TREE SUPPORT
&
LIGHTNING PROTECTION
CHAPTER 9

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Objective 1

Identify when a tree might be helped by the installation of cables, guys, bracing rods, or props.

Why Tree Support?

- ***Codominant stems***: **forked stems nearly the same size in diameter, arising from a common junction and lacking a normal branch union**

http://www.forestryimages.org

Why Tree Support?

- Split or decayed branch unions

http://www.forestryimages.org

http://www.treerot.com

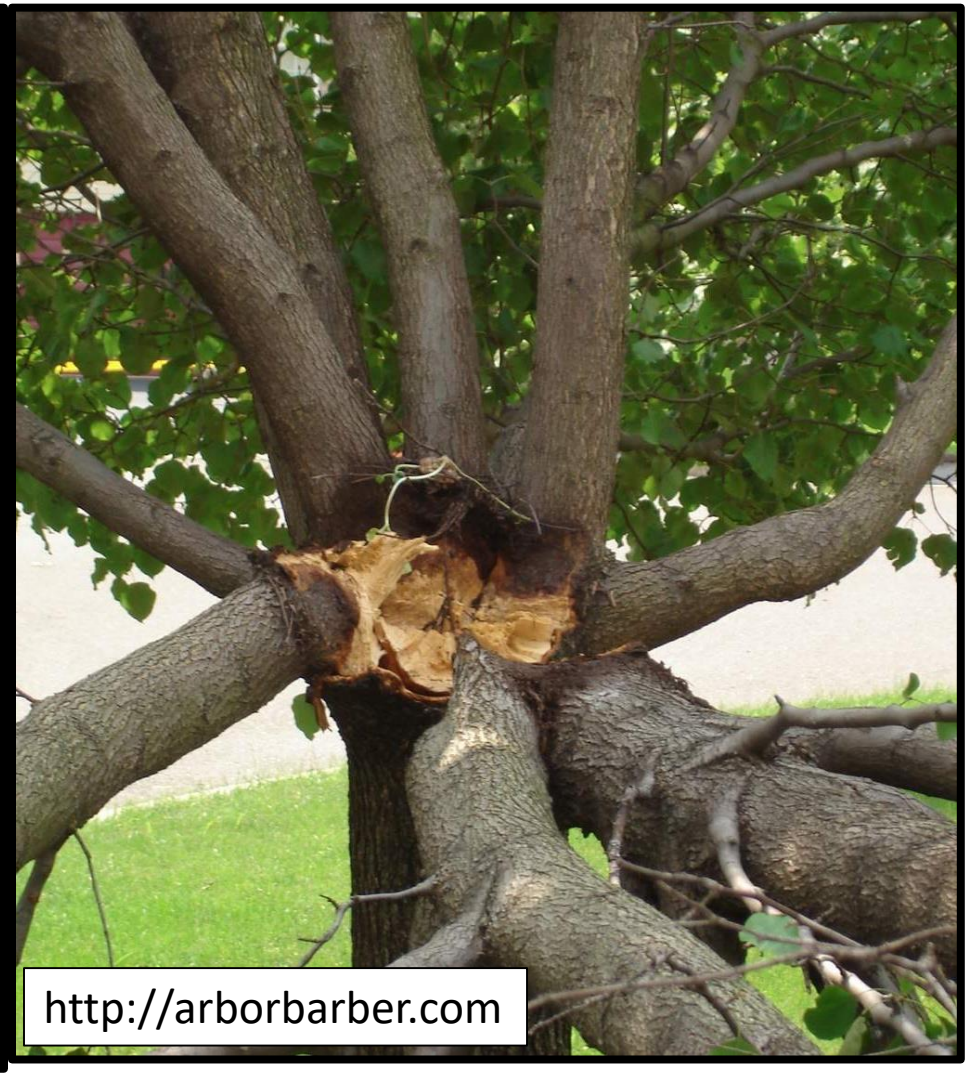
Why Tree Support?

- branch unions with included bark

http://www.forestryimages.org

Why Tree Support?

