LRFD Resistance Factors for Auger Cast In-Place (ACIP) Piles

FDOT BDV31 Two 977-12

Principal Invesitigator

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Project Manager

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E·S·S·I·E Engineering School of Sustainable Infrastructure & Environment

Scope of Work

- Task 1 – Prepare and distribute data request letter to contractors, consultants, and DOTs
- Task 2
  - Review construction techniques and current design methods
  - Organize and upload data into FDOT database
  - 40 to 60 load tests required!
- Task 3
  - Select design methods for analysis
  - Determine bias (and CV for selected design methods
  - Assess sample (dataset) size
  - Determine LRFD Φ for best performing methods and AASHTO loading conditions
- Task 4 – Assess minimum number of load tests per site
- Task 5 – Final report
  - Recommendations for LRFD Φ for total, skin and tip resistances
  - Recommendations for minimum number of load tests

Task 1 – Data Request Letter

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352-392-3394 Fax
www.essie.ufl.edu

Dear Madam/Sir

The Florida Department of Transportation is partnered with the University of Florida in a study to calibrate geotechnical Load and Resistance Factor Design (LRFD) resistance factors for Auger Cast-In-Place (ACIP) Piles for FDOT design. As part of the project, we are collecting any of the following data from all possible sources for ACIP type foundations:

1) Soil exploration data [in-situ (SPT, CPT, etc.),and laboratory results: soil classification and rock strength if available];
2) Load test and boring locations relative to pile load tests;
3) Pile resistance prediction method, and capacity assessment used (Davisson, 3% diameter, etc.);
4) Load test results (static or dynamic) and any tip, skin friction and total load displacement data. Data does not need to be limited to projects in Florida;
5) Installation logs for the piles tested;
6) Results of any integrity testing of load tested piles;
7) Sample certification or acceptance letters;
8) Load test and foundation cost estimates;
9) Additional pertinent information.

All project sites will be identified by the county and a number; information identifying private owners or exact addresses is not requested and will not be disclosed if included.

Success of the project depends on collecting enough information to develop a statistically significant database from which to calibrate resistance factors. As such, we kindly request the relevant data of projects your office has been involved that used the ACIP pile and where a load test has been performed. In order to transfer the data, a FTP website, hosted by the University of Florida, will be made available for transfer of electronic files. And for hardcopy files, arrangements can be made at no expense to your business.

Following receipt of this letter, either the primary researcher on the project, Scott Wasman, or the project manager, Rodrigo Herrera, will contact you regarding any questions you might have. If you have any questions beforehand, please do not hesitate to contact either one at:

Primary Researcher: Scott Wasman, Ph.D., (352) 273-4609, swasman@ufl.edu
Project Manager: Rodrigo Herrera, P.E., (850) 414-4377, Rodrigo.Herrera@dot.state.fl.us

