Our Urban Forest: 100 Years From Now

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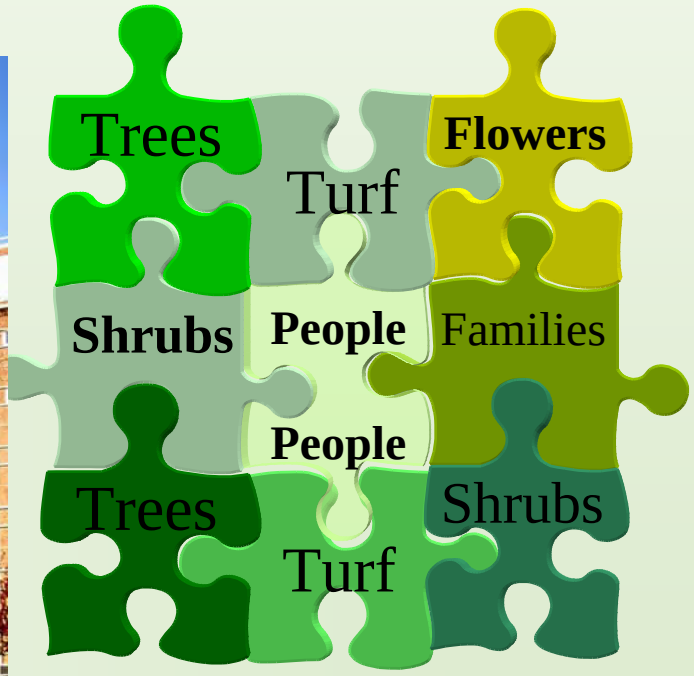
Trees & Us

- Trees are big plants
- Trees are part of our landscape
- Trees are part of our heritage
- Trees are part of our “Big Picture”



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Edmonton's Tree Values

- Natural Tree Stands
- Shelterbelts
- Ornamental Trees

"Edmonton's ornamental elm trees have an assessed value of $464 Million, with a total ornamental tree inventory value of $1.7 Billion."

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Trees & Us - Why do we plant trees?

- Trees deflect noise & wind
- Trees block unwanted views
- Trees limit erosion

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Trees & Us

Why do we plant trees?

- Trees are important
- Trees provide shade
- Trees provide oxygen
- Trees filter our air

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U of A Quad

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U of A Quad – Admin Bldg.

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U of A Quad

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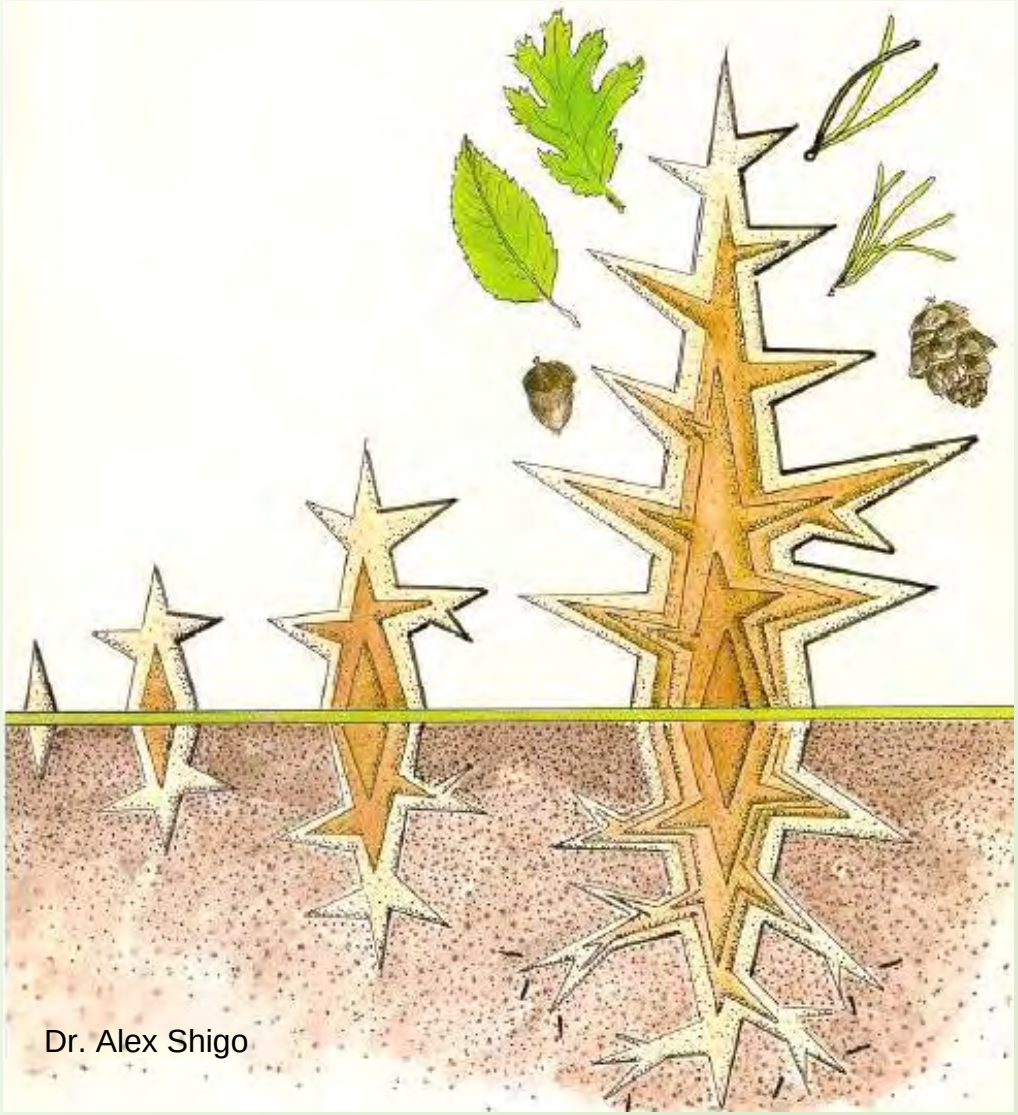
How Does a Tree Grow?

- A tree grows in layers.
- A tree grows like dipping a candle.
- Every layer coats the last.
- This includes the tree's root system.



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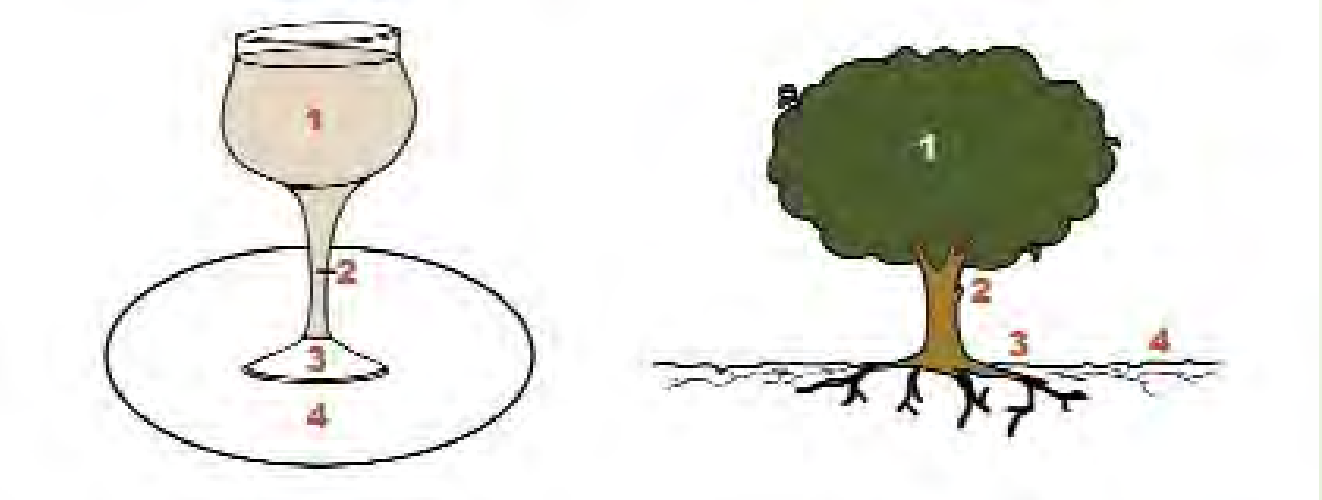
How A Tree Works

