

A photograph of a tree trunk in a city street. The tree trunk is positioned in the center, with a metal grate covering the ground around its base. The grate is made of a dark material with a grid pattern. The ground is paved with concrete slabs. The image is overlaid with a semi-transparent dark grey rectangle, and the title text is centered within this rectangle.

Root-based Concepts for Successful Street Tree Plantings

Tree Anatomy-Roots



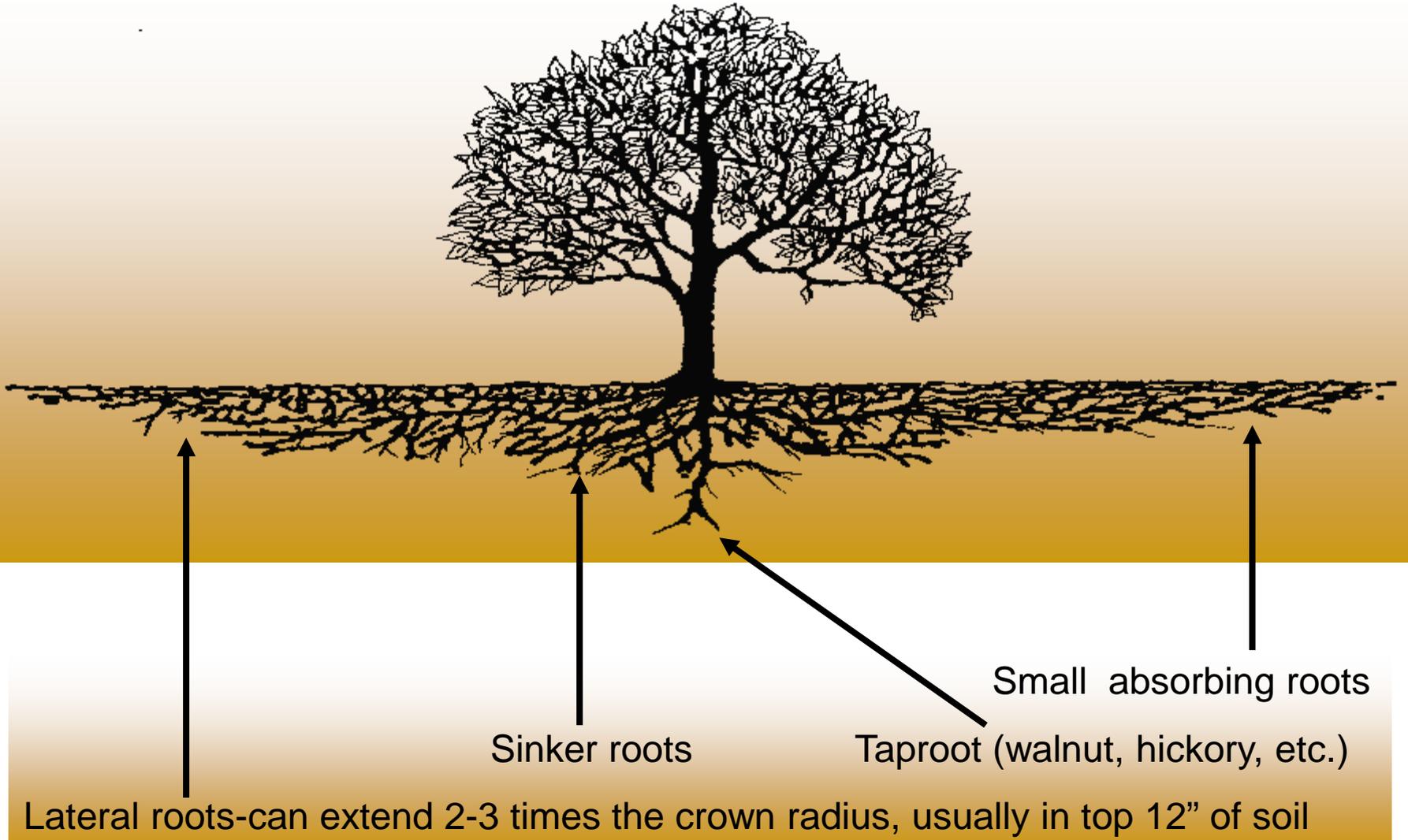
Functions of Tree Roots

- Anchorage
- Absorption
- Conduction
 - Storage

How Roots Grow

- **Lateral roots** (horizontal roots) usually in the top 18"-24" of soil
 - May extend 2-3 times radius of crown
 - Small, fibrous roots** responsible for most water absorption for the tree
 - MUST HAVE adequate soil OXYGEN to live!
- **Sinker roots** grow downward from lateral roots
 - Larger roots mostly responsible for anchoring the tree, providing structural support
- **Tap root** - often a myth, but evident on some species

