Florida Institute of Technology

Dept. of Civil Engineering

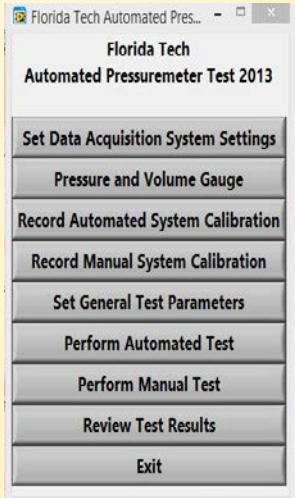
# Development and Testing of the Miniaturized Pavement Pressuremeter

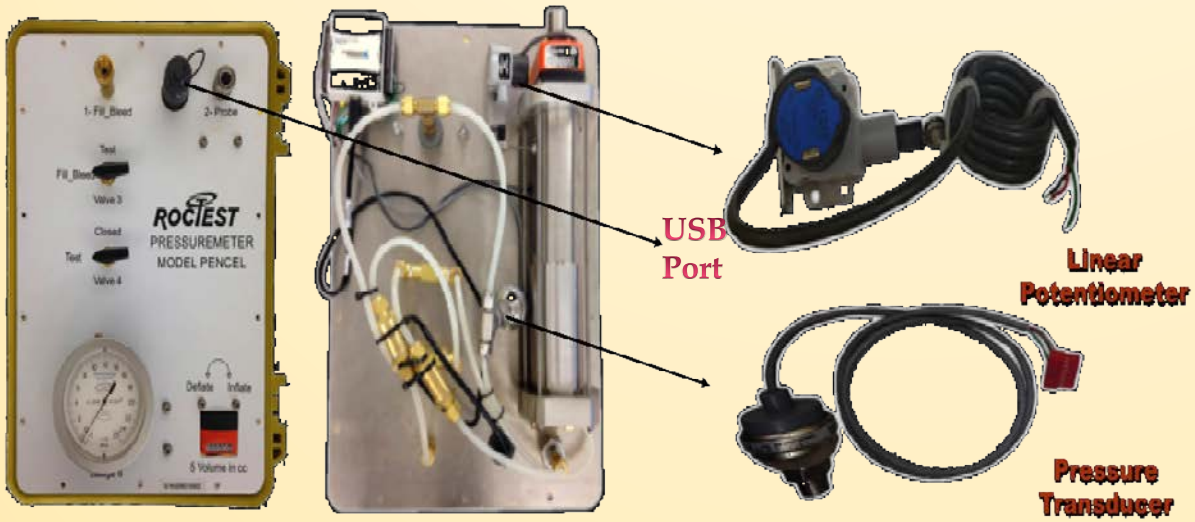
By

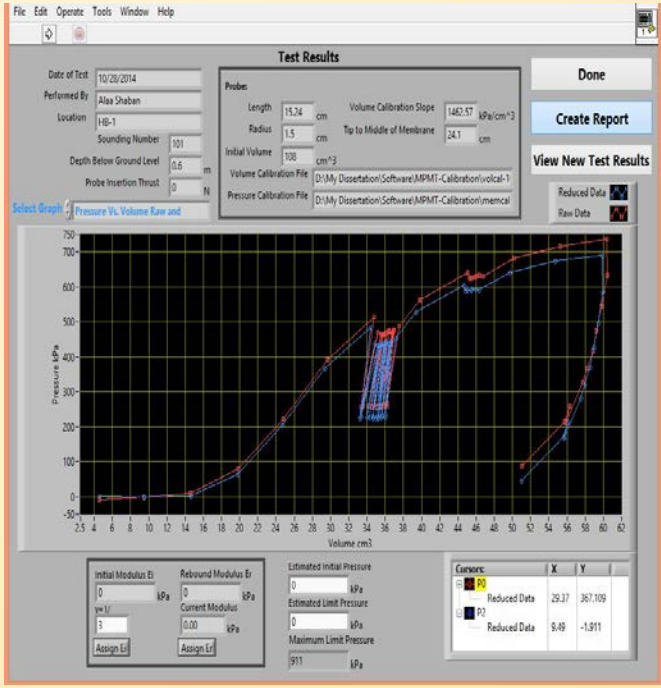
**Paul J. Cosentino, Thaddeus J Misilo, Alaa Shaban, Alexandra Boggs**

# Background

- Pressuremeters have been improved by instrumentation
- Small strains can be measured to help pavement engineers
- Equipment costs are very reasonable
- A simple test PMT stress-strain should be developed



