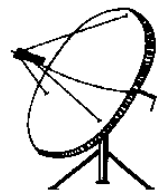


Tower Construction & Safety

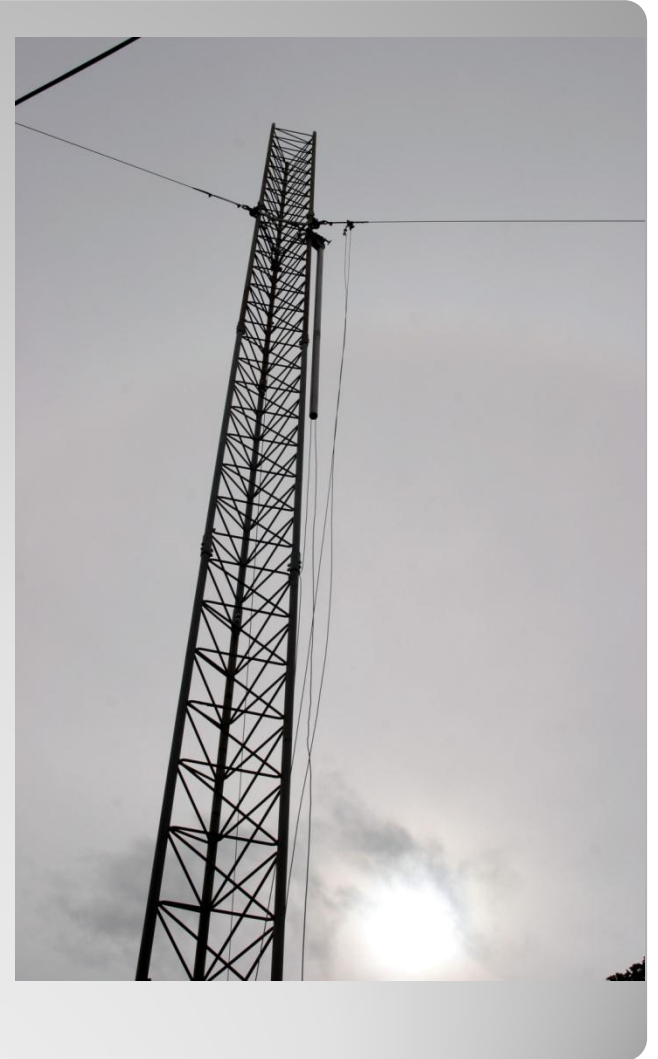
Presented for the 36th Eastern VHF / UHF Society

April 17, 2010

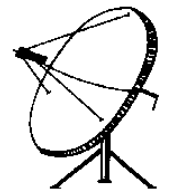
Steven M. Simons W1SMS (ex KF6AJ)



- Planning & Documentation
- Securing the Stuff
- Required Safety Equipment
- Support Staff
- Tools



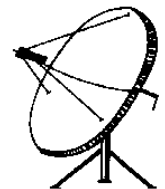
What we will cover today



- Guy Wires & Fittings
- Raising the Tower
- Installing Antennas
- Maintenance
- When Something Fails
- CAD Solid Modeling
- Credits & References



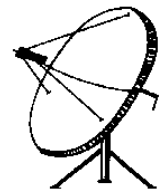
What we will cover today



- How high is up ?
- Will you have help ?
- Did you create a BOM ?
- What about PPE ?



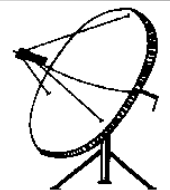
Planning & Documentation

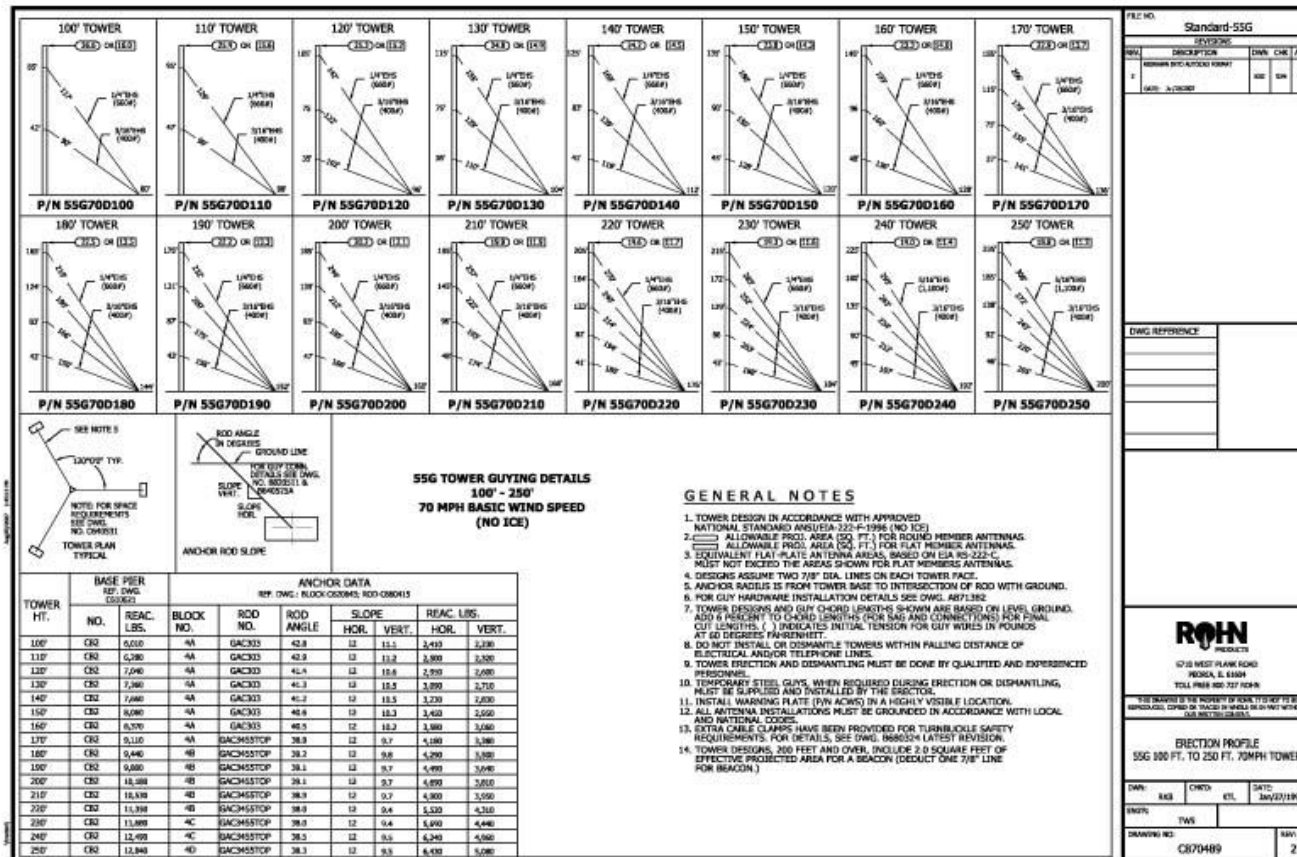




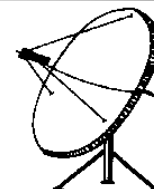
- Do you Have the Proper Tools ?
- Does the "Staff" know their job ?
- Can I capture the details for use later ?

Planning & Documentation





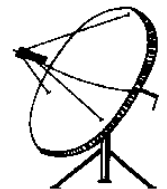
Rohn 55 Guying Specification



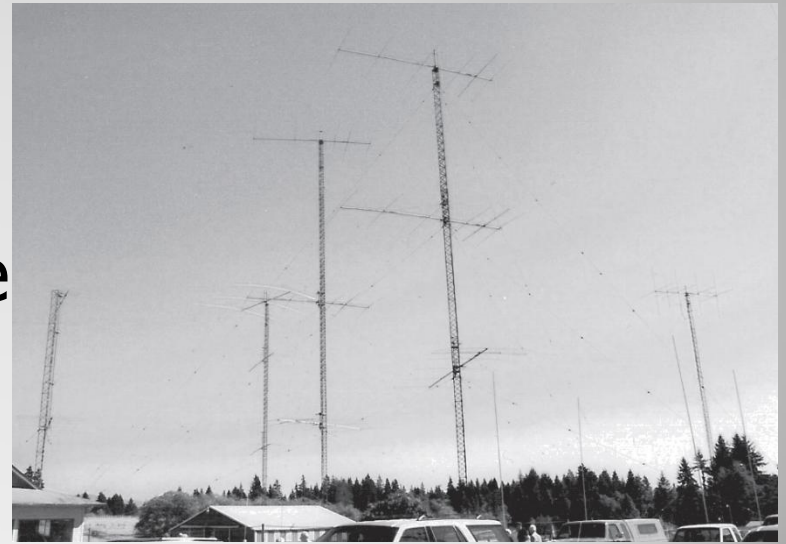
- Option 1 – write the check
\$\$\$\$\$\$
- Option 2 – Scrounge, barter
and trade
 - @ Hamfests
 - Via E-Bay
 - Thru club relationships
- When is a “Good Deal” not such a good deal?
 - Watch out for “free” towers and antennas that
require removal



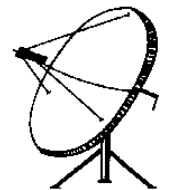
Securing the stuff



- Complete packages can be purchased from vendors
- Some vendors can also arrange for turn-key installation
- Before placing an order, have a complete plan in place



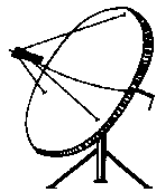
Write the Check \$\$\$\$\$



- Visit hamfests to hunt for components
- Look on the Web (E-Bay)
- Post to reflectors
- Discuss with club members



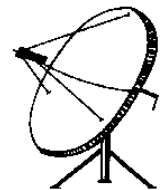
Scrounge, Barter and Trade



- “All you need to do is take it down”
- Typically from an estate or in-active ham and not maintained
- Un-know condition – **BEWARE !**
- Cost to hire a boom truck \$\$
- Cost to refurb components before installation \$
- Cost to repair damage to owner's property \$\$\$
- Injuries \$\$\$\$\$\$\$\$

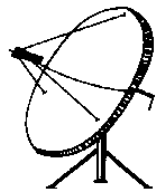


Danger Will Robinson !





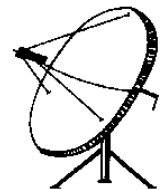
Required Safety Equipment



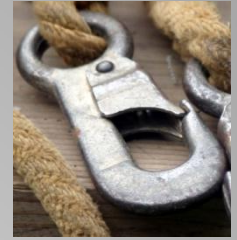
- Harness / Belt / Lanyard
- Steel Shank Boots
- Cell Phone / Walkie Talkie
- Hardhat
- Gloves
- Drinking water
- Safety glasses / goggles
- Suntan Lotion



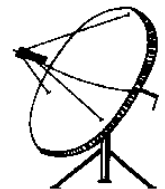
Required Safety Equipment



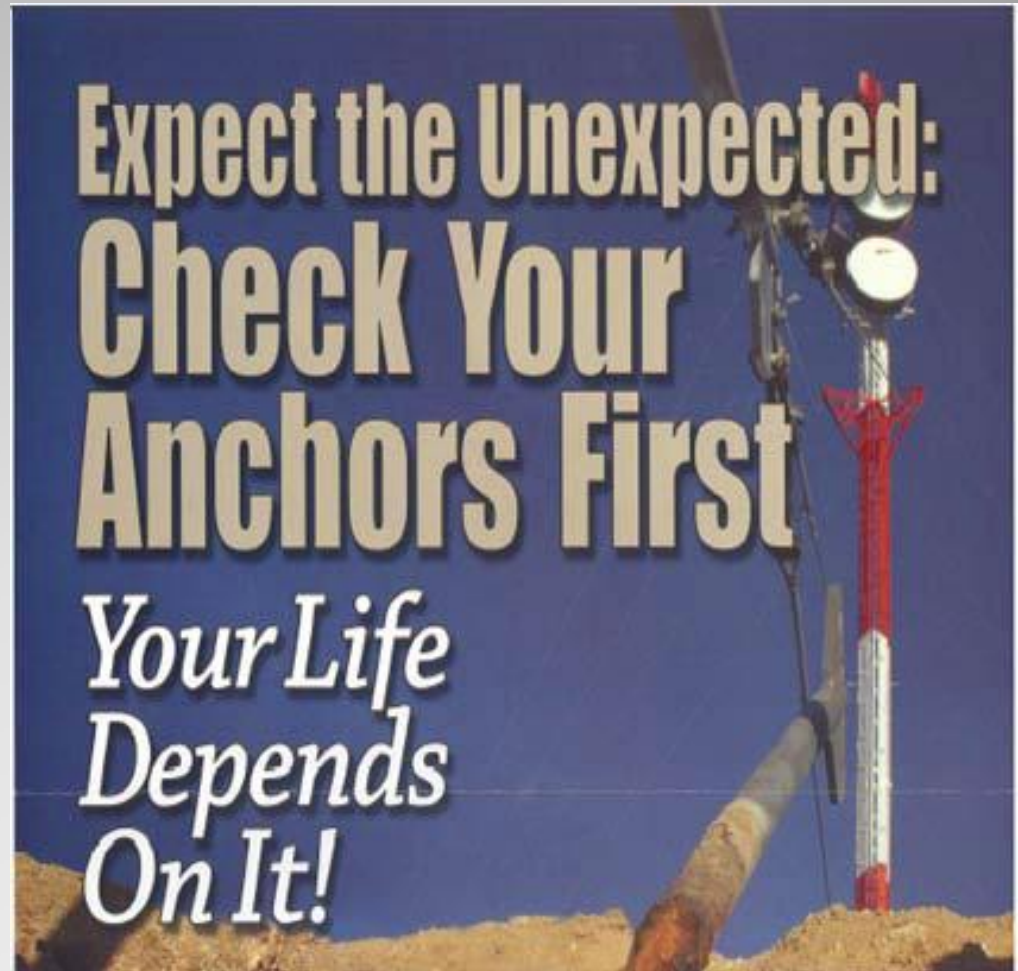
- Pull tests on all equipment
- Condition of harness and /or belt
- Properly operating mechanisms on clips, pulleys, come-along & gin poles



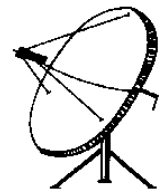
Checking your equipment



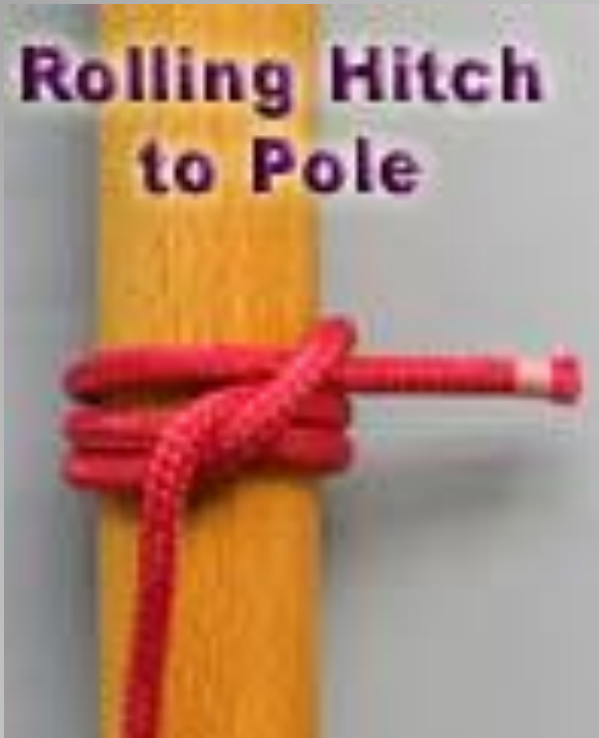
- National Association of Tower Erectors advertisement



