Resolving Tree/Sidewalk Conflicts

TREE CITY USA® BULLETIN No. 3 Editor: Dr. James R. Fazio • $3.00

In resolving conflicts between trees and sidewalks, as in so much of life, an ounce of prevention is worth a pound of cure.

With careful planning there are many ways to avoid such conflicts. Bulletin editor Jim Fazio describes the ways well: wide treelawns, proper species selection, tree wells, root barriers, and better built sidewalks are examples.

I hope you will follow his good advice to head off problems between your own trees and sidewalks, and that you will work to bring about this kind of foresight throughout your community.

With good planning, the cost of tree/sidewalk conflicts can be substantially reduced.

Dealing with tree roots and sidewalks that are already tangled can be a more difficult matter. The solutions may require compromises, such as narrowing the sidewalk beside the tree, adjusting the new sidewalk's location, or wisely accepting imperfect concrete if that saves beautiful trees.

Solutions to tree/sidewalk problems can enhance your city's landscape. Brick pavers, tree grates, and retaining walls can be interesting visual elements in the urban fabric. These features, together with the specimen trees they preserve, can give your town a feeling of quality and distinction. They'll advertise to your residents and visitors that you care about the things that matter.

When conflicts between trees and sidewalks arise, I hope you will do everything possible to resolve them in favor of the trees.

Matt Harris, Chief Executive
Arbor Day Foundation

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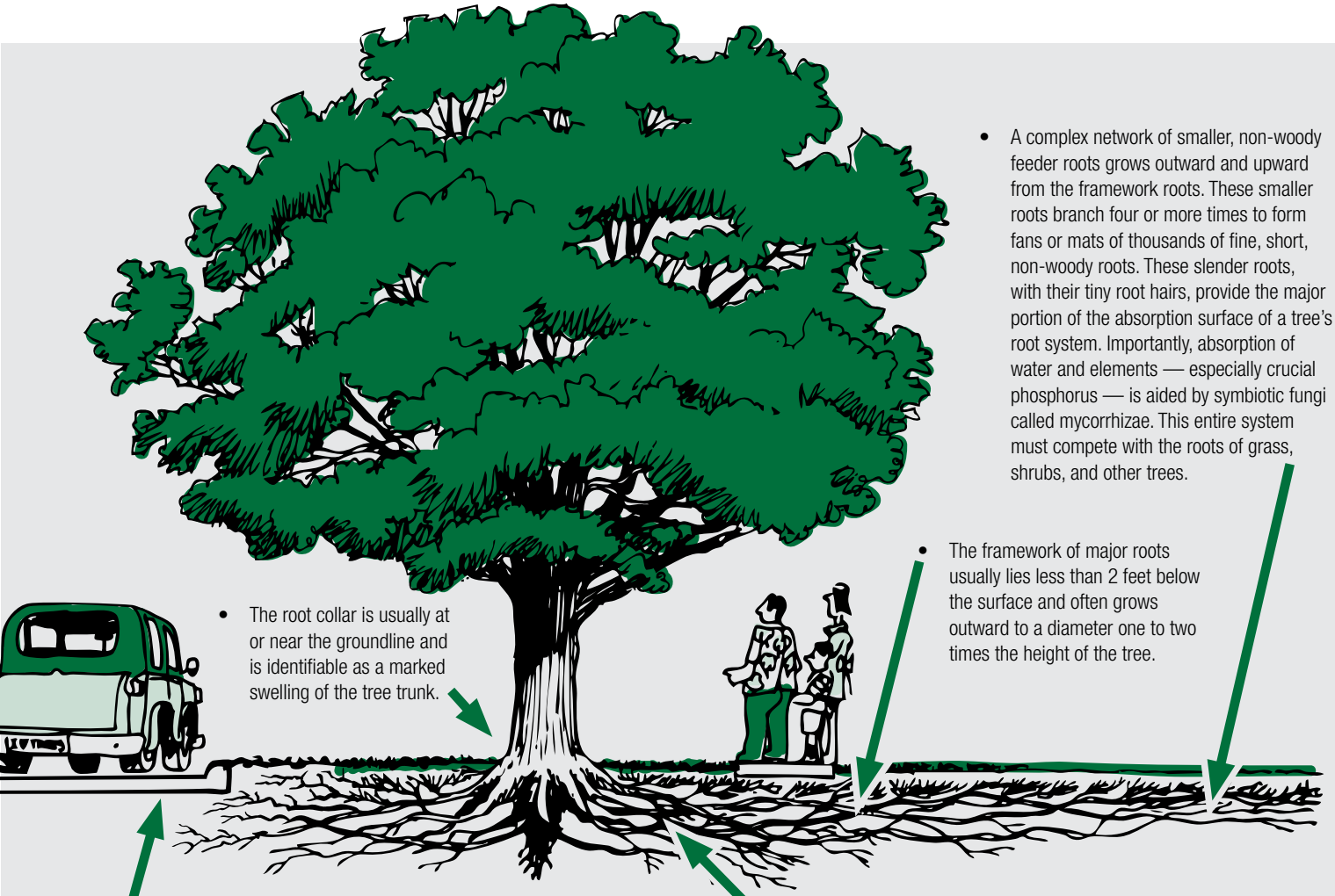
How Roots *Really* Work