- The Root System
- Transpiration
- Effects of construction damage

From “Stupsi”
by Dr. Claus Matthech

Tree Theory



1. Branches & Leaves (Canopy)
2. Stem
3. Root Plate
4. Transport & Feeder Roots

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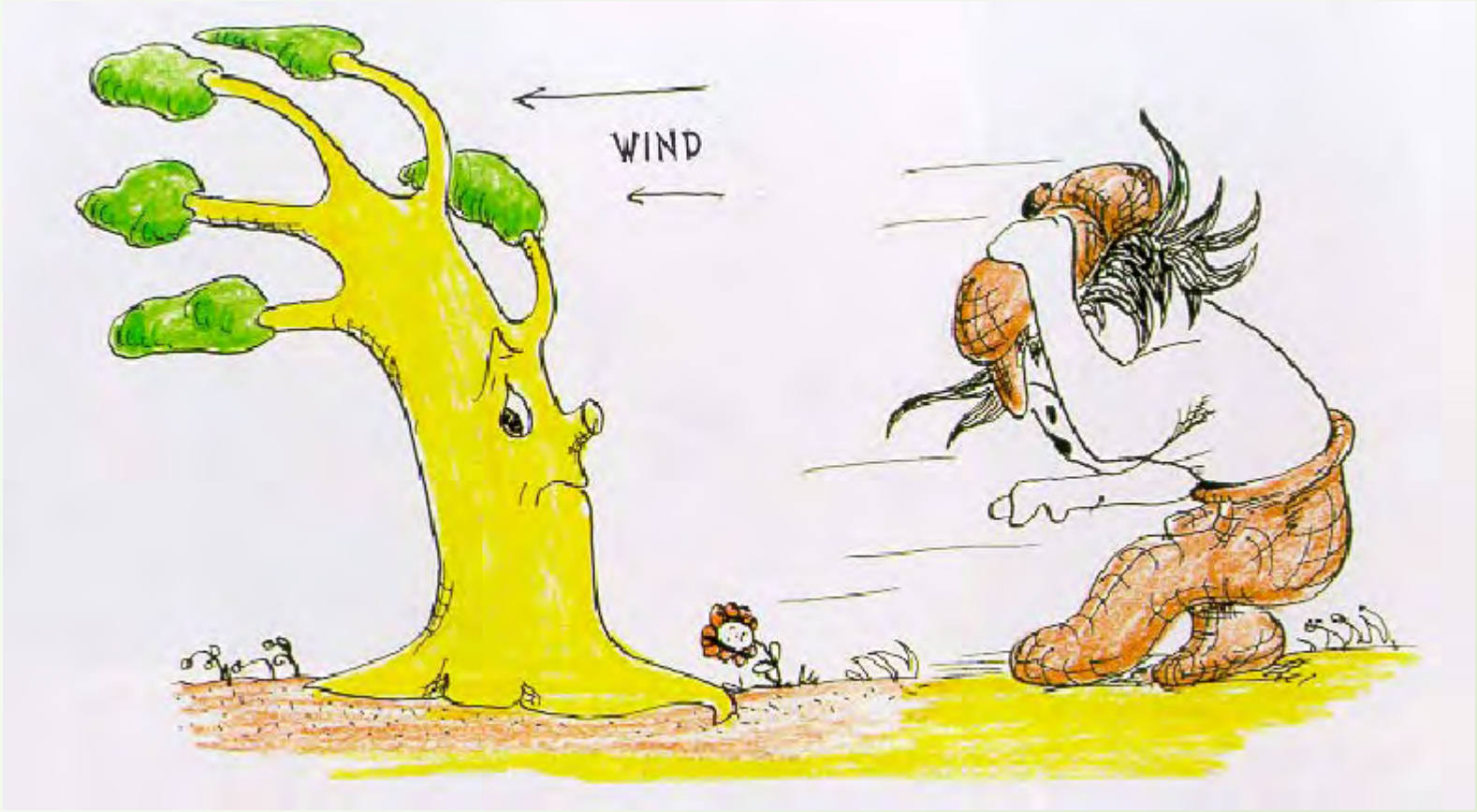
The Wind & Trees



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Understanding Trees as Structures

- Wind Direction
- Stability Problems

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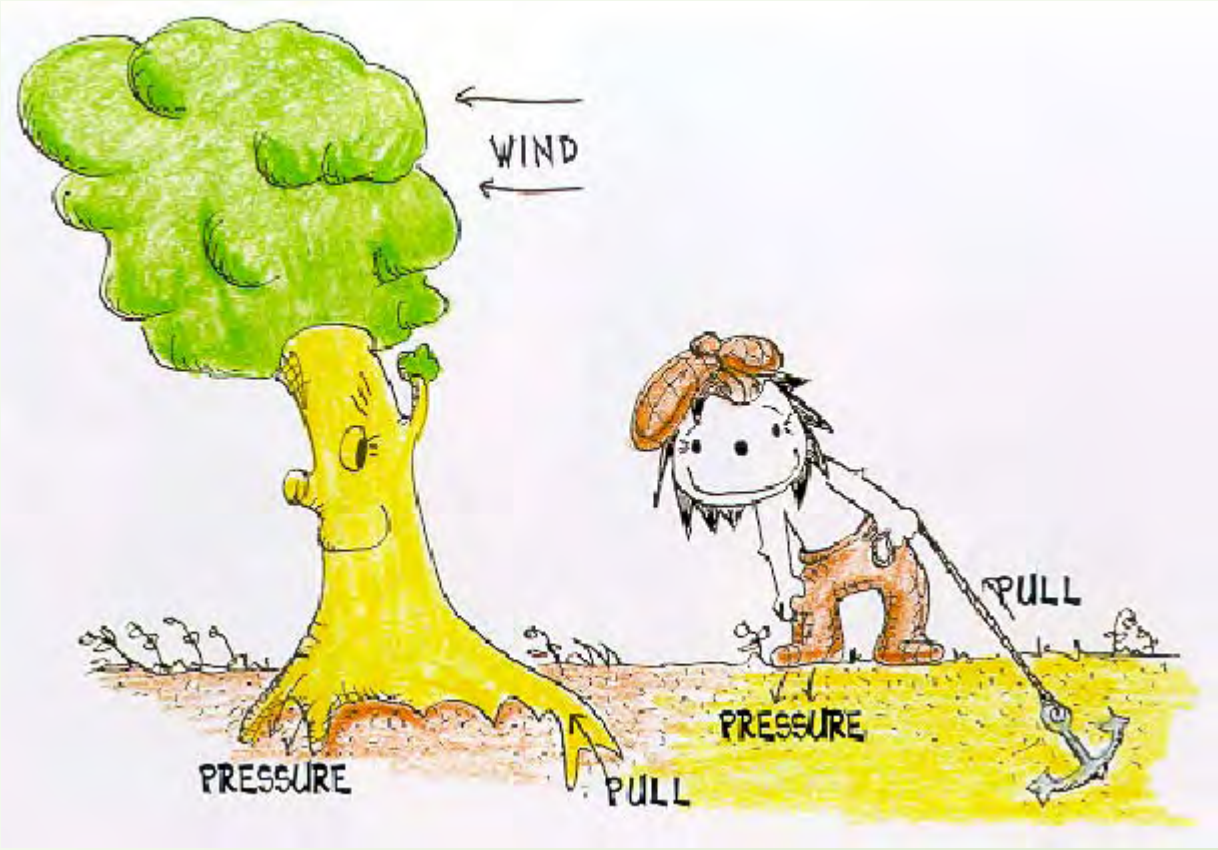
The Wind & Trees



