BED Two 28 977-01
Using the PENCEL PMT to Evaluate Shallow Foundations at Florida's Fine Sand Sites

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FDOT GRIP 2022 Meeting Outline

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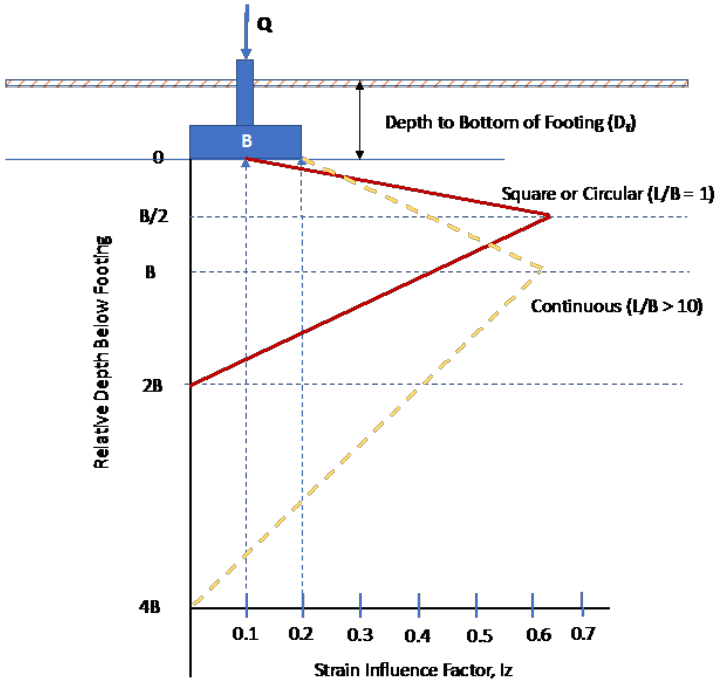
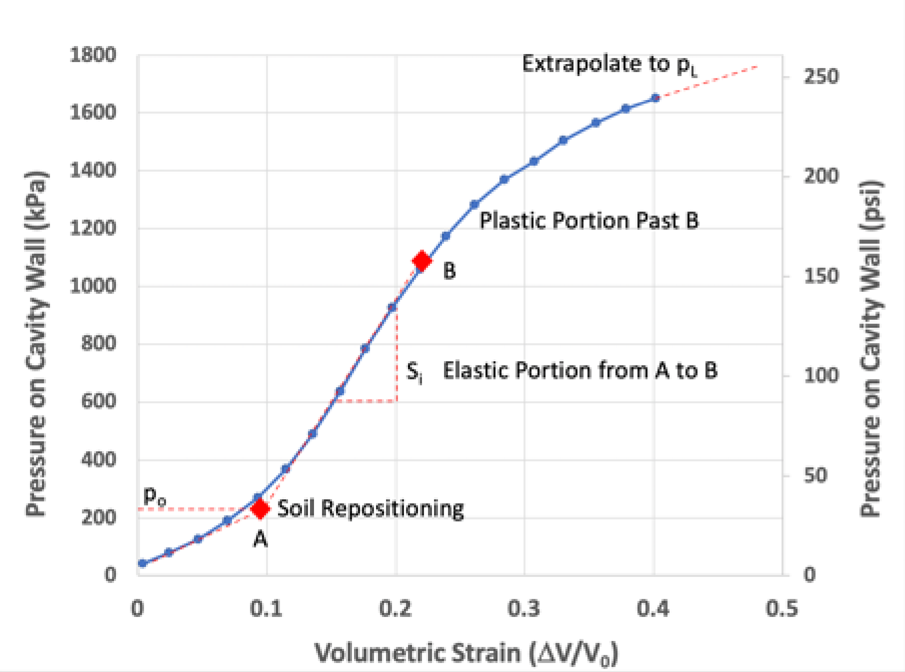
Implementation plan