Tree roots are active, opportunistic extensions of the tree that provide support and supply water, oxygen, and essential elements needed to feed the tree and sustain its life. The anatomy of a tree consists of approximately 5 percent leaves, 15 percent branches, 60 percent trunk, 15 percent large transport roots, and 5 percent fine feeder roots. Roots can range in size from more than a foot in diameter to less than .008 inch.

The woody transport roots increase regularly in diameter, and even display annual rings. It is this increase in size that swells the base of trees, raises the earth around them, and lifts sidewalks.

Roots can be damaged in a number of ways. Extremes of heat and cold, drying, and frost heaving in the upper layers of soil can kill many of the delicate, non-woody feeder roots. Foraging by soil creatures and digging by humans take their toll on roots. New roots form rapidly after injuries, but there is a limit to how much root mortality a tree can withstand. The severing of even a few major transport roots quickly reduces the total system.

Roots will also die when oxygen supplies are cut off by soil compaction, flooding, or construction of large, impervious pavement areas on the ground surface.



- A complex network of smaller, non-woody feeder roots grows outward and upward from the framework roots. These smaller roots branch four or more times to form fans or mats of thousands of fine, short, non-woody roots. These slender roots, with their tiny root hairs, provide the major portion of the absorption surface of a tree's root system. Importantly, absorption of water and elements — especially crucial phosphorus — is aided by symbiotic fungi called mycorrhizae. This entire system must compete with the roots of grass, shrubs, and other trees.

- The framework of major roots usually lies less than 2 feet below the surface and often grows outward to a diameter one to two times the height of the tree.

- The root collar is usually at or near the groundline and is identifiable as a marked swelling of the tree trunk.

- Because roots need oxygen in order to grow, they don't normally grow in the compacted, oxygen-poor soils under paved streets.

Note: A few species have a taproot that grows straight down 3 to 7 feet or more until it encounters impenetrable soil or rock layers or reaches layers with insufficient supplies of oxygen.

- Between four and 11 major woody roots originate from the root collar and grow horizontally through the soil. These major roots branch and taper over a distance of 3-15 feet from the trunk to form an extensive framework of long, rope-like roots which are ¼-1inch in diameter. These are important structural roots, supporting the tree against wind and other elements.

Plan to Avoid Future Conflicts

The best way to prevent tree/sidewalk conflicts is to keep the combatants separated from each other. This, of course, is not easy under crowded conditions, especially given a tree's natural tendency to spread its roots laterally in the upper soil layers where nutrients, water, and oxygen are most plentiful. There is no single solution to the problem, but here are some techniques that may help.

CAREFUL SELECTION

One simple solution to the tree/sidewalk problem that is available to anyone is to select the right tree for the right place.

