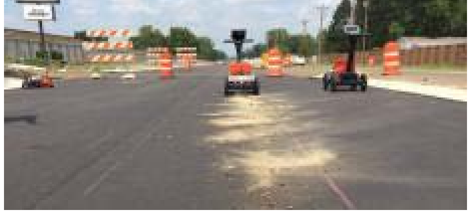




SHRP2 SOLUTIONS
TOOLS FOR THE ROAD AHEAD

Peer Exchange PaveScan RDM Meeting

GSSI Process – From the Beginning, to Now, and Future

Rob Sommerfeldt – Application Specialist
Roger Roberts – SW Engineer

October July 31 – August 1, 2018

U.S. Department of Transportation
Federal Highway Administration

American Association of State Highway and Transportation Officials
AASHTO

Presentation Overview

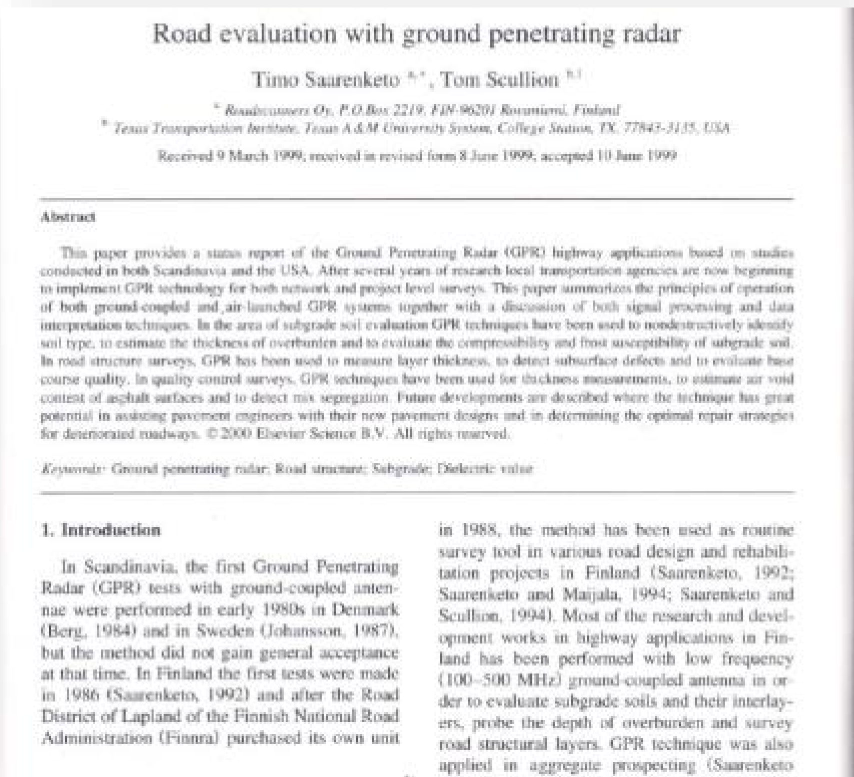
- Background
- Building the Technology
- Where We are Now?
- Future

PaveScan RDM – Background

- Provides compaction information of newly laid and compacted asphalt
- Provides continuous full coverage of a job/project
- Provides core locations
- Collects data using GPS coordinates, Station numbers and Distance
- Outputs KML maps and contours maps
- Provides density numbers for on-site density information and reporting purposes

PaveScan RDM – Background

- Road evaluation with ground penetrating radar



Road evaluation with ground penetrating radar

Timo Saarenketo [a,*], Tom Scullion [b,1]

[a] Roadscanners Oy, P.O.Box 2219, FIN-96201 Rovaniemi, Finland
[b] Texas Transportation Institute, Texas A&M University System, College Station, TX, 77843-3135, USA

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Abstract

This paper provides a status report of the Ground Penetrating Radar (GPR) highway applications based on studies conducted in both Scandinavia and the USA. After several years of research local transportation agencies are now beginning to implement GPR technology for both network and project level surveys. This paper summarizes the principles of operation of both ground-coupled and air-launched GPR systems together with a discussion of both signal processing and data interpretation techniques. In the area of subgrade soil evaluation GPR techniques have been used to nondestructively identify soil type, to estimate the thickness of overburden and to evaluate the compressibility and frost susceptibility of subgrade soil. In road structure surveys, GPR has been used to measure layer thickness, to detect subsurface defects and to evaluate base course quality. In quality control surveys, GPR techniques have been used for thickness measurements, to estimate air void content of asphalt surfaces and to detect mix segregation. Future developments are described where the technique has great potential in assisting pavement engineers with their new pavement designs and in determining the optimal repair strategies for deteriorated roadways.

