Choosing and Building a Ham Radio Tower

GETTING IT RIGHT

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Twin State Radio Club, Inc.

Choosing the right tower for the job

- Stuff to be considered:
  - Frequencies to be used
  - Antenna gain and size
  - Ground space available
  - Wind load and weight of antennas (etc.)
  - Zoning restrictions, safety, & PRB1
  - Neighborhood relationships
  - Budget

Frequencies Supported

- HF
  - Consider the effect of the ground on radiation patterns
  - Antennas interact with the ground if mounted less than ½ wave above ground
  - Take-off angles vs. antenna height needs to be considered
- VHF & UHF
  - Consider line-of-sight vs/ height above average terrain (HAAT) for the frequencies used
  - Vertical antenna patterns less affected by the ground than horizontal
  - 40’ seems to be the optimum height for horizontal 6m beams
- Microwave
  - Line-of-sight, Fresnel-zone clearance are both critical

Size and Type of Antennas

- Fixed, or rotatable antennas?
- Center or butt-mounted?
- Height of various antennas on tower
- Add up square feet of wind load for each antenna, mast, rotator, etc.
- Add up total weight of all antennas, mast, rotator, etc.
- Don’t forget feedline, control cables wind load and weight
- Make sure the tower you choose can support it all with a safety factor that allows for some ice accretion

Space Available - Zoning

- Pay attention to zoning regulations – PRB1 helps, doesn't preempt
- Safe fall-zone – buildings, roads and sidewalks, power lines
- Location with low neighbor visibility
- Space for guy wires at 80% of tower height from base
- Space for tilt-over crank-up tower and antenna to fold down
- Location suitable for feed-line access

Popular Towers for Hams

- Four Basic Configurations
  - House-bracketed triangular lattice towers (Rohn 25)
  - Tubular or triangular lattice crank-up towers
  - Guyed triangular lattice towers
  - Free-standing triangular lattice towers

Bracketed Lattice Towers

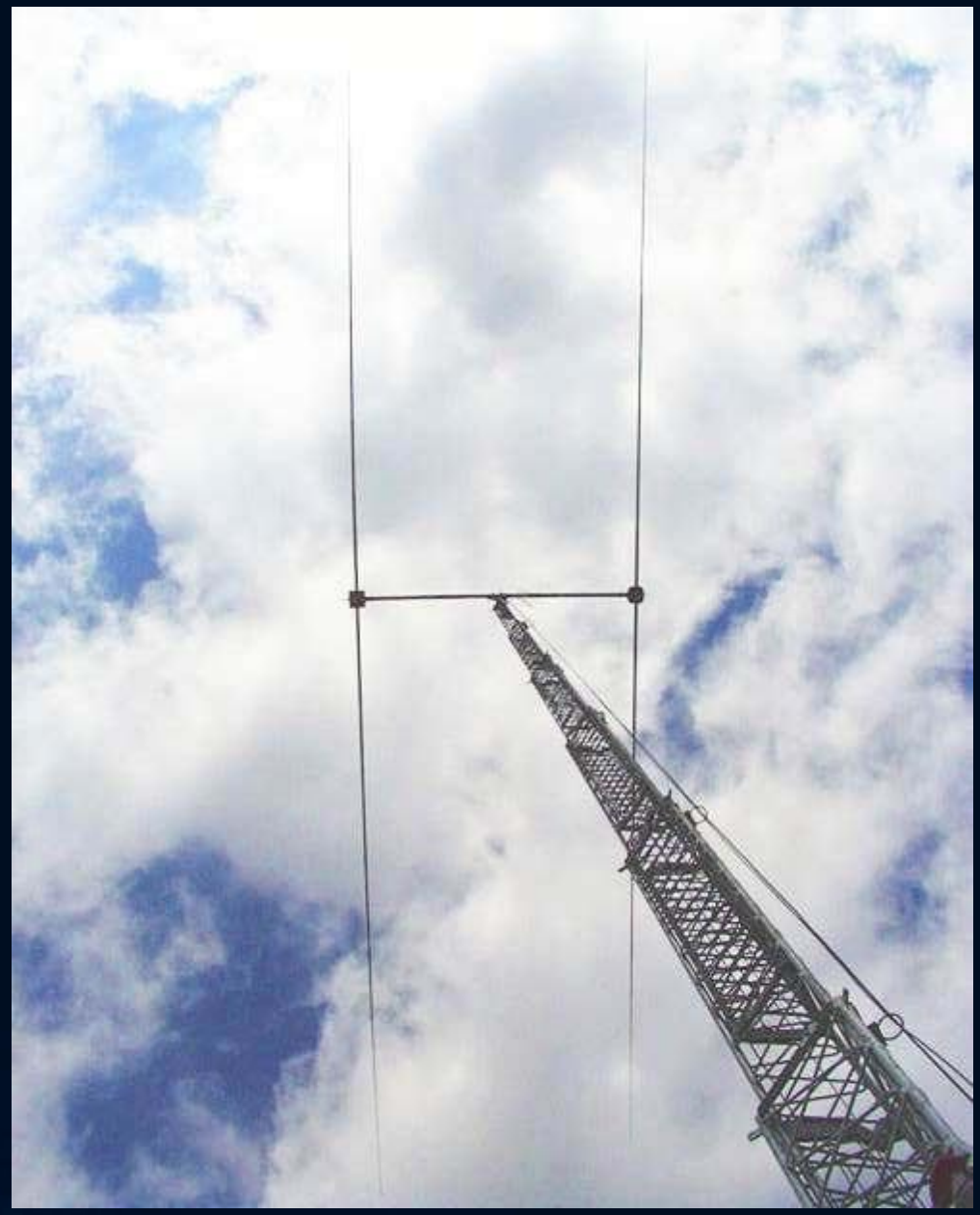
- House-bracketed Rohn model 25G or 45G
- No guys needed, minimal footprint
- 25G can go 30’ above bracket
- 45G can go 40’ above bracket
- Bracket must be at least 12’ above concrete
- Brackets can be bolted through or lagged
- Can support most average tri-band beams
- Not for large antennas or stacks

Guyed Lattice Towers

- Heights to 200’
- Require careful engineering
- Very large footprint
  - Anchors out at 80% of tower height
  - 3 guy-wire sets at 120 ^{o} angles
- Able to support large antenna arrays
- Versatile applications
- Moderately expensive

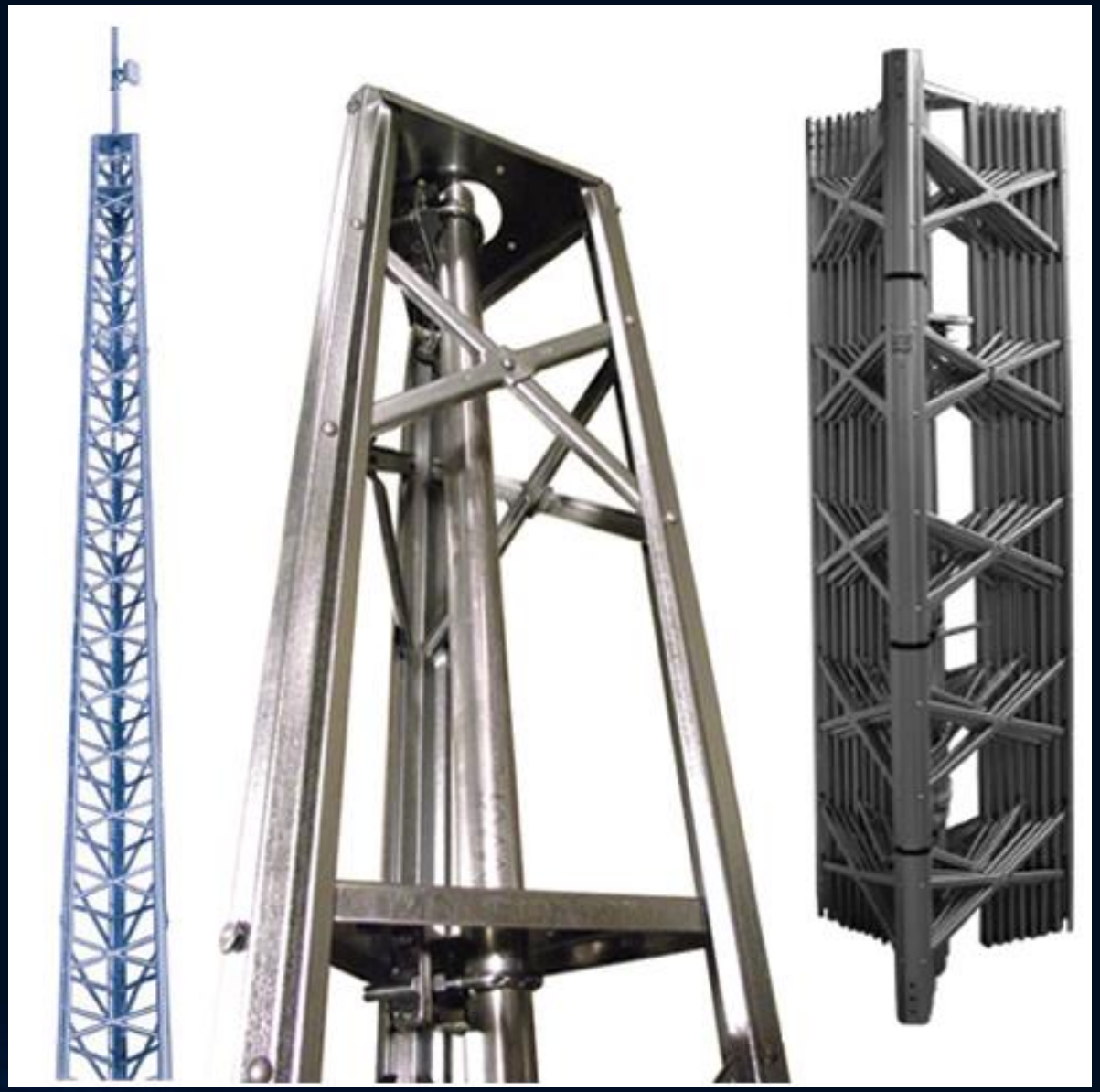
Crank-Up Towers

- Lattice or Tubular types
- Can be bracketed, guyed, or free-standing
- Both steel and aluminum available
- Requires massive concrete base if free-standing
- Heights from 40’ to over 100’
- Light-duty to extreme-duty models
- Generally very expensive to buy, install



Free-Standing Towers

- No guy wires or house-brackets
- Small footprint
- Limited antenna loads
- Larger concrete base needed
- Relatively expensive to install
- Many models and options
- Wade DMX-36 shown at right >



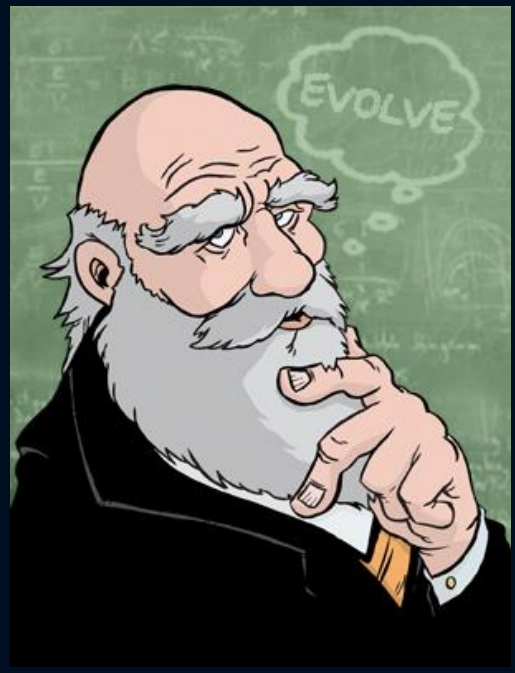
Basic Rules

- Research and design carefully
- Follow manufacturer's instructions
- Respect manufacturer's specifications
- No shortcuts or skimping allowed!
- Beware of "home-made" anything
- Don't overload the tower
- Inspect and maintain regularly
- Safety first

K1PXE's crank-up, ummm, fold-over tower

Avoid earning a Darwin Award

- Stay safe. You don't even want an honorable mention on this website!
- Don't build within falling distance of power lines – add 50% safety margin
- Inspect everything – and again
- Climb with proper safety gear, and know how to use it
- Don't take chances!!!



www.darwinAwards.com

Used Towers

- Can be a good lower-cost option if in good shape
- Inspect thoroughly, inside and out
- Are all original bolts and hardware included? Any rust in the middle of section bolts? (If they were thrown away, that might be a bad sign!)
- Check for straightness
- Look for fine weld cracks, rust pitting
- Surface rust may not be a problem, but look carefully if you see it
- Carefully check any winch cables and hinge pins for rust or damage

Check for Damage

Ancient 1950s Rohn tower sections – DON'T!

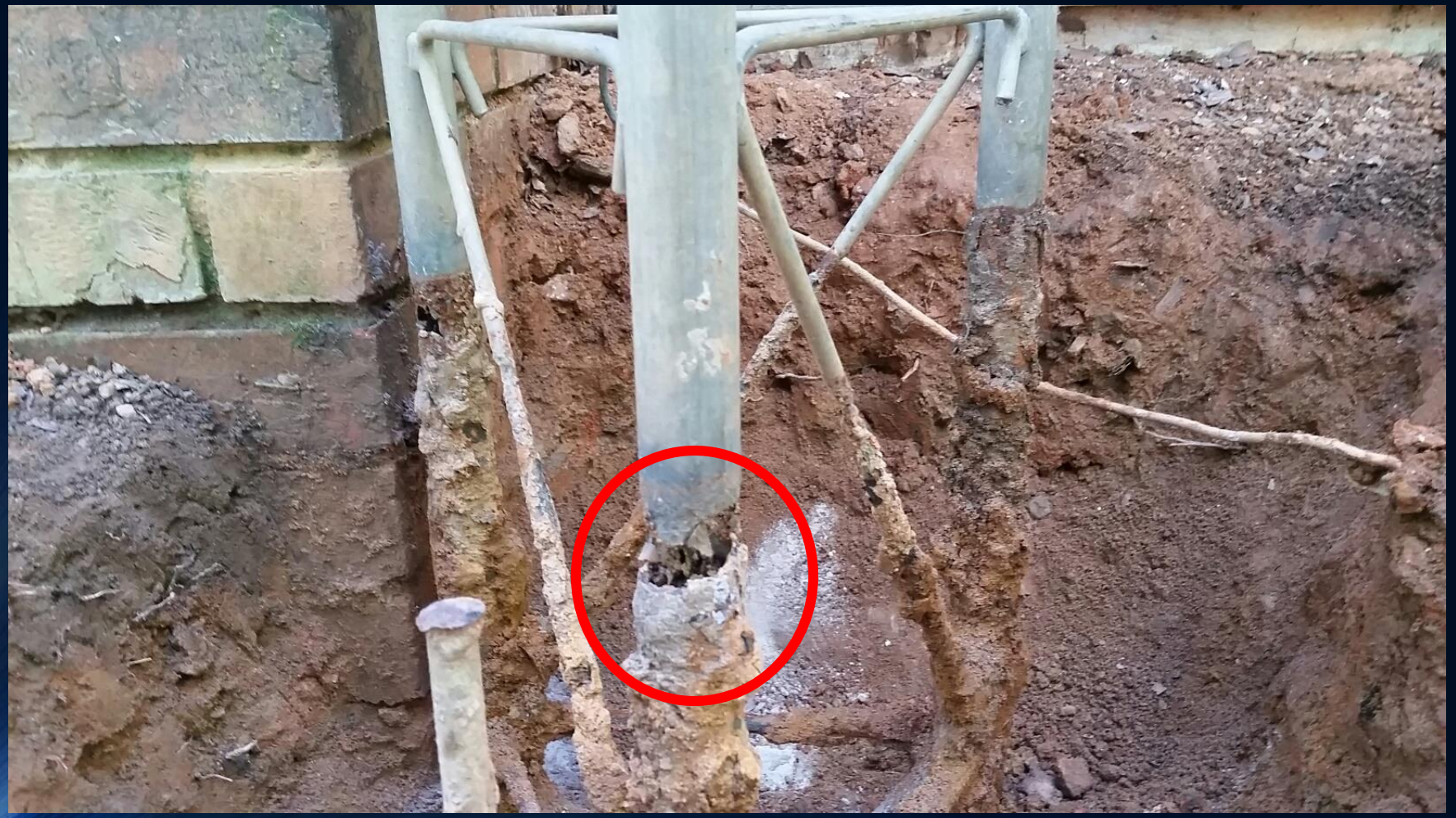
Here's what happens when the winch cable fails

Inspect the cable carefully, replace if old, rusty or damaged

Tower Bases

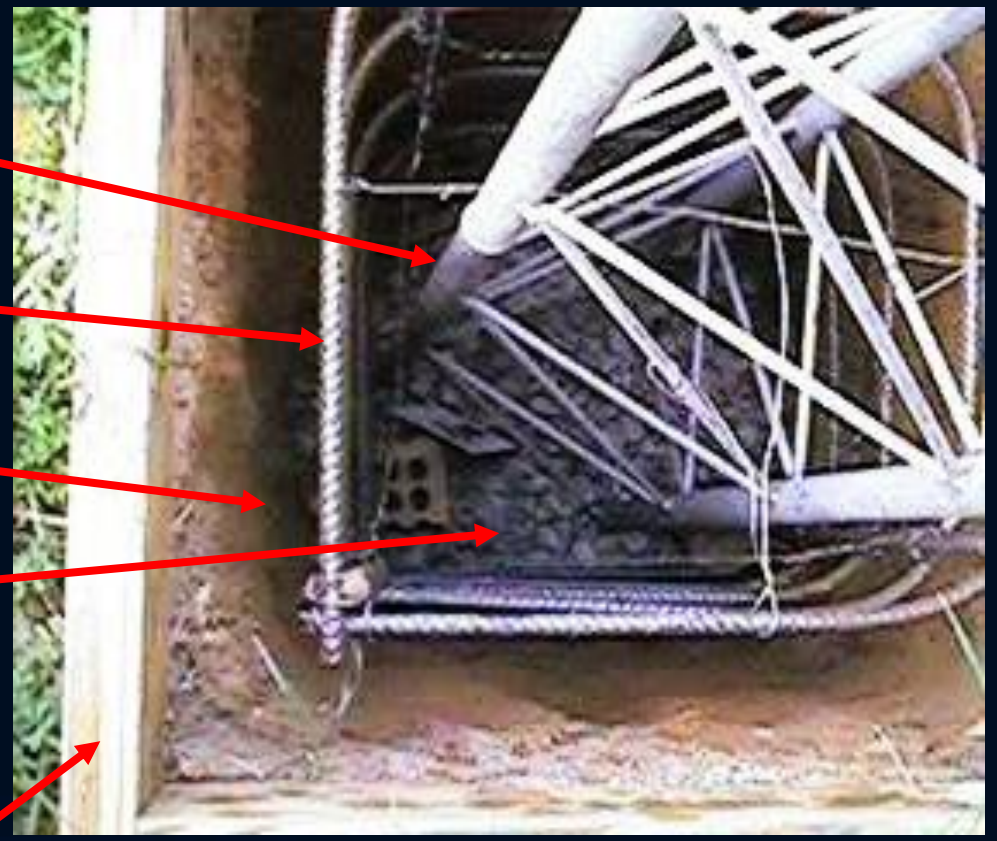
- Standard base designs assume “normal” soil conditions
- Sand and other unstable soils require some engineering
- Use 3000 psi or stronger concrete
- If possible, pour into a straight-sided hole, hand-dug in undisturbed soil
- Form a “crowned” cap at least 3” above grade to keep dirt and moisture away from the tower legs

Why We Keep Moisture and Dirt Away



Rohn 25G Base

- Short base section (SB25G – 3’4”)
- Rebar cage
- Hand dig smaller holes
- Square-sided hole in undisturbed soil
- 6” of crushed stone in bottom of hole
- Wiggle legs 3” into crushed stone
- Cap form at least 3” above finished grade
- Hole can be slightly wider at bottom

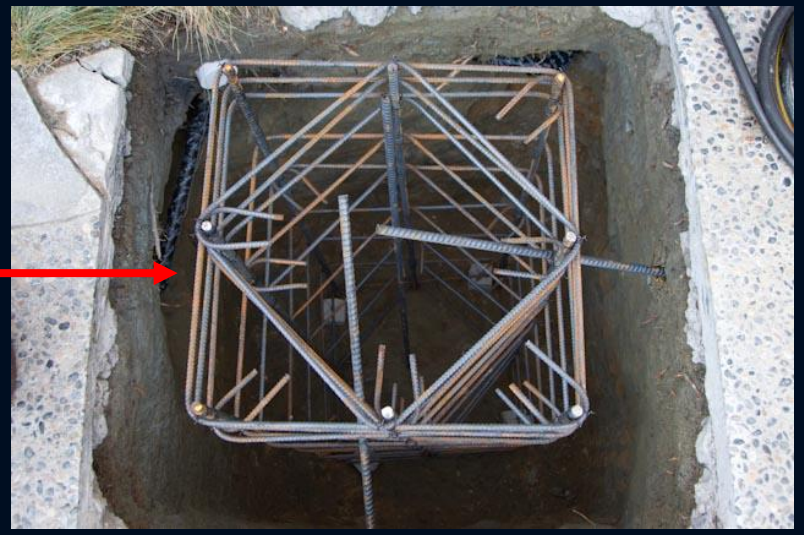


Plumbing the Tower Base (Rohn 25G)

- Use a long level on all three legs
- Ratchet straps work well as alignment guys
- Leave guys in place during concrete pour, remove after concrete is hard
- Double check plumb after pour, before finish
- For bracketed installations, attach a tower section to the base and bracket, then plumb
- Allow concrete to cure for 48 hours
- Keep the concrete cap wet for a “hard” cure

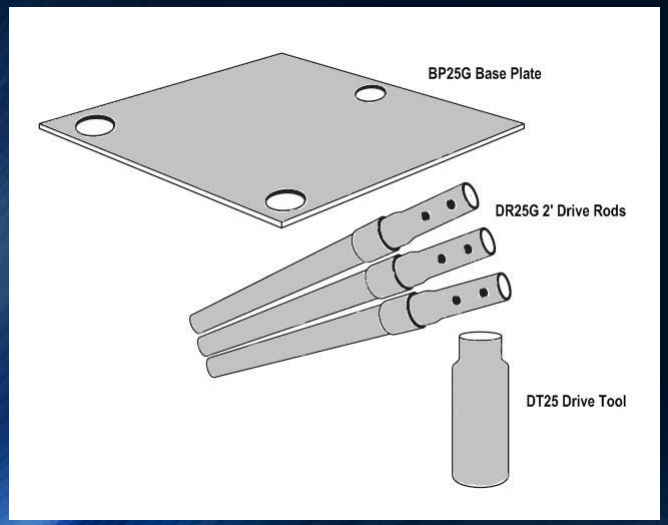
Bases for Crank-Up Towers

- Re-bar cage required as specified
- Dry-fit base to tower before installing to check for proper fit
- Be careful working in deeper holes
- Heavy welded base assembly
- Bottom picture shows a too shallow hole
- Form for a 3” or higher “domed” cap



Alternative 25G No-Concrete Installation "Kit"

- Fine for smaller antennas
- Use a ground stake base kit, plus
- Two house brackets – one high, one low
- Only for compacted, stable soil – not sand or loose gravel



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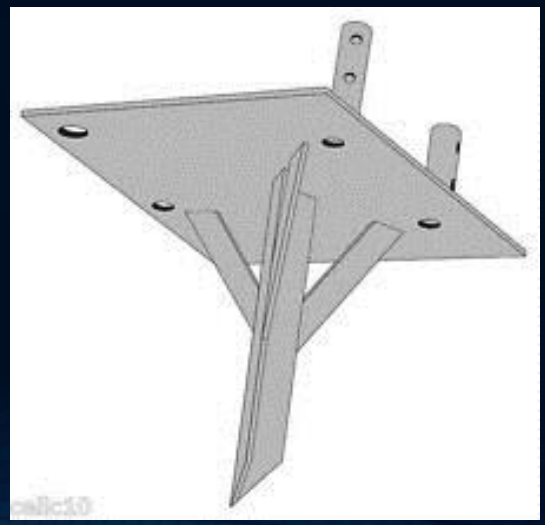
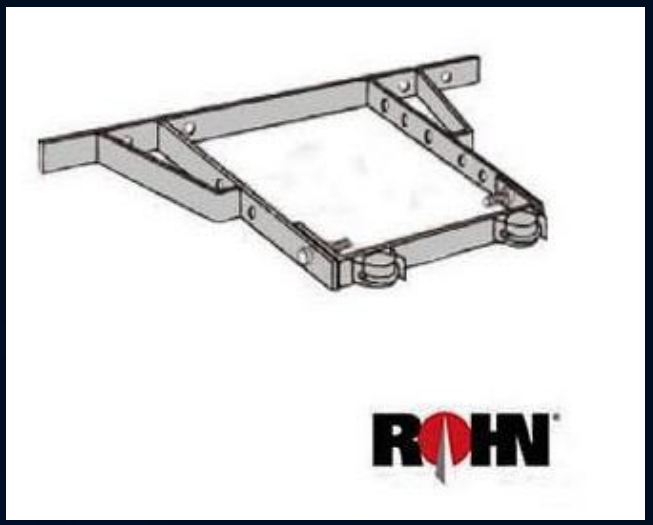


AND TWO

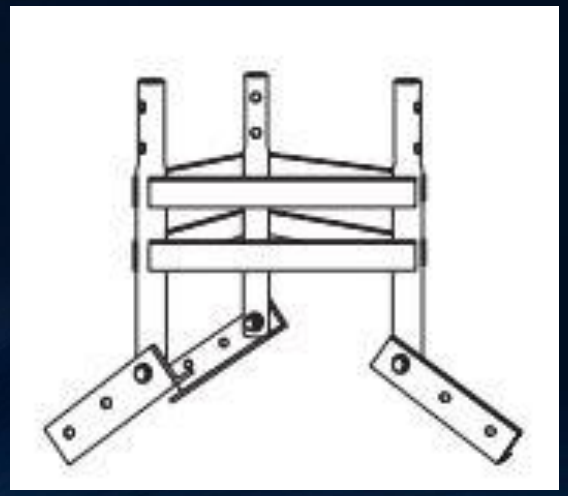


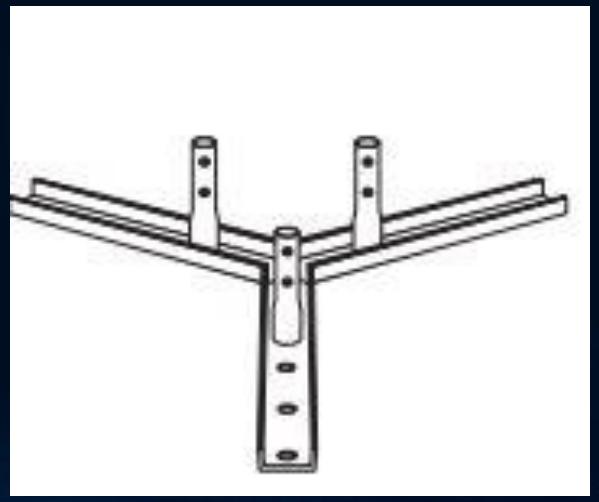
House Bracket Installation

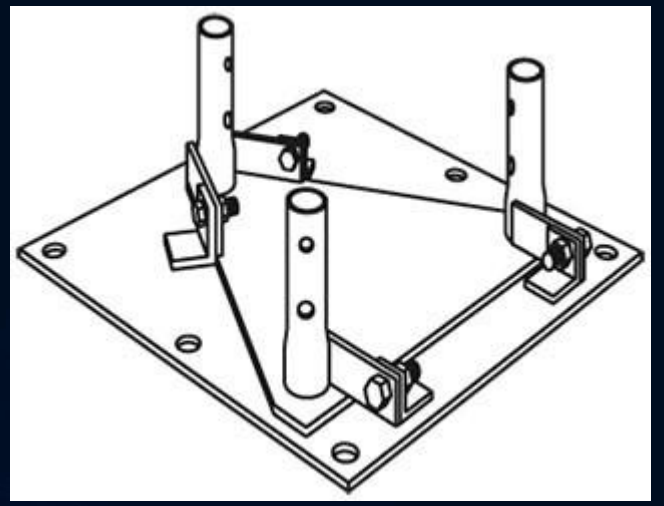
- 4 different models/sizes to fit need
  - 15”, 24”, 36”, 36” heavy duty – all adjustable
- Best on gable end of house
- Bolt-through into attic with threaded rod
- Back up on the inside with long 2x6 plate
- Reinforce gable end wall as needed
- On under-eave installations, lag to header

Other Rohn 25/45 Base Types

- All require guying or house bracket
- Anchor bolt & template kits available
- Roof mounts require additional structural support, preferably down to the foundation

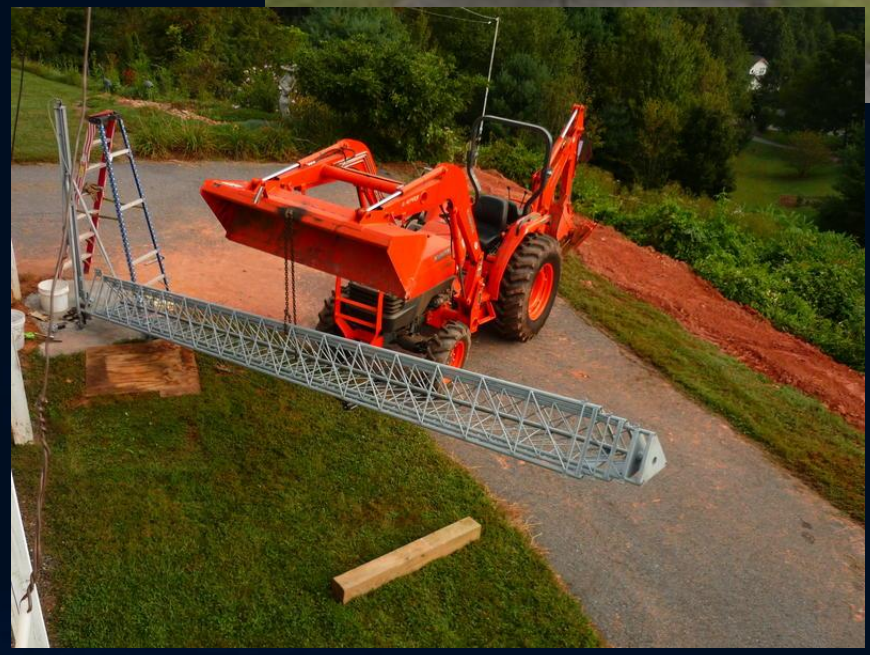






Installing Crank-up Towers

- You aren't moving these without equipment!
- Ok, maybe the really small ones – but with lots of friends to help lift!



