Methods of Calculating Loss of Wood Strength

The following methods can be used to calculate wood strength loss due to decay. **The evaluator must consider aggravating conditions that affect interpretation of the calculations, such as lean, shape of the wound and/or cavity, fissures in the shell, etc.** Refer to text for more complete discussion of limitations.

ASSESSING STRENGTH LOSS FOR TREES WITHOUT EXTERNAL DEFECTS AND DISCONTINUITIES (FROM WAGENER 1963)

This formula calculates the degree of strength loss associated with internal decay. Wagener (1963) suggested that conifers could tolerate up to 33% strength loss without compromising stability. Thus, a tree with a diameter of 16 inches could have a column of decayed wound no greater than 11 inches. Put another way, at least 2.5 inches of sound wood on either side of the decay column must be present.

Sample calculation

A tree that is 27 inches in diameter has a decay column of 22 inches. What is the strength loss?

$$\text{strength loss} = \frac{(\text{diameter of decayed wood})^3}{(\text{diameter of trunk})^3} \times 100$$

$$= \frac{(22)^3}{(27)^3} \times 100$$

$$= \frac{10648}{19683}$$

$$= 54\%$$

ASSESSING STRENGTH LOSS FOR TREES WITH EXTERNAL DEFECTS AND DISCONTINUITIES (FROM SMILEY AND FRAEDRICH 1990).

The Bartlett Tree Research Laboratory has acknowledged that not all trees have intact stems. They developed a variation of the standard strength loss calculation to account for open cavities. Their formula includes the size of the external deformity in the calculation of strength loss:

strength loss =

$$\frac{(\text{diam. decayed wood})^3 + R(\text{diam. trunk wood}^3 - \text{diam decayed wood}^3)}{(\text{diam trunk wood})^3}$$

where, R = ratio of cavity opening to trunk wood circumference.

(Note: Diameter of trunk wood = trunk diameter $- 2 \times$ bark thickness)

In this formula, the amount of strength decreases relative to the size of external defect.

Sample calculation

A 30 inch diameter tree has a decay column 18 inches in diameter as well as an external cavity that is 10 inches in width. What is the strength loss?

Trunk circumference $=$ 3.14 × trunk diameter

$\qquad\qquad\qquad = $ 3.14 × 30

$\qquad\qquad\qquad = $ 94 inches

strength loss $= \dfrac{(18)^3 + (10/94)\,(30^3) - 18^3)}{(30)^3} \times 100$

$\qquad\qquad = \dfrac{(5832) + (.106)\,(27000 - 5832)}{(27000)} \times 100$

$\qquad\qquad = \dfrac{(5832) + (2244)}{(27000)} \times 100$

$\qquad\qquad = $ 30%