Improved Pavement Rehab Decisions using Ground Penetrating Radar (GPR) Technology

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Outline
• GPR technology – how does it work
• GPR pavement applications
  • Layer thickness
  • Base material type
  • Moisture damage
  • Integration with other technologies (FWD, TSD)
• New Developments in GPR systems (3D Radar)

Air-coupled (Horn) Antennas (1 and 2 GHz)

GPR Horn Antenna Equipment

Arkansas DOT
EDOT
Maine DOT
MnDOT

Principles of GPR - Pavements

Sample Graphic GPR Data

Distance
Pavement Surface
Base

Time (depth)
**Pavement Thickness**

![Pavement Thickness Diagram]

**Linear Plot of Pavement Layer Thickness**

![Linear Plot Diagram]

**Tabular Thickness Output**

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<tr>
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<th>Distance From Reference Location (ft)</th>
<th>Total Asphalt Thickness (in.)</th>
<th>Total Base Thickness (in.)</th>
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**GPR Thickness Data for Rehab Planning & Decisions**

- **Shoulder Capacity Studies**
  - do the shoulders have enough pavement to carry the load for traffic diversions, bus lanes, or widenings?
- **Asphalt removal quantity estimates**
  - Construction planning
- **Roadway structure properties (combine with FWD)**
  - Determine depth of weak layer(s)
  - Determine remaining life
  - Specify appropriate rehab

**Can shoulders become bus lanes?**

I-270 in Maryland - 125 lane miles of ramps at 11 interchanges

**I-93 Boston – 1-mile viaduct asphalt overlay thickness to determine removal volume**
Needs ($) Assessment – 4000 miles of ND County Roads – GPR thickness with FWD

Changes in Pavement Structure
Pavement Base Type Evaluation

Base Type Map – Memorial Shoreway, Cleveland, OH Shoulder Evaluation

GPR Data Showing Moisture Damage
Determine location, quantity, and depth of damage

Moisture Damage (stripping) in AC Pavement-I-64 near James City, VA

GPR + Deflection Data
• Combine layer thickness with deflection to calculate
  • Layer moduli (pavement and subgrade)
  • Effective structural number
  • Remaining life
  • Overlay/rehab requirements
Deflection Testing - Falling Weight Deflectometer (FWD)

Deflection Testing – Traffic Speed Deflectometer (TSD)

Remaining Life (years)

I-15 Southbound Segment Analysis

Next Generation GPR - 3D-Radar

3D Radar Equipment
SHRP2 R06D – Detection of Delamination in Asphalt Pavement using 3D Radar

GPR Depth “Slice” showing “stripping” and water infiltration

Mapping a Larger Area (I-75 Gainesville test section)

Thank you!