



Structural Pruning of Young Trees

Bruce R. Fraedrich, Ph.D.

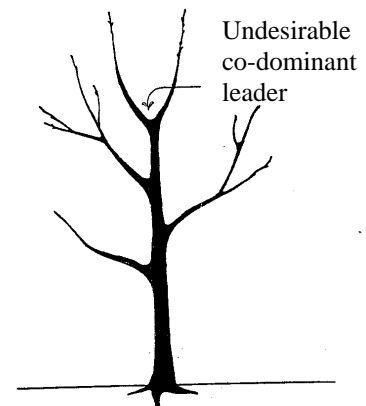
Most structural defects that occur in older trees can be prevented by pruning when the tree is young. This practice can avoid the need for more expensive tree care practices later in the life of the plant and can extend the lifespan of the tree by decreasing the likelihood of branch failures. Structural pruning of young, developing trees provides a desirable and stable form at maturity and is one of the best investments that consumers can make in their landscape.

In nature, trees tend to develop a sound structure in response to competition. They grow in close proximity to other trees and the shade created by the developing forest canopy suppresses growth of lower limbs. At the same time, the dominant trees in the forest tend to maintain a single stem and narrow crown as they grow toward light. This results in a reasonably strong structure in mature forest trees.

Conditions are radically different when trees are planted in the landscape. The crown is exposed to full sun, which encourages a broader, more complex crown than one growing in the forest. Lower branches may grow very large, limbs develop in close proximity to one another and multiple stems can develop. Certain species, particularly those with a decurrent growth form and with an opposite branching habit, are particularly prone to developing structural defects.

Structural Pruning Techniques

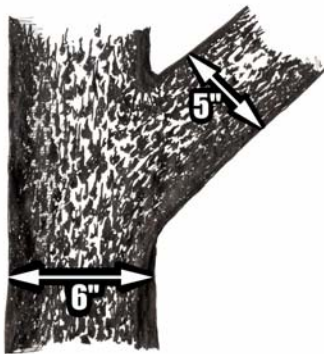
Maintain a single central stem/leader. Unless the tree is intentionally grown as a multi-stemmed specimen as is often done with certain species such as birch and serviceberry, a single stem should be maintained for approximately half of the eventual mature height of the tree. On large maturing species, such as ash or maple, that can eventually reach 70 feet in height, a single stem should be maintained for at least 35 feet before it is allowed to develop multiple leaders of approximately equal size. On smaller maturing trees such as dogwood, a single stem should be maintained for approximately 10 feet. Trees with decurrent branching habits, such as elm, honeylocust and redbud, will need a greater emphasis on structural pruning to develop a single central leader



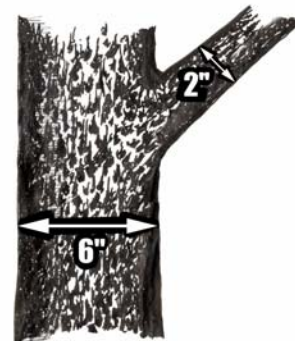
than trees with excurrent habits such as most oak species, tuliptree and conifers. Opposite branched species such as maple, ash and dogwood also have a greater tendency to develop co-dominant stems at a young age. In some cases, competing leaders can be removed entirely to maintain one central stem. This is most appropriate for very young trees that have a single co-dominant stem. On trees with excurrent branching habits that tend to develop multiple leaders, subordinating the leaders by reducing and thinning is usually the best option rather than removal (see section below on subordination).

Maintain Branch/Leader Size: The diameter of all branches and leaders, especially those developing in the lower portion of the crown, should never be larger than 50% of the diameter of stem at the point of attachment. Branches that exceed this guideline, or are growing at a more rapid rate than the primary stem, should be thinned and/or reduced to slow their growth rate relative to the growth rate of the primary stem. This is referred to as **subordination**.

