



## TREE CITY USA BULLETIN

# 3

No.

Dr. James R. Fazio, Editor • \$3.00

# Resolving Tree- Sidewalk Conflicts

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 them 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.

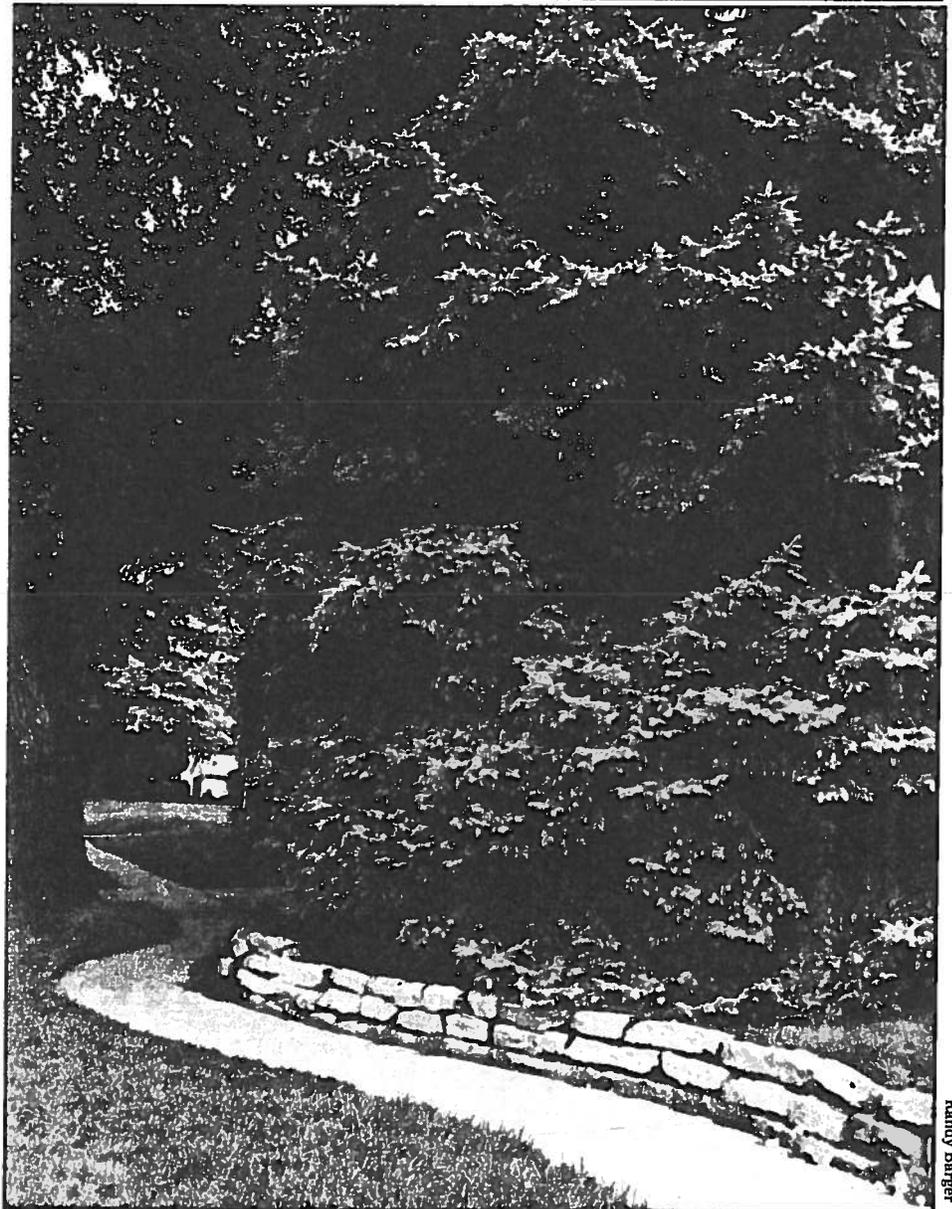
With good planning, the cost of tree-sidewalk conflicts can be substantially reduced.

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 which 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.