- ☑ Match tree size to the width of the treelawn

TREELAWN	TREE SIZE
4' - 6'	Small
6' - 8'	Medium
8' or more	Large

Less than 4 feet is generally insufficient space for growing trees. (Select trees with a single trunk in narrow treelawns.)

- ☑ Where construction, sidewalk replacement, or other work is predictable and root cutting is inevitable, use species that arborists have found to be more tolerant to root damage. Opinions and local conditions vary, but examples include Norway maple, ginkgo, hackberry, hawthorns, ironwoods, cherries, and river birch. (Note: Oaks, beeches, and redbuds are among the species that often cannot withstand root damage.)

- ☑ Always plant any tree at the correct depth. According to the late tree expert Dr. Alex Shigo, many, if not most, tree problems are caused by planting too deep.

- ☑ Deep-rooted trees like oaks are best near sidewalks.

BETTER SIDEWALKS

Sometimes trees take a bum rap. As proof of this, notice that there are sometimes uneven sidewalks on streets where trees have never been planted. The reason is that soil type was not considered in construction of the sidewalk.

Where the soil type is one that shrinks and swells as moisture content changes, a higher standard of sidewalk construction is necessary to prevent lifting and sinking. This might include mechanically compacting the soil before paving (as is done on streets) and using thicker concrete with wire mesh reinforcement. This adds to the expense, but it will prolong the life of the sidewalk whether tree roots are present or not.

For help with identifying the soil properties under a sidewalk, obtain a soil survey map of the area from your local office of the USDA Natural Resources Conservation Service. These maps usually rate soils for construction stability. If the soil is fill or mixed with other materials, a Natural Resources Conservation Service specialist can tell you how to have the soil analyzed.

Careful selection of species to plant next to sidewalks is the single best way to prevent conflicts.

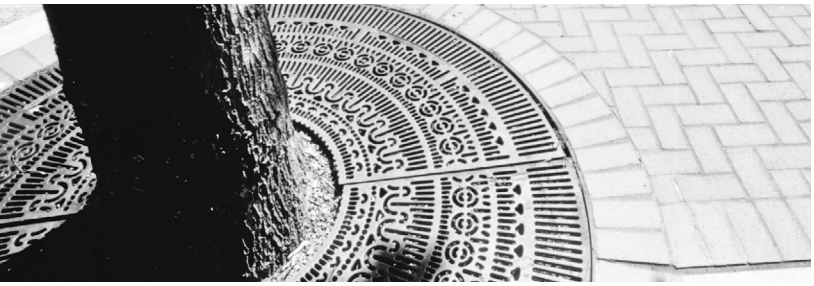
Avoiding Conflicts (continued)

USE PAVERS AND GRATES

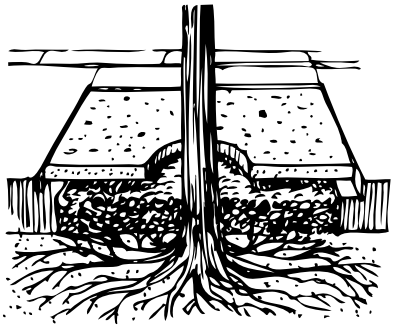
There are many ways to provide expansion space for sidewalk trees while at the same time providing adequate water and aeration.

Whatever is used to cover planting wells, have a plan for enlarging the cover as the tree ages and the trunk widens. Otherwise, the cover will damage and eventually kill the tree. Inspection and adjustment must be planned into the community forestry program just like pruning or watering.

One method is simply to leave a patch of earth, sand, or decorative gravel, delineated and held in place by landscaping timbers or concrete. However, if the border is raised, as in this one, it can be a potential tripping hazard and would be illegal in some cities.



Decorative grates are popular, but regardless of material (for example iron or plastic), cutting is essential — and often ignored — as the tree trunk expands.



The use of planting wells with covers such as 2-inch-thick wood planks provides a smooth walking surface. This method also allows deeper planting, helping to keep roots away from the surface as they begin to spread. By filling the space under the cover with coarse gravel, problems with rodents and trash buildup can be reduced.

