



Natural Resources Conservation Service  
101 South Main  
Temple, TX 76501

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April 7, 2008

Instructions for use:

This document contains a standard drawing, TX-EN-0499, 4 Post Steel Windmill Tower and Foundations For 16' Diameter Mill at 37' Height.

The steel windmill tower design shall be limited to windmills used in the state of Texas only. For windmills used near the Gulf cost line, where design wind speeds are higher, additional analysis and requirements may be required. Design details and limitations are included in the design report. A copy of the design report may be found in Section 1, Reference Lists, Technical Notes and Reference by Discipline, Engineering, State Standard Drawings of the Field Office Technical Guide.

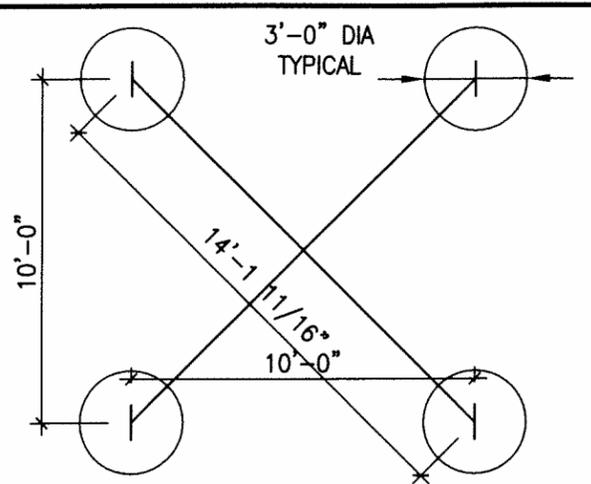
Please be aware that alteration of a sealed engineering document without proper notification to the responsible engineer is an offense under the Texas Engineering Practice Act.

If you need additional information, please contact the State Engineering Staff at (254) 742-9910.

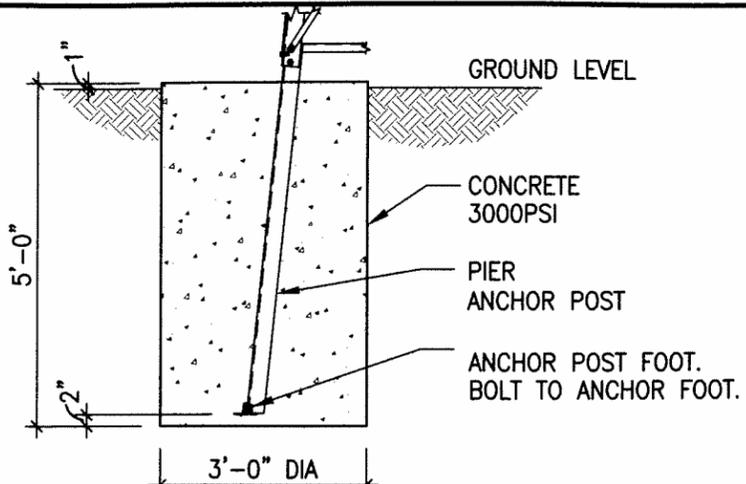
A handwritten signature in black ink that reads "John W. Mueller".

JOHN W. MUELLER  
State Conservation Engineer

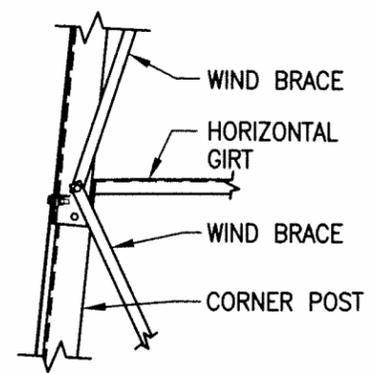




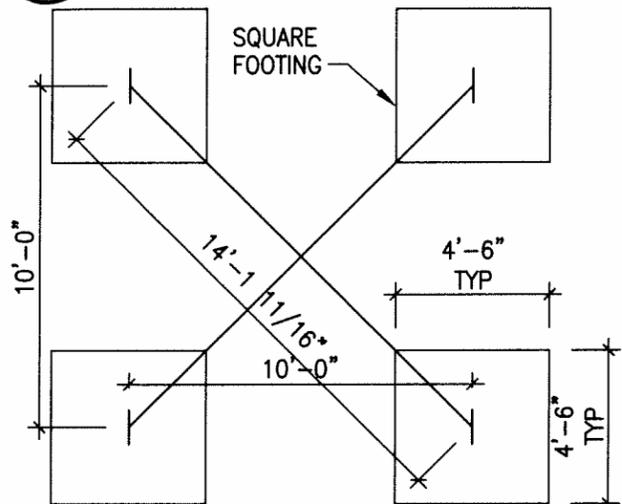
**F** DRILLED PIER ANCHOR HOLE LAYOUT PLAN  
3/16"=1'-0"



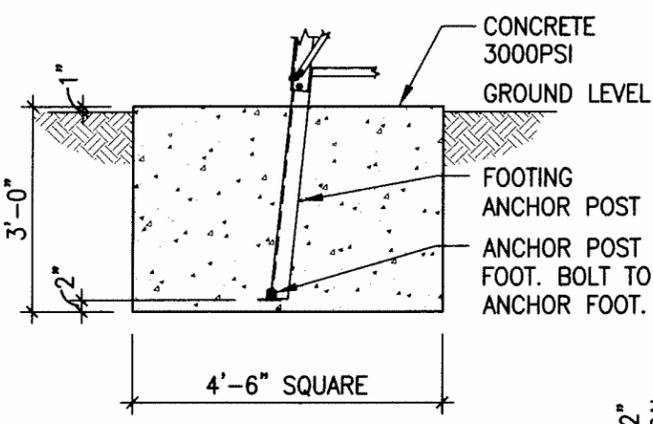
**E** DRILLED PIER ANCHOR HOLE DETAIL  
3/8"=1'-0"



