



Steel Monopoles



Introduction

The following document is for use in assembling and erecting CDMI's wireless steel monopoles. The information is not comprehensive enough to cover all situations or the details of all installations. Special features may require unique installation methods. In this event, the contractor must be familiar with the site specific requirements and the CDMI drawings included with the delivery of the structure. Questions or concerns regarding the monopole or its component parts should be addressed to CDMI.

CDMI documents provided with the monopole do not indicate the method of installation. The contractor should not rely solely on these guidelines to determine the assembly and erection of the structure. It is the contractor's sole responsibility to determine erection procedure and sequence to insure the safety of the monopole and its component parts during installation and assembly.

The contractor shall supervise and direct the installation and shall be solely responsible for all construction means, methods, techniques, sequences, and procedures. Observation visits to the site by the Owner and/or CDMI shall not include inspections of the construction procedures. Due to the varied methods used by contractors in actual field operation, CDMI cannot be liable for damage occurring during assembly and erection.

The contractor shall be responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the work. The contractor is responsible to insure that the project and related work complies with all applicable local, state, and federal safety codes and regulations governing this work.

Site

The site where the monopole is to be located should be prepared per the engineering plans and specifications. Any possible obstructions near the site such as overhead power lines or buildings should be noted and proper precautions taken during crane operation. Assessment of whether the monopole can be assembled on the ground or vertically in the air should be accomplished. The contractor should review the site drawings provided by the Owner and the CDMI drawings for any conflicting information. Consideration should be given to the need for underground antenna cable access as required by the Owner.

Handling and Unloading

Slings for handling the monopole should be made of non-metallic material to protect the finish. Do not roll the monopole tube sections off the delivery truck or drop the sections on the ground. The monopole should be handled in such a manner that no portion is dragged along the ground or any other object that could damage the monopole. A check of the required order of assembly at this stage is highly recommended. Contact CDMI for monopole tube sections out of round due to mishandling during shipping.

Monopole tube sections should be unloaded at the proper location and aligned as required for installation. The lower tube section should be blocked at a point about two feet below the upper end. Blocking should consist of lumber or other suitable materials placed outside the slip joint areas. Blocking should maintain the true alignment of the assembled structure and should be used to prevent the section(s) from rolling. Care must be taken to avoid scratching, denting, or deforming the sections, particularly at the ends.

Erection

Erection of the monopole is performed by assembly on the ground and lifting the entire structure or by stacking - assembly vertically in the air.

Assembly on the ground involves slip joint assembly, attachment of climbing devices, assembly and attachment of antenna mounts, antenna mounting, and installation of antenna cables on the ground prior to erecting the structure by crane.

Assembly in the air involves erecting the monopole vertically section by section. Slip joint assembly is accomplished in the air. The antenna mounts are assembled on the ground and erected with the appropriate tube section. Antenna cables are installed by winching the cables from the ground to the top of the monopole, cable by cable.

Monopole tube sections may be hoisted from a single point with a nylon or padded cable choker and maneuvered into position. The lifting crane must be attached to the monopole tube section, not to appurtenances such as step bolts, step bolt attachment clips, safety cable equipment lugs, or the antenna mounts. If lifting the entire assembly, lift above the center of gravity including the weight of all equipment mounted on the structure prior to erection. The higher the lifting point will result in more nearly vertical alignment of the assembly while suspended above the foundation or the mating male section.

Prior to lifting the structure, any slip joint assembly below the crane attachment point should be tethered together as a safety precaution against pulling apart during lifting. The monopole tube section should not be rocked while lifting. Care should be taken to operate the crane smoothly to avoid impact loads which may adversely affect the monopole or its component parts. Leveling nuts should be adjusted prior to installing the monopole. The nuts should be in a horizontal plane, turned down on the threading to provide enough room on the anchor bolts for the base plate thickness, the top nut and at least an inch of projection for possible adjustment. After the monopole is erected, proper plumbing of the pole can be accomplished by adjusting the heavy hex leveling nuts underneath the base plate.

The amount of room at the site and the size of the equipment available to the contractor will dictate the best method of construction. Where space permits, CDMI recommends assembling the monopole on the ground and erecting the structure as a unit. If the monopole is assembled vertically in the air, extra care may be needed to assure all slip joints are properly assembled. The weight of the monopole tube sections should not be substituted for the jacking force required to make a slip joint. All jacking and assembly procedures, as detailed in this document, should be observed for either method of erection.

Slip Joint Assembly

The CDMI drawings indicate the proper amount of joint overlap required. The drawings list the design slip value +/- 10%. Overlap in the range of 10% less than the design value as well as 10% over the design value is acceptable. The target value is the design slip joint value.

