

# 3 ROPE BRIDGE PROJECT

TROOP 2

11-18-06 .

11-15-08

# CONTENTS

<b>1 Objective</b>	1
<b>2 Itinerary</b>	1
<b>3 Rules</b>	1
<b>Safety</b>	
<b>Other</b>	
<b>4 Basic Organization</b>	2
<b>5 Site layout</b>	3
<b>6 3-2-1 Anchorage</b>	4
<b>Drawing</b>	
<b>Direction tips</b>	
<b>Heavy post option</b>	
<b>7 Log &amp; Stake Anchorage</b>	6
<b>Drawing</b>	
<b>8 Trestles</b>	7
<b>'X' type</b>	
<b>'A' frame type</b>	8
<b>Direction tips</b>	
<b>9 Rope bridge</b>	9
<b>Layout</b>	
<b>10 Overall assembly</b>	10
<b>11 General</b>	14
<b>Whipping</b>	15
<b>Required knots</b>	16
<b>Lashing types</b>	21
<b>Lashing rope lengths</b>	24
<b>12 Scout / troop requirements</b>	25
<b>13 Tools</b>	26
<b>14 Supplies</b>	26

- 1 **OBJECTIVE:**  
Construct a 3 rope bridge spanning 20'  
completely from scratch

2 **ITINERARY**

8 to 9	Breakfast
8:15 to 9	Site selection (see organization)
9 to 11	Bridge project
11 to 1	Lunch
1 to 3	Special Webelo activities
3 to 4	Competition / activity
4:30	Dark

3 **RULES**

**Safety = TOP PRIORITY**

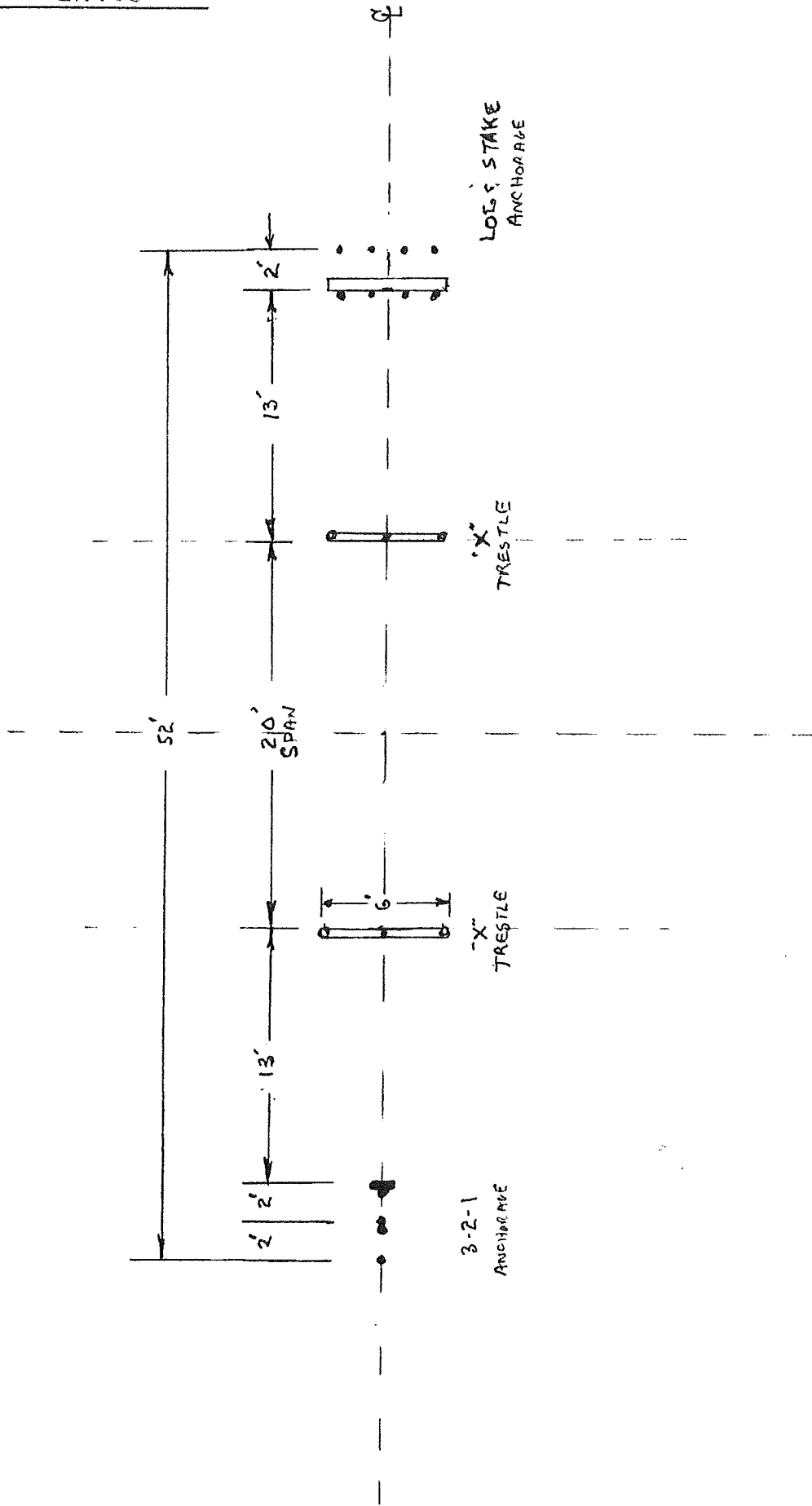
- No horse play while working
- No horse play while crossing bridge
- One person at a time on the bridge
- Stand clear of the tension ropes and anchorages in case something lets go
- Watch anchorage potential energy
- Watch twisted ropes could launch a hold spike if kicked etc
- Stake hatchet safety
- Safety zone for sledge hammer swinging
- Lashings tight
- Proper knots used

**Other**

- Leave no trace practices
- Measure twice, Cut once



# 5. SITE LAYOUT



SCALE 1/8" = 1'-0"  
J. KURSZ  
11-16-06

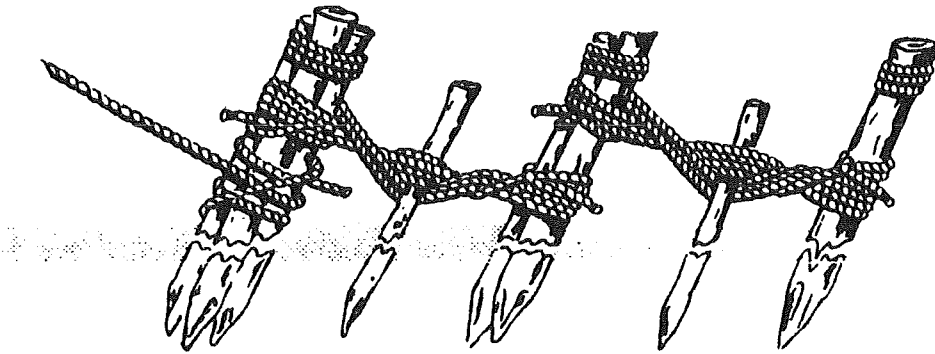


Figure 12-5. Picket holdfast, 3-2-1 combination.

## 3-2-1 Anchor

As the name implies, the 3-2-1 anchor is made by driving stakes in a series: three stakes, then two stakes, and then one stake to form the anchor (see figure 89). All six stakes are 30" long and are driven 18" into the ground at a 20° angle.

First, drive in the set of three stakes. Next, drive in the set of two stakes about 24" away from the first set. Then tie a rope from the top of the three-stake set to the bottom of the two-stake set using at least two loops of 1/4" manila rope, or six to eight loops of binder twine. Then use a small stick to twist the rope tight as in a tourniquet. After the rope is twisted tight, push the end of the stick in the ground to keep it from unwinding.

