

Expanding Street Tree Canopy Cover and Repairing Sidewalks in the City of Los Angeles

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FOR TWENTY-TWO YEARS Los Angeles was without a sidewalk repair program. The result was a gradual deterioration of sidewalks and expenditures of approximately \$2 million annually for trip and fall claims. Today, approximately 4,300 miles (6,920 km) of sidewalk are in need of replacement or repair.

In Fiscal Year 2000/2001 the Los Angeles City Council provided the Department of Public Works, Bureau of Street Services \$8 million to develop a sidewalk repair program to provide safer and more accessible transit surfaces for pedestrians while maintaining a healthy, safe, and sustainable urban forest. After its third year the program has repaired 262 miles (421 km) of sidewalk preserving approximately 7,000 trees that would have otherwise been removed. This paper describes the program and some of the most promising strategies for preserving street trees while improving sidewalks.

POLICIES AND GOALS

The City of Los Angeles included trees as one of the major infrastructure elements in the General Plan Framework in the 1980's. Although expanding the City's "green infrastructure" was a stated policy in the Plan, implementation of this major step lagged behind. Frequently, trees were the last consideration during design and development but the first consideration for removal when they conflicted with other infrastructure. The sidewalk repair program has reaffirmed the importance of increasing tree canopy cover in Los Angeles by positioning it as a policy driving the program's goals:

- > preserve as many large, healthy trees as possible
- > replant sites where existing trees cannot be safely retained

- > plant in nearby, vacant sites
- > plant the largest species appropriate for the site
- > enlarge planting areas where feasible
- > remove trees in phases to retain an acceptable level of canopy cover
- > foster neighborhood involvement in the decision-making process

INITIAL PROGRAM IMPLEMENTATION

The sidewalk repair program is closely associated with the Americans with Disabilities Act (ADA) access ramp program. The ADA created regulations and standards intended to enhance the ability of disabled Americans to access public services.

evaluated to determine the feasibility of tree retention or preservation. Tree removal alternatives are utilized where possible and appropriate.

At sites where sidewalk reconstruction is not possible without tree removal, the trees are posted and the removal request is processed through the Board of Public Works. At locations where residents object to tree removal, and the tree is healthy, the tree may be preserved. Sometimes this limits the opportunity for sidewalk repair. The Bureau meets and confers with residents in community meetings to involve them in the decision-making process. At locations where it is determined that tree removal is required, an additional intent to remove notice is posted on the tree and the affected property

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The Bureau performed a survey of the City's sidewalks to locate damaged sidewalk areas, the extent of the damage, and to determine whether trees were present. The City of Los Angeles contains 6,500 miles (10,461 km) of streets and approximately 10,000 miles (16,093 km) of sidewalks.

Sidewalk repair locations are selected considering ADA requirements, damage severity, constituent requests, frequency of trip, slip, and fall claims, and consultation with the respective Council offices. Once selected, sidewalk repair sites are inspected and

owner is notified fifteen days prior to the commencement of work.

STREET TREE RESOURCE

Data collected in 1990 and 1996 for the City's street tree inventory revealed approximately 670,000 City managed street trees and 133,000 potential tree sites. The stocking level is 82 percent, indicating moderate opportunity for new tree planting. Species composition is diverse, with 28 species each comprising more than 1 percent of the population, and these taken together accounting for 74 percent of all City

street trees. The most abundant species are Crape myrtle (*Lagerstroemia indica*, 8 percent), Mexican fan palm (*Washingtonia robusta*, 7 percent), American sweetgum (*Liquidambar styraciflua*, 7 percent), Southern magnolia (*Magnolia grandiflora*, 6 percent), Indian laurel fig (*Ficus microcarpa* 'Nitida', 5 percent), camphor (*Cinnamomum camphora*, 3 percent) and London plane (*Platanus acerifolia*, 3 percent).

Restricted growing space is reported to be the single most important cause of conflicts between tree roots and hardscape (McPherson, 2000). In the City of Los Angeles, street trees are located in several planting site types: open parkways, tree wells, reverse parkways (placing sidewalk adjacent to the back of curb), unimproved parkways, and in limited cases, raised planters. Thus far, nearly all sidewalk repairs have occurred in open parkways and tree wells.

