Department of Energy

Bonneville Power Administration
P.O. Box 3621
Portland, Oregon 97208-3621

PUBLIC AFFAIRS

August 21, 2012

In reply refer to: DK-7

Vulcraft Group, a Division of the Nucor Corporation
Attn: Russell Balvin
PO Box 59
Norfolk, NE 68702

FOIA #BPA-2012-01752-F

Dear Mr. Balvin:

Thank you for your request for records that you made to the Bonneville Power Administration (BPA) under the Freedom of Information Act (FOIA), 5 U.S.C. 552. Your request was received in this office on Tuesday, August 14, 2012, and has been assigned a control number, BPA-2012-01752-F. Please use this number in any correspondence with the Agency about your request.

You have requested the following:
Structural drawings including material sizes and associated connections for BPA's newly designed one double circuit and three single circuit towers.

We have reviewed your letter and have determined that it addresses all of the criteria of a proper request under the FOIA, DOE, and BPA regulation that implements the FOIA at Title 10, Code of Federal Regulations, Part 1004. You agreed to pay all applicable fees.

Final response:
BPA has provided the requested documents in their entirety on the enclosed CD.

Pursuant to 10 CFR 1004.8, if you are dissatisfied with this determination, or the adequacy of the search, you may appeal in writing within 30 calendar days of receipt of a final response letter. The appeal should be made to the Director, Office of Hearings and Appeals, HG-1, Department of Energy, 1000 Independence Avenue, SW, Washington, DC 20585-1615. The written appeal, including the envelope, must clearly indicate that a FOIA Appeal is being made.

The fees for request total $41.54. You will be billed separately.

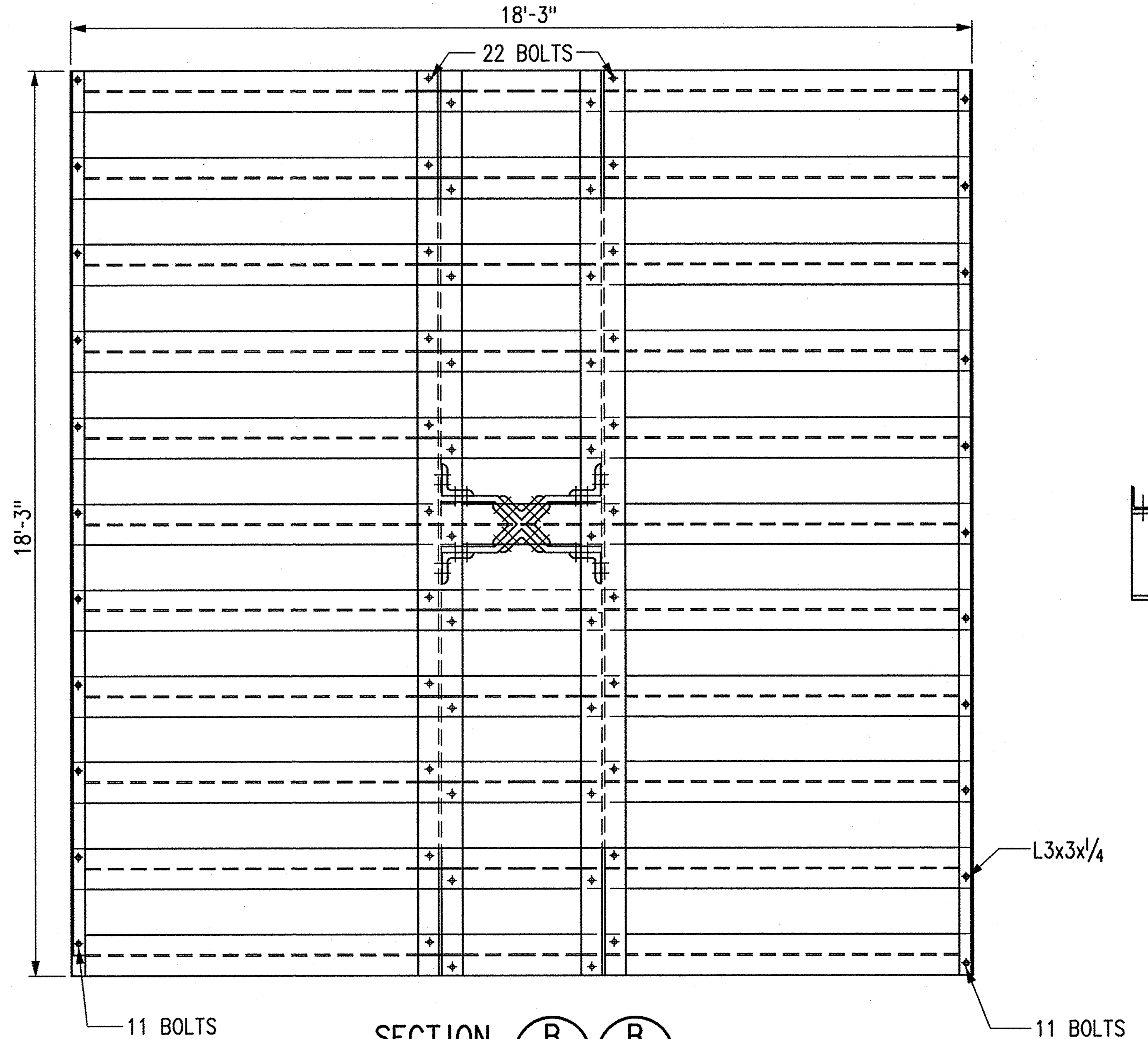
I appreciate the opportunity to assist you. Please contact Kim Winn, Communications Specialist, at 503-230-7305 with any questions about this letter.

Sincerely,

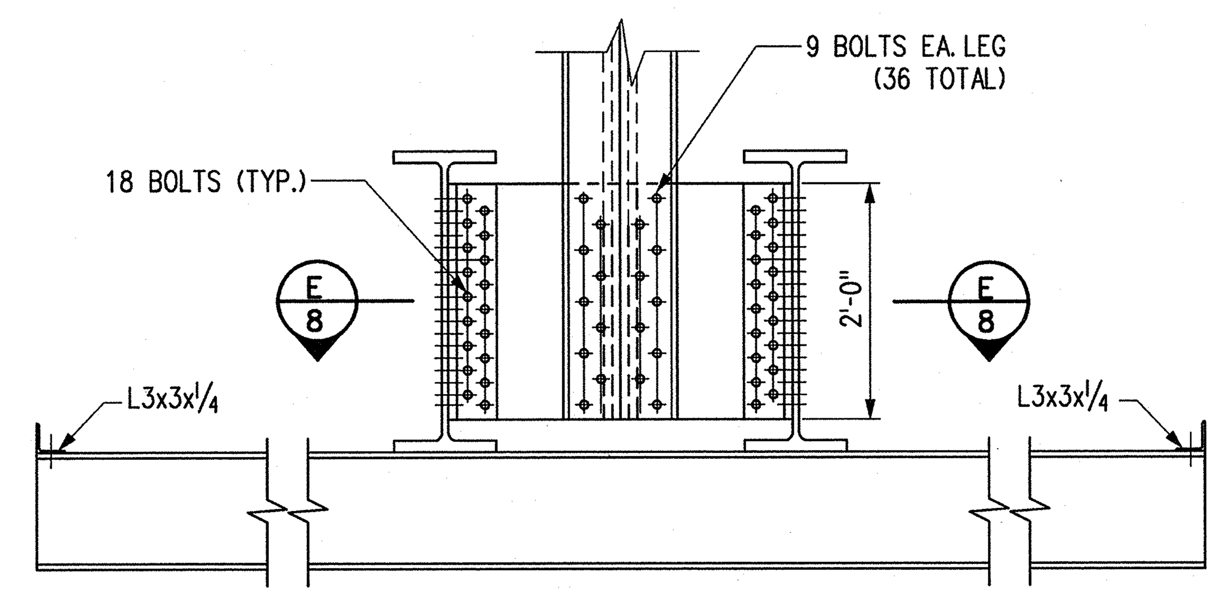
/s/ Christina J. Munro

Christina J. Munro
Freedom of Information Act/Privacy Act Officer

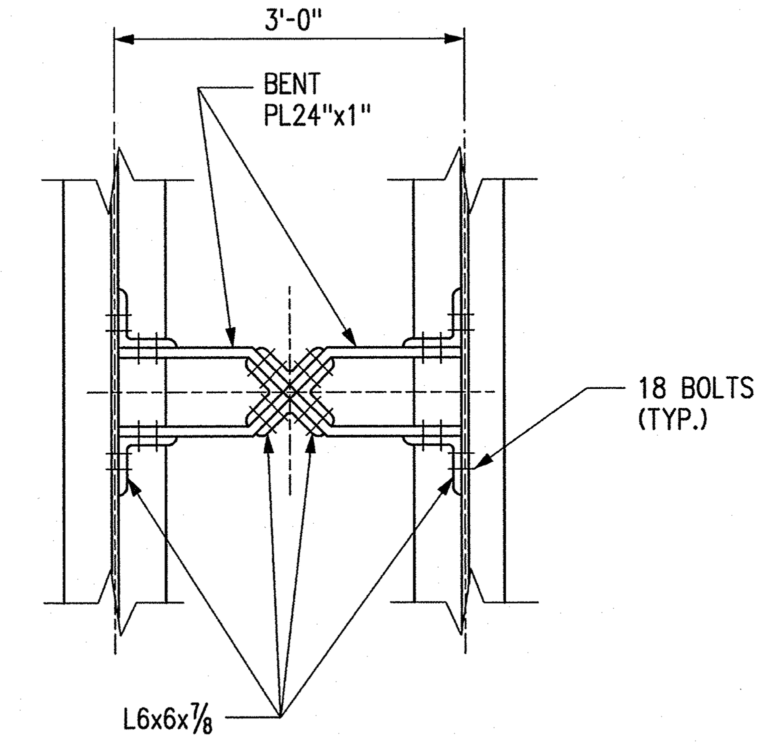
Enclosure: CD



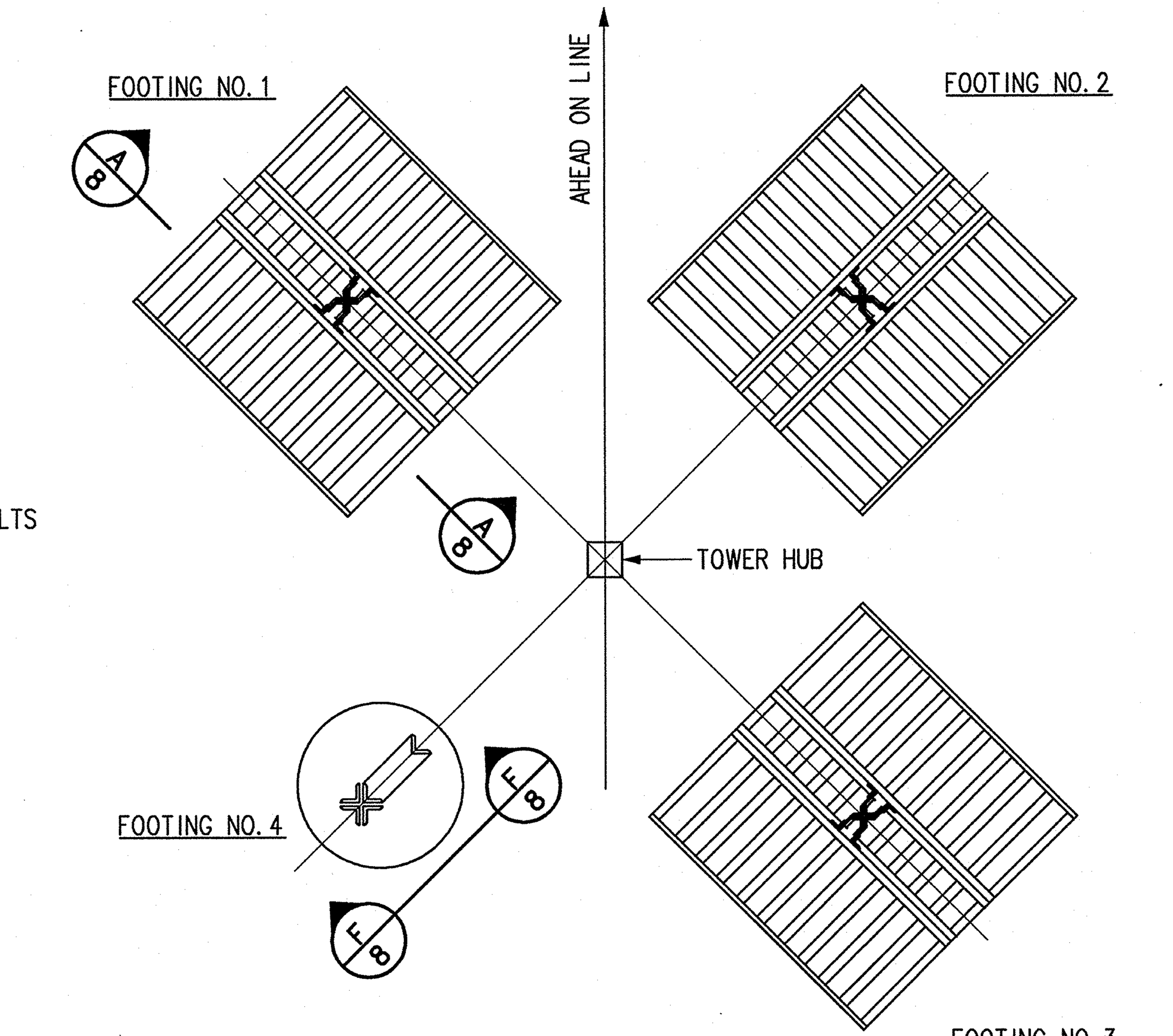
SECTION B/8 B/8



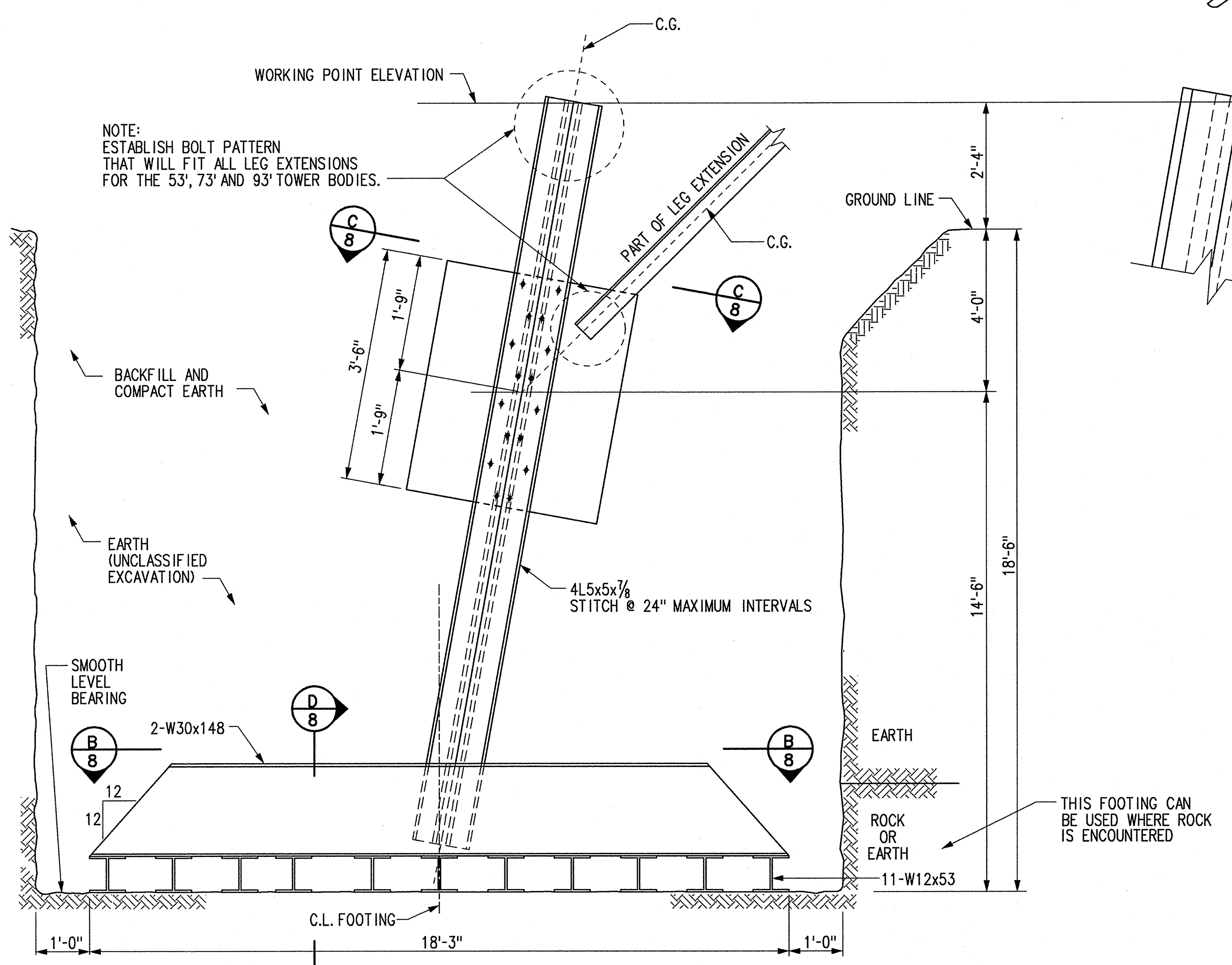
SECTION D/8 D/8



SECTION E/8 E/8



TOWER FOOTING PLAN

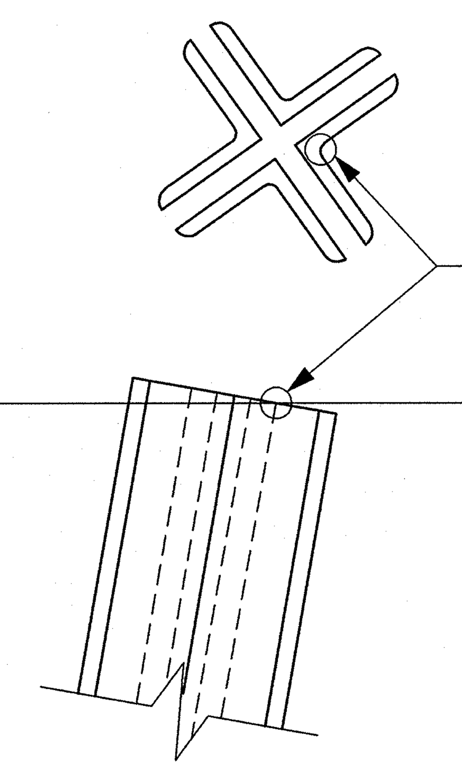


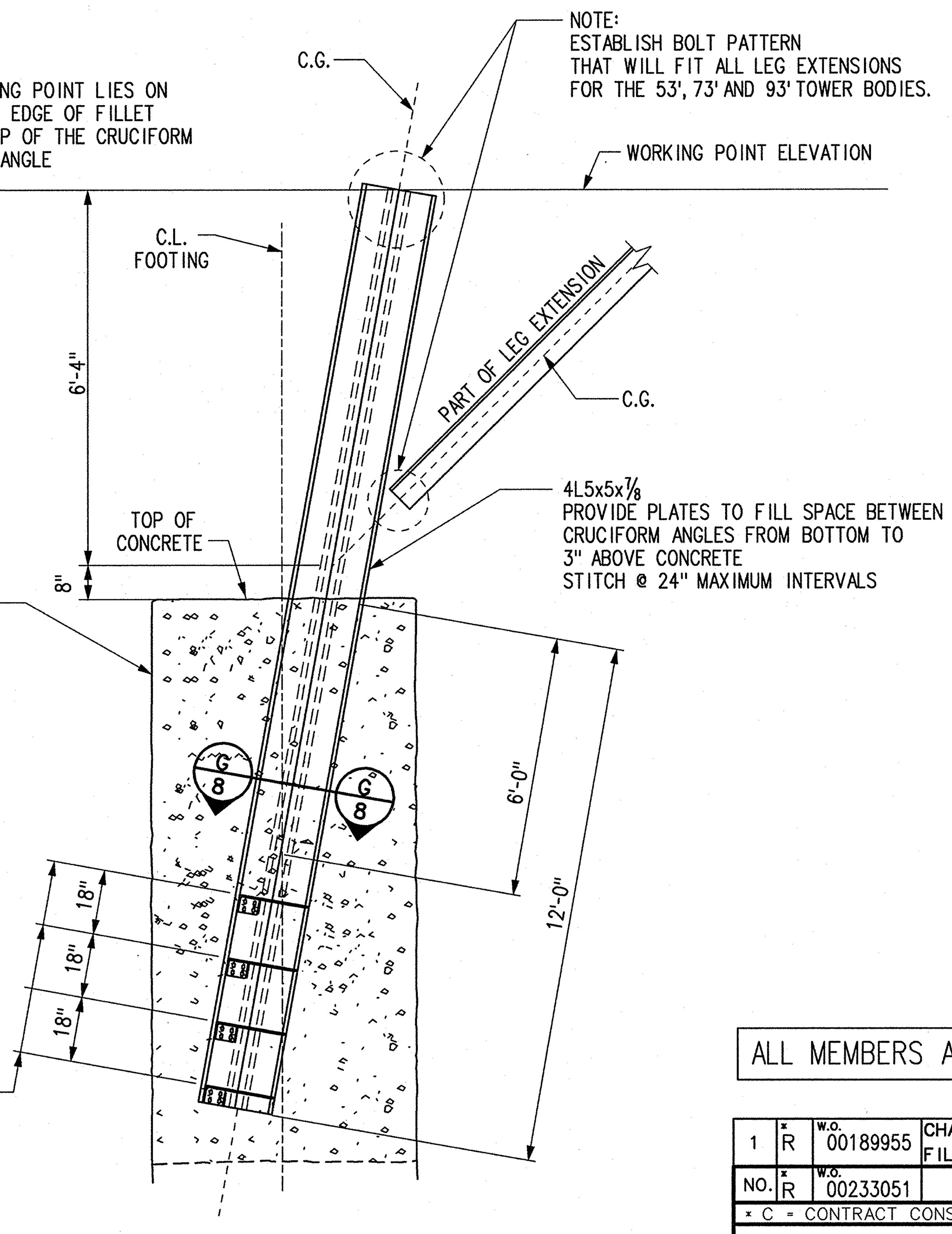
SECTION A/8 A/8

GRILLAGE FOOTING DETAIL

DETAILED WEIGHT OF ONE GRILLAGE FOOTING = 21472 LBS.

MAXIMUM UPLIFT	=	1246 KIPS
MAXIMUM HORIZONTAL SHEAR	=	94 KIPS
MAXIMUM COMPRESSION	=	1358 KIPS

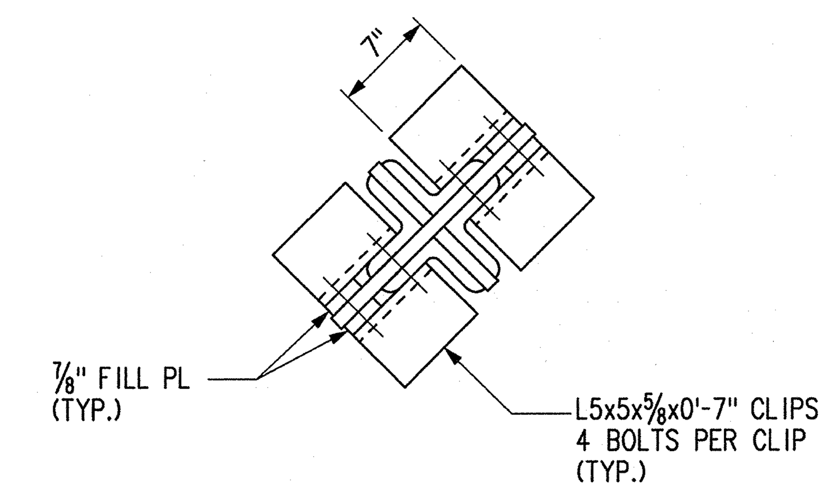




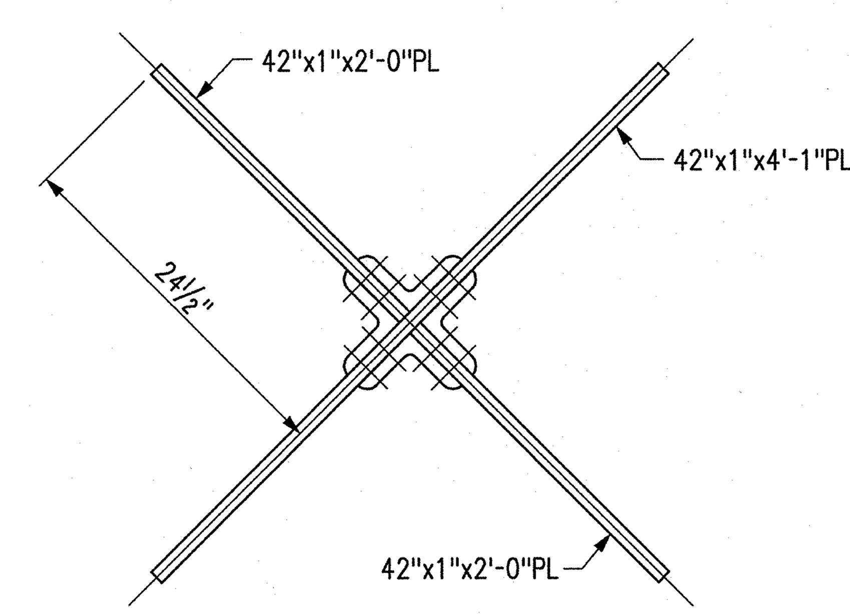
SECTION F/8 F/8

CONCRETE FOOTING STUB DETAIL

DETAILED WEIGHT OF ONE FOOTING STUB = 3161 LBS.



SECTION G/8 G/8



SECTION C/8 C/8

ALL MEMBERS AND PLATES ARE ASTM A572 GRADE 50 STEEL

NO.	*	W.O.	REVISION	BY	DATE	APPROVED
1	R	00189955	CHANGE CLIP SIZE IN SEC. E; CORRECT FILL SIZE IN SEC. G; ADD DETAILED WEIGHT	JCN	11/22/10	JCN DMH DEO
NO.	R	00233051	REVISION	BY	DATE	APPROVED

* C = CONTRACT CONSTRUCTION, FA = FORCE ACCOUNT, R = RECORD

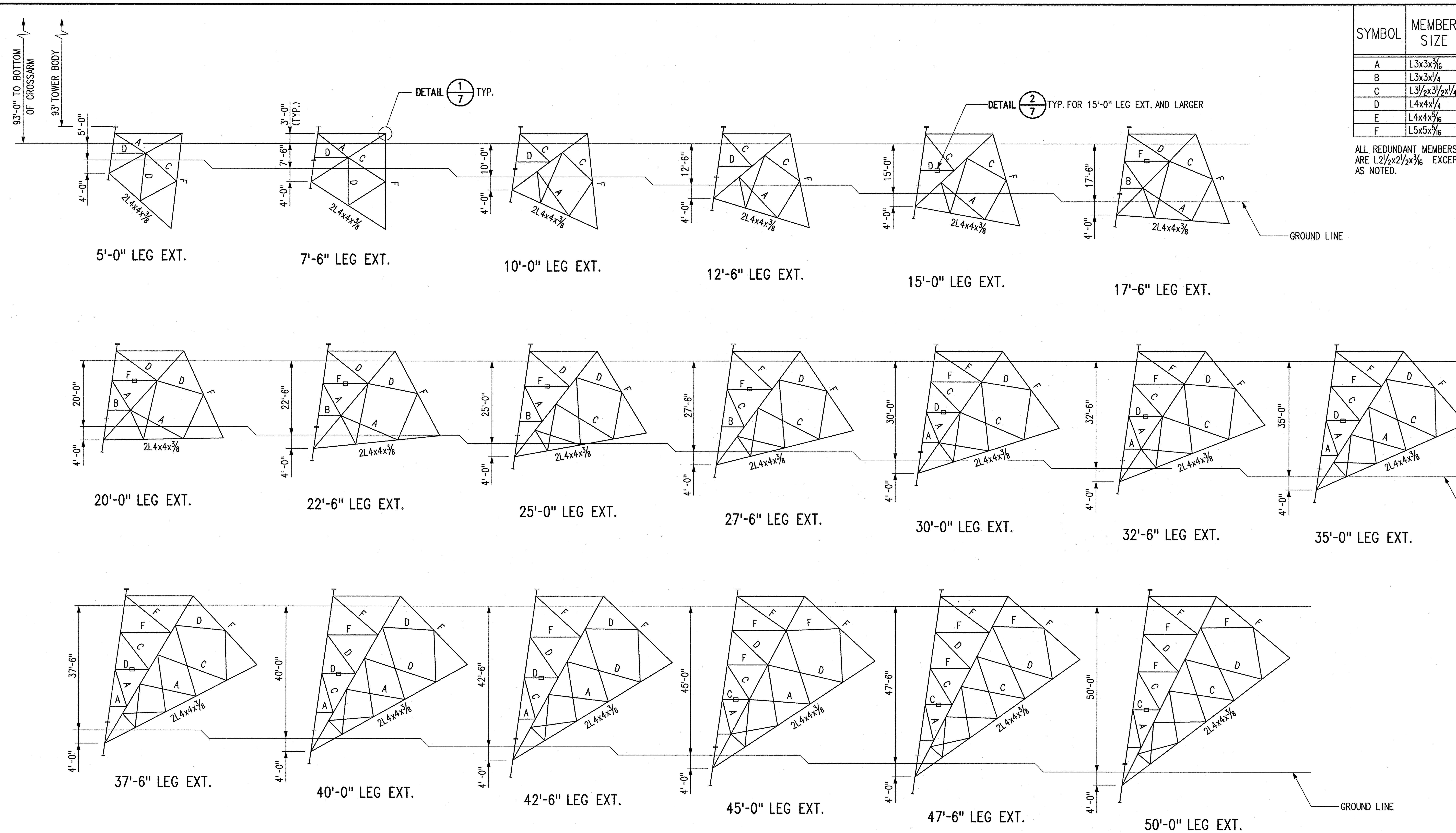
DSGN	J.C. NUNO
DRWN	MF/JCN
CHKD	D.M. HESSE
REVW	G.W. GREEN
CNCR	D.E. O'CLAIRE
APPR	L. KEMPNER (PRINCIPAL ENGINEER)
DATE	6-15-09

UNITED STATES DEPARTMENT OF ENERGY
BONNEVILLE POWER ADMINISTRATION
HEADQUARTERS, PORTLAND, OREGON

500KV DOUBLE CIRCUIT
TRANSMISSION TOWER
MWT = 57,000 LBS

TYPE 139D, 139DE — FOOTINGS

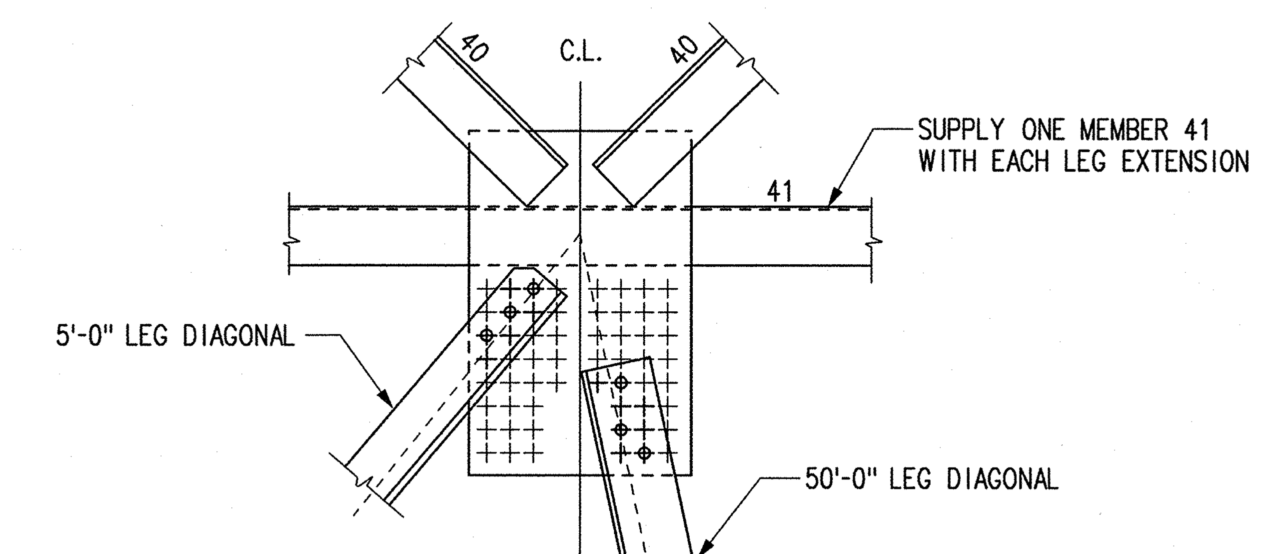
Serial	Source	Size	Sheet	Revision
284768	LFS	A1	8	1



SYMBOL	MEMBER SIZE
A	L3x3x3/16
B	L3x3x1/4
C	L3½x3½x1/4
D	L4x4x1/4
E	L4x4x5/16
F	L5x5x5/16

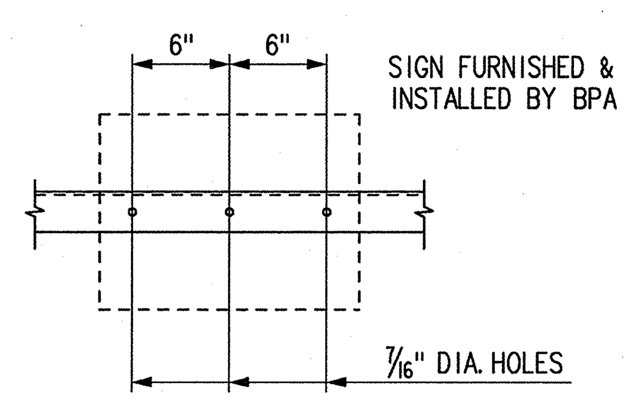
ALL REDUNDANT MEMBERS ARE L2½x2½x3/16 EXCEPT AS NOTED.

LEG EXT. FT.-IN.	DETAILED WEIGHT LBS
5'-0"	4239
7'-6"	4643
10'-0"	5087
12'-6"	5503
15'-0"	5825
17'-6"	6850
20'-0"	7233
22'-6"	7570
25'-0"	8200
27'-6"	8947
30'-0"	9645
32'-6"	10183
35'-0"	10631
37'-6"	11700
40'-0"	12244
42'-6"	12710
45'-0"	13544
47'-6"	14324
50'-0"	14871



UNIVERSAL CENTER PLATE WITH OPTIMUM BOLT HOLE ARRANGEMENT FOR ASSEMBLY OF ANY COMBINATION OF LEG EXTENSIONS FROM 5'-0" TO 50'-0"
USE NUMBERING SCHEME TO IDENTIFY BOLT HOLES FOR LEG EXTENSION.

DETAIL 1/7



DETAIL 2/7

ALL MEMBERS AND PLATES ARE ASTM A572 GRADE 50 STEEL

NOTES:
ALL MAIN LEG ANGLES ARE 4L5x5x7/8 AND CARRY A MAXIMUM FORCE OF 1355.0 KIPS.
LEG CONNECTIONS REQUIRE 36 BOLTS IN DOUBLE SHEAR. MAXIMUM MAIN LEG STITCH LENGTH IS 24".
THE MAIN DIAGONAL CARRIES A MAXIMUM FORCE OF 114.0 KIPS AND REQUIRES 3 BOLTS PER CONNECTION IN DOUBLE SHEAR. MAXIMUM DIAGONAL STITCH LENGTH IS 48".
THE PORTION OF THE MAIN DIAGONAL BELOW THE GROUND LINE IS TO BE CONTINUOUS WITH THAT ABOVE.
= DENOTES SPLICE

L = ∟ 2L = ⅃∟ 4L = ╬ 3/4" TYP.

