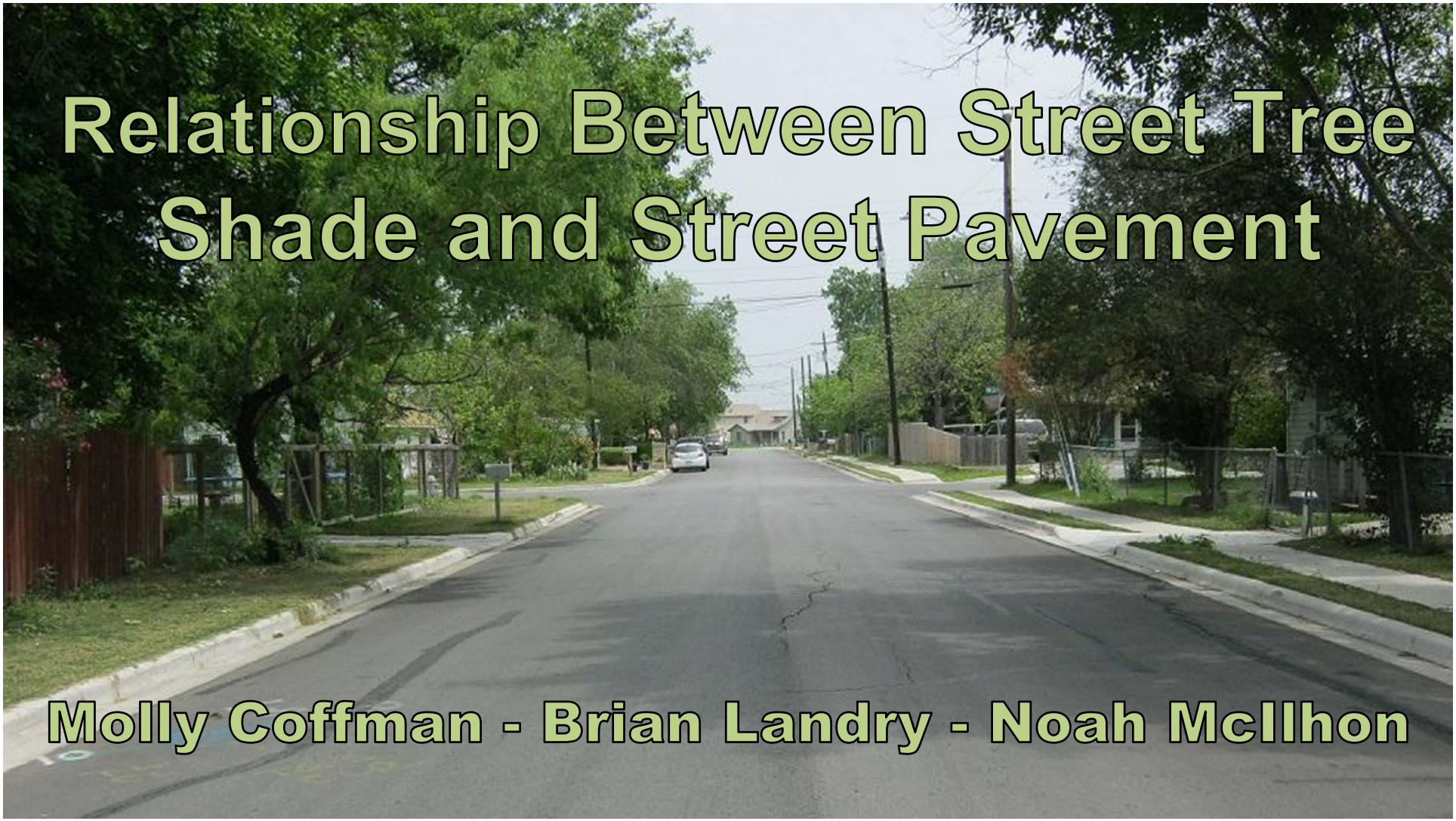


Relationship Between Street Tree Shade and Street Pavement

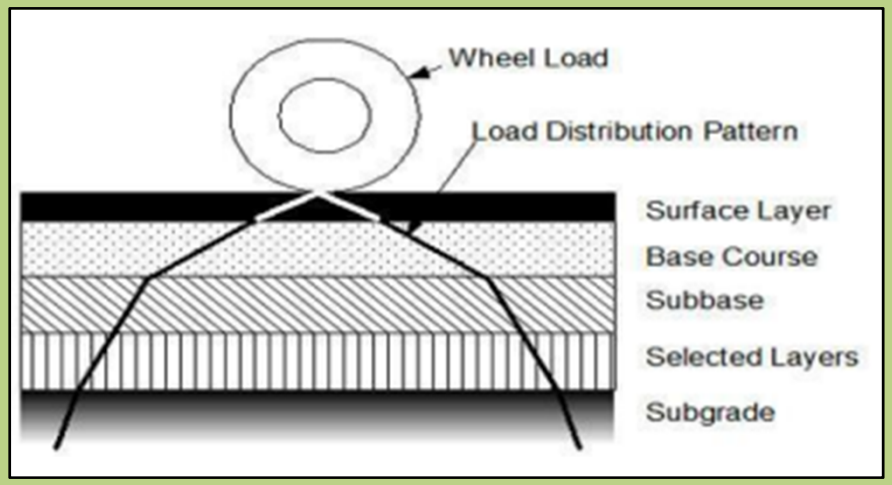
Molly Coffman - Brian Landry - Noah McIlhon

Overview

- Scope of Project
- Research
- Impacts
- Tree Benefits
- Tree Conflicts
- Cost Analysis
- Recommendations

Factors Influencing Pavement Performance

- Traffic
- Moisture
