Prediction of P-y Curves from Dilatometer Tests Case Histories and Results

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ABSTRACT: The p-y method made popular by Reese (1983) has become the de facto method for the analysis of deep foundation systems under lateral loading. This approach has been implemented in computer programs such as FB-MultiPier and LPILE. Both codes include typical p-y curves based on soil parameters, but also allow the input of custom user defined curves. Based on original work by Roberston et al. (1989), p-y curves were generated based on dilatometer soundings at sites where lateral load tests were performed. The sites and tests include:

1) Roosevelt Bridge - Stuart, Florida: single pile and pile group load tests

2) US17 Bypass - Wilmington, North Carolina: single pile and pile/drilled shaft group load tests

3) Rio Puerto Nuevo - San Juan, Puerto Rico: steel pipe pile load tests

4) Salt Lake City International Airport – Utah: single pile and pile group load tests

5) East Pascagoula River Bridge - Mississippi: pile/drilled shaft group load test

6) Auburn NGES - Opelika Alabama: multiple drilled shaft and pile group load tests

The p-y curves were implemented in the program FB-MultiPier to predict the results of a lateral load test at each site. The paper documents the dilatometer sounding data and associated p-y curves. For each load test, the general geometry is presented and the actual load test data is plotted with the dilatometer based predictions.

1 INTRODUCTION

The p-y method, made popular by Reese (1983), is commonly used in the analysis of deep foundations (piles or drilled shafts) under lateral load. The computer programs LPILE (Ensoft, 2005) and FB-MultiPier (Florida BSI, 2005), the standard tools for lateral substructure analysis, include the p-y method. While normalized p-y curves developed from limited research sites are included both programs, it is most useful to develop custom p-y curves derived from insitu soil tests at the project site.

The dilatometer test (DMT) was developed by Marchetti (1980). The DMT is conducted by pushing a flat blade with a laterally inflatable disc to a test depth, then inflating the disc into the soil using gas pressure. The disc moves 1.1 mm laterally, thereby performing an insitu small strain “lateral load test” (figure 1). Thus, logically, the results of the DMT test have been used to develop p-y curves for soil, including those by Robertson et al. (1989) and Gabr and Borden (1988).

Validating of p-y curves generated from any method is accomplished by simulating a full pile or drilled shaft load test using software such as LPILE or FB-MultPier. In this paper, six load tests are examined where DMT tests were performed prior to foundation installation. In the following discussion, each case history is detailed with The DMT sounding data, pile load tests details, derived p-y curves, and comparison of load test and computer based simulation.

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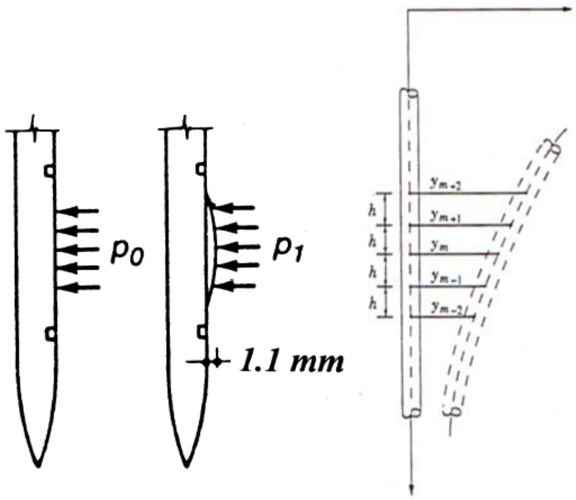

Figure 1 DMT Inflation versus Pile Lateral Loading.

2 SOIL STRUCTURE INTERACTION WITH P-Y CURVES

As previously mentioned, the dilatometer test produces one millimeter of lateral deformation; therefore, there are no increments of pressure with which to develop a load-deformation curve. Therefore, a "hybrid method" using the properties determined from the dilatometer indices are used in conjunction with a parabolic function to develop p-y curves. For this case history, curves determined from dilatometer tests were developed based on the method presented by Robertson et al. (1989).

For cohesive soils a cubic parabolic p-y curve was suggested:

$$\frac{P}{P_u} = 0.5\left(\frac{y}{y_c}\right)^{0.33} \quad (1)$$

$$y_c = \frac{23.67 S_u D^{0.5}}{F_c E_D} \quad (2)$$

where y_c is the reference deflection, Su is the undrained strength of the soil, D is the pile diameter, F_c is a factor ≈ 10, and E_D is the dilatometer modulus. The evaluation of the ultimate lateral resistance Pu is given as:

$$P_u = N_p S_u D \quad (3)$$

At considerable depths Np ≈ 9, but near the surface it reduces to a range of 2 - 4; accordingly,

$$N_p = 3 + \frac{\sigma_{vo}'}{S_u} + \left(J\frac{x}{D}\right) < 9.0 \quad (4)$$

and x = depth, σ_{v0}' = effective stress at depth x, and J = 0.5 (soft clay) to 0.25 (stiff clay).

For cohesionless soils, the same cubic parabola, equation (1) is used, where P_u is from Reese et al. (1974) and Murchison and O'Neill (1984) and is the lesser of:

$$P_u = \sigma_{v0}'[D(K_p - K_a) + xK_p \tan\phi' \tan\beta] \quad (5)$$

$$P_u = \sigma_{v0}' D[K_p^{\ 3} + 2K_a K_p^{\ 2} \tan\phi' - \tan\phi' - K_a] \quad (6)$$

and

$$\beta \text{ is } 45^{\circ} + \frac{\phi'}{2} \quad (7)$$

And y_c is:

$$y_c = \frac{4.17 \sin\phi' \sigma_{v0}'}{E_D F_\phi (1 - \sin\phi')} D \quad (8)$$

where F_ϕ is an empirical factor equal to 1 for cohesionless soil.

Data from a dilatometer soundings at the each test site was reduced using the computer program "Dilly" (GPE Inc., 1993) to get values for ϕ or S_u and E_D for the p-y curves.

3 CASE HISTORIES

In this section, each case history will be briefly introduced. It is the intent of the authors to provide enough information on the case history that the reader may be able to generate p-y curves and perform his or her own analysis. Therefore, the complete DMT sounding, p-y curves generated, pile properties, load test geometry, and the results of the simulation by the author are included at the end of the paper.

3.1 *Roosevelt Bridge - Stuart, Florida*

A submerged 4 by 4 free-head pile group of 760 mm prestressed concrete piles was laterally loaded as part of a test program for the construction of a new bridge over the St. Lucie River by the Florida Department of Transportation. An additional load test on pile 9, one of the piles from the group, was performed by pushing the pile in the opposite direction from the group load test. (Ruesta, and Townsend, 1997).

The soil profile at Roosevelt consisted of layers of loose sand over cemented sand, both with shell fragments.

3.2 *US 17 Bypass – Wilmington North Carolina*

The test program was funded by the NCDOT and NCHRP for a new US 17 bridge over the NE Cape Fear River near Wilmington, NC. At Test Area 2, a 915mm diameter concrete cylinder pile with a wall thickness of 152mm and embedded length of 26.4m was laterally loaded against a 762mm square prestressed concrete pile embedded 27.6 m.

The soil profile at the Wilmington Bypass site was comprised of two zones of sand: a loose alluvial fine sand layer over a dense fine sand known as the Pee Dee formation.

3.3 *Rio Puerto Nuevo, San Juan, Puerto Rico*

The test program consisted of pushing apart two 1219mm with a 19mm thick wall open ended steel pipe piles separated by approximately 7.6m as part of a test program for a cantilever wall system by the US Army Corps of Engineers – Jacksonville District. One pile was driven to elevation -13.1m (short pile), while the other to elevation -19.7m (long pile). Two static load tests were performed on the piles. The first "pre-excavation" test was performed with the ground surface at elevation +0.7m. Subsequently, a cofferdam was installed and the soil excavated to elevation – 5m, "post-excavation", to simulate planned dredging in front of the wall. The post excavation load test was considered in this study.

The subsurface profile at Puerto Nueveo was predominantly clay with some trace fine sands.

3.4 *Salt Lake City International Airport - Utah*

The project consisted of four lateral load tests; two static tests and two StatNAMIC. One of the static tests was performed upon a single pile and the other upon a free-head pile group. According to Peterson (1996), the single pile test, analyzes in this discussion, was performed to obtain the row-multipliers in order to normalize the pile group results. A sheet pile wall was used as reaction.

The soil profile at this site consists of interbedded layers of sand and clay, however, the predominant soil type in the critical depth for lateral analysis was clay.

3.5 *East Pascagoula River Bridge - Mississippi*

The test program consisted of a submerged group of two 2100mm drilled shafts spaced at 3 diameters, which reacted against a group of 6 762mm prestressed concrete piles. Both groups were embedded into 2.4-m thick concrete caps and subjected to static and StatNAMIC lateral loadings (Anderson and Townsend, 1999). For this analysis of the drilled shafts p-y multipliers of 0.8 (leading) and 0.4 (trailing) and for the piles (Ruesta and Townsend, 1997) were used.

Soils at Pascagoula were interbedded layers of sand and clay.

3.6 *Auburn NGES - Opelika, Alabama*

Six 915mm drilled shafts were laterally loaded as part of a static and Statnamic test program for Alabama DOT and FHWA project at Auburn University. Shaft 2 in the SW was analyzed for this study (Anderson at al., 1999) (Brown and Vinson, 1998).

The soil at the Auburn site is characteristic of the Piedmont geological province of the southeastern United States. These soils are derived from weathering of metamorphic rocks, predominantly gneisses and schists of and are composed of micaceous sandy silts.

4 DISCUSSION

Each of the load tests were simulated using FB-Pier, the earlier generation of the program that is currently distributed at FB-MultPier. The structural details of each pile or drilled shaft were collected including the shape, reinforcing details, strength, and modulus. FB-MultiPier includes a full non-linear structural model that accounts for cracked and yielding sections. As the structural models are well developed, the focus of this discussion will attribute quality of fit to soil parameters.