Types of Tree Roots



Concept One:

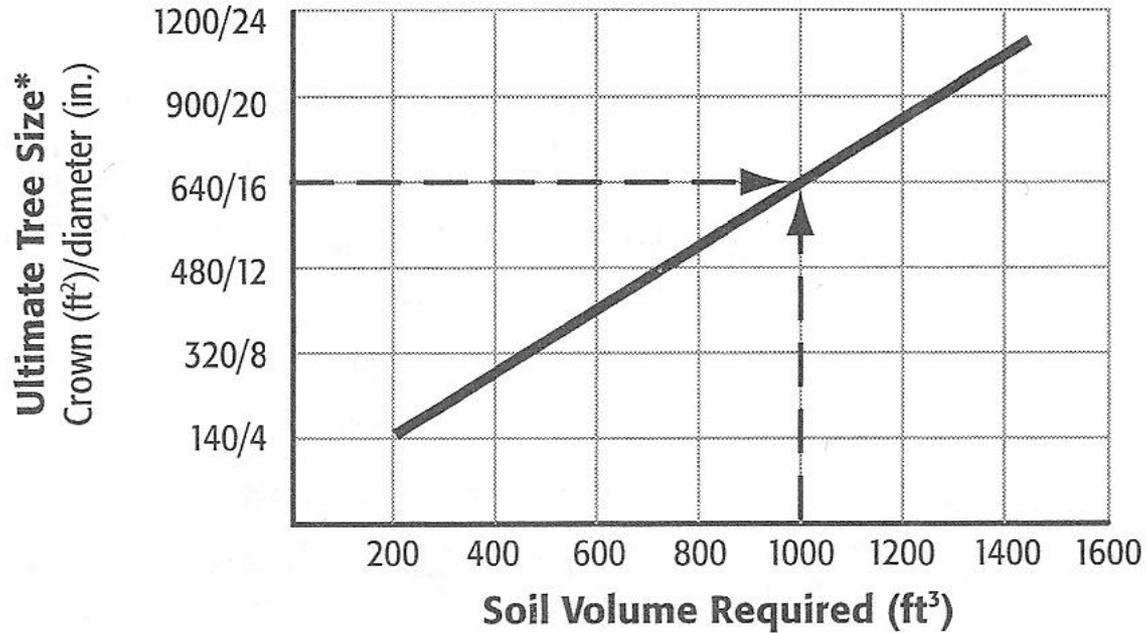
Roots grow best in aerated (oxygenated), fertile, adequately watered soils

Urban Soils are Altered Soils:

- More **Compacted** = less oxygen and water absorption = restricted root growth and function = unhealthy tree
- Generally **Less Fertile** than native soils = the top soil layer has probably been removed or disrupted many times over (compaction also affects fertility)
 - Plant roots and mycorrhizae contribute to the creation of most **soil organic matter (SOM)**
 - SOM helps build soil structure, provides nutrients, increases soil water holding capacity

- **Understand Soils at Site**
 - A Given in SE CO – high pH
 - Could have high salts – if salts high enough any tree will suffer
 - Probably high clay content
 - Determine depth to hard pan
 - If less than 3 feet, recommend breaking up
- **Cultivate Soil**
 - Cultivate the entire planting area to create a common rooting zone where infrastructure does not cover the planting area (planting strips/medians)
 - Break up hard pan
- **Increase Soil Volume**
 - Continuous trenches constructed under pavement
 - Cluster plantings
 - Ideally, plan for 1,000 to 2,000 cubic feet of soil for healthy trees

SOIL VOLUME FOR TREES



* The ultimate tree size is defined by the projected size of the crown and the diameter of the tree at breast height.

Note

For example, a 16 in. diameter tree requires 1000 cu ft of soil.

Source: Reducing Infrastructure Damage by Tree Roots: A Compendium of Strategies





Sharing a common rooting space - median



Sharing a common rooting space – Cluster planting



Trees clustered into one large soil area as shown above often perform better than trees placed individually in a location surrounded by concrete and asphalt. This happens because roots are able to spread out and share the large soil space instead of being confined to a small planting pit.

Source: <http://hort.ifas.ufl.edu/woody/urban-sidewalk-cluster.shtml>

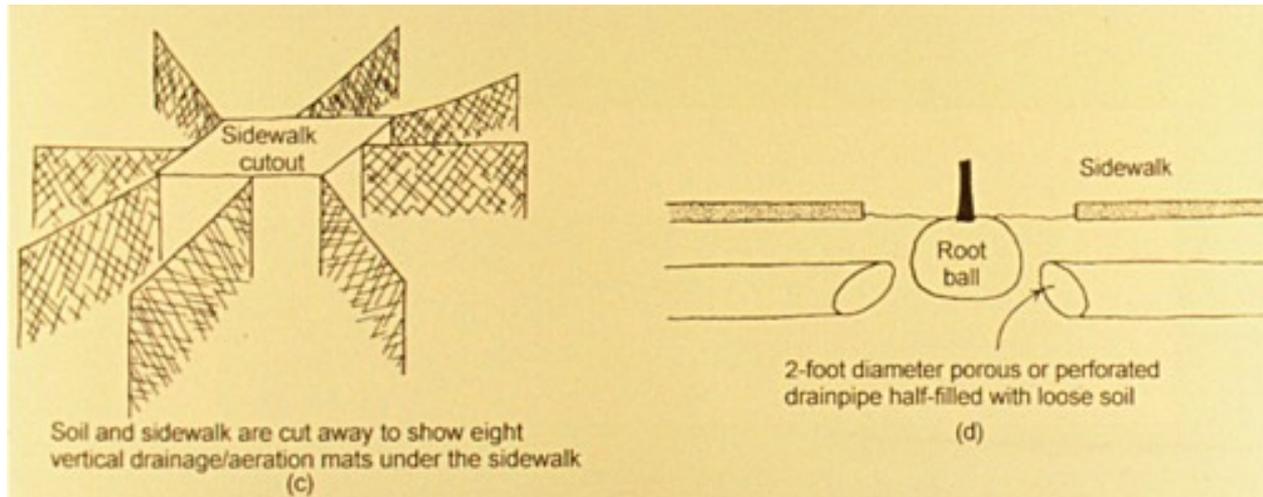


Plant trees on the other side of sidewalk if there is an open lawn area





Creating Root Channels



Tree roots can be directed to grow in channels provided for by good design. Two of these methods are illustrated above. One-inch thick aeration or drainage pads can be installed as illustrated on the left to increase the effective root zone beyond the small planting pit. Typically, soil outside the planting pit is compacted in clayey soil and ill-suited for root growth. If roots do not grow, the tree performs poorly.

