

JERSEY DOT'S

"Turning Problems into Solutions"



Tech Brief

Evaluation of Seismic Pavement Analyzer for Pavement Condition Monitoring

FHWA-NJ-2002-012

May 2002

OBJECTIVE: BEST PERFORMING PAVEMENTS FOR LEAST MONEY

- The interstate highway system is getting older and has reached a point where significant financial resources are needed for their repair and maintenance
- Similar situation can be found in state and local roads, with often fewer financial resources available for such purposes.
- Safety of the large volume traffic on New Jersey's roadways can be best assured through well performing pavements. On the other hand, such traffic conditions demand minimum interruptions due to repeated lane closures for their repair.

SOLUTION: PRECISE AND COMPREHENSIVE PAVEMENT EVALUATION

- Economical pavement management can be conducted only if there are means for their comprehensive evaluation, identification of defects, and continuous condition monitoring.
- Of special interest are procedures and devices that will enable detection of distress precursors in their early stages, and thus minimize the need for rehabilitation and reconstruction through regular maintenance.

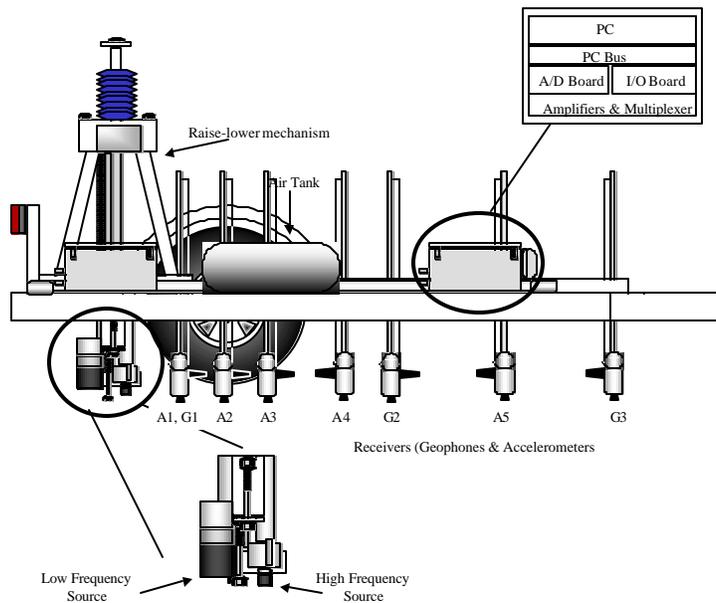
We set out to evaluate the Seismic Pavement Analyzer's (SPA) ability to comprehensively evaluate pavements and to detect various types of defects.

HERE'S WHAT IT LOOKS LIKE...

Seems to be just an ordinary trailer. However, there is quite a lot of ingenuity, knowledge and skills built in it.



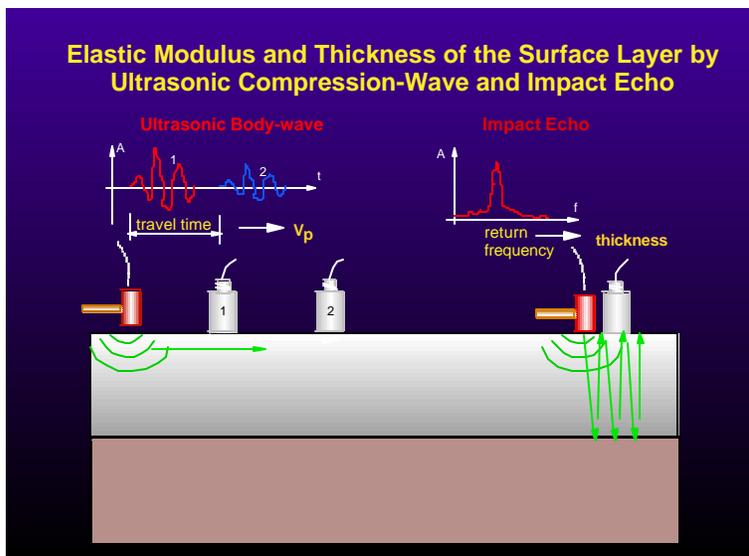
The SPA, is a device for nondestructive evaluation of pavements developed at the University of Texas at El Paso under the Strategic Highway Research Program (SHRP). It is manufactured by Geomeia Research and Development, Inc., El Paso, Texas. The SPA was designed and constructed with the sole objective of having a device that can detect distresses in pavements at their early stages.



THIS IS WHAT IT CAN DO

- Pavement profiling in terms of elastic moduli and layer thicknesses
- Detect voids or loss of support beneath the concrete pavement slab
- Detect and characterize delaminations in concrete pavements and bridge decks
- Detect problems in the subgrade
- Provide data for quality assurance/quality control

BUT HOW CAN IT DO ALL THIS???



To conduct these tasks, the SPA relies on five seismic and ultrasonic methods. Two ultrasonic methods, Ultrasonic Compression waves (**UBW**) and Ultrasonic Surface waves (**USW**), are used in material characterization of the paving layer. The impact echo (**IE**) method is used to measure the paving layer thickness or to detect defects in the paving layer, e.g. delaminations in concrete slabs.

