

Fatality Investigation Report

OR 2003-6-1

Logger killed by falling sheave when yarder tower collapses

SUMMARY

On April 18, 2003, a 42-year-old logger, working as a [chaser](#), was killed while standing on the landing site during a [cable yarding](#) operation. A Madill 071 [yarder](#) was in the process of completing a [turn](#) when the tower collapsed. The tower fell on the boom of a [delimber](#) that was also operating on the [landing](#) site. The force of the impact caused a sheave (cable pulley guide) to shear off from the side of the delimeter's boom. The falling sheave struck the chaser on the head, and punched through his hard hat. Life Flight was summoned. The victim was pronounced dead at the scene shortly after emergency help arrived.



When guyline support failed, the yarder tower fell onto a nearby delimeter (right).

CAUSE OF DEATH: Acute trauma to the head

RECOMMENDATIONS

- **Plan the landing site for yarding requirements beforehand. Make sure nearby anchor stumps are left at an appropriate height to secure [guylines](#), and the guylines will not interfere with [decking](#) the logs at the landing.**
- **Set up yarder guylines according to manufacturer's recommendations, making sure lines are at no more than a 50-degree angle, equally sharing the load, and secured by additional support for the anchors.**
- **Check integrity of the guyline anchors daily, before and during operation.**
- **Maintain proper deflection in the [skyline](#) to reduce stress on the yarder tower.**

INTRODUCTION

Shortly after 7 a.m., on April 18, 2003, a 42-year-old logger, working as a chaser, was killed when a yarder tower collapsed during a cable yarding operation. OR-FACE was notified of the incident by OR-OSHA, through the Department of Consumer & Business Services, on April 21. An OR-FACE investigator visited the site and interviewed the employer on July 8. The equipment was in the same position as the day of the incident. This report is based on the OR-FACE investigation, reports from OR-OSHA, the county sheriff, and medical examiner, and expert consultation. Recommendations were drafted with the assistance of an experienced logger and logging safety expert.

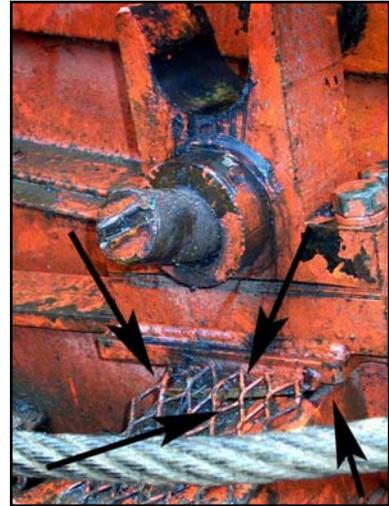
The yarding operation was being conducted on a private tract of second-growth timber, which had been clearcut. The logging company had six employees at the site, and two others working as cutters. The employer was also onsite. The chaser had been on the job 6 weeks. The company had a written safety program, but no safety committee.

INVESTIGATION

The timber on the unit being logged consisted of 20-22 inch dbh (diameter at breast height) Douglas fir. A Madill 071 yarder was used to yard the felled timber to the landing site. A delimeter was located on the landing as well.

The chaser's regular duties included unhooking the turns of logs that were yarded onto the landing, and also [bucking](#) and limbing logs that the delimeter could not handle. At the time of the incident, the chaser was standing to the front left of the delimeter, near the cab. The position was considered a safe spot on the landing, according to a coworker and the employer.

The crew was sending in a [turn](#) of four tree-length logs when the incident occurred, according to the OR-OSHA report. The report states that the logs hung up on a stump in the road line, which put stress on the yarder tower. The back-right [guyline](#) came off of its stump, which increased pressure on the next stump to its left, and that guyline came off of its stump as well. With two guylines down, the other two guylines could not hold the tower in its upright position.



Tower hinge and box beam (arrows) broke, allowing tower to come down.



Anchor stump #1. The cable pulled over the top of the stump. Note proximity of log deck to stump (see Recommendation #1).



Anchor stump #2. Fresh dirt indicates the stump pulled out of the ground and released its guyline.

