Why Shade Streets?

THE UNEXPECTED BENEFIT

SHADED STREETS = HAPPY STREETS

Have you ever walked across an asphalt street on a hot summer day and felt the heat singe the bottom of your shoes? Streets can get as hot as 130°F. But what you may not know is that the same heat that just singed your feet is also accelerating the street's deterioration. Is tree shade the answer to cooler asphalt? Yes, but does it also affect asphalt longevity? Find out…

Center for
Urban Forest Research

After more than 100 years of road and highway building, the United States is now criss-crossed by nearly four million miles of roadways.[1] That translates to nearly 19,000 square miles of asphalt, an area greater than the states of New Hampshire and Vermont combined.[2] Add in all the parking lots, private roads, driveways and road shoulders, and the total amount of paved land comes to approximately one percent of the total area of the contiguous United States.[3]

Many Streets Not Shaded

Many of these miles of roadways are found in our cities. And even though there has been a concerted effort to plant trees along our streets, you can still see many streets without shade trees. As a result, many of our streets are hot during the summer and deteriorating at a faster rate than if they were shaded.

1. Federal Highway Administration. Highway Statistic Series 2001. Table HM-10. November 2002.
2. Derived by multiplying the 8,251,847 lane-miles of roadway (from FHWA. Highway Statistics Series 2001. Table HM-60. November 2002.) by 12 feet, the average lane width.
3. E.O. Wilson. Introduction to R. Forman, Land Mosaics: The Ecology of Landscapes and Regions. Cambridge University Press: 1995.

Asphalt Is...

Asphalt streets are a combination of filler materials, known as aggregate, and a binder, asphalt cement, on top of one or more layers of gravel and compacted soil. As pavement temperatures rise, the binder evaporates and breaks down and the pavement begins to harden. This makes it easier for cracks to form. Small cracks lead to big cracks by, for instance, allowing water to infiltrate the top layer and penetrate and weaken the layers underneath. Once a substantial crack appears, it is then easier for water to infiltrate the top layer and penetrate and weaken the subgrade.

Maintenance and rehabilitation are the two principal treatments used to extend pavement life. These treatments will immediately improve the pavement condition and affect the future rate of deterioration. In general, maintenance can slow the rate of deterioration by correcting small pavement defects before they worsen and contribute to other defects. Reconstruction and resurfacing are more costly techniques intended to rehabilitate the pavement and prolong its life.

THE RESEARCH QUESTION:

Is there an inexpensive way to slow the rate of deterioration of streets and extend the time between treatments? We thought there was, so we asked the question: Is the condition of pavement on tree-shaded streets better than on unshaded streets – all other things being equal? And…the answer is YES.

During our research in Modesto, CA, we found that an unshaded street segment required 6 slurry seals over 30 years, while an identical one planted with small-crowning trees required 5 slurry seals, and one with large-crowning trees required only 2.5 slurry seals. We also found that the shade from the large-crowning trees was projected to save $0.66/ft^2 over the 30-year period compared to the unshaded street.

More shade means more time between repaving. 20% shade on a street improves pavement condition by 11%, which is a 60% savings for resurfacing over 30 years.

The benefits of shade from large-stature trees compared to small-stature trees illustrate the value of investing in large-stature trees.

As pavement conditions deteriorate, maintenance and repair costs become increasingly more time intensive and costly.

SCENARIO	SLURRY SEALS	TOTAL COST ($)	SAVINGS ($)
Unshaded	6	4,971	
Small trees	5	4,142	829
Large trees	2.5	2,071	2,900

Table 1: Savings per unit pavement surface for shaded vs. unshaded street segments over 30 years (area = 4,375 ft^2).

SHADED ASPHALT IS CHEAPER ON THE BUDGET

Assuming slurry seal applications cost $0.19/ft^2, and this price remains fixed over a 30-year period, each application will cost $829 per street segment. A typical segment was 125 ft. by 35 ft. We found that the cost of maintaining the unshaded street segment over 30 years was $4,971, while the cost of maintaining the pavement on the street segment with small-stature trees was $4,142, and on the street segment with large-stature trees was only $2,071. Thus, shade on the street segment with large-stature trees will reduce costs for repaving by $2,900 (58%) over the 30-year period compared to the unshaded street. Shade from the small-stature trees is projected to save only $829 (17%).

Road engineers have long recognized the economic importance of maintaining optimum levels of pavement condition. For example, in Modesto the average lifespan of a shaded residential street is 40 years. Pavements that are well maintained last longer and ultimately require less maintenance. In addition, as pavement conditions deteriorate, maintenance and repair costs become increasingly more expensive.

