



**Johnson | Loading
Impluse | Systems**

Falling Weight Deflectometer Experts



Falling Weight Deflectometers

JILS FMI

Gary Sanati
President



Johnson Impulse Loading Systems

Falling Weight Deflectometer Experts

Truck FWD w/GPR





Foundation Mechanics, Inc Johnson Impulse Loading Systems

- Gary Sanati – Owner/President
- 1987-91 - Graduate UCSB School of Mechanical Engineering
- 1991-99 - EG&G Structural Kinematics and Wyle Laboratories
 - Western Wyle Labs Test Division
- 1999-Present – Purchased Foundation Mechanics, Inc (FMI), John Impulse Loading Systems (JILS) from Bill Johnson
 - Bill Johnson formerly Wyle Labs and currently retired in the Northwest USA
- Huge advancements in JILS production lines such as the integrated FWD and GPR pavement test vehicle



JILS – Improvement by Collaboration

- Dr. Min Chen – Direct Consultant to JILS
 - Programming specialist
 - Ph.D., Mathematics and MS Computer Sciences
- Infrasense
 - Kenneth R. Maser, Ph.D., PE
 - Founded 1987
 - Body of work included 49 US states, Canada, Europe, Middle East, Asia
 - 15 Million square feet of bridge decks (850), 10,000 lane miles of pavement.
- GSSI - Geophysical Survey Systems, Inc
 - Robert Parillo
 - Research and development in GPR since 1974
- Adsys Controls, Inc
 - Brian Goldberg - Founder
 - System integrators, signal processing, dynamic modeling, imaging systems, advanced precision control systems, automated test systems

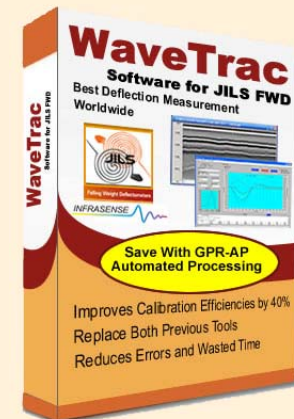
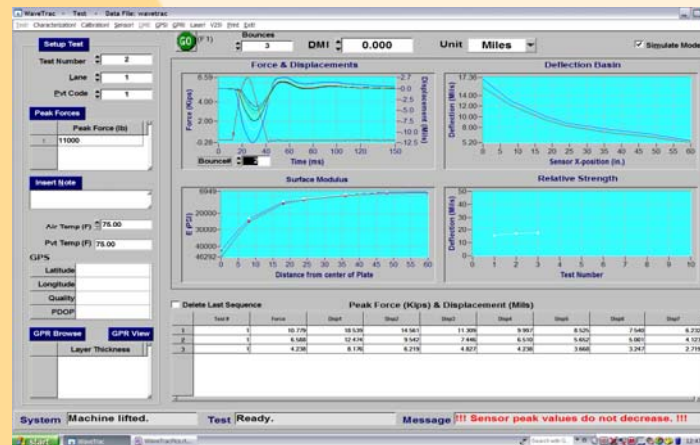


Our Mission

- Though our commitment to quality and efficiency we aim to improve quality and reduce costs of pavement management for its communities, states and nations around the world.

Meeting up to our Mission

- Mechanical engineers of FWDs and GPRs
- Advancing software implementations through research and development





