EVALUATION OF LOAD TESTS FOR DRIVEN PILES FOR THE ALABAMA

DEPARTMENT OF TRANSPORTATION

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Jacob Wayne Hill

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EVALUATION OF LOAD TESTS FOR DRIVEN PILES FOR THE ALABAMA DEPARTMENT OF TRANSPORTATION

Jacob Wayne Hill

A Thesis

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EVALUATION OF LOAD TESTS FOR DRIVEN PILES FOR THE ALABAMA

DEPARTMENT OF TRANSPORTATION

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Date of Graduation

VITA

Jacob Wayne Hill, son of J. Wayne Hill and Teresa Henderson Hill, was born on December 28, 1983 in Gadsden, AL. He completed high school with distinction at Plainview High School in 2002. He attended Gadsden State Community College on a golf scholarship until December 2003 prior to attending Auburn University. He then entered Auburn University in May 2004 and graduated with a Bachelor of Science in Civil Engineering in May 2006. He entered graduate school at Auburn University in May 2006.

THESIS ABSTRACT

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Jacob W. Hill

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A study was carried out to evaluate load testing methods for driven piles for the Alabama Department of Transportation. Dynamic and static load test data were assembled to form the database used in this study. The field reported resistances predicted by the Pile Driving Analyzer (PDA) were compared to 2.5 times the design load for each pile in the study. Blow measurements from the PDA were analyzed using the CAse Pile Wave Analysis Program (CAPWAP) to determine an estimate of ultimate resistance, and compared to the ultimate resistance predicted by the PDA. PDA beta values were compared with results from CAPWAP to confirm pile integrity.

Recommendations and conclusions are described for effectively testing driven piles in Alabama. Correlation is shown between PDA beta values and damage indicated from CAPWAP, in addition to correlations between PDA and CAPWAP.

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Style manual or journal used ASCE Authors' Guide to Journals, Books, and Reference Publications

Computer Software Used Microsoft Word, Microsoft Excel, CAPWAP

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CHAPTER 1

INTRODUCTION

The Alabama Department of Transportation (ALDOT) frequently uses driven piles to support bridges and other transportation-related structures. Current load test methods for driven piles used in ALDOT bridge projects are evaluated.

Historically, static load tests have been relied upon as an accurate measure of a pile's ultimate resistance. Ultimate resistance is the maximum resistance mobilized by the positive shaft resistance and toe bearing in the soil(s) in which the pile is bearing. Static load testing involves loading the pile statically by placing increments of load and recording settlements as the load is applied. Because the pile resistance may setup (resistance increases with time) or relax (resistance decreases with time), static load tests often are performed after some wait period so that equilibrium conditions are re-established (FHWA, 1997). These tests can be very time consuming because reaction piles must be installed adjacent to the test pile so that load can be applied. Figure 1-1 is an illustration of a typical static load test arrangement with reaction piles. Typically, load is applied incrementally until the test pile has failed or until the pile's resistance is at least some factor above the design resistance (usually 2.5 to 3). In most situations, especially in marine environments, static load tests are more time consuming and more expensive compared to the PDA.

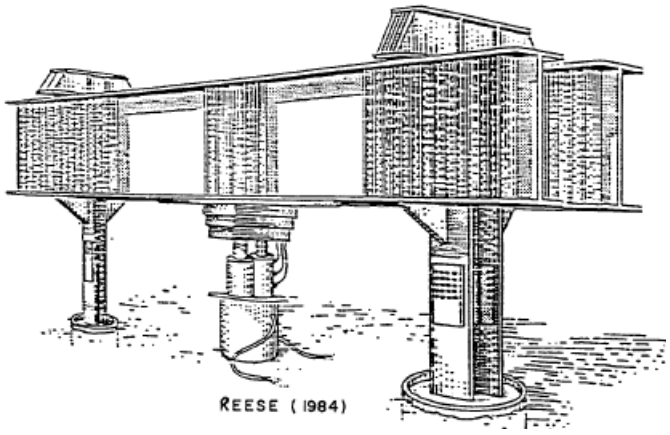

Figure 1-1. Typical Static Load Test Arrangement with Reaction Piles (FHWA, 1992)

The PDA is a computer system which is connected to two strain transducers and two accelerometers bolted to diametrically opposite sides of the pile to monitor strain and acceleration through the theory of wave propagation (Hannigan, Goble, Thendean, Likins, and Rausche, 1997). Figure 1-2 is an illustration of the PDA. These gages can be attached in less than 15 minutes and enable the PDA to analyze each blow as to analyze various parameters. Figure 1-3 shows the arrangement of the transducer and accelerometer arrangement. In addition to capacity, the PDA analyzes each blow for transferred energy, driving stresses, and structural integrity based on input pile properties such as pile length below the transducers, specific weight, wave speed, elastic modulus, and cross-sectional area. The PDA allows the inspector to monitor the pile for damage throughout driving which is not possible with static load tests. All of this testing can occur as a test pile is installed. Although the PDA has been in routine use for over 30 years with obvious performance and economic benefits, skepticism still exists because dynamic testing doesn't allow the inspector to actually see the pile being loaded.

Figure 1-2. Pile Driving Analyzer (FHWA, 1997)

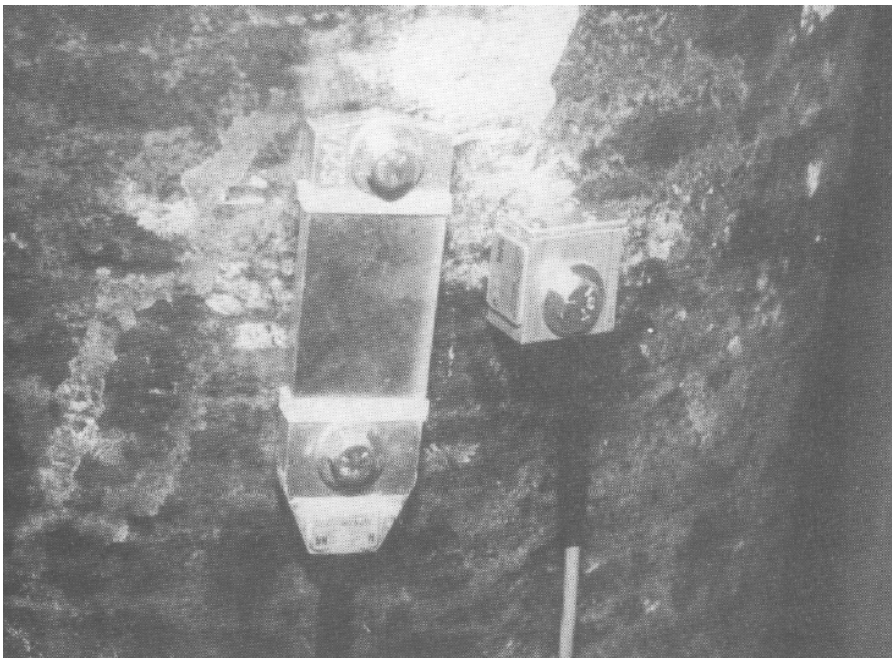

Figure 1-3. Strain Transducer and Accelerometer Bolted to a Pipe Pile (FHWA, 1992)

Limitations

Many benefits exist with the PDA, however certain limitations exist. The PDA's estimated resistance of a pile can be interpreted in different ways, thus possibly introducing human subjectivity. The reliability of these different values is a function of the type of pile, soil, and damping factor (PDA manual, 2001). During testing, the PDA operator must choose a damping factor that he/she determines is the best indication of the soil present at the pile tip. The estimated resistance is a function of the selected damping factor. Therefore, the results are subject to the knowledge of the operator which can result in error.

Research has shown that PDA measurements from end of drive measurement are often highly variable. On a particular project, the PDA underpredicted static resistance by 44 percent (Long, Maniaci, and Samara, 2002). Underpredicted static resistance may be attributed to setup in the soil over time after initial driving. The same research study reports that the PDA just slightly underpredicts resistance by 7 percent when used during restrike. A restrike is the act of driving the pile after some wait period after initial driving to obtain a more reasonable estimate of long term resistance. Restriking the pile after some wait period (hours or days) allows the soil to equilibrate, thus producing a better estimate of the pile's ultimate resistance. This suggests that the precision of the long-term resistance from PDA measurements is highly uncertain at the end of drive and improves with the beginning of restrike measurements in soils with anticipated time dependent changes.

Although the PDA can offer reasonable results when used in conjunction with a restrike, it has been shown that the CAse Pile Wave Analysis Program (CAPWAP) offers

the best estimation of long-term resistance when used on restrike blow measurements (Long, Maniaci, and Samara, 2002). CAPWAP is a more rigorous and time consuming analytical method that combines field measured data with wave equation type procedures to predict the pile's static bearing capacity, resistance distribution, and soil quake and damping characteristics (FHWA, 1997). CAPWAP can be performed on any single hammer blow; however it is typically used to analyze blows at the end of driving or beginning of restrike. CAPWAP is an iterative process that involves measuring and calculating forces and plotting those forces as a function of time (Hussein, Likins, Rausche, 1988). The soil model is changed and the process repeated until no further improvement in the force match can be obtained. The resulting soil model is then considered the best estimate of static bearing capacity, soil resistance distribution along the pile shaft, and the soil quake and damping characteristics (Hannigan, Goble, Thendean, Likins, and Rausche, 1997).

Objective

The primary purpose of this study is to evaluate dynamic load testing methods for driven piles for ALDOT.

Methodology

This study progressed in the following manner:

1.) Assemble a database of dynamic load test data and static load test data.
2.) Compare field reported estimated resistance from the PDA with 2.5 times the design load.
3.) Perform CAPWAP analyses on dynamic load test data collected from the PDA.

4.) Evaluate reliability of ALDOT dynamic load test methodology with anticipated static resistance using CAPWAP results.

CHAPTER 2

LITERATURE REVIEW

Introduction

Driven piles have long been used to support various structures such as buildings, dams, bridges, and offshore structures. Primarily, deep foundations are used to transfer loads to deeper, stronger soils while also controlling settlements. Piles can be installed in a variety of soils in a multitude of environments. Regardless of the situation, the static bearing resistance of piles must be confirmed through testing, thus ensuring that it can support the service loads for which it was designed.

Traditionally, static load testing of driven piles and drilled shafts has been deemed the most reliable method of determining static bearing resistance, although there are other methods to supplement static load tests such as dynamic testing, dynamic formulae and neural networks. Pile load tests are often used on preliminary and production piling to confirm bearing resistance and increase quality control. Unfortunately, there are certain constraints such as large capacity piles or offshore environments that prohibit the use of static load tests. In these cases, dynamic load tests are often performed, but the reliability of these tests in determining static bearing capacity is often questioned.

Background

Over a century ago, it was recognized that pile driving was a phenomenon that could be better approximated by wave propagation (Hussein, Likins, Rausche, 1988).

Although the theory was unrealistic at first, the invention of the computer made wave propagation practical for pile driving; thus resulting in what is known today as the wave equation. The wave equation has the ability to realistically consider the entire hammer-cushion-pile-soil system. The entire driving system is modeled as a series of masses and springs where the size and stiffness of the springs reflect the mass and stiffness of various components of the system while the soil is modeled by a series of elasto-plastic springs and linear viscous dashpots (Hussein, Likins, Rausche, 1988). A schematic of the entire system model is shown in Figure 2-1.

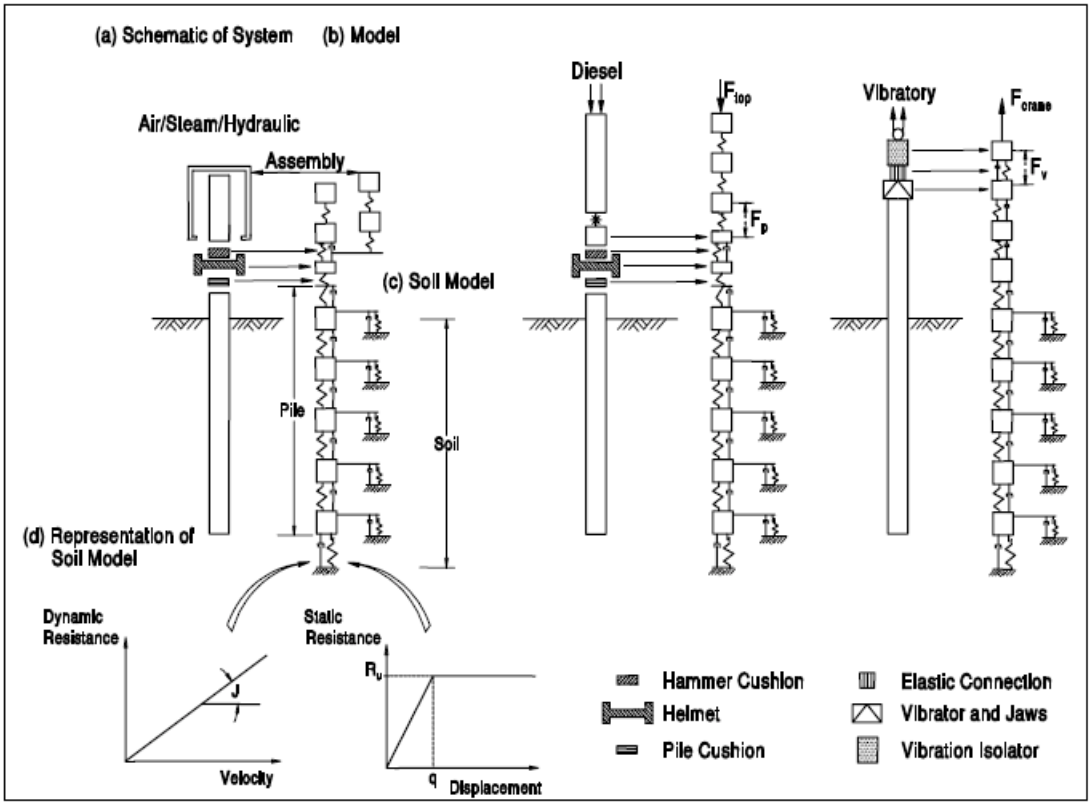

Figure 2-1. Model of the Hammer, Pile, and Soil System and the Soil Resistance Model (Rausche, Liang, Allin, and Rancman, 2004)

Wave equation analysis can be instrumental in answering one or both of the following questions (Hussein, Likins, Rausche, 1988):

1.) Can the pile be safely driven to the required capacity given a complete description of pile, soil, hammer, and cushion properties?
2.) What is the static bearing capacity of the pile based on recorded pile driving observations?

Although the wave equation can offer answers to these questions, piles should be monitored during driving in order to assure accurate results (Hussein, Likins, Rausche, 1988).

One of the first attempts to actually take measurements during pile driving dates back to 1948 in Sweden when Bror Fellenius, head of Swedish State Railroads Geotechnical Department, attempted to take measurements during the hammer impact (Fellenius, 1996). Fellenius used three nickels sandwiched between two smooth steel plates. When the hammer struck the pile, each nickel left a lasting circular impression on the steel plates. The diameter of the impressions was then used to determine a force measurement. Unfortunately, nothing ever became of this experiment.

Later in 1956, Fellenius met with Dr. Hans Christian Fischer, who had previously performed dynamic tests on drill rods using strain gages. Fischer was able to test steel piles with strain gages and show the effect of various hammers on the magnitude of the reflected stress waves using graphodynamic representation. This advancement allowed the Swedish State Railways to establish a means for hammer selection and termination criteria.

In the late 1950's and early 1960's, the Swedish began to learn more about dynamic pile testing through the Gubbero testing program. It was during this program that short duration strain measurements allowed information to be obtained on soil response and driving stresses.

While the Swedish were researching testing of driven piles, so were researchers in the United States. The first noted research of dynamic testing techniques of driven piles took place in 1958 by R.J. Eiber and Professor H.R. Nara by performing lab studies of rods driven into dry sands (Hannigan, Goble, Thendean, Likins, and Rausche, 1997). Later in 1964, a study began by Professors R.H. Scanlan and G.G. Goble. Unlike the Swedish researchers, Scanlan and Goble performed research on transducers that could measure force and velocity during pile driving. These measurements allowed engineers to realize qualitatively the distribution of shaft resistance and the significance of toe resistance (Fellenius, 1996). Although Scanlan left this research effort after two years, Goble continued and created what is known today as the PDA.

The PDA was implemented into Ohio Department of Transportation pile driving projects in 1968, and was commercialized in 1972. Now, the PDA is recognized as the standard inspection tool for pile installations. The PDA system typically consists of two strain transducers and two accelerometers bolted to diametrically opposite sides of the pile to monitor strain and acceleration. The transducers and accelerometers can be attached to most any pile in 15 minutes or less, thus decreasing construction time while increasing quality control (Likins, 1984). These gages enable the PDA to analyze each blow as to analyze various parameters. In addition to capacity, the PDA analyzes each blow for transferred energy, driving stresses, and structural integrity. In the event a

problem is detected such as reduced cross-sectional area, the operator will receive a warning. All warnings shall be evaluated to avoid issues that could compromise the structural integrity of a pile. Although the PDA has been in routine use now for over 30 years, concerns still arise regarding the reliability of it.

Although the PDA and the CASE method can offer reasonable results, selected blows should be analyzed using the CAse Pile Wave Analysis Program (CAPWAP). CAPWAP is a more rigorous analytical method that combines field measured data with wave equation type procedures to predict the pile's static bearing capacity, resistance distribution, and soil quake and damping characteristics (Hannigan, Goble, Thendean, Likins, and Rausche, 1997). Typically, CAPWAP is performed on a single hammer blow from the end of driving or beginning of restrike. CAPWAP is an iterative process that involves measuring and calculating forces and plotting those forces as a function of time (Hussein, Likins, Rausche, 1988). If the forces do not match, the soil model is changed and the process repeated until no further improvement in the force match can be obtained. The resulting soil model is then considered the best estimate of static bearing capacity, soil resistance distribution, and the soil quake and damping characteristics.

Estimation of static resistance of driven piles is also possible through the use of neural networks. Neural networks are computer models that mimic the organizational skills and knowledge acquisition of the human brain (Goh, 1996). Neural networks use data from previous case records to predict the static resistance, thus force and velocity records from historical projects can be input into the network as a basis for estimating static resistance on future projects (Teh, Wong, Goh, and Jaritngam, 1997).

Correlation Studies

Long, Maniaci, and Samara evaluated results from two static load tests in Jacksonville, Illinois compared with dynamic method predictions on steel H-piles (Long, Maniaci, and Samara, 2002). Static load tests were performed on the morning of August 27, 1997 and September 11, 1997, respectively. Restrike of each pile was performed on the same day of its respective static load test. Axial capacity was evaluated by six prediction methods including CAPWAP, Engineering News formula, Wave Equation, Gates Formula, PDA, and the Measured Energy approach. The ratio of predicted capacity by CAPWAP to measured capacity (Q_p/Q_m) for the first pile was 1.05, while the second pile reported a ratio of 0.90. It was concluded that the use of CAPWAP with beginning of restrike data provides the greatest precision of all methods investigated. Another conclusion was formed indicating that there was no significant difference between predictions made for H-piles and predictions made for other piles.

Holm, Jansson, and Moller performed a study on dynamic and static load testing of friction in loose sands (Holm, Jansson, and Moller, 1985). The piling project was located in Fittja, ten km south of Stockholm, Sweden. The five piles were 270 mm square precast concrete piles ranging in length from 16 – 28 meters. The piles were statically tested and failure was defined by the Davisson criteria. Restrike was performed within one week of static load testing, and a CAPWAP analysis was performed on selected restrike blows. Reasonable agreement was obtained based according to CAPWAP and static load test. The ratio of static bearing capacity by CAPWAP (Q_p) to the actual static load test (Q_m) results were 0.83 – 1.16. The authors concluded that these dynamic load

tests of friction piles have given about the same bearing capacity as static load tests and could be used in place of static load tests in this case.

Long and Wysockey performed a study on the accuracy of methods for predicting axial capacity of deep foundations (Long and Wysockey, 1999). A collection of approximately 100 load tests, all of which were loaded to failure, from an FHWA database were used in this study. It was noted that including only tests conducted to failure would produce conservative results because including unfailed load tests would serve to decrease the mean and standard deviation of the sample. Unfailed tests are likely the stronger materials, therefore a sample which excludes the strongest results in a biased sample. They investigated the accuracy of six different methods including CAPWAP. The ratio of beginning of restrike prediction to measured prediction by CAPWAP was 0.86. Although times between static load tests and restrike were not noted, it was concluded that CAPWAP results in the greatest precision when a restrike is performed.

A study was performed by Dr. Dan Brown on the comparison of dynamic and static measurements on the Tampa Crosstown Freeway in Tampa, Florida (Brown, 2005). Brown used data that included a total of nine tests from both drilled shafts and smaller diameter augercast piles with capacities exceeding 560 tons. The mean predicted bearing capacity ratio from CAPWAP to the measured capacity by static load testing was 0.90 with a coefficient of variation of 0.186. It was concluded that CAPWAP estimated a static resistance that is on average considered to be equal to the actual static resistance.

Likins, Rausche, Thendean, and Svinkin conducted a CAPWAP correlation study on 82 piles from the GRL database (Likins, Rausche, Thendean, and Svinkin, 1996). The database consists of piles from all over the world. The cases used in this study were

performed over a number of years, and thus included different versions of CAPWAP and analysis by different engineers. Due to this fact, the dynamic data was reanalyzed with CAPWAP, Version 1.993-1 using the automatic function for a consistent comparison. These data were later analyzed with a best match soil model and a radiation damping soil model. After the analyses were completed, a comparison was made after finding the ratios of predicted static resistance by CAPWAP to the measured static resistance. See Table 2-1 for results. It was concluded that CAPWAP restrike results are clearly superior to other resistance prediction methods.

Table 2-1: Summary of CAPWAP Capacity Prediction at Different Time Ratio (Likins, Rausche, Thendean, and Svinkin, 1996)

Time Ratio[1]	No. of Piles	Mean (CW/LTP)			Coefficient of Variation		
		Automatic	Best Match	Radiation Damping	Automatic	Best Match	Radiation Damping
less than 0.33	30	0.94	0.89	1	0.29	0.17	0.21
0.33 - 1.25	41	0.98	0.95	1.03	0.18	0.15	0.09
greater than 1.25	11	0.97	0.96	1.04	0.2	0.16	0.13

Note: 1 – "Time Ratio" is ratio of "time after driving until restrike" divided by "time after driving until static test".

Conclusion

Past research show that dynamic testing predictions by CAPWAP prove to correlate reasonably well with static load test measurements when using restrike data at similar time after installation. The restrike should be performed at about the same time as the static load test because soil setup or relaxation could cause an error between the predicted and measured results. Also, static load tests should be carried to failure defined

by a criteria such as the Davisson criteria so that the ultimate resistance can be accurately defined, thus creating a more reliable comparison. The proper damping model should be used to create the best soil model. Although certain project constraints can prevent these things from occurring, attempting a restrike as soon as possible after the static load test should create the best possible correlation.

CHAPTER 3

LOAD TEST DATA

Introduction

Thirty projects from the Alabama Department of Transportation database were selected to form the database for which research was performed. A table of project information is shown in Table 3-1. More detailed information for each specific project including soil boring, CAPWAP output, and load-settlement plots are provided in the Appendix. Data were gathered from projects that took place between the years of 2001 and 2005 with the addition of one project from 1995. Other data were available from that period, however not all pile-driving projects had dynamic load tests and static load tests performed on the same pile. The projects selected consisted of projects that had both a dynamic load test using the PDA and static load tests performed on the same test pile so that comparisons could be performed. Projects older than 2001 did not have sufficient records of dynamic load test data for use in this research.

Table 3-1. Descriptions of Piles Used in this Study.

					Estimated Resistance (tons)		Maximum Applied Load (tons)
Project #	Year	Location	Pile Type	Soil Type	PDA	CAPWAP	
BR-193(500)-EOD	2005	Mobile Co.	24" x 24" PSC	Sand	350	328.5	345
BR-193(500)-RSTK	2005	Mobile Co.	24" x 24" PSC	Sand	410	353.6	345
BRF - 98 (29)	2002	Washington Co.	Steel HP 14 x 73	Clay	205	N/A[1]	189
BR - 0006(015)-A	2003	Covington Co.	Steel HP 10 x 42	Sand	116	N/A	126
BR - 0006(015)-B	2003	Covington Co.	Steel HP 14 x 73	Sand	141	120.7	171
BRF-98(31)-A	2001	Washington Co.	Steel HP 10 x 42	Clay	120	N/A	120
BRF-98(31)-B	2001	Washington Co.	Steel HP 14 x 73	Clay	185	N/A	190
BR-1608(200)-A	2002	Coffee Co.	Steel HP 12 x 53	Sand	77	DAMAGE[2]	90
BR-1608(200)-B	2002	Coffee Co.	Steel HP 12 x 53	Silty Sand	138	N/A	135
BR-1608(200)-C	2002	Coffee Co.	Steel HP 12 x 53	Silty Sand	114	DAMAGE[2]	135
BR-6619(103)-STCK	2002	Wilcox Co.	Steel HP 12 x 53	Silt	159	N/A	180
HPP-0192(2)	2002	Calhoun Co.	Steel HP 12 x 84	Clay	61.3	N/A	90
BR-98(32)	2001	Washington Co.	Steel HP 10 x 42	Sand and Gravel	97.5	N/A	120
NHF-1(512)	2005	Russell Co.	Steel HP 12 x 53	Sandy Silt	89	DAMAGE[2]	90
BR-0014(500)	2004	Autauga Co.	Steel HP 12 x 53	Clayey Sand w/ Silt	179	137.7	90
ST-063-171-001	2003	Tuscaloosa	Steel HP 12 x 53	Sandy Clay	132	137	90
NHF-197(13)-A	2003	Tuscaloosa	Steel HP 12 x 53	Clay	100	107.4	90
NHF-197(13)-B-RSTK	2003	Tuscaloosa	Steel HP 14 x 89	Silty Sand	183	140.2	135
M-7510(6)	1995	Mobile/Escambia Co.	14" x 14" PSC	Sand	180	N/A	150
BR-3406(102)-RSTK	2002	Henry Co.	Steel HP 12 x 53	Silty Sand	150	N/A	90
NHF-65-1(246)	2001	Montgomery	Steel HP 10 x 42	Clay with Sand	90	N/A	60
MGF-0012(500)-A-STCK	2003	Covington Co.	Steel HP 12 x 53	Silty Sand	108	101.4	90
MGF-0012(500)-B	2003	Covington Co.	Steel HP 12 x 53	Sand	209.5	163.7	210
BR-0203(511)-STCK	2004	Lamar Co.	Steel HP 14 x 73	Clay w/ Silt and Sand	173	216.4	162
ER-7527(2)-A	2003	Escambia Co.	Steel HP 12 x 53	Silty Sand	120	66.2	99
ER-7527(2)-B	2003	Escambia Co.	Steel HP 12 x 53	Silty Sand with Clay	120	49.1	96
ER-7527(2)-C	2003	Escambia Co.	Steel HP 14 x 89	Silty Sand	150	96.9	171
ER-7527(2)-D	2002	Escambia Co.	Steel HP 14 x 89	Silty Sand with Clay	128	DAMAGE[2]	171
ER-7527(2)-E	2003	Escambia Co.	Steel HP 12 x 53	Silty Sand with Clay	88	74.9	99
BRF-0102(527)-A	2004	Montgomery Co.	Steel HP 12 x 53	Clay with Sand	105	265.4	183
BRF-0102(527)-B	2005	Montgomery Co.	Steel HP 10 x 42	Clay	111	DAMAGE[2]	87

[1]PDA files were no longer available on a data file, therefore CAPWAP analysis could not be performed.
[2]Damage was indicated, therefore the estimated resistance is irrelevant.

Static Load Tests

The Alabama Department of Transportation carries out static load tests to confirm the static resistance of driven piles. The data gathered indicated that piles are not typically tested to failure. Instead, ALDOT tests piles to a prescribed load, either 2.5 or 3 times the design load and evaluates failure according to the Davisson Criteria. The Davisson criterion was proposed by M.T. Davisson in 1972, and has become a commonly accepted criteria to determine whether or not pile resistance has been fully mobilized. According the the Davisson Criteria, failure corresponds to the elastic shortening of the pile plus 0.15 inches plus a factor for the diameter of the pile (d/120) as shown in Figure 3-1 (FHWA, 1997). This criterion is based on the assumption that a pile acts a free column. According to the Davisson Criteria, a pile is deemed to fail when the settlement due to the applied load crosses the Davisson line on the load-settlement plot. If the load-settlement line does not intersect the line, then the pile has an ultimate resistance greater than the maximum applied load. The Davisson Criteria is defined as follows:

$$S_f = \frac{PL}{AE} + 0.15 + \frac{d}{120}$$

Where:

S_f = Settlement at Failure (inches)

P = Applied Load

L = Length of Pile (inches)

A = Cross-Sectional Area

E = Elastic Modulus

d = Pile Diameter (inches)

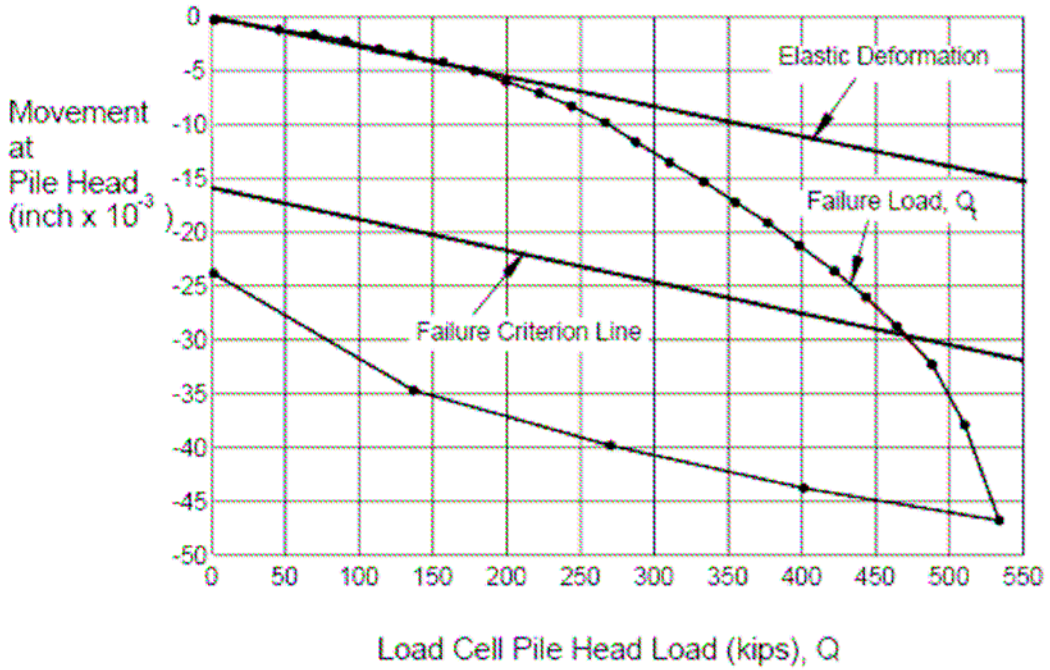

Figure 3-1. Davisson Failure Criteria (Kyfor, Schnore, Carlo, and Baily, 1992)

See Figure 3-2 for a pile that did not achieve Davisson failure criterion and see Figure 3-3 for a pile that did achieve the Davisson failure criterion.