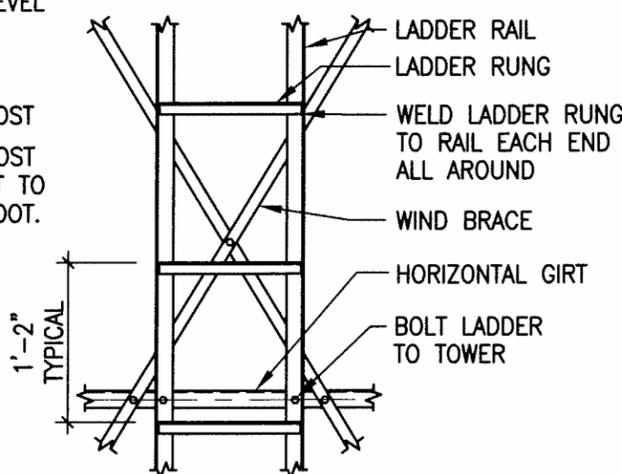
**D** WIND BRACE CONNECTION DETAIL  
3/4"=1'-0"



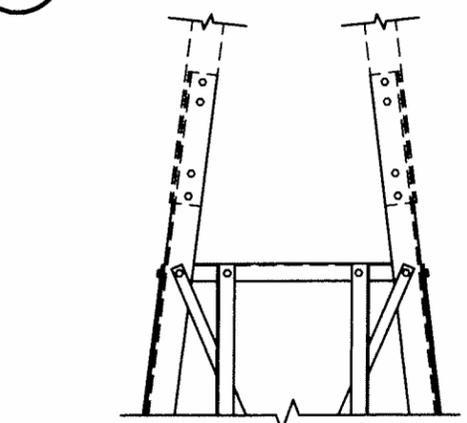
**H** ANCHOR HOLE LAYOUT PLAN  
3/16"=1'-0"



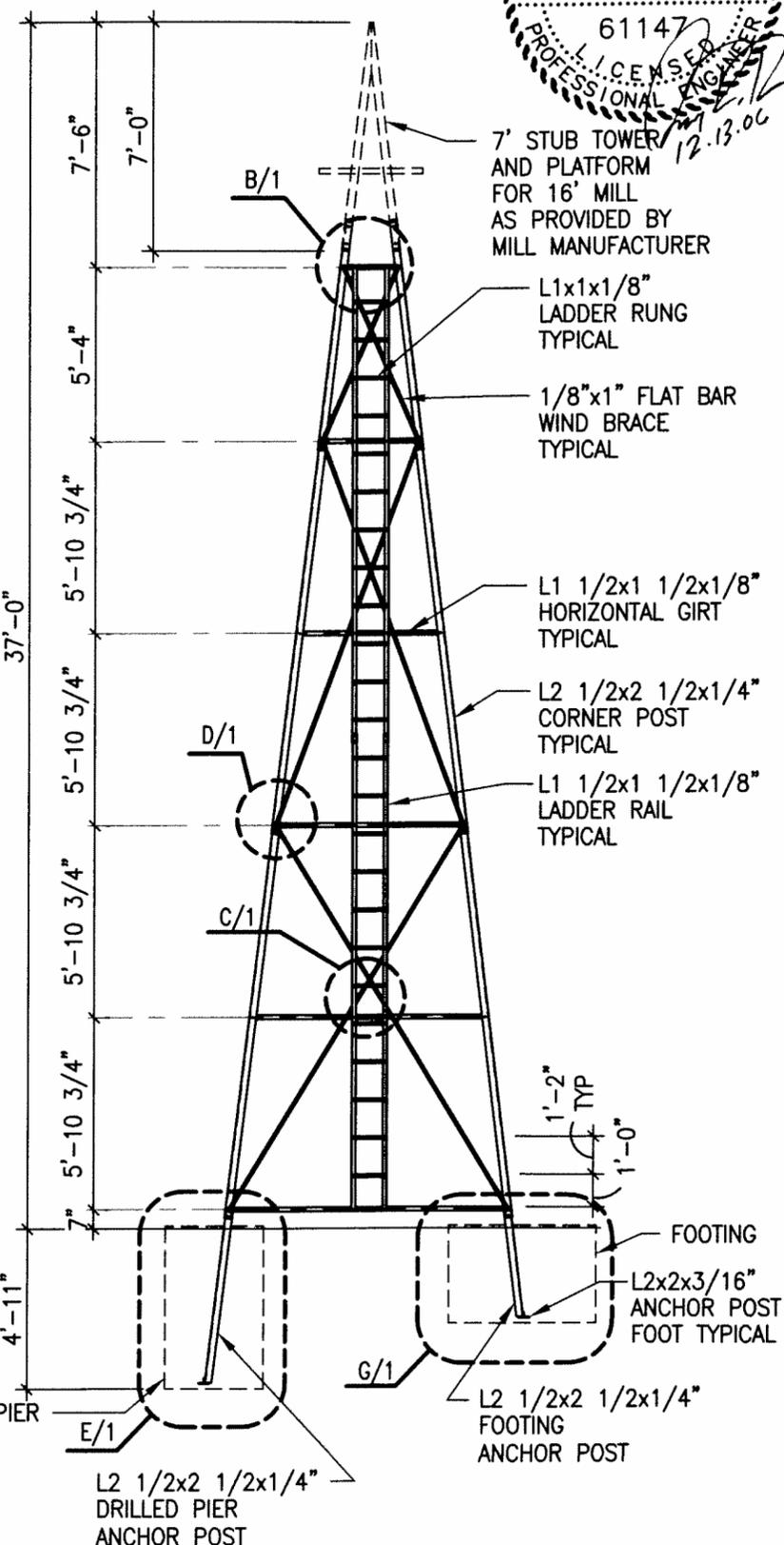
**G** SQUARE FOOTING ANCHOR HOLE DETAIL  
3/8"=1'-0"



**C** WIND BRACE CONNECTION DETAIL  
3/4"=1'-0"



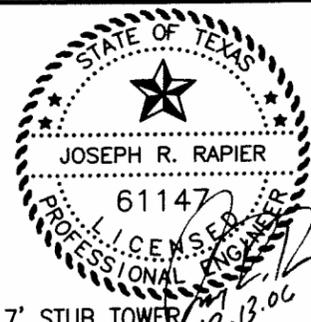
**B** STUB TOWER CONNECTION DETAIL  
3/4"=1'-0"



