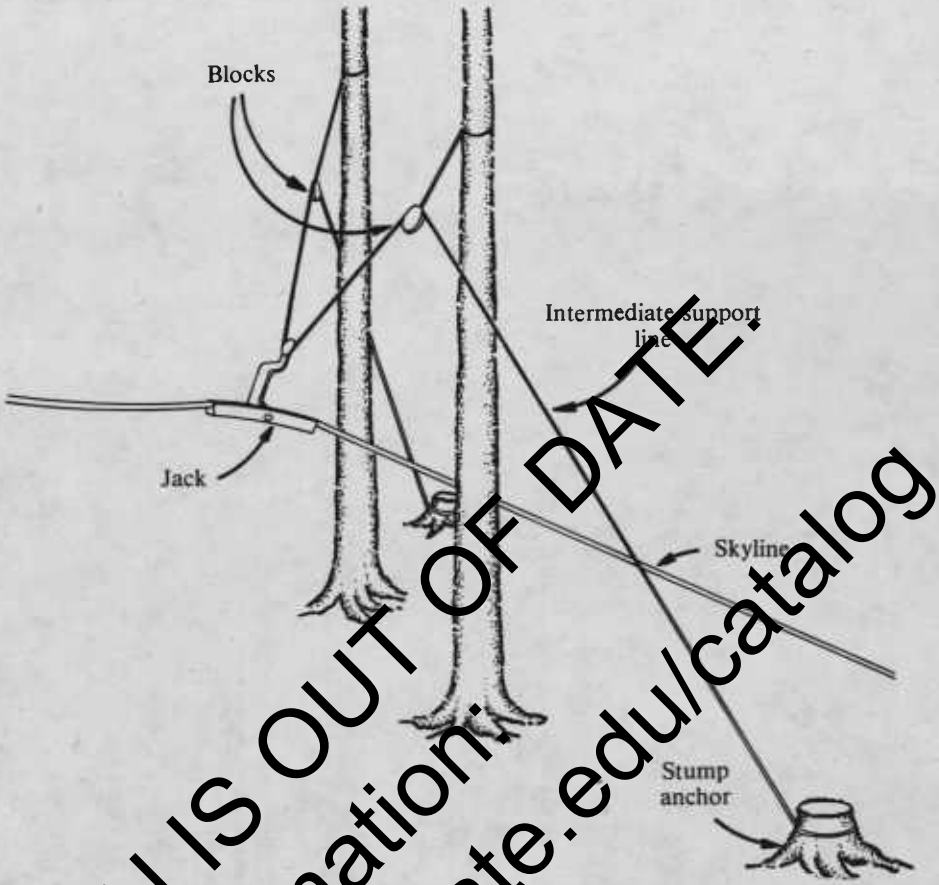
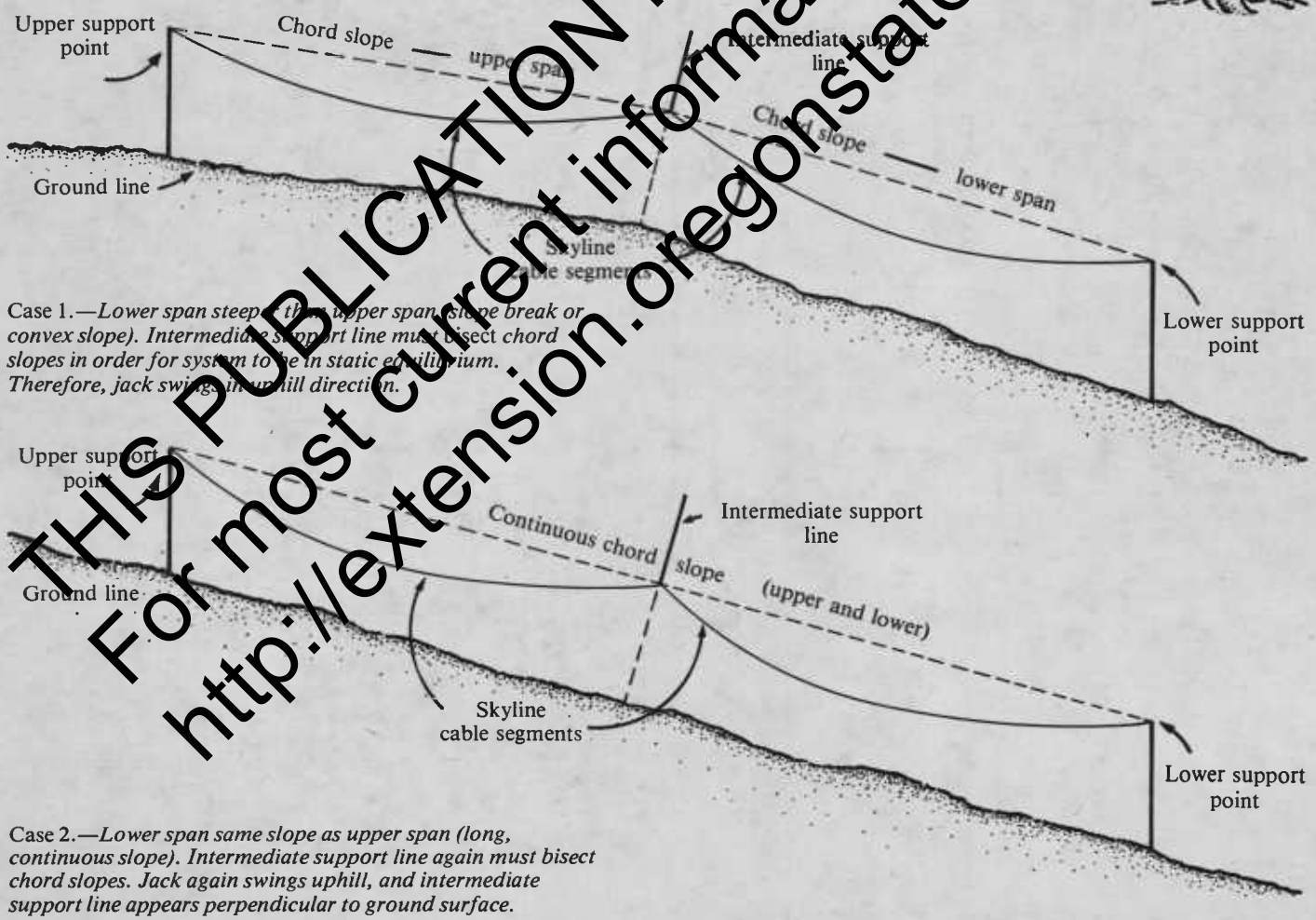