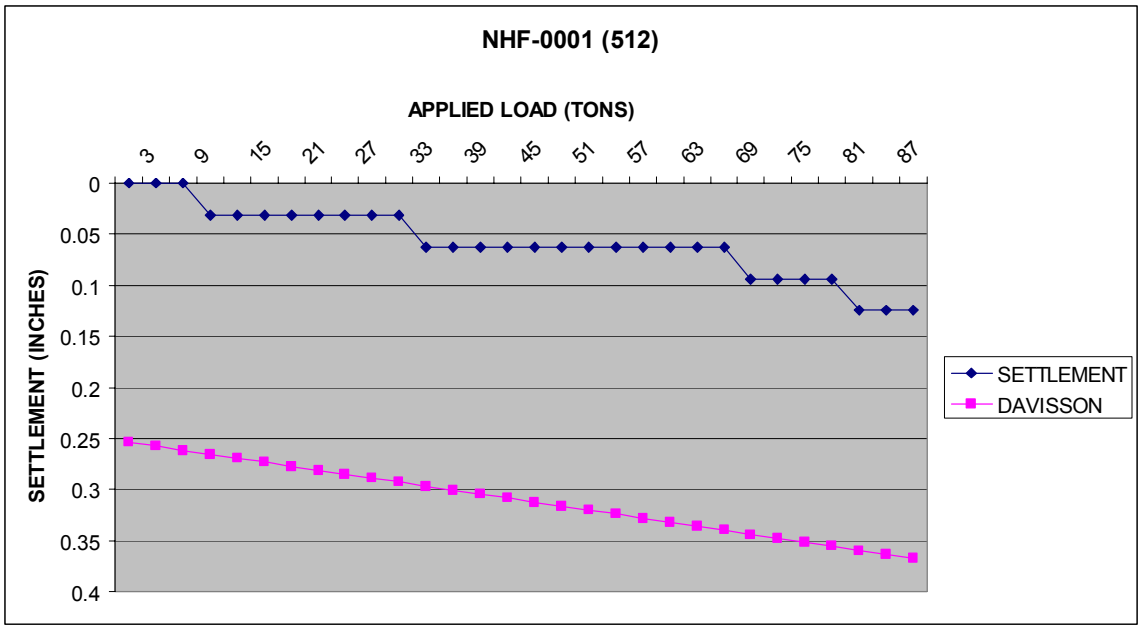

Figure 3-2. Pile that did not achieve Davisson failure criterion

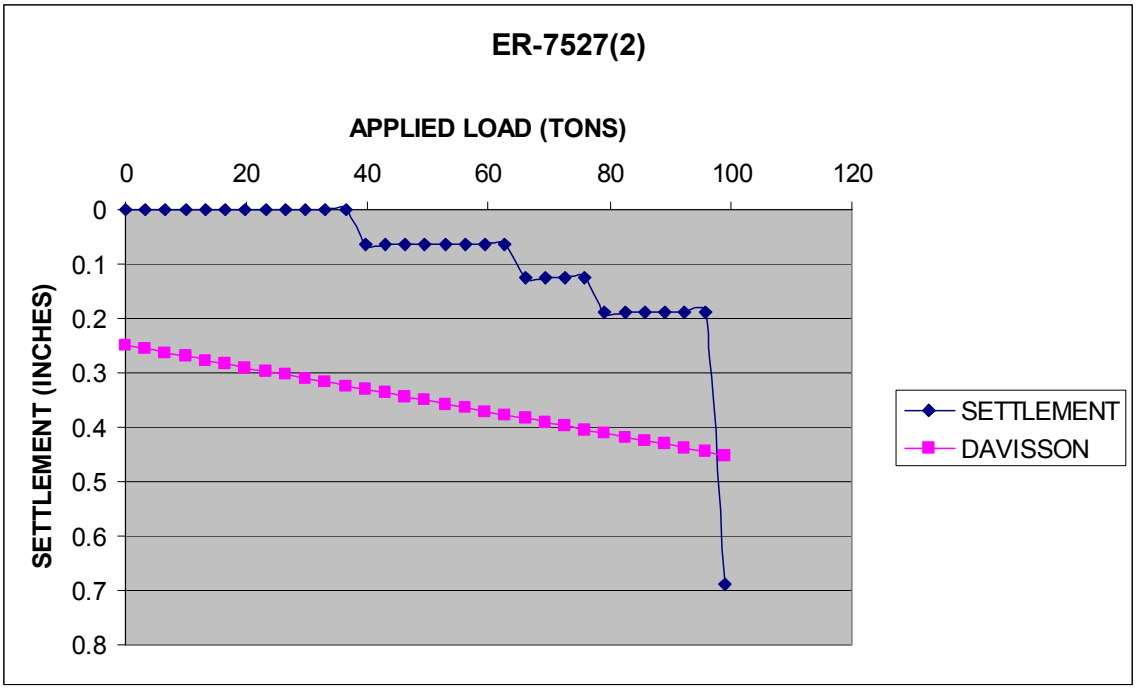

Figure 3-3. Pile that did achieve Davisson failure criterion

Failure criteria were evaluated for all projects in the database. Of all thirty projects reviewed, only one static load test pile was observed to fully mobilize the axial resistance according to the Davisson criterion, and this "failure" occurred at approximately three times design. These data indicate that pile design may be conservative. Therefore, piles could carry much higher loads or be driven less hard for the given loads. See Figure 3-4 for the number of projects that achieved or failed to achieve Davisson criteria during a static load test.

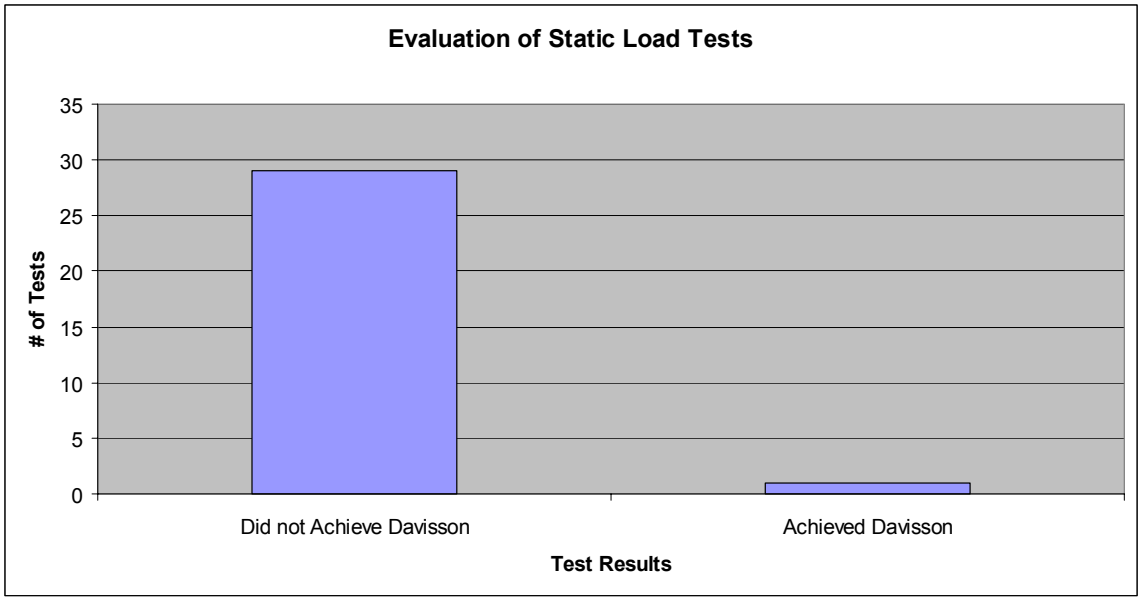

Figure 3-4. Projects that did or did not achieve Davisson Failure Criterion

Settlement of a pile during a transient loading event is of interest to engineers because excessive settlements may cause catastrophic failures. ALDOT provided load – settlement plots from the static load tests of all thirty projects. None of the projects exhibited more than one inch of settlement. See figure 3-5 below for maximum settlement observed during the static load test.

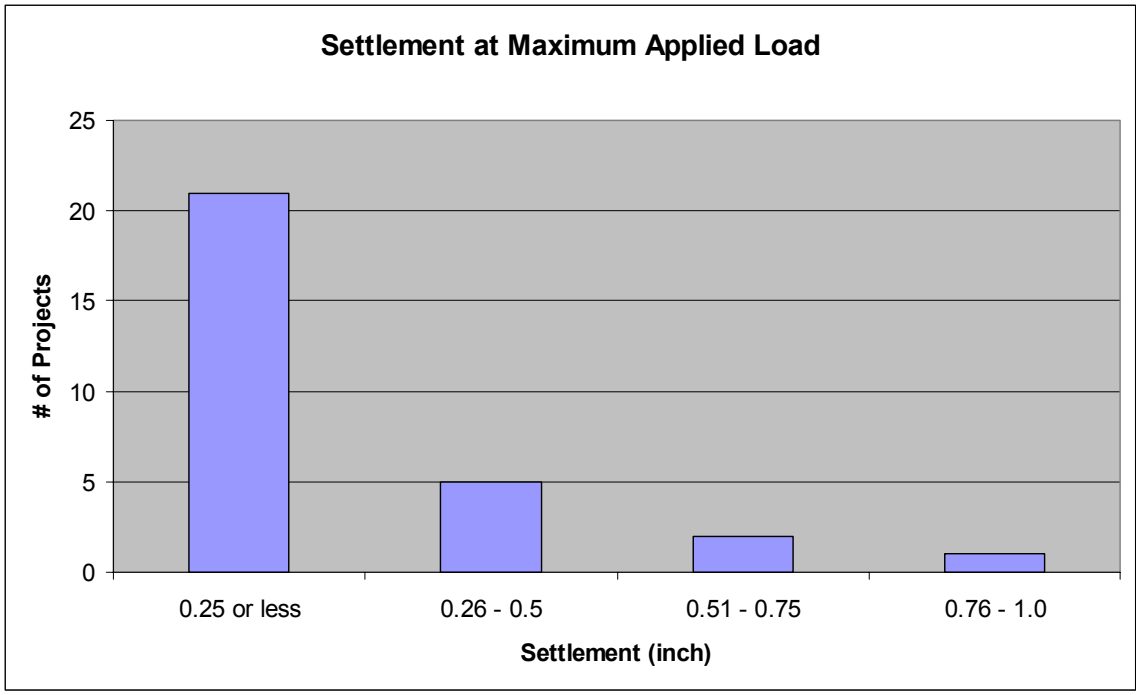

Figure 3-5. Maximum Settlement Observed During the Static Load Test

Dynamic Load Tests

All of the selected projects were subjected to a dynamic test by the PDA either during initial driving or after a brief waiting time or both. The PDA resistances used in this study were the actual resistances selected and recorded by ALDOT's PDA operator which is understood to be a single operator. Obviously, operator selection of the soil parameters can introduce subjectivity into the selection of pile resistance.

Estimated static resistance from the PDA is a function of the soil damping factor selected by the operator. The soil damping factor is the relationship between resistance and velocity, assuming a linear relationship. This dimensionless factor is based on soil type near the pile toe (FHWA, 1997). Typical values of Case damping factors are shown in Table 3-2.

Table 3-2. Case Damping Factors (FHWA, 1997).

Soil Type at Pile Toe	Case Damping Ranges Pile Dynamics (1996)
Clean Sand	0.10 to 0.15
Silty Sand, Sand Silt	0.15 to 0.25
Silt	0.25 to 0.40
Silty Clay, Clayey Silt	0.40 to 0.70
Clay	0.7 or higher

Since only one of the static load tests was carried to failure, the estimated static resistance from the PDA cannot be directly compared to the measured resistance indicated from the static load tests. However, a comparison can be made relating to the following question:

-Did the PDA test correctly indicate that the test pile would support 2.5 times the design load, as indicated by the static load test on all 30 piles?

As illustrated in Figure 3-6, the PDA measurements indicated sufficient static resistance in 26 of the 30 piles.

The 4 projects that did not achieve 2.5 times the design load may imply one or more of the following:

-The driving system may not have mobilized all the soil resistance acting on the pile.

-H-piles which do not bear on rock may behave differently under dynamic and static loading conditions, thus a difference between predicted and measured resistance occur (FHWA, 1997).

-Pore pressures could build up during driving, thus decreasing resistance.

-Dynamic testing estimates the static pile capacity at the time of testing, thus setup or relaxation could occur since there is often several hours, or even days, before a static load test is performed.

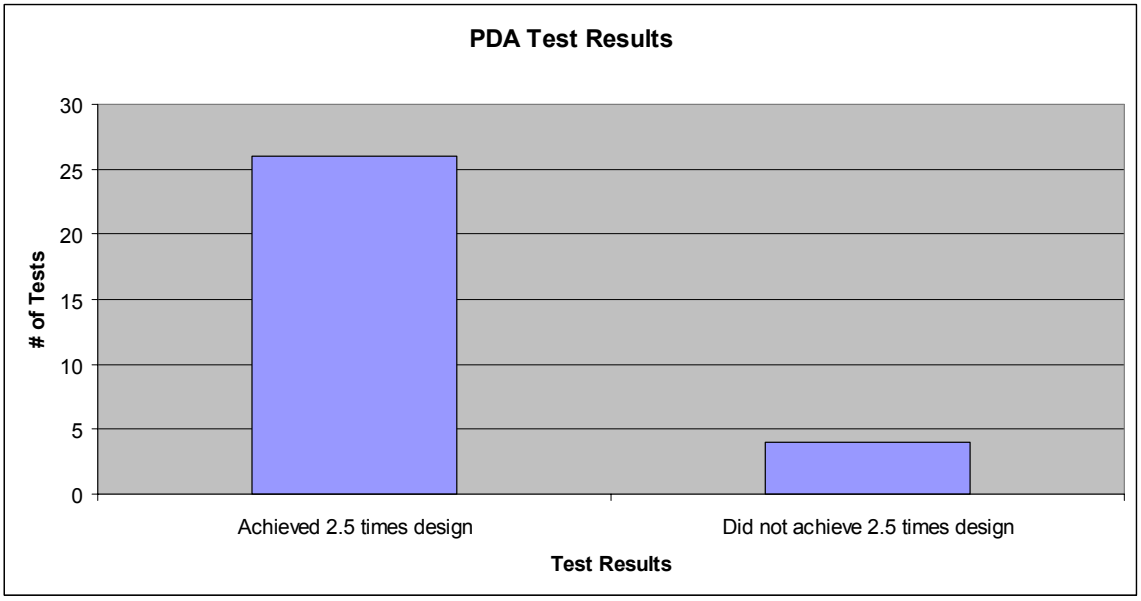

Figure 3-6. PDA Test Results

CAPWAP

Of the thirty selected projects, twenty were subjected to a CAPWAP analysis, performed as a part of this research. The other ten projects were no longer available on a data file; therefore CAPWAP could not be performed. CAPWAP was performed to compare with predicted resistances selected by the PDA operator, in addition to confirming integrity of the tested piles.

CAPWAP utilizes PDA measurements from a specific blow obtained during driving to obtain a more realistic estimate of ultimate resistance. PDA measurements of force and velocity at the pile top are compared in order to determine the forces reflected from the soil resistance acting along the pile length. The reflected forces are termed "wave-up" measurements. CAPWAP is an iterative process comparing the predicted wave-up response versus the measured wave-up response from a computer simulation of the test. Match quality is a computed index of the correlation between measured and computed response which gives the user an idea of the accuracy of the resulting pile capacity. For example, a match quality of 20 would indicate a bad estimate of static resistance, whereas a match quality of 2 would indicate a reasonable estimate of static resistance.

In theory, CAPWAP provides a more accurate interpretation of ultimate resistance from the PDA measurement. However, if an operator were to pick a blow for analysis that does not have adequate transferred energy or contains disproportional wave-up and wave-down curves, then the resulting estimated resistance will not result in an accurate estimate of resistance. In the event the pile driving hammer does not mobilize the full resistance of a pile, the resulting resistance will be inaccurate.

CAPWAP analysis is very time consuming because much iteration with operator input is usually necessary to obtain a good match quality. For this effort, it was common for the CAPWAP user to spend 2 hours or more to obtain a good estimate of static resistance. At this time, CAPWAP is too time-consuming to perform in the field; therefore it is often carried out in the operator's office.

An example CAPWAP analysis procedure is shown below:

1.) The user should select a blow measurement from the PDA with good proportionality and adequate transferred energy and permanent set to mobilize the full resistance along the pile.
2.) Import that blow into CAPWAP
3.) Input the blow count or set per blow.
4.) Input the cross-sectional area of the pile.
5.) Build pile model with initial estimates of soil resistance along the pile length. CAPWAP automatically has default pile segments of 1 meter. Segment lengths can be changed if the CAPWAP engineer believes 1 meter segments are not appropriate for the given project.
6.) Run CAPWAP. The user can choose to perform a single analysis or an automatic analysis in which CAPWAP automatically perform the iterations to find the best match. If the automatic analysis is performed, the results should be checked thoroughly by an experienced engineer to be sure that it is in fact a reasonable solution. The single analysis allows the user to modify the soil parameters and resistance distribution to improve the match quality and most reliably model the resistance on the test pile.

After performing the analysis, the screen like the one shown in Figure 3-7 below should appear.

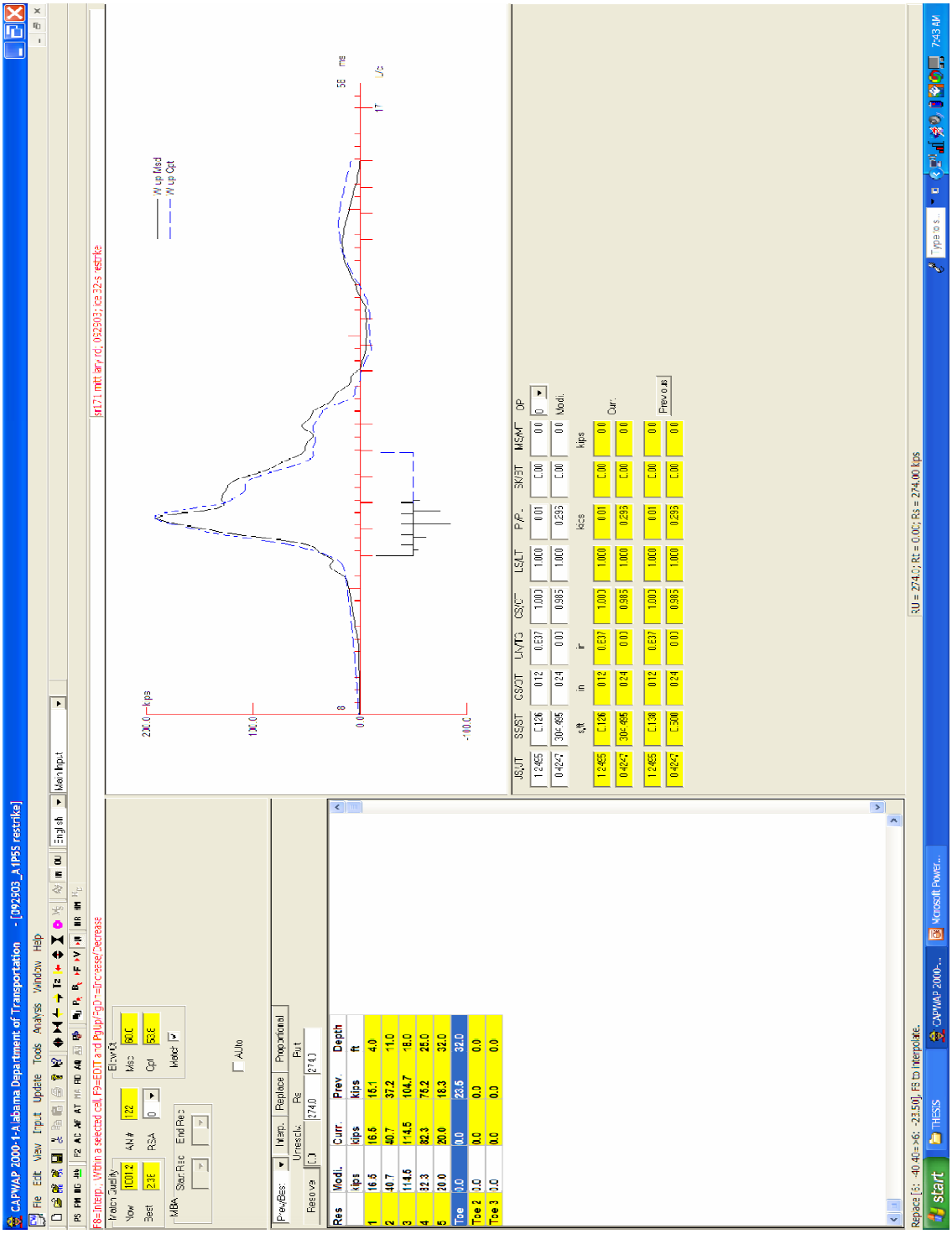

Figure 3-7. 1st iteration of a CAPWAP analysis

The user would like to match the dashed line (wave-up computed) with the solid line (wave-up measured). As shown in Figure 3-7, the measured and computed wave up curves do not match. The match quality of 1001 is shown in the top left-hand corner of the screen. An ideal match quality might be between 0.5 and 5, so this is a bad match. For this particular iteration, it was assumed that all the resistance was along the pile shaft. Based on the match quality, toe resistance must be available so a second iteration must be performed as shown in Figure 3-8.

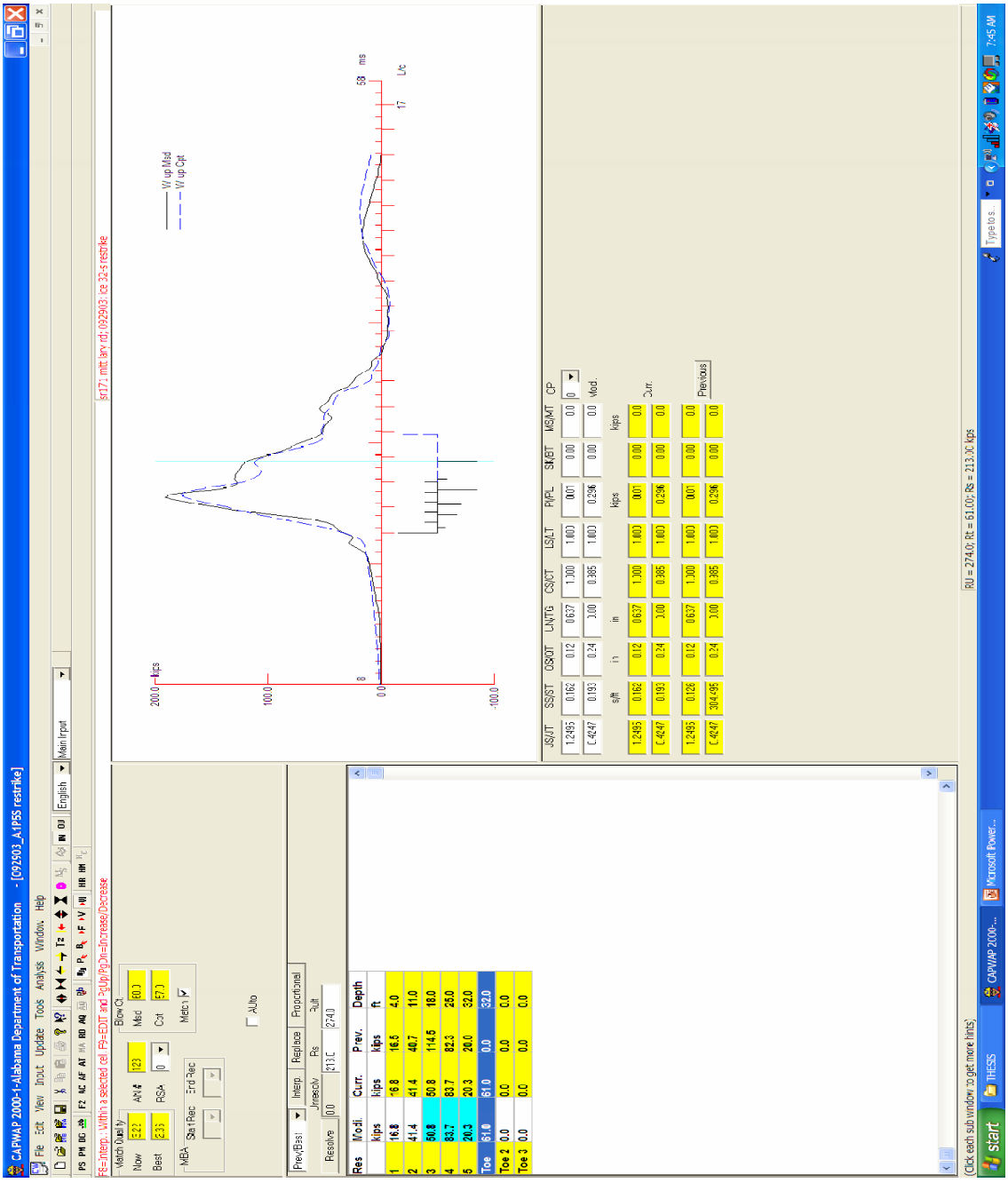

Figure 3-8. 2nd iteration of a CAPWAP analysis

For the second iteration, a toe resistance of 61 kips was entered into the resistance distribution with a corresponding decrease in shaft resistance. The resistance distribution is shown in the left-hand side of the screen. The analysis was performed and it was

noticed that the measured and computed waves matched much better than the previous iteration. This is obvious due to the fact the match quality decreased from 1001 to 3.22. Although the match quality may be acceptable, a third iteration will be performed to determine if further improvement can be obtained.

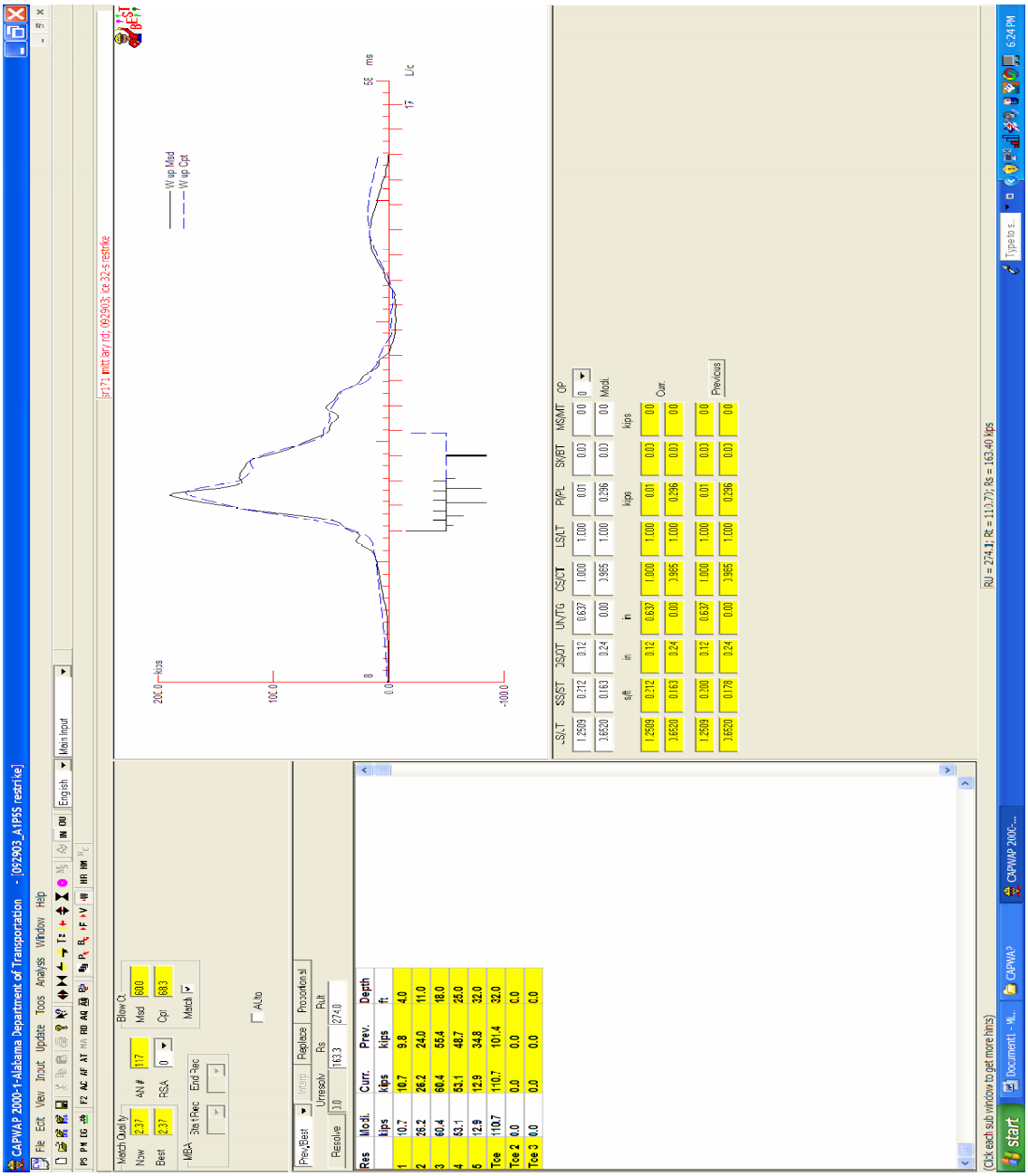

Figure 3-9. 3rd iteration of a CAPWAP analysis

For the 3rd iteration, a toe resistance 110 kips was entered into the resistance with a corresponding decrease in shaft resistance. The toe damping factor was also increased from 0.42 to 0.65 to account for fine grain soils near the pile toe. This analysis resulted in another improvement of match quality. As one can see, the measured and computed waves match up very well. The resulting match quality of 2.37, an improvement from the previous match quality of 3.22, indicates an acceptable match. No further iterations aided in the further improvement of match quality, therefore the resistance distribution and soil parameters shown in Figure 3-9 are assumed to be the best model of resistance distribution and soil parameters.