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Buttress Roots

- Buttress roots on the windward side
- Cutting Buttress root can cause tree to fall over

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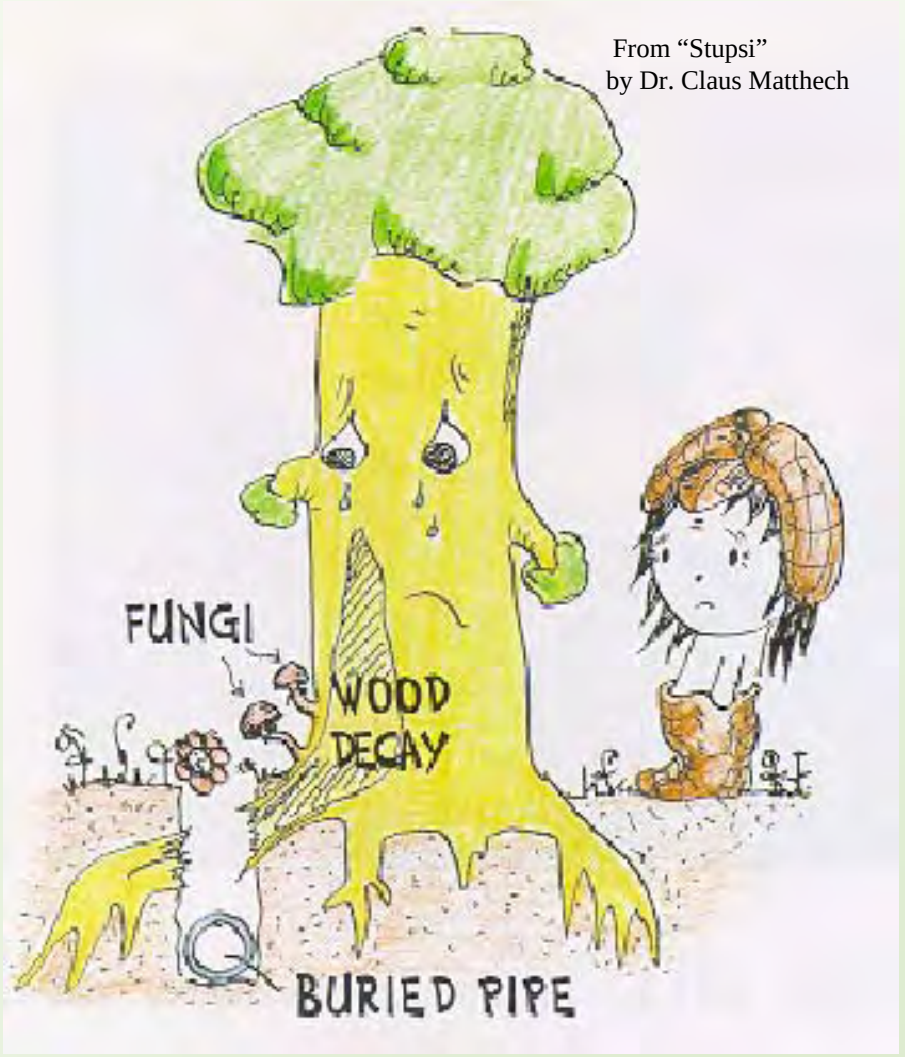
Infrastructure Construction Damage

- Waterlines
- Gas Lines
- Curbs
- Sidewalks
- Other Utility Installation & Repair



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Tree Roots & Construction

- Transport & Feeders
- 85% in the top 45 cm
- Oxygen deprived environment
- Root damage

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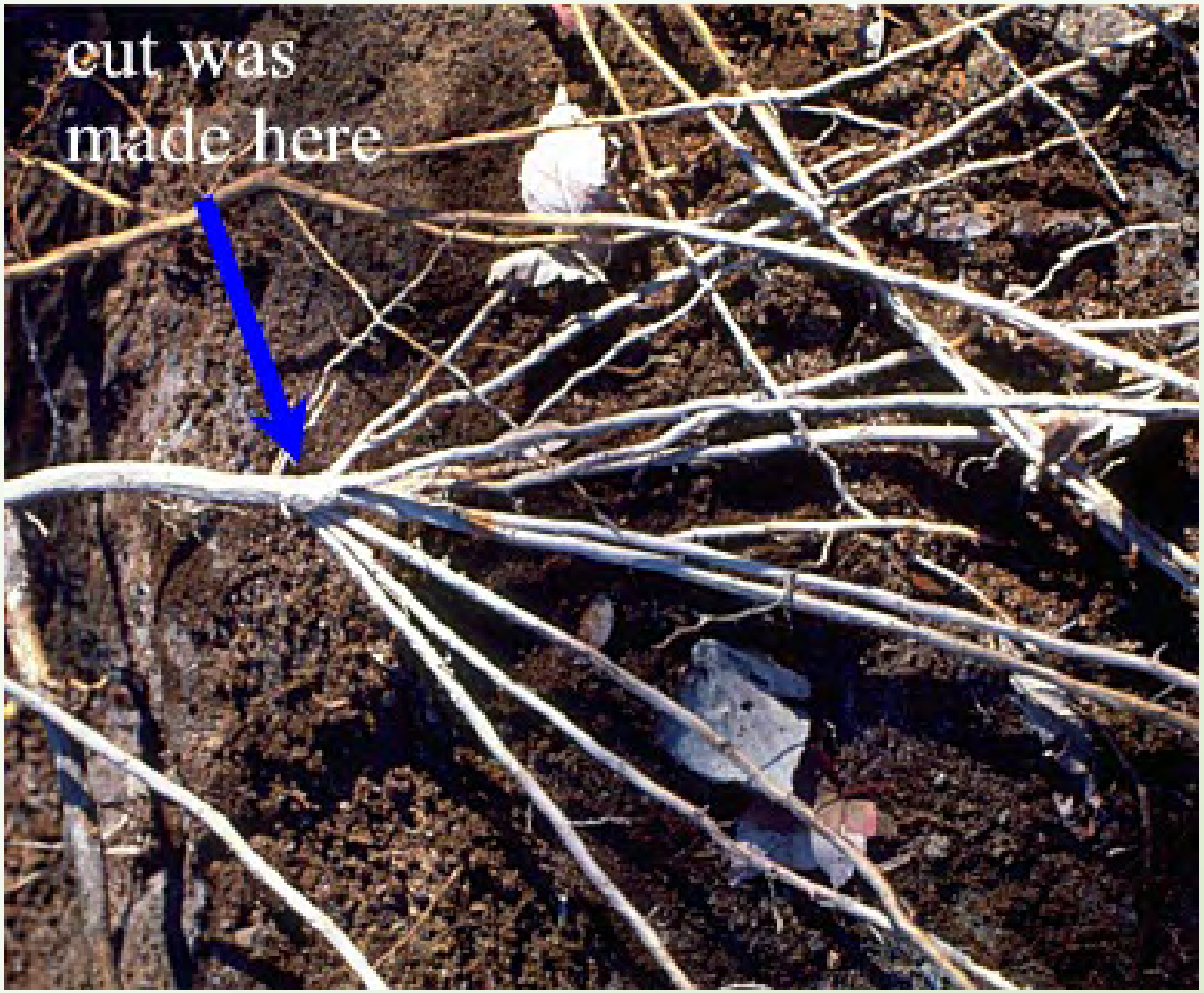
Root Pruning



