RESEARCH LABORATORY TECHNICAL REPORT

BARTLETT TREE EXPERTS
SCIENTIFIC TREE CARE SINCE 1907

Sidewalk Repair Near Trees

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Tree roots grow underneath sidewalk pavement when there is oxygen, water and space for them to grow. Roots are very small when they start growing under pavement but then increase in diameter as the tree grows, resulting in lifting or cracking of the pavement. When pavement lifting is excessive (Figure 1), a pedestrian tripping hazard is created. It then becomes a challenge to preserve the tree while continuing to allow pedestrian use of the sidewalk.

Figure 1: Extreme sidewalk lifting associated with tree roots

The best opportunity for dealing with sidewalk lifting problems is at the time of tree planting or concrete installation. Tree species can be selected to fit the available space. If space is limited, small-maturing trees or species known not to damage pavement should be planted. Alternatively, modifications can be made under or next to the pavement to reduce root growth.

Modifications that will extend the useful life of sidewalk pavement include installation of root barriers alongside the pavement or installing a root-excluding base beneath the concrete (Figure 2). Root barriers must be at least 18 inches (45 cm) deep and the top must be above the soil and mulch surface to be effective. Base layers that successfully exclude roots include washed coarse gravel (1-1.5 inches, 2.5-3.7 cm diameter, with no fines) and foam insulation boards. A gravel base at least 4 inches (10 cm) thick is recommended; thicker is probably better. Gravel is only effective in well drained soils. Foam boards are commonly available from ½ to 2 inches (1.25 to 5 cm) thick. Two 2 inch (5 cm) thick boards can be glued together to provide a 4 inch (10 cm) base for the greatest protection from root growth damage.

Figure 2: Bartlett Lab research plot showing different root growth patterns with no base layer (upper) and where foam board was installed

When roots do lift sidewalks, there are a number of actions that can be taken to ameliorate the problem.

These solutions have varying costs and impacts on tree health, longevity and stability. They may be used alone or in combination and include:

1. Shaving the top of the concrete or installing a ramp to even the surface and reduce the tripping hazard (Figure 3). Shaving or grinding the concrete is done with a specialized cutting machine. The goal is to lower the raised concrete edge to the level of the lower slab. Concrete can be ground to about ½ of its original thickness. The other commonly used alternative is to install a ramp or wedge of asphalt or concrete to smoothly bring the lower level up to the lifted edge (Figure 4).

Figure 3: Concrete shaved/ground to smooth

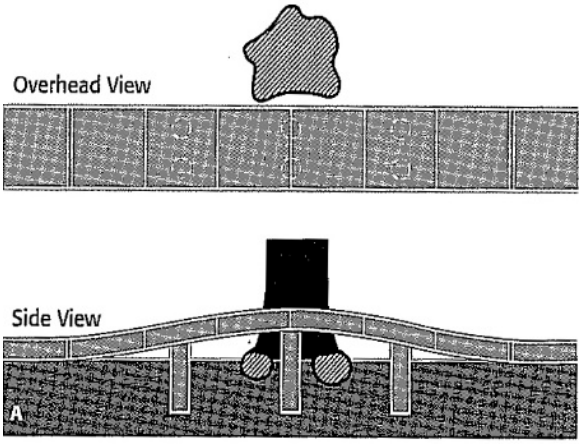
Figure 4: Asphalt ramp/wedge installed to reduce tripping hazard

2. Increasing the distance from the tree to the edge of the sidewalk. This can be done by either narrowing the sidewalk or rerouting it around the tree. The Americans with Disabilities Act (ADA) limits sidewalk width to no less than 39 inches (1m). By increasing the distance from the sidewalk to the trunk, the roots that are most likely to cause damage will no longer be underneath the pavement. Sidewalks can often be curved around a tree with the permission of the property owner (Figure 5). These techniques can avoid damage to large roots that are primarily responsible for tree stability.

