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Street Trees an Urban Infrastructure: Getting at the Root of the Problem

Street trees are an important component of urban "green infrastructure" but root damage to sidewalks, curbs and gutters, and sewers is a serious problem in many cities. For example, a recent survey of sidewalks in San Jose found the estimated repair cost for treerelated damage to be $14.3 million. This amount is staggering when one considers that the city budgets about $1.7 million a year to manage its 250,000 trees. In this article we review results of research conducted at the Center on various aspects of this problem.

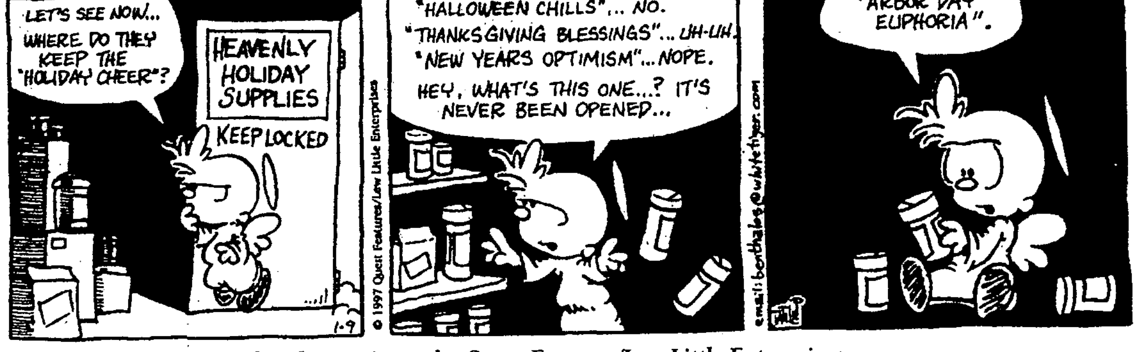
"Infrastructure Repair Costs Associated with Street Trees in 15 Cities" by Greg McPherson and Paula Peper provides insight into the magnitude of the infrastructure repair problem. Results of surveys administered to municipal foresters in 15 cities across the nation reveal that total annual concrete and sewer repair costs attributed to tree damage average $4.28 per street tree and range from $0.18 to $13.65 per tree. On average, repair costs are equivalent to 25 percent of annual tree program expenditures. Sidewalk repair costs are the single largest expense in all cities, averaging $3.01 per tree. Annual curb and gutter and sewer repair costs averaged $1.14 and $1.66 per tree, respectively. Damage is highly variable among cities and tends to be most severe in older areas of cities with deteriorating infrastructure and large trees.

Tree species belonging to genera such as *Liquidambar, Fraxinus, Zelkova, Gleditsia,* and *Prunus* topped the lists of those most often associated with concrete damage. However, these species are among the most common species planted in surveyed cities. All managers agreed that damage is more site specific than species specific. At sites where trees repeatedly uplifted sidewalks, the concrete replacement cycle ranged from five to ten years, whether or not root cutting was part of the replacement procedure. The Sacramento Tree Services Division has adopted a policy of removing "repeat offendee" trees if the concrete requires replacement more than once every eight years at sites where sidewalk relocation is not feasible. Removal still remains a last resort option in Sacramento, as it does in the other cities contacted.

Respondents' repair methods consist of variations on the general theme of removing old concrete, root-pruning or cutting, and pouring new concrete. San Jose routinely cuts roots to an 18-inch depth during sidewalk removal and replacement. In Vancouver, B.C., current replacement methods include relocating sidewalks where possible and using asphalt or crushed rock sidewalk inserts in lieu of concrete where there are repeated problems.

Although respondents listed species selection as a key component in avoiding concrete damage (particularly where planting space cannot be increased), all are considering, and in some cases applying, methods developed to deter damage and lengthen the concrete replacement cycle. When fiscally possible, replacement sidewalks in Modesto are poured with an 8-inch deep apron on the tree side to act as a root barrier. Geotextiles impregnated with herbicide are also being experimentally used as a method for deflecting potentially invasive roots. Other cities are using a variety of commercial root barrier products on an experimental basis, and San José is proposing the use of trenching and copper screening. Two of the cities are tackling the root damage problem from a hardscape engineering perspective. Sacramento has experimented with a foam additive for concrete designed to produce a more elastic sidewalk, one which

Bent Halos



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would bend rather than break and lift, as roots beneath grow and expand. In a similar vein, Vancouver is experimenting with sidewalks engineered with an air gap left between the bottom of the walk and the soil surface. The combined use of planting trenches with these air gaps in wider planting strips is being considered, as well.

One common mitigation measure—the use of root barriers—is the subject of three articles published this year. The first two articles, "Managed Development of Tree Roots. I. Ultra-deep Rootball and Root Barrier Effects on European Hackberry" and "Managed Development of Tree Roots. II. Ultra-deep Rootball and Root Barrier Effects on Southwestern Black Cherry" by Dr. Philip A. Barker compare the root development of *Celtis australis* and *Prunus serotina* trees as affected by rootball depth and a casing that fits snugly around the rootball to function as a root barrier. After three growing seasons, the roots of each tree were excavated to a 32-cm depth in an area within approximately 1 meter radius from the trunk and the dry weights of these roots were recorded. With both species, root weight was significantly reduced for trees treated with the root barrier casing, but no significant weight difference existed between the two rootball depths. However, trees with the 70 cm rootballs (casings removed from bottom half) were stable whereas those with 35 cm encased rootballs wobbled in the ground when the tree trunks were shaken by hand. Roots emerging from the sides of the 70 cm rootballs apparently stabilized the trees better than roots emerging only from the bottoms of the shorter rootballs. Stem growth, as reflected in trunk diameter measurements, was greater for trees with 70 cm rootballs regardless of the presence or absence of the rootball casing.

In the third paper by Dr. Barker and Paula Peper, "Strategies to Prevent Damage to Sidewalks by Tree Roots", results of experiments using several types of root barriers indicate the need for an improved barrier design to prevent development of potentially harmful circling roots inside barriers. In addition, various commercially-marketed root barriers with internal vertical ribs are compared to augment product descriptions by their manufacturers. Two experiments currently installed at the Solano Urban Forest Research Area use three of these commercial barriers. The experiments will be excavated in Spring of 1996 and results should address the effectiveness of vertical ribs in deterring circling roots.

Future research at the Center will include field experiments with different root barriers and modeling studies. We will evaluate the cost effectiveness of different strategies to retain existing trees and design future plantings that are less damaging to the infrastructure, therefore less costly to maintain.

By Paula Peper and Greg McPherson.
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