EVALUATION OF THE LATERAL RESPONSE OF MICROPILES VIA FULL SCALE LOAD TESTING

by

Michael Rotimi Babalola

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Approved by:

____
Dr. J. Brian Anderson

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Dr. Vincent O. Ogunro

____
Dr. Shen-En Chen

____
Dr. David T. Young

____
Dr. John A. Diemer

____
Dr. Howie Fang

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ABSTRACT

MICHAEL ROTIMI BABALOLA.
Evaluation of the lateral response of micropiles via full scale load testing.
(Under the direction of DR. J. BRIAN ANDERSON)

Micropiles are a relatively new deep foundation technology in the United States. As an alternative to driven piles or drilled shafts, micropiles can provide substantial support while minimizing cost, environmental impact, and harmful construction vibrations. In order to implement micropiles for new construction on bridges with unsupported lengths, a better understanding of the performance of micropile constituent materials and the structural performance of single micropiles and micropile groups is required.

This research addressed the behavior of micropiles under lateral loads. In this configuration, micropiles would be subjected to lateral loads. Thus, there was a need to evaluate the behavior of micropiles as bridge bent foundations with respect to joints between micropile sections and embedment or plunge in rock.

The objectives of this study were to demonstrate the lateral performance of micropiles in single and group configurations, determine the effect of casing plunge into rock on lateral resistance of micropiles, determine the effect of casing joints on the lateral resistance of micropile, determine the behavior of jointed micropile sections, and evaluate the durability of micropile casings and jointed sections.

These objectives were investigated using a three pronged approach of numerical modeling, full scale field lateral load tests, and laboratory testing. Sixteen sacrificial micropiles were installed in order to perform six lateral load tests. Rock plunge depths of

1, 2, 5 and 10 feet were investigated. Fourteen of the 16 piles comprised two or three sections. A cap was cast around four of the micropiles to create a bent that was load tested against a group of reaction piles. In addition, nine jointed micropile specimens were fabricated and tested in the laboratory under four- point flexure. Numerical models were developed to predict the behavior of the load tests. Subsequently, the results of the field and lab tests were used to calibrate the model for DOT use. A long term study of the impact of corrosion on micropile sections is submitted for future implementation.

The main findings of this study include:

a) The casing joint has a large impact on the lateral capacity of micropiles. In cases where the micropiles were sufficiently embedded in rock, rather than yielding there was an abrupt failure at the casing joint. This occurrence was observed in the load tests.

b) In this study, two feet of embedment for micropiles was sufficient to carry lateral loads greater than 30 kips. Embedment at 5 and 10 feet produced similar results to 2 feet. One foot of embedment does not appear to be sufficient based upon results of the field tests and numerical models.

c) Based on field and laboratory tests, the strength of the micropiles with respect to the joints in bending moment was approximately 115 kips*ft.

d) Micropiles of 10.75 in. diameter, 0.50 in. wall thickness carried significant lateral load with little deflection. However, the failure mode is brittle, as the piles tested failed abruptly with little lateral displacement.

e) Reduction of the section area at threaded joint by 60% to 70% results in a reasonably accurate model for the behavior of the casing joint using FB-MultiPier computer program.

DEDICATION

My Beloved Wife

My Son

My Daughter

And

In Loving Memory of My Beloved Mother Mrs. A. A. Babalola

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I am indebted to my beloved wife Eunice Babalola and my children Tijesuni Babalola and Toluwalase Babalola for their love, support and daily prayers without which this day will not come. To my father, far in Nigeria, thanks. To my mother who was transformed to glory, I am forever grateful for your love and an example you left for us, your children. Finally, thanks to God for His blessing.

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LIST OF ABBREVIATIONS

ACI	American Concrete Institute
ASTM	American Society for Testing and Materials
CLM	Characteristic Load Methods
C_u	Undrained shear strength of clay
d	Width or diameter of pile
E	Modulus of elasticity
E_p	Modulus of elasticity of pile
E_s	Modulus of soil reaction
ε_c	Compressive strain
ε_t	Tensile strain
FEM	Finite element method
GF	Gage factor
GFRP	Glass fiber reinforced polymer
I	Moment of inertia
IBRD	Innovative Bridge Research and Development
I_p	Moment of inertia of pile
k_h	Coefficient of lateral subgrade reaction
L	Length
LMT	Linear motion transducer
M	Bending moment
MSL	Mean sea level
NAVFAC	Naval Facilities Engineering Command

NCDOT	North Carolina Department of Transportation
OD	Outer diameter
P	Lateral soil resistance
RQD	Rock quality designation
S	Slope
UNCC	University of North Carolina at Charlotte
V	Shear force
y	Lateral deflection
z	Depth below ground surface
Z	Section modulus
κ	Curvature
Δ	Deflection
σ	Stress of beam section
Ψ	Cumulative deviations

CHAPTER 1: INTRODUCTION

Structures such as buildings and bridges are divided into two main components, namely substructure and superstructure. Superstructure is defined as all structure above the bearing elevation and substructure consists of everything below the superstructure. Therefore, substructure incorporates all foundation elements such as columns, wall piers, and foundations. Foundations are generally either shallow foundations or deep foundations, or a combination of the two, as shown in figure 1.1.

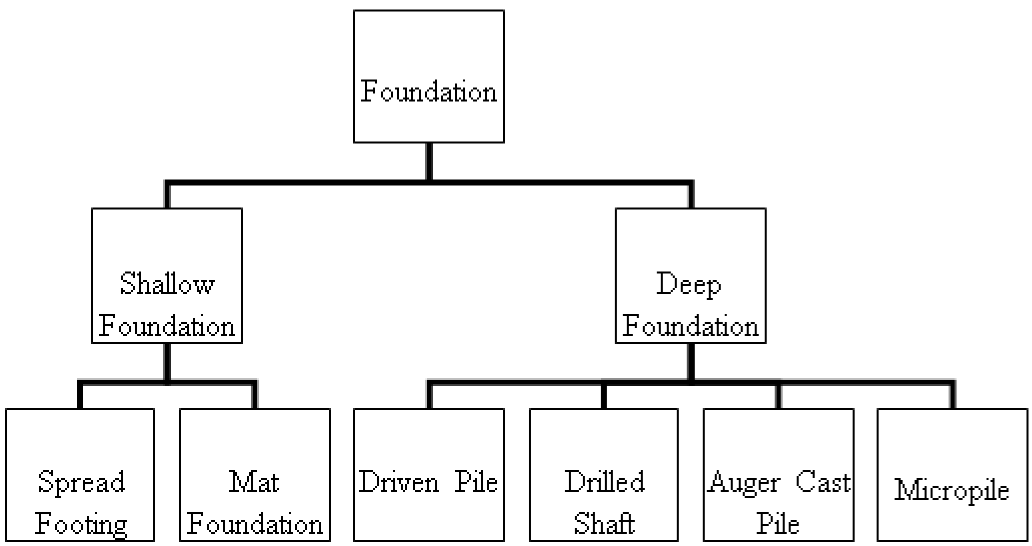


Figure 1.1: Foundation types and classifications (Sabatini et al. 2005)

Shallow foundations are located just below the lowest part of the superstructure they support while deep foundations extend considerably deep into the earth, with respect to their width (at a minimum of 5 to 1). In the case of shallow foundations, the means of support is usually a footing, which is often simply an enlargement of the base of the column, the wall that it supports, or a mat (raft) foundation, on which a number of columns are supported by single slab. Satisfactory performance of a shallow foundation is characterized by (1) safety against overall shear failure of the supporting soil and (2) resistance to excessive displacement, or settlement.

Often times, the soil upon which a structure is to be built has insufficient bearing capacity and/or will produce excessive settlement under design loads. One alternative is the use of a deep foundation. Deep foundations are relatively long and slender members that are driven vertically into soil in the case of a pile, or cast in place as a drilled shaft. A pile is often driven either until it rests on a hard, impenetrable layer of soil or rock, or to a specified depth. Drilled shafts are installed by excavating a vertical hole in the soil and/or rock, then backfilling the hole with reinforced concrete. End bearing foundations, where the load of the structure is primarily transmitted axially through the foundation to the impenetrable layer, are common in the western part of North Carolina. When the foundation cannot be extended to a hard stratum of soil or rock due to its depth, the load of the structure is borne primarily by side friction between the pile or shaft and soil. Such a deep foundation carries its load through skin friction which is common in the eastern part of North Carolina. Figure 1.2 shows how both piles and drilled shafts support loads through side friction and end bearing.

Single deep foundations that support signs or light-posts and pile groups that support bridge piers or offshore construction operations are constantly subjected to significant natural lateral loads (such as wind loads and wave action). Accordingly, deep foundations most be designed to carry these lateral loads. Lateral loading of a single deep foundation is a problem of soil-structure interaction, in which foundation deflection depends on the soil response and soil response depends on foundation deflection (Reese and Wang 1993). Therefore the lateral load capacity is determined by considering three failure mechanisms: (1) structural failure of pile due to yielding of the pile material 2) shear failure of the confining soil due to yielding of the soil, and (3) the pile becoming dysfunctional due to excessive lateral deflection.

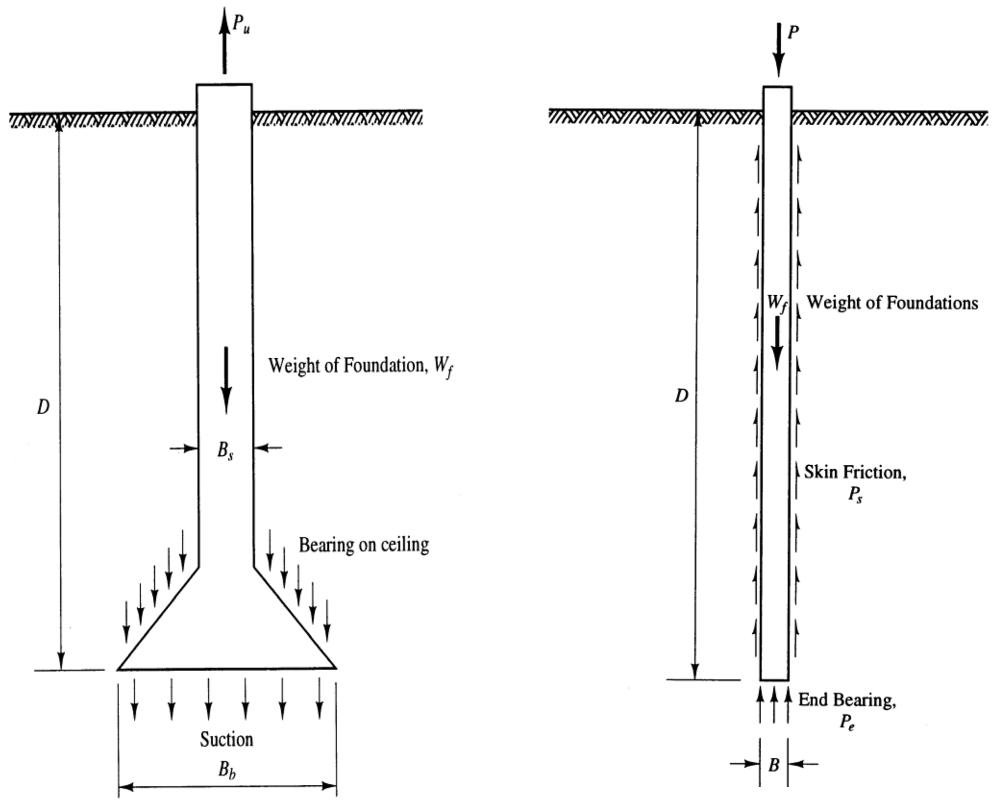


Figure 1.2: Deep foundation load carrying methods (end bearing and skin friction) (O'Neill and Reese 1999)

Micropiles are a relatively new deep foundation technology in the United States. As an alternative to other deep foundations, micropiles can provide substantial support while minimizing cost, environmental impact, and harmful construction vibrations. Micropiles, first used in Italy in the 1950s, are constructed by removing a column of soil using an auger and filling the hole to create a structural column, insitu. Micropile is a small-diameter (typically less than 12 in), drilled and grouted non-displacement pile that may be reinforced. Micropiles are installed in segments that are connected together by threaded joints in the casing. Since micropiles are smaller, the size and amount of equipment needed for their installation is commensurately less than for typical deep foundations. This research will focus primarily on the lateral capacity of micropiles.

1.1 Problem Statement

Building on the success of micropile in retrofit projects, NCDOT proposes using micropiles for bridge replacements and new construction. Although literature and experience exist on micropile applications, there were aspects of micropile behavior that needed to be evaluated to provide confidence for engineers. While axial behavior was well documented in the literature, there is the need to document the performance of micropiles and micropile groups under lateral loads. This aspect of micropile behavior is not well understood and needs attention.

The goal of this project was to evaluate and demonstrate lateral load behavior of micropiles sufficiently enough to allow their use for in interior bents where shallow rock is present. Traditionally, micropiles have not been used for this application because a design criteria has not been established for obtaining micropile fixity in rock, while also considering the effect of threaded joints on lateral deflection, and moment capacity.

1.2 Research Objectives

Micropiles are often installed using casing sections assembled with threaded joints. The question remains how these joints impact the lateral load response of micropiles. In addition, whether by design or specification, the depth micropile casing extends into rock may be overly conservative or overdesigned. Therefore, the following objectives were pursued:

1) Demonstrate the lateral performance of micropiles and a group.
2) Determine the effect of casing plunge into rock on lateral resistance of micropiles.

3) Determine the effect of casing joints on the lateral resistance of micropiles.
4) Determine the behavior of jointed micropile sections.
5) Evaluate the durability of micropile casings and jointed sections.

1.3 Scope of work

The following tasks were completed in order to meet the research objectives:

A. *Literature Review* – A comprehensive review examined material from published journals, geotechnical load test reports, conference proceedings, and test standards. Additional literature was gathered including documentation on field load and laboratory tests on micropile materials conducted by different agencies. Case histories of micropile lateral load tests were included as well.

B. *Preliminary Numerical Modeling* - In order to design the test micropiles and load test apparatus for this project, representative load configurations were simulated to predict the required capacity of load frames, load cells, displacement sensors and hydraulic jacks. The impact of the threaded joints was accounted for in the computer software FB-Multipier using multiple and segmented pile models. A sensitivity analysis was carried out to account for the effect of each parameter on the micropiles.

C. *Field Testing Program*-The goals of the field tests were to demonstrate and document micropile behavior under realistic boundary conditions and the true soil-structure interface. The field test program included lateral load tests on micropiles constructed specifically for this project. A sacrificial group of 16 micropiles was constructed using Innovative Bridge

Research and Development (IBRD) funds in conjunction with a bridge replacement in Western North Carolina. These piles were load tested as individual piles as well as a group.

D. *Single Pile Field Lateral Load Tests*- Lateral load tests were performed in accordance with ASTM D3966 and micropile specific guidelines from Sabatini et al. (2005). Tests were performed by pulling together pairs of micropiles using all thread bars and center-hole jacks. The displacements of the pile tops were monitored using potentiometers. Piles were instrumented with either inclinometer casings or rebar cages with sister bar vibrating wire strain gages to measure displacement and strain concurrent with load and displacement. The top load was determined using load cells.

E. *Pile Group Test*-Four piles were load tested together as a bent. The piles were spaced more than ten diameters center-to-center and cast together in a concrete cap. The displacement of the pile cap was monitored using potentiometers. Piles were instrumented with both inclinometer casings and rebar cages with vibrating wire strain gages to measure displacement and strain concurrent with load and displacement. The load was applied to the pile cap using prestressing cables and two center-hole jacks.

F. *Laboratory Micropile Testing*-Two segment micropiles were fabricated for laboratory testing. Skyline Steel Corporation, CEMEX, and Nicholson Construction donated materials and construction support for the research. A total of 54 linear feet of micropile was fabricated in the lab. Micropiles cast in the lab were grouted with standard Portland Type I cement, mixed with high shear mixer, and tested after curing for 28 days. Selected micropiles were instrumented with strain gages similar to those used in the field load tests. Potentiometers were used to monitor vertical displacement. Nine bending tests were conducted for this research.

G. *Corrosion Testing*-In addition to the structural tests, durability testing was commenced to determine the performance of the micropiles in typical environments. Due to the long term nature of the corrosion tests, this report documents only the strategy of the tests. The corrosion study will continue well beyond the duration of this research project. Marked and labeled micropile casings have been and will be placed in secure field locations that are accessible to NCDOT, UNCC, and Auburn University personnel for many years. Periodically, specimen mass and thickness will be measured.

H. *Results and Interpretation* – The collected data set includes the measured force, ground-line and 12 inches above ground-line deflections, deflected shape with depth and bending strain for micropiles from each load test conducted.

I. *Calibration of Models* – The results of scope items D, E, and F above were used to refine and calibrate FB-Multipier models used in the simulations for item B.

CHAPTER 2: BACKGROUND AND LITERATURE REVIEW

2.1 Background

Structures can be supported by a variety of foundations. The selection of the foundation system is generally based upon several factors such as loads to be imposed, site subsurface materials, special needs (high axial loads, high lateral capacity), environmental site conditions and cost. Piles and drilled shafts are structural members used to transfer loads to deep strata through skin friction and end bearing. Lateral loads on deep foundations are derived from earth pressures, braking forces, wind pressures, current forces from flowing water, centrifugal forces from moving vehicles, wave forces, earthquakes, and impact loads from barges or other vessels. Even if none of the above sources of lateral loading are present, an analysis may be necessary to investigate the lateral deflection and bending moment that would result from the eccentric application of axial loads. Figure 2.1 shows examples of lateral loads. Three criteria must be satisfied in the design of deep foundations subjected to lateral forces and moments: 1) the soil should not be stressed beyond its ultimate capacity, 2) deflections should be within acceptable limits, and 3) the structural integrity of the foundation system must be assured.

Lateral load tests of piles and drilled shafts are sometimes performed to establish the load-movement-rotation behavior of full-sized deep foundations by quantifying load transfer relationships. This is accomplished by measuring combinations of load, deflection and rotation at the pile head, bending moments (strain) along the pile length, and slope/displacement with depth using an inclinometer.

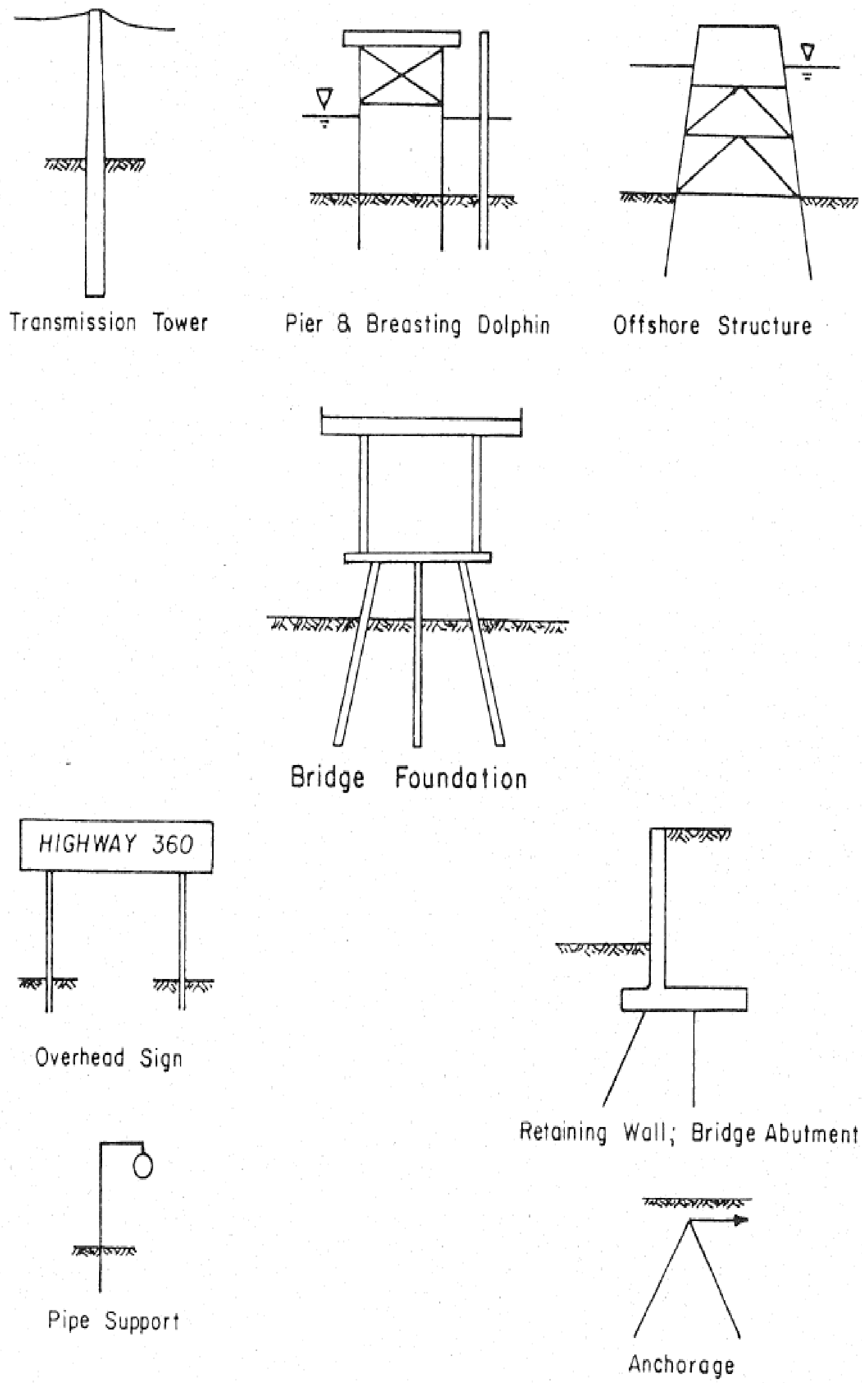


Figure 2.1: Examples of laterally loaded piles (Long and Carroll 2005)

2.2 Types of Deep Foundation

Deep foundations are divided into two major categories, according to their method of installation. The first category consists of driven foundations (H-piles, pipe piles, precast concrete and wood), which displace and disturb the soil, and the second category consists of drilled foundations (drilled pier, augered cast piles and micropiles), that are installed without soil displacement.

2.2.1 Driven Foundations

Piles are long and slender members which transfer the load to deeper soil or rock of high bearing capacity avoiding shallow soil of low bearing capacity. The main types of materials used for piles are wood, steel and concrete. There are two basic types of pile foundations, namely displacement and non-displacement piles. Displacement piles are driven or vibrated into the ground thereby displacing the soil laterally during installation.

Prestressed square concrete piles, and closed ended pipe piles are displacement piles used as friction piles, end bearing piles or combination of the two. H-Piles and open ended pipe piles are non-displacement piles. Although these non-displacement piles actually do displace some material, the volume or amount displaced is substantially less than that of displacement piles. Non-displacement piles are often used where a large number of piles are needed in a small area such as end bent of a bridge.

2.2.2 Drilled Foundations

Drilled shafts are cylindrical, cast-in-place deep foundations that are constructed by placing fluid concrete in a drilled hole. Drilled shafts are constructed in diameters ranging from 18 inches to 12 feet or more to provide deep foundations for buildings, bridges, highway signage and retaining walls. They are typically used for bridges and large structures, where large loads and lateral resistance are major factors. Drilled shafts as deep foundations, distribute loads to deeper and more competent soils and/or rock by means of skin friction, end bearing or a combination of both.

Auger cast piles are a drilled foundation in which the pile is drilled and cast in one continuous process. As the auger is drilling into the ground, the flights of the auger are filled with soil, providing lateral support and maintaining the stability of the hole. When the auger is withdrawn from the hole, concrete or sand/cement grout is placed by pumping the concrete/grout mix through the hollow center of the auger pipe to the base of the auger. Simultaneous pumping of the grout or concrete and withdrawal of the auger provides continuous support of the hole. Reinforcing bars or small cages are placed into the hole filled with fluid concrete/grout immediately after withdrawal of the auger.

2.2.3 Micropiles

Micropiles are thick steel casings that are often drilled and grouted into place. Micropiles are a relatively new deep foundation technology in the United States. Micropiles, first used in Italy in the 1950s, are similar to drilled shafts in that an auger is used to remove a column of soil that will be backfilled to create a structural column. In contrast, micropiles are smaller diameter members (usually 12 inches (300 mm) or less) filled with grout (not concrete) and reinforced with an external casing, a single large diameter rebar, or a combination of the two. Since micropiles are smaller, the size and amount of equipment needed for their installation is commensurately less than for typical drilled shafts. Following recent developments in the United States, micropiles have evolved into high-capacity load bearing elements. Presently, some micropiles are designed for ultimate load carrying capacities exceeding 500 tons (Armour et al. 2000).

Figure 2.2 shows a typical high capacity micropile and Figure 2.3 shows a typical micropile pipe showing the threaded joint. Micropiles are currently used in two general application areas: (1) structural support and (2) in-situ reinforcement.

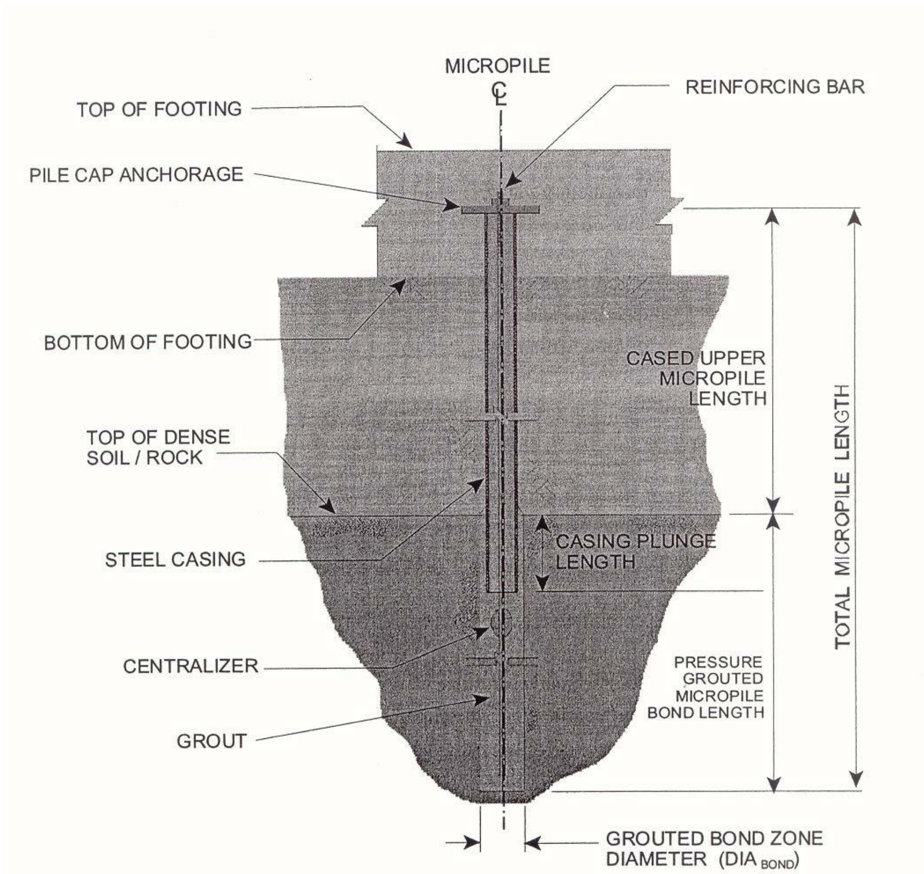


Figure 2.2: Detail of a typical high capacity micropile. (Bruce and Cadden 2005)

Micropiles have specific advantages compared to more conventional support systems. In general, micropiles may be feasible under the following project-specific constraints (Sabatini et al. 2005):

- Project has restricted access or is located in remote area;
- High load capacity in both tension and compression;
- Ability to install where elevated groundwater or caving soil conditions (karst and non-karst forming) are present;

- Tested to verify load carrying capacities;
- Required support system needs to be in closed pile proximity to existing structures;
- Ground and drilling conditions are difficult;
- Pile driving would result in soil liquefaction;
- Vibration or noise needs to be minimized;
- Hazardous or contaminated spoil material will be generated during construction and
- Adaptation of support system to existing structures is required.

Figure 2.3: A Typical micropile threaded joint

The modern micropile installation process begins with drilling through soil into the bedrock or hard bearing stratum using a specialized drill rig. The micropile drill is removed, leaving micropiles in the rock socket, and reinforcement bars are lowered into the micropile steel casings. Grout is pumped or pressure-fed into the casings, the piles are lifted to the mouth of the sockets to allow bonding to piles. Finally, the micropile tops are cut to elevation and capped for foundation rebar. Micropiles may be load tested subsequently to prove the design. Micropiles can be installed in areas of particularly difficult, variable, or unpredictable geologic conditions such as ground with cobbles and boulders, fills with buried utilities and miscellaneous debris, and irregular lenses of competent and weak materials. Soft clays, running sands and high groundwater not conducive to conventional drilled shaft systems cause minimal impacts to micropile installation. It is important to assess the cost of using micropiles based on the physical, environmental and subsurface factors. For example, micropiles are commonly the preferred foundation choice in the challenging urban areas that feature mixed fills, nearby buildings and difficult access. Figure 2.4 shows a typical a micropile under construction.

Figure 2.4: Typical micropile construction

Micropile classifications are based primarily on the method of placement and pressure under which grouting is performed during micropile construction. The classifications are described below and shown schematically in Figure 2.5.

- Type A: Grout flows under gravity. These are non-pressurized and use sand-cement "mortars" or neat cement grouts.
- Type B: Grout is injected as temporary drill casing or auger is withdrawn. Pressurized once at low pressure (44-145 psi).

- Type C: Grout is gravity placed, allowed to set for 15-25 min, and then a second batch of grout is injected at moderate pressure through a sleeved grout pipe.
- Type D: Grout is gravity placed and allowed to harden. When primary grout has hardened, more grout is injected through a sleeved port grout pipe. A movable packer is used so that specific horizon may be treated several times if necessary. High pressure is used (290 -1160psi) (Sabatini et al. 2005).

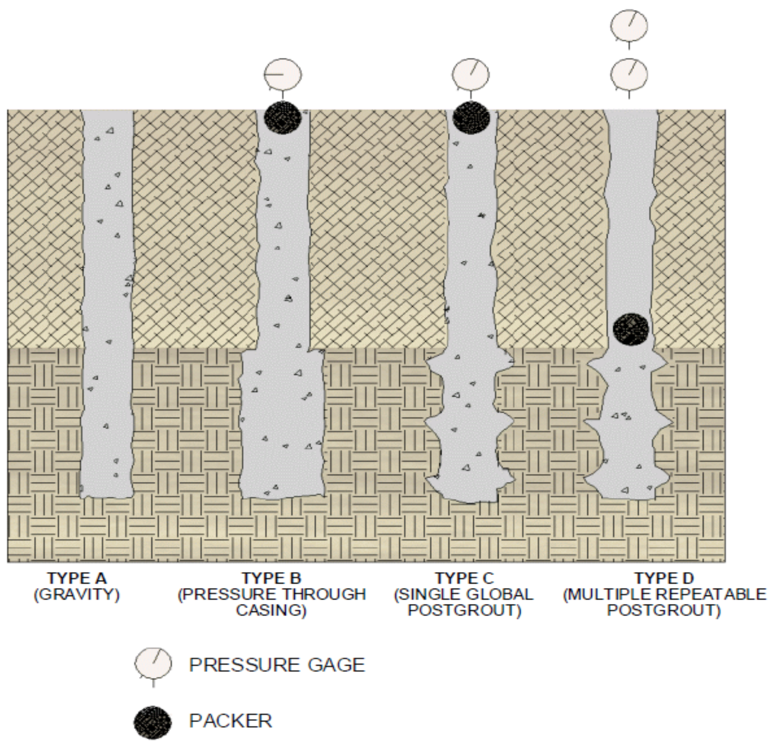


Figure 2.5 Micropile classification system based on grouting (Sabatini et al 2005)

"The construction of a micropile involves a succession of processes, the most significant of which are drilling, placing the reinforcement if needed and grouting. The drilling method is selected with the objective of causing minimal disturbance or upheaval to the ground and structure while being the most efficient, economic and reliable means of penetration. Seven methods of drilling which are common for pile with diameters less than 12 in. and can drilled to a depth of 200 ft. are briefly discussed below.

1. Single-Tube Advancement: Toe of the drill casing is fitted with an open crown or bit and the casing is advanced into the ground by rotation of the drill

head. Water flush is pumped continuously through the casing, which washes debris out and away from the crown.

2. Rotary Duplex: Simultaneous rotation and advancement of the combined drill and casing string. The flushing fluid pumped through the central drill rod to exit from the flushing ports of the drill bit.
3. Rotary Percussive Duplex (Concentric): This is the same as rotary duplex, except casing and rods percussed as well as rotated.
4. Rotary Percussive Duplex (Eccentric): This is the same as rotary duplex, except eccentric bit on rod cuts oversized hole to ease casing advance.
5. Double Head Duplex: This is the same as rotary duplex and rotary percussive concentric duplex, except casing and rod may rotate in opposite directions.
6. Hollow-Stem Auger: These are continuous flight auger systems with a central hollow core similar to those used in auger-cast piling. The pile is installed by purely rotary heads. After the hole has been drilled to the required depth, the cap is knocked off or blown off by grout pressure.
7. Sonic: Sonic drilling is a dual cased drilling system that employs high frequency mechanical vibration to take continuous core samples of overburden and most bedrock formations, and to advance casing into the ground" (Sabatini et al 2005).

2.3 Theoretical Behavior of Deep Foundations under Lateral Loads

The design of piles against lateral loads is usually governed by the maximum tolerable deflection (Poulos and Davis 1980). Lateral deflections of single piles depend on the lateral load, flexural rigidity (EI) of the pile, and the soil resistance to lateral movement which is characterized by soil strength and stiffness. In other words, the lateral loading of a single deep foundation is a soil-structure interaction problem - the deflection of the pile depends on the reaction in the soil and the reaction in the soil depends on the deflection of the pile (Reese and Wang 1993). Design typically depends on the deflection and bending moment in a deep foundation. The bending moment dictates the section of the foundation, and the deflection is used in the evaluation of serviceability of the supported structure. Figure 2.6 shows the relationship among lateral deflection, slope, moment and shear in a deep foundation, and the lateral soil reaction, all as a function of depth that result from applied shear and/or moment.

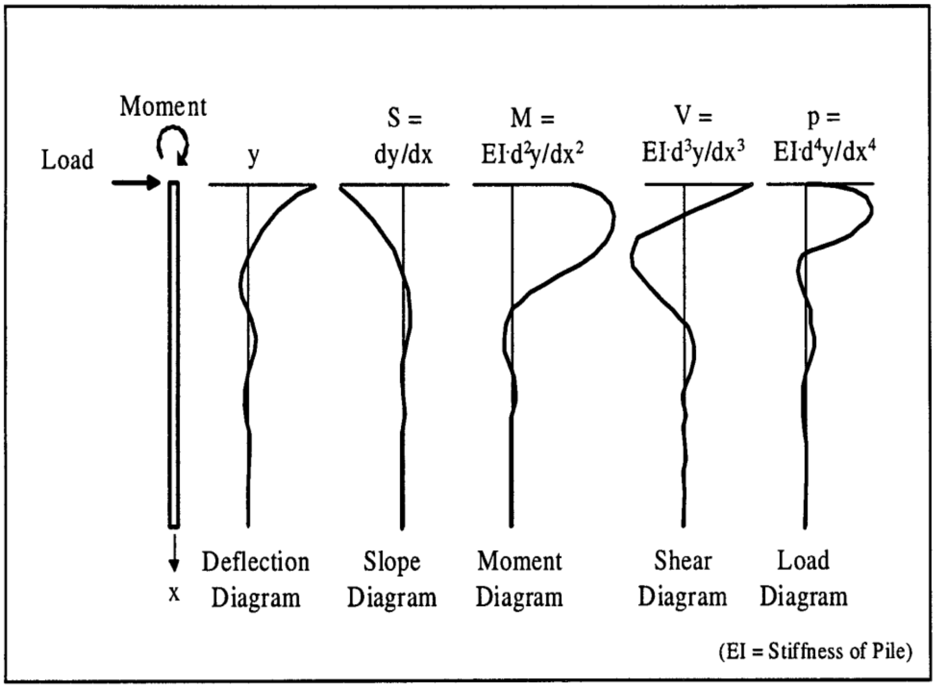


Figure 2.6: Deflections and forces in a long foundation subjected to lateral loads (Matlock and Reese, 1960)

Changes in each of these parameters with depth can be defined by the principles of structural mechanics:

$$S = \frac{dy}{dz} \tag{2.1}$$

$$M = EI\frac{dS}{dz} = EI\frac{d^2y}{dz^2} \tag{2.2}$$

$$V = \frac{dM}{dz} = EI\frac{d^3y}{dz^3} \tag{2.3}$$

$$p = \frac{dV}{dz} = EI\frac{d^4y}{dz^4} \tag{2.4}$$

Where:

S = slope of foundation

M = bending moment in foundation

V = shear force in foundation

p = lateral soil resistance per unit length of the foundation

E = modulus of elasticity of foundation

I = moment of inertia of foundation in the direction of bending

y = lateral deflection

z = depth below ground surface.

2.4 Lateral Load Testing

In determining the lateral load capacity of deep foundations, the most accurate method is static lateral load testing (ASTM D3966-07). Load tests could be at field-scale or lab-scale. The primary purpose of lateral load testing is to verify the lateral load transfer relationship used in the design or to verify load deflection behavior of the foundation. Three possible lateral load test setups are shown in Figure 2.7.

A common method of testing a deep foundation under lateral load is to use another similar deep foundation as the reaction. Most often, lateral loads are applied by a hydraulic jack acting against a reaction system or by a hydraulic jack acting between two deep foundations. The primary means of measuring the load applied to the deep foundation should be a calibrated load cell along with the jack load determined from jack pressure measurements. Lateral displacement of the head is measured using dial gages, scales, potentiometers, or linear variable differential transformers (LVDTs) that measure movement between the foundation head and an independently supported reference beam. Lateral deflection measurements versus depth can be accomplished by installing an inclinometer casing on or in the test foundation and recording inclinometer readings after application or removal of a load increment.

2.5 Corrosion Behavior of Steel and Prediction

Steel piles have been used underground for many years to transmit loads to deeper soil layers or to resist lateral pressures. Pipe and H-piles are used as load-bearing foundations. Considerable concern exists that steel foundation members may corrode in specific soil environments. The corrosion of underground structures is a very widespread problem. Corrosion of the steel on both sub and super structures will result in the reduction of both the axial and the lateral capacity of the structure.

A general definition of corrosion is the degradation of a material through environmental interaction (Beavers and Durr 1998). The fundamental cause of the deterioration of steel piling underground is soil corrosion. The corrosion rate of steel piles in soil is influenced by a number of corrosion related parameters. These include soil minimum resistivity, pH, chloride content, sulfate content, sulfide ion content, soil moisture, and oxygen content within the soil. Measurement of these parameters can give an indication of the corrosivity of a soil.

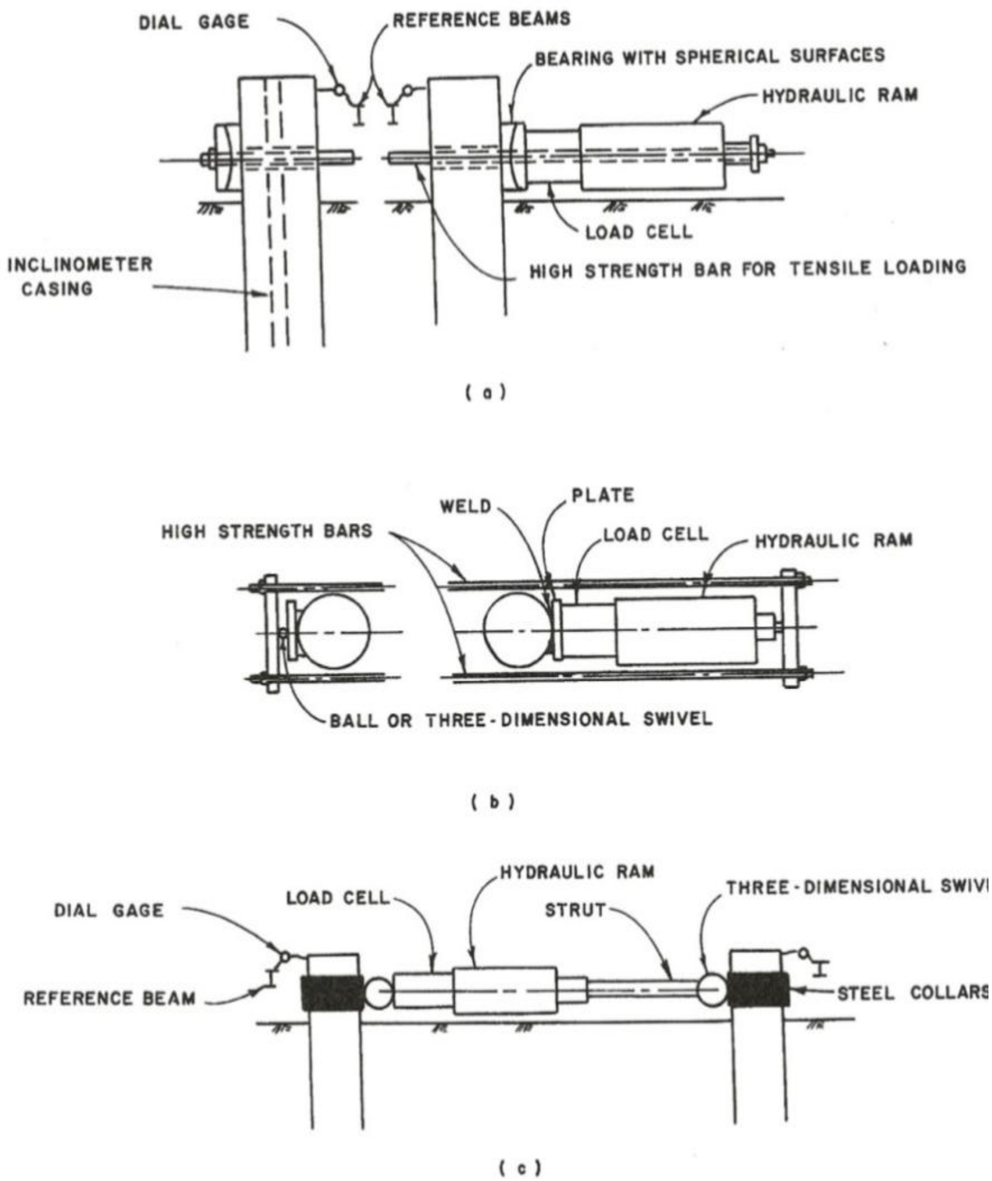


Figure 2.7: Lateral load testing arrangement (ASTM D3966-07)

Corrosion of metals is an electrochemical process involving oxidation (anodic) and reduction (cathodic) reactions on metal surfaces. For metals in soil or water, corrosion is typically a result of contact with soluble salts found in the soil or water. This process requires moisture to form solutions of the soluble salts. Factors that influence the rate and amount of corrosion include the amount of moisture, the conductivity of the solution (soil and/or water), the hydrogen activity of the solution (pH), and the oxygen concentration (aeration). Other factors such as soil organic content, soil porosity, and texture indirectly affect corrosion of metals in soil by affecting the other factors listed above.

Measurement of these parameters can give an indication of the corrosivity of a soil. Unfortunately, because of the number of factors involved and the complex nature of their interaction, actual corrosion rates of driven steel piles cannot be determined by measuring these parameters. Instead, an estimate of the potential for corrosion can be made by comparing site conditions and soil corrosion parameters at a proposed site with historical information at similar sites. In general, the corrosion behavior of structural steel in soil can be divided into two categories, corrosion in disturbed soil and corrosion in undisturbed soil.

When steel piles are used in corrosive soil or corrosive water, special corrosion protection considerations for the steel may be needed. The extent of corrosion protection for steel piles will depend on the subsurface geology, the location of the groundwater table, and the depth to which the soil has been disturbed. Corrosion protection mitigation may include the need for sacrificial metal (corrosion allowance) or the use of protective coatings and/or cathodic protection.

There are four basic methods for Corrosion Control & Corrosion Protection Romanoff, M. (1962).

1. Material Resistant to Corrosion: There are no materials that are immune to corrosion in all environments. Materials must be matched to the environment that they will encounter in service.

2. Protective Coating: Protective coatings are the most widely used corrosion control technique. Essentially, protective coatings are a means for separating the surfaces that are susceptible to corrosion from the factors in the environment which cause corrosion to occur.
3. Cathodic Protection: Cathodic protection can be effectively applied to control corrosion of surfaces that are immersed in water or exposed to soil.
4. Corrosion Inhibitors: Modifying the operating environment. Using a selective backfill around a buried structure.

2.6 Models

There are several approaches available for modeling the interaction of deep foundations subjected to external loading. Specifically, when considering lateral loads, there are four categories, semi empirical, beam on and elastic foundation, elastic theory, and finite element.

2.6.1 Broms Semi Empirical Method

Broms (1964a, 1964b and 1965) separated the lateral analysis of loaded piles embedded in cohesive soils and in cohesionless soils. This method was presented in three papers published in 1964 and 1965. The ultimate lateral load on a pile can be computed by use of simple equations or graphs. The method is based upon the following concepts:

1. Failure occurs in short piles by unlimited rotation of the pile or unlimited movement through the soil, and
2. Failure occurs in long piles or piles of intermediate length by the development of one or more plastic hinges in the pile section.

In the three papers, Broms shows the procedures for the prediction of laterally loaded piles under working loads and the ultimate lateral resistance. Broms method is easily implemented by hand solution, but its limitations make the use of a more sophisticated solution more attractive.

2.6.2 Beam on an Elastic Foundation Method

This approach, also called the Winkler approach (Hsiung and Chen 1997), is the oldest method of predicting pile deflections and bending moments in deep foundations. The approach characterizes the soil as a series of unconnected linearly-elastic springs with stiffness E_s, expressed in unit of force per length squared (FL^{-2}) .The pressure p and the deflection y at a point are related through a stiffness E_s, the modulus of soil reaction defined as:

$$E_s = \frac{-p}{y} \tag{2.5}$$

Where:

p is the lateral soil reaction per unit length of the pile, and

y is the lateral deflection of the pile (Matlock and Reese, 1960).

The negative sign in the equation above shows the direction of soil reaction is opposite to the pile deflection. Another term is the modulus or coefficient of horizontal subgrade reaction, k_h which has the units of force/length^3 (Terzaghi 1955). The previous equation can be rewritten as:

$$E_s = k_h d \tag{2.6}$$

Where:

d is the width or diameter of the pile and

k_h is the horizontal subgrade reaction modulus.

In cohesionless soils and normally consolidated clays, the modulus of horizontal subgrade reaction increases linearly with depth. For over consolidated clays, 0.3the horizontal subgrade reaction is usually assumed to remain constant with increasing depth. The determination of the soil modulus E_s is generally carried out by full scale lateral-load testing, plate load testing, or empirical correlation with other soil properties.

The Winkler beam/spring model is based on the assumption that the soil supporting the beam acts as a system of discrete springs as shown in Figure 2.8. The beam is a function of springs and the applied load. The collective constant is referred to as the subgrade reaction modulus. The governing equation for the deflection of a laterally loaded pile using the subgrade reaction theory is expressed as:

$$E_p I_p \frac{d^4 y}{dx^4} + k_h dy = 0 \tag{2.7}$$

Where:

E_p is the modulus of elasticity of the pile,

I_p is the moment of inertia of the pile section,

y is pile deflection;

x is the depth in the soil,

d is width or diameter of pile and

k_h is the subgrade reaction modulus.

McClelland and Focht (1958, as referenced in Coduto, 1994) used the same beam/spring model in the design of laterally loaded deep foundation as shown in Figure 3.1. The method is also known as the p-y method. The primary shortcomings to the original subgrade reaction approach are:

1. The axial load effect on the foundation is ignored,

2. The soil model used in the technique is discontinuous,
3. The modulus of subgrade reaction is not intrinsic property of the soil, but depends on pile characteristics and the magnitude of deflection, and
4. The subgrade reaction method is a semi-empirical approach.

For real soils, the relationship between soil pressure p and deflection y is nonlinear, with the soil pressure reaching a limiting value when the deflection is sufficiently large. Several approaches have been developed to account for this nonlinearity. Reese and Matlock (1956) argue that the adoption of a linearly increasing modulus of subgrade reaction with depth takes some account of soil yield and nonlinearity, as values of the secant modulus near the top of the pile are likely to be very small, but will increase with depth because of both a higher soil strength and lower levels of deflection.

2.6.3 p-y Method

Broms analysis dealt with the pile lateral behavior under two extreme loading conditions: service loads (i.e. up to one third to one half of the ultimate load), and the ultimate loads (i.e. ultimate lateral capacity). A method is needed to account for the different observed pile behavior under lateral loads and enable the prediction of its deflection at the nonlinear load-deflection zone. To address this issue, nonlinear elasticity methods were developed in which applications of elastic solutions for equivalent soil properties were used in an iterative procedure, ending when displacement compatibility between soil and piles is achieved. The method is referred to as the “p-y curves”, where p is the soil pressure per unit length of pile and y is the pile deflection.

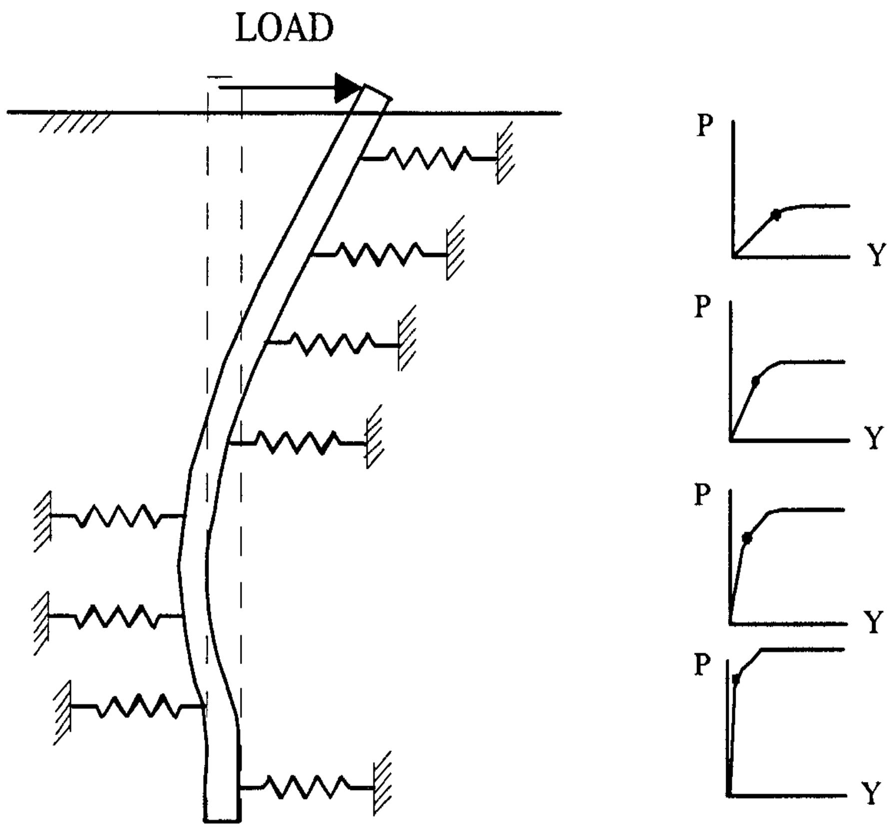


Figure 2.8: Beam/Spring model applied to deep foundations

The p-y curve method is the most versatile tool currently available. This method was developed by Reese and Matlock at the University of Texas at Austin. The p-y curve represents the soil resistance at a particular depth and is defined in terms of soil resistance per unit length versus deflection. The p-y method uses a series of nonlinear springs to model the soil-structure interaction. It models the foundation using a two-dimensional finite difference analysis. The soil resistance will typically rise quickly under small deformations to a maximum where it remains constant or decreases with further deformation. The physical definition of the soil resistance p is given in Figure 2.9. Figure 2.9a shows a profile of a pile that has been installed. The assumption is that the pile has been installed without bending so that the initial soil stresses at the depth X_i are uniformly distributed as shown in Figure 2.9b. If the pile is loaded laterally so that a pile deflection, Y_i occurs at the depth, X_i the soil stresses will become unbalanced as shown in Figure 3.3c. The three factors that have the most influence on the p-y curves are the soil properties, the pile diameter and the nature of loading (Reese and Wang, 2006). The p-y curves are strongly responsive to the nature of loading.

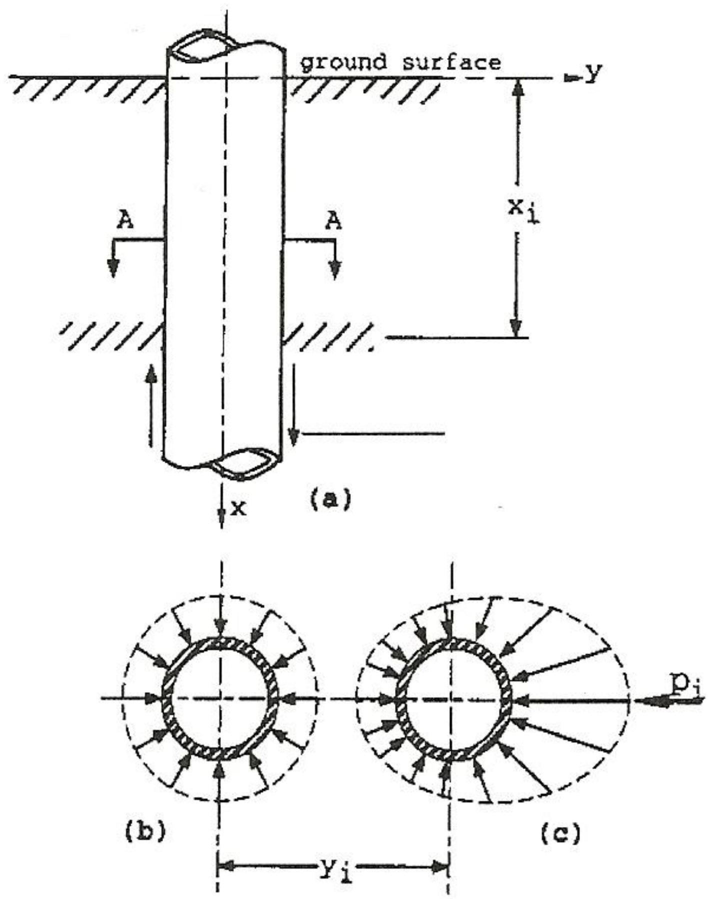


Figure 2.9: Definition of p and y as related to the response of a pile to lateral loading (Reese and Wang 2006)

2.6.4 Theory of Elasticity

Poulos (1971a) presented the first systematic approach for analyzing the behavior of laterally loaded piles and pile groups using the theory of elasticity. Soil is represented as an elastic continuum, the method is applicable for analyzing batter piles, pile groups of any shape and dimension, layered systems and systems in which the soil modulus varies with depth. The Poulos (1971a) method assumed soil to be an ideal, homogeneous, isotropic, semi-infinite elastic material, having a Young's modulus E_s and Poisson's ratio υ_s, which are not affected by the presence of the pile. Poulos assumed the pile to be a thin rectangular vertical strip of width d, length L, and also constant flexural rigidity E_pI_p. In the case of a circular pile, the width d, is taken as the diameter of the circular pile. The pile is divided into n+1 elements and each element is acted upon by a uniform horizontal stress p which is assumed constant across the width or diameter of the pile. Poulos found that the accuracy of the solution depends on the number of elements into which the pile is divided. The horizontal displacements of the soil and the pile are equal along the pile if elastic conditions prevail. The soil displacements for all the points along the pile are expressed as:

$$\{y\} = \frac{d}{E_s}[I]\{p\} \tag{2.8}$$

Where {y}is the column vector of horizontal soil displacements, {p} is the column vector of horizontal loading between soil and pile and [I] is the n+1 by n+1 matrix of soil-displacement-influence factors determined by integrating Mindlin's equation using boundary element analysis (Poulos and Davis 1980).

Poulos (1971a) considered both unrestrained and restrained pile head cases. The major variables influencing pile behavior are the length-to-diameter ratio and the pile-flexibility factor K_R which is defined as:

$$K_R = \frac{E_pI_p}{E_sL^4} \tag{2.9}$$

where K_R is a dimensionless measure of the flexibility of the pile relative to the soil with a limiting value of ∞ for an infinitely rigid pile and zero for an infinitely long pile, "E_p" is the Young's Modulus of pile, "I_p" is the moment of inertia of pile section, "E_s" is the Young's Modulus of soil and "L" is the embedded pile length. For unrestrained pile, the horizontal displacement is evaluated as:

$$y_o = I_h \frac{P}{E_s L} + I_m \frac{M}{E_s L^2} \tag{2.10}$$

where I_h is the displacement influence factor for horizontal load only acting, at the ground surface, I_m is the displacement influence factor for moment only, acting at the ground surface, P is the applied horizontal load, M is applied moment, E_s is the Young Modulus of the soil and L is the embedded pile length. In the case of a restrained pile, the horizontal displacement is evaluated as:

$$y_o = I_f \frac{P}{E_s L} \tag{2.11}$$

where I_f is the displacement influence factor for a restrained pile subjected to horizontal load. The assumption that the soil modulus E_s remains constant with depth is not realistic in the case of piles in sand. The variations in deflection and bending moment along the piles were not considered. The piles must be of constant cross-section, and the pile-head restraints must be either fully-fixed (no rotation) or fully free (no bending moment). The soil must be assumed to be elastic, and have constant and uniform properties with depth.

2.6.5 Finite Element Method

The Finite Element Method (FEM) was first developed in 1943 by R. Courant, who utilized the Ritz method of numerical analysis and minimization of variational calculus to obtain approximate solutions to vibration systems (Grandin 1991). The finite element method is widely used in structural analysis. The method is also used in a wide range of physical problems including heat transfer, seepage, flow of fluids, and electrical and magnetic potential (Zienkiewicz 1977). The finite element method is a numerical technique for finding approximate solutions of partial differential equations as well as of integral equations. FEM uses a complex system of points called nodes which make a grid called a mesh. In order to perform the finite element calculations, the geometry has to be divided into elements. Nodes are assigned at a certain density throughout the material depending on the anticipated stress levels of a particular area.

In essence, the analysis of a structure by finite element method is an application of the displacement method. In frames, trusses, and grids, the elements are bars connected at the nodes; these elements are considered to be one-dimensional. Two-dimensional or three-dimensional finite elements are used in the analysis of walls, slabs, shells, and mass structures. The finite elements can have many shapes with nodes at the corners or on the sides (Bathe 1982). The application of the displacement method can be found in any structural analysis text book such as Ghali and Neville (1997).

The finite difference method (FDM) was first developed by A. Thom in 1920s under the title “the method of square” to solve nonlinear hydrodynamic equations (Morton and Mayers 2005). The finite difference techniques are based upon the approximations that permit replacing differential equations by finite difference equations. These finite difference approximations are algebraic in form, and the solutions are related to grid points. Finite difference solution basically involves three steps:

1. Dividing the solution into a grid of nodes.
2. Approximating the given differential equation by finite difference equivalence that relates the solutions to grid points.

3. Solving the difference equations subject to the prescribed boundary conditions and/or initial conditions.

The finite element method can be used to model pile-soil-pile interaction by considering the soil as a three-dimensional continuum. These methods include the establishment of detailed three dimensional finite element models which incorporate nonlinear properties of piles and the soil within which they are embedded. Such models may also include the so called boundary element method which can perhaps better represent the soil-pile interaction characteristics. The finite element method by nature includes the ability to apply any combination of axial, torsion and lateral loads; the capability of considering the nonlinear behavior of structure and soil; and the potential to model pile-soil-pile-structure interaction.

Pressley and Poulos (1986) analyzed a group of piles using finite element method with elastic-perfectly plastic soil model. Muqtadir and Desai (1986) also studied the behavior of a pile group with nonlinear elastic soil model. Brown and Shie (1990) and Trochanis el al. (1991) also studied the behavior of a single pile group of piles with elastic plastic soil using a 3D finite element analysis. And Zhang and Small (2000) analyzed capped pile groups subjected to both horizontal and vertical loads. From the above tests and studies carried out, it’s demonstrated that finite element method can capture the essential aspects of behavior of a pile. ABAQUS Inc. (1978), ADINA R&D Inc. (1986), ANSYS (1970), and LS-DYNA (1987) are commercially available finite element programs. The most widely used finite difference code for geotechnical analysis is FLAC (Itasca 2011).

2.6.6 Characteristic Load Method

Duncan et al. (1994) presented the characteristic-load method (CLM), following the earlier work of Evans and Duncan (1982). A series of solutions were made with nonlinear p-y curves for a range of soils and for a range of pile-head conditions. The results were analyzed with the view of obtaining simple equations that could be used for rapid prediction of the response of piles under lateral loading. Dimensionless variables were employed in the prediction equations. The characteristic load method (CLM) can be used to determine the following:

1. Ground-line deflections due to lateral load for free-head conditions (fixed-head and flag-pole conditions)
2. Ground-line deflections due to moments applied at the ground line
3. Maximum moments for the conditions 1, 2 and 3 and
4. The location of the point of maximum moments along the pile.

The soil may be either clay or sand, both limited to uniform strength with depth. The prediction equations have the general form for clay and the equation is:

$$P_c = 7.34b^2 \, (E_pR_i) \left\{ \frac{c_u}{E_pR_i} \right\}^{0.68} \tag{2.12}$$

Where

P_c = characteristic load

b = diameter of pile

E_p = modulus of elasticity of material of pile

R_i = ratio of moment of inertia of the pile to that of a solid pile of the same diameter and

C_u = undrained shear strength of clay.

2.6.7 Naval Facilities Engineering Command (NAVFAC) Method

The method is from NAVFAC (1986) and based on Reese and Matlock (1956). The method uses the linear elastic coefficient of subgrade reaction and assumes that the lateral load does not exceed 1/3 of the ultimate lateral load capacity. The NAVFAC method states that the coefficient of subgrade reaction increases linearly with depth in granular soil and normally to slightly overconsolidated cohesive soils. In the case of overconsolidated hard cohesive soil, the coefficient of lateral subgrade reaction varies between 35 to 70 times the undrained shear strength. The equation for computing the coefficient of lateral subgrade reaction is:

$$K_h = \frac{f * z}{D} \tag{2.13}$$

Where

K_h = coefficient of lateral subgrade reaction

f = coefficient of variation of lateral subgrade reaction

z = depth, and

D = width or diameter of loaded area.

2.7 Selected Computer Program Implementations

The p-y approach has been implemented in two separate computer programs that are commonly used by highway departments throughout the United States. Both packages are supported by the Federal Highway Administration.

2.7.1 LPILE/ (COM624P)

Com624P was developed by Shih-tower Wang and Lymon C Reese (1993) at University of Texas for the Federal Highway Administration. Over the years, Com624P has been updated into the 32 bit program LPILE (Reese et al. 2004).The computer program models a single foundation under lateral loading. LPILE divides the member into a maximum of 300 segments and solves the differential equation suggested previously by finite differences method. The soil is modeled by a maximum of nine layers using one or more p-y curves: Sand Reese, Sand API, Liquefiable Sand, Silt, Soft Clay below the Water Table, Stiff Clay below the Water Table with free water, Stiff Clay above the Water Table without free water, Strong Rock, or Weak Rock.

Originally, COM624P modeled pile as a linear elastic beam. The latest release of LPILE (6.0) is capable of modeling nonlinear behavior. For a linear structure, the inputs are the length, width or diameter, cross sectional area, moment of inertia, and modulus of elasticity. If using COM624P or earlier versions of LPILE, there is no provision for prestressed or reinforced sections, thus the user must calculate the cracking moments by hand and compare them to those generated during loading in order to determine if a nonlinear failure has occurred.

To begin the solution, Com624 imposes the loading conditions at the top of the pile and assumes the pile length is such that the boundary conditions of zero shear and moment exist at the tip. The differential equation is solved for the displacements along the pile. Since the soil is considered non-linear, an iterative approach is taken where the soil modulus is varied. When the displacements calculated between two iterations are within a specified tolerance, the program terminates and records the displacements, moments, and shears for that load case.

2.7.2 FB-MultiPier

FB-MultiPier(2010), known previously as Florida Pier or FB-Pier, is a non-linear, hybrid finite element soil-structure interaction program under continual development at the University of Florida by the Florida Bridge Software Institute (BSI). In simple terms, FB-MultiPier models a single pile as sixteen 2-node finite elements and each element has 6 degree of freedom per node. The soil reaction is provided much in the same way as LPILE with load transfer curves applied at the nodes. The program is a complete bridge foundation and pier analysis program. FB-MultiPier can analyze many types of structures including prestressed concrete piles, drilled shafts, H-piles, pipe piles, and various concrete sections, both reinforced and/or prestressed, generally used for bridges. The possible types of loading on these structures include combined axial, lateral, and torsion components on the piles/shafts, pile cap, and pier. The structural model includes both linear and non-linear (concrete cracking, steel yielding) capabilities, as well as biaxial interaction diagrams for all sections (BSI, 2010).

FB-MultiPier uses an iterative solution method to find the stiffness of the soil and pile for a computed set of displacements. The program uses a secant approach which assembles a stiffness matrix and solves for sets of displacements. Convergence is achieved when the system is in static equilibrium and is determined by comparison of the magnitude of the highest out-of-balance nodal force and the tolerance defined in the input file. The system is in static equilibrium and the program terminates when the highest out-of-balance force is lower than the tolerance.

FB-MultiPier uses axial (t-z, Q-z), lateral (p-y), and torsional (T-θ) pile-soil interaction. Sand (O'Neill), Sand (Reese), Clay (O'Neill), Clay API, Soft Clay Below the Water Table, Stiff Clay with Free Water, Stiff Clay without Free Water, and Limestone are the available lateral (p-y) models. The experienced user has the option of entering a customized set of 10 p–y curve points if none of the default curves are suitable.

The axial model consists of two parts; the first is the skin friction portion. The available skin friction models are Driven Pile, Driven Pile in Sand API, Driven Pile in Clay API, Drilled Shaft in Sand, Drilled Shaft in Clay, Drilled Shaft in Limestone, and Drilled Shaft in Intermediate Geomaterial. As with the lateral model, the user can also enter a set of 10 t-z curve points if the default models are not sufficient. The remaining piece of the axial soil model is the end bearing. The program supplies four tip models: Driven Pile, Driven Pile in Sand API, Driven Pile in Clay API, Drilled Shaft in Sand, Drilled Shaft in Clay, and Drilled Shaft in Intermediate Geomaterial. The user can also input a set of 10 Q-z curve points to model the tip if the above models are insufficient. Currently, the hyperbolic model is the only torsional model available.

2.8 Micropile Lateral Load Tests

Since micropiles are almost exclusively used for axial support which comes from skin friction applications, the literature is limited on the subject of micropile lateral load tests. Thus it is important to examine the case histories that do exist to provide a sound basis for the load tests for this study.

Long et al. (2004), at the University of Illinois, conducted research on field micropile response. Tests were conducted on micropiles with diameter of 9.63 inches, wall thickness of 0.55 in, length approximately 50 linear feet, and yield strength of the steel casing of 147 ksi. The test site was located along Interstate 57 about four miles north of the Illinois-Missouri state line. The primary reasons of the tests were to investigate the lateral load behavior of micropiles, to compare the measured lateral behavior with behavior predicted using LPILE, and to determine the structural behavior of the grouted micropile sections.

The subsurface investigation consisted of sampling, visual classification, standard penetration (SPT), water content, and unconfined compressive strength testing. The soil profile consistently showed medium clay overlaying sand. The unconfined compressive strength for the soil varied from 1400 psf near the ground surface to about 2200 psf at around 11 ft. below the ground surface. The strength then decreased to 800 psf at the bottom of the clay layer. The standard penetration tests (SPT) for the sand layer, increased with depth from 8 to 35 blows per foot.

Micropiles were originally tested in axial compression, axial tension, or served as reaction piling. The lateral load test program was conducted after axial load test were completed. Micropiles at the test site were constructed in two stages, an upper section with micropile casing and the lower uncased section with a centered high-strength bar only. The high-strength bar extended the full length of the micropile.

Twelve micropiles were installed at the test site. The deflection of each pile was measured with two dial gauges, one mounted above the other along the length of each pile head. Seven strain gages were used to measure the strain along each pile. The lateral load was applied by pulling two piles together. Plots of lateral load versus displacement and lateral load versus slope were shown in the report. In most cases, the micropile displacements measured in the field test at a given load were in reasonably good agreement with the displacement predicted using LPILE. Most of the tests were limited by the travel of the loading jacks.

Laboratory structural tests in this study (Long 2004) were conducted on a 10 ft. long section of micropile filled with grout. The pile was allowed to cure at the test site for 28 days. The pile was brought into the laboratory and tested in four point bending. The pile showed linear behavior up to 212.5 kips applied load. The modulus of rigidity of 5.0 x 10^6 in^2-kip was obtained from the linear part of the plot. The moment versus curvature relationship for the linear part of the loading curve yielded a modulus of rigidity of 5.28 x 10^6 in^2-kip.

The load-displacement relationships measured in the field were in general agreement with load-displacement relationships predicted using LPILE. When differences occurred, Long (2004) gave the following reasons: soil strength in the field was lower than strength used in LPILE, bending stiffness/strength in the field was lower than assumed in LPILE, and the p-y curves for micropiles may need to be adjusted. Moreover, two tests terminated prematurely due to rotation of the threaded joints.

Richards and Rothbauer (2004) reported the results of lateral load tests on eight projects that utilized 9.6 in. diameter micropiles. The paper compared the lateral test results to predictions using LPILE, NAVFAC, and the Characteristic Load Methods (CLM). The intent was to demonstrate that micropiles and micropile groups can be designed to support lateral loads. The points of lateral loads applications above the ground surface varied from 0.5 to 1 ft.

In each test, two piles were loaded simultaneously using a hand pumped hydraulic jack. Two dial gages were placed at fixed elevations near the top of the pile and at the point of applied load to measure the pile deflection and rotation. The deflections reported in the research were calculated at the ground surface by extrapolating the two dial gage readings.

The conclusions show the micropiles deflected less than predicted due to typical conservatism in the assigned soil parameters or neglecting passive surcharge due to the top of the pile being below ground surface. The analysis of the micropiles for lateral load was sensitive to the soil properties in the upper 10 to 20 feet of micropile.

Tarquinio et al. (2004) reported an analysis of deep foundation alternates in the design and construction of State Route 22, section A02-Lewistown bypass located in Pennsylvania. The value engineering analysis included driven and pre-drilled H-piles and micropiles. The initial design was driven and predrilled H-pile of axial compression capacity is 100 kips total 511 numbers as against 7.0 in. diameter micropile with an axial compression capacity of 200 kips total 295 micropiles.

For this project, a total of seven axial and lateral load tests were conducted to confirm the value of the engineering design and any construction issue. The results of the tests show the displacement vs. applied load graph crosses the failure criterion for micropile bonded in carbonaceous shale. For the micropile bonded in limestone, the displacement vs. applied load graph did not cross the failure criterion. This shows that the compressive strength and the quantity of the rock was also important in the axial and lateral capacity of the micropile.

2.9 Other Deep Foundation Lateral Load Test Case Studies

The purpose of this section is to provide a review of case histories of deep foundation lateral load tests under realistic boundary conditions and the true soil-structure interface.

2.9.1 1-g Model Tests

1-g model tests are test carried out in a small scale under controlled laboratory conditions making them relatively inexpensive. In 1-g model testing, the actual soil-pile system is not modeled using appropriate similitude laws for both soil and pile to correctly simulate the actual field conditions. Similarity between a model and a full-sized object implies that the model can be used to predict the performance of the full-sized object. Such a model is said to be mechanically similar to the full-sized object.

Complete mechanical similarity requires geometric and dynamic similarity. Geometric similarity means that the model is true to scale in length, area, and volume. Dynamic similarity means that the ratios of all types of forces are equal. These forces result from inertia, gravity, viscosity, elasticity, surface tension, and pressure.

Materials such as aluminum, mild steel and wood dowels are used to represent piles in model tests. For these tests, sand was by far the most common soil used for the tests. Piles were held in place as soil was placed around them. Techniques for installing soil included tamping, pluviation, raining, dropping, flooding and boiling. The primary shortcomings of 1-g model testing are scaling and edge effects. Scaling limits the applicability of model tests in simulating the performance of prototypes due to similitude incompatibility. Soil pressure distributions, soil particle movement and at-rest stress levels are all factors influenced by scaling. The significance of edge effects comes in to play if the size of the testing container is too small; the zone of influence may extend beyond the size of the container.

Davisson and Salley (1970) conducted 1-g model tests in conjunction with the Arkansas River Navigation Project on vertical and battered fixed-headed piles fabricated from 0.5-inch-O.D. aluminum tubing. The purpose of the test was to develop criteria for design of pile foundations in sand specifically for the locks and dams of the Arkansas River Navigation Project. The sand used was dry, fine, and fairly uniform with about 7% passing the No. 200 sieve. The lateral tests were divided into four model groups; A through D. Test A investigated the distribution of the subgrade modulus with respect to depth and to investigate the distribution of cyclic loading on single piles. Test series B compared the behavior of a pile group containing vertical and batter piles. Test C included two scale model lock walls, each consisting of three lock wall monoliths placed opposite each other at a distance of 110 ft. In test D, three scaled monoliths of a typical dam section supported on batter piles were tested. Davisson and Salley examined a variety of pile spacing and determined that group effects decreased the effective value of the coefficient of subgrade reaction, n_h, and increased the relative stiffness factor, T. Normalized T values of 1.25 at 4D spacing and 1.30 at 3D spacing were measured. In general it was observed that cyclic loading caused deflections to approximately double.

Cox et al. (1984) reported a study in which tests on 58 single piles and 41 pile groups were performed. The studies were made to investigate the efficiencies of pile groups under lateral loading. The piles were one inch diameter open-ended tubes, with penetrations of two, four, six or eight diameters. Tests were performed on single piles and on 3 and 5 pile groups with clear spacings of 0.5, 1, 2, 3, and 5 diameters in side-by-side or in-line arrangements. The piles were embedded in soft clay with a moisture content of 59% and undrained shear strength of 42 psf. The study concluded that group effects were negligible when side-by-side spacing exceeds 3 times the diameter and in-line spacing exceeds 8 times the diameter.

2.9.2 Centrifuge Tests

Centrifuge modeling is often used to study soil-structure interaction. The purpose of centrifuge testing is to reproduce the stress-strain response observed in the field in reduced (model) scale. Centrifuge modeling relies on the principles of similitude and increased gravitational forces to obtain stresses in smaller models that would be comparable to those occurring in full-scale prototypes. Centrifuge testing is a means of overcoming scaling effects inherent in 1-g model testing. The advantage of centrifuge modeling lies in the ability of the centrifuge to reproduce prototype stress-strain conditions in a reduced scale model (Mcvay et al. 1995). Schofield (1980) provides detailed centrifuge testing principles.

Barton (1984) performed one of the first centrifuge tests on model pile groups consisting of 2, 3 and 6 piles at various spacing and orientations with respect to the loading direction. Piles were installed in two rows. The study showed that the first row (lead row) carried 60% of the applied lateral loads and the second row (trail row) carried the remaining 40% of the applied lateral load at a pile spacing of two diameters.

Selby and Poulos (1984) conducted laboratory tests on model single piles and pile groups in sand. The main objectives of the tests were to examine the shielding effect in laterally loaded pile groups. The model piles were made of aluminum alloy tubes of 0.63 in. diameter, 0.05 in. wall thickness with each length of about 20 in. Load tests were performed in the centrifuge on model pile groups consisting of 2, 3, 4, 5 and 9 piles at various spacing. The results of these tests showed that the leading piles may carry significantly higher moments and shears than central or trailing piles, because of a shielding effect caused by soil movements in active pressure zones.

McVay et al. (1995) conducted centrifuge tests on single piles and 3 x 3 pile groups at three-diameter and five-diameter spacing. The piles were driven and laterally loaded without stopping the centrifuge. The prototype piles were 17 in diameter and 42.5 ft long in medium loose and medium dense sand. The test results support that the group efficiency was independent of soil density. The results of the tests show a group efficiency of about 0.74 for 3D spacing and 0.94 for 5D spacing.

McVay et al. (1996) conducted centrifuge tests on driven in-flight fixed-head plumb and battered 3 x 3 pile groups, at 3D and 5D spacing. The prototype piles were 17 in diameter and 42.5 ft. long in medium loose and medium dense sand. A total of 24 tests were conducted with varying pile spacing, relative density of sand, inclination of the piles and loading direction.

2.9.3 Selected Full-Scale Lateral Load Test Case Studies

Gill (1968) presented the results of lateral load tests carried out at Hamilton Air Force Base and Naval Civil Engineering Laboratory in two papers. In Gill (1968), the San Francisco Bay pile tests were performed to study the horizontal load-displacement characteristics of natural soil deposits and to associate these characteristics with the behavior of laterally loaded piles. 4.5, 8.6, 12.8 and 16 in diameter open ended pipe piles were driven in both the dry area and flooded area. In the flooded area, no tests were carried out until the shear strength of the soil stabilized. Each pile was sufficiently embedded to insure flexible rather than rigid behavior. Lateral loads were applied 30 in. above the ground surface so that the loading consisted of both a horizontal load and a bending moment. Displacement and slope at ground surface were measured versus load. The horizontal displacements determined experimentally and the theoretically for all pile sizes were in fairly close agreement.

Singh and Verma (1973) reported the results of lateral load tests on single piles and pile groups; of mild steel pipes, 2.5 in outside diameter and 16.5 ft. long. The group consisted of four piles arranged in a square pattern at three diameters center to center spacing with a rigidly welded pile cap. The pile groups and single piles were subjected to incremental lateral load applied at ground surface. The horizontal deflection and rotation of the cap at ground level were measured. Plots showed the pile group with pile spacing of three diameters offers less resistance to deflection compared to a single pile under similar conditions of loading. The results also showed that with an increase of deflection, the resistance of both single piles and pile groups decreased, with the resistance of groups decreasing faster than that of the single piles.

Cox et al. (1974) conducted lateral load tests on two 24 in diameter steel pipe piles with a wall thickness of 0.75 in., driven into sand. One pile was subjected to cyclic loads and the other was loaded statically. The piles penetrated to a depth of 69 ft. into clean fine sand to silty fine sand below water. The friction angle of the sand was 39^{o} (Reese et al., 1974) and the buoyant unit weight was 66 pcf. The lateral load was applied at 1 ft. above the ground surface. The calculated values of lateral loads using the Characteristic Load Method which uses dimensional analysis to characterize the nonlinear behavior of laterally loaded piles by means of relationships among dimensionless variables were compared to measured values for lateral load. The results showed that the calculated deflections were about 10% higher than the measured values. The calculated maximum bending moments agreed quite well with the measured values for maximum bending moments.

Reese et al. (1975) conducted lateral load tests on two 24 in. and one 6 in. diameter pipe piles driven into stiff clay. The piles were instrumented to measure bending moments. On both the 6 and 24 in piles, short-term and cyclic loads were applied and the water table was maintained a few inches above the ground surface. The two 24 in. piles were placed horizontally and connected at the ends to create simple beam supports, the two were then jacked apart with hydraulic ram and a load cell in series. The 6 in. pile was connected to a 24 in. pile by tension straps, and a jack was placed between the piles to push the piles apart. The results of the tests were analyzed to obtain the families of curves showing the soil resistance p as a function of pile deflection y. In the case of the 24 in. piles, the comparison between the computed and the measured p-y curves showed excellent agreement. While there was also a reasonable agreement for maximum bending moment for the 6 in. pile, the deflection at ground-line was poor.

Reese and Nyman (1978, as referenced in Reese and VanImpe, 2001) reported the results of an instrumented drilled shaft installed in vuggy limestone in the Florida Keys. The test was performed to gain information for the design of foundations for highway bridges. The drilled shaft diameter was 4 ft. and penetrated about 43.7 ft. into the limestone. A maximum lateral load of 150 kips was applied to drilled shaft at about 11.5 ft. above the limestone elevation. The maximum deflection at the point of load application was about 0.71 in, and about 0.02 in at the top of the rock. Although the load versus deflection curve was nonlinear, there was no indication of rock failure.

The Mechanical Research Department, Ontario, Canada, in an effort to examine the foundation behavior of rigid piers, carried out a full scale tests on two instrumented 5.0ft. diameter drilled shafts. The test results, analyzed and reported by Ismael and Klym (1978), were used to determine the accuracy with which the elastic method and the p-y method could predict the pier is lateral response. Lateral loads were applied to the piers at the ground surface. Displacement readings were taken after each 10 kip load increment. At 40 kips, the load was cycled. The incremental load was increased from 20 kips to a maximum of 160 kips. The elastic solution was unable to model the true non-linear behavior of the pier and the p-y method only provided a conservative estimate.

Brown et al. (1987) reported the results of cyclic lateral load tests on a large-scale pile group and a single pile. The piles consisted of nine 10.75 in. diameter 0.365 in. thick steel-pipe piles in a closely-spaced arrangement. The piles were installed close-ended in a 3 by 3 arrangement with spacing of 3-pile diameter centers to a depth of 43 ft. The results showed greater deflection under the load of piles in group than that of a single pile under a load equal to the average load per pile. Also, the bending moments in the piles in the group were greater than those for the single pile.

Brown et al. (1988) reported the results of a large-scale group of steel pipe piles and an isolated single pile subjected to two-way cyclic lateral loading. The tests were carried out in a submerged firm to dense sand that was placed and compacted around the piles. The pile group consisted of nine 10.75 in. diameter 0.365 in. thick steel pipe piles, arranged in a 3 by 3 group and spaced at three times the diameter. The ultimate objectives of the test were to compare the response of the piles in the group with the response of the single pile and measure the variation in soil resistance within the group. The piles were instrumented to measure the distribution of load to each pile, bending stresses along the length, and the slope at the top for comparison.