The load tests can be separated into several categories. The prominent groups to consider are piles and drilled shafts and cohesionless and cohesive soils. Of the six tests, two are on drilled shafts (Pascagoula and Auburn) and the remaining four are piles (Roosevelt, Wilmington, Puerto Nuevo, and Salt Lake City). The soils represented, three are predominantly cohesionless (Roosevelt, Wilmington, and Auburn), and three have significant cohesive soils (Pascagoula, Puerto Nuevo, and Salt Lake City).

When comparing the load test simulations between drilled shafts and piles, it does not appear that DMT p-y curves work better for drilled shafts or piles.

Considering the difference between cohesive and cohesionless soils, the data suggest that predictions in cohesionless materials are better than those in cohesive materials.

Within the piles, two were prestressed concrete and two were pipe piles. Predictions among the piles may show slightly better prediction for concrete piles versus steel pipe. However, this may be affected by the cohesionless versus cohesive behavior discussed previously.

5 SUMMARY AND CONCLUSION

Six deep foundation load tests were simulated using p-y curves generated from DMT tests. The six tests represent foundation types including drilled shafts, concrete piles, and steel pipe piles. In addition, half

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of the tests were performed in cohesionless soil and the remainder in cohesive soils. From these analyses, the following conclusions are drawn:

1) DMT generated p-y curves provide a better model for cohesionless soils than cohesive
2) There is little difference between the goodness of predictions for DMT p-y curves for piles and drilled shafts.
3) DMT p-y curves may better suited for concrete piles over pipe piles.

It should be noted that these conclusions have been drawn from limited case histories. The author continues to collect case studies of lateral load tests with DMT and other insitu tests for verification of these methods.

6 ACKNOWLEDGEMENTS

Access to load test data was essential to the research this paper was based on. Individuals and agencies that shared data include:

Paul Bullock – Schmertmann and Crapps
Dan Brown – Auburn University
Florida Department of Transportation
Scott Hidden – North Carolina Department of Transportation
Mike Muchard and Don Robertson – Applied Foundation Testing
Kyle Rollins – Brigham Young University
Kimberly Spoor and Pauline Smith – US Army Corps of Engineers Jacksonville District

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DILATOMETER DATA LISTING & INTERPRETATION (BASED ON THE 1988 DILATOMETER MANUAL)   SNDG. NO. DMT-1

University of Florida

JOB FILE: Roosevelt Bridge   FILE NO. : UF1995

LOCATION: Vicinity of Pier 16

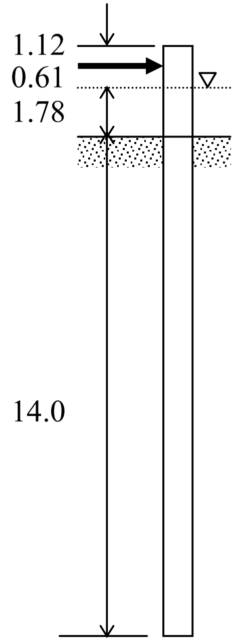
SNDG.BY : Pedro, FCT, Ed   SNDG.DATE: November 1995

ANAL.BY : J.B. Anderson   ANAL.DATE: 27 Dec 05

ANALYSIS PARAMETERS:	LO RANGE =40.00 BARS	ROD DIAM. = 3.57 CM	BL.THICK. = 15.0 MM	SU FACTOR = 1.00
SURF.ELEV. = -2.00 M	LO GAGE 0 = 0.05 BARS	FR.RED.DIA. = 4.78 CM	BL.WIDTH = 96.0 MM	PHI FACTOR = 1.00
WATER DEPTH = 0.00 M	HI GAGE 0 = 0.00 BARS	LIN.ROD WT. = 6.50 KGF/M	DELTA-A = 0.20 BARS	OCR FACTOR = 1.00
SP.GR.WATER = 1.000	CAL GAGE 0 = 0.05 BARS	DELTA/PHI = 0.50	DELTA-B = 1.50 BARS	M FACTOR = 1.00
MAX SU ID = 0.60	SU OPTION = MARCHETTI	MIN PHI ID = 1.20	OCR OPTION= MARCHETTI	K0 FACTOR = 1.00

UNIT CONVERSIONS: 1 BAR = 1.019 KGF/CM2 = 1.044 TSF = 14.51 PSI 1 M = 3.2808 FT

Z (M)	THRUST (KGF)	A (BAR)	B (BAR)	C (BAR)	P0 (BAR)	P1 (BAR)	P2 (BAR)	U0 (BAR)	GAMMA (T/M3)	SVP (BAR)	KD	ID	UD	ED (BAR)	K0	SU (BAR)	QD (BAR)	PHI (DEG)	SIGFF (BAR)	PHIO (DEG)	PC (BAR)	OCR	M (BAR)	SOIL TYPE
*****	******	*****	*****	*****	*****	*****	*****	******	******	******	*****	*****	*****	******	*****	*****	*****	*****	******	*****	*****	*****	******	***********
0.25		0.39	2.85		0.55	1.35		0.025	0.02	-0.025	-21.50	1.51	0.00	28.									0.	SANDY SILT
0.50		0.54	4.05		0.65	2.55		0.049	1.70	-0.028	-21.44	3.17	0.00	66.									0.	SILTY SAND
0.75		0.58	4.85		0.65	3.35		0.074	1.70	-0.011	-53.35	4.67	0.00	94.									0.	SAND
1.00		0.80	5.45		0.85	3.95		0.098	1.70	0.006	118.95	4.11	0.00	107.									521.	SAND
1.25		0.53	3.85		0.65	2.35		0.123	1.70	0.024	22.38	3.23	0.00	59.									193.	SILTY SAND
1.50		1.15	6.85		1.15	5.35		0.147	1.80	0.042	23.92	4.19	0.00	146.									485.	SAND
1.75		0.92	6.05		0.95	4.55		0.172	1.70	0.060	12.88	4.64	0.00	125.									342.	SAND
2.00		0.75	4.45		0.85	2.95		0.196	1.70	0.077	8.44	3.21	0.00	73.									171.	SILTY SAND
2.25		1.07	5.25		1.15	3.75		0.221	1.70	0.095	9.77	2.81	0.00	90.									224.	SILTY SAND
2.50		1.18	5.45		1.25	3.95		0.245	1.70	0.112	9.00	2.68	0.00	94.									225.	SILTY SAND
2.75		1.34	6.85		1.35	5.35		0.270	1.80	0.130	8.29	3.71	0.00	139.									324.	SAND
3.00		1.53	6.85		1.55	5.35		0.294	1.80	0.150	8.37	3.03	0.00	132.									309.	SILTY SAND
3.25		1.53	6.85		1.55	5.35		0.319	1.80	0.169	7.26	3.09	0.00	132.									293.	SILTY SAND
3.50		1.58	7.85		1.55	6.35		0.343	1.80	0.189	6.39	3.97	0.00	167.									351.	SAND
3.75		2.99	13.45		2.75	11.95		0.368	1.90	0.210	11.35	3.86	0.00	319.									836.	SAND
4.00		11.94	33.45		11.15	31.95		0.393	2.15	0.235	45.75	1.93	0.00	722.									2844.	SILTY SAND
4.25		6.13	23.45		5.55	21.95		0.417	2.00	0.261	19.63	3.20	0.00	569.									1786.	SILTY SAND
4.50		2.71	19.65		2.15	18.15		0.442	1.90	0.285	5.99	9.38	0.00	555.									1141.	SAND
4.75		6.39	24.85		5.75	23.35		0.466	2.00	0.308	17.16	3.33	0.00	611.									1839.	SAND
5.00		5.57	19.65		5.15	18.15		0.491	2.00	0.333	14.01	2.79	0.00	451.									1272.	SILTY SAND
5.25		7.18	29.45		6.35	27.95		0.515	2.00	0.357	16.34	3.70	0.00	749.									2222.	SAND



Length: 17.5m

Type: Square, Prestressed

Width: 762mm Void Diameter: 457mm

Void:

Material Properties:

Concrete:

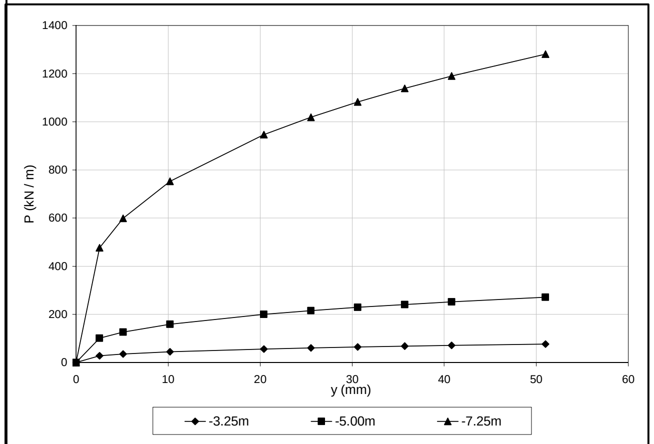
$f'_c = 44.8$ MPa

$E_c = 31.5$ GPa

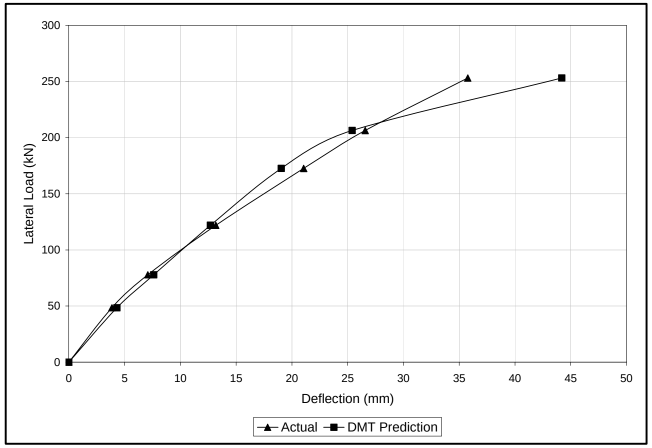
Steel:

$f_y = 275.7$ MPa

$E_s = 200$ GPa



P-y Curves for Roosevelt Bridge



Simulation Results for Roosevelt Bridge

Figure 1Roosevelt Bridge Load Test

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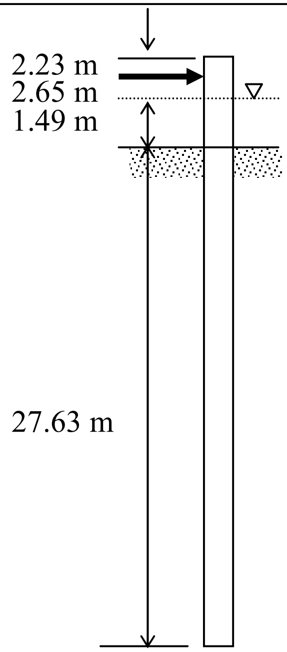
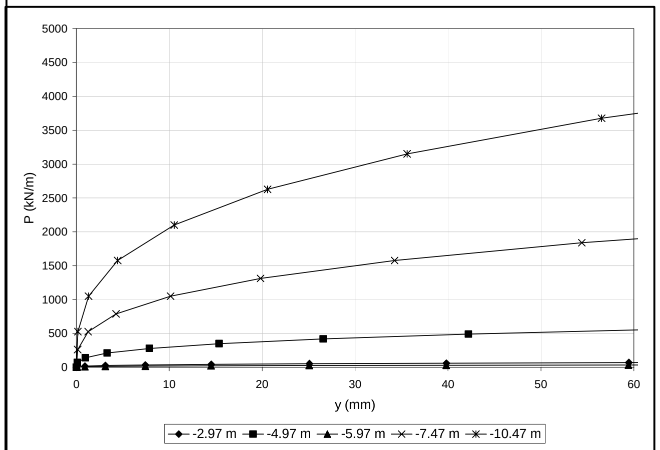
DILATOMETER DATA LISTING & INTERPRETATION (BASED ON THE 1988 DILATOMETER MANUAL)         SNDG. NO.  DMT-1
University of Florida
JOB FILE: Wilmington Bypass- NCDOT                                                       FILE NO. : UF 1998-1
LOCATION: 38+55 34.5 L
SNDG.BY : Brian, Andrew, Norb, Cory, Tom                                                 SNDG.DATE: 6 January 99
ANAL.BY : J.B. Anderson                                                                  ANAL.DATE: 27 Dec 05

ANALYSIS PARAMETERS:      LO RANGE   =40.00 BARS   ROD DIAM.    = 4.44 CM     BL.THICK. = 15.0 MM   SU  FACTOR = 1.00
 SURF.ELEV.  = -1.46 M    LO  GAGE 0 = 0.00 BARS   FR.RED.DIA. = 5.71 CM     BL.WIDTH  = 96.0 MM   PHI FACTOR = 1.00
 WATER DEPTH =  0.00 M    HI  GAGE 0 = 0.00 BARS   LIN.ROD WT. = 6.25 KGF/M  DELTA-A   = 0.19 BARS OCR FACTOR = 1.00
 SP.GR.WATER = 1.000      CAL GAGE 0 = 0.00 BARS   DELTA/PHI    = 0.50       DELTA-B   = 0.42 BARS  M  FACTOR = 1.00
 MAX SU ID   = 0.60       SU OPTION  = MARCHETTI   MIN PHI ID   = 1.20       OCR OPTION= MARCHETTI  K0 FACTOR = 1.00
UNIT CONVERSIONS:         1 BAR = 1.019 KGF/CM2 = 1.044 TSF = 14.51 PSI    1 M = 3.2808 FT
```

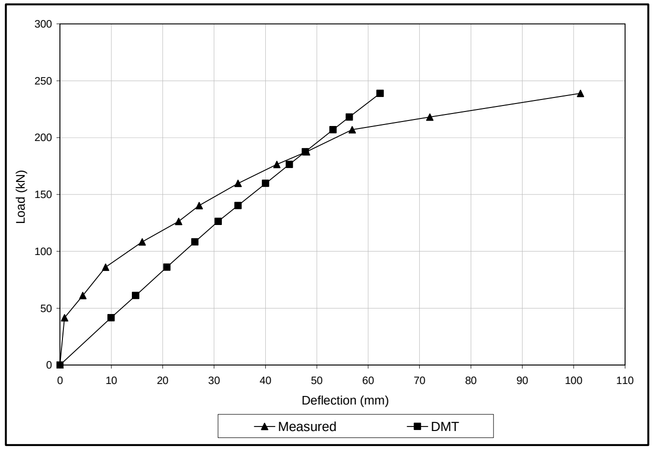
Z (M)	THRUST (KGF)	A (BAR)	B (BAR)	C (BAR)	P0 (BAR)	P1 (BAR)	P2 (BAR)	U0 (BAR)	GAMMA (T/M3)	SVP (BAR)	KD	ID	UD	ED (BAR)	K0	SU (BAR)	QD (BAR)	PHI (DEG)	SIGFF (BAR)	PHIO (DEG)	PC (BAR)	OCR	M (BAR)	SOIL TYPE
*****	******	*****	*****	*****	*****	*****	*****	******	******	******	*****	*****	*****	******	*****	*****	*****	*****	******	*****	*****	*****	******	***********
0.83		0.80	4.20		0.85	3.78		0.081	1.70	0.069	11.15	3.81	0.00	102.									265.	SAND
1.33		1.00	4.40		1.05	3.98		0.131	1.70	0.103	8.90	3.18	0.00	102.									244.	SILTY SAND
1.83		0.80	3.40		0.89	2.98		0.180	1.70	0.138	5.16	2.94	0.00	73.									139.	SILTY SAND
2.33		4.80	12.80		4.62	12.38		0.229	1.80	0.174	25.17	1.77	0.00	269.									908.	SANDY SILT
2.83		1.60	4.20		1.69	3.78		0.278	1.70	0.211	6.69	1.48	0.00	73.									153.	SANDY SILT
3.33		0.60	3.20		0.69	2.78		0.327	1.70	0.246	1.48	5.74	0.00	73.									62.	SAND
3.83		0.80	2.40		0.94	1.98		0.376	1.70	0.280	2.02	1.84	0.00	36.									36.	SILTY SAND
4.33		1.00	2.80		1.13	2.38		0.425	1.60	0.312	2.26	1.77	0.00	43.									47.	SANDY SILT
4.83		1.50	2.20		1.69	1.78		0.474	1.50	0.339	3.58	0.08	0.00	3.	0.90	0.15					0.84	2.5	5.	MUD
5.33		1.40	2.80		1.55	2.38		0.523	1.60	0.366	2.81	0.81	0.00	29.	0.74						0.62	1.7	35.	CLAYEY SILT
5.83		1.60	3.00		1.75	2.58		0.572	1.60	0.395	2.98	0.70	0.00	29.	0.78						0.74	1.9	36.	CLAYEY SILT
6.33		2.70	9.00		2.61	8.58		0.621	1.90	0.432	4.59	3.01	0.00	207.									378.	SILTY SAND
6.83		3.80	12.00		3.61	11.58		0.670	1.90	0.476	6.17	2.71	0.00	277.									573.	SILTY SAND
7.33		4.80	15.00		4.51	14.58		0.719	1.90	0.520	7.28	2.66	0.00	349.									775.	SILTY SAND
7.83		5.60	17.40		5.23	16.98		0.768	2.00	0.567	7.87	2.63	0.00	408.									932.	SILTY SAND
8.33		5.60	15.80		5.31	15.38		0.817	2.00	0.616	7.29	2.24	0.00	349.									772.	SILTY SAND
8.83		7.80	23.80		7.22	23.38		0.867	2.00	0.665	9.55	2.54	0.00	561.									1379.	SILTY SAND
9.33		8.20	27.00		7.48	26.58		0.916	2.00	0.714	9.19	2.91	0.00	663.									1608.	SILTY SAND



Length: 34m
Type: Square Prestressed
Width: 762mm
Void Diameter: 424.2mm
Material Properties:
Concrete:
$f'_c = 41.8$ MPa
$E_c = 30.4$ GPa
Steel:
$f_y = 275.7$ MPa
$E_s = 200$ GPa



P-y Curves for Wilmington



Simulation Results for Wilmington