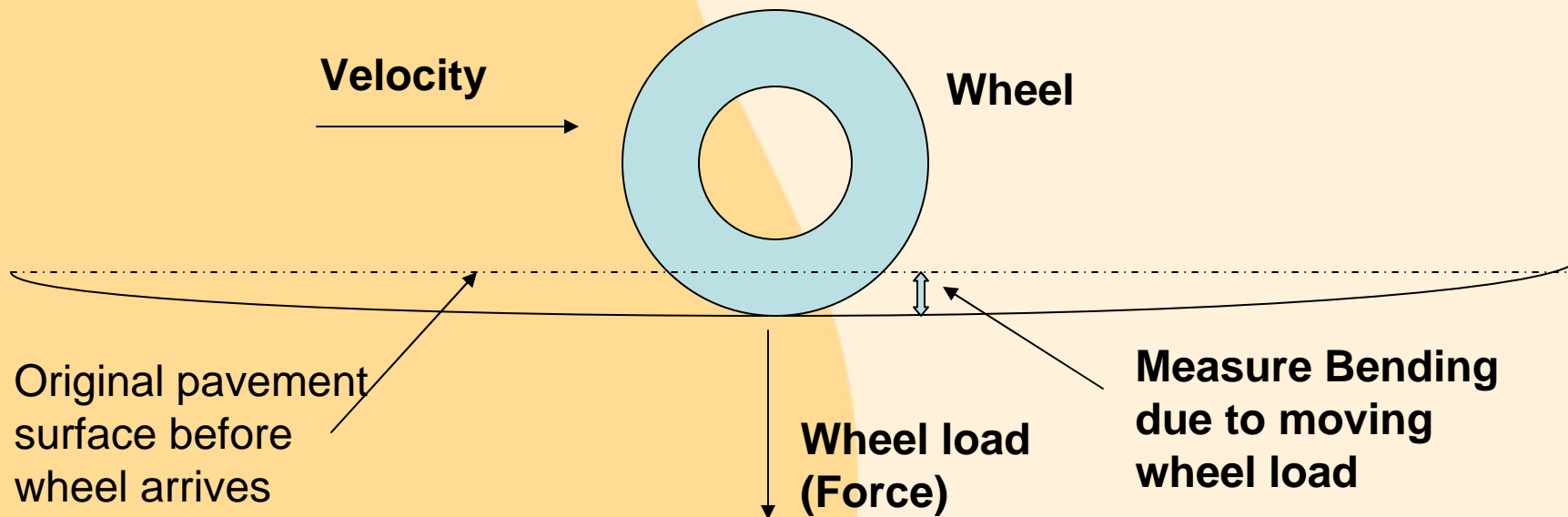
Significant Advancements with Software

- Geophone Sensor
- Bounce Analysis
- Relative Strength
- Automated Processing (GPR)



Geophone Sensor

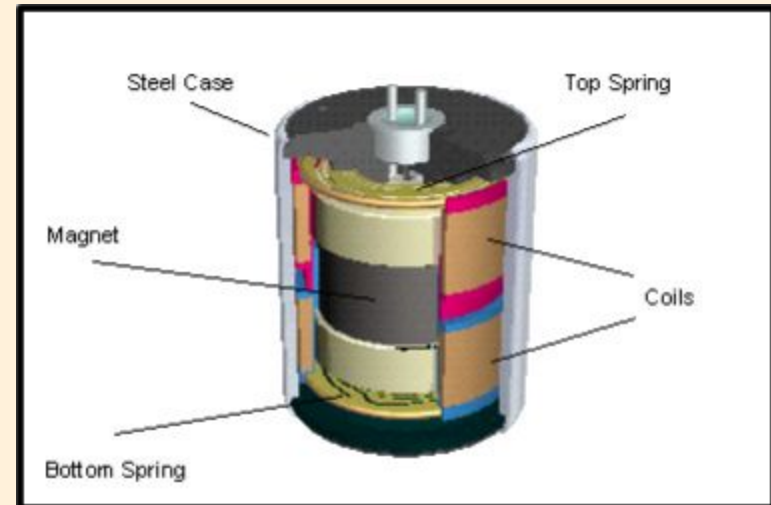
- Measures the movement of the ground pavement when a load is applied





The JILS Geophone

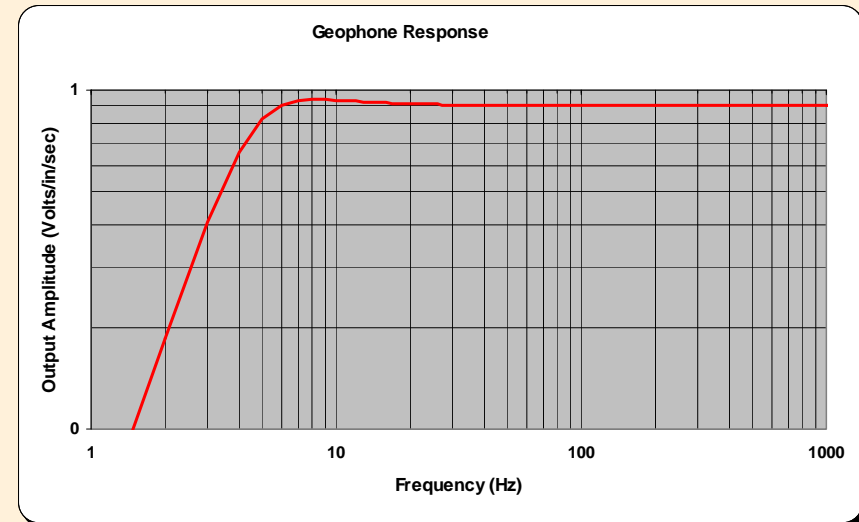
- Geophone best choice of many options
- Geophone converts vibrations into voltage which can then be measured
- Power source is not required
- Amplification is not required
- Highly reliability
- Low sensitivity to temperature change
- Low sensitivity to high tilt angle
- High performance geophone
- Very low distortion spring