It was evident from our results in Modesto that greater tree shade was associated with better pavement condition. **Shady streets *are* happier streets.**

Our Research Document

Effects of Street Tree Shade on Asphalt Concrete Pavement Performance
http://www.fs.fed.us/psw/programs/cufr/products/cufr639mcpherson-JOA-pavingshade.pdf

Additional Resources

Trees for Green Streets
http://www.metro-region.org/article.cfm?articleid=263

Reducing Infrastructure Damage by Tree Roots – A Compendium of Strategies
http://secure.isa-arbor.com/store/Diagnosis-Disorders-and-Plant-Health-Care-C19.aspx

SelecTree: A tree selection guide
http://selectree.calpoly.edu/

Limitations of This Research

Application of our research results outside California's Central Valley are to be considered limited, due to differences in pavement types, pavement wear, and regional climates.

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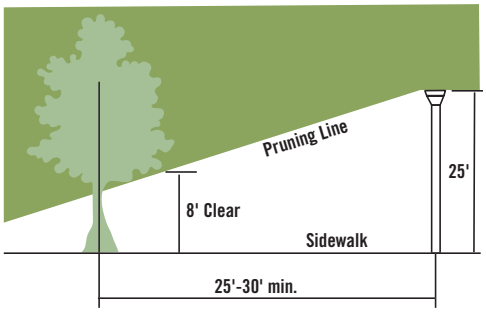
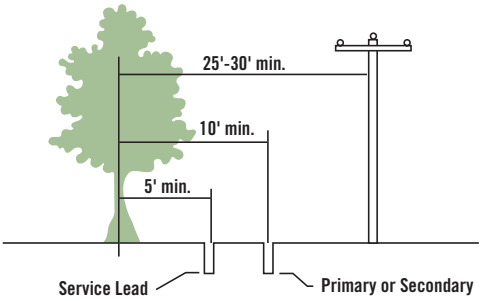
How To Fit Trees on Streets

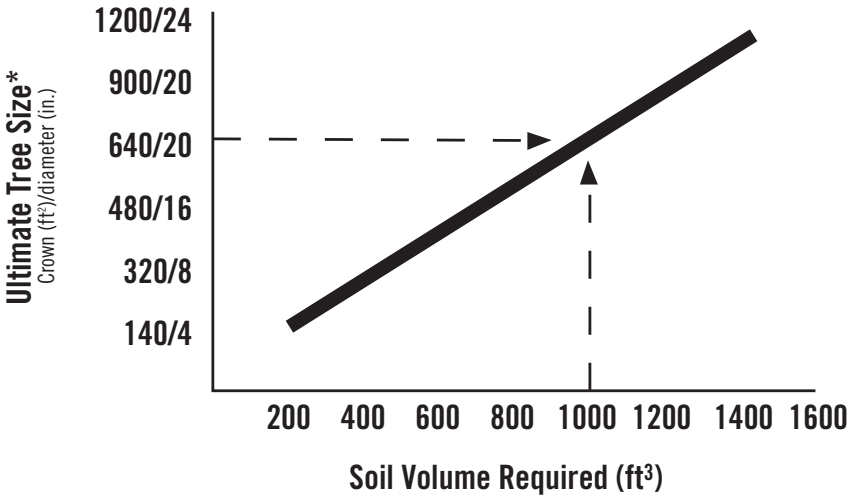
- Start by establishing very clear goals for your street trees including shade and other functions, longevity, stress tolerance, rainfall interception, air pollution uptake, level of maintenance, and infrastructure conflicts.
- Increase your community-wide tree canopy by targeting shade for streets, as well as parking lots, and other paved surfaces.
- Large trees can shade a greater area than smaller trees can but should be used only where space permits. Remember that a tree needs space for both branches and roots.
- Avoid locating trees where they will block illumination from streetlights or views of street signs in parking lots, commercial areas, and along streets.
- Check with local transportation officials for sight visibility requirements. Keep trees at least 30 ft away from street intersections to ensure visibility.



- Avoid planting shallow-rooting species near sidewalks, curbs, and paving. Tree roots can heave pavement if planted too close to sidewalks and patios. Generally, avoid planting within 3 ft of pavement.
- Be aware of strategies to reduce infrastructure damage by tree roots such as meandering walks around trees and selecting deep-rooting species. (Costello and Jones 2003).



- Select only small trees (<25 ft tall) for location under overhead power lines. Do not plant directly above underground water and sewer lines.
- Match each tree to the site. Maintenance requirements and public safety issues influence the type of trees selected for public places. The ideal public tree is not susceptible to wind damage and branch drop, does not require frequent pruning, produces negligible litter, is deep-rooted, has few serious pest and disease problems, and tolerates a wide range of soil conditions, irrigation regimes, and air pollutants (SelecTree).
- Provide adequate soil volume. For trees to deliver benefits over the long term, they require enough soil volume to grow and remain healthy. Matching tree species to the site's soil volume can reduce sidewalk and curb damage as well.



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