- Data from this work will be added to the existing data base that is used in Briaud's 2007 Settlement prediction method, currently presented in Foundation Design textbooks.
  - The new PENCEL PMT data will be compared to the existing data and determine how it will affect the Briaud 2007 settlement prediction method.
  - Existing FDOT sites will be evaluated if piles were driven.
  - Based on the design loads the new digital PENCEL PMT data will be used to determine if PMT testing data would have allowed shallow footings to be safely used.
- This additional information will allow Florida's consulting engineers to confidently use PMT data to design cost effective shallow footings.
- The research report will contain specific guidelines/ recommendations for consulting engineers to follow when using PMT data to design shallow footings.

Introduction

- When Shallow Foundations are used, the zone of soil affected is typically within the top 25 to 25 feet.
- PENCEL PMT stress-strain curve components are easy to interpret and use in footing designs





Introduction (Cont.)

- FHWA reports that 50 to 65 % cost savings is realized when shallow foundations are used in lieu of deep foundations.
- Pressuremeter testing zones are large
- Yield better quality stress-strain data
  - Allows engineers to produce more economical designs
  - Confidently evaluate more complex problems
- Engineering consultants using PENCEL Pressuremeter data saved clients hundreds of thousands of dollars.
  - One realized a savings of $4.5 million dollars during the construction of a 15-story hospital in Jacksonville, Florida.
  - The instrumentation and software developed from *BD-658 Standardizing the Pressuremeter Test for Determining p-y Curves for Laterally Loaded Piles* has resulted in the significant increase in its use and has resulted in an estimated ½ billion dollars in savings.
- Results will be incorporated into FDOT’s Soils and Foundations Handbook.

Overview

- Data from this work will be added to the existing data used in Briaud's 2007 Settlement of Sands prediction method.
  - New PPMT data will be compared to existing PMT data and determine its affect on the Briaud 2007 settlement prediction method.
  - Existing FDOT pile foundation sites will be re-evaluated with the digital PENCEL PMT data to determine if it would have allowed shallow footings to be used.
- The research report will contain specific guidelines/ recommendations for consulting engineers to follow when using PMT data to design shallow footings.

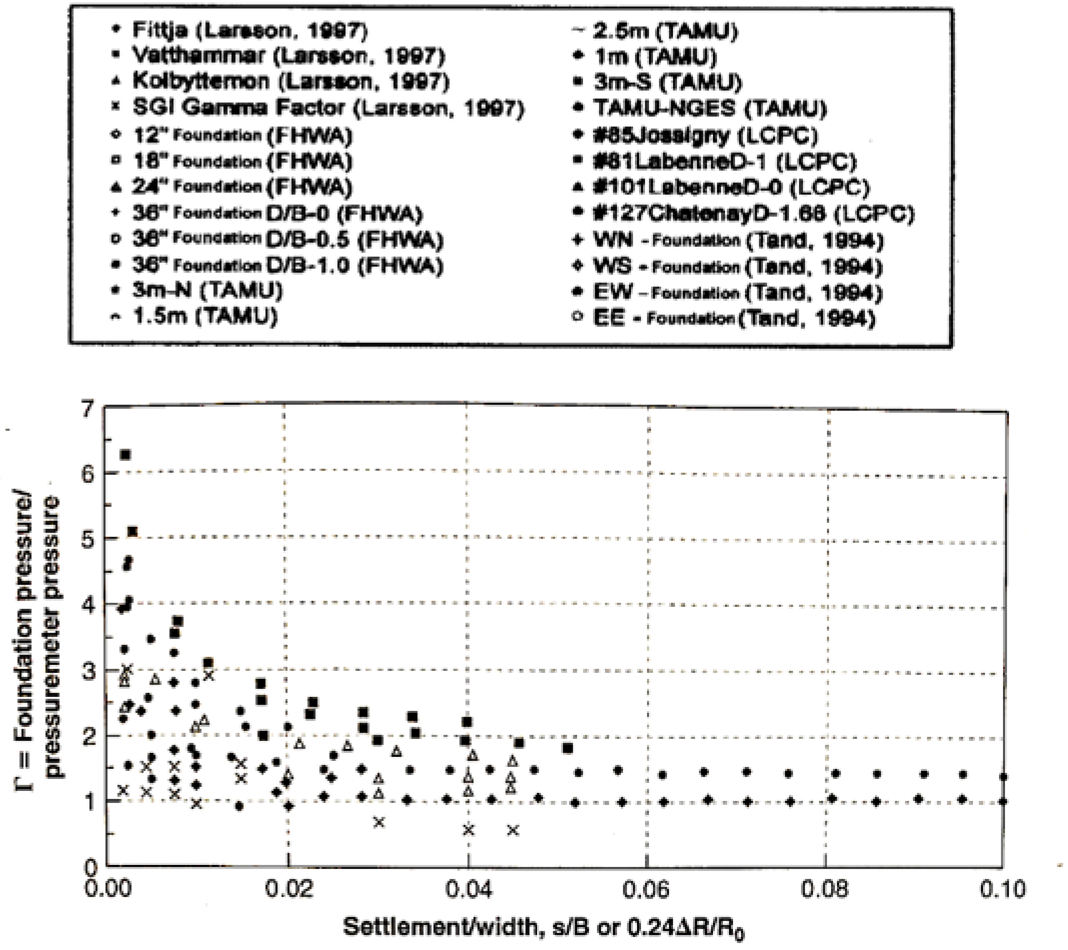
Objective

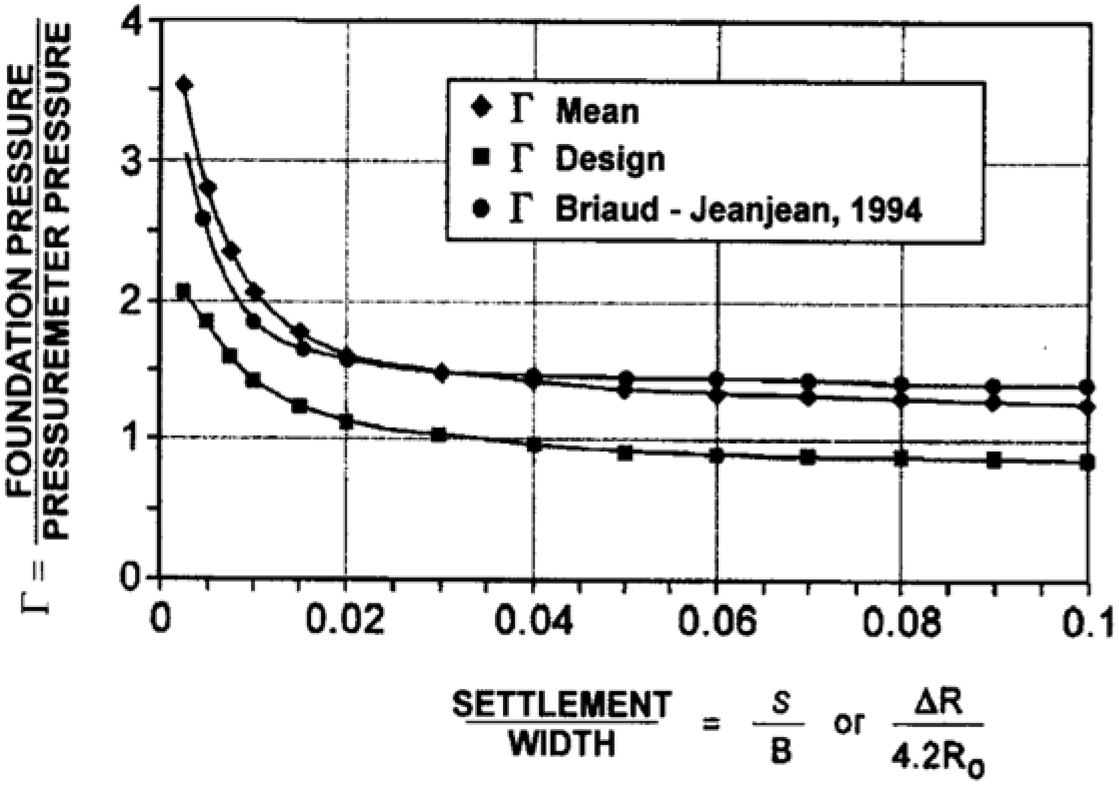
- To improve the confidence that geotechnical engineers would have in using PENCEL PMT data to safely design shallow footings placed on Florida fine sands.

