Rigging Applications in Logging

submitted to

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by

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Guide to Rigging Applications in Logging: Division 7 Forest Activities Code

Introduction

Loggers need background information to help understand the safety provisions of the Forest Activities Code. This brief guide extracts some elements of the code and provides more information to help understand how the code provides safer work practices. This guide is not meant to replace the actual provisions in the Division 7 Forest Activities Code only to supplement them. The following topics are included:

- Forces, lines and angles for rigging in logging
- The meaning of "in the clear"
- The "Potential Failure Zone"
- Stability of Trees as Anchors and Support Trees
- Hazards for the Rigging Crew
- Straps and Rigging for Logging
- Your Obligations as a Supervisor for Safety & Health

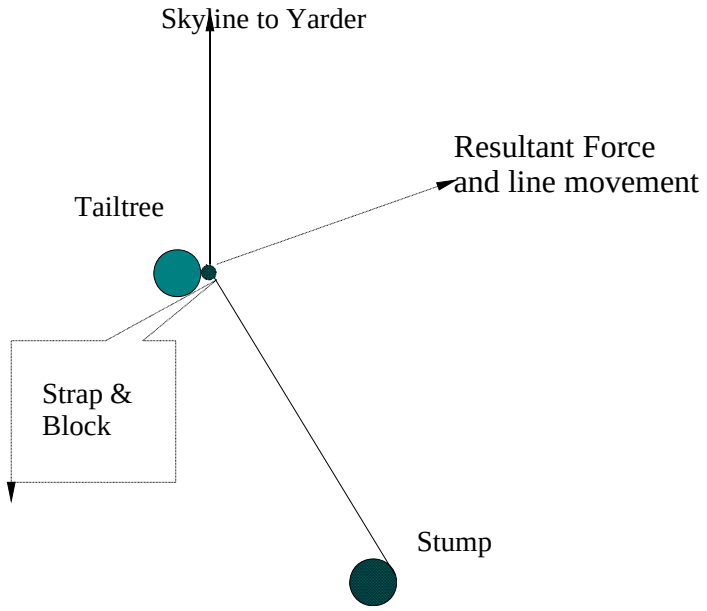
Forces, Lines and Angles for Rigging in Logging

Loggers working with lines of synthetic or wire rope need to understand how forces and angles influence their operations. They need to pick a position "in the clear" if failures were to happen.

When lines pass through a block or sheave, the forces on the lines are balanced and you can predict where the lines will move if failures occur. The diagram below shows how the lines might move if the strap on a tailtree failed and the block and lines move. Because the tension in lines passing through a block are equal, the forces on the block pull in the direction of the lines and the resultant force splits the angle in half between the lines.

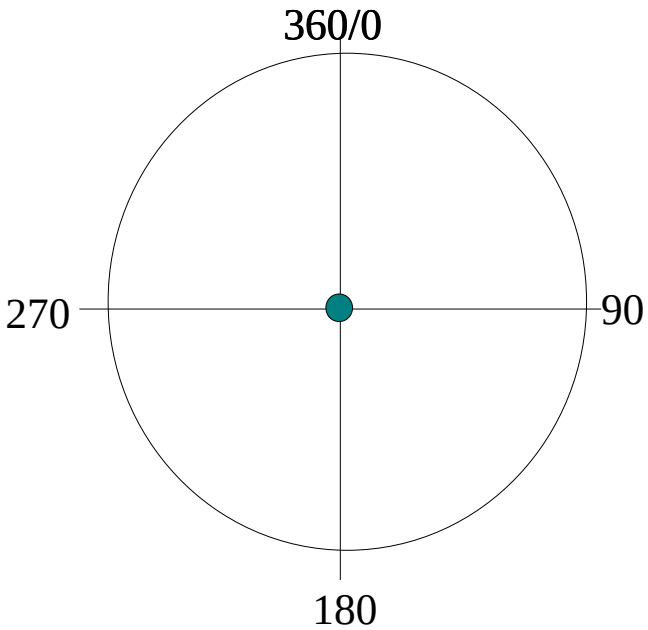
In the example below, when a line from the yarder passes through a block in the tailtree and is anchored to a stump, the failure of the strap supporting the block will likely cause the lines to move in the direction of the resultant force (R) in the diagram. The lines might swing past the direction between the stump and the yarder depending on the amount of the force at failure.