The tower fell forward in the direction of the turn, striking the boom of the delimeter, operating in front of and below the yarder. A [sheave](#) located midway along the boom, attached by a solid steel pin (about 1 3/8-inch diameter), sheared off and was forced downward, though still attached to the cable running through it. The sheave struck the chaser on the head and punched through his hard hat.

Tower stability in a skyline yarding operation involves several primary factors: skyline [deflection](#), skyline braking, and the size of turns and anchorages. It is unclear if the tower failure in this incident was the immediate result of the tower setup, or in the guyline setup. An engineering failure analysis would be necessary to isolate the initial cause of the incident.

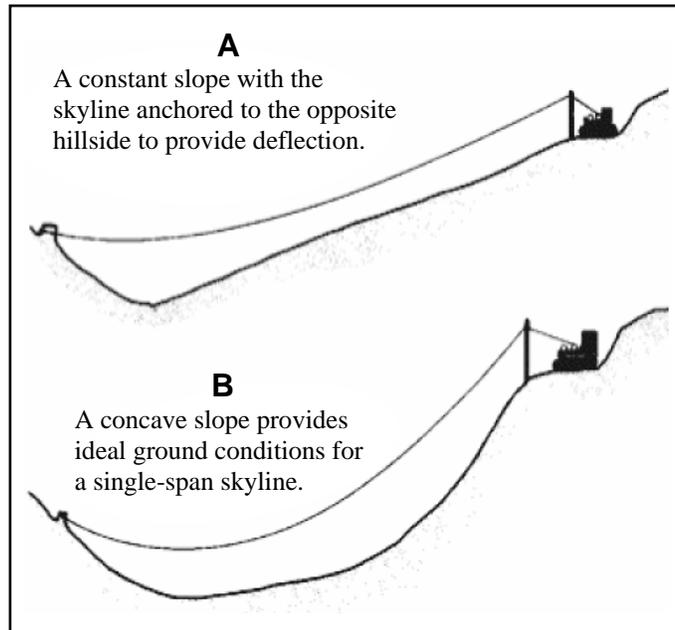


Illustration of proper deflection in skyline cable (Source: Garland, 1997).

The employer believed the skyline deflection on the setup was appropriate for the size of trees in the turns and for the loads exerted on the skyline, while OR-OSHA called the deflection “minimal.”

The two anchor stumps that failed were both 20-22 inch [dbh](#) Douglas fir, 35-40 years old. The third and fourth anchors were guyed off to notched stumps and [double-tied](#) back to green trees. The employer reported checking the anchors daily, during the course of several turns, for signs of failure. One logging expert consulted in this investigation believed the notch cut into the first stump was in the root swell and not in the holding wood, and this may have contributed to the tower failure.

RECOMMENDATIONS/DISCUSSION

Recommendation #1. Plan the landing site for yarding requirements beforehand. Make sure nearby anchor stumps are left at an appropriate height to secure guylines, and the guylines will not interfere with decking the logs at the landing.

Sufficient stump height for guyline anchors must be available around a landing site. In this incident, one guyline was evidently attached to the bowl of the stump, with not much room above the notch, which may have contributed to the guyline pinching off the top of the stump and coming loose.

When planning units, it is also important to give the logger sufficient space around the landing to deck the logs waiting to be shipped. Make sure the decking areas do not interfere with the guylines in any way. A guyline can possibly shake loose when bumped.

Recommendation #2. Set up yarder guylines according to manufacturer's recommendations, making sure lines are at no more than a 50-degree angle, equally sharing the load, and secured by additional support for the anchors.

When setting up the tower, it is important to make sure the guylines are not steeper than 50 degrees, measured horizontally. An angle steeper than 50 degrees puts more downward pressure on the tower, rather than pressure to hold the tower from tipping forward under the weight of the skyline. The downward pressure can cause the tower to buckle if a turn is too heavy. If guylines must be rigged steeper than 50 degrees, the operator needs to back off on turn size.

It is also important that the guylines are placed into the proper guying zones. Zones are spelled out in the manual that came with the yarder, or can be found in OR-OSHA (2005) regulations. If guylines can not be placed into these zones, because of obstructions or lack of good anchors, the operator needs to place additional guylines to share the load of the guyline that cannot be placed within its zone.

