Non-Destructive Infrastructure Evaluation Using GPR

Image Your World
COMPANY VISION

GSSI is an internationally respected corporation known for our technological advancements in the geophysical, archaeological, forensics, infrastructure, public works and transportation industries. We serve our clients with technical expertise, unsurpassed customer support and training facilities, and superior products.

GSSI products are distributed through a series of application specialists and representatives worldwide to five primary markets-concrete inspection, utility mapping and locating, road and bridge deck evaluation, geophysics and archaeology.

GPR LEADER FOR THE TRANSPORTATION INDUSTRY

GSSI has been developing innovative products to meet the needs of the transportation industry for over 30 years. We have developed products that can provide layer thickness information, bridge deck deterioration information, rebar QA/QC information, tunnel condition information (i.e. voids), and now, density information of newly paved and compacted asphalt.
NON-DESTRUCTIVE ASPHALT DENSITY TESTING EQUIPMENT

The PaveScan® RDM is a continuous full-coverage asphalt density assessment tool that provides accurate real-time measurements to ensure pavement life and quality. This system is ideal for uncovering inconsistencies that occur during the paving process, including poor uniformity and significant variations in density. By detecting these problems, PaveScan helps avoid such premature failures as road raveling, cracking, and deterioration along joints.

PaveScan automatically measures the dielectric value to identify anomalies in real-time. In addition, the dielectric values can be used as a means to correlate percent voids and density in new pavement. The innovative technology enables users to obtain critical density data for QA/QC of new pavements.

<table>
<thead>
<tr>
<th>MAX DEPTH</th>
<th>SENSOR FREQUENCY</th>
</tr>
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<tbody>
<tr>
<td>Surface Only</td>
<td>2 GHz</td>
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<table>
<thead>
<tr>
<th>WEIGHT</th>
<th>STORAGE CAPACITY</th>
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<tbody>
<tr>
<td>32.2-36.7 kg (71-81 lbs) (cart dependent)</td>
<td>128 GB</td>
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<table>
<thead>
<tr>
<th>DATA DISPLAY MODES</th>
<th>ACCESSORIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Line Graph, Data Contour Map or Histogram Distribution</td>
<td>Upgrade kit from 1 to 3 sensors</td>
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</table>
PAVESCAN FEATURES

Innovative Technology  PaveScan RDM offers an easy and affordable assessment tool to non-destructively determine asphalt dielectric during application. This system is ideal for uncovering inconsistencies that occur during the paving process, including poor uniformity and significant variations in density.

Groundbreaking Solutions  PaveScan RDM is the premier asphalt test method to identify areas of non-conformity in new pavement. It can be deployed with two different survey methods; utilizing the dielectric values or percent voids/density. There are no site hazards or need to close off work areas as is the case with nuclear gauges/radioactive alternatives.

Data Visualization  From technician to engineer, the PaveScan RDM is easy to operate. With seamless GPS integration, real-time onscreen data output, and export options, this system is ideal for government transportation agencies and paving contractors alike.

TYPICAL USES

Non-destructive asphalt compaction testing
Quality assurance/quality control of new pavements
Determining pavement non-conformity

FCC, RSS-220 and CE Certified
PAVESCAN DATA

Real-time Survey: Dielectric Display  PaveScan automatically calculates the dielectric measurement of new pavement. The variation in dielectric values of an asphalt mix are correlated with variation in asphalt void content. Consequently, PaveScan identifies the outliers and anomalies in compaction, allowing the users to determine the conformity of new pavements and appropriate areas to cores.