Figure 5 *(right).—Side view of double-tree intermediate support with skyline under tension*

Figure 6 *(below).—Why the intermediate support jack swings uphill in multispan logging*



Case 1.—*Lower span steeper than upper span (slope break or convex slope). Intermediate support line must bisect chord slopes in order for system to be in static equilibrium. Therefore, jack swings in uphill direction.*

Case 2.—*Lower span same slope as upper span (long, continuous slope). Intermediate support line again must bisect chord slopes. Jack again swings uphill, and intermediate support line appears perpendicular to ground surface.*

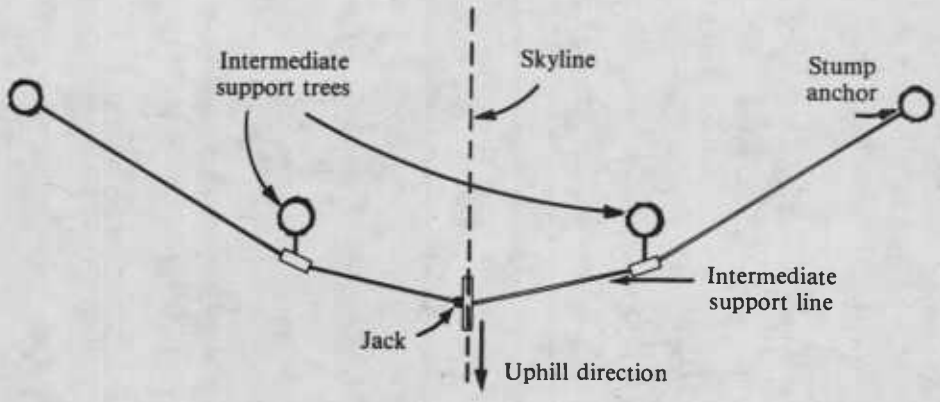


Figure 7.—*Overhead view of a double-tree intermediate support*

Looking at this from an overhead view (figure 7) may help you understand better how to position the trees and anchors to obtain this necessary force balance.

Support trees don't have to be perpendicular to and equidistant from the skyline. In fact, you will rarely find trees in such a convenient arrangement. Even so, do your rigging with the same objective: balanced vertical forces on the support trees, to avoid bending toward or away from the skyline corridor.