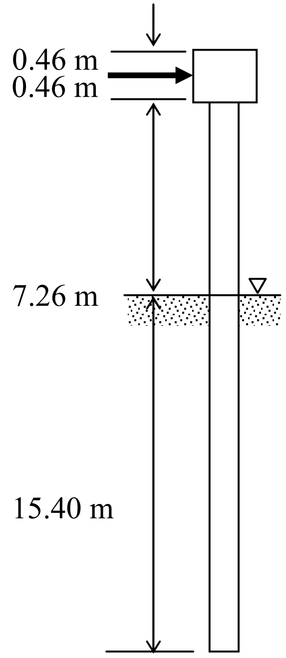
Figure 2 Wilmington Bypass Load Test

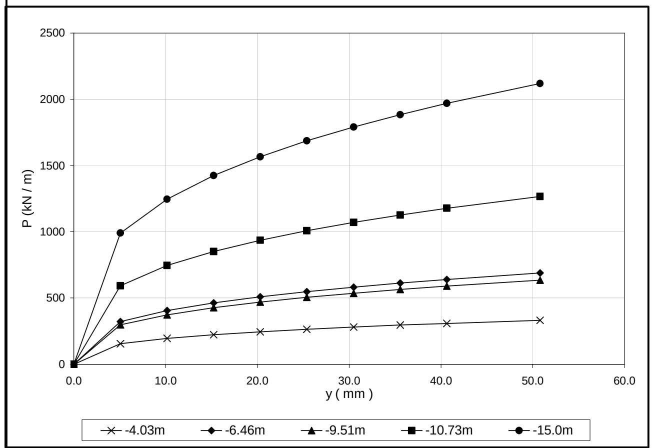
BACK

DILATOMETER DATA LISTING & INTERPRETATION (BASED ON THE 1988 DILATOMETER MANUAL) SNDG. NO. DMT-1
University of Florida
JOB FILE: Rio Puerto Nueveo Project - USACOE Jax FILE NO. : UF 1998-1
LOCATION: CB-59
SNDG.BY : Anderson, Townsend, Guzman, Spoor SNDG.DATE: 10 March 98
ANAL.BY : J.B. Anderson ANAL.DATE: 27 Dec 05

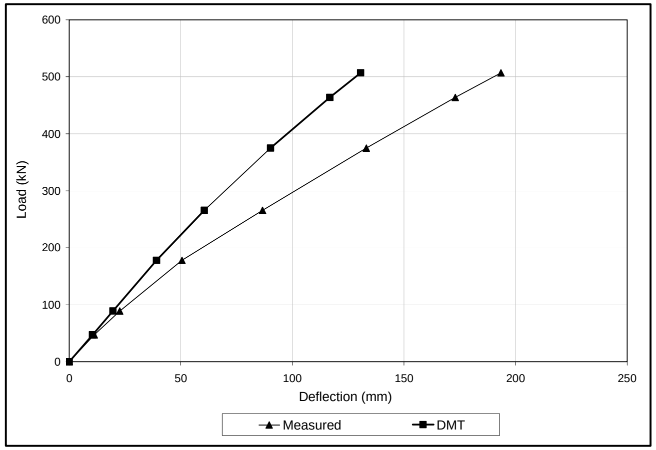
ANALYSIS PARAMETERS: LO RANGE =40.00 BARS ROD DIAM. = 4.44 CM BL.THICK. = 15.0 MM SU FACTOR = 1.00
SURF.ELEV. = 0.00 M LO GAGE 0 = 0.00 BARS FR.RED.DIA. = 5.71 CM BL.WIDTH = 96.0 MM PHI FACTOR = 1.00
WATER DEPTH = 2.68 M HI GAGE 0 = 0.00 BARS LIN.ROD WT. = 6.25 KGF/M DELTA-A = 0.11 BARS OCR FACTOR = 1.00
SP.GR.WATER = 1.000 CAL GAGE 0 = 0.00 BARS DELTA/PHI = 0.50 DELTA-B = 0.97 BARS M FACTOR = 1.00
MAX SU ID = 0.60 SU OPTION = MARCHETTI MIN PHI ID = 1.20 OCR OPTION= MARCHETTI K0 FACTOR = 1.00
UNIT CONVERSIONS: 1 BAR = 1.019 KGF/CM2 = 1.044 TSF = 14.51 PSI 1 M = 3.2808 FT

Z (M)	THRUST (KGF)	A (BAR)	B (BAR)	C (BAR)	P0 (BAR)	P1 (BAR)	P2 (BAR)	U0 (BAR)	GAMMA (T/M3)	SVP (BAR)	KD	ID	UD	ED (BAR)	K0	SU (BAR)	QD (BAR)	PHI (DEG)	SIGFF (BAR)	PHIO (DEG)	PC (BAR)	OCR	M (BAR)	SOIL TYPE
*****	******	*****	*****	*****	*****	*****	*****	******	******	******	*****	*****	*****	******	*****	*****	*****	*****	******	*****	*****	*****	******	***********
5.49		1.70	3.80		1.76	2.83		0.276	1.60	0.586	2.53	0.72	0.00	37.	0.68						0.85	1.4	41.	CLAYEY SILT
6.10		1.10	2.40		1.20	1.43		0.336	1.50	0.619	1.39	0.27	0.00	8.	0.37	0.09					0.35	0.6	7.	MUD
6.71		1.60	3.70		1.66	2.73		0.395	1.60	0.652	1.94	0.85	0.00	37.	0.53						0.62	1.0	32.	CLAYEY SILT
7.32		1.70	3.70		1.76	2.73		0.455	1.60	0.688	1.90	0.74	0.00	34.	0.52						0.64	0.9	28.	CLAYEY SILT
7.92		1.90	4.30		1.94	3.33		0.514	1.60	0.723	1.98	0.97	0.00	48.	0.54						0.71	1.0	42.	SILT
8.53		2.30	5.50		2.30	4.53		0.574	1.70	0.762	2.27	1.29	0.00	77.									81.	SANDY SILT
9.14		3.10	6.60		3.09	5.63		0.634	1.70	0.804	3.05	1.04	0.00	88.	0.80						1.56	1.9	116.	SILT
9.75		2.40	5.40		2.41	4.43		0.694	1.70	0.846	2.03	1.17	0.00	70.	0.55						0.87	1.0	65.	SILT
10.36		3.70	6.60		3.72	5.63		0.754	1.70	0.888	3.34	0.64	0.00	66.	0.86						1.98	2.2	91.	CLAYEY SILT
10.97		4.00	7.80		3.97	6.83		0.814	1.80	0.933	3.39	0.90	0.00	99.	0.87						2.12	2.3	140.	SILT
11.58		3.30	6.30		3.31	5.33		0.873	1.70	0.978	2.50	0.83	0.00	70.	0.67						1.38	1.4	77.	CLAYEY SILT
12.19		3.60	6.40		3.62	5.43		0.933	1.70	1.019	2.64	0.67	0.00	63.	0.70						1.57	1.5	72.	CLAYEY SILT
12.80		3.70	6.90		3.70	5.93		0.993	1.70	1.061	2.55	0.82	0.00	77.	0.68						1.55	1.5	87.	CLAYEY SILT
13.41		6.40	10.40		6.36	9.43		1.053	1.80	1.106	4.80	0.58	0.00	106.	1.13	0.73					4.34	3.9	186.	SILTY CLAY
13.94		7.00	11.90		6.92	10.93		1.105	1.80	1.148	5.07	0.69	0.00	139.	1.17						4.89	4.3	251.	CLAYEY SILT
15.85		9.80	14.60		9.72	13.63		1.292	1.90	1.307	6.45	0.46	0.00	136.	1.38	1.24					8.12	6.2	278.	SILTY CLAY
16.46		11.60	17.40		11.47	16.43		1.352	1.90	1.361	7.44	0.49	0.00	172.	1.52	1.55					10.56	7.8	378.	SILTY CLAY
17.07		11.00	16.60		10.88	15.63		1.412	1.90	1.415	6.69	0.50	0.00	165.	1.42	1.41					9.32	6.6	344.	SILTY CLAY
17.68		11.20	16.00		11.12	15.03		1.472	1.90	1.469	6.57	0.40	0.00	136.	1.40	1.43					9.40	6.4	281.	SILTY CLAY
18.29		13.20	17.40		13.15	16.43		1.532	1.90	1.523	7.63	0.28	0.00	114.	1.55	1.79					12.30	8.1	253.	CLAY





P-y Curves for Puerto Nuevo



Simulation Results for Puerto Nuevo

Length: 23.35m
Type: Steel Pipe
Diameter: 1219 mm
Thickness: 19.1 mm
Material Properties:
Steel:
f_y = 275.7 MPa
E_s = 200 GPa
Cap Concrete:
f'_c = 27.7 MPa
E_c = 24.86 GPa

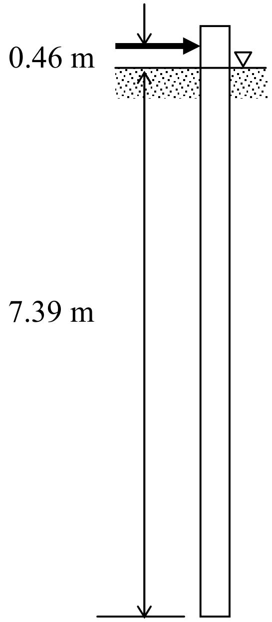
Figure 3 Puerto Nuevo Load Test

BACK