**A** 37' TOWER FOR 16' MILL  
3/16"=1'-0"

37' TOWER FOR 16' MILL					
BILL OF MATERIALS					
QTY	PART NUMBER	DESCRIPTION	MEMBER SIZE	MATERIAL	DETAIL
4	APF-1	ANCHOR POST FOOT	L2 <sup>2</sup> x 2 <sup>3</sup> / <sub>16</sub> x 1'-0"	A36 STEEL	A/2
4	APF-2	ANCHOR POST FOOT	L2 <sup>2</sup> x 2 <sup>3</sup> / <sub>16</sub> x 1'-0"	A36 STEEL	A/2
4	FAP-1	FOOTING ANCHOR POST	L2 1/2 <sup>2</sup> x 2 1/2 <sup>2</sup> x 1/4 <sup>2</sup> x 3'-5"	A36 STEEL	B/2
4	PAP-1	PIER ANCHOR POST	L2 1/2 <sup>2</sup> x 2 1/2 <sup>2</sup> x 1/4 <sup>2</sup> x 5'-5 3/8"	A36 STEEL	B/2
8	CP-1	CORNER POST LOWER	L2 1/2 <sup>2</sup> x 2 1/2 <sup>2</sup> x 1/4 <sup>2</sup> x 12'-3 1/2"	A36 STEEL	C/2
4	CP-2	CORNER POST UPPER	L2 1/2 <sup>2</sup> x 2 1/2 <sup>2</sup> x 1/4 <sup>2</sup> x 7'-2"	A36 STEEL	D/2
4	HG-1	HORIZONTAL GIRT 1	L1 1/2 <sup>2</sup> x 1 1/2 <sup>2</sup> x 1/8 <sup>2</sup> x 8'-7 5/16"	A36 STEEL	C/3
4	HG-2	HORIZONTAL GIRT 2	L1 1/2 <sup>2</sup> x 1 1/2 <sup>2</sup> x 1/8 <sup>2</sup> x 7'-2 5/16"	A36 STEEL	A/3
4	HG-3	HORIZONTAL GIRT 3	L1 1/2 <sup>2</sup> x 1 1/2 <sup>2</sup> x 1/8 <sup>2</sup> x 5'-9 15/16"	A36 STEEL	C/3
4	HG-4	HORIZONTAL GIRT 4	L1 1/2 <sup>2</sup> x 1 1/2 <sup>2</sup> x 1/8 <sup>2</sup> x 4'-4 7/8"	A36 STEEL	B/3
4	HG-5	HORIZONTAL GIRT 5	L1 1/2 <sup>2</sup> x 1 1/2 <sup>2</sup> x 1/8 <sup>2</sup> x 3'-0 1/2"	A36 STEEL	C/3
4	HG-6	HORIZONTAL GIRT 6	L1 1/2 <sup>2</sup> x 1 1/2 <sup>2</sup> x 1/8 <sup>2</sup> x 1'-9 1/16"	A36 STEEL	E/3
8	WB-1	WIND BRACE 1	1/8 <sup>2</sup> x 1 <sup>2</sup> x 13'-11 3/8" FLAT BAR	A36 STEEL	E/2
8	WB-2	WIND BRACE 2	1/8 <sup>2</sup> x 1 <sup>2</sup> x 12'-8 15/16" FLAT BAR	A36 STEEL	F/2
8	WB-3	WIND BRACE 3	1/8 <sup>2</sup> x 1 <sup>2</sup> x 5'-11 3/8" FLAT BAR	A36 STEEL	D/3
24	LDR-1	LADDER RUNG	L1 <sup>2</sup> x 1 <sup>2</sup> x 1/8 <sup>2</sup> x 1'-0"	A36 STEEL	A/4
1	LDR-2	LADDER RAIL 1	L1 1/2 <sup>2</sup> x 1 1/2 <sup>2</sup> x 1/8 <sup>2</sup> x 14'-9 1/4"	A36 STEEL	B/4
1	LDR-3	LADDER RAIL 2	L1 1/2 <sup>2</sup> x 1 1/2 <sup>2</sup> x 1/8 <sup>2</sup> x 14'-9 1/4"	A36 STEEL	C/4
1	LDR-4	LADDER RAIL 3	L1 1/2 <sup>2</sup> x 1 1/2 <sup>2</sup> x 1/8 <sup>2</sup> x 14'-9 1/4"	A36 STEEL	D/4
1	LDR-5	LADDER RAIL 4	L1 1/2 <sup>2</sup> x 1 1/2 <sup>2</sup> x 1/8 <sup>2</sup> x 14'-9 1/4"	A36 STEEL	E/4
112	BLT-1	3/8" DIA. BOLT SET	3/8 <sup>2</sup> x 1 1/2"	GRADE 5 STEEL	REF NOTES
32	BLT-2	5/8" DIA. BOLT SET	5/8 <sup>2</sup> x 1 1/2"	GRADE 5 STEEL	REF NOTES

NOTE: \* BOLT SET INCLUDES BOLT, NUT AND 2 WASHERS



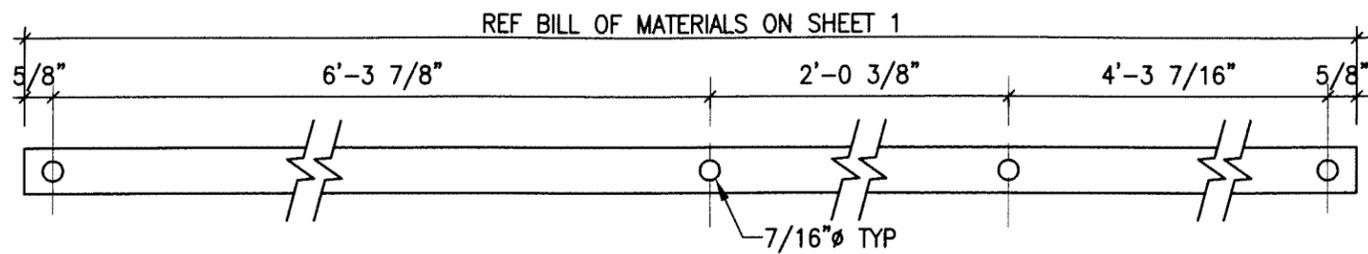
DESIGNED BY: MCV  
DRAWN BY: DLD  
CHECKED BY: JRF  
FILE NAME:  
DATE PLOTTED: JUNE 2008