NO.	*	W.O.	REVISION	BY	DATE	APPROVED
1	R	00189955	ADD DETAILED WEIGHT	JCN	11/22/10	JCN DAH DEO
	R	00233051				

* C = CONTRACT CONSTRUCTION, FA = FORCE ACCOUNT, R = RECORD

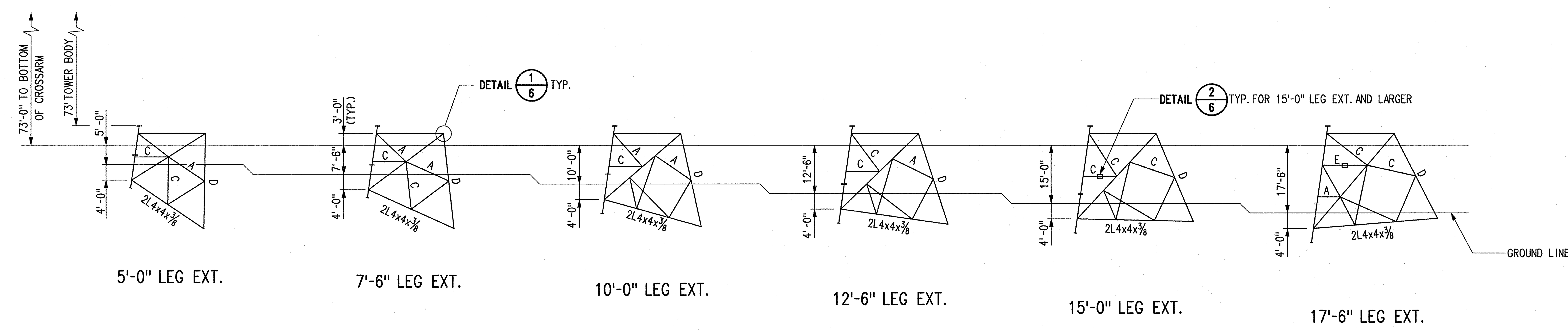
DSGN J.C. NUNO
DRWN M.FETESCU
CHKD D.M. HESSE
REVW G.W. GREEN
CNCR D.E. O'CLAIRE
APPR L. KEMPNER, PRINCIPAL ENGINEER
DATE 6-15-09

UNITED STATES DEPARTMENT OF ENERGY
BONNEVILLE POWER ADMINISTRATION
HEADQUARTERS, PORTLAND, OREGON

500KV DOUBLE CIRCUIT TRANSMISSION TOWER
MWT = 51,000 LBS

TYPE 139D, 139DE — LEG EXT. 93FT BODY

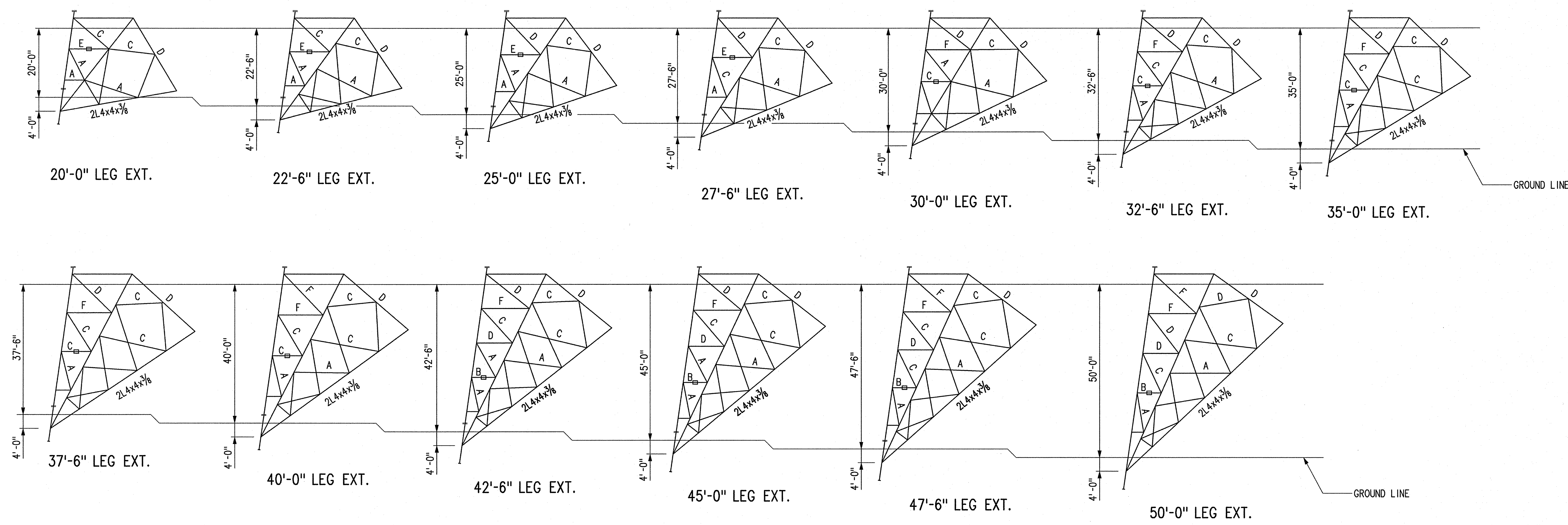
Serial	Source	Size	Sheet	Revision
284768	LFS	A1	7	1

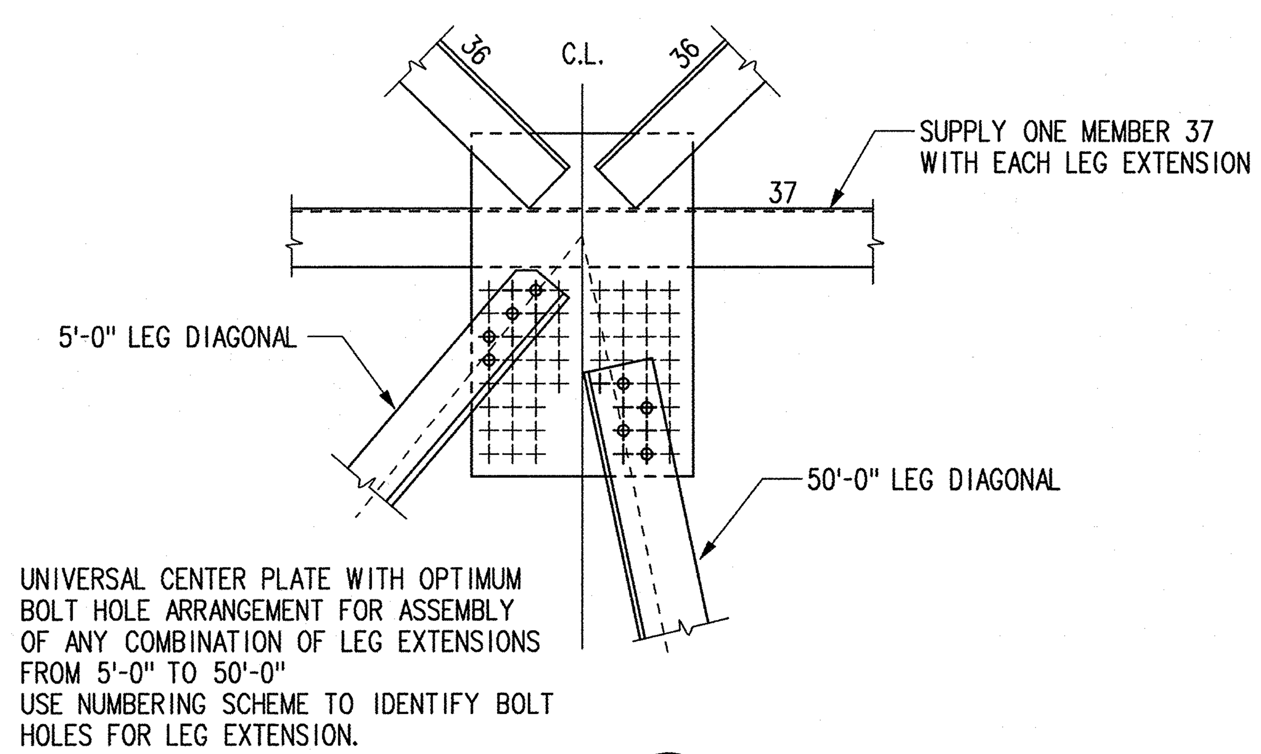


SYMBOL	MEMBER SIZE
A	L3x3x3/16
B	L3x3x1/4
C	L3½x3½x1/4
D	L4x4x1/4
E	L4x4x5/16
F	L5x5x5/16

ALL REDUNDANT MEMBERS ARE L2½x2½x3/16 EXCEPT AS NOTED.

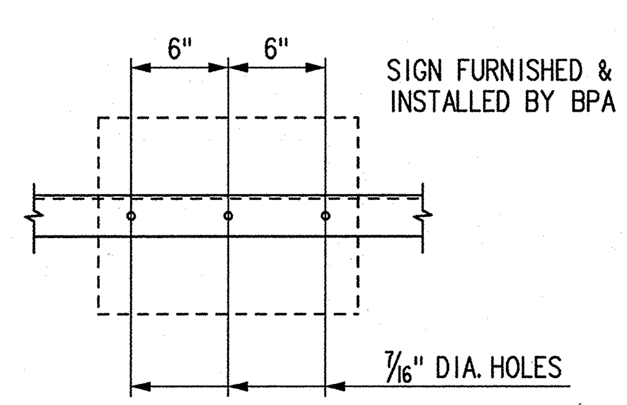
LEG EXT. FT.-IN.	DETAILED WEIGHT LBS
5'-0"	3734
7'-6"	4191
10'-0"	4650
12'-6"	5067
15'-0"	5541
17'-6"	6341
20'-0"	6745
22'-6"	7251
25'-0"	7718
27'-6"	8289
30'-0"	8992
32'-6"	9622
35'-0"	10733
37'-6"	11184
40'-0"	11774
42'-6"	12440
45'-0"	12595
47'-6"	13544
50'-0"	14047





UNIVERSAL CENTER PLATE WITH OPTIMUM BOLT HOLE ARRANGEMENT FOR ASSEMBLY OF ANY COMBINATION OF LEG EXTENSIONS FROM 5'-0" TO 50'-0"
USE NUMBERING SCHEME TO IDENTIFY BOLT HOLES FOR LEG EXTENSION.

DETAIL 1/6



DETAIL 2/6

NOTES:
ALL MAIN LEG ANGLES ARE 4L5x5x7/16 AND CARRY A MAXIMUM FORCE OF 1365.0 KIPS.
LEG CONNECTIONS REQUIRE 36 BOLTS IN DOUBLE SHEAR. MAXIMUM MAIN LEG STITCH LENGTH IS 24".
THE MAIN DIAGONAL CARRIES A MAXIMUM FORCE OF 145.0 KIPS AND REQUIRES 4 BOLTS PER CONNECTION IN DOUBLE SHEAR. MAXIMUM DIAGONAL STITCH LENGTH IS 48".
THE PORTION OF THE MAIN DIAGONAL BELOW THE GROUND LINE IS TO BE CONTINUOUS WITH THAT ABOVE.
▫ DENOTES SPLICE

L - ∟ 2L - ⊥ 4L - ╬ 3/4" TYP.

ALL MEMBERS AND PLATES ARE ASTM A572 GRADE 50 STEEL

NO.	*	W.O.	REVISION	BY	DATE	APPROVED
1	R	00189955	ADD DETAILED WEIGHT	JCN	1/22/10	JCN DMH DEO
NO.	R	00233051	REVISION	BY	DATE	APPROVED

* C = CONTRACT CONSTRUCTION, FA = FORCE ACCOUNT, R = RECORD

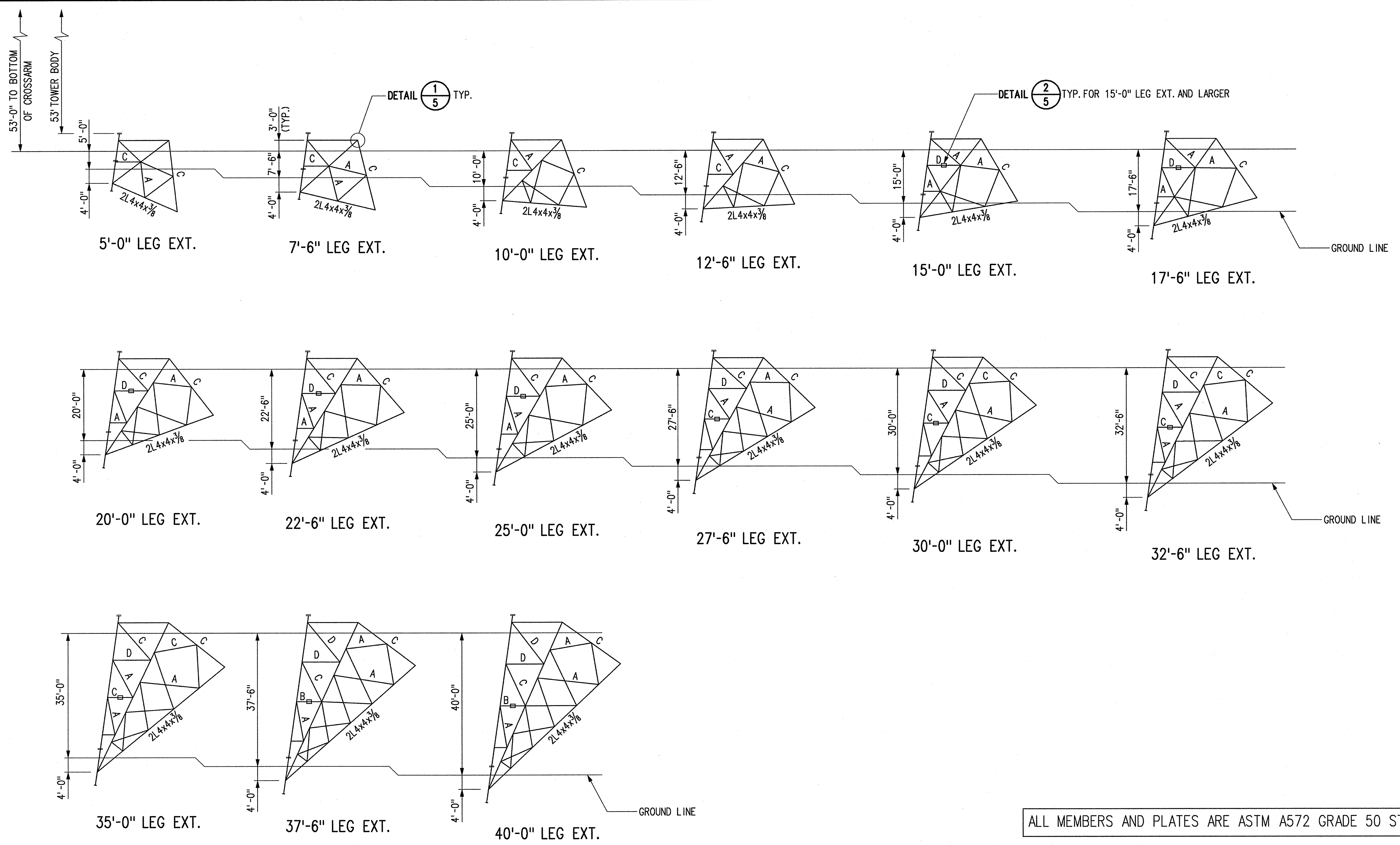
DSGN J.C. NUNO
DRWN M. FETESCU
CHKD D.M. HESSE
REVW G.W. GREEN
CNCR D.E. O'CLAIRE
APPR L. KEMPNER, PRINCIPAL ENGINEER
DATE 6-15-09

UNITED STATES DEPARTMENT OF ENERGY
BONNEVILLE POWER ADMINISTRATION
HEADQUARTERS, PORTLAND, OREGON

500KV DOUBLE CIRCUIT TRANSMISSION TOWER
MWT = 51,000 LBS

TYPE 139D, 139DE LEG EXT. 73FT BODY

Serial	Source	Size	Sheet	Revision
284768	LFS	A1	6	1

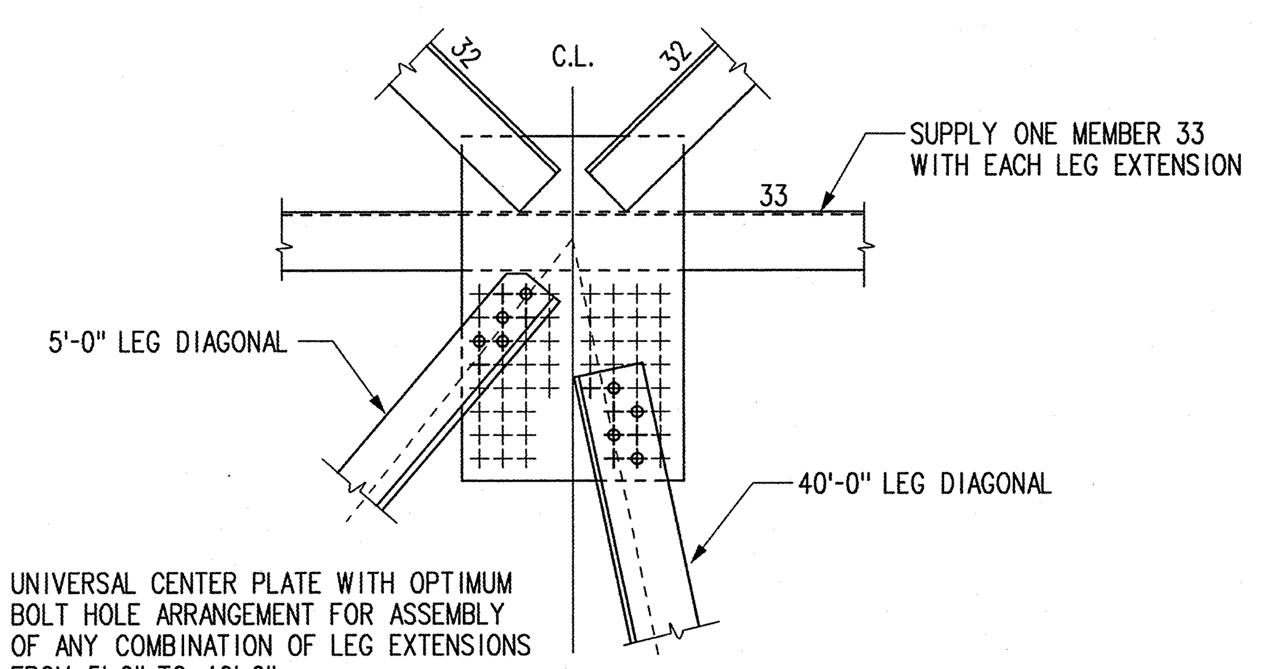


SYMBOL	MEMBER SIZE
A	L3x3x3/16
B	L3x3x1/4
C	L3½x3½x1/4
D	L4x4x1/4
E	L4x4x5/16
F	L5x5x5/16

ALL REDUNDANT MEMBERS ARE L2½x2½x3/16 EXCEPT AS NOTED.

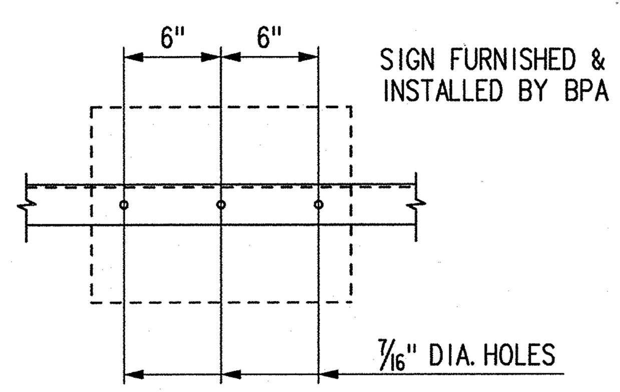
LEG EXT. FT.-IN.	DETAILED WEIGHT LBS
5'-0"	3469
7'-6"	3904
10'-0"	4388
12'-6"	4741
15'-0"	5483
17'-6"	5927
20'-0"	6403
22'-6"	6859
25'-0"	7300
27'-6"	8165
30'-0"	8666
32'-6"	9100
35'-0"	10182
37'-6"	10708
40'-0"	11170

ALL MEMBERS AND PLATES ARE ASTM A572 GRADE 50 STEEL



UNIVERSAL CENTER PLATE WITH OPTIMUM BOLT HOLE ARRANGEMENT FOR ASSEMBLY OF ANY COMBINATION OF LEG EXTENSIONS FROM 5'-0" TO 40'-0"
USE NUMBERING SCHEME TO IDENTIFY BOLT HOLES FOR LEG EXTENSION.

DETAIL 1/5



DETAIL 2/5

NOTES:
ALL MAIN LEG ANGLES ARE 4L5x5x7/8 AND CARRY A MAXIMUM FORCE OF 1375.0 KIPS.
LEG CONNECTIONS REQUIRE 36 BOLTS IN DOUBLE SHEAR. MAXIMUM MAIN LEG STITCH LENGTH IS 24".
THE MAIN DIAGONAL CARRIES A MAXIMUM FORCE OF 176.0 KIPS AND REQUIRES 4 BOLTS PER CONNECTION IN DOUBLE SHEAR. MAXIMUM DIAGONAL STITCH LENGTH IS 48".
THE PORTION OF THE MAIN DIAGONAL BELOW THE GROUND LINE IS TO BE CONTINUOUS WITH THAT ABOVE.
= DENOTES SPLICE

L = ∟ 2L = ⅃∟ 4L = ╬ 3/4" TYP.

NO.	*	W.O.	REVISION	BY	DATE	APPROVED
1	R	00189955	ADD DETAILED WEIGHT	JCN	11/22/10	JCN DMH DEO
	R	00233051				

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REVW G.W. GREEN
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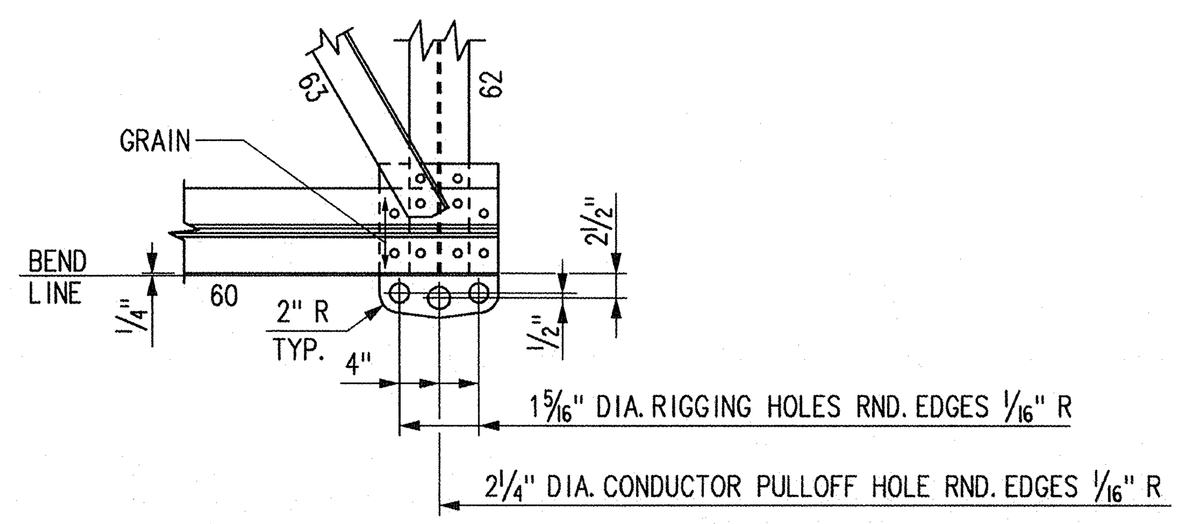
APPR L. KEMPNER, PRINCIPAL ENGINEER
DATE 6-15-09

UNITED STATES DEPARTMENT OF ENERGY
BONNEVILLE POWER ADMINISTRATION
HEADQUARTERS, PORTLAND, OREGON

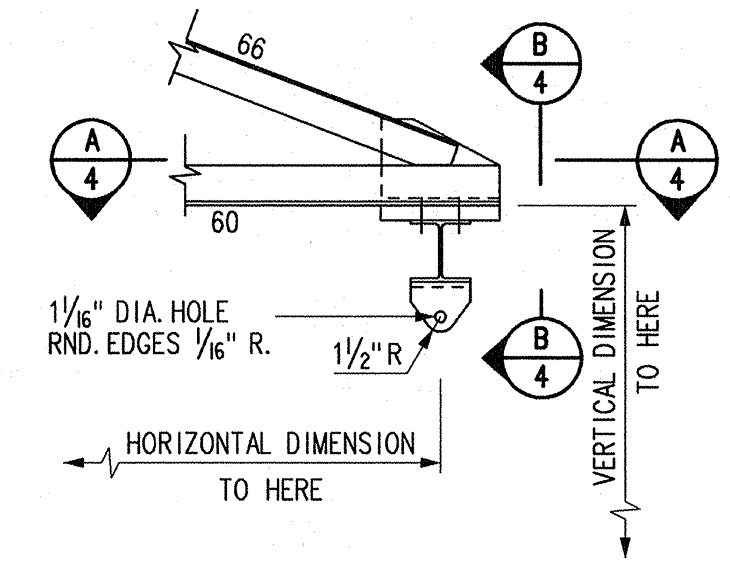
500KV DOUBLE CIRCUIT TRANSMISSION TOWER
MWT = 51,000 LBS

TYPE 139D, 139DE — LEG EXT. 53FT BODY

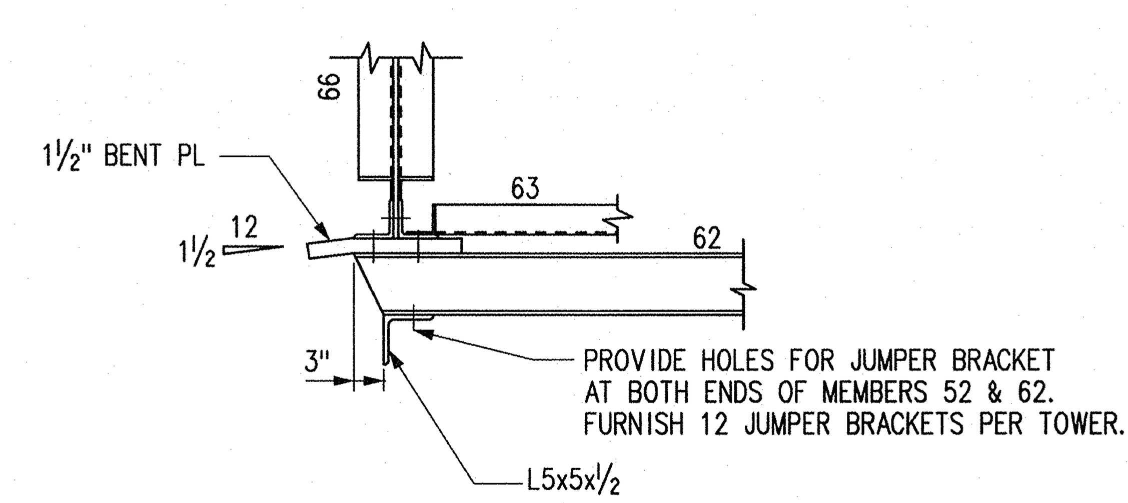
Serial	Source	Size	Sheet	Revision
284768	LFS	A1	5	1



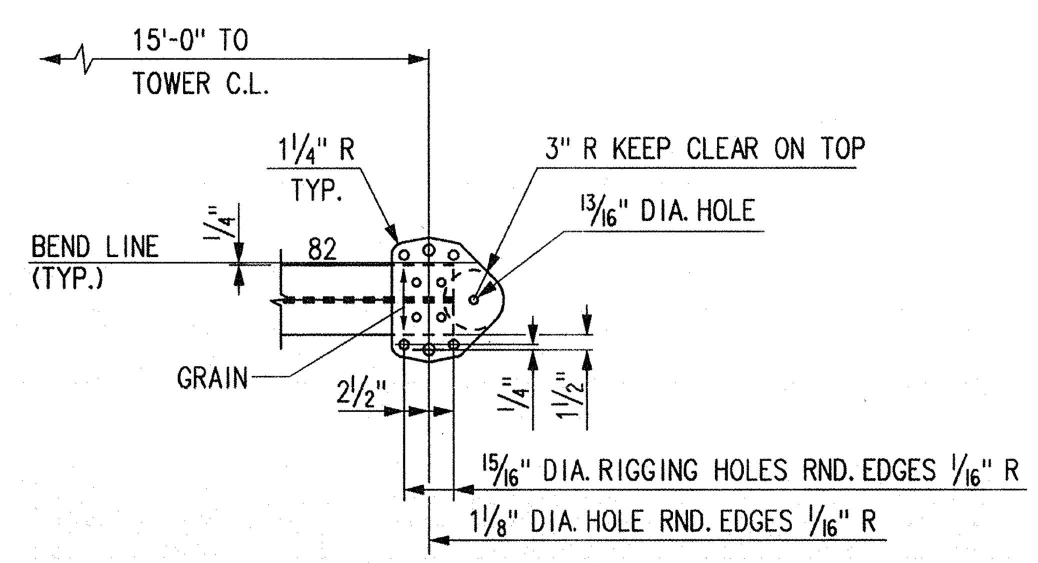
VIEW A/4 A/4



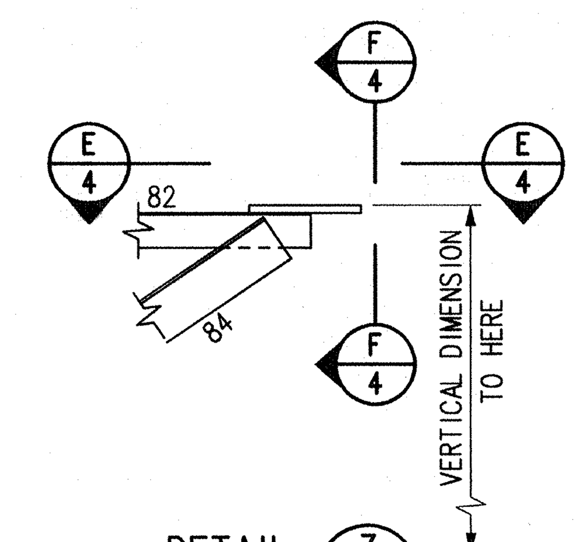
DETAIL 1/4



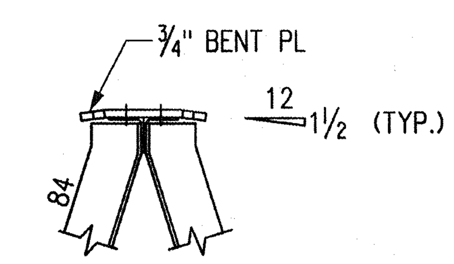
VIEW B/4 B/4



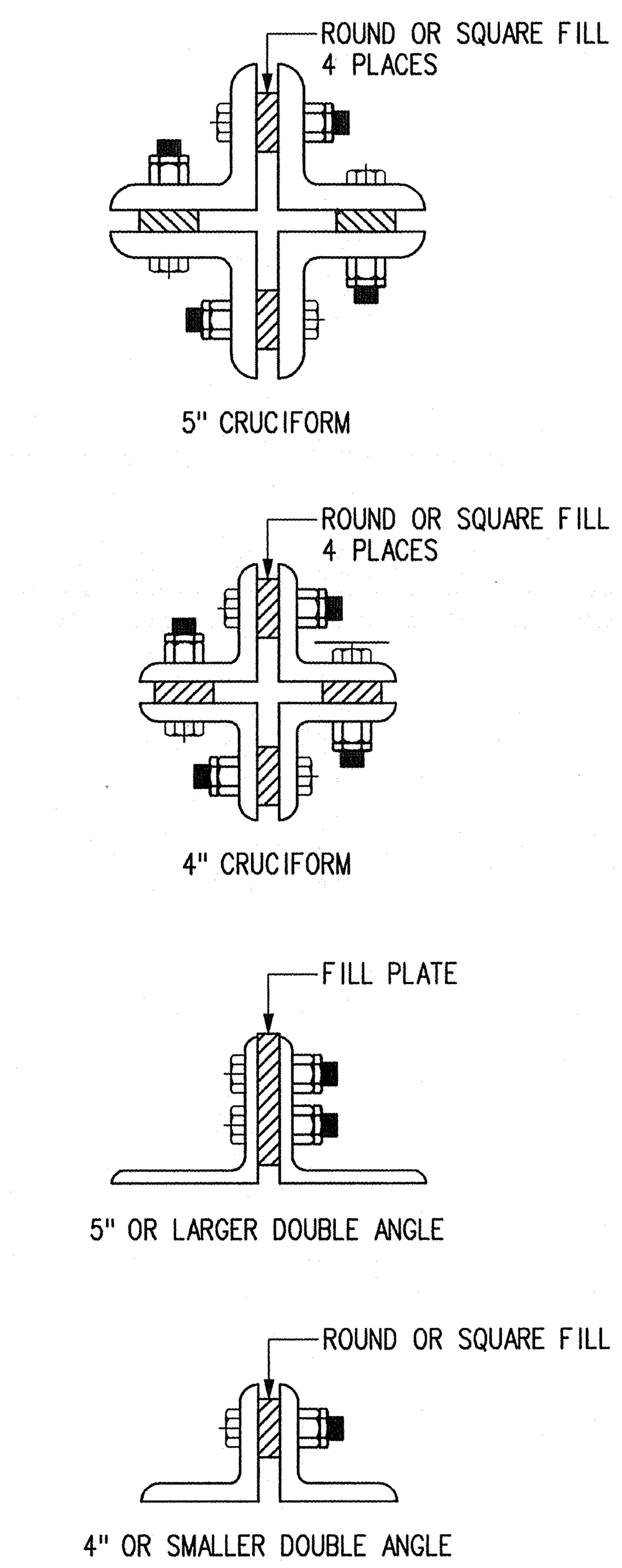
VIEW E/4 E/4



DETAIL 3/4

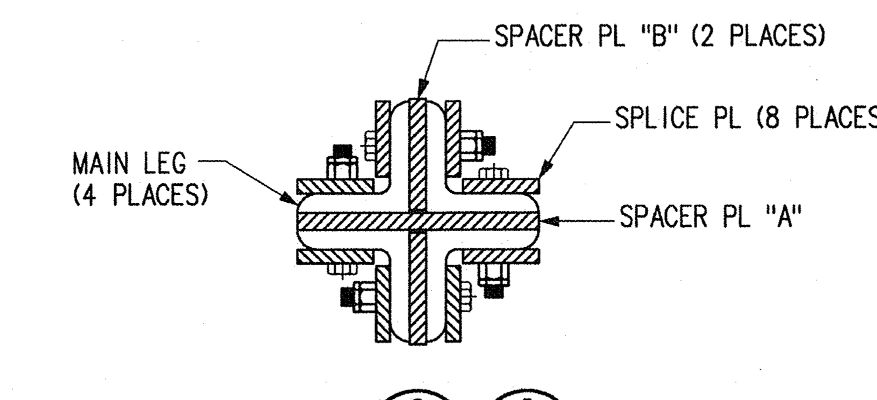


VIEW F/4 F/4

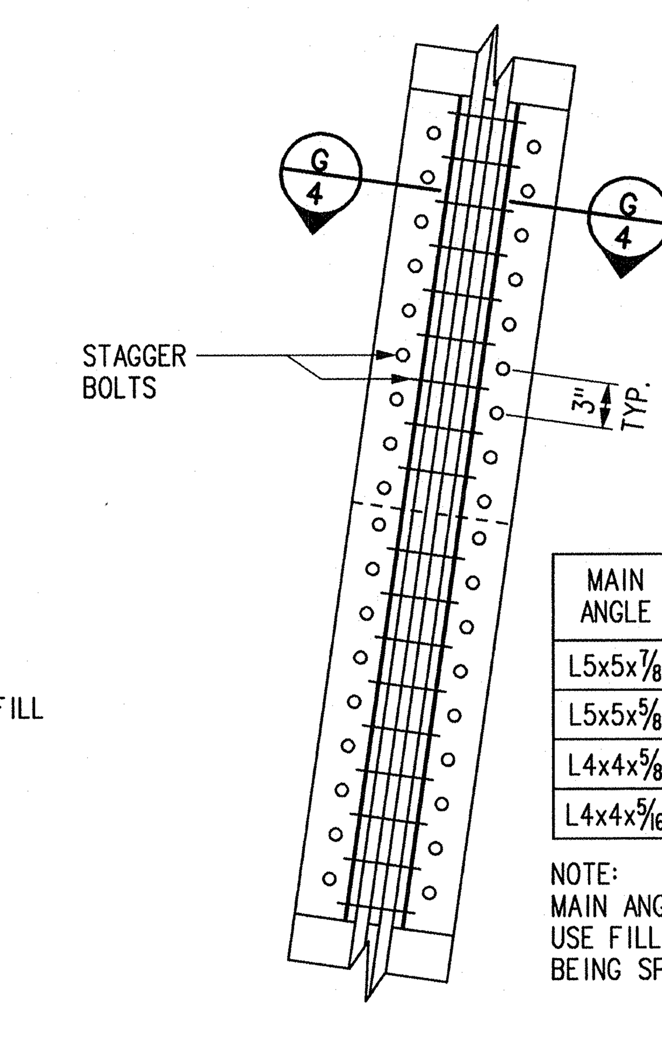


DETAIL 4/4

CRUCIFORM AND DOUBLE ANGLE STITCH DETAILS



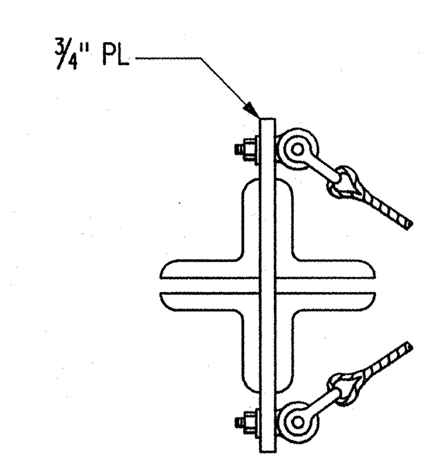
SECTION G/4 G/4



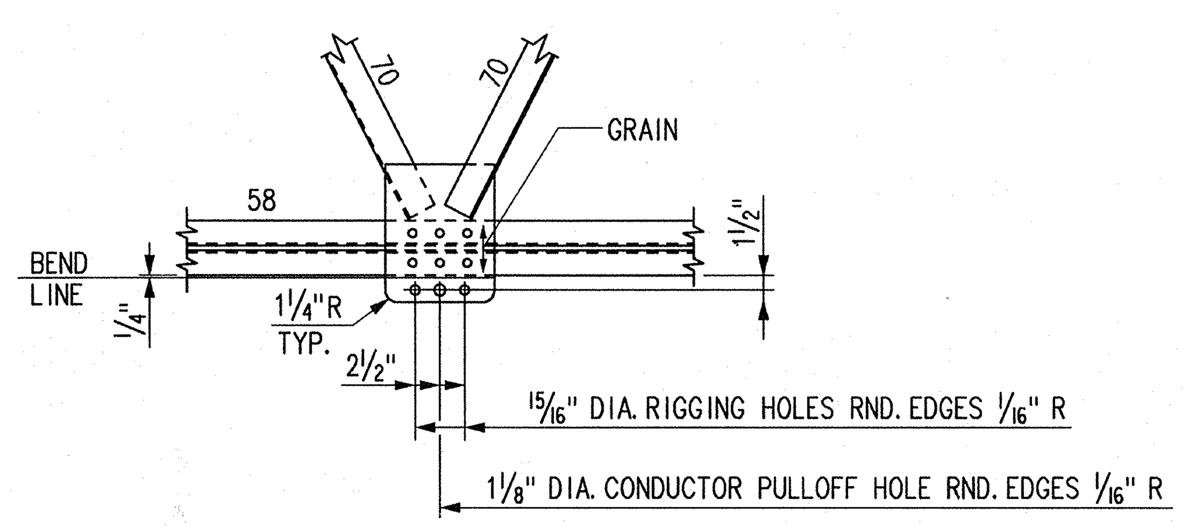
MAIN ANGLE	SPACER PL "A"	SPACER PL "B"	SPLICE PL
L5x5x7/8	3/4x10 3/4	3/4x5	5/8x3 3/8
L5x5x5/8	3/4x10 3/4	3/4x5	1/2x3
L4x4x5/8	3/4x8 3/4	3/4x4	1/2x2 1/2
L4x4x5/16	3/4x8 3/4	3/4x4	1/4x2 1/2

NOTE:
MAIN ANGLE IS SMALLER OF SPLICED ANGLES. USE FILL PL WHEN THICKNESS OF ANGLES BEING SPLICED IS DIFFERENT.