Spectral Analysis of Surface Waves (**SASW**) method is the core of the pavement profiling capability of the SPA. Finally, the Impulse Response (**IR**) technique is used in detection of problems in the subgrade and detection of voids and loss of support under rigid pavements. The SPA provides the pavement engineer with a sophisticated tool to effectively manage maintenance and assist in the prioritization of roadways for repair and rehabilitation.

AND, HERE'S WHAT WE DID...



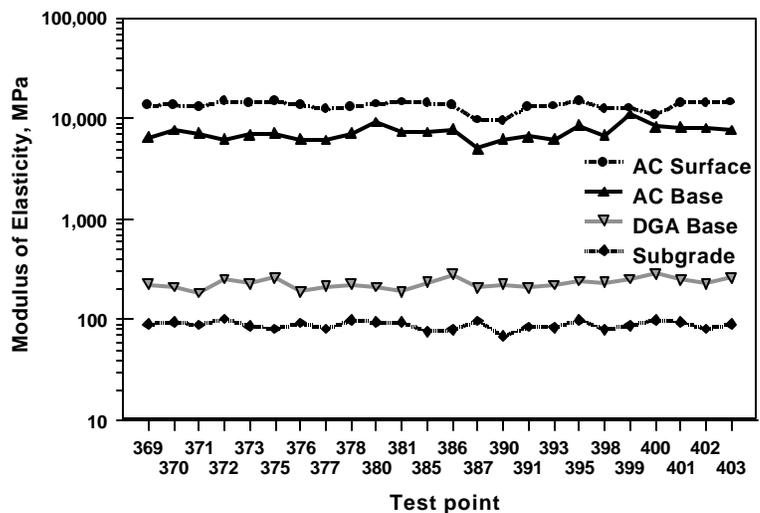
The device was field tested on a number of roadway sections throughout New Jersey. The first and most important objective of the testing program was to evaluate the ability of the SPA to profile pavements. This is important for a number of reasons: to define the actual pavement structure, to monitor changes in pavement layers, to evaluate characteristics and performance of recycled materials in pavements, etc. The second objective was evaluation of the ability of the SPA to detect defects in

pavements. The testing program concentrated on the detection of voids or loss of support, and evaluation of joint load transfer in rigid pavements.

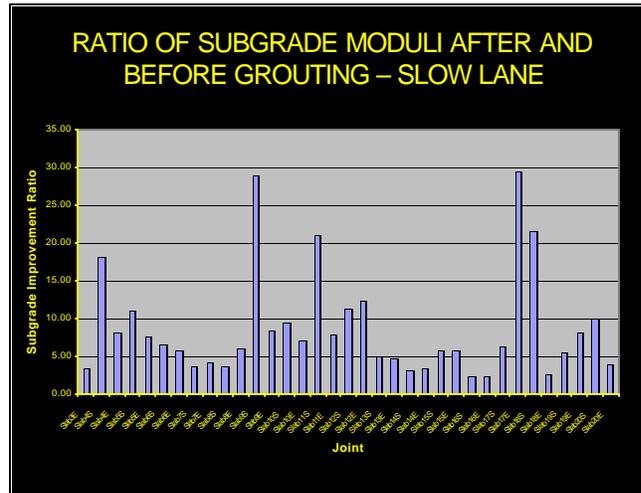
Testing required about 1 minute per point. During this period a pair of pneumatic hammers generate a number of impacts and series of sensors collect enough data for evaluation by the five seismic and ultrasonic techniques. Some of the data reduction procedures are fairly simple and are either fully automated or do not require extensive operator training and intervention. Some of the techniques, in particular the SASW, require data reduction and interpretation in the office.

HERE'S WHAT WE CAME UP WITH...

Results from a number of pavements demonstrate SPA's ability to evaluate, or at least estimate, elastic properties and the thickness of distinctive pavement layers. The accuracy of evaluation is high for the paving layer and decreases with depth. The least accurate evaluation is of the thickness and properties of relatively thin base pavement layers. Impulse Response came out to be the most robust technique for subgrade evaluation.



Voids or loss of support under rigid pavements can be easily detect by the Impulse Response. As an example, joint undersealing program was conducted on a section of Rt. 1287S. The effectiveness of the polyurethane foam undersealing was evaluated and confirmed by the SPA testing. The SPA and IR technique were even able to identify sections where the foam injection caused partial jacking of concrete slabs.



THE BOTTOM LINE...

The Seismic Pavement Analyzer (SPA) evaluated in this study proved to be an effective tool for pavement evaluation with respect to elastic modulus profiling and detection of defects. However, we also noted a number of improvements that can be made to increase the accuracy and speed of testing, and simplify data interpretation, like:

- incorporation of automated data interpretation procedures based on numerical simulations and neural network models, and
- upgrade of the existing software to Windows platform, that will provide more flexible and user friendly environment.

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A final report is available online at <http://www.state.nj.us/transportation/research/research.html>

If you would like a copy of the full report, please FAX the NJDOT, Bureau of Research, Technology Transfer Group at (609) 530-3722 or send an e-mail to Research.Bureau@dot.state.nj.us and ask for:

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