Task 1

- Literature Review and Historical Evaluations Involving Settlement of Sands
  - Settlement methods reviewed for shallow foundations on sands
    - Settlement Prediction Methods from PMT
      - Menard and Rosseau 1962
      - Briaud 2007
    - Settlement from CPT using Schmertmann et al 1978
    - Settlement from DMT using Elasticity Equation
  - Methods of determining moduli from PPMT, DMT, CPT, SPT and plate bearing tests reviewed
  - Case histories of pertinent footing performance reviewed.

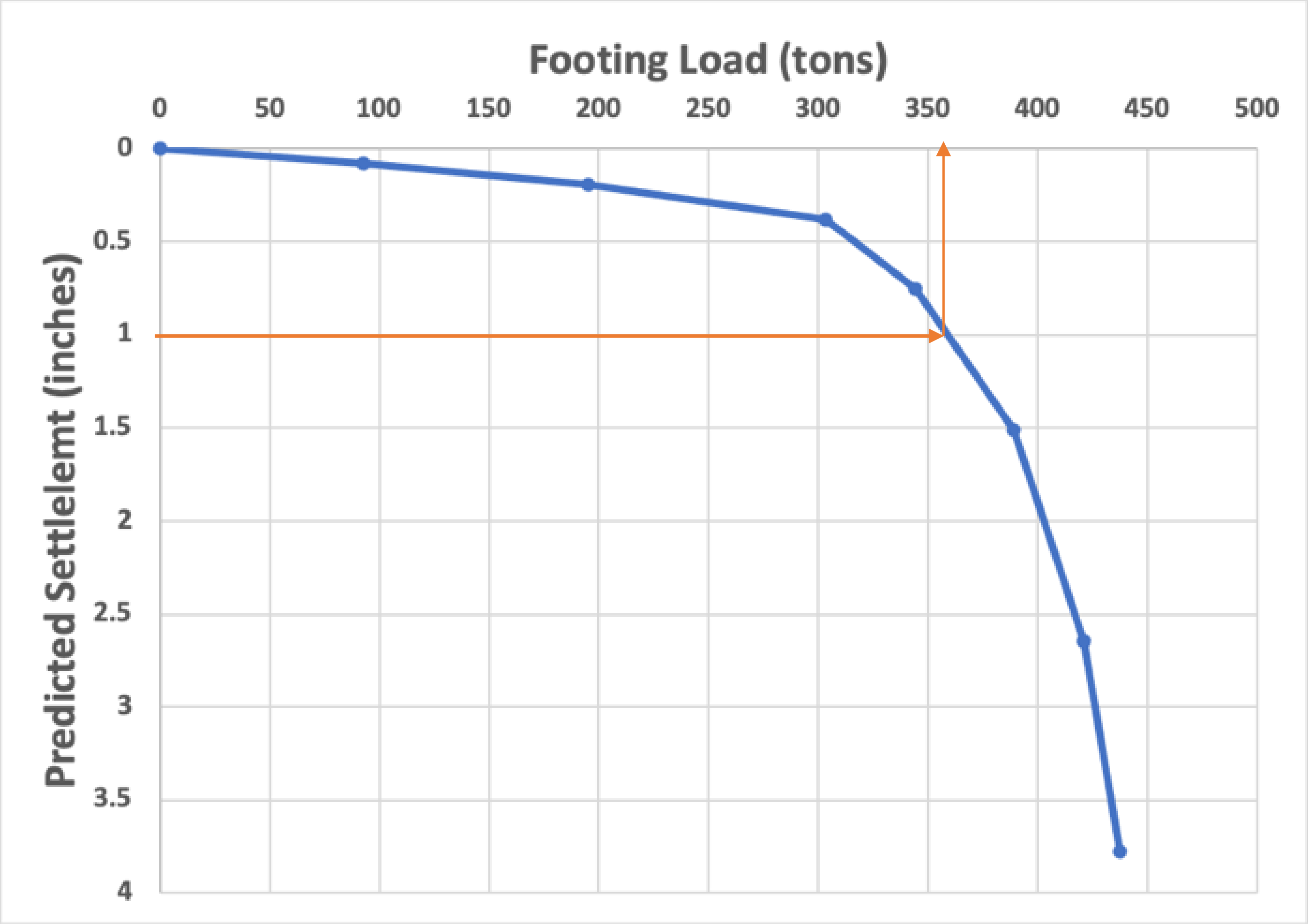
Overview of Briaud Settlement Approach





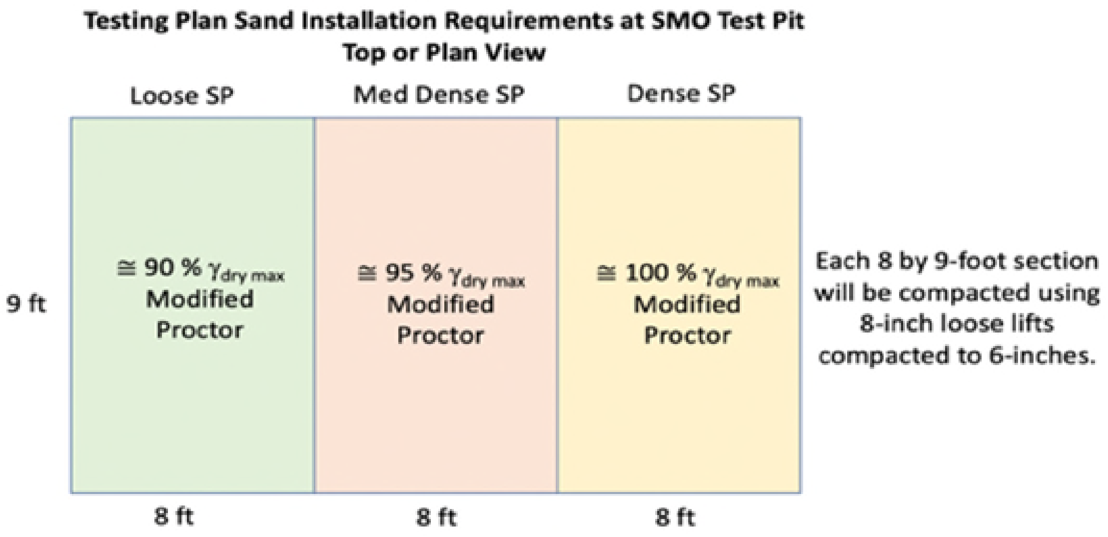
Example Results for a Given Footing Size