For each CAPWAP analysis, a specific blow or multiple blows were analyzed until a desired match quality was obtained. Every effort was made to select a hammer blow for analysis that was at or near end of drive with sufficient energy transfer such that reasonable results could be obtained. After analysis was performed, the predicted ultimate resistance obtained from CAPWAP was compared with the predicted ultimate resistance from the PDA. In theory, CAPWAP offers a better estimate of ultimate resistance than the PDA.

The estimated static resistances from CAPWAP were normalized with that of the PDA as a means of determining the reliability of the PDA field measurements. From these data, the average PDA/CAPWAP was 1.23 with a standard deviation of 0.46 and a coefficient of variation of 0.38. These data suggests that PDA may be overestimating static resistance relative to CAPWAP. This could imply that CAPWAP analyses should be carried out to confirm the estimated resistance measured by the PDA. No correlations could be made between the damping factors and the ratio of static resistance predicted by

PDA to that of CAPWAP. See Figure 3-10 below for the ratios of static resistance indicated by the PDA and CAPWAP. Table 3-3 provides damping factors and percentage of available toe resistance for each value of PDA/CAPWAP.

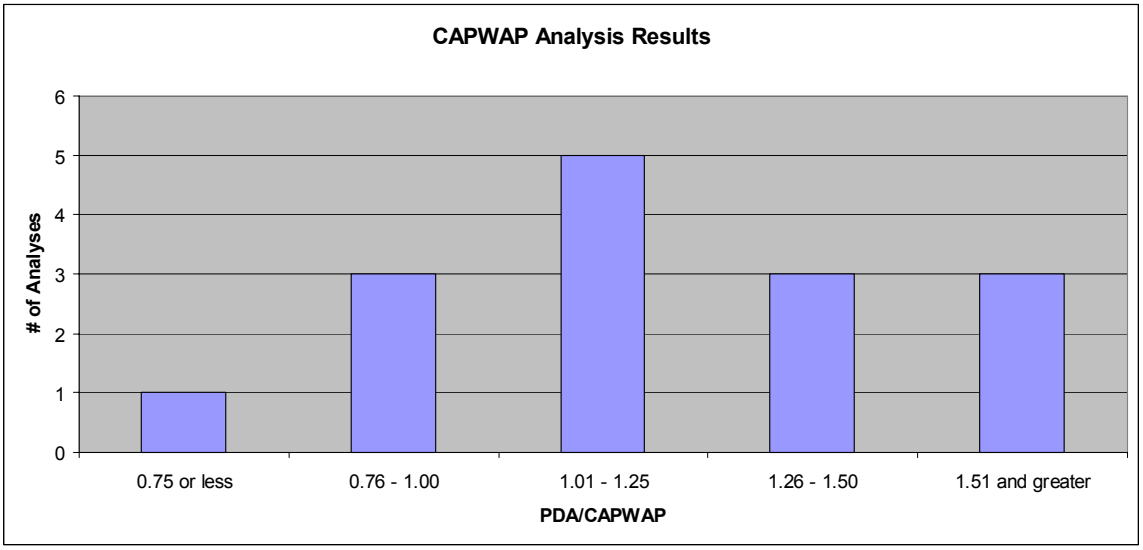

Figure 3-10. Ratio of Static Resistance Indicated by PDA to that of CAPWAP

Table 3-3. Damping Factors and Available Toe Resistance for each value of PDA/CAPWAP

PDA/CAPWAP	PDA Damping Factor	CAPWAP Damping Factors		% Toe Resistance
		Toe	Shaft	
0.4	0.15	0.24	0.87	4
0.8	0.2	0.27	0.7	15
0.93	0.1	0.44	0.16	84
0.96	0.4	0.65	1.25	40
1.07	0.1	0.36	0.19	62
1.07	0.15	0.26	0.36	76
1.16	0.62	0.36	0.72	25
1.17	0.11	0.28	0.46	31
1.17	0.3	0.55	0.43	23
1.28	0.45	0.8	1.25	51
1.3	0.3	0.16	1.26	26
1.31	0.1	0.29	0.3	20
1.55	0.1	0.35	0.53	30
1.81	0.15	0.18	0.52	47
2.44	0.1	0.1	0.5	21

CAPWAP reports damage at some point along the pile based on blow data obtained from the PDA. During monitoring, the PDA checks for changes in impedance (EA/C) throughout driving. Measured values of elastic modulus, cross-sectional area, and wavespeed are entered into the PDA prior to driving the pile. With each blow, the PDA checks for a change in impedance which would indicate a discontinuity at some point along the pile which could be due to cracks for example. Any change in impedance $(EA/C)_{detected}$ will be compared to the measured impedance originally entered into the PDA and the ratio of the detected impedance to the measured impedance is reported as beta as shown below. A discontinuity should cause a tensile wave reflection. Thus, a wave reflected from some point along a pile other than the toe means that a possible discontinuity exists. Beta guidelines are shown in Table 3-3. Beta is reported as a percentage as follows:

$$[(EA/C)_{detected}/(EA/C)_{measured}] \times 100$$

Where:

E = elastic modulus

A = cross-sectional area

C = wave speed (function of pile material)

Table 3-4. Pile Damage Guidelines (FHWA, 1997).

Beta (%)	Severity of Damage
100	Undamaged
80 to 100	Slightly Damaged
60 to 80	Damaged
Below 60	Broken

Beta values for all piles in this study were evaluated for possible damage. 5 of the steel HP piles in this study had beta values ranging from 74% to 78%, respectively. These beta values were compared with damage reported by CAPWAP, and the beta values agreed with CAPWAP reported damage in all 5 cases. Based on these data, it is possible that 5 piles in this study were damaged. See Figure 3-11 below for results.

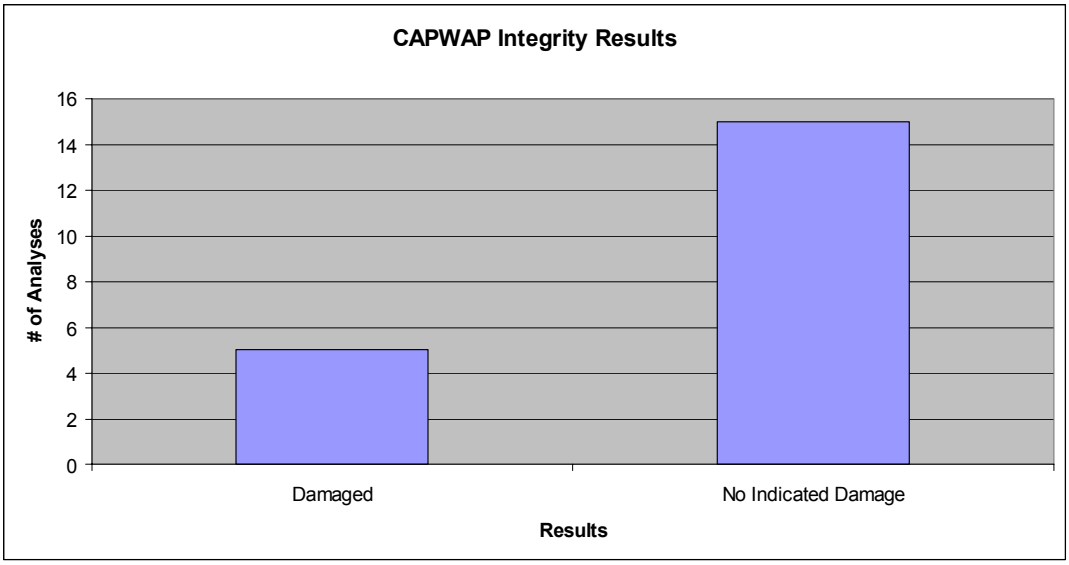

Figure 3-11. CAPWAP Integrity Results

It was observed that each damaged pile was a steel H-pile. Damage could have occurred due to buckling or bending during overdriving. However, damage was not reported on any of the driving records obtained from ALDOT. No concrete piles used in this study indicated damage from either CAPWAP or the PDA.

CHAPTER 4

CONCLUSIONS AND RECOMMENDATIONS

Description of the Study

A study was carried out on a database consisting of thirty pile projects from ALDOT bridge projects. The projects selected consisted of projects with both a dynamic and static load test performed on the same pile. Of the thirty selected projects, twenty were subjected to a CAPWAP analysis based on the PDA data provided by ALDOT. All of this information was analyzed as a means of evaluating driven pile load testing methods used on ALDOT bridge projects.

The static load tests were evaluated according to the Davisson criteria as an indication of failure. 29 of the 30 piles in the database did not achieve Davisson failure criteria. Therefore, a direct comparison between the PDA estimated resistance and measured resistance could not be performed.

In order to evaluate the PDA measurements by more rigorous methods, CAPWAP analysis of static representative blows were performed and compared with field PDA reports to give an indication of the reliability of the PDA predicted resistances.

PDA values were obtained from records obtained from ALDOT. The resistances used in this study were the actual values selected and recorded by ALDOT's PDA operator and were not modified in any manner. These estimated resistances were

compared to 2.5 times the design load and it was realized that the PDA predicted resistance was not adequate in 4 of the 30 projects.

Twenty of the thirty projects were subjected to a CAPWAP analysis from PDA data provided by ALDOT. CAPWAP was performed on specific blows selected by the operator. The selected blows were believed to offer the best possible indication of static resistance based on the provided data. Derived static resistance from CAPWAP was compared with PDA values provided by ALDOT.

Summary Conclusions

1.) Pile design for the ALDOT projects surveyed appears to be conservative with respect to axial resistance. According to the Davisson failure criteria, only one project had a static load resistance less than three times the design load, and at the end of the test it exhibited only 0.7 inches of settlement. None of the projects exhibited a maximum settlement greater than 1 inch. Damage was indicated by CAPWAP on five of the twenty projects analyzed. All projects with indicated damage consisted of steel H-piles. However, no prestressed concrete piles in this study indicated damage. Beta values available in the PDA records confirmed the possible damage. Nothing in the driving records showed that damage was noted by the operator in any of the projects.

2.) PDA indicated a static resistance equal to or greater than 2.5 times the design load in 26 of the 30 projects surveyed. These data could be subject to the following:

    i.) The pile driving system may not have fully mobilized resistance, thus exhibiting resistance estimations lower than the ultimate static resistance.

ii.) These values are operator dependent and could vary with the reliability of selected soil parameters.

3.) CAPWAP analysis indicated that the PDA may have overestimated static resistance in 11 of the projects. On the other hand, CAPWAP indicated that the PDA may have underestimated static resistance on 4 projects. CAPWAP values were normalized with that of the PDA. From this data, the average PDA/CAPWAP was 1.23 with a standard deviation of 0.46 and a coefficient of variation of 0.38. This might suggest the following:

   i.) The PDA indication of resistance is subject to variability due to the simple algorithm used and operator-selected parameters.

   ii.) PDA predicted capacities can overpredict static resistance when compared with CAPWAP resistance estimates.

Summary Recommendations

1.) Based on this study, piles could typically be designed for much higher loads or driven less hard for the given loads on ALDOT projects.

2.) More attention should be given to beta values from the PDA during driving, and note any possible damage on the driving records.

3.) Perform CAPWAP analysis on projects where beta values indicate damage to confirm the possibility. If damage is confirmed by CAPWAP, then appropriate measures should be take by ALDOT to ensure that piles are not overdriven.

Thoughts on Future Research

In order to evaluate the reliability of dynamic load tests, ALDOT should perform static load tests to failure and perform restrikes on all piles subjected to a static load test. This would allow a statistical reliability study to be performed comparing the estimated resistance to the failure resistance from the static load tests as defined by criteria such as the Davisson failure criteria. Other states such as the Illinois Department of Transportation have conducted such studies and have found that good correlation exists between static load test measurements and predicted ultimate resistance from CAPWAP on restrike measurements (Long, Maniaci, and Samara, 2002).

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APPENDIX

PROJECT INFORMATION, SOIL BORINGS, LOAD TEST DATA, AND CAPWAP RESULTS

This appendix contains detailed information about each project including location, pile type, pile driving system, soil data, PDA results, static load test records and CAPWAP results.

PROJECT INFORMATION

NAME:	BR-193(500) SR 193 over Fowl River
DIVISION:	9
LOCATION:	Mobile Co.
BENT/LANE:	Sta 35+24, Bent #12 CL
PILE NO.:	6
DATE DRIVEN:	5/27/2005

HAMMER DETAILS

MAKE/MODEL:	delmag D 48-46
RATED ENERGY (KIP-FT):	107.28 @ 10.5'
WEIGHT (KIPS):	10.217
HAMMER ACTION:	single
AIR/DIESEL:	diesel
OPEN/CLOSED:	open
HAMMER CUSHION:	ALUMINUM

PILE DETAILS

PILE TYPE/MATERIAL:	PSCP 24" x 24"
FURNISHED PILE LENGTH (FT.):	101
WALL THICKNESS (IN.):	24
SIZE/CS. AREA (IN^2):	489.41
DESIGN CAPACITY (TONS):	115
SPLICE DETAILS:	N/A
PILE CUSHION:	OAK

PDA INFORMATION

EOD

PDA CAPACITY (tons):	345

RESTRIKE

DATE:	7/28/2005
SETUP TIME (DAYS):	60
PDA CAPACITY (tons):	499

ELEVATION DETAILS

FINISHED TOTAL LENGTH (FT.):	94.08
EMBEDDED LENGTH (FT.):	80.28
GRADE ELEVATION (FT.):	-8.3
TIP ELEVATION (FT.):	-88.58
GW ELEVATION (FT.):	N/A

CAPWAP RESULTS

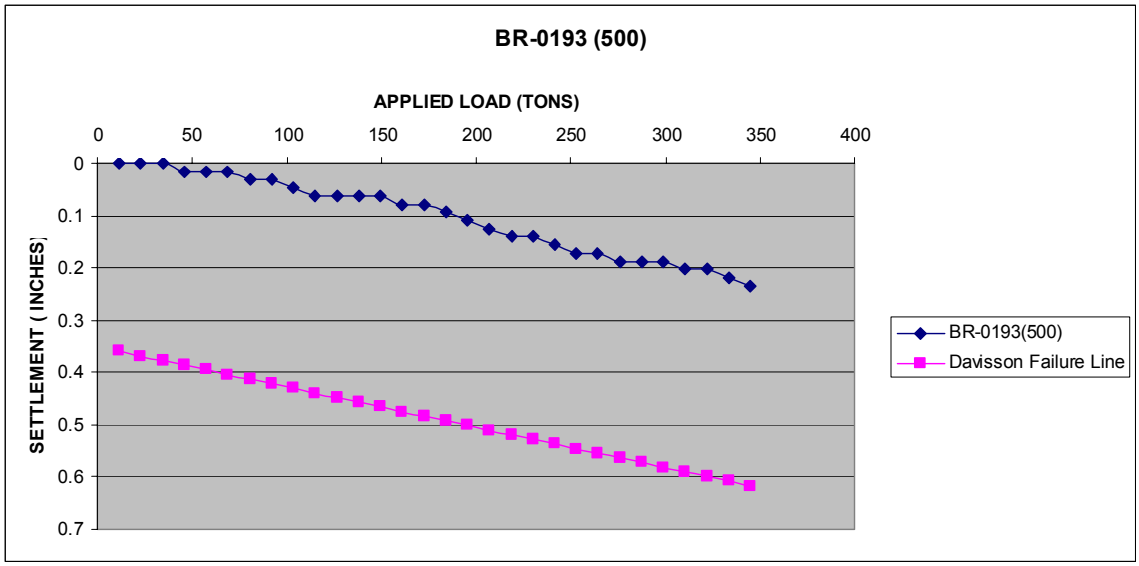
ULTIMATE RESISTANCE (tons):	328.5

STATIC LOAD TEST DATA

DATE TESTED:	6/22/2005
DAVISSON LOAD CAPACITY (TONS):	
MAX. APPLIED LOAD (TONS):	345
DID FAILURE OCCUR:	NO
ESTIMATED ULTIMATE CAPACITY (TONS):	

SOIL INFORMATION

BORING NUMBER:	B-14
BRIEF SOIL DESCRIPTION:	Loose gray sand 20' and below



DEPTH (ft.)		DESCRIPTION	PILE TIP
-25		FAT CLAY (CH) very soft, saturated	
-40		SAND (SP) saturated, very loose	
-50		SAND (SW) saturated, loose	
-51.5		FAT CLAY (CH) very soft, wet, with sand and trace gravel	
-56.5		SANDY LEAN CLAY (CL) firm, wet, trace very fine sand	
-75		SILTY SAND (SM) wet	
-100		SILTY SAND (SM) saturated, loose	TIP ELEV.
-108.5		SAND (SP) dense, saturated	

CAPWAP FINAL RESULTS

Total CAPWAP Capacity: 657.0; along Shaft 246.8; at Toe 410.2 kips

Soil Sgmnt No.	Dist. Below Gages ft	Depth Below Grade ft	Ru kips	Force in Pile kips	Sum of Ru kips	Unit Resist. (Depth) kips/ft	Unit Resist. (Area) ksf	Smith Damping Factor s/ft	Quake in
				657.0					
1	9.9	3.9	20.3	636.7	20.3	3.06	0.42	0.167	0.080
2	16.6	10.5	2.3	634.4	22.6	0.35	0.05	0.167	0.080
3	23.2	17.1	0.0	634.4	22.6	0.00	0.00	0.000	0.080
4	29.8	23.7	0.0	634.4	22.6	0.00	0.00	0.000	0.080
5	36.4	30.4	0.0	634.4	22.6	0.00	0.00	0.000	0.080
6	43.1	37.0	5.5	628.9	28.1	0.83	0.11	0.167	0.080
7	49.7	43.6	13.3	615.6	41.4	2.01	0.27	0.167	0.080
8	56.3	50.2	19.0	596.6	60.3	2.87	0.39	0.167	0.080
9	62.9	56.9	22.4	574.2	82.7	3.38	0.46	0.167	0.080
10	69.6	63.5	22.2	552.0	104.9	3.35	0.45	0.167	0.080
11	76.2	70.1	21.3	530.8	126.2	3.21	0.44	0.167	0.080
12	82.8	76.7	26.6	504.2	152.8	4.01	0.54	0.167	0.080
13	89.5	83.4	40.5	463.7	193.2	6.11	0.83	0.167	0.080
14	96.1	90.0	53.6	410.2	246.8	8.08	1.10	0.167	0.080
Avg. Skin			17.6			2.74	0.36	0.167	0.080
Toe			410.2				120.76	0.194	0.340

Soil Model Parameters/Extensions		Skin	Toe	
Case Damping Factor		0.186	0.359	Smith Type
Unloading Quake	(% of loading quake)	100	65	
Reloading Level	(% of Ru)	100	100	
Unloading Level	(% of Ru)	18		

PROJECT INFORMATION

NAME:	Bilbo Creek on US hwy 43 (state road 13) Project # BRF - 98 (29)
DIVISION:	8
LOCATION:	washington, co
BENT/LANE:	bent 9 NBL
PILE NO.:	4
DATE DRIVEN:	5/1/2002

HAMMER DETAILS

MAKE/MODEL:	Delmag D19-32
RATED ENERGY (KIP-FT):	42.8 @ 10.2'
WEIGHT (KIPS):	4.19
HAMMER ACTION:	single
AIR/DIESEL:	diesel
OPEN/CLOSED:	open
HAMMER CUSHION:	phelonic

PILE DETAILS

PILE TYPE/MATERIAL:	Steel 14 x 73
PILE LENGTH (FT.):	54.75
WALL THICKNESS (IN.):	
SIZE/CS. AREA (IN^2):	21.4
DESIGN CAPACITY:	63
SPLICE DETAILS:	N/A
PILE CUSHION:	Phenolic

PDA INFORMATION

EOD

PDA CAPACITY (tons):	145

RESTRIKE

DATE:	5/6/2002
SETUP TIME (DAYS):	5
PDA CAPACITY (tons);	205

ELEVATION DETAILS

TOTAL LENGTH (FT.):	54.75
EMBEDDED LENGTH (FT.):	10.63
GRADE ELEVATION:	32.88
TIP ELEVATION:	N/A
GW ELEVATION:	8

CAPWAP RESULTS

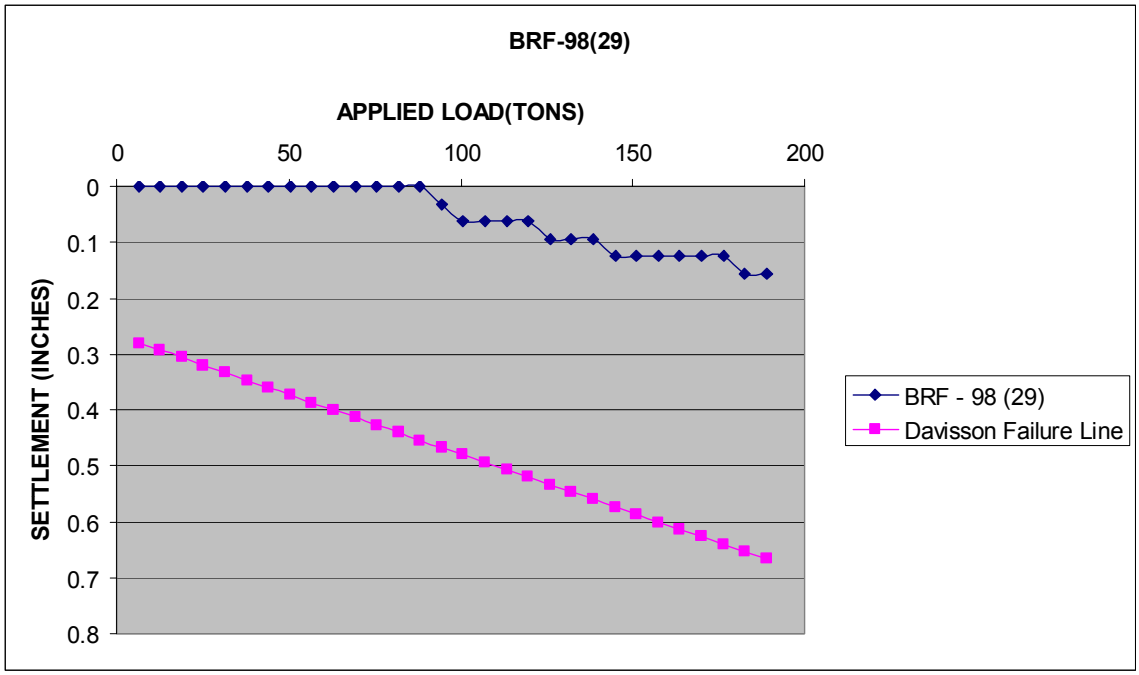
ULTIMATE RESISTANCE:	N/A

STATIC LOAD TEST DATA

DATE TESTED:	5/3/2002
DAVISSON LOAD CAPACITY (TONS):	
MAX. APPLIED LOAD (tons):	189
DID FAILURE OCCUR:	NO
ESTIMATED ULTIMATE CAPACITY (TONS):	

SOIL INFORMATION

BORING NUMBER:	B5
BRIEF SOIL DESCRIPTION:	clay



DEPTH (ft.)		DESCRIPTION	PILE TIP
7		CLAY WITH SAND (CL) gray, moist to wet, very soft alluvium	
-8		SAND (SP) very fine to fine grained trace organics, wet, loose, alluvium	
-50		CLAY WITH SAND (CL/ML) trace mica, blueish gray moist, firm to stiff	TIP ELEV.
-55		Very Stiff to Hard Gray CLAY (CL)	
-59		Medium Dense SILTY SAND, Moist (SC)	

PROJECT INFORMATION

NAME:	BR - 0006(015) U.S. 84 Five Runs Creek
DIVISION:	7
LOCATION:	Covington, co
BENT/LANE:	Abut 9 WBL
PILE NO.:	4
DATE DRIVEN:	11/25/2003

HAMMER DETAILS

MAKE/MODEL:	Kobe K-25
RATED ENERGY (KIP-FT):	51.519
WEIGHT (KIPS):	5.51
HAMMER ACTION:	single
AIR/DIESEL:	diesel
OPEN/CLOSED:	open
HAMMER CUSHION:	Micarta

PILE DETAILS

PILE TYPE/MATERIAL:	HP-steel 10 x 42
PILE LENGTH (FT.):	60.25
WALL THICKNESS (IN.):	
SIZE/CS. AREA (IN^2):	12.4
DESIGN CAPACITY:	42
SPLICE DETAILS:	N/A
PILE CUSHION:	N/A

PDA INFORMATION

EOD

PDA CAPACITY (tons):	116

RESTRIKE

DATE:	N/A
SETUP TIME (DAYS):	
PDA CAPACITY:	

ELEVATION DETAILS

TOTAL LENGTH (FT.):	60.25
EMBEDDED LENGTH (FT.):	42
GRADE ELEVATION:	257.53
TIP ELEVATION:	216.18
GW ELEVATION:	

CAPWAP RESULTS

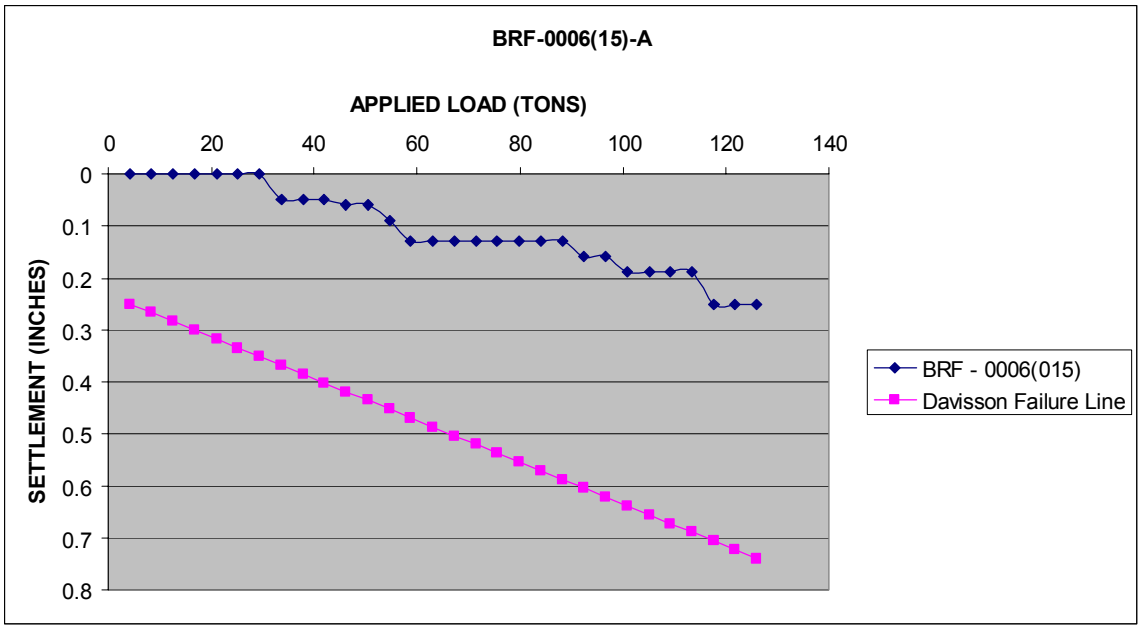
ULTIMATE RESISTANCE:	

STATIC LOAD TEST DATA

DATE TESTED:	12/1/2003
DAVISSON LOAD CAPACITY (TONS):	
MAX. APPLIED LOAD (tons)	126
DID FAILURE OCCUR:	NO
ESTIMATED ULTIMATE CAPACITY (TONS):	

SOIL INFORMATION

BORING NUMBER:	B-5
BRIEF SOIL DESCRIPTION:	silty sand



DEPTH (ft.)		DESCRIPTION	PILE TIP
GW 235		VERY SOFT CLAY AND VERY LOOSE FINE SAND (CL,SP)	
228		Firm and Loose Coarse to Fine SAND (SP)	
198		Firm to Dense SILTY FINE SAND with Weathered LIMESTONE Lenses (SM,SP)	TIP ELEV.
190		Very Dense SILTY FINE SAND with WEATHERED LIMESTONE LENSES (SM)	
165		Boring Terminated at approximately 70 feet - Dense and Firm SILTY Coarse to Fine Sand with Weathered Limestone Lenses (SM)	

PROJECT INFORMATION

NAME:	BR - 0006(015) U.S. 84 Five Runs Creek
DIVISION:	7
LOCATION:	Covington, co
BENT/LANE:	Bent 5 WBL
PILE NO.:	4
DATE DRIVEN:	12/8/2003

HAMMER DETAILS

MAKE/MODEL:	Kobe K-25
RATED ENERGY (KIP-FT):	51.519
WEIGHT (KIPS):	5.51
HAMMER ACTION:	single
AIR/DIESEL:	diesel
OPEN/CLOSED:	open
HAMMER CUSHION:	micarta

PILE DETAILS

PILE TYPE/MATERIAL:	Steel HP 14 x 73
PILE LENGTH (FT.):	60.25
WALL THICKNESS (IN.):	
SIZE/CS. AREA (IN^2):	21.4
DESIGN CAPACITY (tons):	57
SPLICE DETAILS:	N/A
PILE CUSHION:	N/A

PDA INFORMATION

EOD

PDA CAPACITY (tons):	141

RESTRIKE

DATE:	N/A
SETUP TIME (DAYS):	
PDA CAPACITY:	

ELEVATION DETAILS

TOTAL LENGTH (FT.):	60.25
EMBEDDED LENGTH (FT.):	43
GRADE ELEVATION:	240.17
TIP ELEVATION:	198.26
GW ELEVATION:	N/A

CAPWAP RESULTS

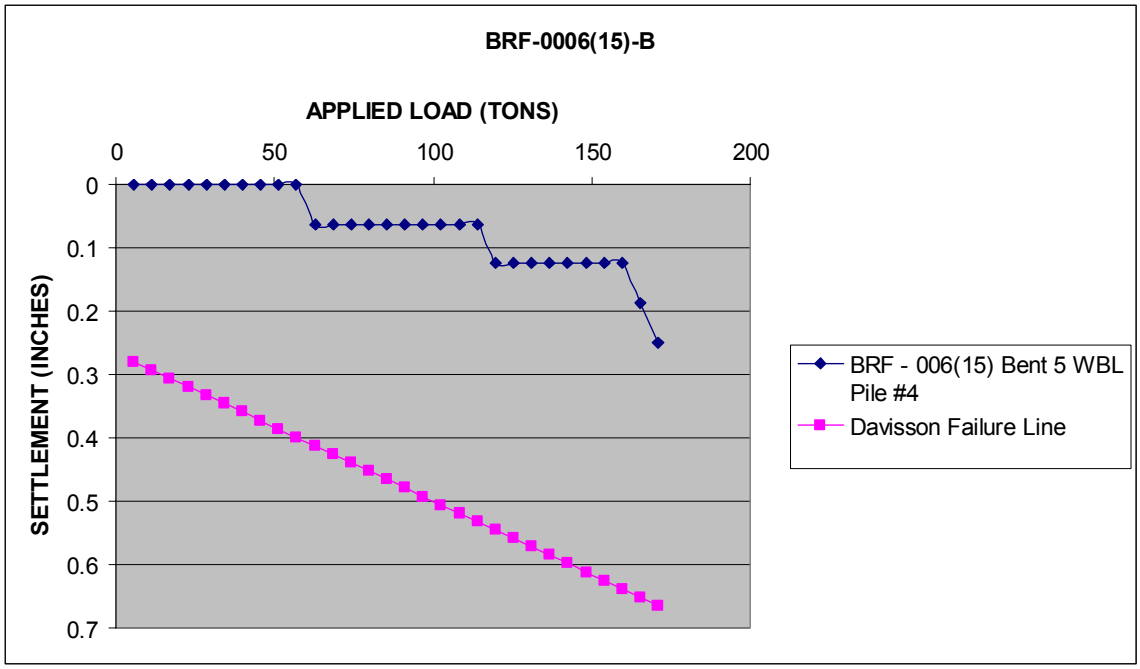
ULTIMATE RESISTANCE (tons):	120.7

STATIC LOAD TEST DATA

DATE TESTED:	12/11/2003
DAVISSON LOAD CAPACITY (TONS):	
MAX. APPLIED LOAD (tons):	171
DID FAILURE OCCUR:	NO
ESTIMATED ULTIMATE CAPACITY (TONS):	

SOIL INFORMATION

BORING NUMBER:	B-3
BRIEF SOIL DESCRIPTION:	silty sand



DEPTH (ft.)		DESCRIPTION	PILE TIP
GW 236		Very Loose SANDY SILT and SILTY FINE SAND	
233		Firm and Loose Coarse to Fine SAND (SP)	
192		Firm to Dense SILTY FINE SAND with Weathered LIMESTONE Lenses (SM,SP)	TIP ELEV.
180		Hard Fine SANDY CLAY with Weathered LIMESTONE Lenses (CL)	
175		Boring Terminated at approximately 70 feet - Dense and Firm SILTY Coarse to Fine Sand with Weathered Limestone Lenses (SM)	

CAPWAP FINAL RESULTS

Total CAPWAP Capacity: 241.4; along Shaft 166.9; at Toe 74.5 kips

Soil Sgmnt No.	Dist. Below Gages ft	Depth Below Grade ft	Ru kips	Force in Pile kips	Sum of Ru kips	Unit Resist. (Depth) kips/ft	Unit Resist. (Area) ksf	Smith Damping Factor s/ft	Quake in
				241.4					
1	23.5	8.5	19.2	222.2	19.2	2.86	1.85	0.104	0.120
2	30.2	15.2	9.7	212.5	28.9	1.44	0.94	0.104	0.120
3	36.9	21.9	27.3	185.2	56.1	4.07	2.64	0.104	0.120
4	43.6	28.6	42.8	142.4	99.0	6.39	4.14	0.104	0.120
5	50.3	35.3	45.9	96.5	144.9	6.85	4.44	0.104	0.120
6	57.0	42.0	22.0	74.5	166.9	3.28	2.12	0.104	0.120
Avg. Skin			27.8			3.97	2.69	0.104	0.120
Toe			74.5				501.28	0.143	0.270

Soil Model Parameters/Extensions		Skin	Toe	
Case Damping Factor		0.463	0.284	Smith Type
Unloading Quake	(% of loading quake)	51	94	
Reloading Level	(% of Ru)	100	100	
Soil Plug Weight	(kips)		0.02	

PROJECT INFORMATION

NAME:	Project No. BRF-98(31) Bridge repl. On US 43 over Bassetts Creek
DIVISION:	8
LOCATION:	Washington Co.
BENT/LANE:	Abut 16
PILE NO.:	5
DATE DRIVEN:	5/14/2001

HAMMER DETAILS

MAKE/MODEL:	Kobelco
RATED ENERGY (KIP-FT):	54.2
WEIGHT (KIPS):	5.51
HAMMER ACTION:	single
AIR/DIESEL:	Diesel
OPEN/CLOSED:	closed
HAMMER CUSHION:	Micarta 2.0"

PILE DETAILS

PILE TYPE/MATERIAL:	HP 10 x 42
PILE LENGTH (FT.):	60.25
WALL THICKNESS (IN.):	
SIZE/CS. AREA (IN^2):	12.4
DESIGN CAPACITY (tons):	40
SPLICE DETAILS:	N/A
PILE CUSHION:	N/A

PDA INFORMATION

EOD

PDA CAPACITY (tons):	120

RESTRIKE

DATE:	
SETUP TIME (tons):	
PDA CAPACITY:	

ELEVATION DETAILS

TOTAL LENGTH (FT.):	44.67
EMBEDDED LENGTH (FT.):	42
GRADE ELEVATION:	35.96
TIP ELEVATION:	-6.46
GW ELEVATION:	

CAPWAP RESULTS

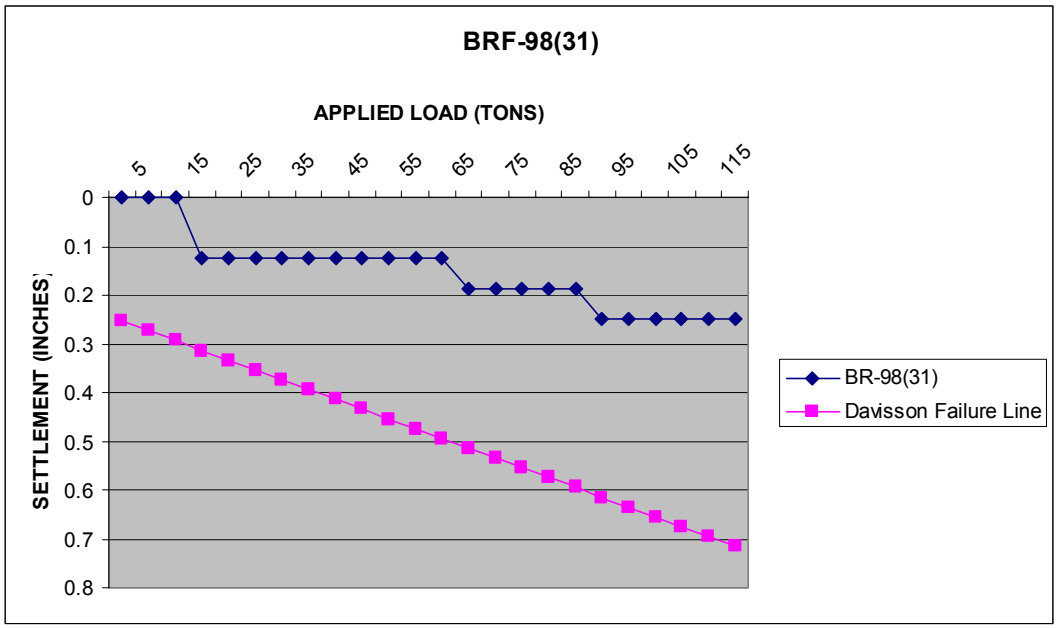
ULTIMATE RESISTANCE:	

STATIC LOAD TEST DATA

DATE TESTED:	5/18/2001
DAVISSON LOAD CAPACITY (tons):	
MAX. APPLIED LOAD (tons):	120
DID FAILURE OCCUR:	NO
ESTIMATE ULTIMATE CAPACITY (tons):	

SOIL INFORMATION

BORING NUMBER:	B-6
BRIEF SOIL DESCRIPTION:	clay



DEPTH (ft.)		DESCRIPTION	PILE TIP
GW 24.69		Very Loose to Loose Tan SILTY Fine SAND (SM) with ORGANICS	
19.69		Stiff Gray Fine SANDY CLAY (CL)	
14.69		Dense Tan Medium to Fine SAND (SP-SM)	
9.69		Firm Gray SILTY Fine SAND (SM)	
4.69		Hard Gray, Red and Yellow CLAY, with trace SAND (CH)	
-0.31		Very Stiff Gray CLAY, with SAND (CL)	
-18.56		Hard to Very Stiff Gray and Red CLAY, with trace SANDSTONE (CH)	TIP ELEV.

PROJECT INFORMATION

NAME:	Project No. BRF-98(31) Bridge repl. On US 43 over Bassetts Creek
DIVISION:	8
LOCATION:	Washington Co.
BENT/LANE:	5
PILE NO.:	3
DATE DRIVEN:	5/25/2001

HAMMER DETAILS

MAKE/MODEL:	Kobelco
RATED ENERGY (KIP-FT):	54.2
WEIGHT (KIPS):	5.51
HAMMER ACTION:	single
AIR/DIESEL:	diesel
OPEN/CLOSED:	closed
HAMMER CUSHION:	micarta

PILE DETAILS

PILE TYPE/MATERIAL:	Steel HP 14 x 73
PILE LENGTH (FT.):	60.25
SIZE/CS. AREA (IN^2):	21.4
DESIGN CAPACITY (tons):	63
SPLICE DETAILS:	added 15.18 ft.
PILE CUSHION:	Micarta

PDA INFORMATION

EOD

PDA CAPACITY (tons):	185

RESTRIKE

DATE:	N/A
SETUP TIME (DAYS):	
PDA CAPACITY:	

ELEVATION DETAILS

TOTAL LENGTH (FT.):	60.25
EMBEDDED LENGTH (FT.):	30
GRADE ELEVATION:	23.55
TIP ELEVATION:	-6
GW ELEVATION:	19

CAPWAP RESULTS

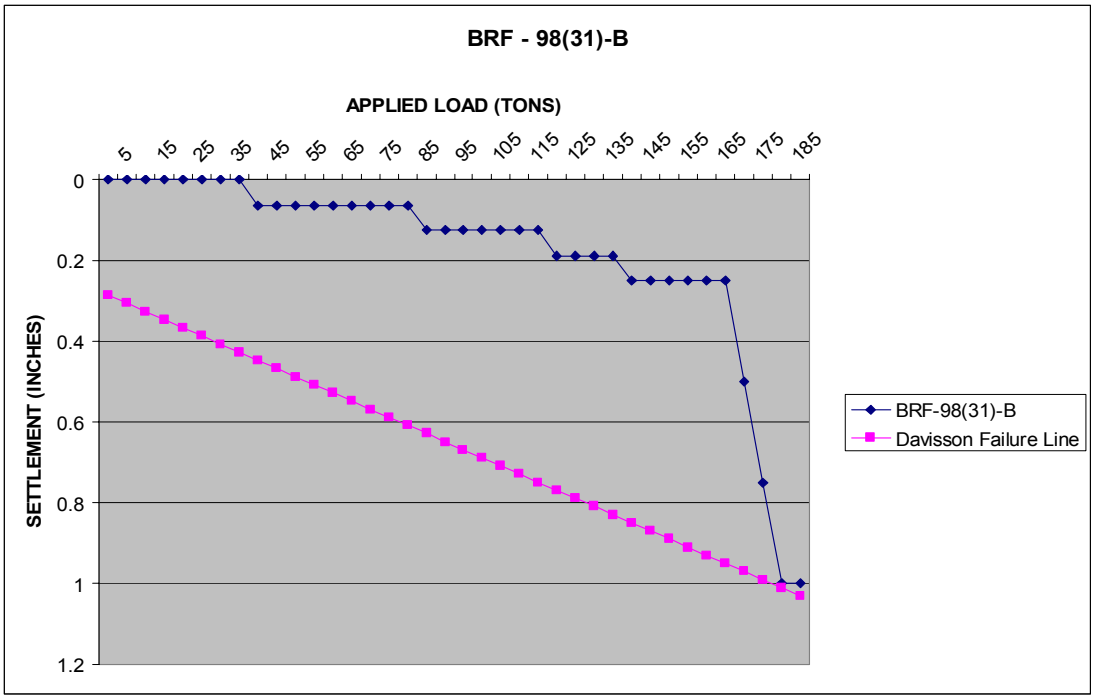
ULTIMATE RESISTANCE:	N/A

STATIC LOAD TEST DATA

DATE TESTED	6/1/2001
DAVISSON LOAD CAPACITY (TONS):	190
MAX. APPLIED LOAD (tons):	Yes
DID FAILURE OCCUR:	185
ESTIMATED ULTIMATE CAPACITY (TONS):	

SOIL INFORMATION

BORING NUMBER:	B-2
BRIEF SOIL DESCRIPTION:	Hard red and gray clay



DEPTH (ft.)		DESCRIPTION	PILE TIP
20.95		Loose Brown SILTY Medium to Fine SAND with trace GRAVEL (SM)	
GW			
11.7		Firm to Loose Light Gray Fine SAND (SP)	
1.7		Very Stiff to Hard Light Gray, Yellow and Red CLAY (CH)	
-8.3		Hard Red and Gray CLAY (CL)	TIP ELEV.
-15.8		Hard Red and Gray CLAY (CH)	
-18.3		Dense Gray CLAYEY Fine SAND (SC)	
-28.3		Hard to Very Stiff Gray and Red CLAY, with SAND (CL)	
-36.55		Hard Gray, Yellow and Red CLAY (CH)	

PROJECT INFORMATION

NAME:	BR-1608(200)-A
DIVISION:	7
LOCATION:	Coffee Co
BENT/LANE:	Abut 1
PILE NO.:	5
DATE DRIVEN:	9/4/2002

HAMMER DETAILS

MAKE/MODEL:	Kobe
RATED ENERGY (KIP-FT):	27.983 @ 9.75 ft.
WEIGHT (KIPS):	Not Recorded
HAMMER ACTION:	single
AIR/DIESEL:	diesel
OPEN/CLOSED:	open
HAMMER CUSHION:	Foster Low

PILE DETAILS

PILE TYPE/MATERIAL:	HP 12 x 53
PILE LENGTH (FT.):	40.3
WALL THICKNESS (IN.):	
SIZE/CS. AREA (IN^2):	15.5
DESIGN CAPACITY (tons):	30
SPLICE DETAILS:	N/A
PILE CUSHION:	N/A

PDA INFORMATION

EOD

PDA CAPACITY (tons):	77

RESTRIKE

DATE:	N/A
SETUP TIME (DAYS):	
PDA CAPACITY:	

ELEVATION DETAILS

TOTAL LENGTH (FT.):	40.3
EMBEDDED LENGTH (FT.):	33
GRADE ELEVATION:	163.5
TIP ELEVATION:	131.57
GW ELEVATION:	147

CAPWAP RESULTS

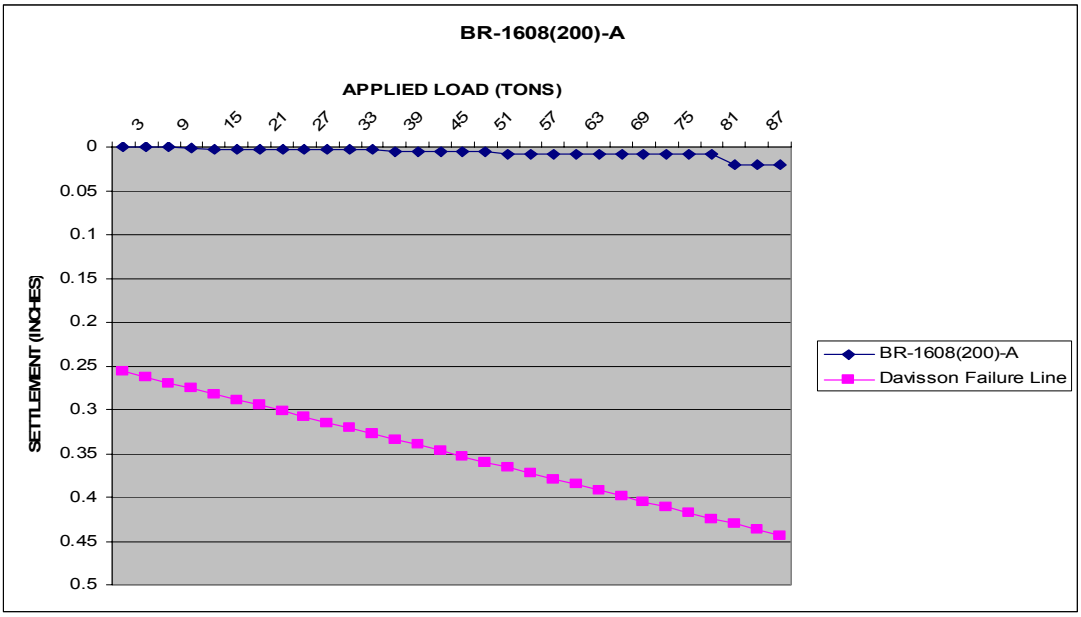
ULTIMATE RESISTANCE:	N/A

STATIC LOAD TEST DATA

DATE TESTED:	9/6/2002
DAVISSON LOAD CAPACITY (TONS):	
MAX. APPLIED LOAD (TONS):	90
DID FAILURE OCCUR:	NO
ESTIMATED ULTIMATE CAPACITY (TONS);	

SOIL INFORMATION

BORING NUMBER:	B-1
BRIEF SOIL DESCRIPTION:	firm to dense silty sand



DEPTH (ft.)		DESCRIPTION	PILE TIP
152.9		Firm to Loose Brown Fine SAND (SP-SM)	
GW			
140.45		Firm White Brown and Orange Fine SAND (SP)	
127.95		Firm to Dense Gray SILT (SM)	TIP ELEV.
102.95		Dense to Very Dense Gray and Black SILTY fine SAND (SM)	
97.95		VERY DENSE gray SILTY fine SAND (SM)	
92.95		VERY DENSE gray SILTY fine SAND (SM)	
82.95		VERY DENSE Fine SAND (SP-SM)	
79.7		Hard Gray Fine SANDY CLAY (CL)	

CAPWAP FINAL RESULTS

Total CAPWAP Capacity: 146.5; along Shaft 134.7; at Toe 11.9 kips

Soil Sgmnt No.	Dist. Below Gages ft	Depth Below Grade ft	Ru kips	Force in Pile kips	Sum of Ru kips	Unit Resist. (Depth) kips/ft	Unit Resist. (Area) ksf	Smith Damping Factor s/ft	Quake in
				146.5					
1	10.2	5.9	20.7	125.9	20.7	3.05	2.32	0.049	0.100
2	16.9	12.7	22.8	103.1	43.4	3.36	2.56	0.049	0.100
3	23.7	19.5	38.6	64.5	82.1	5.70	4.35	0.049	0.100
4	30.5	26.2	38.9	25.6	121.0	5.75	4.38	0.049	0.100
5	37.3	33.0	13.7	11.9	134.7	2.02	1.54	0.049	0.100
Avg. Skin			26.9			4.08	3.03	0.049	0.100
Toe			11.9				110.36	0.152	0.100

Soil Model Parameters/Extensions		Skin	Toe
Case Damping Factor		0.238	0.065
Reloading Level	(% of Ru)	100	100

PROJECT INFORMATION

NAME:	BR-1608(200)
DIVISION:	7
LOCATION:	COFFEE CO.
BENT/LANE:	BENT 4
PILE NO.:	4
DATE DRIVEN:	7/16/2002

HAMMER DETAILS

MAKE/MODEL:	KOBE
RATED ENERGY (KIP-FT):	DIESEL
WEIGHT (KIPS):	N/A
HAMMER ACTION:	SINGLE
AIR/DIESEL:	DIESEL
OPEN/CLOSED:	OPEN
HAMMER CUSHION:	FOSTER LOW

PILE DETAILS

PILE TYPE/MATERIAL:	HP 12 X 53
PILE LENGTH (FT.):	50.3
SIZE/CS. AREA (IN^2):	15.5
DESIGN CAPACITY (tons):	45
SPLICE DETAILS:	N/A
PILE CUSHION:	N/A

PDA INFORMATION

EOD

PDA CAPACITY (tons):	88

RESTRIKE

DATE:	7/18/2002
SETUP TIME (DAYS):	2
PDA CAPACITY (TONS):	138

ELEVATION DETAILS

TOTAL LENGTH (FT.):	50.3
EMBEDDED LENGTH (FT.):	39
GRADE ELEVATION:	157.03
TIP ELEVATION:	118.03
GW ELEVATION:	APPROX. 145

CAPWAP RESULTS

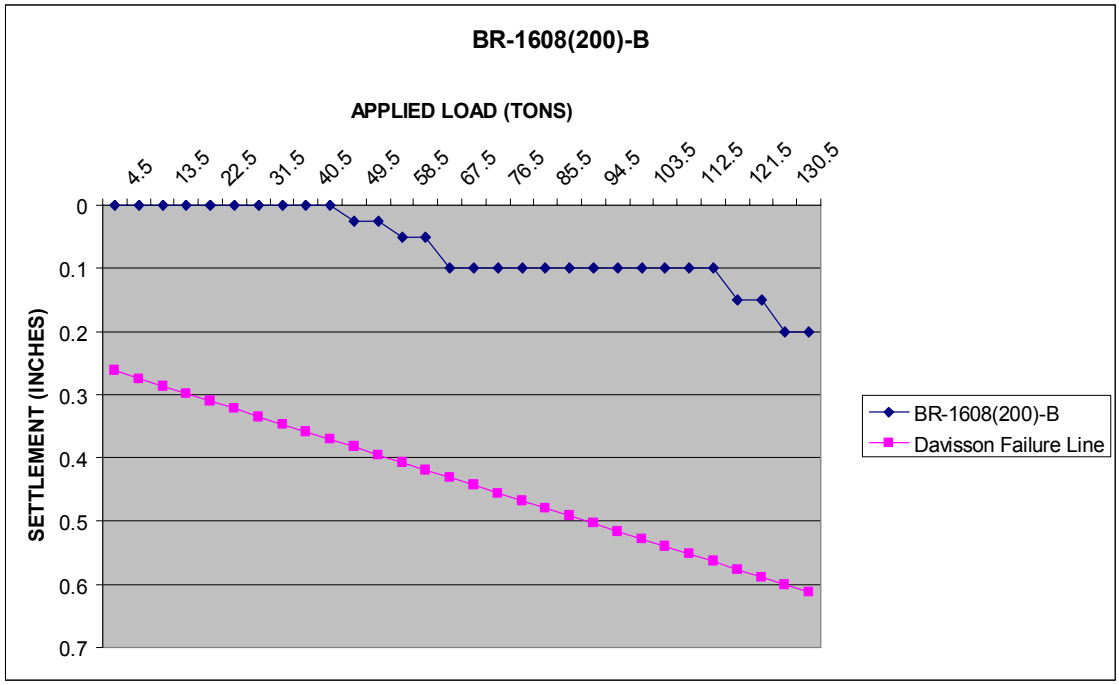
ULTIMATE RESISTANCE:	N/A

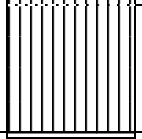
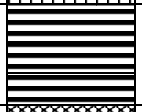
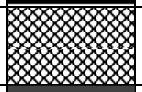
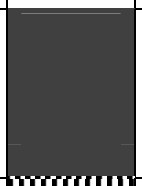
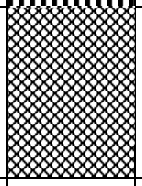
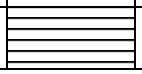
STATIC LOAD TEST DATA

DATE TESTED:	7/18/2002
DAVISSON LOAD CAPACITY (TONS):	
MAX. APPLIED LOAD (TONS):	135
DID FAILURE OCCUR:	NO
ESTIMATED ULTIMATE CAPACITY (TONS):	

SOIL INFORMATION

BORING NUMBER:	B-1
BRIEF SOIL DESCRIPTION:	FIRM TO DENSE SM


BR-1608(200)-B
APPLIED LOAD (TONS)
4.5
13.5
22.5
31.5
40.5
49.5
58.5
67.5
76.5
85.5
94.5
103.5
112.5
121.5
130.5
SETTLEMENT (INCHES)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
BR-1608(200)-B
Davisson Failure Line

DEPTH (ft.)		DESCRIPTION	PILE TIP
148.67		Firm to Loose Brown SAND (SP)	TIP ELEV.
138.67		Firm to Dense Light Gray SILTY Fine SAND (SM)	
133.67		Dense Gray Fine SANDY SILT (ML)	
113.67		Dense to Very Dense Gray and Silty fine SAND (SM)	
88.67		Dense to Very Dense Gray and Black Coarse Sand (SP-SM)	
83.67		Hard Greenish Gray CLAY, with SAND (CH)	
78.67		Very Dense to DENSE Gray SILTY Fine SAND (SM)	
75.17		Hard Greenish Gray CLAY, with SAND and Weathered LIMESTONE Lenses (CL)	
50.22		Very Dense Greenish Gray SILTY Fine SAND, with Weathered LIMESTONE Lenses (SM)	
35.12		Very Dense Gray SILT, with SAND (MH)	
30		Very Dense Gray SILTY Coarse to Fine SAND with LIMESTONE (SM)	

PROJECT INFORMATION

NAME:	BR-1608(200)
DIVISION:	7
LOCATION:	COFFEE CO.
BENT/LANE:	ABUT. 1
PILE NO.:	4
DATE DRIVEN:	11/15/2002

HAMMER DETAILS

MAKE/MODEL:	KOBE K-13
RATED ENERGY (KIP-FT):	27.983 @ 9.75 FT.
WEIGHT (KIPS):	2.870051282
HAMMER ACTION:	SINGLE
AIR/DIESEL:	DIESEL
OPEN/CLOSED:	OPEN
HAMMER CUSHION:	FOSTER LOW

PILE DETAILS

PILE TYPE/MATERIAL:	HP 12 X 53
PILE LENGTH (FT.):	37
SIZE/CS. AREA (IN^2):	15.5
DESIGN CAPACITY (tons):	45
SPLICE DETAILS:	N/A
PILE CUSHION:	N/A

PDA INFORMATION

EOD

PDA CAPACITY (tons):	114

RESTRIKE

DATE:	N/A
SETUP TIME (DAYS):	
PDA CAPACITY:	

ELEVATION DETAILS

TOTAL LENGTH (FT.):	37
EMBEDDED LENGTH (FT.):	36
GRADE ELEVATION:	164.3
TIP ELEVATION:	128.3
GW ELEVATION:	APPROX.145

CAPWAP RESULTS

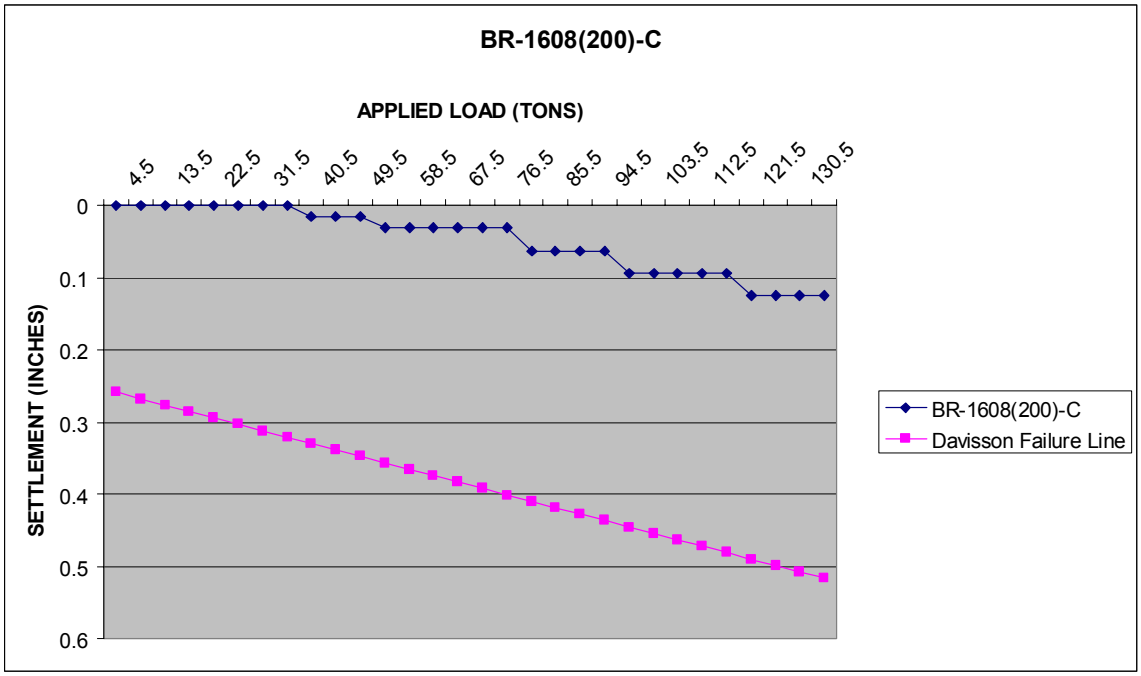
ULTIMATE RESISTANCE:	N/A

SOIL INFORMATION

BORING NUMBER:	B-1
BRIEF SOIL DESCRIPTION:	DENSE GRAY AND BLACK SAND

STATIC LOAD TEST DATA

DATE TESTED:	11/18/2002
DAVISSON LOAD CAPACITY (TONS):	
MAX. APPLIED LOAD (TONS):	135
DID FAILURE OCCUR:	NO
ESTIMATED ULTIMATE CAPACITY (TONS):	