Top
View



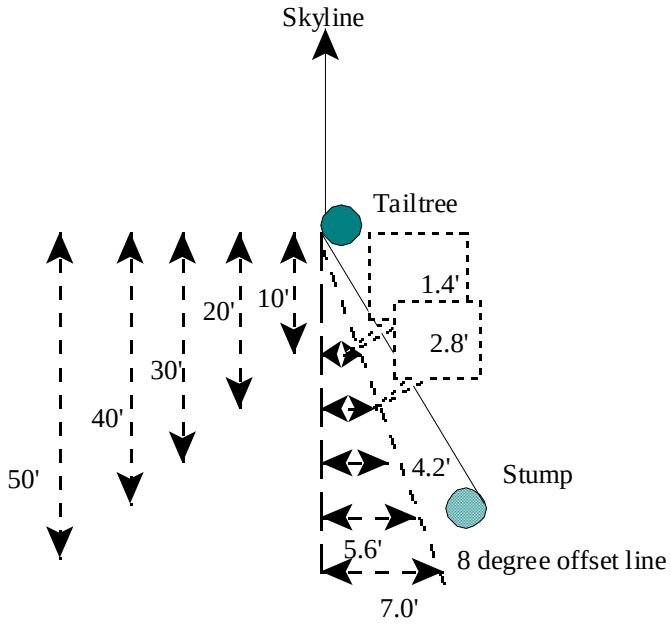
Angles

In Oregon's Forest Activities Safety Code (Div.7), the recommended and allowable placements of cables for the yarder, tailtree or intermediate support trees uses the Azimuth system. A 360 degree circle is oriented so the 0 degree mark is toward the direction where the force is coming from, eg for the yarder, along the skyline; for the tailtree, along the skyline toward the yarder. In the diagram below the angles increase clockwise to 90 degrees, 180 degrees (directly opposite the line of force), 270 degrees and back to 360/0 degrees.



Angular measurement can be made directly in the field using a compass or other instruments. However, it is also possible to make distance measurements to establish positions rather than measure angles directly. For example, when the skyline passes through a tailtree and is anchored more than 8 degrees off from a line extended past the tailtree, loggers must change guyline placement or add guylines. You can measure a horizontal distance (a level measure not along the slope) behind the tree and the offset distance to see if the stump anchor is more than 8 degrees offline.

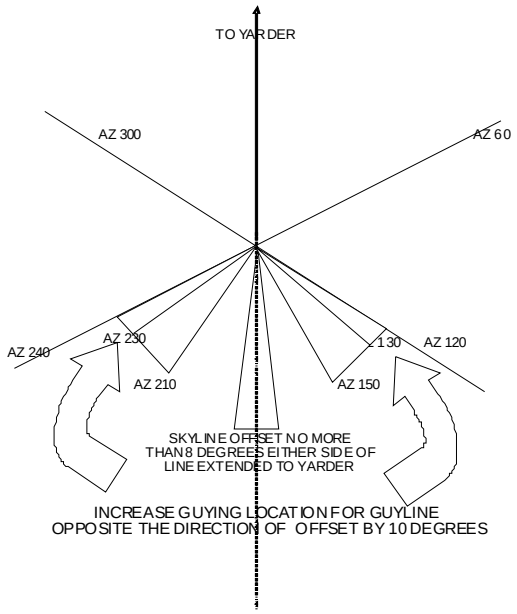
The example below shows the offsets for the distances associated with the 8 degree limit of the Forest Activities Code. Of course you can measure left or right for the angles depending where the anchor stump is located.



In the example above, the anchor stump is more than 8 degrees offset requiring different guyline zones to stabilize the tree than if the anchor were more in line. For the arrangement below, two guylines sized according to the skyline are needed. They need to be in the guyline zones shown by the offset distances shown for the 40 feet (or whatever distance you choose) distance behind the tailtree.

The key Distances and Offsets are shown in the Table below for the key Azimuth angle differences for the tailtree guying.

		Degrees & Offsets (feet)		
Distance	8 degrees	30 degrees	50 degrees	60 degrees
10	1.4	5.8	11.9	17.3
20	2.8	11.5	23.8	34.6
30	4.2	17.3	35.8	52.0
40	5.6	23.1	47.7	69.3
50	7.0	28.9	59.6	86.6