Keywords: Ground penetrating radar; Road structure; Subgrade; Dielectric value

1. Introduction

In Scandinavia, the first Ground Penetrating Radar (GPR) tests with ground-coupled antennae were performed in early 1980s in Denmark (Berg, 1984) and in Sweden (Johansson, 1987), but the method did not gain general acceptance at that time. In Finland the first tests were made in 1986 (Saarenketo, 1992) and after the Road District of Lapland of the Finnish National Road Administration (Finnra) purchased its own unit in 1988, the method has been used as routine survey tool in various road design and rehabilitation projects in Finland (Saarenketo, 1992; Saarenketo and Maijala, 1994; Saarenketo and Scullion, 1994). Most of the research and development works in highway applications in Finland has been performed with low frequency (100–500 MHz) ground-coupled antenna in order to evaluate subgrade soils and their interlayers, probe the depth of overburden and survey road structural layers. GPR technique was also applied in aggregate prospecting (Saarenketo and Maijala, 1994). In early- and mid-1990s

Fig. 2. Texas Transportation Institute (TTI) GPR survey van with Pulse Radar 1.0 GHz horn antenna.

PaveScan RDM – Background

- Road evaluation with ground penetrating radar
- Using Ground Penetrating Radar and Dielectric…

TRANSPORTATION RESEARCH RECORD

Using Ground-Penetrating Radar and Dielectric Probe Measurements in Pavement Density Quality Control

TIMO SAARENKETO

Ground-penetrating radar and capacitance-based dielectric surface probe measurements are used to measure fluctuations in voids, bitumen content, or both, in newly asphalted pavements without causing structural damage. Both methods rely on the compaction of asphalt to reduce the proportion of low-dielectricity air in the material, which increases the volumetric proportions of high-dielectricity bitumen and rock and thus results in higher asphalt dielectricity values. Ground-penetrating radar enables pavement thicknesses to be measured rapidly from a moving vehicle and information on variations in pavement voids content to be collected simultaneously on the basis of dielectricity fluctuations. The results can be calibrated against real void content by material sampling or by comparison of dielectric value with voids content values determined beforehand for the same material under laboratory conditions. This means that the subcontractor can be informed quickly of any values that exceed or fall below the norms and can take immediate steps to rectify such defects. Other advantages offered by the technique are the rapidity of the measurements and the immediate availability of the results. In addition, the one measurement provides simultaneous information on pavement and base thicknesses and the quality of the latter. The dielectric probe based on capacitance measurements lends itself to use in asphalt mass proportioning examinations performed at the laboratory stage, which enables the values to be used directly for monitoring in situ pavement compaction. The advantages of the dielectricity probe are rapidity of measurement, low-cost meters, and the avoidance of radiation. Thus far, the probe has been excessively sensitive to variations in the roughness of pavement surfaces. The theory behind these research methods is discussed, the methods are described, and the results of

Ground-penetrating radar has traditionally been used to measure the thickness of pavements, initially by means of ground-coupled antennae, the use of which was hampered by the low measurement speed and changes in the properties of the antennae with fluctuations in properties of the pavement. The trend around 1990 was thus toward the use of a horn antenna, which allows repeated measurements and higher measurement speeds. Measurement and calculation methods that enable pavement surface dielectric values to be calculated have been developed in recent years for use with these antennae (1), although the technique has been used in the United States only for evaluating the transmission speed of the radar signal in pavement thickness measurements. The principle of the horn antenna technique is described in Figure 2.