DEPTH (ft.)		DESCRIPTION	PILE TIP
152.95		Firm to Loose Brown Fine SAND (SP-SM)	
GW 140.45		Firm White Brown and Orange Fine SAND (SP)	
127.95		Firm to Dense Gray SILT (SM)	TIP ELEV.
102.95		Dense to Very Dense Gray and Black SILTY fine SAND (SM)	
97.95		VERY DENSE gray SILTY fine SAND (SM)	
92.95		VERY DENSE gray SILTY fine SAND (SM)	
82.95		VERY DENSE Fine SAND (SP-SM)	
79.7		Hard Gray Fine SANDY CLAY (CL)	

CAPWAP FINAL RESULTS

Total CAPWAP Capacity: 105.6; along Shaft 104.9; at Toe 0.7 kips

Soil Sgmnt No.	Dist. Below Gages ft	Depth Below Grade ft	Ru kips	Force in Pile kips	Sum of Ru kips	Unit Resist. (Depth) kips/ft	Unit Resist. (Area) ksf	Smith Damping Factor s/ft	Quake in
				105.6					
1	10.4	9.3	0.0	105.6	0.0	0.00	0.00	0.000	0.060
2	17.3	16.2	0.0	105.6	0.0	0.00	0.00	0.000	0.060
3	24.2	23.1	0.0	105.6	0.0	0.00	0.00	0.000	0.060
4	31.2	30.1	14.9	90.7	14.9	2.15	1.64	0.149	0.060
5	38.1	37.0	90.0	0.7	104.9	12.99	9.90	0.149	0.060
Avg. Skin			21.0			2.83	2.31	0.149	0.060
Toe			0.7				6.51	0.458	0.080

Soil Model Parameters/Extensions		Skin	Toe	
Case Damping Factor		0.573	0.012	Smith Type
Unloading Quake	(% of loading quake)	100	97	
Reloading Level	(% of Ru)	100	100	
Unloading Level	(% of Ru)	22		

PROJECT INFORMATION

NAME:	BR-6619(103) GOOSE CREEK RELIEF
DIVISION:	8
LOCATION:	WILCOX CO
BENT/LANE:	ABUT. 1
PILE NO.:	3
DATE DRIVEN:	5/16/2002

HAMMER DETAILS

MAKE/MODEL:	KOBE K-22
RATED ENERGY (KIP-FT):	41.3 @ 8.5 FT
WEIGHT (KIPS):	12.35
HAMMER ACTION:	SINGLE
AIR/DIESEL:	DIESEL
OPEN/CLOSED:	OPEN
HAMMER CUSHION:	SINGLE

PILE DETAILS

PILE TYPE/MATERIAL:	HP 12 X 53
PILE LENGTH (FT.):	41.59
SIZE/CS. AREA (IN^2):	15.5
DESIGN CAPACITY (tons):	60
SPLICE DETAILS:	N/A
PILE CUSHION:	N/A

PDA INFORMATION

EOD

PDA CAPACITY (tons):	150

RESTRIKE

DATE:	5/16/02 - STCK
SETUP TIME (DAYS):	30 MINUTES
PDA CAPACITY:	159 TONS

ELEVATION DETAILS

TOTAL LENGTH (FT.):	41.59
EMBEDDED LENGTH (FT.):	41
GRADE ELEVATION:	76.74
TIP ELEVATION:	37.149
GW ELEVATION:	58

CAPWAP RESULTS

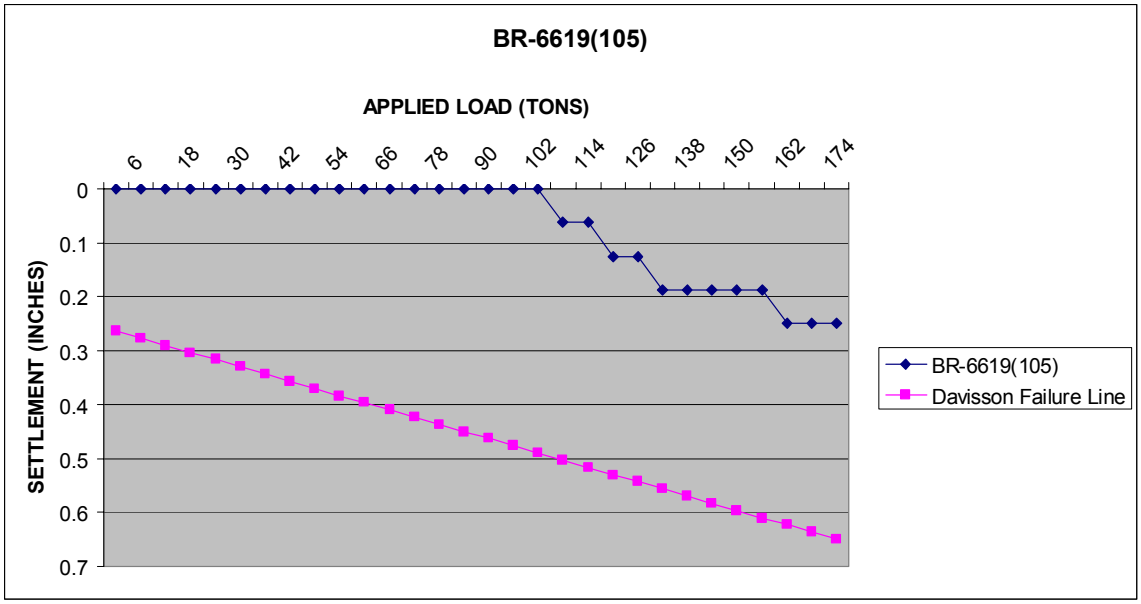
ULTIMATE RESISTANCE:	N/A

STATIC LOAD TEST DATA

DATE TESTED:	5/23/2002
DAVISSON LOAD CAPACITY (TONS):	
MAX. APPLIED LOAD (TONS):	180
DID FAILURE OCCUR:	NO
ESTIMATED ULTIMATE CAPACITY (TONS):	

SOIL INFORMATION

BORING NUMBER:	B-1
BRIEF SOIL DESCRIPTION:	SANDY CLAY



DEPTH (ft.)		DESCRIPTION	PILE TIP
69.4		FAT CLAY (CH) trace organics, brown, moist, firm	
64.4		SANDY LEAN CLAY (CL), gray, wet, soft to firm	
59.4		SAND (SP), with fines, medium density	
54.4		CLAYEY SAND (SC) brown to gray, wet loose	
25		SILT (ML), with thin clay layers, VERY HARD	TIP ELEV.

PROJECT INFORMATION

NAME:	HPP-0192(2) ANNISTON EAST BYPASS
DIVISION:	4
LOCATION:	CALHOUN CO.
BENT/LANE:	ABUT.1
PILE NO.:	6
DATE DRIVEN:	2/21/2002

HAMMER DETAILS

MAKE/MODEL:	DELMAG
RATED ENERGY (KIP-FT):	42.8
WEIGHT (KIPS):	4190
HAMMER ACTION:	SINGLE
AIR/DIESEL:	DIESEL
OPEN/CLOSED:	OPEN
HAMMER CUSHION:	MICARTA

PILE DETAILS

PILE TYPE/MATERIAL:	HP 12 X 84
PILE LENGTH (FT.):	116.5
SIZE/CS. AREA (IN^2):	24.6
DESIGN CAPACITY (tons):	30
SPLICE DETAILS:	ADDED 60'
PILE CUSHION:	N/A

PDA INFORMATION

EOD

PDA CAPACITY (tons):	61.3

RESTRIKE

DATE:	N/A
SETUP TIME (DAYS):	
PDA CAPACITY:	

ELEVATION DETAILS

TOTAL LENGTH (FT.):	116.5
EMBEDDED LENGTH (FT.):	113
GRADE ELEVATION:	NOT RECORDED
TIP ELEVATION:	NOT RECORDED
GW ELEVATION:	18' BELOW G.S.

CAPWAP RESULTS

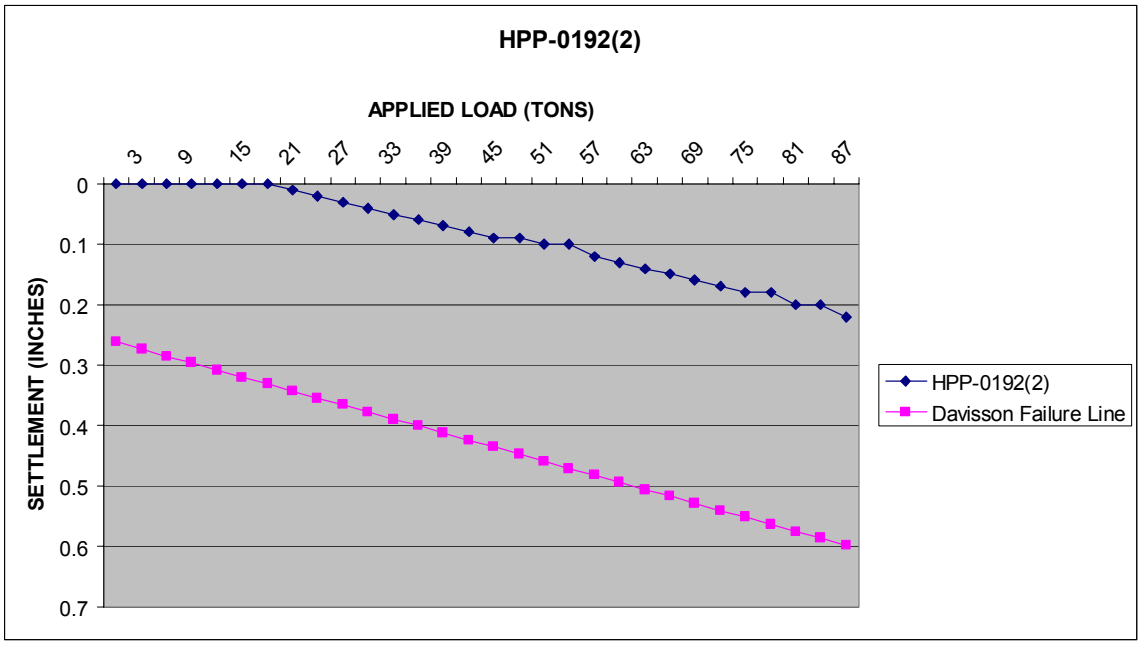
ULTIMATE RESISTANCE:	N/A

STATIC LOAD TEST DATA

DATE TESTED:	2/28/2002
DAVISSON LOAD CAPACITY (TONS):	
MAX. APPLIED LOAD (TONS):	90
DID FAILURE OCCUR:	NO
ESTIMATED ULTIMATE CAPACITY (TONS):	

SOIL INFORMATION

BORING NUMBER:	B-2
BRIEF SOIL DESCRIPTION:	RED CLAY



DEPTH (ft.)		DESCRIPTION	PILE TIP
636		CLAY Fill	NOT RECORDED
GW 615		CLAY	
613		CLAY	
598		SILT	
570		SILT	
555		CLAY/LIMESTONE	

PROJECT INFORMATION

NAME:	PROJECT NO. BR-98(32)
DIVISION:	8
LOCATION:	WASHINGTON CO.
BENT/LANE:	ABUT. 1
PILE NO.:	2
DATE DRIVEN:	3/4/2001

HAMMER DETAILS

MAKE/MODEL:	DELMAG D-19-42
RATED ENERGY (KIP-FT):	N/A
WEIGHT (KIPS):	N/A
HAMMER ACTION:	SINGLE
AIR/DIESEL:	DIESEL
OPEN/CLOSED:	OPEN
HAMMER CUSHION:	

PILE DETAILS

PILE TYPE/MATERIAL:	HP 10 X 42
PILE LENGTH (FT.):	85
SIZE/CS. AREA (IN^2):	12.4
DESIGN CAPACITY (tons):	40
SPLICE DETAILS:	2 SPLICES APPROX. 50 FT
PILE CUSHION:	N/A

PDA INFORMATION

EOD

PDA CAPACITY (tons):	97.5

RESTRIKE

DATE:	3/13/2001
SETUP TIME (DAYS):	9
PDA CAPACITY (TONS):	110

ELEVATION DETAILS

TOTAL LENGTH (FT.):	85
EMBEDDED LENGTH (FT.):	83
GRADE ELEVATION:	39.5
TIP ELEVATION:	-43.5
GW ELEVATION:	40.1

CAPWAP RESULTS

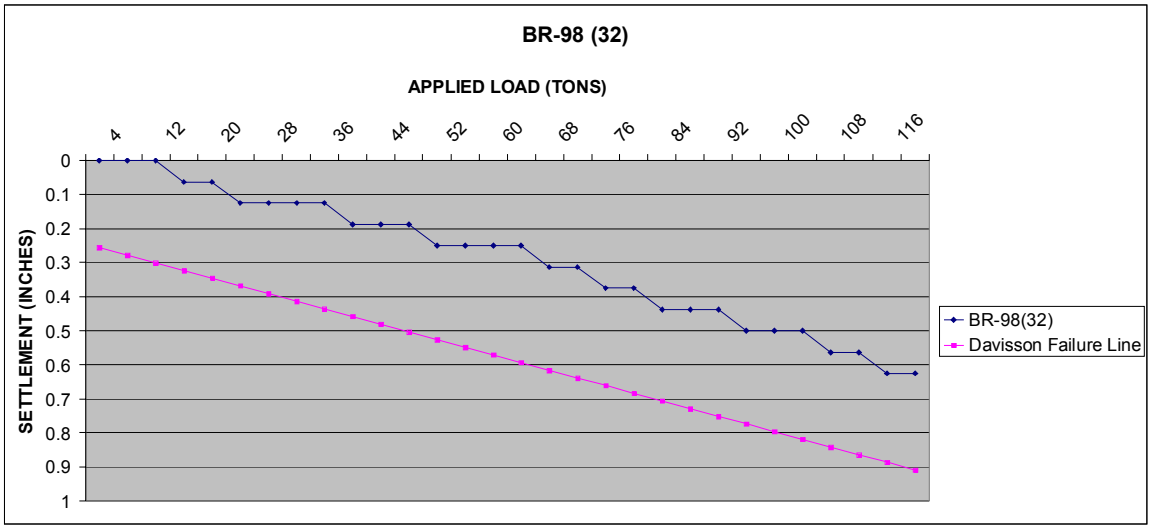
ULTIMATE RESISTANCE:	N/A

STATIC LOAD TEST DATA

DATE TESTED:	3/8/2001
DAVISSON LOAD CAPACITY (TONS):	
MAX. APPLIED LOAD (TONS):	120
DID FAILURE OCCUR:	NO
ESTIMATED ULTIMATE CAPACITY (TONS):	

SOIL INFORMATION

BORING NUMBER:	N/A
BRIEF SOIL DESCRIPTION;	DENSE DAMP GRAY SAND & GRAVEL



DEPTH (ft.)		DESCRIPTION	PILE TIP
GW 29.3		Loose Damp Brown and Tan Silty Sand	
19.1		Loose Damp Tan Silty Sand	
9.5		Medium Damp Gray Silt	
4.2		Very Stiff Damp Gray Sandy Silt	
-13.9		Medium Damp Gray and Brown Sand and Gravel	
-28		Dense Damp Tan Sand and Gravel	
-53.2		Hard Moist Gray SILTY CLAY	TIP ELEV.

PROJECT INFORMATION

NAME:	NHF-0001(512)
DIVISION:	4
LOCATION:	RUSSELL
BENT/LANE:	ABUT 1 SB
PILE NO.:	6
DATE DRIVEN:	1/13/2005

HAMMER DETAILS

MAKE/MODEL:	DELMAG D-19-42
RATED ENERGY (KIP-FT):	20.54 @ 6'
WEIGHT (KIPS):	4.19
HAMMER ACTION:	SINGLE
AIR/DIESEL:	DIESEL
OPEN/CLOSED:	OPEN
HAMMER CUSHION:	MICARTA/ALUM.

PILE DETAILS

PILE TYPE/MATERIAL:	STEEL HP 12 X 53
PILE LENGTH (FT.):	50
SIZE/CS. AREA (IN^2):	15.5
DESIGN CAPACITY (tons):	29
SPLICE DETAILS:	N/A
PILE CUSHION:	N/A

PDA INFORMATION

EOD

PDA CAPACITY (tons):	89

RESTRIKE

DATE:	N/A
SETUP TIME (DAYS):	
PDA CAPACITY (TONS):	

ELEVATION DETAILS

TOTAL LENGTH (FT.):	50
EMBEDDED LENGTH (FT.):	23
GRADE ELEVATION:	235.84
TIP ELEVATION:	214.16
GW ELEVATION:	NOT ENCOUNTERED

CAPWAP RESULTS

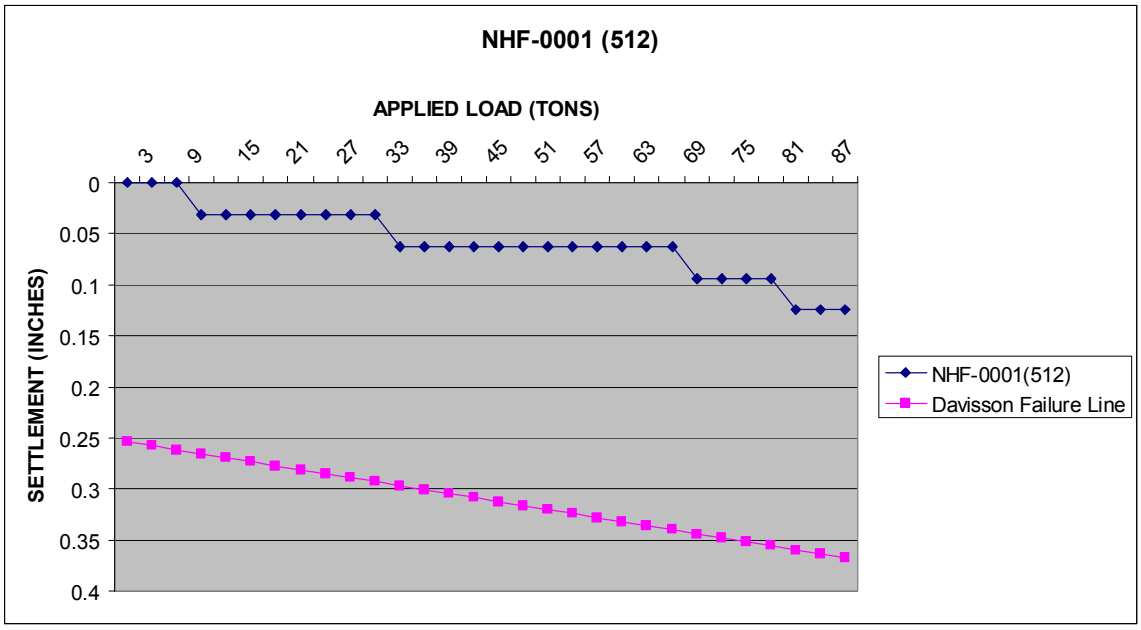
ULTIMATE RESISTANCE:	N/A

STATIC LOAD TEST DATA

DATE TESTED:	1/21/2005
DAVISSON LOAD CAPACITY (TONS):	
MAX. APPLIED LOAD (TONS):	90
DID FAILURE OCCUR:	NO
ESTIMATED ULTIMATE CAPACITY (TONS):	

SOIL INFORMATION

BORING NUMBER:	N/A
BRIEF SOIL DESCRIPTION:	CLAYS NEAR TOP WITH SAND AND SILT NEAR TIP



DEPTH (ft.)		DESCRIPTION	PILE TIP
215			TIP ELEV.
206		CLAYEY SANDY SILT (ML)	
201		Dense, Moist, Dark Gray, Silty, fine grained SAND with Micas, Clay and Fossil Shells - SM	
191		SANDY SILT w/ Pyrite Crystals (ML)	
180		Hard, Dry, Gray, ClAYEY Micaceous, SANDY SILT (ML)	

CAPWAP FINAL RESULTS

Total CAPWAP Capacity: 4.8; along Shaft 4.8; at Toe 0.0 kips

Soil Sgmnt No.	Dist. Below Gages ft	Depth Below Grade ft	Ru kips	Force in Pile kips	Sum of Ru kips	Unit Resist. (Depth) kips/ft	Unit Resist. (Area) ksf	Smith Damping Factor s/ft	Quake in
				4.8					
1	9.9	8.9	4.8	0.0	4.8	0.73	0.56	0.289	0.120
2	16.4	15.4	0.0	0.0	4.8	0.00	0.00	-1.490	0.120
3	23.0	22.0	0.0	0.0	4.8	0.00	0.00	0.000	0.120
Avg. Skin			1.6			0.22	0.19	0.220	0.120
Toe			0.0				0.00	0.000	0.510

Soil Model Parameters/Extensions		Skin	Toe	
Case Damping Factor		0.038	0.000	Smith Type
Unloading Quake	(% of loading quake)	32	2	
Reloading Level	(% of Ru)	100	100	
Unloading Level	(% of Ru)	0		
Soil Plug Weight	(kips)		0.05	

PROJECT INFORMATION

NAME:	BR-0014(500)
DIVISION:	6
LOCATION:	AUTAUGA/DALLAS CO.
BENT/LANE:	ABUT. 1
PILE NO.:	5
DATE DRIVEN:	10/1/2004

HAMMER DETAILS

MAKE/MODEL:	APE D-19-42 DROP
RATED ENERGY (KIP-FT):	37.710 @ 9'
WEIGHT (KIPS):	7.8
HAMMER ACTION:	SINGLE
AIR/DIESEL:	DIESEL
OPEN/CLOSED:	
HAMMER CUSHION:	FOSTER LON

PILE DETAILS

PILE TYPE/MATERIAL:	STEEL HP 12 X 53
PILE LENGTH (FT.):	50.33
SIZE/CS. AREA (IN^2):	15.5
DESIGN CAPACITY (tons):	30
SPLICE DETAILS:	N/A
PILE CUSHION:	N/A

PDA INFORMATION

EOD

PDA CAPACITY (tons):	179

RESTRIKE

DATE:	N/A
SETUP TIME (DAYS):	
PDA CAPACITY (TONS):	

ELEVATION DETAILS

TOTAL LENGTH (FT.):	50.33
EMBEDDED LENGTH (FT.):	36
GRADE ELEVATION:	130.58
TIP ELEVATION:	94.17
GW ELEVATION:	110

CAPWAP RESULTS

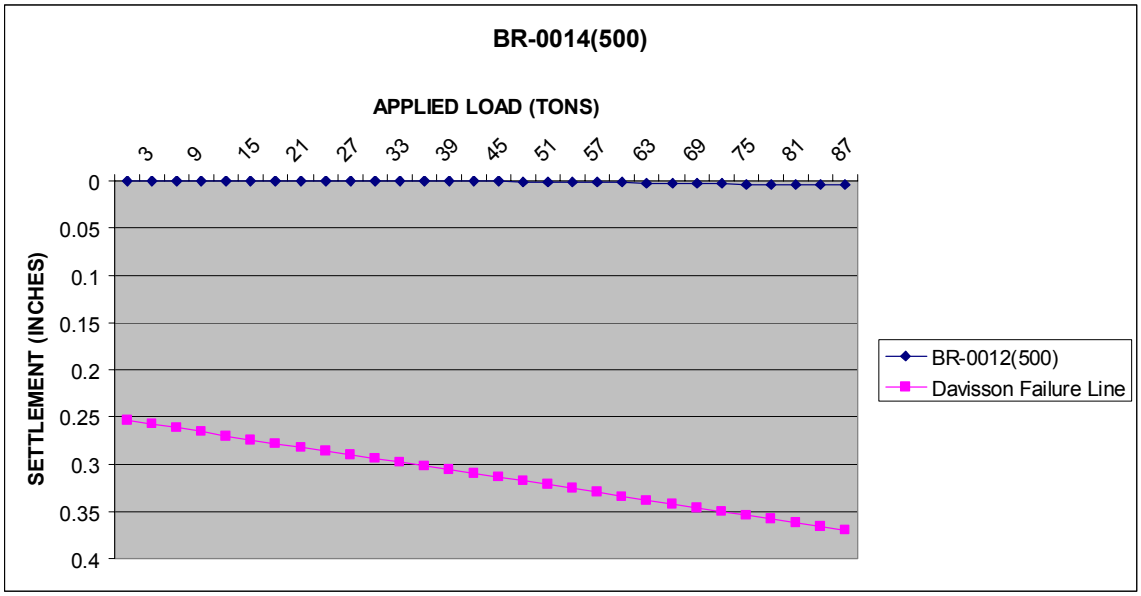
ULTIMATE RESISTANCE (tons):	137.7

STATIC LOAD TEST DATA

DATE TESTED:	10/12/2004
DAVISSON LOAD CAPACITY (TONS):	
MAX. APPLIED LOAD (TONS):	90
DID FAILURE OCCUR:	NO
ESTIMATED ULTIMATE CAPACITY (TONS):	

SOIL INFORMATION

BORING NUMBER:	B-1
BRIEF SOIL DESCRIPTION:	RED CLAY AND GRAVELS AT TOP/ SANDY SILT NEAR TIP



DEPTH (ft.)		DESCRIPTION	PILE TIP
127		FILL, SANDY CLAY (CL) reddish-brown, soft	
116.5		SILTY SAND (SM), reddish tan	
GW			
102		SANDY SILT (ML), olive-gray	
97		SILTY, CLAYEY SAND (SC-SM) dense	
92		SANDY SILT (ML), olive-gray very stiff	TIP ELEV.
64		SILTY, CLAYEY SAND (SC-SM) very dense	

CAPWAP FINAL RESULTS

Total CAPWAP Capacity: 275.4; along Shaft 204.5; at Toe 70.9 kips

Soil Sgmnt No.	Dist. Below Gages ft	Depth Below Grade ft	Ru kips	Force in Pile kips	Sum of Ru kips	Unit Resist. (Depth) kips/ft	Unit Resist. (Area) ksf	Smith Damping Factor s/ft	Quake in
				275.4					
1	6.8	-5.0	0.0	275.4	0.0	0.00	0.00	0.000	0.080
2	13.5	1.7	0.0	275.4	0.0	0.00	0.00	0.000	0.080
3	20.3	8.5	8.4	267.0	8.4	1.24	0.95	0.168	0.032
4	27.0	15.2	23.6	243.4	32.0	3.49	2.66	0.168	0.032
5	33.8	22.0	83.7	159.8	115.6	12.38	9.44	0.168	0.032
6	40.5	28.7	46.1	113.6	161.8	6.83	5.20	0.168	0.032
7	47.3	35.5	42.7	70.9	204.5	6.32	4.82	0.168	0.032
Avg. Skin			29.2			5.76	3.30	0.168	0.032
Toe			70.9				658.62	0.060	0.230

Soil Model Parameters/Extensions		Skin	Toe	
Case Damping Factor		1.264	0.156	Smith Type
Unloading Quake	(% of loading quake)	100	87	
Reloading Level	(% of Ru)	100	100	
Unloading Level	(% of Ru)	32		

PROJECT INFORMATION

NAME	PROJECT ST-063-171-001
DIVISION	5
LOCATION	TUSCALOOSA CO.
BENT/LANE	ABUT 1
PILE NO.	5 SOUTH
DATE DRIVEN	9/25/2003

PILE DETAILS

PILE TYPE/MATERIAL	HP 12 X 53
PILE LENGTH (FT.)	50' 1"
SIZE/CS. AREA (IN^2)	15.5
DESIGN CAPACITY (tons)	30
SPLICE DETAILS	N/A
PILE CUSHION	N/A

ELEVATION DETAILS

TOTAL LENGTH (FT.)	50'1"
EMBEDDED LENGTH (FT.)	32
GRADE ELEVATION	335.55
TIP ELEVATION	297.45
GW ELEVATION	APPROX 40 FT. BELOW GS

SOIL INFORMATION

BORING NUMBER	N/A
BRIEF SOIL DESCRIPTION	SANDY CLAY

HAMMER DETAILS

MAKE/MODEL	ICE 32S
RATED ENERGY (KIP-FT)	N/A
WEIGHT (KIPS)	3
HAMMER ACTION	SINGLE
AIR/DIESEL	DIESEL
OPEN/CLOSED	OPEN
HAMMER CUSHION	N/A