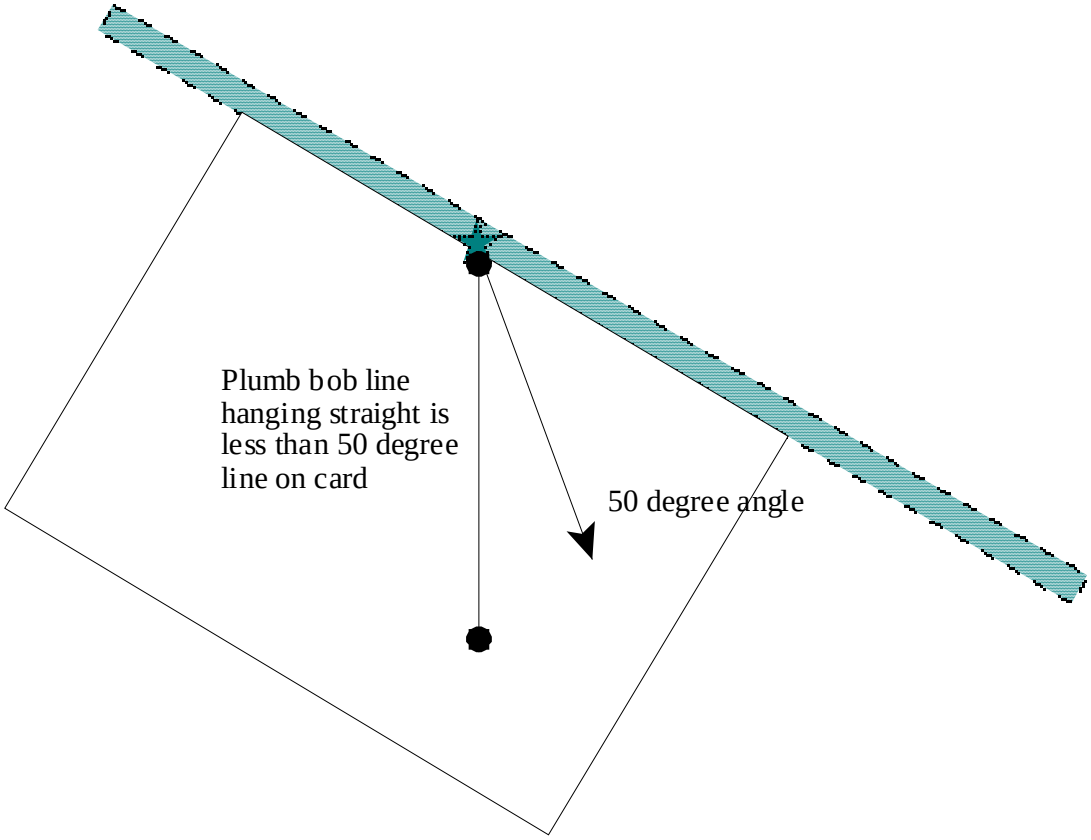


Vertical Angles of Guylines

The vertical angle of lines also influences how they function. If the angle is too steep (high), guylines won't provide the resisting force needed to stabilize yarders or trees. The Forest Activities Safety Code calls for guylines less than 50 degrees from the horizontal in order to be effective. If conditions call for guylines that are steeper, then additional guylines may be needed or the loads reduced in the operation.

It is easy to see if the guyline is less than 50 degrees with the use of a card and a home-made plumb bob. A plumb bob can be made from a string and a nut (or any weight to keep the line hanging straight). The edge of the card is placed along the guyline with the 50 degree mark identified on the card. Hanging the plumb bob from the line will show if the guyline is too steep or within allowable limits. For planning purposes, other instruments (clinometer) will show if guylines are likely to be too steep.

GUYLINE



The meaning of "in the clear"

There are no places on a logging operation that are absolutely safe. There are places "in the clear" where work takes place and where workers have the best chance of avoiding injury if the unexpected happens. For new workers "in the clear" means doing exactly what the experienced crew members tell you to do. Loggers must make judgments about what being "in the clear: means for their jobs. This information will help you develop that judgment.

There are no absolute distances measured in feet or inches to put you in the clear. Experienced loggers know there's an impact zone around any activity, e.g. where a tree can fall out of lead or a log up-end. Then there's a secondary danger zone where trees hit others and knock them down or logs trigger other log movements. Sometimes guidelines like twice the height of trees or twice the length of logs are used to help make judgments.

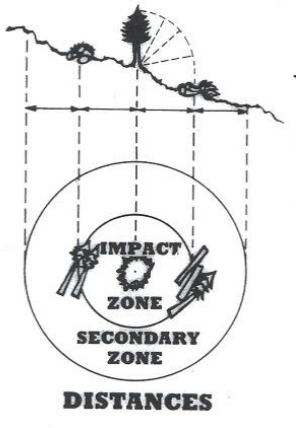
You might use natural barriers- like being over the ridge, behind trees, rocks or large stumps, to help get in the clear. Stay on your feet and pay attention to hazards in front of you, but keep alert in all directions- especially uphill where gravity can send hazards your way.

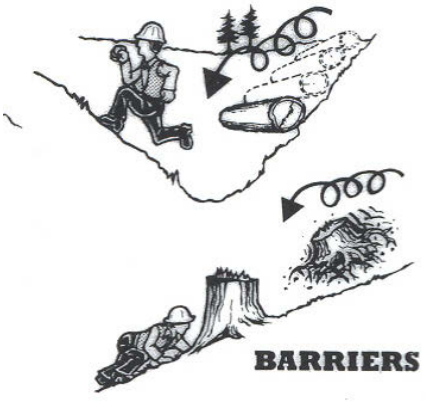
For equipment operations, being in the clear means putting enough distance between yourself and the machine so a sudden unexpected movement would not put you in jeopardy. Get the logger's attention before you move by any logging machine.

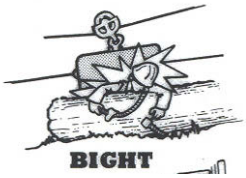
Stay out of the "bight" (Locations where, if rigging failed or lines broke tightened or slackened, the slashing or falling lines would be deadly).

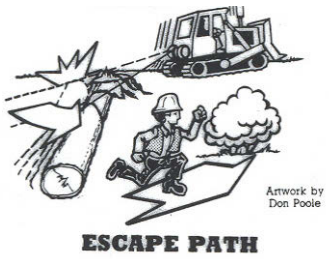
Being "in the clear" means having a clear path of escape available and avoiding working in hazardous confined places (Watch pinch points).