Several conclusions that were presented in the report are, the deflections of the piles in the group were significantly greater than that of the single pile under equal average load; the reduced efficiency of the pile group was due to the effect of shadowing; and the piles in the leading row had similar bending moment with the single pile under the same load per pile. Due to the two-way cyclic loading, significant densification occurred in the sand.

Caltrans (Speer 1992 as referenced in Reese and Vanimpe, 2001) performed lateral load tests on two 7.4 ft. diameter drilled shafts. Shaft A, penetrated 41 ft. into the rock, and shaft B penetrated about 45 ft. into the rock. Both drilled shafts were tested simultaneously. Load was applied incrementally at 4.6 ft. above the ground line for shaft A and 4.1 ft. for shaft B. The load test results showed that shaft A apparently had a structural weakness, so only shaft B was used in developing the recommendations for p-y curves. Groundline deflection of 0.7 in. was measured at a 1,800 kips lateral load, but the deflection increased to about 2.0 inches at a lateral load of about 2,010 kips.

Ruesta and Townsend (1997) reported full-scale lateral load tests on a single pile and pile group consisting of 16 (4 x 4) prestressed 30 in. square concrete piles 54 ft long at the Roosevelt Bridge in Stuart, Florida. The objectives of the test were to provide a better understanding of the lateral resistance of closely spaced (3 diameters) driven piles in a group and whether it could be numerically related to the behavior of a single isolated pile through p-y multipliers, evaluate techniques for determining p-y curves based on in situ tests, verify the latest version of the program FLPIER and provide a general guideline for future load tests and lateral load design recommendations. The test program consisted of a single isolated 30 in. square pile and two 16 pile groups with three diameter spacing. From the lateral load tests, it was concluded that the average pile group response was softer than the single pile response, the p-y multipliers worked well to account for the group effect, and the maximum bending moments for the leading row were higher than the trailing rows.

Rollins et al. (2005a and b) reported the results of lateral load tests performed on a full-scale pile group and single pile in liquefied and preliquefied sand. The studies show the effect of liquefaction as the piles were loaded laterally. In the test before liquefaction, the objective was to evaluate pile-soil-pile interaction effects and improve the understanding of pile group behavior. The test pile was a 12.75 in. outside diameter steel pipe with a 0.375 in. wall thickness driven open ended to a depth of 37.7 ft. below the excavated ground surface. The pile group was arranged at 3 by 3 at 3.3 diameters spacing. The piles were driven into a soil profile of loose to medium dense sand underlain by clay and were instrumented to measure the distribution of load to the top of each pile, bending stresses along the length of each pile, and the slope at the top of each pile for comparison. Pre-liquefaction results showed a reduction in lateral resistance for the pile group relative to the single pile due to the group interaction effects. In addition, outer piles in the row carried about 20-40% greater lateral load than the middle pile in each row. This shows that lateral resistance was a function of position within the row. In contrast to pre-liquefaction tests, group interaction effects were insignificant after liquefaction. The lateral resistance of each pile in the group was similar and about the same as for the single pile.

Rollins et al. (2008) carried out lateral static and Stat NAMIC load tests on two 8.5 ft. diameter drilled shafts at the Cooper River Bridge site in Charleston, South Carolina after liquefying the soil to a depth of 42 ft. using controlled blasting. The intent was to determine the impact of soil liquefaction (similar to that from an earthquake) on the lateral response of the drilled shafts. The interpreted static load-deflection curve indicates that the liquefied sand provided significant lateral resistance and that the reasonable estimate of response could be obtained using a p-y curve for liquefied sand (Dr ≈ 50%) developed by Rollins et al (2005) which include diameter effects.

2.10 Four Point Bending Tests on Beams for Structural Properties

The purpose of this section is to provide a review of case histories of four point bending tests carried out in the laboratory and setup on structural elements.

Zhu et al. (2006) carried out a four-point bending test on precast concrete-filled fiber-reinforced polymer (FRP) tubes (CFFT) in a laboratory set up. A total of five spliced beams 7 ft. long were tested. Each specimen was loaded in four-point bending with 6 ft. span length and a constant moment region of 2 ft. in the middle.

Nakamura et al. (2004) carried out four-point bending tests on steel pipes filled with light mortar having different compressive strength, steel pipes filled with concrete having different compressive strengths and unfilled steel pipes. The steel pipe models were2 ft. in diameter and had wall thicknesses of 0.31 in.

The test specimens were simply supported with a span of 15 ft. and loaded at 5 ft. in from each end supports. The steel pipes were reinforced by diaphragms at the end supports and the loading points. The longitudinal strains of the specimens during loading were measured by using strain gages. For the unfilled steel pipes, the strain gages were located outside the steel pipes and for the filled steel pipes; the gages were inside the steel pipe.

The results of the bending tests show that the concrete filled models had 1.8 times higher bending strength than the steel pipe. In the case of the steel pipe filled with ultralight mortar, with the mortar compressive strength less than 145 psi the bending strength was the same as the steel pipe without any fill. However when the compressive strength of the mortar was above 725 psi, the ductility was significantly improved and the ultimate strain was more than double that of the steel pipe. The tests show that the bending strength of the steel pipes can be controlled by the mechanical properties of the filled materials.

Fam et al. (2003) reported full-scale laboratory, construction and field tests of a new precast composite pile used for the substructure of Route 40 Highway Bridge over the Nottoway River in Virginia. The composite piles consisted of concrete-filled glass fiber reinforced polymer (GFRP), 24.6 in. diameter and 0.21 in. wall thickness.

The tubes were filled with 4800 psi concrete. The typical pile was a 16.4 ft. long and the distance of the two applied loads was 4.9 ft. from the center. The specimens were instrumented to measure the midspan deflection, and the extreme fiber strains at the tension and compression sides within the constant moment zone.

Naguib and Mirmiran (2002) carried out experimental and analytical investigation of the flexural creep behavior of concrete-filled fiber reinforced polymer tubes. Four identical 7 ft. long, 6 in. diameter and 0.6 in. tube wall thickness concrete-filled fiber reinforced polymer tubes (CFFT) were made for the tests. The instrumentation for the tests included both deflection and also top and bottom longitudinal strain gages at the midspan of the beams

Fam and Rizkalla (2002) reported the results of flexural behavior of concrete-filled fiber-reinforced polymer circular tubes. A total of 20 beams were fabricated and tested for bending using four-point loading. Electrical strain gages and displacement transducers were used to measure the strain in axial direction within the constant moment zone along the depth of the beam. Strain gages were also used to measure circumferential strains. A linear motion transducer (LMT) at the mid-span was used to measure the deflection. And, dial gages were attached at the ends to measure any end slip between the tube and the concrete.

Sherman (1976) reported the results of three- point bending tests on circular steel tubes. The tests were carried out to determine the moment redistribution capabilities of round tubes, and to determine if plastic design principles could be applied to tubes subjected to flexure. All the circular steel tubes tested had an outside diameter of 10.75 in. with varying wall thicknesses and yield strengths. The steel pipes were tested as cantilever and simple span under three point load tests. Strain gages were placed at 2.5 in. center to center spacing top and bottom on the outsides of the steel pipes. The deflections were measured with a 0.001 in. dial indicator. Bending moment at the ends of the tubes were measured with a purpose- built end- fixture transducer.

2.11 Corrosion on Highway Structures Case Studies

The purpose of this section is to provide a review of case histories of corrosion effects on structures. Corrosion of steel and concrete on both substructures and superstructures may result in the reduction of the strength and capacity to withstand the design load of those structures. According to the National Bridge Inventory Database, the total number of bridges in the United States is approximately 600,000, of which half were built between 1950 and 1994. The materials of construction for these bridges are concrete, steel, timber, masonry, timber/steel/concrete combinations, and aluminum.

Andersen (1956) indicates that corrosion was not a serious problem when the piles were completely below ground-water level, but it must be guarded against where sea water is present, where ground water has high salinity content, or where the piles are subject to alternate wetting or drying. Hool and Kinne (1943) stated that the amount of corrosion on steel pipe piles in the ground was negligible.

Mason and Ogle (1932, as referenced in Andersen, 1956) inspected a large number of steel pile foundations in bridge structures in Nebraska. They found little, if any corrosion at depths greater than 18 in. below the stream bed or ground water level. The report estimated that the decrease in section due to corrosion had not been more than one percent in twenty years, except in an area where the soils are saline. The loss of section within the saline area was about 2 to 2.5 percent.

A 12 x 65 H-Pile driven to a depth of about 122 ft. in a swamp near the river side toe of the west approach ramp to the Airline Highway Bridge across Bonnet Carre Spillway in New Orleans was pulled out for corrosion assessment after 17 years. Examination after cleaning showed no measurable corrosion. Mill scale was intact over almost the entire surface except for the 3 ft. section in the zone of typical water table fluctuation.

Decker et al. (2008) carried out a study to evaluate the corrosion rate for an abandoned pile foundation on I-15 through the Salt Lake Valley in Utah. A total of 20 piles were extracted after service lives of 34 to 38 years. From each of the five sites, measurement of the soil index properties, pH, resistivity, cation/anion concentrations and water table were recorded. Corrosion behavior at individual sites was reported.

At the 2100 South site, three steel pipe piles were of diameter 12 in. and wall thickness of 0.19 in. filled with concrete and reinforcement limited to the top. The soil consisted of both silt and clay with occasional sand. The water table was above the pile cap. The chloride and sulfate in the soil were all above the FHWA corrosive limit as reported by Elias and Christopher (1997) and the resistivity was below 394 ohm-in. The results of the analysis show an average loss of 2% and a maximum section loss of 4 % over 36 years of pile embedment in the soil at this location.

At the South Temple site, four spiral-welded steel pipe piles of diameter 12 in. and wall thickness of 0.19 in. filled with concrete and reinforcement limited to the top. The soil consisted of both silt and clay with one sand layer. The water table was about 3 ft. below the pile cap. The four piles were exposed to the soil-water environment for about 38 years. The results of the analysis showed an average loss of 5% and a maximum section loss of 12 % after 38 years of pile embedment in the soil-water environment.

At the 2nd South site, three corrugated steel pipe piles of diameter 12 in. and wall thickness of 0.065 in were filled with reinforced concrete. The soil consisted entirely of sand with a high water table. Because of the soil and the water table, only 6 ft. of the steel pipe pile was cut out before the saturated sand collapsed into the excavation. The corrosion rates for these corrugated steel pipe piles were severe to moderate with respect to the percent of section loss, with a maximum section loss of 29 % and an average of 13 %.

At the 6th South site, four corrugated steel pipe piles were removed from the site. The pipe piles were filled with reinforced concrete and step-tapered with depth. The first segment was 18 in. in diameter; the second segment was 16 in. in diameter and the last segment was 14 in. in diameter. The segment wall thickness ranged between 0.045 to 0.055 in. The corrugated pipe piles were removed after about 34 years of soil-water environment exposure. The corrosion rates for these steel pipe piles were severe to moderate with respect to the percent of section loss, with a maximum of 51 % and average of 14 %.

At the 118th South site, two steel pipe piles were removed from the site. The steel pipe piles were 12.5 in. diameter, wall thickness of 0.25 in. and filled with concrete with reinforcement limited to the top. The piles were driven at a 1:4 batter. The piles were removed for corrosion analysis after 37 years of soil-water environment exposure. The corrosion rates for these steel pipe piles were moderate to severe with an average section loss of about 8% in fill material, 13 % in the native soil and a maximum section loss of 28 % near the water table fluctuation zone.

The thickness loss versus tensile capacity loss analysis was carried out on 12 specimens from the steel pile in all the sites. Axial tension tests were conducted on these specimens. The thickness losses on these specimens are within the range of 5 and 29%.From the results of the test, the average thickness loss was about 13.3% whereas the average loss in tensile load capacity was 10.7%. The tension tests indicate that the loss often sile capacity was directly related to the loss of thickness.

2.12 Gaps in the Literatures

From the literature reviewed, five significant gaps were identified:

1) There is limited available information about the performance of micropile joints both in the laboratory and field. The single study by Long et al. (2004) provides a starting point.
2) No researchers have considered the impact of rock embedment on lateral load deflection behavior of micropiles.

3) While piles and drilled shafts have been load tested at full scale as single foundations or groups, there are no instances of loads testing a micropile bent at full scale.
4) No cases in the literature exist where micropile load tests were used to validate models in analysis software such as FB-MultiPier.
5) While there are significant literatures on pile corrosion available, none of that literature considered a micropile section that has a threaded joint.

The objectives and scope of work presented previously in this dissertation support filling these gaps in the literature.

CHAPTER 3: PRELIMINARIES

3.1 Project Information

The project site was located in the narrow, generally flat, alluvial valley of the northwesterly flowing North Fork New River in the Northwestern part of North Carolina just northwest of Boone, NC. The floodplain was approximately 200 to 300 feet wide in the vicinity of the existing bridge. The ground surface elevations along SR 1118 were approximately 3120 feet mean sea level (MSL). Ground surface elevations in the floodplain were approximately 3114 feet MSL and the elevation of the riverbed was approximately 3111 feet MSL. The topography northeast and southwest of the existing bridge, outside of the floodplain, rose steeply to over 3600 feet MSL. Overhead and underground utilities were present at the project site along both sides of SR 1118. The utilities included power, cable, phone and fiber optic lines. The vicinity map is shown in Figure 3.1.

The original bridge was single span, i.e. no piers, and the end bents were founded on timber piles as shown in Figures 3.2 and 3.3. The replacement bridge was longer due to a much larger hydraulic opening based on scour and would require two interior bents along with two end bents. The geometry of the new bridge consisted of three spans with spanning arrangement of 1@30 ft., 1@58 ft. and 1@27 ft. with a skew of 135^0.

Foundations considered for the replacement bridge included drilled shafts, steel pipe piles installed with excavation, and micropiles. The decision to proceed with micropiles was made by the NCDOT based upon cost and environmental impact. The pile sections chosen for the bridge design were 10.75 in. OD casings with wall thickness of 0.5 in. The contractor chose to use duplex drilling for installation. The micropile design followed the current NCDOT specification of 10 ft. of casing penetration (plunge) into rock with an additional 5 feet of bond into the rock. The contractor chose to not use a central bar and instead extended the casing the full length of the pile.

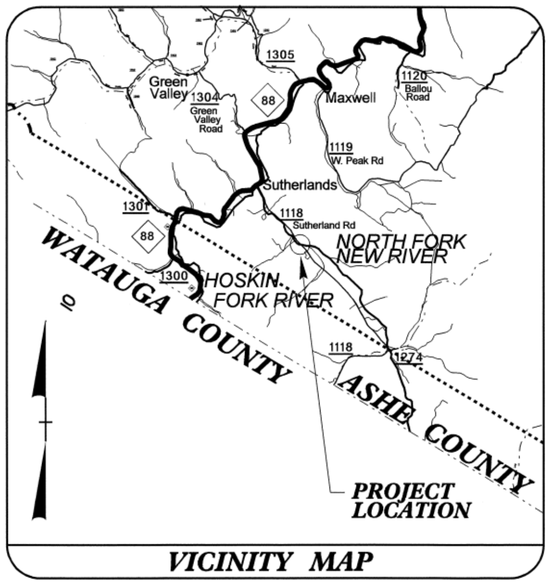


Figure 3.1: Map showing general location of B4012

Figure 3.2: Photo of the bridge alignment along the road

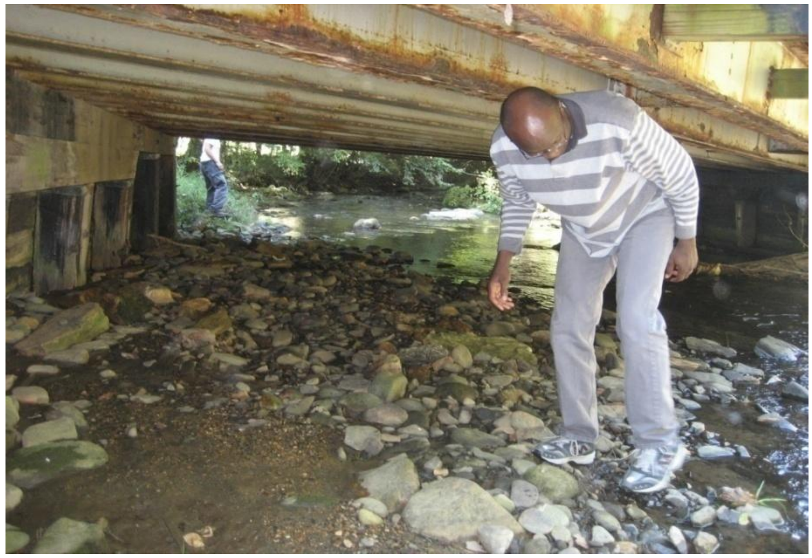


Figure 3.3: Site view of the old bridge.

3.2 Site Geology

The bridge is located within the Blue Ridge Belt of the Blue Ridge Physiographic Province. The 1985 Geologic Map of North Carolina, compiled by the North Carolina Geological Survey, indicates that biotite granitic gneiss underlies the project area. The Blue Ridge Belt materials consist of residual soil, weathered rock and crystalline rock beneath alluvial materials.

The subsurface materials at the bridge site can be divided into five major geologic strata. These strata are from top down, embankment fill, alluvium, residual soil, weathered rock and crystalline rock. The roadway embankment fill consists of 2.5 to 7.0 feet thick of loose to dense, dry to moist, clayey, silty, fine to coarse sand, with trace to little gravel and trace wood fragments, and silty, fine to coarse sandy, gravel with trace organic debris. The alluvium is about 1.5 to 4.2 feet thick and consists of very loose to medium dense, moist to wet, silty, fine to coarse sand, with trace roots, wood fragments and gravel, and silty, fine to coarse sandy and gravel. The residual soil is about 1.1 to 4.5 feet thick, and consists of loose to very dense, dry to moist, micaceous, clayey, silty, fine to coarse sand with relict rock fabric and trace biotite gneiss rock fragments. The weathered rock consisted of about 1.0 to over 5.0 feet thick, and consists of severely weathered, very closely fractured, soft to medium hard, biotite gneiss. The crystalline biotite gneiss consists of an upper section of moderately severe to slightly weathered, very closely to closely fractured, medium hard to hard, biotite gneiss, and a lower section of slightly weathered to fresh, closely to widely fractured, hard to very hard, biotite gneiss. The soil profile is shown in Figure 3.4.

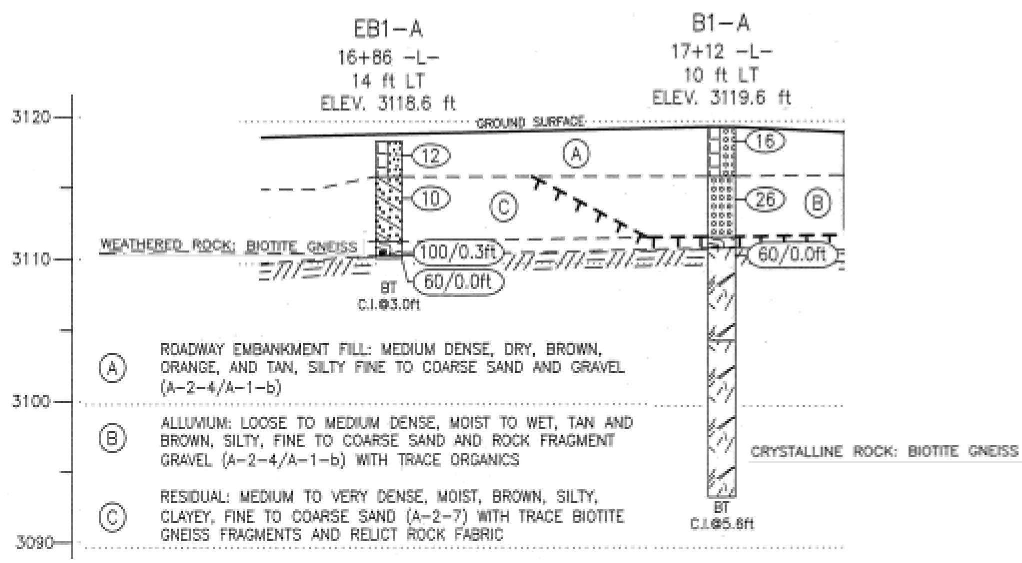


Figure 3.4: Soil profile for the western end bent of B-4012 Ashe County North Carolina

3.3 Modeling for Lateral Loading

The soil-structure interaction for deep foundations is characterized with near field (single pile) and far field (group) behavior. Individual pile soil-structure interaction is characterized with the nonlinear springs shown in Figure 3.5.

FB-MultiPier is a nonlinear finite-element analysis program designed for analyzing bridge interior bent structures composed of nonlinear interior bent columns and caps supported on a linear pile cap and nonlinear piles/shafts with nonlinear soil. This analysis program couples nonlinear structural finite-element analysis with nonlinear static soil models for axial, lateral, and torsional soil behavior to provide a robust system of analysis for coupled bridge interior bent structures and foundation systems.

In contrast to a general finite element program, FB-MultiPier performs the generation of the finite-element model internally, given the geometric definition of the structure and foundation system as input parameters. Piles and drilled shafts always consist of 16 finite elements as shown in Figures 3.6b and 3.9. A section builder facilitates the integration of foundation structural properties into the finite element model. FB-MultiPier consists of an analysis program that is coupled with graphical pre-processor and post-processors. These programs allow the user of FB-MultiPier to view the structure while generating the model and to view the resulting deflections, bi-axial and uni-axial interaction diagrams, and internal forces in a graphical environment.

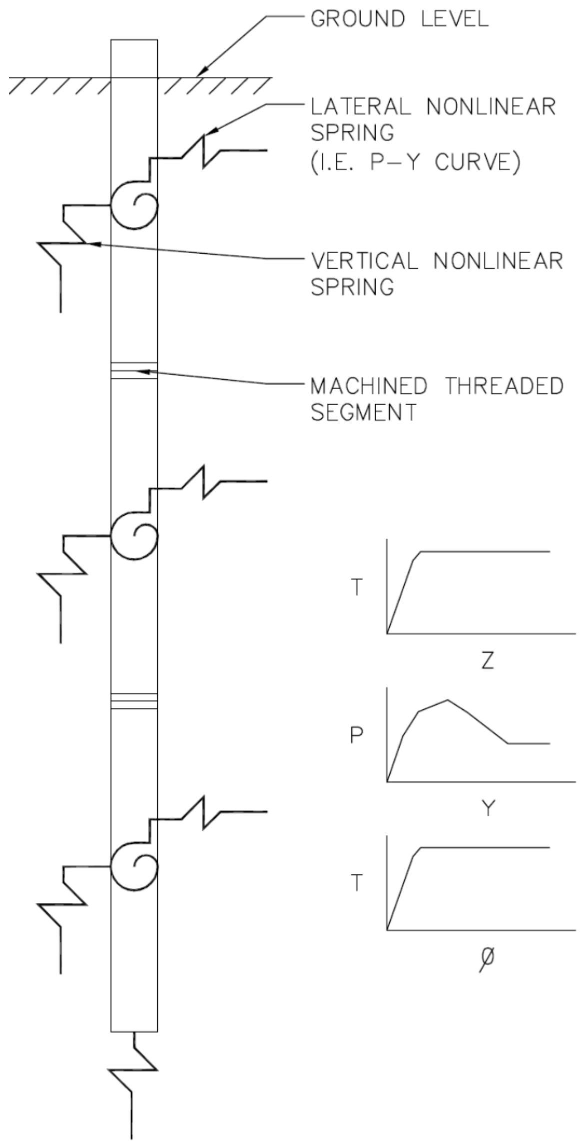


Figure 3.5: Single pile interaction spring models (Drawing not to scale)

The continuum model makes use of solid elements to define both the pile and the soil within the soil structure interaction system, as well as providing interaction between the two through surface definitions. The model as shown in Figure 3.6a considers shear coupling within the soil layers, surface friction at the interface, confinement effects due to soil self-weight deformations, and a precise evaluation of the boundary conditions.

The FB-Multipier replaces the soil with spring and divides the continuum into 16 elements as shown in Figure 3.6b. The soil stiffness properties are calculated at certain intervals and are represented by springs located at each selected point as shown in Figure 3.6b. The model considers only the load-displacement characteristics of the soil through the use of spring elements, and deformation characteristics of the shaft/pile through the use of beam elements.

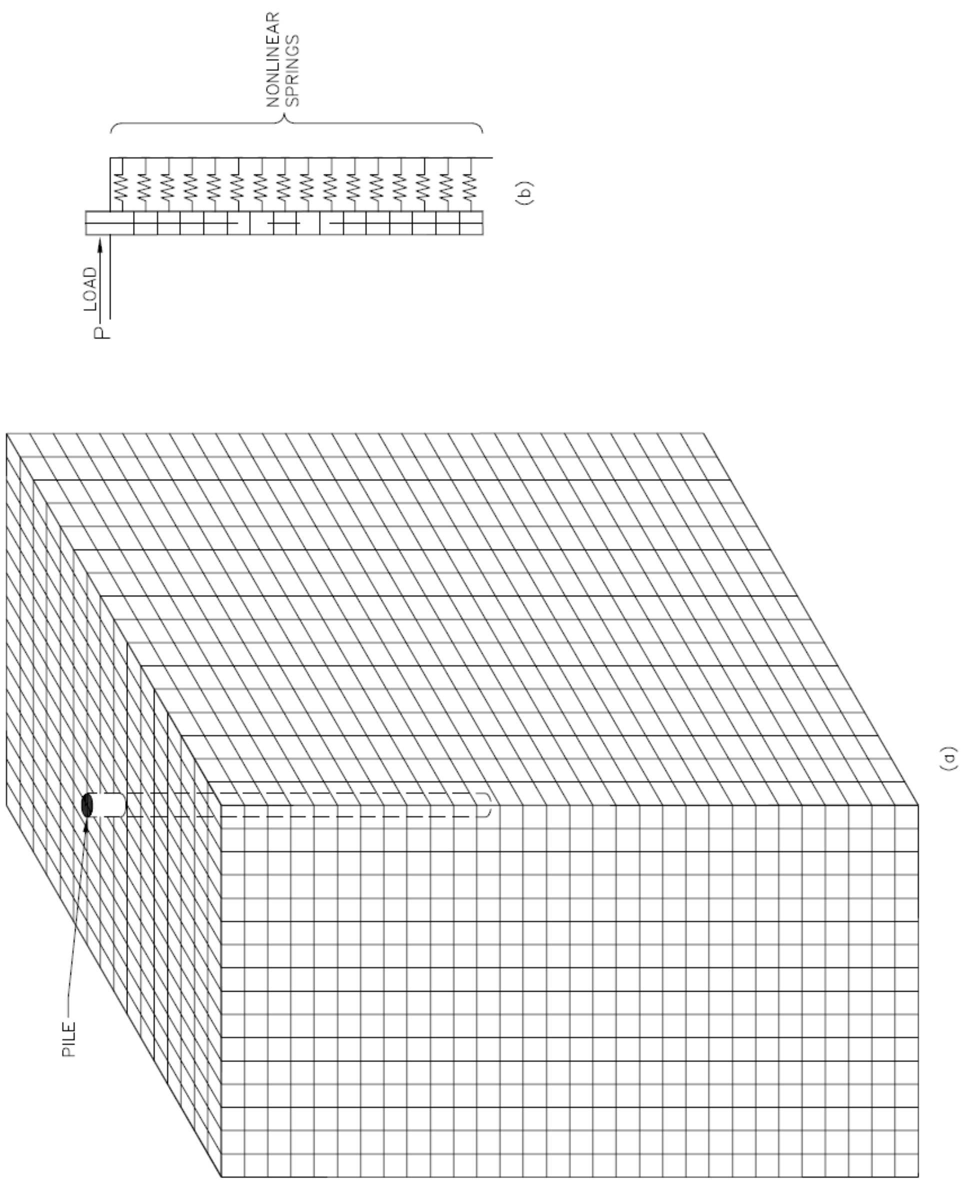


Figure 3.6: Modeling of Pile a) continuum model and b) spring model

3.4 Preliminary Numerical Micropile Load Test Models

It was necessary to know the load-moment-deflection behavior of the field micropiles. FB-MultiPier (BSI 2010) was used to simulate representative load configurations to predict the needed capacity of load frames, displacement sensors, load cells, and hydraulic jacks. This step included the different scenarios of micropile length and rock plunge. Soil and rock property correlations and estimates were based upon borings made at the site and estimated rock parameters. Figure 3.9 shows the soil elevation, rock elevation and the properties of the grouted micropiles and Figure 3.7 is the cross section. Figure 3.8 shows the group representation for the field load test, the soil-structure interaction is characterized with the nonlinear springs.

There was between 5 and 10 feet of overburden soil with an average estimated friction angle of 35 degrees, unit weight of 110 pcf and modulus of subgrade reaction of 25 pci. The rock had an estimated unconfined strength of 29 ksi. The p-y curves by Reese et al. (1974) were used for the overburden soil, while curves developed by McVay and Niraula (2004) were used for the rock. Multiple section micropile models accounted for the impact of the threaded joints. Soil and rock property correlations and estimates were based upon borings made at the site and estimated rock parameters.

Key to these simulations was the feature in FB-MultiPier to model deep foundations as segments. In this case, the micropiles were represented by one of two models. The first model was for the 6.3 ft. unmachined portion of the micropile casing. The second model represented the casing joint which includes the 0.2 ft. portion of the adjoining piles that are machine threaded. The estimated properties of the micropile materials were f'_c = 4000 psi and E_c = 2000 ksi for the grout and f_y = 80 ksi and E_s =

30000 ksi for the casings. In order to initially account for the impact of the casing joint, the thickness of the steel was reduced in the joint segments to 0.2 in. A simple model was devised with three casing sections and two joints. The soil profile was 10 ft. of general soil underlain by hard rock with the top of the micropile 2 ft. above the ground surface. A graphic of the load test model is provided in Figure 3.10. Results of this model show that the upper joint begins to fail at a lateral load of approximately 26.6 kip. The lower joint yield at 28 kips. Additional lateral loading causes the model to become unstable. The load deflection, pile head and bending moment profiles are shown in Figure 3.12 for a single pile.

The analysis was extended to a micropile bent. The bent was composed of 4 micropiles with the same material properties and dimensions as the single pile analyzed previously. The micropiles were spaced at 10 feet center to center. The cap was modeled as a solid concrete member that was 408” x 33” x 30”. The tops of the micropiles were assumed to be at the center of the pile cap. In order to prevent rotation and simulate the likely field load testing setup, the loads were applied at two locations as shown in Figure 3.11. Figures 3.10 and 3.11 show the micropile and micropile bent models and loading. The load deflection, pile head and bending moment profiles are shown in Figures 3.12 and 3.13.

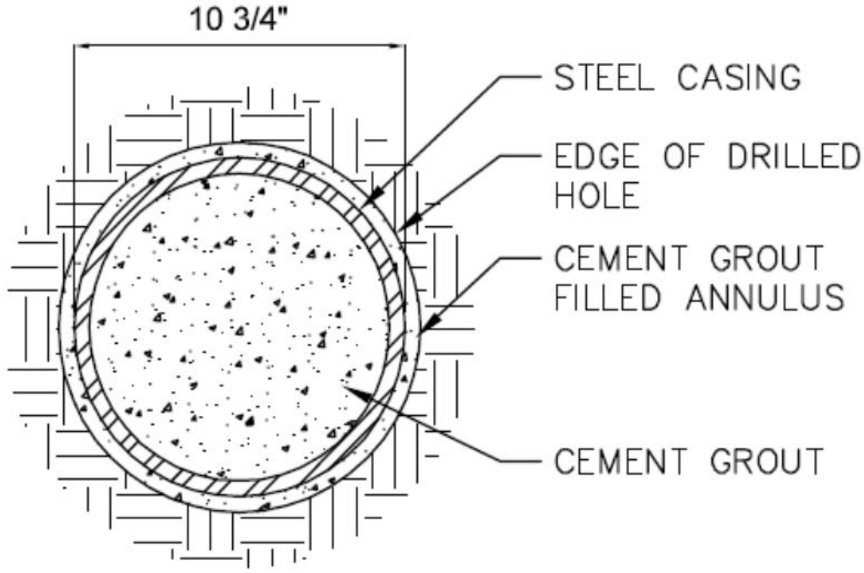


Figure 3.7: Grouted micropile installed section

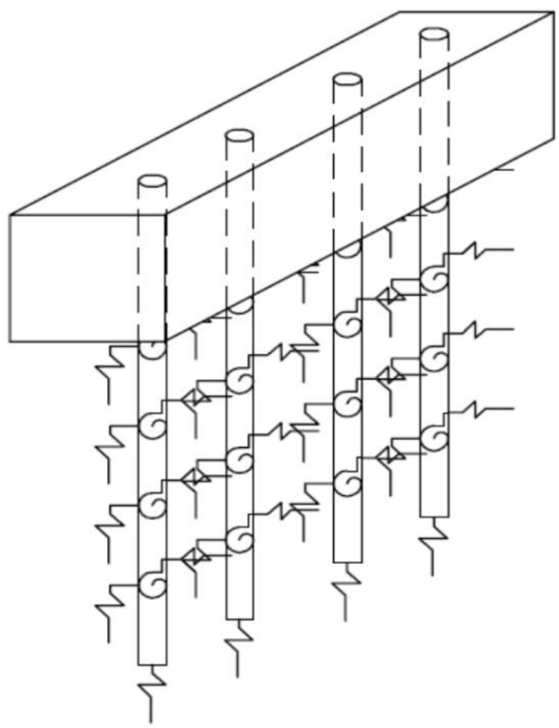


Figure 3.8: Pile grout soil-structure interaction model

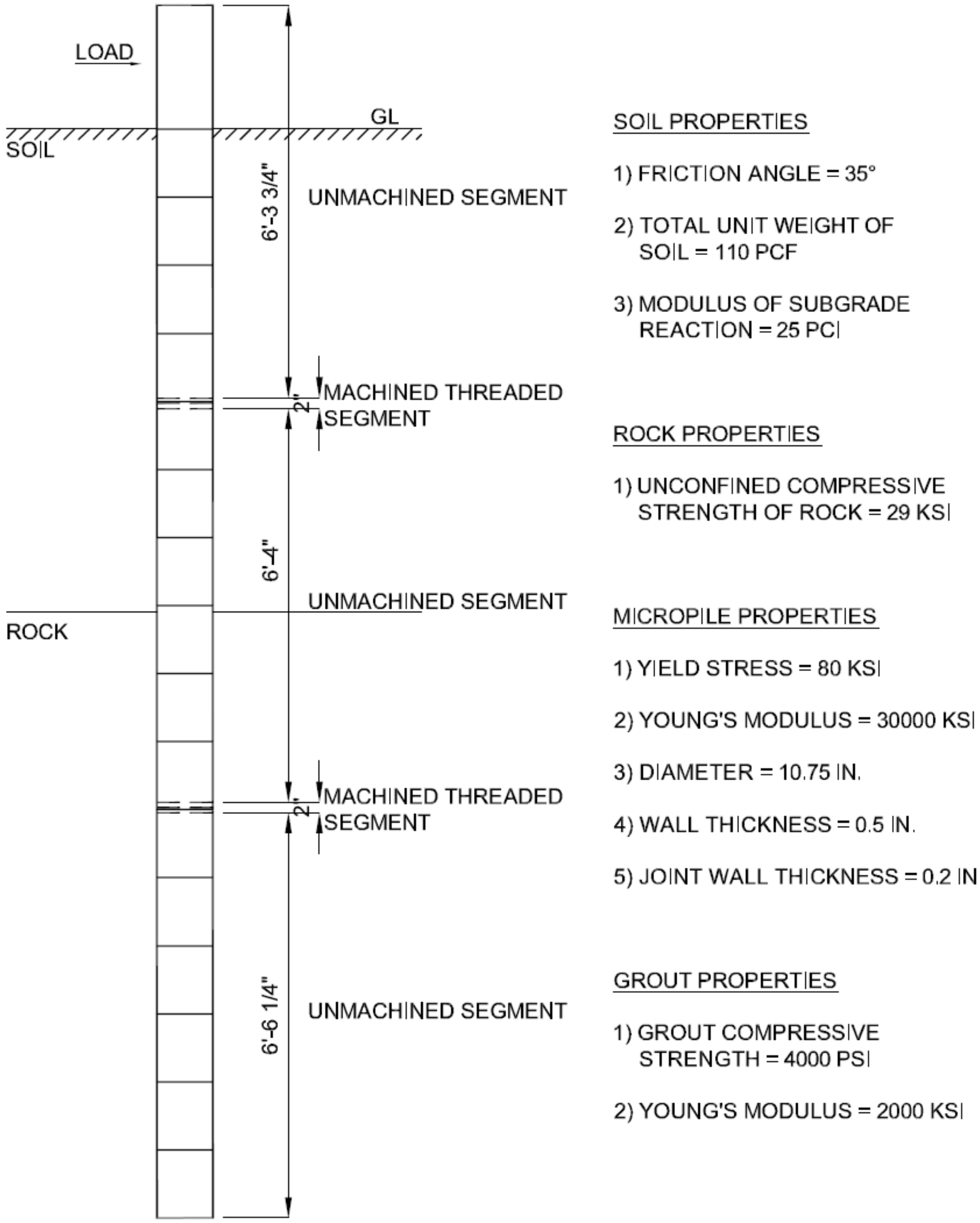


Figure 3.9: Single pile soil-structure interaction models.

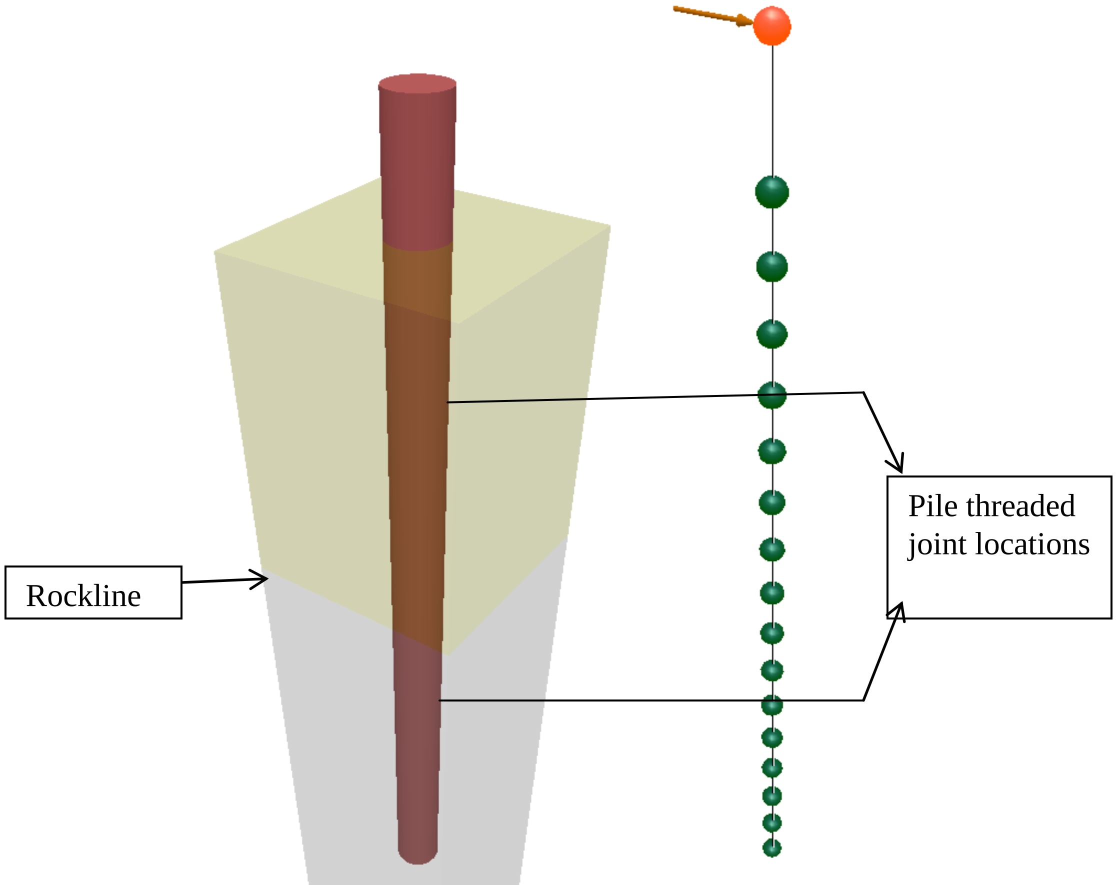


Figure 3.10: FB-MultiPier models for single micropile

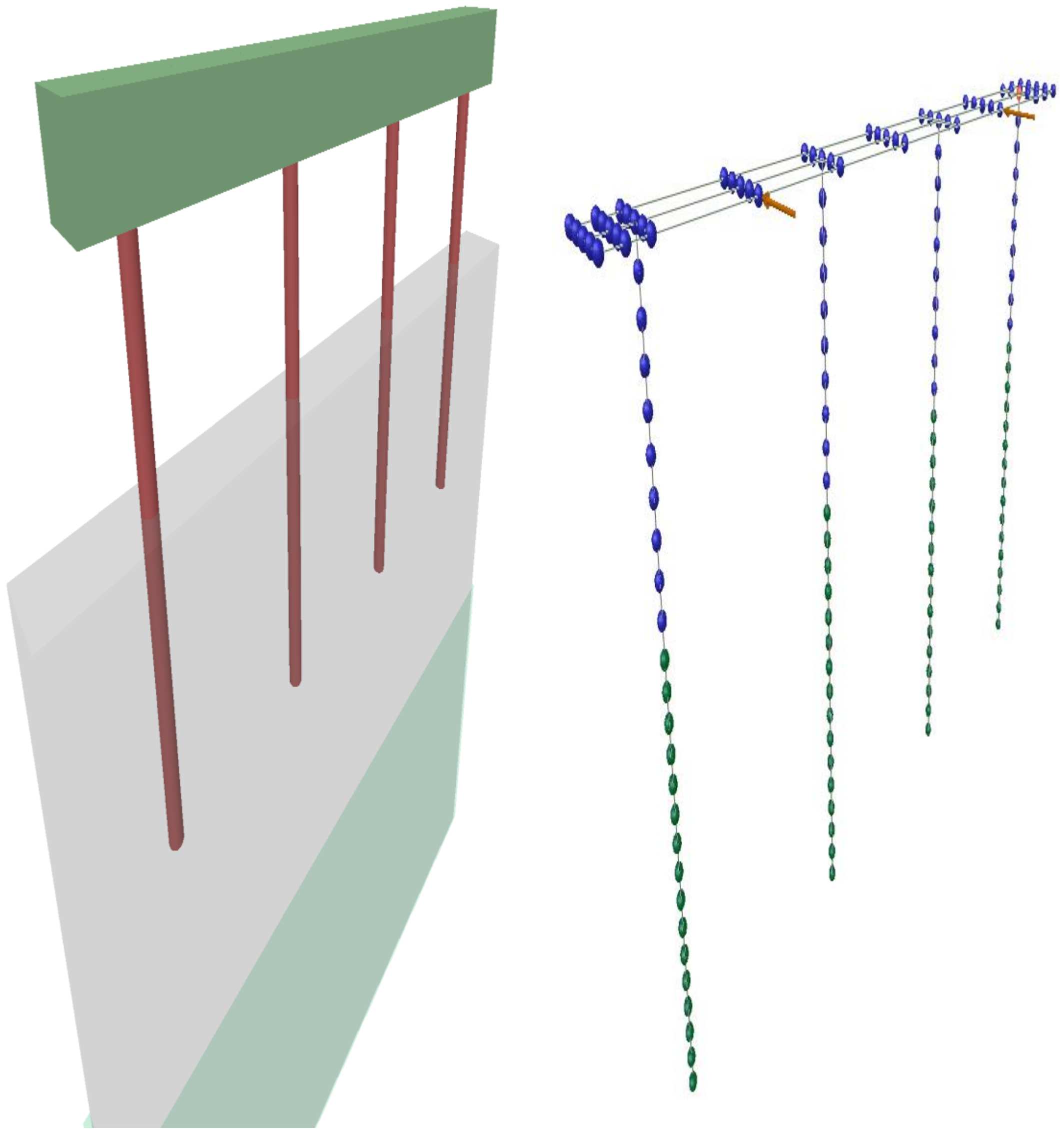


Figure 3.11: FB-MultiPier models for micropile bent

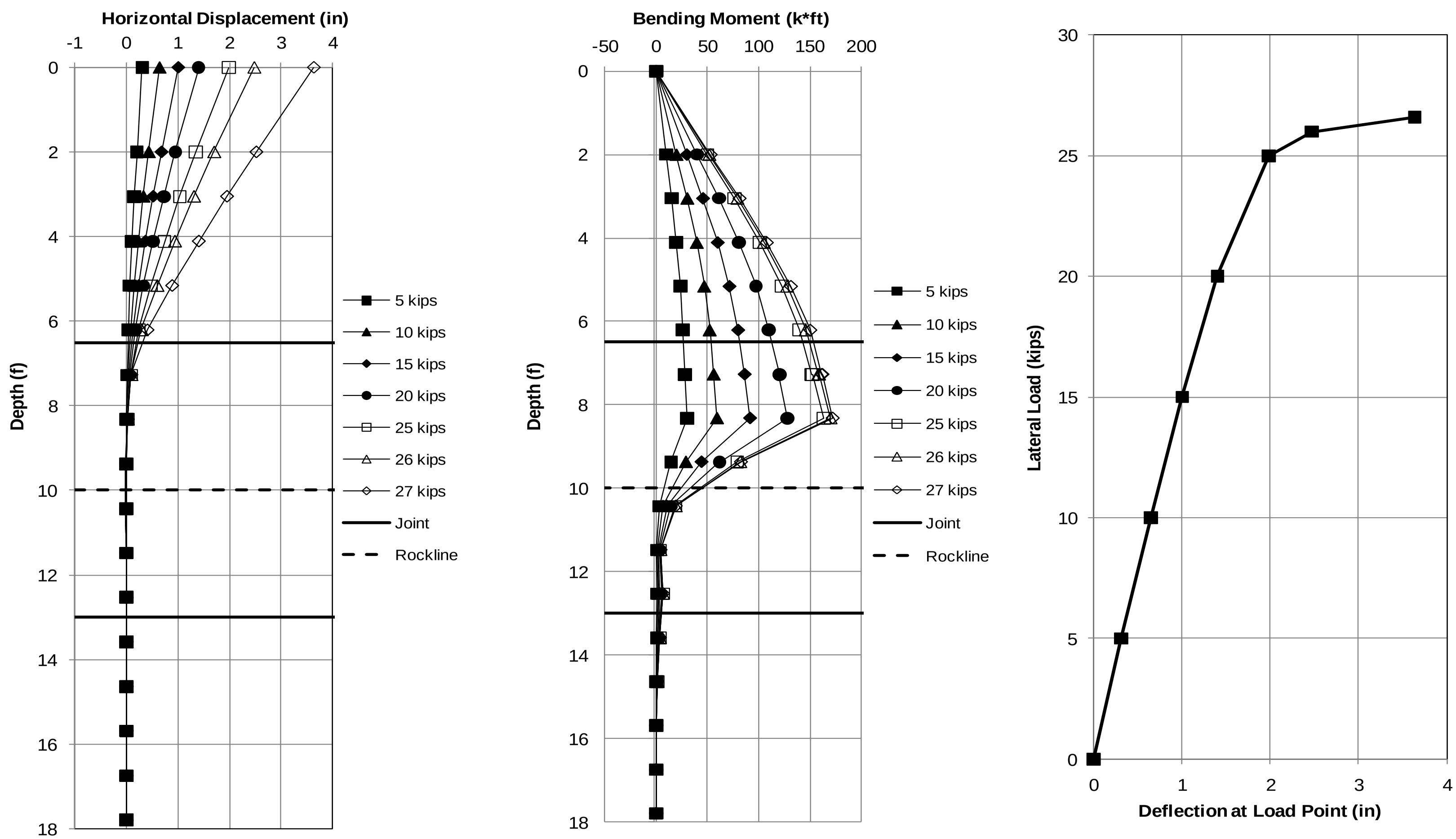


Figure 3.12: The preliminary displacement-depth, bending moment-depth, and top displacement of a typical micropile section

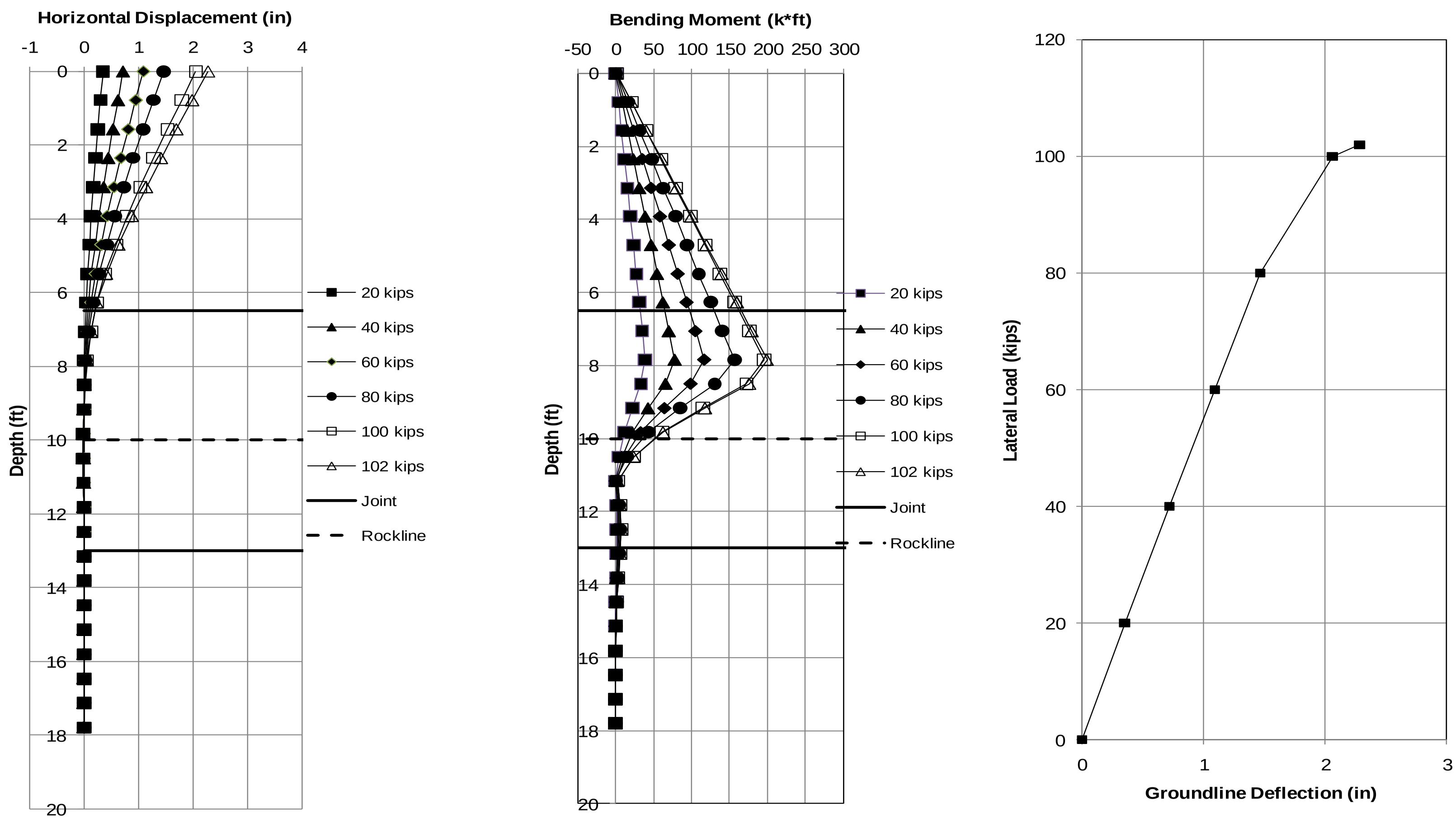


Figure 3.13 Preliminary displacement-depth, bending moment-depth, and top displacement of a typical micropile from a 4 pile bent

3.5 Sensitivity Analysis

One of the objectives of the research program was to develop a model with the ability to predict the behavior of micropiles under lateral load. It is helpful to understand the sensitivity of the micropile moment and deflection to six parameters (steel yield stress, friction angle, subgrade, grout modulus, joint thickness and grout compressive strength) with respect to the applied lateral loads. Sensitivity analysis was used to validate a model, warn of unrealistic model behavior, and also point out important assumptions if any. The analyses formulate model structure, simplify a model, suggest new experiments, suggest accuracy for calculating parameters, and adjust numerical values of parameters. The threaded casing joints were analyzed to show the effect the joint will have on both the deflection and the bending resistance of the jointed micropiles. According to the Micropile Design and Construction Reference Manual (Sabatini et al., 2005), a conservative method assumes that the threaded joint is equivalent to 50% of the casing section thickness. This value is used in this report as a baseline for the joint reduction analysis. The software used in the research for modeling these parametric effects on bridge substructures was FB-MultiPier. The numerical results can be highly sensitive to small changes in the parameter values. The parameters required for micropile modeling in FB-MultiPier are:

1) Micropile steel yield stress,
2) Soil friction angle,
3) Soil subgrade modulus,
4) Micropile joint wall thickness,
5) Micropile grout compressive strength,

6) Micropile grout modulus,

3.5.1 Sensitivity Effect of Steel Yield Stress

Yield strength of steel is the amount of stress at which plastic deformation becomes noticeable and significant. Yield strength is a very important value for use in engineering structural design. If we are designing a component that must support a force during use, we must be sure that the component does not plastically deform. We must therefore select a material that has high yield strength, or we must make the component large enough so that the applied force produces a stress that is below the yield strength. For this section of the research, we are considering variation of the steel yield strength of 80 ksi, 115 ksi and 150 ksi. Table 3.1 shows the parameters used for the analysis. The plots in Figure 3.14 show the effect of yield strength as the lateral loads are increased. Table 3.2 shows the deflections and the moments at each applied laterals. The results of the analysis shows that the higher the steel yield stress the greater the lateral load the pile can carry. The deflection and the moment are about the same but the lateral load is higher with 115 ksi and also higher with 150 ksi.

TABLE 3.1: Varying yield stress of the steel casing

Materials	Parameter Values		
	▬	□	▢
Joint thickness (in)	0.25	0.25	0.25
Yield Stress, (ksi)	115	150	80
Steel Modulus (ksi)	30000	30000	30000
Grout Strength (psi)	4000	4000	4000
Grout Modulus, (ksi)	2000	2000	2000
Friction Angle	35^0	35^0	35^0
Total unit weight, (pcf)	110	110	110
Subgrade, (pci)	25	25	25
Rock Strength,(psf)	417600	417600	417600

Table 3.2: Effect of steel yield stress

Steel Casing Yield (ksi)	80		115		150	
Load (kips)	Deflection (in)	Max. moment (kips*ft)	Deflection (in)	Max. moment (kips*ft)	Deflection (in)	Max. moment (kips*ft)
10	0.6	62.18	0.6	62.18	0.6	62.18
20	1.27	130.24	1.27	130.24	1.27	130.24
30	2.02	204.02	1.98	204.01	1.98	204.01
38	-	-	2.58	266.7	-	-
40	-	-	-	-	2.73	282.4

3.5.2 Sensitivity Effect of Friction Angle

The ultimate soil capacity is the greatest lateral load the soil can sustain regardless of the lateral deflection. Table 3.3 shows the parameters used for the analysis. The plots in Figures 3.15 show the effect of friction angle as the lateral loads are increased. Table 3.4 shows a better picture of the result. From Figure 3.15, the deflection of the pile for each of the friction angles are the same up to about 15 kips lateral load. As the lateral load increases, the effects of the friction angle starts showing on both the deflection and the moment effect. The effect shows as the friction angle increases the deflection and the moment decreases. The result shows a difference of between 6-13 % in both the moment and lateral deflection capacity as the friction angle increases.

TABLE 3.3: Varying friction angle

Materials	Parameter Values		
	■	□	☐
Joint thickness (in)	0.25	0.25	0.25
Yield Stress, (ksi)	115	115	115
Steel Modulus (ksi)	30000	30000	30000
Grout Strength (psi)	4000	4000	4000
Grout Modulus, (ksi)	2000	2000	2000

TABLE 3.3: (cont'd)

Materials	Parameter Values		
	■	□	▣
Friction Angle	35^0	40^0	50^0
Total unit weight,(pcf)	110	110	110
Subgrade, (pci)	25	25	25
Rock Strength,(psf)	417600	417600	417600

TABLE 3.4 Effect of friction angle

Friction Angle	35		40		50	
Load (kips)	Deflection (in)	Max. moment (kips*ft)	Deflection (in)	Max. moment (kips*ft)	Deflection (in)	Max. moment (kips*ft)
10	0.6	62.18	0.6	62.05	0.6	62.02
20	1.27	130.24	1.23	125.24	1.22	123.63
30	1.98	204.01	1.92	194.61	1.85	185.07
38	2.59	266.7	2.49	252.72	-	-
40	-	-	-	-	2.5	247.57

3.5.3 Sensitivity Effect of Subgrade Modulus

Subgrade modulus is the stiffness of subgrade soils in either the compacted condition or the natural state. It is the measure of strength-deformation properties of soil. It is known that the modulus of subgrade reaction is not a soil constant but is a function of the contact pressure and settlement. It depends on foundation loads, foundation size and stratification of the subsoil. The modulus of subgrade reaction is not a unique property of the soil, but depends on pile characteristics and the magnitude of deflection.

Table 3.5 shows the parameters used for the analyses. The plot in Figure 3.16 shows the effect of modulus of subgrade as the lateral loads are increased. Table 3.6 shows a better picture of the result.

TABLE 3.5: Varying subgrade modulus

Materials	Parameter Values			
	▬	□	□	□
Joint thickness (in)	0.25	0.25	0.25	0.25
Yield Stress, (ksi)	115	115	115	115
Steel Modulus (ksi)	30000	30000	30000	30000
Grout Strength (psi)	4000	4000	4000	4000
Grout Modulus, (ksi)	2000	2000	2000	2000
Friction Angle	35^0	35^0	35^0	35^0
Total unit weight, (pcf)	110	110	110	110
Subgrade, (pci)	25	150	250	350
Rock Strength,(psf)	417600	417600	417600	417600

Table 3.6a: Effect of subgrade modulus

Subgrade modulus (pci)	25		150	
Load (kips)	Deflection (in)	Max. moment (kips*ft)	Deflection (in)	Max. moment (kips*ft)
10	0.64	59.6	0.57	55.96
20	1.39	128.17	1.25	126.29
30	2.21	203.56	1.97	201.6
32	2.41	219.18	-	-
38	-	-	2.57	263.77

Table 3.6b: Effect of subgrade modulus

Subgrade modulus (pci)	250		350	
Load (kips)	Deflection (in)	Max. moment (kips*ft)	Deflection (in)	Max. moment (kips*ft)
10	0.56	55.42	0.56	55.03
20	1.25	126.01	1.25	125.93
30	1.97	201.49	1.97	201.47
32	-	-	-	-
38	2.57	263.78	2.57	264.29

While keeping all other parameters constant as shown in Table 3.5, the results show that the variation of the subgrade modulus does appreciably affect both the lateral displacement and the moment of the pile up to 150 pci. The result also shows the load carrying capacity increases from 32 kips to 38 kips before the pile fails. Using the 30 kips lateral load in comparing the effect, for the deflection, a decrease of about 11% as the subgrade changes from 25 pci to 150 pci, thereafter; the deflection effect is not visible. Within the same range, the moment effect is about 1%.

3.5.4 Sensitivity Effect of Threaded Joint

Micropiles are connected through a threaded joint of both male and female as shown in Figure 2.3. The threads have some reduction in the wall thickness (real or virtual for modeling sake) at the location. The sensitivity of the area reduction are evaluated with the help of FB-MultiPier computer program.

Table 3.7 shows the parameters used for the analysis. The plot in Figures 3.17 shows the effect of joint wall thickness as the lateral loads are increased. Table 3.8 shows a better picture of the result. Table 3.2 shows the deflections and the moments at each applied laterals. While keeping all other parameters constant as shown in Table 3.7, the results show that the variation of the joint thickness has great effect on the applied lateral, horizontal displacement and moment capacity.

The results of the analysis show that the higher the joint thickness the greater the lateral load, deflection and the moment capacity. The results show a difference of between 18-24 % in the case of the lateral displacement. Moment capacities are about the same under the same load. And the load capacity is between 10-20 % as the joint thickness changes.

TABLE 3.7: Varying the joint thickness

Materials	Parameter Values		
	■	□	**□**
Joint thickness (in)	0.2	0.3	0.4
Yield Stress, (ksi)	115	115	115
Steel Modulus (ksi)	30000	30000	30000
Grout Strength (psi)	4000	4000	4000
Grout Modulus, (ksi)	2000	2000	2000
Friction Angle	35^{0}	35^{0}	35^{0}
Total unit weight, (pcf)	110	110	110
Subgrade, (pci)	25	25	25
Rock Strength,(psf)	417600	417600	417600

Table 3.8: Effect of joint wall thickness

Joint thickness (in)	0.2		0.3		0.4	
Load (kips)	Deflection (in)	Max. moment (kips*ft)	Deflection (in)	Max. moment (kips*ft)	Deflection (in)	Max. moment (kips*ft)
10	0.65	59.53	0.59	60.99	0.57	61.84
20	1.40	128.07	1.27	129.12	1.20	129.82
30	2.24	203.47	2.00	203.99	1.88	204.26
40	-	-	2.76	282.65	2.59	283.03
50	-	-	-	-	3.40	362.90

3.5.5 Sensitivity Effect of Grout Compressive Strength

ACI defines grout as a mixture of cementitious material and water, with or without aggregate, proportioned to produce a pourable consistency without segregation of constituents. Grout may also contain fly ash, slag, and liquid admixture. Table 3.9 shows the parameters used for the analysis. The plots in Figure 3.18 show the effect of grout compressive strength as the lateral loads are increased. Table 3.10 shows a better picture of the result. The results show a difference of between 3-4.5 % in both the moment and lateral deflection capacity as the grout compressive strength increases from 1000psi to 4000 psi.

TABLE 3.9: Varying grout compressive strength

Materials	Parameter Values		
	▬	□	▢
Joint thickness (in)	0.25	0.25	0.25
Yield Stress, (ksi)	115	115	115
Steel Modulus (ksi)	30000	30000	30000
Grout Strength (psi)	1000	2500	4000
Grout Modulus, (ksi)	2000	2000	2000
Friction Angle	35^{0}	35^{0}	35^{0}
Total unit weight, (pcf)	110	110	110
Subgrade, (pci)	25	25	25
Rock Strength,(psf)	417600	417600	417600

Table 3.10: Effect of grout compressive strength

Grout strength (psi)	1000		2500		4000	
Load (kips)	Deflection (in)	Max. moment (kips*ft)	Deflection (in)	Max. moment (kips*ft)	Deflection (in)	Max. moment (kips*ft)
10	0.65	59.35	0.65	59.57	0.64	59.60
20	1.43	127.85	1.4	128.09	1.39	128.17
30	2.3	203.09	2.24	203.46	2.21	203.56
31	-		2.34	221.24	-	-
32	-		-		2.4	219.18

3.5.6 Sensitivity Effect of Grout Modulus

The physical measure of a material to deform under load is called modulus of elasticity. It is the ratio of stress to the strain of the material or combination of materials as is the case of grouted micropiles. Table 3.11 shows the parameters used for the analysis. The plots in Figure 3.19 show the effect of grout compressive strength as the lateral loads are increased. Table 3.12 shows a better picture of the result. The results show a difference of between 2-4 % in both the moment and lateral deflection capacity as the grout modulus increases from 500 ksi to 2000 ksi.

TABLE 3.11: Varying grout modulus

Materials	Parameter Values		
	▬	▭	□
Joint thickness (in)	0.25	0.25	0.25
Yield Stress, (ksi)	115	150	80
Steel Modulus (ksi)	30000	30000	30000
Grout Strength (psi)	4000	4000	4000
Grout Modulus, (ksi)	500	1000	2000
Friction Angle	35^0	35^0	35^0
Total unit weight, (pcf)	110	110	110
Subgrade, (pci)	25	25	25
Rock Strength,(psf)	417600	417600	417600

Table 3.12: Effect of grout modulus

Grout modulus (ksi)	500		1250		2000	
Load (kips)	Deflection (in)	Max. moment (kips*ft)	Deflection (in)	Max. moment (kips*ft)	Deflection (in)	Max. moment (kips*ft)
10	0.69	58.51	0.66	59.12	0.64	59.60
20	1.46	127.42	1.42	127.84	1.39	128.17
30	2.31	202.99	2.25	203.34	2.21	203.56
32	-		2.46	218.94	2.4	219.18

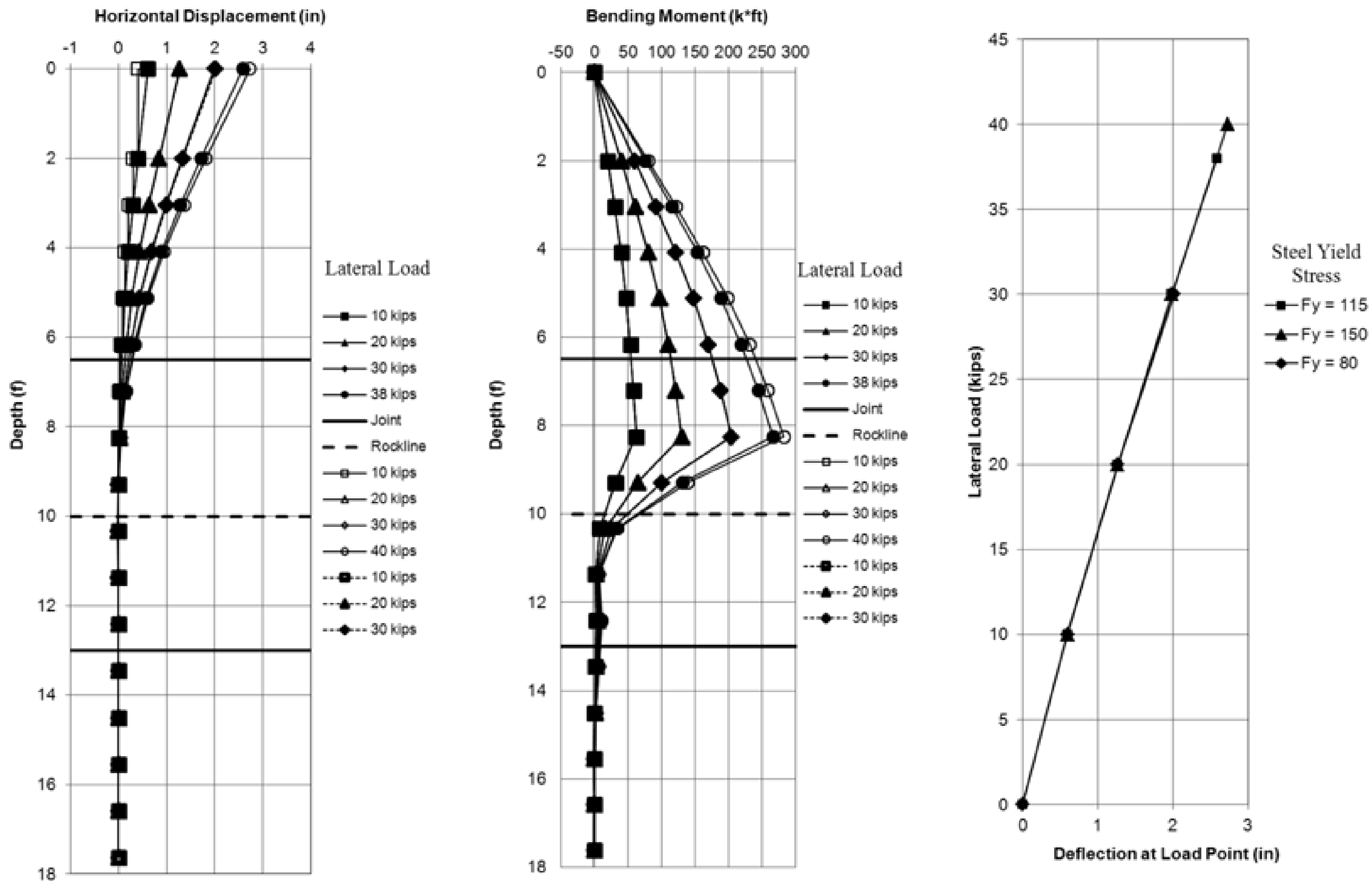


FIGURE 3.14 Effect of steel yield stress

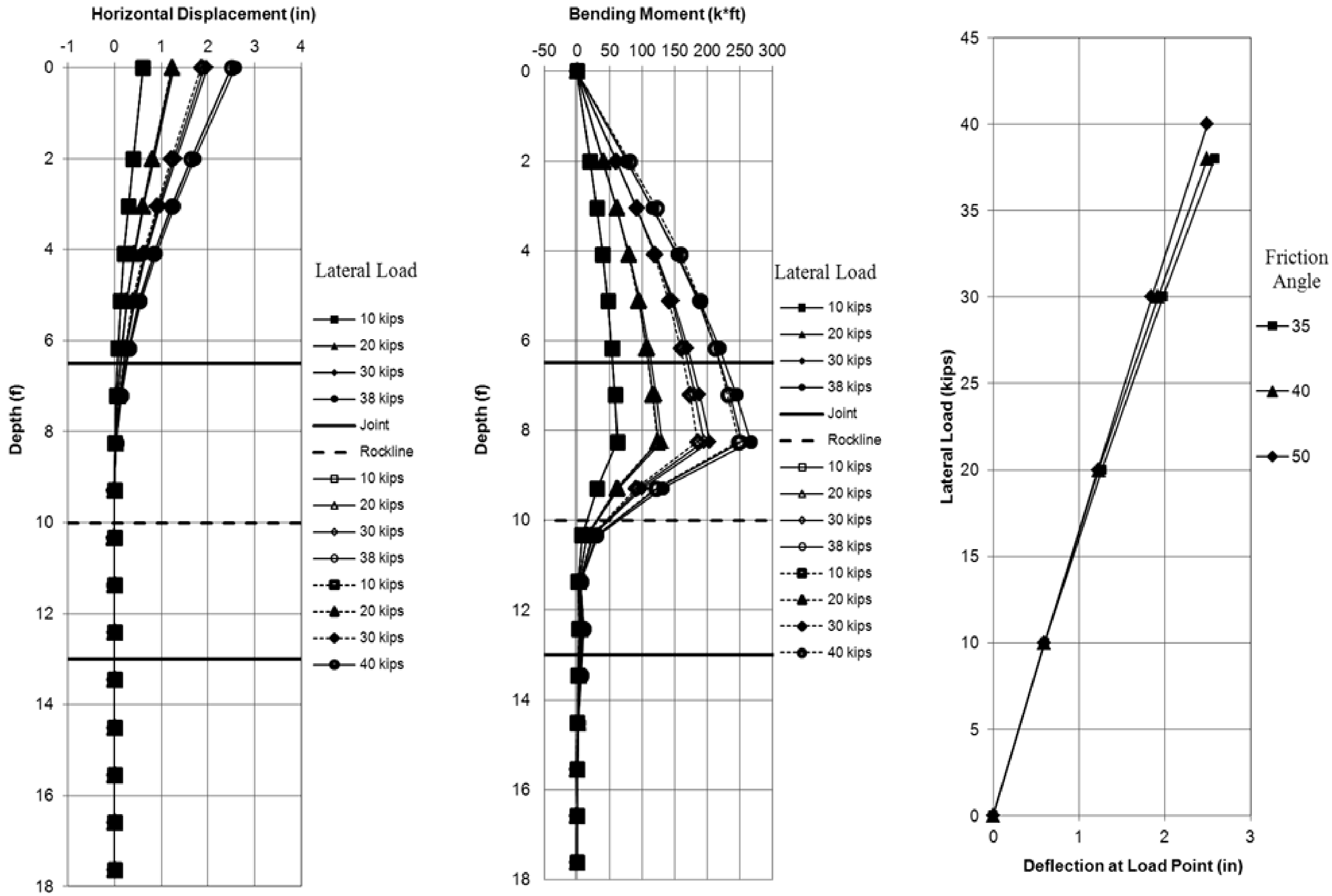


FIGURE 3.15 Effect of friction angle

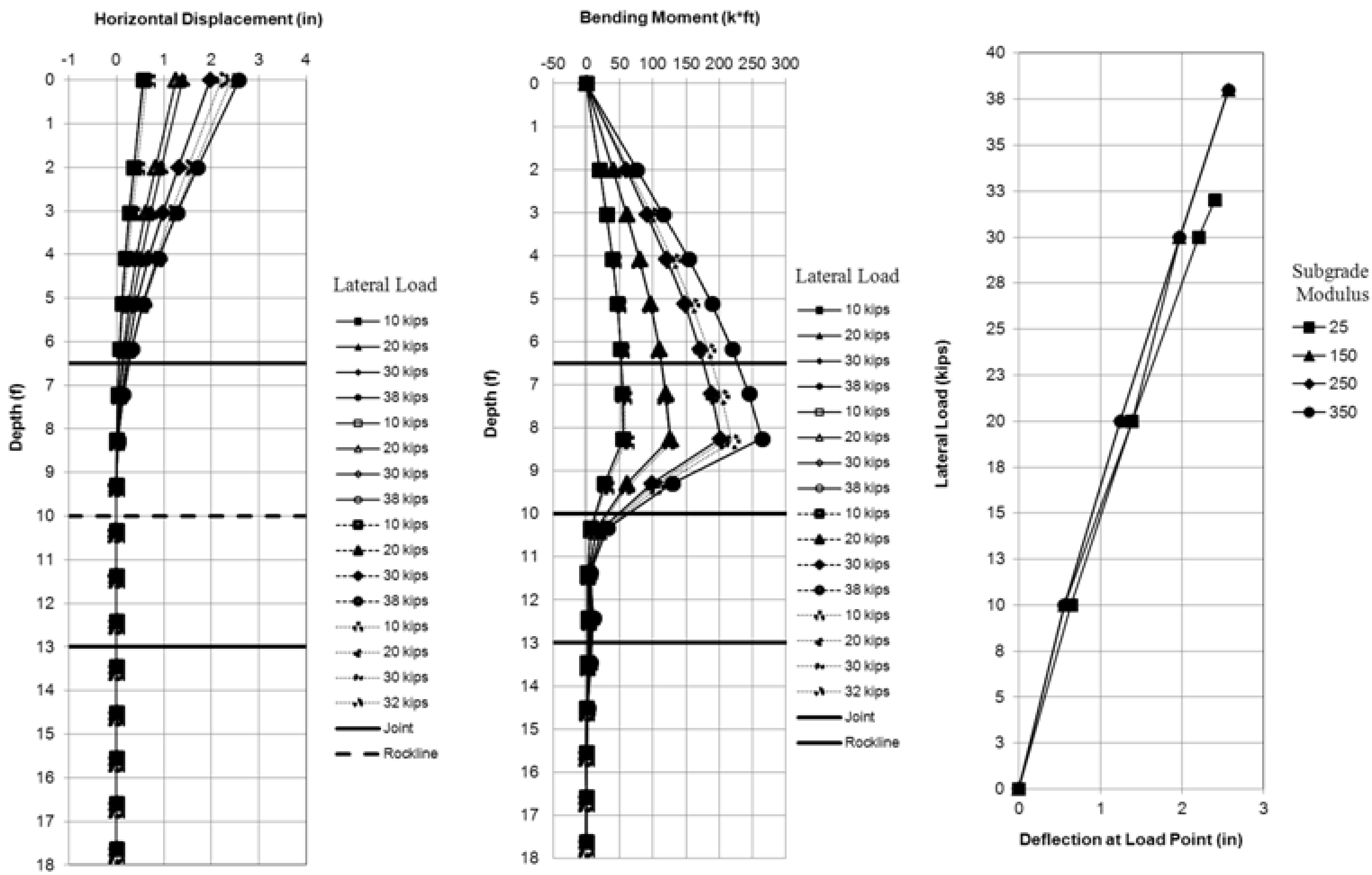


FIGURE 3.16: Effect of Subgrade modulus

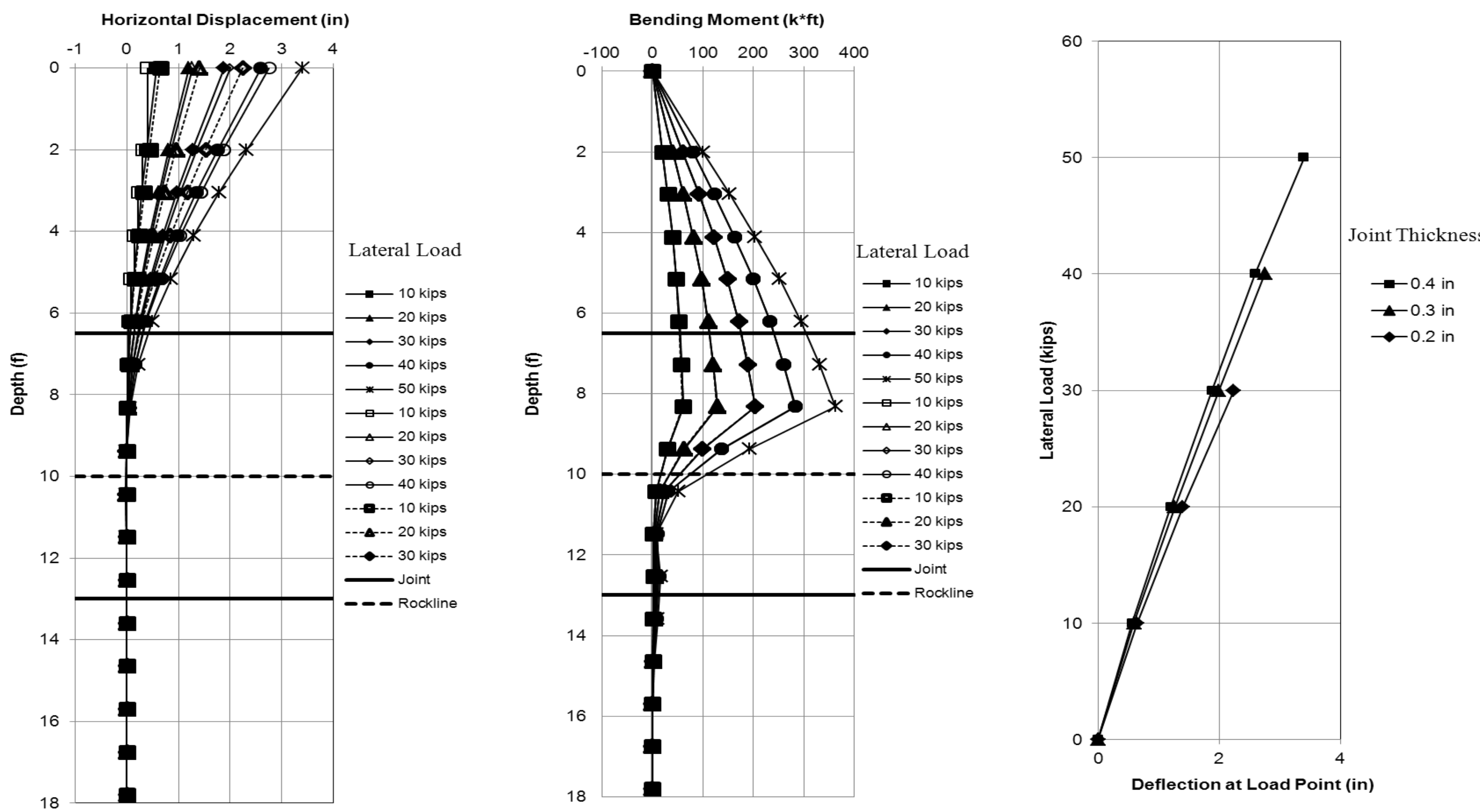


FIGURE 3.17: Effect joint wall thickness

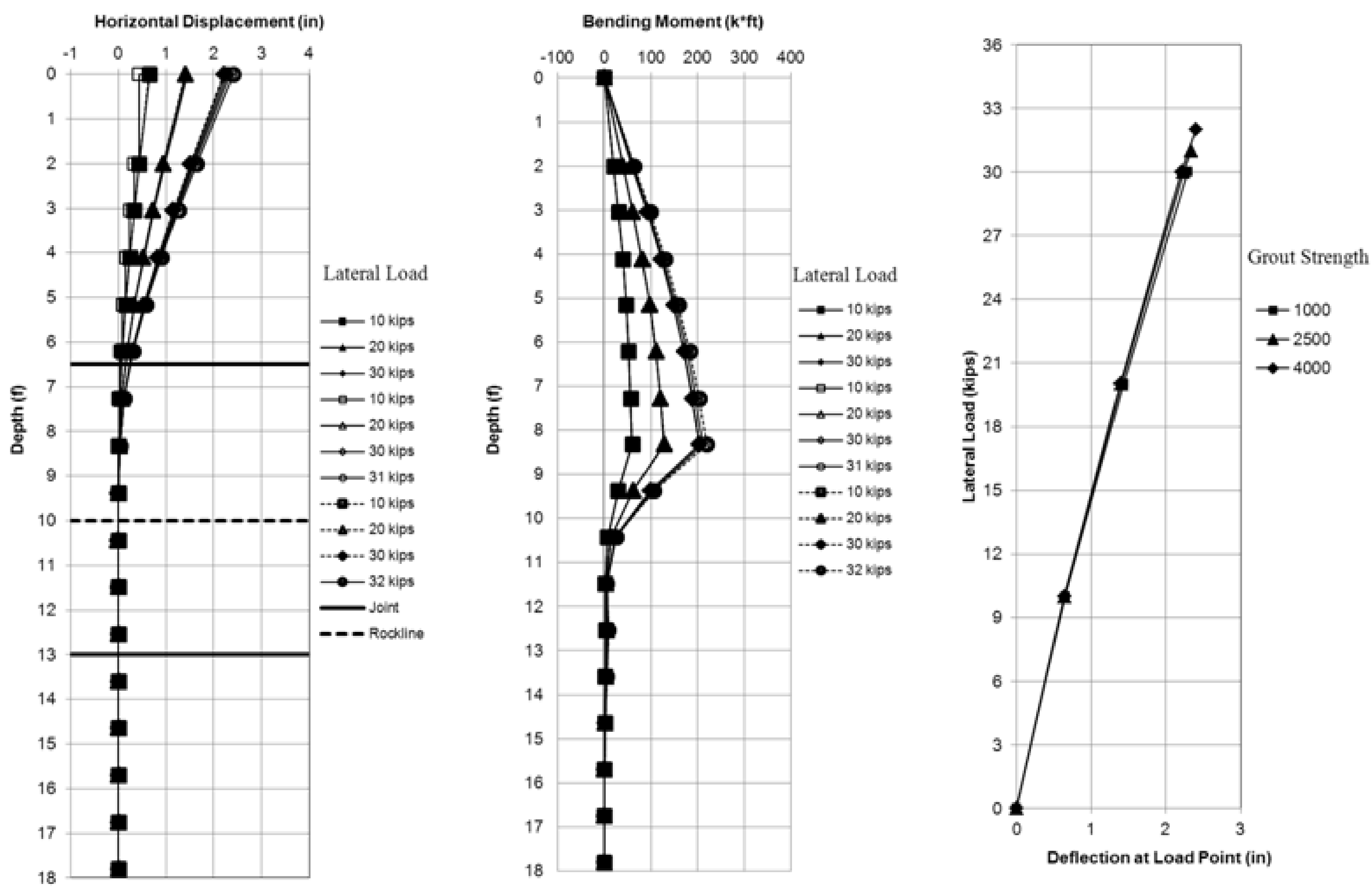


FIGURE 3.18: Effect grout compressive strength

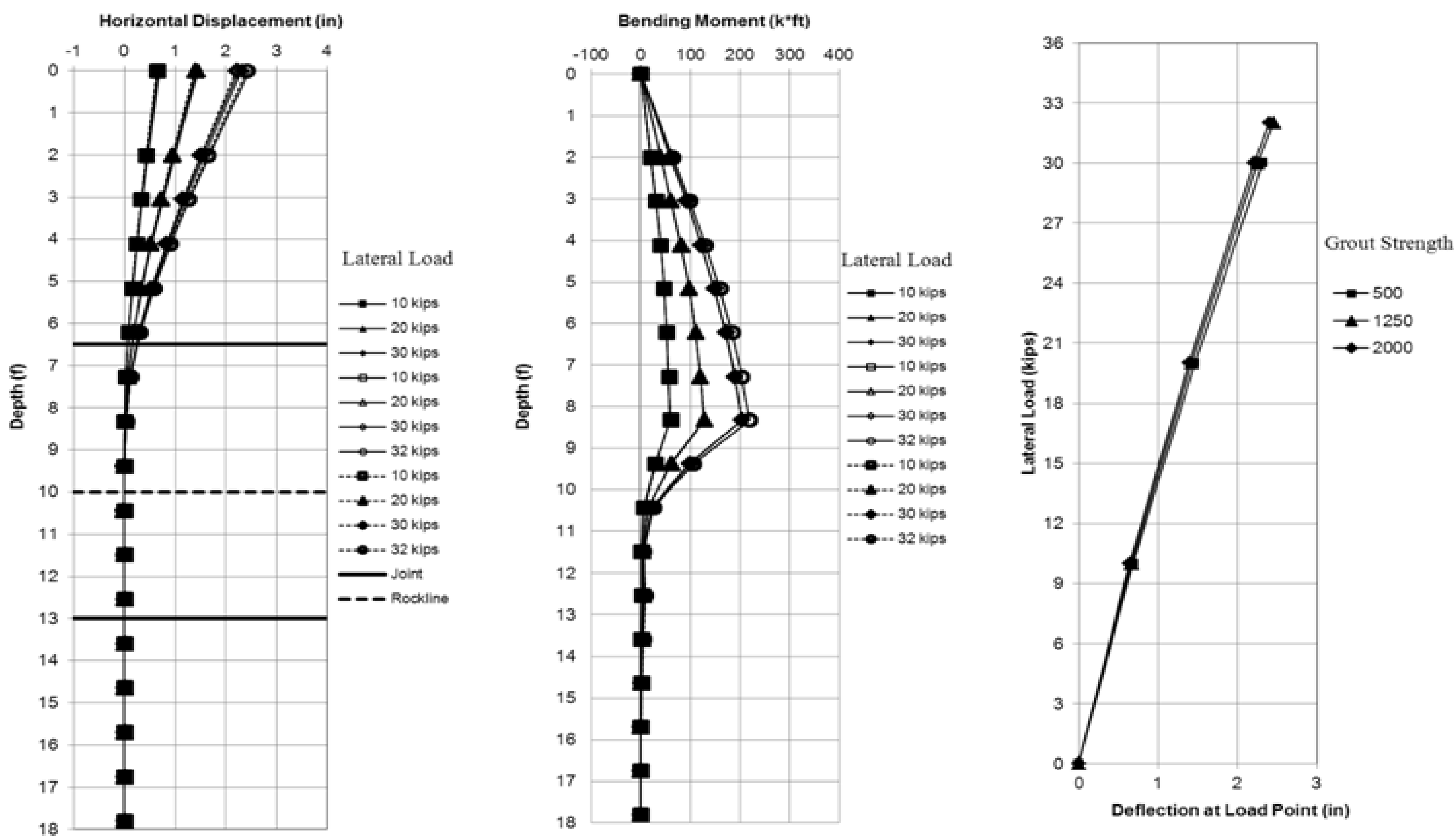


FIGURE 3.19: Effect grout modulus

3.6 Discussion of Sensitivity Analysis

Six parameter studies were performed to investigate the influence of different parameters on the micropile and joint behavior. The parameters studied were steel yield stress, joint wall thickness, friction angle, subgrade, grout modulus and the compressive strength of the grout.