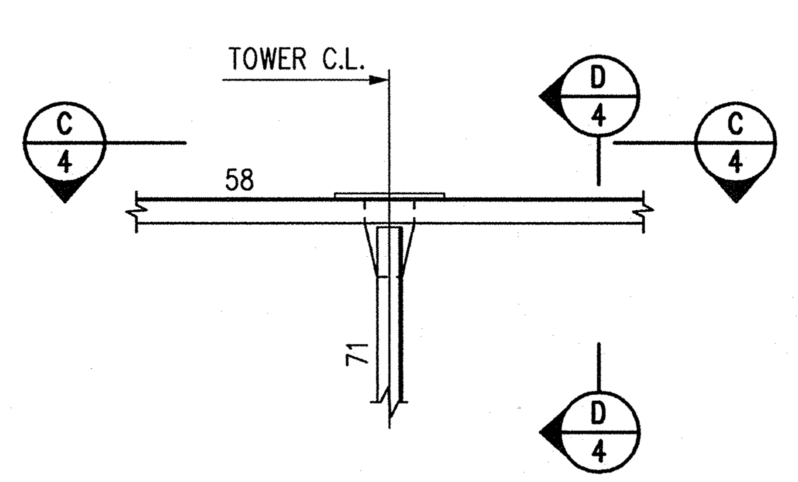
DETAIL 5/4



SECTION H/4 H/4

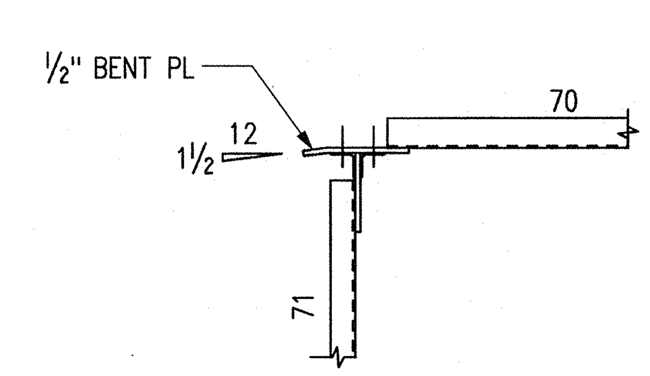


VIEW C/4 C/4

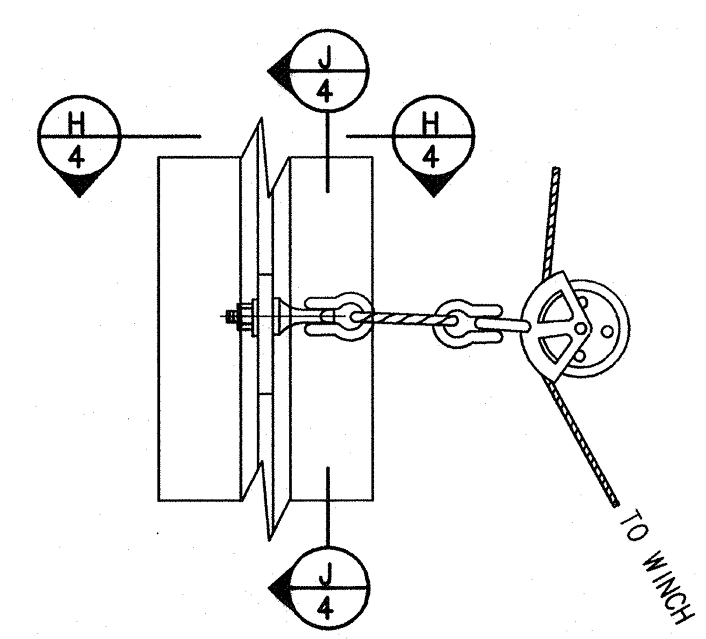


DETAIL 2/4

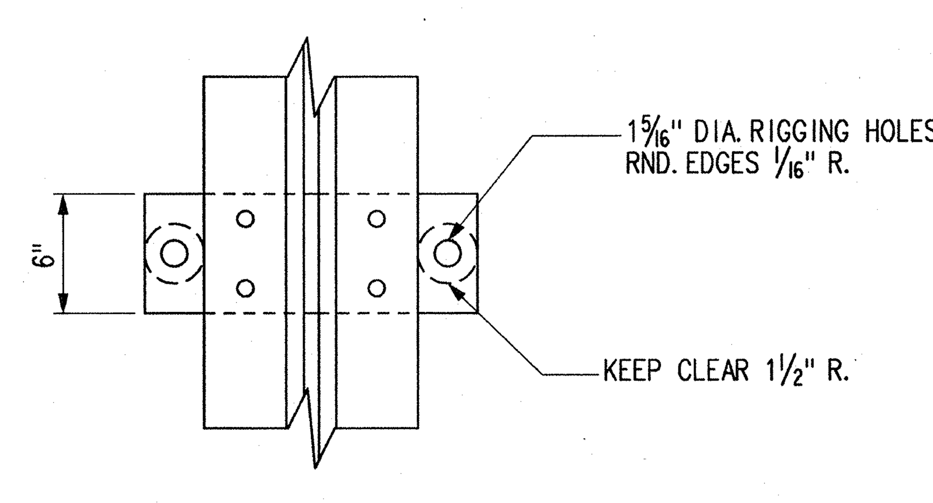
NOTE:
FIBER DEAD-END ATTACHMENT PLATES ARE PART OF TOWER BODY



SECTION D/4 D/4



DETAIL 6/4



SECTION J/4 J/4

ALL MEMBERS AND PLATES ARE ASTM A572 GRADE 50 STEEL

NOTES:
DETAILS AND SECTIONS INDICATE GENERAL LAYOUT OF CONNECTIONS. THE NUMBER OF BOLTS PER CONNECTION SHOWN ON SHEET 2 MUST BE USED FOR ALL CONNECTIONS.

ALL DIMENSIONS ARE TO OUTSIDE OF ANGLE UNLESS OTHERWISE NOTED

NO.	*	W.O.	REVISION	BY	DATE	APPROVED
	R	00233051				

* C - CONTRACT CONSTRUCTION, FA - FORCE ACCOUNT, R - RECORD

DSGN	J.C. NUNO
DRWN	J.C. NUNO
CHKD	D. M. Kruse
REVW	G W Green
CNCR	DE O'Clure
APPR	L. Kompner L. PRINCIPAL ENGINEER
DATE	06/15/09

UNITED STATES DEPARTMENT OF ENERGY
BONNEVILLE POWER ADMINISTRATION
HEADQUARTERS, PORTLAND, OREGON

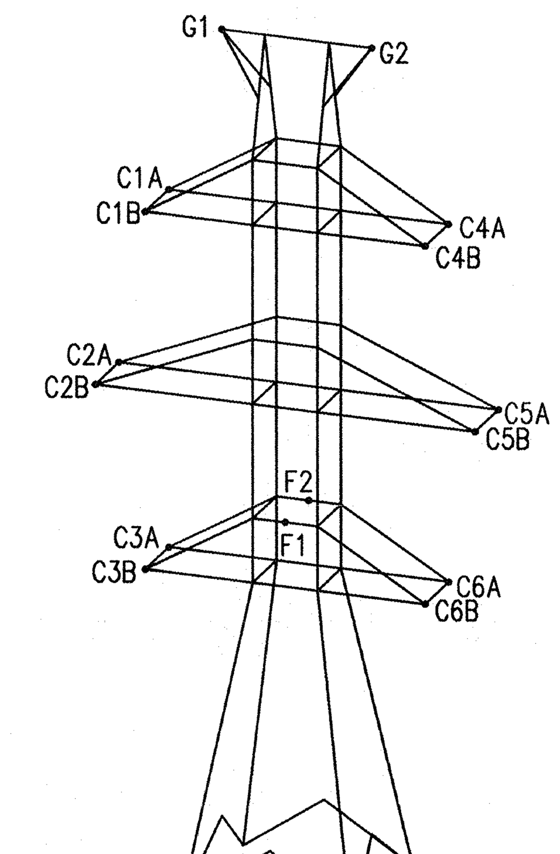
500KV DOUBLE CIRCUIT TRANSMISSION TOWER
MWT = 51,000 LBS

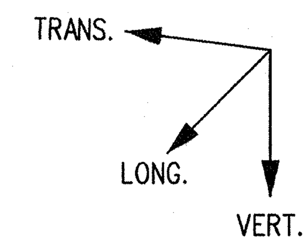
TYPE 139D, 139DE — STRUCTURAL DETAILS

Serial	Source	Size	Sheet	Revision
284768	LFS	A1	4	0

LOAD CASE		C1A	C1B	C2A	C2B	C3A	C3B	C4A	C4B	C5A	C5B	C6A	C6B	G1	G2	F1	F2
A1	LONG	-44.0	44.0	-44.0	44.0	-44.0	44.0	-44.0	44.0	-44.0	44.0	-44.0	44.0	0.0	0.0	6.1	-6.1
	TRANS	33.8	33.8	31.3	31.3	31.3	31.3	33.8	33.8	31.3	31.3	31.3	31.3	11.2	11.2	4.6	4.6
	VERT	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	2.2	2.2	0.6	0.6
A2	LONG	-44.0	44.0	-44.0	44.0	-44.0	44.0	-44.0	44.0	-44.0	44.0	-44.0	44.0	0.0	0.0	6.1	-6.1
	TRANS	31.7	31.7	29.8	29.8	29.8	29.8	31.7	31.7	29.8	29.8	29.8	29.8	10.6	10.6	4.4	4.4
	VERT	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	2.2	2.2	0.6	0.6
B1	LONG	-54.4	54.4	-54.4	54.4	-54.4	54.4	-54.4	54.4	-54.4	54.4	-54.4	54.4	0.0	0.0	9.0	-9.0
	TRANS	36.9	36.9	36.9	36.9	36.9	36.9	36.9	36.9	36.9	36.9	36.9	36.9	17.9	17.9	6.8	6.8
	VERT	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0	9.0	9.0	4.2	4.2
B2	LONG	-63.3	63.3	-63.3	63.3	-63.3	63.3	-63.3	63.3	-63.3	63.3	-63.3	63.3	0.0	0.0	10.3	-10.3
	TRANS	43.4	43.4	41.3	41.3	41.3	41.3	43.4	43.4	41.3	41.3	41.3	41.3	19.7	19.7	7.3	7.3
	VERT	30.2	30.2	30.2	30.2	30.2	30.2	30.2	30.2	30.2	30.2	30.2	30.2	10.1	10.1	4.9	4.9
B2L-0	LONG	0.0	73.1	0.0	73.1	0.0	73.1	0.0	73.1	0.0	73.1	0.0	73.1	16.1	16.1	11.9	0.0
	TRANS	0.0	6.8	0.0	4.8	0.0	4.8	0.0	6.8	0.0	4.8	0.0	4.8	1.8	1.8	1.3	0.0
	VERT	0.0	30.2	0.0	30.2	0.0	30.2	0.0	30.2	0.0	30.2	0.0	30.2	5.1	5.1	4.9	0.0
B2L-1	LONG	0.0	63.3	0.0	63.3	0.0	63.3	0.0	63.3	0.0	63.3	0.0	63.3	14.0	14.0	10.3	0.0
	TRANS	0.0	43.4	0.0	41.3	0.0	41.3	0.0	43.4	0.0	41.3	0.0	41.3	9.9	9.9	7.3	0.0
	VERT	0.0	30.2	0.0	30.2	0.0	30.2	0.0	30.2	0.0	30.2	0.0	30.2	5.1	5.1	4.9	0.0
B2L-2	LONG	-63.3	63.3	-63.3	63.3	-63.3	63.3	0.0	63.3	0.0	63.3	0.0	63.3	0.0	14.0	10.3	-10.3
	TRANS	43.4	43.4	41.3	41.3	41.3	41.3	0.0	43.4	0.0	41.3	0.0	41.3	19.7	9.9	7.3	7.3
	VERT	30.2	30.2	30.2	30.2	30.2	30.2	0.0	30.2	0.0	30.2	0.0	30.2	10.1	5.1	4.9	4.9
B2L-3	LONG	0.0	63.3	0.0	63.3	0.0	63.3	-63.3	63.3	-63.3	63.3	-63.3	63.3	14.0	0.0	10.3	-10.3
	TRANS	0.0	43.4	0.0	41.3	0.0	41.3	43.4	43.4	41.3	41.3	41.3	41.3	9.9	19.7	7.3	7.3
	VERT	0.0	30.2	0.0	30.2	0.0	30.2	30.2	30.2	30.2	30.2	30.2	30.2	5.1	10.1	4.9	4.9
B2L-4	LONG	-63.3	63.3	-63.3	63.3	-63.3	63.3	-63.3	63.3	-63.3	63.3	-63.3	63.3	0.0	0.0	10.3	0.0
	TRANS	43.4	43.4	41.3	41.3	41.3	41.3	43.4	43.4	41.3	41.3	41.3	41.3	19.7	19.7	7.3	0.0
	VERT	30.2	30.2	30.2	30.2	30.2	30.2	30.2	30.2	30.2	30.2	30.2	30.2	10.1	10.1	4.9	0.0
C	LONG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	TRANS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	VERT	44.4	44.4	44.4	44.4	44.4	44.4	44.4	44.4	44.4	44.4	44.4	44.4	17.8	17.8	8.9	8.9
D	LONG	-60.0	60.0	-60.0	60.0	-60.0	60.0	-60.0	60.0	-60.0	60.0	-60.0	60.0	0.0	0.0	7.7	-7.7
	TRANS	39.3	39.3	39.3	39.3	39.3	39.3	39.3	39.3	39.3	39.3	39.3	39.3	14.3	14.3	5.5	5.5
	VERT	23.9	23.9	23.9	23.9	23.9	23.9	23.9	23.9	23.9	23.9	23.9	23.9	4.9	4.9	1.8	1.8
DL-0	LONG	0.0	69.3	0.0	69.3	0.0	69.3	0.0	69.3	0.0	69.3	0.0	69.3	12.5	12.5	8.8	0.0
	TRANS	0.0	4.6	0.0	4.6	0.0	4.6	0.0	4.6	0.0	4.6	0.0	4.6	1.0	1.0	1.1	0.0
	VERT	0.0	23.9	0.0	23.9	0.0	23.9	0.0	23.9	0.0	23.9	0.0	23.9	2.4	2.4	1.8	0.0
DL-1	LONG	0.0	60.0	0.0	60.0	0.0	60.0	0.0	60.0	0.0	60.0	0.0	60.0	10.8	10.8	7.7	0.0
	TRANS	0.0	39.3	0.0	39.3	0.0	39.3	0.0	39.3	0.0	39.3	0.0	39.3	7.2	7.2	5.5	0.0
	VERT	0.0	23.9	0.0	23.9	0.0	23.9	0.0	23.9	0.0	23.9	0.0	23.9	2.5	2.5	1.8	0.0
DL-2	LONG	-60.0	60.0	-60.0	60.0	-60.0	60.0	0.0	60.0	0.0	60.0	0.0	60.0	0.0	10.8	7.7	-7.7
	TRANS	39.3	39.3	39.3	39.3	39.3	39.3	0.0	39.3	0.0	39.3	0.0	39.3	14.3	7.2	5.5	5.5
	VERT	23.9	23.9	23.9	23.9	23.9	23.9	0.0	23.9	0.0	23.9	0.0	23.9	4.9	2.5	1.8	1.8
DL-3	LONG	0.0	60.0	0.0	60.0	0.0	60.0	-60.0	60.0	-60.0	60.0	-60.0	60.0	10.8	0.0	7.7	-7.7
	TRANS	0.0	39.3	0.0	39.3	0.0	39.3	39.3	39.3	39.3	39.3	39.3	39.3	7.2	14.3	5.5	5.5
	VERT	0.0	23.9	0.0	23.9	0.0	23.9	23.9	23.9	23.9	23.9	23.9	23.9	2.5	4.9	1.8	1.8
DL-4	LONG	-60.0	60.0	-60.0	60.0	-60.0	60.0	-60.0	60.0	-60.0	60.0	-60.0	60.0	0.0	0.0	7.7	0.0
	TRANS	39.3	39.3	39.3	39.3	39.3	39.3	39.3	39.3	39.3	39.3	39.3	39.3	14.3	14.3	5.5	0.0
	VERT	23.9	23.9	23.9	23.9	23.9	23.9	23.9	23.9	23.9	23.9	23.9	23.9	4.9	4.9	1.8	0.0
DU	LONG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	TRANS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	VERT	-12.0	-12.0	-12.0	-12.0	-12.0	-12.0	-12.0	-12.0	-12.0	-12.0	-12.0	-12.0	-2.5	-2.5	-0.9	-0.9

NOTE: LOADS SHOWN IN THE ABOVE TABLE ARE BASED ON A TRANSVERSE SPAN OF 2000', A VERTICAL SPAN OF 4000', AND LINE ANGLE OF 0 TO 60 DEGREES. THE TOWER WAS ALSO CHECKED WITH LOADS CALCULATED BASED ON THE SPAN COMBINATIONS SHOWN ON SHEET 1.





ULTIMATE DESIGN CONDITIONS

A1. HIGH WIND ON BARE CONDUCTOR, 100 MPH WIND IN ANY DIRECTION,
SPAN FACTOR = 0.7 FOR C2A/B, C3A/B, C5A/B, C6A/B, F1 AND F2
SPAN FACTOR = 1.0 FOR G1, G2, C1A/B, C4A/B
TOWER GUST FACTOR = 1.2

B1. 40.0 MPH TRANSVERSE WIND ON 2" RADIAL RIME ICE (15 PCF).

B2. 56.6 MPH TRANSVERSE WIND ON 1" RADIAL GLAZE ICE (57 PCF).
SPAN FACTOR = 0.7 FOR C2A/B, C3A/B, C5A/B, C6A/B, F1 AND F2
SPAN FACTOR = 1.0 FOR G1, G2, C1A/B, C4A/B

C. HEAVY VERTICAL (1½" RADIAL GLAZE ICE). NO WIND.

D. NESC 2007 EDITION MEDIUM LOADING 40 MPH WIND WITH ¼" RADIAL GLAZE ICE AND OVERLOAD FACTORS:
1.5 VERTICAL, 2.5 TRANSVERSE, 1.65 LONGITUDINAL.

PROJECTED WIND AREA IS EQUAL TO 1½ TIMES THE PROJECTED AREA OF ONE FACE OF THE TOWER EXCEPT CASE D.

FOR ROUND (APPROXIMATE ROUND) SURFACES:
$P_x = 0.00256 \times V_o^2$
FOR FLAT SURFACES:
$P_x = 0.00256 \times 1.6 \times V_o^2$

LINE ANGLE = 0° - 60°

LOADS SHOWN ARE BASED ON THE FOLLOWING DESIGN SPANS:
(SEE NOTE ON SHEET 1)
V SPAN: 4000 FT.
T SPAN: 2000 FT.

LOAD CASES

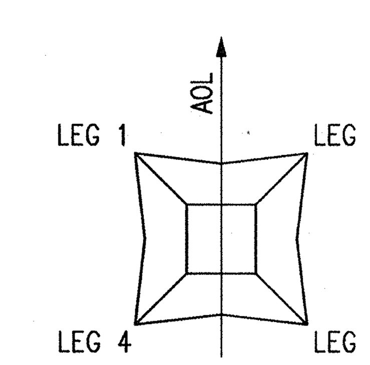
A1	DESIGN CONDITION	A	ALL WIRES INTACT.
A2	DESIGN CONDITION	A	ALL WIRES INTACT, 60° WIND TO LINE.
B1	DESIGN CONDITION	B1	ALL WIRES INTACT.
B2	DESIGN CONDITION	B2	ALL WIRES INTACT.
B2L-0	DESIGN CONDITION	B2	ALL WIRES BROKEN ON ONE FACE @ 0° LINE ANGLE.
B2L-1	DESIGN CONDITION	B2	ALL WIRES BROKEN ON ONE FACE @ 60° LINE ANGLE.
B2L-2	DESIGN CONDITION	B2	ONE GW AND THREE CONDUCTOR PHASES BROKEN ON ONE CIRCUIT.
B2L-3	DESIGN CONDITION	B2	ONE GW AND THREE CONDUCTOR PHASES BROKEN ON ONE CIRCUIT.
B2L-4	DESIGN CONDITION	B2	BROKEN FIBER OPTIC WIRE.
C	DESIGN CONDITION	C	ALL WIRES INTACT.
D	DESIGN CONDITION	D	ALL WIRES INTACT.
DL-0	DESIGN CONDITION	D	ALL WIRES BROKEN ON ONE FACE @ 0° LINE ANGLE.
DL-1	DESIGN CONDITION	D	ALL WIRES BROKEN ON ONE FACE @ 60° LINE ANGLE.
DL-2	DESIGN CONDITION	D	ONE GW AND THREE CONDUCTOR PHASES BROKEN ON ONE CIRCUIT.
DL-3	DESIGN CONDITION	D	ONE GW AND THREE CONDUCTOR PHASES BROKEN ON ONE CIRCUIT.
DL-4	DESIGN CONDITION	D	BROKEN FIBER OPTIC WIRE.
DU	DESIGN CONDITION	D	½ VERTICAL LOAD IN UPLIFT.

ALL LOAD CASES, EXCEPT B2L-2/3/4 AND DL-2/3/4, ARE TO BE REPEATED WITH G1, C1A/B, C2A/B, C3A/B, F1 AND F2 LOADED ONLY.

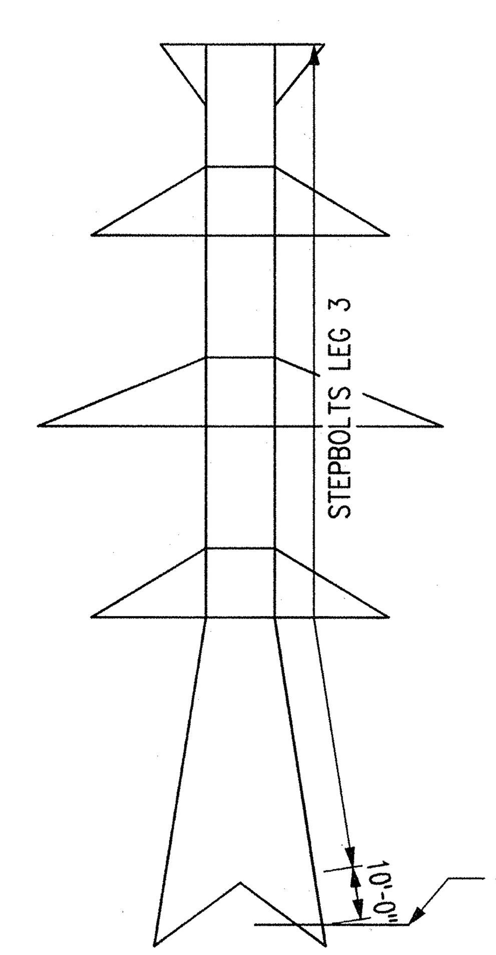
ALL LOAD CASES, EXCEPT B2L-2/3/4 AND DL-2/3/4, ARE TO BE REPEATED WITH G2, C4A/B, C5A/B, C6A/B, F1 AND F2 LOADED ONLY.

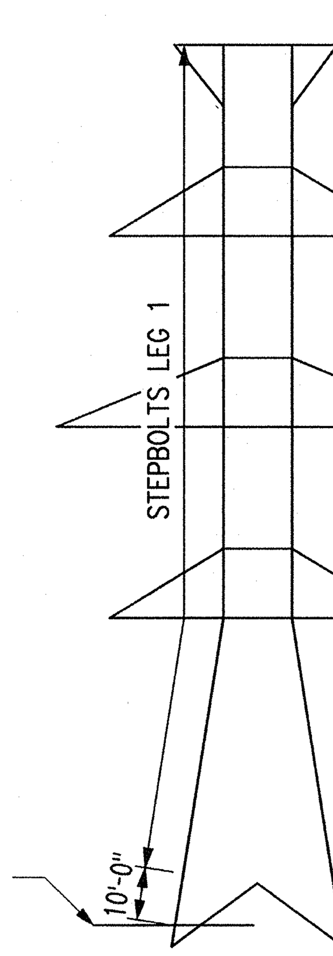
FOR ULTIMATE STRENGTH DESIGN, THE TOWER SHALL BE DESIGNED TO WITHSTAND THE DESIGN LOADS SHOWN WITH A FACTOR OF SAFETY EQUAL TO 1.0 UNLESS OTHERWISE SPECIFIED.

ALL LOADS IN KIPS.



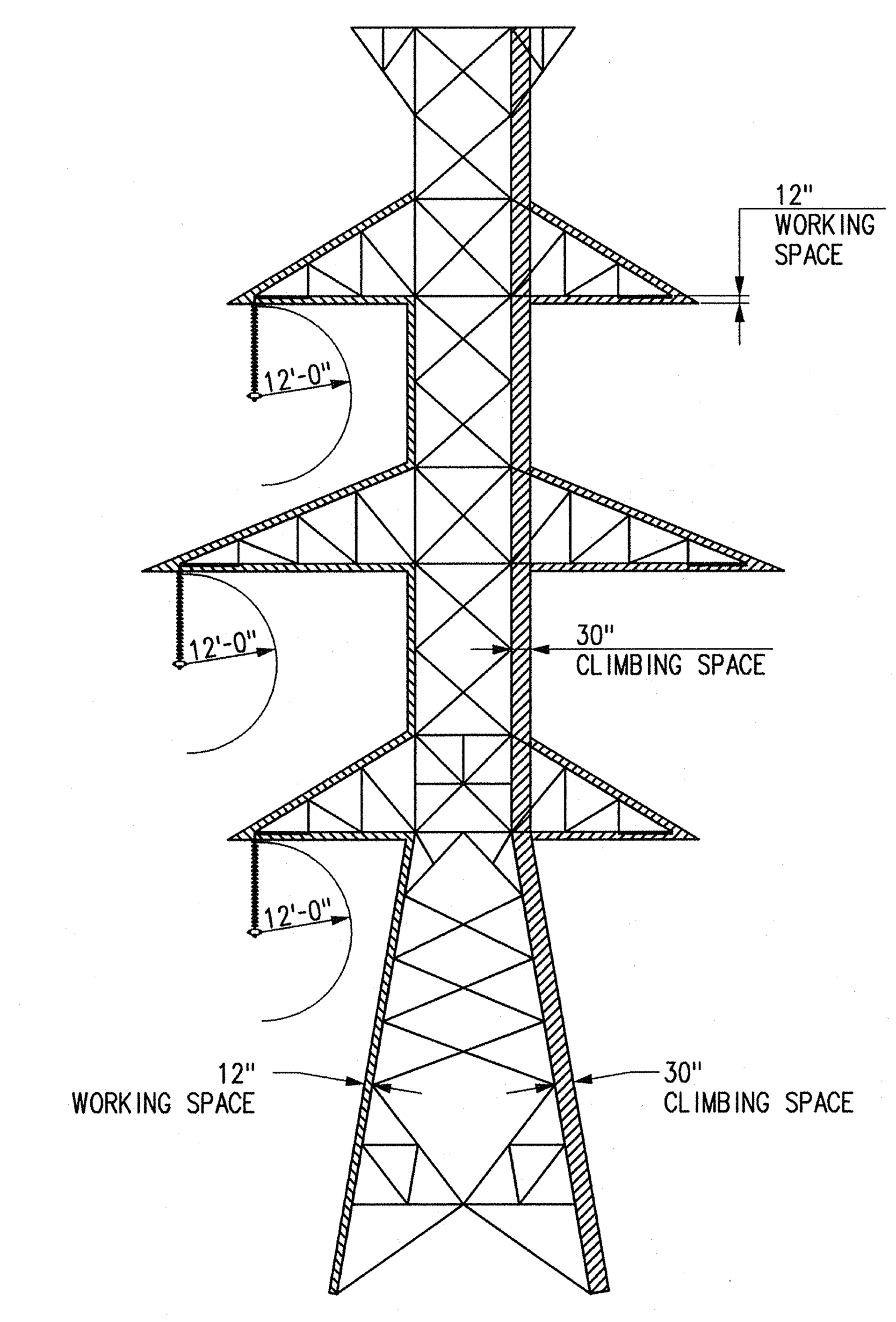
PLAN





VIEW AHEAD ON LINE
TANGENT AND ANGLE TO RIGHT
(STEP UP LEG 3)

VIEW AHEAD ON LINE
ANGLE TO LEFT
(STEP UP LEG 1)



CLEARANCE FROM JUMPER TO CLIMBING SPACE OR WORKING SPACE = 12'-0"

WORKING AND CLIMBING SPACES

NO.	* R	W.O. 00233051	REVISION	BY	DATE	APPROVED
* C = CONTRACT CONSTRUCTION, FA = FORCE ACCOUNT, R = RECORD						

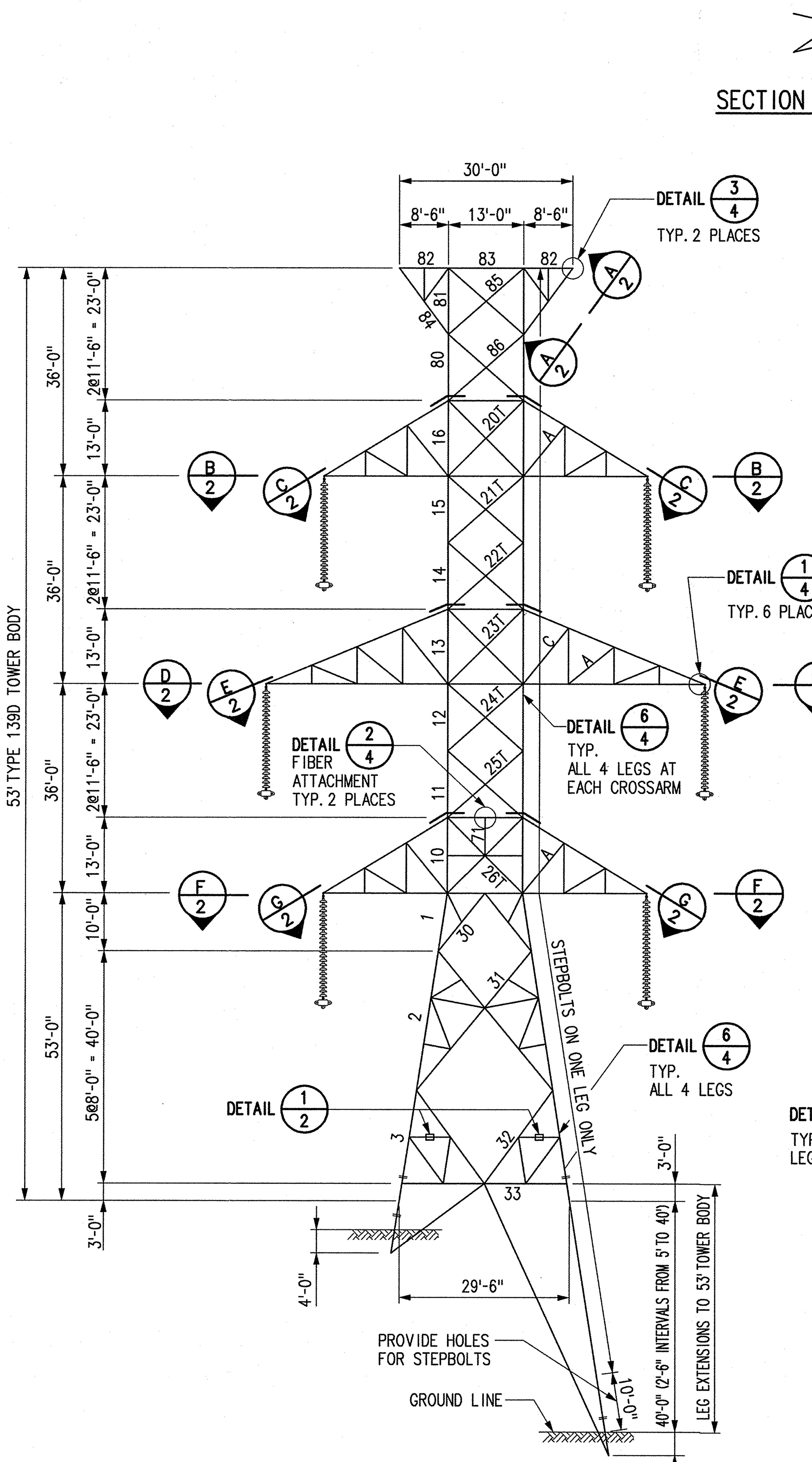
DSGN J.C. NUNO
DRWN MF/JCN
CHKD D.M. Kusse
REVW GW Green
CNCR DE O'CLAIRE
APPR L. Kompru h
PRINCIPAL ENGINEER
DATE 06/15/09

UNITED STATES DEPARTMENT OF ENERGY
BONNEVILLE POWER ADMINISTRATION
HEADQUARTERS, PORTLAND, OREGON

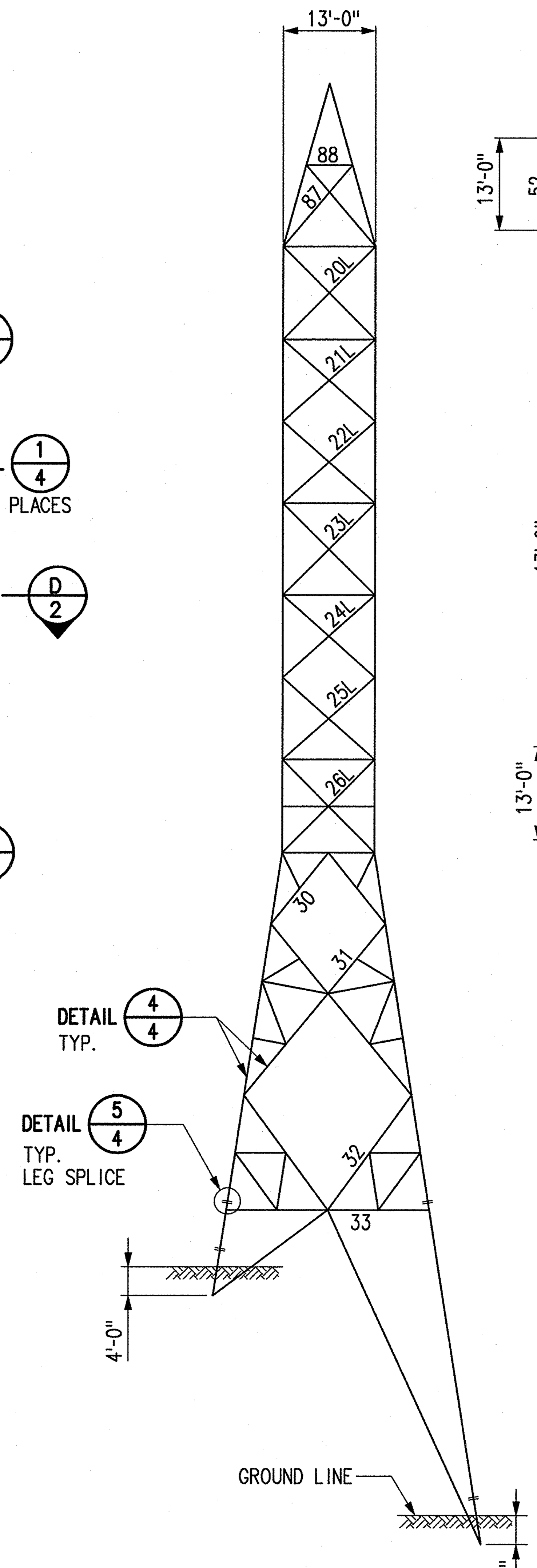
500KV DOUBLE CIRCUIT
TRANSMISSION TOWER
MWT = 51,000 LBS