ROOT AND SOIL MANAGEMENT STRATEGIES

Tree Evaluation

Site inspections revealed that tree roots were associated with more than 90 percent of the damaged sidewalks. To preserve as many of these healthy trees as possible, the health and structural stability of each tree is assessed using the *Tree Hazard Evaluation Form* (Matheny and Clark, 1994). Each tree is graded and placed in one of the Bureau's five condition classes:

- A- Healthy, structurally stable tree with an exceptional historical, aesthetic and/or environmental quality.
- B- Healthy, structurally stable with a useful life-span of more than five years.
- C- Declining tree, creating extensive structural damage, or an improper species/size for the site.
- D- Declining tree, that is structurally unsound or has a high failure potential.
- F- Tree is dead.

Root pruning

Root pruning is the most common miti-

gation method currently employed. Frequently, root pruning precedes application of hardscape engineering strategies such as sidewalk meandering. Since root pruning can compromise tree stability, Bureau arborists inspect trees and complete a Root Pruning Evaluation Form (Street Tree Division, 2001) prior to initiating work (Table 1). Information from the form and a list of species tolerance to root pruning help arborists determine if root pruning is appropriate. Class A trees are not root pruned and special design and construction techniques are utilized to mitigate sidewalk damage and preserve these trees. Arborists perform a second root inspection after the concrete is excavated. Shallow roots that interfere with the sidewalk repair or ramping operation are painted for removal.

Most root pruning occurs in a straight line through one quadrant of the root zone, usually adjacent to the sidewalk. The depth of cut varies with different tree root patterns but is limited to the depth required to replace the sidewalk. Initial root pruning is performed by a Vermeer 50TX root pruning machine (Figure 1). Clean final cuts are then made utilizing chain saws with carbide blades (Figure 2). Selective pruning of individual roots with chain saws is frequently performed prior to ramping sidewalks.

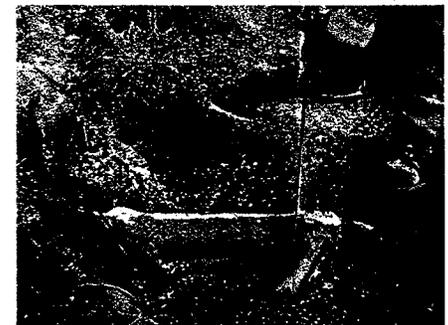
Roots are pruned as far from the trunk as practical. When the planting strip or cut-out can be enlarged, the cutting point is moved further away from the trunk. However, in some cases the boles of mature trees fill the cut-out and the space cannot be enlarged, precipitating pruning roots close to the trunk.

Tree crowns are pruned (i.e., crown cleaning, thinning and reduction) on an as-needed basis prior to root pruning and during follow-up inspections. Ideally, follow-up assessments occur 6, 18, 40, and 78 months after root pruning but inspection frequency depends upon available funds. Information obtained from the monitoring program helps arborists evaluate species tolerance to root pruning.



Figure 1. Straight line root pruning is done initially with a machine through one quadrant of the root zone. The cut is made adjacent to the edge of the sidewalk and only as deep as needed for the sidewalk repair.

Figure 2. Hand saws or chain saws with carbide blades are used for cleaner final cuts than obtained with the root pruning machine. Selective pruning of individual roots by hand is frequently performed prior to repouring sidewalks.



Tree removal

Trees are removed when other mitigation strategies are not possible or tree health is declining and failure potential is high. After trees are removed, planting space may be enlarged to allow planting of medium to large size trees. Creating a larger planting area is accomplished by: enlarging tree wells, minimizing the sidewalk width, creating a reverse parkway (placing

sidewalk adjacent to the back of curb), obtaining additional public easement from the property owner and creating curb bump-outs.

The Bureau works closely with the City Council and the public to retain as many large street trees as possible. To avoid drastic reductions in local tree canopy cover the Bureau's goal is to limit removals to no more than 20 percent of the trees in a block or trees at three consecutive residences within a one-year period.

SIDEWALK ENGINEERING STRATEGIES

Sidewalk grinding

Sidewalk grinding is a temporary measure that restores the offset or heaved portion of a sidewalk to original grade. The Bureau grinds offset sites of 0.5 inches (1.2 cm) or less. Sidewalk grinding is performed at approximately 10 percent of the repair sites.



Figure 3. Wherever possible, cut-outs are enlarged during the sidewalk repair process. In this case, the cut-out was enlarged parallel to the street so access for pedestrians was not impeded. Although not possible here, meandering the sidewalk around the tree increases the cut-out size, but requires permission from the adjacent property owner.



Sidewalk cut-outs

"Borrowing" space from the adjacent sidewalk creates larger sidewalk cut-outs (Figure 3). This alternative reduces sidewalk width for a limited distance adjacent to the tree. The cut-out provides trees with a larger growing space, while reducing the size of pruned roots and their proximity to the root flare. ADA regulations on minimum sidewalk width can limit the use and size of cut-outs.

