Tower Construction and Safety

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Abstract: This presentation will focus on the need for proper planning, implementation and safety while working around or on towers. Many radio amateurs plan to install a new or modify an existing antenna support structure - some of us are new to the hobby and some are not quite as young as we were when the tower and antenna system was first installed. Techniques, tools & training will be discussed along with a demonstration of typical PPE (Personal Protection Equipment).

Introduction: Our hobby demands that we continuously improve our station capabilities with the addition of the latest radio, amplifier and antenna system. In the world of weak signal VHF, UHF and microwave, these antenna systems work best when mounted above all surrounding obstacles such as buildings and trees. Basically, the higher we mount the antenna, the better it works – and, with many dedicated contest stations, more antennas stacked on the tower = greater operational range which means more contest points. So, how do we *safely* get all those "antlers" way up there?

Planning to install the tower: This discussion will move past the land use and zoning legalities and say that the property will support building the proposed tower.

Now, a few questions need to be asked:

1. "How high is up?". What will be the ultimate height of the tower, mast and antenna system.
2. Are you going to erect the tower yourself? Will you have the help of a few buddies (ground crew)?
3. Have you created a BOM (Bill of Materials) including all hardware and supplies required for the installation?
4. Do you have the proper Personal Protective Equipment for this job?
5. Are all necessary tools available
6. Does everyone know their job and how the pieces go together?

Documenting the process and results: We have many digital resources available to us to document all aspects of the project such as a digital camera to capture the hardware before its hoisted in place as in its final position, 3-D CAD programs to model the installation and spreadsheets to create a working BOM. Typical documentation supplied by the tower manufacturer can also be "red lined" to reflect your actual installation.

Securing the hardware and materials: Some of us are fortunate enough to purchase all materials for the project at one time - this ensures that the materials are fresh and not compromised in any way. The rest of us collect the materials little by little through bartering and scrounging at hamfests, scrap metal yards and fellow hams garages.

This is a good time to discuss “When is a deal not a good deal”. Sometimes an older tower (or parts of) are obtained for later use. When the time comes, each part should be thoroughly inspected for corrosion, cracks and voids as these defects will cause mechanical failure resulting in property damage and/or injury and loss of life.

Sometimes you may be enticed by a “free” tower and antenna – all you need to do is remove it. I have been presented many times with these opportunities and in some cases walked away as the hardware was rusted beyond safe use and supported with corroded guy wires and in some cases, no safe way to lower the tower to the ground. It is recommended that the owner be advised to secure the services of a commercially insured boom truck company.

Typical hardware required for the project:

- Tower (sections), guy ring, base, galvanized nuts & bolts and rotor plate
- Guy wire, clips, turnbuckles and, thimbles
- Mast and thrust bearing
- Foundation and guy anchor concrete, re-bar
- U-bolts, all thread, lag bolts – (stainless and or galvanized only)
- Guy anchors

Safety Equipment: Today, we are very aware of safety (or the lack of) based on media coverage of failed designs resulting in injury and death. These include roads and bridges, airplanes, construction cranes, industrial / farming equipment as well as the construction and appliances used in our homes. Most consumer products are tested to known standards and certifications published.

The practice of erecting a tower demands that typical safety equipment is employed, the climber and ground crew have a working knowledge of the tools to be used and safe techniques are followed. A fall from any height will cause injury and possibly death!

Always check your safety equipment before each use.

The following Personal Protective Equipment should be used:

- Fall Arrest Harness
- Climbing belt
- 2 or more lanyards
- Hardhat
- Gloves

- Goggles
- Leather boots with steel shank
- Cell phone / walkie-talkie
- Hard hat or insert for baseball cap
- Suntan lotion

Support Staff: If you are new to the hobby, it is always best to have an experienced person on the "crew" to guide you through the erection process. I for one have learned many tips by first assisting on the ground and then up on the tower. Some of us experienced hams operate solo and it then is imperative that you follow common safety practice as there is no one around to help in the event of an emergency.

A number of us have stories of triumph in the face of danger while working on our towers and antennas. We could walk away from these events unscathed as we were younger, stronger and capable of quick recovery. Today, we need to use mechanical advantages and implement additional safety equipment. These may include an electric winch to raise and lower heavy objects and safety (rope) lines to keep an object in transition steady in the event that the main winch cable fails.

Tools: Installing a tower will require a minimum level of proper hand tools. Approaching the project without the correct equipment will certainly result in a sub-standard installation, failure of installed components, difficulty during installation and maintenance and risk of danger to the entire crew. Make the investment – go to Sears and spend a few more $$$ to equip your shack. Additional tools such as a "come along", canvas bucket and steel wire cutter can be obtained at your local auto parts store, McMaster-Carr supply or Grainger supply.

Specialized Installation Equipment: To make the job safer and easier, it is a good idea to have (on site) and understand the use of the following equipment:

- Gin pole
- Come along
- Pulleys
- Guy wire tension meter
- Electric winch
- Cable grips
- Temporary guy wires with hooks
- Carabiners
- Nylon lifting straps
- Gorilla hook strap
- Rohn Tower Platform

Understanding your ropes: Ropes are an essential to the lifting process as well as to provide a second level of safety. It is important that the rope(s) be inspected every

time before use –if cuts and abrasion is found, then that rope should be disposed of or shortened by cutting away the defective area. Be a good Boy Scout and study your knots so that the correct knot is employed. Also use the proper type (material & work load rating) of rope.

Guy Wires & Fittings: Select the proper size and rating for the application. There are various types (steel or composite) and sizes available, each with their own characteristics. Follow the recommended installation procedure (by the tower manufacturer) for guy wire, clamps and turnbuckles. Ensure that the guy wires are properly routed through thimbles to prevent cuts and abrasion over time. Properly install clamps to ensure long life and not weaken the cable. Use a guy wire tension meter to properly stress all guys. Install safety wires through all turnbuckles to prevent un-winding or protection in the event of failure.

Raising the Tower: Here we go! The erection process should be done in small steps one at a time. As a new tower owner, you need to get your “tower legs” and gain confidence as the structure grows in height. You will experience movements and noises with the addition of each section. You will also understand which of the movements and noises are “happy” and which need to be heeded.

Raising a sectional tower such as Rohn 25 is easy using a gin pole and manual pulling on the rope. If you are installing Rohn 45 or 55 then you need to think twice about the manual method as the weight of each section may exceed 90 lbs.! I always use an electric winch with a remote control as it affords complete control of the lifting process and most importantly the process of mating the sections together at height.

Free standing and telescoping towers typically include a raising mechanism that enables safe and easy erection. Be careful while operating the winch crank as it can snap back and hurt or break a wrist. Always inspect the winch cables and end fittings before use.

Installing Antennas: OK, now the tower is in place and its time to get that antenna system in the air.

Grounding the Tower:

Resources:

Tower Maintenance:

When Something Fails:

Credits and Refrences: