### Urban Design to Accommodate Trees: Sidewalk Solutions

by Dr. Edward F. Gilman, professor Department of Environmental Horticulture University of Florida, Gainesville http://hort.ufl.edu/woody/planting













#### Solutions to tree/sidewalk conflicts



"Compendium of strategies to reduce infrastructure conflicts", western chapter ISA

By Dr. Larry Costello

The idea is to create a system that can accommodate tree roots while minimizing damage to the infrastructure

- re-route sidewalk
- root barriers
- increase distance
- alternative sub-base material
- tree grates
- channeling roots
- cluster planting
- elevated sidewalks
- street light/wire location
- alternate surface materials

# Re-routing walk around tree

- When damaged sidewalks are repaired they can be re-routed around the tree trunks
- This can eliminate the need to prune roots that caused the walk to lift



## Re-routing walk around tree



 Re-routing walks around existing trees does not solve the problem if large (greater than one inch diameter) roots are cut and the tree dies

#### Solutions to tree/sidewalk conflicts



"Compendium of strategies to reduce infrastructure conflicts", western chapter ISA

By Dr. Larry Costello

The idea is to create a system that can accommodate tree roots while minimizing damage to the infrastructure

- re-route sidewalk
- root barriers
- increase distance
- alternative sub-base material
- tree grates
- channeling roots
- cluster planting
- elevated sidewalks
- street light/wire location
- alternate surface materials

#### **Root barriers can deflect**



- Barriers have been placed vertically in the soil to deflect roots away from hardscapes
- Place the barriers sufficiently away from the structure (about six inches) to be protected so that as the roots grow wider they will not touch 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

### The studies

trunk



#### Gilman 1996





Solutions

#### **Root barriers can deflect**



- Roots are deflected horizontally and down by most of the barriers on the market
- In compacted soils and soils with a high water table, roots grow under the barrier and up the other side
- In well drained soil, roots may remain at deeper depths longer

#### Solutions to tree/sidewalk conflicts



"Compendium of strategies to reduce infrastructure conflicts", western chapter ISA

By Dr. Larry Costello

The idea is to create a system that can accommodate tree roots while minimizing damage to the infrastructure

- re-route sidewalk
- root barriers
- increase distance
- alternative sub-base material
- tree grates
- channeling roots
- cluster planting
- elevated sidewalks
- street light/wire location
- alternate surface materials

#### Place trees on other side of walk



Damage can be reduced by planting on the side of the sidewalk away from the curb

- This places the root flare in open soil instead of between the sidewalk and curb
- Roots do not have to grow under the sidewalk to reach the open soil space in the lawn

# Trees too close to the walk

 Damage is likely when
 trees are
 planted too
 close to the
 walk



#### Locate trees away from walk



 Damage is less likely when trees are located far from the walk

# Locate trees on other side of the wall

Damage to the wall and walks would be less likely if the trees on the right side of the photo were located on the other side of the two-foot tall wall to the right



#### Hardscape overkill



New trees were probably not needed in this location because of the large healthy trees that exist several feet behind the new curbing

### **Tree in wrong location**

- Locate trees on the site so they have access to the most soil space
- The dead tree on the right could have been placed in the lawn area on the left



#### Solutions to tree/sidewalk conflicts



"Compendium of strategies to reduce infrastructure conflicts", western chapter ISA

By Dr. Larry Costello

The idea is to create a system that can accommodate tree roots while minimizing damage to the infrastructure

- re-route sidewalk
- root barriers
- increase distance
- alternative sub-base material
- tree grates
- channeling roots
- cluster planting
- elevated sidewalks
- street light/wire location
- alternate surface materials

### Install alternate sub-base material



- Layer of washed gravel installed as sub-base material roots remained under the gravel (left)
- Roots did not grow directly under the slab as they often do when a sand, limestone, or no sub-base is used (right)
- Gravel installation helped prolong the life of sidewalks

#### **8 year study**









### Year 8: Air spade used to expose roots



#### Tree is back there

#### Sidewalk is here

### No roots under slab with gravel on well drained site

No roots in gravel layer

#### Tree is over here

#### Roots growing up after clearing gravel

#### Average root depth

Well drained soil

Gravel with sidewalk DeepRoot with sidewalk Biobarrier with sidewalk Polyethylene with sidewalk Control with sidewalk Control without sidewalk

19a 11b 10b10b10b8b

Average root depth	Well drained soil	Poorly drained soil
Gravel with sidewalk	19a	13
DeepRoot with sidewalk	11b	12
<ul> <li>Biobarrier with sidewalk</li> </ul>	10b	12
Polyethylene with sidewalk	10b	11
Control with sidewalk	10b	13
Control without sidewalk	8b	11

### Install alternate sub-base material



 Low density styrofoam reinforced with wire

 There is little research on these materials and their effects on root growth and sidewalk longevity

#### Solutions to tree/sidewalk conflicts



"Compendium of strategies to reduce infrastructure conflicts", western chapter ISA

By Dr. Larry Costello

The idea is to create a system that can accommodate tree roots while minimizing damage to the infrastructure

- re-route sidewalk
- root barriers
- increase distance
- alternative sub-base material
- tree grates
- channeling roots
- cluster planting
- elevated sidewalks
- street light/wire location
- alternate surface materials

#### Tree grates in downtown landscapes

Tree grates have been used around the base of trees in downtown business districts

- Present a level surface for pedestrians while preventing soil compaction
- Keep in place the soil, mulch, or gravel around the base of trees
- They are a short term solution for landscapes meant to be replaced about every 15 years



#### **Tree grates in parks**



 Tree grates (arrow) are less appropriate for park settings such as this one

If trees grow well the walk is likely to be damaged, and if they grow poorly the walk remains intact

#### Hardware overload

- Thousands of dollars were spent on hardscape
- Unfortunately, after all this money was spent and trees of the appropriate species chosen, exceptionally poor-quality nursery stock was selected



#### More hardware overload



 This tree has little if any chance of success unless the site was designed to accommodate root growth under the pavement

Who will maintain the hardware around the tree

### **Tree grate detail**

- The area below the tree grate and above the root flare is best filled with gravel, not soil, so air can easily reach the root ball
- Mulch or soil placed against the trunk can cause problems for the tree



#### Tree grates can kill if not maintained



 The tree has grown well due mostly to access to unlimited soil space several feet from this planting pit

 This grate has been cut away from the trunk in the past and should be done now

#### Encourage proper irrigation management

- There are many clever ways to maintain trees once planted in urban locations
  - One is to plant flowers at the base of the tree; folks are more likely to realize that the flowers need water than the trees
  - Be careful not to overwater





#### 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.

Thanks to Jim Urban, Urban and Associates for this graph

#### Solutions to tree/sidewalk conflicts



"Compendium of strategies to reduce infrastructure conflicts", western chapter ISA

By Dr. Larry Costello

The idea is to create a system that can accommodate tree roots while minimizing damage to the infrastructure

- re-route sidewalk
- root barriers
- increase distance
- alternative sub-base material
- tree grates
- channeling roots
- cluster planting
- elevated sidewalks
- street light/wire location
- alternate surface materials

### Channel roots to loose, open soil



 Trees can be encouraged to thrive in urban landscapes by directing roots to good soil

 In this case, there is good soil in the open lawn area to the right side of the photograph; roots can be directed to grow into this soil with special provisions described in the next slide

### Take advantage of nearby open soil



 Tree roots can be directed to grow under this walk to the open soil on the right by directing them in channels under the walk

## Channeling roots under pavement

Tree roots can be directed to grow in channels provided for by good design



- (LEFT) One-inch thick aeration or drainage pads installed to increase the effective root zone beyond the small planting pit
- (RIGHT) Using pipes about 2 feet in diameter half filled with loose top soil and slow release fertilizer







![](_page_42_Picture_0.jpeg)

![](_page_43_Picture_0.jpeg)

#### Solutions to tree/sidewalk conflicts

![](_page_44_Picture_1.jpeg)

"Compendium of strategies to reduce infrastructure conflicts", western chapter ISA

By Dr. Larry Costello

The idea is to create a system that can accommodate tree roots while minimizing damage to the infrastructure

- re-route sidewalk
- root barriers
- increase distance
- alternative sub-base material
- tree grates
- channeling roots
- cluster planting
- elevated sidewalks
- street light/wire location
- alternate surface materials

### More soil space means healthier trees

- Root systems of the trees in the large planters (RIGHT) had access to much more soil space
- This sharing of soil space resulted in much larger and healthier trees compared to the small planters pictured on the left
- Plan on providing at least 1000 to 2000 cubic feet of soil for healthy trees

![](_page_45_Picture_5.jpeg)

#### **Cluster planting can increase root space**

![](_page_46_Picture_2.jpeg)

 Trees clustered into one large soil area often perform better than trees placed individually in a location surrounded by concrete and asphalt

Trees grow well because roots are able to spread out and share the large soil space instead of being confined to a small planting pit

### Successful urban tree planting

- Here is a wonderful example of a successful urban tree planting project that includes only three trees but has a tremendous impact on this street
- Why do you think this design was so successful?

![](_page_47_Picture_4.jpeg)

#### Designing appropriate soil space caused success

![](_page_48_Picture_2.jpeg)

- Trees grew well simply because they were given appropriate soil space for root expansion
- Root systems of these three trees are overlapping and have colonized this entire shared soil space

#### **Clusters too small**

- These trees were planted in clusters but the clusters were too small--three tree grates were simply placed end-to-end
- There was not enough soil space for root expansion

![](_page_49_Picture_3.jpeg)

Combined with the heat load from the large expanse of pavement, these trees began to decline within one year of planting

#### Clusters too small-close-up

![](_page_50_Picture_2.jpeg)

 In the dead of summer, these trees had little or no foliage indicating they were stressed or nearly dead.