Geophone Response

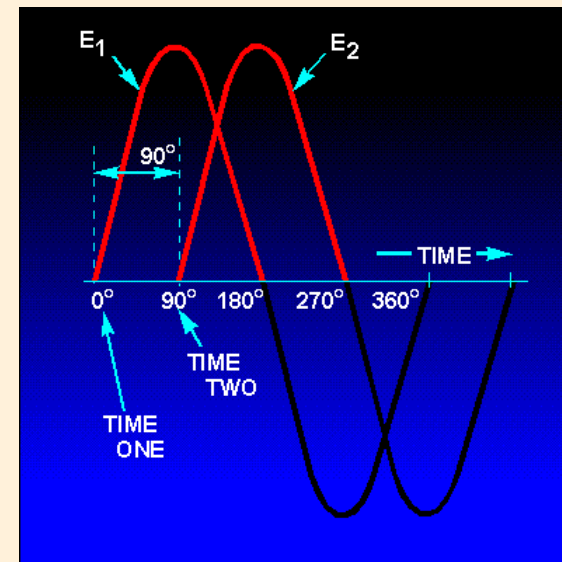
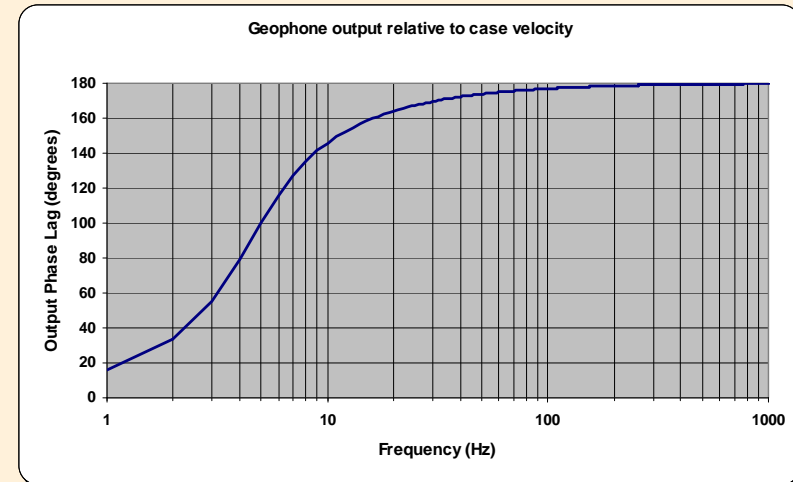
- Different frequencies (vibration-cycles per second) give different responses
- Typically geophones measure velocity not ground motion
- We had to develop this technology to work in this application
- At low frequencies the geophone rolls off.
- This can be corrected





Geophone Phasing

- Phasing means that the coil and case are not moving together.
- Phasing adds complexity to the conversion
- Top graph shows a need for phase correction
- Bottom graph shows two time domain signals out of phase





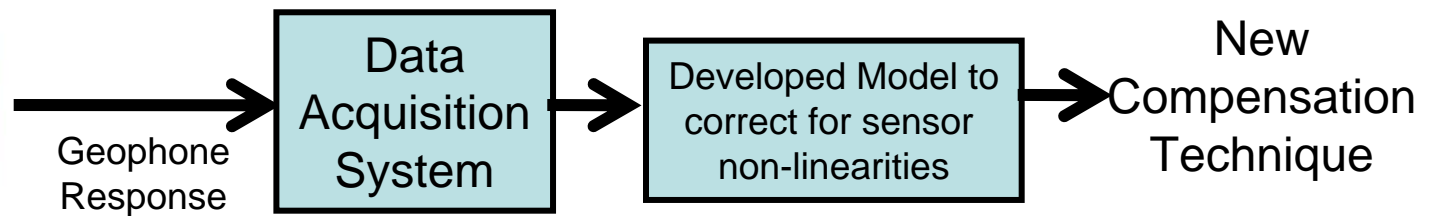
Geophone Correction Process

- Shaker (vibration tester)
- Collect/measure geophone data
- Develop a model to make the needed corrections
- New compensation technique is obtained

Geophone Process



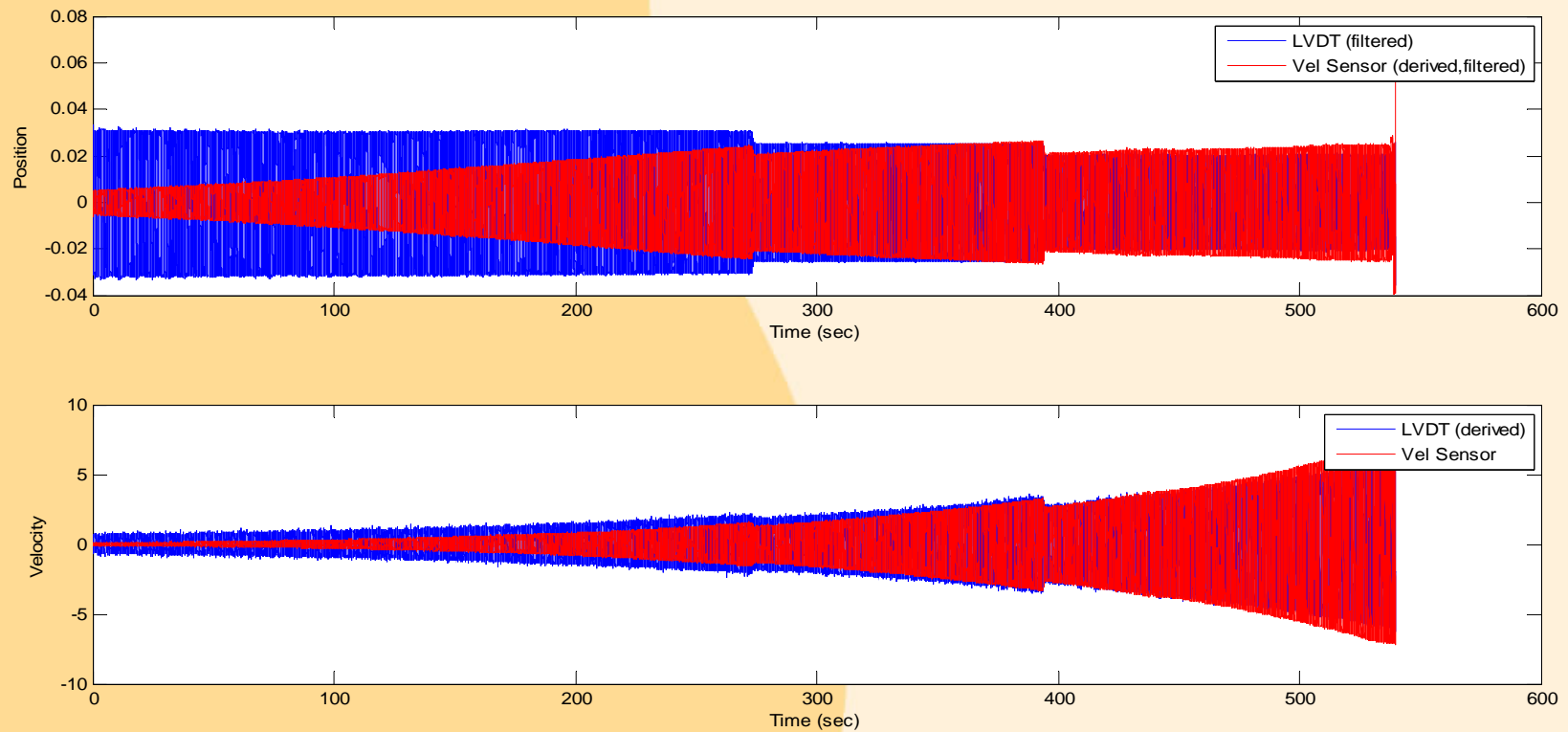
Vibration Tester





Measuring Ground Motion

- Shows sine sweep data of the LVTD vs. Geophone





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Intellectual Process

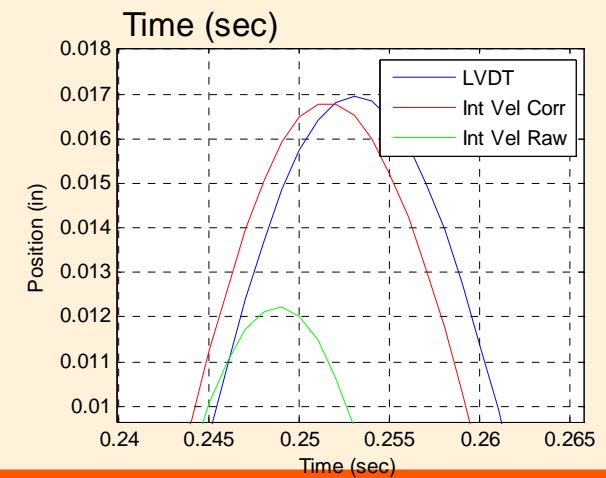
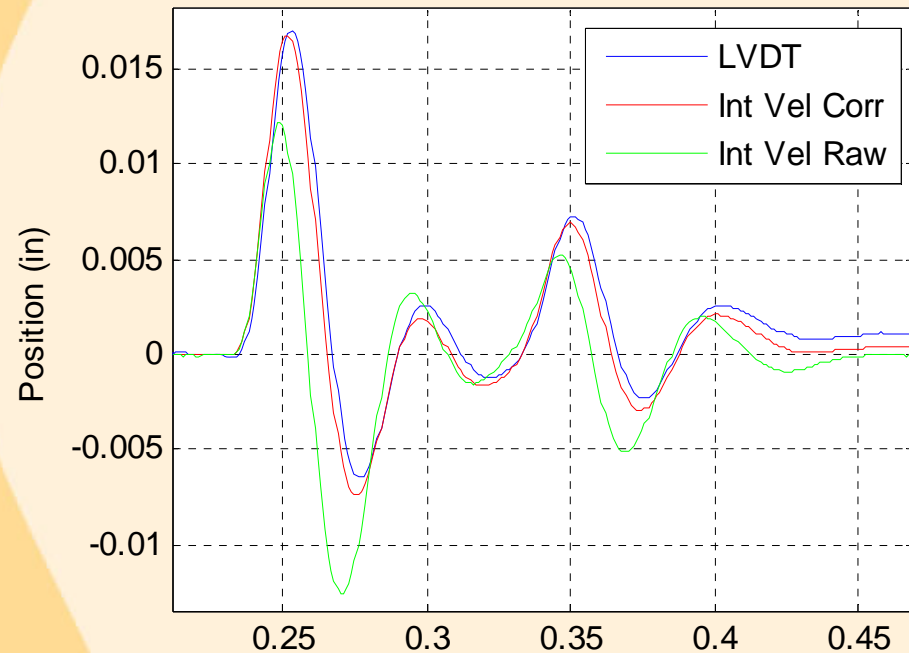
- Dual test measuring
- Accelerometer and LVTD
- Geophone ground measurement was possible





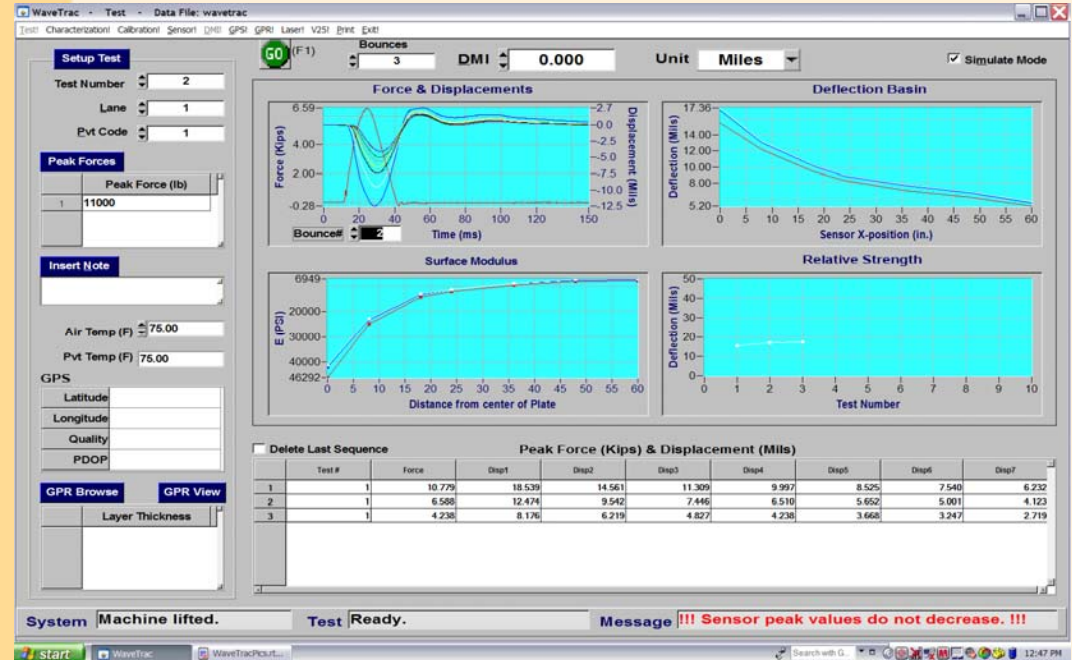
- Through the dual testing the needed corrections were found as shown here by the red line.