From the sensitivity analysis carried out and as shown in results in Figures 3.15, 3.16 and 3.17, the friction angle, subgrade modulus and the joint thickness have the greatest effect compared to others parameters on the lateral deflection, moment and the lateral load carrying of the piles, as shown in Figures 3.14, 3.18 and 3.19.

In the case of the steel yield stress effect, the deflection, as shown in Figure 3.14, has a linear shape with f_y of 150 ksi having a higher lateral failure load as compared to f_y of 115 ksi and f_y of 80 ksi. The same effect occurred in the cases of the compressive strength of the grout and the grout modulus.

The effect of the wall thickness reduction on the deflection of the pile was shown in Figure 3.17 and Table 3.8. The wall thickness was reduced linearly by 20%, for 0.40 in wall thickness, the failure load was 50 kips with a maximum deflection of 3.4 in. and maximum moment of 364 kips*ft. With another 20 % reduction in the wall thickness, the failure load reduces to 40 kips with a maximum deflection of 2.76 in. and maximum moment of 260 kips*ft. When the joint wall thickness was reduced to 0.2 in (60%), the failure load was reduced to 30 kips with a maximum deflection of 2.24 in. and maximum moment of 204 kips*ft.

3.7 Preliminary Laboratory Load Tests Models

Similar to the field testing program, prediction of the laboratory test behavior was a necessary step in planning and executing the research program. Structural analysis of a simply supported beam was used to predict the deflection and the bending moment behavior of the pile. Predictions require the calculations of the bending moment and the deflection of the section under increasing load conditions. Deflections of beams depend on the stiffness of the material and the dimensions of the beams as well as the more obvious applied loads and supports. As an illustration of this process, consider the case of "four-point-bending" shown in Figure 3.22. For the four point flexural test, the specimen lies on a span and stress is uniformly distributed between the loading noses. In order to analyze the behavior of the micropile in pure bending, a fundamental formula was used to determine deflections based on beam curvature. This is given by the expression:

$$\kappa = \frac{1}{R} = \frac{M}{EI} = \frac{d^2 y}{dx^2} \tag{3.1}$$

Where:

κ = curvature

R = the radius of the shape of the curved beam at a distance x from the origin

E = the elastic modulus of the beam material (micropile)

I = moment of inertia of the micropile's cross-section

M = bending moment of the section, distance x from a fixed reference point

y = vertical deflection at the section distance x from the reference point

The load was applied as shown in Figure 3.20; the reaction forces at each of the ends are equal to half the applied load. The deflections from elastic curve relations are based on the following assumptions:

1. The square of the slope of the beam is assumed to be negligible compared to unity.
2. The beam deflection due to shear stresses is negligible (i.e., plane sections remain plane).
3. The value of elastic modulus and moment of inertia remain constant for any interval along the beam.

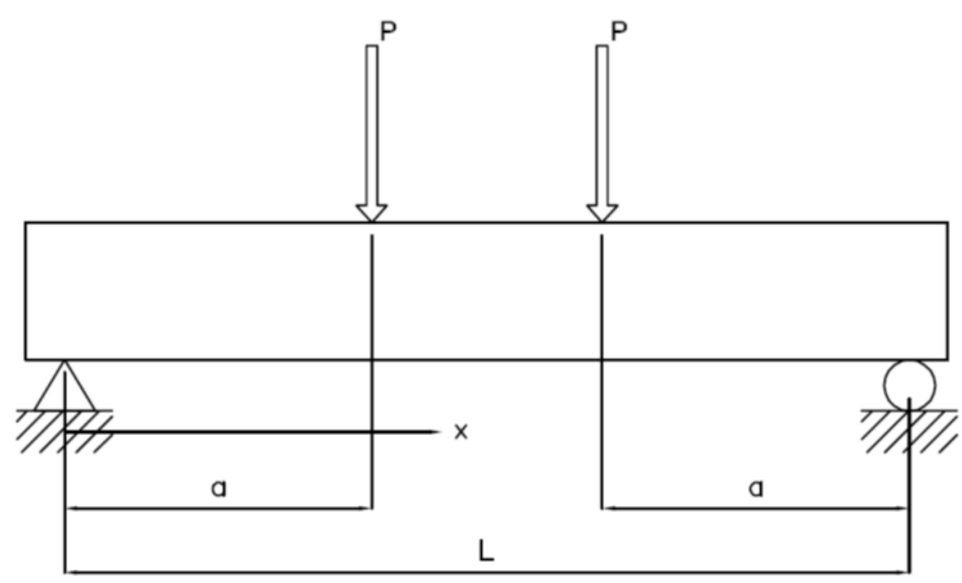


Figure 3.20: Idealized four point loading diagram

For simple beam with two equal concentrated loads symmetrically placed, the displacements of the section are expressed as:

$$\Delta = \frac{Px(3La - 3a^2 - x^2)}{6EI} \quad \text{for } 0 \le x \le a \tag{3.2}$$

$$\Delta(x) = \frac{Pa(3xL - 3x^2 - a^2)}{6EI} \quad \text{for } a \le x \le (L-a) \tag{3.3}$$

$$\Delta(x) = \frac{P(L-x)(3a^2 - 3La + L^2 + x^2 - 2Lx)}{6EI} \quad \text{for } (L-a) \le x \le L \tag{3.4}$$

$$\Delta\ (max) = \frac{Pa(3L^2 - 4a^2)}{24EI} \qquad \text{at center (L/2)} \tag{3.5}$$

In the case of the moment, the moments of the section are expressed as:

$$M_{(max)} = P*a \qquad \text{(between the loads)} \tag{3.6}$$

$$M_x = P*x \qquad \text{for } 0 \le x \le a \tag{3.7}$$

$$M_x = P*a \qquad \text{for } a \le x \le (L\text{-}a) \tag{3.8}$$

$$M_x = P*(L-x) \qquad \text{for } (L\text{-}a) \le x \le L \tag{3.9}$$

The Maximum stress for the section is expressed as:

$$\sigma_{max} = |M_{(max)}| \frac{C}{I} = |\frac{Pa}{Z}| \tag{3.10}$$

Where

Δ = the deflection in inches,

P = point load in kips,

L = length of the pile in feet,

x = location of the moment or deflection, in feet

a = location of the loads

M = moment at any location

σ = stress of the beam section

Z = section modulus of the beam

I = moment of inertia of the section

EI = flexural rigidity of the micropile and grout section.

The above equations 3.2 to 3.10 are used to calculate the deflection and bending moment for each of the applied loads. Figure 3.21 shows the bending moments and deflections for arbitrary loads. The results shown would be for an integral section, thus are an upper bound approximation.

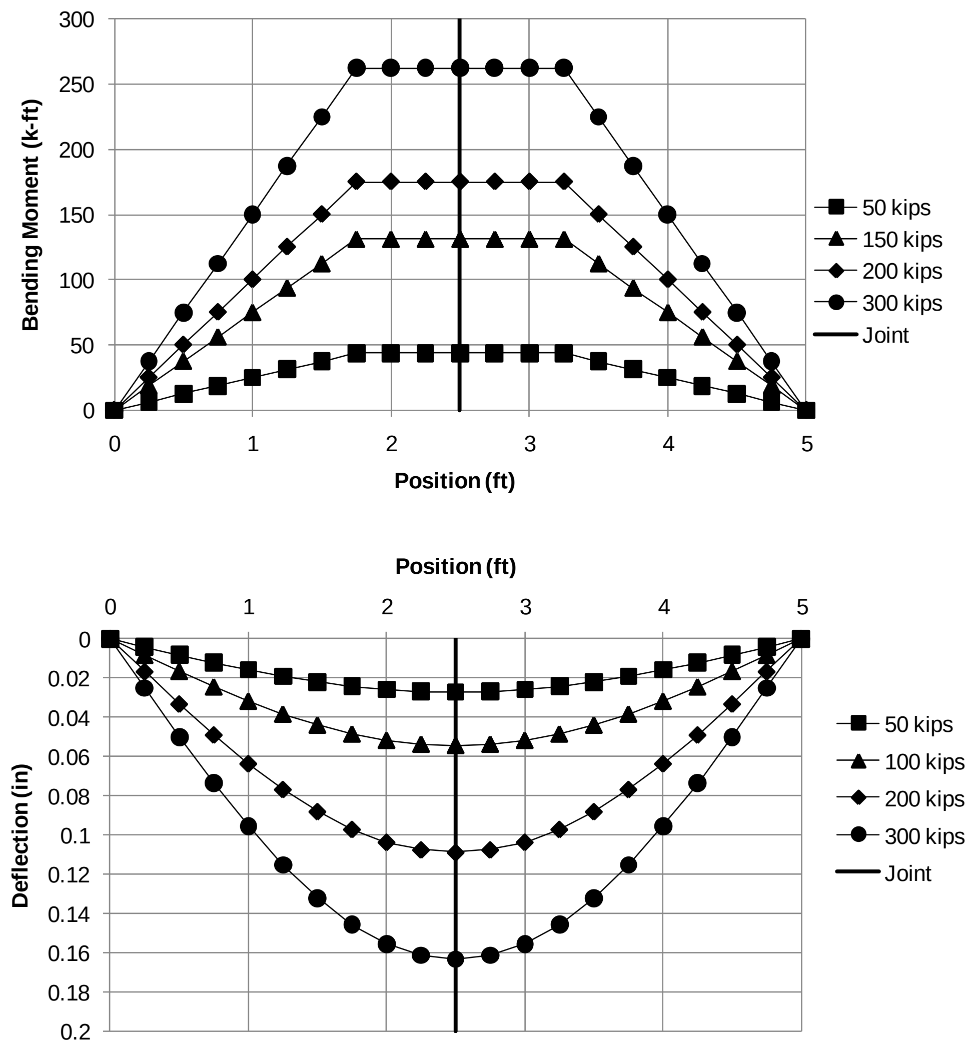


Figure 3.21: Theoretical four point bending behavior for an integral section

CHAPTER 4: FIELD LOAD TESTING PROGRAM

4.1 Background

NCDOT secured funding for the use of micropiles on new bridge foundations through the FHWA Innovative Bridge Research and Deployment Program (IBRD). The funding was used to install micropiles specifically for lateral load testing. When the project was envisioned, and the corresponding bridge project was let, a schedule of micropiles was proposed. The testing arrangement was designed after careful consideration of previous research, existing conditions, available funds, and research objectives. The general strategy for the test setup was to provide a means to apply concentrated load at the top of the pile while measuring force, deflection, and bending moment. Sixteen micropiles would be constructed to perform 9 lateral load tests including a group load test with a cast concrete cap. The original drawing from the bridge plans is Figure 4.1 and the corresponding load test plan is Figure 4.2.

When construction began in August of 2009, several impediments to constructing the piles in the proposed configuration appeared. The three primary obstacles were the position of the new bridge and other infrastructure, the proximity of right of way to the new construction, and overhead utilities. The original 4x4 plan was eventually split into three groups: 2x 2, 2x2, and 4x2. An as- built mock plan of the load test groupings is shown in Figure 4.3. This change necessitated the reconfiguration of most and elimination of three of the proposed load tests. For simplicity, the pile numbering was kept the same. As construction method was up to the contractor, full depth casing was used rather than central bars for all piles installed at the site. The amended load test plan is shown in Figure 4.4.

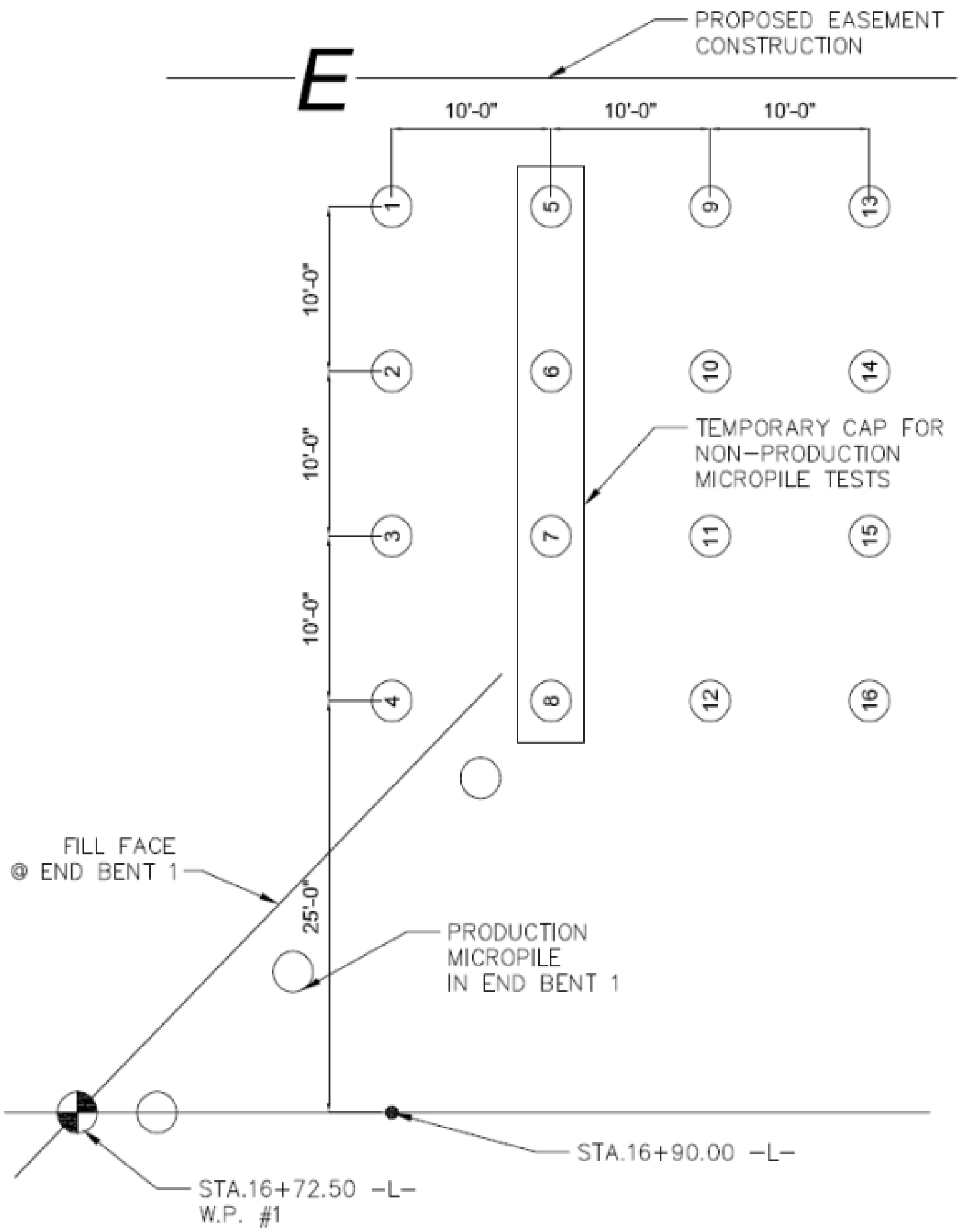


Figure 4.1: Proposed construction layout

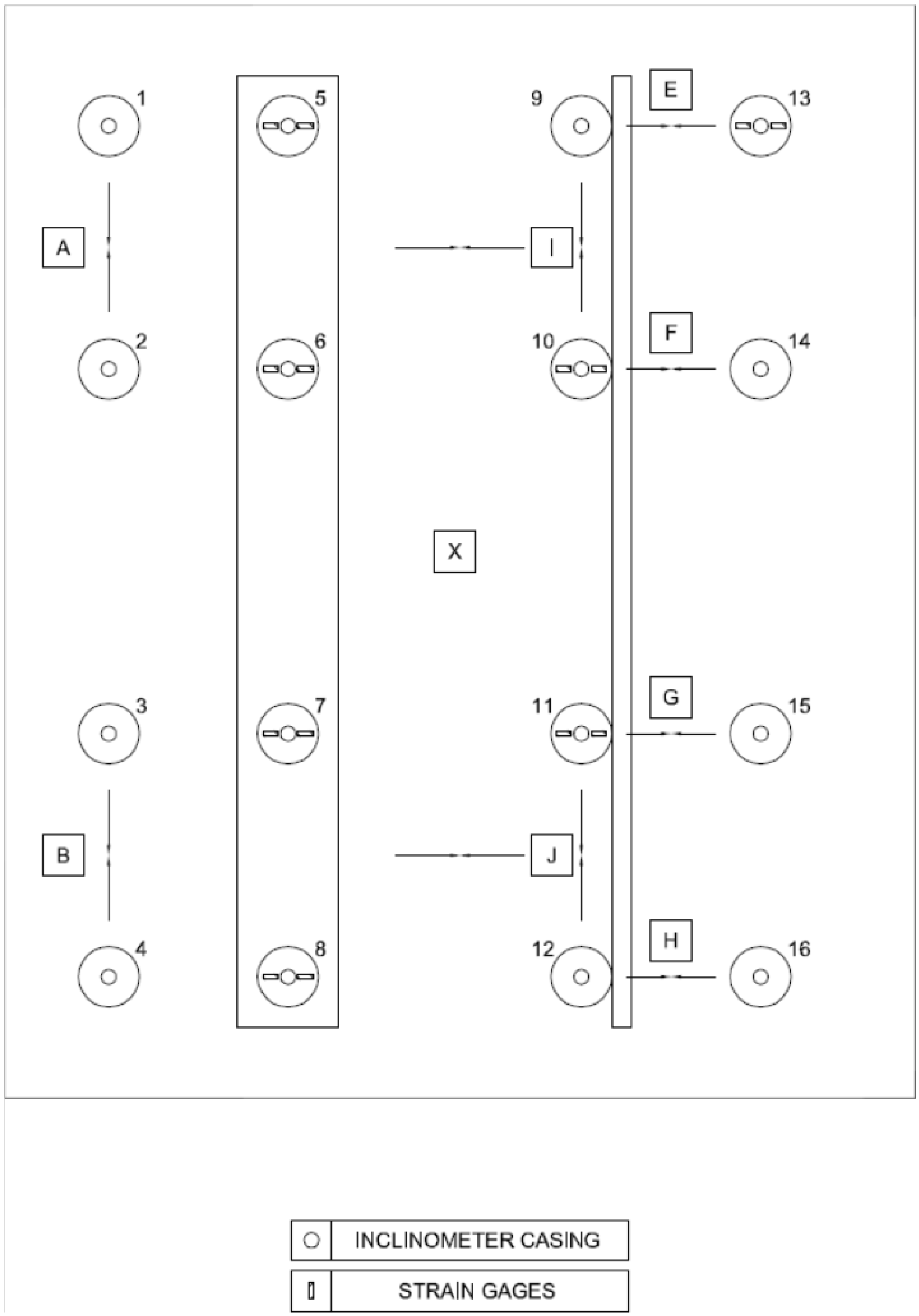


Figure 4.2: Proposed micropile load test layout

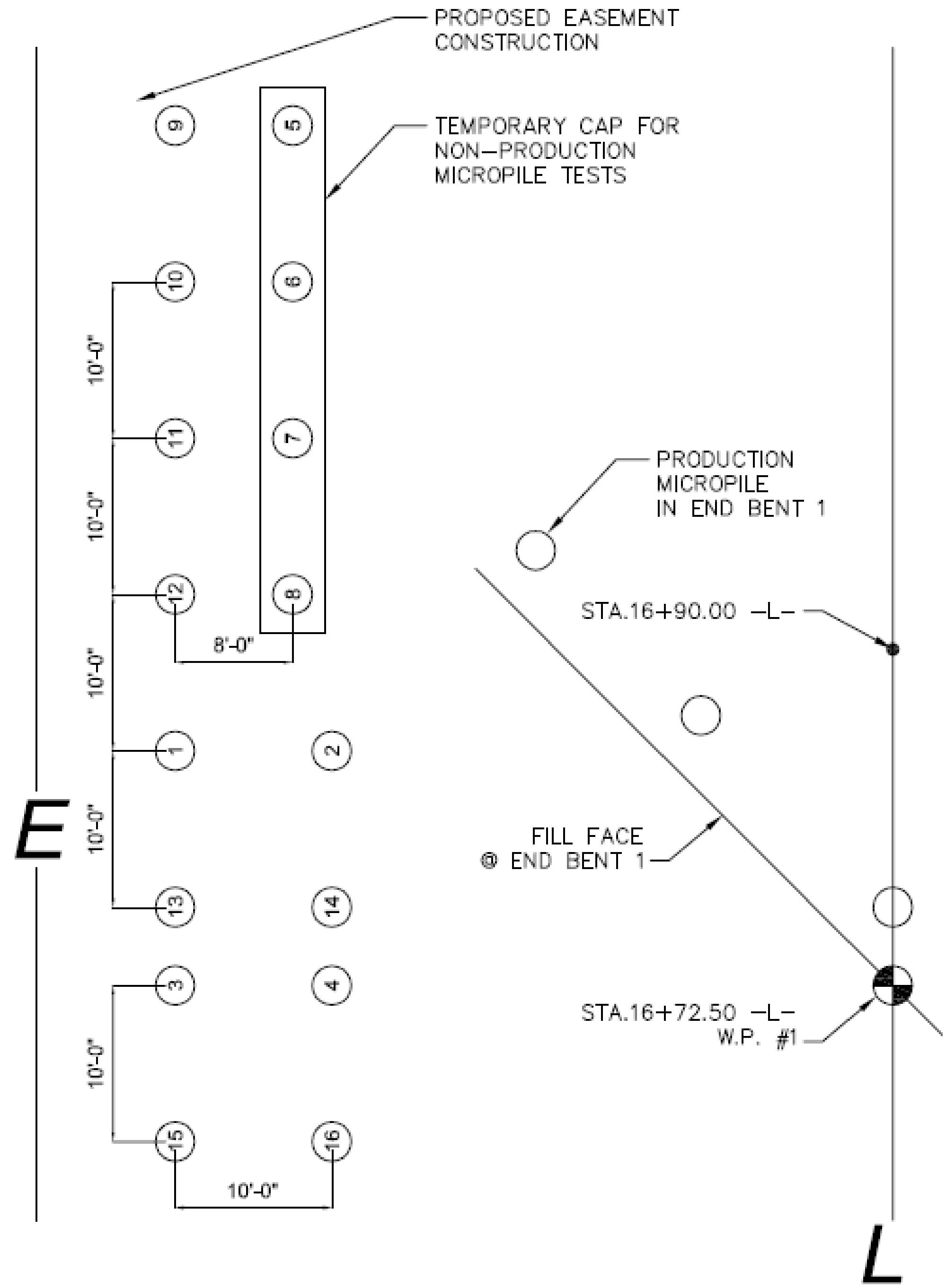
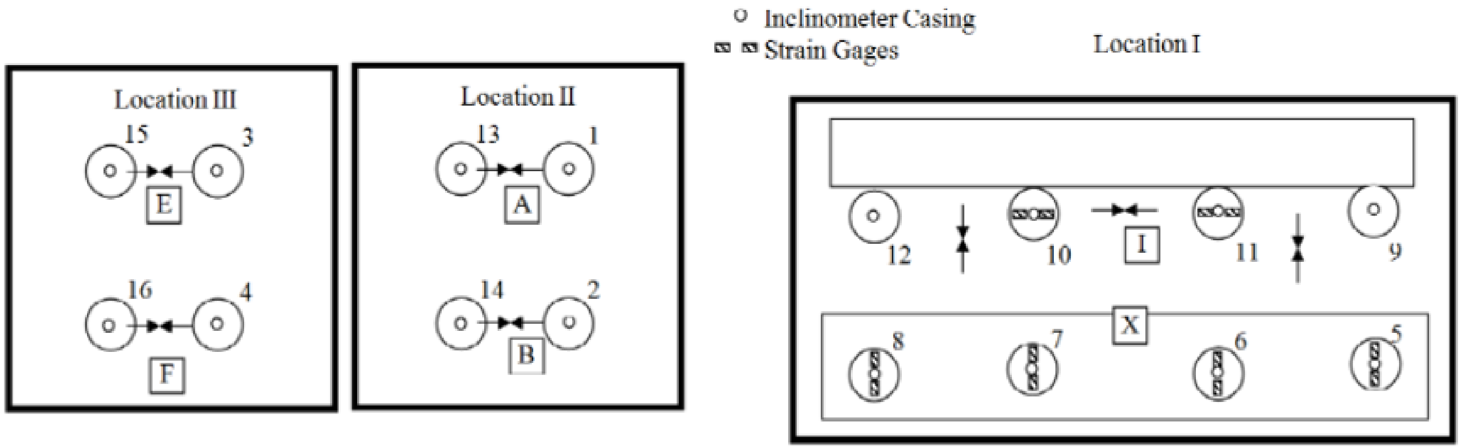


Figure 4.3: As-built layout



Micropile	Description*
1	Casing plunge 1ft
2	Casing plunge 2 ft
3	Casing plunge 5 ft
4	Casing plunge 10 ft
5 – 8	Spec micropile, one casing section above ground, joint exposed, formed cap
9 - 12	Spec micropile , one casing section above ground, joint exposed
13	Casing plunge 1 ft
14	Casing plunge 2 ft
15	Casing plunge 5 ft
16	Casing plunge 10 ft

Load Test	Description
A	Pull 1’ plunge against 1’ plunge
B	Pull 2’ plunge against 2’ plunge
E	Pull 5’ plunge against 5’ plunge
F	Pull 10’ plunge against 10’ plunge
I	Pull 10’ plunge piles not to failure
X	Pull group with cap against frame (A cap will be cast around 5-8 to create a “bent.” Soil will be excavated around 5-8 to simulate scour condition)

*all piles no bond length below casing and center rebar

Figure 4.4: Actual micropile load test layout

4.2 Test Micropiles

The micropiles were installed by Wurster Engineering using a duplex drilling rig manufactured by Klemm. The contractor was allowed to choose the design to meet the performance specification. Therefore, in order to simplify the construction, a full depth casing was used in lieu of a central reinforcing bar in all piles installed for the bridge and load tests.

Installing piles to prescribed depths accounting for the rock was somewhat of a challenge. The contractor was instructed to socket the piles into rock based upon the plan and schedule shown in Figures 4.3 and 4.4, respectively. Therefore even though the pile load tests were between two piles with the same socket depth, the pile load points may vary by as much as a foot, due to the perceived rock depth.

All micropiles were composed of 6.5 ft. segments, 10.75 in. diameter, and 0.5 in. wall thickness. Since casing plunge into rock was a specification, and the rock layer was inconsistent, the number of casings needed to construct the piles was variable. However, every effort to make the new test pairs as similar as possible was made. Table 4.1 shows the field tested micropile properties and Table 4.2 lists the piles and their general attributes.

Table 4.1: Field test micropile properties

	Out to out diameter (in)	In to in diameter (in)	Wall thickness (in)	Thread length (in)	Thread shape	Thread depth (in)	Thread connection
Micropile Properties	10.75	9.75	0.5	2.5	V shape thread	0.122	Left hand

4.3 Instrumentation and Apparatus

The behavior of the micropiles was measured by creating boundary conditions that could be either controlled or measured. This included devising load systems and instrumentation to measure load, strain, and displacement in a similar fashion to the systems used by Long et al. (2004), Rollins and Sparks (2002), and Rollins et al. (2005) following ASTM D3966.

TABLE 4.2 Schedule of lateral pull tests on identical micropiles

Pile	Number of Casings	Total Length (ft.)	Length to Diameter Ratio (L/D)	Plunge in Rock (ft.)	Pile Top Above Ground Surface (ft.)	Pile Top Above Load Point (ft.)	Top of Inclinometer Casing Above Pile Top (ft.)
1	1	6.5	7.3	1	2.9	2.7	0.0
2	2	13	14.5	2	4.4	2.1	2.0
3	2	13	14.5	5	3.8	1.8	1.8
4	3	19.5	21.8	10	2.7	1.7	0.5
5	3	19.5	21.8	10	1.7	0.4	0.5
6	3	19.5	21.8	10	2.3	1.0	0.5
7	3	19.5	21.8	10	2.4	1.2	0.5
8	3	19.5	21.8	10	2.2	0.9	0.5
9	3	19.5	21.8	10	--	--	--
10	3	19.5	21.8	10	1.8	1.7	0.3
11	3	19.5	21.8	10	1.5	1.3	0.7
12	3	19.5	21.8	10	--	--	--
13	1	6.5	7.3	1	1.6	1.4	0.0
14	2	13	14.5	2	4.5	2.0	2.0
15	2	13	14.5	5	4.0	1.8	2.0
16	3	19.5	21.8	10	3.7	2.4	0.7

4.3.1 Loading Frame

A simple load frame was constructed to simultaneously load two single piles by pulling them together. Two key aspects of the design of this frame were economy and portability. The initial design was based heavily upon that presented by Long et al (2004). Load tests A and B were conducted using the first version of the frame.

Problems with the frame resulted in failure of the frame before the completion of load test B. The load frame was then returned to the shop for redesign. The final reaction system consisted of two steel channels that were pulled together using high strength steel all-thread bars. Two “jaws” were manufactured to centralize the load on the pile tops. These jaws had a small amount of articulation against the channels to allow pile top rotation during large deflections. Figure 4.5 displays a drawing and photograph of the load frame used for loading the single piles.

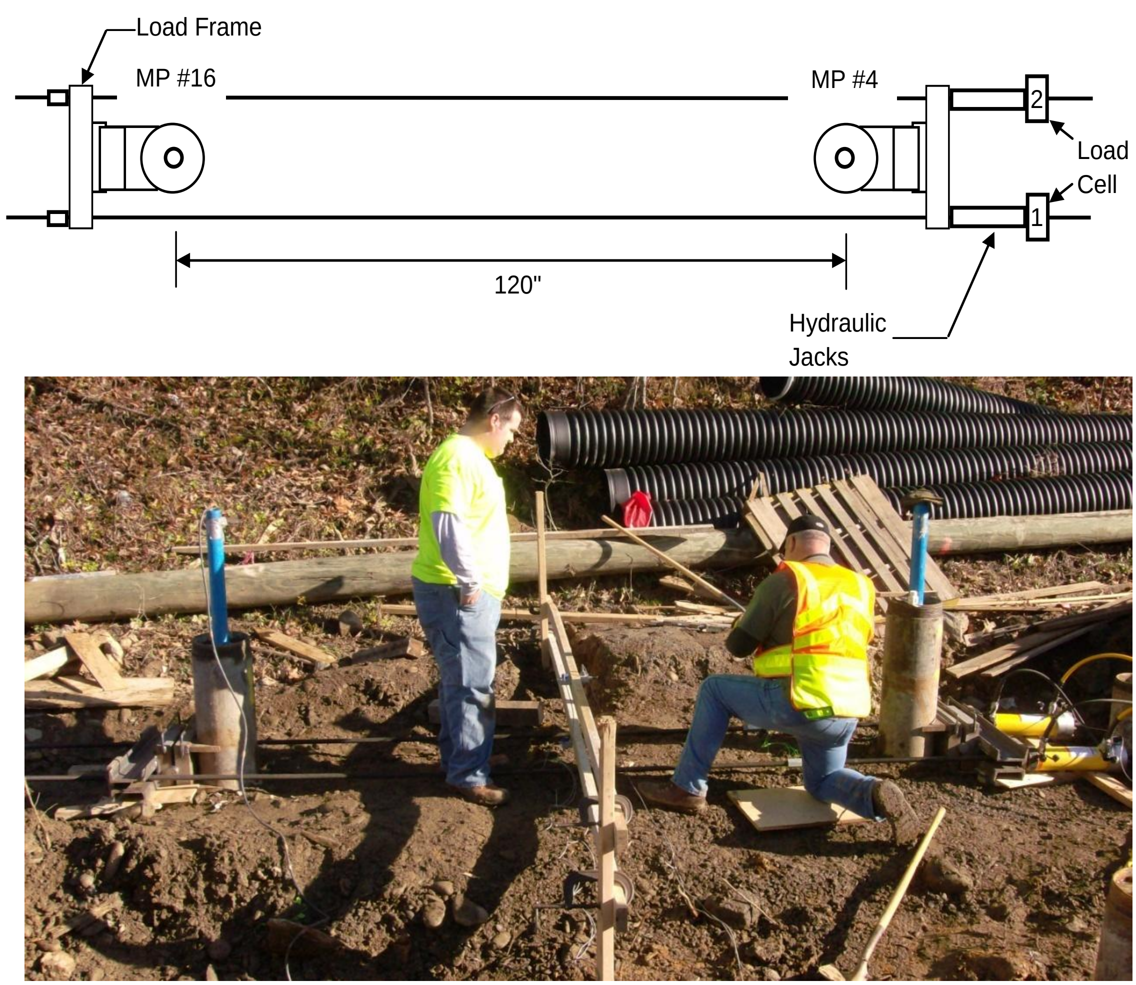


Figure 4.5: Load testing frame

Instead of a loading frame, the group test was performed by pulling a four micropile group with a cast concrete cap against a four micropile group with a steel reaction beam. The same actuators and instrumentation that were used in the single pile tests were used for the group.

4.3.2 Jacks and Hydraulic Pump

Preliminary analysis predicted up to five inches of deflection at the pile tops before failure. The capacity required to perform the group load test was on the order of 50 kips at two locations (100 kips total). In addition, an early decision was made to perform the load tests by pulling, not pushing, so center-hole double acting jacks were required. Therefore, two identical Enerpac #RRH-301060 kip long stroke hydraulic center-hole jacks were used to pull the all thread bars. The jacks were connected to an Enerpac ZU4 Class ZU4408JB pump fitted with a manifold and valves to provide equal pressure to both jacks. The center-hole jacks and hydraulic pump are shown in Figure 4.6.

Figure 4.6: Enerpac jacks and pump

4.3.3 Load Cells and Pressure Gage

Load cells were used to measure the force applied to the single pile load frame as well as the pile bent at the cap. The predicted capacity required was just above 50 kips for each load cell. Due to cost limitations and delivery issues, 50 kip load cells were selected with the assumption there would be some overload capacity available. Two

Omega LCHD-50K load cells were used for the testing. A redundant measurement for the load cells was made using a pressure transducer in line with the hydraulic jacks. The pressure transducer was manufactured by Entran model number EPO W31 10KP with a maximum capacity of 10,000 psi. The load cell and pressure transducer are shown in Figure 4.7.

Figure 4.7: Omega load cell and Entran pressure transducer

4.3.4 Potentiometer

Displacements of the pile heads were monitored using Celesco SP1-25 string potentiometers, like the photos shown in Figure 4.8. The body or reel housings were attached to a fixed wood reference frame that was erected between the test piles during each load test. A pair of threaded eyes was attached by drilling and tapping each pile at the measurement locations. Filament was used to connect the threaded eyes to the potentiometer strings. Examination of the potentiometer data for load tests B, E, and F revealed some interference that was not anticipated. These measurements have been considered suspect for those tests and discarded. The potentiometer results for Tests I and X did not show the same interference.

Figure 4.8: SP1string potentiometer by Celesco

4.3.5 Slope Inclinometer

Inclinometer measurements were used to determine pile deflection and rotation with depth for selected load increments for all micropiles except 9 and 12. In addition, the inclinometer provided a redundant measurement with the potentiometers at the pile heads. Inclinometer casings were installed in all micropiles. The inclinometer casings were placed in the micropiles after pressure grouting. A centralizer made from a slotted PVC pipe that was heated and deformed into a Chinese lantern shape was used to position the inclinometer casings in the center of the micropiles. The inclinometer casing was filled with water prior to grouting to overcome buoyancy so the casing did not float out of the pile. The primary measuring axis of the inclinometer casings was aligned with the direction of the load and pile movement.

The inclinometer probe used in this study was a model 6000 manufactured by Geokon. Measurements were made across the A-A axis and doubled for precision. The casings were model QC manufactured by Slope Indicator. Data for each survey was stored using a GK 603 readout box. Reduction of the inclinometer data was handled using a spreadsheet developed by the PI. The inclinometer, readout, and casing used for the test are shown in Figure 4.9.

Figure 4.9: Geokon 6000 probe with 603 readout box and QC casing by Slope Indicator

Bending moments were computed based upon the inclinometer measurements. Bear in mind that this required a double derivative of the displacement. The bending moment (M) in each of the micropiles was computed from the inclinometer data based on the method published by Ooi and Ramsey (2003). Changes in incremental deviations (Δ) from the initial values are written as:

$$\Delta_A = ID_A - ID_{Ai} \tag{4.1}$$

$$\Delta_B = ID_B - ID_{Bi} \tag{4.2}$$

$$\Delta_C = ID_C - ID_{Ci} \tag{4.3}$$

$$Deflection = (0.0003 * \Delta * L) \tag{4.4}$$

$$Curvature\ (\kappa) = \frac{\psi_A - (2 * \psi_B) + \psi_C}{L^2} \tag{4.5}$$

$$\psi_A = \Delta_A, \tag{4.6}$$

$$\psi_B = \psi_A + \Delta_B \tag{4.7}$$

$$\psi_C = \psi_B + \Delta_C \tag{4.8}$$

$$Bending\ Moment\ (M) = EI * \kappa \tag{4.9}$$

$$EI = (EI)_{micropile\ section} + (EI)_{grout} \tag{4.10}$$

Where

Δ = change in inclinometer reading

i = initial value

κ = curvature (ft^{-1})

ψ = cumulative deviations

L = distance between readings (2ft)

E = Young's modulus of the specified material and

I = moment of inertia of the specified material.

4.3.6 Strain Gages

Installing strain gages in a micropile section that was installed using duplex drilling proved to be a challenge. It was not possible to install the gages on the piles themselves. Therefore, the micropiles were instrumented much like a drilled shaft using sister bars. The micropiles for test I and the micropiles in the bent were outfitted with Geokon model 4911 vibrating wire sister bar strain gages, shown in Figure 4.10, at 2.5 ft. intervals of depth to measure strain concurrent with load and displacement. These rebar strain meters were embedded in concrete or, in this case, grout.

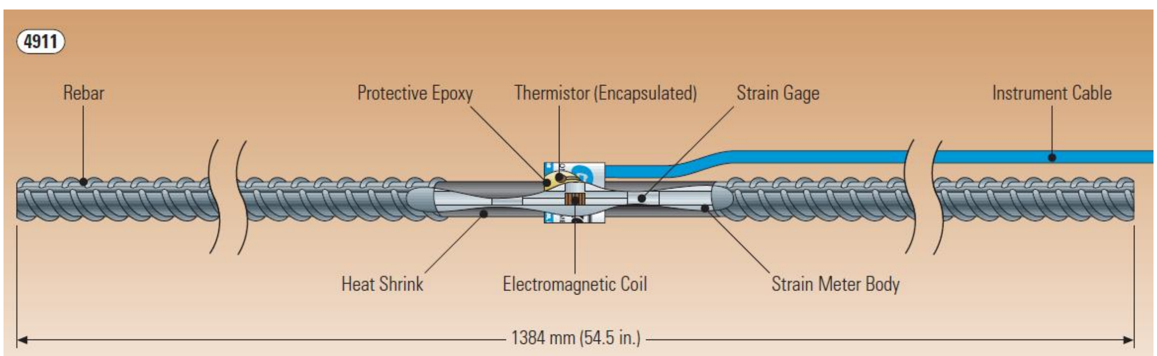


Figure 4.10: Geokon model 4911 sister bar strain meter

The strain gages, measured both tensile strain (+) and compressive strain (-) as the load was applied. The output of the strain gages reading was frequency which was converted to strain using the following equations.

$$Digit = 0.001*(frequency)^2 \tag{4.11}$$

$$Raw\ Strain = 4.062*digit \tag{4.12}$$

$$Apparent\ Strain = Raw\ Strain*Gage\ Factor \tag{4.13}$$

The difference in the tensile and compression strains divided by the distance between the strain gages is the curvature.

$$\kappa = \frac{(\varepsilon_T - \varepsilon_C)}{h} \tag{4.14}$$

The curvature was then used to calculate the bending moment versus depth curves based on the formula:

$$M = GF * \frac{EI(\varepsilon_T - \varepsilon_C)}{h} = \kappa * EI * GF \tag{4.15}$$

Where

ε_T = tensile strain (+)

ε_C = compressive strain (-)

h = horizontal distance between gages spaced at equal but opposite distances from the neutral axis

EI = $(EI)_{\text{micropile section}} + (EI)_{\text{grout infill}}$

GF = the gage factor for each of the strain gage,

E = Young’s modulus of the specified material and

I = moment of inertia of the specified material.

The rebar strain meters were overlapped and tied together with wire ties to make a continuous string of seven gages spaced at 2.5 foot intervals. The resulting strings were 20 feet long. These gage strings were wire tied to the centralizers that were attached to the inclinometer casings. The intent was to push the strain gages to the grout/casing interface, such that bending moments measured would be close to those in the casing. Photographs of an assembled cage are shown in Figure 4.11.The cages were placed inside the micropiles after pressure grouting as shown in Figure 4.12. The winch on the drill rig was used to raise the casing vertical. The tight fit of the centralizers made it necessary for two people to push the cage into the piles. Friction between the centralizers and the casings along with the weight of the gages held them in place. The gage strings were oriented with the direction of loading/pile movement.

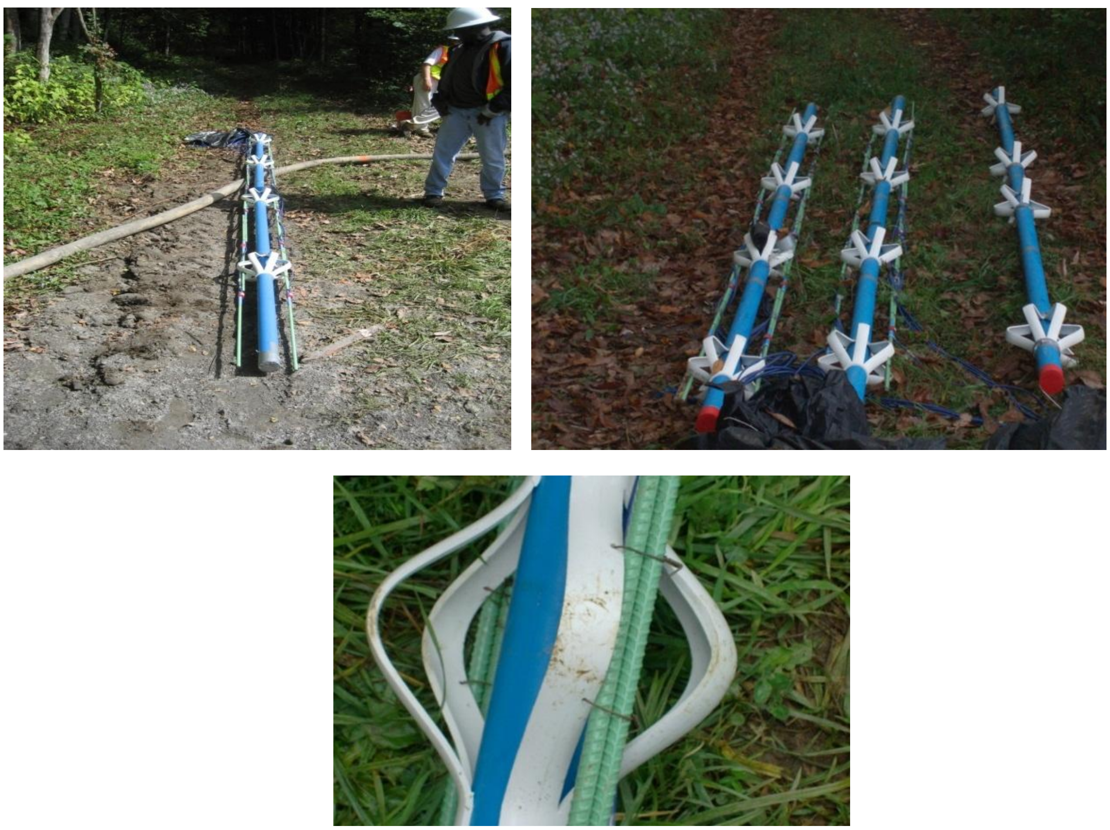


Figure 4.11: Instrumentation cages

Figure 4.12: Photograph of cast micropile with Instrumentation cage.

4.3.7 Data Acquisition

Data for the load test was acquired and stored using a Campbell Scientific CR1000 Datalogger, like the one shown in Figure 4.13. The CR1000 datalogger is a self-contained data acquisition system that contains a microprocessor and storage such that it can function without being connected to a computer. The CR1000 has 16 channels (8 differential) that can measure a maximum of ±5 volts, but can be expanded using multiplexers. There is 4MB of data storage onboard that can be expanded using a compact flash card to capacities on the order of gigabytes.

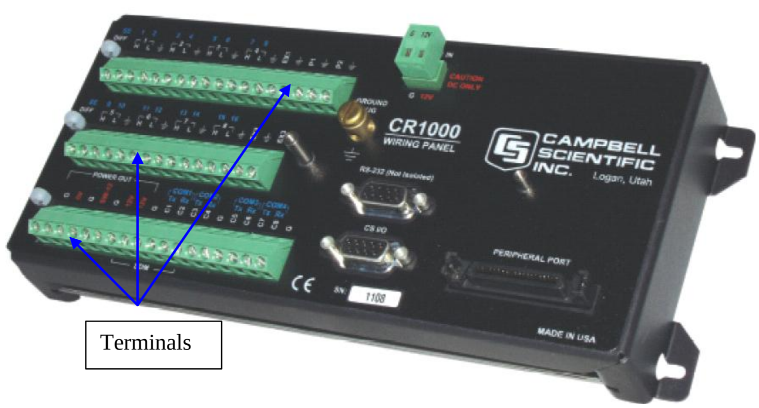


Figure 4.13: CR1000 datalogger

The load cells, potentiometers, and pressure sensor were all analog sensors connected directly to the CR1000. All sensors were powered using external power supplies. The load cells and pressure cell were excited at 10 volts. The potentiometers were powered at 5 volts. The vibrating wire strain gages were connected through a 16 channel multiplexer model AM16/32 to a module that provided the vibrating wire frequency, AVW200. The AVW200 sent the vibrating wire signal, determined the resonant frequency, and controlled the multiplexer. Thus, the output was a data stream that was connected to the CR1000 through one of two RS232 type COM ports.

During the single pile load tests, a single datalogger was used to record output from the load cells, potentiometer, and backup pressure gage. During load tests I and X two synchronized dataloggers were used to read the analog and vibrating wire measurements, respectively.

4.4 Single Micropile Load Tests

Presented in this section is the summary of the results and plots of the single micropile lateral load tests. Table 4.3 contains the schedule followed for the load tests.

TABLE 4.3 Schedule of field load tests

Date	Load Test	Piles	Number of Casings	Rock Plunge (ft.)	Strain Gages
11/16/09	A	1 & 13	1	1	No
11/24/09	B	2 & 14	2	2	No
11/24/09	E	3 & 15	2	5	No
11/24/09	F	4 & 16	3	10	No
11/25/09	I	10 & 11	3	10	Yes
12/10/09	X	5, 6, 7, 8	3	10	Yes

4.4.1 Test “A” Pull 1.0 ft. Embedment Against 1.0 ft. Embedment.

When these test piles were installed, the result was a single 6.5 ft. casing that was embedded about 1.0 ft. into what was thought to be rock at the time as shown in Figure 4.14. There were also issues with the initial load test that required a retest of these piles.

Regardless, these piles immediately rotated in the socket and failed progressively, unable to maintain load for any amount of time. No graphical results were reported.

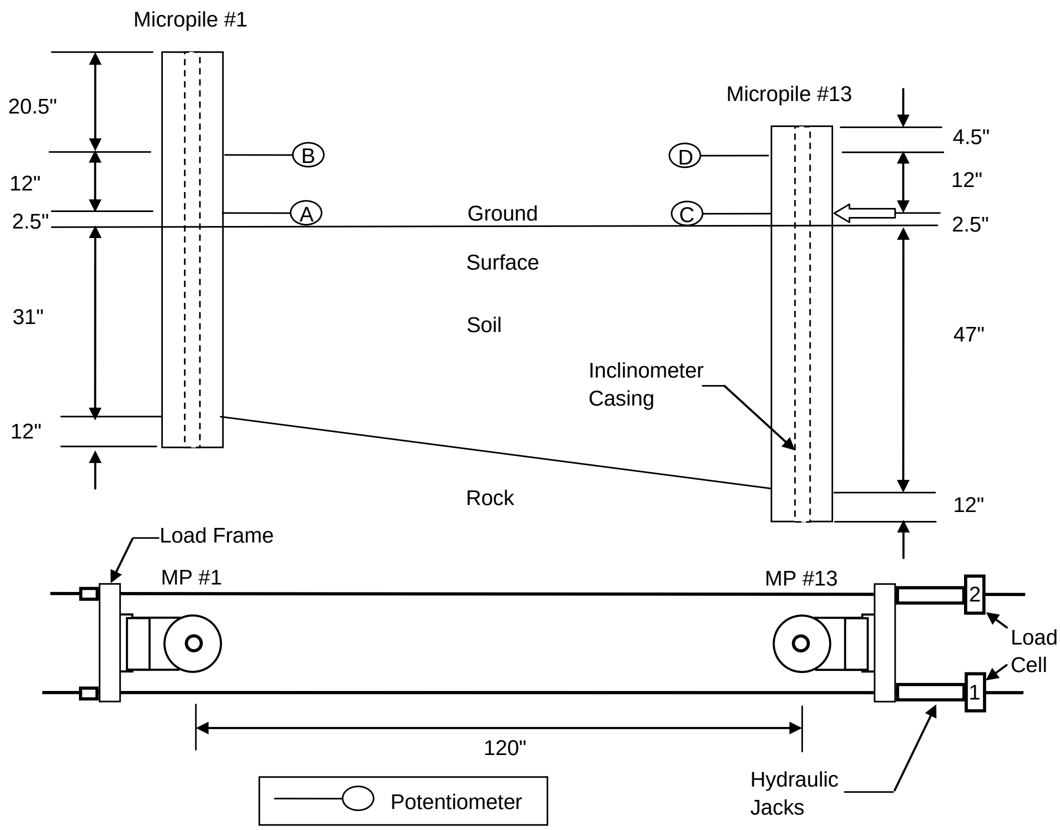


Figure 4.14: Load test “A” micropiles 1 and 13

4.4.2: Test “B” Pull 2.0 ft. Embedment Against 2.0 ft. Embedment.

These test piles consisted of two 6.5 ft. micropile casings. The tips of these piles were embedded 2.0 ft. into the underlying rock. These piles were initially tested, but problems with the load frame prevented load to failure. A sketch of the test configuration is shown in Figure 4.15. This test was repeated after reconfiguring the load frame. Figures 4.16 show the load displacement response with depth for both piles 2 and 14 and Figure 4.17 show the top displacement response with load for both pile 2 and 14.There was excessive lateral displacement of pile 14 until structural failure around 30 kips. Figure 4.18a and b shows photographs of the failure pile 14.

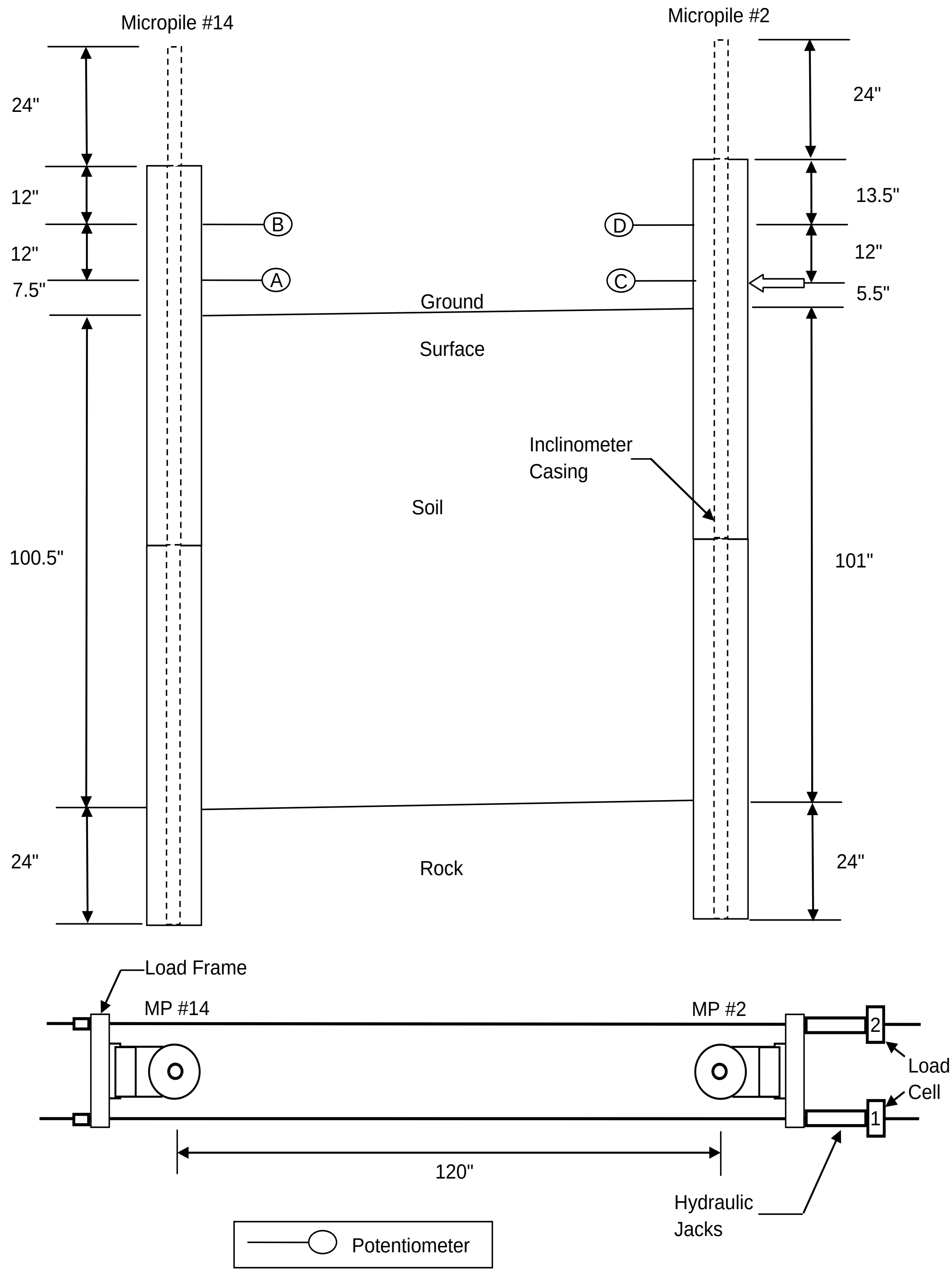


Figure 4.15: Load test B micropiles 2 and 14

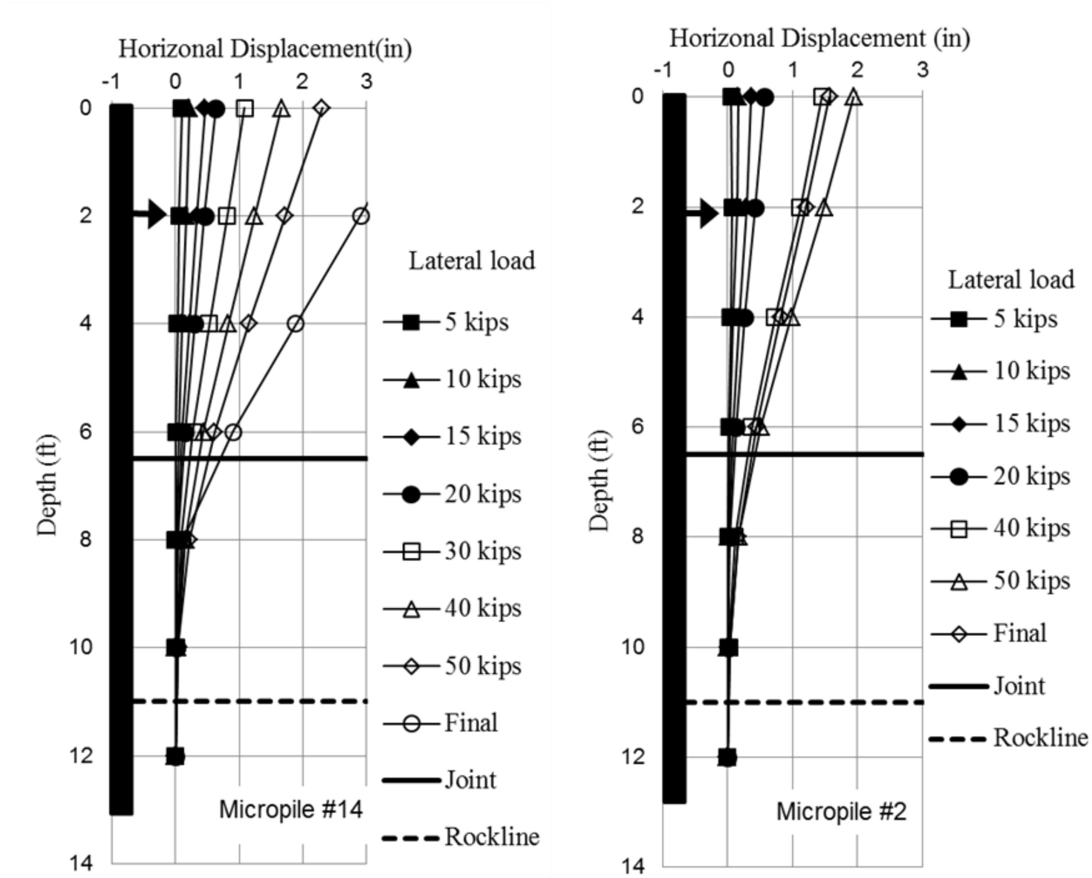


Figure 4.16: Inclinometer deflections for load test B.

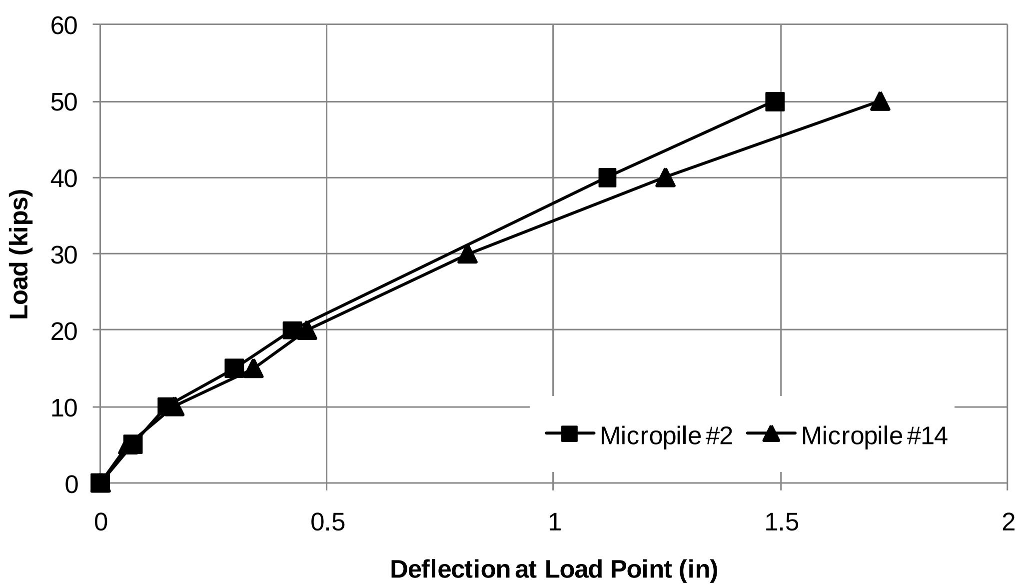


Figure 4.17: Top load deflections for load test B.

(a)

(b)

Figure 4.18: Failure of pile 14

4.4.3 Test "E" Pull 5.0 ft. Embedment Against 5.0 ft. Embedment.

Pile for test E consisted of two 6.5 ft. micropile casings. The tips of these piles were embedded 5 ft. into the underlying rock, as shown in Figure 4.19. The load test was conducted without incident. The load deflection response is shown in Figures 4.20 and 4.21.The load test ended with an abrupt failure of pile 15. Figure 4.22 contains photographs of pile 15 after the test was completed.

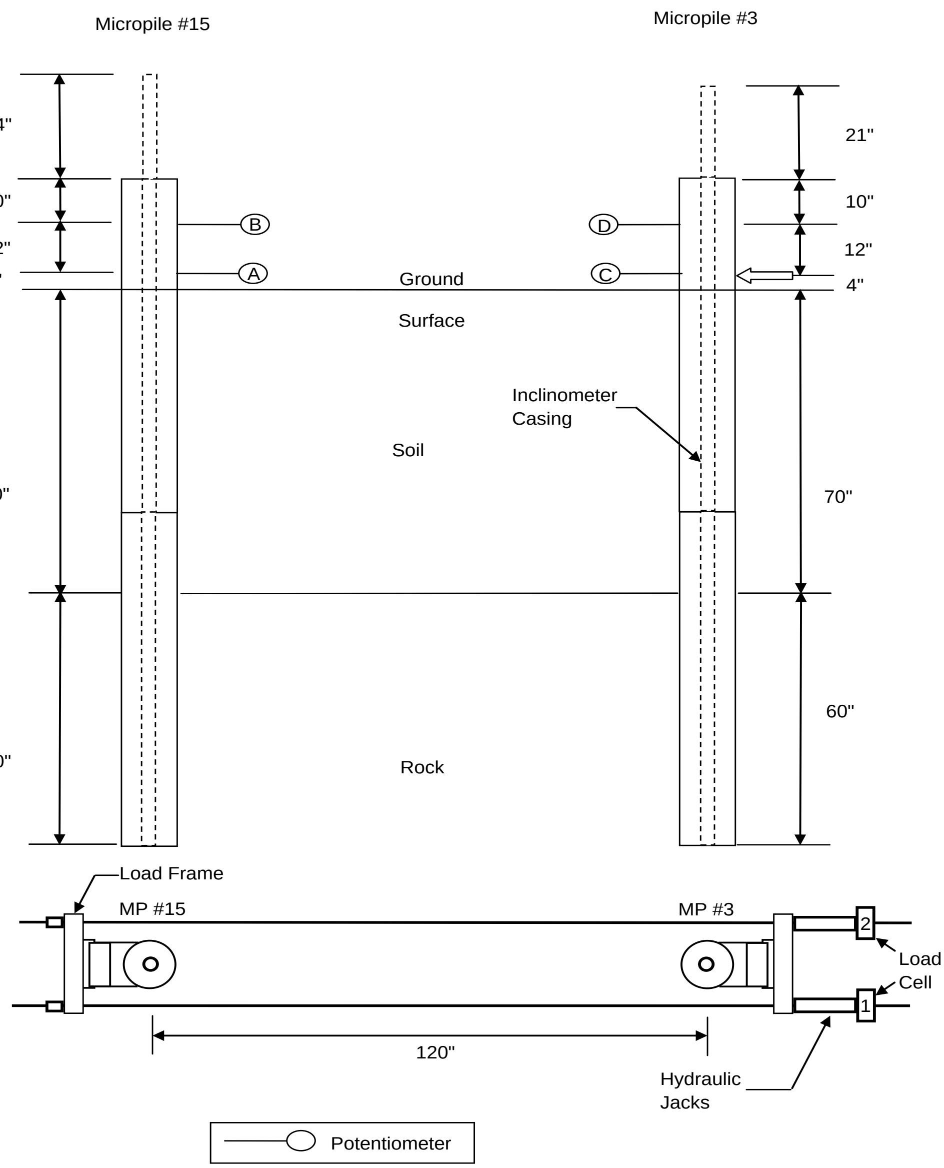


Figure 4.19: Load test E micropiles 3 and 15

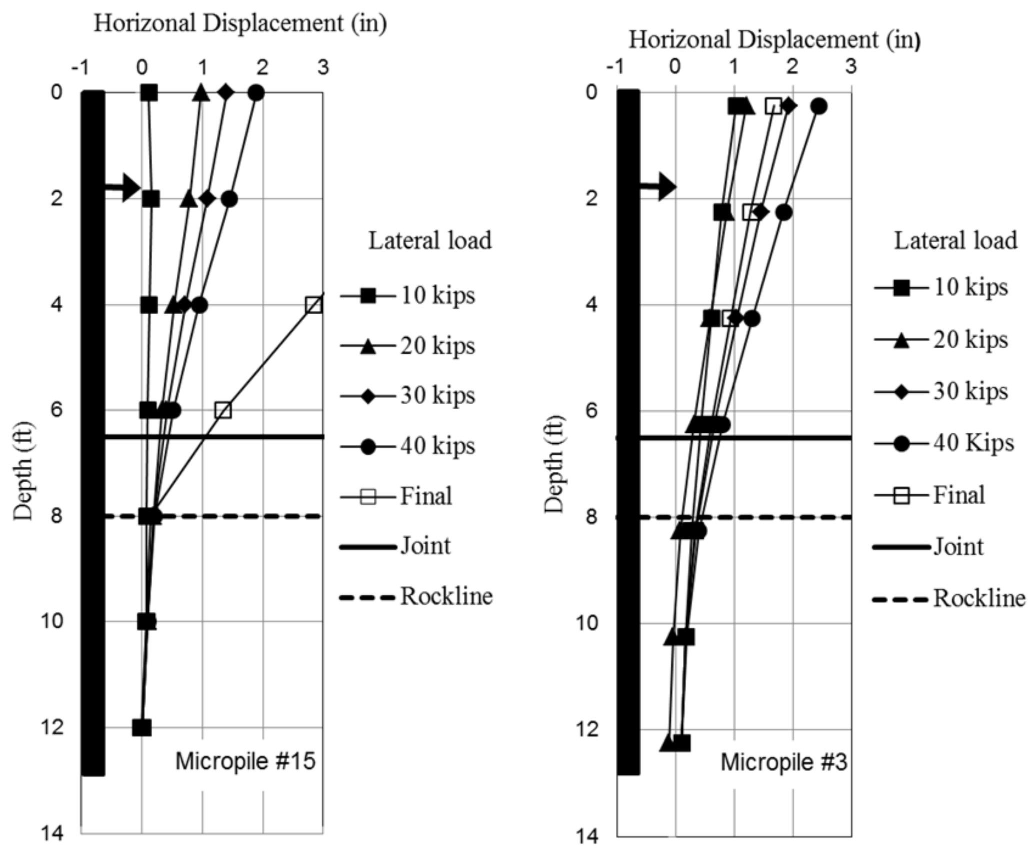


Figure 4.20: Inclinometer deflections for load test E.

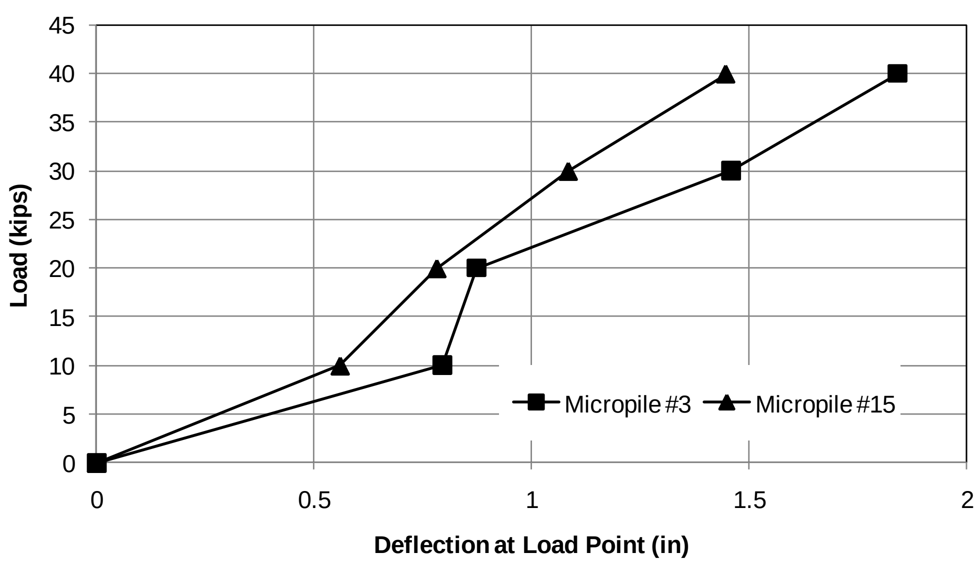


Figure 4.21: Top load deflections for load test E.

(a)

(b)

Figure 4.22: Failure of pile 15

4.4.4 Test “F” Pull 10.0 ft. Embedment Against 10.0 ft. Embedment.

Three 6.5 ft. casing sections were used to construct test piles for load test F. The tips of these piles were embedded 10 ft. into the underlying rock. The test setup is shown in Figure 4.23.The load test ended with an abrupt failure of pile 16. This is evidenced in Figures 4.24 and 4.25 that show the load deflection response. Pile 16 was exhumed post-test to verify failure at the joint as shown in Figure 4.26.

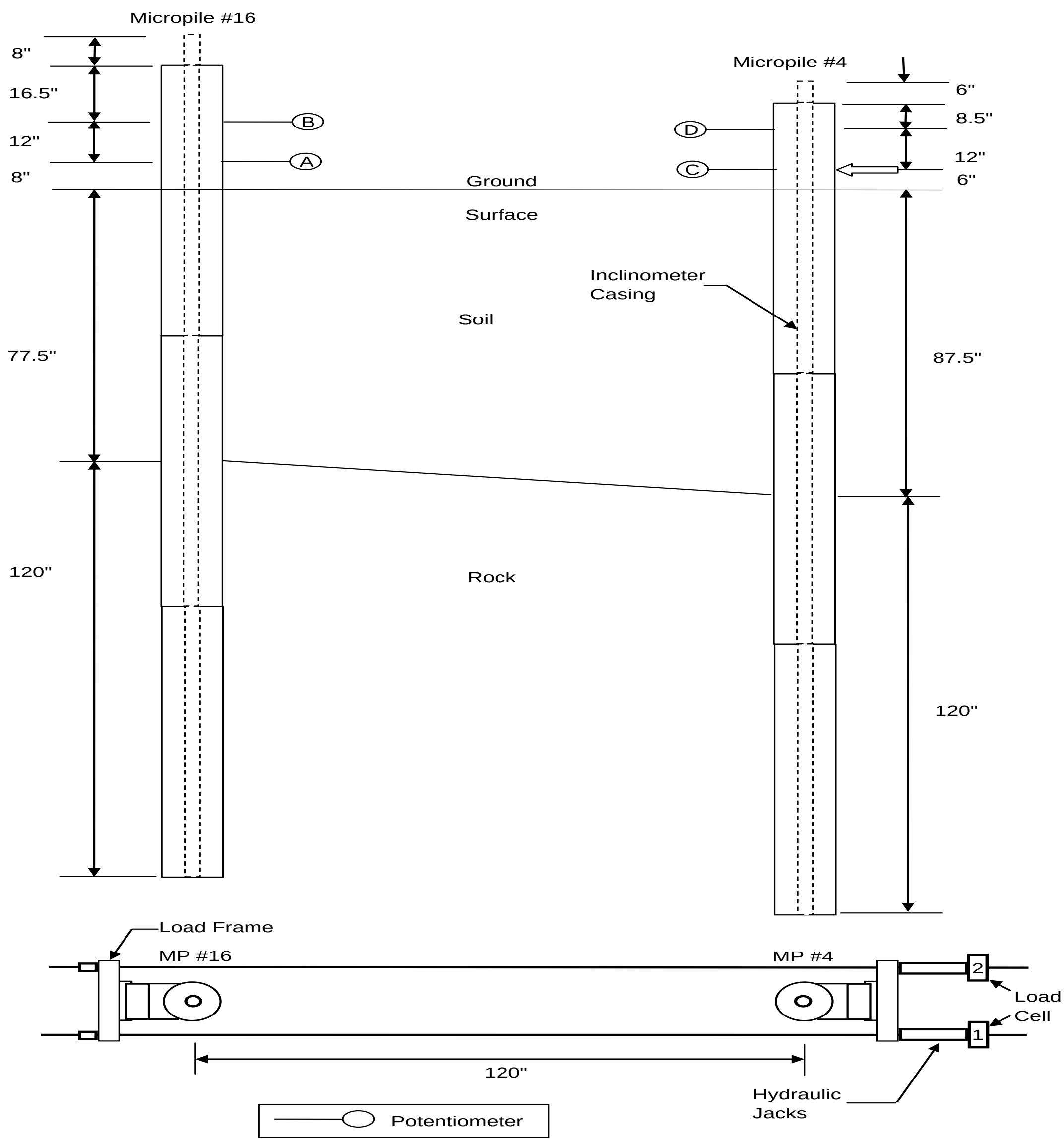


Figure 4.23: Load test F micropiles 4 and 16

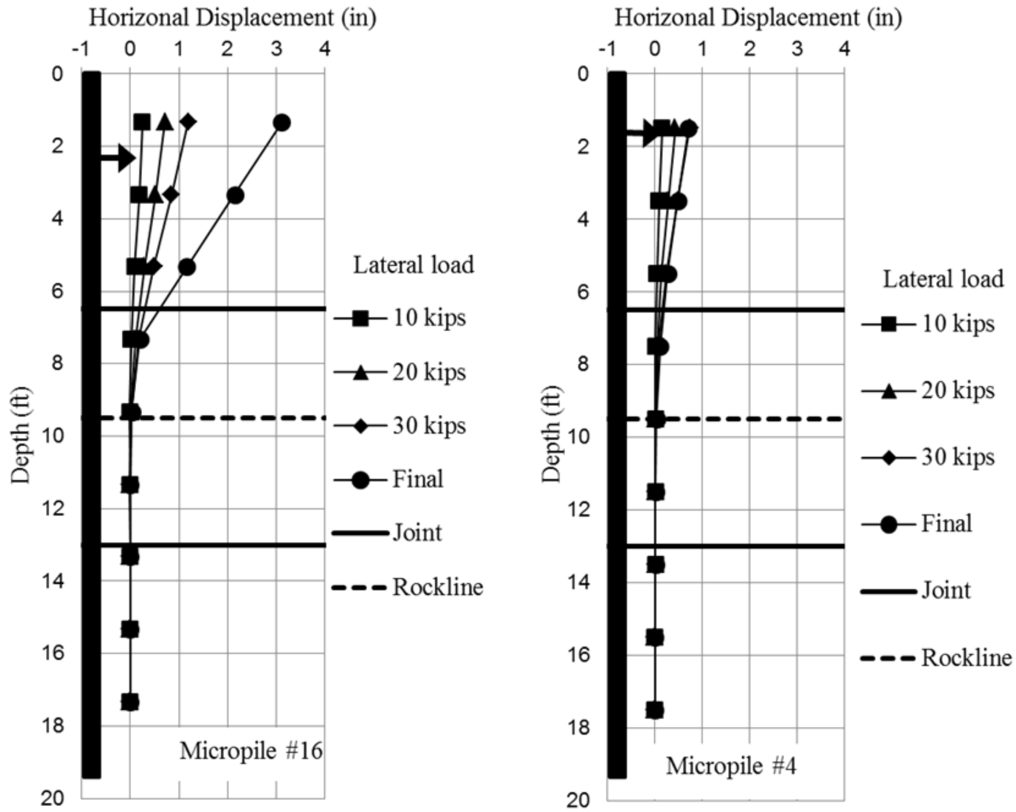


Figure 4.24: Inclinometer deflections for load test F.

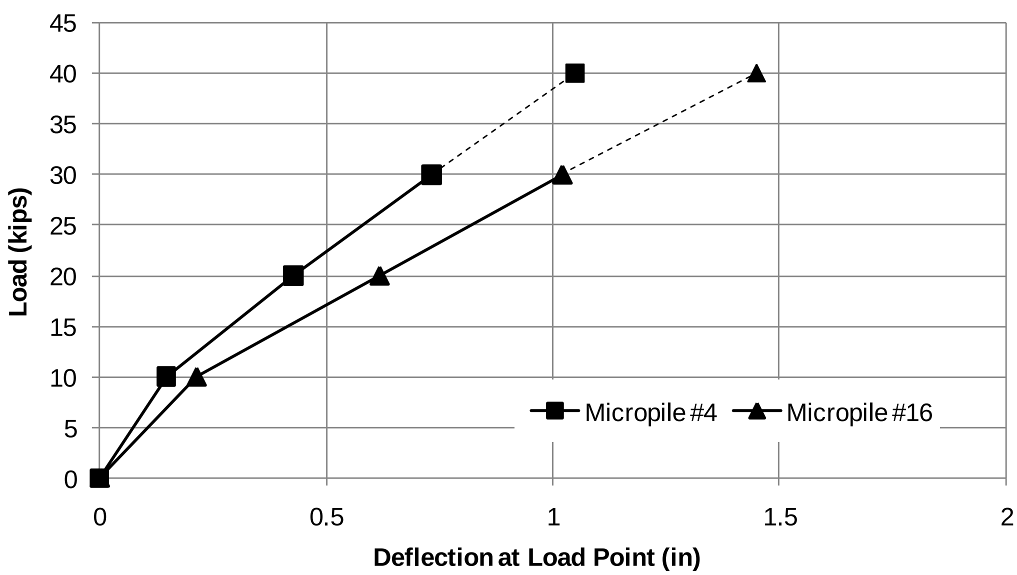


Figure 4.25: Top load deflections for load test F.