Figure 8 shows a double-tree intermediate support with two trees separated up and down the skyline corridor by distance A. The trees are not equidistant from the corridor centerline (distance B is greater then C). However, the intermediate support line anchors are still situated slightly downhill from the support trees, as shown by the distances D and E.

By diagraming the actual tree and anchor locations as in figures 4 and 7, you can solve this positioning problem and decide if the double tree support is the best alternative. If the available trees are separated too far from one another up or down the slope, then a single-tree or leaning-tree support may be more appropriate.

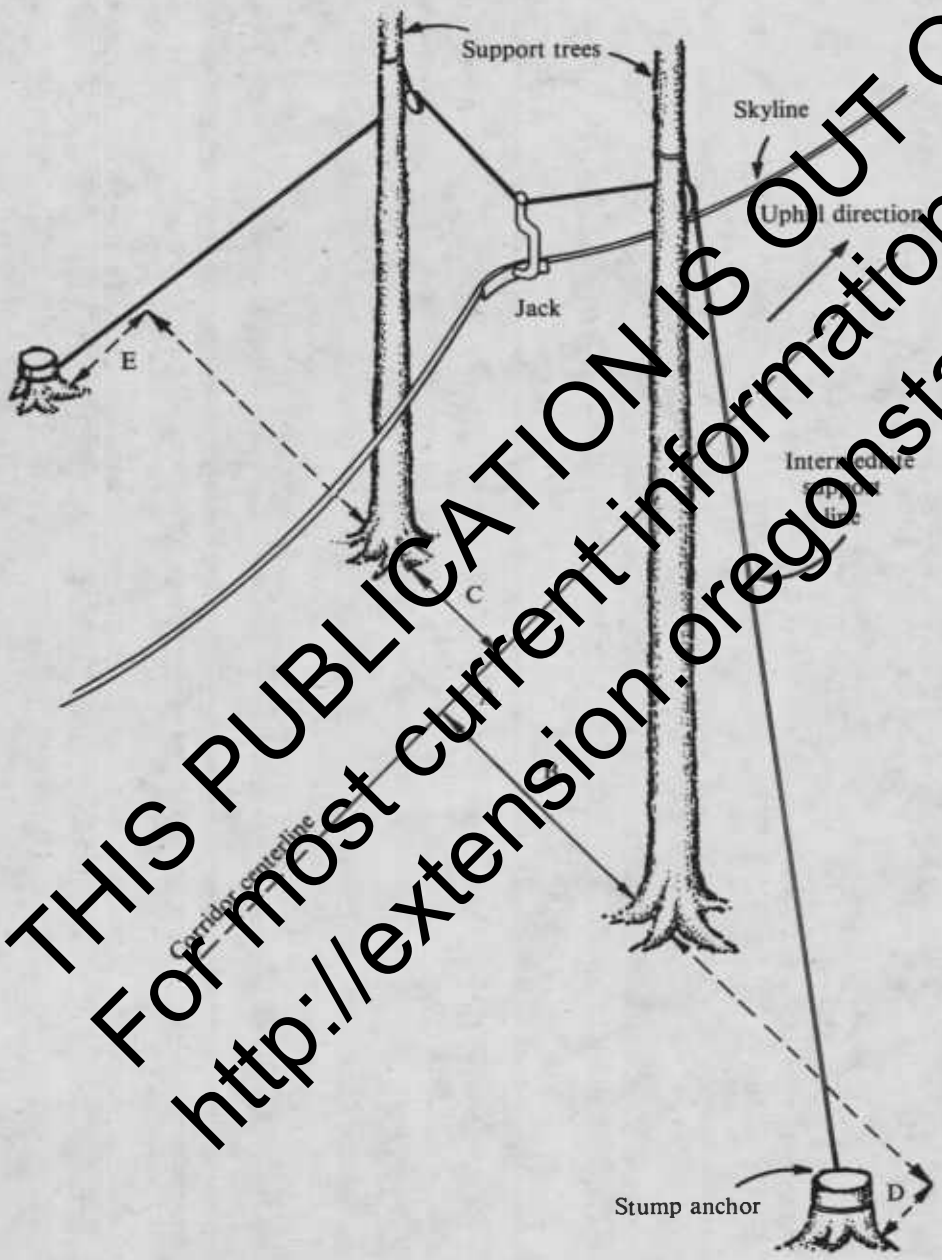


Figure 8.—*Double-tree intermediate support with trees at different locations along corridor and not equidistant from corridor centerline*

Field location procedures

An essential part of multispan planning is collecting accurate profile data for your terrain. Without knowing the shape and length of the slopes over which you'll need to move your logs, it is often not possible to determine whether or not an intermediate support is necessary—or where to locate the support for the most efficient yarding.