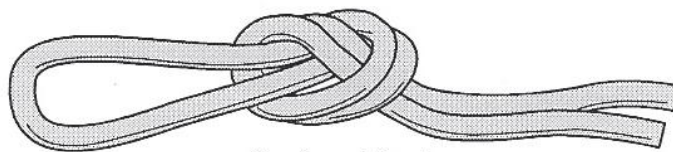
Do a Pre-Flight Inspection



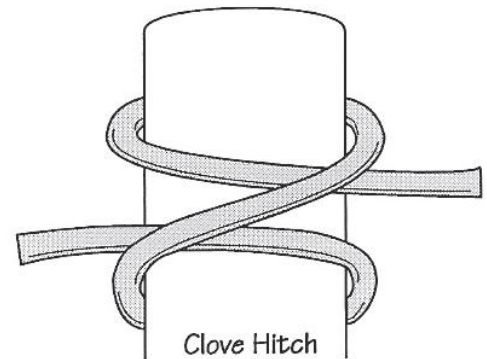
**Rolling Hitch
to Pole**



BOWLINE

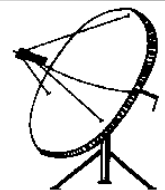


Overhand Knot
In The Middle of a Rope



Clove Hitch

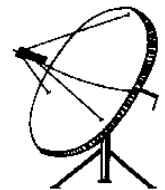
Learn Your Knots



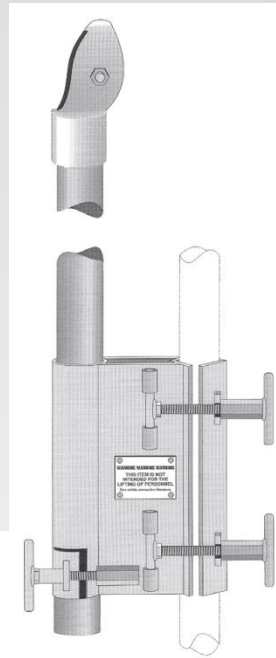
- The man on the tower is in charge
- Involved “staff” needs to understand the master plan
- Have a pre-climb pow-wow



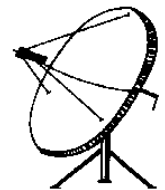
Support Staff



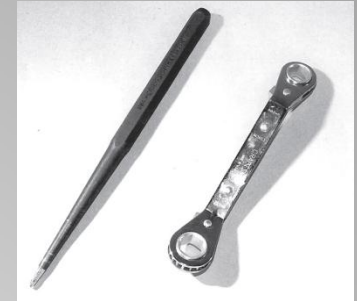
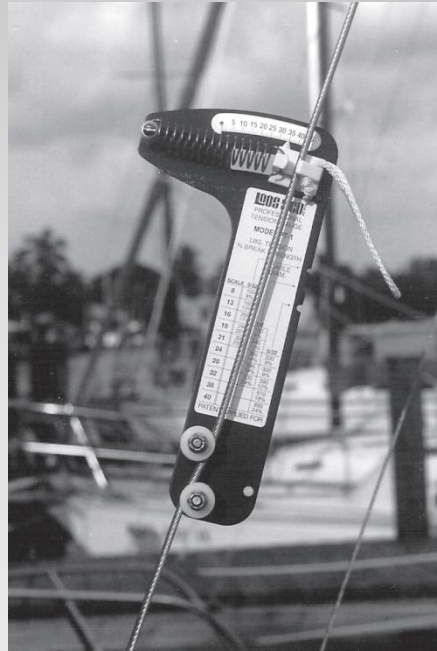
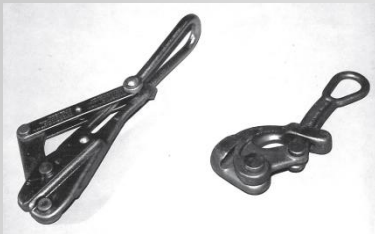
- Gin Pole and rope / cable
- Come-along / winch
- Tower work platform
- Tower Jack



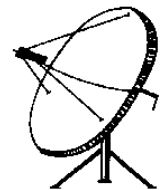
Tools



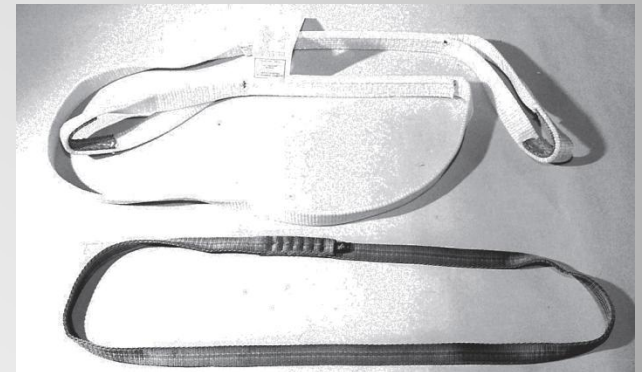
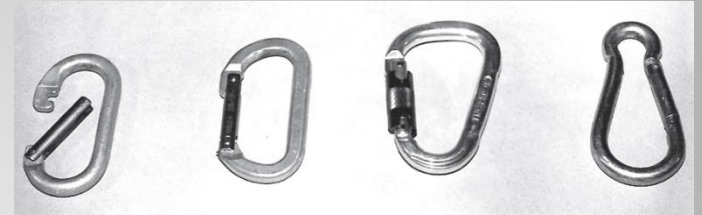
- Hand tools
- Tension meter
- Cable tensioner



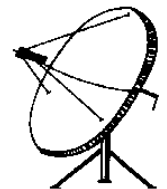
Tools



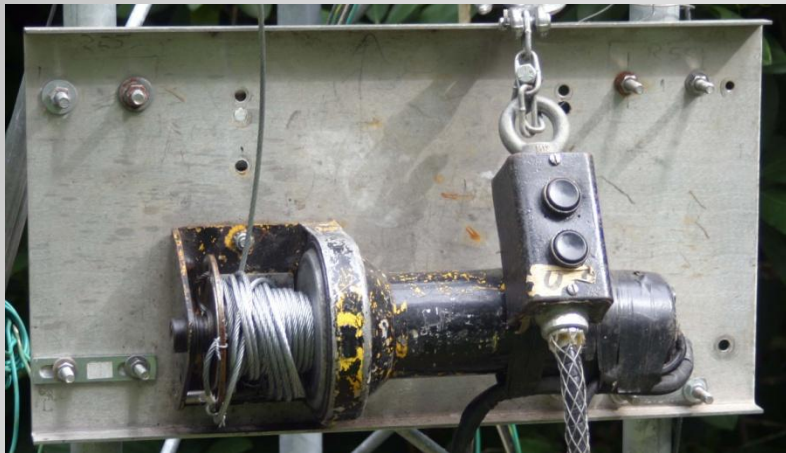
- Pulleys
- Carabineers
- Nylon lifting straps
- Gorilla hook strap



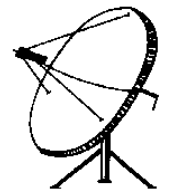
Tools



- An electric winch with remote operation will assist the climber in lifting sections and antennas.