Finally, drive a single stake in the ground about 12 to 24" from the two stake set. Once again, use a twisted rope or binder twine as a tourniquet to hold the two-stake set tightly in place.

Depending on the strain, you can use other configurations, such as 2-1-1, or even 1-1 for a light strain. When using any stake anchor, be sure that it is in direct alignment with the strain being applied.

## Soil Conditions

When driving the stake into the ground, drive it at about a 20° angle. Soil conditions can vary and will dictate how large and long a stake you need. If there will be a heavy strain on the anchor, you might need additional stakes as in the 3-2-1 configuration shown in figure 88. After the stake is driven in the ground, keep your eye on it as strain is applied to see how it is holding.

If ground conditions are unsuitable for even the largest stake you have, use a 4"-diameter spar that's buried 36" in the ground at a 30° angle and anchored in place with a stake (see figure 86).

Figure 86

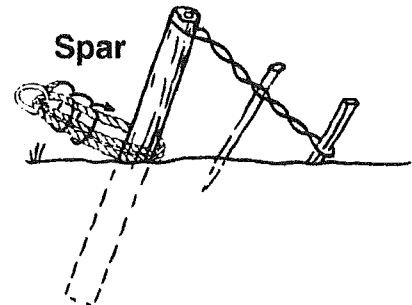
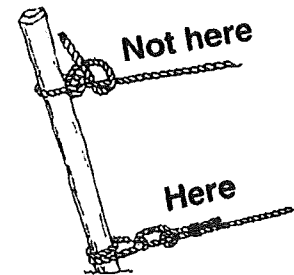


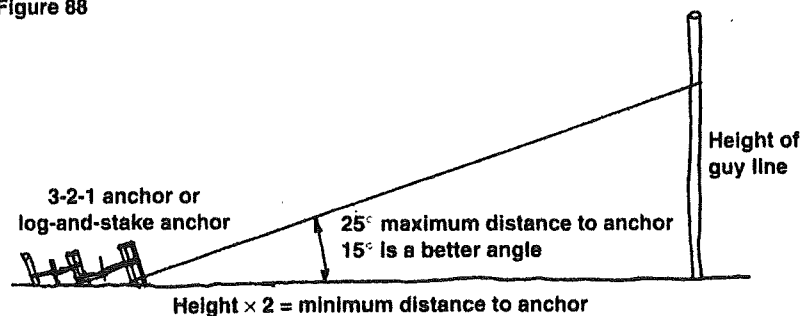
Figure 87



## Guy Line

Always attach the guy line around the stake as close to the ground as you can get it. If the guy line is placed or slips higher on the stake, there will probably be enough leverage to pull the stake loose (see figure 87).

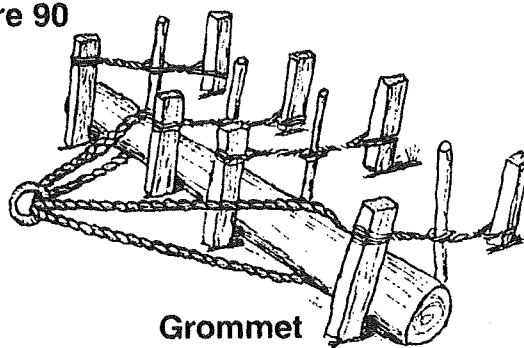
Figure 88



## 7. LOG & STAKE ANCHORAGE

To make the log-and-stake anchor, place a log 4" to 6" in diameter perpendicular to the pull on the line. Then drive in four large stakes in front of the log. Next, slip the rope grommet through the ring and then slip the ends of the grommet around the log (see figure 90).

Figure 90



Drive a second row of stakes 24" behind the front stakes. Then anchor the front stakes to the rear stakes with a tourniquet made of binder twine or rope.

### Strops

It is good practice to use a device called a strop to avoid damage to your long lines. It also makes it easier to tie off your long lines and to make adjustments.

A strop can be made by using a 10' length of  $\frac{1}{2}$ "-diameter manila or polypropylene rope. To make a strop, splice a thimble and ring into one end of the rope (see figure 91), or use a screw pin shackle with a thimble.

The strop can then be wrapped around a rock or tree to attach the line (see figure 92). It can also be used around a spar that is anchored between two trees (see figure 93).

Figure 91

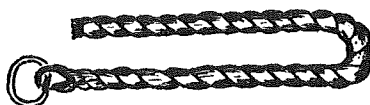


Figure 92

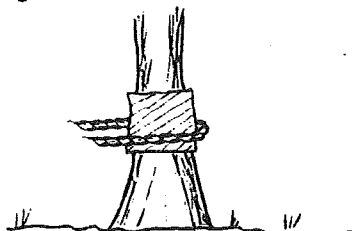
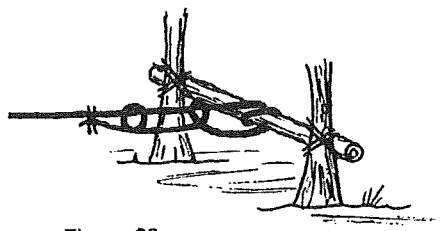