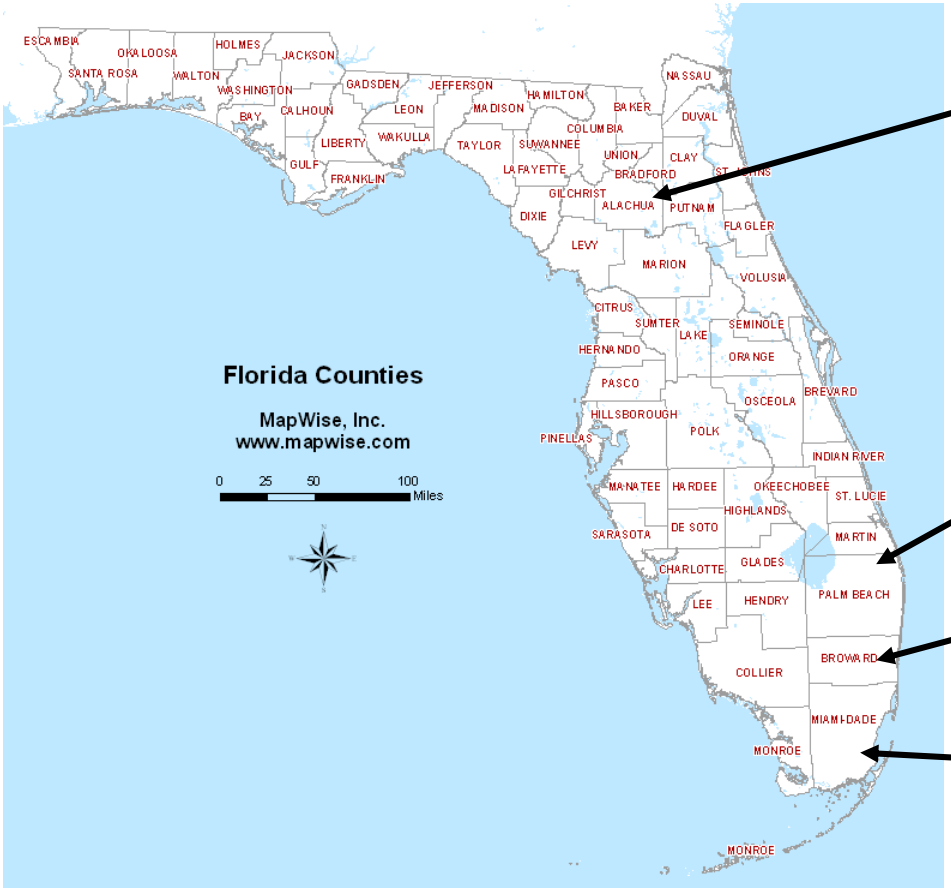
We greatly appreciate your time and participation.

Task 1 – Contributors To Date

- Universal Engineering Sciences
- GEOSOL, Inc
- Dunkelberger Engineering and Testing, Inc. (Terracon)
- Ebsary Foundation Co.
- Nodarse (Terracon)

Thank You!

Task 2 – ACIP Pile Data



2 Projects

2 Projects

3 Projects

4 Projects

Task 2 – Site Data

- Number of borings
  - 4 – 11 per site
  - 50 SPT borings
- Soil types
  - SC, SM, SP
  - CH, CL
  - SP-SC, SP-SM, SM-SC
  - Intermediate (limerock)

Task 2 – ACIP Pile Data

- Number of load tests
  - 16 compression tests (11 instrumented for skin)
  - 6 Tension tests
  - 6 Lateral tests
- Installation Data
  - Pile grouting on 6 project sites
- Pile diameters
  - 14, 16, 18, 24 and 30 inch

FDOT Database-ACIP Data

SPT #1 of 1

Generate elev from depth | Generate depth from elev | CLEAR CONTENTS | DELETE THIS RECORD

Company	
Project Name	Broward-1-8
Section	
Township	
Range	
Coord. System	
Vertical Datum	
Project #	Broward-1-8
county	Broward
hole name	TB-8
test date	
report date	
GWT elev	6 (ft)
top of boring	0 (ft)
ground elev	(ft)
latitude	
longitude	
station #	
offset	
Reference	
x coord.	#N/A (ft)
y coord.	#N/A (ft)
x coord.	#N/A (ft)
y coord.	#N/A (ft)
x coord.	(ft)
y coord.	(ft)
Casing Length	88.5 (ft)