- Subgrade
- Construction Quality
- Maintenance



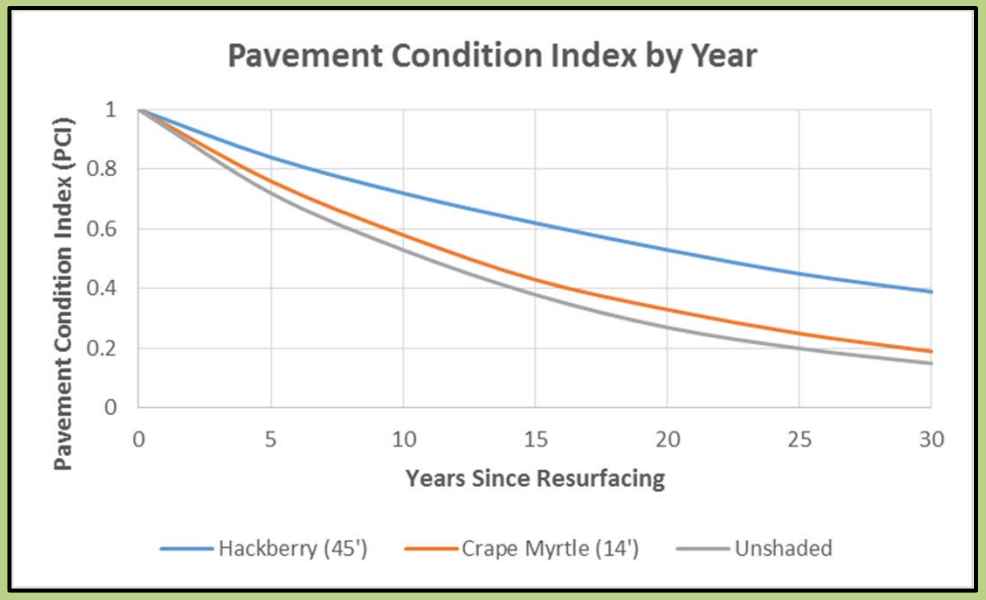
Adlinge, S. (2009). Pavement Deterioration and its Causes. *IOSR Journal of Mechanical & Civil Engineering*. Retrieved from http://www.iosrjournals.org/iosr-jmce/papers/sicete(civil)-volume6/60.pdf

Quantifying Tree Impact on Pavement Performance

McPherson and Muchnick Study:

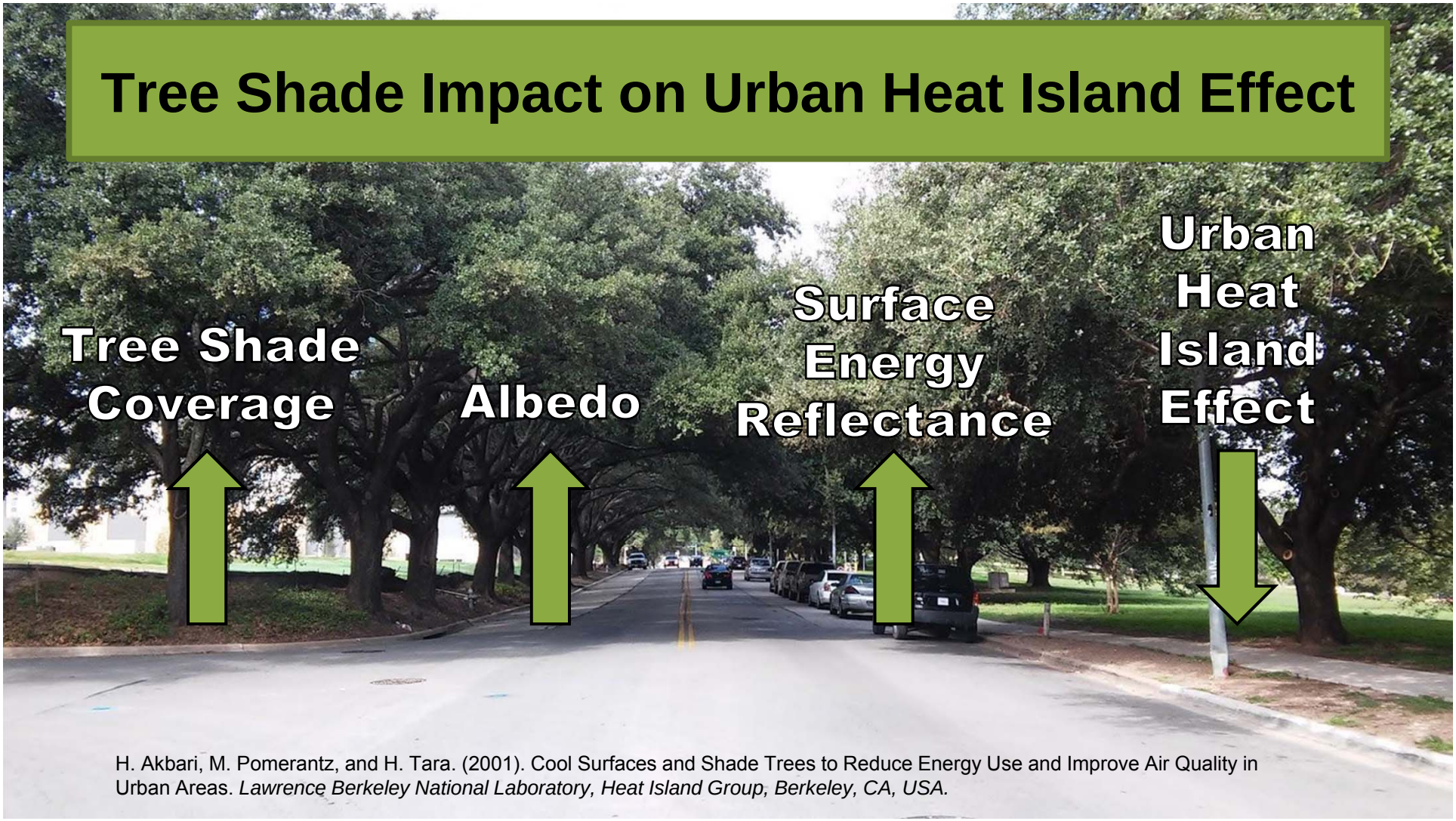
Effects of Street Tree Shade on Asphalt Concrete Pavement Performance

"The complex relationships among factors that affect pavement performance… are not well understood, and their confounding effects are not well quantified. A change in any one of these factors may considerably affect the relationships uncovered in this investigation."



McPherson, E Gregory and J. Muchnick. (2005). Effects Of Street Tree Shade On Asphalt Concrete Pavement Performance, Journal of Arboriculture, Nov 2005.

Tree Shade Impact on Urban Heat Island Effect



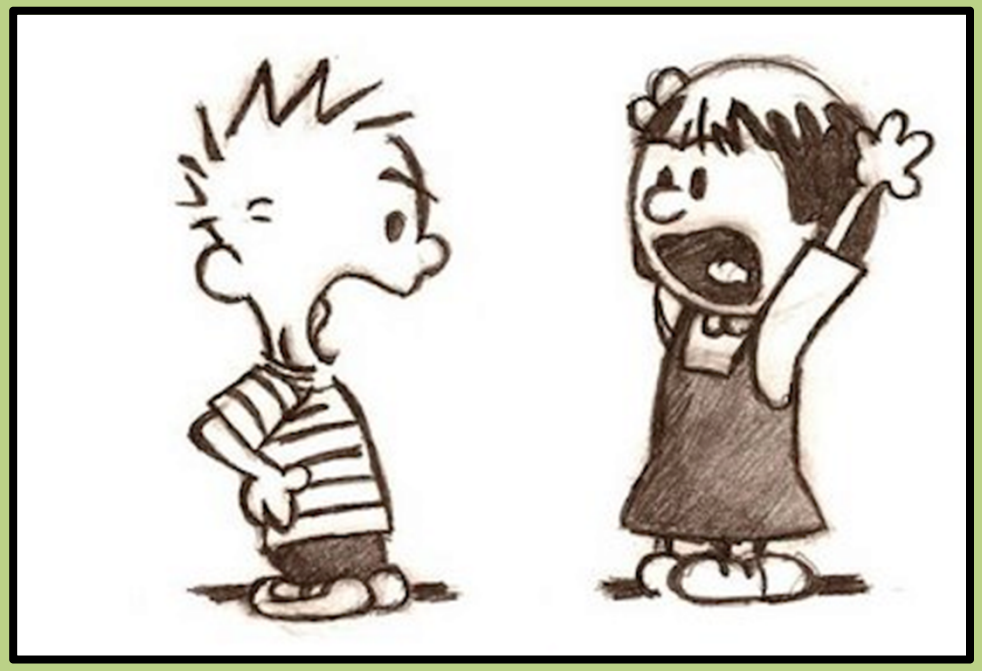
H. Akbari, M. Pomerantz, and H. Tara. (2001). Cool Surfaces and Shade Trees to Reduce Energy Use and Improve Air Quality in Urban Areas. *Lawrence Berkeley National Laboratory, Heat Island Group, Berkeley, CA, USA.*

