ROTS AND RODS

by Robert Felix and Alex L. Shigo [1]

Abstract. Trees with internal rot, or crotches likely to split, can be helped by proper bracing. Although the holes made for the bracing materials are wounds, and wounds start the processes that can lead to rot, the braces can extend the time that trees with rot and weak crotches can remain safe, attractive, and healthy. An understanding of how rots develop and how rods should be properly installed will help the arborist to maximize the benefits of proper tree bracing and to minimize the injury caused by the new wounds required for the bracing materials. Some basic information on the development of tree rots and installation of bracing materials is given.

Rots can lead to breakdown of wood and unsightly and hazardous trees. Rods and other hardware when properly installed can help trees to remain sturdy, attractive and safe trees. An understanding of rots and rods is basic to proper tree care.

Rots and Wounds

Rots are major causes of damage to trees. Most people do not learn about rots until it is too late: a tree falls on a house, car, powerline, or worse yet, a person.

Wounds start the processes that can lead to rots. A wound is a break in the bark that exposes wood. The tree reacts to wounds by forming a chemical protective zone around the injured wood. Most of the time the protective zone effectively inhibits the infection of wood-inhabiting microorganisms, fungi and bacteria. But when the wound is severe, some microorganisms may surmount the protective zone and infect the wood. When microorganisms do infect they do so in successions, one group follows the others until the wood is decomposed or rotted.

However, even when infection does occur, the tree has another line of defense. The tree does not heal, restore to a previous healthy condition, the wounded tissues. The tree does something that is better. The infected tissues are walled-off, compartmentalized. The new wood that forms after the wound is inflicted is not infected unless additional wounds are inflicted at a later time.

There are three major points to remember about tree rot: 1) wounds start the processes, 2) when microorganisms infect they do so in successions, and 3) the tree compartmentalizes the injured and infected wood.

Wounds can be caused by many agents: insects, animals, birds, fire, storms, lightning, and man and some of his activities. When a hole is bored into a tree for any reason, that is indeed a wound. Holes are commonly bored into trees for collection of sugar maple sap, for injection of chemicals, for extraction of cores, for detection of decay with the Shigometer, and for the installation of screw rods, lags, and eyebolts, and other types of hardware. The question that is asked quickly is, "What impact do these wounds have on the tree?" If wounds start the processes that can lead to rot, are you not taking the risk of starting new columns of rot every time a hole is bored? These are very important questions. Here are some answers.

Many factors affect wound response

What happens after a hole is drilled into a tree depends on many factors. Some of the important ones are: time of year of wounding; size, depth, position, and number of holes; vigor of the tree; and condition of the wood that is penetrated by the drill.

Here are some additional details on each of the factors.

Holes made during the beginning of the growing season must be made with great care. The bark can be easily injured at this time. The slightest torn margin of a hole could result in a bark split. In some cases the cambium will die back around the hole. Holes made during the fall when many species of wood-inhabiting fungi are producing heavy spore leads, are often invaded more rapidly than holes made at other times of the year.

The size, depth, number, and position of the holes determine to a great extent the degree of injury. Small diameter holes cause very slight injury. The tree can effectively compartmentalize such holes. As the diameter of the hole increases, so does the degree of injury. A few

[1] The authors are Executive Secretary, National Arborist Association, Wantagh, New York, and Chief Plant Pathologist, U.S. Forest Service, Durham, New Hampshire, respectively.

holes, especially those of small diameter, cause very little injury. But, as numbers increase, so does the degree of injury. Holes in the trunk directly above strong roots do not cause as much injury as holes in the trunk that are between major roots. Holes closer to the base usually cause less injury than holes higher in the trunk. Holes directly above or below other holes cause severe injury. This type of placement should be avoided whenever possible.

The vigor of the tree will have a direct effect on wound closure. Closure of a wound is correlated with current growth rate.