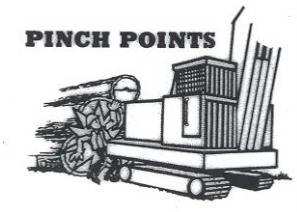
The meaning of "in the clear" varies with every situation in logging. It is a matter of knowing which hazards to expect, how unexpected actions can trigger other hazards, and putting enough distance or barriers between you and the likely hazards. **You must make the final judgment!**

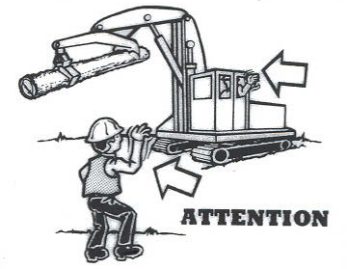








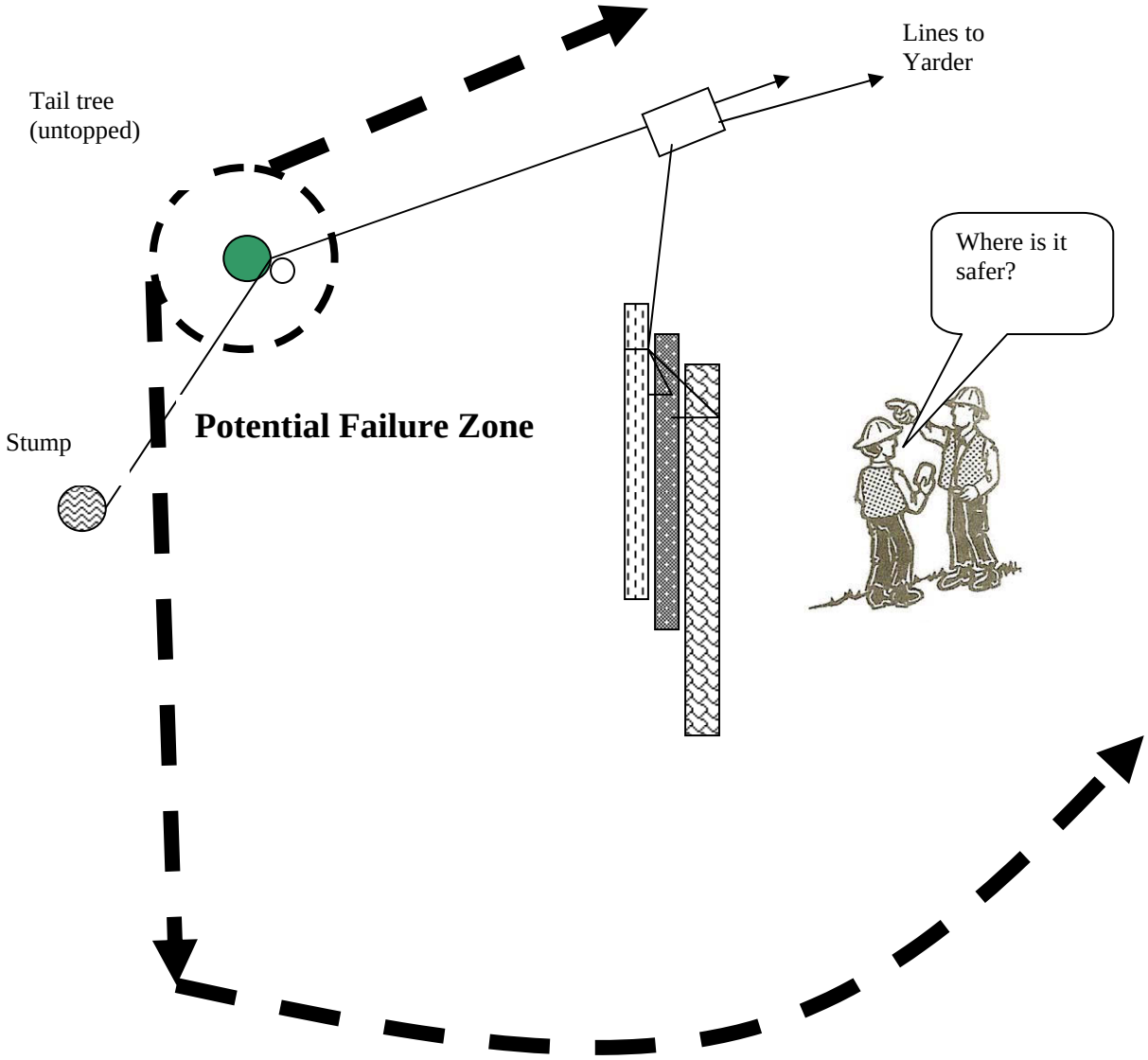




The Potential Failure Zone

Loggers need to be able to estimate where a position "in the clear" would be by identifying the potential failure zone of the operation, especially trees and rigging. The Potential Failure Zone is defined in the Safety Code as:

> **Potential failure zone** – An area that could be impacted by the failure of any part of a standing tree anchor, tail or intermediate support tree as the result of forces or loads imposed on the tree by guylines, running lines or skylines. The boundaries of the zone encompass the area into which the tree or parts of the tree could fall, slide or roll, and all trees, logs, lines and material impacted by the tree failure.



In addition the Safety Code provides some guidance for operating around rigged trees in a specific rule:

437-007-0927 Working Near Standing Tree Anchors, and Tail /Intermediate Support Trees.

1) Affected personnel must be notified of the potential failure zone of any tail tree, intermediate support tree and standing tree anchor.