- multi-stemmed trees

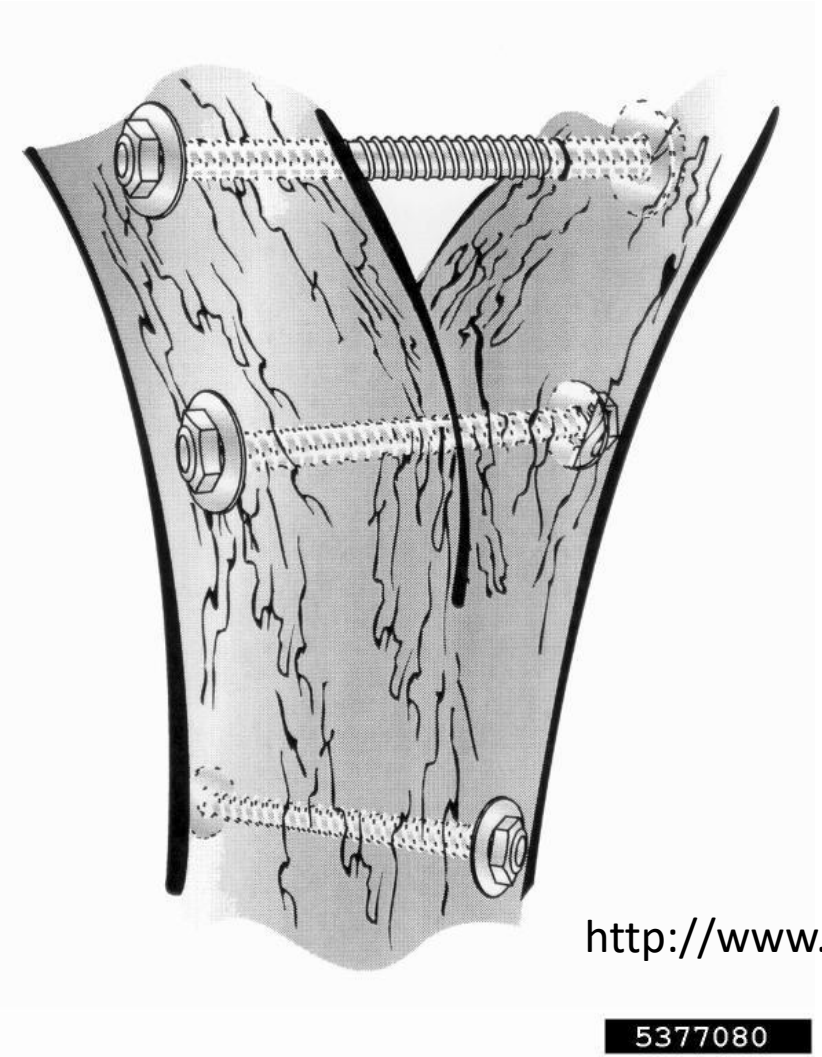


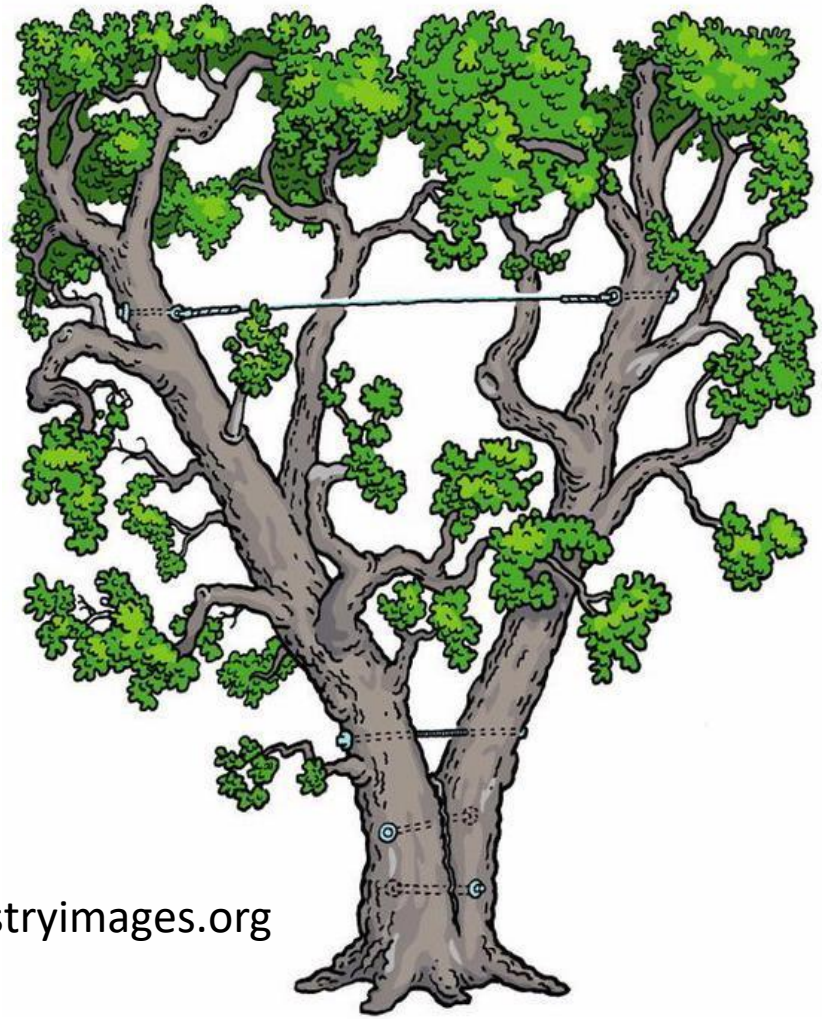
Why Tree Support?

- branches that pose potential threat to property or people

Why Tree Support?

- **reduce the risk of mechanical failure to an acceptable level**





http://www.forestryimages.org

Why Tree Support?

- extend the life of a tree

<u>Objective 2</u>

Recognize the limitations of cabling and bracing systems.

Tree Support Limitations

- **tree risk assessment must be done prior to installation of support system, so knowledge and qualification in this area required**

Tree Support Limitations

- root system must be structurally sound

Tree Support Limitations

- excessive decay should not be present

Tree Support Limitations

- tree or limb may be better off pruned or removed

Tree Support Limitations

- **cannot *eliminate* risk/hazard potential**

http://tomlinsonbomberger.com

http://www.mntreesurgeons.com

- **reactive response to wind could be altered by hardware & new wounds may lead to decay**

Objective 3

Explain the different ways trees can be supported with cables, braces, or guying hardware.

<u>Objective 4</u>

Describe the techniques and materials used in cabling and bracing.

Tree Support Systems

***Static cable system*:**

- **cabling system that utilizes rigid materials such as rods & steel cable to limit movement of limbs with weak branch unions or to provide constant support of heavy limbs**
- **installed by connecting two or more limbs**
- **successfully installed in North America, England, & Australia for decades**