Crank-Up Bases

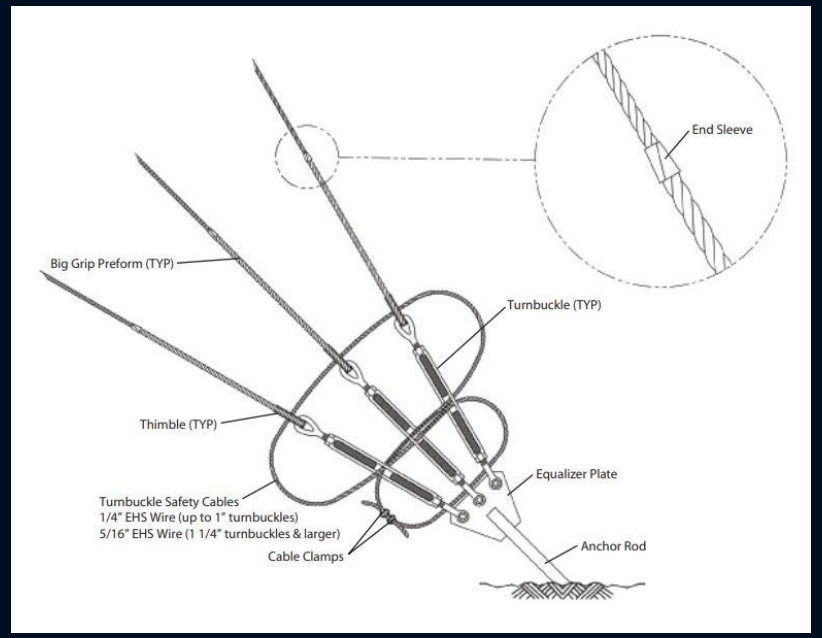
From left:
(1) Tashjian (Triex) / US Tower fixed base
(2) US Tower tilt-base
(3) US Tower rotating tower base with tilt-over fixture removed

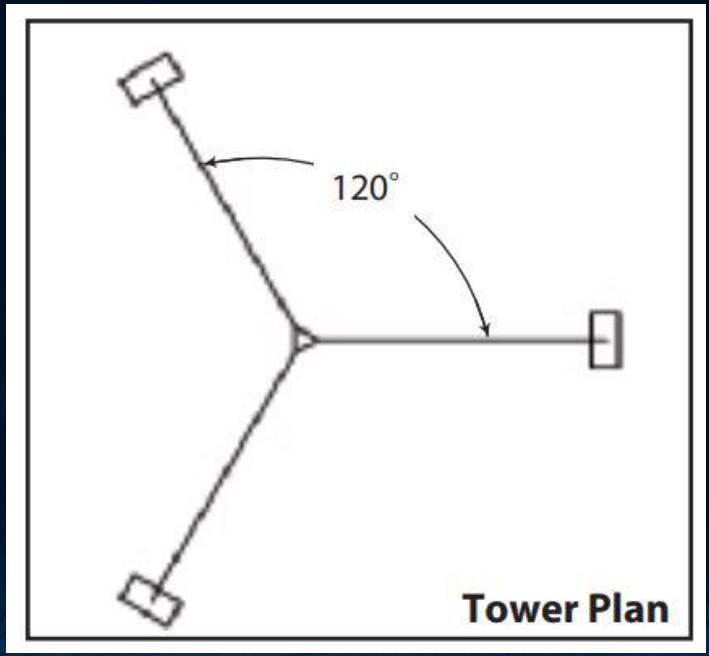
Building Triangular Lattice Towers

- Build on ground and lift with crane, OR
- Stack with a gin pole

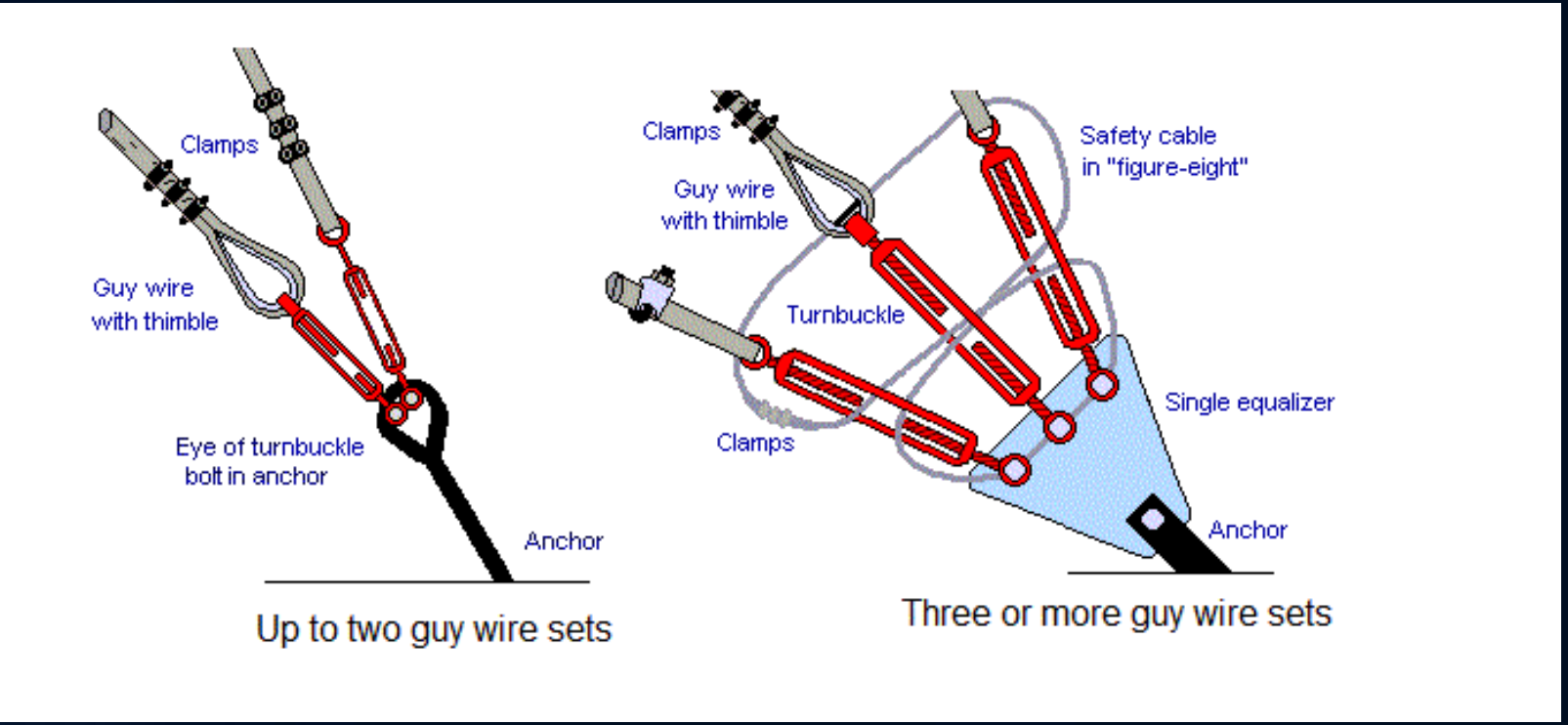
Tower Guying

- 120° anchor base layout angle is critical
- Follow manufacturer's guidelines
- Use only approved materials and hardware



