WIND PROJECT

PAULDING COUNTY, OHIO

Rev.	Date	Description	By
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0B	1/25/18	ISSUED FOR CONSTRUCTION	UEI

WHITE an IEA company

NOTES:

1. REFERENCE COLLECTION ONE LINE FOR CABLE SIZES.

LEGEND:

F	FIXED FITTING
S	SLIP FITTING
E	EXPANSION FITTING
N.S.	NEAR SIDE
F.S.	FAR SIDE
M#	MAJOR MATERIAL
E#	MINOR MATERIAL
D#	DETAIL, SEE DWG.

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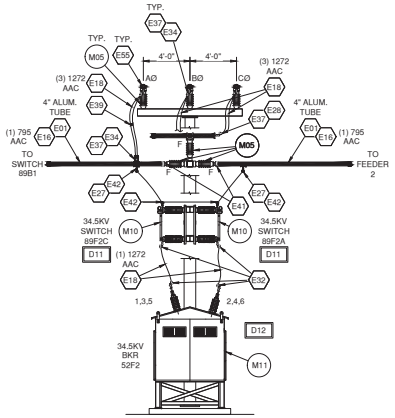
Drawn By: P. IWUCHUKWU
Approved By: J. OLSON
Project Number: 17.01246

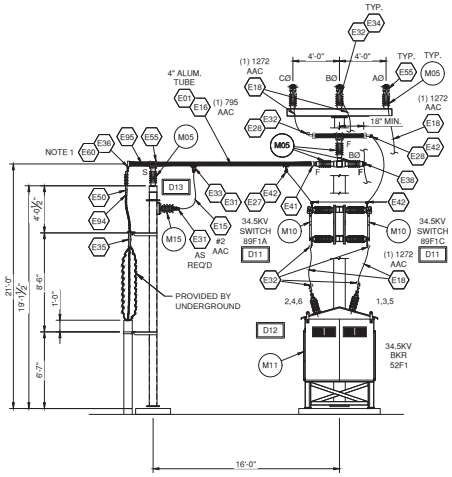
34.5KV ELECTRICAL LAYOUT SECTIONS

DWG #: NWO-EQ2-003

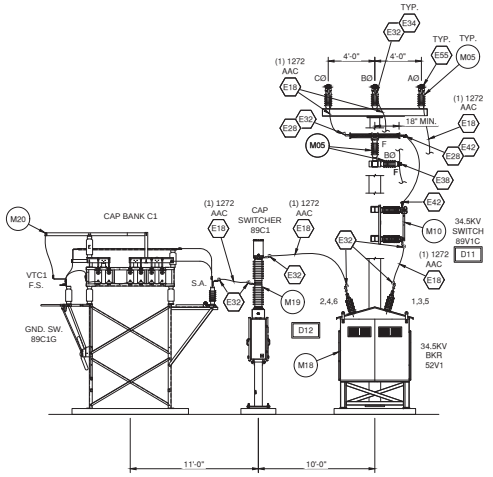
REVISION: 0B



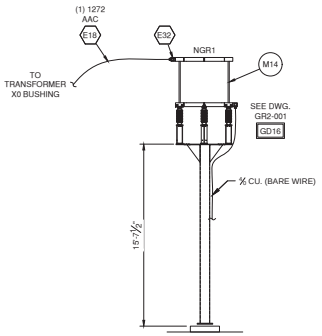
SECTION E-E



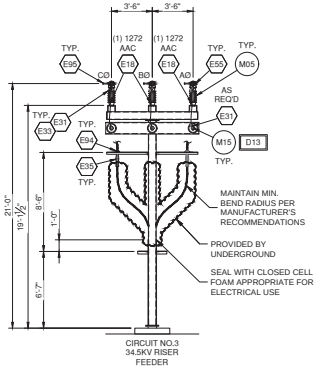
SECTION F-F



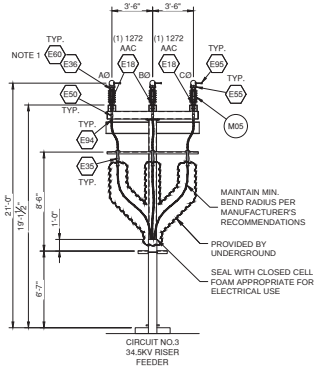
SECTION G-G



SECTION H-H



SECTION I-I



SECTION J-J

SCALE 3/16" = 1'-0"

2' 0 2' 4' 6' 8' 10' 12' 14'

NORTHWEST OHIO WIND PROJECT

PAULDING COUNTY, OHIO

Rev.	Date	Description	By
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NOTES:

1. REFERENCE COLLECTION ONE LINE FOR CABLE SIZES.

LEGEND:

F	FIXED FITTING
S	SLIP FITTING
E	EXPANSION FITTING
N.S.	NEAR SIDE
F.S.	FAR SIDE
M#	MAJOR MATERIAL
E#	MINOR MATERIAL
D#	DETAIL, SEE DWG.

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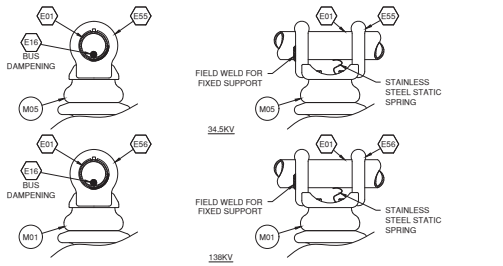
Design By: T. SEVERANCE
Drawn By: P. IWUCHUKWU
Approved By: J. OLSON
Project Number: 17.01246

34.5KV ELECTRICAL LAYOUT SECTIONS

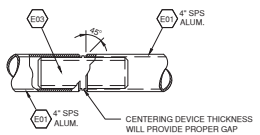
DWG #: NWO-EQ2-004

REVISION: 0B



DETAIL D1

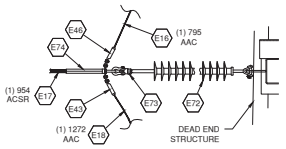
138KV & 34.5KV BUS SUPPORT FITTINGS (FIXED OR SLIP)



DETAIL D2

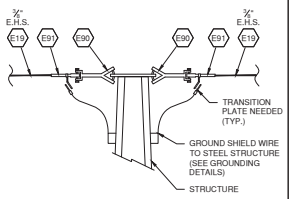
4" BUS SPLICE

NOTE:
1. SUSPENSION INSULATOR ASSEMBLY QUANTITIES DOUBLED TO ACCOUNT FOR TERMINATION AT HAVILAND SWITCHYARD DEADEND. SEE EQ4-001.



DETAIL D3

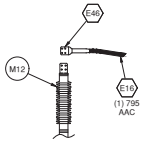
TRANSMISSION LINE TERMINATION



DETAIL D4

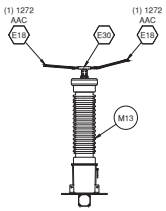
SHIELD WIRE

NOTE:
TO PREVENT TORQUE ON SURGE ARRESTER DO NOT APPLY TENSION TO JUMPER.



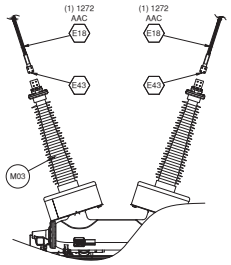
DETAIL D5

138KV SURGE ARRESTER



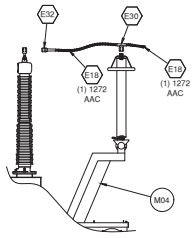
DETAIL D6

138KV CCVT



DETAIL D7

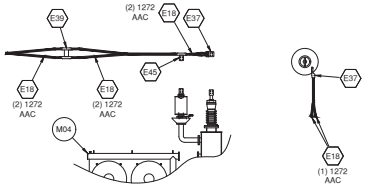
138KV POWER CIRCUIT BREAKER



DETAIL D8

138/34.5KV TRANSFORMER (HIGH SIDE)

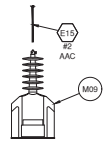
NOTES:
1. TWO CABLES PER PHASE CONNECTED USING ONE (1) DUAL WELDED TERMINAL PAD.



DETAIL D9

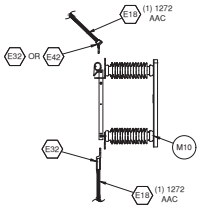
138/34.5KV TRANSFORMER (LOW SIDE)

NOTE:
USE COMPRESSION STYLE LUG ON VT TO CONNECT CONDUCTOR.



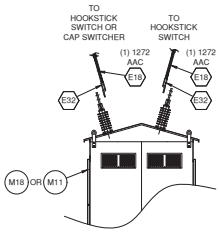
DETAIL D10

34.5KV VOLTAGE TRANSFORMER



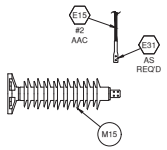
DETAIL D11

34.5KV HOOKSTICK SWITCH



DETAIL D12

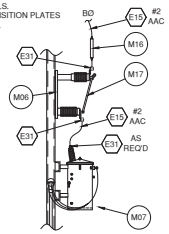
34.5KV BREAKER



DETAIL D13

34.5KV SURGE ARRESTER

NOTE:
1. USE HEAT SHRINK OFF LV TERMINALS.
2. USE TRANSITION PLATES AS REQ'D.



DETAIL D14

STATION SERVICE XFMR

LEGEND:

F	FIXED FITTING
S	SLIP FITTING
E	EXPANSION FITTING
N.S.	NEAR SIDE
F.S.	FAR SIDE
M#	MAJOR MATERIAL SEE DWG. EQ4-001
E#	MINOR MATERIAL SEE DWG. EQ4-001
D#	DETAIL, SEE DWG. EQ3-001

NORTHWEST OHIO WIND PROJECT

PAULDING COUNTY, OHIO

Rev.	Date	Description	By
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0B	1/25/18	ISSUED FOR CONSTRUCTION	UEI

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Design By: T. SEVERANCE
Drawn By: P. IWUCHUKWU
Approved By: J. OLSON
Project Number: 17.01246

138/34.5KV ELECTRICAL DETAILS

DWG #: NWO-EQ3-001

REVISION: 0B

MINOR MATERIAL

BUS, CONNECTORS, END CAPS & COUPLERS

Item #	Quantity	Description	Manufacturer	Catalog #	Supplier
E01	615FT	4" SPS ALUMINUM TUBULAR BUS, SCH. 40, 6063-T6 ALLOY	ALCOA	4" SPS ALUM.	Contractor
E02	6	4" SPS ALUM., END CAP	SEFCOR	ABIR-64	Contractor
E03	AS REQ'D	4" SPS ALUM. TO 4" SPS ALUM. COUPLER-STANDARD	SEFCOR	WSC-6464	Contractor

CONDUCTORS

Item #	Quantity	Description	Manufacturer	Catalog #	Supplier
E15	95FT	#2, AWG, AAC 7 STRAND, CODE NAME "IRIS"	SOUTHWIRE	2 AAC	Contractor
E16	595FT	795 MCM AAC 61 STRAND, CODE NAME "LILAC" (BUS DAMPENING)	SOUTHWIRE	795 AAC	Contractor
E17	990FT	954 MCM ACSR 45/7 STRAND, CODE NAME "RAIL"	SOUTHWIRE	954 ACSR	Contractor
E18	635FT	1272 MCM AAC 61 STRAND, CODE NAME "NARCISSUS"	SOUTHWIRE	1272 AAC	Contractor
E19	1020FT	3/8" 7 STRAND, EXTRA HIGH STRENGTH (EHS) OVERHEAD STATIC SHIELD WIRE	SOUTHWIRE	3/8" EHS GUY	Contractor

TERMINAL PADS, TEES, BUS SUPPORTS, CABLE SPACERS & DEADEND MATERIAL

Item #	Quantity	Description	Manufacturer	Catalog #	Supplier
E27	15	TEE CONNECTOR FOR 4" SPS ALUM. BUS TO 4-HOLE PAD, PERPENDICULAR	SEFCOR	WTFR-64-4B	Contractor
E28	39	TERMINAL PAD, WELDED 4" SPS ALUM. BUS TO NEMA 4-HOLE PAD, CENTER FORMED	SEFCOR	WFTC-64-4B	Contractor
E29	3	TEE CONNECTOR, WELDED, 4" SPS ALUM TO 4" SPS ALUM.	SEFCOR	WFTT-6464	Contractor
E30	6	TEE CONNECTOR, BOLTED, 1272 MCM AAC TO 4-HOLE PAD	SEFCOR	ACF-43-4B	Contractor
E31	18	TERMINAL PAD, COMPRESSION, (1) #2 AWG AAC CABLE TO NEMA 2-HOLE PAD	SEFCOR	AL-292-2A	Contractor
E32	103	TERMINAL PAD, WELDED, (1) 1272 MCM AAC CABLE TO NEMA 4-HOLE PAD	SEFCOR	WFC-39-4B	Contractor
E33	18	TEE CONNECTOR FOR 4" SPS ALUM. BUS TO 2-HOLE PAD	SEFCOR	WTF-6269-2B	Contractor
E34	17	TEE CONNECTOR FOR 4" SPS ALUM. BUS TO 4-HOLE PAD, PARALLEL	SEFCOR	WTF-6269-4B	Contractor
E35	12	SINGLE PHASE CABLE POSITIONER	ALUMA	51919	Contractor
E36	12	TERMINAL PAD, WELDED 4" SPS ALUM. BUS TO NEMA 4-HOLE PAD, 90 DEG.	SEFCOR	WFT90-64-4B	Contractor
E37	12	TERMINAL PAD, WELDED, (2) 1272 MCM AAC CABLE TO NEMA 4-HOLE PAD	SEFCOR	WFC2-39-4B	Contractor
E38	4	BUS SUPPORT, CABLE TO INSULATOR, 1272 MCM AAC, 3" B.C.	SEFCOR	AVCA-43-3	Contractor
E39	8	CABLE SPACER, (2) 1272 MCM AAC, 4" SPACING	SEFCOR	ASPC-41-4	Contractor
E40	3	TERMINAL PAD, EXPANSION, 4" SPS ALUM. BUS TO 4-HOLE PAD, CENTER-FORMED	SEFCOR	WFXTC-64-4B	Contractor
E41	15	BUS SUPPORT, 4" SPS ALUM. BUS TO 3" B.C. INSULATOR	SEFCOR	WVTI-64-3	Contractor
E42	42	TERMINAL PAD, WELDED, (1) 1272 MCM AAC CABLE TO NEMA 4-HOLE PAD, 45 DEG.	SEFCOR	WFC45-39-4A	Contractor
E43	9	TERMINAL PAD, COMPRESSION, (1) 1272 MCM AAC CABLE TO 4-HOLE PAD	SEFCOR	AL-1302-4B	Contractor
E44	1	COUPLER 4" SPS SCH. 40 TO 4" SPS SCH. 40 @ 90°, WELDED, ALUMINUM	SEFCOR	WLBI90-6464	Contractor
E45	3	CABLE SPACER, (2) 1272 MCM AAC, 4-HOLE PAD	SEFCOR	ASPC-41-8-4B	Contractor
E46	6	TERMINAL PAD, COMPRESSION, (1) 795 MCM AAC CABLE TO 4-HOLE PAD	SEFCOR	AL-1031-4B	Contractor
E50	12	TERMINATION KIT, 700-1500 MCM AL.	3M	7666-S-8	Contractor
E55	38	BUS SUPPORT, WELDED, 4" SPS ALUM. BUS, SLIP OR RIGID, 3" B.C.	SEFCOR	ASWH-64-3-SE	Contractor
E56	3	BUS SUPPORT, WELDED, 4" SPS ALUM. BUS, SLIP OR RIGID, 5" B.C.	SEFCOR	WCTI-64-5	Contractor
E60	12	TERMINAL PAD, COMPRESSION, (1) 1250 MCM AAC CABLE TO NEMA 4-HOLE PAD	SEFCOR	AL-1246-4B	Contractor

CABLE TRENCH

Item #	Quantity	Description	Manufacturer	Catalog #	Supplier
E65	AS REQ'D	CABLE TRENCH PEDESTRIAN, 10' LONG, 24" WIDE, 24" DEEP	TRENWA	BP2424-120	Contractor
E66	AS REQ'D	CABLE TRENCH PEDESTRIAN, LID, CONCRETE, 24" WIDE	TRENWA	LP24-30	Contractor
E67	AS REQ'D	CABLE TRENCH VAULT, 4'-6" LONG, 72" WIDE, 24" DEEP	TRENWA	-	Contractor
E68	AS REQ'D	CABLE TRENCH VAULT, LID CONCRETE, 72" WIDE	TRENWA	-	Contractor

SUSPENSION INSULATOR ASSEMBLY

Item #	Quantity	Description	Manufacturer	Catalog #	Supplier
E72	6	INSULATOR, STRAIN, 49.1" LENGTH, 122" LEAKAGE, Y-CLEVIS BALL INSULATORS, 30K	OHIO BRASS	5150081201	Contractor
E73	6	SOCKET CLEVIS, 30K ULT, FOR ANSI 52-3 AND 52-5 BALL, 1-1/8" THROAT WIDTH	HUBBELL	SC-301	Contractor
E74	6	COMPRESSION DEAD END ASSEMBLY, 954 ACSR RAIL, 15 DEG. TERMINAL PADS, DOUBLE TONGUE, VERTICAL CLEVIS	HUBBELL	A101350	Contractor

MINOR MATERIAL

LIGHTING

Item #	Quantity	Description	Manufacturer	Catalog #	Supplier
E80	4	LIGHTING, 250W SECURITY LIGHT, LRD, LAMPHOLDER AND MOUNTINGS, MULTIVOLT, GRAY	AEL	ACP1LED610AMVOLT5KTMGY	Contractor
E81	4	LIGHT MOUNTING BRACKET	HOLOPHANE	BKT-1-PP	Contractor

MISCELLANEOUS

Item #	Quantity	Description	Manufacturer	Catalog #	Supplier
E85	AS REQ'D	JUNCTION BOX, OUTDOOR RATED	HOFFMAN	AS REQ'D	Contractor
E86	AS REQ'D	TRANSITION PLATE, 2-HOLE PAD, ALUM. TO COPPER	SEFCOR	ATP-B	Contractor
E87	AS REQ'D	TRANSITION PLATE, 4-HOLE PAD, ALUM. TO COPPER	SEFCOR	ATP-D	Contractor
E90	10	SHIELD WIRE Y-CLEVIS	SEFCOR	AH-1231	Contractor
E91	10	COMP. DEADEND, HORIZONTAL, 3/8" SHIELD WIRE DEADEND	ANDERSON	86-1225-S	Contractor
E94	12	CABLE FAULT INDICATOR	SEL	1CRI-IR-DT-L	Contractor
E95	18	WELDED, GROUNDING STUD	SEFCOR	WTS-6064	Contractor

MAJOR MATERIAL

Item #	Quantity	Description	Manufacturer	Catalog #	Supplier
M01	3	138KV INSULATOR - 650 KV BIL, STANDARD STRENGTH, 5" BOLT CIRCLE TOP 5" BOLT CIRCLE BOTTOM TR288	TE CONNECTIVITY	SP-TR288PG	Contractor
M02	1	DISCONNECT SWITCH 138KV, 1200A, 650KV BIL, VERTICAL BREAK, VERTICAL MOUNTED, MOTOR OPERATED	CLEAVELAND/PRICE	C06B033G08	Contractor
M03	1	CIRCUIT BREAKER, 138KV, 650KV BIL, 1200A, 40KA, SF6	ABB	145PM40-12C	Contractor
M04	1	MAIN POWER TRANSFORMER 138/34.5/13.8 KV, 70.2/93.6/117 MVA, ONAN/ONAF/ONAF	GEORGIA TRANSFORMER	GA244A	Owner
M05	57	34.5 KV INSULATOR, 200 KV BIL, STANDARD STRENGTH, 3" BOLT CIRCLE TR210	TE CONNECTIVITY	SP-TR210PG	Contractor
M06	1	FUSE HOLDER, SMD-20 VERTICAL-OFFSET STYLE	S&C	192504-E	Contractor
M07	1	STATION SERVICE, 75 KVA, 19,920V - 120/240V	POWER PARTNERS	-	Contractor
M08	1	DISCONNECT SWITCH 34.5KV, 3000A, 200KV BIL, VERTICAL BREAK, WORM-GEAR OPERATED	CLEAVELAND/PRICE	C06A1213G04	Contractor
M09	3	VOLTAGE TRANSFORMER, 34.5KV, 200KV BIL, SINGLE BUSHING, RATIO: 175/300:1, ACC 0.3 WXY	ABB	VOY-20G	Contractor
M10	27	DISCONNECT SWITCH 34.5KV, 1200A, 200KV BIL, VERTICAL MOUNTED, HOOKSTICK OPERATED	SOUTHERN STATES	PBO-1	Contractor
M11	4	GROUNDING CIRCUIT BREAKER, 34.5KV, 200KV BIL, 1200A, 25KA, VACUUM	EMA	P1267-01	Contractor
M12	3	SURGE ARRESTER, 138KV, 88KV MCOV, STATION CLASS NEMA 4-HOLE CONNECTION, UPRIGHT MOUNTING	ABB	Q030SA024A	Contractor
M13	3	CAPACITOR COUPLED VOLTAGE TRANSFORMER, 138KV 80,500:115V/67.08V, 700/1200:1:1, ACC 0.15 WXYZ	TRENCH	TEMP 145	Contractor
M14	1	NEUTRAL GROUNDING REACTOR, 34.5KV, 0.6 OHM, 600A MIN.	TRENCH	-	Contractor
M15	12	SURGE ARRESTER, 30KV, 24.4KV MCOV, STATION CLASS, POLYMER TYPE NEMA 4-HOLE CONNECTION, CANTILEVER MOUNTING	ABB	Q108SA088B	Contractor
M16	2	CURRENT LIMITING FUSE , 12K (1 SPARE)	FERRAZ SHAWMUT	9FS9UBE271	Contractor
M17	2	FUSE, 34.5KV, 38KV MAX, 5E (1 SPARE)	S&C	614005	Contractor
M18	1	CIRCUIT BREAKER, 38KV, 200KV BIL, 1200A, 25KA, VACUUM	EMA	P1267-02	Contractor
M19	1	SWITCHER, CAP, 38KV, 600A, 200KV BIL, 40 KA WITHSTAND	SOUTHERN STATES	CAP-72	Contractor
M20	1	CAPACITOR BANK, 4 MVAR, 34.5KV	ABB	-	Contractor

NORTHWEST OHIO WIND PROJECT

PAULDING COUNTY, OHIO

Rev.	Date	Description	By
0A	10/19/17	PRELIMINARY	UEI
0B	1/25/18	ISSUED FOR CONSTRUCTION	UEI

WHITE an IEA company

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Bismarck - Denver - Detroit Lakes - Fargo - Sioux Falls - St. Paul

Design By: T. SEVERANCE
Drawn By: P. IWUCHUKWU
Approved By: J. OLSON
Project Number: 17.01246

138/34.5KV SUBSTATION MATERIAL LIST

DWG #: NWO-EQ4-001

REVISION: 0B

20163134

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EXTERNAL CABLE SCHEDULE

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CABLE NO.	DWG NO.	FROM	DWG NO.	TO / END DESTINATION	CABLE SIZE	INSULAT.	CABLE DESCRIPTION	APPROX. LENGTH
CONTROL CABLES								
89T1CON1	WD1-001	MARSH. CABINET 1	WD2-001	MOD 89T1	12/C #12	600V	CONTROL CABLE #1	195'
89T1CON2	WD1-001	MARSH. CABINET 1	WD2-001	MOD 89T1	12/C #12	600V	CONTROL CABLE #2	195'
VTHVX	WD1-001	MARSH. CABINET 1	WD2-002	CCVTL1 JUNCTION BOX	7/C #12	600V	VT - LINE X-WDG 115V L-G/69V L-G	190'
VTHVY	WD1-001	MARSH. CABINET 1	WD2-002	CCVTL1 JUNCTION BOX	7/C #12	600V	VT - LINE Y-WDG 115V L-G/69V L-G	190'
VTHVA	WD2-002	CCVTL1 JUNCTION BOX	WD2-002	CCVTL1 A-PHASE UNIT	7/C #12	600V	VT - LINE A-PHASE	15'
VTHVB	WD2-002	CCVTL1 JUNCTION BOX	WD2-002	CCVTL1 B-PHASE UNIT	7/C #12	600V	VT - LINE B-PHASE	30'
VTHVC	WD2-002	CCVTL1 JUNCTION BOX	WD2-002	CCVTL1 C-PHASE UNIT	7/C #12	600V	VT - LINE C-PHASE	45'
52T1CTZ1	WD1-001	MARSH. CABINET 1	WD2-003	BREAKER 52T1	4/C #10	600V	CT - 11T1H, 87T1P RELAYING & DFR1-CT1	205'
52T1CTY1	WD1-001	MARSH. CABINET 1	WD2-003	BREAKER 52T1	4/C #10	600V	CT - 87T1S RELAYING	205'
52T1CTX2	WD1-001	MARSH. CABINET 1	WD2-003	BREAKER 52T1	4/C #10	600V	CT - MTRL1 CHECK METER	205'
52T1CTY2	WD1-001	MARSH. CABINET 1	WD2-003	BREAKER 52T1	4/C #10	600V	CT - 87L1P RELAYING	205'
52T1CTZ2	WD1-001	MARSH. CABINET 1	WD2-003	BREAKER 52T1	4/C #10	600V	CT - 21L1S RELAYING	205'
52T1CON1	WD1-001	MARSH. CABINET 1	WD2-003	BREAKER 52T1	12/C #12	600V	CONTROL CABLE #1	205'
52T1CON2	WD1-001	MARSH. CABINET 1	WD2-003	BREAKER 52T1	12/C #12	600V	CONTROL CABLE #2	205'
52T1CON3	WD1-001	MARSH. CABINET 1	WD2-003	BREAKER 52T1	12/C #12	600V	CONTROL CABLE #3	205'
T1CTH0	WD1-001	MARSH. CABINET 1	WD2-004	TRANSFORMER T1	2/C #10	600V	H01 - CT - 87T1P, 87T1S RELAYING &DFR-CT1	145'
T1CTX0	WD1-001	MARSH. CABINET 1	WD2-004	TRANSFORMER T1	2/C #10	600V	X02 - CT - 87T1P, 87T1S RELAYING &DFR-CT2	145'
T1CTHX	WD1-001	MARSH. CABINET 1	WD2-004	TRANSFORMER T1	4/C #10	600V	CT - WFMS	145'
T1CTXZ	WD1-001	MARSH. CABINET 1	WD2-004	TRANSFORMER T1	4/C #10	600V	CT - BUS DIFF 87B1 RELAYING	145'
T1CTXY	WD1-001	MARSH. CABINET 1	WD2-004	TRANSFORMER T1	4/C #10	600V	CT - 11T1L & 87T1S RELAYING	145'
T1CTXX	WD1-001	MARSH. CABINET 1	WD2-004	TRANSFORMER T1	4/C #10	600V	CT - 87T1P RELAYING & DFR-CT2	145'
T1CON1	WD1-001	MARSH. CABINET 1	WD2-004	TRANSFORMER T1	12/C #12	600V	CONTROL CABLE #1	145'
T1LTC	WD1-001	MARSH. CABINET 1	WD2-004	TRANSFORMER T1	4/C #12	600V	LTC VOLTAGE SOURCE	145'
89B1CON1	WD1-002	MARSH. CABINET 1	WD2-005	SWITCH 89B1	12/C #12	600V	CONTROL CABLE #1	130'
VTB1X	WD1-002	MARSH. CABINET 1	WD2-006	VTB1 JUNCTION BOX	7/C #12	600V	VT - BUS X-WDG 115V L-G/69V L-G	125'
VTB1A	WD2-006	VTB1 JUNCTION BOX	WD2-006	VTB1 A-PHASE UNIT	4/C #12	600V	VT - BUS A-PHASE	15'
VTB1B	WD2-006	VTB1 JUNCTION BOX	WD2-006	VTB1 B-PHASE UNIT	4/C #12	600V	VT - BUS B-PHASE	30'
VTB1C	WD2-006	VTB1 JUNCTION BOX	WD2-006	VTB1 C-PHASE UNIT	4/C #12	600V	VT - BUS C-PHASE	45'
52F1CTX1	WD1-002	MARSH. CABINET 1	WD2-007	BREAKER 52F1	4/C #10	600V	CT - 11F1 RELAYING	140'
52F1CTY1	WD1-002	MARSH. CABINET 1	WD2-007	BREAKER 52F1	4/C #10	600V	CT - BUS DIFF 87B1 RELAYING	140'
52F1CON1	WD1-002	MARSH. CABINET 1	WD2-007	BREAKER 52F1	12/C #12	600V	CONTROL CABLE #1	140'
52F1CON2	WD1-002	MARSH. CABINET 1	WD2-007	BREAKER 52F1	12/C #12	600V	CONTROL CABLE #2	140'
52F2CTX1	WD1-002	MARSH. CABINET 1	WD2-008	BREAKER 52F2	4/C #10	600V	CT - 11F2 RELAYING	120'
52F2CTY1	WD1-002	MARSH. CABINET 1	WD2-008	BREAKER 52F2	4/C #10	600V	CT - BUS DIFF 87B1 RELAYING	120'
52F2CON1	WD1-002	MARSH. CABINET 1	WD2-008	BREAKER 52F2	12/C #12	600V	CONTROL CABLE #1	120'
52F2CON2	WD1-002	MARSH. CABINET 1	WD2-008	BREAKER 52F2	12/C #12	600V	CONTROL CABLE #2	120'
52F3CTX1	WD1-002	MARSH. CABINET 1	WD2-009	BREAKER 52F3	4/C #10	600V	CT - 11F3 RELAYING	105'
52F3CTY1	WD1-002	MARSH. CABINET 1	WD2-009	BREAKER 52F3	4/C #10	600V	CT - BUS DIFF 87B1 RELAYING	105'
52F3CON1	WD1-002	MARSH. CABINET 1	WD2-009	BREAKER 52F3	12/C #12	600V	CONTROL CABLE #1	105'
52F3CON2	WD1-002	MARSH. CABINET 1	WD2-009	BREAKER 52F3	12/C #12	600V	CONTROL CABLE #2	105'
52F4CTX1	WD1-002	MARSH. CABINET 1	WD2-010	BREAKER 52F4	4/C #10	600V	CT - 11F4 RELAYING	85'
52F4CTY1	WD1-002	MARSH. CABINET 1	WD2-010	BREAKER 52F4	4/C #10	600V	CT - BUS DIFF 87B1 RELAYING	85'
52F4CON1	WD1-002	MARSH. CABINET 1	WD2-010	BREAKER 52F4	12/C #12	600V	CONTROL CABLE #1	85'
52F4CON2	WD1-002	MARSH. CABINET 1	WD2-010	BREAKER 52F4	12/C #12	600V	CONTROL CABLE #2	85'
52V1CTX1	WD1-002	MARSH. CABINET 1	WD2-012	BREAKER 52V1	4/C #10	600V	CT - 11V1 RELAYING	155'
52V1CTX2	WD1-002	MARSH. CABINET 1	WD2-012	BREAKER 52V1	4/C #10	600V	CT - BUS DIFF 87B1 RELAYING	155'
52V1CON1	WD1-002	MARSH. CABINET 1	WD2-012	BREAKER 52V1	12/C #12	600V	CONTROL CABLE #1	155'
52V1CON2	WD1-002	MARSH. CABINET 1	WD2-012	BREAKER 52V1	12/C #12	600V	CONTROL CABLE #2	155'
89C1CON1	WD1-002	MARSH. CABINET 1	WD2-013	SWITCHER 89C1	12/C #12	600V	CONTROL CABLE #1	150'
89C1CON2	WD1-002	MARSH. CABINET 1	WD2-013	SWITCHER 89C1	12/C #12	600V	CONTROL CABLE #2	150'
VTC1X	WD1-002	MARSH. CABINET 1	WD2-014	VTC1 JUNCTION BOX	2/C #12 (SHIELDED)	600V	VT - 11C1 RELAYING	160'
VTC1	WD2-014	VTC1 JUNCTION BOX	WD2-014	VTC1 UNIT	2/C #12	600V	VT - UNIT	160'

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EXTERNAL CABLE SCHEDULE

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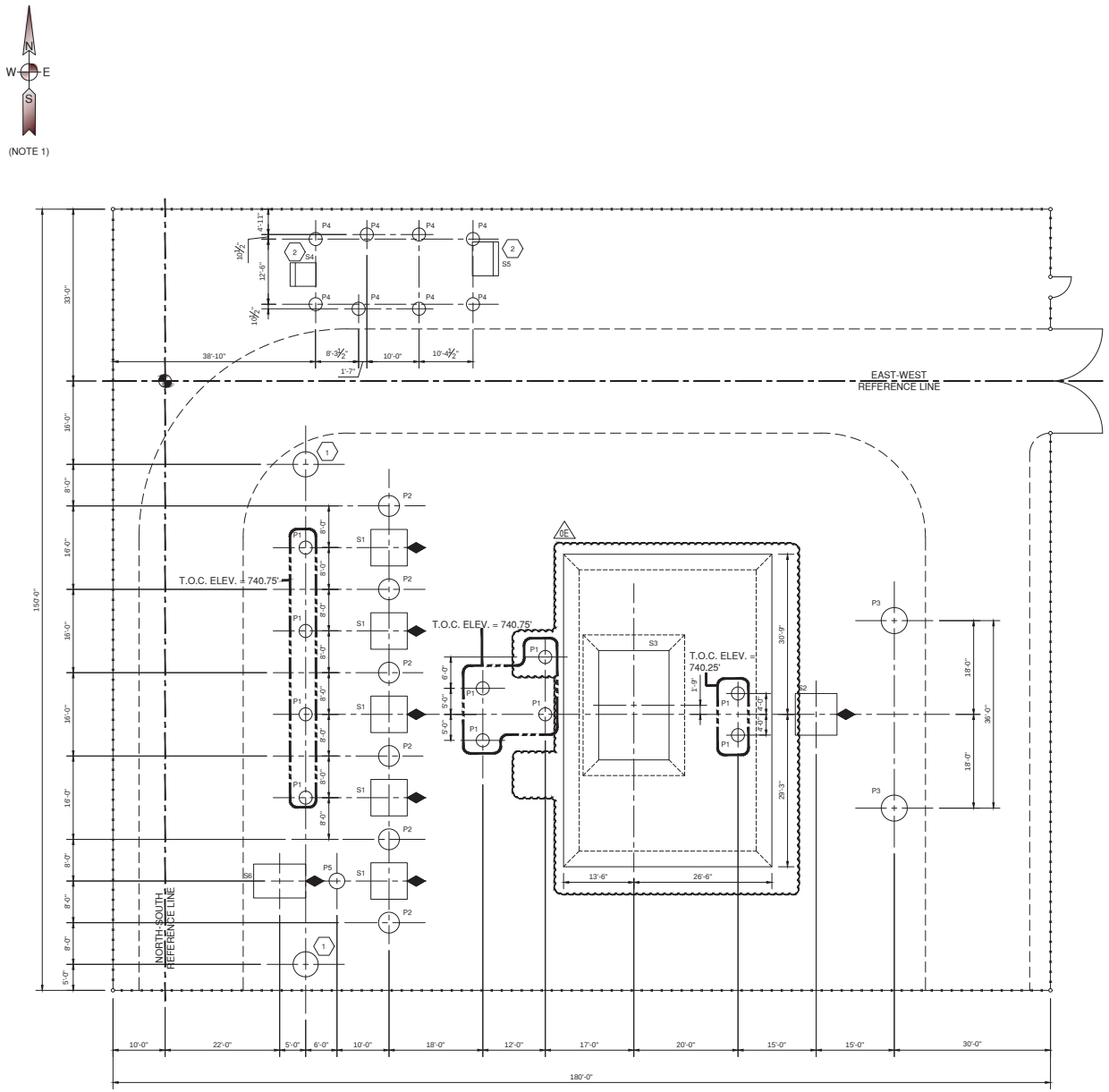
CABLE NO.	DWG NO.	FROM	DWG NO.	TO / END DESTINATION	CABLE SIZE	INSULAT.	CABLE DESCRIPTION	APPROX. LENGTH
AC POWER CABLES								
ACP1	AC1-001	PRIMARY SS XFMR	AC1-001	FUSED DISCONNECT SWITCH #1	1-1/C 500KCMIL/ø&N, 1-#4/0 CU/GND	600V	SS PRIMARY POWER FEED	115'
ACB1	AC1-001	ALTERNATE SS XFMR	AC1-001	FUSED DISCONNECT SWITCH #2	1-1/C 500KCMIL/ø&N, 1-#4/0 CU/GND	600V	SS BACKUP POWER FEED	50'
VTHVAC1	WD1-001	MARSH. CABINET 1	WD2-002	CCVTL1 JUNCTION BOX	2/C #12	600V	JUNCTION BOX HEATER	190'
VTB1AC1	WD1-001	MARSH. CABINET 1	WD2-006	VTB1 JUNCTION BOX	2/C #12	600V	JUNCTION BOX HEATER	125'
89T1AC1	WD1-001	MARSH. CABINET 1	WD2-001	MOD 89T1	2/C #12	600V	MOTOR/HEATERS/LIGHTS/RECEPTACLE	195'
T1AC1	WD1-001	MARSH. CABINET 1	WD2-004	TRANSFORMER T1	3/C #4	600V	TRANSFORMER 1 FANS/HEATERS	145'
T1AC2	WD1-001	MARSH. CABINET 1	WD2-004	TRANSFORMER T1	3/C #4	600V	TRANSFORMER 1 FANS/HEATERS	145'
52T1AC1	WD1-001	MARSH. CABINET 1	WD2-003	BREAKER 52T1	3/C #10	600V	MOTOR/HEATERS/LIGHTS/RECEPTACLE	205'
52F1AC1	WD1-002	MARSH. CABINET 1	WD2-007	BREAKER 52F1	3/C #12	600V	MOTOR/HEATERS/LIGHTS/RECEPTACLE	140'
52F2AC1	WD1-002	MARSH. CABINET 1	WD2-008	BREAKER 52F2	3/C #12	600V	MOTOR/HEATERS/LIGHTS/RECEPTACLE	120'
52F3AC1	WD1-002	MARSH. CABINET 1	WD2-009	BREAKER 52F3	3/C #12	600V	MOTOR/HEATERS/LIGHTS/RECEPTACLE	105'
52F4AC1	WD1-002	MARSH. CABINET 1	WD2-010	BREAKER 52F4	3/C #12	600V	MOTOR/HEATERS/LIGHTS/RECEPTACLE	85'
52V1AC1	WD1-002	MARSH. CABINET 1	WD2-012	BREAKER 52V1	3/C #12	600V	HEATERS/LIGHTS/RECEPTACLE	155'
YL1	WD1-001	MARSH. CABINET 1	AC1-001	NORTHWEST SHIELD POLE LIGHT J-BOX	2/C #10	600V	YARD LIGHTING #1 - NORTHWEST LIGHT	65'
YL1-1	WD1-001	NORTHWEST SHIELD POLE LIGHT J-BOX	AC1-001	SOUTHWEST SHIELD POLE LIGHT J-BOX	2/C #10	600V	YARD LIGHTING #1 - SOUTHWEST LIGHT	160'
YL2	WD1-001	MARSH. CABINET 1	AC1-001	NORTH DEADEND LIGHT J-BOX	2/C #10	600V	YARD LIGHTING #2 - NORTH DEADEND LIGHT	190'
YL2-1	WD1-001	NORTH DEADEND LIGHT J-BOX	AC1-001	SOUTH DEADEND LIGHT J-BOX	2/C #10	600V	YARD LIGHTING #2 - SOUTH DEADEND LIGHT	60'
89C1AC1	WD1-002	MARSH. CABINET 1	WD2-013	SWITCHER 89C1	3/C #12	600V	HEATERS/LIGHTS/RECEPTACLE	150'
DC POWER CABLES								
T1DC1	WD1-001	MARSH. CABINET 1	WD2-004	TRANSFORMER T1	2/C #10	600V	TRANSFORMER T1 DC SUPPLY	145'
52T1DC1	WD1-001	MARSH. CABINET 1	WD2-003	BREAKER 52T1	2/C #12	600V	BKR 52T1 CLOSE & TC1	205'
52F1DC1	WD1-002	MARSH. CABINET 1	WD2-007	BREAKER 52F1	2/C #12	600V	BKR 52F1 CLOSE & TC1	140'
52F2DC1	WD1-002	MARSH. CABINET 1	WD2-008	BREAKER 52F2	2/C #12	600V	BKR 52F2 CLOSE & TC1	120'
52F3DC1	WD1-002	MARSH. CABINET 1	WD2-009	BREAKER 52F3	2/C #12	600V	BKR 52F3 CLOSE & TC1	105'
52F4DC1	WD1-002	MARSH. CABINET 1	WD2-010	BREAKER 52F4	2/C #12	600V	BKR 52F4 CLOSE & TC1	85'
52V1DC1	WD1-002	MARSH. CABINET 1	WD2-012	BREAKER 52V1	2/C #12	600V	BKR 52V1 CLOSE & TC1	155'
89C1DC1	WD1-002	MARSH. CABINET 1	WD2-013	SWITCHER 89C1	2/C #12	600V	MOD 89C1 OPEN & CLOSE	150'
89T1DC1	WD1-001	MARSH. CABINET 1	WD2-001	MOD 89T1	2/C #12	600V	MOD 89T1 OPEN & CLOSE	195'
52T1DC2	WD1-001	MARSH. CABINET 1	WD2-003	BREAKER 52T1	2/C #12	600V	BKR 52T1 TC2	205'
52F1DC2	WD1-002	MARSH. CABINET 1	WD2-007	BREAKER 52F1	2/C #12	600V	BKR 52F1 TC2	140'
52F2DC2	WD1-002	MARSH. CABINET 1	WD2-008	BREAKER 52F2	2/C #12	600V	BKR 52F2 TC2	120'
52F3DC2	WD1-002	MARSH. CABINET 1	WD2-009	BREAKER 52F3	2/C #12	600V	BKR 52F3 TC2	105'
52F4DC2	WD1-002	MARSH. CABINET 1	WD2-010	BREAKER 52F4	2/C #12	600V	BKR 52F4 TC2	85'
52V1DC2	WD1-002	MARSH. CABINET 1	WD2-012	BREAKER 52V1	2/C #12	600V	BKR 52V1 TC2	155'
HOLD	**SIGNAL CABLES**							
FO.09	XXX	HAVILAND SUBSTATION	COM-005	FIBER PATCH PANEL 2	LASER ULTRA-FOX 48/C SINGLE MODE FIBER, 125 MICRON CAT# GX048DSLA9KRF1		UNDERGROUND FIBER TO HAVILAND SUBSTATION	TBD
FO.10	XXX	HAVILAND SUBSTATION	COM-005	FIBER PATCH PANEL 2	LASER ULTRA-FOX 48/C SINGLE MODE FIBER, 125 MICRON CAT# GX048DSLA9KRF1		UNDERGROUND FIBER TO HAVILAND SUBSTATION	TBD
FO.11	XXX	O&M BUILDING	COM-004	FIBER PATCH PANEL 1	EXPRESSLT DRY 12/C SINGLE-MODE, 1550nm PRYSMIAN CAT# F-FDH-1JKT-12-HB-012-F3		O&M BUILDING	TBD
FO.12	WD2-004	TRANSFORMER T1 (RELAYS)	COM-004	FIBER PATCH PANEL 1	LASER ULTRA-FOX 12/C MULTI-MODE FIBER, 62.5 MICRON		TRANSFORMER T1 (RELAYS)	185'



FOUNDATION SCHEDULE				
MARK	QTY	DESCRIPTION	DWG	T.O.C.
P1	10	34.5KV SWITCH STAND 34.5KV 3φ BUS STAND 34.5KV NGR STAND 34.5KV CABLE TERMINATION STRUCTURE 138KV 3Ø LOW BUS STAND	NWO-F2-001	SEE PLAN
P2	6	34.5KV COLLECTION STRUCTURE	NWO-F2-001	740.75'
P3	2	138KV DEAD END	NWO-F2-001	740.0'
P4	8	EQUIPMENT ENCLOSURE	NWO-F2-002	740.0'
P5	1	34.5KV CAP SWITCHER	NWO-F2-001	740.75'
S1	5	34.5KV FEEDER BREAKER SLAB	NWO-F5-001	6" ABOVE F.G.
S2	1	138KV BREAKER SLAB	NWO-F5-001	6" ABOVE F.G.
S3	1	OIL CONTAINMENT/TRANSFORMER SLAB	NWO-F3-001	6" ABOVE F.G.
S4	1	EQUIPMENT ENCLOSURE STOOP	NWO-F5-001	SEE DETAIL
S5	1	EQUIPMENT ENCLOSURE STOOP	NWO-F5-001	SEE DETAIL
S6	1	34.5KV CAP BANK SLAB	NWO-F6-001	6" ABOVE F.G.

NORTHWEST OHIO WIND PROJECT

PAULDING COUNTY, OHIO

Rev.	Date	Description	By
0A	08/30/17	PRELIMINARY	UEI
0B	10/19/17	PRELIMINARY	UEI
0C	11/21/17	90% DESIGN PACKAGE	UEI
0D	01/12/18	ISSUED FOR CONSTRUCTION	UEI
0E	1/25/18	ISSUED FOR CONSTRUCTION	UEI

WHITE
an MEA company

NOTES:

1. SEE GRADING PLAN FOR INDICATION OF TRUE NORTH.

LEGEND:

1 DIRECT EMBED SHIELD POLE, SEE S2-001

2 STOOPS TO BE CENTERED ON DOORS. FORM AROUND AND PROVIDE BOND BREAK AT BUILDING PIERS.

SUBSTATION FENCE

ALIGNMENT MARK

BASE LINE INTERSECTION

SCALE 3/32" = 1'-0"

4' 0 4' 8' 12' 16' 20' 24' 28'

ISSUED FOR CONSTRUCTION

01/12/18

STATE OF OHIO
MARTIN FELIX PADULA
E-80306
REGISTERED
PROFESSIONAL ENGINEER
01-25-2018

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Fargo, North Dakota 58104
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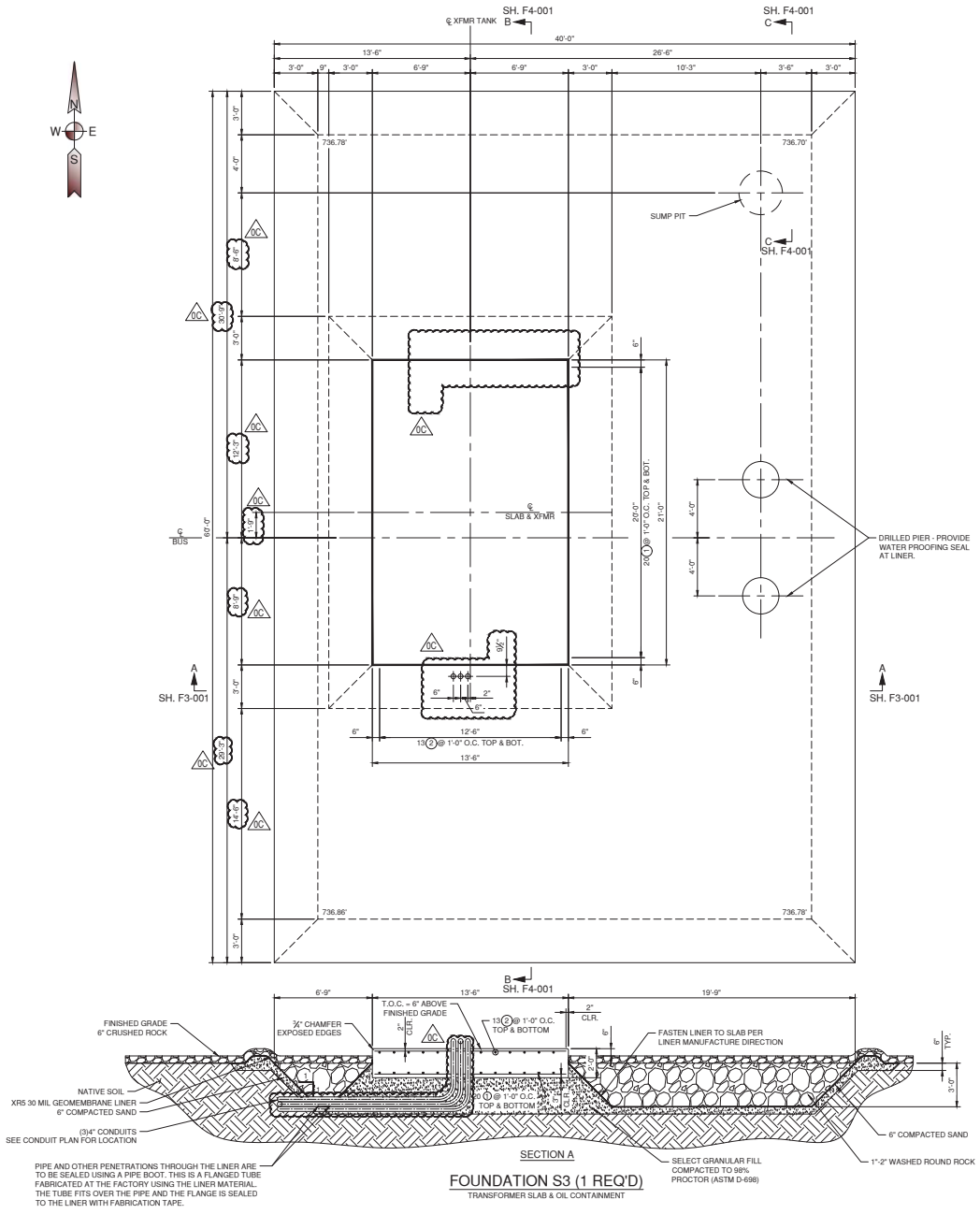
We Value Vision
Bismarck - Denver - Detroit Lakes - Fargo - Sioux Falls - St. Paul

Design By: D. WEBER
Drawn By: V. LEE
Approved By: M. PADULA
Project Number: 17.01246

SUBSTATION FOUNDATION PLAN

DWG #: NWO-F1-001

REVISION: 0E



FOUNDATION S3 (1 REQ'D)

TRANSFORMER SLAB & OIL CONTAINMENT

BAR BENDING DATA

BAR SIZE	D	END HOOKS 180° HOOKS A or G	END HOOKS 180° HOOKS J	END HOOKS 90° HOOKS A or G	STIRRUP & TIE HOOKS 90° HOOKS D	STIRRUP & TIE HOOKS 90° HOOKS A or G
3	2⅜	5"	3"	6"	1½	4"
4	3	6"	4"	8"	2	4½"
5	3⅝	7"	5"	10"	2½	6"
6	4½	8"	6"	1'-0"		
7	5¼	10"	7"	1'-2"		
8	6	11"	8"	1'-4"		
9	9	1'-3"	11¼	1'-7"		
10	10	1'-5"	1'-0¼	1'-10"		

DETAILING DIMENSION — HOOK A or G — 180°

DETAILING DIMENSION — 90°

NOTES:
1. DIMENSIONS OMITTED ARE ZERO
2. DIMENSIONS ARE OUT TO OUT OF BAR
3. DEFORMED REINFORCING BARS ARE TO BE GRADE 60 STEEL (ASTM A615)

NO REQ'D.	CONC. CU. YD.	FND MARK	BAR MARK	QTY	SIZE	NOM. LENGTH	TYPE	A	B	C	D	E	G	J	WT. / BAR	TOTAL WT.
1	21.0	S3	1	40	#8	13'-2"	STR								35.2	1,408.0
			2	26	#8	20'-8"	STR								55.2	1,435.2
															WT. REBAR PER FDN. =	2,843.2

TOTAL CU. YDS. CONC. = 21.0

TOTAL WT. REBAR. = 2,843.2

XFMR OIL	=	12,248 GALLONS
FIRE FLOW	=	5,000 GALLONS
RAIN ON SLAB	=	834 GALLONS
ROCK VOID RATIO	=	0.4
VOLUME OF OIL CONTAINMENT	=	51,847 GALLONS
AVAILABLE VOLUME (VOLUME O.C. X 0.4)		
51,847 GALLONS X 0.4	=	20,739 GALLONS
100 X 20,739 GALLONS / (12,248 GALLONS + 5,000 GALLONS + 834 GALLONS)	=	114.7% CAPACITY
RAIN ON OIL CONTAINMENT - RAIN ON SLAB	=	6,597 GALLONS
VOLUME BERM	=	17,953 GALLONS
FREE BOARD WITH 5" RAIN EVENT	=	7.59'

NOTES:

1. CONCRETE SHALL HAVE A COMPRESSIVE STRENGTH OF 4,500 P.S.I. AT THE END OF 28 DAYS.
2. SOIL BEARING CAPACITY BENEATH FOOTING OR FOUNDATIONS SHALL BE NOT LESS THAN 1,500#/SQ. FT.
3. CONCRETE PLACEMENT: NO CONSTRUCTION JOINTS PERMITTED UNLESS NOTED.
4. EDGES OF CONCRETE: ALL EXPOSED EDGES ABOVE GROUND ROUNDED OR CHAMFERED 3/4 INCH.
5. REINFORCING STEEL: ASTM A-615 GRADE 60.
6. COVER: TWO INCHES MINIMUM PROTECTIVE CONCRETE COVER OVER REINFORCING STEEL UNLESS NOTED.
7. REFER TO DETAILED SPECIFICATION ON CONCRETE.
8. FINISH: TOP SURFACE OF OUTDOOR EQUIPMENT SLABS WOOD FLOATED, LIGHTLY TROWELLED AND THEN BROOMED.

NORTHWEST OHIO WIND PROJECT

PAULDING COUNTY, OHIO

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0C	1/25/18	ISSUED FOR CONSTRUCTION	UEI

WHITE an MEA company

ISSUED FOR CONSTRUCTION

01/12/18

STATE OF OHIO
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01-25-2018

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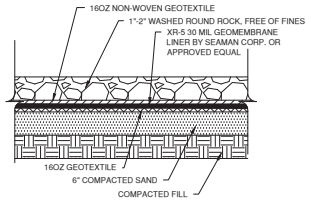
Bismarck - Denver - Detroit Lakes - Fargo - Sioux Falls - St. Paul

Design By: D. WEBER
Drawn By: V. LEE
Approved By: M. PADULA
Project Number: 17.01246

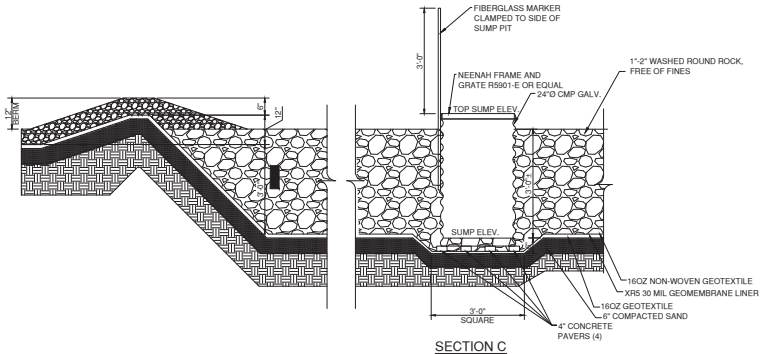
138/34.5KV SUBSTATION FOUNDATION DETAILS SLAB S3

DWG #: NWO-F3-001

REVISION: 0C



SECTION D



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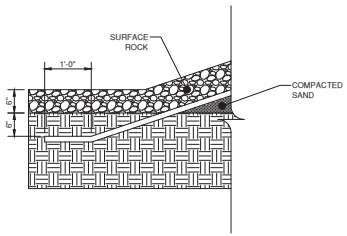
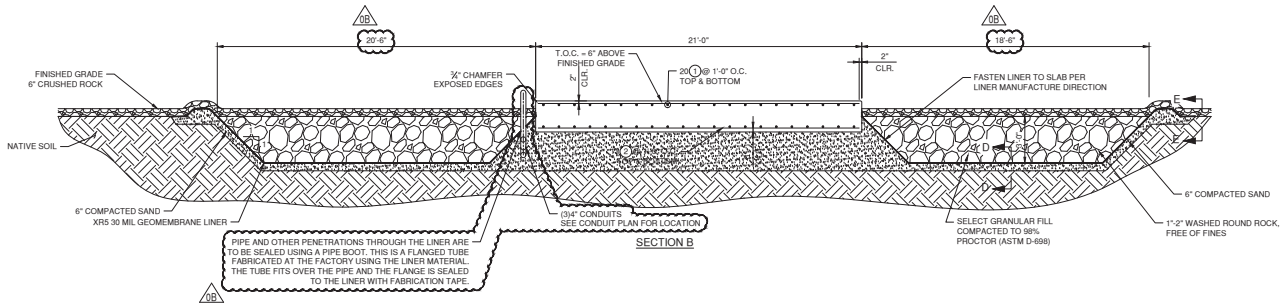


DETAIL E



SECTION B

NORTHWEST OHIO WIND PROJECT

PAULDING COUNTY, OHIO

Rev.	Date	Description	By
0A	01/12/18	ISSUED FOR CONSTRUCTION	UEI
0B	1/25/18	ISSUED FOR CONSTRUCTION	UEI

WHITE an MEA company

ISSUED FOR CONSTRUCTION

01/12/18

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Design By: D. WEBER
Drawn By: T. ADAMS
Approved By: M. PADULA
Project Number: 17.01246

138/34.5KV SUBSTATION XFMR FOUNDATION DETAILS

DWG #: NWO-F4-001

REVISION: 0B

MANUFACTURER ABBREVIATION

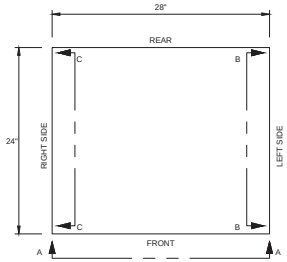
ABB	ASEA BROWN BOVERI
BUSS	BUSSMANN
ERL	ERLPHASE
ES	ELECTROSWITCH CORP.
GE	GENERAL ELECTRIC CO.
SEL	SCHWEITZER ENGINEERING LABORATORIES, INC.
WIL	WILMORE ELECTRONICS CO.

BILL OF MATERIAL

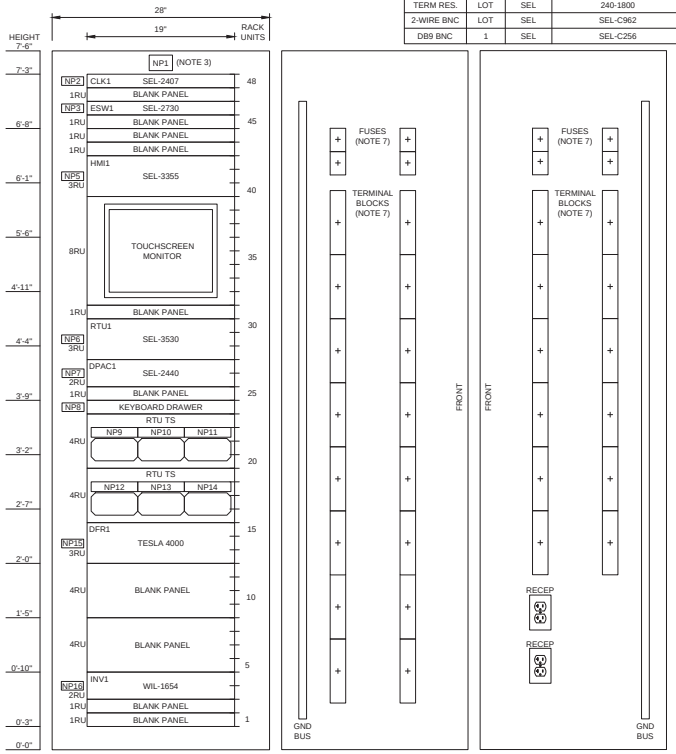
DEVICE(S)	QTY.	MFGR.	CAT. NO.	DESCRIPTION
PANEL	1	N/A		90" X 28" X 24" NEMA 12 PANEL PER RELAY PANEL SPECIFICATION
GROUND BUS	LOT	N/A		1" X 1/4" X 79" COPPER BAR WITH 10-32 HOLES DRILLED AND TAPPED AT 4" CENTERS (18 HOLES MAX). WASHER HEAD SCREWS INCLUDED IN EACH HOLE
TB	LOT	GE	EB25B12	12 POINT TERMINAL BLOCK
TB	LOT	GE	EB27B04S	4 POINT TERMINAL BLOCK
FB	LOT	BUSS	HM25030-1SR	FUSE HOLDER, 1 POLE, 30 AMP, 250 VOLT, SCREW TERMINAL
FB	LOT	BUSS	HM25030-2SR	FUSE HOLDER, 2 POLE, 30 AMP, 250 VOLT, SCREW TERMINAL
FB	LOT	BUSS	HM25030-3SR	FUSE HOLDER, 3 POLE, 30 AMP, 250 VOLT, SCREW TERMINAL
CLK1	1	SEL	24070003B	GPS CLOCK, SEL-2407, KEY CODE 2384, W/ COMPLETE ANTENNA INSTALLATION KIT
ESW1	1	SEL	2730M0ARAX1112AAAAX0	ETHERNET SWITCH, KEY CODE 3140
HMI1	1	SEL	3355#7MC6 (NOTE 8)	RACK-MOUNT RUGGED COMPUTER, SEL-3355, 250 GB SSD, 3390S8 SERIAL CARD, SYNCHROWAVE PDC SOFTWARE WITH SEL-5073. IF PART NUMBER IS NO LONGER AVAILABLE, USE APPROVED EQUIVALENT.
MONITOR	1	SEL	91610013	17" TOUCHSCREEN MONITOR WITH 19" RACK MOUNT BRACKET
KEYBOARD	1	SEL	91610049	RACK MOUNT USB KEYBOARD/DRAWER WITH INTEGRATED TRACKBALL
RTU1	1	SEL	3530HA0D1211A0XXXXXX	REAL-TIME AUTOMATION CONTROLLER, SEL-3530, KEY CODE 4957
DPAC1	1	SEL	24402H12A1A11630	SEL-2440 DISCRETE PROGRAMMABLE AUTOMATION CONTROLLER, KEY CODE 7231
DFR1	1	ERL	109312 TESLA 4000, 36-04P-0-2-60-0-0	DIGITAL FAULT RECORDER, TESLA 4000
RTU TS	2	ABB	FR4H001001001A	TEST SWITCH, FT19R, 4RU, ANSI 70, BLACK COVER A: 10 POTENTIALS B: 10 POTENTIALS C: 10 POTENTIALS
INV1	1	WIL	1654-130-120-60-U	1000VA DC-TO-AC INVERTER, 130VDC INPUT AND 120VAC INPUT, 120VAC OUTPUT
2812MT	1	SEL	2812MTX0	SEL-2812, FIBER-OPTIC TRANSCEIVER W/ IRIG-B TRANSMITTER, KEY CODE 2398
2812MR	2	SEL	2812MRX0	SEL-2812, FIBER-OPTIC TRANSCEIVER W/ IRIG-B RECEIVER, KEY CODE 2386
RECEP	2	N/A	N/A	DUPLEX RECEPTACLE (TO BE POWERED FROM DC-TO-AC INVERTER)
TEE CONN.	LOT	SEL	240-1799	BNC "T" CONNECTOR
TERM RES.	LOT	SEL	240-1800	50 OHM TERMINATION RESISTOR
2-WIRE BNC	LOT	SEL	SEL-C962	2-WIRE TO BNC CABLE
DB9 BNC	1	SEL	SEL-C256	DB9 TO BNC CABLE (FOR SEL-3355)

NAMEPLATE ENGRAVING SCHEDULE

NP NO	NP SIZE	QTY.	FIRST LINE	LET SIZE	SECOND LINE	LET SIZE	THIRD LINE	LET SIZE
NP1	3" X 2"	2	PANEL 1	1/2"	COMMUNICATION	1/4"		
NP2	2.5" X 0.75"	1	CLK1	5/32"	GPS CLOCK	5/32"		
NP3	2.5" X 0.75"	1	ESW1	5/32"	ETHERNET SWITCH	5/32"		
NP4	NOT USED	1						
NP5	2.5" X 0.75"	1	HMI1	5/32"	COMPUTER	5/32"		
NP6	2.5" X 0.75"	1	RTU1	5/32"	REAL-TIME	5/32"	AUTOMATION CONTROLLER	5/32"
NP7	2.5" X 0.75"	1	DPAC1	5/32"	DISCRETE PROGRAMMABLE	5/32"	AUTOMATION CONTROLLER	5/32"
NP8	2.5" X 0.75"	1	KEYBOARD	5/32"				
NP9	6" X 1.25"	1	SEE TAG BELOW	1/8"				
NP10	6" X 1.25"	1	SEE TAG BELOW	1/8"				
NP11	6" X 1.25"	1	SEE TAG BELOW	1/8"				
NP12	6" X 1.25"	1	SEE TAG BELOW	1/8"				
NP13	6" X 1.25"	1	SEE TAG BELOW	1/8"				
NP14	6" X 1.25"	1	SEE TAG BELOW	1/8"				
NP15	2.5" X 0.75"	1	DFR1	5/32"	DIGITAL FAULT	5/32"	RECORDER	5/32"
NP16	2.5" X 0.75"	1	INV1	5/32"	DC-TO-AC INVERTER	5/32"		



PANEL DETAIL
TOP VIEW



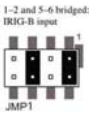
FRONT ELEVATION
DETAIL A-A

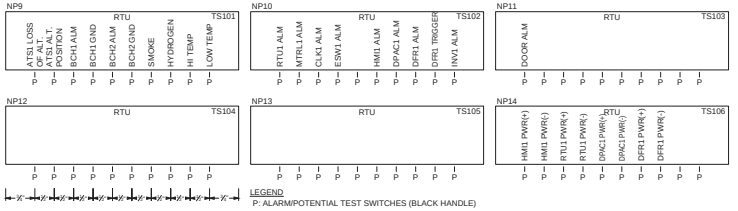
INSIDE LEFT
DETAIL B-B

INSIDE RIGHT
DETAIL C-C

NOTES:

1. REFER TO RELAY PANEL SPECIFICATION FOR INTERNAL AND EXTERNAL FINISH COLOR.
2. NAMEPLATES TO BE FURNISHED FOR EACH DEVICE INTERNAL TO THE PANEL.
3. TWO PANEL NAMEPLATES SHALL BE FURNISHED WITH EACH PANEL, ONE MOUNTED ON THE FRONT AND ONE MOUNTED ON THE BACK.
4. PANEL SUPPLIER SHALL VERIFY MANUFACTURER STYLE NUMBERS.
5. NAMEPLATES ARE TO BE WHITE WITH BLACK LETTERING AND ADHESIVE BACKING. TEXT SHALL BE CENTERED ON EACH LINE.
6. TEST SWITCH NAMEPLATES SHALL BE MOUNTED 1/4" FROM THE TOP OF THE TEST SWITCH ASSEMBLY.
7. TERMINAL & FUSE BLOCKS SHALL BE PROVIDED AS NECESSARY AND ACCESSIBLY MOUNTED.
8. THE COM 1 JUMPERS, LABELED JMP1 ON THE SEL-3355 MAIN BOARD, SHALL BE CONFIGURED BY CONTROL ENCLOSURE VENDOR FOR IRIG-B INPUT FOR TIME SYNCHRONIZATION. FOR IRIG-B INPUT: 1-2 BRIDGED AND 5-6 BRIDGED.





LEGEND
P: ALARM/POTENTIAL TEST SWITCHES (BLACK HANDLE)
T: TRIP TEST SWITCHES (RED HANDLE)
C-C: CURRENT TEST SWITCHES (BLACK HANDLE)

NORTHWEST OHIO WIND PROJECT

PAULDING COUNTY, OHIO

Rev.	Date	Description	By
0A	08/08/17	PRELIMINARY	UEI
0B	10/26/17	MANUFACTURE	UEI
0C	01/25/18	ISSUED FOR CONSTRUCTION	UEI

WHITE
an IEA company

CONSTRUCTION

THIS DOCUMENT HAS BEEN MODIFIED SINCE BEING SIGNED. IT IS NO LONGER A VALID CONSTRUCTION DRAWING.

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Bismarck - Denver - Detroit Lakes - Fargo - Sioux Falls - St. Paul

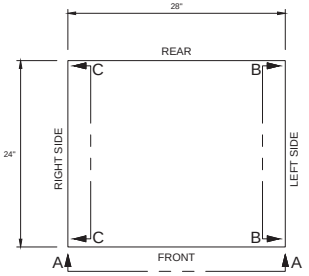
Design By: E. NEUHARDT
Drawn By: E. NEUHARDT
Approved By: J. OLSON
Project Number: 17.01246

SUBSTATION ELEVATION & BOM COMMUNICATION PANEL 1

DWG #: NWO-FE-001
REVISION: 0C

MANUFACTURER ABBREVIATION

ABB	ASEA BROWN BOVERI
BUSS	BUSSMANN
ERL	ERLPHASE
ES	ELECTROSWITCH CORP.
GE	GENERAL ELECTRIC CO.
SEL	SCHWEITZER ENGINEERING LABORATORIES, INC.
WIL	WILMORE ELECTRONICS CO.



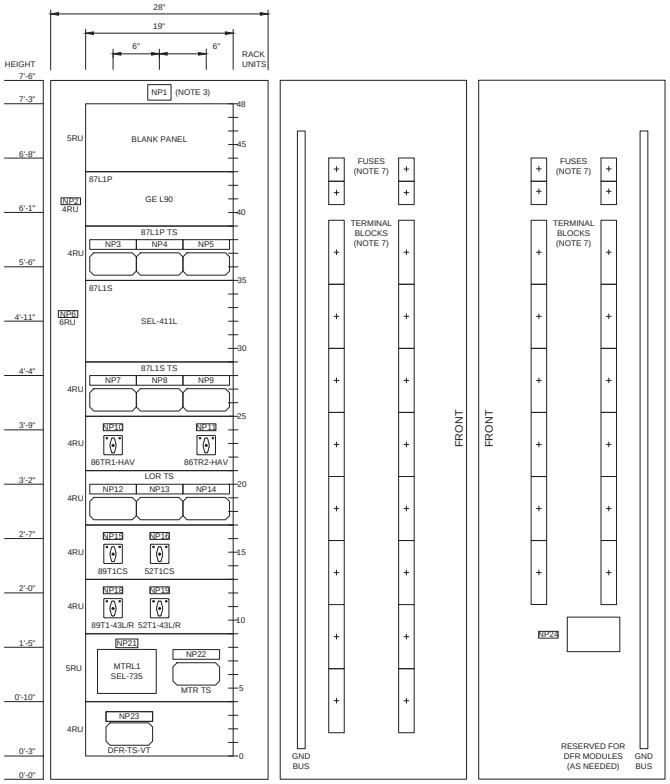
PANEL DETAIL
TOP VIEW

NAMEPLATE ENGRAVING SCHEDULE

NP NO	NP SIZE	QTY.	FIRST LINE	LET SIZE	SECOND LINE	LET SIZE	THIRD LINE	LET SIZE
NP1	3" X 2"	2	PANEL 2	1/2"	138KV HAVILAND LINE	1/4"	RELAYING	1/4"
NP2	2.5" X 0.75"	1	87L1P	5/32"	DIFFERENTIAL AND	5/32"	DISTANCE RELAY	5/32"
NP3	6" X 1.25"	1	SEE TAG BELOW	1/8"				
NP4	6" X 1.25"	1	SEE TAG BELOW	1/8"				
NP5	6" X 1.25"	1	SEE TAG BELOW	1/8"				
NP6	2.5" X 0.75"	1	87L1S	5/32"	DIFFERENTIAL AND	5/32"	DISTANCE RELAY	5/32"
NP7	6" X 1.25"	1	SEE TAG BELOW	1/8"				
NP8	6" X 1.25"	1	SEE TAG BELOW	1/8"				
NP9	6" X 1.25"	1	SEE TAG BELOW	1/8"				
NP10	2.5" X 0.75"	1	86TR1-HAV	5/32"	LOCKOUT	5/32"		
NP11	2.5" X 0.75"	1	86TR2-HAV	5/32"	LOCKOUT	5/32"		
NP12	6" X 1.25"	1	SEE TAG BELOW	1/8"				
NP13	6" X 1.25"	1	SEE TAG BELOW	1/8"				
NP14	6" X 1.25"	1	SEE TAG BELOW	1/8"				
NP15	2.5" X 0.75"	1	89T1CS	5/32"	OPEN/CLOSE	5/32"		
NP16	2.5" X 0.75"	1	52T1CS	5/32"	TRIP/CLOSE	5/32"		
NP17	NOT USED							
NP18	2.5" X 0.75"	1	89T1-43L/R	5/32"	LOCAL/REMOTE	5/32"		
NP19	2.5" X 0.75"	1	52T1-43L/R	5/32"	LOCAL/REMOTE	5/32"		
NP20	NOT USED							
NP21	2.5" X 0.75"	1	MTRL1	5/32"	CHECK METER	5/32"		
NP22	6" X 1.25"	1	SEE TAG BELOW	1/8"				
NP23	6" X 1.25"	1	SEE TAG BELOW	1/8"				
NP24	2.5" X 0.75"	1	DFR-VT1	5/32"	MODULE	5/32"		

BILL OF MATERIAL

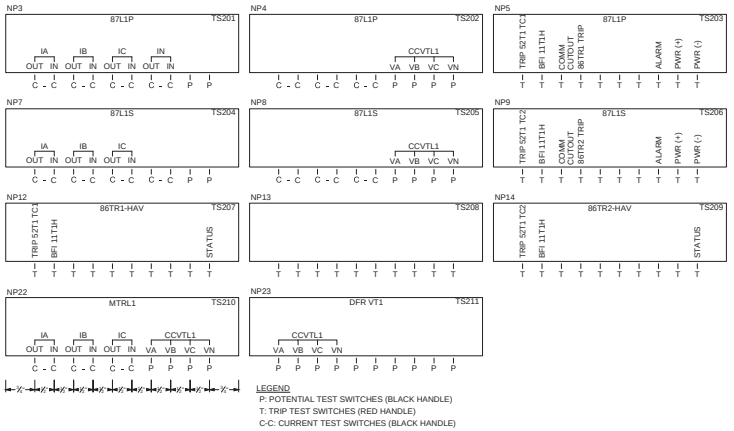
DEVICE(S)	QTY.	MFGR.	CAT. NO.	DESCRIPTION
PANEL	1	N/A		90" X 28" X 24" NEMA 12 PANEL PER RELAY PANEL SPECIFICATION
87L1P	1	GE	L90-TB5-HLH-F8L-H6P-L8L-N6S-S6S-U6D-W7J MOD 11	GE L90, FIRMWARE VERSION 7.24, 1300nm, SINGLE MODE, ELED, 2 CH, (0-6 MI.)
87L1S	1	SEL	0411L1X6X5C8EXH674740X SS-2310	SEL-411L, FIRMWARE VERSION R116, 2 1550nm, SINGLE MODE FIBER (0-65MI.)
TB	LOT	GE	EB27B04S	4 POINT TERMINAL BLOCK
FB	LOT	BUSS	HM25030-1SR	FUSE HOLDER, 1 POLE, 30 AMP, 250 VOLT, SCREW TERMINAL
DFR-VT1	1	ERL	101756	DFR VT MODULE
DFR-TS-VT	1	ABB	129A501G01	DFR VOLTAGE TEST SWITCH
52CS	1	ES	74PD202LT	CONTROL SWITCH (TRIP-CLOSE) WITH PISTOL GRIP, 2 DECKS, GREEN AND RED LEDS, ENGR CODE: 123B-2B23
89CS	1	ES	74PB202NN	CONTROL SWITCH (OPEN-CLOSE) WITH PISTOL GRIP, 2 DECKS, GREEN AND RED LED, ENGR CODE:123B-2D25MW
43L/R	2	ES	24202B	CONTROL SWITCH (LOCAL-REMOTE) WITH OVAL HANDLE, 2 DECKS, ENGR CODE: 10D-2L24A
DIODE	2	E-MAX	910A001 W/632A050	DIODE, HEAVY DUTY, SINGLE TRIPPING, 12A/800V, ELECTRICAL, ASSEMBLY, 300A PEAK NON-REPETITIVE FORWARD CURRENT, WITH DIN RAIL MOUNTING KIT (FOR HIGH SIDE PCB TRIP CIRCUITS)
D1, D2	2	POWEREX	CS240650	DIODE, SINGLE MODE, POWEREX POWER SEMICONDUCTORS, 50A, 600V (FOR AEP LINE RELAYS)
86TR1-HAV 86TR2-HAV	2	ES	78PB08MJ	RELAY, LOR, ELECTROSWITCH - 125 VDC, 8 DECK W/ LIGHT
LOR TS	1	ABB	FR4HP036036036A	TEST SWITCH, FT19R, 4RU, ANSI 70, BLACK COVER A: 10 TRIPS B: 10 TRIPS C: 10 TRIPS
MTRL1	1	SEL	0735HX20944CXXXXXX16101XX	SEL-735, CHECK METER, KEY CODE 2273
MTR TS	1	ABB	774B430G20	METER TEST SWITCH, 6 CURRENTS, 4 POTENTIALS, BLACK COVER
RESISTOR	1	N/A		13K OHM, 5W RESISTOR (FOR AEP LINE RELAY)
TB	LOT	GE	EB25B12	12 POINT TERMINAL BLOCK
TB	LOT	GE	EB27B04S	4 POINT TERMINAL BLOCK
FB	LOT	BUSS	HM25030-1SR	FUSE HOLDER, 1 POLE, 30 AMP, 250 VOLT, SCREW TERMINAL
FB	LOT	BUSS	HM25030-2SR	FUSE HOLDER, 2 POLE, 30 AMP, 250 VOLT, SCREW TERMINAL
FB	LOT	BUSS	HM25030-3SR	FUSE HOLDER, 3 POLE, 30 AMP, 250 VOLT, SCREW TERMINAL
GROUND BUS	LOT	N/A	N/A	1" X 1/4" X 79" COPPER BAR WITH 10-32 HOLES DRILLED AND TAPPED AT 4" CENTERS (18 HOLES MAX). WASHER HEAD SCREWS INCLUDED IN EACH HOLE
87L1P TS, 87L1S TS	2	ABB	FR4H083171036A	TEST SWITCH, FT19R, 4RU, ANSI 70, BLACK COVER A: 8 CURRENTS, 2 POTENTIALS B: 6 CURRENTS, 4 POTENTIALS C: 10 TRIPS



FRONT ELEVATION
DETAIL A-A

INSIDE LEFT
DETAIL B-B

INSIDE RIGHT
DETAIL C-C



LEGEND
P: POTENTIAL TEST SWITCHES (BLACK HANDLE)
T: TRIP TEST SWITCHES (RED HANDLE)
C-C: CURRENT TEST SWITCHES (BLACK HANDLE)

NOTES:

1. REFER TO RELAY PANEL SPECIFICATION FOR INTERNAL AND EXTERNAL FINISH COLOR.
2. NAMEPLATES TO BE FURNISHED FOR EACH DEVICE INTERNAL TO THE PANEL.
3. TWO PANEL NAMEPLATES SHALL BE FURNISHED WITH EACH PANEL, ONE MOUNTED ON THE FRONT AND ONE MOUNTED ON THE BACK.
4. PANEL SUPPLIER SHALL VERIFY MANUFACTURER STYLE NUMBERS.
5. NAMEPLATES ARE TO BE WHITE WITH BLACK LETTERING AND ADHESIVE BACKING. TEXT SHALL BE CENTERED ON EACH LINE.
6. TEST SWITCH NAMEPLATES SHALL BE MOUNTED 1/4" FROM THE TOP OF THE TEST SWITCH ASSEMBLY.
7. TERMINAL & FUSE BLOCKS SHALL BE PROVIDED AS NECESSARY AND ACCESSIBLY MOUNTED.

NORTHWEST OHIO WIND PROJECT

PAULDING COUNTY, OHIO

Rev.	Date	Description	By
0A	08/08/17	PRELIMINARY	UEI
0B	10/26/17	MANUFACTURE	UEI
0C	01/25/18	ISSUED FOR CONSTRUCTION	UEI

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www.ulteig.com
Bismarck - Denver - Detroit Lakes - Fargo - Sioux Falls - St. Paul

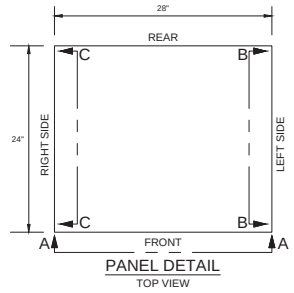
Design By: E. NEUHARDT
Drawn By: E. NEUHARDT
Approved By: J. OLSON
Project Number: 17.01246

SUBSTATION ELEVATION & BOM LINE RELAY PANEL 2

DWG #: NWO-FE-002
REVISION: 0C

MANUFACTURER ABBREVIATION

ABB	ASEA BROWN BOVERI
BUSS	BUSSMANN
ERL	ERLPHASE
ES	ELECTROSWITCH CORP.
GE	GENERAL ELECTRIC CO.
SEL	SCHWEITZER ENGINEERING LABORATORIES, INC.
WIL	WILMORE ELECTRONICS CO.



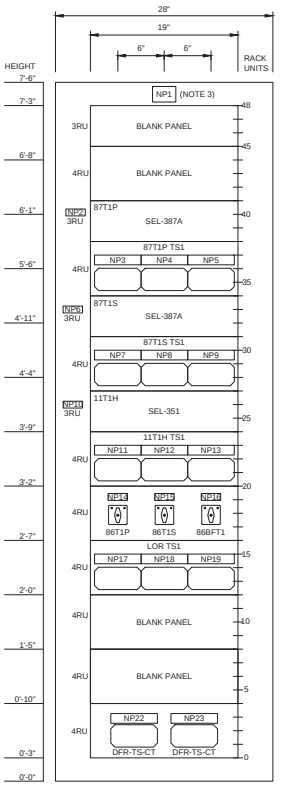
PANEL DETAIL
TOP VIEW

BILL OF MATERIAL

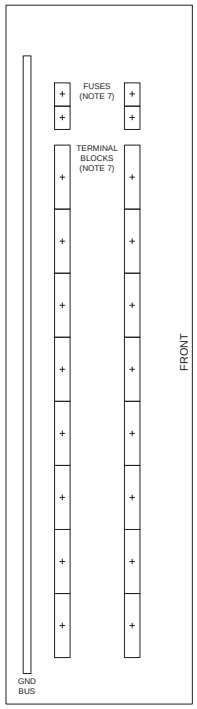
DEVICE(S)	QTY.	MFGR.	CAT. NO.	DESCRIPTION
PANEL	1	N/A		90" X 28" X 24" NEMA 12 PANEL PER RELAY PANEL SPECIFICATION
87T1P, 87T1S	2	SEL	0387A011H23X341	SEL-387A, KEY CODE 677
11T1H	1	SEL	035163C3E544X1	SEL-351, KEY CODE 6135 W/15K OHM 6.5W RESISTOR
87T1P TS1, 87T1S TS1	2	ABB	FR4H083073036A	TEST SWITCH, FT19R, 4RU, ANSI 70, BLACK COVER A: 8 CURRENTS, 2 POTENTIALS B: 10 POTENTIALS C: 10 TRIPS
11T1H TS1	1	ABB	FR4H083001036A	TEST SWITCH, FT19R, 4RU, ANSI 70, BLACK COVER A: 8 CURRENTS, 2 POTENTIALS B: 10 CURRENTS C: 10 TRIPS
86T1P, 86T1S, 86BFT1	3	ES	7810D	LOCKOUT RELAY, SERIES 24, 10 DECK, WITH PISTOL GRIP HANDLE
LOR TS1	1	ABB	FR4H036036036A	TEST SWITCH, FT19R, 4RU, ANSI 70, BLACK COVER A: 10 TRIPS B: 10 TRIPS C: 10 TRIPS
DFR-CT1 DFR-CT2	2	ERL	110739	DFR CT MODULE
DFR-TS-CT	2	ABB	837A407G01	DFR CURRENT TEST SWITCH
TB	LOT	GE	EB25B12	12 POINT TERMINAL BLOCK
TB	LOT	GE	EB27B04S	4 POINT TERMINAL BLOCK
FB	LOT	BUSS	HM25030-1SR	FUSE HOLDER, 1 POLE, 30 AMP, 250 VOLT, SCREW TERMINAL
FB	LOT	BUSS	HM25030-2SR	FUSE HOLDER, 2 POLE, 30 AMP, 250 VOLT, SCREW TERMINAL
FB	LOT	BUSS	HM25030-3SR	FUSE HOLDER, 3 POLE, 30 AMP, 250 VOLT, SCREW TERMINAL
GROUND BUS	LOT	N/A	N/A	1" X 1/4" X 79" COPPER BAR WITH 10-32 HOLES DRILLED AND TAPPED AT 4" CENTERS (18 HOLES MAX). WASHER HEAD SCREWS INCLUDED IN EACH HOLE

NAMEPLATE ENGRAVING SCHEDULE

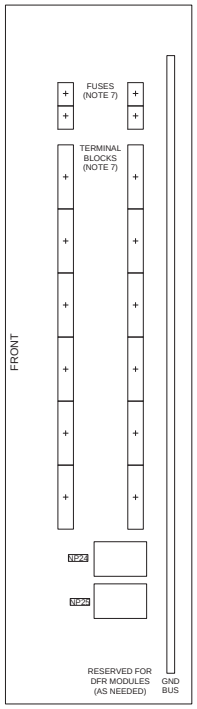
NP NO	NP SIZE	QTY.	FIRST LINE	LET SIZE	SECOND LINE	LET SIZE	THIRD LINE	LET SIZE
NP1	3" X 2"	2	PANEL 3	1/2"	TRANSFORMER T1	1/4"	PROTECTION	1/4"
NP2	2.5" X 0.75"	1	87T1P	5/32"	TRANSFORMER T1	5/32"	DIFFERENTIAL RELAY	5/32"
NP3	6" X 1.25"	1	SEE TAG BELOW	1/8"				
NP4	6" X 1.25"	1	SEE TAG BELOW	1/8"				
NP5	6" X 1.25"	1	SEE TAG BELOW	1/8"				
NP6	2.5" X 0.75"	1	87T1S	5/32"	TRANSFORMER T1	5/32"	DIFFERENTIAL RELAY	5/32"
NP7	6" X 1.25"	1	SEE TAG BELOW	5/32"				
NP8	6" X 1.25"	1	SEE TAG BELOW	5/32"				
NP9	6" X 1.25"	1	SEE TAG BELOW	1/8"				
NP10	2.5" X 0.75"	1	11T1H	5/32"	OVERCURRENT AND	5/32"	BKR FAILURE RELAY	5/32"
NP11	6" X 1.25"	1	SEE TAG BELOW	1/8"				
NP12	6" X 1.25"	1	SEE TAG BELOW	1/8"				
NP13	6" X 1.25"	1	SEE TAG BELOW	1/8"				
NP14	2.5" X 0.75"	1	86T1P	5/32"	LOCKOUT	5/32"		
NP15	2.5" X 0.75"	1	86T1S	5/32"	LOCKOUT	5/32"		
NP16	2.5" X 0.75"	1	86T1BF	5/32"	LOCKOUT	5/32"		
NP17	6" X 1.25"	1	SEE TAG BELOW	1/8"				
NP18	6" X 1.25"	1	SEE TAG BELOW	1/8"				
NP19	6" X 1.25"	1	SEE TAG BELOW	1/8"				
NP20	NOT USED							
NP21	NOT USED							
NP22	6" X 1.25"	1	SEE TAG BELOW	5/32"				
NP23	6" X 1.25"	1	SEE TAG BELOW	5/32"				
NP24	2.5" X 0.75"	1	DFR-CT1	5/32"	MODULE	5/32"		
NP25	2.5" X 0.75"	1	DFR-CT2	5/32"	MODULE	5/32"		



FRONT ELEVATION
DETAIL A-A



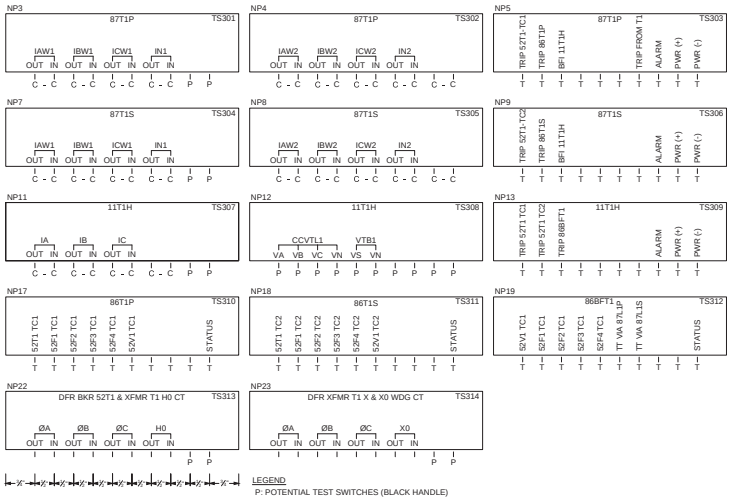
INSIDE LEFT
DETAIL B-B



INSIDE RIGHT
DETAIL C-C

NOTES:

1. REFER TO RELAY PANEL SPECIFICATION FOR INTERNAL AND EXTERNAL FINISH COLOR.
2. NAMEPLATES TO BE FURNISHED FOR EACH DEVICE INTERNAL TO THE PANEL.
3. TWO PANEL NAMEPLATES SHALL BE FURNISHED WITH EACH PANEL, ONE MOUNTED ON THE FRONT AND ONE MOUNTED ON THE BACK.
4. PANEL SUPPLIER SHALL VERIFY MANUFACTURER STYLE NUMBERS.
5. NAMEPLATES ARE TO BE WHITE WITH BLACK LETTERING AND ADHESIVE BACKING. TEXT SHALL BE CENTERED ON EACH LINE.
6. TEST SWITCH NAMEPLATES SHALL BE MOUNTED 1/4" FROM THE TOP OF THE TEST SWITCH ASSEMBLY.
7. TERMINAL & FUSE BLOCKS SHALL BE PROVIDED AS NECESSARY AND ACCESSIBLY MOUNTED.



LEGEND
P: POTENTIAL TEST SWITCHES (BLACK HANDLE)
T: TRIP TEST SWITCHES (RED HANDLE)
C-C: CURRENT TEST SWITCHES (BLACK HANDLE)

NORTHWEST OHIO WIND PROJECT

PAULDING COUNTY, OHIO

Rev.	Date	Description	By
0A	08/08/17	PRELIMINARY	UEI
0B	10/26/17	MANUFACTURE	UEI
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Design By: E. NEUHARDT
Drawn By: E. NEUHARDT
Approved By: J. OLSON
Project Number: 17.01246

SUBSTATION ELEVATION & BOM TRANSFORMER 1 PANEL 3

DWG #: NWO-FE-003
REVISION: 0C

MANUFACTURER ABBREVIATION

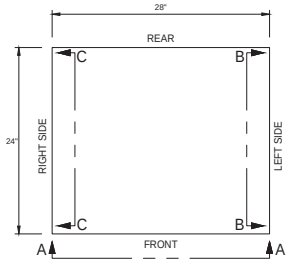
ABB	ASEA BROWN BOVERI
BUSS	BUSSMANN
ERL	ERLPHASE
ES	ELECTROSWITCH CORP.
GE	GENERAL ELECTRIC CO.
SEL	SCHWEITZER ENGINEERING LABORATORIES, INC.
WIL	WILMORE ELECTRONICS CO.

BILL OF MATERIAL

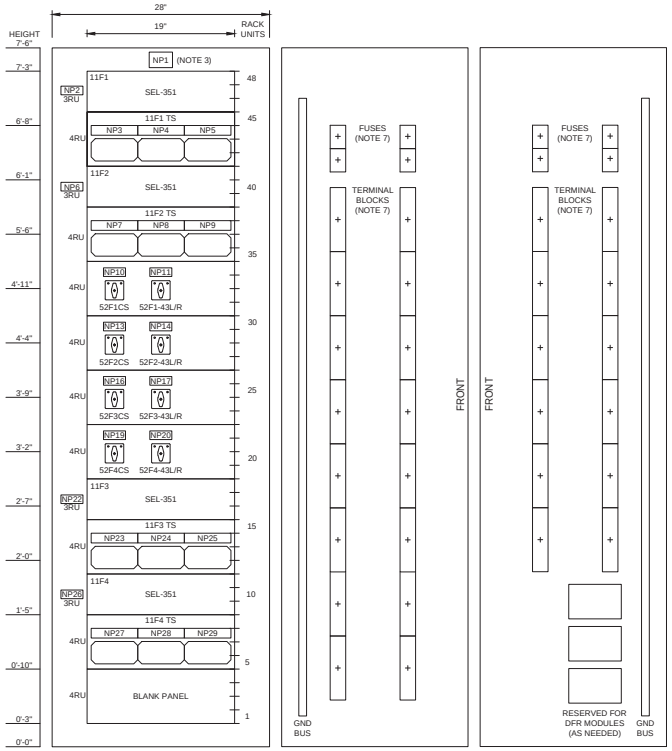
DEVICE(S)	QTY.	MFGR.	CAT. NO.	DESCRIPTION
PANEL	1	N/A		90" X 28" X 24" NEMA 12 PANEL PER RELAY PANEL SPECIFICATION
GROUND BUS	LOT	N/A		1" X 1/4" X 79" COPPER BAR WITH 10-32 HOLES DRILLED AND TAPPED AT 4" CENTERS (18 HOLES MAX). WASHER HEAD SCREWS INCLUDED IN EACH HOLE
TB	LOT	GE	EB25B12	12 POINT TERMINAL BLOCK
TB	LOT	GE	EB27B04S	4 POINT TERMINAL BLOCK
FB	LOT	BUSS	HM25030-1SR	FUSE HOLDER, 1 POLE, 30 AMP, 250 VOLT, SCREW TERMINAL
FB	LOT	BUSS	HM25030-2SR	FUSE HOLDER, 2 POLE, 30 AMP, 250 VOLT, SCREW TERMINAL
FB	LOT	BUSS	HM25030-3SR	FUSE HOLDER, 3 POLE, 30 AMP, 250 VOLT, SCREW TERMINAL
11F1, 11F2, 11F3, 11F4	4	SEL	035163C3E544X1	SEL-351, KEY CODE 6135
11F1 TS 11F2 TS 11F3 TS 11F4 TS	4	ABB	FR4H073001036A	TEST SWITCH, FT19R, 4RU, ANSI 70, BLACK COVER A: 10 CURRENTS B: 10 POTENTIALS C: 10 TRIPS
52CS	4	ES	74PD202LT	CONTROL SWITCH (TRIP-CLOSE) WITH PISTOL GRIP, 2 DECKS, GREEN AND RED LEDS, ENGR CODE: 123B-2B23
43L/R	4	ES	24202B	CONTROL SWITCH (LOCAL-REMOTE) WITH OVAL HANDLE, 2 DECKS, ENGR CODE: 10D-2L24A

NAMEPLATE ENGRAVING SCHEDULE

NP NO	NP SIZE	QTY.	FIRST LINE	LET SIZE	SECOND LINE	LET SIZE	THIRD LINE	LET SIZE
NP1	3" X 2"	2	PANEL 4	1/2"	FEEDER 1, FEEDER 2	1/4"	FEEDER 3 & FEEDER 4	1/4"
NP2	2.5" X 0.75"	1	11F1	5/32"	DIRECTIONAL	5/32"	OVERCURRENT RELAY	5/32"
NP3	6" X 1.25"	1	SEE TAG BELOW	1/8"				
NP4	6" X 1.25"	1	SEE TAG BELOW	1/8"				
NP5	6" X 1.25"	1	SEE TAG BELOW	1/8"				
NP6	2.5" X 0.75"	1	11F2	5/32"	DIRECTIONAL	5/32"	OVERCURRENT RELAY	5/32"
NP7	6" X 1.25"	1	SEE TAG BELOW	1/8"				
NP8	6" X 1.25"	1	SEE TAG BELOW	1/8"				
NP9	6" X 1.25"	1	SEE TAG BELOW	1/8"				
NP10	2.5" X 0.75"	1	52F1CS	5/32"	TRIP/CLOSE	5/32"		
NP11	2.5" X .075"	1	52F1-43L/R	5/32"	LOCAL/REMOTE	5/32"		
NP12	NOT USED							
NP13	2.5" X 0.75"	1	52F2CS	5/32"	TRIP/CLOSE	5/32"		
NP14	2.5" X 0.75"	1	52F2-43L/R	5/32"	LOCAL/REMOTE	5/32"		
NP15	NOT USED							
NP16	2.5" X 0.75"	1	52F3CS	5/32"	TRIP/CLOSE	5/32"		
NP17	2.5" X 0.75"	1	52F3-43L/R	5/32"	LOCAL/REMOTE	5/32"		
NP18	NOT USED							
NP19	2.5" X 0.75"	1	52F4CS	5/32"	TRIP/CLOSE	5/32"		
NP20	2.5" X 0.75"	1	52F4-43L/R	5/32"	LOCAL/REMOTE	5/32"		
NP21	NOT USED							
NP22	2.5" X 0.75"	1	11F3	5/32"	DIRECTIONAL	5/32"	OVERCURRENT RELAY	5/32"
NP23	6" X 1.25"	1	SEE TAG BELOW	1/8"				
NP24	6" X 1.25"	1	SEE TAG BELOW	1/8"				
NP25	6" X 1.25"	1	SEE TAG BELOW	1/8"				
NP26	2.5" X 0.75"	1	11F4	5/32"	DIRECTIONAL	5/32"	OVERCURRENT RELAY	5/32"
NP27	6" X 1.25"	1	SEE TAG BELOW	1/8"				
NP28	6" X 1.25"	1	SEE TAG BELOW	1/8"				
NP29	6" X 1.25"	1	SEE TAG BELOW	1/8"				



PANEL DETAIL
TOP VIEW



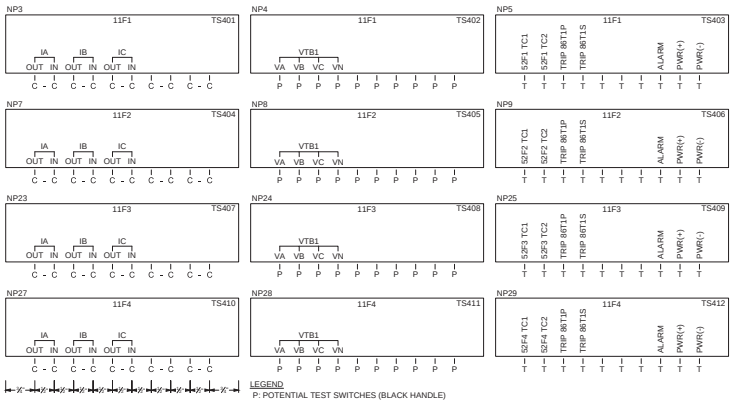
FRONT ELEVATION
DETAIL A-A

INSIDE LEFT
DETAIL B-B

INSIDE RIGHT
DETAIL C-C

NOTES:

1. REFER TO RELAY PANEL SPECIFICATION FOR INTERNAL AND EXTERNAL FINISH COLOR.
2. NAMEPLATES TO BE FURNISHED FOR EACH DEVICE INTERNAL TO THE PANEL.
3. TWO PANEL NAMEPLATES SHALL BE FURNISHED WITH EACH PANEL, ONE MOUNTED ON THE FRONT AND ONE MOUNTED ON THE BACK.
4. PANEL SUPPLIER SHALL VERIFY MANUFACTURER STYLE NUMBERS.
5. NAMEPLATES ARE TO BE WHITE WITH BLACK LETTERING AND ADHESIVE BACKING. TEXT SHALL BE CENTERED ON EACH LINE.
6. TEST SWITCH NAMEPLATES SHALL BE MOUNTED 1/4" FROM THE TOP OF THE TEST SWITCH ASSEMBLY.
7. TERMINAL & FUSE BLOCKS SHALL BE PROVIDED AS NECESSARY AND ACCESSIBLY MOUNTED.



LEGEND
P: POTENTIAL TEST SWITCHES (BLACK HANDLE)
T: TRIP TEST SWITCHES (RED HANDLE)
C-C: CURRENT TEST SWITCHES (BLACK HANDLE)

NORTHWEST OHIO WIND PROJECT

PAULDING COUNTY, OHIO

Rev.	Date	Description	By
0A	08/08/17	PRELIMINARY	UEI
0B	10/26/17	MANUFACTURE	UEI
0C	01/25/18	ISSUED FOR CONSTRUCTION	UEI

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Design By: E. NEUHARDT
Drawn By: E. NEUHARDT
Approved By: J. OLSON
Project Number: 17.01246

SUBSTATION ELEVATION & BOM FEEDER 1, 2, 3 & 4 PANEL 4

DWG #: NWO-FE-004
REVISION: 0C

MANUFACTURER ABBREVIATION

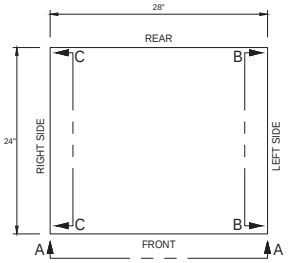
ABB	ASEA BROWN BOVERI
BUSS	BUSSMANN
ERL	ERLPHASE
ES	ELECTROSWITCH CORP.
GE	GENERAL ELECTRIC CO.
SEL	SCHWEITZER ENGINEERING LABORATORIES, INC.
WIL	WILMORE ELECTRONICS CO.

BILL OF MATERIAL

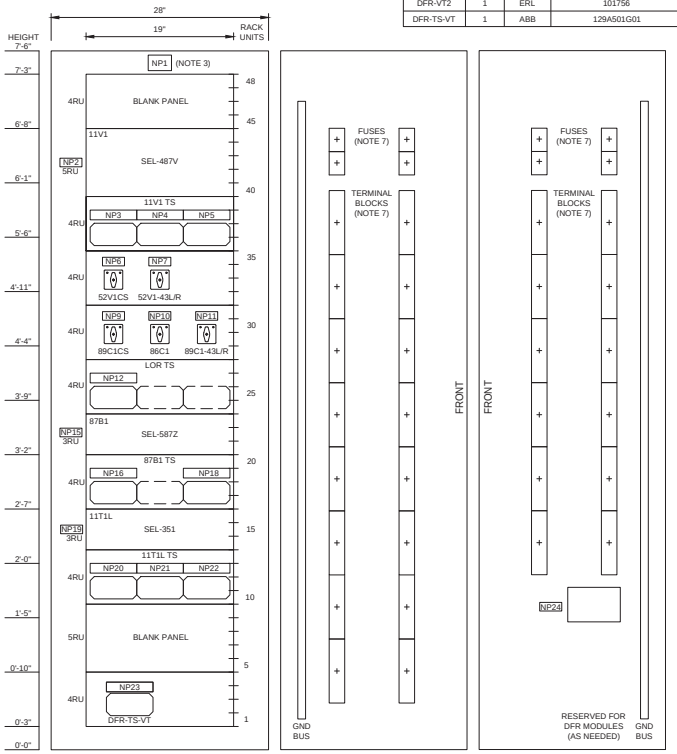
DEVICE(S)	QTY.	MFGR.	CAT. NO.	DESCRIPTION
PANEL	1	N/A		90" X 28" X 24" NEMA 12 PANEL PER RELAY PANEL SPECIFICATION
GROUND BUS	LOT	N/A		1" X 1/4" X 79" COPPER BAR WITH 10-32 HOLES DRILLED AND TAPPED AT 4" CENTERS (18 HOLES MAX). WASHER HEAD SCREWS INCLUDED IN EACH HOLE
TB	LOT	GE	EB25B12	12 POINT TERMINAL BLOCK
TB	LOT	GE	EB27B04S	4 POINT TERMINAL BLOCK
FB	LOT	BUSS	HM25030-1SR	FUSE HOLDER, 1 POLE, 30 AMP, 250 VOLT, SCREW TERMINAL
FB	LOT	BUSS	HM25030-2SR	FUSE HOLDER, 2 POLE, 30 AMP, 250 VOLT, SCREW TERMINAL
FB	LOT	BUSS	HM25030-3SR	FUSE HOLDER, 3 POLE, 30 AMP, 250 VOLT, SCREW TERMINAL
11V1	1	SEL	0487V0X6151XB0X4H52444X	SEL-487V, KEY CODE 6982
11T1L	1	SEL	035163C3E544X1	SEL-351, KEY CODE 6135
87B1	1	SEL	0587Z0X625H12XX	SEL-587Z, KEY CODE 7890
11V1 TS, 11T1L TS	2	ABB	FR4H073001036A	TEST SWITCH, FT19R, 4RU, ANSI 70, BLACK COVER A: 10 CURRENTS B: 10 POTENTIALS C: 10 TRIPS
87B1 TS	1	ABB	FR4H073000036A	TEST SWITCH, FT19R, 4RU, ANSI 70, BLACK COVER A: 10 CURRENTS B: BLANK C: 10 TRIPS
86C1	1	ES	7802D	MANUAL RESET LOCK-OUT RELAY (TRIP-RESET) WITH OVAL HANDLE, 2 DECKS, ENGR CODE: 17C-2L22
LOR TS	1	ABB	FR4H036000000A	TEST SWITCH, FT19R, 4RU, ANSI 70, BLACK COVER A: 10 TRIPS B: BLANK C: BLANK
52V1CS	1	ES	74PD202LT	CONTROL SWITCH (TRIP-CLOSE) WITH PISTOL GRIP, 2 DECKS, GREEN AND RED LEDS, ENGR CODE: 123B-2B23
89C1CS	1	ES	74PBGXRM202LA	CONTROL SWITCH (TRIP-CLOSE) WITH PISTOL GRIP, 2 DECKS, GREEN AND RED LED, ENGR CODE: 123B-2C24BZ
43L/R	2	ES	24202B	CONTROL SWITCH (LOCAL-REMOTE) WITH OVAL HANDLE, 2 DECKS, ENGR CODE: 10D-2L24A
DFR-VT2	1	ERL	101756	DFR VT MODULE
DFR-TS-VT	1	ABB	129A501G01	DFR VOLTAGE TEST SWITCH

NAMEPLATE ENGRAVING SCHEDULE

NP NO	NP SIZE	QTY.	FIRST LINE	LET SIZE	SECOND LINE	LET SIZE	THIRD LINE	LET SIZE
NP1	3" X 2"	2	PANEL 5	1/2"	VAR BUS 1	1/4"	& 34.5KV BUS	1/4"
NP2	2.5" X 0.75"	1	11V1	5/32"	VAR BUS 1 RELAY	5/32"		
NP3	6" X 1.25"	1	SEE TAG BELOW	1/8"				
NP4	6" X 1.25"	1	SEE TAG BELOW	1/8"				
NP5	6" X 1.25"	1	SEE TAG BELOW	1/8"				
NP6	2.5" X 0.75"	1	52V1CS	5/32"	TRIP/CLOSE	5/32"		
NP7	2.5" X 0.75"	1	52V1-43L/R	5/32"	LOCAL/REMOTE	5/32"		
NP8	NOT USED							
NP9	2.5" X 0.75"	1	89C1CS	5/32"	TRIP/CLOSE	5/32"		
NP10	2.5" X 0.75"	1	86C1	5/32"	LOCK-OUT RELAY	5/32"		
NP11	2.5" X 0.75"	1	89C1-43L/R	5/32"	LOCAL/REMOTE	5/32"		
NP12	6" X 1.25"	1	SEE TAG BELOW	1/8"				
NP13	NOT USED							
NP14	NOT USED							
NP15	2.5" X 0.75"	1	87B1	5/32"	34.5KV BUS 1	5/32"	PRIMARY RELAY	5/32"
NP16	6" X 1.25"	1	SEE TAG BELOW	1/8"				
NP17	NOT USED							
NP18	6" X 1.25"	1	SEE TAG BELOW	1/8"				
NP19	2.5" X 0.75"	1	11T1L	5/32"	34.5KV BUS 1	5/32"	SECONDARY RELAY	5/32"
NP20	6" X 1.25"	1	SEE TAG BELOW	1/8"				
NP21	6" X 1.25"	1	SEE TAG BELOW	1/8"				
NP22	6" X 1.25"	1	SEE TAG BELOW	1/8"				
NP23	6" X 1.25"	1	SEE TAG BELOW	1/8"				
NP24	2.5" X 0.75"	1	DFR-VT2	5/32"	MODULE	5/32"		



PANEL DETAIL
TOP VIEW



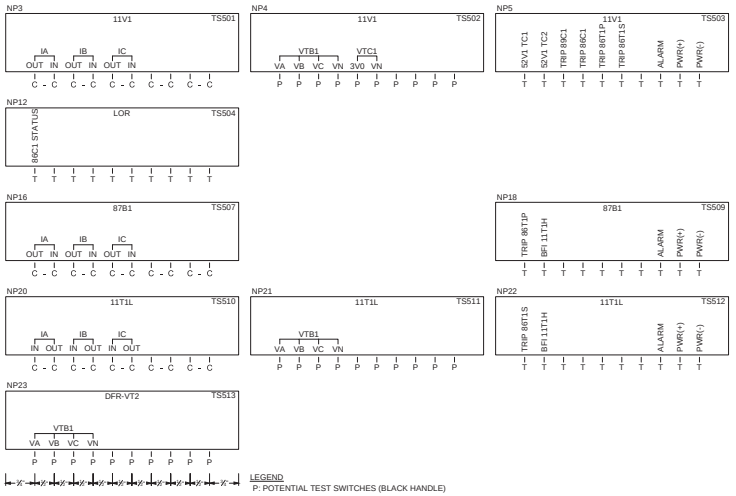
FRONT ELEVATION
DETAIL A-A

INSIDE LEFT
DETAIL B-B

INSIDE RIGHT
DETAIL C-C

NOTES:

1. REFER TO RELAY PANEL SPECIFICATION FOR INTERNAL AND EXTERNAL FINISH COLOR.
2. NAMEPLATES TO BE FURNISHED FOR EACH DEVICE INTERNAL TO THE PANEL.
3. TWO PANEL NAMEPLATES SHALL BE FURNISHED WITH EACH PANEL, ONE MOUNTED ON THE FRONT AND ONE MOUNTED ON THE BACK.
4. PANEL SUPPLIER SHALL VERIFY MANUFACTURER STYLE NUMBERS.
5. NAMEPLATES ARE TO BE WHITE WITH BLACK LETTERING AND ADHESIVE BACKING. TEXT SHALL BE CENTERED ON EACH LINE.
6. TEST SWITCH NAMEPLATES SHALL BE MOUNTED 1/4" FROM THE TOP OF THE TEST SWITCH ASSEMBLY.
7. TERMINAL & FUSE BLOCKS SHALL BE PROVIDED AS NECESSARY AND ACCESSIBLY MOUNTED.



LEGEND
P: POTENTIAL TEST SWITCHES (BLACK HANDLE)
T: TRIP TEST SWITCHES (RED HANDLE)
C-C: CURRENT TEST SWITCHES (BLACK HANDLE)

NORTHWEST OHIO WIND PROJECT

PAULDING COUNTY, OHIO

Rev.	Date	Description	By
0A	08/08/17	PRELIMINARY	UEI
0B	10/26/17	MANUFACTURE	UEI
0C	01/25/18	ISSUED FOR CONSTRUCTION	UEI

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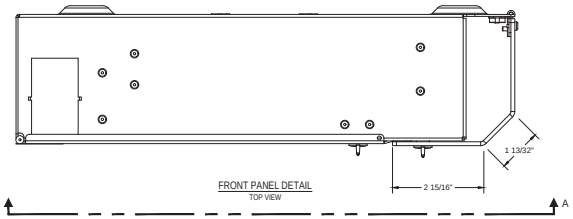
Design By: E. NEUHARDT
Drawn By: E. NEUHARDT
Approved By: J. OLSON
Project Number: 17.01246

SUBSTATION ELEVATION & BOM VAR BUS 1 & 34.5KV BUS PANEL 5

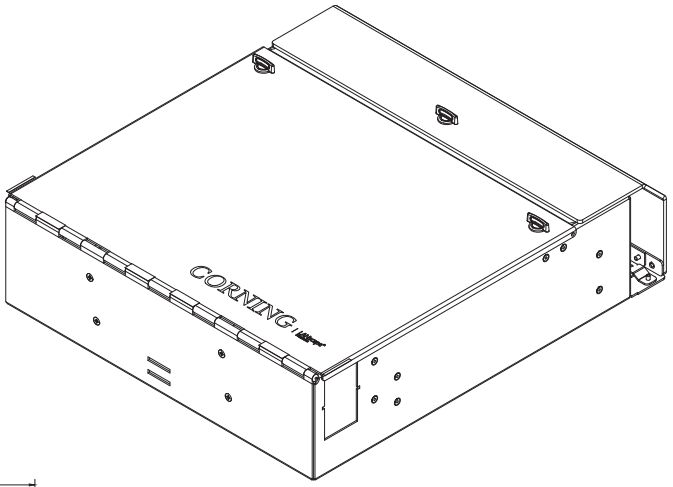
DWG #: NWO-FE-005
REVISION: 0C

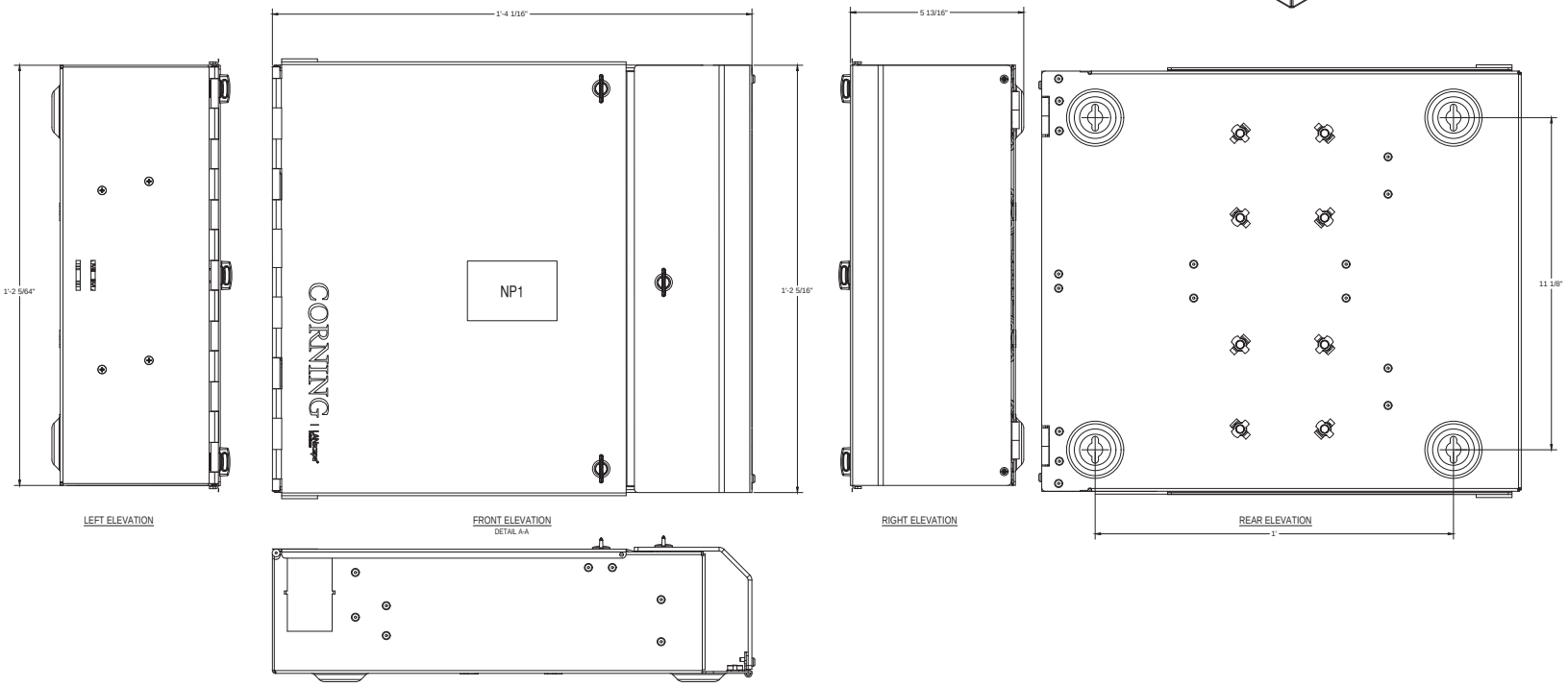
BILL OF MATERIAL				
DEVICE ID	QTY.	MANF.	STYLE OR CAT. NO.	DESCRIPTION
WCH	1	CORNING	WCH-06P	WALL-MOUNTABLE CONNECTOR HOUSING (WCH), HOLDS 6 CCH CONNECTOR PANELS/CASSETTES (14.3 IN X 16.1 IN X 5.8 IN)
STH	1	CORNING	WCH-SPLC-4-8	SPLICE TRAY HOLDER ACCOMODATES (8) 0.2 TYPE 2R REDUCED-LENGTH SPLICE TRAYS
ST	6	CORNING	M67-060	SPLICE TRAYS
SRLF	3	CORNING	WCH-STRNRLF-KIT	EXTERNAL CABLE STRAIN-RELIEF KIT
CCH	1	CORNING	CCH-CS12-6T-P00RE	CLOSET CONNECTOR HOUSING (CCH) SPLICE CASSETTE, 12 FIBER, PIGTAILED, ST COMPATIBLE CONNECTORS, SINGLE-MODE, UPC (OS2)
CCH	1	CORNING	CCH-CP12-5T-P03KH	CLOSET CONNECTOR HOUSING PANEL, PIGTAILED, ST CONNECTORS, SIMPLEX, UPC, 12 F, MULTI-MODE (OM1), 62.5um, 3m LENGHT
CCH	4	CORNING	CCH-CP12-59-P03RH	CLOSET CONNECTOR HOUSING PANEL, PIGTAILED, SC CONNECTORS, DUPLEX, UPC,12 F, SINGLE-MODE (OS2), 3m LENGHT

NAMEPLATE ENGRAVING SCHEDULE								
NP NO.	FIRST LINE	LET SIZE	SECOND LINE	LET SIZE	THIRD LINE	LET SIZE	NP SIZE	NO REQ
NP1	FPP1	1/2"	FIBER OPTIC	1/4"	PATCH PANEL 1	1/4"	3"x2"	2



FRONT PANEL DETAIL
TOP VIEW





LEFT ELEVATION

FRONT ELEVATION
DETAIL A-A

RIGHT ELEVATION

REAR ELEVATION

BOTTOM ELEVATION

NORTHWEST OHIO
WIND PROJECT

PAULDING COUNTY, OHIO

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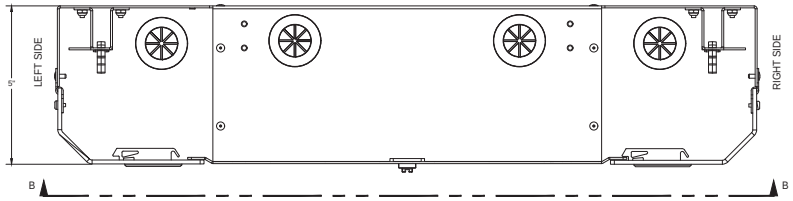
Drawn By: E. NEUHARDT
Approved By: J. OLSON
Project Number: 17.01246

SUBSTATION
ELEVATION & BOM
FIBER OPTIC PATCH
PANEL 1

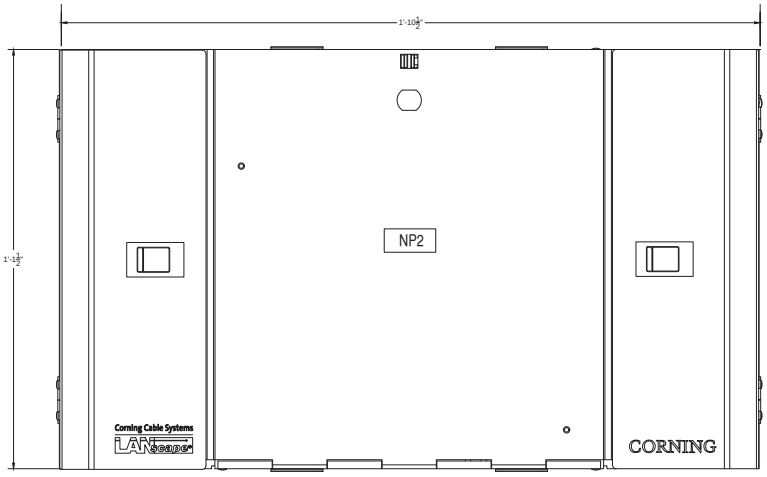
DWG #: NWO-FE-006
REVISION: 0C

BILL OF MATERIAL				
DEVICE ID	QTY.	MANF.	STYLE OR CAT. NO.	DESCRIPTION
WCH	1	CORNING	WCH-CLSSC-012P	WALL-MOUNTABLE CONNECTOR HOUSING (WCH), 12 CCH CONNECTION PANEL (13.5" X 22.5" X 5.1")
STH	1	CORNING	WCH-SPLC-12	SPLICE TRAY HOLDER ACCOMODATES (12) 0.2 TYPE 2R REDUCED-LENGTH SPLICE TRAYS
ST	6	CORNING	M67-060	SPLICE TRAYS
SRLF	3	CORNING	WCH-STRNRLF-KIT	EXTERNAL CABLE STRAIN-RELIEF KIT
CCH	8	CORNING	CCH-CP12-6T-P03RH	CLOSET CONNECTOR HOUSING PANEL, PIGTAILED, ST COMPATIBLE CONNECTORS, SIMPLEX, UPC, 12 F, SINGLE-MODE (OS2) 3m LENGTH

NAMEPLATE ENGRAVING SCHEDULE								
NP NO.	FIRST LINE	LET SIZE	SECOND LINE	LET SIZE	THIRD LINE	LET SIZE	NP SIZE	NO REQ
NP1	FPP2	1/2"	FIBER OPTIC	1/4"	PATCH PANEL 2	1/4"	3"x2"	2



FRONT PANEL DETAIL
TOP VIEW



FRONT ELEVATION
DETAIL B-B

NORTHWEST OHIO WIND PROJECT

PAULDING COUNTY, OHIO

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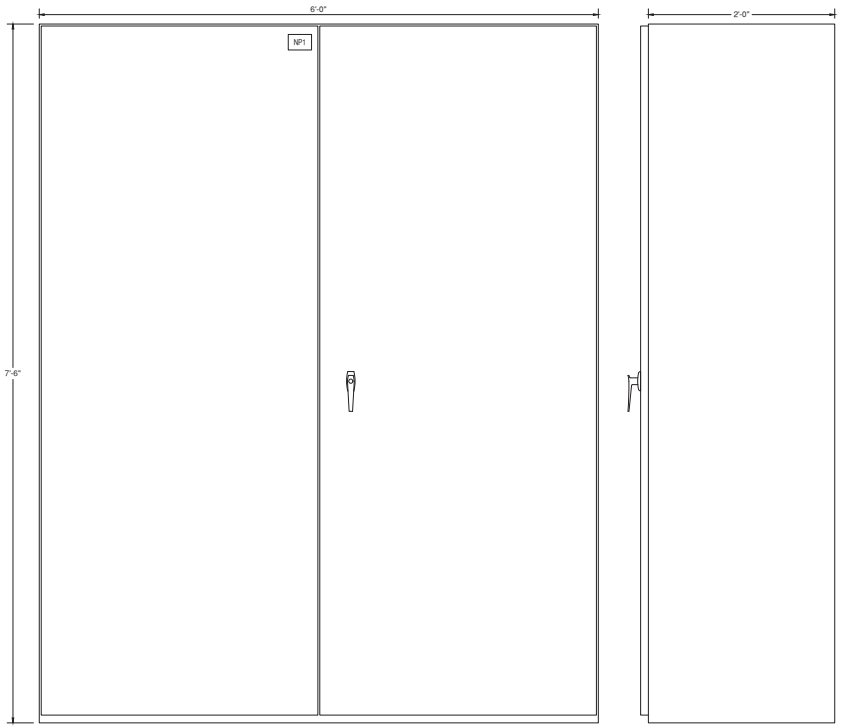
Drawn By: E. NEUHARDT
Approved By: J. OLSON
Project Number: 17.01246

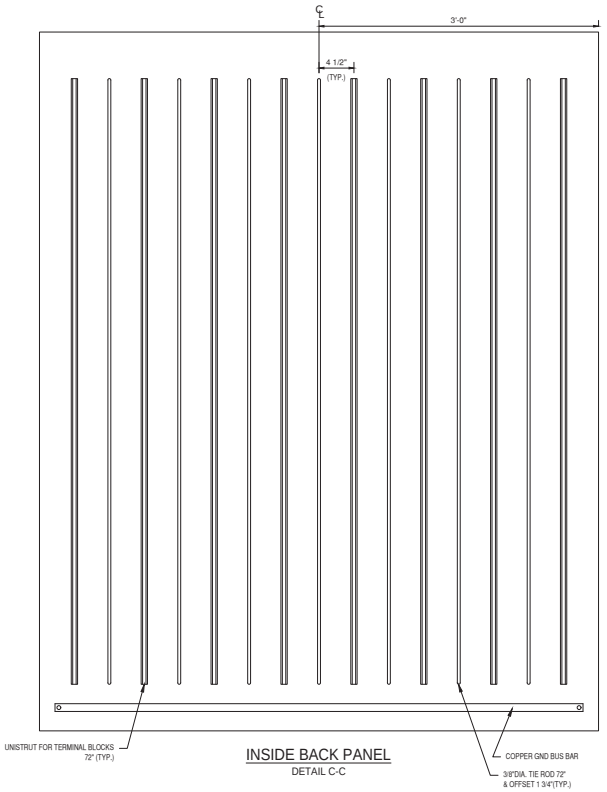
SUBSTATION ELEVATION & BOM FIBER OPTIC PATCH PANEL 2

DWG #: NWO-FE-007
REVISION: 0C

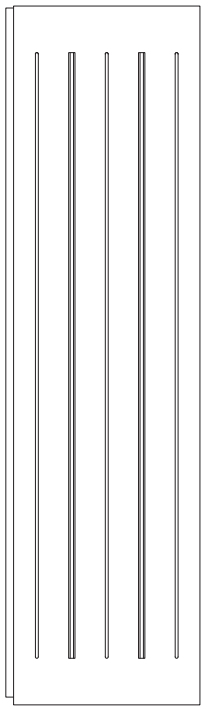


FRONT ELEVATION
DETAIL A-A

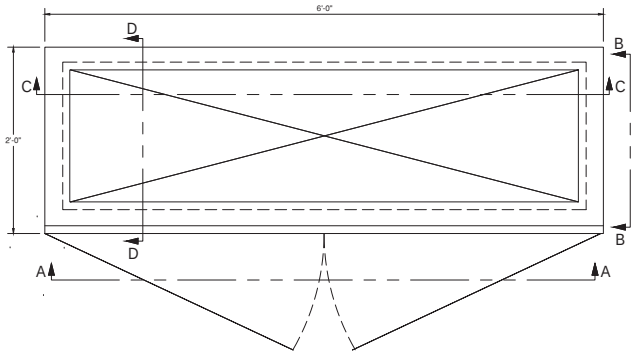
SIDE ELEVATION
DETAIL B-B



INSIDE BACK PANEL
DETAIL C-C



INSIDE SIDE PANEL
DETAIL D-D



PANEL PLAN VIEW
(OPEN TOP AND BOTTOM)

NAMEPLATE ENGRAVING SCHEDULE							
NP NO.	FIRST LINE	LET SIZE	SECOND LINE	LET SIZE	THIRD LINE	LET SIZE	NP SIZE	NO REQ
NP 1	MARSHALLING	1/2"	CABINET 1	1/4"	MC1	1/4"	3"x2"	1

NORTHWEST OHIO
WIND PROJECT

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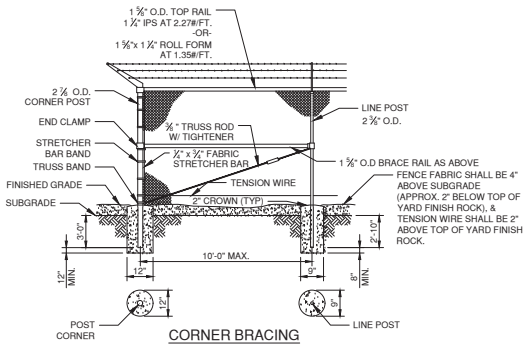
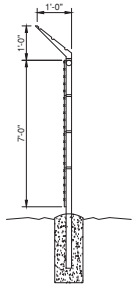
SUBSTATION
ELEVATION
MARSHALLING
CABINET 1

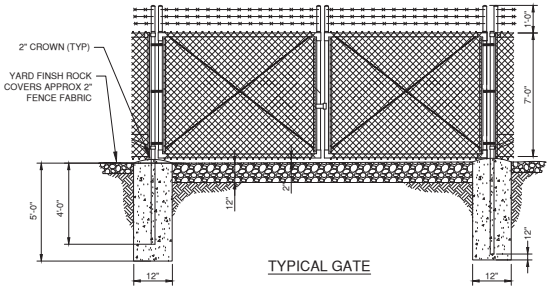
DWG #: NWO-FE-008
REVISION: 0C



CORNER BRACING



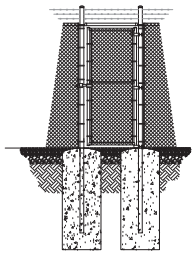
LINE POST



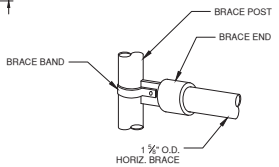
TYPICAL GATE

SECURITY SIGNS

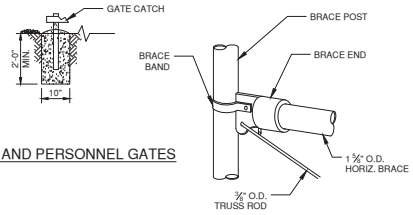
SEE CONSTRUCTION SPECIFICATION FOR COMPLETE LIST OF SECURITY SIGNS.



WALK GATE



BRACE ATTACHMENT



ROADWAY AND PERSONNEL GATES

BRACE AND TRUSS ATTACHMENT

TABLE A FENCE POSTS FOR 9ft FENCE		
USE	TYPE	MINIMUM SIZE
LINE POSTS	ROUND	2⅜" OD; t = .154in.
END, CORNER, PULL POSTS	ROUND	2⅞" OD; t = .203in.
GATE POSTS	ROUND	4" OD; t = .226 in.

FENCE MATERIALS AND ERECTION MATERIAL

1. FABRIC

THE FENCE SHALL BE A MINIMUM OF 7 FT. HIGH. IT SHALL CONSIST OF A MINIMUM NO. 9 USWG STEEL WIRE, WOVEN INTO A 2 IN. DIAMOND MESH. THE MINIMUM BREAKING STRENGTH OF WIRE SHALL BE 1200 LBS. THE SIDES OF THE MESH PATTERN SHALL BE APPROXIMATELY 45° TO A VERTICAL LINE.

THE FABRIC SHALL BE GALVANIZED IN ACCORDANCE WITH ASTM A392, CLASS II.

2. LINE, END, CORNER, PULL AND GATE POSTS

ALL POST SHALL BE STEEL AND CONFORM TO THE SIZES AS LISTED IN TABLE A, (BELOW), FOR THE SPECIFIC TYPE OF APPLICATION. STRENGTH AND PROTECTIVE COATINGS OF ALL FENCE FRAMEWORK SHALL CONFORM TO ASTM F1043.

TUBULAR MATERIAL SHOULD CONFORM TO ASTM A53 GRADE B, FOR ROUND SHAPES AND ASTM A500 GRADE B OR ASTM A501 FOR SQUARE SHAPES. ROLL-FORMED SECTIONS SHALL MEET THE YIELD STRESS REQUIREMENTS OF ASTM A36 AS A MINIMUM.

LINE POSTS SHALL BE OF SUFFICIENT HEIGHT TO; (A) ACCOMMODATE A 7 FT FABRIC; (B) ACCOMMODATE EXTENSION ARMS, AND (C) BE EMBEDDED 34 IN INTO THE CONCRETE FOOTING.

END, CORNER AND PULL POST SHALL BE OF SUFFICIENT HEIGHT TO (A) ACCOMMODATE A 7 FT FABRIC; (B) ACCOMMODATE EXTENSION ARMS OR EXTEND 1 FT EXTRA, AND (C) BE EMBEDDED 36 IN INTO THE CONCRETE FOOTING.

GATE POSTS SHALL BE OF SUFFICIENT HEIGHT TO; (A) ACCOMMODATE A 7 FT FABRIC; (B) ACCOMMODATE EXTENSION ARMS, AND (C) BE EMBEDDED 48 IN INTO THE CONCRETE FOOTING.

ALL TUBULAR POSTS SHALL BE GALVANIZED IN ACCORDANCE WITH ASTM A53. ROLL FORMED SECTIONS SHALL BE GALVANIZED IN ACCORDANCE WITH ASTM A123.

3. TOP RAIL

TOP RAILS SHALL BE ROUND STEEL PIPE OR TUBING. THE MINIMUM SIZE SHALL NOT BE LESS THAN 1 ⅝" OD NOR HAVE A MINIMUM WALL THICKNESS LESS THAN .138 IN. COUPLINGS SHALL BE THE OUTSIDE SLEEVE TYPE, SPACED ABOUT 20 FT APART AND AT LEAST 6 IN LONG, WITH PROVISIONS FOR EXPANSION AND CONTRACTION. THE TOP RAIL SHALL PASS THROUGH THE BASE OF THE EXTENSION ARM AND BE SECURELY FASTENED TO THE END, GATE AND PULL POSTS.

TOP RAILS SHALL BE GALVANIZED IN ACCORDANCE WITH ASTM A53.

4. BARBED WIRE

BARBED WIRE SHALL CONSIST OF TWO STRANDS OF 12 ½ USWG STEEL WIRE WITH 4-POINT BARBS AT A MAXIMUM SPACING OF 5 IN APART. THE WIRE SHALL BE GALVANIZED AFTER WEAVING IN ACCORDANCE WITH ASTM A121, CLASS 3, OR ALUMINUM COATED PER ASTM A-585, CLASS 2.

THREE LINES OF BARBED WIRE SHALL BE PROVIDED.

5. EXTENSION ARMS

THE EXTENSION ARMS SHALL EXTEND UPWARD AND OUTWARD FROM THE FENCE AT AN ANGLE OF 45°. THERE SHALL BE PROVISIONS FOR THREE EQUALLY SPACED LINES OF BARBED WIRE ON THE EXTENDED ARMS. THE UPPERMOST WIRE SHALL BE APPROXIMATELY 1 FT VERTICALLY ABOVE THE FABRIC AND 1 FT HORIZONTALLY OUTSIDE THE FENCE LINE.