Tree wells should be as large as practical, at least 4-6 feet square, and ideally joined under the sidewalk using soil vaults or materials such as those noted on page 8.

An attractive alternative to bare earth or loose mulch is to cover the soil with a layer of sand, then bricks or paving blocks. As the tree grows, the bricks or blocks must be removed to enlarge the growing space.

Porous Pave Permeable Tree Surround is made from recycled rubber chips, which allow water to penetrate.

In Reno, Nevada, a section of steel plates has been used instead of concrete during sidewalk replacement to "bridge" roots of a valued street tree. Although more costly, this helps save trees and provides good public relations with the property owner.

Encourage Deep Root Growth

You can encourage the roots of your trees to grow deep and out of harm's way.

WATERING

Short, frequent waterings wet only the top few inches of soil and encourage roots to grow near the surface. Water longer and less frequently, letting the soil become moist to a depth of several feet. Drilling can aid deep watering. One inch of water per week is recommended, applied slowly within the entire drip line (area under the spread of the tree's crown) and just beyond. Holes 1–2 inches in diameter drilled under the tree will allow better penetration of water and oxygen.

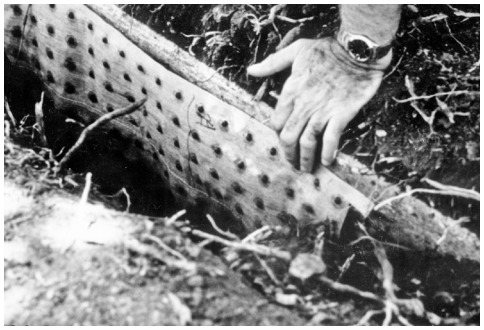
BETTER GROWING SPACE

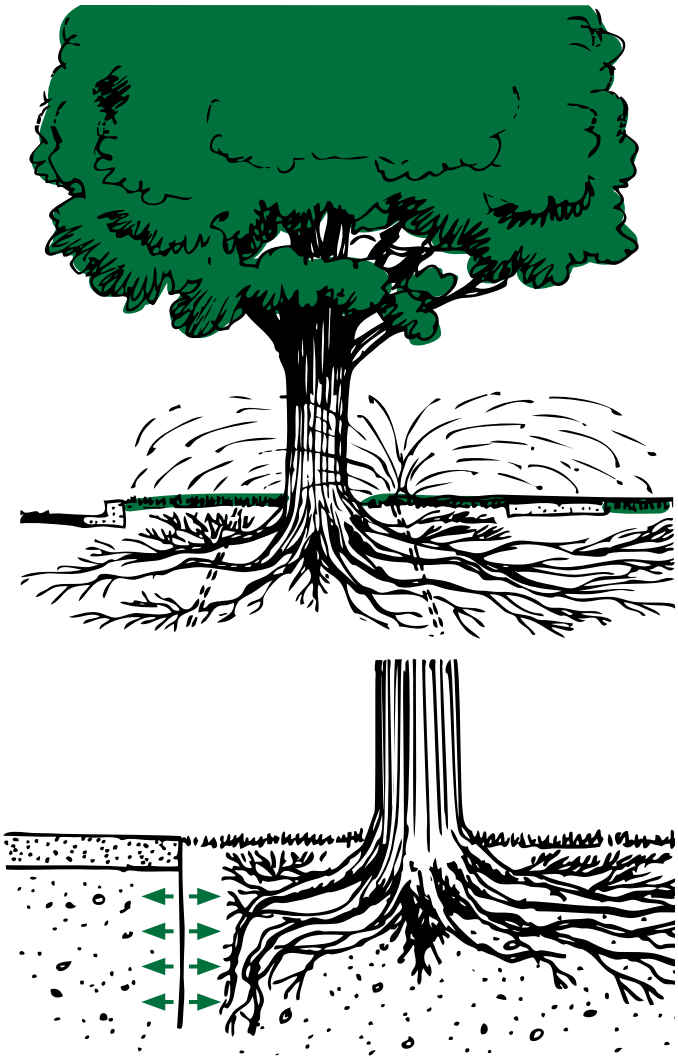
Providing space and favorable growing conditions for roots will encourage roots to stay deep. See page 8 for some effective methods.