 There is not enough shared root space to make an effective large planting space

 Instead of creating many areas with three trees as was done on this site, consider combining the spaces into a few large areas

#### Solutions to tree/sidewalk conflicts

![](_page_51_Picture_1.jpeg)

"Compendium of strategies to reduce infrastructure conflicts", western chapter ISA

By Dr. Larry Costello

The idea is to create a system that can accommodate tree roots while minimizing damage to the infrastructure

- re-route sidewalk
- root barriers
- increase distance
- alternative sub-base material
- tree grates
- channeling roots
- cluster planting
- elevated sidewalks
- street light/wire location
- alternate surface materials

#### Trees struggling in traditional planting pit

- Trees often struggle for survival in traditional planting pits or cut outs in the sidewalk
- These trees were planted this size one year ago; each has died back during the course of the year
- There are methods available to connect the soil space between planting pits and still retain the load-bearing characteristics of the sidewalk

![](_page_52_Picture_5.jpeg)

# Suspending the walk over the soil

![](_page_53_Picture_2.jpeg)

- This walk is suspended above the soil
- There is no contact between the bottom of the slab and the soil; the slabs rest on lateral supports and pilings
- This allows the soil to be placed loosely in the 100 foot long planting hole which promotes root growth
- Good root growth translates into healthy trees

## Suspending the walk over the soil-detail

- There is no contact between the bottom of the slab and the soil; the slabs rest on lateral supports and pilings
- There is an inch of air space between the soil and the bottom of the sidewalk
- Utilities such as electricity and irrigation can be placed in this space for easy access

![](_page_54_Picture_5.jpeg)

### Suspending the walk over the soil--specifications

![](_page_55_Figure_2.jpeg)

- 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

#### Pavement

![](_page_56_Picture_1.jpeg)

![](_page_57_Picture_0.jpeg)

![](_page_57_Picture_1.jpeg)

![](_page_58_Figure_0.jpeg)

![](_page_59_Picture_0.jpeg)

![](_page_60_Picture_0.jpeg)

#### Solutions to tree/sidewalk conflicts

![](_page_61_Picture_1.jpeg)

"Compendium of strategies to reduce infrastructure conflicts", western chapter ISA

By Dr. Larry Costello

The idea is to create a system that can accommodate tree roots while minimizing damage to the infrastructure

- re-route sidewalk
- root barriers
- increase distance
- alternative sub-base material
- tree grates
- channeling roots
- cluster planting
- elevated sidewalks
- street light/wire location
- alternate surface materials

## Street light design and trees

![](_page_62_Picture_2.jpeg)

- Lights and trees are often placed in conflict with each other as shown
- This tall placement ensures that trees will have to be pruned as they grow so light can reach the ground
- The lower placement of street lights illuminates under the canopy where it belongs

In urban designs, place **street lights low** and **canopies high** to avoid conflicts

### Not sustainable

As the trees grow, the light from the tall street lights (blue arrows) will be blocked; this will ensure that trees will be in conflict with the lights

 Place streets lights under the canopy for a low maintenance, more sustainable design.

![](_page_63_Picture_4.jpeg)

#### **Prior planning prevents poor performance- 5 p rule**

![](_page_64_Picture_2.jpeg)

Better planning could have avoided this costly mistake

- Placing wires where trees are meant to be only serves to increase maintenance costs
- You can see that the trees had to be pruned in an unsightly and unhealthy fashion in order to maintain reliable electric service to local utility customers

#### Solutions to tree/sidewalk conflicts

![](_page_65_Picture_1.jpeg)

"Compendium of strategies to reduce infrastructure conflicts", western chapter ISA

By Dr. Larry Costello

The idea is to create a system that can accommodate tree roots while minimizing damage to the infrastructure

- re-route sidewalk
- root barriers
- increase distance
- alternative sub-base material
- tree grates
- channeling roots
- cluster planting
- elevated sidewalks
- street light/wire location
- <u>alternate surface materials</u>

#### Alternative surface materials

- Materials other than concrete have been used as a sidewalk surface. These include:
  - crushed granite
  - wood decking
  - brick-in-sand
  - and more recently, rubber

![](_page_66_Picture_7.jpeg)

- All these materials allow roots to grow beneath without cracking the surface material
- Asphalt is occasionally used but it cracks and heaves easily and is considered unacceptable in many communities

### **Outline of topics**

- Introduction
- Site evaluation
- Species selection
- Formula for success
- Roots/hardscape conflicts
- Trees/sidewalk solutions
- Parking lot/buffer strip solutions
- Structural soils

![](_page_67_Picture_9.jpeg)

### Urban Design to Accommodate Trees: Sidewalk Solutions

by Dr. Edward F. Gilman, professor Department of Environmental Horticulture University of Florida, Gainesville http://hort.ufl.edu/woody/planting

![](_page_68_Picture_2.jpeg)

![](_page_68_Picture_3.jpeg)

![](_page_68_Picture_4.jpeg)

![](_page_68_Picture_5.jpeg)

![](_page_68_Picture_6.jpeg)

![](_page_68_Picture_7.jpeg)

![](_page_69_Picture_0.jpeg)