# Digital vs Manual Engineering Properties

| Soil Type | Engineering Parameters | Manual (kPa) | Digital (kPa) | Δ (kPa) | Error (%) |
|---|---|---|---|---|---|
| Medium Dense Sand | $E_o$ | 14,617 | 14,972 | 355 | -2% |
| | $E_r$ | 132,286 | 186,553 | 54267 | -29% |
| | $P_L$ | 1,436 | 1,433 | -3 | 0.2% |
| Loose Silty Sand | $E_o$ | 5,230 | 6,256 | 1026 | -16% |
| | $E_r$ | 34,216 | 37,002 | 2786 | -8% |
| | $P_L$ | 432 | 433 | 1 | -0.2% |
| Soft Clay | $E_o$ | 1,876 | 2,338 | 462 | -20% |
| | $E_r$ | 5,161 | 5,321 | 160 | -3% |
| | $P_L$ | 140 | 142 | 2 | -1.4% |

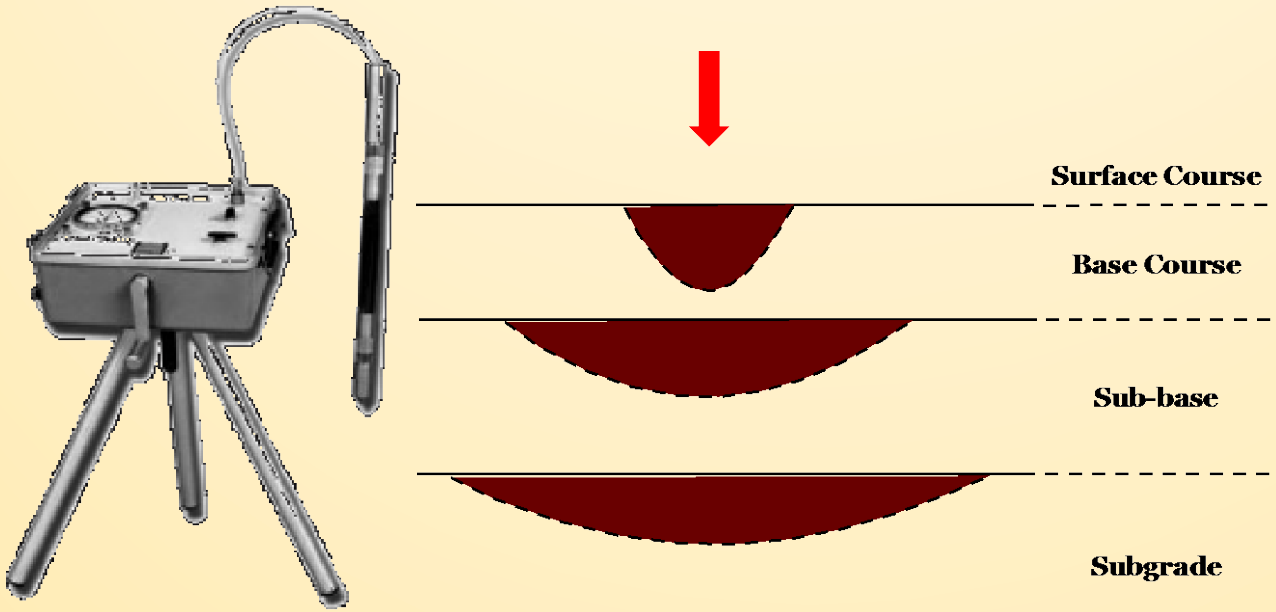
# Problem Statement

*Typical Nuclear Density Equipment*

- Let's Supplement the Nuclear Density Testing with a Small Pressuremeter
  - Nuclear Equipment causes a lot of paperwork
  - Only produces Density and Moisture not Strength and Stiffness
- A small pressuremeter probe is being developed and a test can be run in the same hole as the nuclear density test
  - A fast stress-strain response is being produced
  - The data would help engineers understand in situ pavement performance

# Objective

- The objective is to develop a miniaturized PMT field test that can be completed in about 5 minutes to measure in situ stress-strain pavement material responses



