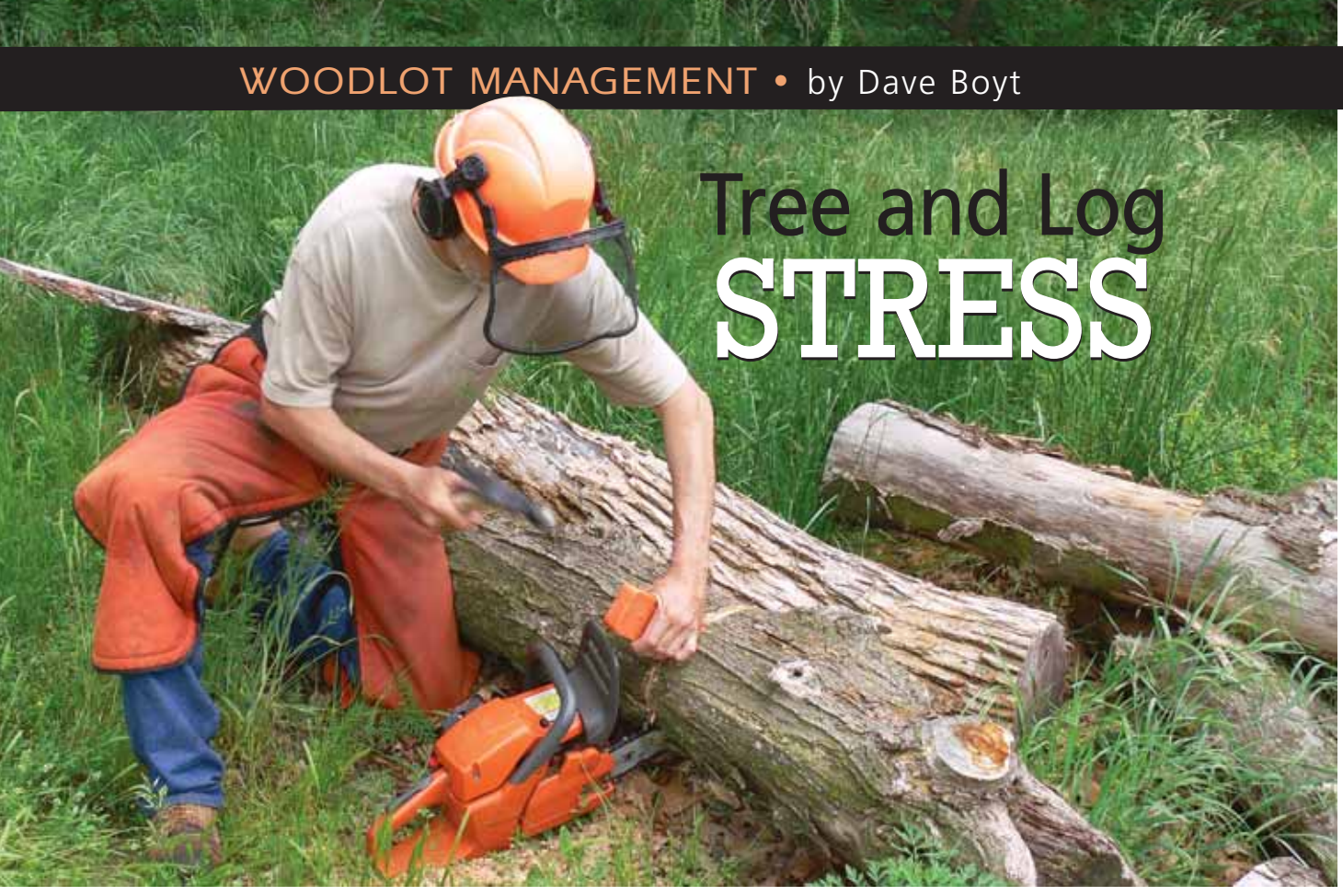


Tree and Log STRESS

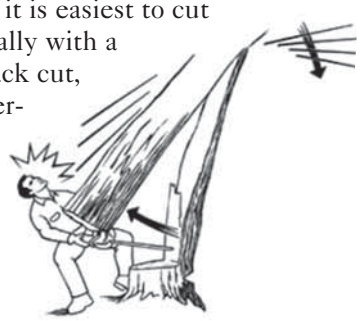
. . . or, "How to NOT Get Your Chain Saw in a Bind!"

