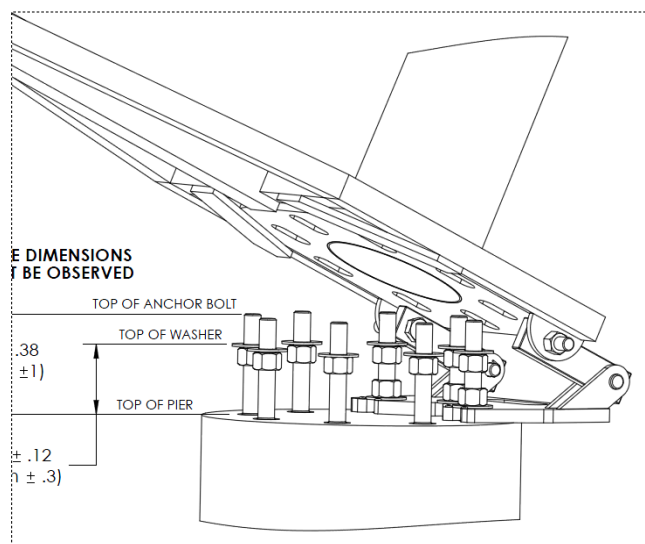



SKYSTREAM 3.7

Sectional Monopole Tower Foundation & Installation Manual

For 34 ft (10.4 m), 45 ft (13.7 m),
55 ft (16.7 m) & 70 ft (21.3 m)

3-CMLT-1409-01 Rev C



 Made in the USA

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Important Safety Instructions

Read these instructions in their entirety before installing.

- 1) SAVE THESE INSTRUCTIONS. This manual contains important instructions for constructing foundations, and raising, lowering and leveling towers that **MUST** be followed.
- 2) Read, Understand and Follow all warnings.
- 3) Read these instructions in their entirety before starting foundation construction and tower installation.
- 4) The foundations, instructions and towers described in this manual are appropriate for XZERES Skystream 3.7 wind turbines. **DO NOT INSTALL ANY OTHER TURBINE.**
- 5) Install foundation and tower in accordance with National Electric Code, and all local building and zoning codes and requirements.
- 6) Obtain building and construction permits prior to starting construction.
- 7) Foundation concrete must be completely cured prior to installing tower [Minimum 2500 PSI, (17235 kPa) 28 day strength].
- 8) Skystream uses high voltage and is potentially dangerous. Follow all safety precautions at all times.
- 9) Follow proper grounding procedures for tower, foundation and wind turbine.
- 10) Remain at a safe distance when raising and lowering tower. **NEVER** stand or walk under tower while it is being raised or lowered.
- 11) Be aware of overhead power lines.
- 12) Do not attempt to raise tower on a windy day.
- 13) Always wear personal protection equipment – closed toe shoes, work gloves, safety glasses, and hardhat.

In this Manual



IMPORTANT:
Please take note



TIP: Helpful information to ease the installation



Professional installation
highly recommended



Warning: Risk of injury or death
- proceed with extreme caution

PRIOR TO INSTALLATION

Introduction

This manual provides information for foundation construction, tower assembly, and tower installation for the following XZERES segmented monopole towers with a Skystream 3.7 wind turbine:

- 34 ft (10.4 m) Monopole Sectional Tilt-Up Tower, part number 3-CMBP-3218-10
- 45 ft (13.7 m) Monopole Sectional Tilt-Up Tower, part number 3-CMBP-3239-100
- 55 ft (16.7 m) Monopole Sectional Tower, part number 3-CMBP-3239-200
- 70 ft (21.3 m) Monopole Sectional Tower, part number 3-CMBP-3239-300

Information for construction of two types of foundation is provided. The choice of foundation will depend on local building conditions, available construction equipment, and local regulations. The foundation types include:

- Mat Foundation – A square foundation; side dimensions vary based on wind speed, depth is approximately four feet deep depending on tower.
- Pier Foundation – A “column” shaped foundation; the diameter and depth of the column vary depending on soil conditions and maximum wind speed.

Directions for raising, leveling, and lowering the tower are provided in this manual, refer to the Skystream Owner’s Manual for instructions for bolting Skystream on the tower.

IMPORTANT NOTE:

The foundation drawings contained in the Appendices of this manual present foundations designed in accordance with the 2006 INTERNATIONAL BUILDING CODE (IBC 2006) and ASCE 7-05 MINIMUM DESIGN LOADS FOR BUILDINGS AND OTHER STRUCTURES.

These drawings may therefore not be appropriate in localities with construction requirements that differ from these standards.

Building Permits and Zoning Requirements

Building codes and installation requirements may vary greatly depending on state, city, and local townships. Be sure to obtain all required building permits BEFORE beginning the installation.

Be sure you understand all installation and inspection requirements. Many localities require inspections at key phases of the installation before additional work can proceed.



IMPORTANT: Do not pour concrete before all required permits are obtained, inspections completed, and you are authorized to proceed.

Professional Installation

Constructing the foundation and raising the Skystream requires in-depth knowledge of Skystream systems, specialized equipment, experience constructing concrete forms and knowledge of local zoning and building codes and inspection requirements. XZERES requires all dealer selling and installing Skystream systems to have completed up-to-date factory training.

Towers are not be to be installed by any unauthorized person. Dealers displaying the “Skystream Dealer” insignia (shown here) on the XZERES Web site have completed factory training on the correct and safe installation of the tower (and Skystream).



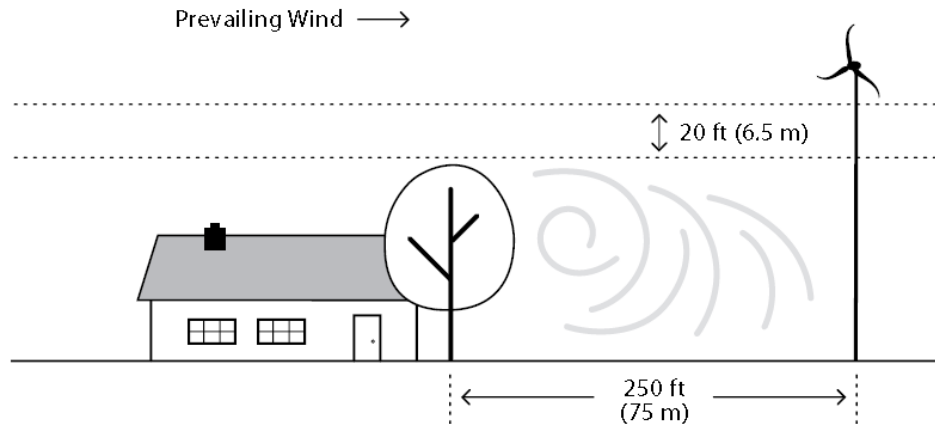
Skystream Dealer

Siting – Finding the best location for Skystream

The optimum location to install any wind turbine, including Skystream, is often a compromise. Local building restrictions, the height of surrounding structures, wire length, and available open space may require Skystream be installed in a less than optimum location. At a minimum try to observe the following general rule for siting the turbine.



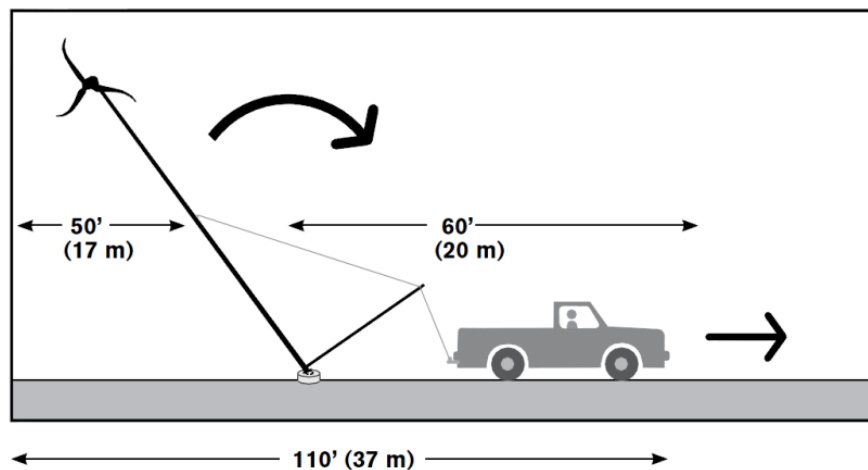
TIP: Your dealer can help you determine the best location for Skystream on your property.



Optimal Skystream location.

The General Rule: For optimum performance, install Skystream 20 ft (6.5 m) above any surrounding object within a 250 ft (75 m) radius. See figure above.

When raising the 45 ft (13.7 m) tower using the Gin Pole Kit a minimum of approximately 110 ft (37 m) are required. Slightly over 50 ft (17) are required on one side of the foundation for the tower and Skystream blades. Depending on the length of vehicle used to raise the tower, over 60 ft (20 m) may be required on the other side of the foundation for the vehicle, pulling cable and gin pole. Slightly less space is required to raise the 34 ft (10.4 m) tower. Refer to the accompanying figure. Refer to the accompanying figure.



TIP: Approximately 110 ft (37 m) are required to raise the tower vertically into position. 50 ft (17 m) are required on one side of the foundation for the tower and wind generator. An additional 60 ft (20 m) are required on the other side of the foundation for the gin pole and pulling vehicle.

CONSTRUCTING THE FOUNDATION

Foundation Drawings

Detailed technical drawings are provided in Appendices A, B, C and D respectively. The drawings were prepared by Tower Engineering Professionals (TEP), Raleigh, North Carolina and reviewed and certified by a State of Arizona Registered Professional Engineer.

The drawings are provided as a reference to assist with obtaining building permits and with the construction approval process.

Note: The dimensions for Pier foundations will vary based on the Soil Class and Wind Zone. For Mat foundations, the Soil Class is assumed to Class 5 (worst case) and therefore the dimensions will only vary based on the Wind Zone.

Wind Zones

The foundation dimensions are in part dictated by the maximum anticipated wind speed the turbine will experience. A larger (or deeper) foundation is required to withstand higher speed winds.

The dimensions and construction details for each of the foundations will change based on the anticipated wind speed. Refer to the accompanying tables to determine your Wind Speed Zone and the location of the foundation dimensions for your tower height and foundation type.

Wind Zones

Zone	Wind Speed
1	120 – 150 mph / 54 – 67 m / sec
2	90 – 120 mph / 40 – 54 m / sec
3	<90 mph / 40 m /sec



TIP: Excellent wind speed information is available on the internet at <http://www.awea.org/index.aspx>



TIP: If your installation requires “Wet Stamped” Foundation Drawings for your state they may be purchased from Tower Engineering Professionals, Raleigh , North Carolina. Phone: 919.661.6351.

Tower Height	Foundation	Wind Zone	For Dimensions See
34 ft (10.4 m)	Mat	2	Appendix A, Sheet S-3A
34 ft (10.4 m)	Mat	3	Appendix A, Sheet S-3B
34 ft (10.4 m)	Pier	2 & 3	Appendix A, Sheet S-5
45 ft (13.7 m)	Mat	2	Appendix B, Sheet S-3A
45 ft (13.7 m)	Mat	3	Appendix B, Sheet S-3B
45 ft (13.7 m)	Pier	2 & 3	Appendix B, Sheet S-4, S-5
55 ft (16.8 m)	Mat	1	Appendix C, Sheet S-4A
55 ft (16.8 m)	Mat	2	Appendix C, Sheet S-4B
55 ft (16.8 m)	Mat	3	Appendix C, Sheet S-4C
55 ft (16.8 m)	Pier	1, 2 & 3	Appendix C, Sheet S-5, S-6
70 ft (21.3 m)	Mat	1	Appendix D, Sheet S-3A
70 ft (21.3 m)	Mat	2	Appendix D, Sheet S-3B
70 ft (21.3 m)	Mat	3	Appendix D, Sheet S-3C
70 ft (21.3 m)	Pier	1, 2 & 3	Appendix D, Sheet S-4, S-5

Soil Conditions

As with the Wind Zones described (previous page), the size of a foundation required to support a wind turbine and tower is in part determined by the soil conditions in which the foundation is constructed. Loose sandy soil will require a larger foundation than bedrock.

Refer to the following tables to determine your Soil Class and the location of the foundation dimensions for your tower height and foundation type.

Soil Class	Description
1	Crystalline Bedrock
2	Sedimentary and Floated Rock
3	Sandy Gravel and / or Gravel
4	Sand, Silty Sand, Clayey Sand, Silty Gravel, and Clayey Gravel (SW, SP, SM, SC, GM, and GC)
5	Clay, Sandy Clay, Silty Clay, Clayey Silt, Silt and Sandy Silt (CL, ML, MH, and CH)

Tower Height	Foundation	Wind Zone	For Dimensions See
34 ft (10.4 m)	Mat	5 **	See Wind Zone data, see ** below
34 ft (10.4 m)	Pier	3,4,5	Appendix A, Sheet S-5
45 ft (13.7 m)	Mat	5 **	See Wind Zone data, see ** below
45 ft (13.7 m)	Pier	3,4,5	Appendix B, Sheet S-5
55 ft (16.8 m)	Mat	5 **	See Wind Zone data, see ** below
55 ft (16.8 m)	Pier	1,2,3,4,5	Appendix C, Sheet S-6
70 ft (21.3 m)	Mat	5 **	See Wind Zone data, see ** below
70 ft (21.3 m)	Pier	1,2,3,4,5	Appendix D, Sheet S-5

** All Mat Foundation Dimensions are based on Soil Class 5 conditions.

Selecting a Foundation Configuration – Pier or Mat

The choice of foundation – Pier or Mat – will depend on a number of factors including soil conditions, the depth of the local water table, frost line and available excavation equipment.

If, for example, a contractor has the correct size auger, installing a Pier foundation may be a more economical choice than a Mat foundation since it may use substantially less concrete.

Regardless of the type of foundation, the foundation must extend below the frost line and must also be above the water table. Engineering professionals must be consulted prior to construction if the frost line is known to be greater than the foundation depth or the water table is less than the foundation depth.

Foundation Bolts and Templates

The 34 ft (10.4 m), 45 ft (13.7 m), 55 ft (16.8 m) and 70 ft (21.3) towers each require different foundation bolt kits as follows:

- 34 ft (10.4 m) and 45 ft (13.7 m) Monopole Sectional Towers, two options for Foundation Bolt Kits are available: 3-CMBP-3258-01 or 3-CMBP-3294
- 55 ft (16.7 m) Monopole Sectional Tower, use Foundation Bolt Kit 3-CMBP-3259-01
- 70 ft (21.3 m) Monopole Sectional Tower, use Foundation Bolt Kit 3-CMBP-3260-01

Each Foundation Bolt Kit includes hot dipped galvanized bolts, nuts and washers constructed of the appropriate steel alloys – DO NOT SUBSTITUTE ALTERNATIVE NUT BOLTS OR WASHERS.

The bolt kits differ from each other in a number of ways. The bolts for the 34 ft (10.4 m), 45 ft (13.7 m) and 55 ft (16.7 m) towers are 42 inches (16.5 cm) long while the bolts for the 70 ft (21.3 m) tower are 50 inches (19.7 cm) long.

Additionally, the bolt kit for the 34 ft (10.4 m) and 45 ft (13.7 m) towers include extra nuts to enable use of the hinge plate kit such that the tower may be tilted into position. All bolt kits include a paper template which may be used to construct a rigid template for securing the foundation bolts as the concrete is poured.

Positioning the Foundation Bolts (Pier and Mat foundations)

Regardless of the foundation it is vital the foundation bolts are correctly positioned in the foundation or it may be extremely difficult if not impossible to bolt the tower to the foundation.

Warning : Be certain to use the correct bolt circle template:

- 34 ft (10.4 m) tower - use 17 inch bolt circle template
- 45 ft (13.7 m) tower - use 19 inch bolt circle template
- 55 ft (16.7 m) tower - use 23 inch bolt circle template
- 70 ft (21.3 m) tower - use 23 inch bolt circle template

Using the paper template supplied with the foundation bolt kit as a guide, construct a rigid template to position the foundation bolts. Secure the foundation bolts to the rigid template using the foundation nuts. Rigid templates may be fabricated using a single piece of plywood or using two pieces of plywood separated by 2 x 4 in lumber.

Warning: The foundation bolts **MUST** project above the foundation 7.0 +/- 0.38 in (18.0 cm +/- 10 mm) and be vertical and parallel to each other. These dimensions are especially critical if the tower is to be tilted into position using hinge plate kit and gin pole. Refer to Appendix E page 65, step 1 & Appendix F page 73, step 1.

Hinge Plate and Gin Pole Installation (34 ft and 45 ft Towers)

The 34 and 45 ft towers may be tilted into position using the appropriate Hinge Plate and Gin Pole Kit. The kits may also be used to aid in with assembly of the tower sections. Refer to the “Assembling Tower Sections Using the Gin Pole” section of this manual. Observe the following important notes:

IMPORTANT NOTES:

- The 34 ft tower requires: Gin Pole Kit PN 2-TWS-102; (Gin Pole PN 3-CMBP-3221) and Hinge Plate Kit PN 2-TWS-103; (Hinge Plate PN 3-CMPB-3220).
- The 45 ft tower requires: Gin Pole Kit PN 2-TWS-200; (Gin Pole PN 3-CMBP-3241) and Hinge Plate Kit PN 2-TWS-300; (Hinge Plate PN 3-CMPB-3240).
- Installation of either Hinge Plate Kit (for 34 or 45 ft tower) requires use of Foundation Bolt Kit 3-CMBP-3258-01.
- The foundation concrete must be fully cured (typically 28 days unless accelerants are used) prior to the tower installation. Concrete minimum compressive strength is 2500 PSI (17235 kPa).

Refer to Appendix E or F respectively for the 34 ft (10.4 m) or 45 ft (13.7 m) tower and perform the following steps.

- Position the hinge plate fully against the three bolts that will be used to secure the hinge plate. Thread three nuts onto the bolts and “snug” the nuts and then tighten the nuts an additional quarter turn.
- Install a nut and washer (washers on top of nuts) on each of the eight foundation bolts. The tops of the washers should be 4.14 inch (105 mm) above the top of the foundation bolts as shown in Appendix E and F.
- Attach the two Hinge Plate Links to the Hinge Plate using the clevis pins and spring pins supplied with the Hinge Plate Kit.
- Attach the tower base section to the Hinge Plate Links using clevis pins and spring pins supplied with the Hinge Plate Kit. Install the clevis pins as shown in Appendix E and F.
- The Hinge Plate and tower base should now appear as shown in Step 3 of Appendix E and F.
- Connect the Gin Pole to the Hinge Plate Links and tower base using the 5/8 x 4 inch hex head bolts that securing the tower base to the Hinge Plate Links. Securely tighten the hex head bolts.

The Gin Pole, Hinge Plate and tower base should now appear as shown in Step 4 of Appendix E and F and assembly of the upper tower sections can begin. Refer to the “Assembling Tower Sections” section of this manual.

Electrical Conduit

Electrical conduit may be cast into the foundation such that the conduit continues below grade to electrical panel. Alternately wire may be routed between tower base plate and foundation. Refer to local building codes **BEFORE** pouring concrete.

Building codes typically require direct burial cables be buried to a minimum depth of 24 in (61 cm) while cables in conduit may be buried at a depth of 18 in (46 cm). Additionally, most codes prohibit embedding cables directly in concrete. Refer to local codes for conduit size and minimum depth requirements.

Tower Grounding

Refer to the Skystream Owner's Manual for complete directions on grounding the tower. It is vital the tower be properly grounded to minimize risk of electrical shock.

Completing the Foundation

Refer to the foundation technical drawings contained in the appendices of this manual for complete notes including; foundation dimensions, construction notes and grading and concrete requirements. Regardless of the foundation 28 days are required for the concrete to cure to a minimum compressive strength of 2500 PSI (17230 kPa).

TOWER INSTALLATION

Assembling Tower Sections Using the Gin Pole (34 ft and 45 ft Towers)

The following equipment should be on hand prior to starting the assembly process:

- 50 ft, 5/16 Grade 70 transport chain with 4700 lb working load with grab hooks on each end.
- Liquid dish soap
- Short lengths of lumber (4 inch x 6 inch) to support the tower sections as the sections they are assembled.

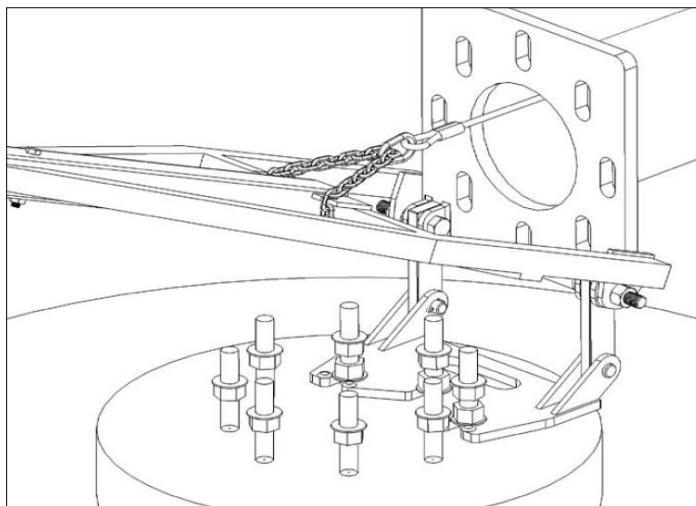
At this point the lowest tower segment, the base, should be bolted to the hinge plate and foundation and gin pole. Perform the following steps to join the tower segments using the gin pole to assist with the process. Refer to Appendix E or F respectively, for the 34 and 45 ft towers and using a permanent marker place “Minimum” and “Maximum” slip length engagement marks at the upper end of the tower base section.

To join the tower sections together :

- Inspect the mating sections of the tower for burrs and roughness and smooth and repair as necessary.
- Align the upper and lower tower section weld seams with each other (see figure).
- Lubricate the base section using a liquid dish soap (do not use grease or oil as this will stain the tower) and LOOSELY assemble the base and mid-sections.
- Run a 5/16 in (8.0 mm) grade 70 transport chain with slip hooks at each end through the tower sections and secure a 4 x 6 x 14 in (10 x 15 x 36 cm) wood block at the end of the pole. See Appendix E or F, Steps 5, 6 and 7.
- Support the tower midsection at its center of gravity; this will aid keeping the sections aligned axially and raise the gin pole approximately 10 to 20 degrees above horizontal and insert chain links into the slotted plates of the gin pole’s central support tube. See Appendix E or F, Step 6.
- The tower sections are fully engaged when a fully grown adult (approximately 200 lb) can fully pull down (pull on the end of gin pole) with the gin pole at a angle of 20 degrees above horizontal.
- Repeat the above process by readjusting the chain links as necessary until the tower mid section is fully seated against the base section.

NOTE : After pulling tower sections together, the tower section being pulled onto the lower section may or may not reach the “Maximum” insertion mark. However, each “Minimum” insertion mark **MUST** be covered by the corresponding upper tower section.

- Repeat the above procedure with each tower section until all sections are assembled. Support the tower as needed as each tower section is added.



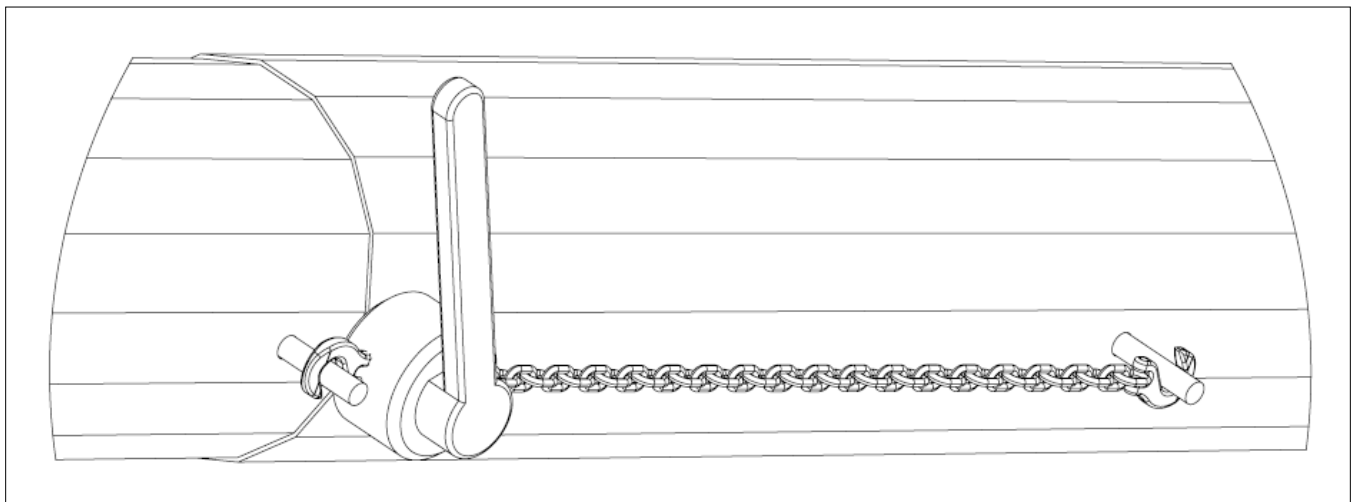
Assembling Tower Sections 55 ft (16.7 m) Tower

The procedure for assembling the 55 (16.7 m) tower is much the same as for assembling the 45 ft (13.7 m) tower; with the major differences being that the 55 ft tower cannot be tilted into position using a hinge plate and gin pole, and the 55 ft tower requires “come-along” chain hoists to pull the tower sections together instead of the using the gin pole for that purpose.

The following equipment should be on hand prior to starting the assembly process:

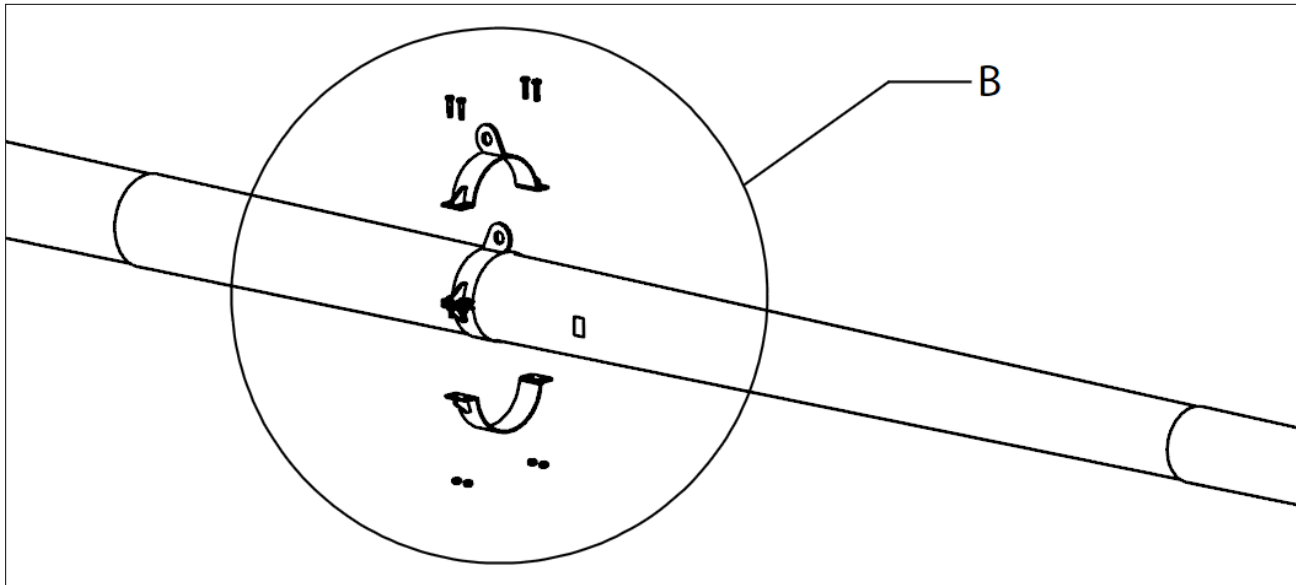
- Two chain hoist “come-alongs” with a minimum 2 ton pull capacity
- Two steel rods, 24 inches long x 1 inch diameter (not provided with tower)
- Liquid dish soap
- Short lengths of lumber to support the tower sections off the ground as the sections are assembled. Refer to Appendix G, 53-23 ASSEMBLY and start the assembly by:
- Inspect the mating sections of the tower sections for burrs and roughness and smooth and repair as necessary. Be sure to inspect and smooth at least the “Design Slip Length” surfaces as indicated in Appendix G.
- Refer to Appendix G, and using a permanent marker place “Minimum” and “Design” slip length engagement marks at the upper end of the tower base section.
- Lubricate the lower section using liquid dish soap, lubricate from the top of the section to the “Design” insertion mark. Do not use grease or oil as this will stain the tower.
- Align the upper and lower tower section weld seams with each other. The weld seam of the “upper” section should lie directly over the lower section weld seam. Loosely start inserting the lower section into the upper section.
- Insert 24 inch long by 1 inch diameter steel rods into the holes provided in the individual tower sections. Refer to Appendix G, Sheet 4, Detail C.
- With one person on each come-along, draw the sections together until the Design slip length is achieved or the come-along reaches maximum strain. The Minimum slip length must be achieved or exceeded; the Design slip length is ideal but may not be achievable.
- Repeat the above procedure with each tower section until all sections are assembled. Support the tower as needed as each tower section is added.

NOTE : After pulling tower sections together the tower section being pulled onto the lower section may or may not reach the “Design” insertion mark. However, each “Minimum” insertion mark **MUST** be covered by the corresponding upper tower section.



Raising the Tower Using the Hinge Plate and Gin Pole (34 and 45 ft Towers)

Refer to the Skystream Owner's Manual for instructions on completing the electrical connections and bolting Skystream on the tower. If you have not raised a tower before, XZERES recommends first raising the tower without the wind turbine installed. This provides the opportunity to practice the procedure without risking damage to the wind turbine.



Follow these steps to raise the tower:

- If not already installed, bolt the Lifting Eye clamp as shown in Appendix E or F for 34 or 45 ft towers.
- Tilt the gin pole to the vertical position and using two shackles and the wire rope cable (with the adjustable end) connect the cable to the gin pole and the Lifting Eye clamp as shown in Appendix E or F.
- **Note:** If necessary, adjust the cable length by following the Adjusting Cable Length section of this manual.
- Connect a second wire rope (provided by installer) to the end of the gin pole and “lifting” vehicle. Minimum strength for the cable and fittings is 7,000 pounds.
- Start to “raise” the tower by slowly driving the “lifting” vehicle directly away from the tower to take the slack out of the cable. Keep the vehicle “in line” with the tower. Avoid loading the tower in a lateral direction.
- The vehicle should stop pulling as the end of the gin pole approaches 3-4 ft (1-1.3 m) above ground level. At this point, two full size adults can complete raising the tower by pushing down on the end of the gin pole.
- Observe that the anchor bolt closest to the hinge pivot axis clears the slot in the tower base. This is normally not an issue unless the anchor bolt projection from the foundation exceeds 7.5 in (19 cm).
- As the tower nears the fully vertical position it may be necessary to “lift” the gin pole to slow the tower as it assumes a fully vertical position. Two people are required for this operation.
- When the tower is completely vertical, install the remaining nuts and washers to secure the tower to the foundation.

If the tower was raised without the turbine, refer to the section on lowering the tower. If the tower was raised with the turbine, proceed to the section on Leveling the Tower.

Lowering the Tower

Lowering the tower is the reverse of raising the tower. Observe the same precautions including not passing under the tower as it is lowered and standing well clear of cables. As with raising the tower, a minimum of three people are recommended.



Warning: Use extreme caution when lowering the tower. Keep well away and to sides of tower and cable.

- Turn OFF power to the turbine.
- If not already in place, install the hinge plate following the directions in Gin Pole and Hinge Plate Installation section of this manual. Observe the recommended bolt tightening procedure.
- Connect a second wire rope (provided by installer) to the end of the gin pole and “lifting” vehicle. Minimum strength for the cable and fittings is 7,000 pounds.
- Position suitable bracing to support the tower top and keep the turbine from contacting the ground after the tower is lowered. The bracing should be located approximately 8 ft (2.4 m) from the tower top to clear the turbine blades.
- Connect the second wire rope cable to the gin pole and lowering vehicle.
- Position the vehicle so there is approximately 1-2 ft (30-60 cm) of slack in the cable and the vehicle is in line with lowering path of the tower.
- Remove the foundation nuts and washers.
- Start the lowering process by having two people lift the gin pole to take up the cable slack. Continue lifting the gin pole as the vehicle keeps the cable taught.
- Once the tower passes the “balance point” the vehicle will be in control of the tower lowering and the individuals at the holding the gin pole should clear the area.
- **Note:** The pulling force of the tower exerted on the vehicle, greatly increases as the tower approaches horizontal.



Warning: Someone MUST be in the vehicle at all times to control lowering the tower. The “pulling” force the tower exerts greatly increases as the tower approaches the horizontal. In other words the tower is lowered using the vehicle brakes to slow the descent of the tower. During lowering keep the vehicle engine running to provide power brake assistance.

Adjusting Cable Length

READ ALL INSTRUCTIONS BEFORE BEGINNING

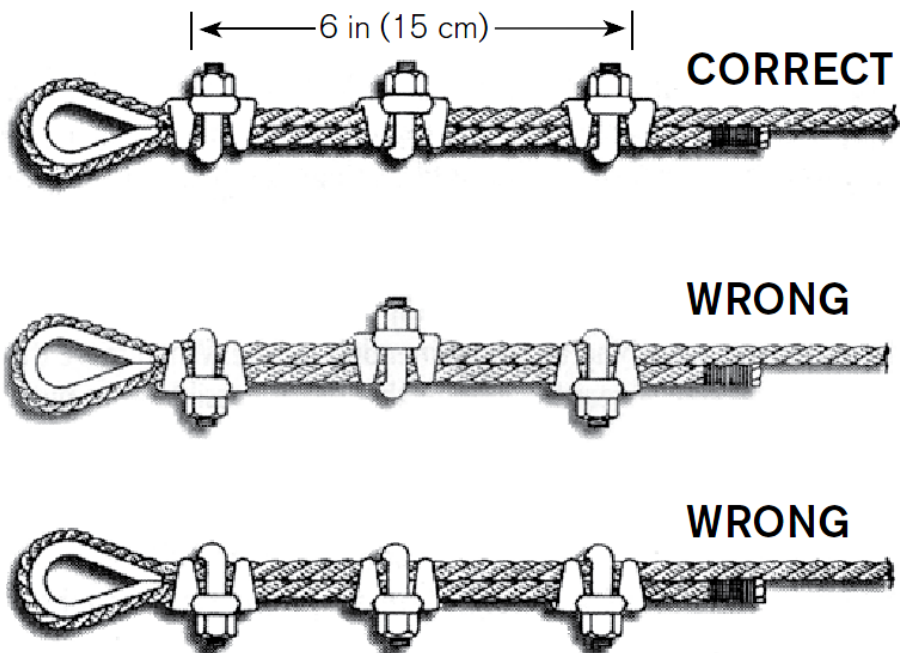


Warning: When using U-Bolt clips, extreme care must be exercised to make certain they are installed correctly. The U-Bolt clip must be installed so that the “U” section is in contact with the “dead” end of the cable. Refer to the accompanying figure (next page).



Warning: The TIGHTENING and RETIGHTENING of the UBolt clip nuts must be accomplished as described in the instructions. Only use forged U-Bolt clips – never use malleable clips in critical heavy duty applications such as raising the tower.

- Determine the required cable length taking into account the two shackles needed to connect the cable to the gin pole and the tower.
- Turn back the cable over the thimble and install the first U-Bolt clip such that the “U” section of the bolt is in contact with the “dead” end of the cable and is approximately 6 in (15 cm) from the base of the thimble. Refer to the accompanying figure.
- Tighten the nuts evenly, alternating from one nut to the other until reaching 30 lb-ft (41 N-m) of torque.
- Install the second U-Bolt clip as near the thimble as possible. As with the previous U-Bolt clip, tighten the nuts evenly, alternating from one nut to the other until reaching 30 lb-ft (41 N-m) of torque.
- Install the third U-Bolt clip midway between the other clips and tighten the nuts to 30 lb-ft (41 N-m) of torque.
- Apply a load to the cable equal or greater than the maximum anticipated load (DO NOT USE THE TOWER AND TURBINE AS THE LOAD) and retighten the nuts to 30 lb-ft (41 N-m) of torque. This step is very important as the cable may stretch and shrink in diameter when a load is applied effectively loosening the U-Bolt clip nuts. Note the maximum load the cable will experience is approximately 2400 lb (1100 kg).



Leveling the Tower

Leveling the tower can be accomplished using only four of the eight foundation bolts. Once the tower is leveled, the remaining bolts can be fully tightened to secure the tower.

Be aware that leveling the tower may require some trial and error adjustments, even though the base is level, the upper tower flange may be off level due to manufacturing tolerances.

To level the tower:

- Level the tower on a calm day to minimize movement of Skystream. Start by loosening all the upper foundation nuts about a full turn.
- Loosen and lower the four nuts on the “sides” of the foundation base plate. In other words the tower should be supported by the four “corner” nuts of the tower base plate.
- Using two bubble levels, set perpendicular to each other on the base plate; adjust the foundation nuts until the tower is level. Magnetic Bullet levels may make this process easier.
- Once the tower is level, tighten all nuts and recheck level.