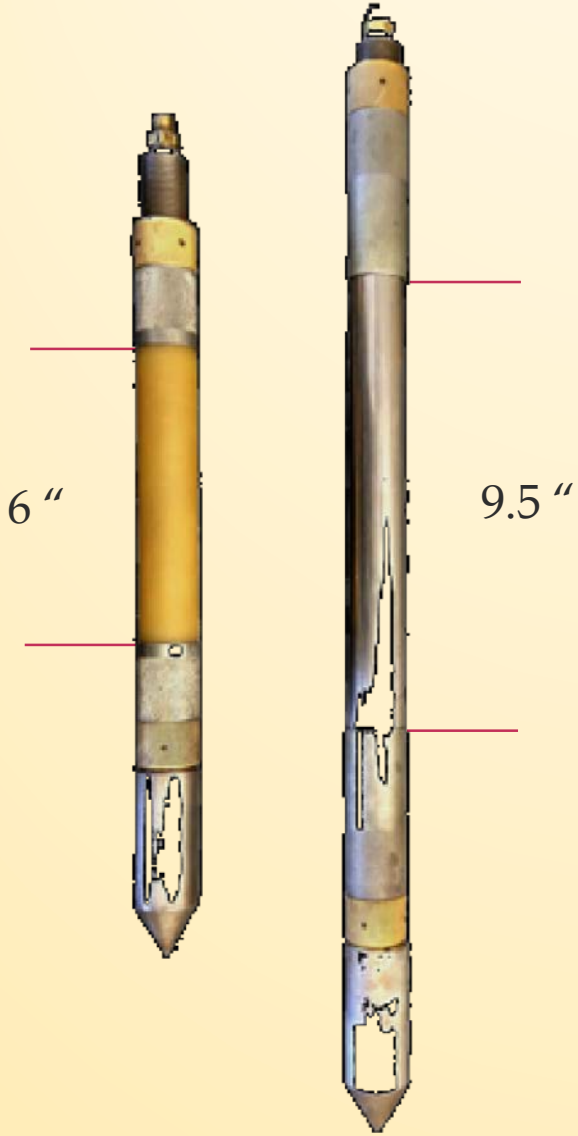
# Methodology

- Literature Search
- Identify and Develop Field Testing Site(s)
  - Local to FIT
  - Base & Subgrade Soils
- Miniaturize the Pressuremeter Probe
  - 5/8″ diameter by 6″ long
- Probe Insertion
  - Driven Solid versus Open Rod/Template System
- Conduct Field Comparison Testing
- Finalize MiniPMT Testing Procedure
- Analyze Results--DRAFT Final Report & Technology Transfer
- Complete Final Report

# Preliminary Results

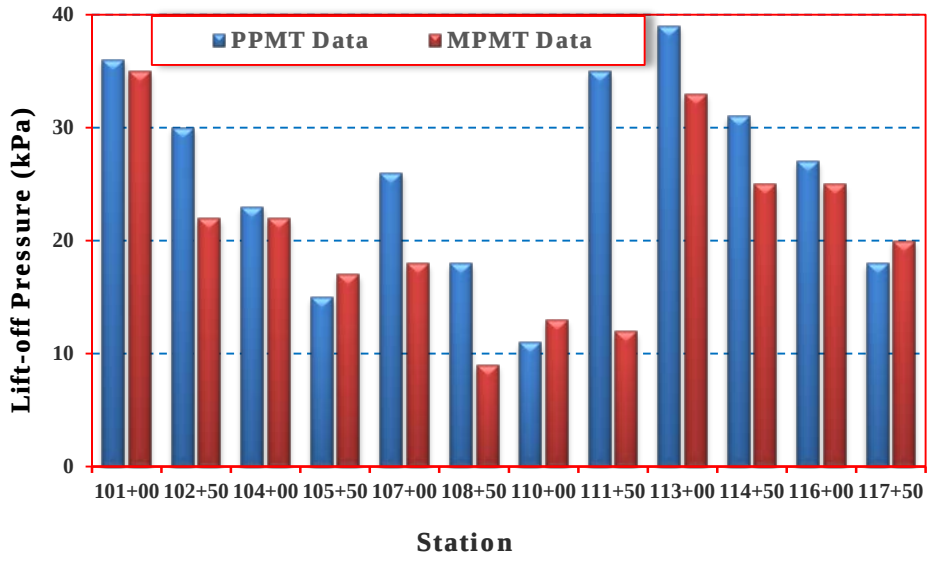
- PENCEL Pressuremeter Probe Size Decreased
  - First Length Decreased from 9.5 to 6 inches
  - Then Diameter Decreased to 5/8$^{th}$ inch for 6 inch length
- Mini PMT Probe Results Compared to PENCEL Probe Results
- Mini PMT Results Compared to Dynamic Cone Penetrometer Results