THE EXTENSION ARM SHALL BE MADE OF PRESSED STEEL OR MALLEABLE IRON AND SHOULD BE DESIGNED FOR A 300 LBS MINIMUM PULL DOWN LOAD BEING APPLIED AT ARMS TIP.

THE EXTENSION ARM SHALL BE GALVANIZED IN ACCORDANCE WITH ASTM A153, CLASS B1.

6. STRETCHER BAR

STRETCHER BARS SHALL BE GALVANIZED STEEL BARS NOT LESS THAN ¼"x ¾". THEY SHALL BE APPROXIMATELY 1 IN LESS THAN THE FABRIC HEIGHT.

THE STRETCHER BAR SHALL BE USED FOR SECURING THE FABRIC TO ALL TERMINAL POSTS. ONE BAR IS REQUIRED FOR EACH GATE AND END POST. TWO ARE REQUIRED FOR EACH CORNER AND PULL POST.

7. POST BRACES

POST BRACES ARE REQUIRED AT EACH GATE, CORNER, PULL AND END POST. IT SHALL CONSIST OF A STRUT, WHICH SHALL NOT BE LESS IN SIZE THAN THE TOP RAIL, AND A TRUSS ROD WITH TURNBUCKLE. THE ROD SHALL BE STEEL AND HAVE A MINIMUM DIAMETER OF ⅜".

THE TRUSS SHALL BE SECURED NEAR THE BASE OF THE CORNER GATE, PULL OR END POST. THE SECOND END SHALL BE SECURED AT APPROXIMATELY MID-HEIGHT ON THE ADJACENT LINE POST.

BRACING MEMBERS SHALL ALL BE HOT-DIP GALVANIZED PER ASTM 153.

8. TENSION WIRE

TENSION WIRE SHALL BE NO. 6 GAUGE COIL SPRING STEEL WIRE. ONE TENSION WIRE SHALL BE LOCATED AT THE BOTTOM OF THE FABRIC AND ATTACHED WITH HOG RINGS TO THE FABRIC ON 24" CENTERS.

9. GATE FRAMES

GATE FRAMES SHALL BE CONSTRUCTED OF TUBULAR STEEL MEMBERS WHICH SHALL BE WELDED AT THE JOINTS. ADDITIONAL HORIZONTAL AND VERTICAL STRUTS MAY BE REQUIRED TO PROVIDE FOR A RIGID GATE PANEL, ALLOWING FOR NO VISIBLE SAG OR TWIST. GATE FRAMES SHALL BE MADE TO HAVE APPROXIMATELY 3" CLEARANCE ABOVE THE ROAD.

FABRIC FOR THE GATE PANELS SHALL BE THE SAME AS THE FENCE.

GATE FRAME AND BRACING MEMBERS SHALL NOT BE LESS THAN THE STRUCTURAL EQUIVALENT OF 2 ⅜" OD STANDARD PIPE. STEEL TENSION RODS AND TURNBUCKLES MAY ALSO BE UTILIZED. GATE FRAME SHALL HAVE PROVISIONS FOR THREE LINES OF BARBED WIRE ABOVE FABRIC. ALL GATE FRAME MATERIAL SHALL BE HOT-DIP GALVANIZED PER ASTM A-120.

10. HARDWARE

HINGES SHALL BE HEAVY DUTY AND ALLOW 180° SWING OF ALL GATE LEAVES. THE HINGES SHALL NOT TWIST OR TURN UNDER THE ACTION OF THE GATE AND SHALL PROVIDE EASE OF OPERATION.

LATCHES, STOPS AND KEEPERS SHALL ALL BE HEAVY DUTY CONSTRUCTION OF GALVANIZED STEEL OR MALLEABLE IRON AND SHALL CONFORM TO ASTM A-48 SPECS FOR GRAY IRON CASTING, ASTM 1-47 SPECS FOR MALLEABLE IRON CASTING AND 2SAE-1025 SPECS FOR ROLLED PRESSED AND FOR STEEL. FORK LATCHES SHALL HAVE A HEAVY DUTY DROP BAR. THE CENTER STOP SHALL BE A SPRING OPERATED LATCHING TYPE MADE TO BE CAST IN CONCRETE AND ENGAGE THE DROP BAR. A KEEPER SHALL BE PROVIDED WHICH WILL SECURE THE FREE END OF THE GATE IN THE OPEN POSITION.

HARDWARE SHALL ALLOW FOR GATE OPERATION FROM EITHER SIDE WITH PROVISIONS FOR SECURING WITH PADLOCK.

ALUMINUM TIES AND BANDS SHALL BE OF ALUMINUM WIRE PER ASTM B-211, OR ALUMINUM STRIP PER ASTM B-209. STEEL TIES AND BANDS SHALL BE OF STEEL WIRE WITH 0.8 OZ. OF ZINC COATING PER SQUARE FT OF SURFACE, NO. 6 GAUGE WIRE FOR FASTENING FABRIC TO LINE POST, NO. 9 GAUGE WIRE FOR FASTENING TO TOP RAIL, ¾" x 1" FOR BANDS, AND ¾" x ¾" STEEL FOR STRETCHER BARS. THE SPACING SHALL BE EVERY 24" ON THE TOP RAIL FOR THE TIES AND EVERY 14" ON THE POSTS FOR THE BAND.

ERECTION

THE FABRIC SHALL BE PLACED ON THE OUTSIDE OF THE POSTS, STRETCHED TAUT AND SECURED TO THE POSTS, TOP RAIL AND TENSION WIRE. THE FABRIC SHALL BE SECURED TO THE LINE POSTS WITH WIRE TIES OR METAL BANDS AT MAXIMUM INTERVALS OF 14". THE TOP AND BOTTOM EDGES SHALL BE SECURED, RESPECTIVELY, TO THE TOP RAIL AND TENSION WIRE WITH TIE WIRES NOT EXCEEDING INTERVALS OF 24". THE FABRIC SHALL BE SECURED TO TERMINAL POSTS BY MEANS OF THE STRETCHER BAR WHICH IS PASSED THROUGH THE END LOOPS OF FABRIC AND IS SECURED TO THE TERMINAL POSTS BY METAL BANDS SPACED AT A MAXIMUM INTERVAL OF 14".

FABRIC FOR FENCING SHALL ALL BE EITHER A LEFT-HAND OR RIGHT-HAND WEAVE. ROLLS OF FABRIC SHALL BE JOINED TOGETHER BY WEAVING A SINGLE STRAND INTO THE END OF THE ROLL TO FORM A CONTINUOUS PIECE.

THE SPACING OF LINE POSTS (10' MAX) SHALL IN GENERAL BE MEASURED PARALLEL TO THE GROUND. ALL POSTS SHALL BE PLACED IN A VERTICAL POSITION EXCEPT AS MAY BE SPECIFICALLY DESIGNATED OTHERWISE, WITH THE STRONG AXIS PARALLEL TO THE FABRIC. ALL POSTS SHALL BE SET IN HOLES AND BACKFILLED WITH CONCRETE. CONCRETE SHALL HAVE A MAXIMUM COMPRESSIVE STRENGTH OF 2500 PSI AT 28 DAYS WITH A MAXIMUM SIZE OF AGGREGATE OF ¾". THE CONCRETE SHALL BE WELL WORKED (RODDED) IN THE HOLE. THE TOP OF THE FOOTING SHALL BE CROWNED TO SHED WATER.

THE MINIMUM DIAMETER OF HOLES FOR LINE POSTS SHALL BE 9" AND 12" FOR TERMINAL POSTS.

THE MINIMUM DEPTH OF THE FOOTING HOLES SHALL BE 42".

NORTHWEST OHIO
WIND PROJECT

PAULDING COUNTY, OHIO

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0B	1/25/18	ISSUED FOR CONSTRUCTION	UEI

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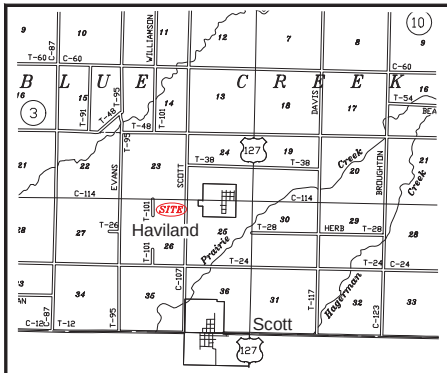
Design By: T. SEVERANCE
Drawn By: P. IWUCHUKWU
Approved By: J. OLSON
Project Number: 17.01246

FENCE PLAN AND DETAILS

DWG #: NWO-FP1-001
REVISION: 0B



VICINITY MAP

CONTROL DATUM

NORTH AMERICAN DATUM OF 1983 (2011)
COORDINATE SYSTEM IS OHIO STATE PLANE, NORTH ZONE

ELEVATIONS ARE BASED ON NAVD 88 AS DETERMINED BY THE NGS (NATIONAL GEODETIC SURVEY).

STATE OF OHIO,
COUNTY OF PAULDING,
TOWNSHIP OF BLUE CREEK,
VILLAGE OF HAVILAND

LOCATED IN NE QTR OF NE QTR, SECTION 26, TOWNSHIP 1 NORTH, RANGE 2 EAST

B.M. #1: ELEVATION = 736.13'

N=498,288.244 E=1,390,872.906

BRASS PLATE FOUND ON CONCRETE MONUMENT LOCATED ON THE SOUTH PROPERTY LINE APPROXIMATELY 374' WEST OF THE EDGE OF PAVEMENT OF C.R. 107.

B.M. #2: ELEVATION = 735.84'

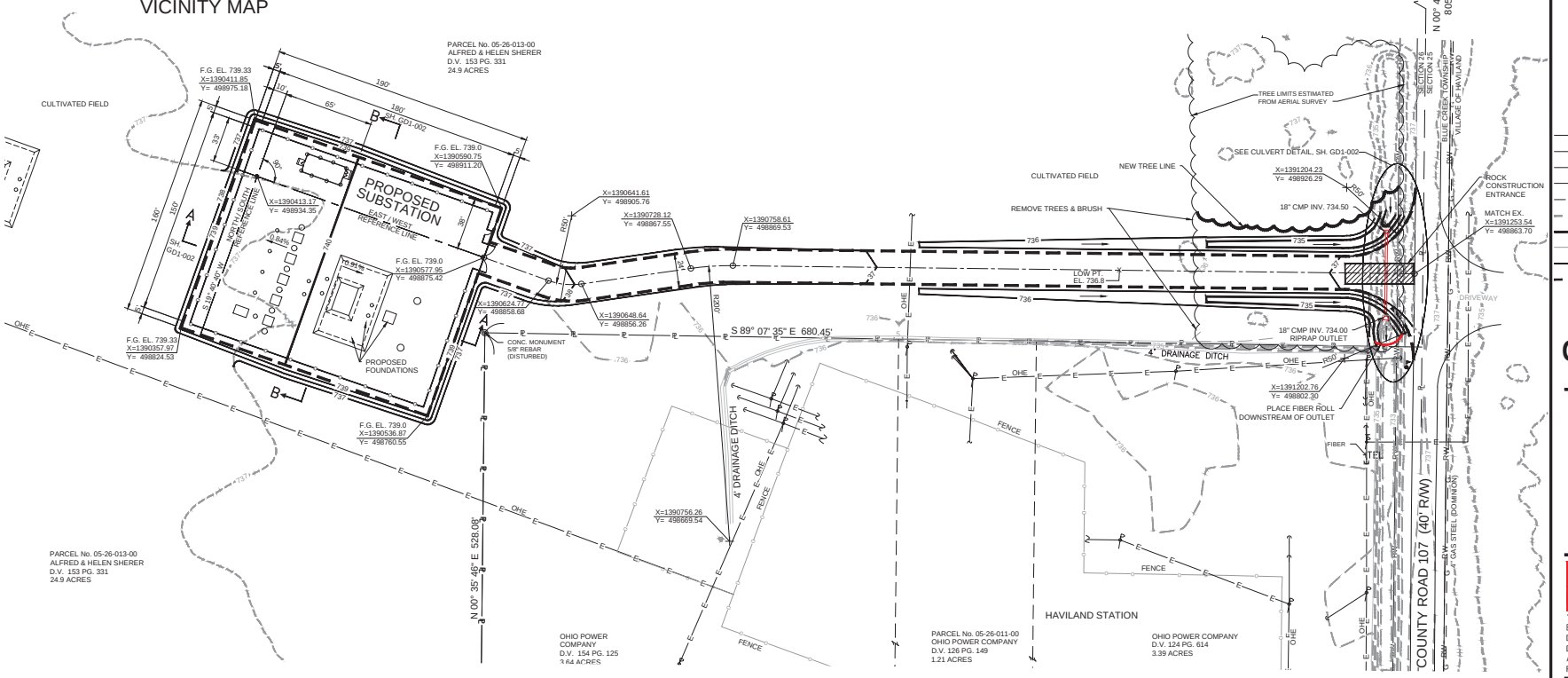
N=498,292.785 E=1,390,573.046

5/8" REBAR FOUND IN CONCRETE MONUMENT LOCATED ON THE SOUTH PROPERTY LINE, IN THE SOUTHWESTERLY CORNER OF THE 3.64 ACRE TRACT OF THE OHIO POWER COMPANY AND BEING APPROXIMATELY 674' WEST OF THE EDGE OF PAVEMENT OF C.R. 107.

GRAPHIC SCALE
0 20 40 80
1 inch = 40 feet

NOTES:

1. CONTOURS ARE SHOWN IN ONE FOOT INTERVALS.
2. F.G. INDICATES TOP OF FINISHED GRADE. SEE TYPICAL SUBSTATION SECTION, SH. 2.



NOTICE

OHIO UTILITIES PROTECTION SERVICE
CALL BEFORE YOU DIG
811 OR 1-800-362-2764

NORTHWEST OHIO WIND PROJECT

PAULDING COUNTY, OHIO

Rev.	Date	Description	By
0A	08/30/17	PRELIMINARY	UEI
0B	09/06/17	PRELIMINARY	UEI
0C	10/19/17	PRELIMINARY	UEI
0D	11/21/17	90% DESIGN PACKAGE	UEI
0E	1/25/18	ISSUED FOR CONSTRUCTION	UEI

WHITE an IEA company

LEGEND

- POWER POLE
- TELEPHONE/POWER POLE
- DEADMAN/GUY POLE
- TEL — TELEPHONE LINE MARKER
- CONC. MONUMENT FD.
- MAILBOX
- OHE — OVERHEAD ELECTRIC
- F.G. — FINISHED GRADE
- PROPERTY LINE
- RW — RIGHT OF WAY
- EDGE OF PAVEMENT
- E — ELECTRIC LINE
- G — GAS MAIN
- EXISTING CONTOUR
- PROPOSED CONTOUR
- EXISTING FENCE
- PROPOSED FENCE
- PROPOSED GRAVEL
- FIBER ROLL

ISSUED FOR CONSTRUCTION

1/25/18

STATE OF OHIO
MARTIN FELIX PADULA
E-80306
REGISTERED
PROFESSIONAL ENGINEER
01-25-2018

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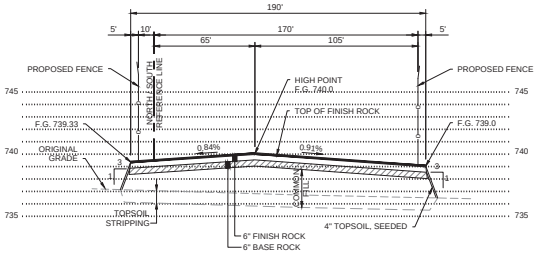
Design By: M. VELILLA
Drawn By: A. GAGNER-HELM
Approved By: M. PADULA
Project Number: 17.01246

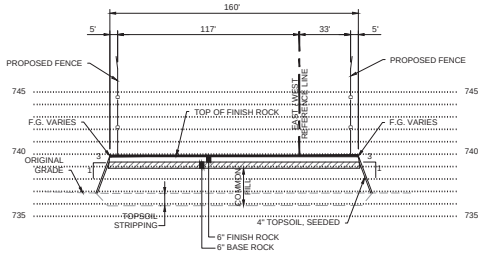
SUBSTATION GRADING PLAN

DWG #: NWO-GD1-001
REVISION: 0E



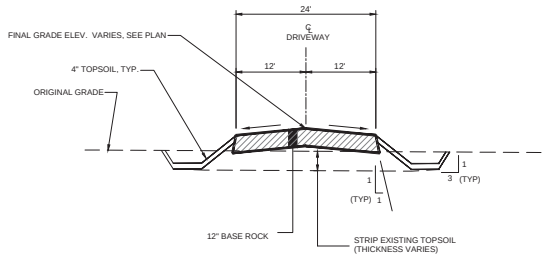
SECTION A-A

SCALE:
HORIZONTAL: 1" = 40'
VERTICAL: 1" = 5'



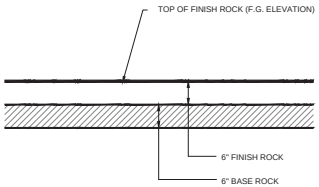
SECTION B-B

SCALE:
HORIZONTAL: 1" = 40'
VERTICAL: 1" = 5'



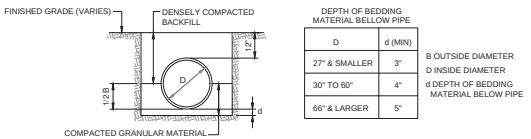
DRIVEWAY SECTION

TYPICAL THRU DRIVEWAY
SCALE: NONE



TYPICAL SUBSTATION SECTION

TYPICAL THRU SUBSTATION PAD
SCALE: NONE

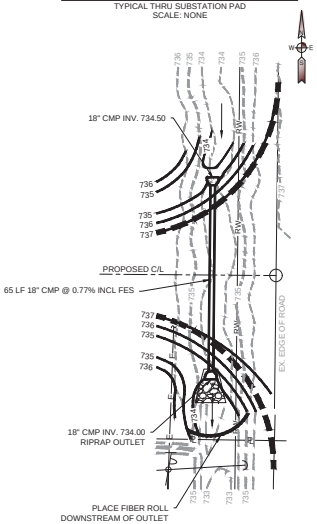


DEPTH OF BEDDING MATERIAL BELLOW PIPE	
D	d (MIN)
27" & SMALLER	3"
30" TO 60"	4"
66" & LARGER	5"

B OUTSIDE DIAMETER
D INSIDE DIAMETER
d DEPTH OF BEDDING MATERIAL BELOW PIPE

TYPICAL PIPE BEDDING SECTION

SCALE: NONE



CULVERT DETAIL PLAN

SCALE: 1"=20'
FOR FULL LEGEND, SEE SH. GD01

CONSTRUCTION NOTES

1. THE SITE TOPSOIL SHALL BE STRIPPED OF VEGETATION TO SUCH DEPTH AS MAY BE NECESSARY TO REMOVE ROOTS AND OTHER ORGANIC MATTER.
2. THE GRADING CONTRACTOR SHALL BE RESPONSIBLE FOR DISPOSAL OF ALL DEBRIS, INCLUDING TREES, BRUSH, ROOTS, AND SOD STRIPPING RESULTING FROM SITE PREPARATION OPERATIONS.
3. PRIOR TO PLACEMENT OF FILL, THE SUBGRADE SHALL BE PROOF-ROLLED WITH A FULLY LOADED TANDEM-AXLE DUMP TRUCK WITH A MINIMUM GROSS WEIGHT OF 25 TONS. UNSUITABLE AREAS OBSERVED SHALL BE IMPROVED BY COMPACTION OR BY REPLACEMENT WITH SUITABLE COMPACTED FILL .
4. AFTER COMPLETION OF STRIPPING, EXCAVATING, AND ALL SUBGRADE SURFACES IN THE AREA, THE CONTRACTOR SHALL OBTAIN APPROVAL OF THE SUBGRADE BY THE OWNER, PRIOR TO FURTHER CONSTRUCTION. ANY UNKNOWN WATER CONDITIONS OR SOIL CONSIDERED TO BE WEAK AND SUBJECT TO SIGNIFICANT DISPLACEMENT UNDER NORMAL EQUIPMENT WHEEL APPLICATION SHALL REQUIRE THE OWNER'S ENGINEER TO BE CONTACTED. UPON DISCOVERY OF ANY UNKNOWN WATER CONDITIONS OR WEAK SUBGRADE MATERIALS, THE ENGINEER MAY ORDER ADDITIONAL SUBCUTS OR GEOTEXTILE TREATMENT. THE CONTRACTOR SHALL PERFORM AND INSTALL THESE CHANGES AS DIRECTED BY THE OWNER. ALL OTHER DEBRIS SHALL BE REMOVED FROM THE SITE AND DISPOSED OF BY THE CONTRACTOR WITHOUT LIABILITY ON THE PART OF THE OWNER.
5. FILLS AND EMBANKMENTS SHALL BE CONSTRUCTED IN UNIFORM LIFTS OR LAYERS NOT EXCEEDING 9 INCHES OF LOOSE FILL AND LAID PARALLEL TO THE FINISHED SURFACE.
6. COMPACT FILL MATERIAL IN LIFTS NOT EXCEEDING 9 INCHES UNCOMPACTED THICKNESS TO 95% OF STANDARD PROCTOR DENSITY (ASTM D698). MAINTAIN MOISTURE CONTENT WITHIN PLUS OR MINUS 2% OF THE OPTIMUM DETERMINED FOR MAXIMUM DENSITY OR AS RECOMMENDED BY GEOTECHNICAL ENGINEERING REPORT. DO NOT PLACE, SPREAD, OR COMPACT FILL MATERIAL DURING WET OR UNFAVORABLE WEATHER CONDITIONS. WET GRANULAR MATERIALS THOROUGHLY DURING OR IMMEDIATELY PRIOR TO COMPACTION.
7. FINISH FILL, EXCAVATED, AND OTHER DISTURBED AREAS TO UNIFORM GRADE AND SECTION NORMALLY OBTAINABLE WITH A BLADE GRADER FINISH GRADE TO A NEAT APPEARANCE AND PROVIDE POSITIVE DRAINAGE. ALLOWABLE TEMPLATE TOLERANCE: ± 0.10 FT.
8. SEE SPECIFICATION FOR FILL MATERIAL DESCRIPTION.
9. SEE GEOTECHNICAL ENGINEERING REPORT STARWOOD ENERGY GROUP GLOBAL, NORTHWEST OHIO WIND PROJECT, PAULDING COUNTY, OHIO, DATED DECEMBER 2014 BY BARR ENGINEERING FOR SITE PREPARATION RECOMMENDATIONS.

GENERAL NOTES

1. STRIPPING MATERIAL TO BE USED FOR DRESSING OF SIDE SLOPES.
2. LOCATION AND STAKING OF THE SITE WITHIN THE PROPERTY LINES WILL BE THE RESPONSIBILITY OF THE CONTRACTOR.
3. ALL SLOPES 3:1 MAXIMUM UNLESS NOTED.
4. BASE ROCK AREA TO HAVE SOIL STERILANT APPLIED PRIOR TO PLACEMENT OF FINISH ROCK.
5. EXCESS MATERIAL SHALL BE HAULED OFF AND DISPOSED OF OFF SITE OR SPREAD EVENLY IN AREAS AS DIRECTED BY OWNER.
6. ELEVATIONS INDICATED IN SUBSTATION GRADED AREA ARE FINISHED GRADE.
7. CONTOURS OUTSIDE OF THE SUBSTATION GRADED AREA INDICATE THE TOP OF FINISHED TOPSOIL.
8. NO EQUIPMENT WILL BE ALLOWED TO CROSS RIVERS OR STREAM BEDS.

BASE ROCK (ROUGH GRADE)

SEE ODOT SPECIFICATION 304 AGGREGATE BASE FOR GRADATION AND DESCRIPTION.

FINISH ROCK (FINISHED GRADE)

1. SEE CONSTRUCTION SPECIFICATIONS 6.02.C5 FOR GRADATION AND DESCRIPTION.
2. SUBSTATION FINISH ROCK SHALL BE INSTALLED BY THE SUBSTATION CONSTRUCTION CREW AFTER INSTALLATION OF FOUNDATIONS, GROUNDING, CONDUIT AND FENCE IS COMPLETE.

STONE RIPRAP (COMMON, DRY)

1. SEE ODOT, ITEM 601.04 FOR GRADATION AND DESCRIPTION.
2. FILTER FABRIC SHALL MEET THE REQUIREMENTS OF DEPARTMENTAL MATERIAL ODOT SPECIFICATION 712.09, TYPE A.

CONSTRUCTION SEQUENCE

1. INSTALL ROCK CONSTRUCTION ENTRANCE.
2. INSTALL SILT FENCE (AS NECESSARY).
3. COMPLETE GRADING.
4. APPLY SEED, MULCH AND EROSION CONTROL BLANKET.
5. INSTALL FIBER ROLLS (AS NECESSARY).
6. AFTER VEGETATION IS ESTABLISHED, REMOVE SILT FENCE.

DETAIL REFERENCES

REFER TO STORM WATER POLLUTION PREVENTION PLAN (SWP3) NARRATIVE FOR NORTHWEST OHIO, PREPARED BY WESTWOOD PROFESSIONAL SERVICES, DATED SEPTEMBER 8, 2017.

SEE **ATTACHMENT E : SITE PLANS, EROSION AND SEDIMENT CONTROL PLANS, DETAILS** FOR THESE DETAILS:

- RIP RAP OUTLETS
- ROCK CONSTRUCTION ENTRANCE
- SILT FENCE
- SURFACE ROUGHENING FOR ALL SLOPES GREATER THAN 4:1
- TYPICAL FIBER ROLLS FOR PERIMETER CONTROL OF CONSTRUCTION AREA LIMIT
- TYPICAL SLOPE STABILIZATION-TEMPORARY EROSION BLANKETS TURF REINFORCEMENT MATS FOR SLOPES

NORTHWEST OHIO WIND PROJECT

PAULDING COUNTY, OHIO

Rev.	Date	Description	By
0A	10/19/17	PRELIMINARY	UEI
0B	11/21/17	90% REVIEW PACKAGE	UEI
0C	1/25/18	ISSUED FOR CONSTRUCTION	UEI

WHITE an IEA company

ISSUED FOR CONSTRUCTION
1/25/18

STATE OF OHIO
MARTIN FELIX PADULA
E-80306
REGISTERED
PROFESSIONAL ENGINEER
01-25-2018

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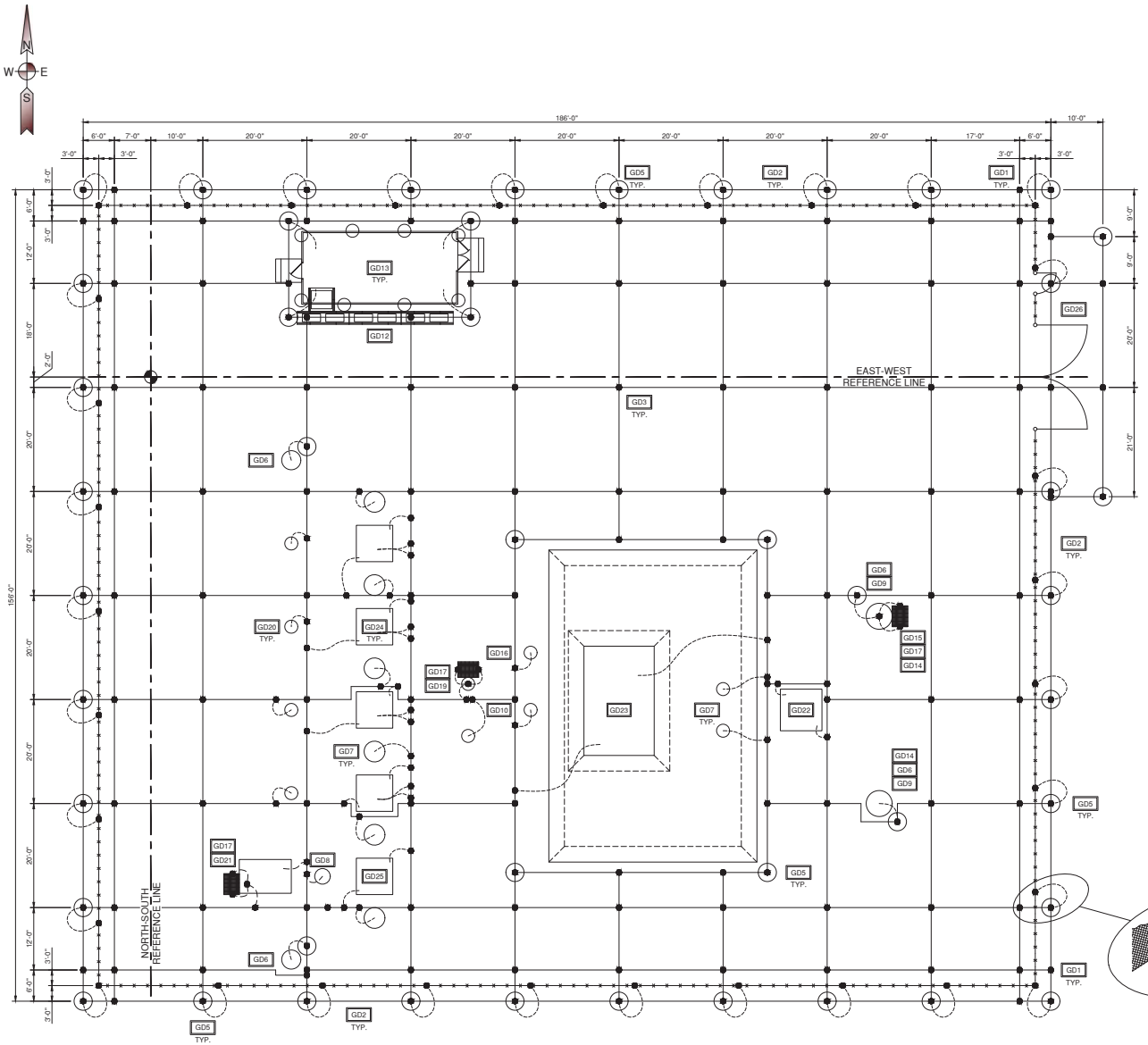
Approved By: M. PADULA
Project Number: 17.01246

SUBSTATION GRADING DETAILS

DWG #: NWO-GD1-002
REVISION: 0C



SUBSTATION GROUNDING NOTES

GROUND PIGTAILS
VERIFY EQUIPMENT GROUNDING LOCATIONS PRIOR TO PULLING UP PIGTAILS.

TESTING
PRIOR TO BRINGING IN THE FEEDER HOME RUNS AND CONNECTING THE TRANSMISSION LINE SHIELDS AND/OR OPGW THE GROUND GRID RESISTANCE SHALL BE MEASURED AND RECORDED.

MAIN GROUNDING SYSTEM
1. PROVIDE A CONTINUOUS GROUND SYSTEM WITH ONE CONDUCTOR LOCATED AROUND THE PERIMETER OF THE STATION AND WITH INTERTIES AND GROUND RODS AS SHOWN ON THE GROUNDING PLAN, TO EFFECTIVELY GROUND ALL STRUCTURES AND EQUIPMENT.
2. 4/0 BARE COPPER WIRE IS TO BE USED FOR THE MAIN GROUND SYSTEM, BURIED 18 INCHES BELOW SUBGRADE.
3. ALL GRID CONDUCTOR CONNECTIONS AS WELL AS CONNECTIONS TO EACH GROUND ROD ARE TO BE EXOTHERMIC.
4. GROUND RODS SHALL BE LOCATED AS SHOWN ON THE GROUNDING PLAN AND SHALL BE FULLY DRIVEN BELOW THE SURFACE OF THE EARTH. IF POSSIBLE, THE TOPS OF THE RODS SHOULD BE APPROXIMATELY ONE FOOT BELOW GRADE.
5. THE ENTIRE AREA INSIDE OF THE PERIMETER GROUND CONDUCTOR MUST BE COVERED WITH 6 INCHES OF CRUSHED ROCK POSSESSING A MINIMUM RESISTIVITY OF 3,000 Ω-m.

CONNECTIONS TO STEEL STRUCTURES AND EQUIPMENT
1. CONNECTIONS OF GROUND CABLES TO STEEL STRUCTURES AND EQUIPMENT SHALL BE SECURELY MADE WITH MECHANICAL CONNECTORS.
2. GROUND LEADS SHALL BE RUN UP AND OVER FOOTINGS AS INDICATED, AND UP THE STRUCTURES IN A NEAT AND WORKMAN-LIKE MANNER.
3. HOLES NECESSARY FOR ATTACHING CONNECTORS SHALL BE FIELD DRILLED AND TAPPED IF NECESSARY, WHERE NO PLATE OR TAB FOR ATTACHMENT HAS BEEN SUPPLIED.
4. WHERE CONNECTIONS TO THE GROUND MAT ARE STUBBED OUT AT EQUIPMENT FOOTINGS IN ADVANCE OF EQUIPMENT INSTALLATION, CARE SHALL BE TAKEN THAT A SUFFICIENT LENGTH OF CABLE PLUS A REASONABLE MARGIN IS LEFT SO THE LEAD MAY BE TRAINED UP ALONG THE WALL OF THE FOOTING AND MADE TO FOLLOW ALL SURFACES CLOSELY IN ROUTING CABLE TO THE POINT OF CONNECTION.
5. GROUND CABLES SHALL BE SUPPORTED APPROXIMATELY EVERY FOUR FEET WHEN EXTENDED UP THE STRUCTURE.

CONNECTIONS TO EQUIPMENT COMPARTMENTS, CONDUIT AND CABLES
1. ALL EQUIPMENT COMPARTMENTS SHALL BE GROUNDED.
2. ALL STEEL CONDUITS SHALL BE EFFECTIVELY GROUNDED EITHER BY DIRECT GROUNDS, OR BY ATTACHMENT TO METAL ENCLOSURE WHICH ARE ADEQUATELY GROUNDED.
3. ALL METALLIC POWER CABLE SHIELDS MUST BE SOLIDLY GROUNDED ON BOTH ENDS OR AS SHOWN ON THE CONTROL DRAWINGS.

FENCE GROUNDING
1. ALL METALLIC FENCING SHALL BE SECURELY TIED TO MAIN GROUND SYSTEM AT EACH FENCE CORNER AND AT INTERMEDIATE INTERVALS AS DETAILED ON THE GROUNDING PLAN.
2. THE PERIPHERAL CONDUCTOR OF THE MAIN GROUND GRID SHALL BE 4/0 BARE COPPER AND LOCATED 3 FEET OUTSIDE OF AND PARALLEL TO THE FENCE AND SHALL BE BURIED 18 INCHES BELOW SUBGRADE.
3. FENCE POSTS SHALL BE CONNECTED TO THE MAIN GROUND GRID AT INTERVALS OF 30 FEET.
4. GROUND RODS SHALL BE DRIVEN ALONG THE CONDUCTOR AND BONDED TO EACH FENCE CORNER AND AT INTERVALS AS DETAILED ON THE GROUNDING PLAN.

SWITCH CONTROL HANDLES AND GROUND MATS
1. ALL GROUP-OPERATED SWITCH CONTROL HANDLES SHALL BE GROUNDED AND PROVIDED WITH A PROTECTIVE SWITCH PLATFORM.
2. SWITCH PLATFORMS SHALL BE CENTERED UNDER THE SWITCH CONTROL ROD, AND GROUNDED AS SHOWN ON THE GROUNDING DETAILS.

GROUND GRID DESIGN DATA

(DESIGN IS BASED ON IEEE STD.80-2013 USING THE FOLLOWING DATA)

1.	SOIL MODEL:		
	LAYER 1 RESISTIVITY	26.42859 OHM-METER	
	LAYER 1 DEPTH	18.94574 FEET	
	LAYER 2 RESISTIVITY	480.6825 OHM-METER	GRID RESISTANCE CALCULATED: 1.2082 OHMS
2.	SURFACE ROCK RESISTIVITY	3,000 OHM-METER	
3.	SURFACE ROCK DEPTH	4 INCHES(6" INSTALLED)	
4.	MAXIMUM SYSTEM FAULT CURRENT	15,000 AMPS	
5.	FAULT DURATION	15 CYCLES	
6.	GRID CURRENT	52.85% OF MAXIMUM FAULT CURRENT	
7.	GPR	13,565.10 VOLTS (PEAK)	
8.	TOUCH PERMISSIBLE	979.7 VOLTS	
	MAX TOUCH	120.689 VOLTS	
	STEP PERMISSIBLE	3,224.5 VOLTS	
	MAX STEP	353.37 VOLTS	

BY FIELD

MEASURED: _____ OHMS TESTED BY: _____ PLEASE PRINT

CONTRACTOR TO PROVIDE DATA ON AS-BUILTS

SCALE 3/32" = 1'-0"

4' 0 4' 8' 12' 16' 20' 24' 28'

NORTHWEST OHIO WIND PROJECT

PAULDING COUNTY, OHIO

Rev.	Date	Description	By
0A	10/19/17	PRELIMINARY	UEI
0B	11/21/17	90% DESIGN PACKAGE	UEI
0C	1/25/18	ISSUED FOR CONSTRUCTION	UEI

WHITE an IEA company

NOTES:

1. FINISH GRAVEL TO EXTEND 5' PAST EDGE OF FENCE.

LEGEND:

- GDXX — DETAIL, SEE GROUNDING DETAIL, DWG.
- SUBSTATION FENCE w/ BARBS
- GROUND ROD (3/4" X 10'-0")
- #4/0 BARE COPPER (SOFT DRAWN) 18" BELOW GRADE
- EXOTHERMIC TYPE CONNECTION
- FENCE CONNECTION WITH GROUND ROD
- PIGTAIL TO EQUIPMENT/STRUCTURE
- SWITCH OPERATOR PLATFORM

ISSUED FOR CONSTRUCTION

THIS DOCUMENT HAS BEEN MODIFIED SINCE IT WAS SIGNED. IT SHALL NO LONGER BE CONSIDERED FOR CONSTRUCTION.

THE ORIGINAL OF THIS DOCUMENT IS A DIGITALLY SIGNED PDF

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Approved By: J. OLSON
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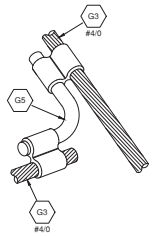
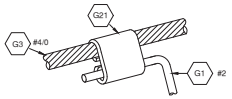
138/34.5KV SUBSTATION GROUNDING PLAN

DWG #: NWO-GR1-001
REVISION: 0C



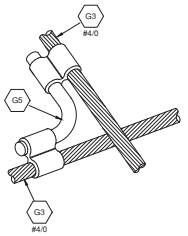
#4/0 RUN TO #4/0 TAP TEE CONNECTION

DETAIL GD1
N.T.S.



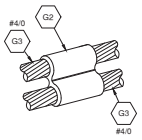
#4/0 RUN TO #2 SOLID TAP COMPRESSION CONNECTION

DETAIL GD2
N.T.S.



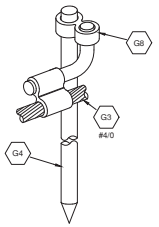
#4/0 RUN TO #4/0 TAP CROSS CONNECTION

DETAIL GD3
N.T.S.



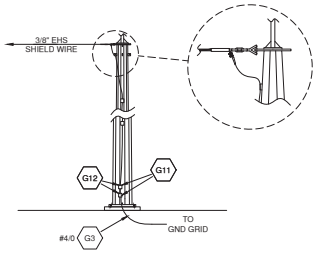
#4/0 RUN TO #4/0 SPLICE CONNECTION

DETAIL GD4
N.T.S.



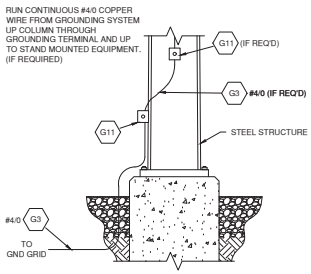
#4/0 RUN TO GROUND ROD CONNECTION

DETAIL GD5
N.T.S.



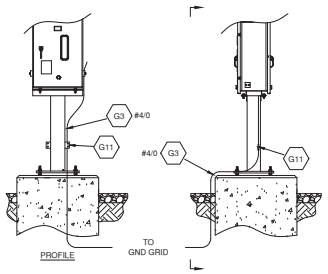
LIGHTNING MAST/H-RAME CONNECTION

DETAIL GD6
N.T.S.



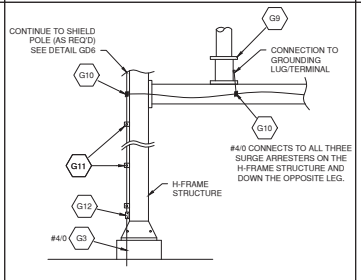
STEEL STRUCTURE CONNECTION

DETAIL GD7
N.T.S.



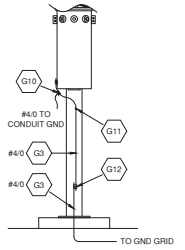
34.5KV CIRCUIT SWITCHER

DETAIL GD8
N.T.S.



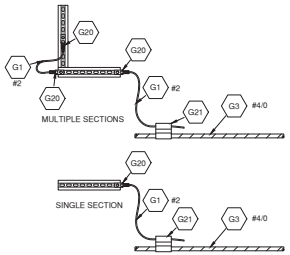
H-FRAME SURGE ARRESTER CONNECTION

DETAIL GD9
N.T.S.



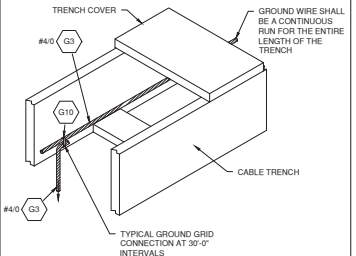
STATION SERVICE XFMR CONNECTION

DETAIL GD10
N.T.S.



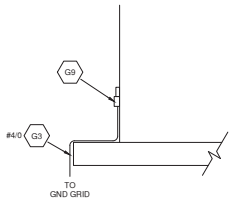
UNI-STRUT CONNECTION

DETAIL GD11
N.T.S.



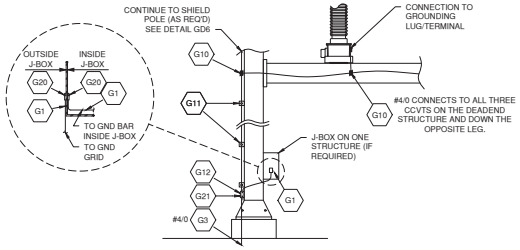
CABLE TRENCH CONNECTION

DETAIL GD12
N.T.S.



EQUIPMENT ENCLOSURE CONNECTION

DETAIL GD13
N.T.S.

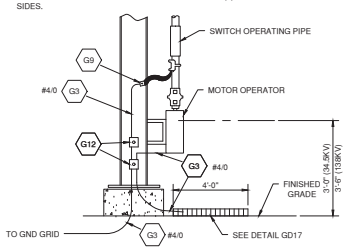


INSTRUMENT TRANSFORMER/J-BOX/EQUIPMENT CONNECTION

DETAIL GD14
N.T.S.

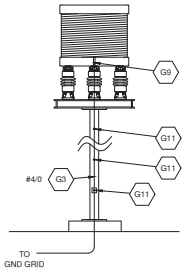
NOTES:

1. CONNECT GROUND PLATFORM TO SWITCH ON TWO (2) SIDES.



MOTOR OPERATED DISCONNECT SWITCH AND OPERATOR PLATFORM

DETAIL GD15
N.T.S.

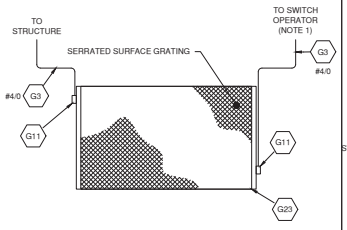


NEUTRAL GROUNDING REACTOR CONNECTION

DETAIL GD16
N.T.S.

NOTES:

1. PLATFORM GROUND SHALL BE A CONTINUOUS CONDUCTOR TO SWITCH OPERATING HANDLE. SPLICES ARE NOT PERMITTED

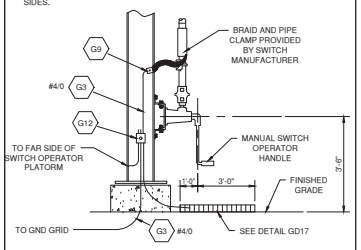


OPERATOR PLATFORM

DETAIL GD17
N.T.S.

NOTES:

1. CONNECT GROUND PLATFORM TO SWITCH ON TWO (2) SIDES.



MANUALLY OPERATED DISCONNECT SWITCH AND OPERATOR PLATFORM

DETAIL GD19
N.T.S.

NORTHWEST OHIO
WIND PROJECT

PAULDING COUNTY, OHIO

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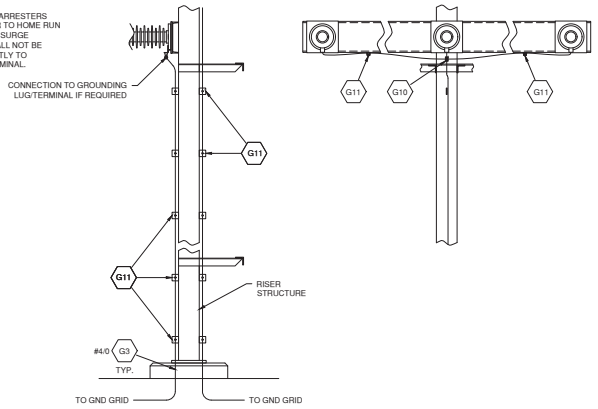
Design By: T. SEVERANCE
Drawn By: P. IWUCHUKWU
Approved By: J. OLSON
Project Number: 17.01246

138/34.5KV SUBSTATION
GROUNDING DETAILS

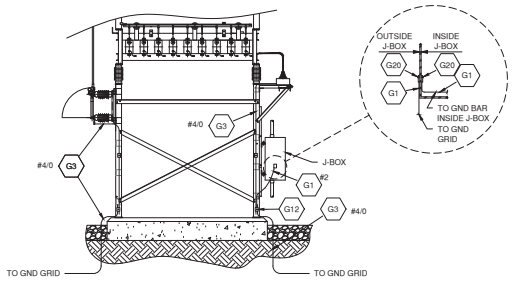
DWG #: NWO-GR2-001
REVISION: 0B

NOTES:

1. OUTER PHASE ARRESTERS SHALL JUMPER TO HOME RUN CONDUCTORS. SURGE ARRESTER SHALL NOT BE JUMPED DIRECTLY TO ADJACENT TERMINAL.



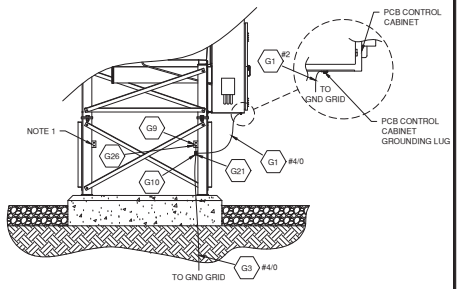
RISER POLE/ARRESTER
DETAIL GD20 N.T.S.



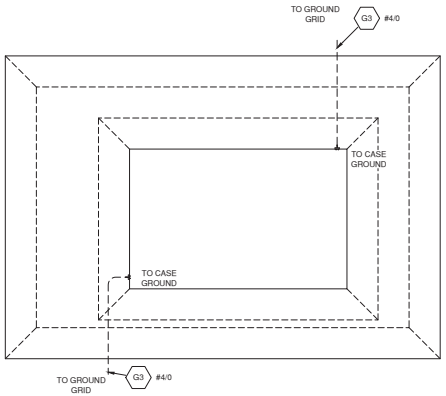
34.5KV CAP BANK AND J-BOX
DETAIL GD21 N.T.S.

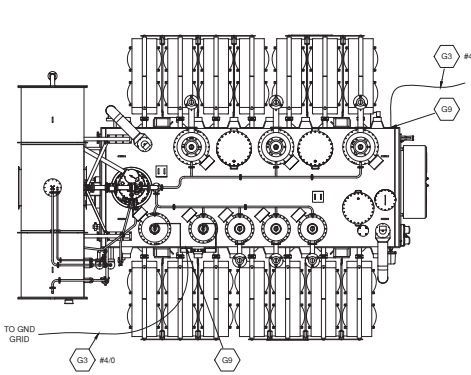
NOTES:

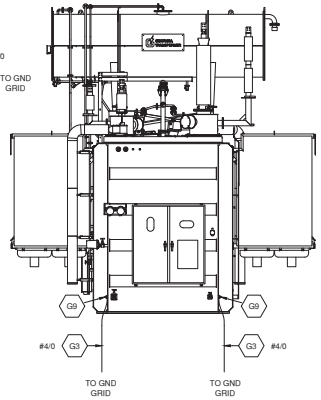
1. CONNECT 2 LEGS OF THE BREAKER STAND IN OPPOSITE CORNERS TO GROUND.

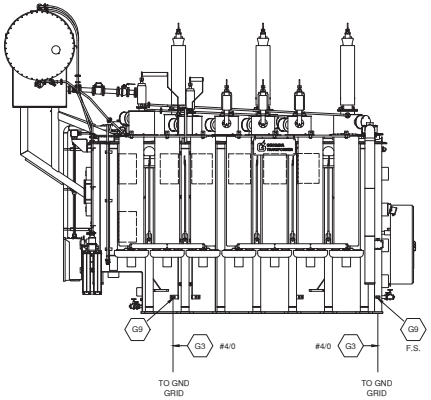


POWER CIRCUIT BREAKER CONNECTION
DETAIL GD22 N.T.S.









TRANSFORMER CONNECTION
DETAIL GD23 N.T.S.

NOTES:

1. IF TRANSFORMER MANUFACTURER HAS PROVIDED ARRESTER AND CASE GROUNDING, THEN ONLY CONNECTIONS TO THE NEMA 2-HOLE PADS AT THE TRANSFORMER BASE ARE NECESSARY.
2. ANY IN-FIELD MODIFICATIONS THAT USE CONDUCTIVE MATERIAL MUST BE PROPERLY GROUNDED.
3. VERIFY GROUND ON XO BUSHING IS NOT CONNECTED TO PREVENT BYPASSING NEUTRAL GROUNDING REACTOR. REMOVE IF NECESSARY.

NORTHWEST OHIO WIND PROJECT

PAULDING COUNTY, OHIO

Rev.	Date	Description	By
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0B	1/25/18	ISSUED FOR CONSTRUCTION	UEI

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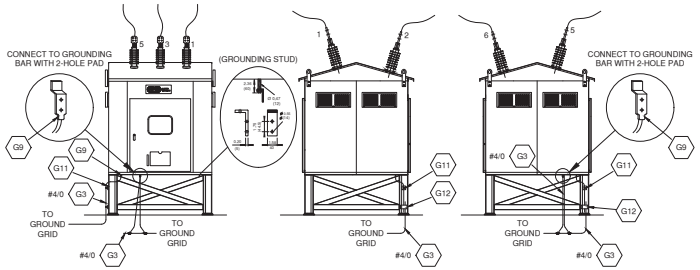
Design By: T. SEVERANCE
Drawn By: P. IWUCHUKWU
Approved By: J. OLSON
Project Number: 17.01246

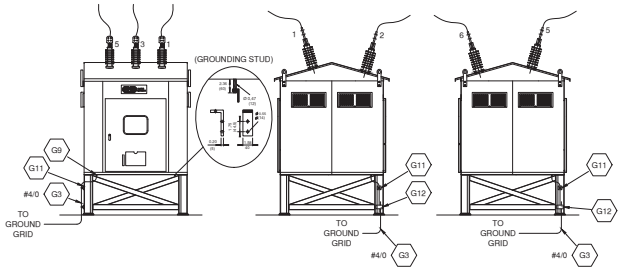
138/34.5KV SUBSTATION GROUNDING DETAILS

DWG #: NWO-GR2-002
REVISION: 0B



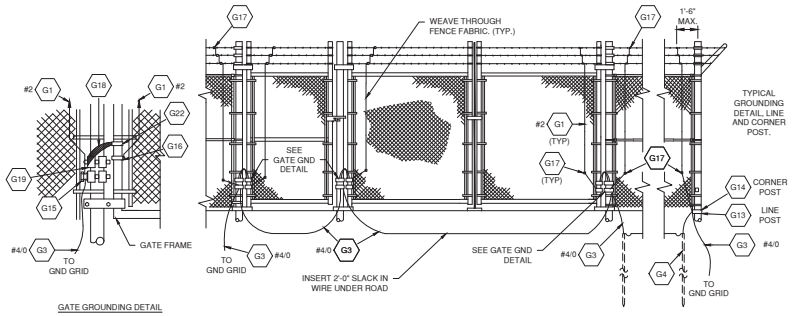
34.5KV GROUNDING BREAKER

DETAIL GD24 N.T.S.



34.5KV VAR BREAKER

DETAIL GD25 N.T.S.



GATE GROUNDING DETAIL

FENCE POST, PEDESTRIAN GATE, AND DOUBLE-SWING GATE FENCE CONNECTION

DETAIL GD26 N.T.S.

NORTHWEST OHIO WIND PROJECT

PAULDING COUNTY, OHIO

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Drawn By:	P. IWUCHUKWU
Approved By:	J. OLSON
Project Number:	17.01246

138/34.5KV SUBSTATION GROUNDING DETAILS

DWG #: NWO-GR2-003

REVISION: 0B

GROUNDING MATERIAL				
Item #	Quantity	Description	Vendor	Catalog #
G1	AS REQ'D	WIRE, TIN PLATED SOLID COPPER, SOFT DRAWN, #2 BARE	-	-
G2	AS REQ'D	COMPRESSION C TAP, 3/0-250KCMIL (MAIN) - 3/0-250KCMIL (TAP)	BURNDY	YGHC29C29
G3	AS REQ'D	WIRE, COPPER #4/0 BARE	-	–
G4	AS REQ'D	GROUND ROD, COPPER WELD, 3/4"X10'-0"	ERICO	633400
G5	AS REQ'D	COMPRESSION CROSS #2-250KCMIL - #2-250KCMIL	BURNDY	YGL29C29
G6	AS REQ'D	NOT USED	-	-
G7	AS REQ'D	NOT USED	-	-
G8	AS REQ'D	COMPRESSION CONNECTOR #2-250KCMIL TO 3/4" GROUND ROD	BURNDY	YGLR29C34
G9	AS REQ'D	COMPRESSION GROUND TERMINAL #4/0 CU TO 2-HOLE NEMA PAD	BURNDY HYLUG	YGA28-2N
G10	AS REQ'D	COMPRESSION C TAP, 250KCMIL - #2 (MAIN), 250KCMIL - #2 (TAP), TIN PLATED	BURNDY	YCHC29TC29
G11	AS REQ'D	BOLTED GROUND CONNECTOR #2/0 - 250 TO FLAT	BURNDY	GB29
G12	AS REQ'D	BOLTED GROUND CONNECTOR (2) #4/0 TO FLAT SURFACE	BURNDY	GC2929
G13	AS REQ'D	U-BOLT CLAMP FOR 2.375" O.D. LINE FENCE POST TO #2 CU	BURNDY	GD1826
G14	AS REQ'D	U-BOLT CLAMP FOR 2.875" O.D. CORNER FENCE POST TO #2 CU	BURNDY	GD1926
G15	AS REQ'D	U-BOLT CLAMP FOR 4" O.D. GATE FRAME TO #2 CU	BURNDY	GD2126
G16	AS REQ'D	U-BOLT CLAMP FOR 1 5/8" O.D. GATE FRAME TO #2 CU	BURNDY	GAR1726
G17	AS REQ'D	BRONZE BOLTED CONNECTOR	FARGO	GC 5000
G18	AS REQ'D	FLEXIBLE TINNED COPPER GROUND BRAID 24"	BURNDY	BD24
G19	AS REQ'D	U-BOLT CLAMP FOR 4" O.D. GATE FRAME TO BRAID	BURNDY	GG22-2
G20	AS REQ'D	COMPRESSION GROUND TERMINAL, #2 TO FLAT	BURNDY HYLUG	YGA2C-2TC38
G21	AS REQ'D	BRONZE PARALLEL CONNECTOR #4/0 TO #2 MAIN AND TAP	BLACKBURN	CC402
G22	AS REQ'D	U-BOLT CLAMP FOR 1 5/8" O.D. TO BRAID	BURNDY	GG17-15
G23	AS REQ'D	GROUNDING PLATFORM	GRATING PACIFIC OR EQUIVALENT	19-W-4

NORTHWEST OHIO WIND PROJECT

PAULDING COUNTY, OHIO

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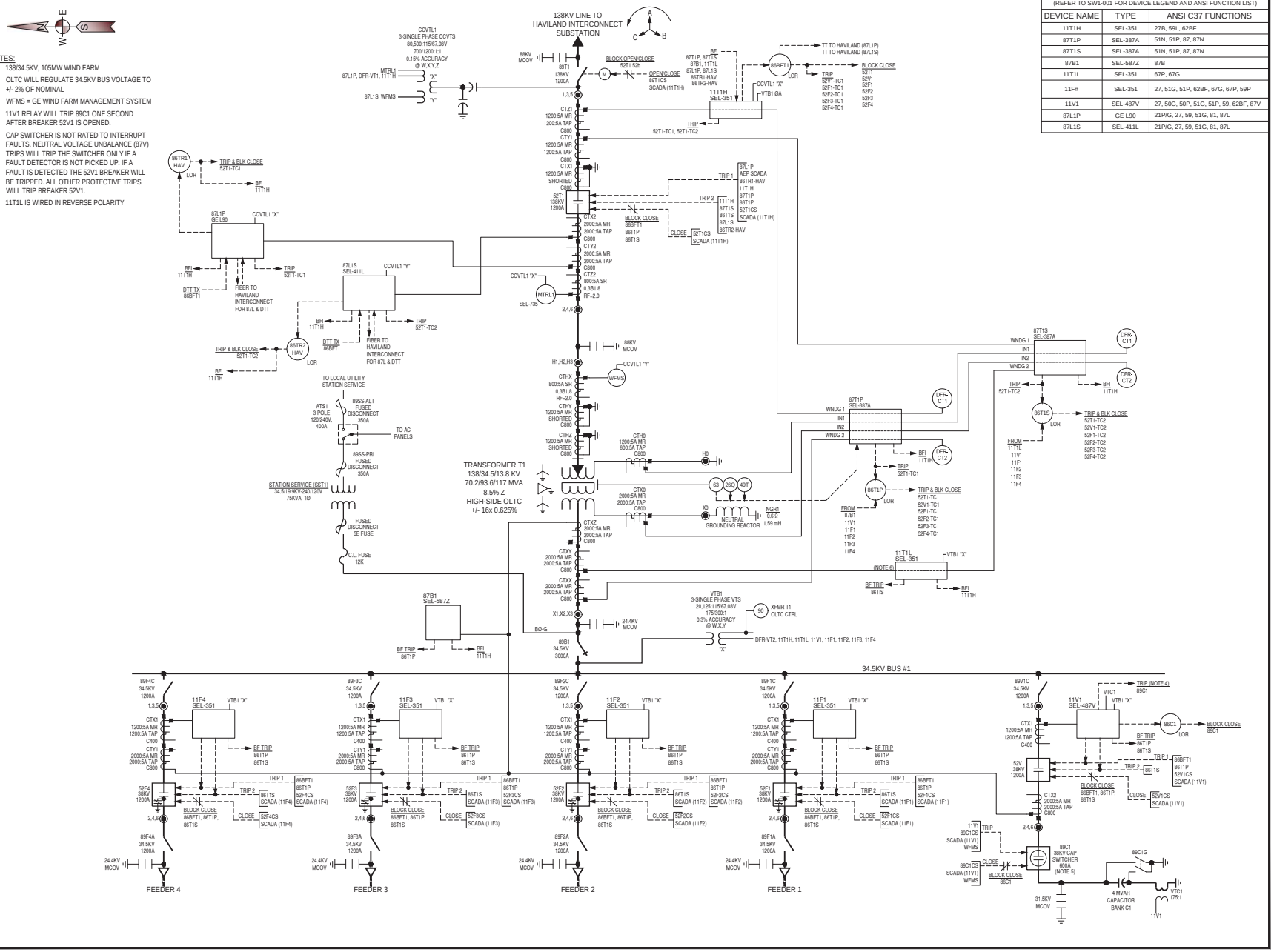
Drawn By: P. IWUCHUKWU
Approved By: J. OLSON
Project Number: 17.01246

138/34.5KV SUBSTATION GROUNDING MATERIAL LIST

DWG #: NWO-GR3-001

REVISION: 0B

DWG#14



NOTES:

1. 138/34.5KV, 105MW WIND FARM
2. OLTC WILL REGULATE 34.5KV BUS VOLTAGE TO +/- 2% OF NOMINAL
3. WFMS = GE WIND FARM MANAGEMENT SYSTEM
4. 11V1 RELAY WILL TRIP 89C1 ONE SECOND AFTER BREAKER 52V1 IS OPENED.
5. CAP SWITCHER IS NOT RATED TO INTERRUPT FAULTS. NEUTRAL VOLTAGE UNBALANCE (87V) TRIPS WILL TRIP THE SWITCHER ONLY IF A FAULT DETECTOR IS NOT PICKED UP. IF A FAULT IS DETECTED THE 52V1 BREAKER WILL BE TRIPPED. ALL OTHER PROTECTIVE TRIPS WILL TRIP BREAKER 52V1.
6. 11T1L IS WIRED IN REVERSE POLARITY

PROTECTIVE RELAY TABLE

(REFER TO SW1-001 FOR DEVICE LEGEND AND ANSI FUNCTION LIST)

DEVICE NAME	TYPE	ANSI C37 FUNCTIONS
11T1H	SEL-351	27B, 59L, 62BF
87T1P	SEL-387A	51N, 51P, 87, 87N
87T1S	SEL-387A	51N, 51P, 87, 87N
87B1	SEL-587Z	87B
11T1L	SEL-351	67P, 67G
11F#	SEL-351	27, 51G, 51P, 62BF, 67G, 67P, 59P
11V1	SEL-487V	27, 50G, 50P, 51G, 51P, 59, 62BF, 87V
87L1P	GE L90	21P/G, 27, 59, 51G, 81, 87L
87L1S	SEL-411L	21P/G, 27, 59, 51G, 81, 87L

NORTHWEST OHIO WIND PROJECT

PAULDING COUNTY, OHIO

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0B	08/08/17	PRELIMINARY	UEI
0C	10/19/17	PRELIMINARY	UEI
0D	11/21/17	90% REVIEW PACKAGE	UEI
0E	01/10/18	90% PACKAGE UPDATES	UEI
0F	01/25/18	ISSUED FOR CONSTRUCTION	UEI

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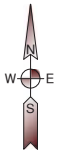
Design By: E. NEUHARDT
Drawn By: E. NEUHARDT
Approved By: J. OLSON
Project Number: 17.01246

SUBSTATION
ONE LINE DIAGRAM

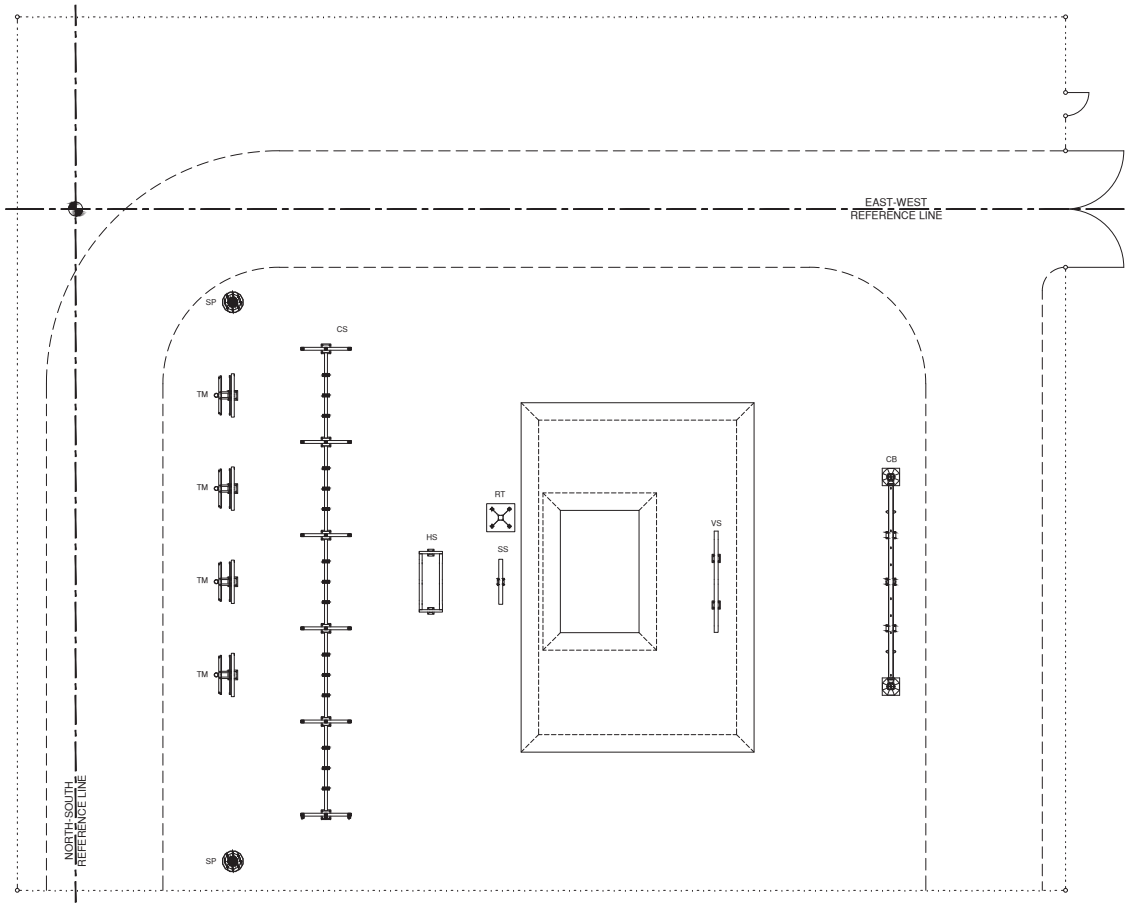
DWG #: NWO-OL1-001

REVISION: 0F



(NOTE 1)

STRUCTURE SCHEDULE			
MARK	QTY	DESCRIPTION	DWG #
CB	1	138kV DEADEND STEEL STRUCTURE "CB"	S1
SP	2	90' SHIELD POLE "SP"	S2
VS	1	138kV 3φ BUS SUPPORT STRUCTURE "VS"	S3
HS	1	34.5kV SWITCH STAND STRUCTURE "HS"	S4
RT	1	34.5kV NGR SUPPORT STRUCTURE "RT"	S5
TM	4	34.5kV CABLE TERMINATION STRUCTURE "TM"	S6
CS	1	34.5kV COLLECTION STRUCTURE "CS"	S7
SS	1	34.5kV 3φ BUS & SS SUPPORT STRUCTURE "SS"	S8



NORTHWEST OHIO
WIND PROJECT

PAULDING COUNTY, OHIO

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NOTES:

1. SEE GRADING PLAN FOR INDICATION OF TRUE NORTH.

LEGEND:

BASE LINE INTERSECTION

FENCE

SCALE 3/32" = 1'-0"

4' 0 4' 8' 12' 16' 20' 24' 28'

ISSUED FOR CONSTRUCTION

STATE OF OHIO
MARTIN FELIX PADULA
E-80306
REGISTERED
PROFESSIONAL ENGINEER
01-25-2018

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Design By: D. WEBER
Drawn By: V. LEE
Approved By: M. PADULA
Project Number: 17.01246

138/34.5KV SUBSTATION
GENERAL ARRANGEMENT
STEEL LOCATION PLAN

DWG #: NWO-S0-001

REVISION: 0B

White Construction, Inc.
Paulding County, Ohio

138/34.5kV Substation Steel Structures

Northwest Ohio Substation

UEI Project #17.01246

January 2018

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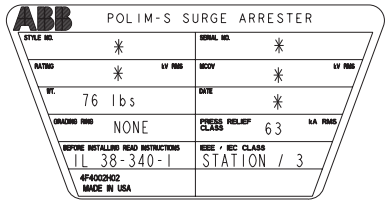
34.5kV Collection Structure 228

34.5kV 3 Phase Bus and SS Support Structure 316

STYLE NO.	RATINGS (kV rms) VOLTAGE Vr	RATINGS (kV rms) MCOV Vmcov	TOV (kV rms) WITH PRIOR ENERGY SINGLE IMPULSE OF 4.5 kJ/kVr	MAXIMUM RESIDUAL VOLTAGE WITH CURRENT WAVE (kV PEAK) SPL (SIPL) 30/60 µS 500 A	LPL (LIPL) 8/20 µS 3 kA	10 kA	20 kA	FOW 0.5 µS 10 kA
STANDARD CREEP								
Q090SA070A	90	70.0	@10 sec = 98.6	178	199	216	238	235
Q094SA073A	94	73.0	@10 sec = 103	186	208	226	249	246
Q096SA076B	96	76.0	@10 sec = 105	190	213	231	255	251
Q102SA082B	102	82.0	@10 sec = 112	201	226	245	270	266
Q108SA084D	108	84.0	@10 sec = 118	214	240	260	287	283
Q108SA088B	108	88.0	@10 sec = 118	214	240	260	287	283
EXTRA CREEP								
Q045SC037A	45	36.5	@10 sec = 49.3	89.1	99.9	108	119	118
Q048SC039A	48	39.0	@10 sec = 52.6	95.6	107	116	128	126
Q051SC041A	51	41.0	@10 sec = 55.8	101	114	123	136	134
Q054SC042A	54	42.0	@10 sec = 59.1	107	120	130	144	142
Q055SC044A	55	44.0	@10 sec = 60.2	109	122	132	146	144
Q060SC048A	60	48.0	@10 sec = 65.7	119	133	144	159	157
Q066SC053A	66	53.0	@10 sec = 72.3	131	147	159	175	173
Q072SB057A	72	57.0	@10 sec = 78.8	142	159	173	191	188
Q075SB060A	75	60.0	@10 sec = 82.1	148	166	180	199	196
Q078SB063A	78	63.0	@10 sec = 85.4	155	173	188	207	204
Q081SB065A	81	65.0	@10 sec = 88.7	160	180	195	215	212
Q084SB068A	84	68.0	@10 sec = 92.0	166	186	202	223	220

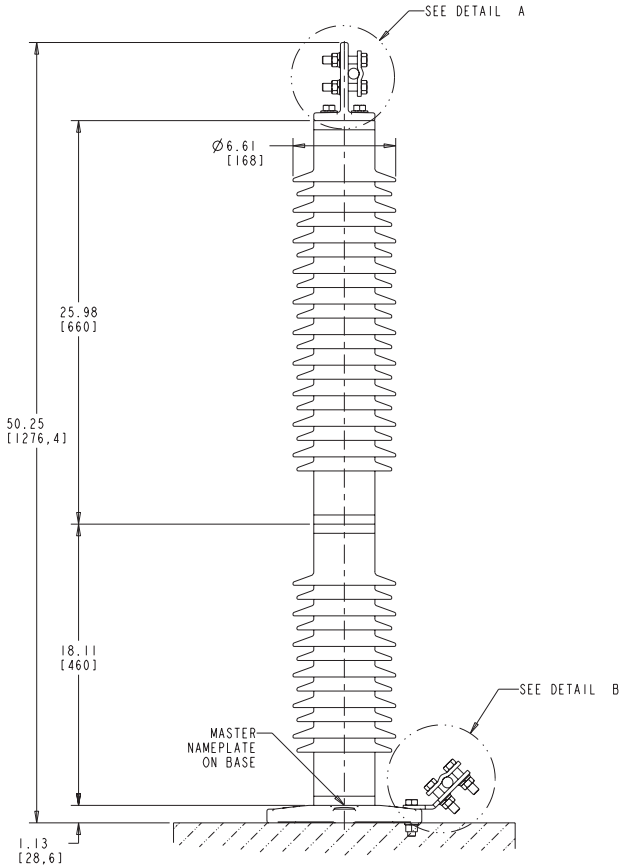


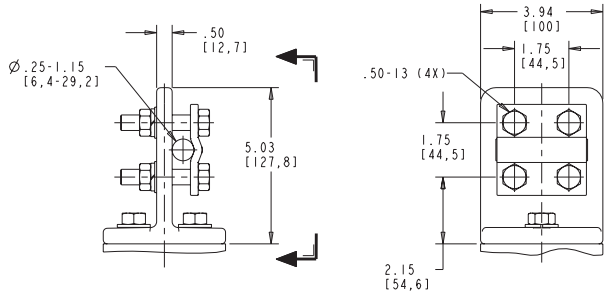
MASTER NAMEPLATE

* ASSIGNED AT THE TIME OF PRODUCTION AND RECORDED IN THE PROPER LOCATIONS

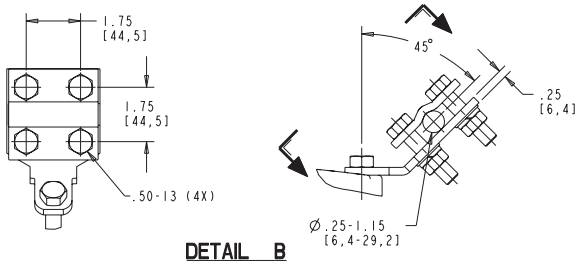
NOTES:
1. FOR MINIMUM PHASE-TO-GROUND AND PHASE-TO-PHASE CLEARANCES WITH TYPE POLIM-S SURGE ARRESTERS, REFER TO THE POLIM-S PRODUCT BULLETIN (2GNM110077). OTHER APPARATUS STANDARDS, OTHER SPECIFICATIONS OR LOCAL CODES MAY SUPERCEDE DISTANCES SPECIFIED.
2. ARRESTER ASSEMBLY CONSISTS OF ARRESTER UNIT, LINE & GROUND TERMINALS WITH CLAMPS, AND .50 INCH HARDWARE.
3. LINE & GROUND TERMINALS CAN ACCOMODATE CU OR AL CABLE SIZE NO. 2 TO 1000 MCM (.25 [6.4] TO 1.15 [29.2]) DIA.
4. LINE & GROUND TERMINAL CLAMP CAN BE MOUNTED AS SHOWN OR ROTATED 90° AS REQUIRED.
5. MTG. SLOTS FOR .50 INCH HARDWARE (3) EQUALLY SPACED, THICKNESS OF LUG = .88 [22.4]
6. DESIGNED FOR VERTICAL OR HORIZONTAL MOUNT.
7. MAX CANTILEVER LOAD 20,000 in-lbs [2260 Nm].
8. PRESSURE RELIEF CLASS IS 63 kA RMS SYMMETRICAL.
9. NOMINAL CREEPAGE DISTANCE 109.2 [2774].
10. MAXIMUM ARRESTER WEIGHT 76.0 lbs [34.5 kg].

Item M12

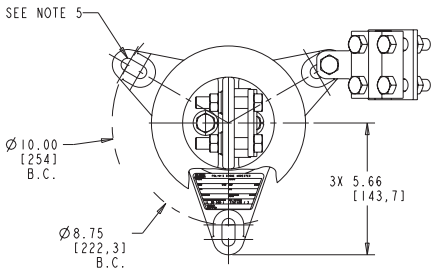




DETAIL A
(ENLARGED)
SCALE 0.500
LINE TERMINAL (ALUMINUM)



DETAIL B
(ENLARGED)
SCALE 0.500
GROUND TERMINAL (GALVANIZED)
(CAN BE ATTACHED TO ANY LUG)



DRILLING PLAN
(ENLARGED)

REV.	DESCRIPTION & DATE
01	APRIL 8, 2011 ADDED STYLE NO.: Q048SC039A, Q051SC041A DJK
02	JULY 29, 2011 NOTE 9: CREEPAGE 109.2 WAS 108.7 DETAIL B: .25 ADDED. DRILLING PLAN RELOCATED DJK
03	NOVEMBER 7, 2013

ALL DIMENSIONS IN INCHES [MM] UNLESS NOTED

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POLIM-S IEEE STATION / IEC CLASS 3
POLYMER ARRESTER
32 SHED HOUSING OUTLINE

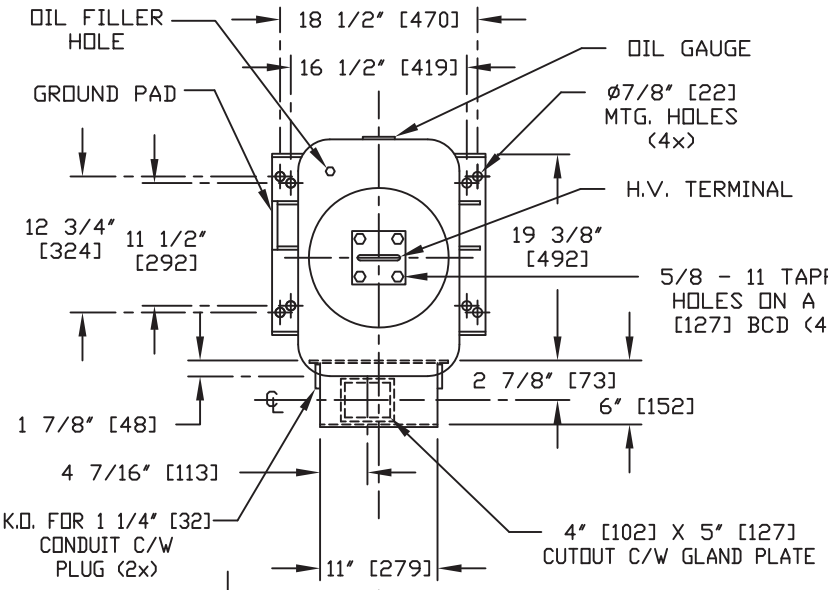
ABB Inc.
Power Products Division
100 Distribution Circle, Mt Pleasant, PA 15666

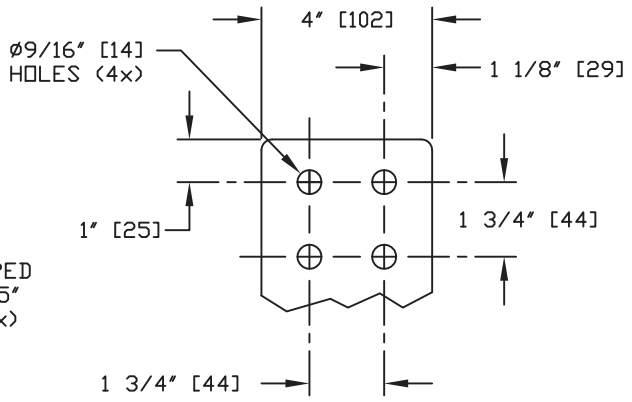
CAD DRW PRO/E WILDFIRE 2.0	
SCALE 0.20	SHEET 1 OF 1
ASSY. DWG.	
DWN KWYGOWSKI	REV.
CHKD DJK	4F4033 3
APPD MGM	

4F4033

DRW

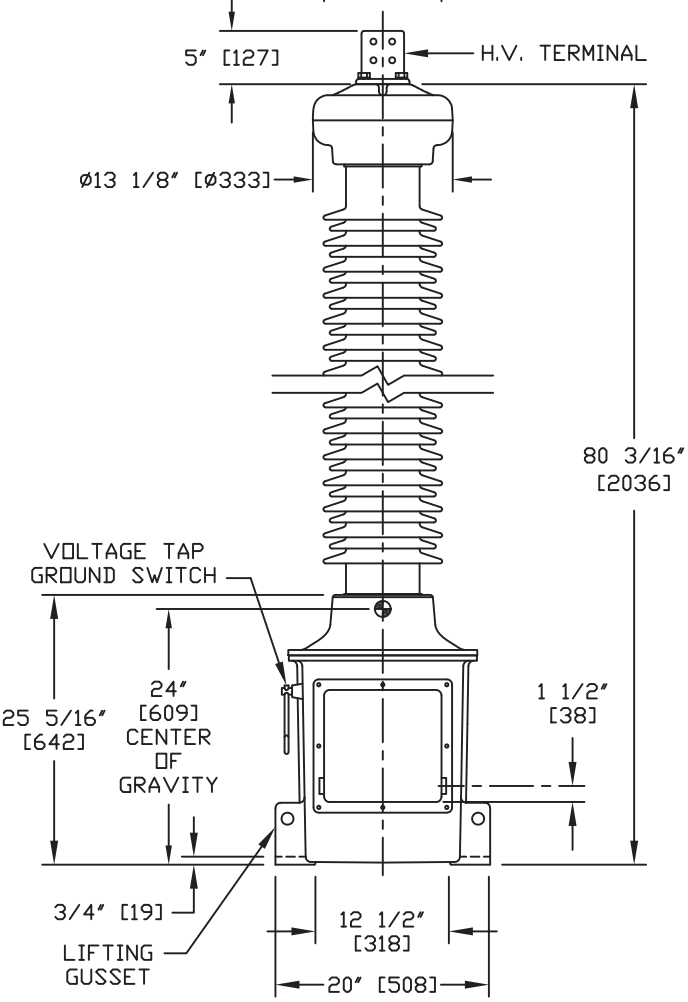
pro_e-bdr-d

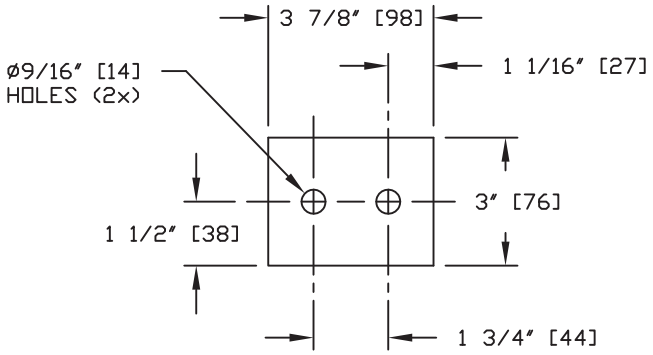




H.V. TERMINAL DETAIL

MATERIAL: 1/2" [13] THICK ALUMINUM





GROUND PAD DETAIL

MATERIAL: 1/2" [13] THICK ALUMINUM
TIN PLATED ALSTAN PROCESS

NOTES:

1. ALL DIMENSIONS ARE IN INCHES AND [MILLIMETERS]
2. INSULATOR COLOR: GREY
3. BASE HOUSING CAST ALUMINUM
4. BIL: 650 kV
5. CREEPAGE DISTANCE: 148" [3760]
6. CAPACITANCE: 10400 pF
7. MAX. HORIZ. TERM. PULL: 1079 LBS 4.8 kN @ 100 mph [160 km/h] WIND SPEED.
8. INSULATOR TYPE: P145
9. TOTAL WEIGHT: 740 LBS 335 kg

PO 79271 OJ; MJE 25181027901; NORTHWEST OHIO SS 0021810292

TOLERANCES UNLESS OTHERWISE SPECIFIED	REVISION No.	REVISION DESCRIPTION	TRENCH LIMITED
0-12"[305]±1/32"[0.8] 12"[305]-24"[610]±1/16"[1.6] 24"[610]-36"[914]±3/32"[2.4] 36"[914]-48"[1219]±1/8[3.2] 48"[1219] AND UP ±3/16"[4.8] WEIGHT±10% ANGULAR±2°			COPYRIGHT, ALL RIGHTS RESERVED

CAPACITOR VOLTAGE TRANSFORMER
TYPE TEMP 145

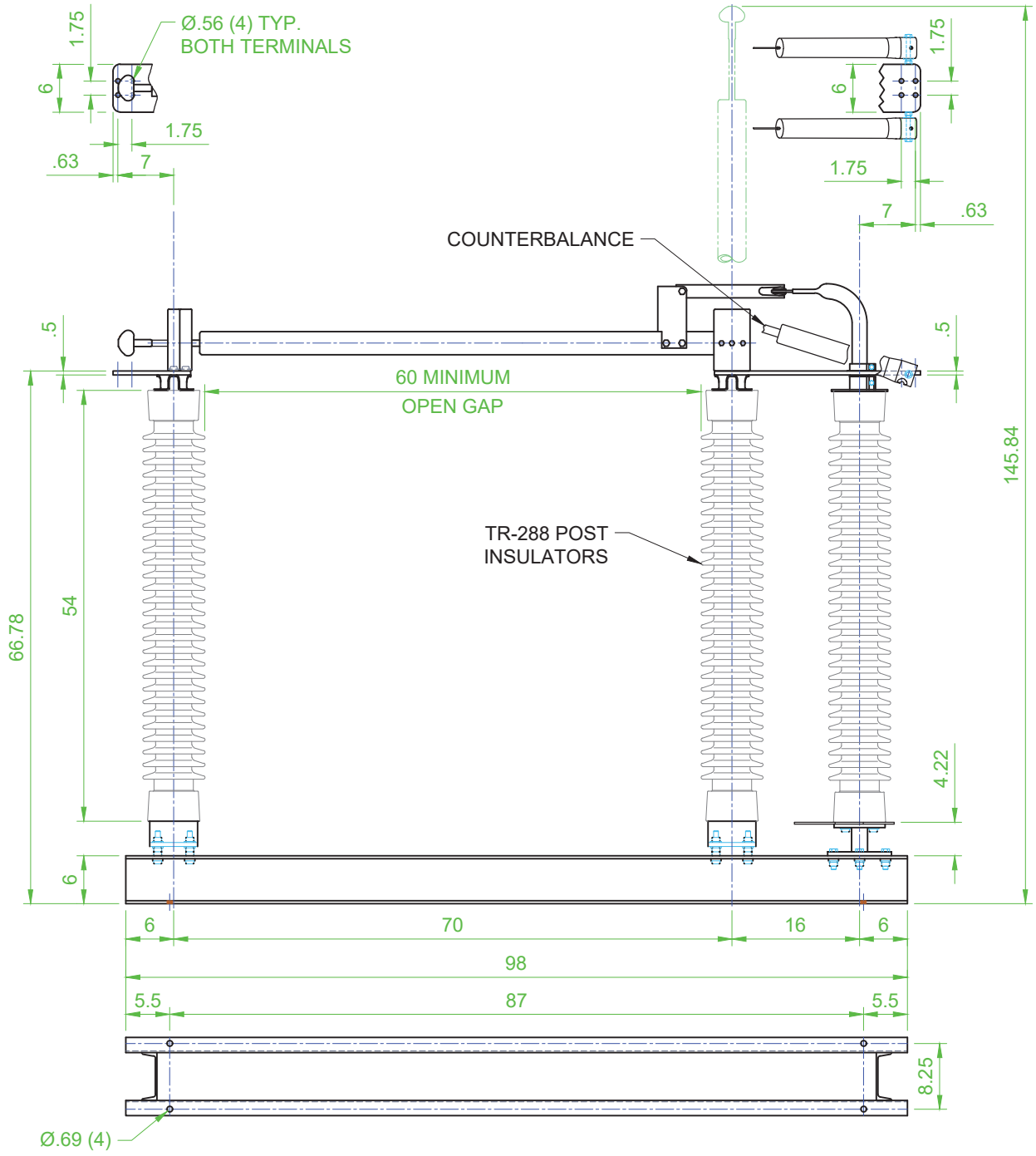
DESG.	DRN.	APPD.	DATE	SCALE	W.O.
	SB		NOV. 23/17	1=18	0418300242-10

M J ELECTRIC LLC

DWG. 1-0418300242-10

NOTES:
1. ALUMINUM TERMINAL PADS.
2. SILVER PLATED CONTACTS.
3. ALL COPPER PARTS ARE TIN PLATED ALL OVER.
4. HOT DIPPED GALV. STEEL CHANNEL BASE 26206B01.
5. ALL DIMENSIONS ARE IN INCHES.

kV NOM.	138
kV MAX.	145
kV BIL	650
AMPS	1200
MOM kA	61
WT./POLE	1025 lbs.

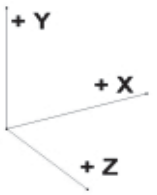


SWITCH STYLE REFERENCE NUMBER: C06B033G08		REV: -
Cleaveland/Price Inc. 14000 Rt. 993 Trafford, PA 15085-9550	DRAWN: MJH / DATE: 01/08/2018	VERSION: 1
V2-CA ALUMINUM VERTICAL BREAK DISC SWITCH 138kV, 1200A, 5" B.C. INSULATOR, 6" CHANNEL BASE	CHECKED: WRM / APPROVED:	DRAWING NO.: C06A2053

Project # :	17.01246	**Ulteig**	By:	DAW
Project Title:	Northwest Ohio		Date:	1/24/2018
Item:	Dead End	**ASCE Load Cases**	Checked:	

Load from upright single node equipment (insulator, surge arrester, etc.)

Equipment Type: TR210



Orientation:	1	(1 Positive Y; -1 Negative Y; Beam runs along X-Axis)
Equip. Weight (lbs):	73	(Dead weight of equipment)
Mom. Arm (in):	30	(Center of support beam to center of equipment)
Shape Factor (C_d):	1.2	(1.2 Round, 1.6 Hex/Oct, 2.0 Square)
Area X-Dir (in^2):	376	(Wind area in X-direction)
Area Z-Dir (in^2):	376	(Wind area in Z-direction)

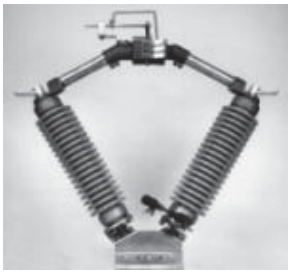
Exposure Coef. (k_z):	1.050	(Per ASCE 7-05, Table 6-3)
Gust Response (G_{RF}):	0.85	(Per ASCE 113)
Ice Weight Factor:	1.5	(Increase in dead weight from ice; Typically 1.5 for 1/2" Ice)
ASCE Wind (psf):	4.15	(4 psf per NESC Heavy Loading Zone)
High Wind (psf):	21.0	($0.00256*k_z*G_{RF}*V^2*(K_d = 0.85)*(I = 1.15)$ per ASCE7-05)

Factored NESC Wt:	1.0	(Per NESC Table 253-1 for factored cases ONLY)
Factored NESC Wind:	1.0	(Per NESC Table 253-1 for factored cases ONLY)
Factored Wind Wt:	1.0	(Per NESC Table 253-1 for factored cases ONLY)
Factored High Wind:	1.0	(Per NESC Table 253-1 for factored cases ONLY)

Loads: NESC Heavy (40 mph wind with 1/2 inch ice) and High Wind (90 mph wind)

	Allowable		Factored		
	NESC	**High Wind**	**NESC**	**High Wind**	
Wind Pressure (psf):	5.7	25.2	5.7	25.2	(Total pressure applied to area)

Wind X-Dir	NESC	High Wind	NESC	High Wind
F_y (lbs):	**-110**	**-73**	**-110**	**-73**
F_x (lbs):	**15**	**66**	**15**	**66**
M_z (ft-lbs):	**-37**	**-165**	**-37**	**-165**



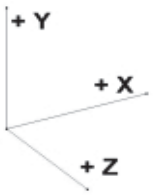
Wind Z-Dir	NESC	High Wind	NESC	High Wind
F_y (lbs):	**-110**	**-73**	**-110**	**-73**
F_z (lbs):	**15**	**66**	**15**	**66**
M_x (ft-lbs):	**37**	**165**	**37**	**165**

Wind 45 Deg	NESC	High Wind	NESC	High Wind
F_y (lbs):	**-110**	**-73**	**-110**	**-73**
F_x (lbs):	**11**	**47**	**11**	**47**
F_z (lbs):	**11**	**47**	**11**	**47**
M_z (ft-lbs):	**-26**	**-116**	**-26**	**-116**
M_x (ft-lbs):	**26**	**116**	**26**	**116**

Project # :	17.01246	**Ulteig**	By:	DAW
Project Title:	Northwest Ohio		Date:	1/24/2018
Item:	Collection Structure	**ASCE Load Cases**	Checked:	

Load from upright single node equipment (insulator, surge arrester, etc.)

Equipment Type: TR210



Orientation:	1	(1 Positive Y; -1 Negative Y; Beam runs along X-Axis)
Equip. Weight (lbs):	939	(Dead weight of equipment)
Mom. Arm (in):	29.8	(Center of support beam to center of equipment)
Shape Factor (C_d):	1.2	(1.2 Round, 1.6 Hex/Oct, 2.0 Square)
Area X-Dir (in^2):	1350	(Wind area in X-direction)
Area Z-Dir (in^2):	1350	(Wind area in Z-direction)

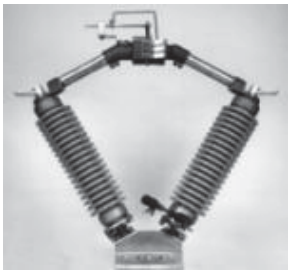
Exposure Coef. (k_z):	1.050	(Per ASCE 7-05, Table 6-3)
Gust Response (G_{RF}):	0.85	(Per ASCE 113)
Ice Weight Factor:	1.5	(Increase in dead weight from ice; Typically 1.5 for 1/2" Ice)
ASCE Wind (psf):	4.15	(4 psf per NESC Heavy Loading Zone)
High Wind (psf):	21.0	($0.00256*k_z*G_{RF}*V^2*(K_d = 0.85)*(I = 1.15)$ per ASCE7-05)

Factored NESC Wt:	1.0	(Per NESC Table 253-1 for factored cases ONLY)
Factored NESC Wind:	1.0	(Per NESC Table 253-1 for factored cases ONLY)
Factored Wind Wt:	1.0	(Per NESC Table 253-1 for factored cases ONLY)
Factored High Wind:	1.0	(Per NESC Table 253-1 for factored cases ONLY)

Loads: NESC Heavy (40 mph wind with 1/2 inch ice) and High Wind (90 mph wind)

	Allowable		Factored		
	NESC	**High Wind**	**NESC**	**High Wind**	
Wind Pressure (psf):	5.7	25.2	5.7	25.2	(Total pressure applied to area)

Wind X-Dir	NESC	High Wind	NESC	High Wind
F_y (lbs):	**-1409**	**-939**	**-1409**	**-939**
F_x (lbs):	**54**	**237**	**54**	**237**
M_z (ft-lbs):	**-133**	**-588**	**-133**	**-588**



Wind Z-Dir	NESC	High Wind	NESC	High Wind
F_y (lbs):	**-1409**	**-939**	**-1409**	**-939**
F_z (lbs):	**54**	**237**	**54**	**237**
M_x (ft-lbs):	**133**	**588**	**133**	**588**

Wind 45 Deg	NESC	High Wind	NESC	High Wind
F_y (lbs):	**-1409**	**-939**	**-1409**	**-939**
F_x (lbs):	**38**	**167**	**38**	**167**
F_z (lbs):	**38**	**167**	**38**	**167**
M_z (ft-lbs):	**-94**	**-415**	**-94**	**-415**
M_x (ft-lbs):	**94**	**415**	**94**	**415**

Project # :	17.01246	**Ulteig**	By:	DAW
Project Title:	Northwest Ohio		Date:	1/24/2018
Item:	138kV Switch	**NESC Load Cases**	Checked:	

Load from a horizontally mounted switch on two beams

Equipment Type:	345kV Switch	
Orientation:	1	(1 Positive Z; -1 Negative Z; Beams run along X-Axis)
Equip. Weight (lbs):	817	(Dead weight of equipment)
Mom. Arm (in):	35	(Center of support beam to center of equipment)
Shape Factor (C_d):	1.6	(1.0 for cylinder, 1.6 for square)
Area X-Dir (in2):	3000	(Wind area in X-direction)
Area Z-Dir (in^2):	1000	(Wind area in Z-direction)
Beam Spacing (in):	87	(Support spacing for equipment)

Exposure Coef. (k_z):	0.950	(Per NESC Table 250-3)
Gust Response (G_{RF}):	0.85	(Per NESC Table 250-3)
Ice Weight Factor:	1.5	(Increase in dead weight from ice; Typically 1.5 for 1/2" Ice)
NESC Wind (psf):	4.15	(4 psf per NESC Heavy Loading Zone)
High Wind (psf):	21.0	(0.00256 x k_z x G_{RF}x V^2 per NESC)

Factored NESC Wt:	1.0	(Per NESC Table 253-1 for factored cases ONLY)
Factored NESC Wind:	1.0	(Per NESC Table 253-1 for factored cases ONLY)
Factored Wind Wt:	1.0	(Per NESC Table 253-1 for factored cases ONLY)
Factored High Wind:	1.0	(Per NESC Table 253-1 for factored cases ONLY)

Loads: NESC Heavy (40 mph wind with 1/2 inch ice) and High Wind (90 mph wind)

	Allowable		Factored		
	NESC	**High Wind**	**NESC**	**High Wind**	
Wind Pressure (psf):	6.6	33.6	6.6	33.6	(Total pressure applied to area)
Mom. $Couple_y$ (lbs):	18.6	94.0	18.6	94.0	(Moment couple due to wind)

Wind X-Dir	NESC	High Wind	NESC	High Wind
F_y (lbs):	**-613**	**-409**	**-613**	**-409**
F_x (lbs):	**69**	**351**	**69**	**351**
M_z (ft-lbs):	**-202**	**-1022**	**-202**	**-1022**

Wind Z-Dir	NESC	High Wind	NESC	High Wind
F_z (lbs):	**23**	**117**	**23**	**117**
$F_{y\ big}$(lbs):	**-631**	**-503**	**-631**	**-503**
$F_{y\ small}$(lbs):	**-594**	**-314**	**-594**	**-314**

Wind 45 Deg	NESC	High Wind	NESC	High Wind
F_z (lbs):	**16**	**83**	**16**	**83**
$F_{y\ big}$(lbs):	**-626**	**-475**	**-626**	**-475**
$F_{y\ small}$(lbs):	**-600**	**-342**	**-600**	**-342**
F_x (lbs):	**49**	**248**	**49**	**248**
M_z (ft-lbs):	**-143**	**-723**	**-143**	**-723**

ASCE 113 Structure Wind Loading

Force = $Q*k_z*V^2*I_{FW}*G_{RF}*C_f*A$

SC force = $5.4 \times (2.26\ I_{SC})^2/(10^7 \times D)$

Input Parameters:			
Structure Height z	=	50	ft
Exposure Category	=	C	
Extreme Wind Velocity V	=	90	mph
Ice Wind Velocity V	=	40	mph
Importance Factor I_{FW}	=	1.0	
C_f	=	1.0	
Wire Supporting Struct?		Yes	
Phase Spacing	=	0.0	ft
Ice thickness t	=	0.50	in

Coefficients:

Q	=	0.00256
k_z	=	1.094
G_{SRF}	=	0.927

NESC Wind Force	=	4.00	psf
Extreme Wind Force	=	21.03	psf
Ice Wind Force	=	4.15	psf

Currently works for W, WT, MC, C and Pipe shapes. Dimensions of L and HSS shapes must be manually entered.

Linear Loads on Structural Members										
				SC Wind force (lb/		xtreme Wind force (lb/f		Ice Wind force (lb/ft)		Ice Weight
Member	C_f	Depth	Width	Major Ax	Minor Ax	Major Axi	Minor Axis	Major Axis	Minor Axis	(lb/ft)
Pipe3-1/2SCH40	0.9	4.00	–	1.20	1.20	6.31	6.31	1.25	1.25	2.80
Oct12	1.4	12.00	12.00	5.60	5.60	29.44	29.44	5.82	5.82	7.77
Oct16	1.4	16.00	16.00	7.47	7.47	39.26	39.26	7.75	7.75	10.26
Oct20	1.4	20.00	20.00	9.33	9.33	49.07	49.07	9.69	9.69	17.90
Oct22	1.4	22.00	22.00	10.27	10.27	53.98	53.98	10.66	10.66	19.66
Oct23	1.4	23.00	23.00	10.73	10.73	56.43	56.43	11.15	11.15	20.54
Oct32	1.4	32.00	32.00	14.93	14.93	78.51	78.51	15.51	15.51	28.45
HSS8X8X.250	2	8.00	8.00	5.33	5.33	28.04	28.04	5.54	5.54	7.35
HSS8X6X.375	2	8.00	8.00	5.33	5.33	28.04	28.04	5.54	5.54	7.35
Oct28.75	1.4	28.75	28.75	13.42	13.42	70.54	70.54	13.93	13.93	25.59
		-	-	-	-	-	-	-	-	-

ASCE 113 Wire Wind Loading

Force = $Q*k_z*V^2*I_{FW}*G_{WRF}*C_f*A$

Input Parameters:			
Conductor Type	=	Bluebird	
Conductors Per Phase	=	1	
Conductor Take Off Height z	=	40	ft
Static Wire Type	=	3/8" EHS	ft
Static Wire Take Off Height z	=	50	ft
Span Length	=	300	ft
Max Pull Off Angle	=	15	°
Exposure Category	=	C	psf
NESC wind pressure	=	4	mph
Extreme Wind Velocity V	=	90	mph
Ice Wind Velocity V	=	40	mph
Importance Factor I_{FW}	=	1.0	
Bell Insulators (10" Ø, 12lb ea.)	=	10.0	

Wire Information				
	Name	AWG	Diameter(in	Weight (lb/ft)
Conductor	Bluebird	2156	1.762	2.511
Static	3/8" EHS		0.375	0.273

Coefficients:		
Q	=	0.00256
Conductor k_z	=	1.044
Static k_z	=	1.094
Conductor G_{SRF}	=	0.797
Static G_{SRF}	=	0.787
C_f	=	1

Conductor Load Cases				Conductor Loading, Wind Perpendicular to Wire				Conductor Loading, Wind Parallel to Wire			
	Tensions (lb)	Wind (psf)	Ice (in)	Pull off (°)	Vertical	Transverse	Longitudinal	Pull off (°)	Vertical	Transverse	Longitudinal
NESC 250B*	1818	4	0.5	15	1061.4	1161.6	2897.5	0	1061.4	0.0	2999.7
Extreme Wind	1478	17.24	0	15	496.7	831.3	1427.6	0	556.7	0.0	1478.0
Ice + Wind	2071	3.41	0.75	15	848.1	688.5	2000.4	0	908.1	0.0	2071.0
Deflection (Wind)	1324	13.45	0	15	496.7	692.7	1278.9	0	556.7	0.0	1324.0
Deflection (Ice + Wind)	1502	3.41	0.375	15	646.1	509.3	1450.8	0	706.1	0.0	1502.0

Static Load Cases				Static Loading, Wind Perpendicular to Wire				Static Loading, Wind Parallel to Wire			
	Tensions (lb)	Wind (psf)	Ice (in)	Pull off (°)	Vertical	Transverse	Longitudinal	Pull off (°)	Vertical	Transverse	Longitudinal
NESC 250B*	1500	4	0.5	15	183.8	812.5	2390.7	0	183.8	0.0	2475.0
Extreme Wind	744	17.85	0	15	41.0	526.9	718.6	0	221.0	0.0	744.0
Ice + Wind	1672	3.53	0.75	15	198.3	920.7	1615.0	0	378.3	0.0	1672.0
Deflection (Wind)	627	13.93	0	15	41.0	431.0	605.6	0	221.0	0.0	627.0
Deflection (Ice + Wind)	899	3.53	0	15	41.0	425.2	868.4	0	221.0	0.0	899.0

Southwire SAG10™

Southwire Company

138kV DE
Wind farm standard 138kV DE

Conductor: 3/ 8x 7 Strand Steel EHS

Area = 0.0792 Sq. in Diameter = 0.360 in Weight = 0.273 lb/ft RTS = 15400 lb
Data from Chart No. 1-1293
English Units
Limits and Outputs in Average Tensions.

Span = 300.0 Feet NESC Heavy Load Zone
Creep is NOT CONSIDERED

Design Points					Final		Initial	
Temp °F	Ice in	Wind psf	K lb/ft	Weight lb/ft	Sag Ft	Tension lb	Sag Ft	Tension lb
0.0	0.50	4.00	0.30	1.226	9.25	1497	9.23	1500*
15.0	0.75	3.53	0.00	1.418	9.58	1672	9.58	1672
15.0	0.38	3.53	0.00	0.697	8.85	889	8.75	899
60.0	0.00	17.85	0.00	0.601	9.25	734	9.12	744
60.0	0.00	13.93	0.00	0.499	9.14	617	8.98	627
-20.0	0.00	0.00	0.00	0.273	7.89	390	7.65	402
0.0	0.00	0.00	0.00	0.273	8.15	378	7.91	389
30.0	0.00	0.00	0.00	0.273	8.52	362	8.29	372
60.0	0.00	0.00	0.00	0.273	8.88	347	8.65	356
90.0	0.00	0.00	0.00	0.273	9.23	334	9.00	342
120.0	0.00	0.00	0.00	0.273	9.56	322	9.34	330
167.0	0.00	0.00	0.00	0.273	10.07	306	9.85	313
212.0	0.00	0.00	0.00	0.273	10.53	293	10.32	299

* Design Condition

Certain information such as the data, opinions or recommendations set forth herein or given by Southwire representatives, is intended as a general guide only. Each installation of overhead electrical conductor, underground electrical conductor, and/or conductor accessories involves special conditions creating problems that require individual solutions and, therefore, the recipient of this information has the sole responsibility in connection with the use of the information. Southwire does not assume any liability in connection with such information.

Southwire SAG10™

Southwire Company

138kV DE
Wind farm standard 138kV DE

Conductor: 2156.0 Kcmil 84/19 Stranding ACSR "BLUEBIRD"

Area = 1.8309 Sq. in Diameter = 1.762 in Weight = 2.511 lb/ft RTS = 60300 lb
Data from Chart No. 1-1020
English Units
Limits and Outputs in Average Tensions.

Span = 300.0 Feet NESC Heavy Load Zone
Creep is NOT CONSIDERED Rolled Rod

Design Points					Final		Initial	
Temp °F	Ice in	Wind psf	K lb/ft	Weight lb/ft	Sag Ft	Tension lb	Sag Ft	Tension lb
0.0	0.50	4.00	0.30	4.324	27.67	1818	27.67	1818*
15.0	0.75	3.53	0.00	4.948	27.81	2071	27.81	2071
15.0	0.38	3.53	0.00	3.585	27.78	1502	27.77	1502
60.0	0.00	17.24	0.00	3.566	28.10	1478	28.10	1478
60.0	0.00	13.45	0.00	3.195	28.10	1324	28.09	1324
-20.0	0.00	0.00	0.00	2.511	27.47	1063	27.47	1063
0.0	0.00	0.00	0.00	2.511	27.64	1057	27.63	1057
30.0	0.00	0.00	0.00	2.511	27.87	1049	27.87	1049
60.0	0.00	0.00	0.00	2.511	28.09	1041	28.08	1041
90.0	0.00	0.00	0.00	2.511	28.29	1034	28.29	1034
120.0	0.00	0.00	0.00	2.511	28.41	1030	28.41	1030
167.0	0.00	0.00	0.00	2.511	28.59	1024	28.59	1024
212.0	0.00	0.00	0.00	2.511	28.77	1018	28.77	1018

* Design Condition

Certain information such as the data, opinions or recommendations set forth herein or given by Southwire representatives, is intended as a general guide only. Each installation of overhead electrical conductor, underground electrical conductor, and/or conductor accessories involves special conditions creating problems that require individual solutions and, therefore, the recipient of this information has the sole responsibility in connection with the use of the information. Southwire does not assume any liability in connection with such information.

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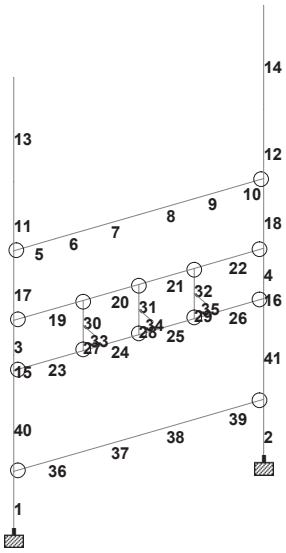
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Load 4

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**************************************************
*                                                *
*           STAAD.Pro V8i SELECTseries4           *
*           Version  20.07.09.21                 *
*           Proprietary Program of               *
*           Bentley Systems, Inc.                *
*           Date=    JAN 17, 2018                *
*           Time=    13:27:22                    *
*                                                *
*      USER ID: Ulteig Engineers                 *
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     1. STAAD SPACE
INPUT FILE: 138kV Single Bay Dead End With CCVT.STD
     2. START JOB INFORMATION
     3. ENGINEER DATE 1/25/2016
     4. JOB NAME ROCKSPRINGS (2015)
     5. ENGINEER NAME EWB
     6. END JOB INFORMATION
     7. INPUT WIDTH 79
     8. UNIT FEET POUND
     9. JOINT COORDINATES
    10. 1 0 0 0; 2 36 0 0; 3 0 25 0; 4 36 25 0; 5 0 40 0; 6 6 40 0; 7 10 40 0
    11. 8 18 40 0; 9 26 40 0; 10 30 40 0; 11 36 40 0; 12 0 50 0; 13 36 50 0; 14 0 65 0
    12. 15 36 65 0; 16 0 22.708 0; 17 36 22.708 0; 18 0 29.958 0; 19 36 29.958 0
    13. 20 10 22.708 0; 21 10 29.958 0; 22 18 22.708 0; 23 18 29.958 0; 24 26 22.708 0
    14. 25 26 29.958 0; 26 10 26.333 0; 27 18 26.333 0; 28 26 26.333 0
    15. 29 10 26.333 3.5; 30 18 26.333 3.5; 31 26 26.333 3.5; 32 0 8.167 0
    16. 33 10 8.167 0; 34 18 8.167 0; 35 26 8.167 0; 36 36 8.167 0
    17. MEMBER INCIDENCES
    18. 1 1 32; 2 2 36; 3 3 18; 4 4 19; 5 5 6; 6 6 7; 7 7 8; 8 8 9; 9 9 10; 10 10 11
    19. 11 5 12; 12 11 13; 13 12 14; 14 13 15; 15 16 3; 16 17 4; 17 18 5; 18 19 11
    20. 19 18 21; 20 21 23; 21 23 25; 22 25 19; 23 16 20; 24 20 22; 25 22 24; 26 24 17
    21. 27 20 26; 28 22 27; 29 24 28; 30 26 21; 31 27 23; 32 28 25; 33 26 29; 34 27 30
    22. 35 28 31; 36 32 33; 37 33 34; 38 34 35; 39 35 36; 40 16 32; 41 17 36
    23. DEFINE MATERIAL START
    24. ISOTROPIC STEEL
    25. E 4.176E+009
    26. POISSON 0.3
    27. DENSITY 489.024
    28. ALPHA 6E-006
    29. DAMP 0.03
    30. G 1.60615E+009
    31. TYPE STEEL
    32. STRENGTH FY 5.184E+006 FU 8.352E+006 RY 1.5 RT 1.2
    33. ISOTROPIC A500-B
    34. E 4.176E+009
    35. POISSON 0.3
    36. DENSITY 489.024
    37. ALPHA 6.5E-006
    38. DAMP 0.03
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39. TYPE STEEL
40. STRENGTH FY 6.624E+006 FU 8.352E+006 RY 1.4 RT 1.3
41. END DEFINE MATERIAL
42. MEMBER PROPERTY AMERICAN
43. 5 TO 10 36 TO 39 TABLE ST HSST10X10X0.375
44. 13 14 TABLE ST PIPS35
45. MEMBER PROPERTY AMERICAN
46. 1 2 PRIS OCT STA 2.66667 END 2.39444 THI 0.03125
47. 11 12 PRIS OCT STA 1.33333 END 1 THI 0.03125
48. MEMBER PROPERTY AMERICAN
49. 3 4 PRIS OCT STA 1.83333 END 1.66667 THI 0.03125
50. MEMBER PROPERTY AMERICAN
51. 15 16 PRIS OCT STA 1.91667 END 1.83333 THI 0.03125
52. 17 18 PRIS OCT STA 1.66667 END 1.33333 THI 0.03125
53. MEMBER PROPERTY AMERICAN
54. 19 TO 26 TABLE ST HSST8X8X0.25
55. 27 TO 35 TABLE D C6X8
56. MEMBER PROPERTY AMERICAN
57. 40 41 PRIS OCT STA 2.39444 END 1.91667 THI 0.03125
58. CONSTANTS
59. MATERIAL A500-B MEMB 19 TO 26
60. MATERIAL STEEL MEMB 1 TO 18 27 TO 41
61. SUPPORTS
62. 1 2 FIXED
63. MEMBER RELEASE
64. 5 19 23 27 TO 29 36 START MY MZ
65. 10 22 26 30 TO 32 39 END MY MZ
66. LOAD 1 LOADTYPE DEAD  TITLE DEAD LOAD
67. SELFWEIGHT Y -1 LIST 1 TO 26 36 TO 41
68. JOINT LOAD
69. 29 TO 31 FY -817
70. 7 TO 9 FY -73
71. 33 TO 35 FY -939
72. LOAD 2 LOADTYPE WIND  TITLE NESC HEAVY WIND X 4 PSF
73. MEMBER LOAD
74. 13 14 UNI GX 1.2
75. 1 2 TRAP GX 14.93 13.42
76. 15 16 TRAP GX 10.73 10.27
77. 3 4 TRAP GX 10.27 9.33
78. 17 18 TRAP GX 9.33 7.47
79. 11 12 TRAP GX 7.47 5.6
80. JOINT LOAD
81. *SWITCH
82. 29 TO 31 FX 67
83. *ARRESTER
84. 7 TO 9 FX 14 MZ -36
85. 33 TO 35 FX 54 MZ -133
86. MEMBER LOAD
87. 40 41 TRAP GX 10.73 13.42
88. LOAD 3 LOADTYPE WIND  TITLE NESC HEAVY WIND Z 4 PSF
89. MEMBER LOAD
90. 13 14 UNI GZ 1.2
91. 5 TO 10 19 TO 26 36 TO 39 UNI GZ 5.33
92. 1 2 TRAP GZ 14.93 13.42
93. 15 16 TRAP GZ 10.73 10.27
94. 3 4 TRAP GZ 10.27 9.33
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 95. 17 18 TRAP GZ 9.33 7.47
 96. 11 12 TRAP GZ 7.47 5.6
 97. JOINT LOAD
 98. *SWITCH
 99. 29 TO 31 FZ 22
100. *ARRESTER
101. 7 TO 9 FZ 14 MX 36
102. 33 TO 35 FZ 54 MX 133
103. MEMBER LOAD
104. 40 41 TRAP GZ 10.73 13.42
105. LOAD 4 LOADTYPE NONE  TITLE WIRE LOAD NESC HEAVY 0 DEG FACTORED 1.65X
106. JOINT LOAD
107. *CONDUCTORS
108. 6 8 10 FY -1061.4 FZ 2999.7
109. *STATIC WIRES
110. 12 13 FY -183.8 FZ 2475
111. LOAD 5 LOADTYPE NONE  TITLE WIRE LOAD NESC HEAVY 15 DEG FACTORED 1.65X
112. JOINT LOAD
113. *CONDUCTORS
114. 6 8 10 FX 1161.6 FY -1061.4 FZ 2897.5
115. *STATIC WIRES
116. 12 13 FX 812.5 FY -183.8 FZ 2390.7
117. LOAD 6 LOADTYPE WIND  TITLE EXT. WIND X 90 MPH
118. MEMBER LOAD
119. 13 14 UNI GX 6.31
120. 1 2 TRAP GX 78.51 70.54
121. 15 16 TRAP GX 56.43 53.98
122. 3 4 TRAP GX 53.98 49.07
123. 17 18 TRAP GX 49.07 39.26
124. 11 12 TRAP GX 39.26 29.44
125. JOINT LOAD
126. *SWITCH
127. 29 TO 31 FX 351
128. *ARRESTER
129. 7 TO 9 FX 66 MZ -165
130. 33 TO 35 FX 237 MZ -588
131. MEMBER LOAD
132. 40 41 TRAP GX 56.43 70.54
133. LOAD 7 LOADTYPE WIND  TITLE EXT. WIND Z 90 MPH
134. MEMBER LOAD
135. 13 14 UNI GZ 6.31
136. 5 TO 10 19 TO 26 36 TO 39 UNI GZ 28.04
137. 1 2 TRAP GZ 78.51 70.54
138. 15 16 TRAP GZ 56.43 53.98
139. 3 4 TRAP GZ 53.98 49.07
140. 17 18 TRAP GZ 49.07 39.26
141. 11 12 TRAP GZ 39.26 29.44
142. JOINT LOAD
143. *SWITCH
144. 29 TO 31 FZ 117
145. *ARRESTER
146. 7 TO 9 FZ 66 MX 165
147. 33 TO 35 FZ 237 MX 588
148. MEMBER LOAD
149. 40 41 TRAP GZ 56.43 70.54
150. LOAD 8 LOADTYPE NONE  TITLE WIRE LOAD EXT. WIND 0 DEG
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151. JOINT LOAD
152. *CONDUCTORS
153. 6 8 10 FY -556.7 FZ 1478
154. *STATIC WIRES
155. 12 13 FY -221 FZ 744
156. LOAD 9 LOADTYPE NONE  TITLE WIRE LOAD EXT. WIND 15 DEG
157. JOINT LOAD
158. *CONDUCTORS
159. 6 8 10 FX 831.3 FY -496.7 FZ 1427.6
160. *STATIC WIRES
161. 12 13 FX 526.9 FY -41 FZ 718.6
162. LOAD 10 LOADTYPE WIND  TITLE ICE WIND X 40 MPH
163. MEMBER LOAD
164. 13 14 UNI GX 1.56
165. 1 2 TRAP GX 15.51 13.93
166. 15 16 TRAP GX 11.63 11.15
167. 3 4 TRAP GX 11.15 10.18
168. 17 18 TRAP GX 10.18 8.24
169. 11 12 TRAP GX 8.24 6.3
170. JOINT LOAD
171. *SWITCH
172. 29 TO 31 FX 69
173. *ARRESTER
174. 7 TO 9 FX 15 MZ -37
175. 33 TO 35 FX 54 MZ -133
176. MEMBER LOAD
177. 40 41 TRAP GX 11.63 13.93
178. LOAD 11 LOADTYPE WIND  TITLE ICE WIND Z
179. MEMBER LOAD
180. 13 14 UNI GZ 1.56
181. 5 TO 10 19 TO 26 36 TO 39 UNI GZ 5.54
182. 1 2 TRAP GZ 15.51 13.93
183. 15 16 TRAP GZ 11.63 11.15
184. 3 4 TRAP GZ 11.15 10.18
185. 17 18 TRAP GZ 10.18 8.24
186. 11 12 TRAP GZ 8.24 6.3
187. JOINT LOAD
188. *SWITCH
189. 29 TO 31 FZ 23
190. *ARRESTER
191. 7 TO 9 FZ 15 MX 37
192. 33 TO 35 FZ 54 MX 133
193. MEMBER LOAD
194. 40 41 TRAP GZ 11.63 13.93
195. LOAD 12 LOADTYPE ICE  TITLE ICE LOAD (0.75")
196. SELFWEIGHT Y -0.75 LIST 1 TO 26 36 TO 41
197. JOINT LOAD
198. 7 TO 9 FY -55
199. 29 TO 31 FY -613
200. 33 TO 35 FY -705
201. LOAD 13 LOADTYPE NONE  TITLE WIRE LOAD ICE WIND 0 DEG
202. JOINT LOAD
203. *CONDUCTORS
204. 6 8 10 FY -908.1 FZ 2071
205. *STATIC WIRES
206. 12 13 FY -378.3 FZ 1672
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207. LOAD 14 LOADTYPE NONE  TITLE WIRE LOAD ICE WIND 15 DEG
208. JOINT LOAD
209. *CONDUCTORS
210. 6 8 10 FX 688.5 FY -848.1 FZ 2000.4
211. *STATIC WIRES
212. 12 13 FX 920.7 FY -198.3 FZ 1615
213. LOAD 15 LOADTYPE WIND  TITLE DEFLECTION WIRE LOAD EXT. WIND 0 DEG
214. JOINT LOAD
215. *CONDUCTORS
216. 6 8 10 FY -556.7 FZ 1324
217. *STATIC WIRES
218. 12 13 FY -221 FZ 627
219. LOAD 16 LOADTYPE WIND  TITLE DEFLECTION WIRE LOAD EXT. WIND 15 DEG
220. JOINT LOAD
221. *CONDUCTORS
222. 6 8 10 FX 692.7 FY -496.7 FZ 1278.9
223. *STATIC WIRES
224. 12 13 FX 431 FY -41 FZ 605.6
225. LOAD 17 LOADTYPE WIND  TITLE DEFLECTION WIRE LOAD ICE + WIND 0 DEG
226. JOINT LOAD
227. *CONDUCTORS
228. 6 8 10 FY -706.1 FZ 1502
229. *STATIC WIRES
230. 12 13 FY -221 FZ 899
231. LOAD 18 LOADTYPE WIND  TITLE DEFLECTION WIRE LOAD ICE + WIND 15 DEG
232. JOINT LOAD
233. *CONDUCTORS
234. 6 8 10 FX 509.3 FY -646.1 FZ 1450.8
235. *STATIC WIRES
236. 12 13 FX 425.2 FY -41 FZ 868.4
237. LOAD COMB 19 NESC HEAVY X
238. 1 1.0 2 2.5 5 1.0 12 0.67
239. LOAD COMB 20 NESC HEAVY Z
240. 1 1.0 3 2.5 4 1.0 12 0.67
241. LOAD COMB 21 EXT WIND X
242. 1 1.0 6 1.0 9 1.0
243. LOAD COMB 22 EXT. WIND Z
244. 1 1.0 7 1.0 8 1.0
245. LOAD COMB 23 ICE + WIND X
246. 1 1.0 10 1.0 12 1.0 14 1.0
247. LOAD COMB 24 ICE + WIND Z
248. 1 1.0 11 1.0 12 1.0 13 1.0
249. LOAD COMB 25 DEFLECTION CHECK EXT. WIND X
250. 1 1.0 6 0.78 16 1.0
251. LOAD COMB 26 DEFLECTION CHECK EXT. WIND Z
252. 1 1.0 7 0.78 15 1.0
253. LOAD COMB 27 DEFLECTION CHECK ICE + WIND X
254. 1 1.0 10 1.0 12 0.5 18 1.0
255. LOAD COMB 28 DEFLECTION CHECK ICE + WIND Z
256. 1 1.0 11 1.0 12 0.5 17 1.0
257. LOAD COMB 29 NESC HEAVY 45 DEGREES
258. 1 1.0 2 1.77 3 1.77 5 0.707 4 0.707 12 0.67
259. LOAD COMB 30 EXT. WIND 45 DEGREES
260. 1 1.0 6 0.707 7 0.707 8 0.707 9 0.707
261. LOAD COMB 31 ICE + WIND 45 DEGREES
262. 1 1.0 10 0.707 11 0.707 12 1.0 13 0.707 14 0.707
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263. PDELTA 5 ANALYSIS SMALLDELTA

P R O B L E M S T A T I S T I C S

NUMBER OF JOINTS 36 NUMBER OF MEMBERS 41
NUMBER OF PLATES 0 NUMBER OF SOLIDS 0
NUMBER OF SURFACES 0 NUMBER OF SUPPORTS 2

SOLVER USED IS THE OUT-OF-CORE BASIC SOLVER

ORIGINAL/FINAL BAND-WIDTH= 34/ 7/ 48 DOF
TOTAL PRIMARY LOAD CASES = 18, TOTAL DEGREES OF FREEDOM = 204
SIZE OF STIFFNESS MATRIX = 10 DOUBLE KILO-WORDS
REQRD/AVAIL. DISK SPACE = 12.2/ 114297.6 MB

***WARNING- APPLIED SELFWEIGHT IS LESS THAN TOTAL WEIGHT OF ALL STRUCTURAL ELEMENTS IN LOAD CASE 1 ALONG Y.**
THIS COULD BE DUE TO SELFWEIGHT APPLIED TO SPECIFIC LIST OF MEMBERS/PLATES/SOLIDS/SURFACES.
TOTAL UNFACTORED WEIGHT OF THE STRUCTURE = 14892.972 POUN
TOTAL UNFACTORED WEIGHT OF THE STRUCTURE APPLIED = 14367.269 POUN

***WARNING- APPLIED SELFWEIGHT IS LESS THAN TOTAL WEIGHT OF ALL STRUCTURAL ELEMENTS IN LOAD CASE 12 ALONG Y.**
THIS COULD BE DUE TO SELFWEIGHT APPLIED TO SPECIFIC LIST OF MEMBERS/PLATES/SOLIDS/SURFACES.
TOTAL UNFACTORED WEIGHT OF THE STRUCTURE = 14892.972 POUN
TOTAL UNFACTORED WEIGHT OF THE STRUCTURE APPLIED = 14367.269 POUN

++ Adjusting Displacements.
++ Adjusting Displacements.
++ Adjusting Displacements.
++ Adjusting Displacements.
++ Adjusting Displacements.