The male tube section should be marked with chalk or non-permanent marker to indicate the proper overlap into the female tube section. Additional marks should be made at 2" increments, for 2" less than minimum overlap, and for 2" more than maximum overlap. The mark for proper overlap should be clearly distinguishable from the other overlap marks. Mating surfaces should be clean. Prior to jacking, check the inside of the female slip joint for galvanizing build-up or other debris. Galvanizing build-up may form a wedge during slip joint assembly and may inhibit achieving proper joint overlap.

Several methods are available for jacking the monopole tube sections together depending on the availability of equipment. Hydraulic jacking devices and mechanical jacking devices, such as ratchet chain hoists or similar devices, are acceptable. Hydraulic jacking devices are effective for making sound, high quality joints. These devices generally have a large capacity to insure proper seating of the tube sections even if the sections are slightly out of round or not aligned precisely. The devices may pull on cables secured to the monopole tube sections with a choker type hitch.

CDMI recommends utilizing a mechanical jacking device. The mechanical jacking device should have a minimum capacity of 4 tons (8,000 lbs). The female tube section should be aligned and its large end slipped over the small end of the male tube section. The longitudinal weld seams must be aligned the full length of the monopole. The monopole tube sections should be worked up and down to help bring the sections together. Do not use any climbing step bolts or any other attachment on the monopole not intended for jacking during the jacking process. The alignment and pulling force must be even and steady. The pulling will be facilitated by flexing the joint either by lifting the small end of the pole slightly, or by lifting the joint slightly. The slip joint should be pulled until the application of additional pulling pressure produces little or no movement. The minimum and maximum insertion should be within +/- 10% of the design slip joint per the provided CDMI drawing.

Caution should always be used when jacking the monopole tube sections together. The contractor should stand a safe distance from the jacking devices and should keep hands away from the slip joint during joint assembly. The jacking forces should be applied until the joint is tight with no more than small gaps. Gaps are more likely where the seam weld is located. Other methods may exist and be available to generate and apply the force needed to obtain a proper slip joint assembly. The contractor must judge the quality of the slip joint based on the overlap length which should be +/- 10% of the design slip length, lack of movement in the joint under the jacking force, and the absence of excessive gaps.

Lubricants applied to the slip joint may be used at the contractor's discretion. Care should be taken to not use a lubricant that will leak from the assembled slip joint and stain the galvanized finish. Soapy water may be used. The contractor will assume all responsibility for any stains to the monopole finish.

The above procedures for slip joint assembly should be followed whether the monopole is assembled on the ground or in the air. If upon completion of the slip joint assembly procedure, a slip joint does not meet all specified criteria herein, contact CDMI prior to proceeding with erection. Under no circumstances erect a monopole without proper slip joint engagement unless written authorization from CDMI has been received.

Flange Connections

An alternative to overlapping slip joint connections are flange joints. A flange joint utilizes a bolted butt flange to flange connection with high-strength structural bolts. Install the

connection bolts to a snug tight condition per AISC requirements. The snug tight condition is defined as the tightness that exists when all plies in a joint are in firm contact. This may be attained by a few impacts of an impact wrench or the full effort of a man using an ordinary spud wrench. Tighten the bolts in a crisscross alternating pattern.

Climbing Equipment Installation (Optional)

Climbing consists of galvanized ladders with ASTM A307 step bolts $\frac{3}{4}$ " dia. x 7 $\frac{1}{2}$ " long and a vertical safety cable system. The step bolts are attached by double galvanized $\frac{3}{4}$ "-10 hex head nuts. Screw one nut onto the step bolt as far as possible. Tighten the outer nut against the ladder shaft sufficiently to prevent the step bolt from loosening. Do not over tighten the step bolt to the extent of damaging the threads or ladder shaft.

The safety climb equipment manufacturer's instructions are provided with the monopole shipment to the contractor responsible for installing the safety climb equipment. The contractor must read and understand these instructions or have the instructions explained prior to installation. Read and follow the manufacturer's instructions for any related safety equipment such as a full body harness that is intended to be used with the safety climb equipment. The provided instructions must be followed for proper installation, use, inspection, and maintenance of the safety climb equipment. Alterations, substitutions, or misuse of the safety climb equipment or failure to follow instructions may result in serious injury or death. The contractor must attach the identification tag provided by the safety climb manufacturer with the equipment to the monopole.

Install the safety climb cable system per the manufacturer's guidelines. Lugs for attachment of the safety cable bottom bracket and top bracket are located above the base plate and 1' below the top of each section. Mount the top safety cable bracket and angle on the top monopole section. Mount the appropriate number of safety cable stand-off brackets with rubber guides. All safety climb equipment should be bolted to the snug tight condition per AISC requirements. Install the safety cable per the manufacturer's instructions and insert the safety cable in the groove of the stand-off rubber guides. Periodic inspection of the safety climb cable for soundness and tautness is recommended.