line #	elev. (ft)	depth (ft)	N blows	interval (in)	Soil Pre-descriptor	Soil Type	Soil Post-descripto	USCS	AASHTO	Note
21	*scroll & click in list boxes here*									
1		0.67			asphaltic concrete					
2		2.00	5		clean limerock/gravel			GW		
3		4.00	4		clean limerock/gravel			GW		
4		6.00	2		silty fine to coarse	Sand	trace to	SP		ll" after the description; at 6 ft, the USCS
5		8.00	27		50% drilling fluid circulation loss					
6		10.00	30		light brown	Limestone Soft	silty sand			(upper limestone formation)
7		15.00	17		light brown	Limestone Soft	fine sand			(upper limestone formation)
8		20.00	9		light gray to brown clean	Sand	y trace to	SP		
9		25.00	7		light gray to brown clean	Sand	y trace to	SP		
10		30.00	2		light gray to brown slightly silty	Sand	y trace to	SP-SM		
11		35.00	2		light gray to brown slightly silty	Sand	y trace to	SP-SM		
12		40.00	2		light gray to brown fine	Sand	y trace to	SP-SM		
13		45.00	6		light gray to brown fine	Sand	y trace to	SP-SM		
14		50.00	65		gray limestone and/or sandstone	Limestone Hard	silty to silty			(lower limestone formation)
15		55.00	47		gray limestone and/or sandstone	Limestone Hard	silty to silty			(lower limestone formation)
16		60.00	34		fine	Sand	y trace to	SP		t 60 ft, the USCS was classified as SP a
17		65.00	15		light gray to gray fine to coarse	Sand	cemented,	SP		n 65 and 75 ft, the USCS was classified
18		70.00	29		light gray to gray fine to coarse	Sand	cemented,	SP		
19		75.00	26		light gray to gray fine to coarse	Sand	cemented,	SP		
20		80.00	34		gray limestone and/or sandstone	Limestone Soft	silty to silty			(lower limestone formation)
21		85.00	96		gray limestone and/or sandstone	Limestone Hard	silty to silty			(lower limestone formation)
22		90.00	80	11	gray limestone and/or sandstone	Limestone Hard	silty to silty			(lower limestone formation)
23										
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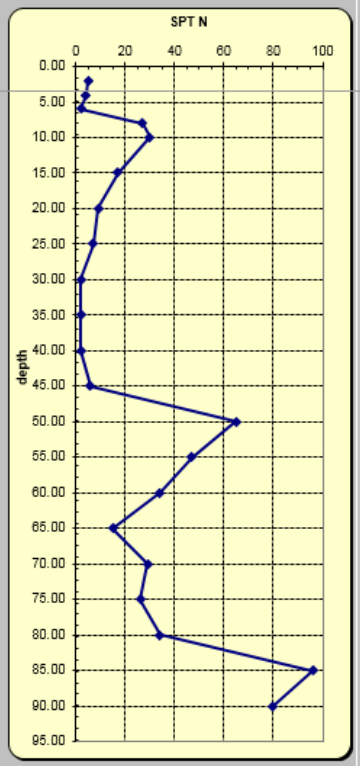
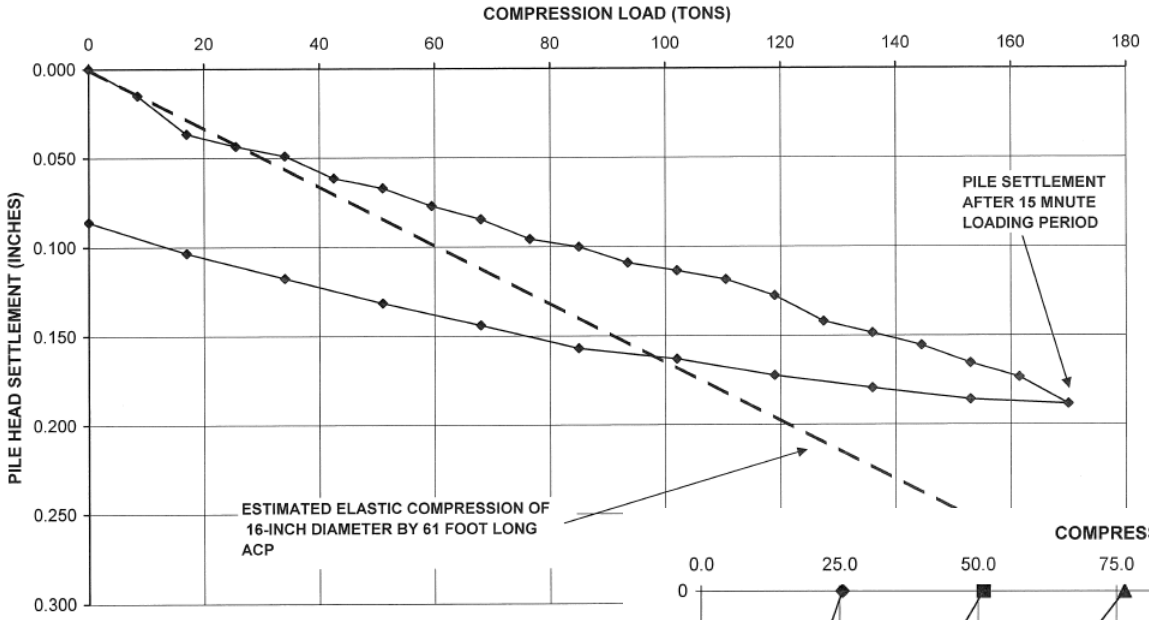
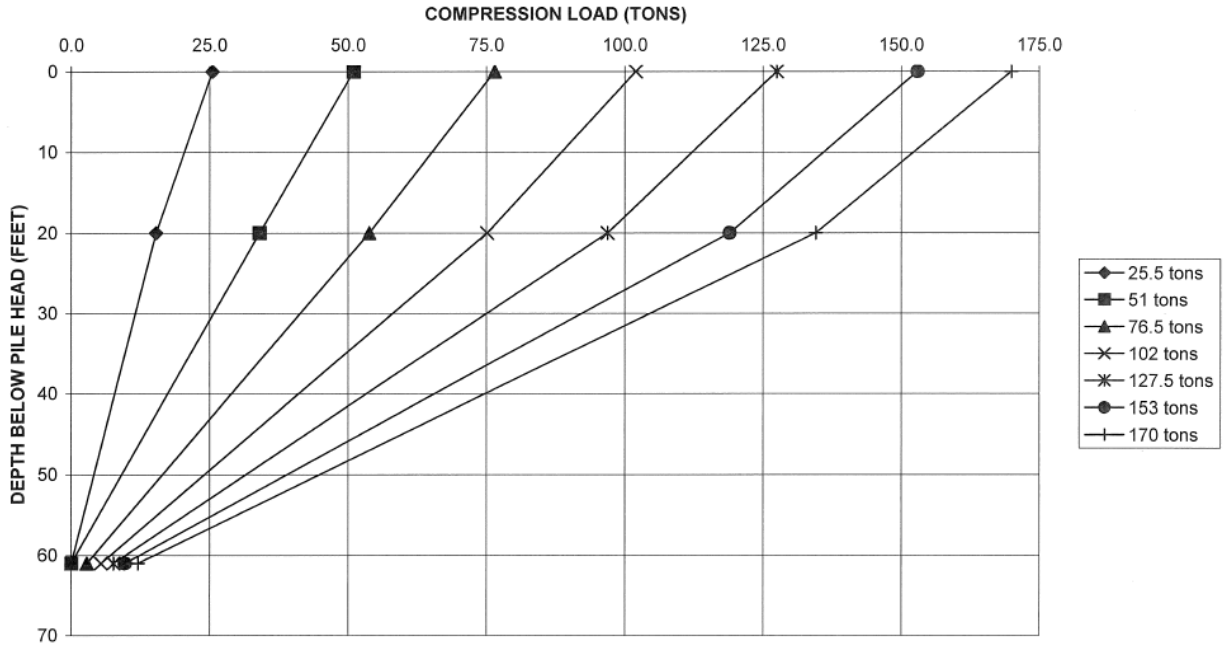