NOTE: The potential failure zone is that area which could be impacted by the failure of any part of a tail tree, intermediate support tree or standing tree anchor as the result of forces or loads imposed on the tree by guylines, running lines or skylines.

2) The boundaries of the potential failure zone must be determined by a competent person.

3) The boundaries of the potential failure zone must encompass the area into which the tree or parts of the tree could fall, slide or roll and all trees, logs, lines and material that could be impacted by the tree failure.

4) Personnel must be in the clear of the turn and out of the potential failure zone of a standing tree skyline or running line anchor before lines are tensioned.

   NOTE: Personnel may be in the potential failure zone when minor positioning of the rigging is needed or to set chokers.

   NOTE: "Before lines are tensioned" means before:
   a) Logs are moved or suspended.
   b) The rigging or carriage is moved to the landing or returned to the brush.
   c) Lines are tight-lined to clear up the road.
   d) Any movement or tightening of the line(s) other than that needed for minor positioning of the rigging or carriage to set chokers.

5) Personnel working around tail and intermediate support trees must be in the clear of the turn and out of the potential failure zone before lines are tensioned.

   NOTE: Personnel may be in the potential failure zone when minor positioning of the rigging is needed or to set chokers.

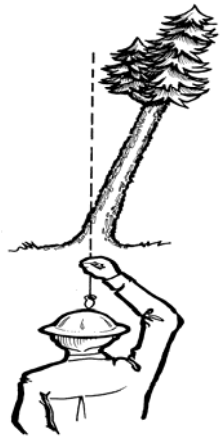
6) If the potential failure zone cannot be determined, personnel must move at least 1 ½ tree lengths from the base of tail and intermediate support trees, and in the clear before lines are tensioned.

7) A competent person must instruct affected personnel in the safe work practices required for work activity in any potential failure zone. This instruction must identify the:
   a) Boundaries of the potential failure zone
   b) Potential for the boundaries of the failure zone to change when line pull and line angles change.
   c) Limitations or restrictions for entering or working in the potential failure zone.

Stability of Trees as Anchors and Support Trees

Trees used to support lines and loads will usually need guylines to keep them stable. The diameter of trees needed to support loads is given in Appendix 7-B of the Division 7 Forest Activities Code. There are conditions when trees do not need guylines for tail trees or single intermediate support trees. Guylines are not required when at the point of rigging attachment the tree does not move more than its diameter in the direction of load as shown in the figure below.

In addition, the tail tree cannot be within reach of workers and the resulting line movement must not pose a hazard to workers if the tail tree failed.



When guylines are required to stabilize the tree, they must be of the size and same material to support the line in tree: 5/8 inch line requires 3/8 inch guylines or larger; for lines greater than 5/8-inch and less than 1-inch, guylines must be at least ½-inch**;** and for 1-inch and larger, guylines must be at least 5/8-inch. Guylines made of synthetic materials, including the end connectors, must have the equivalent strength capacities of wire rope. Tree guylines must not be pre-tensioned beyond the point of tree stability before the load is applied.

A minimum of two guylines must be used on tail trees and located within guying zones to oppose the forces as shown in Figure 7-16 (azimuths 130-150 and 210-230 degrees). Guyline angles from the anchor to the tree must not be greater than 50 degrees measured from the horizontal and arranged and adjusted so they share the load when lines are tensioned. Splicing of guylines is prohibited except to make an eye for an end connection.

At least three guylines are required when the angle of the lines between the tail tree and a tail hold produces an offset of more than 8 degrees between the lines as they enter and leave the tail tree. If a suitable anchor is not available within a specified guying zone, two guylines may be used in lieu of one guyline for that zone provided a guyline is placed on both sides of, and as near as possible to, the affected guying zone. When additional guylines are needed in a tree, they must be placed to oppose the forces.

