



# CHAINSAW FELLING FATAL ACCIDENTS

P. A. Peters  
MEMBER  
ASAE

## ABSTRACT

Logging may be the most dangerous occupation and felling trees with a chainsaw is the most dangerous of logging activities. The major causes of felling fatalities are a hangup fell (26%), poor felling technique (15%), butt rebound (11%), broken limbs or tops (11%), working too close (11%), a snag fell (8%), and struck from behind (5%). Felling into standing timber, a general category that includes hangup fell, snag fell, butt rebound, and broken limbs or tops, accounted for 56% of the felling fatalities.

Compliance with the proposed Occupational Safety and Health Administration (OSHA) safety standard would improve the safety record for the causes of a hangup fell, working too close, poor felling technique, and a snag fell; other causes may require a better understanding of the hazards. Accidents resulting from a felled tree hitting another tree are poorly understood and the data necessary for understanding are infrequently reported in accident investigations. The author suggests the data to be reported and a hazard recognition procedure to be practiced before felling each tree. **KEYWORDS.** Logging, Safety, Forest engineering.

## INTRODUCTION

The Occupational Safety and Health Administration (OSHA) recently has proposed a national safety standard for logging operations, (OSHA 1989). Comments on the proposed standard were received 31 July 1989. The final standard is scheduled for publication in February 1992. In the justification for the proposed standard, OSHA summarized the risk to workers in the logging industry:

- Workers in logging have a higher risk of injury than workers in most other industries.
- If they are injured, loggers have a greater chance of losing workdays.
- When they are injured, their injuries are much more serious and result in much more lost time than do the injuries of most other workers.
- Workers in logging have a higher incidence of fatalities than workers in other industries.

Comparing fatality rates of various occupations, Leigh (1987) identified logging as the most dangerous

occupation, with an annual fatality rate of 129 per 100,000 workers; airplane pilots were second with 98 per 100,000; mining, considered a very hazardous industry, was twelfth with 38 per 100,000. By comparison, the fatality rate for all industries from 1980 to 1985 was 7.9 per 100,000 workers (NIOSH 1989). Leigh's data was widely publicized in *Parade Magazine*, "Is Your Job Killing You?", by Ubell (1989).

Logging is one of the most dangerous occupations and felling trees with a chainsaw is the most dangerous of logging activities. Wolf and Dempsey (1979) reported that 38% of the nonfatal injuries in the Appalachian area occurred to fellers. In 37% of the cases, the worker was hit by a tree or limb. A survey of 1,086 injured workers by the Bureau of Labor Statistics (1984) revealed that 37% were fellers, 53% of the accidents occurred at the cutting site, and 24% of the injured were described as being hit or crushed by a limb, tree, or log. Wimble (1990) reports that of the \$1.5 million paid in accident claims by NORTIM Corporation in 1989, 36% of the accidents were caused by being hit by a falling object.

Adoption of OSHA's proposed logging safety standard should make logging a safer occupation. But there also is a need for better understanding and recognition of the hazards of felling timber with a chainsaw. OSHA (1988) has described 104 logging fatality cases in the "OSHA Report" using OSHA fatality investigation reports as a source. In 65 of the 104 cases, the victim was hit by a tree or limb while working at the felling site. As a step toward better understanding of the hazards associated with felling trees, this paper presents an analysis of the 65 fatal felling accidents described in the "OSHA Report".

## DESCRIPTION OF THE "OSHA REPORT"

The "OSHA Report" describes 104 separate cases involving 105 fatalities. Cases correspond to compliance-officer fatality investigations filed with OSHA Area Offices under federal jurisdiction. This article is concerned with the 65 cases in which felling was a principal activity. Information reported for each case included the sex (all males) and job description of the victim, the SIC Code, and the time, date, and a narrative of the incident. The narrative varied in detail from case to case. Much of the information used in this article was obtained from the narratives which, for most of the cases, reported parties involved, age of the victim, activity at time of accident, object that struck the victim, whether a snag or a hangup was involved, and factors contributing to the accident. Tree species and diameters, and worker experience were reported for some of the cases. Tree heights, distance between felled and hit trees, and ground slope were rarely reported.

---

Article was submitted for publication in February 1991; reviewed and approved for publication by the Emerging Technologies Div. of ASAE in August 1991. Presented as ASAE Paper No. 90-7536.

The use of trade or firm names in this publication is for reader information and does not imply endorsement by the USDA of any product or service.