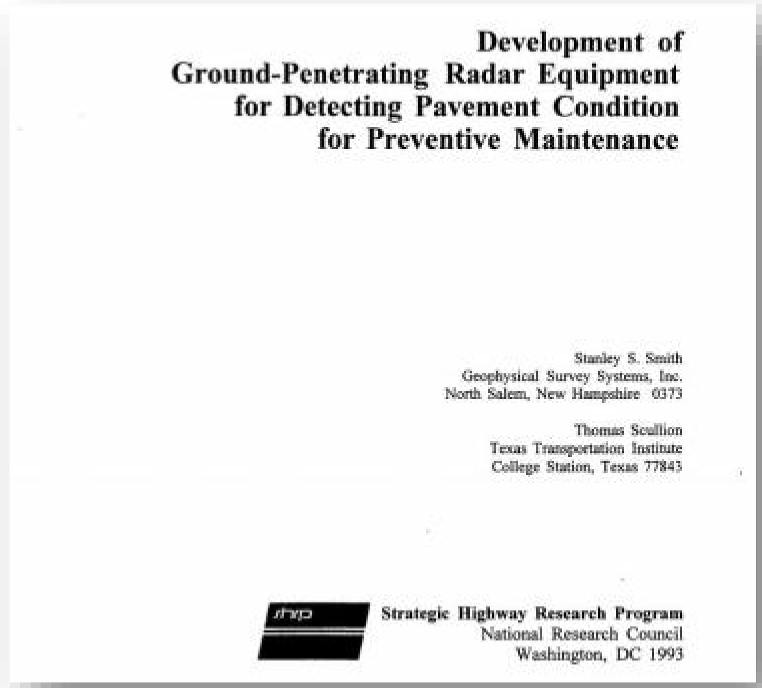
The method was tried in Finland for the first time in the summer of 1993, in a project financed by the Finnish Technology Development Centre. Multichannel, ground-penetrating radar equipment manufactured by Road Radar, Inc., of Canada was tested on experimentally surfaced pedestrian paths beside Highway 4 between Rovaniemi and Saarenkylä, which contained void spaces of different types depending on the number of times the pavements had been rolled. The results were not encouraging, however, mainly due to technical problems and the inability of the interpretation software to identify the correct reflections from the measurement data.

Measurements were continued at the Texas Transportation Insti-

PaveScan RDM – Background

- Road evaluation with ground penetrating radar
- Using Ground Penetrating Radar and Dielectric…
- Development of Ground Penetrating Radar Equipment for Detecting….

1993



Development of
Ground-Penetrating Radar Equipment
for Detecting Pavement Condition
for Preventive Maintenance

Stanley S. Smith
Geophysical Survey Systems, Inc.
North Salem, New Hampshire 0373

Thomas Scullion
Texas Transportation Institute
College Station, Texas 77843

Strategic Highway Research Program
National Research Council
Washington, DC 1993

http://onlinepubs.trb.org/onlinepubs/shrp/SHRP-H-672.pdf

PaveScan RDM – Background

SHRP2 Solution

Rapid Technologies to Enhance Quality Control on Asphalt Pavements (R06C)

GPR, one of two ways to evaluate asphalt pavements during construction

- Measures uniformity and potential defect areas in asphalt pavements during construction.
- Offers real-time testing of potentially 100 percent of the pavement area.

PaveScan RDM – Building the Technology

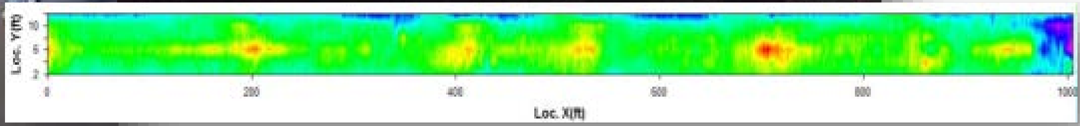
Prototype

- TTI – 2012

PaveScan RDM – Building the Technology

Prototype

- TTI – 2012
- Virginia with TTI – 2013
  - Charlottesville
  - Fredericksburg



PaveScan RDM – Building the Technology

Prototype

- TTI – 2012
- Virginia with TTI – 2013
  - Charlottesville
  - Fredericksburg
- University of Minnesota - 2015

PaveScan RDM – Where We are Now

On-site information, Reports

PaveScan RDM – Where We are Now

Output

PaveScan RDM – Where We are Now

Configure valid data range limits to discard readings such as manhole covers and wet asphalt areas

Export options for both CSV and KML Files of defect area and linear segments

Specify minimum size areas that have compaction below a specified levels. These areas could be fixed if necessary

Continuous linear segments with compaction below a specified level and apply to compaction along joints

PaveScan RDM – Future

- Vehicle Mounted Systems
- Collection Options
- Reporting Options
- On-site Evaluation Options
- Output Options

PaveScan RDM – Conclusion

Questions?

Thank You