To subordinate a vigorous limb, it should be pruned by at least 50% to achieve a reduction in growth. When pruning to subordinate, removal of branches should be concentrated in the outer half of the limb. Subordination of large or rapidly growing branches should continue as necessary for the life of the plant. Permanent branches that are less than half the diameter of the stem are more strongly attached than larger ones. Subordination also encourages development of branch collars that contain protection zones that discourage development of decay in stems if branches are ultimately removed. Subordinating rapidly growing temporary branches and leaders prior to removal will reduce the development of decay in parent limbs and stems following pruning.

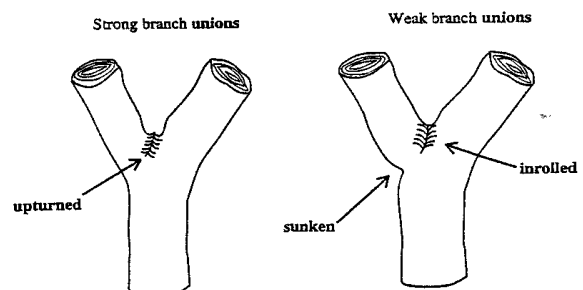


Branches that exceed 50% of the stem diameter at point of attachment are more prone to failure and should be



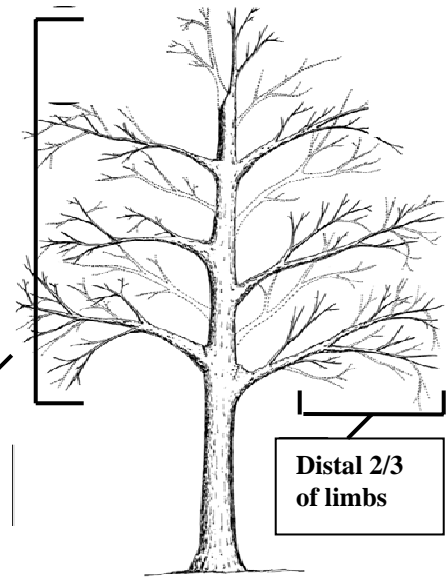
Subordinate permanent limbs so they never exceed 50% of the diameter of the stem at the point of attachment. Subordinate temporary branches prior to pruning.

Branch Attachments: Favor branches that have protruding branch bark ridges as a permanent part of the crown. Branches with in-rolled bark attachments will be more prone to failure and must be subordinated if they are to remain as permanent branches.



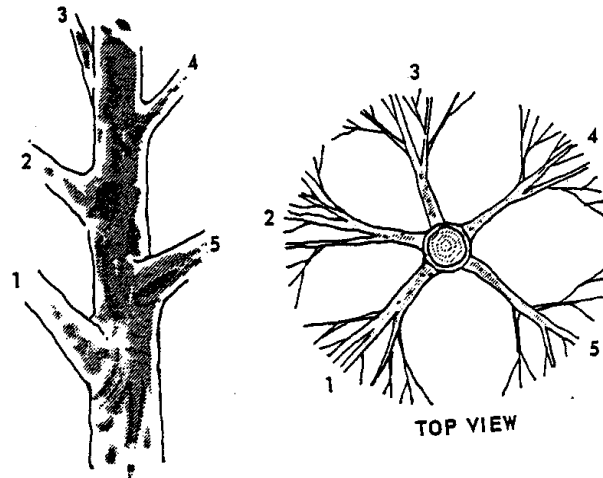
Maintain Foliage Distribution: A live crown ratio of 66% should be maintained along the stem and along each permanent branch or leader. This means that foliage should cover at least the distal two-thirds of the stem and each permanent branch. Delay removing lower branches in order to maintain this live crown ratio. Maintaining lower branches encourages diameter growth that leads to desirable trunk taper. Lower branches also shade the stem and reduce the risk of sun-scald.

Maintain a live crown on the distal two-thirds of the stem and each permanent branch.



Branch distances/distribution:

Thin out closely spaced branches as the crown develops. Prune so that at maturity branches are approximately 12-18 inches apart on large tree species and 6-8 inches apart on small trees. Maintain a balanced radial distribution of branches on the stem to distribute weight and stress.



