RESEARCH LABORATORY TECHNICAL REPORT

BARTLETT TREE EXPERTS
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Tree Support Systems

Cables, Brace Rods and Props

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Tree support systems are used to provide supplemental support to leaders, individual branches and/or entire trees. Cables, braces, guys and props all provide supplemental support by limiting the movement of the branches, leader, or entire trees. When a tree has a structural defect that poses a high likelihood of failure, which may result in injury or property damage, a support system can often reduce this risk.

The most common structural defect with a high risk of failure is a codominant stem, often referred to as a "v-crotch" (Figure 1). Because of the lack of direct structural connections between codominant stems, they are structurally weaker compared with a single stem, especially if bark is included between the two or more stems.

Figure 1: Stem failure at a "v-crotch" with included bark

Another common condition with a high risk of failure are long, heavy or "over-extended branches." These are branches that are unusually long for the tree species, grow beyond the rest of the crown, are horizontal or downward growing, or have the majority of their foliage concentrated at the end of the branch. Breakage of these branches may occur at the junction with the stem or they may split farther out due to tension forces on the top and compression forces on the bottom of the branch. Splits occur when there is heavy loading such as from snow or ice, or during a strong wind. Cables or props are used to reduce the risk of breakage and/or to keep branches off the ground, above pedestrian's heads or away from structures.

A third defect is the weakly anchored tree. This condition exists when a tree is transplanted with a substandard root ball, has been uprooted, has defective roots due to damage or decay, or has another condition that results in poor root anchorage. Guying systems may reduce the risk of failure in these situations.

In each of these cases, pruning or removal should also be considered. Removal is often the best remedy for trees with extensive decay, damaged root systems or

other high risk situations. For young trees, pruning is the preferred method to eliminate codominant stems. The codominant stem may be removed entirely or subordinated. Pruning may remove structural defects or lighten the load on tree parts with high risks of failure. On larger and mature trees, the combination of pruning and a support system may reduce the risk of failure.

Cables

Cables restrict the distance that branches can move in relation to each other. Installed across a weak union, they will greatly reduce the risk of failure. Installed on over-extended branches, they can be used to support the branch.

Figure 2: Installed cable

Cable systems minimally consist of a set of anchors (eyebolts), a cable, and the appropriate means of connecting the cable to the anchor (Figure 2). If the tree dictates a more complex system, more cables and/or brace rods may be required. Cables are installed high in the tree, a distance approximately 2/3 the distance between the weak junction and the ends of the branches. Because cables are relatively small diameter and gray in color, they may be very difficult to see. To find a cable it is often easiest to visually follow the main stem looking for the eyebolt.

Cables and Lightning

Trees with horizontal cables are **not** more susceptible to lightning than trees without cables. However, if a tree with a cable is struck by lightning, there is a higher likelihood for tree damage because the lightning can be conducted into the wood. Risk of lightning damage can be reduced with a lightning protection system. If there is a lightning protection system in a tree with a cable, the two systems should be connected (bonded) to reduce the risk of a lightning strike causing tree damage.

Brace Rods

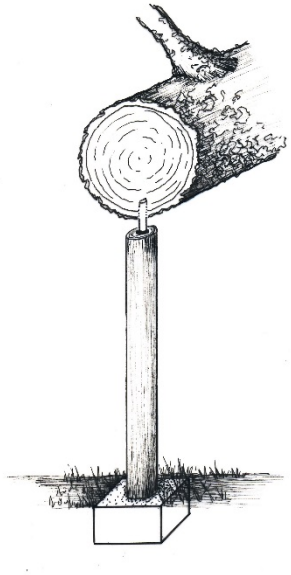
Brace rods are threaded steel rods inserted entirely through the tree with nuts and washers installed on both ends. They are used to reduce the risk of two or more leaders spreading farther apart or moving sideways in relation to each other. They are also used to fasten together a union or branch that is split apart. When bracing trees, at least one cable is usually installed for added support. In cases where it is impractical to install cables, rods can be used alone, but the strength gain will be less than with a cable system.

Props

Props are used under leaning branches or trunks when cables will not provide sufficient support to reduce the risk of failure. Typically, props are used under parts that are nearly horizontal and close to the ground. Props can be made from wood, steel, concrete or other materials. They must have sufficient strength to support the expected load.

The prop must have a provision to keep the branch from falling off. Saddles and straps have been used in the past, but often end up damaging the branch by girdling, so they should be avoided. Other options for keeping the branch on the prop are a threaded rod or bolt. The prop should be designed so as not to restrict future growth of the branch. On the ground side, the prop must be anchored in the ground so as to keep it from moving excessively. A concrete footing is often the preferred anchor.

Figure 3: Prop system



Inspection and Service Life

The client should be aware of the need for periodic inspection of the support by a qualified arborist. The arborist should inspect the cable tension, condition of the cable and associated hardware, its height in the tree, and the structural integrity of the tree.

All support systems have a limited service life. Steel cables may last 20 to 40 years in an arid climate or with a slow-growing tree but, in an area exposed to salt spray or with a rapidly growing tree, cable service life could be much shorter. Guy systems on newly transplanted small trees should be removed after one year unless there is a problem with the root system. On trees up-righted after storms or large transplants, guys should remain in place for three years or more until the root system reestablishes. On mature trees, guy systems may be required permanently.

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