

CMG GardenNotes #617

Structural Pruning of Maturing Trees

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Pruning large trees is a safety issue beyond the training and experience of home gardeners. Hiring a licensed, certified and bonded professional arborist is the best approach for large tree pruning. Certification is provided by the International Society of Arboriculture, ISA. Certified arborists generally list their certification on yellow page advertising and may be found on the ISA web site at www.isa-arbor.com.

This *CMG GardenNote* is written to help the home gardener understand issues involving the structural pruning of maturing trees and to help them communicate with their professional arborist.

As trees mature, pruning should be based on pruning objectives. Do not indiscriminately remove branches. For details on pruning objectives for maturing trees, refer to *CMG GardenNotes* #616, Pruning Maturing Trees.

A common pruning objective with maturing trees is to reduce the potential risk of failure from wind and snow loading. Significant wind damage occurs on structurally weak trees with wind gusts of 60 to 75 mph. Even structurally sound trees may fail with wind gusts above 95 mph.

In Colorado (and other snowy regions), most storm damage occurs with *co-dominant trunks* (adjacent trunks of similar size). Structural problems of this type should have been corrected while the tree was in the early growth stage. [Figure 1]

Figure 1. Co-dominant trunks (adjacent trunks of similar size) account for the majority of storm damage in Colorado landscapes.



Arborists have limited ability to correct structural defects on middle-aged and maturing trees without predisposing the tree to internal decay, cracking and structurally unsound water-sprout (sucker) growth.

For additional details on structural training on young trees, refer to *CMG GardenNotes* #614, Structural Training of Young Shade Trees.

Limitations on How Much Foliage/Live Wood Can Be Removed

The amount of foliage and live wood that can be removed per season depends on the growth rate of the tree. As a rule of thumb for healthy trees, 10-15% of the foliage/live wood may be removed per season. For actively growing, medium-aged trees without growth limitation factors (such as a dry site or restricted rooting spread), up to 20% of the foliage may be removed per season. For young, actively growing trees (in the growth phase of the life cycle) without growth limitation factors, up to 25% of foliage may be removed per season.

Do not remove foliage/live wood from trees showing stress. Severe pruning puts the roots into decline and decreases photosynthesis for two or more years! Heavy pruning also reduces carbohydrate reserves, making the tree less tolerant of insects, diseases, and drought stress.

Limitations on Diameter of Cut

Pruning cuts on branches two inches and less, being primarily *sapwood* (newer xylem rings of living cells active in water transport and storage of photosynthates), are generally not prone to decay. Depending on species and growth rates, *heartwood* (older xylem rings of non-living cells no longer active in water transport) becomes significant as branches reach two to four inches in diameter. At approximately four inches, heartwood dominates the branch structure. The branch becomes prone to decay as heartwood has no resistance to the spread of decay. (Note: Due to chemical changes in the cells, heartwood is often darker in color.) [Figure 2]

Figure 2. Cross section of Douglas fir. Light colored outer rings are sapwood. The dark wood in center is the heartwood.



In an ideal world, all pruning cuts would be two inches in diameter and smaller. Any pruning cut four inches and larger needs to take into account the increased risk for failure and reduced health associated with internal decay and cracking. Cuts on large branches often create new problems, with high risks for failure!

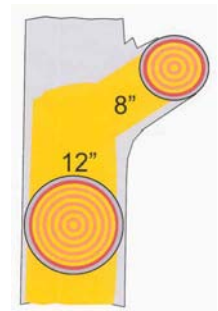
When a pruning cut or other injury opens a branch to decay, the decay column will take the current season of xylem ring and everything older. Decay creates a pipe-like structure in the branch. The healthy, un-decayed wood will be the xylem rings that grow in future years. [Figure 3]

Figure 3. When injury (such as improper pruning cuts) leads to decay, it takes the current season's xylem ring and everything older (inward). New growth (xylem rings that grow in future years) will be resistant to decay. Decay creates a pipe-like structure.