264. PARAMETER 1
265. CODE AISC UNIFIED 2010
266. METHOD ASD
267. UNB 36 MEMB 5 TO 10 19 TO 26
268. UNT 36 MEMB 5 TO 10 19 TO 26
269. LY 36 MEMB 5 TO 10 19 TO 26
270. LZ 36 MEMB 5 TO 10 19 TO 26
271. FYLD 6.624E+006 MEMB 5 TO 10 19 TO 26
272. CHECK CODE MEMB 5 TO 10 13 14 19 TO 26 36 TO 39

STAAD.PRO CODE CHECKING - (AISC-360-10-ASD) v1.2
****

ALL UNITS ARE - KIP INCH (UNLESS OTHERWISE NOTED)

MEMBER NO: 5 CRITICAL RATIO: 0.547(PASS) LOAD: 29
LOCATION (ft): 6.00 CONDITION: Eq. H1-1b
SECTION: HSST10X10X0.375 (AISC SECTIONS)

MEMBER NO: 6 CRITICAL RATIO: 0.686(PASS) LOAD: 29
LOCATION (ft): 4.00 CONDITION: Eq. H1-1b
SECTION: HSST10X10X0.375 (AISC SECTIONS)

MEMBER NO: 7 CRITICAL RATIO: 0.924(PASS) LOAD: 29
LOCATION (ft): 8.00 CONDITION: Eq. H1-1b
SECTION: HSST10X10X0.375 (AISC SECTIONS)

MEMBER NO: 8 CRITICAL RATIO: 0.925(PASS) LOAD: 29
LOCATION (ft): 0.00 CONDITION: Eq. H1-1b
SECTION: HSST10X10X0.375 (AISC SECTIONS)

MEMBER NO: 9 CRITICAL RATIO: 0.689(PASS) LOAD: 29
LOCATION (ft): 0.00 CONDITION: Eq. H1-1b
SECTION: HSST10X10X0.375 (AISC SECTIONS)

MEMBER NO: 10 CRITICAL RATIO: 0.551(PASS) LOAD: 29
LOCATION (ft): 0.00 CONDITION: Eq. H1-1b
SECTION: HSST10X10X0.375 (AISC SECTIONS)

MEMBER NO: 13 CRITICAL RATIO: 0.187(PASS) LOAD: 30
LOCATION (ft): 0.00 CONDITION: Eq. H1-1b
SECTION: PIPS35 (AISC SECTIONS)

MEMBER NO: 14 CRITICAL RATIO: 0.187(PASS) LOAD: 30
LOCATION (ft): 0.00 CONDITION: Eq. H1-1b
SECTION: PIPS35 (AISC SECTIONS)

MEMBER NO: 19 CRITICAL RATIO: 0.622(PASS) LOAD: 24
LOCATION (ft):10.00 CONDITION: Eq. H1-1b
SECTION: HSST8X8X0.25 (AISC SECTIONS)

STAAD.PRO CODE CHECKING - (AISC-360-10-ASD) v1.2
****

ALL UNITS ARE - KIP INCH (UNLESS OTHERWISE NOTED)

MEMBER NO: 20 CRITICAL RATIO: 0.785(PASS) LOAD: 24
LOCATION (ft): 8.00 CONDITION: Eq. H1-1b
SECTION: HSST8X8X0.25 (AISC SECTIONS)

MEMBER NO: 21 CRITICAL RATIO: 0.785(PASS) LOAD: 24
LOCATION (ft): 0.00 CONDITION: Eq. H1-1b
SECTION: HSST8X8X0.25 (AISC SECTIONS)

MEMBER NO: 22 CRITICAL RATIO: 0.622(PASS) LOAD: 24
LOCATION (ft): 0.00 CONDITION: Eq. H1-1b
SECTION: HSST8X8X0.25 (AISC SECTIONS)

MEMBER NO: 23 CRITICAL RATIO: 0.600(PASS) LOAD: 23
LOCATION (ft):10.00 CONDITION: Eq. H1-1b
SECTION: HSST8X8X0.25 (AISC SECTIONS)

MEMBER NO: 24 CRITICAL RATIO: 0.759(PASS) LOAD: 23
LOCATION (ft): 8.00 CONDITION: Eq. H1-1b
SECTION: HSST8X8X0.25 (AISC SECTIONS)

MEMBER NO: 25 CRITICAL RATIO: 0.761(PASS) LOAD: 23
LOCATION (ft): 0.00 CONDITION: Eq. H1-1b
SECTION: HSST8X8X0.25 (AISC SECTIONS)

MEMBER NO: 26 CRITICAL RATIO: 0.605(PASS) LOAD: 23
LOCATION (ft): 0.00 CONDITION: Eq. H1-1b
SECTION: HSST8X8X0.25 (AISC SECTIONS)

MEMBER NO: 36 CRITICAL RATIO: 0.429(PASS) LOAD: 24
LOCATION (ft):10.00 CONDITION: Eq. H1-1b
SECTION: HSST10X10X0.375 (AISC SECTIONS)

MEMBER NO: 37 CRITICAL RATIO: 0.541(PASS) LOAD: 24
LOCATION (ft): 8.00 CONDITION: Eq. H1-1b
SECTION: HSST10X10X0.375 (AISC SECTIONS)

STAAD.PRO CODE CHECKING - (AISC-360-10-ASD) v1.2
****

ALL UNITS ARE - KIP INCH (UNLESS OTHERWISE NOTED)

MEMBER NO: 38 CRITICAL RATIO: 0.541(PASS) LOAD: 24
LOCATION (ft): 0.00 CONDITION: Eq. H1-1b
SECTION: HSST10X10X0.375 (AISC SECTIONS)

MEMBER NO: 39 CRITICAL RATIO: 0.429(PASS) LOAD: 24
LOCATION (ft): 0.00 CONDITION: Eq. H1-1b
SECTION: HSST10X10X0.375 (AISC SECTIONS)

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 273. PARAMETER 2
 274. CODE ASCE 1997
 275. FYLD 5.184E+006 MEMB 1 TO 4 15 TO 18 40 41
 276. CHECK CODE MEMB 1 TO 4 15 TO 18 40 41
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STAAD.PRO CODE CHECKING - (ASCE 10-97) v1.0
****

ALL UNITS ARE - POUN FEET (UNLESS OTHERWISE NOTED)

MEMBER	TABLE	RESULT/ FX	CRITICAL COND/ MY	RATIO/ MZ	LOADING/ LOCATION
1	OCTAGONAL	PASS		0.535	2.67
2	OCTAGONAL	PASS		0.533	2.67
3	OCTAGONAL	PASS		0.467	1.83
4	OCTAGONAL	PASS		0.466	1.83
15	OCTAGONAL	PASS		0.484	1.92
16	OCTAGONAL	PASS		0.483	1.92
17	OCTAGONAL	PASS		0.403	1.67
18	OCTAGONAL	PASS		0.402	1.67
40	OCTAGONAL	PASS		0.838	2.39

MEMBER # 1	SECTION = OCTAGONAL		DEPTH AT START = 2.67		
DEPTH AT END = 2.39	THK. = 0.031	RATIO = 0.535	STATUS = PASS		
MEMBER # 2	SECTION = OCTAGONAL		DEPTH AT START = 2.67		
DEPTH AT END = 2.39	THK. = 0.031	RATIO = 0.533	STATUS = PASS		
MEMBER # 3	SECTION = OCTAGONAL		DEPTH AT START = 1.83		
DEPTH AT END = 1.67	THK. = 0.031	RATIO = 0.467	STATUS = PASS		
MEMBER # 4	SECTION = OCTAGONAL		DEPTH AT START = 1.83		
DEPTH AT END = 1.67	THK. = 0.031	RATIO = 0.466	STATUS = PASS		
MEMBER # 15	SECTION = OCTAGONAL		DEPTH AT START = 1.92		
DEPTH AT END = 1.83	THK. = 0.031	RATIO = 0.484	STATUS = PASS		
MEMBER # 16	SECTION = OCTAGONAL		DEPTH AT START = 1.92		
DEPTH AT END = 1.83	THK. = 0.031	RATIO = 0.483	STATUS = PASS		
MEMBER # 17	SECTION = OCTAGONAL		DEPTH AT START = 1.67		
DEPTH AT END = 1.33	THK. = 0.031	RATIO = 0.403	STATUS = PASS		
MEMBER # 18	SECTION = OCTAGONAL		DEPTH AT START = 1.67		
DEPTH AT END = 1.33	THK. = 0.031	RATIO = 0.402	STATUS = PASS		
MEMBER # 40	SECTION = OCTAGONAL		DEPTH AT START = 2.39		
DEPTH AT END = 1.92	THK. = 0.031	RATIO = 0.838	STATUS = PASS		

ALL UNITS ARE - POUN FEET (UNLESS OTHERWISE NOTED)

MEMBER	TABLE	RESULT/ FX	CRITICAL COND/ MY	RATIO/ MZ	LOADING/ LOCATION

|---|
| MEMBER # 41 SECTION = OCTAGONAL DEPTH AT START = 2.39 |
DEPTH AT END = 1.92 THK. = 0.031 RATIO = 0.835 STATUS = PASS

********** END OF TABULATED RESULT OF DESIGN **********

277. UNIT INCHES KIP
278. PRINT MEMBER STRESSES LIST 1 TO 4 11 12 15 TO 18

MEMBER STRESSES

ALL UNITS ARE KIP /SQ INCH

MEMB	LD	SECT	AXIAL	BEND-Y	BEND-Z	COMBINED	SHEAR-Y	SHEAR-Z
1	1	.0	0.3 C	0.2	0.0	0.4	0.0	0.0
		1.00	0.3 C	0.2	0.0	0.5	0.0	0.0
	2	.0	0.0 T	0.0	0.6	0.6	0.0	0.0
		1.00	0.0 T	0.0	0.5	0.5	0.0	0.0
	3	.0	0.0 T	0.9	0.0	0.9	0.0	0.1
		1.00	0.0 T	0.7	0.0	0.7	0.0	0.1
	4	.0	0.0 C	11.2	0.0	11.3	0.0	0.4
		1.00	0.1 C	11.4	0.0	11.4	0.0	0.4
	5	.0	0.0 C	10.9	4.1	12.4	0.1	0.4
		1.00	0.1 C	11.0	4.1	12.6	0.1	0.4
	6	.0	0.0 T	0.1	3.1	3.1	0.2	0.0
		1.00	0.0 T	0.1	2.5	2.5	0.2	0.0
	7	.0	0.0 T	4.7	0.0	4.7	0.0	0.3
		1.00	0.0 T	3.9	0.0	3.9	0.0	0.3
	8	.0	0.0 C	4.7	0.0	4.7	0.0	0.2
		1.00	0.0 C	4.7	0.0	4.7	0.0	0.2
	9	.0	0.0 C	4.5	2.8	5.5	0.1	0.1
		1.00	0.0 C	4.5	2.8	5.5	0.1	0.2
	10	.0	0.0 T	0.0	0.6	0.6	0.0	0.0
		1.00	0.0 T	0.0	0.5	0.5	0.0	0.0
	11	.0	0.0 T	1.0	0.0	1.0	0.0	0.1
		1.00	0.0 T	0.8	0.0	0.8	0.0	0.1
	12	.0	0.2 C	0.1	0.0	0.3	0.0	0.0
		1.00	0.2 C	0.1	0.0	0.3	0.0	0.0
	13	.0	0.0 C	7.7	0.0	7.7	0.0	0.2
		1.00	0.0 C	7.8	0.0	7.8	0.0	0.3
	14	.0	0.0 C	7.4	3.2	8.7	0.1	0.2
		1.00	0.0 C	7.5	3.3	8.9	0.1	0.3
	15	.0	0.0 C	4.1	0.0	4.1	0.0	0.1
		1.00	0.0 C	4.1	0.0	4.2	0.0	0.2
	16	.0	0.0 C	4.0	2.3	4.8	0.1	0.1
		1.00	0.0 C	4.0	2.4	4.8	0.1	0.1
	17	.0	0.0 C	5.0	0.0	5.0	0.0	0.2
		1.00	0.0 C	5.0	0.0	5.1	0.0	0.2
	18	.0	0.0 C	4.8	1.9	5.6	0.1	0.2
		1.00	0.0 C	4.9	1.9	5.7	0.1	0.2
	19	.0	0.4 C	11.2	5.6	13.6	0.2	0.4
		1.00	0.4 C	11.3	5.3	13.7	0.2	0.4
	20	.0	0.4 C	13.7	0.0	14.1	0.0	0.5
		1.00	0.4 C	13.5	0.0	14.0	0.0	0.5
	21	.0	0.3 C	4.8	5.9	7.9	0.3	0.2
		1.00	0.3 C	4.8	5.4	7.5	0.3	0.2
	22	.0	0.3 C	9.5	0.0	9.8	0.0	0.4
		1.00	0.3 C	8.8	0.0	9.0	0.0	0.5
	23	.0	0.5 C	7.7	3.9	9.6	0.1	0.2
		1.00	0.5 C	7.9	3.8	9.8	0.2	0.3

MEMBER STRESSES

ALL UNITS ARE KIP /SQ INCH

MEMB	LD	SECT	AXIAL	BEND-Y	BEND-Z	COMBINED	SHEAR-Y	SHEAR-Z
	24	.0	0.5 C	8.9	0.0	9.4	0.0	0.3
		1.00	0.5 C	8.9	0.0	9.4	0.0	0.3
	25	.0	0.3 C	4.2	4.7	6.6	0.2	0.1
		1.00	0.3 C	4.2	4.3	6.3	0.2	0.2
	26	.0	0.3 C	7.9	0.0	8.2	0.0	0.4
		1.00	0.3 C	7.3	0.0	7.6	0.0	0.4
	27	.0	0.4 C	5.1	2.6	6.3	0.1	0.2
		1.00	0.4 C	5.2	2.5	6.4	0.1	0.2
	28	.0	0.4 C	6.2	0.0	6.6	0.0	0.2
		1.00	0.4 C	6.1	0.0	6.5	0.0	0.2
	29	.0	0.4 C	17.5	3.9	18.8	0.2	0.6
		1.00	0.4 C	17.5	3.8	18.7	0.2	0.7
	30	.0	0.3 C	10.0	4.2	12.0	0.2	0.4
		1.00	0.3 C	9.5	3.8	11.3	0.2	0.4
	31	.0	0.5 C	11.7	2.7	12.8	0.1	0.4
		1.00	0.5 C	11.7	2.7	12.9	0.1	0.4
2	1	.0	0.3 C	0.2	0.0	0.4	0.0	0.0
		1.00	0.3 C	0.2	0.0	0.5	0.0	0.0
	2	.0	0.0 C	0.0	0.6	0.6	0.0	0.0
		1.00	0.0 C	0.0	0.5	0.5	0.0	0.0
	3	.0	0.0 C	0.9	0.0	0.9	0.0	0.1
		1.00	0.0 C	0.7	0.0	0.7	0.0	0.1
	4	.0	0.0 C	11.2	0.0	11.3	0.0	0.4
		1.00	0.1 C	11.4	0.0	11.4	0.0	0.4
	5	.0	0.0 C	10.9	4.1	12.4	0.1	0.4
		1.00	0.1 C	11.0	4.1	12.6	0.1	0.4
	6	.0	0.0 C	0.1	3.1	3.1	0.2	0.0
		1.00	0.0 C	0.1	2.5	2.5	0.2	0.0
	7	.0	0.0 C	4.7	0.0	4.7	0.0	0.3
		1.00	0.0 C	3.9	0.0	3.9	0.0	0.3
	8	.0	0.0 C	4.7	0.0	4.7	0.0	0.2
		1.00	0.0 C	4.7	0.0	4.7	0.0	0.2
	9	.0	0.0 C	4.5	2.8	5.5	0.1	0.1
		1.00	0.0 C	4.5	2.8	5.5	0.1	0.2
	10	.0	0.0 C	0.0	0.6	0.6	0.0	0.0
		1.00	0.0 C	0.0	0.5	0.5	0.0	0.0
	11	.0	0.0 C	1.0	0.0	1.0	0.0	0.1
		1.00	0.0 C	0.8	0.0	0.8	0.0	0.1
	12	.0	0.2 C	0.1	0.0	0.3	0.0	0.0
		1.00	0.2 C	0.1	0.0	0.3	0.0	0.0
	13	.0	0.0 C	7.7	0.0	7.7	0.0	0.2
		1.00	0.0 C	7.8	0.0	7.8	0.0	0.3
	14	.0	0.0 C	7.4	3.2	8.7	0.1	0.2
		1.00	0.0 C	7.5	3.3	8.8	0.1	0.3
	15	.0	0.0 C	4.1	0.0	4.1	0.0	0.1
		1.00	0.0 C	4.1	0.0	4.2	0.0	0.2

MEMBER STRESSES

ALL UNITS ARE KIP /SQ INCH

MEMB	LD	SECT	AXIAL	BEND-Y	BEND-Z	COMBINED	SHEAR-Y	SHEAR-Z
	16	.0	0.0 C	4.0	2.3	4.8	0.1	0.1
		1.00	0.0 C	4.0	2.4	4.8	0.1	0.1
	17	.0	0.0 C	5.0	0.0	5.0	0.0	0.2
		1.00	0.0 C	5.0	0.0	5.1	0.0	0.2
	18	.0	0.0 C	4.8	1.9	5.6	0.1	0.2
		1.00	0.0 C	4.9	1.9	5.7	0.1	0.2
	19	.0	0.4 C	11.0	5.6	13.4	0.2	0.3
		1.00	0.4 C	11.2	5.3	13.6	0.2	0.4
	20	.0	0.4 C	13.7	0.0	14.1	0.0	0.5
		1.00	0.4 C	13.5	0.0	14.0	0.0	0.5
	21	.0	0.3 C	4.6	5.9	7.8	0.3	0.1
		1.00	0.3 C	4.6	5.4	7.4	0.3	0.2
	22	.0	0.3 C	9.5	0.0	9.8	0.0	0.4
		1.00	0.3 C	8.8	0.0	9.0	0.0	0.5
	23	.0	0.5 C	7.7	3.9	9.5	0.1	0.2
		1.00	0.5 C	7.8	3.8	9.7	0.2	0.3
	24	.0	0.5 C	8.9	0.0	9.4	0.0	0.3
		1.00	0.5 C	8.9	0.0	9.4	0.0	0.3
	25	.0	0.3 C	4.0	4.7	6.5	0.2	0.1
		1.00	0.3 C	4.1	4.3	6.3	0.2	0.1
	26	.0	0.3 C	7.9	0.0	8.2	0.0	0.4
		1.00	0.3 C	7.3	0.0	7.6	0.0	0.4
	27	.0	0.4 C	5.0	2.6	6.3	0.1	0.2
		1.00	0.4 C	5.1	2.5	6.4	0.1	0.2
	28	.0	0.4 C	6.2	0.0	6.6	0.0	0.2
		1.00	0.4 C	6.1	0.0	6.5	0.0	0.2
	29	.0	0.4 C	17.4	3.9	18.7	0.2	0.6
		1.00	0.5 C	17.4	3.8	18.7	0.2	0.7
	30	.0	0.3 C	9.9	4.2	11.8	0.2	0.4
		1.00	0.3 C	9.4	3.8	11.2	0.2	0.4
	31	.0	0.5 C	11.6	2.7	12.8	0.1	0.4
		1.00	0.5 C	11.7	2.7	12.8	0.1	0.4
3	1	.0	0.1 C	0.2	0.0	0.4	0.0	0.0
		1.00	0.1 C	0.0	0.0	0.1	0.0	0.0
	2	.0	0.0 T	0.0	0.3	0.3	0.0	0.0
		1.00	0.0 T	0.0	0.2	0.2	0.0	0.0
	3	.0	0.0 T	0.4	0.0	0.4	0.0	0.0
		1.00	0.0 T	0.3	0.0	0.3	0.0	0.0
	4	.0	0.1 C	10.3	0.0	10.4	0.0	0.5
		1.00	0.1 C	9.2	0.0	9.3	0.0	0.6
	5	.0	0.1 C	10.0	3.7	11.4	0.2	0.5
		1.00	0.1 C	8.9	3.3	10.2	0.2	0.6
	6	.0	0.0 T	0.0	1.4	1.4	0.1	0.0
		1.00	0.0 T	0.0	1.0	1.0	0.1	0.0
	7	.0	0.0 T	2.2	0.0	2.2	0.0	0.2
		1.00	0.0 T	1.6	0.0	1.6	0.0	0.2

MEMBER STRESSES

ALL UNITS ARE KIP /SQ INCH

MEMB	LD	SECT	AXIAL	BEND-Y	BEND-Z	COMBINED	SHEAR-Y	SHEAR-Z
8		.0	0.0 C	4.1	0.0	4.2	0.0	0.2
		1.00	0.0 C	3.6	0.0	3.6	0.0	0.2
9		.0	0.0 C	4.0	2.5	4.9	0.1	0.2
		1.00	0.0 C	3.5	2.2	4.3	0.1	0.2
10		.0	0.0 T	0.0	0.3	0.3	0.0	0.0
		1.00	0.0 T	0.0	0.2	0.2	0.0	0.0
11		.0	0.0 T	0.5	0.0	0.5	0.0	0.0
		1.00	0.0 T	0.3	0.0	0.3	0.0	0.0
12		.0	0.1 C	0.2	0.0	0.3	0.0	0.0
		1.00	0.1 C	0.0	0.0	0.1	0.0	0.0
13		.0	0.1 C	7.0	0.0	7.1	0.0	0.4
		1.00	0.1 C	6.3	0.0	6.3	0.0	0.4
14		.0	0.1 C	6.8	3.1	8.0	0.1	0.4
		1.00	0.1 C	6.1	2.8	7.2	0.2	0.4
15		.0	0.0 C	3.6	0.0	3.7	0.0	0.2
		1.00	0.0 C	3.1	0.0	3.2	0.0	0.2
16		.0	0.0 C	3.5	2.1	4.2	0.1	0.2
		1.00	0.0 C	3.0	1.8	3.7	0.1	0.2
17		.0	0.0 C	4.5	0.0	4.5	0.0	0.2
		1.00	0.1 C	3.9	0.0	4.0	0.0	0.3
18		.0	0.0 C	4.3	1.8	5.1	0.1	0.2
		1.00	0.0 C	3.8	1.6	4.5	0.1	0.3
19		.0	0.3 C	10.3	4.4	12.4	0.2	0.6
		1.00	0.3 C	8.9	3.8	10.7	0.3	0.6
20		.0	0.3 C	11.7	0.0	12.0	0.0	0.7
		1.00	0.3 C	9.9	0.0	10.2	0.0	0.7
21		.0	0.2 C	4.2	3.9	6.0	0.2	0.3
		1.00	0.2 C	3.5	3.3	4.9	0.3	0.3
22		.0	0.2 C	6.5	0.0	6.7	0.0	0.4
		1.00	0.2 C	5.2	0.0	5.3	0.0	0.5
23		.0	0.3 C	7.2	3.4	8.8	0.2	0.4
		1.00	0.3 C	6.1	3.0	7.4	0.2	0.5
24		.0	0.3 C	7.9	0.0	8.2	0.0	0.5
		1.00	0.3 C	6.6	0.0	6.9	0.0	0.5
25		.0	0.2 C	3.7	3.2	5.1	0.2	0.2
		1.00	0.2 C	3.0	2.7	4.2	0.2	0.3
26		.0	0.2 C	5.5	0.0	5.7	0.0	0.4
		1.00	0.2 C	4.4	0.0	4.5	0.0	0.4
27		.0	0.2 C	4.7	2.1	5.7	0.1	0.3
		1.00	0.2 C	3.8	1.8	4.7	0.1	0.3
28		.0	0.2 C	5.3	0.0	5.5	0.0	0.3
		1.00	0.2 C	4.3	0.0	4.5	0.0	0.4
29		.0	0.3 C	15.4	3.1	16.3	0.2	0.9
		1.00	0.3 C	13.3	2.7	14.1	0.2	0.9
30		.0	0.2 C	7.5	2.8	8.7	0.2	0.5
		1.00	0.2 C	6.1	2.3	7.2	0.2	0.5
31		.0	0.3 C	10.5	2.4	11.4	0.1	0.6
		1.00	0.3 C	9.0	2.1	9.8	0.1	0.7

MEMBER STRESSES

ALL UNITS ARE KIP /SQ INCH

MEMB	LD	SECT	AXIAL	BEND-Y	BEND-Z	COMBINED	SHEAR-Y	SHEAR-Z
4	1	.0	0.1 C	0.2	0.0	0.4	0.0	0.0
		1.00	0.1 C	0.0	0.0	0.1	0.0	0.0
	2	.0	0.0 C	0.0	0.3	0.3	0.0	0.0
		1.00	0.0 C	0.0	0.2	0.2	0.0	0.0
	3	.0	0.0 C	0.4	0.0	0.4	0.0	0.0
		1.00	0.0 C	0.3	0.0	0.3	0.0	0.0
	4	.0	0.1 C	10.3	0.0	10.4	0.0	0.5
		1.00	0.1 C	9.2	0.0	9.3	0.0	0.6
	5	.0	0.1 C	9.9	3.7	11.4	0.2	0.5
		1.00	0.1 C	8.9	3.3	10.1	0.2	0.6
	6	.0	0.0 C	0.0	1.4	1.4	0.1	0.0
		1.00	0.0 C	0.0	1.0	1.0	0.1	0.0
	7	.0	0.0 C	2.2	0.0	2.2	0.0	0.2
		1.00	0.0 C	1.6	0.0	1.6	0.0	0.2
	8	.0	0.0 C	4.1	0.0	4.2	0.0	0.2
		1.00	0.0 C	3.6	0.0	3.6	0.0	0.2
	9	.0	0.0 C	4.0	2.5	4.9	0.1	0.2
		1.00	0.0 C	3.5	2.2	4.3	0.1	0.2
	10	.0	0.0 C	0.0	0.3	0.3	0.0	0.0
		1.00	0.0 C	0.0	0.2	0.2	0.0	0.0
	11	.0	0.0 C	0.5	0.0	0.5	0.0	0.0
		1.00	0.0 C	0.3	0.0	0.3	0.0	0.0
	12	.0	0.1 C	0.2	0.0	0.3	0.0	0.0
		1.00	0.1 C	0.0	0.0	0.1	0.0	0.0
	13	.0	0.1 C	7.0	0.0	7.1	0.0	0.4
		1.00	0.1 C	6.3	0.0	6.3	0.0	0.4
	14	.0	0.1 C	6.8	3.1	8.0	0.1	0.4
		1.00	0.1 C	6.1	2.8	7.2	0.2	0.4
	15	.0	0.0 C	3.6	0.0	3.7	0.0	0.2
		1.00	0.0 C	3.1	0.0	3.2	0.0	0.2
	16	.0	0.0 C	3.5	2.1	4.2	0.1	0.2
		1.00	0.0 C	3.0	1.8	3.7	0.1	0.2
	17	.0	0.0 C	4.5	0.0	4.5	0.0	0.2
		1.00	0.1 C	3.9	0.0	4.0	0.0	0.3
	18	.0	0.0 C	4.3	1.8	5.1	0.1	0.2
		1.00	0.0 C	3.8	1.6	4.5	0.1	0.3
	19	.0	0.3 C	10.3	4.4	12.3	0.2	0.6
		1.00	0.3 C	8.9	3.8	10.7	0.3	0.6
	20	.0	0.3 C	11.7	0.0	12.0	0.0	0.7
		1.00	0.3 C	9.9	0.0	10.2	0.0	0.7
	21	.0	0.2 C	4.2	3.9	5.9	0.2	0.3
		1.00	0.2 C	3.5	3.3	5.0	0.3	0.3
	22	.0	0.2 C	6.5	0.0	6.7	0.0	0.4
		1.00	0.2 C	5.2	0.0	5.3	0.0	0.5
	23	.0	0.3 C	7.2	3.4	8.8	0.2	0.4
		1.00	0.3 C	6.1	3.0	7.4	0.2	0.5

MEMBER STRESSES

ALL UNITS ARE KIP /SQ INCH

MEMB	LD	SECT	AXIAL	BEND-Y	BEND-Z	COMBINED	SHEAR-Y	SHEAR-Z
	24	.0	0.3 C	7.9	0.0	8.2	0.0	0.5
		1.00	0.3 C	6.6	0.0	6.9	0.0	0.5
	25	.0	0.2 C	3.7	3.2	5.1	0.2	0.2
		1.00	0.2 C	3.0	2.7	4.2	0.2	0.3
	26	.0	0.2 C	5.5	0.0	5.7	0.0	0.4
		1.00	0.2 C	4.4	0.0	4.5	0.0	0.4
	27	.0	0.2 C	4.6	2.1	5.7	0.1	0.3
		1.00	0.2 C	3.8	1.8	4.7	0.1	0.3
	28	.0	0.2 C	5.3	0.0	5.5	0.0	0.3
		1.00	0.2 C	4.3	0.0	4.5	0.0	0.4
	29	.0	0.3 C	15.4	3.1	16.3	0.2	0.9
		1.00	0.3 C	13.3	2.7	14.1	0.2	0.9
	30	.0	0.2 C	7.5	2.8	8.7	0.2	0.5
		1.00	0.2 C	6.1	2.3	7.2	0.2	0.5
	31	.0	0.3 C	10.5	2.4	11.4	0.1	0.6
		1.00	0.3 C	9.0	2.1	9.8	0.1	0.7
11	1	.0	0.0 C	0.0	0.0	0.0	0.0	0.0
		1.00	0.0 C	0.0	0.0	0.0	0.0	0.0
	2	.0	0.0 C	0.0	0.1	0.1	0.0	0.0
		1.00	0.0 C	0.0	0.0	0.0	0.0	0.0
	3	.0	0.0 C	0.1	0.0	0.1	0.0	0.0
		1.00	0.0 C	0.0	0.0	0.0	0.0	0.0
	4	.0	0.0 C	3.8	0.0	3.8	0.0	0.3
		1.00	0.0 C	0.0	0.0	0.0	0.0	0.4
	5	.0	0.0 C	3.7	1.2	4.1	0.1	0.3
		1.00	0.0 C	0.0	0.0	0.0	0.1	0.3
	6	.0	0.0	0.0	0.5	0.5	0.0	0.0
		1.00	0.0	0.0	0.2	0.2	0.0	0.0
	7	.0	0.0	0.5	0.0	0.5	0.0	0.0
		1.00	0.0	0.2	0.0	0.2	0.0	0.0
	8	.0	0.0 C	1.1	0.0	1.2	0.0	0.1
		1.00	0.0 C	0.0	0.0	0.0	0.0	0.1
	9	.0	0.0 C	1.1	0.8	1.4	0.1	0.1
		1.00	0.0 C	0.0	0.0	0.0	0.1	0.1
	10	.0	0.0	0.0	0.1	0.1	0.0	0.0
		1.00	0.0	0.0	0.0	0.0	0.0	0.0
	11	.0	0.0 C	0.1	0.0	0.1	0.0	0.0
		1.00	0.0 C	0.0	0.0	0.0	0.0	0.0
	12	.0	0.0 C	0.0	0.0	0.0	0.0	0.0
		1.00	0.0 C	0.0	0.0	0.0	0.0	0.0
	13	.0	0.0 C	2.6	0.0	2.6	0.0	0.2
		1.00	0.0 C	0.0	0.0	0.0	0.0	0.2
	14	.0	0.0 C	2.5	1.4	3.0	0.1	0.2
		1.00	0.0 C	0.0	0.0	0.0	0.1	0.2
	15	.0	0.0 C	1.0	0.0	1.0	0.0	0.1
		1.00	0.0 C	0.0	0.0	0.0	0.0	0.1

MEMBER STRESSES

ALL UNITS ARE KIP /SQ INCH

MEMB	LD	SECT	AXIAL	BEND-Y	BEND-Z	COMBINED	SHEAR-Y	SHEAR-Z
	16	.0	0.0 C	0.9	0.7	1.2	0.0	0.1
		1.00	0.0 C	0.0	0.0	0.0	0.1	0.1
	17	.0	0.0 C	1.4	0.0	1.4	0.0	0.1
		1.00	0.0 C	0.0	0.0	0.0	0.0	0.1
	18	.0	0.0 C	1.3	0.7	1.6	0.0	0.1
		1.00	0.0 C	0.0	0.0	0.0	0.1	0.1
	19	.0	0.1 C	3.7	1.5	4.3	0.1	0.3
		1.00	0.0 C	0.0	0.1	0.1	0.1	0.3
	20	.0	0.1 C	4.0	0.0	4.1	0.0	0.3
		1.00	0.0 C	0.1	0.0	0.1	0.0	0.4
	21	.0	0.0 C	1.1	1.3	1.8	0.1	0.1
		1.00	0.0 C	0.0	0.2	0.2	0.1	0.1
	22	.0	0.0 C	1.6	0.0	1.7	0.0	0.1
		1.00	0.0 C	0.2	0.0	0.2	0.0	0.1
	23	.0	0.1 C	2.5	1.5	3.1	0.1	0.2
		1.00	0.0 C	0.0	0.0	0.1	0.1	0.2
	24	.0	0.1 C	2.7	0.0	2.8	0.0	0.2
		1.00	0.0 C	0.0	0.0	0.1	0.0	0.2
	25	.0	0.0 C	0.9	1.1	1.4	0.1	0.1
		1.00	0.0 C	0.0	0.2	0.2	0.1	0.1
	26	.0	0.0 C	1.4	0.0	1.4	0.0	0.1
		1.00	0.0 C	0.2	0.0	0.2	0.0	0.1
	27	.0	0.1 C	1.3	0.8	1.6	0.1	0.1
		1.00	0.0 C	0.0	0.0	0.1	0.1	0.1
	28	.0	0.1 C	1.5	0.0	1.6	0.0	0.1
		1.00	0.0 C	0.0	0.0	0.1	0.0	0.1
	29	.0	0.1 C	5.4	1.1	5.7	0.1	0.4
		1.00	0.0 C	0.1	0.1	0.1	0.1	0.5
	30	.0	0.0 C	1.9	0.9	2.3	0.1	0.1
		1.00	0.0 C	0.1	0.1	0.2	0.1	0.2
	31	.0	0.1 C	3.6	1.1	4.1	0.1	0.3
		1.00	0.0 C	0.0	0.0	0.1	0.1	0.3
12	1	.0	0.0 C	0.0	0.0	0.0	0.0	0.0
		1.00	0.0 C	0.0	0.0	0.0	0.0	0.0
	2	.0	0.0	0.0	0.1	0.1	0.0	0.0
		1.00	0.0	0.0	0.0	0.0	0.0	0.0
	3	.0	0.0 C	0.1	0.0	0.1	0.0	0.0
		1.00	0.0 C	0.0	0.0	0.0	0.0	0.0
	4	.0	0.0 C	3.8	0.0	3.8	0.0	0.3
		1.00	0.0 C	0.0	0.0	0.0	0.0	0.4
	5	.0	0.0 C	3.7	1.2	4.1	0.1	0.3
		1.00	0.0 C	0.0	0.0	0.0	0.1	0.3
	6	.0	0.0	0.0	0.5	0.5	0.0	0.0
		1.00	0.0	0.0	0.2	0.2	0.0	0.0
	7	.0	0.0 C	0.5	0.0	0.5	0.0	0.0
		1.00	0.0 C	0.2	0.0	0.2	0.0	0.0

MEMBER STRESSES

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MEMB	LD	SECT	AXIAL	BEND-Y	BEND-Z	COMBINED	SHEAR-Y	SHEAR-Z
	8	.0	0.0 C	1.1	0.0	1.2	0.0	0.1
		1.00	0.0 C	0.0	0.0	0.0	0.0	0.1
	9	.0	0.0 C	1.1	0.8	1.4	0.1	0.1
		1.00	0.0 C	0.0	0.0	0.0	0.1	0.1
	10	.0	0.0	0.0	0.1	0.1	0.0	0.0
		1.00	0.0	0.0	0.0	0.0	0.0	0.0
	11	.0	0.0 C	0.1	0.0	0.1	0.0	0.0
		1.00	0.0 C	0.0	0.0	0.0	0.0	0.0
	12	.0	0.0 C	0.0	0.0	0.0	0.0	0.0
		1.00	0.0 C	0.0	0.0	0.0	0.0	0.0
	13	.0	0.0 C	2.6	0.0	2.6	0.0	0.2
		1.00	0.0 C	0.0	0.0	0.0	0.0	0.2
	14	.0	0.0 C	2.5	1.4	3.0	0.1	0.2
		1.00	0.0 C	0.0	0.0	0.0	0.1	0.2
	15	.0	0.0 C	1.0	0.0	1.0	0.0	0.1
		1.00	0.0 C	0.0	0.0	0.0	0.0	0.1
	16	.0	0.0 C	0.9	0.7	1.2	0.0	0.1
		1.00	0.0 C	0.0	0.0	0.0	0.1	0.1
	17	.0	0.0 C	1.4	0.0	1.4	0.0	0.1
		1.00	0.0 C	0.0	0.0	0.0	0.0	0.1
	18	.0	0.0 C	1.3	0.7	1.6	0.0	0.1
		1.00	0.0 C	0.0	0.0	0.0	0.1	0.1
	19	.0	0.1 C	3.7	1.5	4.3	0.1	0.3
		1.00	0.0 C	0.0	0.1	0.1	0.1	0.3
	20	.0	0.1 C	4.0	0.0	4.1	0.0	0.3
		1.00	0.0 C	0.1	0.0	0.1	0.0	0.4
	21	.0	0.0 C	1.1	1.3	1.8	0.1	0.1
		1.00	0.0 C	0.0	0.2	0.2	0.1	0.1
	22	.0	0.0 C	1.6	0.0	1.7	0.0	0.1
		1.00	0.0 C	0.2	0.0	0.2	0.0	0.1
	23	.0	0.1 C	2.5	1.5	3.1	0.1	0.2
		1.00	0.0 C	0.0	0.0	0.1	0.1	0.2
	24	.0	0.1 C	2.7	0.0	2.8	0.0	0.2
		1.00	0.0 C	0.0	0.0	0.1	0.0	0.2
	25	.0	0.0 C	0.9	1.1	1.4	0.1	0.1
		1.00	0.0 C	0.0	0.2	0.2	0.1	0.1
	26	.0	0.0 C	1.4	0.0	1.4	0.0	0.1
		1.00	0.0 C	0.2	0.0	0.2	0.0	0.1
	27	.0	0.1 C	1.3	0.8	1.6	0.1	0.1
		1.00	0.0 C	0.0	0.0	0.1	0.1	0.1
	28	.0	0.1 C	1.5	0.0	1.6	0.0	0.1
		1.00	0.0 C	0.0	0.0	0.1	0.0	0.1
	29	.0	0.1 C	5.4	1.1	5.7	0.1	0.4
		1.00	0.0 C	0.1	0.1	0.1	0.1	0.5
	30	.0	0.0 C	1.9	0.9	2.3	0.1	0.1
		1.00	0.0 C	0.1	0.1	0.2	0.1	0.2
	31	.0	0.1 C	3.6	1.1	4.1	0.1	0.3
		1.00	0.0 C	0.0	0.0	0.1	0.1	0.3

MEMBER STRESSES

ALL UNITS ARE KIP /SQ INCH

MEMB	LD	SECT	AXIAL	BEND-Y	BEND-Z	COMBINED	SHEAR-Y	SHEAR-Z
15	1	.0	0.1 C	0.3	0.0	0.5	0.0	0.0
		1.00	0.1 C	0.2	0.0	0.4	0.0	0.0
	2	.0	0.0 T	0.0	0.3	0.3	0.0	0.0
		1.00	0.0 T	0.0	0.3	0.3	0.0	0.0
	3	.0	0.0 T	0.5	0.0	0.5	0.0	0.0
		1.00	0.0 T	0.4	0.0	0.4	0.0	0.0
	4	.0	0.1 C	10.6	0.0	10.6	0.0	0.5
		1.00	0.1 C	10.3	0.0	10.4	0.0	0.5
	5	.0	0.1 C	10.2	3.8	11.7	0.2	0.5
		1.00	0.1 C	10.0	3.7	11.4	0.2	0.5
	6	.0	0.0 T	0.0	1.5	1.5	0.1	0.0
		1.00	0.0 T	0.0	1.4	1.4	0.1	0.0
	7	.0	0.0 T	2.4	0.0	2.4	0.0	0.2
		1.00	0.0 T	2.2	0.0	2.2	0.0	0.2
	8	.0	0.0 C	4.3	0.0	4.3	0.0	0.2
		1.00	0.0 C	4.1	0.0	4.2	0.0	0.2
	9	.0	0.0 C	4.1	2.6	5.0	0.1	0.2
		1.00	0.0 C	4.0	2.5	4.9	0.1	0.2
	10	.0	0.0 T	0.0	0.3	0.3	0.0	0.0
		1.00	0.0 T	0.0	0.3	0.3	0.0	0.0
	11	.0	0.0 T	0.5	0.0	0.5	0.0	0.0
		1.00	0.0 T	0.5	0.0	0.5	0.0	0.0
	12	.0	0.1 C	0.2	0.0	0.3	0.0	0.0
		1.00	0.1 C	0.2	0.0	0.3	0.0	0.0
	13	.0	0.1 C	7.2	0.0	7.3	0.0	0.3
		1.00	0.1 C	7.0	0.0	7.1	0.0	0.4
	14	.0	0.1 C	7.0	3.1	8.2	0.1	0.3
		1.00	0.1 C	6.8	3.1	8.0	0.1	0.4
	15	.0	0.0 C	3.7	0.0	3.8	0.0	0.2
		1.00	0.0 C	3.6	0.0	3.7	0.0	0.2
	16	.0	0.0 C	3.6	2.2	4.4	0.1	0.2
		1.00	0.0 C	3.5	2.1	4.2	0.1	0.2
	17	.0	0.0 C	4.6	0.0	4.7	0.0	0.2
		1.00	0.0 C	4.5	0.0	4.5	0.0	0.2
	18	.0	0.0 C	4.5	1.8	5.2	0.1	0.2
		1.00	0.0 C	4.3	1.8	5.1	0.1	0.2
	19	.0	0.3 C	10.7	4.5	12.8	0.2	0.6
		1.00	0.3 C	10.3	4.4	12.4	0.2	0.6
	20	.0	0.3 C	12.2	0.0	12.5	0.0	0.7
		1.00	0.3 C	11.7	0.0	12.0	0.0	0.7
	21	.0	0.2 C	4.4	4.1	6.3	0.2	0.3
		1.00	0.2 C	4.2	3.9	6.0	0.2	0.3
	22	.0	0.2 C	6.9	0.0	7.1	0.0	0.4
		1.00	0.2 C	6.5	0.0	6.7	0.0	0.4
	23	.0	0.3 C	7.5	3.5	9.1	0.2	0.4
		1.00	0.3 C	7.2	3.4	8.8	0.2	0.4

MEMBER STRESSES

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MEMB	LD	SECT	AXIAL	BEND-Y	BEND-Z	COMBINED	SHEAR-Y	SHEAR-Z
	24	.0	0.3 C	8.3	0.0	8.6	0.0	0.5
		1.00	0.3 C	7.9	0.0	8.2	0.0	0.5
	25	.0	0.2 C	3.9	3.4	5.4	0.2	0.2
		1.00	0.2 C	3.7	3.2	5.1	0.2	0.2
	26	.0	0.2 C	5.9	0.0	6.1	0.0	0.4
		1.00	0.2 C	5.5	0.0	5.7	0.0	0.4
	27	.0	0.2 C	4.9	2.1	6.0	0.1	0.3
		1.00	0.2 C	4.7	2.1	5.7	0.1	0.3
	28	.0	0.2 C	5.5	0.0	5.8	0.0	0.3
		1.00	0.2 C	5.3	0.0	5.5	0.0	0.3
	29	.0	0.3 C	16.0	3.2	16.9	0.2	0.8
		1.00	0.3 C	15.4	3.1	16.3	0.2	0.9
	30	.0	0.2 C	7.9	2.9	9.2	0.2	0.5
		1.00	0.2 C	7.5	2.8	8.7	0.2	0.5
	31	.0	0.3 C	10.9	2.4	11.8	0.1	0.6
		1.00	0.3 C	10.5	2.4	11.4	0.1	0.6
16	1	.0	0.1 C	0.3	0.0	0.5	0.0	0.0
		1.00	0.1 C	0.2	0.0	0.4	0.0	0.0
	2	.0	0.0 C	0.0	0.3	0.3	0.0	0.0
		1.00	0.0 C	0.0	0.3	0.3	0.0	0.0
	3	.0	0.0 C	0.5	0.0	0.5	0.0	0.0
		1.00	0.0 C	0.4	0.0	0.4	0.0	0.0
	4	.0	0.1 C	10.6	0.0	10.6	0.0	0.5
		1.00	0.1 C	10.3	0.0	10.4	0.0	0.5
	5	.0	0.1 C	10.2	3.8	11.7	0.2	0.5
		1.00	0.1 C	9.9	3.7	11.4	0.2	0.5
	6	.0	0.0 C	0.0	1.5	1.5	0.1	0.0
		1.00	0.0 C	0.0	1.4	1.4	0.1	0.0
	7	.0	0.0 C	2.4	0.0	2.4	0.0	0.2
		1.00	0.0 C	2.2	0.0	2.2	0.0	0.2
	8	.0	0.0 C	4.3	0.0	4.3	0.0	0.2
		1.00	0.0 C	4.1	0.0	4.2	0.0	0.2
	9	.0	0.0 C	4.1	2.6	5.0	0.1	0.2
		1.00	0.0 C	4.0	2.5	4.9	0.1	0.2
	10	.0	0.0 C	0.0	0.3	0.3	0.0	0.0
		1.00	0.0 C	0.0	0.3	0.3	0.0	0.0
	11	.0	0.0 C	0.5	0.0	0.5	0.0	0.0
		1.00	0.0 C	0.5	0.0	0.5	0.0	0.0
	12	.0	0.1 C	0.2	0.0	0.3	0.0	0.0
		1.00	0.1 C	0.2	0.0	0.3	0.0	0.0
	13	.0	0.1 C	7.2	0.0	7.3	0.0	0.3
		1.00	0.1 C	7.0	0.0	7.1	0.0	0.4
	14	.0	0.1 C	7.0	3.1	8.2	0.1	0.3
		1.00	0.1 C	6.8	3.1	8.0	0.1	0.4
	15	.0	0.0 C	3.7	0.0	3.8	0.0	0.2
		1.00	0.0 C	3.6	0.0	3.7	0.0	0.2

MEMBER STRESSES

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MEMB	LD	SECT	AXIAL	BEND-Y	BEND-Z	COMBINED	SHEAR-Y	SHEAR-Z
	16	.0	0.0 C	3.6	2.2	4.4	0.1	0.2
		1.00	0.0 C	3.5	2.1	4.2	0.1	0.2
	17	.0	0.0 C	4.6	0.0	4.7	0.0	0.2
		1.00	0.0 C	4.5	0.0	4.5	0.0	0.2
	18	.0	0.0 C	4.5	1.8	5.2	0.1	0.2
		1.00	0.0 C	4.3	1.8	5.1	0.1	0.2
	19	.0	0.3 C	10.7	4.5	12.8	0.2	0.6
		1.00	0.3 C	10.3	4.4	12.3	0.2	0.6
	20	.0	0.3 C	12.2	0.0	12.5	0.0	0.7
		1.00	0.3 C	11.7	0.0	12.0	0.0	0.7
	21	.0	0.2 C	4.4	4.1	6.2	0.2	0.2
		1.00	0.2 C	4.2	3.9	5.9	0.2	0.3
	22	.0	0.2 C	6.9	0.0	7.1	0.0	0.4
		1.00	0.2 C	6.5	0.0	6.7	0.0	0.4
	23	.0	0.3 C	7.5	3.5	9.1	0.2	0.4
		1.00	0.3 C	7.2	3.4	8.8	0.2	0.4
	24	.0	0.3 C	8.3	0.0	8.6	0.0	0.5
		1.00	0.3 C	7.9	0.0	8.2	0.0	0.5
	25	.0	0.2 C	3.9	3.4	5.3	0.2	0.2
		1.00	0.2 C	3.7	3.2	5.1	0.2	0.2
	26	.0	0.2 C	5.9	0.0	6.1	0.0	0.4
		1.00	0.2 C	5.5	0.0	5.7	0.0	0.4
	27	.0	0.2 C	4.9	2.1	5.9	0.1	0.3
		1.00	0.2 C	4.6	2.1	5.7	0.1	0.3
	28	.0	0.2 C	5.5	0.0	5.8	0.0	0.3
		1.00	0.2 C	5.3	0.0	5.5	0.0	0.3
	29	.0	0.3 C	15.9	3.2	16.9	0.2	0.8
		1.00	0.3 C	15.4	3.1	16.3	0.2	0.9
	30	.0	0.2 C	7.9	2.9	9.2	0.2	0.5
		1.00	0.2 C	7.5	2.8	8.7	0.2	0.5
	31	.0	0.3 C	10.9	2.4	11.8	0.1	0.6
		1.00	0.3 C	10.5	2.4	11.4	0.1	0.6
17	1	.0	0.1 C	0.0	0.0	0.1	0.0	0.0
		1.00	0.1 C	0.0	0.0	0.1	0.0	0.0
	2	.0	0.0 T	0.0	0.2	0.2	0.0	0.0
		1.00	0.0 T	0.0	0.1	0.1	0.0	0.0
	3	.0	0.0 T	0.3	0.0	0.3	0.0	0.0
		1.00	0.0 T	0.1	0.0	0.1	0.0	0.0
	4	.0	0.1 C	9.2	0.0	9.3	0.0	0.6
		1.00	0.1 C	3.8	0.0	3.9	0.0	0.7
	5	.0	0.1 C	8.9	3.3	10.2	0.2	0.6
		1.00	0.1 C	3.7	1.2	4.2	0.3	0.7
	6	.0	0.0 T	0.0	1.0	1.0	0.1	0.0
		1.00	0.0 T	0.0	0.5	0.5	0.1	0.0
	7	.0	0.0	1.6	0.0	1.6	0.0	0.1
		1.00	0.0	0.5	0.0	0.5	0.0	0.1

MEMBER STRESSES

ALL UNITS ARE KIP /SQ INCH

MEMB	LD	SECT	AXIAL	BEND-Y	BEND-Z	COMBINED	SHEAR-Y	SHEAR-Z
8		.0	0.0 C	3.6	0.0	3.6	0.0	0.2
		1.00	0.1 C	1.1	0.0	1.2	0.0	0.3
9		.0	0.0 C	3.5	2.2	4.3	0.1	0.2
		1.00	0.0 C	1.1	0.8	1.4	0.2	0.3
10		.0	0.0 T	0.0	0.2	0.2	0.0	0.0
		1.00	0.0 T	0.0	0.1	0.1	0.0	0.0
11		.0	0.0 T	0.3	0.0	0.3	0.0	0.0
		1.00	0.0 T	0.1	0.0	0.1	0.0	0.0
12		.0	0.1 C	0.0	0.0	0.1	0.0	0.0
		1.00	0.1 C	0.0	0.0	0.1	0.0	0.0
13		.0	0.1 C	6.3	0.0	6.3	0.0	0.4
		1.00	0.1 C	2.6	0.0	2.7	0.0	0.5
14		.0	0.1 C	6.1	2.8	7.2	0.2	0.4
		1.00	0.1 C	2.5	1.4	3.0	0.2	0.5
15		.0	0.0 C	3.1	0.0	3.2	0.0	0.2
		1.00	0.1 C	1.0	0.0	1.0	0.0	0.3
16		.0	0.0 C	3.0	1.8	3.7	0.1	0.2
		1.00	0.0 C	0.9	0.7	1.2	0.2	0.3
17		.0	0.1 C	3.9	0.0	4.0	0.0	0.3
		1.00	0.1 C	1.4	0.0	1.4	0.0	0.3
18		.0	0.0 C	3.8	1.6	4.5	0.1	0.3
		1.00	0.1 C	1.3	0.7	1.6	0.1	0.3
19		.0	0.2 C	8.9	3.8	10.6	0.3	0.6
		1.00	0.2 C	3.7	1.5	4.5	0.3	0.7
20		.0	0.2 C	9.9	0.0	10.2	0.0	0.6
		1.00	0.2 C	4.1	0.0	4.3	0.0	0.8
21		.0	0.1 C	3.5	3.3	4.9	0.2	0.2
		1.00	0.1 C	1.1	1.3	1.8	0.2	0.3
22		.0	0.1 C	5.2	0.0	5.3	0.0	0.4
		1.00	0.1 C	1.7	0.0	1.8	0.0	0.4
23		.0	0.2 C	6.1	3.0	7.4	0.2	0.4
		1.00	0.2 C	2.5	1.5	3.2	0.2	0.5
24		.0	0.2 C	6.6	0.0	6.8	0.0	0.4
		1.00	0.2 C	2.7	0.0	2.9	0.0	0.5
25		.0	0.1 C	3.0	2.7	4.2	0.2	0.2
		1.00	0.1 C	0.9	1.1	1.5	0.2	0.3
26		.0	0.1 C	4.4	0.0	4.5	0.0	0.3
		1.00	0.1 C	1.4	0.0	1.5	0.0	0.4
27		.0	0.2 C	3.8	1.8	4.6	0.1	0.3
		1.00	0.2 C	1.3	0.8	1.8	0.1	0.3
28		.0	0.2 C	4.3	0.0	4.5	0.0	0.3
		1.00	0.2 C	1.5	0.0	1.7	0.0	0.4
29		.0	0.2 C	13.3	2.7	14.1	0.2	0.9
		1.00	0.3 C	5.5	1.1	5.9	0.2	1.1
30		.0	0.1 C	6.1	2.3	7.1	0.2	0.4
		1.00	0.1 C	2.0	0.9	2.5	0.2	0.5
31		.0	0.3 C	9.0	2.1	9.7	0.1	0.6
		1.00	0.3 C	3.7	1.1	4.2	0.2	0.7

MEMBER STRESSES

ALL UNITS ARE KIP /SQ INCH

MEMB	LD	SECT	AXIAL	BEND-Y	BEND-Z	COMBINED	SHEAR-Y	SHEAR-Z
18	1	.0	0.1 C	0.0	0.0	0.1	0.0	0.0
		1.00	0.1 C	0.0	0.0	0.1	0.0	0.0
	2	.0	0.0 C	0.0	0.2	0.2	0.0	0.0
		1.00	0.0 C	0.0	0.1	0.1	0.0	0.0
	3	.0	0.0 T	0.3	0.0	0.3	0.0	0.0
		1.00	0.0 T	0.1	0.0	0.1	0.0	0.0
	4	.0	0.1 C	9.2	0.0	9.3	0.0	0.6
		1.00	0.1 C	3.8	0.0	3.9	0.0	0.7
	5	.0	0.1 C	8.9	3.3	10.1	0.2	0.6
		1.00	0.1 C	3.7	1.2	4.2	0.3	0.7
	6	.0	0.0 C	0.0	1.0	1.0	0.1	0.0
		1.00	0.0 C	0.0	0.5	0.5	0.1	0.0
	7	.0	0.0 T	1.6	0.0	1.6	0.0	0.1
		1.00	0.0 T	0.5	0.0	0.5	0.0	0.1
	8	.0	0.0 C	3.6	0.0	3.6	0.0	0.2
		1.00	0.1 C	1.1	0.0	1.2	0.0	0.3
	9	.0	0.0 C	3.5	2.2	4.3	0.1	0.2
		1.00	0.0 C	1.1	0.8	1.4	0.2	0.3
	10	.0	0.0 C	0.0	0.2	0.2	0.0	0.0
		1.00	0.0 C	0.0	0.1	0.1	0.0	0.0
	11	.0	0.0 T	0.3	0.0	0.3	0.0	0.0
		1.00	0.0 T	0.1	0.0	0.1	0.0	0.0
	12	.0	0.1 C	0.0	0.0	0.1	0.0	0.0
		1.00	0.1 C	0.0	0.0	0.1	0.0	0.0
	13	.0	0.1 C	6.3	0.0	6.3	0.0	0.4
		1.00	0.1 C	2.6	0.0	2.7	0.0	0.5
	14	.0	0.1 C	6.1	2.8	7.2	0.2	0.4
		1.00	0.1 C	2.5	1.4	3.0	0.2	0.5
	15	.0	0.0 C	3.1	0.0	3.2	0.0	0.2
		1.00	0.1 C	1.0	0.0	1.0	0.0	0.3
	16	.0	0.0 C	3.0	1.8	3.7	0.1	0.2
		1.00	0.0 C	0.9	0.7	1.2	0.2	0.3
	17	.0	0.1 C	3.9	0.0	4.0	0.0	0.3
		1.00	0.1 C	1.4	0.0	1.4	0.0	0.3
	18	.0	0.0 C	3.8	1.6	4.5	0.1	0.3
		1.00	0.1 C	1.3	0.7	1.6	0.1	0.3
	19	.0	0.2 C	8.9	3.8	10.6	0.3	0.6
		1.00	0.2 C	3.7	1.5	4.5	0.3	0.7
	20	.0	0.2 C	9.9	0.0	10.2	0.0	0.6
		1.00	0.2 C	4.1	0.0	4.3	0.0	0.8
	21	.0	0.1 C	3.5	3.3	4.9	0.2	0.2
		1.00	0.1 C	1.1	1.3	1.8	0.2	0.3
	22	.0	0.1 C	5.2	0.0	5.3	0.0	0.4
		1.00	0.1 C	1.7	0.0	1.8	0.0	0.4
	23	.0	0.2 C	6.1	3.0	7.4	0.2	0.4
		1.00	0.2 C	2.5	1.5	3.2	0.2	0.5

MEMBER STRESSES

ALL UNITS ARE KIP /SQ INCH

MEMB	LD	SECT	AXIAL	BEND-Y	BEND-Z	COMBINED	SHEAR-Y	SHEAR-Z
	24	.0	0.2 C	6.6	0.0	6.8	0.0	0.4
		1.00	0.2 C	2.7	0.0	2.9	0.0	0.5
	25	.0	0.1 C	3.0	2.7	4.2	0.2	0.2
		1.00	0.1 C	0.9	1.1	1.5	0.2	0.3
	26	.0	0.1 C	4.4	0.0	4.5	0.0	0.3
		1.00	0.1 C	1.4	0.0	1.5	0.0	0.4
	27	.0	0.2 C	3.8	1.8	4.6	0.1	0.3
		1.00	0.2 C	1.3	0.8	1.8	0.1	0.3
	28	.0	0.2 C	4.3	0.0	4.5	0.0	0.3
		1.00	0.2 C	1.5	0.0	1.7	0.0	0.4
	29	.0	0.2 C	13.3	2.7	14.1	0.2	0.9
		1.00	0.3 C	5.5	1.1	5.9	0.2	1.1
	30	.0	0.2 C	6.1	2.3	7.1	0.2	0.4
		1.00	0.2 C	2.0	0.9	2.5	0.2	0.5
	31	.0	0.3 C	9.0	2.1	9.7	0.1	0.6
		1.00	0.3 C	3.7	1.1	4.2	0.2	0.7

********** END OF LATEST ANALYSIS RESULT **********

279. UNIT FEET POUND
280. PRINT JOINT DISPLACEMENTS LIST 5 TO 15

JOINT DISPLACEMENT (INCH RADIANS) STRUCTURE TYPE = SPACE

JOINT	LOAD	X-TRANS	Y-TRANS	Z-TRANS	X-ROTAN	Y-ROTAN	Z-ROTAN
5	1	0.00000	-0.00279	0.06098	0.00020	0.00000	0.00000
	2	0.13233	0.00000	0.00346	0.00001	0.00000	-0.00046
	3	0.00000	0.00000	0.20122	0.00070	0.00000	0.00000
	4	0.00000	-0.00104	3.46510	0.01400	0.00000	0.00000
	5	1.25134	-0.00104	3.35043	0.01354	0.00000	-0.00502
	6	0.68935	0.00001	0.01813	0.00005	0.00000	-0.00241
	7	0.00000	0.00000	1.05116	0.00363	0.00000	0.00000
	8	0.00000	-0.00062	1.41130	0.00558	0.00000	0.00000
	9	0.86058	-0.00046	1.36372	0.00539	0.00000	-0.00344
	10	0.14627	0.00000	0.00356	0.00001	0.00000	-0.00052
	11	0.00000	0.00000	0.21805	0.00076	0.00000	0.00000
	12	0.00000	-0.00209	0.04571	0.00015	0.00000	0.00000
	13	0.00000	-0.00102	2.36981	0.00957	0.00000	0.00000
	14	1.01364	-0.00086	2.28933	0.00924	0.00000	-0.00419
	15	0.00000	-0.00062	1.23979	0.00489	0.00000	0.00000
	16	0.71211	-0.00046	1.19787	0.00473	0.00000	-0.00284
	17	0.00000	-0.00075	1.52318	0.00607	0.00000	0.00000
	18	0.59080	-0.00059	1.47134	0.00586	0.00000	-0.00239
	19	1.58217	-0.00523	3.45069	0.01387	0.00000	-0.00617
	20	0.00000	-0.00523	4.05974	0.01605	0.00000	0.00000
	21	1.54993	-0.00324	1.44283	0.00564	0.00000	-0.00584
	22	0.00000	-0.00341	2.52345	0.00942	0.00000	0.00000
	23	1.15991	-0.00574	2.39958	0.00961	0.00000	-0.00470
	24	0.00000	-0.00590	2.69455	0.01069	0.00000	0.00000
	25	1.24980	-0.00324	1.27299	0.00497	0.00000	-0.00472
	26	0.00000	-0.00341	2.12068	0.00793	0.00000	0.00000
	27	0.73707	-0.00443	1.55874	0.00615	0.00000	-0.00290
	28	0.00000	-0.00459	1.82506	0.00711	0.00000	0.00000
	29	1.11892	-0.00566	5.27246	0.02103	0.00000	-0.00437
	30	1.09580	-0.00354	2.77891	0.01056	0.00000	-0.00413
	31	0.82005	-0.00621	3.55738	0.01420	0.00000	-0.00333
6	1	0.00000	-0.17599	0.06098	0.00020	0.00000	-0.00215
	2	0.13234	0.00014	0.00231	0.00001	0.00002	0.00000
	3	0.00000	0.00000	0.22372	0.00071	-0.00028	0.00000
	4	0.00000	-0.30684	4.32934	0.01400	-0.01062	-0.00376
	5	1.25166	-0.30665	4.18358	0.01354	-0.01024	-0.00376
	6	0.68937	0.00066	0.01209	0.00003	0.00008	0.00000
	7	0.00000	0.00000	1.16680	0.00369	-0.00144	0.00000
	8	0.00000	-0.16101	1.83713	0.00558	-0.00523	-0.00197
	9	0.86081	-0.14350	1.77444	0.00539	-0.00505	-0.00176
	10	0.14627	0.00015	0.00238	0.00001	0.00002	0.00000
	11	0.00000	0.00000	0.24160	0.00077	-0.00029	0.00000
	12	0.00000	-0.13208	0.04571	0.00015	0.00000	-0.00162
	13	0.00000	-0.26265	2.96648	0.00957	-0.00733	-0.00321
	14	1.01383	-0.24512	2.86499	0.00924	-0.00707	-0.00300
	15	0.00000	-0.16101	1.62125	0.00489	-0.00469	-0.00197

JOINT DISPLACEMENT (INCH RADIANS) STRUCTURE TYPE = SPACE

JOINT	LOAD	X-TRANS	Y-TRANS	Z-TRANS	X-ROTAN	Y-ROTAN	Z-ROTAN
	16	0.71230	-0.14351	1.56590	0.00472	-0.00452	-0.00176
	17	0.00000	-0.20418	1.95592	0.00607	-0.00532	-0.00250
	18	0.59095	-0.18669	1.88897	0.00586	-0.00513	-0.00229
	19	1.58250	-0.57078	4.28095	0.01386	-0.01020	-0.00699
	20	0.00000	-0.57133	4.98024	0.01608	-0.01132	-0.00700
	21	1.55018	-0.31883	1.84751	0.00563	-0.00496	-0.00391
	22	0.00000	-0.33700	3.06491	0.00948	-0.00667	-0.00413
	23	1.16010	-0.55304	2.97405	0.00960	-0.00706	-0.00677
	24	0.00000	-0.57073	3.31477	0.01070	-0.00762	-0.00699
	25	1.25001	-0.31899	1.63631	0.00495	-0.00446	-0.00391
	26	0.00000	-0.33700	2.59234	0.00798	-0.00581	-0.00413
	27	0.73722	-0.42857	1.97518	0.00615	-0.00511	-0.00525
	28	0.00000	-0.44622	2.28135	0.00712	-0.00561	-0.00546
	29	1.11916	-0.69797	6.51031	0.02104	-0.01521	-0.00855
	30	1.09598	-0.39082	3.44784	0.01060	-0.00823	-0.00479
	31	0.82019	-0.66696	4.40203	0.01421	-0.01038	-0.00817
7	1	0.00000	-0.26681	0.06098	0.00020	0.00000	-0.00158
	2	0.13234	0.00014	0.00154	0.00000	0.00002	0.00000
	3	0.00000	0.00000	0.23554	0.00072	-0.00021	0.00000
	4	0.00000	-0.46330	4.77151	0.01400	-0.00767	-0.00271
	5	1.25174	-0.46309	4.60990	0.01353	-0.00739	-0.00271
	6	0.68938	0.00065	0.00806	0.00002	0.00008	-0.00001
	7	0.00000	0.00000	1.22751	0.00373	-0.00106	0.00000
	8	0.00000	-0.24307	2.05499	0.00558	-0.00378	-0.00142
	9	0.86086	-0.21671	1.98460	0.00539	-0.00364	-0.00127
	10	0.14628	0.00015	0.00158	0.00000	0.00002	0.00000
	11	0.00000	0.00000	0.25397	0.00078	-0.00022	0.00000
	12	0.00000	-0.20024	0.04571	0.00015	0.00000	-0.00118
	13	0.00000	-0.39651	3.27176	0.00957	-0.00529	-0.00232
	14	1.01387	-0.37012	3.15954	0.00924	-0.00511	-0.00217
	15	0.00000	-0.24307	1.81641	0.00489	-0.00338	-0.00142
	16	0.71235	-0.21672	1.75421	0.00472	-0.00327	-0.00127
	17	0.00000	-0.30827	2.17732	0.00607	-0.00384	-0.00181
	18	0.59098	-0.28192	2.10265	0.00586	-0.00371	-0.00165
	19	1.58258	-0.86370	4.70536	0.01385	-0.00735	-0.00509
	20	0.00000	-0.86427	5.45197	0.01610	-0.00818	-0.00509
	21	1.55024	-0.48287	2.05364	0.00562	-0.00356	-0.00285
	22	0.00000	-0.50988	3.34349	0.00952	-0.00483	-0.00300
	23	1.16015	-0.83703	3.26781	0.00960	-0.00509	-0.00493
	24	0.00000	-0.86356	3.63242	0.01071	-0.00551	-0.00508
	25	1.25006	-0.48302	1.82148	0.00494	-0.00320	-0.00285
	26	0.00000	-0.50988	2.83486	0.00801	-0.00421	-0.00300
	27	0.73725	-0.64871	2.18807	0.00614	-0.00369	-0.00382
	28	0.00000	-0.67520	2.51513	0.00713	-0.00405	-0.00398
	29	1.11922	-1.05567	7.14389	0.02105	-0.01098	-0.00621
	30	1.09602	-0.59141	3.79053	0.01062	-0.00594	-0.00349

JOINT DISPLACEMENT (INCH RADIANS) STRUCTURE TYPE = SPACE

JOINT	LOAD	X-TRANS	Y-TRANS	Z-TRANS	X-ROTAN	Y-ROTAN	Z-ROTAN
	31	0.82023	-1.00896	4.83429	0.01421	-0.00750	-0.00594
8	1	0.00000	-0.34554	0.06098	0.00020	0.00000	0.00000
	2	0.13234	0.00000	0.00000	0.00000	0.00002	0.00000
	3	0.00000	0.00000	0.24579	0.00072	0.00000	0.00000
	4	0.00000	-0.60088	5.16034	0.01400	0.00000	0.00000
	5	1.25188	-0.60088	4.98455	0.01353	0.00001	0.00000
	6	0.68939	0.00000	0.00000	0.00000	0.00008	-0.00001
	7	0.00000	0.00000	1.28017	0.00376	0.00000	0.00000
	8	0.00000	-0.31523	2.24658	0.00558	0.00000	0.00000
	9	0.86097	-0.28116	2.16932	0.00539	0.00000	0.00000
	10	0.14628	0.00000	0.00000	0.00000	0.00002	0.00000
	11	0.00000	0.00000	0.26471	0.00079	0.00000	0.00000
	12	0.00000	-0.25933	0.04571	0.00015	0.00000	0.00000
	13	0.00000	-0.51422	3.54020	0.00957	0.00000	0.00000
	14	1.01396	-0.48015	3.41845	0.00924	0.00000	0.00000
	15	0.00000	-0.31523	1.98803	0.00489	0.00000	0.00000
	16	0.71243	-0.28116	1.91974	0.00472	0.00000	0.00000
	17	0.00000	-0.39979	2.37201	0.00607	0.00000	0.00000
	18	0.59104	-0.36573	2.29050	0.00586	0.00000	0.00000
	19	1.58273	-1.12017	5.07616	0.01383	0.00005	-0.00001
	20	0.00000	-1.12017	5.86642	0.01612	0.00000	0.00000
	21	1.55036	-0.62670	2.23031	0.00559	0.00009	-0.00001
	22	0.00000	-0.66077	3.58772	0.00955	0.00000	0.00000
	23	1.16024	-1.08503	3.52514	0.00960	0.00002	0.00000
	24	0.00000	-1.11909	3.91160	0.01071	0.00000	0.00000
	25	1.25016	-0.62670	1.98072	0.00493	0.00007	-0.00001
	26	0.00000	-0.66077	3.04754	0.00803	0.00000	0.00000
	27	0.73732	-0.84093	2.37434	0.00614	0.00002	0.00000
	28	0.00000	-0.87500	2.72055	0.00714	0.00000	0.00000
	29	1.11932	-1.36893	7.69910	0.02105	0.00003	-0.00001
	30	1.09610	-0.76719	4.08810	0.01062	0.00006	-0.00001
	31	0.82029	-1.30790	5.21360	0.01421	0.00001	0.00000
9	1	0.00000	-0.26681	0.06098	0.00020	0.00000	0.00158
	2	0.13234	-0.00014	-0.00154	0.00000	0.00002	0.00000
	3	0.00000	0.00000	0.23554	0.00072	0.00021	0.00000
	4	0.00000	-0.46330	4.77151	0.01400	0.00767	0.00271
	5	1.25174	-0.46351	4.60804	0.01352	0.00742	0.00271
	6	0.68938	-0.00065	-0.00805	-0.00002	0.00008	-0.00001
	7	0.00000	0.00000	1.22751	0.00373	0.00106	0.00000
	8	0.00000	-0.24307	2.05499	0.00558	0.00378	0.00142
	9	0.86086	-0.21685	1.98395	0.00539	0.00365	0.00127
	10	0.14628	-0.00015	-0.00158	0.00000	0.00002	0.00000
	11	0.00000	0.00000	0.25397	0.00078	0.00022	0.00000
	12	0.00000	-0.20024	0.04571	0.00015	0.00000	0.00118
	13	0.00000	-0.39651	3.27176	0.00957	0.00529	0.00232
	14	1.01387	-0.37032	3.15877	0.00924	0.00512	0.00217

JOINT DISPLACEMENT (INCH RADIANS) STRUCTURE TYPE = SPACE

JOINT	LOAD	X-TRANS	Y-TRANS	Z-TRANS	X-ROTAN	Y-ROTAN	Z-ROTAN
	15	0.00000	-0.24307	1.81641	0.00489	0.00338	0.00142
	16	0.71235	-0.21684	1.75372	0.00472	0.00327	0.00127
	17	0.00000	-0.30827	2.17732	0.00607	0.00384	0.00181
	18	0.59098	-0.28203	2.10224	0.00586	0.00371	0.00165
	19	1.58258	-0.86483	4.69580	0.01382	0.00746	0.00508
	20	0.00000	-0.86427	5.45197	0.01610	0.00818	0.00509
	21	1.55024	-0.48431	2.03688	0.00557	0.00374	0.00284
	22	0.00000	-0.50988	3.34349	0.00952	0.00483	0.00300
	23	1.16015	-0.83752	3.26388	0.00959	0.00514	0.00493
	24	0.00000	-0.86356	3.63242	0.01071	0.00551	0.00508
	25	1.25006	-0.48416	1.80842	0.00491	0.00334	0.00284
	26	0.00000	-0.50988	2.83486	0.00801	0.00421	0.00300
	27	0.73725	-0.64911	2.18449	0.00613	0.00373	0.00382
	28	0.00000	-0.67520	2.51513	0.00713	0.00405	0.00398
	29	1.11922	-1.05647	7.13713	0.02103	0.01106	0.00621
	30	1.09602	-0.59243	3.77867	0.01058	0.00606	0.00348
	31	0.82023	-1.00931	4.83151	0.01420	0.00753	0.00594
10	1	0.00000	-0.17599	0.06098	0.00020	0.00000	0.00215
	2	0.13234	-0.00014	-0.00231	-0.00001	0.00002	0.00000
	3	0.00000	0.00000	0.22372	0.00071	0.00028	0.00000
	4	0.00000	-0.30684	4.32934	0.01400	0.01062	0.00376
	5	1.25166	-0.30704	4.18015	0.01352	0.01028	0.00376
	6	0.68937	-0.00066	-0.01208	-0.00003	0.00008	0.00000
	7	0.00000	0.00000	1.16680	0.00369	0.00144	0.00000
	8	0.00000	-0.16101	1.83713	0.00558	0.00523	0.00197
	9	0.86081	-0.14363	1.77323	0.00539	0.00506	0.00176
	10	0.14627	-0.00015	-0.00238	-0.00001	0.00002	0.00000
	11	0.00000	0.00000	0.24160	0.00077	0.00029	0.00000
	12	0.00000	-0.13208	0.04571	0.00015	0.00000	0.00162
	13	0.00000	-0.26265	2.96648	0.00957	0.00733	0.00321
	14	1.01383	-0.24530	2.86358	0.00923	0.00709	0.00300
	15	0.00000	-0.16101	1.62125	0.00489	0.00469	0.00197
	16	0.71230	-0.14362	1.56500	0.00472	0.00453	0.00176
	17	0.00000	-0.20418	1.95592	0.00607	0.00532	0.00250
	18	0.59095	-0.18679	1.88821	0.00586	0.00514	0.00229
	19	1.58250	-0.57188	4.26598	0.01381	0.01032	0.00700
	20	0.00000	-0.57133	4.98024	0.01608	0.01132	0.00700
	21	1.55018	-0.32028	1.82213	0.00556	0.00514	0.00392
	22	0.00000	-0.33700	3.06491	0.00948	0.00667	0.00413
	23	1.16010	-0.55352	2.96789	0.00959	0.00711	0.00678
	24	0.00000	-0.57073	3.31477	0.01070	0.00762	0.00699
	25	1.25001	-0.32012	1.61655	0.00490	0.00460	0.00392
	26	0.00000	-0.33700	2.59234	0.00798	0.00581	0.00413
	27	0.73722	-0.42897	1.96967	0.00613	0.00516	0.00525
	28	0.00000	-0.44622	2.28135	0.00712	0.00561	0.00546
	29	1.11916	-0.69875	6.49971	0.02101	0.01530	0.00855

JOINT DISPLACEMENT (INCH RADIANS) STRUCTURE TYPE = SPACE

JOINT	LOAD	X-TRANS	Y-TRANS	Z-TRANS	X-ROTAN	Y-ROTAN	Z-ROTAN
	30	1.09598	-0.39184	3.42989	0.01055	0.00835	0.00479
	31	0.82019	-0.66730	4.39768	0.01419	0.01041	0.00817
11	1	0.00000	-0.00279	0.06098	0.00020	0.00000	0.00000
	2	0.13233	0.00000	-0.00346	-0.00001	0.00000	-0.00046
	3	0.00000	0.00000	0.20122	0.00070	0.00000	0.00000
	4	0.00000	-0.00104	3.46510	0.01400	0.00000	0.00000
	5	1.25134	-0.00104	3.34369	0.01352	0.00000	-0.00502
	6	0.68935	-0.00001	-0.01813	-0.00005	0.00000	-0.00241
	7	0.00000	0.00000	1.05116	0.00363	0.00000	0.00000
	8	0.00000	-0.00062	1.41130	0.00558	0.00000	0.00000
	9	0.86058	-0.00046	1.36134	0.00538	0.00000	-0.00344
	10	0.14627	0.00000	-0.00356	-0.00001	0.00000	-0.00052
	11	0.00000	0.00000	0.21805	0.00076	0.00000	0.00000
	12	0.00000	-0.00209	0.04571	0.00015	0.00000	0.00000
	13	0.00000	-0.00102	2.36981	0.00957	0.00000	0.00000
	14	1.01364	-0.00086	2.28657	0.00923	0.00000	-0.00419
	15	0.00000	-0.00062	1.23979	0.00489	0.00000	0.00000
	16	0.71211	-0.00046	1.19610	0.00472	0.00000	-0.00284
	17	0.00000	-0.00075	1.52318	0.00607	0.00000	0.00000
	18	0.59080	-0.00059	1.46986	0.00586	0.00000	-0.00239
	19	1.58217	-0.00524	3.42664	0.01380	0.00000	-0.00617
	20	0.00000	-0.00523	4.05974	0.01605	0.00000	0.00000
	21	1.54993	-0.00326	1.40420	0.00554	0.00000	-0.00584
	22	0.00000	-0.00341	2.52345	0.00942	0.00000	0.00000
	23	1.15991	-0.00575	2.38969	0.00958	0.00000	-0.00470
	24	0.00000	-0.00590	2.69455	0.01069	0.00000	0.00000
	25	1.24980	-0.00326	1.24294	0.00489	0.00000	-0.00472
	26	0.00000	-0.00341	2.12068	0.00793	0.00000	0.00000
	27	0.73707	-0.00443	1.55013	0.00613	0.00000	-0.00290
	28	0.00000	-0.00459	1.82506	0.00711	0.00000	0.00000
	29	1.11892	-0.00567	5.25544	0.02098	0.00000	-0.00437
	30	1.09580	-0.00356	2.75160	0.01049	0.00000	-0.00413
	31	0.82005	-0.00621	3.55039	0.01418	0.00000	-0.00333
12	1	0.00000	-0.00288	0.08549	0.00020	0.00000	0.00000
	2	0.19017	0.00000	0.00454	0.00001	0.00000	-0.00050
	3	0.00000	0.00000	0.28710	0.00073	0.00000	0.00000
	4	0.00000	-0.00109	5.24241	0.01533	0.00000	0.00000
	5	1.88550	-0.00109	5.06862	0.01482	0.00000	-0.00546
	6	0.99084	0.00001	0.02380	0.00005	0.00000	-0.00260
	7	0.00000	0.00000	1.49977	0.00382	0.00000	0.00000
	8	0.00000	-0.00067	2.11024	0.00598	0.00000	0.00000
	9	1.29360	-0.00047	2.03891	0.00578	0.00000	-0.00372
	10	0.21117	0.00000	0.00468	0.00001	0.00000	-0.00056
	11	0.00000	0.00000	0.31217	0.00080	0.00000	0.00000
	12	0.00000	-0.00216	0.06407	0.00015	0.00000	0.00000
	13	0.00000	-0.00111	3.58356	0.01047	0.00000	0.00000

JOINT DISPLACEMENT (INCH RADIANS) STRUCTURE TYPE = SPACE

JOINT	LOAD	X-TRANS	Y-TRANS	Z-TRANS	X-ROTAN	Y-ROTAN	Z-ROTAN
	14	1.55211	-0.00091	3.46161	0.01011	0.00000	-0.00468
	15	0.00000	-0.00067	1.85127	0.00523	0.00000	0.00000
	16	1.06996	-0.00047	1.78853	0.00505	0.00000	-0.00307
	17	0.00000	-0.00081	2.28659	0.00655	0.00000	0.00000
	18	0.89408	-0.00060	2.20863	0.00633	0.00000	-0.00262
	19	2.36093	-0.00542	5.20839	0.01515	0.00000	-0.00670
	20	0.00000	-0.00542	6.08858	0.01747	0.00000	0.00000
	21	2.28445	-0.00334	2.14819	0.00603	0.00000	-0.00632
	22	0.00000	-0.00356	3.69549	0.01001	0.00000	0.00000
	23	1.76328	-0.00596	3.61584	0.01047	0.00000	-0.00524
	24	0.00000	-0.00616	4.04528	0.01163	0.00000	0.00000
	25	1.84281	-0.00335	1.89258	0.00529	0.00000	-0.00510
	26	0.00000	-0.00356	3.10658	0.00841	0.00000	0.00000
	27	1.10526	-0.00457	2.33083	0.00662	0.00000	-0.00318
	28	0.00000	-0.00477	2.71628	0.00764	0.00000	0.00000
	29	1.66965	-0.00587	7.93452	0.02293	0.00000	-0.00474
	30	1.61510	-0.00369	4.09609	0.01125	0.00000	-0.00447
	31	1.24664	-0.00648	5.35449	0.01548	0.00000	-0.00371
13	1	0.00000	-0.00288	0.08549	0.00020	0.00000	0.00000
	2	0.19017	0.00000	-0.00454	-0.00001	0.00000	-0.00050
	3	0.00000	0.00000	0.28710	0.00073	0.00000	0.00000
	4	0.00000	-0.00109	5.24241	0.01533	0.00000	0.00000
	5	1.88550	-0.00109	5.05903	0.01480	0.00000	-0.00546
	6	0.99084	-0.00001	-0.02380	-0.00005	0.00000	-0.00260
	7	0.00000	0.00000	1.49977	0.00382	0.00000	0.00000
	8	0.00000	-0.00067	2.11024	0.00598	0.00000	0.00000
	9	1.29360	-0.00047	2.03554	0.00577	0.00000	-0.00372
	10	0.21117	0.00000	-0.00468	-0.00001	0.00000	-0.00056
	11	0.00000	0.00000	0.31217	0.00080	0.00000	0.00000
	12	0.00000	-0.00216	0.06407	0.00015	0.00000	0.00000
	13	0.00000	-0.00111	3.58356	0.01047	0.00000	0.00000
	14	1.55211	-0.00091	3.45769	0.01010	0.00000	-0.00468
	15	0.00000	-0.00067	1.85127	0.00523	0.00000	0.00000
	16	1.06996	-0.00047	1.78602	0.00504	0.00000	-0.00307
	17	0.00000	-0.00081	2.28659	0.00655	0.00000	0.00000
	18	0.89408	-0.00060	2.20653	0.00632	0.00000	-0.00262
	19	2.36093	-0.00543	5.17609	0.01508	0.00000	-0.00670
	20	0.00000	-0.00542	6.08858	0.01747	0.00000	0.00000
	21	2.28445	-0.00337	2.09723	0.00593	0.00000	-0.00632
	22	0.00000	-0.00356	3.69549	0.01001	0.00000	0.00000
	23	1.76328	-0.00596	3.60256	0.01045	0.00000	-0.00524
	24	0.00000	-0.00616	4.04528	0.01163	0.00000	0.00000
	25	1.84281	-0.00336	1.85294	0.00521	0.00000	-0.00510
	26	0.00000	-0.00356	3.10658	0.00841	0.00000	0.00000
	27	1.10526	-0.00457	2.31937	0.00659	0.00000	-0.00318
	28	0.00000	-0.00477	2.71628	0.00764	0.00000	0.00000

JOINT DISPLACEMENT (INCH RADIANS) STRUCTURE TYPE = SPACE

JOINT	LOAD	X-TRANS	Y-TRANS	Z-TRANS	X-ROTAN	Y-ROTAN	Z-ROTAN
	29	1.66965	-0.00587	7.91166	0.02289	0.00000	-0.00474
	30	1.61510	-0.00370	4.06006	0.01118	0.00000	-0.00447
	31	1.24664	-0.00648	5.34511	0.01546	0.00000	-0.00371
14	1	0.00000	-0.00304	0.12244	0.00021	0.00000	0.00000
	2	0.38009	0.00000	0.00617	0.00001	0.00000	-0.00124
	3	0.00000	0.00000	0.51909	0.00147	0.00000	0.00000
	4	0.00000	-0.00109	8.00182	0.01533	0.00000	0.00000
	5	2.86741	-0.00109	7.73615	0.01482	0.00000	-0.00546
	6	1.98549	0.00001	0.03230	0.00005	0.00000	-0.00650
	7	0.00000	0.00000	2.71508	0.00772	0.00000	0.00000
	8	0.00000	-0.00067	3.18674	0.00598	0.00000	0.00000
	9	1.96302	-0.00047	3.07880	0.00578	0.00000	-0.00372
	10	0.44253	0.00000	0.00635	0.00001	0.00000	-0.00153
	11	0.00000	0.00000	0.58734	0.00177	0.00000	0.00000
	12	0.00000	-0.00228	0.09172	0.00015	0.00000	0.00000
	13	0.00000	-0.00111	5.46738	0.01047	0.00000	0.00000
	14	2.39457	-0.00091	5.28100	0.01011	0.00000	-0.00468
	15	0.00000	-0.00067	2.79219	0.00523	0.00000	0.00000
	16	1.62299	-0.00047	2.69737	0.00505	0.00000	-0.00307
	17	0.00000	-0.00081	3.46567	0.00655	0.00000	0.00000
	18	1.36504	-0.00060	3.34733	0.00633	0.00000	-0.00262
	19	3.81763	-0.00565	7.93546	0.01515	0.00000	-0.00855
	20	0.00000	-0.00566	9.48343	0.01932	0.00000	0.00000
	21	3.94851	-0.00350	3.23354	0.00603	0.00000	-0.01022
	22	0.00000	-0.00372	6.02426	0.01391	0.00000	0.00000
	23	2.83710	-0.00623	5.50151	0.01048	0.00000	-0.00621
	24	0.00000	-0.00644	6.26889	0.01259	0.00000	0.00000
	25	3.17167	-0.00350	2.84501	0.00529	0.00000	-0.00814
	26	0.00000	-0.00372	5.03239	0.01146	0.00000	0.00000
	27	1.80757	-0.00478	3.52198	0.00662	0.00000	-0.00414
	28	0.00000	-0.00499	4.22132	0.00860	0.00000	0.00000
	29	2.70001	-0.00611	12.24034	0.02425	0.00000	-0.00605
	30	2.79160	-0.00384	6.49458	0.01401	0.00000	-0.00722
	31	2.00583	-0.00676	8.23301	0.01616	0.00000	-0.00439
15	1	0.00000	-0.00304	0.12244	0.00021	0.00000	0.00000
	2	0.38009	0.00000	-0.00617	-0.00001	0.00000	-0.00124
	3	0.00000	0.00000	0.51909	0.00147	0.00000	0.00000
	4	0.00000	-0.00109	8.00182	0.01533	0.00000	0.00000
	5	2.86741	-0.00109	7.72231	0.01480	0.00000	-0.00546
	6	1.98549	-0.00001	-0.03230	-0.00005	0.00000	-0.00650
	7	0.00000	0.00000	2.71508	0.00772	0.00000	0.00000
	8	0.00000	-0.00067	3.18674	0.00598	0.00000	0.00000
	9	1.96302	-0.00047	3.07394	0.00577	0.00000	-0.00372
	10	0.44253	0.00000	-0.00635	-0.00001	0.00000	-0.00153
	11	0.00000	0.00000	0.58734	0.00177	0.00000	0.00000
	12	0.00000	-0.00228	0.09172	0.00015	0.00000	0.00000

JOINT DISPLACEMENT (INCH RADIANS) STRUCTURE TYPE = SPACE

JOINT	LOAD	X-TRANS	Y-TRANS	Z-TRANS	X-ROTAN	Y-ROTAN	Z-ROTAN
	13	0.00000	-0.00111	5.46738	0.01047	0.00000	0.00000
	14	2.39457	-0.00091	5.27534	0.01010	0.00000	-0.00468
	15	0.00000	-0.00067	2.79219	0.00523	0.00000	0.00000
	16	1.62299	-0.00047	2.69374	0.00504	0.00000	-0.00307
	17	0.00000	-0.00081	3.46567	0.00655	0.00000	0.00000
	18	1.36504	-0.00060	3.34429	0.00632	0.00000	-0.00262
	19	3.81763	-0.00566	7.89079	0.01508	0.00000	-0.00855
	20	0.00000	-0.00566	9.48343	0.01932	0.00000	0.00000
	21	3.94851	-0.00353	3.16408	0.00593	0.00000	-0.01022
	22	0.00000	-0.00372	6.02426	0.01391	0.00000	0.00000
	23	2.83710	-0.00624	5.48315	0.01045	0.00000	-0.00621
	24	0.00000	-0.00644	6.26889	0.01259	0.00000	0.00000
	25	3.17167	-0.00352	2.79099	0.00521	0.00000	-0.00814
	26	0.00000	-0.00372	5.03239	0.01146	0.00000	0.00000
	27	1.80757	-0.00479	3.50625	0.00659	0.00000	-0.00414
	28	0.00000	-0.00499	4.22132	0.00860	0.00000	0.00000
	29	2.70001	-0.00611	12.20872	0.02420	0.00000	-0.00605
	30	2.79160	-0.00386	6.44546	0.01394	0.00000	-0.00722
	31	2.00583	-0.00676	8.22003	0.01614	0.00000	-0.00439

********** END OF LATEST ANALYSIS RESULT **********

281. PRINT MEMBER FORCES LIST 1 TO 5 10 15 TO 18

MEMBER END FORCES STRUCTURE TYPE = SPACE

ALL UNITS ARE -- POUN FEET (LOCAL)

MEMBER	LOAD	JT	AXIAL	SHEAR-Y	SHEAR-Z	TORSION	MOM-Y	MOM-Z
1	1	1	9927.13	0.00	0.00	0.00	4310.22	0.00
		32	-8891.52	0.00	0.00	0.00	-4308.77	0.00
	2	1	-14.08	734.21	-19.54	0.00	487.94	16077.71
		32	14.08	-618.44	19.54	0.00	-328.34	-10562.57
	3	1	0.00	0.00	-1050.47	0.00	24227.59	0.00
		32	0.00	0.00	934.70	0.00	-16129.55	0.00
	4	1	1775.90	0.00	-6974.55	0.00	304274.94	0.00
		32	-1775.90	0.00	6974.55	0.00	-247295.80	0.00
	5	1	1779.16	2554.90	-6745.84	0.00	294237.72	110516.94
		32	-1779.16	-2554.90	6745.84	0.00	-239126.98	-89644.55
	6	1	-62.75	3776.45	-102.37	0.00	2556.19	83446.99
		32	62.75	-3167.80	102.37	0.00	-1720.10	-55134.62
	7	1	0.00	0.00	-5444.31	0.00	126224.26	0.00
		32	0.00	0.00	4835.66	0.00	-84290.31	0.00
	8	1	1056.05	0.00	-2961.00	0.00	126017.84	0.00
		32	-1056.05	0.00	2961.00	0.00	-101830.93	0.00
	9	1	787.14	1773.85	-2863.14	0.00	121793.51	76281.16
		32	-787.14	-1773.85	2863.14	0.00	-98407.10	-61792.13
	10	1	-14.17	780.62	-20.12	0.00	502.50	17490.58
		32	14.17	-660.40	20.12	0.00	-338.14	-11614.93
	11	1	0.00	0.00	-1110.50	0.00	25983.59	0.00
		32	0.00	0.00	990.28	0.00	-17413.82	0.00
	12	1	7447.23	0.00	0.00	0.00	3230.00	0.00
		32	-6670.51	0.00	0.00	0.00	-3229.19	0.00
	13	1	1740.45	0.00	-4778.50	0.00	208244.11	0.00
		32	-1740.45	0.00	4778.50	0.00	-169206.03	0.00
	14	1	1471.99	1953.45	-4619.24	0.00	201209.58	87478.84
		32	-1471.99	-1953.45	4619.24	0.00	-163474.39	-71520.72
	15	1	1056.05	0.00	-2613.00	0.00	110911.05	0.00
		32	-1056.05	0.00	2613.00	0.00	-89566.77	0.00
	16	1	786.96	1470.05	-2526.29	0.00	107181.05	63160.12
		32	-786.96	-1470.05	2526.29	0.00	-86546.02	-51152.57
	17	1	1280.15	0.00	-3152.00	0.00	135247.53	0.00
		32	-1280.15	0.00	3152.00	0.00	-109499.38	0.00
	18	1	1011.02	1189.15	-3046.55	0.00	130666.91	51869.04
		32	-1011.02	-1189.15	3046.55	0.00	-105781.33	-42155.50
	19	1	16660.72	4390.42	-6794.70	0.00	301931.88	150711.22
		32	-15104.71	-4101.00	6794.70	0.00	-246420.16	-116050.98
	20	1	16692.68	0.00	-9600.72	0.00	371318.22	0.00
		32	-15136.66	0.00	9311.30	0.00	-294092.00	0.00
	21	1	10651.53	5550.30	-2965.51	0.00	128659.91	159728.14
		32	-9615.91	-4941.65	2965.51	0.00	-104435.97	-116926.75

MEMBER END FORCES STRUCTURE TYPE = SPACE

ALL UNITS ARE -- POUN FEET (LOCAL)

MEMBER	LOAD	JT	AXIAL	SHEAR-Y	SHEAR-Z	TORSION	MOM-Y	MOM-Z
	22	1	10983.19	0.00	-8405.31	0.00	256552.31	0.00
		32	-9947.57	0.00	7796.66	0.00	-190430.00	0.00
	23	1	18832.19	2734.07	-4639.36	0.00	209252.31	104969.41
		32	-17019.85	-2613.85	4639.36	0.00	-171350.50	-83135.65
	24	1	19114.81	0.00	-5889.00	0.00	241767.92	0.00
		32	-17302.48	0.00	5768.78	0.00	-194157.81	0.00
	25	1	10665.15	4415.68	-2606.14	0.00	113485.09	128248.77
		32	-9629.53	-3940.93	2606.14	0.00	-92196.47	-94157.58
	26	1	10983.19	0.00	-6859.56	0.00	213676.17	0.00
		32	-9947.57	0.00	6384.82	0.00	-159621.98	0.00
	27	1	14647.60	1969.77	-3066.68	0.00	137094.64	69359.62
		32	-13223.62	-1849.55	3066.68	0.00	-112042.83	-53770.43
	28	1	14930.90	0.00	-4262.50	0.00	167156.34	0.00
		32	-13506.92	0.00	4142.28	0.00	-132836.56	0.00
	29	1	17405.28	3105.86	-11594.23	0.00	473369.28	106593.03
		32	-15849.26	-2900.95	11389.32	0.00	-379503.72	-82074.45
	30	1	11185.91	3924.06	-8039.17	0.00	270560.62	112927.80
		32	-10150.29	-3493.75	7608.86	0.00	-206686.41	-82667.22
	31	1	19635.54	1932.99	-7443.55	0.00	315749.66	74213.38
		32	-17823.21	-1847.99	7358.56	0.00	-255293.67	-58776.90
2	1	2	9927.13	0.00	0.00	0.00	4310.22	0.00
		36	-8891.52	0.00	0.00	0.00	-4308.77	0.00
	2	2	14.08	734.21	19.54	0.00	-487.94	16077.71
		36	-14.08	-618.44	-19.54	0.00	328.34	-10562.57
	3	2	0.00	0.00	-1050.47	0.00	24227.59	0.00
		36	0.00	0.00	934.70	0.00	-16129.55	0.00
	4	2	1775.90	0.00	-6974.55	0.00	304274.94	0.00
		36	-1775.90	0.00	6974.55	0.00	-247295.80	0.00
	5	2	1772.64	2554.90	-6728.06	0.00	293581.19	110516.96
		36	-1772.64	-2554.90	6728.06	0.00	-238615.81	-89644.55
	6	2	62.75	3776.41	102.37	0.00	-2556.24	83446.94
		36	-62.75	-3167.76	-102.37	0.00	1720.14	-55134.56
	7	2	0.00	0.00	-5444.31	0.00	126224.26	0.00
		36	0.00	0.00	4835.66	0.00	-84290.31	0.00
	8	2	1056.05	0.00	-2961.00	0.00	126017.84	0.00
		36	-1056.05	0.00	2961.00	0.00	-101830.93	0.00
	9	2	784.96	1773.85	-2856.86	0.00	121562.56	76281.16
		36	-784.96	-1773.85	2856.86	0.00	-98227.38	-61792.13
	10	2	14.17	780.62	20.12	0.00	-502.50	17490.57
		36	-14.17	-660.40	-20.12	0.00	338.14	-11614.93
	11	2	0.00	0.00	-1110.50	0.00	25983.59	0.00
		36	0.00	0.00	990.28	0.00	-17413.82	0.00
	12	2	7447.23	0.00	0.00	0.00	3230.00	0.00
		36	-6670.51	0.00	0.00	0.00	-3229.19	0.00

MEMBER END FORCES STRUCTURE TYPE = SPACE

ALL UNITS ARE -- POUN FEET (LOCAL)

MEMBER	LOAD	JT	AXIAL	SHEAR-Y	SHEAR-Z	TORSION	MOM-Y	MOM-Z
	13	2	1740.45	0.00	-4778.50	0.00	208244.11	0.00
		36	-1740.45	0.00	4778.50	0.00	-169206.03	0.00
	14	2	1468.91	1953.45	-4611.96	0.00	200941.12	87478.84
		36	-1468.91	-1953.45	4611.96	0.00	-163265.42	-71520.72
	15	2	1056.05	0.00	-2613.00	0.00	110911.05	0.00
		36	-1056.05	0.00	2613.00	0.00	-89566.77	0.00
	16	2	785.14	1470.05	-2521.61	0.00	107008.65	63160.12
		36	-785.14	-1470.05	2521.61	0.00	-86411.87	-51152.57
	17	2	1280.15	0.00	-3152.00	0.00	135247.53	0.00
		36	-1280.15	0.00	3152.00	0.00	-109499.38	0.00
	18	2	1009.28	1189.15	-3042.65	0.00	130523.05	51869.04
		36	-1009.28	-1189.15	3042.65	0.00	-105669.36	-42155.50
	19	2	16724.63	4390.42	-6679.20	0.00	298835.66	150711.23
		36	-15168.61	-4101.00	6679.20	0.00	-244267.28	-116050.98
	20	2	16692.68	0.00	-9600.72	0.00	371318.22	0.00
		36	-15136.66	0.00	9311.30	0.00	-294092.00	0.00
	21	2	10774.84	5550.26	-2754.49	0.00	123316.54	159728.09
		36	-9739.22	-4941.61	2754.49	0.00	-100816.02	-116926.69
	22	2	10983.19	0.00	-8405.31	0.00	256552.31	0.00
		36	-9947.57	0.00	7796.66	0.00	-190430.00	0.00
	23	2	18857.44	2734.07	-4591.84	0.00	207978.84	104969.41
		36	-17045.10	-2613.85	4591.84	0.00	-170465.23	-83135.65
	24	2	19114.81	0.00	-5889.00	0.00	241767.92	0.00
		36	-17302.48	0.00	5768.78	0.00	-194157.81	0.00
	25	2	10761.22	4415.65	-2441.76	0.00	109324.99	128248.73
		36	-9725.60	-3940.90	2441.76	0.00	-89378.93	-94157.52
	26	2	10983.19	0.00	-6859.56	0.00	213676.17	0.00
		36	-9947.57	0.00	6384.82	0.00	-159621.98	0.00
	27	2	14674.20	1969.77	-3022.52	0.00	135945.75	69359.61
		36	-13250.22	-1849.55	3022.52	0.00	-111254.58	-53770.43
	28	2	14930.90	0.00	-4262.50	0.00	167156.34	0.00
		36	-13506.92	0.00	4142.28	0.00	-132836.56	0.00
	29	2	17450.52	3105.86	-11512.48	0.00	471177.78	106593.04
		36	-15894.51	-2900.95	11307.57	0.00	-377980.00	-82074.45
	30	2	11273.09	3924.03	-7889.98	0.00	266782.88	112927.77
		36	-10237.47	-3493.72	7459.66	0.00	-204127.11	-82667.17
	31	2	19653.39	1932.99	-7409.95	0.00	314849.31	74213.38
		36	-17841.06	-1847.99	7324.96	0.00	-254667.80	-58776.91
3	1	3	3847.29	0.00	-591.66	0.00	2942.13	0.00
		18	-3414.93	0.00	591.66	0.00	-5.17	0.00
	2	3	-3.00	287.54	-9.77	0.00	31.38	3385.21
		18	3.00	-238.95	9.77	0.00	17.06	-2081.95
	3	3	0.00	0.00	-445.66	0.00	5186.60	0.00
		18	0.00	0.00	397.07	0.00	-3099.38	0.00

MEMBER END FORCES STRUCTURE TYPE = SPACE

ALL UNITS ARE -- POUN FEET (LOCAL)

MEMBER	LOAD	JT	AXIAL	SHEAR-Y	SHEAR-Z	TORSION	MOM-Y	MOM-Z
	4	3	1775.68	0.00	-6974.55	0.00	129708.06	0.00
		18	-1775.68	0.00	6974.55	0.00	-95041.15	0.00
	5	3	1778.94	2554.89	-6745.84	0.00	125402.44	46570.85
		18	-1778.94	-2554.89	6745.84	0.00	-91872.19	-33872.18
	6	3	-13.75	1499.39	-51.18	0.00	164.37	17621.01
		18	13.75	-1243.93	51.18	0.00	89.40	-10830.50
	7	3	0.00	0.00	-2333.06	0.00	27070.38	0.00
		18	0.00	0.00	2077.60	0.00	-16146.40	0.00
	8	3	1055.92	0.00	-2961.00	0.00	51943.16	0.00
		18	-1055.92	0.00	2961.00	0.00	-37241.38	0.00
	9	3	787.04	1773.85	-2863.14	0.00	50182.01	31912.46
		18	-787.04	-1773.85	2863.14	0.00	-35971.36	-23108.12
	10	3	-3.08	315.72	-10.06	0.00	32.31	3828.13
		18	3.08	-262.84	10.06	0.00	17.57	-2395.89
	11	3	0.00	0.00	-480.64	0.00	5702.74	0.00
		18	0.00	0.00	427.77	0.00	-3452.78	0.00
	12	3	2886.03	0.00	-443.91	0.00	2205.81	0.00
		18	-2561.76	0.00	443.91	0.00	-2.90	0.00
	13	3	1740.24	0.00	-4778.50	0.00	88645.40	0.00
		18	-1740.24	0.00	4778.50	0.00	-64895.22	0.00
	14	3	1471.81	1953.45	-4619.24	0.00	85620.41	38593.88
		18	-1471.81	-1953.45	4619.24	0.00	-62670.53	-28887.63
	15	3	1055.92	0.00	-2613.00	0.00	45542.35	0.00
		18	-1055.92	0.00	2613.00	0.00	-32568.52	0.00
	16	3	786.86	1470.05	-2526.29	0.00	43994.31	26390.29
		18	-786.86	-1470.05	2526.29	0.00	-31455.59	-19093.85
	17	3	1279.99	0.00	-3152.00	0.00	56382.74	0.00
		18	-1279.99	0.00	3152.00	0.00	-40727.48	0.00
	18	3	1010.89	1189.15	-3046.55	0.00	54455.34	22120.59
		18	-1010.89	-1189.15	3046.55	0.00	-39329.45	-16216.34
	19	3	7552.36	3273.74	-7659.35	0.00	129900.89	55033.87
		18	-6902.75	-3152.27	7659.35	0.00	-91836.63	-39077.06
	20	3	7556.61	0.00	-8977.79	0.00	147094.58	0.00
		18	-6907.00	0.00	8856.32	0.00	-102796.72	0.00
	21	3	4620.58	3273.24	-3505.98	0.00	53288.51	49533.46
		18	-4188.23	-3017.78	3505.98	0.00	-35887.12	-33938.62
	22	3	4903.21	0.00	-5885.72	0.00	81955.67	0.00
		18	-4470.85	0.00	5630.26	0.00	-53392.94	0.00
	23	3	8202.04	2269.16	-5664.87	0.00	90800.66	42422.00
		18	-7445.43	-2216.28	5664.87	0.00	-62661.03	-31283.52
	24	3	8473.55	0.00	-6294.71	0.00	99496.08	0.00
		18	-7716.93	0.00	6241.84	0.00	-68356.06	0.00
	25	3	4623.42	2639.57	-3157.87	0.00	47064.65	40134.68
		18	-4191.07	-2440.31	3157.87	0.00	-31391.02	-27541.64
	26	3	4903.21	0.00	-5024.45	0.00	69599.38	0.00
		18	-4470.85	0.00	4825.19	0.00	-45167.88	0.00

MEMBER END FORCES STRUCTURE TYPE = SPACE

ALL UNITS ARE -- POUN FEET (LOCAL)

MEMBER	LOAD	JT	AXIAL	SHEAR-Y	SHEAR-Z	TORSION	MOM-Y	MOM-Z
	27	3	6298.11	1504.86	-3870.23	0.00	58532.69	25948.72
		18	-5703.63	-1451.99	3870.23	0.00	-39318.50	-18612.23
	28	3	6570.29	0.00	-4446.26	0.00	66130.52	0.00
		18	-5975.81	0.00	4393.38	0.00	-44186.88	0.00
	29	3	8288.73	2315.26	-11395.51	0.00	194018.97	38917.41
		18	-7639.12	-2229.26	11309.51	0.00	-137610.55	-27632.69
	30	3	5140.54	2314.18	-6394.98	0.00	94399.59	35020.16
		18	-4708.19	-2133.57	6214.37	0.00	-63118.87	-23994.61
	31	3	9002.05	1604.30	-8026.70	0.00	132408.55	29992.36
		18	-8245.43	-1566.91	7989.32	0.00	-92625.75	-22117.45
4	1	4	3847.29	0.00	-591.66	0.00	2942.13	0.00
		19	-3414.93	0.00	591.66	0.00	-5.17	0.00
	2	4	3.00	287.54	9.77	0.00	-31.38	3385.21
		19	-3.00	-238.95	-9.77	0.00	-17.06	-2081.95
	3	4	0.00	0.00	-445.66	0.00	5186.60	0.00
		19	0.00	0.00	397.07	0.00	-3099.38	0.00
	4	4	1775.68	0.00	-6974.55	0.00	129708.06	0.00
		19	-1775.68	0.00	6974.55	0.00	-95041.15	0.00
	5	4	1772.42	2554.91	-6728.06	0.00	125176.52	46570.85
		19	-1772.42	-2554.91	6728.06	0.00	-91734.93	-33872.18
	6	4	13.75	1499.34	51.18	0.00	-164.39	17621.01
		19	-13.75	-1243.88	-51.18	0.00	-89.39	-10830.50
	7	4	0.00	0.00	-2333.06	0.00	27070.38	0.00
		19	0.00	0.00	2077.60	0.00	-16146.40	0.00
	8	4	1055.92	0.00	-2961.00	0.00	51943.16	0.00
		19	-1055.92	0.00	2961.00	0.00	-37241.38	0.00
	9	4	784.86	1773.85	-2856.86	0.00	50102.67	31912.46
		19	-784.86	-1773.85	2856.86	0.00	-35923.17	-23108.12
	10	4	3.08	315.71	10.06	0.00	-32.32	3828.13
		19	-3.08	-262.84	-10.06	0.00	-17.57	-2395.89
	11	4	0.00	0.00	-480.64	0.00	5702.74	0.00
		19	0.00	0.00	427.77	0.00	-3452.78	0.00
	12	4	2886.03	0.00	-443.91	0.00	2205.81	0.00
		19	-2561.76	0.00	443.91	0.00	-2.90	0.00
	13	4	1740.24	0.00	-4778.50	0.00	88645.40	0.00
		19	-1740.24	0.00	4778.50	0.00	-64895.22	0.00
	14	4	1468.73	1953.45	-4611.96	0.00	85528.09	38593.88
		19	-1468.73	-1953.45	4611.96	0.00	-62614.44	-28887.63
	15	4	1055.92	0.00	-2613.00	0.00	45542.35	0.00
		19	-1055.92	0.00	2613.00	0.00	-32568.52	0.00
	16	4	785.04	1470.05	-2521.61	0.00	43935.09	26390.29
		19	-785.04	-1470.05	2521.61	0.00	-31419.62	-19093.85
	17	4	1279.99	0.00	-3152.00	0.00	56382.74	0.00
		19	-1279.99	0.00	3152.00	0.00	-40727.48	0.00

MEMBER END FORCES STRUCTURE TYPE = SPACE

ALL UNITS ARE -- POUN FEET (LOCAL)

MEMBER	LOAD	JT	AXIAL	SHEAR-Y	SHEAR-Z	TORSION	MOM-Y	MOM-Z
	18	4	1009.16	1189.15	-3042.65	0.00	54405.90	22120.59
		19	-1009.16	-1189.15	3042.65	0.00	-39299.42	-16216.34
	19	4	7560.85	3273.76	-7592.71	0.00	129518.10	55033.87
		19	-6911.24	-3152.29	7592.71	0.00	-91784.70	-39077.06
	20	4	7556.61	0.00	-8977.79	0.00	147094.58	0.00
		19	-6907.00	0.00	8856.32	0.00	-102796.72	0.00
	21	4	4645.90	3273.19	-3397.34	0.00	52880.40	49533.48
		19	-4213.54	-3017.73	3397.34	0.00	-36017.72	-33938.62
	22	4	4903.21	0.00	-5885.72	0.00	81955.67	0.00
		19	-4470.85	0.00	5630.26	0.00	-53392.94	0.00
	23	4	8205.12	2269.17	-5637.47	0.00	90643.71	42422.00
		19	-7448.51	-2216.29	5637.47	0.00	-62640.09	-31283.52
	24	4	8473.55	0.00	-6294.71	0.00	99496.08	0.00
		19	-7716.93	0.00	6241.84	0.00	-68356.06	0.00
	25	4	4643.05	2639.54	-3073.34	0.00	46749.00	40134.68
		19	-4210.70	-2440.28	3073.34	0.00	-31494.51	-27541.64
	26	4	4903.21	0.00	-5024.45	0.00	69599.38	0.00
		19	-4470.85	0.00	4825.19	0.00	-45167.88	0.00
	27	4	6302.54	1504.86	-3846.20	0.00	58418.62	25948.72
		19	-5708.05	-1451.99	3846.20	0.00	-39323.61	-18612.23
	28	4	6570.29	0.00	-4446.26	0.00	66130.52	0.00
		19	-5975.81	0.00	4393.38	0.00	-44186.88	0.00
	29	4	8294.74	2315.27	-11348.35	0.00	193748.17	38917.41
		19	-7645.13	-2229.27	11262.35	0.00	-137573.92	-27632.69
	30	4	5158.44	2314.15	-6318.18	0.00	94111.07	35020.16
		19	-4726.09	-2133.54	6137.56	0.00	-63211.20	-23994.61
	31	4	9004.23	1604.30	-8007.33	0.00	132297.59	29992.36
		19	-8247.61	-1566.92	7969.94	0.00	-92610.94	-22117.45
5	1	5	0.00	916.39	0.00	0.00	0.00	0.00
		6	0.00	-647.43	0.00	0.00	0.00	4691.45
	2	5	-21.00	-3.00	0.00	12.42	0.00	0.00
		6	21.00	3.00	0.00	-12.42	0.00	-18.00
	3	5	0.00	0.00	-116.94	-54.00	0.00	0.00
		6	0.00	0.00	84.96	54.00	605.70	0.00
	4	5	0.00	1592.10	-4499.55	0.00	0.00	0.00
		6	0.00	-1592.10	4499.55	0.00	26997.30	9552.60
	5	5	-1742.39	1587.96	-4334.98	16.29	0.00	0.00
		6	1742.39	-1587.96	4334.98	-16.29	26009.88	9527.77
	6	5	-99.03	-13.75	-0.01	65.06	0.00	0.00
		6	99.03	13.75	0.01	-65.06	0.05	-82.49
	7	5	0.00	0.00	-603.72	-247.50	0.00	0.00
		6	0.00	0.00	435.48	247.50	3117.60	0.00
	8	5	0.00	835.05	-2217.00	0.00	0.00	0.00
		6	0.00	-835.05	2217.00	0.00	13302.00	5010.30

MEMBER END FORCES STRUCTURE TYPE = SPACE

ALL UNITS ARE -- POUN FEET (LOCAL)

MEMBER	LOAD	JT	AXIAL	SHEAR-Y	SHEAR-Z	TORSION	MOM-Y	MOM-Z
9		5	-1246.95	743.66	-2137.42	5.72	0.00	0.00
		6	1246.95	-743.66	2137.42	-5.72	12824.53	4461.98
10		5	-22.50	-3.08	0.00	12.79	0.00	0.00
		6	22.50	3.08	0.00	-12.79	0.00	-18.50
11		5	0.00	0.00	-122.22	-55.50	0.00	0.00
		6	0.00	0.00	88.98	55.50	633.60	0.00
12		5	0.00	687.67	0.00	0.00	0.00	0.00
		6	0.00	-485.94	0.00	0.00	0.00	3520.84
13		5	0.00	1362.15	-3106.50	0.00	0.00	0.00
		6	0.00	-1362.15	3106.50	0.00	18639.00	8172.90
14		5	-1032.74	1270.19	-2995.98	6.66	0.00	0.00
		6	1032.74	-1270.19	2995.98	-6.66	17975.89	7621.14
15		5	0.00	835.05	-1986.00	0.00	0.00	0.00
		6	0.00	-835.05	1986.00	0.00	11916.00	5010.30
16		5	-1039.05	743.89	-1915.38	4.27	0.00	0.00
		6	1039.05	-743.89	1915.38	-4.27	11492.28	4463.37
17		5	0.00	1059.15	-2253.00	0.00	0.00	0.00
		6	0.00	-1059.15	2253.00	0.00	13518.00	6354.90
18		5	-763.95	968.04	-2173.72	3.57	0.00	0.00
		6	763.95	-968.04	2173.72	-3.57	13042.33	5808.27
19		5	-1794.89	2957.59	-4334.98	47.34	0.00	0.00
		6	1794.89	-2553.47	4334.98	-47.34	26009.89	16533.18
20		5	0.00	2969.23	-4791.90	-135.00	0.00	0.00
		6	0.00	-2565.11	4711.95	135.00	28511.55	16603.01
21		5	-1345.98	1646.30	-2137.43	70.78	0.00	0.00
		6	1345.98	-1377.34	2137.43	-70.78	12824.58	9070.93
22		5	0.00	1751.44	-2820.72	-247.50	0.00	0.00
		6	0.00	-1482.48	2652.48	247.50	16419.60	9701.75
23		5	-1055.25	2871.16	-2995.98	19.45	0.00	0.00
		6	1055.25	-2400.48	2995.98	-19.45	17975.89	15814.92
24		5	0.00	2966.21	-3228.72	-55.50	0.00	0.00
		6	0.00	-2495.52	3195.48	55.50	19272.60	16385.18
25		5	-1116.29	1649.56	-1915.39	55.02	0.00	0.00
		6	1116.29	-1380.60	1915.39	-55.02	11492.32	9090.47
26		5	0.00	1751.44	-2456.90	-193.05	0.00	0.00
		6	0.00	-1482.48	2325.67	193.05	14347.73	9701.75
27		5	-786.45	2225.18	-2173.72	16.36	0.00	0.00
		6	786.45	-1855.36	2173.72	-16.36	13042.33	12241.63
28		5	0.00	2319.37	-2375.22	-55.50	0.00	0.00
		6	0.00	-1949.55	2341.98	55.50	14151.60	12806.76
29		5	-1269.04	3620.12	-6453.00	-62.08	0.00	0.00
		6	1269.04	-3216.00	6396.39	62.08	38548.17	20508.37
30		5	-951.61	2022.82	-3505.41	-124.94	0.00	0.00
		6	951.61	-1753.86	3386.47	124.94	20675.64	11330.03
31		5	-746.06	3462.94	-4400.86	-25.49	0.00	0.00
		6	746.06	-2992.26	4377.36	25.49	26334.69	19365.59

MEMBER END FORCES STRUCTURE TYPE = SPACE

ALL UNITS ARE -- POUN FEET (LOCAL)

MEMBER	LOAD	JT	AXIAL	SHEAR-Y	SHEAR-Z	TORSION	MOM-Y	MOM-Z
10	1	10	0.00	-647.43	0.00	0.00	0.00	-4691.45
		11	0.00	916.39	0.00	0.00	0.00	0.00
	2	10	21.00	-3.00	0.00	12.42	0.00	-18.00
		11	-21.00	3.00	0.00	-12.42	0.00	0.00
	3	10	0.00	0.00	84.96	54.00	-605.70	0.00
		11	0.00	0.00	-116.94	-54.00	0.00	0.00
	4	10	0.00	-1592.10	4499.55	0.00	-26997.30	-9552.60
		11	0.00	1592.10	-4499.55	0.00	0.00	0.00
	5	10	1742.41	-1596.25	4357.60	16.29	-26145.60	-9577.49
		11	-1742.41	1596.25	-4357.60	-16.29	0.00	0.00
	6	10	98.97	-13.75	0.01	65.06	-0.05	-82.51
		11	-98.97	13.75	-0.01	-65.06	0.00	0.00
	7	10	0.00	0.00	435.48	247.50	-3117.60	0.00
		11	0.00	0.00	-603.72	-247.50	0.00	0.00
	8	10	0.00	-835.05	2217.00	0.00	-13302.00	-5010.30
		11	0.00	835.05	-2217.00	0.00	0.00	0.00
	9	10	1246.95	-746.44	2145.40	5.72	-12872.39	-4478.63
		11	-1246.95	746.44	-2145.40	-5.72	0.00	0.00
	10	10	22.50	-3.08	0.00	12.79	0.00	-18.50
		11	-22.50	3.08	0.00	-12.79	0.00	0.00
	11	10	0.00	0.00	88.98	55.50	-633.60	0.00
		11	0.00	0.00	-122.22	-55.50	0.00	0.00
	12	10	0.00	-485.94	0.00	0.00	0.00	-3520.84
		11	0.00	687.67	0.00	0.00	0.00	0.00
	13	10	0.00	-1362.15	3106.50	0.00	-18639.00	-8172.90
		11	0.00	1362.15	-3106.50	0.00	0.00	0.00
	14	10	1032.76	-1274.11	3005.24	6.66	-18031.43	-7644.68
		11	-1032.76	1274.11	-3005.24	-6.66	0.00	0.00
	15	10	0.00	-835.05	1986.00	0.00	-11916.00	-5010.30
		11	0.00	835.05	-1986.00	0.00	0.00	0.00
	16	10	1039.05	-746.21	1921.33	4.27	-11528.00	-4477.24
		11	-1039.05	746.21	-1921.33	-4.27	0.00	0.00
	17	10	0.00	-1059.15	2253.00	0.00	-13518.00	-6354.90
		11	0.00	1059.15	-2253.00	0.00	0.00	0.00
	18	10	763.95	-970.26	2178.69	3.57	-13072.12	-5821.54
		11	-763.95	970.26	-2178.69	-3.57	0.00	0.00
	19	10	1794.91	-2576.76	4357.60	47.34	-26145.61	-16672.89
		11	-1794.91	2980.87	-4357.60	-47.34	0.00	0.00
	20	10	0.00	-2565.11	4711.95	135.00	-28511.55	-16603.01
		11	0.00	2969.23	-4791.90	-135.00	0.00	0.00
	21	10	1345.92	-1407.62	2145.41	70.78	-12872.44	-9252.58
		11	-1345.92	1676.58	-2145.41	-70.78	0.00	0.00
	22	10	0.00	-1482.48	2652.48	247.50	-16419.60	-9701.75
		11	0.00	1751.44	-2820.72	-247.50	0.00	0.00

MEMBER END FORCES STRUCTURE TYPE = SPACE

ALL UNITS ARE -- POUN FEET (LOCAL)

MEMBER	LOAD	JT	AXIAL	SHEAR-Y	SHEAR-Z	TORSION	MOM-Y	MOM-Z
	23	10	1055.25	-2410.57	3005.24	19.45	-18031.43	-15875.46
		11	-1055.25	2881.25	-3005.24	-19.45	0.00	0.00
	24	10	0.00	-2495.52	3195.48	55.50	-19272.60	-16385.18
		11	0.00	2966.21	-3228.72	-55.50	0.00	0.00
	25	10	1116.25	-1404.36	1921.34	55.02	-11528.04	-9233.04
		11	-1116.25	1673.32	-1921.34	-55.02	0.00	0.00
	26	10	0.00	-1482.48	2325.67	193.05	-14347.73	-9701.75
		11	0.00	1751.44	-2456.90	-193.05	0.00	0.00
	27	10	786.45	-1863.74	2178.69	16.36	-13072.12	-12291.90
		11	-786.45	2233.56	-2178.69	-16.36	0.00	0.00
	28	10	0.00	-1949.55	2341.98	55.50	-14151.60	-12806.76
		11	0.00	2319.37	-2375.22	-55.50	0.00	0.00
	29	10	1269.05	-3232.48	6412.38	129.08	-38644.12	-20607.24
		11	-1269.05	3636.60	-6468.99	-129.08	0.00	0.00
	30	10	951.57	-1775.26	3392.11	225.02	-20709.47	-11458.45
		11	-951.57	2044.22	-3511.05	-225.02	0.00	0.00
	31	10	746.06	-2999.39	4383.91	52.99	-26373.95	-19408.39
		11	-746.06	3470.07	-4407.41	-52.99	0.00	0.00
15	1	16	4061.69	0.00	-591.66	0.00	4299.74	0.00
		3	-3847.29	0.00	591.66	0.00	-2942.13	0.00
	2	16	-3.00	311.61	-9.77	0.00	53.77	4071.63
		3	3.00	-287.54	9.77	0.00	-31.38	-3385.21
	3	16	0.00	0.00	-469.73	0.00	6235.44	0.00
		3	0.00	0.00	445.66	0.00	-5186.60	0.00
	4	16	1775.68	0.00	-6974.55	0.00	145728.25	0.00
		3	-1775.68	0.00	6974.55	0.00	-129708.06	0.00
	5	16	1778.94	2554.89	-6745.84	0.00	140897.34	52439.16
		3	-1778.94	-2554.89	6745.84	0.00	-125402.44	-46570.85
	6	16	-13.75	1625.92	-51.18	0.00	281.69	21201.49
		3	13.75	-1499.39	51.18	0.00	-164.37	-17621.01
	7	16	0.00	0.00	-2459.59	0.00	32561.70	0.00
		3	0.00	0.00	2333.06	0.00	-27070.38	0.00
	8	16	1055.92	0.00	-2961.00	0.00	58738.18	0.00
		3	-1055.92	0.00	2961.00	0.00	-51943.16	0.00
	9	16	787.04	1773.85	-2863.14	0.00	56750.37	35981.93
		3	-787.04	-1773.85	2863.14	0.00	-50182.01	-31912.46
	10	16	-3.08	341.82	-10.06	0.00	55.38	4581.45
		3	3.08	-315.72	10.06	0.00	-32.31	-3828.13
	11	16	0.00	0.00	-506.75	0.00	6834.08	0.00
		3	0.00	0.00	480.64	0.00	-5702.74	0.00
	12	16	3046.83	0.00	-443.91	0.00	3224.11	0.00
		3	-2886.03	0.00	443.91	0.00	-2205.81	0.00
	13	16	1740.24	0.00	-4778.50	0.00	99620.87	0.00
		3	-1740.24	0.00	4778.50	0.00	-88645.40	0.00

MEMBER END FORCES STRUCTURE TYPE = SPACE

ALL UNITS ARE -- POUN FEET (LOCAL)

MEMBER	LOAD	JT	AXIAL	SHEAR-Y	SHEAR-Z	TORSION	MOM-Y	MOM-Z
	14	16	1471.81	1953.45	-4619.24	0.00	96226.62	43079.49
		3	-1471.81	-1953.45	4619.24	0.00	-85620.41	-38593.88
	15	16	1055.92	0.00	-2613.00	0.00	51538.74	0.00
		3	-1055.92	0.00	2613.00	0.00	-45542.35	0.00
	16	16	786.86	1470.05	-2526.29	0.00	49789.89	29762.79
		3	-786.86	-1470.05	2526.29	0.00	-43994.31	-26390.29
	17	16	1279.99	0.00	-3152.00	0.00	63618.11	0.00
		3	-1279.99	0.00	3152.00	0.00	-56382.74	0.00
	18	16	1010.89	1189.15	-3046.55	0.00	61446.42	24849.47
		3	-1010.89	-1189.15	3046.55	0.00	-54455.34	-22120.59
	19	16	7874.51	3333.91	-7659.35	0.00	147491.67	62618.24
		3	-7552.36	-3273.74	7659.35	0.00	-129900.89	-55033.87
	20	16	7878.75	0.00	-9037.95	0.00	167776.73	0.00
		3	-7556.61	0.00	8977.79	0.00	-147094.58	0.00
	21	16	4834.99	3399.77	-3505.98	0.00	61331.80	57183.42
		3	-4620.58	-3273.24	3505.98	0.00	-53288.51	-49533.46
	22	16	5117.61	0.00	-6012.25	0.00	95599.62	0.00
		3	-4903.21	0.00	5885.72	0.00	-81955.67	0.00
	23	16	8577.25	2295.27	-5664.87	0.00	103805.85	47660.94
		3	-8202.04	-2269.16	5664.87	0.00	-90800.66	-42422.00
	24	16	8848.76	0.00	-6320.82	0.00	113978.80	0.00
		3	-8473.55	0.00	6294.71	0.00	-99496.08	0.00
	25	16	4837.83	2738.27	-3157.87	0.00	54309.35	46299.95
		3	-4623.42	-2639.57	3157.87	0.00	-47064.65	-40134.68
	26	16	5117.61	0.00	-5123.14	0.00	81236.61	0.00
		3	-4903.21	0.00	5024.45	0.00	-69599.38	0.00
	27	16	6592.92	1530.97	-3870.23	0.00	67413.59	29430.92
		3	-6298.11	-1504.86	3870.23	0.00	-58532.69	-25948.72
	28	16	6865.10	0.00	-4472.36	0.00	76363.99	0.00
		3	-6570.29	0.00	4446.26	0.00	-66130.52	0.00
	29	16	8610.88	2357.85	-11438.11	0.00	220236.09	44281.28
		3	-8288.73	-2315.26	11395.51	0.00	-194018.97	-38917.41
	30	16	5354.95	2403.64	-6484.44	0.00	109170.42	40428.68
		3	-5140.54	-2314.18	6394.98	0.00	-94399.59	-35020.16
	31	16	9377.26	1622.75	-8045.16	0.00	150858.88	33696.29
		3	-9002.05	-1604.30	8026.70	0.00	-132408.55	-29992.36
16	1	17	4061.69	0.00	-591.66	0.00	4299.74	0.00
		4	-3847.29	0.00	591.66	0.00	-2942.13	0.00
	2	17	3.00	311.61	9.77	0.00	-53.77	4071.63
		4	-3.00	-287.54	-9.77	0.00	31.38	-3385.21
	3	17	0.00	0.00	-469.73	0.00	6235.44	0.00
		4	0.00	0.00	445.66	0.00	-5186.60	0.00
	4	17	1775.68	0.00	-6974.55	0.00	145728.25	0.00
		4	-1775.68	0.00	6974.55	0.00	-129708.06	0.00

MEMBER END FORCES STRUCTURE TYPE = SPACE

ALL UNITS ARE -- POUN FEET (LOCAL)

MEMBER	LOAD	JT	AXIAL	SHEAR-Y	SHEAR-Z	TORSION	MOM-Y	MOM-Z
	5	17	1772.42	2554.91	-6728.06	0.00	140630.48	52439.18
		4	-1772.42	-2554.91	6728.06	0.00	-125176.52	-46570.85
	6	17	13.75	1625.87	51.18	0.00	-281.71	21201.48
		4	-13.75	-1499.34	-51.18	0.00	164.39	-17621.01
	7	17	0.00	0.00	-2459.59	0.00	32561.70	0.00
		4	0.00	0.00	2333.06	0.00	-27070.38	0.00
	8	17	1055.92	0.00	-2961.00	0.00	58738.18	0.00
		4	-1055.92	0.00	2961.00	0.00	-51943.16	0.00
	9	17	784.86	1773.85	-2856.86	0.00	56656.63	35981.93
		4	-784.86	-1773.85	2856.86	0.00	-50102.67	-31912.46
	10	17	3.08	341.82	10.06	0.00	-55.38	4581.45
		4	-3.08	-315.71	-10.06	0.00	32.32	-3828.13
	11	17	0.00	0.00	-506.75	0.00	6834.08	0.00
		4	0.00	0.00	480.64	0.00	-5702.74	0.00
	12	17	3046.83	0.00	-443.91	0.00	3224.11	0.00
		4	-2886.03	0.00	443.91	0.00	-2205.81	0.00
	13	17	1740.24	0.00	-4778.50	0.00	99620.87	0.00
		4	-1740.24	0.00	4778.50	0.00	-88645.40	0.00
	14	17	1468.73	1953.45	-4611.96	0.00	96117.55	43079.49
		4	-1468.73	-1953.45	4611.96	0.00	-85528.09	-38593.88
	15	17	1055.92	0.00	-2613.00	0.00	51538.74	0.00
		4	-1055.92	0.00	2613.00	0.00	-45542.35	0.00
	16	17	785.04	1470.05	-2521.61	0.00	49719.92	29762.79
		4	-785.04	-1470.05	2521.61	0.00	-43935.09	-26390.29
	17	17	1279.99	0.00	-3152.00	0.00	63618.11	0.00
		4	-1279.99	0.00	3152.00	0.00	-56382.74	0.00
	18	17	1009.16	1189.15	-3042.65	0.00	61388.01	24849.47
		4	-1009.16	-1189.15	3042.65	0.00	-54405.90	-22120.59
	19	17	7882.99	3333.93	-7592.71	0.00	146955.95	62618.25
		4	-7560.85	-3273.76	7592.71	0.00	-129518.10	-55033.87
	20	17	7878.75	0.00	-9037.95	0.00	167776.73	0.00
		4	-7556.61	0.00	8977.79	0.00	-147094.58	0.00
	21	17	4860.30	3399.72	-3397.34	0.00	60674.66	57183.41
		4	-4645.90	-3273.19	3397.34	0.00	-52880.40	-49533.48
	22	17	5117.61	0.00	-6012.25	0.00	95599.62	0.00
		4	-4903.21	0.00	5885.72	0.00	-81955.67	0.00
	23	17	8580.33	2295.27	-5637.47	0.00	103586.02	47660.94
		4	-8205.12	-2269.17	5637.47	0.00	-90643.71	-42422.00
	24	17	8848.76	0.00	-6320.82	0.00	113978.80	0.00
		4	-8473.55	0.00	6294.71	0.00	-99496.08	0.00
	25	17	4857.46	2738.23	-3073.34	0.00	53799.93	46299.95
		4	-4643.05	-2639.54	3073.34	0.00	-46749.00	-40134.68
	26	17	5117.61	0.00	-5123.14	0.00	81236.61	0.00
		4	-4903.21	0.00	5024.45	0.00	-69599.38	0.00
	27	17	6597.35	1530.97	-3846.20	0.00	67244.43	29430.92
		4	-6302.54	-1504.86	3846.20	0.00	-58418.62	-25948.72

MEMBER END FORCES STRUCTURE TYPE = SPACE

ALL UNITS ARE -- POUN FEET (LOCAL)

MEMBER	LOAD	JT	AXIAL	SHEAR-Y	SHEAR-Z	TORSION	MOM-Y	MOM-Z
	28	17	6865.10	0.00	-4472.36	0.00	76363.99	0.00
		4	-6570.29	0.00	4446.26	0.00	-66130.52	0.00
	29	17	8616.89	2357.87	-11390.95	0.00	219857.06	44281.28
		4	-8294.74	-2315.27	11348.35	0.00	-193748.17	-38917.41
	30	17	5372.84	2403.60	-6407.63	0.00	108705.83	40428.68
		4	-5158.44	-2314.15	6318.18	0.00	-94111.07	-35020.16
	31	17	9379.44	1622.76	-8025.79	0.00	150703.47	33696.29
		4	-9004.23	-1604.30	8007.33	0.00	-132297.59	-29992.36
17	1	18	2368.63	0.00	0.00	0.00	5.17	0.00
		5	-1620.32	0.00	0.00	0.00	-1.05	0.00
	2	18	-3.00	188.70	0.00	0.00	-12.42	2081.95
		5	3.00	-104.35	0.00	0.00	12.42	-626.17
	3	18	0.00	0.00	-284.64	0.00	3099.38	0.00
		5	0.00	0.00	200.29	0.00	-680.17	0.00
	4	18	1775.90	0.00	-6974.55	0.00	95041.15	0.00
		5	-1775.90	0.00	6974.55	0.00	-24777.47	0.00
	5	18	1779.16	2554.89	-6745.84	0.00	91877.20	33872.18
		5	-1779.16	-2554.89	6745.84	0.00	-23917.27	-8134.80
	6	18	-13.75	980.69	0.00	0.00	-65.06	10830.50
		5	13.75	-537.18	0.00	0.00	65.06	-3292.04
	7	18	0.00	0.00	-1485.38	0.00	16146.40	0.00
		5	0.00	0.00	1041.87	0.00	-3539.54	0.00
	8	18	1056.05	0.00	-2961.00	0.00	37241.38	0.00
		5	-1056.05	0.00	2961.00	0.00	-7452.99	0.00
	9	18	787.14	1773.85	-2863.14	0.00	35973.11	23108.12
		5	-787.14	-1773.85	2863.14	0.00	-7182.60	-5270.49
	10	18	-3.08	211.09	0.00	0.00	-12.79	2395.89
		5	3.08	-118.60	0.00	0.00	12.79	-756.83
	11	18	0.00	0.00	-310.81	0.00	3452.78	0.00
		5	0.00	0.00	218.32	0.00	-812.33	0.00
	12	18	1776.85	0.00	0.00	0.00	2.90	0.00
		5	-1215.61	0.00	0.00	0.00	-0.59	0.00
	13	18	1740.45	0.00	-4778.50	0.00	64895.22	0.00
		5	-1740.45	0.00	4778.50	0.00	-16758.62	0.00
	14	18	1471.99	1953.44	-4619.24	0.00	62672.58	28887.63
		5	-1471.99	-1953.44	4619.24	0.00	-16162.89	-9215.98
	15	18	1056.05	0.00	-2613.00	0.00	32568.52	0.00
		5	-1056.05	0.00	2613.00	0.00	-6281.36	0.00
	16	18	786.96	1470.05	-2526.29	0.00	31456.90	19093.85
		5	-786.96	-1470.05	2526.29	0.00	-6053.76	-4311.23
	17	18	1280.15	0.00	-3152.00	0.00	40727.48	0.00
		5	-1280.15	0.00	3152.00	0.00	-9004.19	0.00
	18	18	1011.02	1189.15	-3046.55	0.00	39330.55	16216.34
		5	-1011.02	-1189.15	3046.55	0.00	-8682.98	-4253.05

MEMBER END FORCES STRUCTURE TYPE = SPACE

ALL UNITS ARE -- POUN FEET (LOCAL)

MEMBER	LOAD	JT	AXIAL	SHEAR-Y	SHEAR-Z	TORSION	MOM-Y	MOM-Z
	19	18	5330.78	3026.65	-6745.84	0.00	91853.26	39077.06
		5	-4206.43	-2815.76	6745.84	0.00	-23887.67	-9700.22
	20	18	5335.02	0.00	-7686.16	0.00	102796.72	0.00
		5	-4210.68	0.00	7475.27	0.00	-26479.34	0.00
	21	18	3142.02	2754.53	-2863.14	0.00	35913.21	33938.62
		5	-2393.71	-2311.03	2863.14	0.00	-7118.60	-8562.53
	22	18	3424.68	0.00	-4446.37	0.00	53392.94	0.00
		5	-2676.37	0.00	4002.87	0.00	-10993.58	0.00
	23	18	5614.39	2164.53	-4619.24	0.00	62667.86	31283.52
		5	-4304.84	-2072.05	4619.24	0.00	-16151.75	-9972.81
	24	18	5885.93	0.00	-5089.31	0.00	68356.06	0.00
		5	-4576.38	0.00	4996.82	0.00	-17572.59	0.00
	25	18	3144.87	2234.98	-2526.29	0.00	31411.31	27541.64
		5	-2396.55	-1889.05	2526.29	0.00	-6004.07	-6879.03
	26	18	3424.68	0.00	-3771.59	0.00	45167.88	0.00
		5	-2676.37	0.00	3425.66	0.00	-9043.26	0.00
	27	18	4265.00	1400.24	-3046.55	0.00	39324.38	18612.23
		5	-3236.06	-1307.75	3046.55	0.00	-8671.54	-5009.88
	28	18	4537.21	0.00	-3462.81	0.00	44186.88	0.00
		5	-3508.27	0.00	3370.32	0.00	-9817.87	0.00
	29	18	6067.24	2140.31	-10204.14	0.00	137622.31	27632.69
		5	-4942.89	-1991.01	10054.83	0.00	-35610.55	-6859.62
	30	18	3662.05	1947.45	-5167.82	0.00	63137.32	23994.61
		5	-2913.73	-1633.90	4854.27	0.00	-12804.88	-6053.71
	31	18	6414.50	1530.32	-6863.94	0.00	92630.58	22117.45
		5	-5104.94	-1464.94	6798.55	0.00	-23842.43	-7050.78
18	1	19	2368.63	0.00	0.00	0.00	5.17	0.00
		11	-1620.32	0.00	0.00	0.00	-1.05	0.00
	2	19	3.00	188.70	0.00	0.00	12.42	2081.95
		11	-3.00	-104.35	0.00	0.00	-12.42	-626.17
	3	19	0.00	0.00	-284.64	0.00	3099.38	0.00
		11	0.00	0.00	200.29	0.00	-680.17	0.00
	4	19	1775.90	0.00	-6974.55	0.00	95041.15	0.00
		11	-1775.90	0.00	6974.55	0.00	-24777.47	0.00
	5	19	1772.64	2554.91	-6728.06	0.00	91729.92	33872.18
		11	-1772.64	-2554.91	6728.06	0.00	-23949.80	-8134.80
	6	19	13.75	980.62	0.00	0.00	65.05	10830.50
		11	-13.75	-537.12	0.00	0.00	-65.06	-3292.04
	7	19	0.00	0.00	-1485.38	0.00	16146.40	0.00
		11	0.00	0.00	1041.87	0.00	-3539.54	0.00
	8	19	1056.05	0.00	-2961.00	0.00	37241.38	0.00
		11	-1056.05	0.00	2961.00	0.00	-7452.99	0.00
	9	19	784.96	1773.85	-2856.86	0.00	35921.41	23108.12
		11	-784.96	-1773.85	2856.86	0.00	-7194.05	-5270.49

MEMBER END FORCES STRUCTURE TYPE = SPACE

ALL UNITS ARE -- POUN FEET (LOCAL)

MEMBER	LOAD	JT	AXIAL	SHEAR-Y	SHEAR-Z	TORSION	MOM-Y	MOM-Z
	10	19	3.08	211.09	0.00	0.00	12.79	2395.89
		11	-3.08	-118.60	0.00	0.00	-12.79	-756.83
	11	19	0.00	0.00	-310.81	0.00	3452.78	0.00
		11	0.00	0.00	218.32	0.00	-812.33	0.00
	12	19	1776.85	0.00	0.00	0.00	2.90	0.00
		11	-1215.61	0.00	0.00	0.00	-0.59	0.00
	13	19	1740.45	0.00	-4778.50	0.00	64895.22	0.00
		11	-1740.45	0.00	4778.50	0.00	-16758.62	0.00
	14	19	1468.91	1953.46	-4611.96	0.00	62612.39	28887.63
		11	-1468.91	-1953.46	4611.96	0.00	-16176.19	-9215.98
	15	19	1056.05	0.00	-2613.00	0.00	32568.52	0.00
		11	-1056.05	0.00	2613.00	0.00	-6281.36	0.00
	16	19	785.14	1470.05	-2521.61	0.00	31418.31	19093.85
		11	-785.14	-1470.05	2521.61	0.00	-6062.31	-4311.23
	17	19	1280.15	0.00	-3152.00	0.00	40727.48	0.00
		11	-1280.15	0.00	3152.00	0.00	-9004.19	0.00
	18	19	1009.28	1189.15	-3042.65	0.00	39298.32	16216.34
		11	-1009.28	-1189.15	3042.65	0.00	-8690.11	-4253.05
	19	19	5339.27	3026.67	-6728.06	0.00	91768.08	39077.06
		11	-4214.92	-2815.79	6728.06	0.00	-23982.30	-9700.22
	20	19	5335.02	0.00	-7686.16	0.00	102796.72	0.00
		11	-4210.68	0.00	7475.27	0.00	-26479.34	0.00
	21	19	3167.34	2754.48	-2856.86	0.00	35991.63	33938.62
		11	-2419.02	-2310.97	2856.86	0.00	-7260.16	-8562.53
	22	19	3424.68	0.00	-4446.37	0.00	53392.94	0.00
		11	-2676.37	0.00	4002.87	0.00	-10993.58	0.00
	23	19	5617.48	2164.54	-4611.96	0.00	62633.25	31283.52
		11	-4307.92	-2072.05	4611.96	0.00	-16190.62	-9972.81
	24	19	5885.93	0.00	-5089.31	0.00	68356.06	0.00
		11	-4576.38	0.00	4996.82	0.00	-17572.59	0.00
	25	19	3164.50	2234.94	-2521.61	0.00	31474.21	27541.64
		11	-2416.18	-1889.01	2521.61	0.00	-6114.10	-6879.03
	26	19	3424.68	0.00	-3771.59	0.00	45167.88	0.00
		11	-2676.37	0.00	3425.66	0.00	-9043.26	0.00
	27	19	4269.42	1400.24	-3042.65	0.00	39317.73	18612.23
		11	-3240.49	-1307.75	3042.65	0.00	-8704.25	-5009.88
	28	19	4537.21	0.00	-3462.81	0.00	44186.88	0.00
		11	-3508.27	0.00	3370.32	0.00	-9817.87	0.00
	29	19	6073.25	2140.33	-10191.56	0.00	137562.16	27632.69
		11	-4948.91	-1991.02	10042.26	0.00	-35677.51	-6859.62
	30	19	3679.95	1947.42	-5163.39	0.00	63192.75	23994.61
		11	-2931.63	-1633.86	4849.83	0.00	-12904.96	-6053.71
	31	19	6416.68	1530.33	-6858.80	0.00	92606.10	22117.45
		11	-5107.12	-1464.94	6793.41	0.00	-23869.91	-7050.78

********** END OF LATEST ANALYSIS RESULT **********

282. PRINT SUPPORT REACTION LIST 1 2

SUPPORT REACTIONS -UNIT POUN FEET STRUCTURE TYPE = SPACE

JOINT	LOAD	FORCE-X	FORCE-Y	FORCE-Z	MOM-X	MOM-Y	MOM Z
1	1	0.00	9927.13	0.00	-4310.22	0.00	0.00
	2	-734.21	-14.08	-19.54	-487.94	0.00	16077.71
	3	0.00	0.00	-1050.47	-24227.59	0.00	0.00
	4	0.00	1775.90	-6974.55	-304274.94	0.00	0.00
	5	-2554.90	1779.16	-6745.84	-294237.72	0.00	110516.94
	6	-3776.45	-62.75	-102.37	-2556.19	0.00	83446.99
	7	0.00	0.00	-5444.31	-126224.26	0.00	0.00
	8	0.00	1056.05	-2961.00	-126017.84	0.00	0.00
	9	-1773.85	787.14	-2863.14	-121793.51	0.00	76281.16
	10	-780.62	-14.17	-20.12	-502.50	0.00	17490.58
	11	0.00	0.00	-1110.50	-25983.59	0.00	0.00
	12	0.00	7447.23	0.00	-3230.00	0.00	0.00
	13	0.00	1740.45	-4778.50	-208244.11	0.00	0.00
	14	-1953.45	1471.99	-4619.24	-201209.58	0.00	87478.84
	15	0.00	1056.05	-2613.00	-110911.05	0.00	0.00
	16	-1470.05	786.96	-2526.29	-107181.05	0.00	63160.12
	17	0.00	1280.15	-3152.00	-135247.53	0.00	0.00
	18	-1189.15	1011.02	-3046.55	-130666.91	0.00	51869.04
	19	-4390.42	16660.72	-6794.70	-301931.88	0.00	150711.22
	20	0.00	16692.68	-9600.72	-371318.22	0.00	0.00
	21	-5550.30	10651.53	-2965.51	-128659.91	0.00	159728.14
	22	0.00	10983.19	-8405.31	-256552.31	0.00	0.00
	23	-2734.07	18832.19	-4639.36	-209252.31	0.00	104969.41
	24	0.00	19114.81	-5889.00	-241767.92	0.00	0.00
	25	-4415.68	10665.15	-2606.14	-113485.09	0.00	128248.77
	26	0.00	10983.19	-6859.56	-213676.17	0.00	0.00
	27	-1969.77	14647.60	-3066.68	-137094.64	0.00	69359.62
	28	0.00	14930.90	-4262.50	-167156.34	0.00	0.00
	29	-3105.86	17405.28	-11594.23	-473369.28	0.00	106593.03
	30	-3924.06	11185.91	-8039.17	-270560.62	0.00	112927.80
	31	-1932.99	19635.54	-7443.55	-315749.66	0.00	74213.38
2	1	0.00	9927.13	0.00	-4310.22	0.00	0.00
	2	-734.21	14.08	19.54	487.94	0.00	16077.71
	3	0.00	0.00	-1050.47	-24227.59	0.00	0.00
	4	0.00	1775.90	-6974.55	-304274.94	0.00	0.00
	5	-2554.90	1772.64	-6728.06	-293581.19	0.00	110516.96
	6	-3776.41	62.75	102.37	2556.24	0.00	83446.94
	7	0.00	0.00	-5444.31	-126224.26	0.00	0.00
	8	0.00	1056.05	-2961.00	-126017.84	0.00	0.00
	9	-1773.85	784.96	-2856.86	-121562.56	0.00	76281.16
	10	-780.62	14.17	20.12	502.50	0.00	17490.57
	11	0.00	0.00	-1110.50	-25983.59	0.00	0.00
	12	0.00	7447.23	0.00	-3230.00	0.00	0.00
	13	0.00	1740.45	-4778.50	-208244.11	0.00	0.00
	14	-1953.45	1468.91	-4611.96	-200941.12	0.00	87478.84
	15	0.00	1056.05	-2613.00	-110911.05	0.00	0.00

SUPPORT REACTIONS -UNIT POUN FEET STRUCTURE TYPE = SPACE

JOINT	LOAD	FORCE-X	FORCE-Y	FORCE-Z	MOM-X	MOM-Y	MOM Z
	16	-1470.05	785.14	-2521.61	-107008.65	0.00	63160.12
	17	0.00	1280.15	-3152.00	-135247.53	0.00	0.00
	18	-1189.15	1009.28	-3042.65	-130523.05	0.00	51869.04
	19	-4390.42	16724.63	-6679.20	-298835.66	0.00	150711.23
	20	0.00	16692.68	-9600.72	-371318.22	0.00	0.00
	21	-5550.26	10774.84	-2754.49	-123316.54	0.00	159728.09
	22	0.00	10983.19	-8405.31	-256552.31	0.00	0.00
	23	-2734.07	18857.44	-4591.84	-207978.84	0.00	104969.41
	24	0.00	19114.81	-5889.00	-241767.92	0.00	0.00
	25	-4415.65	10761.22	-2441.76	-109324.99	0.00	128248.73
	26	0.00	10983.19	-6859.56	-213676.17	0.00	0.00
	27	-1969.77	14674.20	-3022.52	-135945.75	0.00	69359.61
	28	0.00	14930.90	-4262.50	-167156.34	0.00	0.00
	29	-3105.86	17450.52	-11512.48	-471177.78	0.00	106593.04
	30	-3924.03	11273.09	-7889.98	-266782.88	0.00	112927.77
	31	-1932.99	19653.39	-7409.95	-314849.31	0.00	74213.38

********** END OF LATEST ANALYSIS RESULT **********

```
283. *PARAMETER 2
284. *CODE ASCE 1997
285. *LY 40 MEMB 1 TO 4 15 TO 18
286. *LZ 40 MEMB 1 TO 4 15 TO 18
287. *CHECK CODE MEMB 1 TO 4 15 TO 18
288. FINISH
```

********** END OF THE STAAD.Pro RUN **********

**** DATE= JAN 17,2018 TIME= 13:27:25 ****


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************************************************************
*        For questions on STAAD.Pro, please contact        *
*        Bentley Systems or Partner offices                *
*                                                          *
*            Telephone             Web / Email             *
*  USA       +1  (714) 974-2500                            *
*  UK        +44 (0) 808 101 9246                          *
*  SINGAPORE +65 6225-6158                                 *
*  FRANCE    +33 (0) 1 55238400                            *
*  GERMANY   +49 0931 40468                                *
*  INDIA     +91 (033) 4006-2021                           *
*  JAPAN     +81 (03)5952-6500    http://www.ctc-g.co.jp   *
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*  THAILAND  +66 (0)2645-1018/19 partha.p@reisoftwareth.com*
*                                                          *
*  Worldwide  http://selectservices.bentley.com/en-US/     *
*                                                          *
************************************************************
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Project #: 17.01246
Project Name: Northwest Ohio Wind Project
Item Description: 138kV Deadend
Engineer: DAW
Date: 1/24/2018

Development Length		
Bolt Projection	11	in
Bottom Plate Setback	5	in Distance from bottom plate to end of bolt.
Bolt Spacing > 6 in?	Yes	"Yes or No"
f'c	4	ksi
Γ	1.0	(for Fy and f'c in ksi)
Φ	1.0	(for Fy and f'c in ksi)
θ	1.0	(for Fy and f'c in ksi)
α	0.0	(1.0 for Fy=60ksi, 1.2 for Fy=75ksi)
β	0.8	
A_g (in^2)	3.98	
ld (in)	111.56	Max ld: (1.27*A_neb*Fy/Sqrt(f'c) or 0.4dFy)
$Ld_{(min)}$ (in)	56.25	*Min development length is $25d_{bolt}$

	Loads: 19	Loads: 20	Loads: 29	Loads: 21	Loads: 22	Loads: 30	Loads: 23	Loads: 24	Loads: 31
$A_{s(req)}$ (in^2)	1.70	1.39	2.20	1.08	0.98	1.47	1.15	0.87	1.44
$\gamma = A_{s(req)}/A_g$	0.43	0.35	0.55	0.27	0.25	0.37	0.29	0.22	0.36
Ld (in)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Development Length (in)	56.25	56.25	56.25	56.25	56.25	56.25	56.25	56.25	56.25
Bolt Length (ft)	6.02	6.02	6.02	6.02	6.02	6.02	6.02	6.02	6.02

*Ld = ldαβγ

*Development Length = Max of Ld and $Ld_{(min)}$

*Bolt Length = Max Ld+Projection+Bottom Plate Setback

* ASCE/SEI 48-11 ch. 9 and ch. 9 commentary were referenced for bolt length design.