Observe the position of Skystream on calm days. If the wind turbine seems to favor a single position with no wind, the tower may require fine tuning even if it appears level using the bubble leveling technique.

To fine tune the tower realize that the nose cone of the wind turbine will “point” in the direction of the tower low side. Therefore, to level the tower, slightly raise the side of the tower under the nose cone or lower the side of the tower opposite the nose cone. Make fine adjustments. Approximately one turn of a foundation nut equates to slightly more than 1/8 in (3.2 mm) so even a half turn adjustment will make a difference at the tower top.

*See Appendix J for more detail and additional Tower Leveling Techniques

Tightening Foundation Bolts

Tighten the foundation bolts by using the Turn of the Nut Method as described below.



Warning: Never leave foundation bolts loose. Foundation bolts may be temporarily loosened during tower leveling, however, **never leave tower** unless ALL foundation bolts are FULLY tightened.

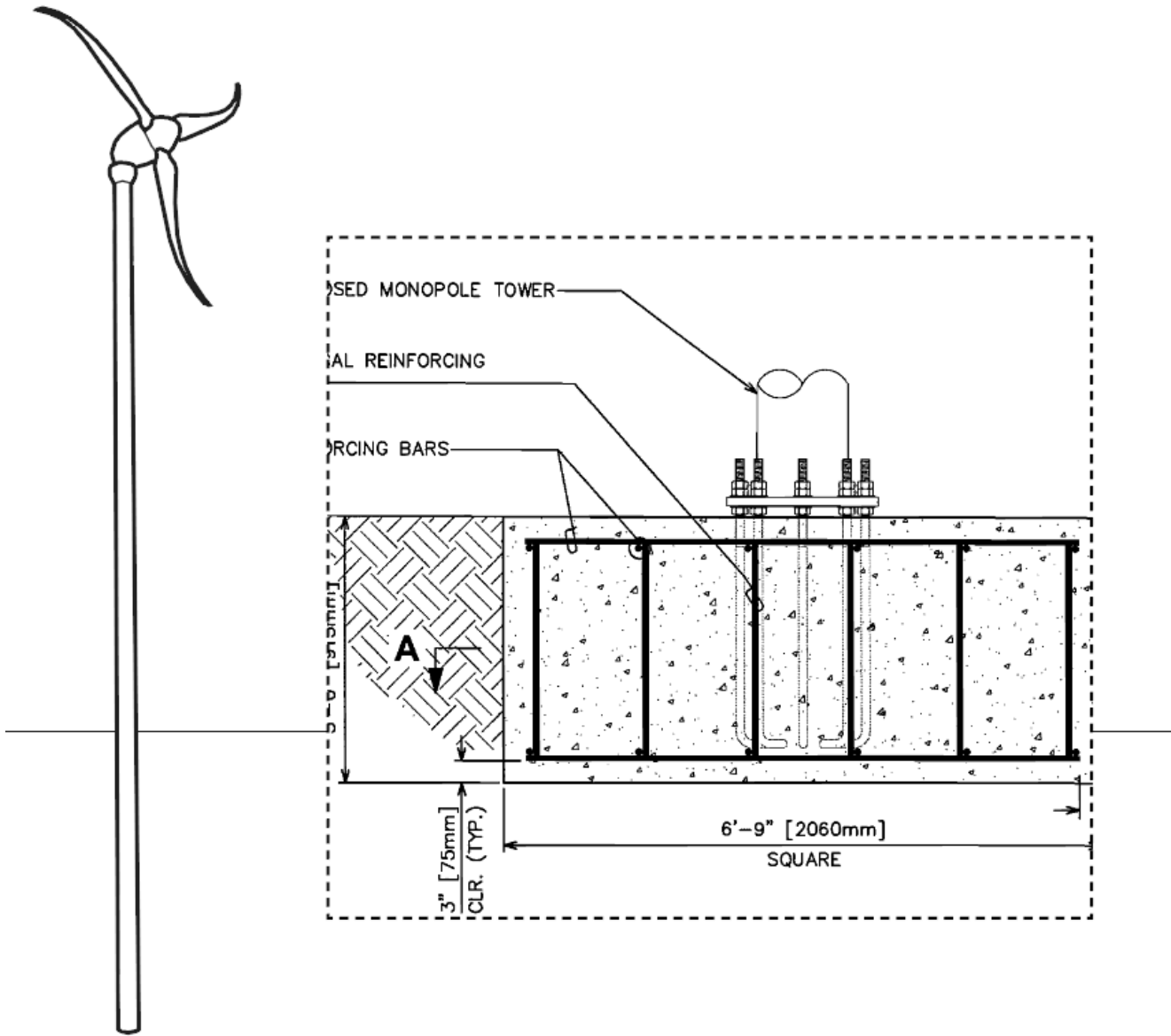
Turn of the Nut Method of Tightening

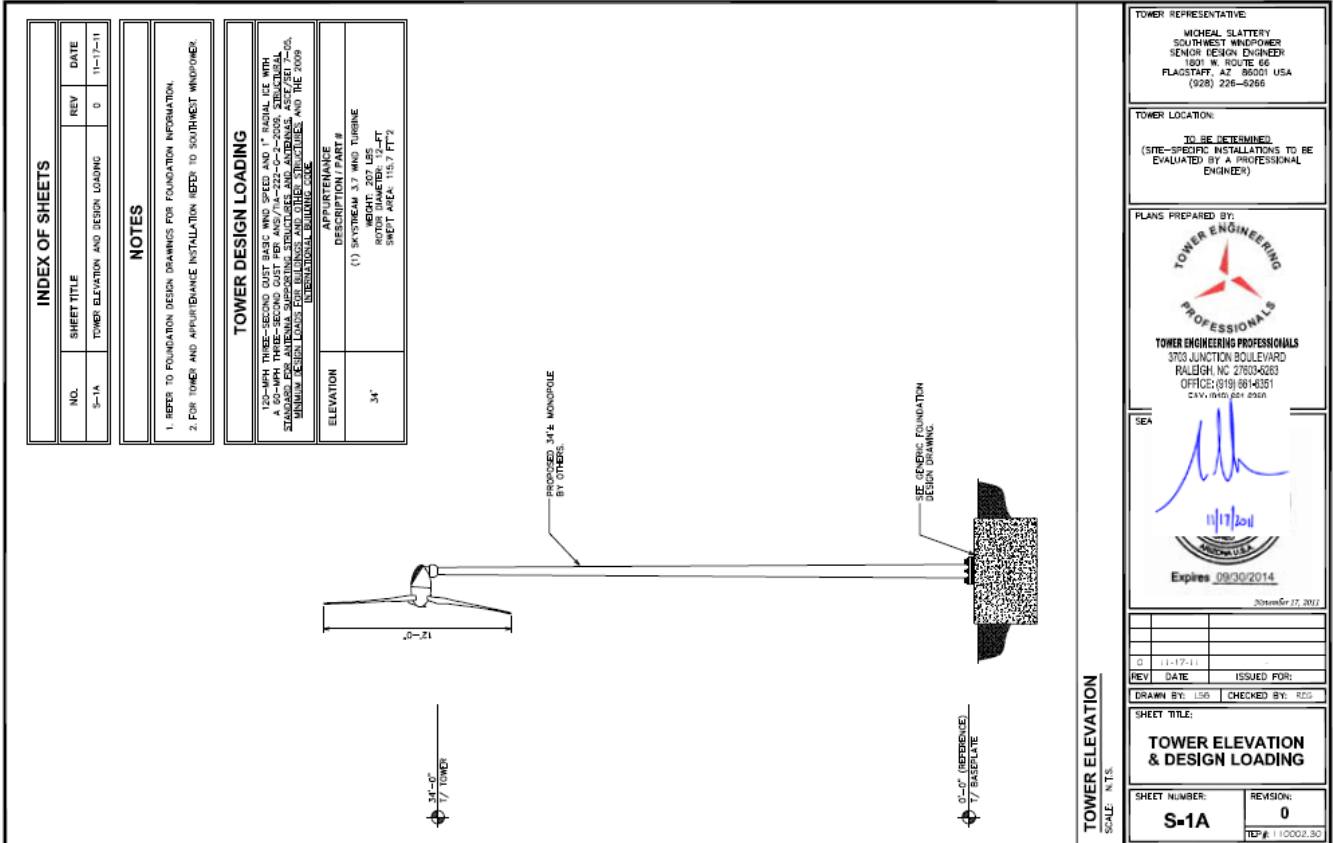
- First tighten each nut to a “snug tight” condition to secure the tower to the foundation. “Snug Tight” is defined as the tightness attained by a “few” impacts of an impact wrench or the full effort of a man using an ordinary spud wrench.
- Following the initial snug tightening, tighten each nut an additional 1/3 turn.

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Skystream 3.7

APPENDIX A: 34 ft (10.4 m) Sectional Monopole Tower Foundations





P/N: 3-CMLT-1415

REV A

**ATTENTION**

THE FOUNDATION DESIGNS ARE IN ACCORDANCE WITH THE 2006/2009 INTERNATIONAL BUILDING CODE, IBC-222-G-2-2009 STRUCTURAL STANDARD FOR ANTENNA SUPPORTING STRUCTURES AND ANTENNAS, AND ASCE 7-05, MINIMUM DESIGN LOADS FOR BUILDINGS AND OTHER STRUCTURES. THE FOUNDATION DESIGNS ARE FOR A 34-FT [10.4M] MONOPOLE (34-17) WITH THE SKYSTREAM 3.7 WIND TURBINE BASED ON THE SOIL INFORMATION LISTED IN TABLE 1804.2/1806.2 (IBC 2006/2009 RESPECTIVELY) REFERENCED ON SHEET S-1 AND THE WIND ZONES DESCRIBED ON SHEET S-2. IT IS THE RESPONSIBILITY OF THE OWNER TO VERIFY BY GEOTECHNICAL INVESTIGATION THAT ACTUAL SOIL PARAMETERS MEET OR EXCEED THOSE SHOWN IN THE REFERENCED TABLE. IF CONDITIONS OTHER THAN THOSE DESCRIBED IN THE REFERENCED TABLE ARE ENCOUNTERED A FOUNDATION ANALYSIS SHOULD BE PERFORMED TO DETERMINE THE STRUCTURAL ADEQUACY OF THE SUBSTRUCTURE.

INDEX OF SHEETS

NO.	SHEET TITLE	REV	DATE
T-1	TITLE SHEET	2	11-17-11
N-1	PROJECT NOTES I	2	11-17-11
N-2	PROJECT NOTES II	2	11-17-11
S-1	TABLE 1804.2/1806.2 PRESUMPTIVE LOAD-BEARING VALUES (IBC 2006/2009)	2	11-17-11
S-2	WIND ZONES AND TOWER REACTIONS	2	11-17-11
S-3A	34-FT [10.4M] MONOPOLE (34-17) FOUNDATION - WIND ZONE 2	2	11-17-11
S-3B	34-FT [10.4M] MONOPOLE (34-17) FOUNDATION - WIND ZONE 3	2	11-17-11
S-4	34-FT [10.4M] MONOPOLE (34-17) FOUNDATION (ALTERNATIVE) - PIER	2	11-17-11
S-5	34-FT [10.4M] MONOPOLE (34-17) FOUNDATION DIMENSIONS - PIER	2	11-17-11

SE

Expires 09/30/2014
November 17, 2011



PROJECT INFORMATION:
**34-FT [10.4M]
MONOPOLE (34-17)
FOUNDATIONS**
Skystream 3.7



2	11-17-2011
1	11-16-2011
0	12-18-2008
REV	DATE

DRAWN BY: LSS	CHECKED BY: REG
SHEET NUMBER: T-1	REVISION: 2
	TEP #: 110002.30

P/N: 3-CMLT-1415

REV A

GENERAL NOTES:

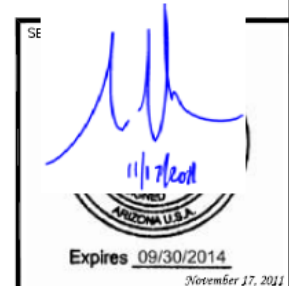
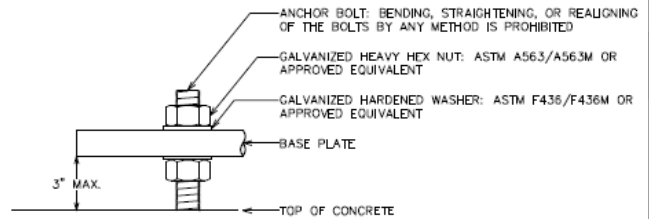
1. ALL WORK PRESENTED ON THESE DRAWINGS MUST BE COMPLETED BY THE CONTRACTOR UNLESS NOTED OTHERWISE.
2. THE CONTRACTOR MUST HAVE CONSIDERABLE EXPERIENCE IN PERFORMANCE OF WORK SIMILAR TO THAT DESCRIBED HEREIN. BY ACCEPTANCE OF THIS ASSIGNMENT, THE CONTRACTOR IS ATTESTING THAT HE DOES HAVE SUFFICIENT EXPERIENCE AND ABILITY, THAT HE IS KNOWLEDGEABLE OF THE WORK TO BE PERFORMED, AND THAT HE IS PROPERLY LICENSED AND PROPERLY REGISTERED TO DO THIS WORK IN THE APPLICABLE STATE/TERRITORY.
3. ALL HARDWARE ASSEMBLY MANUFACTURER'S INSTRUCTIONS SHALL BE FOLLOWED EXACTLY AND SHALL SUPERSEDE ANY CONFLICTING NOTES ENCLOSED HEREIN.
4. IT IS THE CONTRACTOR'S SOLE RESPONSIBILITY TO DETERMINE ERECTION PROCEDURE AND SEQUENCE TO INSURE THE SAFETY OF THE STRUCTURE AND ITS COMPONENT PARTS DURING ERECTION. THIS INCLUDES, BUT IS NOT LIMITED TO, THE ADDITION OF TEMPORARY BRACING, GUYS OR TIE DOWNS THAT MAY BE NECESSARY. SUCH MATERIAL SHALL BE REMOVED AND SHALL REMAIN THE PROPERTY OF THE CONTRACTOR AFTER THE COMPLETION OF THE PROJECT.
5. ALL MATERIALS AND EQUIPMENT FURNISHED SHALL BE NEW AND OF GOOD QUALITY, FREE FROM FAULTS AND DEFECTS, AND IN CONFORMANCE WITH THE CONTRACT DOCUMENTS. ANY AND ALL SUBSTITUTIONS MUST BE PROPERLY APPROVED AND AUTHORIZED IN WRITING BY THE OWNER AND ENGINEER PRIOR TO INSTALLATION. THE CONTRACTOR SHALL FURNISH SATISFACTORY EVIDENCE AS TO THE KIND AND QUALITY OF THE MATERIALS AND EQUIPMENT BEING SUBSTITUTED.
6. THE CONTRACTOR SHALL BE RESPONSIBLE FOR INITIATING, MAINTAINING, AND SUPERVISING ALL SAFETY PRECAUTIONS AND PROGRAMS IN CONNECTION WITH THE WORK.
7. THE CONTRACTOR IS RESPONSIBLE FOR INSURING THAT THIS PROJECT AND RELATED WORK COMPLIES WITH ALL APPLICABLE LOCAL, STATE, AND FEDERAL SAFETY CODES AND REGULATIONS GOVERNING THIS WORK. THE CONTRACTOR SHALL SECURE ALL NECESSARY PERMITS FOR THIS PROJECT FROM ALL APPLICABLE GOVERNMENTAL AGENCIES. ALL PERMITS THAT MUST BE OBTAINED ARE THE RESPONSIBILITY OF THE CONTRACTOR. THE CONTRACTOR WILL BE RESPONSIBLE FOR ABIDING BY ALL CONDITIONS AND REQUIREMENTS OF THE PERMITS.
8. THE CONTRACTOR IS REQUIRED TO MAINTAIN ALL PIPES, DITCHES, AND OTHER DRAINAGE STRUCTURES FREE FROM OBSTRUCTION UNTIL WORK IS ACCEPTED BY THE OWNER. THE CONTRACTOR IS RESPONSIBLE FOR ANY DAMAGES CAUSED BY FAILURE TO MAINTAIN DRAINAGE STRUCTURE IN OPERABLE CONDITION.
9. ALL MATERIALS AND WORKMANSHIP SHALL BE WARRANTED FOR ONE YEAR FROM ACCEPTANCE DATE.

CONNECTION NOTES:

1. OVERSIZED (ROUND) BASE PLATE HOLES SHALL HAVE APPROVED F436 (F436M FOR METRIC) WASHERS INSTALLED, BOTH ABOVE AND BELOW THE BASE PLATE, ON EACH ANCHOR.
2. SLOTTED BASE PLATE HOLES SHALL HAVE EITHER APPROVED F436 (F436M FOR METRIC) WASHERS, OR PLATE WASHERS INSTALLED, BOTH ABOVE AND BELOW THE BASE PLATE, ON EACH ANCHOR. WASHERS SHALL BE SIZED TO COVER THE ENTIRE SLOTTED HOLES. PLATE WASHERS SHALL BE OF ASTM A36 MATERIAL (MINIMUM) AND HAVE A MINIMUM THICKNESS OF 5/16" (8mm).
3. AN APPROVED NUT LOCKING DEVICE SHALL BE INSTALLED ON ALL BOLTED CONNECTIONS TO PREVENT NUT LOOSENING.

BASE INSTALLATION DETAIL:

*AN APPROVED NUT-LOCKING DEVICE SHALL BE USED.



PROJECT INFORMATION:
34-FT [10.4M]
MONOPOLE (34-17)
FOUNDATIONS
 Skystream 3.7

SOUTHWEST
 WIND ENERGY
 1801 West Route 66
 Flagstaff, AZ 86001
 Office: (928) 779-9463
www.windenergy.com

2	11-17-2011
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DRAWN BY: LSS	CHECKED BY: REG
SHEET NUMBER: N-1	REVISION: 2
	TEP#: 110002.30

P/N: 3-CMLT-1415

REV A

REINFORCING STEEL NOTES:

1. THE REINFORCING STEEL SHALL CONFORM TO THE REQUIREMENTS OF ASTM A-615, GRADE 60 [EU GRADE 420] IT SHALL BE DEFORMED AND SPLICES SHALL NOT BE ALLOWED UNLESS OTHERWISE NOTED.
2. WELDING IS PROHIBITED ON REINFORCING STEEL AND EMBEDMENTS.
3. REINFORCING CAGES SHALL BE BRACED TO RETAIN PROPER DIMENSIONS DURING HANDLING AND THROUGHOUT PLACEMENT OF CONCRETE. WHEN TEMPORARY CASING IS UTILIZED, BRACING SHALL BE ADEQUATE TO RESIST FORCES OCCURRING FROM FLOWING CONCRETE DURING CASING EXTRACTION.
4. SPACERS SHALL BE ATTACHED INTERMITTENTLY THROUGHOUT THE ENTIRE LENGTH OF TIEBACK REINFORCING TO INSURE CONCENTRIC PLACEMENT OF CAGES IN EXCAVATIONS.
5. MINIMUM CONCRETE COVER FOR REINFORCEMENT SHALL BE 3" [75mm] IF CAST IN PLACE AND 2" [50mm] COVER IF FORMWORK IS USED AS DEFINED IN ACI 318 SECTION 7.7.1. APPROVED SPACERS SHALL BE USED TO INSURE APPROPRIATE COVER ON REINFORCEMENT.
6. IN REGIONS OF HIGH SEISMIC RISK, ASSIGNED TO SEISMIC DESIGN CATEGORIES C, D, E, AND F, ADDITIONAL TERMINATION DETAILS ARE REQUIRED FOR STEEL REINFORCING BARS. FURTHER, ADDITIONAL DETAILING REQUIREMENTS MAY BE REQUIRED IN OTHER, LESS PRONE AREAS AS REQUIRED BY THE AUTHORITY HAVING JURISDICTION (AHJ).
 - A. SEISMIC HOOKS SHALL BE USED TO TERMINATE STIRRUPS, HOOPS, OR CROSSTIES AS DERIVED PER ACI 318.
 - B. LONGITUDINAL REINFORCING BARS ARE REQUIRED TO HAVE BOTH A STANDARD BEND AND HOOK EXTENSION (MIN. OF 12 BAR DIAMETERS) AT EACH END AS DEFINED PER ACI 318.

CONCRETE NOTES:

1. WORK SHALL BE IN ACCORDANCE WITH THE LATEST REVISION OF THE ACI-318, "BUILDING CODE REQUIREMENTS FOR STRUCTURAL CONCRETE."
2. THE CONCRETE SHALL DEVELOP A MINIMUM COMPRESSIVE STRENGTH OF 2,500 PSI [17230 kPa] IN 28-DAYS. HOWEVER, A MINIMUM COMPRESSIVE STRENGTH OF 3,000 PSI TO 4,500 PSI IN 28-DAYS SHALL BE USED IN LOCATIONS WITH MODERATE TO SEVERE SULFATE EXPOSURE UNLESS OTHERWISE REQUIRED BY THE LOCAL JURISDICTION. IN AREAS OF HIGH SEISMIC RISK AS DEFINED ABOVE, A MINIMUM COMPRESSIVE STRENGTH OF 3,000-PSF SHALL BE ACHIEVED.
3. PROPORTIONS OF CONCRETE MATERIALS SHALL BE SUITABLE FOR THE INSTALLATION METHOD UTILIZED AND SHALL RESULT IN DURABLE CONCRETE FOR RESISTANCE TO LOCAL ANTICIPATED AGGRESSIVE ACTIONS. THE DURABILITY REQUIREMENTS OF ACI-318 SHALL BE SATISFIED BASED ON THE CONDITIONS EXPECTED AT THE SITE.
4. CONCRETE SHALL BE PLACED IN A MANNER THAT WILL PREVENT SEGREGATION OF CONCRETE MATERIALS, INFILTRATION OF WATER OR SOIL, AND OTHER OCCURRENCES THAT MAY DECREASE THE STRENGTH OR DURABILITY OF THE FOUNDATION.
5. FREE FALL CONCRETE MAY BE USED PROVIDED FALL IS VERTICAL DOWN WITHOUT HITTING THE SIDES OF THE EXCAVATION, FORMWORK, REINFORCING BARS, FORM TIES, CAGE BRACING, OR OTHER OBSTRUCTIONS. UNDER NO CIRCUMSTANCES SHALL CONCRETE FALL THROUGH WATER.
6. THE MAXIMUM SIZE OF THE AGGREGATE SHALL NOT EXCEED A SIZE SUITABLE FOR THE INSTALLATION METHOD UTILIZED OR 1/3-CLEAR DISTANCE BEHIND OR BETWEEN REINFORCING. THE MAXIMUM SIZE MAY BE INCREASED TO 2/3-CLEAR DISTANCE PROVIDED WORKABILITY AND METHODS OF CONSOLIDATION SUCH AS VIBRATING WILL PREVENT HONEYCOMBS AND VOIDS.

CONCRETE NOTES (CONTINUED):

7. IF THE FROST LINE IS KNOWN TO BE GREATER THAN THE FOUNDATION DEPTH OR THE WATER TABLE IS LESS THAN THE FOUNDATION DEPTH, THE DESIGN ENGINEER (TOWER ENGINEERING PROFESSIONALS, INC.) SHALL BE NOTIFIED PRIOR TO CONSTRUCTION AND A FOUNDATION ANALYSIS OR RE-DESIGN SHALL BE PERFORMED.



PROJECT INFORMATION:
**34-FT [10.4M]
 MONOPOLE (34-17)
 FOUNDATIONS**
 Skystream 3.7



2	11-17-2011
1	11-16-2011
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DRAWN BY: LSS	CHECKED BY: REG
SHEET NUMBER: N-2	REVISION: 2
	TEP#: 110002.30

TABLE 1804.2/1806.2 PRESUMPTIVE LOAD-BEARING VALUES (IBC 2006/2009)

SOIL CLASS	DESCRIPTION	ALLOWABLE FOUNDATION PRESSURE	LATERAL BEARING (BELOW NATURAL GRADE)	LATERAL SLIDING		ASSUMED UNIT WEIGHT W/O WATER	ASSUMED INTERNAL ANGLE OF FRICTION
				COEFF. OF FRICTION	RESISTANCE		
1	CRYSTALLINE BEDROCK	12,000 psf	1,200 psf/ft	0.70	—	140 pcf	0°
		574.56 kPa	188.50 kPa/m			22 kN/m ³	
2	SEDIMENTARY AND FOLIATED ROCK	4,000 psf	400 psf/ft	0.35	—	130 pcf	0°
		191.52 kPa	62.83 kPa/m			20 kN/m ³	
3	SANDY GRAVEL AND/OR GRAVEL (GW AND GP)	3,000 psf	200 psf/ft	0.35	—	120 pcf	32°
		143.64 kPa	31.42 kPa/m			19 kN/m ³	
4	SAND, SILTY SAND, CLAYEY SAND, SILTY GRAVEL, AND CLAYEY GRAVEL (SW,SP,SM,SC,GM AND GC)	2,000 psf	150 psf/ft	0.25	—	100 pcf	26°
		95.76 kPa	23.56 kPa/m			16 kN/m ³	
5	CLAY, SANDY CLAY, SILTY CLAY, CLAYEY SILT, SILT AND SANDY SILT (CL, ML, MH AND CH)	1,500 psf	100 psf/ft	—	130 psf	90 pcf	0°
		71.82 kPa	15.71 kPa/m		6.22 kPa	14 kN/m ³	



PROJECT INFORMATION:
**34-FT [10.4M]
 MONOPOLE (34-17)
 FOUNDATIONS**
 Skystream 3.7



2	11-17-2011
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REV	DATE

DRAWN BY: LSS	CHECKED BY: REG
SHEET NUMBER: S-1	REVISION: 2
	TEP#: 110002.30

P/N: 3-CMLT-1415

REV A

REFERENCED DOCUMENTS:

1. TOWER DESIGN DRAWINGS BY A.R.E. DATED MARCH 22, 2010, SWWP PN: 3-CMBP-3218-10, QUOTATION #: W09027, VERSION: E, DESCRIPTION: 34' 3 SECTIONS TOWER
2. DRAWING BY SWWP (NO DATE), DWG. NO.: 3-CMBP-3218-10-SS47-34FT-TOWER
3. DOCUMENT BY SWWP DATED NOVEMBER 10, 2011, TITLE: SKYSTREAM 3.7 TOWER TOP LOAD SUMMARY REV.D.PDF

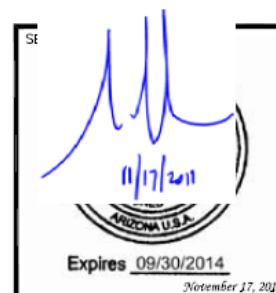
TOWER REACTIONS - 34' [10.4M] MONOPOLE (34-17)

ZONE	MAXIMUM LOADING CRITERIA	FACTORED ** MOMENT	FACTORED ** SHEAR	FACTORED VERTICAL
2	SKYSTREAM WIND TURBINE 120 MPH & 60 MPH W/ 1"-ICE [54 m/sec & 26.8 m/sec w/ 25.4mm-ICE]	48.6 kip-ft	1.77 kips	0.87 kips
		65.9 kN-m	7.87 kN	3.87 kN
3	SKYSTREAM WIND TURBINE 90 MPH & 60 MPH W/ 1"-ICE [40 m/sec & 26.8 m/sec w/ 25.4mm-ICE]	29.3 kip-ft	1.06 kips	0.87 kips
		39.7 kN-m	4.71 kN	3.87 kN

** THE REACTIONS LISTED ARE FOR REFERENCE ONLY AND SHOULD NOT BE SUBSTITUTED FOR A STRUCTURAL ANALYSIS BASED ON SITE-SPECIFIC DATA.

WIND ZONES

ZONE	WIND SPEED
2	90 - 120 MPH [40 - 54 m/sec]
3	≤ 90 MPH [≤ 40 m/sec]



PROJECT INFORMATION:

**34-FT [10.4M]
MONOPOLE (34-17)
FOUNDATIONS**
Skystream 3.7



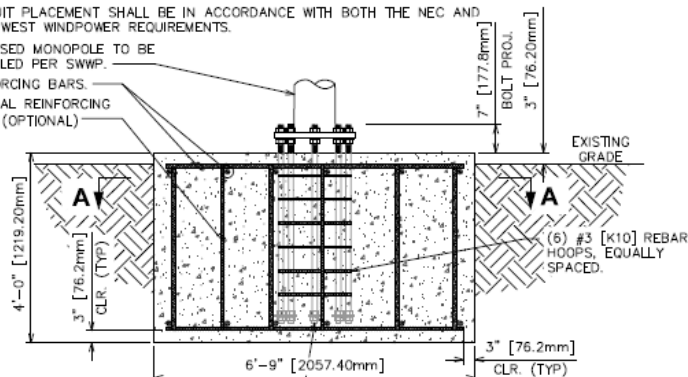
2	11-17-2011
1	11-16-2011
0	12-18-2008
REV	DATE

DRAWN BY: LSS	CHECKED BY: REG
SHEET NUMBER: S-2	REVISION: 2
	TEP#: 110002.30

NOTES:

1. THE FOUNDATION DESIGNS ARE BASED ON THE SOIL INFORMATION LISTED IN TABLE 1804.2/1805.2 (IBC 2006/2009) REFERENCED ON SHEET S-1. IT IS THE RESPONSIBILITY OF THE OWNER TO VERIFY BY GEOTECHNICAL INVESTIGATION THAT ACTUAL SITE SOIL PARAMETERS EQUAL OR EXCEED THOSE SHOWN IN THE REFERENCED TABLE. IF CONDITIONS OTHER THAN THOSE DESCRIBED IN THE REFERENCED TABLE ARE ENCOUNTERED A FOUNDATION ANALYSIS SHOULD BE PERFORMED TO DETERMINE THE STRUCTURAL ADEQUACY OF THE SUBSTRUCTURE.
2. FOUNDATION WIDTH IS BASED ON WIND ZONES 2 AND 3, SEE SHEETS S-3A AND S-3B FOR APPROPRIATE SIZES.
3. IF THE PROPOSED AREA IS FOUND TO CONTAIN FILL MATERIALS, THE EXCAVATION SHALL EXTEND TO THE VIRGIN SAND LAYER AND BE BACKFILLED WITH COMPACTED SAND OR STONE. AFTER EXCAVATION AND PRIOR TO FILL OR CONCRETE PLACEMENT, THE SURFACE OF THE VIRGIN SAND LAYER SHOULD BE MECHANICALLY COMPACTED TO DENSIFY THE SURFACE DISTURBED DURING THE EXCAVATION.
4. ALL BACKFILL SHOULD BE PLACED IN MAXIMUM LOOSE LIFTS OF 8" AND COMPACTED TO A MINIMUM 95% OF ASTM D-1557.
5. TOWER GROUNDING SHALL BE PERFORMED IN ACCORDANCE WITH NEC REQUIREMENTS.
6. CONDUIT PLACEMENT SHALL BE IN ACCORDANCE WITH BOTH THE NEC AND SOUTHWEST WINDPOWER REQUIREMENTS.

PROPOSED MONOPOLE TO BE
INSTALLED PER SWWP.
REINFORCING BARS.
VERTICAL REINFORCING
BARS. (OPTIONAL)

**FOUNDATION - WIND ZONE 2**

SCALE: $\frac{3}{8}" = 1'-0"$ [9.5mm = 304.8mm]

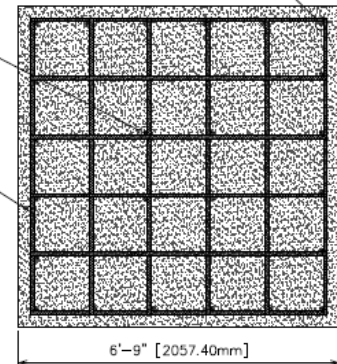
(8) M33 x 1067mm [1 $\frac{1}{4}" \phi$ x 42"] LONG ANCHOR BOLTS (F1554 GR. 55 OR APPROVED EQUAL) ON 17" ϕ [432mm] BOLT CIRCLE. EACH ANCHOR BOLT SHALL BE EMBEDDED WITH A HARDENED WASHER BETWEEN TWO (2) NUTS SECURED BY DEFORMING THREADS. AS A MINIMUM, WASHERS SHALL BE ASTM F436 CIRCULAR WASHERS: MINIMUM O.D.=2 $\frac{3}{4}" \phi$ [70mm], MAX I.D.=1 $\frac{1}{2}" \phi$ [38mm], MINIMUM THICKNESS OF 0.136" [3.45mm].

DESIGN IS BASED ON SOIL CLASS 5:
 $q_{all} = 1500 \text{ psf}$ [71.82 kPa]

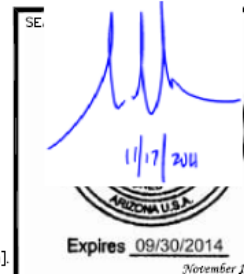
#8 [K25] VERTICAL REINFORCING BARS (OPTIONAL) IN CENTER PLACED AS SHOWN. (4 TOTAL)

(6) #8 [K25] REINFORCING BARS SPACED AS SHOWN EACH WAY, TOP AND BOTTOM (24 TOTAL). ADJUST BARS AS REQUIRED FOR CLEARANCE WITH ANCHOR BOLTS. BAR SPACING SHALL NOT EXCEED 18".

#8 [K25] VERTICAL REINFORCING BARS (OPTIONAL) SPACED EQUALLY AS SHOWN (20 TOTAL) PLACED AS SHOWN.

**SECTION A-A**

SCALE: $\frac{3}{8}" = 1'-0"$ [9.5mm = 304.8mm]



November 17, 2014



TOWER ENGINEERING PROFESSIONALS
3703 JUNCTION BOULEVARD
RALEIGH, NC 27603-5263
(919) 881-6361

PROJECT INFORMATION:

**34-FT [10.4M]
MONOPOLE (34-17)
FOUNDATIONS**
Skystream 3.7



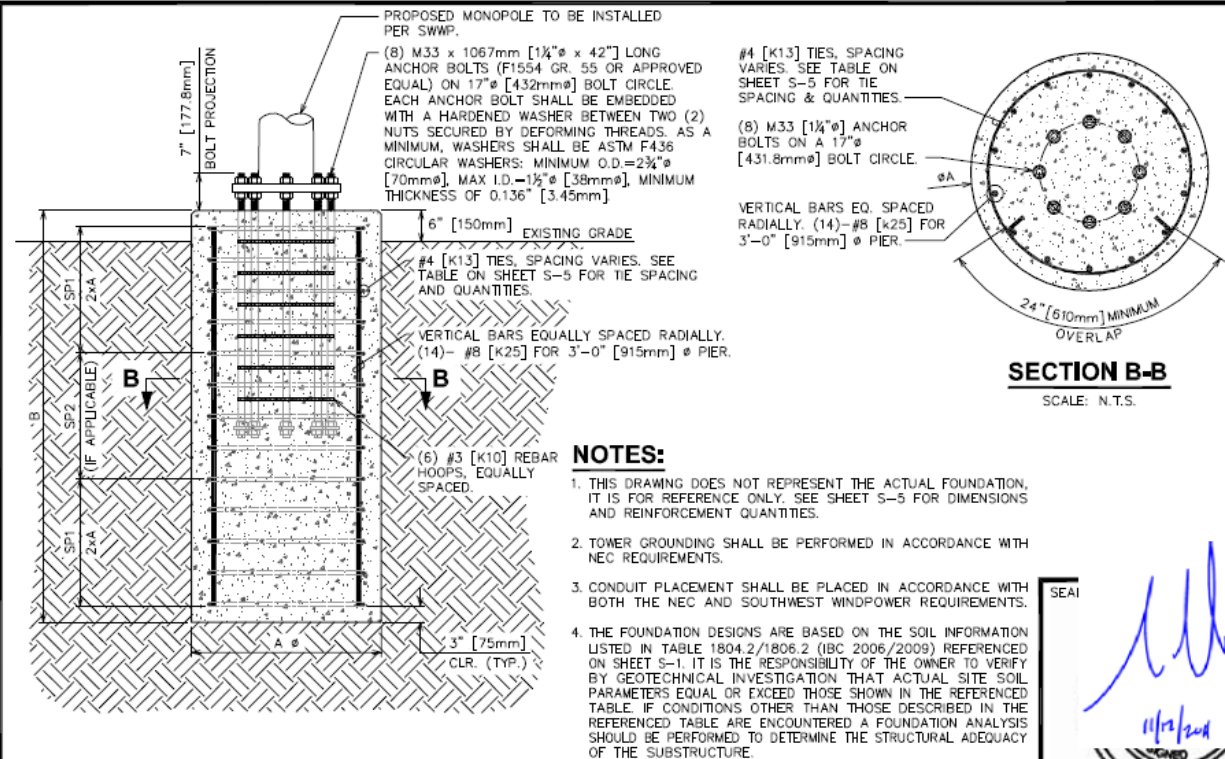
**SOUTHWEST
WINDPOWER**
1801 West Route 66
Flagstaff, AZ 86001
Office: (928) 779-9463
www.windenergy.com

REV	DATE
2	11-17-2011
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DRAWN BY: LSS	CHECKED BY: REG
SHEET NUMBER: S-3A	REVISION: 2
	TEP#: 110002.30

P/N: 3-CMLT-1415

REV A



FOUNDATION ALTERNATIVE - PIER

SCALE: N.T.S.

