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America as a landscape is significantly different than that which we, Western immigrants, found in the early years of settlement. America was a coast to coast wilderness absolutely briming with plants and animals (not to mention native peoples) living in a relatively prestige ecological equilibrium. America still retains some of that wild expansiveness thanks in part to our national parks, conservation efforts, and the fact that some places are just too rugged to tame. That's said, the landscape of this continent, now a nation, has changed dramatically. George Carlin, late comedian, says it best in his skit titled Dumb Americans:

> It just seems to me… that only a really low IQ population could have taken this beautiful continent, this magnificent American landscape that we inherited… Well, actually, we stole it from the Mexicans and the Indians but. Hey, it was nice when we stole it. It looked pretty good. It was pristine…Have you taken a good look at it lately?... Only a nation of unenlightened half-wits could have taken this beautiful place and turned it into what it is today, a shopping mall. A big, fucking shopping mall… That's all you got here, folks. Mile after mile of mall after mall.

Carlin's cynical humor is funny but also worrying to those of us with a bent for nature and a duty towards the future. Malls, as Carlin gets at, are surrounded by parking lots and sidewalks, parking lots are fed by streets, streets are connected to highways, and highways feed the mass of interstates which crisscross the country. All of these impermeable surfaces hasten runoff water laden with the toxins our city life generates. Further, these grey surfaces are limiting factors to trees and green spaces generally.

In a sense our ability to develop land has outpaced our capacity to realize or ascribe moral or intrinsic value to natural spaces. Using an analogy, our tools have outpaced our moral development and awareness. None has stated this sentiment better than the father of American ecology, Aldo Leopold who, in a speech delivered to the University Of Wisconsin College Of Engineering in 1938, ended with the following:

> We end, I think, at what might be called the standard paradox of the twentieth century: our tools are better than we are, and grow better faster than we do. They suffice to crack the atom, to command the tides. But they do not suffice for the oldest task in human history: to live on a piece of land without spoiling it[1].

Carlin's comments provide a useful heuristic tool to give us insight into the scale of our national problem, the green and grey infrastructure conflict. Aldo's moralizing provides us with the self reflection and criticism needed going forward. As students of green space management, then, we must tackle the issue of coast to coast parking lots, of coast to coast grey vs. green infrastructure. Towards this end, we will look at some recent developments of novel best practices and one solid example of a city tackling these issues.

One exciting recent development is the practice of using structural soils, sometimes called skeletal soils, in place of traditional backfill. First a little background: In years past construction practiced a backfill technique in which the soil (more commonly dirt) dug out for a project, say a new housing unit, would be used again as the fill for planting trees or other green scapes. Often times only limited amounts of black dirt, soil, would be brought in. This backfill practice does not always set up a tree, or a green space, for long term success. Urban soils, much like the city profiles that sit upon them, are varied and dynamic. The USDA Urban Soil Primer highlights this point tellingly classifying urban soils into: 1 natural soil, and 2 anthropogenic soil types[2]. Natural soils, as the name suggests, either preserves or closely approximates of the native soils in a given region. These are found in long undisturbed sites, such as parks or private property. Anthropogenic soils, by contrast, are manmade or more often the repercussions of development and are far from the natural soil ancestor it came from. These, I would argue, are much more commonly found urbanely. A long story short, it's far too frequent to find construction projects backfilling with anthropogenic soil to the determent of any tree or green space that might otherwise have better survivability and functionality.

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[1] A. Leopold, *Engineering and Conservation,* pg 254.
[2] USDA *Urban Soils Primer*, pg 10.

Now we have the rise of so called structural soil which, by definition, are examples of anthropogenic soils. That said, structural soils are very intentional whereas most cited examples of urban anthropogenic soils are the unintended consequences of human projects. Giving a general description of structural soil is difficult as there are a few instantiations of this general idea. The goals, however, of these varied instantiations are at least twofold: firstly to provide a stable platform for hardscape such as sidewalks. Secondly, to allow not just for the existence of green spaces, but further, the healthy perpetuation of said green space across time. This is achieved by allowing for air flow, water movement, root growth, and nutrient availability while preventing soil compaction and all the while allowing for the structural stability upon which a path or sidewalk may be installed. This is achieved with carful use of angular rock structures applied in layers, or with elevated plastic cells (commonly called silva cells).