ROOT BARRIERS

Barriers force root growth downward. Research is beginning to show that in well-drained, loamy soils, the trick works. Where soil aeration is poor from either compaction or excessive water, roots sometimes quickly turn back up toward the surface after passing the barrier. However, the roots seem to be less massive when this occurs. Gravel surrounding planter-type barriers like the one shown in the photo on the right below may also help supply enough water and oxygen to greater depths to meet the needs of the roots and keep them deep.

A variation of the solid barrier is a herbicide-impregnated fabric that upon contact retards root growth by preventing cell division. The chemical is not taken up in the plant system like most herbicides, so there is no danger of killing the tree or spreading it to other trees through root grafts. The chemicals involved are said to be long-lasting, environmentally safe, and non-toxic to animals. The fabric is flexible and can be wrapped around drain pipes to prevent clogging or spread like a curtain to deflect growth from beneath sidewalk slabs.





Compacting soil beneath the sidewalk can also create a barrier.

In the case of this newly planted tree, the strategy is to place backfill outside the barrier that will favor root growth after it is forced downward by the barrier.

Community Forestry and Sidewalk Conflict

An active urban forestry program can be the best means of preventing conflicts between roots and sidewalks. By focusing attention on a few preventive methods, any community can cut the costs of sidewalk replacement, reduce the mess from torn-up streets, safeguard its trees, and protect people and parked cars from blown-over trees. But it takes planning, leadership, and a willingness to compromise.

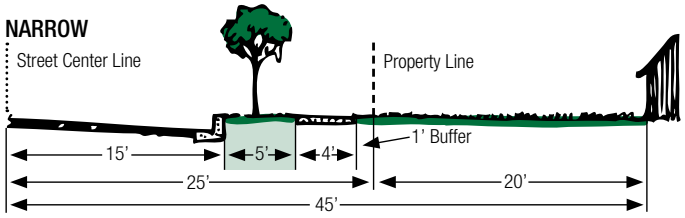
WHEN YOU START WITH A CLEAN SLATE

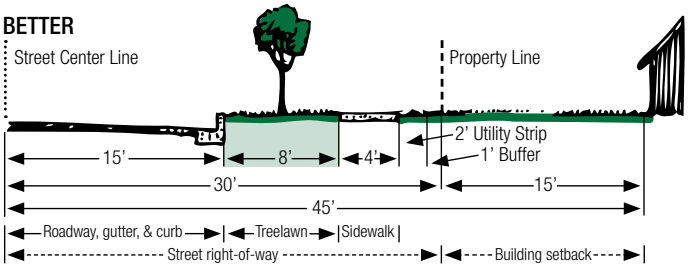
The most efficient way of preventing conflicts is to plan for growing space before streets and houses are even built. Urban foresters and interested citizens need to work with developers and review all subdivision plans prior to their official approval. Space for tree planting must be addressed in the plans just like streets and sewers, and criteria need to reflect what is best for the community, not what is most expedient for the developer.

CURBSIDE TREELAWNS

Curbside treelawns are disappearing as new neighborhoods expand the boundaries of our cities and towns. They are ignored by planners, written out by specifications calling for contiguous curbs and sidewalks, or they are built so narrowly they become a nuisance and soon get filled in with concrete. A revival of curbside treelawns would lend grace and beauty to our new developments, provide a place for piling snow off the street and sidewalks, and give an added measure of protection to pedestrians or children playing on the walks.

Although there is little agreement about the minimum width of a curbside treelawn, consider that even in an 8-foot strip, a mature tree planted in the center will still only have approximately 3 feet separating it from the sidewalk. This space needs to absorb the raised soil that accompanies the swelling of most older trees at ground level. The treelawn must also provide room for a large portion of the spreading lateral root system.