Sidewalk meandering

Meandering, curving the sidewalk around a tree, enables the Bureau to provide more growing space for trees in an aesthetically appealing way. The amount of growing space created can be substantial, therefore, sidewalk meandering is usually the preferred method to retain large, mature trees. Sidewalk meandering often requires permission from the adjacent property owner to dedicate more of their property to the public right-of-way.

Sidewalk ramping

Sidewalk ramping allows for existing roots to remain intact by re-pouring concrete over the roots to create a gradually sloped ramp (Figure 4). It is used when removal of roots would compromise the stability of a grade 'A' tree. Research in the City of Santa Monica suggests that sidewalk ramping does not prevent future damage but can delay it by five years or more (Warriner, 2001).

Flexible paving materials

There are many types of flexible paving: interlocking and standard pavers, common brick, rubber bricks, and poured in place rubberized sidewalks. Flexible paving is used in conjunction with root-pruning to retain original grade, as well as when the level of the paving surface is ramped above or lowered below existing grade. Although the use of flexible paving does not prevent future damage, it does provide more time between repairs and it makes repairs easier and less costly.

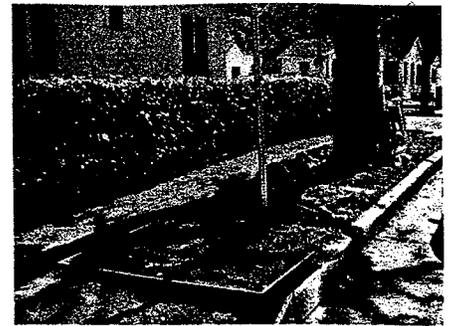


Figure 4. Ramping the sidewalk reduces the amount of root pruning and is used to preserve highly valued trees. Ramping delays damage but does not provide a long-term solution to sidewalk heaving.



PLANNING AND DESIGN STRATEGIES

The Bureau's prevention and remediation strategies address damage that has already occurred. Eliminating the potential for tree roots and infrastructure conflict is the long-term solution to these conflicts. These strategies require extensive interagency cooperation.

Tree species selection

Selecting tree species that are well-suited to their sites is one key to avoiding potential future infrastructure conflicts (Costello et al., 2000). Tree species with a history of creating infrastructure conflicts are not planted near sidewalks. Information from the monitoring program is used to update this tree list.

Providing adequate space for trees
Providing sufficient space and a proper growing medium to fulfill the tree's requirements through maturity is critical to success (Seegebrecht, 2001). Too frequently, development plans do not include these essential ingredients for successful tree planting.

The Bureau is working with the Department of Planning to ensure that the needs of trees in relation to other infrastructure elements are met. Options for providing adequate planting space for trees include: larger parkway areas, reverse parkways, sidewalk elimination, planting pits or planters with tree groupings, larger tree wells and requiring structural soils.

Structural soils

Structural soils are engineered to permit the compaction required of pavement sub-bases while at the same time providing the pore space necessary for healthy tree root growth (Bassuk and Grabosky, 2001). The use of structural soil in urban plazas and streetscapes has been found to promote deeper rooting patterns and vigorous tree growth.

CONCLUSION

The City of Los Angeles' sidewalk repair program is now entering its fourth year. The amount of funding for sidewalk repair work has gradually increased from \$8 million to nearly \$22 million. In 2004 the Bureau anticipates repairing 74 miles (119 km) of sidewalk affecting 6,500 street trees.

By utilizing an array of strategies, the Bureau has limited tree removal to less than 7 percent of the affected trees. The majority of the trees have been preserved through the root pruning method. Anecdotal evidence indicates that root pruning is not affecting the short-term health or vitality of the root pruned trees. To date, no root-pruned trees have failed.

A successful sidewalk repair and tree preservation program requires the coordinated efforts of urban forest managers, arborists, engineers, politicians and other members of the community. Collaboration across disciplines is fundamental to expanding tree canopy cover while improving the City's pedestrian access system over the long-term.

The future of the City of Los Angeles' urban forest looks bright, as a growing number of trees are retained and preserved. Monitoring of these strategies provides a quantitative basis for fine-tuning the program to increase its effectiveness. Lessons learned in Los Angeles will enhance the management of urban forests in cities throughout the world. For further information on this subject consult the new WCISA publication "A Compendium of Strategies to Reduce Hardscape Damage from Tree Roots" (Costello and Jones, 2003).

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