John Rosenow, President  
The National Arbor Day Foundation



Randy Berger

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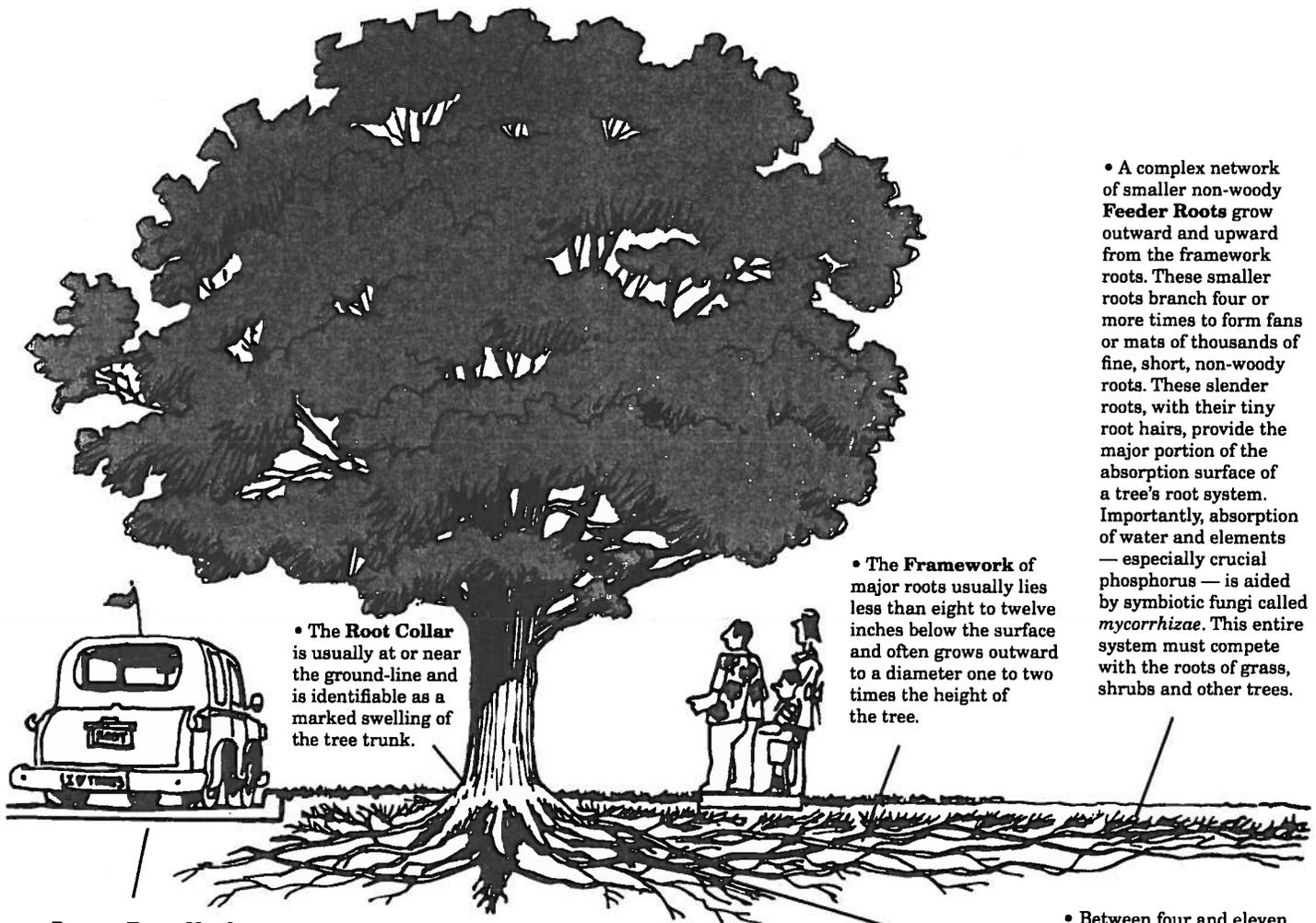
# How Roots Really Work

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 over 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 nematodes and other soil creatures, as well as 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.



• The **Root Collar** is usually at or near the ground-line and is identifiable as a marked swelling of the tree trunk.

• The **Framework** of major roots usually lies less than eight to twelve inches below the surface and often grows outward to a diameter one to two times the height of the tree.

• A complex network of smaller non-woody **Feeder Roots** grow 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.