ex_import | general | SPT | CPT | PMT | DMT | VST | Help

ACIP Pile Load Test Data

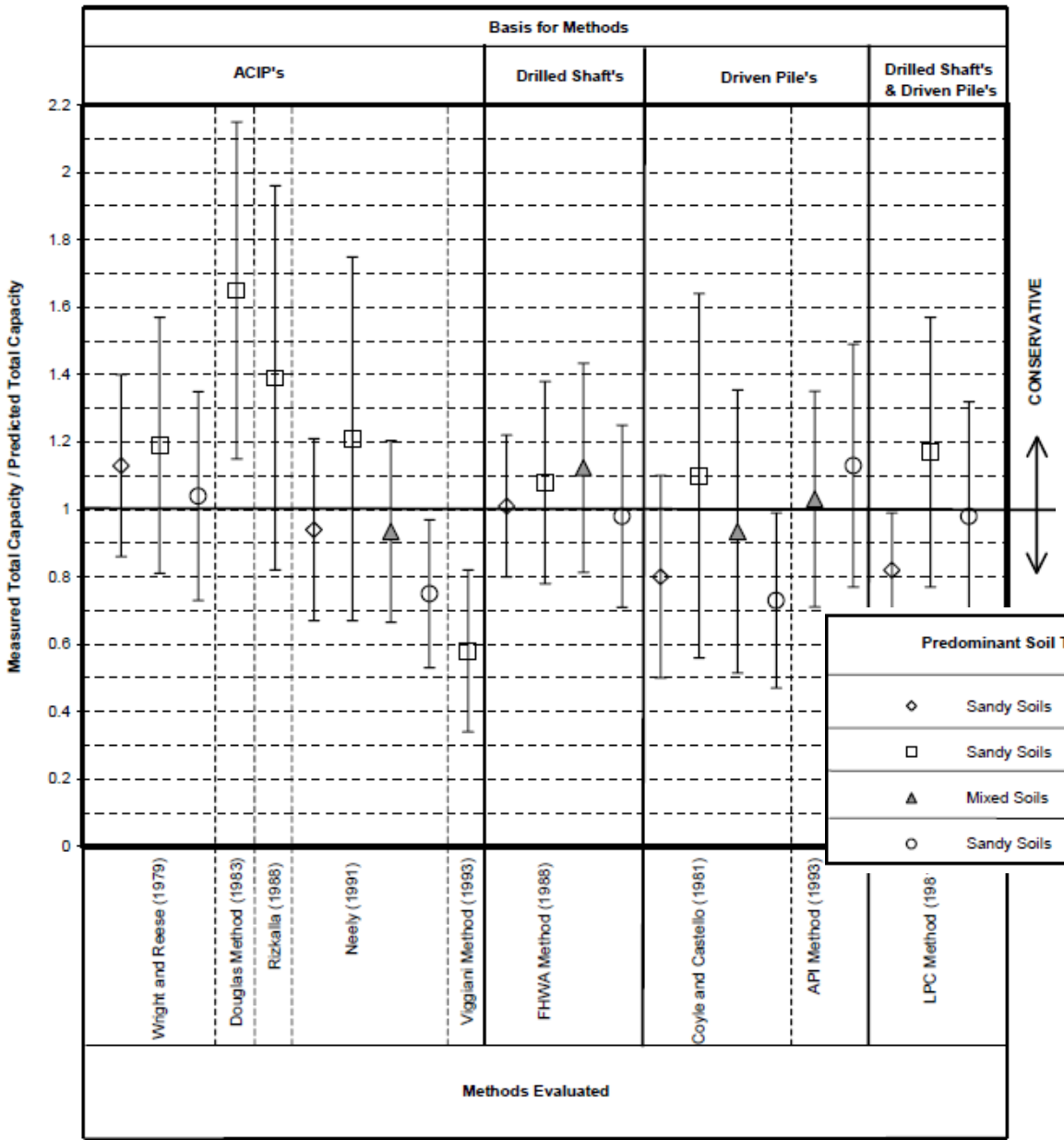




Task 2 – Background and Review

- Current guidelines require LRFD Φ = 0.6 for ACIP piles
- Brown et al. (2007) reviewed methods to estimate side and tip resistance based on:
  - SPT
  - CPT
  - DCPT (Dynamic CPT)
  - Undrained shear strength
  - Unconfined compressive strength of geomaterials
- FDOT guidelines limit capacity estimation to side resistance only; neglecting tip resistance
- Torque, crowd force, penetration rate, tip pressure and concrete volume monitoring on rigs available
- Useful for real time side and tip capacity and adjust pile length
- However; not frequently used and lack of data

Task 2 – Background and Review



	Predominant Soil Type	Study		Ultimate Capacity Defined at Displacements of
◇	Sandy Soils	McVay et al (1994)	-	5 % of the Pile Diameter
□	Sandy Soils	Zelada and Stephenson (2000)	-	5 % of the Pile Diameter
△	Mixed Soils	Coleman and Arcement (2002)	-	10 % of the Pile Diameter
○	Sandy Soils	O'Neill et al. (1999)	-	5 % of the Pile Diameter

Thank You!

Questions?