

Northern Region Ground Penetrating Radar Project

Presentation by

Leo Woster, PE & RLS

NR Materials Engineer

Generous Contribution from

American Engineering Testing, Inc.

Minneapolis, Minnesota

And particularly by

Chunhua Han, PhD, PE



Alaska Statutes: Sec. 19.05.125. Purpose.

- The purpose of AS 19.05 - AS 19.25 is to establish a highway department capable of carrying out a highway planning, construction, and maintenance program that will provide a common defense to the United States and Alaska, a network of highways linking together cities and communities throughout the state (thereby contributing to the development of commerce and industry in the state, and aiding the extraction and utilization of its resources), and otherwise improve the economic and general welfare of the people of the state.



Project Purpose

- Section 308 specifications written for re-hab projects featuring in-place reclaiming were based on the as-builts and some sparsely spaced "peanut" drilling.
- This method was not giving bidders the information necessary to quantify their work, in some cases leading to DSC claims which yielded some substantial Change Orders.
- Led to a decision to try shallow, hi-frequency Ground Penetrating Radar (GPR) to quantify thickness of asphalt layers, thickness of underlying layers, and identification of inter-bedded layers (sandwich layers).



Ground Penetrating Radar (GPR)

Radio waves travel through objects at rates dependent upon the dielectric properties of the material and depths based upon the frequency of the waves

- Define segments of uniform pavement layer thickness visualizing pavement layers to 18 inches deep, (2 GHz).
- Interval of 1 scan per lineal foot (speed dependent) with a high resolution layer thickness resolutions.
- Analysis of a segment will account for intermittent variations in layer thickness resulting from pavement defects or repairs.
- Soil Borings for confirmation and verification.



Applications of GPR

Primary:

- Identify pavement structure layering, thickness of the layers, existence of inter-bedded ("sandwich") layers of asphalt.

Other:

- Calculate material properties
- Detect subsurface anomalies
- Determine depth to bedrock
- Detect stripping and/or layer separation
- Analyze rutting mechanisms
- Detect subsurface moisture and/or freezing
- Hi Frequency yields high details in upper portion of layer structure; lower frequencies (which require lower speeds when data gathering) reads subsurface conditions at depth; *but* lose resolution in upper portion of pavement structure.



Project Overview

- Initial 2 NTP's included four Projects scheduled for Construction in 2010:
 - Parks 287-305 PM: ~36 Lane Miles (\$7280.69); dense peanut drilling. Awarded.
 - Alaska Hwy MP 1222-1235: ~26 Lane Miles (\$7420.70); Advertising this month.
 - Alaska Hwy MP 1212-1222: ~20 Lane Miles (\$1906.69); Awarded.
 - Richardson Hwy MP 265-267 Delta Jct PM, ~4 Lane Miles through downtown Delta Jct. (\$617.79); Tentatively Advertise Feb '10.

Will measure/monitor conditions during construction.



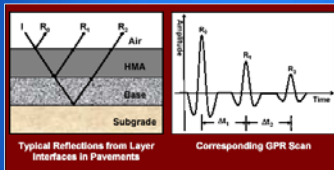
GPR EQUIPMENT MOUNTED ON DOT VEHICLE

Geophysical Survey Systems, Inc.
Unpacking, Installation, Calibration Took About 3 hours



How does it Work?

Two-way travel time in nanoseconds
Amplitude in millivolts



$$D = V \frac{t}{2}$$

Where:

- D = depth to the object (ft),
- V = velocity of wave through medium (ft/s),
- t = two-way travel time (s).



RAW DATA LINE SCAN

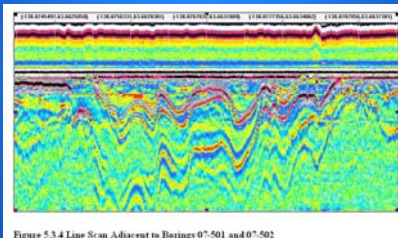
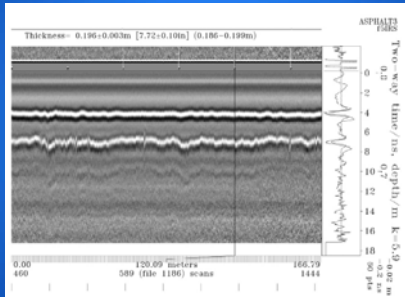


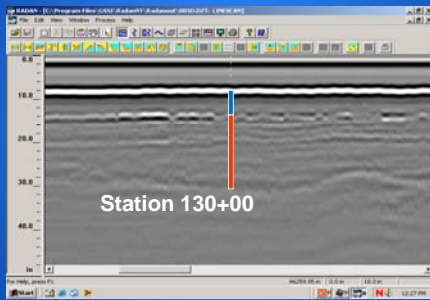
Figure 5.3.4 Line Scan Adjacent to Borelogs 07-501 and 07-502



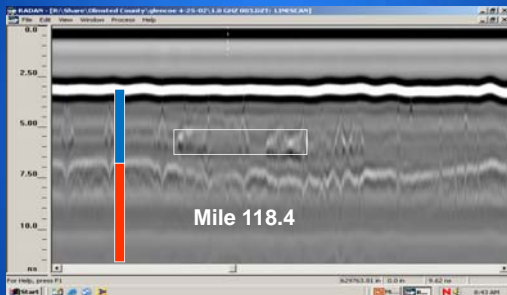
Thickness Measurement



Two Layer Thickness



Subsurface Cracks



???DOES IT WORK ???

- At the present time, we (I??) have put faith in research, expert opinions from various sources (FHWA, other agencies, consultant input, etc).
- Plan is to hire intern, and be on-site for extensive measurements during construction.
- Correlate measurements with GPR Data
- Keeping Open Mind; will report back at next year's summit.



Future Applications (if proves reliable)

- Continue use for design.
- Pavement Management ? Correlate with FWD?
- Post Construction:
 - Non-destructive as-built depth measurements will allow paying only for depths specified; include in pay factors, etc.(will require Aashto Spec.)
 - Correlation with FWD, allowing movement towards a true performance based asphalt design/construction process.