• 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 three to seven feet or more until they encounter impenetrable soil or rock layers, or reach layers with insufficient supplies of oxygen.

• Between four and eleven **Major Woody Roots** originate from the root collar and grow horizontally through the soil. These major roots branch and taper over a distance of three to fifteen feet from the trunk to form an extensive framework of long, rope-like roots which are 1/4 to one inch in diameter. These are important structural roots, supporting the tree against wind, etc.

# 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 tree-lawn

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 can *not* withstand root damage.)
- ✓ Always plant any tree at the correct depth. According to tree expert Dr. Alex Shigo, much unnecessary swelling at the base of tree trunks is caused by planting too deeply.
- ✓ Deep-rooted trees like oaks are best near sidewalks.



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

## Better Sidewalks

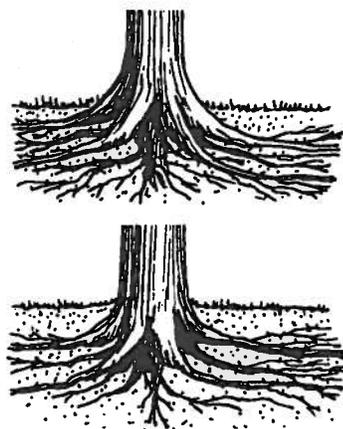
Sometimes trees take a bum rap! As proof of this, notice that there are sometimes uneven sidewalks on streets where trees have never been planted. The reason is that soil type was not considered in construction of the sidewalk.

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 reinforce-

ment. 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.

## The Promise of Genetic Engineering



"...Tree species of a global origin in urban areas are diamonds in the rough...Their potential for genetic improvement compares to that of the wild ancestors of such commercial crops as corn, wheat, broccoli, apples and oranges."

— Philip A. Barker  
USDA Forest Service

When researchers looked at 35 years of maintenance records for 100 sweetgum trees growing along a street in Oakland, California, they found that sidewalks or curbs never had been repaired or replaced beside three of the trees. Elsewhere in California, the scientist noticed that sometimes the buttressed trunk of the popular camphortree was missing, bearing instead a straight trunk right into the ground. Using tissue-cultured progeny of the individual trees with the more desirable traits, scientists hope to develop cultivars that send their roots deeper than their kin's.

Another promising method is to graft (or bud) one species onto a rootstock of the same or different species that is inherently deeper-rooted. For example, ash cultivars which are commonly budded onto the shallow-rooted green ash may be improved for use along streets by budding them onto a deeper-rooted species such as Arizona ash.

# Avoiding Conflicts (Continued)



Vancouver Parks and Recreation



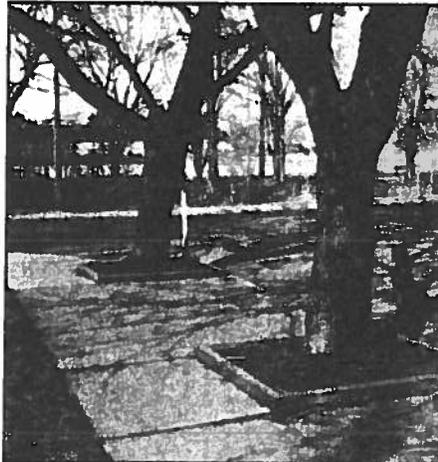
James R. Fazio

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.

## 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.

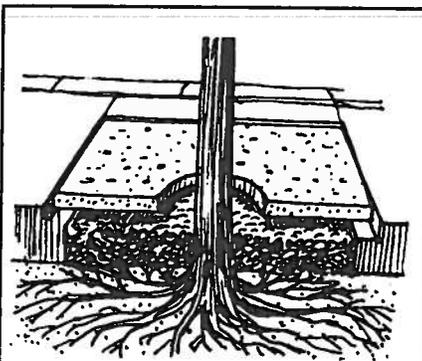


One method is simply to leave a patch of earth, sand or decorative gravel, delineated and held in place by landscaping timbers or concrete. However, if the border is raised, as in this one, it can be a potential tripping hazard and would be illegal in some cities.

