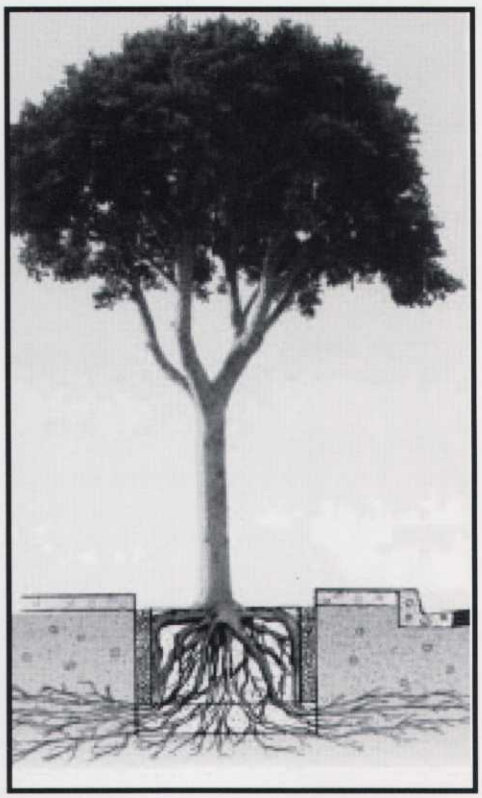
Root Barriers for Golf Course Applications

By Brian Burton



Introduction and Background; Why Root Barriers Are Essential

All pavement and hardscaping installations are critically dependent on the integrity and stability of base materials below the surface. Any disruption or movement of the base material or underlying structure will cause deficiencies to quickly appear on the surface. These defects generally manifest as rutting, heaving, or displacement of paving surfaces, which represent a hazard for players, vehicles, wheelchair users and pedestrians and can be expensive to repair.

In golf course applications the growth and development of tree root systems near pavement installations or turf areas can disrupt the base materials and other components in the manner described. In fact, a recent study cited defects directly attributed to tree root growth as the sixth most common cause of premature pavement in municipal applications.

*A survey of 18 California cities indicated that $70.7 million was spent annually statewide due to conflicts between street tree root growth and pavements. The largest single expenditure was for sidewalk repair ($23 million), followed by curb and gutter repair ($11.8 million), and trip and fall payments ($10.1 million). Substantial funds were invested to remove and replace trees in conflict with hardscape ($6.8 million), and for inspection and repair administration programs ($5.9 million). The use of root barriers and root pruning were the most important mitigation and prevention measures."

***Expenditures Associated With Conflicts Between Street Tree Root Growth And Hardscape In California, United States**
by E. Gregory McPherson

For this reason, root barriers, which prevent the growth of opportunistic tree roots under pavements such as sidewalks and roadways, have been increasingly recognized as essential components of hardscaping installations. Root barriers have consistently proven over time to be effective in eliminating deficiencies in new construction and have been successfully used to retrofit and repair existing installations.

Installing Root Barriers
Proper Detailing and Installation Important
Proper detailing and installation of root barriers is required at locations where tree roots intersect with hardscaping components to ensure successful long-term performance.

Surround Style Planting Applications
The first root barriers made their debut in the early 1970s. The first configuration used was a "surround style" barrier. These surround barriers could be purchased in one-piece, or they were assembled in rolls or panels which were connected together on-site.

Early research showed that the smooth walls of the surround sound barrier often lead to circling of the roots. The young tree roots would hit the side of the barrier and instead of growing in a downward direction they would grow in a horizontal path. This eventually resulted in a circular root configuration that could eventually "girdle" the tree. This kind of root growth pattern could eventually constrict the vascular system of the tree and inhibit growth. Root barriers are now available with ribs that encourage the downward growth of roots. In addition, other features, which are now available, assist in deep watering and continuing oxygen exchange in the soil.

One of the most crucial factors for the long-term success with surround style root barriers is ensuring the installation of the top edge of the root barrier above grade. It is also important to choose a root barrier of sufficient size to accommodate the growth of the tree as it matures over time. An undersized barrier will restrict root growth and compromise the trees ability to maintain a firm anchor in the soil. Additionally if the root barrier size is too two small it would be difficult or impossible to properly backfill between root ball and barrier. This condition will cause air pockets to become filled with water, creating conditions, which can lead to decline of root growth. In general barrier installation is much more successful if the soil to properly prepared. Specifically the soil should be loosened well below the bottom of the barrier to encourage deep rooting. If hard and compacted in later years the roots will grow out from the bottom and simply turn upward.