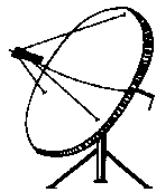
Electric Winch



- The electric winch can be used to safely jog the section into place using the remote control



Easy Does It



- When lifting heavy objects a 2nd rope/cable needs to be attached in the event of primary cable failure.
- Tether all hand tools to the tower with a short rope



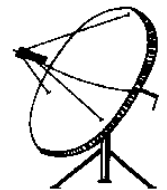
Secondary hoisting safety devices



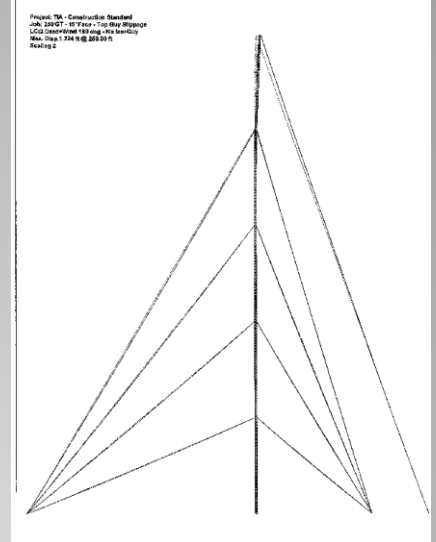
- Proper size and rating
- Use thimbles
- Install wire clips correctly
- Check tension of guy wires
- Add a safety wire to turnbuckles



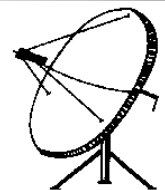
Guy Wires & Fittings

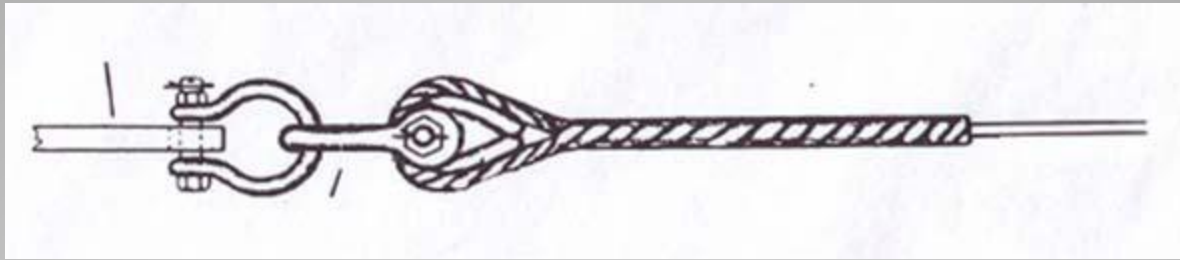


- Common Grade: 1,540 pounds
- Utility Grade: 2,400 pounds
- *Siemens-Martin Grade: 2,550 pounds*
- High Strength Grade: 2,850 pounds
- Stainless Steel Aircraft: 3,700 pounds
- Extra High Strength Grade: 3,990 pounds
- *Phillystran: HPTG4000 4,000 pounds*