(a)

(b)

Figure 4.26: Failure of pile 16

4.4.5 Test “I” Pull 10.0 ft. Embedment Against 10.0 ft. Embedment not to Failure.

These test piles consisted of three 6.5 ft. micropile casings. The tips of these piles were embedded 10.0 ft. into the underlying rock. Figure 4.27 shows plan and elevation views of the load test. The piles were not tested to failure by design, such that they could be used for reaction piles for the group test. The bending moments of the piles at each of the corresponding strain gage locations were calculated from the strain gages using equation 4.15. The response is similar to the initial loads of test F. The goal was to document the load moment response of single micropiles using the sister bar strain gages instead of welding strain gages to the pile segments. The load deflection responses along with the measured bending moments are shown in Figures 4.28, 4.29 and 4.30. Figure 4.31in the combined plot for both the strain gages and the inclinometer data. The measured moment response shown in Figure 4.30looked reasonable when compared to the profile and magnitude determined from the FB-MultiPier simulations.

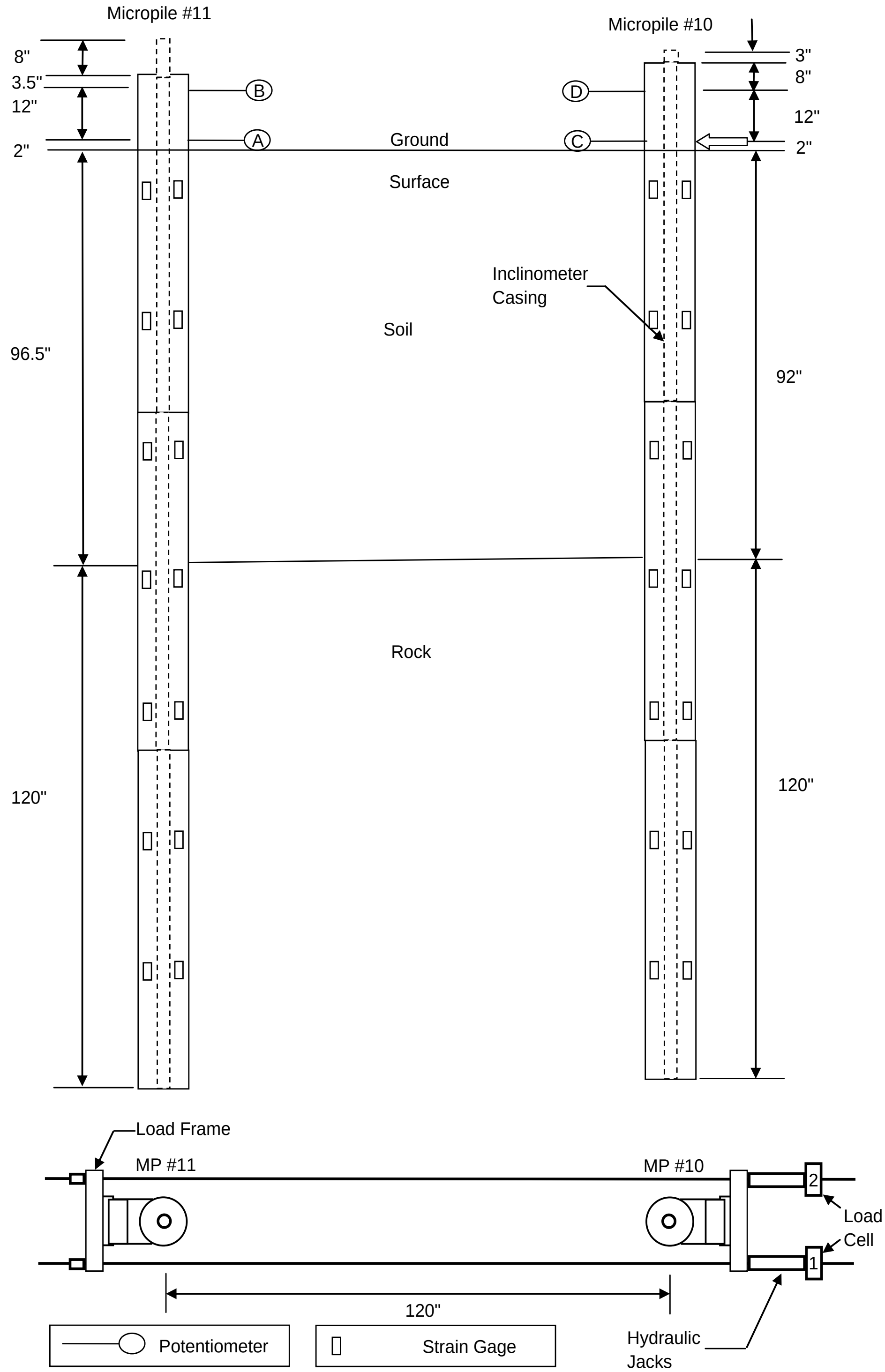


Figure 4.27: Load test I micropiles 10 and 11

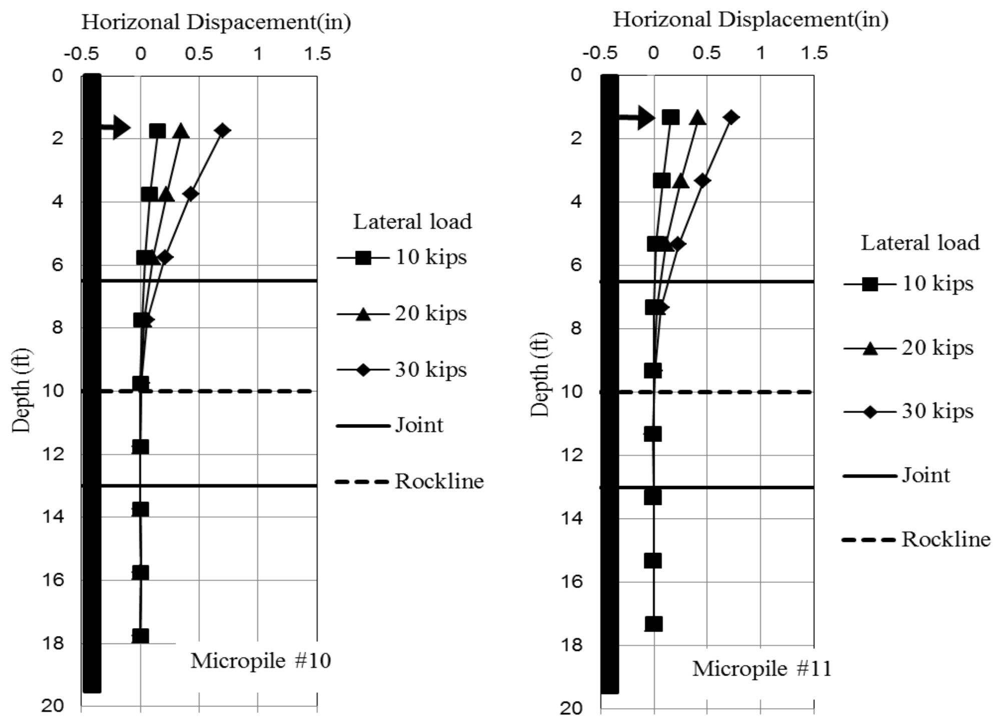
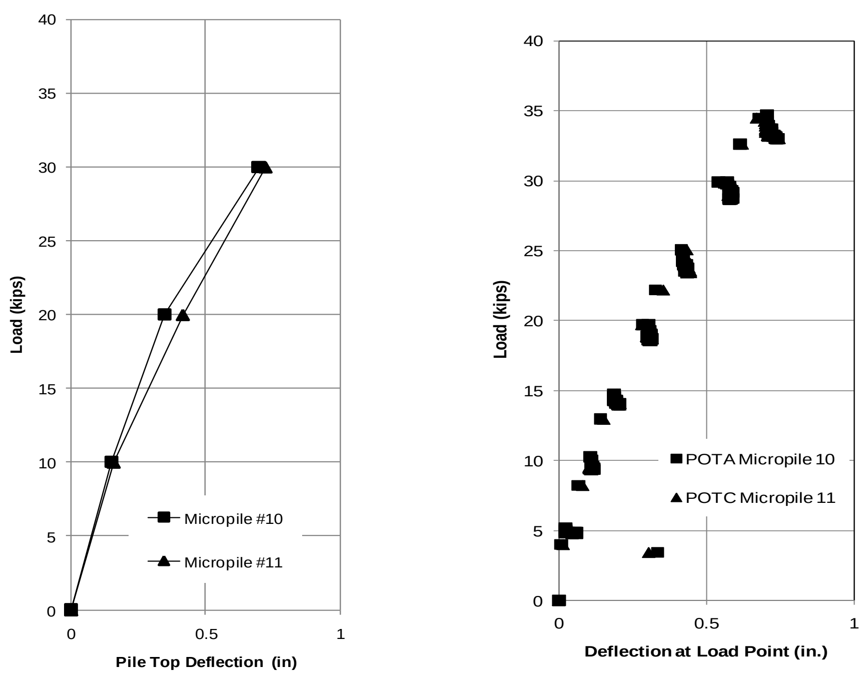


Figure 4.28: Inclinometer deflections for load test I.



a) b)

Figure 4.29: Top load deflections for load test I based on a) inclinometer and b) potentiometer measurements.

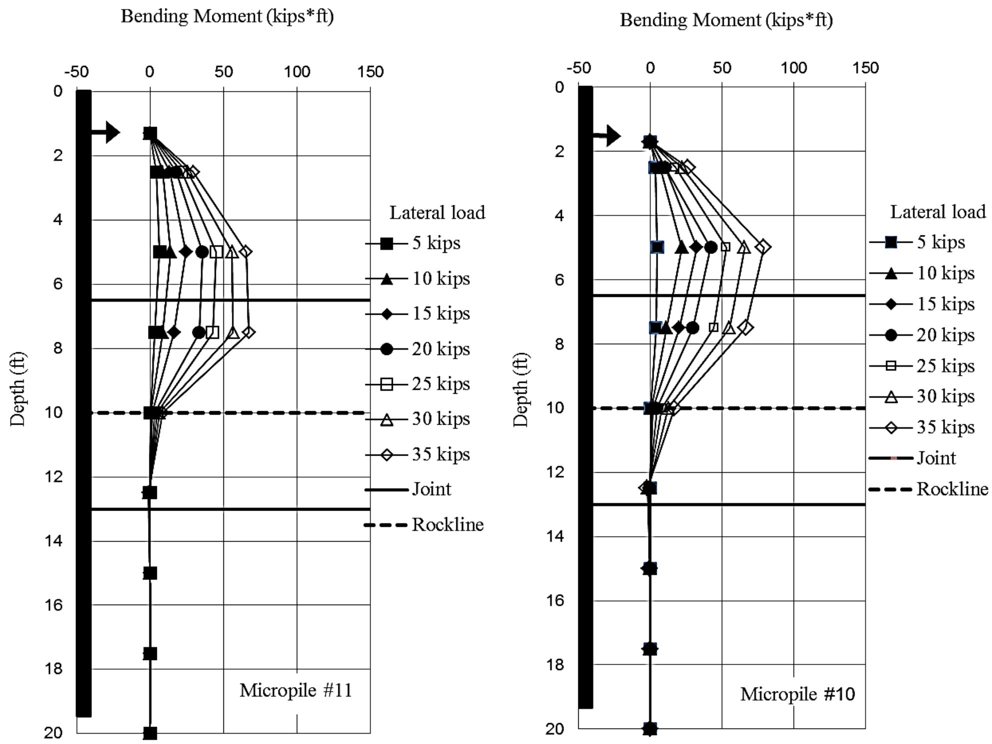


Figure 4.30: Bending moment profiles from stain gages for test I.

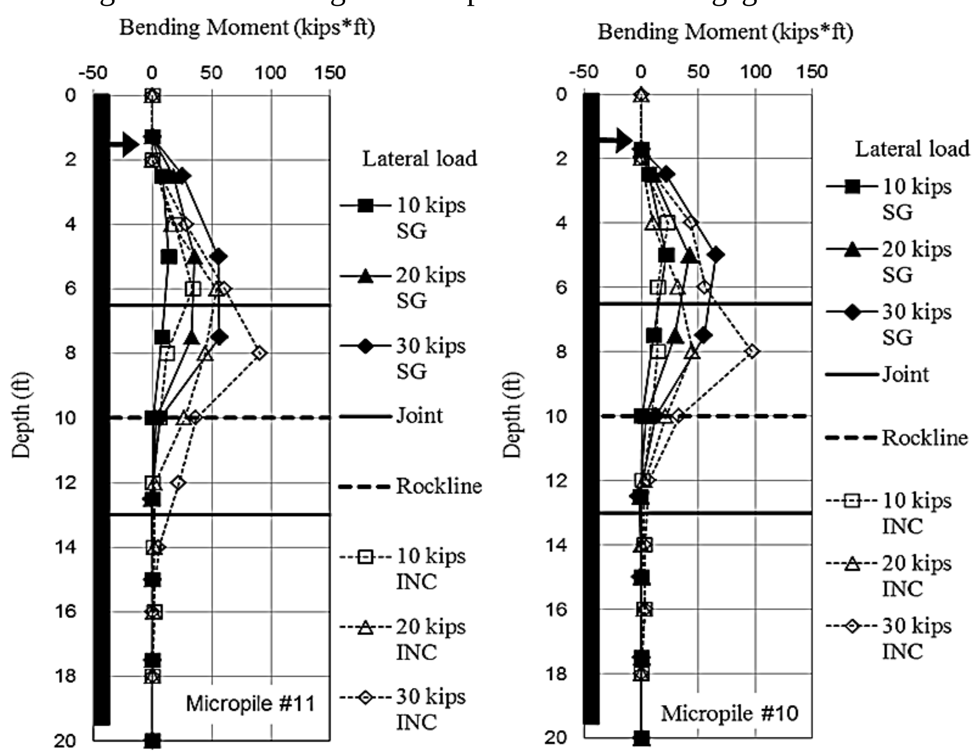


Figure 4.31: Calculated bending moment plot from inclinometer data and strain gages for load test I.

4.5 Micropile Group Lateral Load Tests

The initial lateral load test on the micropile bent began on 12/1/2009 at about 3:30 pm after five hours of preparation. As documented previously in Figures 4.3 and 4.4, micropiles number 9-12 are the reaction piles and 5-8 are the test micropiles. The overburden soil on the north side of the pile bent was removed down to the rockline to simulate scour for the interior bent of a typical bridge. The lateral force was applied at the center of the cap using two prestressing cables that were passed through PVC pipes cast through the pile cap. A stiffened beam was placed behind the reaction micropiles and anchor plates were used to distribute the reaction force at prestressing chucks placed on the cables. On the pile cap side, jacks pushed against the load cells with prestressing chucks. About two hours into the test, at a load of 40 kips, 5:25 pm, the reaction system began to fail. Testing was stopped in order to address the problem.

A week later, a pair of deep beams was supplied by the general contractor to provide additional reaction. Two 2 ft. long micropiles sections were also acquired to stub up piles 10 and 11.The second attempt at the group test began on 12/10/2009 at about 12:45 pm. The load was applied in 10 kip increments and maintained for a period of about 10 minutes for each load increment to allow for creep. Inclinometer tests for each of the piles in the group were performed at 2 ft. intervals for every other loading increment. Figures 4.32 through 4.39 show drawings of the pile and instrumentation setup for the group load test and Figure 4.40 shows a photograph of the test in progress. The test was stopped when the reaction micropiles and prestressing cable yielded, therefore exceeding the stroke of the loading hydraulic jacks.

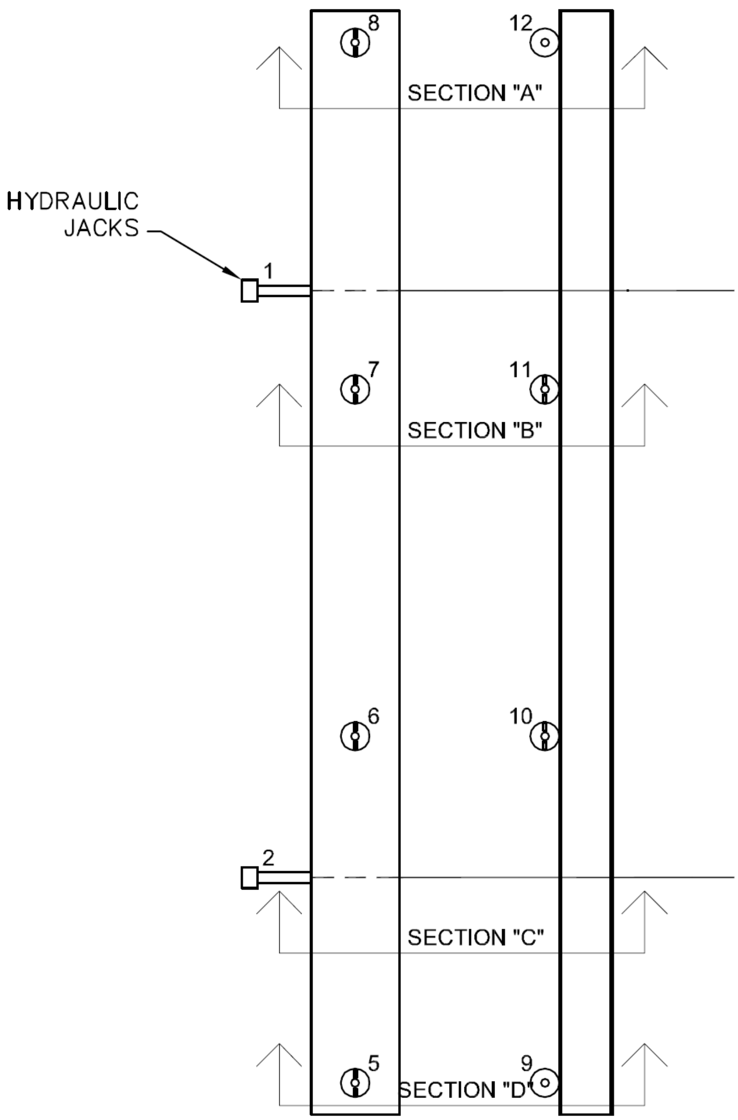


Figure 4.32: Plan view cap group

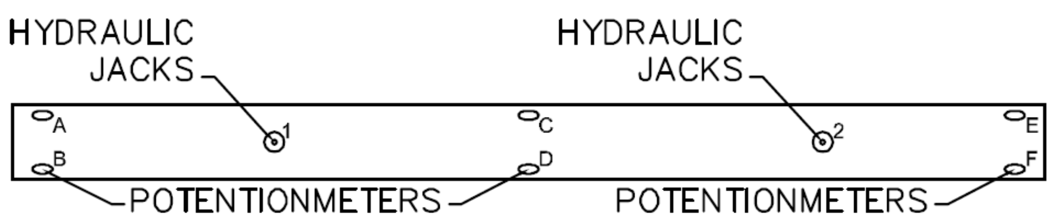


Figure 4.33: Elevation view of cap showing placement of potentiometers

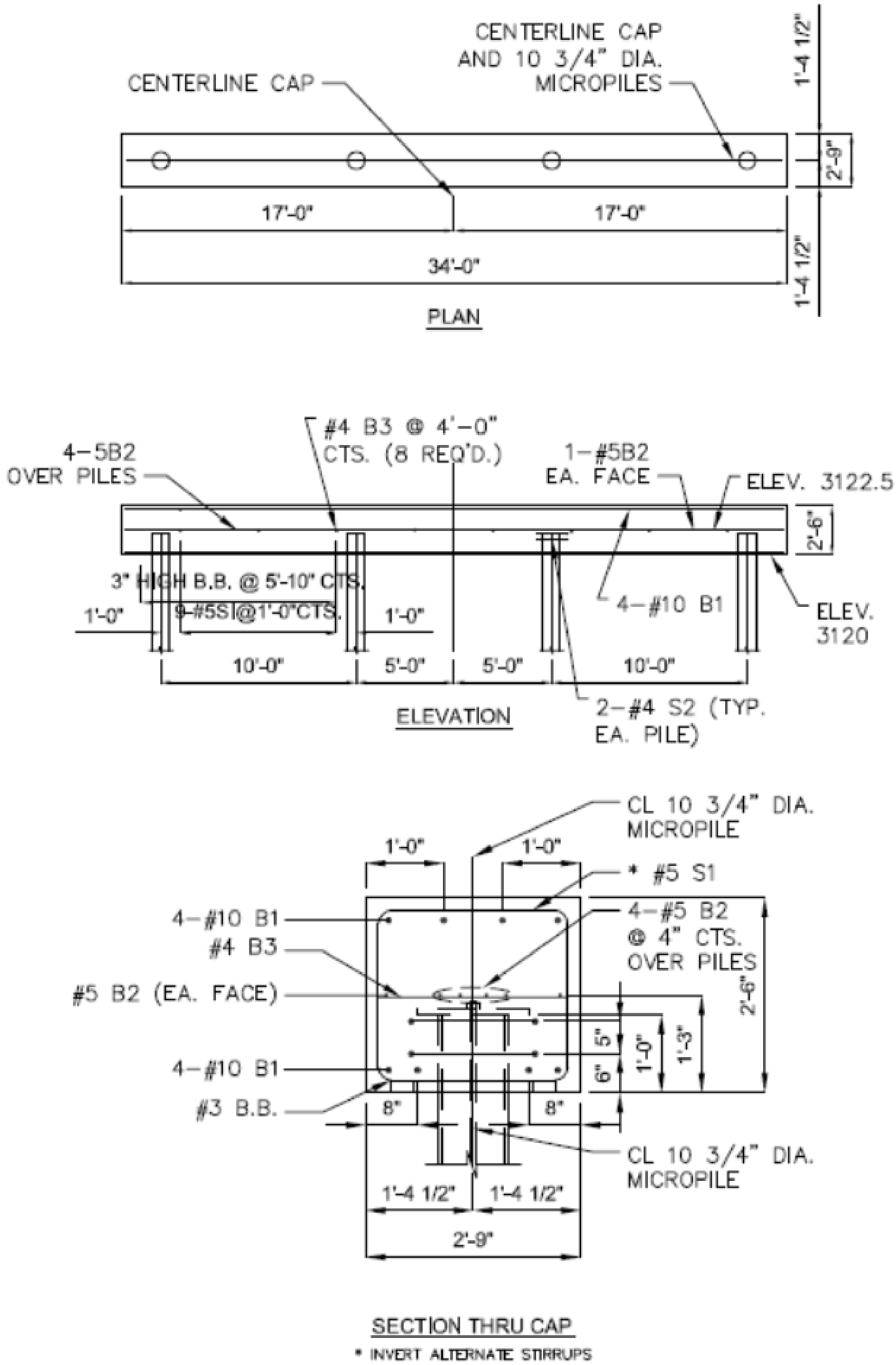


Figure 4.34: Micropile group cap structural detailed

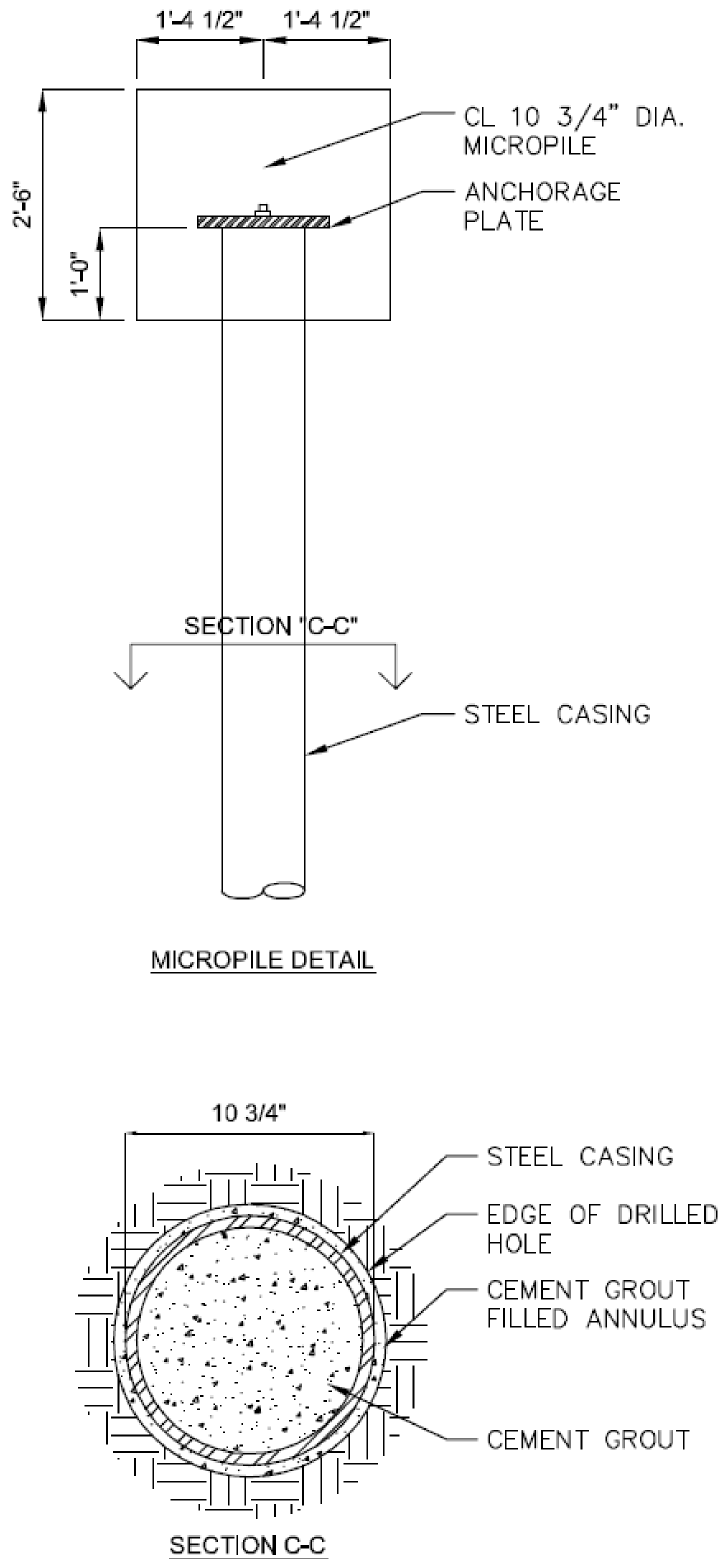


Figure 4.35: Micropile group cap structural section detailed

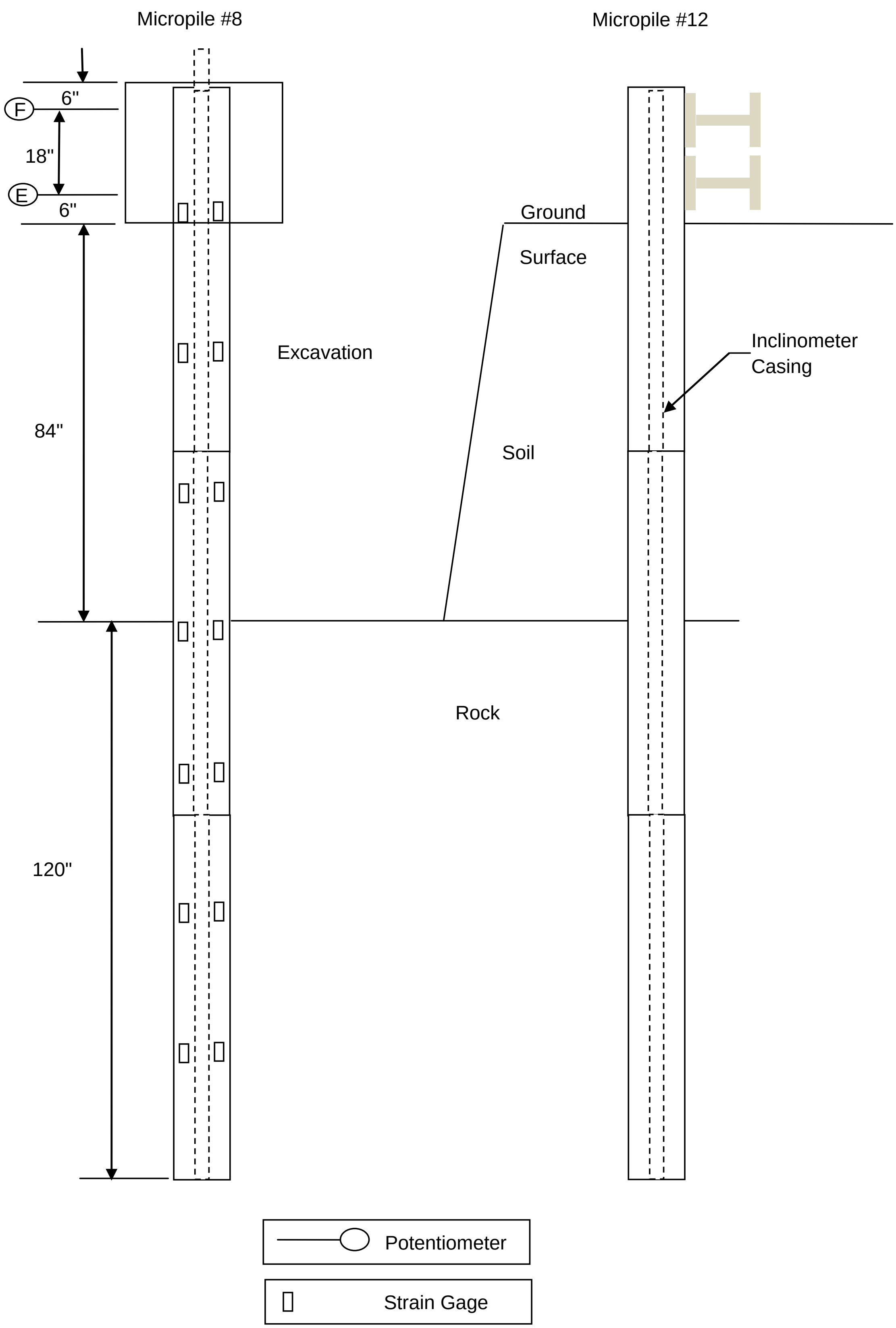


Figure 4.36: Section A showing micropile #8

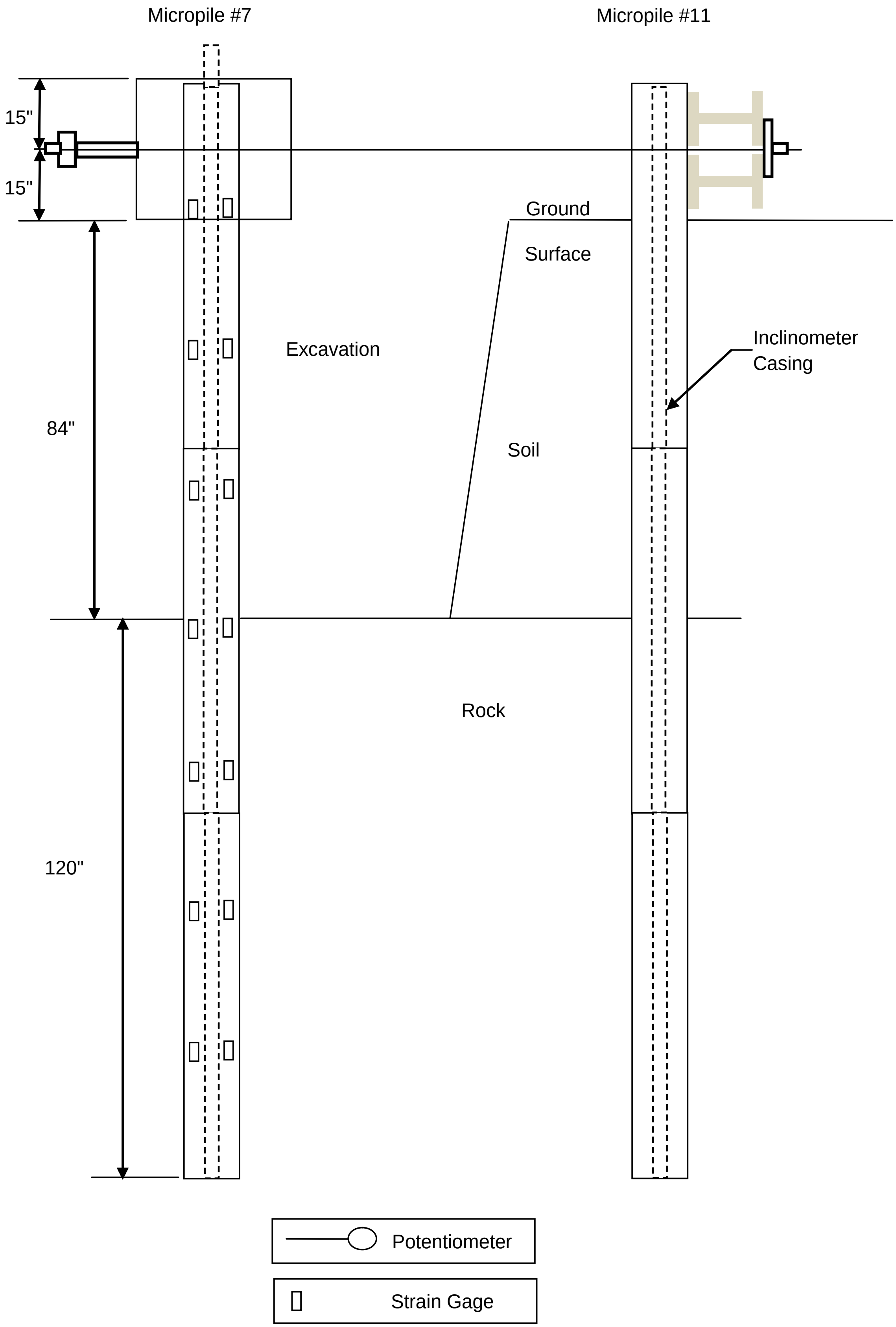


Figure 4.37: Section B showing micropile #7

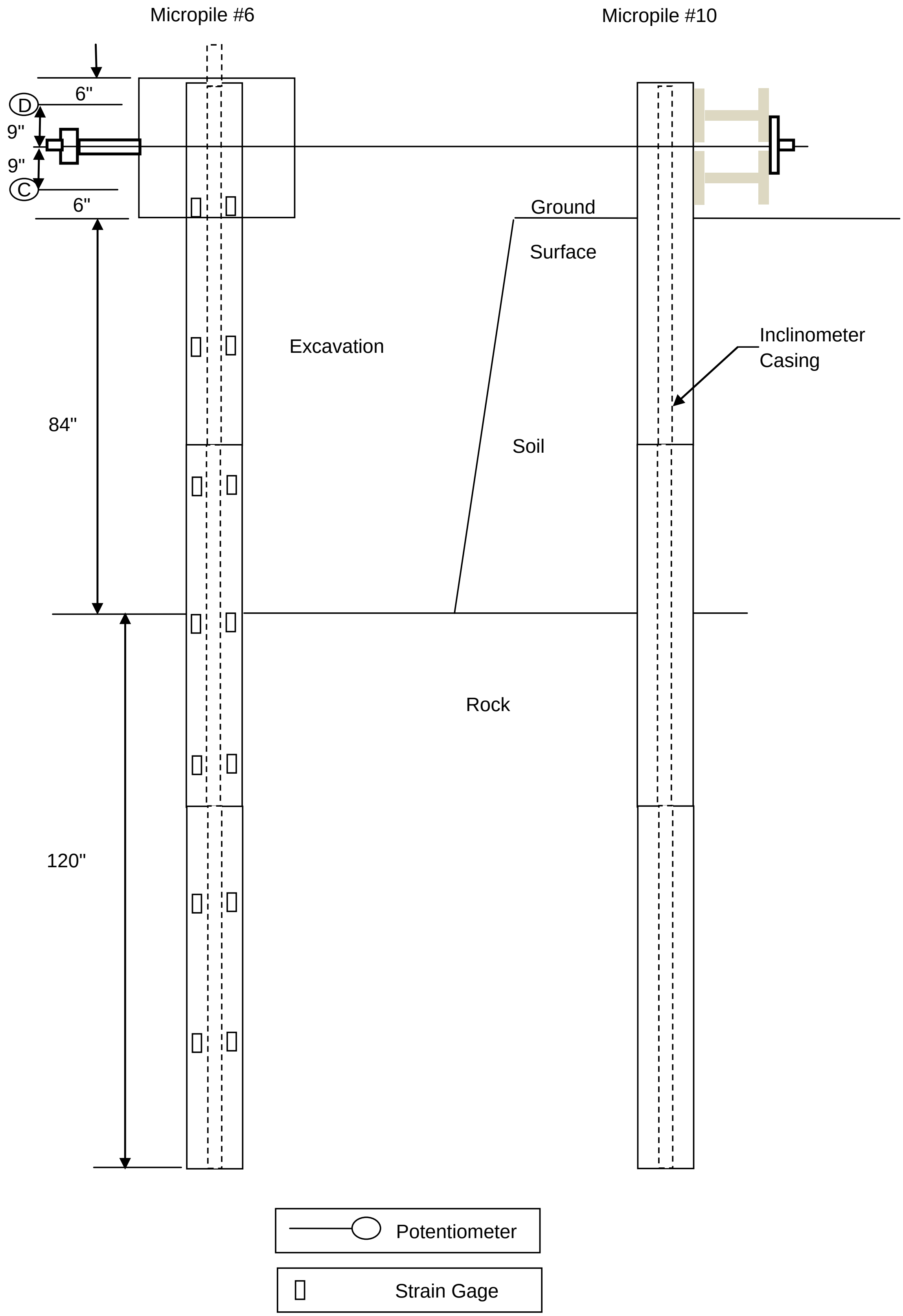


Figure 4.38: Section C showing micropile #6

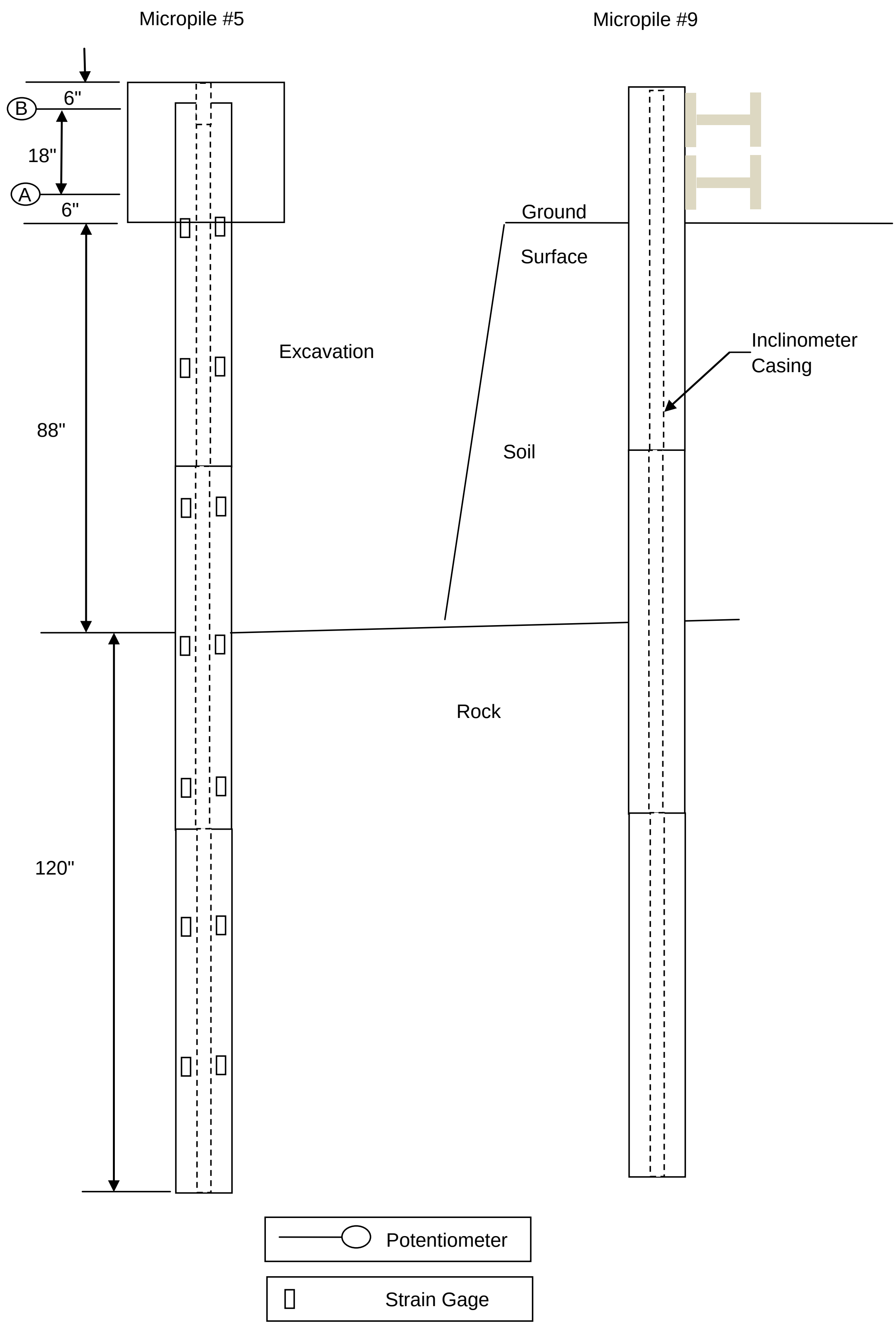


Figure 4.39: Section D showing micropile #5

Figure 4.40: Pile group testing in progress.

Figure 4.41shows horizontal displacement versus depth (below top of pile) curves for the micropiles in the bent calculated from the inclinometer measurements. Figure 4.42 shows the deflection near the load point at the centerline of the cap based on both inclinometer and potentiometer measurements. Pile 5 was not included since the first inclinometer point was below the pile cap due to a construction defect. The bending moment profiles for several load steps are shown in Figure 4.43.

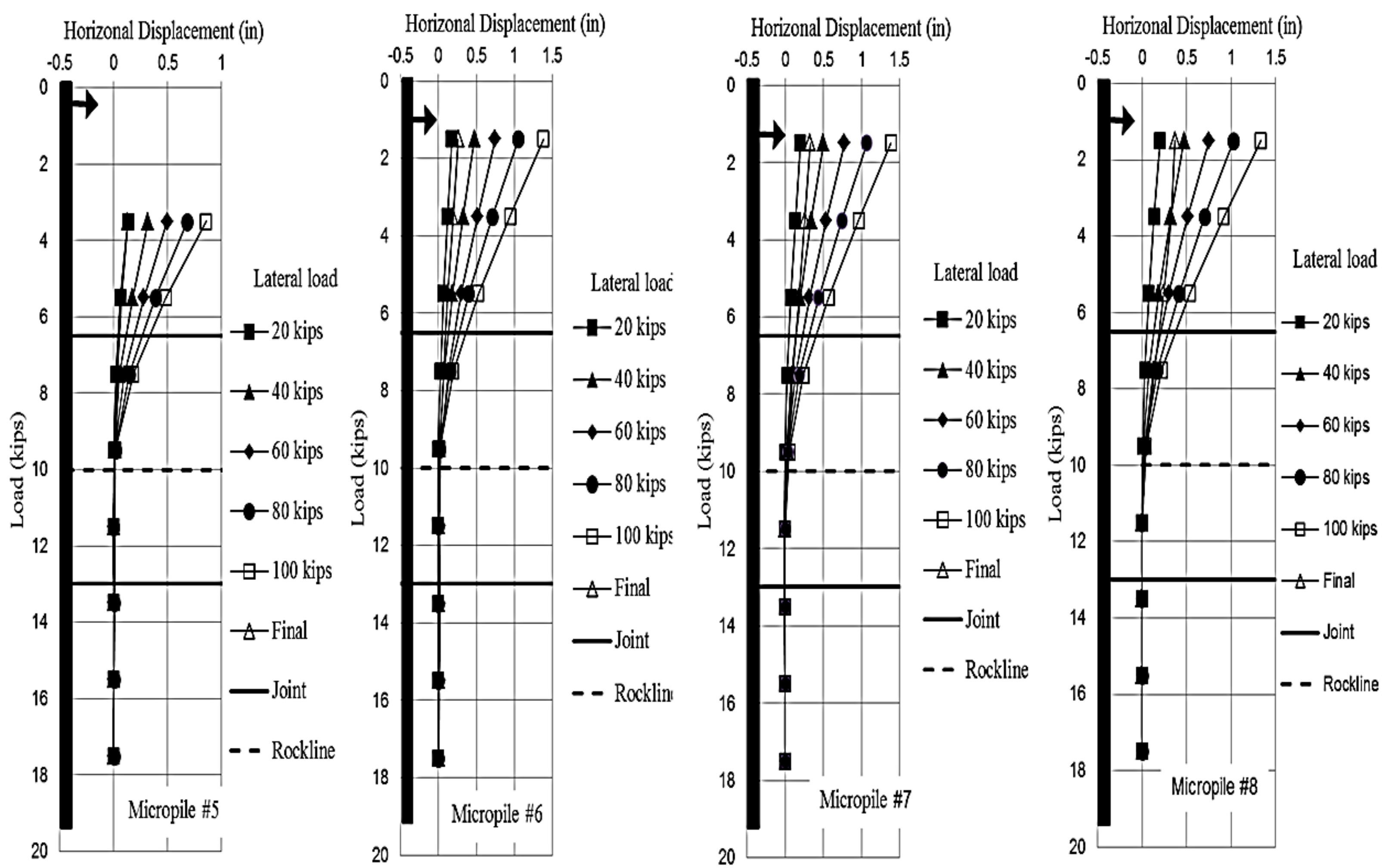


Figure 4.41: Lateral deflection versus depth curves for micropiles during group load test

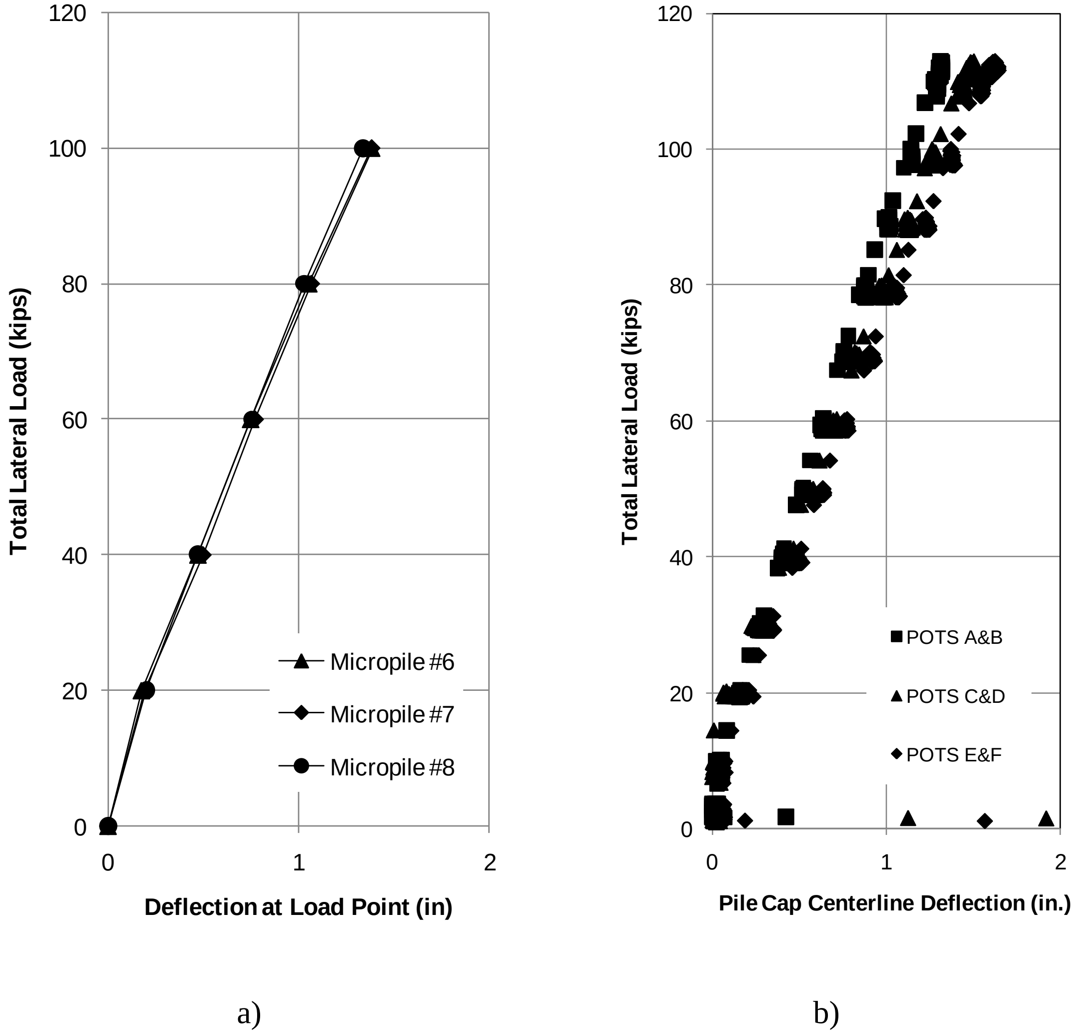


Figure 4.42: Pile top and cap centerline displacements based on a) inclinometer and b) potentiometer measurements

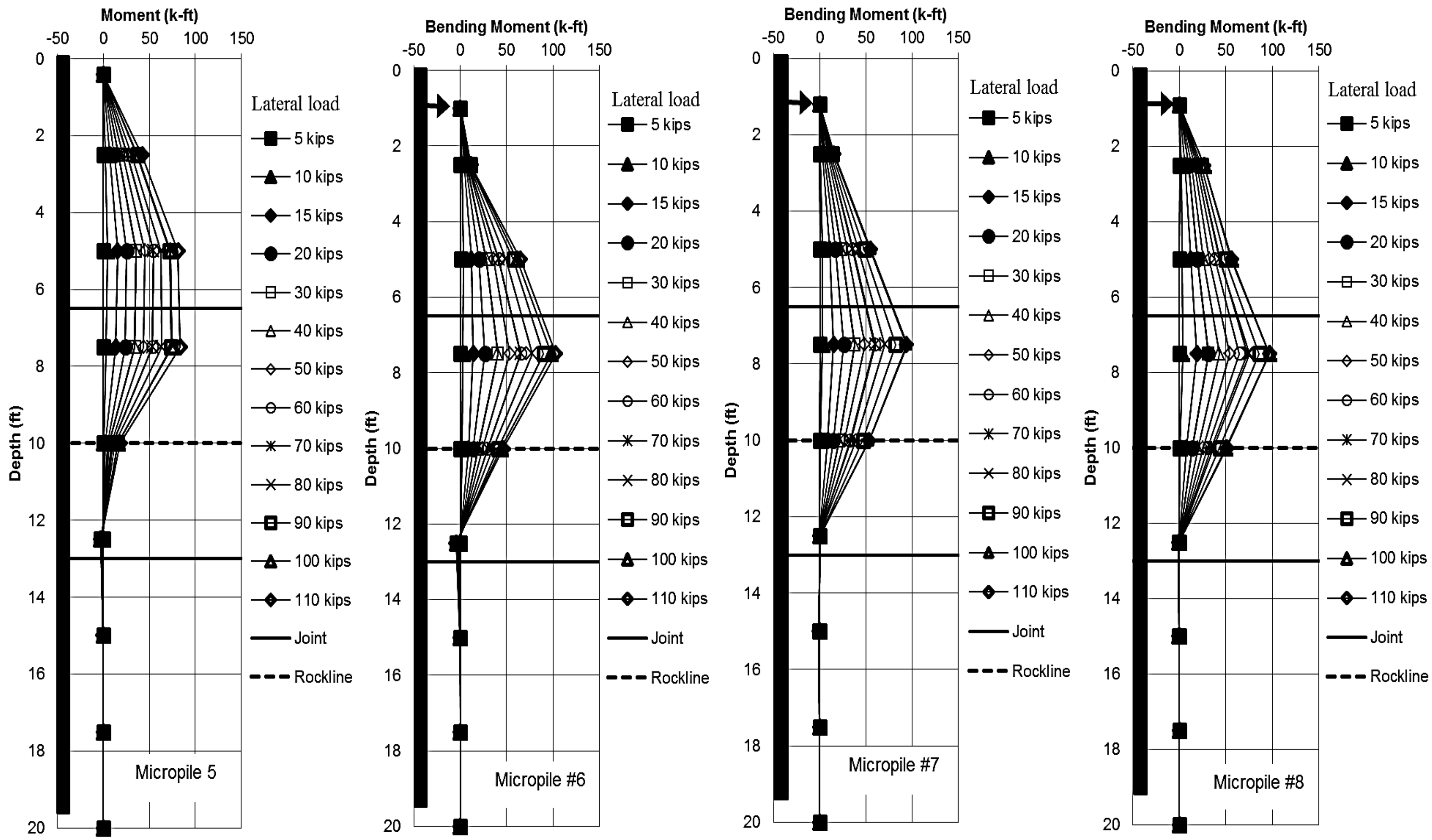


Figure 4.43: Bending moment versus depth (below ground surface) curves

4.6 Discussion of Load Test Results

By design, tests B, E, and F were carried out to failure of the micropile section. In term of load and deflection and response, most of the displacement appeared to occur above the casing joint. The rockline was only a factor for test A, where the pile rotated in the socket. The top load deflection response tracked with the inclinometers showed fairly linear response. The unfortunate consequence of the poor potentiometer data was that the exact displacements at failure were not available. However, in tests B and E, the final inclinometer test was conducted just before the failure load was applied. In test F, the response was extrapolated to get a linear approximation of the failure load and deflection. These tests all ended with an abrupt failure of the upper casing joint. When comparing these load tests to the original FB-MultiPier model, the tests failed in a rather brittle fashion, while the FB-MultiPier model showed more ductile behavior, yielding before failure. The failure loads and top deflections are summarized in Table 4.4.

Load test I was similar to load test F except the piles were instrumented with strain gages, and the test was not conducted to failure, as the piles would be part of the reaction for the group load test. The test was halted at about 35 kips since the others failed at around 40 kips. The peak bending moment measured in piles 10 and 11 was about 79.11 kips*ft and 67.12 kips*ft respectively. The original FB-MultiPier predictions failed at right around 27 kips, and even then the bending moment in the piles was nearly 170 kips*ft. with a top displacement of nearly 4 in.

To further compare the results of the single pile models, the inclinometer measurements were used to calculate bending moment profiles. The solution had limitations; however, this provides a way to assess the bending moment in the sections that had no strain gages. Figure 4.31 establishes the relationship by comparing the calculated bending moment profiles to those measured with strain gages for test I. The comparison appears reasonable at lower load levels but may not predict well at higher loads. As well, the point of maximum bending moment is forced deeper in the pile, looking somewhat like the results from the original FB-MultiPier models.

In terms of the group performance, the piles moved as a unit almost identically. In all likelihood, the piles were nearing the point of yielding. What does not show in the results is that the reaction system was also yielding at around 117 kips of lateral load.

TABLE 4.4: Results of single pile tests to failure except load test I

Pile	Load Test	Pile Length (ft.)	Rock Plunge (ft.)	Peak Load (kips)	Deflection at Peak Load (in)	Bending Moment (kips*ft)
2	B	13	2'	50	1.5	-
14	B	13	2'	50	1.7	-
3	E	13	5'	40	1.45	-
15	E	13	5'	40	1.85	-
4	F	19.5	10'	40	1.1	-
16	F	19.5	10'	40	1.45	-
10	I	19.5	10'	35	0.70	79.11
11	I	19.5	10'	35	0.73	67.12

It is hypothesized as well that ground freezing may have played a role in the limited deflections seen in the group test. Since the load test was conducted on a day when the temperature was below zero, and the soil in front of the piles had been excavated previously, there is a good chance that soils may have been far stiffer due to freezing.

CHAPTER 5: LABORATORY LOAD TESTING AND CORROSION

Presented in this chapter are the laboratory test layouts, instrumentation, procedures, and observations of the load tests for composite micropiles specimens. The bending test essentially measures a metal's ductility. Ductility defines how easily a metal can bend without breaking. The higher the ductility of a metal, the more it can bend without breaking or becoming deformed from its original shape. This is important because certain metals must handle pressure without snapping yet still be ductile enough to bend slightly and not lose their support or shape. Copper and steel are two metals that have a high ductility and do well under pressure.

5.1 Purpose of Laboratory Tests

The goals of the laboratory tests were: (1) to document the material/system behavior of micropiles in a controlled environment, (2) moment capacity of the joints, (3) failure mode of the composite members, (4) the magnitude of the deflection, (5) flexural rigidity of the composite member, and (6) to document the ductility of the composite piles. The advantage of the laboratory tests is that they were designed and performed after the results of the field load tests were known. One issue left unresolved by the field tests was the unknown behavior of the joints as the piles were embedded in overburden. In addition, several of the key load tests were not performed to failure, therefore quantifying the bending moment at failure in the lab tests would complement the load test results from the field campaign.

Along with the strength tests, a program of corrosion tests was commenced in the lab. Since the long term performance of micropiles is impacted by the durability of the steel casings, the program will be a long term study on the impacts of corrosion on casing integrity.

5.2 Four-Point Bending Test for Non-segmented Steel Pipe

For a prismatic member (constant cross section), the maximum normal stress occurs at the maximum moment. For micropile casings used in the lab, the yield stress from coupon tests was 150 ksi. Assuming the casings were continuous pipes, non-segmented, the maximum moment and deflection under the four point bending test are shown in Figure 5.1.

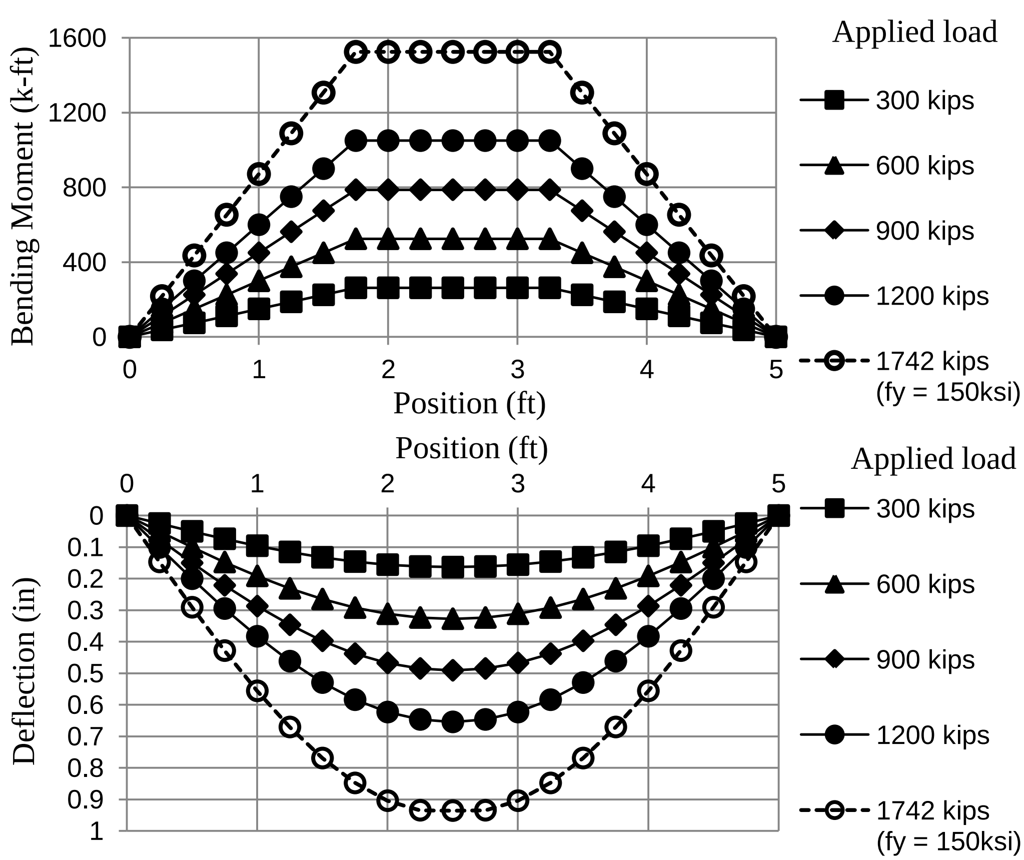


Figure 5.1: Theoretical maximum bending and deflection plots for non-segmented steel pipe.

5.3 Structural Experimental Setup Test

The testing program was designed after consideration of previous research, safety, available funds and materials, and the remaining research objectives. The initial design was based heavily upon that presented by Long and Carroll (2005). The micropile casings were loaded as beams in four-point flexure. During the tests, strain, deflection and load were monitored along with visual documentation of casing twist. The test piles were 6.0 ft. micropiles, consisting of two 3 ft. segments joined with a threaded joint. A drawing of the testing plan is shown in Figure 5.2.The micropiles were filled with grout that was mixed with a high shear mixer and cured in the lab for 28 days. The cross section of the micropile steel casings was the same as the field micropiles: 10.75 in. external diameter and wall thickness of 0.50 in. The yield strength of the micropile steel casing was 80 ksi and the ultimate strength of grout after 28 days was 4000 psi. Nine simply supported micropiles, designated as 1 through 9 were load tested. Table 5.1 lists the micropiles and their general attributes and Table 5.2 shows the lab tested micropile properties.

TABLE 5.1 Schedule of bending tests on identical micropiles

Pile	Number of Casings	Total Length (ft.)	Inside Instrumentation
1	2	6.0	Strain Gages
2	2	6.0	Strain Gages
3	2	6.0	Strain Gages
4	2	6.0	Strain Gages
5	2	6.0	Strain Gages
6	2	6.0	None
7	2	6.0	None
8	2	6.0	None
9	2	6.0	None

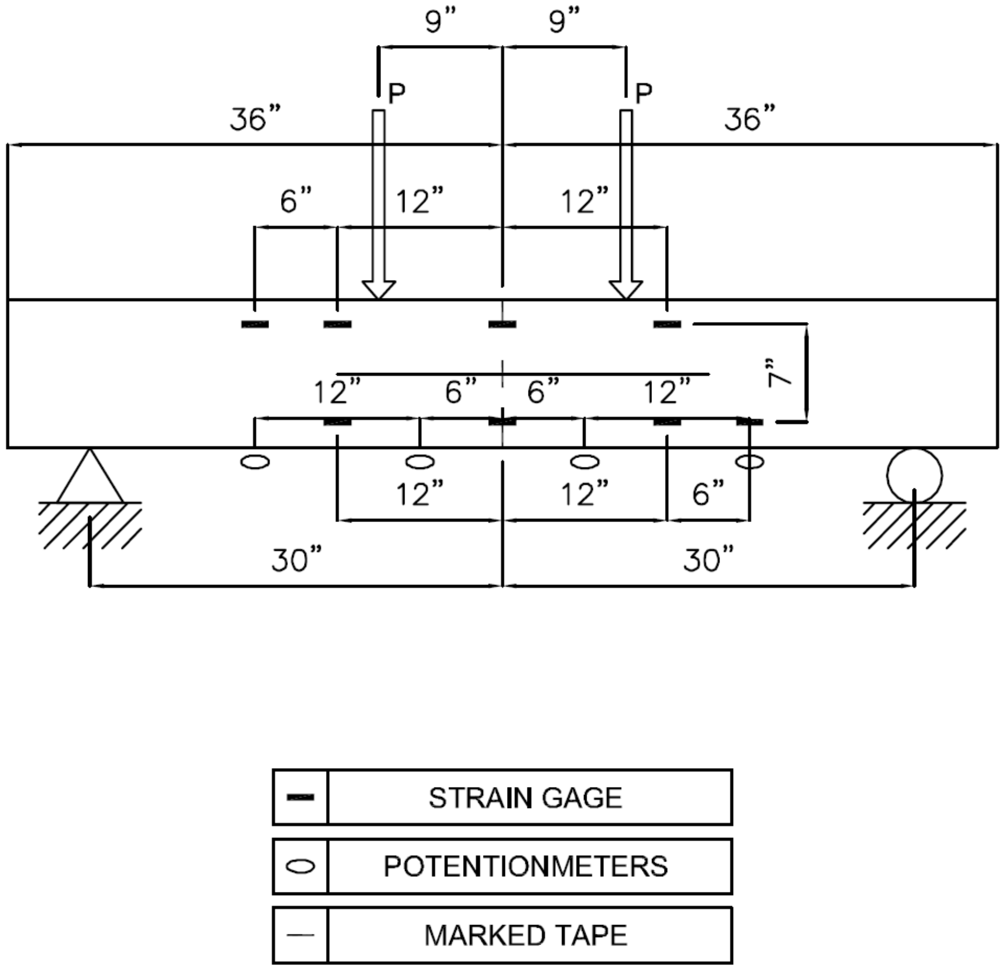


Figure 5.2: Dimensions and setup for structural micropile test

Table 5.2: Laboratory test micropile properties

	Out to out diameter (in)	In to in diameter (in)	Wall thickness (in)	Thread length (in)	Thread shape	Thread depth (in)	Thread connection
Micropile Properties	10.75	9.75	0.5	2.5	V shape thread	0.122	Right hand

5.3.1 Micropile Section Fabrication.

Skyline Steel donated 96 linear feet of micropile casing for the research. The casing was shipped in 1, 2, or 3 foot sections with one or both ends threaded. While a variety of sizes were available, it was decided to use 18 of the 3 ft. sections to make 9 micropiles with a joint in the center (about half of the steel supplied). The remaining sections would be used for the corrosion study, as they were shorter and thus lighter and easier to handle. The micropile sections were joined in the laboratory by threading them together and tightening them using a large set of chain tongs. All 9 casings were stood vertical and strain gages were placed in the appropriate piles in preparation for grouting. CEMEX donated a pallet of Type I cement for grouting the piles. A high shear mixer was supplied by Nicholson Construction to insure that the grout in the lab tests was similar to the grout in the field tests. The micropiles were allowed to cure for 28 days before load testing. Figure 5.3 shows the micropile specimens being grouted.

Figure 5.3: Grouting micropile specimens

5.3.2 Instrumentation and Apparatus.

The behavior of the micropiles was measured by creating boundary conditions that could either be controlled or measured. This included devising load systems and instrumentation to measure load, strain, and displacement in a similar fashion to the systems used by Long et al. (2004) and following ASTM E290-09. All micropiles were instrumented to measure load and deflection. Vibrating wire strain gages were installed in select piles to determine bending moment.

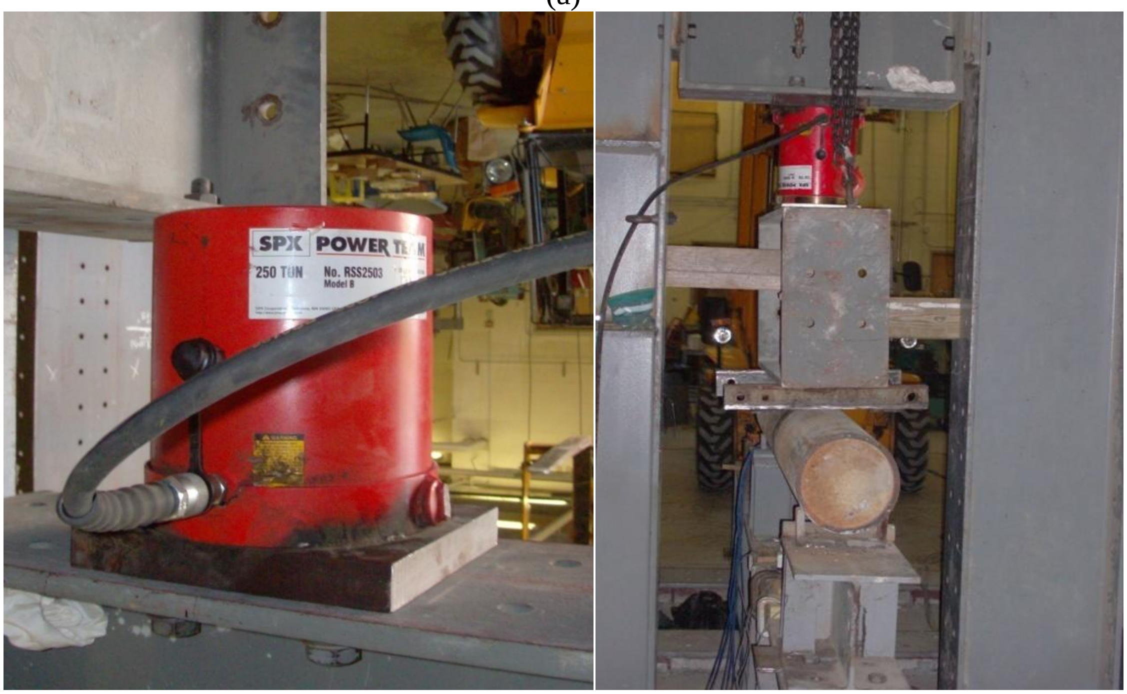
5.3.3 Load Frame and Hydraulic Jack.

A load frame was erected in the UNC Charlotte structures lab in order to load the micropiles as simply supported members in four point flexure. The vertical load was applied at the third points using a single 250 ton jack, RSS2503 by Power team. A 609163S model pump was used to supply hydraulic pressure. Force was measured using a pressure transducer manufactured by Entran, model number EPO W31 10KP.The measured hydraulic pressure was multiplied by the jack plunger area. The jack, load frame, and hydraulic pump with pressure transducer are shown in Figure 6.4.

5.3.4 Potentiometers.

As with the field load tests, cable extension potentiometers were used to monitor micropile deflection. The potentiometers used in the laboratory were PT100 series manufactured by Celesco. For test 1 only, the potentiometers were located at the joint and then 12 in. on either side. For tests 2-9, the potentiometers were located 6 inches and 18 inches on either side of the joint. Figure 5.5 shows the arrangement of four potentiometers used in the majority of the tests.

(a)



(b)

Figure 5.4: Loading head, testing setup, and jack with pressure transducer

5.3.5 Scale Tape

Since one of the questions raised was whether or not the micropile casings would twist or “unscrew” during loading, tape scales were attached to the mating edges of the casing joints. This is shown in Figure 5.6.

Figure 5.5: Photograph of potentiometer locations.

Figure 5.6: Measuring casing twist using scale tape

5.3.6 Strain Gages.

The same vibrating wire strain gages that were used for the field tests were installed in the micropiles for flexure testing. Figure 6.7 shows the eight strain gage assembly before and after insertion into the micropile casing. Due to the limited quantity of gages, five of the micropiles were instrumented with eight strain gages each. The remaining four micropiles were considered for redundant testing and received no gages. Micropiles designated 1-5 have gages while 6-9 are ungaged.

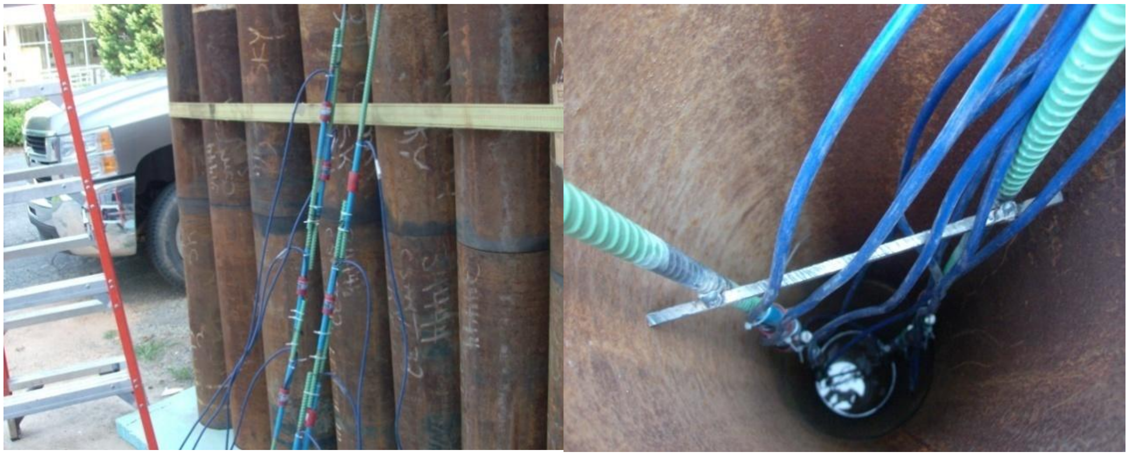


Figure 5.7: Typical strain gage setup.

5.3.7 Data Acquisition

Two separate data acquisition systems were used to monitor the strain gages and analog sensors. To operate the strain gages the same Campbell Scientific CR1000 datalogger that was used in the field was used in the lab. The analog sensors were connected to a National Instruments data acquisition card. The sensors were powered using external power supplies.

5.4 Bending Tests on Grouted Micropiles.

If couples are applied to the ends of the beam and no forces act on the beam, then the bending is termed pure bending. In the case of the loading as shown in Figure 6.2, the portion of the beam between the two applied downward forces which is the location of the joint is subject to pure bending. All load tests were conducted in a similar fashion. The only deviations were for test 1 that included position of the potentiometers as well as the use of an end restraint. The deflection profiles of each of the tests are shown in Figures 5.8 to 5.16 and the potentiometer localized deflections are shown in Figures 5.17

to 5.24. Besides strength, serviceability was also a concern. Table 5.3 shows the maximum deflection and the applied maximum load for all the nine tests conducted.