Gathered Results: Percent Void Display or Density  PaveScan provides users a full coverage survey method to determine asphalt integrity by correlating with percent voids and density. To map the percent void content, users first determine areas to core using the dielectric measurements. After the cores are evaluated, the percent void content can be back-calculated for the survey area and displayed on the PaveScan system, or output via a .csv or KML file.
During data collection, this screen shows lower density (right antenna) near the shoulder joint.
Play back the data on-site to review the project. The “dots” represents recommended coring locations.
ASPHALT COMPACTION INFORMATION - OUTPUT STATISTICS SCREEN

This screen shows the statistics of the data collected:

- Distance Covered
- Median Value
- Min Value
- Max Value
- Standard Deviation
- Histogram 5%
The PaveScan system exports .csv files for importing to any 3rd-party software, as well as exporting KML files. This shows a job with low density on bridges.
COMPLETE GPR SYSTEM FOR ROAD INSPECTION

The affordable RoadScan™ 30 system provides users with an effective tool for quickly determining pavement layer thickness. RoadScan 30 can collect data densities not obtainable using other labor-intensive methods. RoadScan data can be acquired at highway speeds, which eliminates the need for lane closures and provides a safer working environment.

The RoadScan Advantage

The RoadScan system, with available accessories, provides all the components necessary to perform a GPR road inspection. The SIR® 30 control unit is a configurable multi-channel system, allowing users the ability to operate one to four antennas simultaneously at high speeds.

New and improved smart antennas simplify set-up with automatic identification to the SIR 30. Customize the system for your specific needs, configure the RoadScan 30 with your choice of accessory antennas.

<table>
<thead>
<tr>
<th>MAX DEPTH</th>
<th>ANTENNA OPTIONS/ANTENNA FREQUENCY</th>
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<tbody>
<tr>
<td>91 cm (3 ft)</td>
<td>2 GHz, 1 GHz</td>
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<table>
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<tr>
<th>WEIGHT</th>
<th>STORAGE CAPACITY</th>
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<tr>
<td>49.8 kg (110 lbs)</td>
<td>250 GB</td>
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<table>
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<tr>
<th>OPTIONAL SOFTWARE</th>
<th>ACCESSORIES</th>
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<tbody>
<tr>
<td>RADAN 7, RADAN 7 RoadScan Module</td>
<td>Antenna vehicle front mount, Antenna vehicle trailer mount</td>
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</table>
ROADSCAN FEATURES

Non-destructive Pavement Testing  The RoadScan can quickly collect pavement layer thickness data. The system acquires data at highway speeds, which eliminates the need for lane closures and provides a safer working environment.

Quantifiable Data  Ground penetrating radar offers users a quick and effective way to determine pavement layer thickness. GPR can evaluate base and sub-base layers with data collection densities not obtainable by traditional labor-intensive methods, such as coring.

Deliver Pavement Evaluation Results  Data can be easily exported as ASCII output files for simple data transfer to other software programs. Or migrate data results as Google Earth™. kml file for enhanced visualization.

TYPICAL USES

NDT road evaluation
Measure pavement thickness
Evaluate base and sub-base conditions
Measure asphalt prior to milling operations
Determine areas to core

FCC, RSS-220 and CE Certified
ROADSCAN FLEXIBILITY

Using the SIR 30 as the foundation of the RoadScan system, one can obtain additional information with accessory antennas. Many RoadScan clients elect to use the 900 MHz or 400 MHz antenna to obtain additional information on base or sub-base layers.

Base and Sub-base Layers
400 MHz data showing base and sub-base layers.

Subsurface Structure
900 MHz data showing subsurface structure with several layers.
DATA SHOWING A SUB-BASE TURNING INTO A CONCRETE SUB-BASE

Everything at the beginning of the file is more likely NOT concrete. Here are the reasons:

1. We assume the top layer(s) is asphalt. Look a label A. Note the reverse polarity (black is the dominate color). This means the dielectric went lower. In normal circumstances, concrete is normally a higher dielectric than asphalt. So you would expect to see normal polarity (white is the dominate color). When there is an interface between asphalt and concrete, you would expect to see NORMAL POLARITY.

2. Another reason is label B. That interface is way too bright. The bottom of concrete tends to start looking like the sub-base below it. So the interface there should be dim.

3. So in conclusion, though it may be asphalt or some sort of sub-base material, it is more likely NOT CONCRETE.

Everything from the vertical line to the end of the file is more likely concrete. Here are the reasons:

1. We assume the top layer(s) is asphalt. Look a label C. Note the normal polarity (white is the dominate color). This means the dielectric went higher. Concrete is normally a higher dielectric than asphalt. So you would expect to see normal polarity (white is the dominate color).