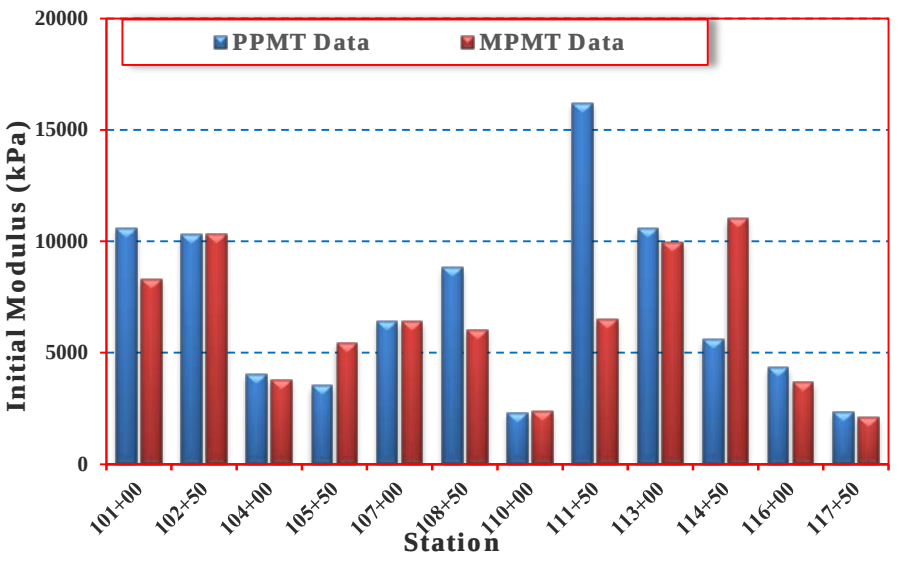
# PENCEL and Mini PMT's

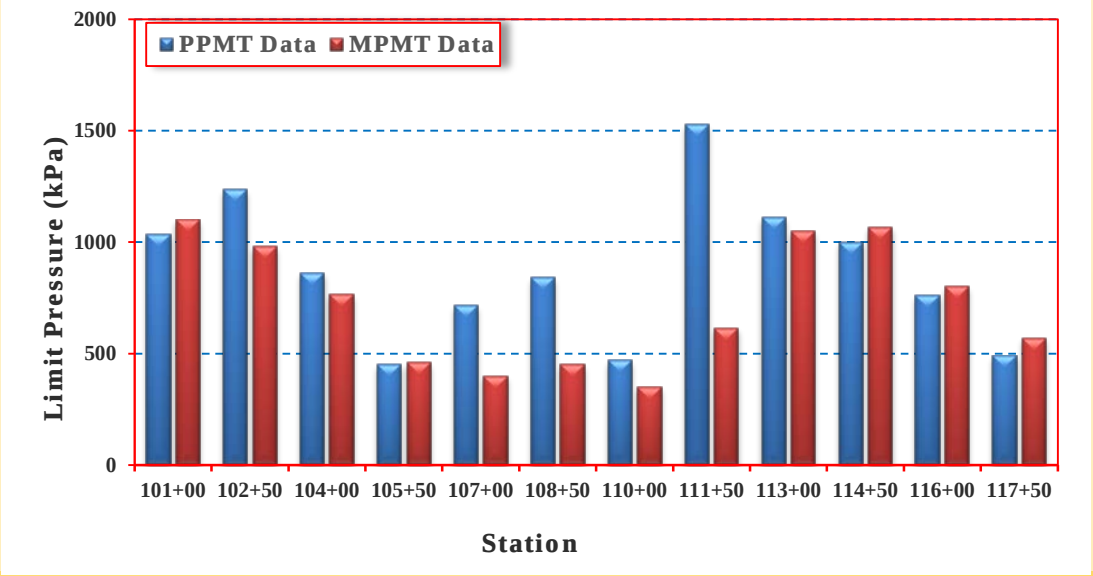



PENCEL Diameter 1.3 inches
Mini Diameter 5/8th inch

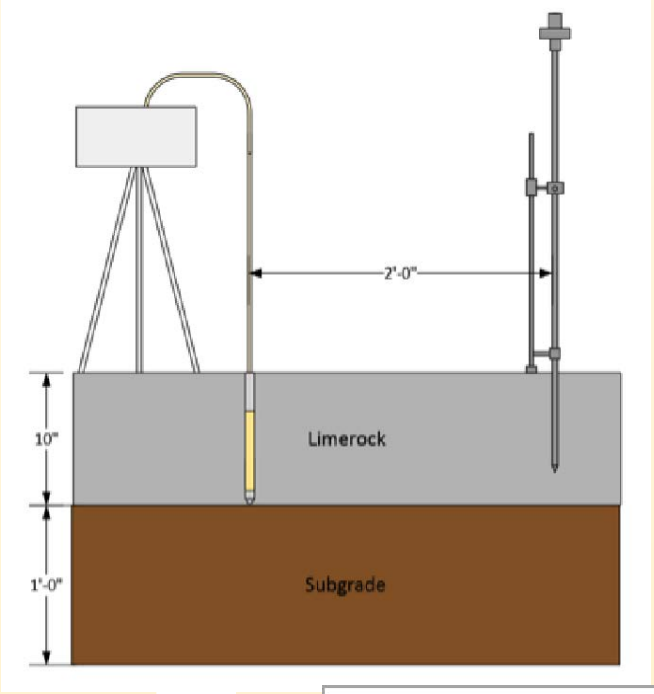