TYPE 139D, 139DE DESIGN CRITERIA

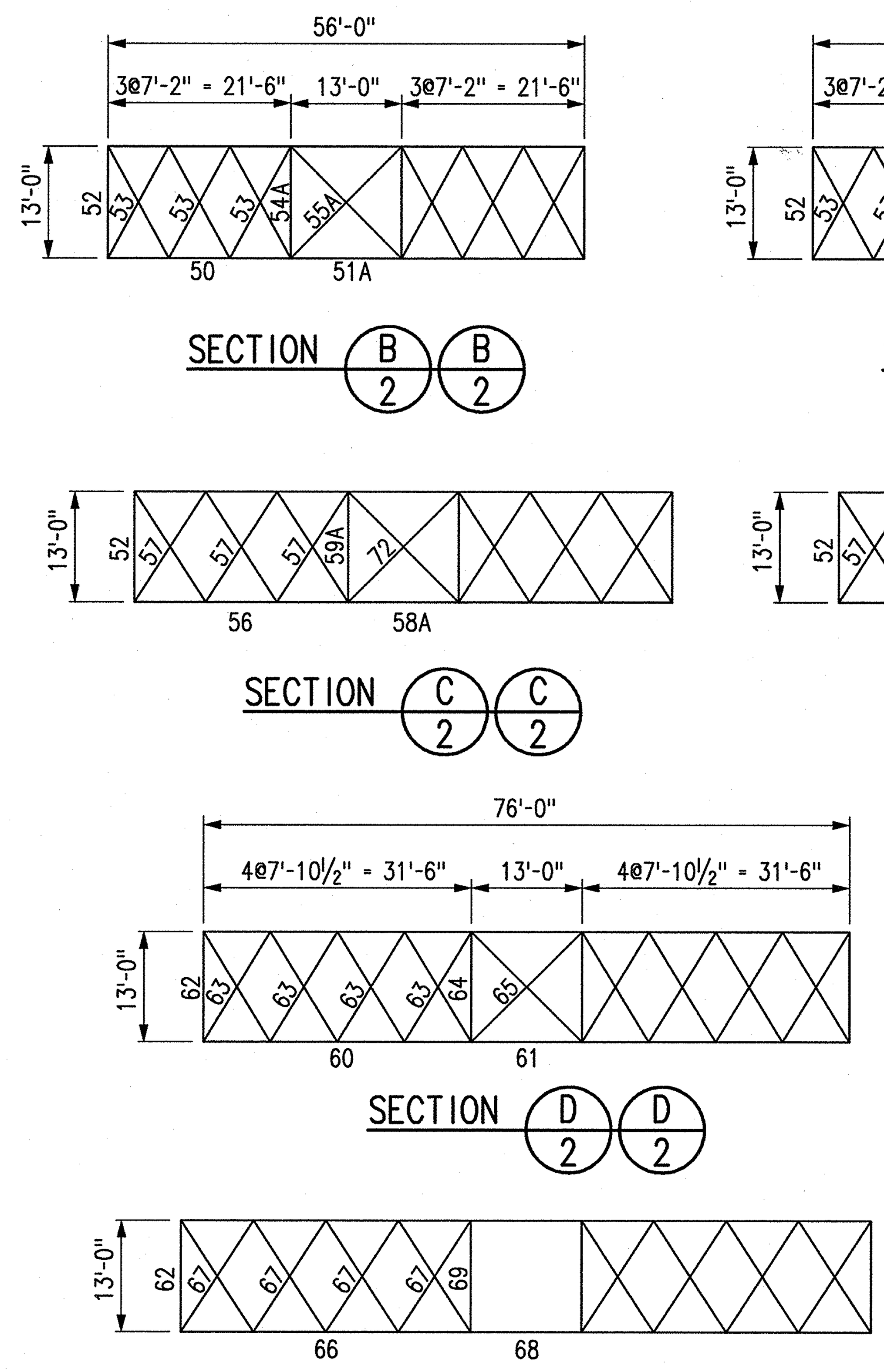
Serial	Source	Size	Sheet	Revision
284768	LFS	A1	3	0

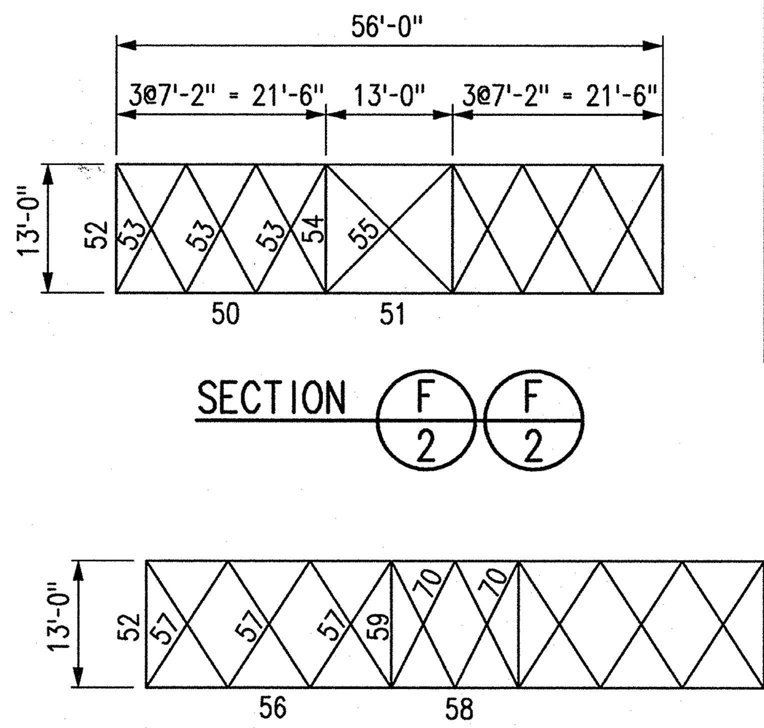


53' TOWER BODY
WITH LEG EXTENSIONS
TRANSVERSE ELEVATION



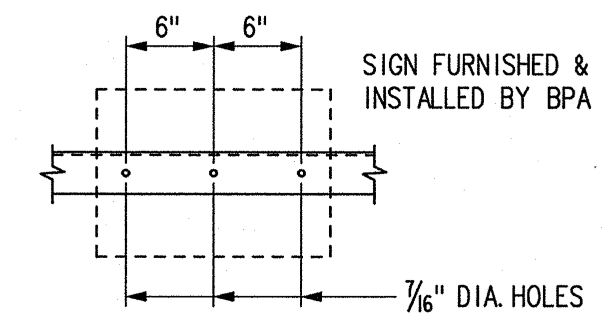
53' TOWER BODY
WITH LEG EXTENSIONS
LONGITUDINAL ELEVATION





SYMBOL	MEMBER SIZE
A	L3x3x3/16
B	L3x3x1/4
C	L3½x3½x1/4
D	L4x4x1/4
E	L4x4x5/16
F	L5x5x5/16

ALL REDUNDANT MEMBERS ARE L2½x2½x3/16 EXCEPT AS NOTED.

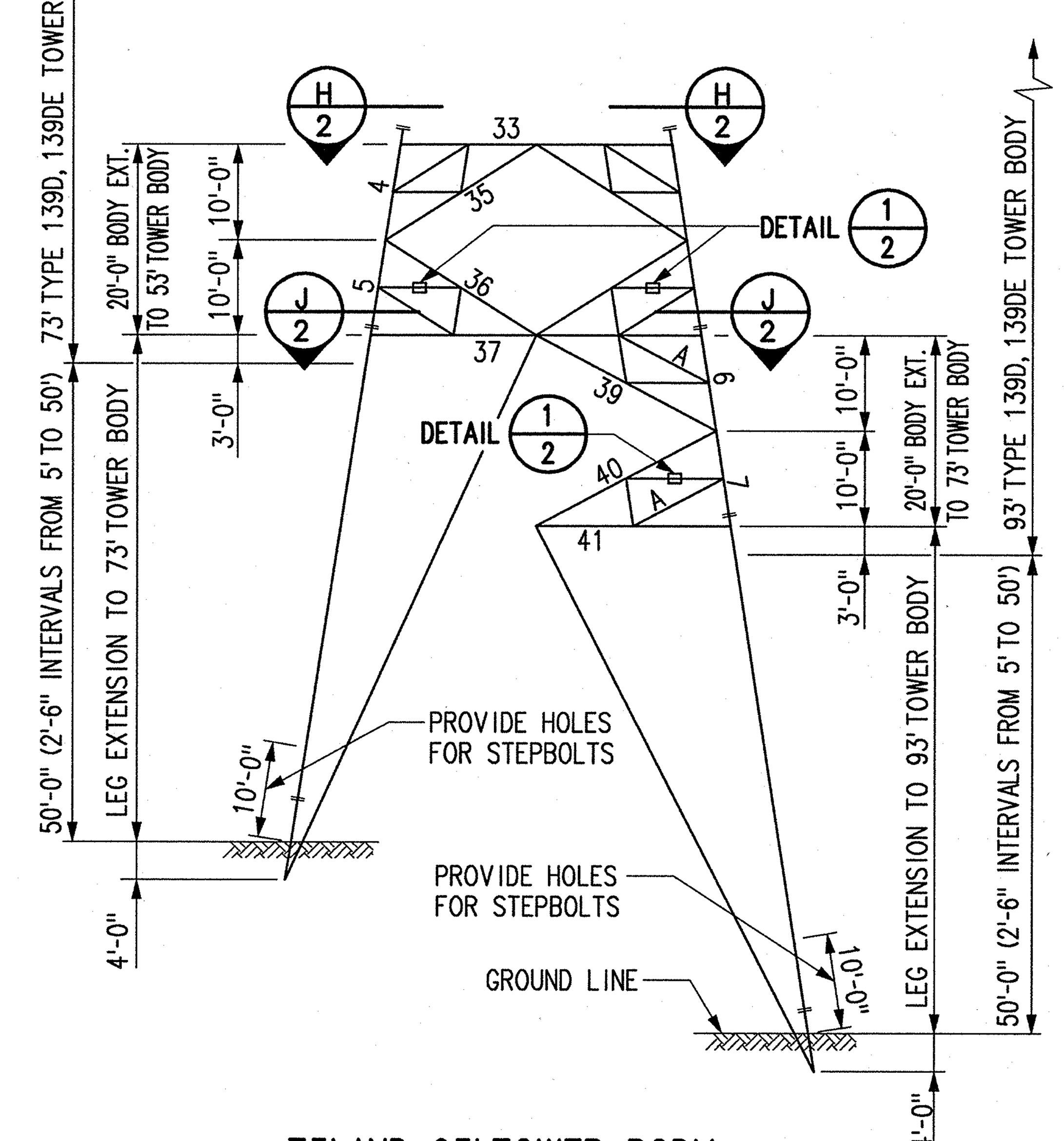


DETAIL 1/2 — LOCATION OF SIGNS SHOWN ARE FOR 5'-0" TO 12'-6" LEG EXTENSIONS. FOR OTHER LEG EXENSIONS SEE LEG EXTENSION SHEETS 5, 6 AND 7.

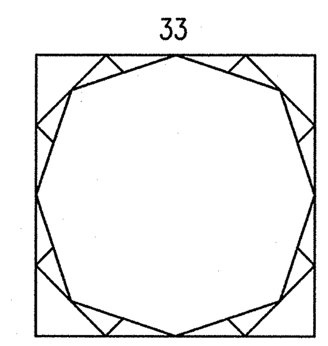
MEMBER	ULT. CONN. LOAD (KIPS)	MEMBER SIZE	NO. OF BOLTS PER CONN.	MAX. STITCH LENGTH (IN)	MEMBER	ULT. CONN. LOAD (KIPS)	MEMBER SIZE	NO. OF BOLTS PER CONN.	MAX. STITCH LENGTH (IN)
1	1315.1	4L5x5x7/8	36●	30	50	162.1	2L4x4x5/16	5●	40
2	1334.9	4L5x5x7/8	36●	30	51	235.7	2L4x4x3/8	6●	24
3	1374.7	4L5x5x7/8	36●	30	51A	97.3	2L5x5x5/16	3●	48
4	1349.1	4L5x5x7/8	36●	24	52	FLEX	W6x20	4	
5	1364.3	4L5x5x7/8	36●	24	53	45.3	L4x4x5/16	3	
6	1346.1	4L5x5x7/8	36●	24	54	199.8	2L4x4x5/16	5●	24
7	1356.3	4L5x5x7/8	36●	24	54A	9.2	L3½x3½x1/4	2	
10	1021.0	4L5x5x5/8	28●	32	55	57.9	L5x5x5/16	3	
11	899.7	4L5x5x5/8	22●	32	55A	32.4	L4x4x5/16	2	
12	621.9	4L4x4x5/8	16●	42	56	105.7	2L3½x3½x1/4	4●	46
13	409.5	4L4x4x5/8	10●	42	57	31.1	L4x4x1/4	2	
14	294.2	4L4x4x5/16	8●	44	58	45.2	2L2½x2½x3/16	2●	36
15	178.8	4L4x4x5/16	8●	44	58A	59.0	2L3x3x3/16	3●	48
16	93.2	4L4x4x5/16	8●	44	59	81.7	2L4x4x5/16	2●	48
20T	54.3	L5x5x5/16	3		59A	19.3	2L3x3x3/16	2●	48
20L	40.6	L5x5x5/16	3		60	200.1	2L4x4x3/8	5●	44
21T	125.0	2L4x4x5/16	4●	48	61	90.5	2L5x5x5/16	3●	48
21L	93.5	2L4x4x5/16	3●	48	62	FLEX	W6x20	4	
22T	125.0	2L4x4x5/16	4●	48	63	40.8	L4x4x5/16	2	
22L	93.5	2L4x4x5/16	3●	48	64	23.4	2L3x3x3/16	2●	48
23T	159.7	2L4x4x3/8	4●	48	65	42.8	L5x5x5/16	3	
23L	123.9	2L4x4x3/8	4●	48	66	119.6	2L3½x3½x1/4	4●	48
24T	270.6	2L5x5x1/2	7●	48	67	23.9	L3½x3½x1/4	2	
24L	177.6	2L5x5x5/16	5●	48	68	91.1	2L3½x3½x1/4	3●	48
25T	270.6	2L5x5x3/8	7●	48	69	22.7	2L3x3x3/16	2●	48
25L	177.6	2L5x5x5/16	5●	48	70	17.8	L3x3x3/16	2	
26T	306.2	2L5x5x1/2	8●	48	71	9.0	L2½x2½x3/16	2	
26L	277.3	2L5x5x3/8	7●	48	72	19.8	L3½x3½x1/4	2	
30	265.7	2L5x5x3/8	7●	48	80	37.9	L5x5x5/16	2	
31	178.8	2L5x5x3/8	5●	48	81	12.1	L5x5x5/16	2	
32	129.3	2L5x5x5/16	4●	48	82	27.3	2L3½x3½x1/4	2●	24
33	5.9	L3x3x3/16	2		83	23.9	2L3½x3½x1/4	2●	48
35	89.6	2L4x4x3/8	3●	48	84	39.7	L5x5x5/16	3	
36	73.4	2L4x4x5/16	2●	48	85	18.2	L3½x3½x1/4	2	
37	6.7	L3½x3½x1/4	2		86	32.6	L4x4x3/8	2	
39	69.8	2L4x4x3/8	2●	48	87	5.1	L3x3x3/16	2	
40	60.0	2L4x4x5/16	2●	48	88	4.2	L2½x2½x3/16	2	
41	6.9	L4x4x1/4	2						

L = L 2L = ⅃L 4L = ╬ 3/4" TYP.

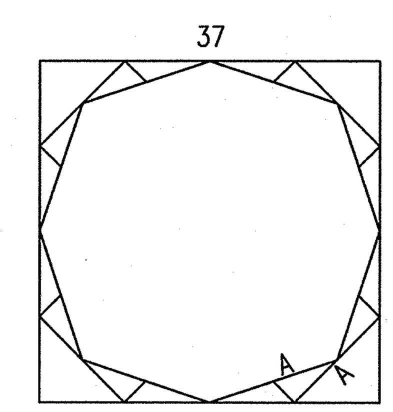
● DENOTES DOUBLE SHEAR
= DENOTES SPLICE
"FLEX" DENOTES DESIGN BASED ON FLEXURAL STRESS
ALL FORCES IN KIPS



73' AND 93' TOWER BODY
WITH LEG EXTENSIONS

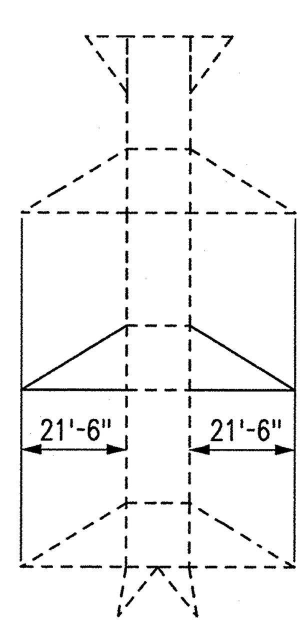


SECTION H/2 H/2
DIAPHRAGM FOR 73' AND 93' TOWER BODY



SECTION J/2 J/2
DIAPHRAGM FOR 93' TOWER BODY ONLY

DETAILED TOWER WEIGHT	TYPE 139D	TYPE 139DE
53 FT BODY	141,786 LBS	139,633 LBS
73 FT BODY	163,778 LBS	161,625 LBS
93 FT BODY	187,013 LBS	184,860 LBS



TYPE 139DE TOWER

NOTE:
DETAIL ARM ATTACHMENTS SO THAT SHORT AND LONG ARMS ARE INTERCHANGEABLE.

ALL MEMBERS AND PLATES ARE ASTM A572 GRADE 50 STEEL

NO.	*	W.O.	REVISION	BY	DATE	APPROVED		
1	R	00189955	UPDATE MEMBER TABLE; ADD DETAILED TOWER WEIGHT	JCN	4/22/10	JCN	DMH	DEO
NO.	R	00233051	REVISION	BY	DATE	APPROVED		

* C = CONTRACT CONSTRUCTION, FA = FORCE ACCOUNT, R = RECORD

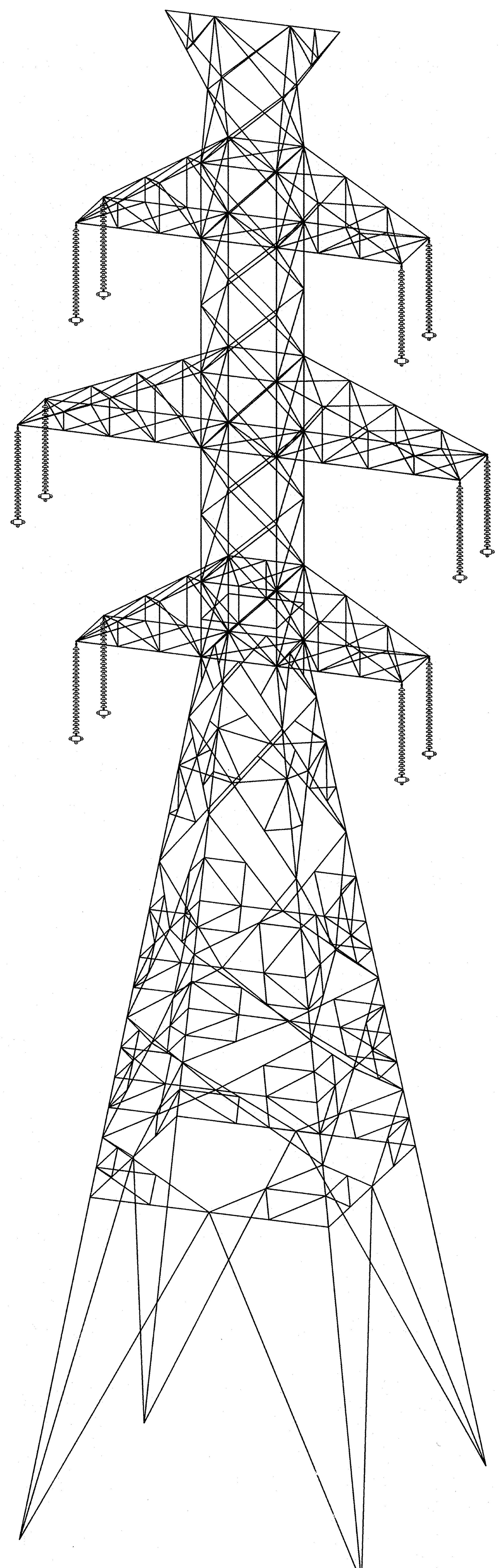
UNITED STATES DEPARTMENT OF ENERGY
BONNEVILLE POWER ADMINISTRATION
HEADQUARTERS, PORTLAND, OREGON

DSGN J.C. NUNO
DRWN MF/JCN
CHKD D.M. HESSE
REVW G.W. GREEN
CNCR D.E. O'CLAIRE
APPR L. KEMPNER, PRINCIPAL ENGINEER
DATE 6-15-09

# 500KV DOUBLE CIRCUIT TRANSMISSION TOWER
MWT = 51,000 LBS

TYPE 139D, 139DE DESIGN CRITERIA

Serial	Source	Size	Sheet	Revision
284768	LFS	A1	2	1



CONDUCTOR

3 - ACSR/TW "DESCHUTES" PER PHASE.
RATED TENSILE STRENGTH = 35,800 LBS. PER SUBCONDUCTOR
CONSTRAINT TENSIONS:
@ 1/2 - 8 - 0 In = 17,000 LBS. PER SUBCONDUCTOR
@ 0 - 0 - 30 In = 10,190 LBS. PER SUBCONDUCTOR

GROUND WIRE

1/2" EXTRA HIGH STRENGTH GALVANIZED STEEL.
RATED STEEL STRENGTH = 26,900 LBS.
CONSTRAINT TENSIONS:
@ 1/2 - 8 - 0 In = 9,500 LBS.
@ 0 - 0 - 30 In = 5,380 LBS.

OPGW FIBER OPTIC

0.591 OPGW FIBER OPTIC CABLE.
RATED TENSILE STRENGTH = 24,300 LBS.
CONSTRAINT TENSIONS:
@ 1/2 - 8 - 0 In = 9,500 LBS.
@ 0 - 0 - 30 In = 4,860 LBS.

ADSS FIBER OPTIC

ADSS 72 FIBER CH7 CABLE
RATED TENSILE STRENGTH = 13,000 LBS.
CONSTRAINT TENSIONS:
@ 1/2 - 8 - 0 In = 7,000 LBS.
@ 0 - 0 - 30 In = 2,600 LBS.

BODY / LEG COMBINATIONS

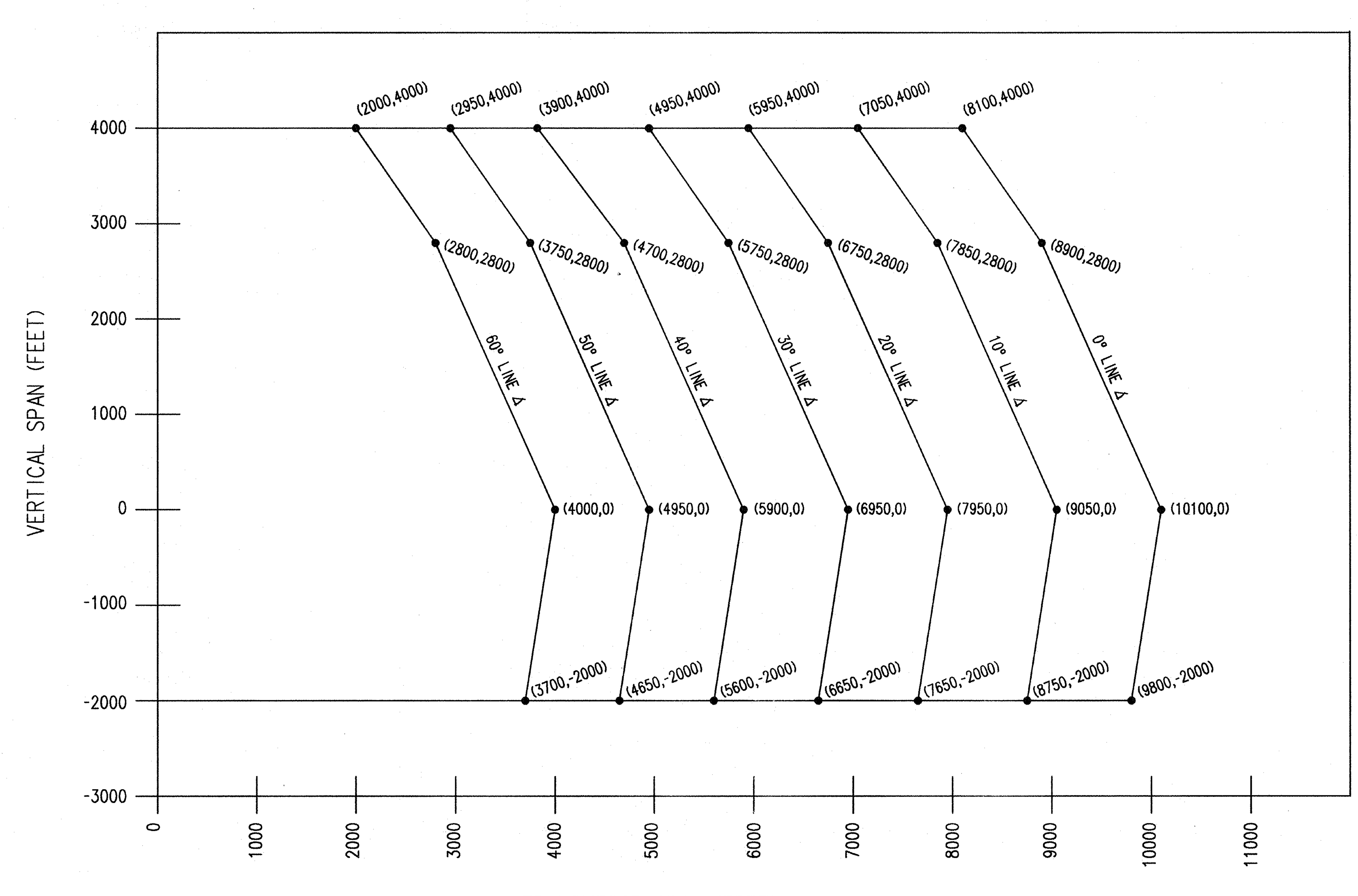
53' BODY WITH 5'-0" TO 40'-0" LEGS IN 2'-6" INCREMENTS
73' BODY WITH 5'-0" TO 50'-0" LEGS IN 2'-6" INCREMENTS
93' BODY WITH 5'-0" TO 50'-0" LEGS IN 2'-6" INCREMENTS
MAXIMUM LEG COMBINATION HEIGHT DIFFERENCE = 20'

DESIGN SPANS

1/2" ICE ZONE

THIS TOWER IS DESIGNED FOR A VERTICAL SPAN OF 4000', A TRANSVERSE SPAN OF 2000', AND A LINE ANGLE OF 0 TO 60 DEGREES. THE TOWER WAS ALSO CHECKED WITH LOADS CALCULATED BASED ON THE SPANS SHOWN IN THE FOLLOWING CHART. ULTIMATE CONNECTION LOADS SHOWN IN THE MEMBER SIZE TABLE REPRESENT THE MAXIMUM LOAD FOR ALL SPAN COMBINATIONS.

TOWER UTILIZATION CAPACITY (1/2" ICE ZONE)



UNIT STRESSES (PSI):

TENSION ON NET SECTION = MINIMUM YIELD STRESS Fy
COMPRESSION ON GROSS SECTION

FOR $KL/r \leq C_c$ $\quad F_a = F_y \left[1 - \frac{1}{2}\left(\frac{KL/r}{C_c}\right)^2\right]$

FOR $KL/r > C_c$ $\quad F_a = \dfrac{286{,}000{,}000}{\left(\frac{KL}{r}\right)^2}$

$C_c = \sqrt{\dfrac{2\pi^2 E}{F_y}}$

(above formulas apply for) $b/t \leq \dfrac{2500}{\sqrt{F_y}}$

FOR $b/t > \dfrac{2500}{\sqrt{F_y}}$, SUBSTITUTE F_{CR} FOR Fy IN ABOVE FORMULAS.

$$\frac{2500}{\sqrt{F_y}} < b/t \leq \frac{3750}{\sqrt{F_y}} \qquad F_{CR} = F_y\left[1.8 - \frac{(b/t)\sqrt{F_y}}{3110}\right]$$

$$\frac{3750}{\sqrt{F_y}} < b/t \leq 20 \qquad F_{CR} = \frac{8{,}400{,}000}{\left(\frac{b}{t}\right)^2}$$

MAXIMUM L/r OF MEMBERS:

TOWER LEGS = 120
MAIN COMPRESSION MEMBERS IN CROSSARMS AND GROUND WIRE PEAKS = 150
OTHER COMPRESSION MEMBERS = 200
REDUNDANTS = 250
TENSION MEMBERS = 450

MATERIAL:

STRUCTURAL STEEL - ASTM A572 GRADE 50.
ALL MEMBERS AND PLATES ARE DESIGNED USING ASTM A572 GRADE 50 UNLESS NOTED OTHERWISE.

MINIMUM SIZE OF MATERIAL
PLATES 1/4" ; ANGLES L2 1/2x2 1/2x3/16
ALL REDUNDANTS ARE L2 1/2x2 1/2x3/16 (EXCEPT AS NOTED)

COATING
HOT DIP GALVANIZED PER ASTM A123. DULLING AS SPECIFIED FOR SPECIFIC PROJECT. USE OF DICHROMATE AS SPECIFIED FOR SPECIFIC PROJECT.

CONNECTIONS

HOT DIPPED GALVANIZED BOLTS ARE 3/4" DIAMETER A325 TYPE 1 WITH LOCKNUT. MINIMUM TWO BOLTS PER CONNECTION FOR MEMBERS CARRYING CALCULATED STRESSES. SINGLE BOLT CONNECTIONS MAY BE USED SUBJECT TO BPA APPROVAL.

BEARING, BOLT SHEAR, AND BOLT TENSION ARE TO BE DESIGNED FOLLOWING THE REQUIREMENTS DEFINED IN ASCE 10-97.

STITCH BOLT LENGTHS FOR DOUBLE ANGLE AND CRUCIFORM SECTIONS ARE CALCULATED AS DEFINED IN ASCE 10-97 AND INCLUDED IN THE MEMBER TABLE ON SHEET 2. A MAXIMUM STITCH LENGTH OF 48" IS USED FOR ALL SECTIONS.

NO.	* R	W.O. 00233051	REVISION	BY	DATE	APPROVED

* C = CONTRACT CONSTRUCTION, FA = FORCE ACCOUNT, R = RECORD

DSGN	J.C. NUNO
DRWN	MF/JCN
CHKD	D.M. Hesse
REVW	GW Green
CNCR	DE O'CLAIRE
APPR	L. Kompon... (PRINCIPAL ENGINEER)
DATE	06/15/09