For example, if a branch with eight-inch diameter xylem (wood) is pruned back to a trunk with 12-inch diameter xylem (wood) and decay results, the decay column in the trunk will be 12 inches wide (that is, the diameter of the trunk wood at the time the injury occurred). The tree would have to add six inches of healthy new growth to meet the minimum standards for structural strength (33% shell). If annual growth rings were 1/4" wide, this would take 12 years! For additional information on tree decay and percent shell, refer to *CMG GardenNotes #611, Tree Growth and Decay*. [Figure 4]

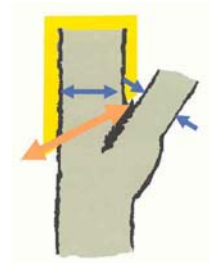
Figure 4. The diameter of the decay column will be the diameter of the current season's xylem ring for the year that injury occurred and inwards. Structural weakness from the decay is offset by the growth of new wood (xylem rings) in future years.



Limitations on Reduction Cuts

Structural pruning often involves a crown **reduction** (lowering tree height). This can only be achieved with **reduction cuts** (removing a larger trunk/branch back to a smaller side branch). In reduction cuts, the diameter of the side branch must be at least one-third the diameter of the trunk/parent branch removed. If the side branch is smaller, it becomes a **heading cut**. [Figure 5]

Figure 5. In reduction cuts (removing a larger trunk/parent branch back to a smaller side branch), the side branch must be at least one-third the diameter of the trunk/parent branch removed. If the side branch is less than one-third the trunk diameter, it is a heading cut. Heading cuts are not acceptable in pruning standards.



A common mistake in lowering the height of large trees is the use of heading cuts, which release waterspout (sucker) growth from the pruned branch. The re-growth will be structurally unsound, resulting in trees that may be more prone to storm damage than before pruning occurred. When pruning maturing trees, heading cuts are not acceptable in pruning standards!

For additional details on reduction cuts refer to *CMG GardenNotes* #613, Pruning Cuts.

Writing Pruning Specifications

Written pruning specifications for structural pruning of maturing trees should include the following:

- Clearly state which tree(s) will be pruned.
- Clearly indicate the objectives for pruning (such as reducing the risk of failure due to wind or snow loading).
- Specify pruning methods to meet the objectives (for example, “structural pruning”).
- Identify branches where work will be done (for example, “*codominant trunk on south side of tree*”).
- State the size specification for the maximum branch size to be removed. For example, “*Cuts should be two inches and less in diameter,*” and “*In a reduction cut, the diameter of the side branch pruned back to should be at least one-third the diameter of the branch removed.*”
- Specify the maximum amount (percentage) of foliage/live wood that can be removed. For example, “*Pruning shall not remove more than 15% of the live crown*”.
- In writing pruning specifications, the word “should” refers to a practice that is routine and recommended. The word “shall” refers to a practice that is mandatory.
- Include these generic safety statements to reduce the homeowner and pruning crew liability: “*All work shall be performed in accordance with American National Standards Institute (ANSI) A300 Pruning Standards and Z133.3 Safety Standards. All work shall be performed under the supervision of a licensed, ISA Certified arborist.*”

Subordinate Pruning Considerations

Structural pruning of maturing trees is often referred to as *subordinate pruning*, where secondary trunks (and side branches) with weak branch unions are subordinated to a dominant trunk. To avoid removing too much foliage/live wood in one season, subordinate pruning generally requires work over a period of years.

In evaluating how to prune the maturing tree, take into account the following considerations:

What Is the Purpose of Pruning the Tree?

Structural pruning of maturing trees generally focuses on reducing the risk of failure from wind and snow loading.

Wind loading – Reduction (lowering the height) of secondary trunks with weak branch unions is the best method to reduce the risk of failure from wind loading. This may not be possible on many maturing trees without introducing decay, internal cracking, and structurally unsound regrowth.

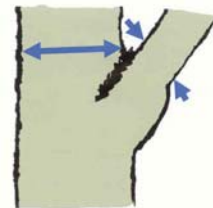
Snow loading – Thinning (removal of small, parallel-growing branches) branches with weak branch unions is the best method to reduce the risk of failure from snow loading. When properly done with removal cuts on small branches (two inches and less), the potential for decay is minimal. Snow loading may also be reduced with *reduction pruning*.