# Comparison PENCEL 9.5 " vs. 6" Mini

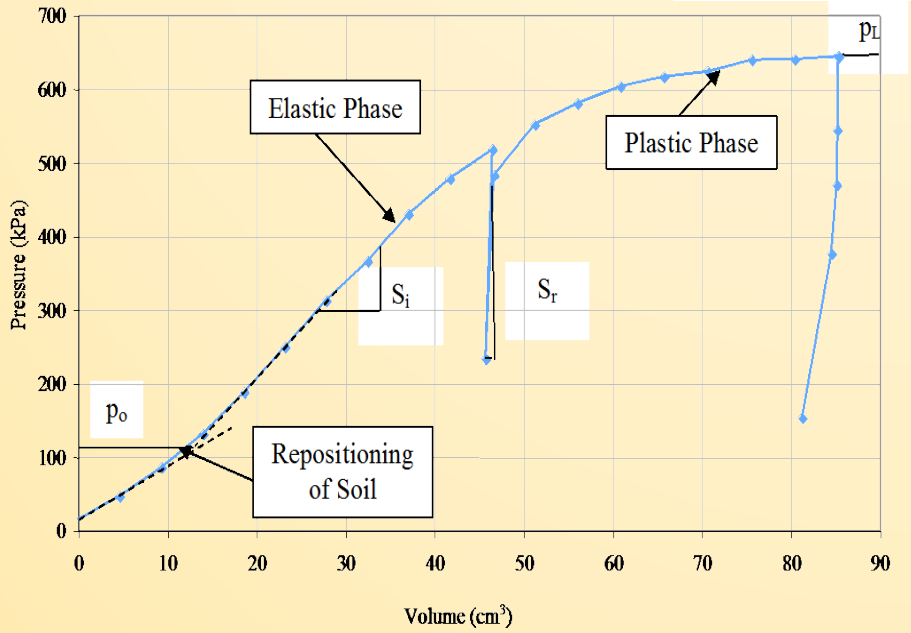


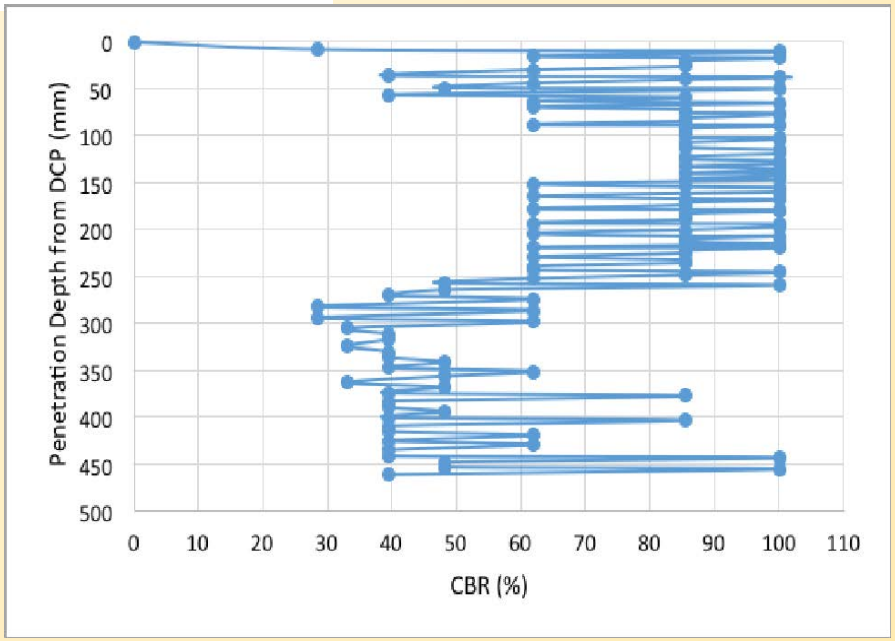



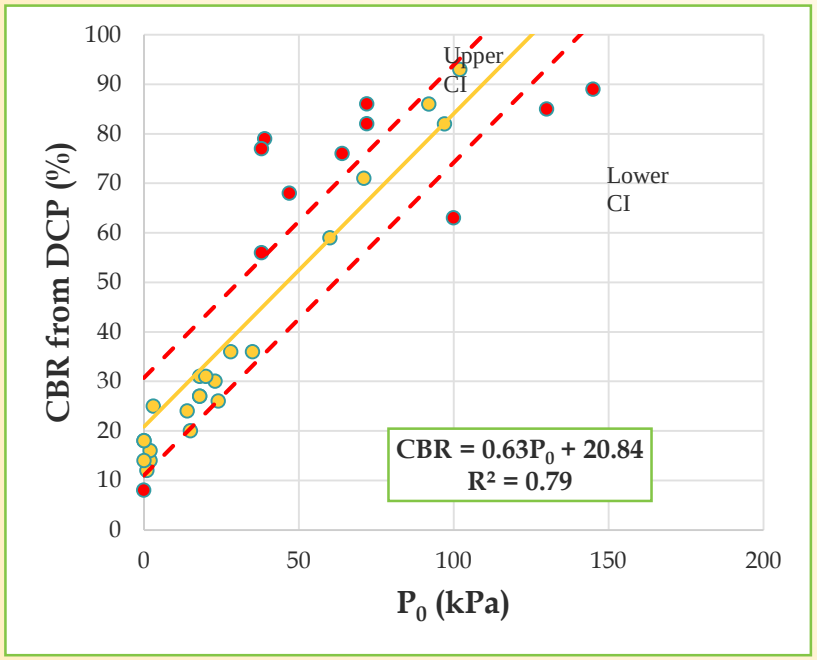
- Preliminary Results
- 6 " Mini PMT vs DCP CBR's