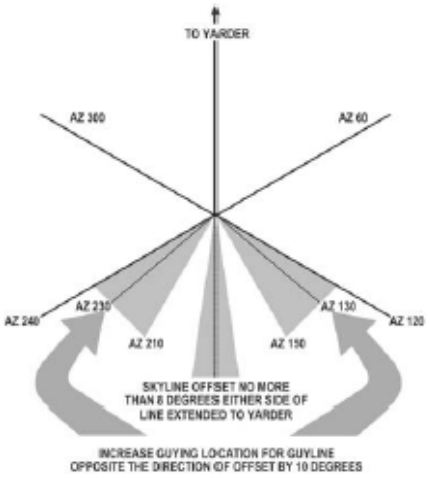
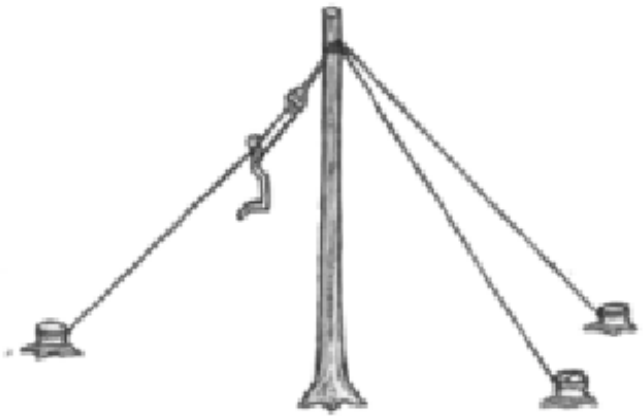
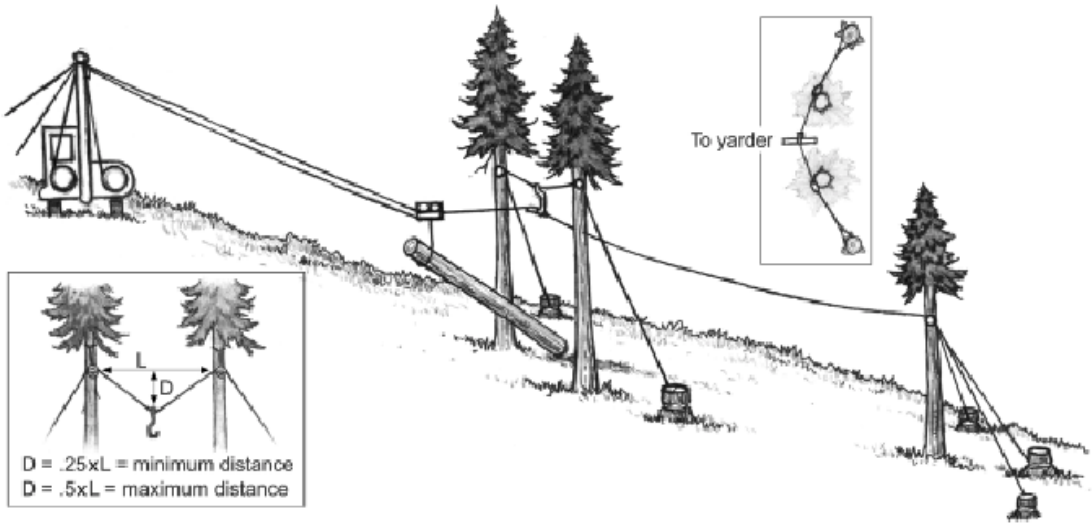


Figure 7-16 – Guylines – Tail Trees

Single tree intermediate supports need guylines opposing the force on the jack when it is loaded.

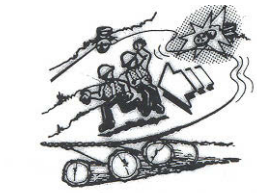


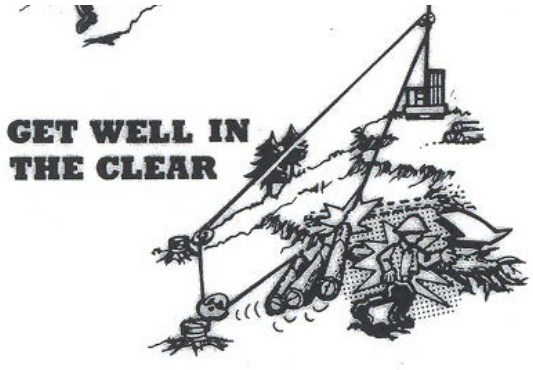
Double tree intermediate supports are designed to be stable without guylines unless a support tree moves more than two feet at the point of rigging attachment.

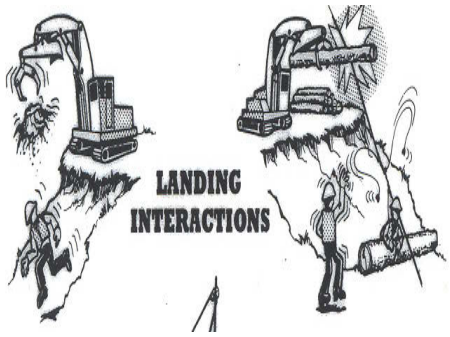


Hazards for the Rigging Crew

The rigging crew faces hazards from the movement of lines and logs, plus the steep slopes themselves are a hazardous work environment. The first step in minimizing hazards is identifying potential situations on the unit. Review the hazards below and develop ways to minimize them using the common sense of your crew.







Solutions to safety and efficiency problems for the rigging crew will depend on the logging system, the terrain and timber, and most of all, on the crew themselves.

Communication with the landing and between rigging crew members is vital. Keep the landing informed where crew members are located at all times. Show the landing team your trails to the work area. Use accepted hand signals when needed.

Never move lines until everyone is “in the clear”. Hold pre-work meetings before beginning the unit to identify hazards and develop solutions.

Arrange the work so no one is put “in the bight”. Select locations “in the clear” when turns break out and move toward the landing. Remove hazards before working in jeopardy, e.g. unstable rootwads, logs, etc.

Keep control of the turn going to the landing. Don’t let hang ups break lines; use techniques rather than horsepower. Build turns up to a safe maximum, but don’t overload the system, lines, stumps, etc.

Face the work and the hazards; watch the turn all the way to the landing. Use proper techniques for pulling line and carrying blocks. Keep your feet on solid footing and be ready to move quickly. Never get in a position where something can fall, roll or slide into you, e.g. setting chokers below logs that might roll.

