

AREA Forum

EVALUATING TREE RISK IN THE URBAN ENVIRONMENT

Commercial and municipal arborists deal with potentially hazardous trees daily. Risk is the first factor that should be diagnosed before starting any treatment. However, determining if a tree is a risk cannot be always accomplished through casual observation. A few methods have been used for many years; some of them very simple, others more sophisticated. Four specialists contributed to this month's Forum. If you would like to participate in the discussion of this subject, please send your thoughts to ach@correo.azc.uam.mx or to the Journal Editor (see inside front cover).

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Evaluations of tree risk typically involve systematic inspections. The structural condition of a tree is assessed and a determination of risk or hazard potential is made. The greater the number of trees inspected and the greater the frequency of inspection, the higher the probability that structural defects are found and mitigating measures can be taken.

Unfortunately, however, many trees are not inspected, while others are inspected infrequently. Most likely, this is related to the great number of trees in our urban forests and the limited number of qualified inspectors. Not all of those in the arboriculture workforce are trained to inspect trees for structural condition. Typically and appropriately, this work falls within the domain of Certified Arborists and arboricultural consultants. The problem, of course, is that although we have many qualified arborists and con-

sultants, we have many more trees than can be inspected on a regular basis.

How can we increase the number of inspections? One simple way is to increase the number of inspectors. Many of those who have daily contact with trees can (and should) conduct limited inspections from the ground. These include commercial and municipal tree workers, park gardeners, and commercial landscape maintenance personnel. These groups can be trained to inspect for certain defects. Adding them as part of the inspection team will substantially increase the number and frequency of inspections.

Certainly there are some qualifications. As mentioned, inspections are limited to visual examinations from the ground. Lift equipment and diagnostic instruments are not used. Even though this limits the scope of inspections, seven key defects can be identified: 1) lean, 2) co-dominant stems, 3) weakly attached branches, 4) cavities or large decay pockets, 5) wood cracks in the trunk or branches, 6) hanging or broken branches, and 7) dead branches. These defects are common in urban trees and (in most cases) all can be seen from a ground inspection. Of course, they are not the only defects that may exist, but they do represent a sizable percentage of defects commonly associated with failures.

Workers can be readily trained to identify these defects and be given instructions to inspect on a daily basis. When a defect is found, a Certified Arborist or arboricultural consultant can be called on to prescribe appropriate remedies or to provide a more in-depth analysis. Regardless, this approach represents an extension of the inspection network and a substantial increase in number of inspectors. Consequently, many more trees can be inspected on a more frequent basis and risks associated with mechanical failure can be reduced.

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In Minneapolis, we regularly condemn hazardous trees in parks, on streets, and even in backyards. Our 70+ employees (50 arborists, 14 arborist crew leaders, 7 district foresters, 1 forestry supervisor, 1 forestry programs manager, 1 community forestry coordinator, 1 office support specialist, and 1 director of forestry) go through an intensive hazard tree workshop conducted by the Minnesota Department of Natural Resources.

The best tool we use is careful observation. We look for structural defects such as splits and deadwood. We also look for the growth of decay-causing fungi on the tree or on the ground. We supply binoculars to our inspectors so they can see high areas. We will bore into a tree to determine the depth of sound wood. We also "sound" the tree with a mallet to check for hollows. Finally, we admittedly err on the side of safety and will remove a tree if there is any doubt about its potential to strike a target and cause human or property damage.

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The SIA (statics integrated assessment) method is a system to assess the breaking safety of trees, and it is widely used in Germany and other countries. It allows for quick and destruction-free tree assessment. The procedure is very simple for practitioners, and no expensive tools are required to carry it out. After having assessed more than 3,000 trees throughout Europe with engineering-based, hi-tech pulling tests we found that hazard trees have calculable patterns. Every practitioner who understands trees knows that their stems can be very hollow without breaking during storm gusts. Yet the question is, how hollow may a tree be without being considered unsafe or even hazardous?

From our calculations, we know that a 75-ft (25-m) tall oak tree in a wind-exposed area with a dense crown and a stem diameter of 40 in. (1,000 mm) needs residual walls of only 2.5 inches (56 mm) to withstand a gale gust of wind force 12 (Beaufort scale = 32.5 m/s). We also found that the same tree with a stem diameter of only 27 in. (670 mm) has reached its safety limit and if hollow, should be considered hazardous. Why is that? Wind speed increases naturally above ground level; therefore, the upper parts of the tree crown are more strained during gusts.

We also know that the diameter of tree trunks has a high impact on the stability of a tree. According to the simple formula $W = d^3 * \pi/32$, it can be easily determined that a 40-in. trunk has a load-bearing capacity eight times higher than a trunk of only 20 in. The thicker tree is also 16 times stiffer.

Consideration also must be given to the fact that material properties may differ between the species. In systematic material research at the University of Stuttgart, it was found that trees studied in Germany have compression strengths between 1.4 kN/cm² (horsechestnut, *Aesculus chinensis*) to 2.8 kN/cm² (oak, *Quercus*).

If all three components of the triangle of statics—wind load, material properties, and load-bearing geometry (diameter of the trunk)—are taken in account, a proper hazardous tree assessment can be done. A small tree with a thick trunk is exposed to less wind load and therefore has a high basic safety factor, which allows for a higher degree of hollowness.

First, the height has to be measured exactly with a regular altimeter/inclinometer. A caliper is then used to measure the trunk diameter. For a simplified load analysis, the crown shape has to be estimated. The obtained values are transferred to a table system (SIA tables) and calculated with a simple pocket calculator.