UNITED STATES DEPARTMENT OF ENERGY
BONNEVILLE POWER ADMINISTRATION
HEADQUARTERS, PORTLAND, OREGON

500KV DOUBLE CIRCUIT
TRANSMISSION TOWER
MWT = 51,000 LBS

TYPE 139D, 139DE STRUCTURAL DESIGN

Serial	Source	Size	Sheet	Revision
284768	LFS	A1	1 OF 9	0

MEMBER	SIZE	LENGTH	LX	EQX	KL/RX	LZ	EQZ	KL/RZ	TENSION CAPACITY	FORCE	LC	COMPRESSION CAPACITY	FORCE	LC	UTIL
1	L3 1/2 X3 1/2 X 1/4 *	5.0	5.0	0	55.4	5.0	0	87.8	65.8	31.5	VT4_ E1	55.3	45.1	VT4_ G1	0.817
2A1	L4X4X 1/4	8.2	8.2	0	78.8	4.3	0	66.2	56.3	22.7	VT4_ E1	55.2	30.7	VT1_ E1	0.556
2A2	L4X4X 1/4	8.2	8.2	0	78.8	4.1	0	62.9	56.3	34.9	VT4_ E1	55.2	42.9	VT1_ E1	0.778
2B	L4X4X 5/16 *	8.2	8.2	0	79.4	4.1	0	63.1	96.6	49.6	VT4_ E1	86.9	71.5	VT1_ E1	0.822
2C	L4X4X 5/16 *	10.3	5.2	0	49.9	5.2	0	79.2	96.6	60.2	VT4_ E1	87.1	80.3	VT1_ E1	0.922
3	L5X5X 5/16 *	6.1	6.1	0	46.9	6.1	0	73.9	128.1	68.4	VT4_ A1	101.5	79.3	VT4_ A1	0.781
4	L5X5X 5/16 *	6.1	6.1	0	46.9	6.1	0	73.9	128.1	68.5	VT4_ A	101.5	85.0	VT4_ A1	0.838
5	L5X5X 5/16 *	6.1	6.1	0	46.9	6.1	0	73.9	128.1	80.6	VT4_ A	101.5	94.3	VT4_ A1	0.930
6	L5X5X 3/8 *	12.2	6.1	0	47.2	6.1	0	74.2	152.4	89.6	VT4_ A	137.2	109.6	VT4_ A1	0.799
7	L5X5X 3/8 *	6.1	6.1	0	47.2	6.1	0	74.2	152.4	95.8	VT4_ A	137.2	110.7	VT4_ A1	0.807
8	L5X5X 3/8 *	10.2	5.1	0	39.3	5.1	0	61.8	152.4	91.7	VT4_ A	150.4	110.8	VT4_ A1	0.737
9	L5X5X 3/8 *	10.2	5.1	0	39.3	5.1	0	61.8	152.4	100.0	VT4_ A	150.4	120.6	VT4_ A1	0.802
10	L5X5X 3/8 *	10.2	5.1	0	39.3	5.1	0	61.8	152.4	93.9	VT4_ A	150.4	117.6	VT4_ A1	0.782
11	L5X5X 3/8 *	10.2	5.1	0	39.3	5.1	0	61.8	152.4	99.1	VT4_ A	150.4	125.7	VT4_ A1	0.836
20	L3X3X 1/4	6.4	6.4	7	101.5	6.4	9	127.0	38.3	28.4	VT1_ E1	25.5	21.2	VT4_ E1	0.829
21	L3X3X 1/4	7.4	11.1	0	143.2	5.5	0	113.3	38.3	16.5	VT4_ A	20.1	16.4	VT4_ A	0.818
22	L3X3X 3/16 *	13.0	13.0	9	149.3	13.0	0	266.8	40.4	30.8	VT1_ C	4.4	0.0		0.762
23	L3X3X 1/4	7.8	7.8	7	110.3	7.8	9	144.2	38.3	17.5	VT4_ A	19.8	17.2	VT4_ A	0.869
24	2L2 1/2 X2 1/2 X 3/16 *	14.4	7.2	0	111.2	14.4	0	146.7	75.9	54.0	VT1_ C	23.9	18.9	VT4_ A	0.789
30	L4X4X 1/4	8.5	8.5	0	81.8	4.3	0	65.3	56.3	34.1	VT4_ E2	54.2	40.3	VT1_ E2	0.743
31	L4X4X 1/4	7.0	7.0	0	67.0	7.0	0	107.0	56.3	31.2	VT4_ E2	44.2	37.5	VT1_ E2	0.849
32	L4X4X 1/4	8.1	8.1	0	78.2	8.1	0	124.8	56.3	24.0	VT4_ E2	35.6	30.0	VT1_ E2	0.843
33	2L2 1/2 X2 1/2 X 3/16 *	9.7	4.8	0	74.5	9.7	0	98.3	75.9	59.6	VT4_ A	52.0	50.7	VT4_ A	0.973
34A	2L2 1/2 X2 1/2 X 3/16 *	3.5	3.5	0	54.0	7.0	0	71.2	68.9	39.3	VT4_ E1	70.1	55.6	VT1_ E1	0.794
34B	2L2 1/2 X2 1/2 X 3/16 *	3.5	3.5	0	54.0	7.0	0	71.2	68.9	22.9	VT1_ E2	70.1	18.0	VT4_ E2	0.332
35	L2 1/2 X2 1/2 X 3/16	9.9	4.9	6	87.8	4.9	8	122.5	22.3	8.5	VT4_ E2	17.1	11.3	VT1_ E2	0.662
40	L2X2X 1/8	5.7	2.8	6	71.2	2.8	6	95.3	10.5	5.0	VT1_ G1	12.3	6.7	VT4_ G1	0.540
41	L2X2X 1/8	6.5	3.4	6	79.6	3.4	6	108.7	10.5	7.7	VT1_ E1	10.9	7.7	VT4_ E1	0.728
42	L2X2X 1/8	6.8	3.5	6	81.3	3.5	6	111.3	10.5	6.8	VT4_ E1	10.5	6.7	VT1_ E1	0.641
43	L2X2X 3/16	9.6	5.1	6	104.4	5.1	8	147.6	15.8	7.9	VT1_ E1	9.5	7.9	VT4_ E1	0.839
44	L2X2X 3/16	9.9	5.2	6	106.3	5.2	8	150.5	15.8	6.7	VT4_ E1	9.1	6.6	VT1_ E1	0.729
45	L2 1/2 X2 1/2 X 3/16	10.2	5.3	6	92.2	5.3	8	129.6	22.3	4.2	VT4_ E1	15.3	12.2	VT1_ C	0.796
46	L3 1/2 X3 1/2 X 1/4	12.3	6.4	6	83.2	6.4	6	114.3	47.3	27.7	VT4_ E2	35.9	33.9	VT1_ E2	0.945
47A	L1 3/4 X1 3/4 X 1/8	4.4	2.5	6	71.6	2.5	6	95.5	8.4	0.5	VT4_ G1	10.8	0.4	VT1_ G1	0.056
47B	L1 3/4 X1 3/4 X 1/8	3.7	2.2	6	66.4	2.2	6	87.2	8.4	0.8	VT1_ G1	11.5	0.8	VT4_ G1	0.093
47C	L1 3/4 X1 3/4 X 1/8	3.1	2.1	6	63.9	2.1	6	83.4	8.4	1.4	VT1_ G1	11.8	1.4	VT4_ G1	0.163
48A	L1 3/4 X1 3/4 X 1/8	4.4	2.5	6	71.6	2.5	6	95.5	8.4	2.2	VT1_ C	10.8	0.0		0.267
48B	L1 3/4 X1 3/4 X 1/8	3.7	2.2	6	66.4	2.2	6	87.2	8.4	0.0	VT1_ G1	11.5	1.6	VT1_ C	0.139
48C	L1 3/4 X1 3/4 X 1/8	3.1	2.1	6	63.9	2.1	6	83.3	8.4	1.4	VT4_ G1	11.8	0.9	VT1_ G1	0.163
50	L4X4X 1/4 *	6.3	6.3	0	60.0	6.3	0	95.8	82.5	70.5	VT1_ C	53.7	17.9	VT4_ E1	0.856
51	L4X4X 1/4 *	6.3	6.3	0	60.0	6.3	0	95.8	78.3	58.6	VT1_ C	53.7	26.1	VT4_ E1	0.749
52	L4X4X 1/4 *	6.9	6.9	0	65.8	6.9	0	105.1	78.3	17.1	VT1_ C	48.3	6.7	VT4_ E1	0.219
53	L4X4X 1/4 *	6.3	6.3	0	60.0	3.1	0	47.9	78.3	21.1	VT4_ E1	70.0	55.6	VT1_ C	0.794
54	L4X4X 1/4 *	6.3	6.3	0	60.0	6.3	0	95.8	78.3	0.8	VT4_ E1	53.7	47.4	VT1_ C	0.882
55	L4X4X 1/4	6.4	6.4	0	61.4	6.4	0	98.1	56.3	0.9	VT4_ E1	48.0	21.3	VT1_ C	0.444
56	L4X4X 3/8 *	2.0	4.0	0	39.0	2.0	0	30.8	114.9	0.9	VT1_ G1	133.5	1.2	VT4_ G1	0.009
60	L2X2X 1/8	7.4	3.7	6	83.9	3.7	6	115.4	10.5	7.6	VT1_ C	10.0	8.4	VT1_ E1	0.837
62	L2X2X 1/8	7.4	3.7	6	83.9	3.7	6	115.4	13.9	8.5	VT1_ E1	10.0	7.7	VT1_ C	0.770
63	L2X2X 3/16 *	4.0	4.0	0	78.4	4.0	0	123.4	21.9	11.4	VT1_ E1	13.5	9.1	VT4_ E1	0.673
64	L2 1/2 X2 1/2 X 3/16 *	7.5	4.0	6	76.7	3.7	6	98.5	38.0	24.3	VT1_ C	25.9	23.8	VT1_ C	0.916
66	L3X3X 1/4	4.0	4.0	0	52.2	4.0	0	82.6	38.3	13.5	VT1_ G1	40.7	23.8	VT4_ G1	0.585
67	L4X4X 1/4 *	2.7	2.7	0	26.3	2.7	0	42.0	78.3	2.5	VT4_ E1	75.3	3.4	VT1_ E1	0.045
68	L1 3/4 X1 3/4 X 1/8	6.6	3.6	6	89.3	3.5	8	121.3	8.4	0.4	VT1_ G1	8.1	1.0	VT4_ G1	0.124
69	L1 3/4 X1 3/4 X 1/8	5.9	3.2	6	82.7	3.2	6	112.1	8.4	2.3	VT4_ G1	9.2	2.0	VT1_ G1	0.269
70	L4X4X 1/4 *	2.7	2.7	0	26.3	2.7	0	42.1	78.3	6.7	VT1_ G1	75.3	7.5	VT4_ G1	0.100
71	L1 3/4 X1 3/4 X 1/8 *	7.4	3.7	6	91.2	3.7	8	126.4	11.6	4.3	VT4_ G1	7.5	3.4	VT1_ G1	0.446
72	L1 3/4 X1 3/4 X 1/8 *	7.4	3.7	6	91.2	3.7	8	126.4	11.6	3.4	VT1_ G1	7.5	4.3	VT4_ G1	0.578
73	L2X2X 1/8	7.9	4.0	6	87.6	4.0	8	121.4	13.9	5.1	VT1_ E1	9.3	4.3	VT4_ E1	0.459
74	L1 3/4 X1 3/4 X 1/8 *	4.0	4.0	0	87.9	4.0	0	138.3	11.6	0.1	VT4_ A	6.3	0.6	VT1_ C	0.097
75	L3 1/2 X3 1/2 X 1/4	4.5	4.5	0	49.2	4.5	0	78.0	47.3	17.6	VT1_ E1	49.2	14.7	VT4_ E1	0.371
76	L2X2X 1/8	4.0	4.0	0	77.4	4.0	0	122.8	13.9	6.2	VT4_ E1	9.1	6.8	VT1_ E1	0.750
80	ST 4 X 9.2 *	4.0	4.0	0	42.1	4.0	0	57.8	87.2	3.3	VT1_ C	115.3	0.0		0.037
81	L2X2X 1/8	7.4	3.7	6	83.9	3.7	6	115.4	10.5	5.4	VT4_ E1	10.0	8.6	VT1_ C	0.860
82	L1 3/4 X1 3/4 X 1/8	4.0	4.0	0	87.9	4.0	0	138.3	8.4	6.3	VT1_ C	6.3	0.0		0.751
83	L1 3/4 X1 3/4 X 1/8	7.4	3.7	6	91.2	3.7	8	126.4	8.4	6.1	VT4_ E1	7.5	7.2	VT1_ E1	0.956
84	L1 3/4 X1 3/4 X 1/8	7.5	3.8	6	92.2	3.8	8	128.0	8.4	5.6	VT4_ E1	7.3	5.6	VT1_ E1	0.763
85	L1 3/4 X1 3/4 X 3/16	4.0	4.0	0	89.4	4.0	0	139.9	12.2	1.7	VT1_ C	9.1	0.0		0.141
90	L3X3X 3/16	10.6	5.3	6	81.2	5.3	6	111.5	29.1	11.9	VT1_ E2	23.9	11.9	VT1_ E2	0.499
91	L2 1/2 X2 1/2 X 3/16	6.3	6.3	0	98.6	6.3	0	157.7	22.3	17.1	VT1_ C	10.4	1.5	VT4_ A	0.767
92	L2 1/2 X2 1/2 X 3/16	9.4	4.7	6	85.0	4.7	6	118.0	22.3	15.3	VT1_ E2	18.2	15.1	VT4_ E2	0.831
93	L2X2X 3/16 *	6.3	6.3	0	124.2	6.3	0	195.4	21.9	10.0	VT1_ C	5.4	0.0		0.456
100	L4X4X 1/4	7.4	7.4	0	71.0	7.4	0	113.3	56.3	35.8	VT1_ E2	41.3	35.8	VT1_ E2	0.867
101	L4X4X 1/4	9.0	9.0	0	86.6	9.0	0	138.3	56.3	23.1	VT1_ E2	29.0	23.2	VT1_ E2	0.800
102	L4X4X 1/4	7.9	9.9	0	95.1	9.9	0	151.8	56.3	15.3	VT1_ E2	24.1	17.4	VT4_ A	0.724
103	L4X4X 1/4	20.1	11.0	6	109.0	11.0	8	156.7	56.3	12.9	VT4_ A	22.6	11.4	VT1_ E2	0.505
104	L3 1/2 X3 1/2 X 1/4	10.6	10.6	0	117.1	10.6	0	185.5	47.3	9.2	VT1_ E2	14.0	10.5	VT4_ A	0.747
105	L3 1/2 X3 1/2 X 1/4	9.5	19.0	0	209.2	9.5	0	165.7	47.3	1.9	VT3_ A	11.0	2.0	VT4_ A	0.183
120	L4X4X 3/8	2.0	2.0	0	19.5	2.0	0	30.8	82.7	1.6	VT4_ A	99.9	2.7	VT1_ C	0.027
121	L3X3X 3/16	11.7	5.8	0	75.1	5.8	0	119.5	29.1	13.6	VT4_ A	21.6	4.7	VT4_ A	0.467
122	L2X2X 1/8	6.6	6.6	0	128.6	6.6	0	203.9	10.5	4.1	VT1_ C	3.3	0.0		0.387
123	L3 1/2 X3 1/2 X 1/4 *	11.5	11.5	0	126.6	5.8	0	100.3	65.8	14.7	VT3_ B2	30.2	6.4	VT4_ A	0.224
107	L4X4X 1/4	14.7	14.7	0	141.5	7.4	0	112.9	56.3	10.1	VT1_ E2	27.7	10.2	VT1_ E2	0.368
108	L4X4X 1/4	14.7	14.7	0	141.5	7.4	0	112.9	56.3	8.0	VT1_ E2	27.7	8.1	VT1_ E2	0.292
109	L4X4X 1/4	12.0	24.0	0	230.4	12.0	0	183.9	56.3	2.5	VT3_ A	10.5	2.6	VT3_ A	0.249
111	L3 1/2 X3 1/2 X 1/4	16.6	16.6	0	183.3	8.3	0	145.2	47.3	7.2	VT4_ E2	14.4	7.3	VT4_ E2	0.510
112	L3X3X 3/16 *	13.3	13.3	0	170.4	6.6	0	135.7	40.4	4.5	VT4_ A	10.7	5.0	VT4_ A	0.463
113	L3X3X 3/16	14.7	14.7	0	189.5	7.4	0	150.9	29.1	6.1	VT4_ E2	8.7	6.0	VT4_ E2	0.696
114	L4X4X 1/4	10.4	10.4	0	99.7	10.4	0	159.1	56.3	18.2	VT4_ A	21.9	18.2	VT4_ A	0.828
115	L3 1/2 X3 1/2 X 1/4	12.0	12.0	0	132.1	12.0	0	209.3	47.3	2.5	VT4_ A	11.0	2.6	VT1_ A	0.239

NOTES:

1. * DENOTES ASTM A572 GRADE 50 STEEL. ALL OTHERS ASTM A36.
2. UNITS ARE FEET AND KIPS.
3. TENSION CAPACITIES:

   TENSION CAPACITIES ARE BASED ON THE REDUCTION IN MEMBER AREA DUE TO BOLT HOLES. THE ACTUAL NUMBER OF HOLES IN THE MEMBER, BASED ON DETAILING, MAY NOT BE THE SAME AS THE DEFAULT NUMBER OF BOLTS USED IN THE MODEL.

   CONNECTION STRENGTH IS NOT CONSIDERED.
4. COMPRESSION CAPACITIES:

   LZ, EQZ, & KL/RZ ARE EQUAL TO LY, EQY & KL/RY FOR SHAPES OTHER THAN SINGLE ANGLES.

   EQUATIONS:

   0: KL/R = L/R
   6: KL/R = 30 + 0.75 L/R
   7: KL/R = 60 + 0.50 L/R
   8: KL/R = 28.6 + 0.76 L/R
   9: KL/R = 46.2 + 0.615 L/R

   CONNECTION STRENGTH IS NOT CONSIDERED.
5. TENSION AND COMPRESSION FORCES CONSIDER ALL FIBER POSITIONS AND ALL COMBINATIONS OF VERTICAL AND TRANSVERSE SPANS.
6. "UTIL" IS MEMBER UTILIZATION (MAXIMUM OF TENSION FORCE / TENSION CAPACITY AND COMPRESSION FORCE / COMPRESSION CAPACITY).
7. MAIN LEG AND DIAGONAL LEG MEMBER MODELING INFORMATION IS NOT INCLUDED DUE TO VARIATIONS FROM DIFFERING LEG EXTENSIONS.
8. MEMBER 56 NOT INCLUDED DUE TO FLEXURAL DESIGN.

WHEN SI SHAPES ARE AVAILABLE AND MORE ECONOMICAL, A SUBTITUTION CAN BE MADE USING THE FOLLOWING SI SHAPES WITH BPA APPROVAL:

ENGLISH OR IMPERIAL SHAPE	METRIC OR SI SHAPE
L1 3/4 X 1 3/4 X 1/8	L 45 X 45 X 3
L1 3/4 X 1 3/4 X 3/16	L 45 X 45 X 5
L2X2X 1/8	L 50 X 50 X 3
L2X2X 3/16	L 50 X 50 X 5
L2 1/2 X 2 1/2 X 3/16	L 65 X 65 X 5
L3X3X 3/16	L 75 X 75 X 5
L3X3X 1/4 □	L 75 X 75 X 6
L3 1/2 X 3 1/2 X 1/4	L 90 X 90 X 6
L4X4 1/4	L 100 X 100 X 6
L4X4 5/16	L 100 X 100 X 8
L4X4 3/8	L 100 X 100 X 10
L5X5 5/16	L 130 X 130 X 8
L5X5 3/8	L 130 X 130 X 10
L5X5 5/8	L 130 X 130 X 16

□ FOR MEMBER 23, USE L75 X 75 X 7.
FOR THE LEG DIAGONAL MEMBERS UNDER THE 80 AND 100 FT. BODIES,
THE FOLLOWING LEG EXT. DIAGONALS SHALL USE L75 X 75 X 7: 22'-6", 37'-6", 47'-6" AND 50'-0".

NO.	*	W.O. 4340	REVISION	BY	DATE	APPROVED
1	R	00189955	MODIFIED GROUND WIRE BRACKETS	DMH	10/19/10	DMH JCN JK

* C = CONTRACT CONSTRUCTION, FA = FORCE ACCOUNT, R = RECORD

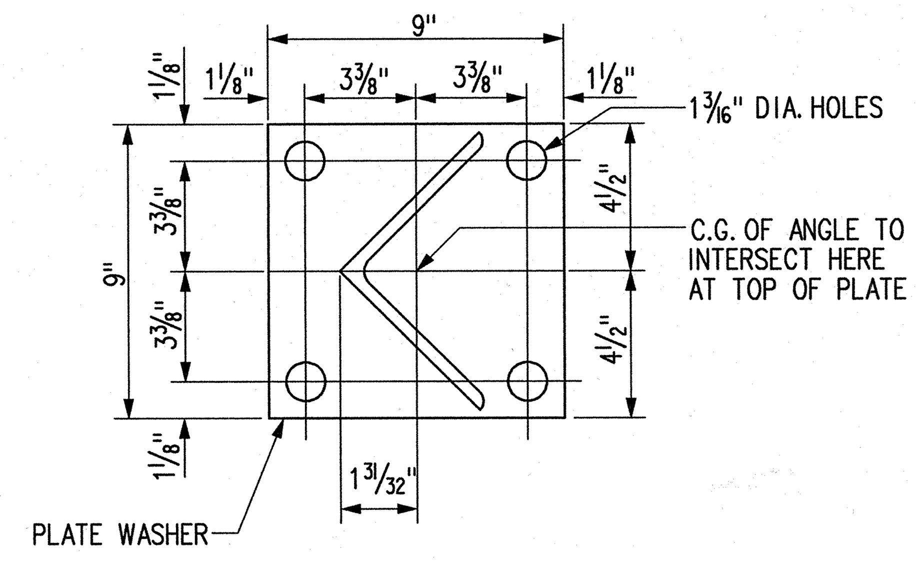
DSGN D.M. HESSE
DRWN D.M. HESSE
CHKD E.T. ORTH
REVW MICHAEL D. MILLER
CNCR G.W. GREEN
APPR LEON KEMPNER JR. PRINCIPAL ENGINEER
DATE 02/24/06

UNITED STATES DEPARTMENT OF ENERGY
BONNEVILLE POWER ADMINISTRATION
HEADQUARTERS, PORTLAND, OREGON

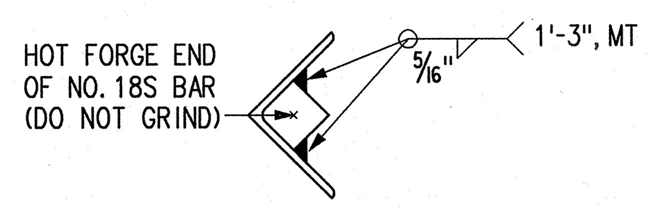
500 KV SINGLE CIRCUIT
TRANSMISSION TOWER
MWT = 51,000 LBS.

TYPE 148M MODELING INFORMATION

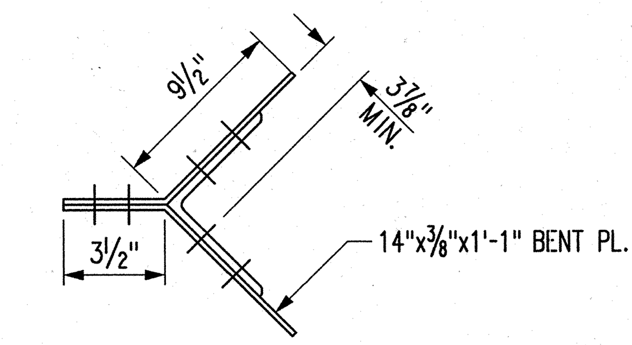
Serial	Source	Size	Sheet	Revision
269911	LFS	A1	10	1



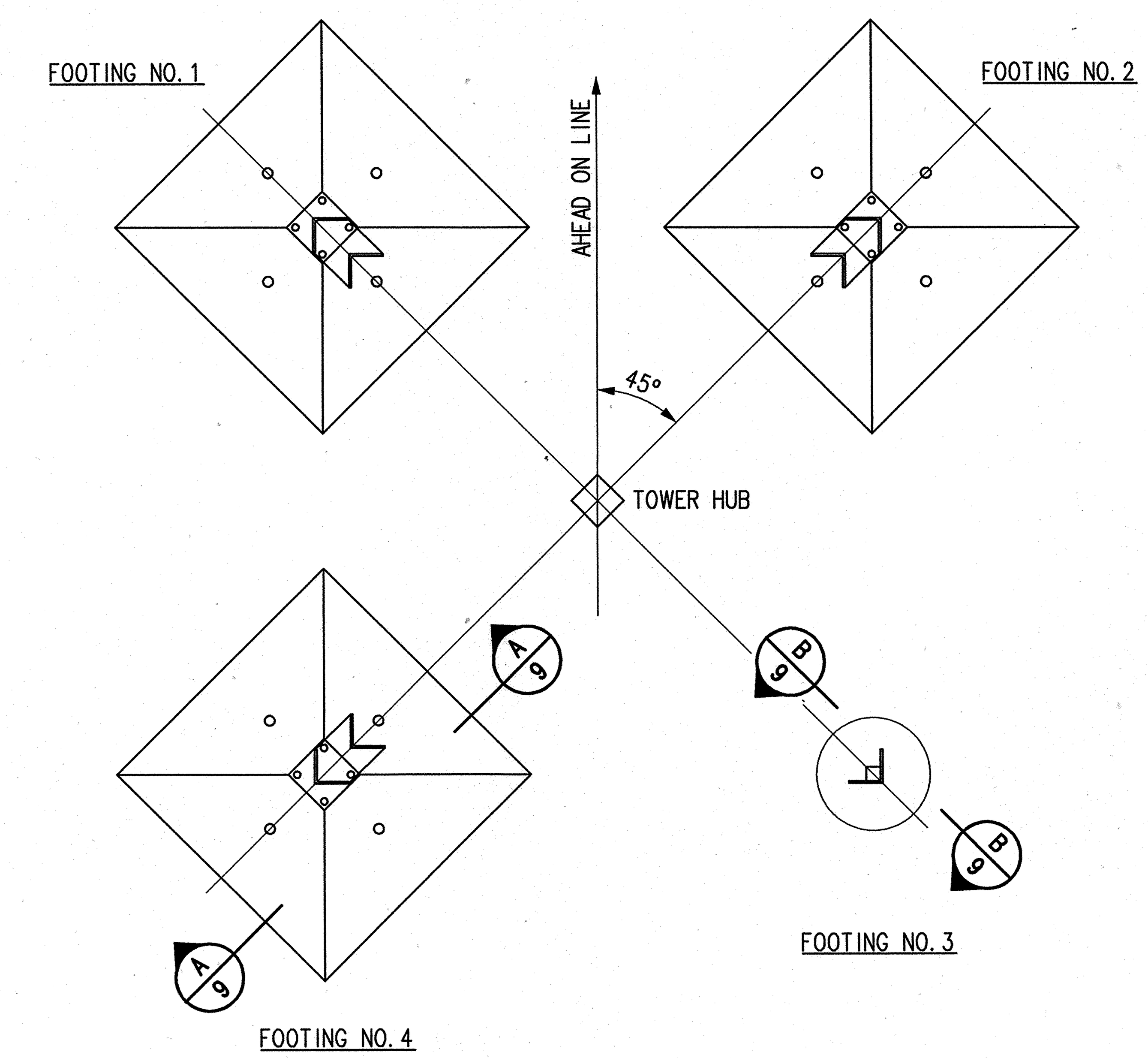
SECTION C/9 C/9



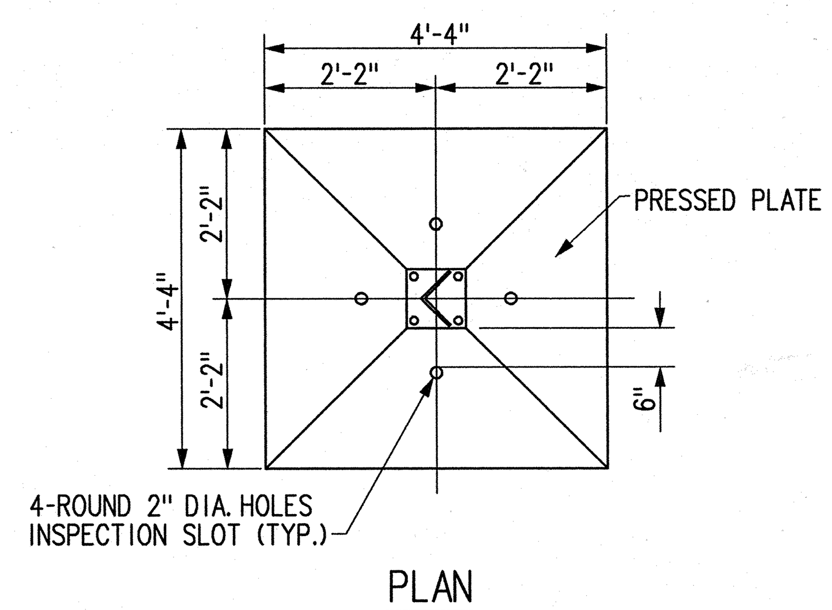
SECTION D/9 D/9



SECTION E/9 E/9

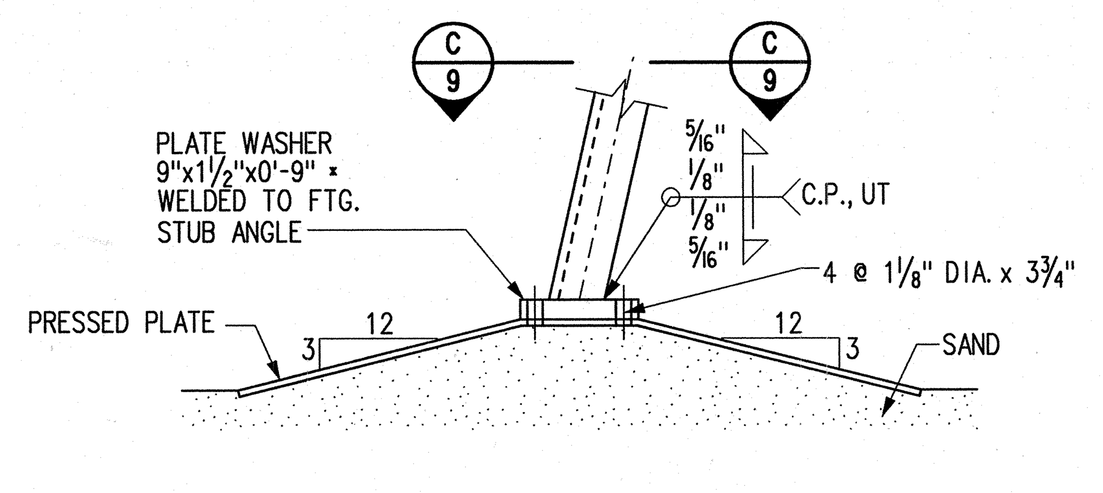


TOWER FOOTING PLAN

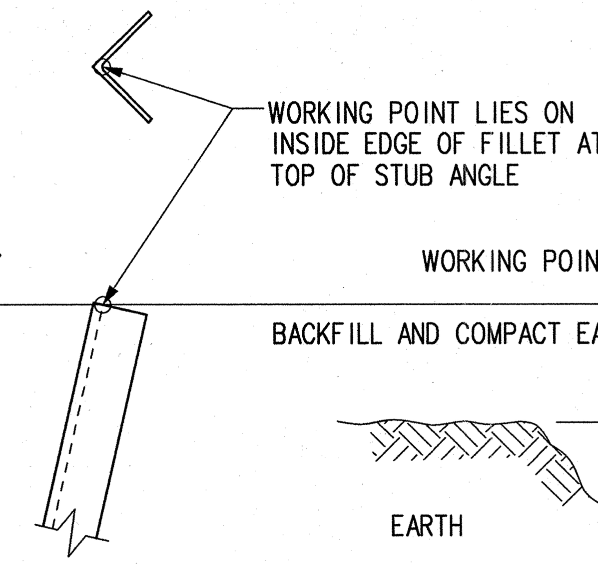


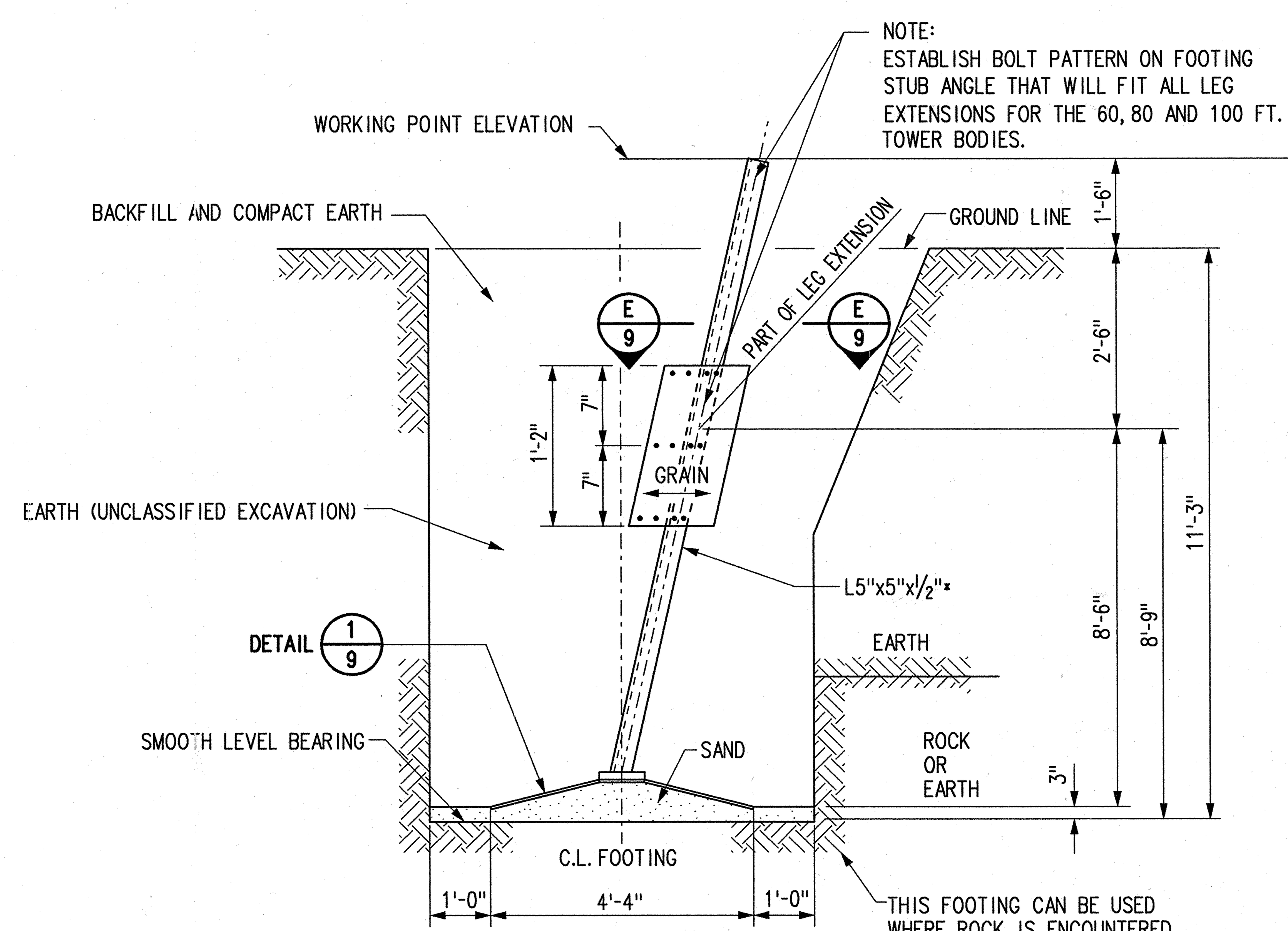
PLAN

52"x½"x4'-4" PRESSED PLATE



DETAIL 1/9



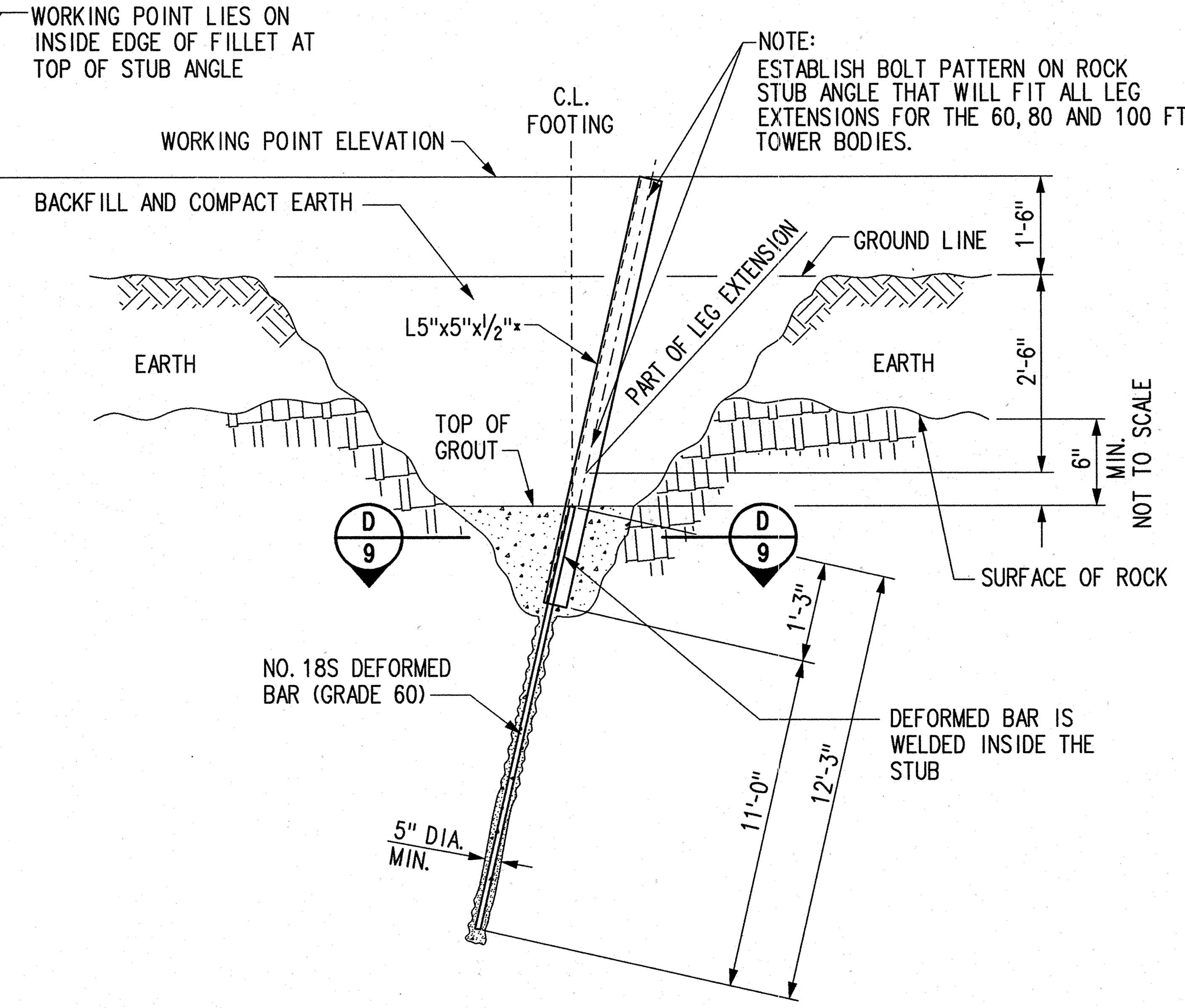


SECTION A/9 A/9

PRESSED PLATE FOOTING DETAIL

DETAILED WEIGHT OF ONE PRESSED PLATE FOOTING = 678 LBS.

MAXIMUM UPLIFT	= 103 KIPS
MAXIMUM HORIZONTAL SHEAR	= 10.1 KIPS
MAXIMUM COMPRESSION	= 128 KIPS



SECTION B/9 B/9

ROCK FOOTING DETAIL (GROUTED TYPE)

DETAILED WEIGHT OF ONE ROCK FOOTING = 242 LBS.

ROCK FOOTING NOTES:

1. USE WHEN ROCK IS JUDGED SUITABLE FOR ANCHORAGE BY THE CONTRACTING OFFICER'S TECHNICAL REPRESENTATIVE.
2. ANY CHANGE IN FOOTING WORKING POINT ELEVATIONS FROM THOSE LISTED ON THE TOWER SITE SUMMARY LIST IS TO BE APPROVED BY THE PROJECT ENGINEER.

GENERAL NOTES:

1. ALL DIMENSIONS ARE TO OUTSIDE EDGE OF ANGLES UNLESS OTHERWISE NOTED.
2. * DENOTES ASTM A572 GRADE 50 STEEL.
3. C.P. = DENOTES COMPLETE PENETRATION.
4. UT = DENOTES ULTRASONIC TESTING.
5. MT = DENOTES MAGNETIC PARTICLE TESTING.