Urban soils to frequently suffer from compaction resulting from the fill used, structural soils solve this by using those angular stones or structural forms to limit compaction and leave room for root development plus water and air flow. One may very easily get a better general understanding of this process by looking at the link below which is a short YouTube video of an installation of structural soil in Stockholm Sweden[3]. The video clearly shows the step by step process, using angular rocks not plastic cells, and gives the viewer a crash course in skeletal soils installations.

As with most new processes studies have looked into structural soils. One such study, *Stability of LandscapeTrees in Engineered and Conventional Urban Soil Mixes* by Julia Bartens et al, tests the effects of structural soils on tree stability versus conventional methods. The study measured stability by setting up plots for both traditional soil pits and skeletal soils. The traditional pits were not all homogeneous; some were compacted to a proctor density of %95[4] in order to replicate an urban situation where human use overly compacted the soil. In these pits were planted *Ulmus parvifolia* and *Prunus serrulata*

[3] https://www.youtube.com/watch?v=S7kbSnnJwDI .
[4] J. Bartens et al, pg 34.

respectively. To measure stability force was applied and calculated off a pulley system attached, after 3years growth, to a tensionmeter rigged to the trunk of each tree. If we may be permitted to summarize their findings:

> Our findings indicate that sensitive tree species planted on conventional tree pits may be more prone to uprooting due to poor root development and that root anchorage could be improved for these species by utilizing a skeletal soil mix that enhances aeration, hydration, and root elongation.[5]"

These findings are exciting and useful to the practicing urban green space manager and to us future planners. The articles scope does not include all the benefits of structural soils however. One example of this is structural soils ability to hold, cool, and filter storm water runoff. In summation, *Stability of Landscape Trees in Engineered and Conventional Urban Soil Mixes* is a useful article to anyone whose future will include working with trees or green spaces and give them reasons and evidence in order to advocate the use of these structural soils.

Structural soils are not the only answer to Carlin's coast to coast mall harangue, another is to improve the functionality and ecological quality of our parking lots. This is exactly what the Seattle Department of Construction and Inspection has done. In a piece titled Tip 515, we find a great account of the use, cost, and benefits of green parking lots. This piece defines a green parking lot as a "parking lots [that] reduce runoff that is [normally] discharged into local water bodies by using permeable paving and natural drainage[6]." Breaking that down a little, permeable paving is a useful solution to the imperviousness of asphalt and concrete and include such things as paving stones, porous asphalt and porous concrete. Natural drainage landscapes, as the name foretells, include things like rain gardens, bio-swals, and selective plantings which all combine to combat the negative aspects of storm water runoff. A further consideration Tip 515 points out seems simple but is all too often ignored in construction that is, grading. The bio-swals and rain gardens will work together only if they stand in a

[5] J. Bartens et al, pg 337
[6] Seattle Dept. of Construction, Tip 515, pg 1.

gradient relation where water, seeking its lowest level, will be allowed to move properly. In effect we make the parking lots part of a larger green infrastructure which captures storm water runoff and filters it on site, cools it on site, and further provides much needed water for a canopy that will inhibit the heat island affect that cities like Seattle are suffering from.

A further point that deserves mention is the cost to benefit relation the Seattle Department of Construction highlights. They bring up four hypothetical parking lot options: 1) the conventional parking lot you and I are accustomed to seeing and put its price at 6.6milliion dollars with yearly maintenance cost at roughly $70,000 dollars. The other options, 2-4, all incorporate the aspects we discussed above such as bio-swals, and rain gardens. Tellingly, these options all come in at a lower install cost for the same sized hypothetical parking lot. What's more, because of the capacity of these green structures, average yearly maintenance costs are projected to be lower for options 2-4. Though the whole numbers are not that far apart there seems no reason to pay more initially and annually on a conventional lot.

In the end, cities like Seattle and new practices like structural soil might give Carlin a little hope and remove from his bag of jokes one that we, as Aldo points out, should be ashamed of. Structural soils and green parking lots must be part of our future. Further, they ought to be part of our present. Why not?

References

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