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Trees & Sidewalk Problems

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Construction Caused Tree Failure

- Root Plate Damage
- Failed Trees

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Tree Failures – Root Plates

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Critical Measurements – the Tree

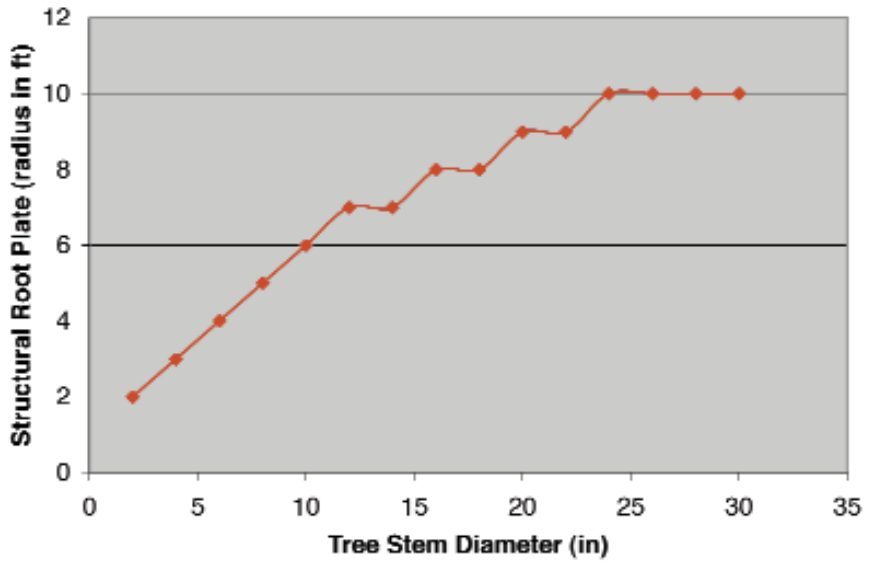
- Critical Root Radius – dbh (inches)*1.25 (feet)
- Critical Root Radius (metric) – dbh (cm)*0.15 (meters)
- Critical Root Area ($A=\pi r^2$)
- American elm at 74.2 cm dbh or 29.2 inches

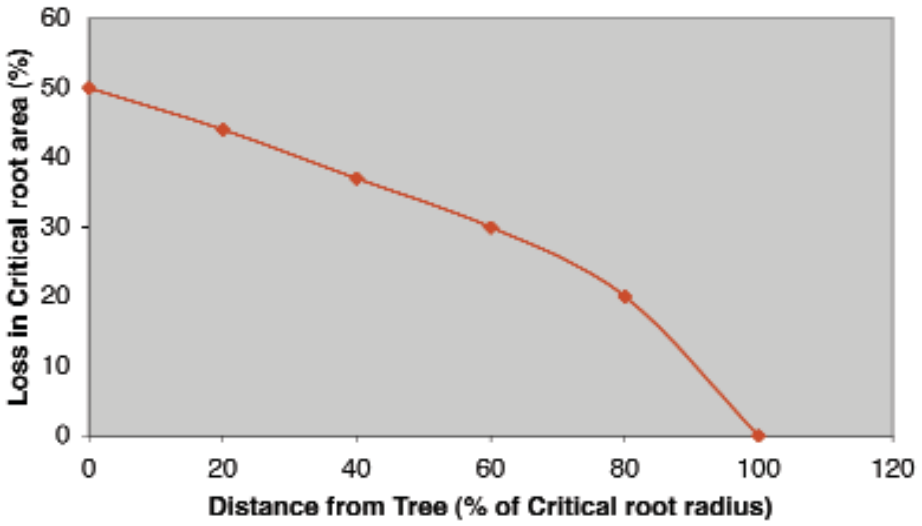
Tree Stem Diameter (in)	Critical Root Radius (ft)	Critical Root Area (ft^2)
2	2.5	19
4	5	78
6	7.5	176
8	10	314
10	12.5	490
12	15	706
14	17.5	962
16	20	1,256
18	22.5	1,590
20	25	1,963

Tree Stem Diameter (in)	Critical Root Radius (ft)	Critical Root Area (ft^2)
22	27.5	2,375
24	30	2,827
26	32.5	3,318
28	35	3,848
30	37.5	4,417
32	40	5,026
34	42.5	5,674
36	45	6,361
38	47.5	7,088
40	50	7,853

Root Plate & Root Areas

- Root Plate
- Critical Root Areas





An Example Tree

- American elm at 12315 – 87 Street
- Measured 74.2 cm dbh @ 90% condition + 5% location (2006)
- Tree Evaluation - $40,100 (2008 $'s)
- Critical Root Radii = 36½ feet (11.1 m) based on 29.2 inches
- Critical Root Zone 4,185 ft² (389 m²)

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An Example Tree

- No excavation within 16 to 18½ feet (based on dbh)
- Linear trench at 16 ft - equals 65% probability of survival
- Linear trench at 18½ ft - equals 68% probability of survival

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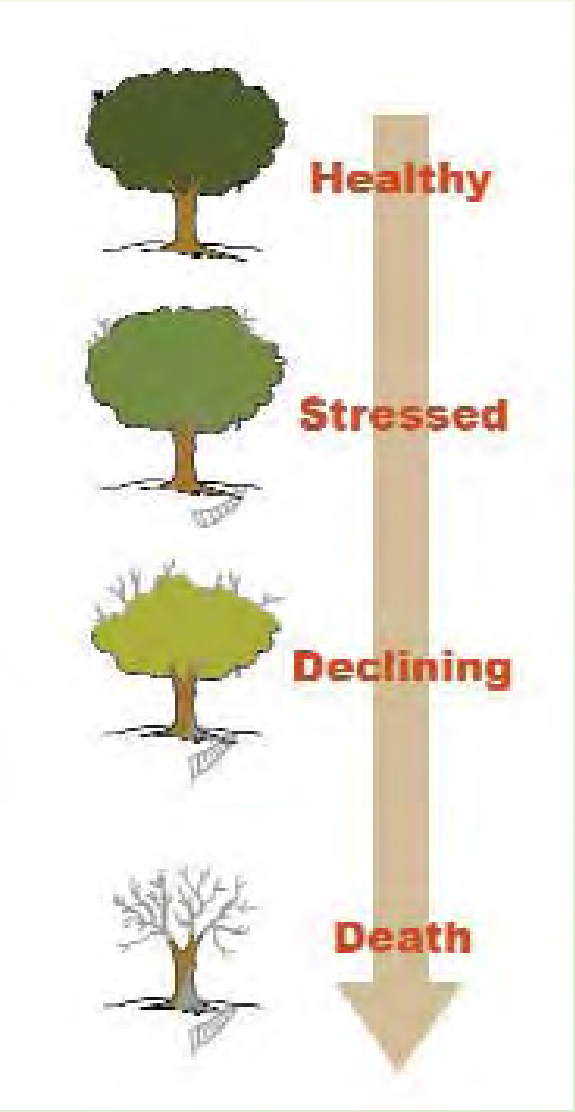
Preserve & Protect Our Trees