Impulse Verification



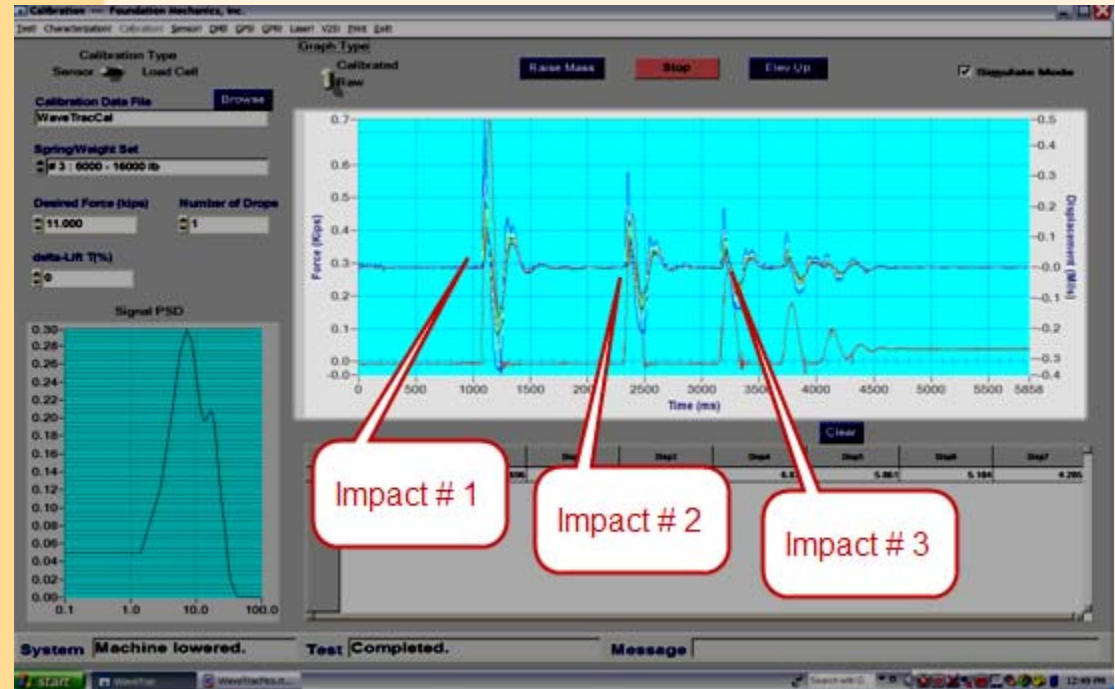
The Bounce Method

- Collects and analyzes data during the bounce portions of each drop
- Uses proprietary logic and algorithms that makes subsequent bounce data reliable and as useful as primary drop data



How it Works

- Raw data displayed here demonstrates the accuracy of each impact recorded during just one drop of which can be seen in the graph through the flattening of the boundary condition before each impact.
- With three qualifying impacts collected during each drop technicians are able to eliminate on average two or more additional drops found to be standard in conventional practices
- Network level testing can be accomplished much faster using this method while maintaining project level accuracies