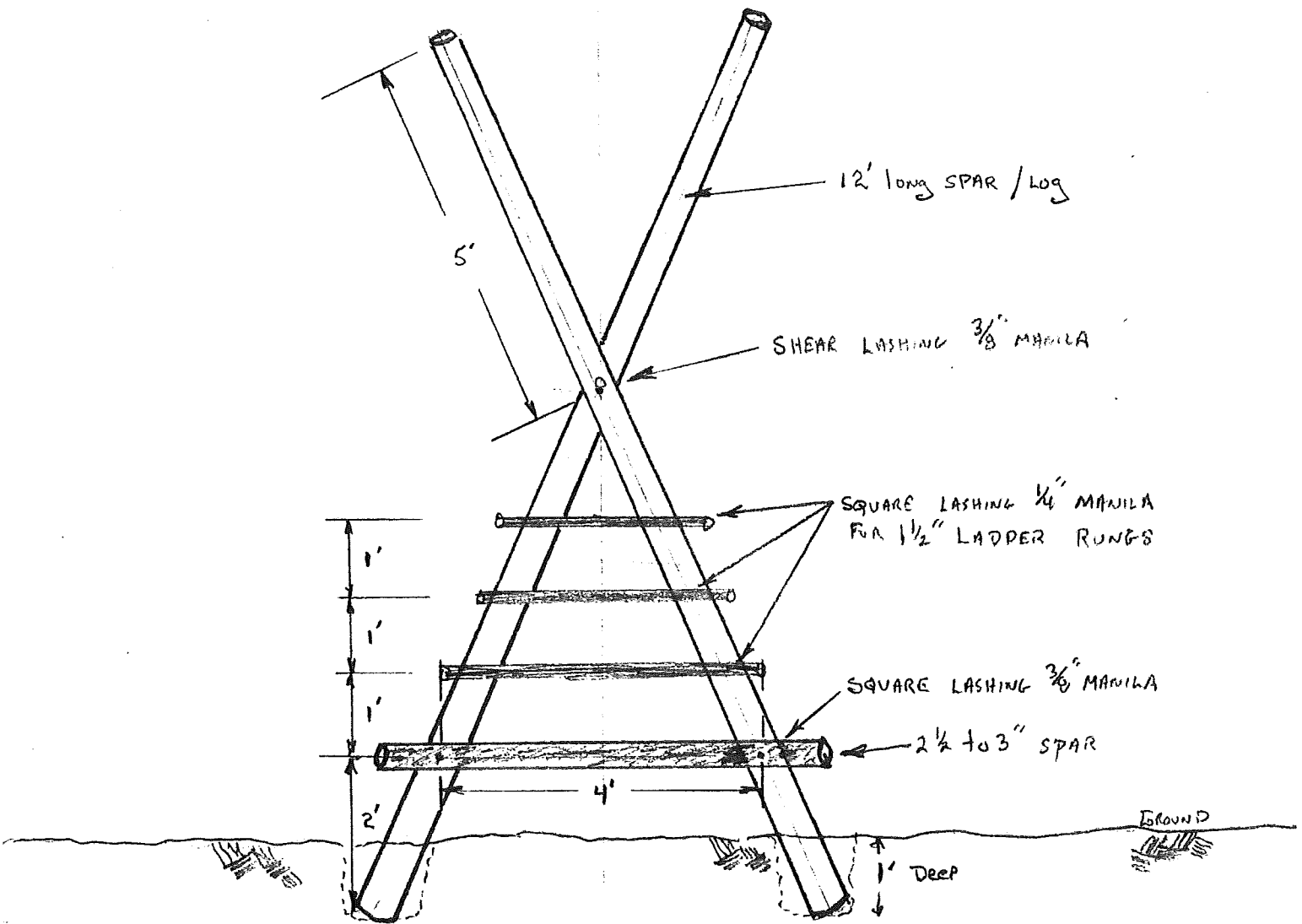
Figure 93





# 8. TRESTLES

'X' type



- LAYOUT & STAKE GROUND AS A template TO HOLD IN POSITION while lashing

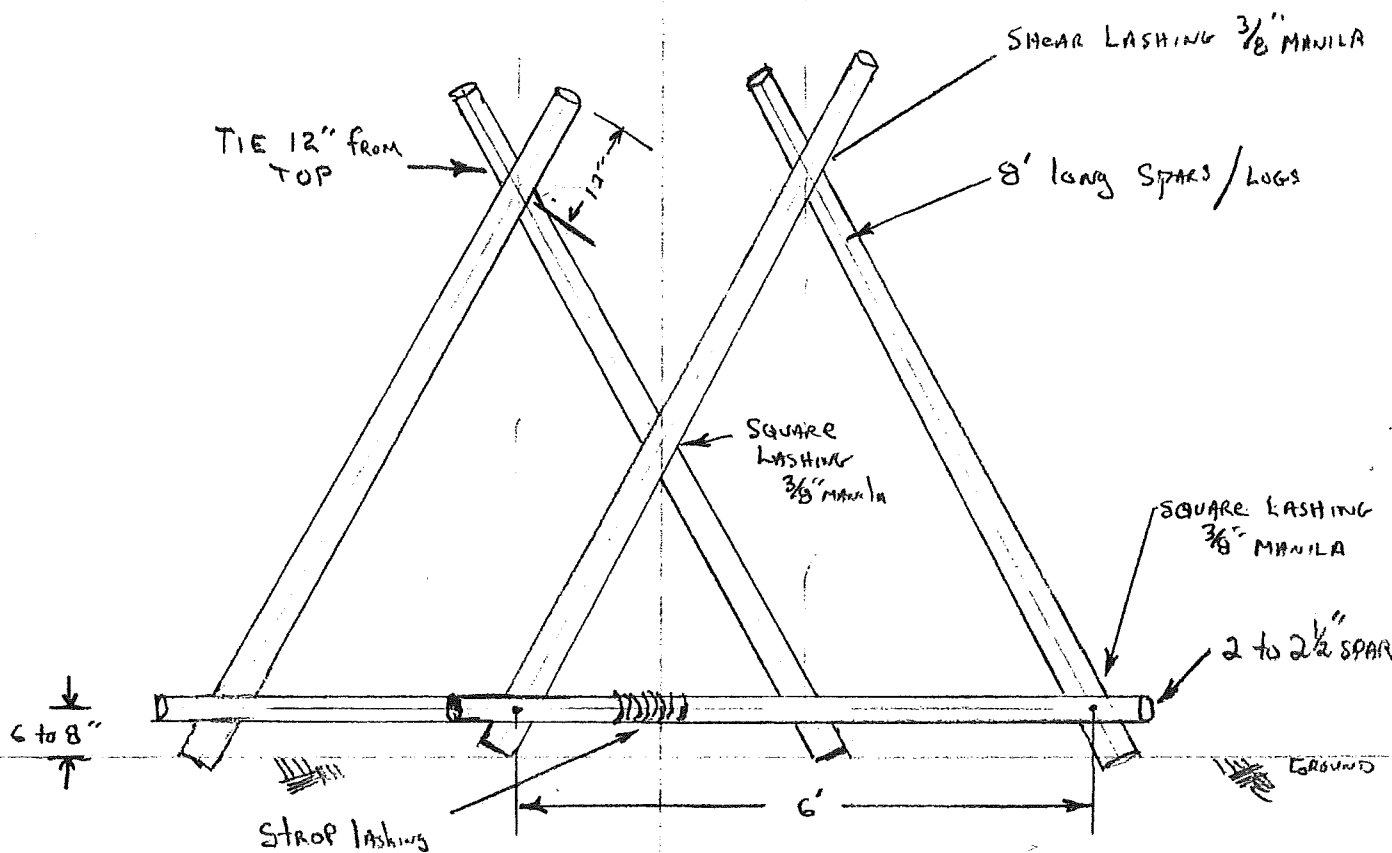
$$\frac{1}{2}'' = 1'-0''$$

# 'A' FRAME TYPE

If you're making an A frame, start with the spars side by side and tie a clove hitch on one spar about 1' from the top end of the spars. Then make ten wraps around the spars, making the wraps somewhat loose. The legs are then spread to the required distance. This should put a strain on the wraps.

With the legs apart, make the frapping turns around the wraps to pull them tight. Finally, complete the lashing by tying a clove hitch on the opposite spar.

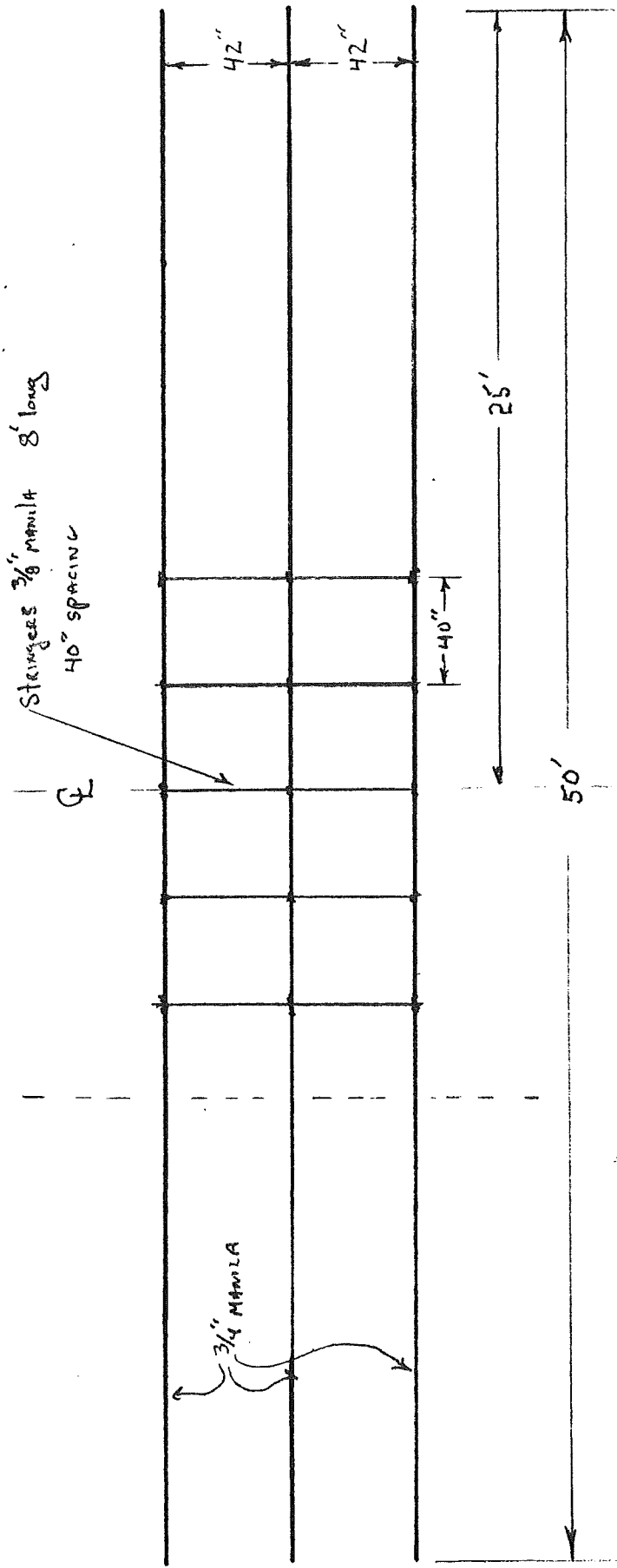
• Adjust height of Base bridge rope by changing 'A' frame overlap