Project #:	17.01246
Project Name:	Northwest Ohio Wind Project
Item Description:	138kV Deadend
Engineer:	DAW
Date:	1/24/2018

Tube Shapes	Selection
Circular	0
Dodecagonal	0
Octagonal	1
Hexagonal	0

*Note: Select the tube shape by inputing a 1 for the selected shape and a 0 for other shapes.

Properties	Value	Unit	
Tube Wall Thickness	0.375	in	
Fillet Weld Thickness	0.25	in	*Note: A reinforcing fillet weld is required. Per ASCE/SEI 48-11 6.3.5.
Outside Diameter, Do	32	in	*Note: (Do) is measured across flats.
Mean Diameter, D	31.63	in	
Gross Area, Ag	57.93	in^2	
Section Modulus, S	477.74	in^3	

Weld Strength, fw (ksi)	70	*Note: Weld material shall be E70XX electrodes.
Parallel Stress, fup (ksi)	50	*Note: Tensile design stress is the same as the base metal per ASCE/SEI 48-11 Table 6-3
Shear Stress, fuv (ksi)	35	*Note: Shear design stress is 0.5x the tensile strength of weld metal per ASCE/SEI 48-11 Table 6-3

	Loads: 19	Loads: 20	Loads: 29	Loads: 21	Loads: 22	Loads: 30	Loads: 23	Loads: 24	Loads: 31
Parallel Stress, fp (ksi)	7.59	9.40	11.95	3.24	6.60	6.91	5.27	6.11	7.96
Utilization	0.15	0.19	0.24	0.06	0.13	0.14	0.11	0.12	0.16
Utilization < 1.0?	YES	YES	YES	YES	YES	YES	YES	YES	YES
Shear Stress, fv (ksi)	0.14	0.17	0.21	0.11	0.15	0.16	0.09	0.10	0.13
Utilization	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00
Utilization < 1.0?	YES	YES	YES	YES	YES	YES	YES	YES	YES
Combined Utilization	0.15	0.19	0.24	0.06	0.13	0.14	0.11	0.12	0.16
Combined Utilization < 1.0?	YES	YES	YES	YES	YES	YES	YES	YES	YES

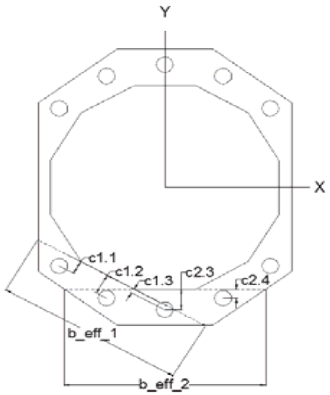
Use a COMPLETE JOINT PENETRATION WELD for all base plate and flange plate to tube connections per ASCE/SEI 48-11 6.3.5.

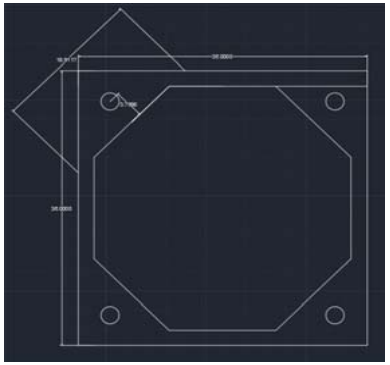
Project #:	17.01246
Project Name:	Northwest Ohio Wind Project
Item Description:	138kV Deadend
Engineer:	DAW
Date:	1/24/2018

Design Plate Thick. (in)	Yield Stress (ksi)
2.25	50

Bolt	Loads: 19	Loads: 20	Loads: 29	Loads: 21	Loads: 22	Loads: 30	Loads: 23	Loads: 24	Loads: 31
B1	36.78	84.88	83.90	4.04	59.39	37.72	27.20	57.18	57.18
B2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B5	101.79	84.88	129.88	64.86	59.39	86.43	72.48	57.18	89.20

Bolt Location	Dist. (in)
c1.1	0
c1.2	0
c1.3	0
c1.4	0
c1.5	3.8
c2.1	0
c2.2	0
c2.3	0
c2.4	0
c2.5	0
c3.1	0
c3.2	0
c3.3	0
c3.4	0
c3.5	0





*Note: Draw out the base plate to scale and measure the dimensions required per the bolt layout.

*Note: As an example of the bolt location naming convention; c1.1 corresponds to bend line 1 bolt 1, c2.3 corresponds to bend line 2, bolt 3.

Bend Line (BL)	Length (in)
b_eff_1	36
b_eff_2	18.91
b_eff_3	13

*Note: Draw out the base plate to scale and measure the dimensions required per the bolt layout.

	Loads: 19	Loads: 20	Loads: 29	Loads: 21	Loads: 22	Loads: 30	Loads: 23	Loads: 24	Loads: 31
BL1_Min. Thickness (in)	1.14	1.04	1.28	0.91	0.87	1.05	0.96	0.85	1.06
BL2_Min. Thickness (in)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BL3_Min. Thickness (in)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Actual Thickness (in)	2.25	2.25	2.25	2.25	2.25	2.25	2.25	2.25	2.25
Actual > Min. ?	YES	YES	YES	YES	YES	YES	YES	YES	YES

* ASCE/SEI 48-11 Appendix VI was referenced for base plate thickness design.

Project #: 17.01246
Project Name: Northwest Ohio Wind Project
Item Description: 138kV Deadend
Engineer: DAW
Date: 1/24/2018

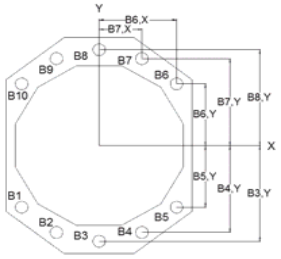
Bolt Diameter (in)	Total # Bolts	Bolt Circle (in)	Clear (Leveling, in)	F1554-55 GR.
2.25	4	39.60	4	55

Strength Reduction Factors					
Tensile	Shear	Fy (ksi)	Fu (ksi)	η	E_s min (d_p)
0.75	0.35	55	178.75	4.5	2.11

A_neb (in^2)	Total Area	I_bcy (in^3)	I_bcx (in^3)
3.19	12.78	2472.16	2472.16

Forces (kip, Kip-in)	Loads: 19	Loads: 20	Loads: 29	Loads: 21	Loads: 22	Loads: 30	Loads: 23	Loads: 24	Loads: 31
Fx	4.39	0	3.106	5.55	0	3.924	2.734	0	1.933
Fy	16.661	16.693	17.405	10.652	10.983	11.186	18.832	19.115	19.636
FZ	6.795	9.721	11.68	2.966	8.658	8.218	4.639	5.939	7.479
Mx	3623.18	4490.68	5705.11	1543.92	3151.56	3298.30	2511.02	2915.57	3799.15
My	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MZ	1808.53	0.00	1279.12	1916.74	0.00	1355.14	1259.63	0.00	890.56

Bolt Dimensions (in)			
B1,X	-13.91	B1,Y	13.91
B2,X	0	B2,Y	0
B3,X	0	B3,Y	0
B4,X	0	B4,Y	0
B5,X	13.91	B5,Y	13.91
B6,X	13.91	B6,Y	-13.91
B7,X	0	B7,Y	0
B8,X	0	B8,Y	0
B9,X	0	B9,Y	0
B10,X	-13.91	B10,Y	-13.91



Bolt Load (kip)	Loads: 19	Loads: 20	Loads: 29	Loads: 21	Loads: 22	Loads: 30	Loads: 23	Loads: 24	Loads: 31
B1	36.78	84.88	83.90	-4.04	59.39	37.72	27.20	57.18	57.18
B2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B5	101.79	84.88	129.88	64.86	59.39	86.43	72.48	57.18	89.20
B6	-28.45	-76.54	-75.20	9.36	-53.90	-32.13	-17.78	-47.62	-47.37
B7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B10	-93.46	-76.54	-121.17	-59.53	-53.90	-80.84	-63.06	-47.62	-79.38

	Loads: 19	Loads: 20	Loads: 29	Loads: 21	Loads: 22	Loads: 30	Loads: 23	Loads: 24	Loads: 31
Shear Capacity (kip)	199.84	199.84	199.84	199.84	199.84	199.84	199.84	199.84	199.84
Bolt Shear (kip)	2.80	2.43	3.70	2.13	2.16	3.04	1.84	1.48	2.35
Utilization	0.01	0.01	0.02	0.01	0.01	0.02	0.01	0.01	0.01
Utilization < 1.0?	YES	YES	YES	YES	YES	YES	YES	YES	YES
Tensile Capacity (kip)	-428.22	-428.22	-428.22	-428.22	-428.22	-428.22	-428.22	-428.22	-428.22
Max Tension (kip)	-93.46	-76.54	-121.17	-59.53	-53.90	-80.84	-63.06	-47.62	-79.38
Utilization	0.22	0.18	0.28	0.14	0.13	0.19	0.15	0.11	0.19
Utilization < 1.0?	YES	YES	YES	YES	YES	YES	YES	YES	YES
Combined Utilization	0.05	0.03	0.08	0.02	0.02	0.04	0.02	0.01	0.03
Utilization < 1.0?	YES	YES	YES	YES	YES	YES	YES	YES	YES

* ASCE/SEI 48-11 ch. 6 and ch. 6 commentary were referenced for bolt design.

Project #:	17.01246
Project Name:	Northwest Ohio Wind Project
Item Description:	138kV Deadend
Engineer:	DAW
Date:	1/24/2018

Tube Shapes	Selection
Circular	0
Dodecagonal	0
Octagonal	1
Hexagonal	0

*Note: Select the tube shape by inputing a 1 for the selected shape and a 0 for other shapes.

Properties	Value	Unit	
Tube Wall Thickness	0.375	in	
Fillet Weld Thickness	0.25	in	*Note: A reinforcing fillet weld is required. Per ASCE/SEI 48-11 6.3.5.
Outside Diameter, Do	22	in	*Note: (Do) is measured across flats.
Mean Diameter, D	21.63	in	
Gross Area, Ag	39.61	in^2	
Section Modulus, S	222.17	in^3	

Weld Strength, fw (ksi)	70	*Note: Weld material shall be E70XX electrodes.
Parallel Stress, fup (ksi)	50	*Note: Tensile design stress is the same as the base metal per ASCE/SEI 48-11 Table 6-3
Shear Stress, fuv (ksi)	35	*Note: Shear design stress is 0.5x the tensile strength of weld metal per ASCE/SEI 48-11 Table 6-3

	Loads: 19	Loads: 20	Loads: 29	Loads: 21	Loads: 22	Loads: 30	Loads: 23	Loads: 24	Loads: 31
Parallel Stress, fp (ksi)	2.13	7.95	10.48	2.88	4.43	5.10	4.91	5.38	7.16
Utilization	0.04	0.16	0.21	0.06	0.09	0.10	0.10	0.11	0.14
Utilization < 1.0?	YES	YES	YES	YES	YES	YES	YES	YES	YES
Shear Stress, fv (ksi)	0.21	0.23	0.29	0.12	0.15	0.17	0.15	0.16	0.21
Utilization	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.01
Utilization < 1.0?	YES	YES	YES	YES	YES	YES	YES	YES	YES
Combined Utilization	0.04	0.16	0.21	0.06	0.09	0.10	0.10	0.11	0.14
Combined Utilization < 1.0?	YES	YES	YES	YES	YES	YES	YES	YES	YES

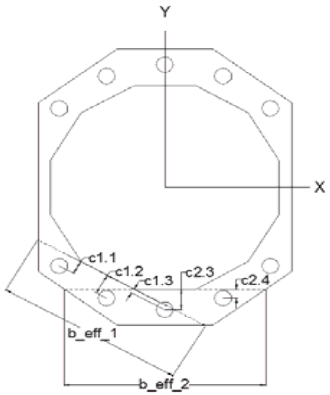
Use a COMPLETE JOINT PENETRATION WELD for all base plate and flange plate to tube connections per ASCE/SEI 48-11 6.3.5.

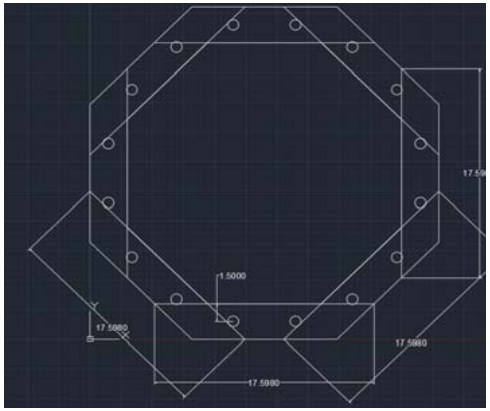
Project #:	17.01246
Project Name:	Northwest Ohio Wind Project
Item Description:	138kV Deadend
Engineer:	DAW
Date:	1/24/2018

Design Plate Thick. (in)	Yield Stress (ksi)
2.25	50

Bolt	Loads: 19	Loads: 20	Loads: 29	Loads: 21	Loads: 22	Loads: 30	Loads: 23	Loads: 24	Loads: 31
B1	22.38	5.77	14.07	10.05	3.17	9.40	10.26	3.69	9.95
B2	13.76	17.17	17.36	0.77	9.52	6.14	4.50	11.40	11.16
B3	6.62	26.07	34.49	9.33	14.48	16.71	15.87	17.42	23.33
B4	12.11	30.75	41.93	12.64	17.09	20.86	20.14	20.59	28.52
B5	3.64	30.75	39.40	9.41	17.09	18.57	17.38	20.59	26.56

Bolt Location	Dist. (in)
c1.1	1.5
c1.2	1.5
c1.3	0
c1.4	0
c1.5	0
c2.1	1.5
c2.2	1.5
c2.3	0
c2.4	0
c2.5	0
c3.1	1.5
c3.2	1.5
c3.3	0
c3.4	0
c3.5	0
c4.1	1.5
c4.2	1.5
c4.3	0
c4.4	0
c4.5	0





*Note: Draw out the base plate to scale and measure the dimensions required per the bolt layout.
*Note: As an example of the bolt location naming convention; c1.1 corresponds to bend line 1 bolt 1, c2.3 corresponds to bend line 2, bolt 3.

Bend Line (BL)	Length (in)
b_eff_1	17.598
b_eff_2	17.598
b_eff_3	17.598
b_eff_4	17.598

*Note: Draw out the base plate to scale and measure the dimensions required per the bolt layout.

	Loads: 19	Loads: 20	Loads: 29	Loads: 21	Loads: 22	Loads: 30	Loads: 23	Loads: 24	Loads: 31
BL1_Min. Thickness (in)	0.61	0.48	0.57	0.33	0.36	0.40	0.39	0.39	0.46
BL2_Min. Thickness (in)	0.61	0.48	0.57	0.33	0.36	0.40	0.39	0.39	0.46
BL3_Min. Thickness (in)	0.61	0.48	0.57	0.33	0.36	0.40	0.39	0.39	0.46
BL4_Min. Thickness (in)	0.61	0.48	0.57	0.33	0.36	0.40	0.39	0.39	0.46
Actual Thickness (in)	2.25	2.25	2.25	2.25	2.25	2.25	2.25	2.25	2.25

Actual > Min. ?	YES	YES	YES	YES	YES	YES	YES	YES	YES

* ASCE/SEI 48-11 Appendix VI was referenced for base plate thickness design.

Project #: 17.01246
Project Name: Northwest Ohio Wind Project
Item Description: 138kV Deadend
Engineer: DAW
Date: 1/24/2018

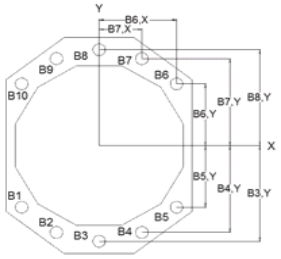
Bolt Diameter (in)	Total # Bolts	Bolt Circle (in)	Clear (Leveling, in)	A324
0.75	16	25.52	0	90

Strength Reduction Factors					
Tensile	Shear	Fy (ksi)	Fu (ksi)	η	E_s min (d_p)
0.75	0.35	90	292.5	6	0.64

A_neb (in^2)	Total Area	I_bcy (in^3)	I_bcx (in^3)
0.92	14.77	848.89	652.28

Forces (kip, Kip-in)	Loads: 19	Loads: 20	Loads: 29	Loads: 21	Loads: 22	Loads: 30	Loads: 23	Loads: 24	Loads: 31
Fx	3.274	0	2.315	3.273	0	2.314	2.269	0	1.604
Fy	7.552	7.557	8.289	4.621	4.903	5.141	8.202	8.474	9.002
FZ	7.659	8.978	11.396	3.506	5.886	6.395	5.665	6.295	8.027
Mx	471.96	1765.14	2328.23	639.47	983.47	1132.80	1089.61	1193.95	1588.91
My	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MZ	1558.81	0.00	467.00	594.41	0.00	420.24	509.06	0.00	359.90

Bolt Dimensions (in)			
B1,X	-12.5	B1,Y	-2.5
B2,X	-10.625	B2,Y	-7.0625
B3,X	-7.0625	B3,Y	-10.625
B4,X	-2.5	B4,Y	-12.5
B5,X	2.5	B5,Y	-12.5
B6,X	7.0625	B6,Y	-10.625
B7,X	10.625	B7,Y	-7.0625
B8,X	12.5	B8,Y	-2.5
B9,X	12.5	B9,Y	2.5
B10,X	10.625	B10,Y	7.0625
B11,X	7.0625	B11,Y	10.625
B12,X	2.5	B12,Y	12.5
B13,X	-2.5	B13,Y	12.5
B14,X	-7.0625	B14,Y	10.625
B15,X	-10.625	B15,Y	7.0625
B16,X	-12.5	B16,Y	2.5



Bolt Load (kip)	Loads: 19	Loads: 20	Loads: 29	Loads: 21	Loads: 22	Loads: 30	Loads: 23	Loads: 24	Loads: 31
B1	-22.38	-5.77	-14.07	-10.05	-3.17	-9.40	-10.26	-3.69	-9.95
B2	13.76	-17.17	-17.36	0.77	-9.52	-6.14	-4.50	-11.40	-11.16
B3	-6.62	-26.07	-34.49	-9.33	-14.48	-16.71	-15.87	-17.42	-23.33
B4	-12.11	-30.75	-41.93	-12.64	-17.09	-20.86	-20.14	-20.59	-28.52
B5	-3.64	-30.75	-39.40	-9.41	-17.09	-18.57	-17.38	-20.59	-26.56
B6	5.35	-26.07	-30.90	-4.76	-14.48	-13.48	-11.96	-17.42	-20.56
B7	13.76	-17.17	-17.36	0.77	-9.52	-6.14	-4.50	-11.40	-11.16
B8	19.99	-5.77	-1.37	6.11	-3.17	2.03	3.58	-3.69	-0.17
B9	23.33	6.72	15.10	10.63	3.79	10.04	11.29	4.75	11.08
B10	23.20	18.11	29.18	13.55	10.14	16.50	17.28	12.46	20.60
B11	19.54	27.01	39.11	14.47	15.09	20.58	20.80	18.48	27.22
B12	13.06	31.70	42.97	13.22	17.70	21.50	21.17	21.65	29.65
B13	4.58	31.70	40.43	9.98	17.70	19.22	18.40	21.65	27.69
B14	-4.40	27.01	31.94	5.34	15.09	14.13	12.99	18.48	21.69
B15	-12.82	18.11	18.39	-0.19	10.14	6.79	5.52	12.46	12.28
B16	-19.05	6.72	2.41	-5.53	3.79	-1.38	-2.55	4.75	1.29

	Loads: 19	Loads: 20	Loads: 29	Loads: 21	Loads: 22	Loads: 30	Loads: 23	Loads: 24	Loads: 31
Shear Capacity (kip)	94.50	94.50	94.50	94.50	94.50	94.50	94.50	94.50	94.50
Bolt Shear (kip)	0.68	0.56	0.86	0.42	0.37	0.54	0.50	0.39	0.60

Utilization	0.01	0.01	0.01	0.00	0.00	0.01	0.01	0.00	0.01
Utilization < 1.0?	YES	YES	YES	YES	YES	YES	YES	YES	YES
Tensile Capacity (kip)	-202.49	-202.49	-202.49	-202.49	-202.49	-202.49	-202.49	-202.49	-202.49
Max Tension (kip)	-22.38	-30.75	-41.93	-12.64	-17.09	-20.86	-20.14	-20.59	-28.52
Utilization	0.11	0.15	0.21	0.06	0.08	0.10	0.10	0.10	0.14
Utilization < 1.0?	YES	YES	YES	YES	YES	YES	YES	YES	YES
Combined Utilization	0.01	0.02	0.04	0.00	0.01	0.01	0.01	0.01	0.02
Utilization < 1.0?	YES	YES	YES	YES	YES	YES	YES	YES	YES

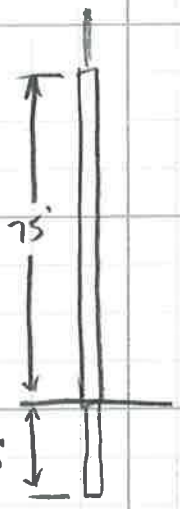
* ASCE/SEI 48-11 ch. 6 and ch. 6 commentary were referenced for bolt design

Project Name _____ Project Number _____

Name MAST Date _____

Sheet 1 of _____

MAST



FROM STAAD, MAX STRESS F_b = 13.2ksi @GROUNDLINE

ALLOWABLE BENDING STRESS:

F_y = 50ksi, 12 SIDED, 33"AF @ GROUNDLINE, 1/4" PLATE

$w = 0.268(D - t - 2BR)$

$w = 8.174"$

D = 33" - 1/4 = 32.75"

t = 1/4"

BR = 4t = 1"

$\frac{w}{t} = \frac{8.174"}{0.25"} = 32.696"$

$\frac{240\sqrt{2}}{\sqrt{F_y}} = \frac{240(1)}{\sqrt{50}} = 33.941$

$\frac{w}{t} \leq \frac{240\sqrt{2}}{\sqrt{F_y}}$ $\therefore F_a = F_y$

F_a = 50ksi is MUCH GREATER THAN f_b = 13.2 ksi

$\therefore$ 12 SIDED TUBE, 1/4" ok.

Project # :
Project Title:
Item: Embedded Shield Pole

Ulteig Engineers

GRE Load Cases

By: JMJ
Date: 1/22/2016
Checked:

Load from Wind on Member

Load Case Constants:

	NESC	High Wind
Wind (psf):	4	21
Ice (in):	0.5	0
C_d (drag):	1	1

Load on Member (lbs/ft):

Width (in)	NESC	NESC 45°	High Wind	High Wind 45°
2	1.0	0.7	3.5	2.5
3	1.3	0.9	5.3	3.7
4	1.7	1.2	7.0	4.9
5	2.0	1.4	8.8	6.2
6	2.3	1.6	10.5	7.4
7	2.7	1.9	12.3	8.7
8	3.0	2.1	14.0	9.9
9	3.3	2.4	15.8	11.1
10	3.7	2.6	17.5	12.4
11	4.0	2.8	19.3	13.6
12	4.3	3.1	21.0	14.8
13	4.7	3.3	22.8	16.1
14	5.0	3.5	24.5	17.3
15	5.3	3.8	26.3	18.6
16	5.7	4.0	28.0	19.8
17	6.0	4.2	29.8	21.0
18	6.3	4.5	31.5	22.3
19	6.7	4.7	33.3	23.5
20	7.0	4.9	35.0	24.7
21	7.3	5.2	36.8	26.0
22	7.7	5.4	38.5	27.2
23	8.0	5.7	40.3	28.5
24	8.3	5.9	42.0	29.7
25	8.7	6.1	43.8	30.9
26	9.0	6.4	45.5	32.2
27	9.3	6.6	47.3	33.4
28	9.7	6.8	49.0	34.6
29	10.0	7.1	50.8	35.9
30	10.3	7.3	52.5	37.1
31	10.7	7.5	54.3	38.4
32	11.0	7.8	56.0	39.6
33	11.3	8.0	57.8	40.8
34	11.7	8.2	59.5	42.1
35	12.0	8.5	61.3	43.3

Project # :
Project Title:
Item: Embedded Shield Pole

Ulteig Engineers

GRE Load Cases

By: JMJ
Date: 1/22/2016
Checked: _____

Load from Conductor or Shield Wire

Wire Specifications:

Wire Type:	3/8 SW
Diameter (in):	0.36
Weight (lbs/ft):	0.273
Span (ft):	200
Max Angle (^{o}):	0
Pull-Off Ht. (ft):	75
k_z (wire):	1.2
G_{RF} (wire):	0.86
Bell Insulators:	0

k_z Wire Value	G_{RF} Wire Value	Pull-Off Ht (ft):
1.00	0.93	0 - 33
1.10	0.88	33 - 50
1.20	0.86	50 - 80
1.30	0.83	80 - 115

*Assumes each bell is 12 lbs and 10" diameter.

SAG10 Output Tensions:

NESC (lbs):	1500
Wind (lbs):	841

Load Case Constants:

	NESC	High Wind
Wind (psf):	4	21.40
Ice (in):	0.5	0

Wind Longitudinal to Wire (parallel):

	NESC	High Wind
Pull-Off (^{o}):	0	0
Vertical (lbs):	80.8	27.3
Horiz. (lbs):	0.0	0.0
Tension (lbs):	1500.0	841.0

Wind Transverse to Wire (perpendicular):

	NESC	High Wind
Pull-Off (^{o}):	0	0
Vertical (lbs):	80.8	27.3
Horiz. (lbs):	45.3	64.2
Tension (lbs):	1500.0	841.0

Wind 45 Degrees to Wire (45^o):

	NESC	High Wind
Pull-Off (^{o}):	0	0
Vertical (lbs):	80.8	27.3
Horiz. (lbs):	32.1	45.4
Tension (lbs):	1500.0	841.0

Notes:

Vertical = {wire wt. + $(\pi/4)[(\text{ice dia.}/12)^2 - (\text{dia.}/12)^2](\delta_{ice})$}(half span)

Horizontal = (sag tension)sin (pull-off angle) + (wind pressure)(ice dia./12)(half span)

Horizontal with 45^o wind= (sag tension)sin (pull-off angle) + (wind pressure)(ice dia./12)(half span)sin 45

Tension = (sag tension)cos (pull-off angle)

High Wind Pressure = .00256 x G_{RF} x k_z x 90^2

```
            **************************************************
            *                                                *
            *           STAAD.Pro                            *
            *           Version  2007    Build 02            *
            *           Proprietary Program of               *
            *           Research Engineers,  Intl.           *
            *           Date=    SEP 30, 2008                *
            *           Time=    12:51:25                    *
            *                                                *
            *      USER ID:                                  *
            **************************************************
```

```
     1. STAAD SPACE
INPUT FILE: EmbedShieldPole.STD
     2. START JOB INFORMATION
     3. ENGINEER DATE 30-SEP-08
     4. JOB NAME
     5. JOB CLIENT
     6. JOB NO
     7. JOB PART EMBEDDED SHIELD POLE
     8. ENGINEER NAME JMJ
     9. END JOB INFORMATION
    10. INPUT WIDTH 79
    11. UNIT FEET POUND
    12. JOINT COORDINATES
    13. 1 0 0 0; 2 0 17 0; 3 0 46 0; 4 0 75 0
    14. MEMBER INCIDENCES
    15. 1 1 2; 2 2 3; 3 3 4
    16. DEFINE MATERIAL START
    17. ISOTROPIC STEEL
    18. E 4.176E+009
    19. POISSON 0.3
    20. DENSITY 489.024
    21. ALPHA 6.5E-006
    22. DAMP 0.03
    23. END DEFINE MATERIAL
    24. MEMBER PROPERTY AMERICAN
    25. 1 PRIS DOD STA 2.75 END 2.5 THI 0.020833
    26. 2 PRIS DOD STA 2.5 END 2 THI 0.020833
    27. 3 PRIS DOD STA 2 END 1.5 THI 0.020833
    28. CONSTANTS
    29. MATERIAL STEEL ALL
    30. SUPPORTS
    31. 1 FIXED
    32. LOAD 1 LOADTYPE NONE  TITLE NESC HEAVY 1/2" ICE 40 MPH WIND
    33. SELFWEIGHT Y -1.5
    34. JOINT LOAD
    35. 4 FX 3000 FY -162
    36. MEMBER LOAD
    37. 1 LIN Y -11.7 -10.3
    38. 2 LIN Y -10.3 -8.3
    39. 3 LIN Y -8.3 -6.3
    40. LOAD 2 LOADTYPE NONE  TITLE HIGH WIND 90 MPH WIND
```

```
41. SELFWEIGHT Y -1
42. JOINT LOAD
43. 4 FX 1682 FY -54
44. MEMBER LOAD
45. 1 LIN Y -59.5 -52.5
46. 2 LIN Y -52.5 -42
47. 3 LIN Y -42 -31.5
48. PDELTA ANALYSIS
```

P R O B L E M S T A T I S T I C S

NUMBER OF JOINTS/MEMBER+ELEMENTS/SUPPORTS = 4/ 3/ 1

SOLVER USED IS THE OUT-OF-CORE BASIC SOLVER

ORIGINAL/FINAL BAND-WIDTH= 1/ 1/ 12 DOF
TOTAL PRIMARY LOAD CASES = 2, TOTAL DEGREES OF FREEDOM = 18
SIZE OF STIFFNESS MATRIX = 1 DOUBLE KILO-WORDS
REQRD/AVAIL. DISK SPACE = 12.0/ 123302.0 MB

++ Adjusting Displacements 12:51:25

```
49. UNIT INCHES KIP
50. PRINT MEMBER STRESSES LIST 1 TO 3
```

MEMBER STRESSES

ALL UNITS ARE KIP /SQ INCH

MEMB	LD	SECT	AXIAL	BEND-Y	BEND-Z	COMBINED	SHEAR-Y	SHEAR-Z
1	1	.0	0.3 C	0.0	13.7	14.0	0.3	0.0
		1.00	0.2 C	0.0	12.6	12.8	0.3	0.0
	2	.0	0.2 C	0.0	13.3	13.5	0.4	0.0
		1.00	0.2 C	0.0	10.9	11.0	0.4	0.0
2	1	.0	0.2 C	0.0	12.6	12.8	0.3	0.0
		1.00	0.1 C	0.0	9.5	9.6	0.3	0.0
	2	.0	0.2 C	0.0	10.9	11.0	0.4	0.0
		1.00	0.1 C	0.0	6.7	6.8	0.3	0.0
3	1	.0	0.1 C	0.0	9.5	9.6	0.3	0.0
		1.00	0.0 C	0.0	0.0	0.0	0.4	0.0
	2	.0	0.1 C	0.0	6.7	6.8	0.3	0.0
		1.00	0.0 C	0.0	0.0	0.0	0.2	0.0

********** END OF LATEST ANALYSIS RESULT **********

51. UNIT FEET POUND
52. PRINT JOINT DISPLACEMENTS LIST 4

JOINT DISPLACEMENT (INCH RADIANS) STRUCTURE TYPE = SPACE

JOINT	LOAD	X-TRANS	Y-TRANS	Z-TRANS	X-ROTAN	Y-ROTAN	Z-ROTAN
4	1	11.29195	-0.00515	0.00000	0.00000	0.00000	-0.02223
	2	9.36242	-0.00335	0.00000	0.00000	0.00000	-0.01735

********** END OF LATEST ANALYSIS RESULT **********

53. PRINT MEMBER FORCES LIST 1 TO 3

MEMBER END FORCES STRUCTURE TYPE = SPACE

ALL UNITS ARE -- POUN FEET (LOCAL)

MEMBER	LOAD	JT	AXIAL	SHEAR-Y	SHEAR-Z	TORSION	MOM-Y	MOM-Z
1	1	1	7989.03	3688.52	0.00	0.00	0.00	250052.06
		2	-5810.58	-3501.52	0.00	0.00	0.00	-188970.39
	2	1	5272.02	5082.41	0.00	0.00	0.00	241613.69
		2	-3819.72	-4130.41	0.00	0.00	0.00	-163473.31
2	1	2	5810.58	3527.35	0.00	0.00	0.00	188970.39
		3	-2629.54	-3257.65	0.00	0.00	0.00	-90728.16
	2	2	3819.72	4144.14	0.00	0.00	0.00	163473.31
		3	-1699.03	-2773.89	0.00	0.00	0.00	-63897.81
3	1	3	2629.54	3239.24	0.00	0.00	0.00	90728.16
		4	-162.00	-3027.54	0.00	0.00	0.00	0.00
	2	3	1699.03	2761.62	0.00	0.00	0.00	63897.81
		4	-54.00	-1695.87	0.00	0.00	0.00	0.00

********** END OF LATEST ANALYSIS RESULT **********

54. PRINT SUPPORT REACTION LIST 1

SUPPORT REACTIONS -UNIT POUN FEET STRUCTURE TYPE = SPACE

JOINT	LOAD	FORCE-X	FORCE-Y	FORCE-Z	MOM-X	MOM-Y	MOM Z
1	1	-3668.40	7989.03	0.00	0.00	0.00	250052.06
	2	-5070.00	5272.02	0.00	0.00	0.00	241613.69

********** END OF LATEST ANALYSIS RESULT **********

55. FINISH

********** END OF THE STAAD.Pro RUN **********

**** DATE= SEP 30,2008 TIME= 12:51:25 ****

```
*************************************************************
*         For questions on STAAD.Pro, please contact        *
*   Research Engineers Offices at the following locations   *
*                                                           *
*               Telephone               Email               *
*  USA:      +1 (714)974-2500       support@bentley.com      *
*  CANADA    +1 (905)632-4771       detech@odandetech.com    *
*  UK        +44(1454)207-000       support@reel.co.uk       *
*  FRANCE    +33(0)1 64551084       support@reel.co.uk       *
*  GERMANY   +49/931/40468-71       info@reig.de             *
*  NORWAY    +47 67 57 21 30        staad@edr.no             *
*  SINGAPORE +65 6225-6158          support@bentley.com      *
*  INDIA     +91(033)4006-2021      support@bentley.com      *
*  JAPAN     +81(03)5952-6500       eng-eye@crc.co.jp        *
*  CHINA     +86(411)363-1983       support@bentley.com      *
*  THAILAND  +66(0)2645-1018/19     support@bentley.com      *
*                                                           *
*  North America                   support@bentley.com      *
*  Europe                          support@bentley.com      *
*  Asia                            support@bentley.com      *
*************************************************************
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Dodecagonal Pole

Splice Plate Design

Page_____

Project:

Structure Type: Embedded Shield Pole

Job Number:

Input (Dodecagonal)

Total Height =	75	ft.
Pole Size @ Splice =	30	in.
Pole Plate Thickness =	0.25	in.
Pole Plate Fy =	50	ksi
Splice Plate Fy =	50	ksi
Mx (kip.*ft.) =	0	
Mz (kip.*ft.) =	312	
Axial Tension (kips.) =	0	
Torque (kip.*ft.) =	0	
Shear x (kips) =	5.8	
Shear z (kips) =	0	
# of Bolt's per face*	2	
# of faces w/ AB's (8 or 12)	12	
K=	1	
Gage=	4	in.
Bolt Size =	**0.750**	in.

V=	0.242	kips
Area=	0.442	$in.^2$
Ft=	29.821	kips
a=	31.500	in.
b=	29.289	in.
c=	23.250	in.
d=	15	in.
Mcap(8BF)=	474.6	k.-ft.
Mcap(12BF)=	707.5	k.-ft.

Output

Plate Size =	35.5	in.	**Bolt Size =**	0.75	in.
Thickness =	1.00	in.	**Bolt Type**	**Unity**	
Dist. to Tube =	1.500	in.	A325	0.441	
Dist. to Edge =	1.250	in.	Bending Width=	4.0625	in.
Plate Fy =	50.0	ksi	**Recommended Gage**	4.06	in.
Weld Req'd	5.0	(*1/16th)	OK		

Plate Stresses Calculated For Weld Desig

K=	2.1	Weld Force =	5.146		
E=	29000	Weld t =	3.70		
P*	3			P=	0
				Vx=	5.8
Area =	24.2	Fa=	50.0	Vz=	0
I =	2705.5	Fa(comp)=	26.79	T=	0
S =	181.9	Fe=	26.93	Mx=	0
S2=	673.00	Ft=	45	Mz=	312
J =	5291.5			Vy&z=	5.800
Width=	8.0	Kl/r=	103.10	C_{my}=	1.000
w/t=	31.9	Cc=	107.00	C_{mz}=	1.000
Q/It=	0.08413			fa=	0.000
C/J=	0.00279			fby=	0.000
				fbz=	20.585
				UNITY	**0.412**
				COMBO	**20.602**

Reaction	P (kips)	Vx (kips)	Vz (kips)	Torq. (k-ft.)	Mx (k-ft.)	Mz (k-ft.)
Load Case 1	8.7	5.8	0	0	0	312

Dodecagonal Pole

Splice Plate Design

Page_____

Project:

Structure Type: Embedded Shield Pole

Job Number:

Input (Dodecagonal)

Total Height =	75	ft.
Pole Size @ Splice =	24	in.
Pole Plate Thickness =	0.25	in.
Pole Plate Fy =	50	ksi
Splice Plate Fy =	50	ksi
Mx (kip.*ft.) =	0	
Mz (kip.*ft.) =	150	
Axial Tension (kips.) =	0	
Torque (kip.*ft.) =	0	
Shear x (kips) =	5.3	
Shear z (kips) =	0	
# of Bolt's per face*	2	
# of faces w/ AB's (8 or 12)	12	
K=	1	
Gage=	3.25	in.
Bolt Size =	**0.750**	in.

V=	0.221	kips
Area=	0.442	$in.^2$
Ft=	29.821	kips
a=	25.500	in.
b=	23.691	in.
c=	18.750	in.
d=	12	in.
Mcap(8BF)=	383.0	k.-ft.
Mcap(12BF)=	570.2	k.-ft.

Output

Plate Size =	29.5	in.	**Bolt Size =**	0.75	in.
Thickness =	0.75	in.	**Bolt Type**	**Unity**	
Dist. to Tube =	1.500	in.	A325	0.263	
Dist. to Edge =	1.250	in.	Bending Width=	3.6875	in.
Plate Fy =	50.0	ksi	**Recommended Gage**	3.25	in.
Weld Req'd	5.0	(*1/16th)	OK		

Plate Stresses Calculated For Weld Desig

K=	2.1	Weld Force =	3.882		
E=	29000	Weld t =	2.79		
P*	3			P=	0
				Vx=	5.3
Area =	19.3	Fa=	50.0	Vz=	0
I =	1376.5	Fa(comp)=	17.13	T=	0
S =	115.9	Fe=	17.13	Mx=	0
S2=	428.01	Ft=	45	Mz=	150
J =	2692.2			Vy&z=	5.300
Width=	6.4	Kl/r=	129.28	Cmy=	1.000
w/t=	25.5	Cc=	107.00	Cmz=	1.000
Q/It=	0.10517			fa=	0.000
C/J=	0.00436			fby=	0.000
				fbz=	15.529
				UNITY	**0.311**
				COMBO	**15.559**

Reaction	P (kips)	Vx (kips)	Vz (kips)	Torq. (k-ft.)	Mx (k-ft.)	Mz (k-ft.)
Load Case 1	3.9	5.3	0	0	0	150

****
*
* CAISSON - Pier Foundations Analysis and Design - Copyright Power Line Systems, Inc. 1993-2010 *
*
****

Project Title:
Project Notes: Direct Embed Shield Mast

Calculation Method: Full 8CD

******* I N P U T D A T A

Pier Properties

Diameter (ft)	Distance of Top of Pier above Ground (ft)	Concrete Strength (ksi)	Steel Yield Strength (ksi)
2.75	0.00		

Soil Properties

Layer	Type	Thickness (ft)	Depth at Top of Layer (ft)	Density (lbs/ft^3)	CU (psf)	KP	PHI (deg)
1	Clay	5.00	0.00	125.0	10.0		
2	Clay	15.00	5.00	58.0	3000.0		

Design (Factored) Loads at Top of Pier

Moment (ft-k)	Axial Load (kips)	Shear Load (kips)	Additional Safety Factor Against Soil Failure
400.0	12.8	5.90	1.60

******* R E S U L T S

Calculated Pier Properties

Length (ft)	Weight (kips)	End Bearing Pressure (psf)
11.750	10.468	2155.0

Ultimate Resisting Forces Along Pier

Type	Distance of Top of Layer to Top of Pier (ft)	Thickness (ft)	Density (lbs/ft^3)	CU (psf)	KP	Force (kips)	Arm (ft)
Clay	0.00	5.00	125.0	10.0		1.10	2.50
Clay	5.00	3.45	58.0	3000.0		227.39	6.72
Clay	8.45	3.30	58.0	3000.0		-218.11	10.10

Shear and Moments Along Pier

Distance below Top of Pier (ft)	Shear (with Safety Factor) (kips)	Moment (with Safety Factor) (ft-k)	Shear (without Safety Factor) (kips)	Moment (without Safety Factor) (ft-k)
0.00	10.4	671.0	6.5	419.4
1.18	10.1	683.0	6.3	426.9
2.35	9.9	694.8	6.2	434.2
3.53	9.6	706.2	6.0	441.4
4.70	9.3	717.3	5.8	448.3
5.88	-48.5	703.0	-30.3	439.4
7.05	-126.0	600.5	-78.8	375.3
8.23	-203.6	406.8	-127.2	254.3
9.40	-155.1	182.2	-96.9	113.9
10.58	-77.5	45.6	-48.5	28.5
11.75	0.0	-0.0	0.0	-0.0

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*
* CAISSON - Pier Foundations Analysis and Design - Copyright Power Line Systems, Inc. 1993-2010 *
*
*
****
****

Project Title:
Project Notes: Direct Embed Shield Mast

Calculation Method: Full 8CD

******* I N P U T D A T A

Pier Properties

Diameter (ft)	Distance of Top of Pier above Ground (ft)	Concrete Strength (ksi)	Steel Yield Strength (ksi)
2.75	0.00		

Soil Properties

Layer	Type	Thickness (ft)	Depth at Top of Layer (ft)	Density (lbs/ft^3)	CU (psf)	KP	PHI (deg)
1	Clay	5.00	0.00	100.0	0.0		
2	Clay	10.00	5.00	100.0	2300.0		
3	Clay	8.50	15.00	100.0	3300.0		
4	Sand	1.00	23.50	120.0		5.290	43.00

Design (Factored) Loads at Top of Pier

Moment (ft-k)	Axial Load (kips)	Shear Load (kips)	Additional Safety Factor Against Soil Failure
400.0	12.8	5.90	1.60

******* R E S U L T S

Calculated Pier Properties

Length (ft)	Weight (kips)	End Bearing Pressure (psf)
12.750	11.359	2155.0

Ultimate Resisting Forces Along Pier

Type	Distance of Top of Layer to Top of Pier (ft)	Thickness (ft)	Density (lbs/ft^3)	CU (psf)	KP	Force (kips)	Arm (ft)
Clay	0.00	5.00	100.0	0.0		0.00	2.50
Clay	5.00	3.97	100.0	2300.0		201.12	6.99
Clay	8.97	3.78	100.0	2300.0	-	191.02	10.86

Shear and Moments Along Pier

Distance below Top of Pier (ft)	Shear (with Safety Factor) (kips)	Moment (with Safety Factor) (ft-k)	Shear (without Safety Factor) (kips)	Moment (without Safety Factor) (ft-k)
0.00	10.1	669.6	6.3	418.5
1.28	10.1	682.5	6.3	426.6
2.55	10.1	695.4	6.3	434.6
3.83	10.1	708.3	6.3	442.7
5.10	5.0	720.9	3.2	450.6
6.38	-59.5	686.2	-37.2	428.9
7.65	-124.0	569.2	-77.5	355.8
8.93	-188.5	370.0	-117.8	231.3
10.20	-129.0	164.5	-80.6	102.8
11.48	-64.5	41.1	-40.3	25.7
12.75	0.0	-0.0	0.0	-0.0

138 kV 3Ø Bus Support

- NESC HEAVY -> 4psf WIND + ½" ICE
- WIND -> 115MPH WIND
- WIND + SC -> 115 MPH WIND + 40,000AMP S.C.
- SEISMIC

SHORT CIRCUIT FORCE

$$\text{MAX } F_{sc} = \frac{5M \cdot 1.0\,(1.42\times\sqrt{2}\times 40000)^2}{10^7\cdot(8\times 12)} = 25.92\ \text{lb/ft}$$

SHORT CIRCUIT FORCE ON INSULATOR = $25.92\ \text{lb/ft} \cdot 6'\text{-}0" = 155.52$ lb

SHORT CIRCUIT MOMENT AT TOP OF INSULATOR = $155.52\text{ lb}\times\frac{54"}{12} = 699.84$ ft-lb

WIND FORCES:

4psf -> NESC HEAVY

90 mph WIND FORCE = $0.00265\cdot 115^2\cdot 1.0\cdot 1.0\cdot 1.0 = 35.05$ psf

SHAPE FACTOR = 1.0 FOR INSULATOR + BUS 1.6 for STAND

NESC HEAVY

WIND ON BUS = $4\text{psf}\times\frac{4.5"+1}{12} = 1.83$ p/ft @ 45°: 7.8 lb

WIND LOAD FORCE ON BUS AT COLUMN = $1.83\ \text{lb/ft}\cdot 6' = 11$ lb 35 lb-ft

MOMENT FROM WIND ON BUS AT T/COL = $11\text{lb}\times\frac{54"}{12} = 119.5$ lb-ft

WIND LOAD FORCE ON INSULATOR AT COLUMN = $4\text{psf}\times\frac{9.69+1}{12}\times\frac{54}{12} = 16.04$ lb 11.3 lb

MOMENT FROM WIND ON INSULATOR AT T/COL = $16.04\text{lb}\times\frac{54}{12\times 2} = 36.1$ ft-lb 25.5 ft-lb

WIND LOADING ON 8x8 COLUMN = $4\text{psf}\times\frac{8+1}{12}\times 1.6 = 4.8$ lb/ft 3.4 lb/ft

90 MPH WIND

WIND ON BUS = $35.05\text{psf}\times\frac{4.5}{12} = 13.14$ lb/ft

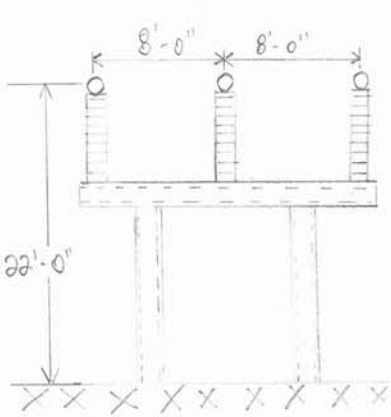
WIND LOAD FORCE ON BUS AT COLUMN = $13.14\ \text{lb/ft}\times 6' = 78.9$ lb 65.8 lb

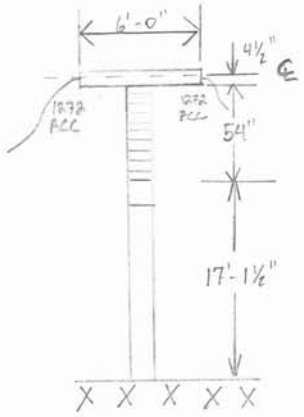
MOMENT FROM BUS WIND AT T/COL = $78.9\text{ lb}\times\frac{54}{12} = 355.1$ lb-ft 251.1 lb-ft

WIND LOAD FORCE ON INSULATOR AT COLUMN = $35.05\text{psf}\times\frac{9.69}{12}\times\frac{54}{12} = 127.41$ lb 90.1 lb

MOMENT FROM WIND ON INSULATOR AT T/COL = $127.41\text{lb}\times\frac{54}{2\times 12} = 276$ ft-lb 195.2 ft-lb

WIND LOADING ON 8x8 COLUMN = $35.05\text{psf}\times\frac{8}{12}\times 1.6 = 37.4$ lb/ft 26.4 lb/ft





BUS: 4"Ø ALUMINUM x 6'-0" O.D. = 4.50" WT. = 3.733 lb/ft

INSULATOR: LAPP 115kV 650kV BIL 54" TALL 9.69" DIAMETER WT. = 200

VERTICAL FORCES FROM HEAVY ICE

BUS WT = $3.733\ \text{lb/ft}\times 6'\text{-}0" = 22.4$ lb

½" ICE ON BUS WT. = $\frac{\pi}{4}\left[\left(\frac{4.5+1}{12}\right)^2-\left(\frac{4.5}{12}\right)^2\right]\times 57\text{pcf} = 3.11\ \text{lb/ft}\times 6'\text{-}0" = 18.7$

TOTAL ICE + BUS WT. = 22.4 lb + 18.7 lb = 41.1 lb

INSULATOR WT. = 200 lbs

½" ICE ON INSULATOR = $\frac{\pi}{4}\times\left[\left(\frac{9.69+1}{12}\right)^2-\left(\frac{9.69}{12}\right)^2\right]\times 57\text{pcf} = 6.34\ \text{lb/ft}\times\frac{54"}{12} = 28.5$ lb

TOTAL ICE + INSULATOR WT. = 200 lb + 28.5 lb = 228.5 lb

SEISMIC LOAD

$S_{DS} = 0.148g$

$S_{D1} = 0.062g$

$F_a = 1.6$

$F_v = 2.4$

$T = 0.02\,(17+\frac{1}{12})^{0.8} = 0.272$ s

$S_{D1}/S_{DS} = 0.062g/0.148g = 0.419 > 0.272$

$S_a = 0.062g/0.272 = 0.228$

$F_E = \left(\frac{0.228}{2.7}\right)\left[(1.0\cdot 1.0\cdot 3)(300\text{lb}+22.41\text{lb})\right](1.25)(1.0) = 241.43$ lb

TABLE 3. ROUND TUBULAR BUS COPPER OR ALUMINUM

Size	Outside Diameter	Inside Diameter	Moment of Inertia (i)	Section Modulus (S)	Weight	
					Aluminum	Copper
in.	in.	in.	$in.^4$	$in.^3$	lb/ft	lb/ft
Schedule 40						
1/2	0.84	0.622	0.0171	0.0407	0.294	0.956
3/4	1.05	0.824	0.0370	0.0705	0.391	1.300
1	1.315	1.049	0.0873	0.1328	0.581	1.830
1-1/2	1.90	1.610	0.3100	0.3260	0.940	3.190
2	2.375	2.067	0.6660	0.5610	1.264	4.210
2-1/2	2.875	2.469	1.5300	1.0640	2.004	6.120
3	3.50	3.068	3.0170	1.7240	2.621	8.720
3-1/2	4.00	3.548	4.7880	2.3940	3.151	11.380
4	4.50	4.026	7.2320	3.2140	3.733	12.900
5	5.563	5.047	15.1600	5.4510	5.057	16.210
6	6.625	6.065	28.1400	8.5000	6.564	19.350
Schedule 80						
1/2	0.84	0.546	0.0201	0.0478	0.376	1.250
3/4	1.05	0.742	0.0448	0.0853	0.510	1.700
1	1.315	0.957	0.1056	0.1606	0.751	2.500
1-1/2	1.90	1.50	0.3910	0.4120	1.256	4.180
2	2.375	1.939	0.8680	0.7310	1.737	5.780
2-1/2	2.875	2.323	1.9240	1.3390	2.650	8.820
3	3.50	2.90	3.8940	2.2250	3.547	11.790
3-1/2	4.00	3.364	6.2810	3.1400	4.326	14.340
4	4.50	3.826	9.6110	4.2720	5.183	17.220
5	5.563	~~4.183~~ 4.81	20.6700	7.4320	7.188	23.620
6	6.625	5.761	40.4900	12.2200	9.884	32.830

NOTE: Values given are for both 6061-T6 and 6063-T6 aluminum alloys.

ALUMINUM WELDMENT BUS SUPPORT TUBE TO INSULATOR TYPE WURE

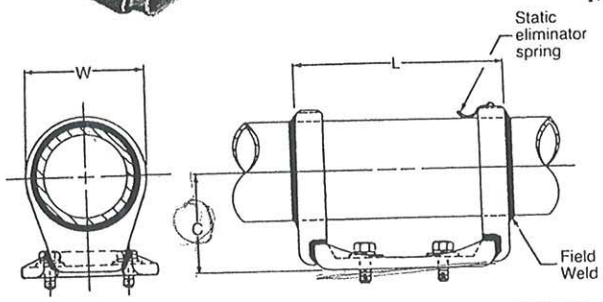
ALUMINUM
WURE

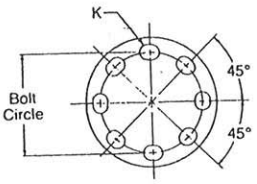
Aluminum alloy horizontal weldment bus support for aluminum tubing. Designed for slip-fit or rigid applications.

Cap screws are supplied for upright mounting. Static eliminator springs is furnished as standard.

For mounting to base of insulator; nuts, bolts, and lockwashers will be supplied by adding "-B" to catalog number; example: WURE-30-5-B.

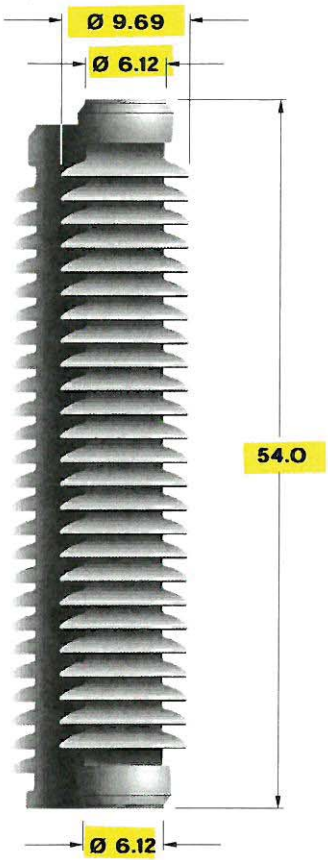
Material: Castings—356-T6 aluminum alloy
Mounting hardware—galvanized steel
Static spring—stainless steel





CATALOG NUMBER	ALUMINUM CONDUCTOR SIZE IPS/EHIPS	BOLT CIRCLE DIA.	DIMENSIONS—INCHES (MM)				APPROX. WT. EACH LBS. (KG)
			L	C	W	K	
WURE-10-3	1	3	6½ (165.1)	2 (50.8)	3 (76.2)	9/16 x ¾	1.5 (.68)
WURE-10-5	1	5	9⅛ (231.78)	2¼ (57.15)	3 (76.2)	11/16 x ⅞	1.9 (.86)
WURE-12-3	1¼	3	6½ (165.1)	2½ (63.5)	3 (76.2)	9/16 x ¾	1.7 (.77)
WURE-12-5	1¼	5	9⅛ (231.78)	2½ (63.5)	3 (76.2)	11/16 x ⅞	2.2 (1.0)
WURE-14-3	1½	3	6½ (165.1)	2½ (63.5)	3 (76.2)	9/16 x ¾	1.7 (.77)
WURE-14-5	1½	5	9⅛ (231.78)	2½ (63.5)	3 (76.2)	11/16 x ⅞	2.3 (1.04)
WURE-20-3	2	3	6½ (165.1)	2¾ (69.85)	3¼ (82.55)	9/16 x ¾	2.5 (1.13)
WURE-20-5	2	5	9⅛ (231.78)	2¾ (69.85)	3¼ (82.55)	11/16 x ⅞	3.0 (1.36)
WURE-24-3	2½	3	6½ (165.1)	3⅛ (79.38)	3¾ (95.25)	9/16 x ¾	2.8 (1.27)
WURE-24-5	2½	5	9⅛ (231.78)	3⅛ (79.38)	3¾ (95.25)	11/16 x ⅞	3.2 (1.45)
WURE-30-3	3	3	6½ (165.1)	3⅝ (92.08)	4½ (114.3)	9/16 x ¾	2.7 (1.22)
WURE-30-5	3	5	9⅛ (231.78)	3⅝ (92.08)	4½ (114.3)	11/16 x ⅞	3.4 (1.54)
WURE-34-3	3½	3	6½ (165.1)	4 (101.6)	5¼ (133.35)	9/16 x ¾	4.2 (1.90)
WURE-34-5	3½	5	9⅛ (231.78)	4 (101.6)	5¼ (133.35)	11/16 x ⅞	4.7 (2.13)
WURE-40-3	4	3	6½ (165.1)	4½ (114.3)	5⅝ (142.88)	9/16 x ¾	3.9 (1.77)
WURE-40-5	4	5	9⅜ (238.12)	4½ (114.3)	5⅝ (142.88)	11/16 x ⅞	5.7 (2.58)
WURE-50-5	5	5	9⅜ (238.12)	4⅞ (123.82)	6¾ (171.45)	11/16 x ⅞	6.1 (2.77)
WURE-60-5	6	5	9⅞ (250.82)	5⅜ (136.52)	7¾ (196.85)	11/16 x ⅞	6.9 (3.13)

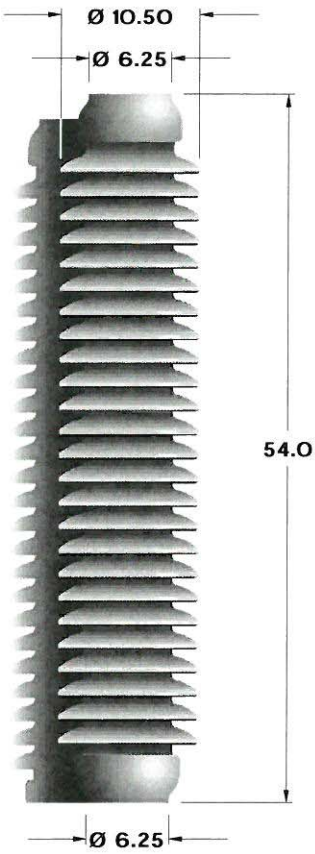
STANDARD STRENGTH UNIT



4 TAPPED HOLES
5/8-11 +.015 OVERSIZE
11/16" FULL THREAD
ON 5.0" BOLT CIRCLE

315288-70

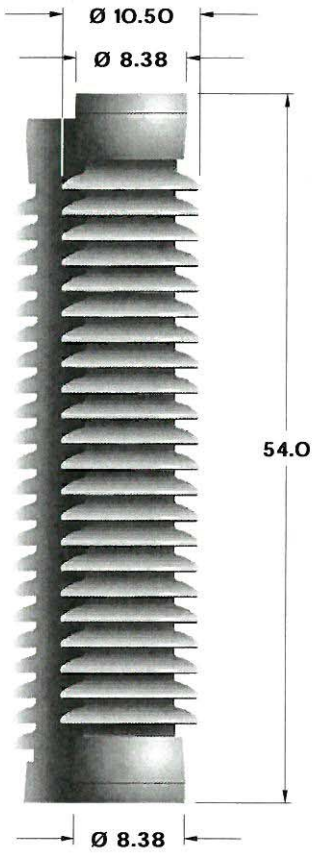
HIGH STRENGTH UNIT



4 TAPPED HOLES
5/8-11 +.015 OVERSIZE
3/4" FULL THREAD
ON 5.0" BOLT CIRCLE

315289-70

EXTRA-HIGH STRENGTH UNIT



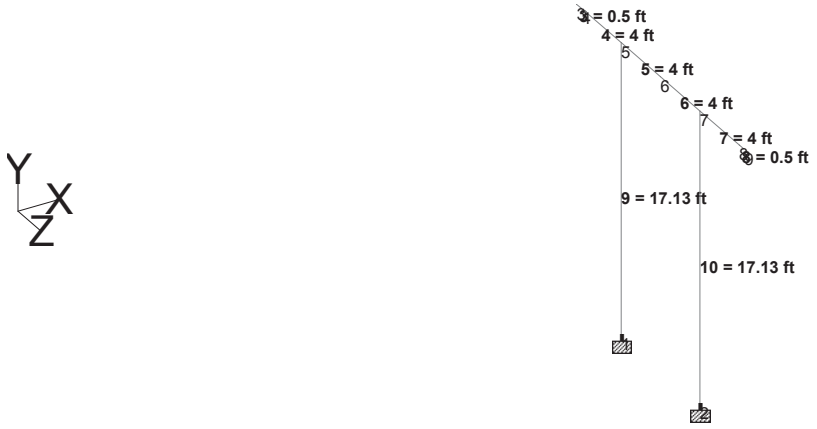
4 TAPPED HOLES
3/4-10 +.015 OVERSIZE
7/8" FULL THREAD
ON 7.0" BOLT CIRCLE

314857-70

CHARACTERISTICS

Lapp Catalog Number	315288-70	315289-70	314857-70
Ansi Technical Reference Number	T.R.288	T.R.289	
Dimensions			
Leakage Distance, Inches	116	116	116
Mechanical Values *			
Cantilever Strength, Upright, Pounds	1450	2200	4100
Cantilever Strength, Underhung, Pounds	1450	2200	4100
Tensile Strength, Pounds	20000	25000	40000
Torsion Strength, Inch-Pounds	60000	90000	120000
Compression Strength, Pounds	60000	75000	120000
Electrical Values			
Voltage Class, kV	138	138	138
Impulse Flashover, Positive, kV	710	710	710
Low Frequency Withstand, 10 Sec. Wet, kV	275	275	275
Impulse Withstand, kV	650	650	650
Radio Influence Voltage Data			
Test Voltage, Rms to Ground, kV	88	88	88
Maximum RIV, Microvolts at 1000 kHz	200	200	200
Weight			
Net Weight, Each, Pounds	200	255	311

* For Maximum recommended working loads see " Specifications," page 5.
Note: For RG glazed insulators equivalent to these standard insulators, see table on page 9.
Illustrations shown are true representations of Lapp products at the time of printing, but are subject to change at any time. **ALL DIMENSIONS ARE IN INCHES**


Y
X
Z
3 = 0.5 ft
4 = 4 ft
5
5 = 4 ft
6
6 = 4 ft
7
7 = 4 ft
8 = 0.5 ft
9 = 17.13 ft
10 = 17.13 ft
Load 1

```
**************************************************
*                                                *
*           STAAD.Pro V8i SELECTseries4          *
*           Version  20.07.09.21                 *
*           Proprietary Program of               *
*           Bentley Systems, Inc.                *
*           Date=    DEC 11, 2017                *
*           Time=    13:11:36                    *
*                                                *
*      USER ID: Ulteig Engineers                 *
**************************************************
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```
     1. STAAD SPACE
INPUT FILE: NWO 138kV High Bus Support.STD
     2. START JOB INFORMATION
     3. ENGINEER DATE 12-DEC-17
     4. JOB NAME NORTHWEST OHIO SUBSATATION
     5. JOB CLIENT WHITE
     6. JOB NO 17.01246
     7. JOB REV 001
     8. JOB PART 138KV HIGH BUS SUPPORT
     9. ENGINEER NAME DAW
    10. END JOB INFORMATION
    11. INPUT WIDTH 79
    12. UNIT FEET POUND
    13. JOINT COORDINATES
    14. 1 0 0 0; 2 0 0 8; 3 0 17.125 -4.5; 4 0 17.125 -4; 5 0 17.125 0; 6 0 17.125 4
    15. 7 0 17.125 8; 8 0 17.125 12; 9 0 17.125 12.5
    16. MEMBER INCIDENCES
    17. 3 4 3; 4 4 5; 5 5 6; 6 6 7; 7 7 8; 8 8 9; 9 1 5; 10 2 7
    18. DEFINE MATERIAL START
    19. ISOTROPIC STEEL
    20. E 4.176E+009
    21. POISSON 0.3
    22. DENSITY 489.024
    23. ALPHA 6E-006
    24. DAMP 0.03
    25. END DEFINE MATERIAL
    26. CONSTANTS
    27. BETA 0 MEMB 10
    28. MATERIAL STEEL ALL
    29. MEMBER PROPERTY AMERICAN
    30. 3 TO 8 TABLE ST HSST8X8X0.25
    31. 9 10 TABLE ST HSST8X8X0.375
    32. SUPPORTS
    33. 1 2 FIXED
    34. LOAD 1 LOADTYPE NONE  TITLE NESC 4PSF WIND + 1/2" ICE - X-DIR
    35. SELFWEIGHT Y -1.5
    36. *WIND AND DL FROM INSULATOR _6' OF 4" AL. BUS
    37. JOINT LOAD
    38. 4 6 8 FX 16.1 FY -270 MZ -36.1
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39. *WIND LOAD ON HSS STAND
40. MEMBER LOAD
41. 3 TO 10 UNI GX 4.8
42. ***END OF LOAD CASE #1***
43. LOAD 2 LOADTYPE NONE  TITLE NESC 4PSF WIND + 1/2" ICE - Z-DIR
44. SELFWEIGHT Y -1.5
45. JOINT LOAD
46. *WIND AND DL FROM INSULATOR _6' OF 4" AL. BUS
47. 4 6 8 FY -270 FZ 27.1 MX 85.6
48. *WIND LOAD ON HSS STAND
49. MEMBER LOAD
50. 9 10 UNI GZ 4.8
51. ***END OF LOAD CASE #2***
52. LOAD 3 LOADTYPE NONE  TITLE NESC 4PSF WIND + 1/2" ICE - 45-DEGREES
53. SELFWEIGHT Y -1.5
54. JOINT LOAD
55. *WIND AND DL FROM INSULATOR _6' OF 4" AL. BUS
56. 4 6 8 FX 11.3 FY -270 FZ 19.1 MX 60.5 MZ -25.5
57. *WIND LOAD ON HSS STAND
58. MEMBER LOAD
59. 3 TO 10 UNI GX 3.4
60. 9 10 UNI GZ 3.4
61. ***END OF LOAD CASE #3***
62. LOAD 4 LOADTYPE NONE  TITLE NESC 115MPH HIGH WIND FROM X-DIR
63. SELFWEIGHT Y -1
64. *WIND AND DL FROM INSULATOR _6' OF 4" AL. BUS
65. JOINT LOAD
66. 4 6 8 FX 127.4 FY -222.4 MZ -276
67. *WIND LOAD ON HSS STAND
68. MEMBER LOAD
69. 3 TO 10 UNI GX 37.4
70. ***END OF LOAD CASE #4***
71. LOAD 5 LOADTYPE NONE  TITLE NESC 115MPH HIGH WIND FROM Z-DIR
72. SELFWEIGHT Y -1
73. JOINT LOAD
74. *WIND AND DL FROM INSULATOR _6' OF 4" AL. BUS
75. 4 6 8 FY -222.4 FZ 205.4 MX 631.1
76. *WIND LOAD ON HSS STAND
77. MEMBER LOAD
78. 9 10 UNI GZ 37.4
79. ***END OF LOAD CASE #5***
80. LOAD 6 LOADTYPE NONE  TITLE NESC 115MPH HIGH WIND FROM 45-DEGREES
81. SELFWEIGHT Y -1
82. JOINT LOAD
83. *WIND AND DL FROM INSULATOR _6' OF 4" AL. BUS
84. 4 6 8 FX 90.1 FY -222.4 FZ 145.9 MX 446.3 MZ -195.2
85. *WIND LOAD ON HSS STAND
86. MEMBER LOAD
87. 3 TO 10 UNI GX 26.4
88. 9 10 UNI GZ 26.4
89. ***END OF LOAD CASE #6***
90. LOAD 7 LOADTYPE NONE  TITLE NESC 115MPH HIGH WIND FROM X-DIR + SC
91. SELFWEIGHT Y -1
92. *WIND AND DL FROM INSULATOR _6' OF 4" AL. BUS
93. JOINT LOAD
94. 4 6 8 FX 127.4 FY -222.4 MZ -276
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 95. *WIND LOAD ON HSS STAND
 96. MEMBER LOAD
 97. 3 TO 10 UNI GX 37.4
 98. JOINT LOAD
 99. *SHORT CIRCUIT LOADING
100. 8 FZ 155.52 MX 699.84
101. 6 FZ -155.52 MX -699.84
102. ***END OF LOAD CASE #7***
103. LOAD 8 LOADTYPE NONE  TITLE NESC 115MPH HIGH WIND FROM Z-DIR + SC
104. SELFWEIGHT Y -1
105. JOINT LOAD
106. *WIND AND DL FROM INSULATOR _6' OF 4" AL. BUS
107. 4 6 8 FY -222.4 FZ 205.4 MX 631.1
108. *WIND LOAD ON HSS STAND
109. MEMBER LOAD
110. 9 10 UNI GZ 37.4
111. JOINT LOAD
112. *SHORT CIRCUIT LOADING
113. 8 FZ 155.52 MX 699.84
114. 6 FZ -155.52 MX -699.84
115. ***END OF LOAD CASE #8***
116. LOAD 9 LOADTYPE NONE  TITLE NESC 115MPH HIGH WIND FROM 45-DEGREES + SC
117. SELFWEIGHT Y -1
118. JOINT LOAD
119. *WIND AND DL FROM INSULATOR _6' OF 4" AL. BUS
120. 4 6 8 FX 90.1 FY -222.4 FZ 145.9 MX 446.3 MZ -195.2
121. *WIND LOAD ON HSS STAND
122. MEMBER LOAD
123. 3 TO 10 UNI GX 26.4
124. 9 10 UNI GZ 26.4
125. JOINT LOAD
126. *SHORT CIRCUIT LOADING
127. 8 FZ 155.52 MX 699.84
128. 6 FZ -155.52 MX -699.84
129. ***END OF LOAD CASE #9***
130. LOAD 10 LOADTYPE NONE  TITLE SEISMIC - X-DIR
131. SELFWEIGHT Y -1
132. *DL FROM INSULATOR _6' OF 4" AL. BUS
133. JOINT LOAD
134. *SEISMIC LOADING AT 2/3 HEIGHT
135. 4 6 8 FY -222.4
136. UNIT FEET KIP
137. MEMBER LOAD
138. 9 10 CON GX 0.24143 11.42
139. ***END OF LOAD CASE #10***
140. UNIT FEET POUND
141. LOAD 11 LOADTYPE NONE  TITLE SEISMIC - Z-DIR
142. SELFWEIGHT Y -1
143. *DL FROM INSULATOR _6' OF 4" AL. BUS
144. JOINT LOAD
145. *SEISMIC LOADING AT 2/3 HEIGHT
146. 4 6 8 FY -222.4
147. UNIT FEET KIP
148. MEMBER LOAD
149. 9 10 CON GZ 0.24143 11.42
150. ***END OF LOAD CASE #11***
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151. UNIT FEET POUND
152. LOAD 12 LOADTYPE NONE  TITLE SEISMIC - 45-DEGREES
153. SELFWEIGHT Y -1
154. *DL FROM INSULATOR _6' OF 4" AL. BUS
155. JOINT LOAD
156. *SEISMIC LOADING AT 2/3 HEIGHT
157. 4 6 8 FY -222.4
158. UNIT FEET KIP
159. MEMBER LOAD
160. 9 10 CON GX 0.171 11.42
161. 9 10 CON GZ 0.171 11.42
162. ***END OF LOAD CASE #12***
163. PDELTA ANALYSIS
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P R O B L E M S T A T I S T I C S

NUMBER OF JOINTS	9	NUMBER OF MEMBERS	8
NUMBER OF PLATES	0	NUMBER OF SOLIDS	0
NUMBER OF SURFACES	0	NUMBER OF SUPPORTS	2

SOLVER USED IS THE OUT-OF-CORE BASIC SOLVER

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ORIGINAL/FINAL BAND-WIDTH=     5/     2/     18 DOF
TOTAL PRIMARY LOAD CASES =    12, TOTAL DEGREES OF FREEDOM =      42
SIZE OF STIFFNESS MATRIX =        1 DOUBLE  KILO-WORDS
REQRD/AVAIL. DISK SPACE  =     12.0/      0.0 MB
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++ Adjusting Displacements.

164. PARAMETER 1
165. CODE AISC UNIFIED 2010
166. METHOD ASD
167. KY 2.1 MEMB 9 10
168. KZ 2.1 MEMB 9 10
169. UNB 20.833 MEMB 3 TO 8
170. UNT 20.833 MEMB 3 TO 8
171. CHECK CODE ALL
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STAAD.PRO CODE CHECKING - (AISC-360-10-ASD) v1.2
****

ALL UNITS ARE - KIP INCH (UNLESS OTHERWISE NOTED)

MEMBER NO: 3 CRITICAL RATIO: 0.000(PASS) ✓ LOAD: 1
LOCATION (ft): 0.00 CONDITION:
SECTION: HSST8X8X0.25 (AISC SECTIONS)

MEMBER NO: 4 CRITICAL RATIO: 0.055(PASS) ✓ LOAD: 4
LOCATION (ft): 4.00 CONDITION: Eq. H1-1b
SECTION: HSST8X8X0.25 (AISC SECTIONS)

MEMBER NO: 5 CRITICAL RATIO: 0.110(PASS) ✓ LOAD: 8
LOCATION (ft): 0.00 CONDITION: Eq. H1-1b
SECTION: HSST8X8X0.25 (AISC SECTIONS)

MEMBER NO: 6 CRITICAL RATIO: 0.155(PASS) ✓ LOAD: 8
LOCATION (ft): 4.00 CONDITION: Eq. H1-1b
SECTION: HSST8X8X0.25 (AISC SECTIONS)

MEMBER NO: 7 CRITICAL RATIO: 0.080(PASS) ✓ LOAD: 9
LOCATION (ft): 0.00 CONDITION: Eq. H1-1b
SECTION: HSST8X8X0.25 (AISC SECTIONS)

MEMBER NO: 8 CRITICAL RATIO: 0.000(PASS) ✓ LOAD: 1
LOCATION (ft): 0.00 CONDITION:
SECTION: HSST8X8X0.25 (AISC SECTIONS)

MEMBER NO: 9 CRITICAL RATIO: 0.297(PASS) ✓ LOAD: 9
LOCATION (ft): 0.00 CONDITION: Eq. H1-1b
SECTION: HSST8X8X0.375 (AISC SECTIONS)

MEMBER NO: 10 CRITICAL RATIO: 0.296(PASS) ✓ LOAD: 6
LOCATION (ft): 0.00 CONDITION: Eq. H1-1b
SECTION: HSST8X8X0.375 (AISC SECTIONS)

ALL MEMBER's PASS

172. UNIT INCHES KIP
173. PRINT MEMBER FORCES ALL

MEMBER END FORCES STRUCTURE TYPE = SPACE

ALL UNITS ARE -- KIP INCH (LOCAL)

MEMBER	LOAD	JT	AXIAL	SHEAR-Y	SHEAR-Z	TORSION	MOM-Y	MOM-Z
3	1	4	0.00	0.02	0.00	0.00	0.01	0.05
		3	0.00	0.00	0.00	0.00	0.00	0.00
	2	4	0.00	0.02	0.00	0.00	0.00	0.05
		3	0.00	0.00	0.00	0.00	0.00	0.00
	3	4	0.00	0.02	0.00	0.00	0.01	0.05
		3	0.00	0.00	0.00	0.00	0.00	0.00
	4	4	0.00	0.01	-0.02	0.00	0.06	0.04
		3	0.00	0.00	0.00	0.00	0.00	0.00
	5	4	0.00	0.01	0.00	0.00	0.00	0.04
		3	0.00	0.00	0.00	0.00	0.00	0.00
	6	4	0.00	0.01	-0.01	0.00	0.04	0.04
		3	0.00	0.00	0.00	0.00	0.00	0.00
	7	4	0.00	0.01	-0.02	0.00	0.06	0.04
		3	0.00	0.00	0.00	0.00	0.00	0.00
	8	4	0.00	0.01	0.00	0.00	0.00	0.04
		3	0.00	0.00	0.00	0.00	0.00	0.00
	9	4	0.00	0.01	-0.01	0.00	0.04	0.04
		3	0.00	0.00	0.00	0.00	0.00	0.00
	10	4	0.00	0.01	0.00	0.00	0.00	0.04
		3	0.00	0.00	0.00	0.00	0.00	0.00
	11	4	0.00	0.01	0.00	0.00	0.00	0.04
		3	0.00	0.00	0.00	0.00	0.00	0.00
	12	4	0.00	0.01	0.00	0.00	0.00	0.04
		3	0.00	0.00	0.00	0.00	0.00	0.00
4	1	4	0.00	-0.29	-0.02	-0.43	-0.01	0.05
		5	0.00	0.43	0.04	0.43	1.36	-17.35
	2	4	0.03	-0.29	0.00	0.00	0.00	-0.97
		5	-0.03	0.43	0.00	0.00	0.00	-16.33
	3	4	0.02	-0.29	-0.01	-0.31	-0.01	-0.67
		5	-0.02	0.43	0.03	0.31	0.96	-16.63
	4	4	0.00	-0.23	-0.15	-3.31	-0.06	0.04
		5	0.00	0.33	0.30	3.31	10.66	-13.60
	5	4	0.21	-0.23	0.00	0.00	0.00	-7.54
		5	-0.21	0.33	0.00	0.00	0.00	-6.03
	6	4	0.15	-0.23	-0.10	-2.34	-0.04	-5.32
		5	-0.15	0.33	0.21	2.34	7.53	-8.25
	7	4	0.00	-0.23	-0.15	-3.31	-0.06	0.04
		5	0.00	0.33	0.30	3.31	10.66	-13.60
	8	4	0.21	-0.23	0.00	0.00	0.00	-7.54
		5	-0.21	0.33	0.00	0.00	0.00	-6.03
	9	4	0.15	-0.23	-0.10	-2.34	-0.04	-5.32
		5	-0.15	0.33	0.21	2.34	7.53	-8.25

MEMBER END FORCES STRUCTURE TYPE = SPACE

ALL UNITS ARE -- KIP INCH (LOCAL)

MEMBER	LOAD	JT	AXIAL	SHEAR-Y	SHEAR-Z	TORSION	MOM-Y	MOM-Z
	10	4	0.00	-0.23	0.00	0.00	0.00	0.04
		5	0.00	0.33	0.00	0.00	0.00	-13.60
	11	4	0.00	-0.23	0.00	0.00	0.00	0.04
		5	0.00	0.33	0.00	0.00	0.00	-13.60
	12	4	0.00	-0.23	0.00	0.00	0.00	0.04
		5	0.00	0.33	0.00	0.00	0.00	-13.60
5	1	5	-0.05	0.28	0.03	0.22	-1.21	10.67
		6	0.05	-0.14	-0.01	-0.22	0.36	-0.72
	2	5	-0.06	0.12	0.00	0.00	0.00	3.48
		6	0.06	0.03	0.00	0.00	0.00	-1.23
	3	5	-0.06	0.17	0.02	0.15	-0.86	5.59
		6	0.06	-0.02	-0.01	-0.15	0.26	-1.08
	4	5	-0.04	0.21	0.21	1.66	-9.52	8.28
		6	0.04	-0.11	-0.06	-1.66	2.87	-0.63
	5	5	-0.14	-1.01	0.00	0.00	0.00	-46.50
		6	0.14	1.11	0.00	0.00	0.00	-4.41
	6	5	-0.11	-0.66	0.15	1.25	-6.81	-30.52
		6	0.11	0.75	-0.05	-1.25	2.03	-3.31
	7	5	-0.06	0.22	0.21	1.65	-9.52	6.52
		6	0.06	-0.12	-0.06	-1.65	2.87	1.75
	8	5	-0.16	-1.00	0.00	0.00	0.00	-48.26
		6	0.16	1.10	0.00	0.00	0.00	-2.03
	9	5	-0.13	-0.64	0.15	1.25	-6.81	-32.28
		6	0.13	0.74	-0.05	-1.25	2.03	-0.93
	10	5	-0.04	0.21	0.00	0.00	0.00	8.28
		6	0.04	-0.11	0.00	0.00	0.00	-0.63
	11	5	-0.04	0.00	0.00	0.00	0.00	-1.58
		6	0.04	0.09	0.00	0.00	0.00	-0.63
	12	5	-0.04	0.06	0.00	0.00	0.00	1.30
		6	0.04	0.03	0.00	0.00	0.00	-0.63
6	1	6	-0.05	-0.14	-0.01	-0.22	-0.36	0.72
		7	0.05	0.28	0.03	0.22	1.21	-10.67
	2	6	-0.04	-0.30	0.00	0.00	0.00	0.20
		7	0.04	0.44	0.00	0.00	0.00	-17.86
	3	6	-0.04	-0.25	-0.01	-0.15	-0.26	0.35
		7	0.04	0.39	0.02	0.15	0.85	-15.75
	4	6	-0.04	-0.11	-0.06	-1.66	-2.87	0.63
		7	0.04	0.21	0.21	1.66	9.52	-8.28
	5	6	0.06	-1.33	0.00	0.00	0.00	-3.16
		7	-0.06	1.43	0.00	0.00	0.00	-63.05
	6	6	0.03	-0.98	-0.04	-1.09	-2.03	-2.05
		7	-0.03	1.07	0.15	1.09	6.64	-47.08
	7	6	-0.21	-0.10	-0.06	-1.66	-2.87	6.65
		7	0.21	0.19	0.21	1.66	9.52	-13.69

MEMBER END FORCES STRUCTURE TYPE = SPACE

ALL UNITS ARE -- KIP INCH (LOCAL)

MEMBER	LOAD	JT	AXIAL	SHEAR-Y	SHEAR-Z	TORSION	MOM-Y	MOM-Z
	8	6	-0.11	-1.32	0.00	0.00	0.00	2.86
		7	0.11	1.41	0.00	0.00	0.00	-68.46
	9	6	-0.14	-0.96	-0.04	-1.10	-2.03	3.97
		7	0.14	1.06	0.15	1.10	6.65	-52.48
	10	6	-0.04	-0.11	0.00	0.00	0.00	0.63
		7	0.04	0.21	0.00	0.00	0.00	-8.28
	11	6	-0.04	-0.32	0.00	0.00	0.00	0.63
		7	0.04	0.41	0.00	0.00	0.00	-18.14
	12	6	-0.04	-0.26	0.00	0.00	0.00	0.63
		7	0.04	0.35	0.00	0.00	0.00	-15.27
7	1	7	0.00	0.43	0.04	0.43	-1.36	17.35
		8	0.00	-0.29	-0.02	-0.43	0.01	-0.05
	2	7	-0.03	0.43	0.00	0.00	0.00	18.38
		8	0.03	-0.29	0.00	0.00	0.00	-1.08
	3	7	-0.02	0.43	0.03	0.31	-0.96	18.08
		8	0.02	-0.29	-0.01	-0.31	0.01	-0.78
	4	7	0.00	0.33	0.30	3.31	-10.66	13.60
		8	0.00	-0.23	-0.15	-3.31	0.06	-0.04
	5	7	-0.21	0.33	0.00	0.00	0.00	21.17
		8	0.21	-0.23	0.00	0.00	0.00	-7.61
	6	7	-0.15	0.33	0.21	2.34	-7.53	18.96
		8	0.15	-0.23	-0.10	-2.34	0.04	-5.39
	7	7	-0.16	0.33	0.30	3.31	-10.66	22.00
		8	0.16	-0.23	-0.15	-3.31	0.06	-8.43
	8	7	-0.36	0.33	0.00	0.00	0.00	29.56
		8	0.36	-0.23	0.00	0.00	0.00	-16.01
	9	7	-0.30	0.33	0.21	2.34	-7.53	27.35
		8	0.30	-0.23	-0.10	-2.34	0.04	-13.79
	10	7	0.00	0.33	0.00	0.00	0.00	13.60
		8	0.00	-0.23	0.00	0.00	0.00	-0.04
	11	7	0.00	0.33	0.00	0.00	0.00	13.60
		8	0.00	-0.23	0.00	0.00	0.00	-0.04
	12	7	0.00	0.33	0.00	0.00	0.00	13.60
		8	0.00	-0.23	0.00	0.00	0.00	-0.04
8	1	8	0.00	0.02	0.00	0.00	-0.01	0.05
		9	0.00	0.00	0.00	0.00	0.00	0.00
	2	8	0.00	0.02	0.00	0.00	0.00	0.05
		9	0.00	0.00	0.00	0.00	0.00	0.00
	3	8	0.00	0.02	0.00	0.00	-0.01	0.05
		9	0.00	0.00	0.00	0.00	0.00	0.00
	4	8	0.00	0.01	0.02	0.00	-0.06	0.04
		9	0.00	0.00	0.00	0.00	0.00	0.00
	5	8	0.00	0.01	0.00	0.00	0.00	0.04
		9	0.00	0.00	0.00	0.00	0.00	0.00

MEMBER END FORCES STRUCTURE TYPE = SPACE

ALL UNITS ARE -- KIP INCH (LOCAL)

MEMBER	LOAD	JT	AXIAL	SHEAR-Y	SHEAR-Z	TORSION	MOM-Y	MOM-Z
	6	8	0.00	0.01	0.01	0.00	-0.04	0.04
		9	0.00	0.00	0.00	0.00	0.00	0.00
	7	8	0.00	0.01	0.02	0.00	-0.06	0.04
		9	0.00	0.00	0.00	0.00	0.00	0.00
	8	8	0.00	0.01	0.00	0.00	0.00	0.04
		9	0.00	0.00	0.00	0.00	0.00	0.00
	9	8	0.00	0.01	0.01	0.00	-0.04	0.04
		9	0.00	0.00	0.00	0.00	0.00	0.00
	10	8	0.00	0.01	0.00	0.00	0.00	0.04
		9	0.00	0.00	0.00	0.00	0.00	0.00
	11	8	0.00	0.01	0.00	0.00	0.00	0.04
		9	0.00	0.00	0.00	0.00	0.00	0.00
	12	8	0.00	0.01	0.00	0.00	0.00	0.04
		9	0.00	0.00	0.00	0.00	0.00	0.00
9	1	1	1.62	0.15	-0.05	0.14	3.31	22.56
		5	-0.71	-0.06	0.05	-0.14	6.68	-0.65
	2	1	1.46	0.00	-0.17	0.00	13.98	0.00
		5	-0.55	0.00	0.09	0.00	12.84	0.00
	3	1	1.51	0.10	-0.14	0.10	10.85	15.95
		5	-0.60	-0.05	0.08	-0.10	11.03	-0.46
	4	1	1.14	1.15	-0.04	1.14	2.63	176.04
		5	-0.54	-0.51	0.04	-1.14	5.32	-4.97
	5	1	-0.08	0.00	-0.99	0.00	84.75	0.00
		5	0.68	0.00	0.35	0.00	52.53	0.00
	6	1	0.28	0.81	-0.71	0.72	60.75	124.28
		5	0.33	-0.36	0.26	-0.72	38.77	-3.59
	7	1	1.16	1.15	-0.06	1.14	4.43	176.04
		5	-0.55	-0.51	0.06	-1.14	7.08	-4.97
	8	1	-0.06	0.00	-1.01	0.00	86.54	0.00
		5	0.67	0.00	0.37	0.00	54.29	0.00
	9	1	0.29	0.81	-0.73	0.72	62.54	124.28
		5	0.31	-0.36	0.28	-0.72	40.53	-3.59
	10	1	1.14	0.24	-0.04	0.00	2.63	33.19
		5	-0.54	0.00	0.04	0.00	5.32	0.00
	11	1	0.94	0.00	-0.28	0.00	25.91	0.00
		5	-0.33	0.00	0.04	0.00	15.18	0.00
	12	1	1.00	0.17	-0.21	0.00	19.12	23.51
		5	-0.39	0.00	0.04	0.00	12.30	0.00
10	1	2	1.62	0.15	0.05	-0.14	-3.31	22.56
		7	-0.71	-0.06	-0.05	0.14	-6.68	-0.65
	2	2	1.78	0.00	-0.07	0.00	7.36	0.00
		7	-0.87	0.00	-0.01	0.00	-0.53	0.00
	3	2	1.73	0.10	-0.04	-0.10	4.23	15.95
		7	-0.83	-0.05	-0.02	0.10	-2.33	-0.46

← MAX MOMENT FOR BP DESIGN

← MAX MOMENT FOR TOP OF PLATE DESIGN

MAX BP FORCE AT 4

MEMBER END FORCES STRUCTURE TYPE = SPACE

ALL UNITS ARE -- KIP INCH (LOCAL)

MEMBER	LOAD	JT	AXIAL	SHEAR-Y	SHEAR-Z	TORSION	MOM-Y	MOM-Z
	4	2	1.14	1.15	0.04	-1.14	-2.63	176.04
		7	-0.54	-0.51	-0.04	1.14	-5.32	-4.97
	5	2	2.36	0.00	-0.91	0.00	79.43	0.00
		7	-1.76	0.00	0.27	0.00	41.88	0.00
	6	2	2.01	0.81	-0.63	-0.89	55.46	124.37
		7	-1.40	-0.36	0.18	0.89	28.12	-3.44
	7	2	1.13	1.15	0.06	-1.14	-3.19	176.04
		7	-0.53	-0.51	-0.06	1.14	-8.31	-4.97
	8	2	2.35	0.00	-0.89	0.00	78.88	0.00
		7	-1.75	0.00	0.25	0.00	38.90	0.00
	9	2	1.99	0.81	-0.61	-0.89	54.90	124.36
		7	-1.39	-0.36	0.16	0.89	25.14	-3.44
	10	2	1.14	0.24	0.04	0.00	-2.63	33.19
		7	-0.54	0.00	-0.04	0.00	-5.32	0.00
	11	2	1.35	0.00	-0.20	0.00	20.64	0.00
		7	-0.74	0.00	-0.04	0.00	4.54	0.00
	12	2	1.29	0.17	-0.13	0.00	13.85	23.51
		7	-0.68	0.00	-0.04	0.00	1.66	0.00

********** END OF LATEST ANALYSIS RESULT **********

174. PRINT JOINT DISPLACEMENTS ALL

JOINT DISPLACEMENT (INCH RADIANS) STRUCTURE TYPE = SPACE

JOINT	LOAD	X-TRANS	Y-TRANS	Z-TRANS	X-ROTAN	Y-ROTAN	Z-ROTAN
1	1	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
	2	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
	3	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
	4	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
	5	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
	6	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
	7	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
	8	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
	9	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
	10	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
	11	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
	12	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
2	1	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
	2	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
	3	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
	4	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
	5	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
	6	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
	7	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
	8	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
	9	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
	10	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
	11	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
	12	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
3	1	0.10278	-0.01501	-0.00001	-0.00031	-0.00003	-0.00074
	2	0.00000	-0.01092	0.02688	-0.00023	0.00000	0.00000
	3	0.07262	-0.01212	0.01899	-0.00025	-0.00002	-0.00052
	4	0.80174	-0.01184	-0.00001	-0.00025	-0.00024	-0.00577
	5	0.00000	0.01913	0.20625	0.00039	0.00000	0.00000
	6	0.56525	0.01009	0.14605	0.00020	-0.00016	-0.00407
	7	0.80177	-0.01178	0.00448	-0.00024	-0.00024	-0.00577
	8	0.00000	0.01918	0.21073	0.00039	0.00000	0.00000
	9	0.56527	0.01014	0.15053	0.00021	-0.00016	-0.00407
	10	0.12613	-0.01184	-0.00001	-0.00025	0.00000	-0.00079
	11	0.00000	-0.00712	0.05397	-0.00016	0.00000	0.00000
	12	0.08931	-0.00849	0.03822	-0.00019	0.00000	-0.00056
4	1	0.10260	-0.01314	-0.00001	-0.00031	-0.00003	-0.00074
	2	0.00000	-0.00957	0.02688	-0.00023	0.00000	0.00000
	3	0.07249	-0.01062	0.01899	-0.00025	-0.00002	-0.00052
	4	0.80028	-0.01036	-0.00001	-0.00025	-0.00024	-0.00577
	5	0.00000	0.01678	0.20625	0.00039	0.00000	0.00000
	6	0.56428	0.00886	0.14605	0.00020	-0.00016	-0.00407
	7	0.80031	-0.01031	0.00448	-0.00024	-0.00024	-0.00577
	8	0.00000	0.01683	0.21073	0.00039	0.00000	0.00000
	9	0.56430	0.00891	0.15053	0.00021	-0.00016	-0.00407
	10	0.12613	-0.01036	-0.00001	-0.00025	0.00000	-0.00079

MAX Δx HORIZONTAL MEMBER

JOINT DISPLACEMENT (INCH RADIANS) STRUCTURE TYPE = SPACE

JOINT	LOAD	X-TRANS	Y-TRANS	Z-TRANS	X-ROTAN	Y-ROTAN	Z-ROTAN	
	11	0.00000	-0.00615	0.05397	-0.00016	0.00000	0.00000	
	12	0.08931	-0.00738	0.03822	-0.00019	0.00000	-0.00056	
5	1	0.10130	-0.00079	-0.00001	-0.00012	-0.00002	-0.00072	
	2	0.00000	-0.00069	0.02688	-0.00006	0.00000	0.00000	
	3	0.07158	-0.00072	0.01898	-0.00008	-0.00001	-0.00051	
	4	0.79007	-0.00057	-0.00001	-0.00010	-0.00013	-0.00564	
	5	0.00000	0.00026	0.20620	0.00036	0.00000	0.00000	
	6	0.55752	0.00002	0.14601	0.00023	-0.00008	-0.00398	
	7	0.79009	-0.00058	0.00448	-0.00009	-0.00013	-0.00564	MAX Δ VERTICAL MEMBER
	8	0.00000	0.00025	0.21068	0.00037	0.00000	0.00000	
	9	0.55752	0.00001	0.15050	0.00023	-0.00008	-0.00398	
	10	0.12613	-0.00057	-0.00001	-0.00010	0.00000	-0.00079	
	11	0.00000	-0.00043	0.05397	-0.00001	0.00000	0.00000	
	12	0.08932	-0.00047	0.03822	-0.00004	0.00000	-0.00056	
6	1	0.10100	0.00091	0.00000	0.00000	0.00000	-0.00073	
	2	0.00000	0.00091	0.02689	-0.00002	0.00000	0.00000	
	3	0.07138	0.00091	0.01900	-0.00001	0.00000	-0.00052	
	4	0.78771	0.00081	0.00000	0.00000	0.00000	-0.00571	
	5	0.00000	0.00081	0.20623	-0.00014	0.00000	0.00000	
	6	0.55633	0.00081	0.14604	-0.00010	0.00001	-0.00403	
	7	0.78771	0.00184	0.00449	-0.00005	0.00000	-0.00571	
	8	0.00000	0.00183	0.21072	-0.00018	0.00000	0.00000	
	9	0.55633	0.00184	0.15053	-0.00014	0.00001	-0.00403	
	10	0.12613	0.00081	0.00000	0.00000	0.00000	-0.00079	
	11	0.00000	0.00081	0.05398	-0.00003	0.00000	0.00000	
	12	0.08934	0.00081	0.03823	-0.00002	0.00000	-0.00056	
7	1	0.10130	-0.00079	0.00001	0.00012	0.00002	-0.00072	
	2	0.00000	-0.00090	0.02690	0.00018	0.00000	0.00000	
	3	0.07160	-0.00087	0.01901	0.00016	0.00001	-0.00051	
	4	0.79007	-0.00057	0.00001	0.00010	0.00013	-0.00564	
	5	0.00000	-0.00140	0.20622	0.00055	0.00000	0.00000	
	6	0.55849	-0.00116	0.14603	0.00042	0.00010	-0.00399	
	7	0.79006	-0.00056	0.00454	0.00018	0.00013	-0.00564	
	8	0.00000	-0.00140	0.21075	0.00064	0.00000	0.00000	
	9	0.55848	-0.00115	0.15056	0.00051	0.00010	-0.00399	
	10	0.12613	-0.00057	0.00001	0.00010	0.00000	-0.00079	
	11	0.00000	-0.00071	0.05399	0.00018	0.00000	0.00000	
	12	0.08935	-0.00067	0.03824	0.00016	0.00000	-0.00056	
8	1	0.10260	-0.01314	0.00001	0.00031	0.00003	-0.00074	
	2	0.00000	-0.01672	0.02690	0.00039	0.00000	0.00000	
	3	0.07252	-0.01567	0.01901	0.00037	0.00002	-0.00052	
	4	0.80028	-0.01036	0.00001	0.00025	0.00024	-0.00577	
	5	0.00000	-0.03749	0.20626	0.00088	0.00000	0.00000	
	6	0.56617	-0.02957	0.14606	0.00070	0.00018	-0.00408	
	7	0.80026	-0.01922	0.00458	0.00053	0.00024	-0.00577	
	8	0.00000	-0.04634	0.21083	0.00117	0.00000	0.00000	MAX ΔZ HORIZONTAL MEMBER

JOINT DISPLACEMENT (INCH RADIANS) STRUCTURE TYPE = SPACE

JOINT	LOAD	X-TRANS	Y-TRANS	Z-TRANS	X-ROTAN	Y-ROTAN	Z-ROTAN	
	9	0.56615	-0.03843	0.15063	0.00098	0.00018	-0.00408	
	10	0.12613	-0.01036	0.00001	0.00025	0.00000	-0.00079	
	11	0.00000	-0.01457	0.05399	0.00033	0.00000	0.00000	
	12	0.08936	-0.01334	0.03824	0.00031	0.00000	-0.00056	
9	1	0.10278	-0.01501	0.00001	0.00031	0.00003	-0.00074	
	2	0.00000	-0.01909	0.02690	0.00039	0.00000	0.00000	
	3	0.07265	-0.01789	0.01901	0.00037	0.00002	-0.00052	
	4	0.80174	-0.01184	0.00001	0.00025	0.00024	-0.00577	
	5	0.00000	-0.04278	0.20626	0.00088	0.00000	0.00000	
	6	0.56725	-0.03375	0.14606	0.00070	0.00018	-0.00408	
	7	0.80171	-0.02240	0.00458	0.00053	0.00024	-0.00577	
	8	0.00000	-0.05333	0.21083	0.00117	0.00000	0.00000	MAX ΔY HORIZONTAL MEMBER
	9	0.56723	-0.04431	0.15063	0.00098	0.00018	-0.00408	
	10	0.12613	-0.01184	0.00001	0.00025	0.00000	-0.00079	
	11	0.00000	-0.01656	0.05399	0.00033	0.00000	0.00000	
	12	0.08936	-0.01518	0.03824	0.00031	0.00000	-0.00056	

********** END OF LATEST ANALYSIS RESULT **********

175. UNIT FEET KIP
176. PRINT SUPPORT REACTION ALL

SUPPORT REACTIONS -UNIT KIP FEET STRUCTURE TYPE = SPACE

JOINT	LOAD	FORCE-X	FORCE-Y	FORCE-Z	MOM-X	MOM-Y	MOM Z	
1	1	-0.15	1.62	-0.05	-0.28	0.01	1.88	
	2	0.00	1.46	-0.17	-1.17	0.00	0.00	
	3	-0.10	1.51	-0.14	-0.90	0.01	1.33	
	4	-1.15	1.14	-0.04	-0.22	0.09	14.67	
	5	0.00	-0.08	-0.99	-7.06	0.00	0.00	
	6	-0.81	0.28	-0.71	-5.06	0.06	10.36	
	7	-1.15	1.16	-0.06	-0.37	0.10	14.67	MAX MOMENT CASE FOR D.P. DESIG
	8	0.00	-0.06	-1.01	-7.21	0.00	0.00	
	9	-0.81	0.29	-0.73	-5.21	0.06	10.36	
	10	-0.24	1.14	-0.04	-0.22	0.00	2.77	
	11	0.00	0.94	-0.28	-2.16	0.00	0.00	
	12	-0.17	1.00	-0.21	-1.59	0.00	1.96	
2	1	-0.15	1.62	0.05	0.28	-0.01	1.88	
	2	0.00	1.78	-0.07	-0.61	0.00	0.00	
	3	-0.10	1.73	-0.04	-0.35	-0.01	1.33	
	4	-1.15	1.14	0.04	0.22	-0.09	14.67	
	5	0.00	2.36	-0.91	-6.62	0.00	0.00	MAX VERTICAL CASE FOR D.P. DESIGN
	6	-0.81	2.01	-0.63	-4.62	-0.07	10.36	
	7	-1.15	1.13	0.06	0.27	-0.09	14.67	
	8	0.00	2.35	-0.89	-6.57	0.00	0.00	
	9	-0.81	1.99	-0.61	-4.58	-0.07	10.36	
	10	-0.24	1.14	0.04	0.22	0.00	2.77	
	11	0.00	1.35	-0.20	-1.72	0.00	0.00	
	12	-0.17	1.29	-0.13	-1.15	0.00	1.96	

********** END OF LATEST ANALYSIS RESULT **********

177. FINISH

********** END OF THE STAAD.Pro RUN **********

**** DATE= DEC 11,2017 TIME= 13:11:39 ****

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************************************************************
*        For questions on STAAD.Pro, please contact        *
*        Bentley Systems or Partner offices                *
*                                                          *
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*  FRANCE    +33 (0) 1 55238400                            *
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*                                                          *
*  Worldwide  http://selectservices.bentley.com/en-US/     *
*                                                          *
************************************************************
```

Deflection Check

Max Horizontal Δ of Horizontal Member = 0.80177" x-dir [JT3 LC7]

Allowable = $L/100 = \frac{(2\times4)\times12}{100} = 0.96" > 0.80177"$ OK ✓

Max Vertical Δ of Horizontal Member = 0.05333" y-dir [JT9 LC8]

Allowable = $L/200 = \frac{(2\times4)(12)}{200} = 0.48" > 0.05333"$ OK ✓

Max Horizontal Δ of Vertical Members = 0.79009" x-dir [JT5 LC7]

Allowable = $L/100 = \frac{17.125\times12}{100} = 2.055" > 0.79009"$ OK ✓

Loading for Caisson from STAAD

	Vert	Moment	Shear
Max Vert	2.36k	6.62k	0.91k
Max Moment	1.16k	14.67k-ft	1.15k

Values to use for Caisson Input [1.6x factor]

	Vert	Moment	Shear
Max Vert	3.78k	10.59k-ft	1.46k
Max Moment	1.86k	23.47k-ft	1.84k

This MathCAD document is used to calculate the following:

1. Base Plate thickness for bearing type(Square Tube Column)
2. Checks Anchor bolt Diameter & Edge Distance
3. Checks Fillet Weld Size

References which are used for the base plate design are:

1. AISC UNIFIED Construction Manual, 13th Edition.

ASD Design Factors

$\Omega_{BP} := 1.67$ $\Omega_{AB} := 2.00$

Definition of Units

$kip \equiv 1000 \cdot lb$ $kin \equiv kip \cdot in$ $ksi \equiv \frac{kip}{in^2}$ $psi \equiv \frac{lb}{in^2}$

Determine Plate Dimensions

Depth of Column

Dimensions for Column used: HSS8x8x3/8

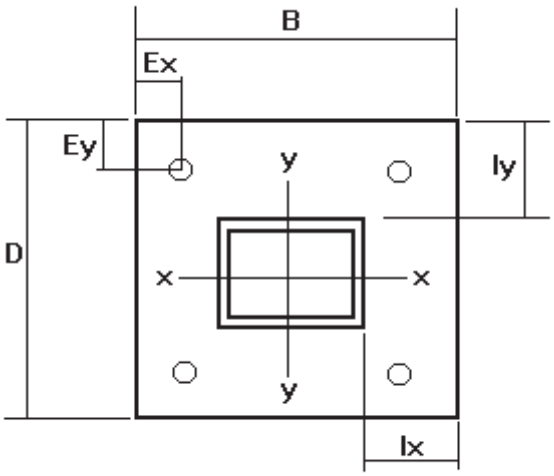
$d := 8 \cdot in$ $tw := 0.375 \cdot in$

$bf := 8 \cdot in$ $tf := 0.375 \cdot in$

Enter the dimensions for the plate.

$B := 17 \cdot in$ $Ex := 2 \cdot in$

$D := 17 \cdot in$ $Ey := 2 \cdot in$



Design Forces ***(Wind From X-Dir)***

$Axial := 1.14 \cdot kip$

$Fx := 0.04 \cdot kip$ $My := 2.63 \cdot kin$

$Fy := 1.15 \cdot kip$ $Mx := 176.04 \cdot kin$

Base Plate and Anchor Bolt Material Properties.

$fy_{BP} := 36.0 \cdot ksi$ *Yield Stress of Base Plate.*

$fu_{AB} := 58.0 \cdot ksi$ *Tensile Stress of Anchor Bolt (58ksi for A36)*

Estimated Anchor Bolts:

$AB_Dia := 1.00 \cdot in$ $A_{AB} := \left(\frac{\pi}{4}\right) \cdot AB_Dia^2$ $A_{AB} = 0.785 \cdot in^2$

The nominal tensile and shear stress for the bolts is based on the formula from page 16.1-104 of the 13th Edition of the AISC UNIFIED manual.

$F_{nt} := 0.75 \cdot fu_{AB}$ $F_{nt} = 43.5 \cdot ksi$

$F_{nv} := 0.40 \cdot fu_{AB}$ $F_{nv} = 23.2 \cdot ksi$

Determine Plate Thickness for Leveling Nut Base Plate.

A. Proportion Axial Force

$P_Ax := \frac{Axial}{4}$ $P_Ax = 0.3 \cdot kip$

B. Determine Bolt Forces due to Mx (for two bolts in compression)

$FC_Mx := \frac{Mx}{D - 2 \cdot Ey}$ $FC_Mx = 13.5 \cdot kip$

$P_Mx := 2 \cdot P_Ax + FC_Mx$ $P_Mx = 14.1 \cdot kip$

C. Determine Bolt Forces due to My (for two bolts in compression)

$FC_My := \frac{My}{B - 2 \cdot Ex}$ $FC_My = 0.2 \cdot kip$

$P_My := 2 \cdot P_Ax + FC_My$ $P_My = 0.8 \cdot kip$

D. Determine Thickness Required for Mx

$l_Mx := \frac{D - 2 \cdot Ey - d}{2}$ $l_Mx = 2.5 \cdot in$

$M_Mx := P_Mx \cdot l_Mx$ $M_Mx = 35.3 \cdot kin$

$t_Mx := \sqrt{\frac{\Omega_{BP} \cdot 4 \cdot M_Mx}{fy_{BP} \cdot B}}$ $t_Mx = 0.6 \cdot in$

E. Determine Thickness Required for My

$$l_My := \frac{B - 2 \cdot Ex - bf}{2} \qquad l_My = 2.5 \cdot in$$

$$M_My := P_My \cdot l_My \qquad M_My = 1.9 \cdot kin$$

$$t_My := \sqrt{\frac{\Omega_{BP} \cdot 4 \cdot M_My}{fy_{BP} \cdot D}} \qquad t_My = 0.1 \cdot in$$

F. Determine Total Plate Thickness Required

$$t_min := \sqrt{t_Mx^2 + t_My^2} \qquad t_min = 0.637 \cdot in$$

Check Anchor Bolt Diameter:

Calculate the Actual Tension per Bolt.

$$Max_Tension := \frac{FC_Mx + FC_My}{2} - P_Ax \qquad Max_Tension = 6.6 \cdot kip$$

Calculate the Allowable Tension per Bolt

$$R_{nt} := F_{nt} \cdot A_{AB} \qquad R_{nt} = 34.2 \cdot kip$$

$$Allowable_Tension := \frac{R_{nt}}{\Omega_{AB}} \qquad Allowable_Tension = 17.1 \cdot kip$$

Tension_Check = "OK"

Calculate the Actual Shear per Bolt.

$$Max_Shear := \frac{\sqrt{\left(Fy^2 + Fx^2\right)}}{4} \qquad Max_Shear = 0.288 \cdot kip$$

Calculate the Allowable Shear per Bolt.

$$R_{nv} := F_{nv} \cdot A_{AB} \qquad R_{nv} = 18.2 \cdot kip$$

$$Allowable_Shear := \frac{R_{nv}}{\Omega_{AB}} \qquad Allowable_Shear = 9.1 \cdot kip$$

Shear_Check = "OK"

Calculate the Allowable Combined Tension and Shear.

The combo check for tension and shear is a unity calculation. The equation result must be less than 1.00.

$$Unity_Calc := \left(\frac{Max_Tension}{Allowable_Tension}\right)^2 + \left(\frac{Max_Shear}{Allowable_Shear}\right)^2 = 0.15$$

Combo_Check = "OK"

Minimum Edge distance check (From Table J3.4). Minimum Edge Distance Must Be Greater than the Actual Bolt Hole Distances.

$AB_Dia = 1 \cdot in$

$Min_Edge = 1\frac{3}{4} \cdot in$ $Ex = 2 \cdot in$ $Ey = 2 \cdot in$

Edge_Check = "OK"

2" Edge Distance OK per note "a" from AISC Table J3.4

Determine Fillet Weld Size Required:

This design procedure is from Blodgett Section 7.4. The weld is treated as a line.

Calculate the the length of the welds, using the formulas contained in Table 5.

For Square Tubes:

$Swx := (bf) \cdot d + \frac{d^2}{3}$ $Swx = 85.333 \cdot in^2$

$Swy := bf \cdot d + \frac{(bf)^2}{3}$ $Swy = 85.333 \cdot in^2$

Calculate the stress for each direction:

$fmx := \frac{Mx}{Swx}$ $fmx = 2.063 \cdot \frac{kip}{in}$

$fmy := \frac{My}{Swy}$ $fmy = 0.031 \cdot \frac{kip}{in}$

Calculate the combined stress:

$f_act := \sqrt{(fmx^2 + fmy^2)}$ $f_act = 2.063 \cdot \frac{kip}{in}$

Allowable for fillet welds and A36 materialfor E70 weld material per AISC UNIFIED is 0.30(weld material)(0.707 for throat)=14850 psi..

The weld size required is determined by dividing the actual stress by the allowable stress.

$$w_reqd := \frac{f_act}{14850 \cdot psi} \qquad w_reqd = 0.139 \cdot in$$

Check Table J2.4 of the AISC ASD manual to check if w_reqd is greater than the minimum size required.

$tf = 0.375 \cdot in$ $tw = 0.375 \cdot in$ $t_min = 0.637 \cdot in$

Values to be Used:

Plate Thickness = 1 inch
Anchor Bolt = 1 inch diameter
Weld Size = 5/16 inch all around

This MathCAD document is used to calculate the following:

1. Base Plate thickness for bearing type(Square Tube Column)
2. Checks Anchor bolt Diameter & Edge Distance
3. Checks Fillet Weld Size

References which are used for the base plate design are:

1. AISC UNIFIED Construction Manual, 13th Edition.

ASD Design Factors

$\Omega_{BP} := 1.67$ $\Omega_{AB} := 2.00$

Definition of Units

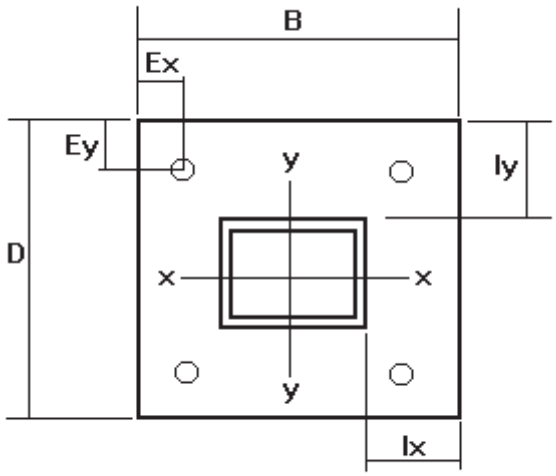
$kip \equiv 1000 \cdot lb$ $kin \equiv kip \cdot in$ $ksi \equiv \frac{kip}{in^2}$ $psi \equiv \frac{lb}{in^2}$

Determine Plate Dimensions

Depth of Column
Dimensions for Column used: HSS8x8x3/8

$d := 8 \cdot in$ $tw := 0.375 \cdot in$

$bf := 8 \cdot in$ $tf := 0.375 \cdot in$



Enter the dimensions for the plate.

$B := 17 \cdot in$ $Ex := 2 \cdot in$

$D := 17 \cdot in$ $Ey := 2 \cdot in$

Design Forces ***(Wind From 45-Deg)***

$Axial := 0.29 \cdot kip$

$Fx := 0.73 \cdot kip$ $My := 62.54 \cdot kin$

$Fy := 0.81 \cdot kip$ $Mx := 124.28 \cdot kin$

Base Plate and Anchor Bolt Material Properties.

$fy_{BP} := 36.0 \cdot ksi$ *Yield Stress of Base Plate.*

$fu_{AB} := 58.0 \cdot ksi$ *Tensile Stress of Anchor Bolt (58ksi for A36)*

Estimated Anchor Bolts:

$AB_Dia := 1.00 \cdot in$ $A_{AB} := \left(\frac{\pi}{4}\right) \cdot AB_Dia^2$ $A_{AB} = 0.785 \cdot in^2$

The nominal tensile and shear stress for the bolts is based on the formula from page 16.1-104 of the 13th Edition of the AISC UNIFIED manual.

$F_{nt} := 0.75 \cdot fu_{AB}$ $F_{nt} = 43.5 \cdot ksi$

$F_{nv} := 0.40 \cdot fu_{AB}$ $F_{nv} = 23.2 \cdot ksi$

Determine Plate Thickness for Leveling Nut Base Plate.

A. Proportion Axial Force

$P_Ax := \frac{Axial}{4}$ $P_Ax = 0.1 \cdot kip$

B. Determine Bolt Forces due to Mx (for two bolts in compression)

$FC_Mx := \frac{Mx}{D - 2 \cdot Ey}$ $FC_Mx = 9.6 \cdot kip$

$P_Mx := 2 \cdot P_Ax + FC_Mx$ $P_Mx = 9.7 \cdot kip$

C. Determine Bolt Forces due to My (for two bolts in compression)

$FC_My := \frac{My}{B - 2 \cdot Ex}$ $FC_My = 4.8 \cdot kip$

$P_My := 2 \cdot P_Ax + FC_My$ $P_My = 5 \cdot kip$

D. Determine Thickness Required for Mx

$l_Mx := \frac{D - 2 \cdot Ey - d}{2}$ $l_Mx = 2.5 \cdot in$

$M_Mx := P_Mx \cdot l_Mx$ $M_Mx = 24.3 \cdot kin$

$t_Mx := \sqrt{\frac{\Omega_{BP} \cdot 4 \cdot M_Mx}{fy_{BP} \cdot B}}$ $t_Mx = 0.5 \cdot in$

E. Determine Thickness Required for My

$l_My := \frac{B - 2 \cdot Ex - bf}{2}$ $l_My = 2.5 \cdot in$

$M_My := P_My \cdot l_My$ $M_My = 12.4 \cdot kin$

$$t_My := \sqrt{\frac{\Omega_{BP} \cdot 4 \cdot M_My}{fy_{BP} \cdot D}} \qquad t_My = 0.4 \cdot in$$

F. Determine Total Plate Thickness Required

$$t_min := \sqrt{t_Mx^2 + t_My^2} \qquad t_min = 0.633 \cdot in$$

Check Anchor Bolt Diameter:

Calculate the Actual Tension per Bolt.

$$Max_Tension := \frac{FC_Mx + FC_My}{2} - P_Ax \qquad Max_Tension = 7.1 \cdot kip$$

Calculate the Allowable Tension per Bolt

$$R_{nt} := F_{nt} \cdot A_{AB} \qquad R_{nt} = 34.2 \cdot kip$$

$$Allowable_Tension := \frac{R_{nt}}{\Omega_{AB}} \qquad Allowable_Tension = 17.1 \cdot kip$$

Tension_Check = "OK"

Calculate the Actual Shear per Bolt.

$$Max_Shear := \frac{\sqrt{\left(Fy^2 + Fx^2\right)}}{4} \qquad Max_Shear = 0.273 \cdot kip$$

Calculate the Allowable Shear per Bolt.

$$R_{nv} := F_{nv} \cdot A_{AB} \qquad R_{nv} = 18.2 \cdot kip$$

$$Allowable_Shear := \frac{R_{nv}}{\Omega_{AB}} \qquad Allowable_Shear = 9.1 \cdot kip$$

Shear_Check = "OK"

Calculate the Allowable Combined Tension and Shear.

The combo check for tension and shear is a unity calculation. The equation result must be less than 1.00.

$$Unity_Calc := \left(\frac{Max_Tension}{Allowable_Tension}\right)^2 + \left(\frac{Max_Shear}{Allowable_Shear}\right)^2 = 0.174$$

Combo_Check = "OK'

Minimum Edge distance check (From Table J3.4). Minimum Edge Distance Must Be Greater than the Actual Bolt Hole Distances.

AB_Dia = 1·in

Min_Edge = $1\frac{3}{4}\cdot$in Ex = 2·in Ey = 2·in

Edge_Check = "OK"

2" Edge Distance OK per note "a" from AISC Table J3.4

Determine Fillet Weld Size Required:

This design procedure is from Blodgett Section 7.4. The weld is treated as a line.

Calculate the the length of the welds, using the formulas contained in Table 5.

For Square

$Swx := (bf)\cdot d + \frac{d^2}{3}$ $Swx = 85.333\cdot in^2$

$Swy := bf\cdot d + \frac{(bf)^2}{3}$ $Swy = 85.333\cdot in^2$

Calculate the stress for each direction:

$fmx := \frac{Mx}{Swx}$ $fmx = 1.456\cdot\frac{kip}{in}$

$fmy := \frac{My}{Swy}$ $fmy = 0.733\cdot\frac{kip}{in}$

Calculate the combined stress:

$f_act := \sqrt{(fmx^2 + fmy^2)}$ $f_act = 1.63\cdot\frac{kip}{in}$

Allowable for fillet welds and A36 materialfor E70 weld material per AISC UNIFIED is 0.30(weld material)(0.707 for throat)=14850 psi..

The weld size required is determined by dividing the actual stress by the allowable stress.

$w_reqd := \frac{f_act}{14850\cdot psi}$ $w_reqd = 0.11\cdot in$

Check Table J2.4 of the AISC ASD manual to check if w_reqd is greater than the minimum size required.

$tf = 0.375 \cdot in$ $tw = 0.375 \cdot in$ $t_min = 0.633 \cdot in$

Values to be Used:

Plate Thickness = 1 inch
Anchor Bolt = 1 inch diameter
Weld Size = 5/16 inch all around

This MathCAD document is used to calculate the following:

1. Top Plate thickness for bearing and flexure (Square Tube Column)
2. Checks Equipment Bolt Diameter & Edge Distance
3. Checks Fillet Weld Size

References which are used for the top plate design are:

1. AISC UNIFIED Construction Manual, 13th Edition.

ASD Design Factors

$\Omega_{TP} := 1.67$ $\Omega_{EB} := 2.00$

Definition of Units

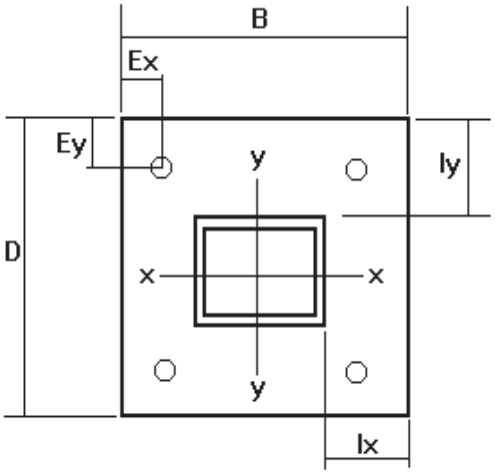
$kip \equiv 1000 \cdot lb$ $kin \equiv kip \cdot in$ $ksi \equiv \frac{kip}{in^2}$ $psi \equiv \frac{lb}{in^2}$

Determine Plate Dimensions

Dimensions for Column used: HSS8x8x3/8

$d := 8 \cdot in$ $tw := 0.375 \cdot in$

$bf := 8 \cdot in$ $tf := 0.375 \cdot in$



Enter the dimensions for the plate.

$B := 14 \cdot in$ $Ex := 1.5 \cdot in$

$D := 14 \cdot in$ $Ey := 1.5 \cdot in$

Design Forces ***(Wind From Z-Dir)***

$Axial := 0.67 \cdot kip$

$Fx := 0.37 \cdot kip$ $My := 54.29 \cdot kin$

$Fy := 0 \cdot kip$ $Mx := 0 \cdot kin$

Top Plate and Equipment Bolt Material Properties.

$fy_{TP} := 36.0 \cdot ksi$ *Yield Stress of Top Plate.*

$fu_{EB} := 58.0 \cdot ksi$ *Tensile Stress of Equipment Bolt (58ksi for A36)*

Estimated Equipment Bolts:

$EB_Dia := .625 \cdot in$ $A_{EB} := \left(\frac{\pi}{4}\right) \cdot EB_Dia^2$ $A_{EB} = 0.307 \cdot in^2$

The nominal tensile and shear stress for the bolts is based on the formula from page 16.1-104 of the 13th Edition of the AISC UNIFIED manual.

$F_{nt} := 0.75 \cdot fu_{EB}$ $F_{nt} = 43.5 \cdot ksi$

$F_{nv} := 0.40 \cdot fu_{EB}$ $F_{nv} = 23.2 \cdot ksi$

Determine Plate Thickness for Equipment Top Plate.

A. Proportion Axial Force

$$P_Ax := \frac{Axial}{4} \qquad P_Ax = 0.2 \cdot kip$$

B. Determine Bolt Forces due to Mx (for two bolts in compression)

$$FC_Mx := \frac{Mx}{D - 2 \cdot Ey} \qquad FC_Mx = 0 \cdot kip$$

$$P_Mx := 2 \cdot P_Ax + FC_Mx \qquad P_Mx = 0.3 \cdot kip$$

C. Determine Bolt Forces due to My (for two bolts in compression)

$$FC_My := \frac{My}{B - 2 \cdot Ex} \qquad FC_My = 4.9 \cdot kip$$

$$P_My := 2 \cdot P_Ax + FC_My \qquad P_My = 5.3 \cdot kip$$

D. Determine Thickness Required for Mx

$$l_Mx := \frac{D - 2 \cdot Ey - d}{2} \qquad l_Mx = 1.5 \cdot in$$

$$M_Mx := P_Mx \cdot l_Mx \qquad M_Mx = 0.5 \cdot kin$$

$$t_Mx := \sqrt{\frac{\Omega_{TP} \cdot 4 \cdot M_Mx}{fy_{TP} \cdot B}} \qquad t_Mx = 0.1 \cdot in$$

E. Determine Thickness Required for My

$$l_My := \frac{B - 2 \cdot Ex - bf}{2} \qquad l_My = 1.5 \cdot in$$

$$M_My := P_My \cdot l_My \qquad M_My = 7.9 \cdot kin$$

$$t_My := \sqrt{\frac{\Omega_{TP} \cdot 4 \cdot M_My}{fy_{TP} \cdot D}} \qquad t_My = 0.32 \cdot in$$

F. Determine Total Plate Thickness Required

$$t_min := \sqrt{t_Mx^2 + t_My^2} \qquad t_min = 0.334 \cdot in$$

Check Equipment Bolt Diameter:

Calculate the Actual Tension per Bolt.

$$Max_Tension := \frac{FC_Mx + FC_My}{2} - P_Ax \qquad Max_Tension = 2.3\cdot kip$$

Calculate the Allowable Tension per Bolt.

$$R_{nt} := F_{nt}\cdot A_{EB} \qquad R_{nt} = 13.3\cdot kip$$

$$Allowable_Tension := \frac{R_{nt}}{\Omega_{EB}} \qquad Allowable_Tension = 6.7\cdot kip$$

Tension_Check = "OK"

Calculate the Actual Shear per

$$Max_Shear := \frac{\sqrt{\left(Fy^2 + Fx^2\right)}}{4} \qquad Max_Shear = 0.093\cdot kip$$

Calculate the Allowable Shear per Bolt.

$$R_{nv} := F_{nv}\cdot A_{EB} \qquad R_{nv} = 7.1\cdot kip$$

$$Allowable_Shear := \frac{R_{nv}}{\Omega_{EB}} \qquad Allowable_Shear = 3.6\cdot kip$$

Shear_Check = "OK"

The combo check for tension and shear is a unity calculation. The equation result must be less than 1.00.

$$Unity_Calc := \left(\frac{Max_Tension}{Allowable_Tension}\right)^2 + \left(\frac{Max_Shear}{Allowable_Shear}\right)^2 = 0.12$$

Combo_Check = "OK"

Minimum Edge distance check (From Table J3.4). Minimum Edge Distance Must Be Greater than the Actual Bolt Hole Distances.

$$EB_Dia = \frac{5}{8}\cdot in$$

$$Min_Edge = 1\frac{1}{8}\cdot in \qquad Ex = 1\frac{1}{2}\cdot in \qquad Ey = 1\frac{1}{2}\cdot in$$

Edge_Check = "OK"

Determine Fillet Weld Size Required:

This design procedure is from Blodgett Section 7.4. The weld is treated as a line.

Calculate the the length of the welds, using the formulas contained in Table 5.

For Square

$Swx := (bf)\cdot d + \frac{d^2}{3}$ $Swx = 85.333\cdot in^2$

$Swy := bf\cdot d + \frac{(bf)^2}{3}$ $Swy = 85.333\cdot in^2$

Calculate the stress for each direction:

$fmx := \frac{Mx}{Swx}$ $fmx = 0\cdot\frac{kip}{in}$

$fmy := \frac{My}{Swy}$ $fmy = 0.636\cdot\frac{kip}{in}$

Calculate the combined stress:

$f_act := \sqrt{(fmx^2 + fmy^2)}$ $f_act = 0.636\cdot\frac{kip}{in}$

Allowable for fillet welds and A36 materialfor E70 weld material per AISC UNIFIED is 0.30(weld material)(0.707 for throat)=14850 psi..

The weld size required is determined by dividing the actual stress by the allowable stress.

$w_reqd := \frac{f_act}{14850\cdot psi}$ $w_reqd = 0.043\cdot in$

Check Table J2.4 of the AISC ASD manual to check if w_reqd is greater than the minimum size required.

$tf = 0.375\cdot in$ $tw = 0.375\cdot in$ $t_min = 0.334\cdot in$

Values to be Used:

Top Plate Thickness = 1/2 inch
Equipment Bolt = 5/8 inch diameter
Weld Size = 5/16 inch all around

Instrument transformers and sensors

Types VOY-20 and VOY-20G
Outdoor voltage transformers

Product features
– 36 kV outdoor, 200 kV BIL, 60 Hertz
– Electrical clearances:
  VOY-20:
  Strike: 16.0" (406 mm)
  Creep: 27.25" (692 mm)
  VOY-20G:
  Strike: 16.0" (406 mm)
  Creep: 27.5" (698 mm)

Application
Types VOY-20 and VOY-20G outdoor voltage transformers are designed for solid-state relaying and electronic metering where the burden of the device is negligible.

Construction features
The layer wound and shielded high voltage winding is designed to withstand continuous operation at 1.9 times the line-to-ground voltage level when applied on a 36 kV, 250 kV BIL system. The core and coil assembly is cast under a vacuum in a polyurethane resin formulated for outdoor service.

Terminals
The primary line terminals are electro-tin plated copper and accommodate #10 to 250 MCM conductors. The H2 neutral terminal of the VOY-20G is insulated to withstand a 19 kV test level and can be disconnected from the external ground cable for power factor measurement.

Secondary terminals are clamp-type and are sized for #14 through #3 wire. A ground terminal is also provided for grounding the secondary circuit at the transformer.

Junction box
The molded junction box has a 1" conduit hub on either end and a knock out for a 1" conduit fitting on the bottom. The box is anchored to the body of the transformer with screws and can easily be detached, simplifying installation and change out procedures.

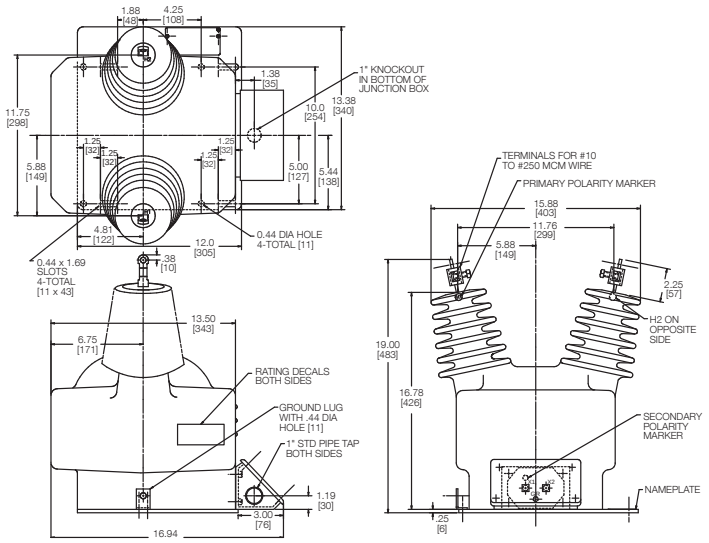
Baseplate
The base is constructed of corrosion-resistant aluminum and is secured to the encapsulated base support.

Mounting
The VOY-20 and VOY-20G can be mounted in the upright or cantilever positions.

Test reports
IEEE test reports are stored electronically and can be e-mailed in various formats at the time of shipment.

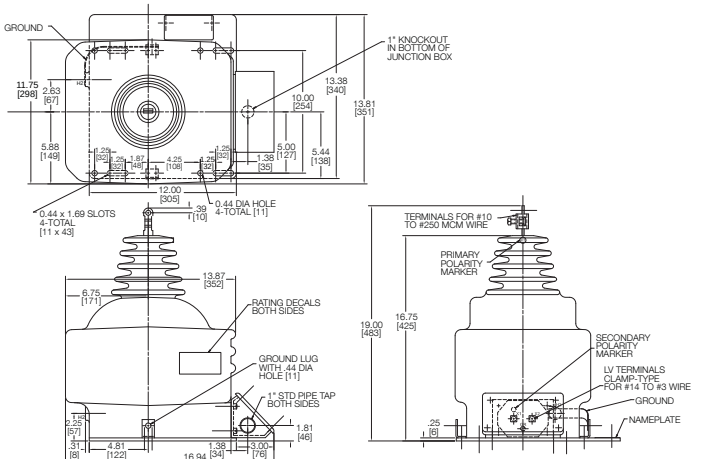
Standards
This unit can be tested to all applicable IEEE, CSA, or IEC standards as requested.

Unit dimensions



Type VOY-20

(Approximate weight: 148 lbs.)



Type VOY-20G

(Approximate weight: 142 lbs.)

Selection guide

Primary voltage	Winding ratio	IEEE metering accuracy	Thermal rating	Style number
VOY-20				
27600/27600Y	240:1	0.3 W, X, M, Y	1000	7881A82G03
34500/34500Y	275:1	0.3 W, X, M, Y	1000	7881A82G04
VOY-20G				
20125/34500GY	175/300:1	0.3 W, X, M, Y	1000	7526A55G01

+ Thermal rating at 30° C

Additional styles available upon request. Contact your ABB sales representative or call +1-252-827-3212 for more information.

For more information please contact:

ABB Inc.
Medium Voltage Distribution Components
3022 NC 43 North
Pinetops, NC 27864
USA
Phone: +1 252 827 3212
Fax: +1 252 827 4286

www.abb.com/mediumvoltage

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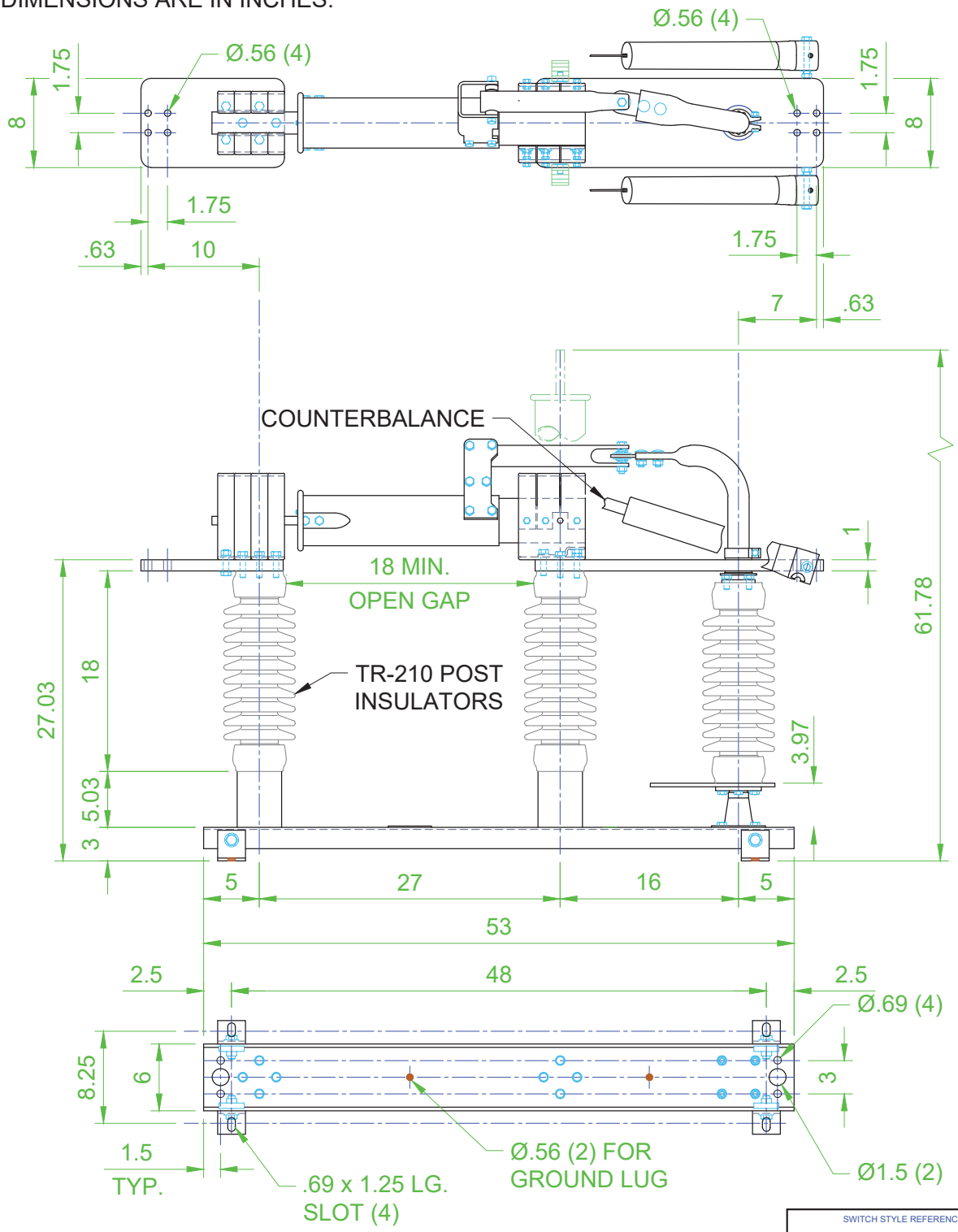
1VAP429742-DB October 2014 Rev. B

NOTES:

1. ALUMINUM TERMINAL PADS.
2. SILVER PLATED CONTACTS.
3. ALL COPPER PARTS ARE TINNED ALL OVER.
4. HOT-DIP GALVANIZED CHANNEL BASE C452A272H002 WITH MOUNTING CLIPS C401A012G002.
5. ALL DIMENSIONS ARE IN INCHES.

kV NOM.	34.5
kV MAX.	38
kV BIL	200
AMPS	3000
MOM kA	120
WT./POLE	495 lbs.



SWITCH STYLE REFERENCE NUMBER	REV
C06A1213G04	-

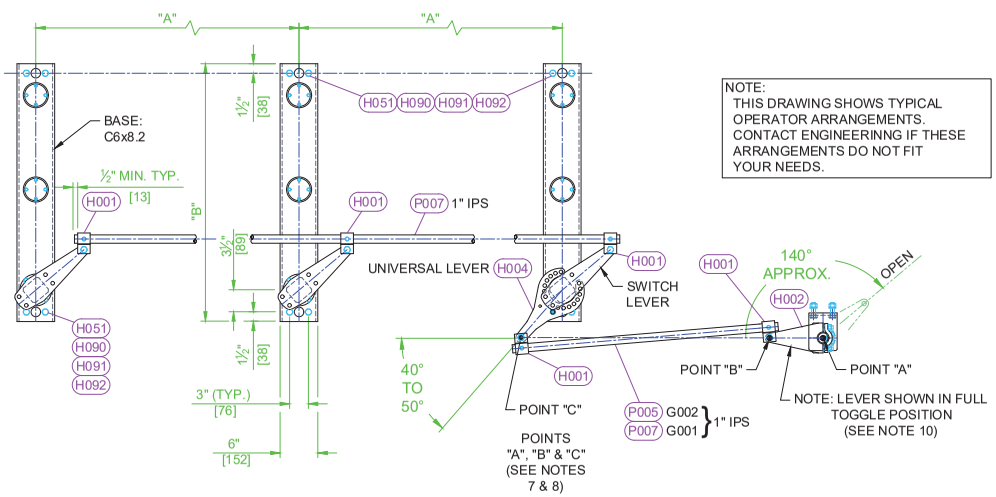
Cleaveland/Price Inc. 14000 Rt. 993 Trafford, PA 15085-9550

DRAWN	DATE	VERSION
MJH	01/08/2018	1

V2-CA ALUMINUM VERTICAL BREAK DISCONNECT SWITCH
34.5kV, 3000A, 3" B.C. INSULATORS, 6" CHANNEL BASE

CHECKED	DRAWING NO.
WRM	C06A2054
APPROVED	

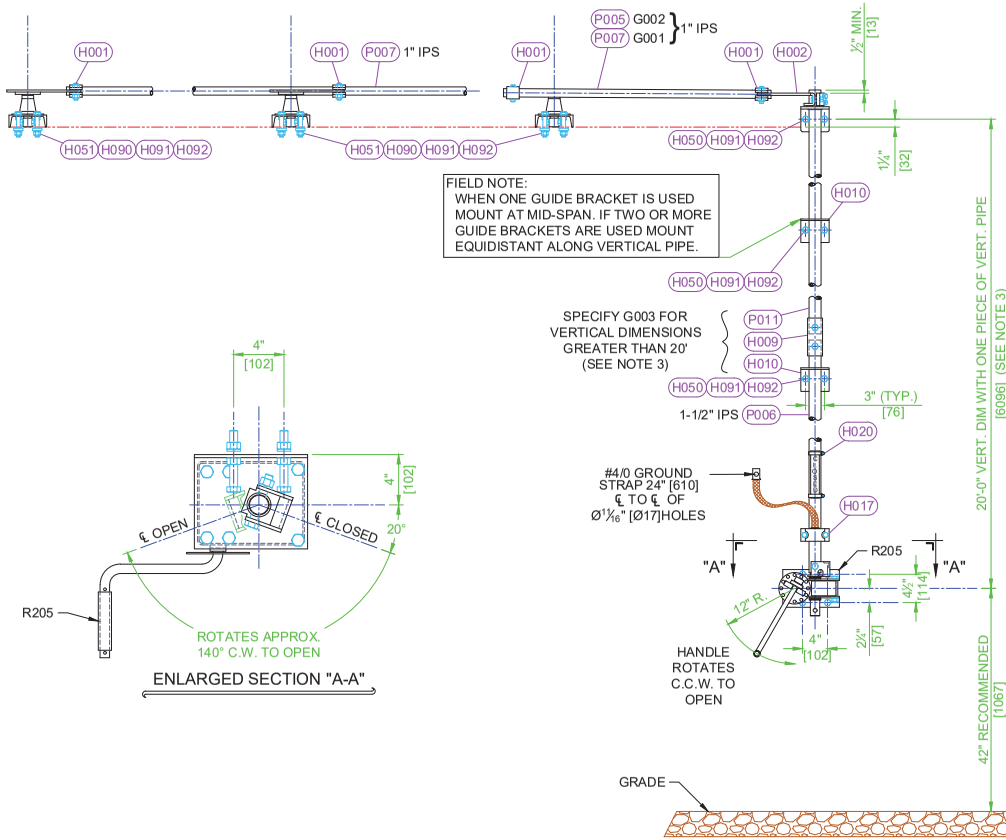
G003	G002	G001	STYLE NO.	SIZE1	SIZE2	DESCRIPTION	ITEM
-	5	5	C110A021G001	1"		1" IPS STANDARD ROD END	H001
-	1	1	C110A158G001	1-1/2"		OUTBOARD BEARING ASSEMBLY CONSISTING OF: (1) LEVER ASSEMBLY (1) CPVC BEARING (1) BRACKET	H002
-	1	1	C110A037G001			UNIVERSAL LEVER ASSEMBLY	H004
-	1	-	GP100-0-0-126	1"		1" IPS DRIVE PIPE - 10'-6" [3200 MM]	P005
-	1	1	GP150-1-1-252	1-1/2"		1-1/2" IPS VERT. PIPE - 21'-0" [6400 MM]	P006
-	1	1	GP100-0-0-252	1"		1" IPS INTERPHASE PIPE - 21'-0" [6400 MM]	P007
1	-	-	C110A030G002	1-1/2"	1-1/2"	1-1/2" IPS COUPLING - GALV.	H009
1	1	1	C110A036H001			1-1/2" IPS GUIDE BRACKET	H010
1	-	-	GP150-1-1-252	1-1/2"		1-1/2" IPS VERT. PIPE - 21'-0" [6400 MM]	P011
-	1	1	C110A202G003	1-1/2"		GROUND STRAP CLAMP ASSEMBLY	H017
-	1	1	C110A366G002	1-1/2"		OPEN/CLOSED INDICATOR	H020
2	4	4	F70100GVUC2			5/8-11 X 2" LG. HEX HEAD BOLT - GALV.	H050
-	12	12	F70100GVUC3T			5/8-11 X 3.5" LG. HEX HEAD BOLT - GALV.	H051
-	12	12	F70599BGU			5/8" SIZE BEVEL WASHER - GALV.	H090
2	16	16	F70210EBUC			5/8-11 HEX NUT - GALV.	H091
2	16	16	F70510CUU			5/8" SIZE SPLIT LOCKWASHER - GALV.	H092
-	1	1	C410A001G013			5/8" SPARE HARDWARE KIT - GALV.	H999
-	1	1	C110A001			GH GEARED HANDCRANK	R205



NOTE:
THIS DRAWING SHOWS TYPICAL OPERATOR ARRANGEMENTS. CONTACT ENGINEERINNG IF THESE ARRANGEMENTS DO NOT FIT YOUR NEEDS.

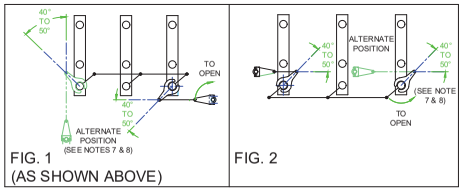
FIELD NOTE:
THE DRIVE LEVER SUPPORTS THE VERTICAL PIPE AND ACTS AS THE BEARING RETAINER. THE LEVER MUST MAINTAIN CONTACT WITH THE BEARING THROUGHOUT SWITCH OPERATION.

kV	GROUP	DIM. "A" ANSI MIN.		DIM. "A" WITH ARC HORN		DIM. "B" BASE LENGTH	
7.2	G001	18	[457]	36	[914]	41	[1041]
14.4	G001	24	[610]	36	[914]	41	[1041]
23	G001	30	[762]	48	[1219]	50	[1270]
34.5	G001	36	[914]	60	[1524]	50	[1270]
46	G002	48	[1219]	72	[1829]	56	[1422]
69	G002	60	[1524]	84	[2134]	66	[1676]



ENLARGED SECTION "A-A"

NOTES:
1. SWITCH & OPERATOR SHOWN IN CLOSED POSITION.
2. PHASE SPACINGS ARE ANSI MINIMUMS.
3. FOR VERTICAL DIMENSIONS ABOVE 20'-0" [6096 MM] SPECIFY G003 FOR EACH ADDITIONAL 21 FT. [6400 MM] REQ'D.
4. FIELD CUT P005 AS REQ'D FROM 21' [6400 MM] LENGTH OF ITEM P007 FOR 7.2 TO 34.5 kV ASSEMBLIES.
5. ALL MOUNTING HOLES 1⁹⁄₁₆ DIA. [17 MM] UNLESS NOTED.
6. SEE INSTRUCTION BOOK FOR OPTIONAL OUTBOARD BEARING MOUNTING ARRANGEMENTS.
7. SET UNIVERSAL LEVER WITHIN SPECIFIED ANGLES AND MOUNT IN PLACE WITH THREE BOLTS.
8. UNIVERSAL LEVER H004 IS ADJUSTABLE IN 18° INCREMENTS TO MAINTAIN A 40° TO 50° ANGLE AND TOGGLE POSITION. BEARING ASSEMBLY MAY BE LOCATED AT ANY DESIRED LOCATION.
9. GALVICON ALL FIELD DRILLED HOLES AND CUT PIPE ENDS.
10. WITH SWITCH CLOSED, LINE UP POINTS "A", "B" AND "C" TO ACHIEVE FULL TOGGLE LINKAGE.
11. ALL DIMENSIONS ARE IN INCHES EXCEPT WHERE NOTED.
12. DIMENSIONS SHOWN IN [ ] ARE IN MM.
13. CUT VERTICAL PIPE OFF APPROX ½" [13] ABOVE OUTBOARD BEARING LEVER TO ALLOW FOR PROPER CLEARANCE WHEN THE LEVER ROTATES.



FOR SWING HANDLE ASSEMBLY C600C020
FOR MOTOR OPERATOR ASSEMBLY C604C020

REV	REVISION	DRAWN	CHECKED	APPROVED	DATE
A	CHG. H020 WAS C110A366G001 ADD LEVER RETAINER NOTE. DP 9-21-95				
B	CHANGED PIPE TO GP CODES. REMOVED H016 CM 10-24-13				
C	ADDED H050, H051, H091, H092, & H999 SPL 05-25-16				
D	ADDED H090. ZJM 10-19-16	DP	GBN	-	02/04/1994

Cleaveland/Price Inc.
14000 Route 993 : Trafford, PA 15085

VERSION	SHEET	SCALE
1	1 OF 1	NONE

TYP V2-C/V2-CA OPER ASSY
7.2/69kV HORIZ MT GEARED HANDCRANK

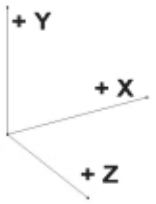
DWG NO. C602C020

Project # :	17.01246	**Ulteig Engineers, Inc**		By:	DAW
Project Title:	Northwest Ohio			Date:	1/24/2018
Item:	34.5kV Switch Stand	**Load Cases**		Checked:	

Load from a horizontally mounted switch or fuse at 2 points
(load is split between 2 nodes)

Equipment: 34.5kV Switch

Orientation: Ypos (Ypos, Yneg; Asuming switches are on Staad x-axis, which grid are the switches in?)



Specifications:

Weight (lbs):	500	(weight of individual piece of equipment with no ice)
Y_{arm} (in):	18	(moment arm; typically half of total height)
C_d (drag):	1.6	(drag coefficiant; 1 for cylinder, 1.6 for square)
$Area_x$ (in^2):	1200	(area wind hits in x-direction)
$Area_z$ (in^2):	280	(area wind hits in z-direction)
D (in):	54	(length between nodes)
k_z:	0.92	(exposure coefficient; table 250-2 NESC)
G_{RF}:	1	(gust response factor = 1)

Loads: NESC Heavy (40 mph wind with 1" ice) and High Wind (90 mph wind)

	NESC	High Wind	
P (psf):	6.4	30.5	(C_d x 4psf NESC, .00256 x k_z x G_{RF} x C_d x $90mph^2$ high wind)
F_y (lbs):	-500.0	-250.0	($^{weight}/_2$; NESC includes 2 for ice)

Wind X-Dir	NESC	High Wind	
F_y (lbs):	**-500.0**	**-250.0**	($^{weight}/_2$; NESC includes 2 for ice)
F_x (lbs):	**26.7**	**127.2**	($^{P}/_2$ x A_x)
M_z (ft-lbs):	**-40.0**	**-190.8**	(F_x x Y_{arm})

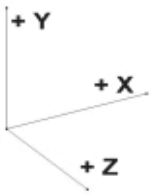
Wind Z-Dir	NESC	High Wind	
F_z (lbs):	**6.2**	**29.7**	($^{P}/_2$ x A_z)
$Couple_y$ (lbs):	4.1	19.8	(2 x F_z x Y_{arm} / D)
$F_{y\ big}$(lbs):	**-504.1**	**-269.8**	($^{weight}/_2$ - $couple_y$; NESC includes 2 for ice)
$F_{y\ small}$(lbs):	**-495.9**	**-230.2**	($^{weight}/_2$ + $couple_y$; NESC includes 2 for ice)

Wind 45 Deg	NESC	High Wind	
F_z (lbs):	**4.4**	**21.0**	($^{P}/_2$ x A_z x sin45)
$Couple_y$ (lbs):	2.9	14.0	(2 x F_z x Y_{arm} / D)
$F_{y\ big}$(lbs):	**-502.9**	**-264.0**	($^{weight}/_2$ - $couple_y$; NESC includes 2 for ice)
$F_{y\ small}$(lbs):	**-497.1**	**-236.0**	($^{weight}/_2$ + $couple_y$; NESC includes 2 for ice)
F_x (lbs):	**18.9**	**89.9**	($^{P}/_2$ x A_x x sin45)
M_z (ft-lbs):	**-28.3**	**-134.9**	(F_x x Y_{arm})

Project # :	17.01246	**Ulteig**	By:	DAW
Project Title:	Northwest Ohio		Date:	1/24/2018
Item:	PT	**NESC Load Cases**	Checked:	

Load from upright single node equipment (insulator, surge arrester, etc.)

Equipment Type: 34.5kV PT



Orientation:	1	(1 Positive Y; -1 Negative Y; Beam runs along X-Axis)
Equip. Weight (lbs):	142	(Dead weight of equipment)
Mom. Arm (in):	12	(Center of support beam to center of equipment)
Shape Factor (C_d):	2	(1.2 Round, 1.6 Hex/Oct, 2.0 Square)
Area X-Dir (in^2):	232	(Wind area in X-direction)
Area Z-Dir (in^2):	232	(Wind area in Z-direction)

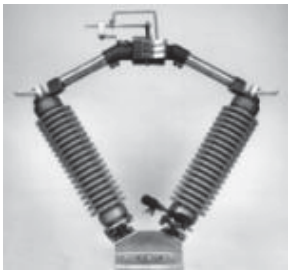
Exposure Coef. (k_z):	0.92	(Per ASCE 7-05, Table 6-3)
Gust Response (G_{RF}):	0.85	(Per ASCE 113)
Ice Weight Factor:	1.5	(Increase in dead weight from ice; Typically 1.5 for 1/2" Ice)
NESC Wind (psf):	4.0	(4 psf per NESC Heavy Loading Zone)
High Wind (psf):	15.9	($0.00256*k_z*G_{RF}*V^2*(K_d = 0.85)*(I = 1.15)$ per ASCE7-05)

Factored NESC Wt:	1.5	(Per NESC Table 253-1 for factored cases ONLY)
Factored NESC Wind:	2.5	(Per NESC Table 253-1 for factored cases ONLY)
Factored Wind Wt:	1.0	(Per NESC Table 253-1 for factored cases ONLY)
Factored High Wind:	1.0	(Per NESC Table 253-1 for factored cases ONLY)

Loads: NESC Heavy (40 mph wind with 1/2 inch ice) and High Wind (90 mph wind)

	Allowable		Factored		
	NESC	**High Wind**	**NESC**	**High Wind**	
Wind Pressure (psf):	9.2	31.7	23.0	31.7	(Total pressure applied to area)

Wind X-Dir	NESC	High Wind	NESC	High Wind
F_y (lbs):	**-213**	**-142**	**-320**	**-142**
F_x (lbs):	**15**	**51**	**37**	**51**
M_z (ft-lbs):	**-15**	**-51**	**-37**	**-51**



Wind Z-Dir	NESC	High Wind	NESC	High Wind
F_y (lbs):	**-213**	**-142**	**-320**	**-142**
F_z (lbs):	**15**	**51**	**37**	**51**
M_x (ft-lbs):	**15**	**51**	**37**	**51**

Wind 45 Deg	NESC	High Wind	NESC	High Wind
F_y (lbs):	**-213**	**-142**	**-320**	**-142**
F_x (lbs):	**10**	**36**	**26**	**36**
F_z (lbs):	**10**	**36**	**26**	**36**
M_z (ft-lbs):	**-10**	**-36**	**-26**	**-36**
M_x (ft-lbs):	**10**	**36**	**26**	**36**

Project # :	17.01246	**Ulteig Engineers**		By:	DAW
Project Title:	Northwest Ohio			Date:	1/24/2018
Item:	34.5kV Switch Stand	**Load Cases**		Checked:	

Load from Wind on Member

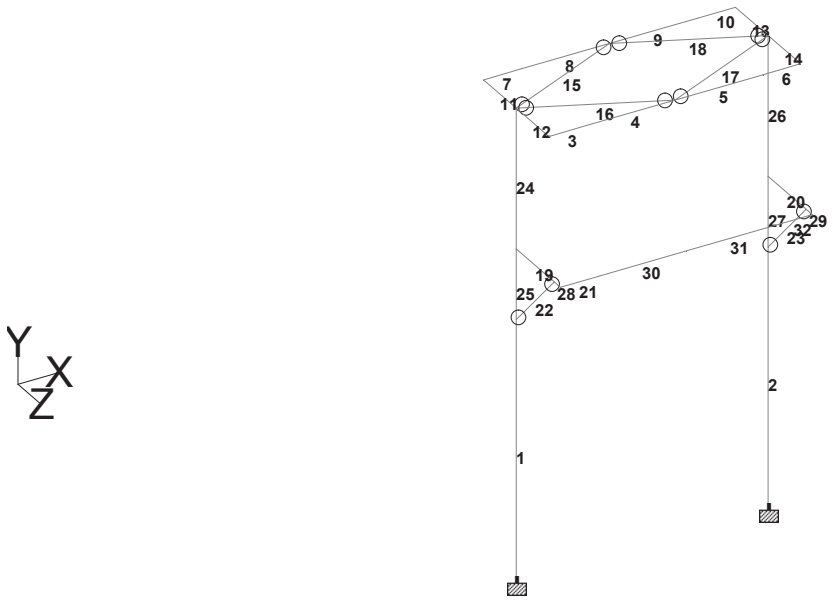
Load Case Constants:

	NESC	High Wind
Wind (psf):	4	20.74
Ice (in):	1	0
C_d (drag):	1.6	1.6

Load on Member (lbs/ft):

Width (in)	NESC	NESC 45°	High Wind	High Wind 45°
2	2.1	1.5	5.5	3.9
3	2.7	1.9	8.3	5.9
4	3.2	2.3	11.1	7.8
5	3.7	2.6	13.8	9.8
6	4.3	3.0	16.6	11.7
7	4.8	3.4	19.4	13.7
8	5.3	3.8	22.1	15.6
9	5.9	4.1	24.9	17.6
10	6.4	4.5	27.7	19.6
11	6.9	4.9	30.4	21.5
12	7.5	5.3	33.2	23.5
13	8.0	5.7	35.9	25.4
14	8.5	6.0	38.7	27.4

Software licensed to Ulteig Engineers	Job No 17.01246	Sheet No 1	Rev
	Part		
Job Title Northwest Ohio	Ref		
	By DAW	Date 1-3-18	Chd
Client	File 34.5kV Switch.std	Date/Time 03-Jan-2018 11:06	



Load 1