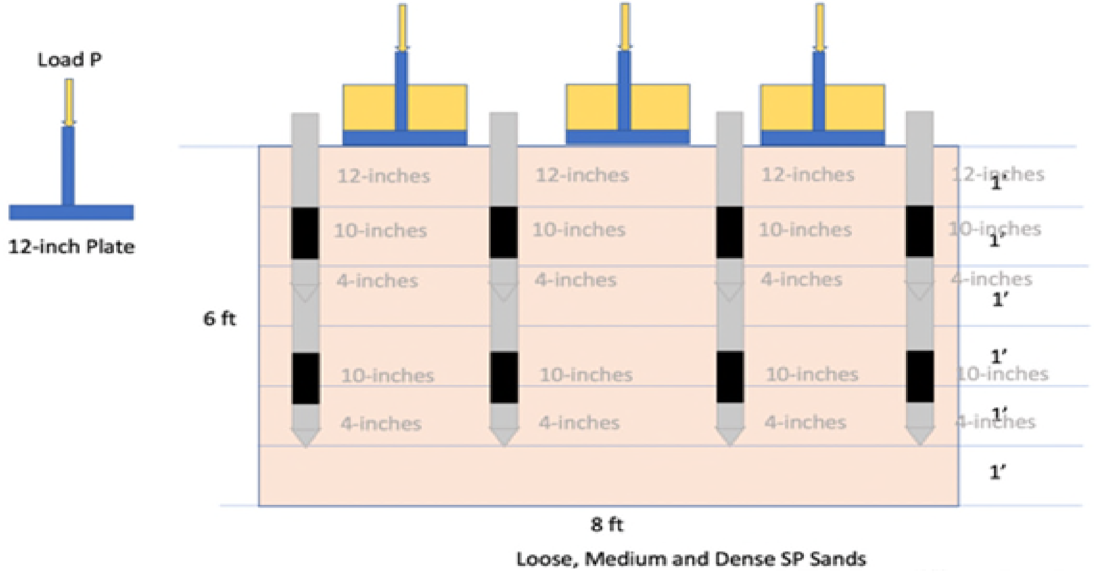
- PMT data converted to Load-Settlement
- 360 tons produce 1-inch settlement



Task 2

- *PPMT and Plate Bearing Test Pit Evaluations of Fine Sands:*
  - *The two FDOT SMO test pits being used to evaluate typical Florida mechanically stabilized earth (MSE) wall backfill sands.*
    - *Starvation Hill the stronger of the two materials has been placed*
    - *Osteen Sand the weaker is being placed*
    - *Aren't these cool names for sand☺*
    - *Plate Bearing Tests, PPMT, CPT, DMT and density tests will be performed in each pit.*
  - *Loose, medium dense, and dense sand are being placed within each 8-foot wide, 9-foot-long pit subsection to a depth of about 5-feet*





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Current Status of Test Pit #1

- ***Three zones of Starvation Hill Sands placed and ready for testing next week***