NO.	*	W.O.	REVISION	BY	DATE	APPROVED
	R	00004340				

* C - CONTRACT CONSTRUCTION, FA - FORCE ACCOUNT, R - RECORD

DSGN	JM SHAUGHNESSY
DRWN	M FETESCU
CHKD	M J Quay (signature)
REVW	(signature)
CNCR	G W Green (signature)
APPR	Glen Kempner (signature), PRINCIPAL ENGINEER
DATE	02/24/06

UNITED STATES DEPARTMENT OF ENERGY
BONNEVILLE POWER ADMINISTRATION
HEADQUARTERS, PORTLAND, OREGON

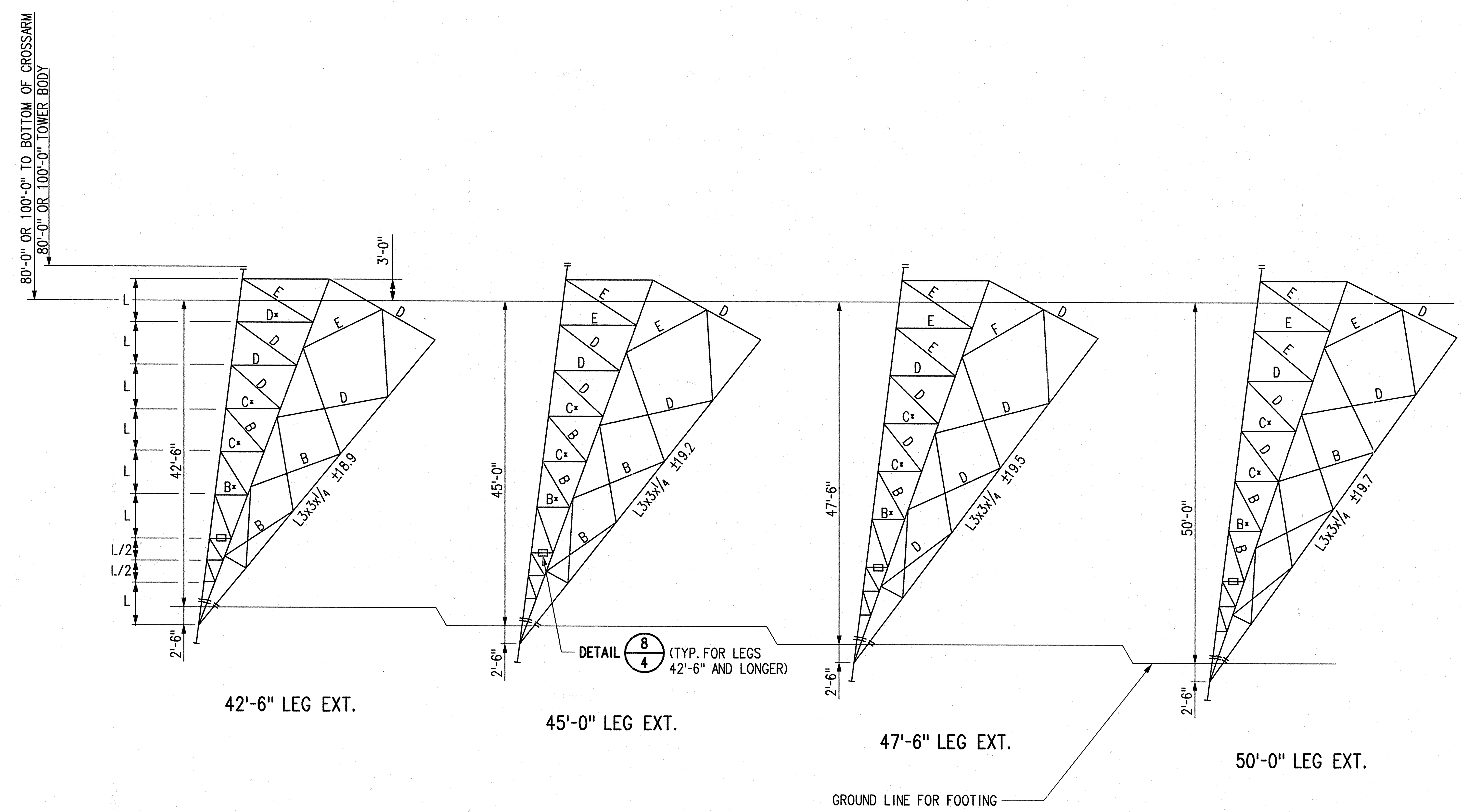
500 KV SINGLE CIRCUIT
TRANSMISSION TOWER
MWT = 51,000 LBS.
TYPE 148M PRESSED PLATE & ROCK FOOTINGS

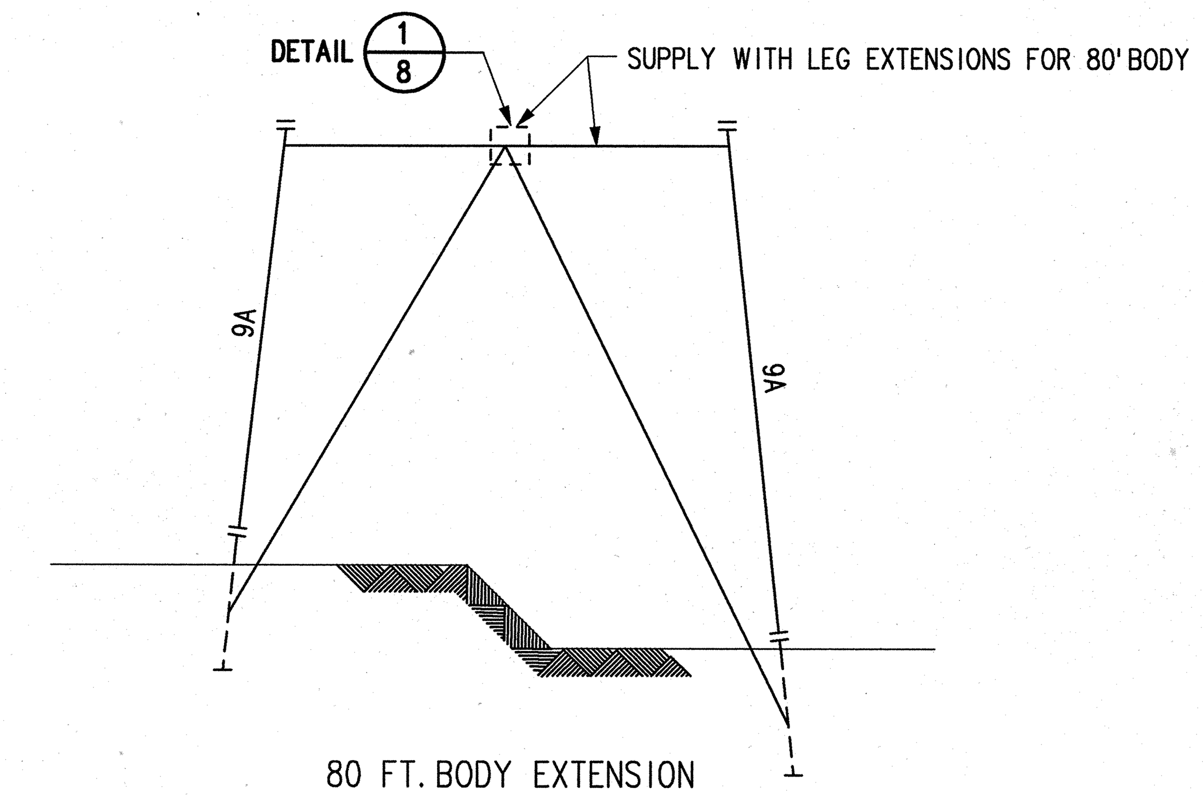
Serial	Source	Size	Sheet	Revision
269911	LFS	A1	9	0

SYMBOL	MEMBER SIZE
A	L1¾x1¾x⅛
B	L2x2x⅛
C	L2x2x3/16
D	L2½x2½x3/16
E	L3x3x3/16
F	L3½x3½x¼

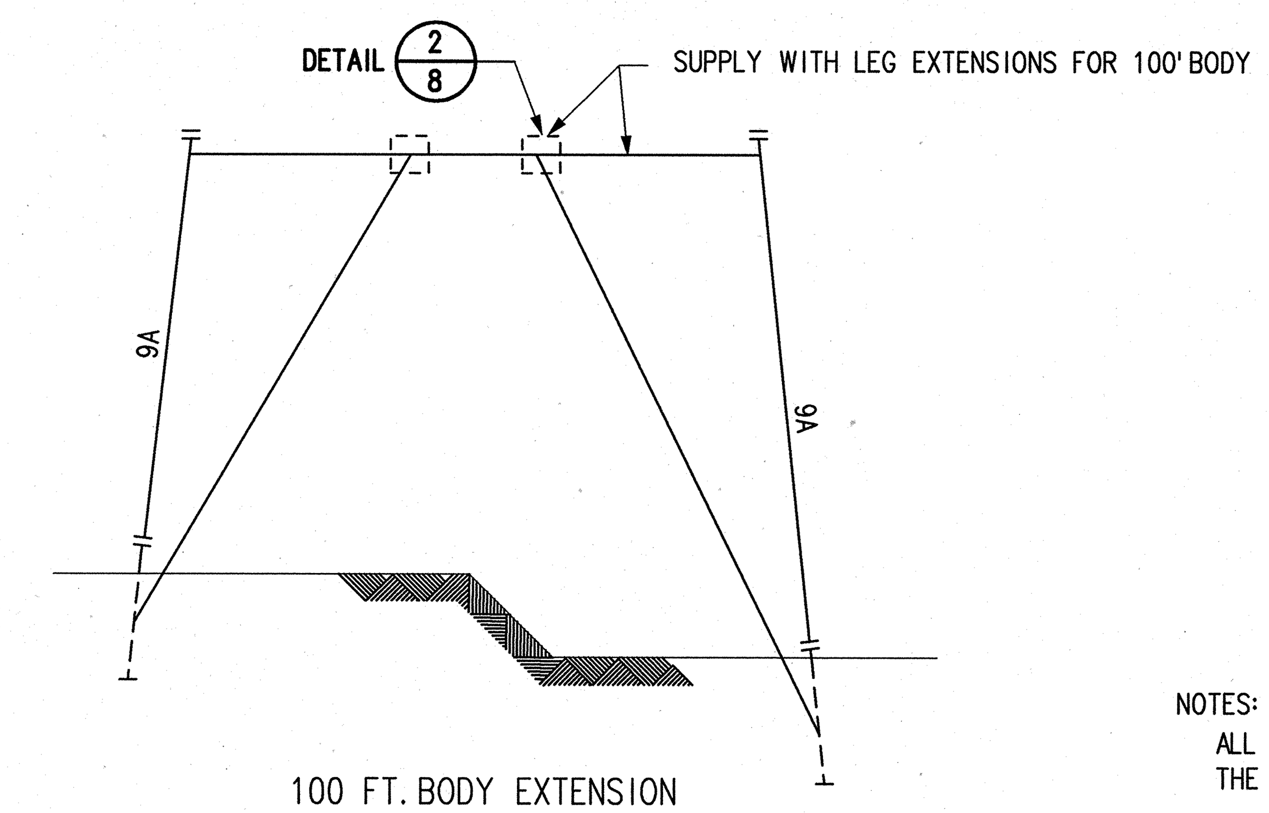
ALL REDUNDANT MEMBERS ARE L1¾x1¾x⅛ EXCEPT AS NOTED.

LEG EXT. FT.-IN.	DETAILED WEIGHT	
	80' (LBS)	100' (LBS)
42'-6"	2319	2436
45'-0"	2408	2445
47'-6"	2654	2692
50'-0"	2610	2647

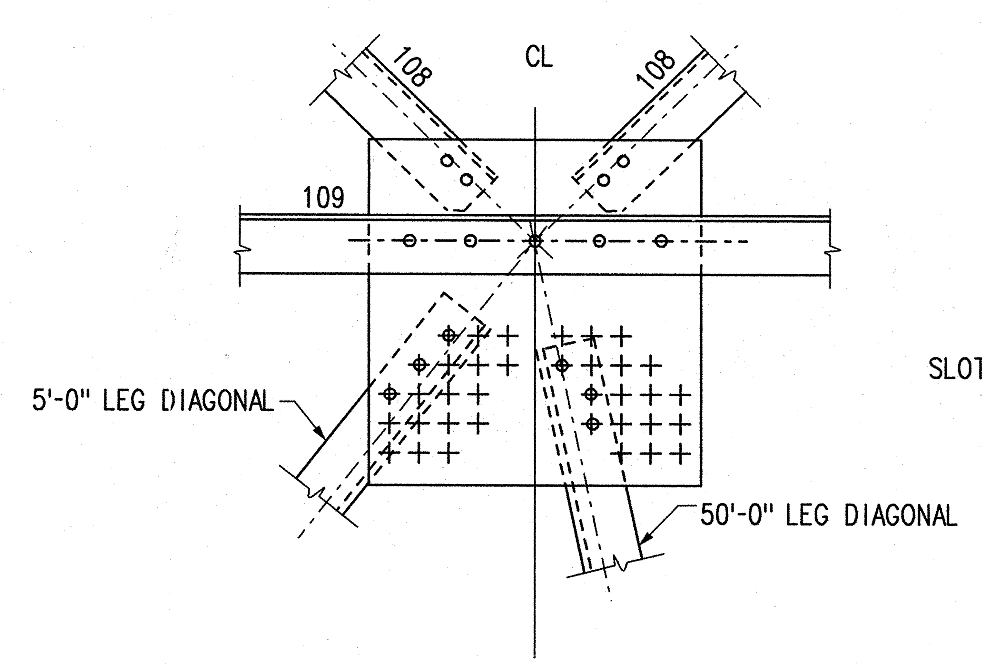




80 FT. BODY EXTENSION



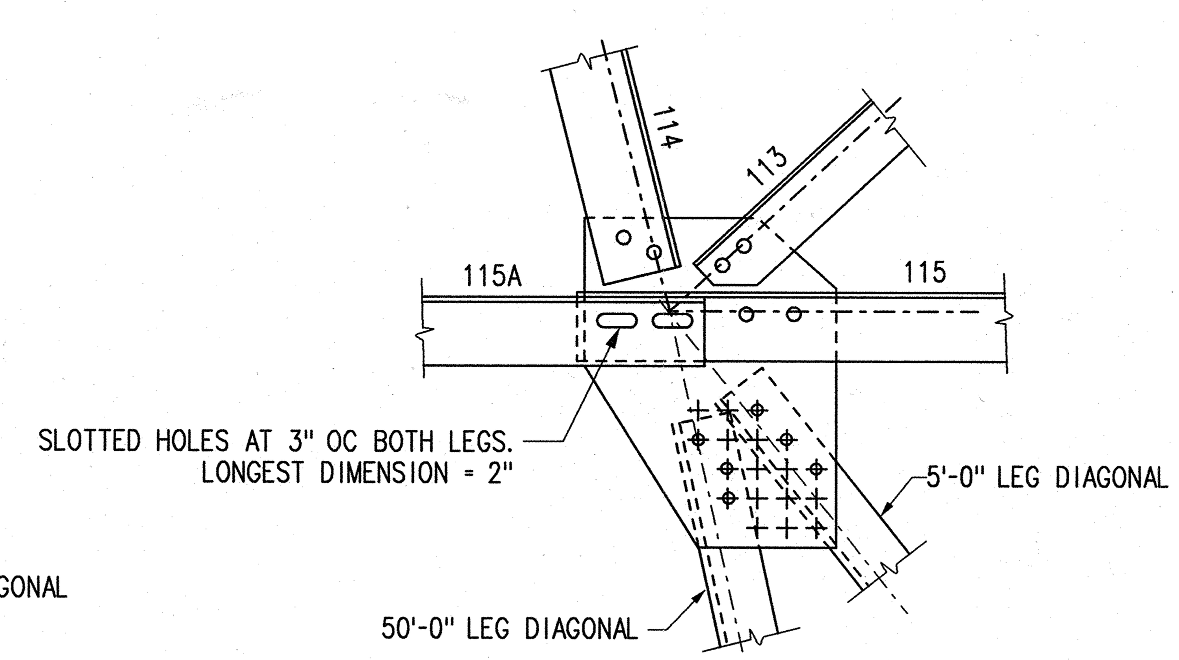
100 FT. BODY EXTENSION



DETAIL 1/8

80 FT. BODY
UNIVERSAL PLATE WITH OPTIMUM BOLT HOLE ARRANGEMENT FOR ASSEMBLY OF MBR. 109 AND ANY COMBINATION OF LEG EXTENSIONS FROM 5'-0" TO 50'-0". FURNISH ONE PLATE AND ONE MEMBER 109 WITH EACH 80' LEG EXTENSION.

USE NUMBERING SCHEME TO IDENTIFY BOLT HOLES FOR LEG EXT.



DETAIL 2/8

100 FT. BODY
UNIVERSAL PLATE WITH OPTIMUM BOLT HOLE ARRANGEMENT FOR ASSEMBLY OF ANY COMBINATION OF LEG EXTENSIONS FROM 5'-0" TO 50'-0". FURNISH TWO PLATES, TWO MEMBER 115, AND ONE MEMBER 115A WITH EACH 100' LEG EXTENSION.

USE NUMBERING SCHEME TO IDENTIFY BOLT HOLES FOR LEG EXT.

NOTES:
- ALL LEG ANGLES (9A) ARE L5x5x⅜*
- THE MAIN DIAGONAL CARRIES A MAXIMUM LOAD OF 19.7 KIPS AND REQUIRES A MINIMUM OF 3 BOLTS PER CONNECTION.
- * DENOTES ASTM A572 GRADE 50 STEEL
- = DENOTES SPLICE
- + DENOTES TENSION
- - DENOTES COMPRESSION
- ALL FORCES ARE IN KIPS.

NO.	W.O. 4340	REVISION	BY	DATE	APPROVED

C - CONTRACT CONSTRUCTION, FA - FORCE ACCOUNT, R - RECORD

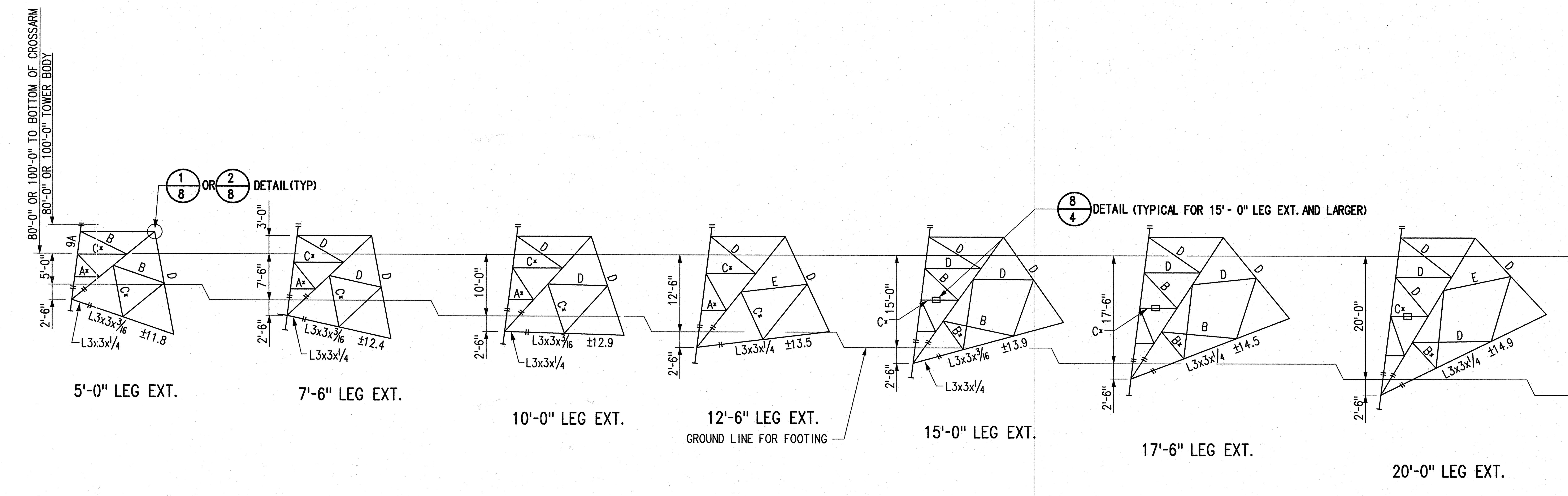
UNITED STATES DEPARTMENT OF ENERGY
BONNEVILLE POWER ADMINISTRATION
HEADQUARTERS, PORTLAND, OREGON

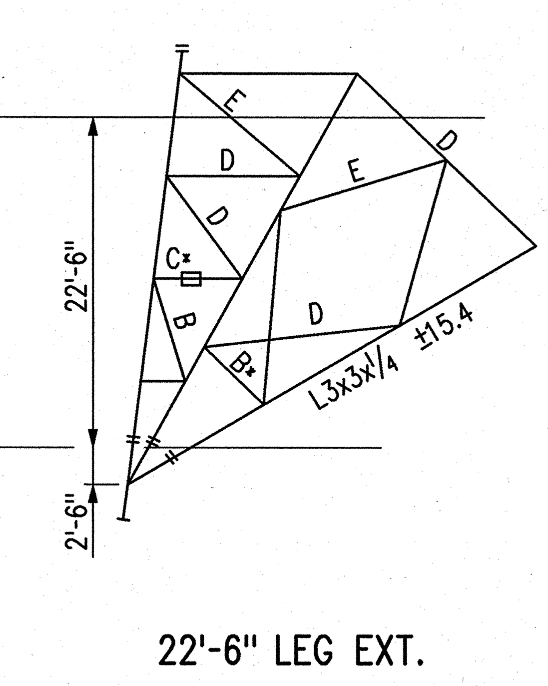
500 KV SINGLE CIRCUIT TRANSMISSION TOWER
MWT = 51,000 LBS.

TYPE 148M LEG EXT 80 & 100 FT BODIES

DSGN	MDM
DRWN	MDM
CHKD	E.T. Orth
REVW	[signature]
CNCR	[signature]
APPR	[signature] PRINCIPAL ENGINEER
DATE	02/24/06

Serial	Source	Size	Sheet	Revision
269911	LFS	A1	8	0

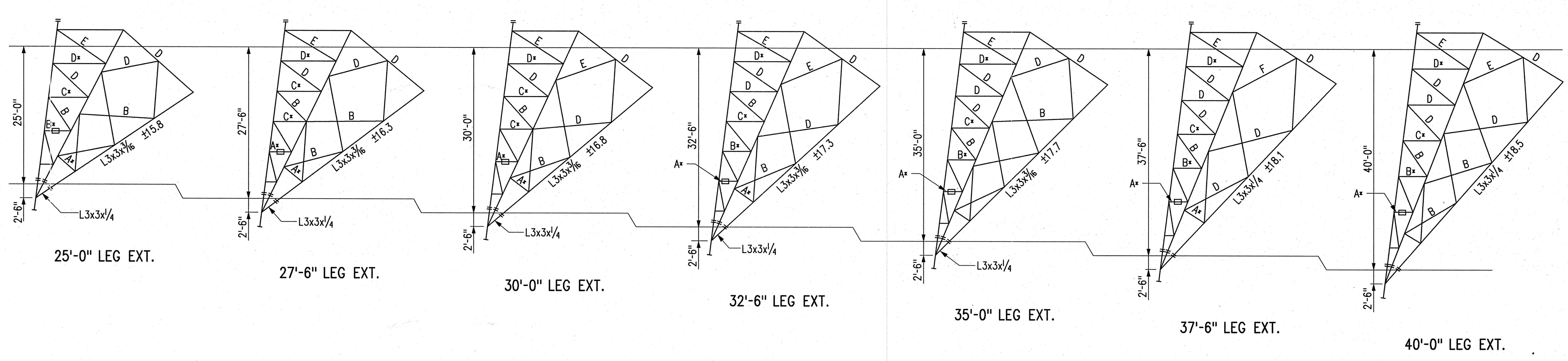




SYMBOL	MEMBER SIZE
A	L1¾x1¾x⅛
B	L2x2x⅛
C	L2x2x3/16
D	L2½x2½x3/16
E	L3x3x3/16
F	L3½x3½x¼

ALL REDUNDANT MEMBERS ARE L1¾x1¾x⅛ EXCEPT AS NOTED.

LEG EXT. FT.-IN.	DETAILED WEIGHT 80' (LBS)	100' (LBS)
5'-0"	712	744
7'-6"	814	852
10'-0"	877	914
12'-6"	996	1033
15'-0"	1081	1118
17'-6"	1198	1235
20'-0"	1343	1380
22'-6"	1433	1470
25'-0"	1435	1473
27-6"	1546	1584
30'-0"	1703	1741
32'-6"	1800	1838
35-0"	1852	1890
37'-6"	2185	2223
40'-0"	2188	2225



NOTES:

- ALL LEG ANGLES (9A) ARE L5x5x⅜*
- THE MAIN DIAGONAL CARRIES A MAXIMUM LOAD OF 19.7 KIPS AND REQUIRES A MINIMUM OF 3 BOLTS PER CONNECTION.
- * DENOTES ASTM A572 GRADE 50 STEEL
- = DENOTES SPLICE
- + DENOTES TENSION
- - DENOTES COMPRESSION
- ALL FORCES ARE IN KIPS.

NO.	W.O. 4340	REVISION	BY	DATE	APPROVED

• C = CONTRACT CONSTRUCTION, FA = FORCE ACCOUNT, R = RECORD

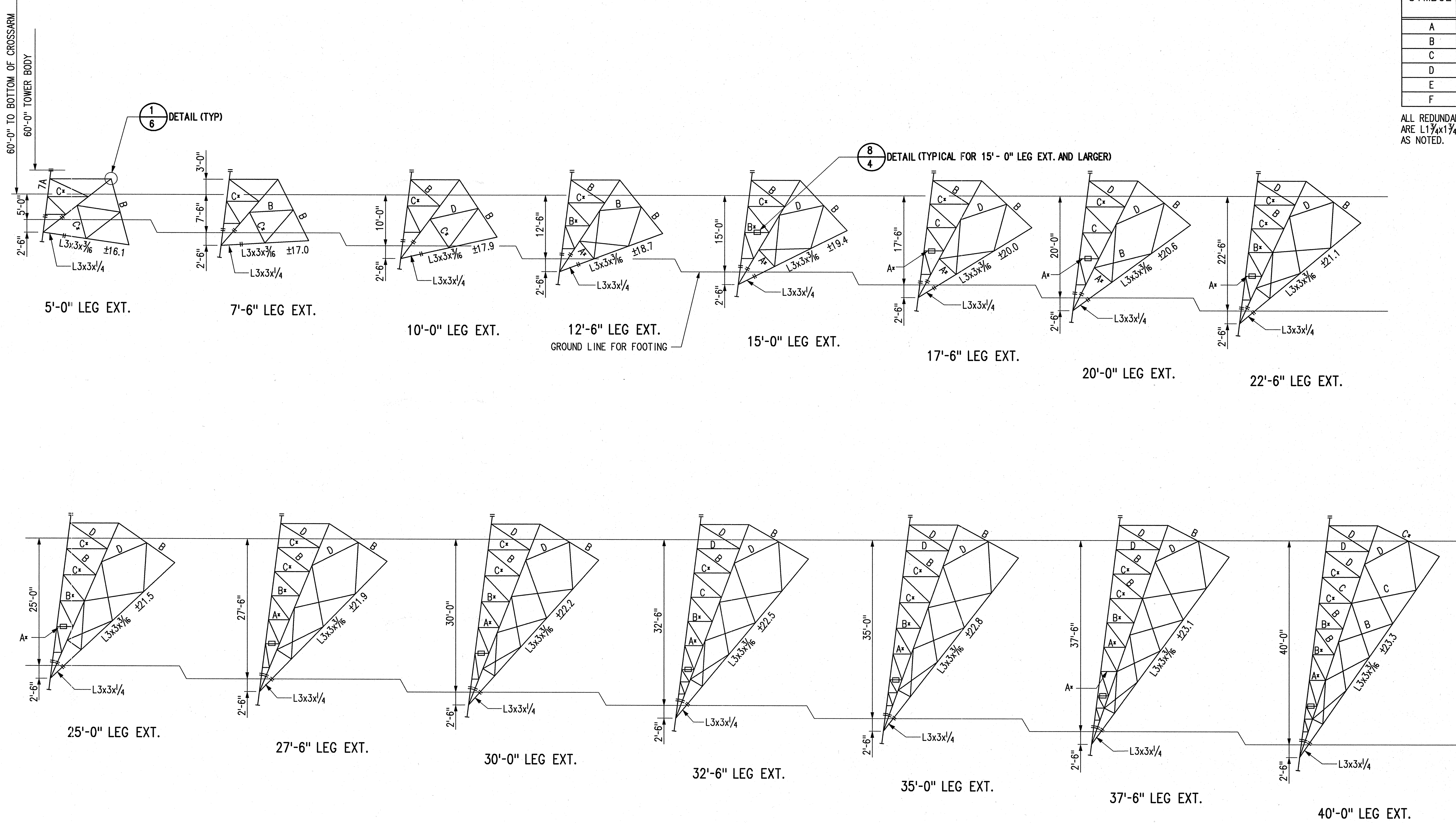
DSGN M D MILLER
DRWN M D MILLER
CHKD E.T. Orth
REVW [signature]
CNCR G W Greer
APPR [signature] PRINCIPAL ENGINEER
DATE 02/24/06

UNITED STATES DEPARTMENT OF ENERGY
BONNEVILLE POWER ADMINISTRATION
HEADQUARTERS, PORTLAND, OREGON

500 KV SINGLE CIRCUIT TRANSMISSION TOWER
MWT = 51,000 LBS.

TYPE 148M LEG EXT 80 & 100 FT BODIES

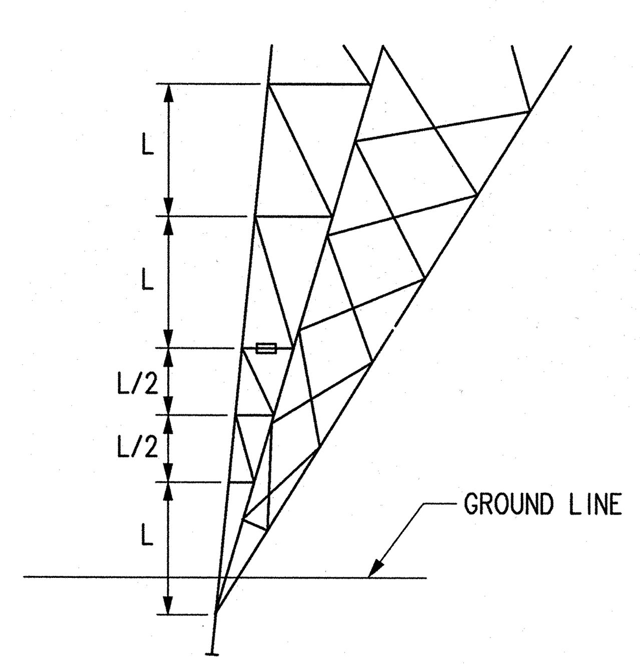
Serial	Source	Size	Sheet	Revision
269911	LFS	A1	7	0



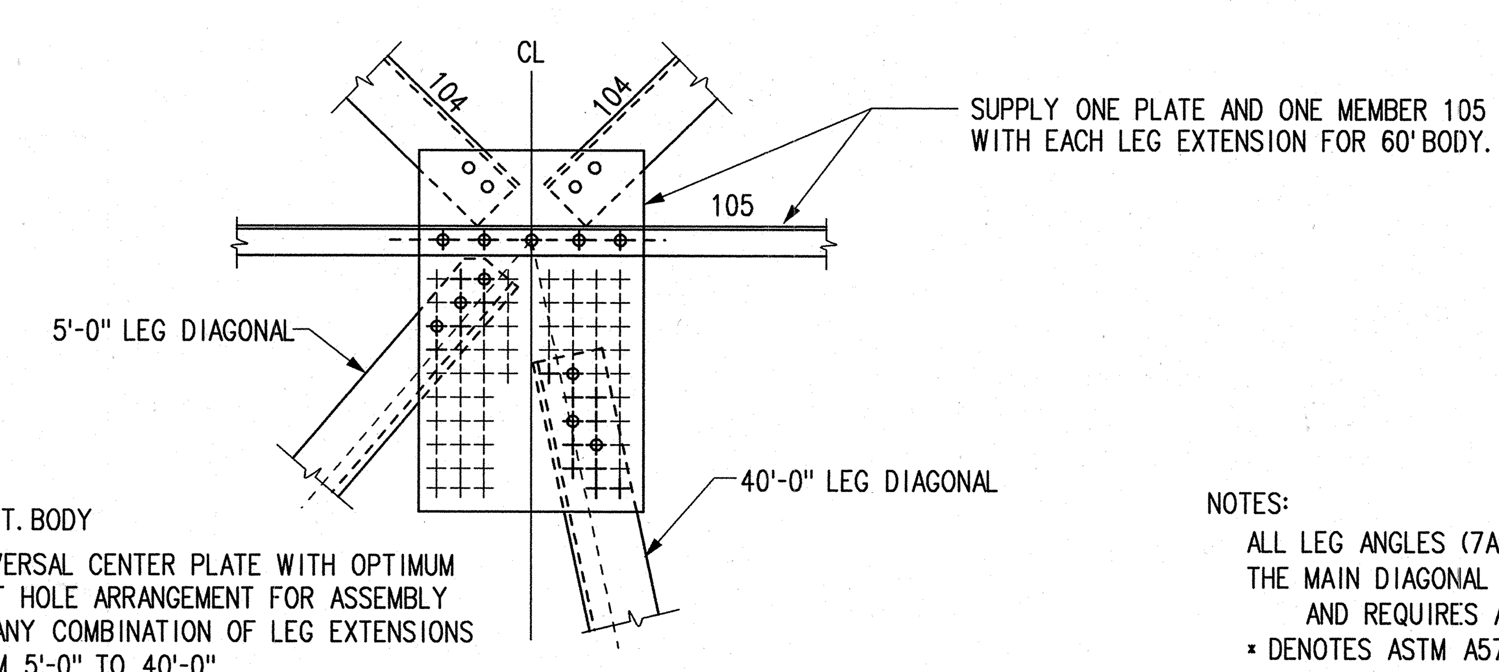
SYMBOL	MEMBER SIZE
A	L1¾x1¾x⅛
B	L2x2x⅛
C	L2x2x3/16
D	L2½x2½x3/16
E	L3x3x3/16
F	L3½x3½x¼

ALL REDUNDANT MEMBERS ARE L1¾x1¾x⅛ EXCEPT AS NOTED.

LEG EXT. FT.-IN.	DETAILED WEIGHT LBS
5'-0"	560
7'-6"	614
10'-0"	702
12'-6"	771
15'-0"	852
17'-6"	945
20'-0"	1033
22'-6"	1135
25'-0"	1194
27-6"	1278
30'-0"	1373
32'-6"	1489
35-0"	1551
37-6"	1673
40'-0"	1812



TYPICAL FOR LEG EXTENSIONS FROM 32'-6" TO 40'-0".



60 FT. BODY
UNIVERSAL CENTER PLATE WITH OPTIMUM BOLT HOLE ARRANGEMENT FOR ASSEMBLY OF ANY COMBINATION OF LEG EXTENSIONS FROM 5'-0" TO 40'-0"
USE NUMBERING SCHEME TO IDENTIFY BOLT HOLES FOR LEG EXT.

DETAIL 1/6

NOTES:

ALL LEG ANGLES (7A) ARE L5x5x5/16*
THE MAIN DIAGONAL CARRIES A MAXIMUM LOAD OF 23.3 KIPS AND REQUIRES A MINIMUM OF 3 BOLTS PER CONNECTION.
* DENOTES ASTM A572 GRADE 50 STEEL
= DENOTES SPLICE
+ DENOTES TENSION
- DENOTES COMPRESSION
ALL FORCES ARE IN KIPS.

NO.	W.O. 4340	REVISION	BY	DATE	APPROVED

* C - CONTRACT CONSTRUCTION, FA - FORCE ACCOUNT, R - RECORD

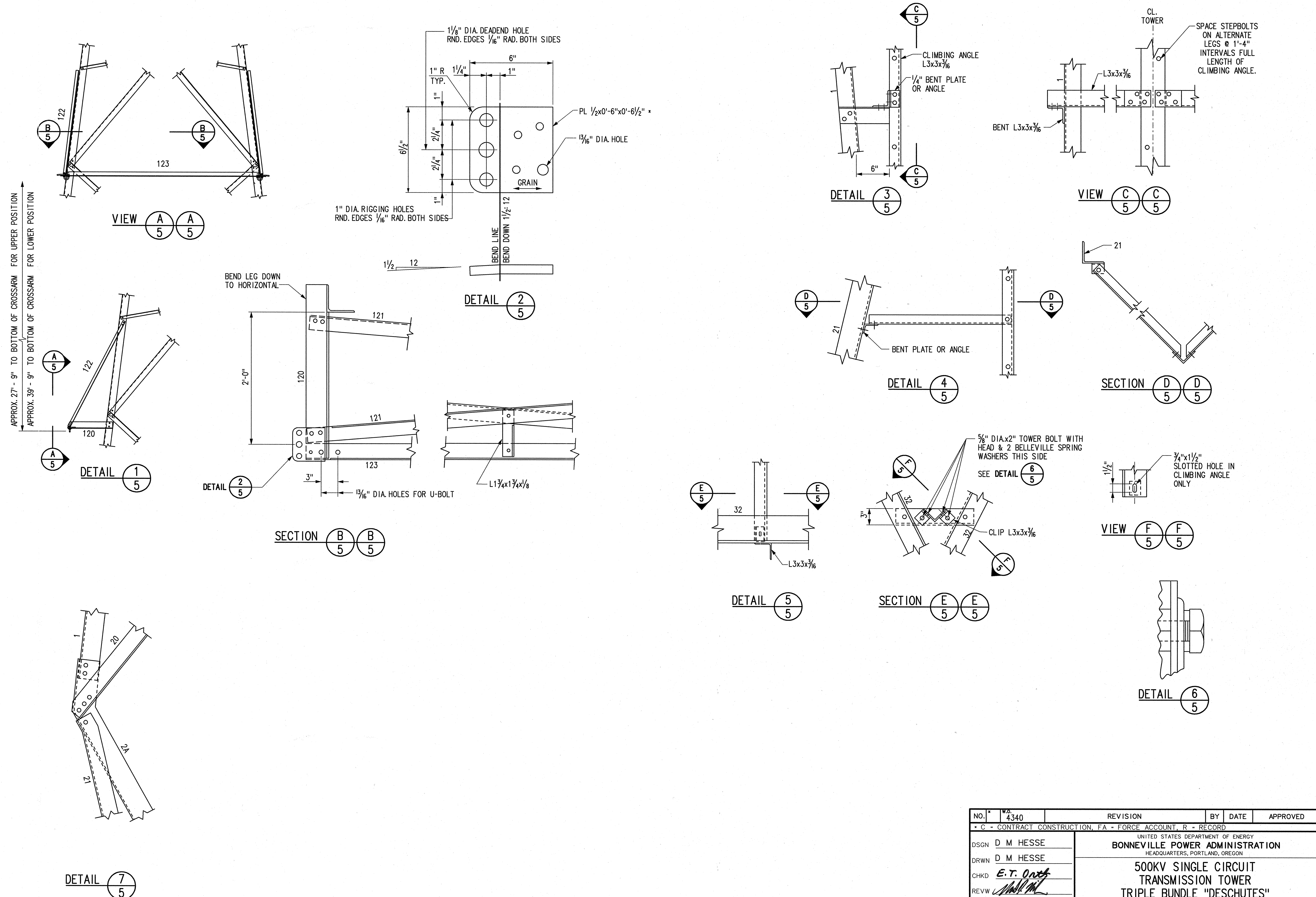
DSGN D M HESSE
DRWN MF/DMH
CHKD E.T. Orth
REVW [signature]
CNCR GW Green
APPR [signature] PRINCIPAL ENGINEER
DATE 02/24/06

UNITED STATES DEPARTMENT OF ENERGY
BONNEVILLE POWER ADMINISTRATION
HEADQUARTERS, PORTLAND, OREGON

500 KV SINGLE CIRCUIT TRANSMISSION TOWER
MWT = 51,000 LBS.

TYPE 148M — LEG EXT 60 FT BODY

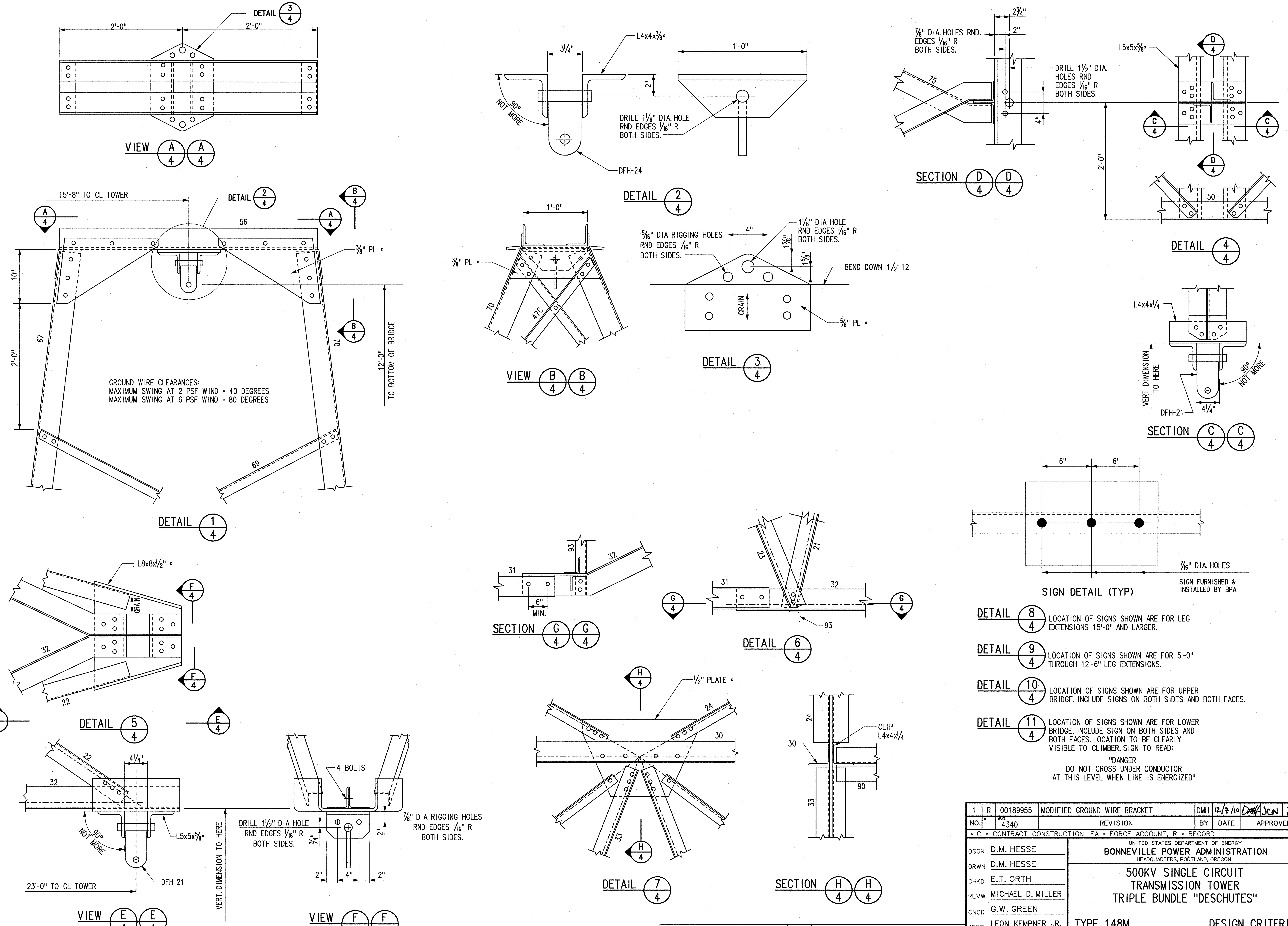
Serial	Source	Size	Sheet	Revision
269911	LFS	A1	6	0



NO.	*	W.O. 4340	REVISION	BY	DATE	APPROVED

* C - CONTRACT CONSTRUCTION, FA - FORCE ACCOUNT, R - RECORD

DSGN D M HESSE	UNITED STATES DEPARTMENT OF ENERGY BONNEVILLE POWER ADMINISTRATION HEADQUARTERS, PORTLAND, OREGON
DRWN D M HESSE	500KV SINGLE CIRCUIT TRANSMISSION TOWER TRIPLE BUNDLE "DESCHUTES"
CHKD E.T. Orth	
REVW [signature]	
CNCR [signature]	
APPR [signature] PRINCIPAL ENGINEER	TYPE 148M DESIGN CRITERIA
DATE 02/24/06	Serial 269911 · Source LFS · Size A1 · Sheet 5 · Revision 0



DETAIL 8/4 — LOCATION OF SIGNS SHOWN ARE FOR LEG EXTENSIONS 15'-0" AND LARGER.