```
**************************************************
*                                                *
*           STAAD.Pro V8i SELECTseries4           *
*           Version  20.07.09.21                 *
*           Proprietary Program of               *
*           Bentley Systems, Inc.                *
*           Date=    JAN  4, 2018                *
*           Time=     9:59: 3                    *
*                                                *
*      USER ID: Ulteig Engineers                 *
**************************************************
```

```
     1. STAAD SPACE
INPUT FILE: 34.5kV Switch.STD
     2. START JOB INFORMATION
     3. ENGINEER DATE 1-3-18
     4. JOB NAME NORTHWEST OHIO
     5. JOB NO 17.01246
     6. ENGINEER NAME DAW
     7. END JOB INFORMATION
     8. INPUT WIDTH 79
     9. UNIT FEET POUND
    10. JOINT COORDINATES
    11. 1 0 0 0; 2 0 18.594 0; 3 10 0 0; 4 10 18.594 0; 5 0 18.594 2.25
    12. 6 1.5 18.594 2.25; 7 5 18.594 2.25; 8 8.5 18.594 2.25; 9 10 18.594 2.25
    13. 10 0 18.594 -2.25; 11 1.5 18.594 -2.25; 12 5 18.594 -2.25; 13 8.5 18.594 -2.25
    14. 14 10 18.594 -2.25; 15 0 13 0; 16 10 13 0; 17 0 10.1875 0; 18 10 10.1875 0
    15. 19 0 13 3.042; 20 10 13 3.042; 21 0 13 2.625; 22 10 13 2.625; 23 1.5 13 3.042
    16. 24 5 13 3.042; 25 8.5 13 3.042
    17. MEMBER INCIDENCES
    18. 1 1 17; 2 3 18; 3 5 6; 4 6 7; 5 7 8; 6 8 9; 7 10 11; 8 11 12; 9 12 13
    19. 10 13 14; 11 2 10; 12 2 5; 13 4 14; 14 4 9; 15 2 12; 16 2 7; 17 4 7; 18 4 12
    20. 19 15 21; 20 16 22; 21 19 23; 22 17 21; 23 18 22; 24 15 2; 25 17 15; 26 16 4
    21. 27 18 16; 28 21 19; 29 22 20; 30 23 24; 31 24 25; 32 25 20
    22. DEFINE MATERIAL START
    23. ISOTROPIC STEEL
    24. E 4.176E+009
    25. POISSON 0.3
    26. DENSITY 489.024
    27. ALPHA 6E-006
    28. DAMP 0.03
    29. END DEFINE MATERIAL
    30. MEMBER PROPERTY AMERICAN
    31. 1 2 24 TO 27 TABLE ST W8X31
    32. 3 TO 10 TABLE ST C6X10
    33. 15 TO 18 TABLE ST L20203
    34. 11 TO 14 TABLE ST HSST6X6X0.25
    35. 19 TO 21 28 TO 32 TABLE ST W6X15
    36. 22 23 TABLE ST L25256
    37. CONSTANTS
    38. BETA 180 MEMB 7 TO 10
```

```
39. BETA 45 MEMB 15 17 22 23
40. BETA 315 MEMB 16 18
41. BETA 90 MEMB 1 2 24 TO 27
42. MATERIAL STEEL ALL
43. SUPPORTS
44. 1 3 FIXED
45. MEMBER RELEASE
46. 15 TO 18 22 23 START MY MZ
47. 15 TO 18 22 23 END MY MZ
48. LOAD 1 LOADTYPE NONE  TITLE NESC HEAVY (X-DIR)
49. SELFWEIGHT Y -2
50. *WIND ON STAND
51. MEMBER LOAD
52. 1 2 24 TO 27 UNI GX 5.3
53. 11 TO 14 19 20 28 29 UNI GX 4.3
54. 22 23 UNI GX 2.7
55. JOINT LOAD
56. *SWITCH
57. 6 TO 8 11 TO 13 FX 27 FY -500 MZ -40
58. *JUMPER
59. 6 TO 8 FX 43 FY -15 MZ -21
60. *BUS
61. 11 TO 13 FX 9 FY -34 MZ -26
62. *PT
63. 23 TO 25 FX 15 FY -213 MZ -15
64. LOAD 2 LOADTYPE NONE  TITLE NESC HEAVY (Z-DIR)
65. SELFWEIGHT Y -2
66. *WIND ON STAND
67. MEMBER LOAD
68. 1 2 24 TO 27 UNI GZ 5.3
69. 3 TO 10 21 30 TO 32 UNI GZ 4.3
70. JOINT LOAD
71. *SWITCH
72. 6 TO 8 11 TO 13 FY -504 FZ 6
73. *JUMPER
74. 6 TO 8 FY -29.4 FZ 8.3 MX 21
75. *BUS
76. 11 TO 13 FY -34
77. *PT
78. 23 TO 25 FY -213 FZ 15 MX 15
79. LOAD 3 LOADTYPE NONE  TITLE NESC HEAVY (45 DEG)
80. SELFWEIGHT Y -2
81. *WIND ON STAND
82. MEMBER LOAD
83. 1 2 24 TO 27 UNI GX 3.8
84. 1 2 24 TO 27 UNI GZ 3.8
85. 11 TO 14 19 20 28 29 UNI GX 3
86. 3 TO 10 21 30 TO 32 UNI GZ 3
87. 22 23 UNI GX 1.9
88. JOINT LOAD
89. *SWITCH
90. 6 TO 8 11 TO 13 FX 19 FY -503 FZ 4 MZ -28
91. *JUMPER
92. 6 TO 8 FX 5.9 FY -29.4 FZ 5.9 MX 14.8 MZ -14.8
93. *BUS
94. 11 TO 13 FX 6 FY -34 MZ -18
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 95. *PT
 96. 23 TO 25 FX 10 FY -213 FZ 10 MX 10 MZ -10
 97. LOAD 4 LOADTYPE IMPERFECTION  TITLE HIGH WIND (X-DIR)
 98. SELFWEIGHT Y -1
 99. *WIND ON STAND
100. MEMBER LOAD
101. 11 TO 14 19 20 28 29 UNI GX 16.6
102. 1 2 24 TO 27 UNI GX 22.1
103. 22 23 UNI GX 8.3
104. JOINT LOAD
105. *SWITCH
106. 6 TO 8 11 TO 13 FX 127 FY -250 MZ -191
107. *JUMPER
108. 6 TO 8 FX 43 FY -15 MZ -107.5
109. *BUS
110. 11 TO 13 FX 36 FY -19 MZ -105
111. *PT
112. 23 TO 25 FX 51 FY -142 MZ -51
113. LOAD 5 LOADTYPE IMPERFECTION  TITLE HIGH WIND (Z-DIR)
114. SELFWEIGHT Y -1
115. *WIND ON STAND
116. MEMBER LOAD
117. 3 TO 10 21 30 TO 32 UNI GZ 16.6
118. 1 2 24 TO 27 UNI GZ 22.1
119. JOINT LOAD
120. *SWITCH
121. 6 TO 8 11 TO 13 FY -270 FZ 30
122. *JUMPER
123. 6 TO 8 FY -15 FZ 43 MX 107.5
124. *BUS
125. 11 TO 13 FY -19
126. *PT
127. 23 TO 25 FY -142 FZ 51 MX 51
128. LOAD 6 LOADTYPE IMPERFECTION  TITLE HIGH WIND (45 DEG)
129. SELFWEIGHT Y -1
130. *WIND ON STAND
131. MEMBER LOAD
132. 11 TO 14 19 20 28 29 UNI GX 11.7
133. 1 2 24 TO 27 UNI GX 15.6
134. 3 TO 10 21 30 TO 32 UNI GZ 11.7
135. 1 2 24 TO 27 UNI GZ 15.6
136. 22 23 UNI GX 5.9
137. JOINT LOAD
138. *SWITCH
139. 6 TO 8 11 TO 13 FX 90 FY -264 FZ 21 MZ -135
140. *JUMPER
141. 6 TO 8 FX 30.4 FY -15 FZ 30.4 MX 76 MZ -76
142. *BUS
143. 11 TO 13 FX 25 FY -19 MZ -74
144. *PT
145. 23 TO 25 FX 36 FY -142 FZ 36 MX 36 MZ -36
146. LOAD 7 LOADTYPE IMPERFECTION  TITLE HIGH WIND + S.C. (X-DIR)
147. SELFWEIGHT Y -1
148. *WIND ON STAND
149. MEMBER LOAD
150. 11 TO 14 19 20 28 29 UNI GX 16.6
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```
151. 1 2 24 TO 27 UNI GX 22.1
152. 22 23 UNI GX 8.3
153. JOINT LOAD
154. *SWITCH
155. 6 TO 8 11 TO 13 FX 127 FY -250 MZ -191
156. *JUMPER
157. 6 TO 8 FX 43 FY -15 MZ -107.5
158. *BUS
159. 11 TO 13 FX 36 FY -19 MZ -105
160. *PT
161. 23 TO 25 FX 51 FY -142 MZ -51
162. *S.C.
163. 8 13 FX 211 MZ -615
164. 7 12 FX -211 MZ 615
165. LOAD 8 LOADTYPE IMPERFECTION  TITLE HIGH WIND + S.C. (Z-DIR)
166. SELFWEIGHT Y -1
167. *WIND ON STAND
168. MEMBER LOAD
169. 3 TO 10 21 30 TO 32 UNI GZ 16.6
170. 1 2 24 TO 27 UNI GZ 22.1
171. JOINT LOAD
172. *SWITCH
173. 6 TO 8 11 TO 13 FY -269 FZ 30
174. *JUMPER
175. 6 TO 8 FY -15 FZ 43 MX 107.5
176. *BUS
177. 11 TO 13 FY -19
178. *PT
179. 23 TO 25 FY -142 FZ 51 MX 51
180. *S.C.
181. 8 13 FX 211 MZ -615
182. 7 12 FX -211 MZ 615
183. LOAD 9 LOADTYPE IMPERFECTION  TITLE HIGH WIND + S.C. (45 DEG)
184. SELFWEIGHT Y -1
185. *WIND ON STAND
186. MEMBER LOAD
187. 11 TO 14 19 20 28 29 UNI GX 11.7
188. 1 2 24 TO 27 UNI GX 15.6
189. 3 TO 10 21 30 TO 32 UNI GZ 11.7
190. 1 2 24 TO 27 UNI GZ 15.6
191. 22 23 UNI GX 5.9
192. JOINT LOAD
193. *SWITCH
194. 6 TO 8 11 TO 13 FX 90 FY -264 FZ 21 MZ -135
195. *JUMPER
196. 6 TO 8 FX 30.4 FY -15 FZ 30.4 MX 76 MZ -76
197. *BUS
198. 11 TO 13 FX 25 FY -19 MZ -74
199. *PT
200. 23 TO 25 FX 51 FY -142 MZ -51
201. *S.C.
202. 8 13 FX 211 MZ -615
203. 7 12 FX -211 MZ 615
204. PDELTA 3 ANALYSIS
```

P R O B L E M S T A T I S T I C S

NUMBER OF JOINTS	**25**	**NUMBER OF MEMBERS**	**32**
NUMBER OF PLATES	**0**	**NUMBER OF SOLIDS**	**0**
NUMBER OF SURFACES	**0**	**NUMBER OF SUPPORTS**	**2**

SOLVER USED IS THE OUT-OF-CORE BASIC SOLVER

ORIGINAL/FINAL BAND-WIDTH= 16/ 6/ 42 DOF
TOTAL PRIMARY LOAD CASES = 9, TOTAL DEGREES OF FREEDOM = 138
SIZE OF STIFFNESS MATRIX = 6 DOUBLE KILO-WORDS
REQRD/AVAIL. DISK SPACE = 12.1/ 0.0 MB

++ Adjusting Displacements.
++ Adjusting Displacements.
++ Adjusting Displacements.

205. PRINT JOINT DISPLACEMENTS LIST 1 TO 14

Max Horizontal Deflection(Vert. Member) = L/100

Max Horizontal Deflection = (18.75*12)/100 = 2.25"

Max Vertical Deflection(Horz. Member) = L/200

Max Vertical Deflection = (10*12)/200 = 0.6"

JOINT DISPLACEMENT (INCH RADIANS) STRUCTURE TYPE = SPACE

JOINT	LOAD	X-TRANS	Y-TRANS	Z-TRANS	X-ROTAN	Y-ROTAN	Z-ROTAN
1	1	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
	2	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
	3	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
	4	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
	5	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
	6	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
	7	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
	8	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
	9	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
2	1	0.35337	-0.00211	0.16102	0.00101	0.00056	-0.00190
	2	0.00088	-0.00247	0.29744	0.00190	0.00000	-0.00081
	3	0.19692	-0.00228	0.25455	0.00162	0.00012	-0.00141
	4	1.19216	-0.00011	0.11845	0.00072	0.00068	-0.00405
	5	0.00097	-0.00128	0.76323	0.00486	0.00000	-0.00038
	6	0.84302	-0.00046	0.58756	0.00371	0.00045	-0.00296
	7	1.20311	-0.00011	0.11834	0.00072	0.00067	-0.00404
	8	0.01193	-0.00128	0.76326	0.00486	0.00000	-0.00036
	9	0.87496	-0.00045	0.55421	0.00351	0.00056	-0.00302
3	1	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
	2	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
	3	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
	4	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
	5	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
	6	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
	7	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
	8	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
	9	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
4	1	0.35190	-0.00278	0.09433	0.00062	0.00056	-0.00027
	2	-0.00088	-0.00247	0.29744	0.00190	0.00000	0.00081
	3	0.19525	-0.00265	0.24025	0.00155	0.00012	0.00023
	4	1.19149	-0.00241	0.03746	0.00029	0.00068	-0.00322
	5	-0.00097	-0.00128	0.76323	0.00486	0.00000	0.00038
	6	0.84147	-0.00209	0.53409	0.00343	0.00044	-0.00218
	7	1.20274	-0.00241	0.03757	0.00029	0.00067	-0.00344
	8	0.01029	-0.00127	0.76319	0.00486	0.00000	0.00016
	9	0.87383	-0.00210	0.48696	0.00316	0.00056	-0.00243
5	1	0.36803	-0.03571	0.16102	0.00132	0.00054	-0.00176
	2	0.00006	-0.06231	0.29745	0.00233	-0.00004	-0.00130
	3	0.19947	-0.05354	0.25456	0.00200	0.00008	-0.00158
	4	1.21081	-0.01755	0.11845	0.00062	0.00069	-0.00236
	5	0.00004	-0.13769	0.76325	0.00514	-0.00006	-0.00065
	6	0.85484	-0.10128	0.58757	0.00375	0.00042	-0.00186
	7	1.22184	-0.01757	0.11834	0.00062	0.00070	-0.00229
	8	0.01114	-0.13772	0.76328	0.00514	-0.00005	-0.00058
	9	0.89006	-0.09581	0.55423	0.00355	0.00055	-0.00182
6	1	0.36801	-0.06540	0.15152	0.00128	0.00052	-0.00140

Displacement X = 1.203" < 2.25"

Displacement Z = 0.763" < 2.25"

JOINT DISPLACEMENT (INCH RADIANS) STRUCTURE TYPE = SPACE

JOINT	LOAD	X-TRANS	Y-TRANS	Z-TRANS	X-ROTAN	Y-ROTAN	Z-ROTAN
	2	0.00004	-0.08780	0.29908	0.00748	-0.00009	-0.00134
	3	0.19945	-0.08201	0.25369	0.00562	0.00005	-0.00141
	4	1.21082	-0.04861	0.10622	0.00064	0.00067	-0.00115
	5	0.00003	-0.15058	0.76798	0.03154	-0.00026	-0.00068
	6	0.85484	-0.12712	0.58270	0.02244	0.00026	-0.00102
	7	1.22185	-0.04700	0.10602	0.00064	0.00067	-0.00103
	8	0.01113	-0.14893	0.76787	0.03154	-0.00025	-0.00056
	9	0.89007	-0.12032	0.54710	0.02223	0.00039	-0.00091
7	1	0.36796	-0.09006	0.12930	0.00118	0.00055	0.00030
	2	0.00000	-0.12096	0.29976	0.01123	0.00000	0.00000
	3	0.19940	-0.11237	0.24951	0.00827	0.00012	0.00012
	4	1.21075	-0.04838	0.07870	0.00069	0.00066	0.00075
	5	0.00000	-0.16753	0.76709	0.05087	0.00000	0.00000
	6	0.85478	-0.13234	0.56375	0.03616	0.00043	0.00052
	7	1.22179	-0.03977	0.07837	0.00069	0.00065	0.00097
	8	0.01111	-0.15881	0.76676	0.05087	0.00000	0.00022
	9	0.89002	-0.11785	0.52305	0.03592	0.00055	0.00077
8	1	0.36794	-0.04980	0.10515	0.00113	0.00060	0.00123
	2	-0.00004	-0.08780	0.29908	0.00748	0.00009	0.00134
	3	0.19937	-0.07641	0.24379	0.00564	0.00019	0.00126
	4	1.21078	-0.01497	0.05029	0.00077	0.00070	0.00019
	5	-0.00003	-0.15058	0.76798	0.03154	0.00026	0.00068
	6	0.85479	-0.10386	0.54581	0.02255	0.00064	0.00034
	7	1.22192	-0.00913	0.05027	0.00077	0.00069	-0.00016
	8	0.01118	-0.14466	0.76785	0.03154	0.00025	0.00033
	9	0.89013	-0.09097	0.50060	0.02229	0.00074	0.00000
9	1	0.36792	-0.02943	0.09433	0.00111	0.00060	0.00080
	2	-0.00006	-0.06231	0.29745	0.00233	0.00004	0.00130
	3	0.19935	-0.05385	0.24025	0.00202	0.00017	0.00102
	4	1.21076	-0.02046	0.03746	0.00080	0.00073	-0.00105
	5	-0.00004	-0.13769	0.76325	0.00514	0.00006	0.00065
	6	0.85477	-0.10399	0.53410	0.00391	0.00052	-0.00056
	7	1.22190	-0.02043	0.03757	0.00080	0.00072	-0.00135
	8	0.01117	-0.13763	0.76320	0.00514	0.00006	0.00035
	9	0.89011	-0.09673	0.48697	0.00364	0.00063	-0.00085
10	1	0.33780	0.01848	0.16102	0.00068	0.00058	-0.00187
	2	0.00006	0.04049	0.29744	0.00148	0.00004	-0.00130
	3	0.19303	0.03409	0.25456	0.00125	0.00015	-0.00160
	4	1.17432	0.02093	0.11845	0.00080	0.00066	-0.00246
	5	0.00008	0.12546	0.76324	0.00464	0.00004	-0.00065
	6	0.83077	0.09951	0.58757	0.00370	0.00045	-0.00193
	7	1.18544	0.02087	0.11834	0.00080	0.00065	-0.00239
	8	0.01115	0.12544	0.76327	0.00464	0.00003	-0.00058
	9	0.85979	0.09413	0.55422	0.00350	0.00056	-0.00191
11	1	0.33779	-0.01399	0.15045	0.00061	0.00059	-0.00158
	2	0.00005	0.01487	0.29726	0.00150	0.00001	-0.00134

Displacement Y = 0.168" < 0.6"

JOINT DISPLACEMENT (INCH RADIANS) STRUCTURE TYPE = SPACE

JOINT	LOAD	X-TRANS	Y-TRANS	Z-TRANS	X-ROTAN	Y-ROTAN	Z-ROTAN
	3	0.19302	0.00506	0.25213	0.00124	0.00014	-0.00145
	4	1.17432	-0.01271	0.10636	0.00066	0.00068	-0.00132
	5	0.00006	0.11246	0.76490	0.00464	-0.00010	-0.00069
	6	0.83076	0.07195	0.58088	0.00360	0.00038	-0.00113
	7	1.18545	-0.01113	0.10642	0.00065	0.00067	-0.00121
	8	0.01113	0.11411	0.76505	0.00464	-0.00010	-0.00057
	9	0.85979	0.06748	0.54566	0.00339	0.00048	-0.00105
12	1	0.33775	-0.04751	0.12606	0.00044	0.00056	0.00009
	2	0.00000	-0.01847	0.29579	0.00152	0.00000	0.00000
	3	0.19297	-0.02704	0.24575	0.00121	0.00012	0.00008
	4	1.17426	-0.02150	0.07721	0.00032	0.00069	0.00052
	5	0.00000	0.09533	0.76225	0.00466	0.00000	0.00000
	6	0.83068	0.06082	0.55993	0.00337	0.00046	0.00037
	7	1.18540	-0.01289	0.07754	0.00031	0.00069	0.00074
	8	0.01108	0.10405	0.76258	0.00466	0.00000	0.00022
	9	0.85972	0.06258	0.52016	0.00314	0.00057	0.00059
13	1	0.33772	-0.01460	0.10361	0.00022	0.00052	0.00110
	2	-0.00005	0.01487	0.29726	0.00150	-0.00001	0.00134
	3	0.19293	0.00756	0.24201	0.00112	0.00010	0.00124
	4	1.17429	0.00322	0.04895	-0.00005	0.00065	0.00003
	5	-0.00006	0.11246	0.76490	0.00464	0.00010	0.00069
	6	0.83067	0.08372	0.54294	0.00312	0.00050	0.00023
	7	1.18553	0.00909	0.04913	-0.00005	0.00066	-0.00032
	8	0.01112	0.11836	0.76496	0.00464	0.00010	0.00033
	9	0.85981	0.08240	0.49804	0.00286	0.00063	-0.00013
14	1	0.33770	0.00401	0.09433	0.00012	0.00051	0.00073
	2	-0.00006	0.04049	0.29744	0.00148	-0.00004	0.00130
	3	0.19291	0.02981	0.24025	0.00108	0.00008	0.00101
	4	1.17427	-0.00464	0.03746	-0.00021	0.00063	-0.00115
	5	-0.00008	0.12546	0.76324	0.00464	-0.00004	0.00065
	6	0.83064	0.08210	0.53409	0.00301	0.00039	-0.00062
	7	1.18551	-0.00458	0.03757	-0.00021	0.00063	-0.00144
	8	0.01109	0.12551	0.76320	0.00464	-0.00003	0.00036
	9	0.85978	0.07474	0.48697	0.00274	0.00051	-0.00093

********** END OF LATEST ANALYSIS RESULT **********

206. PRINT MEMBER FORCES LIST 1 TO 3 6 7 10 TO 14 24 TO 27

MEMBER END FORCES STRUCTURE TYPE = SPACE

ALL UNITS ARE -- POUN FEET (LOCAL)

MEMBER	LOAD	JT	AXIAL	SHEAR-Y	SHEAR-Z	TORSION	MOM-Y	MOM-Z	
1	1	1	3359.59	-43.66	-234.22	-4.14	2567.31	-2211.85	
		17	-2727.85	43.66	180.22	4.14	-417.85	1752.32	
	2	1	3790.34	-216.00	84.96	-2.12	-539.07	-4590.75	
		17	-3158.61	162.00	-84.96	2.12	-332.58	2633.31	
	3	1	3564.76	-165.50	-103.93	-2.95	1233.45	-3858.04	
		17	-2933.02	126.78	65.21	2.95	-351.32	2343.74	
	4	1	566.71	-75.48	-1106.93	-5.50	10472.52	-1840.71	
		17	-250.84	75.48	881.79	5.50	-322.83	1070.26	
	5	1	2005.87	-890.93	26.42	-0.88	-176.11	-13146.76	Max Moment for B.P. Design (x/z - Dir.)
		17	-1690.00	665.78	-26.42	0.88	-94.15	5172.08	
	6	1	1013.22	-682.25	-780.24	-4.02	7390.06	-10144.04	Max Moment for B.P. Design (45 Deg.)
		17	-697.36	523.32	621.31	4.02	-221.87	3987.00	
	7	1	574.32	-75.38	-1119.50	-5.19	10591.51	-1839.01	
		17	-258.45	75.38	894.35	5.19	-313.19	1069.48	
	8	1	2010.60	-890.95	13.73	-0.58	-56.17	-13147.33	
		17	-1694.73	665.81	-13.73	0.58	-83.88	5172.28	
	9	1	999.70	-641.73	-808.08	-4.42	7678.77	-9535.78	
		17	-683.83	482.80	649.16	4.42	-226.21	3792.73	
2	1	3	4153.90	43.66	-411.51	0.16	3692.45	-973.77	
		18	-3522.16	-43.66	357.52	-0.16	287.18	1408.54	
	2	3	3790.34	-216.00	-84.96	2.12	539.07	-4590.75	
		18	-3158.61	162.00	84.96	-2.12	332.58	2633.31	
	3	3	4009.93	-137.52	-276.96	1.33	2331.32	-3542.93	
		18	-3378.20	98.81	238.25	-1.33	329.54	2312.11	
	4	3	3325.04	75.48	-1181.18	-3.34	11013.56	-93.90	
		18	-3009.17	-75.48	956.04	3.34	31.12	860.33	
	5	3	2005.87	-890.93	-26.42	0.88	176.11	-13146.76	
		18	-1690.00	665.78	26.42	-0.88	94.15	5172.08	
	6	3	2962.52	-574.08	-835.98	-2.14	7791.55	-8957.33	
		18	-2646.65	415.16	677.05	2.14	14.56	3870.94	
	7	3	3317.42	75.38	-1168.61	-3.66	10974.67	-95.68	
		18	-3001.56	-75.38	943.47	3.66	-58.33	861.15	
	8	3	1995.14	-890.90	-13.73	0.56	136.68	-13146.04	
		18	-1679.27	665.76	13.73	-0.56	4.40	5171.87	
	9	3	2976.05	-506.60	-853.13	-3.00	8007.35	-8043.56	
		18	-2660.18	347.68	694.20	3.00	-22.95	3649.00	
3	1	5	55.54	681.27	-1.18	0.26	2.40	-230.40	
		6	-55.54	-649.79	1.18	-0.26	-0.67	1228.83	
	2	5	84.01	918.30	-23.32	-30.54	21.34	760.16	
		6	-84.01	-886.82	16.87	30.54	8.82	593.86	

MEMBER END FORCES STRUCTURE TYPE = SPACE

ALL UNITS ARE -- POUN FEET (LOCAL)

MEMBER	LOAD	JT	AXIAL	SHEAR-Y	SHEAR-Z	TORSION	MOM-Y	MOM-Z
	3	5	72.70	805.05	-16.58	-21.52	15.63	261.80
		6	-72.70	-773.57	12.08	21.52	5.86	922.34
	4	5	-32.81	-239.48	-1.18	-0.12	4.18	-2659.26
		6	32.81	255.22	1.18	0.12	-2.37	2288.15
	5	5	59.85	486.08	-101.55	-156.67	93.21	425.74
		6	-59.85	-470.34	76.65	156.67	40.46	291.65
	6	5	3.44	-13.74	-72.21	-110.88	68.43	-1728.50
		6	-3.44	29.48	54.66	110.88	26.72	1696.09
	7	5	-47.32	-235.59	-0.94	-0.13	3.85	-2743.80
		6	47.32	251.33	0.94	0.13	-2.40	2378.49
	8	5	45.22	488.48	-101.32	-156.67	92.90	339.75
		6	-45.22	-472.74	76.42	156.67	40.43	381.21
	9	5	-17.40	-20.79	-71.91	-110.83	68.04	-1877.78
		6	17.40	36.53	54.36	110.83	26.67	1834.76
6	1	8	101.40	-1068.82	0.48	0.11	-1.49	54.57
		9	-101.40	1100.30	-0.48	-0.11	0.68	-1681.59
	2	8	84.01	-886.82	16.87	30.54	-8.82	-593.86
		9	-84.01	918.30	-23.32	-30.54	-21.34	-760.16
	3	8	92.67	-997.13	11.84	21.48	-6.63	-268.36
		9	-92.67	1028.61	-16.34	-21.48	-14.54	-1251.12
	4	8	104.95	-1137.02	-0.35	-0.20	-2.83	1688.88
		9	-104.95	1152.76	0.35	0.20	3.24	-3406.18
	5	8	59.85	-470.34	76.65	156.67	-40.46	-291.65
		9	-59.85	486.08	-101.55	-156.67	-93.21	-425.74
	6	8	100.84	-952.66	53.55	110.61	-30.41	1108.20
		9	-100.84	968.40	-71.10	-110.61	-63.18	-2549.00
	7	8	97.99	-1133.13	-0.52	-0.19	-3.10	1570.78
		9	-97.99	1148.87	0.52	0.19	3.78	-3282.19
	8	8	52.82	-465.00	76.35	156.68	-40.67	-408.53
		9	-52.82	480.74	-101.25	-156.68	-92.55	-300.81
	9	8	87.33	-959.78	53.29	110.68	-30.65	1018.68
		9	-87.33	975.52	-70.84	-110.68	-62.54	-2470.11
7	1	10	53.71	-737.33	-0.92	0.42	1.59	50.63
		11	-53.71	705.84	0.92	-0.42	-0.16	-1133.16
	2	10	96.95	-925.30	14.76	-0.07	-12.99	-768.71
		11	-96.95	893.82	-8.31	0.07	-4.32	-595.83
	3	10	80.66	-816.63	9.80	0.08	-8.11	-298.15
		11	-80.66	785.15	-5.30	-0.08	-3.20	-903.37
	4	10	-35.10	201.04	-1.02	0.86	3.85	2493.48
		11	35.10	-216.78	1.02	-0.86	-2.36	-2180.02
	5	10	126.13	-492.42	65.13	-0.04	-58.17	-433.68
		11	-126.13	476.68	-40.23	0.04	-20.87	-293.28
	6	10	48.90	-13.62	45.25	0.58	-38.32	1617.98
		11	-48.90	-2.12	-27.70	-0.58	-16.37	-1626.72

MEMBER END FORCES STRUCTURE TYPE = SPACE

ALL UNITS ARE -- POUN FEET (LOCAL)

MEMBER	LOAD	JT	AXIAL	SHEAR-Y	SHEAR-Z	TORSION	MOM-Y	MOM-Z
	7	10	-49.29	197.23	-0.81	0.87	3.55	2578.50
		11	49.29	-212.97	0.81	-0.87	-2.38	-2270.72
	8	10	111.83	-494.80	65.36	-0.03	-58.48	-347.77
		11	-111.83	479.06	-40.46	0.03	-20.89	-382.74
	9	10	28.07	-11.83	45.54	0.65	-38.70	1740.89
		11	-28.07	-3.91	-27.99	-0.65	-16.43	-1746.90
10	1	13	98.57	1069.77	0.71	0.57	-0.89	57.56
		14	-98.57	-1101.25	-0.71	-0.57	-0.09	1570.86
	2	13	96.95	893.82	-8.31	0.07	4.32	595.83
		14	-96.95	-925.30	14.76	-0.07	12.99	768.71
	3	13	101.16	999.49	-5.50	0.22	2.43	291.28
		14	-101.16	-1030.97	10.00	-0.22	9.21	1231.75
	4	13	105.01	1110.58	-0.35	0.94	-2.61	-1577.33
		14	-105.01	-1126.32	0.35	-0.94	3.23	3254.94
	5	13	126.13	476.68	-40.23	0.04	20.87	293.28
		14	-126.13	-492.42	65.13	-0.04	58.17	433.68
	6	13	148.05	937.72	-28.60	0.65	12.87	-1035.51
		14	-148.05	-953.46	46.15	-0.65	43.31	2453.88
	7	13	98.47	1106.77	-0.76	0.93	-2.75	-1459.63
		14	-98.47	-1122.51	0.76	-0.93	3.99	3131.47
	8	13	119.42	471.25	-40.51	0.03	20.66	410.29
		14	-119.42	-486.99	65.41	-0.03	58.80	308.47
	9	13	135.10	939.50	-29.06	0.71	12.75	-927.52
		14	-135.10	-955.24	46.61	-0.71	44.12	2348.49
11	1	2	-0.92	817.40	44.04	50.63	-111.56	1749.49
		10	0.92	-737.33	-53.71	-50.63	1.59	-0.42
	2	2	14.76	1005.37	96.95	-768.71	-205.16	2171.88
		10	-14.76	-925.30	-96.95	768.71	-12.99	0.07
	3	2	9.80	896.70	73.91	-298.15	-165.78	1927.55
		10	-9.80	-816.63	-80.66	298.15	-8.11	-0.08
	4	2	-1.02	-161.00	-72.45	2493.48	117.15	-406.43
		10	1.02	201.04	35.10	-2493.48	3.85	-0.86
	5	2	65.13	532.46	126.13	-433.68	-225.63	1152.26
		10	-65.13	-492.42	-126.13	433.68	-58.17	0.04
	6	2	45.25	53.66	22.58	1617.98	-42.14	75.89
		10	-45.25	-13.62	-48.90	-1617.98	-38.32	-0.58
	7	2	-0.81	-157.19	-86.64	2578.50	149.38	-397.85
		10	0.81	197.23	49.29	-2578.50	3.55	-0.87
	8	2	65.36	534.84	111.83	-347.77	-193.14	1157.63
		10	-65.36	-494.80	-111.83	347.77	-58.48	0.03
	9	2	45.54	51.87	1.75	1740.89	5.10	71.96
		10	-45.54	-11.83	-28.07	-1740.89	-38.70	-0.65
12	1	2	-1.18	761.35	-45.87	-230.40	116.49	1622.69
		5	1.18	-681.27	55.54	230.40	-2.40	0.26

MEMBER END FORCES STRUCTURE TYPE = SPACE

ALL UNITS ARE -- POUN FEET (LOCAL)

MEMBER	LOAD	JT	AXIAL	SHEAR-Y	SHEAR-Z	TORSION	MOM-Y	MOM-Z
	2	2	-23.32	998.38	-84.01	760.16	210.35	2186.69
		5	23.32	-918.30	84.01	-760.16	-21.34	-30.54
	3	2	-16.58	885.13	-65.95	261.80	171.61	1922.91
		5	16.58	-805.05	72.70	-261.80	-15.63	-21.52
	4	2	-1.18	-199.44	70.16	-2659.26	-111.67	-493.67
		5	1.18	239.48	-32.81	2659.26	-4.18	-0.12
	5	2	-101.55	526.12	-59.85	425.74	227.86	1294.24
		5	101.55	-486.08	59.85	-425.74	-93.21	-156.67
	6	2	-72.21	26.30	22.88	-1728.50	46.62	124.40
		5	72.21	13.74	3.44	1728.50	-68.43	-110.88
	7	2	-0.94	-195.55	84.67	-2743.80	-144.63	-484.90
		5	0.94	235.59	-47.32	2743.80	-3.85	-0.13
	8	2	-101.32	528.52	-45.22	339.75	194.63	1299.64
		5	101.32	-488.48	45.22	-339.75	-92.90	-156.67
	9	2	-71.91	19.25	43.73	-1877.78	-0.63	108.52
		5	71.91	20.79	-17.40	1877.78	-68.04	-110.83
13	1	4	-0.71	1181.33	-108.25	1570.86	232.76	2567.34
		14	0.71	-1101.25	98.57	-1570.86	-0.09	0.57
	2	4	14.76	1005.37	-96.95	768.71	205.16	2171.88
		14	-14.76	-925.30	96.95	-768.71	12.99	0.07
	3	4	10.00	1111.04	-107.91	1231.75	225.99	2409.51
		14	-10.00	-1030.97	101.16	-1231.75	9.21	0.22
	4	4	0.35	1166.36	-142.36	3254.94	275.05	2578.32
		14	-0.35	-1126.32	105.01	-3254.94	3.23	0.94
	5	4	65.13	532.46	-126.13	433.68	225.63	1152.26
		14	-65.13	-492.42	126.13	-433.68	58.17	0.04
	6	4	46.15	993.50	-174.37	2453.88	319.37	2189.35
		14	-46.15	-953.46	148.05	-2453.88	43.31	0.65
	7	4	0.76	1162.55	-135.82	3131.47	259.59	2569.75
		14	-0.76	-1122.51	98.47	-3131.47	3.99	0.93
	8	4	65.41	527.03	-119.42	308.47	209.90	1140.06
		14	-65.41	-486.99	119.42	-308.47	58.80	0.03
	9	4	46.61	995.28	-161.42	2348.49	289.41	2193.33
		14	-46.61	-955.24	135.10	-2348.49	44.12	0.71
14	1	4	-0.48	1180.38	111.07	-1681.59	-238.34	2565.88
		9	0.48	-1100.30	-101.40	1681.59	-0.68	-0.11
	2	4	-23.32	998.38	84.01	-760.16	-210.35	2186.69
		9	23.32	-918.30	-84.01	760.16	21.34	-30.54
	3	4	-16.34	1108.69	99.42	-1251.12	-230.62	2425.87
		9	16.34	-1028.61	-92.67	1251.12	14.54	-21.48
	4	4	0.35	1192.80	142.30	-3406.18	-274.91	2638.57
		9	-0.35	-1152.76	-104.95	3406.18	-3.24	0.20
	5	4	-101.55	526.12	59.85	-425.74	-227.86	1294.24
		9	101.55	-486.08	-59.85	425.74	93.21	-156.67

MEMBER END FORCES STRUCTURE TYPE = SPACE

ALL UNITS ARE -- POUN FEET (LOCAL)

MEMBER	LOAD	JT	AXIAL	SHEAR-Y	SHEAR-Z	TORSION	MOM-Y	MOM-Z
	6	4	-71.10	1008.44	127.17	-2549.00	-319.61	2333.96
		9	71.10	-968.40	-100.84	2549.00	63.18	-110.61
	7	4	0.52	1188.91	135.34	-3282.19	-258.70	2629.81
		9	-0.52	-1148.87	-97.99	3282.19	-3.78	0.19
	8	4	-101.25	520.78	52.82	-300.81	-211.39	1282.24
		9	101.25	-480.74	-52.82	300.81	92.55	-156.68
	9	4	-70.84	1015.56	113.65	-2470.11	-288.55	2350.08
		9	70.84	-975.52	-87.33	2470.11	62.54	-110.68
24	1	15	1952.49	-22.98	-49.81	4.94	-65.67	-11.89
		2	-1605.60	22.98	20.16	-4.94	281.15	-126.83
	2	15	2377.42	-103.10	172.32	5.19	568.88	-532.72
		2	-2030.53	73.45	-172.32	-5.19	-1528.41	15.70
	3	15	2155.53	-72.18	58.89	5.84	184.54	-358.17
		2	-1808.64	50.92	-80.15	-5.84	-559.57	-4.02
	4	15	-173.44	-5.34	-625.16	5.48	-2009.77	58.49
		2	346.88	5.34	501.53	-5.48	5152.95	-87.28
	5	15	1246.16	-444.13	123.60	2.23	166.81	-2316.14
		2	-1072.72	320.50	-123.60	-2.23	-857.34	146.53
	6	15	267.33	-316.98	-386.06	4.48	-1428.50	-1584.52
		2	-93.88	229.72	298.79	-4.48	3348.08	51.71
	7	15	-165.78	-5.22	-647.41	4.75	-2054.66	58.89
		2	339.23	5.22	523.78	-4.75	5322.51	-87.09
	8	15	1250.93	-444.13	101.12	1.49	120.90	-2316.33
		2	-1077.49	320.51	-101.12	-1.49	-685.43	146.56
	9	15	258.42	-317.00	-421.59	4.47	-1502.05	-1572.31
		2	-84.98	229.74	334.32	-4.47	3620.28	39.75
25	1	17	2108.05	-602.15	-176.89	-3.16	418.76	-1752.32
		15	-1933.65	602.15	161.99	3.16	69.33	53.03
	2	17	2468.41	-787.31	84.60	-2.67	332.07	-2633.31
		15	-2294.01	772.40	-84.60	2.67	-570.45	427.95
	3	17	2268.80	-727.46	-62.77	-2.70	351.56	-2343.74
		15	-2094.40	716.77	52.08	2.70	-183.33	303.31
	4	17	-87.69	-381.32	-868.52	-1.02	327.01	-1070.26
		15	174.89	381.32	806.37	1.02	2025.72	-1.92
	5	17	1051.60	-1256.30	26.29	-1.28	93.78	-5172.08
		15	-964.40	1194.14	-26.29	1.28	-167.83	1713.58
	6	17	162.02	-1015.78	-613.04	-1.02	224.68	-3987.00
		15	-74.82	971.90	569.16	1.02	1439.44	1190.69
	7	17	-80.04	-381.19	-881.09	-0.67	317.41	-1069.48
		15	167.24	381.19	818.93	0.67	2070.77	-2.35
	8	17	1056.33	-1256.33	13.62	-0.93	83.55	-5172.28
		15	-969.12	1194.17	-13.62	0.93	-121.75	1713.65
	9	17	178.46	-946.91	-640.86	-1.24	229.18	-3792.73
		15	-91.26	903.04	596.98	1.24	1513.50	1190.01

Max Moment for T.P. Design

MEMBER END FORCES STRUCTURE TYPE = SPACE

ALL UNITS ARE -- POUN FEET (LOCAL)

MEMBER	LOAD	JT	AXIAL	SHEAR-Y	SHEAR-Z	TORSION	MOM-Y	MOM-Z
26	1	16	2735.15	22.98	-366.19	-5.57	-1268.94	121.01
		4	-2388.26	-22.98	336.54	5.57	3252.43	-1.43
	2	16	2377.42	-103.10	-172.32	-5.19	-568.88	-532.72
		4	-2030.53	73.45	172.32	5.19	1528.41	15.70
	3	16	2593.31	-72.03	-278.11	-4.63	-979.18	-381.26
		4	-2246.42	50.78	256.85	4.63	2482.55	16.99
	4	16	2545.76	5.34	-770.49	0.15	-2624.67	-34.30
		4	-2372.31	-5.34	646.87	-0.15	6661.25	60.27
	5	16	1246.16	-444.13	-123.60	-2.23	-166.81	-2316.14
		4	-1072.72	320.50	123.60	2.23	857.34	146.53
	6	16	2188.99	-308.75	-599.97	-0.24	-1845.98	-1670.49
		4	-2015.55	221.48	512.71	0.24	5001.52	147.84
	7	16	2538.10	5.22	-748.24	0.89	-2500.06	-34.74
		4	-2364.66	-5.22	624.62	-0.89	6413.81	60.08
	8	16	1235.39	-444.12	-101.12	-1.49	-41.58	-2316.01
		4	-1061.94	320.49	101.12	1.49	607.21	146.72
	9	16	2197.90	-308.73	-564.45	0.85	-1857.93	-1679.47
		4	-2024.45	221.46	477.18	-0.85	4817.26	159.99
27	1	18	2898.92	-517.61	-353.53	2.18	-285.29	-1408.54
		16	-2724.52	517.61	338.62	-2.18	1275.70	-52.20
	2	18	2468.41	-787.31	-84.60	2.67	-332.07	-2633.31
		16	-2294.01	772.40	84.60	-2.67	570.45	427.95
	3	18	2701.28	-711.27	-235.11	2.65	-328.30	-2312.11
		16	-2526.88	700.58	224.42	-2.65	983.52	315.93
	4	18	2604.26	-292.07	-943.10	1.76	-26.36	-860.33
		16	-2517.06	292.07	880.95	-1.76	2642.55	36.95
	5	18	1051.60	-1256.30	-26.29	1.28	-93.78	-5172.08
		16	-964.40	1194.14	26.29	-1.28	167.83	1713.58
	6	18	2062.12	-953.52	-668.81	1.61	-11.06	-3870.94
		16	-1974.92	909.65	624.93	-1.61	1858.92	1233.16
	7	18	2596.61	-292.20	-930.59	1.46	63.11	-861.15
		16	-2509.41	292.20	868.43	-1.46	2518.12	37.40
	8	18	1040.90	-1256.24	-13.70	0.98	-4.01	-5171.87
		16	-953.70	1194.09	13.70	-0.98	42.78	1713.67
	9	18	2093.61	-868.88	-686.08	0.85	26.54	-3649.00
		16	-2006.41	825.00	642.21	-0.85	1871.37	1250.58

********** END OF LATEST ANALYSIS RESULT **********

207. PRINT SUPPORT REACTION LIST 1 3

SUPPORT REACTIONS -UNIT POUN FEET STRUCTURE TYPE = SPACE

JOINT	LOAD	FORCE-X	FORCE-Y	FORCE-Z	MOM-X	MOM-Y	MOM Z	
1	1	-234.22	3359.59	-43.66	-2211.85	-4.14	2567.31	
	2	84.96	3790.34	-216.00	-4590.75	-2.12	-539.07	
	3	-103.93	3564.76	-165.50	-3858.04	-2.95	1233.45	
	4	-1106.93	566.71	-75.48	-1840.71	-5.50	10472.52	
	5	26.42	2005.87	-890.93	-13146.76	-0.88	-176.11	
	6	-780.24	1013.22	-682.25	-10144.04	-4.02	7390.06	
	7	-1119.50	574.32	-75.38	-1839.01	-5.19	10591.51	
	8	13.73	2010.60	-890.95	-13147.33	-0.58	-56.17	MAX MOMENT CASE FOR D.P. DESIGN
	9	-808.08	999.70	-641.73	-9535.78	-4.42	7678.77	
3	1	-411.51	4153.90	43.66	-973.77	0.16	3692.45	MAX VERTICAL CASE FOR D.P. DESIGN
	2	-84.96	3790.34	-216.00	-4590.75	2.12	539.07	
	3	-276.96	4009.93	-137.52	-3542.93	1.33	2331.32	
	4	-1181.18	3325.04	75.48	-93.90	-3.34	11013.56	
	5	-26.42	2005.87	-890.93	-13146.76	0.88	176.11	
	6	-835.98	2962.52	-574.08	-8957.33	-2.14	7791.55	
	7	-1168.61	3317.42	75.38	-95.68	-3.66	10974.67	
	8	-13.73	1995.14	-890.90	-13146.04	0.56	136.68	
	9	-853.13	2976.05	-506.60	-8043.56	-3.00	8007.35	

********** END OF LATEST ANALYSIS RESULT **********

208. PARAMETER 1
209. CODE AISC UNIFIED 2010
210. METHOD ASD
211. LY 6 MEMB 3 TO 10
212. LZ 6 MEMB 3 TO 10
213. CHECK CODE MEMB 1 TO 18 24 TO 27

STAAD.PRO CODE CHECKING - (AISC-360-10-ASD) v1.2
****

ALL UNITS ARE - KIP INCH (UNLESS OTHERWISE NOTED)

MEMBER NO: 1 CRITICAL RATIO: 0.486(PASS) LOAD: 6
LOCATION (ft): 0.00 CONDITION: Eq. H1-1b
SECTION: W8X31 (AISC SECTIONS)

MEMBER NO: 2 CRITICAL RATIO: 0.485(PASS) LOAD: 6
LOCATION (ft): 0.00 CONDITION: Eq. H1-1b
SECTION: W8X31 (AISC SECTIONS)

MEMBER NO: 3 CRITICAL RATIO: 0.249(PASS) LOAD: 7
LOCATION (ft): 0.00 CONDITION: Eq. H1-1b
SECTION: C6X10 (AISC SECTIONS)

MEMBER NO: 4 CRITICAL RATIO: 0.258(PASS) LOAD: 7
LOCATION (ft): 0.00 CONDITION: Eq. H1-1b
SECTION: C6X10 (AISC SECTIONS)

MEMBER NO: 5 CRITICAL RATIO: 0.240(PASS) LOAD: 7
LOCATION (ft): 3.50 CONDITION: Eq. H1-1b
SECTION: C6X10 (AISC SECTIONS)

MEMBER NO: 6 CRITICAL RATIO: 0.310(PASS) LOAD: 4
LOCATION (ft): 1.50 CONDITION: Eq. H1-1b
SECTION: C6X10 (AISC SECTIONS)

MEMBER NO: 7 CRITICAL RATIO: 0.234(PASS) LOAD: 7
LOCATION (ft): 0.00 CONDITION: Eq. H1-1b
SECTION: C6X10 (AISC SECTIONS)

MEMBER NO: 8 CRITICAL RATIO: 0.248(PASS) LOAD: 7
LOCATION (ft): 0.00 CONDITION: Eq. H1-1b
SECTION: C6X10 (AISC SECTIONS)

MEMBER NO: 9 CRITICAL RATIO: 0.229(PASS) LOAD: 7
LOCATION (ft): 3.50 CONDITION: Eq. H1-1b
SECTION: C6X10 (AISC SECTIONS)

STAAD.PRO CODE CHECKING - (AISC-360-10-ASD) v1.2
****

ALL UNITS ARE - KIP INCH (UNLESS OTHERWISE NOTED)

MEMBER NO: 10 CRITICAL RATIO: 0.296(PASS) LOAD: 4
LOCATION (ft): 1.50 CONDITION: Eq. H1-1b
SECTION: C6X10 (AISC SECTIONS)

MEMBER NO: 11 CRITICAL RATIO: 0.155(PASS) LOAD: 7
LOCATION (ft): 0.00 CONDITION:
SECTION: HSST6X6X0.25 (AISC SECTIONS)

MEMBER NO: 12 CRITICAL RATIO: 0.165(PASS) LOAD: 7
LOCATION (ft): 0.00 CONDITION:
SECTION: HSST6X6X0.25 (AISC SECTIONS)

MEMBER NO: 13 CRITICAL RATIO: 0.196(PASS) LOAD: 4
LOCATION (ft): 0.00 CONDITION:
SECTION: HSST6X6X0.25 (AISC SECTIONS)

MEMBER NO: 14 CRITICAL RATIO: 0.205(PASS) LOAD: 4
LOCATION (ft): 0.00 CONDITION:
SECTION: HSST6X6X0.25 (AISC SECTIONS)

MEMBER NO: 15 CRITICAL RATIO: 0.068(PASS) LOAD: 2
LOCATION (ft): 2.74 CONDITION: Eq. H1-1b
SECTION: L20203 (AISC SECTIONS)

MEMBER NO: 16 CRITICAL RATIO: 0.121(PASS) LOAD: 8
LOCATION (ft): 5.48 CONDITION: Eq. H3-8
SECTION: L20203 (AISC SECTIONS)

MEMBER NO: 17 CRITICAL RATIO: 0.106(PASS) LOAD: 5
LOCATION (ft): 0.00 CONDITION: Eq. H3-8
SECTION: L20203 (AISC SECTIONS)

MEMBER NO: 18 CRITICAL RATIO: 0.063(PASS) LOAD: 6
LOCATION (ft): 0.00 CONDITION: Sec. E1
SECTION: L20203 (AISC SECTIONS)

STAAD.PRO CODE CHECKING - (AISC-360-10-ASD) v1.2
****

ALL UNITS ARE - KIP INCH (UNLESS OTHERWISE NOTED)

MEMBER NO: 24 CRITICAL RATIO: 0.213 (PASS) LOAD: 7
LOCATION (ft): 5.59 CONDITION: Eq. H1-1b
SECTION: W8X31 (AISC SECTIONS)

MEMBER NO: 25 CRITICAL RATIO: 0.098 (PASS) LOAD: 5
LOCATION (ft): 0.00 CONDITION: Eq. H1-1b
SECTION: W8X31 (AISC SECTIONS)

MEMBER NO: 26 CRITICAL RATIO: 0.270 (PASS) LOAD: 4
LOCATION (ft): 5.59 CONDITION: Eq. H1-1b
SECTION: W8X31 (AISC SECTIONS)

MEMBER NO: 27 CRITICAL RATIO: 0.112 (PASS) LOAD: 4
LOCATION (ft): 2.81 CONDITION: Eq. H1-1b
SECTION: W8X31 (AISC SECTIONS)

ALL MEMBERS PASS

214. FINISH

********** END OF THE STAAD.Pro RUN **********

**** DATE= JAN 4,2018 TIME= 9:59: 5 ****

****
* For questions on STAAD.Pro, please contact *
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* *
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* *
****

This MathCAD document is used to calculate the following:

1. *End Plate thickness for bearing type*
2. *Checks Connection Bolt Diameterfor 4 bolt end plates only*
3. *Checks Fillet Weld Size*

References which are used for the End Plate design are:

1. *AISC UNIFIED Construction Manual, 13th Edition.*

ASD Design Factors

$\Omega_{BP} := 1.67$ $\Omega_{AB} := 2.00$

Definition of Units

$kip \equiv 1000 \cdot lb$ $kin \equiv kip \cdot in$ $ksi \equiv \frac{kip}{in^2}$ $psi \equiv \frac{lb}{in^2}$

Determine Plate Dimensions

Depth of Column

Dimensions for Column used: **W8x31**

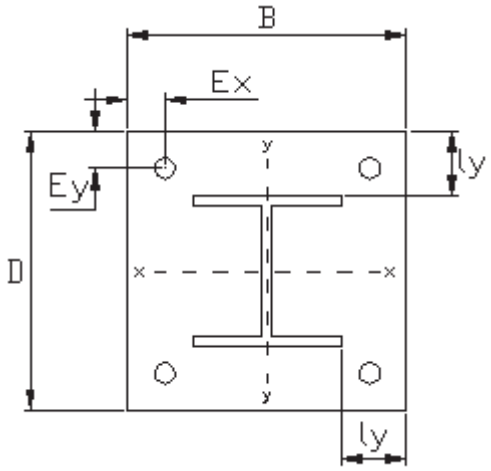
$d := 8.0 \cdot in$ $tw := 0.285 \cdot in$

$bf := 8.0 \cdot in$ $tf := 0.435 \cdot in$

Enter the dimensions for the plate.

$B := 13 \cdot in$ $Ex := 1.5 \cdot in$

$D := 13 \cdot in$ $Ey := 1.5 \cdot in$



"plate"

Design Forces

$Axial := 0.34 \cdot kip$

$Fx := .532 \cdot kip$ $My := 63.87 \cdot kin$

$Fy := .005 \cdot kip$ $Mx := 1.07 \cdot kin$

$Torsion := .057 \cdot kin$

End Plate and Connection Bolt Material Properties.

$fy_{BP} := 36.0 \cdot ksi$ *Yield Stress of End Plate.*

$F_{nt} := 90 \cdot ksi$ *Nominal Tensile Stress of A325 Bolt*

$F_{nv} := 48 \cdot ksi$ *Nominal Shear Stress of A325 Bolt*

Estimated Connection Bolt and Weld

Size:

$Bolt_Dia := 0.625 \cdot in$ $A_{Bolt} := \left(\frac{\pi}{4}\right) \cdot Bolt_Dia^2$ $A_{Bolt} = 0.307 \cdot in^2$

$Weld := \frac{1}{4} \cdot in$ $B_{head} = 0.531 \cdot in$

Determine Plate Thickness for End Plate.

A. Proportion Axial Force

$P_Ax := \frac{Axial}{4}$ $P_Ax = 0.1 \cdot kip$

B. Determine Bolt Forces due to Mx (for two bolts in compression)

$FC_Mx := \frac{Mx}{D - 2 \cdot Ey}$ $FC_Mx = 0.1 \cdot kip$

$P_Mx := 2 \cdot P_Ax + FC_Mx$ $P_Mx = 0.3 \cdot kip$

C. Determine Bolt Forces due to My (for two bolts in compression)

$FC_My := \frac{My}{B - 2 \cdot Ex}$ $FC_My = 6.4 \cdot kip$

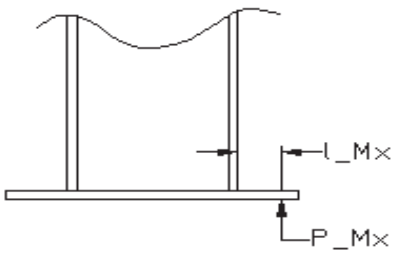
$P_My := 2 \cdot P_Ax + FC_My$ $P_My = 6.6 \cdot kip$

D. Determine Thickness Required for Mx

$l_Mx := \frac{D - 2 \cdot Ey - d}{2} - B_{head} - Weld$ $l_Mx = 0.2 \cdot in$

$M_Mx := P_Mx \cdot l_Mx$ $M_Mx = 0.1 \cdot kin$

$t_Mx := \sqrt{\frac{\Omega_{BP} \cdot 4 \cdot M_Mx}{fy_{BP} \cdot B}}$ $t_Mx = 0.0 \cdot in$



"moment"

E. Determine Thickness Required for My

$l_My := \frac{B - 2 \cdot Ex - bf}{2} - B_{head} - Weld$ $l_My = 0.2 \cdot in$

$M_My := P_My \cdot l_My$ $M_My = 1.4 \cdot kin$

$$t_My := \sqrt{\frac{\Omega_{BP} \cdot 4 \cdot M_My}{fy_{BP} \cdot D}} \qquad t_My = 0.1 \cdot in$$

F. Determine Total Plate Thickness Required

$$t_min := \sqrt{t_Mx^2 + t_My^2} \qquad t_min = 0.1 \cdot in$$

Check Connection Bolt Diameter:

Calculate the Actual Tension per Bolt.

$$Max_Tension := \frac{FC_Mx + FC_My}{2} + P_Ax \qquad Max_Tension = 3.3 \cdot kip$$

Calculate the Allowable Tension per Bolt

$$R_{nt} := F_{nt} \cdot A_{Bolt} \qquad R_{nt} = 27.6 \cdot kip$$

$$R_Allow_T := \frac{R_{nt}}{\Omega_{AB}} \qquad R_Allow_T = 13.8 \cdot kip$$

Calculate the Actual Shear per Bolt.

$$F_{torsion} := \frac{Torsion}{\sqrt{\left(\frac{D - 2 \cdot Ey}{2}\right)^2 + \left(\frac{B - 2 \cdot Ex}{2}\right)^2}} \qquad F_{torsion} = 0.008 \cdot kip$$

$$Shear := \frac{\sqrt{\left(Fy^2 + Fx^2 + F_{torsion}^2\right)}}{4} \qquad Shear = 0.133 \cdot kip$$

Calculate the Allowable Shear per Bolt.

$$R_{nv} := F_{nv} \cdot A_{Bolt} \qquad R_{nv} = 14.7 \cdot kip$$

$$R_Allow_V := \frac{R_{nv}}{\Omega_{AB}} \qquad R_Allow_V = 7.4 \cdot kip$$

Calculate the Allowable Combined Tension and Shear.

$$F_v := \frac{Shear}{A_{Bolt}} \qquad F_v = 0.4 \cdot ksi$$

$$F_{nt_comb} := 1.3 \cdot F_{nt} - \left(\frac{\Omega_{AB} \cdot F_{nt}}{F_{nv}}\right) \cdot F_v \qquad F_{nt_comb} = 115.374 \cdot ksi$$

Fnt_comb needs to be less than or equal to Fnt.

$$Fnt_comb := if\left(F_{nt_comb} \le F_{nt}, F_{nt_comb}, F_{nt}\right) \qquad Fnt_comb = 90 \cdot ksi$$

$$R_Allow_C := \frac{Fnt_comb \cdot A_{Bolt}}{\Omega_{AB}} \qquad R_Allow_C = 13.8 \cdot kip$$

If Allowable is Greater than Actual, the Anchor Bolt Size and Type are Adequate.

Determine Fillet Weld Size Required:

This design procedure is from Blodgett Section 7.4. The weld is treated as a line.

Calculate the the length of the welds, using the formulas contained in Table 5.

For Square Tubes:

$$Swx := 2 \cdot bf \cdot d + \frac{d^2}{3} \qquad Swx = 149.333 \cdot in^2$$

$$Swy := 2 \cdot \frac{bf^2}{3} + (d - 2 \cdot tf) \cdot tw \qquad Swy = 44.699 \cdot in^2$$

Calculate the stress for each direction:

$$fmx := \frac{Mx}{Swx} \qquad fmx = 0.007 \cdot \frac{kip}{in}$$

$$fmy := \frac{My}{Swy} \qquad fmy = 1.429 \cdot \frac{kip}{in}$$

Calculate the combined stress:

$$f_act := \sqrt{(fmx^2 + fmy^2)} \qquad f_act = 1.429 \cdot \frac{kip}{in}$$

Allowable for fillet welds and A36 materialfor E70 weld material per AISC UNIFIED is 0.30(weld material)(0.707 for throat)=14850 psi..

The weld size required is determined by dividing the actual stress by the allowable stress.

$$w_reqd := \frac{f_act}{14850 \cdot psi} \qquad w_reqd = 0.096 \cdot in$$

Check Table J2.4 of the AISC ASD manual to check if w_reqd is greater than the minimum size required.

$tf = 0.435 \cdot in$ $tw = 0.285 \cdot in$ $t_min = 0.146 \cdot in$

Values to be Used:

Plate Thickness = 1/2 inch
Connection Bolt = 5/8 inch diameter

Weld Size = 1/4 inch all around

This MathCAD document is used to calculate the following:

1. *Base Plate thickness for bearing type*
2. *Checks Anchor bolt Diameter*
3. *Checks Fillet Weld Size*

References which are used for the base plate design are:

1. *AISC UNIFIED Construction Manual, 13th Edition.*

ASD Design

Factors

$\Omega_{BP} := 1.67$ $\Omega_{AB} := 2.00$

Definition of Units

$kip \equiv 1000 \cdot lb$ $kin \equiv kip \cdot in$ $ksi \equiv \frac{kip}{in^2}$ $psi \equiv \frac{lb}{in^2}$

Determine Plate Dimensions

Depth of Column

Dimensions for Column used: W8x31

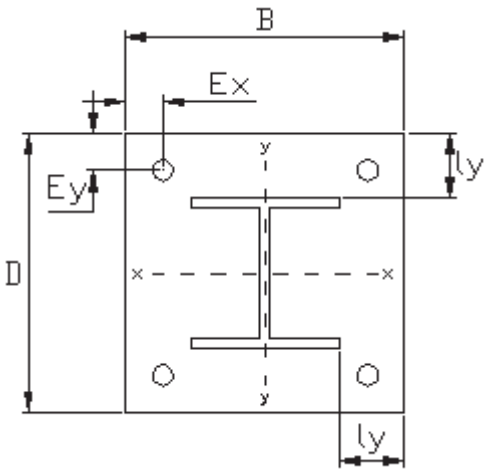
$d := 8 \cdot in$ $tw := 0.285 \cdot in$

$bf := 8 \cdot in$ $tf := 0.435 \cdot in$

Enter the dimensions for the plate.

$B := 17 \cdot in$ $Ex := 2.5 \cdot in$

$D := 17 \cdot in$ $Ey := 2.5 \cdot in$



Design Forces

"plate"

$Axial := 1.01 \cdot kip$

$Fx := .68 \cdot kip$ $My := 88.68 \cdot kin$

$Fy := .78 \cdot kip$ $Mx := 121.73 \cdot kin$

Base Plate and Anchor Bolt Material Properties.

$fy_{BP} := 50 \cdot ksi$ *Yield Stress of Base Plate.*

$fu_{AB} := 58 \cdot ksi$ *Tensile Stress of Anchor Bolt (58ksi for A36)*

Estimated Anchor Bolts:

$AB_Dia := 1.\cdot in$ $A_{AB} := \left(\frac{\pi}{4}\right)\cdot AB_Dia^2$ $A_{AB} = 0.785\cdot in^2$

The nominal tensile and shear stress for the bolts is based on the formula from page 16.1-104 of the 13th Edition of the AISC UNIFIED manual.

$F_{nt} := 0.75\cdot fu_{AB}$ $F_{nt} = 43.5\cdot ksi$

$F_{nv} := 0.40\cdot fu_{AB}$ $F_{nv} = 23.2\cdot ksi$

Determine Plate Thckness for Leveling Nut Base Plate.

A. Proportion Axial Force

$P_Ax := \frac{Axial}{4}$ $P_Ax = 0.253\cdot kip$

B. Determine Bolt Forces due to Mx (for two bolts in compression)

$FC_Mx := \frac{Mx}{D - 2\cdot Ey}$ $FC_Mx = 10.144\cdot kip$

$P_Mx := 2\cdot P_Ax + FC_Mx$ $P_Mx = 10.649\cdot kip$

C. Determine Bolt Forces due to My (for two bolts in compression)

$FC_My := \frac{My}{B - 2\cdot Ex}$ $FC_My = 7.39\cdot kip$

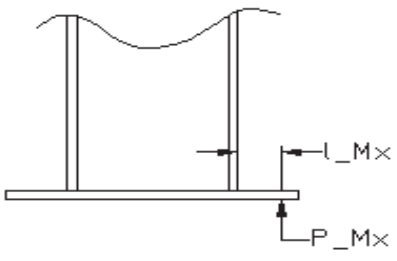
$P_My := 2\cdot P_Ax + FC_My$ $P_My = 7.895\cdot kip$

D. Determine Thickness Required for Mx

$l_Mx := \frac{D - 2\cdot Ey - d}{2}$ $l_Mx = 2.0\cdot in$

$M_Mx := P_Mx\cdot l_Mx$ $M_Mx = 21.3\cdot kin$

$t_Mx := \sqrt{\frac{\Omega_{BP}\cdot 4\cdot M_Mx}{fy_{BP}\cdot B}}$ $t_Mx = 0.4\cdot in$



"moment"

E. Determine Thickness Required for My

$$l_My := \frac{B - 2 \cdot Ex - bf}{2} \qquad l_My = 2.0 \cdot in$$

$$M_My := P_My \cdot l_My \qquad M_My = 15.8 \cdot kin$$

$$t_My := \sqrt{\frac{\Omega_{BP} \cdot 4 \cdot M_My}{fy_{BP} \cdot D}} \qquad t_My = 0.4 \cdot in$$

F. Determine Total Plate Thickness Required

$$t_min := \sqrt{t_Mx^2 + t_My^2} \qquad t_min = 0.54 \cdot in$$

Check Anchor Bolt Diameter:

Calculate the Actual Tension per Bolt.

$$Max_Tension := \frac{FC_Mx + FC_My}{2} - P_Ax \qquad Max_Tension = 8.5 \cdot kip$$

Calculate the Allowable Tension per Bolt.

$$R_{nt} := F_{nt} \cdot A_{AB} \qquad R_{nt} = 34.2 \cdot kip$$

$$R_Allow_T := \frac{R_{nt}}{\Omega_{AB}} \qquad R_Allow_T = 17.1 \cdot kip$$

Calculate the Actual Shear per Bolt.

$$Shear := \frac{\sqrt{\left(Fy^2 + Fx^2\right)}}{4} \qquad Shear = 0.259 \cdot kip$$

Calculate the Allowable Shear per Bolt.

$$R_{nv} := F_{nv} \cdot A_{AB} \qquad R_{nv} = 18.2 \cdot kip$$

$$R_Allow_V := \frac{R_{nv}}{\Omega_{AB}} \qquad R_Allow_V = 9.1 \cdot kip$$

Calculate the Allowable Combined Tension and Shear.

$$F_v := \frac{Shear}{A_{AB}} \qquad F_v = 0.3 \cdot ksi$$

$$F_{nt_comb} := 1.3 \cdot F_{nt} - \left(\frac{\Omega_{AB} \cdot F_{nt}}{F_{nv}} \right) \cdot F_v \qquad F_{nt_comb} = 55.315 \cdot ksi$$

Fnt_comb needs to be less than or equal to Fnt.

$$Fnt_comb := if\left(F_{nt_comb} \le F_{nt}, F_{nt_comb}, F_{nt}\right) \qquad Fnt_comb = 43.5 \cdot ksi$$

$$R_Allow_C := \frac{Fnt_comb \cdot A_{AB}}{\Omega_{AB}} \qquad R_Allow_C = 17.1 \cdot kip$$

If Allowable is Greater than Actual, the Anchor Bolt Size and Type are Adequate.

Determine Fillet Weld Size Required:

This design procedure is from Blodgett Section 7.4. The weld is treated as a line.

Calculate the the length of the welds, using the formulas contained in Table 5.

$$Swx := 2 \cdot bf \cdot d + \frac{d^2}{3} \qquad Swx = 149.333 \cdot in^2$$

$$Swy := 2 \cdot \frac{bf^2}{3} + (d - 2 \cdot tf) \cdot tw \qquad Swy = 44.699 \cdot in^2$$

Calculate the stress for each direction:

$$fmx := \frac{Mx}{Swx} \qquad fmx = 0.068\,ft \cdot ksi$$

$$fmy := \frac{My}{Swy} \qquad fmy = 0.165\,ft \cdot ksi$$

Calculate the combined stress:

$$f_act := \sqrt{\left(fmx^2 + fmy^2\right)} \qquad f_act = 0.179\,ft \cdot ksi$$

Allowable for fillet welds and A36 materialfor E70 weld material per AISC UNIFIED is 0.30(weld material)(0.707 for throat)=14850 psi..

The weld size required is determined by dividing the act stress by the allowable stress.

$$w_reqd := \frac{f_act}{14850 \cdot psi} \qquad w_reqd = 0.144 \cdot in$$

Check Table J2.4 of the AISC ASD manual to check if w_reqd is greater than the minimum size required.

$tf = 0.435 \cdot in$ $tw = 0.285 \cdot in$ $t_min = 0.54 \cdot in$

Values to be Used:

Thickness = 1 inch
Anchor Bolt = 1 inch diameter
Weld Size = 1/4 inch all around

This MathCAD document is used to calculate the following:

1. *Base Plate thickness for bearing type*
2. *Checks Anchor bolt Diameter*
3. *Checks Fillet Weld Size*

References which are used for the base plate design are:

1. *AISC UNIFIED Construction Manual, 13th Edition.*

ASD Design

Factors

$\Omega_{BP} := 1.67$ $\Omega_{AB} := 2.00$

Definition of Units

$kip \equiv 1000 \cdot lb$ $kin \equiv kip \cdot in$ $ksi \equiv \frac{kip}{in^2}$ $psi \equiv \frac{lb}{in^2}$

Determine Plate Dimensions

Depth of Column

Dimensions for Column used: W8x31

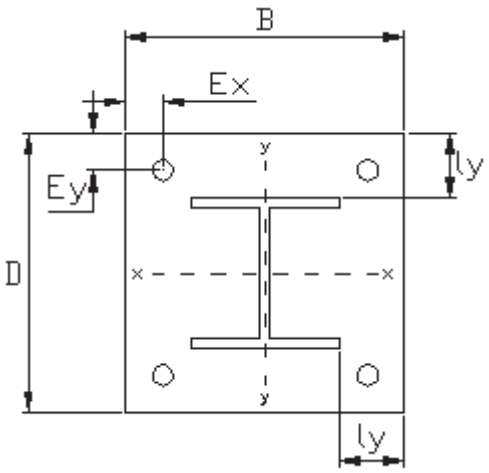
$d := 8 \cdot in$ $tw := 0.285 \cdot in$

$bf := 8 \cdot in$ $tf := 0.435 \cdot in$

Enter the dimensions for the plate.

$B := 17 \cdot in$ $Ex := 2.5 \cdot in$

$D := 17 \cdot in$ $Ey := 2.5 \cdot in$



Design Forces

"plate"

$Axial := 2.006 \cdot kip$

$Fx := 0.026 \cdot kip$ $My := 2.11 \cdot kin$

$Fy := .891 \cdot kip$ $Mx := 157.76 \cdot kin$

Base Plate and Anchor Bolt Material Properties.

$fy_{BP} := 50 \cdot ksi$ *Yield Stress of Base Plate.*

$fu_{AB} := 58 \cdot ksi$ *Tensile Stress of Anchor Bolt (58ksi for A36)*

Estimated Anchor Bolts:

$AB_Dia := 1.\cdot in$ $\quad A_{AB} := \left(\frac{\pi}{4}\right)\cdot AB_Dia^2$ $\quad A_{AB} = 0.785\cdot in^2$

The nominal tensile and shear stress for the bolts is based on the formula from page 16.1-104 of the 13th Edition of the AISC UNIFIED manual.

$F_{nt} := 0.75\cdot fu_{AB}$ $\quad F_{nt} = 43.5\cdot ksi$

$F_{nv} := 0.40\cdot fu_{AB}$ $\quad F_{nv} = 23.2\cdot ksi$

Determine Plate Thckness for Leveling Nut Base Plate.

A. Proportion Axial Force

$P_Ax := \frac{Axial}{4}$ $\quad P_Ax = 0.501\cdot kip$

B. Determine Bolt Forces due to Mx (for two bolts in compression)

$FC_Mx := \frac{Mx}{D - 2\cdot Ey}$ $\quad FC_Mx = 13.147\cdot kip$

$P_Mx := 2\cdot P_Ax + FC_Mx$ $\quad P_Mx = 14.15\cdot kip$

C. Determine Bolt Forces due to My (for two bolts in compression)

$FC_My := \frac{My}{B - 2\cdot Ex}$ $\quad FC_My = 0.176\cdot kip$

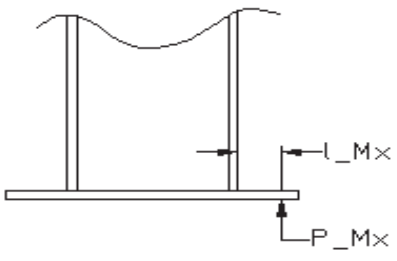
$P_My := 2\cdot P_Ax + FC_My$ $\quad P_My = 1.179\cdot kip$

D. Determine Thickness Required for Mx

$l_Mx := \frac{D - 2\cdot Ey - d}{2}$ $\quad l_Mx = 2.0\cdot in$

$M_Mx := P_Mx\cdot l_Mx$ $\quad M_Mx = 28.3\cdot kin$

$t_Mx := \sqrt{\frac{\Omega_{BP}\cdot 4\cdot M_Mx}{fy_{BP}\cdot B}}$ $\quad t_Mx = 0.5\cdot in$



"moment"

E. Determine Thickness Required for My

$$l_My := \frac{B - 2 \cdot Ex - bf}{2} \qquad l_My = 2.0 \cdot in$$

$$M_My := P_My \cdot l_My \qquad M_My = 2.4 \cdot kin$$

$$t_My := \sqrt{\frac{\Omega_{BP} \cdot 4 \cdot M_My}{fy_{BP} \cdot D}} \qquad t_My = 0.1 \cdot in$$

F. Determine Total Plate Thickness Required

$$t_min := \sqrt{t_Mx^2 + t_My^2} \qquad t_min = 0.49 \cdot in$$

Check Anchor Bolt Diameter:

Calculate the Actual Tension per Bolt.

$$Max_Tension := \frac{FC_Mx + FC_My}{2} - P_Ax \qquad Max_Tension = 6.2 \cdot kip$$

Calculate the Allowable Tension per Bolt.

$$R_{nt} := F_{nt} \cdot A_{AB} \qquad R_{nt} = 34.2 \cdot kip$$

$$R_Allow_T := \frac{R_{nt}}{\Omega_{AB}} \qquad R_Allow_T = 17.1 \cdot kip$$

Calculate the Actual Shear per Bolt.

$$Shear := \frac{\sqrt{\left(Fy^2 + Fx^2\right)}}{4} \qquad Shear = 0.223 \cdot kip$$

Calculate the Allowable Shear per Bolt.

$$R_{nv} := F_{nv} \cdot A_{AB} \qquad R_{nv} = 18.2 \cdot kip$$

$$R_Allow_V := \frac{R_{nv}}{\Omega_{AB}} \qquad R_Allow_V = 9.1 \cdot kip$$

Calculate the Allowable Combined Tension and Shear.

$$F_v := \frac{Shear}{A_{AB}} \qquad F_v = 0.3 \cdot ksi$$

$$F_{nt_comb} := 1.3 \cdot F_{nt} - \left(\frac{\Omega_{AB} \cdot F_{nt}}{F_{nv}} \right) \cdot F_v \qquad F_{nt_comb} = 55.486 \cdot ksi$$

Fnt_comb needs to be less than or equal to Fnt.

$$Fnt_comb := if\left(F_{nt_comb} \le F_{nt}, F_{nt_comb}, F_{nt}\right) \qquad Fnt_comb = 43.5 \cdot ksi$$

$$R_Allow_C := \frac{Fnt_comb \cdot A_{AB}}{\Omega_{AB}} \qquad R_Allow_C = 17.1 \cdot kip$$

If Allowable is Greater than Actual, the Anchor Bolt Size and Type are Adequate.

Determine Fillet Weld Size Required:

This design procedure is from Blodgett Section 7.4. The weld is treated as a line.

Calculate the the length of the welds, using the formulas contained in Table 5.

$$Swx := 2 \cdot bf \cdot d + \frac{d^2}{3} \qquad Swx = 149.333 \cdot in^2$$

$$Swy := 2 \cdot \frac{bf^2}{3} + (d - 2 \cdot tf) \cdot tw \qquad Swy = 44.699 \cdot in^2$$

Calculate the stress for each direction:

$$fmx := \frac{Mx}{Swx} \qquad fmx = 0.088\,ft \cdot ksi$$

$$fmy := \frac{My}{Swy} \qquad fmy = 3.934 \times 10^{-3}\,ft \cdot ksi$$

Calculate the combined stress:

$$f_act := \sqrt{\left(fmx^2 + fmy^2\right)} \qquad f_act = 0.088\,ft \cdot ksi$$

Allowable for fillet welds and A36 materialfor E70 weld material per AISC UNIFIED is 0.30(weld material)(0.707 for throat)=14850 psi..

The weld size required is determined by dividing the act stress by the allowable stress.

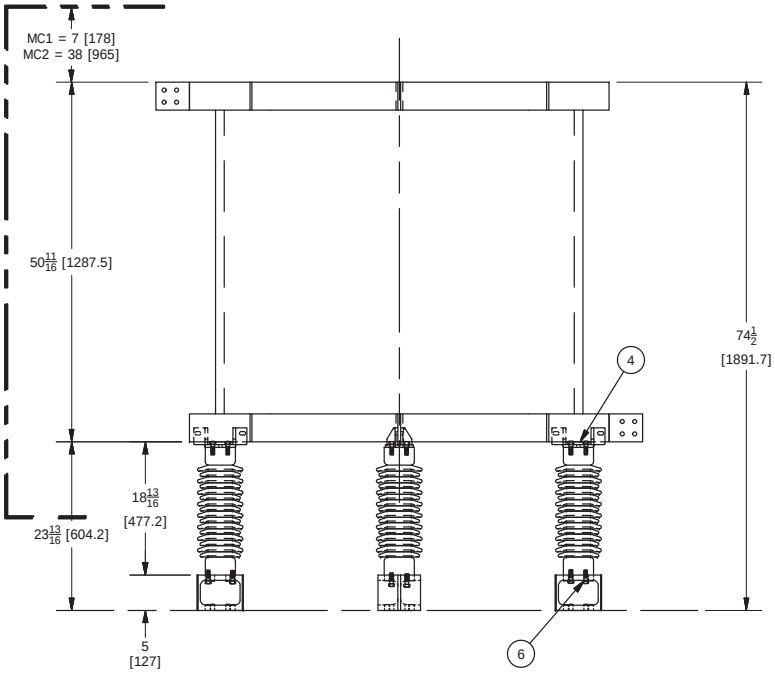
$$w_reqd := \frac{f_act}{14850 \cdot psi} \qquad w_reqd = 0.071 \cdot in$$

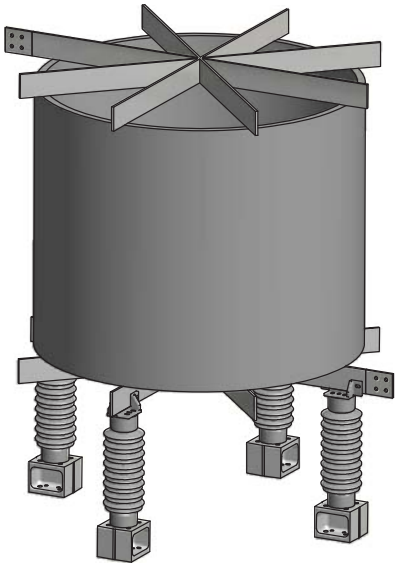
Check Table J2.4 of the AISC ASD manual to check if w_reqd is greater than the minimum size required.

$tf = 0.435 \cdot in$ $tw = 0.285 \cdot in$ $t_min = 0.491 \cdot in$

Values to be Used:

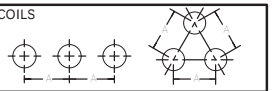
Thickness = 1 inch
Anchor Bolt = 1 inch diameter
Weld Size = 1/4 inch all around



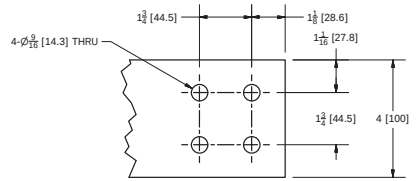


THE MAGNETIC FIELD OF THE REACTOR CAUSES THERMAL AND ELECTRODYNAMIC EFFECTS ON NEIGHBOURING METALLIC PARTS. THE RECOMMENDED MAGNETIC CLEARANCE CONTOUR (MC) IS SHOWN DASH-DOTTED IN THE DRAWING. FOR SMALL METALLIC PARTS DISTANCES ACCORDING TO MC1 HAVE TO BE OBSERVED. FOR METALLIC PARTS FORMING CLOSED LOOPS, SUCH AS GROUNDING WIRE, CONCRETE REBAR, ETC. DISTANCES ACCORDING TO MC2 HAVE TO BE OBSERVED. SPECIAL CARE MUST BE TAKEN FOR PLACEMENT OF SENSITIVE EQUIPMENT IN THE VICINITY OF THE REACTOR.

MINIMUM DISTANCES BETWEEN COILS
A = 115 [2921]

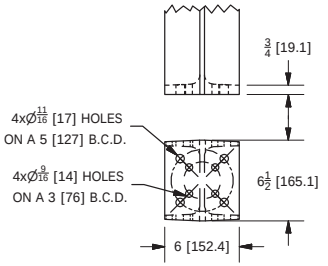


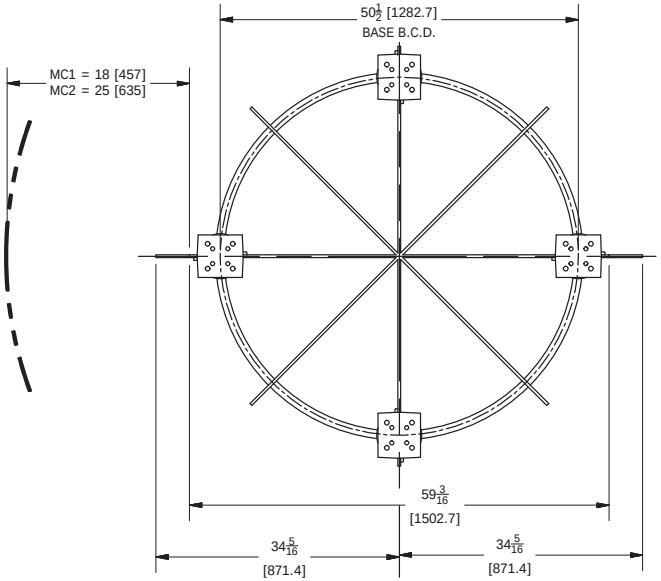
TERMINAL DETAIL



MATERIAL - 3/8 [10] THK. BARE ALUMINUM
TERMINALS ARE COATED WITH GREASE FOR PROTECTION DURING TRANSPORTATION. REMOVE EXCESS GREASE BEFORE APPLYING JOINT COMPOUND

BASE MOUNTING DETAIL





NOTES

1 - UNIT SUITABLE FOR INDOOR OR OUTDOOR INSTALLATION DEPENDING ON INSULATORS
2 - ALUMINUM CONDUCTORS
3 - LIFTING INSTRUCTIONS INCLUDED
4 - UNIT FINISH: LIGHT GREY No. ASA 70
5 - UNIT BUILT TO SPEC: IEEE C57.32-2015
6 - CONTINUOUS CURRENT: 600 A.
7 - MECHANICAL PEAK: 51 kA.
8 - BIL ACROSS COIL: 200 kV.
9 - BIL ACROSS BASE INSULATOR: 200 kV.
10 - BASE INSULATORS: TR210 GREY
11 - TOTAL APPROX. WEIGHT: 1085 lb. 492 kg.
12 - SYSTEM VOLTAGE: 34.5 kV.
13 - SEISMIC: UBC 1991 - Zone 2A.

HARDWARE DETAILS:

4. 1/2" -13 x 1 1/4" ST. STL. BOLT WITH LOCKWASHER & FLAT WASHER
6. 1/2" -13 x 1 1/2" ST. STL. BOLT WITH LOCKWASHER

TOLERANCES	REVISIONS	
0 [0] - 6 [152] ±1/16 [1.6] 6 [152] - 12 [305] ±1/8 [3] 12 [305] - 36 [914] ±1/4 [6] 36 [914] - 80 [2032] ±1/2 [13] 80 [2032] AND UP ±3/4 [19] ANGULAR ±2°	No.	DESCRIPTION

PROJECTION METHOD 1 TO ISO 5456-2

TRENCH LIMITED
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FINAL OUTLINE DRAWING

DRY-TYPE AIR CORE NEUTRAL GROUNDING REACTOR
THERMAL SHORT CIRCUIT: 20 kA./3 SEC. L=1.592 mH.
INSULATION CLASS: 34.5 kV., 60 Hz.

TRENCH

SCALE	UNITS		
NTS	in [mm]	M J ELETRIC LLC P.O. No.: 79086	Q.21810285
AUTHOR	APPROVAL	DWG No.	DATE / REV.
K.M.		418100148-10-OL	Dec/06/2017 / 0

Project # :	17.01246	**Ulteig Engineers, Inc**		By:	DAW
Project Title:	Northwest Ohio			Date:	1/24/2018
Item:	NGR Stand	**Load Cases**		Checked:	
Link to item:	NGR				

Load from a horizontally mounted insulator, fuse, surge arrester, etc.

Equipment:	NGR
Orientation:	Ypos

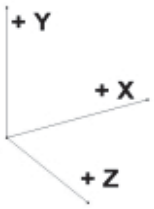
(Ypos, Yneg; Asuming switches are on Staad x-axis, which grid are the switches in?)

	Input
	Output

Equipment Specifications

Weight	1150	lbs	← Select Units
Y_{arm} :	89.5	inches	
$Area_x$:	3300	square inches	
$Area_z$:	3300	square inches	
NESC Wind :	4	psf	*(Refer to NESC Table 250-4)

*(Refer to NESC Table 250-4)



Basic Wind	90	mph	
Ice & Wind (wind) :	40	mph	*refer to ASCE 07-10 figure 26.5-1
Ice Thinkness	0.5	inches	
C_d :	1		Per ASCE 113 3.1.5.6 Table 3-9
k_z:	0.9		Per ASCE 113 table 3-1
G_{RF}:	1.2		(ASCE 113, 3.1.5.5.1, Table 3-4a & Table 3-4b)

High Wind: $P = .00256 k_z c_d G_{RF} (v^2)$

NESC: $P = (NESC\ WIND\ pressure) * C_d$

ICE & Wind: : $P = .00256 k_z c_d G_{RF} (v^2)$

Loads	NESC	High Wind	Ice & Wind	
P (psf):	4	22.4	4.4	**psf**
F_y (lbs):	-2300	-1150	-1725	**lbs**

Select Output Units	
Force	kips
Moment	lb-ft

Wind X-Dir	NESC	High Wind	Ice & Wind	
F_y :	**-2.3000**	**-1.1500**	**-1.7250**	**kips**
F_x :	**0.0917**	**0.5132**	**0.1014**	**kips**
M_z :	**-683.7**	**-3827.7**	**-756.1**	**lb-ft**

Wind Z-Dir	NESC	High Wind	Ice & Wind	
F_y (lbs):	**-2.3000**	**-1.1500**	**-1.7250**	**kips**
F_z (lbs):	**0.09167**	**0.5132**	**0.1014**	**kips**
M_x (ft-lbs):	**-683.7**	**3827.7**	**-756.1**	**lb-ft**

Wind 45 Deg	NESC	High Wind	Ice & Wind	
F_y (lbs):	**-2.3000**	**-1.1500**	**-1.7250**	**kips**
F_x (lbs):	**0.06482**	**0.36290**	**0.07168**	**kips**
F_z (lbs):	**0.06482**	**0.36290**	**0.07168**	**lbs**
M_z (ft-lbs):	**-483.4**	**-2706.6**	**-534.6**	**lb-ft**
M_x (ft-lbs):	**483.4**	**2706.6**	**534.6**	**lb-ft**

Project # :	17.01246	**Ulteig Engineers**	By: DAW
Project Title:	Northwest Ohio		Date: 1/24/2018
Item:	34.5kV NGR	**Load Cases**	Checked:

Load from Wind on Member

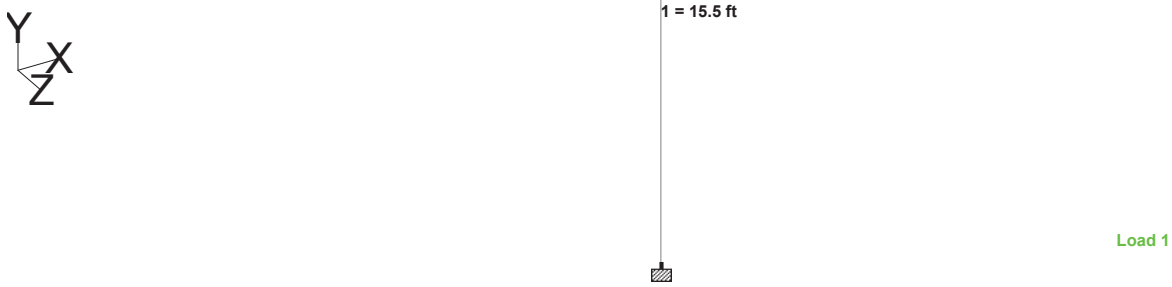
k_z:	0.98	(See table 250-2 NESC C2-2012 - at average height)
G_{rf}:	1.15	(See table 250-3 NESC C2-2012 - at average height)
I_{FW}:	1.0	(ASCE 113, 50 yr MRI)
C_d:	2.0	(ASCE 113, Table 3-9)
High Wind:	90	(ASCE 7-05)
Ice & Wind:	40	(ASCE 7-05)

Load Case Constants:

	NESC	High Wind	Ice & Wind
Wind (psf):	4	23.37	4.62
Ice (in):	0.5	0	1

Load on Member (lbs/ft):

Width (in)	NESC	NESC 45°	High Wind	High Wind 45°	Ice & Wind	Ice & Wind 45°
2	2.0	1.4	7.8	5.5	5.0	3.5
3	2.7	1.9	11.7	8.3	7.1	5.0
4	3.3	2.4	15.6	11.0	9.2	6.5
5	4.0	2.8	19.5	13.8	11.4	8.0
6	4.7	3.3	23.4	16.5	13.5	9.5
7	5.3	3.8	27.3	19.3	15.6	11.0
8	6.0	4.2	31.2	22.0	17.7	12.5
9	6.7	4.7	35.1	24.8	19.8	14.0
10	7.3	5.2	38.9	27.5	22.0	15.5
11	8.0	5.7	42.8	30.3	24.1	17.0
12	8.7	6.1	46.7	33.0	26.2	18.5
13	9.3	6.6	50.6	35.8	28.3	20.0
14	10.0	7.1	54.5	38.6	30.4	21.5
15	10.7	7.5	58.4	41.3	32.6	23.0
16	11.3	8.0	62.3	44.1	34.7	24.5


Y
X
Z
1 = 15.5 ft
Load 1

```
**************************************************
*                                                *
*           STAAD.Pro V8i SELECTseries4           *
*           Version  20.07.09.21                 *
*           Proprietary Program of               *
*           Bentley Systems, Inc.                *
*           Date=    JAN 16, 2018                *
*           Time=     9:51:45                    *
*                                                *
*      USER ID: Ulteig Engineers                 *
**************************************************
```

```
     1. STAAD SPACE
INPUT FILE: NWO 34.5kV NGR Stand.STD
     2. START JOB INFORMATION
     3. ENGINEER DATE 04-JAN-18
     4. END JOB INFORMATION
     5. INPUT WIDTH 79
     6. UNIT FEET KIP
     7. JOINT COORDINATES
     8. 1 0 0 0; 2 0 15.5 0
     9. MEMBER INCIDENCES
    10. 1 1 2
    11. DEFINE MATERIAL START
    12. ISOTROPIC STEEL
    13. E 4.176E+006
    14. POISSON 0.3
    15. DENSITY 0.489024
    16. ALPHA 6.5E-006
    17. DAMP 0.03
    18. TYPE STEEL
    19. STRENGTH FY 5184 FU 8352 RY 1.5 RT 1.2
    20. END DEFINE MATERIAL
    21. MEMBER PROPERTY AMERICAN
    22. 1 TABLE ST HSST10X10X0.25
    23. CONSTANTS
    24. MATERIAL STEEL ALL
    25. SUPPORTS
    26. 1 FIXED
    27. LOAD 1 LOADTYPE NONE  TITLE NESC HEAVY 1/2" ICE 40 MPH WIND X-DIR
    28. *SELFWEIGHT + ICE
    29. SELFWEIGHT Y -1.5
    30. MEMBER LOAD
    31. *WIND LOAD
    32. UNIT FEET POUND
    33. 1 UNI GX 22
    34. JOINT LOAD
    35. *NGR LOAD
    36. 2 FX 101.4 FY -1725 MZ -756.1
    37. UNIT FEET KIP
    38. LOAD 2 LOADTYPE NONE  TITLE NESC HEAVY 1/2" ICE 40 MPH Z-DIR
```

```
39. *SELFWEIGHT + ICE
40. SELFWEIGHT Y -1.5
41. MEMBER LOAD
42. *WIND LOAD
43. UNIT FEET POUND
44. 1 UNI GZ 22
45. JOINT LOAD
46. *NGR LOAD
47. 2 FY -1725 FZ 101.4 MX 756.1
48. UNIT FEET KIP
49. LOAD 3 LOADTYPE NONE  TITLE NESC HEAVY 1/2" ICE 40 MPH 45 DEG
50. *SELFWEIGHT + ICE
51. SELFWEIGHT Y -1.5
52. UNIT FEET POUND
53. MEMBER LOAD
54. *WIND LOAD
55. 1 UNI GX 15.5
56. 1 UNI GZ 15.5
57. JOINT LOAD
58. *NGR LOAD
59. 2 FX 71.7 FY -1725 FZ 71.7 MX 534.6 MZ -534.6
60. UNIT FEET KIP
61. LOAD 4 LOADTYPE NONE  TITLE HIGH WIND 90 MPH X-DIR
62. *SELFWEIGHT
63. SELFWEIGHT Y -1
64. UNIT FEET POUND
65. MEMBER LOAD
66. *WIND LOAD
67. 1 UNI GX 38.9
68. JOINT LOAD
69. *NGR LOAD
70. 2 FX 543.2 FY -1150 MZ -3827.7
71. UNIT FEET KIP
72. LOAD 5 LOADTYPE NONE  TITLE HIGH WIND 90 MPH Z-DIR
73. *SELFWEIGHT
74. SELFWEIGHT Y -1
75. UNIT FEET POUND
76. MEMBER LOAD
77. *WIND LOAD
78. 1 UNI GZ 38.9
79. JOINT LOAD
80. *NGR LOAD
81. 2 FY -1150 FZ 513.2 MX 3827.7
82. UNIT FEET KIP
83. LOAD 6 LOADTYPE NONE  TITLE HIGH WIND 90 MPH 45 DEG
84. *SELFWEIGHT
85. SELFWEIGHT Y -1
```

```
86. UNIT FEET POUND
87. MEMBER LOAD
88. *WIND LOAD
89. 1 UNI GX 27.5
90. 1 UNI GZ 27.5
91. JOINT LOAD
92. *NGR LOAD
93. 2 FX 362.9 FY -1150 FZ 362.9 MX 2706.6 MZ -2706.6
94. PDELTA 3 ANALYSIS
```

P R O B L E M S T A T I S T I C S

NUMBER OF JOINTS	**2**	**NUMBER OF MEMBERS**	**1**
NUMBER OF PLATES	**0**	**NUMBER OF SOLIDS**	**0**
NUMBER OF SURFACES	**0**	**NUMBER OF SUPPORTS**	**1**

SOLVER USED IS THE OUT-OF-CORE BASIC SOLVER

ORIGINAL/FINAL BAND-WIDTH= 1/ 1/ 6 DOF
TOTAL PRIMARY LOAD CASES = 6, TOTAL DEGREES OF FREEDOM = 6
SIZE OF STIFFNESS MATRIX = 1 DOUBLE KILO-WORDS
REQRD/AVAIL. DISK SPACE = 12.0/ 0.0 MB

```
++ Adjusting Displacements.
++ Adjusting Displacements.
++ Adjusting Displacements.