```
DILATOMETER DATA LISTING & INTERPRETATION (BASED ON THE 1988 DILATOMETER MANUAL)         SNDG. NO.  DMT-SE
University of Florida
JOB FILE: Salt Lake City                                                                 FILE NO. : SLC
LOCATION: BYU Load Test Site
SNDG.BY : ???                                                                            SNDG.DATE: November 1995
ANAL.BY : J.B. Anderson                                                                  ANAL.DATE: 27 Dec 05

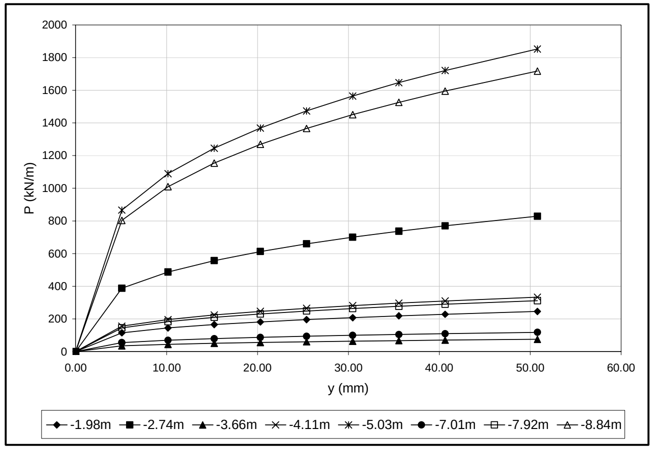
ANALYSIS PARAMETERS:      LO RANGE   =40.00 BARS   ROD DIAM.    = 3.57 CM      BL.THICK. = 15.0 MM   SU  FACTOR = 1.00
 SURF.ELEV.  =  0.00 M    LO  GAGE 0 = 0.00 BARS   FR.RED.DIA. = 4.78 CM      BL.WIDTH  = 96.0 MM   PHI FACTOR = 1.00
 WATER DEPTH =  2.44 M    HI  GAGE 0 = 0.00 BARS   LIN.ROD WT. = 6.50 KGF/M  DELTA-A   = 0.16 BARS OCR FACTOR = 1.00
 SP.GR.WATER = 1.000      CAL GAGE 0 = 0.01 BARS   DELTA/PHI    = 0.50        DELTA-B   = 0.62 BARS  M  FACTOR = 1.00
 MAX SU ID   = 0.60       SU OPTION  = MARCHETTI   MIN PHI ID   = 1.20        OCR OPTION= MARCHETTI  K0 FACTOR = 1.00
UNIT CONVERSIONS:         1 BAR = 1.019 KGF/CM2 = 1.044 TSF = 14.51 PSI    1 M = 3.2808 FT
```

Z (M)	THRUST (KGF)	A (BAR)	B (BAR)	C (BAR)	P0 (BAR)	P1 (BAR)	P2 (BAR)	U0 (BAR)	GAMMA (T/M3)	SVP (BAR)	KD	ID	UD	ED (BAR)	K0	SU (BAR)	QD (BAR)	PHI (DEG)	SIGFF (BAR)	PHIO (DEG)	PC (BAR)	OCR	M (BAR)	SOIL TYPE
*****	******	*****	*****	*****	*****	*****	*****	******	******	******	*****	*****	*****	******	*****	*****	*****	*****	******	*****	*****	*****	******	***********
1.68		2.00	6.20		2.00	5.59		0.000	1.70	0.339	5.90	1.80	0.00	125.									249.	SANDY SILT
1.83		2.25	5.55		2.29	4.94		0.000	1.70	0.364	6.30	1.15	0.00	92.	1.36						2.18	6.0	188.	SILT
1.98		2.05	5.25		2.10	4.64		0.000	1.70	0.389	5.40	1.21	0.00	88.									167.	SANDY SILT
2.13		1.50	4.90		1.54	4.29		0.000	1.70	0.414	3.72	1.79	0.00	95.									149.	SANDY SILT
2.29		2.45	6.45		2.46	5.84		0.000	1.70	0.441	5.58	1.37	0.00	117.									227.	SANDY SILT
2.44		8.30	16.40		8.10	15.79		0.000	1.95	0.468	17.33	0.95	0.00	267.	2.56						13.58	29.0	806.	SILT
2.59		7.05	15.50		6.84	14.89		0.015	1.95	0.482	14.16	1.18	0.00	279.	2.27						10.21	21.2	791.	SILT
2.74		10.00	22.50		9.58	21.89		0.029	1.95	0.496	19.28	1.29	0.00	427.									1333.	SANDY SILT
2.90		17.00	34.00		16.36	33.39		0.045	2.10	0.512	31.88	1.04	0.00	591.	3.61						38.45	75.1	2126.	SILT
3.05		14.00	27.00		13.56	26.39		0.060	2.10	0.528	25.57	0.95	0.00	445.	3.19						28.12	53.3	1509.	SILT
3.20		4.40	8.05		4.43	7.44		0.075	1.80	0.542	8.03	0.69	0.00	105.	1.60						4.74	8.7	238.	CLAYEY SILT
3.35		2.15	4.50		2.24	3.89		0.089	1.70	0.553	3.89	0.77	0.00	57.	0.97						1.56	2.8	88.	CLAYEY SILT
3.51		2.25	4.35		2.35	3.74		0.105	1.70	0.564	3.99	0.62	0.00	48.	0.98						1.66	2.9	75.	CLAYEY SILT
3.66		1.65	3.30		1.78	2.69		0.120	1.60	0.573	2.89	0.55	0.00	32.	0.76	0.20					1.02	1.8	39.	SILTY CLAY
3.81		1.35	2.95		1.48	2.34		0.134	1.60	0.582	2.31	0.64	0.00	30.	0.62						0.73	1.3	30.	CLAYEY SILT
3.96		1.20	2.90		1.32	2.29		0.149	1.60	0.591	1.99	0.82	0.00	34.	0.54						0.59	1.0	29.	CLAYEY SILT
4.11		0.90	3.50		0.98	2.89		0.164	1.70	0.601	1.36	2.34	0.00	66.									56.	SILTY SAND
4.27		5.20	19.00		4.72	18.39		0.180	2.00	0.614	7.39	3.01	0.00	474.									1061.	SILTY SAND
4.42		15.50	34.50		14.76	33.89		0.194	2.10	0.630	23.14	1.31	0.00	664.									2187.	SANDY SILT
4.57		12.50	30.00		11.83	29.39		0.209	2.10	0.646	18.00	1.51	0.00	609.									1862.	SANDY SILT
4.72		13.00	29.50		12.38	28.89		0.224	2.10	0.662	18.37	1.36	0.00	573.									1762.	SANDY SILT
4.88		13.50	31.50		12.81	30.89		0.239	2.10	0.679	18.51	1.44	0.00	627.									1934.	SANDY SILT
5.03		11.00	27.00		10.41	26.39		0.254	2.10	0.695	14.60	1.57	0.00	555.									1585.	SANDY SILT
5.18		10.50	25.50		9.96	24.89		0.269	2.10	0.712	13.62	1.54	0.00	518.									1447.	SANDY SILT
5.33		8.00	20.00		7.61	19.39		0.284	1.95	0.727	10.08	1.61	0.00	409.									1025.	SANDY SILT
5.49		8.50	21.00		8.08	20.39		0.299	1.95	0.742	10.50	1.58	0.00	427.									1087.	SANDY SILT
5.64		10.00	25.50		9.43	24.89		0.314	2.10	0.757	12.05	1.69	0.00	536.									1436.	SANDY SILT
5.79		13.00	32.00		12.26	31.39		0.329	2.10	0.773	15.44	1.60	0.00	664.									1933.	SANDY SILT
5.94		15.00	35.50		14.18	34.89		0.343	2.10	0.789	17.54	1.50	0.00	718.									2179.	SANDY SILT
6.10		12.50	32.00		11.73	31.39		0.359	2.10	0.806	14.11	1.73	0.00	682.									1927.	SANDY SILT
6.25		14.50	31.50		13.86	30.89		0.374	2.10	0.822	16.40	1.26	0.00	591.									1754.	SANDY SILT
6.40		10.50	22.00		10.13	21.39		0.389	1.95	0.838	11.64	1.16	0.00	391.	2.02						13.06	15.6	1032.	SILT
6.55		3.50	8.60		3.45	7.99		0.403	1.80	0.850	3.59	1.49	0.00	157.									237.	SANDY SILT
6.71		2.70	6.20		2.73	5.59		0.419	1.70	0.862	2.68	1.23	0.00	99.									120.	SANDY SILT
6.86		3.50	5.10		3.63	4.49		0.434	1.70	0.873	3.66	0.27	0.00	30.	0.92	0.41					2.24	2.6	44.	CLAY
7.01		3.50	5.10		3.63	4.49		0.448	1.70	0.883	3.60	0.27	0.00	30.	0.91	0.41					2.21	2.5	43.	CLAY
7.16		3.55	5.15		3.68	4.54		0.463	1.70	0.893	3.60	0.27	0.00	30.	0.91	0.41					2.23	2.5	43.	CLAY
7.32		4.00	6.05		4.11	5.44		0.479	1.70	0.904	4.01	0.37	0.00	46.	0.99	0.47					2.68	3.0	72.	SILTY CLAY
7.47		3.80	5.50		3.92	4.89		0.494	1.70	0.914	3.75	0.28	0.00	34.	0.94	0.44					2.44	2.7	50.	CLAY
7.62		5.20	11.00		5.12	10.39		0.508	1.80	0.925	4.98	1.14	0.00	183.	1.16						3.84	4.2	331.	SILT
7.77		3.60	8.40		3.57	7.79		0.523	1.80	0.937	3.25	1.39	0.00	146.									206.	SANDY SILT
7.92		5.30	10.50		5.25	9.89		0.538	1.80	0.949	4.96	0.99	0.00	161.	1.16						3.92	4.1	290.	SILT
8.08		9.00	21.00		8.61	20.39		0.553	1.95	0.963	8.37	1.46	0.00	409.									951.	SANDY SILT
8.23		9.50	21.50		9.11	20.89		0.568	1.95	0.977	8.74	1.38	0.00	409.									969.	SANDY SILT
8.38		7.50	20.00		7.08	19.39		0.583	2.00	0.991	6.56	1.89	0.00	427.									898.	SILTY SAND
8.53		8.10	22.50		7.59	21.89		0.598	2.00	1.006	6.95	2.05	0.00	496.									1073.	SILTY SAND
8.69		12.00	28.00		11.41	27.39		0.613	2.10	1.022	10.56	1.48	0.00	555.									1415.	SANDY SILT
8.84		9.00	23.50		8.48	22.89		0.628	2.00	1.038	7.57	1.83	0.00	500.									1118.	SILTY SAND
8.99		17.00	41.00		16.01	40.39		0.643	2.10	1.053	14.59	1.59	0.00	846.									2418.	SANDY SILT

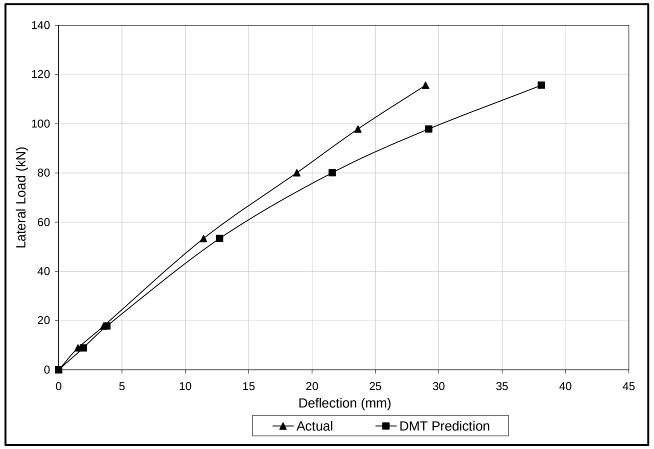


Length: 7.85m
Type: Closed End Concrete Filled Pipe
Diameter: 305mm
Thickness: 9.5mm
Material Properties
Concrete:
$f'_c = 18.6$ MPa
$E_c = 17.2$ GPa
Steel:
$f_y = 275.7$ MPa
$E_s = 200$ GPa

Figure 4a Salt Lake City Load Test



P-y Curves for Salt Lake City



Simulation Results for Salt Lake City

Figure 4b Salt Lake City Load Test continued

BACK

DILATOMETER DATA LISTING & INTERPRETATION (BASED ON THE 1988 DILATOMETER MANUAL)   SNDG. NO. DMT-1
Schmertmann & Crapps, Inc.
JOB FILE: Pascagoula Load Test Program   FILE NO. : 970
LOCATION: Sta. 250+12, Offset 103' LT C.L.
SNDG.BY : C.Kohlhof,T.Esin/S&C;W.Watkins/SES   SNDG.DATE: 03 Sep 97 to 05 Sep
ANAL.BY : T.Esin   ANAL.DATE: 09 Sep 97

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ANALYSIS PARAMETERS:      LO RANGE   =10.00 BARS   ROD DIAM.    = 4.44 CM      BL.THICK. = 14.6 MM   SU  FACTOR = 1.00
 SURF.ELEV.   = -5.15 M   LO  GAGE 0 =-0.01 BARS   FR.RED.DIA. = 5.34 CM      BL.WIDTH  = 95.8 MM   PHI FACTOR = 1.00
 WATER DEPTH =  0.00 M    HI  GAGE 0 = 0.15 BARS   LIN.ROD WT. = 6.27 KGF/M   DELTA-A   = 0.23 BARS OCR FACTOR = 1.00
 SP.GR.WATER = 1.034      CAL GAGE 0 =-0.01 BARS   DELTA/PHI    = 0.50        DELTA-B   = 0.46 BARS  M  FACTOR = 1.00
 MAX SU ID   = 0.60       SU OPTION  = MARCHETTI   MIN PHI ID  = 1.20         OCR OPTION= MARCHETTI  K0 FACTOR = 1.00
UNIT CONVERSIONS:         1 BAR = 1.019 KGF/CM2 = 1.044 TSF = 14.51 PSI     1 M = 3.2808 FT
```
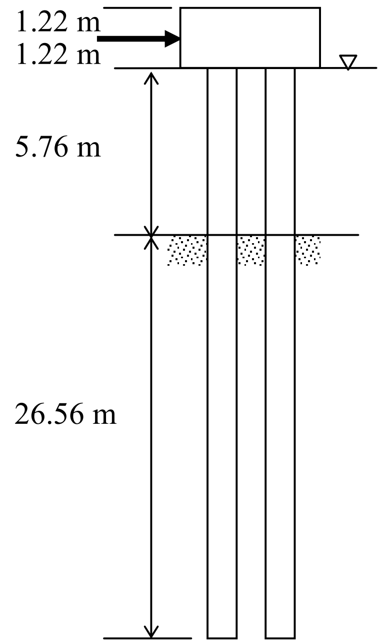