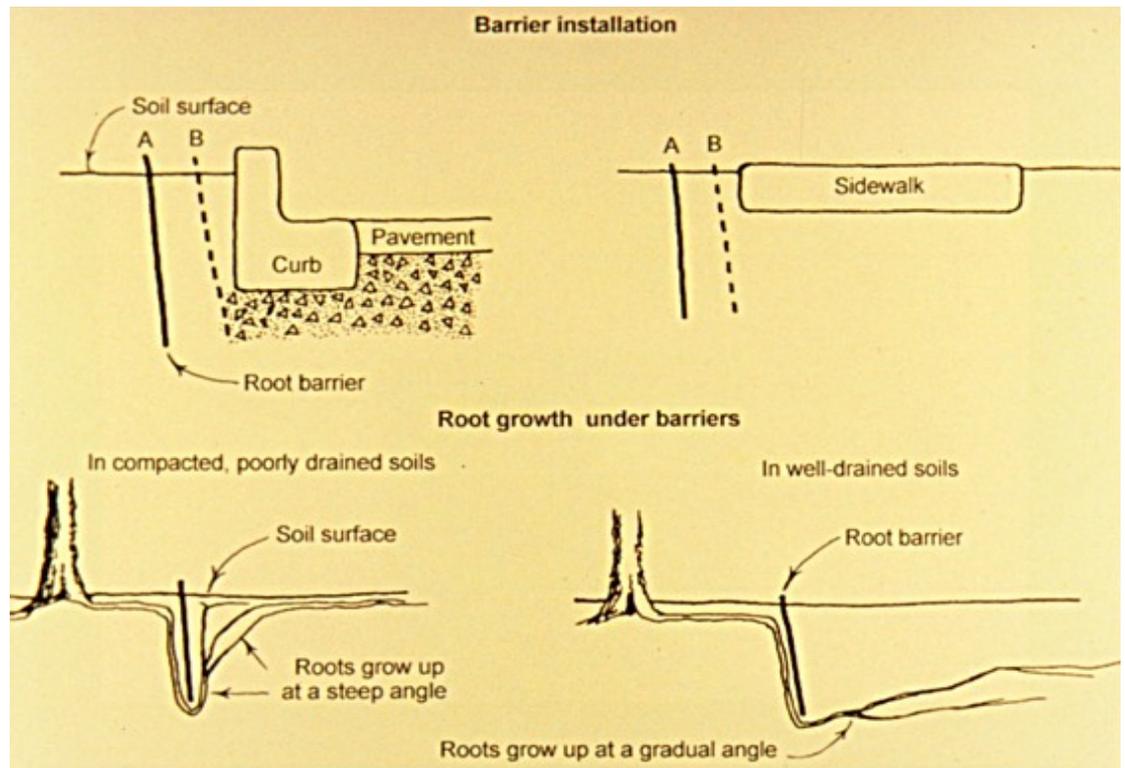
The system illustrated on the right uses a pipe about 2 feet in diameter half filled with loose top soil and slow release fertilizer. The pipe is placed at the edge of the root ball and extends under the walk into open soil space where roots can thrive.

Source: <http://hort.ifas.ufl.edu/woody/urban-sidewalk-channel2.shtml>



Source: <http://hort.ifas.ufl.edu/woody/urban-sidewalk-CHANNE3.shtml>

Root Barriers



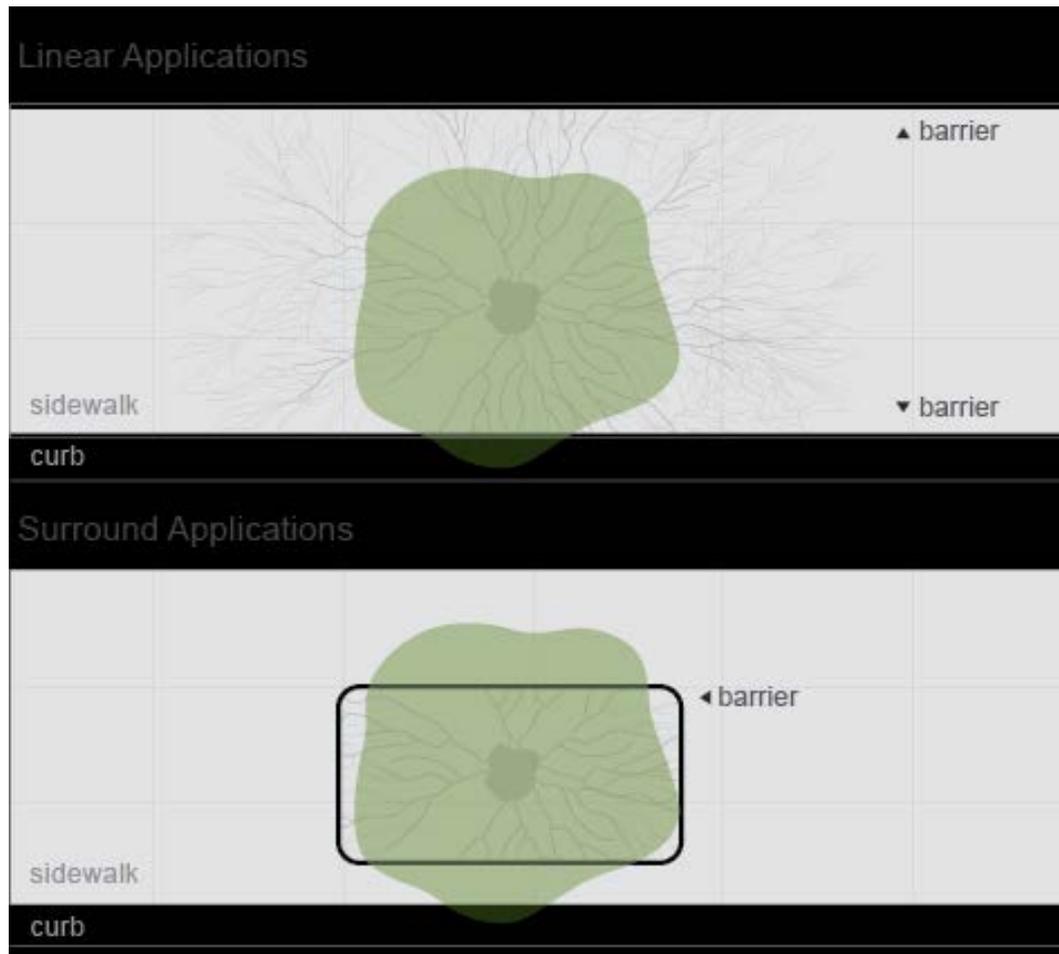
(Top) Barriers have been placed vertically in the soil to deflect roots away from hardscapes. Place the barriers sufficiently away from the structure (like six inches) to be protected so that expansion of the root will keep the root from touching the curb or walk. Be sure the top of the barriers reaches above the top of the soil so roots do not grow over it.