3. Bridging the pavement over the roots. Bridges are simply sidewalks that are raised near the tree to allow root growth beneath. They may be supported near the tree by concrete piers or they may be supported by the base layer (Figure 6). The steps to install bridges are: remove the existing concrete, base and soil from above the existing roots; drill holes and install concrete form tubes (e.g. Sonotubes®, Quick-Tube®) if needed for additional support; level the base with the top of the roots using coarse sand or pea gravel; apply a layer of foam board with holes cut for piers (if installed); frame for concrete, pour reinforced concrete and finish. The maximum ADA allowed slope for this type of construction is 1:20.

Figure 5: Sidewalk rerouted to increase the distance from the trunk and avoid root damage

Figure 6: Sidewalk bridging plan from Costello and Jones



4. Replacing concrete with interlocking paver blocks or rubber pavers (Figure 7). This alternative will not slow pavement lifting, but will allow for a smoother transition and the removal of blocks that have lifted too high. Pavers are installed by removing the concrete and base materials above the roots and removing the soil between the roots (if needed) using a supersonic air excavation tool, installing a new sub-base of coarse sand or pea gravel and leveling and compacting the sub-base slightly above the existing roots. Next, install a geotextile fabric (e.g. Typar 3341) on top of the base, install and compact a coarse sand base layer, and finally, install the pavers. Paver joints should *not* be mortared.

Figure 7: Sidewalk narrowed and pavers installed to provide more room for root growth

5. Root shaving then installing new concrete. If the pavement must be reinstalled flat and in the same location from which it was removed, the height of the offending roots will need to be lowered. For mature trees, it is best not to cut roots greater than 2 inches (5 cm) in diameter. However, it is usually roots that are larger than this that create sidewalk lifting problems. It is better to remove the top surface of a root rather than the entire root (Figure 8). This is done by shaving the root using a chainsaw or debarking tool. Large roots should not be cut more than 1/3 of their diameter. Cut roots do tend to callus quickly, so a layer of rigid foam or pipe insulation foam should be installed between the shaved root surface and the new concrete. The loss of tree stability from root shaving and the rate of decay in shaved roots are not known. The tree should be inspected annually for health and stability if shaving is done closer than three times the trunk diameter (DBH) from the base of the tree.

Figure 8: Root top shaved to lower the surface

6. Root removal and sidewalk replacement. The removal of roots at the edge of the sidewalk followed by concrete replacement will provide a longer term solution to sidewalk lifting but will have the greatest effect on tree health and stability. A thorough tree structural analysis should be

conducted before roots are removed. It is recommended that buttress roots not be cut closer to the trunk than a distance equal to three times the trunk diameter (DBH). If they need to be severed closer than 1.5 times trunk diameter, tree removal should be considered since it is very likely that tree stability will be affected at this distance, depending on tree species and condition (Figure 9). When reinstalling the pavement next to a root cut tree, allow space for callus and trunk diameter growth. Installation of a root barrier or root-excluding base (foam board or washed gravel) should also be considered under the new pavement to avoid reoccurrence of the problem.

Figure 9: This new smooth and level sidewalk required root cutting within 1.5 times trunk diameter.

Trees provide many benefits in urban areas; however they do occasionally conflict with sidewalks, especially when trees are not designed into the urban infrastructure. It is best to plan for these conflicts and install trees that are compatible with sidewalks or implement measures at the time of planting to reduce conflicts. If this cannot be done, there are many techniques that can be used to retain trees and reduce damage to the pavement. The method that is least damaging to the tree while allowing for a safe sidewalk should be used. *Always have a qualified arborist present for any root cutting.*

For more details see:

Larry Costello and Katherine Jones. 2003. *Reducing infrastructure damage by tree roots: a compendium of strategies*. ISA Press Champaign IL. 119pp.

James Urban. 2008. *Up by roots*. ISA Press Champaign IL. 479pp.

Sources:

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