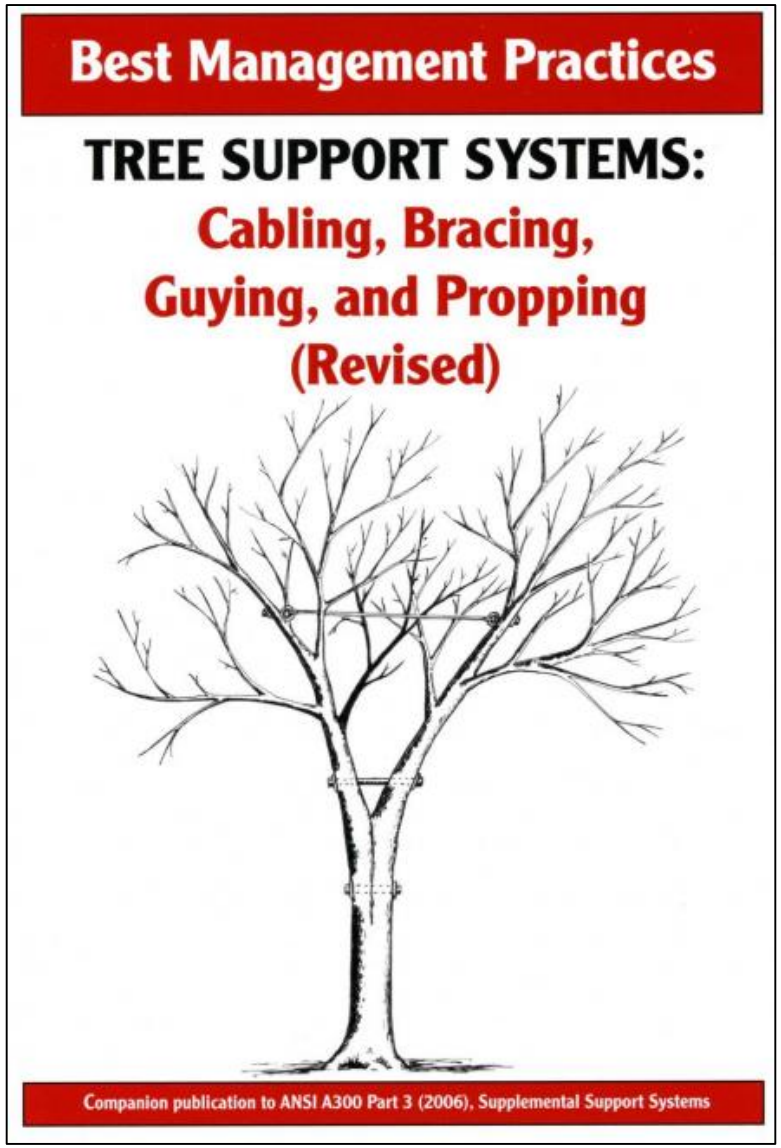
Cabling Hardware

- different sizes and types
- selected based on size of limbs, weight to be supported, & presence of decay
- if inadequate support system may fail
- Use ANSI A300 (Part 3)-2013, Revision of ANSI A300 (Part 3)-2006: Standards for Tree Support Systems, to specify the minimum hardware sizes for various limb sizes

Minimum hardware sizes for cabling trees:

Max Limb Diameter (at anchor attachment point) inches	Estimated Load (lbs)	Lag Hook (diameter in inches)	Eye Bolt (diameter in inches)	Amon nut/Loop nut (threaded rod diameter in inches)	Common Grade Cable (galvanized 1x7) diameter in inches	EHS Cable (1x7) diameter in inches	Aircraft Cable (galvanized 7x19) diameter in inches
2	100	1/4	1/4	1/4	1/8	3/16	1/8
3.5	200	5/16	1/4	1/4	3/16	3/16	1/8
5	300	3/8	1/4	1/4	1/4	3/16	1/8
8	600	1/2	5/16	5/16	5/16	3/16	3/16
10	900	5/8	3/8	3/8	3/8	1/4	1/4
15	1000	N/A	3/8	3/8	7/16	1/4	1/4
18	1200	N/A	3/8	3/8	1/2	1/4	1/4
20	1400	N/A	1/2	7/16	1/2	5/16	1/4
24	2200	N/A	1/2	1/2	N/A	5/16	3/8
28	3300	N/A	5/8	5/8	N/A	7/16	1/2
30	3700	N/A	N/A	7/8	N/A	7/16	1/2

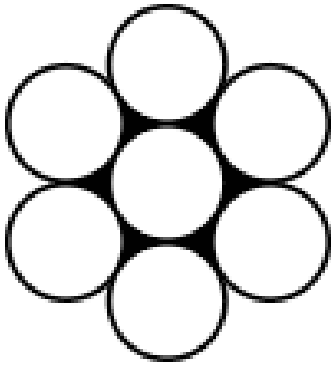
Cabling Hardware



Cabling Hardware

7-strand, common grade cable:

- steel cable with 7 strands twisted together in a spiral pattern
- relatively malleable (bendable) & easy to work with
- commonly used in North America to add supplemental structural support to trees
- terminated by wrapping onto itself using an eye splice



1x7 Strand

Cabling Hardware

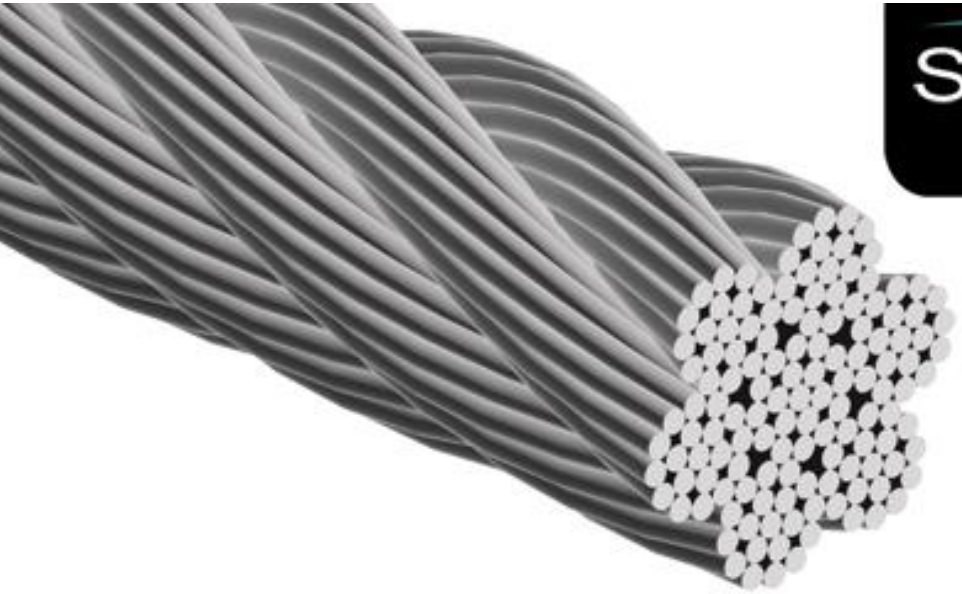
Extra-high-strength (EHS) cable:

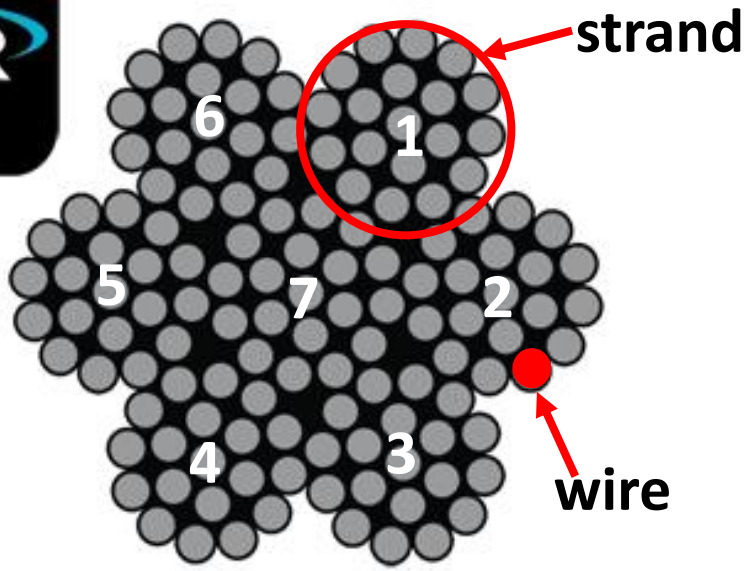
- **type of 7-strand steel cable, often used to cable trees**
- **stronger but less flexible than 7-strand common grade cable**
- **commonly used in North America**
- **must be terminated with dead-end tree grips or a manufactured cable termination (cable stop)**

Cabling Hardware

Aircraft Cable:

- steel wire rope of various constructions designated by the number of strands in the rope & the number of wires in each strand
- Commonly made of 7 strands of 19 galvanized wires
- strong & flexible
- limited choices for attachment
- widely used in cabling in Australia, New Zealand, & the UK



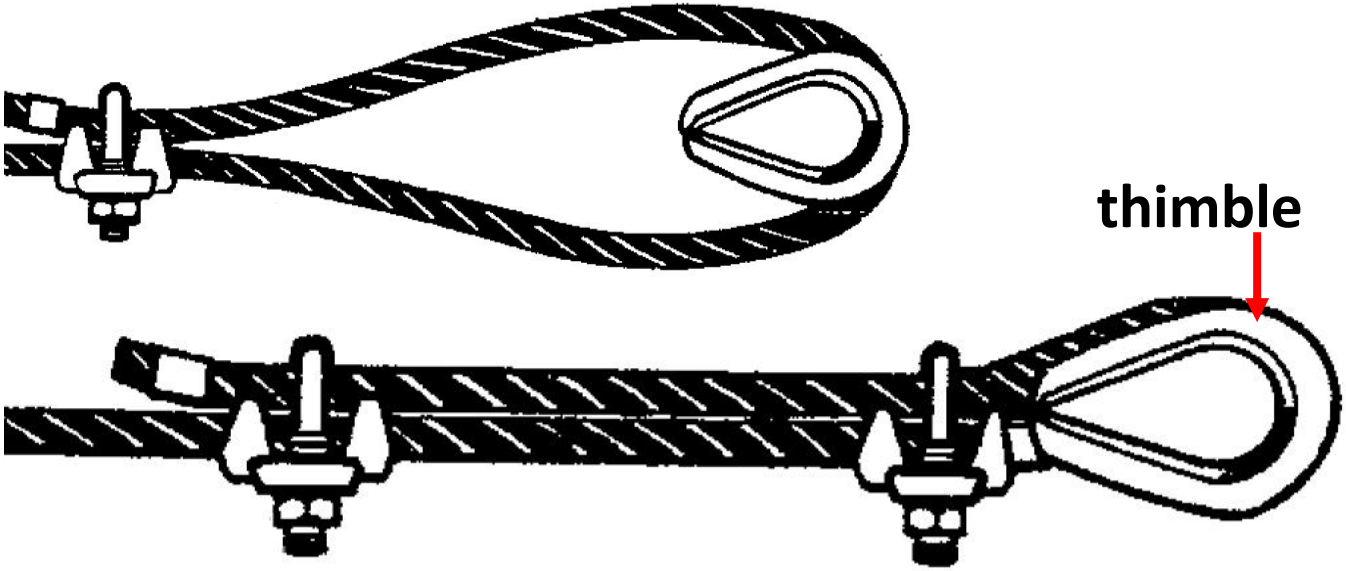


Cabling Hardware

Installation of Aircraft Cable:

- slide a metal swage (a sleeve type fitting used to terminate a wire rope or cable) of the proper size onto the cable
- wrap the cable around the thimble & back through the swage
- position & compress the swage
- cut off any excess cable prior to fastening the swage
- terminate by crimping the swage tightly to the cable