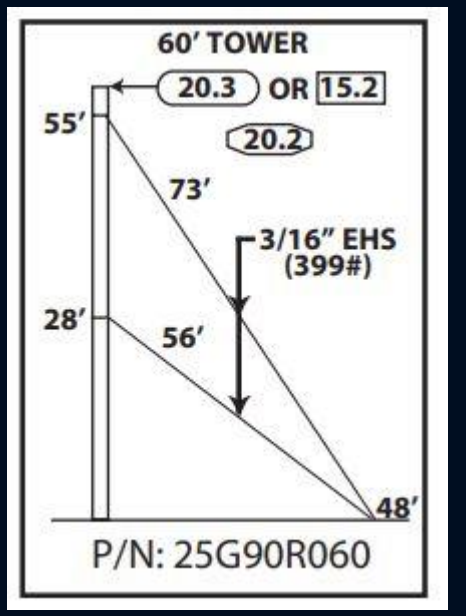


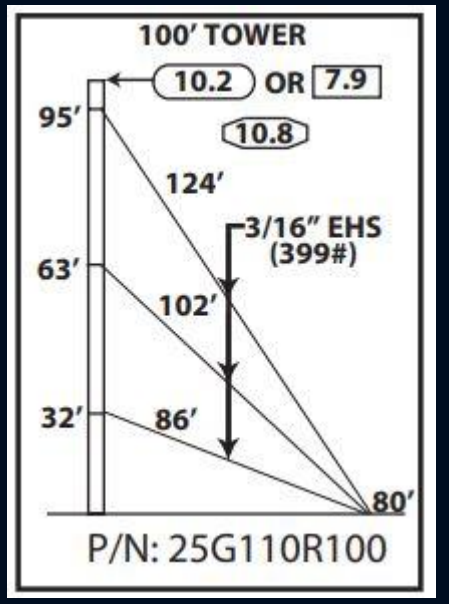
Guy Anchor Types

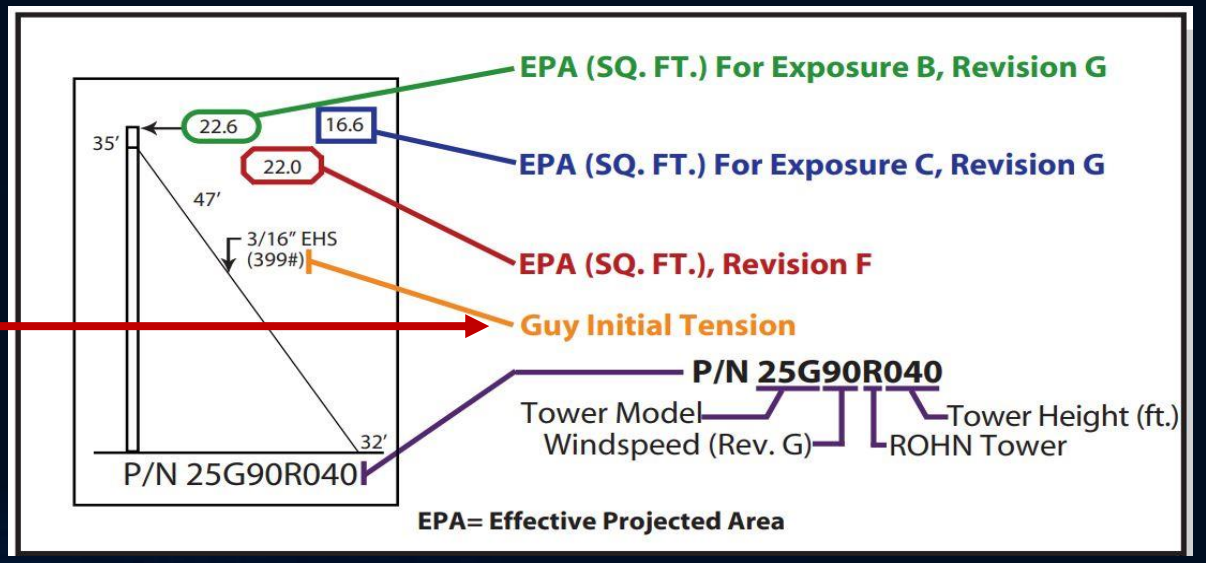


Guying Specifications

- Rohn catalog specifies all guying details:
  - Anchor block size and depth
  - Anchor rod angle
  - Number and height of guys
  - Guy wire length & diameter
  - All dimensions assume flat ground
  - Guy tension
- Don’t over-tighten guys

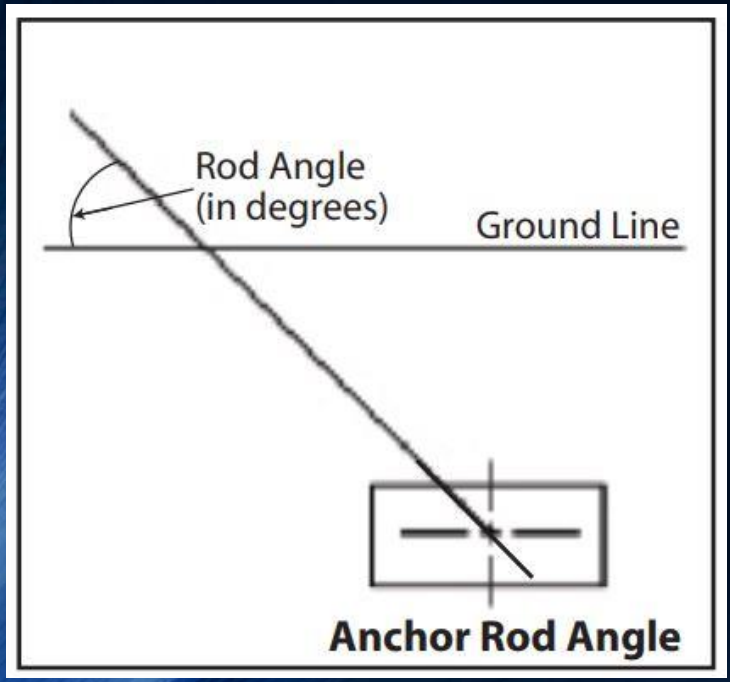


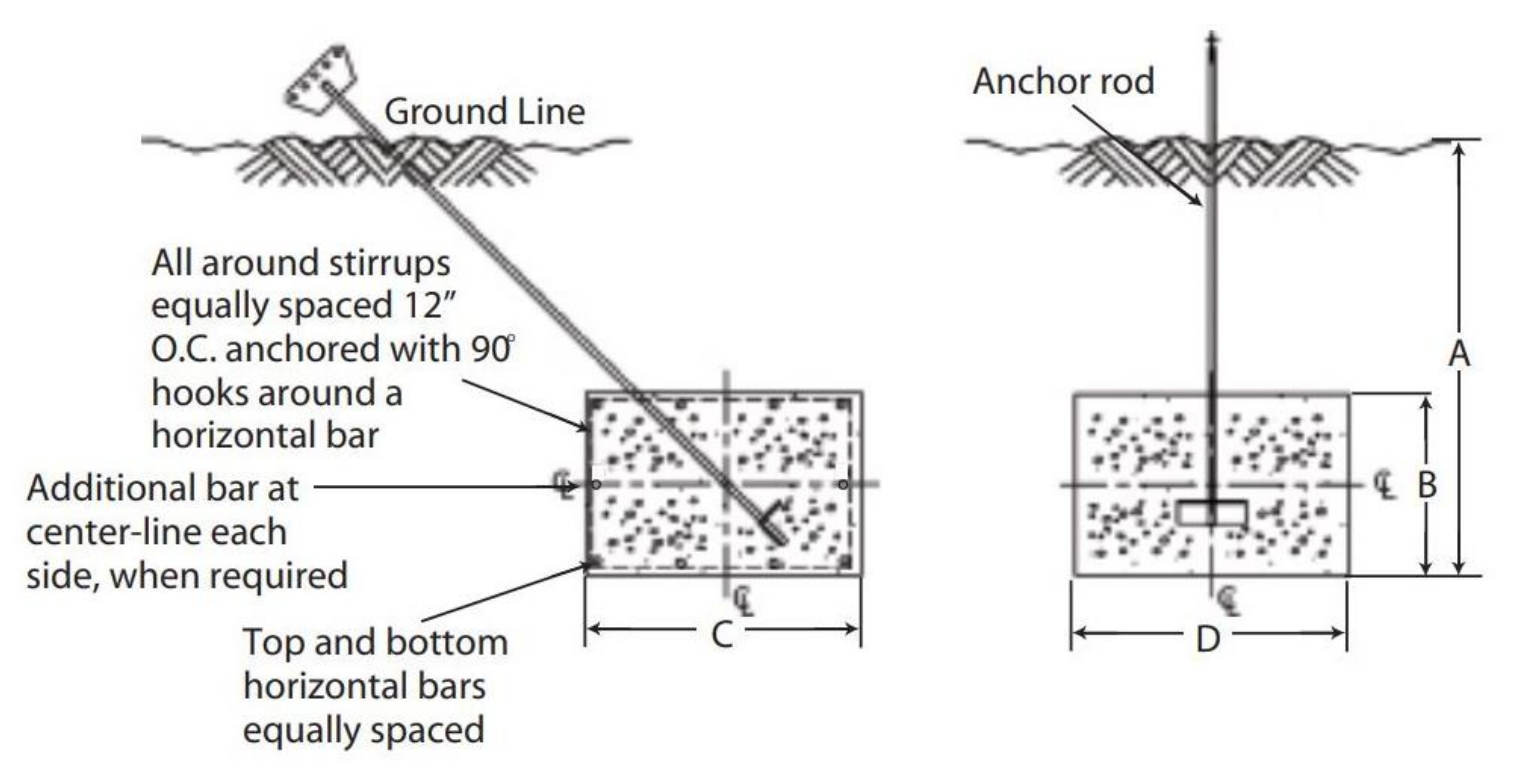




Guy Anchors

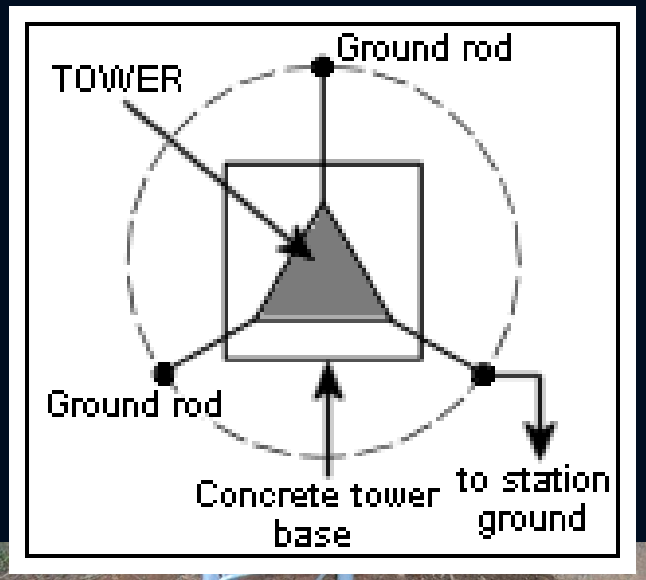
Rohn catalog specifies block and depth dimensions