SEAL

[Signature]

11/17/2011

REGISTERED PROFESSIONAL ENGINEER

ARIZONA U.S.A.

Expires 09/30/2014

November 17, 2011

 TOWER ENGINEERING PROFESSIONALS 3703 JUNCTION BOULEVARD RALEIGH, NC 27609-5263 (919) 661-6351	PROJECT INFORMATION: 34-FT [10.4M] MONOPOLE (34-17) FOUNDATIONS Skystream 3.7	 SOUTHWEST WINDPOWER 1801 West Route 66 Flagstaff, AZ 86001 Office: (928) 779-9463 www.windenergy.com		DRAWN BY: LSS	CHECKED BY: REG		
			2	11-17-2011	SHEET NUMBER: S-4	REVISION: 2	
			1	11-16-2011			TEP#: 110002.30
			0	12-18-2008			
			REV	DATE			

P/N: 3-CMLT-1415

REV A

34-FT [10.4M] MONOPOLE (34-17) FOUNDATION DIMENSIONS - PIER								
ZONE	SOIL CLASS	DIMENSION		VERTICAL REINF.		TIE SPACING		#4 [K13] TIE QUANTITY
		A	B	SIZE	QTY.	SP1	SP2	
2	3	3'-0" [915mm]	9'-0" [2743mm]	#8 [K25]	14	6"± [150mm] O.C.	N/A	18
	4	3'-0" [915mm]	9'-6" [2896mm]	#8 [K25]	14	6"± [150mm] O.C.	N/A	19
	5	3'-0" [915mm]	11'-0" [3353mm]	#8 [K25]	14	6"± [150mm] O.C.	N/A	22
ZONE	SOIL CLASS	DIMENSION		VERTICAL REINF.		TIE SPACING		#4 [K13] TIE QUANTITY
		A	B	SIZE	QTY.	SP1	SP2	
3	3	3'-0" [915mm]	7'-6" [2286mm]	#8 [K25]	14	6"± [150mm] O.C.	N/A	15
	4	3'-0" [915mm]	8'-0" [2438mm]	#8 [K25]	14	6"± [150mm] O.C.	N/A	16
	5	3'-0" [915mm]	9'-6" [2896mm]	#8 [K25]	14	6"± [150mm] O.C.	N/A	19

SE.



11/17/2011

ARIZONA U.S.A.

Expires 09/30/2014

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PROJECT INFORMATION:
**34-FT [10.4M]
MONOPOLE (34-17)
FOUNDATIONS**
Skystream 3.7

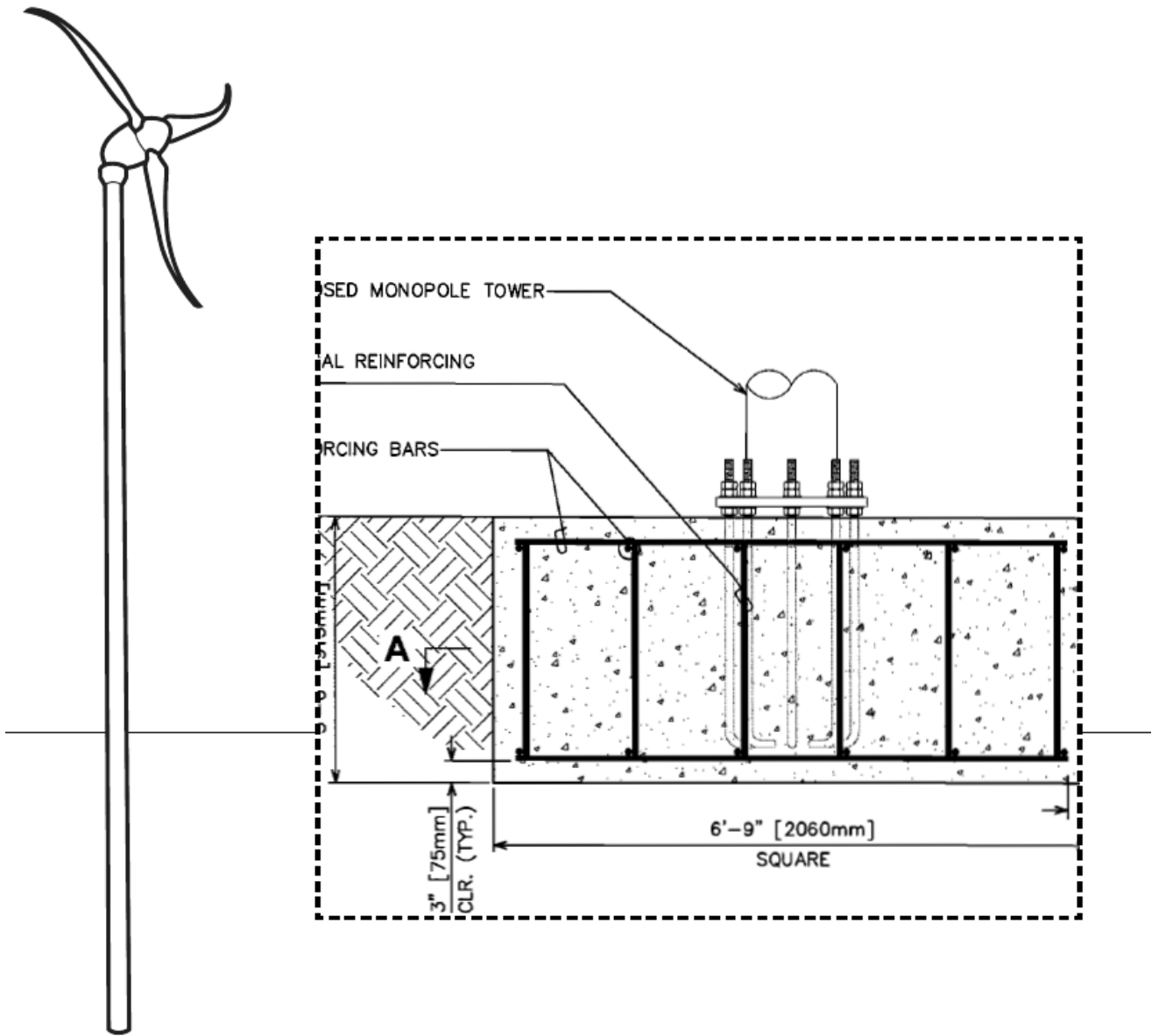


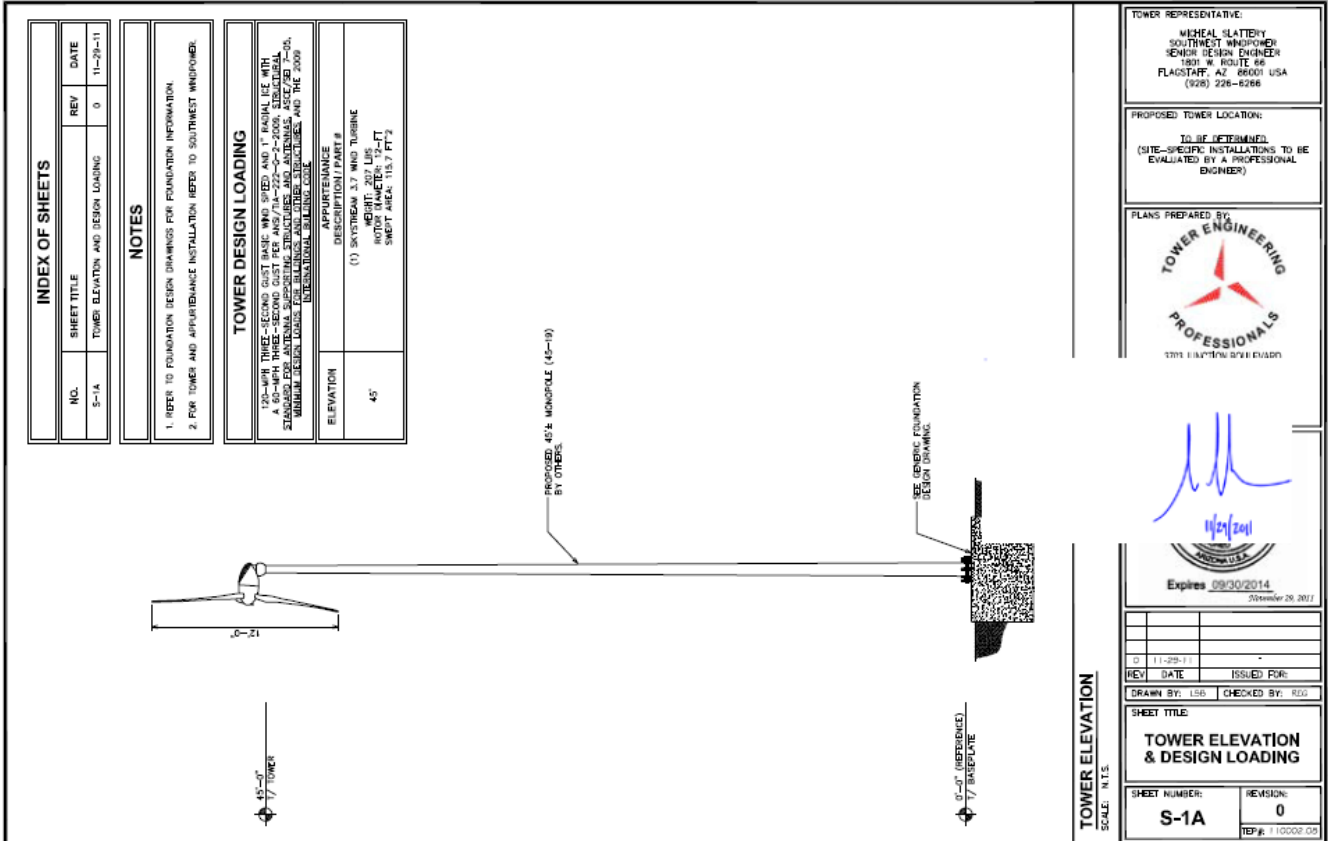
2	11-17-2011
1	11-16-2011
0	12-18-2008
REV	DATE

DRAWN BY: LSB	CHECKED BY: REG
SHEET NUMBER: S-5	REVISION: 2
	TEP#: 110002.30

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SKYSTREAM 3.7
Appendix B: 45 ft (13.7 m) Sectional Monopole Tower Foundations





P/N: 3-CMLT-1417

REV A



SOUTHWEST
WINDPOWER

SKYSTREAM 3.7


ATTENTION

THE FOUNDATION DESIGNS ARE IN ACCORDANCE WITH THE 2006/2009 INTERNATIONAL BUILDING CODE, TIA-222-G-2-2009 STRUCTURAL STANDARD FOR ANTENNA SUPPORTING STRUCTURES AND ANTENNAS, AND ASCE 7-05, MINIMUM DESIGN LOADS FOR BUILDINGS AND OTHER STRUCTURES. THE FOUNDATION DESIGNS ARE FOR A 45-FT [13.7M] MONOPOLE (45-19) WITH THE SKYSTREAM 3.7 WIND TURBINE BASED ON THE SOIL INFORMATION LISTED IN TABLE 1804.2/1806.2 (IBC 2006/2009 RESPECTIVELY) REFERENCED ON SHEET S-1 AND THE WIND ZONES DESCRIBED ON SHEET S-2. IT IS THE RESPONSIBILITY OF THE OWNER TO VERIFY BY GEOTECHNICAL INVESTIGATION THAT ACTUAL SOIL PARAMETERS MEET OR EXCEED THOSE SHOWN IN THE REFERENCED TABLE. IF CONDITIONS OTHER THAN THOSE DESCRIBED IN THE REFERENCED TABLE ARE ENCOUNTERED A FOUNDATION ANALYSIS SHOULD BE PERFORMED TO DETERMINE THE STRUCTURAL ADEQUACY OF THE SUBSTRUCTURE.

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SE



11/29/2011

Expires 09/30/2014
November 29, 2011



PROJECT INFORMATION:
**45-FT [13.7M]
MONOPOLE (45-19)
FOUNDATIONS**
Skystream 3.7



4	11-29-2011
3	04-07-2011
2	03-15-2011
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REV	DATE

DRAWN BY: LSS	CHECKED BY: REG
SHEET NUMBER: T-1	REVISION: 4
	TEP#: 110002.06

P/N: 3-CMLT-1417

REV A

GENERAL NOTES:

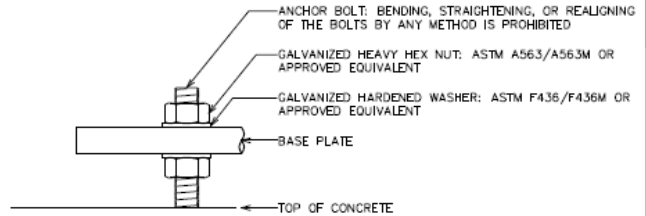
1. ALL WORK PRESENTED ON THESE DRAWINGS MUST BE COMPLETED BY THE CONTRACTOR UNLESS NOTED OTHERWISE.
2. THE CONTRACTOR MUST HAVE CONSIDERABLE EXPERIENCE IN PERFORMANCE OF WORK SIMILAR TO THAT DESCRIBED HEREIN. BY ACCEPTANCE OF THIS ASSIGNMENT, THE CONTRACTOR IS ATTESTING THAT HE DOES HAVE SUFFICIENT EXPERIENCE AND ABILITY, THAT HE IS KNOWLEDGEABLE OF THE WORK TO BE PERFORMED, AND THAT HE IS PROPERLY LICENSED AND PROPERLY REGISTERED TO DO THIS WORK IN THE APPLICABLE STATE/TERRITORY.
3. ALL HARDWARE ASSEMBLY MANUFACTURER'S INSTRUCTIONS SHALL BE FOLLOWED EXACTLY AND SHALL SUPERSEDE ANY CONFLICTING NOTES ENCLOSED HEREIN.
4. IT IS THE CONTRACTOR'S SOLE RESPONSIBILITY TO DETERMINE ERECTION PROCEDURE AND SEQUENCE TO INSURE THE SAFETY OF THE STRUCTURE AND ITS COMPONENT PARTS DURING ERECTION. THIS INCLUDES, BUT IS NOT LIMITED TO, THE ADDITION OF TEMPORARY BRACING, GUYS OR TIE DOWNS THAT MAY BE NECESSARY. SUCH MATERIAL SHALL BE REMOVED AND SHALL REMAIN THE PROPERTY OF THE CONTRACTOR AFTER THE COMPLETION OF THE PROJECT.
5. ALL MATERIALS AND EQUIPMENT FURNISHED SHALL BE NEW AND OF GOOD QUALITY, FREE FROM FAULTS AND DEFECTS, AND IN CONFORMANCE WITH THE CONTRACT DOCUMENTS. ANY AND ALL SUBSTITUTIONS MUST BE PROPERLY APPROVED AND AUTHORIZED IN WRITING BY THE OWNER AND ENGINEER PRIOR TO INSTALLATION. THE CONTRACTOR SHALL FURNISH SATISFACTORY EVIDENCE AS TO THE KIND AND QUALITY OF THE MATERIALS AND EQUIPMENT BEING SUBSTITUTED.
6. THE CONTRACTOR SHALL BE RESPONSIBLE FOR INITIATING, MAINTAINING, AND SUPERVISING ALL SAFETY PRECAUTIONS AND PROGRAMS IN CONNECTION WITH THE WORK.
7. THE CONTRACTOR IS RESPONSIBLE FOR INSURING THAT THIS PROJECT AND RELATED WORK COMPLIES WITH ALL APPLICABLE LOCAL, STATE, AND FEDERAL SAFETY CODES AND REGULATIONS GOVERNING THIS WORK. THE CONTRACTOR SHALL SECURE ALL NECESSARY PERMITS FOR THIS PROJECT FROM ALL APPLICABLE GOVERNMENTAL AGENCIES. ALL PERMITS THAT MUST BE OBTAINED ARE THE RESPONSIBILITY OF THE CONTRACTOR. THE CONTRACTOR WILL BE RESPONSIBLE FOR ABIDING BY ALL CONDITIONS AND REQUIREMENTS OF THE PERMITS.
8. THE CONTRACTOR IS REQUIRED TO MAINTAIN ALL PIPES, DITCHES, AND OTHER DRAINAGE STRUCTURES FREE FROM OBSTRUCTION UNTIL WORK IS ACCEPTED BY THE OWNER. THE CONTRACTOR IS RESPONSIBLE FOR ANY DAMAGES CAUSED BY FAILURE TO MAINTAIN DRAINAGE STRUCTURE IN OPERABLE CONDITION.
9. ALL MATERIALS AND WORKMANSHIP SHALL BE WARRANTED FOR ONE YEAR FROM ACCEPTANCE DATE.

CONNECTION NOTES:

1. OVERSIZED (ROUND) BASE PLATE HOLES SHALL HAVE APPROVED F436 (F436M FOR METRIC) WASHERS INSTALLED, BOTH ABOVE AND BELOW THE BASE PLATE, ON EACH ANCHOR.
2. SLOTTED BASE PLATE HOLES SHALL HAVE EITHER APPROVED F436 (F436M FOR METRIC) WASHERS, OR PLATE WASHERS INSTALLED, BOTH ABOVE AND BELOW THE BASE PLATE, ON EACH ANCHOR. WASHERS SHALL BE SIZED TO COVER THE ENTIRE SLOTTED HOLES. PLATE WASHERS SHALL BE OF ASTM A36 MATERIAL (MINIMUM) AND HAVE A MINIMUM THICKNESS OF 5/16" (8mm).
3. AN APPROVED NUT LOCKING DEVICE SHALL BE INSTALLED ON ALL BOLTED CONNECTIONS TO PREVENT NUT LOOSENING.

BASE INSTALLATION DETAIL:

*AN APPROVED NUT-LOCKING DEVICE SHALL BE USED.



SE.

[Signature]
11/29/2011
AZ
ARIZONA U.S.A.

Expires 09/30/2014

November 29, 2011



TOWER ENGINEERING PROFESSIONALS
3703 JUNCTION BOULEVARD
RALEIGH, NC 27603-5263
(919) 661-6351

PROJECT INFORMATION:

**45-FT [13.7M]
MONOPOLE (45-19)
FOUNDATIONS**
Skystream 3.7



**SOUTHWEST
WINDPOWER**
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REV A

REINFORCING STEEL NOTES:

1. THE REINFORCING STEEL SHALL CONFORM TO THE REQUIREMENTS OF ASTM A-615, GRADE 60 [EU GRADE 420] IT SHALL BE DEFORMED AND SPLICES SHALL NOT BE ALLOWED UNLESS OTHERWISE NOTED.
2. WELDING IS PROHIBITED ON REINFORCING STEEL AND EMBEDMENTS.
3. REINFORCING CAGES SHALL BE BRACED TO RETAIN PROPER DIMENSIONS DURING HANDLING AND THROUGHOUT PLACEMENT OF CONCRETE. WHEN TEMPORARY CASING IS UTILIZED, BRACING SHALL BE ADEQUATE TO RESIST FORCES OCCURRING FROM FLOWING CONCRETE DURING CASING EXTRACTION.
4. SPACERS SHALL BE ATTACHED INTERMITTENTLY THROUGHOUT THE ENTIRE LENGTH OF TIEBACK REINFORCING TO INSURE CONCENTRIC PLACEMENT OF CAGES IN EXCAVATIONS.
5. MINIMUM CONCRETE COVER FOR REINFORCEMENT SHALL BE 3" [75mm] IF CAST IN PLACE AND 2" [50mm] COVER IF FORMWORK IS USED AS DEFINED IN ACI 318 SECTION 7.7.1. APPROVED SPACERS SHALL BE USED TO INSURE APPROPRIATE COVER ON REINFORCEMENT.
6. IN REGIONS OF HIGH SEISMIC RISK, ASSIGNED TO SEISMIC DESIGN CATEGORIES C, D, E, AND F, ADDITIONAL TERMINATION DETAILS ARE REQUIRED FOR STEEL REINFORCING BARS. FURTHER, ADDITIONAL DETAILING REQUIREMENTS MAY BE REQUIRED IN OTHER, LESS PRONE AREAS AS REQUIRED BY THE AUTHORITY HAVING JURISDICTION (AHJ).
 - A. SEISMIC HOOKS SHALL BE USED TO TERMINATE STIRRUPS, HOOPS, OR CROSSTIES AS DEFINED PER ACI 318.
 - B. LONGITUDINAL REINFORCING BARS ARE REQUIRED TO HAVE BOTH A STANDARD BEND AND HOOK EXTENSION (MIN. OF 12 BAR DIAMETERS) AT EACH END AS DEFINED PER ACI 318.

CONCRETE NOTES:

1. WORK SHALL BE IN ACCORDANCE WITH THE LATEST REVISION OF THE ACI-318, "BUILDING CODE REQUIREMENTS FOR STRUCTURAL CONCRETE."
2. THE CONCRETE SHALL DEVELOP A MINIMUM COMPRESSIVE STRENGTH OF 2,500 PSI [17230 kPa] IN 28-DAYS. HOWEVER, A MINIMUM COMPRESSIVE STRENGTH OF 3,000 PSI TO 4,500 PSI IN 28-DAYS SHALL BE USED IN LOCATIONS WITH MODERATE TO SEVERE SULFATE EXPOSURE UNLESS OTHERWISE REQUIRED BY THE LOCAL JURISDICTION. IN AREAS OF HIGH SEISMIC RISK AS DEFINED ABOVE, A MINIMUM COMPRESSIVE STRENGTH OF 3,000-PSF SHALL BE ACHIEVED.
3. PROPORTIONS OF CONCRETE MATERIALS SHALL BE SUITABLE FOR THE INSTALLATION METHOD UTILIZED AND SHALL RESULT IN DURABLE CONCRETE FOR RESISTANCE TO LOCAL ANTICIPATED AGGRESSIVE ACTIONS. THE DURABILITY REQUIREMENTS OF ACI-318 SHALL BE SATISFIED BASED ON THE CONDITIONS EXPECTED AT THE SITE.
4. CONCRETE SHALL BE PLACED IN A MANNER THAT WILL PREVENT SEGREGATION OF CONCRETE MATERIALS, INFILTRATION OF WATER OR SOIL, AND OTHER OCCURRENCES THAT MAY DECREASE THE STRENGTH OR DURABILITY OF THE FOUNDATION.
5. FREE FALL CONCRETE MAY BE USED PROVIDED FALL IS VERTICAL DOWN WITHOUT HITTING THE SIDES OF THE EXCAVATION, FORMWORK, REINFORCING BARS, FORM TIES, CAGE BRACING, OR OTHER OBSTRUCTIONS. UNDER NO CIRCUMSTANCES SHALL CONCRETE FALL THROUGH WATER.
6. THE MAXIMUM SIZE OF THE AGGREGATE SHALL NOT EXCEED A SIZE SUITABLE FOR THE INSTALLATION METHOD UTILIZED OR 1/3-CLEAR DISTANCE BEHIND OR BETWEEN REINFORCING. THE MAXIMUM SIZE MAY BE INCREASED TO 2/3-CLEAR DISTANCE PROVIDED WORKABILITY AND METHODS OF CONSOLIDATION SUCH AS VIBRATING WILL PREVENT HONEYCOMBS AND VOIDS.

CONCRETE NOTES (CONTINUED):

7. IF THE FROST LINE IS KNOWN TO BE GREATER THAN THE FOUNDATION DEPTH OR THE WATER TABLE IS LESS THAN THE FOUNDATION DEPTH, THE DESIGN ENGINEER (TOWER ENGINEERING PROFESSIONALS, INC.) SHALL BE NOTIFIED PRIOR TO CONSTRUCTION AND A FOUNDATION ANALYSIS OR RE-DESIGN SHALL BE PERFORMED.

SE/



11/29/2011



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PROJECT INFORMATION:
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	TEP #: 110002.06

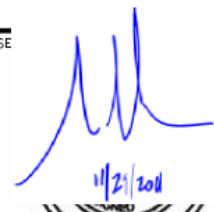
P/N: 3-CMLT-1417

REV A


TABLE 1804.2/1806.2 PRESUMPTIVE LOAD-BEARING VALUES (IBC 2006/2009)

SOIL CLASS	DESCRIPTION	ALLOWABLE FOUNDATION PRESSURE	LATERAL BEARING (BELOW NATURAL GRADE)	LATERAL SLIDING		ASSUMED UNIT WEIGHT W/O WATER	ASSUMED INTERNAL ANGLE OF FRICTION
				COEFF. OF FRICTION	RESISTANCE		
1	CRYSTALLINE BEDROCK	12,000 psf	1,200 psf/ft	0.70	-	140 pcf	0°
		574.56 kPa	188.50 kPa/m			22 kN/m ³	
2	SEDIMENTARY AND FOLIATED ROCK	4,000 psf	400 psf/ft	0.35	-	130 pcf	0°
		191.52 kPa	62.83 kPa/m			20 kN/m ³	
3	SANDY GRAVEL AND/OR GRAVEL (GW AND GP)	3,000 psf	200 psf/ft	0.35	-	120 pcf	32°
		143.64 kPa	31.42 kPa/m			19 kN/m ³	
4	SAND, SILTY SAND, CLAYEY SAND, SILTY GRAVEL, AND CLAYEY GRAVEL (SW,SP,SM,SC,GM AND GC)	2,000 psf	150 psf/ft	0.25	-	100 pcf	26°
		95.76 kPa	23.56 kPa/m			16 kN/m ³	
5	CLAY, SANDY CLAY, SILTY CLAY, CLAYEY SILT, SILT AND SANDY SILT (CL, ML, MH AND CH)	1,500 psf	100 psf/ft	-	130 psf	90 pcf	0°
		71.82 kPa	15.71 kPa/m		6.22 kPa	14 kN/m ³	

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11/21/2011



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	TEP#: 110002.08

P/N: 3-CMLT-1417

REV A

REFERENCED DOCUMENTS:

1. TOWER DESIGN DRAWINGS BY A.R.E. DATED MARCH 4, 2010, QUOTATION #: W09027, VERSION: F, DESCRIPTION: 45' STANDARD TOWER
2. DOCUMENT BY SWWP DATED NOVEMBER 10, 2011, TITLE: SKYSTREAM 3.7 TOWER TOP LOAD SUMMARY REV_D.PDF

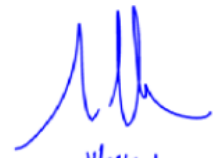
TOWER REACTIONS - 45' [13.7M] MONOPOLE (45-19)

ZONE	MAXIMUM LOADING CRITERIA	FACTORED ** MOMENT	FACTORED ** SHEAR	FACTORED VERTICAL
2	SKYSTREAM WIND TURBINE 120 MPH & 60 MPH W/ 1"-ICE [54 m/sec & 26.8 m/sec w/ 25.4mm-ICE]	78.5 kip-ft	2.38 klps	1.38 klps
		106.5 kN-m	10.58 kN	6.15 kN
3	SKYSTREAM WIND TURBINE 90 MPH & 60 MPH W/ 1"-ICE [40 m/sec & 26.8 m/sec w/ 25.4mm-ICE]	45.1 kip-ft	1.35 klps	1.38 klps
		61.1 kN-m	6.01 kN	6.15 kN

** THE REACTIONS LISTED ARE FOR REFERENCE ONLY AND SHOULD NOT BE SUBSTITUTED FOR A STRUCTURAL ANALYSIS BASED ON SITE-SPECIFIC DATA.

WIND ZONES

ZONE	WIND SPEED
2	90 - 120 MPH [40 - 54 m/s]
3	≤ 90 MPH [≤ 40 m/s]



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 3703 JUNCTION BOULEVARD
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 (919) 661-6351

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**SOUTHWEST
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SHEET NUMBER:

S-2

REVISION:

4

TEP#: 110002.06

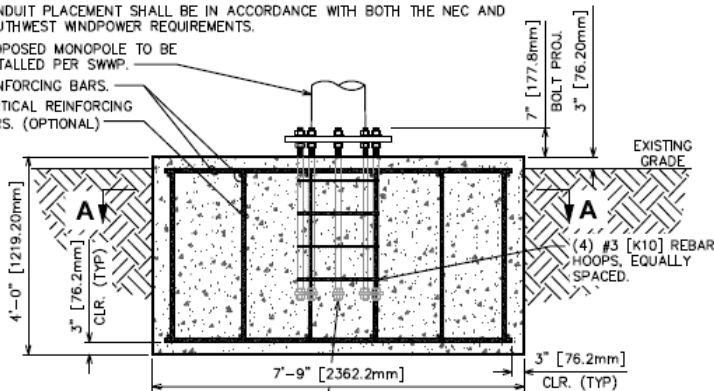
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REV A

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2. FOUNDATION WIDTH IS BASED ON WIND ZONES 2-3, SEE SHEETS S-3A - S-3B FOR APPROPRIATE SIZES.
3. IF THE PROPOSED AREA IS FOUND TO CONTAIN FILL MATERIALS, THE EXCAVATION SHALL EXTEND TO THE VIRGIN SAND LAYER AND BE BACKFILLED WITH COMPACTED SAND OR STONE. AFTER EXCAVATION AND PRIOR TO FILL OR CONCRETE PLACEMENT, THE SURFACE OF THE VIRGIN SAND LAYER SHOULD BE MECHANICALLY COMPACTED TO DENSIFY THE SURFACE DISTURBED DURING THE EXCAVATION.
4. ALL BACKFILL SHOULD BE PLACED IN MAXIMUM LOOSE LIFTS OF 8" AND COMPACTED TO A MINIMUM 95% OF ASTM D-1557.
5. TOWER GROUNDING SHALL BE PERFORMED IN ACCORDANCE WITH NEC REQUIREMENTS.
6. CONDUIT PLACEMENT SHALL BE IN ACCORDANCE WITH BOTH THE NEC AND SOUTHWEST WINDPOWER REQUIREMENTS.

PROPOSED MONOPOLE TO BE
INSTALLED PER SWWP.
REINFORCING BARS.
VERTICAL REINFORCING
BARS. (OPTIONAL)



FOUNDATION - WIND ZONE 2

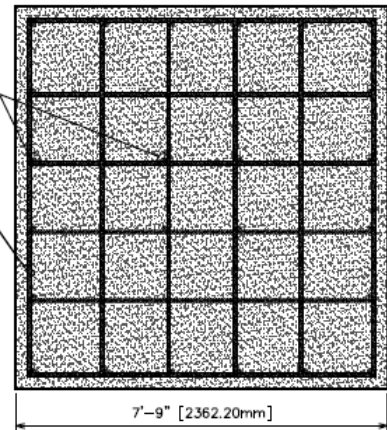
SCALE: $\frac{3}{8}'' = 1'-0''$ [9.5mm = 304.8mm]

(8) M33 x 1067mm [1 1/2" x 42"] LONG ANCHOR BOLTS (F1554 GR. 55 OR APPROVED EQUAL) ON 19" [482.6mm] BOLT CIRCLE. EACH ANCHOR BOLT SHALL BE EMBEDDED WITH A HARDENED WASHER BETWEEN TWO (2) NUTS SECURED BY DEFORMING THREADS. AS A MINIMUM, WASHERS SHALL BE ASTM F436 CIRCULAR WASHERS: MINIMUM O.D.=2 3/4" [70mm], MAX I.D.=1 1/2" [38mm], MINIMUM THICKNESS OF 0.136" [3.45mm].

DESIGN IS BASED ON SOIL CLASS 5:
 $q'_{all} = 1500 \text{ psf}$ [71.82 kPa]

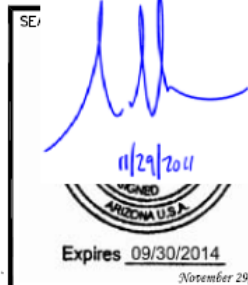
#8 [K25] VERTICAL REINFORCING BARS
(OPTIONAL) PLACED AS SHOWN. (24
TOTAL)

(6) #8 [K25] REINFORCING BARS
SPACED EQUALLY EACH WAY, TOP AND
BOTTOM (24 TOTAL). ADJUST BARS AS
REQUIRED FOR CLEARANCE WITH
ANCHOR BOLTS. BAR SPACING SHALL
NOT EXCEED 18".



SECTION A-A

SCALE: $\frac{3}{8}'' = 1'-0''$ [9.5mm = 304.8mm]



PROJECT INFORMATION:
**45-FT [13.7M]
MONOPOLE (45-19)
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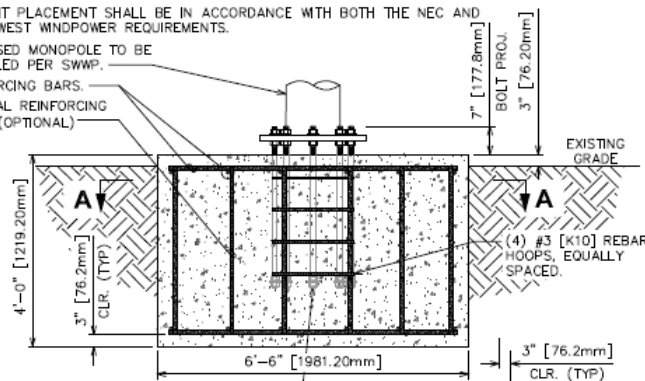
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PROPOSED MONOPOLE TO BE
INSTALLED PER SWWP.
REINFORCING BARS.
VERTICAL REINFORCING
BARS. (OPTIONAL)



FOUNDATION - WIND ZONE 3

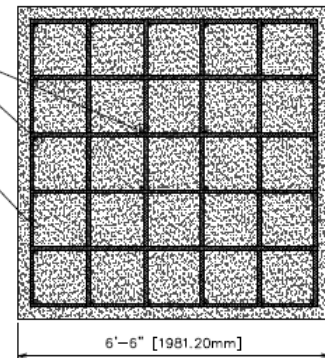
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DESIGN IS BASED ON SOIL CLASS 5:
 $q'_{all} = 1500 \text{ psf}$ [71.82 kPa]

#8 [K25] VERTICAL REINFORCING BARS
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SPACED EQUALLY EACH WAY, TOP
AND BOTTOM (24 TOTAL). ADJUST
BARS AS REQUIRED FOR CLEARANCE
WITH ANCHOR BOLTS. BAR SPACING
SHALL NOT EXCEED 18".