2. Another reason is label D. That interface is dim. The bottom of concrete tends to start looking like the sub-base below it. So the interface there should be dim.

3. So in conclusion, this is more likely concrete.
Concrete Begins

Unknown, but not concrete
The BridgeScan™ is a complete, affordable GPR system that provides an effective tool for quickly determining the condition of aging bridge decks, parking structures, balconies and other concrete structures. This system is also used to obtain accurate concrete cover depth on new structures.

**The BridgeScan Advantage**

The American Society of Civil Engineers reported that as of 2016, the average bridge in the U.S. is 43 years old and an increasing number of bridges will soon need major rehab or retirement (ASCE, 2017). Traditional bridge deck inspection methods, like hammer soundings and chain dragging, rely on a person to interpret acoustical feedback to determine good and bad areas of concrete.

The application of BridgeScan provides an accurate condition assessment of a bridge deck as well as other reinforced concrete structures.

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<thead>
<tr>
<th>MAX DEPTH</th>
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<tr>
<td>10 m (35 feet)</td>
<td>350 MHz</td>
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<tr>
<th>WEIGHT</th>
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<tr>
<td>15.4 kg (34 pounds)</td>
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<tr>
<th>STORAGE CAPACITY</th>
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<tr>
<td>64 GB</td>
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<tr>
<th>OPTIONAL SOFTWARE</th>
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<tr>
<td>RADAN 7 for UtilityScan, RADAN 7</td>
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<tr>
<th>ACCESSORIES</th>
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<tbody>
<tr>
<td>Transit case, Battery booster kit, Sunshade, Model 656 rugged cart</td>
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BRIDGESCAN FEATURES

Acquire Data  BridgeScan can identify areas of deterioration inside reinforced concrete bridges. The GPR system makes overlay thickness and concrete cover depth measurements easy to achieve and automatically accommodates for the bridge skew angle.

Cost Effective Bridge Surveys  With BridgeScan, repair costs can be estimated accurately, saving project time and money for Departments of Transportation and pavement contractors.

Record Results  Data can be easily exported as ASCII .csv output files for simple data transfer to other software programs. Or, migrate data results as a Google Earth™.kml file for enhanced visualization.

TYPICAL USES

Bridge deck condition assessment
Void detection and location
Measure concrete thickness
Inspection of other reinforced concrete structures

FCC, RSS-220 and CE Certified
BRIDGESCANN FLEXIBILITY

Concrete Scanning and Inspection
Determine the condition of concrete, parking structures, or balconies with the addition of a small cart and software options.

Utility Locating and Mapping
Locate the depth and position of metallic and non-metallic pipes in real time using our 400 MHz or 350 HS antennas and cart options.
The BridgeScan system output data to a 3rd party contour mapping software. This shows areas of more deterioration (red, yellow..) and less deterioration (blue, light blue..)
This data shows the correlation between the raw data (very dim rebar) and the contour map showing deterioration areas.
COMPLETE GPR SYSTEM FOR CONCRETE INSPECTION

The StructureScan™ Mini XT is GSSI’s newest generation of our very popular all-in-one GPR systems. The StructureScan Mini XT offers a 2.7 GHz antenna for superior target resolution and can reach depths of up to 50 cm (20 inches). This system is designed with the option for users to add accessories and tailor the unit to specific applications.

The Mini XT Advantage

The StructureScan Mini XT is ideal for locating the position and depth of metallic and non-metallic objects in concrete structures, including rebar, conduit, post-tension cables, voids and service utilities. In addition, the Mini XT can help identify structural elements including pan deck, concrete cover, and slab thickness.