4 POST STEEL WINDMILL TOWER AND FOUNDATIONS FOR 16' DIAMETER MILL AT 37' HEIGHT

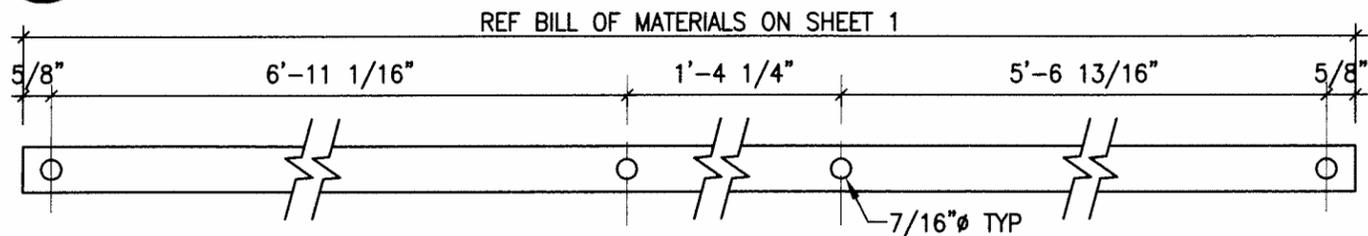


**NRC**  
Natural Resource Conservation Service  
U.S. Department of Agriculture

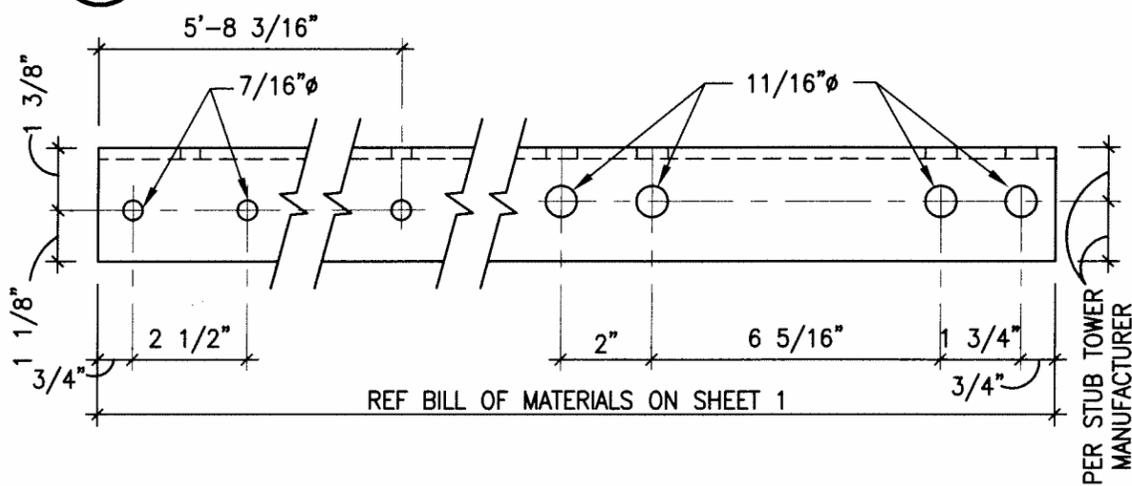
REVISIONS: \_\_\_\_\_ DATE: \_\_\_\_\_  
DRAWING NO. TX-EN-0499  
SHEET 1 OF 4



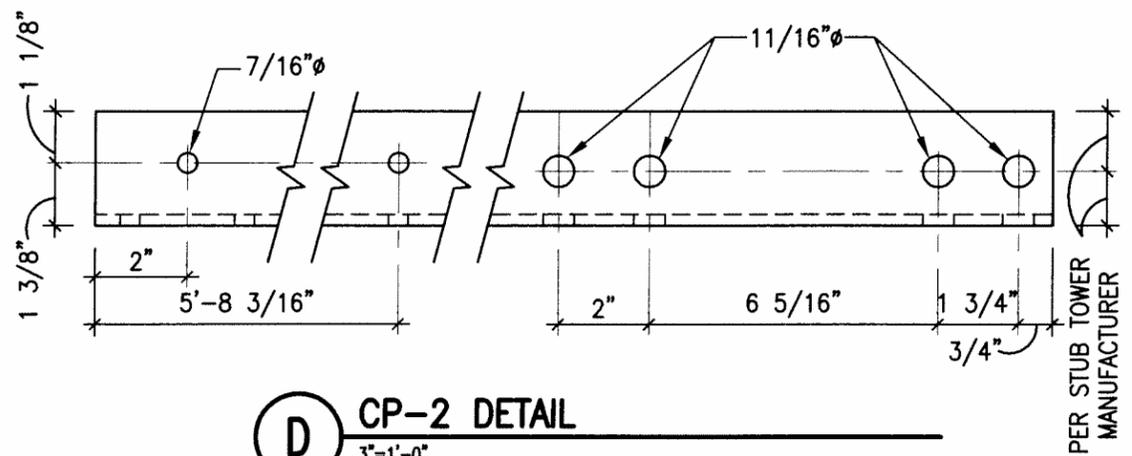
**F** WB-2 DETAIL  
3"=1'-0"



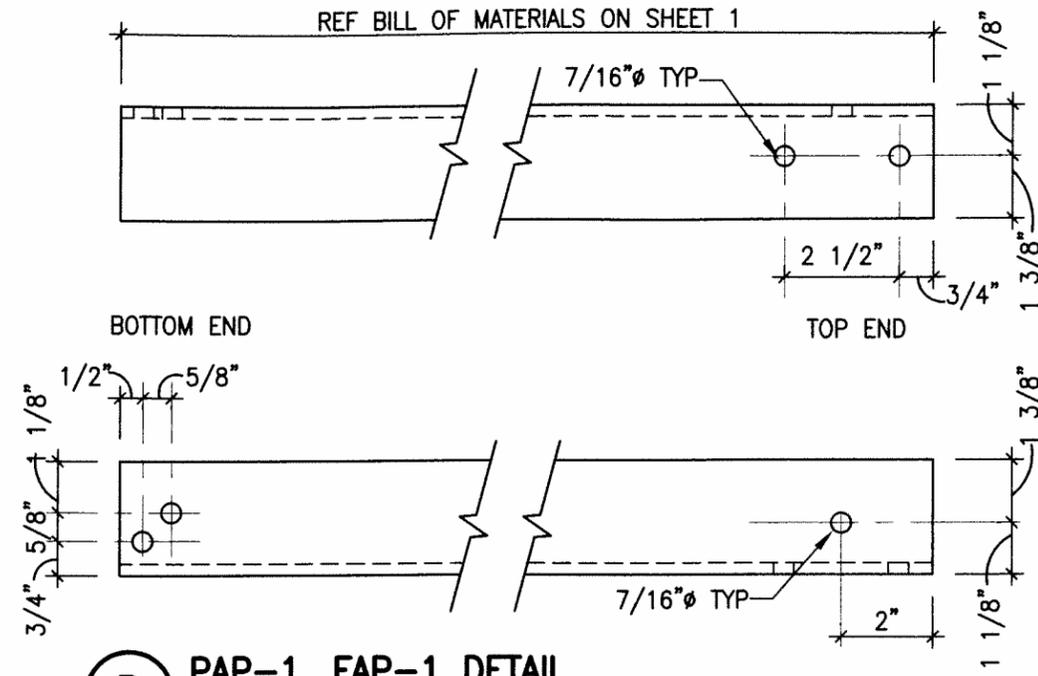
**E** WB-1 DETAIL  
3"=1'-0"