As well as proper soil preparation, accommodations for adequate soil moisture below the barrier should also be made at planting time. If adequate moisture levels below the barrier are not maintained the roots tend to grow near the surface where moisture is readily available.

Installation

* In instances where a tree pit is located within an area to be surfaced the subgrade should be prepared according to the design specifications.
* The initial planting hole as shown in the diagram. (Consideration should be given to installation of drainage devices or amendments to correct any adverse soil or planting conditions.)

Continued on page 8

Root Barriers (Cont'd)

* It is also recommended to dig an additional 12" to establish the largest possible rooting area below the depth of the barrier. This area should be re-compacted, either with the original excavation materials or soil amendments as necessary. This ensures that the roots will be able to penetrate the ground below the barrier, yet will not settle below grade with watering.
* Assemble the appropriate number of panels with the vertical root deflecting ribs on the panel facing inward toward the root ball.
* Next, place the barrier in the center of the planting hole, with the double top edge of the barrier positioned at the top of soil grade, (if there is no tree grate.) With a tree grate, place the barrier just below the lip that the tree grate sits on.
* Install the tree inside the barrier. Backfill soil inside the barrier to a level 1/2 inch below the double top edge of the root barrier. This will ensure that roots do not grow over the top of the root barrier.

Linear Installations

* When the tree pit is located beside a sidewalk or area to be surfaced, install the base and geotextiles where specified
* Determine the correct number of panels to be used. Depending upon the actual planting plan and the number of trees involved, the length of linear barrier will vary. As a general rule of thumb take the anticipated mature canopy diameter of the tree and add 2 feet.
* Choose the barrier that best suits the application. Generally if a sidewalk, patio or driveway is to be protected. (For most applications 18", root barriers are generally considered a sufficient depth. 12" root barriers can be used as an alternative choice for non-aggressive trees. For curb and gutter protection, or for more aggressive roots, however, 24" are generally a better choice.
* Excavate the area where pavements are to be laid. Place the barrier in a trench, at the edge of the excavated area, with the vertical ribs facing toward the tree and align in a straight fashion
* Install surfacing materials in specified manner. Follow the same procedures that you would normally. Be sure to keep the barrier's double top edge at least 1/2" above grade, or at grade, to ensure roots do not grow over the top. Plant the tree(s).

Trees have three primary forms of roots: the large, woody structural roots near the tree base, the long, woody transport roots and the ephemeral, absorbing roots. The absorbing roots usually do not form woody materials. These transport roots carry food to the root tips, as well as water and essential elements to the leaves. The longer a transport root survives, the bigger it becomes. Roots grow where soil resources are most plentiful. And if that area is near the soil surface, then that's where the roots will grow.

The two resources most important to tree-root growth are oxygen and water. Oxygen is available only near the soil surface in large air-filled soil pores. Tremendous competition exists for this oxygen between tree roots and other plant roots. Because of the ease with which roots pull water from the soil, roots sense and grow toward areas where plenty of water is available. The quandary is that water supplies must be located in the same soil areas where atmospheric oxygen also is available. Soil organisms quickly use the dissolved oxygen in soil water and, as a result, it is not as readily available to tree roots as atmospheric soil oxygen.

Atmospheric oxygen is essential to tree life. The aboveground portion of a tree has no problem finding oxygen in the air for respiration. (Oxygen content in the atmosphere is about 21 percent.) For roots, however, the plight of getting enough oxygen is severe.

For unconstrained root growth, the soil atmosphere must contain more than 15 percent oxygen. As soil-oxygen levels fall below 5 percent, root growth stops. Oxygen levels of less than 2 percent lead to root decline and death. The three major problems that cause inadequate soil oxygen are:
* Competing organisms
* Soil compaction,
* Water-filled pores (saturation).

All of these problems lead to an oxygen-limited condition of the soil: an anaerobic condition. Under anaerobic soil conditions, different types of microorganisms-primarily bacteria-take over the soil. The anaerobic organisms produce toxins and consume or infect roots. Several tree root rots thrive at low soil-oxygen levels.

Warmer temperatures disrupt oxygen use by tree roots. As soil and air temperatures increase, so does oxygen demand in a tree and in the surrounding soil. For every 18 degrees F increase in temperature, oxygen demand doubles for both tree roots and other soil organisms. Increasing temperatures cause tree roots to respire faster, which uses food and oxygen more quickly

An additional example of root-oxygen problems occurs on recreation sites where foot and vehicle traffic have compacted the soil, collapsing the soil air pores. To maximize landscape performance, some landscape managers add composted organic matter and nitrogen to the soil, along with continuous irrigation. The result is a rich mess of oxygen-demanding microbes fueled by organic material and nitrogen.