DETAIL 9/4 — LOCATION OF SIGNS SHOWN ARE FOR 5'-0" THROUGH 12'-6" LEG EXTENSIONS.

DETAIL 10/4 — LOCATION OF SIGNS SHOWN ARE FOR UPPER BRIDGE. INCLUDE SIGNS ON BOTH SIDES AND BOTH FACES.

DETAIL 11/4 — LOCATION OF SIGNS SHOWN ARE FOR LOWER BRIDGE. INCLUDE SIGN ON BOTH SIDES AND BOTH FACES. LOCATION TO BE CLEARLY VISIBLE TO CLIMBER. SIGN TO READ:

"DANGER
DO NOT CROSS UNDER CONDUCTOR
AT THIS LEVEL WHEN LINE IS ENERGIZED"

NO.	*	W.O.	REVISION	BY	DATE	APPROVED
1	R	00189955	MODIFIED GROUND WIRE BRACKET	DMH	12/7/10	DMH JCN JLC
		4340				

* C - CONTRACT CONSTRUCTION, FA - FORCE ACCOUNT, R - RECORD

DRAWING NO.	SHEET	TITLE
149692-FDG-A1	1	DROP FORGED HANGERS DETAILS

REFERENCE DRAWINGS

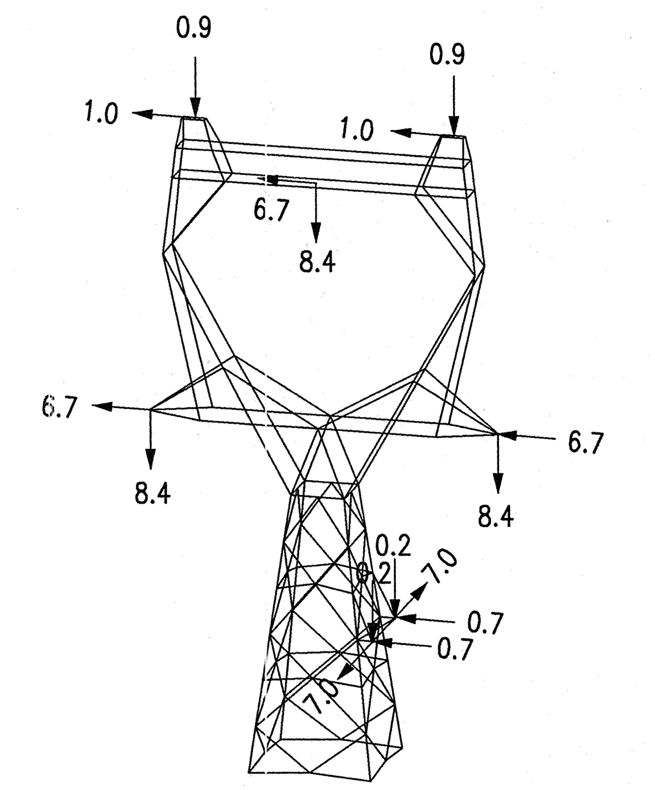
DSGN	D.M. HESSE
DRWN	D.M. HESSE
CHKD	E.T. ORTH
REVW	MICHAEL D. MILLER
CNCR	G.W. GREEN
APPR	LEON KEMPNER JR. PRINCIPAL ENGINEER
DATE	02/24/06

UNITED STATES DEPARTMENT OF ENERGY
BONNEVILLE POWER ADMINISTRATION
HEADQUARTERS, PORTLAND, OREGON

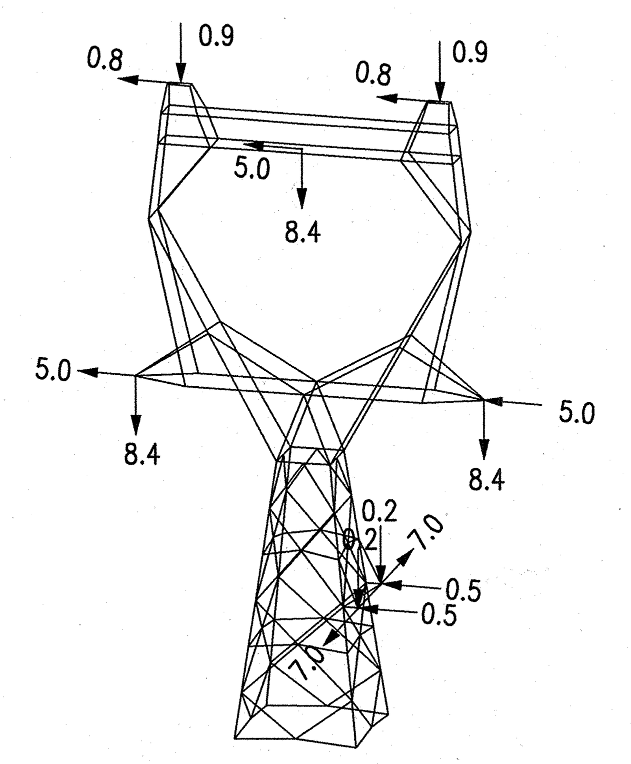
500KV SINGLE CIRCUIT
TRANSMISSION TOWER
TRIPLE BUNDLE "DESCHUTES"

TYPE 148M — DESIGN CRITERIA

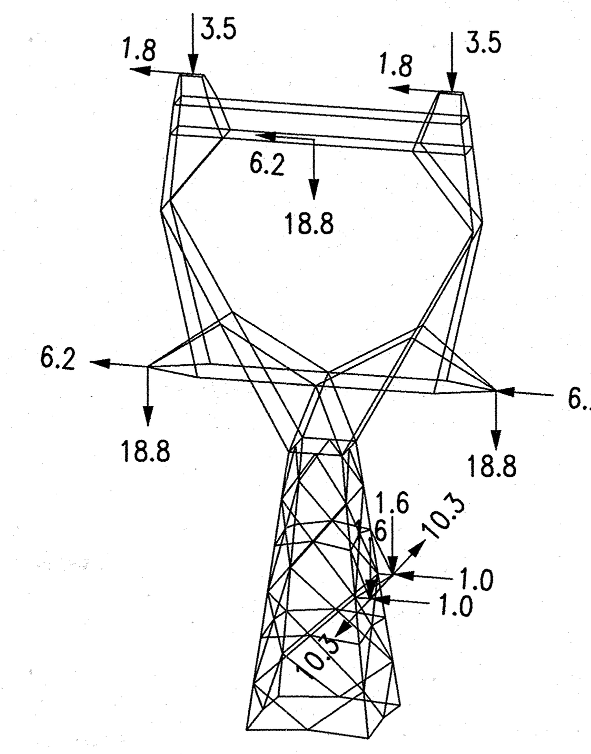
Serial	Source	Size	Sheet	Revision
269911	LFS	A1	4	1



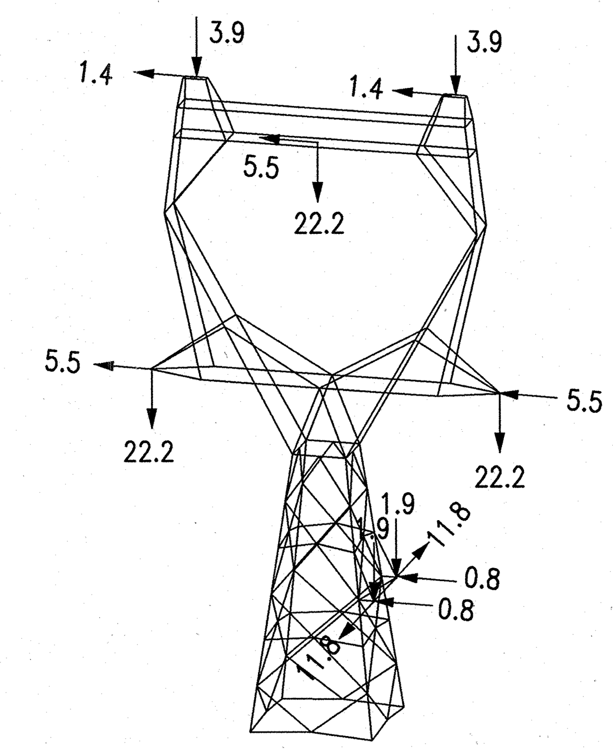
CASE A - 100 MPH WIND ON TOWER
@ 90° TO TRANSVERSE FACE W/ 1.2 GUST FACTOR



CASE A1 - 100 MPH WIND ON TOWER
@ 60° TO TRANSVERSE FACE W/ 1.2 GUST FACTOR



CASE B1 - 40 MPH WIND



CASE B2 - 56.6 MPH WIND

ULTIMATE DESIGN CONDITIONS

A. HIGH WIND ON BARE CONDUCTOR, 100 MPH WIND IN ANY DIRECTION, SPAN FACTOR = 0.7, TOWER GUST FACTOR = 1.2.

B1. 40.0 MPH TRANSVERSE WIND ON 2" RADIAL RIME ICE (15 PCF).

B2. 56.6 MPH WIND ON 1" RADIAL GLAZE ICE (57 PCF). SPAN FACTOR = 0.7.

C. HEAVY VERTICAL (1½" RADIAL GLAZE ICE). NO WIND.

D. NESC 2002 EDITION MEDIUM LOADING 40 MPH WIND WITH ¼" RADIAL GLAZE ICE AND OVERLOAD FACTORS: 1.5 VERTICAL, 2.5 TRANSVERSE, 1.65 LONGITUDINAL.

E. BROKEN CONDUCTOR, NO ICE, NO WIND. IMPACT FACTOR = 0.67

G. UNBALANCED ICE ON OVERHEAD GROUNDWIRE AND ADSS FIBER. NO WIND.

PROJECTED WIND AREA IS EQUAL TO 1½ TIMES THE PROJECTED AREA OF ONE FACE OF THE TOWER EXCEPT CASE D.

FOR ROUND (APPROXIMATE ROUND) SURFACES:
$P=0.00256 \times V_s^2$

FOR FLAT SURFACES:
$P=0.004 \times V_s^2$

LINE ANGLE = 0°

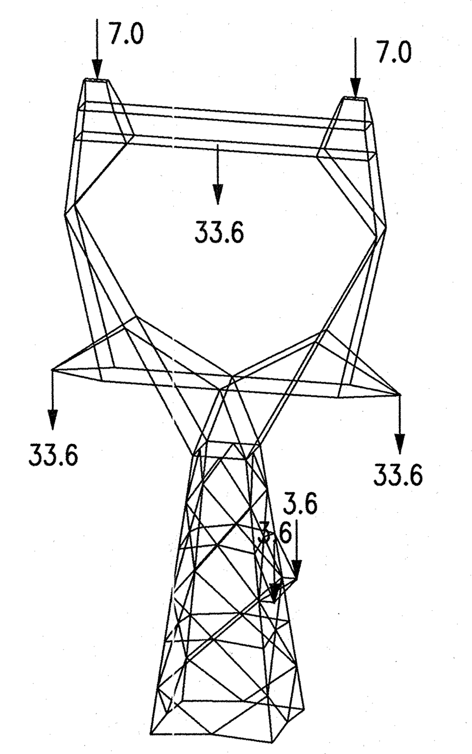
DESIGN SPANS: (SEE NOTE ON SHEET 1)
V SPAN: 1600 FT.
T SPAN: 1150 FT.

LOAD CASES

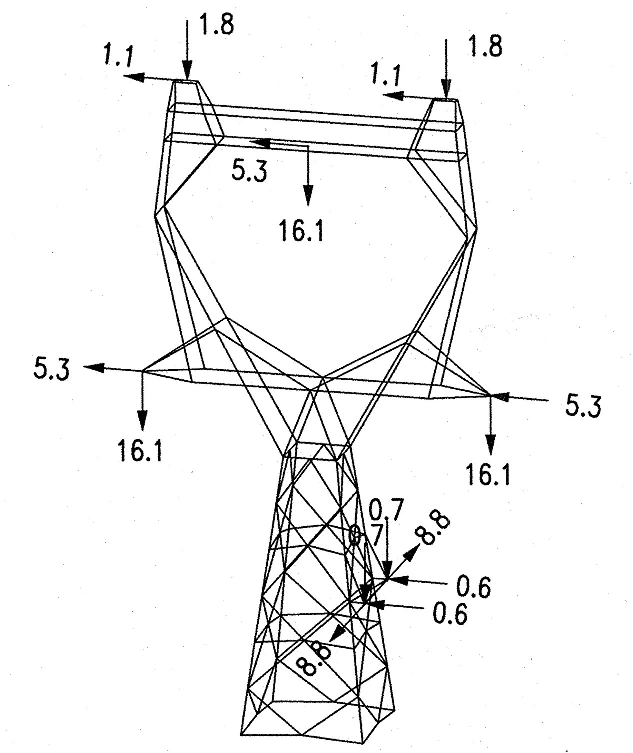
A DESIGN CONDITION A ALL WIRES INTACT.
A1 DESIGN CONDITION A ALL WIRES INTACT, 60° WIND TO LINE.
B1 DESIGN CONDITION B1 ALL WIRES INTACT.
B2 DESIGN CONDITION B2 ALL WIRES INTACT.
C DESIGN CONDITION C ALL WIRES INTACT.
D DESIGN CONDITION D ALL WIRES INTACT.
E1 DESIGN CONDITION E MIDDLE PHASE BROKEN.
E2 DESIGN CONDITION E OUTSIDE PHASE BROKEN.
G1 DESIGN CONDITION G BOTH GW AND ADSS WITH UNBALANCED ICE.
R RIGGING LOADS.

ADSS FIBER LOADS SHALL BE REPEATED IN ALL POSITIONS.

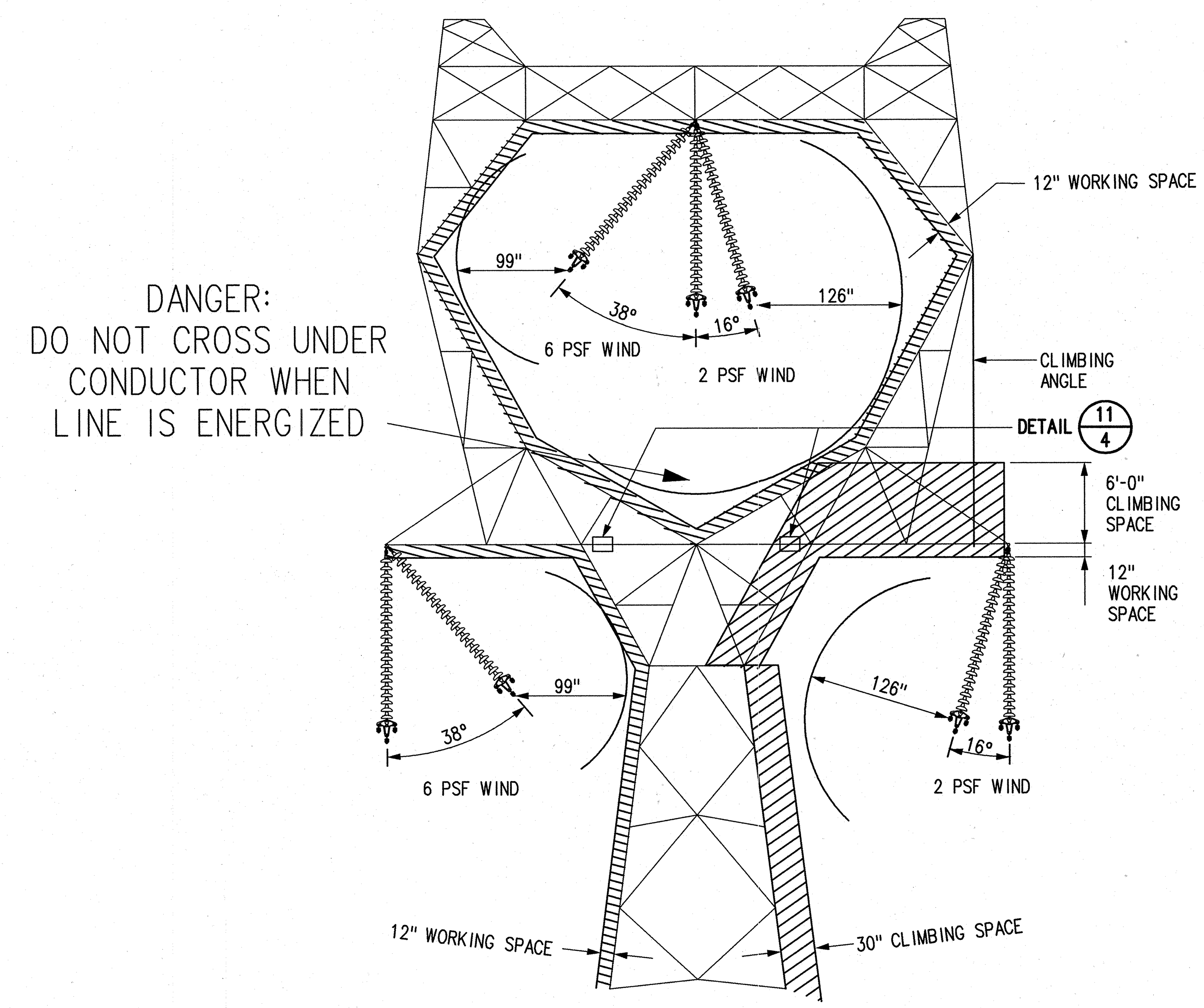
FOR ULTIMATE STRENGTH DESIGN, THE TOWER SHALL BE DESIGNED TO WITHSTAND THE DESIGN LOADS SHOWN WITH A FACTOR OF SAFETY EQUAL TO 1.0, UNLESS OTHERWISE SPECIFIED.
ALL LOADS IN KIPS.



CASE C - NO WIND



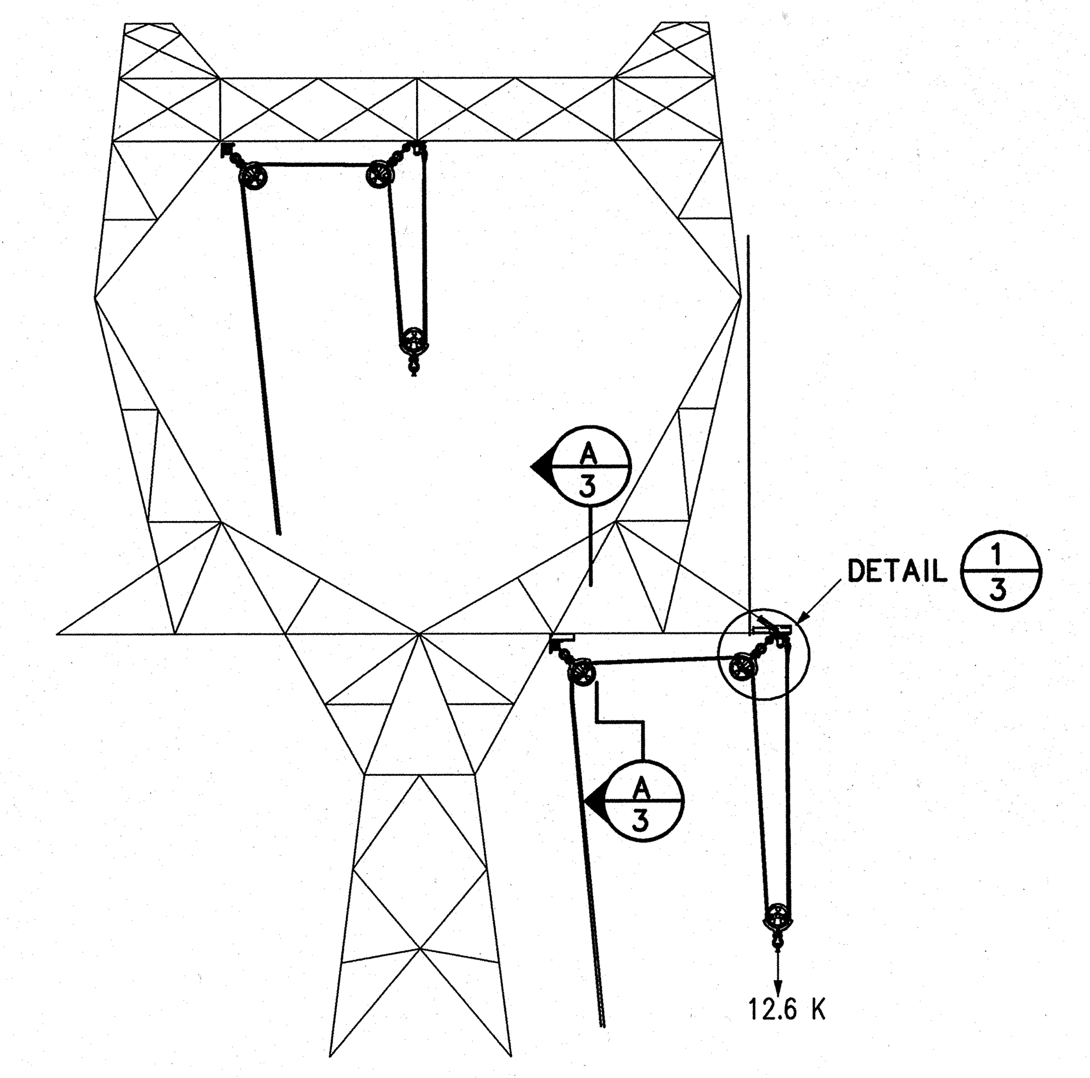
CASE D - 40 MPH WIND W/ OVERLOAD FACTORS



CLEARANCE TO STEEL AT 6 psf INSULATOR SWING (38°) = 99"

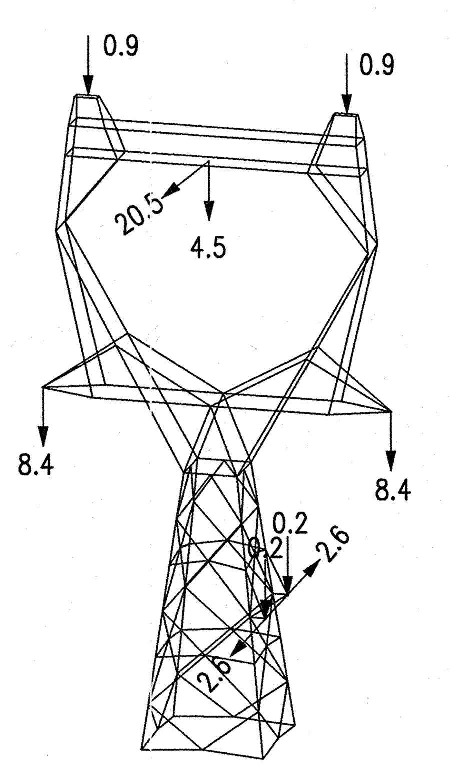
CLEARANCE TO SURFACE OF WORKING AND CLIMBING SPACES AT 2 psf INSULATOR SWING (16°) = 126"

WORKING AND CLIMBING SPACES

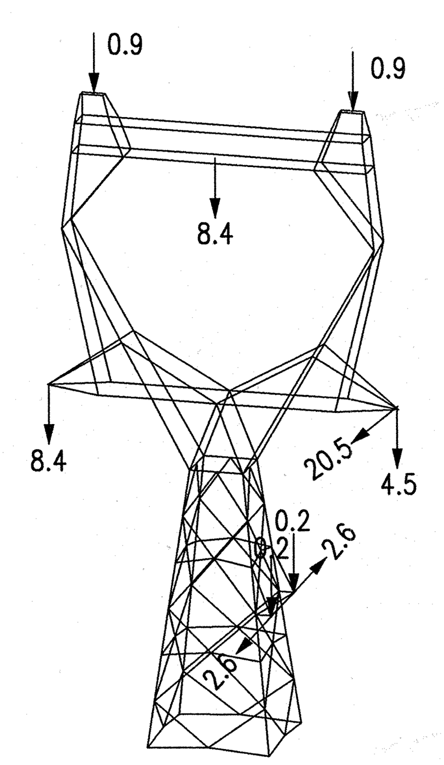


TYPICAL RIGGING LAYOUT
GENERAL LOCATION AND LAYOUT

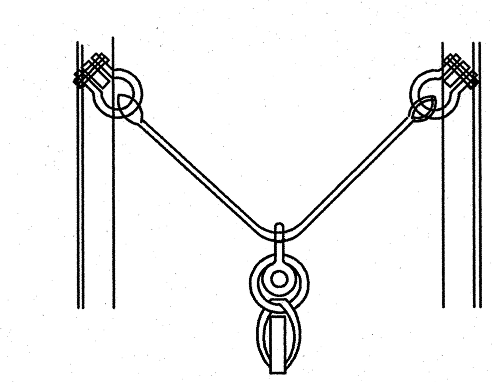
CASE R - NO WIND



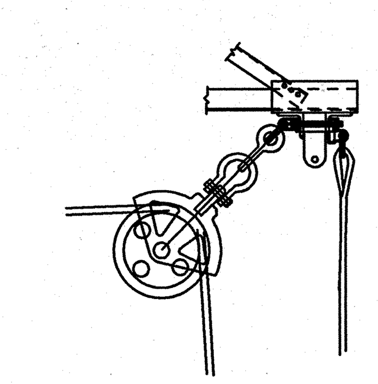
CASE E1 - NO WIND



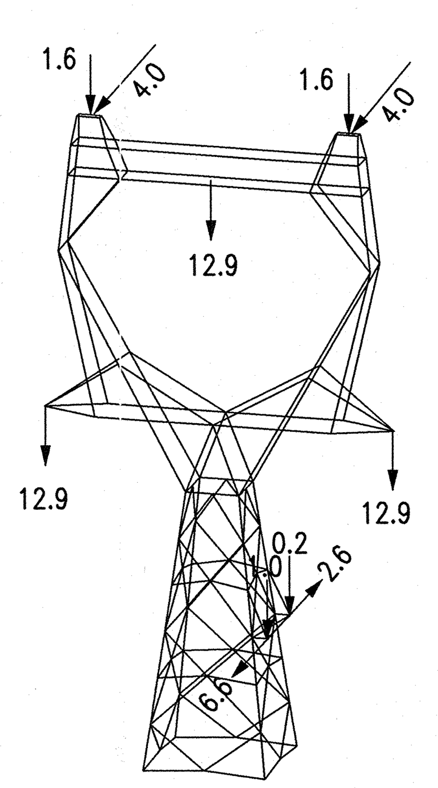
CASE E2 - NO WIND



VIEW A/3 A/3



DETAIL 1/3

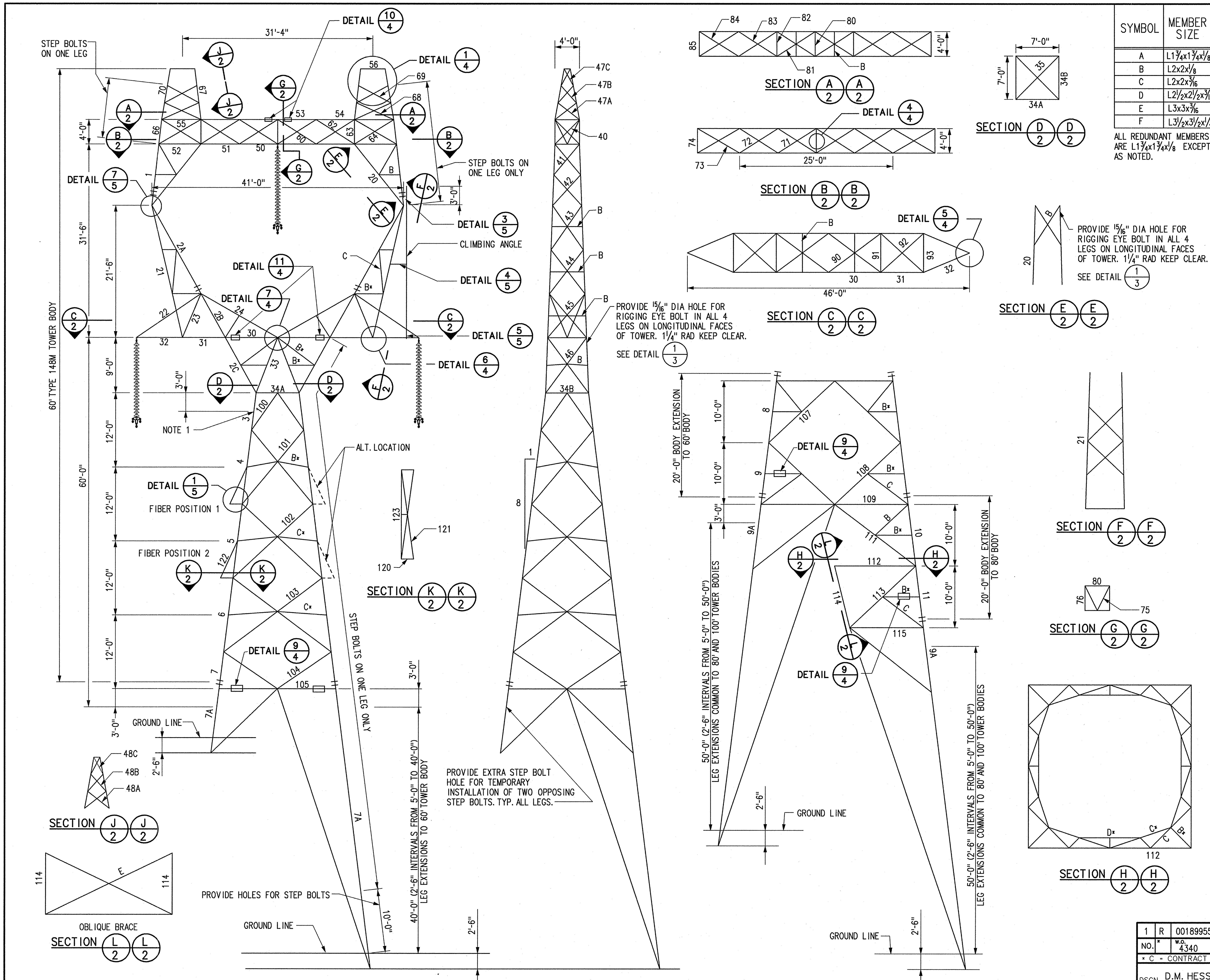


CASE G1 - NO WIND

NO.	*	W.O. 4340	REVISION	BY	DATE	APPROVED

* C - CONTRACT CONSTRUCTION, FA - FORCE ACCOUNT, R - RECORD

DSGN DMH/MDM	UNITED STATES DEPARTMENT OF ENERGY BONNEVILLE POWER ADMINISTRATION HEADQUARTERS, PORTLAND, OREGON
DRWN D M HESSE	500KV SINGLE CIRCUIT TRANSMISSION TOWER TRIPLE BUNDLE "DESCHUTES"
CHKD E.T. Orth	
REVW [signature]	
CNCR GW Geer	
APPR [signature] PRINCIPAL ENGINEER	TYPE 148M DESIGN CRITERIA
DATE 02/24/06	Serial 269911 · Source LFS · Size A1 · Sheet 3 · Revision 0



SYMBOL	MEMBER SIZE
A	L1 3/4x1 3/4x1/8
B	L2x2x1/8
C	L2x2x3/16
D	L2 1/2x2 1/2x3/16
E	L3x3x3/16
F	L3 1/2x3 1/2x1/4

ALL REDUNDANT MEMBERS ARE L1 3/4x1 3/4x1/8 EXCEPT AS NOTED.