If you think cutting with a chain saw is stressful, imagine what it must be like for the tree! Tension, compression, shear, and torsion all need to be resolved with every cut you make, or you just might find yourself (well, your chain saw at least) in a pinch. Applying a very basic knowledge of stress helps to visualize and predict just how a tree or log will react when cut.

PINCH #1: Felling

The easiest stresses to visualize with are tension and compression. Even a perfectly balanced tree trunk is a complex structure of tension in the outer layers of wood and compression toward the center, with the juvenile wood in the center being under extreme compression. This gives the trees the properties of a prestressed column, which is structurally stronger than a simple column.

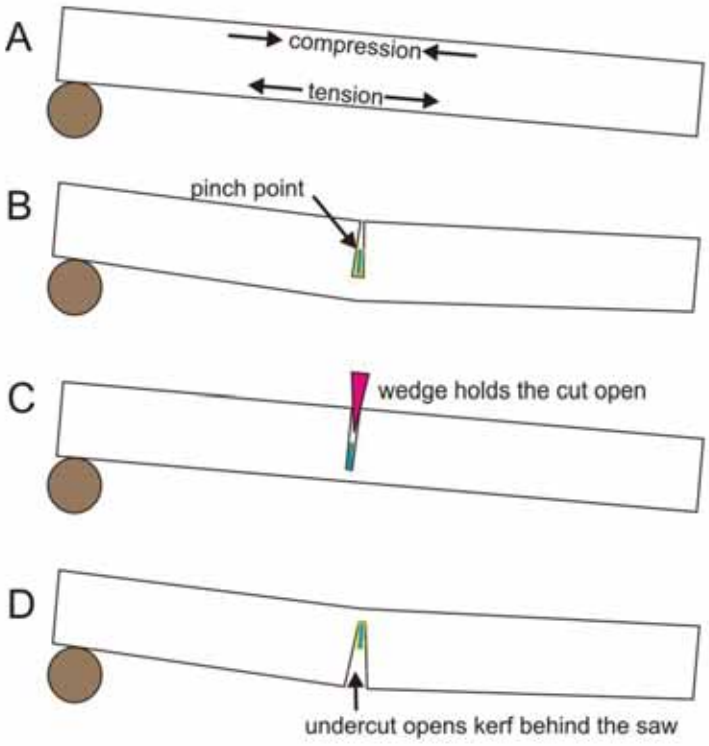
In the real world, trees lean and have an uneven branch distribution. When practical, it is easiest to cut the tree in the direction that it "wants" to go, but even that can have its hazards, especially with a heavy lean or branch imbalance. Many loggers cut a narrow hinge and then make the back cut, continuing the cut as the tree falls to avoid splitting out the wood in a violent and dangerous "barber chair." At best, this puts the logger in a dangerous place next to the tree while it falls. At worst, the stress splits the tree up the trunk, which puts the logger at extreme risk when it breaks off and comes crashing down sideways to the stump. The greater the lean and/or branch distribution, the sooner the hinge starts to give way, and the greater the risk. To see the effect, just key in "tree barber chair" as a search on YouTube and observe from a safe place in front of your computer monitor.



Left: If you suspect back lean on a tree, drive in a wedge behind the hinge to hold it off your saw while you finish the cut. Then drive in the wedge to topple the tree over (it may take several wedges).