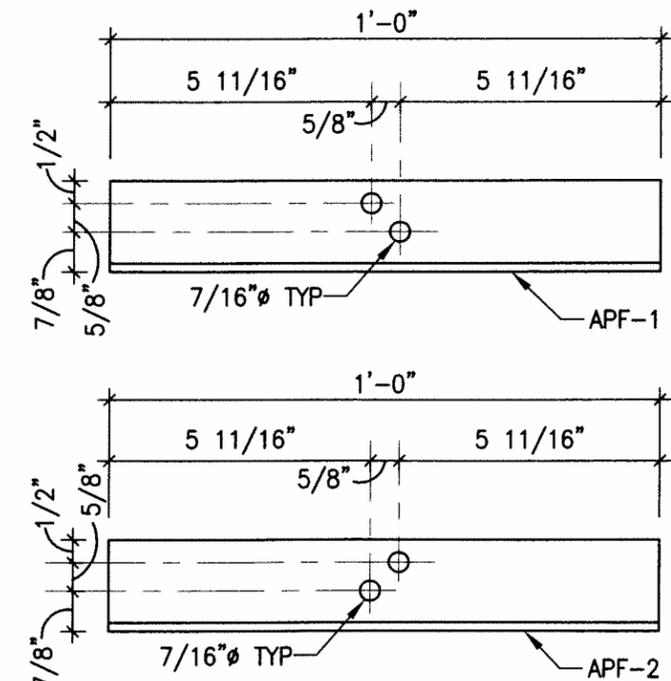
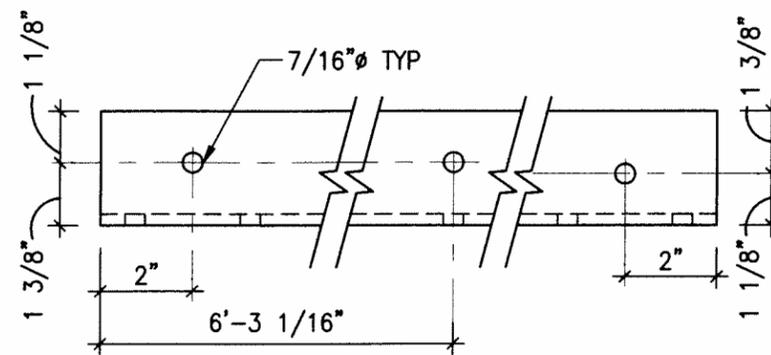
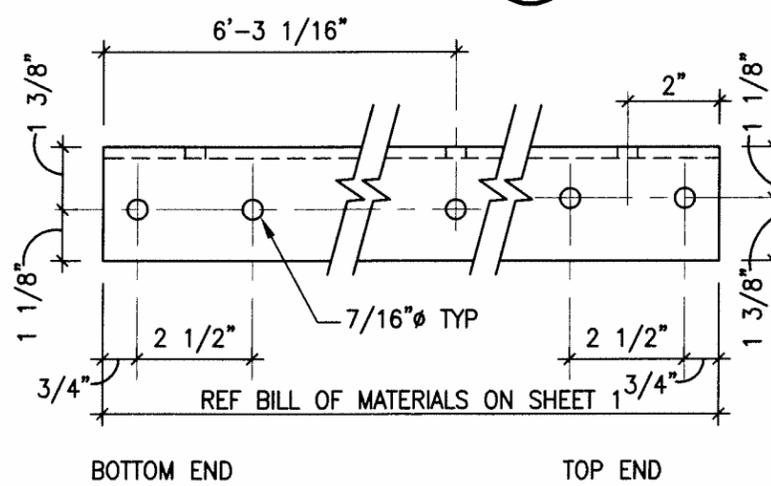
**D** CP-2 DETAIL  
3"=1'-0"



**C** CP-1 DETAIL  
3"=1'-0"



**B** PAP-1, FAP-1 DETAIL  
3"=1'-0"



**A** APF-1 & APF-2 DETAIL  
3"=1'-0"

STATE OF TEXAS  
 JOSEPH R. RAPIER  
 61147  
 LICENSED PROFESSIONAL ENGINEER  
 12.13.05

THIS DRAWING WAS PREPARED FOR NCS BY:  
 NSC  
 CARROLL, SMITH & COOPER, INC.  
 ENGINEERS-ARCHITECTS-PLANNERS

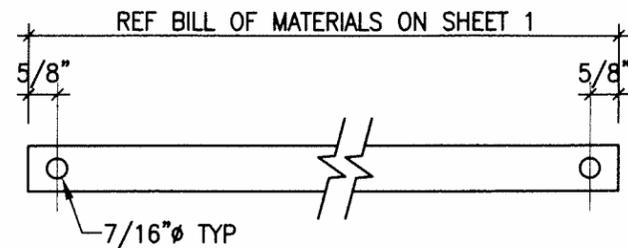
DESIGNED BY: MOY  
 DRAWN BY: DLD  
 CHECKED BY: JRE  
 FILE NAME:  
 DATE PLOTTED: JUNE 2005