The author is Penn A. Peters, Project Leader, USDA-Forest Service, Northeastern Forest Experiment Station, Morgantown, WV.

person who limbs the trees he has felled is called a feller. A limber is one who cuts limbs off the felled tree, cuts the unmerchantable top off, and cuts the stem into products (also commonly called buckers, trimmers, delimiters, or limber sawyers). A logger is one employed in getting timber products from the stump to the mill; "logger" is used in this article when a more specific occupation could not be identified. A skidder operator is one who operates a skidder and may set his own chokers.

Seventy-four percent of the fatal accidents occurred when a feller was working alone; 5% with a limber working alone. Twenty-one percent of the fatal accidents occurred when at least two people were involved; 9% involved two fellers, 5% a feller and a limber, 3% a feller and a skidder operator, and 4% other combinations (fig. 2b).

Eighty-three percent of the accidents occurred when felling was the principal function being performed, 15% occurred during limbing (fig. 2c). Many of the accidents while limbing resulted from a hangup falling on the limber. All accidents involving hangups were considered felling related.

In 93% of the cases in which responsibility was assigned, the feller was at least partially responsible for the accident; 80% of the time he was solely responsible (fig. 2d). In 9% of the cases, there was no responsibility assigned. Responsibility is used in the sense that there may have been some action the individual could have taken that would have prevented the accident; it does not imply legal liability.

### FACTORS CONTRIBUTING TO AN ACCIDENT

When possible, the factors contributing to an accident were identified (fig. 3). The major factors were: a hangup fell on the victim in 26% of the cases; poor felling technique was used in 15%; the butt of the felled tree rebounded into the feller in 11%; broken limbs or tops from the felled tree or a hit tree struck the feller in 11%; working too close to the feller in 11%; a falling snag struck the victim in 8%; and a limb, top, or uprooted tree fell forward striking the feller from behind in 5%. In 14% of the accidents, the contributing factor was unknown or was due to some other factor. In the following sections, each of these factors is considered individually because the danger zone is unique for each factor and the hazard may be recognized by the characteristics of the timber stand.

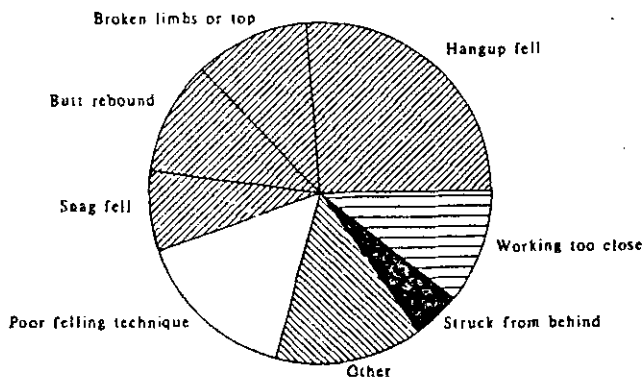


Figure 3—Principal factors contributing to an accident.

### HANGUP FELL

A hangup fell on the victim in 26% of the cases. "OSHA Report" Case 44 is typical of the consequences of walking under a hangup:

A logging crew was cutting trees. Apparently one logger had cut a tree and it had become lodged in another tree.

The logger, apparently, was walking to another area to continue cutting when the hung up tree became dislodged and the top eight to ten feet of the falling tree struck the logger. His hard hat was split and he sustained a fatal fractured skull.

There were no witnesses. The logger was experienced. The logging crew had been cautioned to be careful of lodged trees, approximately fifteen minutes prior to the incident.

In some cases, the worker was limbing felled trees under a hangup which fell on him. Two types of accidents involving hangups were not included in this category. They were 1) felling a tree with a hangup in it, and 2) felling a tree into a hangup with the hope of dislodging it. These accidents were attributed to poor felling technique.

Hangups should be identified clearly and pulled down with mechanical equipment at the earliest opportunity. Immediately, the feller who created the hangup should alert other coworkers. The frequency with which hangups are implicated in fatal accidents suggests they are very difficult to see or the danger is greatly underestimated.

The danger zone associated with a hangup consists of a pie-shaped area with the center at the base of the hangup, radius equal to the length of the hangup, and circular arc length equal to twice the crown of the hung tree (assuming it could roll off in either direction) plus the crown of the support tree (fig. 4). The proposed OSHA standard states, "Lodged trees shall be marked and lowered to the ground using mechanical or other safe techniques before any work is continued within two tree lengths of the lodged tree."