- Trees are twice as large as they appear
- Construction - damage below ground
- Mortality Spiral & Tree death



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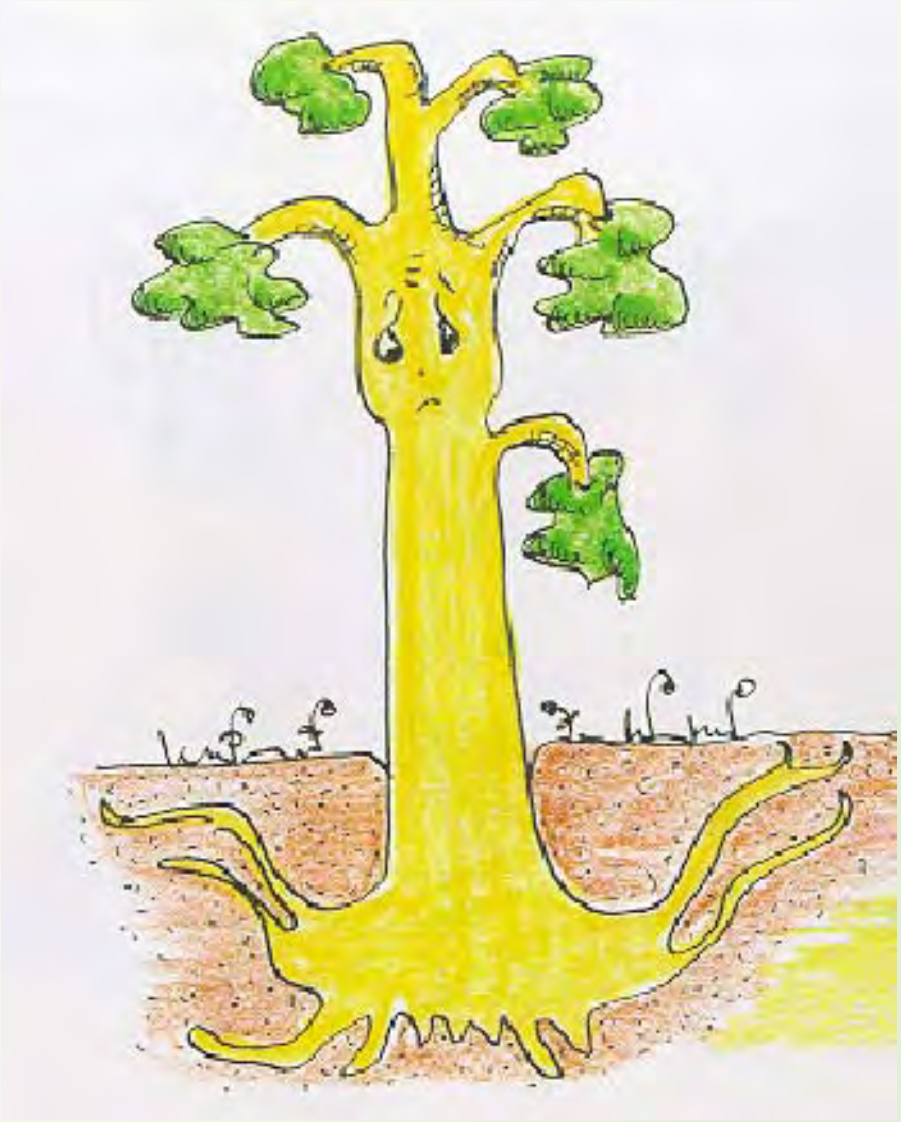
Planting Too Deep Or Too Much Fill



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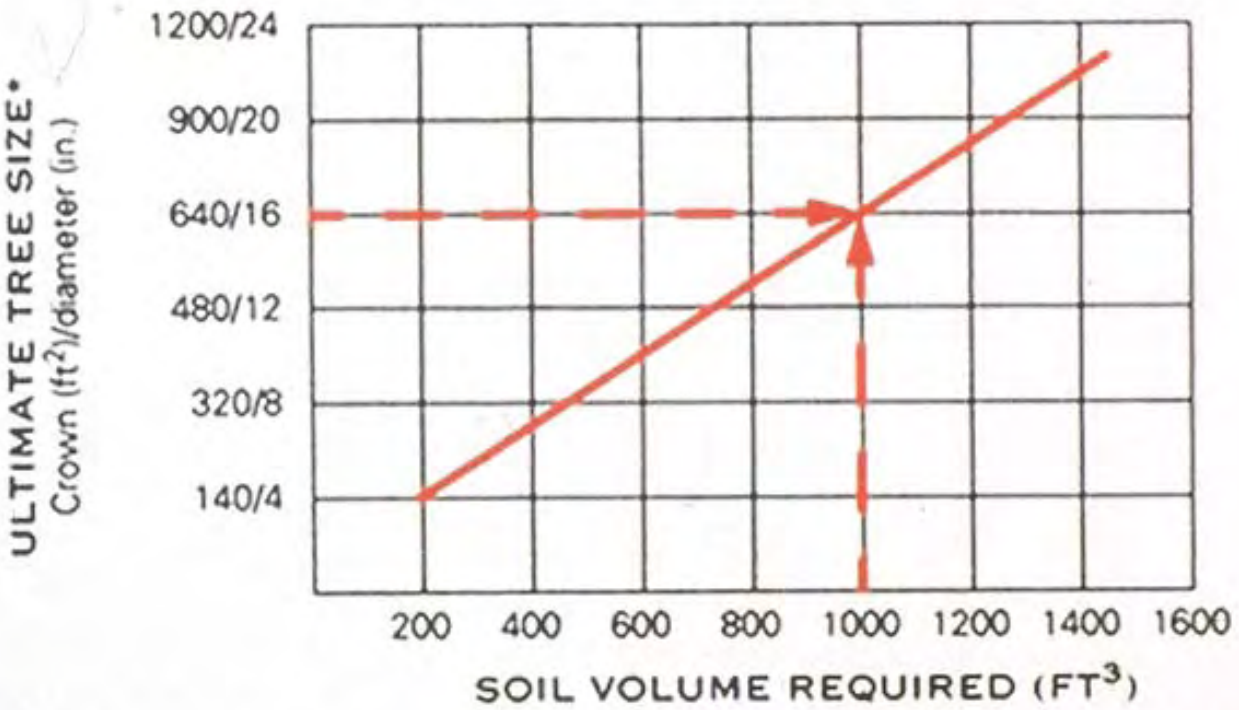
SOIL VOLUME FOR TREES



*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.