## New Ideas...

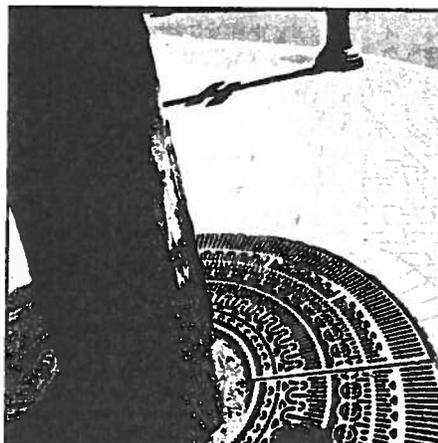
James Urban of Urban & Associates (915 Creek Dr., Annapolis, MD 21403) is one of the nation's leading experts on ways to provide space for tree-root growth under city conditions. Among Urban's newest techniques is the use of aeration sheets—thick, vertically-placed strips of filter fabric extending outward from the tree (like the spokes of a wheel) under surrounding pavement material. This provides a "safe" path, or "root channel," for roots to follow.

Another innovation is CU-Structural Soil. This is a patented mix of crushed stone and minerals that provides strength beneath concrete that meets engineering standards, yet provides a satisfactory environment for tree roots. Contact Cornell University's Urban Horticulture Institute (607-255-4586).



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 from beneath the tree's root collar. By filling the space under the cover with coarse gravel, problems with rodents and trash buildup can be reduced.

The tree wells should be large — 4 to 6 feet square — for best effectiveness.

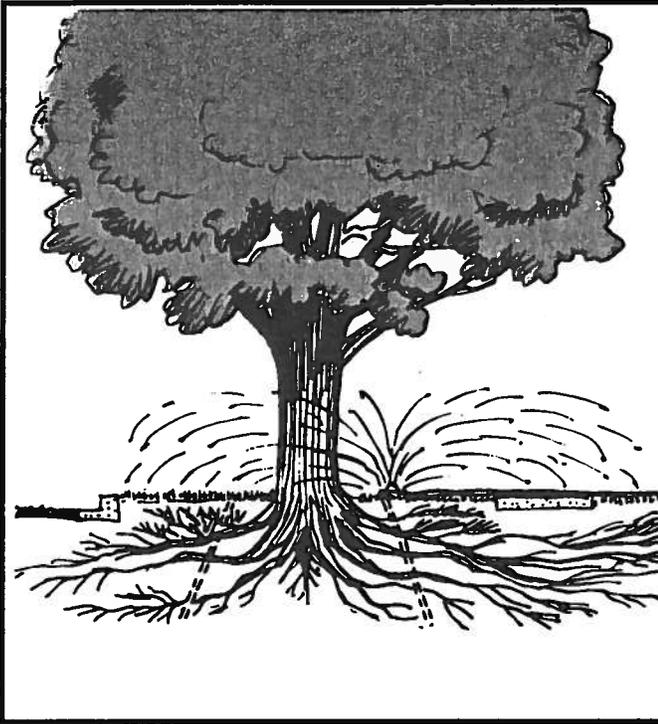


Decorative iron grates. These should be cut back or removed when the tree grows to the inside edge.



SPC Structural Plastics

Tough but lightweight plastic/fiberglass grates available from Structural Plastics Corp., 3401 Chief Dr., Holly, MI 48442.



# Encourage Deep Root Growth

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

## • Watering

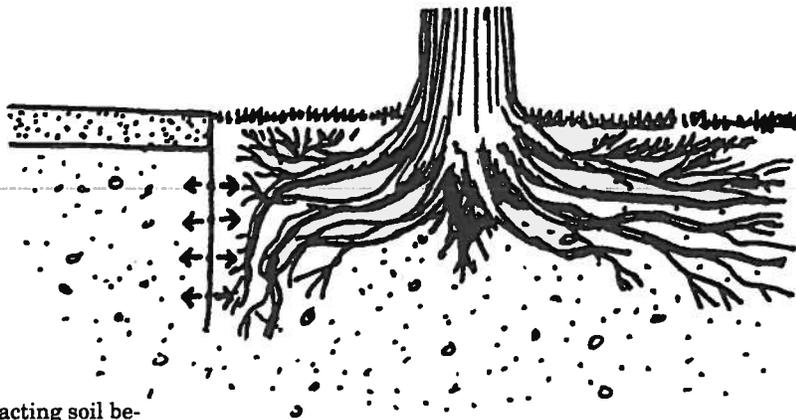
Short, frequent waterings wet only the top few inches of soil and encourage roots to grow near the surface. Water longer and less frequently, letting the soil become moist to a depth of several feet. Drilling can aid deep watering. One inch of water per week is recommended, applied slowly within the entire drip line (area under the spread of the tree's crown) and just beyond. You may want to water from a gently running garden hose for 4 to 6 hours on a weekly basis.