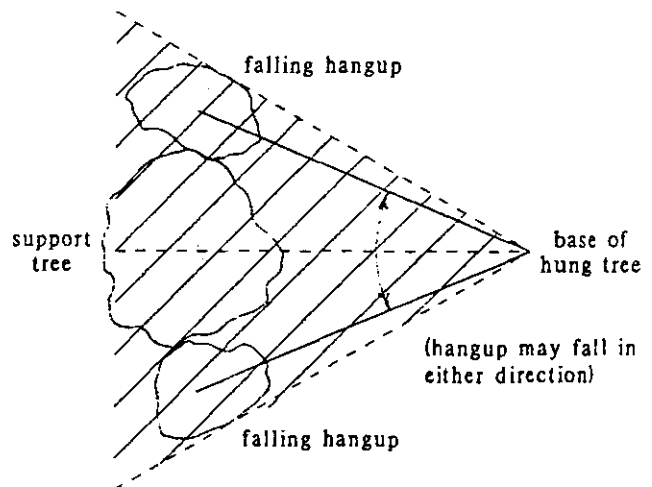


Figure 4—Danger zone associated with a falling hangup.

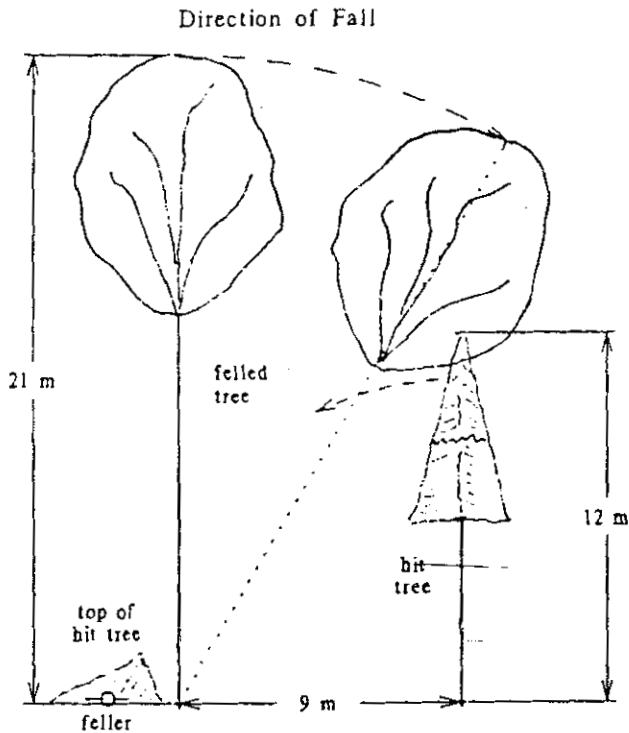


Figure 6—Feller struck by a broken top.

The operator was struck on the front of his head by the 4-in. diameter section. An ambulance was called and arrived on the scene within ten minutes. The coroner pronounced the sawyer dead on the scene.

The sawyer was not wearing a hard hat.

The geometry of "OSHA Report" Case 74 is shown in figure 6. This is the only case for which the heights of the felled and hit trees and the distance between them were given. Apparently, the base of the crown of the felled tree hit the top of the crown of the hit tree, breaking out the top of the hit tree which was thrown back at the feller.

In other cases, limbs were broken off the felled tree or the hit tree and were thrown back hitting the feller. Information from the few cases available suggest that larger and older trees may be a factor in causing broken limb accidents.

The danger zone is a rectangular area with centerline along the direction of fall with width equal to the crown width of the felled or hit tree and length from the hit tree to some distance behind the felled tree (total length at least as great as the height of the shorter of the hit tree or felled tree) (fig. 7). Notice that the recommended retreat path could be in the danger zone.

#### WORKING TOO CLOSE

Working too close was used to describe a fatality when a co-worker was hit by the felled tree as it fell. It was a contributing factor in 11% of the cases. In the majority of cases, a limber was working too close to the feller and was hit by the felled tree; in some cases, another feller walked into the area as the tree was falling; in others, a skidder operator drove into the area and stepped out of the cab as the tree fell. In a number of cases, the feller, aware of co-

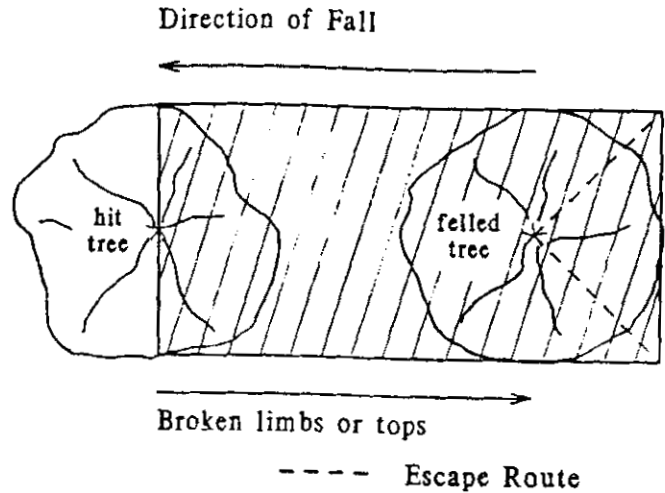


Figure 7—Danger zone associated with broken limbs or tops.

