Solving Difficult Soil Problems

James Urban, FASLA, ISA
Urban Tree + Soils
Annapolis, Maryland
Tree Requirements

1. Sufficient soil volume
2. Water in
3. Water out
4. Zone of rapid root taper
5. Room for canopy growth
6. Quality nursery stock

Respect the base of the tree
What is more important in the specification and review of soil?

Data Source: Kim Coder
Sketch Interpretation: James Urban
With apologies to Justus and Kim
Factors controlling soil performance
Consider how we harvest, handle and install soil.

**Drainage** is controlled by compaction and structure **as much as soil type!**

**Water holding capacity**
Organic matter can improve water holding capacity. You can have too much compost in the soil, particularly in deep soils.

**Compaction**
Likely the most critical factor in soil health.

**Soil chemistry**
Minimum impact on plant performance in a reasonable range. Nutrient recommendations are for crop yields not plant health.
Step one

Step two

Machine “double spading”

Soil moisture is critical
Not to wet or dry

Topsoil from first row

Add compost

Turn Subsoil

Remove topsoil

compost

compost

Step 3

Respread topsoil

Soil Compaction Modification

English “double spading”
Compost!!!!

Get it into the soil, not just on top!

Organic matter does NOT get used up by the tree. Tree ROOTS (not the leaves) are net contributors of organic matter to the soil.
Subsoiling large site

Subsoiling small site

Trenches filled with compost

SUBSOILING
Dealing with compaction: Cultivation (break it up!)

- Backhoe
- Auger
- Chisels and rippers
3. Compaction reduction in the root zone of mature trees

- Vertical mulching
- Air Spade / compost soil mixing
- Radial trenching
Drainage Modification

1. Drain lines
2. Topography modification
3. Soil bulk density modification
4. Soil texture modification
Drain lines

Coarse sand

Forget the sock!

Holes on the bottom
1. PVC pipe
2. Double walled pipe
3. Corrugated pipe

Cleanouts and inspection risers
Subsoiling

Reducing compaction improves drainage

Trenches filled with compost
Increasing soil water holding capacity

1. Soil texture and compaction modification
2. Topography modification
3. Soil amendments
Add Compost

**BUT** - Don’t add too much compost to soils below the top 150-300mm.
Greater than 10-15% compost by moist volume in the lower soil levels will result in excess soil shrinkage.

2.5-3% Soil Organic Matter by dry weight is a reasonable for trees!
Soil Reuse / Replacement

Soil removal and ped retention

Use big loaders and excavators

Remove soil in big scoops to preserve clumps. Do not screen. Preserve peds!
What are usable soils?

Collected soils for resale

Undisturbed field soil

Construction on disturbed soils

Previous development sites

While some of these soils may look terrible they may be just fine with the addition of a little compost.
Field **mixing several soil layers** with compost (4:1) to make good quality planting soil

Finished w/ great plant growth
Planting Soil Compaction

Densiometer
accurate but expensive

Penetrometer
inexpensive but not accurate
Soil Installation

**Anticipated settlement**: 10-15% of soil depth

- A/O horizon with **added compost** tilled into upper soil layer
- Added soil to **accommodate settlement**
- **Specified soil depth**

**BS 3882** is silent on compaction requirements

- **Soil lifts**
- **Avoid tracking over soil**
Re-Thinking Manufactured Soil

Are we putting too much sand in our soils?
Soil screening machines......

.....produces soil with few soil peds

Maintain macro pore space with soil ped retention
Light screening through 50 to 100mm square mesh may be needed on soil with larger amounts of debris or heavier clay.

BUT where you can……

Control construction debris and trash by approval of soil source not by screening.
Change specs to allow a combined rocks, roots, sticks, debris up to 5% or maybe even 10%. Eliminate “free of” from your spec.
New York City Urban Soil / Reforestation Study

Nancy Sonti  
nancyfsonti@fs.fed.us
Old Cattle Market, Ipswich
Using existing soil in Silva Cells

Great peds

Brick

Beer can

Excellent tree growth
Blending soil and sand together

**Greater** proportion of **micropores**

**Lower** proportion of **macropores**

Internal structure of soil peds lost

**Screened Mix**

- 25% Topsoil
- 60% Sand
- 15% Compost

**Soil peds segregated from sand**

**Greater** proportion of **macropores**

**Lower** proportion of **micropores**

Internal structure of soil peds retained

**Unscreened Mix**

- 60% Topsoil
- 25% Sand
- 15% Compost

Morton Arboretum soil mix / soil screening test 2014/15

Bryant Scharenbroch
Re-Thinking the BS 3882

Need to rethink the 50mm restriction

Soil specifications including BS 3882, ignore soil structure

The edges of the textural triangle are difficult soils
**Existing soil.**

1. Locate, purchase, deliver and install Imported Planting Soil and soil amendments.
2. Harvest and stockpile existing site soils suitable for Planting Soil.
3. Modify existing stockpiled site soil.
   a. Modify existing site soil in place for use as Planting Soil.
   b. Install existing or modified existing soil for use as Planting Soil.
4. Locate, purchase, deliver and install subsurface Drain Lines.
5. Fine grade Planting Soil.
6. Install Compost into Planting Soil.
7. Clean up and disposal of all excess and surplus material.

**Notes:**
- Coordinate this list with the other related specification sections. Add or delete sections as appropriate.
- Drawings and general provisions of contract, including general and supplementary conditions and Division I specifications, apply to work of this section.
- Shall consist of specifications, general conditions, and the drawings. The intent of these documents is to include all labor, materials, and services necessary for the proper execution of the work. The documents are to be considered as one. Whatever is called for by any parts shall be as binding as if called for in all parts.

**Related Documents and References**

- Related Documents:
  - Section - Tree and Plant Protection
  - Section - Lawn
  - Section - Irrigation
  - Section - Planting
  - Division I specifications, apply to work of this section.

**Related Specification Section**

- 1 Trees shall be of quality prescribed in crown observations details and observations and root requirements related to this detail.

**Tree preservation**

**Urban Tree Foundation**

700 East Murray

Visalia, CA 93292

[559.713.0631](tel:559.713.0631)

[www.urbanantree.org](http://www.urbanantree.org)
Thank you!