

# Tree Roots and Sidewalk Damage

Linda Dodge and Jim Geiger

**W**E HAVE MILLIONS OF trees along our streets, in parks and backyards, providing many environmental, social, and economic benefits. However, as you are well aware, trees and hardscape are often not compatible. When damage occurs to sidewalks, curbs, driveways or patios, people often forget all the benefits they provide and only focus on what it will cost to fix the damage.

In an effort to do something about this damage, a two-day symposium was held in late March 2001 at the University of California in Davis. The intent was to develop strategies to reduce hardscape damage caused by tree roots. The first day researchers and practitioners shared the latest findings and experiences. The second day was devoted to developing strategies for future research and education.

## CURRENT RESEARCH:

**Costs** - Dr. Greg McPherson of the Western Center for Urban Forest Research and Education related some surprising survey statistics on costs due to root damage. Of the \$70 million spent annually in California, 61 percent goes for hardscape repair, 13 percent for liability and legal fees, 10 percent for tree removal and replacement, 8 percent for prevention and mitigation, and 8 percent for administration and inspection. Annual costs for trip and fall claims are \$9 million in California, with the average payment being \$6,245.

**Downsizing** - Another interesting finding, which is being found all over the west, is that tree removal and replacement with smaller-stature species is leading to a "downsizing" of the urban forest and a loss of the benefits that large-canopied trees offer. In ad-

dition, tree managers reported that the most important factors associated with hardscape damage are restricted planting space, incorrect species, shallow soil, fine-textured or compacted soils and inadequate site design or engineering.

**Soil characteristics** - Dr. Larry Costello of the University of California Cooperative Extension shared the results of a study conducted in Modesto, CA. The researchers looked at characteristics of soils at tree sites with and without sidewalk damage. They found no consistent relationship between soil conditions and damage to sidewalks.

**Root architecture** - Dr. Dave Burger is examining cultivar selection based on

## PRACTITIONERS' EXPERIENCE:

**Water jet tools** - In Modesto, CA the city loans out several water jet tools to sidewalk replacement crews to help them create deeper channels for tree root growth in an attempt to discourage surface rooting.

**Retaining mature trees** - In Sunnyvale, CA the Public Works Department's right-of-way concrete maintenance staff uses root barriers, root pruning techniques and are experimenting with interlocking sidewalk pavers in their efforts to retain as many mature street trees as possible.

**Plan review** - In Santa Monica, CA a city forester reviews all new development plans. The city forester includes "tree protection zones" in almost every plan.

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root architecture at the Environmental Horticulture Department, UC Davis. Deep-rooting cultivars may provide alternatives for better rootstocks on plants near hardscape.

**Structural soils** - Dr. Nina Bassuk of the Urban Horticulture Institute at Cornell University shared her latest findings on the use of "structural soils." Over the past several years she has developed and refined a soil mix that provides increased underground pore space for tree roots without compromising the load-bearing needs of streets and sidewalks. The mix combines angular crushed stone and clay loam soil with hydrogel as a binding agent.

**Allies in the city council** - In Redwood City, CA the city forester works closely with the city council and the public to retain as many large street trees as possible by setting limits on removals within each block and using larger-scale species for new plantings when space permits.

## DESIGN/ENGINEERING PERSPECTIVE:

**Conflict avoidance, root guidance, or hardscape resistance** - Jim Urban, a landscape architect in Annapolis, MD, says that conflict avoidance can be easily designed into a new landscape by providing larger tree planting spaces, use of the monolithic street and sidewalk design that eliminates the park-

way strip, or use of a meandering curvilinear sidewalk that provides more room for trees. Root guidance can be achieved by including root barriers, gravel layers to direct root growth, or structural soil in the design specifications.

**Appropriate habitats** - Gary Mason, an Oakland, CA landscape architect, suggests designing appropriate habitats for urban trees. Instead of planting in straight, evenly spaced rows, trees could be grouped in groves or clusters along streets in urban wilderness areas. Alternative materials for walkways could be used and design criteria could be tailored to accommodate trees in their mature stage.

**Mixing and pouring concrete** - Concrete engineers, George Seegebrecht of Skokie, IL and Dave Holman of Danville, CA, emphasized the importance of basic design criteria in mixing and pouring concrete. Joints should be placed in concrete so panels are approximately square. If the length-to-width ratio exceeds 1.5 to 1 cracking may occur. The shrinking and expanding of clay soils often causes concrete to crack, but roots are viewed as the culprit.

#### FUTURE RESEARCH AND EDUCATION:

##### Root and soil management:

**Cultivar development** - Species selection and cultivar development for improved root architecture is an important area of research.

**Root Guidance** - More information is needed regarding the long-term effects of root guidance methods (barriers, trenching, chemical control) on overall tree health.

**Soil Management** - Research and outreach regarding soil management techniques are viewed as crucial.

**Site assessment/management** - Better site assessment, awareness of soil structure and management of soil compaction, drainage and temperature are among the most important factors.

**Benefit/Cost Analysis** - Benefit/cost analysis and consumer education are seen as ways to obtain official recognition of the urban forest in municipal policy and design.

**Better coordination** - Better coordination of city and county agencies responsible for urban trees and infrastructure should foster new urban design paradigm beneficial to all sectors.

#### DESIGN AND PLANNING:

**Street design** - Street designs should be reevaluated to include nontraditional (groves or clusters) tree planting locations, larger easements or bigger planting holes.

**Sidewalks** - Sidewalks should be redesigned or relocated.

**Alternative materials** - Alternative walkway or base materials need to be developed, including flexible pavement, and the use of structural soils should be more widely adopted.

**Root biology** - More applied research needs to be done on root biology and how the growth is affected by root control measures such as pruning, guidance and chemical control.

**Instrumentation** - New instrumentation for remote sensing of roots would prove useful.

**Education** - Of prime importance is the education of stakeholders and consumers about new design and planning options and how they will benefit the urban forest.

#### ENGINEERING:

**Alternative pavement materials** - Research and field testing of alternative pavement materials is seen as important, including stronger or flexible (rubberized) concrete and asphalt, the addition of rebar or wire mesh, and the inclusion of alleopathic chemicals or root toxins.

**Tree/site design matrix** - The development of a tree/site matrix would fa-

ilitate matching the planting site with a compatible tree species.

**Structural soil mix** - The use of a structural soil mix or compressible base material during site preparation needs refinement and further field tests.

**Soil volumes** - Research is needed to determine appropriate soil volumes for healthy tree root growth.

**Guidance** - Innovations for directing tree root growth include trenching, geotextile barriers, injection of gel materials into soil to reduce oxygen at the concrete/soil interface, modifying soil temperature to deter roots, and increasing light levels to force root growth downward.

**Temporary repair** - The long-term effects and legalities of temporary repair methods such as concrete jacking to level walkways and sidewalk grinding and ramping need to be fully determined.

**Maximize service life** - Planning agencies need to match the life expectancy of landscape and hardscape elements so as to get the maximum service life of each.

**Maximum efficiency** - Management agencies need to combine tree and sidewalk installation and repair efforts to maximize their efficiency.

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