4 POST STEEL WINDMILL TOWER AND FOUNDATIONS FOR 16' DIAMETER MILL AT 37' HEIGHT

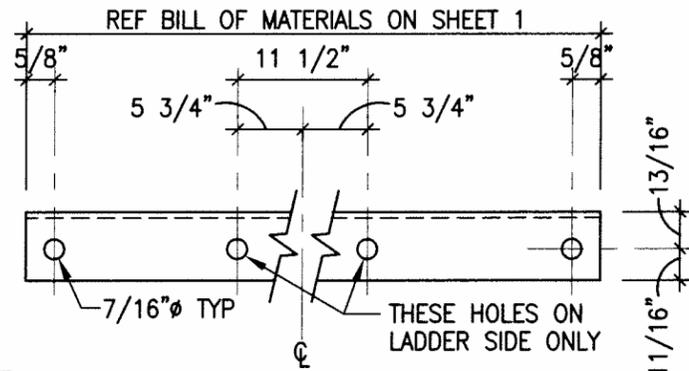


**NRCS**  
 National Resources Conservation Service  
 U.S. Department of Agriculture

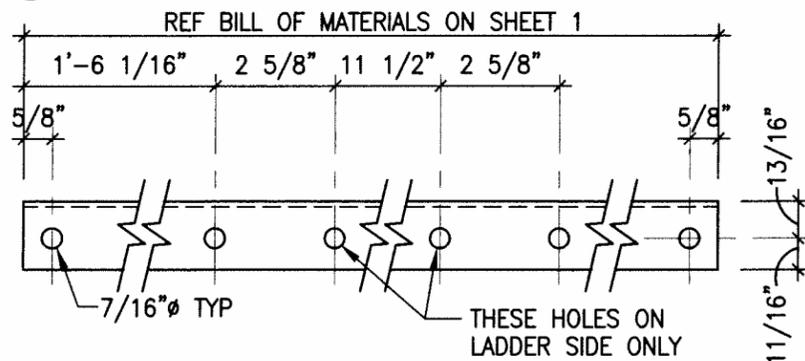
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 SHEET 2 OF 4



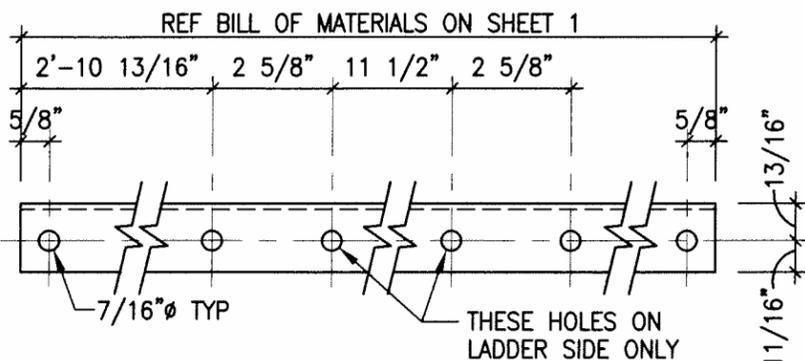
**D** WB-3 DETAIL  
3'=1'-0"



**C** HG-1, HG-3, AND HG-5 DETAIL  
3'=1'-0"



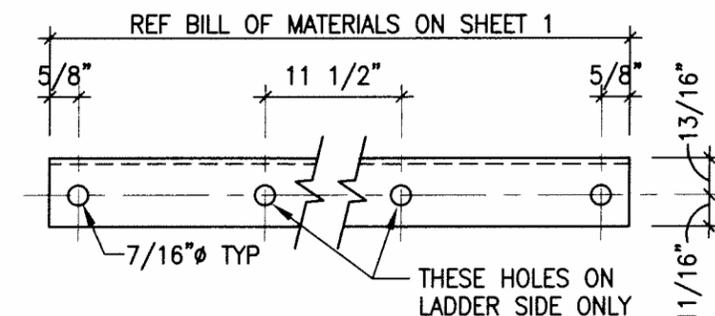
**B** HG-4 DETAIL  
3'=1'-0"



**A** HG-2 DETAIL  
3'=1'-0"

### CONSTRUCTION SPECIFICATIONS

- I. GENERAL INFORMATION  
EXTREME CAUTION MUST BE TAKEN DURING THE ASSEMBLY AND INSTALLATION OF A WINDMILL TOWER. THE FOLLOWING SAFETY PRECAUTIONS ARE RECOMMENDATIONS FOR A SAFE INSTALLATION:
  - A. WEAR AND USE APPROPRIATE SAFETY EQUIPMENT INCLUDING, BUT NOT LIMITED TO AN ANSI APPROVED HARD HAT, STEEL-TOED BOOTS, AND A SAFETY HARNESS.
  - B. TIGHTEN ALL BOLTS AND NUTS AT EACH LEVEL OF THE TOWER PRIOR TO CONSTRUCTING OR CLIMBING ON THE NEXT LEVEL OF THE TOWER.
  - C. AVOID ERECTING A WINDMILL TOWER BELOW OR NEAR OVERHEAD POWER LINES.
- II. ASSEMBLY
  - A. FOUNDATIONS  
THE CONCRETE FOUNDATIONS SHOWN IN THE DRAWING HAVE BEEN DESIGNED FOR WIND SPEEDS OF UP TO 90 MILES PER HOUR. IT IS IMPORTANT THAT THE FOUNDATIONS BE EXCAVATED AND ERECTED AS SHOWN ON THE DRAWING AT THE MINIMUM DEPTH SHOWN ON SHEET 1. THE ANCHOR POSTS WITH ANCHOR FEET MAY BE SET IN THE PROPER POSITION BY ERECTING THE BOTTOM SECTION OF THE TOWER AND SETTING IT IN THE HOLES. ALLOW 72 HOURS FOR THE CONCRETE TO CURE BEFORE COMPLETING THE TOWER ERECTION.
  - B. TOWER  
THE WINDMILL TOWER MAY BE ASSEMBLED ON THE GROUND AND THEN HOISTED INTO PLACE USING A CRANE. CAUTION MUST BE TAKEN NOT TO DAMAGE ANY OF THE MEMBERS DURING HOISTING. THE TOWER MAY ALSO BE ERECTED IN PLACE FROM THE GROUND UP. WHEN ERECTING THE TOWER ONE SECTION AT A TIME FROM THE GROUND UP, SCAFFOLDING PLANKS MAY BE USED AT EACH LEVEL.
  - C. REFER TO THE DETAILS PROVIDED ON THE DRAWINGS FOR PROPER ERECTION AND ASSEMBLY. CARE MUST BE TAKEN TO BOLT TOGETHER EACH CONNECTION AS SHOWN IN THE DETAILS. THE CORNER POSTS MUST BE OVERLAPPED AS SHOWN IN ORDER FOR THE GIRTS AND BRACES TO PROPERLY FIT. UPON COMPLETION OF THE TOWER CHECK ALL BOLTED CONNECTIONS AND TIGHTEN ANY LOOSE BOLTS.
  - D. REFER TO THE MANUFACTURERS ASSEMBLY INSTRUCTIONS FOR PROPER INSTALLATION OF THE STUB TOWER, PLATFORMS, AND MILL.