What Is the Structural Integrity of the Branch Union?

To evaluate the structural integrity of the branch union (crotch) compare the diameters of the trunk/parent branch and the side branch. Any side branch with a diameter larger than one-half that of the adjacent trunk will be structurally weak. For example, if the diameter of the trunk is four inches, all side branches should be less than two inches.

A structurally strong branch union has a **branch collar** (where the annual growth rings of the trunk wrap around the annual growth rings of the side branch). For a branch collar to develop, the side branch needs to be less than one-half the diameter of the adjacent trunk. Less than one-third is preferred. Branch unions with branch collars are also more resistant to the spread of decay. For more details on branch collars, refer to *CMG GardenNotes #612, Developing Strong Branch Unions*. [Figure 6]

Figure 6. To evaluate the structural strength of a branch union, compare the diameters of the trunk and side branch. A branch union is structurally strong when it has a branch collar. For the branch collar to develop, the diameter of the side branch needs to be less than one-half the diameter of the adjacent trunk.



Branch unions can also be compromised with narrow crotch angles, leading to **included bark** (bark against bark) and multiple branching originating in the same area.

Co-dominant trunks – In Colorado (and other snowy regions), most storm damage occurs due to **co-dominant trunks** (adjacent trunks of similar size). Structural problems of this type should have been corrected while the tree was in the early growth stage. Arborists have limited ability to correct structural defects on middle-aged and mature trees without predisposing the tree to internal decay and cracking.

What Is the Aesthetic Value of the Branch?

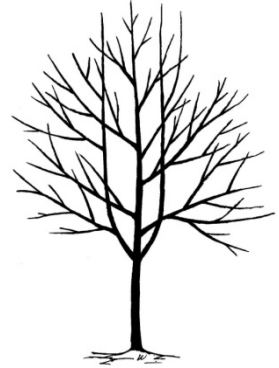
Is the branch in question important to the tree's balance and appearance? If the branch were removed, would its removal create a major gap in the canopy?

Where Should the Pruning Cut Be Made?

If the three previous questions lead to the conclusion that a secondary trunk or branch needs to be pruned, several considerations are needed to determine where to make the actual cut. Sometimes none of the options meet pruning guidelines, and the better of the bad options is chosen.

For illustration, look at the tree in Figure 7. It has three trunks. If the branch unions do not have branch collars (that is, the secondary trunks are more than half the diameter of the primary trunk), the tree is prone to storm damage.

Figure 7. As drawn, the tree has three trunks. Evaluate the need for subordinate pruning by comparing the diameters of the secondary (left and right) trunks to the center trunk. To be structurally strong with branch collars, the left and right trunk need to be less than half the diameter of the center trunk.



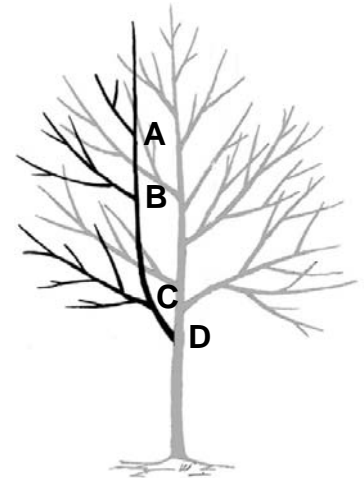
Considerations for the Secondary Trunk on the Left

As drawn in Figure 8, there are four sites where pruning could occur to lower the tree height (wind loading) and reduce the snow loading potential.

Figure 8. As drawn, there are four locations where pruning could occur.