(Bottom) Roots are deflected horizontally and down by most of the barriers on the market. In compacted soils and soils with a high water table, they grow under the barrier and up the other side. In well drained soil, roots may remain at deeper depths longer. In other words, barriers may be most effective where they are least needed.

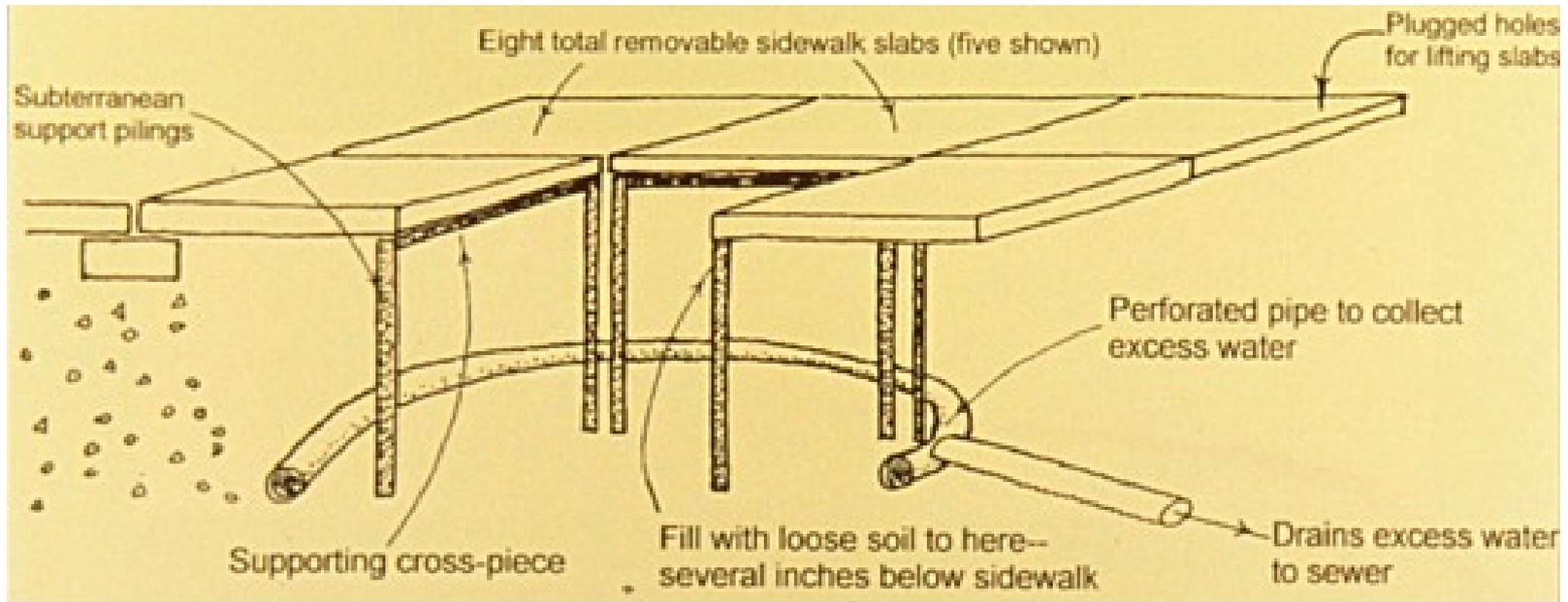
Source: <http://hort.ifas.ufl.edu/woody/urban-sidewalk-barriers.shtml>