95. PRINT JOINT DISPLACEMENTS ALL
```

MAX HORIZONTAL DEFLECTION OF A VERTICAL MEMBER = L/100

MAX HORIZONTAL DEFLECTION OF A VERTICAL MEMBER = (15.5*12)/100 = 1.86"

JOINT DISPLACEMENT (INCH RADIANS) STRUCTURE TYPE = SPACE

JOINT	LOAD	X-TRANS	Y-TRANS	Z-TRANS	X-ROTAN	Y-ROTAN	Z-ROTAN
1	1	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
	2	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
	3	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
	4	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
	5	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
	6	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
2	1	0.16077	-0.00149	0.00000	0.00000	0.00000	-0.00133
	2	0.00000	-0.00149	0.16077	0.00133	0.00000	0.00000
	3	0.11350	-0.00149	0.11350	0.00094	0.00000	-0.00094
	4	0.60376	-0.00099	0.00000	0.00000	0.00000	-0.00526
	5	0.00000	-0.00099	0.58784	0.00513	0.00000	0.00000
	6	0.41566	-0.00099	0.41566	0.00363	0.00000	-0.00363

MAX HORIZONTAL DEFLECTION OF A VERTICAL MEMBER = 0.60" < 1.86"

********** END OF LATEST ANALYSIS RESULT **********

96. PRINT MEMBER FORCES ALL

MEMBER END FORCES STRUCTURE TYPE = SPACE

ALL UNITS ARE -- POUN FEET (LOCAL)

MEMBER	LOAD	JT	AXIAL	SHEAR-Y	SHEAR-Z	TORSION	MOM-Y	MOM-Z	
1	1	1	2432.45	442.40	0.00	0.00	0.00	4998.40	
		2	-1725.00	-101.40	0.00	0.00	0.00	-756.10	
	2	1	2432.45	0.00	-442.40	0.00	4998.40	0.00	
		2	-1725.00	0.00	101.40	0.00	-756.10	0.00	
	3	1	2432.45	311.95	-311.95	0.00	3527.55	3527.55	
		2	-1725.00	-71.70	71.70	0.00	-534.60	-534.60	
	4	1	1621.64	1146.15	0.00	0.00	0.00	16989.89	MAX MOMENT FOR B.P. DESIGN (X/Z - DIR.)
		2	-1150.00	-543.20	0.00	0.00	0.00	-3827.70	
	5	1	1621.64	0.00	-1116.15	0.00	16523.05	0.00	
		2	-1150.00	0.00	513.20	0.00	-3827.70	0.00	MAX MOMENT FOR T.P. DESIGN
	6	1	1621.64	789.15	-789.15	0.00	11682.99	11682.99	MAX MOMENT FOR B.P. DESIGN (45 DEG.)
		2	-1150.00	-362.90	362.90	0.00	-2706.60	-2706.60	

********** END OF LATEST ANALYSIS RESULT **********

97. PRINT SUPPORT REACTION LIST 1

SUPPORT REACTIONS -UNIT POUN FEET STRUCTURE TYPE = SPACE

JOINT	LOAD	FORCE-X	FORCE-Y	FORCE-Z	MOM-X	MOM-Y	MOM Z
1	1	-442.40	2432.45	0.00	0.00	0.00	4998.40
	2	0.00	2432.45	-442.40	-4998.40	0.00	0.00
	3	-311.95	2432.45	-311.95	-3527.55	0.00	3527.55
	4	-1146.15	1621.64	0.00	0.00	0.00	16989.89
	5	0.00	1621.64	-1116.15	-16523.05	0.00	0.00
	6	-789.15	1621.64	-789.15	-11682.99	0.00	11682.99

********** END OF LATEST ANALYSIS RESULT **********

```
 98. PARAMETER 1
 99. CODE AISC UNIFIED 2010
100. FYLD 6.624E+006 ALL
101. FU 8.352E+006 ALL
102. KY 2 ALL
103. KZ 2 ALL
104. CHECK CODE MEMB 1
```

STAAD.PRO CODE CHECKING - (AISC-360-10-LRFD) v1.2
****

ALL UNITS ARE - KIP INCH (UNLESS OTHERWISE NOTED)

MEMBER NO: 1 CRITICAL RATIO: 0.259(PASS) LOAD: 6
LOCATION (ft): 0.00 CONDITION: Eq. H1-1b
SECTION: HSST10X10X0.25 (AISC SECTIONS)

ALL MEMBERS PASS

105. FINISH

********** END OF THE STAAD.Pro RUN **********

**** DATE= JAN 16,2018 TIME= 9:51:47 ****


```
**********************************************************
*        For questions on STAAD.Pro, please contact      *
*        Bentley Systems or Partner offices              *
*                                                        *
*            Telephone            Web / Email            *
*  USA       +1  (714) 974-2500                          *
*  UK        +44 (0) 808 101 9246                        *
*  SINGAPORE +65 6225-6158                               *
*  FRANCE    +33 (0) 1 55238400                          *
*  GERMANY   +49 0931 40468                              *
*  INDIA     +91 (033) 4006-2021                         *
*  JAPAN     +81 (03)5952-6500    http://www.ctc-g.co.jp *
*  CHINA     +86 21 6288 4040                            *
*  THAILAND  +66 (0)2645-1018/19 partha.p@reisoftwareth.com*
*                                                        *
*  Worldwide  http://selectservices.bentley.com/en-US/   *
*                                                        *
**********************************************************
```

This MathCAD document is used to calculate the following:

1. Top Plate thickness for bearing and flexure (Square Tube Column)
2. Checks Equipment Bolt Diameter & Edge Distance
3. Checks Fillet Weld Size

References which are used for the top plate design are:

1. AISC UNIFIED Construction Manual, 13th Edition.

ASD Design Factors

$\Omega_{TP} := 1.67$ $\Omega_{EB} := 2.00$

Definition of Units

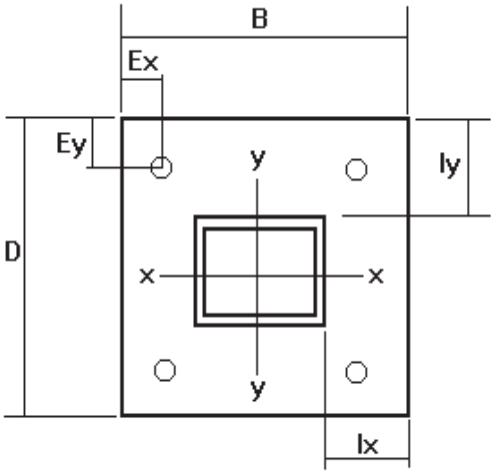
$kip \equiv 1000 \cdot lb$ $kin \equiv kip \cdot in$ $ksi \equiv \frac{kip}{in^2}$ $psi \equiv \frac{lb}{in^2}$

Determine Plate Dimensions

Dimensions for Column used: HSS10x10x1/4

$d := 10 \cdot in$ $tw := 0.25 \cdot in$

$bf := 10 \cdot in$ $tf := 0.25 \cdot in$



Enter the dimensions for the plate.

$B := 58 \cdot in$ $Ex := 1.5 \cdot in$

$D := 58 \cdot in$ $Ey := 1.5 \cdot in$

Design Forces ***(Wind From X-Dir)***

$Axial := 1.2 \cdot kip$

$Fx := .51 \cdot kip$ $My := 45.9 \cdot kin$

$Fy := 0 \cdot kip$ $Mx := 0 \cdot kin$

Top Plate and Equipment Bolt Material Properties.

$fy_{TP} := 36.0 \cdot ksi$ *Yield Stress of Top Plate.*

$fu_{EB} := 58.0 \cdot ksi$ *Tensile Stress of Equipment Bolt (58ksi for A36)*

Estimated Equipment Bolts:

$EB_Dia := .625 \cdot in$ $A_{EB} := \left(\frac{\pi}{4}\right) \cdot EB_Dia^2$ $A_{EB} = 0.307 \cdot in^2$

The nominal tensile and shear stress for the bolts is based on the formula from page 16.1-120 of the 14th Edition of the AISC UNIFIED manual.

$F_{nt} := 0.75 \cdot fu_{EB}$ $F_{nt} = 43.5 \cdot ksi$

$F_{nv} := 0.45 \cdot fu_{EB}$ $F_{nv} = 26.1 \cdot ksi$

Determine Plate Thickness for Equipment Top Plate.

A. Proportion Axial Force

$$P_Ax := \frac{Axial}{4} \qquad P_Ax = 0.3 \cdot kip$$

B. Determine Bolt Forces due to Mx (for two bolts in compression)

$$FC_Mx := \frac{Mx}{D - 2 \cdot Ey} \qquad FC_Mx = 0 \cdot kip$$

$$P_Mx := 2 \cdot P_Ax + FC_Mx \qquad P_Mx = 0.6 \cdot kip$$

C. Determine Bolt Forces due to My (for two bolts in compression)

$$FC_My := \frac{My}{B - 2 \cdot Ex} \qquad FC_My = 0.8 \cdot kip$$

$$P_My := 2 \cdot P_Ax + FC_My \qquad P_My = 1.4 \cdot kip$$

D. Determine Thickness Required for Mx

$$l_Mx := \frac{D - 2 \cdot Ey - d}{2} \qquad l_Mx = 22.5 \cdot in$$

$$M_Mx := P_Mx \cdot l_Mx \qquad M_Mx = 13.5 \cdot kin$$

$$t_Mx := \sqrt{\frac{\Omega_{TP} \cdot 4 \cdot M_Mx}{fy_{TP} \cdot B}} \qquad t_Mx = 0.2 \cdot in$$

E. Determine Thickness Required for My

$$l_My := \frac{B - 2 \cdot Ex - bf}{2} \qquad l_My = 22.5 \cdot in$$

$$M_My := P_My \cdot l_My \qquad M_My = 32.3 \cdot kin$$

$$t_My := \sqrt{\frac{\Omega_{TP} \cdot 4 \cdot M_My}{fy_{TP} \cdot D}} \qquad t_My = 0.32 \cdot in$$

F. Determine Total Plate Thickness Required

$$t_min := \sqrt{t_Mx^2 + t_My^2} \qquad t_min = 0.383 \cdot in$$

Check Equipment Bolt Diameter:

Calculate the Actual Tension per Bolt.

$$Max_Tension := \frac{FC_Mx + FC_My}{2} - P_Ax \qquad Max_Tension = 0.12 \cdot kip$$

Calculate the Allowable Tension per Bolt.

$$R_{nt} := F_{nt} \cdot A_{EB} \qquad R_{nt} = 13.3 \cdot kip$$

$$Allowable_Tension := \frac{R_{nt}}{\Omega_{EB}} \qquad Allowable_Tension = 6.7 \cdot kip$$

Tension_Check = "OK"

Calculate the Actual Shear per

$$Max_Shear := \frac{\sqrt{\left(Fy^2 + Fx^2\right)}}{4} \qquad Max_Shear = 0.128 \cdot kip$$

Calculate the Allowable Shear per Bolt.

$$R_{nv} := F_{nv} \cdot A_{EB} \qquad R_{nv} = 8.0 \cdot kip$$

$$Allowable_Shear := \frac{R_{nv}}{\Omega_{EB}} \qquad Allowable_Shear = 4.0 \cdot kip$$

Shear_Check = "OK"

The combo check for tension and shear is a unity calculation. The equation result must be less than 1.00.

$$Unity_Calc := \left(\frac{Max_Tension}{Allowable_Tension}\right)^2 + \left(\frac{Max_Shear}{Allowable_Shear}\right)^2 = 0.001$$

Combo_Check = "OK"

Minimum Edge distance check (From Table J3.4). Minimum Edge Distance Must Be Greater than the Actual Bolt Hole Distances.

$$EB_Dia = \frac{5}{8} \cdot in$$

$$Min_Edge = 1\frac{1}{8} \cdot in \qquad Ex = 1\frac{1}{2} \cdot in \qquad Ey = 1\frac{1}{2} \cdot in$$

Edge_Check = "OK"

Determine Fillet Weld Size

Required:

This design procedure is from Blodgett Section 7.4. The weld is treated as a line.

Calculate the the length of the welds, using the formulas contained in Table 5.

For Square

$Swx := (bf)\cdot d + \frac{d^2}{3}$ $Swx = 133.333\cdot in^2$

$Swy := bf\cdot d + \frac{(bf)^2}{3}$ $Swy = 133.333\cdot in^2$

Calculate the stress for each direction:

$fmx := \frac{Mx}{Swx}$ $fmx = 0\cdot\frac{kip}{in}$

$fmy := \frac{My}{Swy}$ $fmy = 0.344\cdot\frac{kip}{in}$

Calculate the combined stress:

$f_act := \sqrt{(fmx^2 + fmy^2)}$ $f_act = 0.344\cdot\frac{kip}{in}$

Allowable for fillet welds and A36 materialfor E70 weld material per AISC UNIFIED is 0.30(weld material)(0.707 for throat)=14850 psi..

The weld size required is determined by dividing the actual stress by the allowable stress.

$w_reqd := \frac{f_act}{14850\cdot psi}$ $w_reqd = 0.023\cdot in$

Check Table J2.4 of the AISC ASD manual to check if w_reqd is greater than the minimum size required.

$tf = 0.25\cdot in$ $tw = 0.25\cdot in$ $t_min = 0.383\cdot in$

Values to be Used:

Top Plate Thickness = 1/2 inch
Equipment Bolt = 5/8 inch diameter
Weld Size = 5/16 inch all around

This MathCAD document is used to calculate the following:

1. Base Plate thickness for bearing type(Square Tube Column)
2. Checks Anchor bolt Diameter & Edge Distance
3. Checks Fillet Weld Size

References which are used for the base plate design are:

1. AISC UNIFIED Construction Manual, 13th Edition.

ASD Design Factors

$\Omega_{BP} := 1.67$ $\Omega_{AB} := 2.00$

Definition of Units

$kip \equiv 1000 \cdot lb$ $kin \equiv kip \cdot in$ $ksi \equiv \frac{kip}{in^2}$ $psi \equiv \frac{lb}{in^2}$

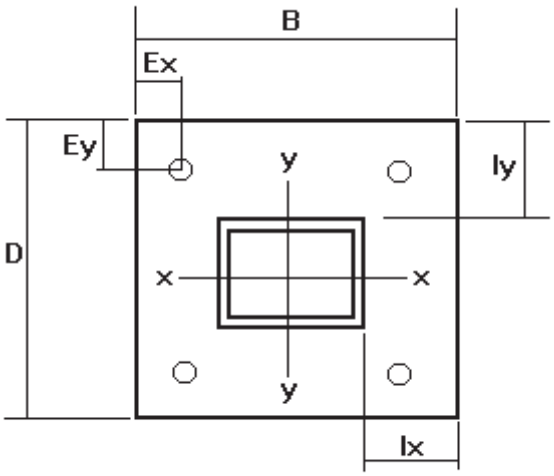
Determine Plate Dimensions

Depth of Column

Dimensions for Column used: HSS10x10x1/4

$d := 10 \cdot in$ $tw := 0.25 \cdot in$

$bf := 10 \cdot in$ $tf := 0.25 \cdot in$



Enter the dimensions for the plate.

$B := 16 \cdot in$ $Ex := 2 \cdot in$

$D := 16 \cdot in$ $Ey := 2 \cdot in$

Design Forces ***(Wind From X-Dir)***

$Axial := 1.6 \cdot kip$

$Fx := 0 \cdot kip$ $My := 0 \cdot kin$

$Fy := 1.2 \cdot kip$ $Mx := 203.9 \cdot kin$

Base Plate and Anchor Bolt Material Properties.

$fy_{BP} := 36.0 \cdot ksi$ *Yield Stress of Base Plate.*

$fu_{AB} := 58.0 \cdot ksi$ *Tensile Stress of Anchor Bolt (58ksi for A36)*

Estimated Anchor Bolts:

$AB_Dia := 1.00 \cdot in$ $A_{AB} := \left(\frac{\pi}{4}\right) \cdot AB_Dia^2$ $A_{AB} = 0.785 \cdot in^2$

The nominal tensile and shear stress for the bolts is based on the formula from page 16.1-120 of the 14th Edition of the AISC UNIFIED manual.

$F_{nt} := 0.75 \cdot fu_{AB}$ $F_{nt} = 43.5 \cdot ksi$

$F_{nv} := 0.45 \cdot fu_{AB}$ $F_{nv} = 26.1 \cdot ksi$

Determine Plate Thickness for Leveling Nut Base Plate.

A. Proportion Axial Force

$P_Ax := \frac{Axial}{4}$ $P_Ax = 0.4 \cdot kip$

B. Determine Bolt Forces due to Mx (for two bolts in compression)

$FC_Mx := \frac{Mx}{D - 2 \cdot Ey}$ $FC_Mx = 17 \cdot kip$

$P_Mx := 2 \cdot P_Ax + FC_Mx$ $P_Mx = 17.8 \cdot kip$

C. Determine Bolt Forces due to My (for two bolts in compression)

$FC_My := \frac{My}{B - 2 \cdot Ex}$ $FC_My = 0.0 \cdot kip$

$P_My := 2 \cdot P_Ax + FC_My$ $P_My = 0.8 \cdot kip$

D. Determine Thickness Required for Mx

$l_Mx := \frac{D - 2 \cdot Ey - d}{2}$ $l_Mx = 1.0 \cdot in$

$M_Mx := P_Mx \cdot l_Mx$ $M_Mx = 17.8 \cdot kin$

$t_Mx := \sqrt{\frac{\Omega_{BP} \cdot 4 \cdot M_Mx}{fy_{BP} \cdot B}}$ $t_Mx = 0.5 \cdot in$

E. Determine Thickness Required for My

$$l_My := \frac{B - 2 \cdot Ex - bf}{2} \qquad l_My = 1.0 \cdot in$$

$$M_My := P_My \cdot l_My \qquad M_My = 0.8 \cdot kin$$

$$t_My := \sqrt{\frac{\Omega_{BP} \cdot 4 \cdot M_My}{fy_{BP} \cdot D}} \qquad t_My = 0.1 \cdot in$$

F. Determine Total Plate Thickness Required

$$t_min := \sqrt{t_Mx^2 + t_My^2} \qquad t_min = 0.464 \cdot in$$

Check Anchor Bolt Diameter:

Calculate the Actual Tension per Bolt.

$$Max_Tension := \frac{FC_Mx + FC_My}{2} - P_Ax \qquad Max_Tension = 8.1 \cdot kip$$

Calculate the Allowable Tension per Bolt

$$R_{nt} := F_{nt} \cdot A_{AB} \qquad R_{nt} = 34.2 \cdot kip$$

$$Allowable_Tension := \frac{R_{nt}}{\Omega_{AB}} \qquad Allowable_Tension = 17.1 \cdot kip$$

Tension_Check = "OK"

Calculate the Actual Shear per Bolt.

$$Max_Shear := \frac{\sqrt{\left(Fy^2 + Fx^2\right)}}{4} \qquad Max_Shear = 0.3 \cdot kip$$

Calculate the Allowable Shear per Bolt.

$$R_{nv} := F_{nv} \cdot A_{AB} \qquad R_{nv} = 20.5 \cdot kip$$

$$Allowable_Shear := \frac{R_{nv}}{\Omega_{AB}} \qquad Allowable_Shear = 10.2 \cdot kip$$

Shear_Check = "OK"

Calculate the Allowable Combined Tension and Shear.

The combo check for tension and shear is a unity calculation. The equation result must be less than 1.00.

$$Unity_Calc := \left(\frac{Max_Tension}{Allowable_Tension}\right)^2 + \left(\frac{Max_Shear}{Allowable_Shear}\right)^2 = 0.225$$

Combo_Check = "OK"

Minimum Edge distance check (From Table J3.4). Minimum Edge Distance Must Be Greater than the Actual Bolt Hole Distances.

$AB_Dia = 1 \cdot in$

$Min_Edge = 1\frac{3}{4} \cdot in$ $Ex = 2 \cdot in$ $Ey = 2 \cdot in$

Edge_Check = "OK"

2" Edge Distance OK per note "a" from AISC Table J3.4

Determine Fillet Weld Size Required:

This design procedure is from Blodgett Section 7.4. The weld is treated as a line.

Calculate the the length of the welds, using the formulas contained in Table 5.

For Square Tubes:

$Swx := (bf) \cdot d + \frac{d^2}{3}$ $Swx = 133.333 \cdot in^2$

$Swy := bf \cdot d + \frac{(bf)^2}{3}$ $Swy = 133.333 \cdot in^2$

Calculate the stress for each direction:

$fmx := \frac{Mx}{Swx}$ $fmx = 1.529 \cdot \frac{kip}{in}$

$fmy := \frac{My}{Swy}$ $fmy = 0 \cdot \frac{kip}{in}$

Calculate the combined stress:

$f_act := \sqrt{(fmx^2 + fmy^2)}$ $f_act = 1.529 \cdot \frac{kip}{in}$

Allowable for fillet welds and A36 materialfor E70 weld material per AISC UNIFIED is 0.30(weld material)(0.707 for throat)=14850 psi..

The weld size required is determined by dividing the actual stress by the allowable stress.

$$w_reqd := \frac{f_act}{14850 \cdot psi} \qquad w_reqd = 0.103 \cdot in$$

Check Table J2.4 of the AISC ASD manual to check if w_reqd is greater than the minimum size required.

$tf = 0.25 \cdot in$ $tw = 0.25 \cdot in$ $t_min = 0.464 \cdot in$

Values to be Used:

Plate Thickness = 1 inch
Anchor Bolt = 1 inch diameter
Weld Size = 5/16 inch all around

This MathCAD document is used to calculate the following:

1. Base Plate thickness for bearing type(Square Tube Column)
2. Checks Anchor bolt Diameter & Edge Distance
3. Checks Fillet Weld Size

References which are used for the base plate design are:

1. AISC UNIFIED Construction Manual, 13th Edition.

ASD Design Factors

$\Omega_{BP} := 1.67$ $\Omega_{AB} := 2.00$

Definition of Units

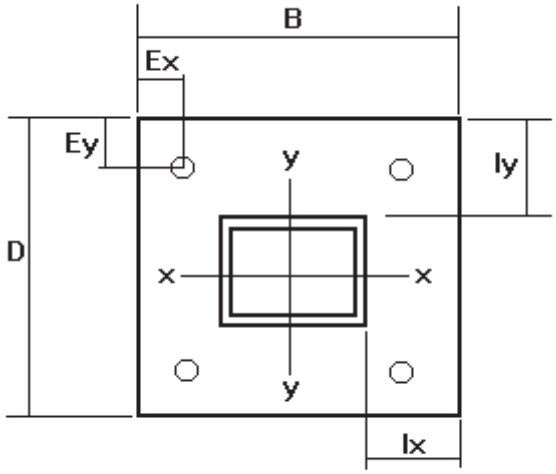
$kip \equiv 1000 \cdot lb$ $kin \equiv kip \cdot in$ $ksi \equiv \frac{kip}{in^2}$ $psi \equiv \frac{lb}{in^2}$

Determine Plate Dimensions

Depth of Column
Dimensions for Column used: HSS10x10x1/4

$d := 10 \cdot in$ $tw := 0.25 \cdot in$

$bf := 10 \cdot in$ $tf := 0.25 \cdot in$



Enter the dimensions for the plate.

$B := 16 \cdot in$ $Ex := 2 \cdot in$

$D := 16 \cdot in$ $Ey := 2 \cdot in$

Design Forces ***(Wind From 45-Deg)***

$Axial := 1.6 \cdot kip$

$Fx := 0.79 \cdot kip$ $My := 140.2 \cdot kin$

$Fy := 0.79 \cdot kip$ $Mx := 140.2 \cdot kin$

Base Plate and Anchor Bolt Material Properties.

$fy_{BP} := 36.0 \cdot ksi$ *Yield Stress of Base Plate.*

$fu_{AB} := 58.0 \cdot ksi$ *Tensile Stress of Anchor Bolt (58ksi for A36)*

Estimated Anchor Bolts:

$AB_Dia := 1.00 \cdot in$ $A_{AB} := \left(\frac{\pi}{4}\right) \cdot AB_Dia^2$ $A_{AB} = 0.785 \cdot in^2$

The nominal tensile and shear stress for the bolts is based on the formula from page 16.1-120 of the 14th Edition of the AISC UNIFIED manual.

$F_{nt} := 0.75 \cdot fu_{AB}$ $F_{nt} = 43.5 \cdot ksi$

$F_{nv} := 0.45 \cdot fu_{AB}$ $F_{nv} = 26.1 \cdot ksi$

Determine Plate Thickness for Leveling Nut Base Plate.

A. Proportion Axial Force

$P_Ax := \frac{Axial}{4}$ $P_Ax = 0.4 \cdot kip$

B. Determine Bolt Forces due to Mx (for two bolts in compression)

$FC_Mx := \frac{Mx}{D - 2 \cdot Ey}$ $FC_Mx = 11.7 \cdot kip$

$P_Mx := 2 \cdot P_Ax + FC_Mx$ $P_Mx = 12.5 \cdot kip$

C. Determine Bolt Forces due to My (for two bolts in compression)

$FC_My := \frac{My}{B - 2 \cdot Ex}$ $FC_My = 11.7 \cdot kip$

$P_My := 2 \cdot P_Ax + FC_My$ $P_My = 12.5 \cdot kip$

D. Determine Thickness Required for Mx

$l_Mx := \frac{D - 2 \cdot Ey - d}{2}$ $l_Mx = 1.0 \cdot in$

$M_Mx := P_Mx \cdot l_Mx$ $M_Mx = 12.5 \cdot kin$

$t_Mx := \sqrt{\frac{\Omega_{BP} \cdot 4 \cdot M_Mx}{fy_{BP} \cdot B}}$ $t_Mx = 0.4 \cdot in$

E. Determine Thickness Required for My

$l_My := \frac{B - 2 \cdot Ex - bf}{2}$ $l_My = 1.0 \cdot in$

$M_My := P_My \cdot l_My$ $M_My = 12.5 \cdot kin$

$$t_My := \sqrt{\frac{\Omega_{BP} \cdot 4 \cdot M_My}{fy_{BP} \cdot D}} \qquad t_My = 0.4 \cdot in$$

F. Determine Total Plate Thickness Required

$$t_min := \sqrt{t_Mx^2 + t_My^2} \qquad t_min = 0.538 \cdot in$$

Check Anchor Bolt Diameter:

Calculate the Actual Tension per Bolt.

$$Max_Tension := \frac{FC_Mx + FC_My}{2} - P_Ax \qquad Max_Tension = 11.3 \cdot kip$$

Calculate the Allowable Tension per Bolt

$$R_{nt} := F_{nt} \cdot A_{AB} \qquad R_{nt} = 34.2 \cdot kip$$

$$Allowable_Tension := \frac{R_{nt}}{\Omega_{AB}} \qquad Allowable_Tension = 17.1 \cdot kip$$

Tension_Check = "OK"

Calculate the Actual Shear per Bolt.

$$Max_Shear := \frac{\sqrt{\left(Fy^2 + Fx^2\right)}}{4} \qquad Max_Shear = 0.279 \cdot kip$$

Calculate the Allowable Shear per Bolt.

$$R_{nv} := F_{nv} \cdot A_{AB} \qquad R_{nv} = 20.5 \cdot kip$$

$$Allowable_Shear := \frac{R_{nv}}{\Omega_{AB}} \qquad Allowable_Shear = 10.2 \cdot kip$$

Shear_Check = "OK"

Calculate the Allowable Combined Tension and Shear.

The combo check for tension and shear is a unity calculation. The equation result must be less than 1.00.

$$Unity_Calc := \left(\frac{Max_Tension}{Allowable_Tension}\right)^2 + \left(\frac{Max_Shear}{Allowable_Shear}\right)^2 = 0.437$$

Combo_Check = "OK'

Minimum Edge distance check (From Table J3.4). Minimum Edge Distance Must Be Greater than the Actual Bolt Hole Distances.

$AB_Dia = 1 \cdot in$

$Min_Edge = 1\frac{3}{4} \cdot in$ $Ex = 2 \cdot in$ $Ey = 2 \cdot in$

Edge_Check = "OK"

2" Edge Distance OK per note "a" from AISC Table J3.4

Determine Fillet Weld Size Required:

This design procedure is from Blodgett Section 7.4. The weld is treated as a line.

Calculate the the length of the welds, using the formulas contained in Table 5.

For Square

$Swx := (bf) \cdot d + \frac{d^2}{3}$ $Swx = 133.333 \cdot in^2$

$Swy := bf \cdot d + \frac{(bf)^2}{3}$ $Swy = 133.333 \cdot in^2$

Calculate the stress for each direction:

$fmx := \frac{Mx}{Swx}$ $fmx = 1.051 \cdot \frac{kip}{in}$

$fmy := \frac{My}{Swy}$ $fmy = 1.051 \cdot \frac{kip}{in}$

Calculate the combined stress:

$f_act := \sqrt{(fmx^2 + fmy^2)}$ $f_act = 1.487 \cdot \frac{kip}{in}$

Allowable for fillet welds and A36 materialfor E70 weld material per AISC UNIFIED is 0.30(weld material)(0.707 for throat)=14850 psi..

The weld size required is determined by dividing the actual stress by the allowable stress.

$w_reqd := \frac{f_act}{14850 \cdot psi}$ $w_reqd = 0.1 \cdot in$

Check Table J2.4 of the AISC ASD manual to check if w_reqd is greater than the minimum size required.

$tf = 0.25 \cdot in$ $tw = 0.25 \cdot in$ $t_min = 0.538 \cdot in$

Values to be Used:

Plate Thickness = 1 inch
Anchor Bolt = 1 inch diameter
Weld Size = 5/16 inch all around

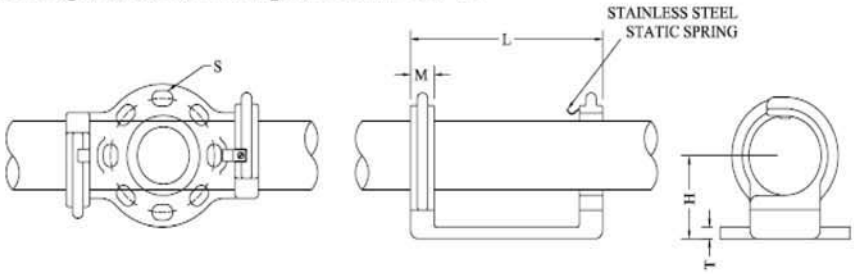
ALUMINUM BUS SUPPORTS

TYPE ASWH

Horizontal Weldment
Pipe to Insulator

Castings: 356-T6 Aluminum
Mounting Hardware: Galvanized Steel

Aluminum alloy weldment bus support for aluminum pipe. Designed for slip or rigid fit applications. When rigid fit is required, you must weld the hooks to the pipe. Delete the SE suffix to eliminate the static spring. Hardware supplied for cap mounted. For pin mounted, add suffix (P) to catalog number, Example: ASWH-58-5P



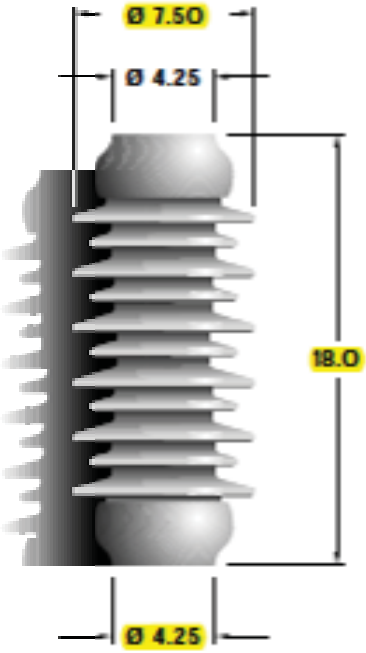
CATALOG NUMBER	PIPE SIZE	B.C.	DIMENSIONS - INCHES						WEIGHT (POUNDS)
			H	L	T	M	S	J	
ASWH-30-3-SE	3/4	3	2	5 1/2	9/32	1/2	9/16 x 3/4	1/2	1.16
ASWH-30-5-SE		5	2 1/4	8	3/8	5/8	11/16 X 1	5/8	2.01
ASWH-39-3-SE	1	3	2	6	5/16	3/4	9/16 x 13/16	1/2	1.16
ASWH-39-5-SE		5	2 1/4	8 1/4	3/8	3/4	11/16 X 1	5/8	2.23
ASWH-49-3-SE	1 1/4	3	2 1/4	7 1/4	1/2	1 1/8	9/16 x 13/16	1/2	2.95
ASWH-49-5-SE		5	2 1/4	9 1/4	9/16	1 1/8	11/16 X 1	5/8	3.45
ASWH-53-3-SE	1 1/2	3	2 1/2	7 1/4	9/16	1 1/8	9/16 x 13/16	1/2	2.81
ASWH-53-5-SE		5	2 1/2	9 1/4	9/16	1 1/8	11/16 X 1	5/8	3.67
ASWH-58-3-SE	2	3	2 3/4	7 1/4	9/16	1 1/8	9/16 x 13/16	1/2	2.95
ASWH-58-5-SE		5	2 3/4	9 1/4	9/16	1 1/8	11/16 X 1-1/16	5/8	3.77
ASWH-60-3-SE	2 1/2	3	3 1/8	7 1/4	9/16	1 1/8	9/16 x 13/16	1/2	3.45
ASWH-60-5-SE		5	3 1/8	9 1/4	9/16	1 1/8	11/16 X 1-1/16	5/8	4.27
ASWH-60-7-SE		7	3 1/8	12 1/2	1/2	1 1/8	13/16 X 1-1/8	3/4	6.49
ASWH-62-3-SE	3	3	3 5/8	7 1/4	9/16	1 1/8	9/16 x 13/16	1/2	3.95
ASWH-62-5-SE		5	3 5/8	9 1/4	1/2	1 1/8	11/16 X 1	5/8	4.77
ASWH-62-7-SE		7	3 5/8	12 1/2	1/2	1 1/4	13/16 X 1-1/8	3/4	6.99
ASWH-63-3-SE	3 1/2	3	4	7 1/4	1/2	1 1/8	9/16 x 13/16	1/2	3.95
ASWH-63-5-SE		5	4	9 1/4	3/8	1 1/8	11/16 X 1	5/8	4.77
ASWH-63-7-SE		7	4	12 1/2	1/2	1 3/16	13/16 X 1-1/8	3/4	6.99
ASWH-64-3-SE	4	3	4 1/2	7 1/4	9/16	1 1/8	9/16 x 13/16	1/2	3.95
ASWH-64-5-SE		5	4 1/2	9 1/4	9/16	1 1/8	11/16 X 1	5/8	4.77
ASWH-64-7-SE		7	4 1/2	12 1/2	1/2	1 1/8	13/16 X 1-1/8	3/4	6.99
ASWH-67-3-SE	5	3	5	7 5/8	1/2	1 1/2	9/16 x 13/16	1/2	5.94
ASWH-67-5-SE		5	5	9 5/8	1/2	1 1/2	11/16 X 1	5/8	6.78
ASWH-67-7-SE		7	5	11 1/2	1/2	1 3/8	13/16 X 1-5/16	3/4	9.59
ASWH-69-3-SE	6	3	5 1/2	7 5/8	1/2	1 1/2	9/16 x 3/4	1/2	5.96
ASWH-69-5-SE		5	5 1/2	9 5/8	1/2	1 1/2	11/16 X 1	5/8	6.78
ASWH-69-7-SE		7	5 1/2	12 7/8	1/2	1 1/2	13/16 X 1-1/8	3/4	9

TABLE 3. ROUND TUBULAR BUS COPPER OR ALUMINUM

Size	Outside Diameter	Inside Diameter	Moment of Inertia (i)	Section Modulus (S)	Weight	
					Aluminum	Copper
in.	in.	in.	$in.^4$	$in.^3$	lb/ft	lb/ft
Schedule 40						
1/2	0.84	0.622	0.0171	0.0407	0.294	0.956
3/4	1.05	0.824	0.0370	0.0705	0.391	1.300
1	1.315	1.049	0.0873	0.1328	0.581	1.830
1-1/2	1.90	1.610	0.3100	0.3260	0.940	3.190
2	2.375	2.067	0.6660	0.5610	1.264	4.210
2-1/2	2.875	2.469	1.5300	1.0640	2.004	6.120
3	3.50	3.068	3.0170	1.7240	2.621	8.720
3-1/2	4.00	3.548	4.7880	2.3940	3.151	11.380
4	4.50	4.026	7.2320	3.2140	3.733	12.900
5	5.563	5.047	15.1600	5.4510	5.057	16.210
6	6.625	6.065	28.1400	8.5000	6.564	19.350
Schedule 80						
1/2	0.84	0.546	0.0201	0.0478	0.376	1.250
3/4	1.05	0.742	0.0448	0.0853	0.510	1.700
1	1.315	0.957	0.1056	0.1606	0.751	2.500
1-1/2	1.90	1.50	0.3910	0.4120	1.256	4.180
2	2.375	1.939	0.8680	0.7310	1.737	5.780
2-1/2	2.875	2.323	1.9240	1.3390	2.650	8.820
3	3.50	2.90	3.8940	2.2250	3.547	11.790
3-1/2	4.00	3.364	6.2810	3.1400	4.326	14.340
4	4.50	3.826	9.6110	4.2720	5.183	17.220
5	5.563	~~4.183~~ 4.81	20.6700	7.4320	7.188	23.620
6	6.625	5.761	40.4900	12.2200	9.884	32.830

NOTE: Values given are for both 6061-T6 and 6063-T6 aluminum alloys.

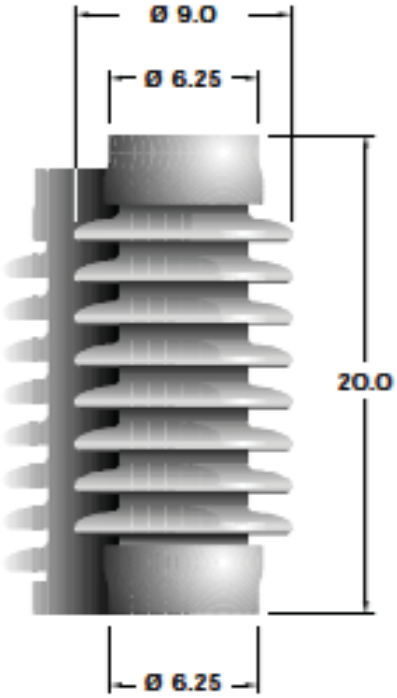
STANDARD STRENGTH UNIT



4 TAPPED HOLES
1/2-13 +.015 OVERSIZE
5/8" FULL THREAD
ON 3.0" BOLT CIRCLE

315210-70

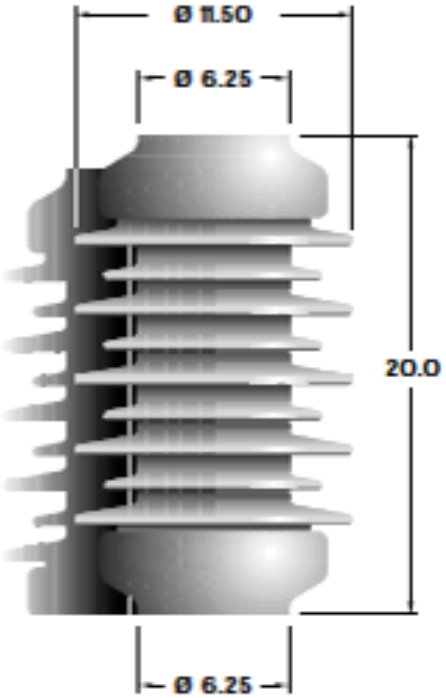
HIGH STRENGTH UNIT



4 TAPPED HOLES
5/8-11 +.015 OVERSIZE
3/4" FULL THREAD
ON 5.0" BOLT CIRCLE

315231-70

EXTRA-HIGH STRENGTH UNIT



4 TAPPED HOLES
5/8-11 +.015 OVERSIZE
3/4" FULL THREAD
ON 5.0" BOLT CIRCLE

318455-70

CHARACTERISTICS

Lapp Catalog Number Ancil Technical Reference Number	315210-70 T.R.210	315231-70 T.R.231	318455-70
Dimensions			
Leakage Distance, Inches	37	37	37
Mechanical Values *			
Cantilever Strength, Upright, Pounds	2000	4000	8000
Cantilever Strength, Underhung, Pounds	2000	4000	8000
Tensile Strength, Pounds	12000	25000	28000
Torsion Strength, Inch-Pounds	10000	20000	40000
Compression Strength, Pounds	15000	30000	60000
Electrical Values			
Voltage Class, kV	34.5	34.5	34.5
Impulse Flashover, Positive, kV	225	225	225
Low Frequency Withstand, 10 Sec. Wet, kV	80	80	80
Impulse Withstand, kV	200	200	200
Radio Influence Voltage Data			
Test Voltage, Rms to Ground, kV	22	22	22
Maximum RIV, Microvolts at 1000 kHz	100	100	100
Weight			
Net Weight, Each, Pounds	41	74	117

* For Maximum recommended working loads see "Specifications," page 5.
Note: For RG glazed insulators equivalent to these standard insulators, see table on page 9.
Illustrations shown are true representations of Lapp products at the time of printing, but are subject to change at any time.

ALL DIMENSIONS ARE IN INCHES

Project # :	17.01246	**Ulteig Engineers**		By:	DAW
Project Title:	Northwest Ohio			Date:	1/24/2018
Item:	Station Service/3ph Bus	**NESC Load Cases**		Checked:	

Load from Wind on Member

Load Case Constants:

	NESC	High Wind
Wind (psf):	4	20.74
Ice (in):	0.5	0
C_d (drag):	1.6	1.6

Load on Member (lbs/ft):

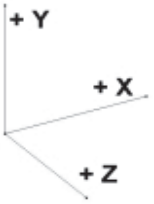
Width (in)	NESC	NESC 45°	High Wind	High Wind 45°
2	1.6	1.1	5.5	3.9
3	2.1	1.5	8.3	5.9
4	2.7	1.9	11.1	7.8
5	3.2	2.3	13.8	9.8
6	3.7	2.6	16.6	11.7
7	4.3	3.0	19.4	13.7
8	4.8	3.4	22.1	15.6
9	5.3	3.8	24.9	17.6
10	5.9	4.1	27.7	19.6
11	6.4	4.5	30.4	21.5
12	6.9	4.9	33.2	23.5
13	7.5	5.3	35.9	25.4
14	8.0	5.7	38.7	27.4

Project # :	17.01246	**Ulteig Engineers, Inc**		By:	DAW
Project Title:	Nortwest Ohio			Date:	1/24/2018
Item:	Feeder Riser/3ph Bus	**NESC Load Cases**		Checked:	

Load from a horizontally mounted insulator, fuse, surge arrester, etc.

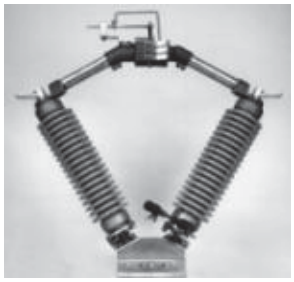
Equipment: 34.5kV Insulator

Orientation: Ypos (Ypos, Yneg; Asuming switches are on Staad x-axis, which grid are the switches in?)



Specifications:

Weight (lbs):	41	(weight of individual piece of equipment with no ice)
Y_{arm} (in):	13	(moment arm; typically half of total height)
C_d (drag):	1	(drag coefficiant; 1 for cylinder, 1.6 for square)
$Area_x$ (in^2):	144	(area wind hits in x-direction)
$Area_z$ (in^2):	144	(area wind hits in z-direction)
k_z:	0.92	(exposure coefficient; table 250-2 NESC)
G_{RF}:	1.02	(gust response factor; table 250-3 NESC)



Loads: NESC Heavy (40 mph wind with 1/2" ice) and High Wind (90 mph wind)

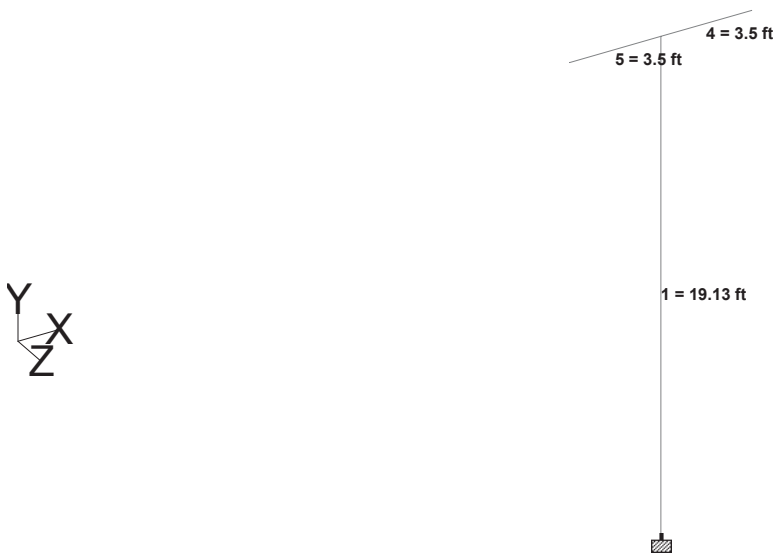
	NESC	High Wind	
P (psf):	4.0	19.5	(C_d x 4psf NESC, .00256 x k_z x G_{RF} x C_d x $90mph^2$ high wind)
F_y (lbs):	-61.5	-41.0	(weight; NESC includes 1.5 for ice)

Wind X-Dir	NESC	High Wind	
F_y (lbs):	**-61.5**	**-41.0**	(weight; NESC includes 1.5 for ice)
F_x (lbs):	**4.0**	**19.5**	(P x A_x)
M_z (ft-lbs):	**-4.3**	**-21.1**	(F_x x Y_{arm})

Wind Z-Dir	NESC	High Wind	
F_y (lbs):	**-61.5**	**-41.0**	(weight; NESC includes 1.5 for ice)
F_z (lbs):	**4.0**	**19.5**	(P x A_z)
M_x (ft-lbs):	**4.3**	**21.1**	(F_z x Y_{arm})

Wind 45 Deg	NESC	High Wind	
F_y (lbs):	**-61.5**	**-41.0**	(weight; NESC includes 1.5 for ice)
F_x (lbs):	**2.8**	**13.8**	(P x A_x x sin45)
F_z (lbs):	**2.8**	**13.8**	(P x A_z x sin45)
M_z (ft-lbs):	**-3.1**	**-14.9**	(F_x x Y_{arm})
M_x (ft-lbs):	**3.1**	**14.9**	(F_z x Y_{arm})

Software licensed to Ulteig Engineers	Job No	Sheet No 1	Rev
	Part Feeder Riser		
Job Title Northwest Ohio	Ref		
	By DAW	Date 3-JAN-18	Chd
Client White	File 34.5kV Feeder Riser.std	Date/Time 17-Jan-2018 20:27	



```
**************************************************
*                                                *
*           STAAD.Pro V8i SELECTseries4           *
*           Version  20.07.09.21                 *
*           Proprietary Program of               *
*           Bentley Systems, Inc.                *
*           Date=    JAN 17, 2018                *
*           Time=    20:27:24                    *
*                                                *
*      USER ID: Ulteig Engineers                 *
**************************************************
```

```
     1. STAAD SPACE
INPUT FILE: 34.5kV Feeder Riser.STD
     2. START JOB INFORMATION
     3. ENGINEER DATE 3-JAN-18
     4. JOB NAME NORTHWEST OHIO
     5. JOB PART FEEDER RISER
     6. ENGINEER NAME DAW
     7. JOB CLIENT WHITE
     8. END JOB INFORMATION
     9. INPUT WIDTH 79
    10. UNIT FEET POUND
    11. JOINT COORDINATES
    12. 1 0 0 0; 4 0 19.125 0; 5 -3.5 19.125 0; 6 3.5 19.125 0
    13. MEMBER INCIDENCES
    14. 1 1 4; 4 4 6; 5 4 5
    15. DEFINE MATERIAL START
    16. ISOTROPIC STEEL
    17. E 4.176E+009
    18. POISSON 0.3
    19. DENSITY 489.024
    20. ALPHA 6E-006
    21. DAMP 0.03
    22. END DEFINE MATERIAL
    23. MEMBER PROPERTY AMERICAN
    24. 1 TABLE ST HSST8X8X0.375
    25. 4 5 TABLE ST HSST8X8X0.25
    26. CONSTANTS
    27. MATERIAL STEEL ALL
    28. SUPPORTS
    29. 1 FIXED
    30. LOAD 1 LOADTYPE NONE  TITLE NESC HEAVY 1/2" ICE 40 MPH WIND X-DIR
    31. SELFWEIGHT Y -1.5
    32. JOINT LOAD
    33. *BUS
    34. 4 FX 26 FY -111 MZ -70
    35. 5 FX -1129 FY -111 MZ 3016
    36. 6 FX 1129 FY -111 MZ -3016
    37. *INSULATOR
    38. 4 TO 6 FX 4 FY -61.5 MZ -5
```

```
39. MEMBER LOAD
40. 1 UNI GX 4.8
41. *SSVT
42. LOAD 2 LOADTYPE NONE  TITLE NESC HEAVY 1/2" ICE 40 MPH WIND Z-DIR
43. SELFWEIGHT Y -1.5
44. JOINT LOAD
45. *BUS
46. 4 TO 6 FY -111
47. *INSULATOR
48. 4 TO 6 FY -61.5 FZ 4 MX 5
49. MEMBER LOAD
50. 1 4 5 UNI GZ 4.8
51. *SSVT
52. LOAD 3 LOADTYPE NONE  TITLE NESC HEAVY 1/2" ICE 40 MPH WIND 45 DEG
53. SELFWEIGHT Y -1.5
54. JOINT LOAD
55. *BUS
56. 4 FX 19 FY -111 MZ -50
57. 5 FX -799 FY -111 MZ 2132
58. 6 FX 799 FY -111 MZ -2132
59. *INSULATOR
60. 4 TO 6 FX 3 FY -61.5 FZ 3 MX 4 MZ -4
61. MEMBER LOAD
62. 1 UNI GX 3.4
63. 1 4 5 UNI GZ 3.4
64. *SSVT
65. LOAD 4 LOADTYPE NONE  TITLE HIGH WIND 90 MPH WIND X-DIR
66. SELFWEIGHT Y -1
67. JOINT LOAD
68. *BUS
69. 4 FX 108 FY -66 MZ -289
70. 5 FX -1211 FY -66 MZ 3235
71. 6 FX 1211 FY -66 MZ -3235
72. *INSULATOR
73. 4 TO 6 FX 20 FY -41 MZ -22
74. MEMBER LOAD
75. 1 UNI GX 22.1
76. *SSVT
77. LOAD 5 LOADTYPE NONE  TITLE HIGH WIND 90 MPH WIND Z-DIR
78. SELFWEIGHT Y -1
79. JOINT LOAD
80. *BUS
81. 4 TO 6 FY -66
82. *INSULATOR
83. 4 TO 6 FY -41 FZ 20 MX 22
84. MEMBER LOAD
85. 1 4 5 UNI GZ 22.1
86. *SSVT
87. LOAD 6 LOADTYPE NONE  TITLE HIGH WIND 90 MPH WIND 45 DEG
88. SELFWEIGHT Y -1
89. JOINT LOAD
90. *BUS
91. 4 FX 77 FY -66 MZ -204
92. 5 FX -857 FY -66 MZ 2287
93. 6 FX 857 FY -66 MZ -2287
94. *INSULATOR
```

```
 95. 4 TO 6 FX 14 FY -41 FZ 14 MX 15 MZ -15
 96. MEMBER LOAD
 97. 1 UNI GX 15.6
 98. 1 4 5 UNI GZ 15.6
 99. *SSVT
100. PDELTA ANALYSIS SMALLDELTA
```

P R O B L E M S T A T I S T I C S

NUMBER OF JOINTS	**4**	**NUMBER OF MEMBERS**	**3**
NUMBER OF PLATES	**0**	**NUMBER OF SOLIDS**	**0**
NUMBER OF SURFACES	**0**	**NUMBER OF SUPPORTS**	**1**

SOLVER USED IS THE OUT-OF-CORE BASIC SOLVER

ORIGINAL/FINAL BAND-WIDTH= 2/ 2/ 18 DOF
TOTAL PRIMARY LOAD CASES = 6, TOTAL DEGREES OF FREEDOM = 18
SIZE OF STIFFNESS MATRIX = 1 DOUBLE KILO-WORDS
REQRD/AVAIL. DISK SPACE = 12.0/ 0.0 MB

```
++ Adjusting Displacements.
++ Adjusting Displacements.

101. PARAMETER 1
102. CODE AISC UNIFIED 2010
103. METHOD ASD
104. KY 2.1 MEMB 1
105. KZ 2.1 MEMB 1
106. LX 19 MEMB 1
107. LY 19 MEMB 1
108. LZ 19 MEMB 1
109. UNB 19 MEMB 1
110. UNT 19 MEMB 1
111. CHECK CODE ALL
```

STAAD.PRO CODE CHECKING - (AISC-360-10-ASD) v1.2
****

ALL UNITS ARE - KIP INCH (UNLESS OTHERWISE NOTED)

MEMBER NO: 1 CRITICAL RATIO: 0.221(PASS) LOAD: 6
LOCATION (ft): 0.00 CONDITION: Eq. H1-1b
SECTION: HSST8X8X0.375 (AISC SECTIONS)

MEMBER NO: 4 CRITICAL RATIO: 0.108(PASS) LOAD: 1
LOCATION (ft): 0.00 CONDITION: Eq. H1-1b
SECTION: HSST8X8X0.25 (AISC SECTIONS)

MEMBER NO: 5 CRITICAL RATIO: 0.108(PASS) LOAD: 1
LOCATION (ft): 0.00 CONDITION: Eq. H1-1b
SECTION: HSST8X8X0.25 (AISC SECTIONS)

ALL MEMBERS PASS

112. PRINT JOINT DISPLACEMENTS LIST 4 TO 6

JOINT DISPLACEMENT (INCH RADIANS) STRUCTURE TYPE = SPACE

JOINT	LOAD	X-TRANS	Y-TRANS	Z-TRANS	X-ROTAN	Y-ROTAN	Z-ROTAN
4	1	0.11062	-0.00097	0.00000	0.00000	0.00000	-0.00071
	2	0.00000	-0.00097	0.11422	0.00071	0.00000	0.00000
	3	0.08019	-0.00097	0.08176	0.00051	0.00000	-0.00051
	4	0.49378	-0.00063	0.00000	0.00000	0.00000	-0.00314
	5	0.00000	-0.00063	0.53046	0.00331	0.00000	0.00000
	6	0.34955	-0.00063	0.37378	0.00233	0.00000	-0.00222
5	1	0.11039	0.01022	0.00000	0.00000	0.00000	0.00013
	2	0.00000	-0.00386	0.11435	0.00072	0.00000	0.00009
	3	0.08003	0.00667	0.08186	0.00051	0.00000	0.00010
	4	0.49354	0.11267	0.00000	0.00000	0.00000	-0.00229
	5	0.00000	-0.00245	0.53111	0.00332	0.00002	0.00006
	6	0.34938	0.07911	0.37423	0.00234	0.00001	-0.00160
6	1	0.11085	-0.04906	0.00000	0.00000	0.00000	-0.00154
	2	0.00000	-0.00386	0.11435	0.00072	0.00000	-0.00009
	3	0.08036	-0.03639	0.08186	0.00051	0.00000	-0.00113
	4	0.49403	-0.15096	0.00000	0.00000	0.00000	-0.00399
	5	0.00000	-0.00245	0.53111	0.00332	-0.00002	-0.00006
	6	0.34973	-0.10762	0.37423	0.00234	-0.00001	-0.00284

Displacement Z = 0.531" < 2.295"

Displacement X = 0.350" < 2.295"

Displacement Y = 0.151" < 0.21"

********** END OF LATEST ANALYSIS RESULT **********

113. PRINT MEMBER FORCES ALL

Max Horizontal Deflection(Vert. Member) = L/100

Max Horizontal Deflection = (19.125*12)/100 = 2.295"

Max Vertical Deflection(Horz. Member) = L/200

Max Vertical Deflection = (3.5*12)/200 = 0.21"

MEMBER END FORCES STRUCTURE TYPE = SPACE

ALL UNITS ARE -- POUN FEET (LOCAL)

MEMBER	LOAD	JT	AXIAL	SHEAR-Y	SHEAR-Z	TORSION	MOM-Y	MOM-Z	
1	1	1	1783.87	129.80	0.00	0.00	0.00	1695.77	
		4	-770.67	-38.00	0.00	0.00	0.00	-79.41	
	2	1	1783.87	0.00	-137.40	0.00	1777.09	0.00	
		4	-770.67	0.00	45.60	0.00	-15.00	0.00	
	3	1	1783.87	93.03	-97.82	0.00	1269.80	1224.96	
		4	-770.67	-28.00	32.80	0.00	-12.00	-59.13	
	4	1	1165.25	590.66	0.00	0.00	0.00	7617.09	
		4	-489.78	-168.00	0.00	0.00	0.00	-328.33	
	5	1	1165.25	0.00	-637.36	0.00	8250.43	0.00	Max Moment for B.P. Design (x/z - Dir.)
		4	-489.78	0.00	214.70	0.00	-66.00	0.00	
	6	1	1165.25	417.35	-449.55	0.00	5815.45	5388.58	Max Moment for B.P. Design (45 Deg.)
		4	-489.78	-119.00	151.20	0.00	-45.00	-235.63	
4	1	4	-1133.00	299.09	0.00	0.00	0.00	3841.73	Max Moment for T.P. Design
		6	1133.00	-172.50	0.00	0.00	0.00	-3021.00	
	2	4	0.00	299.09	-20.80	-5.00	43.40	825.28	
		6	0.00	-172.50	4.00	5.00	0.00	0.00	
	3	4	-802.00	299.09	-14.90	-4.00	31.32	2958.91	
		6	802.00	-172.50	3.00	4.00	0.00	-2136.00	
	4	4	-1231.00	191.39	0.00	0.00	0.00	3763.76	
		6	1231.00	-107.00	0.00	0.00	0.00	-3257.00	
	5	4	0.00	191.39	-97.35	-22.00	205.36	522.18	
		6	0.00	-107.00	20.00	22.00	0.00	0.00	
	6	4	-871.00	191.39	-68.60	-15.00	144.52	2816.42	
		6	871.00	-107.00	14.00	15.00	0.00	-2302.00	
5	1	4	-1125.00	299.09	0.00	0.00	0.00	3837.32	
		5	1125.00	-172.50	0.00	0.00	0.00	-3011.00	
	2	4	0.00	299.09	20.80	5.00	-43.40	825.28	
		5	0.00	-172.50	-4.00	-5.00	0.00	0.00	
	3	4	-796.00	299.09	14.90	4.00	-31.32	2953.78	
		5	796.00	-172.50	-3.00	-4.00	0.00	-2128.00	
	4	4	-1191.00	191.39	0.00	0.00	0.00	3746.43	
		5	1191.00	-107.00	0.00	0.00	0.00	-3213.00	
	5	4	0.00	191.39	97.35	22.00	-205.36	522.18	
		5	0.00	-107.00	-20.00	-22.00	0.00	0.00	
	6	4	-843.00	191.39	68.60	15.00	-144.52	2799.79	
		5	843.00	-107.00	-14.00	-15.00	0.00	-2272.00	

********** END OF LATEST ANALYSIS RESULT **********

114. PRINT SUPPORT REACTION LIST 1

SUPPORT REACTIONS -UNIT POUN FEET STRUCTURE TYPE = SPACE

JOINT	LOAD	FORCE-X	FORCE-Y	FORCE-Z	MOM-X	MOM-Y	MOM Z	
1	1	-129.80	1783.87	0.00	0.00	0.00	1695.77	
	2	0.00	1783.87	-137.40	-1777.09	0.00	0.00	MAX VERTICAL CASE FOR D.P. DESIGN
	3	-93.03	1783.87	-97.82	-1269.80	0.00	1224.96	
	4	-590.66	1165.25	0.00	0.00	0.00	7617.09	
	5	0.00	1165.25	-637.36	-8250.43	0.00	0.00	MAX MOMENT CASE FOR D.P. DESIGN
	6	-417.35	1165.25	-449.55	-5815.45	0.00	5388.58	

********** END OF LATEST ANALYSIS RESULT **********

115. FINISH

********** END OF THE STAAD.Pro RUN **********

**** DATE= JAN 17,2018 TIME= 20:27:25 ****

```
*************************************************************
*        For questions on STAAD.Pro, please contact         *
*        Bentley Systems or Partner offices                 *
*                                                           *
*            Telephone             Web / Email              *
*  USA       +1  (714) 974-2500                             *
*  UK        +44 (0) 808 101 9246                           *
*  SINGAPORE +65 6225-6158                                  *
*  FRANCE    +33 (0) 1 55238400                             *
*  GERMANY   +49 0931 40468                                 *
*  INDIA     +91 (033) 4006-2021                            *
*  JAPAN     +81 (03)5952-6500    http://www.ctc-g.co.jp    *
*  CHINA     +86 21 6288 4040                               *
*  THAILAND  +66 (0)2645-1018/19 partha.p@reisoftwareth.com*
*                                                           *
*  Worldwide  http://selectservices.bentley.com/en-US/      *
*                                                           *
*************************************************************
```

This MathCAD document is used to calculate the following:

1. Base Plate thickness for bearing type(Square Tube Column)
2. Checks Anchor bolt Diameter & Edge Distance
3. Checks Fillet Weld Size

References which are used for the base plate design are:

1. AISC UNIFIED Construction Manual, 13th Edition.

ASD Design Factors

$\Omega_{BP} := 1.67$ $\Omega_{AB} := 2.00$

Definition of Units

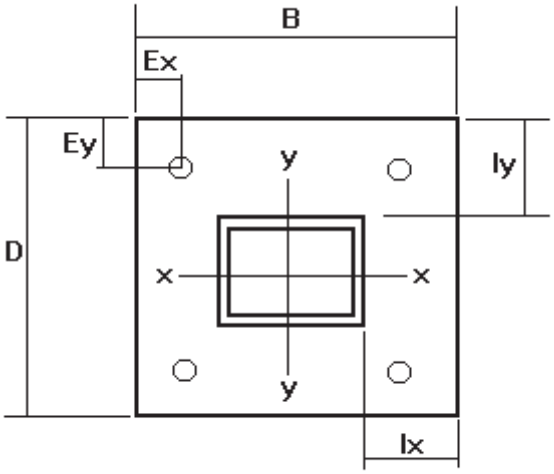
$kip \equiv 1000 \cdot lb$ $kin \equiv kip \cdot in$ $ksi \equiv \frac{kip}{in^2}$ $psi \equiv \frac{lb}{in^2}$

Determine Plate Dimensions

Depth of Column
Dimensions for Column used: HSS8x8x3/8

$d := 8 \cdot in$ $tw := 0.375 \cdot in$

$bf := 8 \cdot in$ $tf := 0.375 \cdot in$



Enter the dimensions for the plate.

$B := 16 \cdot in$ $Ex := 2 \cdot in$

$D := 16 \cdot in$ $Ey := 2 \cdot in$

Design Forces ***(Wind From 45-Deg)***

$Axial := 1.2 \cdot kip$

$Fx := 0.45 \cdot kip$ $My := 69.8 \cdot kin$

$Fy := 0.42 \cdot kip$ $Mx := 64.7 \cdot kin$

Base Plate and Anchor Bolt Material Properties.

$fy_{BP} := 36.0 \cdot ksi$ *Yield Stress of Base Plate.*

$fu_{AB} := 58.0 \cdot ksi$ *Tensile Stress of Anchor Bolt (58ksi for A36)*

Estimated Anchor Bolts:

$AB_Dia := 1.00 \cdot in$ $A_{AB} := \left(\frac{\pi}{4}\right) \cdot AB_Dia^2$ $A_{AB} = 0.785 \cdot in^2$

The nominal tensile and shear stress for the bolts is based on the formula from page 16.1-120 of the 14th Edition of the AISC UNIFIED manual.

$F_{nt} := 0.75 \cdot fu_{AB}$ $F_{nt} = 43.5 \cdot ksi$

$F_{nv} := 0.45 \cdot fu_{AB}$ $F_{nv} = 26.1 \cdot ksi$

Determine Plate Thickness for Leveling Nut Base Plate.

A. Proportion Axial Force

$P_Ax := \frac{Axial}{4}$ $P_Ax = 0.3 \cdot kip$

B. Determine Bolt Forces due to Mx (for two bolts in compression)

$FC_Mx := \frac{Mx}{D - 2 \cdot Ey}$ $FC_Mx = 5.4 \cdot kip$

$P_Mx := 2 \cdot P_Ax + FC_Mx$ $P_Mx = 6 \cdot kip$

C. Determine Bolt Forces due to My (for two bolts in compression)

$FC_My := \frac{My}{B - 2 \cdot Ex}$ $FC_My = 5.8 \cdot kip$

$P_My := 2 \cdot P_Ax + FC_My$ $P_My = 6.4 \cdot kip$

D. Determine Thickness Required for Mx

$l_Mx := \frac{D - 2 \cdot Ey - d}{2}$ $l_Mx = 2.0 \cdot in$

$M_Mx := P_Mx \cdot l_Mx$ $M_Mx = 12.0 \cdot kin$

$t_Mx := \sqrt{\frac{\Omega_{BP} \cdot 4 \cdot M_Mx}{fy_{BP} \cdot B}}$ $t_Mx = 0.4 \cdot in$

E. Determine Thickness Required for My

$l_My := \frac{B - 2 \cdot Ex - bf}{2}$ $l_My = 2.0 \cdot in$

$M_My := P_My \cdot l_My$ $M_My = 12.8 \cdot kin$

$$t_My := \sqrt{\frac{\Omega_{BP} \cdot 4 \cdot M_My}{fy_{BP} \cdot D}} \qquad t_My = 0.4 \cdot in$$

F. Determine Total Plate Thickness Required

$$t_min := \sqrt{t_Mx^2 + t_My^2} \qquad t_min = 0.536 \cdot in$$

Check Anchor Bolt Diameter:

Calculate the Actual Tension per Bolt.

$$Max_Tension := \frac{FC_Mx + FC_My}{2} - P_Ax \qquad Max_Tension = 5.3 \cdot kip$$

Calculate the Allowable Tension per Bolt

$$R_{nt} := F_{nt} \cdot A_{AB} \qquad R_{nt} = 34.2 \cdot kip$$

$$Allowable_Tension := \frac{R_{nt}}{\Omega_{AB}} \qquad Allowable_Tension = 17.1 \cdot kip$$

Tension_Check = "OK"

Calculate the Actual Shear per Bolt.

$$Max_Shear := \frac{\sqrt{\left(Fy^2 + Fx^2\right)}}{4} \qquad Max_Shear = 0.154 \cdot kip$$

Calculate the Allowable Shear per Bolt.

$$R_{nv} := F_{nv} \cdot A_{AB} \qquad R_{nv} = 20.5 \cdot kip$$

$$Allowable_Shear := \frac{R_{nv}}{\Omega_{AB}} \qquad Allowable_Shear = 10.2 \cdot kip$$

Shear_Check = "OK"

Calculate the Allowable Combined Tension and Shear.

The combo check for tension and shear is a unity calculation. The equation result must be less than 1.00.

$$Unity_Calc := \left(\frac{Max_Tension}{Allowable_Tension}\right)^2 + \left(\frac{Max_Shear}{Allowable_Shear}\right)^2 = 0.097$$

Combo_Check = "OK'

Minimum Edge distance check (From Table J3.4). Minimum Edge Distance Must Be Greater than the Actual Bolt Hole Distances.

$AB_Dia = 1 \cdot in$

$Min_Edge = 1\frac{3}{4} \cdot in$ $Ex = 2 \cdot in$ $Ey = 2 \cdot in$

Edge_Check = "OK"

2" Edge Distance OK per note "a" from AISC Table J3.4

Determine Fillet Weld Size Required:

This design procedure is from Blodgett Section 7.4. The weld is treated as a line.

Calculate the the length of the welds, using the formulas contained in Table 5.

For Square

$Swx := (bf) \cdot d + \frac{d^2}{3}$ $Swx = 85.333 \cdot in^2$

$Swy := bf \cdot d + \frac{(bf)^2}{3}$ $Swy = 85.333 \cdot in^2$

Calculate the stress for each direction:

$fmx := \frac{Mx}{Swx}$ $fmx = 0.758 \cdot \frac{kip}{in}$

$fmy := \frac{My}{Swy}$ $fmy = 0.818 \cdot \frac{kip}{in}$

Calculate the combined stress:

$f_act := \sqrt{(fmx^2 + fmy^2)}$ $f_act = 1.115 \cdot \frac{kip}{in}$

Allowable for fillet welds and A36 materialfor E70 weld material per AISC UNIFIED is 0.30(weld material)(0.707 for throat)=14850 psi..

The weld size required is determined by dividing the actual stress by the allowable stress.

$w_reqd := \frac{f_act}{14850 \cdot psi}$ $w_reqd = 0.075 \cdot in$

Check Table J2.4 of the AISC ASD manual to check if w_reqd is greater than the minimum size required.

$tf = 0.375 \cdot in$ $tw = 0.375 \cdot in$ $t_min = 0.536 \cdot in$

Values to be Used:

Plate Thickness = 1 inch
Anchor Bolt = 1 inch diameter
Weld Size = 5/16 inch all around

This MathCAD document is used to calculate the following:

1. Top Plate thickness for bearing and flexure (Square Tube Column)
2. Checks Equipment Bolt Diameter & Edge Distance
3. Checks Fillet Weld Size

References which are used for the top plate design are:

1. AISC UNIFIED Construction Manual, 13th Edition.

ASD Design Factors

$\Omega_{TP} := 1.67$ $\Omega_{EB} := 2.00$

Definition of Units

$kip \equiv 1000 \cdot lb$ $kin \equiv kip \cdot in$ $ksi \equiv \frac{kip}{in^2}$ $psi \equiv \frac{lb}{in^2}$

Determine Plate Dimensions

Dimensions for Column used: HSS8x8x3/8

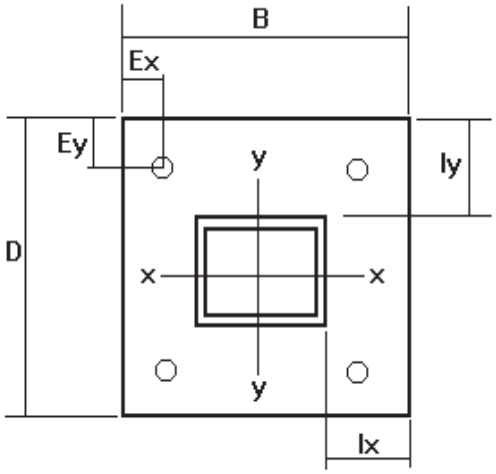
$d := 8 \cdot in$ $tw := 0.375 \cdot in$

$bf := 8 \cdot in$ $tf := 0.375 \cdot in$

Enter the dimensions for the plate.

$B := 14 \cdot in$ $Ex := 1.5 \cdot in$

$D := 14 \cdot in$ $Ey := 1.5 \cdot in$



Design Forces ***(Wind From X-Dir)***

$Axial := 1.1 \cdot kip$

$Fx := 0.3 \cdot kip$ $My := 0 \cdot kin$

$Fy := 0 \cdot kip$ $Mx := 46.1 \cdot kin$

Top Plate and Equipment Bolt Material Properties.

$fy_{TP} := 36.0 \cdot ksi$ *Yield Stress of Top Plate.*

$fu_{EB} := 58.0 \cdot ksi$ *Tensile Stress of Equipment Bolt (58ksi for A36)*

Estimated Equipment Bolts:

$EB_Dia := .625 \cdot in$ $A_{EB} := \left(\frac{\pi}{4}\right) \cdot EB_Dia^2$ $A_{EB} = 0.307 \cdot in^2$

The nominal tensile and shear stress for the bolts is based on the formula from page 16.1-120 of the 14th Edition of the AISC UNIFIED manual.

$F_{nt} := 0.75 \cdot fu_{EB}$ $F_{nt} = 43.5 \cdot ksi$

$F_{nv} := 0.45 \cdot fu_{EB}$ $F_{nv} = 26.1 \cdot ksi$

Determine Plate Thickness for Equipment Top Plate.

A. Proportion Axial Force

$$P_Ax := \frac{Axial}{4} \qquad P_Ax = 0.3 \cdot kip$$

B. Determine Bolt Forces due to Mx (for two bolts in compression)

$$FC_Mx := \frac{Mx}{D - 2 \cdot Ey} \qquad FC_Mx = 4.2 \cdot kip$$

$$P_Mx := 2 \cdot P_Ax + FC_Mx \qquad P_Mx = 4.7 \cdot kip$$

C. Determine Bolt Forces due to My (for two bolts in compression)

$$FC_My := \frac{My}{B - 2 \cdot Ex} \qquad FC_My = 0.0 \cdot kip$$

$$P_My := 2 \cdot P_Ax + FC_My \qquad P_My = 0.6 \cdot kip$$

D. Determine Thickness Required for Mx

$$l_Mx := \frac{D - 2 \cdot Ey - d}{2} \qquad l_Mx = 1.5 \cdot in$$

$$M_Mx := P_Mx \cdot l_Mx \qquad M_Mx = 7.1 \cdot kin$$

$$t_Mx := \sqrt{\frac{\Omega_{TP} \cdot 4 \cdot M_Mx}{fy_{TP} \cdot B}} \qquad t_Mx = 0.3 \cdot in$$

E. Determine Thickness Required for My

$$l_My := \frac{B - 2 \cdot Ex - bf}{2} \qquad l_My = 1.5 \cdot in$$

$$M_My := P_My \cdot l_My \qquad M_My = 0.8 \cdot kin$$

$$t_My := \sqrt{\frac{\Omega_{TP} \cdot 4 \cdot M_My}{fy_{TP} \cdot D}} \qquad t_My = 0.10 \cdot in$$

F. Determine Total Plate Thickness Required

$$t_min := \sqrt{t_Mx^2 + t_My^2} \qquad t_min = 0.324 \cdot in$$

Check Equipment Bolt Diameter:

Calculate the Actual Tension per Bolt.

$$Max_Tension := \frac{FC_Mx + FC_My}{2} - P_Ax \qquad Max_Tension = 1.82 \cdot kip$$

Calculate the Allowable Tension per Bolt.

$$R_{nt} := F_{nt} \cdot A_{EB} \qquad R_{nt} = 13.3 \cdot kip$$

$$Allowable_Tension := \frac{R_{nt}}{\Omega_{EB}} \qquad Allowable_Tension = 6.7 \cdot kip$$

Tension_Check = "OK"

Calculate the Actual Shear per

$$Max_Shear := \frac{\sqrt{\left(Fy^2 + Fx^2\right)}}{4} \qquad Max_Shear = 0.075 \cdot kip$$

Calculate the Allowable Shear per Bolt.

$$R_{nv} := F_{nv} \cdot A_{EB} \qquad R_{nv} = 8.0 \cdot kip$$

$$Allowable_Shear := \frac{R_{nv}}{\Omega_{EB}} \qquad Allowable_Shear = 4.0 \cdot kip$$

Shear_Check = "OK"

The combo check for tension and shear is a unity calculation. The equation result must be less than 1.00.

$$Unity_Calc := \left(\frac{Max_Tension}{Allowable_Tension}\right)^2 + \left(\frac{Max_Shear}{Allowable_Shear}\right)^2 = 0.075$$

Combo_Check = "OK"

Minimum Edge distance check (From Table J3.4). Minimum Edge Distance Must Be Greater than the Actual Bolt Hole Distances.

$$EB_Dia = \frac{5}{8} \cdot in$$

$$Min_Edge = 1\frac{1}{8} \cdot in \qquad Ex = 1\frac{1}{2} \cdot in \qquad Ey = 1\frac{1}{2} \cdot in$$

Edge_Check = "OK"

Determine Fillet Weld Size Required:

This design procedure is from Blodgett Section 7.4. The weld is treated as a line.

Calculate the the length of the welds, using the formulas contained in Table 5.

For Square

$Swx := (bf)\cdot d + \frac{d^2}{3}$ $Swx = 85.333\cdot in^2$

$Swy := bf\cdot d + \frac{(bf)^2}{3}$ $Swy = 85.333\cdot in^2$

Calculate the stress for each direction:

$fmx := \frac{Mx}{Swx}$ $fmx = 0.54\cdot\frac{kip}{in}$

$fmy := \frac{My}{Swy}$ $fmy = 0\cdot\frac{kip}{in}$

Calculate the combined stress:

$f_act := \sqrt{(fmx^2 + fmy^2)}$ $f_act = 0.54\cdot\frac{kip}{in}$

Allowable for fillet welds and A36 materialfor E70 weld material per AISC UNIFIED is 0.30(weld material)(0.707 for throat)=14850 psi..

The weld size required is determined by dividing the actual stress by the allowable stress.

$w_reqd := \frac{f_act}{14850\cdot psi}$ $w_reqd = 0.036\cdot in$

Check Table J2.4 of the AISC ASD manual to check if w_reqd is greater than the minimum size required.

$tf = 0.375\cdot in$ $tw = 0.375\cdot in$ $t_min = 0.324\cdot in$

Values to be Used:

Top Plate Thickness = 1/2 inch
Equipment Bolt = 5/8 inch diameter
Weld Size = 5/16 inch all around

This MathCAD document is used to calculate the following:

1. Base Plate thickness for bearing type(Square Tube Column)
2. Checks Anchor bolt Diameter & Edge Distance
3. Checks Fillet Weld Size

References which are used for the base plate design are:

1. AISC UNIFIED Construction Manual, 13th Edition.

ASD Design Factors

$\Omega_{BP} := 1.67$ $\Omega_{AB} := 2.00$

Definition of Units

$kip \equiv 1000 \cdot lb$ $kin \equiv kip \cdot in$ $ksi \equiv \frac{kip}{in^2}$ $psi \equiv \frac{lb}{in^2}$

Determine Plate Dimensions

Depth of Column

Dimensions for Column used: HSS8x8x3/8

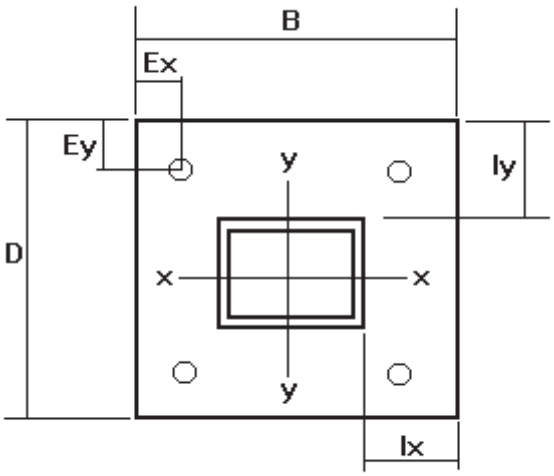
$d := 8 \cdot in$ $tw := 0.375 \cdot in$

$bf := 8 \cdot in$ $tf := 0.375 \cdot in$

Enter the dimensions for the plate.

$B := 16 \cdot in$ $Ex := 2 \cdot in$

$D := 16 \cdot in$ $Ey := 2 \cdot in$



Design Forces ***(Wind From Z-Dir)***

$Axial := 1.2 \cdot kip$

$Fx := 0.64 \cdot kip$ $My := 99 \cdot kin$

$Fy := 0 \cdot kip$ $Mx := 0 \cdot kin$

Base Plate and Anchor Bolt Material Properties.

$fy_{BP} := 36.0 \cdot ksi$ *Yield Stress of Base Plate.*

$fu_{AB} := 58.0 \cdot ksi$ *Tensile Stress of Anchor Bolt (58ksi for A36)*

Estimated Anchor Bolts:

$AB_Dia := 1.00 \cdot in$ $A_{AB} := \left(\frac{\pi}{4}\right) \cdot AB_Dia^2$ $A_{AB} = 0.785 \cdot in^2$

The nominal tensile and shear stress for the bolts is based on the formula from page 16.1-120 of the 14th Edition of the AISC UNIFIED manual.

$F_{nt} := 0.75 \cdot fu_{AB}$ $F_{nt} = 43.5 \cdot ksi$

$F_{nv} := 0.45 \cdot fu_{AB}$ $F_{nv} = 26.1 \cdot ksi$

Determine Plate Thickness for Leveling Nut Base Plate.

A. Proportion Axial Force

$P_Ax := \frac{Axial}{4}$ $P_Ax = 0.3 \cdot kip$

B. Determine Bolt Forces due to Mx (for two bolts in compression)

$FC_Mx := \frac{Mx}{D - 2 \cdot Ey}$ $FC_Mx = 0 \cdot kip$

$P_Mx := 2 \cdot P_Ax + FC_Mx$ $P_Mx = 0.6 \cdot kip$

C. Determine Bolt Forces due to My (for two bolts in compression)

$FC_My := \frac{My}{B - 2 \cdot Ex}$ $FC_My = 8.3 \cdot kip$

$P_My := 2 \cdot P_Ax + FC_My$ $P_My = 8.9 \cdot kip$

D. Determine Thickness Required for Mx

$l_Mx := \frac{D - 2 \cdot Ey - d}{2}$ $l_Mx = 2.0 \cdot in$

$M_Mx := P_Mx \cdot l_Mx$ $M_Mx = 1.2 \cdot kin$

$t_Mx := \sqrt{\frac{\Omega_{BP} \cdot 4 \cdot M_Mx}{fy_{BP} \cdot B}}$ $t_Mx = 0.1 \cdot in$

E. Determine Thickness Required for My

$$l_My := \frac{B - 2 \cdot Ex - bf}{2} \qquad l_My = 2.0 \cdot in$$

$$M_My := P_My \cdot l_My \qquad M_My = 17.7 \cdot kin$$

$$t_My := \sqrt{\frac{\Omega_{BP} \cdot 4 \cdot M_My}{fy_{BP} \cdot D}} \qquad t_My = 0.5 \cdot in$$

F. Determine Total Plate Thickness Required

$$t_min := \sqrt{t_Mx^2 + t_My^2} \qquad t_min = 0.468 \cdot in$$

Check Anchor Bolt Diameter:

Calculate the Actual Tension per Bolt.

$$Max_Tension := \frac{FC_Mx + FC_My}{2} - P_Ax \qquad Max_Tension = 3.8 \cdot kip$$

Calculate the Allowable Tension per Bolt

$$R_{nt} := F_{nt} \cdot A_{AB} \qquad R_{nt} = 34.2 \cdot kip$$

$$Allowable_Tension := \frac{R_{nt}}{\Omega_{AB}} \qquad Allowable_Tension = 17.1 \cdot kip$$

Tension_Check = "OK"

Calculate the Actual Shear per Bolt.

$$Max_Shear := \frac{\sqrt{\left(Fy^2 + Fx^2\right)}}{4} \qquad Max_Shear = 0.16 \cdot kip$$

Calculate the Allowable Shear per Bolt.

$$R_{nv} := F_{nv} \cdot A_{AB} \qquad R_{nv} = 20.5 \cdot kip$$

$$Allowable_Shear := \frac{R_{nv}}{\Omega_{AB}} \qquad Allowable_Shear = 10.2 \cdot kip$$

Shear_Check = "OK"

Calculate the Allowable Combined Tension and Shear.

The combo check for tension and shear is a unity calculation. The equation result must be less than 1.00.

$$Unity_Calc := \left(\frac{Max_Tension}{Allowable_Tension}\right)^2 + \left(\frac{Max_Shear}{Allowable_Shear}\right)^2 = 0.05$$

Combo_Check = "OK"

Minimum Edge distance check (From Table J3.4). Minimum Edge Distance Must Be Greater than the Actual Bolt Hole Distances.

$AB_Dia = 1 \cdot in$

$Min_Edge = 1\frac{3}{4} \cdot in$ $Ex = 2 \cdot in$ $Ey = 2 \cdot in$

Edge_Check = "OK"

2" Edge Distance OK per note "a" from AISC Table J3.4

Determine Fillet Weld Size Required:

This design procedure is from Blodgett Section 7.4. The weld is treated as a line.

Calculate the the length of the welds, using the formulas contained in Table 5.

For Square Tubes:

$Swx := (bf) \cdot d + \frac{d^2}{3}$ $Swx = 85.333 \cdot in^2$

$Swy := bf \cdot d + \frac{(bf)^2}{3}$ $Swy = 85.333 \cdot in^2$

Calculate the stress for each direction:

$fmx := \frac{Mx}{Swx}$ $fmx = 0 \cdot \frac{kip}{in}$

$fmy := \frac{My}{Swy}$ $fmy = 1.16 \cdot \frac{kip}{in}$

Calculate the combined stress:

$f_act := \sqrt{(fmx^2 + fmy^2)}$ $f_act = 1.16 \cdot \frac{kip}{in}$

Allowable for fillet welds and A36 materialfor E70 weld material per AISC UNIFIED is 0.30(weld material)(0.707 for throat)=14850 psi..

The weld size required is determined by dividing the actual stress by the allowable stress.

$$w_reqd := \frac{f_act}{14850 \cdot psi} \qquad w_reqd = 0.078 \cdot in$$

Check Table J2.4 of the AISC ASD manual to check if w_reqd is greater than the minimum size required.

$tf = 0.375 \cdot in$ $tw = 0.375 \cdot in$ $t_min = 0.468 \cdot in$

Values to be Used:

Plate Thickness = 1 inch
Anchor Bolt = 1 inch diameter
Weld Size = 5/16 inch all around

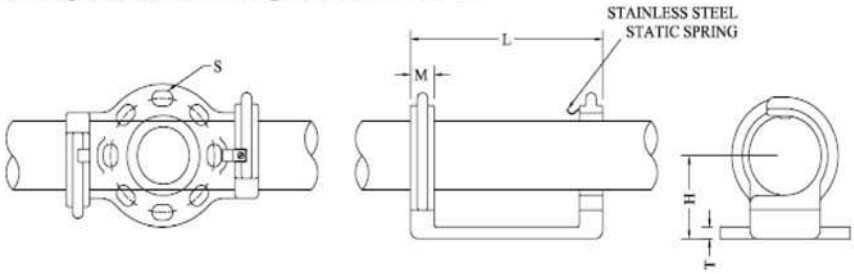
ALUMINUM BUS SUPPORTS

TYPE ASWH

Horizontal Weldment
Pipe to Insulator

Castings: 356-T6 Aluminum
Mounting Hardware: Galvanized Steel

Aluminum alloy weldment bus support for aluminum pipe. Designed for slip or rigid fit applications. When rigid fit is required, you must weld the hooks to the pipe. Delete the SE suffix to eliminate the static spring. Hardware supplied for cap mounted. For pin mounted, add suffix (P) to catalog number, Example: ASWH-58-5P



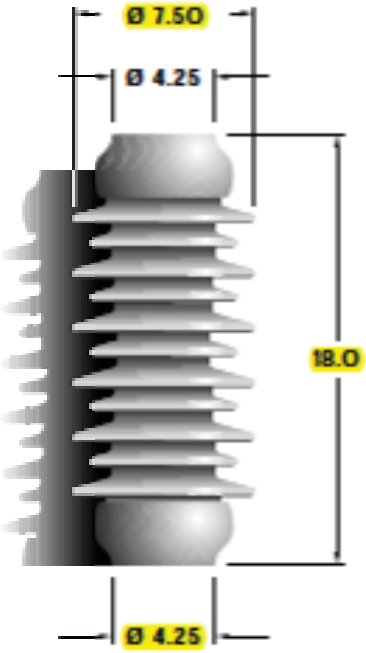
CATALOG NUMBER	PIPE SIZE	B.C.	DIMENSIONS - INCHES						WEIGHT (POUNDS)
			H	L	T	M	S	J	
ASWH-30-3-SE	3/4	3	2	5 1/2	9/32	1/2	9/16 x 3/4	1/2	1.16
ASWH-30-5-SE		5	2 1/4	8	3/8	5/8	11/16 X 1	5/8	2.01
ASWH-39-3-SE	1	3	2	6	5/16	3/4	9/16 x 13/16	1/2	1.16
ASWH-39-5-SE		5	2 1/4	8 1/4	3/8	3/4	11/16 X 1	5/8	2.23
ASWH-49-3-SE	1 1/4	3	2 1/4	7 1/4	1/2	1 1/8	9/16 x 13/16	1/2	2.95
ASWH-49-5-SE		5	2 1/4	9 1/4	9/16	1 1/8	11/16 X 1	5/8	3.45
ASWH-53-3-SE	1 1/2	3	2 1/2	7 1/4	9/16	1 1/8	9/16 x 13/16	1/2	2.81
ASWH-53-5-SE		5	2 1/2	9 1/4	9/16	1 1/8	11/16 X 1	5/8	3.67
ASWH-58-3-SE	2	3	2 3/4	7 1/4	9/16	1 1/8	9/16 x 13/16	1/2	2.95
ASWH-58-5-SE		5	2 3/4	9 1/4	9/16	1 1/8	11/16 X 1-1/16	5/8	3.77
ASWH-60-3-SE	2 1/2	3	3 1/8	7 1/4	9/16	1 1/8	9/16 x 13/16	1/2	3.45
ASWH-60-5-SE		5	3 1/8	9 1/4	9/16	1 1/8	11/16 X 1-1/16	5/8	4.27
ASWH-60-7-SE		7	3 1/8	12 1/2	1/2	1 1/8	13/16 X 1-1/8	3/4	6.49
ASWH-62-3-SE	3	3	3 5/8	7 1/4	9/16	1 1/8	9/16 x 13/16	1/2	3.95
ASWH-62-5-SE		5	3 5/8	9 1/4	1/2	1 1/8	11/16 X 1	5/8	4.77
ASWH-62-7-SE		7	3 5/8	12 1/2	1/2	1 1/4	13/16 X 1-1/8	3/4	6.99
ASWH-63-3-SE	3 1/2	3	4	7 1/4	1/2	1 1/8	9/16 x 13/16	1/2	3.95
ASWH-63-5-SE		5	4	9 1/4	3/8	1 1/8	11/16 X 1	5/8	4.77
ASWH-63-7-SE		7	4	12 1/2	1/2	1 3/16	13/16 X 1-1/8	3/4	6.99
ASWH-64-3-SE	4	3	4 1/2	7 1/4	9/16	1 1/8	9/16 x 13/16	1/2	3.95
ASWH-64-5-SE		5	4 1/2	9 1/4	9/16	1 1/8	11/16 X 1	5/8	4.77
ASWH-64-7-SE		7	4 1/2	12 1/2	1/2	1 1/8	13/16 X 1-1/8	3/4	6.99
ASWH-67-3-SE	5	3	5	7 5/8	1/2	1 1/2	9/16 x 13/16	1/2	5.94
ASWH-67-5-SE		5	5	9 5/8	1/2	1 1/2	11/16 X 1	5/8	6.78
ASWH-67-7-SE		7	5	11 1/2	1/2	1 3/8	13/16 X 1-5/16	3/4	9.59
ASWH-69-3-SE	6	3	5 1/2	7 5/8	1/2	1 1/2	9/16 x 3/4	1/2	5.96
ASWH-69-5-SE		5	5 1/2	9 5/8	1/2	1 1/2	11/16 X 1	5/8	6.78
ASWH-69-7-SE		7	5 1/2	12 7/8	1/2	1 1/2	13/16 X 1-1/8	3/4	9

TABLE 3. ROUND TUBULAR BUS COPPER OR ALUMINUM

Size	Outside Diameter	Inside Diameter	Moment of Inertia (i)	Section Modulus (S)	Weight	
					Aluminum	Copper
in.	in.	in.	$in.^4$	$in.^3$	lb/ft	lb/ft
Schedule 40						
1/2	0.84	0.622	0.0171	0.0407	0.294	0.956
3/4	1.05	0.824	0.0370	0.0705	0.391	1.300
1	1.315	1.049	0.0873	0.1328	0.581	1.830
1-1/2	1.90	1.610	0.3100	0.3260	0.940	3.190
2	2.375	2.067	0.6660	0.5610	1.264	4.210
2-1/2	2.875	2.469	1.5300	1.0640	2.004	6.120
3	3.50	3.068	3.0170	1.7240	2.621	8.720
3-1/2	4.00	3.548	4.7880	2.3940	3.151	11.380
4	4.50	4.026	7.2320	3.2140	3.733	12.900
5	5.563	5.047	15.1600	5.4510	5.057	16.210
6	6.625	6.065	28.1400	8.5000	6.564	19.350
Schedule 80						
1/2	0.84	0.546	0.0201	0.0478	0.376	1.250
3/4	1.05	0.742	0.0448	0.0853	0.510	1.700
1	1.315	0.957	0.1056	0.1606	0.751	2.500
1-1/2	1.90	1.50	0.3910	0.4120	1.256	4.180
2	2.375	1.939	0.8680	0.7310	1.737	5.780
2-1/2	2.875	2.323	1.9240	1.3390	2.650	8.820
3	3.50	2.90	3.8940	2.2250	3.547	11.790
3-1/2	4.00	3.364	6.2810	3.1400	4.326	14.340
4	4.50	3.826	9.6110	4.2720	5.183	17.220
5	5.563	~~4.183~~ 4.81	20.6700	7.4320	7.188	23.620
6	6.625	5.761	40.4900	12.2200	9.884	32.830

NOTE: Values given are for both 6061-T6 and 6063-T6 aluminum alloys.

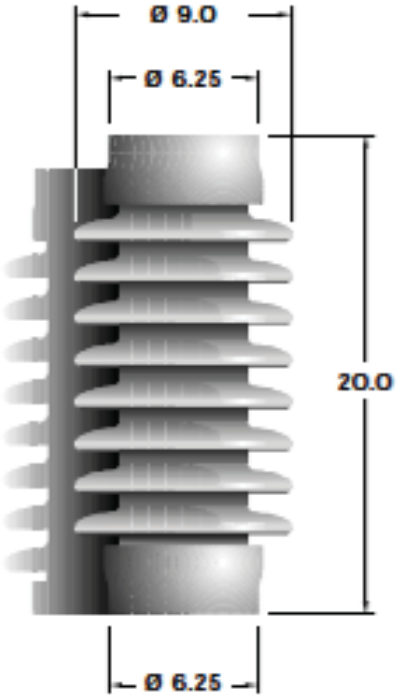
STANDARD STRENGTH UNIT



4 TAPPED HOLES
1/2-13 +.015 OVERSIZE
5/8" FULL THREAD
ON 3.0" BOLT CIRCLE

315210-70

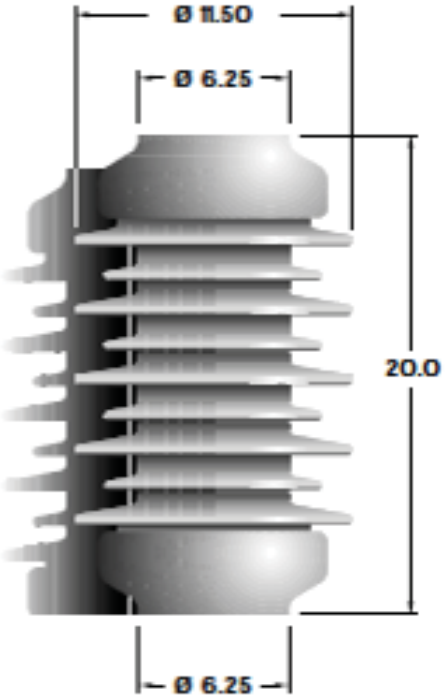
HIGH STRENGTH UNIT



4 TAPPED HOLES
5/8-11 +.015 OVERSIZE
3/4" FULL THREAD
ON 5.0" BOLT CIRCLE

315231-70

EXTRA-HIGH STRENGTH UNIT



4 TAPPED HOLES
5/8-11 +.015 OVERSIZE
3/4" FULL THREAD
ON 5.0" BOLT CIRCLE

318455-70

CHARACTERISTICS

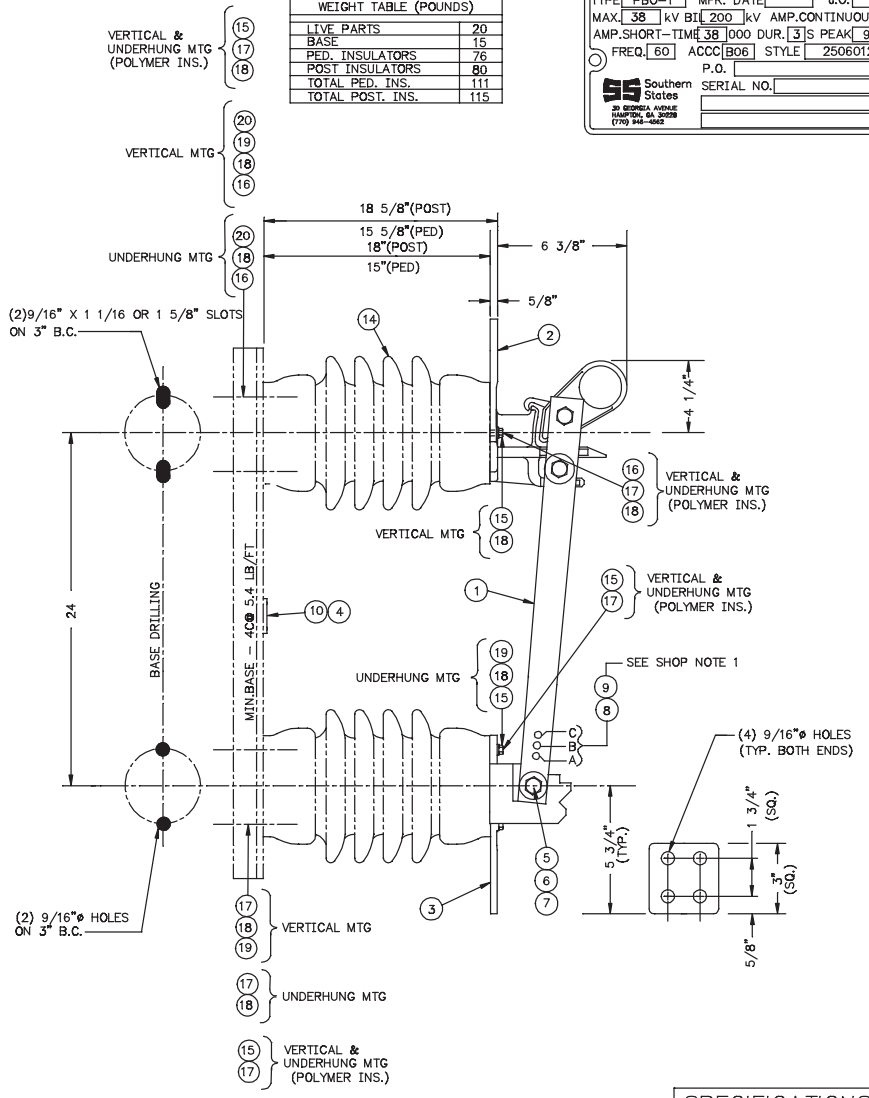
Lapp Catalog Number Ancil Technical Reference Number	315210-70 T.R.210	315231-70 T.R.231	318455-70
Dimensions			
Leakage Distance, Inches	37	37	37
Mechanical Values *			
Cantilever Strength, Upright, Pounds	2000	4000	8000
Cantilever Strength, Underhung, Pounds	2000	4000	8000
Tensile Strength, Pounds	12000	25000	28000
Torsion Strength, Inch-Pounds	10000	20000	40000
Compression Strength, Pounds	15000	30000	60000
Electrical Values			
Voltage Class, kV	34.5	34.5	34.5
Impulse Flashover, Positive, kV	225	225	225
Low Frequency Withstand, 10 Sec. Wet, kV	80	80	80
Impulse Withstand, kV	200	200	200
Radio Influence Voltage Data			
Test Voltage, Rms to Ground, kV	22	22	22
Maximum RIV, Microvolts at 1000 kHz	100	100	100
Weight			
Net Weight, Each, Pounds	41	74	117

* For Maximum recommended working loads see "Specifications," page 5.
Note: For RG glazed insulators equivalent to these standard insulators, see table on page 9.
Illustrations shown are true representations of Lapp products at the time of printing, but are subject to change at any time.

ALL DIMENSIONS ARE IN INCHES

WEIGHT TABLE (POUNDS)	
LIVE PARTS	20
BASE	15
PED. INSULATORS	76
POST INSULATORS	80
TOTAL PED. INS.	111
TOTAL POST. INS.	115

TYPE PBO-1 MFR. DATE J.O.
MAX. 38 kV BIL 200 kV AMP.CONTINUOUS 1200
AMP.SHORT-TIME 38 000 DUR. 3 S PEAK 99 000
FREQ. 60 ACCC B06 STYLE 25060121
P.O.
SERIAL NO.
Southern States
30 GEORGIA AVENUE
HAMPTON, GA 30228
(770) 946-4562
147



NOTES:
1. MAX. WIDTH OF LIVE PARTS 5 3/8" (HINGE END).

SHOP NOTES:
1. ITEMS 8 & 9 TO BE INSTALLED IN BLADE AT FINAL ASS'Y AS REQUIRED.
   (A) HOLE "A" FOR 70 DEGREE BLADE OPENING
   (B) HOLE "B" FOR 90 DEGREE BLADE OPENING
   (C) HOLE "C" FOR 135 DEGREE BLADE OPENING
   (D) DISREGARD ITEMS 8 & 9 FOR 180 DEGREE BLADE OPENING
2. INSULATORS TO BE INVERTED FOR UNDERHUNG MTG.

SPECIFICATIONS	
The following specifications shall be considered a part of this drawing	
SUBJECT	SPEC. NO.
BLADE ADJ.	M-4041

C-25060121 BILL OF MATERIAL

PBO-1 38.0 kV 1200 A
VERT. & UND. MOUNTED 3" B.C.
70° - 180° BLADE OPENING

ITEM	DESCRIPTION	PCS	DWG SIZE	PART NO.	BASIC	QUANTITY
1	BLADE ASSEMBLY		C	08122839	1	
2	JAW SILVER ASSEMBLY		A	08122827	1	
3	HINGE BASE		C	05178318	1	
4	NAMEPLATE		A	01450147	1	
5	1/2 X 5 ST. STL. H.H. BOLT			01045080	1	
6	1/2 ST. STL. HEX JAM LOCK NUT			01179090	1	
7	1/2 ST. STL. BELLEVILLE WASHER			01189062	2	
8	STOP PIN SST		A	01279038	1	
9	ST. STL. COTTER PIN			01191224	1	
	DO NOT REQUISITION BELOW THIS LINE			CONTROL COUNT	9	
10	#6 X 5/16 SST DRIVE SCREW			01150187	2	
	VERTICAL MOUNTING					
14	INS. PED - 34.5KV, TR-10					2
15	1/2 X 1 1/4 BOLT H.H., GALV			01055020	4	
16	1/2 X 1 3/4 BOLT H.H., GALV			01055028	2	
17	1/2 X 1 1/2 BOLT H.H., GALV			01055024	2	
18	1/2 LOCKWASHER, GALV.			01185280	8	
19	1/2 HEX NUT, GALV.			0117508O	4	
20	1/2 PLAINWASHER, GALV.			01185064	2	
14	INS POST-34.5KV, TR-210					2
15	1/2 X 1 1/4 BOLT H.H.,GALV.			01055020	4	
16	1/2 X 1 BOLT H.H., GALV.			01055016	2	
17	1/2 X 1 BOLT H.H., GALV.			01055016	2	
18	1/2 LOCKWASHER, GALV.			01185280	8	
20	1/2 PLAINWASHER, GALV.			01185064	2	
	UNDERHUNG MOUNTING					
14	INS. PED. 34.5KV - TR-10					2
15	1/2 X 1 3/4 BOLT H.H., GALV			01055028	4	
16	1/2 X 1 BOLT H.H., GALV.			01055016	2	
17	1/2 X 1 BOLT H.H., GALV.			01055016	2	
18	1/2 LOCKWASHER, GALV.			01185280	8	
19	1/2 HEX NUT, GALV.			01175080	4	
20	1/2 PLAINWASHER, GALV.			01185064	2	
14	INS POST-34.5KV, TR-210					2
15	1/2 X 1 1/4 BOLT H.H.,GALV.			01055020	4	
16	1/2 X 1 BOLT H.H., GALV.			01055016	2	
17	1/2 X 1 BOLT H.H., GALV.			01055016	2	
18	1/2 LOCKWASHER, GALV.			01185280	8	
20	1/2 PLAINWASHER, GALV.			01185064	4	
	VERTICAL & UNDERHUNG MOUNTING					
14	INS. POLYMER 34.5KV					2
15	1/2 X 1 1/4 BOLT H.H., GALV			01055020	6	
16	1/2 X 1 1/2 BOLT H.H., GALV.			01055024	2	
17	1/2 LOCKWASHER, GALV.			01185280	8	
18	1/2 PLAINWASHER, GALV.			01185064	4	

DESCRIPTION	PRODUCT NO.	REV.
38.0 kV	25060121	D

NO.	DATE	BY	REVISION
10	9/10/14	NR	REVISED NOTE SPECS.
9	7/31/13	NR	REVISED SLOT NOTE
8	3/20/08	NR	IT4 WAS 01450068(R-D)
7	4/14/04	JAH	ADDED HARDWARE FOR MOUNTING POLYMER INSULATORS.
6	02/14/01	RH	ITEM 6 WAS 01179058 (REV.C)
5	4/14/99	JAH	CORRECTED ACCC DESIGNATION
4	06/08/95	JRS	ITEM 8 WAS 01270336 (REV.B) QUAN. OF ITEM 9 WAS 2

REVISE ON CAD SYSTEM ONLY

Southern States, Inc.
30 GEORGIA AVENUE
HAMPTON, GEORGIA 30228-2199
TELEPHONE: (770) 946-4562
FAX: (770) 946-8106

PBO-1 38.0 kV 1200 A
VERT. & UND. MOUNTED 3" B.C.
70° - 180° BLADE OPENING

ANSI C37.30

DRAWN	8/5/81	WLB	APPROVED
TRACED			SHEET NO. OF SHEETS
CHECKED	8/20/81	WEB	C-25060121 REV. 10
J.O.	P.O.		

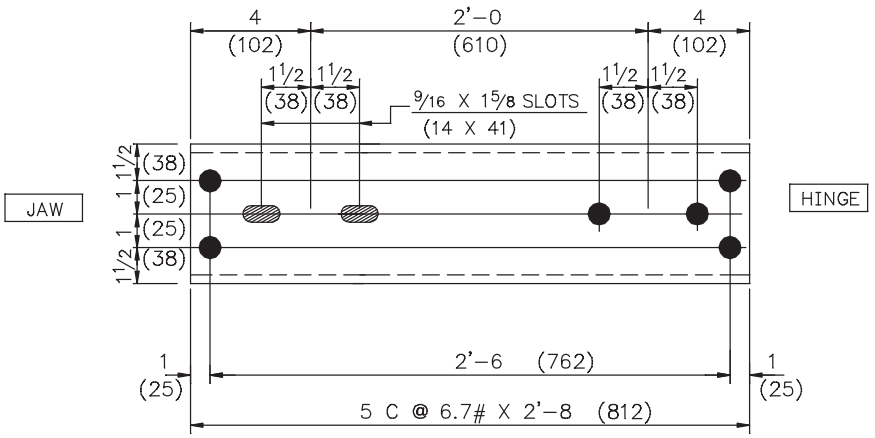
M. J. Electric, LLC Job 25181005500 Submittal 14 Hook Sticks

A	PRODUCT NUMBER 15125030

J.O. NO.
J.O. ITEM
SUB ITEM

BILL OF MATERIAL

ITEM	DESCRIPTION	PCS	DWG SIZE	PART NO.	QUAN.
1	5 C @ 6.7# X 2'-8	1		16063300	2.67



MK- 15125030 -REQ'D

NOTES:
1) ALL STEEL HOT DIP GALV. AFTER FABRICATION.
2) ALL HOLES 9/16Ø UNLESS NOTED.
3) STAMP MK. NOS. ON MEMBERS WITH MIN. CHARACTER HT. OF 3/8" BEFORE GALV.
4) DIMENSIONS SHOWN IN "( )" ARE IN MILLIMETERS.

BASE APPLICABLE TO THE FOLLOWING EQUIPMENT: PBO, PR, HPA, BPA, B, B-1, HP, MP, HMH-2, BP, PBO-1.

REVISE ON CAD SYSTEM ONLY

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NO.	DATE	BY	REVISION
5	7/94	RC	ADDED DIM. IN MM

Southern States, LLC
30 GEORGIA AVENUE
HAMPTON, GEORGIA 30228-2199
TELEPHONE: (770) 946-4562
FAX: (770) 946-8106

BASE DETAILS
34.5 KV 100-1200 AMP

DRAWN	6/63	TW
CHECKED	6/63	JBG
APPROVED		

APPROVED CHIEF ENG.
SHEET NO. 1 OF 1 SHTS.
A- 15125030 REV. 5

M. J. Electric, LLC Job 2518100500 Submittal 14 Hook Sticks

Project # :	17.01246	**Ulteig**		By:	DAW
Project Title:	Nortwest Ohio			Date:	1/24/2018
Item:	Collection Structure	**ASCE Load Cases**		Checked:	

Load from rigid tubular bus. Single and double spans.

Orientation Single:	1	(1 Upright; -1 Underhung; Bus runs along Z-Axis)
Orientation Double:	1	(1 Upright; -1 Underhung; Bus runs along Z-Axis)
Bus Size:	4	(Choose 2.5, 3, 3.5, 4, 5 or 6 inch bus)
Phase Spacing (ft):	4	(Horizontal phase to phase spacing)
Mom Arm Sngle (ft):	2.583	(Center of support beam to center of bus)
Mom Arm Dble(ft):	2.583	(Center of support beam to center of bus)
Short Circ (amps):	0	(If applicable; Adds significant load to bus)
Simple Span (ft):	0	(Support to support spacing of single span)
Double Span (ft):	16	(Average support spacing of double spans)
Dampener (lbs/ft):	0.745	(If applicable; Add weight per foot of dampening)

Bus Nominal Size	4.0 inches	(Verify nominal diameter)
Bus Outside Dia (in):	4.500	(Outside diameter of tubular bus)
Bus Weight (lbs/ft):	3.733	(Dead weight of tubular bus)
Short Circ (lbs/ft):	0.000	($5.4 \times (2.26\ I_{SC})^2/10^7 \times D$)
Exposure Coef. (k_z):	0.900	(Per NESC Table 250-3)
Gust Response (G_{RF}):	1.02	(Per NESC Table 250-3)
NESC Wind (psf):	4.0	(4 psf per NESC Heavy Loading Zone)
High Wind (psf):	19.0	($0.00256 \times k_z \times G_{RF} \times V^2$ per NESC)
Factored NESC Wt:	1.0	(Factor applied to weight if applicable per NESC Table 253-1)
Factored NESC Wind:	1.0	(Factor applied to wind if applicable per NESC Table 253-1)
Factored Wind Wt:	1.0	(Factor applied to weight if applicable per NESC Table 253-1)
Factored High Wind:	1.0	(Factor applied to wind if applicable per NESC Table 253-1)

Loads: ASCE Combined (40 mph wind with 1/2 inch ice) and High Wind (90 mph wind)

	ASCE	High Wind	
Vert. Load (lbs/ft):	7.59	4.48	(Load from bus, ice, and dampening)
Horiz. Load (lbs/ft):	1.83	7.14	(Load from wind and short circuit)

	Single Span		Double Span End Support		Double Span Center Support	
Wind X-Dir	ASCE	High Wind	ASCE	High Wind	ASCE	High Wind
F_y (lbs):	**0**	**0**	**-46**	**-27**	**-152**	**-90**
F_x (lbs):	**0**	**0**	**11**	**43**	**37**	**143**
M_z (ft-lbs):	**0**	**0**	**-28**	**-111**	**-95**	**-369**
	Single Span		**Double Span End Support**		**Double Span Center Support**	
Wind Z-Dir	ASCE	High Wind	ASCE	High Wind	ASCE	High Wind
F_y (lbs):	**0**	**0**	**-46**	**-27**	**-152**	**-90**
	Single Span		**Double Span End Support**		**Double Span Center Support**	
Wind 45 Deg	ASCE	High Wind	ASCE	High Wind	ASCE	High Wind
F_y (lbs):	**0**	**0**	**-46**	**-27**	**-152**	**-90**
F_x (lbs):	**0**	**0**	**8**	**30**	**26**	**101**
M_z (ft-lbs):	**0**	**0**	**-20**	**-78**	**-67**	**-261**

Project # :	17.01246	**Ulteig**		By:	DAW
Project Title:	Nortwest Ohio			Date:	1/24/2018
Item:	Collection Structure	**ASCE Load Cases**		Checked:	

Load from rigid tubular bus. Single and double spans.

Orientation Single:	1	(1 Upright; -1 Underhung; Bus runs along Z-Axis)
Orientation Double:	1	(1 Upright; -1 Underhung; Bus runs along Z-Axis)
Bus Size:	4	(Choose 2.5, 3, 3.5, 4, 5 or 6 inch bus)
Phase Spacing (ft):	4	(Horizontal phase to phase spacing)
Mom Arm Sngle (ft):	2.583	(Center of support beam to center of bus)
Mom Arm Dble(ft):	2.583	(Center of support beam to center of bus)
Short Circ (amps):	40000	(If applicable; Adds significant load to bus)
Simple Span (ft):	0	(Support to support spacing of single span)
Double Span (ft):	16	(Average support spacing of double spans)
Dampener (lbs/ft):	0.745	(If applicable; Add weight per foot of dampening)

Bus Nominal Size	4.0 inches	(Verify nominal diameter)
Bus Outside Dia (in):	4.500	(Outside diameter of tubular bus)
Bus Weight (lbs/ft):	3.733	(Dead weight of tubular bus)
Short Circ (lbs/ft):	91.937	($5.4 \times (2.26\ I_{SC})^2/10^7 \times D$)
Exposure Coef. (k_z):	0.900	(Per NESC Table 250-3)
Gust Response (G_{RF}):	1.02	(Per NESC Table 250-3)
NESC Wind (psf):	4.0	(4 psf per NESC Heavy Loading Zone)
High Wind (psf):	19.0	($0.00256 \times k_z \times G_{RF} \times V^2$ per NESC)
Factored NESC Wt:	1.0	(Factor applied to weight if applicable per NESC Table 253-1)
Factored NESC Wind:	1.0	(Factor applied to wind if applicable per NESC Table 253-1)
Factored Wind Wt:	1.0	(Factor applied to weight if applicable per NESC Table 253-1)
Factored High Wind:	1.0	(Factor applied to wind if applicable per NESC Table 253-1)

Loads: ASCE Combined (40 mph wind with 1/2 inch ice) and High Wind (90 mph wind)

	ASCE	High Wind	
Vert. Load (lbs/ft):	7.59	4.48	(Load from bus, ice, and dampening)
Horiz. Load (lbs/ft):	93.77	99.08	(Load from wind and short circuit)

	Single Span		Double Span End Support		Double Span Center Support	
Wind X-Dir	ASCE	High Wind	ASCE	High Wind	ASCE	High Wind
F_y (lbs):	**0**	**0**	**-46**	**-27**	**-152**	**-90**
F_x (lbs):	**0**	**0**	**563**	**594**	**1875**	**1982**
M_z (ft-lbs):	**0**	**0**	**-1453**	**-1535**	**-4844**	**-5118**
	Single Span		**Double Span End Support**		**Double Span Center Support**	
Wind Z-Dir	ASCE	High Wind	ASCE	High Wind	ASCE	High Wind
F_y (lbs):	**0**	**0**	**-46**	**-27**	**-152**	**-90**
	Single Span		**Double Span End Support**		**Double Span Center Support**	
Wind 45 Deg	ASCE	High Wind	ASCE	High Wind	ASCE	High Wind
F_y (lbs):	**0**	**0**	**-46**	**-27**	**-152**	**-90**
F_x (lbs):	**0**	**0**	**398**	**420**	**1326**	**1401**
M_z (ft-lbs):	**0**	**0**	**-1027**	**-1086**	**-3425**	**-3619**

Project # :	17.01246	**Ulteig**		By:	DAW
Project Title:	Northwest Ohio			Date:	1/24/2018
Item:	Collection Structure	**ASCE Load Cases**		Checked:	

Load from rigid tubular bus. Single and double spans.

Orientation Single:	1	(1 Upright; -1 Underhung; Bus runs along Z-Axis)
Orientation Double:	1	(1 Upright; -1 Underhung; Bus runs along Z-Axis)
Bus Size:	4	(Choose 2.5, 3, 3.5, 4, 5 or 6 inch bus)
Phase Spacing (ft):	3.5	(Horizontal phase to phase spacing)
Mom Arm Sngle (ft):	2.583	(Center of support beam to center of bus)
Mom Arm Dble(ft):	2.583	(Center of support beam to center of bus)
Short Circ (amps):	0	(If applicable; Adds significant load to bus)
Simple Span (ft):	14	(Support to support spacing of single span)
Double Span (ft):	0	(Average support spacing of double spans)
Dampener (lbs/ft):	0.745	(If applicable; Add weight per foot of dampening)

Bus Nominal Size	4.0 inches	(Verify nominal diameter)
Bus Outside Dia (in):	4.500	(Outside diameter of tubular bus)
Bus Weight (lbs/ft):	3.733	(Dead weight of tubular bus)
Short Circ (lbs/ft):	0.000	($5.4 \times (2.26\ I_{SC})^2/10^7 \times D$)
Exposure Coef. (k_z):	0.900	(Per NESC Table 250-3)
Gust Response (G_{RF}):	1.02	(Per NESC Table 250-3)
NESC Wind (psf):	4.0	(4 psf per NESC Heavy Loading Zone)
High Wind (psf):	19.0	($0.00256 \times k_z \times G_{RF} \times V^2$ per NESC)
Factored NESC Wt:	1.0	(Factor applied to weight if applicable per NESC Table 253-1)
Factored NESC Wind:	1.0	(Factor applied to wind if applicable per NESC Table 253-1)
Factored Wind Wt:	1.0	(Factor applied to weight if applicable per NESC Table 253-1)
Factored High Wind:	1.0	(Factor applied to wind if applicable per NESC Table 253-1)

Loads: ASCE Combined (40 mph wind with 1/2 inch ice) and High Wind (90 mph wind)

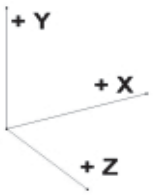
	ASCE	High Wind	
Vert. Load (lbs/ft):	7.59	4.48	(Load from bus, ice, and dampening)
Horiz. Load (lbs/ft):	1.83	7.14	(Load from wind and short circuit)

	Single Span		Double Span End Support		Double Span Center Support	
Wind X-Dir	ASCE	High Wind	ASCE	High Wind	ASCE	High Wind
F_y (lbs):	**-53**	**-31**	**0**	**0**	**0**	**0**
F_x (lbs):	**13**	**50**	**0**	**0**	**0**	**0**
M_z (ft-lbs):	**-33**	**-129**	**0**	**0**	**0**	**0**
	Single Span		**Double Span End Support**		**Double Span Center Support**	
Wind Z-Dir	ASCE	High Wind	ASCE	High Wind	ASCE	High Wind
F_y (lbs):	**-53**	**-31**	**0**	**0**	**0**	**0**
	Single Span		**Double Span End Support**		**Double Span Center Support**	
Wind 45 Deg	ASCE	High Wind	ASCE	High Wind	ASCE	High Wind
F_y (lbs):	**-53**	**-31**	**0**	**0**	**0**	**0**
F_x (lbs):	**9**	**35**	**0**	**0**	**0**	**0**
M_z (ft-lbs):	**-23**	**-91**	**0**	**0**	**0**	**0**

Project # :	17.01246	**Ulteig**	By:	DAW
Project Title:	Northwest Ohio		Date:	1/24/2018
Item:	Collection Structure	**ASCE Load Cases**	Checked:	

Load from upright single node equipment (insulator, surge arrester, etc.)

Equipment Type: 34.5kV Insulator



Orientation:	-1	(1 Positive Y; -1 Negative Y; Beam runs along X-Axis)
Equip. Weight (lbs):	41	(Dead weight of equipment)
Mom. Arm (in):	16	(Center of support beam to center of equipment)
Shape Factor (C_d):	1.2	(1.2 Round, 1.6 Hex/Oct, 2.0 Square)
Area X-Dir (in^2):	232	(Wind area in X-direction)
Area Z-Dir (in^2):	232	(Wind area in Z-direction)

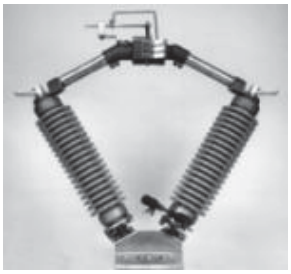
Exposure Coef. (k_z):	0.900	(Per ASCE 7-05, Table 6-3)
Gust Response (G_{RF}):	1.02	(Per ASCE 113)
Ice Weight Factor:	1.5	(Increase in dead weight from ice; Typically 1.5 for 1/2" Ice)
ASCE Wind (psf):	4.0	(4 psf per NESC Heavy Loading Zone)
High Wind (psf):	19.0	($0.00256*k_z*G_{RF}*V^2*(K_d = 0.85)*(I = 1.15)$ per ASCE7-05)

Factored NESC Wt:	1.0	(Per NESC Table 253-1 for factored cases ONLY)
Factored NESC Wind:	1.0	(Per NESC Table 253-1 for factored cases ONLY)
Factored Wind Wt:	1.0	(Per NESC Table 253-1 for factored cases ONLY)
Factored High Wind:	1.0	(Per NESC Table 253-1 for factored cases ONLY)

Loads: NESC Heavy (40 mph wind with 1/2 inch ice) and High Wind (90 mph wind)

	Allowable		Factored		
	NESC	**High Wind**	**NESC**	**High Wind**	
Wind Pressure (psf):	5.5	22.8	5.5	22.8	(Total pressure applied to area)

Wind X-Dir	NESC	High Wind	NESC	High Wind
F_y (lbs):	**-62**	**-41**	**-62**	**-41**
F_x (lbs):	**9**	**37**	**9**	**37**
M_z (ft-lbs):	**12**	**49**	**12**	**49**



Wind Z-Dir	NESC	High Wind	NESC	High Wind
F_y (lbs):	**-62**	**-41**	**-62**	**-41**
F_z (lbs):	**9**	**37**	**9**	**37**
M_x (ft-lbs):	**-12**	**-49**	**-12**	**-49**

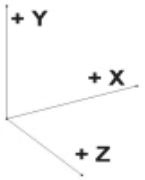
Wind 45 Deg	NESC	High Wind	NESC	High Wind
F_y (lbs):	**-62**	**-41**	**-62**	**-41**
F_x (lbs):	**6**	**26**	**6**	**26**
F_z (lbs):	**6**	**26**	**6**	**26**
M_z (ft-lbs):	**8**	**35**	**8**	**35**
M_x (ft-lbs):	**-8**	**-35**	**-8**	**-35**

Project # : 17.01246 **Ulteig** By: DAW

Project Title: Northwest Ohio Date: 1/24/2018

Item: 34.5kV Collection Structure **Xcel Load Cases** Checked: _____

Load from a vertically mounted switch on two beams



Equipment Type: 34.5kV Hookstick

Orientation:	-1	(1 Positive Z; -1 Negative Z; Beams run along X-Axis)
Equip. Weight (lbs):	417	(Dead weight of equipment)
Mom. Arm (in):	15	(Center of support beam to center of equipment)
Shape Factor (C_d):	1.6	(1.0 for cylinder, 1.6 for square)
Area X-Dir (in^2):	500	(Wind area in X-direction)
Area Z-Dir (in^2):	160	(Wind area in Z-direction)
Beam Spacing (in):	30	(Support spacing for equipment)

Exposure Coef. (k_z):	0.9	(Per NESC Table 250-3)
Gust Response (G_{RF}):	1.0	(Per NESC Table 250-3)
Ice Weight Factor:	1.5	(Increase in dead weight from ice; Typically 1.5 for 1/2" Ice)
NESC Wind (psf):	4.0	(4 psf per NESC Heavy Loading Zone)
High Wind (psf):	19.0	(0.00256 x k_z x G_{RF}x V^2 per NESC)

Factored NESC Wt:	1.0	(Per NESC Table 253-1 for factored cases ONLY)
Factored NESC Wind:	1.0	(Per NESC Table 253-1 for factored cases ONLY)
Factored Wind Wt:	1.0	(Per NESC Table 253-1 for factored cases ONLY)
Factored High Wind:	1.0	(Per NESC Table 253-1 for factored cases ONLY)

Loads: NESC Heavy (40 mph wind with 1/2 inch ice) and High Wind (90 mph wind)

	Allowable		Factored		
	NESC	**High Wind**	**NESC**	**High Wind**	
Wind Pressure (psf):	6.4	30.5	6.4	30.5	(Total pressure applied to area)
Mom. $Couple_z$ (lbs):	313	209	313	209	(Moment couple due to weight)

Wind X-Dir	NESC	High Wind	NESC	High Wind
F_y (lbs):	**-313**	**-209**	**-313**	**-209**
F_x (lbs):	**11**	**53**	**11**	**53**
$F_{z\ big}$(lbs):	**313**	**209**	**313**	**209**
$F_{z\ small}$(lbs):	**-313**	**-209**	**-313**	**-209**
M_y (ft-lbs):	**-14**	**-66**	**-14**	**-66**

Wind Z-Dir	NESC	High Wind	NESC	High Wind
F_y (lbs):	**-313**	**-209**	**-313**	**-209**
$F_{z\ big}$(lbs):	**316**	**225**	**316**	**225**
$F_{z\ small}$(lbs):	**-309**	**-192**	**-309**	**-192**

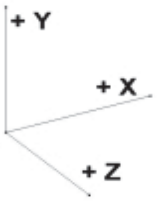
Wind 45 Deg	NESC	High Wind	NESC	High Wind
F_y (lbs):	**-313**	**-209**	**-313**	**-209**
F_x (lbs):	**8**	**37**	**8**	**37**
$F_{z\ big}$(lbs):	**315**	**220**	**315**	**220**
$F_{z\ small}$(lbs):	**-310**	**-197**	**-310**	**-197**
M_y (ft-lbs):	**-10**	**-47**	**-10**	**-47**

Project # :	17.01426	**Ulteig**		By:	DAW
Project Title:	Northwest Ohio			Date:	1/24/2018
Item:	34.5kV Collection Structure	**NESC Load Cases**		Checked:	

Load from cantilevered single node equipment (insulator, surge arrester, etc.)

Equipment Type: 34.5kV Insulator

Orientation:	-1	(1 Positive Z; -1 Negative Z; Beams run along X-Axis)
Equip. Weight (lbs):	41	(Dead weight of equipment)
Mom. Arm (in):	16	(Center of support beam to center of equipment)
Shape Factor (C_d):	1.2	(1.0 for cylinder, 1.6 for square)
Area X-Dir (in^2):	232	(Wind area in X-direction)
Area Z-Dir (in^2):	232	(Wind area in Z-direction)



Exposure Coef. (k_z):	0.9	(Per NESC Table 250-3)
Gust Response (G_{RF}):	1.02	(Per NESC Table 250-3)
Ice Weight Factor:	1.5	(Increase in dead weight from ice; Typically 1.5 for 1/2" Ice)
NESC Wind (psf):	4.0	(4 psf per NESC Heavy Loading Zone)
High Wind (psf):	19.0	(0.00256 x k_z x G_{RF}x V^2 per NESC)

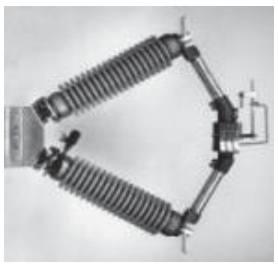
Factored NESC Wt:	1.0	(Per NESC Table 253-1 for factored cases ONLY)
Factored NESC Wind:	1.0	(Per NESC Table 253-1 for factored cases ONLY)
Factored Wind Wt:	1.0	(Per NESC Table 253-1 for factored cases ONLY)
Factored High Wind:	1.0	(Per NESC Table 253-1 for factored cases ONLY)

Loads: NESC Heavy (40 mph wind with 1" ice) and High Wind (90 mph wind)

	Allowable		Factored		
	NESC	**High Wind**	**NESC**	**High Wind**	
Wind Pressure (psf):	4.8	22.8	4.8	22.8	(Total pressure applied to area)

Wind X-Dir	NESC	High Wind	NESC	High Wind
F_y (lbs):	**-62**	**-41**	**-62**	**-41**
F_x (lbs):	**8**	**37**	**8**	**37**
M_x (ft-lbs):	**-82**	**-55**	**-82**	**-55**
M_y (ft-lbs):	**-10**	**-49**	**-10**	**-49**

Wind Z-Dir	NESC	High Wind	NESC	High Wind
F_y (lbs):	**-62**	**-41**	**-62**	**-41**
F_z (lbs):	**8**	**37**	**8**	**37**
M_x (ft-lbs):	**-82**	**-55**	**-82**	**-55**



Wind 45 Deg	NESC	High Wind	NESC	High Wind
F_y (lbs):	**-62**	**-41**	**-62**	**-41**
F_x (lbs):	**5**	**26**	**5**	**26**
F_z (lbs):	**5**	**26**	**5**	**26**
M_x (ft-lbs):	**-82**	**-55**	**-82**	**-55**
M_y (ft-lbs):	**-7**	**-35**	**-7**	**-35**

ASCE 113 Structure Wind Loading

Force = $Q*k_z*V^2*I_{FW}*G_{RF}*C_f*A$

Input Parameters:			
Structure Height z	=	21	ft
Exposure Category	=	C	
Extreme Wind Velocity V	=	90	mph
Ice Wind Velocity V		40	mph
Importance Factor I_{FW}	=	1.0	
C_f	=	1.0	
Wire Supporting Struct?		No	

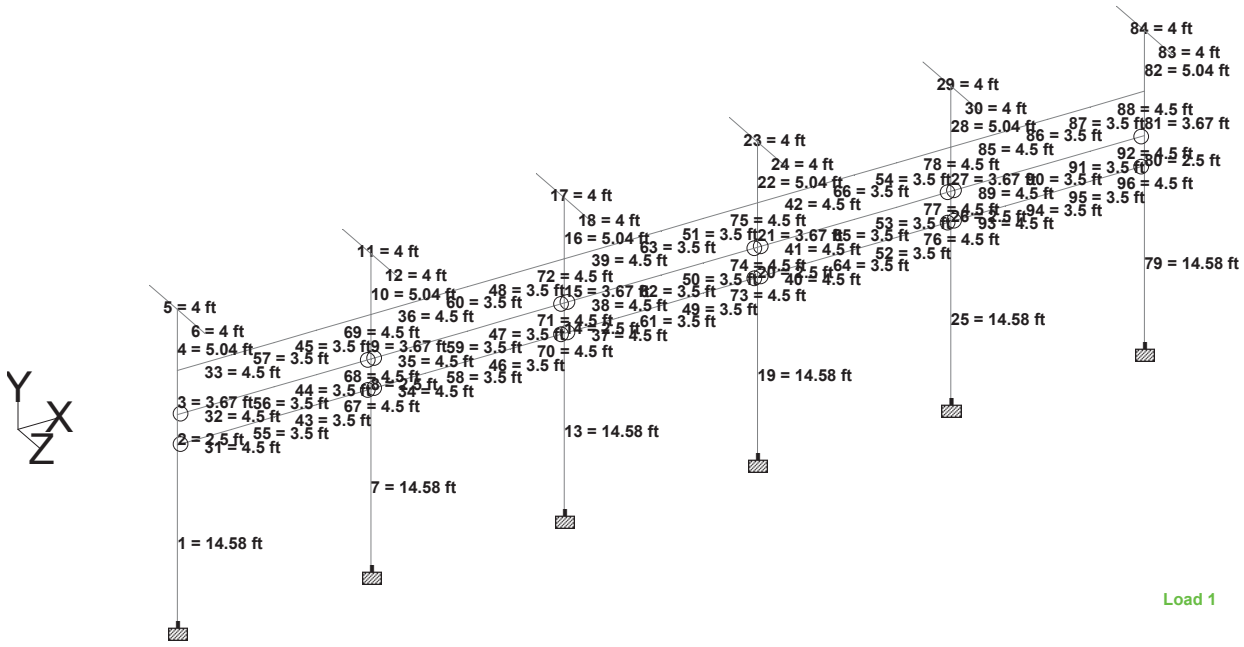
Coefficients:

Q	=	0.00256
k_z	=	0.900
G_{SRF}	=	1.020

NESC Wind Force	=	10.00	psf
Extreme Wind Force	=	19.04	psf
Ice Wind Force	=	3.76	psf

Currently works for W, WT, MC, C and Pipe shapes. Dimensions of L and HSS shapes must be manually entered.

Linear Loads on Structural Members									
				NESC Wind force (lb/ft)		Extreme Wind force (lb/ft		Ice Wind force (lb/ft)	
Member	C_f	Depth	Width	Major Axis	Minor Axis	Major Axis	Minor Axis	Major Axis	Minor Axis
W6X15	1.6	5.99	5.99	7.99	7.99	15.20	15.20	3.00	3.00
HSS6X6X.250	2	6.00	6.00	10.00	10.00	19.04	19.04	3.76	3.76
HSS12X12X.375	2	12.00	12.00	20.00	20.00	38.07	38.07	7.52	7.52
		-	-	-	-	-	-	-	-
		-	-	-	-	-	-	-	-
		-	-	-	-	-	-	-	-
		-	-	-	-	-	-	-	-
		-	-	-	-	-	-	-	-
		-	-	-	-	-	-	-	-
		-	-	-	-	-	-	-	-
		-	-	-	-	-	-	-	-


Y
X
Z
84 = 4 ft
83 = 4 ft
82 = 5.04 ft
29 = 4 ft
30 = 4 ft
28 = 5.04 ft
88 = 4.5 ft
87 = 3.5 ft
81 = 3.67 ft
86 = 3.5 ft
85 = 4.5 ft
23 = 4 ft
24 = 4 ft
22 = 5.04 ft
78 = 4.5 ft
54 = 3.5 ft
27 = 3.67 ft
80 = 3.5 ft
91 = 3.5 ft
66 = 3.5 ft
89 = 4.5 ft
96 = 4.5 ft
42 = 4.5 ft
95 = 3.5 ft
17 = 4 ft
18 = 4 ft
75 = 4.5 ft
94 = 3.5 ft
16 = 5.04 ft
51 = 3.5 ft
21 = 3.67 ft
53 = 3.5 ft
63 = 3.5 ft
41 = 4.5 ft
76 = 4.5 ft
11 = 4 ft
39 = 4.5 ft
52 = 3.5 ft
12 = 4 ft
74 = 4.5 ft
64 = 3.5 ft
79 = 14.58 ft
10 = 5.04 ft
72 = 4.5 ft
48 = 3.5 ft
15 = 3.67 ft
62 = 3.5 ft
50 = 3.5 ft
40 = 4.5 ft
60 = 3.5 ft
73 = 4.5 ft
5 = 4 ft
36 = 4.5 ft
38 = 4.5 ft
49 = 3.5 ft
6 = 4 ft
71 = 4.5 ft
61 = 3.5 ft
25 = 14.58 ft
69 = 4.5 ft
47 = 3.5 ft
37 = 4.5 ft
4 = 5.04 ft
45 = 3.5 ft
9 = 3.67 ft
59 = 3.5 ft
70 = 4.5 ft
57 = 3.5 ft
35 = 4.5 ft
46 = 3.5 ft
33 = 4.5 ft
68 = 4.5 ft
58 = 3.5 ft
19 = 14.58 ft
34 = 4.5 ft
44 = 3.5 ft
3 = 3.67 ft
56 = 3.5 ft
67 = 4.5 ft
32 = 4.5 ft
43 = 3.5 ft
13 = 14.58 ft
2 = 2.5 ft
55 = 3.5 ft
31 = 4.5 ft
7 = 14.58 ft
1 = 14.58 ft
Load 1

```
**************************************************
*                                                *
*           STAAD.Pro V8i SELECTseries4           *
*           Version  20.07.09.21                 *
*           Proprietary Program of               *
*           Bentley Systems, Inc.                *
*           Date=    JAN  4, 2018                *
*           Time=     9:20:33                    *
*                                                *
*      USER ID: Ulteig Engineers                 *
**************************************************
```

```
     1. STAAD SPACE
INPUT FILE: Collection Structure.STD
     2. START JOB INFORMATION
     3. ENGINEER DATE 23-JAN-14
     4. END JOB INFORMATION
     5. INPUT WIDTH 79
     6. UNIT FEET POUND
     7. JOINT COORDINATES
     8. 1 0 0 0; 2 0 14.583 0; 3 0 17.083 0; 4 0 20.75 0; 5 0 25.792 0; 6 0 25.792 -4
     9. 7 0 25.792 4; 8 16 0 0; 9 16 14.583 0; 10 16 17.083 0; 11 16 20.75 0
    10. 12 16 25.792 0; 13 16 25.792 -4; 14 16 25.792 4; 15 32 0 0; 16 32 14.583 0
    11. 17 32 17.083 0; 18 32 20.75 0; 19 32 25.792 0; 20 32 25.792 -4; 21 32 25.792 4
    12. 22 48 0 0; 23 48 14.583 0; 24 48 17.083 0; 25 48 20.75 0; 26 48 25.792 0
    13. 27 48 25.792 -4; 28 48 25.792 4; 29 64 0 0; 30 64 14.583 0; 31 64 17.083 0
    14. 32 64 20.75 0; 33 64 25.792 0; 34 64 25.792 -4; 35 64 25.792 4; 36 8 14.583 0
    15. 37 8 17.083 0; 38 8 20.75 0; 39 24 14.583 0; 40 24 17.083 0; 41 24 20.75 0
    16. 42 40 14.583 0; 43 40 17.083 0; 44 40 20.75 0; 45 56 14.583 0; 46 56 17.083 0
    17. 47 56 20.75 0; 48 4.5 14.583 0; 49 4.5 17.083 0; 50 4.5 20.75 0
    18. 51 20.5 14.583 0; 52 20.5 17.083 0; 53 20.5 20.75 0; 54 36.5 14.583 0
    19. 55 36.5 17.083 0; 56 36.5 20.75 0; 57 52.5 14.583 0; 58 52.5 17.083 0
    20. 59 52.5 20.75 0; 60 11.5 14.583 0; 61 11.5 17.083 0; 62 11.5 20.75 0
    21. 63 27.5 14.583 0; 64 27.5 17.083 0; 65 27.5 20.75 0; 66 43.5 14.583 0
    22. 67 43.5 17.083 0; 68 43.5 20.75 0; 69 59.5 14.583 0; 70 59.5 17.083 0
    23. 71 59.5 20.75 0; 72 80 0 0; 73 80 14.583 0; 74 80 17.083 0; 75 80 20.75 0
    24. 76 80 25.792 0; 77 80 25.792 4; 78 80 25.792 -4; 79 68.5 14.583 0
    25. 80 68.5 17.083 0; 81 68.5 20.75 0; 82 72 14.583 0; 83 72 17.083 0
    26. 84 72 20.75 0; 85 75.5 14.583 0; 86 75.5 17.083 0; 87 75.5 20.75 0
    27. MEMBER INCIDENCES
    28. 1 1 2; 2 2 3; 3 3 4; 4 4 5; 5 6 5; 6 5 7; 7 8 9; 8 9 10; 9 10 11; 10 11 12
    29. 11 13 12; 12 12 14; 13 15 16; 14 16 17; 15 17 18; 16 18 19; 17 20 19; 18 19 21
    30. 19 22 23; 20 23 24; 21 24 25; 22 25 26; 23 27 26; 24 26 28; 25 29 30; 26 30 31
    31. 27 31 32; 28 32 33; 29 34 33; 30 33 35; 31 2 48; 32 3 49; 33 4 50; 34 9 51
    32. 35 10 52; 36 11 53; 37 16 54; 38 17 55; 39 18 56; 40 23 57; 41 24 58; 42 25 59
    33. 43 36 60; 44 37 61; 45 38 62; 46 39 63; 47 40 64; 48 41 65; 49 42 66; 50 43 67
    34. 51 44 68; 52 45 69; 53 46 70; 54 47 71; 55 48 36; 56 49 37; 57 50 38; 58 51 39
    35. 59 52 40; 60 53 41; 61 54 42; 62 55 43; 63 56 44; 64 57 45; 65 58 46; 66 59 47
    36. 67 60 9; 68 61 10; 69 62 11; 70 63 16; 71 64 17; 72 65 18; 73 66 23; 74 67 24
    37. 75 68 25; 76 69 30; 77 70 31; 78 71 32; 79 72 73; 80 73 74; 81 74 75; 82 75 76
    38. 83 76 77; 84 76 78; 85 32 81; 86 81 84; 87 84 87; 88 87 75; 89 31 80; 90 80 83
```

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39. 91 83 86; 92 86 74; 93 30 79; 94 79 82; 95 82 85; 96 85 73
40. DEFINE MATERIAL START
41. ISOTROPIC STEEL
42. E 4.176E+009
43. POISSON 0.3
44. DENSITY 489.024
45. ALPHA 6E-006
46. DAMP 0.03
47. TYPE STEEL
48. STRENGTH FY 5.184E+006 FU 8.352E+006 RY 1.5 RT 1.2
49. END DEFINE MATERIAL
50. MEMBER PROPERTY AMERICAN
51. 1 TO 4 7 TO 10 13 TO 16 19 TO 22 25 TO 28 79 TO 82 TABLE ST HSST12X12X0.375
52. 5 6 11 12 17 18 23 24 29 30 33 36 39 42 45 48 51 54 57 60 63 66 69 72 75 78 -
53. 83 TO 88 TABLE ST HSST6X6X0.25
54. 31 32 34 35 37 38 40 41 43 44 46 47 49 50 52 53 55 56 58 59 61 62 64 65 67 -
55. 68 70 71 73 74 76 77 89 TO 96 TABLE ST W6X15
56. CONSTANTS
57. MATERIAL STEEL ALL
58. SUPPORTS
59. 1 8 15 22 29 72 FIXED
60. MEMBER RELEASE
61. 31 32 34 35 37 38 40 41 89 93 START MY MZ
62. 67 68 70 71 73 74 76 77 92 96 END MY MZ
63. LOAD 1 LOADTYPE NONE  TITLE WIND + ICE (WIND +X)
64. SELFWEIGHT Y -1.5
65. MEMBER LOAD
66. 1 TO 4 7 TO 10 13 TO 16 19 TO 22 25 TO 28 79 TO 82 UNI GX 7.5
67. 5 6 11 12 17 18 23 24 29 30 83 84 UNI GX 3.8
68. JOINT LOAD
69. *EAST HOOKSTICKS
70. 37 40 43 46 49 52 55 58 61 64 67 70 80 83 86 FX 11 FY -313 FZ 313 MY 14
71. 36 39 42 45 48 51 54 57 60 63 66 69 79 82 85 FX 11 FY -313 FZ -313 MY 14
72. *WEST HOOKSTICKS
73. 37 40 43 46 49 52 55 58 61 64 67 70 80 83 86 FX 11 FY -313 FZ -313 MY -14
74. 36 39 42 45 48 51 54 57 60 63 66 69 79 82 85 FX 11 FY -313 FZ 313 MY -14
75. *TOP BUS
76. 5 TO 7 76 TO 78 FX 9 FY -108 MZ -12
77. 12 TO 14 19 TO 21 26 TO 28 33 TO 35 FX 9 FY -214 MZ -12
78. *WEST INSULATORS
79. 38 41 47 50 53 59 62 65 71 81 84 87 FX 8 FY -62 MX 82 MY -10
80. *TRANSFORMER BUS
81. 44 56 68 FX 21 FY -115 MX 82 MY 10 MZ -33
82. *FEEDER BUS
83. 38 41 44 47 50 53 56 59 62 65 68 71 81 84 87 FX 21 FY -115 MX -82 MY -10 MZ -33
84. *C PHASE INSULATOR
85. 50 53 56 59 81 FX 9 FY -62 MZ -12
86. LOAD 2 LOADTYPE NONE  TITLE WIND + ICE (WIND +Z)
87. SELFWEIGHT Y -1.5
88. MEMBER LOAD
89. 1 TO 4 7 TO 10 13 TO 16 19 TO 22 25 TO 28 79 TO 82 UNI GZ 7.5
90. 31 TO 78 85 TO 96 UNI GZ 3
91. JOINT LOAD
92. *EAST HOOKSTICKS
93. 37 40 43 46 49 52 55 58 61 64 67 70 80 83 86 FY -313 FZ 316
94. 36 39 42 45 48 51 54 57 60 63 66 69 79 82 85 FY -313 FZ -309
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 95. *WEST HOOKSTICKS
 96. 37 40 43 46 49 52 55 58 61 64 67 70 80 83 86 FY -313 FZ -316
 97. 36 39 42 45 48 51 54 57 60 63 66 69 79 82 85 FY -313 FZ 309
 98. *TOP BUS
 99. 5 TO 7 76 TO 78 FY -108 FZ 20 MX 40
100. 12 TO 14 19 TO 21 26 TO 28 33 TO 35 FY -214 FZ 46 MX 107
101. *WEST INSULATORS
102. 38 41 47 50 53 59 62 65 71 81 84 87 FY -62 FZ 8 MX 82
103. *TRANSFORMER BUS
104. 44 56 68 FY -115 MX 115
105. *FEEDER BUS
106. 38 41 44 47 50 53 56 59 62 65 68 71 81 84 87 FY -115 MX -115
107. *C PHASE INSULATOR
108. 50 53 56 59 81 FY -62 FZ 9 MX 12
109. LOAD 3 LOADTYPE NONE  TITLE WIND + ICE (WIND @45)
110. SELFWEIGHT Y -1.5
111. MEMBER LOAD
112. 1 TO 4 7 TO 10 13 TO 16 19 TO 22 25 TO 28 79 TO 82 UNI GX 5.3
113. 5 6 11 12 17 18 23 24 29 30 83 84 UNI GX 2.7
114. 1 TO 4 8 TO 10 13 TO 16 19 TO 22 25 TO 28 79 TO 82 UNI GZ 5.3
115. 31 TO 78 85 TO 96 UNI GZ 2.1
116. JOINT LOAD
117. *EAST HOOKSTICKS
118. 37 40 43 46 49 52 55 58 61 64 67 70 80 83 86 FX 8 FY -313 FZ 315 MY 10
119. 36 39 42 45 48 51 54 57 60 63 66 69 79 82 85 FX 8 FY -313 FZ -310 MY 10
120. *WEST HOOKSTICKS
121. 37 40 43 46 49 52 55 58 61 64 67 70 80 83 86 FX 8 FY -313 FZ -315 MY -10
122. 36 39 42 45 48 51 54 57 60 63 66 69 79 82 85 FX 8 FY -313 FZ 310 MY -10
123. *TOP BUS
124. 5 TO 7 76 TO 78 FX 6 FY -108 FZ 14 MX 28 MZ -8
125. 12 TO 14 19 TO 21 26 TO 28 33 TO 35 FX 6 FY -214 FZ 32 MX 75 MZ -8
126. *WEST INSULATORS
127. 38 41 47 50 53 59 62 65 71 81 84 87 FX 5 FY -62 FZ 5 MX 82 MY 7
128. *TRANSFORMER BUS
129. 44 56 68 FX 14 FY -115 MX 82 MY 7
130. *FEEDER BUS
131. 38 41 44 47 50 53 56 59 62 65 68 71 81 84 87 FX 15 FY -115 MX -82 MY -7
132. *C PHASE INSULATOR
133. 50 53 56 59 81 FX 6 FY -62 FZ 6 MX 8 MZ -8
134. LOAD 4 LOADTYPE NONE  TITLE EXTREME WIND (WIND +X)
135. SELFWEIGHT Y -1.5
136. MEMBER LOAD
137. 1 TO 4 7 TO 10 13 TO 16 19 TO 22 25 TO 28 79 TO 82 UNI GX 38.1
138. 5 6 11 12 17 18 23 24 29 30 83 84 UNI GX 19.1
139. JOINT LOAD
140. *EAST HOOKSTICKS
141. 37 40 43 46 49 52 55 58 61 64 67 70 80 83 86 FX 54 FY -209 FZ 209 MY 66
142. 36 39 42 45 48 51 54 57 60 63 66 69 79 82 85 FX 54 FY -209 FZ -209 MY 66
143. *WEST HOOKSTICKS
144. 37 40 43 46 49 52 55 58 61 64 67 70 80 83 86 FX 54 FY -209 FZ 209 MY -66
145. 36 39 42 45 48 51 54 57 60 63 66 69 79 82 85 FX 54 FY -209 FZ -209 MY -66
146. *TOP BUS
147. 5 TO 7 76 TO 78 FX 37 FY -68 MZ -49
148. 12 TO 14 19 TO 21 26 TO 28 33 TO 35 FX 37 FY -131 MZ -49
149. *WEST INSULATORS
150. 38 41 47 50 53 59 62 65 71 81 84 87 FX 37 FY -41 MX 55 MY 49
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151. *TRANSFORMER BUS
152. 44 56 68 FX 87 FY -72 MX 55 MY 49
153. *FEEDER BUS
154. 38 41 44 47 50 53 56 59 62 65 68 71 81 84 87 FX 87 FY -72 MX -55 MY -49
155. *C PHASE INSULATOR
156. 50 53 56 59 81 FX 37 FY -41 MZ -49
157. LOAD 5 LOADTYPE NONE  TITLE EXTREME WIND (WIND +Z)
158. SELFWEIGHT Y -1.5
159. MEMBER LOAD
160. 1 TO 4 7 TO 10 13 TO 16 19 TO 22 25 TO 28 79 TO 82 UNI GZ 38.1
161. 31 TO 78 85 TO 96 UNI GZ 15.2
162. JOINT LOAD
163. *EAST HOOKSTICKS
164. 37 40 43 46 49 52 55 58 61 64 67 70 80 83 86 FY -209 FZ 225
165. 36 39 42 45 48 51 54 57 60 63 66 69 79 82 85 FY -209 FZ -192
166. *WEST HOOKSTICKS
167. 37 40 43 46 49 52 55 58 61 64 67 70 80 83 86 FY -209 FZ -225
168. 36 39 42 45 48 51 54 57 60 63 66 69 79 82 85 FY -209 FZ 192
169. *TOP BUS
170. 5 TO 7 76 TO 78 FY -68 FZ 80 MX 160
171. 12 TO 14 19 TO 21 26 TO 28 33 TO 35 FY -131 FZ 180 MX 418
172. *WEST INSULATORS
173. 38 41 47 50 53 59 62 65 71 81 84 87 FY -41 FZ 37 MX 55
174. *TRANSFORMER BUS
175. 44 56 68 FY -72 MX 55
176. *FEEDER BUS
177. 38 41 44 47 50 53 56 59 62 65 68 71 81 84 87 FY -72 MX -55
178. *C PHASE INSULATOR
179. 50 53 56 59 81 FY -41 FZ 37 MX 49
180. LOAD 6 LOADTYPE NONE  TITLE EXTREME WIND (WIND @45)
181. SELFWEIGHT Y -1.5
182. MEMBER LOAD
183. 1 TO 4 7 TO 10 13 TO 16 19 TO 22 25 TO 28 79 TO 82 UNI GX 26.9
184. 5 6 11 12 17 18 23 24 29 30 83 84 UNI GX 13.5
185. 1 TO 4 7 TO 10 13 TO 16 19 TO 22 25 TO 28 79 TO 82 UNI GZ 26.9
186. 31 TO 78 85 TO 96 UNI GZ 10.7
187. JOINT LOAD
188. *EAST HOOKSTICKS
189. 37 40 43 46 49 52 55 58 61 64 67 70 80 83 86 FX 37 FY -209 FZ 220 MY 47
190. 36 39 42 45 48 51 54 57 60 63 66 69 79 82 85 FX 37 FY -209 FZ -197 MY 47
191. *WEST HOOKSTICKS
192. 37 40 43 46 49 52 55 58 61 64 67 70 80 83 86 FX 37 FY -209 FZ -220 MY -47
193. 36 39 42 45 48 51 54 57 60 63 66 69 79 82 85 FX 37 FY -209 FZ 197 MY -47
194. *TOP BUS
195. 5 TO 7 76 TO 78 FX 26 FY -68 FZ 56 MX 113 MZ -35
196. 12 TO 14 19 TO 21 26 TO 28 33 TO 35 FX 26 FY -131 FZ 127 MX 296 MZ -35
197. *WEST INSULATORS
198. 38 41 47 50 53 59 62 65 71 81 84 87 FX 26 FY -41 FZ 26 MX 55 MY 35
199. *TRANSFORMER BUS
200. 44 56 68 FX 61 FY -72 MX 55 MY 35
201. *FEEDER BUS
202. 38 41 44 47 50 53 56 59 62 65 68 71 81 84 87 FX 61 FY -72 MX -55 MY -35
203. *C PHASE INSULATOR
204. 50 53 56 59 81 FX 26 FY -41 FZ 26 MX 35 MZ -35
205. PDELTA 3 ANALYSIS
```

P R O B L E M S T A T I S T I C S

NUMBER OF JOINTS	**87**	**NUMBER OF MEMBERS**	**96**
NUMBER OF PLATES	**0**	**NUMBER OF SOLIDS**	**0**
NUMBER OF SURFACES	**0**	**NUMBER OF SUPPORTS**	**6**

SOLVER USED IS THE OUT-OF-CORE BASIC SOLVER

ORIGINAL/FINAL BAND-WIDTH= 51/ 5/ 36 DOF
TOTAL PRIMARY LOAD CASES = 6, TOTAL DEGREES OF FREEDOM = 486
SIZE OF STIFFNESS MATRIX = 18 DOUBLE KILO-WORDS
REQRD/AVAIL. DISK SPACE = 12.4/ 0.0 MB

++ Adjusting Displacements.
++ Adjusting Displacements.
++ Adjusting Displacements.