- See overall Assembly section 10 for Double 'A' frame installation info.
- Layout & stake GROUND AS A template to hold in position while lashing AND ALSO to replicate size

$$\frac{1}{2}'' = 1'-0''$$

# 9. ROPE BRIDGE FABRICATION



ALL KNOTS ARE CLOVE KNOTS

USE STAKE TO KEEP ROPES PROPERLY SPACED

$$\frac{3}{16} = 1'-0"$$

## Double A-Frame Monkey Bridge

Using a double A frame to build a monkey bridge is a departure from the usual X frame that supports the foot rope and hand ropes. This new method has two distinct advantages over the X-frame version.

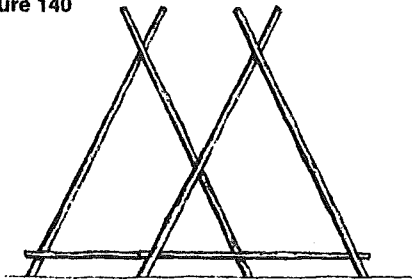
First, the double A frame provides a wider base, making it less likely to tip over. The second advantage is that the positions of the A frames can be adjusted so that the span between the hand ropes can be narrowed for better balance as you make the crossing.

**Building the A frames.** The first step in building this monkey bridge is to build four A frames using the 8' spars for the two legs, and 6' spars for the ledger.

Lay out the first set of three spars (two legs and one ledger) on the ground in position for lashing. Before lashing, drive three stakes, as follows, to help you to make all four A frames the same size: Drive a stake at the top to mark where the leg spars cross. Then drive stakes to mark the positions of where the bottom ledger crosses the legs. This will also indicate how far the legs are spread apart.

Now you can lash the four A frames together, laying them out one at a time using the stakes. Remember that all three lashings on the A frames are square lashings, even though the spars cross at less than a 90° angle.

Figure 140



**Double A frame.** When you have four A frames, you can lash two of them together to form a double A frame (see figure 140). Lay one A frame on the ground and then put another on top so that the bottom ledgers overlap one-half their length (approximately 3').

The first step in lashing the A frames together is to go up to where the two legs cross (the X formed by one leg from each A frame). Then with a good tight square lashing, lash the two legs together.

**Note:** The point where these legs are lashed together is where the foot rope will rest. You can adjust the overlap of the two A frames to adjust how high the foot rope will be off the ground. Also note where the tops of the A frames are because this is where the hand ropes will be.

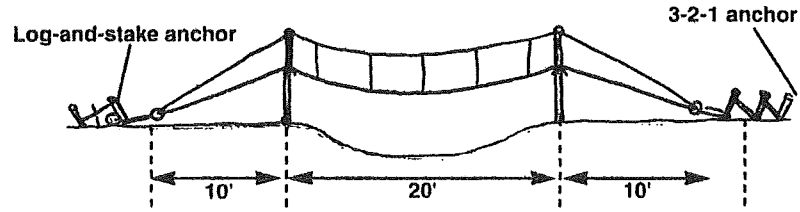
To complete the double A frame, stand it up so that the butt ends of all four legs rest solidly on level ground. Lash the two bottom ledgers together where they overlap with three strop lashings.

Now repeat this entire process to build the second double A frame.

**Site preparation.** Before you can erect the double A frames, you need to prepare the site. Begin by stretching a length of binder twine along the center line of where the monkey bridge is to be built.

Working from the center, measure out 10' toward each end to mark where the A frames are to be placed. They should be 20' apart. Then mark out another 10' from each A frame to where the anchors are to be built (see figure 141).

Figure 141



**Note:** These dimensions are for building a bridge with a 20' span. This is the maximum span for a bridge using a 50' rope. The extra 30' of rope is needed to have 15' of rope at each end for the proper distance from the A frames to the anchors (10'), and for the knots at the anchors (5').

**Build the anchors.** The foot rope will be attached to anchors at both ends. Before erecting the double A frames, build a 3-2-1 anchor, or a log-and-stake anchor 10' from where the double A frames will be erected (see figure 141).

**Rope grommet.** After the anchors are built, attach a rope grommet with a ring or shackle in it. (You can make the rope grommet with a 10' length of 1/2"-diameter polypropylene rope. Refer to the "Anchors" section, page 55, for more about rope grommets.)

**Position the A frames.** Prepare to erect the bridge by moving the A frames into position no more than 20' apart. Lay them down on the binder twine that marks the center line of the bridge.

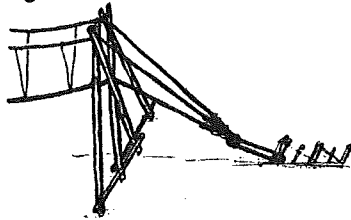
**Hand and foot ropes.** Now you can prepare the foot and hand ropes for the monkey bridge. Lay the foot rope in a straight line off to the side of where the A frames are laying. Then lay the two hand ropes

on the ground next to each other so they're parallel to the foot rope and 42" away.

**Stringer ropes.** Now you can add the stringer ropes that will go from the foot rope to the hand ropes. Start by tying the center of an 8'-long stringer rope (use 1/4" manila rope) at the center of the foot rope, using a clove hitch. The stringer rope is tied around the foot rope so that both ends are 4' long. Add two more stringer ropes on both sides of the center stringer rope (so there are five stringer ropes in all), tying them about 4' apart.

Tie one end of each stringer rope to one of the hand ropes, again using a clove hitch. Then do the same with the other ends of the stringer ropes, attaching them to the other hand rope.

Figure 142



12

**Assemble the bridge.** You're just about ready to assemble the bridge. First place a piece of heavy canvas (called a "saddle") in the V formed by both double A frames. This will protect the foot rope and allow it to slide a little in the V without interfering with the lashing rope.

Now get the crew together to erect the bridge. You will need a safety officer to watch for any problems that might occur, and a signal caller to tell the crew members what to do.

You will need two Scouts to lift and hold each double A frame in place, two more Scouts to lift the foot rope into the V of the double A frames, and two more Scouts to lift the two hand ropes into place at the tops of the A frames.

Lift everything into place. Then while holding the A frames steady, temporarily tie the hand and foot ropes into the rings on the grommets using a roundturn and two half hitches (see figure 142).

**Tighten the foot rope.** Now you can put a strain on the foot rope. It's not necessary to use block and tackle since this will put too much strain on the lashings, the anchors, and the foot rope itself when there is a load on the bridge.

Whatever strain three or four Scouts can put on the foot rope by pulling it by hand will be enough. As soon as the bridge is used a few times, there will be a sag in the rope. This is fine because it means that you are working with a reduced strain on the foot rope as a safety measure.