Z (M)	THRUST (KGF)	A (BAR)	B (BAR)	C (BAR)	P0 (BAR)	P1 (BAR)	P2 (BAR)	U0 (BAR)	GAMMA (T/M3)	SVP (BAR)	KD	ID	UD	ED (BAR)	K0	SU (BAR)	QD (BAR)	PHI (DEG)	SIGFF (BAR)	PHIO (DEG)	PC (BAR)	OCR	M (BAR)	SOIL TYPE
*****	******	*****	*****	*****	*****	*****	*****	******	******	******	*****	*****	*****	******	*****	*****	*****	*****	******	*****	*****	*****	******	***********
5.76	314.	2.98	6.98		3.04	6.52		0.584	1.78	0.051	48.24	1.41	0.00	121.	6.14		3.6	31.3	0.08	24.0	23.35	457.8	481.	SANDY SILT
6.07	391.	2.48	5.22	0.76	2.61	4.76	0.99	0.616	1.78	0.074	27.04	1.08	0.19	75.	3.29						4.28	58.1	257.	SILT
6.27	684.	1.95	4.73		2.08	4.27		0.636	1.78	0.088	16.31	1.52	0.19	76.	2.04		18.2	41.2	0.15	36.5	2.63	29.8	226.	SANDY SILT
6.85	905.	1.57	7.09	0.44	1.56	6.63	0.67	0.695	1.88	0.134	6.47	5.87	-0.03	176.	0.74		28.3	44.0	0.23	40.4	0.55	4.1	373.	SAND
7.16	2726.	3.12	12.20	0.49	2.94	11.58	0.72	0.727	1.98	0.161	13.76	3.91	-0.00	300.	1.43		83.3	46.7	0.28	43.7	2.47	15.3	840.	SAND
7.44	3868.	4.42	16.65	0.53	4.08	16.03	0.76	0.755	1.98	0.187	17.80	3.59	0.00	415.	1.92		116.6	46.6	0.32	43.9	4.98	26.6	1263.	SAND
7.77	4150.	1.96	14.60	0.54	1.60	13.98	0.77	0.788	1.88	0.216	3.76	15.24	-0.02	430.									709.	SAND
8.07	2400.	1.29	7.70	0.51	1.23	7.24	0.74	0.819	1.78	0.239	1.74	14.47	-0.19	208.									204.	SAND
8.37	895.	2.88	6.92	0.60	2.94	6.46	0.83	0.849	1.78	0.261	8.01	1.68	-0.01	122.	1.14		23.5	38.2	0.42	35.1	2.29	8.8	279.	SANDY SILT
8.68	602.	2.99	4.42	2.20	3.18	3.96	2.43	0.881	1.68	0.282	8.16	0.34	0.67	27.	1.62	0.36					2.53	9.0	62.	CLAY
8.98	273.	3.26	4.76	2.46	3.45	4.30	2.69	0.911	1.78	0.303	8.39	0.34	0.70	30.	1.65	0.40					2.83	9.4	68.	CLAY
9.29	144.	3.28	4.75	2.42	3.47	4.29	2.65	0.943	1.78	0.325	7.77	0.32	0.68	28.	1.57	0.39					2.70	8.3	64.	CLAY
9.59	288.	3.47	5.06	2.64	3.65	4.60	2.87	0.973	1.78	0.347	7.72	0.35	0.71	33.	1.56	0.41					2.86	8.2	73.	SILTY CLAY
9.90	288.	3.34	5.08	2.47	3.52	4.62	2.70	1.005	1.78	0.370	6.79	0.44	0.67	38.	1.43	0.38					2.49	6.7	80.	SILTY CLAY
10.20	370.	3.78	5.35	2.66	3.97	4.89	2.89	1.035	1.78	0.392	7.48	0.32	0.63	32.	1.53	0.45					3.07	7.8	71.	CLAY
10.51	448.	4.15	6.15	2.73	4.31	5.69	2.96	1.066	1.78	0.414	7.84	0.42	0.58	48.	1.58	0.50					3.49	8.4	107.	SILTY CLAY
10.81	514.	4.56	6.62	3.09	4.72	6.16	3.32	1.097	1.78	0.436	8.31	0.40	0.61	50.	1.64	0.57					4.02	9.2	115.	SILTY CLAY
11.12	576.	4.85	7.12	3.18	5.00	6.66	3.41	1.128	1.78	0.459	8.44	0.43	0.59	58.	1.65	0.61					4.34	9.4	134.	SILTY CLAY
11.42	607.	5.23	7.80	3.34	5.37	7.34	3.57	1.159	1.88	0.482	8.72	0.47	0.57	68.	1.69	0.67					4.80	9.9	162.	SILTY CLAY
11.73	838.	5.82	8.92	3.32	5.93	8.46	3.55	1.190	1.88	0.508	9.33	0.53	0.50	88.	1.76	0.77					5.61	11.0	213.	SILTY CLAY
12.03	792.	5.18	7.18	3.68	5.34	6.72	3.91	1.221	1.78	0.532	7.76	0.33	0.65	48.	1.56	0.64					4.40	8.3	107.	CLAY
12.34	838.	4.85	7.08	2.65	5.00	6.62	2.88	1.252	1.78	0.554	6.77	0.43	0.43	56.	1.43	0.56					3.71	6.7	118.	SILTY CLAY
12.64	833.	4.29	6.62	2.30	4.44	6.16	2.53	1.283	1.78	0.576	5.48	0.55	0.40	60.	1.24	0.45					2.77	4.8	113.	SILTY CLAY
12.90	3580.	5.63	22.05	1.06	5.08	21.43	1.29	1.309	2.08	0.599	6.30	4.33	-0.01	567.	0.77		107.0	43.0	1.01	41.5	2.57	4.3	1190.	SAND
13.25	4300.	6.45	9.05	4.82	6.58	8.59	5.05	1.345	1.88	0.632	8.30	0.38	0.71	70.	1.63	0.82					5.81	9.2	161.	SILTY CLAY
13.56	4100.	4.62	25.35	1.11	3.86	24.73	1.34	1.376	1.98	0.659	3.76	8.42	-0.01	724.	0.36		130.6	44.8	1.12	43.6	0.71	1.1	1196.	SAND
13.86	4250.	5.62	14.85	1.03	5.43	14.23	1.26	1.406	1.98	0.687	5.86	2.19	-0.04	305.	0.69		128.7	43.4	1.16	42.2	2.44	3.6	613.	SILTY SAND
14.17	4750.	5.85	11.75	2.83	5.83	11.13	3.06	1.438	1.88	0.714	6.15	1.21	0.37	184.	0.71		143.9	43.7	1.21	42.6	2.69	3.8	372.	SANDY SILT
14.47	4900.	5.61	16.65	1.11	5.33	16.03	1.34	1.468	1.98	0.740	5.22	2.77	-0.03	371.	0.57		151.5	44.2	1.26	43.2	1.86	2.5	715.	SILTY SAND
14.78	6950.	5.67	26.75	1.20	4.89	26.13	1.43	1.500	2.08	0.771	4.40	6.27	-0.02	737.	0.25		223.0	47.2	1.34	46.3	0.46	0.6	1317.	SAND
15.08	4950.	5.49	9.80	3.27	5.54	9.34	3.50	1.530	1.88	0.799	5.02	0.95	0.49	132.	1.16						3.36	4.2	239.	SILT
15.39	6700.	4.57	17.45	1.33	4.20	16.83	1.56	1.562	1.98	0.826	3.19	4.79	-0.00	438.	0.03		218.4	47.9	1.44	47.1	0.01	0.0	661.	SAND
15.69	6250.	6.03	10.40	4.10	6.08	9.78	4.33	1.592	1.88	0.852	5.27	0.82	0.61	128.	1.21						3.86	4.5	238.	CLAYEY SILT
15.99	3200.	7.50	9.80	5.73	7.65	9.34	5.96	1.623	1.88	0.877	6.87	0.28	0.72	59.	1.44	0.90					6.01	6.9	124.	CLAY
16.30	1373.	9.45	13.20	6.52	9.53	12.58	6.75	1.654	1.98	0.904	8.71	0.39	0.65	106.	1.69	1.25					8.98	9.9	249.	SILTY CLAY
16.60	1430.	7.17	9.45	5.05	7.32	8.99	5.28	1.684	1.88	0.931	6.05	0.30	0.64	58.	1.33	0.82					5.24	5.6	115.	CLAY
16.91	1605.	6.54	8.51	4.52	6.71	8.05	4.75	1.716	1.88	0.957	5.22	0.27	0.61	47.	1.20	0.70					4.27	4.5	85.	CLAY
17.21	2073.	8.70	13.05	3.47	8.75	12.43	3.70	1.746	1.98	0.983	7.13	0.52	0.28	128.	1.48	1.06					7.14	7.3	275.	SILTY CLAY
17.52	2068.	8.45	12.15	5.51	8.54	11.53	5.74	1.778	1.88	1.010	6.69	0.44	0.59	104.	1.42	1.01					6.65	6.6	217.	SILTY CLAY
17.82	2037.	5.71	7.72	4.40	5.87	7.26	4.63	1.808	1.78	1.034	3.93	0.34	0.69	48.	0.97	0.53					2.97	2.9	74.	CLAY
18.13	2068.	6.14	8.49	4.52	6.29	8.03	4.75	1.840	1.88	1.058	4.20	0.39	0.65	60.	1.02	0.59					3.37	3.2	97.	SILTY CLAY
18.26	3395.	6.34	9.90	3.89	6.43	9.44	4.12	1.853	1.88	1.069	4.28	0.66	0.50	105.	1.04						3.50	3.3	171.	CLAYEY SILT
18.36	11500.	7.21	30.30	1.67	6.33	29.68	1.90	1.863	2.08	1.078	4.14	5.23	0.01	810.									1405.	SAND
23.39	3400.	3.88	9.85	1.90	3.83	9.43	2.12	2.373	1.88	1.545	0.94	3.83	-0.17	194.	0.26		114.4	39.5	2.53	39.3	0.61	0.4	165.	SAND
23.54	3950.	7.11	27.10	2.11	6.37	26.52	2.33	2.389	2.08	1.559	2.55	5.06	-0.01	699.	0.46		122.2	39.1	2.54	39.0	2.06	1.3	919.	SAND
23.69	3700.	5.84	25.05	2.05	5.14	24.47	2.27	2.404	1.98	1.574	1.74	7.07	-0.05	671.	0.36		119.1	39.2	2.57	39.1	1.24	0.8	657.	SAND
24.00	2600.	6.46	9.80	5.15	6.54	9.38	5.37	2.435	1.88	1.601	2.57	0.69	0.71	98.	0.69						2.36	1.5	110.	CLAYEY SILT
24.30	772.	7.51	12.00	4.31	7.55	11.42	4.53	2.466	1.88	1.626	3.12	0.76	0.41	134.	0.81						3.26	2.0	177.	CLAYEY SILT
24.61	364.	7.72	11.45	4.14	7.79	10.87	4.36	2.497	1.88	1.652	3.21	0.58	0.35	107.	0.83	0.66					3.45	2.1	142.	SILTY CLAY
24.91	6000.	8.35	29.60	2.29	7.55	29.02	2.51	2.528	2.08	1.680	2.99	4.28	-0.00	745.	0.44		186.9	41.3	2.79	41.3	2.22	1.3	1081.	SAND
25.22	7400.	7.76	28.10	2.29	7.00	27.52	2.51	2.559	2.08	1.712	2.60	4.62	-0.01	712.	0.32		236.8	43.0	2.88	43.1	1.31	0.8	946.	SAND
25.52	5950.	8.26	26.60	2.25	7.60	26.02	2.47	2.590	2.08	1.743	2.88	3.67	-0.02	639.	0.43		185.4	41.1	2.89	41.1	2.23	1.3	906.	SAND
25.82	5100.	5.82	17.10	2.30	5.52	16.52	2.52	2.620	1.98	1.772	1.63	3.80	-0.03	382.	0.29		166.3	40.8	2.93	40.9	1.01	0.6	354.	SAND
26.13	5000.	4.89	17.00	2.35	4.54	16.42	2.57	2.651	1.98	1.801	1.05	6.27	-0.04	412.	0.21		167.5	41.1	2.98	41.2	0.55	0.3	350.	SAND
26.43	6150.	5.25	20.10	2.37	4.77	19.52	2.59	2.682	1.98	1.829	1.14	7.07	-0.04	512.	0.17		205.7	42.4	3.06	42.5	0.39	0.2	435.	SAND
26.74	4950.	5.03	17.60	2.40	4.66	17.02	2.62	2.713	1.98	1.858	1.05	6.34	-0.05	429.									365.	SAND
27.04	4200.	10.20	20.90	2.82	9.76	20.32	3.04	2.744	2.03	1.886	3.72	1.51	0.04	367.	0.65		119.6	37.2	3.03	37.4	4.89	2.6	566.	SANDY SILT
27.35	3000.	9.30	12.20	0.00	9.41	11.62	0.22	2.775	1.88	1.914	3.47	0.33	-0.38	77.	0.88	0.84					4.52	2.4	108.	CLAY
27.65	1229.	11.20	15.35	8.30	11.08	14.77	8.52	2.806	1.98	1.941	4.27	0.45	0.69	128.	1.03	1.10					6.33	3.3	208.	SILTY CLAY
27.96	1157.	10.35	13.30	9.75	10.29	12.72	9.97	2.837	1.88	1.968	3.79	0.33	0.96	84.	0.95	0.96					5.33	2.7	127.	CLAY
28.26	1178.	9.25	11.95	8.23	9.38	11.37	8.45	2.868	1.88	1.993	3.27	0.31	0.86	69.	0.84	0.81					4.28	2.1	94.	CLAY
28.57	1193.	8.80	11.25	7.65	8.94	10.67	7.87	2.899	1.88	2.019	2.99	0.29	0.82	60.	0.78	0.73					3.78	1.9	76.	CLAY
28.87	1543.	9.05	11.80	0.00	9.17	11.22	0.22	2.929	1.88	2.043	3.06	0.33	-0.43	71.	0.80	0.76					3.96	1.9	91.	CLAY
29.18	1749.	9.40	13.90	5.22	9.43	13.32	5.44	2.961	1.88	2.069	3.13	0.60	0.38	135.	0.81						4.16	2.0	176.	CLAYEY SILT
29.48	1610.	11.00	14.85	8.75	10.90	14.27	8.97	2.991	1.98	2.096	3.77	0.43	0.76	117.	0.94	1.02					5.64	2.7	176.	SILTY CLAY
29.79	1641.	13.20	18.90	8.31	13.01	18.32	8.53	3.023	1.98	2.124	4.70	0.53	0.55	184.	1.11	1.36					8.06	3.8	318.	SILTY CLAY
30.09	1924.	13.20	18.05	8.32	13.05	17.47	8.54	3.053	1.98	2.152	4.64	0.44	0.55	153.	1.10	1.36					8.01	3.7	263.	SILTY CLAY
30.40	1800.	12.05	17.15	8.40	11.89	16.57	8.62	3.085	1.98	2.181	4.04	0.53	0.63	163.	0.99	1.15					6.52	3.0	255.	SILTY CLAY
30.70	1698.	10.70	14.35	9.00	10.61	13.77	9.22	3.115	1.88	2.207	3.39	0.42	0.81	110.	0.87	0.94					5.04	2.3	153.	SILTY CLAY
31.01	1610.	13.70	17.10	10.80	13.62	16.52	10.86	3.147	1.98	2.235	4.69	0.28	0.74	101.	1.11	1.43					8.44	3.8	173.	CLAY
31.31	1965.	13.60	17.70	10.00	13.49	17.12	10.22	3.177	1.98	2.263	4.56	0.35	0.68	126.	1.09	1.39					8.18	3.6	214.	SILTY CLAY
31.54	2505.	14.70	20.00	10.05	14.53	19.42	10.11	3.200	1.98	2.284	4.96	0.43	0.61	170.	1.15	1.56					9.42	4.1	302.	SILTY CLAY