206. PRINT JOINT DISPLACEMENTS ALL

JOINT DISPLACEMENT (INCH RADIANS) STRUCTURE TYPE = SPACE

JOINT	LOAD	X-TRANS	Y-TRANS	Z-TRANS	X-ROTAN	Y-ROTAN	Z-ROTAN
1	1	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
	2	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
	3	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
	4	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
	5	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
	6	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
2	1	0.06725	-0.00176	-0.00091	-0.00001	0.00000	-0.00057
	2	0.00014	-0.00181	0.08782	0.00084	-0.00013	-0.00001
	3	0.04752	-0.00178	0.06111	0.00058	-0.00008	-0.00041
	4	0.31805	-0.00125	0.03495	0.00039	-0.00006	-0.00267
	5	0.00004	-0.00149	0.41017	0.00389	-0.00057	-0.00001
	6	0.22260	-0.00132	0.28865	0.00274	-0.00041	-0.00187
3	1	0.08447	-0.00194	-0.00118	-0.00001	0.00000	-0.00057
	2	0.00049	-0.00200	0.11381	0.00089	-0.00015	-0.00002
	3	0.05978	-0.00196	0.07923	0.00062	-0.00010	-0.00041
	4	0.39804	-0.00136	0.04743	0.00042	-0.00007	-0.00263
	5	0.00028	-0.00165	0.53111	0.00413	-0.00067	-0.00001
	6	0.27868	-0.00145	0.37375	0.00291	-0.00047	-0.00185
4	1	0.10979	-0.00208	-0.00159	-0.00001	0.00000	-0.00059
	2	0.00210	-0.00216	0.15418	0.00094	-0.00018	-0.00007
	3	0.07814	-0.00211	0.10742	0.00065	-0.00012	-0.00044
	4	0.51126	-0.00143	0.06606	0.00043	-0.00008	-0.00252
	5	0.00147	-0.00178	0.71866	0.00434	-0.00082	-0.00005
	6	0.35836	-0.00154	0.50570	0.00306	-0.00058	-0.00178
5	1	0.14624	-0.00218	-0.00216	-0.00001	0.00000	-0.00061
	2	0.00634	-0.00225	0.21160	0.00096	-0.00018	-0.00007
	3	0.10512	-0.00220	0.14758	0.00067	-0.00012	-0.00045
	4	0.66662	-0.00151	0.09178	0.00043	-0.00008	-0.00259
	5	0.00466	-0.00186	0.98496	0.00443	-0.00082	-0.00005
	6	0.46819	-0.00162	0.69305	0.00312	-0.00058	-0.00183
6	1	0.14700	-0.00946	-0.00216	-0.00021	-0.00002	-0.00062
	2	0.01522	0.03750	0.21161	0.00078	-0.00018	-0.00007
	3	0.11127	0.02354	0.14758	0.00049	-0.00013	-0.00046
	4	0.67355	0.01390	0.09178	0.00028	-0.00017	-0.00264
	5	0.04378	0.20855	0.98498	0.00440	-0.00082	-0.00005
	6	0.49800	0.14495	0.69307	0.00305	-0.00064	-0.00187
7	1	0.14683	-0.00856	-0.00216	0.00019	0.00002	-0.00062
	2	-0.00254	-0.05566	0.21161	0.00118	-0.00018	-0.00007
	3	0.09990	-0.04161	0.14758	0.00089	-0.00011	-0.00046
	4	0.66576	-0.02691	0.09178	0.00057	0.00001	-0.00264
	5	-0.03446	-0.22222	0.98498	0.00469	-0.00081	-0.00005
	6	0.44266	-0.15814	0.69307	0.00334	-0.00052	-0.00187
8	1	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
	2	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
	3	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
	4	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000

Max Horizontal Deflection(Vert. Member) = L/100

Max Horizontal Deflection = (25.792*12)/100 = 3.095"

Max Vertical Deflection(Horz. Member) = L/200

Max Vertical Deflection = (16*12)/200 = 0.96"

Displacement X = 0.667" < 3.095"

JOINT DISPLACEMENT (INCH RADIANS) STRUCTURE TYPE = SPACE

JOINT	LOAD	X-TRANS	Y-TRANS	Z-TRANS	X-ROTAN	Y-ROTAN	Z-ROTAN
	5	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
	6	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
9	1	0.06754	-0.00297	-0.00004	0.00000	0.00000	-0.00058
	2	0.00032	-0.00297	0.11873	0.00114	-0.00009	-0.00001
	3	0.04777	-0.00297	0.08028	0.00078	-0.00006	-0.00041
	4	0.31871	-0.00233	0.05009	0.00058	-0.00005	-0.00268
	5	0.00018	-0.00232	0.54379	0.00519	-0.00039	-0.00001
	6	0.22310	-0.00233	0.38330	0.00366	-0.00027	-0.00188
10	1	0.08490	-0.00329	-0.00006	0.00000	0.00000	-0.00057
	2	0.00073	-0.00329	0.15422	0.00122	-0.00011	-0.00002
	3	0.06016	-0.00329	0.10474	0.00084	-0.00008	-0.00041
	4	0.39913	-0.00258	0.06896	0.00063	-0.00006	-0.00263
	5	0.00047	-0.00257	0.70543	0.00553	-0.00045	-0.00001
	6	0.27950	-0.00258	0.49724	0.00390	-0.00032	-0.00185
11	1	0.10927	-0.00352	-0.00008	0.00000	0.00000	-0.00052
	2	0.00173	-0.00352	0.20959	0.00129	-0.00013	-0.00002
	3	0.07766	-0.00352	0.14308	0.00089	-0.00009	-0.00037
	4	0.51024	-0.00277	0.09668	0.00063	-0.00008	-0.00235
	5	0.00119	-0.00276	0.95711	0.00585	-0.00055	-0.00002
	6	0.35756	-0.00276	0.67467	0.00412	-0.00039	-0.00165
12	1	0.14112	-0.00366	-0.00011	0.00000	0.00000	-0.00053
	2	0.00316	-0.00366	0.28939	0.00134	-0.00013	-0.00002
	3	0.10059	-0.00366	0.19848	0.00093	-0.00009	-0.00038
	4	0.65509	-0.00287	0.13473	0.00063	-0.00008	-0.00241
	5	0.00221	-0.00286	1.31847	0.00604	-0.00055	-0.00002
	6	0.45937	-0.00287	0.92944	0.00426	-0.00039	-0.00170
13	1	0.14190	-0.01539	-0.00011	-0.00035	-0.00002	-0.00054
	2	0.00944	0.05062	0.28941	0.00106	-0.00013	-0.00002
	3	0.10543	0.03045	0.19849	0.00063	-0.00010	-0.00039
	4	0.66184	0.01943	0.13473	0.00040	-0.00016	-0.00247
	5	0.02858	0.28641	1.31853	0.00611	-0.00055	-0.00002
	6	0.48021	0.19876	0.92948	0.00424	-0.00045	-0.00174
14	1	0.14170	-0.01533	-0.00011	0.00035	0.00002	-0.00054
	2	-0.00312	-0.08133	0.28941	0.00176	-0.00013	-0.00002
	3	0.09668	-0.06117	0.19849	0.00133	-0.00008	-0.00039
	4	0.65440	-0.04095	0.13473	0.00086	0.00001	-0.00247
	5	-0.02415	-0.30780	1.31853	0.00656	-0.00055	-0.00002
	6	0.44282	-0.22023	0.92948	0.00470	-0.00033	-0.00174
15	1	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
	2	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
	3	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
	4	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
	5	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
	6	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
16	1	0.06782	-0.00299	0.00049	0.00000	0.00000	-0.00057
	2	0.00052	-0.00300	0.12634	0.00121	0.00000	-0.00001

JOINT DISPLACEMENT (INCH RADIANS) STRUCTURE TYPE = SPACE

JOINT	LOAD	X-TRANS	Y-TRANS	Z-TRANS	X-ROTAN	Y-ROTAN	Z-ROTAN
	3	0.04803	-0.00300	0.08796	0.00085	-0.00001	-0.00041
	4	0.31920	-0.00234	0.05563	0.00064	-0.00001	-0.00268
	5	0.00034	-0.00234	0.57381	0.00548	-0.00001	-0.00001
	6	0.22349	-0.00234	0.40463	0.00387	-0.00001	-0.00188
17	1	0.08504	-0.00332	0.00064	0.00000	0.00000	-0.00056
	2	0.00081	-0.00332	0.16421	0.00130	-0.00001	-0.00001
	3	0.06028	-0.00332	0.11437	0.00091	-0.00001	-0.00040
	4	0.39948	-0.00259	0.07619	0.00069	-0.00001	-0.00262
	5	0.00053	-0.00259	0.74467	0.00585	-0.00001	-0.00001
	6	0.27977	-0.00259	0.52513	0.00413	-0.00001	-0.00184
18	1	0.10894	-0.00355	0.00085	0.00000	0.00000	-0.00051
	2	0.00146	-0.00356	0.22339	0.00138	-0.00001	-0.00002
	3	0.07735	-0.00356	0.15568	0.00096	-0.00001	-0.00037
	4	0.50978	-0.00278	0.10653	0.00069	-0.00001	-0.00233
	5	0.00097	-0.00278	1.01082	0.00618	-0.00001	-0.00001
	6	0.35717	-0.00278	0.71283	0.00436	-0.00001	-0.00164
19	1	0.14048	-0.00369	0.00115	0.00000	0.00000	-0.00053
	2	0.00274	-0.00370	0.30859	0.00143	-0.00001	-0.00002
	3	0.10003	-0.00370	0.21519	0.00100	-0.00001	-0.00038
	4	0.65376	-0.00289	0.14823	0.00069	-0.00001	-0.00240
	5	0.00181	-0.00289	1.39248	0.00638	-0.00001	-0.00001
	6	0.45833	-0.00289	0.98201	0.00450	-0.00001	-0.00169
20	1	0.14100	-0.01516	0.00115	-0.00034	-0.00002	-0.00054
	2	0.00306	0.05485	0.30860	0.00115	-0.00001	-0.00002
	3	0.10120	0.03368	0.21520	0.00070	-0.00003	-0.00039
	4	0.65741	0.02231	0.14823	0.00046	-0.00010	-0.00245
	5	0.00243	0.30249	1.39254	0.00644	-0.00001	-0.00001
	6	0.46092	0.21018	0.98205	0.00447	-0.00007	-0.00173
21	1	0.14132	-0.01563	0.00115	0.00035	0.00002	-0.00054
	2	0.00241	-0.08565	0.30860	0.00185	-0.00001	-0.00002
	3	0.09979	-0.06448	0.21520	0.00140	0.00000	-0.00039
	4	0.65617	-0.04386	0.14823	0.00092	0.00007	-0.00245
	5	0.00119	-0.32393	1.39254	0.00690	-0.00001	-0.00001
	6	0.46000	-0.23168	0.98205	0.00494	0.00005	-0.00173
22	1	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
	2	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
	3	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
	4	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
	5	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
	6	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
23	1	0.06804	-0.00300	-0.00049	0.00000	0.00000	-0.00057
	2	0.00075	-0.00300	0.12631	0.00121	0.00000	-0.00001
	3	0.04825	-0.00300	0.08869	0.00085	0.00000	-0.00041
	4	0.31936	-0.00234	0.05563	0.00064	0.00001	-0.00268
	5	0.00050	-0.00234	0.57369	0.00548	0.00000	0.00000
	6	0.22366	-0.00234	0.40455	0.00387	0.00000	-0.00188

Displacement Z = 1.392" < 3.095"

JOINT DISPLACEMENT (INCH RADIANS) STRUCTURE TYPE = SPACE

JOINT	LOAD	X-TRANS	Y-TRANS	Z-TRANS	X-ROTAN	Y-ROTAN	Z-ROTAN
24	1	0.08517	-0.00332	-0.00064	0.00000	0.00000	-0.00056
	2	0.00094	-0.00332	0.16418	0.00130	0.00000	-0.00001
	3	0.06041	-0.00332	0.11531	0.00091	0.00000	-0.00040
	4	0.39957	-0.00259	0.07618	0.00069	0.00001	-0.00262
	5	0.00062	-0.00259	0.74452	0.00585	0.00000	0.00000
	6	0.27985	-0.00259	0.52502	0.00413	0.00000	-0.00183
25	1	0.10860	-0.00356	-0.00085	0.00000	0.00000	-0.00049
	2	0.00112	-0.00356	0.22334	0.00138	0.00000	0.00000
	3	0.07701	-0.00356	0.15695	0.00097	0.00000	-0.00035
	4	0.50953	-0.00278	0.10652	0.00069	0.00001	-0.00232
	5	0.00073	-0.00278	1.01061	0.00618	0.00000	0.00000
	6	0.35692	-0.00278	0.71268	0.00436	0.00000	-0.00162
26	1	0.13885	-0.00370	-0.00115	0.00000	0.00000	-0.00050
	2	0.00112	-0.00370	0.30851	0.00143	0.00000	0.00000
	3	0.09841	-0.00370	0.21692	0.00100	0.00000	-0.00036
	4	0.65266	-0.00289	0.14822	0.00069	0.00001	-0.00239
	5	0.00073	-0.00289	1.39219	0.00638	0.00000	0.00000
	6	0.45723	-0.00289	0.98180	0.00450	0.00000	-0.00167
27	1	0.13937	-0.01564	-0.00115	-0.00035	-0.00002	-0.00052
	2	0.00095	0.05484	0.30853	0.00115	0.00000	0.00000
	3	0.09884	0.03404	0.21693	0.00071	-0.00001	-0.00037
	4	0.65507	0.02231	0.14822	0.00046	-0.00007	-0.00244
	5	0.00078	0.30242	1.39224	0.00644	0.00000	0.00000
	6	0.45938	0.21014	0.98184	0.00447	-0.00006	-0.00171
28	1	0.13969	-0.01517	-0.00115	0.00034	0.00002	-0.00052
	2	0.00128	-0.08563	0.30853	0.00185	0.00000	0.00000
	3	0.09890	-0.06484	0.21693	0.00140	0.00001	-0.00037
	4	0.65631	-0.04386	0.14822	0.00092	0.00010	-0.00244
	5	0.00069	-0.32386	1.39224	0.00690	0.00000	0.00000
	6	0.45936	-0.23163	0.98184	0.00494	0.00006	-0.00171
29	1	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
	2	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
	3	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
	4	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
	5	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
	6	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
30	1	0.06818	-0.00297	0.00004	0.00000	0.00000	-0.00057
	2	0.00096	-0.00297	0.11847	0.00114	0.00009	0.00000
	3	0.04841	-0.00297	0.08339	0.00080	0.00006	-0.00040
	4	0.31919	-0.00231	0.05009	0.00058	0.00005	-0.00268
	5	0.00066	-0.00232	0.54270	0.00518	0.00038	0.00000
	6	0.22359	-0.00232	0.38263	0.00365	0.00027	-0.00187
31	1	0.08519	-0.00328	0.00006	0.00000	0.00000	-0.00055
	2	0.00101	-0.00329	0.15387	0.00121	0.00011	0.00000
	3	0.06044	-0.00328	0.10839	0.00086	0.00007	-0.00039
	4	0.39934	-0.00256	0.06896	0.00063	0.00006	-0.00262

JOINT DISPLACEMENT (INCH RADIANS) STRUCTURE TYPE = SPACE

JOINT	LOAD	X-TRANS	Y-TRANS	Z-TRANS	X-ROTAN	Y-ROTAN	Z-ROTAN
	5	0.00068	-0.00257	0.70401	0.00552	0.00045	0.00000
	6	0.27972	-0.00256	0.49636	0.00389	0.00032	-0.00183
32	1	0.10837	-0.00351	0.00008	0.00000	0.00000	-0.00049
	2	0.00084	-0.00352	0.20912	0.00128	0.00013	0.00000
	3	0.07677	-0.00352	0.14749	0.00091	0.00009	-0.00035
	4	0.50954	-0.00275	0.09668	0.00063	0.00008	-0.00232
	5	0.00051	-0.00276	0.95516	0.00584	0.00055	0.00000
	6	0.35687	-0.00275	0.67345	0.00412	0.00039	-0.00163
33	1	0.13863	-0.00365	0.00011	0.00000	0.00000	-0.00050
	2	0.00068	-0.00366	0.28874	0.00133	0.00013	0.00000
	3	0.09810	-0.00365	0.20390	0.00095	0.00009	-0.00036
	4	0.65315	-0.00285	0.13473	0.00063	0.00008	-0.00239
	5	0.00033	-0.00286	1.31580	0.00603	0.00055	0.00000
	6	0.45746	-0.00286	0.92775	0.00425	0.00039	-0.00168
34	1	0.13941	-0.01533	0.00011	-0.00035	-0.00002	-0.00052
	2	-0.00557	0.05047	0.28875	0.00106	0.00013	0.00000
	3	0.09423	0.03126	0.20391	0.00065	0.00008	-0.00036
	4	0.65247	0.01945	0.13473	0.00040	-0.00001	-0.00245
	5	-0.02593	0.28583	1.31586	0.00609	0.00055	0.00000
	6	0.44105	0.19841	0.92779	0.00423	0.00033	-0.00172
35	1	0.13920	-0.01538	0.00011	0.00035	0.00002	-0.00052
	2	0.00694	-0.08118	0.28875	0.00176	0.00013	0.00000
	3	0.10290	-0.06197	0.20391	0.00134	0.00010	-0.00036
	4	0.65990	-0.04093	0.13473	0.00086	0.00016	-0.00245
	5	0.02658	-0.30723	1.31586	0.00655	0.00055	0.00000
	6	0.47813	-0.21984	0.92779	0.00469	0.00045	-0.00172
36	1	0.06741	-0.32074	-0.00048	0.00000	0.00000	-0.00001
	2	0.00023	-0.32087	0.11970	0.00099	-0.00016	-0.00001
	3	0.04766	-0.32078	0.08218	0.00068	-0.00010	-0.00001
	4	0.31846	-0.22741	-0.52940	0.00048	-0.00008	-0.00001
	5	0.00011	-0.22787	0.56023	0.00454	-0.00070	0.00000
	6	0.22291	-0.22755	0.39434	0.00320	-0.00049	-0.00001
37	1	0.08470	-0.32085	-0.00062	0.00000	-0.00001	-0.00001
	2	0.00061	-0.32106	0.15043	0.00105	-0.00021	-0.00001
	3	0.05998	-0.32091	0.10346	0.00073	-0.00013	-0.00001
	4	0.39867	-0.22730	0.62781	0.00053	-0.00011	-0.00001
	5	0.00037	-0.22804	0.70148	0.00483	-0.00091	0.00000
	6	0.27915	-0.22752	0.49367	0.00341	-0.00064	-0.00001
38	1	0.10955	-0.03403	-0.00084	0.00000	-0.00001	0.00027
	2	0.00192	-0.03325	0.18534	0.00104	-0.00035	0.00002
	3	0.07791	-0.03379	0.12734	0.00078	-0.00022	0.00020
	4	0.51084	-0.02899	0.08145	0.00053	-0.00020	0.00118
	5	0.00133	-0.02542	0.85458	0.00513	-0.00151	0.00002
	6	0.35802	-0.02792	0.60193	0.00361	-0.00107	0.00083
39	1	0.06769	-0.32136	0.00022	0.00000	0.00000	0.00000
	2	0.00042	-0.32143	0.13896	0.00118	-0.00004	0.00000

JOINT DISPLACEMENT (INCH RADIANS) STRUCTURE TYPE = SPACE

JOINT	LOAD	X-TRANS	Y-TRANS	Z-TRANS	X-ROTAN	Y-ROTAN	Z-ROTAN
	3	0.04791	-0.32138	0.09561	0.00081	-0.00004	0.00000
	4	0.31904	-0.22806	-0.51992	0.00061	-0.00003	0.00000
	5	0.00026	-0.22828	0.64203	0.00534	-0.00016	0.00000
	6	0.22335	-0.22813	0.45242	0.00376	-0.00011	0.00000
40	1	0.08499	-0.32182	0.00029	0.00000	0.00000	0.00000
	2	0.00077	-0.32188	0.17566	0.00126	-0.00005	0.00000
	3	0.06023	-0.32184	0.12106	0.00087	-0.00005	0.00000
	4	0.39939	-0.22841	0.64609	0.00066	-0.00004	0.00000
	5	0.00050	-0.22860	0.80836	0.00569	-0.00020	0.00000
	6	0.27969	-0.22847	0.56971	0.00401	-0.00015	0.00000
41	1	0.10912	-0.03306	0.00052	0.00000	-0.00001	0.00026
	2	0.00160	-0.03289	0.22162	0.00126	-0.00007	0.00002
	3	0.07752	-0.03300	0.15265	0.00093	-0.00007	0.00019
	4	0.51010	-0.02582	0.10316	0.00066	-0.00005	0.00115
	5	0.00108	-0.02513	1.00716	0.00605	-0.00027	0.00002
	6	0.35743	-0.02562	0.71012	0.00426	-0.00019	0.00081
42	1	0.06794	-0.32143	0.00000	0.00000	0.00001	0.00000
	2	0.00064	-0.32143	0.14274	0.00121	0.00000	0.00000
	3	0.04815	-0.32143	0.09982	0.00085	0.00000	0.00000
	4	0.31937	-0.22829	-0.51885	0.00064	0.00000	0.00000
	5	0.00042	-0.22829	0.65698	0.00548	0.00000	0.00000
	6	0.22363	-0.22829	0.46318	0.00387	0.00000	0.00000
43	1	0.08513	-0.32184	0.00000	0.00000	0.00001	0.00000
	2	0.00087	-0.32184	0.18063	0.00130	0.00000	0.00000
	3	0.06035	-0.32184	0.12634	0.00091	0.00000	0.00000
	4	0.39961	-0.22859	0.65109	0.00069	0.00000	0.00000
	5	0.00058	-0.22859	0.82789	0.00585	0.00000	0.00000
	6	0.27987	-0.22859	0.58371	0.00413	0.00000	0.00000
44	1	0.10880	-0.03879	0.00000	0.00000	0.00001	0.00025
	2	0.00129	-0.03869	0.22496	0.00138	0.00000	0.00002
	3	0.07720	-0.03876	0.15761	0.00097	-0.00001	0.00019
	4	0.50978	-0.02892	0.10714	0.00069	0.00000	0.00114
	5	0.00085	-0.02852	1.01760	0.00621	0.00001	0.00001
	6	0.35713	-0.02881	0.71762	0.00438	0.00001	0.00080
45	1	0.06813	-0.32150	-0.00022	0.00000	0.00000	0.00000
	2	0.00085	-0.32143	0.13881	0.00117	0.00004	0.00000
	3	0.04835	-0.32147	0.09754	0.00083	0.00003	0.00000
	4	0.31937	-0.22850	-0.52340	0.00061	0.00003	0.00000
	5	0.00058	-0.22828	0.64143	0.00533	0.00016	0.00000
	6	0.22368	-0.22843	0.45232	0.00376	0.00011	0.00000
46	1	0.08520	-0.32194	-0.00029	0.00000	0.00000	0.00000
	2	0.00098	-0.32188	0.17547	0.00126	0.00005	0.00000
	3	0.06044	-0.32192	0.12336	0.00089	0.00004	0.00000
	4	0.39954	-0.22879	0.64913	0.00066	0.00003	0.00000
	5	0.00065	-0.22860	0.80757	0.00569	0.00021	0.00000
	6	0.27984	-0.22873	0.56946	0.00401	0.00015	0.00000

Displacement Y = 0.322" < 0.96"

JOINT DISPLACEMENT (INCH RADIANS) STRUCTURE TYPE = SPACE

JOINT	LOAD	X-TRANS	Y-TRANS	Z-TRANS	X-ROTAN	Y-ROTAN	Z-ROTAN
47	1	0.10851	-0.03293	-0.00052	0.00000	-0.00001	0.00025
	2	0.00098	-0.03290	0.22143	0.00126	0.00008	0.00001
	3	0.07690	-0.03292	0.15581	0.00095	0.00005	0.00018
	4	0.50962	-0.02526	0.10315	0.00066	0.00005	0.00114
	5	0.00062	-0.02514	1.00636	0.00604	0.00030	0.00001
	6	0.35696	-0.02523	0.70960	0.00426	0.00021	0.00080
48	1	0.06735	-0.24865	-0.00066	-0.00001	0.00000	-0.00326
	2	0.00019	-0.24877	0.10929	0.00092	-0.00033	-0.00326
	3	0.04760	-0.24868	0.07543	0.00064	-0.00022	-0.00326
	4	0.31830	-0.17631	-0.40318	0.00044	0.00584	-0.00231
	5	0.00008	-0.17676	0.51250	0.00425	-0.00155	-0.00231
	6	0.22279	-0.17645	0.36066	0.00300	-0.00109	-0.00231
49	1	0.08460	-0.24876	-0.00086	-0.00001	-0.00001	-0.00326
	2	0.00055	-0.24895	0.13794	0.00098	-0.00038	-0.00326
	3	0.05989	-0.24882	0.09533	0.00068	-0.00025	-0.00326
	4	0.39841	-0.17624	0.49410	0.00048	-0.00601	-0.00231
	5	0.00033	-0.17692	0.64485	0.00453	-0.00176	-0.00231
	6	0.27896	-0.17644	0.45372	0.00319	-0.00124	-0.00231
50	1	0.10966	-0.03276	-0.00131	-0.00001	-0.00001	-0.00034
	2	0.00200	-0.02373	0.17009	0.00098	-0.00036	-0.00043
	3	0.07802	-0.03016	0.11760	0.00073	-0.00023	-0.00036
	4	0.51105	-0.06116	0.07339	0.00048	-0.00018	0.00011
	5	0.00139	-0.01815	0.78848	0.00481	-0.00156	-0.00033
	6	0.35819	-0.04829	0.55511	0.00339	-0.00111	-0.00002
51	1	0.06763	-0.24953	0.00011	0.00000	0.00000	-0.00325
	2	0.00038	-0.24958	0.13364	0.00116	-0.00021	-0.00325
	3	0.04786	-0.24955	0.09138	0.00080	-0.00016	-0.00325
	4	0.31891	-0.17718	-0.39140	0.00060	0.00590	-0.00230
	5	0.00022	-0.17735	0.61697	0.00527	-0.00101	-0.00231
	6	0.22325	-0.17723	0.43476	0.00372	-0.00071	-0.00230
52	1	0.08496	-0.24995	0.00014	0.00000	0.00000	-0.00325
	2	0.00075	-0.25000	0.16982	0.00124	-0.00022	-0.00325
	3	0.06020	-0.24997	0.11639	0.00086	-0.00017	-0.00325
	4	0.39930	-0.17750	0.51461	0.00065	-0.00597	-0.00230
	5	0.00049	-0.17765	0.78126	0.00562	-0.00105	-0.00231
	6	0.27962	-0.17755	0.55060	0.00396	-0.00074	-0.00231
53	1	0.10919	-0.03187	0.00015	0.00000	-0.00001	-0.00032
	2	0.00166	-0.02356	0.21731	0.00126	-0.00013	-0.00042
	3	0.07759	-0.02948	0.14888	0.00092	-0.00011	-0.00035
	4	0.51019	-0.05754	0.10060	0.00065	-0.00007	0.00014
	5	0.00113	-0.01798	0.98968	0.00599	-0.00054	-0.00032
	6	0.35751	-0.04570	0.69773	0.00422	-0.00039	0.00000
54	1	0.06789	-0.24959	0.00022	0.00000	0.00001	-0.00325
	2	0.00059	-0.24959	0.13910	0.00121	-0.00017	-0.00325
	3	0.04810	-0.24959	0.09710	0.00085	-0.00012	-0.00325
	4	0.31931	-0.17735	-0.38873	0.00064	0.00595	-0.00231

JOINT DISPLACEMENT (INCH RADIANS) STRUCTURE TYPE = SPACE

JOINT	LOAD	X-TRANS	Y-TRANS	Z-TRANS	X-ROTAN	Y-ROTAN	Z-ROTAN
	5	0.00038	-0.17736	0.63851	0.00548	-0.00085	-0.00231
	6	0.22358	-0.17735	0.45017	0.00387	-0.00060	-0.00231
55	1	0.08509	-0.24998	0.00028	0.00000	0.00001	-0.00325
	2	0.00084	-0.24998	0.17698	0.00130	-0.00017	-0.00325
	3	0.06032	-0.24998	0.12358	0.00091	-0.00012	-0.00325
	4	0.39957	-0.17764	0.52087	0.00069	-0.00595	-0.00231
	5	0.00056	-0.17765	0.80941	0.00585	-0.00085	-0.00231
	6	0.27984	-0.17765	0.57069	0.00413	-0.00060	-0.00231
56	1	0.10887	-0.03539	0.00047	0.00000	0.00001	-0.00041
	2	0.00136	-0.02724	0.22456	0.00139	-0.00002	-0.00050
	3	0.07727	-0.03311	0.15699	0.00097	-0.00002	-0.00043
	4	0.50981	-0.05933	0.10703	0.00069	-0.00001	0.00009
	5	0.00091	-0.02010	1.01573	0.00623	-0.00009	-0.00037
	6	0.35718	-0.04759	0.71630	0.00439	-0.00007	-0.00005
57	1	0.06809	-0.24965	-0.00034	0.00000	0.00000	-0.00325
	2	0.00081	-0.24959	0.13687	0.00119	-0.00013	-0.00325
	3	0.04831	-0.24963	0.09614	0.00084	-0.00009	-0.00325
	4	0.31938	-0.17752	-0.39166	0.00062	0.00599	-0.00231
	5	0.00055	-0.17736	0.62971	0.00540	-0.00069	-0.00231
	6	0.22368	-0.17747	0.44405	0.00381	-0.00049	-0.00231
58	1	0.08519	-0.25006	-0.00044	0.00000	0.00000	-0.00325
	2	0.00096	-0.25001	0.17407	0.00127	-0.00011	-0.00325
	3	0.06043	-0.25004	0.12232	0.00090	-0.00008	-0.00325
	4	0.39957	-0.17780	0.52012	0.00067	-0.00593	-0.00231
	5	0.00064	-0.17766	0.79792	0.00576	-0.00064	-0.00231
	6	0.27986	-0.17776	0.56266	0.00406	-0.00045	-0.00231
59	1	0.10855	-0.03139	-0.00083	0.00000	-0.00001	-0.00033
	2	0.00104	-0.02319	0.22340	0.00130	0.00002	-0.00042
	3	0.07696	-0.02904	0.15708	0.00096	0.00001	-0.00035
	4	0.50961	-0.05681	0.10511	0.00067	0.00004	0.00014
	5	0.00067	-0.01771	1.01294	0.00613	0.00002	-0.00032
	6	0.35696	-0.04511	0.71428	0.00432	0.00002	0.00000
60	1	0.06747	-0.24918	-0.00029	0.00000	0.00000	0.00325
	2	0.00027	-0.24928	0.12281	0.00105	0.00001	0.00325
	3	0.04771	-0.24921	0.08382	0.00073	0.00002	0.00325
	4	0.31859	-0.17680	-0.39671	0.00053	-0.00600	0.00230
	5	0.00014	-0.17713	0.57096	0.00482	0.00015	0.00230
	6	0.22300	-0.17690	0.40208	0.00340	0.00010	0.00230
61	1	0.08480	-0.24935	-0.00037	0.00000	-0.00001	0.00324
	2	0.00066	-0.24951	0.15562	0.00112	-0.00004	0.00325
	3	0.06006	-0.24940	0.10649	0.00078	-0.00002	0.00324
	4	0.39889	-0.17679	0.50367	0.00057	0.00578	0.00229
	5	0.00042	-0.17732	0.72112	0.00514	-0.00006	0.00230
	6	0.27932	-0.17695	0.50776	0.00362	-0.00005	0.00230
62	1	0.10943	-0.01444	-0.00037	0.00000	-0.00001	0.00054
	2	0.00184	-0.02229	0.19863	0.00113	-0.00027	0.00043

JOINT DISPLACEMENT (INCH RADIANS) STRUCTURE TYPE = SPACE

JOINT	LOAD	X-TRANS	Y-TRANS	Z-TRANS	X-ROTAN	Y-ROTAN	Z-ROTAN
	3	0.07781	-0.01668	0.13586	0.00083	-0.00018	0.00051
	4	0.51060	0.02041	0.08949	0.00057	-0.00017	0.00085
	5	0.00127	-0.01711	0.91124	0.00544	-0.00115	0.00033
	6	0.35783	0.00917	0.64211	0.00384	-0.00082	0.00069
63	1	0.06775	-0.24955	0.00034	0.00000	0.00000	0.00325
	2	0.00047	-0.24960	0.13697	0.00119	0.00013	0.00325
	3	0.04797	-0.24956	0.09474	0.00083	0.00008	0.00325
	4	0.31913	-0.17720	-0.38914	0.00062	-0.00596	0.00230
	5	0.00029	-0.17736	0.63010	0.00540	0.00069	0.00231
	6	0.22343	-0.17725	0.44410	0.00381	0.00049	0.00230
64	1	0.08502	-0.24997	0.00044	0.00000	0.00000	0.00325
	2	0.00078	-0.25002	0.17419	0.00128	0.00012	0.00325
	3	0.06025	-0.24999	0.12061	0.00089	0.00007	0.00325
	4	0.39945	-0.17753	0.51793	0.00067	0.00590	0.00230
	5	0.00051	-0.17766	0.79843	0.00576	0.00065	0.00231
	6	0.27974	-0.17757	0.56281	0.00406	0.00045	0.00231
65	1	0.10905	-0.01405	0.00083	0.00000	-0.00001	0.00052
	2	0.00154	-0.02214	0.22334	0.00129	-0.00001	0.00043
	3	0.07745	-0.01636	0.15475	0.00095	-0.00003	0.00050
	4	0.50998	0.02165	0.10512	0.00067	-0.00004	0.00080
	5	0.00103	-0.01701	1.01271	0.00611	-0.00001	0.00032
	6	0.35733	0.01007	0.71411	0.00431	-0.00001	0.00066
66	1	0.06799	-0.24960	-0.00022	0.00000	0.00001	0.00325
	2	0.00068	-0.24959	0.13909	0.00121	0.00017	0.00325
	3	0.04820	-0.24960	0.09742	0.00085	0.00011	0.00325
	4	0.31939	-0.17737	-0.38889	0.00064	-0.00595	0.00231
	5	0.00046	-0.17736	0.63846	0.00548	0.00085	0.00231
	6	0.22366	-0.17737	0.45015	0.00387	0.00060	0.00231
67	1	0.08515	-0.24999	-0.00028	0.00000	0.00001	0.00325
	2	0.00090	-0.24998	0.17697	0.00130	0.00017	0.00325
	3	0.06038	-0.24999	0.12399	0.00091	0.00011	0.00325
	4	0.39961	-0.17766	0.52103	0.00069	0.00595	0.00231
	5	0.00059	-0.17765	0.80934	0.00585	0.00085	0.00231
	6	0.27988	-0.17766	0.57066	0.00413	0.00060	0.00231
68	1	0.10872	-0.01814	-0.00047	0.00000	0.00001	0.00060
	2	0.00122	-0.02619	0.22437	0.00138	0.00002	0.00050
	3	0.07712	-0.02039	0.15747	0.00097	0.00001	0.00058
	4	0.50970	0.01939	0.10702	0.00069	0.00001	0.00084
	5	0.00080	-0.01940	1.01495	0.00620	0.00010	0.00037
	6	0.35706	0.00777	0.71575	0.00437	0.00007	0.00070
69	1	0.06815	-0.24964	-0.00011	0.00000	0.00000	0.00325
	2	0.00090	-0.24958	0.13344	0.00116	0.00021	0.00325
	3	0.04838	-0.24962	0.09382	0.00082	0.00014	0.00325
	4	0.31931	-0.17753	-0.39425	0.00060	-0.00594	0.00231
	5	0.00062	-0.17735	0.61615	0.00527	0.00101	0.00231
	6	0.22365	-0.17748	0.43447	0.00371	0.00071	0.00231

JOINT DISPLACEMENT (INCH RADIANS) STRUCTURE TYPE = SPACE

JOINT	LOAD	X-TRANS	Y-TRANS	Z-TRANS	X-ROTAN	Y-ROTAN	Z-ROTAN
70	1	0.08520	-0.25005	-0.00014	0.00000	0.00000	0.00325
	2	0.00099	-0.25000	0.16956	0.00124	0.00022	0.00325
	3	0.06044	-0.25003	0.11929	0.00087	0.00015	0.00325
	4	0.39947	-0.17781	0.51712	0.00065	0.00601	0.00231
	5	0.00067	-0.17765	0.78019	0.00562	0.00106	0.00231
	6	0.27980	-0.17776	0.55013	0.00396	0.00075	0.00231
71	1	0.10845	-0.01432	-0.00015	0.00000	-0.00001	0.00052
	2	0.00092	-0.02251	0.21683	0.00125	0.00013	0.00042
	3	0.07685	-0.01667	0.15274	0.00093	0.00009	0.00049
	4	0.50961	0.02182	0.10060	0.00065	0.00007	0.00079
	5	0.00057	-0.01728	0.98774	0.00595	0.00056	0.00032
	6	0.35693	0.01011	0.69644	0.00420	0.00039	0.00065
72	1	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
	2	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
	3	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
	4	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
	5	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
	6	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
73	1	0.06824	-0.00185	0.00091	0.00001	0.00000	-0.00057
	2	0.00113	-0.00180	0.08673	0.00082	0.00013	-0.00001
	3	0.04851	-0.00184	0.06131	0.00058	0.00009	-0.00040
	4	0.31881	-0.00172	0.03498	0.00039	0.00006	-0.00267
	5	0.00080	-0.00148	0.40571	0.00384	0.00058	0.00000
	6	0.22336	-0.00165	0.28596	0.00271	0.00041	-0.00187
74	1	0.08524	-0.00205	0.00118	0.00001	0.00000	-0.00055
	2	0.00127	-0.00199	0.11240	0.00088	0.00015	0.00000
	3	0.06056	-0.00203	0.07950	0.00062	0.00011	-0.00039
	4	0.39863	-0.00192	0.04748	0.00042	0.00007	-0.00261
	5	0.00088	-0.00164	0.52530	0.00409	0.00067	0.00000
	6	0.27928	-0.00184	0.37025	0.00288	0.00048	-0.00183
75	1	0.10814	-0.00222	0.00159	0.00001	0.00000	-0.00047
	2	0.00046	-0.00214	0.15225	0.00092	0.00019	0.00005
	3	0.07649	-0.00219	0.10778	0.00066	0.00013	-0.00032
	4	0.50996	-0.00211	0.06613	0.00043	0.00008	-0.00243
	5	0.00022	-0.00177	0.71075	0.00430	0.00082	0.00004
	6	0.35707	-0.00201	0.50096	0.00303	0.00058	-0.00169
76	1	0.13729	-0.00231	0.00216	0.00001	0.00000	-0.00049
	2	-0.00257	-0.00224	0.20896	0.00094	0.00019	0.00005
	3	0.09618	-0.00229	0.14807	0.00067	0.00013	-0.00033
	4	0.65966	-0.00219	0.09187	0.00043	0.00008	-0.00249
	5	-0.00217	-0.00185	0.97412	0.00438	0.00082	0.00004
	6	0.46127	-0.00209	0.68658	0.00309	0.00058	-0.00174
77	1	0.13788	-0.00959	0.00216	0.00021	0.00002	-0.00050
	2	0.00636	-0.05508	0.20896	0.00117	0.00019	0.00005
	3	0.10284	-0.04180	0.14808	0.00089	0.00014	-0.00034
	4	0.66659	-0.02761	0.09187	0.00057	0.00017	-0.00255

JOINT DISPLACEMENT (INCH RADIANS) STRUCTURE TYPE = SPACE

JOINT	LOAD	X-TRANS	Y-TRANS	Z-TRANS	X-ROTAN	Y-ROTAN	Z-ROTAN
	5	0.03717	-0.21988	0.97414	0.00464	0.00082	0.00004
	6	0.49115	-0.15724	0.68660	0.00331	0.00064	-0.00178
78	1	0.13806	-0.00869	0.00216	-0.00019	-0.00002	-0.00050
	2	-0.01151	0.03695	0.20896	0.00077	0.00019	0.00005
	3	0.09045	0.02356	0.14808	0.00049	0.00012	-0.00034
	4	0.65880	0.01324	0.09187	0.00028	-0.00001	-0.00255
	5	-0.04152	0.20624	0.97414	0.00435	0.00082	0.00004
	6	0.43565	0.14309	0.68660	0.00302	0.00052	-0.00178
79	1	0.06821	-0.24936	0.00029	0.00000	0.00000	-0.00325
	2	0.00101	-0.24927	0.12232	0.00105	0.00000	-0.00325
	3	0.04845	-0.24933	0.08613	0.00074	0.00000	-0.00325
	4	0.31915	-0.17745	-0.40077	0.00053	0.00606	-0.00231
	5	0.00070	-0.17712	0.56892	0.00480	-0.00014	-0.00230
	6	0.22357	-0.17735	0.40120	0.00339	-0.00010	-0.00231
80	1	0.08522	-0.24965	0.00037	0.00000	-0.00001	-0.00325
	2	0.00109	-0.24950	0.15497	0.00112	0.00005	-0.00325
	3	0.06048	-0.24961	0.10921	0.00079	0.00003	-0.00325
	4	0.39921	-0.17785	0.51088	0.00057	-0.00588	-0.00231
	5	0.00074	-0.17732	0.71846	0.00512	0.00008	-0.00230
	6	0.27964	-0.17769	0.50676	0.00361	0.00005	-0.00231
81	1	0.10832	-0.03131	0.00037	0.00000	-0.00001	-0.00033
	2	0.00074	-0.02335	0.19801	0.00113	0.00028	-0.00043
	3	0.07670	-0.02903	0.13969	0.00085	0.00020	-0.00035
	4	0.50973	-0.05577	0.08950	0.00057	0.00017	0.00018
	5	0.00043	-0.01782	0.90867	0.00545	0.00118	-0.00033
	6	0.35698	-0.04441	0.64061	0.00384	0.00084	0.00003
82	1	0.06823	-0.32099	0.00048	0.00000	0.00000	0.00001
	2	0.00104	-0.32086	0.11902	0.00098	0.00017	0.00001
	3	0.04848	-0.32095	0.08386	0.00069	0.00011	0.00001
	4	0.31909	-0.22834	-0.53487	0.00049	0.00008	0.00000
	5	0.00073	-0.22787	0.55746	0.00451	0.00071	0.00000
	6	0.22353	-0.22820	0.39315	0.00318	0.00050	0.00000
83	1	0.08523	-0.32126	0.00062	0.00000	-0.00001	0.00001
	2	0.00114	-0.32105	0.14955	0.00105	0.00022	0.00001
	3	0.06051	-0.32120	0.10545	0.00074	0.00015	0.00001
	4	0.39907	-0.22878	0.63738	0.00053	0.00011	0.00000
	5	0.00078	-0.22803	0.69786	0.00481	0.00093	0.00000
	6	0.27955	-0.22855	0.49229	0.00339	0.00066	0.00000
84	1	0.10827	-0.03270	0.00084	0.00000	-0.00001	0.00025
	2	0.00065	-0.03327	0.18417	0.00103	0.00037	0.00001
	3	0.07664	-0.03287	0.13001	0.00079	0.00026	0.00018
	4	0.50984	-0.02269	0.08149	0.00053	0.00020	0.00117
	5	0.00037	-0.02543	0.84982	0.00510	0.00157	0.00001
	6	0.35703	-0.02352	0.59907	0.00359	0.00111	0.00082
85	1	0.06824	-0.24888	0.00066	0.00001	0.00000	0.00326
	2	0.00108	-0.24876	0.10843	0.00091	0.00033	0.00326

JOINT DISPLACEMENT (INCH RADIANS) STRUCTURE TYPE = SPACE

JOINT	LOAD	X-TRANS	Y-TRANS	Z-TRANS	X-ROTAN	Y-ROTAN	Z-ROTAN
	3	0.04849	-0.24884	0.07647	0.00065	0.00023	0.00326
	4	0.31898	-0.17721	-0.40754	0.00044	-0.00590	0.00231
	5	0.00076	-0.17676	0.50899	0.00422	0.00156	0.00231
	6	0.22347	-0.17707	0.35893	0.00297	0.00110	0.00231
86	1	0.08524	-0.24912	0.00086	0.00001	-0.00001	0.00326
	2	0.00119	-0.24893	0.13683	0.00097	0.00038	0.00326
	3	0.06053	-0.24906	0.09657	0.00069	0.00027	0.00326
	4	0.39890	-0.17759	0.50165	0.00048	0.00611	0.00232
	5	0.00082	-0.17691	0.64028	0.00449	0.00178	0.00231
	6	0.27945	-0.17739	0.45160	0.00317	0.00126	0.00231
87	1	0.10822	-0.01378	0.00131	0.00001	-0.00001	0.00053
	2	0.00057	-0.02269	0.16837	0.00097	0.00037	0.00043
	3	0.07658	-0.01634	0.11899	0.00073	0.00026	0.00050
	4	0.50991	0.02505	0.07345	0.00048	0.00018	0.00079
	5	0.00030	-0.01746	0.78147	0.00475	0.00160	0.00033
	6	0.35706	0.01232	0.55084	0.00335	0.00113	0.00065

********** END OF LATEST ANALYSIS RESULT **********

207. PRINT MEMBER FORCES ALL

MEMBER END FORCES STRUCTURE TYPE = SPACE

ALL UNITS ARE -- POUN FEET (LOCAL)

MEMBER	LOAD	JT	AXIAL	SHEAR-Y	SHEAR-Z	TORSION	MOM-Y	MOM-Z
1	1	1	5252.87	435.93	3.29	3.79	-66.84	5740.31
		2	-4064.29	-326.56	-3.29	-3.79	18.50	-154.50
	2	1	5397.16	-13.35	-379.66	387.25	6632.76	-55.43
		2	-4208.59	13.35	270.29	-387.25	-1858.55	-139.14
	3	1	5300.89	303.77	-263.06	248.19	4608.50	4035.93
		2	-4112.32	-226.48	185.77	-248.19	-1311.87	-150.93
	4	1	3899.12	2150.80	-21.41	170.02	2072.50	27519.72
		2	-2710.55	-1595.18	21.41	-170.02	-1750.64	-118.31
	5	1	4542.93	-10.10	-1822.52	1706.77	31156.76	-45.59
		2	-3354.36	10.10	1266.91	-1706.77	-8495.16	-101.73
	6	1	4091.70	1502.15	-1284.90	1207.23	21933.88	19242.48
		2	-2903.13	-1109.87	892.62	-1207.23	-5972.36	-132.01
2	1	2	2944.67	102.96	3.29	3.79	-18.50	154.50
		3	-2740.91	-84.21	-3.29	-3.79	10.21	83.53
	2	2	3089.06	-129.53	-246.27	387.25	1858.40	139.14
		3	-2885.30	129.53	227.52	-387.25	-1259.70	-462.89
	3	2	2992.72	34.07	-168.95	248.19	1311.77	150.93
		3	-2788.96	-20.82	155.70	-248.19	-901.59	-79.37
	4	2	1902.69	992.95	-649.20	170.02	1750.54	118.31
		3	-1698.93	-897.70	649.20	-170.02	-125.68	2257.01
	5	2	2546.83	-99.56	-1145.25	1706.77	8494.53	101.73
		3	-2343.07	99.56	1050.00	-1706.77	-5725.83	-350.59
	6	2	2095.37	665.26	-806.80	1207.23	5971.92	132.01
		3	-1891.61	-598.01	739.55	-1207.23	-4024.85	1456.38
3	1	3	1621.28	-242.49	3.29	3.79	-10.21	-83.53
		4	-1322.41	270.00	-3.29	-3.79	-1.91	-853.01
	2	3	1765.77	-293.41	-203.48	387.25	1259.54	462.89
		4	-1466.89	293.41	175.98	-387.25	-558.36	-1538.60
	3	3	1669.36	-257.83	-138.87	248.19	901.48	79.37
		4	-1370.48	277.26	119.43	-248.19	-424.32	-1058.14
	4	3	891.07	3.61	-21.30	170.02	125.58	-2257.01
		4	-592.20	136.10	21.30	-170.02	-46.33	2021.08
	5	3	1535.54	-226.25	-928.29	1706.77	5725.15	350.59
		4	-1236.66	226.25	788.57	-1706.77	-2555.63	-1180.10
	6	3	1083.86	-62.44	-653.54	1207.23	4024.37	-1456.38
		4	-784.98	161.08	554.89	-1207.23	-1798.44	1052.75
4	1	4	948.48	95.21	0.00	0.00	-0.04	423.00
		5	-537.54	-57.40	0.00	0.00	0.00	-36.00
	2	4	948.48	0.00	-97.82	0.00	521.38	0.26
		5	-537.54	0.00	60.00	0.00	-119.98	0.00

MEMBER END FORCES STRUCTURE TYPE = SPACE

ALL UNITS ARE -- POUN FEET (LOCAL)

MEMBER	LOAD	JT	AXIAL	SHEAR-Y	SHEAR-Z	TORSION	MOM-Y	MOM-Z
	3	4	948.48	66.32	-68.72	0.00	365.60	292.70
		5	-537.54	-39.60	42.00	0.00	-83.98	-24.00
	4	4	828.48	455.90	0.00	0.00	1.34	1969.43
		5	-417.54	-263.80	0.00	0.00	0.00	-147.00
	5	4	828.48	0.00	-432.10	0.00	2188.12	0.17
		5	-417.54	0.00	240.00	0.00	-479.93	0.00
	6	4	828.48	321.63	-303.63	0.02	1537.66	1390.44
		5	-417.54	-186.00	168.00	-0.02	-338.95	-105.00
5	1	6	0.00	-108.00	-9.00	-12.00	0.00	0.00
		5	0.00	214.77	24.20	12.00	66.40	-645.54
	2	6	20.00	-108.00	0.00	0.00	0.00	-40.00
		5	-20.00	214.77	0.00	0.00	0.01	-605.47
	3	6	14.00	-108.00	-6.00	-8.00	0.00	-28.00
		5	-14.00	214.77	16.80	8.00	45.61	-617.51
	4	6	0.00	-68.00	-37.00	-49.00	0.00	0.00
		5	0.00	174.77	113.40	49.00	300.80	-485.54
	5	6	80.00	-68.00	0.00	0.00	0.00	-160.00
		5	-80.00	174.77	0.00	0.00	0.26	-324.14
	6	6	56.00	-68.00	-26.00	-35.00	0.00	-113.00
		5	-56.00	174.77	80.00	35.00	212.14	-371.86
6	1	5	0.00	214.77	24.20	12.00	-66.40	645.54
		7	0.00	-108.00	-9.00	-12.00	0.00	0.00
	2	5	-20.00	214.77	0.00	0.00	-0.01	685.45
		7	20.00	-108.00	0.00	0.00	0.00	-40.00
	3	5	-14.00	214.77	16.80	8.00	-45.61	673.49
		7	14.00	-108.00	-6.00	-8.00	0.00	-28.00
	4	5	0.00	174.77	113.40	49.00	-300.80	485.54
		7	0.00	-68.00	-37.00	-49.00	0.00	0.00
	5	5	-80.00	174.77	0.00	0.00	-0.26	644.07
		7	80.00	-68.00	0.00	0.00	0.00	-160.00
	6	5	-56.00	174.77	80.00	35.00	-212.12	597.81
		7	56.00	-68.00	-26.00	-35.00	0.00	-113.00
7	1	8	8464.78	431.37	0.11	4.43	-3.01	5738.14
		9	-7276.21	-321.99	-0.11	-4.43	1.42	-200.72
	2	8	8460.60	-14.19	-474.30	273.97	8832.56	-49.65
		9	-7272.03	14.19	364.92	-273.97	-2635.57	-157.07
	3	8	8463.49	300.35	-258.98	190.99	5764.44	4036.28
		9	-7274.92	-223.06	258.98	-190.99	-1935.10	-188.45
	4	8	6769.04	2133.70	19.79	162.46	2732.05	27490.32
		9	-5580.46	-1578.09	-19.79	-162.46	-2994.83	-261.76
	5	8	6749.75	-10.79	-2250.19	1150.22	40745.42	-41.33
		9	-5561.18	10.79	1694.58	-1150.22	-11703.19	-115.95

MEMBER END FORCES STRUCTURE TYPE = SPACE

ALL UNITS ARE -- POUN FEET (LOCAL)

MEMBER	LOAD	JT	AXIAL	SHEAR-Y	SHEAR-Z	TORSION	MOM-Y	MOM-Z
	6	8	6763.30	1490.19	-1586.00	815.52	28719.17	19223.34
		9	-5574.72	-1097.91	1193.71	-815.52	-8253.86	-237.47
8	1	9	5037.15	259.83	0.11	4.43	-1.42	200.72
		10	-4833.39	-241.08	-0.11	-4.43	1.15	432.56
	2	9	5032.97	-37.03	-316.94	273.97	2635.68	157.07
		10	-4829.21	37.03	298.19	-273.97	-1852.19	-249.46
	3	9	5035.86	171.32	-225.39	190.99	1935.17	188.45
		10	-4832.10	-158.07	212.14	-190.99	-1378.20	228.37
	4	9	3965.40	1365.29	-1234.24	162.46	2994.90	261.76
		10	-3761.64	-1270.04	1234.24	-162.46	96.77	3058.29
	5	9	3946.12	-27.52	-1451.42	1150.22	11703.67	115.95
		10	-3742.36	27.52	1356.17	-1150.22	-8142.40	-184.66
	6	9	3959.66	948.03	-1022.65	815.52	8254.21	237.47
		10	-3755.90	-880.78	955.40	-815.52	-5745.02	2066.67
9	1	10	2594.33	375.52	0.11	4.43	-1.15	-432.56
		11	-2295.45	-348.01	-0.11	-4.43	0.76	1764.11
	2	10	2590.14	76.05	-250.22	273.97	1852.31	249.46
		11	-2291.27	-76.05	222.72	-273.97	-973.92	29.62
	3	10	2593.04	285.03	-178.57	190.99	1378.28	-228.37
		11	-2294.16	-265.59	159.13	-190.99	-751.29	1241.50
	4	10	2146.58	1444.97	19.69	162.46	-96.70	-3058.29
		11	-1847.71	-1305.26	-19.69	-162.46	29.10	8119.33
	5	10	2127.30	57.60	-1113.08	1150.22	8142.92	184.66
		11	-1828.42	-57.60	973.37	-1150.22	-4275.93	26.67
	6	10	2140.84	1033.18	-784.53	815.52	5745.39	-2066.67
		11	-1841.97	-934.54	685.88	-815.52	-3019.94	5687.43
10	1	11	1266.48	95.21	0.00	0.00	0.00	423.56
		12	-855.54	-57.40	0.00	0.00	0.00	-36.00
	2	11	1266.48	0.00	-175.82	0.00	1119.09	0.13
		12	-855.54	0.00	138.00	0.00	-320.91	0.00
	3	11	1266.48	66.32	-122.72	0.00	781.24	293.06
		12	-855.54	-39.60	96.00	0.00	-224.94	-24.00
	4	11	1017.48	455.90	0.00	0.00	2.57	1971.17
		12	-606.54	-263.80	0.00	0.00	0.00	-147.00
	5	11	1017.48	0.00	-732.10	0.00	4485.18	0.07
		12	-606.54	0.00	540.00	0.00	-1253.76	0.00
	6	11	1017.48	321.63	-516.63	0.05	3168.00	1391.62
		12	-606.54	-186.00	381.00	-0.05	-887.83	-105.00
11	1	13	0.00	-214.00	-9.00	-12.00	0.00	0.00
		12	0.00	320.77	24.20	12.00	66.40	-1069.54
	2	13	46.00	-214.00	0.00	0.00	0.00	-107.00
		12	-46.00	320.77	0.00	0.00	0.02	-962.33

MEMBER END FORCES STRUCTURE TYPE = SPACE

ALL UNITS ARE -- POUN FEET (LOCAL)

MEMBER	LOAD	JT	AXIAL	SHEAR-Y	SHEAR-Z	TORSION	MOM-Y	MOM-Z	
	3	13	32.00	-214.00	-6.00	-8.00	0.00	-75.00	
		12	-32.00	320.77	16.80	8.00	45.61	-994.45	
	4	13	0.00	-131.00	-37.00	-49.00	0.00	0.00	
		12	0.00	237.77	113.40	49.00	300.80	-737.54	
	5	13	180.00	-131.00	0.00	0.00	0.00	-418.00	
		12	-180.00	237.77	0.00	0.00	0.40	-315.20	
	6	13	127.00	-131.00	-26.00	-35.00	0.00	-296.00	
		12	-127.00	237.77	80.00	35.00	212.22	-439.41	
12	1	12	0.00	320.77	24.20	12.00	-66.40	1069.54	
		14	0.00	-214.00	-9.00	-12.00	0.00	0.00	
	2	12	-46.00	320.77	0.00	0.00	-0.02	1176.24	
		14	46.00	-214.00	0.00	0.00	0.00	-107.00	
	3	12	-32.00	320.77	16.80	8.00	-45.61	1144.39	
		14	32.00	-214.00	-6.00	-8.00	0.00	-75.00	
	4	12	0.00	237.77	113.40	49.00	-300.80	737.54	
		14	0.00	-131.00	-37.00	-49.00	0.00	0.00	
	5	12	-180.00	237.77	0.00	0.00	-0.40	1150.97	
		14	180.00	-131.00	0.00	0.00	0.00	-418.00	
	6	12	-127.00	237.77	80.00	35.00	-212.18	1031.24	
		14	127.00	-131.00	-26.00	-35.00	0.00	-296.00	
13	1	15	8530.88	442.92	-1.92	-7.03	36.98	5808.96	
		16	-7342.30	-333.55	1.92	7.03	-8.63	-102.49	
	2	15	8538.50	-4.15	-495.10	14.15	9360.91	9.83	
		16	-7349.93	4.15	385.73	-14.15	-2854.67	-70.08	
	3	15	8538.74	311.49	-343.50	30.62	6510.30	4103.85	
		16	-7350.16	-234.20	266.21	-30.62	-2006.41	-93.21	
	4	15	6796.11	2148.84	1.62	26.96	3131.37	27590.22	
		16	-5607.54	-1593.22	-1.62	-26.96	-3126.30	-140.02	
	5	15	6794.61	-3.33	-2343.01	26.97	42881.34	3.12	
		16	-5606.03	3.33	1787.40	-26.97	-12468.02	-51.55	
	6	15	6795.67	1502.99	-1652.10	19.97	30237.40	19306.42	Max Moment for B.P. Design (45 Deg.)
		16	-5607.10	-1110.71	1259.81	-19.97	-8796.12	-133.09	
14	1	16	5103.24	305.75	-1.92	-7.03	8.64	102.49	
		17	-4899.48	-287.00	1.92	7.03	-3.78	645.62	
	2	16	5110.87	-13.56	-337.74	14.15	2854.70	70.08	
		17	-4907.11	13.56	318.99	-14.15	-2017.99	-103.86	
	3	16	5111.10	209.84	-232.61	30.62	2006.44	93.21	
		17	-4907.34	-196.59	219.36	-30.62	-1430.45	419.93	
	4	16	3992.47	1486.41	-1252.39	26.96	3126.33	140.02	
		17	-3788.71	-1391.16	1252.39	-26.96	11.30	3482.98	
	5	16	3990.97	-8.27	-1544.21	26.97	12468.16	51.55	
		17	-3787.21	8.27	1448.96	-26.97	-8671.32	-72.15	

MEMBER END FORCES STRUCTURE TYPE = SPACE

ALL UNITS ARE -- POUN FEET (LOCAL)

MEMBER	LOAD	JT	AXIAL	SHEAR-Y	SHEAR-Z	TORSION	MOM-Y	MOM-Z	
	6	16	3992.04	1038.61	-1088.64	19.97	8796.22	133.09	
		17	-3788.28	-971.36	1021.39	-19.97	-6119.62	2397.62	
15	1	17	2660.42	227.19	-1.92	-7.03	3.78	-645.62	
		18	-2361.54	-199.69	1.92	7.03	3.31	1433.30	
	2	17	2668.05	-50.23	-270.99	14.15	2018.03	103.86	
		18	-2369.17	50.23	243.49	-14.15	-1062.32	-287.94	
	3	17	2668.28	141.07	-185.77	30.62	1430.47	-419.93	
		18	-2369.40	-121.64	166.33	-30.62	-776.23	905.20	
	4	17	2173.65	1241.90	1.61	26.96	-11.28	-3482.98	
		18	-1874.77	-1102.19	-1.61	-26.96	10.51	7799.47	
	5	17	2172.15	-26.31	-1205.77	26.97	8671.47	72.15	
		18	-1873.27	26.31	1066.06	-26.97	-4461.21	-168.55	
	6	17	2173.21	865.75	-850.22	19.97	6119.73	-2397.62	
		18	-1874.34	-767.11	751.57	-19.97	-3151.19	5404.51	
16	1	18	1266.48	95.21	0.00	0.00	0.03	423.53	
		19	-855.54	-57.40	0.00	0.00	0.00	-36.00	
	2	18	1266.48	0.00	-175.82	0.00	1119.57	0.11	
		19	-855.54	0.00	138.00	0.00	-320.91	0.00	
	3	18	1266.48	66.32	-122.72	0.00	781.60	293.04	
		19	-855.54	-39.60	96.00	0.00	-224.94	-24.00	
	4	18	1017.48	455.90	0.00	0.00	2.82	1971.11	
		19	-606.54	-263.80	0.00	0.00	0.00	-147.00	
	5	18	1017.48	0.00	-732.10	0.00	4486.56	0.06	
		19	-606.54	0.00	540.00	0.00	-1253.77	0.00	Max Moment for T.P. Design
	6	18	1017.48	321.63	-516.63	0.05	3168.97	1391.58	
		19	-606.54	-186.00	381.00	-0.05	-887.83	-105.00	
17	1	20	0.00	-214.00	-9.00	-12.00	0.00	0.00	
		19	0.00	320.77	24.20	12.00	66.40	-1069.54	
	2	20	46.00	-214.00	0.00	0.00	0.00	-107.00	
		19	-46.00	320.77	0.00	0.00	0.00	-962.32	
	3	20	32.00	-214.00	-6.00	-8.00	0.00	-75.00	
		19	-32.00	320.77	16.80	8.00	45.60	-994.44	
	4	20	0.00	-131.00	-37.00	-49.00	0.00	0.00	
		19	0.00	237.77	113.40	49.00	300.80	-737.54	
	5	20	180.00	-131.00	0.00	0.00	0.00	-418.00	
		19	-180.00	237.77	0.00	0.00	0.01	-314.96	
	6	20	127.00	-131.00	-26.00	-35.00	0.00	-296.00	
		19	-127.00	237.77	80.00	35.00	212.03	-439.29	
18	1	19	0.00	320.77	24.20	12.00	-66.40	1069.54	
		21	0.00	-214.00	-9.00	-12.00	0.00	0.00	
	2	19	-46.00	320.77	0.00	0.00	0.00	1176.23	
		21	46.00	-214.00	0.00	0.00	0.00	-107.00	

MEMBER END FORCES STRUCTURE TYPE = SPACE

ALL UNITS ARE -- POUN FEET (LOCAL)

MEMBER	LOAD	JT	AXIAL	SHEAR-Y	SHEAR-Z	TORSION	MOM-Y	MOM-Z	
	3	19	-32.00	320.77	16.80	8.00	-45.60	1144.38	
		21	32.00	-214.00	-6.00	-8.00	0.00	-75.00	
	4	19	0.00	237.77	113.40	49.00	-300.80	737.54	
		21	0.00	-131.00	-37.00	-49.00	0.00	0.00	
	5	19	-180.00	237.77	0.00	0.00	-0.01	1150.72	
		21	180.00	-131.00	0.00	0.00	0.00	-418.00	
	6	19	-127.00	237.77	80.00	35.00	-211.98	1031.12	
		21	127.00	-131.00	-26.00	-35.00	0.00	-296.00	
19	1	22	8546.16	451.25	1.92	-7.03	-36.97	5861.16	
		23	-7357.59	-341.88	-1.92	7.03	8.63	-32.97	
	2	22	8538.52	4.14	-495.03	-7.12	9358.98	61.84	
		23	-7349.95	-4.14	385.66	7.12	-2853.79	-0.97	
	3	22	8538.30	319.81	-346.09	-1.23	6563.58	4155.99	
		23	-7349.72	-242.52	268.80	1.23	-2021.33	-23.83	
	4	22	6793.05	2155.66	1.62	-27.03	3131.24	27632.10	
		23	-5604.47	-1600.05	-1.62	27.03	-3126.18	-82.39	
	5	22	6794.62	3.33	-2342.72	1.93	42873.49	44.17	Max Moment for B.P. Design (x/z - Dir.)
		23	-5606.04	-3.33	1787.11	-1.93	-12464.46	4.58	
	6	22	6793.53	1509.77	-1651.92	0.52	30232.14	19348.08	
		23	-5604.96	-1117.49	1259.64	-0.52	-8793.54	-75.86	
20	1	23	5118.53	331.35	1.92	-7.03	-8.64	32.97	
		24	-4914.77	-312.60	-1.92	7.03	3.77	779.13	
	2	23	5110.88	12.07	-337.67	-7.12	2853.83	0.97	
		24	-4907.12	-12.07	318.92	7.12	-2017.30	29.29	
	3	23	5110.66	235.46	-235.21	-1.23	2021.36	23.83	
		24	-4906.90	-222.21	221.96	1.23	-1438.79	553.32	
	4	23	3989.41	1502.06	-1252.38	-27.03	3126.20	82.39	
		24	-3785.65	-1406.81	1252.38	27.03	11.40	3579.67	
	5	23	3990.98	7.28	-1543.92	1.93	12464.60	-4.58	
		24	-3787.22	-7.28	1448.67	-1.93	-8668.50	22.82	
	6	23	3989.90	1054.18	-1088.43	0.52	8793.64	75.86	
		24	-3786.14	-986.93	1021.18	-0.52	-6117.59	2493.74	
21	1	24	2675.70	324.92	1.92	-7.03	-3.78	-779.13	
		25	-2376.83	-297.42	-1.92	7.03	-3.31	1925.12	
	2	24	2668.06	47.64	-270.92	-7.12	2017.34	-29.29	
		25	-2369.19	-47.64	243.42	7.12	-1061.89	204.01	
	3	24	2667.84	238.85	-188.36	-1.23	1438.82	-553.32	
		25	-2368.96	-219.42	168.92	1.23	-775.00	1397.05	
	4	24	2170.59	1292.39	1.63	-27.03	-11.37	-3579.67	
		25	-1871.71	-1152.67	-1.63	27.03	10.49	8081.20	
	5	24	2172.16	24.59	-1205.48	1.93	8668.65	-22.82	
		25	-1873.28	-24.59	1065.77	-1.93	-4459.46	113.01	

MEMBER END FORCES STRUCTURE TYPE = SPACE

ALL UNITS ARE -- POUN FEET (LOCAL)

MEMBER	LOAD	JT	AXIAL	SHEAR-Y	SHEAR-Z	TORSION	MOM-Y	MOM-Z
	6	24	2171.08	916.32	-849.97	0.52	6117.70	-2493.74
		25	-1872.20	-817.68	751.32	-0.52	-3150.12	5686.00
22	1	25	1266.48	95.21	0.00	0.00	-0.03	423.42
		26	-855.54	-57.40	0.00	0.00	0.00	-36.00
	2	25	1266.48	0.00	-175.82	0.00	1119.57	0.00
		26	-855.54	0.00	138.00	0.00	-320.91	0.00
	3	25	1266.48	66.32	-122.72	0.00	781.64	292.92
		26	-855.54	-39.60	96.00	0.00	-224.94	-24.00
	4	25	1017.48	455.90	0.00	0.00	2.82	1971.05
		26	-606.54	-263.80	0.00	0.00	0.00	-147.00
	5	25	1017.48	0.00	-732.10	0.00	4486.55	0.00
		26	-606.54	0.00	540.00	0.00	-1253.77	0.00
	6	25	1017.48	321.63	-516.63	0.05	3168.97	1391.52
		26	-606.54	-186.00	381.00	-0.05	-887.83	-105.00
23	1	27	0.00	-214.00	-9.00	-12.00	0.00	0.00
		26	0.00	320.77	24.20	12.00	66.40	-1069.54
	2	27	46.00	-214.00	0.00	0.00	0.00	-107.00
		26	-46.00	320.77	0.00	0.00	0.00	-962.32
	3	27	32.00	-214.00	-6.00	-8.00	0.00	-75.00
		26	-32.00	320.77	16.80	8.00	45.60	-994.44
	4	27	0.00	-131.00	-37.00	-49.00	0.00	0.00
		26	0.00	237.77	113.40	49.00	300.80	-737.54
	5	27	180.00	-131.00	0.00	0.00	0.00	-418.00
		26	-180.00	237.77	0.00	0.00	0.00	-314.96
	6	27	127.00	-131.00	-26.00	-35.00	0.00	-296.00
		26	-127.00	237.77	80.00	35.00	212.02	-439.29
24	1	26	0.00	320.77	24.20	12.00	-66.40	1069.54
		28	0.00	-214.00	-9.00	-12.00	0.00	0.00
	2	26	-46.00	320.77	0.00	0.00	0.00	1176.23
		28	46.00	-214.00	0.00	0.00	0.00	-107.00
	3	26	-32.00	320.77	16.80	8.00	-45.60	1144.38
		28	32.00	-214.00	-6.00	-8.00	0.00	-75.00
	4	26	0.00	237.77	113.40	49.00	-300.80	737.54
		28	0.00	-131.00	-37.00	-49.00	0.00	0.00
	5	26	-180.00	237.77	0.00	0.00	0.00	1150.73
		28	180.00	-131.00	0.00	0.00	0.00	-418.00
	6	26	-127.00	237.77	80.00	35.00	-211.98	1031.12
		28	127.00	-131.00	-26.00	-35.00	0.00	-296.00
25	1	29	8456.59	459.92	-0.11	4.43	3.02	5910.18
		30	-7268.02	-350.55	0.11	-4.43	-1.43	44.02
	2	29	8460.75	14.24	-473.46	-272.81	8813.57	121.74
		30	-7272.18	-14.24	364.09	272.81	-2628.95	86.50

MEMBER END FORCES STRUCTURE TYPE = SPACE

ALL UNITS ARE -- POUN FEET (LOCAL)

MEMBER	LOAD	JT	AXIAL	SHEAR-Y	SHEAR-Z	TORSION	MOM-Y	MOM-Z
	3	29	8457.88	328.87	-329.56	-189.18	6185.80	4208.11
		30	-7269.30	-251.58	252.27	189.18	-1888.75	55.90
	4	29	6730.37	2155.84	19.73	-162.16	2732.27	27623.01
		30	-5541.80	-1600.23	-19.73	162.16	-2994.43	-72.42
	5	29	6749.85	10.82	-2246.76	-1145.39	40667.68	88.89
		30	-5561.28	-10.82	1691.14	1145.39	-11676.10	69.30
	6	29	6736.25	1512.18	-1584.12	-808.88	28671.85	19355.35
		30	-5547.68	-1119.90	1191.83	808.88	-8235.16	-49.14
26	1	30	5028.96	333.38	-0.11	4.43	1.43	-44.02
		31	-4825.19	-314.63	0.11	-4.43	-1.16	861.02
	2	30	5033.11	36.44	-316.10	-272.81	2629.06	-86.50
		31	-4829.35	-36.44	297.35	272.81	-1847.70	177.64
	3	30	5030.24	244.84	-218.67	-189.18	1888.83	-55.90
		31	-4826.48	-231.59	205.42	189.18	-1348.44	656.37
	4	30	3926.73	1420.91	-1234.25	-162.16	2994.50	72.42
		31	-3722.97	-1325.66	1234.25	162.16	97.15	3386.35
	5	30	3946.22	27.14	-1447.99	-1145.39	11676.60	-69.30
		31	-3742.46	-27.14	1352.74	1145.39	-8124.01	137.15
	6	30	3932.61	1003.21	-1020.56	-808.88	8235.51	49.14
		31	-3728.85	-935.96	953.31	808.88	-5731.86	2392.73
27	1	31	2586.13	219.33	-0.11	4.43	1.15	-861.02
		32	-2287.26	-191.83	0.11	-4.43	-0.76	1619.60
	2	31	2590.29	-79.66	-249.38	-272.81	1847.82	-177.64
		32	-2291.42	79.66	221.88	272.81	-972.53	-114.50
	3	31	2587.42	128.99	-171.83	-189.18	1348.53	-656.37
		32	-2288.54	-109.56	152.40	189.18	-746.10	1097.08
	4	31	2107.91	1326.50	19.80	-162.16	-97.07	-3386.35
		32	-1809.03	-1186.79	-19.80	162.16	28.99	8012.45
	5	31	2127.39	-59.98	-1109.65	-1145.39	8124.54	-137.15
		32	-1828.52	59.98	969.94	1145.39	-4270.21	-82.83
	6	31	2113.79	914.69	-781.93	-808.88	5732.24	-2392.73
		32	-1814.91	-816.05	683.29	808.88	-3016.76	5578.67
28	1	32	1266.48	95.21	0.00	0.00	0.00	423.42
		33	-855.54	-57.40	0.00	0.00	0.00	-36.00
	2	32	1266.48	0.00	-175.82	0.00	1119.08	-0.01
		33	-855.54	0.00	138.00	0.00	-320.91	0.00
	3	32	1266.48	66.32	-122.72	0.00	781.33	292.92
		33	-855.54	-39.60	96.00	0.00	-224.94	-24.00
	4	32	1017.48	455.90	0.00	0.00	2.57	1971.08
		33	-606.54	-263.80	0.00	0.00	0.00	-147.00
	5	32	1017.48	0.00	-732.10	0.00	4485.13	-0.01
		33	-606.54	0.00	540.00	0.00	-1253.76	0.00

MEMBER END FORCES STRUCTURE TYPE = SPACE

ALL UNITS ARE -- POUN FEET (LOCAL)

MEMBER	LOAD	JT	AXIAL	SHEAR-Y	SHEAR-Z	TORSION	MOM-Y	MOM-Z
	6	32	1017.48	321.63	-516.63	0.05	3167.97	1391.54
		33	-606.54	-186.00	381.00	-0.05	-887.83	-105.00
29	1	34	0.00	-214.00	-9.00	-12.00	0.00	0.00
		33	0.00	320.77	24.20	12.00	66.40	-1069.54
	2	34	46.00	-214.00	0.00	0.00	0.00	-107.00
		33	-46.00	320.77	0.00	0.00	-0.02	-962.33
	3	34	32.00	-214.00	-6.00	-8.00	0.00	-75.00
		33	-32.00	320.77	16.80	8.00	45.59	-994.45
	4	34	0.00	-131.00	-37.00	-49.00	0.00	0.00
		33	0.00	237.77	113.40	49.00	300.80	-737.54
	5	34	180.00	-131.00	0.00	0.00	0.00	-418.00
		33	-180.00	237.77	0.00	0.00	-0.39	-315.21
	6	34	127.00	-131.00	-26.00	-35.00	0.00	-296.00
		33	-127.00	237.77	80.00	35.00	211.83	-439.41
30	1	33	0.00	320.77	24.20	12.00	-66.40	1069.54
		35	0.00	-214.00	-9.00	-12.00	0.00	0.00
	2	33	-46.00	320.77	0.00	0.00	0.02	1176.24
		35	46.00	-214.00	0.00	0.00	0.00	-107.00
	3	33	-32.00	320.77	16.80	8.00	-45.59	1144.39
		35	32.00	-214.00	-6.00	-8.00	0.00	-75.00
	4	33	0.00	237.77	113.40	49.00	-300.80	737.54
		35	0.00	-131.00	-37.00	-49.00	0.00	0.00
	5	33	-180.00	237.77	0.00	0.00	0.39	1150.97
		35	180.00	-131.00	0.00	0.00	0.00	-418.00
	6	33	-127.00	237.77	80.00	35.00	-211.78	1031.24
		35	127.00	-131.00	-26.00	-35.00	0.00	-296.00
31	1	2	-223.60	1118.60	0.00	0.00	0.00	0.00
		48	223.60	-1017.05	0.00	0.00	0.00	4805.23
	2	2	-116.19	1119.00	-23.97	-0.15	0.00	0.00
		48	116.19	-1017.45	10.47	0.15	77.50	4807.02
	3	2	-192.42	1118.72	-16.77	-0.10	0.00	0.00
		48	192.42	-1017.17	7.32	0.10	54.19	4805.76
	4	2	-602.23	805.90	622.90	-0.09	0.00	0.00
		48	602.23	-704.36	-622.90	0.09	-2803.04	3398.09
	5	2	-89.46	807.24	-121.49	-0.63	0.00	0.00
		48	89.46	-705.69	53.09	0.63	392.82	3404.10
	6	2	-444.62	806.31	-85.23	-0.45	0.00	0.00
		48	444.62	-704.76	37.08	0.45	275.19	3399.92
32	1	3	-326.70	1118.13	0.00	0.00	0.00	0.00
		49	326.70	-1016.58	0.00	0.00	0.00	4803.11
	2	3	-163.87	1118.78	-23.96	-0.16	0.00	0.00
		49	163.87	-1017.23	10.46	0.16	77.45	4806.04

MEMBER END FORCES STRUCTURE TYPE = SPACE

ALL UNITS ARE -- POUN FEET (LOCAL)

MEMBER	LOAD	JT	AXIAL	SHEAR-Y	SHEAR-Z	TORSION	MOM-Y	MOM-Z
	3	3	-278.65	1118.33	-16.75	-0.11	0.00	0.00
		49	278.65	-1016.78	7.30	0.11	54.13	4803.99
	4	3	-894.09	804.96	-620.50	-0.10	0.00	0.00
		49	894.09	-703.41	620.50	0.10	2792.26	3393.85
	5	3	-126.69	807.12	-121.45	-0.68	0.00	0.00
		49	126.69	-705.57	53.05	0.68	392.62	3403.56
	6	3	-660.45	805.62	-85.03	-0.48	0.00	0.00
		49	660.45	-704.07	36.88	0.48	274.31	3396.79
33	1	4	365.21	373.92	3.29	-1.95	3.79	430.01
		50	-365.21	-253.81	-3.29	1.95	-18.60	983.32
	2	4	293.41	518.41	-78.17	-36.97	387.25	1538.34
		50	-293.41	-398.29	64.67	36.97	-65.50	524.76
	3	4	343.59	422.00	-50.71	-58.72	248.19	765.44
		50	-343.59	-301.88	41.26	58.72	-40.97	864.09
	4	4	592.00	-236.29	-21.30	-44.99	170.02	-3990.51
		50	-592.00	356.40	21.30	44.99	-73.82	2659.90
	5	4	226.25	408.18	-356.47	-367.51	1706.77	1179.94
		50	-226.25	-288.06	288.07	367.51	-255.22	386.90
	6	4	482.71	-43.50	-251.26	-260.78	1207.21	-2443.19
		50	-482.71	163.62	203.11	260.78	-182.88	1979.06
34	1	9	-219.77	1118.62	0.00	0.00	0.00	0.00
		51	219.77	-1017.07	0.00	0.00	0.00	4805.31
	2	9	-139.03	1118.90	-23.97	-0.04	0.00	0.00
		51	139.03	-1017.35	10.47	0.04	77.48	4806.55
	3	9	-196.16	1118.70	-16.77	-0.03	0.00	0.00
		51	196.16	-1017.15	7.32	0.03	54.20	4805.68
	4	9	-491.04	806.27	623.80	-0.03	0.00	0.00
		51	491.04	-704.72	-623.80	0.03	-2807.08	3399.71
	5	9	-106.19	807.19	-121.47	-0.14	0.00	0.00
		51	106.19	-705.64	53.07	0.14	392.73	3403.86
	6	9	-372.50	806.55	-85.33	-0.10	0.00	0.00
		51	372.50	-705.00	37.18	0.10	275.65	3400.98
35	1	10	-126.26	1119.05	0.00	0.00	0.00	0.00
		52	126.26	-1017.50	0.00	0.00	0.00	4807.23
	2	10	-50.79	1119.30	-23.99	-0.04	0.00	0.00
		52	50.79	-1017.75	10.49	0.04	77.57	4808.36
	3	10	-103.69	1119.13	-16.78	-0.03	0.00	0.00
		52	103.69	-1017.58	7.33	0.03	54.27	4807.58
	4	10	-395.15	806.58	-624.57	-0.03	0.00	0.00
		52	395.15	-705.03	624.57	0.03	2810.56	3401.10
	5	10	-41.57	807.40	-121.55	-0.15	0.00	0.00
		52	41.57	-705.85	53.15	0.15	393.08	3404.80

MEMBER END FORCES STRUCTURE TYPE = SPACE

ALL UNITS ARE -- POUN FEET (LOCAL)

MEMBER	LOAD	JT	AXIAL	SHEAR-Y	SHEAR-Z	TORSION	MOM-Y	MOM-Z
	6	10	-286.05	806.83	-85.40	-0.11	0.00	0.00
		52	286.05	-705.28	37.25	0.11	275.96	3402.23
36	1	11	208.41	382.81	3.40	-1.19	0.85	526.35
		53	-208.41	-262.70	-3.40	1.19	-16.14	926.54
	2	11	217.35	523.11	-44.07	21.20	88.72	1591.67
		53	-217.35	-403.00	30.57	-21.20	79.34	492.44
	3	11	210.32	429.60	-32.52	-20.78	84.52	848.64
		53	-210.32	-309.48	23.07	20.78	40.66	814.73
	4	11	151.64	-213.14	-1.60	-13.32	-10.34	-3748.51
		53	-151.64	333.26	1.60	13.32	17.60	2519.79
	5	11	168.65	412.03	-206.54	-109.26	408.04	1222.51
		53	-168.65	-291.92	138.14	109.26	367.95	361.59
	6	11	156.81	-26.10	-145.32	-77.73	286.38	-2260.62
		53	-156.81	146.21	97.17	77.73	259.52	1873.48
37	1	16	-181.57	1118.80	0.00	0.00	0.00	0.00
		54	181.57	-1017.25	0.00	0.00	0.00	4806.09
	2	16	-148.43	1118.85	-23.96	0.00	0.00	0.00
		54	148.43	-1017.30	10.46	0.00	77.47	4806.36
	3	16	-172.52	1118.81	-16.77	0.00	0.00	0.00
		54	172.52	-1017.26	7.32	0.00	54.22	4806.17
	4	16	-273.85	806.97	625.57	0.00	0.00	0.00
		54	273.85	-705.42	-625.57	0.00	-2815.06	3402.87
	5	16	-111.12	807.17	-121.47	0.00	0.00	0.00
		54	111.12	-705.62	53.07	0.00	392.70	3403.79
	6	16	-222.60	807.03	-85.47	0.00	0.00	0.00
		54	222.60	-705.48	37.32	0.00	276.28	3403.16
38	1	17	-120.07	1119.08	0.00	0.00	0.00	0.00
		55	120.07	-1017.53	0.00	0.00	0.00	4807.36
	2	17	-87.47	1119.13	-23.98	0.00	0.00	0.00
		55	87.47	-1017.58	10.48	0.00	77.53	4807.61
	3	17	-111.20	1119.09	-16.78	0.00	0.00	0.00
		55	111.20	-1017.54	7.33	0.00	54.27	4807.42
	4	17	-220.42	807.14	-626.01	0.00	0.00	0.00
		55	220.42	-705.59	626.01	0.00	2817.04	3403.65
	5	17	-59.61	807.34	-121.53	0.00	0.00	0.00
		55	59.61	-705.79	53.13	0.00	392.98	3404.54
	6	17	-169.66	807.20	-85.51	0.00	0.00	0.00
		55	169.66	-705.65	37.36	0.00	276.48	3403.93
39	1	18	199.94	457.79	1.48	2.15	-11.82	811.33
		56	-199.94	-337.68	-1.48	-2.15	5.17	979.00
	2	18	267.59	605.72	-30.74	-8.55	77.07	1887.34
		56	-267.59	-485.60	17.24	8.55	30.90	568.67

MEMBER END FORCES STRUCTURE TYPE = SPACE

ALL UNITS ARE -- POUN FEET (LOCAL)

MEMBER	LOAD	JT	AXIAL	SHEAR-Y	SHEAR-Z	TORSION	MOM-Y	MOM-Z
	3	18	221.00	512.43	-21.53	-7.41	52.39	1146.66
		56	-221.00	-392.32	12.08	7.41	23.26	889.57
	4	18	-85.64	-162.93	0.00	0.01	-9.30	-3556.92
		56	85.64	283.05	0.00	-0.01	9.29	2553.05
	5	18	194.96	460.74	-149.30	-34.91	388.70	1398.62
		56	-194.96	-340.62	80.90	34.91	129.33	404.73
	6	18	-1.67	23.68	-105.06	-24.94	273.16	-2073.51
		56	1.67	96.44	56.91	24.94	91.29	1909.79
40	1	23	-126.09	1119.05	0.00	0.00	0.00	0.00
		57	126.09	-1017.50	0.00	0.00	0.00	4807.23
	2	23	-140.50	1118.89	-23.97	0.04	0.00	0.00
		57	140.50	-1017.34	10.47	-0.04	77.48	4806.52
	3	23	-131.58	1119.00	-16.78	0.03	0.00	0.00
		57	131.58	-1017.45	7.33	-0.03	54.25	4807.01
	4	23	-47.84	807.70	627.43	0.03	0.00	0.00
		57	47.84	-706.15	-627.43	-0.03	-2823.42	3406.17
	5	23	-107.17	807.18	-121.47	0.15	0.00	0.00
		57	107.17	-705.64	53.07	-0.15	392.72	3403.84
	6	23	-63.90	807.55	-85.62	0.10	0.00	0.00
		57	63.90	-706.00	37.47	-0.10	276.94	3405.47
41	1	24	-41.76	1119.43	0.00	0.00	0.00	0.00
		58	41.76	-1017.88	0.00	0.00	0.00	4808.97
	2	24	-51.90	1119.29	-23.99	0.04	0.00	0.00
		58	51.90	-1017.75	10.49	-0.04	77.57	4808.34
	3	24	-46.55	1119.39	-16.80	0.03	0.00	0.00
		58	46.55	-1017.84	7.35	-0.03	54.32	4808.75
	4	24	-10.84	807.82	-627.74	0.03	0.00	0.00
		58	10.84	-706.27	627.74	-0.03	2824.84	3406.71
	5	24	-42.30	807.39	-121.55	0.16	0.00	0.00
		58	42.30	-705.85	53.15	-0.16	393.07	3404.79
	6	24	-18.28	807.69	-85.66	0.11	0.00	0.00
		58	18.28	-706.15	37.51	-0.11	277.13	3406.14
42	1	25	132.74	389.06	3.40	-1.19	4.79	578.08
		59	-132.74	-268.94	-3.40	1.19	-20.08	902.71
	2	25	219.95	529.34	-41.34	61.13	65.65	1641.46
		59	-219.95	-409.22	27.84	-61.13	90.00	470.67
	3	25	160.90	435.83	-28.13	7.23	44.47	899.61
		59	-160.90	-315.72	18.68	-7.23	60.86	791.72
	4	25	-223.42	-208.79	1.63	13.32	-36.28	-3706.01
		59	223.42	328.90	-1.63	-13.32	28.96	2495.20
	5	25	170.37	416.46	-202.77	41.17	372.95	1257.90
		59	-170.37	-296.34	134.37	-41.17	385.64	346.12

MEMBER END FORCES STRUCTURE TYPE = SPACE

ALL UNITS ARE -- POUN FEET (LOCAL)

MEMBER	LOAD	JT	AXIAL	SHEAR-Y	SHEAR-Z	TORSION	MOM-Y	MOM-Z
	6	25	-105.72	-21.69	-142.56	28.90	261.34	-2220.00
		59	105.72	141.80	94.41	-28.90	271.82	1851.77
43	1	36	-179.60	-312.91	0.00	0.00	0.00	-6038.07
		60	179.60	391.89	0.00	0.00	0.00	4805.75
	2	36	-116.19	-313.00	-0.02	-0.15	-95.84	-6040.04
		60	116.19	391.98	-10.48	0.15	77.50	4807.02
	3	36	-160.42	-312.93	-0.02	-0.10	-67.03	-6038.66
		60	160.42	391.91	-7.33	0.10	54.21	4806.13
	4	36	-386.23	-208.67	-208.22	-0.09	3532.09	-4266.84
		60	386.23	287.66	208.22	0.09	-2807.61	3399.89
	5	36	-89.46	-209.00	-0.06	-0.63	-485.78	-4273.44
		60	89.46	287.98	-53.14	0.63	392.82	3404.10
	6	36	-296.62	-208.78	-0.22	-0.45	-340.47	-4268.85
		60	296.62	287.76	-37.23	0.45	275.52	3401.16
44	1	37	-282.70	-312.90	0.00	0.00	0.00	-6035.33
		61	282.70	391.89	0.00	0.00	0.00	4803.63
	2	37	-163.87	-313.00	-0.03	-0.16	-95.78	-6038.78
		61	163.87	391.98	-10.47	0.16	77.45	4806.04
	3	37	-246.65	-312.93	-0.04	-0.11	-66.94	-6036.37
		61	246.65	391.91	-7.31	0.11	54.14	4804.36
	4	37	-678.09	-208.67	208.10	-0.10	-3518.15	-4261.37
		61	678.09	287.65	-208.10	0.10	2796.81	3395.65
	5	37	-126.69	-209.00	-0.12	-0.68	-485.52	-4272.74
		61	126.69	287.98	-53.08	0.68	392.62	3403.56
	6	37	-512.45	-208.78	-0.41	-0.48	-339.33	-4264.80
		61	512.45	287.76	-37.04	0.48	274.63	3398.02
45	1	38	432.21	-255.62	3.29	-1.95	-9.89	-949.70
		62	-432.21	349.04	-3.29	1.95	-1.62	-109.16
	2	38	293.41	-111.13	-29.17	-90.97	-83.33	-919.03
		62	-293.41	204.56	18.67	90.97	167.36	366.30
	3	38	389.59	-207.54	-17.91	-50.72	-52.37	-928.80
		62	-389.59	300.97	10.56	50.72	102.47	38.36
	4	38	877.00	-716.83	-21.30	-44.99	-1.23	-756.98
		62	-877.00	810.25	21.30	44.99	76.36	-1919.02
	5	38	226.25	-72.36	-123.87	-318.51	-402.18	-692.76
		62	-226.25	165.79	70.67	318.51	743.70	275.83
	6	38	682.71	-524.04	-87.66	-225.78	-282.81	-737.90
		62	-682.71	617.46	50.21	225.78	526.38	-1261.85
46	1	39	-175.77	-312.91	0.00	0.00	0.00	-6038.17
		63	175.77	391.89	0.00	0.00	0.00	4805.83
	2	39	-139.03	-313.00	-0.01	-0.04	-95.81	-6039.44
		63	139.03	391.98	-10.49	0.04	77.48	4806.55

MEMBER END FORCES STRUCTURE TYPE = SPACE

ALL UNITS ARE -- POUN FEET (LOCAL)

MEMBER	LOAD	JT	AXIAL	SHEAR-Y	SHEAR-Z	TORSION	MOM-Y	MOM-Z
	3	39	-164.16	-312.93	-0.01	-0.03	-67.03	-6038.56
		63	164.16	391.91	-7.34	0.03	54.21	4806.06
	4	39	-275.04	-208.68	-208.19	-0.03	3537.32	-4268.94
		63	275.04	287.66	208.19	0.03	-2811.66	3401.52
	5	39	-106.19	-209.00	-0.02	-0.14	-485.66	-4273.13
		63	106.19	287.98	-53.18	0.14	392.73	3403.86
	6	39	-224.50	-208.78	-0.09	-0.10	-341.06	-4270.21
		63	224.50	287.76	-37.36	0.10	275.98	3402.21
47	1	40	-82.26	-312.91	0.00	0.00	0.00	-6040.65
		64	82.26	391.89	0.00	0.00	0.00	4807.75
	2	40	-50.79	-313.00	0.00	-0.04	-95.93	-6041.78
		64	50.79	391.98	-10.50	0.04	77.57	4808.36
	3	40	-71.69	-312.93	-0.01	-0.03	-67.12	-6041.01
		64	71.69	391.91	-7.34	0.03	54.28	4807.96
	4	40	-179.15	-208.68	208.17	-0.03	-3541.82	-4270.74
		64	179.15	287.66	-208.17	0.03	2815.14	3402.91
	5	40	-41.57	-209.00	-0.01	-0.15	-486.11	-4274.34
		64	41.57	287.98	-53.19	0.15	393.08	3404.80
	6	40	-138.05	-208.78	-0.08	-0.11	-341.45	-4271.83
		64	138.05	287.76	-37.37	0.11	276.29	3403.47
48	1	41	275.41	-246.73	3.40	-1.19	-11.97	-924.01
		65	-275.41	340.15	-3.40	1.19	0.08	-103.46
	2	41	217.35	-106.43	4.93	-32.80	-108.52	-903.10
		65	-217.35	199.85	-15.43	32.80	72.91	366.92
	3	41	256.32	-199.95	0.28	-12.78	-70.11	-905.98
		65	-256.32	293.37	-7.63	12.78	56.31	42.32
	4	41	436.64	-693.68	-1.60	-13.32	-23.29	-699.06
		65	-436.64	787.11	1.60	13.32	28.97	-1894.05
	5	41	168.65	-68.51	26.06	-60.26	-499.59	-680.91
		65	-168.65	161.93	-79.26	60.26	315.36	277.52
	6	41	356.81	-506.64	18.28	-42.73	-352.35	-693.78
		65	-356.81	600.06	-55.73	42.73	222.95	-1244.00
49	1	42	-137.57	-312.91	0.00	0.00	0.00	-6039.18
		66	137.57	391.89	0.00	0.00	0.00	4806.61
	2	42	-148.43	-313.00	0.00	0.00	-95.80	-6039.19
		66	148.43	391.98	-10.50	0.00	77.47	4806.36
	3	42	-140.52	-312.93	0.00	0.00	-67.06	-6039.18
		66	140.52	391.91	-7.35	0.00	54.23	4806.54
	4	42	-57.85	-208.68	-208.18	0.00	3547.65	-4273.02
		66	57.85	287.66	208.18	0.00	-2819.65	3404.68
	5	42	-111.12	-209.00	0.00	0.00	-485.63	-4273.03
		66	111.12	287.98	-53.20	0.00	392.70	3403.79

MEMBER END FORCES STRUCTURE TYPE = SPACE

ALL UNITS ARE -- POUN FEET (LOCAL)

MEMBER	LOAD	JT	AXIAL	SHEAR-Y	SHEAR-Z	TORSION	MOM-Y	MOM-Z
	6	42	-74.60	-208.78	-0.06	0.00	-341.86	-4273.02
		66	74.60	287.76	-37.39	0.00	276.60	3404.40
50	1	43	-76.07	-312.91	0.00	0.00	0.00	-6040.81
		67	76.07	391.89	0.00	0.00	0.00	4807.88
	2	43	-87.47	-313.00	0.00	0.00	-95.88	-6040.80
		67	87.47	391.98	-10.50	0.00	77.53	4807.61
	3	43	-79.20	-312.93	0.00	0.00	-67.12	-6040.81
		67	79.20	391.91	-7.35	0.00	54.28	4807.80
	4	43	-4.42	-208.68	208.18	0.00	-3550.20	-4274.02
		67	4.42	287.66	-208.18	0.00	2821.63	3405.46
	5	43	-59.61	-209.00	0.00	0.00	-485.99	-4274.00
		67	59.61	287.98	-53.20	0.00	392.98	3404.54
	6	43	-21.66	-208.78	-0.06	0.00	-342.11	-4274.02
		67	21.66	287.76	-37.39	0.00	276.80	3405.17
51	1	44	292.94	-277.75	1.48	2.15	0.00	-1119.44
		68	-292.94	371.17	-1.48	-2.15	-5.17	-16.67
	2	44	267.59	-129.82	2.26	3.45	-41.37	-1083.04
		68	-267.59	223.24	-12.76	-3.45	15.06	464.90
	3	44	285.00	-223.11	1.27	0.59	-31.68	-1085.31
		68	-285.00	316.53	-8.62	-0.59	14.37	140.51
	4	44	299.36	-705.47	0.00	0.01	-9.28	-800.06
		68	-299.36	798.90	0.00	-0.01	9.28	-1833.80
	5	44	194.96	-81.80	9.30	14.09	-189.90	-786.06
		68	-194.96	175.22	-62.50	-14.09	64.21	336.13
	6	44	268.33	-518.86	6.54	10.06	-133.97	-796.03
		68	-268.33	612.29	-43.99	-10.06	45.51	-1184.31
52	1	45	-82.09	-312.91	0.00	0.00	0.00	-6040.65
		69	82.09	391.89	0.00	0.00	0.00	4807.75
	2	45	-140.50	-313.00	0.01	0.04	-95.81	-6039.40
		69	140.50	391.98	-10.51	-0.04	77.48	4806.52
	3	45	-99.58	-312.93	0.00	0.03	-67.10	-6040.27
		69	99.58	391.91	-7.35	-0.03	54.27	4807.38
	4	45	168.16	-208.68	-208.18	0.03	3558.46	-4277.28
		69	-168.16	287.66	208.18	-0.03	-2828.02	3407.98
	5	45	-107.17	-209.00	0.02	0.15	-485.66	-4273.11
		69	107.17	287.98	-53.22	-0.15	392.72	3403.84
	6	45	84.10	-208.78	-0.06	0.10	-342.70	-4276.01
		69	-84.10	287.76	-37.39	-0.10	277.26	3406.71
53	1	46	2.24	-312.91	0.00	0.00	0.00	-6042.89
		70	-2.24	391.89	0.00	0.00	0.00	4809.49
	2	46	-51.90	-313.00	0.00	0.04	-95.93	-6041.75
		70	51.90	391.98	-10.50	-0.04	77.57	4808.34

MEMBER END FORCES STRUCTURE TYPE = SPACE

ALL UNITS ARE -- POUN FEET (LOCAL)

MEMBER	LOAD	JT	AXIAL	SHEAR-Y	SHEAR-Z	TORSION	MOM-Y	MOM-Z
	3	46	-14.55	-312.93	0.00	0.03	-67.18	-6042.53
		70	14.55	391.91	-7.35	-0.03	54.33	4809.13
	4	46	205.16	-208.68	208.17	0.03	-3560.30	-4277.98
		70	-205.16	287.66	-208.17	-0.03	2829.45	3408.52
	5	46	-42.30	-209.00	0.01	0.16	-486.11	-4274.33
		70	42.30	287.98	-53.21	-0.16	393.07	3404.79
	6	46	129.72	-208.78	-0.07	0.11	-342.95	-4276.87
		70	-129.72	287.76	-37.38	-0.11	277.45	3407.38
54	1	47	199.74	-240.49	3.40	-1.19	-8.03	-922.03
		71	-199.74	333.91	-3.40	1.19	-3.86	-83.47
	2	47	219.95	-100.20	7.66	7.13	-109.53	-903.14
		71	-219.95	193.62	-18.16	-7.13	64.26	388.76
	3	47	206.90	-193.71	4.67	15.23	-74.86	-904.80
		71	-206.90	287.13	-12.02	-15.23	45.60	63.05
	4	47	61.58	-689.33	1.63	13.32	-23.25	-690.71
		71	-61.58	782.75	-1.63	-13.32	17.52	-1885.67
	5	47	170.37	-64.08	29.83	90.17	-503.73	-680.93
		71	-170.37	157.50	-83.03	-90.17	305.95	293.05
	6	47	94.28	-502.23	21.04	63.90	-354.71	-687.95
		71	-94.28	595.65	-58.49	-63.90	215.43	-1233.61
55	1	48	-201.60	392.08	0.00	0.00	0.00	-4805.23
		36	201.60	-313.09	0.00	0.00	0.00	6038.07
	2	48	-116.19	391.98	-10.52	-0.15	-77.50	-4807.02
		36	116.19	-313.00	0.02	0.15	95.84	6040.04
	3	48	-176.42	392.05	-7.37	-0.10	-54.19	-4805.76
		36	176.42	-313.07	0.02	0.10	67.03	6038.66
	4	48	-494.23	288.31	209.78	-0.09	2803.04	-3398.09
		36	494.23	-209.33	-209.78	0.09	-3532.09	4266.84
	5	48	-89.46	287.98	-53.26	-0.63	-392.82	-3404.10
		36	89.46	-209.00	0.06	0.63	485.78	4273.44
	6	48	-370.62	288.21	-37.67	-0.45	-275.19	-3399.92
		36	370.62	-209.22	0.22	0.45	340.47	4268.85
56	1	49	-304.70	392.08	0.00	0.00	0.00	-4803.11
		37	304.70	-313.10	0.00	0.00	0.00	6035.33
	2	49	-163.87	391.98	-10.53	-0.16	-77.45	-4806.04
		37	163.87	-313.00	0.03	0.16	95.78	6038.78
	3	49	-262.65	392.05	-7.39	-0.11	-54.13	-4803.99
		37	262.65	-313.07	0.04	0.11	66.94	6036.37
	4	49	-786.09	288.31	-209.90	-0.10	-2792.26	-3393.85
		37	786.09	-209.33	209.90	0.10	3518.15	4261.37
	5	49	-126.69	287.98	-53.32	-0.68	-392.62	-3403.56
		37	126.69	-209.00	0.12	0.68	485.52	4272.74

MEMBER END FORCES STRUCTURE TYPE = SPACE

ALL UNITS ARE -- POUN FEET (LOCAL)

MEMBER	LOAD	JT	AXIAL	SHEAR-Y	SHEAR-Z	TORSION	MOM-Y	MOM-Z
	6	49	-586.45	288.21	-37.86	-0.48	-274.31	-3396.79
		37	586.45	-209.22	0.41	0.48	339.33	4264.80
57	1	50	403.21	14.81	3.29	-1.95	-1.40	-1028.32
		38	-403.21	78.62	-3.29	1.95	-10.11	916.70
	2	50	293.41	159.29	-47.67	-57.97	65.50	-524.76
		38	-293.41	-65.87	37.17	57.97	83.33	919.03
	3	50	369.59	62.88	-30.26	-50.72	40.97	-872.09
		38	-369.59	30.54	22.91	50.72	52.37	928.80
	4	50	753.00	-510.40	-21.30	-44.99	73.82	-2708.90
		38	-753.00	603.83	21.30	44.99	1.23	756.98
	5	50	226.25	134.06	-214.07	-318.51	255.22	-386.90
		38	-226.25	-40.64	160.87	318.51	402.18	692.76
	6	50	595.71	-317.62	-151.11	-225.78	182.88	-2014.06
		38	-595.71	411.04	113.66	225.78	282.81	737.90
58	1	51	-197.77	392.08	0.00	0.00	0.00	-4805.31
		39	197.77	-313.09	0.00	0.00	0.00	6038.17
	2	51	-139.03	391.98	-10.51	-0.04	-77.48	-4806.55
		39	139.03	-313.00	0.01	0.04	95.81	6039.44
	3	51	-180.16	392.05	-7.36	-0.03	-54.20	-4805.68
		39	180.16	-313.07	0.01	0.03	67.03	6038.56
	4	51	-383.04	288.31	209.81	-0.03	2807.08	-3399.71
		39	383.04	-209.32	-209.81	0.03	-3537.32	4268.94
	5	51	-106.19	287.98	-53.22	-0.14	-392.73	-3403.86
		39	106.19	-209.00	0.02	0.14	485.66	4273.13
	6	51	-298.50	288.20	-37.54	-0.10	-275.65	-3400.98
		39	298.50	-209.22	0.09	0.10	341.06	4270.21
59	1	52	-104.26	392.08	0.00	0.00	0.00	-4807.23
		40	104.26	-313.09	0.00	0.00	0.00	6040.65
	2	52	-50.79	391.98	-10.50	-0.04	-77.57	-4808.36
		40	50.79	-313.00	0.00	0.04	95.93	6041.78
	3	52	-87.69	392.05	-7.36	-0.03	-54.27	-4807.58
		40	87.69	-313.07	0.01	0.03	67.12	6041.01
	4	52	-287.15	288.31	-209.83	-0.03	-2810.56	-3401.10
		40	287.15	-209.32	209.83	0.03	3541.82	4270.74
	5	52	-41.57	287.98	-53.21	-0.15	-393.08	-3404.80
		40	41.57	-209.00	0.01	0.15	486.11	4274.34
	6	52	-212.05	288.20	-37.53	-0.11	-275.96	-3402.23
		40	212.05	-209.22	0.08	0.11	341.45	4271.83
60	1	53	246.41	23.70	3.40	-1.19	-3.86	-971.54
		41	-246.41	69.73	-3.40	1.19	-8.03	891.01
	2	53	217.35	164.00	-13.57	0.20	-79.34	-492.44
		41	-217.35	-70.57	3.07	-0.20	108.52	903.10

MEMBER END FORCES STRUCTURE TYPE = SPACE

ALL UNITS ARE -- POUN FEET (LOCAL)

MEMBER	LOAD	JT	AXIAL	SHEAR-Y	SHEAR-Z	TORSION	MOM-Y	MOM-Z
	3	53	236.32	70.48	-12.07	-12.78	-40.66	-822.73
		41	-236.32	22.95	4.72	12.78	70.11	905.98
	4	53	312.64	-487.26	-1.60	-13.32	-17.60	-2568.79
		41	-312.64	580.68	1.60	13.32	23.29	699.06
	5	53	168.65	137.92	-64.14	-60.26	-367.95	-361.59
		41	-168.65	-44.49	10.94	60.26	499.59	680.91
	6	53	269.81	-300.21	-45.17	-42.73	-259.52	-1908.48
		41	-269.81	393.64	7.72	42.73	352.35	693.78
61	1	54	-159.57	392.08	0.00	0.00	0.00	-4806.09
		42	159.57	-313.09	0.00	0.00	0.00	6039.18
	2	54	-148.43	391.98	-10.50	0.00	-77.47	-4806.36
		42	148.43	-313.00	0.00	0.00	95.80	6039.19
	3	54	-156.52	392.05	-7.35	0.00	-54.22	-4806.17
		42	156.52	-313.07	0.00	0.00	67.06	6039.18
	4	54	-165.85	288.31	209.82	0.00	2815.06	-3402.87
		42	165.85	-209.32	-209.82	0.00	-3547.65	4273.02
	5	54	-111.12	287.98	-53.20	0.00	-392.70	-3403.79
		42	111.12	-209.00	0.00	0.00	485.63	4273.03
	6	54	-148.60	288.20	-37.51	0.00	-276.28	-3403.16
		42	148.60	-209.22	0.06	0.00	341.86	4273.02
62	1	55	-98.07	392.08	0.00	0.00	0.00	-4807.36
		43	98.07	-313.09	0.00	0.00	0.00	6040.81
	2	55	-87.47	391.98	-10.50	0.00	-77.53	-4807.61
		43	87.47	-313.00	0.00	0.00	95.88	6040.80
	3	55	-95.20	392.05	-7.35	0.00	-54.27	-4807.42
		43	95.20	-313.07	0.00	0.00	67.12	6040.81
	4	55	-112.42	288.31	-209.82	0.00	-2817.04	-3403.65
		43	112.42	-209.32	209.82	0.00	3550.20	4274.02
	5	55	-59.61	287.98	-53.20	0.00	-392.98	-3404.54
		43	59.61	-209.00	0.00	0.00	485.99	4274.00
	6	55	-95.66	288.20	-37.51	0.00	-276.48	-3403.93
		43	95.66	-209.22	0.06	0.00	342.11	4274.02
63	1	56	250.94	45.68	1.48	2.15	-5.17	-1057.00
		44	-250.94	47.75	-1.48	-2.15	0.00	1053.44
	2	56	267.59	193.60	-8.24	3.45	-30.90	-568.67
		44	-267.59	-100.18	-2.26	-3.45	41.37	1083.04
	3	56	256.00	100.32	-6.08	0.59	-23.26	-897.57
		44	-256.00	-6.89	-1.27	-0.59	31.68	1085.31
	4	56	125.36	-468.05	0.00	0.01	-9.29	-2602.05
		44	-125.36	561.47	0.00	-0.01	9.28	800.06
	5	56	194.96	155.62	-43.90	14.09	-129.33	-404.73
		44	-194.96	-62.20	-9.30	-14.09	189.90	786.06

MEMBER END FORCES STRUCTURE TYPE = SPACE

ALL UNITS ARE -- POUN FEET (LOCAL)

MEMBER	LOAD	JT	AXIAL	SHEAR-Y	SHEAR-Z	TORSION	MOM-Y	MOM-Z
	6	56	146.33	-281.44	-30.91	10.06	-91.29	-1944.79
		44	-146.33	374.86	-6.54	-10.06	133.97	796.03
64	1	57	-104.09	392.08	0.00	0.00	0.00	-4807.23
		45	104.09	-313.09	0.00	0.00	0.00	6040.65
	2	57	-140.50	391.98	-10.49	0.04	-77.48	-4806.52
		45	140.50	-313.00	-0.01	-0.04	95.81	6039.40
	3	57	-115.58	392.05	-7.35	0.03	-54.25	-4807.01
		45	115.58	-313.07	0.00	-0.03	67.10	6040.27
	4	57	60.16	288.31	209.82	0.03	2823.42	-3406.17
		45	-60.16	-209.32	-209.82	-0.03	-3558.46	4277.28
	5	57	-107.17	287.98	-53.18	0.15	-392.72	-3403.84
		45	107.17	-209.00	-0.02	-0.15	485.66	4273.11
	6	57	10.10	288.20	-37.51	0.10	-276.94	-3405.47
		45	-10.10	-209.22	0.06	-0.10	342.70	4276.01
65	1	58	-19.76	392.08	0.00	0.00	0.00	-4808.97
		46	19.76	-313.09	0.00	0.00	0.00	6042.89
	2	58	-51.90	391.98	-10.50	0.04	-77.57	-4808.34
		46	51.90	-313.00	0.00	-0.04	95.93	6041.75
	3	58	-30.55	392.05	-7.35	0.03	-54.32	-4808.75
		46	30.55	-313.07	0.00	-0.03	67.18	6042.53
	4	58	97.16	288.31	-209.83	0.03	-2824.84	-3406.71
		46	-97.16	-209.32	209.83	-0.03	3560.30	4277.98
	5	58	-42.30	287.98	-53.19	0.16	-393.07	-3404.79
		46	42.30	-209.00	-0.01	-0.16	486.11	4274.33
	6	58	55.72	288.20	-37.52	0.11	-277.13	-3406.14
		46	-55.72	-209.22	0.07	-0.11	342.95	4276.87
66	1	59	170.74	29.94	3.40	-1.19	0.08	-947.71
		47	-170.74	63.49	-3.40	1.19	-11.97	889.03
	2	59	219.95	170.22	-10.84	40.13	-90.00	-470.67
		47	-219.95	-76.80	0.34	-40.13	109.53	903.14
	3	59	186.90	76.72	-7.68	15.23	-60.86	-799.72
		47	-186.90	16.71	0.33	-15.23	74.86	904.80
	4	59	-62.42	-482.90	1.63	13.32	-28.96	-2544.20
		47	62.42	576.33	-1.63	-13.32	23.25	690.71
	5	59	170.37	142.34	-60.37	90.17	-385.64	-346.12
		47	-170.37	-48.92	7.17	-90.17	503.73	680.93
	6	59	7.28	-295.80	-42.41	63.90	-271.82	-1886.77
		47	-7.28	389.23	4.96	-63.90	354.71	687.95
67	1	60	-157.60	-1017.17	0.00	0.00	0.00	-4805.75
		9	157.60	1118.72	0.00	0.00	0.00	0.00
	2	60	-116.19	-1017.45	10.47	-0.15	-77.50	-4807.02
		9	116.19	1119.00	-23.97	0.15	0.00	0.00

MEMBER END FORCES STRUCTURE TYPE = SPACE

ALL UNITS ARE -- POUN FEET (LOCAL)

MEMBER	LOAD	JT	AXIAL	SHEAR-Y	SHEAR-Z	TORSION	MOM-Y	MOM-Z
	3	60	-144.42	-1017.26	7.32	-0.10	-54.21	-4806.13
		9	144.42	1118.80	-16.77	0.10	0.00	0.00
	4	60	-278.23	-704.76	-623.91	-0.09	2807.61	-3399.89
		9	278.23	806.31	623.91	0.09	0.00	0.00
	5	60	-89.46	-705.69	53.09	-0.63	-392.82	-3404.10
		9	89.46	807.24	-121.49	0.63	0.00	0.00
	6	60	-222.62	-705.04	37.15	-0.45	-275.52	-3401.16
		9	222.62	806.59	-85.30	0.45	0.00	0.00
68	1	61	-260.70	-1016.70	0.00	0.00	0.00	-4803.63
		10	260.70	1118.25	0.00	0.00	0.00	0.00
	2	61	-163.87	-1017.23	10.46	-0.16	-77.45	-4806.04
		10	163.87	1118.78	-23.96	0.16	0.00	0.00
	3	61	-230.65	-1016.86	7.31	-0.11	-54.14	-4804.36
		10	230.65	1118.41	-16.76	0.11	0.00	0.00
	4	61	-570.09	-703.82	621.51	-0.10	-2796.81	-3395.65
		10	570.09	805.36	-621.51	0.10	0.00	0.00
	5	61	-126.69	-705.57	53.05	-0.68	-392.62	-3403.56
		10	126.69	807.12	-121.45	0.68	0.00	0.00
	6	61	-438.45	-704.34	36.95	-0.48	-274.63	-3398.02
		10	438.45	805.89	-85.10	0.48	0.00	0.00
69	1	62	461.21	-526.04	3.29	-1.95	-18.38	76.16
		11	-461.21	646.16	-3.29	1.95	3.57	-2714.02
	2	62	293.41	-381.56	-10.67	-123.97	-167.36	-366.30
		11	-293.41	501.67	-2.83	123.97	185.24	-1621.42
	3	62	409.59	-477.97	-5.56	-50.72	-102.47	-38.36
		11	-409.59	598.08	-3.89	50.72	106.46	-2383.20
	4	62	1001.00	-923.25	-21.30	-44.99	-76.36	1919.02
		11	-1001.00	1043.37	21.30	44.99	172.80	-6341.99
	5	62	226.25	-278.79	-33.67	-318.51	-743.70	-275.83
		11	-226.25	398.90	-34.73	318.51	742.19	-1249.24
	6	62	769.71	-730.46	-24.21	-225.78	-526.38	1261.85
		11	-769.71	850.58	-23.94	225.78	529.09	-4818.43
70	1	63	-153.77	-1017.19	0.00	0.00	0.00	-4805.83
		16	153.77	1118.74	0.00	0.00	0.00	0.00
	2	63	-139.03	-1017.35	10.47	-0.04	-77.48	-4806.55
		16	139.03	1118.90	-23.97	0.04	0.00	0.00
	3	63	-148.16	-1017.24	7.32	-0.03	-54.21	-4806.06
		16	148.16	1118.79	-16.77	0.03	0.00	0.00
	4	63	-167.04	-705.12	-624.81	-0.03	2811.66	-3401.52
		16	167.04	806.67	624.81	0.03	0.00	0.00
	5	63	-106.19	-705.64	53.07	-0.14	-392.73	-3403.86
		16	106.19	807.19	-121.47	0.14	0.00	0.00

MEMBER END FORCES STRUCTURE TYPE = SPACE

ALL UNITS ARE -- POUN FEET (LOCAL)

MEMBER	LOAD	JT	AXIAL	SHEAR-Y	SHEAR-Z	TORSION	MOM-Y	MOM-Z
	6	63	-150.50	-705.27	37.25	-0.10	-275.98	-3402.21
		16	150.50	806.82	-85.40	0.10	0.00	0.00
71	1	64	-60.26	-1017.61	0.00	0.00	0.00	-4807.75
		17	60.26	1119.16	0.00	0.00	0.00	0.00
	2	64	-50.79	-1017.75	10.49	-0.04	-77.57	-4808.36
		17	50.79	1119.30	-23.99	0.04	0.00	0.00
	3	64	-55.69	-1017.66	7.34	-0.03	-54.28	-4807.96
		17	55.69	1119.21	-16.79	0.03	0.00	0.00
	4	64	-71.15	-705.43	625.59	-0.03	-2815.14	-3402.91
		17	71.15	806.98	-625.59	0.03	0.00	0.00
	5	64	-41.57	-705.85	53.15	-0.15	-393.08	-3404.80
		17	41.57	807.40	-121.55	0.15	0.00	0.00
	6	64	-64.05	-705.55	37.32	-0.11	-276.29	-3403.47
		17	64.05	807.10	-85.47	0.11	0.00	0.00
72	1	65	304.41	-517.15	3.40	-1.19	-20.08	70.46
		18	-304.41	637.27	-3.40	1.19	4.79	-2668.16
	2	65	217.35	-376.85	23.43	-65.80	-72.91	-366.92
		18	-217.35	496.97	-36.93	65.80	-62.92	-1599.51
	3	65	276.32	-470.37	12.63	-12.78	-56.31	-42.32
		18	-276.32	590.49	-22.08	12.78	-21.76	-2344.90
	4	65	560.64	-900.11	-1.60	-13.32	-28.97	1894.05
		18	-560.64	1020.22	1.60	13.32	36.26	-6213.66
	5	65	168.65	-274.93	116.26	-60.26	-315.36	-277.52
		18	-168.65	395.05	-184.66	60.26	-361.73	-1230.13
	6	65	443.81	-713.06	81.73	-42.73	-222.95	1244.00
		18	-443.81	833.18	-129.88	42.73	-253.23	-4722.57
73	1	66	-115.57	-1017.36	0.00	0.00	0.00	-4806.61
		23	115.57	1118.91	0.00	0.00	0.00	0.00
	2	66	-148.43	-1017.30	10.46	0.00	-77.47	-4806.36
		23	148.43	1118.85	-23.96	0.00	0.00	0.00
	3	66	-124.52	-1017.35	7.33	0.00	-54.23	-4806.54
		23	124.52	1118.90	-16.78	0.00	0.00	0.00
	4	66	50.15	-705.82	-626.59	0.00	2819.65	-3404.68
		23	-50.15	807.37	626.59	0.00	0.00	0.00
	5	66	-111.12	-705.62	53.07	0.00	-392.70	-3403.79
		23	111.12	807.17	-121.47	0.00	0.00	0.00
	6	66	-0.60	-705.76	37.39	0.00	-276.60	-3404.40
		23	0.60	807.31	-85.54	0.00	0.00	0.00
74	1	67	-54.07	-1017.64	0.00	0.00	0.00	-4807.88
		24	54.07	1119.19	0.00	0.00	0.00	0.00
	2	67	-87.47	-1017.58	10.48	0.00	-77.53	-4807.61
		24	87.47	1119.13	-23.98	0.00	0.00	0.00

MEMBER END FORCES STRUCTURE TYPE = SPACE

ALL UNITS ARE -- POUN FEET (LOCAL)

MEMBER	LOAD	JT	AXIAL	SHEAR-Y	SHEAR-Z	TORSION	MOM-Y	MOM-Z
	3	67	-63.20	-1017.63	7.34	0.00	-54.28	-4807.80
		24	63.20	1119.18	-16.79	0.00	0.00	0.00
	4	67	103.58	-705.99	627.03	0.00	-2821.63	-3405.46
		24	-103.58	807.54	-627.03	0.00	0.00	0.00
	5	67	-59.61	-705.79	53.13	0.00	-392.98	-3404.54
		24	59.61	807.34	-121.53	0.00	0.00	0.00
	6	67	52.34	-705.93	37.44	0.00	-276.80	-3405.17
		24	-52.34	807.48	-85.59	0.00	0.00	0.00
75	1	68	334.94	-601.17	1.48	2.15	5.17	-49.33
		25	-334.94	721.29	-1.48	-2.15	-11.82	-2926.62
	2	68	267.59	-453.24	12.76	3.45	-15.06	-464.90
		25	-267.59	573.36	-26.26	-3.45	-72.77	-1845.47
	3	68	314.00	-546.53	8.62	0.59	-14.37	-140.51
		25	-314.00	666.65	-18.07	-0.59	-45.70	-2589.58
	4	68	473.36	-942.90	0.00	0.01	-9.28	1833.80
		25	-473.36	1063.02	0.00	-0.01	9.25	-6346.24
	5	68	194.96	-319.22	62.50	14.09	-64.21	-336.13
		25	-194.96	439.34	-130.90	-14.09	-371.02	-1370.91
	6	68	390.33	-756.29	43.99	10.06	-45.51	1184.31
		25	-390.33	876.40	-92.14	-10.06	-260.86	-4857.52
76	1	69	-60.09	-1017.61	0.00	0.00	0.00	-4807.75
		30	60.09	1119.16	0.00	0.00	0.00	0.00
	2	69	-140.50	-1017.34	10.47	0.04	-77.48	-4806.52
		30	140.50	1118.89	-23.97	-0.04	0.00	0.00
	3	69	-83.58	-1017.53	7.33	0.03	-54.27	-4807.38
		30	83.58	1119.08	-16.78	-0.03	0.00	0.00
	4	69	276.16	-706.55	-628.45	0.03	2828.02	-3407.98
		30	-276.16	808.10	628.45	-0.03	0.00	0.00
	5	69	-107.17	-705.64	53.07	0.15	-392.72	-3403.84
		30	107.17	807.18	-121.47	-0.15	0.00	0.00
	6	69	158.10	-706.27	37.54	0.10	-277.26	-3406.71
		30	-158.10	807.82	-85.69	-0.10	0.00	0.00
77	1	70	24.24	-1018.00	0.00	0.00	0.00	-4809.49
		31	-24.24	1119.55	0.00	0.00	0.00	0.00
	2	70	-51.90	-1017.75	10.49	0.04	-77.57	-4808.34
		31	51.90	1119.29	-23.99	-0.04	0.00	0.00
	3	70	1.45	-1017.92	7.35	0.03	-54.33	-4809.13
		31	-1.45	1119.47	-16.80	-0.03	0.00	0.00
	4	70	313.16	-706.67	628.77	0.03	-2829.45	-3408.52
		31	-313.16	808.22	-628.77	-0.03	0.00	0.00
	5	70	-42.30	-705.85	53.15	0.16	-393.07	-3404.79
		31	42.30	807.39	-121.55	-0.16	0.00	0.00

MEMBER END FORCES STRUCTURE TYPE = SPACE

ALL UNITS ARE -- POUN FEET (LOCAL)

MEMBER	LOAD	JT	AXIAL	SHEAR-Y	SHEAR-Z	TORSION	MOM-Y	MOM-Z
	6	70	203.72	-706.42	37.58	0.11	-277.45	-3407.38
		31	-203.72	807.97	-85.73	-0.11	0.00	0.00
78	1	71	228.74	-510.91	3.40	-1.19	-16.14	50.47
		32	-228.74	631.03	-3.40	1.19	0.86	-2620.03
	2	71	219.95	-370.62	26.16	-25.87	-64.26	-388.76
		32	-219.95	490.74	-39.66	25.87	-83.99	-1549.66
	3	71	226.90	-464.13	17.02	15.23	-45.60	-63.05
		32	-226.90	584.25	-26.47	-15.23	-52.35	-2296.05
	4	71	185.58	-895.75	1.63	13.32	-17.52	1885.67
		32	-185.58	1015.87	-1.63	-13.32	10.11	-6186.44
	5	71	170.37	-270.50	120.03	90.17	-305.95	-293.05
		32	-170.37	390.62	-188.43	-90.17	-388.55	-1194.69
	6	71	181.28	-708.65	84.49	63.90	-215.43	1233.61
		32	-181.28	828.77	-132.64	-63.90	-273.47	-4692.61
79	1	72	5508.90	462.65	-3.29	3.79	66.86	5923.63
		73	-4320.33	-353.28	3.29	-3.79	-18.50	53.66
	2	72	5364.64	13.31	-376.09	-389.63	6554.41	127.26
		73	-4176.07	-13.31	266.72	389.63	-1832.88	67.34
	3	72	5460.89	330.50	-263.70	-270.37	4623.32	4219.10
		73	-4272.31	-253.21	186.41	270.37	-1316.42	56.67
	4	72	5165.50	2169.01	-21.36	-169.82	2074.98	27655.76
		73	-3976.93	-1613.40	21.36	169.82	-1750.21	45.16
	5	72	4521.42	10.08	-1807.85	-1716.44	30835.49	92.97
		73	-3332.85	-10.08	1252.24	1716.44	-8390.05	54.26
	6	72	4972.73	1521.54	-1273.80	-1210.68	21733.16	19380.62
		73	-3784.16	-1129.25	881.52	1210.68	-5913.34	29.10
80	1	73	3200.89	364.53	-3.29	3.79	18.51	-53.66
		74	-2997.13	-345.78	3.29	-3.79	-10.21	945.95
	2	73	3056.54	131.61	-242.70	-389.63	1832.73	-67.34
		74	-2852.78	-131.61	223.95	389.63	-1243.10	396.39
	3	73	3152.85	295.53	-169.61	-270.37	1316.31	-56.67
		74	-2949.09	-282.28	156.36	270.37	-904.23	781.99
	4	73	3169.72	1192.56	-647.55	-169.82	1750.11	-45.16
		74	-2965.96	-1097.31	647.55	169.82	-128.05	2927.90
	5	73	2525.32	100.93	-1130.58	-1716.44	8389.40	-54.26
		74	-2321.56	-100.93	1035.33	1716.44	-5657.87	306.60
	6	73	2976.85	865.85	-796.05	-1210.68	5912.89	-29.10
		74	-2773.09	-798.60	728.80	1210.68	-3986.63	2123.04
81	1	74	1877.69	350.84	-3.29	3.79	10.21	-945.95
		75	-1578.82	-323.34	3.29	-3.79	1.91	2185.35
	2	74	1733.25	299.61	-199.91	-389.63	1242.94	-396.39
		75	-1434.37	-299.61	172.41	389.63	-555.02	1494.96

MEMBER END FORCES STRUCTURE TYPE = SPACE

ALL UNITS ARE -- POUN FEET (LOCAL)

MEMBER	LOAD	JT	AXIAL	SHEAR-Y	SHEAR-Z	TORSION	MOM-Y	MOM-Z
	3	74	1829.63	335.42	-139.55	-270.37	904.12	-781.99
		75	-1530.75	-315.99	120.11	270.37	-424.06	1978.59
	4	74	2158.76	459.31	-21.43	-169.82	127.94	-2927.90
		75	-1859.88	-319.59	21.43	169.82	-46.23	4374.66
	5	74	1514.03	230.35	-913.61	-1716.44	5657.18	-306.60
		75	-1215.15	-230.35	773.89	1716.44	-2542.06	1151.22
	6	74	1965.78	394.14	-643.45	-1210.68	3986.14	-2123.04
		75	-1666.90	-295.50	544.81	1210.68	-1787.68	3399.26
82	1	75	948.48	95.21	0.00	0.00	0.04	422.55
		76	-537.54	-57.40	0.00	0.00	0.00	-36.00
	2	75	948.48	0.00	-97.82	0.00	521.34	-0.19
		76	-537.54	0.00	60.00	0.00	-119.98	0.00
	3	75	948.48	66.32	-68.72	0.00	365.61	292.25
		76	-537.54	-39.60	42.00	0.00	-83.98	-24.00
	4	75	828.48	455.90	0.00	0.00	1.34	1969.14
		76	-417.54	-263.80	0.00	0.00	0.00	-147.00
	5	75	828.48	0.00	-432.10	0.00	2187.97	-0.12
		76	-417.54	0.00	240.00	0.00	-479.93	0.00
	6	75	828.48	321.63	-303.63	0.02	1537.57	1390.14
		76	-417.54	-186.00	168.00	-0.02	-338.95	-105.00
83	1	76	0.00	214.77	24.20	12.00	-66.40	645.54
		77	0.00	-108.00	-9.00	-12.00	0.00	0.00
	2	76	-20.00	214.77	0.00	0.00	0.01	685.45
		77	20.00	-108.00	0.00	0.00	0.00	-40.00
	3	76	-14.00	214.77	16.80	8.00	-45.59	673.49
		77	14.00	-108.00	-6.00	-8.00	0.00	-28.00
	4	76	0.00	174.77	113.40	49.00	-300.80	485.54
		77	0.00	-68.00	-37.00	-49.00	0.00	0.00
	5	76	-80.00	174.77	0.00	0.00	0.26	644.09
		77	80.00	-68.00	0.00	0.00	0.00	-160.00
	6	76	-56.00	174.77	80.00	35.00	-211.86	597.82
		77	56.00	-68.00	-26.00	-35.00	0.00	-113.00
84	1	76	0.00	214.77	-24.20	-12.00	66.40	645.54
		78	0.00	-108.00	9.00	12.00	0.00	0.00
	2	76	20.00	214.77	0.00	0.00	-0.01	605.48
		78	-20.00	-108.00	0.00	0.00	0.00	40.00
	3	76	14.00	214.77	-16.80	-8.00	45.59	617.51
		78	-14.00	-108.00	6.00	8.00	0.00	28.00
	4	76	0.00	174.77	-113.40	-49.00	300.80	485.54
		78	0.00	-68.00	37.00	49.00	0.00	0.00
	5	76	80.00	174.77	0.00	0.00	-0.26	324.15
		78	-80.00	-68.00	0.00	0.00	0.00	160.00