Considerations for locations A, B and C with reduction cuts (removing a larger trunk back to a smaller side branch)

- If location A has a 2-inch trunk with a 1-inch side branch, it meets the pruning guidelines for both size (decay potential) and reduction cut (waterspout growth). However, as drawn, it may have little potential to minimize storm damage, as the height is not significantly lowered (wind loading), and the total potential for snow loading has not been significantly reduced.
- If location A has a 2-inch trunk with a half-inch side branch, it does not meet the reduction cut guideline (waterspout growth), as the side branch is one-fourth the size of the trunk being removed. Due to the size relationship, this becomes a heading cut. Watersprouts regrowth on the trunk could make it more prone to storm damage than before pruning!
- If location B has a four-inch trunk and a 3-inch side branch it violates the size (decay) guideline because the trunk is too large, predisposing the trunk to decay and internal cracking. This is typical when pruning maturing trees, as branches will be too large except in the outer canopy. The 3" side branch is within the reduction cut (waterspout) guideline, making it a reduction cut.



- If location B has a 4-inch trunk and a 1-inch side branch it violates both the size (decay) and the reduction cut (waterspout) guidelines.
- If location C has a 6-inch trunk and a 3-inch side branch it violates the size (decay) standard. The 3-inch side branch is within the reduction cut (waterspout) standard.

Considerations for location D with a removal cut (removing a smaller side branch back to a larger trunk/parent branch)

- Is the branch important to the aesthetics of the tree? As drawn, the removal of the entire branch would create a gap in the canopy.
- Removal of the left side secondary trunk plus additional pruning on the right side to aesthetically balance the tree would remove too much of the tree's foliage/live wood in a single season.
- If location D has an 8-inch trunk with a 6-inch side branch (secondary trunk), it violates the size (decay) guideline. Being a removal cut (removing a smaller side branch back to a larger trunk/parent branch), it does not have a reduction cut standard. Without a branch collar, the branch union is prone to decay.

Better of the Bad Options

In reality, it is common that none of the potential cuts meets acceptable pruning guidelines, and the arborist looks for the better of the bad options. Due to the diameter of the limbs, large trees have few acceptable options based on the size guideline (potential for internal decay and cracking). It is common that secondary trunks may not have any side branches of an acceptable size relationship for a reduction cut.

- If the tree species is prone to decay, avoid compromising on the size (decay) guideline, opening the tree to decay and internal cracking.
- If the tree is in a stressed site (including limited water or root spread potential) avoid compromising on the size (decay) guideline, as the tree is more prone to decay.
- If the tree is vigorously growing or the total amount of foliage/live wood being removed is at the maximum allowed in pruning standards, avoid compromising on the reduction cut (waterspout) guideline, as the tree is more prone to waterspout growth. With growth, the tree may become more prone to storm damage than before pruning. If the tree will be pruned each year (dealing with the waterspout growth) this becomes less of an issue.
- If tree failure would not cause injury or significant property damage, no pruning may be the better option.
- If tree failure would cause injury or significant property damage, it may be better to accept limited decay and work with resulting structural issues from regrowth than to leave the tree at high risk for storm damage.

- Storm failures are more common on young and medium-sized trees as the co-dominant and secondary trunk reach 3-4 inches in diameter. Old, mature trees are actually less prone to storm damage, having had their weakness tested in previous megastorms.

Illustrations of Subordinate Pruning Situations

Medium-Aged Tree with Codominant Trunks

With codominant trunks, one trunk is subordinated to a dominant trunk. Figure 9 illustrates this. It may require annual pruning over a period of years.

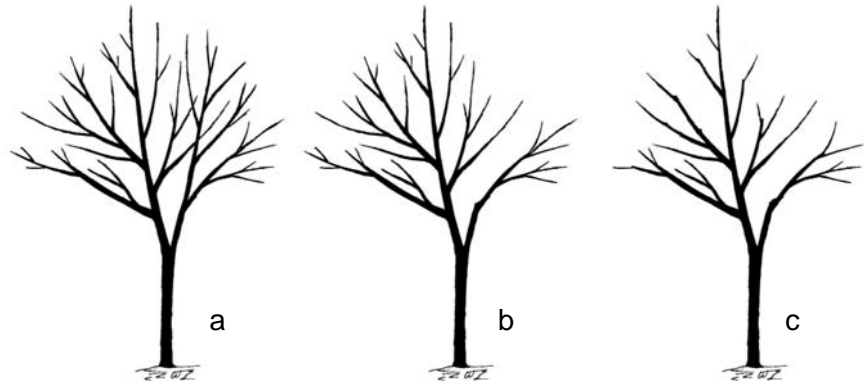


Figure 9. Before and after pruning with codominant trunks.