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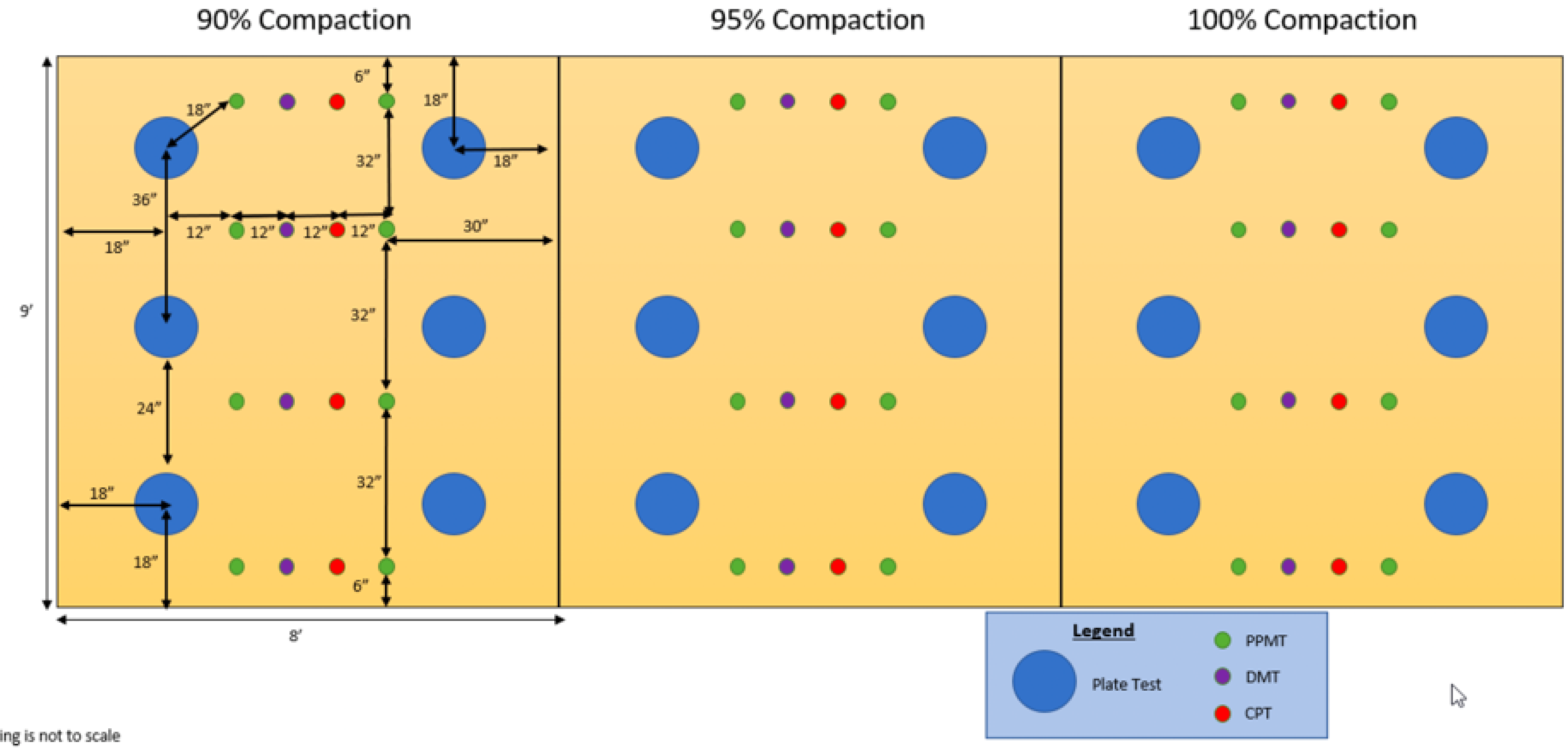
Starvation Hill Testing Plan



Drawing is not to scale

Task 3

- ***Site Selection, Visits, and Data Procurement:***
  - *PI and PM work together to select a minimum of 3 and up to 5 FDOT evaluation sites.*
  - *They are based on the Task 1 literature and historical findings, with a goal of identifying FDOT sites with soil properties that may allow structures to be supported on shallow foundations.*
  - *The information to be gathered will include as a minimum:*
    - *site locations and descriptions,*
    - *design phase test boring locations, with pertinent elevations and data, and*
    - *associated generalized subsurface profile.*
  - *Currently considering the following locations:*
    - *Keystone borrow pit, Keystone Heights, Clay Co.*
    - *Newberry retention pond, Newberry, Alachua Co.*