MEMBER END FORCES STRUCTURE TYPE = SPACE

ALL UNITS ARE -- POUN FEET (LOCAL)

MEMBER	LOAD	JT	AXIAL	SHEAR-Y	SHEAR-Z	TORSION	MOM-Y	MOM-Z
	6	76	56.00	174.77	-80.00	-35.00	211.88	371.86
		78	-56.00	-68.00	26.00	35.00	0.00	113.00
85	1	32	132.12	389.75	3.29	-1.95	3.57	577.01
		81	-132.12	-269.63	-3.29	1.95	-18.38	906.90
	2	32	299.61	534.19	-6.40	120.68	-188.82	1664.17
		81	-299.61	-414.08	-7.10	-120.68	186.99	469.93
	3	32	183.67	437.81	-3.21	50.45	-136.84	906.06
		81	-183.67	-317.70	-6.24	-50.45	129.89	794.23
	4	32	-545.31	-224.32	21.43	44.89	-172.27	-3797.10
		81	545.31	344.44	-21.43	-44.89	76.15	2514.98
	5	32	230.35	420.41	-49.41	305.09	-756.83	1277.54
		81	-230.35	-300.30	-18.99	-305.09	824.38	344.35
	6	32	-313.13	-31.34	-34.02	215.11	-535.46	-2277.60
		81	313.13	151.46	-14.13	-215.11	581.07	1865.22
86	1	81	170.12	30.63	3.29	-1.95	-1.62	-951.90
		84	-170.12	62.79	-3.29	1.95	-9.89	895.64
	2	81	299.61	175.08	24.10	99.68	-186.99	-469.93
		84	-299.61	-81.65	-34.60	-99.68	83.94	919.45
	3	81	209.67	78.70	17.24	58.45	-129.89	-802.23
		84	-209.67	14.73	-24.59	-58.45	56.51	914.25
	4	81	-384.31	-498.44	21.43	44.89	-76.15	-2563.98
		84	384.31	591.86	-21.43	-44.89	1.39	657.03
	5	81	230.35	146.30	92.99	354.09	-824.38	-344.35
		84	-230.35	-52.87	-146.19	-354.09	404.67	693.04
	6	81	-200.13	-305.46	66.13	250.11	-581.07	-1900.22
		84	200.13	398.88	-103.58	-250.11	284.78	667.98
87	1	84	199.12	-239.79	3.29	-1.95	-10.11	-928.64
		87	-199.12	333.22	-3.29	1.95	-1.40	-74.44
	2	84	299.61	-95.35	42.60	66.68	-83.94	-919.45
		87	-299.61	188.77	-53.10	-66.68	-83.92	421.98
	3	84	229.67	-191.73	29.59	58.45	-56.51	-914.25
		87	-229.67	285.15	-36.94	-58.45	-60.13	79.39
	4	84	-260.31	-704.86	21.43	44.89	-1.39	-657.03
		87	260.31	798.28	-21.43	-44.89	-73.45	-1972.44
	5	84	230.35	-60.13	183.19	354.09	-404.67	-693.04
		87	-230.35	153.55	-236.39	-354.09	-330.91	318.95
	6	84	-113.13	-511.88	129.58	250.11	-284.78	-667.98
		87	113.13	605.30	-167.03	-250.11	-233.84	-1286.75
88	1	87	228.12	-510.22	3.29	-1.95	-18.60	41.44
		75	-228.12	630.33	-3.29	1.95	3.79	-2607.90
	2	87	299.61	-365.77	61.10	33.68	83.92	-421.98
		75	-299.61	485.89	-74.60	-33.68	-389.63	-1494.77

MEMBER END FORCES STRUCTURE TYPE = SPACE

ALL UNITS ARE -- POUN FEET (LOCAL)

MEMBER	LOAD	JT	AXIAL	SHEAR-Y	SHEAR-Z	TORSION	MOM-Y	MOM-Z
	3	87	249.67	-462.15	41.94	58.45	60.13	-79.39
		75	-249.67	582.27	-51.39	-58.45	-270.37	-2270.84
	4	87	-136.31	-911.28	21.43	44.89	73.45	1972.44
		75	136.31	1031.40	-21.43	-44.89	-169.82	-6343.79
	5	87	230.35	-266.55	273.39	354.09	330.91	-318.95
		75	-230.35	386.67	-341.79	-354.09	-1716.44	-1151.09
	6	87	-26.13	-718.30	193.03	250.11	233.84	1286.75
		75	26.13	838.42	-241.18	-250.11	-1210.70	-4789.41
89	1	31	-71.06	1119.30	0.00	0.00	0.00	0.00
		80	71.06	-1017.75	0.00	0.00	0.00	4808.36
	2	31	-168.00	1118.76	-23.96	0.16	0.00	0.00
		80	168.00	-1017.22	10.46	-0.16	77.45	4805.95
	3	31	-101.14	1119.14	-16.79	0.11	0.00	0.00
		80	101.14	-1017.59	7.34	-0.11	54.29	4807.63
	4	31	314.00	808.88	-630.45	0.10	0.00	0.00
		80	-314.00	-707.33	630.45	-0.10	2837.04	3411.46
	5	31	-129.42	807.11	-121.44	0.69	0.00	0.00
		80	129.42	-705.56	53.04	-0.69	392.60	3403.52
	6	31	182.46	808.35	-85.89	0.49	0.00	0.00
		80	-182.46	-706.80	37.74	-0.49	278.15	3409.07
90	1	80	-49.06	392.08	0.00	0.00	0.00	-4808.36
		83	49.06	-313.09	0.00	0.00	0.00	6042.12
	2	80	-168.00	391.98	-10.46	0.16	-77.45	-4805.95
		83	168.00	-313.00	-0.04	-0.16	95.77	6038.67
	3	80	-85.14	392.05	-7.34	0.11	-54.29	-4807.63
		83	85.14	-313.07	-0.01	-0.11	67.15	6041.08
	4	80	422.00	288.31	-209.88	0.10	-2837.04	-3411.46
		83	-422.00	-209.33	209.88	-0.10	3576.08	4284.11
	5	80	-129.42	287.98	-53.08	0.69	-392.60	-3403.52
		83	129.42	-209.00	-0.12	-0.69	485.50	4272.69
	6	80	256.46	288.21	-37.70	0.49	-278.15	-3409.07
		83	-256.46	-209.22	0.25	-0.49	344.26	4280.66
91	1	83	-27.06	-312.91	0.00	0.00	0.00	-6042.12
		86	27.06	391.89	0.00	0.00	0.00	4808.88
	2	83	-168.00	-313.00	0.04	0.16	-95.77	-6038.67
		86	168.00	391.98	-10.54	-0.16	77.45	4805.95
	3	83	-69.14	-312.93	0.01	0.11	-67.15	-6041.08
		86	69.14	391.92	-7.36	-0.11	54.30	4808.01
	4	83	530.00	-208.67	208.12	0.10	-3576.08	-4284.11
		86	-530.00	287.66	-208.12	-0.10	2841.67	3413.28
	5	83	-129.42	-209.00	0.12	0.69	-485.50	-4272.69
		86	129.42	287.98	-53.32	-0.69	392.60	3403.52

MEMBER END FORCES STRUCTURE TYPE = SPACE

ALL UNITS ARE -- POUN FEET (LOCAL)

MEMBER	LOAD	JT	AXIAL	SHEAR-Y	SHEAR-Z	TORSION	MOM-Y	MOM-Z
	6	83	330.46	-208.78	-0.25	0.49	-344.26	-4280.66
		86	-330.46	287.76	-37.20	-0.49	278.48	3410.32
92	1	86	-5.06	-1017.87	0.00	0.00	0.00	-4808.88
		74	5.06	1119.42	0.00	0.00	0.00	0.00
	2	86	-168.00	-1017.22	10.46	0.16	-77.45	-4805.95
		74	168.00	1118.76	-23.96	-0.16	0.00	0.00
	3	86	-53.14	-1017.67	7.34	0.11	-54.30	-4808.01
		74	53.14	1119.22	-16.79	-0.11	0.00	0.00
	4	86	638.00	-707.73	631.48	0.10	-2841.67	-3413.28
		74	-638.00	809.28	-631.48	-0.10	0.00	0.00
	5	86	-129.42	-705.56	53.04	0.69	-392.60	-3403.52
		74	129.42	807.11	-121.44	-0.69	0.00	0.00
	6	86	404.46	-707.07	37.81	0.49	-278.48	-3410.32
		74	-404.46	808.62	-85.96	-0.49	0.00	0.00
93	1	30	-77.26	1119.27	0.00	0.00	0.00	0.00
		79	77.26	-1017.72	0.00	0.00	0.00	4808.24
	2	30	-118.29	1118.99	-23.97	0.15	0.00	0.00
		79	118.29	-1017.44	10.47	-0.15	77.50	4806.97
	3	30	-90.32	1119.19	-16.79	0.11	0.00	0.00
		79	90.32	-1017.64	7.34	-0.11	54.29	4807.85
	4	30	96.84	808.17	628.62	0.09	0.00	0.00
		79	-96.84	-706.62	-628.62	-0.09	-2828.77	3408.28
	5	30	-90.85	807.24	-121.49	0.65	0.00	0.00
		79	90.85	-705.69	53.09	-0.65	392.81	3404.08
	6	30	41.41	807.89	-85.75	0.46	0.00	0.00
		79	-41.41	-706.34	37.60	-0.46	277.53	3407.01
94	1	79	-55.26	392.08	0.00	0.00	0.00	-4808.24
		82	55.26	-313.09	0.00	0.00	0.00	6041.95
	2	79	-118.29	391.98	-10.48	0.15	-77.50	-4806.97
		82	118.29	-313.00	-0.02	-0.15	95.84	6039.99
	3	79	-74.32	392.05	-7.34	0.11	-54.29	-4807.85
		82	74.32	-313.07	-0.01	-0.11	67.15	6041.37
	4	79	204.84	288.31	209.81	0.09	2828.77	-3408.28
		82	-204.84	-209.33	-209.81	-0.09	-3565.38	4280.01
	5	79	-90.85	287.98	-53.14	0.65	-392.81	-3404.08
		82	90.85	-209.00	-0.06	-0.65	485.77	4273.41
	6	79	115.41	288.21	-37.58	0.46	-277.53	-3407.01
		82	-115.41	-209.22	0.13	-0.46	343.46	4278.00
95	1	82	-33.26	-312.91	0.00	0.00	0.00	-6041.95
		85	33.26	391.89	0.00	0.00	0.00	4808.76
	2	82	-118.29	-313.00	0.02	0.15	-95.84	-6039.99
		85	118.29	391.98	-10.52	-0.15	77.50	4806.97

MEMBER END FORCES STRUCTURE TYPE = SPACE

ALL UNITS ARE -- POUN FEET (LOCAL)

MEMBER	LOAD	JT	AXIAL	SHEAR-Y	SHEAR-Z	TORSION	MOM-Y	MOM-Z
	3	82	-58.32	-312.93	0.01	0.11	-67.15	-6041.37
		85	58.32	391.92	-7.36	-0.11	54.31	4808.23
	4	82	312.84	-208.67	-208.19	0.09	3565.38	-4280.01
		85	-312.84	287.66	208.19	-0.09	-2833.39	3410.10
	5	82	-90.85	-209.00	0.06	0.65	-485.77	-4273.41
		85	90.85	287.98	-53.26	-0.65	392.81	3404.08
	6	82	189.41	-208.78	-0.13	0.46	-343.46	-4278.00
		85	-189.41	287.76	-37.32	-0.46	277.86	3408.25
96	1	85	-11.26	-1017.84	0.00	0.00	0.00	-4808.76
		73	11.26	1119.39	0.00	0.00	0.00	0.00
	2	85	-118.29	-1017.44	10.47	0.15	-77.50	-4806.97
		73	118.29	1118.99	-23.97	-0.15	0.00	0.00
	3	85	-42.32	-1017.72	7.34	0.11	-54.31	-4808.23
		73	42.32	1119.27	-16.79	-0.11	0.00	0.00
	4	85	420.84	-707.02	-629.64	0.09	2833.39	-3410.10
		73	-420.84	808.57	629.64	-0.09	0.00	0.00
	5	85	-90.85	-705.69	53.09	0.65	-392.81	-3404.08
		73	90.85	807.24	-121.49	-0.65	0.00	0.00
	6	85	263.41	-706.62	37.67	0.46	-277.86	-3408.25
		73	-263.41	808.16	-85.82	-0.46	0.00	0.00

********** END OF LATEST ANALYSIS RESULT **********

208. PRINT SUPPORT REACTION LIST 1 8 15 22 29 72

SUPPORT REACTIONS -UNIT POUN FEET STRUCTURE TYPE = SPACE

JOINT	LOAD	FORCE-X	FORCE-Y	FORCE-Z	MOM-X	MOM-Y	MOM Z	
1	1	-435.93	5252.87	3.29	66.84	3.79	5740.31	
	2	13.35	5397.16	-379.66	-6632.76	387.25	-55.43	
	3	-303.77	5300.89	-263.06	-4608.50	248.19	4035.93	
	4	-2150.80	3899.12	-21.41	-2072.50	170.02	27519.72	
	5	10.10	4542.93	-1822.52	-31156.76	1706.77	-45.59	
	6	-1502.15	4091.70	-1284.90	-21933.88	1207.23	19242.48	
8	1	-431.37	8464.78	0.11	3.01	4.43	5738.14	
	2	14.19	8460.60	-474.30	-8832.56	273.97	-49.65	
	3	-300.35	8463.49	-258.98	-5764.44	190.99	4036.28	
	4	-2133.70	6769.04	19.79	-2732.05	162.46	27490.32	
	5	10.79	6749.75	-2250.19	-40745.42	1150.22	-41.33	
	6	-1490.19	6763.30	-1586.00	-28719.17	815.52	19223.34	
15	1	-442.92	8530.88	-1.92	-36.98	-7.03	5808.96	
	2	4.15	8538.50	-495.10	-9360.91	14.15	9.83	
	3	-311.49	8538.74	-343.50	-6510.30	30.62	4103.85	MAX VERTICAL CASE FOR D.P. DESIGN
	4	-2148.84	6796.11	1.62	-3131.37	26.96	27590.22	
	5	3.33	6794.61	-2343.01	-42881.34	26.97	3.12	MAX MOMENT CASE FOR D.P. DESIGN
	6	-1502.99	6795.67	-1652.10	-30237.40	19.97	19306.42	
22	1	-451.25	8546.16	1.92	36.97	-7.03	5861.16	
	2	-4.14	8538.52	-495.03	-9358.98	-7.12	61.84	
	3	-319.81	8538.30	-346.09	-6563.58	-1.23	4155.99	
	4	-2155.66	6793.05	1.62	-3131.24	-27.03	27632.10	
	5	-3.33	6794.62	-2342.72	-42873.49	1.93	44.17	
	6	-1509.77	6793.53	-1651.92	-30232.14	0.52	19348.08	
29	1	-459.92	8456.59	-0.11	-3.02	4.43	5910.18	
	2	-14.24	8460.75	-473.46	-8813.57	-272.81	121.74	
	3	-328.87	8457.88	-329.56	-6185.80	-189.18	4208.11	
	4	-2155.84	6730.37	19.73	-2732.27	-162.16	27623.01	
	5	-10.82	6749.85	-2246.76	-40667.68	-1145.39	88.89	
	6	-1512.18	6736.25	-1584.12	-28671.85	-808.88	19355.35	
72	1	-462.65	5508.90	-3.29	-66.86	3.79	5923.63	
	2	-13.31	5364.64	-376.09	-6554.41	-389.63	127.26	
	3	-330.50	5460.89	-263.70	-4623.32	-270.37	4219.10	
	4	-2169.01	5165.50	-21.36	-2074.98	-169.82	27655.76	
	5	-10.08	4521.42	-1807.85	-30835.49	-1716.44	92.97	
	6	-1521.54	4972.73	-1273.80	-21733.16	-1210.68	19380.62	

********** END OF LATEST ANALYSIS RESULT **********

209. PARAMETER 1
210. CODE AISC UNIFIED 2010

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211. METHOD ASD
212. FYLD 7.2E+006 MEMB 31 32 34 35 37 38 40 41 43 44 46 47 49 50 52 53 55 56 58 -
213. 59 61 62 64 65 67 68 70 71 73 74 76 77 89 TO 96
214. FYLD 6.624E+006 MEMB 1 TO 30 33 36 39 42 45 48 51 54 57 60 63 66 69 72 75 -
215. 78 TO 88
216. FU 9.36E+006 MEMB 31 32 34 35 37 38 40 41 43 44 46 47 49 50 52 53 55 56 58 -
217. 59 61 62 64 65 67 68 70 71 73 74 76 77 89 TO 96
218. FU 8.352E+006 MEMB 1 TO 30 33 36 39 42 45 48 51 54 57 60 63 66 69 72 75 78 -
219. 79 TO 88
220. LX 16 MEMB 31 TO 78 85 TO 96
221. LY 16 MEMB 31 TO 78 85 TO 96
222. LZ 16 MEMB 31 TO 78 85 TO 96
223. CHECK CODE ALL
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STAAD.PRO CODE CHECKING - (AISC-360-10-ASD) v1.2
****

ALL UNITS ARE - KIP INCH (UNLESS OTHERWISE NOTED)

MEMBER NO: 1 CRITICAL RATIO: 0.282(PASS) LOAD: 6
LOCATION (ft): 0.00 CONDITION: Eq. H1-1b
SECTION: HSST12X12X0.375 (AISC SECTIONS)

MEMBER NO: 2 CRITICAL RATIO: 0.061(PASS) LOAD: 5
LOCATION (ft): 0.00 CONDITION: Eq. H1-1b
SECTION: HSST12X12X0.375 (AISC SECTIONS)

MEMBER NO: 3 CRITICAL RATIO: 0.041(PASS) LOAD: 5
LOCATION (ft): 0.00 CONDITION: Eq. H1-1b
SECTION: HSST12X12X0.375 (AISC SECTIONS)

MEMBER NO: 4 CRITICAL RATIO: 0.020(PASS) LOAD: 6
LOCATION (ft): 0.00 CONDITION: Eq. H1-1b
SECTION: HSST12X12X0.375 (AISC SECTIONS)

MEMBER NO: 5 CRITICAL RATIO: 0.031(PASS) LOAD: 4
LOCATION (ft): 4.00 CONDITION: Eq. H1-1b
SECTION: HSST6X6X0.25 (AISC SECTIONS)

MEMBER NO: 6 CRITICAL RATIO: 0.032(PASS) LOAD: 6
LOCATION (ft): 0.00 CONDITION: Eq. H1-1b
SECTION: HSST6X6X0.25 (AISC SECTIONS)

MEMBER NO: 7 CRITICAL RATIO: 0.331(PASS) LOAD: 6
LOCATION (ft): 0.00 CONDITION: Eq. H1-1b
SECTION: HSST12X12X0.375 (AISC SECTIONS)

MEMBER NO: 8 CRITICAL RATIO: 0.084(PASS) LOAD: 5
LOCATION (ft): 0.00 CONDITION: Eq. H1-1b
SECTION: HSST12X12X0.375 (AISC SECTIONS)

MEMBER NO: 9 CRITICAL RATIO: 0.058(PASS) LOAD: 5
LOCATION (ft): 0.00 CONDITION: Eq. H1-1b
SECTION: HSST12X12X0.375 (AISC SECTIONS)

STAAD.PRO CODE CHECKING - (AISC-360-10-ASD) v1.2
****

ALL UNITS ARE - KIP INCH (UNLESS OTHERWISE NOTED)

MEMBER NO: 10 CRITICAL RATIO: 0.030(PASS) LOAD: 5
LOCATION (ft): 0.00 CONDITION: Eq. H1-1b
SECTION: HSST12X12X0.375 (AISC SECTIONS)

MEMBER NO: 11 CRITICAL RATIO: 0.044(PASS) LOAD: 1
LOCATION (ft): 4.00 CONDITION: Eq. H1-1b
SECTION: HSST6X6X0.25 (AISC SECTIONS)

MEMBER NO: 12 CRITICAL RATIO: 0.049(PASS) LOAD: 6
LOCATION (ft): 0.00 CONDITION: Eq. H1-1b
SECTION: HSST6X6X0.25 (AISC SECTIONS)

MEMBER NO: 13 CRITICAL RATIO: 0.342(PASS) LOAD: 6
LOCATION (ft): 0.00 CONDITION: Eq. H1-1b
SECTION: HSST12X12X0.375 (AISC SECTIONS)

MEMBER NO: 14 CRITICAL RATIO: 0.089(PASS) LOAD: 5
LOCATION (ft): 0.00 CONDITION: Eq. H1-1b
SECTION: HSST12X12X0.375 (AISC SECTIONS)

MEMBER NO: 15 CRITICAL RATIO: 0.061(PASS) LOAD: 5
LOCATION (ft): 0.00 CONDITION: Eq. H1-1b
SECTION: HSST12X12X0.375 (AISC SECTIONS)

MEMBER NO: 16 CRITICAL RATIO: 0.030(PASS) LOAD: 5
LOCATION (ft): 0.00 CONDITION: Eq. H1-1b
SECTION: HSST12X12X0.375 (AISC SECTIONS)

MEMBER NO: 17 CRITICAL RATIO: 0.044(PASS) LOAD: 1
LOCATION (ft): 4.00 CONDITION: Eq. H1-1b
SECTION: HSST6X6X0.25 (AISC SECTIONS)

MEMBER NO: 18 CRITICAL RATIO: 0.049(PASS) LOAD: 6
LOCATION (ft): 0.00 CONDITION: Eq. H1-1b
SECTION: HSST6X6X0.25 (AISC SECTIONS)

STAAD.PRO CODE CHECKING - (AISC-360-10-ASD) v1.2
****

ALL UNITS ARE - KIP INCH (UNLESS OTHERWISE NOTED)

MEMBER NO: 19 CRITICAL RATIO: 0.342(PASS) LOAD: 6
LOCATION (ft): 0.00 CONDITION: Eq. H1-1b
SECTION: HSST12X12X0.375 (AISC SECTIONS)

MEMBER NO: 20 CRITICAL RATIO: 0.088(PASS) LOAD: 5
LOCATION (ft): 0.00 CONDITION: Eq. H1-1b
SECTION: HSST12X12X0.375 (AISC SECTIONS)

MEMBER NO: 21 CRITICAL RATIO: 0.061(PASS) LOAD: 5
LOCATION (ft): 0.00 CONDITION: Eq. H1-1b
SECTION: HSST12X12X0.375 (AISC SECTIONS)

MEMBER NO: 22 CRITICAL RATIO: 0.030(PASS) LOAD: 5
LOCATION (ft): 0.00 CONDITION: Eq. H1-1b
SECTION: HSST12X12X0.375 (AISC SECTIONS)

MEMBER NO: 23 CRITICAL RATIO: 0.044(PASS) LOAD: 1
LOCATION (ft): 4.00 CONDITION: Eq. H1-1b
SECTION: HSST6X6X0.25 (AISC SECTIONS)

MEMBER NO: 24 CRITICAL RATIO: 0.049(PASS) LOAD: 6
LOCATION (ft): 0.00 CONDITION: Eq. H1-1b
SECTION: HSST6X6X0.25 (AISC SECTIONS)

MEMBER NO: 25 CRITICAL RATIO: 0.332(PASS) LOAD: 6
LOCATION (ft): 0.00 CONDITION: Eq. H1-1b
SECTION: HSST12X12X0.375 (AISC SECTIONS)

MEMBER NO: 26 CRITICAL RATIO: 0.084(PASS) LOAD: 5
LOCATION (ft): 0.00 CONDITION: Eq. H1-1b
SECTION: HSST12X12X0.375 (AISC SECTIONS)

MEMBER NO: 27 CRITICAL RATIO: 0.058(PASS) LOAD: 5
LOCATION (ft): 0.00 CONDITION: Eq. H1-1b
SECTION: HSST12X12X0.375 (AISC SECTIONS)

STAAD.PRO CODE CHECKING - (AISC-360-10-ASD) v1.2
****

ALL UNITS ARE - KIP INCH (UNLESS OTHERWISE NOTED)

MEMBER NO: 28 CRITICAL RATIO: 0.030(PASS) LOAD: 5
LOCATION (ft): 0.00 CONDITION: Eq. H1-1b
SECTION: HSST12X12X0.375 (AISC SECTIONS)

MEMBER NO: 29 CRITICAL RATIO: 0.044(PASS) LOAD: 1
LOCATION (ft): 4.00 CONDITION: Eq. H1-1b
SECTION: HSST6X6X0.25 (AISC SECTIONS)

MEMBER NO: 30 CRITICAL RATIO: 0.049(PASS) LOAD: 6
LOCATION (ft): 0.00 CONDITION: Eq. H1-1b
SECTION: HSST6X6X0.25 (AISC SECTIONS)

MEMBER NO: 31 CRITICAL RATIO: 0.393(PASS) LOAD: 4
LOCATION (ft): 4.50 CONDITION: Eq. H1-1b
SECTION: W6X15 (AISC SECTIONS)

MEMBER NO: 32 CRITICAL RATIO: 0.392(PASS) LOAD: 4
LOCATION (ft): 4.50 CONDITION: Eq. H1-1b
SECTION: W6X15 (AISC SECTIONS)

MEMBER NO: 33 CRITICAL RATIO: 0.162(PASS) LOAD: 4
LOCATION (ft): 0.00 CONDITION: Eq. H1-1b
SECTION: HSST6X6X0.25 (AISC SECTIONS)

MEMBER NO: 34 CRITICAL RATIO: 0.393(PASS) LOAD: 4
LOCATION (ft): 4.50 CONDITION: Eq. H1-1b
SECTION: W6X15 (AISC SECTIONS)

MEMBER NO: 35 CRITICAL RATIO: 0.393(PASS) LOAD: 4
LOCATION (ft): 4.50 CONDITION: Eq. H1-1b
SECTION: W6X15 (AISC SECTIONS)

MEMBER NO: 36 CRITICAL RATIO: 0.147(PASS) LOAD: 4
LOCATION (ft): 0.00 CONDITION: Eq. H1-1b
SECTION: HSST6X6X0.25 (AISC SECTIONS)

STAAD.PRO CODE CHECKING - (AISC-360-10-ASD) v1.2
****

ALL UNITS ARE - KIP INCH (UNLESS OTHERWISE NOTED)

MEMBER NO: 37 CRITICAL RATIO: 0.393(PASS) LOAD: 4
LOCATION (ft): 4.50 CONDITION: Eq. H1-1b
SECTION: W6X15 (AISC SECTIONS)

MEMBER NO: 38 CRITICAL RATIO: 0.393(PASS) LOAD: 4
LOCATION (ft): 4.50 CONDITION: Eq. H1-1b
SECTION: W6X15 (AISC SECTIONS)

MEMBER NO: 39 CRITICAL RATIO: 0.139(PASS) LOAD: 4
LOCATION (ft): 0.00 CONDITION: Eq. H1-1b
SECTION: HSST6X6X0.25 (AISC SECTIONS)

MEMBER NO: 40 CRITICAL RATIO: 0.393(PASS) LOAD: 4
LOCATION (ft): 4.50 CONDITION: Eq. H1-1b
SECTION: W6X15 (AISC SECTIONS)

MEMBER NO: 41 CRITICAL RATIO: 0.393(PASS) LOAD: 4
LOCATION (ft): 4.50 CONDITION: Eq. H1-1b
SECTION: W6X15 (AISC SECTIONS)

MEMBER NO: 42 CRITICAL RATIO: 0.146(PASS) LOAD: 4
LOCATION (ft): 0.00 CONDITION: Eq. H1-1b
SECTION: HSST6X6X0.25 (AISC SECTIONS)

MEMBER NO: 43 CRITICAL RATIO: 0.493(PASS) LOAD: 4
LOCATION (ft): 0.00 CONDITION: Eq. H1-1b
SECTION: W6X15 (AISC SECTIONS)

MEMBER NO: 44 CRITICAL RATIO: 0.492(PASS) LOAD: 4
LOCATION (ft): 0.00 CONDITION: Eq. H1-1b
SECTION: W6X15 (AISC SECTIONS)

MEMBER NO: 45 CRITICAL RATIO: 0.079(PASS) LOAD: 4
LOCATION (ft): 3.50 CONDITION: Eq. H1-1b
SECTION: HSST6X6X0.25 (AISC SECTIONS)

STAAD.PRO CODE CHECKING - (AISC-360-10-ASD) v1.2
****

ALL UNITS ARE - KIP INCH (UNLESS OTHERWISE NOTED)

MEMBER NO: 46 CRITICAL RATIO: 0.493 (PASS) LOAD: 4
LOCATION (ft): 0.00 CONDITION: Eq. H1-1b
SECTION: W6X15 (AISC SECTIONS)

MEMBER NO: 47 CRITICAL RATIO: 0.493 (PASS) LOAD: 4
LOCATION (ft): 0.00 CONDITION: Eq. H1-1b
SECTION: W6X15 (AISC SECTIONS)

MEMBER NO: 48 CRITICAL RATIO: 0.076 (PASS) LOAD: 4
LOCATION (ft): 3.50 CONDITION: Eq. H1-1b
SECTION: HSST6X6X0.25 (AISC SECTIONS)

MEMBER NO: 49 CRITICAL RATIO: 0.493 (PASS) LOAD: 4
LOCATION (ft): 0.00 CONDITION: Eq. H1-1b
SECTION: W6X15 (AISC SECTIONS)

MEMBER NO: 50 CRITICAL RATIO: 0.493 (PASS) LOAD: 4
LOCATION (ft): 0.00 CONDITION: Eq. H1-1b
SECTION: W6X15 (AISC SECTIONS)

MEMBER NO: 51 CRITICAL RATIO: 0.073 (PASS) LOAD: 4
LOCATION (ft): 3.50 CONDITION: Eq. H1-1b
SECTION: HSST6X6X0.25 (AISC SECTIONS)

MEMBER NO: 52 CRITICAL RATIO: 0.496 (PASS) LOAD: 4
LOCATION (ft): 0.00 CONDITION: Eq. H1-1b
SECTION: W6X15 (AISC SECTIONS)

MEMBER NO: 53 CRITICAL RATIO: 0.497 (PASS) LOAD: 4
LOCATION (ft): 0.00 CONDITION: Eq. H1-1b
SECTION: W6X15 (AISC SECTIONS)

MEMBER NO: 54 CRITICAL RATIO: 0.074 (PASS) LOAD: 4
LOCATION (ft): 3.50 CONDITION: Eq. H1-1b
SECTION: HSST6X6X0.25 (AISC SECTIONS)

STAAD.PRO CODE CHECKING - (AISC-360-10-ASD) v1.2
****

ALL UNITS ARE - KIP INCH (UNLESS OTHERWISE NOTED)

MEMBER NO: 55 CRITICAL RATIO: 0.493(PASS) LOAD: 4
LOCATION (ft): 3.50 CONDITION: Eq. H1-1b
SECTION: W6X15 (AISC SECTIONS)

MEMBER NO: 56 CRITICAL RATIO: 0.493(PASS) LOAD: 4
LOCATION (ft): 3.50 CONDITION: Eq. H1-1b
SECTION: W6X15 (AISC SECTIONS)

MEMBER NO: 57 CRITICAL RATIO: 0.109(PASS) LOAD: 4
LOCATION (ft): 0.00 CONDITION: Eq. H1-1b
SECTION: HSST6X6X0.25 (AISC SECTIONS)

MEMBER NO: 58 CRITICAL RATIO: 0.493(PASS) LOAD: 4
LOCATION (ft): 3.50 CONDITION: Eq. H1-1b
SECTION: W6X15 (AISC SECTIONS)

MEMBER NO: 59 CRITICAL RATIO: 0.493(PASS) LOAD: 4
LOCATION (ft): 3.50 CONDITION: Eq. H1-1b
SECTION: W6X15 (AISC SECTIONS)

MEMBER NO: 60 CRITICAL RATIO: 0.102(PASS) LOAD: 4
LOCATION (ft): 0.00 CONDITION: Eq. H1-1b
SECTION: HSST6X6X0.25 (AISC SECTIONS)

MEMBER NO: 61 CRITICAL RATIO: 0.493(PASS) LOAD: 4
LOCATION (ft): 3.50 CONDITION: Eq. H1-1b
SECTION: W6X15 (AISC SECTIONS)

MEMBER NO: 62 CRITICAL RATIO: 0.494(PASS) LOAD: 4
LOCATION (ft): 3.50 CONDITION: Eq. H1-1b
SECTION: W6X15 (AISC SECTIONS)

MEMBER NO: 63 CRITICAL RATIO: 0.102(PASS) LOAD: 4
LOCATION (ft): 0.00 CONDITION: Eq. H1-1b
SECTION: HSST6X6X0.25 (AISC SECTIONS)

STAAD.PRO CODE CHECKING - (AISC-360-10-ASD) v1.2
****

ALL UNITS ARE - KIP INCH (UNLESS OTHERWISE NOTED)

MEMBER NO: 64 CRITICAL RATIO: 0.495(PASS) LOAD: 4
LOCATION (ft): 3.50 CONDITION: Eq. H1-1b
SECTION: W6X15 (AISC SECTIONS)

MEMBER NO: 65 CRITICAL RATIO: 0.495(PASS) LOAD: 4
LOCATION (ft): 3.50 CONDITION: Eq. H1-1b
SECTION: W6X15 (AISC SECTIONS)

MEMBER NO: 66 CRITICAL RATIO: 0.100(PASS) LOAD: 4
LOCATION (ft): 0.00 CONDITION: Eq. H1-1b
SECTION: HSST6X6X0.25 (AISC SECTIONS)

MEMBER NO: 67 CRITICAL RATIO: 0.392(PASS) LOAD: 4
LOCATION (ft): 0.00 CONDITION: Eq. H1-1b
SECTION: W6X15 (AISC SECTIONS)

MEMBER NO: 68 CRITICAL RATIO: 0.392(PASS) LOAD: 4
LOCATION (ft): 0.00 CONDITION: Eq. H1-1b
SECTION: W6X15 (AISC SECTIONS)

MEMBER NO: 69 CRITICAL RATIO: 0.253(PASS) LOAD: 4
LOCATION (ft): 4.50 CONDITION: Eq. H1-1b
SECTION: HSST6X6X0.25 (AISC SECTIONS)

MEMBER NO: 70 CRITICAL RATIO: 0.392(PASS) LOAD: 4
LOCATION (ft): 0.00 CONDITION: Eq. H1-1b
SECTION: W6X15 (AISC SECTIONS)

MEMBER NO: 71 CRITICAL RATIO: 0.392(PASS) LOAD: 4
LOCATION (ft): 0.00 CONDITION: Eq. H1-1b
SECTION: W6X15 (AISC SECTIONS)

MEMBER NO: 72 CRITICAL RATIO: 0.245(PASS) LOAD: 4
LOCATION (ft): 4.50 CONDITION: Eq. H1-1b
SECTION: HSST6X6X0.25 (AISC SECTIONS)

STAAD.PRO CODE CHECKING - (AISC-360-10-ASD) v1.2
****

ALL UNITS ARE - KIP INCH (UNLESS OTHERWISE NOTED)

MEMBER NO: 73 CRITICAL RATIO: 0.393 (PASS) LOAD: 4
LOCATION (ft): 0.00 CONDITION: Eq. H1-1b
SECTION: W6X15 (AISC SECTIONS)

MEMBER NO: 74 CRITICAL RATIO: 0.394 (PASS) LOAD: 4
LOCATION (ft): 0.00 CONDITION: Eq. H1-1b
SECTION: W6X15 (AISC SECTIONS)

MEMBER NO: 75 CRITICAL RATIO: 0.249 (PASS) LOAD: 4
LOCATION (ft): 4.50 CONDITION: Eq. H1-1b
SECTION: HSST6X6X0.25 (AISC SECTIONS)

MEMBER NO: 76 CRITICAL RATIO: 0.397 (PASS) LOAD: 4
LOCATION (ft): 0.00 CONDITION: Eq. H1-1b
SECTION: W6X15 (AISC SECTIONS)

MEMBER NO: 77 CRITICAL RATIO: 0.397 (PASS) LOAD: 4
LOCATION (ft): 0.00 CONDITION: Eq. H1-1b
SECTION: W6X15 (AISC SECTIONS)

MEMBER NO: 78 CRITICAL RATIO: 0.242 (PASS) LOAD: 4
LOCATION (ft): 4.50 CONDITION: Eq. H1-1b
SECTION: HSST6X6X0.25 (AISC SECTIONS)

MEMBER NO: 79 CRITICAL RATIO: 0.283 (PASS) LOAD: 6
LOCATION (ft): 0.00 CONDITION: Eq. H1-1b
SECTION: HSST12X12X0.375 (AISC SECTIONS)

MEMBER NO: 80 CRITICAL RATIO: 0.060 (PASS) LOAD: 5
LOCATION (ft): 0.00 CONDITION: Eq. H1-1b
SECTION: HSST12X12X0.375 (AISC SECTIONS)

MEMBER NO: 81 CRITICAL RATIO: 0.040 (PASS) LOAD: 5
LOCATION (ft): 0.00 CONDITION: Eq. H1-1b
SECTION: HSST12X12X0.375 (AISC SECTIONS)

STAAD.PRO CODE CHECKING - (AISC-360-10-ASD) v1.2
****

ALL UNITS ARE - KIP INCH (UNLESS OTHERWISE NOTED)

MEMBER NO: 82 CRITICAL RATIO: 0.020(PASS) LOAD: 6
LOCATION (ft): 0.00 CONDITION: Eq. H1-1b
SECTION: HSST12X12X0.375 (AISC SECTIONS)

MEMBER NO: 83 CRITICAL RATIO: 0.032(PASS) LOAD: 6
LOCATION (ft): 0.00 CONDITION: Eq. H1-1b
SECTION: HSST6X6X0.25 (AISC SECTIONS)

MEMBER NO: 84 CRITICAL RATIO: 0.031(PASS) LOAD: 4
LOCATION (ft): 0.00 CONDITION: Eq. H1-1b
SECTION: HSST6X6X0.25 (AISC SECTIONS)

MEMBER NO: 85 CRITICAL RATIO: 0.156(PASS) LOAD: 4
LOCATION (ft): 0.00 CONDITION: Eq. H1-1b
SECTION: HSST6X6X0.25 (AISC SECTIONS)

MEMBER NO: 86 CRITICAL RATIO: 0.104(PASS) LOAD: 4
LOCATION (ft): 0.00 CONDITION: Eq. H1-1b
SECTION: HSST6X6X0.25 (AISC SECTIONS)

MEMBER NO: 87 CRITICAL RATIO: 0.080(PASS) LOAD: 4
LOCATION (ft): 3.50 CONDITION: Eq. H1-1b
SECTION: HSST6X6X0.25 (AISC SECTIONS)

MEMBER NO: 88 CRITICAL RATIO: 0.254(PASS) LOAD: 4
LOCATION (ft): 4.50 CONDITION: Eq. H1-1b
SECTION: HSST6X6X0.25 (AISC SECTIONS)

MEMBER NO: 89 CRITICAL RATIO: 0.398(PASS) LOAD: 4
LOCATION (ft): 4.50 CONDITION: Eq. H1-1b
SECTION: W6X15 (AISC SECTIONS)

MEMBER NO: 90 CRITICAL RATIO: 0.501(PASS) LOAD: 4
LOCATION (ft): 3.50 CONDITION: Eq. H1-1b
SECTION: W6X15 (AISC SECTIONS)

STAAD.PRO CODE CHECKING - (AISC-360-10-ASD) v1.2
****

ALL UNITS ARE - KIP INCH (UNLESS OTHERWISE NOTED)

MEMBER NO: 91 CRITICAL RATIO: 0.503(PASS) LOAD: 4
LOCATION (ft): 0.00 CONDITION: Eq. H1-1b
SECTION: W6X15 (AISC SECTIONS)

MEMBER NO: 92 CRITICAL RATIO: 0.403(PASS) LOAD: 4
LOCATION (ft): 0.00 CONDITION: Eq. H1-1b
SECTION: W6X15 (AISC SECTIONS)

MEMBER NO: 93 CRITICAL RATIO: 0.394(PASS) LOAD: 4
LOCATION (ft): 4.50 CONDITION: Eq. H1-1b
SECTION: W6X15 (AISC SECTIONS)

MEMBER NO: 94 CRITICAL RATIO: 0.497(PASS) LOAD: 4
LOCATION (ft): 3.50 CONDITION: Eq. H1-1b
SECTION: W6X15 (AISC SECTIONS)

ALL MEMBERS PASS

MEMBER NO: 95 CRITICAL RATIO: 0.499(PASS) LOAD: 4
LOCATION (ft): 0.00 CONDITION: Eq. H1-1b
SECTION: W6X15 (AISC SECTIONS)

MEMBER NO: 96 CRITICAL RATIO: 0.399(PASS) LOAD: 4
LOCATION (ft): 0.00 CONDITION: Eq. H1-1b
SECTION: W6X15 (AISC SECTIONS)

224. FINISH

********** END OF THE STAAD.Pro RUN **********

**** DATE= JAN 4,2018 TIME= 9:20:36 ****

```
*************************************************************
*        For questions on STAAD.Pro, please contact         *
*        Bentley Systems or Partner offices                 *
*                                                           *
*            Telephone             Web / Email              *
*  USA       +1  (714) 974-2500                             *
*  UK        +44 (0) 808 101 9246                           *
*  SINGAPORE +65 6225-6158                                  *
*  FRANCE    +33 (0) 1 55238400                             *
*  GERMANY   +49 0931 40468                                 *
*  INDIA     +91 (033) 4006-2021                            *
*  JAPAN     +81 (03)5952-6500    http://www.ctc-g.co.jp    *
*  CHINA     +86 21 6288 4040                               *
*  THAILAND  +66 (0)2645-1018/19 partha.p@reisoftwareth.com*
*                                                           *
*  Worldwide  http://selectservices.bentley.com/en-US/      *
*                                                           *
*************************************************************
```

This MathCAD document is used to calculate the following:

1. Base Plate thickness for bearing type(Square Tube Column)
2. Checks Anchor bolt Diameter
3. Checks Fillet Weld Size

References which are used for the base plate design are:

1. AISC UNIFIED Construction Manual, 13th Edition.

ASD Design Factors

$\Omega_{BP} := 1.67$ $\Omega_{AB} := 2.00$

Definition of Units

$kip \equiv 1000 \cdot lb$ $kin \equiv kip \cdot in$ $ksi \equiv \frac{kip}{in^2}$ $psi \equiv \frac{lb}{in^2}$

Determine Plate Dimensions

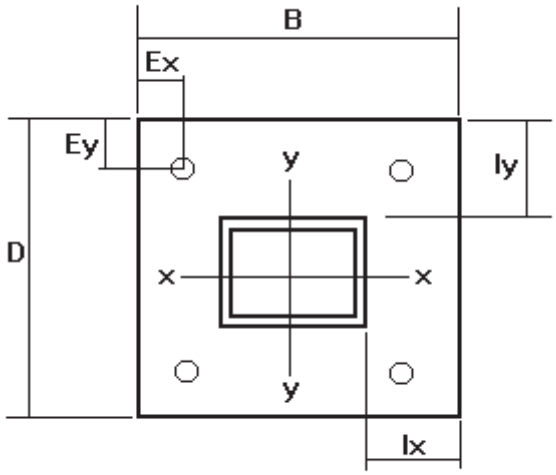
Depth of Column

Dimensions for Column used:

HSS12x12x3/8

$d := 12 \cdot in$ $tw := 0.375 \cdot in$

$bf := 12 \cdot in$ $tf := 0.375 \cdot in$



Enter the dimensions for the plate.

$B := 20 \cdot in$ $Ex := 2 \cdot in$

$D := 20 \cdot in$ $Ey := 2 \cdot in$

Design Forces

$Axial := 6.976 \cdot kip$

$Fx := 1.652 \cdot kip$ $My := 362.849 \cdot kin$

$Fy := 1.503 \cdot kip$ $Mx := 231.677 \cdot kin$

Base Plate and Anchor Bolt Material Properties.

$fy_{BP} := 36.0 \cdot ksi$ *Yield Stress of Base Plate*

$fu_{AB} := 58.0 \cdot ksi$ *Tensile Stress of Anchor Bolt (58ksi for A36)*

Estimated Anchor Bolts:

$AB_Dia := 1.5 \cdot in$ $A_{AB} := \left(\frac{\pi}{4}\right) \cdot AB_Dia^2$ $A_{AB} = 1.767 \cdot in^2$

The nominal tensile and shear stress for the bolts is based on the formula from page 16.1-104 of the 13th Edition of the AISC UNIFIED manual.

$F_{nt} := 0.75 \cdot fu_{AB}$ $F_{nt} = 43.5 \cdot ksi$

$F_{nv} := 0.40 \cdot fu_{AB}$ $F_{nv} = 23.2 \cdot ksi$

Determine Plate Thickness for Leveling Nut Base Plate.

A. Proportion Axial Force

$P_Ax := \frac{Axial}{4}$ $P_Ax = 1.7 \cdot kip$

B. Determine Bolt Forces due to Mx (for two bolts in compression)

$FC_Mx := \frac{Mx}{D - 2 \cdot Ey}$ $FC_Mx = 14.5 \cdot kip$

$P_Mx := 2 \cdot P_Ax + FC_Mx$ $P_Mx = 18 \cdot kip$

C. Determine Bolt Forces due to My (for two bolts in compression)

$FC_My := \frac{My}{B - 2 \cdot Ex}$ $FC_My = 22.7 \cdot kip$

$P_My := 2 \cdot P_Ax + FC_My$ $P_My = 26.2 \cdot kip$

D. Determine Thickness Required for Mx

$l_Mx := \frac{D - 2 \cdot Ey - d}{2}$ $l_Mx = 2.0 \cdot in$

$M_Mx := P_Mx \cdot l_Mx$ $M_Mx = 35.9 \cdot kin$

$t_Mx := \sqrt{\frac{\Omega_{BP} \cdot 4 \cdot M_Mx}{fy_{BP} \cdot B}}$ $t_Mx = 0.6 \cdot in$

E. Determine Thickness Required for My

$$l_My := \frac{B - 2 \cdot Ex - bf}{2} \qquad l_My = 2.0 \cdot in$$

$$M_My := P_My \cdot l_My \qquad M_My = 52.3 \cdot kin$$

$$t_My := \sqrt{\frac{\Omega_{BP} \cdot 4 \cdot M_My}{fy_{BP} \cdot D}} \qquad t_My = 0.7 \cdot in$$

F. Determine Total Plate Thickness Required

$$t_min := \sqrt{t_Mx^2 + t_My^2} \qquad t_min = 0.9 \cdot in$$

Check Anchor Bolt Diameter:

Calculate the Actual Tension per Bolt.

$$Max_Tension := \frac{FC_Mx + FC_My}{2} - P_Ax \qquad Max_Tension = 16.8 \cdot kip$$

Calculate the Allowable Tension per Bolt.

$$R_{nt} := F_{nt} \cdot A_{AB} \qquad R_{nt} = 76.9 \cdot kip$$

$$R_Allow_T := \frac{R_{nt}}{\Omega_{AB}} \qquad R_Allow_T = 38.4 \cdot kip$$

Calculate the Actual Shear per Bolt.

$$Shear := \frac{\sqrt{\left(Fy^2 + Fx^2\right)}}{4} \qquad Shear = 0.558 \cdot kip$$

Calculate the Allowable Shear per Bolt.

$$R_{nv} := F_{nv} \cdot A_{AB} \qquad R_{nv} = 41.0 \cdot kip$$

$$R_Allow_V := \frac{R_{nv}}{\Omega_{AB}} \qquad R_Allow_V = 20.5 \cdot kip$$

Calculate the Allowable Combined Tension and Shear.

$$F_v := \frac{Shear}{A_{AB}} \qquad F_v = 0.3 \cdot ksi$$

$$F_{nt_comb} := 1.3 \cdot F_{nt} - \left(\frac{\Omega_{AB} \cdot F_{nt}}{F_{nv}}\right) \cdot F_v \qquad F_{nt_comb} = 55.365 \cdot ksi$$

Fnt_comb needs to be less than or equal to Fnt.

$$Fnt_comb := if\left(F_{nt_comb} \le F_{nt}, F_{nt_comb}, F_{nt}\right) \qquad Fnt_comb = 43.5 \cdot ksi$$

$$R_Allow_C := \frac{Fnt_comb \cdot A_{AB}}{\Omega_{AB}} \qquad R_Allow_C = 38.4 \cdot kip$$

If Allowable is Greater than Actual, the Anchor Bolt Size and Type are Adequate.

Determine Fillet Weld Size Required:

This design procedure is from Blodgett Section 7.4. The weld is treated as a line.
Calculate the the length of the welds, using the formulas contained in Table 5.
For Square Tubes:

$$Swx := (bf) \cdot d + \frac{d^2}{3} \qquad Swx = 192 \cdot in^2$$

$$Swy := bf \cdot d + \frac{(bf)^2}{3} \qquad Swy = 192 \cdot in^2$$

Calculate the stress for each direction:

$$fmx := \frac{Mx}{Swx} \qquad fmx = 1.207 \cdot \frac{kip}{in}$$

$$fmy := \frac{My}{Swy} \qquad fmy = 1.89 \cdot \frac{kip}{in}$$

Calculate the combined stress:

$$f_act := \sqrt{\left(fmx^2 + fmy^2\right)} \qquad f_act = 2.242 \cdot \frac{kip}{in}$$

Allowable for fillet welds and A36 materialfor E70 weld material per AISC UNIFIED is 0.30(weld material)(0.707 for throat)=14850 psi..
The weld size required is determined by dividing the actual stress by the allowable stress.

$$w_reqd := \frac{f_act}{14850 \cdot psi} \qquad w_reqd = 0.151 \cdot in$$

Check Table J2.4 of the AISC ASD manual to check if w_reqd is greater than the minimum size required.

$tf = 0.375 \cdot in$ $tw = 0.375 \cdot in$ $t_min = 0.905 \cdot in$

Values to be Used:

Plate Thickness = 1 1/2 inch
Anchor Bolt = 1 1/2 inch diameter
Weld Size = 3/8 inch all around

This MathCAD document is used to calculate the following:

1. Base Plate thickness for bearing type(Square Tube Column)
2. Checks Anchor bolt Diameter
3. Checks Fillet Weld Size

References which are used for the base plate design are:

1. AISC UNIFIED Construction Manual, 13th Edition.

ASD Design Factors

$\Omega_{BP} := 1.67$ $\Omega_{AB} := 2.00$

Definition of Units

$kip \equiv 1000 \cdot lb$ $kin \equiv kip \cdot in$ $ksi \equiv \frac{kip}{in^2}$ $psi \equiv \frac{lb}{in^2}$

Determine Plate Dimensions

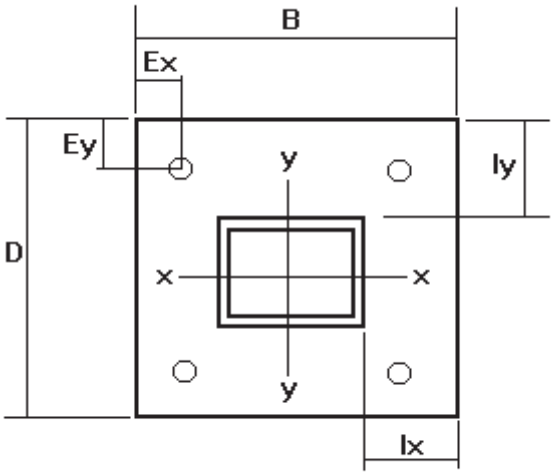
Depth of Column

Dimensions for Column used:

HSS12x12x3/8

$d := 12 \cdot in$ $tw := 0.375 \cdot in$

$bf := 12 \cdot in$ $tf := 0.375 \cdot in$



Enter the dimensions for the plate.

$B := 20 \cdot in$ $Ex := 2 \cdot in$

$D := 20 \cdot in$ $Ey := 2 \cdot in$

Design Forces

$Axial := 6.794 \cdot kip$

$Fx := 2.342 \cdot kip$ $My := 514.482 \cdot kin$

$Fy := 0.003 \cdot kip$ $Mx := 0.530 \cdot kin$

Base Plate and Anchor Bolt Material Properties.

$fy_{BP} := 36.0 \cdot ksi$ *Yield Stress of Base Plate*

$fu_{AB} := 58.0 \cdot ksi$ *Tensile Stress of Anchor Bolt (58ksi for A36)*

Estimated Anchor Bolts:

$AB_Dia := 1.5 \cdot in$ $A_{AB} := \left(\frac{\pi}{4}\right) \cdot AB_Dia^2$ $A_{AB} = 1.767 \cdot in^2$

The nominal tensile and shear stress for the bolts is based on the formula from page 16.1-104 of the 13th Edition of the AISC UNIFIED manual.

$F_{nt} := 0.75 \cdot fu_{AB}$ $F_{nt} = 43.5 \cdot ksi$

$F_{nv} := 0.40 \cdot fu_{AB}$ $F_{nv} = 23.2 \cdot ksi$

Determine Plate Thickness for Leveling Nut Base Plate.

A. Proportion Axial Force

$P_Ax := \frac{Axial}{4}$ $P_Ax = 1.7 \cdot kip$

B. Determine Bolt Forces due to Mx (for two bolts in compression)

$FC_Mx := \frac{Mx}{D - 2 \cdot Ey}$ $FC_Mx = 0 \cdot kip$

$P_Mx := 2 \cdot P_Ax + FC_Mx$ $P_Mx = 3.4 \cdot kip$

C. Determine Bolt Forces due to My (for two bolts in compression)

$FC_My := \frac{My}{B - 2 \cdot Ex}$ $FC_My = 32.2 \cdot kip$

$P_My := 2 \cdot P_Ax + FC_My$ $P_My = 35.6 \cdot kip$

D. Determine Thickness Required for Mx

$l_Mx := \frac{D - 2 \cdot Ey - d}{2}$ $l_Mx = 2.0 \cdot in$

$M_Mx := P_Mx \cdot l_Mx$ $M_Mx = 6.9 \cdot kin$

$t_Mx := \sqrt{\frac{\Omega_{BP} \cdot 4 \cdot M_Mx}{fy_{BP} \cdot B}}$ $t_Mx = 0.3 \cdot in$

E. Determine Thickness Required for My

$$l_My := \frac{B - 2 \cdot Ex - bf}{2} \qquad l_My = 2.0 \cdot in$$

$$M_My := P_My \cdot l_My \qquad M_My = 71.1 \cdot kin$$

$$t_My := \sqrt{\frac{\Omega_{BP} \cdot 4 \cdot M_My}{fy_{BP} \cdot D}} \qquad t_My = 0.8 \cdot in$$

F. Determine Total Plate Thickness Required

$$t_min := \sqrt{t_Mx^2 + t_My^2} \qquad t_min = 0.9 \cdot in$$

Check Anchor Bolt Diameter:

Calculate the Actual Tension per Bolt.

$$Max_Tension := \frac{FC_Mx + FC_My}{2} - P_Ax \qquad Max_Tension = 14.4 \cdot kip$$

Calculate the Allowable Tension per Bolt.

$$R_{nt} := F_{nt} \cdot A_{AB} \qquad R_{nt} = 76.9 \cdot kip$$

$$R_Allow_T := \frac{R_{nt}}{\Omega_{AB}} \qquad R_Allow_T = 38.4 \cdot kip$$

Calculate the Actual Shear per Bolt.

$$Shear := \frac{\sqrt{\left(Fy^2 + Fx^2\right)}}{4} \qquad Shear = 0.586 \cdot kip$$

Calculate the Allowable Shear per Bolt.

$$R_{nv} := F_{nv} \cdot A_{AB} \qquad R_{nv} = 41.0 \cdot kip$$

$$R_Allow_V := \frac{R_{nv}}{\Omega_{AB}} \qquad R_Allow_V = 20.5 \cdot kip$$

Calculate the Allowable Combined Tension and Shear.

$$F_v := \frac{Shear}{A_{AB}} \qquad F_v = 0.3 \cdot ksi$$

$$F_{nt_comb} := 1.3 \cdot F_{nt} - \left(\frac{\Omega_{AB} \cdot F_{nt}}{F_{nv}}\right) \cdot F_v \qquad F_{nt_comb} = 55.308 \cdot ksi$$

Fnt_comb needs to be less than or equal to Fnt.

$$Fnt_comb := if\left(F_{nt_comb} \le F_{nt}, F_{nt_comb}, F_{nt}\right) \qquad Fnt_comb = 43.5\cdot ksi$$

$$R_Allow_C := \frac{Fnt_comb \cdot A_{AB}}{\Omega_{AB}} \qquad R_Allow_C = 38.4\cdot kip$$

If Allowable is Greater than Actual, the Anchor Bolt Size and Type are Adequate.

Determine Fillet Weld Size Required:

This design procedure is from Blodgett Section 7.4. The weld is treated as a line.

Calculate the the length of the welds, using the formulas contained in Table 5.

For Square Tubes:

$$Swx := (bf)\cdot d + \frac{d^2}{3} \qquad Swx = 192\cdot in^2$$

$$Swy := bf\cdot d + \frac{(bf)^2}{3} \qquad Swy = 192\cdot in^2$$

Calculate the stress for each direction:

$$fmx := \frac{Mx}{Swx} \qquad fmx = 0.003\cdot \frac{kip}{in}$$

$$fmy := \frac{My}{Swy} \qquad fmy = 2.68\cdot \frac{kip}{in}$$

Calculate the combined stress:

$$f_act := \sqrt{\left(fmx^2 + fmy^2\right)} \qquad f_act = 2.68\cdot \frac{kip}{in}$$

Allowable for fillet welds and A36 materialfor E70 weld material per AISC UNIFIED is 0.30(weld material)(0.707 for throat)=14850 psi..

The weld size required is determined by dividing the actual stress by the allowable stress.

$$w_reqd := \frac{f_act}{14850\cdot psi} \qquad w_reqd = 0.18\cdot in$$

Check Table J2.4 of the AISC ASD manual to check if w_reqd is greater than the minimum size required.

$tf = 0.375 \cdot in$ $tw = 0.375 \cdot in$ $t_min = 0.85 \cdot in$

Values to be Used:

Plate Thickness = 1 1/2 inch
Anchor Bolt = 1 1/2 inch diameter
Weld Size = 3/8 inch all around

This MathCAD document is used to calculate the following:

1. End Plate thickness for bearing type(Square Tube Column)
2. Checks Connection Bolt Diameterfor 4 bolt end plates only
3. Checks Fillet Weld Size

References which are used for the End Plate design are:

1. AISC UNIFIED Construction Manual, 13th Edition.

ASD Design Factors

$\Omega_{BP} := 1.67$ $\Omega_{AB} := 2.00$

Definition of Units

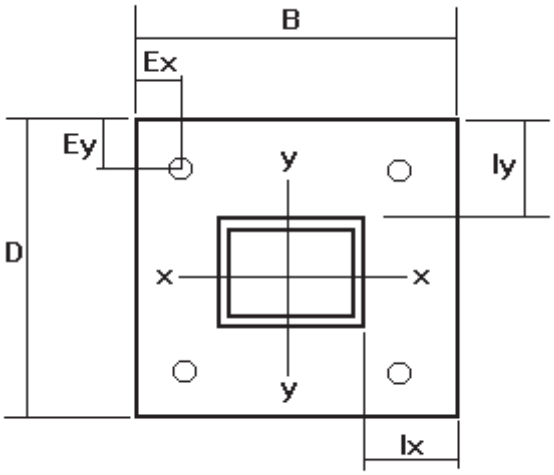
$kip \equiv 1000 \cdot lb$ $kin \equiv kip \cdot in$ $ksi \equiv \frac{kip}{in^2}$ $psi \equiv \frac{lb}{in^2}$

Determine Plate Dimensions

Depth of Column
Dimensions for Column used:
HSS12x12x1/2

$d := 12 \cdot in$ $tw := 0.5 \cdot in$

$bf := 12 \cdot in$ $tf := 0.5 \cdot in$



Enter the dimensions for the plate.

$B := 18 \cdot in$ $Ex := 1.5 \cdot in$

$D := 18 \cdot in$ $Ey := 1.5 \cdot in$

Design Forces

$Axial := 0.899 \cdot kip$

$Fx := 0.252 \cdot kip$ $My := 1.152 \cdot kin$

$Fy := 0.435 \cdot kip$ $Mx := 55.2 \cdot kin$

$Torsion := 17.952 \cdot kin$

End Plate and Connection Bolt Material Properties.

$fy_{BP} := 36.0 \cdot ksi$ *Yield Stress of End Plate.*

$F_{nt} := 90 \cdot ksi$ *Nominal Tensile Stress of A325 Bolt*

$F_{nv} := 48 \cdot ksi$ *Nominal Shear Stress of A325 Bolt*

Estimated Connection Bolt and Weld Size:

$Bolt_Dia := 0.625 \cdot in$ $A_{Bolt} := \left(\frac{\pi}{4}\right) \cdot Bolt_Dia^2$ $A_{Bolt} = 0.307 \cdot in^2$

$Weld := \frac{5}{16} \cdot in$ $B_{head} = 0.531 \cdot in$

Determine Plate Thickness for End Plate.

A. Proportion Axial Force

$P_Ax := \frac{Axial}{4}$ $P_Ax = 0.2 \cdot kip$

B. Determine Bolt Forces due to Mx (for two bolts in compression)

$FC_Mx := \frac{Mx}{D - 2 \cdot Ey}$ $FC_Mx = 3.7 \cdot kip$

$P_Mx := 2 \cdot P_Ax + FC_Mx$ $P_Mx = 4.1 \cdot kip$

C. Determine Bolt Forces due to My (for two bolts in compression)

$FC_My := \frac{My}{B - 2 \cdot Ex}$ $FC_My = 0.1 \cdot kip$

$P_My := 2 \cdot P_Ax + FC_My$ $P_My = 0.5 \cdot kip$

D. Determine Thickness Required for Mx

$l_Mx := \frac{D - 2 \cdot Ey - d}{2} - B_{head} - Weld$ $l_Mx = 0.7 \cdot in$

$M_Mx := P_Mx \cdot l_Mx$ $M_Mx = 2.7 \cdot kin$

$t_Mx := \sqrt{\frac{\Omega_{BP} \cdot 4 \cdot M_Mx}{fy_{BP} \cdot B}}$ $t_Mx = 0.2 \cdot in$

E. Determine Thickness Required for My

$l_My := \frac{B - 2 \cdot Ex - bf}{2} - B_{head} - Weld$ $l_My = 0.7 \cdot in$

$M_My := P_My \cdot l_My$ $M_My = 0.3 \cdot kin$

$$t_My := \sqrt{\frac{\Omega_{BP} \cdot 4 \cdot M_My}{fy_{BP} \cdot D}} \qquad t_My = 0.1 \cdot in$$

F. Determine Total Plate Thickness Required

$$t_min := \sqrt{t_Mx^2 + t_My^2} \qquad t_min = 0.2 \cdot in$$

Check Connection Bolt Diameter:

Calculate the Actual Tension per Bolt.

$$Max_Tension := \frac{FC_Mx + FC_My}{2} + P_Ax \qquad Max_Tension = 2.1 \cdot kip$$

Calculate the Allowable Tension per Bolt

$$R_{nt} := F_{nt} \cdot A_{Bolt} \qquad R_{nt} = 27.6 \cdot kip$$

$$R_Allow_T := \frac{R_{nt}}{\Omega_{AB}} \qquad R_Allow_T = 13.8 \cdot kip$$

Calculate the Actual Shear per Bolt.

$$F_{torsion} := \frac{Torsion}{\sqrt{\left(\frac{D - 2 \cdot Ey}{2}\right)^2 + \left(\frac{B - 2 \cdot Ex}{2}\right)^2}} \qquad F_{torsion} = 1.693 \cdot kip$$

$$Shear := \frac{\sqrt{\left(Fy^2 + Fx^2 + F_{torsion}^2\right)}}{4} \qquad Shear = 0.441 \cdot kip$$

Calculate the Allowable Shear per Bolt.

$$R_{nv} := F_{nv} \cdot A_{Bolt} \qquad R_{nv} = 14.7 \cdot kip$$

$$R_Allow_V := \frac{R_{nv}}{\Omega_{AB}} \qquad R_Allow_V = 7.4 \cdot kip$$

Calculate the Allowable Combined Tension and Shear.

$$F_v := \frac{Shear}{A_{Bolt}} \qquad F_v = 1.4 \cdot ksi$$

$$F_{nt_comb} := 1.3 \cdot F_{nt} - \left(\frac{\Omega_{AB} \cdot F_{nt}}{F_{nv}}\right) \cdot F_v \qquad F_{nt_comb} = 111.605 \cdot ksi$$

Fnt_comb needs to be less than or equal to Fnt.

$$Fnt_comb := if\left(F_{nt_comb} \le F_{nt}, F_{nt_comb}, F_{nt}\right) \qquad Fnt_comb = 90 \cdot ksi$$

$$R_Allow_C := \frac{Fnt_comb \cdot A_{Bolt}}{\Omega_{AB}} \qquad R_Allow_C = 13.8 \cdot kip$$

If Allowable is Greater than Actual, the Anchor Bolt Size and Type are Adequate.

Determine Fillet Weld Size Required:

This design procedure is from Blodgett Section 7.4. The weld is treated as a line.

Calculate the the length of the welds, using the formulas contained in Table 5.

For Square Tubes:

$$Swx := (bf) \cdot d + \frac{d^2}{3} \qquad Swx = 192 \cdot in^2$$

$$Swy := (bf) \cdot d + \frac{(bf)^2}{3} \qquad Swy = 192 \cdot in^2$$

Calculate the stress for each direction:

$$fmx := \frac{Mx}{Swx} \qquad fmx = 0.288 \cdot \frac{kip}{in}$$

$$fmy := \frac{My}{Swy} \qquad fmy = 0.006 \cdot \frac{kip}{in}$$

Calculate the combined stress:

$$f_act := \sqrt{\left(fmx^2 + fmy^2\right)} \qquad f_act = 0.288 \cdot \frac{kip}{in}$$

Allowable for fillet welds and A36 materialfor E70 weld material per AISC UNIFIED is 0.30(weld material)(0.707 for throat)=14850 psi..
The weld size required is determined by dividing the actual stress by the allowable stress.

$$w_reqd := \frac{f_act}{14850 \cdot psi} \qquad w_reqd = 0.019 \cdot in$$

Check Table J2.4 of the AISC ASD manual to check if w_reqd is greater than the minimum size required.

$tf = 0.5 \cdot in$ $tw = 0.5 \cdot in$ $t_min = 0.177 \cdot in$

Values to be Used:

Plate Thickness = 1/2 inch
Connection Bolt = 5/8 inch diameter

Weld Size = 5/16 inch all around

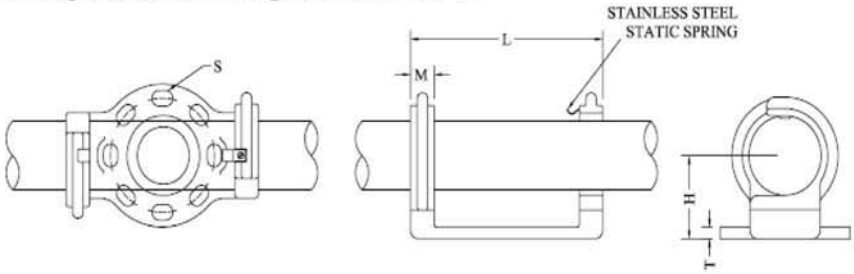
ALUMINUM BUS SUPPORTS

TYPE ASWH

Horizontal Weldment
Pipe to Insulator

Castings: 356-T6 Aluminum
Mounting Hardware: Galvanized Steel

Aluminum alloy weldment bus support for aluminum pipe. Designed for slip or rigid fit applications. When rigid fit is required, you must weld the hooks to the pipe. Delete the SE suffix to eliminate the static spring. Hardware supplied for cap mounted. For pin mounted, add suffix (P) to catalog number, Example: ASWH-58-5P



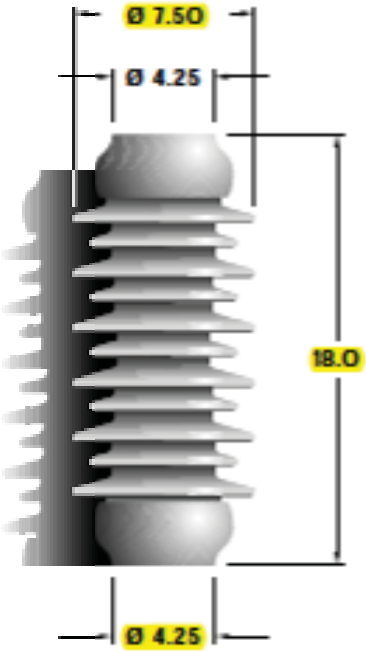
CATALOG NUMBER	PIPE SIZE	B.C.	DIMENSIONS - INCHES						WEIGHT (POUNDS)
			H	L	T	M	S	J	
ASWH-30-3-SE	3/4	3	2	5 1/2	9/32	1/2	9/16 x 3/4	1/2	1.16
ASWH-30-5-SE		5	2 1/4	8	3/8	5/8	11/16 X 1	5/8	2.01
ASWH-39-3-SE	1	3	2	6	5/16	3/4	9/16 x 13/16	1/2	1.16
ASWH-39-5-SE		5	2 1/4	8 1/4	3/8	3/4	11/16 X 1	5/8	2.23
ASWH-49-3-SE	1 1/4	3	2 1/4	7 1/4	1/2	1 1/8	9/16 x 13/16	1/2	2.95
ASWH-49-5-SE		5	2 1/4	9 1/4	9/16	1 1/8	11/16 X 1	5/8	3.45
ASWH-53-3-SE	1 1/2	3	2 1/2	7 1/4	9/16	1 1/8	9/16 x 13/16	1/2	2.81
ASWH-53-5-SE		5	2 1/2	9 1/4	9/16	1 1/8	11/16 X 1	5/8	3.67
ASWH-58-3-SE	2	3	2 3/4	7 1/4	9/16	1 1/8	9/16 x 13/16	1/2	2.95
ASWH-58-5-SE		5	2 3/4	9 1/4	9/16	1 1/8	11/16 X 1-1/16	5/8	3.77
ASWH-60-3-SE	2 1/2	3	3 1/8	7 1/4	9/16	1 1/8	9/16 x 13/16	1/2	3.45
ASWH-60-5-SE		5	3 1/8	9 1/4	9/16	1 1/8	11/16 X 1-1/16	5/8	4.27
ASWH-60-7-SE		7	3 1/8	12 1/2	1/2	1 1/8	13/16 X 1-1/8	3/4	6.49
ASWH-62-3-SE	3	3	3 5/8	7 1/4	9/16	1 1/8	9/16 x 13/16	1/2	3.95
ASWH-62-5-SE		5	3 5/8	9 1/4	1/2	1 1/8	11/16 X 1	5/8	4.77
ASWH-62-7-SE		7	3 5/8	12 1/2	1/2	1 1/4	13/16 X 1-1/8	3/4	6.99
ASWH-63-3-SE	3 1/2	3	4	7 1/4	1/2	1 1/8	9/16 x 13/16	1/2	3.95
ASWH-63-5-SE		5	4	9 1/4	3/8	1 1/8	11/16 X 1	5/8	4.77
ASWH-63-7-SE		7	4	12 1/2	1/2	1 3/16	13/16 X 1-1/8	3/4	6.99
ASWH-64-3-SE	4	3	4 1/2	7 1/4	9/16	1 1/8	9/16 x 13/16	1/2	3.95
ASWH-64-5-SE		5	4 1/2	9 1/4	9/16	1 1/8	11/16 X 1	5/8	4.77
ASWH-64-7-SE		7	4 1/2	12 1/2	1/2	1 1/8	13/16 X 1-1/8	3/4	6.99
ASWH-67-3-SE	5	3	5	7 5/8	1/2	1 1/2	9/16 x 13/16	1/2	5.94
ASWH-67-5-SE		5	5	9 5/8	1/2	1 1/2	11/16 X 1	5/8	6.78
ASWH-67-7-SE		7	5	11 1/2	1/2	1 3/8	13/16 X 1-5/16	3/4	9.59
ASWH-69-3-SE	6	3	5 1/2	7 5/8	1/2	1 1/2	9/16 x 3/4	1/2	5.96
ASWH-69-5-SE		5	5 1/2	9 5/8	1/2	1 1/2	11/16 X 1	5/8	6.78
ASWH-69-7-SE		7	5 1/2	12 7/8	1/2	1 1/2	13/16 X 1-1/8	3/4	9

TABLE 3. ROUND TUBULAR BUS COPPER OR ALUMINUM

Size	Outside Diameter	Inside Diameter	Moment of Inertia (i)	Section Modulus (S)	Weight	
					Aluminum	Copper
in.	in.	in.	$in.^4$	$in.^3$	lb/ft	lb/ft
Schedule 40						
1/2	0.84	0.622	0.0171	0.0407	0.294	0.956
3/4	1.05	0.824	0.0370	0.0705	0.391	1.300
1	1.315	1.049	0.0873	0.1328	0.581	1.830
1-1/2	1.90	1.610	0.3100	0.3260	0.940	3.190
2	2.375	2.067	0.6660	0.5610	1.264	4.210
2-1/2	2.875	2.469	1.5300	1.0640	2.004	6.120
3	3.50	3.068	3.0170	1.7240	2.621	8.720
3-1/2	4.00	3.548	4.7880	2.3940	3.151	11.380
4	4.50	4.026	7.2320	3.2140	3.733	12.900
5	5.563	5.047	15.1600	5.4510	5.057	16.210
6	6.625	6.065	28.1400	8.5000	6.564	19.350
Schedule 80						
1/2	0.84	0.546	0.0201	0.0478	0.376	1.250
3/4	1.05	0.742	0.0448	0.0853	0.510	1.700
1	1.315	0.957	0.1056	0.1606	0.751	2.500
1-1/2	1.90	1.50	0.3910	0.4120	1.256	4.180
2	2.375	1.939	0.8680	0.7310	1.737	5.780
2-1/2	2.875	2.323	1.9240	1.3390	2.650	8.820
3	3.50	2.90	3.8940	2.2250	3.547	11.790
3-1/2	4.00	3.364	6.2810	3.1400	4.326	14.340
4	4.50	3.826	9.6110	4.2720	5.183	17.220
5	5.563	~~4.183~~ 4.81	20.6700	7.4320	7.188	23.620
6	6.625	5.761	40.4900	12.2200	9.884	32.830

NOTE: Values given are for both 6061-T6 and 6063-T6 aluminum alloys.

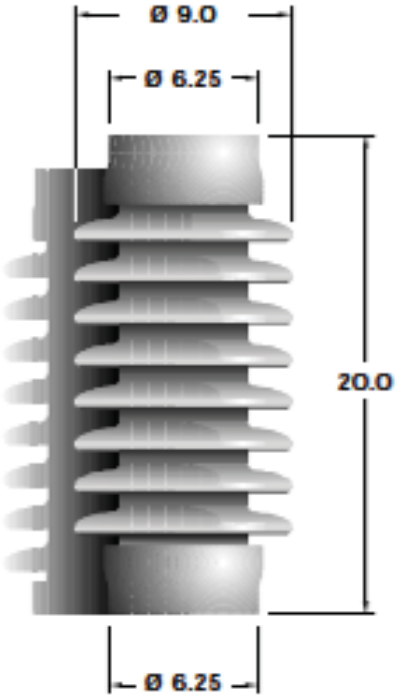
STANDARD STRENGTH UNIT



4 TAPPED HOLES
1/2-13 +.015 OVERSIZE
5/8" FULL THREAD
ON 3.0" BOLT CIRCLE

315210-70

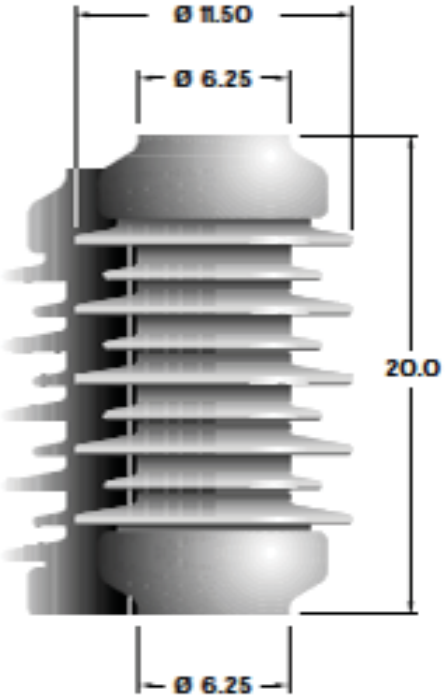
HIGH STRENGTH UNIT



4 TAPPED HOLES
5/8-11 +.015 OVERSIZE
3/4" FULL THREAD
ON 5.0" BOLT CIRCLE

315231-70

EXTRA-HIGH STRENGTH UNIT



4 TAPPED HOLES
5/8-11 +.015 OVERSIZE
3/4" FULL THREAD
ON 5.0" BOLT CIRCLE

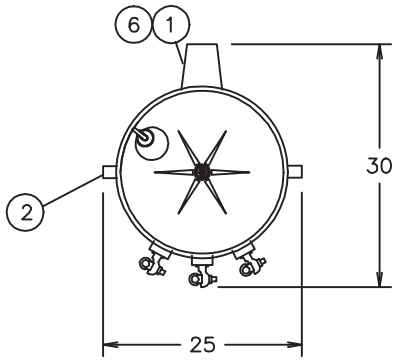
318455-70

CHARACTERISTICS

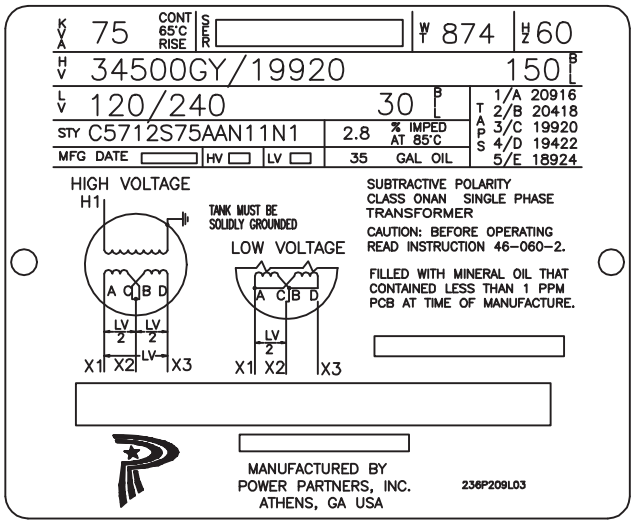
Lapp Catalog Number Ancil Technical Reference Number	315210-70 T.R.210	315231-70 T.R.231	318455-70
Dimensions			
Leakage Distance, Inches	37	37	37
Mechanical Values *			
Cantilever Strength, Upright, Pounds	2000	4000	8000
Cantilever Strength, Underhung, Pounds	2000	4000	8000
Tensile Strength, Pounds	12000	25000	28000
Torsion Strength, Inch-Pounds	10000	20000	40000
Compression Strength, Pounds	15000	30000	60000
Electrical Values			
Voltage Class, kV	34.5	34.5	34.5
Impulse Flashover, Positive, kV	225	225	225
Low Frequency Withstand, 10 Sec. Wet, kV	80	80	80
Impulse Withstand, kV	200	200	200
Radio Influence Voltage Data			
Test Voltage, Rms to Ground, kV	22	22	22
Maximum RIV, Microvolts at 1000 kHz	100	100	100
Weight			
Net Weight, Each, Pounds	41	74	117

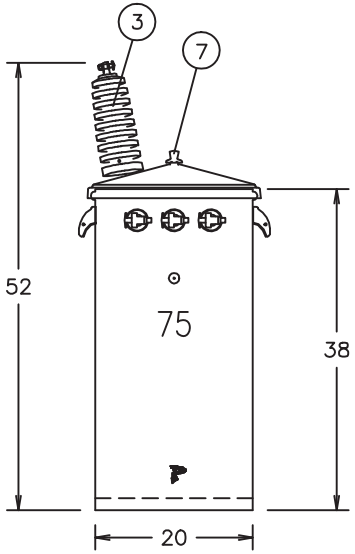
* For Maximum recommended working loads see "Specifications," page 5.
Note: For RG glazed insulators equivalent to these standard insulators, see table on page 9.
Illustrations shown are true representations of Lapp products at the time of printing, but are subject to change at any time.

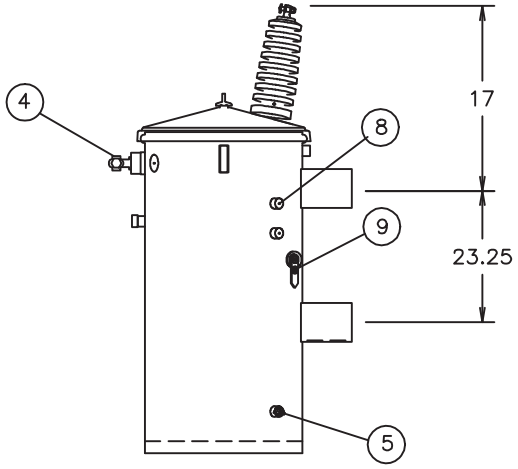
ALL DIMENSIONS ARE IN INCHES



1 HANGER BRACKET (A.N.S.I. TYPE –A–)
2 LIFTING HOOK
3 HV BUSH WITH MECH CONN FOR #8 SOL TO #2
4 LV BUSH WITH MECH CONN FOR #1/0–500MCM
5 TANK GROUND CONN FOR #8 TO #2
6 NAMEPLATE ON/NEAR BOTTOM HANGER LUG
7 COVER BOLT
8 HV ARRESTER MNTG PADS (.50–13)
9 EXTERNAL TC OPER. MECH. HANDLE







THIS OUTLINE SKETCH REPRESENTS THE APPROXIMATE DIMENSIONS AND THE FOLLOWING TOLERANCES APPLY:
PLAN DIMENSIONS: ±2.0"
VERTICAL DIMENSIONS: ±3.0"

DRAWING NOT TO SCALE

THIS OUTLINE CAN BE USED FOR MOUNTING PURPOSES. IT IS NOT TO BE REGARDED AS INDICATING THE EXACT DETAILS OF CONSTRUCTION.

OUTLINE DESCRIPTION
- ■ APPROVAL
- □ CONSTRUCTION
- □ FILE
- □

POWER PARTNERS Inc. ATHENS, GA., U.S.A.			POWER PARTNERS INC.
PART NAME C5712S75AAN11N1			
DISTRIBUTION TRANSFORMER --OUTLINE--	REV NO. 01		APPD
DESC 1 PHASE OUTLINE			DATE 01/18/18
DFTM PITTMAN	DRAWING ID XXXXXXXX		USER CDP
GROUP/SUB STDOUT R14	ENG. REF CIM0111N1 ITEM 1		
SCALE NONE	APPD		FORMAT B
DEF XXX / NOTE XX / FIN XX / U/M IN			DIST XX

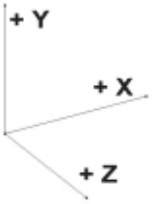
REV DATA

Project # :	17.01246	**Ulteig Engineers, Inc**		By:	DAW
Project Title:	Northwest Ohio			Date:	1/24/2018
Item:	Feeder Riser/3ph Bus	**NESC Load Cases**		Checked:	

Load from a horizontally mounted insulator, fuse, surge arrester, etc.

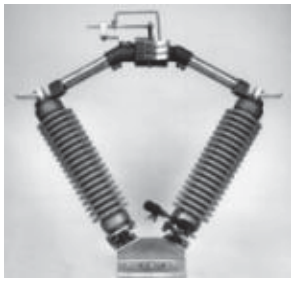
Equipment: 34.5kV Insulator

Orientation: Ypos (Ypos, Yneg; Asuming switches are on Staad x-axis, which grid are the switches in?)



Specifications:

Weight (lbs):	41	(weight of individual piece of equipment with no ice)
Y_{arm} (in):	13	(moment arm; typically half of total height)
C_d (drag):	1	(drag coefficiant; 1 for cylinder, 1.6 for square)
$Area_x$ (in^2):	144	(area wind hits in x-direction)
$Area_z$ (in^2):	144	(area wind hits in z-direction)
k_z:	0.92	(exposure coefficient; table 250-2 NESC)
G_{RF}:	1.02	(gust response factor; table 250-3 NESC)



Loads: NESC Heavy (40 mph wind with 1/2" ice) and High Wind (90 mph wind)

	NESC	High Wind	
P (psf):	4.0	19.5	(C_d x 4psf NESC, .00256 x k_z x G_{RF} x C_d x $90mph^2$ high wind)
F_y (lbs):	-61.5	-41.0	(weight; NESC includes 1.5 for ice)

Wind X-Dir	NESC	High Wind	
F_y (lbs):	**-61.5**	**-41.0**	(weight; NESC includes 1.5 for ice)
F_x (lbs):	**4.0**	**19.5**	(P x A_x)
M_z (ft-lbs):	**-4.3**	**-21.1**	(F_x x Y_{arm})

Wind Z-Dir	NESC	High Wind	
F_y (lbs):	**-61.5**	**-41.0**	(weight; NESC includes 1.5 for ice)
F_z (lbs):	**4.0**	**19.5**	(P x A_z)
M_x (ft-lbs):	**4.3**	**21.1**	(F_z x Y_{arm})

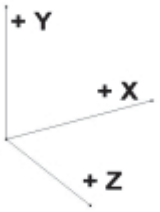
Wind 45 Deg	NESC	High Wind	
F_y (lbs):	**-61.5**	**-41.0**	(weight; NESC includes 1.5 for ice)
F_x (lbs):	**2.8**	**13.8**	(P x A_x x sin45)
F_z (lbs):	**2.8**	**13.8**	(P x A_z x sin45)
M_z (ft-lbs):	**-3.1**	**-14.9**	(F_x x Y_{arm})
M_x (ft-lbs):	**3.1**	**14.9**	(F_z x Y_{arm})

Project # :	17.01246	**Ulteig Engineers, Inc**		By:	DAW
Project Title:	Northwest Ohio			Date:	1/24/2018
Item:	Station Service/3ph Bus	**NESC Load Cases**		Checked:	

Load from a vertically mounted insulator, fuse, surge arrester, etc

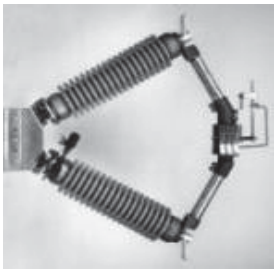
Equipment: 75kVA Station Service

Orientation: Zpos (Zpos, Zneg; Asuming switches are on Staad x-axis, which grid are the switches in?)



Specifications:

Weight (lbs):	1000	(weight of individual piece of equipment with no ice)
Y_{arm} (in):	26	(moment arm; typically half of total height)
C_d (drag):	1.6	(drag coefficiant; 1 for cylinder, 1.6 for square)
$Area_x$ (in^2):	1300	(area wind hits in x-direction)
$Area_z$ (in^2):	1300	(area wind hits in z-direction)
k_z:	0.92	(exposure coefficient; table 250-2 NESC)
G_{RF}:	1.02	(gust response factor; table 250-3 NESC)



Loads: NESC Heavy (40 mph wind with 1/2" ice) and High Wind (90 mph wind)

	NESC	High Wind	
P (psf):	6.4	31.1	(C_d x 4psf NESC, .00256 x k_z x G_{RF} x C_d x $90mph^2$ high wind)
F_y (lbs):	-1500.0	-1000.0	(weight; NESC includes 1.5 for ice)

Wind X-Dir	NESC	High Wind	
F_y (lbs):	**-1500.0**	**-1000.0**	(weight; NESC includes 1.5 for ice)
F_x (lbs):	**57.8**	**281.1**	(P x A_x)
M_x (ft-lbs):	**3250.0**	**2166.7**	(F_y x Y_{arm})
M_y (ft-lbs):	**125.2**	**609.0**	(F_x x Y_{arm})

Wind Z-Dir	NESC	High Wind	
F_y (lbs):	**-1500.0**	**-1000.0**	(weight; NESC includes 1.5 for ice)
F_z (lbs):	**57.8**	**281.1**	(P x A_z)
M_x (ft-lbs):	**3250.0**	**2166.7**	(F_y x Y_{arm})

Wind 45 Deg	NESC	High Wind	
F_y (lbs):	**-1500.0**	**-1000.0**	(weight; NESC includes 1.5 for ice)
F_x (lbs):	**40.9**	**198.7**	(P x A_x x sin45)
F_z (lbs):	**40.9**	**198.7**	(P x A_z x sin45)
M_x (ft-lbs):	**3250.0**	**2166.7**	(F_y x Y_{arm})
M_y (ft-lbs):	**88.5**	**430.6**	(F_x x Y_{arm} x sin45)

Project # :	17.01246	**Ulteig Engineers**		By:	DAW
Project Title:	Northwest Ohio			Date:	1/24/2018
Item:	Station Service/3ph Bus	**NESC Load Cases**		Checked:	

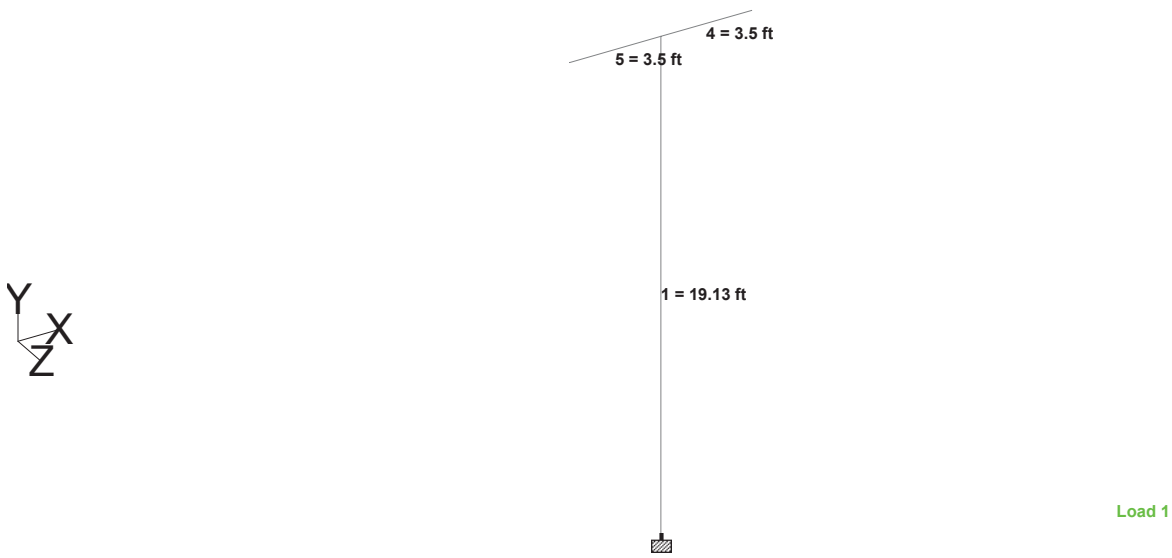
Load from Wind on Member

Load Case Constants:

	NESC	High Wind
Wind (psf):	4	20.74
Ice (in):	0.5	0
C_d (drag):	1.6	1.6

Load on Member (lbs/ft):

Width (in)	NESC	NESC 45°	High Wind	High Wind 45°
2	1.6	1.1	5.5	3.9
3	2.1	1.5	8.3	5.9
4	2.7	1.9	11.1	7.8
5	3.2	2.3	13.8	9.8
6	3.7	2.6	16.6	11.7
7	4.3	3.0	19.4	13.7
8	4.8	3.4	22.1	15.6
9	5.3	3.8	24.9	17.6
10	5.9	4.1	27.7	19.6
11	6.4	4.5	30.4	21.5
12	6.9	4.9	33.2	23.5
13	7.5	5.3	35.9	25.4
14	8.0	5.7	38.7	27.4


4 = 3.5 ft
5 = 3.5 ft
1 = 19.13 ft
Y
X
Z
Load 1

```
**************************************************
*                                                *
*           STAAD.Pro V8i SELECTseries4           *
*           Version  20.07.09.21                 *
*           Proprietary Program of               *
*           Bentley Systems, Inc.                *
*           Date=    JAN 17, 2018                *
*           Time=    18: 5: 6                    *
*                                                *
*      USER ID: Ulteig Engineers                 *
**************************************************
```

```
     1. STAAD SPACE
INPUT FILE: 34.5kV 3Ph Bus and SSVT Stand.STD
     2. START JOB INFORMATION
     3. ENGINEER DATE 3-JAN-18
     4. JOB NAME NORTHWEST OHIO
     5. JOB PART STATION SERVICE/3PHASE BUS
     6. ENGINEER NAME DAW
     7. JOB CLIENT WHITE
     8. END JOB INFORMATION
     9. INPUT WIDTH 79
    10. UNIT FEET POUND
    11. JOINT COORDINATES
    12. 1 0 0 0; 4 0 19.125 0; 5 -3.5 19.125 0; 6 3.5 19.125 0
    13. MEMBER INCIDENCES
    14. 1 1 4; 4 4 6; 5 4 5
    15. DEFINE MATERIAL START
    16. ISOTROPIC STEEL
    17. E 4.176E+009
    18. POISSON 0.3
    19. DENSITY 489.024
    20. ALPHA 6E-006
    21. DAMP 0.03
    22. END DEFINE MATERIAL
    23. MEMBER PROPERTY AMERICAN
    24. 1 TABLE ST HSST8X8X0.375
    25. 4 5 TABLE ST HSST8X8X0.25
    26. CONSTANTS
    27. MATERIAL STEEL ALL
    28. SUPPORTS
    29. 1 FIXED
    30. LOAD 1 LOADTYPE NONE  TITLE NESC HEAVY 1/2" ICE 40 MPH WIND X-DIR
    31. SELFWEIGHT Y -1.5
    32. JOINT LOAD
    33. *BUS
    34. 4 FX 26 FY -111 MZ -70
    35. 5 FX -1129 FY -111 MZ 3016
    36. 6 FX 1129 FY -111 MZ -3016
    37. *INSULATOR
    38. 4 TO 6 FX 4 FY -61.5 MZ -5
```

```
39. MEMBER LOAD
40. 1 UNI GX 4.8
41. *SSVT
42. 1 CON GY -1500 11.104 0.333
43. 1 CON GX 58 11.104 0.333
44. 1 CMOM GX 3250 11.104 0.333
45. 1 CMOM GY 125 11.104 0.333
46. LOAD 2 LOADTYPE NONE  TITLE NESC HEAVY 1/2" ICE 40 MPH WIND Z-DIR
47. SELFWEIGHT Y -1.5
48. JOINT LOAD
49. *BUS
50. 4 TO 6 FY -111
51. *INSULATOR
52. 4 TO 6 FY -61.5 FZ 4 MX 5
53. MEMBER LOAD
54. 1 4 5 UNI GZ 4.8
55. *SSVT
56. 1 CON GY -1500 11.104 0.333
57. 1 CON GZ 58 11.104 0.333
58. 1 CMOM GX 3250 11.104 0.333
59. LOAD 3 LOADTYPE NONE  TITLE NESC HEAVY 1/2" ICE 40 MPH WIND 45 DEG
60. SELFWEIGHT Y -1.5
61. JOINT LOAD
62. *BUS
63. 4 FX 19 FY -111 MZ -50
64. 5 FX -799 FY -111 MZ 2132
65. 6 FX 799 FY -111 MZ -2132
66. *INSULATOR
67. 4 TO 6 FX 3 FY -61.5 FZ 3 MX 4 MZ -4
68. MEMBER LOAD
69. 1 UNI GX 3.4
70. 1 4 5 UNI GZ 3.4
71. *SSVT
72. 1 CON GY -1500 11.104 0.333
73. 1 CON GX 41 11.104 0.333
74. 1 CON GZ 41 11.104 0.333
75. 1 CMOM GX 3250 11.104 0.333
76. 1 CMOM GY 89 11.104 0.333
77. LOAD 4 LOADTYPE NONE  TITLE HIGH WIND 90 MPH WIND X-DIR
78. SELFWEIGHT Y -1
79. JOINT LOAD
80. *BUS
81. 4 FX 108 FY -66 MZ -289
82. 5 FX -1211 FY -66 MZ 3235
83. 6 FX 1211 FY -66 MZ -3235
84. *INSULATOR
85. 4 TO 6 FX 20 FY -41 MZ -22
86. MEMBER LOAD
87. 1 UNI GX 22.1
88. *SSVT
89. 1 CON GY -1000 11.104 0.333
90. 1 CON GX 281 11.104 0.333
91. 1 CMOM GX 2167 11.104 0.333
92. 1 CMOM GY 608 11.104 0.333
93. LOAD 5 LOADTYPE NONE  TITLE HIGH WIND 90 MPH WIND Z-DIR
94. SELFWEIGHT Y -1
```

```
 95. JOINT LOAD
 96. *BUS
 97. 4 TO 6 FY -66
 98. *INSULATOR
 99. 4 TO 6 FY -41 FZ 20 MX 22
100. MEMBER LOAD
101. 1 4 5 UNI GZ 22.1
102. *SSVT
103. 1 CON GY -1000 11.104 0.333
104. 1 CON GZ 281 11.104 0.333
105. 1 CMOM GX 2167 11.104 0.333
106. LOAD 6 LOADTYPE NONE  TITLE HIGH WIND 90 MPH WIND 45 DEG
107. SELFWEIGHT Y -1
108. JOINT LOAD
109. *BUS
110. 4 FX 77 FY -66 MZ -204
111. 5 FX -857 FY -66 MZ 2287
112. 6 FX 857 FY -66 MZ -2287
113. *INSULATOR
114. 4 TO 6 FX 14 FY -41 FZ 14 MX 15 MZ -15
115. MEMBER LOAD
116. 1 UNI GX 15.6
117. 1 4 5 UNI GZ 15.6
118. *SSVT
119. 1 CON GY -1000 11.104 0.333
120. 1 CON GX 199 11.104 0.333
121. 1 CON GZ 199 11.104 0.333
122. 1 CMOM GY 431 11.104 0.333
123. 1 CMOM GX 2167 11.104 0.333
124. PDELTA ANALYSIS SMALLDELTA
```

P R O B L E M S T A T I S T I C S

NUMBER OF JOINTS	**4**	**NUMBER OF MEMBERS**	**3**
NUMBER OF PLATES	**0**	**NUMBER OF SOLIDS**	**0**
NUMBER OF SURFACES	**0**	**NUMBER OF SUPPORTS**	**1**

SOLVER USED IS THE OUT-OF-CORE BASIC SOLVER

ORIGINAL/FINAL BAND-WIDTH= 2/ 2/ 18 DOF
TOTAL PRIMARY LOAD CASES = 6, TOTAL DEGREES OF FREEDOM = 18
SIZE OF STIFFNESS MATRIX = 1 DOUBLE KILO-WORDS
REQRD/AVAIL. DISK SPACE = 12.0/ 0.0 MB

```
++ Adjusting Displacements.
++ Adjusting Displacements.

125. PARAMETER 1
```

```
126. CODE AISC UNIFIED 2010
127. METHOD ASD
128. KY 2.1 MEMB 1
129. KZ 2.1 MEMB 1
130. LX 19 MEMB 1
131. LY 19 MEMB 1
132. LZ 19 MEMB 1
133. UNB 19 MEMB 1
134. UNT 19 MEMB 1
135. CHECK CODE ALL
```

STAAD.PRO CODE CHECKING - (AISC-360-10-ASD) v1.2
****

ALL UNITS ARE - KIP INCH (UNLESS OTHERWISE NOTED)

MEMBER NO: 1 CRITICAL RATIO: 0.355(PASS) LOAD: 6
LOCATION (ft): 0.00 CONDITION: Eq. H1-1b
SECTION: HSST8X8X0.375 (AISC SECTIONS)

ALL MEMBERS PASS

MEMBER NO: 4 CRITICAL RATIO: 0.108(PASS) LOAD: 1
LOCATION (ft): 0.00 CONDITION: Eq. H1-1b
SECTION: HSST8X8X0.25 (AISC SECTIONS)

MEMBER NO: 5 CRITICAL RATIO: 0.108(PASS) LOAD: 1
LOCATION (ft): 0.00 CONDITION: Eq. H1-1b
SECTION: HSST8X8X0.25 (AISC SECTIONS)

136. PRINT JOINT DISPLACEMENTS LIST 4 TO 6

JOINT DISPLACEMENT (INCH RADIANS) STRUCTURE TYPE = SPACE

JOINT	LOAD	X-TRANS	Y-TRANS	Z-TRANS	X-ROTAN	Y-ROTAN	Z-ROTAN
4	1	0.14454	-0.00163	0.29713	0.00182	0.00013	-0.00089
	2	0.00000	-0.00163	0.44546	0.00272	0.00002	0.00000
	3	0.10422	-0.00163	0.40301	0.00246	0.00010	-0.00064
	4	0.65615	-0.00107	0.19711	0.00121	0.00062	-0.00401
	5	0.00000	-0.00107	0.89089	0.00540	0.00008	0.00000
	6	0.46471	-0.00107	0.68654	0.00417	0.00050	-0.00284
5	1	0.14432	0.01726	0.30250	0.00182	0.00013	-0.00006
	2	0.00000	-0.00452	0.44632	0.00272	0.00002	0.00009
	3	0.10406	0.01147	0.40744	0.00247	0.00011	-0.00003
	4	0.65591	0.14899	0.22316	0.00121	0.00062	-0.00316
	5	0.00000	-0.00289	0.89506	0.00541	0.00010	0.00006
	6	0.46454	0.10477	0.70800	0.00417	0.00051	-0.00223
6	1	0.14478	-0.05743	0.29177	0.00182	0.00013	-0.00172
	2	0.00000	-0.00452	0.44486	0.00272	0.00001	-0.00009
	3	0.10438	-0.04252	0.39877	0.00247	0.00010	-0.00126
	4	0.65640	-0.18816	0.17106	0.00121	0.00062	-0.00487
	5	0.00000	-0.00289	0.88802	0.00541	0.00006	-0.00006
	6	0.46489	-0.13416	0.66599	0.00417	0.00049	-0.00347

Displacement X = 0.656" < 2.295"

Displacement Z = 0.891" < 2.295"

Displacement Y = 0.188" < 0.21"

********** END OF LATEST ANALYSIS RESULT **********

137. PRINT MEMBER FORCES ALL

Max Horizontal Deflection(Vert. Member) = L/100

Max Horizontal Deflection = (19.125*12)/100 = 2.295"

Max Vertical Deflection(Horz. Member) = L/200

Max Vertical Deflection = (3.5*12)/200 = 0.21"

MEMBER END FORCES STRUCTURE TYPE = SPACE

ALL UNITS ARE -- POUN FEET (LOCAL)

MEMBER	LOAD	JT	AXIAL	SHEAR-Y	SHEAR-Z	TORSION	MOM-Y	MOM-Z	
1	1	1	3283.87	187.80	0.00	-143.30	3300.19	2351.00	
		4	-770.67	-38.00	0.00	-1.01	0.00	-77.96	
	2	1	3283.87	0.00	-195.40	-19.31	5734.21	0.00	
		4	-770.67	0.00	45.60	0.00	-15.00	0.00	
	3	1	3283.87	134.02	-138.83	-115.73	5034.43	1688.57	
		4	-770.67	-28.00	32.80	-0.58	-12.00	-58.40	
	4	1	2165.25	871.66	0.00	-696.32	2188.80	10768.43	
		4	-489.78	-168.00	0.00	-5.26	0.00	-320.91	
	5	1	2165.25	0.00	-918.36	-93.57	13599.62	0.00	Max Moment for B.P. Design (x/z - Dir.)
		4	-489.78	0.00	214.70	0.00	-66.00	0.00	
	6	1	2165.25	616.35	-648.55	-560.53	10242.31	7621.86	Max Moment for B.P. Design (45 Deg.)
		4	-489.78	-119.00	151.20	-3.00	-45.00	-231.91	
4	1	4	-1133.00	299.09	0.00	0.00	0.51	3841.01	Max Moment for T.P. Design
		6	1133.00	-172.50	0.00	0.00	0.00	-3021.00	
	2	4	0.00	299.09	-20.80	-5.00	43.40	825.28	
		6	0.00	-172.50	4.00	5.00	0.00	0.00	
	3	4	-802.00	299.09	-14.90	-4.00	31.61	2958.54	
		6	802.00	-172.50	3.00	4.00	0.00	-2136.00	
	4	4	-1231.00	191.39	0.00	0.00	2.67	3759.99	
		6	1231.00	-107.00	0.00	0.00	0.00	-3257.00	
	5	4	0.00	191.39	-97.35	-22.00	205.36	522.18	
		6	0.00	-107.00	20.00	22.00	0.00	0.00	
	6	4	-871.00	191.39	-68.60	-15.00	146.04	2814.52	
		6	871.00	-107.00	14.00	15.00	0.00	-2302.00	
5	1	4	-1125.00	299.09	0.00	0.00	0.50	3838.05	
		5	1125.00	-172.50	0.00	0.00	0.00	-3011.00	
	2	4	0.00	299.09	20.80	5.00	-43.40	825.28	
		5	0.00	-172.50	-4.00	-5.00	0.00	0.00	
	3	4	-796.00	299.09	14.90	4.00	-31.03	2954.14	
		5	796.00	-172.50	-3.00	-4.00	0.00	-2128.00	
	4	4	-1191.00	191.39	0.00	0.00	2.59	3750.08	
		5	1191.00	-107.00	0.00	0.00	0.00	-3213.00	
	5	4	0.00	191.39	97.35	22.00	-205.36	522.18	
		5	0.00	-107.00	-20.00	-22.00	0.00	0.00	
	6	4	-843.00	191.39	68.60	15.00	-143.04	2801.62	
		5	843.00	-107.00	-14.00	-15.00	0.00	-2272.00	

********** END OF LATEST ANALYSIS RESULT **********

138. PRINT SUPPORT REACTION LIST 1

SUPPORT REACTIONS -UNIT POUN FEET STRUCTURE TYPE = SPACE

JOINT	LOAD	FORCE-X	FORCE-Y	FORCE-Z	MOM-X	MOM-Y	MOM Z	
1	1	-187.80	3283.87	0.00	-3300.19	-143.30	2351.00	
	2	0.00	3283.87	-195.40	-5734.21	-19.31	0.00	
	3	-134.02	3283.87	-138.83	-5034.43	-115.73	1688.57	Max Vertical Case for D.P. Design
	4	-871.66	2165.25	0.00	-2188.80	-696.32	10768.43	
	5	0.00	2165.25	-918.36	-13599.62	-93.57	0.00	Max Moment Case for D.P. Design
	6	-616.35	2165.25	-648.55	-10242.31	-560.53	7621.86	

********** END OF LATEST ANALYSIS RESULT **********

139. FINISH

********** END OF THE STAAD.Pro RUN **********

**** DATE= JAN 17,2018 TIME= 18: 5: 8 ****

****
* For questions on STAAD.Pro, please contact *
* Bentley Systems or Partner offices *
* *
* Telephone Web / Email *
* USA +1 (714) 974-2500 *
* UK +44 (0) 808 101 9246 *
* SINGAPORE +65 6225-6158 *
* FRANCE +33 (0) 1 55238400 *
* GERMANY +49 0931 40468 *
* INDIA +91 (033) 4006-2021 *
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* *
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* *
****

This MathCAD document is used to calculate the following:

1. Base Plate thickness for bearing type(Square Tube Column)
2. Checks Anchor bolt Diameter & Edge Distance
3. Checks Fillet Weld Size

References which are used for the base plate design are:

1. AISC UNIFIED Construction Manual, 13th Edition.

ASD Design Factors

$\Omega_{BP} := 1.67$ $\Omega_{AB} := 2.00$

Definition of Units

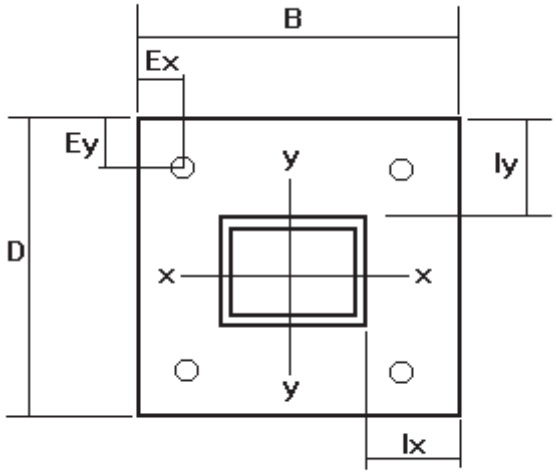
$kip \equiv 1000 \cdot lb$ $kin \equiv kip \cdot in$ $ksi \equiv \frac{kip}{in^2}$ $psi \equiv \frac{lb}{in^2}$

Determine Plate Dimensions

Depth of Column
Dimensions for Column used: HSS8x8x3/8

$d := 8 \cdot in$ $tw := 0.375 \cdot in$

$bf := 8 \cdot in$ $tf := 0.375 \cdot in$



Enter the dimensions for the plate.

$B := 16 \cdot in$ $Ex := 2 \cdot in$

$D := 16 \cdot in$ $Ey := 2 \cdot in$

Design Forces ***(Wind From 45-Deg)***

$Axial := 2.2 \cdot kip$

$Fx := 0.65 \cdot kip$ $My := 122.9 \cdot kin$

$Fy := 0.62 \cdot kip$ $Mx := 91.5 \cdot kin$

Base Plate and Anchor Bolt Material Properties.

$fy_{BP} := 36.0 \cdot ksi$ *Yield Stress of Base Plate.*

$fu_{AB} := 58.0 \cdot ksi$ *Tensile Stress of Anchor Bolt (58ksi for A36)*

Estimated Anchor Bolts:

$AB_Dia := 1.00 \cdot in$ $A_{AB} := \left(\frac{\pi}{4}\right) \cdot AB_Dia^2$ $A_{AB} = 0.785 \cdot in^2$

The nominal tensile and shear stress for the bolts is based on the formula from page 16.1-120 of the 14th Edition of the AISC UNIFIED manual.

$F_{nt} := 0.75 \cdot fu_{AB}$ $F_{nt} = 43.5 \cdot ksi$

$F_{nv} := 0.45 \cdot fu_{AB}$ $F_{nv} = 26.1 \cdot ksi$

Determine Plate Thickness for Leveling Nut Base Plate.

A. Proportion Axial Force

$P_Ax := \frac{Axial}{4}$ $P_Ax = 0.6 \cdot kip$

B. Determine Bolt Forces due to Mx (for two bolts in compression)

$FC_Mx := \frac{Mx}{D - 2 \cdot Ey}$ $FC_Mx = 7.6 \cdot kip$

$P_Mx := 2 \cdot P_Ax + FC_Mx$ $P_Mx = 8.7 \cdot kip$

C. Determine Bolt Forces due to My (for two bolts in compression)

$FC_My := \frac{My}{B - 2 \cdot Ex}$ $FC_My = 10.2 \cdot kip$

$P_My := 2 \cdot P_Ax + FC_My$ $P_My = 11.3 \cdot kip$

D. Determine Thickness Required for Mx

$l_Mx := \frac{D - 2 \cdot Ey - d}{2}$ $l_Mx = 2.0 \cdot in$

$M_Mx := P_Mx \cdot l_Mx$ $M_Mx = 17.4 \cdot kin$

$t_Mx := \sqrt{\frac{\Omega_{BP} \cdot 4 \cdot M_Mx}{fy_{BP} \cdot B}}$ $t_Mx = 0.4 \cdot in$

E. Determine Thickness Required for My

$l_My := \frac{B - 2 \cdot Ex - bf}{2}$ $l_My = 2.0 \cdot in$

$M_My := P_My \cdot l_My$ $M_My = 22.7 \cdot kin$

$$t_My := \sqrt{\frac{\Omega_{BP} \cdot 4 \cdot M_My}{fy_{BP} \cdot D}} \qquad t_My = 0.5 \cdot in$$

F. Determine Total Plate Thickness Required

$$t_min := \sqrt{t_Mx^2 + t_My^2} \qquad t_min = 0.682 \cdot in$$

Check Anchor Bolt Diameter:

Calculate the Actual Tension per Bolt.

$$Max_Tension := \frac{FC_Mx + FC_My}{2} - P_Ax \qquad Max_Tension = 8.4 \cdot kip$$

Calculate the Allowable Tension per Bolt

$$R_{nt} := F_{nt} \cdot A_{AB} \qquad R_{nt} = 34.2 \cdot kip$$

$$Allowable_Tension := \frac{R_{nt}}{\Omega_{AB}} \qquad Allowable_Tension = 17.1 \cdot kip$$

Tension_Check = "OK"

Calculate the Actual Shear per Bolt.

$$Max_Shear := \frac{\sqrt{\left(Fy^2 + Fx^2\right)}}{4} \qquad Max_Shear = 0.225 \cdot kip$$

Calculate the Allowable Shear per Bolt.

$$R_{nv} := F_{nv} \cdot A_{AB} \qquad R_{nv} = 20.5 \cdot kip$$

$$Allowable_Shear := \frac{R_{nv}}{\Omega_{AB}} \qquad Allowable_Shear = 10.2 \cdot kip$$

Shear_Check = "OK"

Calculate the Allowable Combined Tension and Shear.

The combo check for tension and shear is a unity calculation. The equation result must be less than 1.00.

$$Unity_Calc := \left(\frac{Max_Tension}{Allowable_Tension}\right)^2 + \left(\frac{Max_Shear}{Allowable_Shear}\right)^2 = 0.241$$

Combo_Check = "OK'

Minimum Edge distance check (From Table J3.4). Minimum Edge Distance Must Be Greater than the Actual Bolt Hole Distances.

$AB_Dia = 1 \cdot in$

$Min_Edge = 1\frac{3}{4} \cdot in$ $Ex = 2 \cdot in$ $Ey = 2 \cdot in$

Edge_Check = "OK"

2" Edge Distance OK per note "a" from AISC Table J3.4

Determine Fillet Weld Size Required:

This design procedure is from Blodgett Section 7.4. The weld is treated as a line.

Calculate the the length of the welds, using the formulas contained in Table 5.

For Square

$Swx := (bf) \cdot d + \frac{d^2}{3}$ $Swx = 85.333 \cdot in^2$

$Swy := bf \cdot d + \frac{(bf)^2}{3}$ $Swy = 85.333 \cdot in^2$

Calculate the stress for each direction:

$fmx := \frac{Mx}{Swx}$ $fmx = 1.072 \cdot \frac{kip}{in}$

$fmy := \frac{My}{Swy}$ $fmy = 1.44 \cdot \frac{kip}{in}$

Calculate the combined stress:

$f_act := \sqrt{(fmx^2 + fmy^2)}$ $f_act = 1.796 \cdot \frac{kip}{in}$

Allowable for fillet welds and A36 materialfor E70 weld material per AISC UNIFIED is 0.30(weld material)(0.707 for throat)=14850 psi..

The weld size required is determined by dividing the actual stress by the allowable stress.

$w_reqd := \frac{f_act}{14850 \cdot psi}$ $w_reqd = 0.121 \cdot in$

Check Table J2.4 of the AISC ASD manual to check if w_reqd is greater than the minimum size required.

$tf = 0.375 \cdot in$ $tw = 0.375 \cdot in$ $t_min = 0.682 \cdot in$

Values to be Used:

Plate Thickness = 1 inch
Anchor Bolt = 1 inch diameter
Weld Size = 5/16 inch all around

This MathCAD document is used to calculate the following:

1. Base Plate thickness for bearing type(Square Tube Column)
2. Checks Anchor bolt Diameter & Edge Distance
3. Checks Fillet Weld Size

References which are used for the base plate design are:

1. AISC UNIFIED Construction Manual, 13th Edition.

ASD Design Factors

$\Omega_{BP} := 1.67$ $\Omega_{AB} := 2.00$

Definition of Units

$kip \equiv 1000 \cdot lb$ $kin \equiv kip \cdot in$ $ksi \equiv \frac{kip}{in^2}$ $psi \equiv \frac{lb}{in^2}$

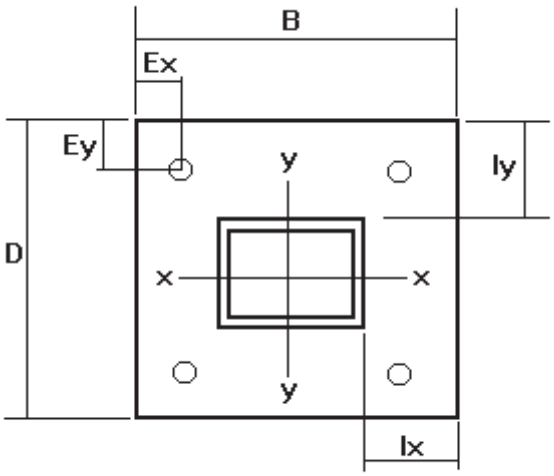
Determine Plate Dimensions

Depth of Column

Dimensions for Column used: HSS8x8x3/8

$d := 8 \cdot in$ $tw := 0.375 \cdot in$

$bf := 8 \cdot in$ $tf := 0.375 \cdot in$



Enter the dimensions for the plate.

$B := 16 \cdot in$ $Ex := 2 \cdot in$

$D := 16 \cdot in$ $Ey := 2 \cdot in$

Design Forces ***(Wind From Z-Dir)***

$Axial := 2.2 \cdot kip$

$Fx := 0.92 \cdot kip$ $My := 163.2 \cdot kin$

$Fy := 0 \cdot kip$ $Mx := 0 \cdot kin$

Base Plate and Anchor Bolt Material Properties.

$fy_{BP} := 36.0 \cdot ksi$ *Yield Stress of Base Plate.*

$fu_{AB} := 58.0 \cdot ksi$ *Tensile Stress of Anchor Bolt (58ksi for A36)*

Estimated Anchor Bolts:

$AB_Dia := 1.00 \cdot in$ $A_{AB} := \left(\frac{\pi}{4}\right) \cdot AB_Dia^2$ $A_{AB} = 0.785 \cdot in^2$

The nominal tensile and shear stress for the bolts is based on the formula from page 16.1-120 of the 14th Edition of the AISC UNIFIED manual.

$F_{nt} := 0.75 \cdot fu_{AB}$ $F_{nt} = 43.5 \cdot ksi$

$F_{nv} := 0.45 \cdot fu_{AB}$ $F_{nv} = 26.1 \cdot ksi$

Determine Plate Thickness for Leveling Nut Base Plate.

A. Proportion Axial Force

$P_Ax := \frac{Axial}{4}$ $P_Ax = 0.6 \cdot kip$

B. Determine Bolt Forces due to Mx (for two bolts in compression)

$FC_Mx := \frac{Mx}{D - 2 \cdot Ey}$ $FC_Mx = 0 \cdot kip$

$P_Mx := 2 \cdot P_Ax + FC_Mx$ $P_Mx = 1.1 \cdot kip$

C. Determine Bolt Forces due to My (for two bolts in compression)

$FC_My := \frac{My}{B - 2 \cdot Ex}$ $FC_My = 13.6 \cdot kip$

$P_My := 2 \cdot P_Ax + FC_My$ $P_My = 14.7 \cdot kip$

D. Determine Thickness Required for Mx

$l_Mx := \frac{D - 2 \cdot Ey - d}{2}$ $l_Mx = 2.0 \cdot in$

$M_Mx := P_Mx \cdot l_Mx$ $M_Mx = 2.2 \cdot kin$

$t_Mx := \sqrt{\frac{\Omega_{BP} \cdot 4 \cdot M_Mx}{fy_{BP} \cdot B}}$ $t_Mx = 0.2 \cdot in$

E. Determine Thickness Required for My

$$l_My := \frac{B - 2 \cdot Ex - bf}{2} \qquad l_My = 2.0 \cdot in$$

$$M_My := P_My \cdot l_My \qquad M_My = 29.4 \cdot kin$$

$$t_My := \sqrt{\frac{\Omega_{BP} \cdot 4 \cdot M_My}{fy_{BP} \cdot D}} \qquad t_My = 0.6 \cdot in$$

F. Determine Total Plate Thickness Required

$$t_min := \sqrt{t_Mx^2 + t_My^2} \qquad t_min = 0.605 \cdot in$$

Check Anchor Bolt Diameter:

Calculate the Actual Tension per Bolt.

$$Max_Tension := \frac{FC_Mx + FC_My}{2} - P_Ax \qquad Max_Tension = 6.3 \cdot kip$$

Calculate the Allowable Tension per Bolt

$$R_{nt} := F_{nt} \cdot A_{AB} \qquad R_{nt} = 34.2 \cdot kip$$

$$Allowable_Tension := \frac{R_{nt}}{\Omega_{AB}} \qquad Allowable_Tension = 17.1 \cdot kip$$

Tension_Check = "OK"

Calculate the Actual Shear per Bolt.

$$Max_Shear := \frac{\sqrt{\left(Fy^2 + Fx^2\right)}}{4} \qquad Max_Shear = 0.23 \cdot kip$$

Calculate the Allowable Shear per Bolt.

$$R_{nv} := F_{nv} \cdot A_{AB} \qquad R_{nv} = 20.5 \cdot kip$$

$$Allowable_Shear := \frac{R_{nv}}{\Omega_{AB}} \qquad Allowable_Shear = 10.2 \cdot kip$$

Shear_Check = "OK"

Calculate the Allowable Combined Tension and Shear.

The combo check for tension and shear is a unity calculation. The equation result must be less than 1.00.

$$Unity_Calc := \left(\frac{Max_Tension}{Allowable_Tension}\right)^2 + \left(\frac{Max_Shear}{Allowable_Shear}\right)^2 = 0.134$$

Combo_Check = "OK'

Minimum Edge distance check (From Table J3.4). Minimum Edge Distance Must Be Greater than the Actual Bolt Hole Distances.

$AB_Dia = 1 \cdot in$

$Min_Edge = 1\frac{3}{4} \cdot in$ $Ex = 2 \cdot in$ $Ey = 2 \cdot in$

Edge_Check = "OK"

2" Edge Distance OK per note "a" from AISC Table J3.4

Determine Fillet Weld Size Required:

This design procedure is from Blodgett Section 7.4. The weld is treated as a line.

Calculate the the length of the welds, using the formulas contained in Table 5.

For Square Tubes:

$Swx := (bf) \cdot d + \frac{d^2}{3}$ $Swx = 85.333 \cdot in^2$

$Swy := bf \cdot d + \frac{(bf)^2}{3}$ $Swy = 85.333 \cdot in^2$

Calculate the stress for each direction:

$fmx := \frac{Mx}{Swx}$ $fmx = 0 \cdot \frac{kip}{in}$

$fmy := \frac{My}{Swy}$ $fmy = 1.912 \cdot \frac{kip}{in}$

Calculate the combined stress:

$f_act := \sqrt{(fmx^2 + fmy^2)}$ $f_act = 1.912 \cdot \frac{kip}{in}$

Allowable for fillet welds and A36 materialfor E70 weld material per AISC UNIFIED is 0.30(weld material)(0.707 for throat)=14850 psi..

The weld size required is determined by dividing the actual stress by the allowable stress.

$$w_reqd := \frac{f_act}{14850 \cdot psi} \qquad w_reqd = 0.129 \cdot in$$

Check Table J2.4 of the AISC ASD manual to check if w_reqd is greater than the minimum size required.

$tf = 0.375 \cdot in$ $tw = 0.375 \cdot in$ $t_min = 0.605 \cdot in$

Values to be Used:

Plate Thickness = 1 inch
Anchor Bolt = 1 inch diameter
Weld Size = 5/16 inch all around

This MathCAD document is used to calculate the following:

1. Top Plate thickness for bearing and flexure (Square Tube Column)
2. Checks Equipment Bolt Diameter & Edge Distance
3. Checks Fillet Weld Size

References which are used for the top plate design are:

1. AISC UNIFIED Construction Manual, 13th Edition.

ASD Design Factors

$\Omega_{TP} := 1.67$ $\Omega_{EB} := 2.00$

Definition of Units

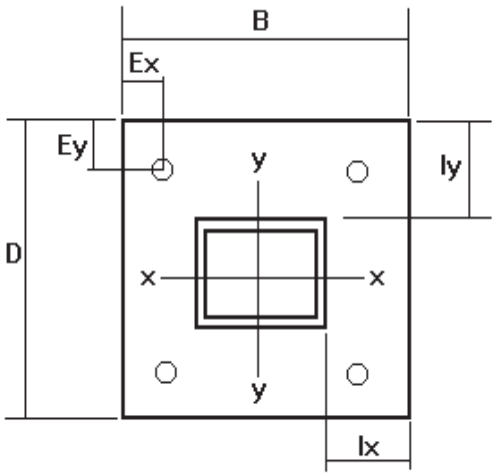
$kip \equiv 1000 \cdot lb$ $kin \equiv kip \cdot in$ $ksi \equiv \frac{kip}{in^2}$ $psi \equiv \frac{lb}{in^2}$

Determine Plate Dimensions

Dimensions for Column used: HSS8x8x3/8

$d := 8 \cdot in$ $tw := 0.375 \cdot in$

$bf := 8 \cdot in$ $tf := 0.375 \cdot in$



Enter the dimensions for the plate.

$B := 14 \cdot in$ $Ex := 1.5 \cdot in$

$D := 14 \cdot in$ $Ey := 1.5 \cdot in$

Design Forces ***(Wind From X-Dir)***

$Axial := 1.1 \cdot kip$

$Fx := 0 \cdot kip$ $My := 0.01 \cdot kin$

$Fy := 0.3 \cdot kip$ $Mx := 46.1 \cdot kin$

Top Plate and Equipment Bolt Material Properties.

$fy_{TP} := 36.0 \cdot ksi$ *Yield Stress of Top Plate.*

$fu_{EB} := 58.0 \cdot ksi$ *Tensile Stress of Equipment Bolt (58ksi for A36)*

Estimated Equipment Bolts:

$EB_Dia := .625 \cdot in$ $A_{EB} := \left(\frac{\pi}{4}\right) \cdot EB_Dia^2$ $A_{EB} = 0.307 \cdot in^2$

The nominal tensile and shear stress for the bolts is based on the formula from page 16.1-120 of the 14th Edition of the AISC UNIFIED manual.

$F_{nt} := 0.75 \cdot fu_{EB}$ $F_{nt} = 43.5 \cdot ksi$

$F_{nv} := 0.45 \cdot fu_{EB}$ $F_{nv} = 26.1 \cdot ksi$

Determine Plate Thickness for Equipment Top Plate.

A. Proportion Axial Force

$$P_Ax := \frac{Axial}{4} \qquad P_Ax = 0.3 \cdot kip$$

B. Determine Bolt Forces due to Mx (for two bolts in compression)

$$FC_Mx := \frac{Mx}{D - 2 \cdot Ey} \qquad FC_Mx = 4.2 \cdot kip$$

$$P_Mx := 2 \cdot P_Ax + FC_Mx \qquad P_Mx = 4.7 \cdot kip$$

C. Determine Bolt Forces due to My (for two bolts in compression)

$$FC_My := \frac{My}{B - 2 \cdot Ex} \qquad FC_My = 9.1 \times 10^{-4} \cdot kip$$

$$P_My := 2 \cdot P_Ax + FC_My \qquad P_My = 0.6 \cdot kip$$

D. Determine Thickness Required for Mx

$$l_Mx := \frac{D - 2 \cdot Ey - d}{2} \qquad l_Mx = 1.5 \cdot in$$

$$M_Mx := P_Mx \cdot l_Mx \qquad M_Mx = 7.1 \cdot kin$$

$$t_Mx := \sqrt{\frac{\Omega_{TP} \cdot 4 \cdot M_Mx}{fy_{TP} \cdot B}} \qquad t_Mx = 0.3 \cdot in$$

E. Determine Thickness Required for My

$$l_My := \frac{B - 2 \cdot Ex - bf}{2} \qquad l_My = 1.5 \cdot in$$

$$M_My := P_My \cdot l_My \qquad M_My = 0.8 \cdot kin$$

$$t_My := \sqrt{\frac{\Omega_{TP} \cdot 4 \cdot M_My}{fy_{TP} \cdot D}} \qquad t_My = 0.10 \cdot in$$

F. Determine Total Plate Thickness Required

$$t_min := \sqrt{t_Mx^2 + t_My^2} \qquad t_min = 0.324 \cdot in$$

Check Equipment Bolt Diameter:

Calculate the Actual Tension per Bolt.

$$Max_Tension := \frac{FC_Mx + FC_My}{2} - P_Ax \qquad Max_Tension = 1.82 \cdot kip$$

Calculate the Allowable Tension per Bolt.

$$R_{nt} := F_{nt} \cdot A_{EB} \qquad R_{nt} = 13.3 \cdot kip$$

$$Allowable_Tension := \frac{R_{nt}}{\Omega_{EB}} \qquad Allowable_Tension = 6.7 \cdot kip$$

Tension_Check = "OK"

Calculate the Actual Shear per

$$Max_Shear := \frac{\sqrt{\left(Fy^2 + Fx^2\right)}}{4} \qquad Max_Shear = 0.075 \cdot kip$$

Calculate the Allowable Shear per Bolt.

$$R_{nv} := F_{nv} \cdot A_{EB} \qquad R_{nv} = 8.0 \cdot kip$$

$$Allowable_Shear := \frac{R_{nv}}{\Omega_{EB}} \qquad Allowable_Shear = 4.0 \cdot kip$$

Shear_Check = "OK"

The combo check for tension and shear is a unity calculation. The equation result must be less than 1.00.

$$Unity_Calc := \left(\frac{Max_Tension}{Allowable_Tension}\right)^2 + \left(\frac{Max_Shear}{Allowable_Shear}\right)^2 = 0.075$$

Combo_Check = "OK"

Minimum Edge distance check (From Table J3.4). Minimum Edge Distance Must Be Greater than the Actual Bolt Hole Distances.

$$EB_Dia = \frac{5}{8} \cdot in$$

$$Min_Edge = 1\frac{1}{8} \cdot in \qquad Ex = 1\frac{1}{2} \cdot in \qquad Ey = 1\frac{1}{2} \cdot in$$

Edge_Check = "OK"

Determine Fillet Weld Size

Required:

This design procedure is from Blodgett Section 7.4. The weld is treated as a line.

Calculate the the length of the welds, using the formulas contained in Table 5.

For Square

$Swx := (bf)\cdot d + \frac{d^2}{3}$ $\quad Swx = 85.333\cdot in^2$

$Swy := bf\cdot d + \frac{(bf)^2}{3}$ $\quad Swy = 85.333\cdot in^2$

Calculate the stress for each direction:

$fmx := \frac{Mx}{Swx}$ $\quad fmx = 0.54\cdot\frac{kip}{in}$

$fmy := \frac{My}{Swy}$ $\quad fmy = 1.172\times 10^{-4}\cdot\frac{kip}{in}$

Calculate the combined stress:

$f_act := \sqrt{\left(fmx^2 + fmy^2\right)}$ $\quad f_act = 0.54\cdot\frac{kip}{in}$

Allowable for fillet welds and A36 materialfor E70 weld material per AISC UNIFIED is 0.30(weld material)(0.707 for throat)=14850 psi..

The weld size required is determined by dividing the actual stress by the allowable stress.

$w_reqd := \frac{f_act}{14850\cdot psi}$ $\quad w_reqd = 0.036\cdot in$

Check Table J2.4 of the AISC ASD manual to check if w_reqd is greater than the minimum size required.

$tf = 0.375\cdot in$ $\quad tw = 0.375\cdot in$ $\quad t_min = 0.324\cdot in$

Values to be Used:

Top Plate Thickness = 1/2 inch
Equipment Bolt = 5/8 inch diameter
Weld Size = 5/16 inch all around

Transmittal

3350 38th Avenue South, Fargo, ND 58104

PROJECT:	White - Northwest Ohio - EPC 17.01246	DATE:	1/25/2018
SUBJECT:	Northwest Ohio Wind - Substation - P&C, Physical, Structural and Civil - Issued For Construction	TRANSMITTAL ID:	00019
PURPOSE:	For your review and comment	VIA:	Info Exchange

FROM

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Bernisha Goldsmith United States	IEA	Bernisha.Goldsmith@iea.net	

REMARKS:

Al,

Available for download are the Northwest Ohio substation P&C, physical, structural and civil drawings and specifications issued for construction.

Let us know if you have any questions.

Thanks,
TJ

Transmittal

DATE: 1/25/2018
TRANSMITTAL ID: 00019

DESCRIPTION OF CONTENTS

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1	1/25/2018	NWO-GD1-002.pdf	
1	1/25/2018	NWO-AC1-001.pdf	
1	1/25/2018	NWO-AC1-002.pdf	
1	1/25/2018	NWO-AS1-001.pdf	
1	1/25/2018	NWO-AS1-002.pdf	
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DATE: 1/25/2018
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1	1/24/2018	NWO-EQ2-001.pdf	
1	1/24/2018	NWO-EQ2-002.pdf	
1	1/24/2018	NWO-EQ2-003.pdf	
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1	1/24/2018	NWO-EQ4-001.pdf	
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2/5/2018 11:19:49 AM

in

Case No(s). 13-0197-EL-BGN, 16-1687-EL-BGA, 17-1099-EL-BGA

Summary: Notice of Compliance with Condition 6 Substation Issued for Construction Drawings electronically filed by Christine M.T. Pirik on behalf of Trishe Wind Ohio, LLC