SECTION A-A

SCALE: $\frac{3}{8}" = 1'-0"$ [9.5mm = 304.8mm]

SE
[Signature]
11/25/2011
ARIZONA U.S.A.
Expires 09/30/2014
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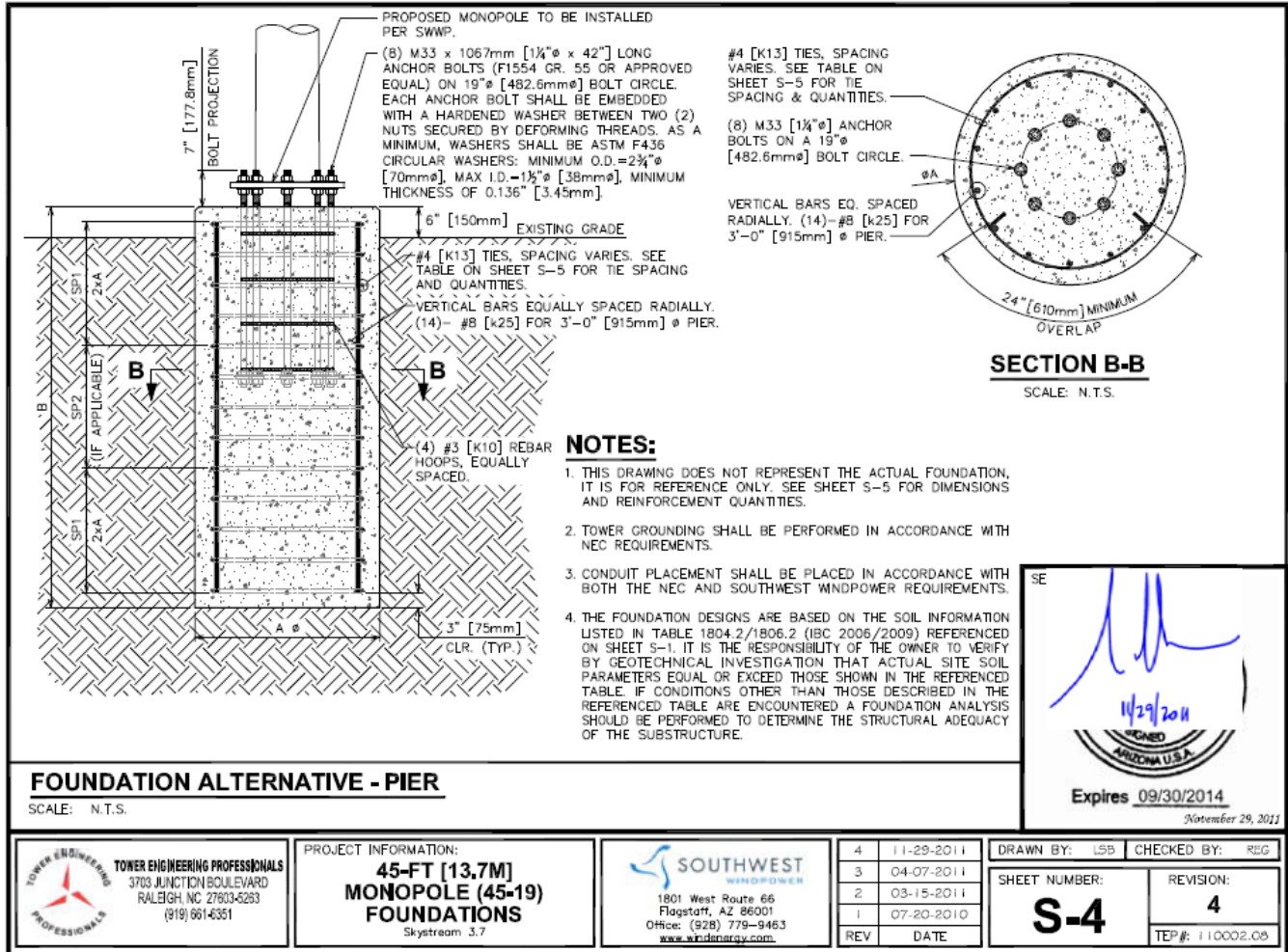
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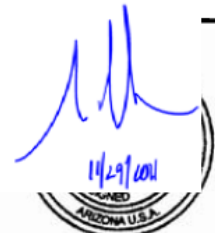
REV A



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REV A

45-FT [13.7M] MONOPOLE (45-19) FOUNDATION DIMENSIONS - PIER								
ZONE	SOIL CLASS	DIMENSION		VERTICAL REINF.		TIE SPACING		#4 [K13] TIE QUANTITY
		A	B	SIZE	QTY.	SP1	SP2	
2	3	3'-0" [915mm]	10'-0" [3048mm]	#8 [K25]	14	6"± [150mm] O.C.	12"± [300mm] O.C.	20
	4	3'-0" [915mm]	11'-0" [3353mm]	#8 [K25]	14	6"± [150mm] O.C.	12"± [300mm] O.C.	22
	5	3'-0" [915mm]	13'-0" [3962mm]	#8 [K25]	14	6"± [150mm] O.C.	12"± [300mm] O.C.	26
ZONE	SOIL CLASS	DIMENSION		VERTICAL REINF.		TIE SPACING		#4 [K13] TIE QUANTITY
		A	B	SIZE	QTY.	SP1	SP2	
3	3	3'-0" [915mm]	8'-6" [2591mm]	#8 [K25]	14	6"± [150mm] O.C.	12"± [300mm] O.C.	17
	4	3'-0" [915mm]	9'-0" [2743mm]	#8 [K25]	14	6"± [150mm] O.C.	12"± [300mm] O.C.	18
	5	3'-0" [915mm]	10'-6" [3200mm]	#8 [K25]	14	6"± [150mm] O.C.	12"± [300mm] O.C.	20



Expires 09/30/2014

November 29, 2011



PROJECT INFORMATION:
**45-FT [13.7M]
MONOPOLE (45-19)
FOUNDATIONS**
Skystredm 3.7

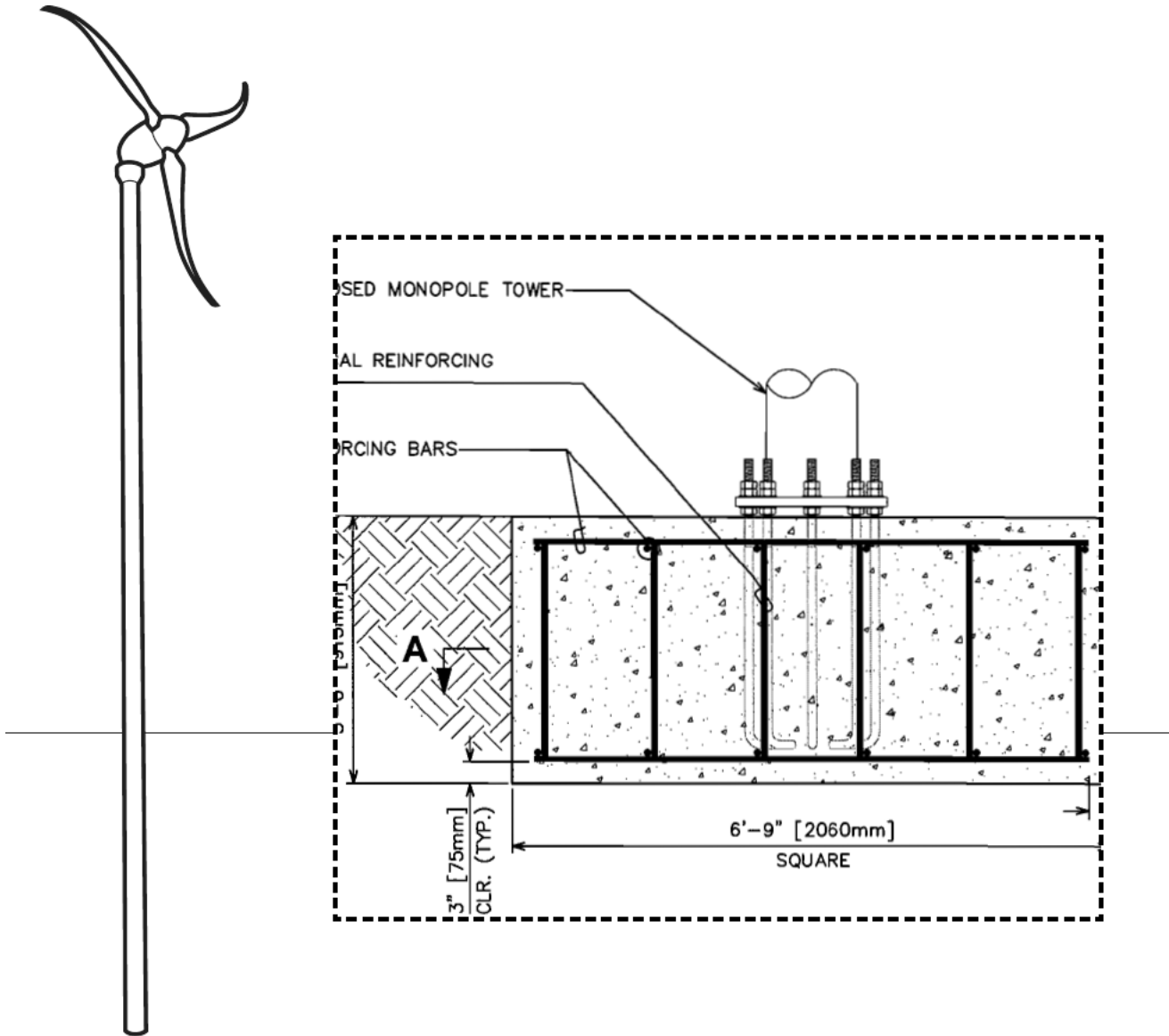


4	11-29-2011
3	04-07-2011
2	03-15-2011
1	07-20-2010
REV	DATE

DRAWN BY: LSB	CHECKED BY: REG
SHEET NUMBER: S-5	REVISION: 4
	TEP#: 110002.06

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SKYSTREAM 3.7
Appendix C: 55 ft (16.8 m) Sectional Monopole Tower Foundations



Southwest Windpower

Renewable Energy Made Simple

SKYSTREAM 3.7

ATTENTION

THE FOUNDATION DESIGNS ARE IN ACCORDANCE WITH THE 2006 INTERNATIONAL BUILDING CODE, IBC-222-G-2-2009 STRUCTURAL STANDARD FOR ANTENNA SUPPORTING STRUCTURES AND ANTENNAS, AND ASCE 7-05, MINIMUM DESIGN LOADS FOR BUILDINGS AND OTHER STRUCTURES. THE FOUNDATION DESIGNS ARE FOR A 55-FT [16.8M] MONOPOLE WITH THE SKYSTREAM 3.7 WIND TURBINE BASED ON THE SOIL INFORMATION LISTED IN TABLE 1804.2 (IBC 2006) REFERENCED ON SHEET S-2 AND THE WIND ZONES DESCRIBED ON SHEET S-3. IT IS THE RESPONSIBILITY OF THE OWNER TO VERIFY BY GEOTECHNICAL INVESTIGATION THAT ACTUAL SOIL INVESTIGATION PARAMETERS MEET OR EXCEED THOSE SHOWN IN THE REFERENCED TABLE. IF CONDITIONS OTHER THAN THOSE DESCRIBED IN THE REFERENCED TABLE ARE ENCOUNTERED A FOUNDATION ANALYSIS SHOULD BE PERFORMED TO DETERMINE THE STRUCTURAL ADEQUACY OF THE SUBSTRUCTURE.

INDEX OF SHEETS

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S-4A	55-FT [16.8M] MONOPOLE FOUNDATION - WIND ZONE 1	1	07-08-10
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SEAL:



July 8, 2010



PROJECT INFORMATION:

**55-FT [16.8M]
MONOPOLE
FOUNDATIONS**

Southwest Windpower
Renewable Energy Made Simple
1801 West Route 66
Flagstaff, AZ 86001
Office: (928) 779-9463

REV	DATE
1	07-08-2010
0	04-13-2010

DRAWN BY: JRM	CHECKED BY: REG
SHEET NUMBER: T-1	REVISION: 1
	TEP#: 100002.09

GENERAL NOTES:

1. ALL WORK PRESENTED ON THESE DRAWINGS MUST BE COMPLETED BY THE CONTRACTOR UNLESS NOTED OTHERWISE.
2. THE CONTRACTOR MUST HAVE CONSIDERABLE EXPERIENCE IN PERFORMANCE OF WORK SIMILAR TO THAT DESCRIBED HEREIN. BY ACCEPTANCE OF THIS ASSIGNMENT, THE CONTRACTOR IS ATTESTING THAT HE DOES HAVE SUFFICIENT EXPERIENCE AND ABILITY, THAT HE IS KNOWLEDGEABLE OF THE WORK TO BE PERFORMED AND THAT HE IS PROPERLY LICENSED AND PROPERLY REGISTERED TO DO THIS WORK IN THE APPLICABLE STATE/TERRITORY.
3. ALL HARDWARE ASSEMBLY MANUFACTURER'S INSTRUCTIONS SHALL BE FOLLOWED EXACTLY AND SHALL SUPERSEDE ANY CONFLICTING NOTES ENCLOSED HEREIN.
4. IT IS THE CONTRACTOR'S SOLE RESPONSIBILITY TO DETERMINE ERECTION PROCEDURE AND SEQUENCE TO INSURE THE SAFETY OF THE STRUCTURE AND ITS COMPONENT PARTS DURING ERECTION. THIS INCLUDES, BUT IS NOT LIMITED TO, THE ADDITION OF TEMPORARY BRACING, GUYS OR TIE DOWNS THAT MAY BE NECESSARY. SUCH MATERIAL SHALL BE REMOVED AND SHALL REMAIN THE PROPERTY OF THE CONTRACTOR AFTER THE COMPLETION OF THE PROJECT.
5. ALL MATERIALS AND EQUIPMENT FURNISHED SHALL BE NEW AND OF GOOD QUALITY, FREE FROM FAULTS AND DEFECTS AND IN CONFORMANCE WITH THE CONTRACT DOCUMENTS. ANY AND ALL SUBSTITUTIONS MUST BE PROPERLY APPROVED AND AUTHORIZED IN WRITING BY THE OWNER AND ENGINEER PRIOR TO INSTALLATION. THE CONTRACTOR SHALL FURNISH SATISFACTORY EVIDENCE AS TO THE KIND AND QUALITY OF THE MATERIALS AND EQUIPMENT BEING SUBSTITUTED.
6. THE CONTRACTOR SHALL BE RESPONSIBLE FOR INITIATING, MAINTAINING, AND SUPERVISING ALL SAFETY PRECAUTIONS AND PROGRAMS IN CONNECTION WITH THE WORK.
7. THE CONTRACTOR IS RESPONSIBLE FOR INSURING THAT THIS PROJECT AND RELATED WORK COMPLIES WITH ALL APPLICABLE LOCAL, STATE, AND FEDERAL SAFETY CODES AND REGULATIONS GOVERNING THIS WORK. CONTRACTOR SHALL SECURE ALL NECESSARY PERMITS FOR THIS PROJECT FROM ALL APPLICABLE GOVERNMENTAL AGENCIES. ALL PERMITS THAT MUST BE OBTAINED ARE THE RESPONSIBILITY OF THE CONTRACTOR. THE CONTRACTOR WILL BE RESPONSIBLE FOR ABIDING BY ALL CONDITIONS AND REQUIREMENTS OF THE PERMITS.
8. THE CONTRACTOR IS REQUIRED TO MAINTAIN ALL PIPES, DITCHES, AND OTHER DRAINAGE STRUCTURES FREE FROM OBSTRUCTION UNTIL WORK IS ACCEPTED BY THE OWNER. THE CONTRACTOR IS RESPONSIBLE FOR ANY DAMAGES CAUSED BY FAILURE TO MAINTAIN DRAINAGE STRUCTURE IN OPERABLE CONDITION.
9. ALL MATERIALS AND WORKMANSHIP SHALL BE WARRANTED FOR ONE YEAR FROM ACCEPTANCE DATE.

REINFORCING STEEL NOTES:

1. THE REINFORCING STEEL SHALL CONFORM TO THE REQUIREMENTS OF ASTM A-615, GRADE 60 [EU GRADE 420]. IT SHALL BE DEFORMED AND SPLICES SHALL NOT BE ALLOWED UNLESS OTHERWISE NOTED.
2. WELDING IS PROHIBITED ON REINFORCING STEEL AND EMBEDMENTS.
3. REINFORCING CAGES SHALL BE BRACED TO RETAIN PROPER DIMENSIONS DURING HANDLING AND THROUGHOUT PLACEMENT OF CONCRETE. WHEN TEMPORARY CASING IS UTILIZED, BRACING SHALL BE ADEQUATE TO RESIST FORCES OCCURRING FROM FLOWING CONCRETE DURING CASING EXTRACTION.
4. SPACERS SHALL BE ATTACHED INTERMITTENTLY THROUGHOUT THE ENTIRE LENGTH OF TIEBACK REINFORCING TO INSURE CONCENTRIC PLACEMENT OF CAGES IN EXCAVATIONS.

REINFORCING STEEL NOTES (CONTINUED):

5. MINIMUM CONCRETE COVER FOR REINFORCEMENT SHALL BE 3" [75mm] IF CAST IN PLACE AND 2" [50mm] COVER IF FORMWORK IS USED AS DEFINED IN ACI 318 SECTION 7.7.1. APPROVED SPACERS SHALL BE USED TO INSURE APPROPRIATE COVER ON REINFORCEMENT.
6. IN REGIONS OF HIGH SEISMIC RISK, ASSIGNED TO SEISMIC DESIGN CATEGORIES C, D, E, AND F, ADDITIONAL TERMINATION DETAILS ARE REQUIRED FOR STEEL REINFORCING BARS. FURTHER, ADDITIONAL DETAILING REQUIREMENTS MAY BE REQUIRED IN OTHER, LESS PRONE AREAS AS REQUIRED BY THE AUTHORITY HAVING JURISDICTION (AHJ).
 - A. SEISMIC HOOKS SHALL BE USED TO TERMINATE STIRRUPS, HOOPS, OR CROSSTIES AS DEFINED PER ACI 318.
 - B. LONGITUDINAL REINFORCING BARS ARE REQUIRED TO HAVE BOTH A STANDARD BEND AND HOOK EXTENSION (MIN. OF 12 BAR DIAMETERS) AT EACH END AS DEFINED PER ACI 318.

CONCRETE NOTES:

1. WORK SHALL BE IN ACCORDANCE WITH THE LATEST REVISION OF THE ACI-318, "BUILDING CODE REQUIREMENTS FOR REINFORCED CONCRETE."
2. THE CONCRETE SHALL DEVELOP A MINIMUM COMPRESSIVE STRENGTH OF 2,500 PSI [17230 kPa] IN 28-DAYS. HOWEVER, A MINIMUM COMPRESSIVE STRENGTH OF 3,000 PSI TO 4,500 PSI IN 28-DAYS SHALL BE USED IN LOCATIONS WITH MODERATE TO SEVERE SULFATE EXPOSURE UNLESS OTHERWISE REQUIRED BY THE LOCAL JURISDICTION.
3. PROPORTIONS OF CONCRETE MATERIALS SHALL BE SUITABLE FOR THE INSTALLATION METHOD UTILIZED AND SHALL RESULT IN DURABLE CONCRETE FOR RESISTANCE TO LOCAL ANTICIPATED AGGRESSIVE ACTIONS. THE DURABILITY REQUIREMENTS OF ACI-318 SHALL BE SATISFIED BASED ON THE CONDITIONS EXPECTED AT THE SITE.
4. CONCRETE SHALL BE PLACED IN A MANNER THAT WILL PREVENT SEGREGATION OF CONCRETE MATERIALS, INFILTRATION OF WATER OR SOIL, AND OTHER OCCURRENCES THAT MAY DECREASE THE STRENGTH OR DURABILITY OF THE FOUNDATION.
5. FREE FALL CONCRETE MAY BE USED PROVIDED FALL IS VERTICAL DOWN WITHOUT HITTING THE SIDES OF THE EXCAVATION, FORMWORK, REINFORCING BARS, FORM TIES, CAGE BRACING, OR OTHER OBSTRUCTIONS. UNDER NO CIRCUMSTANCES SHALL CONCRETE FALL THROUGH WATER.
6. THE MAXIMUM SIZE OF THE AGGREGATE SHALL NOT EXCEED A SIZE SUITABLE FOR THE INSTALLATION METHOD UTILIZED OR 1/3-CLEAR DISTANCE BEHIND OR BETWEEN REINFORCING. THE MAXIMUM SIZE MAY BE INCREASED TO 2/3-CLEAR DISTANCE PROVIDED WORKABILITY AND METHODS OF CONSOLIDATION SUCH AS VIBRATING WILL PREVENT HONEYCOMBS AND VOIDS.
7. IF THE FROST LINE IS KNOWN TO BE GREATER THAN THE FOUNDATION DEPTH OR THE WATER TABLE IS LESS THAN THE FOUNDATION DEPTH, THE DESIGN ENGINEER (TOWER ENGINEERING PROFESSIONALS, INC.) SHALL BE NOTIFIED PRIOR TO CONSTRUCTION AND A FOUNDATION ANALYSIS OR RE-DESIGN SHALL BE PERFORMED.

SEAL:



July 8, 2010



TOWER ENGINEERING PROFESSIONALS
3703 JUNCTION BOULEVARD
RALEIGH, NC 27603-5283
(919) 661-6351

PROJECT INFORMATION:

**55-FT [16.8M]
MONOPOLE
FOUNDATIONS**

Southwest Windpower
Renewable Energy Made Simple

1801 West Route 66
Flagstaff, AZ 86001
Office: (928) 779-9463

I	07-06-2010
O	04-13-2010
REV	DATE

DRAWN BY: JRM | CHECKED BY: REG

SHEET NUMBER:

S-1

REVISION:

1

TEP#: 100002.09

TABLE 1804.2 ALLOWABLE FOUNDATION AND LATERAL PRESSURE (IBC 2006)

SOIL CLASS	DESCRIPTION	ALLOWABLE FOUNDATION PRESSURE	LATERAL BEARING (BELOW NATURAL GRADE)	LATERAL SLIDING		ASSUMED UNIT WEIGHT W/O WATER	ASSUMED INTERNAL ANGLE OF FRICTION
				COEFF. OF FRICTION	RESISTANCE		
1	CRYSTALLINE BEDROCK	12,000 psf	1,200 psf/ft	0.70	—	140 pcf	0°
		574.56 kPa	188.50 kPa/m			22 kN/m ³	
2	SEDIMENTARY AND FOLIATED ROCK	4,000 psf	400 psf/ft	0.35	—	130 pcf	0°
		191.52 kPa	62.83 kPa/m			20 kN/m ³	
3	SANDY GRAVEL AND/OR GRAVEL (GW AND GP)	3,000 psf	200 psf/ft	0.35	—	120 pcf	32°
		143.64 kPa	31.42 kPa/m			19 kN/m ³	
4	SAND, SILTY SAND, CLAYEY SAND, SILTY GRAVEL, AND CLAYEY GRAVEL (SW,SP,SM,SC,GM AND GC)	2,000 psf	150 psf/ft	0.25	—	100 pcf	26°
		95.76 kPa	23.56 kPa/m			16 kN/m ³	
5	CLAY, SANDY CLAY, SILTY CLAY, CLAYEY SILT, SILT AND SANDY SILT (CL, ML, MH AND CH)	1,500 psf	100 psf/ft	—	130 psf	90 pcf	0°
		71.82 kPa	15.71 kPa/m		6.22 kPa	14 kN/m ³	



July 8, 2010



PROJECT INFORMATION:
**55-FT [16.8M]
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I	07-06-2010
O	04-13-2010
REV	DATE

DRAWN BY: JRM	CHECKED BY: REG
SHEET NUMBER: S-2	REVISION: 1 TEP#: 100002.09

TOWER REACTIONS - 55' [16.8M] MONOPOLE

ZONE	MAXIMUM LOADING CRITERIA	FACTORED ** MOMENT	FACTORED ** SHEAR	FACTORED VERTICAL
1	SKYSTREAM WIND TURBINE 150 MPH & 60 MPH W/ 1"-ICE [67 m/sec & 26.8 m/sec w/ 25.4mm-ICE]	189.4 kip-ft	5.71 kips	2.37 kips
		256.8 kN-m	25.40 kN	10.54 kN
2	SKYSTREAM WIND TURBINE 120 MPH & 60 MPH W/ 1"-ICE [54 m/sec & 26.8 m/sec w/ 25.4mm-ICE]	148.8 kip-ft	4.14 kips	2.37 kips
		201.7 kN-m	18.42 kN	10.54 kN
3	SKYSTREAM WIND TURBINE 90 MPH & 60 MPH W/ 1"-ICE [40 m/sec & 26.8 m/sec w/ 25.4mm-ICE]	117.2 kip-ft	2.91 kips	2.37 kips
		158.9 kN-m	12.94 kN	10.54 kN

** THE REACTIONS LISTED ARE FOR REFERENCE ONLY AND SHOULD NOT BE SUBSTITUTED FOR A STRUCTURAL ANALYSIS BASED ON SITE-SPECIFIC DATA.

WIND ZONES

ZONE	WIND SPEED
1	120 - 150 MPH [54 - 67 m/sec]
2	90 - 120 MPH [40 - 54 m/sec]
3	≤ 90 MPH [≤ 40 m/sec]

SEAL:



July 8, 2010



TOWER ENGINEERING PROFESSIONALS
3703 JUNCTION BOULEVARD
RALEIGH, NC 27603-5263
(919) 861-6351

PROJECT INFORMATION:

**55-FT [16.8M]
MONOPOLE
FOUNDATIONS**

Southwest Windpower

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1801 West Route 66
Flagstaff, AZ 86001
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I	07-08-2010
O	04-13-2010
REV	DATE

DRAWN BY: JAB CHECKED BY: KMM

SHEET NUMBER:

S-3

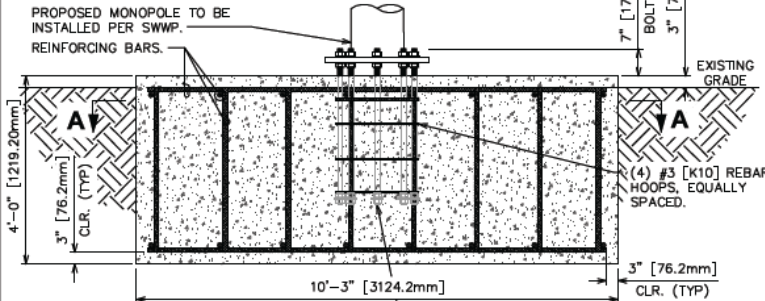
REVISION:

1

TEP#: 100002.09

NOTES:

1. THE FOUNDATION DESIGNS ARE BASED ON THE SOIL INFORMATION LISTED IN TABLE 1804.2 (IBC 2006) REFERENCED ON SHEET S-2. IT IS THE RESPONSIBILITY OF THE OWNER TO VERIFY BY GEOTECHNICAL INVESTIGATION THAT ACTUAL SITE SOIL PARAMETERS EQUAL OR EXCEED THOSE SHOWN IN THE REFERENCED TABLE. IF CONDITIONS OTHER THAN THOSE DESCRIBED IN THE REFERENCED TABLE ARE ENCOUNTERED A FOUNDATION ANALYSIS SHOULD BE PERFORMED TO DETERMINE THE STRUCTURAL ADEQUACY OF THE SUBSTRUCTURE.
2. FOUNDATION WIDTH IS BASED ON WIND ZONES 1-3, SEE SHEETS S-4A - S-4C FOR APPROPRIATE SIZES.
3. IF THE PROPOSED AREA IS FOUND TO CONTAIN FILL MATERIALS, THE EXCAVATION SHALL EXTEND TO THE VIRGIN SAND LAYER AND BE BACKFILLED WITH COMPACTED SAND OR STONE. AFTER EXCAVATION AND PRIOR TO FILL OR CONCRETE PLACEMENT, THE SURFACE OF THE VIRGIN SAND LAYER SHOULD BE MECHANICALLY COMPACTED TO DENSIFY THE SURFACE DISTURBED DURING THE EXCAVATION.
4. ALL BACKFILL SHOULD BE PLACED IN MAXIMUM LOOSE LIFTS OF 8" AND COMPACTED TO A MINIMUM 95% OF ASTM D-1557.
5. TOWER GROUNDING SHALL BE PERFORMED IN ACCORDANCE WITH NEC REQUIREMENTS.
6. CONDUIT PLACEMENT SHALL BE IN ACCORDANCE WITH BOTH THE NEC AND SOUTHWEST WINDPOWER REQUIREMENTS.



DESIGN IS BASED ON SOIL CLASS 5:
 $q_{all} = 1500 \text{ psf} [71.82 \text{ kPa}]$

FOUNDATION - WIND ZONE 1

SCALE: $\frac{3}{8}" = 1'-0"$ 9.5mm = 304.8mm]

#8 [K25] VERTICAL REINFORCING BARS IN CENTER PLACED AS SHOWN. (4 TOTAL)

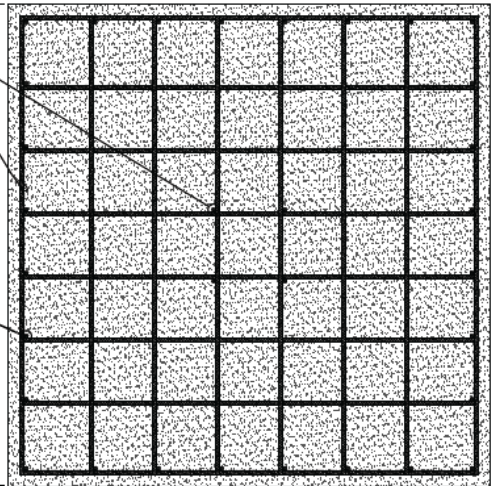
(8) #8 [K25] REINFORCING BARS SPACED EQUALLY EACH WAY, TOP AND BOTTOM (32 TOTAL). ADJUST BARS AS REQUIRED TO CLEAR ANCHOR BOLTS. BAR SPACING SHALL NOT EXCEED 18".

#8 [K25] VERTICAL REINFORCING BARS SPACED EQUALLY AS SHOWN. (28 TOTAL)

7" [177.8mm] BOLT PROJ.
3" [76.2mm]

(4) #3 [K10] REBAR HOOPS, EQUALLY SPACED.

(8) $1\frac{1}{4}" \phi \times 42"$ LONG ANCHOR BOLTS (F1554 GR. 55 OR APPROVED EQUAL) ON $23" \phi$ BOLT CIRCLE. EACH ANCHOR BOLT SHALL BE EMBEDDED WITH A HARDENED WASHER BETWEEN TWO (2) NUTS SECURED BY DEFORMING THREADS. AS A MINIMUM, WASHERS SHALL BE ASTM F436 CIRCULAR WASHERS: MINIMUM O.D. = $2\frac{3}{4}" \phi$, MAX I.D. = $1\frac{1}{2}" \phi$, MINIMUM THICKNESS OF 0.136".



SECTION A-A

SCALE: $\frac{3}{8}" = 1'-0"$ [9.5mm = 304.8mm]

SEAL:



PROJECT INFORMATION:

**55-FT [16.8M]
MONOPOLE
FOUNDATIONS**

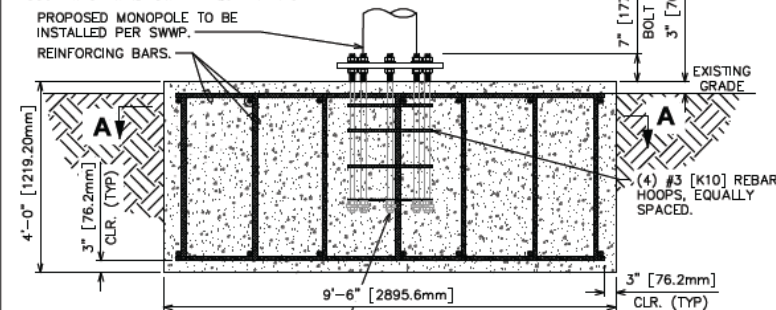
Southwest Windpower
Renewable Energy Made Simple
1801 West Route 66
Flagstaff, AZ 86001
Office: (928) 779-9463

REV	DATE
1	07-06-2010
0	04-13-2010

DRAWN BY: JRM	CHECKED BY: REG
SHEET NUMBER: S-4A	REVISION: 1
TEP#: 100002.09	

NOTES:

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5. TOWER GROUNDING SHALL BE PERFORMED IN ACCORDANCE WITH NEC REQUIREMENTS.
6. CONDUIT PLACEMENT SHALL BE IN ACCORDANCE WITH BOTH THE NEC AND SOUTHWEST WINDPOWER REQUIREMENTS.



DESIGN IS BASED ON SOIL CLASS 5:
 $q = 1500 \text{ psf} [71.82 \text{ kPa}]$

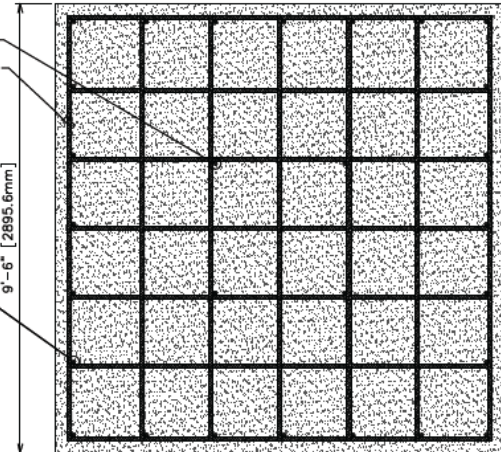
FOUNDATION - WIND ZONE 2

SCALE: $\frac{3}{8}" = 1'-0"$ [9.5mm = 304.8mm]

#8 [K25] VERTICAL REINFORCING BARS IN CENTER PLACED AS SHOWN. (4 TOTAL)

(7) #8 [K25] REINFORCING BARS SPACED EQUALLY EACH WAY, TOP AND BOTTOM (28 TOTAL). ADJUST BARS AS REQUIRED TO CLEAR ANCHOR BOLTS. BAR SPACING SHALL NOT EXCEED 18".

#8 [K25] VERTICAL REINFORCING BARS SPACED EQUALLY AS SHOWN. (24 TOTAL)



SECTION A-A

SCALE: $\frac{3}{8}" = 1'-0"$ [9.5mm = 304.8mm]

SEAL:



PROJECT INFORMATION:

**55-FT [16.8M]
 MONOPOLE
 FOUNDATIONS**

Southwest Windpower
 Renewable Energy Made Simple

1801 West Route 66
 Flagstaff, AZ 86001
 Office: (928) 779-9463

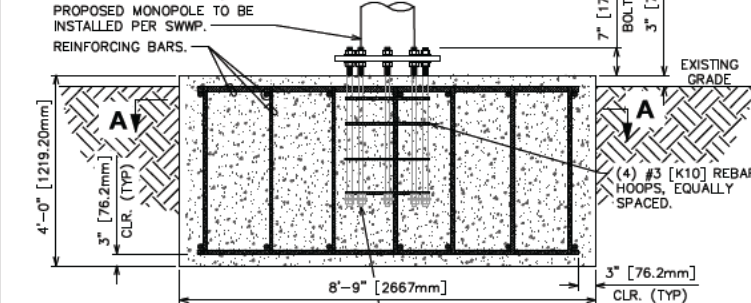
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REV	DATE

DRAWN BY: JRM CHECKED BY: REG

SHEET NUMBER:	REVISION:
S-4B	1
	TEP#: 100002.09

NOTES:

1. THE FOUNDATION DESIGNS ARE BASED ON THE SOIL INFORMATION LISTED IN TABLE 1804.2 (IBC 2006) REFERENCED ON SHEET S-2. IT IS THE RESPONSIBILITY OF THE OWNER TO VERIFY BY GEOTECHNICAL INVESTIGATION THAT ACTUAL SITE SOIL PARAMETERS EQUAL OR EXCEED THOSE SHOWN IN THE REFERENCED TABLE. IF CONDITIONS OTHER THAN THOSE DESCRIBED IN THE REFERENCED TABLE ARE ENCOUNTERED A FOUNDATION ANALYSIS SHOULD BE PERFORMED TO DETERMINE THE STRUCTURAL ADEQUACY OF THE SUBSTRUCTURE.
2. FOUNDATION WIDTH IS BASED ON WIND ZONES 1-3, SEE SHEETS S-4A - S-4C FOR APPROPRIATE SIZES.
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5. TOWER GROUNDING SHALL BE PERFORMED IN ACCORDANCE WITH NEC REQUIREMENTS.
6. CONDUIT PLACEMENT SHALL BE IN ACCORDANCE WITH BOTH THE NEC AND SOUTHWEST WINDPOWER REQUIREMENTS.



DESIGN IS BASED ON SOIL CLASS 5:
 $q'_s = 1500 \text{ psf} [71.82 \text{ kPa}]$

FOUNDATION - WIND ZONE 3

SCALE: $\frac{3}{8}" = 1'-0" [9.5 \text{ mm} = 304.8 \text{ mm}]$

#8 [K25] VERTICAL REINFORCING BARS SPACED EQUALLY AS SHOWN. (24 TOTAL)

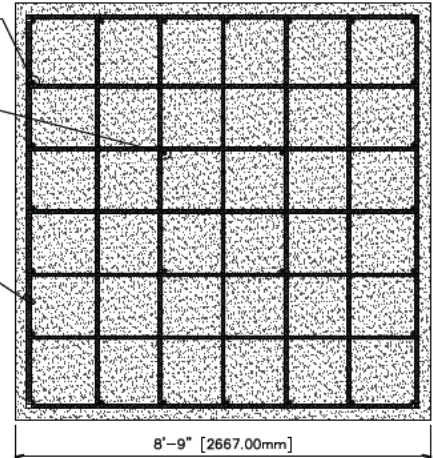
#8 [K25] VERTICAL REINFORCING BARS IN CENTER PLACED AS SHOWN. (4 TOTAL)

(7) #8 [K25] REINFORCING BARS SPACED EQUALLY EACH WAY, TOP AND BOTTOM (28 TOTAL). ADJUST BARS AS REQUIRED TO CLEAR ANCHOR BOLTS. BAR SPACING SHALL NOT EXCEED 18".

7" [177.8mm] BOLT PROJ. 3" [76.20mm]

(4) #3 [K10] REBAR HOOPS, EQUALLY SPACED.

(8) $1\frac{1}{2}" \phi \times 42"$ LONG ANCHOR BOLTS (F1554 GR. 55 OR APPROVED EQUAL) ON $23" \phi$ BOLT CIRCLE. EACH ANCHOR BOLT SHALL BE EMBEDDED WITH A HARDENED WASHER BETWEEN TWO (2) NUTS SECURED BY DEFORMING THREADS. AS A MINIMUM, WASHERS SHALL BE ASTM F436 CIRCULAR WASHERS: MINIMUM O.D. $\sim 2\frac{3}{4}" \phi$, MAX I.D. $\sim 1\frac{1}{2}" \phi$, MINIMUM THICKNESS OF 0.136".