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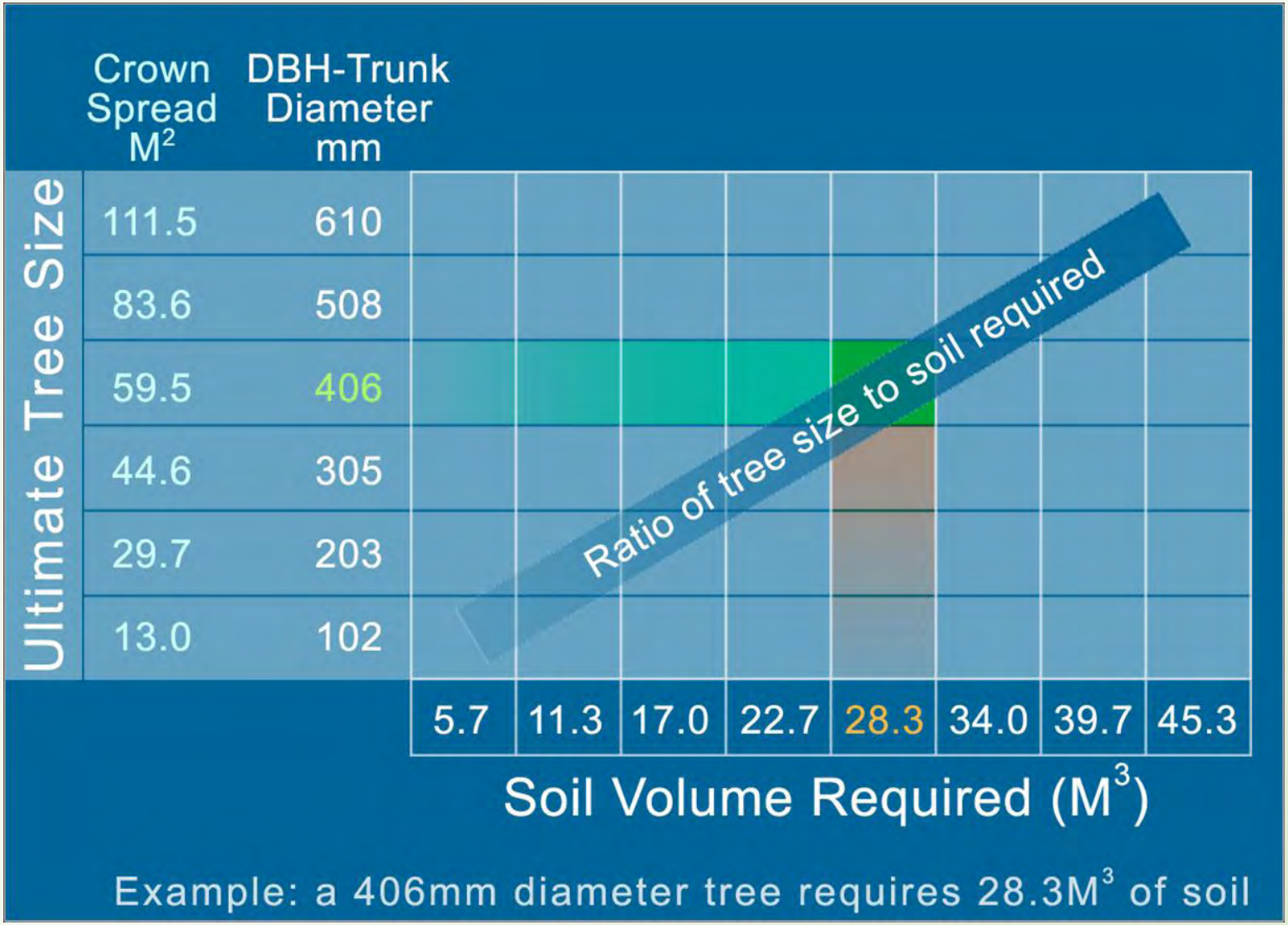

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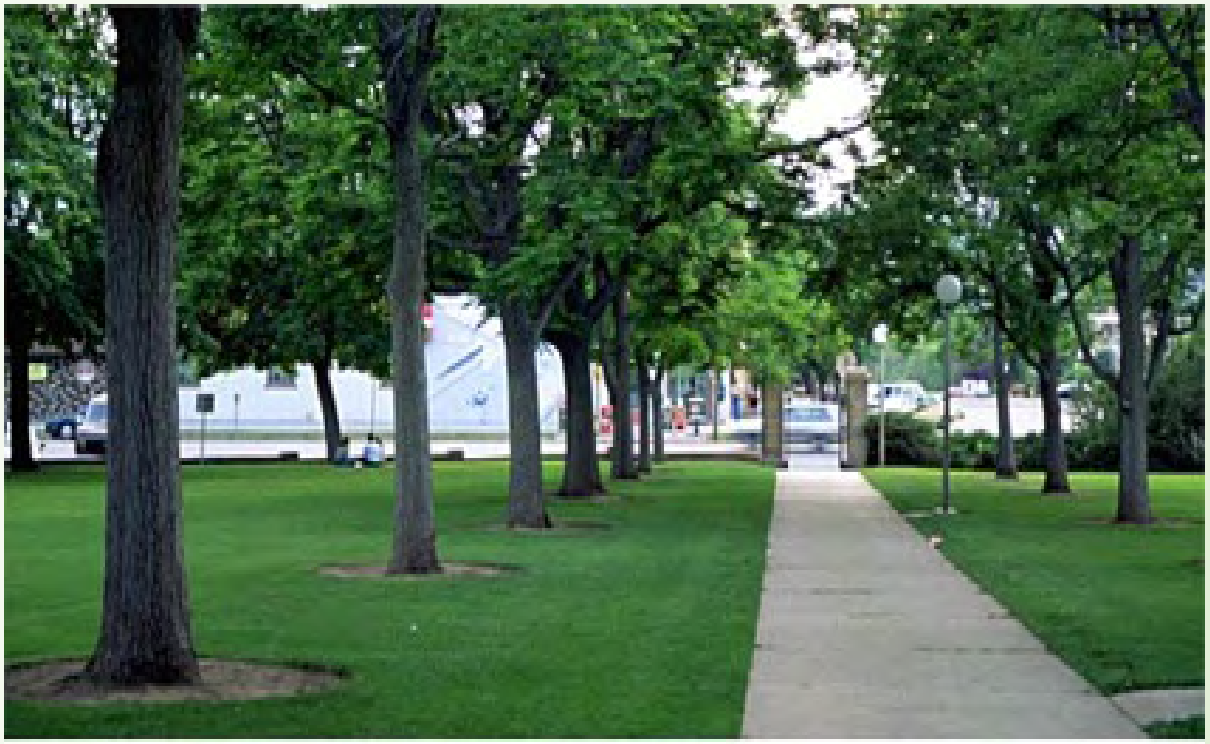
Locate trees away from walk



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

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Trees too close to the walk

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Locate trees on other side of wall

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Hardscape overkill & over planting

- New trees were not needed here.
- Large healthy trees exist several feet behind.