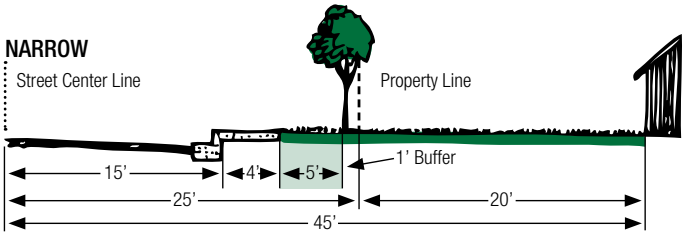


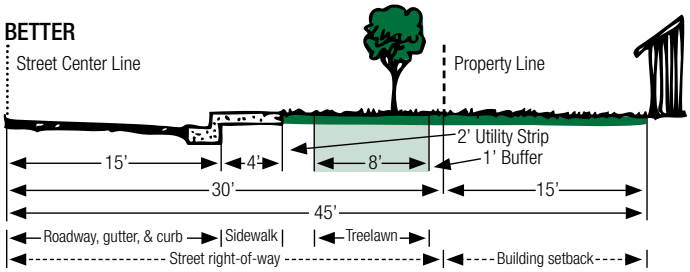


BOUNDARY TREELAWNS

By planting trees at least 3 feet from the edge of the walk, there should be no problem with uplifting as the lower trunk expands.

It is possible to provide either curbside or boundary treelawns of adequate width without reducing the number of lots per subdivision (a major objection from developers and tax-conscious officials). As illustrated by U.S. Forest Service researchers, the difference between adequate and inadequate space for urban trees can be made up by reducing the required distance between the street right-of-way and the closest edge of a house or other building. The space between the house and the actual street remain the same. This is illustrated in the schematic below. Notice, too, that under improved conditions, a utility strip is provided and located far enough away from the trees that root damage is minimized when digging becomes necessary.

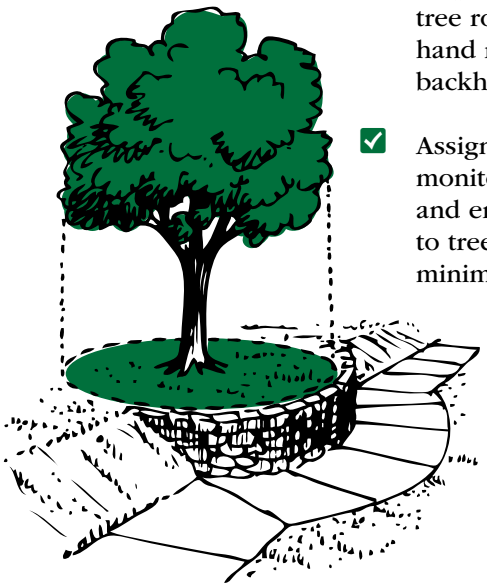




WHEN YOU REPLACE A SIDEWALK

In established neighborhoods, there is much that a good forestry program can do to prevent trees (and people) from being the losers when roots must be cut during sidewalk replacement. Here are some suggestions offered by experienced urban foresters:

- ☑ Prune a year in advance to reduce mechanical stress on the roots and to allow recovery before the tree receives additional trauma from root cutting.
- ☑ Do sidewalk work early in the spring and end all root cutting by mid-summer. This will allow maximum root recovery before dormancy.
- ☑ Provide a coordinated service in which the municipality does the pruning, then fertilizes immediately following construction. A needle-injected, soluable compound that is low in nitrogen and high in phosphorus and potassium is recommended for aiding root recovery.
- ☑ Provide residents who are affected by sidewalk replacement with literature about adequate watering (slow application of at least 1 inch of water per week.) Better yet, give them a copy of this bulletin.
- ☑ Write into any contract that excavated roots will be back-filled the same day to prevent drying. When this method is not possible, roots should be covered with wet burlap and watered. Cleanly prune off the jagged ends of cut roots.
- ☑ Require that digging near tree roots be done by hand rather than with a backhoe.
- ☑ Assign an arborist to monitor construction and ensure that damage to trees is kept to a minimum.



