Pavement GPR Study for TN County Roads

PROBLEM STATEMENT

Since 1983, TDOT has absorbed approximately 3,500 miles of former county roads into its system. The composition and structural capacity of a large portion of these road ways is unknown, except for new overlays that have been constructed since that time.

Determination of pavement composition and structural capacity are the primary objectives of TDOT; thus, obtaining pavement layer thickness and identification of layer structure using ground-penetrating radar (GPR) will assist significantly in that effort. Information from GPR data can be augmented by deflection data and core tests to determine structural capacity and overall pavement conditions.

BENEFITS TO TDOT

The proposed study will benefit TDOT in the following aspects:

1) Information on pavement composition and structural capacity of former county roads would be of great value to TDOT, including the Pavement Design Office and the Division of Materials and Tests.
2) Identification of pavement layer structure and thickness, nondestructively and rapidly using GPR, will provide for an inventory of the surveyed roadway system, which currently does not exist and will provide data for a pavement management system (PMS).
3) This work will provide TDOT with a network-level survey that identifies pavement composition of the 3,500 miles of roadway network and estimate the structural capacity of key points in the network using falling weight deflectometer (FWD).
4) Validation of GPR data (thickness of pavement layers) collected from both project- and network-level surveys using core data will provide a better understanding of the appropriate scan density for data collection for the entire 3,500 miles.
5) In this work, a geographic information system (GIS) will be integrated in the PMS. The GIS database will provide a user-friendly tool to store, manage, and display pavement information along the scanned roadway segments.

OBJECTIVE

The objectives of the proposed research are to:

1) Use GPR for estimating pavement structure including hot-mix asphalt (HMA), base, and subbase layer thickness, on former county roads that were absorbed by TDOT in 1983.
2) Perform dynamic (network-level) scanning of 3,500 miles. This will be done using one 1 GHz antenna while collecting data on posted roadway speed (30-50 mph).
3) Perform static (project-level) scanning at multiple points along the 10 selected sites using two (high, 2 GHz and low, 100 MHz frequency) GPR antennas. The static scans will be done to obtain more accurate data on pavement thickness for the shallow and deep layers. Data collected from static scans will be compared with data from dynamic scans. The purpose of this comparison is to validate the data obtained on the network-level and determine an appropriate dynamic scanning density.
4) Validate both static and dynamic GPR data (and software) with selected core tests taken at specific points on the roadway segments. Core tests will be also conducted for the network-level survey for GPR calibration purpose. We will core every 50 miles, hence 70 total cores will be required for equipment calibration for the entire 3,500 miles.
5) Determine the structural capacity of selected roadway segments using GPR data and FWD or core data.
6) Develop a GIS-based PMS application will allow sage the collected GPR, core, and FWD data for easy dissemination.

SCOPE

The scope of the proposed work includes:

- The TDOT Pavement GPR Study will estimate the pavement thickness for 3,500 miles of former county roadways.
- At a few selected sites on each of the 3,500 miles roadway pavements, project-level evaluation will be conducted, where a static high scan density will be used for data collection and interpretation. At these locations, a more detailed pavement assessment will be determined.
- FWD data will be used to determine structural capacity at certain locations of the 3,500 lane-miles.
- Core data will be used to validate the GPR data collected on both the project- and network-levels. The number of cores that will be used for validation purpose will not exceed 25 cores.
- Dynamic GPR data will be collected along the right wheel path or the centerline of the surveyed lane, whichever preferred by TDOT.