PDA INFORMATION

EOD

PDA CAPACITY (tons)	110

RESTRIKE

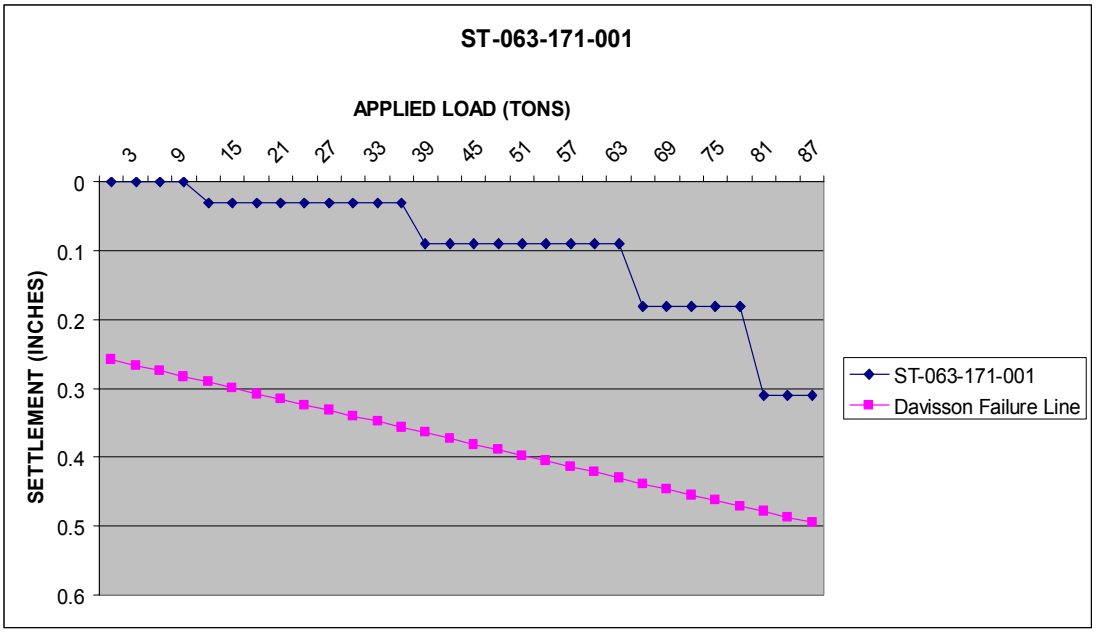
DATE	9/29/2003
SETUP TIME (DAYS)	4
PDA CAPACITY (TONS)	132

CAPWAP RESULTS

ULTIMATE RESISTANCE(tons):	137

STATIC LOAD TEST DATA

DATE TESTED	9/29/2003
DAVISSON LOAD CAPACITY (TONS)	
MAX. APPLIED LOAD (TONS)	90
DID FAILURE OCCUR	NO
ESTIMATED ULTIMATE CAPACITY (TONS)	


ST-063-171-001
APPLIED LOAD (TONS)
3
9
15
21
27
33
39
45
51
57
63
69
75
81
87
SETTLEMENT (INCHES)
0
0.1
0.2
0.3
0.4
0.5
0.6
ST-063-171-001
Davisson Failure Line

CAPWAP FINAL RESULTS

Total CAPWAP Capacity: 273.9; along Shaft 163.2; at Toe 110.7 kips

Soil Sgmnt No.	Dist. Below Gages ft	Depth Below Grade ft	Ru kips	Force in Pile kips	Sum of Ru kips	Unit Resist. (Depth) kips/ft	Unit Resist. (Area) ksf	Smith Damping Factor s/ft	Quake in
				273.9					
1	7.0	4.0	10.7	263.2	10.7	1.53	1.16	0.212	0.120
2	14.0	11.0	26.2	237.0	36.9	3.74	2.85	0.212	0.120
3	21.0	18.0	60.4	176.6	97.3	8.63	6.57	0.212	0.120
4	28.0	25.0	53.1	123.6	150.4	7.58	5.78	0.212	0.120
5	35.0	32.0	12.9	110.7	163.2	1.84	1.40	0.212	0.120
Avg. Skin			32.6			5.10	3.56	0.212	0.120
Toe			110.7				1028.11	0.163	0.240

Soil Model Parameters/Extensions		Skin	Toe
Case Damping Factor		1.251	0.652
Unloading Quake	(% of loading quake)	100	98
Reloading Level	(% of Ru)	100	100
Unloading Level	(% of Ru)	63	
Soil Plug Weight	(kips)		0.30

PROJECT INFORMATION

NAME:	NHF-197(13) RD BTWN NORTHPORT AND GORDO
DIVISION:	5
LOCATION:	TUSCALOOSA CO.
BENT/LANE:	ABUT 1
PILE NO.:	3
DATE DRIVEN:	4/23/2003

HAMMER DETAILS

MAKE/MODEL:	KOBE K-25
RATED ENERGY (KIP-FT):	51.519
WEIGHT (KIPS):	5.07
HAMMER ACTION:	SINGLE
AIR/DIESEL:	DIESEL
OPEN/CLOSED:	OPEN
HAMMER CUSHION:	MICARTA

PILE DETAILS

PILE TYPE/MATERIAL:	STEEL HP 12 X 53
PILE LENGTH (FT.):	36'4"
SIZE/CS. AREA (IN^2):	15.5
DESIGN CAPACITY (tons):	30
SPLICE DETAILS:	N/A
PILE CUSHION:	N/A

PDA INFORMATION

EOD

PDA CAPACITY (tons):	100

RESTRIKE

DATE:	N/A
SETUP TIME (DAYS):	
PDA CAPACITY:	

ELEVATION DETAILS

TOTAL LENGTH (FT.):	36'4"
EMBEDDED LENGTH (FT.):	35
GRADE ELEVATION:	221.75
TIP ELEVATION:	186.7
GW ELEVATION:	211.5

CAPWAP RESULTS

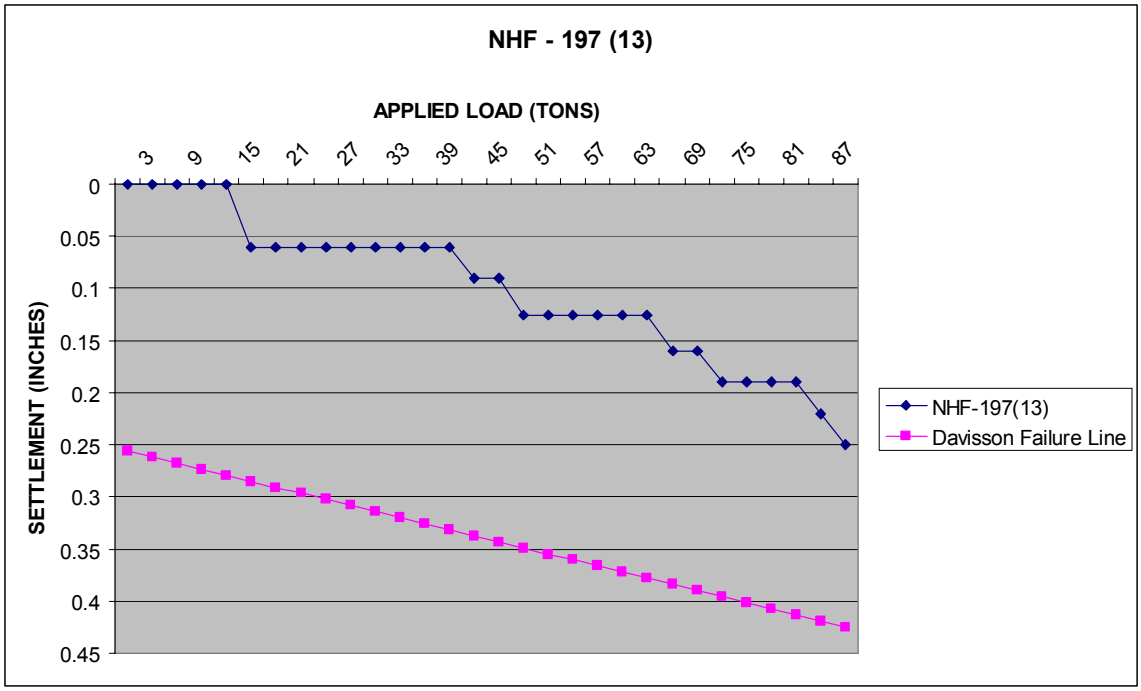
ULTIMATE RESISTANCE (tons):	107.4

SOIL INFORMATION

BORING NUMBER:	B-1
BRIEF SOIL DESCRIPTION:	RED-BROWN CLAY NEAR TOP/FIRM MOIST TO WET GRAY POORLY-GRADED SAND W/ SILT AT TIP

STATIC LOAD TEST DATA

DATE TESTED:	4/24/2003
DAVISSON LOAD CAPACITY (TONS):	
MAX. APPLIED LOAD (TONS):	90
DID FAILURE OCCUR:	NO
ESTIMATED ULTIMATE CAPACITY (TONS):	



DEPTH (ft.)		DESCRIPTION	PILE TIP
217		FIRM TO VERY SOFT MOIST REDDISH-BROWN SANDY LEAN CLAY (CL)	
GW			
191		VERY LOOSE TO VERY FIRM MOIST GRAYISH-BROWN POORLY-GRADED SAND WITH SILT (SP-SM)	
166		DENSE TO VERY FIRM MOIST TO WET GRAY POORLY-GRADED SAND WITH SILT (SP-SM)	TIP ELEV
161		VERY STIFF WET GRAY SANDY FAT CLAY (CH)	
156		VERY STIFF WET DARK GRAY SANDY LEAN CLAY (CL)	
140		BORING TERMINATED AT 80 FEET - HARD WET GREENISH-GRAY SANDY FAT CLAY (CH)	

CAPWAP FINAL RESULTS

Total CAPWAP Capacity: 214.7; along Shaft 33.6; at Toe 181.2 kips

Soil Sgmnt No.	Dist. Below Gages ft	Depth Below Grade ft	Ru kips	Force in Pile kips	Sum of Ru kips	Unit Resist. (Depth) kips/ft	Unit Resist. (Area) ksf	Smith Damping Factor s/ft	Quake in
				214.7					
1	14.1	6.8	0.0	214.7	0.0	0.00	0.00	0.000	0.100
2	21.2	13.8	7.1	207.7	7.1	1.01	0.77	0.133	0.100
3	28.2	20.9	10.8	196.9	17.9	1.53	1.17	0.133	0.100
4	35.3	27.9	7.4	189.5	25.3	1.05	0.80	0.133	0.100
5	42.3	35.0	8.3	181.2	33.6	1.18	0.90	0.133	0.100
Avg. Skin			6.7			0.96	0.72	0.133	0.100
Toe			181.2				1683.24	0.067	0.370

Soil Model Parameters/Extensions		Skin	Toe	
Case Damping Factor		0.161	0.440	Smith Type
Unloading Quake	(% of loading quake)	2	39	
Reloading Level	(% of Ru)	100	100	
Soil Plug Weight	(kips)		0.11	

PROJECT INFORMATION

NAME:	NHF-197(13)
DIVISION:	5
LOCATION:	TUSCALOOSA CO.
BENT/LANE:	2
PILE NO.:	5
DATE DRIVEN:	4/23/2003

HAMMER DETAILS

MAKE/MODEL:	KOBE K-25
RATED ENERGY (KIP-FT):	51.519
WEIGHT (KIPS):	5.07
HAMMER ACTION:	SINGLE
AIR/DIESEL:	DIESEL
OPEN/CLOSED:	OPEN
HAMMER CUSHION:	MICARTA

PILE DETAILS

PILE TYPE/MATERIAL:	STEEL HP 14 X 89
PILE LENGTH (FT.):	39.11
SIZE/CS. AREA (IN^2):	26.1
DESIGN CAPACITY (tons):	45
SPLICE DETAILS:	N/A
PILE CUSHION:	N/A

PDA INFORMATION

EOD

PDA CAPACITY (tons):	140

RESTRIKE

DATE:	5/2/2003
SETUP TIME (DAYS):	10
PDA CAPACITY:	183

ELEVATION DETAILS

TOTAL LENGTH (FT.):	39.11
EMBEDDED LENGTH (FT.):	33
GRADE ELEVATION:	217.9
TIP ELEVATION:	184.9
GW ELEVATION:	214

CAPWAP RESULTS

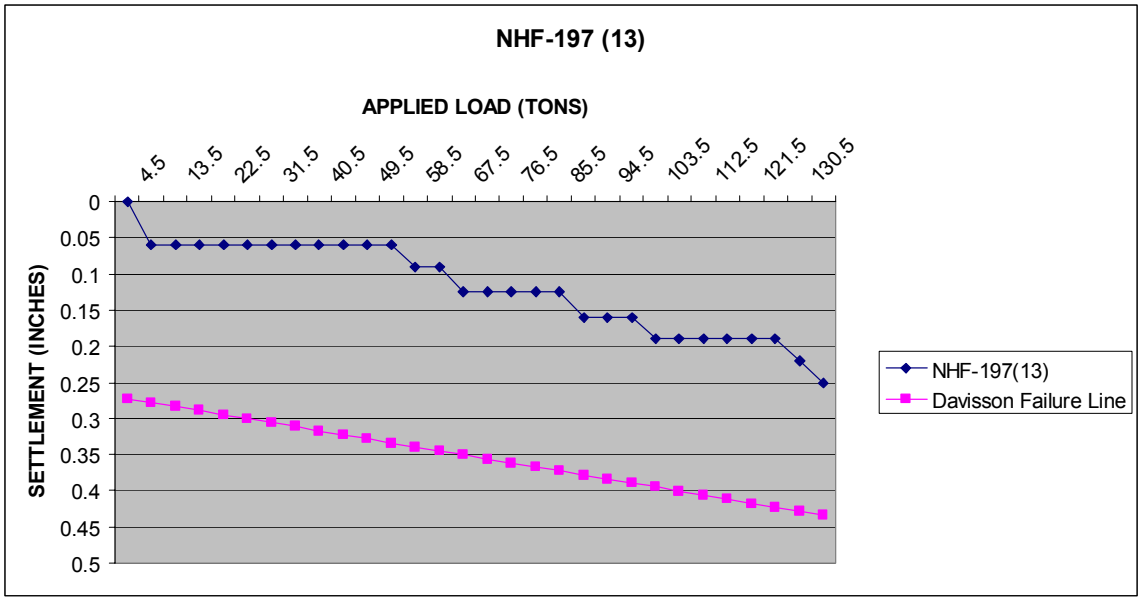
ULTIMATE RESISTANCE (tons):	140.2

STATIC LOAD TEST DATA

DATE TESTED:	4/23/2003
DAVISSON LOAD CAPACITY (TONS):	
MAX. APPLIED LOAD (TONS):	135
DID FAILURE OCCUR:	NO
ESTIMATED ULTIMATE CAPACITY (TONS):	

SOIL INFORMATION

BORING NUMBER:	B-3
BRIEF SOIL DESCRIPTION:	RED AND BROWN CLAY NEAR TOP/ VERY FIRM WET GRAY CLAYEY SAND W/ GRAVEL AT TIP



DEPTH (ft.)		DESCRIPTION	PILE TIP
GW 213		STIFF MOIST TO WET MOTTLED RED AND BROWN SANDY LEAN CLAY (CL)	
197		LOOSE WET BROWNISH-GRAY POORLY GRADED SAND WITH SILT (SP-SM)	
193		VERY FIRM WET GRAY CLAYEY SAND WITH GRAVEL (SC)	
176		VERY FIRM TO VERY DENSE WET GRAY POORLY-GRADED SAND WITH SILT (SP-SM)	TIP ELEV.

CAPWAP FINAL RESULTS

Total CAPWAP Capacity: 280.3; along Shaft 225.6; at Toe 54.7 kips

Soil Sgmnt No.	Dist. Below Gages ft	Depth Below Grade ft	Ru kips	Force in Pile kips	Sum of Ru kips	Unit Resist. (Depth) kips/ft	Unit Resist. (Area) ksf	Smith Damping Factor s/ft	Quake in
				280.3					
1	10.2	8.9	7.4	272.9	7.4	1.09	0.64	0.061	0.080
2	17.0	15.6	20.8	252.1	28.2	3.06	1.80	0.061	0.080
3	23.8	22.4	47.0	205.1	75.2	6.92	4.06	0.061	0.080
4	30.5	29.2	75.1	130.0	150.2	11.06	6.49	0.061	0.080
5	37.3	36.0	75.4	54.7	225.6	11.10	6.52	0.061	0.080
Avg. Skin			45.1			6.27	3.90	0.061	0.080
Toe			54.7				301.64	0.248	0.290

Soil Model Parameters/Extensions		Skin	Toe	
Case Damping Factor		0.295	0.292	Smith Type
Reloading Level	(% of Ru)	100	100	
Unloading Level	(% of Ru)	5		
Soil Plug Weight	(kips)		0.12	

PROJECT INFORMATION

NAME:	M-7510(6)
DIVISION:	9
LOCATION:	MOBILE/ESCAMBIA
BENT/LANE:	OUT OF STRUCT.
PILE NO.:	TP 1
DATE DRIVEN:	10/27/1995

HAMMER DETAILS

MAKE/MODEL:	KOBE K-22
RATED ENERGY (KIP-FT):	41.3
WEIGHT (KIPS):	4.85
HAMMER ACTION:	SINGLE
AIR/DIESEL:	DIESEL
OPEN/CLOSED:	OPEN
HAMMER CUSHION:	FOSTERLON MICARTA

PILE DETAILS

PILE TYPE/MATERIAL:	14" PSC
PILE LENGTH (FT.):	90
SIZE/CS. AREA (IN^2):	196
DESIGN CAPACITY (tons):	50
SPLICE DETAILS:	N/A
PILE CUSHION:	PLYWOOD

PDA INFORMATION

EOD

PDA CAPACITY (tons):	180

RESTRIKE

DATE:	N/A
SETUP TIME (DAYS):	
PDA CAPACITY (TONS):	

ELEVATION DETAILS

TOTAL LENGTH (FT.):	90
EMBEDDED LENGTH (FT.):	65
GRADE ELEVATION:	117.65
TIP ELEVATION:	52
GW ELEVATION:	112

CAPWAP RESULTS

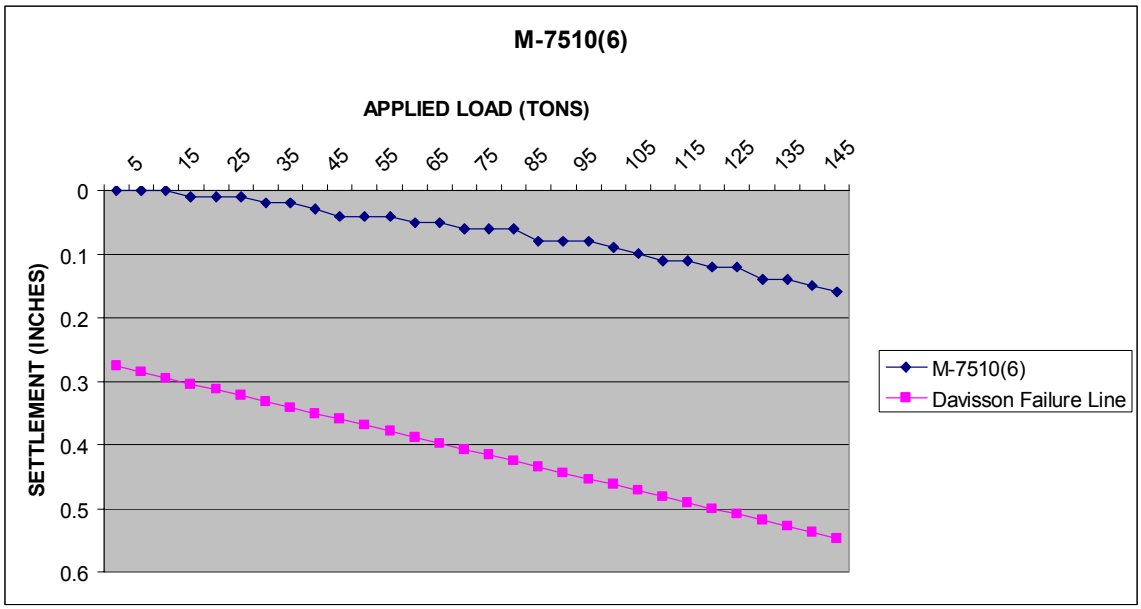
ULTIMATE RESISTANCE:	N/A

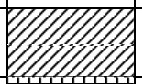
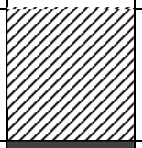
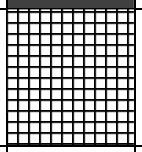
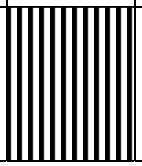
STATIC LOAD TEST DATA

DATE TESTED:	11/17/1995
DAVISSON LOAD CAPACITY (TONS):	
MAX. APPLIED LOAD (TONS):	150
DID FAILURE OCCUR:	NO
ESTIMATED ULTIMATE CAPACITY (TONS):	

SOIL INFORMATION

BORING NUMBER:	ABUT #1
BRIEF SOIL DESCRIPTION:	MED/WET/DENSE /BROWN SILTY SAND


M-7510(6)
APPLIED LOAD (TONS)
5
15
25
35
45
55
65
75
85
95
105
115
125
135
145
SETTLEMENT (INCHES)
0
0.1
0.2
0.3
0.4
0.5
0.6
M-7510(6)
Davisson Failure Line

DEPTH (ft.)		DESCRIPTION	PILE TIP
GW 111		Very Loose Damp Brown Clayey Sand with organics	
108		Loose Wet Brown and Gray CLAYEY SAND (SC)	
92		Medium Wet Brown CLAYEY SAND (SC)	
84		Loose Wet Brown and Gray CLAYEY SAND (SC)	
62		Medium Wet Brown Sand	
57		Very Loose Wet Brown and Gray Silty Sand	
53		Dense Wet Brown and Gray Silty Sand	
39		Very Dense Wet Brown and Gray Clayey Silty Sand	TIP ELEV.

PROJECT INFORMATION

NAME:	BR-3406(102)
DIVISION:	7
LOCATION:	HENRY CO
BENT/LANE:	ABUT 1
PILE NO.:	5
DATE DRIVEN:	5/7/2002

HAMMER DETAILS

MAKE/MODEL:	KOBE K-13
RATED ENERGY (KIP-FT):	27.983
WEIGHT (KIPS):	2.87
HAMMER ACTION:	SINGLE
AIR/DIESEL:	DIESEL
OPEN/CLOSED:	OPEN
HAMMER CUSHION:	N/A

PILE DETAILS

PILE TYPE/MATERIAL:	STEEL HP 12 X 53
PILE LENGTH (FT.):	39.5
SIZE/CS. AREA (IN^2):	15.5
DESIGN CAPACITY (tons):	30
SPLICE DETAILS:	N/A
PILE CUSHION:	N/A

PDA INFORMATION

EOD

PDA CAPACITY (tons):	104.5

RESTRIKE

DATE:	5/14/2002
SETUP TIME (DAYS):	7
PDA CAPACITY:	150

ELEVATION DETAILS

TOTAL LENGTH (FT.):	39.5
EMBEDDED LENGTH (FT.):	35.73
GRADE ELEVATION:	188.91
TIP ELEVATION:	153.44
GW ELEVATION:	182

CAPWAP RESULTS

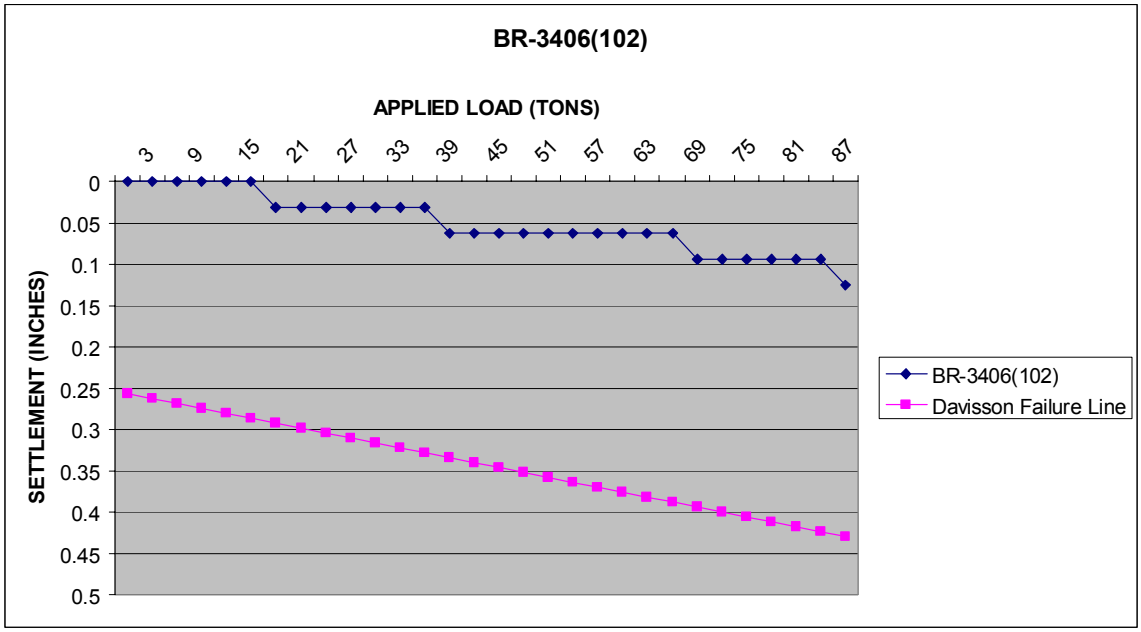
ULTIMATE RESISTANCE:	N/A

STATIC LOAD TEST DATA

DATE TESTED:	5/14/2002
DAVISSON LOAD CAPACITY (TONS):	
MAX. APPLIED LOAD (TONS):	90
DID FAILURE OCCUR:	NO
ESTIMATED ULTIMATE CAPACITY (TONS):	

SOIL INFORMATION

BORING NUMBER:	B-1
BRIEF SOIL DESCRIPTION:	CLAYEY SAND (SC) AT TOP/ SILTY SAND (SM) NEAR BOTTOM



DEPTH (ft.)		DESCRIPTION	PILE TIP
182.3		FILL, CLAYEY SAND (SC), reddish-brown, loose	
GW 175.3		SILTY SAND (SM), blueish-gray, firm	
167.3		SILTY SAND (SC-SM) olive-gray, dense	
134.3		SILTY SAND (SM), very firm to very dense	TIP ELEV.

