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Designers & Manufacturers of Communication Towers
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The Ten Most Common Tower Building Mistakes

Written by Steve Morris, K7LXC

After working on over 150 amateur radio tower and antenna systems over the last 15 years, I have seen many problems and failures that could have, and should have, been avoided. By avoiding making these mistakes, you can make your tower and antenna system safer and more reliable. It'll even let you sleep nights better when that big storm blows through.

1. Not following the manufacturer's specifications

Commercially manufactured towers have to comply with current standards for wind loading and structural integrity. Licensed Professional Engineers (PE's) design the towers and make the calculations to make them safe. If you don't follow their specs at a minimum, the tower will not take the stresses and loads that it is subject to. In other words, it'll probably fail.

One of the immutable laws of antenna and tower construction is the LXC Prime Directive - "DO what the manufacturer says". Violation of this rule could be catastrophic. The inverse of this law is DON'T DO what the manufacturer DOESN'T SAY. In other words, don't invent something that the manufacturer hasn't intended. Here are a couple of examples. A ham was installing a KLM antenna that used the Lexan element brackets. After final assembly, he spray-painted the whole antenna with clear Krylon spray paint. Why? Because he always did that to protect his antennas. Unfortunately the Krylon reacted with the Lexan in the boom-to-element brackets and cracked all of them. Did the manufacturer say to do that? No.

Here's another. Another amateur taped the bottom of the turnbuckles on the anchor end of his tower guy wires. Over time, the tape trapped water that eventually rusted the turnbuckle and he couldn't see it because it was covered up by the tape. All it took was a medium-sized windstorm to break the turnbuckle and have the tower fail. Did the manufacturer say to tape the turnbuckles? No. Not only did he do something the manufacturer didn't specify, but he also violated Mistake #8 below - Not doing an annual inspection.

2. Overloading

This is the most common reason for amateur tower failure. The first thing you need to know to plan and build a tower and antenna system is what the wind speed rating for your county is. Next, you need the manufacturer's specifications for that wind speed. Then you must not exceed the wind load rating based on those factors. This is even more important for crank-up towers. Refer also to number 1.



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Let's face it, many amateurs overload their towers and get away with it. I've seen tower installations that have violated just about every one of the ten mistakes and their installation has been up for 20 years. Why is that? First of all the manufacturers have built in some amount of engineering overhead - sometimes 30 to 50%. And sometimes the tower is actually stronger than the engineer's specs. This over-engineering is done to increase long-term reliability, not to let you put more antennas on it. Another reason is that it might be sheer luck - after all, every time you speed you don't get a speeding ticket do you?

Whatever the reason, it's NEVER a good idea to overload anything. If in doubt, err on the side of conservatism - you'll never regret it.

3. Underestimating wind forces

Wind pressure on a tower and antenna system can be tremendous. Unless you've been up on a tower during a windstorm to feel the pressure and the forces, it's difficult to appreciate how significant they are. Increases in wind pressure are not linear; wind loading goes up as the CUBE of wind speed. An increase of 10 MPH in wind speed can increase the wind force by almost 50% in some cases (see Chart 1).

4. Not building to the wind speed rating for the county

While many counties, and even whole states, in the US are only rated for 70 MPH winds (the minimum rating), many other counties have ratings much higher, up to 115 MPH for Dade and Broward in Florida for example. Find out what the wind speed rating is for your county, or your specific location and use that as the minimum design parameter for your tower and antenna system.

County wind speeds for all 3076 counties in the US from the TIA-222 Tower Standard are online. Remember these are the minimums and some building departments might use a slightly higher figure for their building permits.

5. Using the wrong mast for the job

This is an all too common failure. Stacks of medium to large sized HF beams can put huge stresses on your mast. There are two materials available - pipe and tubing. Pipe is designed to transport liquids and is not rated for strength. It's fine for small installations where you don't have much wind speed or loading or when there is only one antenna at the top of the tower. Tubing is carbon alloy steel, IS rated for strength and is the preferred material.

What you're interested in is the yield strength. For instance, with a Cushcraft 402CD 10 feet up the mast, a TH11DX 6 inches above the top of the tower and a 70 MPH wind speed, the bending moment is 18,218 in-lbs and you'll need a 2" mast with a yield strength of 42,000 psi and a wall thickness of 0.188 inches. An aluminum mast of 6061-



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T6 isn't suitable because its yield strength is only 35,000 psi so you need to look at something like SAE 1026 tubing that has a yield of approximately 65,000 psi. Obviously for taller masts, bigger loads or higher wind speeds you'll need a bigger mast. Talk to your local tower supplier and they can provide you with the specs for different materials. For more information on masts, Dave Leeson, W6NL, ex-W6QHS's book, "Physical Design of Yagi Antennas" has a great chapter on this topic.

6. Not having the guy wires tensioned properly

Proper guy wire tension is a critical part of a tower's ability to handle wind stresses. Having the wrong tension can be like driving your car with over or under-inflated tires; it is potentially dangerous and is not the proper specification from the manufacturer. Having too little tension can result in wind slamming of the tower and guys as the tower is blown back and forth. Too much tension puts too much preload on the guys and lowers the safety margin significantly.

Probably 90% of ham towers use 3/16" EHS steel guy wires. Guy wire tension is typically 10% of the breaking strength - in the case of 3/16" EHS that would be 400 pounds. The only inexpensive and accurate way to measure this is to use a Loos Tensioner. I devoted three columns to guy wire topics that included reviews of the Loos so you've probably already seen the info.

7. Not having a proper ground system

A good ground system is necessary not only for lightning protection but also for minimizing RFI to adjacent electronic devices. A ground system will protect your equipment, your home and your life.

Whole books have been written on this topic so it's something that will be covered in a future column. If you're interested in more information, read the book "The 'Grounds' for Lightning & EMP Protection" from the Polyphaser Company, a leading manufacturer of lightning protection hardware.

8. Not doing an annual inspection

Your tower and antennas system is in a constant state of deterioration. While it may be a slow process, it is going on continually. The best way to find and fix small problems before they grow into big problems and potential calamities is by doing an annual inspection.

You want to look at everything and push and pull on the hardware. You also want to put a wrench to 10% or more of the tower nuts for tightness as well as all of the nuts on appurtenances (antennas, mounts, U-bolts, etc.).

9. Not fitting the tower sections on the ground

Tower sections, new or used, may not fit easily together. It's much easier to correct alignment problems on the ground than up on the tower.



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A handy tool for doing this is the [Tower*Jack Combo](#) that combines a leg aligner along with a jack for pulling sections together or pushing them apart.

10. Using the wrong hardware

Since tower and antenna materials are in a constant state of deterioration, you should only use hardware that minimizes corrosion. Galvanized or stainless steel materials are the only ones that will survive outdoor use reliably.

While corrosion is a big problem, using the wrong hardware also includes substituting the wrong hardware, i.e. using general hardware store-type bolts for tower legs when they call for SAE Graded ones; using hardware totally unsuited for the task, i.e. installing the WRONG type of 'screw-in' anchor (see Photo 1) or anchor rods; use of non-closed-eye eyebolts (use only welded or forged ones); use of the wrong guy material (EHS only!); and many more. Using the wrong hardware can be disastrous.

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