More Tree Benefits

- Shade reduces the surrounding air temperature
- "Oasis Effect" 9°F - 12.6°F
- Buildings require less energy for cooling
- Reduction in CO_2 and other pollutants
- Decreased soil erosion
- More pleasant pedestrian experience

Potential Tree Conflicts with Pavement

- Tree roots disturb pavement and may cause cracking
- Subsurface moisture changes can cause cracking



Tree Layout from Study

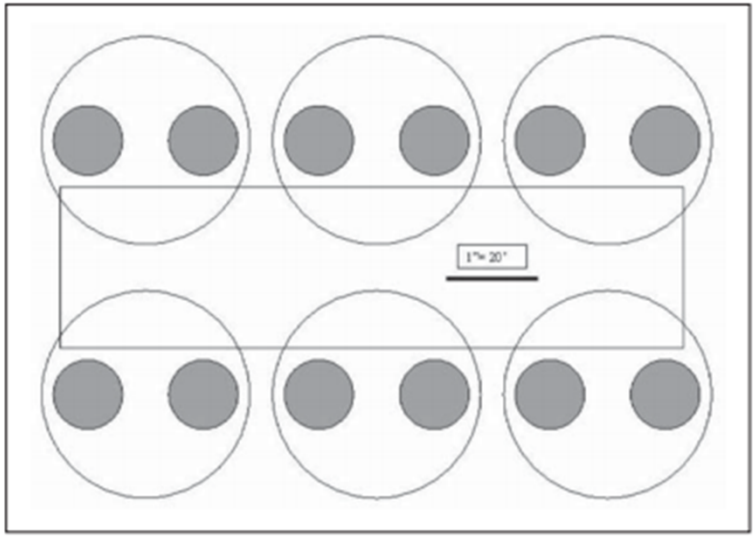


Figure 1. Two scenarios showing locations and sizes of 12 crape myrtle (shaded circles) and 6 hackberry (unshaded circles) street trees 30 years after planting. The trees were assumed to be planted along identical street segments, each 38.1 m (125 ft) long and 10.7 m (35 ft) wide.

McPherson, E Gregory and J. Muchnick. 2005. Effects Of Street Tree Shade On Asphalt Concrete Pavement Performance, Journal of Arboriculture, Nov 2005.http://www.fs.fed.us/psw/publications/mcpherson/psw_2005_mcpherson001_joa_1105.pdf

Annual Costs Per Linear Mile

	Road Lifespan (Years)	Average Cost of Surface Treatments per Year ($)	Average Cost of Tree Maintenance per Year ($)	Average Cost of Road per Year ($)
Un-Shaded	65	1150	0	7500
Partial Shade (14 ft Diameter)	75	970	6000	12700
Full Shade (45 ft Diameter)	90	575	8200	14500

McPherson, E Gregory and J. Muchnick. 2005. Effects Of Street Tree Shade On Asphalt Concrete Pavement Performance, Journal of Arboriculture, Nov 2005.
McPherson, E Gregory. 2003. A Benefit Cost Analysis of Ten Street Tree Shade Species in Modesto California, Journal of Arboriculture, Jan

Recommendations for Study

- Collect field data on matching high and low shade street segments (20-30 pairs).
- For street segments with no matching counterpart, extract asphalt cores to insure material properties are similar.
- Assess pavement distress: alligator cracking, block cracking, distortions, rutting, weathering.
- Calculate Pavement Condition Index and Tree Shade Index.

  PCI: Ranges from 100 for new concrete to 0 for a pavement beyond repair

  TSI: Calculated from tree dimensions and crown density to give average amount of shade
- Record the number of surface treatments required over X-year period.