SECTION A-A

SCALE: $\frac{3}{8}" = 1'-0" [9.5 \text{ mm} = 304.8 \text{ mm}]$

SEAL:



July 8, 2010



TOWER ENGINEERING PROFESSIONALS
 3703 JUNCTION BOULEVARD
 RALEIGH, NC 27603-5263
 (919) 981-4351

PROJECT INFORMATION:

**55-FT [16.8M]
 MONOPOLE
 FOUNDATIONS**

Southwest Windpower
 Renewable Energy Made Simple

1801 West Route 66
 Flagstaff, AZ 86001
 Office: (928) 779-9463

REV	DATE
1	07-06-2010
0	04-13-2010

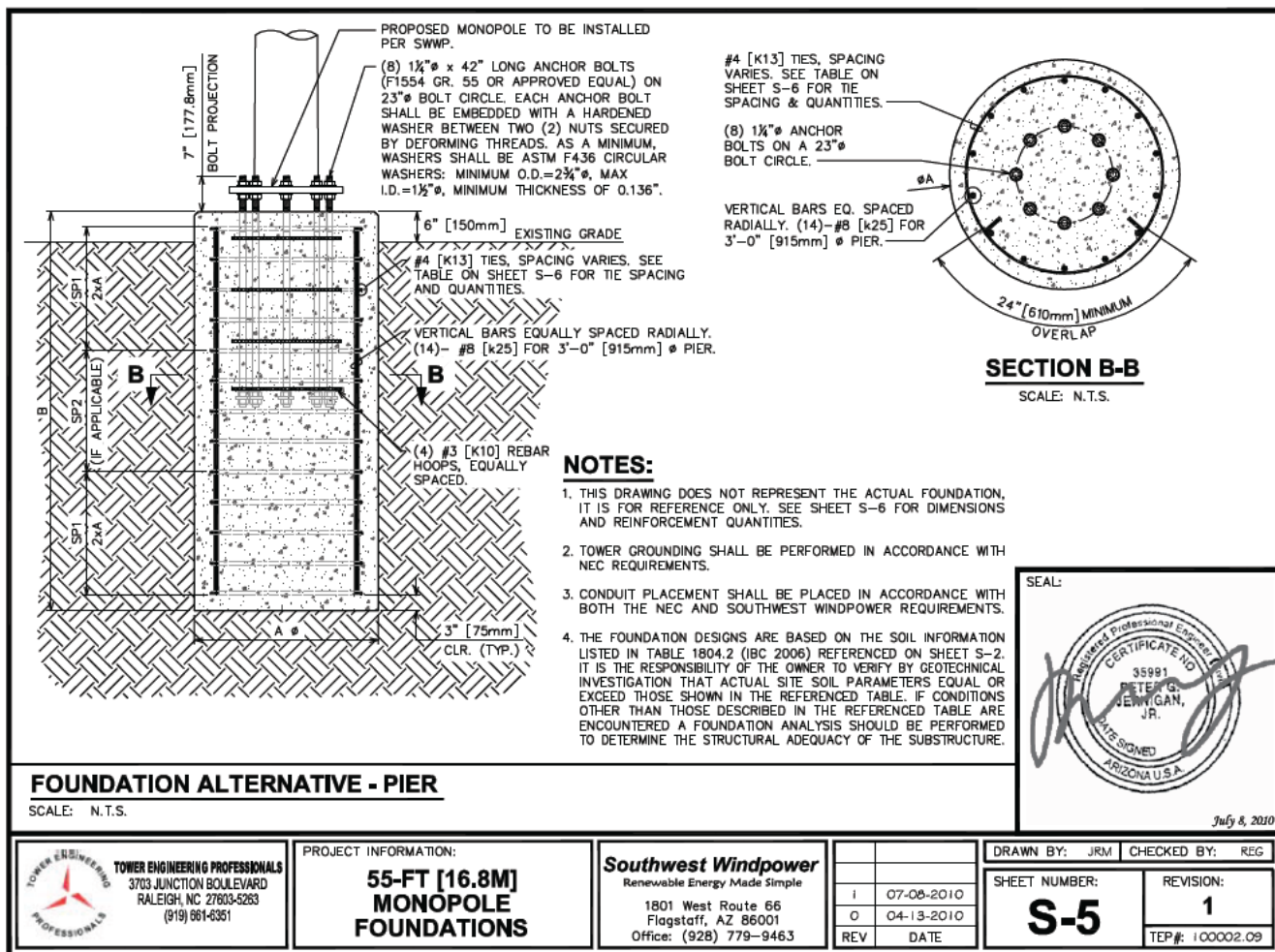
DRAWN BY: JRM CHECKED BY: REG

SHEET NUMBER: REVISION:

S-4C

1

TEP#: 100002.09



55-FT [16.8M] MONOPOLE FOUNDATION DIMENSIONS - PIER								
ZONE	SOIL CLASS	DIMENSION		VERTICAL REINF.		TIE SPACING		#4 [K13] TIE QUANTITY
		A	B	SIZE	QTY.	SP1	SP2	
1	1	3'-0" [915mm]	16'-6" [5030mm]	#8 [K25]	14	6"± [150mm] O.C.	12"± [300mm] O.C.	29
	2	3'-0" [915mm]	16'-6" [5030mm]	#8 [K25]	14	6"± [150mm] O.C.	12"± [300mm] O.C.	29
	3	3'-0" [915mm]	16'-6" [5030mm]	#8 [K25]	14	6"± [150mm] O.C.	12"± [300mm] O.C.	29
	4	3'-0" [915mm]	17'-6" [5335mm]	#8 [K25]	14	6"± [150mm] O.C.	12"± [300mm] O.C.	30
	5	3'-0" [915mm]	20'-6" [6250mm]	#8 [K25]	14	6"± [150mm] O.C.	12"± [300mm] O.C.	33
ZONE	SOIL CLASS	DIMENSION		VERTICAL REINF.		TIE SPACING		#4 [K13] TIE QUANTITY
		A	B	SIZE	QTY.	SP1	SP2	
2	1	3'-0" [915mm]	14'-6" [4420mm]	#8 [K25]	14	6"± [150mm] O.C.	12"± [300mm] O.C.	27
	2	3'-0" [915mm]	14'-6" [4420mm]	#8 [K25]	14	6"± [150mm] O.C.	12"± [300mm] O.C.	27
	3	3'-0" [915mm]	14'-6" [4420mm]	#8 [K25]	14	6"± [150mm] O.C.	12"± [300mm] O.C.	27
	4	3'-0" [915mm]	16'-6" [5030mm]	#8 [K25]	14	6"± [150mm] O.C.	12"± [300mm] O.C.	29
	5	3'-0" [915mm]	18'-6" [5640mm]	#8 [K25]	14	6"± [150mm] O.C.	12"± [300mm] O.C.	31
ZONE	SOIL CLASS	DIMENSION		VERTICAL REINF.		TIE SPACING		#4 [K13] TIE QUANTITY
		A	B	SIZE	QTY.	SP1	SP2	
3	1	3'-0" [915mm]	13'-6" [4120mm]	#8 [K25]	14	6"± [150mm] O.C.	12"± [300mm] O.C.	26
	2	3'-0" [915mm]	13'-6" [4120mm]	#8 [K25]	14	6"± [150mm] O.C.	12"± [300mm] O.C.	26
	3	3'-0" [915mm]	13'-6" [4120mm]	#8 [K25]	14	6"± [150mm] O.C.	12"± [300mm] O.C.	26
	4	3'-0" [915mm]	14'-6" [4120mm]	#8 [K25]	14	6"± [150mm] O.C.	12"± [300mm] O.C.	27
	5	3'-0" [915mm]	17'-6" [5340mm]	#8 [K25]	14	6"± [150mm] O.C.	12"± [300mm] O.C.	30

SEAL:



July 8, 2020



PROJECT INFORMATION:

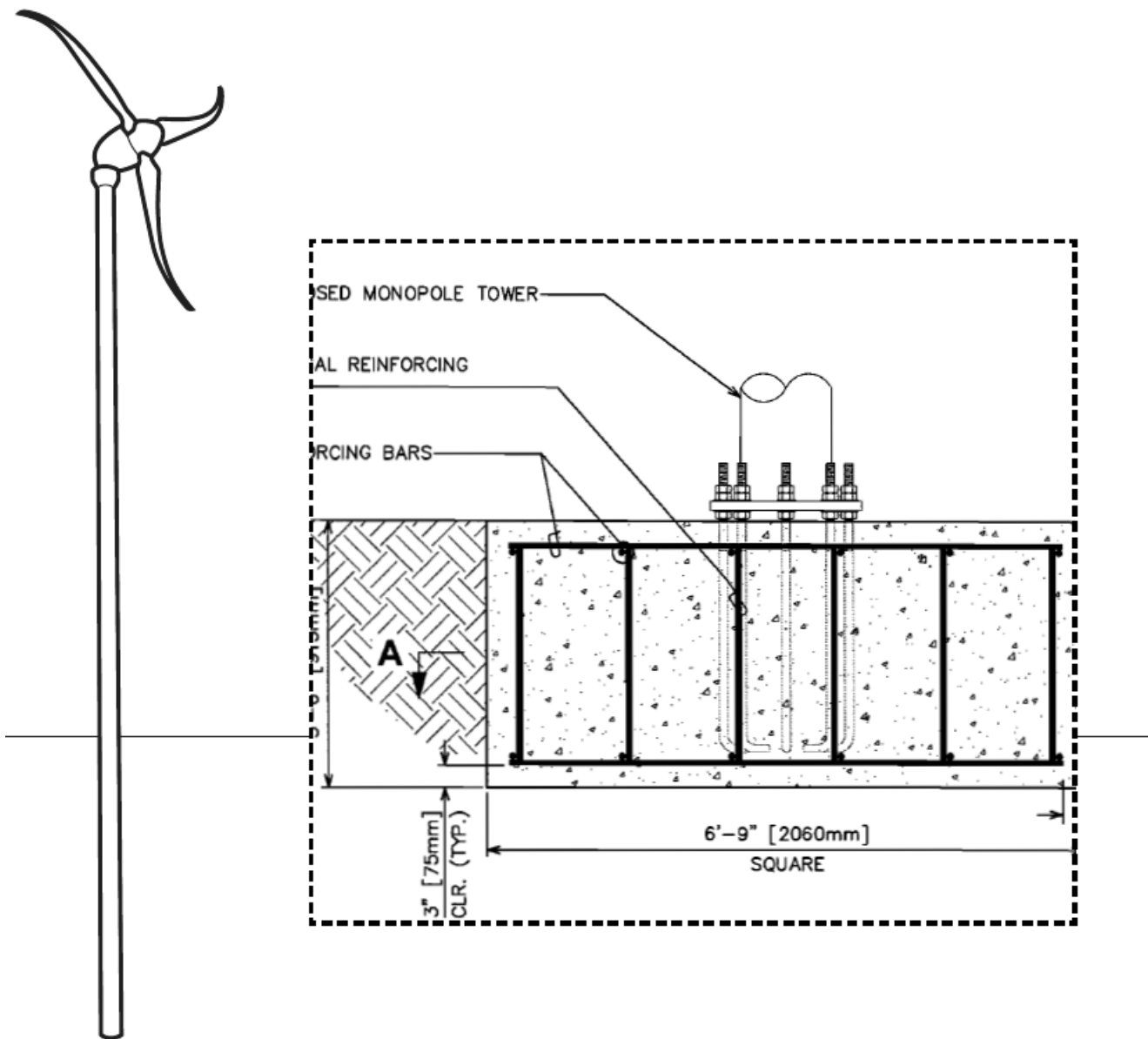
**55-FT [16.8M]
MONOPOLE
FOUNDATIONS**

Southwest Windpower
Renewable Energy Made Simple
1801 West Route 66
Flagstaff, AZ 86001
Office: (928) 779-9463

I	07-08-2010
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	TEP #: 100002.09

SKYSTREAM 3.7
APPENDIX D: 70 ft (21.3 m) Sectional Monopole Tower Foundations



Southwest Windpower

Renewable Energy Made Simple

SKYSTREAM 3.7

ATTENTION

THE FOUNDATION DESIGNS ARE IN ACCORDANCE WITH THE 2006 INTERNATIONAL BUILDING CODE, TIA-222-G-2-2009 STRUCTURAL STANDARD FOR ANTENNA SUPPORTING STRUCTURES AND ANTENNAS, AND ASCE 7-05, MINIMUM DESIGN LOADS FOR BUILDINGS AND OTHER STRUCTURES. THE FOUNDATION DESIGNS ARE FOR A 70-FT [21.3M] MONOPOLE WITH THE SKYSTREAM 3.7 WIND TURBINE BASED ON THE SOIL INFORMATION LISTED IN TABLE 1804.2 (IBC 2006) REFERENCED ON SHEET S-1 AND THE WIND ZONES DESCRIBED ON SHEET S-2. IT IS THE RESPONSIBILITY OF THE OWNER TO VERIFY BY GEOTECHNICAL INVESTIGATION THAT ACTUAL SOIL INVESTIGATION PARAMETERS MEET OR EXCEED THOSE SHOWN IN THE REFERENCED TABLE. IF CONDITIONS OTHER THAN THOSE DESCRIBED IN THE REFERENCED TABLE ARE ENCOUNTERED A FOUNDATION ANALYSIS SHOULD BE PERFORMED TO DETERMINE THE STRUCTURAL ADEQUACY OF THE SUBSTRUCTURE.

INDEX OF SHEETS

NO.	SHEET TITLE	REV	DATE
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N-2	PROJECT NOTES II	1	07-26-10
S-1	TABLE 1804.2 ALLOWABLE FOUNDATION AND LATERAL PRESSURE (IBC 2006)	1	07-26-10
S-2	WIND ZONES AND TOWER REACTIONS	1	07-26-10
S-3A	70-FT [21.3M] MONOPOLE FOUNDATION - WIND ZONE 1	1	07-26-10
S-3B	70-FT [21.3M] MONOPOLE FOUNDATION - WIND ZONE 2	1	07-26-10
S-3C	70-FT [21.3M] MONOPOLE FOUNDATION - WIND ZONE 3	1	07-26-10
S-4	70-FT [21.3M] MONOPOLE FOUNDATION (ALTERNATIVE) - PIER	1	07-26-10
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SEAL:



Expires 09/30/2011

July 26, 2010



TOWER ENGINEERING PROFESSIONALS
3703 JUNCTION BOULEVARD
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(919) 861-6351

PROJECT INFORMATION:

**70-FT [21.3M]
MONOPOLE
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SHEET NUMBER:

T-1

REVISION:

1

TEP#: 100002.09

GENERAL NOTES:

1. ALL WORK PRESENTED ON THESE DRAWINGS MUST BE COMPLETED BY THE CONTRACTOR UNLESS NOTED OTHERWISE.
2. THE CONTRACTOR MUST HAVE CONSIDERABLE EXPERIENCE IN PERFORMANCE OF WORK SIMILAR TO THAT DESCRIBED HEREIN. BY ACCEPTANCE OF THIS ASSIGNMENT, THE CONTRACTOR IS ATTESTING THAT HE DOES HAVE SUFFICIENT EXPERIENCE AND ABILITY, THAT HE IS KNOWLEDGEABLE OF THE WORK TO BE PERFORMED, AND THAT HE IS PROPERLY LICENSED AND PROPERLY REGISTERED TO DO THIS WORK IN THE APPLICABLE STATE/TERRITORY.
3. ALL HARDWARE ASSEMBLY MANUFACTURER'S INSTRUCTIONS SHALL BE FOLLOWED EXACTLY AND SHALL SUPERSEDE ANY CONFLICTING NOTES ENCLOSED HEREIN.
4. IT IS THE CONTRACTOR'S SOLE RESPONSIBILITY TO DETERMINE ERECTION PROCEDURE AND SEQUENCE TO INSURE THE SAFETY OF THE STRUCTURE AND ITS COMPONENT PARTS DURING ERECTION. THIS INCLUDES, BUT IS NOT LIMITED TO, THE ADDITION OF TEMPORARY BRACING, GUYS OR TIE DOWNS THAT MAY BE NECESSARY. SUCH MATERIAL SHALL BE REMOVED AND SHALL REMAIN THE PROPERTY OF THE CONTRACTOR AFTER THE COMPLETION OF THE PROJECT.
5. ALL MATERIALS AND EQUIPMENT FURNISHED SHALL BE NEW AND OF GOOD QUALITY, FREE FROM FAULTS AND DEFECTS, AND IN CONFORMANCE WITH THE CONTRACT DOCUMENTS. ANY AND ALL SUBSTITUTIONS MUST BE PROPERLY APPROVED AND AUTHORIZED IN WRITING BY THE OWNER AND ENGINEER PRIOR TO INSTALLATION. THE CONTRACTOR SHALL FURNISH SATISFACTORY EVIDENCE AS TO THE KIND AND QUALITY OF THE MATERIALS AND EQUIPMENT BEING SUBSTITUTED.
6. THE CONTRACTOR SHALL BE RESPONSIBLE FOR INITIATING, MAINTAINING, AND SUPERVISING ALL SAFETY PRECAUTIONS AND PROGRAMS IN CONNECTION WITH THE WORK.
7. THE CONTRACTOR IS RESPONSIBLE FOR INSURING THAT THIS PROJECT AND RELATED WORK COMPLIES WITH ALL APPLICABLE LOCAL, STATE, AND FEDERAL SAFETY CODES AND REGULATIONS GOVERNING THIS WORK. THE CONTRACTOR SHALL SECURE ALL NECESSARY PERMITS FOR THIS PROJECT FROM ALL APPLICABLE GOVERNMENTAL AGENCIES. ALL PERMITS THAT MUST BE OBTAINED ARE THE RESPONSIBILITY OF THE CONTRACTOR. THE CONTRACTOR WILL BE RESPONSIBLE FOR ABIDING BY ALL CONDITIONS AND REQUIREMENTS OF THE PERMITS.
8. THE CONTRACTOR IS REQUIRED TO MAINTAIN ALL PIPES, DITCHES, AND OTHER DRAINAGE STRUCTURES FREE FROM OBSTRUCTION UNTIL WORK IS ACCEPTED BY THE OWNER. THE CONTRACTOR IS RESPONSIBLE FOR ANY DAMAGES CAUSED BY FAILURE TO MAINTAIN DRAINAGE STRUCTURE IN OPERABLE CONDITION.
9. ALL MATERIALS AND WORKMANSHIP SHALL BE WARRANTED FOR ONE YEAR FROM ACCEPTANCE DATE.

CONNECTION NOTES:

1. OVERSIZED (ROUND) BASE PLATE HOLES SHALL HAVE APPROVED F436 (F436M FOR METRIC) WASHERS INSTALLED, BOTH ABOVE AND BELOW THE BASE PLATE, ON EACH ANCHOR.
2. SLOTTED BASE PLATE HOLES SHALL HAVE EITHER APPROVED F436 (F436M FOR METRIC) WASHERS, OR PLATE WASHERS INSTALLED, BOTH ABOVE AND BELOW THE BASE PLATE, ON EACH ANCHOR. WASHERS SHALL BE SIZED TO COVER THE ENTIRE SLOTTED HOLES. PLATE WASHERS SHALL BE OF ASTM A36 MATERIAL (MINIMUM) AND HAVE A MINIMUM THICKNESS OF 5/16".
3. AN APPROVED NUT LOCKING DEVICE SHALL BE INSTALLED ON ALL BOLTED CONNECTIONS TO PREVENT NUT LOOSENING.



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REINFORCING STEEL NOTES:

1. THE REINFORCING STEEL SHALL CONFORM TO THE REQUIREMENTS OF ASTM A-615, GRADE 60 [EU GRADE 420]. IT SHALL BE DEFORMED AND SPLICES SHALL NOT BE ALLOWED UNLESS OTHERWISE NOTED.
2. WELDING IS PROHIBITED ON REINFORCING STEEL AND EMBEDMENTS.
3. REINFORCING CAGES SHALL BE BRACED TO RETAIN PROPER DIMENSIONS DURING HANDLING AND THROUGHOUT PLACEMENT OF CONCRETE. WHEN TEMPORARY CASING IS UTILIZED, BRACING SHALL BE ADEQUATE TO RESIST FORCES OCCURRING FROM FLOWING CONCRETE DURING CASING EXTRACTION.
4. SPACERS SHALL BE ATTACHED INTERMITTENTLY THROUGHOUT THE ENTIRE LENGTH OF TIEBACK REINFORCING TO INSURE CONCENTRIC PLACEMENT OF CAGES IN EXCAVATIONS.
5. MINIMUM CONCRETE COVER FOR REINFORCEMENT SHALL BE 3" [75mm] IF CAST IN PLACE AND 2" [50mm] COVER IF FORMWORK IS USED AS DEFINED IN ACI 318 SECTION 7.7.1. APPROVED SPACERS SHALL BE USED TO INSURE APPROPRIATE COVER ON REINFORCEMENT.
6. IN REGIONS OF HIGH SEISMIC RISK, ASSIGNED TO SEISMIC DESIGN CATEGORIES C, D, E, AND F, ADDITIONAL TERMINATION DETAILS ARE REQUIRED FOR STEEL REINFORCING BARS. FURTHER, ADDITIONAL DETAILING REQUIREMENTS MAY BE REQUIRED IN OTHER, LESS PRONE AREAS AS REQUIRED BY THE AUTHORITY HAVING JURISDICTION (AHJ).
 - A. SEISMIC HOOKS SHALL BE USED TO TERMINATE STIRRUPS, HOOPS, OR CROSSTIES AS DEFINED PER ACI 318.
 - B. LONGITUDINAL REINFORCING BARS ARE REQUIRED TO HAVE BOTH A STANDARD BEND AND HOOK EXTENSION (MIN. OF 12 BAR DIAMETERS) AT EACH END AS DEFINED PER ACI 318.

CONCRETE NOTES:

1. WORK SHALL BE IN ACCORDANCE WITH THE LATEST REVISION OF THE ACI-318, "BUILDING CODE REQUIREMENTS FOR STRUCTURAL CONCRETE."
2. THE CONCRETE SHALL DEVELOP A MINIMUM COMPRESSIVE STRENGTH OF 2,500 PSI [17230 kPa] IN 28-DAYS. HOWEVER, A MINIMUM COMPRESSIVE STRENGTH OF 3,000 PSI TO 4,500 PSI IN 28-DAYS SHALL BE USED IN LOCATIONS WITH MODERATE TO SEVERE SULFATE EXPOSURE UNLESS OTHERWISE REQUIRED BY THE LOCAL JURISDICTION.
3. PROPORTIONS OF CONCRETE MATERIALS SHALL BE SUITABLE FOR THE INSTALLATION METHOD UTILIZED AND SHALL RESULT IN DURABLE CONCRETE FOR RESISTANCE TO LOCAL ANTICIPATED AGGRESSIVE ACTIONS. THE DURABILITY REQUIREMENTS OF ACI-318 SHALL BE SATISFIED BASED ON THE CONDITIONS EXPECTED AT THE SITE.
4. CONCRETE SHALL BE PLACED IN A MANNER THAT WILL PREVENT SEGREGATION OF CONCRETE MATERIALS, INFILTRATION OF WATER OR SOIL, AND OTHER OCCURRENCES THAT MAY DECREASE THE STRENGTH OR DURABILITY OF THE FOUNDATION.
5. FREE FALL CONCRETE MAY BE USED PROVIDED FALL IS VERTICAL DOWN WITHOUT HITTING THE SIDES OF THE EXCAVATION, FORMWORK, REINFORCING BARS, FORM TIES, CAGE BRACING, OR OTHER OBSTRUCTIONS. UNDER NO CIRCUMSTANCES SHALL CONCRETE FALL THROUGH WATER.
6. THE MAXIMUM SIZE OF THE AGGREGATE SHALL NOT EXCEED A SIZE SUITABLE FOR THE INSTALLATION METHOD UTILIZED OR 1/3-CLEAR DISTANCE BEHIND OR BETWEEN REINFORCING. THE MAXIMUM SIZE MAY BE INCREASED TO 2/3-CLEAR DISTANCE PROVIDED WORKABILITY AND METHODS OF CONSOLIDATION SUCH AS VIBRATING WILL PREVENT HONEYCOMBS AND VOIDS.

CONCRETE NOTES (CONTINUED):

7. IF THE FROST LINE IS KNOWN TO BE GREATER THAN THE FOUNDATION DEPTH OR THE WATER TABLE IS LESS THAN THE FOUNDATION DEPTH, THE DESIGN ENGINEER (TOWER ENGINEERING PROFESSIONALS, INC.) SHALL BE NOTIFIED PRIOR TO CONSTRUCTION AND A FOUNDATION ANALYSIS OR RE-DESIGN SHALL BE PERFORMED.



TOWER ENGINEERING PROFESSIONALS
3703 JUNCTION BOULEVARD
RALEIGH, NC 27603-5263
(919) 661-6351

PROJECT INFORMATION:

**70-FT [21.3M]
MONOPOLE
FOUNDATIONS**

Southwest Windpower

Renewable Energy Made Simple
1801 West Route 66
Flagstaff, AZ 86001
Office: (928) 779-9463

I	07-26-2010
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TABLE 1804.2 ALLOWABLE FOUNDATION AND LATERAL PRESSURE (IBC 2006)

SOIL CLASS	DESCRIPTION	ALLOWABLE FOUNDATION PRESSURE	LATERAL BEARING (BELOW NATURAL GRADE)	LATERAL SLIDING		ASSUMED UNIT WEIGHT W/O WATER	ASSUMED INTERNAL ANGLE OF FRICTION
				COEFF. OF FRICTION	RESISTANCE		
1	CRYSTALLINE BEDROCK	12,000 psf	1,200 psf/ft	0.70	—	140 pcf	0°
		574.56 kPa	188.50 kPa/m			22 kN/m ³	
2	SEDIMENTARY AND FOLIATED ROCK	4,000 psf	400 psf/ft	0.35	—	130 pcf	0°
		191.52 kPa	62.83 kPa/m			20 kN/m ³	
3	SANDY GRAVEL AND/OR GRAVEL (GW AND GP)	3,000 psf	200 psf/ft	0.35	—	120 pcf	32°
		143.64 kPa	31.42 kPa/m			19 kN/m ³	
4	SAND, SILTY SAND, CLAYEY SAND, SILTY GRAVEL, AND CLAYEY GRAVEL (SW,SP,SM,SC,GM AND GC)	2,000 psf	150 psf/ft	0.25	—	100 pcf	26°
		95.76 kPa	23.56 kPa/m			16 kN/m ³	
5	CLAY, SANDY CLAY, SILTY CLAY, CLAYEY SILT, SILT AND SANDY SILT (CL, ML, MH AND CH)	1,500 psf	100 psf/ft	—	130 psf	90 pcf	0°
		71.82 kPa	15.71 kPa/m		6.22 kPa	14 kN/m ³	

SEAL:



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S-1

REVISION:

1

TEP#: 100002.09

TOWER REACTIONS - 70' [21.3M] MONOPOLE

ZONE	MAXIMUM LOADING CRITERIA	FACTORED ** MOMENT	FACTORED ** SHEAR	FACTORED VERTICAL
1	SKYSTREAM WIND TURBINE 140 MPH & 60 MPH W/ 1"-ICE [63 m/sec & 26.8 m/sec w/ 25.4mm-ICE]	212.9 kip-ft	4.79 kips	2.71 kips
		288.7 kN-m	21.31 kN	12.05 kN
2	SKYSTREAM WIND TURBINE 120 MPH & 60 MPH W/ 1"-ICE [54 m/sec & 26.8 m/sec w/ 25.4mm-ICE]	183.3 kip-ft	3.88 kips	2.71 kips
		248.5 kN-m	17.26 kN	12.05 kN
3	SKYSTREAM WIND TURBINE 90 MPH & 60 MPH W/ 1"-ICE [40 m/sec & 26.8 m/sec w/ 25.4mm-ICE]	147.5 kip-ft	2.79 kips	2.71 kips
		200.0 kN-m	12.41 kN	12.05 kN

** THE REACTIONS LISTED ARE FOR REFERENCE ONLY AND SHOULD NOT BE SUBSTITUTED FOR A STRUCTURAL ANALYSIS BASED ON SITE-SPECIFIC DATA.

WIND ZONES

ZONE	WIND SPEED
1	120 - 140 MPH [54 - 63 m/sec]
2	90 - 120 MPH [40 - 54 m/sec]
3	≤ 90 MPH [≤ 40 m/sec]

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S-2

REVISION:

1

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NOTES:

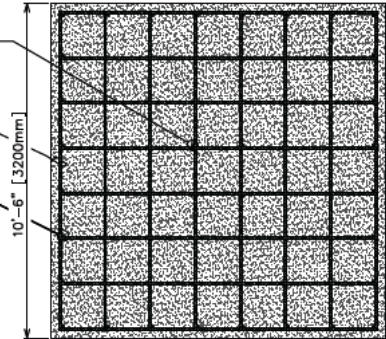
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2. FOUNDATION WIDTH IS BASED ON WIND ZONES 1-3, SEE SHEETS S-3A - S-3C FOR APPROPRIATE SIZES.
3. IF THE PROPOSED AREA IS FOUND TO CONTAIN FILL MATERIALS, THE EXCAVATION SHALL EXTEND TO THE VIRGIN SAND LAYER AND BE BACKFILLED WITH COMPACTED SAND OR STONE. AFTER EXCAVATION AND PRIOR TO FILL OR CONCRETE PLACEMENT, THE SURFACE OF THE VIRGIN SAND LAYER SHOULD BE MECHANICALLY COMPACTED TO DENSIFY THE SURFACE DISTURBED DURING THE EXCAVATION.
4. ALL BACKFILL SHOULD BE PLACED IN MAXIMUM LOOSE LIFTS OF 8" AND COMPACTED TO A MINIMUM 95% OF ASTM D-1557.
5. TOWER GROUNDING SHALL BE PERFORMED IN ACCORDANCE WITH THE NEC REQUIREMENTS FOR GROUNDING.
6. CONDUIT PLACEMENT SHALL BE IN ACCORDANCE WITH BOTH THE NEC AND SOUTHWEST WINDPOWER REQUIREMENTS.

DESIGN IS BASED ON SOIL CLASS 5:
 $q_a = 1500 \text{ psf} [71.82 \text{ kPa}]$

#8 [K25] VERTICAL REINFORCING BARS
 IN CENTER PLACED AS SHOWN.
 (4 TOTAL)

(8) #8 [K25] REINFORCING BARS
 SPACED EQUALLY EACH WAY, TOP AND
 BOTTOM (32 TOTAL). ADJUST BARS AS
 REQUIRED TO CLEAR ANCHOR BOLTS.
 BAR SPACING SHALL NOT EXCEED 18".

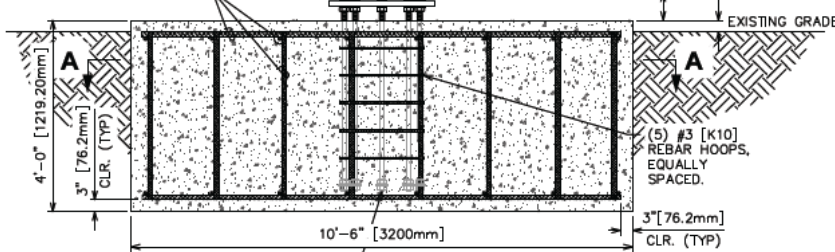
#8 [K25] VERTICAL REINFORCING
 BARS SPACED EQUALLY AS
 SHOWN. (28 TOTAL)



SECTION A-A

SCALE: $\frac{1}{4}" = 1'-0" [6.4mm = 304.8mm]$

PROPOSED MONOPOLE TO BE
 INSTALLED PER SWMP.
 REINFORCING BARS.



FOUNDATION - WIND ZONE 1

SCALE: $\frac{3}{8}" = 1'-0" [9.5mm = 304.8mm]$

(8) $1\frac{1}{4}" \times 50"$ LONG ANCHOR BOLTS (F1554 GR. 55 OR APPROVED EQUAL) ON $23"$ BOLT
 CIRCLE. EACH ANCHOR BOLT SHALL BE EMBEDDED WITH A HARDENED WASHER BETWEEN
 TWO (2) NUTS SECURED BY DEFORMING THREADS. AS A MINIMUM, WASHERS SHALL BE
 ASTM F436 CIRCULAR WASHERS: MINIMUM O.D. = $2\frac{3}{4}"$, MAX I.D. = $1\frac{1}{2}"$, MINIMUM THICKNESS
 OF 0.136".

SEAL:



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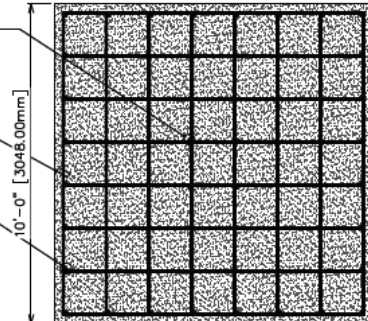
1. THE FOUNDATION DESIGNS ARE BASED ON THE SOIL INFORMATION LISTED IN TABLE 1804.2 (IBC 2006) REFERENCED ON SHEET S-1. IT IS THE RESPONSIBILITY OF THE OWNER TO VERIFY BY GEOTECHNICAL INVESTIGATION THAT ACTUAL SITE SOIL PARAMETERS EQUAL OR EXCEED THOSE SHOWN IN THE REFERENCED TABLE. IF CONDITIONS OTHER THAN THOSE DESCRIBED IN THE REFERENCED TABLE ARE ENCOUNTERED A FOUNDATION ANALYSIS SHOULD BE PERFORMED TO DETERMINE THE STRUCTURAL ADEQUACY OF THE SUBSTRUCTURE.
2. FOUNDATION WIDTH IS BASED ON WIND ZONES 1-3, SEE SHEETS S-3A - S-3C FOR APPROPRIATE SIZES.
3. IF THE PROPOSED AREA IS FOUND TO CONTAIN FILL MATERIALS, THE EXCAVATION SHALL EXTEND TO THE VIRGIN SAND LAYER AND BE BACKFILLED WITH COMPACTED SAND OR STONE. AFTER EXCAVATION AND PRIOR TO FILL OR CONCRETE PLACEMENT, THE SURFACE OF THE VIRGIN SAND LAYER SHOULD BE MECHANICALLY COMPACTED TO DENSIFY THE SURFACE DISTURBED DURING THE EXCAVATION.
4. ALL BACKFILL SHOULD BE PLACED IN MAXIMUM LOOSE LIFTS OF 8" AND COMPACTED TO A MINIMUM 95% OF ASTM D-1557.
5. TOWER GROUNDING SHALL BE PERFORMED IN ACCORDANCE WITH THE NEC REQUIREMENTS FOR GROUNDING.
6. CONDUIT PLACEMENT SHALL BE IN ACCORDANCE WITH BOTH THE NEC AND SOUTHWEST WINDPOWER REQUIREMENTS.

DESIGN IS BASED ON SOIL CLASS 5:
 $q_{all} = 1500 \text{ psf} [71.82 \text{ kPa}]$

#8 [K25] VERTICAL REINFORCING BARS IN CENTER PLACED AS SHOWN. (4 TOTAL)

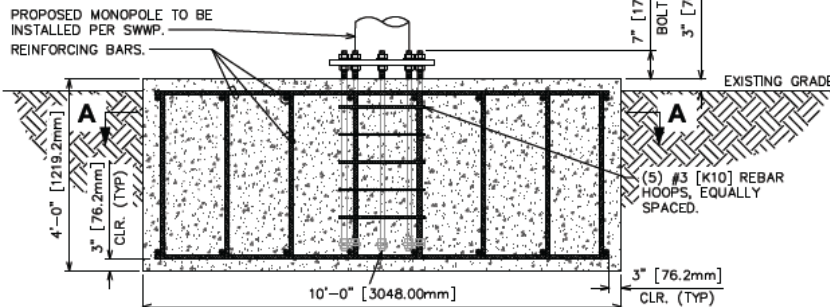
(8) #8 [K25] REINFORCING BARS SPACED EQUALLY EACH WAY, TOP AND BOTTOM (32 TOTAL). ADJUST BARS AS REQUIRED TO CLEAR ANCHOR BOLTS. BAR SPACING SHALL NOT EXCEED 18".

#8 [K25] VERTICAL REINFORCING BARS SPACED EQUALLY AS SHOWN (28 TOTAL)



SECTION A-A

SCALE: $\frac{1}{4}" = 1'-0"$ [6.4mm = 304.8mm]



FOUNDATION - WIND ZONE 2

SCALE: $\frac{3}{8}" = 1'-0"$ [9.5mm = 304.8mm]

(8) $1\frac{1}{2}" \times 50"$ LONG ANCHOR BOLTS (F1554 GR. 55 OR APPROVED EQUAL) ON $23"\varnothing$ BOLT CIRCLE. EACH ANCHOR BOLT SHALL BE EMBEDDED WITH A HARDENED WASHER BETWEEN TWO (2) NUTS SECURED BY DEFORMING THREADS. AS A MINIMUM, WASHERS SHALL BE ASTM F436 CIRCULAR WASHERS: O.D. = $2\frac{3}{4}"\varnothing$, MAX I.D. = $1\frac{1}{2}"\varnothing$, MINIMUM THICKNESS OF 0.136".

SEAL:



Expires 09/30/2011

July 26, 2010



TOWER ENGINEERING PROFESSIONALS
 3703 JUNCTION BOULEVARD
 RALEIGH, NC 27603-5263
 (919) 861-6351

PROJECT INFORMATION:

**70-FT [21.3M]
 MONOPOLE
 FOUNDATIONS**

Southwest Windpower
 Renewable Energy Made Simple

1801 West Route 66
 Flagstaff, AZ 86001
 Office: (928) 779-9463

REV	DATE
I	07-26-2010
O	04-13-2010

DRAWN BY: JRM CHECKED BY: RZG

SHEET NUMBER: S-3B	REVISION: 1
TEP#: 100002.09	

NOTES:

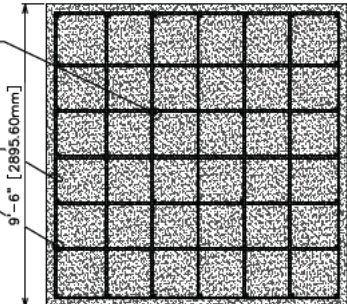
1. THE FOUNDATION DESIGNS ARE BASED ON THE SOIL INFORMATION LISTED IN TABLE 1804.2 (IBC 2006) REFERENCED ON SHEET S-1. IT IS THE RESPONSIBILITY OF THE OWNER TO VERIFY BY GEOTECHNICAL INVESTIGATION THAT ACTUAL SITE SOIL PARAMETERS EQUAL OR EXCEED THOSE SHOWN IN THE REFERENCED TABLE. IF CONDITIONS OTHER THAN THOSE DESCRIBED IN THE REFERENCED TABLE ARE ENCOUNTERED A FOUNDATION ANALYSIS SHOULD BE PERFORMED TO DETERMINE THE STRUCTURAL ADEQUACY OF THE SUBSTRUCTURE.
2. FOUNDATION WIDTH IS BASED ON WIND ZONES 1-3, SEE SHEETS S-3A - S-3C FOR APPROPRIATE SIZES.
3. IF THE PROPOSED AREA IS FOUND TO CONTAIN FILL MATERIALS, THE EXCAVATION SHALL EXTEND TO THE VIRGIN SAND LAYER AND BE BACKFILLED WITH COMPACTED SAND OR STONE. AFTER EXCAVATION AND PRIOR TO FILL OR CONCRETE PLACEMENT, THE SURFACE OF THE VIRGIN SAND LAYER SHOULD BE MECHANICALLY COMPACTED TO DENSIFY THE SURFACE DISTURBED DURING THE EXCAVATION.
4. ALL BACKFILL SHOULD BE PLACED IN MAXIMUM LOOSE LIFTS OF 8" AND COMPACTED TO A MINIMUM 95% OF ASTM D-1557.
5. TOWER GROUNDING SHALL BE PERFORMED IN ACCORDANCE WITH THE NEC REQUIREMENTS FOR GROUNDING.
6. CONDUIT PLACEMENT SHALL BE IN ACCORDANCE WITH BOTH THE NEC AND SOUTHWEST WINDPOWER REQUIREMENTS.