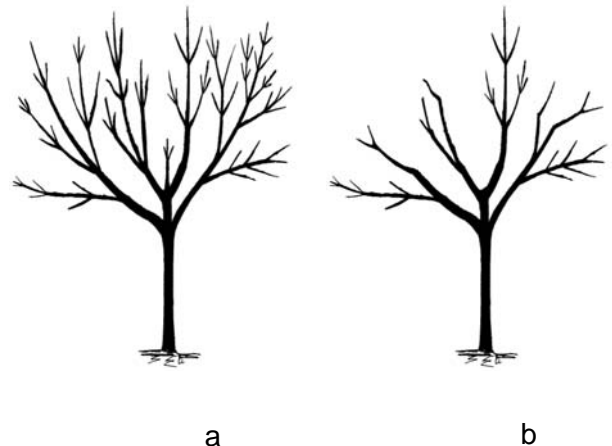
- Tree before pruning.
- Codominant trunk on right subordinated to trunk on left.
- Tree balanced with other, more upright growing branches on left subordinated to the dominant trunk.

Vigorously Growing Branches Chokeout the Central Leader

On species with opposite branching patterns, vigorously growing lower branches often chokeout the central leader. Figure 10 illustrates the pruning approach. It may require annual pruning over a period of years.

Figure 10. Before and after views of a tree whose vigorously growing branches chokeout the central leader.

- Before pruning
- Desired look after pruning



Young Tree Rounded with Heading Cuts

Trees should never be rounded with heading cuts. Figure 11 illustrates the pruning approach. It may require annual pruning over a period of years.

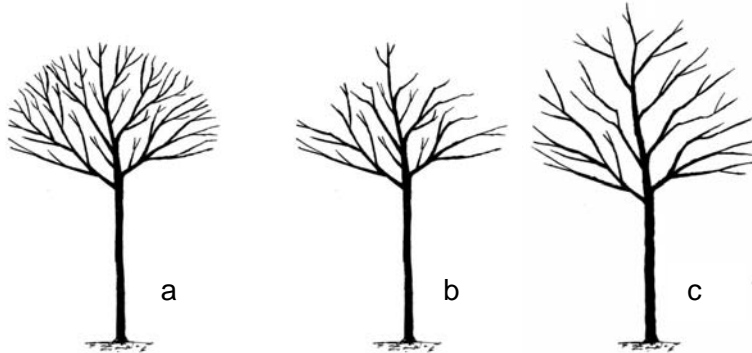


Figure 11. Before and after views of a young tree rounded with heading cuts.

- a. Before pruning
- b. Desired look after pruning, subordinating side branches to a dominant trunk.
- c. Tree with growth.

Upright Growing Trees with Numerous Upright Growing Branches

Some species of trees (including Callery pear and some crabapple cultivars) have numerous upright growing branches. Figure 12 illustrates the pruning approach. It may require annual pruning over a period of years.

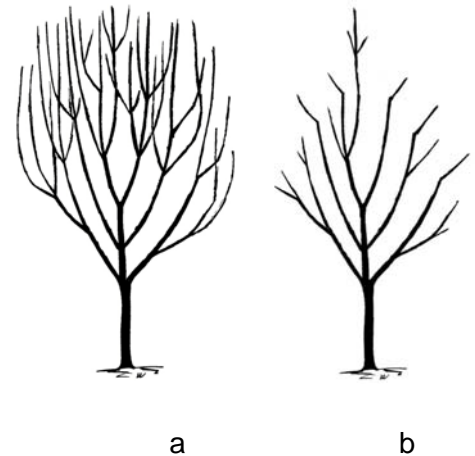


Figure 12. Before and after views of an upright growing tree with numerous upright growing branches.

- a. Before pruning
- b. Desired look after pruning

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