Root Barrier Products:

<http://www.deeproot.com/products/root-barrier/applications>



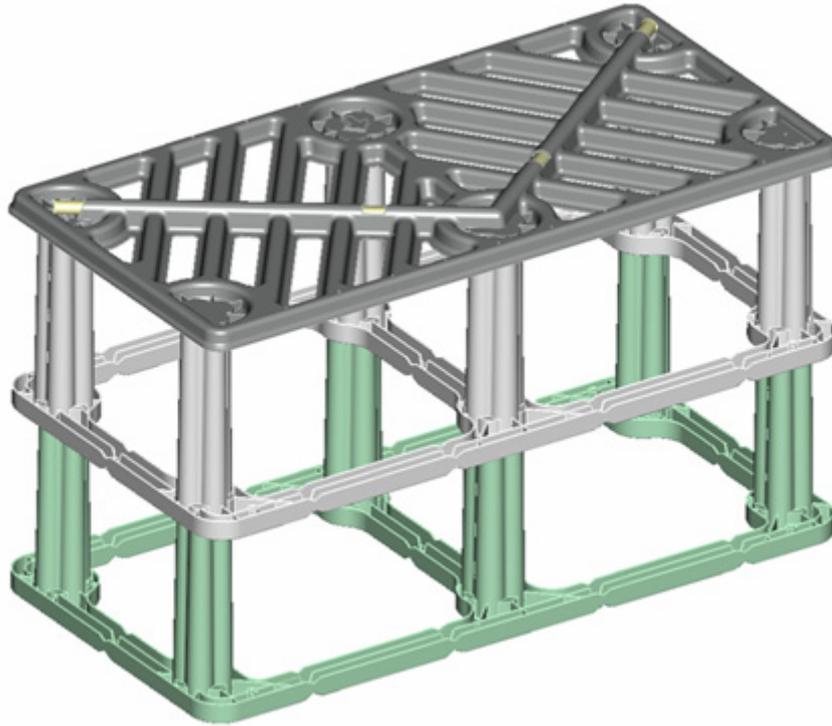
Suspended Sidewalks



The specification for the suspended walk calls for soil to be loosely placed in the planting area before installing slabs on the pilings and lateral support pieces. The drainage system ensures that excess water moves away from the soil system.

Source: <http://hort.ifas.ufl.edu/woody/urban-sidewalk-elevate4.shtml>

Silva Cell



The [Silva Cell](#) product supports the sidewalk or parking lot pavement without compacting the soil. The plastic Structural Cell (two tiers shown) carries the weight of even very large vehicles so soil is backfilled at low bulk density. This allows roots to grow in loose soil.