workers in the area, exercised poor judgment. In most, however, the feller was unaware of co-workers in the area. The burden of responsibility in most of these accidents was on the co-worker. The proposed OSHA standard states, "Employees shall not approach a feller closer than twice the height of trees being felled until the feller has acknowledged that it is safe to do so." The danger zone of a felled tree consists of a circle with center at the stump of the felled tree and radius equal to the height of the felled tree. "OSHA Report" Case 94 is an example:

Two sawyers were working in the same area felling trees. One of the sawyers had notched a tree to fall northwest. As he was sawing it, the wind or some other force caused the tree to fall in an undesirable direction.

The sawyer working on the tree got his saw pinched by the falling tree but it was freed by the action of the fall. It was after this that he noticed that the tree had fallen on the other sawyer. He and another worker freed the trapped sawyer by sectioning the tree. They evacuated him by stretcher to where he could be taken to the hospital by ambulance. However, the sawyer died at the hospital.

#### SNAG FELL

A snag fell on the victim in 8% of the cases. "OSHA Report" Case 48 is typical:

The sawyer had just felled an 80-ft tall, 30-in. diameter at the stump red fir tree. The force with which it struck the ground was apparently sufficient to dislodge a dead snag tamarack tree previously supported by nearby cedar trees.

The dislodged snag fell striking the sawyer and knocked him approximately 16.5 ft down the 30° slope. The sawyer was found by coworkers. The sawyer had a broken neck.

The sawyer had been employed by this company for six weeks, but had previous logging experience. He was wearing a hard hat.

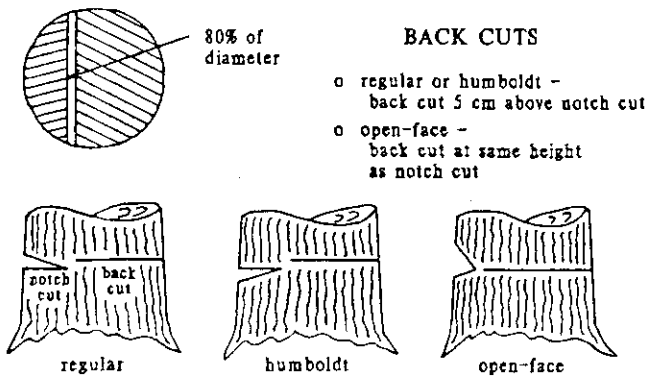


Figure 9—Notch cuts.

**DIRECTION OF FALL (DOF)**

The planned direction of fall (DOF) is subject to many practical constraints such as ownership boundaries, roads, and power lines. On steep terrain, timber often is felled downhill to avoid accidents; hangups occur less easily, too. In some stands, trees are felled on the contours to minimize breakage. In addition to these considerations, the planned DOF should be selected to avoid the hazards of tree rebound, breaking limbs or tops, and trees being pulled over from behind. Having selected the planned DOF, the feller must control it with a safe felling technique.

The hazards associated with felling a tree in standing timber relate to the direction of fall (DOF). If the actual DOF is not the planned DOF, the feller is exposed to hazards he has not anticipated. In the extreme, the tree may sit back and fall backward. It is unlikely that the most careful feller would know the hazards from this new

direction. Therefore, it is extremely important that the feller maintain control over the DOF.

Control of the DOF is achieved by making the notch cut perpendicular to the expected DOF. The best chainsaws have a sightline that, when aligned with the desired DOF, places the notch cut perpendicular to the DOF. The three most popular notch cuts (regular, humboldt, and open-face) are shown in figure 9 (APA 1988). The notch should be deep enough that the width of the holding wood is approximately 80% of the tree diameter. The notch cut is followed by a back cut to fell the tree, the holding wood should not be cut through completely, or control of the DOF will be lost. The regular and humboldt cutting methods recommend a backcut 5 cm (2 in.) above the notch; the open-face cutting method recommends a backcut at the same height as the notch. Felling techniques have been developed for tree lean, wind, asymmetrical crowns, and asymmetrical weight distribution. For detailed discussion, see Conway, 1973; Tilton Equipment Company, 1988; APA, 1988.

Many fellers have lost their lives because their felling technique was poor and the DOF was not controlled.