All guylines must share the load being placed on the tower. Guylines attached to anchors at different distances from the tower need to be tensioned, so all guylines share the load equally. Guyline anchors that are closer, for example, need to be set slightly looser than those that are farther away, so the guylines will all have the same tension on them when the tower is under load.

Use only healthy trees or stumps as anchors. Cut notches for guyline cable placement 1½ times the circumference of the cable, and no more, to ensure the cable stays in the groove, without reducing the integrity of the anchor. A deeper notch effectively decreases the diameter and holding power of the stump, and increases the risk of parts [slabbing](#) off.

If notching will be too deep (or too high or too low) on anchor stumps, consider alternative guyline anchorage systems. Trees harvested today are smaller than their predecessors, and the use of [tie-back anchors](#) and other alternatives for additional support for the guyline anchor is not uncommon. Alternatives for securing guylines and stabilizing the tower include (but are not limited to): use of heavy logging equipment, logs placed in open trenches (“deadman”), tie-back stumps, or specialized equipment such as tipping plates.

Recommendation #3. Check security of the guyline anchors daily, before and during operation.

Stumps used as anchors should be observed daily for signs of failure: pulling out of the ground, slabbing off, becoming loosely attached, wire rope eating too deeply into the notch, and so on. Check anchors (stumps) while the operation is in progress. Do not attempt to continue logging operations if an anchor stump/tree shows signs of failure.

Recommendation #4. Maintain proper deflection in the skyline to reduce stress on the yarder tower. Consider using slightly less pressure on the skyline brake.

Insufficient deflection (sag) in the skyline may have been a contributing factor in this tower failure. Deflection helps to absorb and dissipate forces exerted upon the skyline during the yarding cycle. With insufficient deflection, the forces on the tower will be transferred directly onto the yarder guylines and anchors. If the operator is unable to achieve proper line deflection, [payloads](#) on the skyline should be backed off.

Also in this incident, a hangup may have increased pressure on the yarder tower. By using slightly less pressure on the skyline brake, the skyline will reel out in the event of an overload situation. A brake will hold tension in the skyline, but under extreme tension will slip and reel out more skyline to increase deflection and load capacity. The operator needs to be careful when using this method when minimal lift is involved, as the carriage can hit the ground if the skyline reels out too fast, or too much.

REFERENCES

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GLOSSARY

Bucking: To saw felled trees into shorter lengths.

Cable yarding: The movement of felled trees or logs from the area where they are felled to the landing on a system composed of a cable suspended from spars and/or towers. The trees or logs may be either dragged across the ground on the cable or carried while suspended from the cable.

Chaser: Member of a logging crew who unhooks the logs at the landing and does other odd jobs.

Dbh: Diameter at breast height.

Deck: A pile of logs on a landing.

Deflection: Vertical distance between the skyline, measured at midspan, and the straight-line “chord” between the two endpoints; frequently expressed as a percentage of the horizontal span length

Delimber: A multifunction machine used to delimb trees and arrange logs in piles on the ground.

Guyline: An anchored line used to support a tower or spar in yarding operations.

Landing: Flat ground where logs are yarded and loaded on transport; a collection point for logs.

Payload: Gross weight of a loaded vehicle minus the weight of the vehicle itself.

Sheave: A wheel or disk with a grooved rim, especially one used as a pulley.

Skyline: Cableway stretched taut between two spar trees and used as a track for a skyline carriage.

Slabbing: When a stump or tree crushes under pressure and a lateral split in the grain sheers off.

Tie-back anchor: Additional anchor tied to the main anchor stump to reduce pressure on the root system of the main stump (*double-tied* indicates two tie-back anchors).

Turn: Any log or group of logs attached by some means to power and moved from a point of rest to a landing.

Yarder: System of power-operated winches used to haul logs from a stump to a landing.

For More Information

The Center for Research on Occupational and Environmental Toxicology at Oregon Health & Science University performs Fatality Assessment and Control Evaluation (FACE) investigations through a cooperative agreement with the National Institute for Occupational Safety and Health (NIOSH), Division of Safety Research (DSR). The goal of these evaluations is to prevent fatal work injuries in the future by studying the working environment, the worker, the task the worker was performing, the tools the worker was using, the energy exchange resulting in fatal injury, and the role of management in controlling how these factors interact.

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