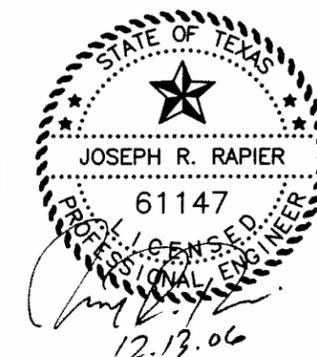
**E** HG-6 DETAIL  
3'=1'-0"

### GENERAL NOTES

- I. CODES:  
ALL FABRICATION, ERECTION AND DESIGN OF STRUCTURAL MEMBERS SHALL MEET THE MINIMUM STANDARDS OF THE FOLLOWING CODES:
  - A. AMERICAN CONCRETE INSTITUTE (ACI): ACI 318-95 & ALL OTHER ACI STANDARDS
  - B. AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC) MANUAL OF STEEL CONSTRUCTION - ALLOWABLE STRESS - NINTH EDITION
  - C. AMERICAN SOCIETY OF CIVIL ENGINEERS - STANDARD 7-02
  - D. AMERICAN WELDING SOCIETY (AWS)
  - E. AMERICAN IRON AND STEEL INSTITUTE (AISI)
- II. MATERIAL PROPERTIES
 

STEEL	
ANGLES AND FLAT BAR	ASTM A36 - 36 KSI
CONCRETE	
PIERS & FOOTINGS	3000 PSI AT 28 DAYS
BOLTS	
3/8" BOLTED CONNECTIONS	ASTM A325 OR BETTER
- III. FOUNDATION
  - A. ALL PIERS AND FOOTINGS ARE DESIGNED ON AN ALLOWABLE SOIL BEARING OF 2000 POUNDS PER SQUARE FOOT.
  - B. WINDMILL FOOT SHALL BE 2" ABOVE GROUND SURFACE AS SHOWN IN E/1.
  - C. EXCAVATED FOUNDATION HOLES SHALL REMAIN DRY UNTIL CONCRETE PLACEMENT. CONCRETE SHALL NOT BE PLACED IF MOISTURE EXISTS IN THE EXCAVATED HOLES.
- IV. RUST PREVENTION
  - A. ALL STEEL ANGLES AND FLAT BAR SHALL BE HOT-DIP GALVANIZED AFTER FABRICATION IN COMPLIANCE WITH ASTM A123/A123M.
  - B. ALL STEEL ANGLE AND FLAT BAR MAY BE PAINTED OR COATED WITH A RUST PREVENTATIVE SHOP PRIMER OR PAINT ACCORDING TO MANUFACTURERS SPECIFICATIONS TO A DRY FILM THICKNESS OF NO LESS THAN 1.5 MILS.
  - C. ALL STEEL BOLTS, NUTS AND WASHERS SHALL BE PLATED OR HOT-DIP GALVANIZED IN COMPLIANCE WITH ASTM A153/A153M.
- V. ALTERNATE TOWERS  
THE USE OF OTHER WINDMILL TOWERS AND/OR TOWER CONFIGURATIONS IS ACCEPTABLE PROVIDED THAT THE TOWER HAS BEEN DESIGNED FOR MAXIMUM LOADS AND LOAD COMBINATIONS WITHIN A SPECIFIED GEOGRAPHICAL AREA OF TEXAS. THE DESIGN MUST BE SIGNED AND SEALED BY A LICENSED PROFESSIONAL ENGINEER, LICENSED TO PRACTICE IN TEXAS.

16' MILL ON 37' STEEL TOWER				
PUMPING SPECIFICATIONS				
PIPE DIAMETER (IN)	CAPACITY (GAL/HR)	MAXIMUM WELL DEPTH; LONG STROKE (FT)	MAXIMUM WELL DEPTH; SHORT STROKE (FT)	MAXIMUM TOWER LIFT CAPACITY (LB)
1 7/8"	180	920	1224	6871.7
2"	190	750	998	6884.7
2 1/2"	325	490	652	6405.8
3"	470	360	479	6002.7
3 1/2"	640	265	352	5355.1
4"	830	200	266	4830.0
4 1/2"	1050	160	213	4585.0
5"	1300	130	173	4333.7
6"	1875	85	113	3753.0