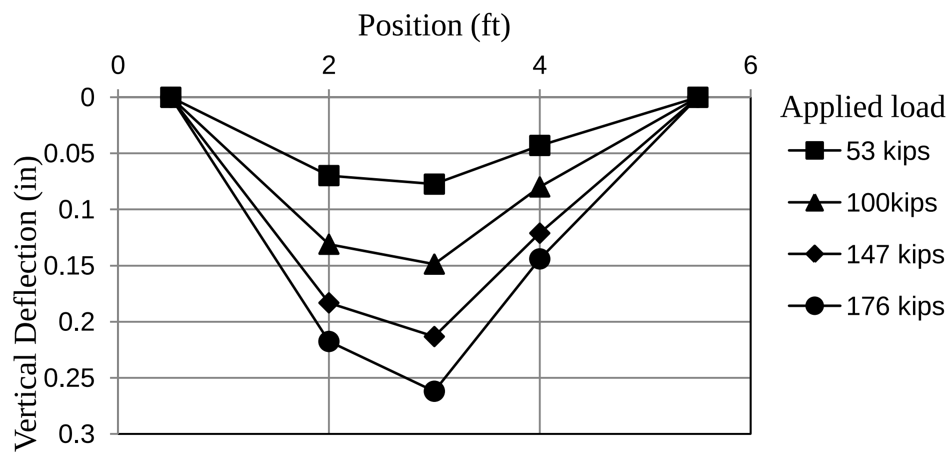


Figure 5.8: Micropile 1 deflection profile

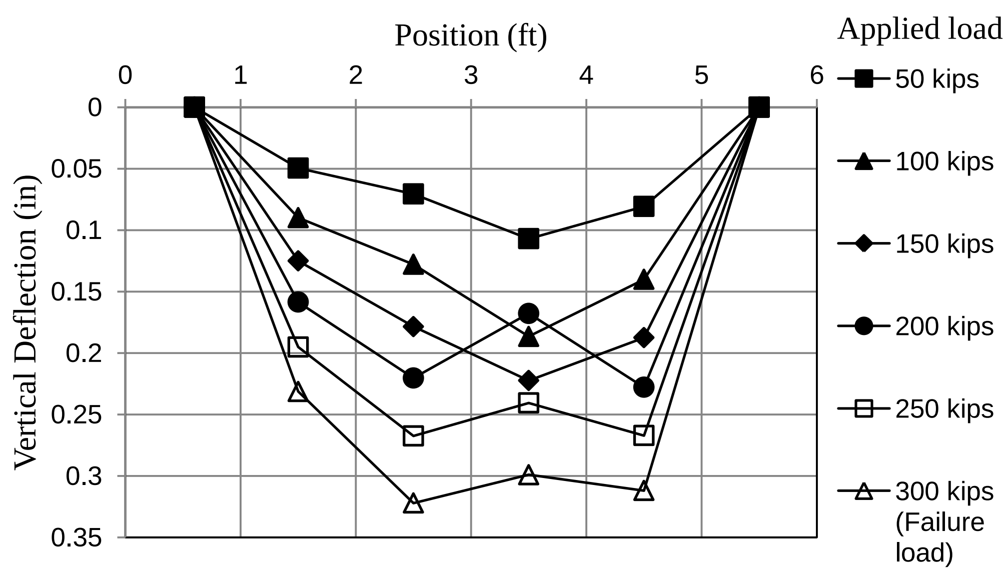


Figure 5.9: Micropile 2 deflection profile

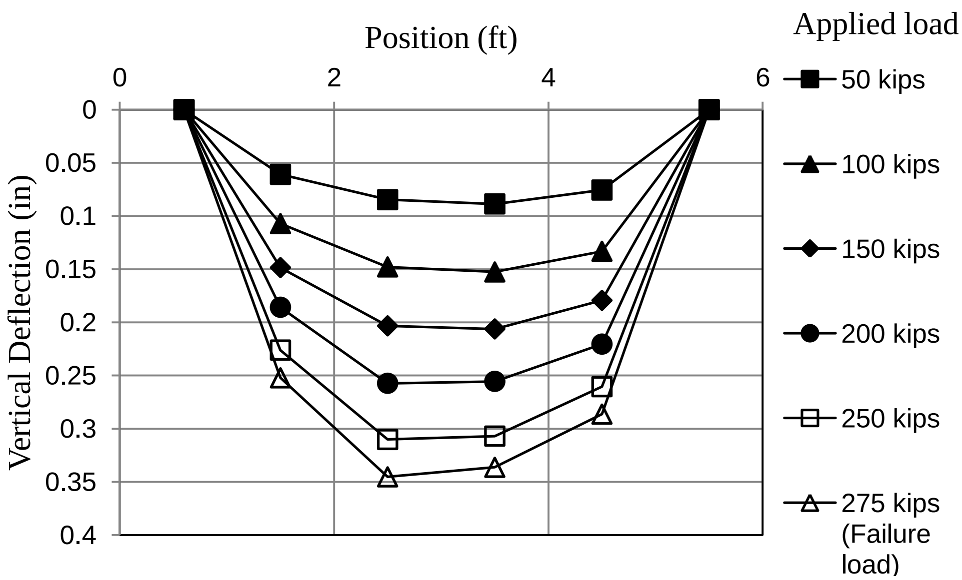


Figure 5.10: Micropile 3 deflection profile

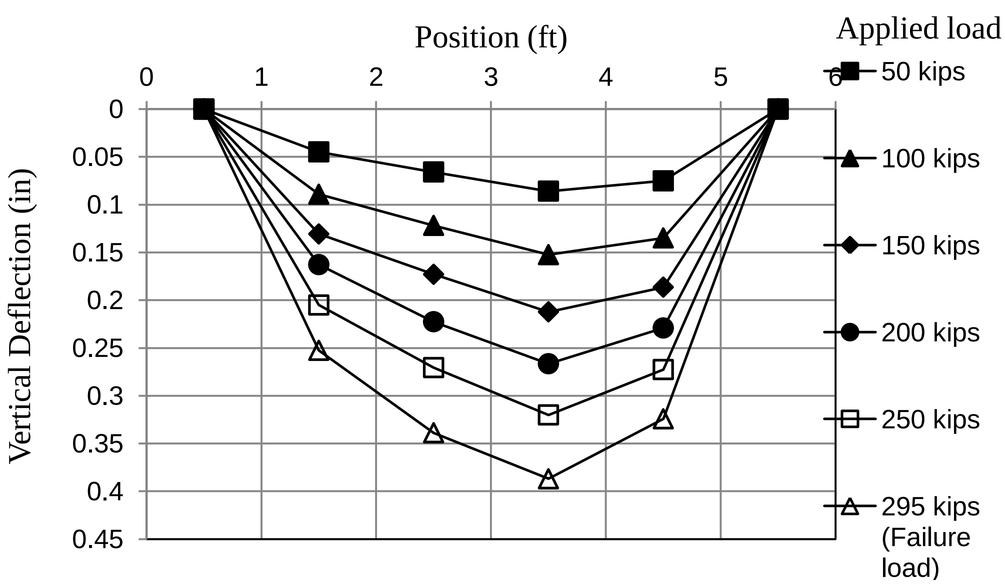


Figure 5.11: Micropile 4 deflection profile

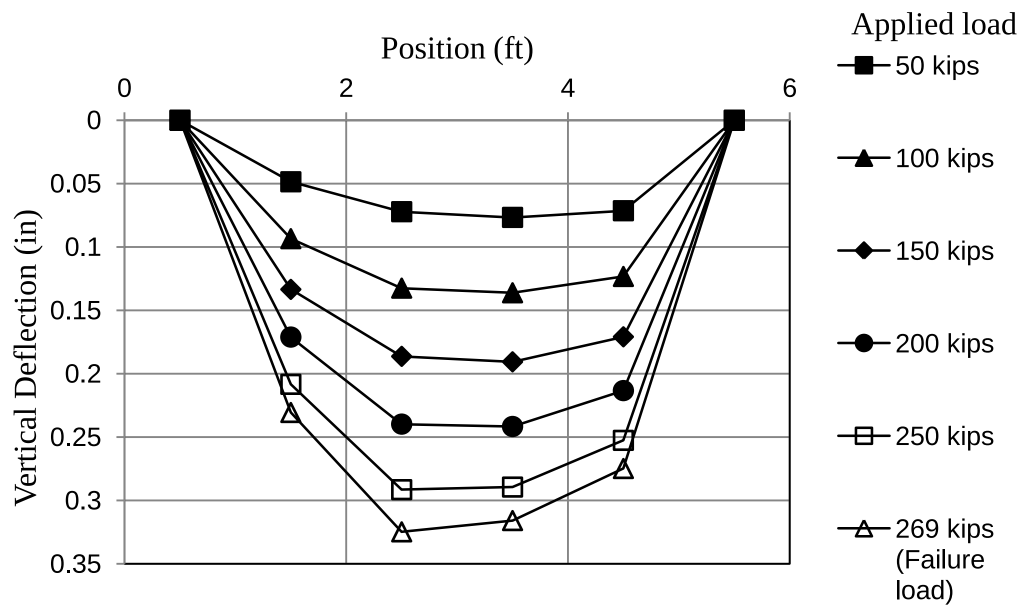


Figure 5.12: Micropile 5 deflection profile

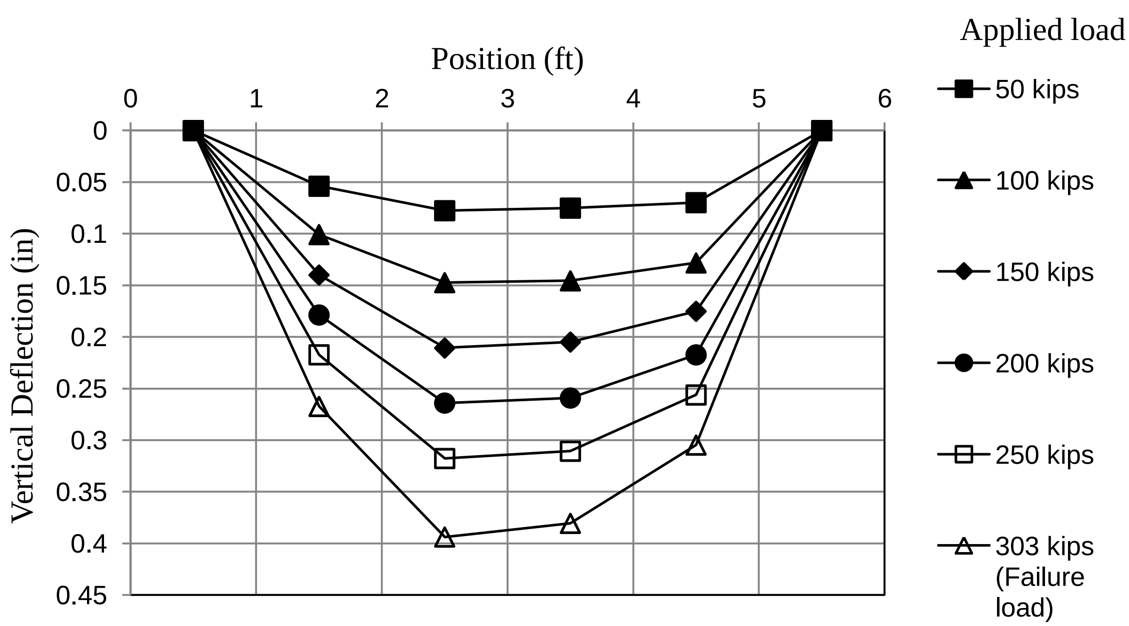


Figure 5.13: Micropile 6 deflection profile

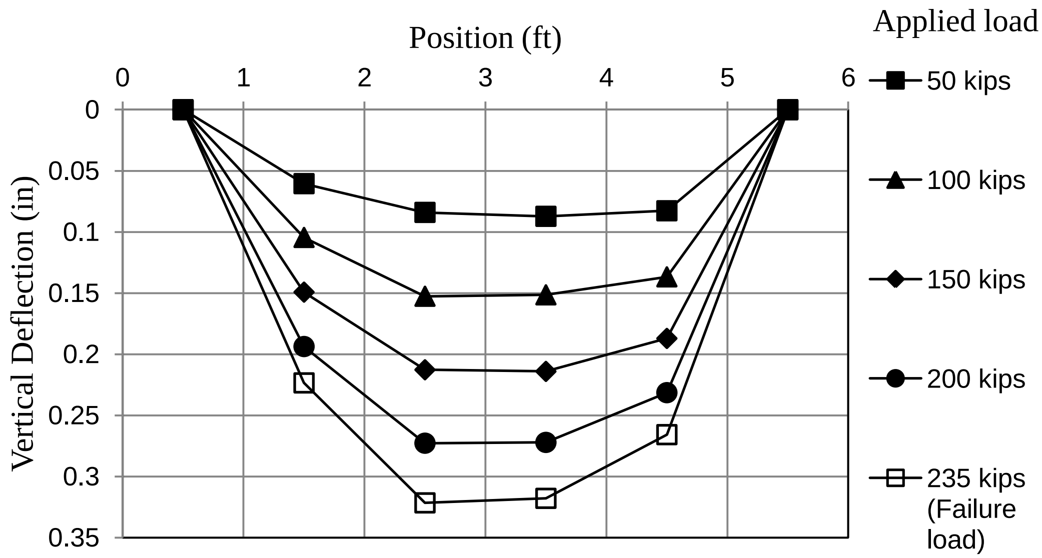


Figure 5.14: Micropile 7 deflection profile

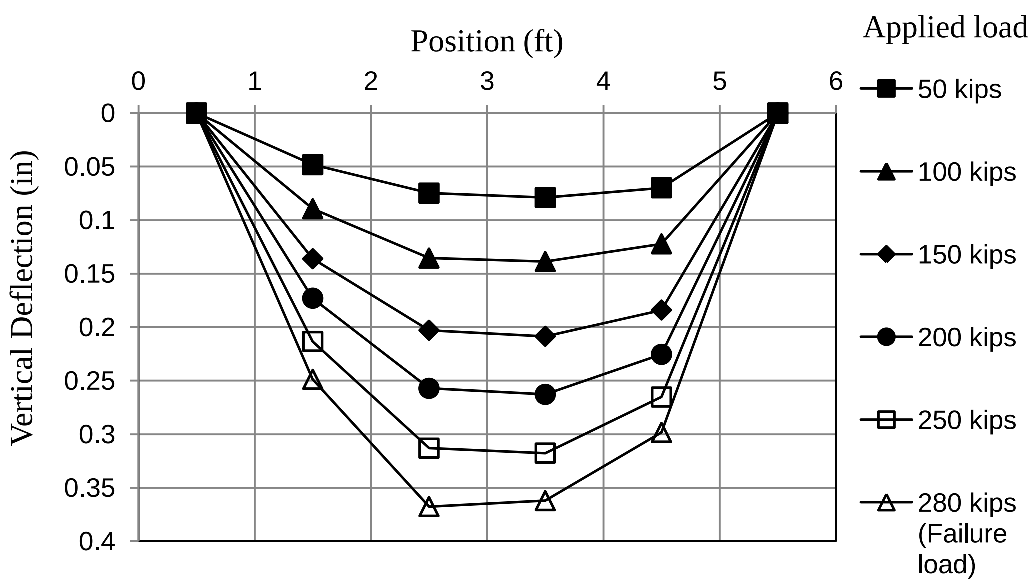


Figure 5.15: Micropile 8 deflection profile

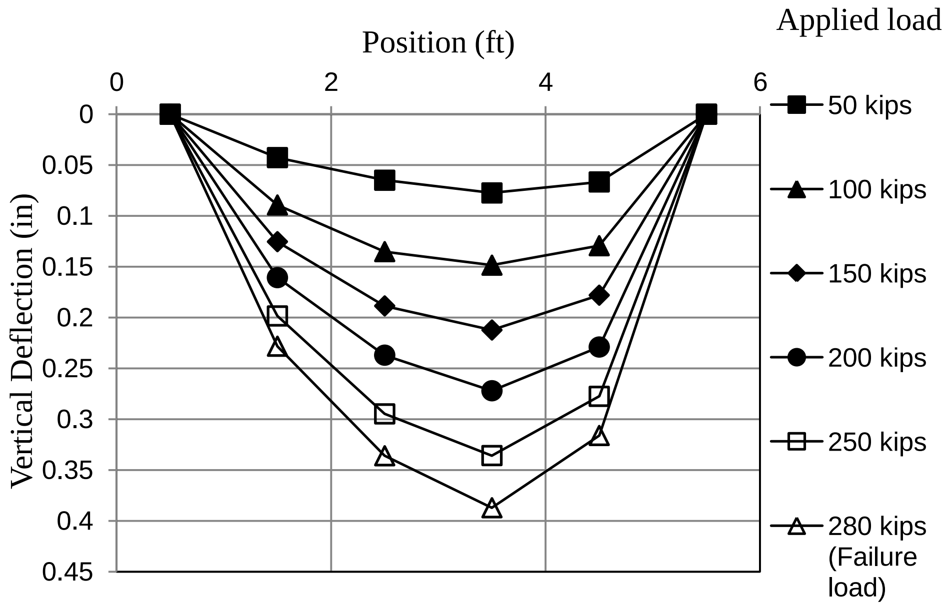


Figure 5.16: Micropile 9 deflection profile

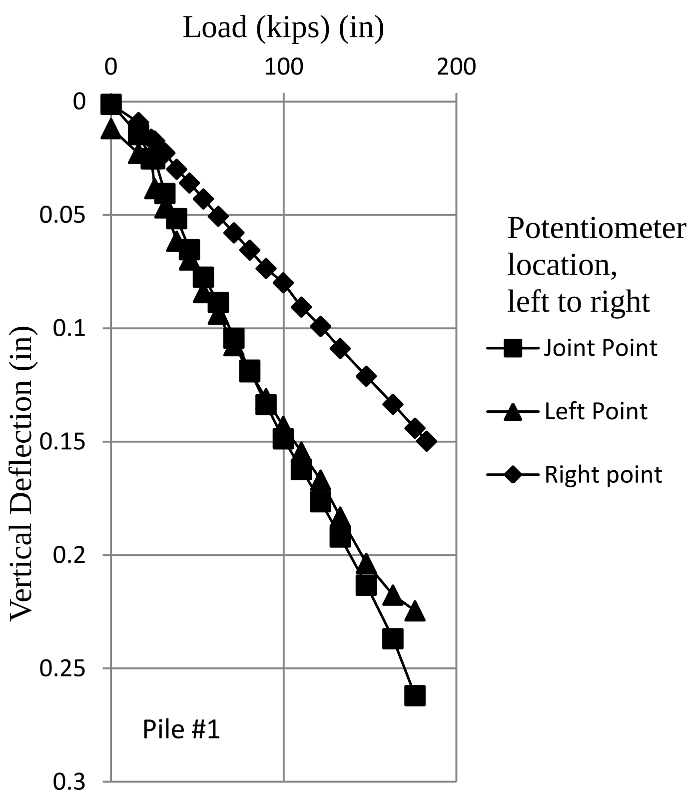


Figure 5.17: Micropile 1 point deflection profile

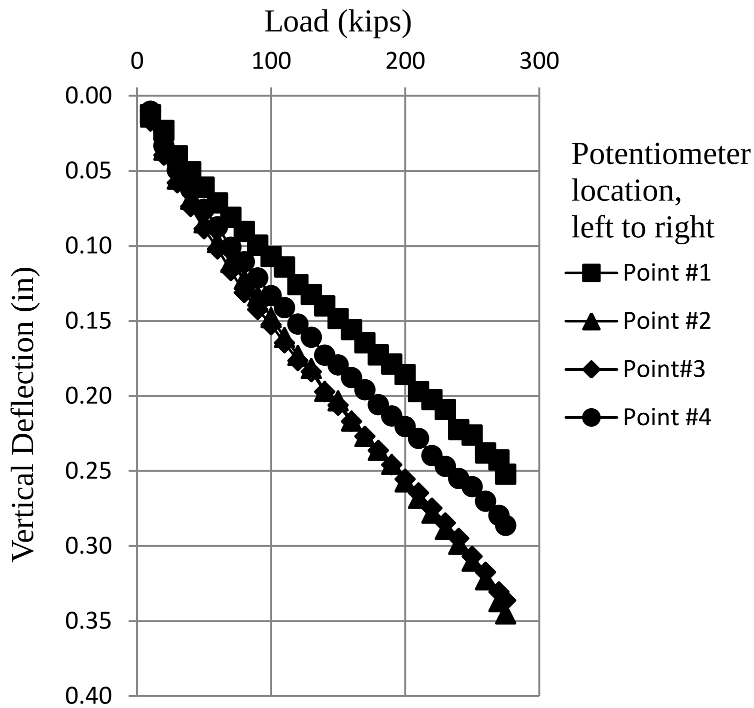


Figure 5.18: Micropile 3 point deflection profile

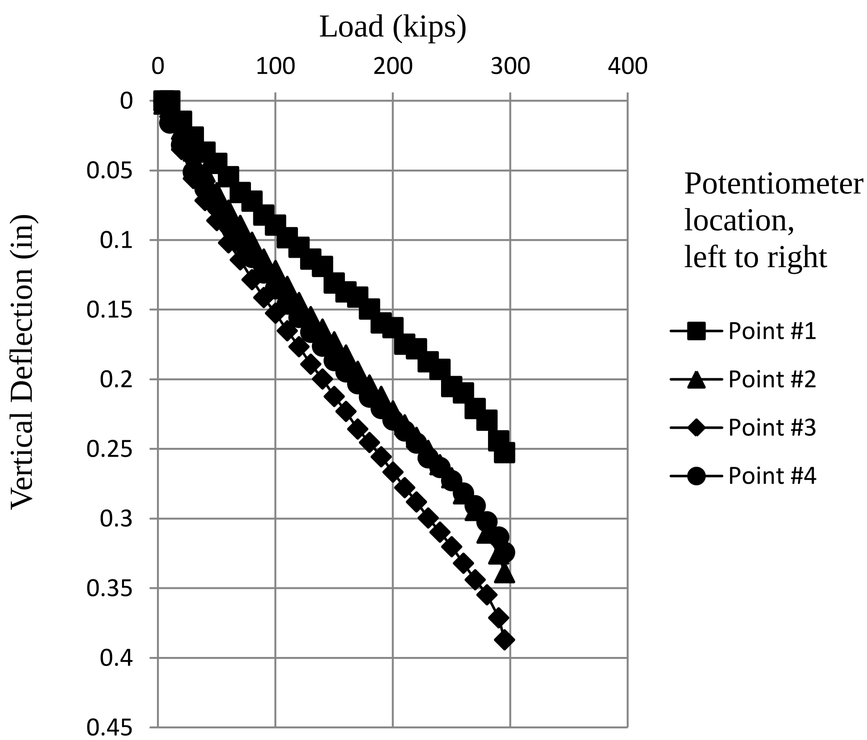


Figure 5.19: Micropile 4 point deflection profile

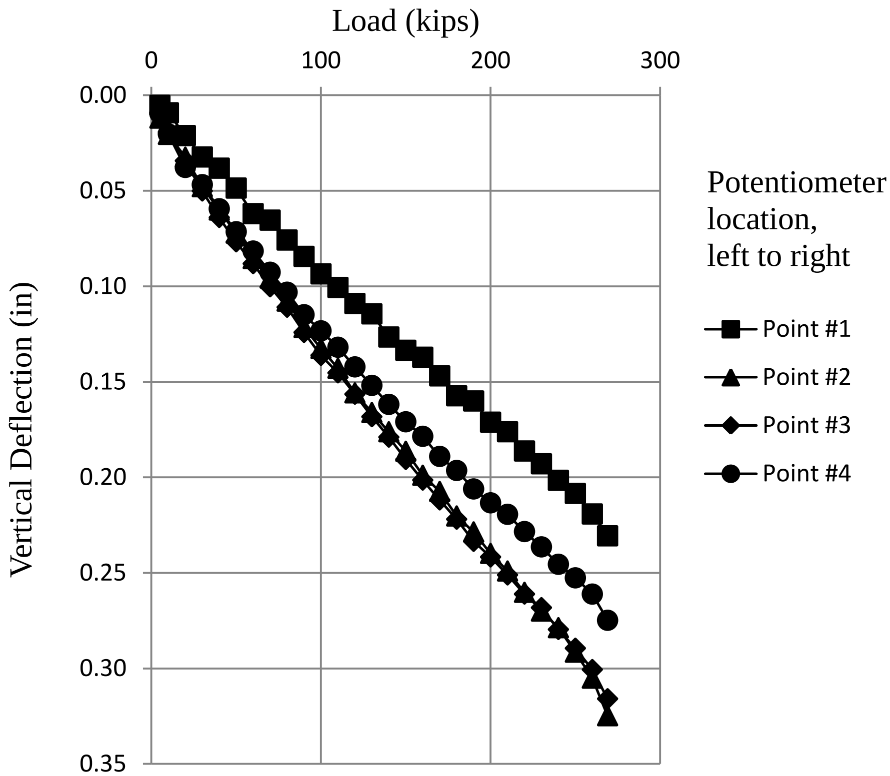


Figure 5.20: Micropile 5 point deflection profile

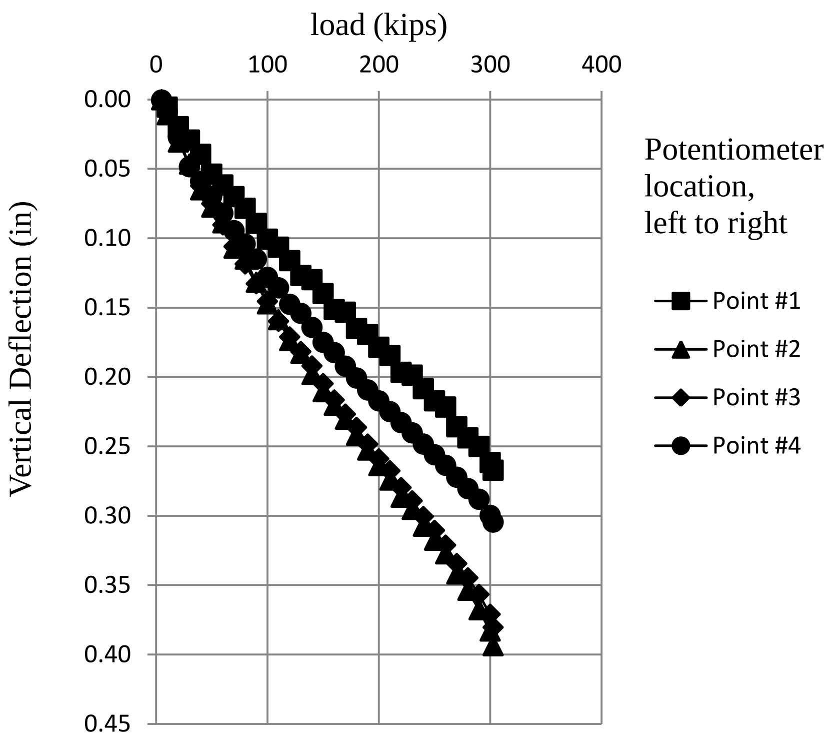


Figure 5.21: Micropile 6 point deflection profile

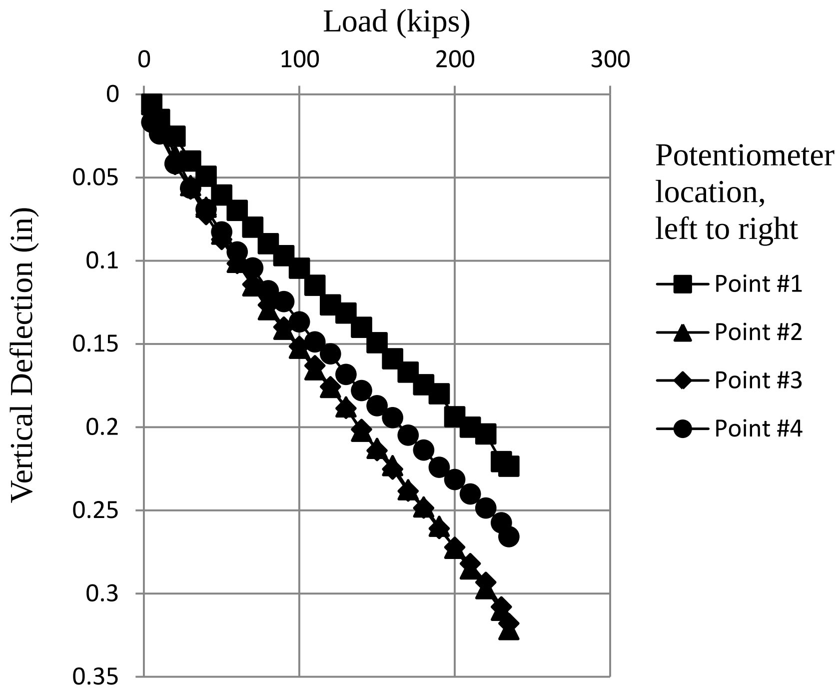


Figure 5.22: Micropile 7 point deflection profile

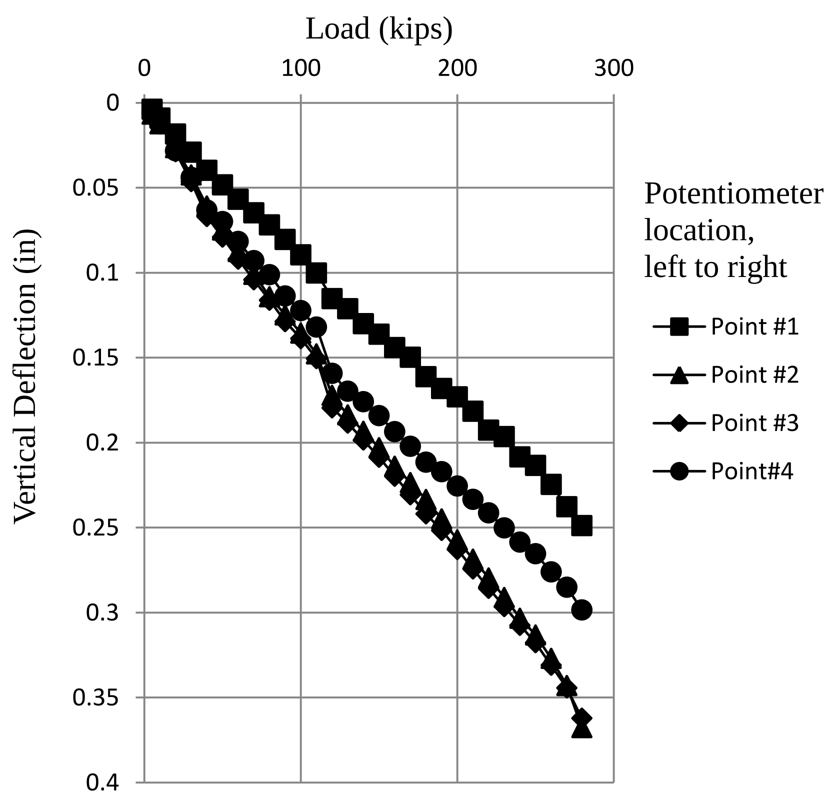


Figure 5.23: Micropile 8 point deflection profile

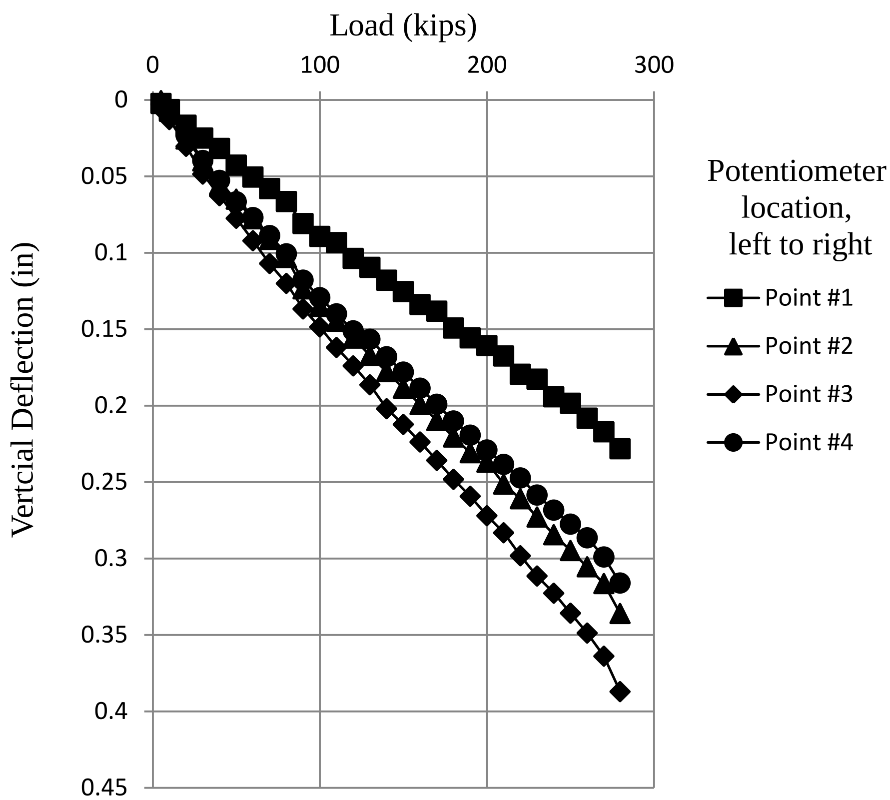


Figure 5.24: Micropile 9 point deflection profile

Table 5.3: Summary of deflection test results

Date	Pile	Number of Casings	Strain Gages	Casing Unscrew at Failure (in)	Deflection at Maximum Load (in)	Theoretical Deflection at Maximum Load (in)	Maximum Applied Force (kips)
9/10/10	1	2	Yes	0.120	0.458	0.164	300
9/14/10	2	2	Yes	0.120	0.330	0.165	303
9/14/10	3	2	Yes	0.120	0.340	0.147	270
9/15/10	4	2	Yes	0.120	0.387	0.161	295
9/10/10	5	2	Yes	0.120	0.325	0.147	269
9/16/10	6	2	No	0.120	0.390	0.165	302
9/16/10	7	2	No	0.120	0.320	0.128	235
9/16/10	8	2	No	0.120	0.368	0.153	280
9/15/10	9	2	No	0.120	0.387	0.153	280

To check the properties of micropile, it was essential to properly evaluate the flexural rigidity (EI). The apparent flexural rigidity, (EI_a), of the micropile composite was determined based on Equation 3.5. The back calculated apparent flexural rigidities (EI_a) based on the maximum deflection for the micropile sections are shown in Table 5.4.

Table 5.4: Apparent flexural rigidity for the nine deflection tests from lab

Deflection at Maximum Load (in)	Maximum Applied Force (kips)	Flexural Rigidity (EI) (kips-ft^2)
0.458	300	35964.79
0.330	303	50413.92
0.340	270	43602.02
0.387	295	41853.60
0.325	269	44769.71
0.390	302	42517.15
0.320	235	40321.78
0.368	280	41776.50
0.387	280	39725.45

The value of the flexural rigidity for the overall micropile with grout was found as the sum of the individual rigidities for each member in the cross-section by using the equation 5.1.

$$(EI)_{micropile\ composite} = \sum (EI)_{micropile\ steel} + \sum (EI)_{grout\ section} \qquad (5.1)$$

Young's modulus (E) of the steel casing is 432000 ksf,

Moment of the inertia of the steel casing is 0.01022 ft^4

$(EI)_{micropile\ steel}$= (4320000 ksf) * (0.01022 ft^4) = 44166.7 kips*ft^2

Young's modulus (E) of the grout is 288000 ksf,

Moment of the inertia of grout section is 0.02141 ft^4

$(EI)_{micropile\ steel}$ = (288000 ksf) * (0.02141 ft^4) = 6166.67 kips* ft^2

$(EI)_{micropile\ composite} = \sum (EI)_{micropile\ steel} + \sum (EI)_{grout\ section}$

44166.7 kips*ft^2 + 6166.67 kips* ft^2

50333.37 kips* ft^2

The average value obtained for the flexural rigidity from the deflection test in the lab was 42327.2 kips* ft^2, the computed value from the micropile section was 50333.3 kips* ft^2. The difference between the lab and the composite section value was about 8006.1 kips* ft^2 (16 %.). Table 5.5 shows the summary of the three methods used to determine flexural rigidity for the micropile composite section. The differences in values as shown in Table 5.5 show the effect of the joint with respect to the flexural rigidity.

Table 5.5: Summary of two methods for average flexural rigidity

	Sum of the individual using equation 5.1	Laboratory deflection using equation 3.5
Flexural Rigidity (EI) kips*ft^2	50333.37	42327.22

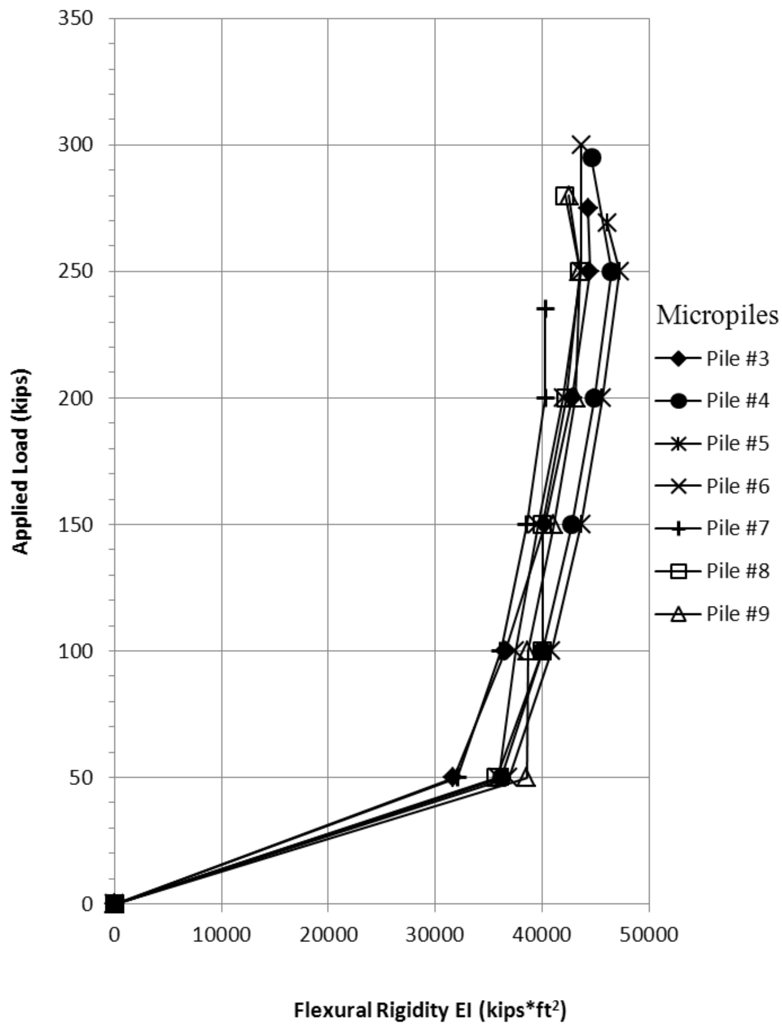


Figure 5.25: Plots of the pile flexural rigidity reaction

Table 5.6: Flexural rigidity based on the applied load

	Flexural Rigidity (kips* ft^2)						
Applied Load (kips)	Pile #3	Pile #4	Pile #5	Pile #6	Pile #7	Pile #8	Pile #9
0	0	0	0	0	0	0	0
50	31686.2	36178	36883.5	35950.6	32060.2	35704	38542.6
100	36549.2	40048.6	40874.5	37491.8	36116.6	40050	38698.3
150	40230.1	42760.7	43698.1	39643.6	38591.1	40033	41084.4
200	42835	44903	45616.6	41993.5	40301.5	42234	43137.2
235	-	-	-	-	40321.7	-	-

Table 5.6: (cont'd)

Flexural Rigidity (kips* ft^2)							
Applied Load (kips)	Pile #3	Pile #4	Pile #5	Pile #6	Pile #7	Pile #8	Pile #9
250	44490.2	46473.6	47254.5	43694.3	-	43524	43529.2
269	-	-	46106.4	-	-	-	-
275	44310.4	-	-	-	-	-	-
280	-	-	-	-	-	42135	42517.9
295	-	44638.5	-	-	-	-	-
300	-	-	-	43683.2	-	-	-

As shown in Table 5.1, micropiles 1 to 5 were instrumented with strain gages to measure the strain as the piles were tested to failure. Equation 4.15 and the average flexural rigidity of 42,327.2 kips* ft^2 were used to calculate the bending moment for each of the micropiles load tested. The results of the individual tests in the form of bending moment along the micropiles and the joint bending moment are shown in Figures 5.25 to 5.30 and Table 5.6.

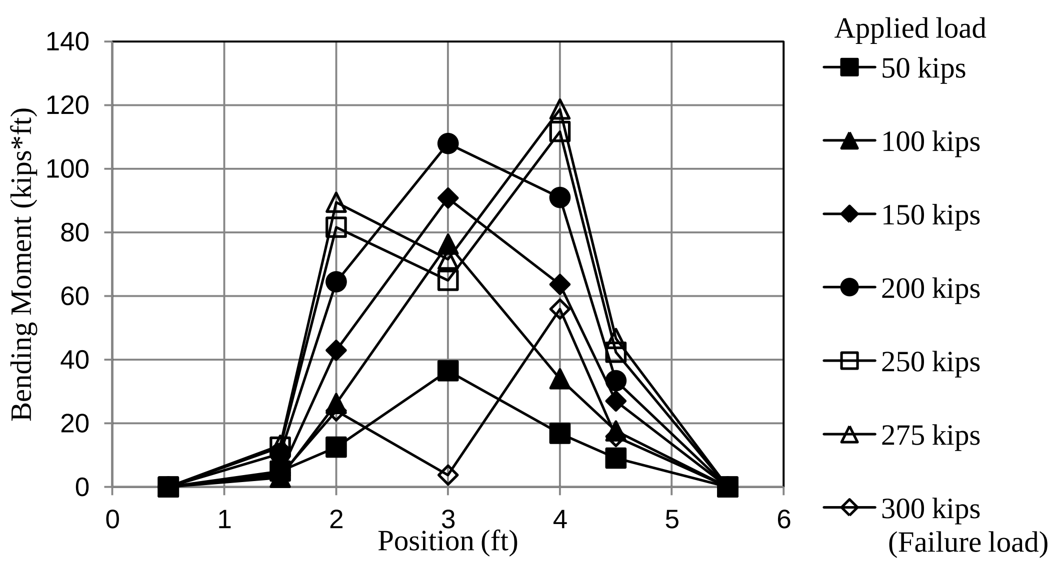


Figure 5.26: Micropile 1 bending moment profile

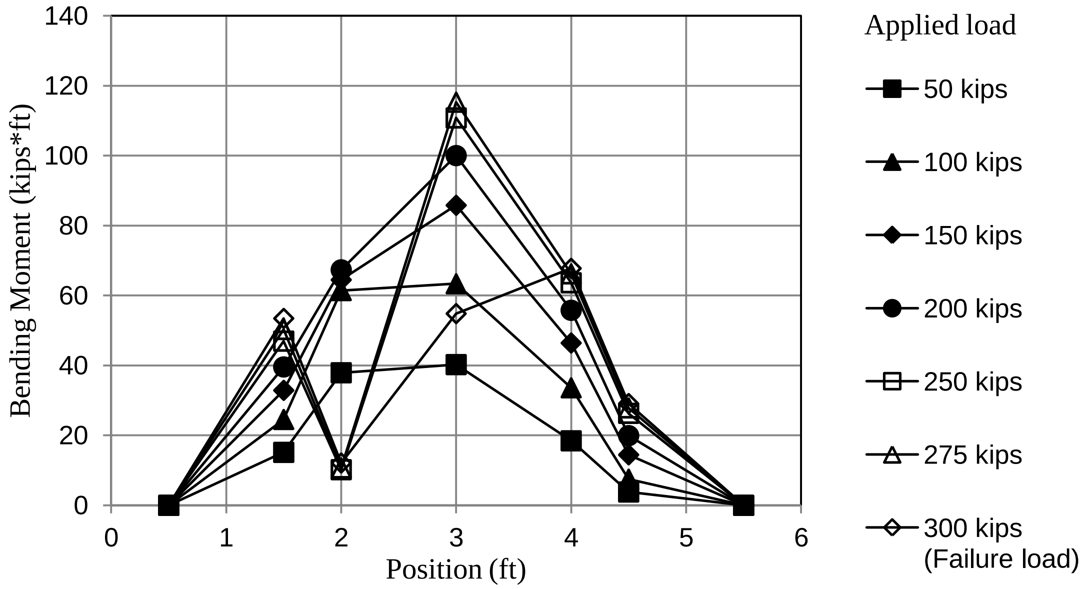


Figure 5.27: Micropile 2 bending moment profile

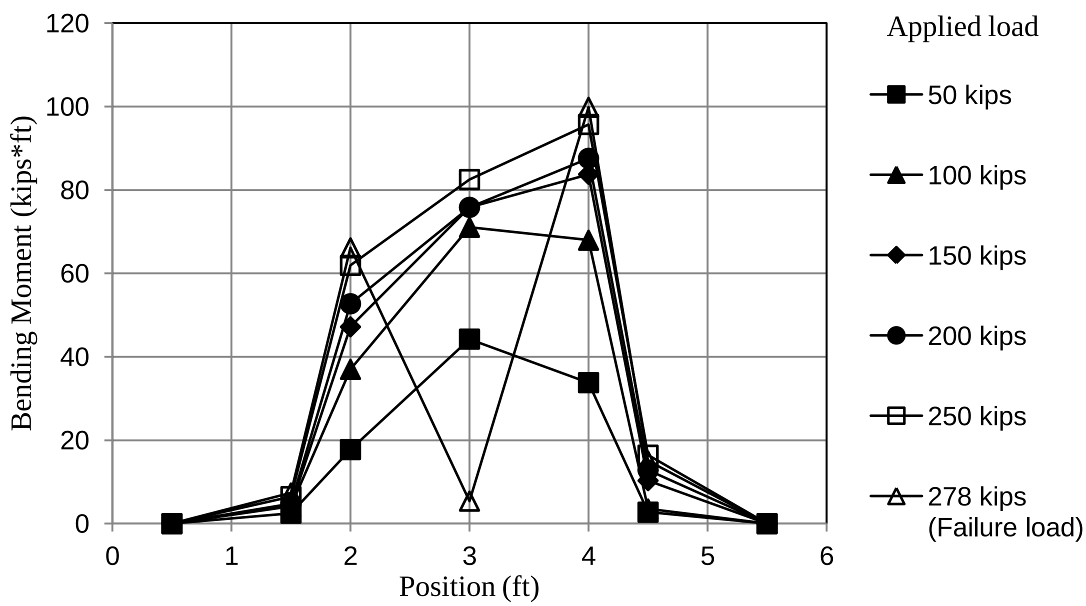


Figure 5.28: Micropile 3 bending moment profile

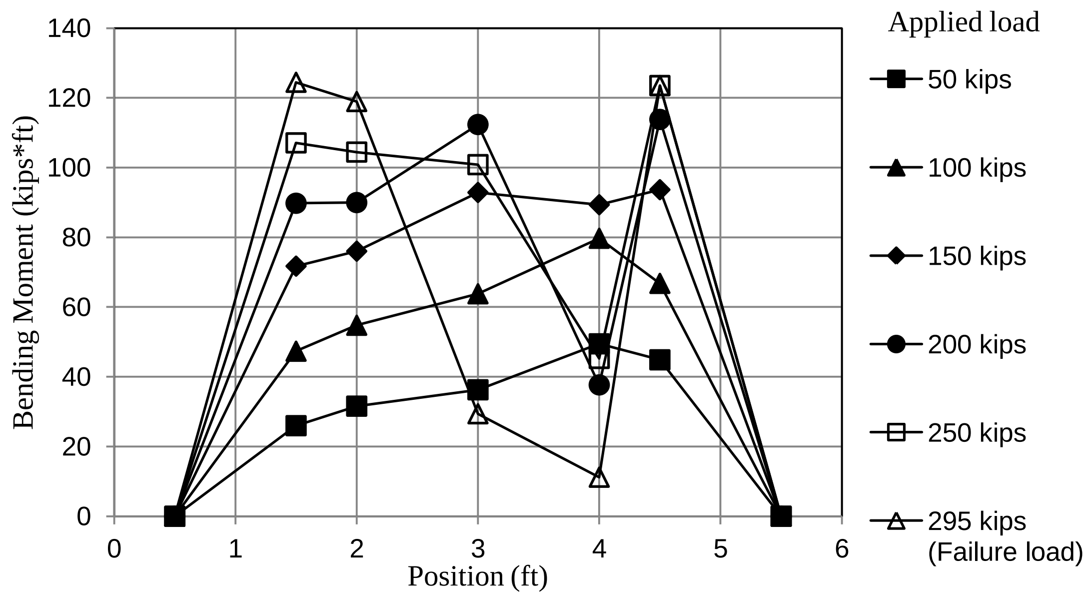


Figure 5.29: Micropile 4 bending moment profile

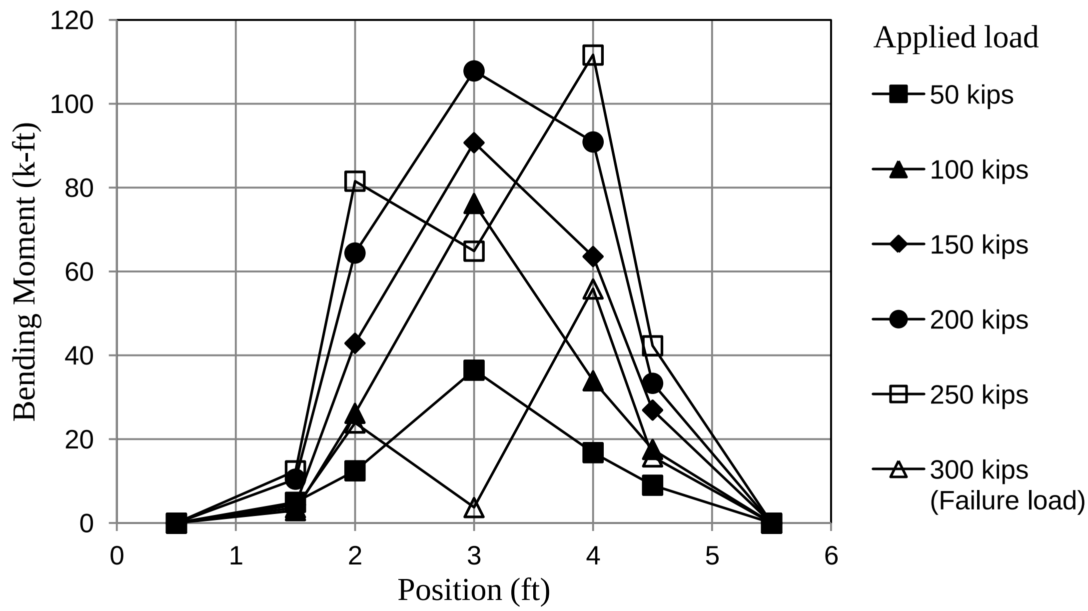


Figure 5.30: Micropile 5 bending moment profile

Table 5.7 Results of bending moment for piles 1-5

Maximum Applied Force (kips)	Theoretical Maximum Bending Moment at Maximum Load (kips*ft.)	Laboratory Maximum Joint Measured Bending Moment (kips*ft.)
300	262.50	113.90
303	265.13	107.30
270	236.25	76.50
295	258.13	119.12
269	235.38	113.90

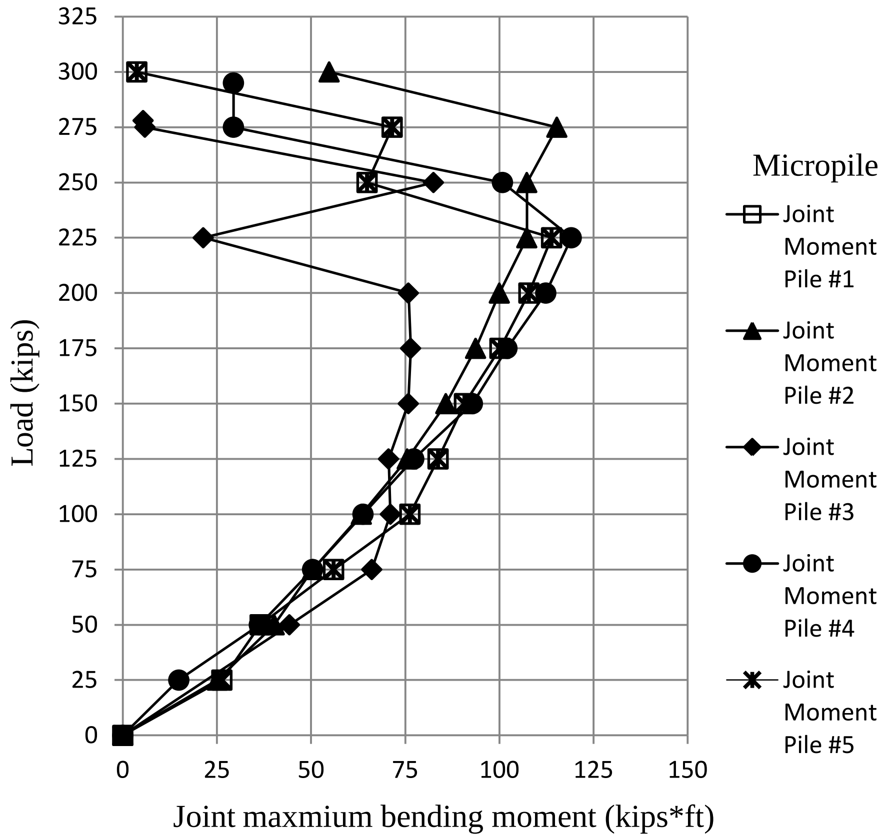


Figure 5.31: Joint bending moments from strain gages for piles 1-5

5.5 Discussion of Bending Test Results.

The primary results of the laboratory tests are shown in Tables 5.2 to 5.6. The best of three of the test results shown in Table 5.7 gives the average failure bending moment of 115.64 kips*ft. There was no significant casing rotation beyond 0.12 in for all of the piles tested. The slopes of the curves showed in Figures 5.17 to 5.24 represent the average stiffness of the composite piles and Table 5.8 shows the final results. The joint bending moment versus load plots in Figure 5.31 show linear increase of moment up to about 225 kips before decline and failure. Figure 5.32 shows a typical failure mode of a micropile tested in the laboratory.

From the nine tests conducted in the laboratory, the average deflection is 0.367 in. The calculated mid-span maximum deflection for an integral section shown in section 3.6 Figure 3.30 is 0.164. The large difference is due to the joint. The laboratory mid-span deflection is 2.24 times more than the calculated deflection and the mid-span moment is 2.37 times more than the calculated moment.

Figure 5.32: Failure mode of one of the tested micropile

Vertical deflections at the potentiometer locations and the applied load are shown in Figures 5.17 through 5.24. In these tests, the applied load increased linearly with the vertical deflection until the micropile failed at the joint. After the failure of the joint as shown in Figure 5.31, the micropile moment dropped to almost zero as shown in Figure 5.30.

Nakamura et al. (2004) as stated in the literature review section reported the bending tests on mortar filled steel pipes without joints. The result of the plots of the deflection versus the applied load had almost the same curve shape as a steel pipe under bending test and same ductility. The contribution of the mortar was small as compared with a steel pipe with no mortar.

TABLE 5.8 Average Stiffness of the composite pile from lab tests

Test #	Load (kips)	Max. Deflection (ft)	Stiffness (kips/ft)
1	300	0.038	7860.26
2	303	0.028	11018.18
3	270	0.028	9529.41
4	295	0.032	9147.29
5	269	0.027	9932.31
6	302	0.033	9292.31
7	235	0.027	8812.5
8	280	0.031	9130.43
9	280	0.032	8682.17
Average Stiffness (kips/ft)		=	9267.21

For a prismatic member (constant cross section), the maximum normal stress will occur at the maximum moment. Table 5.7 shows the maximum moment for the micropiles 1 to 5, that is the micropiles with strain gages. The formula for determining the maximum bending stress for a solid circular section is:

$$\sigma_{max} = \frac{32 \times M}{\pi \times D^3} \quad (5.2)$$

$$\sigma_{Allow} \geq \sigma_{Beam} \quad (5.3)$$

Where

M = maximum bending moment

D = outer diameter of the section.

Table 5.9 shows the analysis of the bending stress for the micropile for the lab tests. Results show that the bending stresses are much lower than the allowable stress of 150 ksi. Considering the theoretical four point bending behavior of an integral section, the maximum bending moment under an applied load of 300 kips is 262.5 kips-ft. Using equation 5.3, the bending stress is 25.82 ksi. From this result, it shows that a non-segmented pipe of the same properties will not fail at an applied load of 300 kips.

TABLE 5.9: Lab bending stresses

Lab Test #	Lab Max. Moment (kips-ft)	Lab Micropile Bending Stress (ksi)
1	113.9	11.21
2	107.3	10.56
3	76.5	7.53
4	119.12	11.72
5	113.9	11.21

5.6 Corrosion Testing Plan

In addition to the structural tests, durability testing was commenced to determine the performance of the micropiles in typical environments. Due to the long term nature of the corrosion tests, this report documents only the strategy of the tests. The corrosion study will continue well beyond the duration of this research project.

Marked and labeled micropile casings have been and will be placed in secure field locations that are accessible to NCDOT, UNCC, and Auburn University personnel for many years. Periodically, specimen mass and thickness will be measured. The primary corrosion tests will be carried out for period of three years. At an interval of approximately three months the micropiles will be measured to determine any changes in the cross-sectional area.

In addition to nondestructive measurements, structural tests will be conducted on weathering specimens. The first three micropiles will be tested after one year, the second set after two years, and the final trio will be tested at the end of the third year. The results will be compared to determine any loss in structural strength due to corrosion. The final corrosion result will be published separately. Table 5.10 shows the location, number and baseline properties of the micropiles. Table5.11 contains the schedule for corrosion testing.

TABLE 5.10: Baseline properties of the micropile

Number	Location	Properties
3	Auburn University NGES	diameter = 10.75 in wall thickness 0.5 in length = 1 ft fy = 150 ksi
3	Mountain location where subject to deicing salt	
3	Piedmont location, typical climate	

TABLE 5.11: Summaries of durability and material tests

	Durability Tests											
	First Year (Three months interval)				Second Year (Three months interval)				Third Year(Three months interval)			
Mass and thickness measurement	1st	2nd	3rd	4th	1st	2nd	3rd	4th	1st	2nd	3rd	4th
	Material											
Micropile Testing	First test after 12 months				Second test after 12 months				Third test after 12 months			

CHAPTER 6: MODEL CALIBRATION

6.1 Introduction

One of the objectives of the research was to develop a model with the ability to predict the behavior of micropiles under lateral load. The software available for modeling bridge substructures was FB-Multiplier. The focus of this section was the calibration of the FB-Multiplier model. The original model in Chapter 3 used soil parameters that were based on SPT tests and idealized parameters for the micropile sections as a baseline for the analysis. For the calibration, the actual section properties were used. The strengths and Young's Modulus of both the steel (f_y = 115 ksi, E_s = 30,000 ksi) and grout (f'_c 4 ksi, E_g = 2000 ksi) were known. Summary of both the field and the laboratory test results area shown in Table 6.1. The flexural rigidity valued obtain in the lab test was used to calculate the bending moment for each of the field and lab test.

Table 6.1: Summary of both field and lab test results

Test Result	Average Deflection (in)	Average applied load for single pile to failure (kips)	Bending Moment (kips-ft)	Computed Flexural Rigidity (kips *ft^2)	Computed Bending Stress (ksi1)
Field	1.31	35.0	74.12*	55865.06*	7.29*
Laboratory	0.367	280.0	113.56	42327.22	11.38

* Note: Result, from pile 10 and 11, pile test not to failure

6.2 Modeling

6.2.1 Load Test "I"

Load test I was the starting point for model calibration. Since the strain profile was measured along the length of the pile, it serves as the best case to initiate the calibration. Piles 10 and 11 were almost nearly identically installed; therefore a single model was used.

When comparing the results of the field tests to the predictions, it was evident that the soil resistance was under predicted by a fair amount. Recall that while the micropile sections were 10.75in diameter with a wall thickness of 0.5 in. In order to model the joint, the thickness was reduced to 0.2 in for a 0.2 ft section of pile between two full sections. Based on the shape of the measured bending moment curves compared to the predictions from Chapter 3, there appears to be more soil resistance to carry the bending moment. Thus, the logical place to adjust the parameters for a better match was the soil, specifically the p-y curve parameters. The rock compressive strength was held constant at 29 ksi using the McVay and Niraula (2004) model. The overburden soil was adjusted.

The three parameters required for the Reese et al. (1974) sand model were friction angle, unit weight, and subgrade modulus. Since the unit weight doesn't have a large impact, the two parameters that were adjusted were the friction angle, Ø, and subgrade modulus, k. The parameters were increased progressively until the model load test matched the deflection and bending moment profiles along with the displacement at the load point from the field load test. After multiple iterations, the final soil parameters were increased to Ø = 50^{o}, γ = 110 pcf, and k = 350 pci. The matching results are shown in Figure 6.5.

6.2.2 Load Test “F”

The piles in load test F were almost identical to those in Load test I, except there were no strain gages. Load test F was carried out until failure of pile #16. Thus, the soil model developed for load test I was used in the model for load test F to failure. Use of the soil model for load test I produced a very good match for the initial loading of the piles, but did not capture the failure mode well. There was some evidence that suggests the upper joint in pile 16 was weaker than the others. Thus, the joint model was adjusted slightly to improve the match. The casing joint thickness was adjusted down to 0.14 in. The resulting model is shown in Figure 6.6.

6.2.3 Load Test “E”

Load test E was simulated using the soil, pile, and joint models now fully developed. The match was not great, but this was likely due to the reloading of these piles due to issues with the load frame. The resulting model for this load test is shown in Figure 6.7.

6.2.4 Load Test “B”

Again, using the fully developed model with the full 0.2 in joint, load test B was simulated. The model matches exactly. The results are shown in Figure 6.8.

6.2.5 Load Test “A”

An attempt was made to simulate load test A. Since there was no measurable data, the goal was to determine if the one foot embedment was truly the reason of such poor performance. The model piles carry upwards of 40 kips of lateral force but it also appear that the pile rotates in the rock socket monolithically, which was the behavior noted in the field. For comparison, the result of this model is shown in Figure 6.9.

6.2.6 Load Test "X"

With the structural model developed, a model for the group load test that was created for Chapter 4 was modified to match the true field conditions. Of course in this case, the soil was removed in front of the piles prior to load testing to simulate scour. The prediction is shown in Figure 6.10

The response of the group appears to be much stiffer than the prediction shows. There could be several explanations, but likely the closest would be the residual effects of soil around the piles above the rockline. Limited access brought on by right of way and construction issues made the excavation of the soil difficult at best. The contractor was able to remove the soil in front of the piles, but not around them. Furthermore, there was still grout around several of the piles after the excavation. As mention previously, the freezing temperatures experienced before and during the load test may have had an impact on the soil response as well.

6.3 Discussion

Having known the yield stress of the micropile, the diameter, the pile wall thickness, the compressive strength of the grout the modulus of the steel and the grout, the model was remarkably easy to calibrate. The micropiles on this project are pressure grouted. Using the measured parameters for the section and the amended soil model provided a good match in many of the load tests. The question might be raised concerning the magnitude of the soil properties used to affect the match. One possible explanation is the impact of grout on the surrounding soils. Since grout return is used as a mechanism to verify grouting the socket, the soil is more or less improved around the pile. There is a possibility that this could have been the source of the high friction angle and subgrade modulus. On the other hand, the SPT characterization may have been less than ideal for these soil types. Anderson and Townsend (2001) show the poor reliability of SPT parameters for lateral loading analysis.

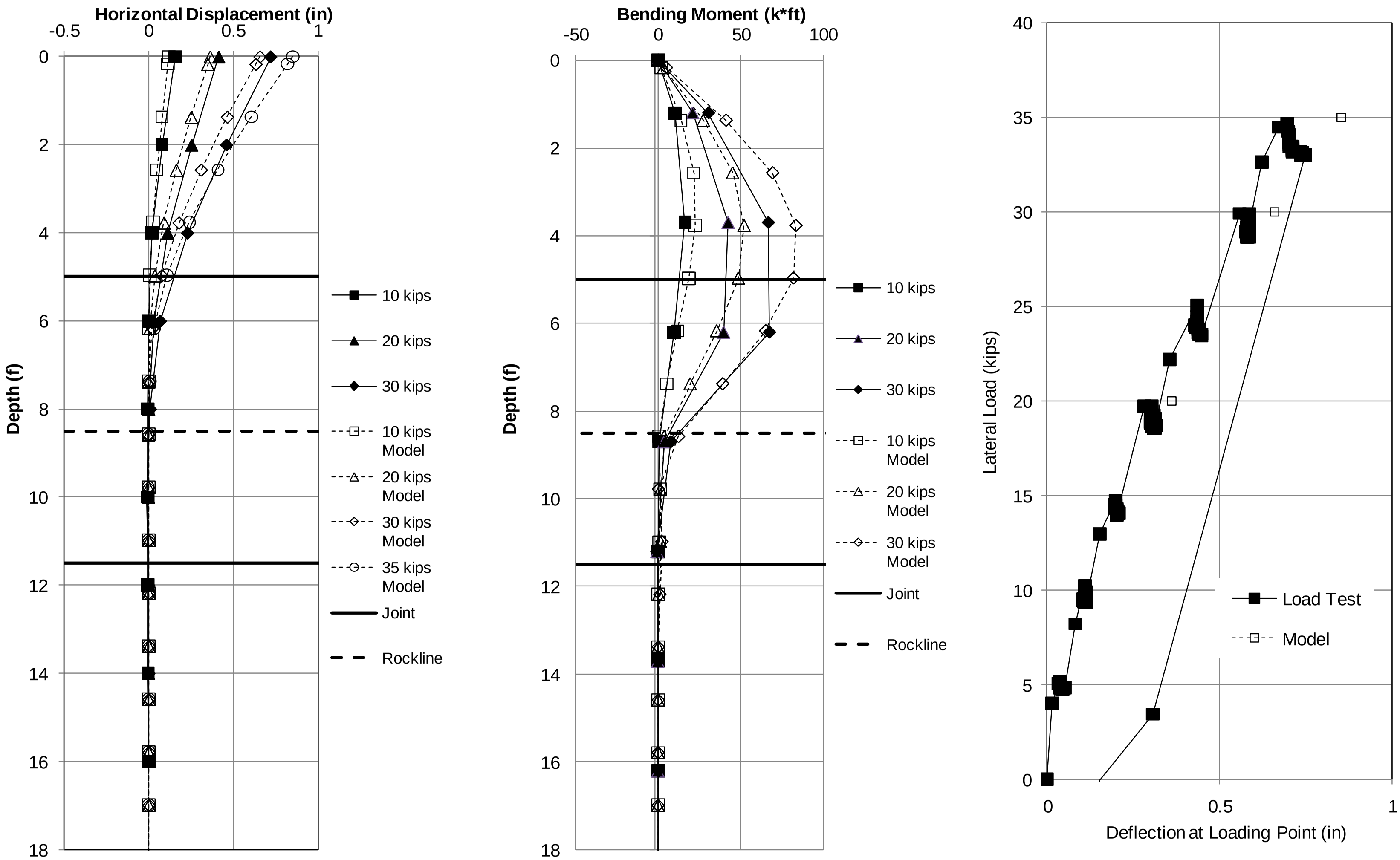


Figure 6.1: Calibrated model for load test I piles 10 and 11

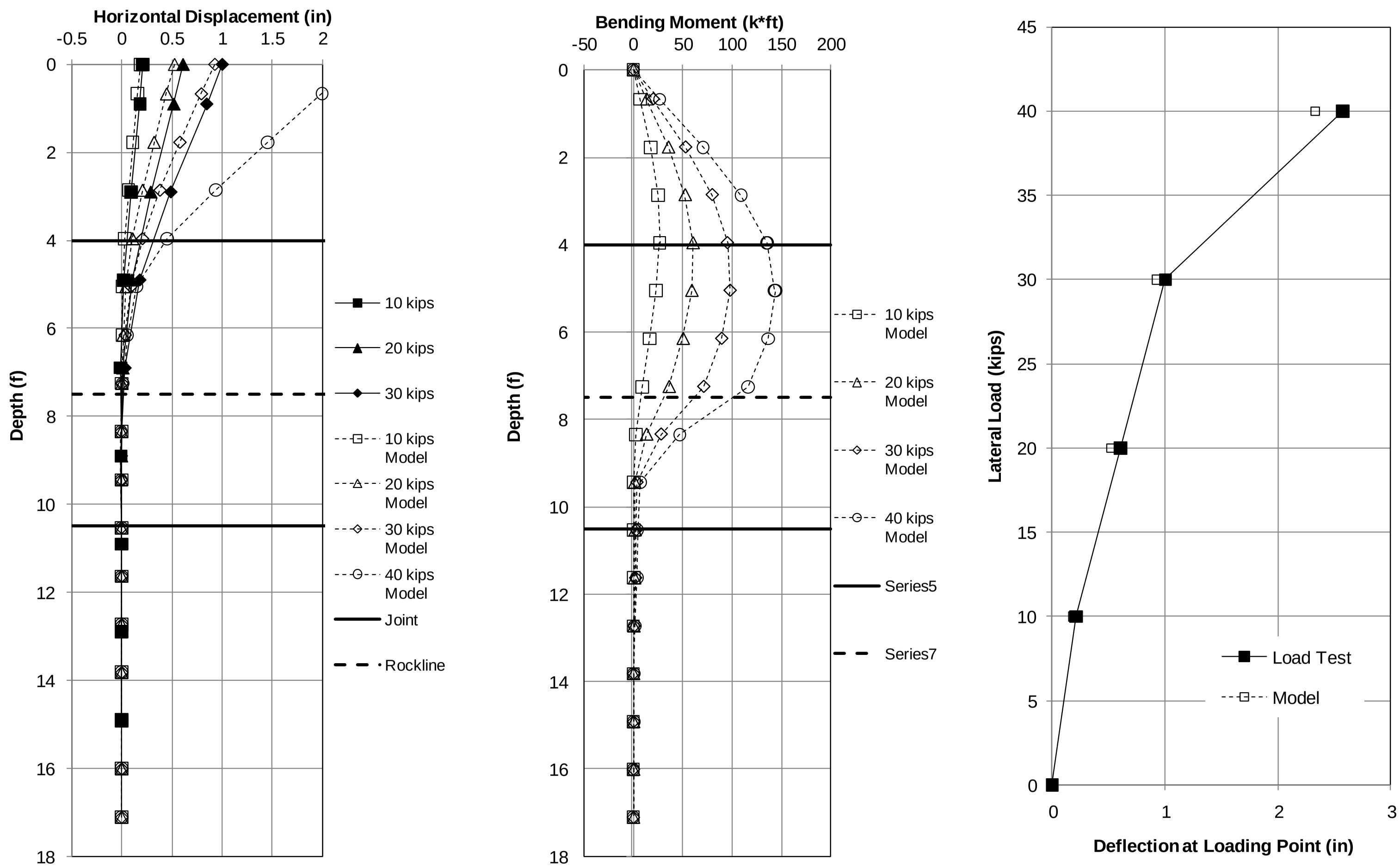


Figure 6.2: Calibrated model for load test F pile 16

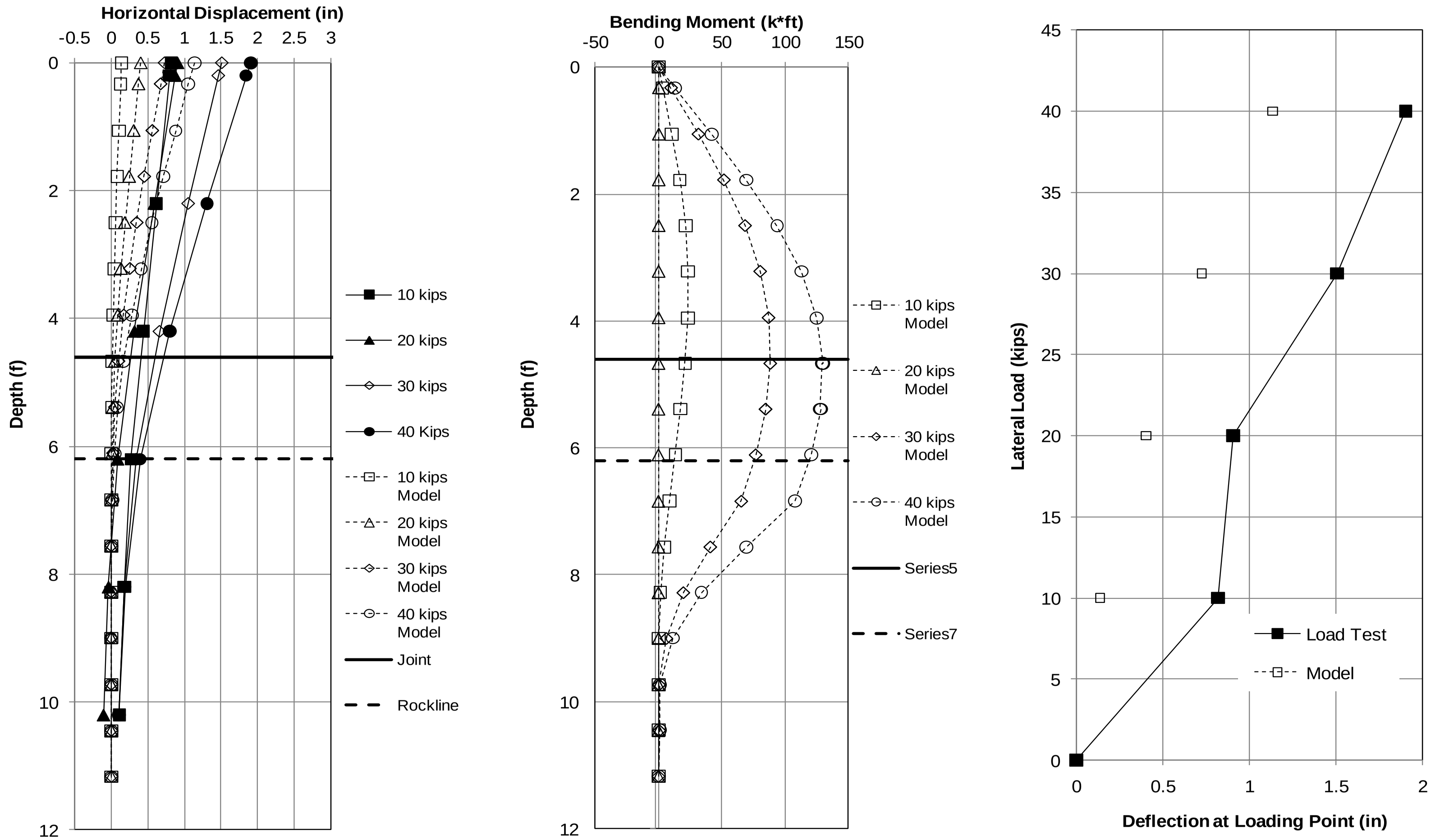


Figure 6.3: Calibrated model for load test E piles 3 and 15

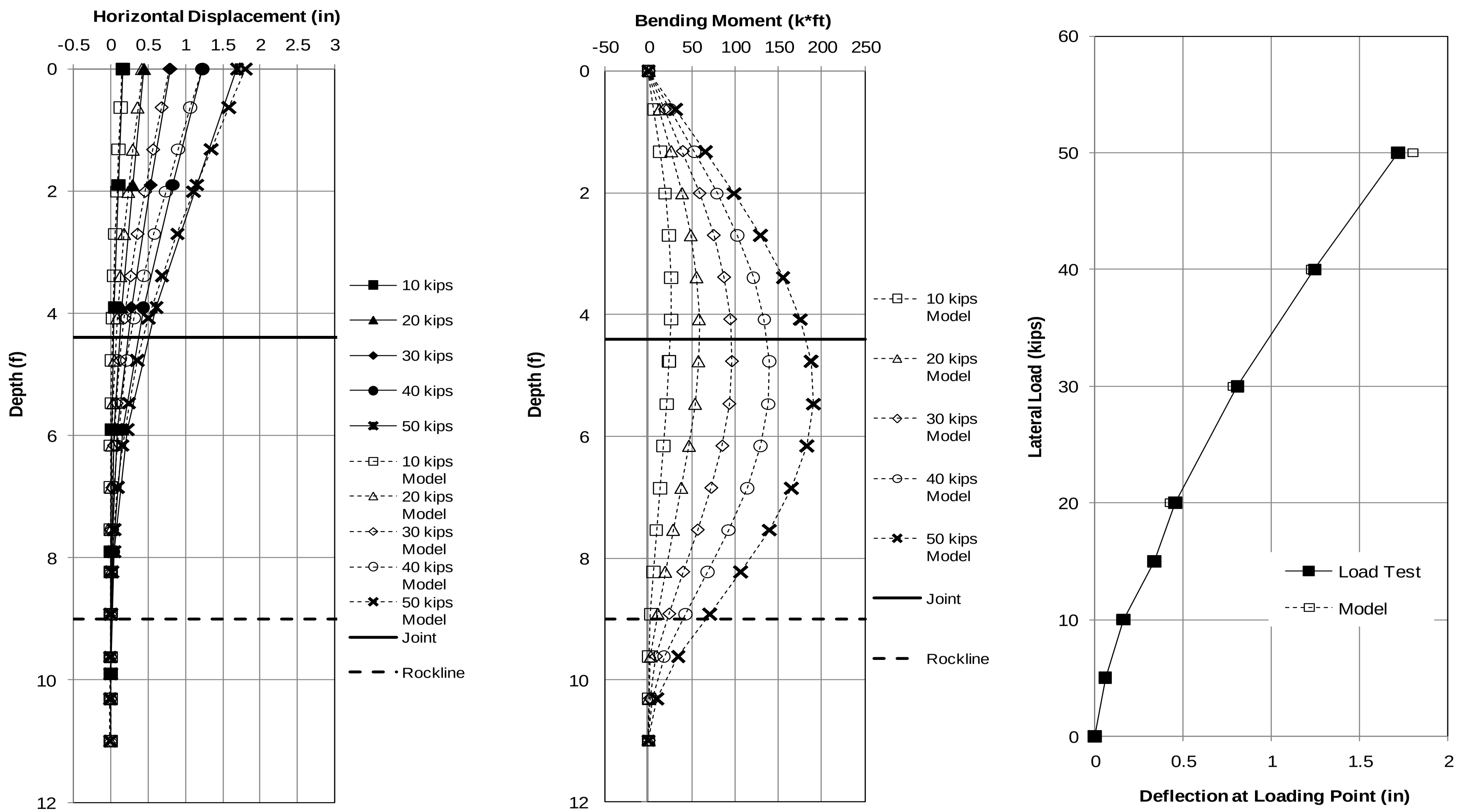


Figure 6.4: Calibrated model for load test B piles 2 and 14

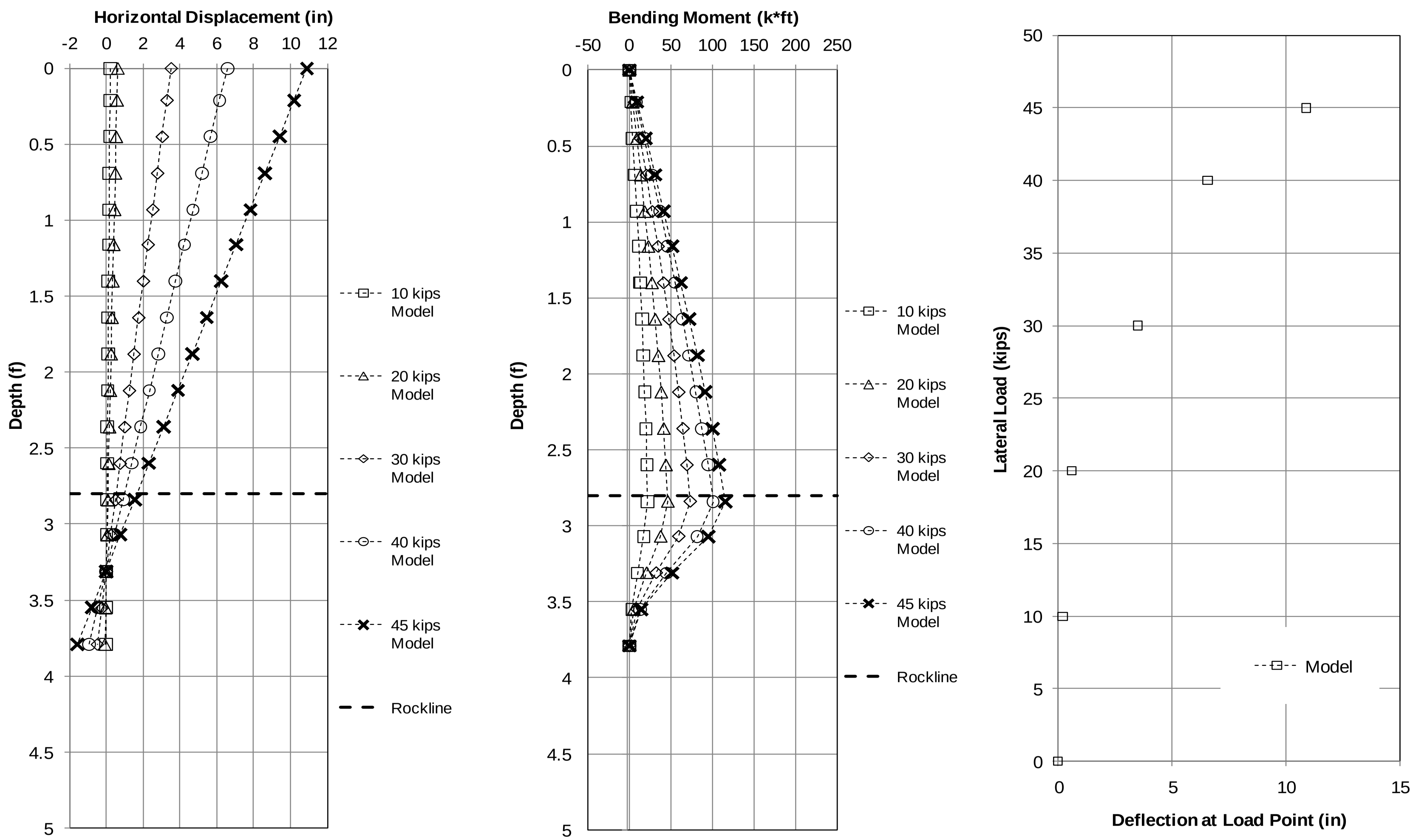


Figure 6.5: Calibrated model for load test A pile 1

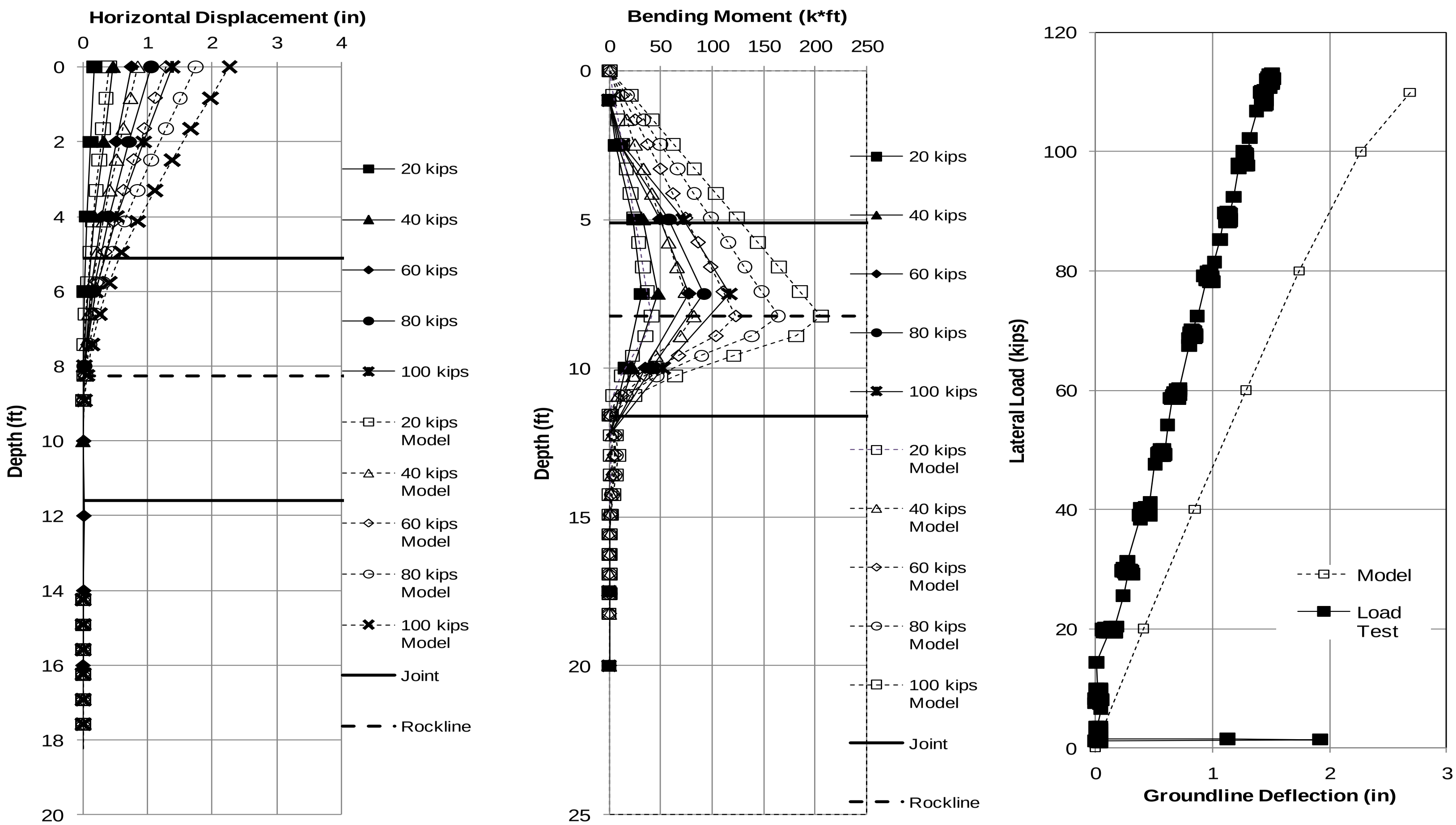


Figure 6.6: Calibrated model for load test X piles 5, 6, 7, and 8

CHAPTER 7: RESEARCH SUMMARY, CONCLUSIONS, CONTRIBUTIONS AND RECOMMENDATIONS.

7.1 Research Summary

A research program was conducted in order to gain insight on the behavior of micropiles for bridge bent applications. Of interest was how micropiles behave with respect to the number and location of threaded joint sand embedment of casing in rock. The program consisted of preliminary simulations and predictions, extensive field lateral load and laboratory testing programs, and calibration of a numerical model.

In order to confidently establish the feasibility of using micropiles as a bridge bent configuration structures, information and performance data was gathered in critical areas of structural behavior and performance, including soil-pile load transfer interactions. The overall objective of this research project was to establish the feasibility of using micropiles in bridge substructures. Table 7.1 outlines the five detailed objectives of the project and indicates how each objective was met.

TABLE 7.1: Detail research objectives

Objective	Evidence of objective completion
Demonstrate the lateral performance of micropiles in single and group configurations	An experimental study was designed and implemented to investigate the lateral capacity of micropiles in both single and group configurations.

TABLE 7.1: (cont'd)

Determine the effect of casing plunge into rock on lateral resistance of micropiles.	An experimental study was designed and implemented to investigate the effect of casing plunge into rock. The embedment into rock investigated were 1 ft, 2 ft 5 ft and 10 ft.
Determine the effect of casing joints on lateral resistance of micropiles	The study investigated the effects of joints, documented the deflection and moment capacity of the joints.
Determine the behavior of jointed micropile sections	The study documented the failure mode of the joint under moment application.
Evaluate the durability of micropile casings and jointed sections	The study was commenced by placing micropile casing under typical environment to evaluate the corrosion rate and it structural effect.

7.2 Conclusions

Based on the data, analyses, and results presented in this dissertation, the following conclusions have been developed regarding the lateral response of micropiles based on full-scale load testing:

1) The casing joint has a large impact on the lateral capacity of micropiles. In cases where the micropiles were sufficiently embedded in rock, rather than yielding of the micropile, there was an abrupt failure at the casing joint. This was observed in all of the load tests.
2) Two feet of embedment for micropiles in this study was sufficient to carry lateral load. Embedment at 5 and 10 feet produced similar results to those for 2 feet. One foot of embedment does not appear to be sufficient based upon results of the field tests and numerical models. If the pile design is

controlled by lateral load, the finding shows a 2 ft embedment into good rock give a potential lateral capacity of 50 kips per pile.

3) The moment of inertia of the micropile section was determined at failure, the load deflection response up to failure was linear. The change in linearity take place after the pile section fails.
4) The strength of the micropile for a 10.75 in diameter and 0.5 in wall thickness with respect to the joints from field and laboratory tests was around 115 kips*ft in moment capacity.
5) Another major documented contribution is, micropiles of 10.75 in diameter and 0.5 in wall thickness size can carry significant lateral load with little deflection. However, the failure mode is brittle, as the test-piles failed abruptly with little lateral displacement.
6) Reduction of the section area at threaded joint by 60% to 70% results in a reasonably accurate model for the behavior of the casing joint as predicated by computer software, FB-MultiPier. The contribution shows the important of flexural rigidity in the design of a composite structural member.
7) Grout return used to verify grouting the socket does lead to improvement of the soil around the piles, thereby increasing the lateral resistance or capacity of the pile.

7.3 Contributions

Based on the analysis of the data connected in both the field and the laboratory tests on micropile with respect to joint action, and the gaps fond in the literatures that we reviewed, the following are the contributions to both science and knowledge:

1) The result of the research shows that an embedment of 2 ft in high quantity rock give a lateral capacity of 50 kips.

2) Another major documented contribution is, micropiles of 10.75 in diameter and 0.5 in wall thickness size can carry significant lateral load with little deflection. However, the failure mode is brittle, as the test-piles failed abruptly with little lateral displacement. The abrupt failure of the joint is a major contribution to the threaded joint effect of micropile as a structural member.

3) FB-MultiPier software was used to validate models for segmented micropile.