MEMBER	ULT. CONN. LOAD (KIPS)	MEMBER SIZE	NO. OF BOLTS PER CONN.
1	45.1	L3 1/2x3 1/2x1/4*	4
2A	42.9	L4x4x1/4	4
2B	71.5	L4x4x5/16*	6
2C	80.3	L4x4x5/16*	6
3	79.3	L5x5x5/16*	6
4	85.0	L5x5x5/16*	6
5	94.3	L5x5x5/16*	8
6	109.6	L5x5x3/8*	8
7	109.9	L5x5x3/8*	8
7A	110.1	L5x5x5/16*	8
8	110.8	L5x5x3/8*	8
9	120.6	L5x5x3/8*	8
9A	126.1	L5x5x3/8*	10
10	117.6	L5x5x3/8*	10
11	125.7	L5x5x3/8*	10
20	28.4	L3x3x1/4	3
21	16.5	L3x3x1/4	2
22	30.8	L3x3x3/16*	3
23	17.5	L3x3x1/4	2
24	54.0	2L2 1/2x2 1/2x3/16*	3 •
30	40.3	L4x4x1/4	3
31	37.5	L4x4x1/4	4
32	30.0	L4x4x1/4	4
33	59.6	2L2 1/2x2 1/2x3/16*	3 •
34A	55.6	2L2 1/2x2 1/2x3/16*	3 •
34B	22.9	2L2 1/2x2 1/2x3/16*	2
35	11.3	L2 1/2x2 1/2x3/16	2
40	6.7	L2x2x1/8	2
41	7.7	L2x2x1/8	2
42	6.8	L2x2x1/8	2
43	7.9	L2x2x3/16	2
44	6.7	L2x2x3/16	2
45	12.2	L2 1/2x2 1/2x3/16	2
46	33.9	L3 1/2x3 1/2x1/4	3
47A	0.5	L1 3/4x1 3/4x1/8	2
47B	0.8	L1 3/4x1 3/4x1/8	2
47C	1.4	L1 3/4x1 3/4x1/8	2
48A	2.2	L1 3/4x1 3/4x1/8	2
48B	1.6	L1 3/4x1 3/4x1/8	2
48C	1.4	L1 3/4x1 3/4x1/8	2
50 / 51	70.5	L4x4x1/4* CONTINUOUS	4
52	17.1	L4x4x1/4*	2
53	55.6	L4x4x1/4*	4
54	47.4	L4x4x1/4*	4
55	21.3	L4x4x1/4	2
56	FLEX	L4x4x3/8*	2

MEMBER	ULT. CONN. LOAD (KIPS)	MEMBER SIZE	NO. OF BOLTS PER CONN.
60	8.3	L2x2x1/8	2
62	8.5	L2x2x1/8	2
63	11.4	L2x2x3/16*	2
64	24.3	L2 1/2x2 1/2x3/16*	3
66	23.8	L3x3x1/4	2
67	3.4	L4x4x1/4*	4
68	1.0	L1 3/4x1 3/4x1/8	2
69	2.3	L1 3/4x1 3/4x1/8	2
70	7.5	L4x4x1/4*	4
71	4.3	L1 3/4x1 3/4x1/8*	2
72	4.3	L1 3/4x1 3/4x1/8*	2
73	5.1	L2x2x1/8	2
74	0.6	L1 3/4x1 3/4x1/8*	2
75	17.6	L3 1/2x3 1/2x1/4	2
76	6.8	L2x2x1/8	2
80	3.3	ST4x9.2*	2
81	8.6	L2x2x1/8	2
82	6.3	L1 3/4x1 3/4x1/8	2
83	7.2	L1 3/4x1 3/4x1/8	2
84	5.6	L1 3/4x1 3/4x1/8	2
85	1.7	L1 3/4x1 3/4x3/16	2
90	11.9	L3x3x3/16	2
91	17.1	L2 1/2x2 1/2x3/16	2
92	15.3	L2 1/2x2 1/2x3/16	2
93	10.0	L2x2x3/16*	2
100	35.8	L4x4x1/4	3
101	23.2	L4x4x1/4	2
102	17.4	L4x4x1/4	2
103	12.9	L4x4x1/4	2
104	10.5	L3 1/2x3 1/2x1/4	2
105	2.0	L3 1/2x3 1/2x1/4	2
107	10.2	L4x4x1/4	2
108	8.1	L4x4x1/4	2
109	2.6	L4x4x1/4	2
111	7.3	L3 1/2x3 1/2x1/4	2
112	5.0	L3x3x3/16*	2
113	6.1	L3x3x3/16	2
114	18.2	L4x4x1/4	2
115	2.6	L3 1/2x3 1/2x1/4	2
120	2.7	L4x4x3/8	2
121	13.6	L3x3x3/16	2
122	4.1	L2x2x1/8	2
123	14.7	L3 1/2x3 1/2x1/4*	2

* DENOTES ASTM A572 GRADE 50 STEEL
= DENOTES SPLICE
• DENOTES DOUBLE SHEAR
+ DENOTES TENSION
- DENOTES COMPRESSION
FLEX DENOTES DESIGN BASED ON FLEXURAL STRESSES
ALL FORCES IN KIPS

ESTIMATED TOWER WEIGHT
60 FT BODY = 17604 LBS
80 FT BODY = 21314 LBS
100 FT BODY = 27025 LBS
FIBER BRACKET = 318 LBS

60' TOWER BODY WITH LEG EXTENSIONS TRANSVERSE ELEVATION

60' TOWER BODY WITH LEG EXTENSIONS LONGITUDINAL ELEVATION

80' AND 100' TOWER BODIES WITH LEG EXTENSIONS

NO.	*	W.O.	REVISION	BY	DATE	APPROVED
1	R	00189955	MODIFIED GROUND WIRE BRACKETS	DMH	10/19/10	DMH JCW JK
		4340				

* C = CONTRACT CONSTRUCTION, FA = FORCE ACCOUNT, R = RECORD

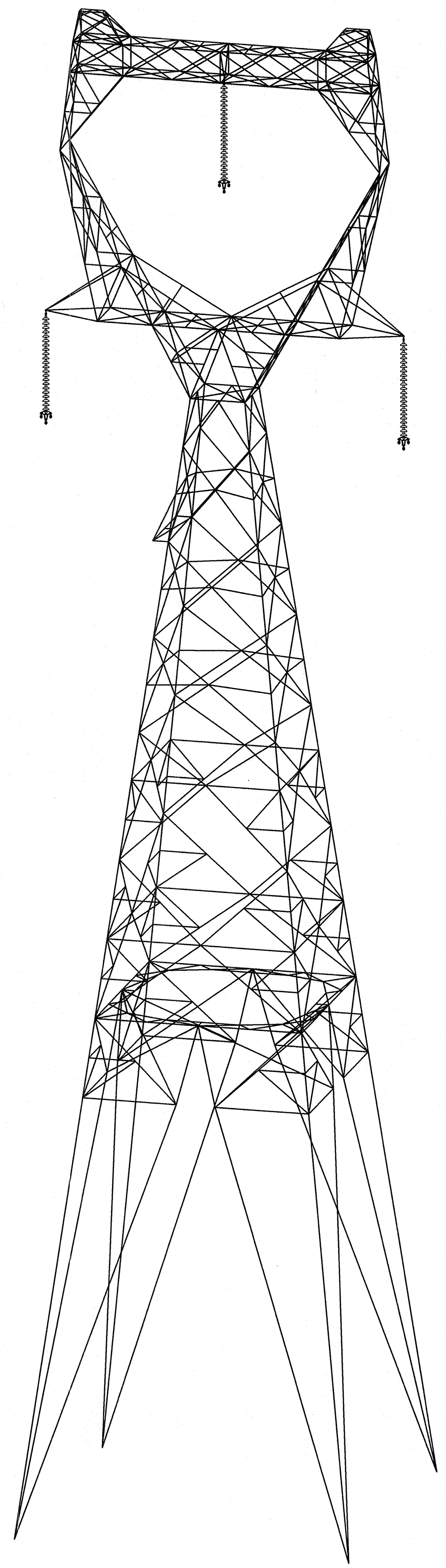
DSGN D.M. HESSE
DRWN D.M. HESSE
CHKD E.T. ORTH
REVW MICHAEL D. MILLER
CNCR G.W. GREEN
APPR LEON KEMPNER JR, PRINCIPAL ENGINEER
DATE 02/24/06

UNITED STATES DEPARTMENT OF ENERGY
BONNEVILLE POWER ADMINISTRATION
HEADQUARTERS, PORTLAND, OREGON

500KV SINGLE CIRCUIT TRANSMISSION TOWER TRIPLE BUNDLE "DESCHUTES"

TYPE 148M — DESIGN CRITERIA

Serial	Source	Size	Sheet	Revision
269911	LFS	A1	2	1



CONDUCTOR

3- ACSR/TW "DESCHUTES" PER PHASE.
RATED TENSILE STRENGTH = 36,400 LBS.
CONSTRAINT TENSIONS:
@ ½ - 8 - 0 In = 17,000 LBS. PER SUBCONDUCTOR
@ 0 - 0 - 30 In = 10,190 LBS. PER SUBCONDUCTOR

GROUND WIRE

½" EXTRA HIGH STRENGTH GALVANIZED STEEL.
RATED STEEL STRENGTH = 26,900 LBS.
CONSTRAINT TENSIONS:
@ ½ - 8 - 0 In = 9,500 LBS.
@ 0 - 0 - 30 In = 5,380 LBS.

OPGW FIBER OPTIC

1- 0.591 OPGW FIBER OPTIC CABLE.
RATED TENSILE STRENGTH = 24,300 LBS.
CONSTRAINT TENSIONS:
@ ½ - 8 - 0 In = 9,500 LBS.
@ 0 - 0 - 30 In = 4,860 LBS.

ADSS FIBER OPTIC

ADSS 72 FIBER CH7 CABLE
RATED TENSILE STRENGTH = 13,000 LBS.
CONSTRAINT TENSIONS:
@ ½ - 8 - 0 In = 7,000 LBS.
@ 0 - 0 - 30 In = 2,600 LBS.

CONDUCTOR CLEARANCE

MAXIMUM SWING AT 6 psf WIND = 38°
MAXIMUM SWING AT 2 psf WIND = 16°
CONDUCTOR SLOPE = 10° UP TO 15° DOWN

BODY / LEG COMBINATIONS

60' BODY WITH 5' TO 40' LEGS IN 2'-6" INCREMENTS
80' BODY WITH 5' TO 50' LEGS IN 2'-6" INCREMENTS
100' BODY WITH 5' TO 50' LEGS IN 2'-6" INCREMENTS

WORKING AND CLIMBING SPACES

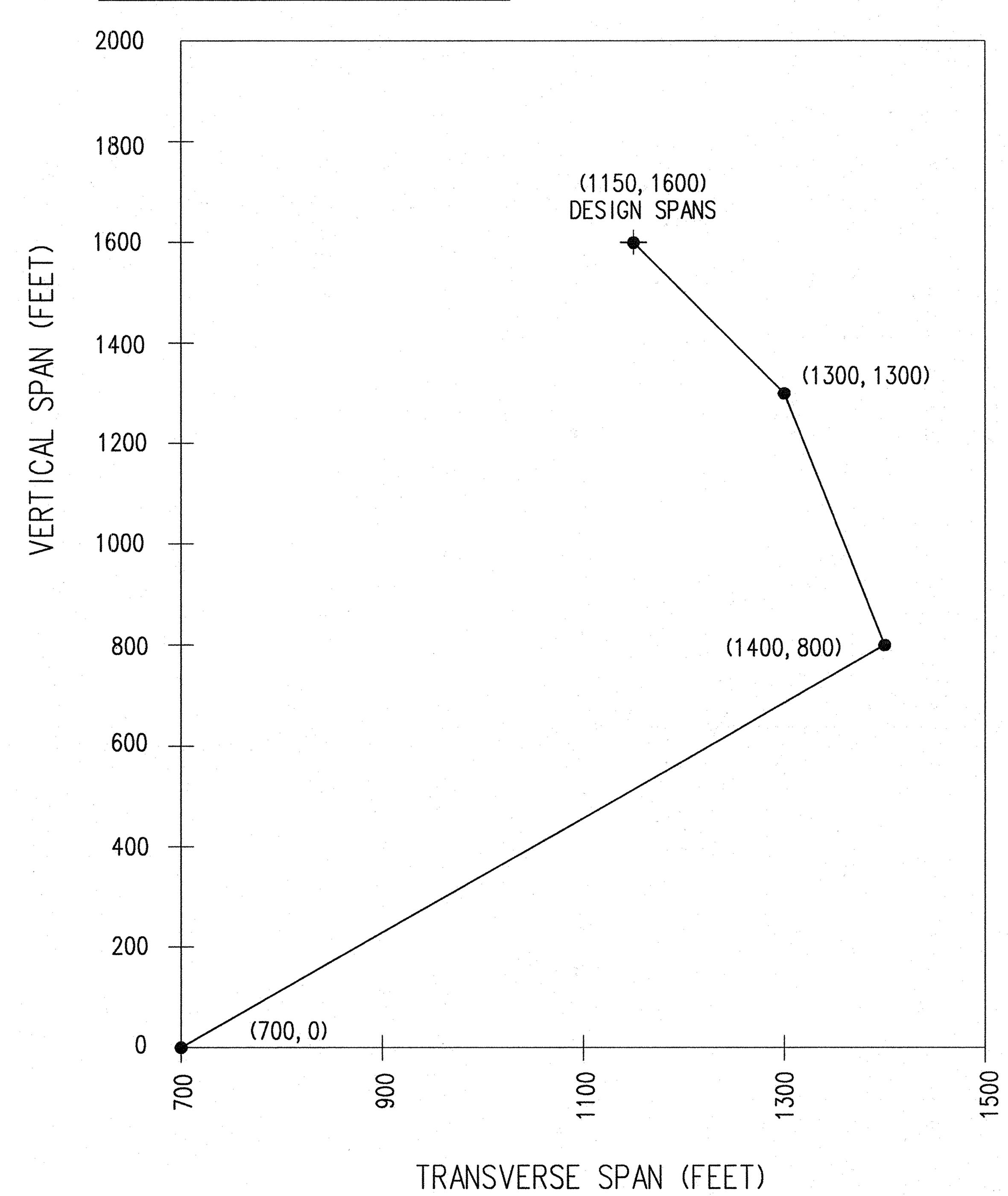
CLEARANCE TO STEEL AT 6 psf INSULATOR SWING (38°) = 99"

CLEARANCE TO SURFACE OF WORKING AND CLIMBING SPACES AT 2 psf INSULATOR SWING (16°) = 126"

DESIGN SPANS

THIS TOWER IS DESIGNED FOR A VERTICAL SPAN OF 1600' AND A TRANSVERSE SPAN OF 1150'. THE TOWER WAS CHECKED WITH LOADS CALCULATED BASED ON THE SPANS SHOWN IN THE FOLLOWING CHART. ULTIMATE CONNECTION LOADS SHOWN IN THE MEMBER SIZE TABLE REPRESENT THE MAXIMUM LOAD FOR ALL SPAN COMBINATIONS. A LINE ANGLE OF 0 DEGREES WAS USED FOR ALL SPANS.

TOWER UTILIZATION CAPACITY



UNIT STRESSES (PSI):

TENSION ON NET SECTION = MINIMUM YIELD STRESS Fy
COMPRESSION ON GROSS SECTION

FOR $KL/r \leq C_c$ $\quad F_a = F_y \left[1 - \frac{1}{2}\left(\frac{KL/r}{C_c}\right)^2\right]$

FOR $KL/r > C_c$ $\quad F_a = \dfrac{286{,}000{,}000}{\left(\frac{KL}{r}\right)^2}$

WHERE $C_c = \sqrt{\dfrac{2\pi^2 E}{F_y}}$

(for both of the above) $b/t \leq \dfrac{2500}{\sqrt{F_y}}$

FOR $b/t > \dfrac{2500}{\sqrt{F_y}}$, SUBSTITUTE F_{CR} FOR Fy IN ABOVE FORMULAS.

$\dfrac{2500}{\sqrt{F_y}} < b/t \leq \dfrac{3750}{\sqrt{F_y}} \qquad F_{CR} = F_y \left[1.8 - \dfrac{(b/t)\sqrt{F_y}}{3110}\right]$

$\dfrac{3750}{\sqrt{F_y}} < b/t \leq 20 \qquad F_{CR} = \dfrac{8{,}400{,}000}{\left(\frac{b}{t}\right)^2}$

MAXIMUM L/r OF MEMBERS:

TOWER LEGS = 120
MAIN COMPRESSION MEMBERS IN CROSSARMS AND GROUND WIRE PEAKS = 150
OTHER COMPRESSION MEMBERS = 200
REDUNDANTS = 250
TENSION MEMBERS = 450

MATERIAL:

STRUCTURAL STEEL - ASTM A36. MINIMUM YIELD STRESS Fy = 36,000 PSI

HIGH STRENGTH LOW ALLOY STRUCTURAL STEEL - ASTM A572 GRADE 50.
ALL MEMBERS ARE DESIGNED USING ASTM A36 EXCEPT WHERE NOTED.
MEMBERS MARKED WITH * ARE DESIGNED FOR HSLA STRUCTURAL STEEL ASTM A572 GRADE 50.

MINIMUM SIZE OF MATERIAL
PLATES 3/16"; ANGLES L1¾x1¾x⅛
ALL REDUNDANTS ARE L1¾x1¾x⅛ (EXCEPT AS NOTED)

COATING
HOT DIP GALVANIZED PER ASTM A123. DULLING AS SPECIFIED FOR SPECIFIC PROJECT.
USE OF DICHROMATE AS SPECIFIED FOR SPECIFIC PROJECT.

CONNECTIONS:

HOT DIPPED GALVANIZED BOLTS ARE ⅝" DIAMETER ASTM A325 OR A449 TYPE 1, HEAVY HEX HEAD WITH LOCKNUT. MINIMUM TWO BOLTS PER CONNECTION FOR MEMBERS CARRYING CALCULATED STRESSES. SINGLE BOLT CONNECTIONS MAY BE USED SUBJECT TO BPA APPROVAL.

BEARING, BOLT SHEAR, AND BOLT TENSION ARE TO BE DESIGNED FOLLOWING THE REQUIREMENTS DEFINED IN ASCE 10-97.

NO.	*R	W.O.	REVISION	BY	DATE	APPROVED
1	R	00214170	MODIFIED VT CURVE	MF	12-4-08	DMH RGB
	R	4340				

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APPR LEON KEMPNER JR, PRINCIPAL ENGINEER
DATE 02/24/06

UNITED STATES DEPARTMENT OF ENERGY
BONNEVILLE POWER ADMINISTRATION
HEADQUARTERS, PORTLAND, OREGON

500 KV SINGLE CIRCUIT
TRANSMISSION TOWER
MWT = 51,000 LBS.

TYPE 148M — STRUCTURAL DESIGN

Serial	Source	Size	Sheet	Revision
269911	LFS	A1	1 OF 10	1

MEMBER	SIZE	LENGTH	LX	EQX	KL/RX	LZ	EQZ	KL/RZ	TENSION CAPACITY	TENSION FORCE	TENSION LC	COMPRESSION CAPACITY	COMPRESSION FORCE	COMPRESSION LC	CONNECTION BOLTS	CONNECTION SHEAR	CONNECTION BEARING	CONNECTION CAPACITY	UTILIZATION
1	4L5X5X7/8 W/0.75' SPC	10.2	10.2	0	50.3	10.2	0	50.3	1289.8	1201.0	2_B2L-1	1419.8	1315.1	B2L-2	36	2	2	1617.2	0.931T
2	4L5X5X7/8 W/0.75' SPC	24.6	8.2	0	40.2	8.2	0	40.2	1289.8	1239.4	2_B2L-1	1483.2	1334.9	1_B2L-1	36	2	2	1617.2	0.961T
3	4L5X5X7/8 W/0.75' SPC	16.4	8.2	0	40.2	8.2	0	40.2	1289.8	1268.3	3_B2L-1	1483.2	1374.7	1_B2L-1	36	2	2	1617.2	0.983T
4	4L5X5X7/8 W/0.75' SPC	10.2	5.1	0	25.1	5.1	0	25.1	1289.8	1248.4	3_B2L-1	1514.4	1349.1	1_B2L-1	36	2	2	1617.2	0.968T
5	4L5X5X7/8 W/0.75' SPC	10.2	5.1	0	25.1	5.1	0	25.1	1289.8	1257.6	3_B2L-1	1514.4	1364.3	1_B2L-1	36	2	2	1617.2	0.975T
6	4L5X5X7/8 W/0.75' SPC	10.2	5.1	0	25.1	5.1	0	25.1	1289.8	1241.8	3_B2L-1	1514.4	1346.1	1_B2L-1	36	2	2	1617.2	0.963T
7	4L5X5X7/8 W/0.75' SPC	10.2	5.1	0	25.1	5.1	0	25.1	1289.8	1248.1	3_B2L-1	1514.4	1356.3	1_B2L-1	36	2	2	1617.2	0.968T
10	4L5X5X5/8 W/0.75' SPC	13.0	6.5	0	32.6	6.5	0	32.6	953.3	922.5	3_B2L-3	1059.5	1021.0	B2L-2	28	2	2	1257.8	0.968T
11	4L5X5X5/8 W/0.75' SPC	11.5	11.5	0	57.7	11.5	0	57.7	953.3	797.8	3_B2L-3	1001.8	899.7	B2L-2	22	2	2	988.3	0.910S
12	4L4X4X5/8 W/0.75' SPC	11.5	11.5	0	69.2	11.5	0	69.2	703.3	554.8	2_B2L-1	729.3	621.9	B2L-2	16	2	2	718.8	0.865S
13	4L4X4X5/8 W/0.75' SPC	13.0	13.0	0	78.2	13.0	0	78.2	703.3	347.3	2_B2L-2	675.8	409.5	B2L-2	10	2	2	449.2	0.912S
14	4L4X4X5/16 W/0.75'SPC	11.5	11.5	0	71.4	11.5	0	71.4	370.6	252.3	3_B2L-1	359.9	294.2	B2L-2	8	2	2	359.4	0.819S
15	4L4X4X5/16 W/0.75'SPC	11.5	11.5	0	71.4	11.5	0	71.4	370.6	142.3	B2L-2	359.9	178.8	B2L-2	8	2	2	359.4	0.498S
16	4L4X4X5/16 W/0.75'SPC	13.0	13.0	0	80.7	13.0	0	80.7	370.6	60.2	3_B2	343.3	93.2	CL	8	2	2	359.4	0.271C
20T	L5X5X 5/16	18.4	9.2	6	83.0	9.2	6	113.6	128.8	54.3	CR	67.0	49.6	CR	3	1	1	67.4	0.806S
20L	L5X5X 5/16	18.4	9.2	6	83.0	9.2	6	113.6	128.8	36.2	B2L-1	67.0	40.6	B2L-0	3	1	1	67.4	0.605C
21T	2L4X4X 5/16	17.4	8.7	0	84.0	8.7	0	57.9	204.0	125.0	3_B2L-2	166.1	122.9	1_B2L-2	4	2	2	179.7	0.740C
21L	2L4X4X 5/16	17.4	8.7	0	84.0	8.7	0	57.9	204.0	92.3	3_B2L-0R	166.1	93.5	3_B2L-0R	3	2	2	134.8	0.694S
22T	2L4X4X 5/16	17.4	8.7	0	84.0	8.7	0	57.9	204.0	122.9	1_B2L-2	166.1	125.0	3_B2L-2	4	2	2	179.7	0.753C
22L	2L4X4X 5/16	17.4	8.7	0	84.0	8.7	0	57.9	204.0	93.5	3_B2L-0R	166.1	92.3	3_B2L-0R	3	2	2	134.8	0.694S
23T	2L4X4X 3/8	18.4	9.2	0	89.7	9.2	0	60.9	243.1	133.4	3_B2L-3	185.5	159.7	B2L-2	4	2	2	179.7	0.889S
23L	2L4X4X 3/8	18.4	9.2	0	89.7	9.2	0	60.9	243.1	123.9	B2L-2	185.5	117.6	B2L-0L	4	2	2	179.7	0.690S
24T	2L5X5X 1/2	17.4	8.7	0	67.6	8.7	0	46.5	403.7	251.6	3_B2L-2	380.1	270.6	1_B2L-2	7	2	2	314.5	0.861S
24L	2L5X5X 5/16	17.4	8.7	0	66.3	8.7	0	47.1	257.6	177.6	3_B2L-0R	212.7	175.6	3_B2L-0R	5	2	2	224.6	0.825C
25T	2L5X5X 3/8	17.4	8.7	0	66.8	8.7	0	46.9	306.8	270.6	1_B2L-2	290.7	251.6	3_B2L-2	7	2	2	314.5	0.882T
25L	2L5X5X 5/16	17.4	8.7	0	66.3	8.7	0	47.1	257.6	175.6	3_B2L-0R	212.7	177.6	3_B2L-0R	5	2	2	224.6	0.835C
26T	2L5X5X 1/2	9.2	9.2	0	71.6	9.2	0	49.2	403.7	262.8	3_B2L-3	368.6	306.2	1_B2L-2	8	2	2	359.4	0.852S
26L	2L5X5X 3/8	18.4	9.2	0	70.7	9.2	0	49.7	306.8	277.3	2_B2L-2	282.2	251.6	2_B2L-3	7	2	2	314.5	0.904T
30	2L5X5X 3/8	12.9	6.5	0	49.8	12.9	0	69.9	306.8	265.7	B2L-0R	283.9	265.7	B2L-0R	7	2	2	314.5	0.936C
31	2L5X5X 3/8	31.4	9.3	0	71.7	18.6	0	100.7	306.8	177.2	B2L-0R	201.0	178.8	B2L-0R	5	2	2	224.6	0.890C
32	2L5X5X 5/16	20.0	10.0	0	76.6	20.0	0	108.8	257.6	128.5	B2L-0R	143.9	129.3	B2L-0R	4	2	2	179.7	0.898C
33	L3X3X 3/16	14.3	14.3	0	183.7	7.1	0	146.2	46.3	4.8	A1L	9.2	5.9	2_A1	2	1	1	27.4	0.636C
35	2L4X4X 3/8	18.8	9.4	0	91.7	18.8	8	>124.6	243.1	88.4	B2L-0R	105.3	89.6	B2L-0R	3	2	2	134.8	0.851C
36	2L4X4X 5/16	18.8	9.4	0	91.0	18.8	8	>125.3	204.0	73.4	B2L-0R	87.4	73.4	B2L-0R	2	2	2	89.8	0.839C
37	L3 1/2 X3 1/2 X 1/4	17.4	17.4	0	191.5	8.7	0	151.7	71.8	5.5	3_A1	13.2	6.7	2_A1	2	1	1	36.6	0.508C
39	2L4X4X 3/8	21.5	10.7	0	104.8	21.5	8	>142.4	243.1	69.8	B2L-0R	80.6	69.8	B2L-0R	2	2	2	89.8	0.865C
40	2L4X4X 5/16	21.5	10.7	0	104.0	21.5	8	>143.2	204.0	59.0	B2L-0R	66.9	60.0	B2L-0R	2	2	2	89.8	0.897C
41	L4X4X 1/4	20.5	20.5	0	196.9	10.3	0	157.2	82.5	5.6	2_A1	14.3	6.9	2_A1	2	1	1	36.6	0.479C
50	2L4X4X 5/16	7.2	7.2	0	69.4	7.2	0	47.8	204.0	102.7	3_B2L-2	189.6	162.1	B2L-2	5	2	2	224.6	0.855C
51	2L4X4X 3/8	6.5	3.3	0	31.7	6.5	0	43.1	243.1	204.2	3_B2L-0R	262.8	235.7	B2L-1R	6	2	2	269.5	0.897C
51A	2L5X5X 5/16	13.0	13.0	0	99.4	13.0	0	70.6	257.6	75.8	3_B2L-0	162.0	97.3	B2L-0	3	2	2	134.8	0.722S
52	6 X 20	13.0	13.0	0	58.6	13.0	0	104.0	249.5	61.9	3_B2L-4	154.9	2.7	CL	4	1	1	0.0	0.248T
53	L4X4X 5/16	14.8	7.4	6	83.9	7.4	6	115.5	102.0	45.3	3_B2L-0R	51.4	45.3	3_B2L-0R	3	1	1	67.4	0.881C
54	2L4X4X 5/16	6.5	3.3	0	31.5	6.5	0	43.3	204.0	195.9	2_B2L-2	220.3	199.8	2_B2L-2	5	2	2	224.6	0.960T
54A	L3 1/2 X3 1/2 X 1/4	13.0	13.0	9	>143.1	13.0	9	>226.7	71.8	9.2	CR	9.4	5.5	3_B2L	2	1	1	36.6	0.589C
55	L5X5X 5/16	18.4	9.2	6	83.0	9.2	6	113.6	128.8	52.0	3_B2L-2	67.0	57.9	B2L-2	3	1	1	67.4	0.864C
55A	L4X4X 5/16	18.4	9.2	6	96.7	9.2	8	>141.2	102.0	30.6	3_B2L-2	34.4	32.4	B2L-1R	2	1	1	44.9	0.942C
56	2L3 1/2 X3 1/2 X 1/4	8.4	8.4	0	92.2	8.4	0	63.2	143.6	105.7	B2L-2	105.0	69.3	3_B2L-2	4	2	2	146.3	0.736T
57	L4X4X 1/4	15.5	7.7	6	85.7	7.7	6	118.9	82.5	31.1	B2L-1	39.3	31.1	B2L-1	2	1	1	36.6	0.850B
58	2L2 1/2 X2 1/2 X 3/16	6.5	6.5	0	100.3	6.5	0	66.1	73.6	45.2	C	50.5	23.9	3_B2L-0	2	2	2	54.8	0.825B
58A	2L3X3X 3/16	13.0	13.0	9	>166.1	13.0	0	113.0	92.6	59.0	C	22.6	21.6	3_C	3	2	2	82.3	0.958C
59	2L4X4X 5/16	13.0	13.0	9	>125.8	13.0	0	86.7	204.0	76.5	2_B2L-4	86.7	81.7	3_B2	2	2	2	89.8	0.942C
59A	2L3X3X 3/16	13.0	13.0	9	>166.1	13.0	0	113.0	92.6	15.6	3_B2L-4	22.6	19.3	B2	2	2	2	54.8	0.855C
60	2L4X4X 3/8	7.9	7.9	0	76.8	7.9	0	52.2	243.1	141.1	3_B2L-0L	212.3	200.1	B2L-1R	5	2	2	224.6	0.942C
61	2L5X5X 5/16	13.0	13.0	0	99.4	13.0	0	70.6	257.6	70.9	3_B2L-0	162.0	90.5	B2L-0	3	2	2	134.8	0.672S
62	6 X 20	13.0	13.0	0	58.6	13.0	0	104.0	249.5	63.3	B2L-4	154.9	1.6	B2L	4	1	1	0.0	0.254T
63	L4X4X 5/16	15.2	7.6	6	85.2	7.6	6	117.6	102.0	40.8	3_B2L-0R	49.7	40.8	3_B2L-0R	2	1	1	44.9	0.908S
64	2L3X3X 3/16	13.0	13.0	9	>166.1	13.0	0	113.0	92.6	23.4	B2L-4	22.6	19.6	3_B2	2	2	2	54.8	0.867C
65	L5X5X 5/16	18.4	9.2	6	83.0	9.2	6	113.6	128.8	42.4	3_B2L-2	67.0	42.8	B2L-2	3	1	1	67.4	0.639C
66	2L3 1/2 X3 1/2 X 1/4	8.5	8.5	0	93.8	8.5	0	64.3	143.6	119.6	C	103.0	70.4	3_B2L-0	4	2	2	146.3	0.832T
67	L3 1/2 X3 1/2 X 1/4	15.5	7.8	6	94.2	7.8	8	>135.5	71.8	23.9	B2L-0	26.3	23.9	B2L-0	2	1	1	36.6	0.907C
68	2L3 1/2 X3 1/2 X 1/4	13.0	13.0	9	>143.1	13.0	0	98.1	143.6	91.1	C	47.2	31.4	3_C	3	2	2	109.7	0.831B
69	2L3X3X 3/16	13.0	13.0	9	>166.1	13.0	0	113.0	92.6	22.7	1_B2	22.6	20.7	3_B2L-4	2	2	2	54.8	0.915C
70	L3X3X 3/16	14.5	7.3	6	100.1	7.3	8	>148.8	46.3	17.8	2_B2L-2	14.1	9.2	2_B2L-4	2	1	1	27.4	0.654C
71	L2 1/2 X2 1/2 X 3/16	6.5	6.5	7	110.6	6.5	9	>161.8	36.8	4.2	3_CL	9.8	9.0	CR	2	1	1	27.4	0.919C
72	L3 1/2 X3 1/2 X 1/4	18.4	9.2	6	105.9	9.2	8	>160.3	71.8	19.8	C	18.8	15.4	3_B2L-2	2	1	1	36.6	0.821C
80	L5X5X 5/16	12.0	12.0	6	98.9	12.0	8	>144.9	128.8	36.7	3_B2L-2	41.3	37.9	2_B2L-3	2	1	1	44.9	0.919C
81	L5X5X 5/16	12.0	12.0	6	98.9	12.0	8	>144.9	128.8	12.1	B2	41.3	12.1	3_B2L-2	2	1	1	44.9	0.294C
82	2L3 1/2 X3 1/2 X 1/4	8.5	4.3	0	46.8	4.3	0	32.1	143.6	27.3	B2	149.2	26.2	3_B2	2	2	2	73.1	0.374B
83	2L3 1/2 X3 1/2 X 1/4	13.0	13.0	9	>143.1	13.0	0	98.1	143.6	23.9	C	47.2	12.9	3_B2R	2	2	2	73.1	0.327B
84	L5X5X 5/16	14.7	7.3	6	72.3	7.3	6	96.7	128.8	37.8	3_B2L-0	83.5	39.7	B2L-0	3	1	1	67.4	0.589S
85	L3 1/2 X3 1/2 X 1/4	17.7	8.8	6	102.9	8.8	8	>154.0	71.8	17.6	3_B2L-2	20.4	18.2	B2	2	1	1	36.6	0.894C
86	L4X4X 3/8	17.7	8.8	6	94.6	8.8	8	>136.0	121.6	32.6	2_B2L-3	44.2	32.3	2_B2L-2	2	1	1	44.9	0.730C
87	L3X3X 3/16	15.1	10.1	8	>129.3	10.1	8	>205.8	46.3	4.4	3_B2L-4	7.4	5.1	B2	2	1	1	27.4	0.688C
88	L2 1/2 X2 1/2 X 3/16	6.5	6.5	6	105.9	6.5	9	>161.8	36.8	4.2	B2	9.8	4.0	3_B2L-4	2	1	1	27.4	0.402C

NOTES:

1. ALL MEMBERS ARE ASTM A572 GRADE 50 STEEL.

2. UNITS ARE FEET AND KIPS.

3. TENSION CAPACITIES:

   TENSION CAPACITIES ARE BASED ON THE REDUCTION IN MEMBER AREA DUE TO BOLT HOLES. THE ACTUAL NUMBER OF HOLES IN THE MEMBER, BASED ON DETAILING, MAY NOT BE THE SAME AS THE DEFAULT NUMBER OF BOLTS USED IN THE MODEL.

   TENSION CAPACITIES DO NOT CONSIDER CONNECTION STRENGTH.

4. COMPRESSION CAPACITIES:

   LZ, EQZ, & KL/RZ ARE EQUAL TO LY, EQY & KL/RY FOR SHAPES OTHER THAN SINGLE ANGLES.

   EQUATIONS:

Equation	Range	Description
0: KL/R = L/R	0 <= L/r <= 120	LEG MEMBERS BOLTED IN BOTH FACES
	120 <= L/r <= 200	UNRESTRAINED AGAINST ROTATION AT BOTH ENDS
6: KL/R = 30 + 0.75 L/R	0 <= L/r <= 120	CONCENTRIC LOAD AT ONE END, NORMAL FRAMING ECCENTRICITY AT OTHER
7: KL/R = 60 + 0.50 L/R	0 <= L/r <= 120	NORMAL FRAMING ECCENTRICITIES AT BOTH ENDS
8: KL/R = 28.6 + 0.76 L/R	120 <= L/r <= 225	PARTIALLY RESTRAINED AGAINST ROTATION AT ONE END
9: KL/R = 46.2 + 0.615 L/R	120 <= L/r <= 250	PARTIALLY RESTRAINED AGAINST ROTATION AT BOTH ENDS

   COMPRESSION CAPACITIES DO NOT CONSIDER CONNECTION STRENGTH.

5. MAXIMUM TENSION AND COMPRESSION FORCES CONSIDER ALL SPAN COMBINATIONS. LOAD CASE LABELS IN THE MODELING INFORMATION TABLE INCLUDE A PREFIX TO HELP DISTINGUISH BETWEEN THE SPAN COMBINATIONS.

TSPAN (FT)	VSPAN (FT)	LOAD CASE PREFIX
2000	4000	NONE
2800	2800	1_
4000	0	2_
3700	-2000	3_

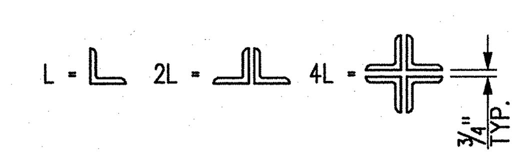
EXAMPLE: 1_A2 INDICATES THE FORCE OCCURS IN LOAD CASE A2 WITH A TSPAN OF 2800' AND A VSPAN OF 2800'.

6. UTILIZATION IS MEMBER UTILIZATION - MAXIMUM OF:
   TENSION FORCE / TENSION CAPACITY,
   COMPRESSION FORCE / COMPRESSION CAPACITY,
   MAXIMUM MEMBER FORCE / CONNECTION CAPACITY.

   C = COMPRESSION, T = TENSION, S = CONNECTION SHEAR, B = CONNECTION BEARING CONTROLS.

7. CONNECTION SHEAR IS THE NUMBER OF SHEAR PLANES. CONNECTION BEARING IS THE NUMBER OF BEARING SURFACES.

8. MAIN LEG AND DIAGONAL LEG MEMBER MODELING INFORMATION IS NOT INCLUDED DUE TO VARIATIONS FROM DIFFERING LEG EXTENSIONS.



NO.	*	W.O.	REVISION	BY	DATE	APPROVED
1	R	00189955	UPDATE TABLE	JCN	4/22/10	JCN DMH DEO
	R	00233051				

* C = CONTRACT CONSTRUCTION, FA = FORCE ACCOUNT, R = RECORD

UNITED STATES DEPARTMENT OF ENERGY
BONNEVILLE POWER ADMINISTRATION
HEADQUARTERS, PORTLAND, OREGON

500KV DOUBLE CIRCUIT TRANSMISSION TOWER MWT = 51,000 LBS

TYPE 139D, 139DE MODELING INFORMATION

DSGN J.C. NUNO
DRWN MF/JCN
CHKD D.M. HESSE
REVW G.W. GREEN
CNCR D.E. O'CLAIRE
APPR L. KEMPNER, PRINCIPAL ENGINEER
DATE 6-15-09

Serial	Source	Size	Sheet	Revision
284768	LFS	A1	9	1