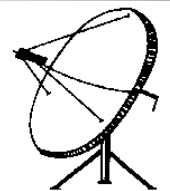
3/16" Guy Wire Specifications

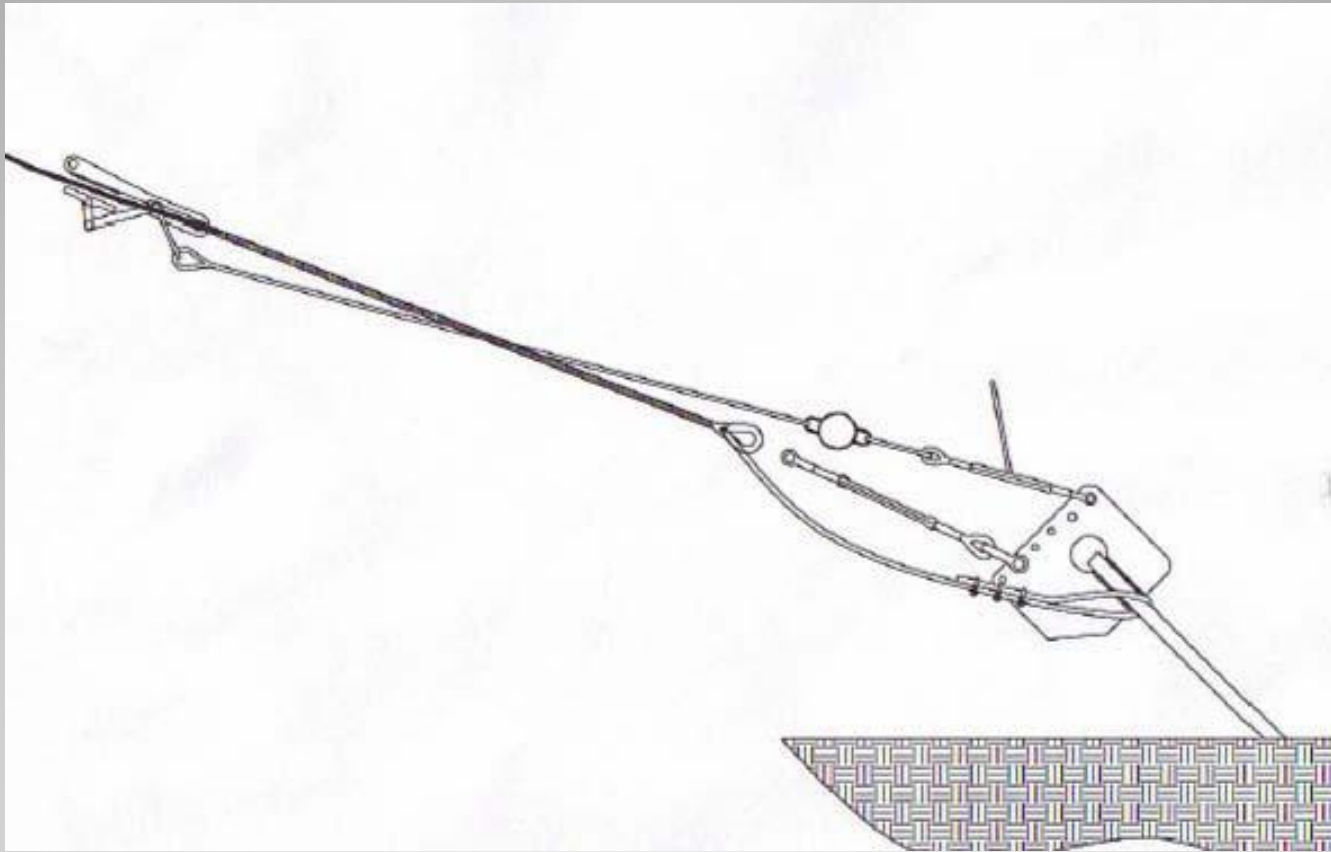




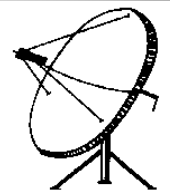
- 1/4" 6,650 pounds breaking strength
- 5/16" 11,200 pounds breaking strength
- 3/8" 15,400 pounds breaking strength

EHS - Extra High Strength wire





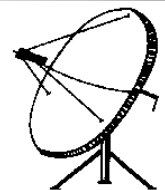
Tensioning the Guy Wires

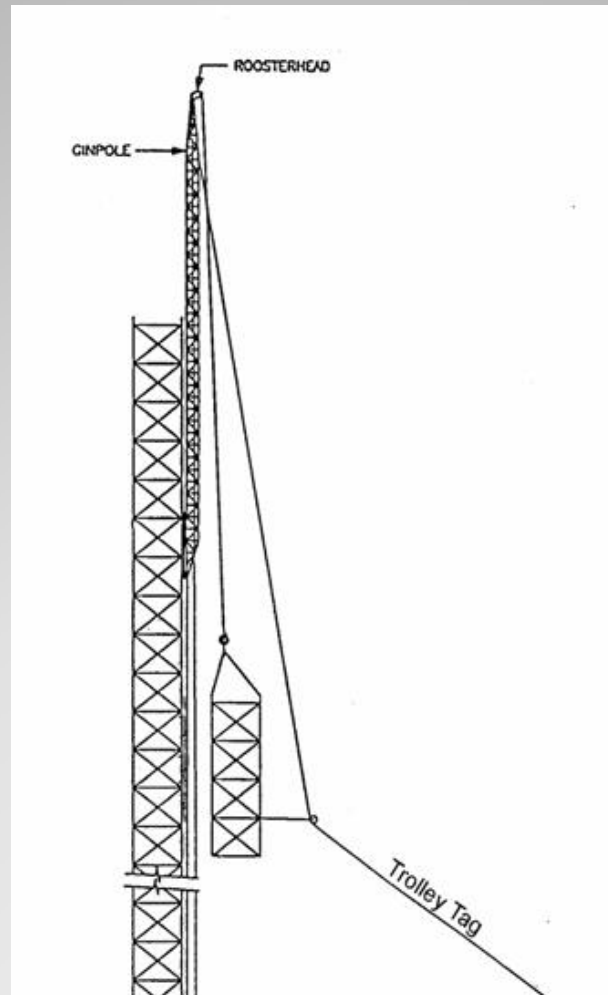


- Gravity and the laws of physics always win !
- Always be connected to the tower in 2 places
- Do not get creative – follow Mfg recommendations and specs
- Use nylon safety straps

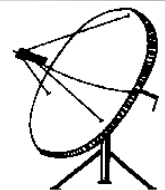


Raising the Tower





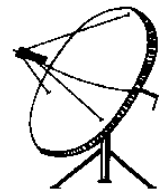
Lifting using a Trolley Tag Line



- Don't climb with anything in your hands
- Don't put any hardware in your mouth
- Remove any rings and/or neck chains
- Be on the lookout for bees, wasps and their nests
- Don't climb when tired
- Don't try to lift anything by yourself