PROJECT INFORMATION

NAME:	NHF-65-1(246) COBBS FORD RD TO N OR S.R. 14
DIVISION:	6
LOCATION:	MONTGOMERY CO.
BENT/LANE:	ABUT. 1 SB
PILE NO.:	4
DATE DRIVEN:	8/8/2001

HAMMER DETAILS

MAKE/MODEL:	3000# DROP
RATED ENERGY (KIP-FT):	21 AT 7' STROKE
WEIGHT (KIPS):	3
HAMMER ACTION:	DROP
AIR/DIESEL:	
OPEN/CLOSED:	
HAMMER CUSHION:	4" WOOD

PILE DETAILS

PILE TYPE/MATERIAL:	STEEL HP 10 X 42
PILE LENGTH (FT.):	23.13
SIZE/CS. AREA (IN^2):	12.4
DESIGN CAPACITY (tons):	30
SPLICE DETAILS:	N/A
PILE CUSHION:	N/A

PDA INFORMATION

EOD

PDA CAPACITY (tons):	90

RESTRIKE

DATE:	N/A
SETUP TIME (DAYS):	
PDA CAPACITY:	

ELEVATION DETAILS

TOTAL LENGTH (FT.):	23.13
EMBEDDED LENGTH (FT.):	20
GRADE ELEVATION:	389.6
TIP ELEVATION:	367.43
GW ELEVATION:	370

CAPWAP RESULTS

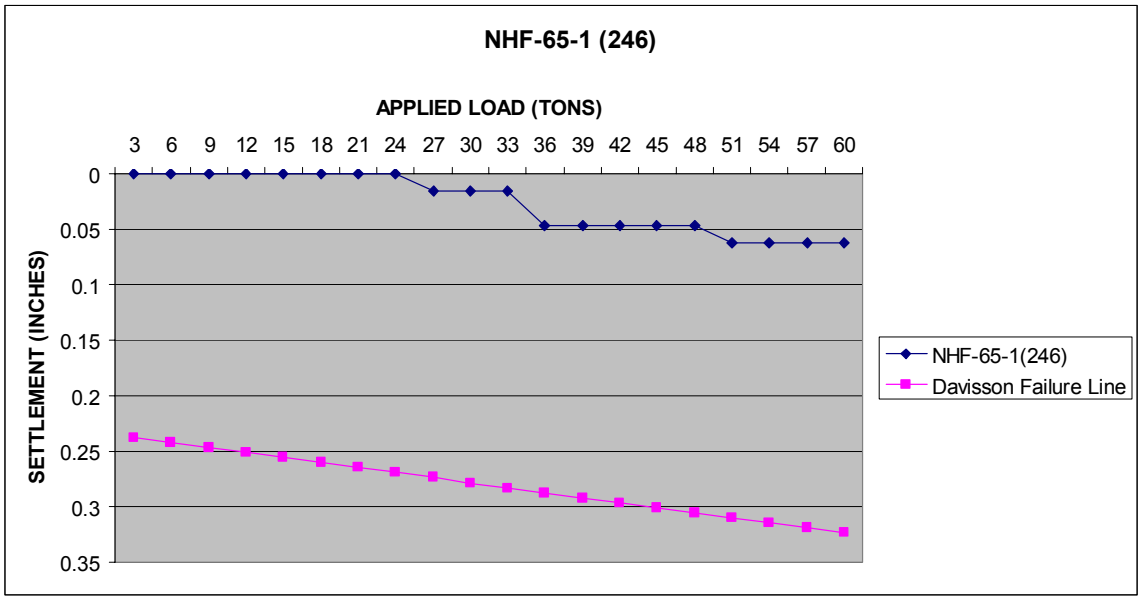
ULTIMATE RESISTANCE:	N/A

STATIC LOAD TEST DATA

DATE TESTED:	8/10/2001
DAVISSON LOAD CAPACITY (TONS):	
MAX. APPLIED LOAD (TONS):	60
DID FAILURE OCCUR:	NO
ESTIMATED ULTIMATE CAPACITY (TONS):	

SOIL INFORMATION

BORING NUMBER:	N/A
BRIEF SOIL DESCRIPTION:	RED SANDY CLAY



DEPTH (ft.)		DESCRIPTION	PILE TIP
390		Medium Moist Silty Sandy Clay	
GW 378		Brown and Red Gravelly Clay	
370		Wet Tan Silty Sand	
335		Very Stiff Damp Gray and Tan Silty Clay	TIP ELEV.
300		Medium Damp, Yellow and Tan Silty Sand	
280		Hard, Damp, Tan, Brown Silty Clay	

PROJECT INFORMATION

NAME:	MGF-0012(500) U.S. 84 S OF OPP
DIVISION:	7
LOCATION:	COVINGTON CO.
BENT/LANE:	ABUT 1 EB
PILE NO.:	3
DATE DRIVEN:	5/29/2003

HAMMER DETAILS

MAKE/MODEL:	DELMAG D19-32
RATED ENERGY (KIP-FT):	42.8 - 5' STROKE
WEIGHT (KIPS):	4.19
HAMMER ACTION:	SINGLE
AIR/DIESEL:	DIESEL
OPEN/CLOSED:	OPEN
HAMMER CUSHION:	1" ALUM 1" CONBAST

PILE DETAILS

PILE TYPE/MATERIAL:	STEEL HP 12 X 53
PILE LENGTH (FT.):	40
WALL THICKNESS (IN.):	
SIZE/CS. AREA (IN^2):	15.5
DESIGN CAPACITY (tons):	30
SPLICE DETAILS:	N/A
PILE CUSHION:	N/A

PDA INFORMATION

EOD

PDA CAPACITY (tons):	59.5

RESTRIKE

DATE:	5/29/03 - SETCK
SETUP TIME:	60 MIN
PDA CAPACITY:	108

ELEVATION DETAILS

TOTAL LENGTH (FT.):	40
EMBEDDED LENGTH (FT.):	37
GRADE ELEVATION:	246.95
TIP ELEVATION:	207.4
GW ELEVATION:	232.7

CAPWAP RESULTS

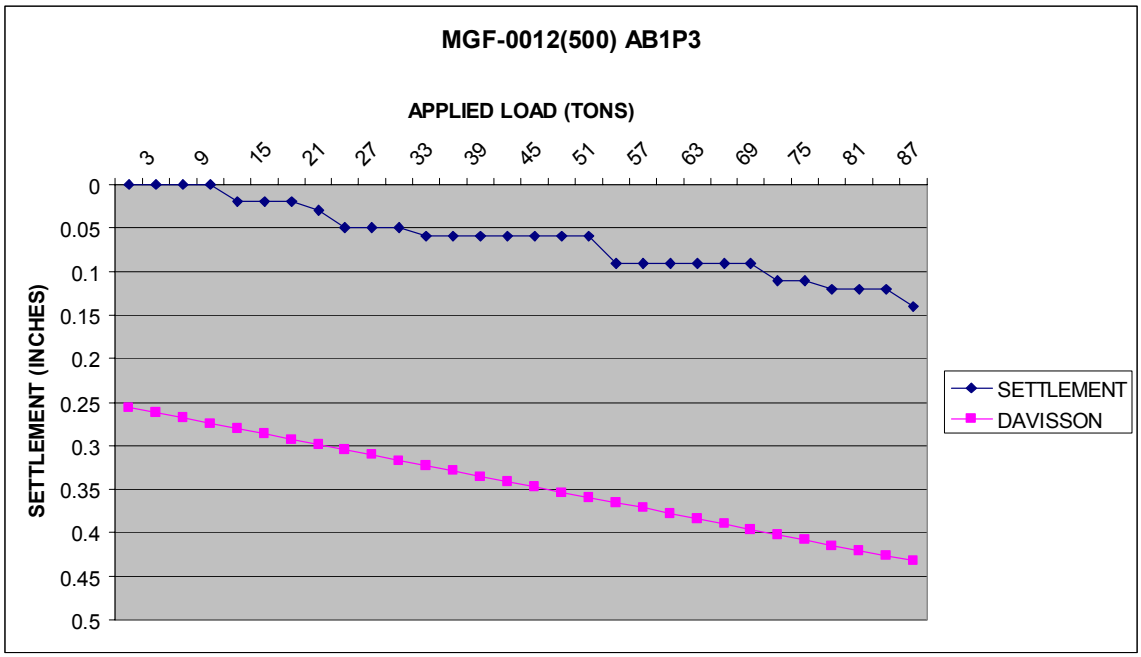
ULTIMATE RESISTANCE (tons):	101.4

STATIC LOAD TEST DATA

DATE TESTED:	6/5/2003
DAVISSON LOAD CAPACITY (TONS):	
MAX. APPLIED LOAD (TONS):	90
DID FAILURE OCCUR:	NO
ESTIMATED ULTIMATE CAPACITY (TONS):	

SOIL INFORMATION

BORING NUMBER:	B-5
BRIEF SOIL DESCRIPTION:	DENSE TO FIRM GRAY SILTY FINE SAND



DEPTH (ft.)		DESCRIPTION	PILE TIP
GW 222.05		Very Loose light brown SILTY fine SAND (SM)	
217.05		Very Dense yellow and red coarse to fine SAND (SP-SM)	
202.05		Dense to Firm gray SILTY fine SAND (SM)	TIP ELEV.
177.05		Dense to Firm gray weathered LIMESTONE (ML)	
167.05		Dense gray and white CLAYEY coarse to fine SAND, with weathered LIMESTONE (SC)	

CAPWAP FINAL RESULTS

Total CAPWAP Capacity: 202.7; along Shaft 64.4; at Toe 138.3 kips

Soil Sgmnt No.	Dist. Below Gages ft	Depth Below Grade ft	Ru kips	Force in Pile kips	Sum of Ru kips	Unit Resist. (Depth) kips/ft	Unit Resist. (Area) ksf	Smith Damping Factor s/ft	Quake in
				202.7					
1	7.4	6.4	1.9	200.8	1.9	0.26	0.20	0.154	0.040
2	14.8	13.8	9.2	191.6	11.1	1.24	0.95	0.154	0.040
3	22.2	21.2	17.1	174.6	28.2	2.31	1.76	0.154	0.040
4	29.6	28.6	17.3	157.3	45.5	2.33	1.78	0.154	0.040
5	37.1	36.0	19.0	138.3	64.4	2.56	1.95	0.154	0.040
Avg. Skin			12.9			1.79	1.33	0.154	0.040
Toe			138.3				1284.69	0.051	0.590

Soil Model Parameters/Extensions		Skin	Toe
Case Damping Factor		0.359	0.257
Unloading Quake	(% of loading quake)	2	14
Reloading Level	(% of Ru)	100	100
Soil Plug Weight	(kips)		0.02

PROJECT INFORMATION

NAME:	MGF-0012(500)
DIVISION:	7
LOCATION:	COVINGTON CO.
BENT/LANE:	3 EB
PILE NO.:	1
DATE DRIVEN:	7/29/2003

HAMMER DETAILS

MAKE/MODEL:	DELMAG D19-32
RATED ENERGY (KIP-FT):	42.8 - 5' STROKE
WEIGHT (KIPS):	4.19
HAMMER ACTION:	SINGLE
AIR/DIESEL:	DIESEL
OPEN/CLOSED:	OPEN
HAMMER CUSHION:	1" CONBEST 1" ALUM

PILE DETAILS

PILE TYPE/MATERIAL:	STEEL HP 12 X 53
PILE LENGTH (FT.):	40
WALL THICKNESS (IN.):	
SIZE/CS. AREA (IN^2):	15.5
DESIGN CAPACITY (tons):	70
SPLICE DETAILS:	N/A
PILE CUSHION:	N/A

PDA INFORMATION

EOD

PDA CAPACITY (tons):	209.5

RESTRIKE

DATE:	N/A
SETUP TIME (DAYS):	
PDA CAPACITY:	

ELEVATION DETAILS

TOTAL LENGTH (FT.):	40
EMBEDDED LENGTH (FT.):	36
GRADE ELEVATION:	226.68
TIP ELEVATION:	191.36
GW ELEVATION:	230.5

CAPWAP RESULTS

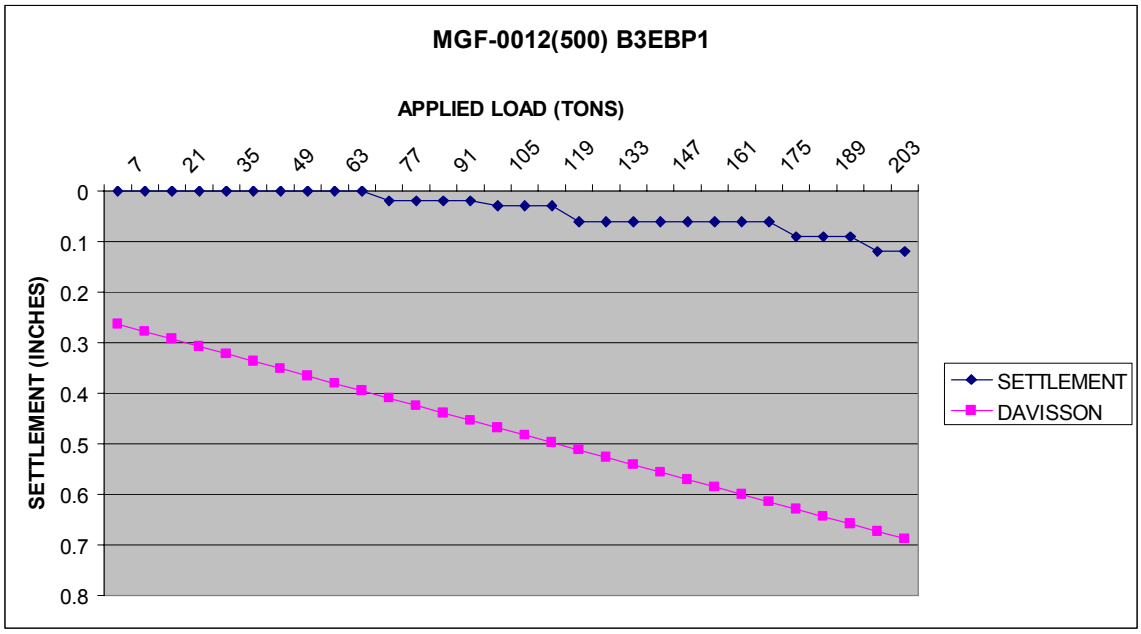
ULTIMATE RESISTANCE (tons):	163.7

STATIC LOAD TEST DATA

DATE TESTED:	8/8/2003
DAVISSON LOAD CAPACITY (TONS):	
MAX. APPLIED LOAD (TONS):	210
DID FAILURE OCCUR:	NO
ESTIMATED ULTIMATE CAPACITY (TONS):	

SOIL INFORMATION

BORING NUMBER	B-3
BRIEF SOIL DESCRIPTION	HARD TO VERY STIFF LIGHT GREENISH GRAY WEATHERED LIMESTONE (CH)



DEPTH (ft.)		DESCRIPTION	PILE TIP
235.6		Loose red SILTY fine SAND (SM)	
GW 231.35		VERY Loose red and brown CLAYEY coarse to fine SAND (SC)	
226.35		VERY Loose dark brown SILTY fine SAND, with ORGANIC fines and WOOD (SM)	
221.35		SOFT Yellow and Light Gray CLAY (CL)	
216.35		FIRM Greenish gray SILT (ML)	
201.35		FIRM Greenish gray SILTY fine SAND (SM)	
181.35		DENSE to VERY DENSE light greenish gray weathered LIMESTONE (ML)	TIP ELEV.
166.35		VERY DENSE yellow fine SAND (SP-SM)	
131.35		VERY DENSE pale yellow fine SAND (SP)	

CAPWAP FINAL RESULTS

Total CAPWAP Capacity: 327.1; along Shaft 161.3; at Toe 165.8 kips

Soil Sgmnt No.	Dist. Below Gages ft	Depth Below Grade ft	Ru kips	Force in Pile kips	Sum of Ru kips	Unit Resist. (Depth) kips/ft	Unit Resist. (Area) ksf	Smith Damping Factor s/ft	Quake in
				327.1					
1	10.1	8.0	9.8	317.3	9.8	1.45	1.11	0.214	0.100
2	16.9	14.8	35.4	282.0	45.2	5.25	4.00	0.214	0.100
3	23.6	21.5	56.5	225.5	101.6	8.38	6.38	0.214	0.100
4	30.3	28.3	44.1	181.4	145.7	6.54	4.98	0.214	0.100
5	37.1	35.0	15.6	165.8	161.3	2.31	1.76	0.214	0.100
Avg. Skin			32.3			4.61	3.65	0.214	0.100
Toe			165.8				1540.45	0.134	0.150

Soil Model Parameters/Extensions		Skin	Toe
Case Damping Factor		1.250	0.805
Unloading Quake	(% of loading quake)	50	100
Reloading Level	(% of Ru)	100	100
Unloading Level	(% of Ru)	99	
Soil Plug Weight	(kips)		0.16

PROJECT INFORMATION

NAME:	BR-0203(511)
DIVISION:	5
LOCATION:	LAMAR CO.
BENT/LANE:	6
PILE NO.:	4
DATE DRIVEN:	8/17/2004

HAMMER DETAILS

MAKE/MODEL:	DELMAG D19-42
RATED ENERGY (KIP-FT):	42
WEIGHT (KIPS):	4
HAMMER ACTION:	SINGLE
AIR/DIESEL:	DIESEL
OPEN/CLOSED:	OPEN
HAMMER CUSHION:	A-36 - 3 INCHES

PILE DETAILS

PILE TYPE/MATERIAL:	STEEL HP 14 X 73
PILE LENGTH (FT.):	50.25
WALL THICKNESS (IN.):	
SIZE/CS. AREA (IN^2):	21.4
DESIGN CAPACITY (tons):	54
SPLICE DETAILS:	N/A
PILE CUSHION:	N/A

PDA INFORMATION

EOD

PDA CAPACITY (tons):	134

RESTRIKE

DATE:	30 MIN. SETCK
SETUP TIME (DAYS):	
PDA CAPACITY (TONS):	173

ELEVATION DETAILS

TOTAL LENGTH (FT.):	50.25
EMBEDDED LENGTH (FT.):	23
GRADE ELEVATION:	268.5
TIP ELEVATION:	245.33
GW ELEVATION:	268

CAPWAP RESULTS

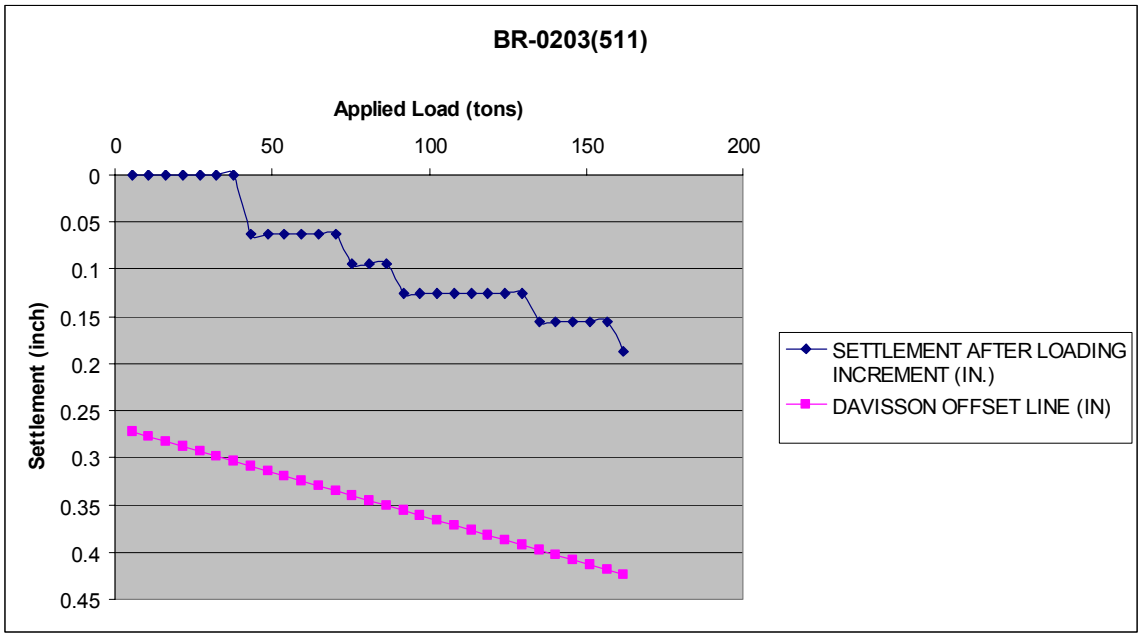
ULTIMATE RESISTANCE (tons):	216.4

STATIC LOAD TEST DATA

DATE TESTED:	8/19/2004
DAVISSON LOAD CAPACITY (TONS):	
MAX. APPLIED LOAD (TONS):	162
DID FAILURE OCCUR:	NO
ESTIMATED ULTIMATE CAPACITY (TONS):	

SOIL INFORMATION

BORING NUMBER:	B-3
BRIEF SOIL DESCRIPTION:	MOIST BROWN CLAY W/ SILT AND CLAY AT TOP/ VERY DENSE WET BROWN SAND W/ THIN ROCK LAYERS AT TIP



DEPTH (ft.)		DESCRIPTION	PILE TIP
262		Medium Moist Gray Clay w/ Silt & Fine Sand	TIP ELEV.
257		Medium Wet Gray Sand w/ Silt and Small Rock Fragments	
223		Very Dense Wet Orange Sand w/ Gravel	
217		Very Dense Wet Tan Silt w/ Sand	
209		Very Dense Wet Brown and Gray Silt w/ Fine Sand Clay Rock Fragments	
204		Hard Moist Red and Gray Clay w/ Small Rock Fragments	
196		Hard Moist Red and Gray Clay w/ Silt	

CAPWAP FINAL RESULTS

Total CAPWAP Capacity: 432.3; along Shaft 369.4; at Toe 62.9 kips

Soil Sgmnt No.	Dist. Below Gages ft	Depth Below Grade ft	Ru kips	Force in Pile kips	Sum of Ru kips	Unit Resist. (Depth) kips/ft	Unit Resist. (Area) ksf	Smith Damping Factor s/ft	Quake in
				432.3					
1	27.0	2.7	0.0	432.3	0.0	0.00	0.00	0.000	0.100
2	33.8	9.5	61.0	371.3	61.0	9.03	5.85	0.071	0.100
3	40.6	16.2	0.0	371.3	61.0	0.00	0.00	0.000	0.100
4	47.3	23.0	308.4	62.9	369.4	45.61	29.58	0.071	0.100
Avg. Skin			92.4			16.06	8.86	0.071	0.100
Toe			62.9				423.48	0.162	0.420

Soil Model Parameters/Extensions		Skin	Toe	
Case Damping Factor		0.696	0.272	Smith Type
Reloading Level	(% of Ru)	100	100	
Unloading Level	(% of Ru)	30		
Soil Plug Weight	(kips)		0.05	

PROJECT INFORMATION

NAME:	ER-7527(2)
DIVISION:	9
LOCATION:	ESCAMBIA
BENT/LANE:	ABUT 6
PILE NO.:	5
DATE DRIVEN:	10/29/2003

HAMMER DETAILS

MAKE/MODEL:	KOBE K-13
RATED ENERGY (KIP-FT):	25.4
WEIGHT (KIPS):	2.87
HAMMER ACTION:	SINGLE
AIR/DIESEL:	DIESEL
OPEN/CLOSED:	OPEN
HAMMER CUSHION:	MICARTA-3.5"

PILE DETAILS

PILE TYPE/MATERIAL:	STEEL HP 12 X 53
PILE LENGTH (FT.):	45
WALL THICKNESS (IN.):	
SIZE/CS. AREA (IN^2):	15.5
DESIGN CAPACITY (tons):	33
SPLICE DETAILS:	N/A
PILE CUSHION:	N/A

PDA INFORMATION

EOD

PDA CAPACITY (tons):	120

RESTRIKE

DATE:	N/A
SETUP TIME (DAYS):	
PDA CAPACITY (TONS):	

ELEVATION DETAILS

TOTAL LENGTH (FT.):	45
EMBEDDED LENGTH (FT.):	44
GRADE ELEVATION:	94.85
TIP ELEVATION:	50.85
GW ELEVATION:	

CAPWAP RESULTS

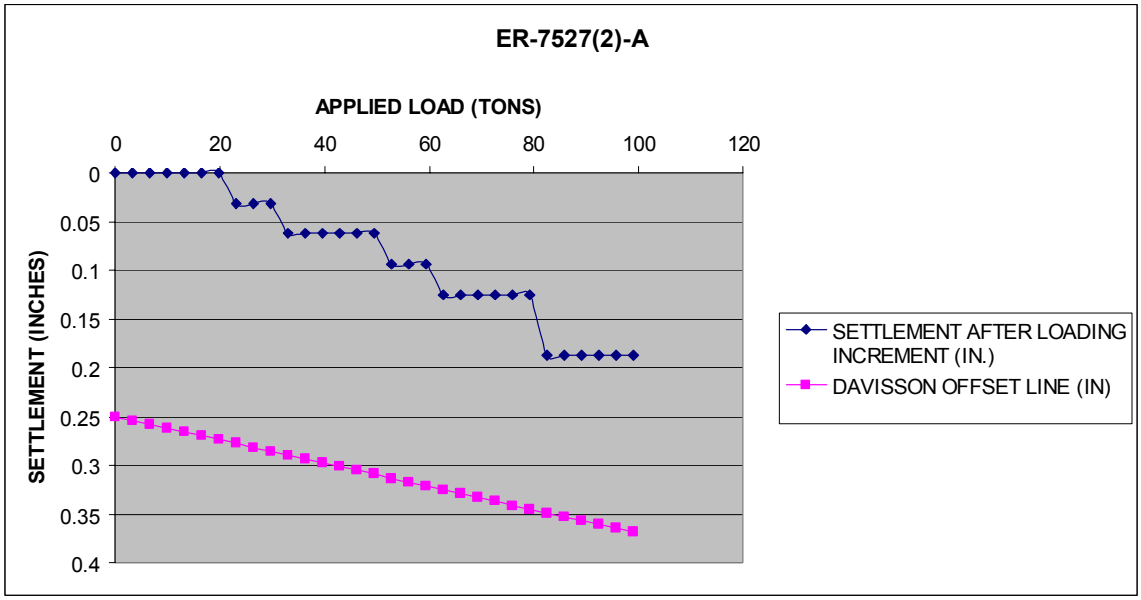
ULTIMATE RESISTANCE (tons):	66.2

STATIC LOAD TEST DATA

DATE TESTED:	11/5/2003
DAVISSON LOAD CAPACITY (TONS):	
MAX. APPLIED LOAD (TONS):	99
DID FAILURE OCCUR:	NO
ESTIMATED ULTIMATE CAPACITY (TONS):	

SOIL INFORMATION

BORING NUMBER:	RB-3
BRIEF SOIL DESCRIPTION:	SILTY SAND



DEPTH (ft.)		DESCRIPTION	PILE TIP
80		Soft to Firm SILTY CLAY	
8		Loose to Dense SAND and SILTY SAND	TIP ELEV.

CAPWAP FINAL RESULTS

Total CAPWAP Capacity: 132.3; along Shaft 70.5; at Toe 61.8 kips

Soil Sgmnt No.	Dist. Below Gages ft	Depth Below Grade ft	Ru kips	Force in Pile kips	Sum of Ru kips	Unit Resist. (Depth) kips/ft	Unit Resist. (Area) ksf	Smith Damping Factor s/ft	Quake in
				132.3					
1	6.7	2.6	0.0	132.3	0.0	0.00	0.00	0.000	0.100
2	13.5	9.3	9.9	122.4	9.9	1.47	1.12	0.203	0.100
3	20.2	16.0	17.0	105.5	26.9	2.52	1.92	0.203	0.100
4	27.0	22.8	19.4	86.1	46.2	2.88	2.19	0.203	0.100
5	33.7	29.5	16.2	69.9	62.4	2.40	1.83	0.203	0.100
6	40.4	36.3	8.1	61.8	70.5	1.20	0.91	0.203	0.100
7	47.2	43.0	0.0	61.8	70.5	0.00	0.00	0.000	0.100
Avg. Skin			10.1			1.64	1.14	0.203	0.100
Toe			61.8				574.33	0.078	0.270

Soil Model Parameters/Extensions		Skin	Toe
Case Damping Factor		0.516	0.175
Unloading Quake	(% of loading quake)	25	100
Reloading Level	(% of Ru)	100	100
Unloading Level	(% of Ru)	55	
Soil Plug Weight	(kips)		0.03

PROJECT INFORMATION

NAME	ER-7527(2)
DIVISION	9
LOCATION	ESCAMBIA
BENT/LANE	ABUT 1
PILE NO.	4
DATE DRIVEN	6/11/2003

HAMMER DETAILS

MAKE/MODEL	KOBE K-13
RATED ENERGY (KIP-FT)	25.4
WEIGHT (KIPS)	2.87
HAMMER ACTION	SINGLE
AIR/DIESEL	DIESEL
OPEN/CLOSED	OPEN
HAMMER CUSHION	MICARTA-3.5"

PILE DETAILS

PILE TYPE/MATERIAL	STEEL HP 12 X 53
PILE LENGTH (FT.)	51.74
WALL THICKNESS (IN.)	
SIZE/CS. AREA (IN2)	15.5
DESIGN CAPACITY (tons)	32
SPLICE DETAILS	N/A
PILE CUSHION	N/A

PDA INFORMATION

EOD

PDA CAPACITY (tons)	120

RESTRIKE

DATE	N/A
SETUP TIME (DAYS)	
PDA CAPACITY (TONS)	

ELEVATION DETAILS

TOTAL LENGTH (FT.)	51.74
EMBEDDED LENGTH (FT.)	50.74
GRADE ELEVATION	97.78
TIP ELEVATION	47.04
GW ELEVATION	N/A

CAPWAP RESULTS

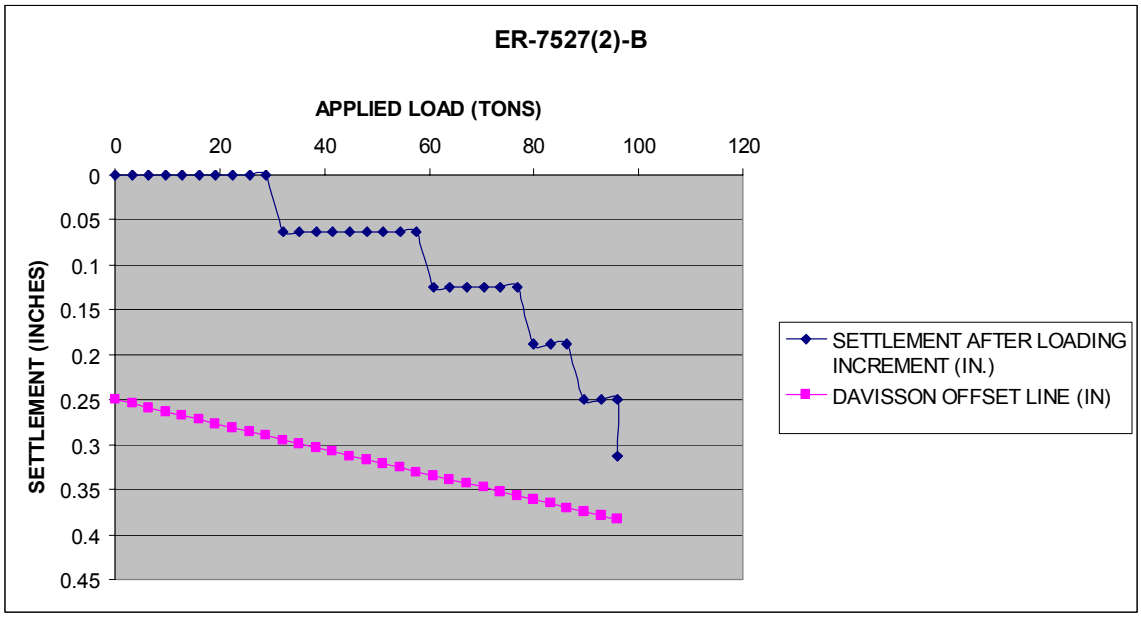
ULTIMATE RESISTANCE (tons):	41.4

SOIL INFORMATION

BORING NUMBER	N/A
BRIEF SOIL DESCRIPTION	SILTY SAND

STATIC LOAD TEST DATA

DATE TESTED	6/11/2003
DAVISSON LOAD CAPACITY (TONS)	
MAX. APPLIED LOAD (TONS)	96
DID FAILURE OCCUR	NO
ESTIMATED ULTIMATE CAPACITY (TONS)	110



DEPTH (ft.)		DESCRIPTION	PILE TIP
90			
25		Soft to Very Stiff CLAY with Loose to Firm SAND and SILTY SAND	TIP ELEV
7		Loose to Dense SAND and Dense to Hard SILTY SAND with some Hard CLAY seams	

CAPWAP FINAL RESULTS

Total CAPWAP Capacity: 98.1; along Shaft 77.1; at Toe 21.0 kips

Soil Sgmnt No.	Dist. Below Gages ft	Depth Below Grade ft	Ru kips	Force in Pile kips	Sum of Ru kips	Unit Resist. (Depth) kips/ft	Unit Resist. (Area) ksf	Smith Damping Factor s/ft	Quake in
				98.1					
1	10.2	6.2	3.6	94.5	3.6	0.53	0.40	0.178	0.040
2	17.0	13.0	5.2	89.3	8.8	0.76	0.58	0.178	0.040
3	23.8	19.8	8.2	81.1	17.0	1.20	0.92	0.178	0.040
4	30.6	26.6	13.3	67.8	30.3	1.95	1.49	0.178	0.040
5	37.4	33.4	17.7	50.2	48.0	2.60	1.98	0.178	0.040
6	44.2	40.2	16.7	33.5	64.6	2.45	1.87	0.178	0.040
7	51.0	47.0	12.5	21.0	77.1	1.84	1.40	0.178	0.040
Avg. Skin			11.0			1.64	1.23	0.178	0.040
Toe			21.0				194.93	0.026	0.090