DESIGN IS BASED ON SOIL CLASS 5:
 $q'_{ai} = 1500 \text{ psf } [71.82 \text{ kPa}]$

#8 [K25] VERTICAL REINFORCING BARS IN CENTER PLACED AS SHOWN. (4 TOTAL)

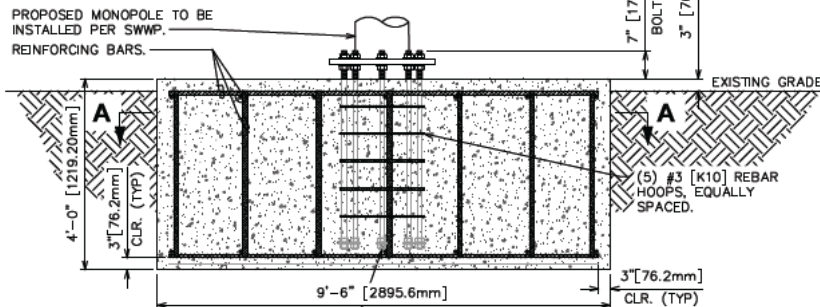
(7) #8 [K25] REINFORCING BARS SPACED EQUALLY EACH WAY, TOP AND BOTTOM (28 TOTAL). ADJUST BARS AS REQUIRED TO CLEAR ANCHOR BOLTS. BAR SPACING SHALL NOT EXCEED 18".

#8 [K25] VERTICAL REINFORCING BARS SPACED EQUALLY AS SHOWN (24 TOTAL)



SECTION A-A

SCALE: $\frac{1}{4}" = 1'-0" [6.4mm = 304.8mm]$



FOUNDATION - WIND ZONE 3

SCALE: $\frac{3}{8}" = 1'-0" [9.5mm = 304.8mm]$

SEAL:



Expires 09/30/2011

July 26, 2010



TOWER ENGINEERING PROFESSIONALS
 3703 JUNCTION BOULEVARD
 RALEIGH, NC 27603-6263
 (919) 661-6351

PROJECT INFORMATION:

**70-FT [21.3M]
 MONOPOLE
 FOUNDATIONS**

Southwest Windpower
 Renewable Energy Made Simple

1801 West Route 66
 Flagstaff, AZ 86001
 Office: (928) 779-9463

REV	DATE
I	07-26-2010
O	04-13-2010

DRAWN BY: JRM CHECKED BY: REG

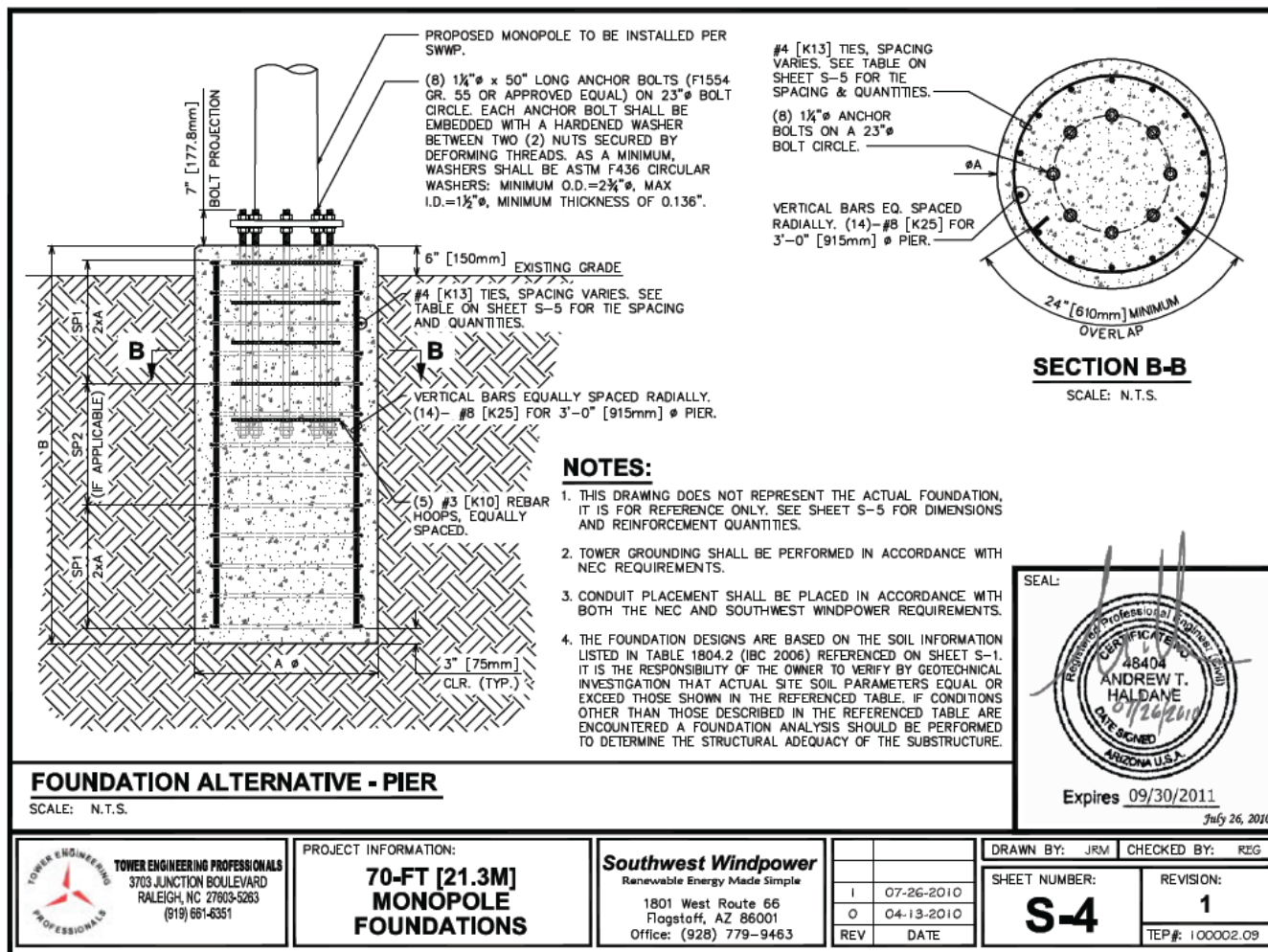
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S-3C

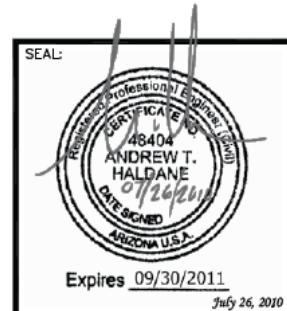
REVISION:

1

TEP#: 100002.09



70-FT [21.3M] MONOPOLE FOUNDATION DIMENSIONS - PIER								
ZONE	SOIL CLASS	DIMENSION		VERTICAL REINF.		TIE SPACING		#4 [K13] TIE QUANTITY
		A	B	SIZE	QTY.	SP1	SP2	
1	1	3'-0" [915mm]	16'-6" [5030mm]	#8 [K25]	14	6"± [150mm] O.C.	12"± [300mm] O.C.	29
	2	3'-0" [915mm]	16'-6" [5030mm]	#8 [K25]	14	6"± [150mm] O.C.	12"± [300mm] O.C.	29
	3	3'-0" [915mm]	16'-6" [5030mm]	#8 [K25]	14	6"± [150mm] O.C.	12"± [300mm] O.C.	29
	4	3'-0" [915mm]	18'-6" [5640mm]	#8 [K25]	14	6"± [150mm] O.C.	12"± [300mm] O.C.	31
	5	3'-0" [915mm]	20'-6" [6248mm]	#8 [K25]	14	6"± [150mm] O.C.	12"± [300mm] O.C.	33
ZONE	SOIL CLASS	DIMENSION		VERTICAL REINF.		TIE SPACING		#4 [K13] TIE QUANTITY
		A	B	SIZE	QTY.	SP1	SP2	
2	1	3'-0" [915mm]	15'-6" [4724mm]	#8 [K25]	14	6"± [150mm] O.C.	12"± [300mm] O.C.	28
	2	3'-0" [915mm]	15'-6" [4724mm]	#8 [K25]	14	6"± [150mm] O.C.	12"± [300mm] O.C.	28
	3	3'-0" [915mm]	15'-6" [4724mm]	#8 [K25]	14	6"± [150mm] O.C.	12"± [300mm] O.C.	28
	4	3'-0" [915mm]	17'-6" [5334mm]	#8 [K25]	14	6"± [150mm] O.C.	12"± [300mm] O.C.	30
	5	3'-0" [915mm]	19'-6" [5944mm]	#8 [K25]	14	6"± [150mm] O.C.	12"± [300mm] O.C.	32
ZONE	SOIL CLASS	DIMENSION		VERTICAL REINF.		TIE SPACING		#4 [K13] TIE QUANTITY
		A	B	SIZE	QTY.	SP1	SP2	
3	1	3'-0" [915mm]	14'-6" [4420mm]	#8 [K25]	14	6"± [150mm] O.C.	12"± [300mm] O.C.	27
	2	3'-0" [915mm]	14'-6" [4420mm]	#8 [K25]	14	6"± [150mm] O.C.	12"± [300mm] O.C.	27
	3	3'-0" [915mm]	14'-6" [4420mm]	#8 [K25]	14	6"± [150mm] O.C.	12"± [300mm] O.C.	27
	4	3'-0" [915mm]	15'-6" [4724mm]	#8 [K25]	14	6"± [150mm] O.C.	12"± [300mm] O.C.	28
	5	3'-0" [915mm]	18'-6" [5639mm]	#8 [K25]	14	6"± [150mm] O.C.	12"± [300mm] O.C.	31



PROJECT INFORMATION:

**70-FT [21.3M]
MONOPOLE
FOUNDATIONS**

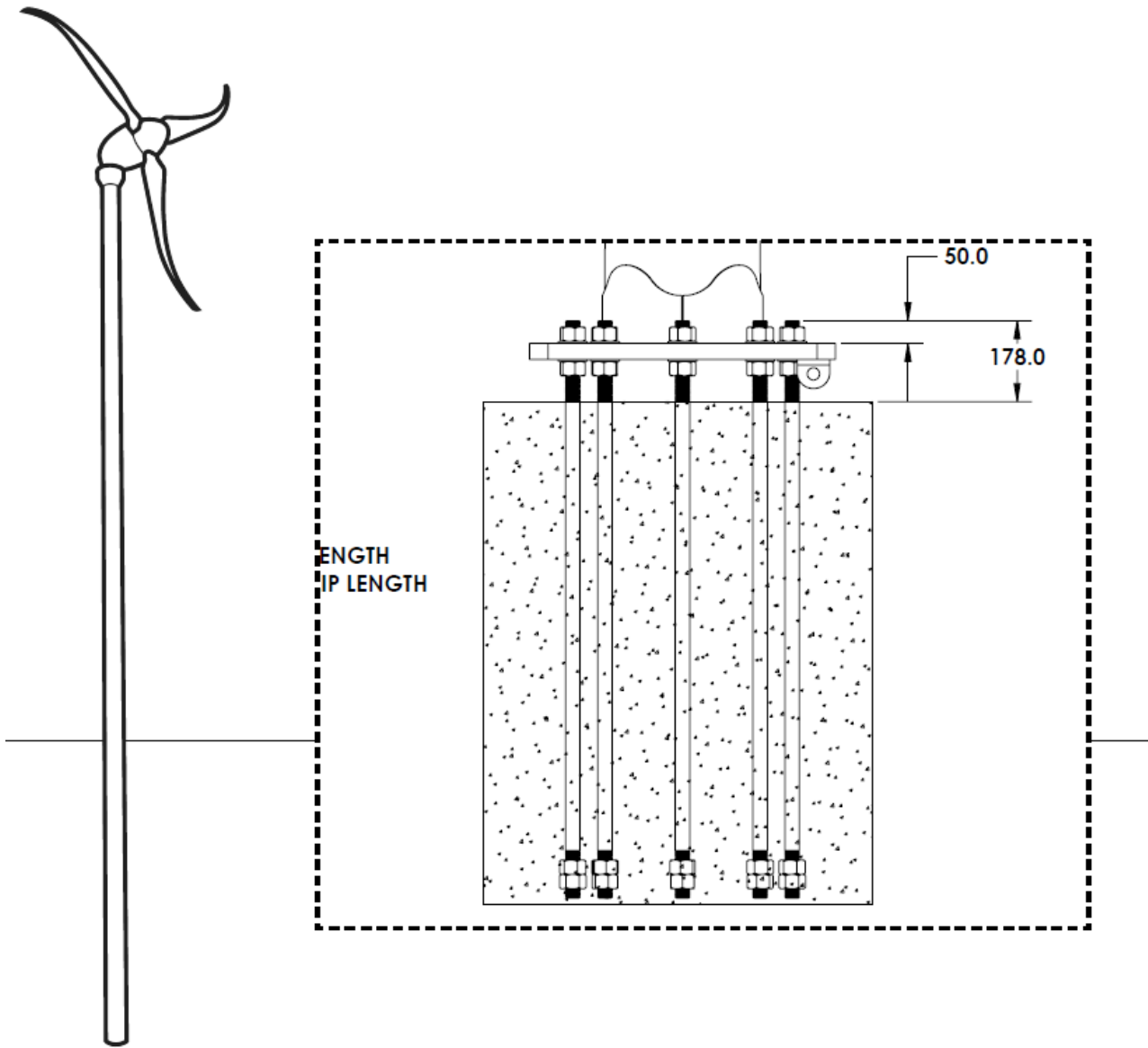
Southwest Windpower
Renewable Energy Made Simple
1801 West Route 66
Flagstaff, AZ 86001
Office: (928) 779-9463

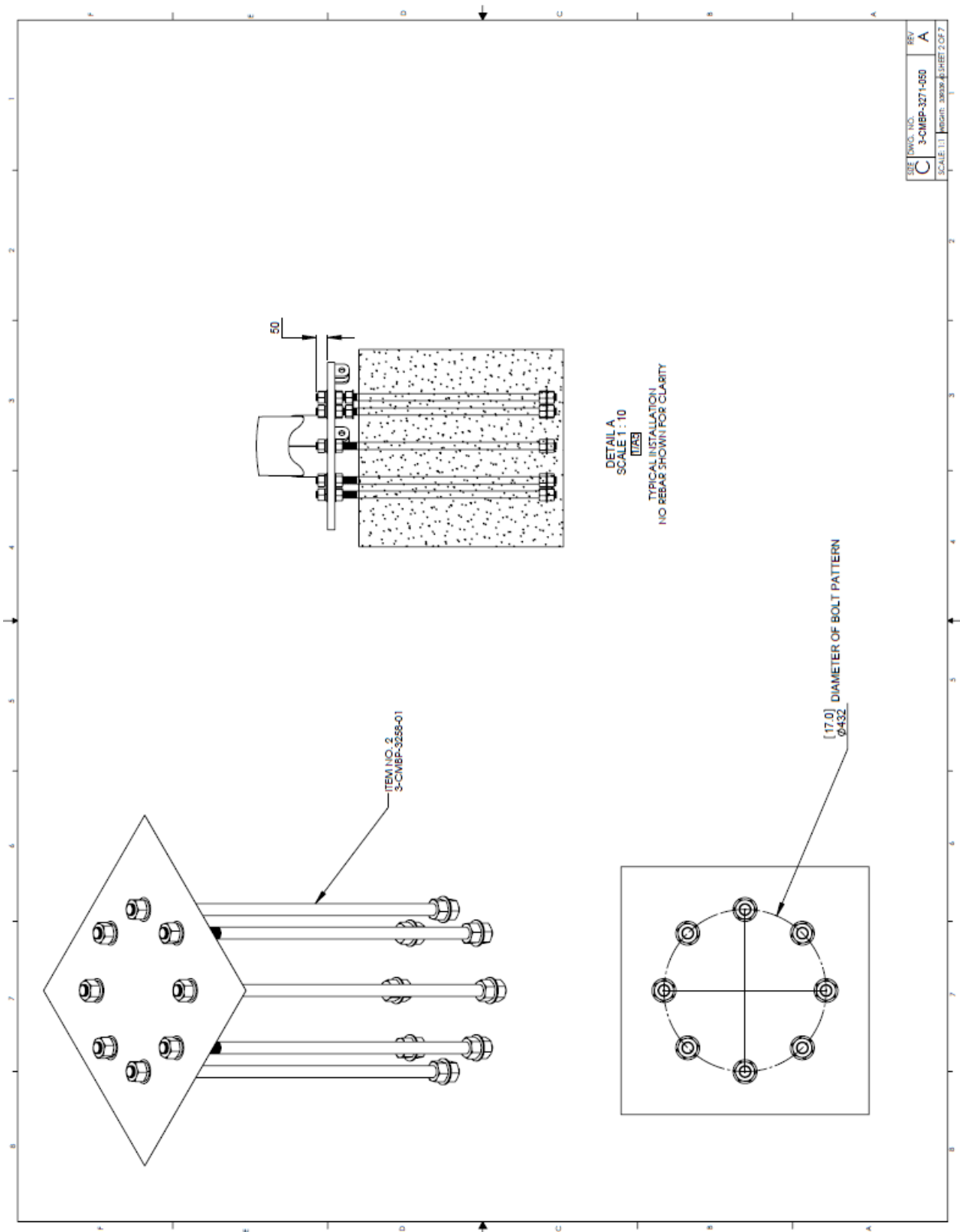
I	07-26-2010
O	04-13-2010
REV	DATE

DRAWN BY: JRM	CHECKED BY: REG
SHEET NUMBER: S-5	REVISION: 1
	TEP#: 100002.09

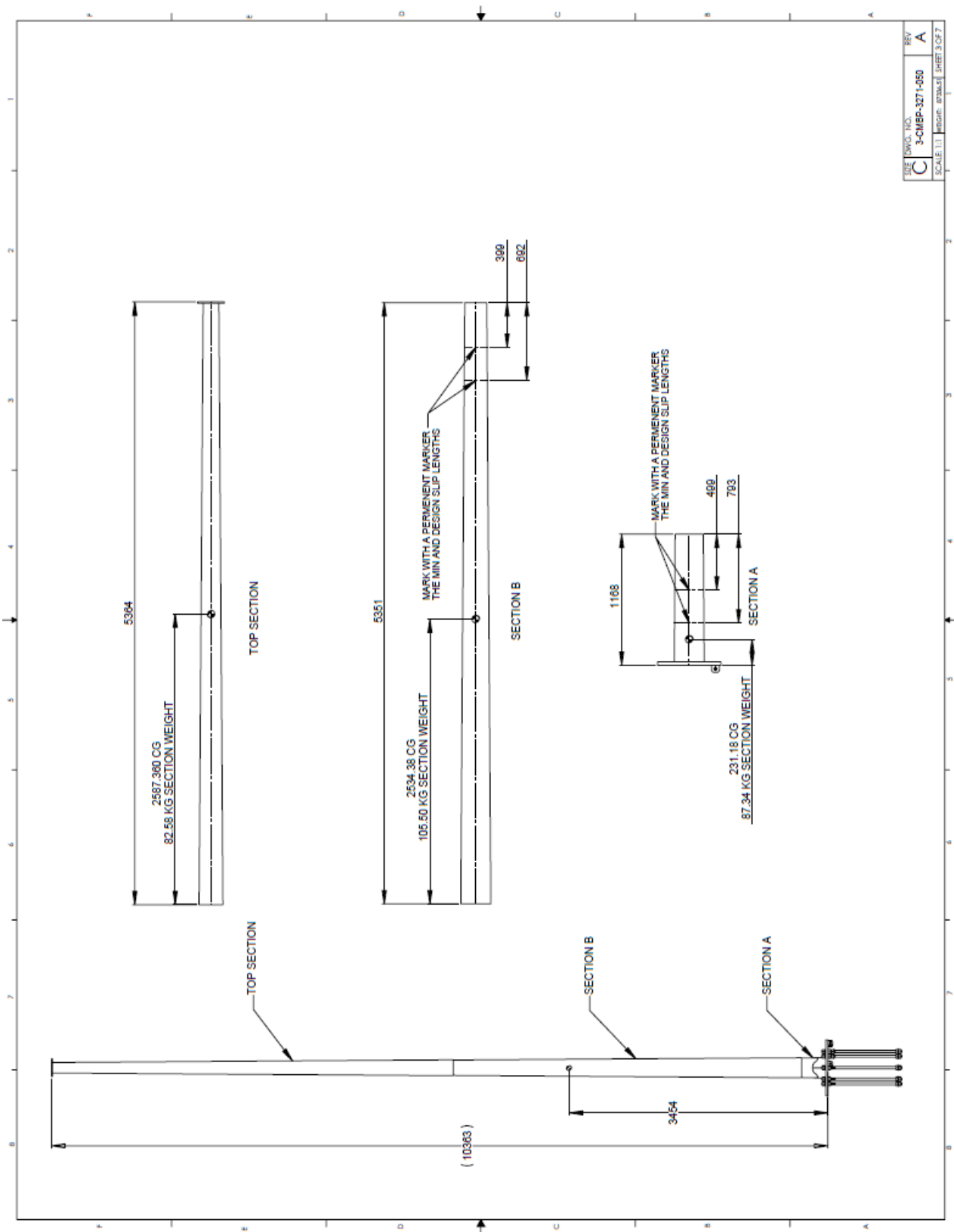
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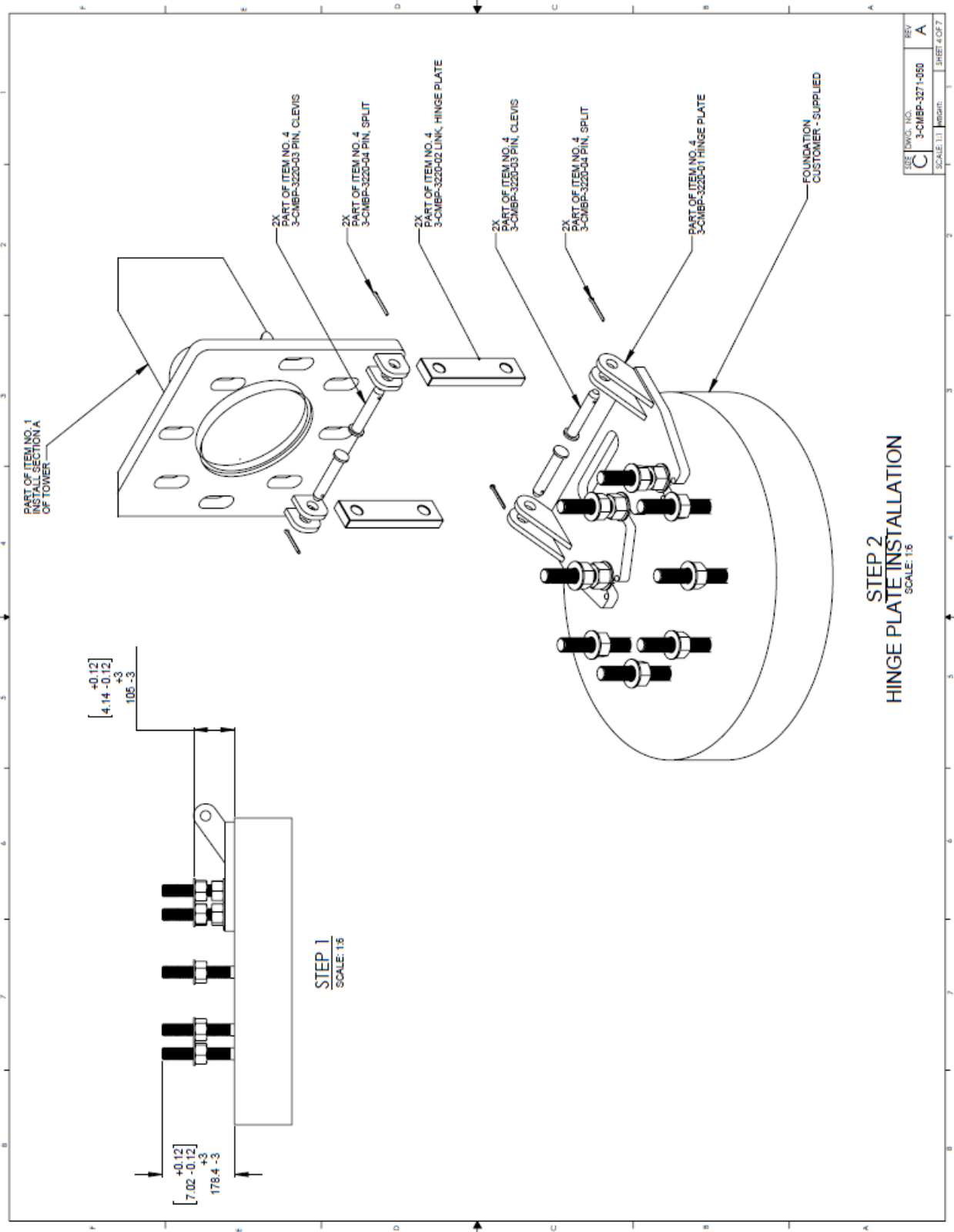
SKYSTREAM 3.7
Appendix E: 34 ft (10.4 m) Tower Assembly Booklet

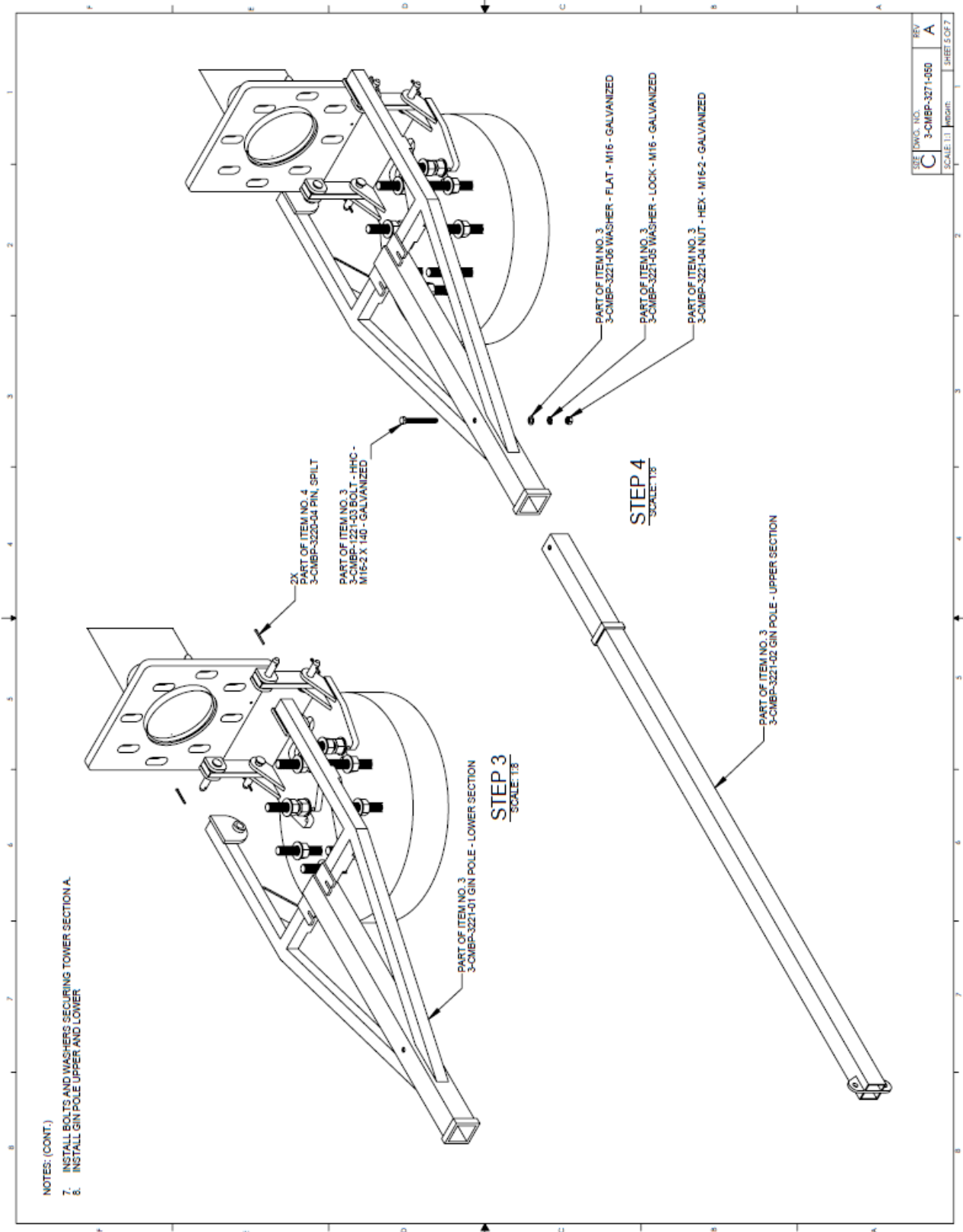


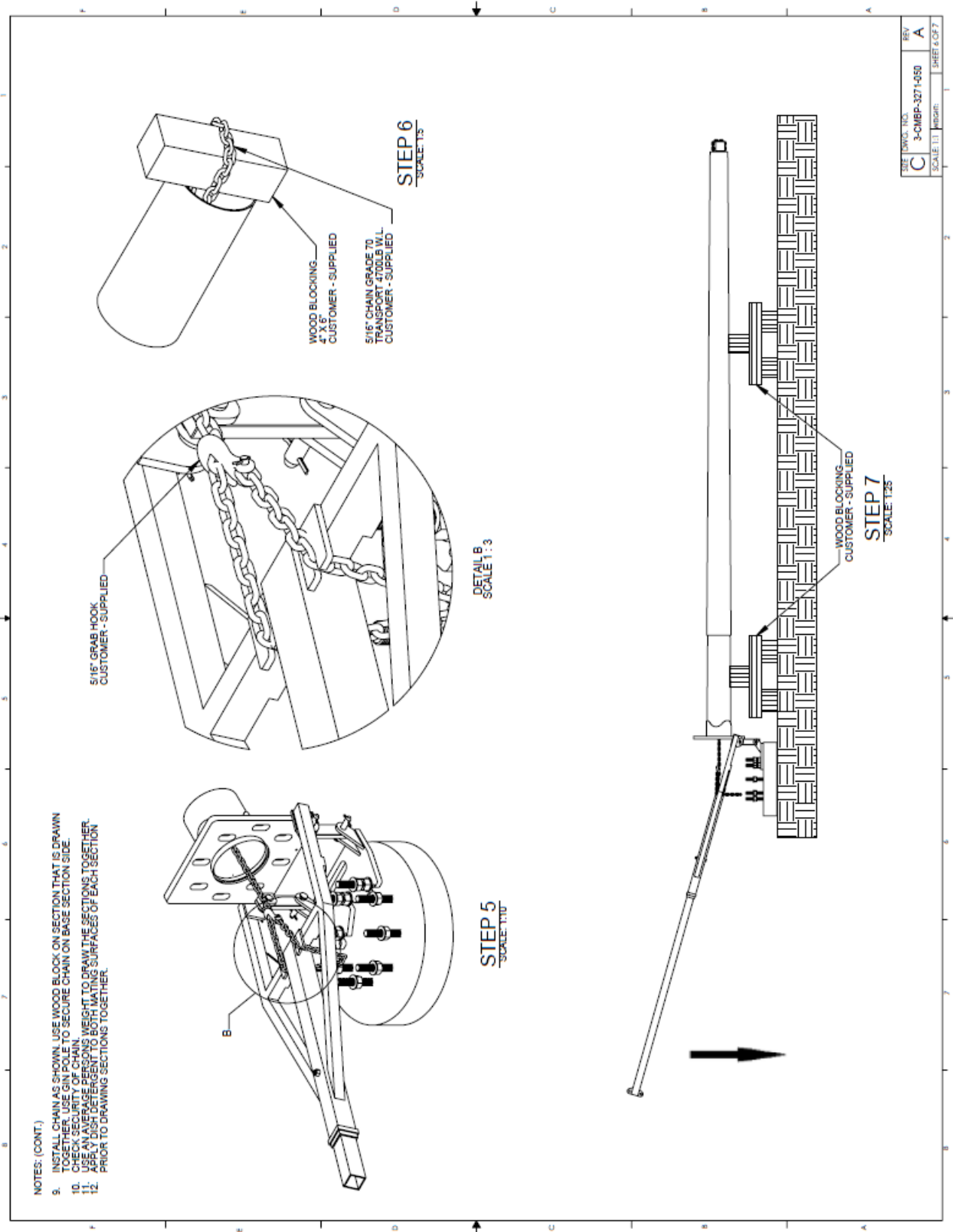


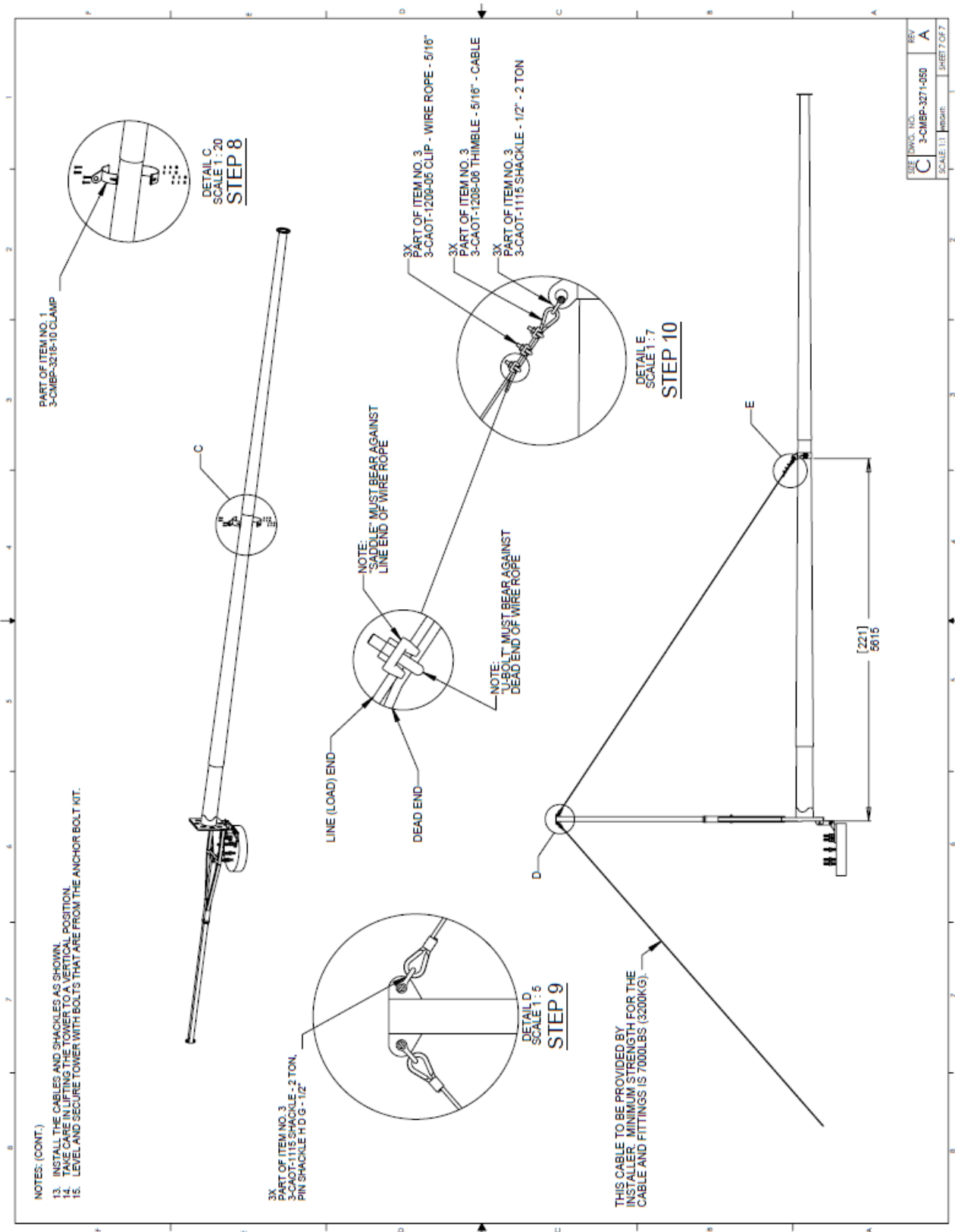
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SCALE 1:1	SECTION 30000	SHEET 2 OF 7