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Task 4

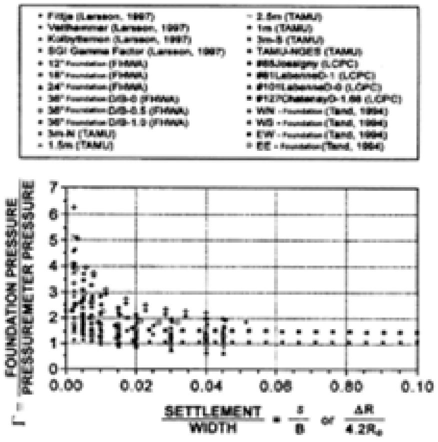
- **PPMT, CPT, DMT, and Field Plate Load Testing:**
  - Instrumented PPMT testing, CPT and DMT will be performed within the top 30 feet at each of the chosen sites from Task 3, near an existing test boring with SPT N-values.
  - Two options for the PPMT testing are proposed.
    - One option is to hydraulically push the PPMT probe to the desired depth and conduct tests adjacent to SPT Test borings.
    - The other option is to use a standard drill rig, conduct standard penetration testing (SPT) at 2.5-foot intervals followed by hydraulically pushing the PPMT probe to the subsequent test depth.
  - Plate loading tests will be performed using available steel plate systems.
    - Currently, there are 24- and 30-inch plates available for this testing.

Task 5

- **Analyzing Modulus Effects on Foundation Settlement and Bearing Capacity**
  - Load-settlement predictions for various size footings based on theories that required PMT, CPT, DMT, SPT, and plate loading data.
  - Using the structural loads and the test results for each site, bearing capacity predictions will be developed.
  - Comparisons will be made between footings designed based on PPMT and other options.
  - Conclusions and recommendations will be developed.

Task 6

- **Extrapolation of Design Procedure Data into Design Flow Chart using Florida Site Conditions:**
  - Load-settlement predictions from the Florida fine sands will be overlaid onto the existing data.
  - A PENCEL PMT Shallow Footings on Fine Sands Design Approach Flow Chart will be developed with
    - information needed to properly identify sites where this approach would be beneficial
    - testing procedures for obtaining and reducing the PENCEL PMT soils information needed for shallow footing designs and
    - applicable bearing capacity, settlement, and lateral load analyses approaches for footing designs
  - This information will be included in the final report.



Tasks 7 & 8

- **Task 7 – Draft Final and Closeout Teleconference:**
  - Ninety (90) days prior to the end date of the task work order, the university will submit a draft final report in PDF and Word formats to research.center@dot.state.fl.us.
  - The draft final report will contain a written summary of the results obtained from each of the first 6 tasks.
- **Task 8 – Final Report:**
  - Deliverable 8: Upon Department approval of the draft final report, the university will submit the Final Report in PDF and Word formats electronically to the Research Center at research.center@dot.state.fl.us. The Final Report is due by the end date of the task work order which is 3/31/2024.

Project Timeline

Task No	Description	Months																							
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
N/A	**Project Kick-off Meeting**	4 2022																							
1	**Literature Review and Historical Evaluations Concerning Settlement of Sands**	4 2022	5 2022	6 2022	7 2022	8 2022	9 2022																		
2	**PPMT and Plate Bearing Test Pit Evaluations of Fine Sands**		5 2022	6 2022	7 2022	8 2022	9 2022	10 2022	11 2022	12 2022	1 2023	2 2023	3 2023	4 2023											
3	**Site Selection, Site Visits, and Procurement of Site Data:**		5 2022	6 2022	7 2022	8 2022	9 2022	10 2022																	
4	**PPMT, CPT, DMT, SPT, and Field Plate Load Testing**						9 2022	10 2022	11 2022	12 2022	1 2023	2 2023	3 2023	4 2023	5 2023	6 2023	7 2023								
5	**Analyzing the Modulus Effects on Foundation Settlement and Bearing Capacity**												3 2023	4 2023	5 2023	6 2023	7 2023	8 2023	9 2023	10 2023					
6	**Extrapolation of Design Procedure Data with Design Flow Chart using Florida Site Conditions**											2 2023	3 2023	4 2023	5 2023	6 2023	7 2023	8 2023	9 2023	10 2023	11 2023				
7	**Draft Final Report and Closeout Teleconference**														5 2023	6 2023	7 2023	8 2023	9 2023	10 2023	11 2023	12 2023			
8	**Final Report**																					12 2023	1 2024	2 2024	3 2024

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Closing Slide, What's Our School Name☺ and Mascot?

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