## • Holes

Every 2-3 years, 3 or 4 holes approximately 1-2 inches in diameter may be drilled or water-jetted at an angle down and outward from near the base of the tree. The holes allow penetration of water and oxygen.

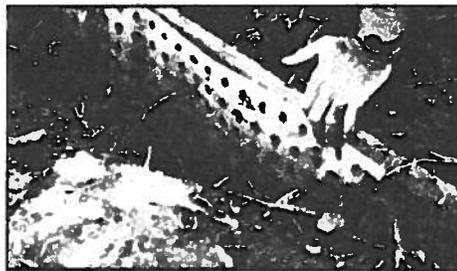
# Root Barriers

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 below, right, may also help supply enough water and oxygen to greater depths to meet the needs of the roots and keep them deep.

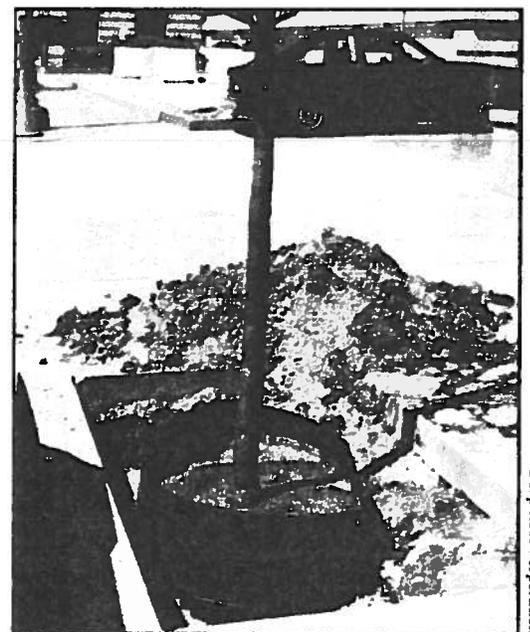


Compacting soil beneath the sidewalk can also create a barrier.

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.



Reemay, Inc.



Deep Root Corporation

Impenetrable barriers placed to a depth of 12 inches around the rootball of a new tree, or between a tree and a sidewalk, are showing promise of reducing damage to walkways. These may be commercial products, or such things as exterior grade plywood, inverted plastic garbage cans, metal, particleboard, etc.

# 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.



TREE CITY USA

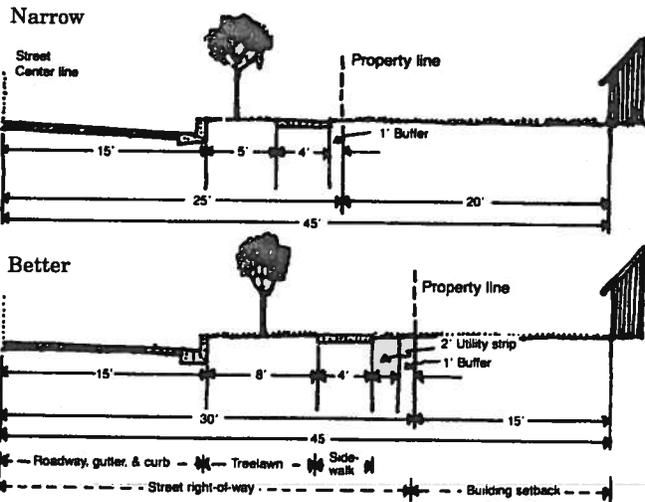
## When You Start with a Clean Slate

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.