One of the most important factors that one must consider when holes are put into a tree is the condition of the wood penetrated by the drill. Holes, large and small, can be drilled into sound wood and the tree will usually compartmentalize the injury effectively. At worst a column of rot the diameter of the hole or only slightly larger will develop. When holes are bored into trees and drain tubes are inserted for slime flux, the tissues penetrated are those infected by bacteria mostly. The slime flux tissues or wetwood are seldom inhabited by wood-decay fungi. But, when decayed wood is penetrated by a drill, the decay will spread rapidly out to the healthy tissues beyond the decay column. In summary, you can put a hole in healthy or discolored wood and usually cause little additional injury, but when you put a hole into decay, the decay will usually spread rapidly to the wood around the hole.

What does it all mean?

What does all of this mean for the person who wants to brace a tree with rods, screws, and cables? Will the procedure cause more harm than good?

First we should ask why a person adds all types of metal braces to a tree. The braces are usually added for two reasons: 1) TO PREVENT crotch splitting and 2) TO REDUCE the hazard potential of trees that have rot.

With the first reason, PREVENTION is the key word. The form or shape of a tree may be such that crotch splitting could occur. The installation of support cables in this situation is a standard arboricultural practice. This is particularly true of the "V" shaped crotches. Yet, for aesthetic reasons, the tree is wanted because of its form. In such a case the holes for the hardware will be made usually through sound or only slightly discolored wood.

Bracing to prevent splitting will then reduce the chances for wounds. And, the prevention of wounds is the best way to prevent rot.

Bracing trees that have rot is much more complicated. Before cavities are filled, rods are usually inserted to add strength to the trunk. Cavities can be filled to add strength to the trunk, to add aesthetic appeal, and to give the callus a base. It is doubtful that cavity filling will stop the development of decay. When cavities are being prepared for filling, great care should be taken so as not to disrupt the hard compartment boundary that separates the decay in the cavity from the surrounding healthy, sound wood. Remove only the decayed wood that comes out easily.

Tree injury caused by holes

The major problem now centers about the holes that must be made through sound wood surrounding the cavity. As stated above, a hole into decayed wood will cause the decay to spread rapidly into the wood around the hole. Yet, such holes must be made. The point now is how to maximize the beneficial aspects of the braces and to minimize the harmful aspects of the holes. First, and ever so important, is to point out that even though the tree may be harmed during this procedure, it will probably still be better off after the treatment. The bracing will extend the time that the tree can remain safe, healthy, and attractive.

The question then comes as to the number of holes and their positions. The cavity may look very serious, but internally it may end very abruptly and be surrounded by sound, healthy wood. Or, the cavity may not look serious, but internally it may be very large. How are you to know which situation you have? The number of holes and their positions will depend greatly on the internal condition of the tree. If too few rods are put in, the tree may not be helped. It could then break at a point slightly above the highest rod. Then the other case may occur. Why put many rods in when only a few are needed.

The internal condition of a tree can now be determined by the proper use of a pulsed-current

meter called the Shigometer[1]. The meter sends a pulsed current and measures the electrical resistance to it to 500 thousand ohms. As wood tissues progress from sound to decayed, the resistance decreases. To determine the internal condition of a tree a 3/32 inch hole is drilled to a depth of 8 inches. The drill bit is powered by a battery operated drill. A twisted wire probe is then inserted into the hole. An abrupt decrease in resistance will signal the presence of decay.

But wait; are we not making another hole — another wound? Yes, but the hole is so small that the tree can usually compartmentalize it very effectively. The information gained from the probe must be weighted against the amount of injury to the tree. And, besides, some much larger holes are going to be put into the tree. If the few probe holes can give information that will maximize the benefits of the large holes to be made for the rods, then the small probe holes are of more benefit than harm.

How many probe holes should be made and where? First probe on the opposite side of the obvious defect or cavity. This will tell you how much sound wood is supporting the tree at this weakest spot. Then probe a foot directly above the obvious defect or cavity. This will tell you how much sound wood there is at the second weakest place. With most large cavities, the amount of sound wood to the sides of the cavity can be easily seen. But, if this is in doubt, then probes can be made at right angles to the cavity. In some bases it may be necessary to make additional probes above the cavity to determine the extent of the rot column. (Details on the use of the Shigometer are available from the second author.)

Screw rods, eyebolts, and cables

Now it comes time to make the holes and to insert the screw rods, eyebolts, or lags. It is extremely important to have all the proper tools and hardware for the job. Tools should be checked to make certain they are functioning properly, especially power tools such as large ¾ inch, reversible drills. Drill bits must be sharp. A clean hole made with sharp tools will minimize the injury to the tree. Take great care not to injure the bark around the hole. The proper size rods, lags, eyebolts, and cable must be used.

