RESEARCH
PROJECT CAPSULE
[12-1P]
February 2012
TECHNOLOGY TRANSFER PROGRAM

Assessment of Pavement Distresses Caused by Trees on Rural Highways

JUST THE FACTS:

Start Date:
February 1, 2012

Duration:
29 months

End Date:
August 31, 2014

Funding:
SPR: TT-Fed/TT-Reg

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Sponsored jointly by the Louisiana Department of Transportation and Development and Louisiana State University

POINTS OF INTEREST:

Problem Addressed / Objective of Research / Mehodology Used Implementation Potential

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PROBLEM

In Louisiana, longitudinal cracks, meandering cracks, and subsidence in the pavement surface have occurred at isolated locations in rural areas where trees are present. These distresses have led to pavement service life reduction, costly maintenance repairs, and numerous complaints from the public. The purpose of this research is to determine the factors contributing to these distresses and develop cost effective mitigation strategies.

OBJECTIVE

The purpose of this research is to identify the geological, environmental, and roadway design/construction/material factors contributing to pavement distresses when trees and flora are present. Once identified through site assessment(s), cost effective mitigation strategies (preferably with methods common to the transportation community) will be identified. Test sections will be proposed based upon these results. Three DOTD districts were informally surveyed and the remainder of the districts will be surveyed during the course of this study. The locations of roadways with tree related distresses will be catalogued and placed on Geographic Information Systems (GIS) based maps. Pavement distress identification and problematic tree species guidelines will be provided as well.

METHODOLOGY

LTRC conducted an informal survey of Districts 08, 05, and 58 to find locations with pavement distresses caused by trees. Based upon the data collected and field visits in District 08, LA 494, control section 360-05, Natchitoches Parish, CSLM 1.936 to 0.836, has been selected as the project to conduct this assessment with the District 08 administrator's approval. It is an ideal candidate because there is a 5,808-ft. section with continuous longitudinal cracks in the pavement with an adjacent tree line. In order to meet the objectives of this proposal, a detailed geotechnical and environmental assessment of LA 494 will be conducted under the following tasks:

Task 1: Conduct a Comprehensive Literature Review
The research team will conduct a comprehensive literature review using standard search engines from Transportation Research Information Services (TRIS), COPENDEX, the National Cooperative Highway Research Program (NCHRP), the Federal Highway Administration (FHWA), the National Highway Institute (NHI), and Google.

Task 2: Conduct a State-wide Survey
A state-wide survey will be conducted by email. Survey questions will be created to gather the following information:

1. Locations of pavement distresses caused or accelerated by trees
2. Types of distresses such as longitudinal cracking and subsidence
3. Distances of trees from the edge of the roadway
4. Previous mitigation attempts (patching, crack sealing, and full depth repair)
5. Performance and cost effectiveness of the repair

Once the survey data are obtained, the locations of the distressed areas will be placed on a GIS map of Louisiana and made available through the Pavement Management System (PMS).

Task 3: Site Investigation
Conduct a topographic survey of the site from tree line to tree line and catalog tree species and develop plans with cross sections. Determine geologic strata with cone readings and obtain soil samples from the strata with shelby tubes.

Task 4: Pre-test-section Instrumentation and Data Collection
Discovering the seasonal moisture/suction variation and ground movement prior to constructing the test sections are prudent. This information will assist the researchers in refining the test section's design as well as establishing the appropriate instrumentation plan for each test section. Site instrumentation will include tube placement for neutron probe moisture content readings, ground movement devices, time domain reflectometers, suction devices, tree transpiration measurement devices, and an onsite weather station.

Task 5: Basic Laboratory Program
As soil samples are procured from each site, soil property determination will begin at the LTRC Geotechnical Laboratory. The following testing shall be conducted for each site:

- Soil classification properties such as Atterberg Limits, sieve analysis, specific gravity, maximum dry density, optimum moisture content, void ratio, and porosity

Task 6: Interim Report
An interim report will be prepared covering the literature search, state-wide survey, and site investigation outlined in Tasks 1, 2, 3, and 5.