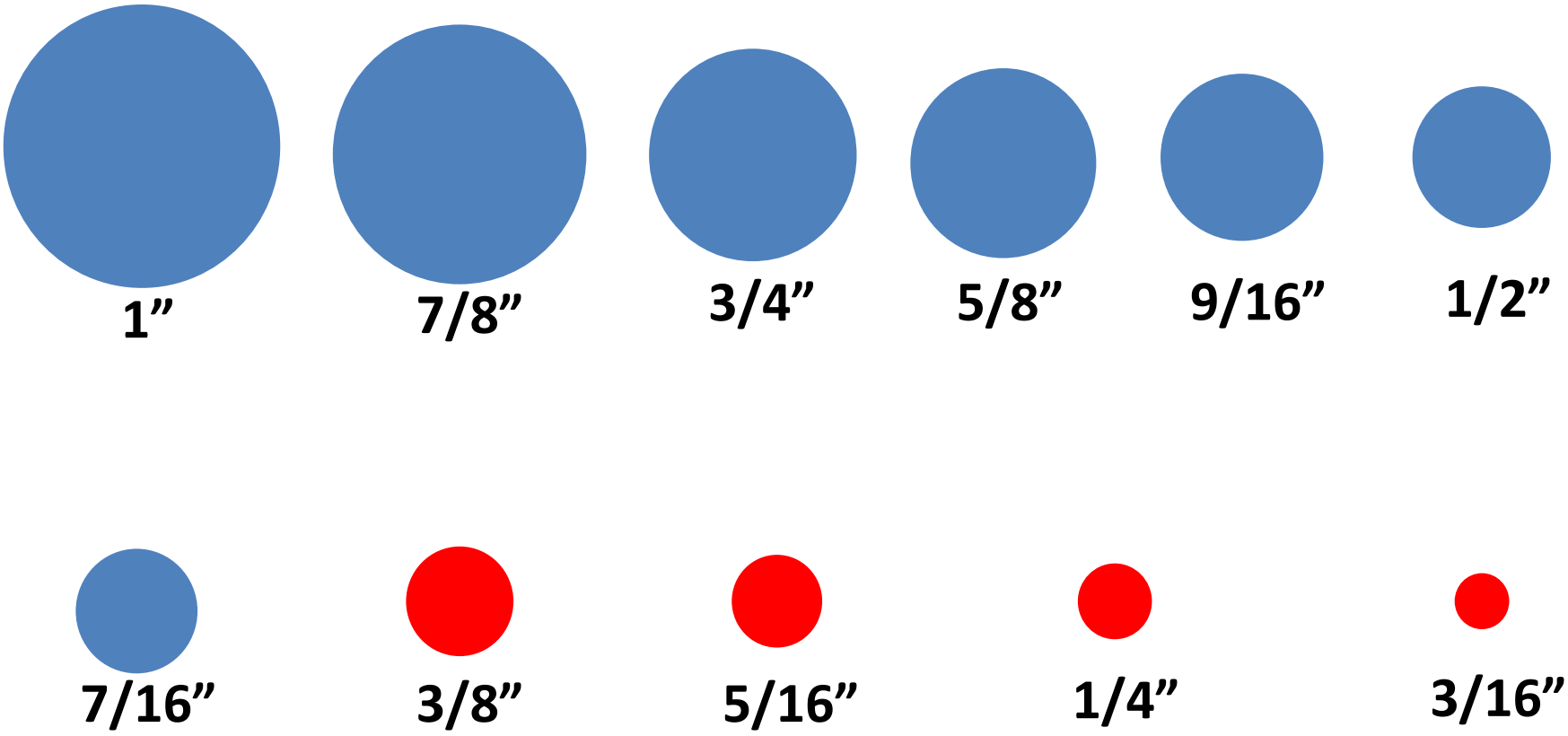
swage



Cabling Hardware

***<u>Cable Sizes commonly used in trees</u>*:**

3/16 to 3/8 inch



Cabling Hardware

Anchor hardware:

- **Preferred hardware to which the cable termination is affixed in a cabling or guying installation**
- **passes through the tree limb & is fastened on the opposite side**
- **Types: eye bolts, threaded rods with amon-eye nuts, lag eyes, lag hooks, and J-hooks**

Cabling Hardware

***Eye bolts*:**

- **cable anchors with a closed eye, usually machine threaded**
- **only drop-forged are accepted & approved for tree support systems in the US**

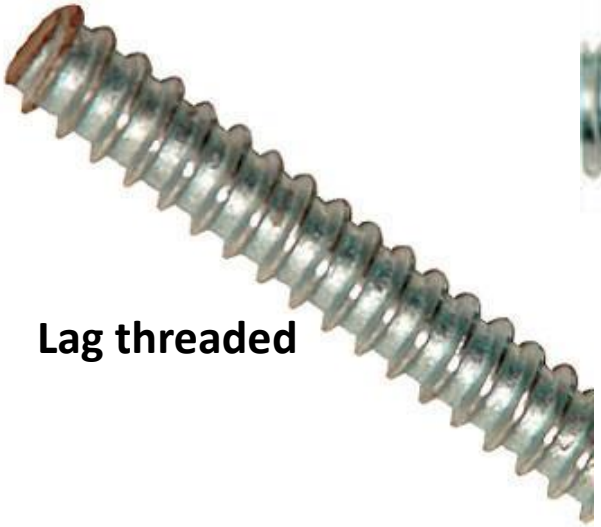
Drop-forged:
-metal working process where a hammer is raised & then “dropped” onto the workpiece to form it to the shape of the die
-produces a piece that is stronger than an equivalent cast or machined piece

http://www.sherrilltree.com/

Cabling Hardware

Threaded rods:

- metal rod used to support weak sections or crotches of a tree
- AKA: bracing rod
- drop forged
- length of rod can be adjusted easily for any job
- used with amon-eye nuts



Lag threaded

Machine threaded

Cabling Hardware

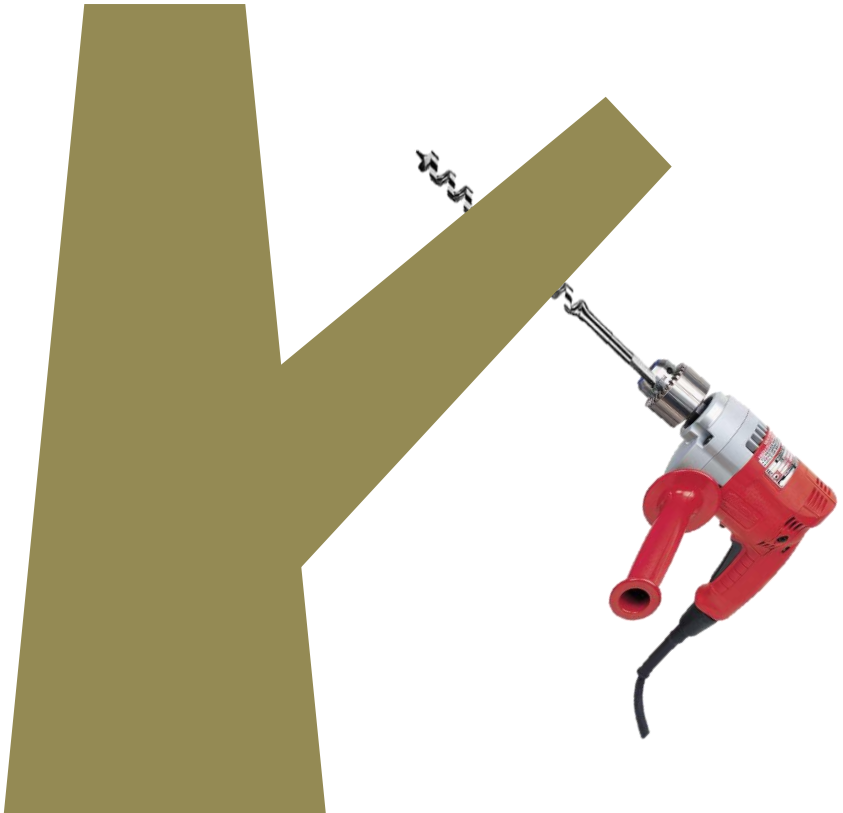
Amon-eye nuts:

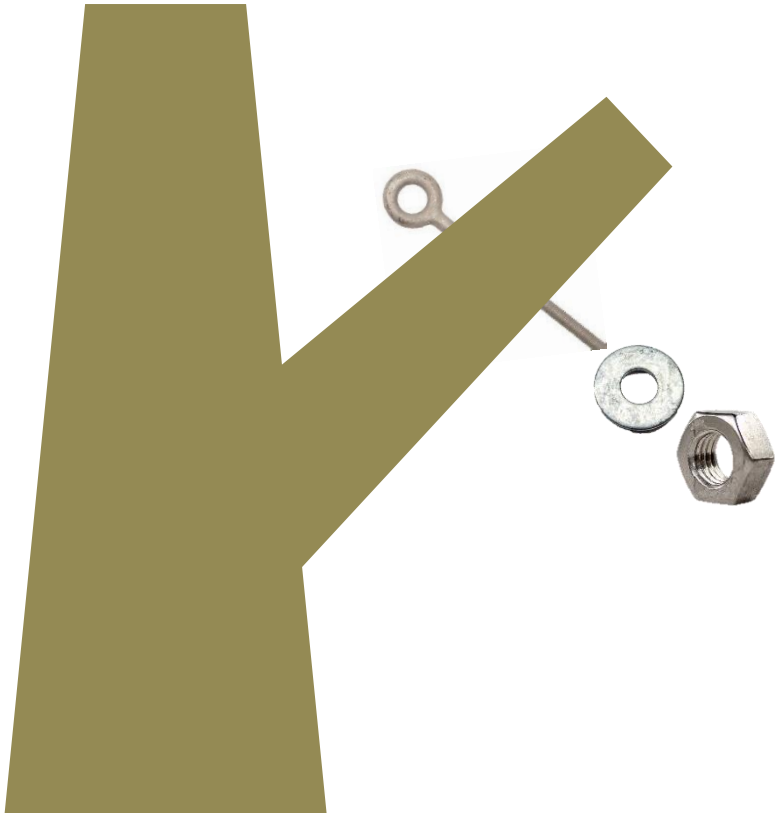
- **specialized nut used in cabling trees that have a large eye for attaching a cable to a threaded rod**

Cabling Hardware

<u>Installing Eye Bolts or Threaded Rods with Amon-eye Nuts:</u>

- **drill hole 1/16”-1/8” larger than the hardware being installed completely through the limb being cabled**
- **install eye bolt or threaded rod with a round washer & nut on outside end**





Cabling Hardware

Installing Eye Bolts or Threaded Rods with Amon-eye Nuts:

- **seat washer directly against bark (on thick barked trees, chisel away the bark or drill to countersink the washer against but not into the sapwood)**
- **to prevent unscrewing, peen (bend, round, or flatten the end of through-hardware to prevent the nuts from backing off) the exposed threads on the end of the eye bolt, as well as both ends of the threaded rod used with the Amon-eye nut**

Chiseled bark

http://illinoisarborist.org

Peened threads

Cabling Hardware

Lag eye:

- **lag-threaded drop-forged cable anchor with a closed eye**
- **dead end hardware**

Cabling Hardware

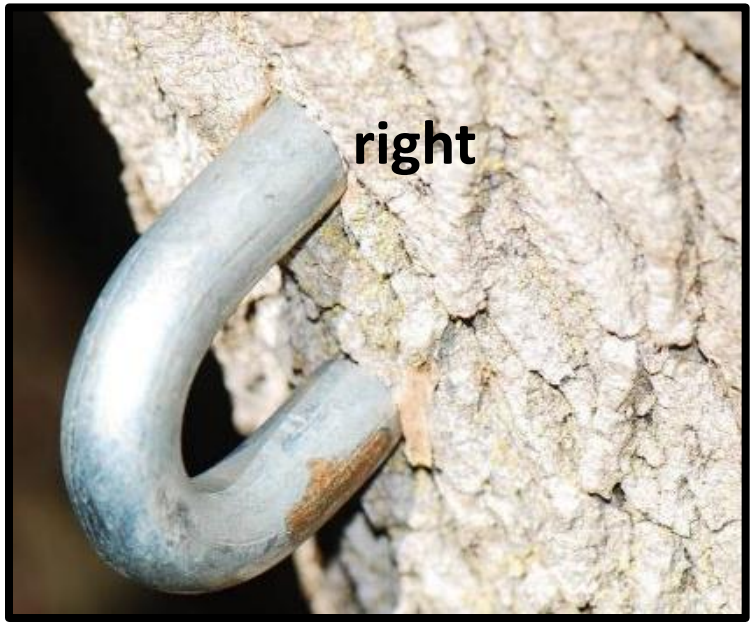
Lag hook (J-hook):

- **lag-threaded drop-forged cable anchor with an open eye in the shape of a "J"**
- **dead end hardware**
- **comes with right & left handed threads so that when each end is twisted into the branch to tension the cable, the cable will not come unlaid or unwound**
- **standard lag sizes used in tree cabling are 5/16, 3/8, 1/2, & 5/8 inch diameter**

Cabling Hardware

Installing Lag Hooks (J-hooks):

- **pre-drill a hole 1/16 to 1/8 inch smaller in diameter than the lag**
- **screw the lag into the tree so that the J-loop is vertically positioned (facing up or down) with the open end just barely contacting the bark**
- **if installed at an angle that will prevent screwing it in completely, it may be preferable to install an eye bolt or other anchoring hardware**



Cabling Hardware

Use of Lags:

- **lags are usually considered the weakest portion of a cable system**
- **if not properly installed, can pull out of tree when it moves**
- **work well on small limbs & trees with strong, decay-resistant wood**

Cabling Hardware

Do Not Install Lags:

- **in limbs greater than 8”-10” in diameter**
- **in limbs with decay (limits holding capacity & spreads decay into healthy wood)**
- **if full length of threads cannot easily be seated into the limb**

Cabling Hardware

Washers:

- **used to anchor eye bolts & threaded rods when installing cables**
- **heavy duty, heat treated, round washers are recommended due to the larger diameter, thicker metal, & increased metal strength reducing the risk of the nut pulling through the tree**

http://www.sherrilltree.com

Cabling Hardware

***Thimbles*:**

- **a device used to form & protect the termination loop in the cable when attaching the cable to its anchoring hardware**
- **increase the bend radius of & reduce wear & tear on a rope when attached to hardware**
- **always used when forming an eye in the end of common-grade, 7-strand cable**
- **galvanized or stainless steel heavy-duty recommended**

Stainless steel

Galvanized

http://www.sherrilltree.com

Cabling Hardware

Installing Thimbles:

- use right size for cable
- if anchoring hardware connection is closed, as with the eye bolt, bend open thimble, insert through hole, & then close for cable application
- if bend is too tight, cable will be weakened
- if practical, use same type of metal throughout system to avoid corrosion

http://outonalimbseattle.com

Cabling Hardware

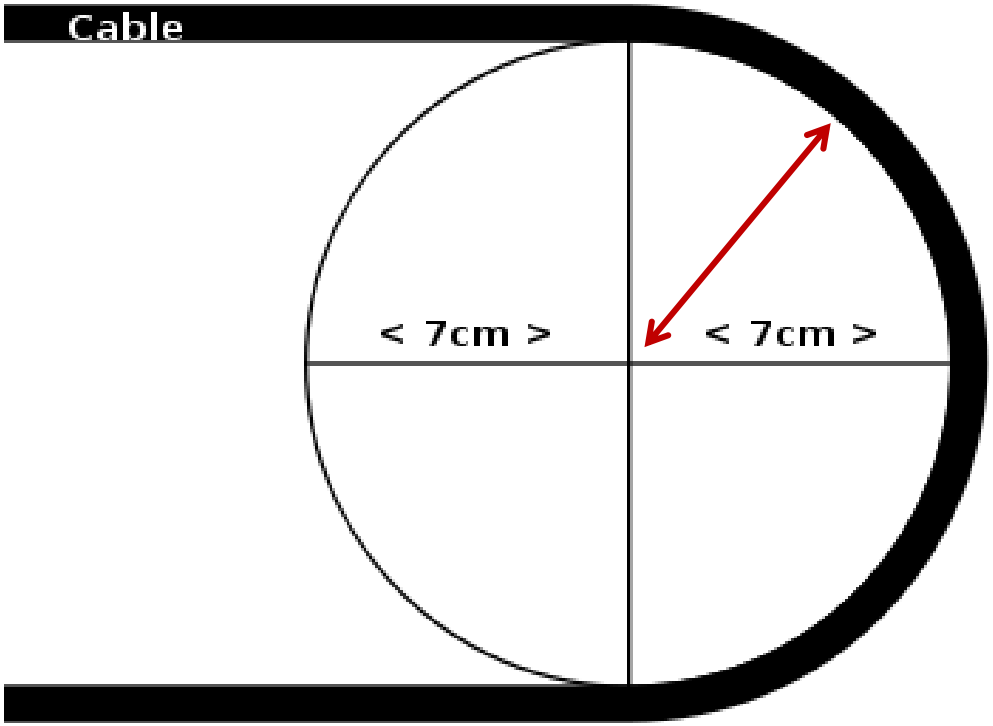
Use of Thimbles:

- **Purpose is to protect cable from abrasive wear & increase the cable's bend radius**
- **soft, common-grade cable installed directly on hardware may eventually cause wear & cable breakage due to the steel-to-steel contact & abrasion**

http://content.aviation-safety-bureau.com

bend radius:

- radius of an object around which a line passes
- measured to the inside curvature, the minimum radius one can bend a cable without kinking it, damaging it, or shortening its life



Cabling Hardware

***Eye Splice*:**

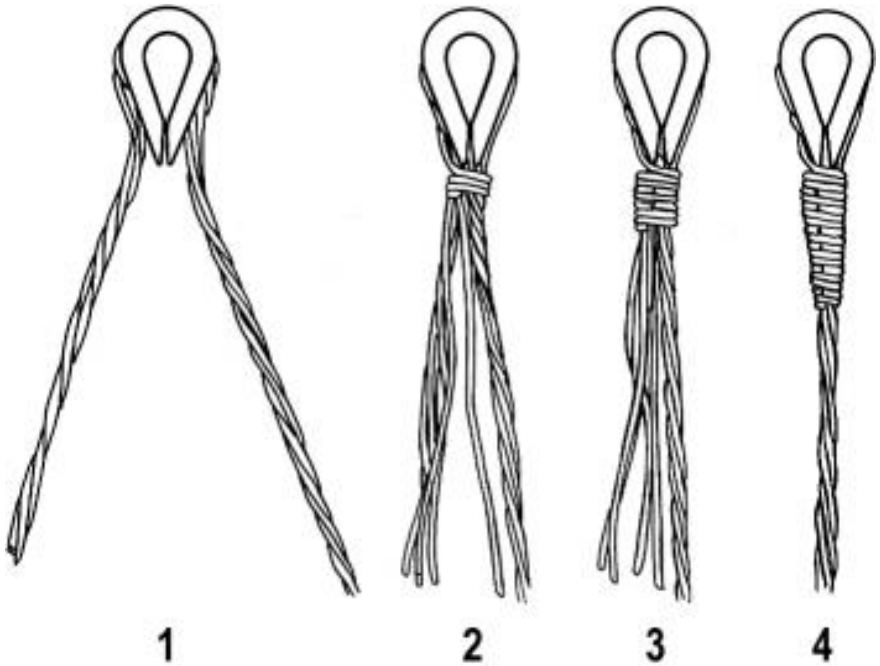
- **a splice that forms a closed eye or termination loop**
- **hand formed in common-grade cable by wrapping the successive strands back upon the standing part to attach the cable to anchor hardware**
- **always use a thimble when forming**

http://www.sv-mom.com/

Cabling Hardware

Installing an Eye Splice:

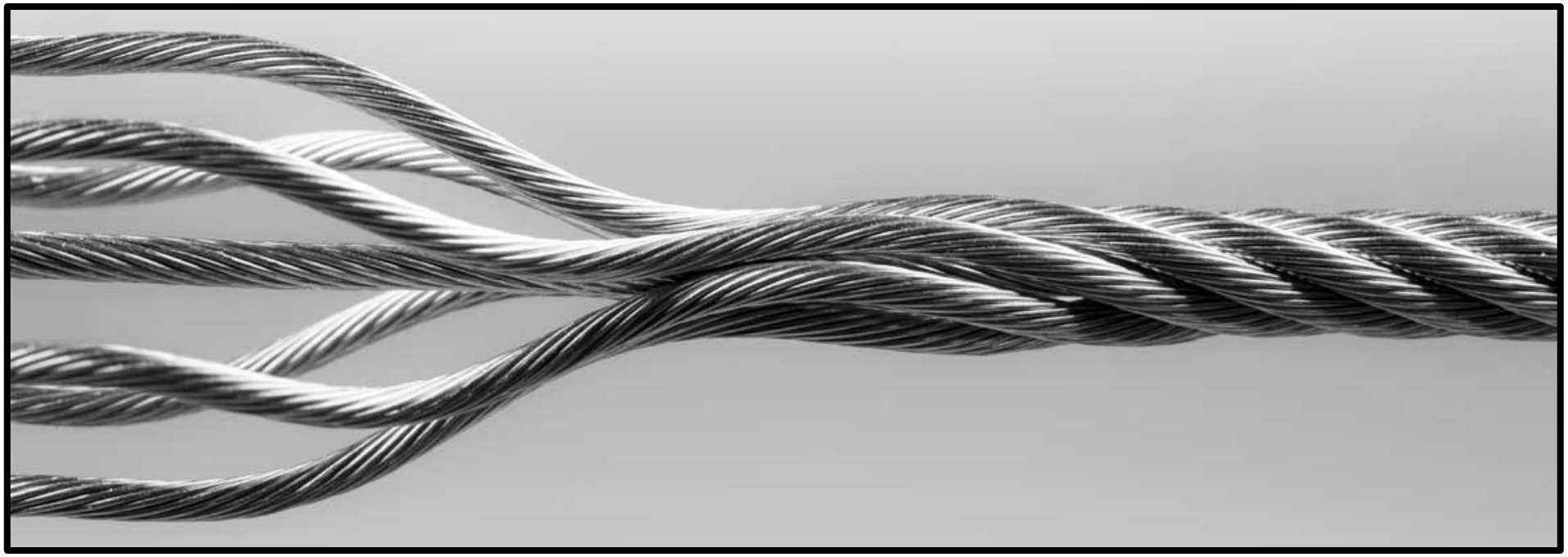
- **wrap the end of the cable around the thimble & then separate the cable strands**
- **individually wrap each strand around the cable with at least two complete turns per strand in the same direction**
- **the finished splice will have a neat appearance & provide optimal holding power**



Cabling Hardware

<u>Do Not Use an Eye Splice on EHS Cables:</u>

- **EHS cables are not malleable enough to form an eye splice**
- **a Dead-end Grip or a manufactured cable termination is required to form a termination at the end of 7-strand EHS cable**



Cabling Hardware

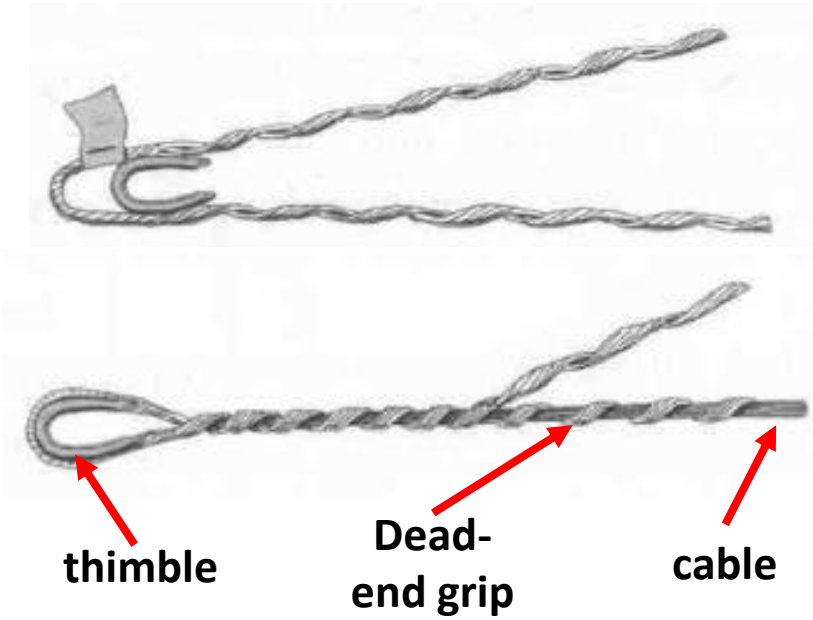
***Dead-End Grip*:**

- **cable-termination device that must be used to terminate EHS tree support system cable to anchoring hardware**
- **a manufactured spiral-wrap design**
- **install over heavy-duty thimbles to reduce wear on the grip hardware**

Cabling Hardware

Installing Dead-End Grips:

- **place the thimble in the dead-end grip**
- **wrap one side of the grip onto the EHS cable**
- **wrap the second side, fitting it between the wraps of the first side**
- **both ends should be completely wrapped & in contact with the cable when finished**



Cabling Hardware

Use of Dead-End Grips:

- **not designed to withstand high dynamic loads created by large branches twisting & swaying**
- **gusting & excessive winds can cause bending & twisting, leading to metal fatigue & failure**
- **consider the wind conditions & potential for twisting prior to installing**

Cabling Hardware

***Cable Stop*:**

- **manufactured cable termination**
- **metal knobs that can be affixed to the ends of steel cable strands to terminate a cable installation**
- **larger than the hole, therefore not allowing the cable to retreat**
- **acceptable as long as they meet strength requirements of applicable standards**

http://www.wesspur.com

Cabling Hardware

Installing Cable Stops:

- **Drill hole 1/16” larger than cable, completely through the trunk/branch to be cabled**
- **Insert cable through trunk, leave excess of 6” outside trunk to place the cable stop over**
- **Slide cable stop onto cable (small hole toward tree), & twist cable strand counterclockwise**
- **Insert tapered piece over center wire (small end toward tree), & pull cable strand & cable stop tight to tree**
- **Bend middle wire over**

http://www.wesspur.com