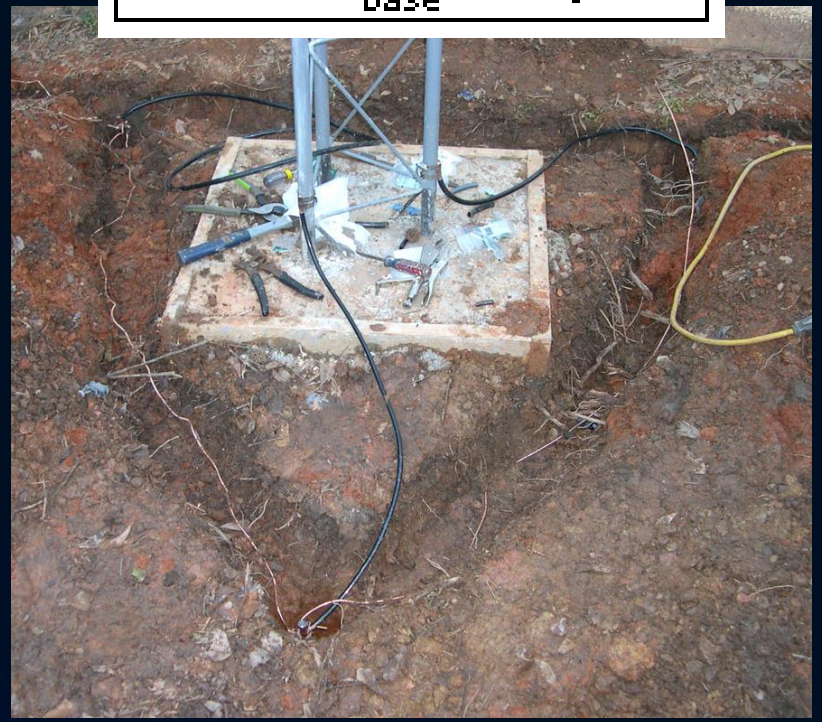




Tower Grounding

- Ground each leg to buried loop and rods
- Bond to house and station grounds
- 8 ga. or larger diameter bare copper wire
- Bronze ground clamps ONLY





At the Top of the Tower

At the Top of the Tower

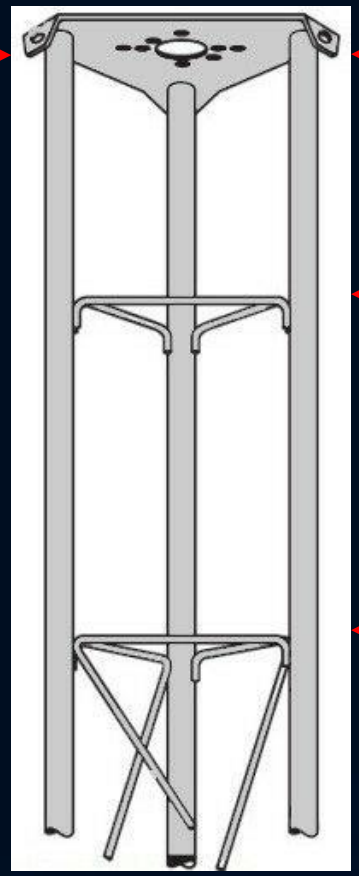
- Do it right the first time - repairs can be difficult and expensive!
- Thrust bearings keep excess weight and stress off the rotator
- Available for 2” and 3” dia. masts

At the Top of the Tower

- Make sure your rotator will fit into the tower
- Best to install and align the rotator and bearing on the ground
- Use short mast stub to align bearing and rotator positions – prevents binding and rotator damage
- Carefully seal all connections, support cables

At the Top of the Tower

- 25AG-4 top section
- Two thrust bearings are better than one
- Makes it possible to remove rotator and leave antenna in place for a short period
- Fairly expensive option!



Thrust bearing on top plate

Accessory shelf with 2nd bearing

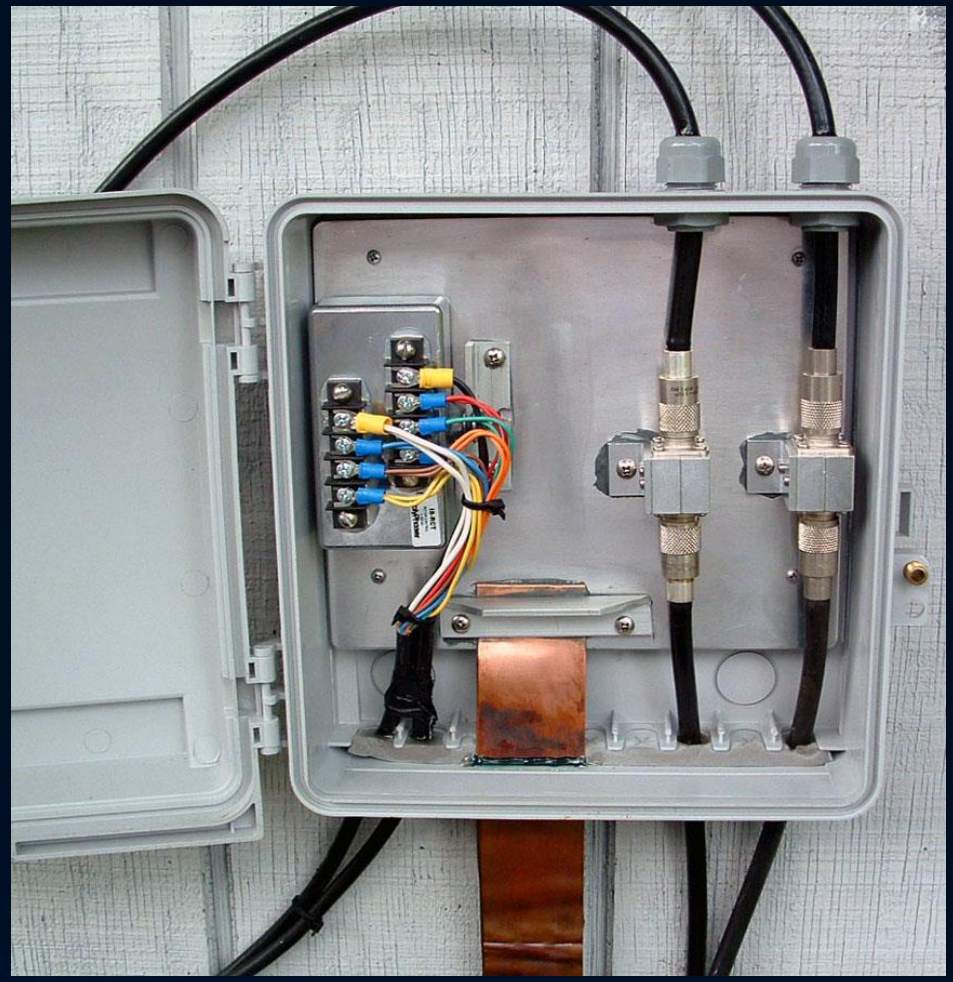
Accessory shelf with rotator

At the Top of the Tower

- Use only mast pipe suited to the job
- 2” steel pipe is fine for short stubs
- Stacked arrays need thick-wall, high-strength aluminum mast
- Light arrays – 2”
- Heavier arrays – 3”
- Even aluminum is heavy – this is crane territory!

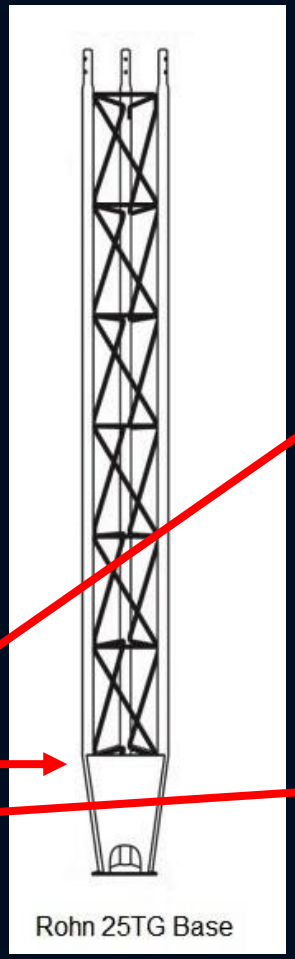
Lightning Protection

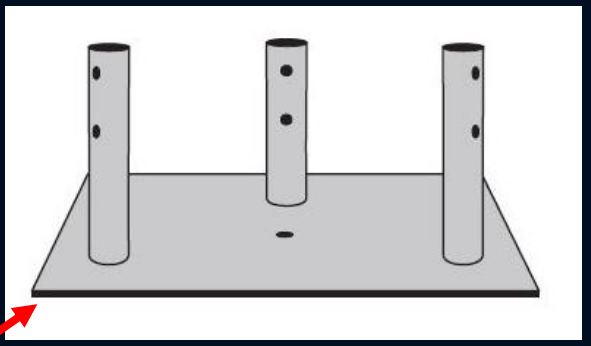
- Entry panels keep lightning energy outside the house
- Expensive, but good insurance
- Connect to ground rod directly below
- Bond to tower ground system and house AC ground
- Available from multiple suppliers

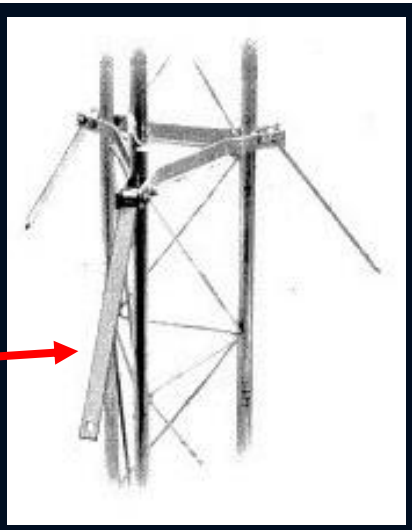


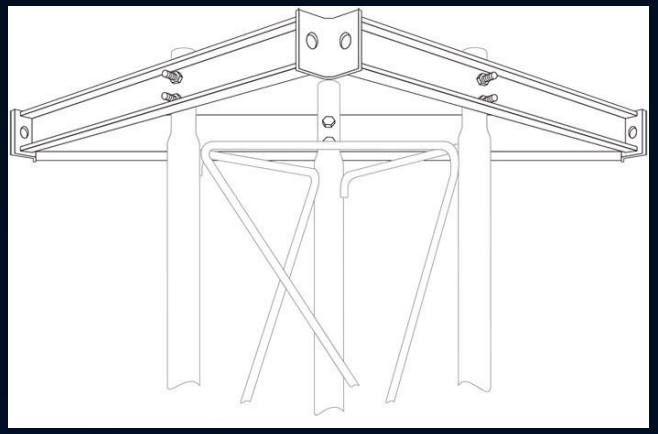
Anti-Torque Guying

- Large antennas create large torsional forces
- Resulting twisting motion can damage towers
- Three prevention methods:
  - Pier-pin tower base (flat plate or tapered base)
  - Torque arm guy wire brackets
  - 6-guy torque arm bracket
- Best solution is a combination – pier-pin base, plus either torque bracket