THIS DRAWING WAS PREPARED FOR NCRCS BY: **ESG**  
 PARSONS, SMITH & COOPER, INC.  
 CONSULTING ENGINEERS

DESIGNED BY: MRY  
 DRAWN BY: DLD  
 CHECKED BY: JFR  
 FILE NAME:  
 DATE PLOTTED: JUNE 2009

4 POST STEEL WINDMILL TOWER AND FOUNDATIONS FOR 16' DIAMETER MILL AT 37' HEIGHT

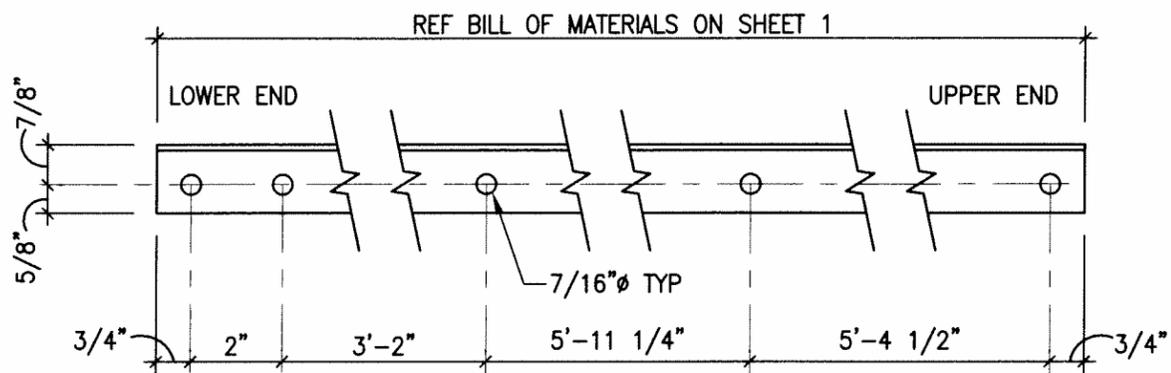


**NCRCS**  
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 U.S. Department of Agriculture

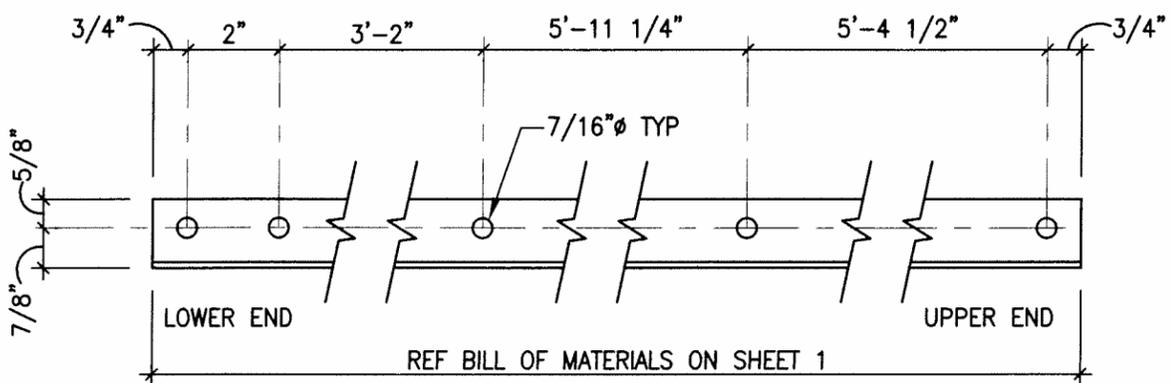
REVISIONS DATE

DRAWING NO. TX-EN-0499

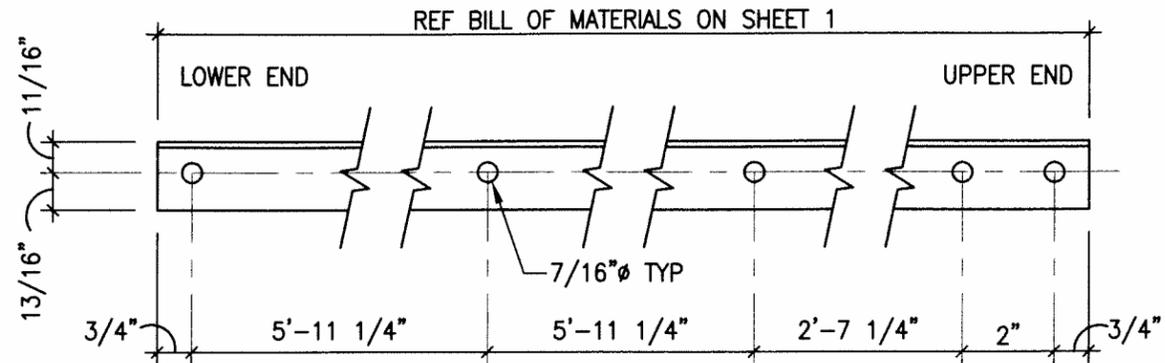
SHEET **3** OF 4



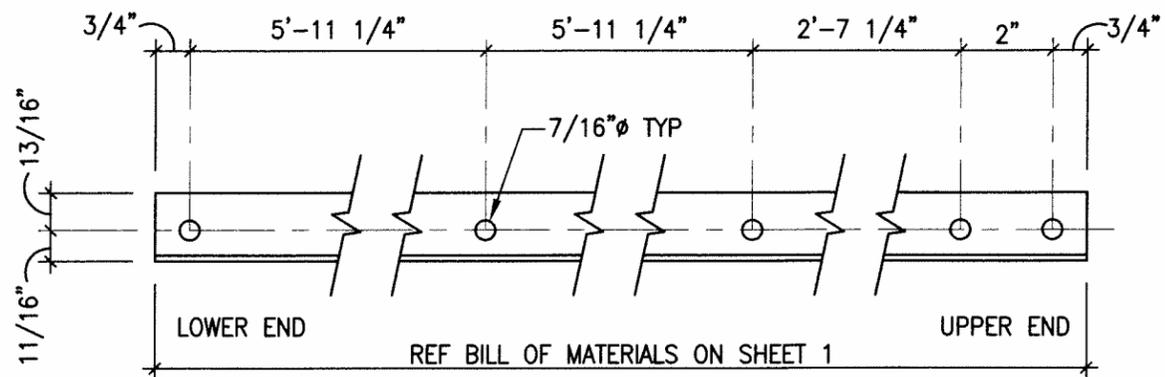
**E** LDR-5 DETAIL  
3"=1'-0"



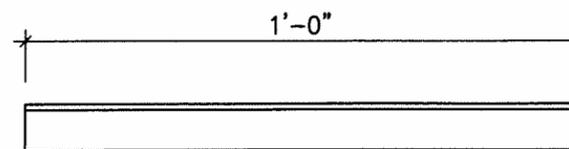
**D** LDR-4 DETAIL  
3"=1'-0"



**C** LDR-3 DETAIL  
3"=1'-0"



**B** LDR-2 DETAIL  
3"=1'-0"



**A** LDR-1 DETAIL  
3"=1'-0"



THIS DRAWING WAS PREPARED FOR NCRS BY:  
  
 PERSONNEL WITH A COVER, INC.  
 10000 N. LOOP WEST, SUITE 1000  
 DALLAS, TEXAS 75243-1000

DRAWN BY: MCV  
 DESIGN BY: DLD  
 CHECKED BY: JFR  
 FILE NAME:  
 DATE PLOTTED: JUNE 2009

4 POST STEEL WINDMILL TOWER AND FOUNDATIONS FOR 16' DIAMETER MILL AT 37' HEIGHT



REVISIONS DATE

DRAWING NO. TX-EN-0499

SHEET 4 OF 4