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Re-routing walk around tree

- Sidewalks - re-routed around large tree trunks
- This eliminates the need to prune roots that caused the walk to lift

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Re-routing walk around tree

- Same tree, different view
- Sacramento, CA

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Re-routing walk around tree

- Re-routing walks around existing trees does not solve the problem if large (> 1” in diameter) roots are cut causing the tree to die.

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Sidewalks and trees

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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.

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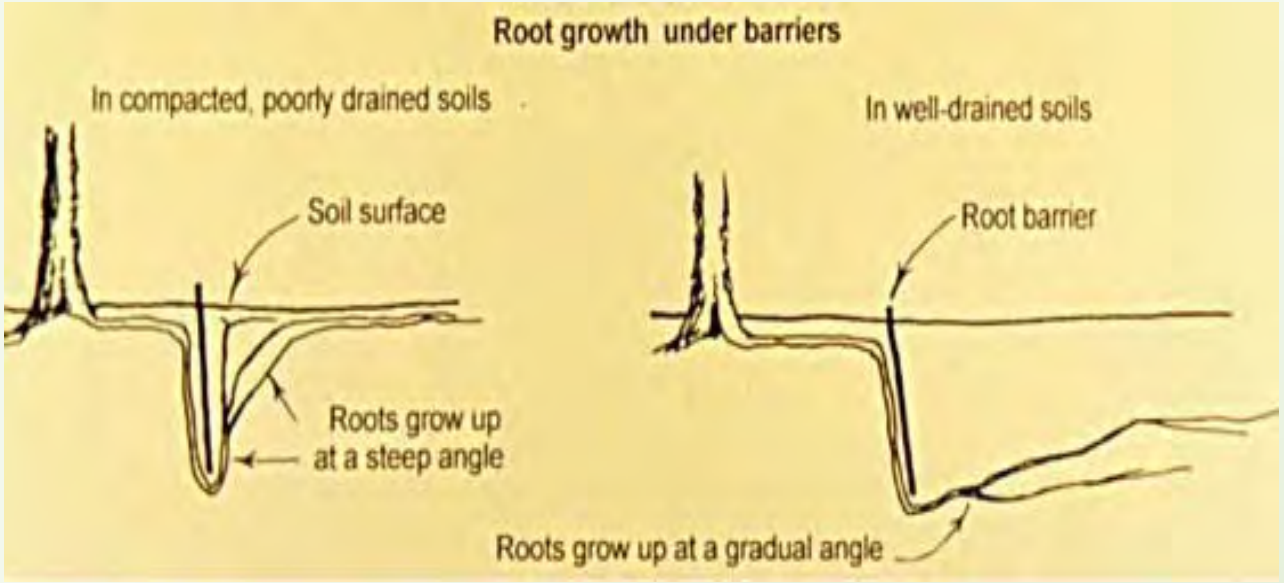
Root grow & root barriers



- Roots are deflected horizontally and down by root barrier.
- *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.

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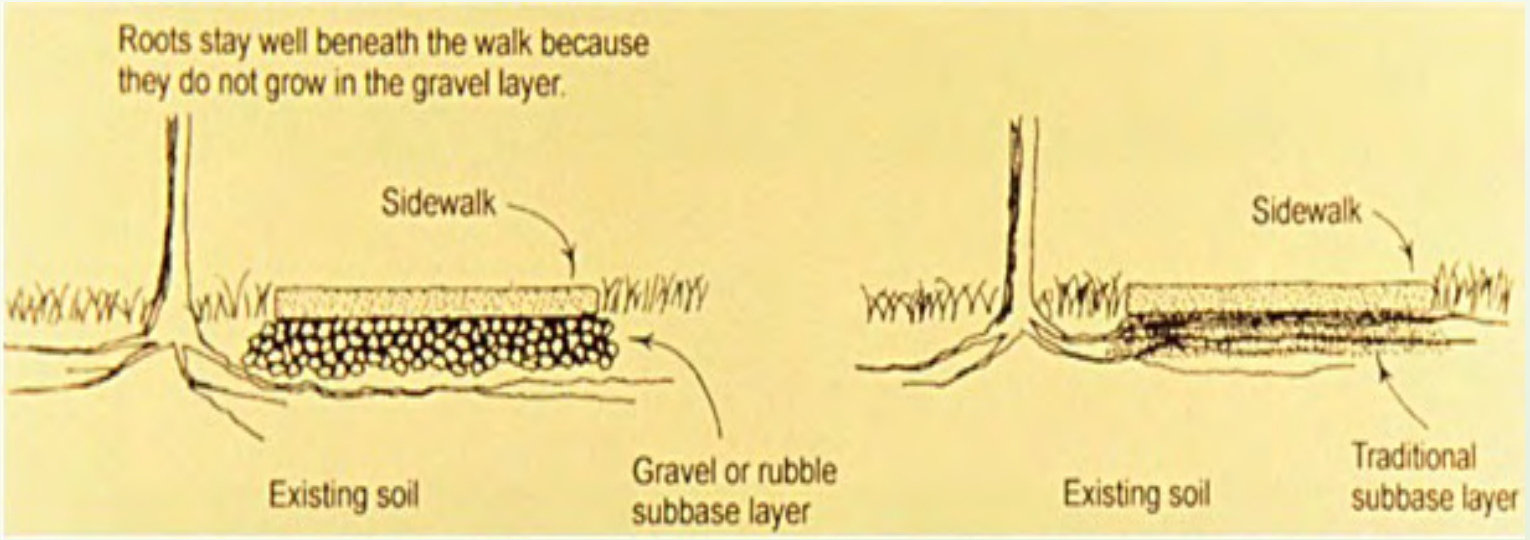
Install alternate sub-base material



- 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 sand, limestone, or no sub-base is used (right)
- Gravel installation helped prolong the life of sidewalks

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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

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Tree grates in parks

- Tree grates (arrow) are less appropriate in park settings like this.
- If trees survive it is likely to be damaged or vandalized.
- If they grow poorly the walk remains intact.

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Hardware overload

- Thousands of dollars were spent on hardscape.
- Unfortunately, while trees of an appropriate species was chosen, exceptionally poor-quality nursery stock was selected.

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More hardware overload

- Root growth - no chance of success unless the site was designed to allow for root growth under the pavement.
- Who will maintain the hardware around the tree?

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Tree grate detail

- Area below the tree grate and above the root flare is best filled with gravel so air can easily reach the root ball.
- Mulch or soil placed against the trunk can cause problems for the tree.

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Tree grates can kill if not maintained

- The tree has grown well due to access to unlimited soil space.
- This grate has been cut away from the trunk in the past and should be done now.

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Structural soil design

- Structural soil supports the weight of walks, roads, pedestrians and vehicles as well as provide a well-aerated soil substrate for tree root growth.

- Weight is transferred from aggregate to aggregate then to the soil under the aggregate; no weight is borne by the soil between aggregates.