Everyone on the rigging crew needs to be able to predict how the lines will move, how logs will move, and what to expect from others on the rigging crew. Yarder engineers and loader operators will not do anything to move lines unexpectedly when the crew is setting chokers.

Straps and Rigging

A competent person must inspect all rigging (blocks, shackles, etc.) for damage, cracks or wear including wire and synthetic rope, straps, guylines and other lines before they are used. Repairs or replacements must be made before they are used.

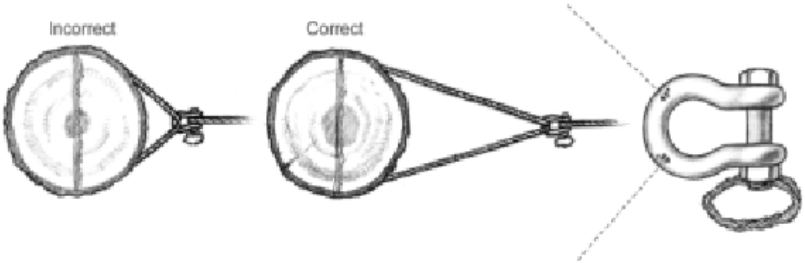
Wire rope must be taken out of service or repaired when there is evidence of chafing, sawing, crushing, kinking, crystallization, bird-caging, corrosion, heat damage, and other damage that weakens the rope or when one or more wires are broken at the base of a poured nubbin or end fitting. Wire rope must be removed from service when 12 1/2 % of the wires are broken within a distance of one lay, except for chokers, cat and skidder winch lines, and carriage droplines that do not move the carriage.

A shackle must have a rated breaking strength greater than the rated breaking strength of the line that they are used with and the manufacturer's rated breaking strength of shackles must be used in determining the size requirements when the make, size and steel classification of the shackle can be identified. Shackles must be 120,000 psi ultimate tensile strength or better.

The shackle pin diameter must be 1/8- inch larger than the indicated shackle size for shackles up to 1 3/4 inches and 1/4- inch larger than the indicated shackle size for shackles 1 3/4-inch up through 3 inches. Replacement shackle pins must meet the manufacturer's original specifications. Shackle pins and nuts must be replaced when the threads are worn or stripped. or when the original diameter is reduced by 15%. Sleeve shackles or choker bells must be used where choked lines are permitted. Sleeve shackles are required for guylines.

Safety pins must secure shackles used to hang blocks, jacks, or rigging on trees, anchor guylines and join guyline or deadman strap eyes. When skylines are attached with a shackle using a knockout pin, the pin must be one size larger than the skyline and secured with a molly, latchpin, or cotterkey large enough to retain the shackle pin. Mollies must be rolled in with the lay of the line. Mollies must not be used to connect eyes of load-bearing lines.

Straps must be of the same or better material than the lines they support. After a strap is passed around an anchor and the two eyes are contained in the "U" part of the shackle, the angle created by the strap eyes must not be greater than 90 degrees. Another guide is that the shackle and eyes must not be closer than the same diameter of the anchor where the strap is attached. When a two part strap or two chokers are used to hang a block, jack, tree shoe, or rigging, both eyes or ends must be under approximately equal tension.



Straight sided shackle w/flush pin, bell shackle with knockout pin/mollie, sleeve shackle with safety pin

Straps or chokers used at or near the ground to hang or support blocks, jacks, tree shoes, or rigging must be sized in accordance with Table 7-7(Div. 7).

Table 7-7
Strap Sizes For Rigging At Or Near The Ground

Skyline or Running Line Size In Inches	Block Hung In Both Eyes	Block Hung In Single Eye	Skyline or Running Line Size In Inches	Block Hung In Both Eyes	Block Hung In Single Eye
5/16	1/4	1/2	7/8	7/8	1 1/4
3/8	1/4	9/16	1	1	1 3/8
7/16	5/16	5/8	1 1/8	1	not permitted
1/2	3/8	3/4	1 1/4	1	not permitted
9/16	7/16	7/8	1 3/8	1	not permitted
5/8	5/8	1	1 1/2	1 1/8	not permitted
3/4	3/4	1 1/8	1 5/8	1 1/4	not permitted

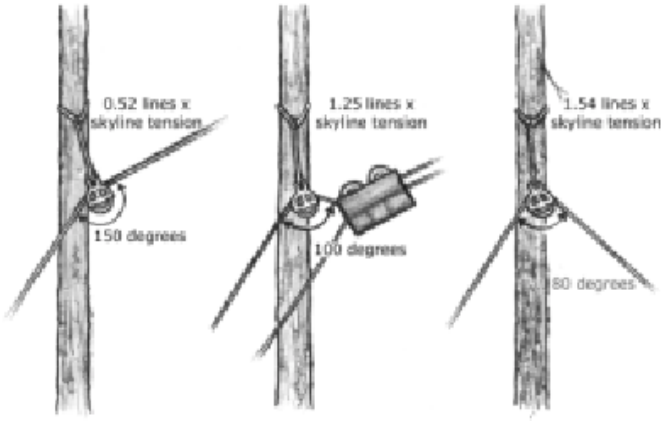
Straps or chokers used to hang or support blocks, jacks, tree shoes, or rigging in tail and intermediate trees must be sized in accordance with Table 7-8 (Div. 7).