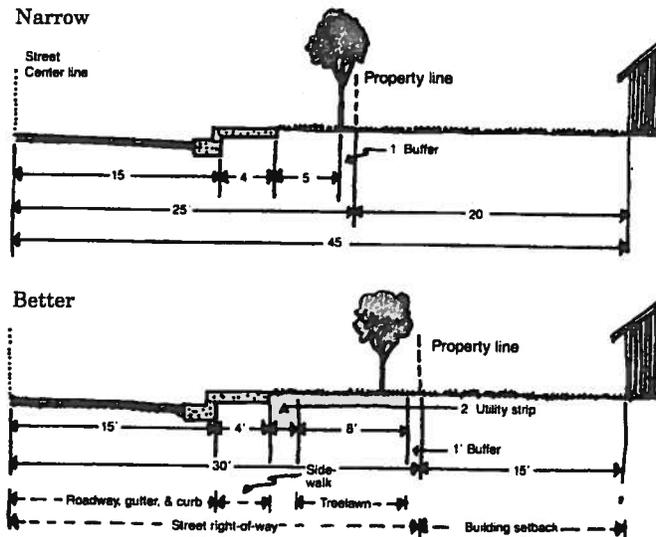
Although there is little agreement about the minimum width of a curbside treelawn, consider that even in an 8-foot strip, a mature tree planted in the center will still only have approximately 3 feet separating it from the sidewalk. This space needs to absorb the raised soil that accompanies the swelling 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.

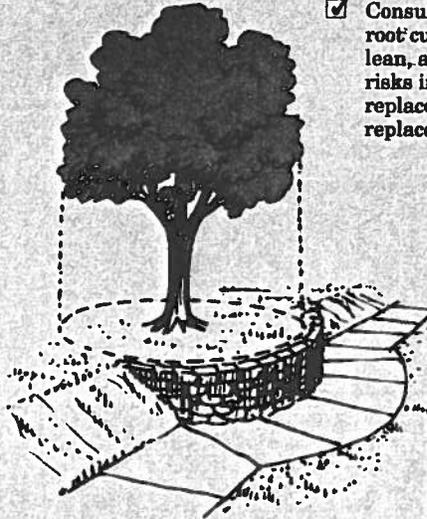
It is possible to provide either curbside or boundary treelawns of adequate width *without* reducing the number of lots per subdivision (a major objection from developers and tax-conscious officials). As illustrated by the USDA Forest Service's Landscape and Urban Forestry Research Unit at Berkeley, California, 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 to the right. 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

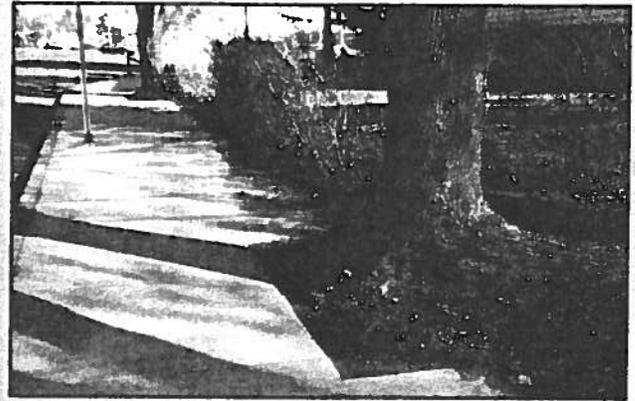
In established neighborhoods, there is much that a good forestry program can do to prevent trees (and people) from being the losers when roots must be cut during sidewalk replacement. Here are some suggestions offered by experienced urban foresters:

- ✓ 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, soluble 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 assure 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



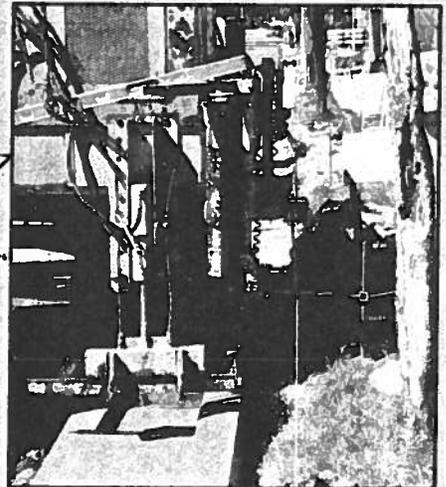
cutting and to keep the base of the trunk at the original ground level.

- ✓ 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.