4) Micropiles can be effectively use as a groups in an interior bent configuration.

5) From the laboratory bending tests, the apparent yield stress for this section (10.7diameter, 0.5 in wall thickness and f_y of 115 ksi) due to the joint is 11.4 ksi which is only 10% of the 115 ksi from the coupon test.

6) The tests in the laboratory shows minimum casing twisting of 0.12 in.

7) Due to the joints, the flexural rigidity for the segmented section is 16% less than a non-segmented section.

8) The segmented pipe section has both the maximum moment and deflection of more than two times the non-segmented pipe section.

9) The low value in the bending stress of about 10% of the steel yield stress of the micropile section used in both test shows the magnitude effect the joint has on the lateral capacity of the section.

10) Changing the yield of the steel, deflection will not change; yield strength of steel is not part of deflection calculation.

11) The threads are putting stress on each other. The yield of the joint is happening at a fraction of the section strength. The average value got from the lab test was about 11.4 ksi.

7.4 Limitations

Research studies on deep foundations are often restricted financial limitations of the project. It is not cost effective to construct multiple sections (size and length) to assess all possibilities. In addition, most projects such as this one must be coupled with construction activities and are constrained by the budgets of those projects.

This study focused on 10.75 in diameter 0.5 in. thick micropiles. No other sizes were used in any part of this work. While the author believes the results can be adapted to other micropile sizes, the user is cautioned to verify material properties and behaviors before applying these results directly.

7.5 Design Applications

The results of this work prove micropiles are economically feasible foundations that can carry significant lateral loads when properly embedded in rock. As mentioned before, the study focused on a single pile size (10.75 in outer diameter with 0.5 in wall thickness). Based on the results of this study, the following issues need to be considered in overcoming the casing joint failure in the use of micropiles as a non-displacement pile in deep foundations applications:

1) The micropile interior bent configuration should be a short column not a long column.

2) The micropile should be embedded in high quantity rock not weak rock.

3) In the design of a larger lateral and moment capacity, an inner casing of a lesser diameter without joint micropile can be inserted to brace up the joint before grout. The braced joint section should be above the rock elevation. The finding in the research shows that the joint in the rock as zero deflection.

7.6 Recommendations

Based on the findings from this investigation, the following recommendations are made for future work on micropile:

1) It would be beneficial at the least, to perform a lateral load test with the other sizes to verify or recalibrate the models.

2) Evaluation of the applied torque from the drill rig used to install the piles on the joints.

3) Full-scale field and laboratory testing of reinforce joints for higher lateral and moment capacity.

4) The effect of a lower rock quality designation (RQD) on micropile embedment.

5) Verification of the impact of ground freezing on the lateral and moment capacity of micropiles with respect to joints and rock embedment.

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APPENDIX A: LATERAL LOAD TEST B

TABLE A.1: Inclinometer measurements for pile 2

PROJECT:ASHE MICROPILE LATERAL LOAD TESTING

MICROPILE NO: 2

DATE: 11/24/09

TIME:

	Baseline		
Depth (ft)	A+	A-	Diff. (A)
14	-258	176	-434
12	-208	165	-373
10	-209	169	-378
8	-200	163	-363
6	-188	146	-334
4	-146	111	-257
2	-139	32	-171

Depth (ft)	A+	A-	Diff. (A)	Change	Increment	Total
5 kips						
14	-257	175	-432	2	0.0012	0.0012
12	-203	166	-369	4	0.0024	0.0036
10	-206	166	-372	6	0.0036	0.0072
8	-183	152	-335	28	0.0168	0.024
6	-170	128	-298	36	0.0216	0.0456
4	-125	90	-215	42	0.0252	0.0708
2	-111	83	-194	-23	-0.0138	0.057

Depth (ft)	A+	A-	Diff. (A)	Change	Increment	Total
10 kips						
14	-258	175	-433	1	0.0006	0.0006
12	-206	165	-371	2	0.0012	0.0018
10	-200	161	-361	17	0.0102	0.012
8	-176	136	-312	51	0.0306	0.0426
6	-148	105	-253	81	0.0486	0.0912
4	-100	65	-165	92	0.0552	0.1464
2	-83	63	-146	25	0.015	0.1614

Depth (ft)	A+	A-	Diff. (A)	Change	Increment	Total
15 kips						
14	-258	175	-433	1	0.0006	0.0006
12	-204	164	-368	5	0.003	0.0036
10	-189	151	-340	38	0.0228	0.0264
8	-147	109	-256	107	0.0642	0.0906
6	-108	65	-173	161	0.0966	0.1872
4	-57	21	-78	179	0.1074	0.2946
2	-59	2	-61	110	0.066	0.3606

Depth (ft)	A+	A-	Diff. (A)	Change	Increment	Total
20 kips						
14	-259	175	-434	0	0	0
12	-203	162	-365	8	0.0048	0.0048
10	-181	141	-322	56	0.0336	0.0384
8	-127	88	-215	148	0.0888	0.1272
6	-76	35	-111	223	0.1338	0.261
4	-18	-31	13	270	0.162	0.423
2	43	-31	74	245	0.147	0.57

Depth (ft)	A+	A-	Diff. (A)	Change	Increment	Total
40 kips						
14	-259	176	-435	-1	-0.0006	-0.0006
12	-190	151	-341	32	0.0192	0.0186
10	-127	89	-216	162	0.0972	0.1158
8	14	-53	67	430	0.258	0.3738
6	112	-154	266	600	0.36	0.7338
4	175	-210	385	642	0.3852	1.119
2	169	-215	384	555	0.333	1.452

Depth (ft)	A+	A-	Diff. (A)	Change	Increment	Total
50 kips						
14	-260	176	-436	-2	-0.0012	-0.0012
12	-181	141	-322	51	0.0306	0.0294
10	-94	53	-147	231	0.1386	0.168
8	87	-124	211	574	0.3444	0.5124
6	205	-247	452	786	0.4716	0.984
4	273	-309	582	839	0.5034	1.4874
2	276	-312	588	759	0.4554	1.9428

Depth (ft)	A+	A-	Diff. (A)	Change	Increment	Total
Final						
14	-259	175	-434	0	0	0
12	-180	139	-319	54	0.0324	0.0324
10	-104	65	-169	209	0.1254	0.1578
8	39	-79	118	481	0.2886	0.4464
6	126	-166	292	626	0.3756	0.822
4	180	-214	394	651	0.3906	1.2126
2	187	-241	428	599	0.3594	1.572

TABLE A.2: Inclinometer measurements for pile 14
PROJECT:ASHE MICROPILE LATERAL LOAD TESTING
MICROPILE NO: 14
DATE: 11/24/09
TIME:

	Baseline data		
Depth (ft)	A+	A-	Diff. (A)
14	207	-292	499
12	247	-287	534
10	216	-258	474
8	209	-247	456
6	267	-317	584
4	405	-436	841
2	435	-465	900

Depth (ft)	A+	A-	Diff. (A)	Change	Increment	Total
5 kips						
14	210	-292	502	3	0.0018	0.0018
12	249	-288	537	3	0.0018	0.0036
10	220	-252	472	-2	-0.0012	0.0024
8	217	-256	473	17	0.0102	0.0126
6	287	-335	622	38	0.0228	0.0354
4	427	-456	883	42	0.0252	0.0606
2	459	-504	963	63	0.0378	0.0984

Depth (ft)	A+	A-	Diff. (A)	Change	Increment	Total
10 kips						
14	205	-292	497	-2	-0.0012	-0.0012
12	251	-289	540	6	0.0036	0.0024
10	229	-268	497	23	0.0138	0.0162
8	239	-274	513	57	0.0342	0.0504
6	312	-360	672	88	0.0528	0.1032
4	456	-484	940	99	0.0594	0.1626
2	476	-519	995	95	0.057	0.2196

Depth (ft)	A+	A-	Diff. (A)	Change	Increment	Total
15 kips						
14	205	-292	497	-2	-0.0012	-0.0012
12	257	-293	550	16	0.0096	0.0084
10	245	-279	524	50	0.03	0.0384
8	270	-307	577	121	0.0726	0.111
6	360	-406	766	182	0.1092	0.2202
4	503	-533	1036	195	0.117	0.3372
2	536	-576	1112	212	0.1272	0.4644

Depth (ft)	A+	A-	Diff. (A)	Change	Increment	Total
20 kips						
14	205	-291	496	-3	-0.0018	-0.0018
12	254	-295	549	15	0.009	0.0072
10	248	-289	537	63	0.0378	0.045
8	293	-331	624	168	0.1008	0.1458
6	392	-440	832	248	0.1488	0.2946
4	539	-570	1109	268	0.1608	0.4554
2	573	-613	1186	286	0.1716	0.627

Depth (ft)	A+	A-	Diff. (A)	Change	Increment	Total
30 kips						
14	209	-291	500	1	0.0006	0.0006
12	263	-303	566	32	0.0192	0.0198
10	279	-320	599	125	0.075	0.0948
8	360	-397	757	301	0.1806	0.2754
6	481	-532	1013	429	0.2574	0.5328
4	637	-665	1302	461	0.2766	0.8094
2	670	-684	1354	454	0.2724	1.0818

Depth (ft)	A+	A-	Diff. (A)	Change	Increment	Total
40 kips						
14	209	-292	501	2	0.0012	0.0012
12	273	-312	585	51	0.0306	0.0318
10	320	-360	680	206	0.1236	0.1554
8	444	-481	925	469	0.2814	0.4368
6	595	-643	1238	654	0.3924	0.8292
4	754	-782	1536	695	0.417	1.2462
2	788	-816	1604	704	0.4224	1.6686

Depth (ft)	A+	A-	Diff. (A)	Change	Increment	Total
50 kips						
14	204	-291	495	-4	-0.0024	-0.0024
12	285	-325	610	76	0.0456	0.0432
10	361	-402	763	289	0.1734	0.2166
8	543	-572	1115	659	0.3954	0.612
6	718	-765	1483	899	0.5394	1.1514
4	881	-908	1789	948	0.5688	1.7202
2	908	-963	1871	971	0.5826	2.3028

Depth (ft)	A+	A-	Diff. (A)	Change	Increment	Total
Final						
14	204	-292	496	-3	-0.0018	-0.0018
12	274	-314	588	54	0.0324	0.0306
10	296	-324	620	146	0.0876	0.1182
8	860	-899	1759	1303	0.7818	0.9
6	1095	-1142	2237	1653	0.9918	1.8918
4	1246	-1280	2526	1685	1.011	2.9028
2	1251	-1290	2541	1641	0.9846	3.8874

TABLE A.3: Load measurements for load test B

TIMESTAMP	RECORD #	LoadA lbs	LoadB lbs	Total lbs
11/24/2009 18:01	0	278.4	168.1	446.5
11/24/2009 18:02	1	278.4	224.1	502.5
11/24/2009 18:02	2	278.4	168.1	446.5
11/24/2009 18:03	3	278.4	168.1	446.5
11/24/2009 18:03	4	1286.2	1176.6	2462.8
11/24/2009 18:04	5	1230.2	1176.6	2406.8
11/24/2009 18:04	6	1174.2	1176.6	2350.8
11/24/2009 18:05	7	1174.2	1176.6	2350.8
11/24/2009 18:05	8	1174.2	1120.6	2294.8
11/24/2009 18:06	9	1174.2	1120.6	2294.8
11/24/2009 18:06	10	1174.2	1120.6	2294.8
11/24/2009 18:07	11	1174.2	1120.6	2294.8
11/24/2009 18:07	12	1174.2	1120.6	2294.8
11/24/2009 18:08	13	1174.2	1120.6	2294.8
11/24/2009 18:08	14	1118.2	1120.6	2238.8
11/24/2009 18:09	15	1118.2	1176.6	2294.8
11/24/2009 18:09	16	1118.2	1176.6	2294.8
11/24/2009 18:10	17	1118.2	1176.6	2294.8
11/24/2009 18:10	18	1118.2	1176.6	2294.8
11/24/2009 18:11	19	1118.2	1120.6	2238.8
11/24/2009 18:11	20	1118.2	1120.6	2238.8
11/24/2009 18:12	21	1118.2	1120.6	2238.8
11/24/2009 18:12	22	1118.2	1120.6	2238.8
11/24/2009 18:13	23	1118.2	1120.6	2238.8
11/24/2009 18:13	24	1118.2	1120.6	2238.8
11/24/2009 18:14	25	2741.9	2633.4	5375.3
11/24/2009 18:14	26	2685.9	2633.4	5319.3
11/24/2009 18:15	27	2629.9	2577.4	5207.3
11/24/2009 18:15	28	2629.9	2521.3	5151.3
11/24/2009 18:16	29	2629.9	2521.3	5151.3
11/24/2009 18:16	30	2573.9	2521.3	5095.3
11/24/2009 18:17	31	2573.9	2465.3	5039.2
11/24/2009 18:17	32	2517.9	2465.3	4983.2
11/24/2009 18:18	33	2517.9	2465.3	4983.2
11/24/2009 18:18	34	2517.9	2465.3	4983.2
11/24/2009 18:19	35	2517.9	2465.3	4983.2
11/24/2009 18:19	36	2517.9	2409.3	4927.2
11/24/2009 18:20	37	2517.9	2409.3	4927.2
11/24/2009 18:20	38	2517.9	2409.3	4927.2
11/24/2009 18:21	39	2517.9	2409.3	4927.2
11/24/2009 18:21	40	2517.9	2409.3	4927.2
11/24/2009 18:22	41	2517.9	2409.3	4927.2
11/24/2009 18:22	42	2517.9	2409.3	4927.2
11/24/2009 18:23	43	2517.9	2409.3	4927.2
11/24/2009 18:23	44	2517.9	2409.3	4927.2

TIMESTAMP	RECORD #	LoadA lbs	LoadB lbs	TotalLoad lbs
11/24/2009 18:24	45	2462.0	2409.3	4871.2
11/24/2009 18:24	46	4533.5	4426.3	8959.9
11/24/2009 18:25	47	4925.5	4762.5	9688.0
11/24/2009 18:25	48	4813.5	4650.5	9463.9
11/24/2009 18:26	49	4757.5	4650.5	9407.9
11/24/2009 18:26	50	4757.5	4538.4	9295.9
11/24/2009 18:27	51	4701.5	4538.4	9239.9
11/24/2009 18:27	52	4701.5	4538.4	9239.9
11/24/2009 18:28	53	4701.5	4538.4	9239.9
11/24/2009 18:28	54	4645.5	4538.4	9183.9
11/24/2009 18:29	55	4645.5	4538.4	9183.9
11/24/2009 18:29	56	4645.5	4482.4	9127.9
11/24/2009 18:30	57	4645.5	4482.4	9127.9
11/24/2009 18:30	58	4645.5	4482.4	9127.9
11/24/2009 18:31	59	4589.5	4482.4	9071.9
11/24/2009 18:31	60	4533.5	4482.4	9015.9
11/24/2009 18:32	61	4533.5	4482.4	9015.9
11/24/2009 18:32	62	4533.5	4426.3	8959.9
11/24/2009 18:33	63	4533.5	4426.3	8959.9
11/24/2009 18:33	64	4533.5	4426.3	8959.9
11/24/2009 18:34	65	4533.5	4426.3	8959.9
11/24/2009 18:34	66	4533.5	4426.3	8959.9
11/24/2009 18:35	67	6269.2	6219.3	12488.5
11/24/2009 18:35	68	6101.2	6051.2	12152.4
11/24/2009 18:36	69	6101.2	5995.2	12096.4
11/24/2009 18:36	70	6101.2	5939.1	12040.4
11/24/2009 18:37	71	5989.2	5939.1	11928.4
11/24/2009 18:37	72	5989.2	5939.1	11928.4
11/24/2009 18:38	73	5989.2	5883.1	11872.3
11/24/2009 18:38	74	5989.2	5883.1	11872.3
11/24/2009 18:39	75	5989.2	5883.1	11872.3
11/24/2009 18:39	76	5989.2	5827.1	11816.3
11/24/2009 18:40	77	5989.2	5827.1	11816.3
11/24/2009 18:40	78	5989.2	5827.1	11816.3
11/24/2009 18:41	79	5933.3	5827.1	11760.3
11/24/2009 18:41	80	5989.2	5827.1	11816.3
11/24/2009 18:42	81	5989.2	5827.1	11816.3
11/24/2009 18:42	82	5989.2	5827.1	11816.3
11/24/2009 18:43	83	5989.2	5827.1	11816.3
11/24/2009 18:43	84	5989.2	5827.1	11816.3
11/24/2009 18:44	85	5933.3	5827.1	11760.3
11/24/2009 18:44	86	5933.3	5827.1	11760.3
11/24/2009 18:45	87	8004.8	7900.2	15905.0
11/24/2009 18:45	88	7836.9	7732.1	15568.9
11/24/2009 18:46	89	7724.9	7620.0	15344.9

TIMESTAMP	RECORD #	LoadA lbs	LoadB lbs	TotalLoad lbs
11/24/2009 18:46	90	7724.9	7620.0	15344.9
11/24/2009 18:47	91	7668.9	7620.0	15288.9
11/24/2009 18:47	92	7668.9	7564.0	15232.9
11/24/2009 18:48	93	7668.9	7564.0	15232.9
11/24/2009 18:48	94	7612.9	7564.0	15176.9
11/24/2009 18:49	95	7556.9	7507.9	15064.9
11/24/2009 18:49	96	7556.9	7507.9	15064.9
11/24/2009 18:50	97	7612.9	7507.9	15120.9
11/24/2009 18:50	98	7556.9	7507.9	15064.9
11/24/2009 18:51	99	7556.9	7507.9	15064.9
11/24/2009 18:51	100	7556.9	7507.9	15064.9
11/24/2009 18:52	101	7556.9	7507.9	15064.9
11/24/2009 18:52	102	7556.9	7507.9	15064.9
11/24/2009 18:53	103	7556.9	7507.9	15064.9
11/24/2009 18:53	104	7556.9	7451.9	15008.8
11/24/2009 18:54	105	7556.9	7451.9	15008.8
11/24/2009 18:54	106	7556.9	7451.9	15008.8
11/24/2009 18:55	107	8396.8	8292.4	16689.1
11/24/2009 18:55	108	8788.7	8628.5	17417.2
11/24/2009 18:56	109	8732.7	8628.5	17361.2
11/24/2009 18:56	110	8620.7	8516.5	17137.2
11/24/2009 18:57	111	8620.7	8516.5	17137.2
11/24/2009 18:57	112	8620.7	8516.5	17137.2
11/24/2009 18:58	113	8620.7	8460.4	17081.2
11/24/2009 18:58	114	8620.7	8460.4	17081.2
11/24/2009 18:59	115	8620.7	8460.4	17081.2
11/24/2009 18:59	116	8564.7	8404.4	16969.1
11/24/2009 19:00	117	8564.7	8404.4	16969.1
11/24/2009 19:00	118	8564.7	8404.4	16969.1
11/24/2009 19:01	119	8564.7	8404.4	16969.1
11/24/2009 19:01	120	8564.7	8404.4	16969.1
11/24/2009 19:02	121	8564.7	8404.4	16969.1
11/24/2009 19:02	122	8564.7	8404.4	16969.1
11/24/2009 19:03	123	8564.7	8404.4	16969.1
11/24/2009 19:03	124	8564.7	8404.4	16969.1
11/24/2009 19:04	125	8564.7	8404.4	16969.1
11/24/2009 19:04	126	8508.7	8404.4	16913.1
11/24/2009 19:05	127	8508.7	8404.4	16913.1
11/24/2009 19:05	128	9964.4	9861.2	19825.6
11/24/2009 19:06	129	9852.5	9749.1	19601.6
11/24/2009 19:06	130	9796.5	9637.1	19433.5
11/24/2009 19:07	131	9796.5	9637.1	19433.5
11/24/2009 19:07	132	9796.5	9637.1	19433.5
11/24/2009 19:08	133	9684.5	9581.0	19265.5
11/24/2009 19:08	134	9684.5	9581.0	19265.5

TIMESTAMP	RECORD #	LoadA lbs	LoadB lbs	TotalLoad lbs
11/24/2009 19:09	135	9684.5	9525.0	19209.5
11/24/2009 19:09	136	9684.5	9525.0	19209.5
11/24/2009 19:10	137	9684.5	9581.0	19265.5
11/24/2009 19:10	138	9684.5	9581.0	19265.5
11/24/2009 19:11	139	9684.5	9525.0	19209.5
11/24/2009 19:11	140	9684.5	9469.0	19153.5
11/24/2009 19:12	141	9628.5	9469.0	19097.5
11/24/2009 19:12	142	9628.5	9469.0	19097.5
11/24/2009 19:13	143	9628.5	9469.0	19097.5
11/24/2009 19:13	144	9628.5	9469.0	19097.5
11/24/2009 19:14	145	9628.5	9469.0	19097.5
11/24/2009 19:14	146	9628.5	9525.0	19153.5
11/24/2009 19:15	147	9572.5	9412.9	18985.5
11/24/2009 19:15	148	11476.1	11374.0	22850.1
11/24/2009 19:16	149	11196.2	11093.8	22290.0
11/24/2009 19:16	150	11084.2	10981.8	22066.0
11/24/2009 19:17	151	11028.2	10981.8	22010.0
11/24/2009 19:17	152	11028.2	10869.7	21897.9
11/24/2009 19:18	153	10972.2	10869.7	21841.9
11/24/2009 19:18	154	10972.2	10869.7	21841.9
11/24/2009 19:19	155	10972.2	10813.7	21785.9
11/24/2009 19:19	156	10916.2	10869.7	21785.9
11/24/2009 19:20	157	10860.3	10813.7	21673.9
11/24/2009 19:20	158	10860.3	10757.6	21617.9
11/24/2009 19:21	159	10916.2	10813.7	21729.9
11/24/2009 19:21	160	10860.3	10757.6	21617.9
11/24/2009 19:22	161	10860.3	10757.6	21617.9
11/24/2009 19:22	162	10860.3	10757.6	21617.9
11/24/2009 19:23	163	10860.3	10757.6	21617.9
11/24/2009 19:23	164	10804.3	10701.6	21505.9
11/24/2009 19:24	165	10804.3	10701.6	21505.9
11/24/2009 19:24	166	10804.3	10701.6	21505.9
11/24/2009 19:25	167	10804.3	10701.6	21505.9
11/24/2009 19:25	168	10804.3	10701.6	21505.9
11/24/2009 19:26	169	12483.9	12382.5	24866.4
11/24/2009 19:26	170	12316.0	12158.4	24474.3
11/24/2009 19:27	171	12204.0	12158.4	24362.4
11/24/2009 19:27	172	12204.0	12102.3	24306.3
11/24/2009 19:28	173	12204.0	12046.3	24250.3
11/24/2009 19:28	174	12092.0	11990.3	24082.3
11/24/2009 19:29	175	12092.0	11990.3	24082.3
11/24/2009 19:29	176	12092.0	11990.3	24082.3
11/24/2009 19:30	177	12092.0	11990.3	24082.3
11/24/2009 19:30	178	12092.0	11990.3	24082.3
11/24/2009 19:31	179	12036.0	11990.3	24026.3

TIMESTAMP	RECORD #	LoadA lbs	LoadB lbs	TotalLoad lbs
11/24/2009 19:31	180	12036.0	11934.3	23970.3
11/24/2009 19:32	181	11980.0	11934.3	23914.3
11/24/2009 19:32	182	11980.0	11878.2	23858.3
11/24/2009 19:33	183	11980.0	11878.2	23858.3
11/24/2009 19:33	184	11980.0	11878.2	23858.3
11/24/2009 19:34	185	11980.0	11878.2	23858.3
11/24/2009 19:34	186	11980.0	11878.2	23858.3
11/24/2009 19:35	187	11980.0	11878.2	23858.3
11/24/2009 19:35	188	11980.0	11878.2	23858.3
11/24/2009 19:36	189	11980.0	11934.3	23914.3
11/24/2009 19:36	190	15059.4	14903.8	29963.2
11/24/2009 19:37	191	14499.5	14343.5	28843.0
11/24/2009 19:37	192	14387.5	14175.4	28563.0
11/24/2009 19:38	193	14275.6	14119.4	28395.0
11/24/2009 19:38	194	14275.6	14063.4	28338.9
11/24/2009 19:39	195	14219.6	14063.4	28283.0
11/24/2009 19:39	196	14163.6	14063.4	28227.0
11/24/2009 19:40	197	14163.6	14007.3	28170.9
11/24/2009 19:40	198	14163.6	13951.3	28114.9
11/24/2009 19:41	199	14107.6	13951.3	28058.9
11/24/2009 19:41	200	14107.6	13951.3	28058.9
11/24/2009 19:42	201	14107.6	13895.3	28002.9
11/24/2009 19:42	202	14107.6	13895.3	28002.9
11/24/2009 19:43	203	14107.6	13895.3	28002.9
11/24/2009 19:43	204	14107.6	13895.3	28002.9
11/24/2009 19:44	205	14107.6	13895.3	28002.9
11/24/2009 19:44	206	14107.6	13895.3	28002.9
11/24/2009 19:45	207	14051.6	13895.3	27946.9
11/24/2009 19:45	208	13995.6	13895.3	27890.9
11/24/2009 19:46	209	13995.6	13895.3	27890.9
11/24/2009 19:46	210	15731.3	15576.2	31307.4
11/24/2009 19:47	211	17466.9	17313.1	34780.0
11/24/2009 19:47	212	17243.0	17089.0	34331.9
11/24/2009 19:48	213	17131.0	16976.9	34107.9
11/24/2009 19:48	214	17075.0	16920.9	33995.9
11/24/2009 19:49	215	17019.0	16920.9	33939.9
11/24/2009 19:49	216	17019.0	16808.8	33827.8
11/24/2009 19:50	217	16907.0	16808.8	33715.8
11/24/2009 19:50	218	16907.0	16808.8	33715.8
11/24/2009 19:51	219	16907.0	16752.8	33659.8
11/24/2009 19:51	220	16850.8	16752.6	33603.4
11/24/2009 19:52	221	16850.8	16696.5	33547.3
11/24/2009 19:52	222	16850.9	16696.6	33547.4
11/24/2009 19:53	223	16794.9	16640.5	33435.4
11/24/2009 19:53	224	16794.9	16640.6	33435.5

TIMESTAMP	RECORD #	LoadA lbs	LoadB lbs	TotalLoad lbs
11/24/2009 19:54	225	16794.9	16640.6	33435.5
11/24/2009 19:54	226	16794.9	16640.6	33435.5
11/24/2009 19:55	227	16738.9	16640.6	33379.6
11/24/2009 19:55	228	16738.9	16640.6	33379.6
11/24/2009 19:56	229	16739.0	16640.6	33379.6
11/24/2009 19:56	230	16683.0	16584.6	33267.6
11/24/2009 19:57	231	19818.4	19554.2	39372.5
11/24/2009 19:57	232	20154.3	20002.4	40156.7
11/24/2009 19:58	233	19874.4	19778.3	39652.7
11/24/2009 19:58	234	19762.4	19666.2	39428.6
11/24/2009 19:59	235	19706.4	19554.2	39260.6
11/24/2009 19:59	236	19650.4	19498.2	39148.6
11/24/2009 20:00	237	19594.4	19442.1	39036.6
11/24/2009 20:00	238	19538.5	19386.1	38924.6
11/24/2009 20:01	239	19482.5	19386.1	38868.6
11/24/2009 20:01	240	19482.5	19330.1	38812.6
11/24/2009 20:02	241	19426.5	19330.1	38756.6
11/24/2009 20:02	242	19426.5	19274.1	38700.6
11/24/2009 20:03	243	19370.5	19274.1	38644.6
11/24/2009 20:03	244	19370.5	19218.1	38588.6
11/24/2009 20:04	245	19370.5	19218.1	38588.6
11/24/2009 20:04	246	19371.2	19162.7	38533.8
11/24/2009 20:05	247	19315.2	19162.7	38477.8
11/24/2009 20:05	248	19315.1	19162.5	38477.6
11/24/2009 20:06	249	19315.1	19162.5	38477.6
11/24/2009 20:06	250	19315.3	19162.8	38478.2
11/24/2009 20:07	251	19315.3	19106.8	38422.1
11/24/2009 20:07	252	22842.6	22636.6	45479.2
11/24/2009 20:08	253	22450.7	22244.4	44695.0
11/24/2009 20:08	254	22282.5	22076.1	44358.7
11/24/2009 20:09	255	22226.5	21964.1	44190.6
11/24/2009 20:09	256	22170.4	21964.0	44134.4
11/24/2009 20:10	257	22114.4	21851.9	43966.4
11/24/2009 20:10	258	22058.5	21851.9	43910.4
11/24/2009 20:11	259	22002.4	21851.8	43854.2
11/24/2009 20:11	260	21946.4	21739.8	43686.1
11/24/2009 20:12	261	21946.3	21739.7	43686.0
11/24/2009 20:12	262	21890.3	21739.7	43630.0
11/24/2009 20:13	263	21890.3	21683.6	43573.9
11/24/2009 20:13	264	21890.3	21683.6	43573.9
11/24/2009 20:14	265	21834.2	21627.5	43461.7
11/24/2009 20:14	266	21834.2	21627.5	43461.7
11/24/2009 20:15	267	21834.2	21627.5	43461.7
11/24/2009 20:15	268	21778.2	21571.5	43349.6
11/24/2009 20:16	269	21778.2	21571.4	43349.6

TIMESTAMP	RECORD #	LoadA lbs	LoadB lbs	TotalLoad lbs
11/24/2009 20:16	270	21778.2	21571.4	43349.6
11/24/2009 20:17	271	21778.1	21571.4	43349.5
11/24/2009 20:17	272	24857.5	24653.0	49510.6
11/24/2009 20:18	273	24801.5	24541.0	49342.5
11/24/2009 20:18	274	24577.6	24372.9	48950.4
11/24/2009 20:19	275	24465.6	24260.8	48726.4
11/24/2009 20:19	276	24353.6	24148.7	48502.3
11/24/2009 20:20	277	24241.6	24092.7	48334.3
11/24/2009 20:20	278	24185.6	24036.6	48222.3
11/24/2009 20:21	279	24185.6	23980.6	48166.2
11/24/2009 20:21	280	24130.4	23925.4	48055.8
11/24/2009 20:22	281	24074.4	23925.4	47999.8
11/24/2009 20:22	282	24074.3	23869.2	47943.5
11/24/2009 20:23	283	24074.3	23869.2	47943.5
11/24/2009 20:23	284	24018.1	23869.0	47887.2
11/24/2009 20:24	285	23962.2	23813.0	47775.2
11/24/2009 20:24	286	23962.5	23757.4	47719.9
11/24/2009 20:25	287	23962.5	23757.4	47719.9
11/24/2009 20:25	288	23962.3	23757.2	47719.5
11/24/2009 20:26	289	23962.3	23757.2	47719.5
11/24/2009 20:26	290	23962.3	23757.2	47719.5
11/24/2009 20:27	291	23850.2	23701.0	47551.2
11/24/2009 20:27	292	23850.2	23645.0	47495.2
11/24/2009 20:28	293	13212.5	13055.5	26268.0
11/24/2009 20:28	294	13212.5	13111.6	26324.1
11/24/2009 20:29	295	13212.2	13111.3	26323.4
11/24/2009 20:29	296	13212.2	13055.2	26267.4
11/24/2009 20:30	297	13212.1	13055.1	26267.2
11/24/2009 20:30	298	13212.1	13055.1	26267.2
11/24/2009 20:31	299	13211.8	13054.9	26266.7
11/24/2009 20:31	300	13211.8	13054.9	26266.7
11/24/2009 20:32	301	7501.0	7395.9	14896.9
11/24/2009 20:32	302	12316.0	12046.4	24362.4
11/24/2009 20:33	303	110.4	56.0	166.5
11/24/2009 20:33	304	110.4	0.0	110.4
11/24/2009 20:34	305	110.4	0.0	110.4
11/24/2009 20:34	306	110.4	0.0	110.4
11/24/2009 20:35	307	85997.3	111218.5	197215.8

APPENDIX B: LATERAL LOAD TEST E

TABLE B.1: Inclinometer measurements for pile 3

ASHE MICROPILE LATERAL LOAD TESTING

MICROPILE NO: 3

DATE: 11/16/09

TIME:

	Baseline		
Depth (ft)	A+	A-	Diff. (A)
14	-31	-71	40
12	28	-67	95
10	25	-66	91
8	8	-47	55
6	4	-50	54
4	30	-62	92
2	-15	-31	16

Depth (ft)	A+	A-	Diff. (A)	Change	Increment	Total
10 kips						
14	69	-154	223	183	0.1098	0.1098
12	83	-123	206	111	0.0666	0.1764
10	106	-143	249	158	0.0948	0.2712
8	147	-185	332	277	0.1662	0.4374
6	154	-195	349	295	0.177	0.6144
4	181	-214	395	303	0.1818	0.7962
2	193	-232	425	409	0.2454	1.0416

Depth (ft)	A+	A-	Diff. (A)	Change	Increment	Total
20 kips						
14	68	-153	221	181	-0.1086	-0.1086
12	85	-125	210	115	0.069	-0.0396
10	129	-168	297	206	0.1236	0.084
8	203	-241	444	389	0.2334	0.3174
6	230	-276	506	452	0.2712	0.5886
4	267	-299	566	474	0.2844	0.873
2	268	-312	580	564	0.3384	1.2114

Depth (ft)	A+	A-	Diff. (A)	Change	Increment	Total
30 kips						
14	68	-152	220	180	0.108	0.108
12	89	-128	217	122	0.0732	0.1812
10	162	-200	362	271	0.1626	0.3438
8	272	-311	583	528	0.3168	0.6606
6	331	-373	704	650	0.39	1.0506
4	371	-403	774	682	0.4092	1.4598
2	385	-425	810	794	0.4764	1.9362

Depth (ft)	A+	A-	Diff. (A)	Change	Increment	Total
40 Kips						
14	67	-152	219	179	0.1074	0.1074
12	93	-133	226	131	0.0786	0.186
10	197	-240	437	346	0.2076	0.3936
8	346	-383	729	674	0.4044	0.798
6	432	-473	905	851	0.5106	1.3086
4	476	-507	983	891	0.5346	1.8432
2	489	-522	1011	995	0.597	2.4402

Depth (ft)	A+	A-	Diff. (A)	Change	Increment	Total
Final						
14	64	-151	215	175	0.105	0.105
12	91	-132	223	128	0.0768	0.1818
10	157	-195	352	261	0.1566	0.3384
8	241	-277	518	463	0.2778	0.6162
6	279	-321	600	546	0.3276	0.9438
4	310	-345	655	563	0.3378	1.2816
2	314	-357	671	655	0.393	1.6746

TABLE B.2: Inclinometer measurements for pile 15

PROJECT:ASHE MICROPILE LATERAL LOAD TESTING

MICROPILE NO: 15

DATE: DATE :11/24/09

TIME:

	Baseline		
Depth (ft)	A+	A-	Diff. (A)
14	-14	-31	17
12	-12	28	-40
10	-10	25	-35
8	-8	8	-16
6	-6	4	-10
4	-4	30	-34
2	-2	-15	13

Depth (ft)	A+	A-	Diff. (A)	Change	Increment	Total
10 kips						
14	-32	-72	40	23	0.0138	0.0138
12	29	-68	97	137	0.0822	0.096
10	31	-74	105	140	0.084	0.18
8	55	-90	145	161	0.0966	0.2766
6	77	-118	195	205	0.123	0.3996
4	100	-135	235	269	0.1614	0.561
2	79	-121	200	187	0.1122	0.6732

Depth (ft)	A+	A-	Diff. (A)	Change	Increment	Total
20 kips						
14	-31	-73	42	25	0.015	0.015
12	31	-68	99	139	0.0834	0.0984
10	39	-79	118	153	0.0918	0.1902
8	95	-131	226	242	0.1452	0.3354
6	143	-180	323	333	0.1998	0.5352
4	175	-205	380	414	0.2484	0.7836
2	145	-198	343	330	0.198	0.9816

Depth (ft)	A+	A-	Diff. (A)	Change	Increment	Total
30 kips						
14	-33	-73	40	23	0.0138	0.0138
12	30	-69	99	139	0.0834	0.0972
10	47	-89	136	171	0.1026	0.1998
8	153	-191	344	360	0.216	0.4158
6	228	-269	497	507	0.3042	0.72
4	272	-304	576	610	0.366	1.086
2	251	-277	528	515	0.309	1.395

Depth (ft)	A+	A-	Diff. (A)	Change	Increment	Total
40 kips						
14	-30	-72	42	25	0.015	0.015
12	31	-70	101	141	0.0846	0.0996
10	55	-99	154	189	0.1134	0.213
8	223	-260	483	499	0.2994	0.5124
6	336	-375	711	721	0.4326	0.945
4	387	-418	805	839	0.5034	1.4484
2	357	-395	752	739	0.4434	1.8918

Depth (ft)	A+	A-	Diff. (A)	Change	Increment	Total
Final						
14	-31	-70	39	22	-0.0132	-0.0132
12	30	-68	98	138	0.0828	0.0696
10	25	-65	90	125	0.075	0.1446
8	976	-1013	1989	2005	1.203	1.3476
6	1220	-1258	2478	2488	1.4928	2.8404
4	1253	-1284	2537	2571	1.5426	4.383
2	1215	-1261	2476	2463	1.4778	5.8608

TABLE A.3: Load measurements for load test E

TIMESTAMP	RECORD #	LoadA lbs	LoadB lbs	Total lbs
11/24/2009 10:20	0	614.3	560.3	1174.6
11/24/2009 10:21	1	614.3	560.3	1174.6
11/24/2009 10:21	2	614.3	560.3	1174.6
11/24/2009 10:22	3	614.3	560.3	1174.6
11/24/2009 10:22	4	2406.0	2297.2	4703.2
11/24/2009 10:23	5	2518.0	2409.3	4927.2
11/24/2009 10:23	6	2517.9	2409.3	4927.2
11/24/2009 10:24	7	2462.0	2409.3	4871.2
11/24/2009 10:24	8	2517.9	2409.3	4927.2
11/24/2009 10:25	9	2517.9	2409.3	4927.2
11/24/2009 10:25	10	2462.0	2409.3	4871.2
11/24/2009 10:26	11	2462.0	2353.2	4815.2
11/24/2009 10:26	12	2462.0	2353.2	4815.2
11/24/2009 10:27	13	2462.0	2353.2	4815.2
11/24/2009 10:27	14	2462.0	2409.3	4871.2
11/24/2009 10:28	15	2462.0	2353.2	4815.2
11/24/2009 10:28	16	2462.0	2353.2	4815.2
11/24/2009 10:29	17	2461.9	2353.2	4815.2
11/24/2009 10:29	18	2461.9	2353.2	4815.2
11/24/2009 10:30	19	2461.9	2353.2	4815.2
11/24/2009 10:30	20	2461.9	2353.2	4815.2
11/24/2009 10:31	21	2461.9	2353.2	4815.2
11/24/2009 10:31	22	2461.9	2353.2	4815.2
11/24/2009 10:32	23	2461.9	2353.2	4815.2
11/24/2009 10:32	24	2406.0	2353.2	4759.2
11/24/2009 10:33	25	5149.4	4930.6	10080.0
11/24/2009 10:33	26	5037.4	4874.6	9912.0
11/24/2009 10:34	27	5037.4	4818.5	9856.0
11/24/2009 10:34	28	5037.4	4818.5	9856.0
11/24/2009 10:35	29	4981.4	4818.5	9800.0
11/24/2009 10:35	30	4981.4	4818.5	9800.0
11/24/2009 10:36	31	4981.4	4818.5	9800.0
11/24/2009 10:36	32	4981.4	4818.5	9800.0
11/24/2009 10:37	33	4981.4	4818.5	9800.0
11/24/2009 10:37	34	4981.4	4818.5	9800.0
11/24/2009 10:38	35	4981.4	4818.5	9800.0
11/24/2009 10:38	36	4981.4	4818.5	9800.0
11/24/2009 10:39	37	4981.4	4818.5	9800.0
11/24/2009 10:39	38	4981.4	4818.5	9800.0
11/24/2009 10:40	39	4981.4	4818.5	9800.0
11/24/2009 10:40	40	4925.5	4818.5	9744.0
11/24/2009 10:41	41	4981.4	4762.5	9744.0
11/24/2009 10:41	42	4981.4	4762.5	9744.0
11/24/2009 10:42	43	4925.5	4762.5	9688.0
11/24/2009 10:42	44	4925.5	4762.5	9688.0

TIMESTAMP	RECORD #	LoadA lbs	LoadB lbs	Total lbs
11/24/2009 10:43	45	4925.5	4818.5	9744.0
11/24/2009 10:43	46	4925.5	4818.5	9744.0
11/24/2009 10:44	47	4981.4	4818.5	9800.0
11/24/2009 10:44	48	4981.4	4818.5	9800.0
11/24/2009 10:45	49	4981.4	4818.5	9800.0
11/24/2009 10:45	50	4981.4	4818.5	9800.0
11/24/2009 10:46	51	4981.4	4818.5	9800.0
11/24/2009 10:46	52	4925.5	4818.5	9744.0
11/24/2009 10:47	53	7724.9	7451.9	15176.8
11/24/2009 10:47	54	7612.9	7339.9	14952.8
11/24/2009 10:48	55	7612.9	7339.9	14952.8
11/24/2009 10:48	56	7500.9	7283.8	14784.8
11/24/2009 10:49	57	7501.0	7283.8	14784.8
11/24/2009 10:49	58	7501.0	7283.8	14784.8
11/24/2009 10:50	59	7501.0	7283.8	14784.8
11/24/2009 10:50	60	7501.0	7283.8	14784.8
11/24/2009 10:51	61	7501.0	7283.8	14784.8
11/24/2009 10:51	62	7445.0	7283.8	14728.8
11/24/2009 10:52	63	7501.0	7227.8	14728.8
11/24/2009 10:52	64	7501.0	7227.8	14728.8
11/24/2009 10:53	65	7501.0	7227.8	14728.8
11/24/2009 10:53	66	7501.0	7283.8	14784.8
11/24/2009 10:54	67	7501.0	7283.8	14784.8
11/24/2009 10:54	68	7501.0	7283.8	14784.8
11/24/2009 10:55	69	7501.0	7283.8	14784.8
11/24/2009 10:55	70	7501.0	7227.8	14728.8
11/24/2009 10:56	71	7501.0	7283.8	14784.8
11/24/2009 10:56	72	7501.0	7227.8	14728.8
11/24/2009 10:57	73	7501.0	7227.8	14728.8
11/24/2009 10:57	74	10244.4	9917.2	20161.6
11/24/2009 10:58	75	10076.4	9805.2	19881.6
11/24/2009 10:58	76	10020.5	9805.2	19825.6
11/24/2009 10:59	77	9964.5	9749.1	19713.6
11/24/2009 10:59	78	9964.5	9749.1	19713.6
11/24/2009 11:00	79	9964.5	9693.1	19657.6
11/24/2009 11:00	80	9964.5	9693.1	19657.6
11/24/2009 11:01	81	9908.5	9693.1	19601.6
11/24/2009 11:01	82	9908.5	9693.1	19601.6
11/24/2009 11:02	83	9908.5	9637.1	19545.6
11/24/2009 11:02	84	9908.5	9693.1	19601.6
11/24/2009 11:03	85	9908.5	9693.1	19601.6
11/24/2009 11:03	86	9908.5	9637.1	19545.6
11/24/2009 11:04	87	9852.1	9636.8	19488.9
11/24/2009 11:04	88	9852.1	9636.8	19488.9
11/24/2009 11:05	89	9851.9	9636.5	19488.4

TIMESTAMP	RECORD #	LoadA lbs	LoadB lbs	Total lbs
11/24/2009 11:05	90	9851.9	9636.5	19488.4
11/24/2009 11:06	91	9851.6	9636.3	19487.9
11/24/2009 11:06	92	9851.6	9636.3	19487.9
11/24/2009 11:07	93	9851.5	9580.1	19431.6
11/24/2009 11:07	94	9851.5	9580.1	19431.6
11/24/2009 11:08	95	12594.7	12493.4	25088.0
11/24/2009 11:08	96	12482.5	12325.1	24807.6
11/24/2009 11:09	97	12426.5	12269.1	24695.6
11/24/2009 11:09	98	12370.8	12269.4	24640.2
11/24/2009 11:10	99	12370.8	12213.3	24584.2
11/24/2009 11:10	100	12371.1	12213.6	24584.6
11/24/2009 11:11	101	12315.1	12213.6	24528.6
11/24/2009 11:11	102	12314.8	12213.3	24528.2
11/24/2009 11:12	103	12314.8	12213.3	24528.2
11/24/2009 11:12	104	12315.1	12157.5	24472.6
11/24/2009 11:13	105	12315.1	12157.5	24472.6
11/24/2009 11:13	106	12258.8	12157.3	24416.1
11/24/2009 11:14	107	12258.8	12157.3	24416.1
11/24/2009 11:14	108	12314.6	12101.1	24415.7
11/24/2009 11:15	109	12258.7	12157.1	24415.8
11/24/2009 11:15	110	12258.5	12157.0	24415.5
11/24/2009 11:16	111	12258.5	12157.0	24415.5
11/24/2009 11:16	112	12258.5	12100.9	24359.4
11/24/2009 11:17	113	12258.4	12100.8	24359.2
11/24/2009 11:17	114	12258.4	12100.8	24359.2
11/24/2009 11:18	115	12258.3	12100.7	24359.0
11/24/2009 11:18	116	15225.3	15013.9	30239.1
11/24/2009 11:19	117	15057.2	14845.7	29902.9
11/24/2009 11:19	118	14945.3	14789.7	29735.0
11/24/2009 11:20	119	14945.2	14789.6	29734.8
11/24/2009 11:20	120	14889.2	14733.6	29622.8
11/24/2009 11:21	121	14889.2	14733.5	29622.7
11/24/2009 11:21	122	14889.2	14677.5	29566.7
11/24/2009 11:22	123	14833.1	14677.5	29510.6
11/24/2009 11:22	124	14833.1	14677.5	29510.6
11/24/2009 11:23	125	14833.1	14677.4	29510.5
11/24/2009 11:23	126	14833.1	14621.4	29454.5
11/24/2009 11:24	127	14833.1	14621.4	29454.5
11/24/2009 11:24	128	14777.1	14621.4	29398.5
11/24/2009 11:25	129	14777.1	14621.4	29398.5
11/24/2009 11:25	130	14777.1	14621.3	29398.4
11/24/2009 11:26	131	14777.1	14565.3	29342.4
11/24/2009 11:26	132	14721.1	14565.3	29286.4
11/24/2009 11:27	133	14777.0	14621.3	29398.4
11/24/2009 11:27	134	14721.0	14621.3	29342.4

TIMESTAMP	RECORD #	LoadA lbs	LoadB lbs	Total lbs
11/24/2009 11:28	135	14721.0	14565.3	29286.3
11/24/2009 11:28	136	14721.0	14565.3	29286.3
11/24/2009 11:29	137	17464.0	17310.3	34774.3
11/24/2009 11:29	138	17687.9	17478.3	35166.3
11/24/2009 11:30	139	17632.0	17422.3	35054.3
11/24/2009 11:30	140	17575.4	17365.7	34941.1
11/24/2009 11:31	141	17519.4	17365.7	34885.1
11/24/2009 11:31	142	17519.5	17365.8	34885.3
11/24/2009 11:32	143	17519.5	17309.8	34829.3
11/24/2009 11:32	144	17463.5	17309.8	34773.3
11/24/2009 11:33	145	17463.6	17253.9	34717.5
11/24/2009 11:33	146	17463.6	17253.9	34717.5
11/24/2009 11:34	147	17463.7	17253.9	34717.6
11/24/2009 11:34	148	17463.7	17197.9	34661.6
11/24/2009 11:35	149	17407.8	17198.0	34605.7
11/24/2009 11:35	150	17407.8	17198.0	34605.7
11/24/2009 11:36	151	17351.8	17198.0	34549.8
11/24/2009 11:36	152	17407.8	17198.0	34605.8
11/24/2009 11:37	153	17351.9	17142.0	34493.9
11/24/2009 11:37	154	17295.9	17142.0	34437.9
11/24/2009 11:38	155	17295.9	17142.0	34438.0
11/24/2009 11:38	156	17295.9	17142.0	34438.0
11/24/2009 11:39	157	17240.0	17142.1	34382.0
11/24/2009 11:39	158	19815.0	19606.9	39422.0
11/24/2009 11:40	159	20038.9	19831.0	39869.9
11/24/2009 11:40	160	19983.0	19775.0	39758.0
11/24/2009 11:41	161	19983.0	19719.0	39702.0
11/24/2009 11:41	162	19927.0	19719.0	39646.0
11/24/2009 11:42	163	19927.0	19719.0	39646.0
11/24/2009 11:42	164	19926.7	19718.8	39645.5
11/24/2009 11:43	165	19926.7	19662.7	39589.5
11/24/2009 11:43	166	19814.9	19662.8	39477.7
11/24/2009 11:44	167	19870.8	19662.8	39533.6
11/24/2009 11:44	168	19870.9	19662.9	39533.7
11/24/2009 11:45	169	19814.9	19662.9	39477.8
11/24/2009 11:45	170	19815.0	19662.9	39477.8
11/24/2009 11:46	171	19815.0	19662.9	39477.8
11/24/2009 11:46	172	19815.3	19663.2	39478.5
11/24/2009 11:47	173	19815.3	19663.2	39478.5
11/24/2009 11:47	174	19814.6	19606.5	39421.0
11/24/2009 11:48	175	19814.6	19606.5	39421.0
11/24/2009 11:48	176	19814.6	19606.5	39421.0
11/24/2009 11:49	177	19758.0	19605.9	39364.0
11/24/2009 11:49	178	19758.0	19605.9	39364.0
11/24/2009 11:50	179	21604.7	21398.0	43002.7

TIMESTAMP	RECORD #	LoadA lbs	LoadB lbs	Total lbs
11/24/2009 11:50	180	11473.3	11427.2	22900.5
11/24/2009 11:51	181	9010.2	9018.4	18028.6
11/24/2009 11:51	182	8674.3	8682.3	17356.6
11/24/2009 11:52	183	8618.5	8570.4	17189.0
11/24/2009 11:52	184	8562.6	8570.4	17133.0
11/24/2009 11:53	185	8562.4	8514.2	17076.6
11/24/2009 11:53	186	8562.4	8458.2	17020.6
11/24/2009 11:54	187	8450.3	8458.1	16908.4
11/24/2009 11:54	188	8450.3	8458.1	16908.4
11/24/2009 11:55	189	8450.5	8458.3	16908.8
11/24/2009 11:55	190	8450.5	8458.3	16908.8
11/24/2009 11:56	191	8394.5	8402.3	16796.8
11/24/2009 11:56	192	8394.4	8402.1	16796.6
11/24/2009 11:57	193	8394.4	8402.1	16796.6
11/24/2009 11:57	194	8394.3	8402.0	16796.3
11/24/2009 11:58	195	8394.3	8402.0	16796.3
11/24/2009 11:58	196	8394.2	8345.9	16740.1
11/24/2009 11:59	197	7442.7	7393.7	14836.4
11/24/2009 11:59	198	54.3	56.0	110.3
11/24/2009 12:00	199	54.3	56.0	110.3
11/24/2009 12:00	200	54.3	56.0	110.3
11/24/2009 12:01	201	54.3	56.0	110.3
11/24/2009 12:01	202	54.3	56.0	110.3
11/24/2009 12:02	203	54.3	56.0	110.3

APPENDIX C: LATERAL LOAD TEST F

TABLE C.1: Inclinometer measurements for pile 4

PROJECT:ASHE MICROPILE LATERAL LOAD TESTING
MICROPILE NO: 4
DATE:
TIME:

	Baseline data		
Depth (ft)	A+	A-	Diff. (A)
18	-309	272	-581
16	-289	245	-534
14	-254	228	-482
12	-274	230	-504
10	-307	265	-572
8	-333	297	-630
6	-391	343	-734
4	-421	385	-806
2	-483	436	-919

Depth (ft)	A+	A-	Diff. (A)	Change	Increment	Total
10 kips						
18	-310	269	-579	2	0.0012	0.0012
16	-288	245	-533	1	0.0006	0.0018
14	-254	219	-473	9	0.0054	0.0072
12	-270	232	-502	2	0.0012	0.0084
10	-306	270	-576	-4	-0.0024	0.006
8	-328	298	-626	4	0.0024	0.0084
6	-364	316	-680	54	0.0324	0.0408
4	-376	353	-729	77	0.0462	0.087
2	-436	382	-818	101	0.0606	0.1476

Depth (ft)	A+	A-	Diff. (A)	Change	Increment	Total
20 kips						
18	-309	270	-579	2	0.0012	0.0012
16	-289	245	-534	0	0	0.0012
14	-254	221	-475	7	0.0042	0.0054
12	-273	232	-505	-1	-0.0006	0.0048
10	-303	263	-566	6	0.0036	0.0084
8	-306	269	-575	55	0.033	0.0414
6	-311	263	-574	160	0.096	0.1374
4	-304	268	-572	234	0.1404	0.2778
2	-357	313	-670	249	0.1494	0.4272

Depth (ft)	A+	A-	Diff. (A)	Change	Increment	Total
30 kips						
18	-309	269	-578	3	0.0018	0.0018
16	-290	246	-536	-2	-0.0012	0.0006
14	-253	223	-476	6	0.0036	0.0042
12	-274	231	-505	-1	-0.0006	0.0036
10	-303	260	-563	9	0.0054	0.009
8	-276	258	-534	96	0.0576	0.0666
6	-251	199	-450	284	0.1704	0.237
4	-224	183	-407	399	0.2394	0.4764
2	-268	223	-491	428	0.2568	0.7332

Depth (ft)	A+	A-	Diff. (A)	Change	Increment	Total
Final						
18	-310	270	-580	1	0.0006	0.0006
16	-289	246	-535	-1	-0.0006	0
14	-253	221	-474	8	0.0048	0.0048
12	-269	230	-499	5	0.003	0.0078
10	-290	251	-541	31	0.0186	0.0264
8	-268	230	-498	132	0.0792	0.1056
6	-256	205	-461	273	0.1638	0.2694
4	-249	214	-463	343	0.2058	0.4752
2	-302	242	-544	375	0.225	0.7002

TABLE C.2: Inclinometer measurements for pile 16

PROJECT:ASHE MICROPILE LATERAL LOAD TESTING

MICROPILE NO: 16

DATE: 11/24/09

TIME:

	Baseline data		
Depth (ft)	A+	A-	Diff. (A)
18	246	-284	530
16	252	-292	544
14	286	-321	607
12	269	-308	577
10	269	-310	579
8	280	-317	597
6	269	-314	583
4	290	-321	611
2	355	-334	689

Depth (ft)	A+	A-	Diff. (A)	Change	Increment	Total
10 kips						
18	242	-284	526	-4	-0.0024	-0.0024
16	252	-292	544	0	0	-0.0024
14	290	-322	612	5	0.003	0.0006
12	262	-307	569	-8	-0.0048	-0.0042
10	262	-309	571	-8	-0.0048	-0.009
8	308	-344	652	55	0.033	0.024
6	329	-375	704	121	0.0726	0.0966
4	362	-393	755	144	0.0864	0.183
2	375	-416	791	102	0.0612	0.2442

Depth (ft)	A+	A-	Diff. (A)	Change	Increment	Total
20 kips						
18	247	-284	531	1	0.0006	0.0006
16	251	-293	544	0	0	0.0006
14	284	-322	606	-1	-0.0006	0
12	268	-309	577	0	0	0
10	281	-321	602	23	0.0138	0.0138
8	354	-391	745	148	0.0888	0.1026
6	424	-470	894	311	0.1866	0.2892
4	479	-511	990	379	0.2274	0.5166
2	492	-532	1024	335	0.201	0.7176

Depth (ft)	A+	A-	Diff. (A)	Change	Increment	Total
30 kips						
18	246	-284	530	0	0	0
16	242	-293	535	-9	-0.0054	-0.0054
14	285	-322	607	0	0	-0.0054
12	268	-307	575	-2	-0.0012	-0.0066
10	309	-332	641	62	0.0372	0.0306
8	404	-439	843	246	0.1476	0.1782
6	529	-572	1101	518	0.3108	0.489
4	580	-629	1209	598	0.3588	0.8478
2	613	-652	1265	576	0.3456	1.1934

Depth (ft)	A+	A-	Diff. (A)	Change	Increment	Total
Final						
18	246	-288	534	4	0.0024	0.0024
16	252	-292	544	0	0	0.0024
14	284	-321	605	-2	-0.0012	0.0012
12	270	-309	579	2	0.0012	0.0024
10	293	-336	629	50	0.03	0.0324
8	411	-455	866	269	0.1614	0.1938
6	1071	-1115	2186	1603	0.9618	1.1556
4	1111	-1145	2256	1645	0.987	2.1426
2	1124	-1168	2292	1603	0.9618	3.1044

TABLE C.3: Load measurements for load test F

TIMESTAMP	RECORD #	LoadA lbs	LoadB lbs	Total lbs
11/24/2009 14:33	0	334.1573	224.0451	558.2024
11/24/2009 14:33	1	334.1573	224.0451	558.2024
11/24/2009 14:34	2	334.1573	224.0451	558.2024
11/24/2009 14:34	3	446.0869	336.0626	782.1494
11/24/2009 14:35	4	2516.969	2520.469	5037.438
11/24/2009 14:35	5	2516.973	2464.463	4981.437
11/24/2009 14:36	6	2461.003	2464.463	4925.466
11/24/2009 14:36	7	2461.007	2408.456	4869.463
11/24/2009 14:37	8	2461.007	2408.456	4869.463
11/24/2009 14:37	9	2405.04	2408.458	4813.499
11/24/2009 14:38	10	2405.04	2408.458	4813.499
11/24/2009 14:38	11	2405.043	2408.46	4813.503
11/24/2009 14:39	12	2405.043	2408.46	4813.503
11/24/2009 14:39	13	2405.044	2352.451	4757.496
11/24/2009 14:40	14	2349.074	2352.451	4701.526
11/24/2009 14:40	15	2349.076	2352.452	4701.528
11/24/2009 14:41	16	2405.046	2352.452	4757.498
11/24/2009 14:41	17	2405.047	2352.453	4757.5
11/24/2009 14:42	18	2405.047	2296.443	4701.489
11/24/2009 14:42	19	2405.047	2296.443	4701.489
11/24/2009 14:43	20	2349.078	2296.443	4645.521
11/24/2009 14:43	21	2349.078	2296.443	4645.521
11/24/2009 14:44	22	2349.079	2296.444	4645.523
11/24/2009 14:44	23	2349.079	2352.455	4701.534
11/24/2009 14:45	24	2349.079	2352.456	4701.535
11/24/2009 14:45	25	5035.648	5040.976	10076.63
11/24/2009 14:46	26	4923.709	4872.945	9796.654
11/24/2009 14:46	27	4923.709	4872.945	9796.654
11/24/2009 14:47	28	4867.739	4816.935	9684.674
11/24/2009 14:47	29	4867.739	4760.923	9628.662
11/24/2009 14:48	30	4811.77	4760.924	9572.693
11/24/2009 14:48	31	4811.77	4760.924	9572.693
11/24/2009 14:49	32	4755.8	4760.924	9516.725
11/24/2009 14:49	33	4755.8	4760.924	9516.725
11/24/2009 14:50	34	4755.8	4760.924	9516.725
11/24/2009 14:50	35	4811.84	4704.978	9516.817
11/24/2009 14:51	36	4755.869	4704.978	9460.847
11/24/2009 14:51	37	4699.885	4704.965	9404.85
11/24/2009 14:52	38	4755.855	4648.953	9404.809
11/24/2009 14:52	39	4755.775	4648.88	9404.656
11/24/2009 14:53	40	4755.775	4648.88	9404.656
11/24/2009 14:53	41	4699.811	4648.885	9348.695
11/24/2009 14:54	42	4699.811	4648.885	9348.695
11/24/2009 14:54	43	4699.815	4592.878	9292.693
11/24/2009 14:55	44	4699.815	4592.878	9292.693

TIMESTAMP	RECORD #	LoadA lbs	LoadB lbs	Total lbs
11/24/2009 14:55	45	4867.729	4816.924	9684.652
11/24/2009 14:56	46	7498.323	7393.419	14891.74
11/24/2009 14:56	47	7386.386	7281.4	14667.79
11/24/2009 14:57	48	7330.416	7281.4	14611.82
11/24/2009 14:57	49	7330.419	7225.393	14555.81
11/24/2009 14:58	50	7274.449	7169.382	14443.83
11/24/2009 14:58	51	7274.449	7225.393	14499.84
11/24/2009 14:59	52	7218.481	7113.374	14331.86
11/24/2009 14:59	53	7218.481	7113.374	14331.86
11/24/2009 15:00	54	7218.483	7113.375	14331.86
11/24/2009 15:00	55	7218.483	7113.375	14331.86
11/24/2009 15:01	56	7218.485	7113.377	14331.86
11/24/2009 15:01	57	7162.516	7113.377	14275.89
11/24/2009 15:02	58	7162.518	7113.379	14275.9
11/24/2009 15:02	59	7162.518	7057.369	14219.89
11/24/2009 15:03	60	7106.649	7057.465	14164.12
11/24/2009 15:03	61	7106.649	7057.465	14164.12
11/24/2009 15:04	62	7106.527	7057.35	14163.88
11/24/2009 15:04	63	7106.527	7057.35	14163.88
11/24/2009 15:05	64	7106.532	7057.354	14163.89
11/24/2009 15:05	65	7106.532	6945.333	14051.87
11/24/2009 15:06	66	7106.532	6945.333	14051.87
11/24/2009 15:06	67	9961.012	9913.906	19874.92
11/24/2009 15:07	68	10072.95	9913.906	19986.86
11/24/2009 15:07	69	9961.016	9857.9	19818.92
11/24/2009 15:08	70	9905.046	9801.89	19706.94
11/24/2009 15:08	71	9905.049	9745.882	19650.93
11/24/2009 15:09	72	9793.108	9745.882	19538.99
11/24/2009 15:09	73	9848.943	9689.742	19538.69
11/24/2009 15:10	74	9792.974	9745.753	19538.73
11/24/2009 15:10	75	9792.866	9689.639	19482.5
11/24/2009 15:11	76	9736.897	9633.63	19370.53
11/24/2009 15:11	77	9736.947	9633.678	19370.63
11/24/2009 15:12	78	9736.947	9633.678	19370.63
11/24/2009 15:12	79	9736.988	9633.716	19370.7
11/24/2009 15:13	80	9736.988	9633.716	19370.7
11/24/2009 15:13	81	9681.188	9633.879	19315.07
11/24/2009 15:14	82	9681.188	9633.879	19315.07
11/24/2009 15:14	83	9681.188	9577.867	19259.05
11/24/2009 15:15	84	9625.08	9521.727	19146.81
11/24/2009 15:15	85	9625.08	9521.727	19146.81
11/24/2009 15:16	86	9625.106	9521.751	19146.86
11/24/2009 15:16	87	9625.106	9521.751	19146.86
11/24/2009 15:17	88	12479.41	12378.13	24857.54
11/24/2009 15:17	89	12423.44	12322.12	24745.57

TIMESTAMP	RECORD #	LoadA lbs	LoadB lbs	Total lbs
11/24/2009 15:18	90	12311.56	12210.16	24521.72
11/24/2009 15:18	91	12255.59	12154.15	24409.74
11/24/2009 15:19	92	12199.5	12098.02	24297.51
11/24/2009 15:19	93	12199.5	12042.01	24241.5
11/24/2009 15:20	94	12143.42	12041.91	24185.34
11/24/2009 15:20	95	12143.42	12041.91	24185.34
11/24/2009 15:21	96	12143.34	12041.83	24185.18
11/24/2009 15:21	97	12087.38	11985.82	24073.2
11/24/2009 15:22	98	12031.41	11985.82	24017.23
11/24/2009 15:22	99	12031.34	11985.76	24017.11
11/24/2009 15:23	100	12031.34	11985.76	24017.11
11/24/2009 15:23	101	12031.29	11985.71	24017.01
11/24/2009 15:24	102	12031.29	11929.71	23961
11/24/2009 15:24	103	12031.59	11929.99	23961.58
11/24/2009 15:25	104	11975.62	11929.99	23905.61
11/24/2009 15:25	105	11975.52	11873.88	23849.41
11/24/2009 15:26	106	11975.52	11873.88	23849.41
11/24/2009 15:26	107	11975.78	11874.13	23849.91
11/24/2009 15:27	108	11975.78	11874.13	23849.91
11/24/2009 15:27	109	14606.59	14562.86	29169.44
11/24/2009 15:28	110	14942.41	14842.91	29785.32
11/24/2009 15:28	111	14774.49	14674.87	29449.36
11/24/2009 15:29	112	14662.55	14618.86	29281.41
11/24/2009 15:29	113	14662.75	14563.04	29225.8
11/24/2009 15:30	114	14606.78	14563.04	29169.82
11/24/2009 15:30	115	14606.78	14451.02	29057.8
11/24/2009 15:31	116	14550.97	14451.17	29002.14
11/24/2009 15:31	117	14550.97	14451.17	29002.14
11/24/2009 15:32	118	14495.12	14451.3	28946.42
11/24/2009 15:32	119	14495.12	14451.3	28946.42
11/24/2009 15:33	120	14495.02	14395.19	28890.21
11/24/2009 15:33	121	14495.02	14395.19	28890.21
11/24/2009 15:34	122	14494.94	14395.11	28890.05
11/24/2009 15:34	123	14494.94	14395.11	28890.05
11/24/2009 15:35	124	14438.91	14395.05	28833.96
11/24/2009 15:35	125	14438.91	14339.04	28777.95
11/24/2009 15:36	126	14438.86	14282.98	28721.83
11/24/2009 15:36	127	14382.88	14282.98	28665.86
11/24/2009 15:37	128	14383.04	14283.13	28666.18
11/24/2009 15:37	129	14383.04	14283.13	28666.18
11/24/2009 15:38	130	14383.04	14283.13	28666.18
11/24/2009 15:38	131	17629.31	17531.76	35161.07
11/24/2009 15:39	132	17181.54	17083.66	34265.2
11/24/2009 15:39	133	17069.76	16971.8	34041.56
11/24/2009 15:40	134	17013.79	16971.8	33985.59

TIMESTAMP	RECORD #	LoadA lbs	LoadB lbs	Total lbs
11/24/2009 15:40	135	16957.72	16859.67	33817.39
11/24/2009 15:41	136	16901.75	16859.67	33761.42
11/24/2009 15:41	137	16901.66	16859.59	33761.26
11/24/2009 15:42	138	16845.69	16803.58	33649.27
11/24/2009 15:42	139	16845.63	16747.51	33593.14
11/24/2009 15:43	140	16789.66	16747.51	33537.16
11/24/2009 15:43	141	16789.37	16747.23	33536.6
11/24/2009 15:44	142	16789.37	16691.22	33480.59
11/24/2009 15:44	143	16733.64	16691.45	33425.09
11/24/2009 15:45	144	16733.64	16691.45	33425.09
11/24/2009 15:45	145	16733.83	16691.64	33425.47
11/24/2009 15:46	146	16733.83	16691.64	33425.47
11/24/2009 15:46	147	16677.86	16691.64	33369.5
11/24/2009 15:47	148	16677.78	16691.56	33369.34
11/24/2009 15:47	149	16677.78	16691.56	33369.34
11/24/2009 15:48	150	16677.72	16579.47	33257.19
11/24/2009 15:48	151	16677.72	16579.47	33257.19
11/24/2009 15:49	152	19868.01	19772.08	39640.09
11/24/2009 15:49	153	7666.35	7673.584	15339.93
11/24/2009 15:50	154	7722.41	7729.682	15452.09
11/24/2009 15:50	155	7722.41	7729.682	15452.09
11/24/2009 15:51	156	7722.481	7729.75	15452.23
11/24/2009 15:51	157	7722.481	7729.75	15452.23
11/24/2009 15:52	158	7722.431	7729.701	15452.13
11/24/2009 15:52	159	7722.431	7729.701	15452.13
11/24/2009 15:53	160	7722.279	7729.556	15451.84
11/24/2009 15:53	161	7722.279	7729.556	15451.84
11/24/2009 15:54	162	7722.279	7729.556	15451.84
11/24/2009 15:54	163	7722.158	7729.44	15451.6
11/24/2009 15:55	164	7722.158	7785.451	15507.61
11/24/2009 15:55	165	7722.171	7785.462	15507.63
11/24/2009 15:56	166	7722.171	7785.462	15507.63
11/24/2009 15:56	167	7722.29	7785.579	15507.87
11/24/2009 15:57	168	5707.346	5545.125	11252.47
11/24/2009 15:57	169	110.281	56.01203	166.293

APPENDIX D: LATERAL LOAD TEST I

TABLE D.1: Inclinometer measurements for pile 10

PROJECT: ASHE MICROPILE LATERAL LOAD TESTING
MICROPILE NO: 10
DATE: 11/25/09
TIME:

	Baseline data		
Depth (ft)	A+	A-	Diff. (A)
18	184	-222	406
16	190	-229	419
14	200	-235	435
12	192	-232	424
10	226	-256	482
8	243	-283	526
6	211	-251	462
4	171	-206	377
2	122	-166	288

Depth (ft)	A+	A-	Diff. (A)	Change	Increment	Total
10 kips						
17.75	184	-223	407	1	0.0006	0.0006
15.75	191	-230	421	2	0.0012	0.0018
13.75	197	-235	432	-3	-0.0018	0
11.75	193	-233	426	2	0.0012	0.0012
9.75	222	-259	481	-1	-0.0006	0.0006
7.75	252	-291	543	17	0.0102	0.0108
5.75	232	-274	506	44	0.0264	0.0372
3.75	205	-243	448	71	0.0426	0.0798
1.75	165	-238	403	115	0.069	0.1488

Depth (ft)	A+	A-	Diff. (A)	Change	Increment	Total
20 kips						
17.75	185	-222	407	1	0.0006	0.0006
15.75	193	-229	422	3	0.0018	0.0024
13.75	198	-234	432	-3	-0.0018	0.0006
11.75	191	-231	422	-2	-0.0012	-0.0006
9.75	226	-260	486	4	0.0024	0.0018
7.75	267	-304	571	45	0.027	0.0288
5.75	277	-315	592	130	0.078	0.1068
3.75	265	-303	568	191	0.1146	0.2214
1.75	224	-274	498	210	0.126	0.3474

Depth (ft)	A+	A-	Diff.(A)	Change	Increment	Total
30 kips						
17.75	185	-223	408	2	0.0012	0.0012
15.75	192	-229	421	2	0.0012	0.0024
13.75	197	-233	430	-5	-0.003	-0.0006
11.75	192	-233	425	1	0.0006	0
9.75	232	-263	495	13	0.0078	0.0078
7.75	276	-326	602	76	0.0456	0.0534
5.75	340	-382	722	260	0.156	0.2094
3.75	351	-392	743	366	0.2196	0.429
1.75	328	-409	737	449	0.2694	0.6984

TABLE D.2: Inclinometer measurements for pile 11

PROJECT:ASHE MICROPILE LATERAL LOAD TESTING

MICROPILE NO: 11

DATE: 11/25/09

TIME:

	Baseline data		
Depth (ft)	A+	A-	Diff. (A)
18	-98	61	-159
16	-101	61	-162
14	-61	26	-87
12	-66	23	-89
10	-49	6	-55
8	-58	20	-78
6	-81	41	-122
4	-57	21	-78
2	-60	15	-75

Depth (ft)	A+	A-	Diff. (A)	Change	Increment	Total
10 kips						
17.333	-99	61	-160	-1	-0.0006	-0.0006
15.333	-105	62	-167	-5	-0.003	-0.0036
13.333	-61	28	-89	-2	-0.0012	-0.0048
11.333	-64	25	-89	0	0	-0.0048
9.333	-50	6	-56	-1	-0.0006	-0.0054
7.333	-53	15	-68	10	0.006	0.0006
5.333	-65	24	-89	33	0.0198	0.0204
3.333	-14	-33	19	97	0.0582	0.0786
1.333	3	-55	58	133	0.0798	0.1584

Depth (ft)	A+	A-	Diff. (A)	Change	Increment	Total
20 kips						
17.333	-103	61	-164	-5	-0.003	-0.003
15.333	-102	61	-163	-1	-0.0006	-0.0036
13.333	-61	25	-86	1	0.0006	-0.003
11.333	-66	25	-91	-2	-0.0012	-0.0042
9.333	-49	4	-53	2	0.0012	-0.003
7.333	-39	-14	-25	53	0.0318	0.0288
5.333	-18	-33	15	137	0.0822	0.111
3.333	64	-97	161	239	0.1434	0.2544
1.333	78	-117	195	270	0.162	0.4164

Depth (ft)	A+	A-	Diff. (A)	Change	Increment	Total
30 kips						
17.333	-99	61	-160	-1	-0.0006	-0.0006
15.333	-102	62	-164	-2	-0.0012	-0.0018
13.333	-62	27	-89	-2	-0.0012	-0.003
11.333	-66	35	-101	-12	-0.0072	-0.0102
9.333	-47	-22	-25	30	0.018	0.0078
7.333	-17	-38	21	99	0.0594	0.0672
5.333	54	-95	149	271	0.1626	0.2298
3.333	142	-166	308	386	0.2316	0.4614
1.333	162	-202	364	439	0.2634	0.7248

TABLE D.3: Load and displacement measurements for load test I

TIMESTAMP	RECORD	LoadA	LoadB	TotalLoad	PotA	PotB	PotC	PotD
	#	lbs	lbs	lbs	in	in	in	in
11/25/2009 11:07	0	169.5143	56.37474	225.8891	20.64579	21.70527	20.49618	21.41968
11/25/2009 11:07	1	169.5143	56.37474	225.8891	20.64579	21.70345	20.49618	21.4215
11/25/2009 11:08	2	2141.198	2085.865	4227.063	20.63864	21.67985	20.48168	21.38708
11/25/2009 11:08	3	2704.536	2705.987	5410.523	20.62435	21.65807	20.45993	21.36715
11/25/2009 11:08	4	2704.433	2593.15	5297.583	20.62463	21.66018	20.46202	21.36926
11/25/2009 11:08	5	2704.433	2593.15	5297.583	20.62463	21.65836	20.46202	21.36563
11/25/2009 11:09	6	2704.433	2593.15	5297.583	20.62463	21.65836	20.46383	21.36926
11/25/2009 11:09	7	2648.101	2593.15	5241.251	20.62463	21.65836	20.46202	21.36744
11/25/2009 11:09	8	2591.769	2593.15	5184.919	20.62463	21.65836	20.4602	21.36382
11/25/2009 11:09	9	2591.69	2593.08	5184.771	20.62485	21.65859	20.46042	21.36405
11/25/2009 11:10	10	2591.69	2593.08	5184.771	20.62485	21.65678	20.46042	21.36405
11/25/2009 11:10	11	2591.69	2536.709	5128.399	20.62485	21.65859	20.46042	21.36405
11/25/2009 11:10	12	2591.69	2480.338	5072.028	20.62485	21.65859	20.46042	21.36405
11/25/2009 11:10	13	2591.627	2480.284	5071.911	20.62075	21.65442	20.45991	21.36351
11/25/2009 11:11	14	2591.627	2480.284	5071.911	20.61718	21.65079	20.45991	21.36351
11/25/2009 11:11	15	2591.627	2480.284	5071.911	20.61897	21.65079	20.4581	21.3617
11/25/2009 11:11	16	2591.627	2480.284	5071.911	20.61718	21.65079	20.4581	21.3617
11/25/2009 11:11	17	2591.576	2480.241	5071.817	20.61746	21.65108	20.45475	21.35837
11/25/2009 11:12	18	2591.576	2480.241	5071.817	20.61746	21.64927	20.45294	21.35656
11/25/2009 11:12	19	2591.576	2480.241	5071.817	20.61746	21.64382	20.45294	21.35837
11/25/2009 11:12	20	2591.576	2480.241	5071.817	20.61389	21.64382	20.45294	21.35656
11/25/2009 11:12	21	2591.536	2480.207	5071.742	20.6145	21.6444	20.45177	21.35534
11/25/2009 11:13	22	2591.536	2480.207	5071.742	20.6145	21.64259	20.45177	21.35534
11/25/2009 11:13	23	2591.536	2480.207	5071.742	20.6145	21.63533	20.45177	21.35534
11/25/2009 11:13	24	2591.536	2480.207	5071.742	20.59485	21.61354	20.45721	21.36802
11/25/2009 11:13	25	2591.536	2480.207	5071.742	20.59485	21.61354	20.45902	21.36802
11/25/2009 11:14	26	2591.544	2480.213	5071.757	20.59531	21.61403	20.45767	21.36307
11/25/2009 11:14	27	2591.544	2480.213	5071.757	20.59531	21.61221	20.45586	21.36307
11/25/2009 11:14	28	2591.544	2480.213	5071.757	20.59531	21.61221	20.45767	21.36307
11/25/2009 11:14	29	2591.544	2480.213	5071.757	20.59531	21.60858	20.45404	21.36307
11/25/2009 11:15	30	2591.609	2480.269	5071.877	20.59428	21.6075	20.45121	21.362
11/25/2009 11:15	31	2591.609	2480.269	5071.877	20.59428	21.60568	20.45121	21.362
11/25/2009 11:15	32	2591.609	2480.269	5071.877	20.59071	21.60568	20.45121	21.36019
11/25/2009 11:15	33	2591.609	2480.269	5071.877	20.59249	21.60568	20.45121	21.36019
11/25/2009 11:16	34	2591.562	2480.229	5071.79	20.58879	21.60555	20.45108	21.35644
11/25/2009 11:16	35	2591.562	2480.229	5071.79	20.59058	21.60555	20.45108	21.35644
11/25/2009 11:16	36	2591.562	2480.229	5071.79	20.59058	21.60374	20.45108	21.35462
11/25/2009 11:16	37	2535.234	2480.229	5015.462	20.58879	21.60555	20.45108	21.35644
11/25/2009 11:17	38	2535.234	2480.229	5015.462	20.58879	21.60555	20.45108	21.36006
11/25/2009 11:17	39	2535.294	2480.281	5015.574	20.58691	21.60545	20.45098	21.35633
11/25/2009 11:17	40	2591.623	2480.281	5071.903	20.58691	21.60363	20.44736	21.35452
11/25/2009 11:17	41	2591.623	2480.281	5071.903	20.58691	21.60545	20.44736	21.35452
11/25/2009 11:18	42	2591.623	2480.281	5071.903	20.58691	21.60182	20.44555	21.35452
11/25/2009 11:18	43	4281.573	4171.451	8453.023	20.58038	21.59158	20.41535	21.30807
11/25/2009 11:18	44	5295.514	5186.128	10481.64	20.54107	21.54801	20.38634	21.27547

TIMESTAMP	RECORD	LoadA	LoadB	TotalLoad	PotA	PotB	PotC	PotD
	#	lbs	lbs	lbs	in	in	in	in
11/25/2009 11:18	45	5182.854	5073.386	10256.24	20.5375	21.54801	20.38634	21.27547
11/25/2009 11:19	46	5070.193	4960.644	10030.84	20.5375	21.54801	20.38634	21.27547
11/25/2009 11:19	47	5070.083	4960.543	10030.63	20.53729	21.54598	20.38614	21.27164
11/25/2009 11:19	48	5070.083	4960.543	10030.63	20.53729	21.54598	20.38433	21.26982
11/25/2009 11:19	49	5070.083	4960.543	10030.63	20.53729	21.5478	20.38614	21.27526
11/25/2009 11:20	50	5070.083	4960.543	10030.63	20.53729	21.5478	20.38614	21.26982
11/25/2009 11:20	51	5013.667	4904.093	9917.76	20.53783	21.54654	20.38667	21.27219
11/25/2009 11:20	52	4957.34	4847.724	9805.064	20.53783	21.54836	20.38667	21.274
11/25/2009 11:20	53	4957.34	4847.724	9805.064	20.53783	21.5411	20.38486	21.27219
11/25/2009 11:21	54	4957.34	4847.724	9805.064	20.53783	21.5411	20.38486	21.27038
11/25/2009 11:21	55	4957.34	4847.724	9805.064	20.53783	21.53928	20.38486	21.26857
11/25/2009 11:21	56	4957.449	4847.825	9805.274	20.53111	21.53428	20.38528	21.27082
11/25/2009 11:21	57	4957.449	4847.825	9805.274	20.53469	21.53428	20.3871	21.27626
11/25/2009 11:22	58	4957.449	4847.825	9805.274	20.53469	21.53428	20.3871	21.27626
11/25/2009 11:22	59	4957.449	4847.825	9805.274	20.53826	21.53973	20.39072	21.27807
11/25/2009 11:22	60	4957.537	4847.906	9805.443	20.5379	21.53573	20.39037	21.27589
11/25/2009 11:22	61	4957.537	4847.906	9805.443	20.5379	21.53754	20.39218	21.27589
11/25/2009 11:23	62	4957.537	4847.906	9805.443	20.5379	21.53573	20.38675	21.27589
11/25/2009 11:23	63	4957.537	4847.906	9805.443	20.5379	21.53573	20.38675	21.27589
11/25/2009 11:23	64	4957.429	4847.807	9805.235	20.53692	21.53833	20.38577	21.27487
11/25/2009 11:23	65	4957.429	4847.807	9805.235	20.53514	21.5347	20.38577	21.27487
11/25/2009 11:24	66	4957.429	4847.807	9805.235	20.53514	21.53833	20.38758	21.27487
11/25/2009 11:24	67	4901.1	4847.807	9748.906	20.53514	21.53288	20.39302	21.2803
11/25/2009 11:24	68	4901.191	4847.891	9749.082	20.53326	21.53461	20.39112	21.28021
11/25/2009 11:24	69	4901.191	4847.891	9749.082	20.53683	21.53279	20.39293	21.28021
11/25/2009 11:25	70	4844.861	4847.891	9692.752	20.53148	21.53279	20.38931	21.2784
11/25/2009 11:25	71	4844.861	4847.891	9692.752	20.53505	21.53279	20.39293	21.27116
11/25/2009 11:25	72	4844.861	4847.891	9692.752	20.53505	21.53279	20.39293	21.27297
11/25/2009 11:25	73	4844.758	4791.424	9636.182	20.53389	21.53345	20.39174	21.27181
11/25/2009 11:26	74	4844.758	4847.794	9692.552	20.53032	21.53164	20.38631	21.26818
11/25/2009 11:26	75	4844.758	4791.424	9636.182	20.53032	21.52982	20.38631	21.26818
11/25/2009 11:26	76	4844.758	4791.424	9636.182	20.52853	21.52982	20.38631	21.26818
11/25/2009 11:26	77	4844.675	4734.979	9579.654	20.53012	21.53143	20.38611	21.26798
11/25/2009 11:27	78	4844.675	4734.979	9579.654	20.53012	21.53325	20.38611	21.26798
11/25/2009 11:27	79	4844.675	4734.979	9579.654	20.53369	21.53325	20.38792	21.2716
11/25/2009 11:27	80	4844.675	4734.979	9579.654	20.53191	21.53325	20.38611	21.26798
11/25/2009 11:27	81	4844.855	4735.144	9580	20.53066	21.53381	20.38665	21.26855
11/25/2009 11:28	82	4844.855	4735.144	9580	20.53066	21.53018	20.38665	21.26855
11/25/2009 11:28	83	4844.855	4735.144	9580	20.53066	21.53018	20.38665	21.26855
11/25/2009 11:28	84	4844.855	4735.144	9580	20.52887	21.53018	20.38484	21.26673
11/25/2009 11:28	85	6647.369	6538.97	13186.34	20.50608	21.49614	20.34357	21.2219
11/25/2009 11:29	86	7548.642	7440.896	14989.54	20.45962	21.43623	20.29825	21.16756
11/25/2009 11:29	87	7435.982	7328.156	14764.14	20.45962	21.43623	20.29825	21.16756
11/25/2009 11:29	88	7435.982	7328.156	14764.14	20.45783	21.4326	20.30006	21.16756
11/25/2009 11:29	89	7435.982	7328.156	14764.14	20.45962	21.43442	20.30006	21.16937
11/25/2009 11:30	90	7323.182	7271.651	14594.83	20.45996	21.43296	20.30041	21.17154
11/25/2009 11:30	91	7323.182	7215.281	14538.46	20.45818	21.43296	20.29859	21.16791