Task 7: Advanced Laboratory Program and Model Verifications
The following advanced soil testing shall be conducted prior to model verifications:

- Soil water characteristic curve (SWCC) parameters on samples retrieved from site locations
- Additional lab tests such as hydraulic conductivity, capillary potential, tube suction tests, shrink/swell, and mineralogical tests to determine soil components such as kaolinite, illite, and montmorillonite
- In-place stress states

Task 8: Feasibility Analysis, Proposed Test Sections, and Final Report
Once the laboratory testing, field data collection, and model verification have been completed, a detailed feasibility/cost analysis will be conducted and the experiment with proposed test sectons will be adjusted according. Factors in the feasibility/cost analysis include, but are not limited to, costs of materials, constructability of test sections, environmental impact, service life, and maintenance of roadway treatments after construction.

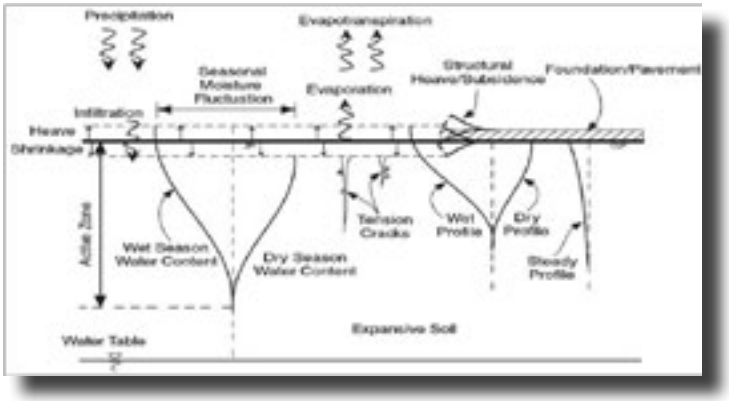
A final report will be prepared covering the work conducted in Tasks 1 to 8 and will be completed by the end of this task.

Task 9: Final Report Review Period
During this period, the final report is reviewed by the PRC, LTRC executives, and the LTRC editorial staff. Revisions to the report are completed by the PI as required.

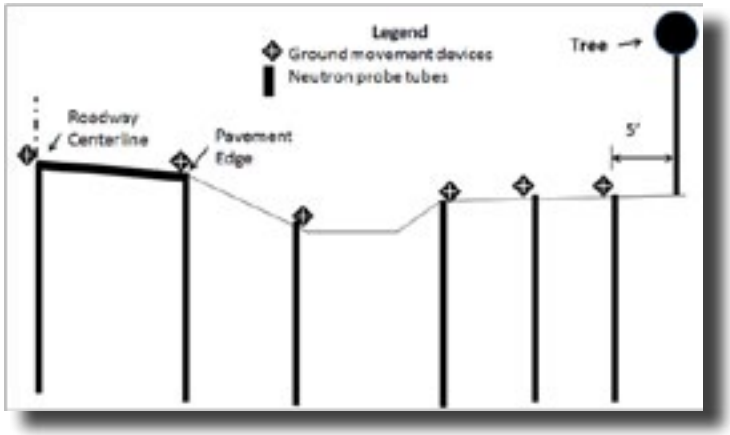
IMPLEMENTATION POTENTIAL

Pavement distresses caused by trees exist at isolated locations on rural highways. This study lays the ground work to identify the distress mechanisms. Test sections can be designed to mitigate the distress mechanisms and assessed to determine their effectiveness. Selecting the appropriate mitigation methods for tree related distresses leads to obtaining the designed service life of the pavement.

LA 494 pavement distress (longitudinal cracks)



Schematic of seasonal subgrade moisture content variation



Research instrumentation plan for LA 494

For more information about LTRC's research program, please visit our Web site at www.ltrc.lsu.edu.