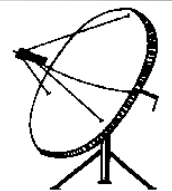
Climbing the Tower

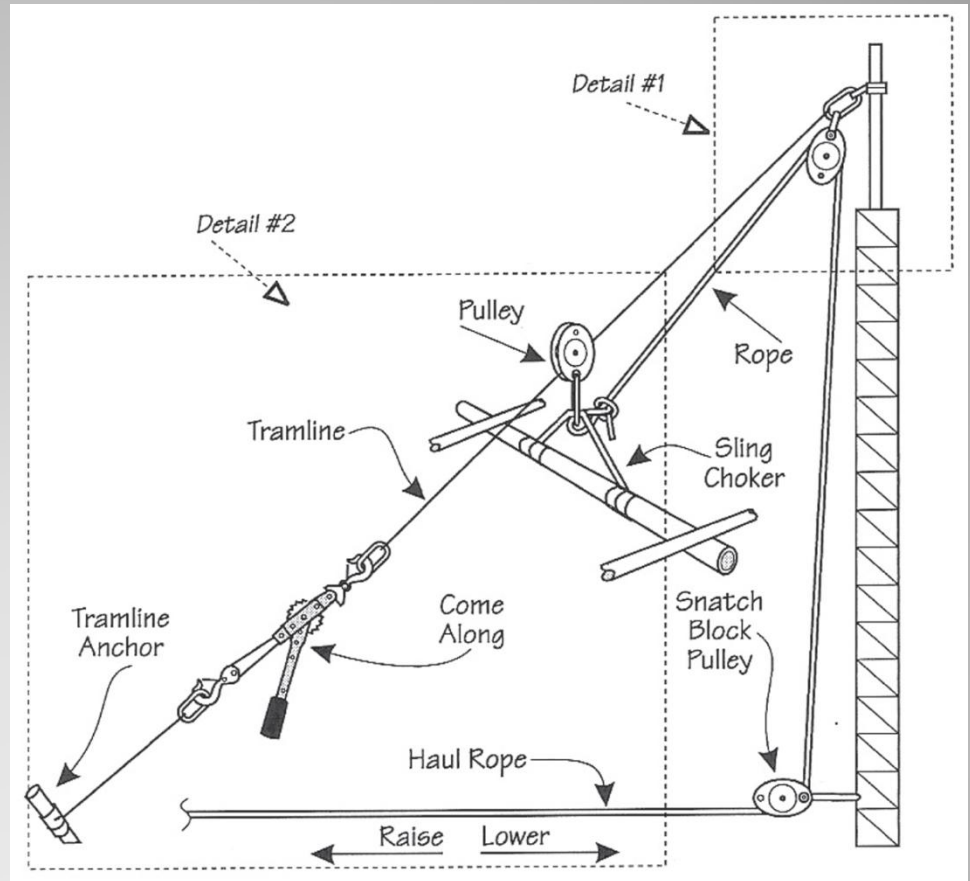
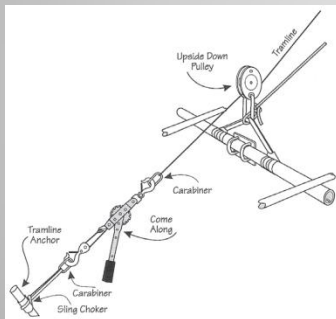
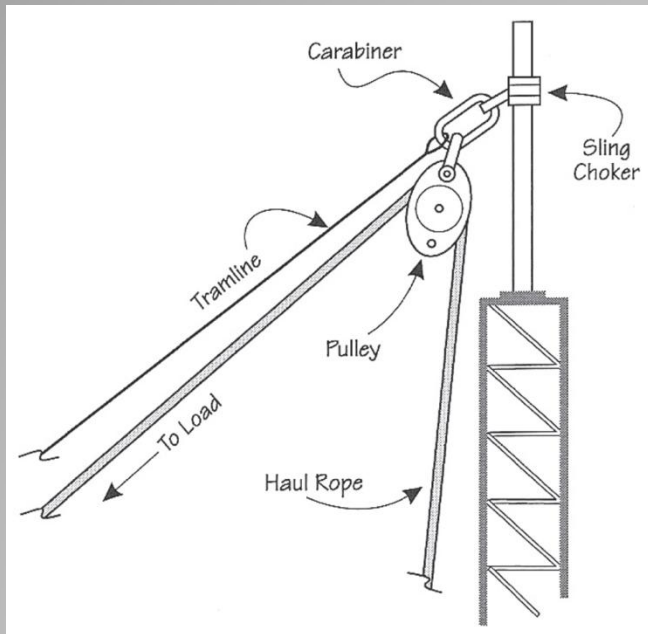


- Resting periods
- Use tag lines
- Use a tram for large arrays
- Employ redundant lift lines