Rohn 25TG Base

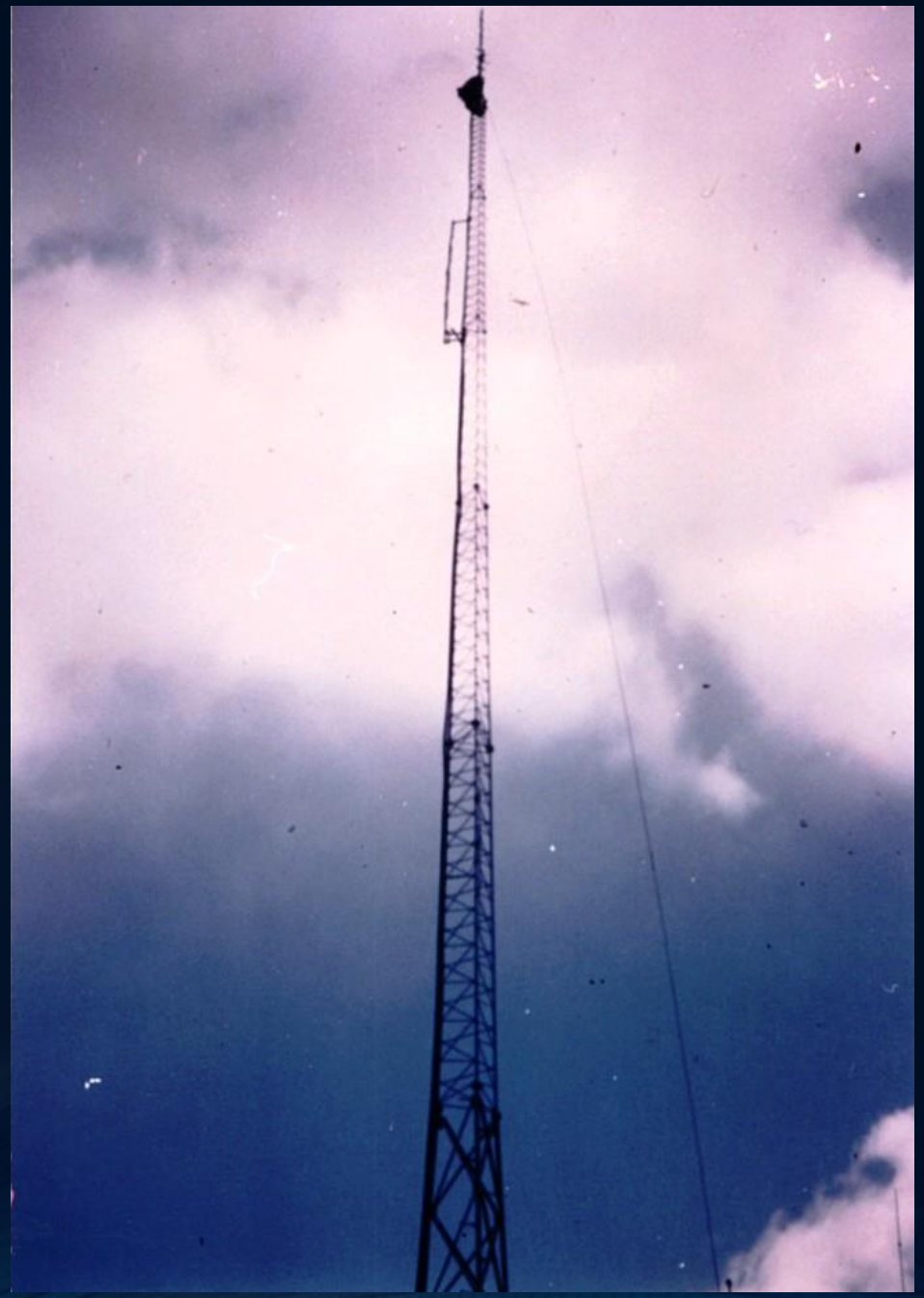






Adding antenna to 100’ Rohn SSV police and fire dispatch tower

100’ Rohn 25G ham tower for W1HAD (SK) Ansonia, CT

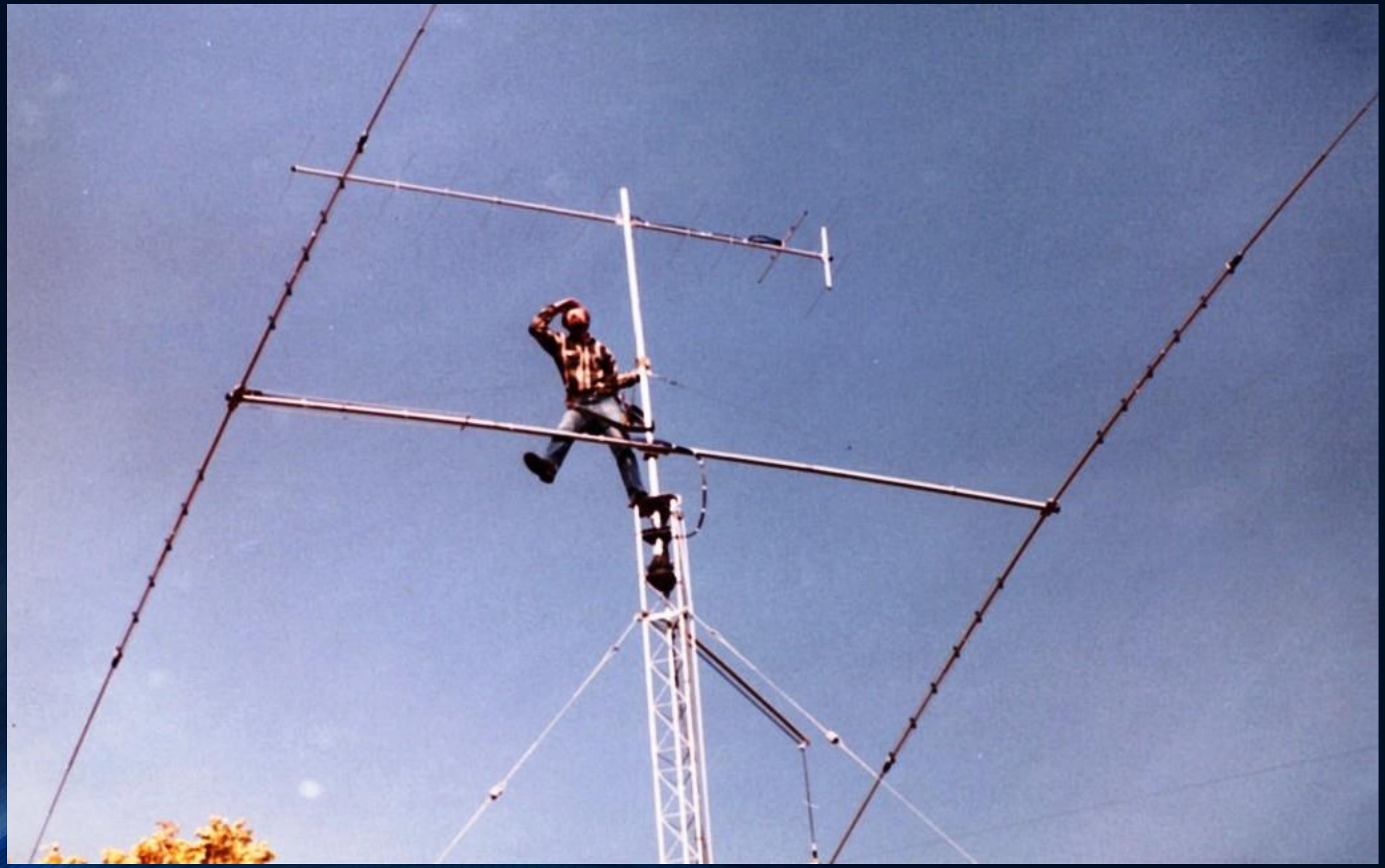


Adding antenna to 140’ Rohn SSV police/fire repeater site

(Guilford, CT)