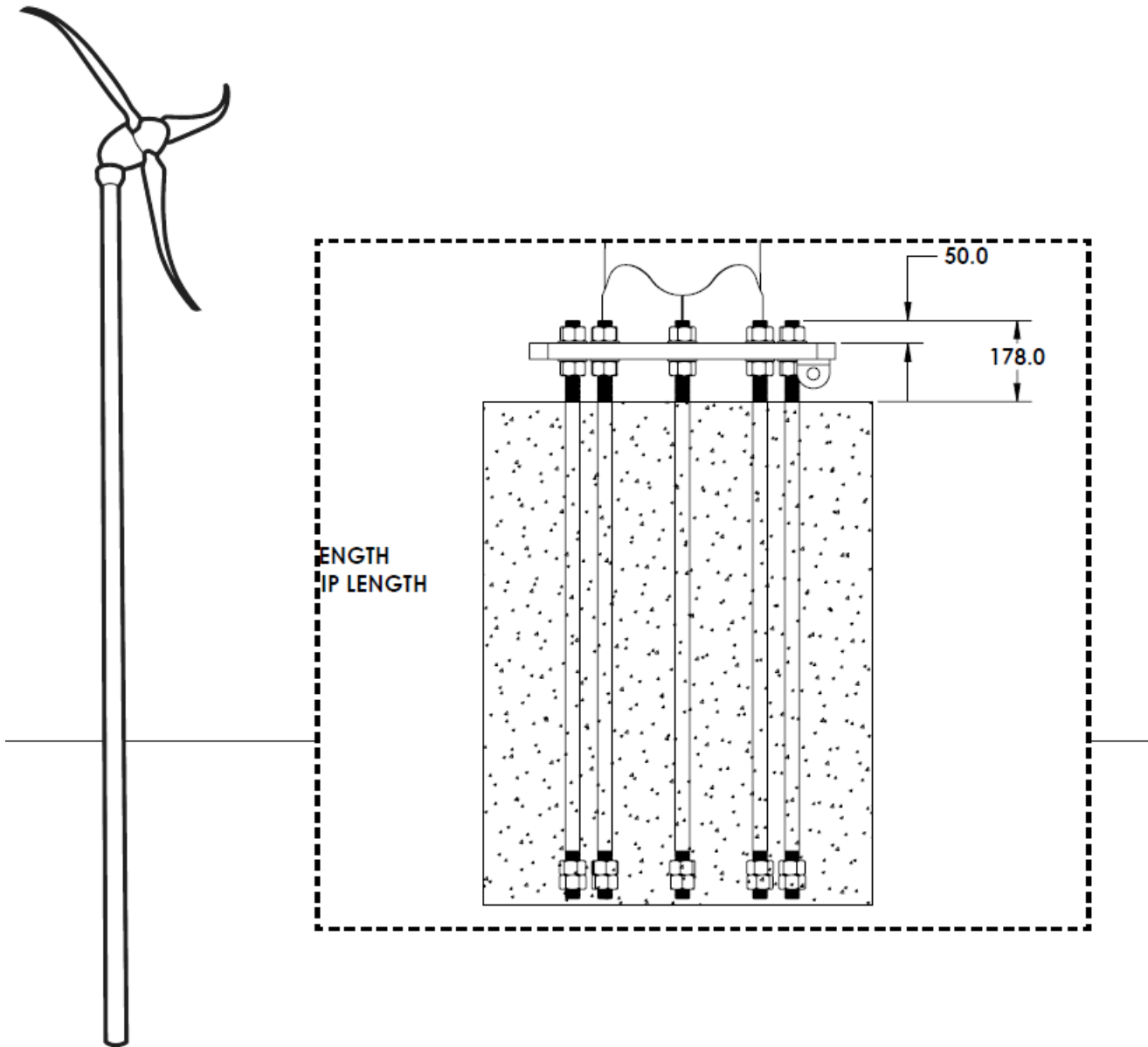


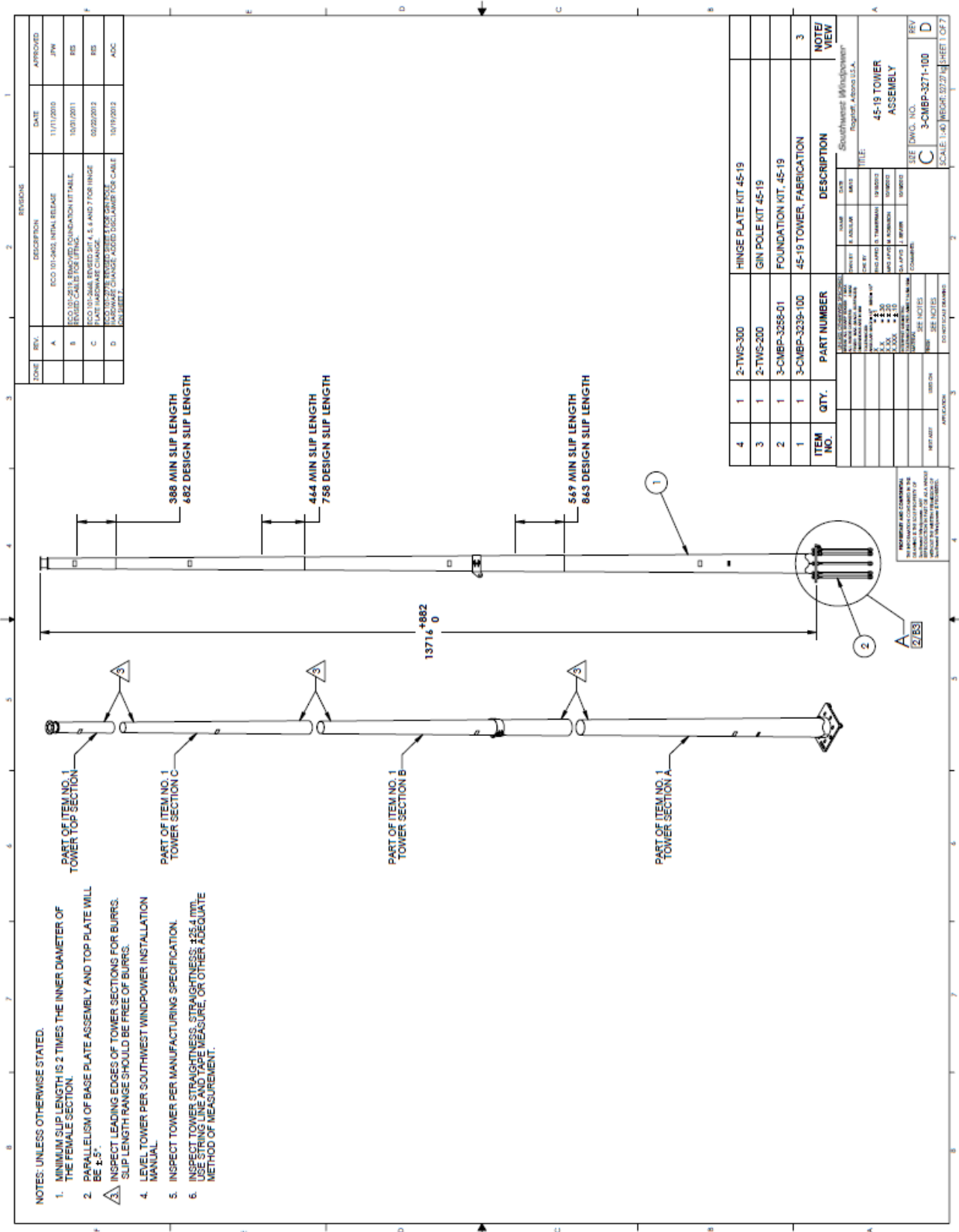


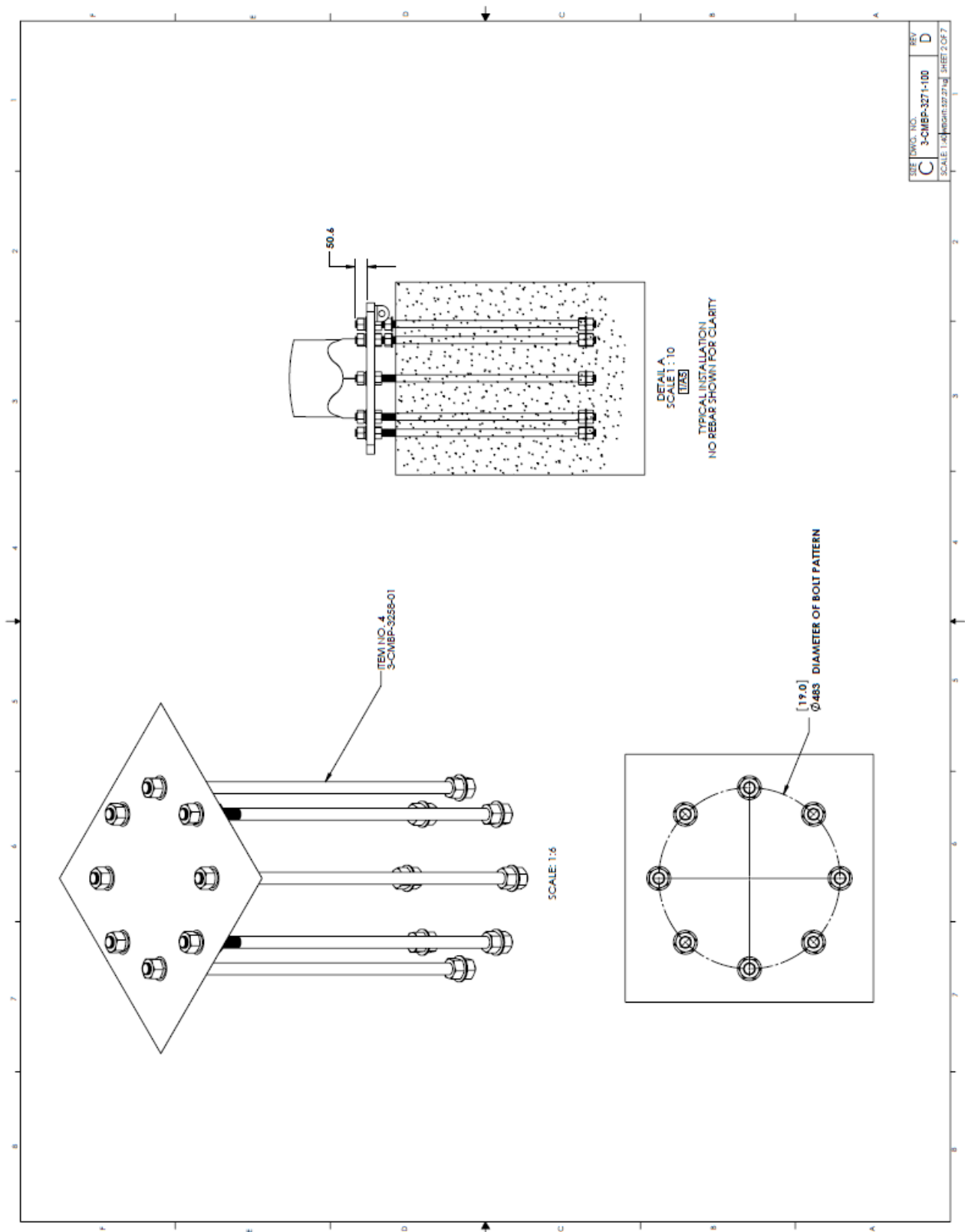


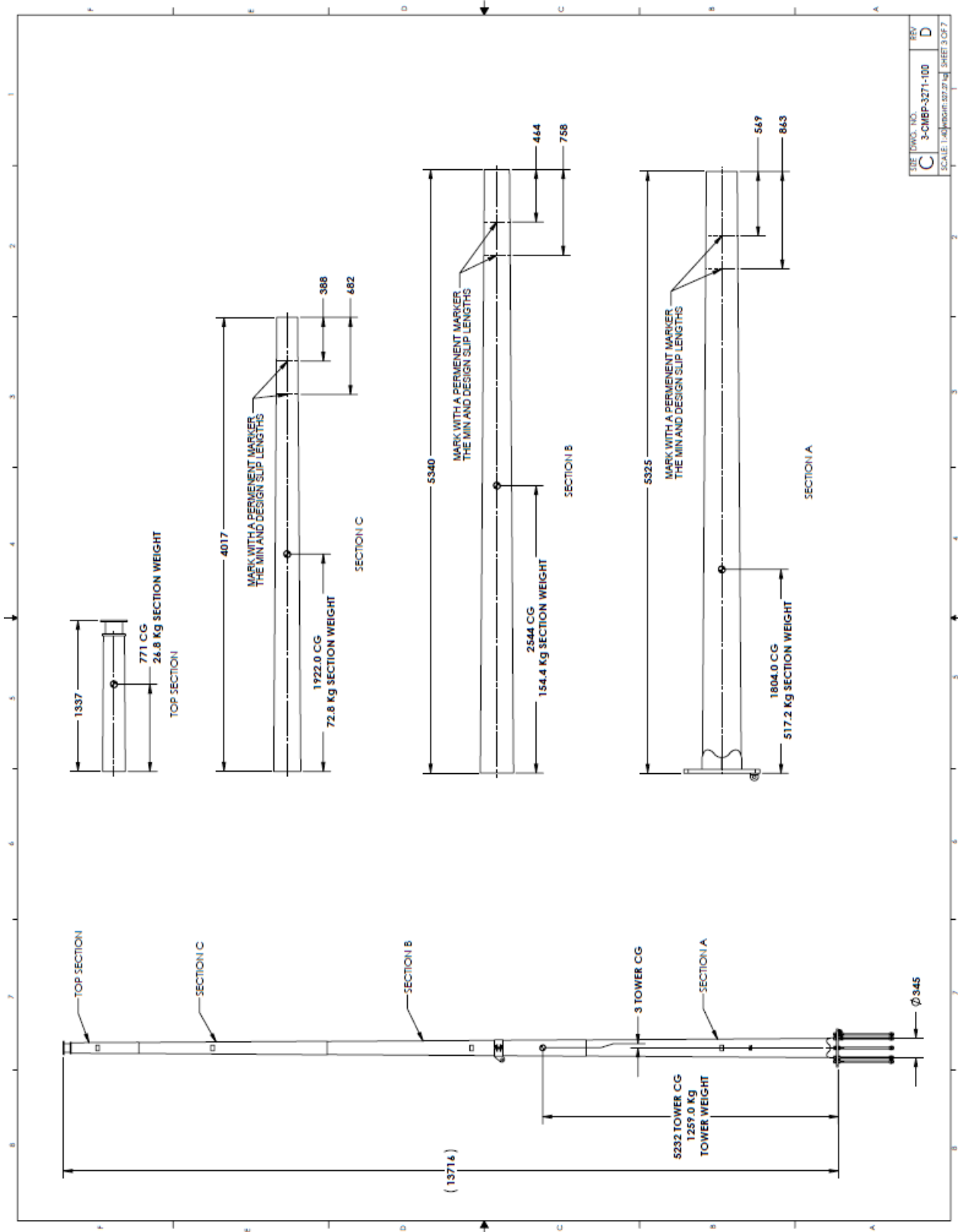


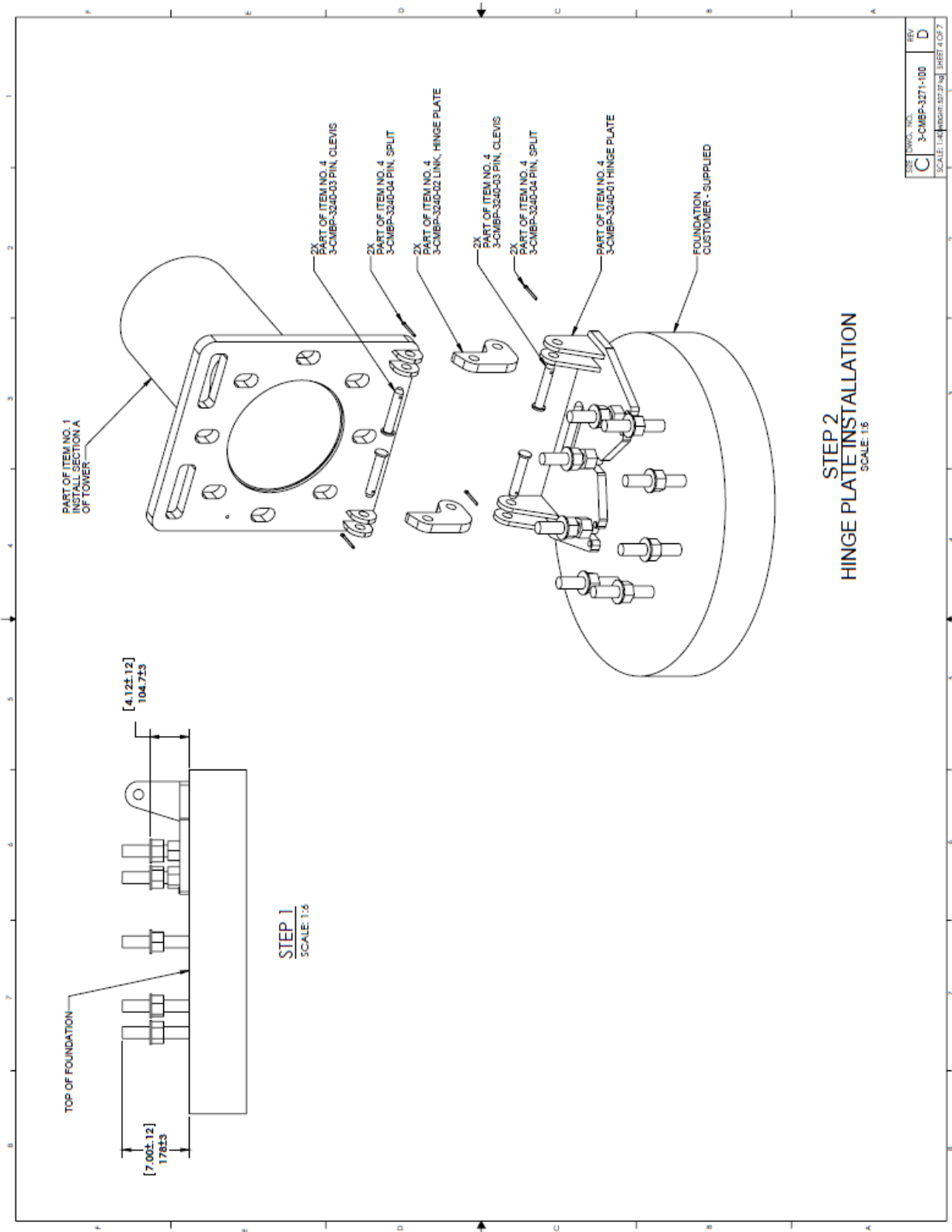
SKYSTREAM 3.7
Appendix F: 45 ft (13.7 m) Tower Assembly Booklet



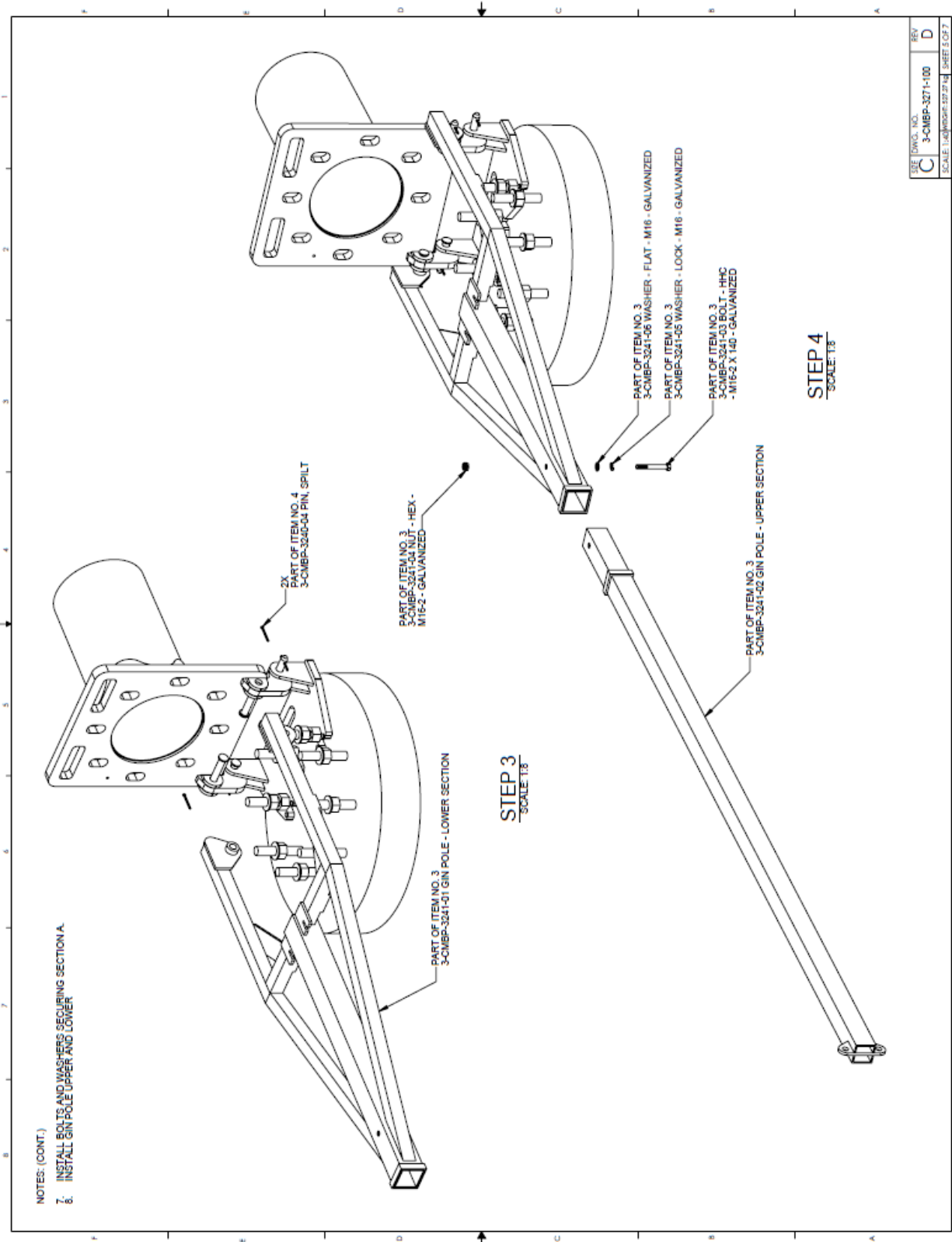




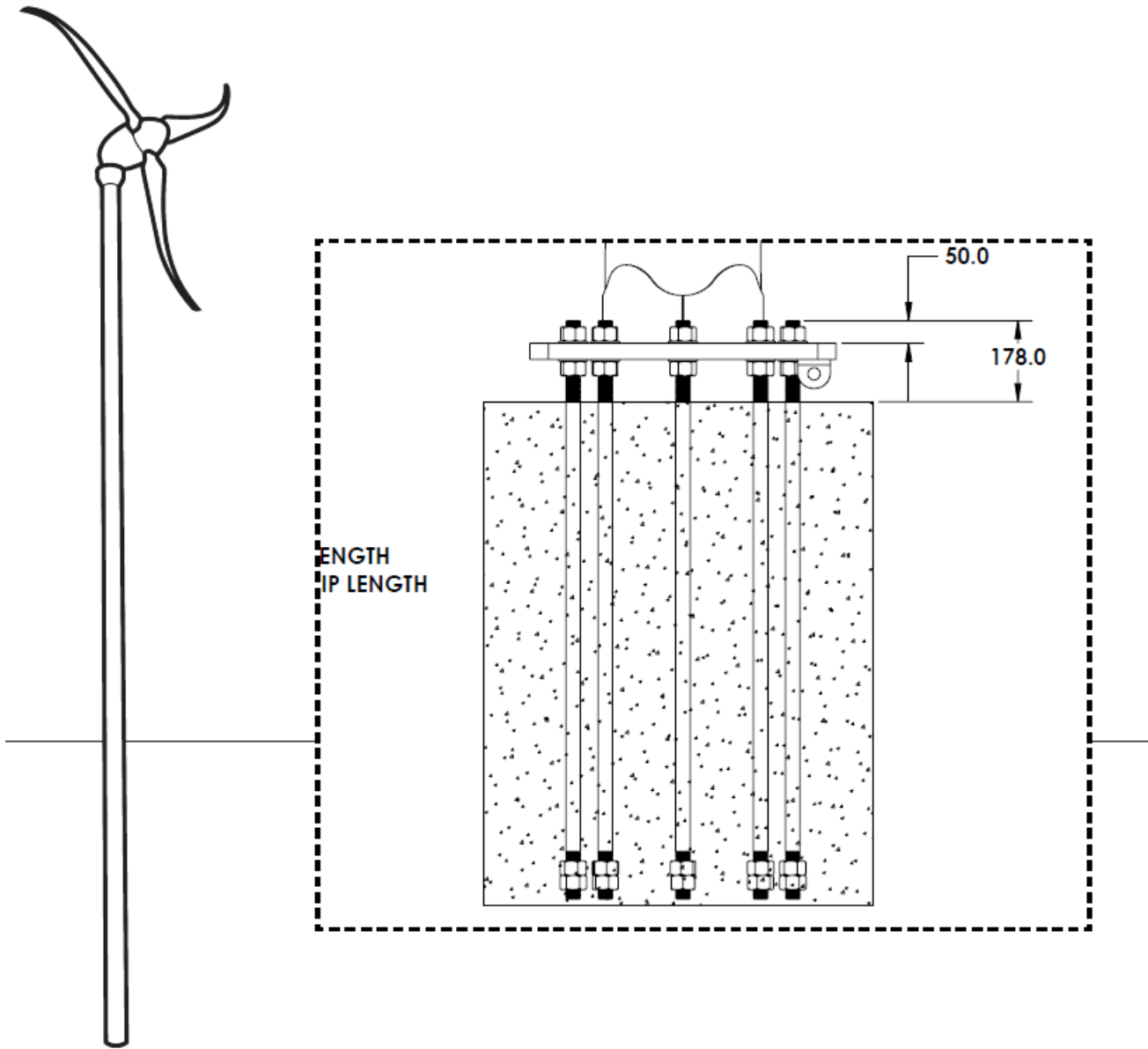


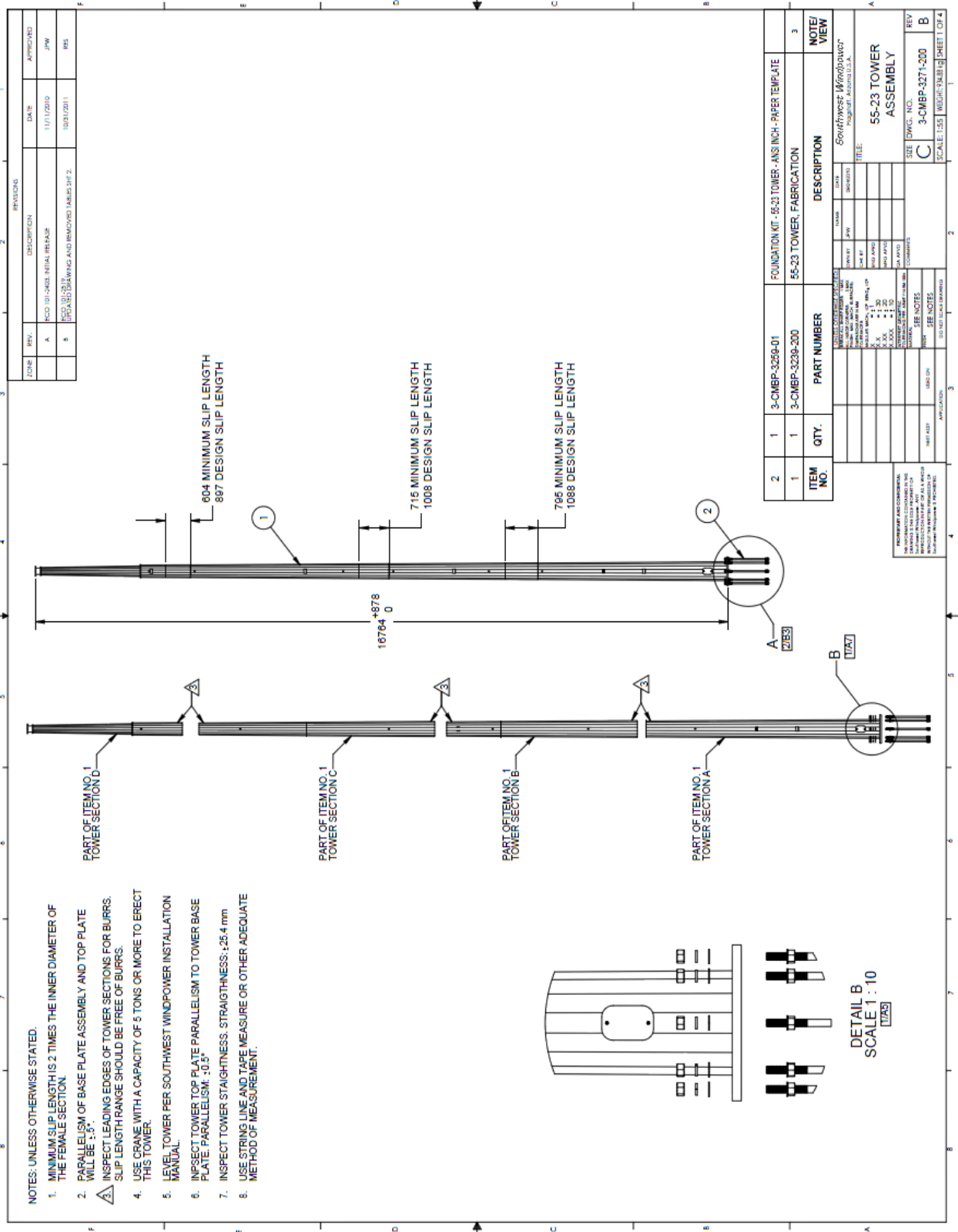


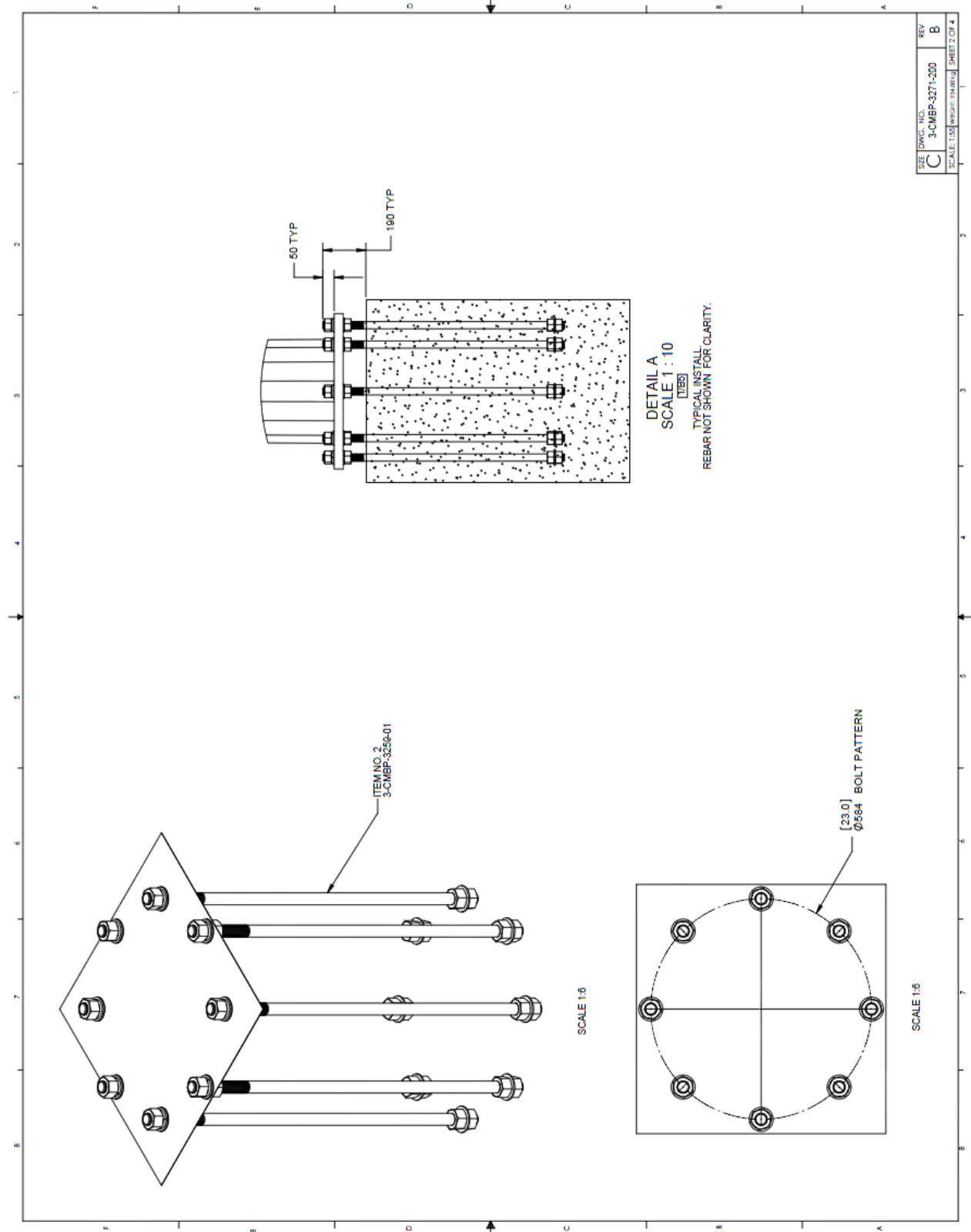
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D			