**Tighten the hand ropes.** Next, tie the hand ropes to the top ends of the A frames. First, loosen one end at a time from the anchors. Then use a clove hitch to tie the hand rope to the top end of the leg of the double A frame. As you're tying these clove hitches, adjust the strain on the sections of the hand ropes between the double A frames to match the sag of the foot rope. Also adjust the length of the stringer ropes so there is even strain between the foot rope and both hand ropes.

After the hand ropes are tied to the tops of the A frames, move down and retie the ends of the hand ropes to the rings in the grommets using a roundturn and two half hitches.

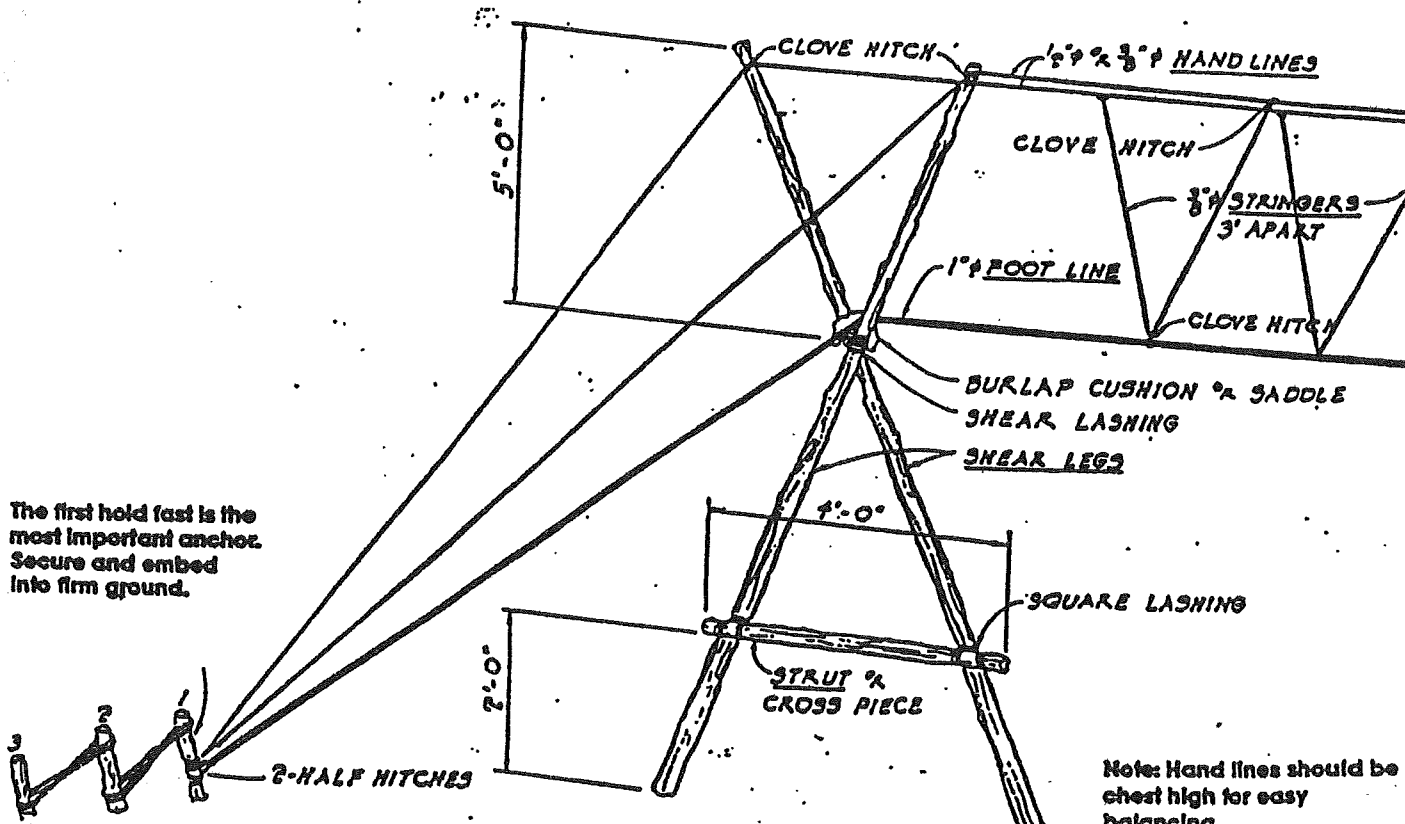
**Final testing.** With caution, one crew member can get on the bridge as all lashings, anchors, and knots are observed by the safety officer and all other crew members. Make adjustments as required. Then secure the running ends of the hand ropes and foot rope with a piece of cord.

Safe operation calls for only one Scout to be on the foot rope of the monkey bridge at a time.

# MONKEY BRIDGE CONSTRUCTION

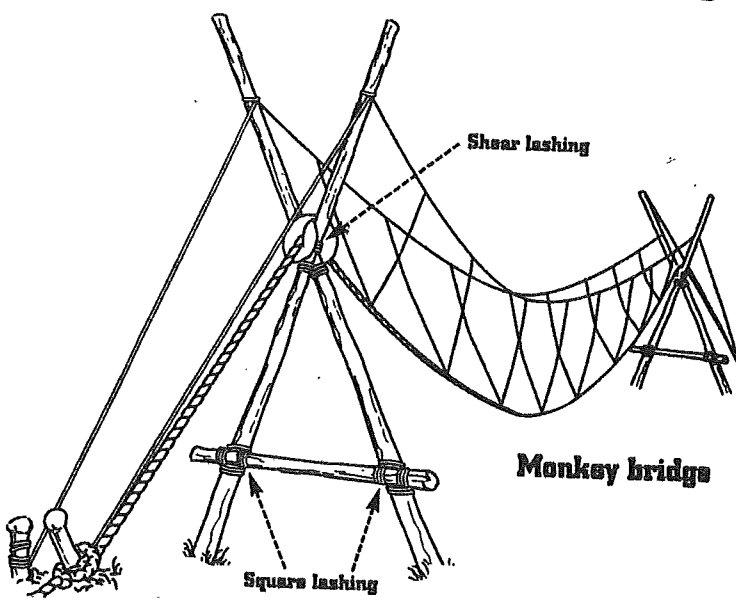
Logs required:

- 4-12' long, approximately 4" butt shear legs
- 2-4' long, approximately 2" —struts hand lines
- 6-3' long, approximately 2" —hold fasts Clove Hitch.
- Rope and lashing as required  $\frac{1}{2}$ " stringers, 3' apart.



The first hold fast is the most important anchor. Secure and embed into firm ground.

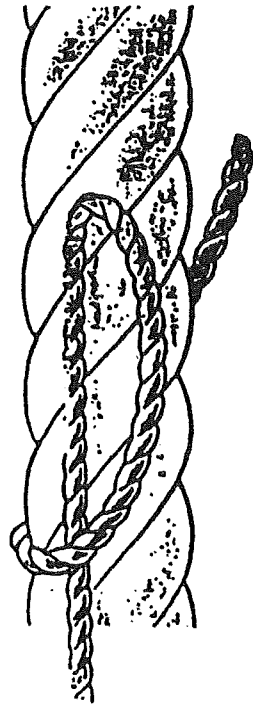
Note: Hand lines should be chest high for easy balancing.