When you collect profile data, look for distinct breaks in a convex slope where an unsupported cable would likely be too close to the ground. These points are probable locations for intermediate supports and may sometimes be quite evident.

When you're working with extremely broken terrain or long and continuous slopes, however, good locations for intermediate supports may be less obvious.

In all situations, keep notes on trees along the skyline corridor that you could use as supports. This information is necessary when you analyze the profile to determine payload. This approach also holds true for locating tail spars at the outer end of the profile.

Your recorded information must include tree d.b.h., species, and location in reference to the terrain profile line. Remember: Try not to use trees with obvious defects.

The next step in multispan project planning is to return to your home or office and analyze your terrain profile(s) with a computer or chain and board model to determine skyline payload capabilities.

This analysis includes determining the location and heights of intermediate supports that you will need to carry an adequate payload. You'll need this information to do the final selection and rigging of intermediate supports.

The "Stick Trick" method

Now you return to the field and locate the position on the ground where you will rig the intermediate support. There are a number of ways to insure that the available intermediate support trees and anchors are correctly positioned to meet the objectives of any particular skyline setting.

The following directions will, however, present a simple and practical procedure, the "Stick Trick" method:

1. Starting at the intermediate support trees you selected, measure off a distance (100 feet is convenient) along the skyline profile in an uphill direction.
2. Using a clinometer or abney level, locate the point in space between these trees where the jack must hang. (You will have determined this height in the skyline analysis process.)
3. Once you locate the jack height you obtained from a payload analysis, try to fix this spot in space by using some reference point on the bole of an adjacent tree, or some feature in the background of crown canopy.
4. Keeping your eye trained on this spot, use the side scale of the clinometer to construct an angle between 25° to 35° (35° is a good starting point) *turned counterclockwise* from the horizontal.
5. Using a straightedge (a straight stick you might find in the woods will do nicely), extend the 35° line from the point where the jack must hang until it intersects with the bole of the right-hand intermediate support tree. This is the point where a block must hang. Mark this point by reference or measure its height with the clinometer (figure 9).

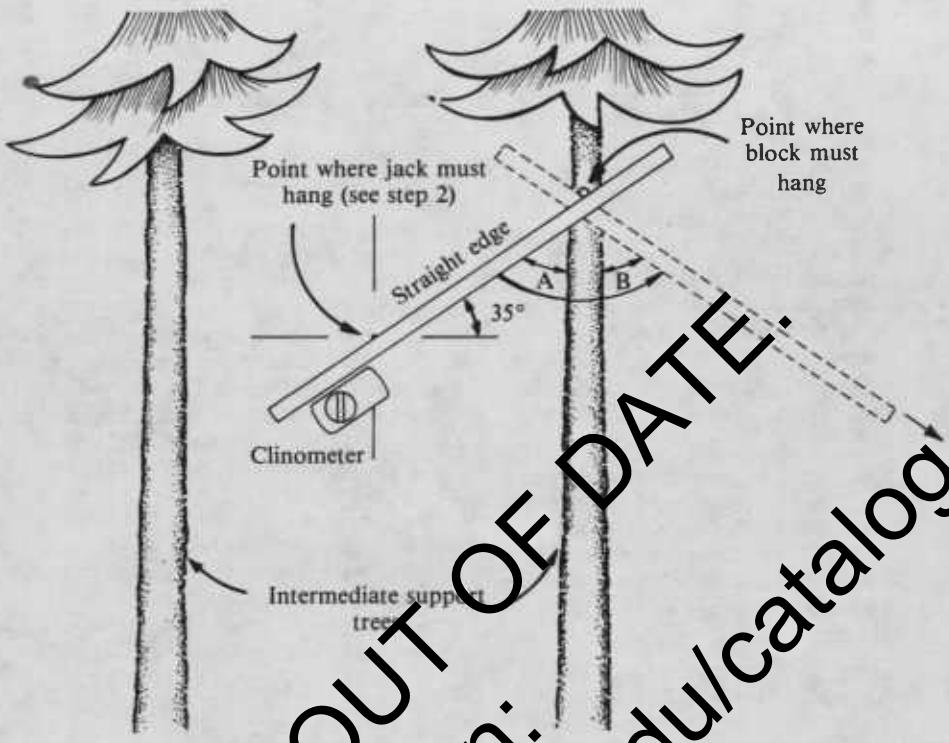


Figure 9.—*The Stick Trick: Rotate the straightedge until the angle you constructed on the inside portion of the support tree is duplicated on the outside—that is, when angle A equals angle B.*