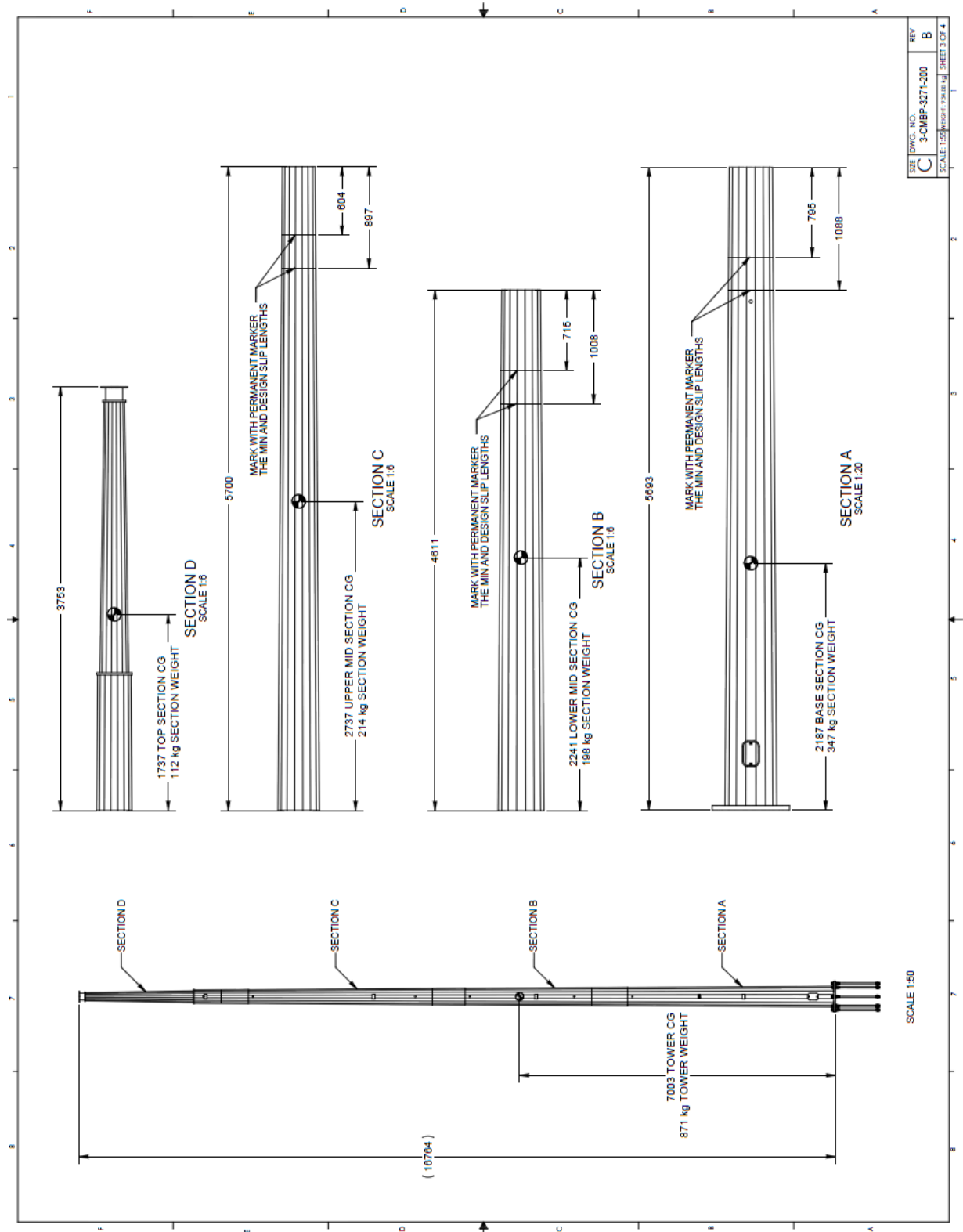


SKYSTREAM 3.7
Appendix G: 55 ft (16.8 m) Tower Assembly Booklet

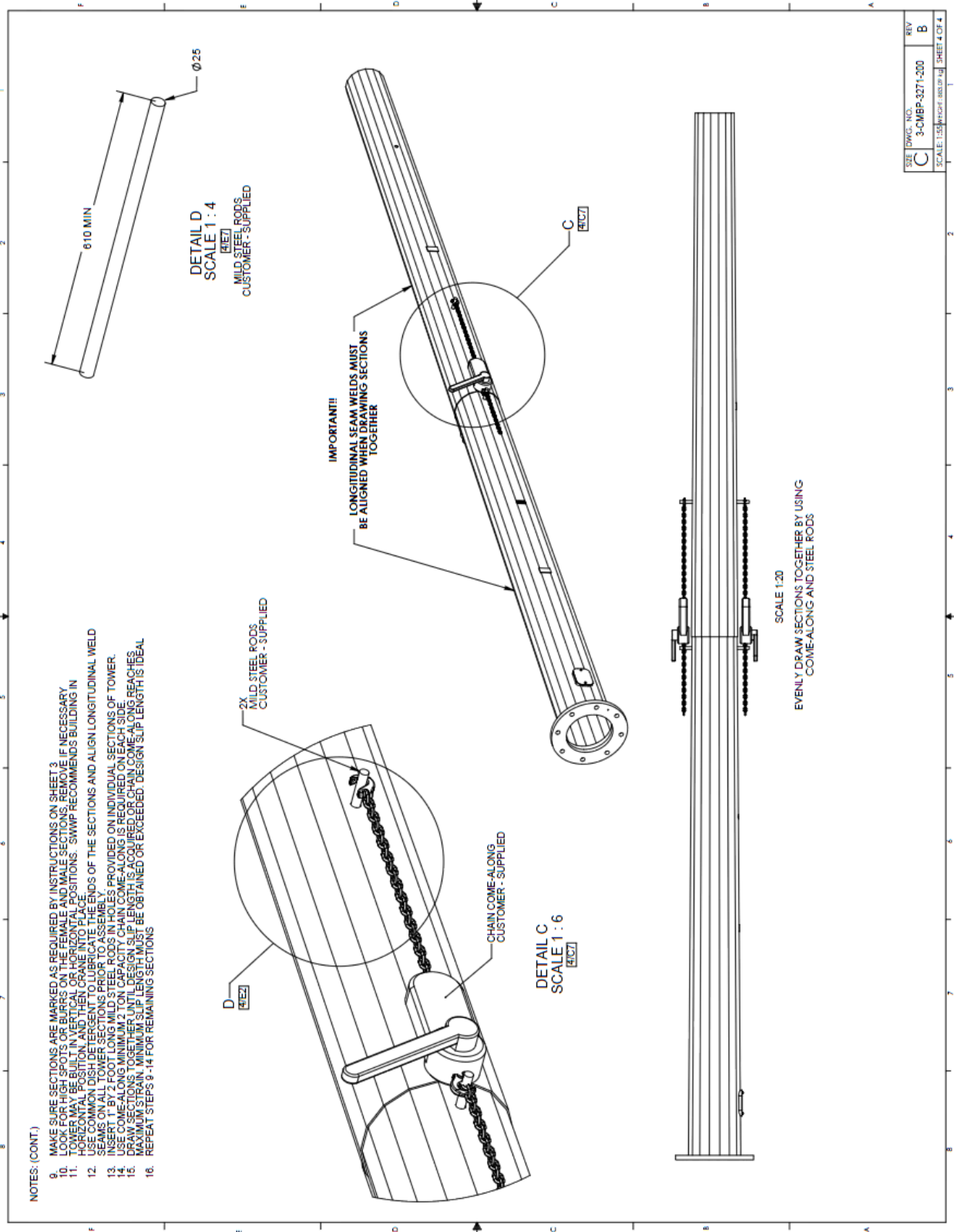








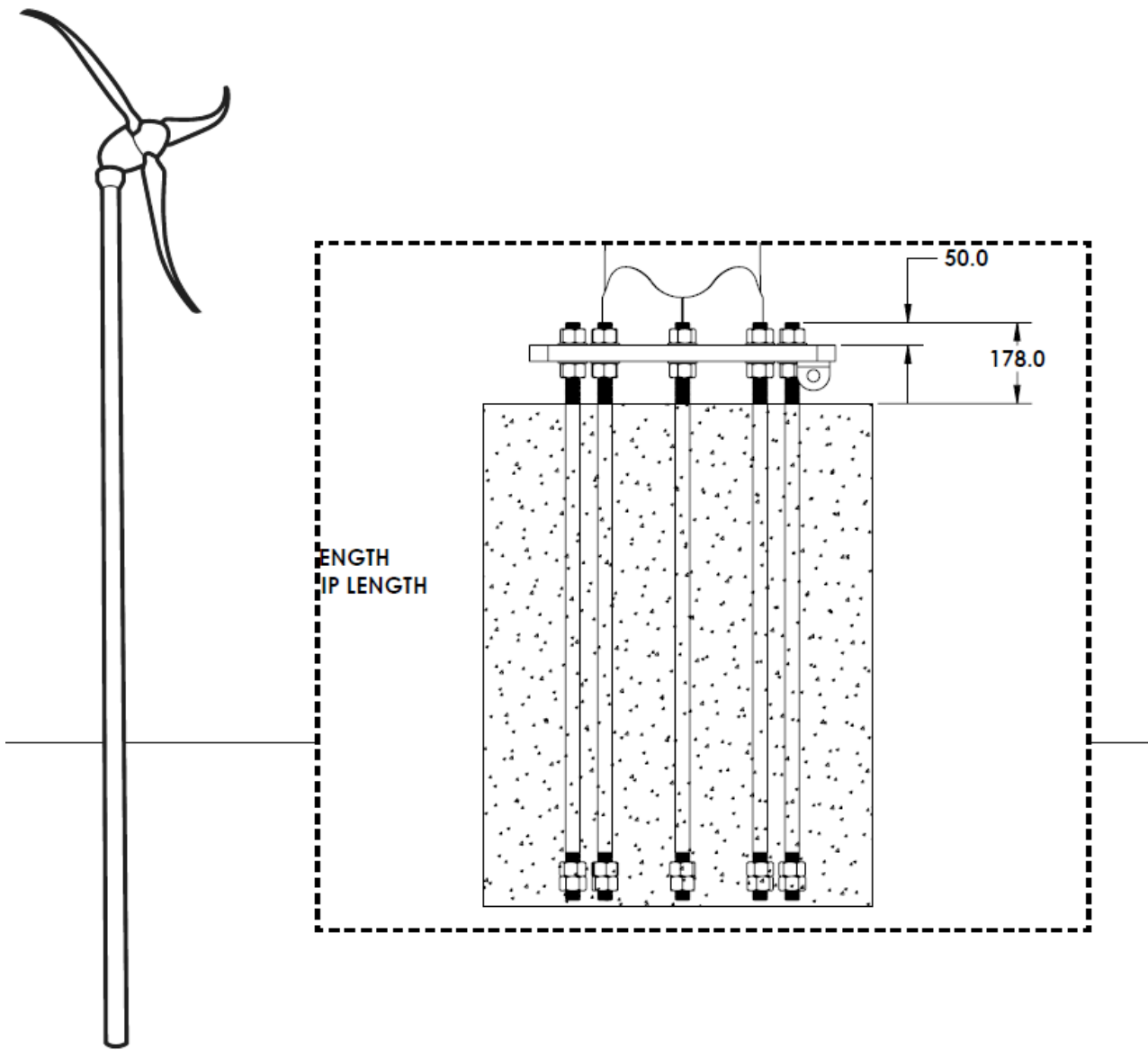
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B			
C	3-CMLT-3271-200		
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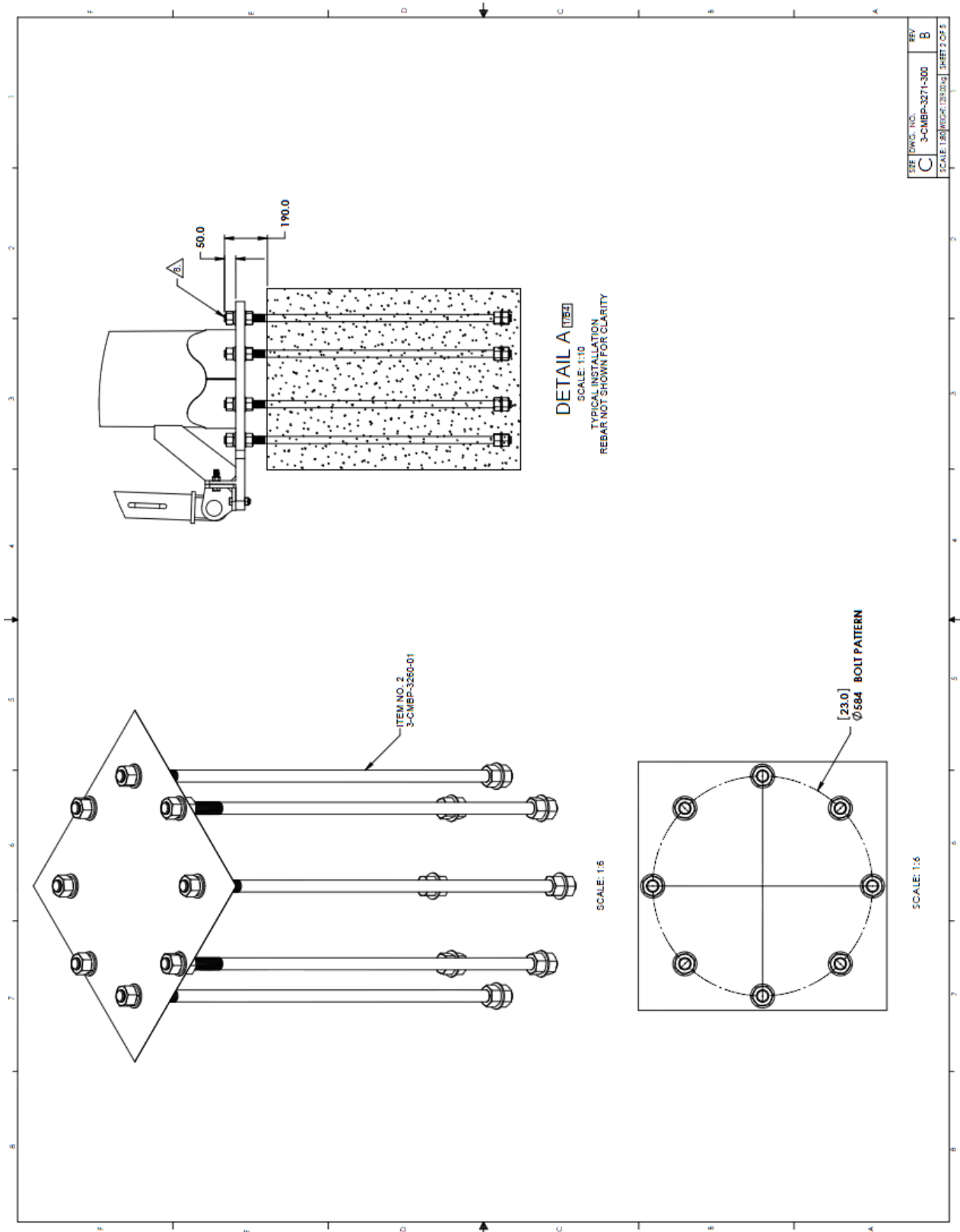


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SHEET 4 OF 4		

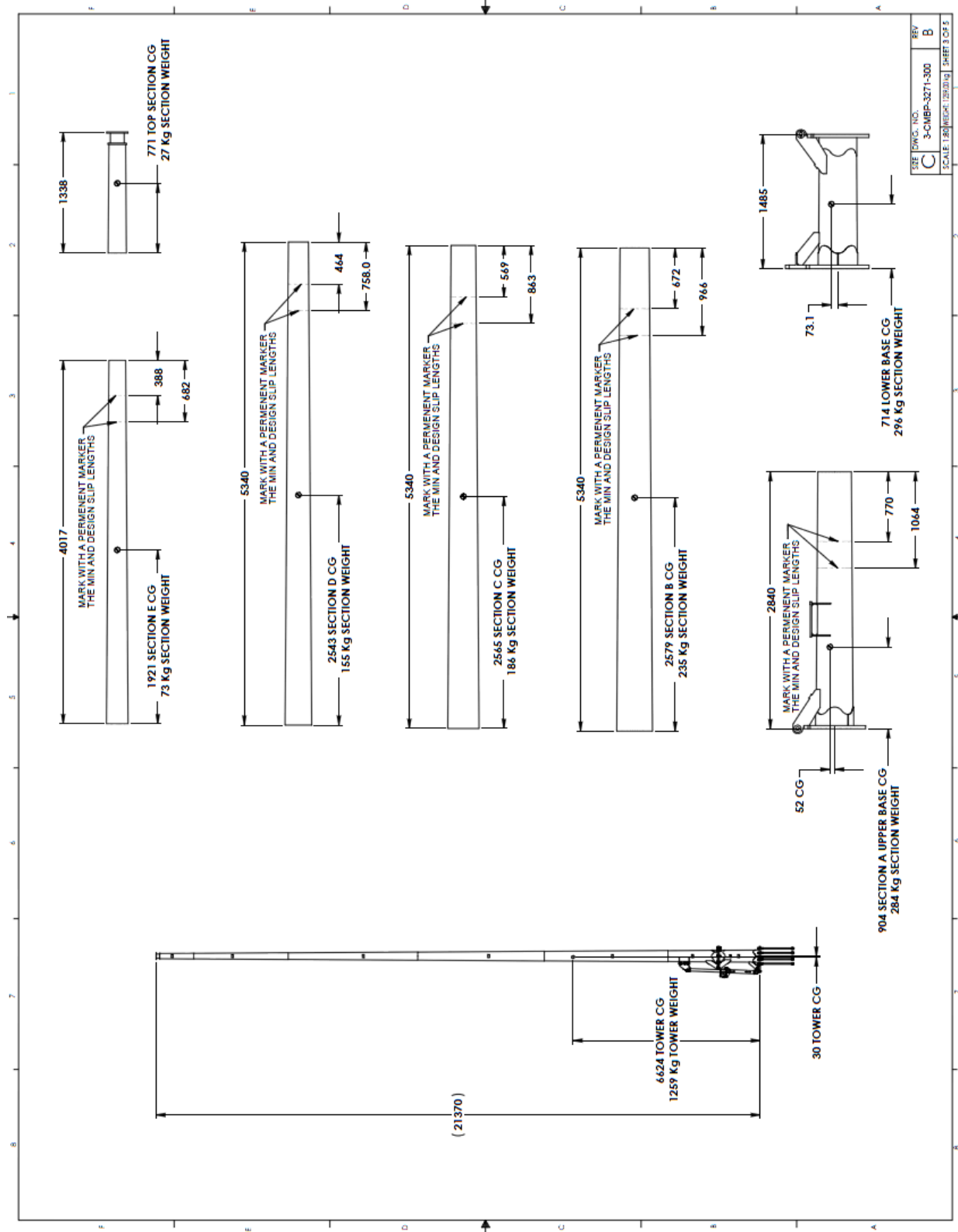
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SKYSTREAM 3.7
Appendix H: 70 ft (21.3 m) Tower Assembly Booklet

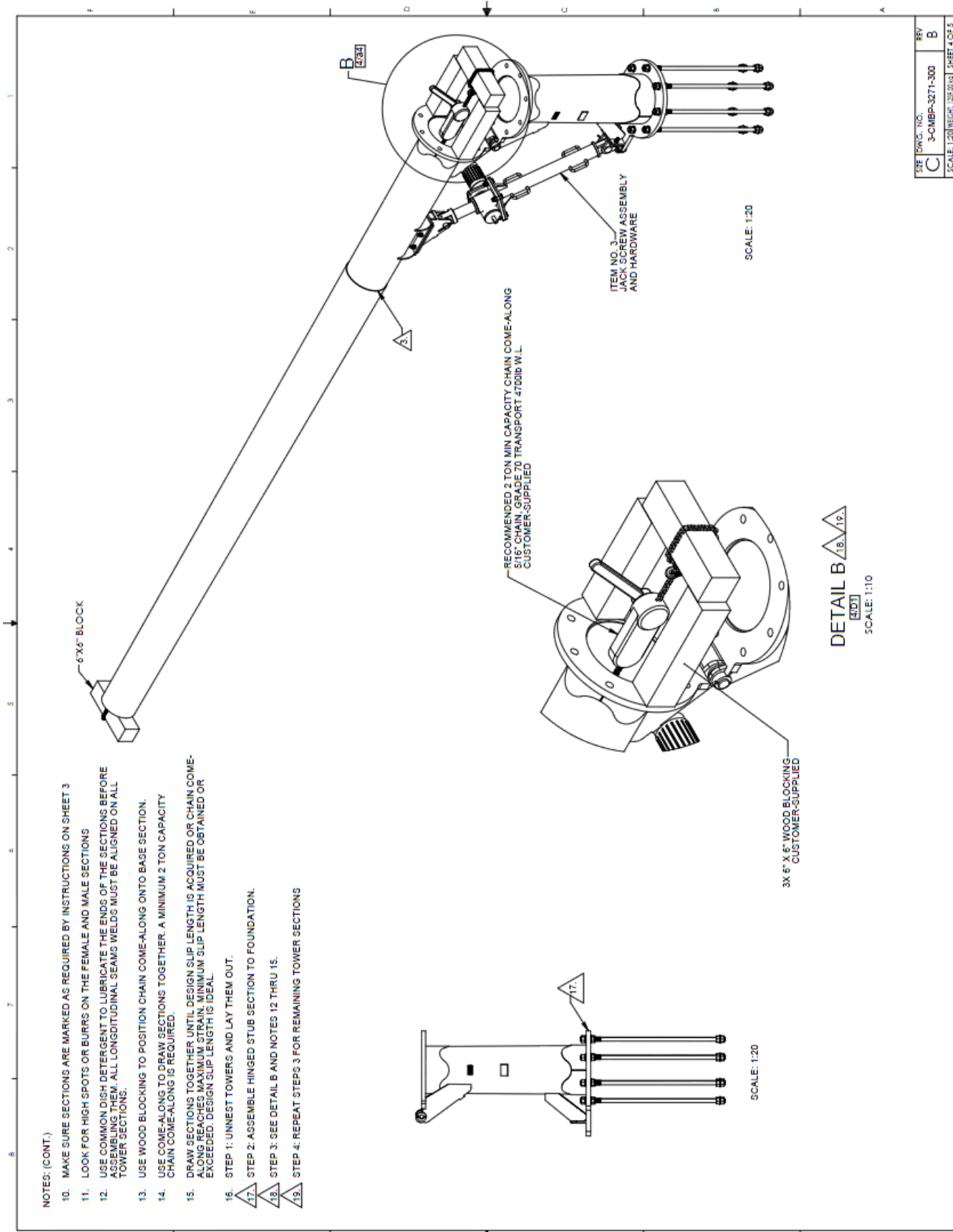




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D	3-CMBP-3271-300	1/20/13
E	3-CMBP-3271-300	1/20/13
F	3-CMBP-3271-300	1/20/13
G	3-CMBP-3271-300	1/20/13
H	3-CMBP-3271-300	1/20/13
I	3-CMBP-3271-300	1/20/13
J	3-CMBP-3271-300	1/20/13
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R	3-CMBP-3271-300	1/20/13
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U	3-CMBP-3271-300	1/20/13
V	3-CMBP-3271-300	1/20/13
W	3-CMBP-3271-300	1/20/13
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Z	3-CMBP-3271-300	1/20/13

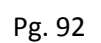


SEE DWG. NO.	REV
C	B
3-CMBP-3271-300	
SCALE: 1:50 (REAR: 1:500)	SHEET 3 OF 3

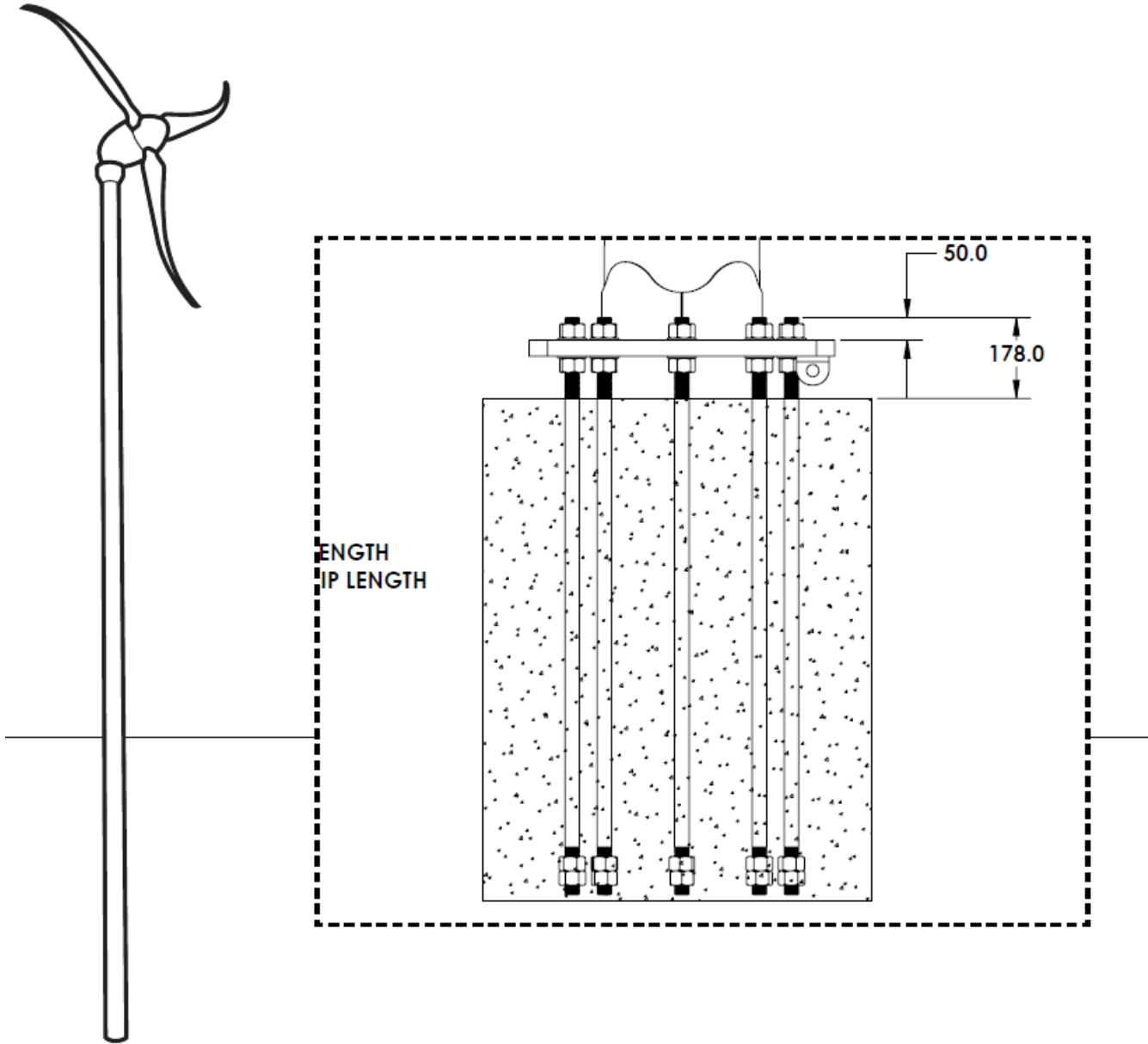


NOTES: (CONT.)

10. MAKE SURE SECTIONS ARE MARKED AS REQUIRED BY INSTRUCTIONS ON SHEET 3
11. LOOK FOR HIGH SPOTS OR BURRS ON THE FEMALE AND MALE SECTIONS
12. USE COMMON DISH DETERGENT TO LUBRICATE THE ENDS OF THE SECTIONS BEFORE ASSEMBLING THEM. ALL LONGITUDINAL SEAMS WELDS MUST BE ALIGNED ON ALL TOWER SECTIONS.
13. USE WOOD BLOCKING TO POSITION CHAIN COME-ALONG ONTO BASE SECTION.
14. USE CHAIN COME-ALONG TO DRAW SECTIONS TOGETHER. A MINIMUM 2 TON CAPACITY CHAIN COME-ALONG IS REQUIRED.
15. DRAW SECTIONS TOGETHER UNTIL DESIGN SLIP LENGTH IS ACQUIRED OR CHAIN COME-ALONG CHAIN BREAKS. THE DESIGN SLIP LENGTH MUST BE OBTAINED OR EXCEEDED. DESIGN SLIP LENGTH IS IDEAL.
16. STEP 1: UNNEST TOWERS AND LAY THEM OUT.
17. STEP 2: ASSEMBLE HINGED STUB SECTION TO FOUNDATION.
18. STEP 3: SEE DETAIL B AND NOTES 12 THRU 15.
19. STEP 4: REPEAT STEPS 3 FOR REMAINING TOWER SECTIONS



SKYSTREAM 3.7
Appendix J: Tower Leveling Techniques



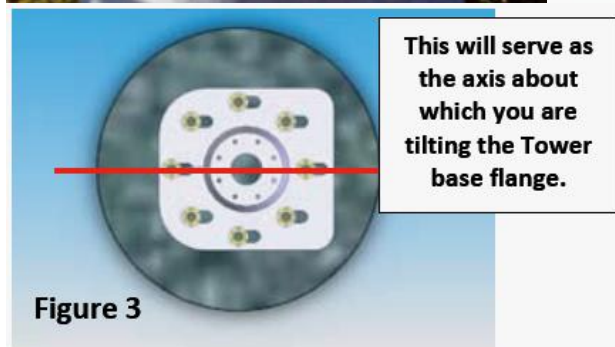
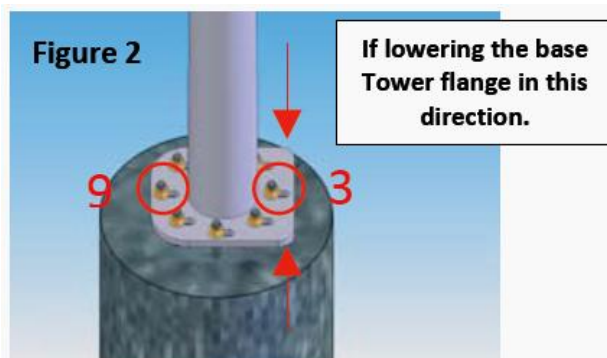
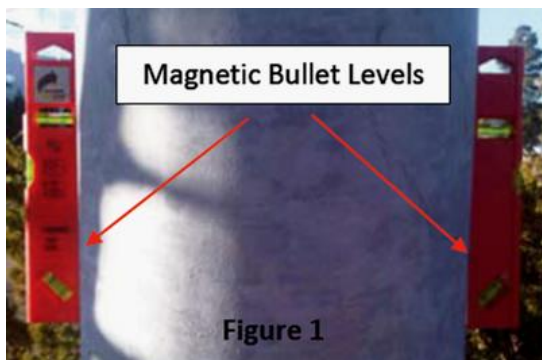
1. Direct Observation Method:

Tower leveling can be accomplished by a direct observation method of viewing Skystream's behavior and response to changes made at the Tower base with a combination of simple tools and an incremental adjustment procedure using conditional feedback:

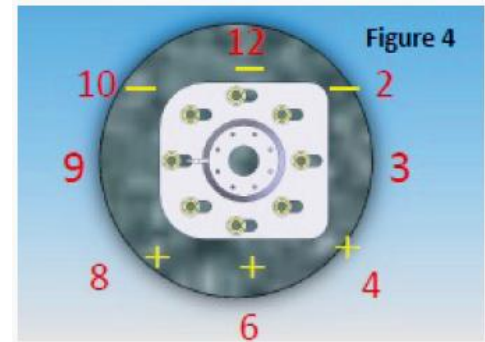
- It is necessary to perform this operation with little or very light winds.
- Observe if the Turbine has a strong tendency to gravitationally orient in one particular direction (or yaw attitude) that is contrary or irrespective to the apparent wind direction.
- If the Turbine is behaving in this manner, it indicates that the Tower is significantly out of plumb (the top Tower flange is not level). This indicates that the Tower must be adjusted in a direction opposite from which the Turbine is self-orienting.
- Place one small magnetic bullet level (see Figure 1) on both sides of the Tower directly above an opposing pair of the foundation bolts. Should the Tower be visibly out of plumb or the Turbine gravitationally self-orienting, choose the pair of bolts that is closest (nearest) to the plane of the rotor axis. By comparison of the two level bubbles you will observe the extent to which the Tower is out of level.

If the Tower is not obviously out of plumb, or there is no indication that the Turbine self-orient (meaning it is unclear if the Turbine is in or out of level), then carefully reposition the Levels opposite one another above each of the respective opposing foundation bolt sets.

- When you determine which direction the top of the Tower must be moved to level the top flange, locate the pair of bolts on the Tower base flange that is nearest to the 90° plane for the necessary adjustment.
- Make sure that the upper and lower nuts are tight on each of these foundation bolts. These bolts will be the hinge on which the Tower rotates while you make adjustments. (As a suggestion, identify these bolts as three o'clock and nine o'clock, see Figures 2 and 3.)

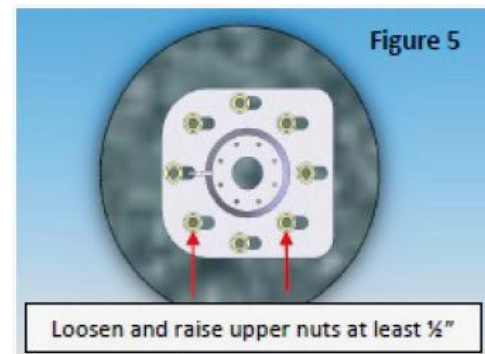


- g. One side of the Tower base flange will be lowered and the other side will be raised as you adjust the Tower top flange to level. On the Tower flange side that will be lowered, make a (-) mark on the Tower above each of the three foundation bolts; on the Tower flange side that will be raised, make a (+) mark on the Tower above each of the three foundation bolts, with a Sharpie® pen (permanent marker pen), for later reference (see Figure 4).



- h. Locate the center foundation bolt on the side that is in the plane of the needed lowering adjustment (as a suggestion, regard that bolt as twelve o'clock and the opposing bolt on the opposing side of the Tower flange that must be raised as six o'clock; then identify the remaining foundation bolts as two, four, eight and ten o'clock; see Figure 4).

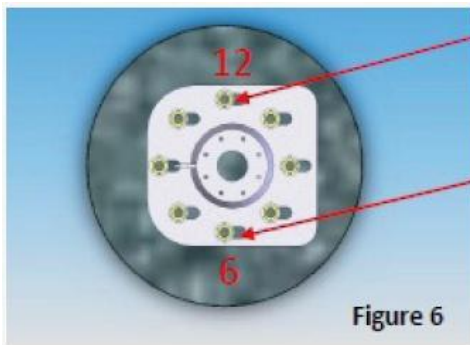
- i. On the foundation bolts at two and ten o'clock, loosen the lower foundation bolts (beneath the Tower flange) and position them well out of the way (at least 1/2" beneath the Tower flange). (See Figure 5).



- j. On the foundation bolts at four and eight o'clock loosen the upper nuts (above the Tower flange) and position them well out of the way (at least 1/2" above the Tower flange). (See Figure 5).

- k. On the foundation bolt at twelve o'clock, loosen and lower the nut below the Tower flange, and position it so there is a 1/4" to 3/8" gap between it and the Tower flange (see Figure 6).

- l. On the foundation bolt at six o'clock, loosen and raise the nut above the Tower flange and position so there is a 1/4" to 3/8" gap between it and the Tower flange (see Figure 6).



Loosen and lower the nut below the Tower flange so there is a 1/4" to 3/8" space between it and the Tower flange.

Loosen and raise the nut above the Tower flange so there is a 1/4" to 3/8" space between it and the Tower flange -then raise (tighten) the tower nut to lift the Tower flange to tip the Tower on the three o'clock and nine o'clock axis

- m. With the Bullet Levels positioned above the twelve and six o'clock bolts, carefully raise (tighten) the lower nut on the foundation bolt at six o'clock, in effect lifting that side of the Tower flange on the nut and tipping the Tower about the hinge of the three and nine o'clock axis foundation bolts.
- n. Proceed gradually and observe the bubbles in each Bullet Level. Generally, because of the taper in the Tower, the bubbles will both hug the bubble line when you split the difference between the two references.
- o. If necessary, continue to add distance between the lower nut at the twelve o'clock foundation bolt and raise the Tower flange with the lower nut at the six o'clock foundation bolt until the Bullet Level bubbles are equal.

- p. Hand-tighten all four nuts (above and below the Tower flange) on the twelve and six o'clock foundation bolts to minimize sway of the Tower.
- q. Pause here to observe the behavior of the Turbine. If it has reoriented away from its specific or particular direction (gravitational yaw attitude) and is responding to subtle changes in wind direction, then you have made the Tower top flange level.
- r. On the other hand, should the Turbine continue to demonstrate a strong gravitational preference to one direction (yaw attitude), then the level reference from the Tower base was insufficient (this may be the case when adjusting a segmented tower). In which case, continue to incrementally tip the tower by adjusting the six and twelve o'clock bolts until the Turbine barely begins to demonstrate movement on the yaw axis.
- s. Pause again to observe the Turbine. If it slowly shifts to orient to the wind, then the Tower top flange is level.

As you will determine, this is a “trial and observation” process, and the Tower can be out of plumb in more than one axis.

- t. If necessary, tighten all the nuts and begin the process again with a new set of opposing foundation bolt nuts, with this instance selected at three and nine o'clock positions.

Be patient and make minor adjustments, it is very easy to overcompensate, and above all, **observe the behavior of the Turbine**. The Turbine's ability to orient/reorient easily on the yaw axis in response to the wind direction is far more important than any secondary references.

2. Bucket Truck Manual Method:

In the event that a bucket truck or man-lift with service height sufficient to access the Turbine is available during the installation, you can quickly and accurately adjust the Tower for level as follows:

Warning: Before riding up in any Bucket Truck or Lift to approach an installed Skystream Turbine on an erect Tower, make certain that the power is turned off and the Skystream Turbine is disabled.

- a. Again, it is necessary to perform the operation with little or very light winds.
- b. When within reach of the Turbine Nacelle, manually push the Turbine around the yaw axis to observe if the Turbine gravitationally orients to one yaw position.
- c. To determine the center of location, push the Turbine off of its gravitational orientation in both directions. The harder you must push, the greater the Tower top is out of level.
- d. Observe the Tower base and determine which two opposing foundation bolts will serve best as the hinge points for making adjustments at the Tower base.
- e. Go to the ground and make the foundation bolt adjustments as described above (*or have an assistant make the adjustments*).
- f. Again, make minor and incremental adjustments at the Tower base and re-examine if the Turbine returns or drifts back to an identical gravitational orientation. Eventually you will be able to rotate the Turbine in a full 360° axis, a few degrees at a time, and the Turbine will remain stationary at each step during the rotation indicating that the top Tower flange is level.
- g. Secure the foundation bolt nuts being careful not to affect your final adjustments.

3. Bucket Truck Digital Method:

In the event that a bucket truck or man-lift with service height sufficient to access the Turbine is available during the installation, you can quickly and accurately adjust the Tower using a Digital Level as follows:

Warning: Before riding up in any Bucket Truck or Lift to approach an installed Skystream Turbine on an erect Tower, make certain that the power is turned off and the Skystream Turbine is disabled.

- a. It is necessary to perform this operation with little or very light winds.
- b. Firmly strap the Digital Level to the top of the Turbine nacelle (see Figure 7).
- c. Observe the Level reading at 8 evenly spaced locations as the Turbine is pivoted.
- d. Release the Turbine at each point and note any movement if it is pulled to a low point.
- e. Adjust the foundation bolt nuts until the Digital Level reads the same value (within 0.5°) at the eight evenly spaced locations and the Turbine does not move at any of the locations. Record the values in the included table below.
- f. Secure all the foundation bolt nuts taking care not to alter the final adjustment.
- g. Check that the Turbine is level again by moving the Turbine and releasing through the eight locations; no movement due to gravity should be observed.



Figure 7

Leveling Measurement Record - Turbine

Point 1 (45°)	
Point 2 (90°)	
Point 3 (135°)	
Point 4 (180°)	
Point 5 (225°)	
Point 6 (270°)	
Point 7 (315°)	
Point 8 (360°)	

The tower may also slightly lean to one side under the influence of bright sunlight. The sun heats one side of the tower and it expands, flexing the tower and the tower remains tilted until the sun is no longer fixed on the tower (expansion and contraction). This follows a very regular pattern throughout the day if the sun is shining.

We appreciate your support of our company and products. Should you have questions or concerns, or need additional information please contact our Technical Services department at

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