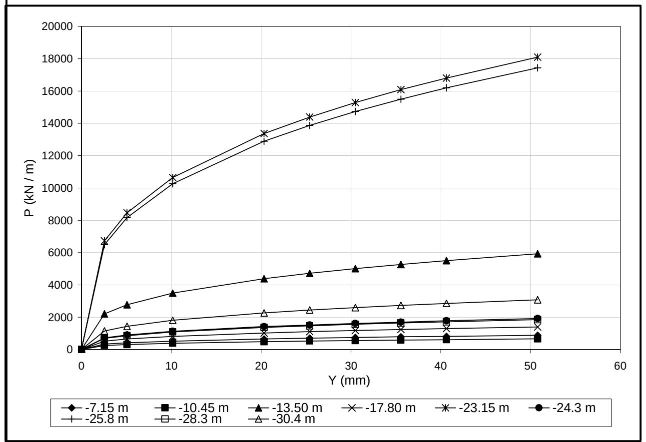


Length: 33.5m
Type: Drilled Shaft Group
Diameter: 2134 mm
Material Properties:
Concrete:
$f'_c = 33.1$ MPa
$E_c = 27.2$ GPa
Steel:
$f_y = 275.7$ MPa
$E_s = 200$ GPa

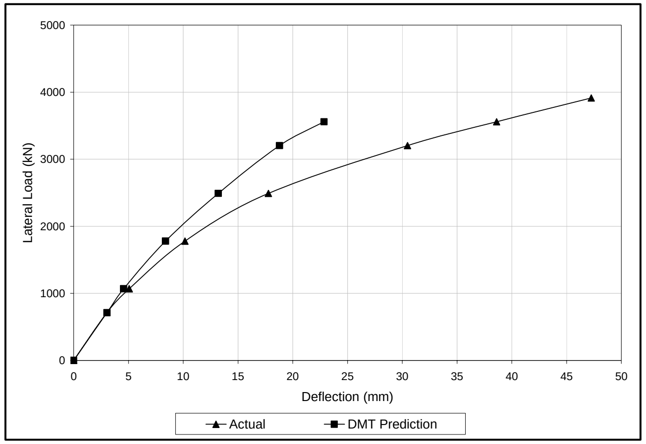
Reinforcement Details:
48 # 14 bars above elevation –7.6 m
24 # 14 bars below elevation –7.6 m
76 mm clear cover.