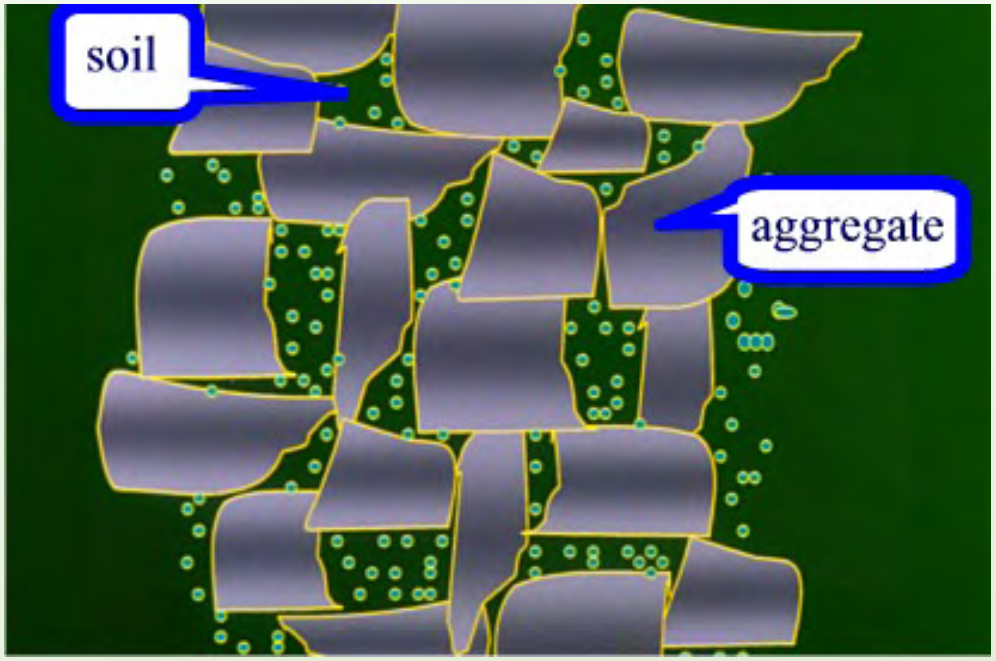

Illustration credit: Jason Grabosky, Rutgers University

This allows roots to grow well in the soil between the aggregates.

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Structural soil installed

- Structural soil is composed of small aggregate material.
- These angular rocks about one inch in diameter.
- They have enough soil to almost fill the space between the rocks.

Photo credit: Jason Grabosky, Rutgers University

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Root Growth In Structural Soil After Three Years

- Roots grew well in structural soil under a sidewalk.
- The walk has been removed (blue arrow) in the first three years after tree planting.
- Roots grew down and out from the tree.
- It is not known if all trees will grow like this one.

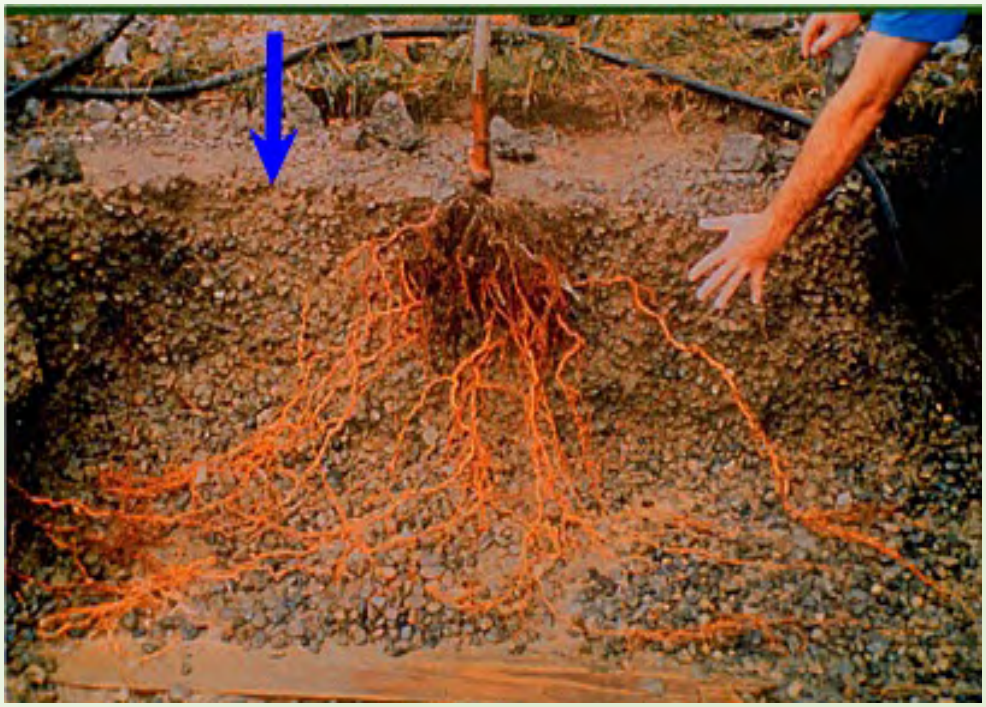

Photo credit: Jason Grabosky, Rutgers University

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Suspending 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.

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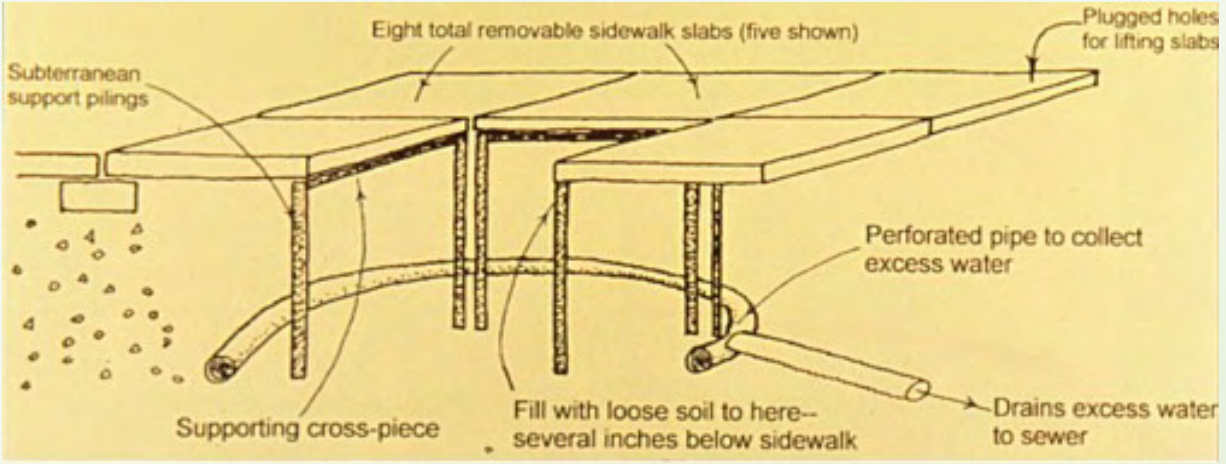
Suspending walk over the soil specifications



- 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.

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Take advantage of nearby open soil

- Tree roots can be directed to grow under this walk to the open soil.
- Directing them in channels under the walk.

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Cluster planting to increase root space

- Trees clustered into one large soil area often perform better than trees placed individually in the 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.

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Designing appropriate soil space

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

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Clusters too small

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

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

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Clusters too small--close-up

- 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

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Street light design and trees

- 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

Urban designs should place **street lights low** and **canopies high** to avoid conflicts

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

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Prior planning prevents poor performance

Better planning could have avoided this costly mistake

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

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Trees & Pollution

- $SO_{x's}$ & $NO_{x's}$
- Ozone or O_3
- Ash, Aspen poplar, Birch, Elm, and Maple
- Elevated CO_2 levels extends growing season
- Elevated O_3 levels shortens growing season

Construction Equipment Pollution

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Our Healthy Trees

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Conclusion

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THANK YOU

If you have any questions please feel free to ask

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