Table 7-8
Strap Sizes For Rigging Hung In Tail and Intermediate Support Trees

Skyline Or Running Line Size In Inches	Block Hung In Both Eyes	Block Hung In Single Eye**
5/16	1/4	5/16
3/8	1/4	3/8
7/16	5/16	3/8
1/2	5/16	1/2
9/16	3/8	1/2
5/8	3/8	9/16
3/4	1/2	3/4
7/8	9/16	3/4
1	5/8	7/8
1 1/8	3/4	1
1 1/4	3/4	1 1/8
1 3/8	7/8	not permitted
1 1/2	1	not permitted
1 5/8	1	not permitted
2	1 1/8	not permitted

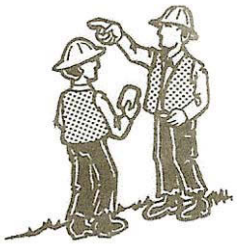
NOTE: Flat angle on skyline through block or jack.

For straps hung in trees where the interior angle (smaller angles between where lines enter and leave the block) create excessive loading on the strap as shown below, additional precautions must be taken, such as using a larger strap, lightening loads, moving the carriage ahead on the line, and so forth to reduce the load on the strap.



Your Obligations as a Supervisor for Safety & Health

As a person in charge of other employees, you are the Employer's agent supervising and directing the work of other employees. You are a supervisor! While you may be doing work yourself and responsible for productive actions of others, you are the primary person responsible for the safety of those who work in your care.



The employer has authorized you to be their representative for implementing the safety and health program including:

- showing the purpose of the safety and health program
- identifying the safety and health personnel implementing the program
- providing ongoing evaluation of employee's safety performance
- implementing a disciplinary policy to address unsafe work practices
- acting as the competent person in your area with authority to supervise all personnel and enforce the safety and health program.

The organization needs to provide you with the resources and training to carry out the management commitment for a safety and health program.

You have specific responsibilities as a supervisor to:

1) Supervise all employees at the site and enforce the company's safety and health program.
2) Verify that all current and new employees:
   a) Can safely perform assigned tasks.
   b) Have received adequate job safety instruction and training.
3) Periodically review the safety performance of each employee.
4) Provide job safety and health instruction, training or disciplinary action to an employee when the employee is working in an unsafe manner.
   NOTE: This training can be limited to the specific information needed to correct the unsafe work practice(s).
5) Closely supervise each employee who is receiving job safety and health instruction and training.
6) Require all employees to demonstrate the ability to safely perform their work task before permitting them to work independently.

Oregon Administrative Rule 437-007-0110.

The Supervisor's Job is an important leadership position for employers and you were chosen because of management's confidence in you. You will be the person employees come to in case of an accident and so your First Aid and CPR (cardio-pulmonary resuscitation) skills need to be current and you should be prepared to use them. You will be involved in hazard identification and elimination, preserving an accident scene, accident investigation, employee involvement, training, evaluating employees and keeping records. You may have some concerns about being a supervisor and should discuss them with your own supervisor to know what is expected of you.

Some supervisors "seem" to know everything about all the jobs they supervise, but that probably is not true. Logging jobs are complex and supervisors cannot be expected to be experts at all logging jobs or even some types of skills needed in logging. Some skills need constant practice to be good at performing them. What supervisors need to know and demonstrate is how to do the task safely and effectively. They need to identify the hazards around each job and how to eliminate the hazard if possible, or take safe actions to protect the workers. Special trainers or demonstrators can help train workers on specific skills needed if their jobs require it. For supervising some jobs you will need to help workers handle difficult circumstances and thus, should be "competent" for example, to tell workers how to fell and buck timber or how to use machines on steep slopes.

Working supervisors may not be comfortable because they are part of a team of workers and the managers are separate and a "we versus them" attitude may be present. When it comes to the safety of forest workers, it is all about US! There can be no barriers to working safely and workers, supervisors, and managers all have the same goal: To come home safely at the end of the day! Supervisors are the key communicators so workers and managers can trust in each other and the supervisor to do what is best for safety and health.

Supervisors may be concerned that they will be grooming someone to do their job if they train another worker. They may get the message that production is above everything. They may be told there is no money for safety. Supervisors themselves may not be good examples of safety

behaviors. They may not want to discipline friends or relatives for unsafe behaviors. Supervisors may be intimidating or be intimidated on the crews. They may shout and not listen to employees. None of these actions can be tolerated by employers in a safe and effective operation. Employees need to trust supervisors; supervisors need to trust managers; and managers need to trust the owners for the safety chain of supervision to be strong.

Supervisors need to know how to **motivate** people by rewarding them for the proper actions and by correcting their improper actions immediately and using disciplinary procedures to assure compliance. However, supervisors need to know what **de-motivates** people as well. Rewarding someone for improper actions (like ignoring safety violations for selected workers) or punishing a worker for doing the right action (not responding to workers who bring up safety issues) is de-motivating. De-motivating actions spread distrust throughout the organization like a wildfire.

The supervisor's overall safety responsibility is to identify hazards and unsafe worker behaviors and correct them before an accident occurs. There is no more important job.