Source: <http://hort.ifas.ufl.edu/woody/urban-sidewalk-elevate5.shtml>

Tree cell applications

Large soil volume

Soil volume provided

1,200 cu ft @ 32' tree spacing

33.9 m³ @ 9.6m tree spacing

Includes 160 cu ft/4.32 m³

soil within tree opening

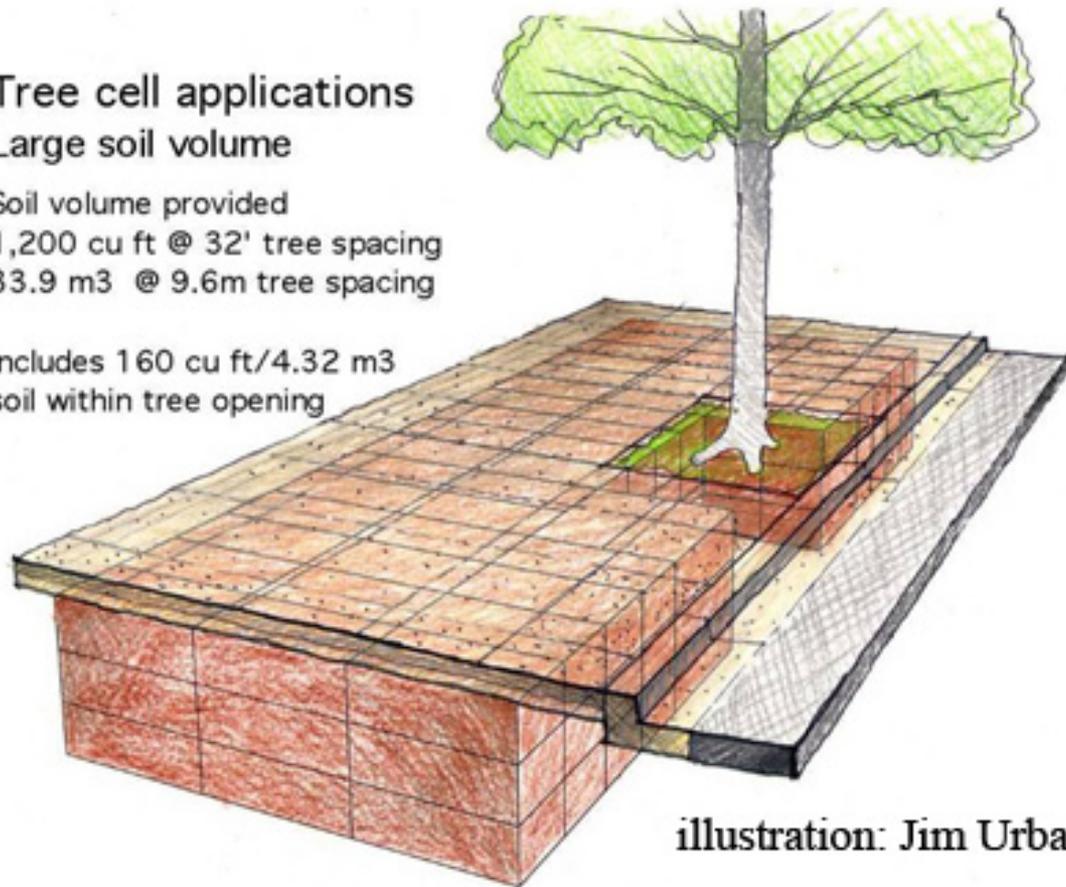


illustration: Jim Urban

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Source: <http://hort.ifas.ufl.edu/woody/urban-sidewalk-elevate6.shtml>

Concept Two:

Respect the Base of the Tree!

- Avoid the use of tree grates
 - Maximize distance between trees and infrastructure
 - Provide the largest sized planting space possible
 - These suggestions not meant to indicate that this represents enough soil for root growth. It does not. This is simply a guideline for the dimensions of the opening in the walk to accommodate root flare.
 - ***Minimum* dimensions for cutouts in sidewalks to accommodate root flare on trees of various sizes:**
 - large maturing trees - 8 x 8 feet
 - medium sized trees - 6 x 6 feet
 - small stature trees - 4 x 4 feet
- (source: <http://hort.ifas.ufl.edu/woody/appropriate-tree-pits.shtml>)
- Choose species appropriate for site
 - Sidewalk cut-out (smaller maturing species with smaller root flare)
 - Median/planting strip (larger maturing species with larger root flare)