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<thead>
<tr>
<th>MAX DEPTH</th>
<th>ANTENNA FREQUENCY</th>
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<tr>
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<tr>
<td>RADAN 7 for</td>
<td>Palm XT Antenna,</td>
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<tr>
<td>StructureScan Mini</td>
<td>LineTrac XT,</td>
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<td></td>
<td>Accessory Pole</td>
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STRUCTURESCAN MINI XT FEATURES

High Frequency, High Resolution Concrete Antenna The StructureScan Mini XT employs a new 2.7 GHz antenna that provides excellent near surface resolution while also maintaining the ability to resolve deeper targets.

Enhanced Data Visualization Get first-in-class data visualization with a state-of-the-art 6.5 inch HD touchscreen user interface and several operation modes designed for beginner to advanced use.

Operation modes include: QuickScan to collect 2D data with the push of one button, ScanMax to access advanced options, and Scan3D for complex reinforcement environments.

Accessories for Advanced Capabilities Incorporated into the design are three accessory ports that allow the use of add-on accessories including the Palm XT, LineTrac XT, and an extension pole.

TYPICAL USES

- Find Rebar, Post Tension, Conduits, and Non-metallic Objects
- Measure Slab Thickness and Void Location
- Concrete Scanning and Imaging
- Condition Assessment
- Structure Inspection

FCC, RSS-220 and CE Certified
ACCESSORIES

2300 MHz – Palm XT Antenna

Palm XT is a small form factor GPR antenna that gives users unprecedented access in tightly spaced areas and enables easy overhead scanning. This 2300 MHz Palm XT antenna offers superior depth penetration and resolution with three data collection modes.

- **Standard**  Requires no special set up, and is ready for plug-and-play operation
- **Cross Polarization**  Highlights non-metallic objects such as PVC while de-emphasizing metallic objects like rebar and wire mesh
- **Side Car**  Transitions the survey wheel to the side of the antenna and allows it to fit into smaller spaces

**LineTrac XT**

LineTrac XT adds the ability to detect AC power and induced RF present in conduits. This accessory combines radar data with a magnetometer, which allows the LineTrac XT to detect low amplitude AC signals associated with difficult to locate conduits.

Features include:
- Seamless fusion with GPR data
- Aids in target discrimination
- Detection at 50/60 Hz
- Rugged, IP-65 rated enclosure
COMPACT GPR SYSTEM FOR UTILITY LOCATING

The UtilityScan® provides a rich feature set that redefines the level of performance available in a low cost utility locating system. Its compact size makes it extremely portable and easy to maneuver in tight survey areas. The simple operation is ideally suited to meet the needs of service providers, engineering contractors and state and local municipalities. Best of all, the breakthrough technology designed into UtilityScan results in high quality data sets that are second to none.

The UtilityScan Advantage

Reliable mark outs, paper records, and as-builds on buried utilities are rare. Damaging utilities can be costly, leading to cost overruns, project delays, and safety concerns. Recent specifications from ASCE and PAS 128, require that contractors and municipalities have accurate and up-to-date information on active and abandoned utilities. UtilityScan can quickly identify the location and depth of service utilities such as gas, communications, and sewer lines - as well as other metallic and nonmetallic targets including underground storage tanks and PVC pipes.

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UtilityScan Features

Compact and Portable  The UtilityScan is incredibly compact. Weighing in at only 34 pounds, UtilityScan can collapse to fit in the back of a small vehicle or even in an airline overhead compartment. For survey conditions in rough terrain, the user can remove the handle and wheels and place the capsule into the (optional) rugged cart.

Premium Features, Entry Level Price
UtilityScan is based on GSSI’s patented HyperStacking technology, which provides excellent near-surface resolution and increased depth penetration in all soil types. A new wireless antenna eliminates the need for cabling, resulting in a system that can withstand challenging field conditions.

Advanced Capabilities  UtilityScan can be provided with LineTrac power detection module. This module is designed to identify and trace the precise location of underground electric and RF induced utilities. Another feature of this system is the integrated GPS and built in GPS adapter for an additional GPS pole (customer provided).

Typical Uses

Scan utilities – metallic and non-metallic
Locate water lines
Detect voids and underground storage tanks (USTs)
Identify soil and foundation characteristics
Locate shallow objects for archaeology

FCC, RSS-220 and CE Certified