Figure 5a Pascagoula Load Test

BACK



P-y Curves for Pascagoula



Simulation Results for Pascagoula

Figure 5b Pascagoula Load Test Continued

BACK

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DILATOMETER DATA LISTING & INTERPRETATION (BASED ON THE 1988 DILATOMETER MANUAL)        SNDG. NO.  DMT-2
University of Florida
JOB FILE: Auburn Spring Villa NGES                                                      FILE NO. : AU-2
LOCATION: Spring Villa Site
SNDG.BY : ???                                                                           SNDG.DATE: August 1996
ANAL.BY : J.B. Anderson                                                                 ANAL.DATE: 15 Dec 05

ANALYSIS PARAMETERS:     LO RANGE   =40.00 BARS   ROD DIAM.    = 3.57 CM      BL.THICK. = 15.0 MM   SU  FACTOR = 1.00
 SURF.ELEV.  =  0.00 M   LO  GAGE 0 = 0.00 BARS   FR.RED.DIA. = 4.78 CM      BL.WIDTH  = 96.0 MM   PHI FACTOR = 1.00
 WATER DEPTH =  2.44 M   HI  GAGE 0 = 0.00 BARS   LIN.ROD WT. = 6.50 KGF/M  DELTA-A   = 0.16 BARS OCR FACTOR = 1.00
 SP.GR.WATER = 1.000     CAL GAGE 0 = 0.00 BARS   DELTA/PHI    = 0.50         DELTA-B   = 0.62 BARS  M  FACTOR = 1.00
 MAX SU ID   = 0.60      SU OPTION  = MARCHETTI   MIN PHI ID   = 1.20         OCR OPTION= MARCHETTI  K0 FACTOR = 1.00
UNIT CONVERSIONS:        1 BAR = 1.019 KGF/CM2 = 1.044 TSF = 14.51 PSI    1 M = 3.2808 FT
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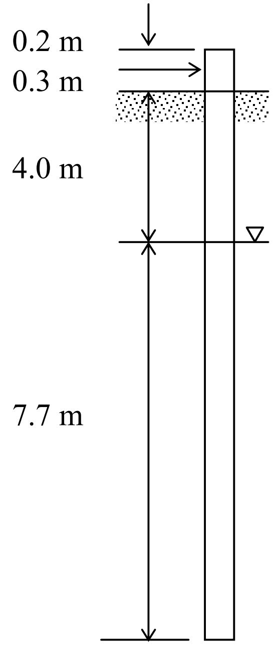
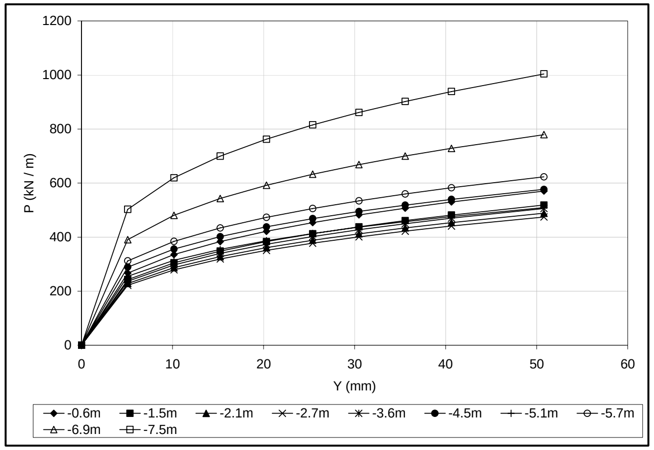
Z (M)	THRUST (KGF)	A (BAR)	B (BAR)	C (BAR)	P0 (BAR)	P1 (BAR)	P2 (BAR)	U0 (BAR)	GAMMA (T/M3)	SVP (BAR)	KD	ID	UD	ED (BAR)	K0	SU (BAR)	QD (BAR)	PHI (DEG)	SIGFF (BAR)	PHIO (DEG)	PC (BAR)	OCR	M (BAR)	SOIL TYPE
*****	******	*****	*****	*****	*****	*****	*****	******	******	******	*****	*****	*****	******	*****	*****	*****	*****	******	*****	*****	*****	******	************
0.30		2.70	8.70		2.60	8.08		0.000	1.90	0.055	47.25	2.11	0.00	190.									755.	SILTY SAND
0.60		4.90	10.10		4.84	9.48		0.000	1.80	0.109	44.21	0.96	0.00	161.	4.30						13.70	125.1	629.	SILT
1.20		5.10	11.40		4.98	10.78		0.000	1.80	0.215	23.13	1.16	0.00	201.	3.02						9.82	45.6	662.	SILT
1.50		4.10	9.40		4.03	8.78		0.000	1.80	0.268	15.03	1.18	0.00	165.	2.35						6.24	23.2	475.	SILT
1.80		3.70	8.25		3.67	7.63		0.000	1.80	0.321	11.42	1.08	0.00	137.	2.00						4.87	15.2	361.	SILT
2.10		3.80	8.15		3.78	7.53		0.000	1.80	0.374	10.10	0.99	0.00	130.	1.85						4.68	12.5	326.	SILT
2.40		3.80	8.05		3.79	7.43		0.000	1.80	0.427	8.86	0.96	0.00	126.	1.70						4.36	10.2	301.	SILT
2.70		3.60	7.35		3.61	6.73		0.026	1.80	0.455	7.88	0.87	0.00	108.	1.58						3.86	8.5	245.	CLAYEY SILT
3.00		3.30	6.95		3.32	6.33		0.055	1.80	0.478	6.82	0.92	0.00	105.	1.44						3.24	6.8	221.	SILT
3.30		2.85	6.70		2.86	6.08		0.084	1.70	0.501	5.54	1.16	0.00	112.	1.25						2.45	4.9	214.	SILT
3.60		3.55	7.25		3.56	6.63		0.114	1.80	0.523	6.60	0.89	0.00	106.	1.41						3.37	6.4	222.	CLAYEY SILT
3.90		4.70	8.40		4.71	7.78		0.143	1.80	0.546	8.37	0.67	0.00	106.	1.64						5.09	9.3	247.	CLAYEY SILT
4.20		3.95	7.55		3.97	6.93		0.173	1.80	0.570	6.66	0.78	0.00	103.	1.42						3.72	6.5	215.	CLAYEY SILT
4.50		4.40	8.45		4.40	7.83		0.202	1.80	0.593	7.07	0.82	0.00	119.	1.47						4.25	7.2	256.	CLAYEY SILT
4.80		3.65	7.25		3.67	6.63		0.232	1.80	0.617	5.57	0.86	0.00	103.	1.25						3.05	4.9	196.	CLAYEY SILT
5.10		3.70	7.25		3.72	6.63		0.261	1.80	0.640	5.40	0.84	0.00	101.	1.23						3.02	4.7	190.	CLAYEY SILT
5.40		3.70	6.90		3.74	6.28		0.290	1.80	0.664	5.19	0.74	0.00	88.	1.19						2.94	4.4	162.	CLAYEY SILT
5.70		4.05	8.85		4.01	8.23		0.320	1.80	0.687	5.37	1.14	0.00	146.	1.22						3.21	4.7	276.	SILT
6.00		4.25	9.50		4.19	8.88		0.349	1.80	0.711	5.40	1.22	0.00	163.									308.	SANDY SILT
6.30		4.15	8.60		4.13	7.98		0.379	1.80	0.735	5.10	1.03	0.00	134.	1.18						3.17	4.3	245.	SILT
6.60		4.80	9.95		4.74	9.33		0.408	1.80	0.758	5.72	1.06	0.00	159.	1.28						3.90	5.1	309.	SILT
6.90		5.00	9.80		4.96	9.18		0.438	1.80	0.782	5.78	0.93	0.00	146.	1.29						4.10	5.2	286.	SILT
7.20		6.05	11.50		5.98	10.88		0.467	1.80	0.805	6.84	0.89	0.00	170.	1.44						5.49	6.8	360.	CLAYEY SILT
7.50		5.85	12.50		5.72	11.88		0.497	1.80	0.829	6.30	1.18	0.00	214.	1.36						4.96	6.0	437.	SILT
7.80		4.55	11.80		4.39	11.18		0.526	1.80	0.852	4.53	1.76	0.00	236.									412.	SANDY SILT
8.10		7.25	21.25		6.75	20.63		0.555	2.00	0.879	7.05	2.24	0.00	482.									1049.	SILTY SAND

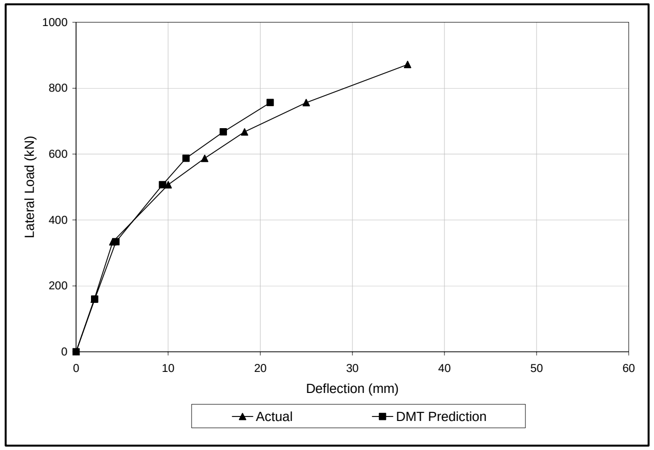


Length: 12m
Type: Drilled Shaft
Diameter: 915 mm
Material Properties
Concrete:
$f'_c = 33.1$ MPa
$E_c = 27.7$ GPa
Steel:
$f_y = 275.7$ MPa
$E_s = 200$ GPa

Reinforcement Details: 12 #11 Bars
76mm clear cover



P-y Curves for Auburn



Simulation Results for Auburn

Figure 6 Auburn Load Test

BACK