Soil Model Parameters/Extensions		Skin	Toe
Case Damping Factor		0.497	0.020
Unloading Quake	(% of loading quake)	30	43
Reloading Level	(% of Ru)	100	100
Unloading Level	(% of Ru)	9	
Soil Plug Weight	(kips)		0.01

PROJECT INFORMATION

NAME:	ER-7527(2)
DIVISION:	9
LOCATION:	ESCAMBIA
BENT/LANE:	3
PILE NO.:	3
DATE DRIVEN:	11/4/2003

HAMMER DETAILS

MAKE/MODEL:	KOBE K-25
RATED ENERGY (KIP-FT):	5
WEIGHT (KIPS):	5.5
HAMMER ACTION:	SINGLE
AIR/DIESEL:	DIESEL
OPEN/CLOSED:	OPEN
HAMMER CUSHION:	MICARTA-3.5"

PILE DETAILS

PILE TYPE/MATERIAL:	STEEL HP 14 X 89
PILE LENGTH (FT.):	67.53
SIZE/CS. AREA (IN^2):	26.1
DESIGN CAPACITY (tons):	57
SPLICE DETAILS:	N/A
PILE CUSHION:	N/A

PDA INFORMATION

EOD

PDA CAPACITY (tons):	150

RESTRIKE

DATE:	N/A
SETUP TIME (DAYS):	
PDA CAPACITY (TONS):	

ELEVATION DETAILS

TOTAL LENGTH (FT.):	67.53
EMBEDDED LENGTH (FT.):	57
GRADE ELEVATION:	86
TIP ELEVATION:	28.99
GW ELEVATION:	

CAPWAP RESULTS

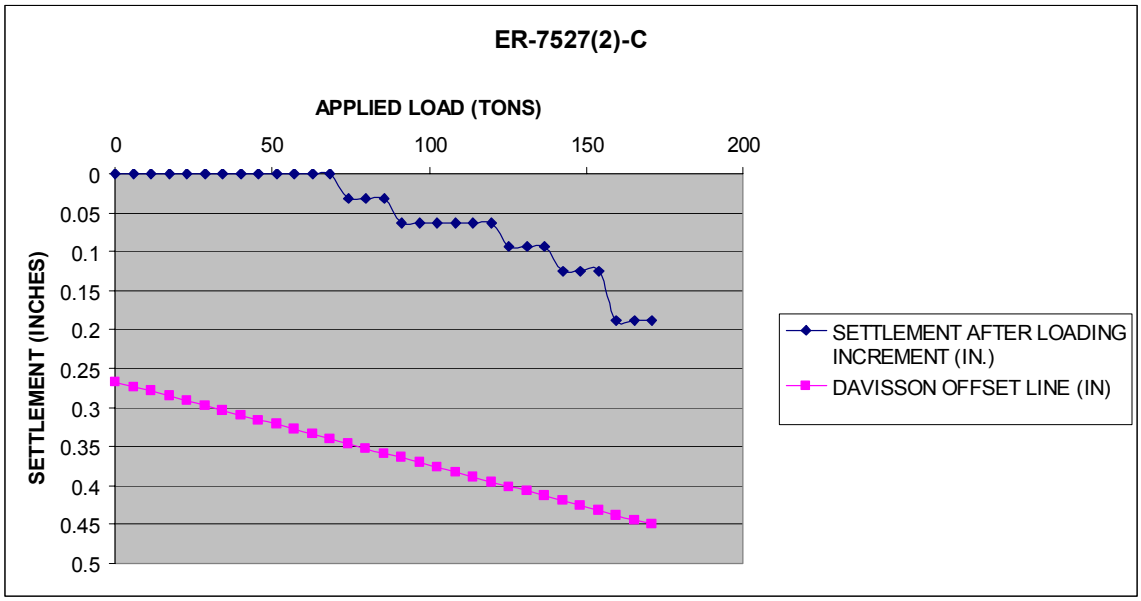
ULTIMATE RESISTANCE (tons):	96.9

STATIC LOAD TEST DATA

DATE TESTED:	11/6/2003
DAVISSON LOAD CAPACITY (TONS):	
MAX. APPLIED LOAD (TONS):	171
DID FAILURE OCCUR:	NO
ESTIMATED ULTIMATE CAPACITY (TONS):	

SOIL INFORMATION

BORING NUMBER:	RB-3
BRIEF SOIL DESCRIPTION:	DENSE TO SILTY SAND



DEPTH (ft.)		DESCRIPTION	PILE TIP
72		Soft to Firm SILTY CLAY	
7		Loose to Dense SAND and SILTY SAND	28.99

CAPWAP FINAL RESULTS

Total CAPWAP Capacity: 193.7; along Shaft 135.3; at Toe 58.4 kips

Soil Sgmnt No.	Dist. Below Gages ft	Depth Below Grade ft	Ru kips	Force in Pile kips	Sum of Ru kips	Unit Resist. (Depth) kips/ft	Unit Resist. (Area) ksf	Smith Damping Factor s/ft	Quake in
				193.7					
1	10.4	8.7	10.0	183.7	10.0	1.45	0.85	0.184	0.060
2	17.3	15.6	10.1	173.6	20.1	1.46	0.86	0.184	0.060
3	24.2	22.5	10.2	163.4	30.3	1.48	0.87	0.184	0.060
4	31.1	29.4	27.4	136.0	57.7	3.96	2.33	0.184	0.060
5	38.0	36.3	40.2	95.8	97.8	5.82	3.42	0.184	0.060
6	44.9	43.2	32.7	63.2	130.5	4.73	2.78	0.184	0.060
7	51.8	50.1	4.8	58.4	135.3	0.69	0.41	0.184	0.060
8	58.7	57.0	0.0	58.4	135.3	0.00	0.00	0.000	0.060
Avg. Skin			16.9			2.37	1.44	0.184	0.060
Toe			58.4				321.97	0.276	0.240

Soil Model Parameters/Extensions		Skin	Toe
Case Damping Factor		0.535	0.345
Unloading Quake	(% of loading quake)	50	100
Reloading Level	(% of Ru)	100	100
Unloading Level	(% of Ru)	17	
Soil Plug Weight	(kips)		0.04

PROJECT INFORMATION

NAME:	ER-7527(2)
DIVISION:	9
LOCATION:	ESCAMBIA CO
BENT/LANE:	10
PILE NO.:	3
DATE DRIVEN:	9/17/2002

HAMMER DETAILS

MAKE/MODEL:	KOBE K-25
RATED ENERGY (KIP-FT):	5.07
WEIGHT (KIPS):	5071
HAMMER ACTION:	SINGLE
AIR/DIESEL:	DIESEL
OPEN/CLOSED:	OPEN
HAMMER CUSHION:	MICARTA

PILE DETAILS

PILE TYPE/MATERIAL:	STEEL HP 14 x 89
PILE LENGTH (FT.):	64.2
WALL THICKNESS (IN.):	
SIZE/CS. AREA (IN^2):	26.1
DESIGN CAPACITY (tons):	57
SPLICE DETAILS:	N/A
PILE CUSHION:	N/A

PDA INFORMATION

EOD

PDA CAPACITY (tons):	128

RESTRIKE

DATE:	N/A
SETUP TIME (DAYS);	
PDA CAPACITY:	

ELEVATION DETAILS

TOTAL LENGTH (FT.):	64.2
EMBEDDED LENGTH (FT.):	55
GRADE ELEVATION:	87.08
TIP ELEVATION:	32.08
GW ELEVATION:	N/A

CAPWAP RESULTS

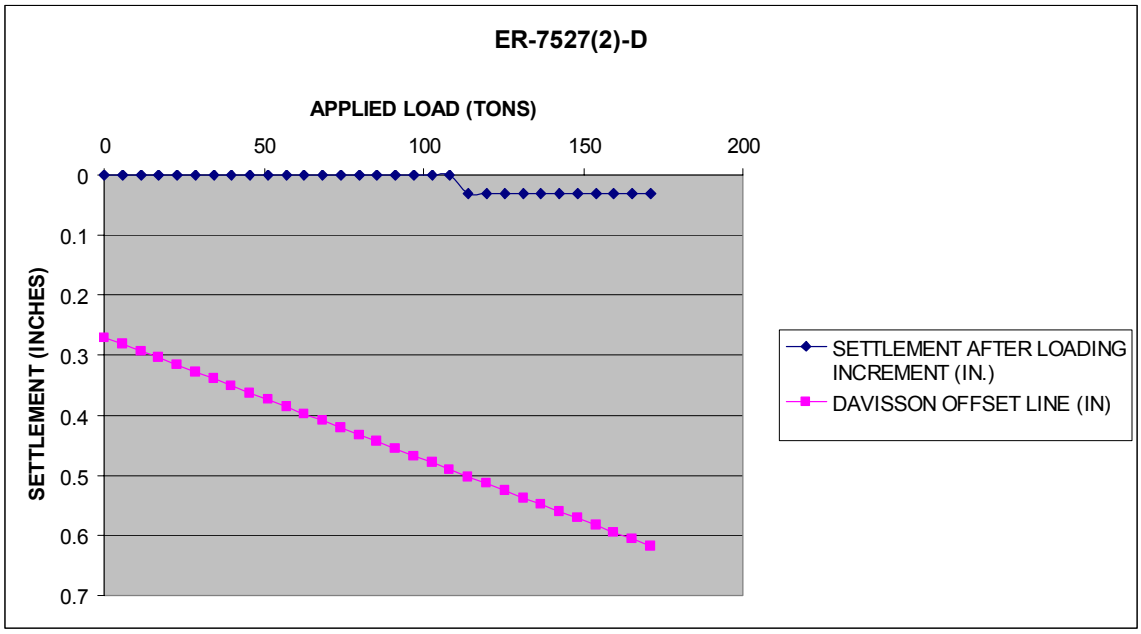
ULTIMATE RESISTANCE (tons):	N/A

STATIC LOAD TEST DATA

DATE TESTED:	9/17/2002
DAVISSON LOAD CAPACITY (TONS):	
MAX. APPLIED LOAD (TONS):	171
DID FAILURE OCCUR:	NO
ESTIMATED ULTIMATE CAPACITY (TONS):	

SOIL INFORMATION

BORING NUMBER:	RB-12
BRIEF SOIL DESCRIPTION:	DENSE TO SILTY SAND



DEPTH (ft.)		DESCRIPTION	PILE TIP
80		Soft to Very Stiff CLAY with Loose to Firm SAND and SILTY SAND	
7		LOOSE TO VERY DENSE SAND TO SILTY SAND WITH SOME CLAY SEAMS	TIP ELEV.

CAPWAP FINAL RESULTS

Total CAPWAP Capacity: 328.2; along Shaft 118.3; at Toe 209.8 kips

Soil Sgmnt No.	Dist. Below Gages ft	Depth Below Grade ft	Ru kips	Force in Pile kips	Sum of Ru kips	Unit Resist. (Depth) kips/ft	Unit Resist. (Area) ksf	Smith Damping Factor s/ft	Quake in
				328.2					
1	10.1	7.8	0.0	328.2	0.0	0.00	0.00	0.000	0.060
2	16.9	14.5	1.4	326.8	1.4	0.21	0.12	0.200	0.060
3	23.6	21.3	8.1	318.7	9.5	1.20	0.70	0.200	0.060
4	30.4	28.0	16.0	302.7	25.5	2.37	1.39	0.200	0.060
5	37.1	34.8	27.0	275.7	52.5	4.00	2.35	0.200	0.060
6	43.9	41.5	33.0	242.7	85.5	4.89	2.87	0.200	0.060
7	50.6	48.3	23.9	218.8	109.4	3.54	2.08	0.200	0.060
8	57.4	55.0	9.0	209.8	118.3	1.33	0.78	0.200	0.060
Avg. Skin			14.8			2.15	1.29	0.200	0.060
Toe			209.8				1157.56	0.029	0.560

Soil Model Parameters/Extensions		Skin	Toe
Case Damping Factor		0.508	0.129
Unloading Quake	(% of loading quake)	2	10
Reloading Level	(% of Ru)	100	100

PROJECT INFORMATION

NAME:	ER-7527(2)-
DIVISION:	9
LOCATION:	ESCAMBIA CO
BENT/LANE:	ABUT 1
PILE NO.:	5
DATE DRIVEN:	7/15/2003

HAMMER DETAILS

MAKE/MODEL:	KOBE K-13
RATED ENERGY (KIP-FT):	2.87
WEIGHT (KIPS):	2.87
HAMMER ACTION:	SINGLE
AIR/DIESEL:	DIESEL
OPEN/CLOSED:	OPEN
HAMMER CUSHION:	MICARTA

PILE DETAILS

PILE TYPE/MATERIAL:	STEEL HP 12 x 53
PILE LENGTH (FT.):	38.2
WALL THICKNESS (IN.):	
SIZE/CS. AREA (IN^2):	15.5
DESIGN CAPACITY (tons):	33
SPLICE DETAILS:	N/A
PILE CUSHION:	N/A

PDA INFORMATION

EOD

PDA CAPACITY (tons):	88

RESTRIKE

DATE:	N/A
SETUP TIME (DAYS):	
PDA CAPACITY:	

ELEVATION DETAILS

TOTAL LENGTH (FT.):	38.2
EMBEDDED LENGTH (FT.):	36
GRADE ELEVATION:	95.28
TIP ELEVATION:	57.08
GW ELEVATION:	N/A

CAPWAP RESULTS

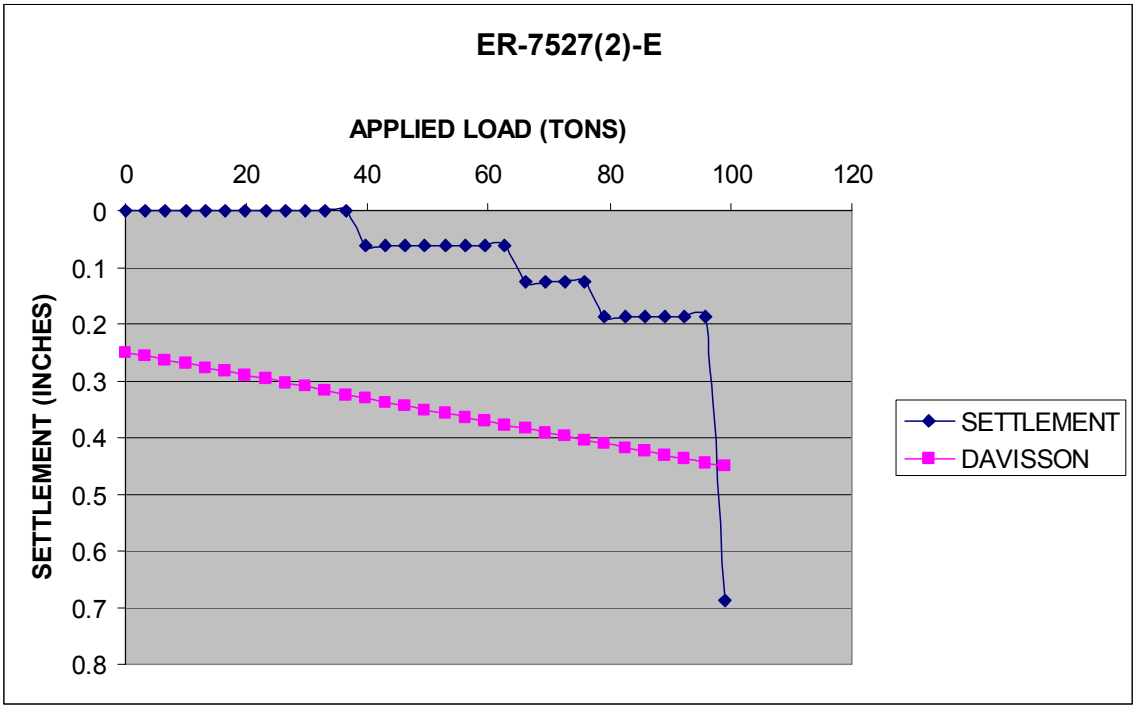
ULTIMATE RESISTANCE (tons):	74.9

STATIC LOAD TEST DATA

DATE TESTED:	7/17/2003
DAVISSON LOAD CAPACITY (TONS):	98
MAX. APPLIED LOAD (TONS):	99
DID FAILURE OCCUR:	YES
ESTIMATED ULTIMATE CAPACITY (TONS):	98

SOIL INFORMATION

BORING NUMBER:	RB-4
BRIEF SOIL DESCRIPTION:	LOOSE TO VERY DENSE SAND TO SILTY SAND



DEPTH (ft.)		DESCRIPTION	PILE TIP
85		Soft to Firm SILTY CLAY	
25		LOOSE TO VERY DENSE SAND TO SILTY SAND WITH SOME CLAY SEAMS	TIP ELEV.

CAPWAP FINAL RESULTS

Total CAPWAP Capacity: 149.7; along Shaft 115.4; at Toe 34.3 kips

Soil Sgmnt No.	Dist. Below Gages ft	Depth Below Grade ft	Ru kips	Force in Pile kips	Sum of Ru kips	Unit Resist. (Depth) kips/ft	Unit Resist. (Area) ksf	Smith Damping Factor s/ft	Quake in
				149.7					
1	6.7	3.5	1.3	148.4	1.3	0.19	0.15	0.102	0.080
2	13.5	10.3	1.6	146.8	2.9	0.24	0.18	0.102	0.080
3	20.2	17.0	11.5	135.3	14.4	1.70	1.30	0.102	0.080
4	27.0	23.8	29.8	105.5	44.2	4.42	3.37	0.102	0.080
5	33.7	30.5	42.8	62.8	87.0	6.34	4.83	0.102	0.080
6	40.5	37.3	27.2	35.6	114.1	4.03	3.07	0.102	0.080
7	47.2	44.0	1.3	34.3	115.4	0.19	0.15	0.102	0.080
Avg. Skin			16.5			2.62	1.86	0.102	0.080
Toe			34.3				318.47	0.444	0.400

Soil Model Parameters/Extensions		Skin	Toe	
Case Damping Factor		0.426	0.550	Smith Type
Reloading Level	(% of Ru)	100	100	
Unloading Level	(% of Ru)	16		
Soil Plug Weight	(kips)		0.11	

PROJECT INFORMATION

NAME:	BRF-0102(527)
DIVISION:	6
LOCATION:	MONTGOMERY CO.
BENT/LANE:	4 FTG 8
PILE NO.:	4
DATE DRIVEN:	11/8/2004

HAMMER DETAILS

MAKE/MODEL:	APE
RATED ENERGY (KIP-FT):	4.189
WEIGHT (KIPS):	4.189
HAMMER ACTION:	SINGLE
AIR/DIESEL:	DIESEL
OPEN/CLOSED:	OPEN
HAMMER CUSHION:	FOSTERLON

PILE DETAILS

PILE TYPE/MATERIAL:	STEEL HP 12 x 53
PILE LENGTH (FT.):	31.2
WALL THICKNESS (IN.):	
SIZE/CS. AREA (IN^2):	15.5
DESIGN CAPACITY (tons):	60
SPLICE DETAILS:	N/A
PILE CUSHION:	N/A

PDA INFORMATION

EOD

PDA CAPACITY (tons):	105

RESTRIKE

DATE:	N/A
SETUP TIME (DAYS):	
PDA CAPACITY:	

ELEVATION DETAILS

TOTAL LENGTH (FT.):	31.2
EMBEDDED LENGTH (FT.):	28.11
GRADE ELEVATION:	157.81
TIP ELEVATION:	129.7
GW ELEVATION:	

CAPWAP RESULTS

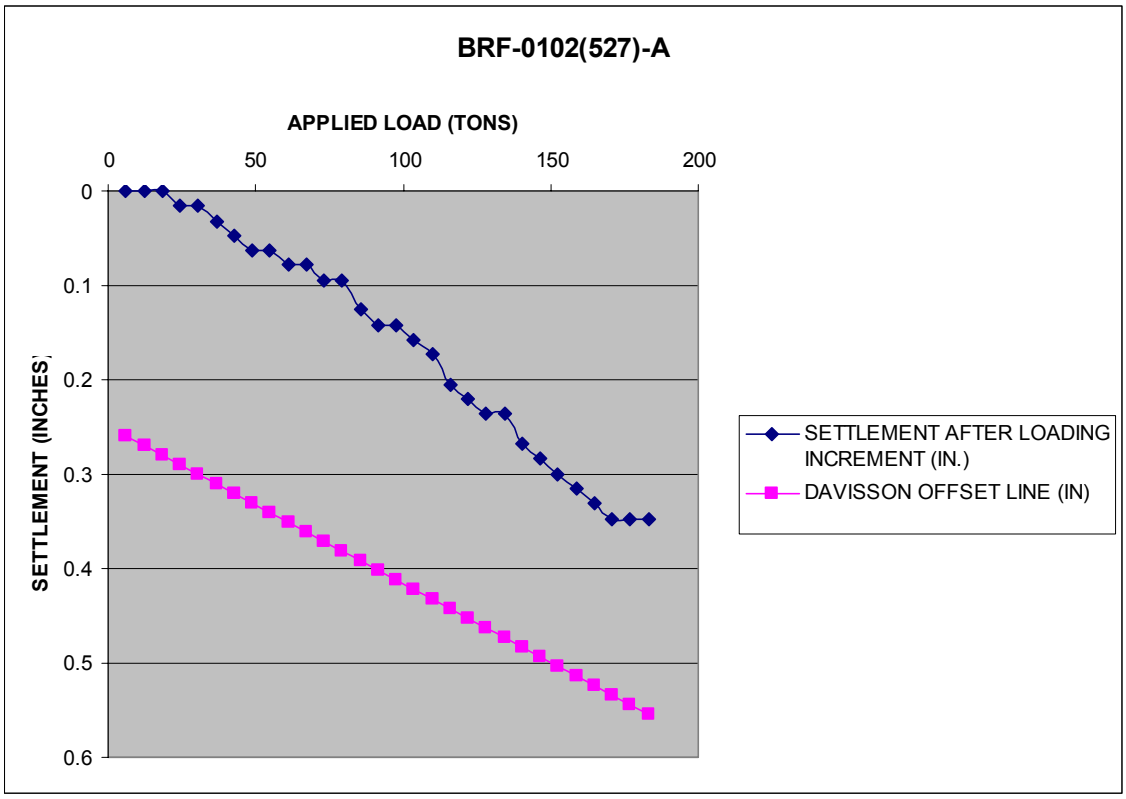
ULTIMATE RESISTANCE (tons):	265.4

STATIC LOAD TEST DATA

DATE TESTED:	11/10/2004
DAVISSON LOAD CAPACITY (TONS):	
MAX. APPLIED LOAD (TONS):	183
DID FAILURE OCCUR:	NO
ESTIMATED ULTIMATE CAPACITY (TONS):	

SOIL INFORMATION

BORING NUMBER:	N/A
BRIEF SOIL DESCRIPTION:	GRAY CLAY/SAND


BRF-0102(527)-A
APPLIED LOAD (TONS)
0
50
100
150
200
0
0.1
0.2
0.3
0.4
0.5
0.6
SETTLEMENT (INCHES)
SETTLEMENT AFTER LOADING INCREMENT (IN.)
DAVISSON OFFSET LINE (IN)

CAPWAP FINAL RESULTS

Total CAPWAP Capacity: 530.7; along Shaft 509.8; at Toe 20.9 kips

Soil Sgmnt No.	Dist. Below Gages ft	Depth Below Grade ft	Ru kips	Force in Pile kips	Sum of Ru kips	Unit Resist. (Depth) kips/ft	Unit Resist. (Area) ksf	Smith Damping Factor s/ft	Quake in
				530.7					
1	27.0	7.7	68.7	462.0	68.7	10.16	7.74	0.047	0.050
2	33.8	14.5	24.6	437.4	93.3	3.64	2.77	0.047	0.050
3	40.6	21.2	416.5	20.9	509.8	61.62	46.95	0.047	0.050
4	47.3	28.0	0.0	20.9	509.8	0.00	0.00	0.000	0.050
Avg. Skin			127.5			18.21	14.37	0.047	0.050
Toe			20.9				194.13	0.316	0.190

Soil Model Parameters/Extensions		Skin	Toe	
Case Damping Factor		0.870	0.239	Smith Type
Reloading Level	(% of Ru)	100	100	
Unloading Level	(% of Ru)	67		

PROJECT INFORMATION

NAME:	BRF-0102(527)
DIVISION:	6
LOCATION:	MONTGOMERY CO
BENT/LANE:	ABUT 4
PILE NO.:	20
DATE DRIVEN:	2/17/2005

HAMMER DETAILS

MAKE/MODEL:	APE
RATED ENERGY (KIP-FT):	4.18
WEIGHT (KIPS):	4.18
HAMMER ACTION:	SINGLE
AIR/DIESEL:	DIESEL
OPEN/CLOSED:	OPEN
HAMMER CUSHION:	FOSTERLON

PILE DETAILS

PILE TYPE/MATERIAL:	STEEL HP 10 x 42
PILE LENGTH (FT.):	60.3
WALL THICKNESS (IN.):	
SIZE/CS. AREA (IN^2):	12.4
DESIGN CAPACITY (tons):	57
SPLICE DETAILS:	N/A
PILE CUSHION:	N/A

PDA INFORMATION

EOD

PDA CAPACITY (tons):	111

RESTRIKE

DATE:	N/A
SETUP TIME (DAYS):	
PDA CAPACITY:	

ELEVATION DETAILS

TOTAL LENGTH (FT.):	60.3
EMBEDDED LENGTH (FT.):	55.9
GRADE ELEVATION:	188.2
TIP ELEVATION:	132.3
GW ELEVATION:	

CAPWAP RESULTS

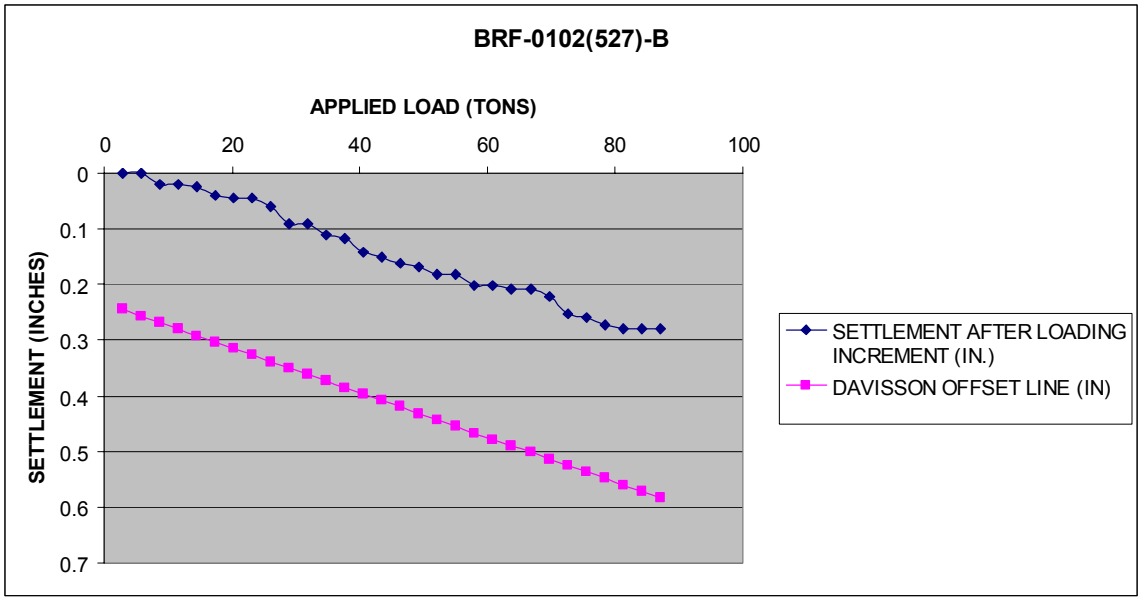
ULTIMATE RESISTANCE (tons):	N/A

STATIC LOAD TEST DATA

DATE TESTED:	2/20/2005
DAVISSON LOAD CAPACITY (TONS):	
MAX. APPLIED LOAD (TONS):	87
DID FAILURE OCCUR:	NO
ESTIMATED ULTIMATE CAPACITY (TONS):	

SOIL INFORMATION

BORING NUMBER:	
BRIEF SOIL DESCRIPTION:	RED-YELLOW CLAY


BRF-0102(527)-B
APPLIED LOAD (TONS)
0
20
40
60
80
100
SETTLEMENT (INCHES)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
SETTLEMENT AFTER LOADING INCREMENT (IN.)
DAVISSON OFFSET LINE (IN)

CAPWAP FINAL RESULTS

Total CAPWAP Capacity: 312.7; along Shaft 211.8; at Toe 101.0 kips

Soil Sgmnt No.	Dist. Below Gages ft	Depth Below Grade ft	Ru kips	Force in Pile kips	Sum of Ru kips	Unit Resist. (Depth) kips/ft	Unit Resist. (Area) ksf	Smith Damping Factor s/ft	Quake in
				312.7					
1	16.8	6.8	0.0	312.7	0.0	0.00	0.00	0.000	0.100
2	23.5	13.5	0.0	312.7	0.0	0.00	0.00	0.000	0.100
3	30.2	20.2	0.6	312.1	0.6	0.09	0.08	0.091	0.100
4	36.9	26.9	15.2	296.9	15.8	2.27	1.93	0.091	0.100
5	43.6	33.6	44.4	252.5	60.2	6.62	5.64	0.091	0.100
6	50.3	40.3	71.2	181.4	131.4	10.62	9.04	0.091	0.100
7	57.0	47.0	80.4	101.0	211.8	11.99	10.21	0.091	0.100
Avg. Skin			30.3			4.51	3.84	0.091	0.100
Toe			101.0				1172.66	0.052	0.470

Soil Model Parameters/Extensions		Skin	Toe	
Case Damping Factor		0.886	0.239	Smith Type
Reloading Level	(% of Ru)	100	100	
Unloading Level	(% of Ru)	48		
Soil Plug Weight	(kips)		0.04	