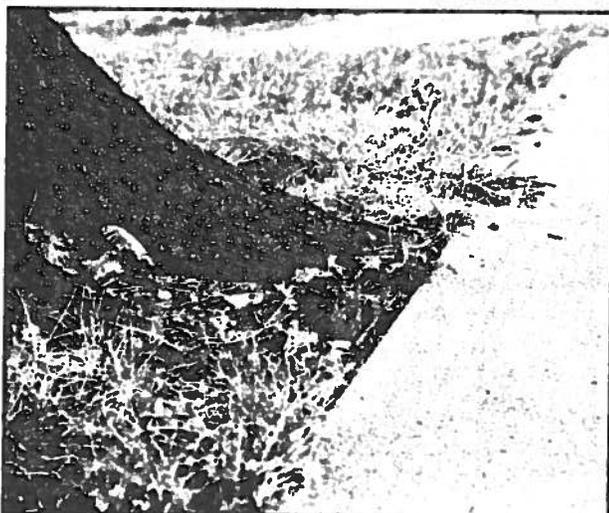
James R. Fazio

- ✓ 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.



James R. Fazio

*Reducing excavation for forms should be a key objective next to trees. Slip form pavers pour continuous curb and gutter and require the minimum excavation for curb replacement.*



Randy Berger

## When Minor Repairs Will Do

The root in the photo at the left has raised the sidewalk a bit. One option is to move the sidewalk a foot or two to the right — 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.



# Other Sources of Information

## Articles

- **The Ecology of Tree Roots and the Practical Significance Thereof**  
by Thomas O. Perry. August, 1982.
- **Effectiveness of Three Barrier Materials for Stopping Regenerating Roots of Established Trees**  
by J. Alan Wagar and Philip A. Barker. November, 1993.

Of the many technical articles about roots in urban soils, the above two are particularly helpful. They appeared in the *Journal of Arboriculture* (P.O. Box 3129, Champaign, IL 61826).

- **Street Trees and Construction** by Ken Ottman, Kevin Genich and Jeff Boeder.

This article appeared in the June, 1996, issue of *Arborist News* and is available through the same address as above or by contacting the International Society of Arboriculture at 217-355-9411.

- **Tree Roots Do Not CAUSE Sidewalk Damage**  
Hamilton County Soil and Water Conservation District,  
29 Triangle Park Dr., Suite 2901, Cincinnati, OH 45246.

The title of this free, 2-page flier is intentionally provocative. The article is Cincinnati forester Steve Sandfort's argument for engineering sidewalks based on soil type rather than building all sidewalks to one set of specifications. His observation is that well-built sidewalks may be economical in the long run and should prevent the sacrificing of nearby trees. Research by Ohio State University and the City of Cincinnati seems to be verifying Sandfort's ideas.



The focus of the October, 1992 issue of *Fremontia* was devoted to tree roots and their problems in urban soils. Copies are available for \$5.00 ppd. from: California Native Plant Society, 2707 K St., Suite 1, Sacramento, CA 95816.

## Books and Videos

Considerable details about soils and roots are included in:

- **Arboriculture - Integrated Management of Landscape Trees, Shrubs, and Vines**  
by Richard W. Harris *et al* (2004, 580 pp., Prentice-Hall, Upper Saddle River, NJ)

If you are interested in purchasing this or other tree-related books, please visit [www.arborday.org/books](http://www.arborday.org/books)

Other related resources are available from the International Society of Arboriculture, P.O. Box 3129, Champaign, IL 61826 or phone 888/ISA-TREE. Also available online.

- **Landscape Below Ground Video Set**  
*Landscape Below Ground: Proceedings of an International Workshop on Tree Root Development in Urban Soils* (200 pp.)
- **Landscape Below Ground II** (265 pp.)
- **Root Injury and Tree Health Video** (booklet also available)
- **Trenching and Tunneling and Utility Pruning Video Set**



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TREE CITY USA

The Tree City USA program is sponsored by The National Arbor Day Foundation in cooperation with the USDA Forest Service and National Association of State Foresters. To achieve the national recognition of being named as a Tree City USA, a town or city must meet four standards:

- Standard 1: A Tree Board or Department
- Standard 2: A Tree Care Ordinance
- Standard 3: An Annual Community Forestry Program
- Standard 4: An Arbor Day Observance and Proclamation

Each winning 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 or The National Arbor Day Foundation.



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