70’ Rohn 25G fold-over tower

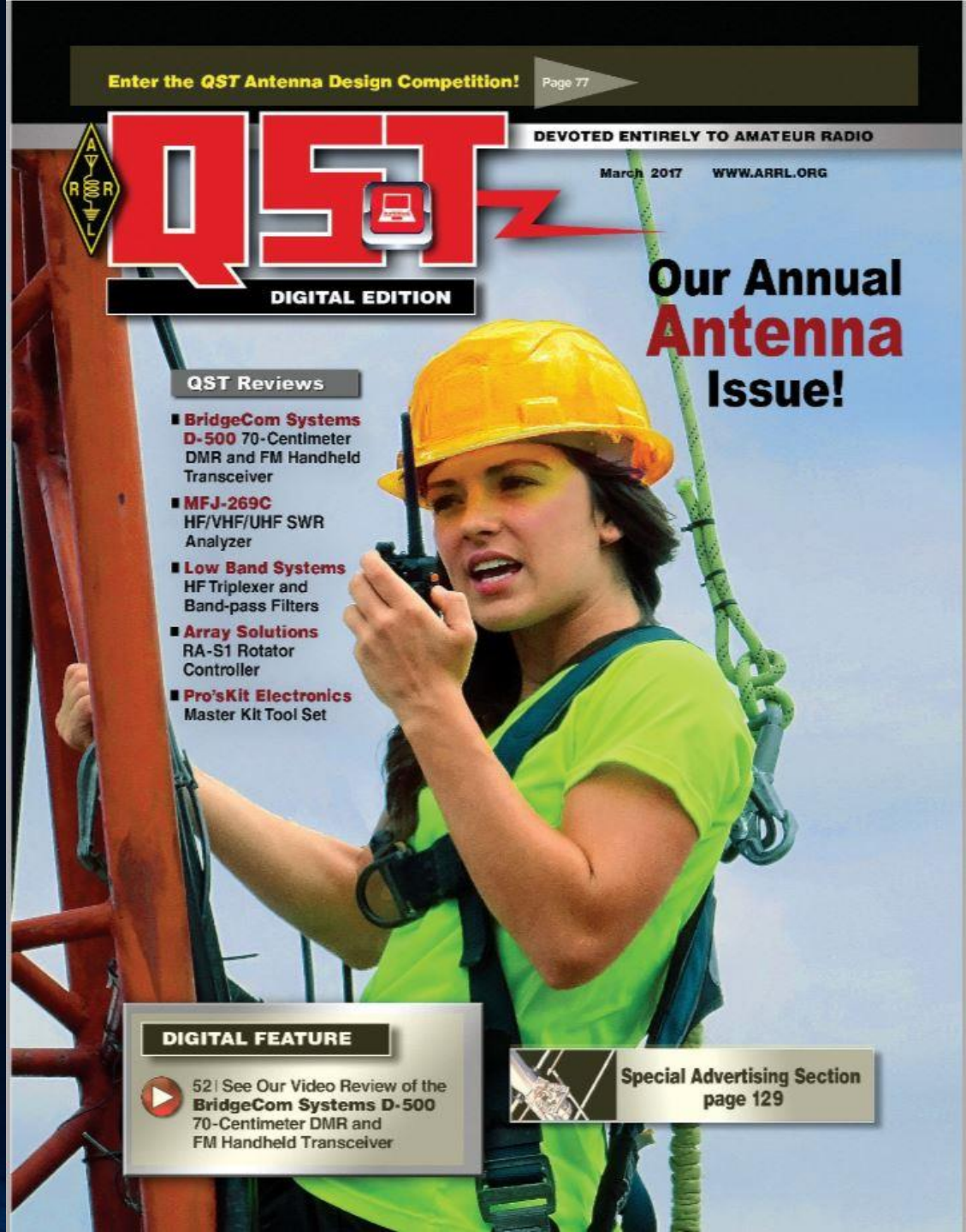
KM1A (SK) Killingworth, CT



250’ Rohn 65G commercial lease tower
(Derby, CT)

Darwin Award Candidates

- Anyone remember this gem?
- How many errors can you find?



Darwin Award Candidates

Stacked big beams on a light-duty tower with no anti-torque guying

Darwin Award Candidates

Tower guyed to a fence post – what could go wrong?

And, check out the heavy-duty hardware store turnbuckle!

(This one's a Florida CB'er)

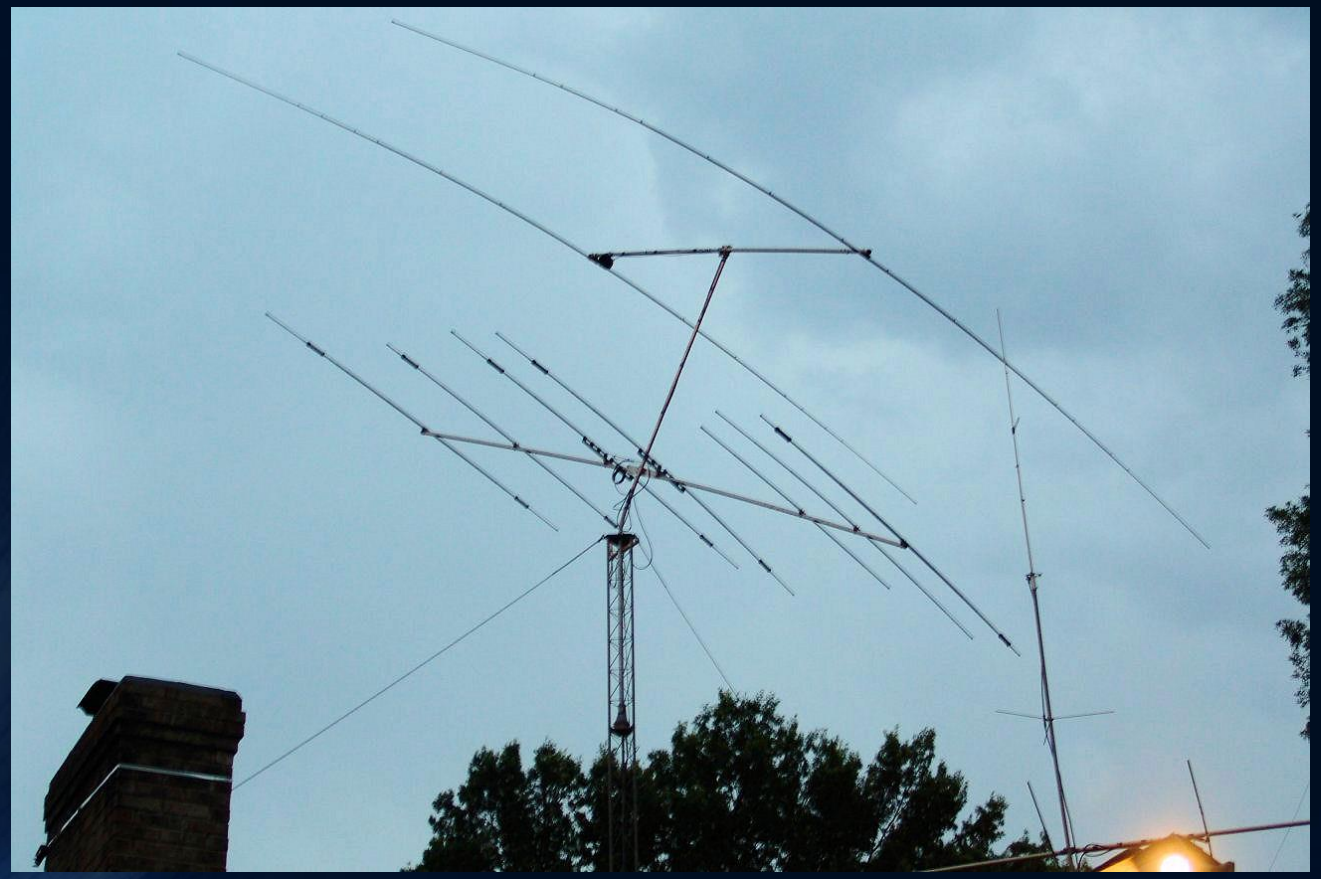
Darwin Award Candidates

Heavily loaded tower with screw-in guy anchors

Darwin Award Candidates

No concrete – just steel in the dirt

Darwin Award Candidates



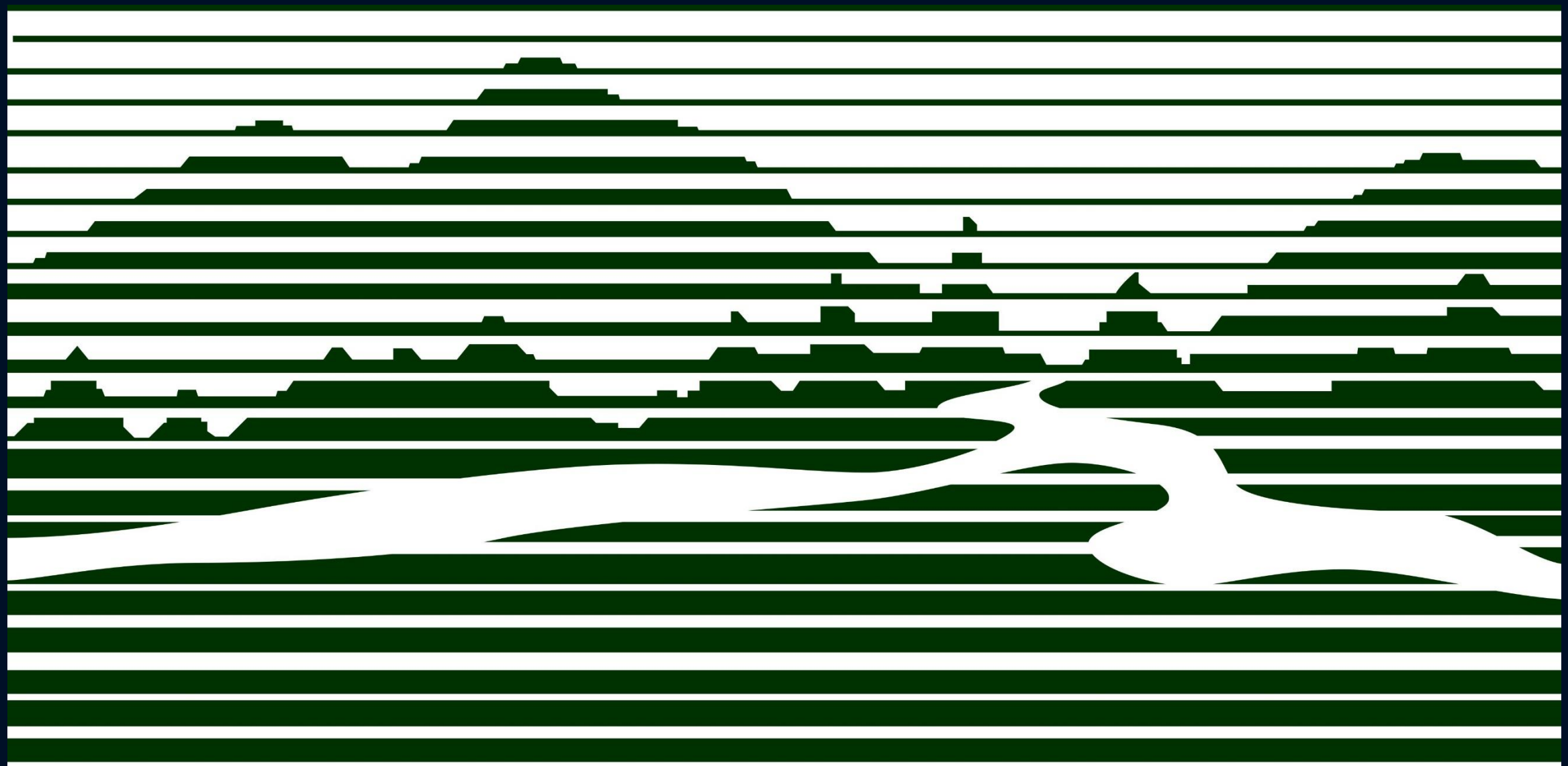
2” steel water pipe for a mast

Darwin Award Candidates

Overloaded light-duty crank-up tower

A Word from our Sponsors


LOONEY TUNES
Thats all Folks.



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