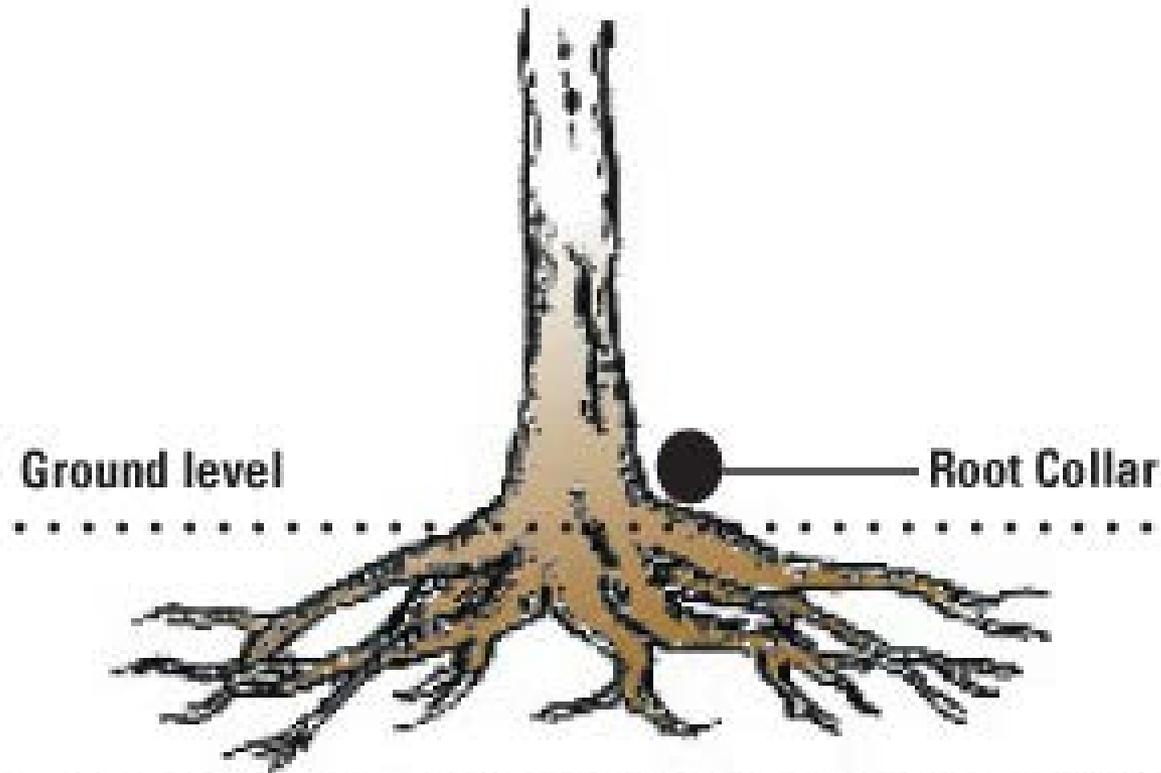
Root Flare (root collar)

a crucial part of tree structure

Trees depend upon a strong connection between the root system and the trunk, called the root flare. A tree needs to resist the forces and gravity and wind that are put on the crown. It does this by adding more wood at the base, developing a distinct flare.



The root flare (collar) is made of tissue similar to the trunk and cannot withstand higher levels of soil moisture, and thus will be susceptible to fungus invasion. If buried underneath the soil the collar will eventually succumb to fungal invasion and begin to rot.



Root collar should be one to three inches above ground level.

Picture Source: treesatlanta.org

Buried Root flare (collar)



Picture Source: <http://www.missouribotanicalgarden.org/>

Excavated Root flare (collar)



Picture Source: shadetreeexpert.com



Avoid Tree Grates

- Expensive!
- Create a tripping hazard
- Girdle tree trunks
- Compromise the structural stability of the tree by damaging the root flare



Problems with Tree Grates



Concept Three: Provide Supplemental Water Year-Round

- **Deep Watering** is the number one management tool for keeping trees healthy
- Establish 12 to 18 inches of soil moisture within the dripline
- Water for the entire tree lifespan - essential in Southeastern Colorado's semi-arid climate
- Deep water once a week during the growing season
- Trees also need watered during the fall and winter, especially when precipitation is low; water only when air and soil temperatures are above freezing
- A good rule of thumb is to deep water trees once a month through fall and winter

Root Concepts:

Key Points

- Provide Adequate Space for Tree Growth
- Provide Adequate Soils for Tree Growth
 - Aerated
 - Adequate Volume
- Understand that the Root Flare (collar) is a critical structural component of a tree
- Avoid Tree Grates
- Water, Water, Water!



Resources

Ed Gilman, University of Florida:

<http://hort.ifas.ufl.edu/woody/urban-sidewalk.shtml>

Deep Root: <http://www.deeproot.com/products>

James Urban (leading expert in Urban Tree Design):

<http://www.jamesurban.net/webinars-1/>