ARBORICULTURE & URBAN FORESTRY

Volume 40, Issue 5, September 2014

Formerly the Journal of Arboriculture, 1975 – 2005 (Volumes 1 – 31)

ISA

www.isa-arbor.com

CONTENTS

Abstract. Root systems of nearly all trees in the built environment are subject to impacts of human activities that can affect tree health and reduce longevity. These influences are present from early stages of nursery development and throughout the life of the tree. Reduced root systems from root loss or constriction can reduce stability and increase stress. Natural infection of urban tree roots after severing has not been shown to lead to extensive decay development. Roots often conflict with infrastructure in urban areas because of proximity. Strategies to provide root space under pavements and to reduce pavement heaving have been developed, but strategies for prevention of foundation and sewer pipe damage are limited to increasing separation or improved construction.

Key Words. Ground-Penetrating Radar; Infrastructure Damage; Root Architecture; Root Decay; Root Defects; Rooting Space; Root Flare; Root Severing; Stability.

Abstract. Pine plantations are prone to stem breakage due to high cyclic stress levels associated with hurricane force winds. Stress analytical and finite element simulation models were constructed of a representative profile of a (Sitka) *Picea sitchensis* tree. The profile surface stress (*S*) was determined due to the combined load of tree self-weight and hurricane wind speed. The results were complemented by reference to two other studies by other researchers that investigated the impact of fatigue cycles on failure (*N*) of pine wood and tree sway cycles to present a stem fatigue life prediction. The position of maximum surface profile stress and trunk fracture initiation location was ascertained from a non-uniform stress response. No stress uniformity along the trunk profile was observed for any wind-load case examined. The analytical model and finite element analysis of the *P. sitchensis* tree trunk profile revealed a statically adequate strength reserve factor of 1.4, which suggested another mode of failure was responsible. Fatigue life failure prediction was examined under cyclic and same-stress amplitude related to the hurricane wind speed of 33 m s^{-1}. Predicted trunk fracture occurred in 2.6 hours, which dramatically reduced to two minutes with an increase in wind speed of only 1 m s^{-1}. The calculated exposure time was similar to that recorded during Hurricane Hugo's transit in 1989. The time-to-failure prediction obtained by the method of analysis provided in this study seemed plausible, and that the profile associated with the *P. sitchensis* tree would suffer trunk breakage by low cycle fatigue failure.

Key Words. Failure; Fatigue; Finite Element Analysis; Hurricane; *Picea sitchensis*; Sitka Spruce; Stress; Wind; Wind Load.

Abstract. Million Trees LA (MTLA) is one of several large-scale mayoral tree planting initiatives in the United States, striving to create more livable cities through urban forestry. This study combined field sampling of tree survival and growth with numerical modeling of future benefits to assess performance of MTLA plantings. From 2006 to 2010 MTLA planted a diverse mix of 91,786 trees. Survivorship rates of 79.8%, 90.7%, and 77.1% for street, park and yard trees were relatively high compared to other studies. Growth rates averaged 0.99 and 1.1 cm DBH per year for street and yard trees. They were similar to rates for the same species in Claremont, California, U.S., and trees in other subtropical urban forests. Projected over 40 years, the amounts of CO_2 stored per tree planted per year (20.1 kg), avoided emissions (27.7 kg), rainfall interception (1.5 m^3), and air conditioning savings (47.4 kWh) exceeded estimates from a previous assessment. One reason is that MTLA has planted more larger-stature trees than anticipated. Avoided CO_2 emissions from energy savings were relatively large because trees were judiciously located for building shade. Park tree plantings were projected to store the most CO_2 (42.0 kg per tree per year) because of their large-stature and high survival rate. Although MTLA has not reached its goal of planting 1 million trees, early results suggest that it is achieving success in terms of tree survival, growth, and performance. Continued success will depend on proper tree care practices, strategically selecting and locating new trees, monitoring threats, and adapting to challenges that arise.

Key Words. California; Carbon Monitoring; Park; Planting; Sequestration; Street Trees; Tree Growth and Mortality; Tree Planting Initiatives; Urban Forestry; Yard.