As these organisms use oxygen, and oxygen is not easily replenished because of water filling all available pore spaces, more portions of the site become anaerobic. In anaerobic conditions, microbes can use soil nitrogen, manganese, sulphur and carbon for respiration as oxygen is depleted. Under these same conditions, however, tree roots decline and die.

Water

Roots search for water holds similar problems. Too much water and the tree drowns (suffocates). Too little water and the tree starves (desiccates).

Continuous soil saturation or flooded conditions lead to low soil oxygen and, thus, major tree-root problems. Unregulated, poorly adjusted and improperly zoned irrigation can all cause root damage, especially in warm weather. Saturated soils also are prone to mechanical damage, which reduces aeration and thus lessens trees' ability to survive well there. As water fills and occupies all available soil pores, any

Concluded on Page 9

Root Barriers (Concluded)

activity on the soil (walking, driving vehicles or parking, for example) disrupts soil structure. These activities result in rutting, puddling and compacting of the soil, which lead to root injury and death.

Structures, which rely directly on the subgrade for support, such as retaining walls and concrete pavement installations are susceptible to changes in soil moisture levels that can cause differential movement within the subgrade.

Tree roots are very aggressive, growing near the soil's surface in search of water, nutrients, and oxygen. They can extend underground, spreading outward, two to three times the diameter of the tree canopy. As the tree grows, the roots grow, becoming larger and larger, exerting tremendous pressure on concrete and asphalt.

Moisture Movement in the Soil

Damage can also be caused by the effect tree roots have on the moisture movement in the soil. Where tree roots extract large amounts of water, the subgrade may shrink and cause damage to structures. Typically, the damage is not caused by direct physical pressure from the roots themselves but by radial growth of tree roots in the immediate environment. Gravel layers in subbase materials can create high humidity and aggressive tree species will take advantage of the enhanced conditions to increase their root growth.

Structures, which rely directly on the subgrade for support, such as retaining walls, are susceptible to changes in soil moisture levels that can cause differential movement within the subgrade.

About the Author: Brian Burton is a Member is Standing Committee for Technical Evaluations for the Canadian Construction Materials Commission and is a regular contributor to many leading landscaping and engineering publications.

2002 Committees

Scholarship Tournament Committee
Co-Chairman
Andy Slack
Gary Ingram
Sub-Chairman
Mike Hill

Scholarship Committee
Chairman
P.J. Spellman
Sub-Chairman
Bob Lapic

Programs & Golf Committee
Chairman
Mike Hill
Sub-Chairman
P.J. Spellman
Bob Lapic

Education & Institute Committee
Co-Chairman
Vince Keats
Jim Irvine
Sub-Chairman
Bob Costa

Membership Committee
Chairperson
P.J. Spellman
Sub-Chairman
Bob Lapic
Pat Finlen

Research Committee
Co-Chairman
Patrick R. Finlen
Jim Irvine
Sub-Chairman
Bob Costa

Nominating Committee
Chairman
Bob Costa
Sub-Chairman
Jeff Shafer

Bylaws Committee
Chairman
Bob Costa
Sub-Chairman
Jeff Shafer

Public Relations Media And Awards Committee
Co-Chairman
Bob Costa and Bob Lapic
Sub-Chairman
Jeff Shafer
Pat Finlen

Sponsorship
Co-Chairman
Bob Costa
Mike Hill
Sub-Chairman
Jeff Shafer
Barb Mikel
P.J. Spellman

Newsletter Editor
Ken Williams (non BOD)

California Golf Course Superintendents Association Delegates

Jeff Shafer
Gary Carls (non BOD)

GCSA of America Chapter Delegate
Bob Lapic
1st Alternate
Jeff Shafer
2nd Alternate
Bob Costa

First Tee Program
Chairman
Mike Hill
Sub-Chairman
P.J. Spellman

Certification Attestor Liaison
Chairman
Wayne Lindelof (Non BOD)
Sub-Chairman
Pat Finlen

Government Relations Liaison
Chairman
Jim Irvine
Sub- Chairman
Jeff Shafer

Technical Assistance Network Liaison
Chairman
Bruce Olson
Sub Chairman
Pat Finlen