Cables fastened with eyebolts, lags, or amon nuts with wood screws are used for bracing large limbs. In all cases, decisions must be made to maximize support and minimize injury to the tree. Installing a cable ⅔ of the way up from a "V" shaped crotch is a good rule of thumb. Never install an eyebolt, lag, or rod above or below an existing wound on a limb.

Angle of the eyebolts or screw rods is important.

When bracing branches that contain rot or cavities that have obvious rot, do not "dead end" the screws. When the decay from the interior of the trunk or branch spreads to the wood around such a screw, the holding power of the screw will be gone. When rot is known to exist in the wood, or when it is suspect, it is best to use rods with large nuts and washers at the end. Then even if rot spreads out to the wood around the rod, the washer will be compartmentalized by the growing tree, and this will continue to give support to the rod.

After you determine the proper position for the eyebolt or screw rod, drill a hole the same diameter as the fastener and slide it in. Nuts and washers on the ends of the fasteners will provide sufficient structural support to offset any loss of holding power resulting from decay that may spread to the wood surrounding the internal rod.

When installing lags, a drill bit 1/16 inches smaller than the lag diameter must be used. The hole should be drilled at a right angle to the limb to be braced. The lag is then screwed in. When the cable is installed, the pressure will be on the sides of the hole.

It is best to shape the bark around the washer so that smooth, rounded margins result. Avoid any shape that has sharp pointed edges. Cracks could develop above and below such shapes. The important point here is to have healthy bark in contact with healthy wood. Closure of a wound is highly dependent on current growth rate. A vigorous, fast growing tree will quickly form callus around the wound. Do everything within reason to increase vigor of trees after bracing. Bracing done during the dormant period before active growth in the spring will give the tree the best opportunity to quickly begin to close the wound. Wounds from fall bracing will give

[1] The Shigometer, registered trademark by the manufacturers; Mortheast Electronics, Concord, N.H. The use of trade or firm names does not indicate endorsement by the U.S. Dept. of Agriculture, the U.S. Forest Service, or the National Arborists Association.

microorganisms that might infect the wounds the advantage.

Wound dressing over the wounds is not recommended. But, if some dressing is required or wanted by the owner of the tree, then apply only a very thin coating. Avoid using thick coatings of dressings. Small bubbles could form under such coatings and this would greatly benefit the wood-inhabiting microorganisms by creating conditions favorable for their growth. Also, wound dressing is not a preservative for the hardware installed.

A tree hurts, too

Yes, trees are big and tough. Some trees can endure great stress and many severe wounds and still they go on living. Other trees — even in the same species — may be weaklings that can not respond effectively to stress and wounds. It is impossible to generalize about living things. Survival depends on variations within a species. What this means within the context of rots and rods is that there are times when we can do much to help some trees. *We can buy time. We can buy safety. We can maintain the aesthetic value of a tree.* Then again, there are times when all we do still does not help. The treated tree dies, or falls during a storm. But, this does not mean we should stop trying to help. It only means that we must try harder to reduce the failures and increase the successes. Trees, like all living things, live, wane, die, and decay. There is not much we can do to extend the life of a tree far beyond its genetic potential for longevity. There does come a time when a tree must be removed. There does come a time when further bracing will not help.

The professional arborist can do much to help trees by understanding rots and rods. Thus he can minimize the injury caused by the holes required for the installment of the bracing materials and maximize the benefits of bracing. Proper bracing will extend the time that trees with rots and weak branches will remain safe, attractive, and healthy.

Figure 1. Section from a red oak showing decay associated with a 6-year-old drill home made to insert a threaded rod. Arrows A show decay column above the hole. Arrow B shows the size of the tree at the time the hole was made. The large washer that was at the end of the rod (Arrows C) and the 6 growth rings that formed after the hole was made, gave the rod its holding power. The hole had been drilled into a central column of decay. When holes are drilled into decay, new decay will spread rapidly out around the edges of the new hole. New growth rings will compartmentalize the washer and give the rod holding power.