6. Because the intermediate support line on the outside of a tree should form approximately the same angle as on the inside, fix in your mind the angle the straightedge is now making with the tree. Then turn the stick quickly but carefully, *to the right* until the stick makes approximately the same angle to the *outside* portion of the support tree. You are using your eyes alone here, and no more clinometer measurements are necessary. The observer relies solely on his or her eye to successfully complete this rotation—with a little practice, it is quite easy to do it with adequate results.
7. The lower end of the stick is now pointing to the area on the ground where you must anchor the intermediate support line. Note some reference points, so that you can identify this area later. (One easy way to do this is to have an assistant walk to the area indicated by the stick while you direct the assistant's movements. Once in place, the assistant should mark the position with plastic flagging.)
8. Mark the ground position on the skyline profile from the location where you made the clinometer readings; you will use this position again.
9. In order to balance forces on the intermediate support trees, your anchoring points must be slightly downhill from the trees (figures 5, 7, and 8). Proceed down the skyline corridor to the right-side intermediate support tree and turn an angle 90° from the direction of the profile. Walking in this direction, go out to the anchoring area you determined in steps 6 and 7.
10. When you reach the anchoring area, move slightly downhill (5 to 10 feet) to look for anchoring opportunities. If acceptable anchors are available, mark the best one and return to the point marked on the ground profile in step 8. Repeat this process (steps 1 to 10) for the *left* side of the skyline jack.
11. If anchors are not available for either tree, you have four alternatives:
    - Change the angle that the intermediate support line makes at the jack. Try 40° and see how that changes the required anchor locations.
    - Move slightly higher in the intermediate support trees. If you use this alternative, try to move up *the same distance* in both trees. Changing the rigging height in only one tree displaces the jack sideways, toward the lower rigging point. This will cause a dogleg in the skyline that may present problems when the carriage must pass the jack. Minor doglegs at the intermediate support jack are

acceptable and also quite common. Recent research reported carriage passage of an intermediate support with an 8° dogleg; however, the same system couldn't handle a 12.25° dogleg successfully (see FRL Research Note 74, "For further reading," righthand column).

- Choose a different intermediate support location. It is generally better to move slightly *uphill* than it is to go downhill, to locate a new intermediate support.
- Try to design a single-tree intermediate support.

12. When you find acceptable anchors for both ends of the intermediate support line, remeasure the heights to the point where the blocks must hang in the trees. Add 3 to 5 feet to this height to allow for strap length. This will be the rigging height to pass along to the climber.
13. Measure the diameter outside bark at this point with a Relaskop or measure d.b.h. and modify that measurement according to the form class of the tree. Subtract an appropriate bark thickness and proceed with a buckling analysis to determine if the selected trees are large enough to withstand the forces they will be subjected to during yarding. Consult the Oregon State Safety Code, logging section, for tree-diameter guidelines.

This method is not a precise surveying procedure, and there are many opportunities for inaccuracy—but it works. Experienced logging engineers and multispan loggers use this "Stick Trick" regularly with satisfactory results.

Care in turning the various angles is important for acceptable results. With a little practice, this method can be a useful planning tool for project layout foresters and loggers.

Summary

Multispan skyline logging systems are being used throughout the Pacific Northwest with excellent results. Intermediate supports are often unnecessary on *every* skyline road in a project area. However, when terrain presents a problem for the single-span skyline, multispan rigging provides that extra lift to raise the skyline and payload over the obstruction.

Loggers who have used intermediate skyline supports have been favorably impressed by the increased ease of yarding and the improvements in productivity. Many skyline yarders and carriages can be easily and inexpensively adapted to log over intermediate supports.

Experts agree that as loggers and land managers become more familiar with this system, they will routinely rig intermediate supports to reach those difficult pieces of ground they have previously avoided or left for helicopter logging systems.

For further reading

Lysne, D. H., and S. E. Armitage, *Multispan Logging of Old-Growth Timber in Southwest Oregon,* Oregon State University, School of Forestry, Forest Research Laboratory Research Note 74 (Corvallis, 1983). No charge for single copies; order from OSU College of Forestry, Corvallis 97331.

Mann, John W., "Skyline Deflection: How Much Is Enough?" *Forestry Intensified Research Report,* vol. 5, no. 1, Oregon State University Extension Service (Medford, 1983). No charge for single copies; order from Forestry Intensified Research Program, 1301 Maple Grove Dr., Medford 97501.

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