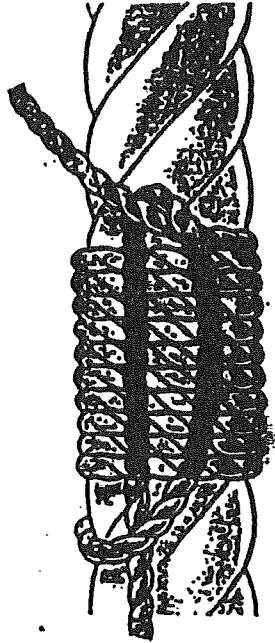
## II. GENERAL



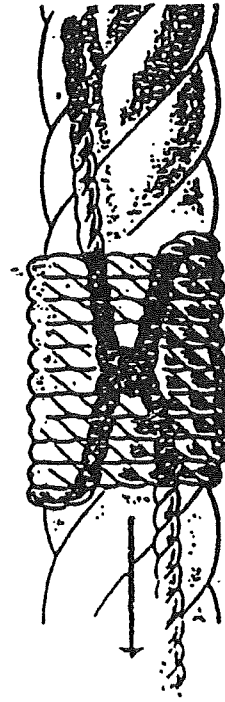
# WHIPPING ROPE PREVENTS RAVELLING



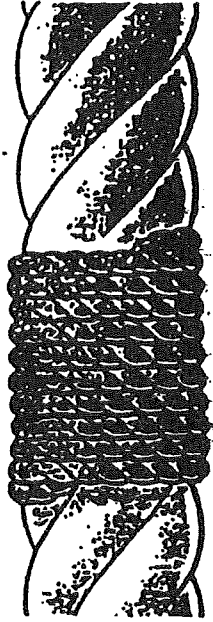
1. LAY A BIGHT ALONG THE ROPE



2. WIND YARN TIGHTLY AROUND BIGHT AND ROPE. INSERT WINDING END THROUGH BIGHT.

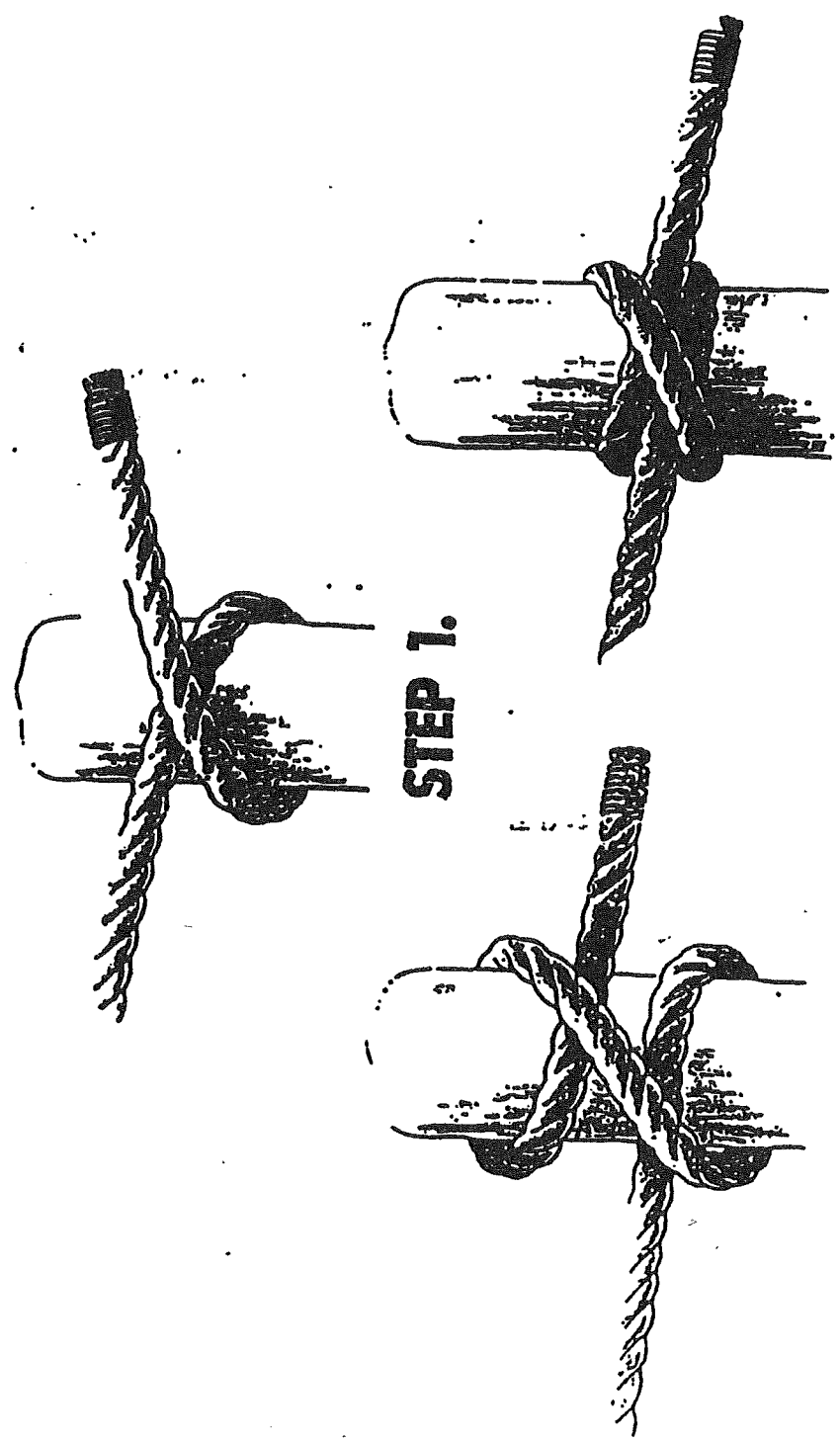


3. PULL STANDING END DRAWING BIGHT OUT OF SIGHT



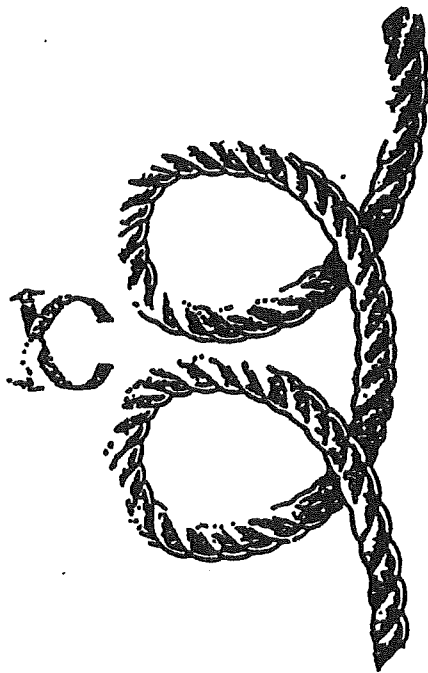
4. TRIM BOTH ENDS OF YARN CUT ROPE

**CLOVE HITCH USED TO FASTEN AN OBJECT AND TO START AND FINISH LASHINGS**

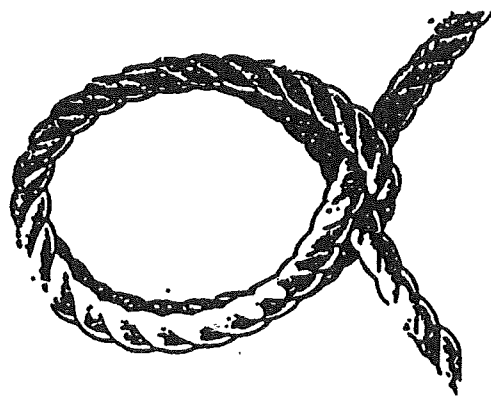


**STEP 2.**  
**STEP 3. DRAW TIGHT**

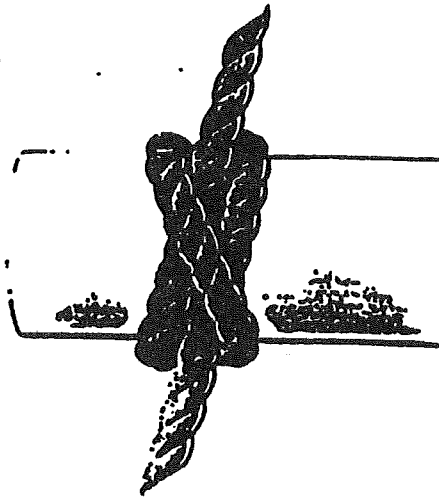
# CLOVE HITCH MADE IN THE CENTER OF A ROPE