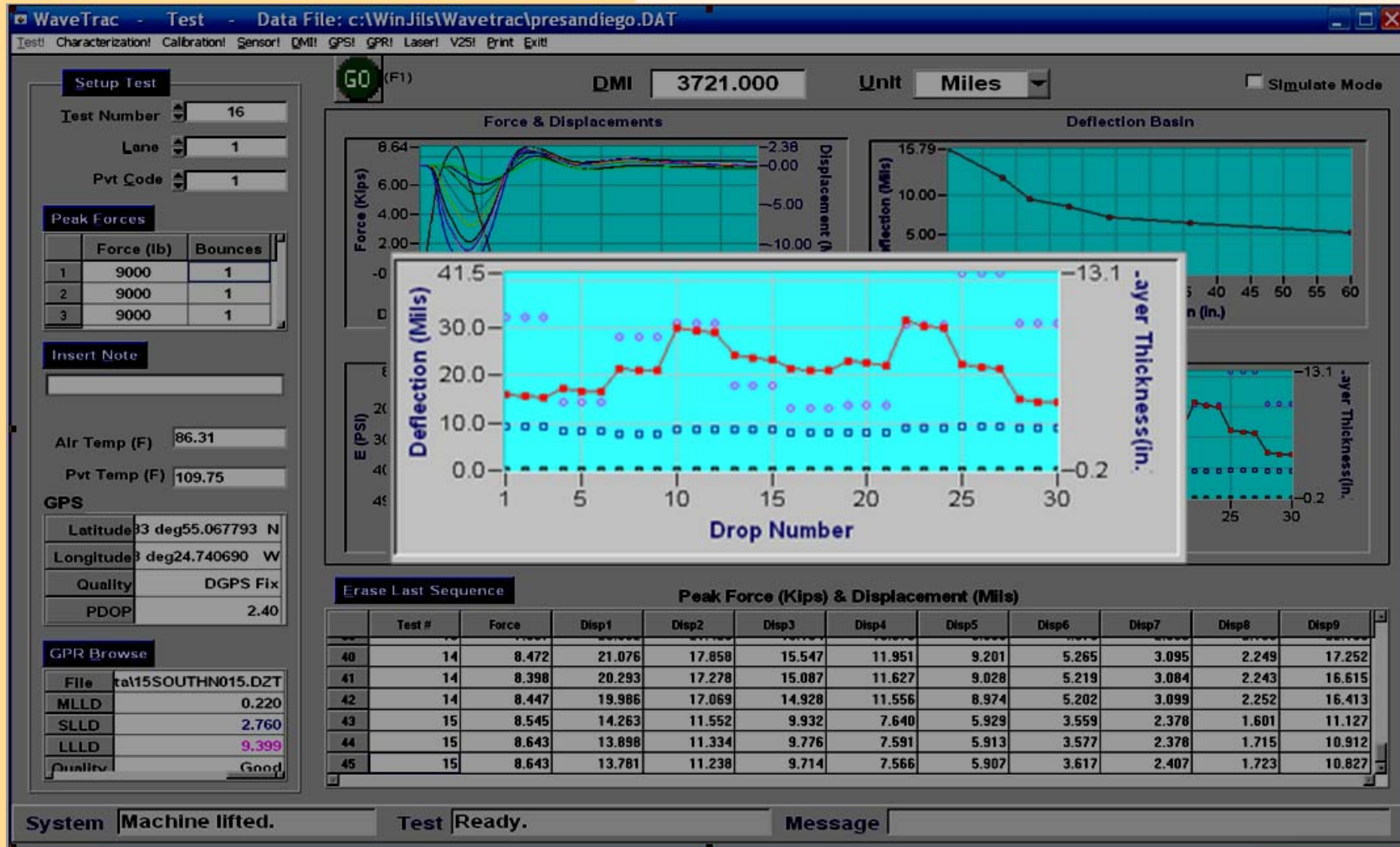




Relative Strength Analysis

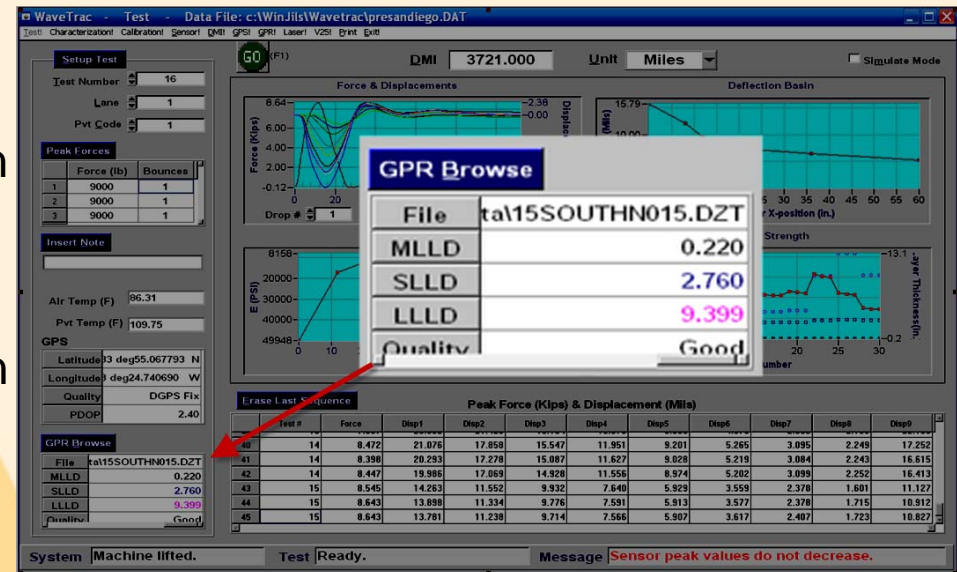
- Was created to better support the design process
- Changes in the structure can be quickly identified
- RSA gives design engineers the information they need to do their analysis of FWD data by providing data that maps the structure by section
- Empower field operators to make informed decisions to take additional measurements on-the-fly

Relative Strength Graph



GPR-AP (Auto Processing)

- GPR-AP gets layer depths and thickness information automatically at every test location in real time.
- Eliminates the need for manual GPR processing.
- Obtain FWD and GPR data sets in less than 30 seconds.
- Ability to see where structural changes occur in real time
- Ability to pinpoint where coring tests are needed on the fly
- Dr. Ken Maser of Infrasense and JILS developed this algorithm specifically for the JILS Integrated FWD and GPR product line.
- Now available in WaveTrac