Whether using the "Humboldt notch," favored by West Coast loggers, or the top notch more common in the central and eastern hardwoods, the idea is to create a wide hinge that not only controls the direction of the fall, but also allows the logger to bore cut through the center of the tree (just behind the hinge) to relieve the high tension in that area. A wide angle hinge bends with the tree as it falls all the way to the ground and is less likely to pull fibers out of the center of the log (and cause the loss of valuable wood) or initiate a barber chair turning the entire log into a big piece of firewood. The bore cut allows the logger to focus exclusively on making a good hinge while there is still plenty of wood to hold the tree. With the tree sitting on the hinge (in compression) and the back strap (under tension), all the logger needs to do is to finish cutting the back strap from a standing position and walk along a predetermined escape route as the tree falls.

With a back lean, the hinge is under tension and the back strap is in compression. Many a chain saw bar has been pinched when the tree settles back on it. To avoid this, drive a plastic felling wedge (never use a metal wedge) or two into the saw kerf behind the hinge before cutting the back strap. After cutting the back strap, driving wedges in further will topple a tree with a slight-to-moderate back lean in the desired direction. Using this technique, a tree with a heavy lean can be pushed or pulled over in a controlled manner with the chain saw operator safely out of harm's way.



A simple beam is supported on both ends. Gravity puts the top of the beam under compression and the bottom in tension (A). These are equal but opposite forces. Cutting from the top results in compression against the chain saw bar, pinching it (B). Driving a logging wedge in the top (C) holds the compression off the bar, allowing you to finish the cut. Another strategy is to cut from the bottom up (D) allowing the tension to pull the cut open as you complete it.

PINCH #2: Simple Beam

In engineering terms, a simple beam is one supported on both ends. The top of the wood is in compression, and the bottom is under tension. Cutting straight down through the log decreases the amount of holding wood, increasing both compression and tension stress on the remaining wood. When the stress exceeds the limit of the wood—around 7,000 pounds per square inch (psi)— the uncut wood under the bar fails, and the top of the log clamps down on the bar, locking it firmly in place. When that happens, it may be possible to free up the bar by driving in a felling wedge, but the usual course of

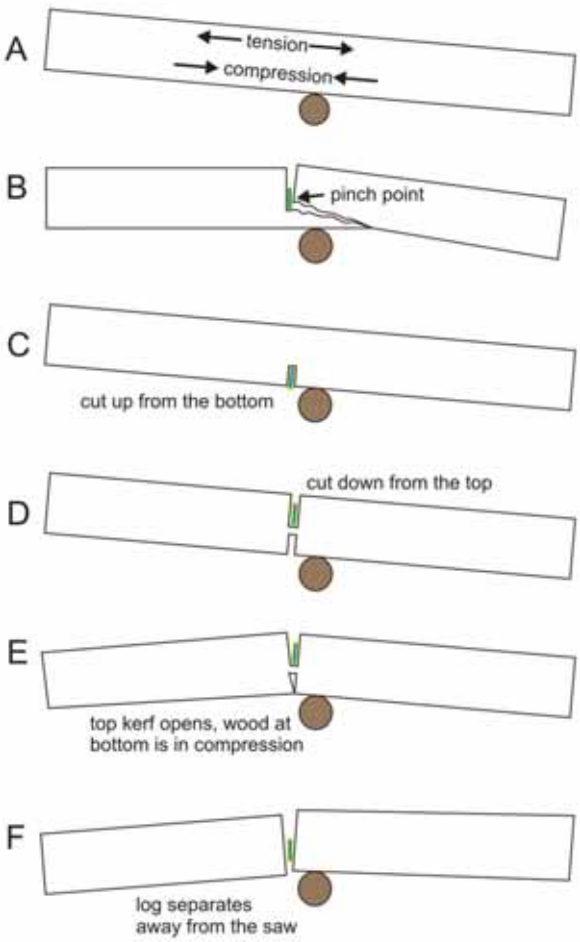
With the wedge in place, you can finish cutting a simple beam without pinching the bar.

action is to cut it free with another saw. If you don't have another saw handy, you will suffer the humiliation of asking someone to free up your saw.