- ☑ When grade changes are necessary, use retaining walls on cuts, or wells (covered by a grate) in fills, to minimize root cutting and to keep the base of the trunk at the original ground level.
- ☑ Make ordinances and street plans flexible enough to allow variations in sidewalk widths to accommodate existing mature trees.
- ☑ Match sidewalk construction standards to soil properties.

- ☑ Consult an arborist to evaluate the effects of root cutting. Species, prevailing wind patterns, lean, and condition of the tree help to predict the risks involved when roots are cut for sidewalk replacement. For safety, tree removal and replacement is sometimes necessary.

WHEN MINOR REPAIRS WILL DO

The root in the photo below has raised the sidewalk. One option is to move the sidewalk a foot or two away from the tree — with the homeowner's permission. A less expensive solution is the addition of a sloped ramp, as shown below, to reduce tripping. Another way to solve the problem without damaging the tree is to use a concrete saw or grinder to cut off the protruding edge.

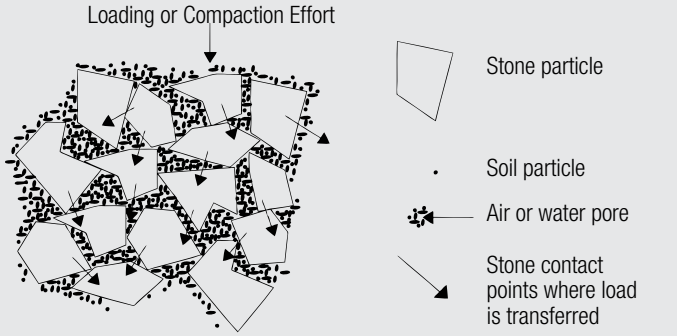
Add a small concrete or asphalt "ramp" to reduce tripping.

Making More Room for Roots

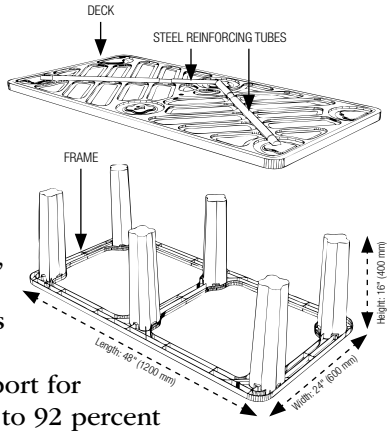
Two inventions in recent years offer a win-win solution to a dual problem. When sidewalks, parking lots, or roadways are installed, compaction of the subsoil is necessary to bear the surface material without cracking or breaking. Unfortunately, the compaction creates a barrier or hostile growing environment for healthy tree roots. These two innovations provide the strength necessary to satisfy engineers while at the same time providing space for tree root growth.

C-U STRUCTURAL SOIL™

This is a patented product resulting from research at Cornell University's Urban Horticulture Institute. C-U Structural Soil™ is a mixture that contains .75"–1.5" angular crushed stone to provide the weight-bearing capacity. Clay-loam is added to provide a good growth medium in the spaces between the rocks. Hydrogel is also added to the mix to hold the soil to the stone surfaces rather than letting it completely fill the pores needed for aeration, or to compromise the weight-bearing job done by the stone. All is done by licensed producers to ensure adherence to the exacting standards of the formula.



SILVA CELLS



Silva Cells were developed by landscape architect James Urban of Annapolis, Maryland, and Deep Root Partners, LP of San Francisco.

The concept is a series of modular, interlocking "cells" that provide support for surface material and up to 92 percent of the space available for uncompacted soil and healthy root growth.

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Standard 1: A tree board or department
Standard 2: A tree care ordinance
Standard 3: A community forestry program with an annual budget of at least $2 per capita
Standard 4: An Arbor Day observance and proclamation

Each recognized community receives a Tree City USA flag, plaque, and community entrance signs. Towns and cities of every size can qualify. Tree City USA application forms are available from your state forester, the Arbor Day Foundation at **arborday.org/treecity,** or your state forestry agency.

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FOR MORE INFORMATION

For additional information to help reduce conflicts between roots and sidewalks, please visit **arborday.org/bulletins**.

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