TIMESTAMP	RECORD	LoadA	LoadB	TotalLoad	PotA	PotB	PotC	PotD
	#	lbs	lbs	lbs	in	in	in	in
11/25/2009 11:30	92	7323.182	7215.281	14538.46	20.45639	21.43478	20.29859	21.16791
11/25/2009 11:30	93	7323.182	7215.281	14538.46	20.45996	21.43296	20.29678	21.16791
11/25/2009 11:31	94	7323.327	7215.419	14538.75	20.45845	21.43325	20.29343	21.1682
11/25/2009 11:31	95	7323.327	7215.419	14538.75	20.45309	21.43325	20.29343	21.16639
11/25/2009 11:31	96	7266.998	7215.419	14482.42	20.45309	21.43325	20.29343	21.16639
11/25/2009 11:31	97	7266.998	7215.419	14482.42	20.45309	21.42962	20.29343	21.16276
11/25/2009 11:32	98	7210.783	7215.528	14426.31	20.45331	21.43167	20.29365	21.16118
11/25/2009 11:32	99	7210.783	7215.528	14426.31	20.45331	21.42622	20.29365	21.16299
11/25/2009 11:32	100	7210.783	7159.157	14369.94	20.45331	21.42804	20.29183	21.16118
11/25/2009 11:32	101	7210.783	7159.157	14369.94	20.45331	21.42985	20.29546	21.16118
11/25/2009 11:33	102	7210.783	7102.786	14313.57	20.45331	21.42804	20.29365	21.16299
11/25/2009 11:33	103	7210.875	7102.872	14313.75	20.45349	21.43004	20.29382	21.16317
11/25/2009 11:33	104	7210.875	7102.872	14313.75	20.45349	21.42822	20.29382	21.16498
11/25/2009 11:33	105	7210.875	7102.872	14313.75	20.45349	21.43004	20.29382	21.16317
11/25/2009 11:34	106	7210.875	7102.872	14313.75	20.45349	21.43185	20.29382	21.16317
11/25/2009 11:34	107	7211.052	7103.039	14314.09	20.45363	21.43382	20.29396	21.16513
11/25/2009 11:34	108	7211.052	7103.039	14314.09	20.45363	21.43018	20.29396	21.16513
11/25/2009 11:34	109	7211.052	7103.039	14314.09	20.45363	21.43382	20.29396	21.16694
11/25/2009 11:35	110	7211.052	7103.039	14314.09	20.45363	21.43018	20.29214	21.16332
11/25/2009 11:35	111	7211.09	7103.075	14314.16	20.45374	21.42849	20.29226	21.16162
11/25/2009 11:35	112	7211.09	7103.075	14314.16	20.45374	21.42849	20.29045	21.16162
11/25/2009 11:35	113	7211.09	7103.075	14314.16	20.45195	21.42849	20.28863	21.16162
11/25/2009 11:36	114	7211.09	7103.075	14314.16	20.44123	21.41941	20.29226	21.16343
11/25/2009 11:36	115	7210.865	7102.863	14313.73	20.44311	21.4195	20.29235	21.16172
11/25/2009 11:36	116	7210.865	7102.863	14313.73	20.43954	21.4195	20.29416	21.16172
11/25/2009 11:36	117	7210.865	7102.863	14313.73	20.43954	21.4195	20.29235	21.16172
11/25/2009 11:37	118	7210.865	7102.863	14313.73	20.44132	21.4195	20.29235	21.16172
11/25/2009 11:37	119	7210.865	7102.863	14313.73	20.44132	21.4195	20.29235	21.16172
11/25/2009 11:37	120	7210.941	7102.935	14313.88	20.43961	21.41958	20.29423	21.16179
11/25/2009 11:37	121	7210.941	7102.935	14313.88	20.44139	21.41958	20.29423	21.16179
11/25/2009 11:38	122	7154.609	7102.935	14257.54	20.44139	21.41595	20.29605	21.16904
11/25/2009 11:38	123	7154.609	7102.935	14257.54	20.43961	21.41232	20.29423	21.16722
11/25/2009 11:38	124	7154.669	7102.991	14257.66	20.43966	21.41238	20.2961	21.16729
11/25/2009 11:38	125	7154.669	7102.991	14257.66	20.43966	21.41238	20.29429	21.16729
11/25/2009 11:39	126	7098.337	7102.991	14201.33	20.43966	21.41238	20.29429	21.16366
11/25/2009 11:39	127	10027.6	9921.638	19949.24	20.36282	21.31797	20.21452	21.06765
11/25/2009 11:39	128	10027.81	9921.837	19949.65	20.34321	21.29442	20.19281	21.05321
11/25/2009 11:39	129	9915.144	9809.089	19724.23	20.345	21.29442	20.19644	21.0514
11/25/2009 11:40	130	9858.811	9809.089	19667.9	20.345	21.29078	20.19281	21.04596
11/25/2009 11:40	131	9802.477	9696.34	19498.82	20.34321	21.28897	20.18556	21.03872
11/25/2009 11:40	132	9802.502	9696.364	19498.87	20.34325	21.28901	20.18559	21.03875
11/25/2009 11:40	133	9802.502	9696.364	19498.87	20.33967	21.28901	20.18559	21.03875
11/25/2009 11:41	134	9689.836	9639.989	19329.82	20.33967	21.28901	20.18378	21.03875
11/25/2009 11:41	135	9689.836	9639.989	19329.82	20.33967	21.28901	20.18378	21.03875
11/25/2009 11:41	136	9689.836	9583.615	19273.45	20.3361	21.28175	20.18741	21.03875
11/25/2009 11:41	137	9689.854	9583.634	19273.49	20.3397	21.28904	20.19287	21.04603
11/25/2009 11:42	138	9689.854	9583.634	19273.49	20.3397	21.28904	20.19106	21.03878

TIMESTAMP	RECORD	LoadA	LoadB	TotalLoad	PotA	PotB	PotC	PotD
	#	lbs	lbs	lbs	in	in	in	in
11/25/2009 11:42	139	9689.854	9583.634	19273.49	20.33792	21.28177	20.18562	21.03697
11/25/2009 11:42	140	9689.854	9583.634	19273.49	20.33434	21.28177	20.18562	21.03516
11/25/2009 11:42	141	9689.869	9583.648	19273.52	20.33437	21.2818	20.18565	21.03156
11/25/2009 11:43	142	9633.536	9583.648	19217.18	20.33437	21.2818	20.18565	21.03156
11/25/2009 11:43	143	9633.536	9583.648	19217.18	20.33615	21.2818	20.18565	21.037
11/25/2009 11:43	144	9577.203	9583.648	19160.85	20.33437	21.2818	20.18565	21.03881
11/25/2009 11:43	145	9577.215	9583.66	19160.88	20.33975	21.28908	20.19292	21.04426
11/25/2009 11:44	146	9577.215	9527.285	19104.5	20.34689	21.29271	20.19835	21.04789
11/25/2009 11:44	147	9577.215	9470.911	19048.13	20.34689	21.29453	20.19654	21.04789
11/25/2009 11:44	148	9577.215	9470.911	19048.13	20.34689	21.29271	20.19473	21.04789
11/25/2009 11:44	149	9577.224	9470.921	19048.14	20.34155	21.2891	20.19474	21.04609
11/25/2009 11:45	150	9577.224	9470.921	19048.14	20.33976	21.2891	20.19293	21.04428
11/25/2009 11:45	151	9577.224	9470.921	19048.14	20.33976	21.2891	20.19112	21.04247
11/25/2009 11:45	152	9577.224	9470.921	19048.14	20.33797	21.28728	20.19112	21.03884
11/25/2009 11:45	153	9577.224	9470.921	19048.14	20.33976	21.2891	20.19112	21.03884
11/25/2009 11:46	154	9577.367	9471.058	19048.43	20.33978	21.2873	20.18569	21.03886
11/25/2009 11:46	155	9521.033	9471.058	18992.09	20.33978	21.28366	20.18569	21.03886
11/25/2009 11:46	156	9464.698	9471.058	18935.76	20.33799	21.28366	20.18569	21.03705
11/25/2009 11:46	157	9464.698	9471.058	18935.76	20.3362	21.28185	20.18569	21.03705
11/25/2009 11:47	158	9464.347	9470.717	18935.06	20.33264	21.28005	20.18389	21.03162
11/25/2009 11:47	159	9464.347	9470.717	18935.06	20.33264	21.28186	20.18026	21.03343
11/25/2009 11:47	160	9464.347	9470.717	18935.06	20.33264	21.28005	20.18208	21.03343
11/25/2009 11:47	161	9464.347	9470.717	18935.06	20.33264	21.27641	20.18026	21.03162
11/25/2009 11:48	162	9464.53	9470.895	18935.43	20.33264	21.28005	20.18027	21.03163
11/25/2009 11:48	163	9464.53	9470.895	18935.43	20.33979	21.28913	20.18571	21.03888
11/25/2009 11:48	164	9464.53	9470.895	18935.43	20.34336	21.28913	20.19296	21.04612
11/25/2009 11:48	165	9464.53	9414.52	18879.05	20.34336	21.29276	20.19296	21.04612
11/25/2009 11:49	166	9464.53	9358.146	18822.68	20.33979	21.28913	20.18752	21.03888
11/25/2009 11:49	167	9464.543	9358.158	18822.7	20.33732	21.28478	20.18503	21.03817
11/25/2009 11:49	168	9464.543	9358.158	18822.7	20.33553	21.28297	20.18503	21.03817
11/25/2009 11:49	169	11267.22	11162.14	22429.36	20.31945	21.25937	20.14152	20.99107
11/25/2009 11:50	170	12731.89	12571.5	25303.39	20.23189	21.15225	20.06175	20.9005
11/25/2009 11:50	171	12394.07	12289.81	24683.88	20.22488	21.15059	20.06189	20.89702
11/25/2009 11:50	172	12337.74	12233.43	24571.17	20.22488	21.14332	20.06008	20.8934
11/25/2009 11:50	173	12281.41	12177.06	24458.46	20.22488	21.13969	20.06189	20.89521
11/25/2009 11:51	174	12281.41	12177.06	24458.46	20.22488	21.13969	20.06189	20.89702
11/25/2009 11:51	175	12168.71	12120.66	24289.38	20.22321	21.13799	20.06019	20.89351
11/25/2009 11:51	176	12168.71	12064.29	24233	20.21428	21.12892	20.06201	20.89351
11/25/2009 11:51	177	12168.71	12064.29	24233	20.21785	21.12892	20.06382	20.89895
11/25/2009 11:52	178	12168.71	12064.29	24233	20.22321	21.13618	20.06926	20.90438
11/25/2009 11:52	179	12168.69	12064.27	24232.96	20.2233	21.13628	20.06754	20.90086
11/25/2009 11:52	180	12056.03	12064.27	24120.29	20.21973	21.13083	20.06391	20.90086
11/25/2009 11:52	181	12056.03	12064.27	24120.29	20.21794	21.13264	20.06391	20.90086
11/25/2009 11:53	182	12056.03	12007.89	24063.92	20.21973	21.13083	20.06028	20.89904
11/25/2009 11:53	183	12056.03	11951.52	24007.54	20.21616	21.12901	20.06028	20.89723
11/25/2009 11:53	184	12056.18	11951.67	24007.85	20.21265	21.12909	20.05673	20.89369
11/25/2009 11:53	185	12056.18	11951.67	24007.85	20.21265	21.12909	20.05492	20.89369

TIMESTAMP	RECORD	LoadA	LoadB	TotalLoad	PotA	PotB	PotC	PotD
	#	lbs	lbs	lbs	in	in	in	in
11/25/2009 11:54	186	12056.18	11951.67	24007.85	20.21265	21.12909	20.05492	20.89369
11/25/2009 11:54	187	12056.18	11951.67	24007.85	20.21087	21.12909	20.05673	20.89369
11/25/2009 11:54	188	12056.3	11951.79	24008.09	20.2145	21.12915	20.05679	20.89375
11/25/2009 11:54	189	11999.97	11951.79	23951.75	20.21093	21.12552	20.05679	20.89375
11/25/2009 11:55	190	11943.63	11951.79	23895.42	20.21093	21.12734	20.05498	20.89375
11/25/2009 11:55	191	11943.63	11951.79	23895.42	20.21093	21.12552	20.05498	20.89193
11/25/2009 11:55	192	11943.56	11895.34	23838.91	20.21276	21.1292	20.05502	20.8938
11/25/2009 11:55	193	11943.56	11895.34	23838.91	20.21276	21.1292	20.05502	20.8938
11/25/2009 11:56	194	11943.56	11895.34	23838.91	20.21276	21.1292	20.05502	20.8938
11/25/2009 11:56	195	11943.56	11895.34	23838.91	20.21633	21.1292	20.05865	20.8938
11/25/2009 11:56	196	11943.51	11838.91	23782.42	20.21101	21.12742	20.05506	20.89384
11/25/2009 11:56	197	11943.51	11838.91	23782.42	20.2128	21.12742	20.05506	20.89384
11/25/2009 11:57	198	11943.51	11838.91	23782.42	20.21101	21.12742	20.05506	20.89384
11/25/2009 11:57	199	11943.51	11838.91	23782.42	20.21101	21.12561	20.05506	20.89384
11/25/2009 11:57	200	11943.51	11838.91	23782.42	20.21101	21.12379	20.05506	20.89202
11/25/2009 11:57	201	11943.46	11838.87	23782.33	20.21104	21.12382	20.04965	20.88843
11/25/2009 11:58	202	11943.46	11838.87	23782.33	20.20925	21.12382	20.05146	20.88843
11/25/2009 11:58	203	11943.46	11838.87	23782.33	20.21104	21.12201	20.05146	20.88662
11/25/2009 11:58	204	11943.46	11838.87	23782.33	20.21104	21.12564	20.05509	20.89386
11/25/2009 11:58	205	11943.43	11838.83	23782.26	20.21106	21.12748	20.0533	20.89389
11/25/2009 11:59	206	11943.43	11838.83	23782.26	20.21106	21.12567	20.0533	20.89208
11/25/2009 11:59	207	11943.43	11838.83	23782.26	20.21821	21.12385	20.05511	20.89389
11/25/2009 11:59	208	11943.43	11838.83	23782.26	20.21821	21.12385	20.05511	20.89389
11/25/2009 11:59	209	11943.4	11838.81	23782.21	20.21287	21.12205	20.05513	20.89391
11/25/2009 12:00	210	11887.06	11838.81	23725.87	20.21108	21.12205	20.05513	20.8921
11/25/2009 12:00	211	11830.73	11838.81	23669.54	20.21108	21.11842	20.04969	20.88847
11/25/2009 12:00	212	15154.46	14995.82	30150.28	20.10565	20.99133	19.9391	20.75623
11/25/2009 12:00	213	15098.09	14995.79	30093.89	20.08243	20.9623	19.91736	20.73632
11/25/2009 12:01	214	15154.43	14995.79	30150.22	20.07528	20.95504	19.91011	20.72907
11/25/2009 12:01	215	15041.76	14939.42	29981.18	20.07528	20.95685	19.91011	20.72726
11/25/2009 12:01	216	14985.42	14883.04	29868.47	20.06813	20.94777	19.91011	20.72726
11/25/2009 12:01	217	14872.76	14826.67	29699.43	20.06635	20.94777	19.91011	20.72726
11/25/2009 12:02	218	14872.94	14770.47	29643.42	20.06815	20.94961	19.91193	20.72909
11/25/2009 12:02	219	14872.94	14770.47	29643.42	20.06815	20.94779	19.91012	20.72909
11/25/2009 12:02	220	14816.61	14714.1	29530.7	20.05921	20.93327	19.91556	20.73271
11/25/2009 12:02	221	14760.27	14657.72	29417.99	20.05921	20.93508	19.91737	20.73452
11/25/2009 12:03	222	14760.21	14657.66	29417.88	20.06101	20.93509	19.91738	20.73272
11/25/2009 12:03	223	14760.21	14657.66	29417.88	20.06101	20.93328	19.91557	20.73272
11/25/2009 12:03	224	14760.21	14657.66	29417.88	20.05744	20.93328	19.91376	20.7291
11/25/2009 12:03	225	14703.88	14657.66	29361.54	20.05744	20.93328	19.91194	20.72729
11/25/2009 12:04	226	14647.7	14657.82	29305.52	20.06102	20.93328	19.91376	20.73454
11/25/2009 12:04	227	14647.7	14601.44	29249.14	20.06102	20.93873	19.91739	20.73454
11/25/2009 12:04	228	14647.7	14601.44	29249.14	20.06102	20.94055	19.91739	20.73454
11/25/2009 12:04	229	14647.7	14545.07	29192.77	20.06638	20.94055	19.92102	20.73998
11/25/2009 12:05	230	14647.7	14545.07	29192.77	20.06817	20.94055	19.92102	20.74179
11/25/2009 12:05	231	14647.62	14544.99	29192.61	20.06817	20.94055	19.9174	20.73455
11/25/2009 12:05	232	14647.62	14544.99	29192.61	20.06817	20.94055	19.91558	20.73455

TIMESTAMP	RECORD #	LoadA lbs	LoadB lbs	TotalLoad lbs	PotA in	PotB in	PotC in	PotD in
11/25/2009 12:05	233	14647.62	14544.99	29192.61	20.06639	20.94237	19.9174	20.73455
11/25/2009 12:06	234	14647.62	14544.99	29192.61	20.0646	20.94055	19.9174	20.73093
11/25/2009 12:06	235	14535.09	14545.13	29080.22	20.06281	20.93874	19.91015	20.73093
11/25/2009 12:06	236	14535.09	14545.13	29080.22	20.06103	20.93693	19.91196	20.72912
11/25/2009 12:06	237	14535.09	14545.13	29080.22	20.06103	20.93511	19.91015	20.72731
11/25/2009 12:07	238	14535.09	14545.13	29080.22	20.06103	20.93329	19.91015	20.72731
11/25/2009 12:07	239	14535.21	14488.86	29024.07	20.05924	20.9333	19.91015	20.7255
11/25/2009 12:07	240	14535.21	14432.48	28967.69	20.05567	20.9333	19.91015	20.7255
11/25/2009 12:07	241	14535.21	14432.48	28967.69	20.05746	20.93148	19.91015	20.72188
11/25/2009 12:08	242	14535.21	14432.48	28967.69	20.05924	20.9333	19.91015	20.72731
11/25/2009 12:08	243	14535.09	14432.38	28967.47	20.06104	20.93693	19.91015	20.72731
11/25/2009 12:08	244	14535.09	14432.38	28967.47	20.0664	20.94056	19.91741	20.73094
11/25/2009 12:08	245	14535.09	14432.38	28967.47	20.06282	20.94056	19.91559	20.73275
11/25/2009 12:09	246	14535.09	14432.38	28967.47	20.06818	20.94056	19.91559	20.73275
11/25/2009 12:09	247	14535.09	14432.38	28967.47	20.0664	20.94056	19.91559	20.73094
11/25/2009 12:09	248	14535.21	14432.48	28967.69	20.06283	20.94057	19.9156	20.73094
11/25/2009 12:09	249	14535.21	14432.48	28967.69	20.06283	20.93875	19.91378	20.72913
11/25/2009 12:10	250	14535.21	14432.48	28967.69	20.0664	20.94057	19.9156	20.73275
11/25/2009 12:10	251	14478.87	14432.48	28911.36	20.06283	20.94057	19.91197	20.73094
11/25/2009 12:10	252	14478.96	14432.57	28911.53	20.06819	20.94057	19.91741	20.73457
11/25/2009 12:10	253	14478.96	14432.57	28911.53	20.06819	20.94057	19.9156	20.73457
11/25/2009 12:11	254	14478.96	14432.57	28911.53	20.06819	20.94057	19.91741	20.73457
11/25/2009 12:11	255	14478.96	14432.57	28911.53	20.0664	20.94057	19.91741	20.73457
11/25/2009 12:11	256	16506.92	16349.25	32856.17	20.03245	20.90426	19.8739	20.6766
11/25/2009 12:11	257	17464.63	17251.28	34715.91	19.96812	20.82801	19.82495	20.62407
11/25/2009 12:12	258	17577.3	17364.04	34941.34	19.93953	20.79533	19.80138	20.58965
11/25/2009 12:12	259	17351.96	17138.53	34490.48	19.93953	20.79533	19.79776	20.58602
11/25/2009 12:12	260	17239.16	17082.03	34321.19	19.93953	20.79351	19.79413	20.58602
11/25/2009 12:12	261	17126.49	17025.65	34152.14	19.93953	20.78806	19.79413	20.5824
11/25/2009 12:13	262	17126.49	17025.65	34152.14	19.93595	20.78806	19.79413	20.58059
11/25/2009 12:13	263	17013.82	16912.9	33926.72	19.93416	20.78806	19.79413	20.5824
11/25/2009 12:13	264	17013.82	16912.9	33926.72	19.92523	20.77899	19.79232	20.57878
11/25/2009 12:13	265	17013.72	16912.81	33926.53	19.9288	20.7808	19.79413	20.5824
11/25/2009 12:14	266	16901.05	16912.81	33813.86	19.9288	20.7808	19.79413	20.58421
11/25/2009 12:14	267	16901.05	16800.05	33701.11	19.92702	20.7808	19.79413	20.5824
11/25/2009 12:14	268	16901.05	16800.05	33701.11	19.92523	20.7808	19.78688	20.58059
11/25/2009 12:14	269	16901.21	16800.21	33701.42	19.92523	20.77899	19.78688	20.57516
11/25/2009 12:15	270	16901.21	16800.21	33701.42	19.92344	20.77354	19.78507	20.57334
11/25/2009 12:15	271	16901.21	16800.21	33701.42	19.92523	20.77899	19.78688	20.57516
11/25/2009 12:15	272	16844.87	16800.21	33645.08	19.92523	20.77717	19.78507	20.57516
11/25/2009 12:15	273	16788.43	16800.1	33588.53	19.92523	20.77536	19.78507	20.57516
11/25/2009 12:16	274	16788.43	16743.72	33532.15	19.92523	20.77536	19.78507	20.57334
11/25/2009 12:16	275	16788.43	16687.35	33475.77	19.92523	20.7808	19.78688	20.57697
11/25/2009 12:16	276	16788.43	16687.35	33475.77	19.92523	20.7808	19.78688	20.57516
11/25/2009 12:16	277	16788.34	16687.26	33475.6	19.92702	20.7808	19.78688	20.57516
11/25/2009 12:17	278	16788.34	16687.26	33475.6	19.92344	20.77354	19.78688	20.57516
11/25/2009 12:17	279	16788.34	16687.26	33475.6	19.92344	20.77172	19.78688	20.57697

TIMESTAMP	RECORD #	LoadA lbs	LoadB lbs	TotalLoad lbs	PotA in	PotB in	PotC in	PotD in
11/25/2009 12:17	280	16788.34	16687.26	33475.6	19.91987	20.77172	19.78688	20.57516
11/25/2009 12:17	281	16788.34	16687.26	33475.6	19.91808	20.76991	19.78507	20.57334
11/25/2009 12:18	282	16732.17	16687.42	33419.59	19.91808	20.76628	19.78507	20.57516
11/25/2009 12:18	283	16732.17	16687.42	33419.59	19.91272	20.75902	19.7615	20.56066
11/25/2009 12:18	284	16675.83	16687.42	33363.26	19.91093	20.75902	19.75787	20.56066
11/25/2009 12:18	285	16675.83	16687.42	33363.26	19.91093	20.75902	19.75968	20.56066
11/25/2009 12:19	286	16675.73	16687.32	33363.05	19.91093	20.75357	19.75787	20.56066
11/25/2009 12:19	287	16675.73	16630.95	33306.68	19.91093	20.75175	19.75968	20.56247
11/25/2009 12:19	288	16675.73	16630.95	33306.68	19.91093	20.75357	19.7615	20.56429
11/25/2009 12:19	289	16675.73	16574.57	33250.3	19.91093	20.75357	19.75968	20.56066
11/25/2009 12:20	290	16675.65	16574.49	33250.14	19.91093	20.75175	19.75787	20.56066
11/25/2009 12:20	291	16675.65	16574.49	33250.14	19.91093	20.75175	19.75787	20.56066
11/25/2009 12:20	292	16675.65	16574.49	33250.14	19.90915	20.75175	19.75787	20.56066
11/25/2009 12:20	293	16675.65	16574.49	33250.14	19.90915	20.75175	19.75787	20.56066
11/25/2009 12:21	294	16675.65	16574.49	33250.14	19.91093	20.74994	19.75787	20.56066
11/25/2009 12:21	295	16675.58	16574.43	33250.01	19.90915	20.75175	19.75787	20.56066
11/25/2009 12:21	296	16675.58	16574.43	33250.01	19.90557	20.74994	19.75606	20.55885
11/25/2009 12:21	297	16675.58	16574.43	33250.01	19.91093	20.75175	19.75787	20.55885
11/25/2009 12:22	298	16675.58	16574.43	33250.01	19.91093	20.75175	19.75606	20.55885
11/25/2009 12:22	299	16675.53	16574.38	33249.91	19.90557	20.74994	19.75606	20.55885
11/25/2009 12:22	300	16675.53	16574.38	33249.91	19.90557	20.74631	19.75243	20.55523
11/25/2009 12:22	301	16675.53	16574.38	33249.91	19.90736	20.74994	19.75425	20.55704
11/25/2009 12:23	302	16675.53	16574.38	33249.91	19.90736	20.74994	19.75425	20.56066
11/25/2009 12:23	303	16675.72	16574.56	33250.29	19.90557	20.74812	19.75062	20.55704
11/25/2009 12:23	304	16675.72	16574.56	33250.29	19.90379	20.74631	19.75062	20.55704
11/25/2009 12:23	305	16675.72	16574.56	33250.29	19.90379	20.74449	19.75062	20.55342
11/25/2009 12:24	306	16675.72	16574.56	33250.29	19.90379	20.74449	19.74881	20.55342
11/25/2009 12:24	307	1803.235	1860.401	3663.637	20.31123	21.26919	20.19117	21.09325
11/25/2009 12:24	308	113.189	56.3758	169.5648	20.43274	21.41625	20.34346	21.26715
11/25/2009 12:24	309	56.85416	56.3758	113.2299	20.45419	21.43985	20.34346	21.26896

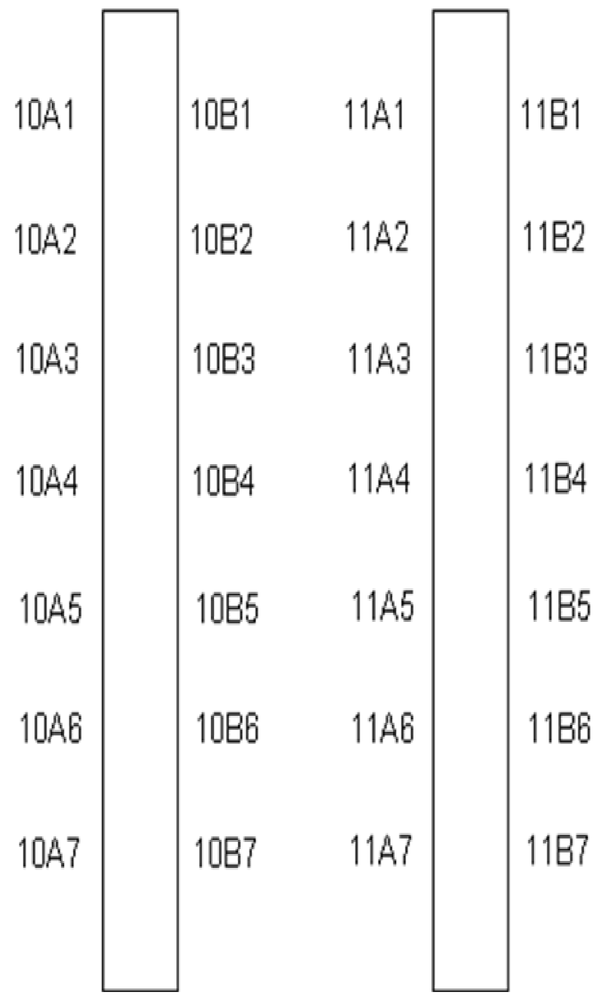

Figure D.1: General Positions of strain gages in piles 10 and 11

TABLE D.4 Strain gage measurements for pile 10

TIMESTAMP TS	10A1 Comp. Strain	10B1 Tensile Strain	Moment (k*ft)	10A2 Comp. Strain	10B2 Tensile Strain	Moment (k*ft)	10A3 Comp. Strain	10B3 Tensile Strain	Moment (k*ft)	10A4 Comp. Strain	10B4 Tensile Strain	Moment (k*ft)	10A5 Comp. Strain	10B5 Tensile Strain	Moment (k*ft)	10A6 Comp. Strain	10B6 Tensile Strain	Moment (k*ft)	10A7 Comp. Strain	10B7 Tensile Strain	Moment (k*ft)
11/25/2009 10:50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11/25/2009 10:51	-0.10743	-0.04615	0.00423	-0.11611	-0.04694	0.004775	-0.06671	-0.11157	-0.0031	-0.05352	-0.04926	0.000294	-0.03718	-0.0634	-0.00181	-0.09027	-0.08049	0.000675	-0.08738	-0.0612	0.001807
11/25/2009 10:52	-0.11299	-0.07568	0.002575	-0.12901	-0.06499	0.004419	-0.09025	-0.17119	-0.00559	-0.0669	-0.05684	0.000695	-0.0587	-0.07529	-0.00115	-0.10793	-0.09774	0.000704	-0.10226	-0.07233	0.002066
11/25/2009 10:53	-0.11299	-0.0886	0.001683	-0.1327	-0.06861	0.004424	-0.10203	-0.20582	-0.00716	-0.07072	-0.06063	0.000697	-0.06653	-0.07925	-0.00088	-0.11971	-0.10157	0.001252	-0.11155	-0.07418	0.00258
11/25/2009 10:54	-0.11114	-0.09783	0.000918	-0.13454	-0.07402	0.004177	-0.10988	-0.23082	-0.00835	-0.07263	-0.06063	0.000829	-0.07435	-0.08321	-0.00061	-0.12167	-0.1054	0.001123	-0.11341	-0.07603	0.00258
11/25/2009 10:55	-0.19819	-0.12737	0.004889	-0.24327	-0.14985	0.006449	-0.21975	-0.42701	-0.01431	-0.09748	-0.09852	-7.2E-05	-0.09392	-0.10303	-0.00063	-0.13737	-0.11882	0.001281	-0.11899	-0.08345	0.002453
11/25/2009 10:56	-0.25561	-0.10891	0.010127	-0.25986	-0.13721	0.008466	-0.23152	-0.45009	-0.01509	-0.09939	-0.1061	-0.00046	-0.08805	-0.09312	-0.00035	-0.16092	-0.14565	0.001054	-0.11899	-0.0816	0.002581
11/25/2009 10:57	-0.23338	-0.05907	0.012033	-0.26723	-0.13902	0.008851	-0.22956	-0.45971	-0.01589	-0.09366	-0.10231	-0.0006	-0.08805	-0.08321	0.000334	-0.15503	-0.14756	0.000516	-0.10783	-0.07418	0.002323
11/25/2009 10:58	-0.22227	-0.12921	0.006424	-0.25802	-0.13902	0.008214	-0.24525	-0.46933	-0.01547	-0.10513	-0.1042	6.39E-05	-0.09588	-0.08718	0.000601	-0.17073	-0.15906	0.000806	-0.11899	-0.07974	0.002709
11/25/2009 10:59	-0.12966	-0.10891	0.001432	-0.16771	-0.07041	0.006717	-0.16089	-0.29814	-0.00947	-0.08028	-0.06442	0.001095	-0.08609	-0.08321	0.000199	-0.16877	-0.15715	0.000802	-0.11527	-0.07974	0.002452
11/25/2009 11:00	-0.12225	-0.11076	0.000794	-0.16034	-0.0668	0.006457	-0.16481	-0.30391	-0.0096	-0.08028	-0.06442	0.001095	-0.09001	-0.07727	0.000879	-0.16484	-0.15523	0.000664	-0.11341	-0.07789	0.002452
11/25/2009 11:01	-6.20123	5.579676	0.813233	-7.04986	5.227914	0.847517	-2.01664	1.644908	0.252751	0.005734	-0.1042	-0.00759	-0.09196	-0.07727	0.001014	-0.19232	-0.17823	0.000973	-0.13944	-0.09458	0.003097
11/25/2009 11:02	-0.53899	0.371049	0.062819	-1.18308	0.465824	0.113821	-0.86128	-0.32123	0.037279	-0.09748	-0.15725	-0.00413	-0.10957	-0.0951	0.000999	-0.18839	-0.16864	0.001363	-0.12643	-0.08345	0.002966
11/25/2009 11:03	-0.74272	0.26767	0.069746	-1.39497	0.462213	0.128198	-0.83382	-0.4174	0.028745	-0.08601	-0.15725	-0.00492	-0.10957	-0.09906	0.000726	-0.18643	-0.17823	0.000566	-0.12271	-0.08902	0.002326
11/25/2009 11:04	-0.72605	0.245617	0.067066	-1.35812	0.426101	0.123162	-0.86521	-0.47125	0.027194	-0.10513	-0.16294	-0.00399	-0.1174	-0.10105	0.001129	-0.18839	-0.17631	0.000834	-0.12457	-0.08531	0.00271
11/25/2009 11:05	-0.71123	0.236287	0.065406	-1.33969	0.408045	0.120644	-0.86521	-0.48664	0.026132	-0.09939	-0.16483	-0.00452	-0.11544	-0.10105	0.000994	-0.18447	-0.17439	0.000696	-0.12643	-0.08716	0.00271
11/25/2009 11:06	-0.61863	0.204904	0.056847	-1.21993	0.426101	0.113623	-0.81028	-0.32892	0.033227	-0.08793	-0.12315	-0.00243	-0.10762	-0.08718	0.001411	-0.17466	-0.15906	0.001076	-0.11527	-0.07789	0.00258
11/25/2009 11:07	-0.61678	0.212288	0.057229	-1.20887	0.435129	0.113483	-0.78085	-0.33084	0.031063	-0.08219	-0.12125	-0.0027	-0.1037	-0.08321	0.001414	-0.17269	-0.16098	0.000809	-0.11713	-0.07789	0.002709
11/25/2009 11:08	-0.61307	0.217827	0.057356	-1.19966	0.433323	0.112722	-0.77693	-0.31545	0.031855	-0.08219	-0.11368	-0.00217	-0.10175	-0.07925	0.001553	-0.16877	-0.15715	0.000802	-0.11341	-0.07603	0.00258
11/25/2009 11:09	-31.7562	31.79885	4.387114	-44.1907	41.5034	5.915345	-41.7384	23.65573	4.514063	-0.18158	0.08147	0.018158	-0.08022	-0.54681	-0.03221	-0.29044	-0.29129	-5.9E-05	-0.1729	-0.11498	0.003999
11/25/2009 11:10	-30.8306	31.16894	4.279736	-43.5425	41.20098	5.849725	-42.8771	23.80259	4.602805	-0.51033	0.269045	0.053799	-0.47546	-1.0282	-0.03815	-0.69074	-0.7876	-0.00669	-0.21752	-0.16505	0.003622
11/25/2009 11:11	-30.5269	30.89396	4.239792	-43.3125	41.06618	5.824537	-43.3111	23.87022	4.637433	-0.61354	0.329676	0.065109	-0.60459	-1.07178	-0.03225	-1.09298	-1.12483	-0.0022	-0.29003	-0.19101	0.006835
11/25/2009 11:12	-30.3207	30.72303	4.213764	-43.2285	40.97145	5.8122	-43.6011	23.91466	4.660517	-0.69954	0.346729	0.072223	-0.66328	-1.14309	-0.03312	-1.24406	-1.25895	-0.00103	-0.30304	-0.20685	0.006709
11/25/2009 11:13	-30.1459	30.57441	4.191434	-43.0988	40.88037	5.798662	-43.8171	23.94365	4.677429	-0.76261	0.354308	0.077099	-0.69263	-1.18865	-0.03424	-1.33627	-1.33942	-0.00022	-0.31234	-0.20685	0.007351
11/25/2009 11:14	-30.0649	30.55026	4.184176	-43.0696	40.90041	5.796328	-43.9981	23.96104	4.691122	-0.81039	0.352414	0.080267	-0.71024	-1.22431	-0.03549	-1.39906	-1.3969	0.000149	-0.31234	-0.20956	0.007095
11/25/2009 11:15	-29.9968	30.49267	4.175499	-43.0367	40.88583	5.793053	-44.1557	23.9823	4.703469	-0.84862	0.354308	0.083036	-0.72784	-1.25006	-0.03605	-1.44614	-1.44096	0.000358	-0.31978	-0.21326	0.007352
11/25/2009 11:16	-29.9213	30.4295	4.16593	-42.9892	40.86398	5.788267	-44.2997	24.01708	4.71581	-0.88684	0.354308	0.085675	-0.73958	-1.26986	-0.0366	-1.48146	-1.47162	0.000679	-0.32163	-0.21697	0.007225
11/25/2009 11:17	-29.8569	30.38306	4.158276	-42.9509	40.85305	5.784865	-44.4184	24.04027	4.725603	-0.91742	0.359993	0.088178	-0.74741	-1.28769	-0.03729	-1.51089	-1.49844	0.000859	-0.32349	-0.21512	0.007481
11/25/2009 11:18	-29.8182	30.35705	4.153813	-42.9454	40.86398	5.785241	-44.5468	24.03641	4.734201	-0.94799	0.352414	0.089765	-0.75719	-1.30652	-0.03785	-1.53639	-1.52335	0.000901	-0.32721	-0.21883	0.007482
11/25/2009 11:19	-54.3296	59.62662	7.866233	-96.5249	307.0095	27.8554	-108.02	21.83389	8.96364	-4.74011	1.989751	0.464553	-0.16436	-2.51567	-0.16231	-1.74631	-1.85095	-0.00722	-0.36811	-0.25035	0.008129
11/25/2009 11:20	-65.1529	58.50162	8.535697	-69.5471	310.1036	26.20675	-165.16	22.85775	12.97859	-7.80994	2.33093	0.700009	-0.12131	-3.04639	-0.20191	-2.78598	-2.74745	0.00266	-0.47222	-0.31526	0.010835
11/25/2009 11:21	-64.5079	57.98218	8.455317	-68.9787	310.4462	26.19116	-166.83	23.02197	13.10523	-8.43017	2.33093	0.742823	-0.17806	-3.26817	-0.21331	-3.17826	-3.09604	0.005675	-0.51498	-0.34678	0.01161
11/25/2009 11:22	-64.1022	57.75799	8.411837	-68.6754	310.6869	26.18684	-167.681	23.17847	13.17479	-8.75838	2.35178	0.766919	-0.20154	-3.39291	-0.2203	-3.39008	-3.29906	0.006283	-0.53914	-0.35976	0.012382
11/25/2009 11:23	-63.7714	57.62534	8.379847	-68.2849	311.3241	26.20387	-167.985	23.80838	13.23925	-8.89958	2.480677	0.785563	-0.18393	-3.44043	-0.22479	-3.50971	-3.41014	0.006873	-0.54286	-0.36162	0.012511
11/25/2009 11:24	-63.5174	57.44973	8.350188	-68.0524	311.3857	26.19207	-168.371	23.96297	13.27654	-9.0446	2.503423	0.797143	-0.18197	-3.49785	-0.22889	-3.58816	-3.49058	0.006736	-0.54844	-0.36718	0.012512
11/25/2009 11:25	-63.3255	57.3227	8.328171	-67.8563	311.4415	26.18239	-168.616	24.1311	13.30506	-9.16671	2.520483	0.80675	-0.1898	-3.5434	-0.23149	-3.65484	-3.55963	0.006579	-0.55402	-0.37089	0.012641
11/25/2009 11:26	-63.1464	57.20601	8.307683	-67.6746	311.4512	26.17051	-168.886	24.23545	13.33088	-9.26783	2.533752	0.814647	-0.1898	-3.58894	-0.23464	-3.70387	-3.61123	0.006394	-0.55959	-0.3746	0.01277
11/25/2009 11:27	-62.9946	57.1116	8.290762	-67.5311	311.4723	26.16207	-169.112	24.32821	13.35288	-9.3556	2.548917	0.821752	-0.19175	-3.62656	-0.2371	-3.74309	-3.65528	0.006061	-0.55959	-0.37645	0.012642
11/25/2009 11:28	-62.916	57.02381	8.279276	-67.5438	311.5262	26.16667	-169.433	24.4345	13.38238	-9.46244	2.558395	0.829781	-0.20349	-3.66219	-0.23875	-3.78623	-3.70124	0.005867	-0.56703	-0.38202	0.012771
11/25/2009 11:29	-62.7369	56.93788	8.260979	-67.3186	311.5243	26.15098	-169.547	24.55239	13.39838	-9.50442	2.571664	0.833595	-0.19567	-3.69189	-0.24134	-3.81369	-3.73188	0.005647	-0.56703	-0.37831	0.013027
11/25/2009 11:30	-94.3388	86.59953	12.48992	-123.453	436.2695	38.63686	-252.778	88.55649	23.56185	-19.0882	12.05843	2.150005	1.976633	-5.01435	-0.48258	-3.95292	-4.00956	-0.00391	-0.60607	-0.39871	0.014314
11/25/2009 11:31	-93.2366	85.61299	12.34573	-121.901	435.2997	38.46276	-254.294	89.19225	23.71038	-20.52	12.42688	2.274274	1.980548	-5.28355	-0.50143	-4.14902	-4.22978	-0.00557	-0.63581	-0.4191	0.014959
11/25/2009 11:32	-92.7026	85.0437	12.26957	-121.156	434.8306	38.37895	-254.836	89.5757	23.77422	-21.1939	12.6206	2.334164	1.99425	-5.44784	-0.51372	-4.28041	-4.39063	-0.00761	-0.65254	-0.42467	0.01573
11/25/2009 11:33	-92.3684	84.72244	12.22433	-120.831	434.5823	38.33938	-255.168	89.80656	23.81309	-21.5974	12.77255	2.372507	2.007952	-5.55868	-0.52231	-4.38041	-4.52083	-0.00969	-0.66184	-0.43023	0.015988
11/25/2009 11:34	-92.1686	84.51392	12.19614	-120.691	434.468	38.32182	-255.45	90.0257	23.84767	-21.8714	12.89981	2.40021	2.021654	-5.63785	-0.52872	-4.46081	-4.61848	-0.01088	-0.67485	-0.43394	0.01663
11/25/2009 11:35	-91.9506	84.30165	12.16644	-120.375	434.2926	38.2879	-255.619	90.31528	23.87938	-22.0865	13.01378	2.422922	2.035356	-5.70317	-0.53418	-4.52355	-4.70273	-0.01237	-0.67857	-0.44136	0.016375
11/25/2009 11:36	-91.7998	84.13635	12.14462	-120.28	434.204	38.27521	-255.814	90.464	23.90304	-22.2654	13.09166	2.440647	2.045143	-5.75265	-0.53827	-4.57846	-4.77166	-0.01334	-0.686	-0.44877	0.016376
11/25/2009 11:37	-91.6617	84.00111	12.12576	-120.195	434.1232	38.26381	-255.985	90.61271	23.92516	-22.41	13.16384	2.455613	2.051015	-5.77046	-0.53991	-4.62944	-4.84059	-0.01458	-0.69344	-0.45063	0.016761
11/25/2009 11:38	-91.5346	83.87714	12.10842	-120.125	434.0443	38.25353	-256.134	90.72817	23.94343	-22.5375	13.22273	2.468479	2.056888	-5.81202	-0.54318	-4.67258	-4.89611	-0.01543	-0.6953	-0.45434	0.016633

TIMESTAMP TS	10A1 Comp. Strain	10B1 Tensile Strain	Moment (k*ft)	10A2 Comp. Strain	10B2 Tensile Strain	Moment (k*ft)	10A3 Comp. Strain	10B3 Tensile Strain	Moment (k*ft)	10A4 Comp. Strain	10B4 Tensile Strain	Moment (k*ft)	10A5 Comp. Strain	10B5 Tensile Strain	Moment (k*ft)	10A6 Comp. Strain	10B6 Tensile Strain	Moment (k*ft)	10A7 Comp. Strain	10B7 Tensile Strain	Moment (k*ft)
11/25/2009 11:39	-91.4437	83.78699	12.09593	-120.082	434.0128	38.24838	-256.28	90.84753	23.96172	-22.6498	13.28351	2.480425	2.058845	-5.84171	-0.54536	-4.70787	-4.94398	-0.0163	-0.69716	-0.45804	0.016506
11/25/2009 11:40	-105.322	79.88553	12.78458	-204.605	525.1143	50.37148	-338.791	163.5677	34.67707	-33.6728	29.46874	4.35857	6.082912	-6.63926	-0.87819	-4.39806	-4.8291	-0.02975	-0.65626	-0.40798	0.017139
11/25/2009 11:41	-100.037	80.27028	12.44632	-205.972	521.7396	50.23289	-346.326	162.3324	35.11193	-39.0757	30.82569	4.825191	6.239628	-7.16563	-0.92535	-4.52748	-5.07226	-0.03761	-0.69344	-0.42467	0.018553
11/25/2009 11:42	-98.1955	79.93995	12.29644	-205.001	520.8546	50.10481	-346.856	161.5611	35.09534	-40.3918	31.25648	4.94578	6.255299	-7.38526	-0.94159	-4.60003	-5.22351	-0.04304	-0.71575	-0.44321	0.018813
11/25/2009 11:43	-97.3355	79.70536	12.22088	-204.455	520.3101	50.02953	-347.166	161.6365	35.1219	-41.2545	31.52717	5.024017	6.255299	-7.53563	-0.95197	-4.65689	-5.33263	-0.04665	-0.72504	-0.44321	0.019455
11/25/2009 11:44	-96.7766	79.62842	12.17699	-204.066	519.8978	49.97419	-347.411	161.7891	35.14937	-41.8839	31.78454	5.085229	6.257258	-7.63456	-0.95893	-4.69807	-5.41878	-0.04975	-0.73062	-0.44321	0.019839
11/25/2009 11:45	-96.4173	79.53834	12.14597	-203.863	519.7077	49.94707	-347.634	161.9338	35.17477	-42.3882	31.95993	5.132142	6.257258	-7.71766	-0.96467	-4.73532	-5.4877	-0.05194	-0.73248	-0.44506	0.01984
11/25/2009 11:46	-96.1233	79.40322	12.11635	-203.673	519.5355	49.92206	-347.86	162.0845	35.20071	-42.8108	32.12389	5.172636	6.255299	-7.79878	-0.97013	-4.76277	-5.55279	-0.05453	-0.73062	-0.44877	0.019455
11/25/2009 11:47	-95.9218	79.285	12.09428	-203.671	519.4215	49.91406	-348.087	162.2193	35.22569	-43.2903	32.21541	5.212052	6.229833	-7.87989	-0.97397	-4.80395	-5.62171	-0.05645	-0.73434	-0.45063	0.019584
11/25/2009 11:48	-95.6042	79.14051	12.06238	-203.414	519.1093	49.87475	-348.262	162.2986	35.24329	-43.6295	32.33553	5.243759	6.225915	-7.93529	-0.97753	-4.8314	-5.66957	-0.05786	-0.7362	-0.45434	0.019456
11/25/2009 11:49	-95.4299	79.07108	12.04556	-203.236	518.8951	49.84768	-348.39	162.3958	35.25884	-43.9119	32.43086	5.26983	6.225915	-7.97684	-0.9804	-4.85492	-5.7136	-0.05927	-0.7362	-0.45434	0.019456
11/25/2009 11:50	-95.1976	78.93035	12.0198	-203.009	518.637	49.81417	-348.511	162.4692	35.27224	-44.162	32.5281	5.293808	6.227874	-8.02036	-0.98354	-4.87061	-5.7538	-0.06097	-0.7362	-0.45434	0.019456
11/25/2009 11:51	-117.122	189.8302	21.18847	-279.144	645.6512	63.83732	-421.84	307.4783	50.34379	-77.1996	46.43151	8.534081	11.26477	-9.75316	-1.45084	-4.00979	-5.21202	-0.08299	-0.63581	-0.34122	0.020335
11/25/2009 11:52	-114.679	189.1435	20.9724	-275.306	643.3784	63.41549	-421.867	335.7406	52.29656	-85.9349	44.99399	9.037832	10.9236	-10.4354	-1.47438	-4.04313	-5.38241	-0.09245	-0.65626	-0.34678	0.021363
11/25/2009 11:53	-113.632	188.8864	20.8824	-274.029	642.589	63.27283	-421.712	337.83	52.4301	-88.6022	44.95194	9.21905	10.81185	-10.7163	-1.48605	-4.05686	-5.4877	-0.09877	-0.66741	-0.3542	0.021621
11/25/2009 11:54	-112.981	188.6505	20.82119	-273.235	642.1043	63.18457	-421.925	338.7646	52.50928	-89.9203	45.04177	9.316237	10.74715	-10.8883	-1.49346	-4.06274	-5.56237	-0.10352	-0.67299	-0.35605	0.021878
11/25/2009 11:55	-112.473	188.4281	20.77075	-272.618	641.7158	63.11515	-422.123	339.2779	52.55839	-90.8495	45.13352	9.386712	10.69421	-11.0208	-1.49895	-4.06862	-5.62745	-0.1076	-0.68043	-0.35791	0.022263
11/25/2009 11:56	-111.856	188.0867	20.70461	-271.961	641.1678	63.03195	-422.265	339.5233	52.58516	-91.619	45.20806	9.444977	10.64716	-11.1275	-1.50308	-4.07451	-5.67914	-0.11077	-0.68043	-0.35976	0.022135
11/25/2009 11:57	-111.614	188.1174	20.69	-271.688	641.1228	63.01005	-422.393	339.8752	52.61827	-92.3227	45.30555	9.500282	10.61775	-11.2047	-1.50637	-4.07843	-5.72126	-0.1134	-0.68229	-0.35791	0.022391
11/25/2009 11:58	-111.409	188.0598	20.67192	-271.496	641.0554	62.99211	-422.467	340.1554	52.64271	-92.9025	45.36289	9.544263	10.59422	-11.2719	-1.50939	-4.08431	-5.7672	-0.11617	-0.686	-0.35791	0.022648
11/25/2009 11:59	-111.19	187.9563	20.64966	-271.31	640.9306	62.97069	-422.603	340.4091	52.66967	-93.4391	45.43553	9.586316	10.57069	-11.3253	-1.51145	-4.08823	-5.79974	-0.11814	-0.68229	-0.35976	0.022263
11/25/2009 12:00	-111.024	187.893	20.6338	-271.114	640.8468	62.95137	-422.706	340.6689	52.69469	-93.9512	45.51581	9.627209	10.56481	-11.3688	-1.51404	-4.08039	-5.82272	-0.12027	-0.67857	-0.3542	0.022391
11/25/2009 12:01	-129.629	240.4713	25.5475	-313.429	749.7349	73.38869	-448.342	428.3592	60.51746	-101.301	44.40725	10.05802	14.41081	-12.8554	-1.88215	-2.74675	-4.38105	-0.11281	-0.52427	-0.16319	0.024925
11/25/2009 12:02	-147.507	241.163	26.82935	-365.578	771.6809	78.50338	-494.203	448.4036	65.06678	-157.5	46.49269	14.0813	14.09691	-15.1735	-2.0205	-1.43437	-4.4385	-0.20737	-0.49825	-0.13167	0.025304
11/25/2009 12:03	-145.723	239.7624	26.6095	-363.566	771.5325	78.35422	-496.251	449.3326	65.27228	-162.956	46.45445	14.45531	13.70063	-15.9006	-2.04333	-1.33824	-4.61274	-0.22603	-0.52427	-0.14465	0.026205
11/25/2009 12:04	-144.929	239.0884	26.50819	-362.155	771.6287	78.26344	-497.053	449.8806	65.36549	-165.664	46.69726	14.65903	13.57509	-16.2858	-2.06125	-1.25976	-4.70656	-0.23793	-0.52427	-0.13909	0.026589
11/25/2009 12:05	-144.326	238.5868	26.43192	-361.228	771.52	78.19199	-497.616	450.2723	65.4314	-167.034	46.92096	14.76899	13.4417	-16.5446	-2.06991	-1.21071	-4.76975	-0.24568	-0.52613	-0.13167	0.027229
11/25/2009 12:06	-143.656	238.1162	26.35319	-360.296	771.5785	78.13171	-497.87	450.7307	65.48052	-167.836	47.2747	14.84876	13.38481	-16.6947	-2.07634	-1.14596	-4.8157	-0.25332	-0.52799	-0.13352	0.027229
11/25/2009 12:07	-143.268	237.7716	26.30261	-359.687	771.4928	78.08373	-498.155	450.8911	65.51127	-168.508	47.45445	14.90758	13.31027	-16.8527	-2.08211	-1.11064	-4.85591	-0.25853	-0.52613	-0.12425	0.027741
11/25/2009 12:08	-142.903	237.4172	26.25298	-359.203	771.3298	78.03908	-498.394	450.962	65.53266	-169.049	47.60169	14.9551	13.23966	-16.9849	-2.08705	-1.07532	-4.89994	-0.26401	-0.52613	-0.12796	0.027485
11/25/2009 12:09	-142.691	237.3185	26.23153	-358.994	771.4364	78.03203	-498.654	451.0912	65.55954	-169.54	47.66097	14.9931	13.15139	-17.1332	-2.0905	-1.06551	-4.94589	-0.26786	-0.53357	-0.12981	0.02787
11/25/2009 12:10	-142.504	237.1946	26.21008	-358.723	771.4907	78.01702	-498.87	451.3871	65.59487	-169.939	47.75085	15.02684	13.10431	-17.2181	-2.09311	-1.03804	-4.97653	-0.27187	-0.53357	-0.12981	0.02787
11/25/2009 12:11	-142.271	237.0029	26.18073	-358.421	771.4803	77.99544	-499.064	451.5705	65.62097	-170.357	47.88281	15.06475	13.06508	-17.2991	-2.09599	-1.00469	-5.00333	-0.27602	-0.53357	-0.12796	0.027998
11/25/2009 12:12	-146.057	264.7719	28.35893	-367.836	814.7085	81.62933	-502.166	486.7977	68.26677	-169.88	54.36412	15.47926	13.8713	-15.8611	-2.05238	-0.52003	-3.94254	-0.23625	-0.45735	0.012982	0.032466
11/25/2009 12:13	-178.095	280.6573	31.66699	-442.952	926.6756	94.54341	-574.297	559.8438	78.28814	-209.869	64.07346	18.90985	17.62542	-18.168	-2.47077	3.879215	-2.667	-0.45188	-0.28073	0.168764	0.031028
11/25/2009 12:14	-174.904	277.9037	31.2567	-439.042	925.041	94.16071	-577.102	562.2109	78.64513	-215.898	65.03081	19.39211	17.15037	-18.8769	-2.48691	4.311283	-2.73595	-0.48646	-0.29003	0.176182	0.032182
11/25/2009 12:15	-173.561	276.6337	31.0763	-437.711	924.3449	94.02077	-578.308	563.2144	78.79766	-218.757	65.49516	19.62151	16.90108	-19.2797	-2.49751	4.509653	-2.7915	-0.50399	-0.29189	0.18731	0.033078
11/25/2009 12:16	-172.74	275.6878	30.95434	-437.301	926.2621	94.12484	-579.125	563.3884	78.86604	-220.107	65.80027	19.73578	16.72247	-19.5561	-2.50426	4.639285	-2.83747	-0.51611	-0.29189	0.191019	0.033334
11/25/2009 12:17	-172.146	275.0228	30.86741	-436.632	926.2299	94.07643	-579.75	563.6622	78.9281	-220.989	66.0555	19.81431	16.59489	-19.7535	-2.50908	4.741421	-2.88344	-0.52633	-0.29189	0.194728	0.03359
11/25/2009 12:18	-171.623	274.549	30.7986	-436.133	925.9257	94.02095	-580.212	563.8468	78.97274	-221.647	66.27812	19.87506	16.48497	-19.9055	-2.51198	4.821953	-2.91026	-0.53374	-0.29189	0.200292	0.033975
11/25/2009 12:19	-171.309	274.1278	30.74784	-435.712	925.84	93.98596	-580.608	564.008	79.0112	-222.241	66.46045	19.92862	16.39469	-20.0397	-2.51502	4.894629	-2.94473	-0.54114	-0.28817	0.198437	0.03359
11/25/2009 12:20	-170.898	273.7788	30.69541	-435.154	925.6301	93.93296	-580.948	564.163	79.04539	-222.765	66.61783	19.97565	16.31226	-20.1483	-2.51682	4.949628	-2.96772	-0.54652	-0.28817	0.200292	0.033718
11/25/2009 12:21	-170.698	273.6112	30.67003	-434.879	925.5744	93.91015	-581.249	564.3327	79.07785	-223.225	66.75218	20.01669	16.24357	-20.2411	-2.51848	5.002663	-2.99262	-0.5519	-0.29003	0.205856	0.03423
11/25/2009 12:22	-170.477	273.4942	30.64667	-434.622	925.5316	93.88948	-581.53	564.5068	79.10928	-223.645	66.8827	20.05468	16.18665	-20.322	-2.52014	5.045878	-3.01368	-0.55634	-0.28817	0.205856	0.034102
11/25/2009 12:23	-170.307	273.5605	30.63954	-434.474	925.6023	93.88413	-581.78	564.7041	79.14016	-224.044	67.00938	20.09102	16.13759	-20.3931	-2.52166	5.091056	-3.03092	-0.56065	-0.28631	0.215129	0.034614
11/25/2009 12:24	-170.294	273.7282	30.65025	-434.557	925.8615	93.90777	-582.06	564.9843	79.17879	-224.389	67.13798	20.12371	16.09638	-20.4464	-2.52249	5.126414	-3.04433	-0.56401	-0.28259	0.213274	0.034229

TABLE D.5 Strain gage measurements for pile 11

TIMESTAMP TS	11A1 Comp. Strain	11B1 Tensile Strain	Moment (k*ft)	11A2 Comp. Strain	11B2 Tensile Strain	Moment (k*ft)	11A3 Comp. Strain	11B3 Tensile Strain	Moment (k*ft)	11A4 Comp. Strain	11B4 Tensile Strain	Moment (k*ft)	11A5 Comp. Strain	11B5 Tensile Strain	Moment (k*ft)	11A6 Comp. Strain	11B6 Tensile Strain	Moment (k*ft)	11A7 Comp. Strain	11B7 Tensile Strain	Moment (k*ft)
11/25/2009 10:50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11/25/2009 10:51	-0.09504	-0.03109	0.004415	-0.11996	-0.06521	0.003779	-0.09899	-0.06945	0.002039	-0.07205	-0.08743	-0.00106	-0.07396	-0.08011	-0.00042	-0.05041	-0.05008	2.29E-05	-0.0767	-0.06456	0.000838
11/25/2009 10:52	-0.0931	-0.03886	0.003744	-0.14705	-0.09688	0.003463	-0.12649	-0.0901	0.002512	-0.091	-0.1079	-0.00117	-0.08913	-0.09875	-0.00066	-0.06592	-0.05393	0.000828	-0.09396	-0.08165	0.00085
11/25/2009 10:53	-0.10086	-0.06217	0.002671	-0.15285	-0.11551	0.002578	-0.13383	-0.09948	0.002371	-0.10048	-0.12092	-0.00141	-0.09671	-0.1062	-0.00065	-0.06786	-0.06356	0.000297	-0.0978	-0.09114	0.000459
11/25/2009 10:54	-0.12026	-0.01943	0.00696	-0.17607	-0.08384	0.006366	-0.14666	-0.07133	0.0052	-0.10996	-0.09859	0.000785	-0.10051	-0.09688	0.00025	-0.07174	-0.06356	0.000564	-0.10163	-0.09494	0.000462
11/25/2009 10:55	-0.13189	0.025257	0.010848	-0.09094	-0.00745	0.005763	-0.0385	-0.02816	0.000714	-0.07773	-0.09487	-0.00118	-0.09103	-0.09502	-0.00028	-0.06786	-0.06356	0.000297	-0.10547	-0.09874	0.000465
11/25/2009 10:56	-0.13577	0.031085	0.011518	-0.09287	-0.00373	0.006154	-0.03483	-0.02816	0.000461	-0.07963	-0.09487	-0.00105	-0.09103	-0.09688	-0.0004	-0.07174	-0.06356	0.000564	-0.10739	-0.10064	0.000466
11/25/2009 10:57	-0.12414	0.038857	0.011251	-0.0832	0.003726	0.006	-0.02933	-0.02628	0.000211	-0.07394	-0.08557	-0.0008	-0.08154	-0.09875	-0.00119	-0.0601	-0.06163	-0.00011	-0.09972	-0.09494	0.00033
11/25/2009 10:58	-0.13965	0.038857	0.012322	-0.09674	-0.00559	0.006292	-0.04216	-0.03566	0.000449	-0.08532	-0.09859	-0.00092	-0.09103	-0.11179	-0.00143	-0.0698	-0.07126	-0.0001	-0.10739	-0.10443	0.000204
11/25/2009 10:59	-0.14547	0.046628	0.01326	-0.14898	-0.03167	0.008098	-0.10633	-0.07508	0.002157	-0.08721	-0.10045	-0.00091	-0.09482	-0.11365	-0.0013	-0.06786	-0.07126	-0.00024	-0.1093	-0.10443	0.000336
11/25/2009 11:00	-0.14741	0.050514	0.013662	-0.13544	-0.01863	0.008063	-0.09533	-0.06194	0.002305	-0.11186	-0.1172	-0.00037	-0.10051	-0.12483	-0.00168	-0.07174	-0.07512	-0.00023	-0.1093	-0.10633	0.000205
11/25/2009 11:01	-7.77414	0.814108	0.592834	-8.47355	1.833609	0.711488	-2.40646	0.688922	0.21367	-0.05119	-0.07441	-0.0016	-0.07775	-0.11551	-0.00261	-0.06786	-0.07319	-0.00037	-0.11122	-0.10633	0.000337
11/25/2009 11:02	-1.64456	0.928754	0.177632	-2.01378	1.882067	0.268925	-0.66176	0.626972	0.088959	-0.08911	-0.10045	-0.00078	-0.09292	-0.12669	-0.00233	-0.06786	-0.07512	-0.0005	-0.11122	-0.10254	0.0006
11/25/2009 11:03	-1.6019	0.911266	0.17348	-1.97317	1.846655	0.263677	-0.65076	0.604445	0.086645	-0.08911	-0.10232	-0.00091	-0.09103	-0.12669	-0.00246	-0.0698	-0.07512	-0.00037	-0.11122	-0.10443	0.000469
11/25/2009 11:04	-1.57281	0.90155	0.170802	-1.95189	1.820562	0.260407	-0.6416	0.596935	0.085494	-0.091	-0.10232	-0.00078	-0.09103	-0.13228	-0.00285	-0.06786	-0.07704	-0.00063	-0.11122	-0.10443	0.000469
11/25/2009 11:05	-1.52046	0.884062	0.165981	-1.92288	1.781423	0.255703	-0.6416	0.598813	0.085624	-0.08911	-0.08929	-1.3E-05	-0.09103	-0.12855	-0.00259	-0.06592	-0.07512	-0.00063	-0.11122	-0.10254	0.0006
11/25/2009 11:06	-1.33818	0.781075	0.146289	-1.83004	1.63978	0.239517	-0.64893	0.555636	0.083149	-0.10048	-0.09859	0.00013	-0.09103	-0.13042	-0.00272	-0.06786	-0.07512	-0.0005	-0.11314	-0.10443	0.000601
11/25/2009 11:07	-1.34206	0.783018	0.146691	-1.743	1.634189	0.233123	-0.6031	0.563145	0.080504	-0.08911	-0.09487	-0.0004	-0.08913	-0.13042	-0.00285	-0.06592	-0.07704	-0.00077	-0.1093	-0.10633	0.000205
11/25/2009 11:08	-1.33818	0.781075	0.146289	-1.74107	1.626734	0.232475	-0.6031	0.561267	0.080375	-0.091	-0.09301	-0.00014	-0.08534	-0.13601	-0.0035	-0.06592	-0.07704	-0.00077	-0.10739	-0.10064	0.000466
11/25/2009 11:09	-43.6165	30.45779	5.11324	-53.3882	58.09741	7.695692	-21.7635	29.58278	3.544364	-0.07205	0.723708	0.05493	0.125163	-0.13042	-0.01764	-0.04459	-0.06163	-0.00118	-0.10163	-0.09684	0.000331
11/25/2009 11:10	-43.1606	29.95368	5.046972	-53.0224	57.83163	7.652096	-22.0135	29.7395	3.572438	-0.12703	0.723708	0.058725	0.125163	-0.13973	-0.01829	-0.04653	-0.06163	-0.00104	-0.10163	-0.09494	0.000462
11/25/2009 11:11	-42.9297	29.67624	5.011887	-52.9343	57.70345	7.637167	-22.2507	29.84712	3.596241	-0.17822	0.714406	0.061616	0.12137	-0.1565	-0.01918	-0.04459	-0.06741	-0.00158	-0.09972	-0.09494	0.00033
11/25/2009 11:12	-42.7758	29.48868	4.988316	-52.8136	57.58094	7.620381	-22.3383	29.89622	3.605675	-0.20097	0.716266	0.063315	0.123266	-0.16023	-0.01957	-0.04265	-0.06356	-0.00144	-0.09972	-0.09494	0.00033
11/25/2009 11:13	-42.5988	29.32849	4.965041	-52.7121	57.46973	7.605697	-22.4295	29.91888	3.613537	-0.22561	0.703242	0.064118	0.117577	-0.17141	-0.01995	-0.04653	-0.06741	-0.00144	-0.0978	-0.09684	6.62E-05
11/25/2009 11:14	-42.5892	29.307	4.962893	-52.7102	57.49235	7.607126	-22.4879	30.01518	3.624214	-0.22751	0.725569	0.06579	0.123266	-0.17141	-0.02034	-0.04653	-0.06356	-0.00118	-0.0978	-0.09304	0.000328
11/25/2009 11:15	-42.5354	29.24057	4.95459	-52.6892	57.45466	7.60307	-22.5518	30.05672	3.63149	-0.24268	0.725569	0.066837	0.119474	-0.17699	-0.02046	-0.04459	-0.06163	-0.00118	-0.09972	-0.09304	0.000461
11/25/2009 11:16	-42.4603	29.16243	4.944016	-52.6317	57.40377	7.595591	-22.5919	30.08504	3.636216	-0.24836	0.733011	0.067743	0.127059	-0.17513	-0.02086	-0.04459	-0.06741	-0.00158	-0.09588	-0.09114	0.000327
11/25/2009 11:17	-42.4161	29.12531	4.9384	-52.6068	57.37926	7.592181	-22.6321	30.11337	3.640942	-0.25405	0.733011	0.068135	0.123266	-0.17886	-0.02086	-0.04265	-0.06356	-0.00144	-0.09396	-0.08735	0.000457
11/25/2009 11:18	-42.393	29.07648	4.933435	-52.6068	57.36984	7.59153	-22.6758	30.15491	3.646832	-0.25974	0.742314	0.06917	0.127059	-0.18072	-0.02125	-0.03878	-0.06163	-0.00158	-0.08821	-0.09114	-0.0002
11/25/2009 11:19	-88.1208	61.46198	10.32548	-118.38	119.8739	16.44631	-61.6877	75.08484	9.441214	-1.72691	4.085061	0.401192	0.834477	-0.26828	-0.07612	0.025204	-0.03467	-0.00413	-0.07479	-0.07595	-8E-05
11/25/2009 11:20	-87.3465	60.14339	10.18102	-117.521	119.042	16.32964	-63.0245	75.61446	9.570047	-2.26704	4.321523	0.454799	0.853444	-0.33535	-0.08206	0.019388	-0.03852	-0.004	-0.07479	-0.07595	-8E-05
11/25/2009 11:21	-86.9594	59.42233	10.10452	-117.092	118.4716	16.26063	-63.3844	75.74401	9.603833	-2.49255	4.407173	0.476278	0.862927	-0.38379	-0.08606	0.019388	-0.04045	-0.00413	-0.07095	-0.07405	-0.00021
11/25/2009 11:22	-86.6828	59.04121	10.05912	-116.816	118.1206	16.21734	-63.5797	75.81832	9.622445	-2.67447	4.463033	0.492691	0.851547	-0.41732	-0.08759	0.017449	-0.04237	-0.00413	-0.07287	-0.07215	4.93E-05
11/25/2009 11:23	-86.5359	58.77405	10.03054	-116.674	117.9318	16.19452	-63.605	75.89834	9.629716	-2.81279	4.505859	0.505196	0.847754	-0.449	-0.08951	0.017449	-0.04623	-0.0044	-0.07287	-0.07215	4.93E-05
11/25/2009 11:24	-86.4959	58.58744	10.0149	-116.75	117.9375	16.20013	-63.9667	75.94597	9.657969	-2.96628	4.498411	0.515277	0.82689	-0.49371	-0.09116	0.007755	-0.05008	-0.00399	-0.07287	-0.07405	-8.2E-05
11/25/2009 11:25	-86.4692	58.38709	9.999222	-116.79	117.9013	16.20037	-64.1728	76.0622	9.680221	-3.05533	4.539376	0.524252	0.824993	-0.51234	-0.09231	0.009694	-0.052	-0.00426	-0.07095	-0.07405	-0.00021
11/25/2009 11:26	-86.4272	58.34977	9.993749	-116.678	117.8956	16.19228	-64.2361	76.20129	9.694191	-3.08375	4.604547	0.530713	0.840167	-0.50861	-0.0931	0.011633	-0.05393	-0.00453	-0.06903	-0.07215	-0.00022
11/25/2009 11:27	-86.3872	58.23191	9.982849	-116.714	117.9032	16.19528	-64.435	76.2737	9.712918	-3.15576	4.61572	0.536454	0.83258	-0.53097	-0.09412	0.013572	-0.05586	-0.00479	-0.0652	-0.07215	-0.00048
11/25/2009 11:28	-86.309	58.16317	9.972705	-116.534	117.8403	16.17854	-64.397	76.42804	9.720951	-3.13302	4.701375	0.540797	0.857237	-0.5142	-0.09467	0.019388	-0.052	-0.00493	-0.0652	-0.06456	4.42E-05
11/25/2009 11:29	-90.073	86.89234	12.21566	-128.737	238.8333	25.37288	-72.8727	140.115	14.70224	-2.90754	13.185	1.110845	1.1721	-0.09688	-0.0876	0.071736	0.065486	-0.00043	-0.04602	-0.03228	0.000949
11/25/2009 11:30	-155.315	77.97252	16.10351	-173.972	248.1335	29.13737	-132.413	142.7891	18.99684	-8.27276	14.72974	1.58783	2.917472	-0.32045	-0.22351	0.28695	0.050078	-0.01635	-0.01534	-0.03228	-0.00117
11/25/2009 11:31	-154.946	76.41735	15.97071	-172.865	247.5489	29.02061	-133.277	143.1327	19.08018	-8.7592	15.02083	1.641501	2.953524	-0.40428	-0.23178	0.292767	0.040447	-0.01742	-0.01534	-0.02848	-0.00091
11/25/2009 11:32	-154.719	75.48327	15.89051	-172.144	247.0407	28.9357	-133.797	143.4125	19.13539	-9.02983	15.22423	1.674224	2.980089	-0.44341	-0.23632	0.298584	0.034669	-0.01822	-0.01534	-0.03038	-0.00104
11/25/2009 11:33	-154.619	75.00842	15.85085	-171.788	246.8413	28.8974	-134.226	143.675	19.18313	-9.22855	15.36793	1.697859	2.997166	-0.48439	-0.24033	0.304401	0.036595	-0.01849	-0.01534	-0.02658	-0.00078
11/25/2009 11:34	-154.532	74.59467	15.81632	-171.5	246.6654	28.86538	-134.595	143.8777	19.22256	-9.3894	15.47803	1.716563	3.006654	-0.52165	-0.24355	0.304401	0.030817	-0.01889	-0.00767	-0.02658	-0.00131
11/25/2009 11:35	-154.45	74.25385	15.78707	-171.296	246.5384	28.84253	-134.823	144.0302	19.24881	-9.51808	15.56388	1.731372	3.016142	-0.55146	-0.24627	0.304401	0.026965	-0.01915	-0.01151	-0.02468	-0.00091
11/25/2009 11:36	-154.378	73.97806	15.7631	-171.132	246.4328	28.82388	-135.008	144.1518	19.26999	-9.62973	15.63293	1.743845	3.018039	-0.58313	-0.24858	0.30634	0.025039	-0.01942	-0.00959	-0.02279	-0.00091
11/25/2009 11:37	-154.327	73.75152	15.74396	-171.01	246.3585	28.81036	-135.168	144.2638	19.28877	-9.72435	15.69825	1.754885	3.019937	-0.60362	-0.25013	0.310217	0.025039	-0.01969	-0.00575	-0.02279	-0.00118
11/25/2009 11:38	-154.278	73.5447	15.7263	-170.902	246.2823	28.79761	-135.309	144.3583	19.30501	-9.80382	15.74864	1.76385	3.019937	-0.6297	-0.25193	0.310217	0.025039	-0.01969	-0.00575	-0.02089	-0.00104