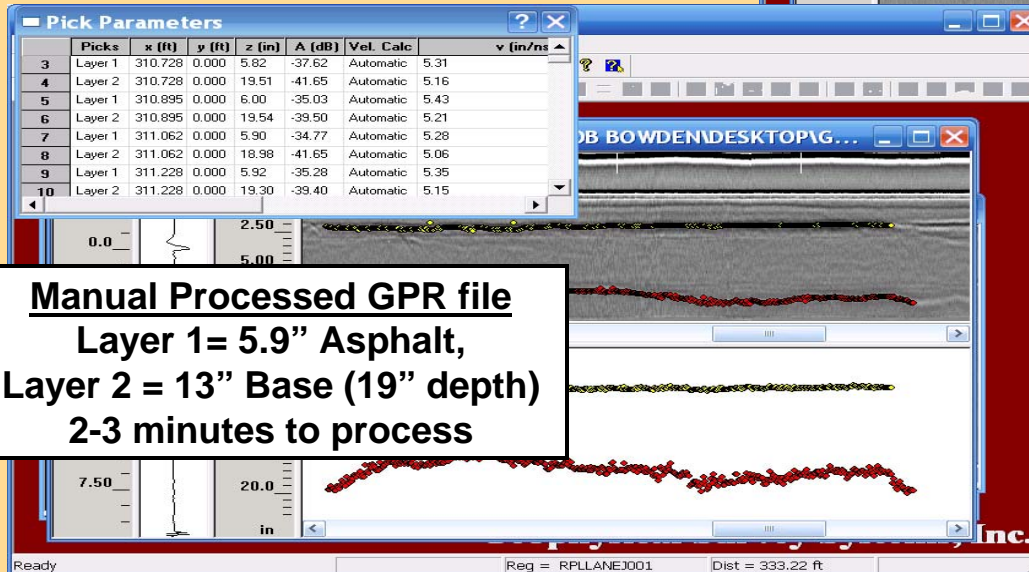
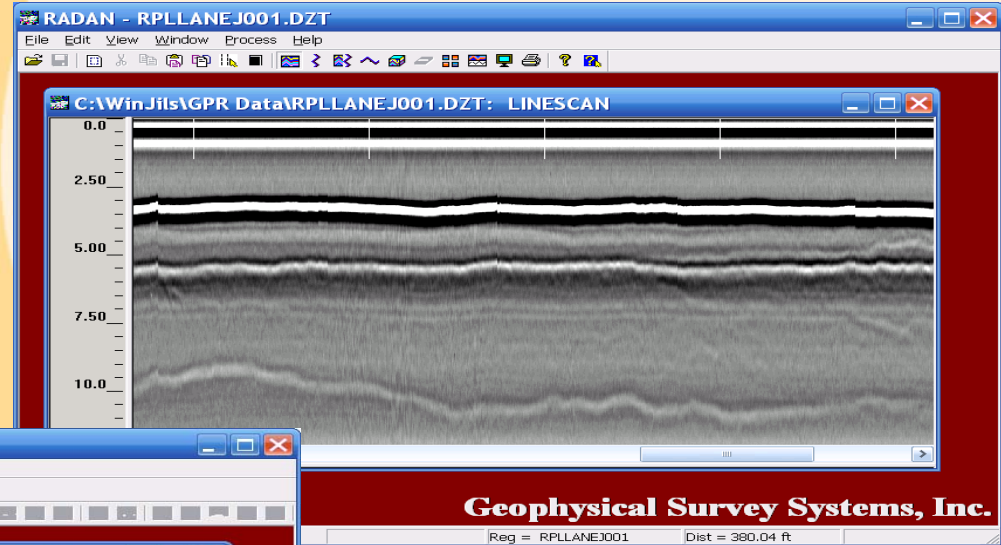


Concept and Technology Developed by:



Raw Ground Penetrating Radar (GPR) data

- Raw Data on the right would be observed while collecting data in transit between FWD test points



- Radan to manually process the file
- GPR-AP skips this step and begins recording your layered pics automatically
- Dr Ken Maser will be talking on this in more detail



GPR-AP Dataset

- FWD/GPR dataset
- Records three additional Quality indicators developed by JILS for each of the three layers detected by GPR-AP
- Developed for engineers

Sample data set:

| Test # | Lane# | Distance | <u>pvmtcode</u> | Load | Sens1 | Sens2 | Sens3 | Sens4 | Sens5 | Sens6 | <u>Sen7</u> | <u>P Tem</u> |
|--------|-------|----------|-----------------|------|--------------|-------------|-------------|-------------|-------------|-------------|-------------|--------------|
| 5 | 1 | 0.000 | 1 | 5.99 | 10.50 | 8.10 | 6.32 | 5.64 | 4.80 | 4.27 | 3.49 | 67.5 |
| 5 | 1 | 0.000 | 1 | 5.99 | 10.50 | 8.10 | 6.32 | 5.64 | 4.80 | 4.27 | 3.49 | 67.5 |
| 5 | 1 | 0.000 | 1 | 5.99 | <u>10.50</u> | <u>8.10</u> | <u>6.32</u> | <u>5.64</u> | <u>4.80</u> | <u>4.27</u> | <u>3.49</u> | <u>67.5</u> |

Drop Sequence Completed Time: 21:25 Air Temp (F): 64.0

Note: none, GPR: 5.253, 2.554, 17.226, Good (1.000, 0.394, 0.032)



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Thank You

Questions...

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