When to Prune

Structural pruning is best undertaken in winter when leaves do not obscure the branches. Pruning should begin as soon as trees establish and resume normal growth rates following planting. This generally occurs two years after planting but may be longer on large transplants. Inspect trees on an annual basis for the first ten years after they become established and prune as needed to provide desirable structure. On small maturing species, the first ten years after establishment is the critical period for structural pruning but on large maturing species, pruning for structure should continue for up to 25 years following planting. Pruning cycles generally can be extended to every 2-4 years during the 11-25 year period following establishment.

Species Requirement for Structural Pruning

High Maintenance Species		
Species requiring frequent inspection and greater attention to structural pruning		
Most high maintenance species have excurrent branching habits		
<i>Latin Name</i>	Common Name	Inherent structural defects
<i>Acer</i>	Maple	Tends to develop co-dominant stems. Opposite branching habit results in closely spaced limbs. Poor angle of branch attachment. Weak wood. Decay prone. Dense branch ends.
<i>Betula</i>	Birch	Tends to develop multiple leaders from root collar. Can be grown as a multi-stemmed tree or must receive training to develop a single stem. On river birch, the terminal tends to dieback during droughts resulting in co-dominant leads.
<i>Cercidiphyllum</i>	Katsuratree	Tends to develop multiple leaders low on the stem. Can be grown as a multi-stemmed tree or must receive training to develop a single stem.
<i>Cercis</i>	Redbud	Tends to develop multiple leaders branching at a low height. Leaders have narrow angle of attachment.
<i>Cladrastris</i>	Yellowwood	Tends to develop multiple leaders branching at a low height. Leaders have narrow angle of attachment.
<i>Cornus</i>	Dogwood	Tends to develop multiple leaders branching at a low height. Opposite branching habit results in closely spaced limbs.
<i>Fraxinus</i>	Ash	Narrow angle of branch attachment. Upright growth habit. Tends to develop multiple leaders branching at a low height. Opposite branching habit results in closely spaced limbs.
<i>Gleditsia</i>	Honeylocust	May develop multiple leaders but failures seldom occur at maturity.
<i>Lagerstroemia</i>	Crapemyrtle	Tends to develop multiple leaders from root collar. Can be grown as a multi-stemmed tree or must receive training to develop a single stem.

High Maintenance Species (cont.)		
<i>Latin Name</i>	Common Name	Inherent structural defects
<i>Malus</i>	Crabapple	Closely spaced limbs, dense crown.
<i>Pyrus</i>	Pear	Narrow angle of branch attachment. Upright growth habit. Tends to develop multiple leaders branching at a low height and a common location on the stem. Multiple leaders on nursery trees are difficult to correct. Pruning for sound structure must begin in the nursery
<i>Salix</i>	Willow	Branches tend to develop low on the stem and grow rapidly.
<i>Sophora</i>	Pagoda Tree	Branches tend to develop low on the stem and grow rapidly. Dense branch ends. Brittle wood.
<i>Tilia</i>	Linden	Co-dominant leaders. Closely spaced branches, Weak wood. Dense branch ends.
<i>Ulmus</i>	Elm	Develops multiple leaders low on the stem. Narrow angle of branch attachment. Develops dense branch ends.
<i>Zelkova</i>	Zelkova	Narrow angle of branch attachment. Upright growth habit. Tends to develop multiple leaders branching at a low height and a common location on the stem. Multiple leaders on nursery trees are difficult to correct. Pruning for sound structure must begin in the nursery.

Lower Maintenance		
Species that tend to develop good structure in full sun		
<i>Latin Name</i>	Common Name	Comments
<i>Pinus, Picea, Abies, Tsuga, etc.</i>	Conifers	Monitor for co-dominant stems.
<i>Fagus</i>	Beech	Maintain size of lower branches.
<i>Ginkgo</i>	Ginkgo	
<i>Liquidambar</i>	Sweetgum	
<i>Liriodendron</i>	Tuliptree	
<i>Magnolia</i>	Magnolia	
<i>Platanus</i>	Sycamore	
<i>Poplar</i>	Poplar	Brittle wood and prone to decay. Monitor for co-dominant stems.
<i>Quercus</i>	Oak	Certain oaks such as live oak tend to develop multiple leaders at a low height and require more attention to structural pruning.