**STEP 1.**

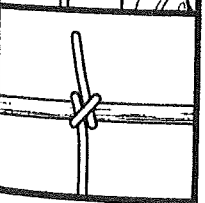
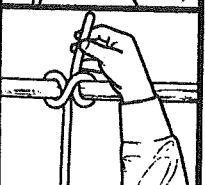
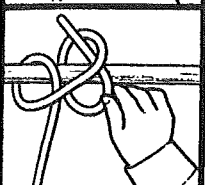
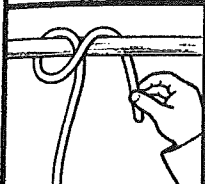
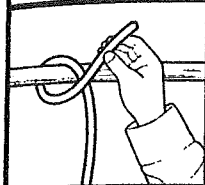
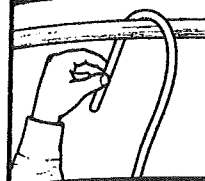


**STEP 2.**

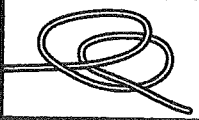


**STEP 3. DRAW TIGHT**

## CLOVE HITCH



### Alternative method



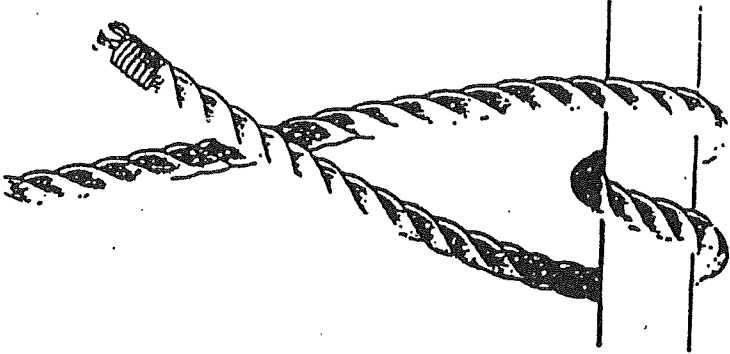
### CLOVE HITCH

*Clove* comes from the word *cleave*, meaning "to split," and is used to describe the *clove hitch* because it is split into two parts in the same way that the foot of a sheep or deer is split into two parts.

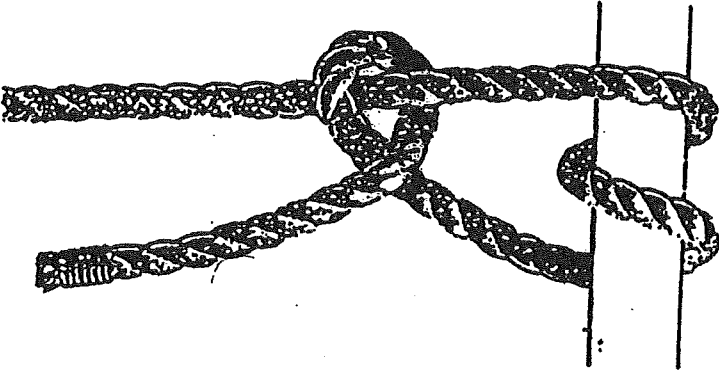
Form the first half hitch of the clove hitch by taking a *bight* (loop) around the pole and then across itself. Form the second half hitch of the clove hitch by taking a second *bight* around the pole and tucking the end of the rope under the rope between the two loops. When pulled tight, the clove hitch should look like an X. The difference between a clove hitch and two half hitches is that a clove hitch is tied around an object and two half hitches are tied around the rope's own standing part.

An alternative way of tying a clove hitch is to make an overhand loop in the rope. Then make a second overhand loop next to the first loop. Next, without turning over either loop, place the first loop on top of the second loop. Finally, place the two loops over the end of a pole or around the neck of a bear bag and pull tight.

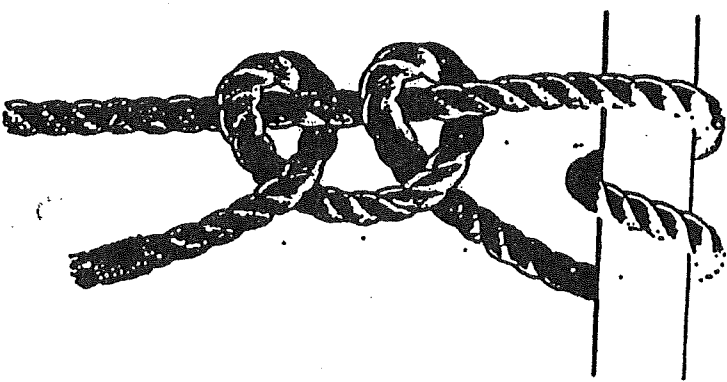
**ROUND TURN AND TWO HALF HITCHES**  
**USED AS A TEMPORARY FASTENING TO A RING OR SPAR**



**STEP 1.**

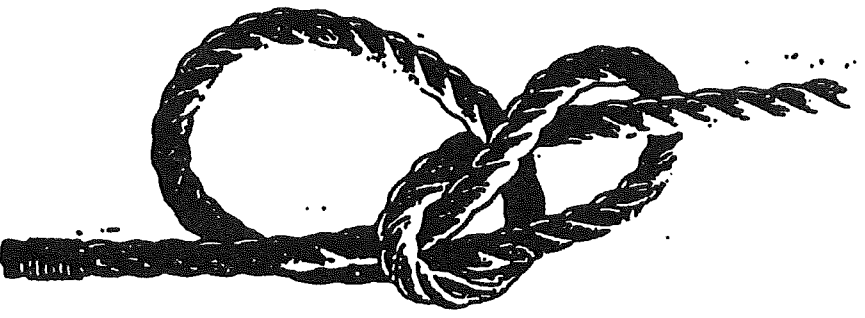


**STEP 2.**



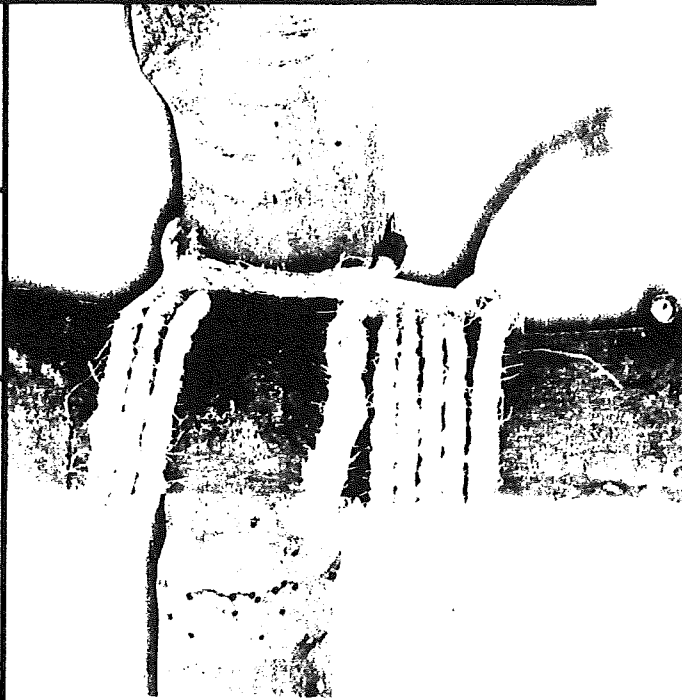
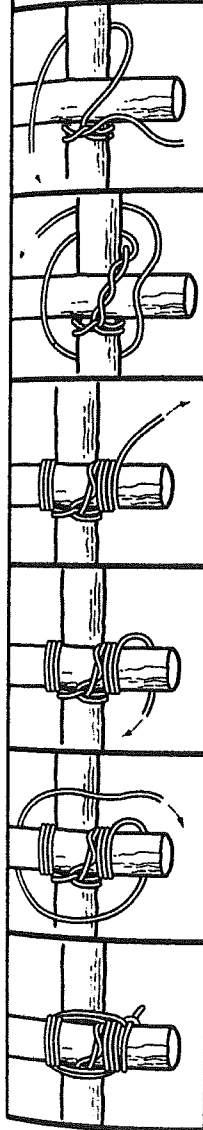
**STEP 3.**