You have several courses of actions to avoid binding up the bar when cutting a simple beam. If you can get the bar under the log and cut up, the bottom (under tension) releases first, pulling the wood away from the bar. It is a quick way to deal with branches under 4 inches, but cutting with the top of the bar pushes the saw toward you instead of pulling it into the cut, and involves lifting the saw up through the cut instead of letting gravity help, so it can involve significant physical effort.

A wedging technique is the safest and most reliable for bucking the stem and cutting branches over 12 inches in diameter. Start the cut from the top. When you have cut in about 6 inches, set a wedge to hold the cut open while you finish the cut. It doesn't take much—I usually just tap it with another wedge. The only downside to the wedge technique is that, of course, you need to have a wedge or two with you, and you have to pause to set it in place.

If you are familiar with bore cutting, a couple more strategies are available. On stem cuts or branches over 14 inches, cut down from the top about 1/4 of the way through the log; then make a bore cut a couple of inches under the top cut to hold the compression (much as the wedge does, as described above). Cut all the way down through the wood, then make an up cut through the strap to finish the cut. Sometimes, you'll misread the log, and the cut will start to close up on the bar as you cut down. If you catch it early, pull the bar out and make several plunge cuts at the bottom of the kerf to open it up. The top of the cut will pinch together and hold the wood while you finish the cut.



A cantilevered beam is supported on one end, putting the top in tension and the bottom under compression (A). Cutting from the top down relieves the tension as the fibers pull the cut open, but shear stress can cause the log to split, damaging the log and pinching your saw (B). Starting the cut from the bottom (C), then finishing the cut from the top (D), pulls the top kerf apart and compresses the bottom kerf (E), which pushes the log apart as you finish the cut (F).

For bucking cantilevered logs without splitting them, first cut the bottom 1/3 of the log; then finish cutting the cantilever log from the top. If you're not sure which way the log is stressed, drive a wedge into the top kerf as soon as you have cut enough room for it.

Pinch #3: Cantilever

A cantilever is a beam supported on one end with the other end hanging. The compression is on the bottom, and tension is on the top—the opposite of the simple beam. As you cut down, the wood fibers pull away from the bar. Generally, this means that the bar won't pinch, but it can still happen, especially when bucking a large log. A cantilevered log is also more likely to split lengthwise when you get about 2/3 of the way through the cut (this is the wood failing in shear)—not a good thing when cutting walnut! In general, the best way to avoid this situation is the opposite of a simple beam cut. Cut the bottom 1/3 of the log, either with an up cut or a plunge cut down, and then cut down from the top. As you cut down, the bottom kerf will close up. When you cut through the strap of holding wood, the bottom kerf will pinch, pushing the log apart and away from the bar.

Pinch #4: Spring Pole

A spring pole is a tree or limb that is held in a bent shape by the weight of the tree. You probably won't pinch your saw cutting

one, but it can be a real hazard. If you've ever cut one from either end, you've experienced the explosive force that has been the demise of many loggers. The safest approach is to shave off wood from the underside (compression side), about midway through the bend to relieve the stress; then cut it through at that point before cutting it flush to the ground or the log. There are some excellent videos on YouTube that show the technique.