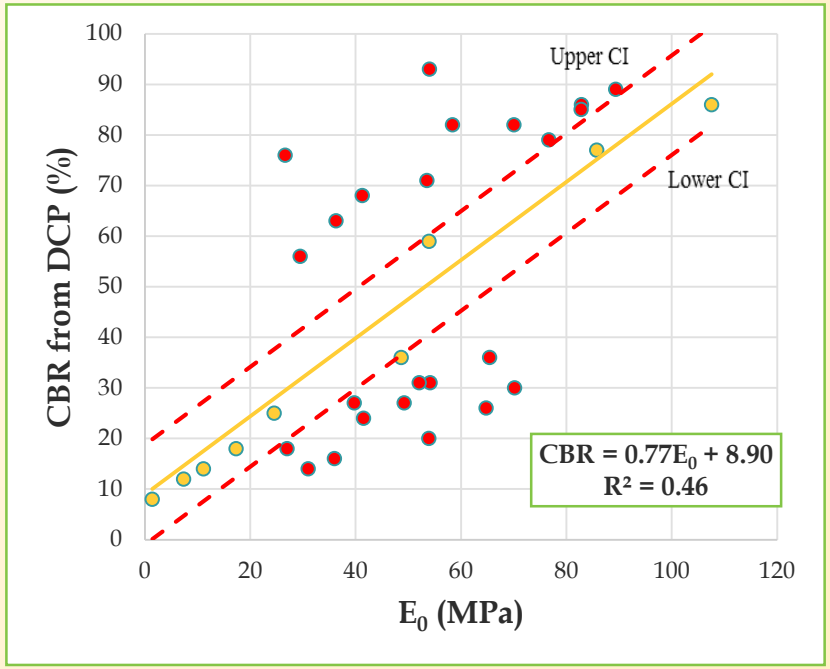


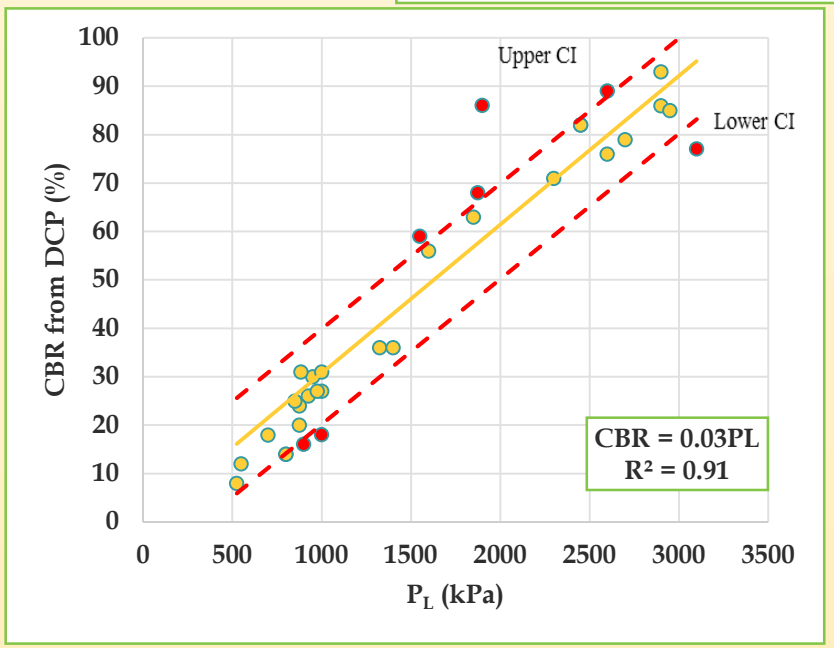



# Predicted Field CBR vs. Mini-PMT Properties



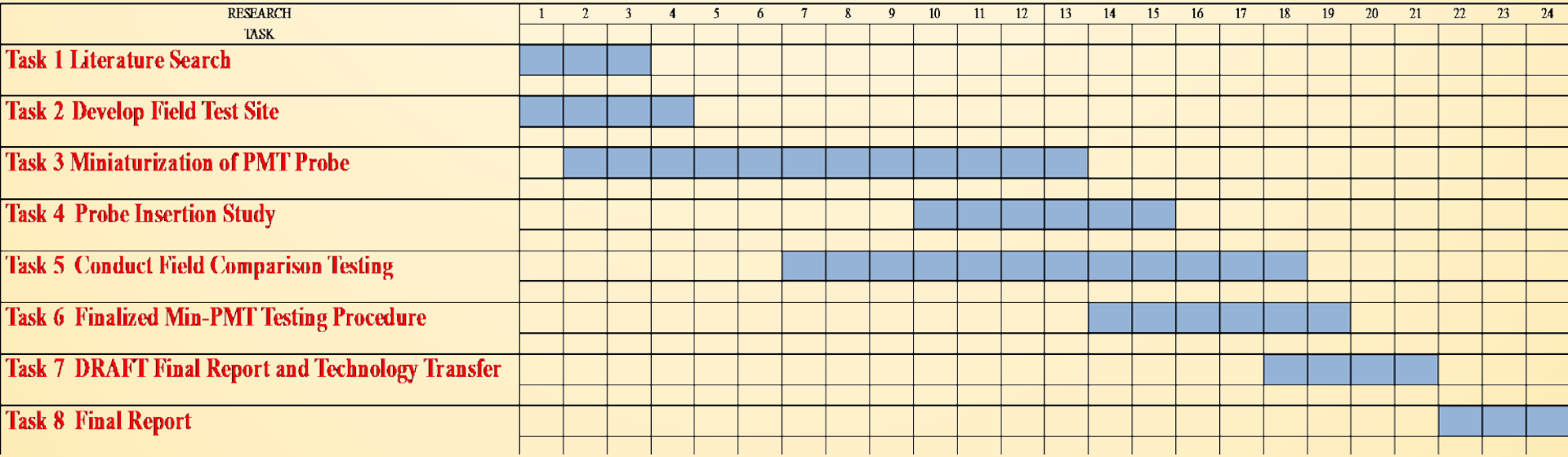



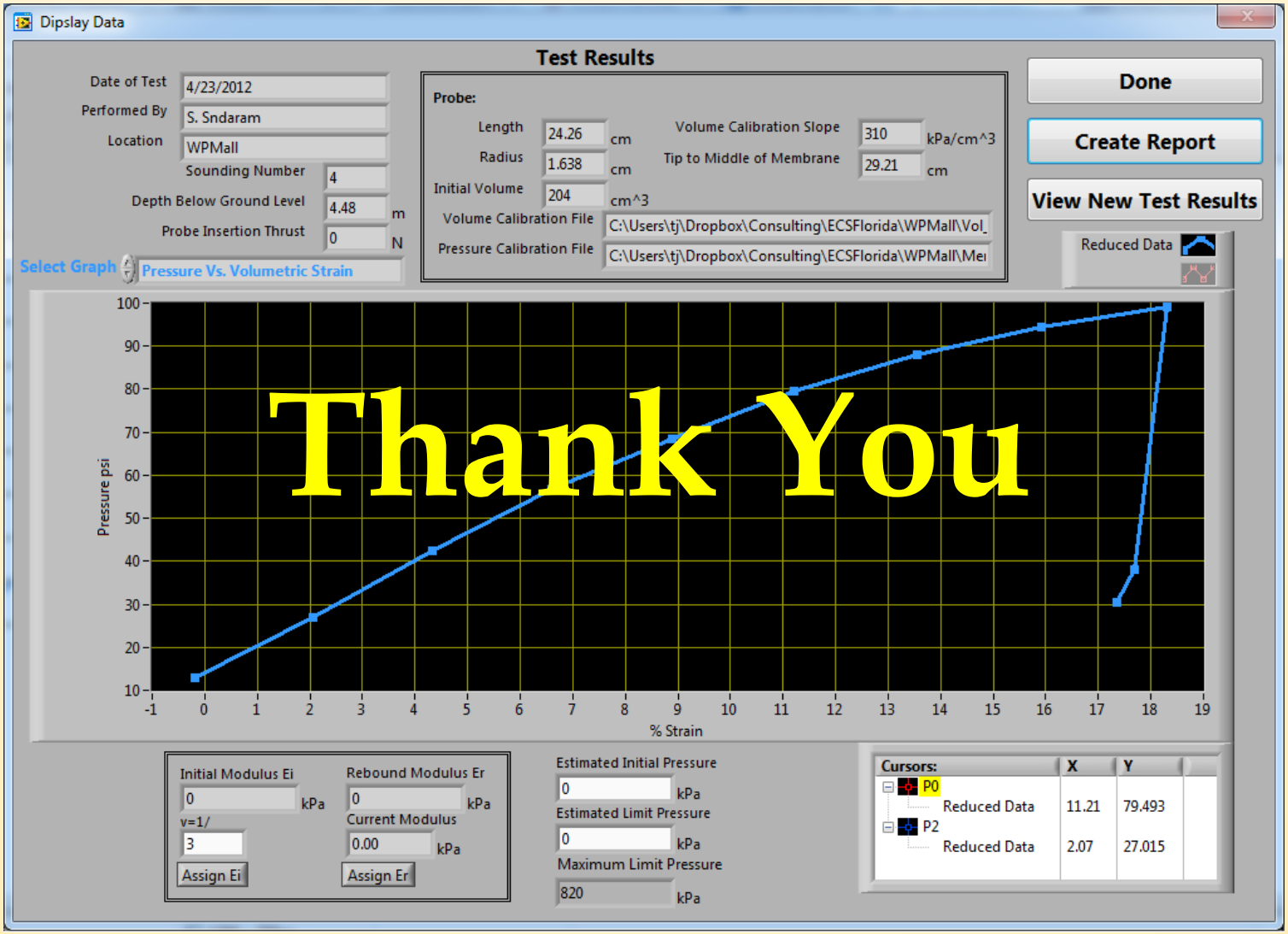

*Note Upper and Lower 95 % Confidence Intervals*

# Proposed Schedule

## PROJECT SCHEDULE

**Project Title** — Development and Testing of the Miniaturized Pavement Pressuremeter
Research Agency — **Florida Institute of Technology**
Principal Investigator — Paul J. Cosentino, Ph.D. P.E.

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Test Results
Date of Test
4/23/2012
Performed By
S. Sndaram
Location
WPMall
Sounding Number
4
Depth Below Ground Level
4.48
m
Probe Insertion Thrust
0
N
Select Graph
Pressure Vs. Volumetric Strain
Probe:
Length
24.26
cm
Radius
1.638
cm
Initial Volume
204
cm^3
Volume Calibration Slope
310
kPa/cm^3
Tip to Middle of Membrane
29.21
cm
Volume Calibration File
C:\Users\tj\Dropbox\Consulting\ECSFlorida\WPMall\Vol_
Pressure Calibration File
C:\Users\tj\Dropbox\Consulting\ECSFlorida\WPMall\Mei
Done
Create Report
View New Test Results
Reduced Data
Thank You
Pressure psi
% Strain
Initial Modulus Ei
0
kPa
v=1/
3
Assign Ei
Rebound Modulus Er
0
kPa
Current Modulus
0.00
kPa
Assign Er
Estimated Initial Pressure
0
kPa
Estimated Limit Pressure
0
kPa
Maximum Limit Pressure
820
kPa
Cursors:
X
Y
P0
Reduced Data
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P2
Reduced Data
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27.015