**BOWLINE USED TO FORM A LOOP:  
WILL NOT JAM OR SLIP**



**STEP 1. STEP 2. STEP 3. DRAW TIGHT-**

## SQUARE LASHING

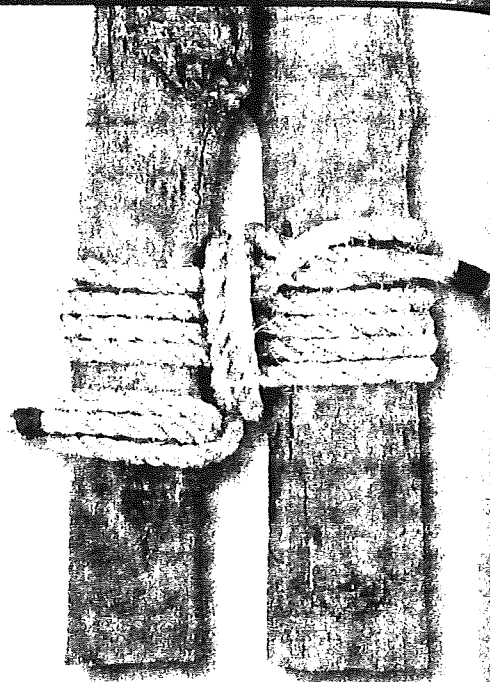
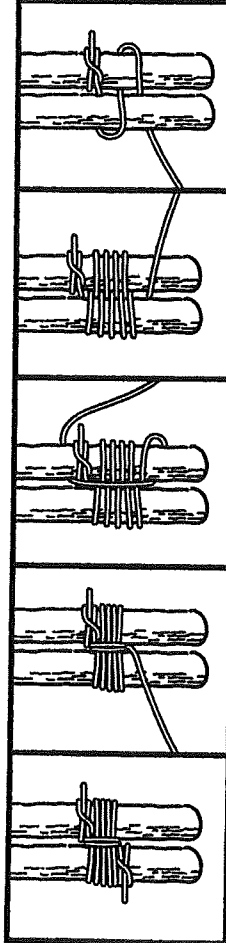


### SQUARE LASHING

Use a *square lashing* to bind together poles that touch and cross each other at an angle between 45 and 90 degrees. Notice that the rope crosses the pole at a right angle.

Place the poles in position. Tie a clove hitch around the bottom pole near the crosspiece. Make three tight *wrapping turns* around both poles. As you form the wrapping turns, lay the rope on the **outside** of each previous turn as it crosses the top pole, and on the **inside** of each previous turn as it crosses the bottom pole. Add two *frapping turns* around the wrapping turns. Finish with a clove hitch around the top pole. Be sure to work the ending clove hitch tight against the lashing.

## SHEAR LASHING



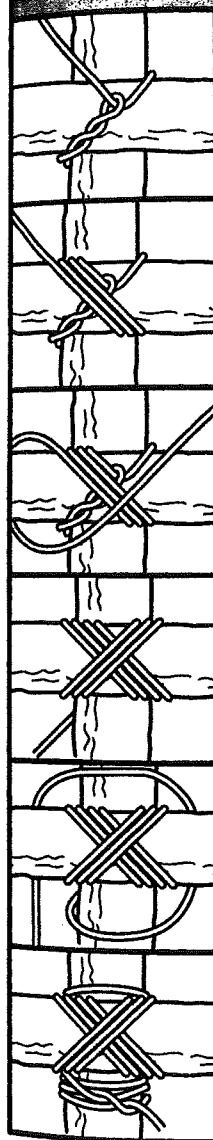
### SHEAR LASHING

Use the *shear lashing* to bind together poles that cross each other at an angle between 0 and 45 degrees, or where a flexible joint between the poles is needed, such as in a set of shear legs for an A-frame.

Lay the poles alongside each other so that their bottom ends are even. Tie a clove hitch around one pole. Add five or six snug wrapping turns by weaving the rope back and forth around the poles. Then take two frapping turns between the two poles; pull each frap tight. End with a clove hitch worked tight against the lashing on the second pole. Spread the ends of the poles to form the angle you need.



## DIAGONAL LASHING



### DIAGONAL LASHING

Use a diagonal lashing to bind together poles that do not touch but cross each other at an angle between 45 and 90 degrees. Notice that the rope crosses the pole on a diagonal.

Tie a timber hitch around both poles and pull it tight so that the poles contact each other. Then make three tight wrapping turns on the opposite diagonal. Be careful that the wrapping turns lay beside each other. Next, make three wrapping turns on the same diagonal as the beginning timber hitch. After the wrapping turns are applied, cinch them down with two frapping turns. Finally, tie off the rope with a clove hitch. Be sure to work the ending clove hitch tight against the lashing.

- ROPE DIAMETER WHAT TO USE

IF COMBINED SPAR DIAMETERS  $\leq 6''$  USE  $\frac{1}{4}''$  MANILA

$> 6''$  USE  $\frac{3}{8}''$  MANILA

- SQUARE LASHING ROPE LENGTH

JAPANESE 4' OF ROPE FOR EACH INCH OF COMBINED DIAMETER

EXAMPLE a 3" SPAR + 4" SPAR =  $4 \times 7$  OR 28' OF LASHING ROPE

\* STANDARD 3' OF ROPE FOR EACH INCH OF COMBINED DIAMETER

EXAMPLE a 3" SPAR + 4" SPAR =  $3 \times 7$  OR 21' OF LASHING ROPE

- SHEAR LASHING REQUIRES 30% MORE ROPE THAN STANDARD SQUARE

EXAMPLE a 3" SPAR + 4" SPAR =  $(3 \times 7)(1.3)$  OR  $\approx 28'$

- IF A LASHING ROPE IS NOT LONG ENOUGH, ADD A PIECE TO THE LASHING ROPE USING A SQUARE KNOT.

## **12. Scout / troop requirements**

**Work gloves**

**Tape measures ( one for each of 5 teams )**

**Duct tape**

**Knife to cut rope**

**Sledge mauls**

**shovel**

## 13. TOOLS

26

- GRAB CHAIN
- CABLE CHOKER
- SLINGS
- TURNBUCKLE
- SHACKLES
- 100' TAPE MEASURE
- 16' TAPE MEASURE
- SLEDGE
- TUNNELING BAR
- POST HOLE DIGGER
- SHOVEL
- RAKE
- TRASH BAGS
- HATCHET
- BOW SAW
- WORK GLOVES

- SAFETY GLASSES

## 14. SUPPLIES

- 4 CA 12' SPARES 6" BUTT

### List of Materials for Double A-Frame Monkey Bridge

- 8 4" x 8' A-frame legs
- 4 3" x 6' ledgers
- 15 ¼" lashing ropes
- 1 ½" or ¾" x 50' rope
- 2 ½" x 50' hand ropes
- 5 ¼" x 8' stringer ropes
- 46 6 pioneering stakes for each 3-2-1 anchor
- 8 pioneering stakes for each log-and-stake anchor
- 1 5" x 4' spar for log-and-stake anchor
- 2 ½" x 10' polypropylene ropes for anchor strops
- 1 ½" x 3" welded ring, or ¾" screw pin shackle
- 2 pieces of scrap canvas for foot rope saddle
- binder twine for anchor tieback straps