Pinch #5: Windthrow

Cleanup and salvage after a storm—especially a tornado, which twists the tree as it falls—are the most challenging chain saw work I've ever done. In addition to tension, compression, and shear, you are also dealing with torsion (twisting). Add to that, stress from the roots still in the ground trying to pull the tree back to vertical, and you have a combination of forces conspiring to bind up your saw so hard and so fast that you will wonder how you'll ever get it out. I have even had a couple of incidents where I took the chain saw off the bar to avoid the tree rolling over onto the saw when it was finally cut free. Good judgement, they say, comes from experience, and experience comes from bad judgement. My personal record is three saws hung up in a 34-inch-diameter pecan blown down by a tornado. The solution is in wedges. Because the stresses are so unpredictable, start out with a bore cut 1/4 of the way to the bottom and cut down; then set the wedge on each side to keep it from closing up. Then do the same from the top. Next, cut down toward the bottom cut, inserting another wedge on each side when you cut through the middle, for a total of six wedges. As you finish the cut, be prepared for two things: the stem will break loose and possibly roll toward or away from you, and the root ball will fall back in place with amazing speed and force. There are a number of variations to this technique, and you will have to adapt it to your particular situation as your judgement and experience dictate. Because of the hazard, it is a good idea to have a reliable safety person in your line of sight who can also watch the area where the root ball will fall.

The author continues to learn the art of salvaging tornado blowdowns. He has two saws stuck in this 36-inch-diameter diameter pecan (you can just see the tip of the bar of a saw sticking out from the bottom of the initial cut on the far right). This photo was taken seconds before getting a third saw bound up.

Safety

No discussion is complete without a note about safety. Clearly, you and any helpers should be wearing personal protective equipment (PPE), which includes a hard hat, hearing protection, eye and face protection, chaps, and steel-toe boots. If possible, have a reliable assistant on hand to help keep an eye on things, as well as to drive in wedges. Of particular importance is to keep bystanders away, especially when cutting a tree off a root ball. Always maintain good awareness, be willing to walk away from a job beyond your capability, and practice the techniques, especially bore cutting, in a controlled, noncritical situation with an experienced logger to advise you before attempting more challenging cuts. Once they become second nature, you can move on to more complex and difficult situations. YouTube videos are especially helpful. "Chain saw fails," "Tree barber chair," and "Chain saw bore cut" will bring up some interesting videos.

I bind up more bars when limbing than any other time. Limbs are often under torsion (twisting) as well as compression and tension. Cut 90 degrees to the branch and drive in a wedge to keep the pressure off the bar.

Conclusion

Visualizing the forces acting on a log or branch before starting to cut them will help you deal with the stress before the strain (movement of the wood) pinches the saw. Careful observation of any movement of the wood will usually give you a good indication of how to make your cut and, if necessary, set your wedges. With experience, you will be the one helping a less-skilled logger free up a pinched saw. ■

Dave Boyt has a BS degree in Forest Management and an MS in Wood Technology. He manages a tree farm (2006 Missouri Tree Farm of the Year), and operates a band saw sawmill.

ADDINGTON EQUIPMENT

ENHANCING FARM & FORESTY FOR OVER 20 YEARS

NEW! An articulating tractor that drives into the the material being mowed. No looking over your shoulder.

AE INC

603-435-9970

WE DO CUSTOM FABRICATION!

Call us to discuss your special operating needs.

Made in the USA • Chichester, NH

sales@addingtonequipment.com

DGL TIMBER TECHNOLOGIES

On the cutting edge of quality and innovation

The Most Advanced **SWINGBLADE** in the World!—the **SB 1020 48″ Slabber**

"Deal Factory Direct!"

PROMO SPECIALS ON NOW!

www.dltimbertech.com

877-420-5998 Call toll free

BELL'S FIREWOOD PROCESSORS

- 66 HP CAT Diesel Engine
- 44" Circular Saw
- 20" Diameter Capacity
- Single Joystick Control
- 30 Ton Splitter Cylinder

FIREWOOD TUMBLER

- Sturdy HSS Steel Welded
- 4' Diameter Barrel
- Clean Out Chute
- Removes Debris & Bark as large as 2 ¼"
- Works with all of our Double chain Hydraulic Lift conveyors
- Optional Honda Power Pack Available

Please Call for Details

1-888-995-1965

or Visit us Online **www.bellsmachining.com**

Financing Available

Made In Canada

BELL'S Machining Welding & Hydraulics — Diesel & Equipment Repair — Perth, Ontario