



## Remote-operated jacks

# A safer way to fall trees manually

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**M**anual tree falling is a dangerous career. In the last two years alone, WorkSafeBC has documented 30 serious manual falling incidents. The overwhelming hazards to a manual tree faller are falling trees and flying debris. Finding ways to reduce hazards in this profession will greatly improve working conditions and ensure fallers return home at the end of the day.

In 2007, WorkSafeBC funded a research project to analyze the mechanics of using a remote-operated lightweight hydraulic jack to assist a manual faller. Traditionally, a faller can only leave the work space around the base of the tree once the tree stem has been cut and wedged to the point where it begins to displace from the stump. The remote-operated jack system would allow the faller to leave sufficient holding wood to ensure the tree stem remains standing until the faller exits the hazardous region around the base of the tree. The remote-operated jack, which would be pre-set in the backcut, would then be engaged to force the tree stem to displace from the stump.

Preliminary research studied the mechanics of a standing tree, and how the structure changes as it is being cut. First, researchers needed to determine the amount of holding wood required so a tree stem does not displace from the stump as the faller is cutting the tree. Second, they needed to develop a mechanism to remotely initiate displacement of the tree stem from the stump when the faller is

in the clear. This research assumed that trees are to be felled in the direction of their lean. A leaning tree requires less jacking force than a vertical tree; therefore, the research shows that lightweight hydraulic jacks could be used as the mechanism to initiate displacement of the tree stem from the stump

When a tree commits to falling under its own weight, the tensile stress increases on the backcut side of the tree and fibres can be pulled out of the tree, while the compressive stress increases on the undercut side of the tree and cells can be crushed. This research proposes using a design stress to predict the point when a tree will commit to falling under its own weight. Existing data suggests 33 Mega Pascals (MPa) of pressure is a reasonable design stress that accounts for compression in the holding wood at the time when the tree commits to falling under its own weight. This was supported by calculating the maximum compression in the holding wood from a small sample of test trees.

A “holding-wood design procedure” was then developed to meet the objectives of this research.

... continued on page 19

Photo, far right: Hydraulic flange spreader.  
Bottom photo:  
A traditional backcut with manually driven wedge.



Florian Neill photo



Ionut Aron photo

# Field testing is scheduled for this year

...continued from page 18

This design procedure had two goals. First, the holding wood had to be sufficiently weak to permit a 44.5 kilo Newton (kN) jack to produce the 33 MPa design stress in the holding wood. When considering this first goal, and assuming the tree is initially vertical, the required width of the holding wood is significantly related to the tree diameter at the stump height, but is not significantly related to the total height of the tree. Second, the holding wood had to be strong enough to ensure the tree does not move while the falling cuts are being made, given naturally occurring destabilizing loads such as an initial lean. When considering this second goal, the required width of the holding wood is significantly related to the total height of the tree, but is not significantly related to the tree diameter at the stump height. Since the second goal is considering a leaning tree, the horizontal displacement of the center of mass is significant

and this is highly correlated with the total tree height.

This research indicates that for some combinations of diameter at breast height and total tree height, a relatively small initial lean could compromise the ability of the holding wood to maintain static equilibrium while the jack is being set in the backcut. Field testing of the proposed holding wood design procedure has been funded by WorkSafeBC, and will be conducted in 2009. This project will determine how much holding wood is needed to resist naturally occurring destabilizing forces before the jack is engaged, yet still make the tree weak enough so a small jack can remotely initiate displacement of the tree stem from the stump.

For a link to the full journal article or an update on the field testing contact Dr. C. Kevin Lyons at [kevyons@interchange.ubc.ca](mailto:kevyons@interchange.ubc.ca) 