**INVESTIGATION REPORTS OF THE FELLED TREE-HIT TREE ACCIDENT**

Additional data in the narrative of the incident in the "OSHA Report" would have been a great help in reconstructing what happened and in developing guidelines for recognizing the hazards of felling a tree into another tree(s). The data required in the reports are felled tree height and species, hit-tree height and species, horizontal distance between trees, and elevation difference between trees or ground slope. Although not absolutely necessary,

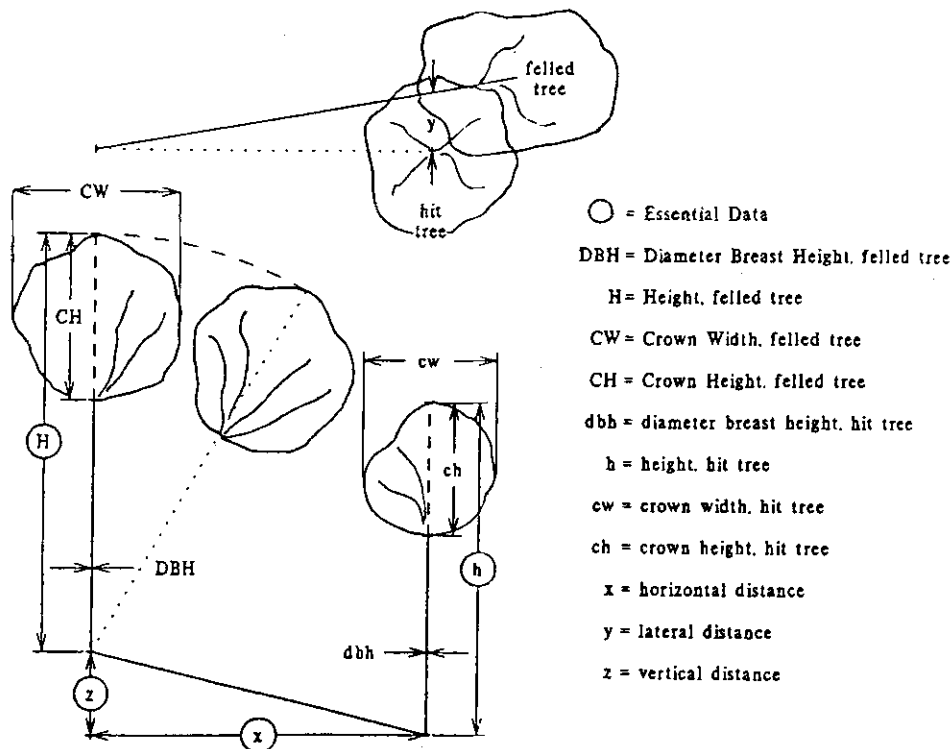


Figure 10—Investigation report data for felled tree-hit tree accidents.

### Snags

- NEVER work within the falling radius of a snag.

### Widowmakers

- CHECK overhead for broken or dead limbs that may fall without warning, particularly when felling a tree and driving in wedges.

### Falling

- See Hangups, Snags, and Widowmakers
- PLAN the DIRECTION OF FALL to avoid hitting another tree or trees, if possible.
- BE AWARE of these hazards with respect to the DIRECTION OF FALL, should the felled tree hit another tree:
  - From the Back: You are in danger from broken or dead limbs, from part of the tree behind you breaking off, or from the whole tree behind you being pulled over. You are especially at risk if both trees are hardwoods, trees are large, branches intertwine, or trees have vines in them.
  - From the Side: You are in danger from broken or dead limbs. The danger signals are: both trees are hardwoods, trees are large, branches intertwine, and trees have vines in them.
  - From the Front: You are in the greatest danger from this direction. You could be struck by broken limbs and tops or from the rebounding of the falling tree.

a) broken limbs and tops: If the falling tree sideswipes or hits the top of another tree, limbs or tops may be broken out of either tree and thrown back at you. You are especially at risk if the falling tree is a large hardwood.

b) falling-tree butt rebound: If the falling tree hits the top of another tree or trees, the falling tree may be thrown back and swung sideways. You are especially at risk if the falling tree is a conifer or a hardwood with a small crown and hits a shorter hardwood with a large crown, a forked tree, or two trees close together. Resist the temptation to knock down a small tree (or trees) by felling a large tree into it. This practice may be a factor in this type of accident.

### A NOTE OF WARNING

Since the hazards associated with a felled tree's hitting another tree are relative to the DIRECTION OF FALL, it is extremely important that the feller have control over the DIRECTION OF FALL by good felling technique. The author recommends the open-face notch method made popular by Soren Eriksson and used extensively in the "Game of Logging" training program (Ard, 1990). Other acceptable methods are the regular notch and humboldt methods.