Antenna Mounts

CDMI provides a variety of antenna mounts. Arms are available as top mounted or band-on installation on a monopole. Band-on mounts are attached to the monopole with $\frac{3}{4}$ " stainless steel banding *which is not supplied with the mount.* CDMI drawings for the mounts are provided with the shipment of the monopole and are included with the monopole drawings. Assemble the mount per the provided drawings. Bolts should be tightened to the snug tight condition per AISC requirements. **Do not climb on mounts at any time.**

Anchor Bolt Installation

After the monopole has been erected, the anchor bolt heavy hex nuts must be properly tightened to ensure that the structure will perform as designed. The top heavy hex nuts should be turned down as quickly as possible after placement of the monopole on the leveling nuts. Below the monopole base plate, use a galvanized flat washer and a galvanized heavy hex nut for leveling.

Using a galvanized flat and two galvanized heavy hex nuts above the base plate is recommended. Two threads of the anchor bolts should always extend above the top nuts.

Before final tightening of the nuts the monopole should be measured for plumbness. Different techniques may be used to obtain the same objective which is to align the centerline of the monopole top with the centerline of the base plate. Plumbing the monopole does not mean leveling the base plate. The plumbing should be done on a calm day early in the morning when there is minimum heat effect from the sun and when there is no appreciable wind. The heat from the sun on one side of the structure can cause a visible bow to occur. To plumb the monopole, transits should be setup away from the monopole at 90 degrees to each other and at a distance approximately equal to the height of the monopole. The transits should be plumbed, centered on the center line of the monopole at the base, and then tilted upward to the top of the structure. Slightly loosen the heavy hex nuts above the base plate and adjust the heavy hex leveling nuts located under the base plate.

The top of the monopole is moved by adjusting the anchor bolt nuts so that the top of the monopole is centered when viewed from each transit. Note that a small amount of rotation of a leveling nut will represent a number of inches of movement at the top of the monopole. The taller the monopole the more sensitive the adjustment of the leveling nuts will be. Do not loosen the top heavy hex nuts more than one turn at a time or dramatic structure movement may occur. Keep hands and fingers away from loosened anchor bolt nuts as a shift in wind could cause the monopole to move pinching hands or fingers below loosened nuts and the base plate. The final operation should be checking the monopole for plumb in two directions at 90 degrees and re-tightening all anchor bolt nuts top and bottom.

After the monopole is plumbed, snug up all the bottom anchor bolt leveling nuts until the washers are in firm contact with the bottom of the base plate. Do not over tighten the leveling nuts or the pole will be moved out of plumb. Bring all top anchor bolt nuts down to a snug tight condition on the top of the base plate. Fully tighten each top anchor bolt nut using the full effort of a single man. Anchor bolt nuts should be tightened in alternating fashion working diagonally back and forth until all nuts have been secured. Tighten the locking nuts in a similar fashion. Check all leveling nuts to ensure that they have not been loosened in the process. Any nuts which have been loosened should be tightened again. Re-check monopole for plumb and re-adjust if necessary.

Inspection

Once the monopole is totally assembled, the structure should be thoroughly inspected. Repair any damages to the galvanized surface of the monopole which may have occurred during shipping, unloading, jacking, or erection. This can be accomplished with hot stick or zinc rich paint for galvanized surfaces or touch-up paint for painted structures. Hot stick is recommended since it most nearly matches the original galvanizing. Zinc rich paints (95% zinc) are acceptable, however do not provide the same millage and protection as the original galvanizing.

Do not weld, cut, burn, or drill holes in the field on a monopole or its component parts unless written permission is received from CDMI. The fumes from welding on a galvanized surface can be hazardous. Unauthorized welding, cutting, burning, or drilling will void the warranty.

Maintenance

Routine maintenance of the monopole installation is strongly recommended. Check for proper drainage and any signs of corrosion due to poor drainage at the base. The anchor bolt nuts should be checked and tightened if required. Grounding connections should be inspected for integrity. Prior to climbing, the safety climb cable should be inspected for soundness and tautness. Check the connection of the safety cable bottom bracket and tighten if required. Each step bolt should be verified for tightness during the initial climb of the monopole. Visually inspect each slip joint during the climb. Inspect the galvanized finish of the monopole for any signs of corrosion. Check the connection of the top safety cable bracket on the lug below the top of the monopole. Antenna mounting pipe brackets should be periodically checked for plumbness and tightened. Check the connection of the lightning rod if applicable.