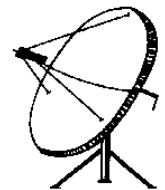


Installing Antennas

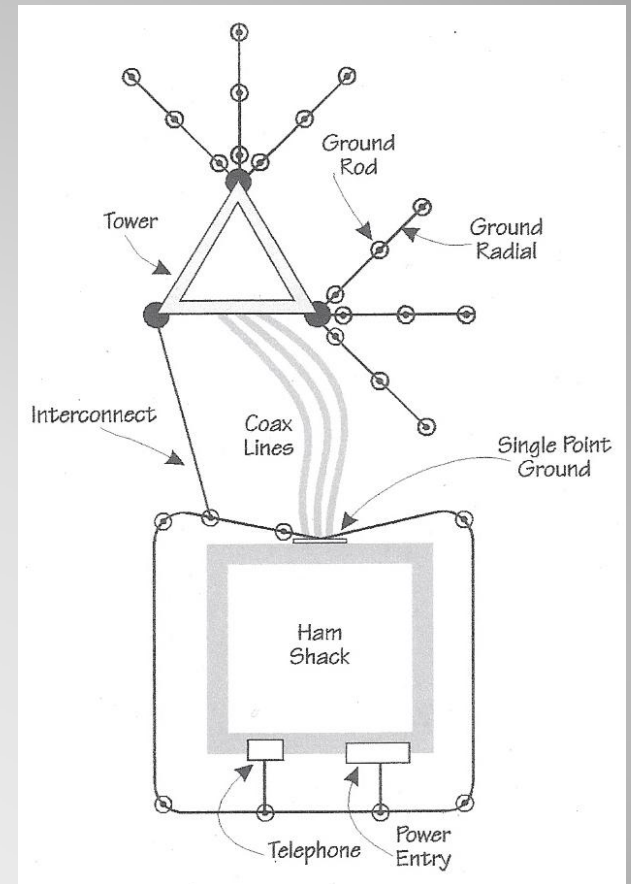




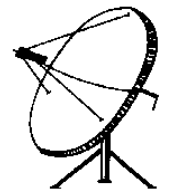
Tramline Schematic



- Do not forget grounding of tower & shack
- Lightning protection



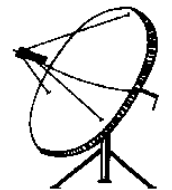
Additional Safety Preparations



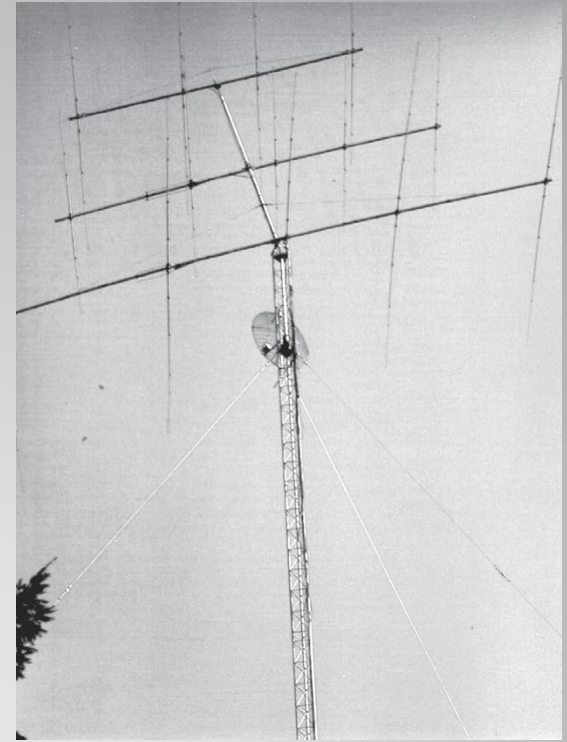
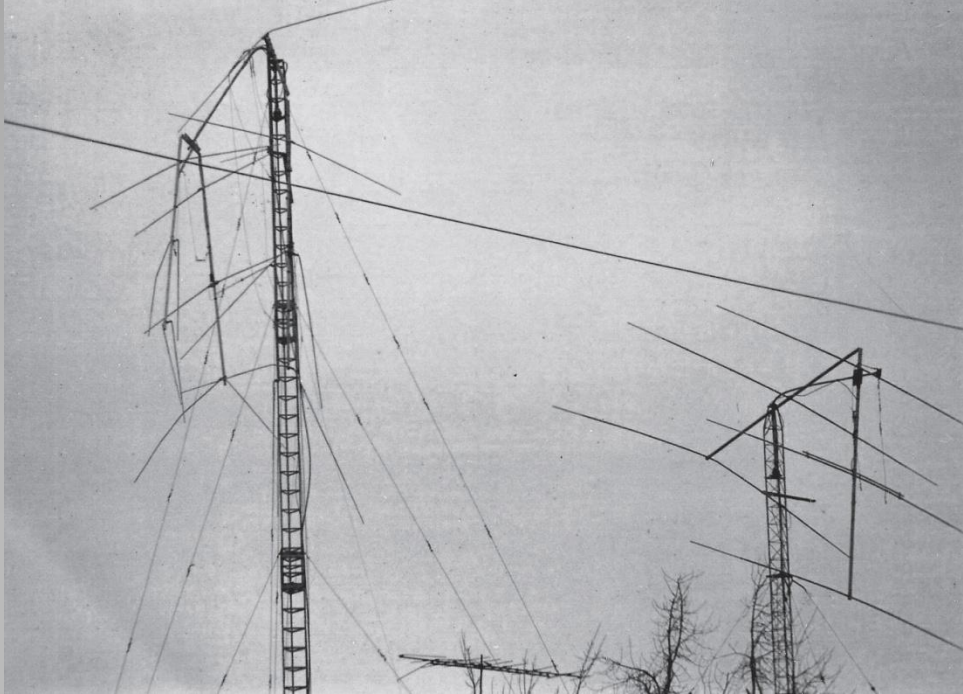
- Check the guy wire tension periodically
- Check guy clips
- Check tower leg bolts



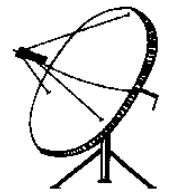
Maintenance



- Uh Oh ☹️



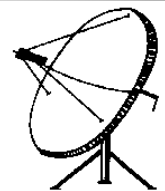
When Something Fails



- Whoops

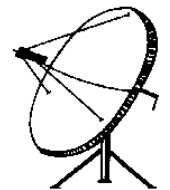


Failed guy rod anchor



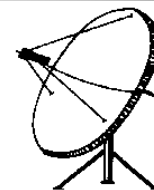
- Solid modeling techniques are useful to:
 - Layout a typical tower installation
 - Determine proper clearances in multiple antenna configurations
 - Determine feed-line lengths
 - Check side mounted antenna to guy wire interferences
 - Perform FEA – Finite Element Analysis

Using Solid Modeling (CAD)



- **Dick Knadle K2RIW** Post to reflector on 6.8.09
- **Steve Morris K7LXC** Book titled "Up The Tower" The complete Guide to Tower Construction
www.championradio.com
- **S. Khrystyne Keane K1SFA** Article QST 9.09 Keeping Safe: Tower Safety
- **Tim Duffy K3LR** email
- **Standards for Broadcast Structures** ANSI/EIA/TIA-222-G

Credits & References



- McMaster-Carr Supply
- Grainger
- Rohn Towers www.rohnnet.com
- Wilton W. Wilcox, Jr., "Tower Climbing Safety and Rescue" ComTrain LLC
www.comtrainusa.com

References