TIMESTAMP TS	11A1 Comp. Strain	11B1 Tensile Strain	Moment (k*ft)	11A2 Comp. Strain	11B2 Tensile Strain	Moment (k*ft)	11A3 Comp. Strain	11B3 Tensile Strain	Moment (k*ft)	11A4 Comp. Strain	11B4 Tensile Strain	Moment (k*ft)	11A5 Comp. Strain	11B5 Tensile Strain	Moment (k*ft)	11A6 Comp. Strain	11B6 Tensile Strain	Moment (k*ft)	11A7 Comp. Strain	11B7 Tensile Strain	Moment (k*ft)
11/25/2009 11:39	-154.243	73.35757	15.71092	-170.819	246.21	28.78694	-135.439	144.4452	19.31998	-9.87194	15.7953	1.771773	3.027527	-0.64833	-0.25374	0.314095	0.019261	-0.02035	-0.00384	-0.01899	-0.00105
11/25/2009 11:40	-219.368	92.95771	21.55938	-234.878	386.312	42.87984	-196.823	359.6074	38.40957	-18.8651	24.65905	3.00441	4.877934	-1.2351	-0.42197	0.628209	0.050078	-0.03991	0.034518	0.003798	-0.00212
11/25/2009 11:41	-217.967	90.38256	21.28496	-232.389	384.0333	42.55072	-201.834	362.9085	38.98338	-21.0934	26.11577	3.258781	4.988031	-1.69144	-0.46107	0.649538	0	-0.04484	0.0326	0.003798	-0.00199
11/25/2009 11:42	-217.442	89.04705	21.15648	-231.543	383.0796	42.42649	-203.287	364.1981	39.17271	-22.0467	26.59832	3.357898	4.951964	-1.94846	-0.47633	0.64566	-0.03852	-0.04723	0.026847	0	-0.00185
11/25/2009 11:43	-217.085	88.08315	21.06532	-231.036	382.5027	42.35172	-203.885	365.1424	39.27914	-22.7904	26.8976	3.42989	4.879832	-2.18125	-0.48742	0.637904	-0.08282	-0.04975	0.019176	0	-0.00132
11/25/2009 11:44	-216.894	87.44723	21.00822	-230.646	382.082	42.29577	-204.181	365.8297	39.34702	-23.6207	27.14078	3.503996	4.710896	-2.54625	-0.50095	0.603002	-0.14638	-0.05173	0.009588	-0.0076	-0.00119
11/25/2009 11:45	-216.66	86.94566	20.95744	-230.325	381.7115	42.248	-204.169	366.2637	39.37614	-24.6868	27.30166	3.588687	4.447061	-3.03598	-0.51654	0.535136	-0.24075	-0.05356	-0.00767	-0.01519	-0.00052
11/25/2009 11:46	-216.45	86.47769	20.91064	-229.88	381.369	42.19361	-203.937	366.6295	39.38542	-25.6432	27.48312	3.667233	4.168057	-3.45491	-0.5262	0.459516	-0.33127	-0.05459	-0.02493	-0.02468	1.69E-05
11/25/2009 11:47	-216.132	85.95449	20.85259	-229.464	380.8162	42.12675	-204.064	366.8808	39.41147	-26.1449	27.65149	3.713488	4.052285	-3.67088	-0.53312	0.428493	-0.38134	-0.0559	-0.03452	-0.02468	0.000679
11/25/2009 11:48	-215.866	85.55176	20.80645	-229.096	380.3597	42.06885	-204.221	367.0818	39.43623	-26.5919	27.8311	3.75674	3.953595	-3.84029	-0.538	0.401347	-0.43142	-0.05748	-0.04602	-0.03038	0.00108
11/25/2009 11:49	-215.74	85.29118	20.77974	-228.882	380.1374	42.03971	-204.418	367.2667	39.46254	-26.9407	28.03877	3.795158	3.866295	-4.01343	-0.54393	0.381958	-0.48727	-0.06	-0.05369	-0.03038	0.001609
11/25/2009 11:50	-215.504	117.4138	22.98082	-228.567	469.7957	48.20699	-204.808	427.7781	43.66653	-26.8955	29.03237	3.860621	4.152874	-4.89017	-0.62423	0.447882	-0.57778	-0.0708	-0.0326	-0.01139	0.001464
11/25/2009 11:51	-269.105	107.0883	25.96809	-301.202	484.1107	54.20899	-280.613	445.8975	50.14998	-38.7973	30.24143	4.765646	4.359752	-5.77793	-0.69979	0.502173	-0.94176	-0.09967	-0.06328	-0.01329	0.003451
11/25/2009 11:52	-267.517	104.9165	25.70857	-299.509	481.3977	53.90484	-281.807	446.517	50.27516	-40.099	31.05574	4.911708	4.200322	-6.15569	-0.71486	0.453899	-1.10351	-0.10749	-0.0767	-0.01899	0.003984
11/25/2009 11:53	-266.651	103.7141	25.56579	-298.713	480.224	53.76889	-282.7	447.0957	50.37673	-40.9697	31.4901	5.001794	4.143384	-6.28409	-0.71979	0.428493	-1.19594	-0.11213	-0.08438	-0.01899	0.004514
11/25/2009 11:54	-266.024	102.7773	25.45785	-298.246	479.3684	53.67764	-283.173	447.3382	50.42612	-42.032	32.52185	5.146345	4.078855	-6.61157	-0.73794	0.370324	-1.29415	-0.1149	-0.09205	-0.01899	0.005043
11/25/2009 11:55	-265.463	101.9596	25.36268	-297.826	478.5617	53.59291	-283.523	447.5297	50.46356	-42.7482	32.90389	5.222157	4.035204	-6.73437	-0.74341	0.312156	-1.36925	-0.11606	-0.10355	-0.02089	0.005706
11/25/2009 11:56	-264.777	101.2784	25.26831	-297.323	477.8468	53.50886	-283.811	447.6826	50.49393	-43.1223	33.10055	5.261552	4.014327	-6.78089	-0.74518	0.285012	-1.42316	-0.11791	-0.10739	-0.01899	0.006102
11/25/2009 11:57	-264.66	101.0013	25.24105	-297.204	477.6391	53.48634	-284.086	447.8823	50.52671	-43.3816	33.25413	5.290058	4.008633	-6.80135	-0.7462	0.271439	-1.4559	-0.11924	-0.10739	-0.02089	0.005971
11/25/2009 11:58	-264.432	100.6707	25.20249	-297.04	477.3235	53.45324	-284.349	448.1249	50.56161	-43.6015	33.37587	5.313641	3.999144	-6.8181	-0.7467	0.261745	-1.48478	-0.12056	-0.10739	-0.01899	0.006102
11/25/2009 11:59	-264.227	100.3658	25.16735	-296.878	477.0547	53.42349	-284.586	448.3267	50.59192	-43.7857	33.48264	5.333724	3.989655	-6.8367	-0.74733	0.255928	-1.50596	-0.12162	-0.10739	-0.01519	0.006364
11/25/2009 12:00	-264.066	100.0174	25.13149	-296.751	476.7309	53.39234	-284.827	448.4816	50.61923	-43.963	33.55943	5.350571	3.97637	-6.84601	-0.74705	0.246234	-1.52906	-0.12255	-0.1093	-0.01519	0.006497
11/25/2009 12:01	-315.41	137.539	31.2664	-381.332	596.8189	67.52035	-377.811	554.5173	64.35726	-53.014	45.1037	6.772925	6.227732	-7.21624	-0.92802	0.701893	-1.61379	-0.15985	-0.0652	0.028482	0.006467
11/25/2009 12:02	-312.27	134.7557	30.85754	-378.866	591.3782	66.9746	-389.556	573.0031	66.44406	-56.4456	46.26411	7.089902	6.267604	-7.47483	-0.94862	0.829872	-1.74664	-0.17785	-0.06903	0.036078	0.007256
11/25/2009 12:03	-311.074	132.8319	30.64216	-377.003	589.4191	66.71074	-390.956	574.8242	66.66641	-57.4914	46.74864	7.195543	6.242921	-7.55855	-0.9627	0.860898	-1.82173	-0.18518	-0.07287	0.039875	0.007783
11/25/2009 12:04	-310.427	131.6492	30.51589	-375.97	588.2883	66.56137	-391.791	575.8317	66.79364	-58.063	47.04351	7.255352	6.22963	-7.60877	-0.95525	0.880289	-1.87179	-0.18997	-0.0767	0.045572	0.008441
11/25/2009 12:05	-310.067	130.8331	30.43403	-375.415	587.7178	66.48367	-392.444	576.5583	66.88886	-58.5427	47.21255	7.300133	6.208745	-7.6683	-0.95791	0.886106	-1.90837	-0.1929	-0.07479	0.045572	0.008308
11/25/2009 12:06	-309.702	130.1265	30.36073	-375.06	587.2739	66.42855	-393.043	577.2204	66.97593	-58.9717	47.32525	7.33753	6.20115	-7.70737	-0.96009	0.891923	-1.9411	-0.19556	-0.07479	0.045572	0.008308
11/25/2009 12:07	-309.48	129.6389	30.31173	-374.829	586.9317	66.38897	-393.517	577.7723	67.04671	-59.3408	47.35718	7.365211	6.199251	-7.74271	-0.96239	0.89968	-1.96228	-0.19756	-0.0767	0.04937	0.008703
11/25/2009 12:08	-309.188	129.1096	30.25507	-374.516	586.5355	66.33999	-393.91	578.2242	67.10505	-59.7024	47.31962	7.387575	6.184062	-7.77806	-0.96379	0.89968	-1.98539	-0.19915	-0.07479	0.04937	0.00857
11/25/2009 12:09	-308.982	128.8509	30.22301	-374.222	586.268	66.30124	-394.063	579.1677	67.18	-59.974	44.00549	7.177555	6.216339	-8.17612	-0.99349	0.901619	-2.04892	-0.20367	-0.0767	0.053167	0.008965
11/25/2009 12:10	-308.858	128.6122	30.19797	-374.046	586.0855	66.27653	-392.096	580.0343	67.10477	-62.7137	43.5325	7.33402	5.61259	-8.32306	-0.96196	0.744552	-2.14134	-0.19921	-0.08438	0.051269	0.009363
11/25/2009 12:11	-308.674	128.2879	30.16288	-373.874	585.847	66.24819	-391.969	580.703	67.14145	-62.9402	43.53062	7.349527	5.580316	-8.34538	-0.96127	0.703832	-2.18562	-0.19945	-0.08246	0.055066	0.009493
11/25/2009 12:12	-341.654	165.8239	35.03044	-433.827	682.8794	77.08465	-448.71	665.6617	76.92348	-65.8671	52.54597	8.173888	7.232243	-8.27656	-1.07055	1.045117	-2.12786	-0.21903	-0.02685	0.104436	0.009062
11/25/2009 12:13	-349.63	162.2957	35.33752	-448.864	688.6437	78.52052	-484.521	665.6617	79.39549	-78.2163	61.68509	9.657195	9.295053	-10.0544	-1.33567	1.324366	-2.253	-0.24694	-0.01726	0.121526	0.00958
11/25/2009 12:14	-347.81	159.9361	35.04896	-445.655	685.3236	78.06984	-488.239	665.6617	79.65212	-80.2202	63.34684	9.910226	9.555338	-10.3315	-1.37276	1.36897	-2.32038	-0.25467	-0.01726	0.127223	0.009973
11/25/2009 12:15	-346.926	158.6297	34.89778	-444.388	684.2341	77.90714	-489.961	665.6617	79.771	-81.1435	64.04411	10.02209	9.547738	-10.4207	-1.37839	1.407756	-2.36081	-0.26014	-0.01151	0.134818	0.010101
11/25/2009 12:16	-346.265	157.6236	34.78267	-443.335	683.3766	77.77527	-491.05	665.6617	79.84612	-81.7719	64.44179	10.09293	9.580037	-10.482	-1.38486	1.436845	-2.39547	-0.26454	-0.01342	0.140515	0.010626
11/25/2009 12:17	-345.778	156.8716	34.69721	-442.698	682.7003	77.68464	-491.775	665.6617	79.89623	-82.2325	64.70567	10.14293	9.597137	-10.5248	-1.38899	1.458178	-2.42434	-0.268	-0.01151	0.144313	0.010756
11/25/2009 12:18	-345.323	156.2497	34.62283	-442.128	682.1484	77.60721	-492.351	665.6617	79.93597	-82.611	64.90359	10.18272	9.616136	-10.562	-1.39287	1.473693	-2.44937	-0.2708	-0.00767	0.150009	0.010884
11/25/2009 12:19	-344.931	155.6538	34.55462	-441.664	681.5881	77.53651	-492.756	665.6617	79.96389	-82.9336	65.06758	10.21631	9.635136	-10.5824	-1.39559	1.489207	-2.46862	-0.2732	-0.00575	0.151908	0.010883
11/25/2009 12:20	-344.627	155.286	34.50826	-441.315	681.2259	77.48738	-493.155	665.6617	79.99147	-83.2207	65.20331	10.2455	9.667435	-10.5992	-1.39898	1.51248	-2.48595	-0.27601	-0.00575	0.157605	0.011276
11/25/2009 12:21	-344.432	155.052	34.47864	-441.119	681.0342	77.46063	-493.484	665.6617	80.0142	-83.4593	65.32772	10.27056	9.673135	-10.6252	-1.40117	1.527994	-2.50327	-0.27827	-0.00192	0.159504	0.011143
11/25/2009 12:22	-344.238	154.8102	34.44859	-440.937	680.792	77.43137	-493.768	665.6617	80.03378	-83.6811	65.45591	10.29472	9.676935	-10.6401	-1.40245	1.535752	-2.5206	-0.28	0.001918	0.1652	0.011271
11/25/2009 12:23	-344.164	154.8102	34.44347	-440.89	680.832	77.43084	-494.022	665.6617	80.05134	-83.8657	65.56903	10.31526	9.688335	-10.6475	-1.40375	1.547388	-2.53215	-0.2816	0.003835	0.167099	0.01127
11/25/2009 12:24	-344.211	154.7742	34.44423	-440.983	680.8889	77.44122	-494.28	665.6617	80.06912	-84.039	65.6746	10.33452	9.695935	-10.6624	-1.40531	1.560964	-2.54178	-0.28321	0.005753	0.172796	0.011531

TABLE D.6: Bending moments for pile 10

Depth (ft)	Moment (k-ft)	Moment (k-ft)	Moment (k-ft)	Moment (k-ft)	Moment (k-ft)	Moment (k-ft)	Moment (k-ft)
	5 kips	10 kips	15 kips	20 kips	25 kips	30 kips	35 kips
1.7	0	0	0	0	0	0	0
2.5	4.158	8.291	12.126	12.094	20.690	26.303	30.867
5	5.785	26.162	38.264	49.914	63.010	78.084	94.076
7.5	4.726	13.353	23.925	35.226	52.618	65.511	78.928
10	0.088	0.822	2.456	5.212	9.500	14.908	19.814
12.5	-0.037	-0.237	-0.540	-0.974	-1.506	-2.082	-2.509
15	0.001	0.006	-0.015	-0.056	-0.113	-0.259	-0.526
17.5	0.007	0.013	0.017	0.020	0.022	0.028	0.034
20	0	0	0	0	0	0	0

TABLE D.7: Bending moments for pile 11

Depth (ft)	Moment (k-ft)	Moment (k-ft)	Moment (k-ft)	Moment (k-ft)	Moment (k-ft)	Moment (k-ft)	Moment (k-ft)
	5 kips	10 kips	15 kips	20 kips	25 kips	30 kips	35 kips
1.3	0	0	0	0	0	0	0
2.5	4.938	9.983	15.744	20.853	25.241	30.312	34.697
5	7.592	16.195	28.810	42.127	53.486	66.389	77.685
7.5	3.641	9.713	19.289	39.411	50.527	67.047	79.896
10	0.068	0.536	1.755	3.713	5.290	7.365	10.143
12.5	-0.021	-0.094	-0.250	-0.533	-0.746	-0.962	-1.389
15	-0.001	-0.005	-0.020	-0.056	-0.119	-0.198	-0.268
17.5	0.000	0.000	-0.001	0.001	0.006	0.009	0.011
20	0	0	0	0	0	0	0

APPENDIX E: LATERAL LOAD TEST X

TABLE E.1: Inclinometer measurements for pile 5

PROJECT:ASHE MICROPILE LATERAL LOAD TESTING
MICROPILE NO: 5
DATE: 12/10/09

	Baseline data		
Depth (ft)	A+	A-	Diff. (A)
18	-100	65	-165
16	-119	81	-200
14	-123	87	-210
12	-116	78	-194
10	-86	46	-132
8	-89	51	-140
6	-92	52	-144
4	-38	-11	-27

Depth (ft)	A+	A-	Diff. (A)	Change	Increment	Total
20 kips						
18	-103	66	-169	-4	-0.0024	-0.0024
16	-120	79	-199	1	0.0006	-0.0018
14	-124	85	-209	1	0.0006	-0.0012
12	-115	77	-192	2	0.0012	0
10	-82	44	-126	6	0.0036	0.0036
8	-73	38	-111	29	0.0174	0.021
6	-59	17	-76	68	0.0408	0.0618
4	26	-63	89	116	0.0696	0.1314

Depth (ft)	A+	A-	Diff. (A)	Change	Increment	Total
40 kips						
18	-101	67	-168	-3	-0.0018	-0.0018
16	-119	81	-200	0	0	-0.0018
14	-122	88	-210	0	0	-0.0018
12	-116	79	-195	-1	-0.0006	-0.0024
10	-79	42	-121	11	0.0066	0.0042
8	-49	7	-56	84	0.0504	0.0546
6	7	-50	57	201	0.1206	0.1752
4	88	-125	213	240	0.144	0.3192

Depth (ft)	A+	A-	Diff. (A)	Change	Increment	Total
60 kips						
18	-102	65	-167	-2	-0.0012	-0.0012
16	-119	79	-198	2	0.0012	0
14	-124	85	-209	1	0.0006	0.0006
12	-118	79	-197	-3	-0.0018	-0.0012
10	-76	38	-114	18	0.0108	0.0096
8	-22	-32	10	150	0.09	0.0996
6	58	-97	155	299	0.1794	0.279
4	149	-187	336	363	0.2178	0.4968

Depth (ft)	A+	A-	Diff. (A)	Change	Increment	Total
80 kips						
18	-101	59	-160	5	0.003	0.003
16	-118	81	-199	1	0.0006	0.0036
14	-123	88	-211	-1	-0.0006	0.003
12	-117	81	-198	-4	-0.0024	0.0006
10	-72	36	-108	24	0.0144	0.015
8	20	-59	79	219	0.1314	0.1464
6	109	-146	255	399	0.2394	0.3858
4	219	-249	468	495	0.297	0.6828

Depth (ft)	A+	A-	Diff. (A)	Change	Increment	Total
100 kips						
18	-102	65	-167	-2	-0.0012	-0.0012
16	-119	80	-199	1	0.0006	-0.0006
14	-125	87	-212	-2	-0.0012	-0.0018
12	-120	80	-200	-6	-0.0036	-0.0054
10	-68	27	-95	37	0.0222	0.0168
8	46	-87	133	273	0.1638	0.1806
6	159	-202	361	505	0.303	0.4836
4	280	-318	598	625	0.375	0.8586

Depth (ft)	A+	A-	Diff. (A)	Change	Increment	Total
Final						
18	-99	67	-166	-1	-0.0006	-0.0006
16	-117	77	-194	6	0.0036	0.003
14	-120	87	-207	3	0.0018	0.0048
12	-113	77	-190	4	0.0024	0.0072
10	-76	41	-117	15	0.009	0.0162
8	-72	35	-107	33	0.0198	0.036
6	-62	25	-87	57	0.0342	0.0702
4	19	-54	73	100	0.06	0.1302

TABLE E.2: Inclinometer measurements for pile 6

PROJECT:ASHE MICROPILE LATERAL LOAD TESTING

MICROPILE NO: 6

DATE: 12/10/09

	Baseline data		
Depth (ft)	A+	A-	Diff. (A)
18	-308	274	-582
16	-304	264	-568
14	-304	267	-571
12	-306	271	-577
10	-302	263	-565
8	-297	262	-559
6	-310	268	-578
4	-285	250	-535
2	-291	249	-540

Depth (ft)	A+	A-	Diff. (A)	Change	Increment	Total
20 kips						
18	-310	275	-585	-3	-0.0018	-0.0018
16	-305	263	-568	0	0	-0.0018
14	-308	271	-579	-8	-0.0048	-0.0066
12	-310	270	-580	-3	-0.0018	-0.0084
10	-299	260	-559	6	0.0036	-0.0048
8	-275	235	-510	49	0.0294	0.0246
6	-277	236	-513	65	0.039	0.0636
4	-240	206	-446	89	0.0534	0.117
2	-244	199	-443	97	0.0582	0.1752

Depth (ft)	A+	A-	Diff. (A)	Change	Increment	Total
40 kips						
18	-306	274	-580	2	0.0012	0.0012
16	-305	266	-571	-3	-0.0018	-0.0006
14	-305	266	-571	0	0	-0.0006
12	-309	266	-575	2	0.0012	0.0006
10	-291	258	-549	16	0.0096	0.0102
8	-245	208	-453	106	0.0636	0.0738
6	-219	178	-397	181	0.1086	0.1824
4	-171	126	-297	238	0.1428	0.3252
2	-167	128	-295	245	0.147	0.4722

Depth (ft)	A+	A-	Diff. (A)	Change	Increment	Total
60 kips						
18	-309	270	-579	3	0.0018	0.0018
16	-305	245	-550	18	0.0108	0.0126
14	-306	260	-566	5	0.003	0.0156
12	-311	272	-583	-6	-0.0036	0.012
10	-289	251	-540	25	0.015	0.027
8	-216	179	-395	164	0.0984	0.1254
6	-166	123	-289	289	0.1734	0.2988
4	-103	71	-174	361	0.2166	0.5154
2	-97	54	-151	389	0.2334	0.7488

Depth (ft)	A+	A-	Diff. (A)	Change	Increment	Total
80 kips						
18	-308	276	-584	-2	-0.0012	-0.0012
16	-304	266	-570	-2	-0.0012	-0.0024
14	-304	267	-571	0	0	-0.0024
12	-311	271	-582	-5	-0.003	-0.0054
10	-285	242	-527	38	0.0228	0.0174
8	-186	147	-333	226	0.1356	0.153
6	-106	64	-170	408	0.2448	0.3978
4	-28	-17	-11	524	0.3144	0.7122
2	-14	-44	30	570	0.342	1.0542

Depth (ft)	A+	A-	Diff. (A)	Change	Increment	Total
100 kips						
18	-307	276	-583	-1	-0.0006	-0.0006
16	-303	265	-568	0	0	-0.0006
14	-305	271	-576	-5	-0.003	-0.0036
12	-313	274	-587	-10	-0.006	-0.0096
10	-280	239	-519	46	0.0276	0.018
8	-153	114	-267	292	0.1752	0.1932
6	-42	-15	-27	551	0.3306	0.5238
4	66	-102	168	703	0.4218	0.9456
2	70	-121	191	731	0.4386	1.3842

Depth (ft)	A+	A-	Diff. (A)	Change	Increment	Total
Final						
18	-308	272	-580	2	0.0012	0.0012
16	-302	261	-563	5	0.003	0.0042
14	-302	271	-573	-2	-0.0012	0.003
12	-306	269	-575	2	0.0012	0.0042
10	-291	254	-545	20	0.012	0.0162
8	-262	222	-484	75	0.045	0.0612
6	-260	217	-477	101	0.0606	0.1218
4	-225	195	-420	115	0.069	0.1908
2	-230	188	-418	122	0.0732	0.264

TABLE E.3: Inclinometer measurements for pile 7

PROJECT:ASHE MICROPILE LATERAL LOAD TESTING

MICROPILE NO: 7

DATE: 12/10/09

	Baseline data		
Depth (ft)	A+	A-	Diff. (A)
18	-466	429	-895
16	-451	414	-865
14	-388	353	-741
12	-353	316	-669
10	-338	301	-639
8	-348	313	-661
6	-389	349	-738
4	-412	380	-792
2	-437	399	-836

Depth (ft)	A+	A-	Diff. (A)	Change	Increment	Total
20 kips						
18	-465	429	-894	1	0.0006	0.0006
16	-452	426	-878	-13	-0.0078	-0.0072
14	-389	354	-743	-2	-0.0012	-0.0084
12	-354	315	-669	0	0	-0.0084
10	-330	294	-624	15	0.009	0.0006
8	-326	290	-616	45	0.027	0.0276
6	-351	309	-660	78	0.0468	0.0744
4	-364	330	-694	98	0.0588	0.1332
2	-384	348	-732	104	0.0624	0.1956

Depth (ft)	A+	A-	Diff. (A)	Change	Increment	Total
40 kips						
18	-466	428	-894	1	0.0006	0.0006
16	-453	414	-867	-2	-0.0012	-0.0006
14	-388	356	-744	-3	-0.0018	-0.0024
12	-355	315	-670	-1	-0.0006	-0.003
10	-327	281	-608	31	0.0186	0.0156
8	-294	257	-551	110	0.066	0.0816
6	-294	251	-545	193	0.1158	0.1974
4	-296	262	-558	234	0.1404	0.3378
2	-312	256	-568	268	0.1608	0.4986

Depth (ft)	A+	A-	Diff. (A)	Change	Increment	Total
60 kips						
18	-465	429	-894	1	0.0006	0.0006
16	-452	412	-864	1	0.0006	0.0012
14	-389	355	-744	-3	-0.0018	-0.0006
12	-354	317	-671	-2	-0.0012	-0.0018
10	-314	277	-591	48	0.0288	0.027
8	-262	226	-488	173	0.1038	0.1308
6	-237	196	-433	305	0.183	0.3138
4	-229	195	-424	368	0.2208	0.5346
2	-242	196	-438	398	0.2388	0.7734

Depth (ft)	A+	A-	Diff. (A)	Change	Increment	Total
80 kips						
18	-465	429	-894	1	0.0006	0.0006
16	-452	414	-866	-1	-0.0006	0
14	-390	355	-745	-4	-0.0024	-0.0024
12	-354	316	-670	-1	-0.0006	-0.003
10	-304	268	-572	67	0.0402	0.0372
8	-228	193	-421	240	0.144	0.1812
6	-177	135	-312	426	0.2556	0.4368
4	-156	128	-284	508	0.3048	0.7416
2	-165	126	-291	545	0.327	1.0686

Depth (ft)	A+	A-	Diff. (A)	Change	Increment	Total
100 kips						
18	-464	430	-894	1	0.0006	0.0006
16	-452	414	-866	-1	-0.0006	0
14	-390	355	-745	-4	-0.0024	-0.0024
12	-354	317	-671	-2	-0.0012	-0.0036
10	-292	250	-542	97	0.0582	0.0546
8	-195	159	-354	307	0.1842	0.2388
6	-114	74	-188	550	0.33	0.5688
4	-82	49	-131	661	0.3966	0.9654
2	-87	48	-135	701	0.4206	1.386

Depth (ft)	A+	A-	Diff. (A)	Change	Increment	Total
Final						
18	-466	429	-895	0	0	0
16	-452	413	-865	0	0	0
14	-388	354	-742	-1	-0.0006	-0.0006
12	-351	324	-675	-6	-0.0036	-0.0042
10	-307	268	-575	64	0.0384	0.0342
8	-291	259	-550	111	0.0666	0.1008
6	-325	283	-608	130	0.078	0.1788
4	-350	315	-665	127	0.0762	0.255
2	-374	343	-717	119	0.0714	0.3264

TABLE E.4: Inclinometer measurements for pile 8

PROJECT:ASHE MICROPILE LATERAL LOAD TESTING

MICROPILE NO: 8

DATE: 12/10/09

	Baseline data		
Depth (ft)	A+	A-	Diff. (A)
18	-767	727	-1494
16	-736	700	-1436
14	-717	680	-1397
12	-688	648	-1336
10	-671	630	-1301
8	-673	633	-1306
6	-704	664	-1368
4	-665	629	-1294
2	-575	530	-1105

Depth (ft)	A+	A-	Diff. (A)	Change	Increment	Total
20 kips						
18	-765	728	-1493	1	0.0006	0.0006
16	-737	701	-1438	-2	-0.0012	-0.0006
14	-716	681	-1397	0	0	-0.0006
12	-688	650	-1338	-2	-0.0012	-0.0018
10	-665	623	-1288	13	0.0078	0.006
8	-651	613	-1264	42	0.0252	0.0312
6	-666	628	-1294	74	0.0444	0.0756
4	-617	583	-1200	94	0.0564	0.132
2	-517	471	-988	117	0.0702	0.2022

Depth (ft)	A+	A-	Diff. (A)	Change	Increment	Total
40 kips						
18	-766	727	-1493	1	0.0006	0.0006
16	-739	700	-1439	-3	-0.0018	-0.0012
14	-717	679	-1396	1	0.0006	-0.0006
12	-689	650	-1339	-3	-0.0018	-0.0024
10	-657	616	-1273	28	0.0168	0.0144
8	-622	582	-1204	102	0.0612	0.0756
6	-612	571	-1183	185	0.111	0.1866
4	-554	517	-1071	223	0.1338	0.3204
2	-447	406	-853	252	0.1512	0.4716

Depth (ft)	A+	A-	Diff. (A)	Change	Increment	Total
60 kips						
18	-766	726	-1492	2	0.0012	0.0012
16	-738	702	-1440	-4	-0.0024	-0.0012
14	-716	681	-1397	0	0	-0.0012
12	-687	650	-1337	-1	-0.0006	-0.0018
10	-648	608	-1256	45	0.027	0.0252
8	-589	553	-1142	164	0.0984	0.1236
6	-557	520	-1077	291	0.1746	0.2982
4	-487	454	-941	353	0.2118	0.51
2	-375	325	-700	405	0.243	0.753

Depth (ft)	A+	A-	Diff. (A)	Change	Increment	Total
80 kips						
18	-767	728	-1495	-1	-0.0006	-0.0006
16	-738	700	-1438	-2	-0.0012	-0.0018
14	-718	681	-1399	-2	-0.0012	-0.003
12	-690	649	-1339	-3	-0.0018	-0.0048
10	-640	600	-1240	61	0.0366	0.0318
8	-559	519	-1078	228	0.1368	0.1686
6	-501	460	-961	407	0.2442	0.4128
4	-431	382	-813	481	0.2886	0.7014
2	-302	258	-560	545	0.327	1.0284

Depth (ft)	A+	A-	Diff. (A)	Change	Increment	Total
100 kips						
18	-766	727	-1493	1	0.0006	0.0006
16	-738	702	-1440	-4	-0.0024	-0.0018
14	-716	682	-1398	-1	-0.0006	-0.0024
12	-689	651	-1340	-4	-0.0024	-0.0048
10	-632	590	-1222	79	0.0474	0.0426
8	-522	485	-1007	299	0.1794	0.222
6	-441	403	-844	524	0.3144	0.5364
4	-346	313	-659	635	0.381	0.9174
2	-223	183	-406	699	0.4194	1.3368

Depth (ft)	A+	A-	Diff. (A)	Change	Increment	Total
Final						
18	-767	727	-1494	0	0	0
16	-740	701	-1441	-5	-0.003	-0.003
14	-718	681	-1399	-2	-0.0012	-0.0042
12	-687	648	-1335	1	0.0006	-0.0036
10	-634	591	-1225	76	0.0456	0.042
8	-589	553	-1142	164	0.0984	0.1404
6	-621	579	-1200	168	0.1008	0.2412
4	-593	562	-1155	139	0.0834	0.3246
2	-504	524	-1028	77	0.0462	0.3708

TABLE E.5: Load and displacement measurements for load test X

TIMESTAMP	RECORD #	LoadA lbs	LoadB lbs	PotA in	PotB in	PotC in	PotD in	PotE in	PotF in
12/10/2009 14:15	367	790.2	959.2	6.1104	6.5604	13.5068	8.8263	20.3776	22.1106
12/10/2009 14:15	369	790.2	959.2	6.1104	6.5604	13.4742	8.8263	20.3702	22.1034
12/10/2009 14:16	371	902.9	902.8	6.1122	6.5586	13.4524	8.8263	20.3739	22.1106
12/10/2009 14:16	373	733.8	1015.6	6.1050	6.5568	13.4470	8.8263	20.3702	22.0962
12/10/2009 14:17	375	790.2	902.8	6.1068	6.5459	13.5177	8.8244	20.3813	22.1106
12/10/2009 14:17	377	564.6	733.5	6.1068	6.5622	13.3671	8.8263	20.3849	22.1251
12/10/2009 14:18	379	677.4	846.4	6.1068	6.5332	13.5667	8.8263	20.3813	22.1142
12/10/2009 14:18	381	564.7	733.5	6.1050	6.5568	13.3508	8.8299	20.3886	22.1142
12/10/2009 14:19	383	564.7	733.5	6.1086	6.5350	13.5957	8.8208	20.3849	22.1070
12/10/2009 14:19	385	564.6	733.5	6.1032	6.5550	13.3817	8.8208	20.3776	22.1106
12/10/2009 14:20	387	564.6	677.1	6.1086	6.5295	13.5957	8.8190	20.3849	22.1070
12/10/2009 14:20	389	451.9	620.7	6.1032	6.5422	13.3744	8.8244	20.3813	22.1179
12/10/2009 14:21	391	451.9	564.2	6.1104	6.5441	13.5975	8.8335	20.3960	22.1106
12/10/2009 14:21	393	451.9	620.7	6.1014	6.5386	13.3762	8.8208	20.3702	22.1070
12/10/2009 14:22	395	451.9	564.2	6.1140	6.5459	13.6012	8.8317	20.3886	22.1034
12/10/2009 14:22	397	564.6	620.7	6.1158	6.5223	13.3889	8.8208	20.3739	22.1106
12/10/2009 14:23	399	508.3	620.7	6.1104	6.5604	13.5939	8.8281	20.3886	22.1034
12/10/2009 14:23	401	564.6	677.1	6.1122	6.5168	13.4016	8.8299	20.3813	22.0889
12/10/2009 14:24	403	451.9	564.2	6.1193	6.5640	13.5776	8.8281	20.3776	22.1034
12/10/2009 14:24	405	508.3	564.2	6.1175	6.5313	13.4034	8.8244	20.3776	22.0926
12/10/2009 14:25	407	508.2	789.9	6.1175	6.5622	13.5812	8.8263	20.3813	22.0926
12/10/2009 14:25	409	959.3	1015.6	6.1175	6.5531	13.4234	8.8226	20.3739	22.1142
12/10/2009 14:26	411	902.9	959.2	6.1122	6.5568	13.5740	8.8263	20.3739	22.0889
12/10/2009 14:26	413	733.8	733.5	6.1193	6.5459	13.4161	8.8208	20.3776	22.1142
12/10/2009 14:27	415	677.4	959.2	6.1122	6.5604	13.5594	8.8317	20.3702	22.0781
12/10/2009 14:27	417	959.3	959.2	6.1211	6.5586	13.4252	8.8208	20.3665	22.0998
12/10/2009 14:28	419	902.9	959.2	6.1140	6.5659	13.5703	8.8263	20.3665	22.0817
12/10/2009 14:28	421	846.6	902.8	6.1211	6.5622	13.3998	8.8190	20.3665	22.0998
12/10/2009 14:29	423	677.4	677.1	6.1068	6.5604	13.5449	8.8281	20.3702	22.0817
12/10/2009 14:29	425	790.2	789.9	6.1211	6.5586	13.4669	8.8263	20.3776	22.1034
12/10/2009 14:30	427	733.8	789.9	6.1050	6.5622	13.5195	8.8317	20.3849	22.1179
12/10/2009 14:30	429	846.6	846.4	6.1175	6.5622	13.5068	8.8281	20.3739	22.1070
12/10/2009 14:31	431	733.8	846.4	6.1926	6.5713	13.4996	8.8317	20.3702	22.1070
12/10/2009 14:31	433	733.8	733.5	6.1193	6.5750	13.5123	11.0886	20.3665	22.1142
12/10/2009 14:32	435	508.3	620.7	6.1140	6.5713	13.4996	8.8426	20.3776	22.3672
12/10/2009 14:32	437	621.0	564.3	6.1193	6.5695	13.4814	8.8408	20.3739	22.1179
12/10/2009 14:33	439	4793.5	4796.1	6.1229	6.5822	13.4869	8.8426	20.3739	22.1070
12/10/2009 14:33	441	5131.8	4965.4	6.1265	6.5877	13.4905	8.8444	20.3776	22.1251
12/10/2009 14:34	443	4906.3	4852.6	6.1229	6.5877	13.4506	8.8426	20.3702	22.1034
12/10/2009 14:34	445	5019.0	4852.6	6.1265	6.5877	13.5159	8.8444	20.4034	22.1142
12/10/2009 14:35	447	4906.3	4796.2	6.1247	6.5913	13.4506	8.8389	20.3665	22.1034
12/10/2009 14:35	449	4906.3	4796.2	6.1265	6.5859	13.5159	8.8426	20.3849	22.1142
12/10/2009 14:36	451	4793.5	4796.2	6.1265	6.5931	13.4324	8.8408	20.3665	22.0998
12/10/2009 14:36	453	4906.3	4796.2	6.1247	6.5786	13.5123	8.8408	20.3813	22.1179
12/10/2009 14:37	455	4737.1	4739.7	6.1265	6.5986	13.4125	8.8371	20.3628	22.0962
12/10/2009 14:37	457	4793.5	4739.7	6.1247	6.5859	13.5068	8.8353	20.3776	22.1070

TIMESTAMP	RECORD	LoadA	LoadB	PotA	PotB	PotC	PotD	PotE	PotF
	#	lbs	lbs	in	in	in	in	in	in
12/10/2009 14:38	459	4680.7	4739.7	6.1265	6.5986	13.3998	8.8353	20.3628	22.1034
12/10/2009 14:38	461	4793.4	4739.7	6.1265	6.5840	13.5086	8.8353	20.3739	22.1106
12/10/2009 14:39	463	4680.7	4739.7	6.1265	6.5913	13.3998	8.8353	20.3628	22.0998
12/10/2009 14:39	465	4793.6	4796.3	6.1193	6.5786	13.5286	8.8335	20.3702	22.1070
12/10/2009 14:40	467	4680.9	4627.0	6.1247	6.5949	13.4071	8.8353	20.3628	22.0998
12/10/2009 14:40	469	4793.6	4683.4	6.1247	6.5786	13.5105	8.8335	20.3776	22.1070
12/10/2009 14:41	471	4680.8	4627.0	6.1247	6.5986	13.3962	8.8353	20.3628	22.0998
12/10/2009 14:41	473	4793.6	4683.4	6.1247	6.5822	13.5014	8.8335	20.3739	22.1070
12/10/2009 14:42	475	4680.8	4627.0	6.1265	6.6058	13.4071	8.8371	20.3628	22.1034
12/10/2009 14:42	477	4680.8	4570.5	6.1247	6.5859	13.5032	8.8353	20.3776	22.1034
12/10/2009 14:43	479	3778.6	3837.0	6.1265	6.6058	13.4361	8.8353	20.3628	22.1070
12/10/2009 14:43	481	3665.9	3837.0	6.1247	6.5913	13.5123	8.8335	20.3739	22.1106
12/10/2009 14:44	483	5019.1	5021.9	6.1265	6.6077	13.3944	8.8371	20.3628	22.0926
12/10/2009 14:44	485	4793.6	4909.1	6.1229	6.5913	13.5322	8.8353	20.3776	22.1070
12/10/2009 14:45	487	4511.6	4683.4	6.1265	6.6058	13.4234	8.8353	20.3628	22.0962
12/10/2009 14:45	489	4342.5	4570.5	6.1283	6.5931	13.5195	8.8389	20.3776	22.1179
12/10/2009 14:46	491	4173.3	4288.4	6.1247	6.6004	13.4324	8.8426	20.3665	22.0962
12/10/2009 14:46	493	4173.3	4288.4	6.1301	6.5931	13.5123	8.8426	20.3849	22.1142
12/10/2009 14:47	495	4116.9	4175.5	6.1265	6.5949	13.4506	8.8426	20.3702	22.1070
12/10/2009 14:47	497	4060.5	4175.5	6.1247	6.5986	13.5340	8.8444	20.3997	22.1215
12/10/2009 14:48	499	4060.5	4175.5	6.1301	6.5968	13.4742	8.8426	20.3813	22.1142
12/10/2009 14:48	501	4060.7	4175.7	6.1283	6.5968	13.4996	8.8408	20.3665	22.1215
12/10/2009 14:49	503	4060.7	4175.7	6.1265	6.5931	13.5050	8.8426	20.3776	22.1034
12/10/2009 14:49	505	4060.8	4119.3	6.1283	6.5968	13.5014	8.8408	20.3739	22.1142
12/10/2009 14:50	507	4004.4	4062.9	6.1283	6.5968	13.5032	8.8408	20.3776	22.1106
12/10/2009 14:50	509	4004.5	4063.0	6.1336	6.6004	13.5359	8.8462	20.3739	22.1215
12/10/2009 14:51	511	4004.5	4063.0	6.1247	6.6022	13.5377	8.8444	20.3813	22.1142
12/10/2009 14:51	513	3948.2	4063.1	6.1265	6.6004	13.5377	8.8462	20.3776	22.1142
12/10/2009 14:52	515	4850.4	4740.2	6.1247	6.6004	13.5395	8.8480	20.3776	22.1287
12/10/2009 14:52	517	10320.4	9932.1	6.2284	6.7257	13.6284	8.9930	20.4993	22.2588
12/10/2009 14:53	519	10264.1	9932.1	6.2266	6.7294	13.6502	8.9985	20.5066	22.2660
12/10/2009 14:53	521	10264.2	9819.3	6.2284	6.7257	13.6012	8.9930	20.5103	22.2624
12/10/2009 14:54	523	10207.8	9819.3	6.2213	6.7276	13.6647	8.9948	20.4993	22.2552
12/10/2009 14:54	525	10151.5	9762.9	6.2302	6.7276	13.5867	8.9894	20.5066	22.2660
12/10/2009 14:55	527	10151.5	9706.5	6.2266	6.7257	13.6756	8.9930	20.4956	22.2443
12/10/2009 14:55	529	10038.8	9706.6	6.2356	6.7257	13.5540	8.9858	20.4956	22.2660
12/10/2009 14:56	531	10038.8	9706.6	6.2248	6.7257	13.7010	8.9930	20.4993	22.2407
12/10/2009 14:56	533	10038.8	9706.6	6.2302	6.7276	13.5431	8.9876	20.4956	22.2696
12/10/2009 14:57	535	9982.4	9706.6	6.2195	6.7276	13.6864	8.9967	20.4956	22.2371
12/10/2009 14:57	537	9982.4	9706.6	6.2230	6.7276	13.5486	8.9876	20.4993	22.2696
12/10/2009 14:58	539	9926.1	9706.7	6.2248	6.7239	13.6828	8.9930	20.4956	22.2515
12/10/2009 14:58	541	9926.1	9650.2	6.2248	6.7257	13.5431	8.9876	20.4956	22.2515
12/10/2009 14:59	543	9926.1	9650.3	6.2284	6.7294	13.6883	8.9894	20.4956	22.2515
12/10/2009 14:59	545	9926.1	9650.3	6.2266	6.7312	13.5431	8.9948	20.4993	22.2515
12/10/2009 15:00	547	9926.1	9593.9	6.2213	6.7294	13.6937	8.9894	20.5103	22.2552
12/10/2009 15:00	549	9926.1	9593.9	6.2266	6.7330	13.5504	8.9967	20.5103	22.2515
12/10/2009 15:01	551	9926.2	9593.9	6.2213	6.7239	13.6937	8.9948	20.5103	22.2515

TIMESTAMP	RECORD	LoadA	LoadB	PotA	PotB	PotC	PotD	PotE	PotF
	#	lbs	lbs	in	in	in	in	in	in
12/10/2009 15:01	553	9869.8	9593.9	6.2266	6.7294	13.5467	8.9840	20.5066	22.2624
12/10/2009 15:02	555	9869.8	9593.9	6.2230	6.7221	13.6937	8.9948	20.5103	22.2624
12/10/2009 15:02	557	9869.8	9593.9	6.2302	6.7276	13.5558	8.9858	20.5066	22.2624
12/10/2009 15:03	559	9869.8	9593.9	6.2195	6.7257	13.6919	8.9948	20.5103	22.2624
12/10/2009 15:03	561	9813.4	9593.9	6.2302	6.7257	13.6610	8.9876	20.4956	22.2588
12/10/2009 15:04	563	9813.4	9593.9	6.2266	6.7312	13.6973	8.9858	20.4993	22.2588
12/10/2009 15:04	565	9813.4	9593.9	6.2248	6.7257	13.5885	8.9894	20.4845	22.2588
12/10/2009 15:05	567	9813.4	9593.9	6.2248	6.7257	13.6030	8.9912	20.4993	22.2515
12/10/2009 15:05	569	9813.4	9593.9	6.2248	6.7257	13.6338	8.9894	20.4956	22.2515
12/10/2009 15:06	571	9813.4	9593.9	6.2284	6.7239	13.5921	8.9930	20.5029	22.3383
12/10/2009 15:06	573	9813.4	9593.9	6.2266	6.7276	13.6883	8.9912	20.4993	22.2443
12/10/2009 15:07	575	9813.4	9593.9	6.2266	6.7330	13.5467	8.9912	20.5029	22.2588
12/10/2009 15:07	577	9813.4	9537.5	6.2195	6.7257	13.6864	8.9948	20.5066	22.2732
12/10/2009 15:08	579	9813.4	9594.0	6.2230	6.7312	13.6991	8.9894	20.4993	22.2660
12/10/2009 15:08	581	12971.5	12528.6	6.2713	6.7893	13.7536	9.0655	20.5656	22.3383
12/10/2009 15:09	583	15396.5	14786.0	6.3196	6.8566	13.6973	9.1362	20.6136	22.4069
12/10/2009 15:09	585	15227.8	14673.6	6.3196	6.8584	13.8080	9.1308	20.6173	22.4142
12/10/2009 15:10	587	15227.8	14560.7	6.3178	6.8547	13.6647	9.1326	20.6099	22.4033
12/10/2009 15:10	589	15171.8	14561.1	6.3232	6.8638	13.8080	9.1344	20.6136	22.4033
12/10/2009 15:11	591	15115.4	14561.1	6.3250	6.8566	13.6810	9.1326	20.6173	22.3961
12/10/2009 15:11	593	15115.8	14505.0	6.3232	6.8566	13.8116	9.1380	20.6136	22.4105
12/10/2009 15:12	595	15115.8	14448.6	6.3232	6.8620	13.6828	9.1399	20.6320	22.4069
12/10/2009 15:12	597	15059.4	14448.6	6.3268	6.8566	13.8098	9.1399	20.6246	22.4214
12/10/2009 15:13	599	15003.3	14448.8	6.3268	6.8693	13.6973	9.1417	20.6062	22.4214
12/10/2009 15:13	601	15003.3	14448.8	6.3321	6.8638	13.8062	9.1417	20.6320	22.4214
12/10/2009 15:14	603	15003.5	14449.0	6.3321	6.8765	13.7300	9.1471	20.6246	22.4214
12/10/2009 15:14	605	14947.1	14449.0	6.3339	6.8693	13.7989	9.1453	20.6394	22.4286
12/10/2009 15:15	607	14890.8	14392.8	6.3286	6.8711	13.7245	9.1453	20.6246	22.4142
12/10/2009 15:15	609	14890.8	14392.8	6.3321	6.8638	13.7808	9.1471	20.6394	22.4214
12/10/2009 15:16	611	14891.0	14336.4	6.3290	6.8643	13.7309	9.1495	20.6223	22.4121
12/10/2009 15:16	613	14891.0	14336.4	6.3254	6.8643	13.7817	9.1459	20.6519	22.4265
12/10/2009 15:17	615	14834.7	14336.5	6.3311	6.8647	13.7462	9.1482	20.6308	22.4133
12/10/2009 15:17	617	14778.3	14336.5	6.3329	6.8647	13.7825	9.1482	20.6272	22.4350
12/10/2009 15:18	619	14778.4	14336.6	6.3314	6.8668	13.7667	9.1504	20.6317	22.4251
12/10/2009 15:18	621	14778.4	14336.6	6.3368	6.8759	13.7867	9.1468	20.6317	22.4360
12/10/2009 15:19	623	14778.4	14336.7	6.3316	6.8707	13.8017	9.1526	20.6325	22.4295
12/10/2009 15:19	625	19516.2	18852.2	6.4139	6.9688	13.8507	9.2632	20.7394	22.5488
12/10/2009 15:20	627	20531.5	19868.2	6.4336	7.0051	13.8997	9.2994	20.7652	22.5741
12/10/2009 15:20	629	20419.5	19756.0	6.4355	7.0071	13.8910	9.2997	20.7658	22.5747
12/10/2009 15:21	631	20306.6	19643.1	6.4320	7.0071	13.9182	9.3015	20.7695	22.5892
12/10/2009 15:21	633	20307.3	19530.8	6.4393	7.0091	13.9240	9.2981	20.7700	22.5788
12/10/2009 15:22	635	20194.4	19530.8	6.4321	7.0037	13.9639	9.2999	20.7663	22.5716
12/10/2009 15:22	637	20194.9	19531.3	6.4358	7.0129	13.9351	9.2928	20.7740	22.5828
12/10/2009 15:23	639	20194.9	19474.8	6.4322	7.0110	13.9678	9.3037	20.7667	22.5648
12/10/2009 15:23	641	20138.9	19418.7	6.4395	7.0111	13.9335	9.2948	20.7706	22.5904
12/10/2009 15:24	643	20082.5	19418.7	6.4341	7.0111	13.9698	9.3020	20.7706	22.5651
12/10/2009 15:24	645	20082.8	19419.0	6.4415	7.0115	13.9523	9.2952	20.7753	22.5914

TIMESTAMP	RECORD	LoadA	LoadB	PotA	PotB	PotC	PotD	PotE	PotF
	#	lbs	lbs	in	in	in	in	in	in
12/10/2009 15:25	647	20082.8	19419.0	6.4362	7.0096	13.9595	9.3043	20.7827	22.5770
12/10/2009 15:25	649	20026.7	19419.3	6.4366	7.0101	13.9623	9.2958	20.7841	22.6002
12/10/2009 15:26	651	19970.2	19419.3	6.4402	7.0120	13.9587	9.2977	20.7767	22.5822
12/10/2009 15:26	653	19970.4	19363.0	6.4388	7.0087	13.9468	9.2964	20.7779	22.5762
12/10/2009 15:27	655	19970.4	19363.0	6.4352	7.0105	13.9595	9.2964	20.7779	22.5870
12/10/2009 15:27	657	19970.6	19306.7	6.4371	7.0142	13.9433	9.3073	20.7781	22.5801
12/10/2009 15:28	659	19970.6	19306.7	6.4281	7.0124	13.9633	9.2983	20.7781	22.5764
12/10/2009 15:28	661	19914.2	19306.7	6.4371	7.0088	13.9197	9.2946	20.7818	22.5692
12/10/2009 15:29	663	19857.9	19306.8	6.4302	7.0055	13.9602	9.2969	20.7790	22.5774
12/10/2009 15:29	665	19857.9	19306.8	6.4391	7.0091	13.8913	9.2896	20.7753	22.5738
12/10/2009 15:30	667	19858.0	19306.9	6.4304	7.0057	13.9535	9.2972	20.7760	22.5782
12/10/2009 15:30	669	19858.0	19306.9	6.4447	7.0075	13.8246	9.2972	20.7724	22.5818
12/10/2009 15:31	671	19858.1	19307.0	6.4342	7.0059	13.9575	9.2956	20.7692	22.5897
12/10/2009 15:31	673	19858.1	19307.0	6.4288	7.0059	13.8631	9.2974	20.7877	22.5752
12/10/2009 15:32	675	19858.1	19307.1	6.4343	7.0097	13.9541	9.3013	20.7734	22.6299
12/10/2009 15:32	677	19858.1	19307.1	6.4343	7.0006	13.9033	9.2976	20.7697	22.5829
12/10/2009 15:33	679	19801.8	19307.1	6.4362	7.0044	13.9272	9.2942	20.7737	22.5833
12/10/2009 15:33	681	19801.8	19307.1	6.4362	7.0098	13.9417	9.3032	20.7811	22.5869
12/10/2009 15:34	683	19745.4	19307.1	6.4381	7.0117	13.8057	9.2979	20.7667	22.5872
12/10/2009 15:34	685	20873.7	20323.3	6.4381	7.0172	13.9673	9.3143	20.7999	22.5909
12/10/2009 15:35	687	25161.1	24613.8	6.5330	7.1372	14.0255	9.4304	20.8960	22.7285
12/10/2009 15:35	689	25273.9	24726.7	6.5294	7.1409	14.0582	9.4504	20.9034	22.7430
12/10/2009 15:36	691	25161.1	24613.8	6.5437	7.1463	14.0219	9.4413	20.8887	22.7430
12/10/2009 15:36	693	25161.1	24500.9	6.5313	7.1428	14.0602	9.4541	20.9073	22.7359
12/10/2009 15:37	695	25161.1	24500.9	6.5259	7.1464	13.9948	9.4432	20.8962	22.7287
12/10/2009 15:37	697	25048.3	24388.1	6.5349	7.1446	14.0603	9.4524	20.9074	22.7397
12/10/2009 15:38	699	25048.3	24388.1	6.5313	7.1483	13.9858	9.4433	20.8964	22.7470
12/10/2009 15:38	701	25048.3	24388.1	6.5367	7.1483	14.0712	9.4434	20.9002	22.7543
12/10/2009 15:39	703	25048.3	24388.1	6.5367	7.1465	13.9786	9.4434	20.8891	22.7399
12/10/2009 15:39	705	25048.3	24331.6	6.5385	7.1520	14.0695	9.4452	20.8929	22.7327
12/10/2009 15:40	707	24935.5	24275.2	6.5349	7.1447	13.9878	9.4452	20.9040	22.7291
12/10/2009 15:40	709	24935.5	24275.2	6.5368	7.1375	14.0677	9.4471	20.8967	22.7437
12/10/2009 15:41	711	24935.5	24275.2	6.5368	7.1465	14.0005	9.4489	20.8819	22.7437
12/10/2009 15:41	713	24936.4	24276.0	6.5350	7.1375	14.0678	9.4435	20.8967	22.7401
12/10/2009 15:42	715	24936.4	24276.0	6.5421	7.1502	13.9824	9.4435	20.8783	22.7329
12/10/2009 15:42	717	24937.1	24276.7	6.5422	7.1429	14.0496	9.4453	20.8968	22.7402
12/10/2009 15:43	719	24824.3	24276.7	6.5368	7.1448	14.0151	9.4507	20.8857	22.7293
12/10/2009 15:43	721	24824.8	24277.2	6.5350	7.1448	14.0460	9.4417	20.9079	22.7438
12/10/2009 15:44	723	24824.8	24277.2	6.5368	7.1393	14.0224	9.4453	20.8931	22.7294
12/10/2009 15:44	725	24824.8	24277.2	6.5386	7.1448	14.0333	9.4453	20.8857	22.7402
12/10/2009 15:45	727	27306.7	26873.9	6.5672	7.1884	14.0751	9.5052	20.9374	22.7836
12/10/2009 15:45	729	30184.0	29922.6	6.6299	7.2720	14.1386	9.6013	21.0039	22.8849
12/10/2009 15:46	731	30015.4	29697.4	6.6245	7.2721	14.1623	9.6013	21.0150	22.8994
12/10/2009 15:46	733	29902.5	29584.5	6.6281	7.2721	14.1223	9.5977	21.0150	22.8849
12/10/2009 15:47	735	29903.0	29472.1	6.6245	7.2757	14.1641	9.5995	21.0150	22.8668
12/10/2009 15:47	737	29903.0	29472.1	6.6317	7.2739	14.1514	9.5923	21.0113	22.8885
12/10/2009 15:48	739	29790.6	29472.5	6.6245	7.2739	14.1732	9.6014	21.0261	22.8741

TIMESTAMP	RECORD #	LoadA lbs	LoadB lbs	PotA in	PotB in	PotC in	PotD in	PotE in	PotF in
12/10/2009 15:48	741	29790.6	29416.0	6.6299	7.2757	14.1587	9.5923	21.0261	22.8994
12/10/2009 15:49	743	29790.9	29359.8	6.6263	7.2739	14.1587	9.5977	21.0224	22.8741
12/10/2009 15:49	745	29790.9	29359.8	6.6245	7.2739	14.1568	9.5959	21.0187	22.8633
12/10/2009 15:50	747	29791.2	29360.1	6.6227	7.2757	14.1605	9.5959	21.0113	22.8777
12/10/2009 15:50	749	29791.2	29360.1	6.6245	7.2775	14.1605	9.5996	21.0187	22.8669
12/10/2009 15:51	751	29678.5	29303.8	6.6174	7.2757	14.1623	9.5959	21.0261	22.8741
12/10/2009 15:51	753	29678.5	29247.4	6.6263	7.2775	14.1569	9.5850	21.0224	22.8741
12/10/2009 15:52	755	29678.5	29247.4	6.6174	7.2703	14.1587	9.5977	21.0261	22.8777
12/10/2009 15:52	757	29678.7	29247.5	6.6317	7.2757	14.1478	9.5887	21.0150	22.8778
12/10/2009 15:53	759	29678.7	29247.5	6.6263	7.2721	14.1659	9.6032	21.0261	22.8741
12/10/2009 15:53	761	29678.8	29247.6	6.6227	7.2775	14.1169	9.5959	21.0187	22.8850
12/10/2009 15:54	763	29678.8	29247.6	6.6245	7.2721	14.1659	9.5905	21.0335	22.8886
12/10/2009 15:54	765	29678.9	29247.7	6.6263	7.2757	14.0752	9.5941	21.0150	22.8850
12/10/2009 15:55	767	29678.9	29247.7	6.6245	7.2775	14.1641	9.5941	21.0224	22.8778
12/10/2009 15:55	769	29622.6	29191.4	6.6210	7.2739	14.1042	9.5978	21.0261	22.8742
12/10/2009 15:56	771	29566.2	29191.4	6.6263	7.2648	14.1659	9.5978	21.0150	22.8850
12/10/2009 15:56	773	29566.2	29134.9	6.6210	7.2757	14.0861	9.5959	21.0151	22.8886
12/10/2009 15:57	775	29566.2	29134.9	6.6263	7.2685	14.1569	9.5959	21.0261	22.8922
12/10/2009 15:57	777	29566.3	29135.0	6.6245	7.2812	14.1042	9.5959	21.0077	22.8778
12/10/2009 15:58	779	29566.3	29135.0	6.6263	7.2721	14.1496	9.6032	21.0298	22.8814
12/10/2009 15:58	781	29566.3	29135.0	6.6263	7.2685	14.1169	9.5978	21.0114	22.8778
12/10/2009 15:59	783	29566.3	29135.0	6.6263	7.2721	14.1369	9.5923	21.0298	22.8814
12/10/2009 15:59	785	29509.9	29135.1	6.6263	7.2775	14.1623	9.5996	21.0261	22.8886
12/10/2009 16:00	787	29453.5	29135.1	6.6281	7.2794	14.0480	9.6032	21.0224	22.8669
12/10/2009 16:00	789	29453.5	29135.1	6.6245	7.2739	14.1660	9.5996	21.0335	22.8886
12/10/2009 16:01	791	29453.5	29135.1	6.6281	7.2830	14.1678	9.5923	21.0151	22.8886
12/10/2009 16:01	793	30356.3	29925.6	6.6281	7.2775	14.1714	9.6086	21.0335	22.8850
12/10/2009 16:02	795	35321.5	34837.9	6.7265	7.4157	14.2458	9.7411	21.1368	23.0441
12/10/2009 16:02	797	35095.8	34725.0	6.7247	7.4139	14.2840	9.7519	21.1590	23.0550
12/10/2009 16:03	799	34982.9	34612.1	6.7265	7.4157	14.2168	9.7501	21.1442	23.0622
12/10/2009 16:03	801	34982.9	34555.6	6.7301	7.4212	14.2894	9.7519	21.1516	23.0477
12/10/2009 16:04	803	34870.1	34442.7	6.7301	7.4175	14.2295	9.7556	21.1590	23.0550
12/10/2009 16:04	805	34870.1	34442.7	6.7319	7.4066	14.2858	9.7574	21.1553	23.0658
12/10/2009 16:05	807	34870.1	34386.2	6.7301	7.4175	14.2113	9.7556	21.1405	23.0622
12/10/2009 16:05	809	34757.3	34329.8	6.7319	7.4139	14.2785	9.7538	21.1590	23.0586
12/10/2009 16:06	811	34758.5	34330.9	6.7319	7.4212	14.2386	9.7538	21.1405	23.0622
12/10/2009 16:06	813	34758.5	34330.9	6.7337	7.4103	14.2785	9.7538	21.1664	23.0550
12/10/2009 16:07	815	34758.2	34274.2	6.7283	7.4103	14.2404	9.7574	21.1442	23.0477
12/10/2009 16:07	817	34758.2	34217.8	6.7319	7.4139	14.2567	9.7538	21.1700	23.0622
12/10/2009 16:08	819	34758.2	34217.8	6.7319	7.4121	14.2622	9.7519	21.1700	23.0477
12/10/2009 16:08	821	34701.6	34217.6	6.7337	7.4139	14.2585	9.7519	21.1664	23.0513
12/10/2009 16:09	823	34645.2	34217.6	6.7283	7.4121	14.2803	9.7556	21.1700	23.0550
12/10/2009 16:09	825	34645.0	34217.4	6.7319	7.4139	14.2477	9.7501	21.1737	23.0513
12/10/2009 16:10	827	34645.0	34217.4	6.7247	7.4121	14.2821	9.7556	21.1700	23.0333
12/10/2009 16:10	829	34644.9	34217.3	6.7301	7.4139	14.2604	9.7447	21.1627	23.0477
12/10/2009 16:11	831	34644.9	34217.3	6.7247	7.4157	14.2912	9.7538	21.1700	23.0333
12/10/2009 16:11	833	34644.8	34160.8	6.7301	7.4121	14.2785	9.7483	21.1774	23.0586

TIMESTAMP	RECORD	LoadA	LoadB	PotA	PotB	PotC	PotD	PotE	PotF
	#	lbs	lbs	in	in	in	in	in	in
12/10/2009 16:12	835	34644.8	34104.3	6.7265	7.4121	14.2749	9.7556	21.1700	23.0369
12/10/2009 16:12	837	36451.5	36025.2	6.7516	7.4430	14.3021	9.7864	21.1737	23.0730
12/10/2009 16:13	839	40232.0	39752.0	6.8250	7.5502	14.3911	9.9043	21.2623	23.1924
12/10/2009 16:13	841	40062.4	39638.7	6.8321	7.5593	14.3983	9.9170	21.2734	23.1960
12/10/2009 16:14	843	39949.5	39525.8	6.8250	7.5557	14.4001	9.9079	21.2807	23.2032
12/10/2009 16:14	845	39894.2	39413.9	6.8339	7.5557	14.4001	9.9025	21.2734	23.2068
12/10/2009 16:15	847	39837.8	39413.9	6.8232	7.5502	14.3947	9.9116	21.2697	23.2068
12/10/2009 16:15	849	39837.3	39300.5	6.8375	7.5575	14.2967	9.9007	21.2660	23.1924
12/10/2009 16:16	851	39724.4	39300.5	6.8250	7.5539	14.4074	9.9134	21.2844	23.2104
12/10/2009 16:16	853	39724.4	39300.5	6.8267	7.5575	14.3711	9.9079	21.2660	23.2104
12/10/2009 16:17	855	39724.0	39187.2	6.8303	7.5575	14.4020	9.9061	21.2807	23.2141
12/10/2009 16:17	857	39724.0	39187.2	6.8339	7.5593	14.3602	9.9152	21.2771	23.2104
12/10/2009 16:18	859	39610.9	39186.9	6.8321	7.5502	14.4110	9.9152	21.2734	23.2104
12/10/2009 16:18	861	39610.9	39186.9	6.8321	7.5612	14.3584	9.9134	21.2844	23.2177
12/10/2009 16:19	863	39610.6	39186.6	6.8303	7.5539	14.4038	9.9152	21.2807	23.2213
12/10/2009 16:19	865	39610.6	39073.7	6.8339	7.5630	14.3493	9.9152	21.2623	23.2104
12/10/2009 16:20	867	39610.4	39073.5	6.8339	7.5521	14.3874	9.9134	21.2807	23.2177
12/10/2009 16:20	869	39610.4	39073.5	6.8303	7.5521	14.3675	9.9134	21.2697	23.2068
12/10/2009 16:21	871	39610.3	39073.3	6.8321	7.5521	14.3820	9.9152	21.2807	23.2177
12/10/2009 16:21	873	39497.4	39073.3	6.8357	7.5521	14.3820	9.9134	21.2771	23.2104
12/10/2009 16:22	875	39553.7	39073.2	6.8357	7.5557	14.3856	9.9152	21.2660	23.2141
12/10/2009 16:22	877	39497.3	39016.8	6.8321	7.5593	14.3965	9.9188	21.2807	23.2213
12/10/2009 16:23	879	39497.2	39016.7	6.8339	7.5575	14.3893	9.9170	21.2844	23.2141
12/10/2009 16:23	881	39497.2	38960.2	6.8303	7.5539	14.4074	9.9134	21.2807	23.2104
12/10/2009 16:24	883	39497.2	38960.2	6.8393	7.5593	14.3874	9.9116	21.2807	23.2213
12/10/2009 16:24	885	39498.5	38961.4	6.8321	7.5575	14.4147	9.9188	21.2771	23.1996
12/10/2009 16:25	887	39498.5	38961.4	6.8321	7.5630	14.4020	9.9152	21.2844	23.2321
12/10/2009 16:25	889	39498.1	38961.1	6.8321	7.5575	14.4001	9.9206	21.2881	23.2068
12/10/2009 16:26	891	39498.1	38961.1	6.8321	7.5593	14.4038	9.9134	21.2771	23.1996
12/10/2009 16:26	893	39497.9	38960.8	6.8285	7.5612	14.4020	9.9116	21.2807	23.2068
12/10/2009 16:27	895	39497.9	38960.8	6.8321	7.5593	14.4110	9.9225	21.2844	23.2068
12/10/2009 16:27	897	39441.2	38960.6	6.8303	7.5557	14.4110	9.9170	21.2918	23.2177
12/10/2009 16:28	899	39441.2	38904.2	6.8357	7.5612	14.4092	9.9061	21.2881	23.2213
12/10/2009 16:28	901	39386.0	38905.3	6.8285	7.5539	14.4074	9.9170	21.2844	23.2249
12/10/2009 16:29	903	39386.0	38848.9	6.8375	7.5666	14.4092	9.9061	21.2734	23.2177
12/10/2009 16:29	905	39385.6	38848.5	6.8339	7.5593	14.4147	9.9279	21.2881	23.2249
12/10/2009 16:30	907	39385.6	38848.5	6.8303	7.5612	14.4056	9.9152	21.2807	23.2177
12/10/2009 16:30	909	40852.3	40655.0	6.8464	7.5793	14.4365	9.9406	21.3213	23.2466
12/10/2009 16:31	911	44914.8	44833.5	6.9305	7.6902	14.4964	10.0640	21.4062	23.3804
12/10/2009 16:31	913	44858.1	44833.2	6.9466	7.7139	14.5472	10.0767	21.4283	23.3912
12/10/2009 16:32	915	44688.8	44720.2	6.9466	7.7048	14.4982	10.0839	21.4394	23.3949
12/10/2009 16:32	917	44576.0	44607.3	6.9466	7.6993	14.5418	10.0803	21.4247	23.3985
12/10/2009 16:33	919	44520.8	44552.1	6.9449	7.7121	14.4946	10.0821	21.4136	23.4093
12/10/2009 16:33	921	44464.4	44495.6	6.9520	7.7048	14.5272	10.0803	21.4394	23.4021
12/10/2009 16:34	923	44463.9	44438.7	6.9520	7.7175	14.5054	10.0857	21.4210	23.4021
12/10/2009 16:34	925	44351.1	44382.2	6.9520	7.7066	14.5436	10.0894	21.4542	23.4093
12/10/2009 16:35	927	44352.2	44383.3	6.9520	7.7011	14.5127	10.0894	21.4357	23.3949

TIMESTAMP	RECORD #	LoadA lbs	LoadB lbs	PotA in	PotB in	PotC in	PotD in	PotE in	PotF in
12/10/2009 16:35	929	44352.2	44270.4	6.9520	7.7102	14.5182	10.0894	21.4320	23.4165
12/10/2009 16:36	931	44353.1	44271.3	6.9538	7.7066	14.5327	10.0857	21.4283	23.3985
12/10/2009 16:36	933	44296.7	44271.3	6.9556	7.7121	14.5254	10.0875	21.4320	23.4057
12/10/2009 16:37	935	44241.0	44272.0	6.9502	7.7102	14.5490	10.0857	21.4357	23.4129
12/10/2009 16:37	937	44241.0	44159.1	6.9538	7.7084	14.5182	10.0894	21.4431	23.4093
12/10/2009 16:38	939	44241.5	44159.6	6.9484	7.7084	14.5490	10.0894	21.4394	23.3912
12/10/2009 16:38	941	44241.5	44159.6	6.9520	7.7121	14.5272	10.0803	21.4320	23.4021
12/10/2009 16:39	943	44242.0	44160.1	6.9502	7.7102	14.5472	10.0894	21.4357	23.3876
12/10/2009 16:39	945	44242.0	44160.1	6.9484	7.7102	14.5399	10.0839	21.4431	23.4129
12/10/2009 16:40	947	44185.6	44103.6	6.9520	7.7048	14.5381	10.0857	21.4394	23.3949
12/10/2009 16:40	949	44185.9	44047.5	6.9484	7.7121	14.5418	10.0803	21.4394	23.3912
12/10/2009 16:41	951	44129.5	44047.5	6.9466	7.7121	14.5399	10.0821	21.4357	23.3912
12/10/2009 16:41	953	44129.8	44047.8	6.9520	7.7121	14.5436	10.0894	21.4394	23.3912
12/10/2009 16:42	955	46217.7	46193.7	6.9681	7.7375	14.5799	10.1238	21.4726	23.4382
12/10/2009 16:42	957	50113.4	49696.9	7.0594	7.8539	14.6598	10.2327	21.5538	23.5503
12/10/2009 16:43	959	49944.1	49696.9	7.0558	7.8557	14.6688	10.2490	21.5686	23.5576
12/10/2009 16:43	961	49774.7	49527.4	7.0540	7.8648	14.6725	10.2417	21.5575	23.5540
12/10/2009 16:44	963	49661.8	49470.9	7.0558	7.8593	14.6725	10.2508	21.5723	23.5648
12/10/2009 16:44	965	49550.5	49359.5	7.0522	7.8648	14.6325	10.2454	21.5575	23.5612
12/10/2009 16:45	967	49437.7	49303.0	7.0594	7.8666	14.6743	10.2417	21.5649	23.5648
12/10/2009 16:45	969	49438.9	49247.8	7.0612	7.8629	14.6289	10.2435	21.5612	23.5648
12/10/2009 16:46	971	49382.5	49191.3	7.0612	7.8539	14.6815	10.2454	21.5649	23.5648
12/10/2009 16:46	973	49327.1	49135.9	7.0558	7.8611	14.6144	10.2490	21.5538	23.5684
12/10/2009 16:47	975	49327.1	49135.9	7.0594	7.8539	14.6525	10.2417	21.5649	23.5684
12/10/2009 16:47	977	49327.9	49136.7	7.0612	7.8702	14.6362	10.2435	21.5427	23.5503
12/10/2009 16:48	979	49215.0	49080.2	7.0630	7.8593	14.6598	10.2454	21.5686	23.5612
12/10/2009 16:48	981	49215.0	49023.7	7.0612	7.8557	14.6471	10.2490	21.5501	23.5540
12/10/2009 16:49	983	49215.6	49024.3	7.0576	7.8557	14.6325	10.2454	21.5501	23.5648
12/10/2009 16:49	985	49215.6	49024.3	7.0612	7.8593	14.6489	10.2490	21.5575	23.5540
12/10/2009 16:50	987	49216.2	48968.4	7.0630	7.8629	14.6489	10.2490	21.5464	23.5648
12/10/2009 16:50	989	49159.7	48911.9	7.0558	7.8611	14.6707	10.2472	21.5575	23.5720
12/10/2009 16:51	991	49103.7	48912.3	7.0594	7.8593	14.6452	10.2454	21.5612	23.5648
12/10/2009 16:51	993	49103.7	48912.3	7.0576	7.8666	14.6761	10.2490	21.5575	23.5431
12/10/2009 16:52	995	49104.0	48912.6	7.0612	7.8629	14.6670	10.2417	21.5575	23.5648
12/10/2009 16:52	997	49104.0	48912.6	7.0612	7.8611	14.6743	10.2454	21.5649	23.5576
12/10/2009 16:53	999	49104.3	48912.9	7.0612	7.8629	14.6198	10.2544	21.5538	23.5612
12/10/2009 16:53	1001	49104.3	48799.9	7.0594	7.8593	14.6761	10.2544	21.5759	23.5576
12/10/2009 16:54	1003	49104.5	48800.1	7.0630	7.8648	14.5545	10.2435	21.5612	23.5576
12/10/2009 16:54	1005	49104.5	48800.1	7.0612	7.8575	14.6634	10.2490	21.5723	23.5612
12/10/2009 16:55	1007	48991.7	48800.2	7.0540	7.8539	14.6126	10.2472	21.5649	23.5648
12/10/2009 16:55	1009	48991.7	48800.2	7.0630	7.8611	14.6452	10.2435	21.5649	23.5648
12/10/2009 16:56	1011	48991.7	48800.2	7.0612	7.8593	14.6743	10.2454	21.5723	23.5503
12/10/2009 16:56	1013	48991.9	48743.9	7.0612	7.8666	14.6725	10.2399	21.5723	23.5612
12/10/2009 16:57	1015	48991.9	48687.4	7.0576	7.8575	14.6743	10.2508	21.5796	23.5684
12/10/2009 16:57	1017	48992.0	48687.5	7.0647	7.8684	14.6761	10.2417	21.5686	23.5576
12/10/2009 16:58	1019	48992.0	48687.5	7.0594	7.8648	14.6761	10.2599	21.5796	23.5756
12/10/2009 16:58	1021	53620.2	53206.1	7.1238	7.9575	14.7487	10.3506	21.6424	23.6769

TIMESTAMP	RECORD	LoadA	LoadB	PotA	PotB	PotC	PotD	PotE	PotF
	#	lbs	lbs	in	in	in	in	in	in
12/10/2009 16:59	1023	54974.8	54787.6	7.1757	8.0120	14.8086	10.4104	21.7125	23.7456
12/10/2009 16:59	1025	55087.7	55013.6	7.1828	8.0193	14.7759	10.4195	21.7125	23.7456
12/10/2009 17:00	1027	54749.1	54787.7	7.1828	8.0193	14.8195	10.4195	21.7125	23.7420
12/10/2009 17:00	1029	54974.9	55126.6	7.1828	8.0320	14.7669	10.4322	21.7236	23.7673
12/10/2009 17:01	1031	54749.1	54957.2	7.1882	8.0229	14.8141	10.4304	21.7272	23.7673
12/10/2009 17:01	1033	54636.3	54900.7	7.1882	8.0375	14.7669	10.4304	21.7051	23.7456
12/10/2009 17:02	1035	54523.4	54787.8	7.1864	8.0266	14.7959	10.4340	21.7236	23.7564
12/10/2009 17:02	1037	54410.5	54731.3	7.1828	8.0248	14.7977	10.4322	21.7088	23.7420
12/10/2009 17:03	1039	54410.5	54674.8	7.1846	8.0229	14.7923	10.4322	21.7088	23.7637
12/10/2009 17:03	1041	54297.7	54618.4	7.1900	8.0266	14.7796	10.4322	21.7088	23.7420
12/10/2009 17:04	1043	54297.7	54561.9	7.1846	8.0284	14.8068	10.4322	21.7162	23.7456
12/10/2009 17:04	1045	54184.8	54561.9	7.1793	8.0302	14.8068	10.4322	21.7125	23.7673
12/10/2009 17:05	1047	54184.8	54505.4	7.1864	8.0266	14.7868	10.4286	21.7162	23.7384
12/10/2009 17:05	1049	54128.4	54449.0	7.1828	8.0284	14.8195	10.4340	21.7088	23.7311
12/10/2009 17:06	1051	54072.0	54449.0	7.1864	8.0302	14.7959	10.4231	21.7088	23.7456
12/10/2009 17:06	1053	54072.0	54449.0	7.1828	8.0266	14.8032	10.4358	21.7199	23.7275
12/10/2009 17:07	1055	54015.5	54392.5	7.1811	8.0302	14.8068	10.4268	21.7125	23.7456
12/10/2009 17:07	1057	53959.1	54336.0	7.1864	8.0320	14.8050	10.4286	21.7088	23.7384
12/10/2009 17:08	1059	53959.1	54336.0	7.1828	8.0320	14.8086	10.4358	21.7162	23.7347
12/10/2009 17:08	1061	53959.1	54336.0	7.1757	8.0266	14.8141	10.4286	21.7199	23.7420
12/10/2009 17:09	1063	53959.1	54279.6	7.1828	8.0302	14.8068	10.4195	21.7162	23.7420
12/10/2009 17:09	1065	53902.7	54279.6	7.1793	8.0248	14.8086	10.4304	21.7162	23.7347
12/10/2009 17:10	1067	53846.2	54223.1	7.1775	8.0338	14.8104	10.4231	21.7051	23.7420
12/10/2009 17:10	1069	53846.2	54223.1	7.1793	8.0266	14.8123	10.4304	21.7199	23.7456
12/10/2009 17:11	1071	53846.2	54223.1	7.1811	8.0284	14.7995	10.4268	21.7088	23.7492
12/10/2009 17:11	1073	53846.2	54223.1	7.1828	8.0302	14.8123	10.4231	21.7162	23.7492
12/10/2009 17:12	1075	53789.8	54166.6	7.1846	8.0284	14.7723	10.4268	21.7125	23.7384
12/10/2009 17:12	1077	53789.8	54110.1	7.1811	8.0211	14.8159	10.4304	21.7125	23.7492
12/10/2009 17:13	1079	53789.8	54223.1	7.1828	8.0284	14.7832	10.4304	21.7014	23.7564
12/10/2009 17:13	1081	54184.9	57047.2	7.1936	8.0375	14.8359	10.4594	21.7605	23.7818
12/10/2009 17:14	1083	53846.3	58233.3	7.1954	8.0557	14.8014	10.4739	21.7494	23.7998
12/10/2009 17:14	1085	53846.3	57273.1	7.1990	8.0466	14.8322	10.4739	21.7863	23.8143
12/10/2009 17:15	1087	53846.3	57047.2	7.1972	8.0429	14.8322	10.4739	21.7641	23.7998
12/10/2009 17:15	1089	53846.3	56934.3	7.1972	8.0448	14.8268	10.4757	21.7531	23.8179
12/10/2009 17:16	1091	53620.5	59306.5	7.1990	8.0484	14.8395	10.4812	21.7863	23.8071
12/10/2009 17:16	1093	53281.8	59532.4	7.2115	8.0611	14.8377	10.4993	21.7937	23.8360
12/10/2009 17:17	1095	53281.8	58741.7	7.2043	8.0611	14.8685	10.5011	21.8010	23.8541
12/10/2009 17:17	1097	53281.8	58515.8	7.2097	8.0593	14.8504	10.5011	21.8047	23.8396
12/10/2009 17:18	1099	53281.8	58289.8	7.2043	8.0629	14.8685	10.4993	21.7974	23.8215
12/10/2009 17:18	1101	53281.8	58176.9	7.2079	8.0611	14.8558	10.4957	21.8010	23.8432
12/10/2009 17:19	1103	53281.8	58063.9	7.2061	8.0575	14.8613	10.5029	21.8047	23.8288
12/10/2009 17:19	1105	53281.8	57950.9	7.2043	8.0593	14.8576	10.4975	21.8084	23.8505
12/10/2009 17:20	1107	53281.8	57950.9	7.2115	8.0611	14.8631	10.4957	21.7974	23.8324
12/10/2009 17:20	1109	53281.8	57838.0	7.2061	8.0629	14.8722	10.5084	21.7937	23.8288
12/10/2009 17:21	1111	53225.4	57838.0	7.2043	8.0593	14.8722	10.5011	21.8010	23.8360
12/10/2009 17:21	1113	47637.7	47558.2	7.1274	7.9520	14.7868	10.3868	21.6940	23.7058
12/10/2009 17:22	1115	47750.6	47784.1	7.1310	7.9520	14.7868	10.3814	21.6977	23.7131

TIMESTAMP	RECORD #	LoadA lbs	LoadB lbs	PotA in	PotB in	PotC in	PotD in	PotE in	PotF in
12/10/2009 17:22	1117	23480.8	23948.5	6.6961	7.3594	14.3257	9.7937	21.2623	23.1707
12/10/2009 17:23	1119	23932.3	24061.5	6.6961	7.3575	14.3421	9.7937	21.2697	23.1634
12/10/2009 17:23	1121	24045.2	24174.5	6.6997	7.3630	14.3221	9.7955	21.2807	23.1707
12/10/2009 17:24	1123	24158.1	24287.4	6.6979	7.3557	14.3348	9.7991	21.2697	23.1743
12/10/2009 17:24	1125	24271.0	24400.4	6.7015	7.3684	14.2894	9.7955	21.2475	23.1598
12/10/2009 17:25	1127	24383.8	24400.4	6.6997	7.3612	14.3221	9.7937	21.2734	23.1671
12/10/2009 17:25	1129	24383.8	24513.4	6.7015	7.3594	14.3057	9.7973	21.2512	23.1526
12/10/2009 17:26	1131	18288.2	18639.2	6.5959	7.2248	14.2204	9.6685	21.1885	23.0477
12/10/2009 17:26	1133	14224.4	14685.4	6.5118	7.1085	14.1260	9.5524	21.0889	22.9248
12/10/2009 17:27	1135	14337.3	14911.4	6.5154	7.1085	14.1079	9.5506	21.0778	22.9429
12/10/2009 17:27	1137	14450.2	15024.3	6.5154	7.1103	14.1333	9.5488	21.0815	22.9248
12/10/2009 17:28	1139	14619.5	15024.3	6.5172	7.1139	14.1242	9.5542	21.0852	22.9284
12/10/2009 17:28	1141	14675.9	15137.3	6.5118	7.1121	14.1478	9.5542	21.0962	22.9465
12/10/2009 17:29	1143	14788.8	15137.3	6.5154	7.1103	14.1278	9.5506	21.0962	22.9320
12/10/2009 17:29	1145	14788.8	15193.8	6.5136	7.1157	14.1514	9.5542	21.0852	22.9176
12/10/2009 17:30	1147	1581.5	1581.5	6.2935	6.8121	13.8991	9.2404	20.8748	22.6536

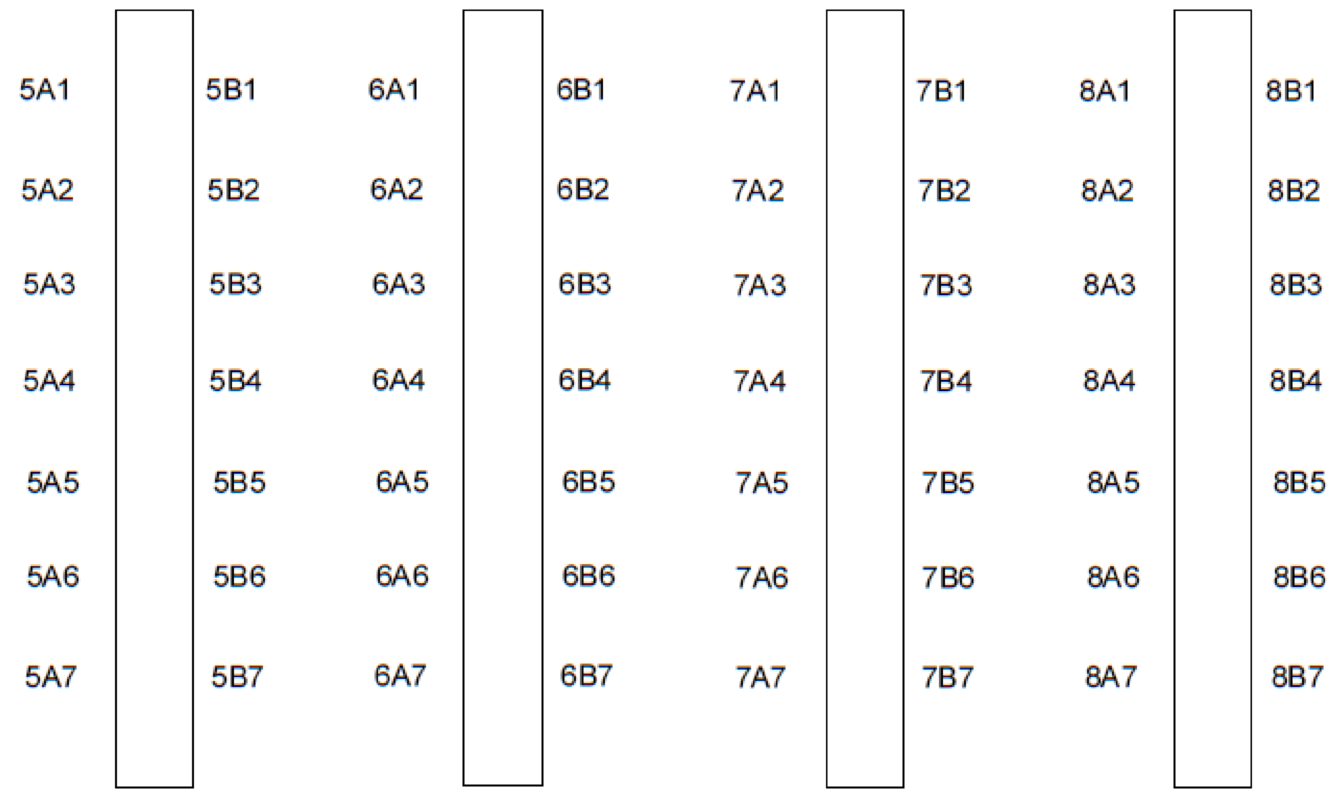

Figure E.1 General position of strain gages in piles 5, 6. 7, and 8

TABLE E.6 Strain gage measurements for pile 5

TS	5A1 Comp. Strain	5B1 Tensile Strain	Moment (k*ft)	5A2 Comp. Strain	5B2 Tensile Strain	Moment (k*ft)	5A3 Comp. Strain	5B3 Tensile Strain	Moment (k*ft)	5A4 Comp. Strain	5B4 Tensile Strain	Moment (k*ft)	5A5 Comp. Strain	5B5 Tensile Strain	Moment (k*ft)	5A6 Comp. Strain	5B6 Tensile Strain	Moment (k*ft)	5A7 Comp. Strain	5B7 Tensile Strain	Moment (k*ft)
12/10/2009 14:14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12/10/2009 14:14	-1.30006	-2.05101	-0.05184	-1.62495	-1.7029	-0.00538	-1.31775	-1.37806	-0.00416	-1.15184	-1.26569	-0.00786	-0.59388	-0.75538	-0.01115	-0.1168	-0.09767	0.001321	0.050561	0.011285	-0.00271
12/10/2009 14:15	-1.33791	-2.06993	-0.05053	-1.6639	-1.72752	-0.00439	-1.32509	-1.39133	-0.00457	-1.14805	-1.26378	-0.00799	-0.5995	-0.75157	-0.0105	-0.11871	-0.10142	0.001194	0.048689	0.013166	-0.00245
12/10/2009 14:16	-1.42305	-2.03966	-0.04256	-1.70841	-1.74646	-0.00263	-1.35262	-1.42923	-0.00529	-1.1651	-1.29633	-0.00906	-0.60512	-0.76683	-0.01116	-0.12829	-0.11645	0.000817	0.048689	0.018808	-0.00206
12/10/2009 14:17	-1.66712	-2.3688	-0.04844	-1.96805	-1.96235	0.000393	-1.55998	-1.62065	-0.00419	-1.3299	-1.47438	-0.00997	-0.66507	-0.85266	-0.01295	-0.1436	-0.10142	0.002912	0.043071	0.009404	-0.00232
12/10/2009 14:18	-1.6482	-2.29692	-0.04478	-1.91242	-1.96425	-0.00358	-1.5086	-1.6415	-0.00917	-1.328	-1.46289	-0.00931	-0.67818	-0.84503	-0.01152	-0.13595	-0.12396	0.000827	0.03558	0.011285	-0.00168
12/10/2009 14:19	-1.73334	-2.36691	-0.04373	-1.93838	-1.93395	0.000306	-1.49208	-1.6794	-0.01293	-1.328	-1.43992	-0.00773	-0.66507	-0.84694	-0.01255	-0.13595	-0.12396	0.000827	0.046816	0.007523	-0.00271
12/10/2009 14:20	-1.78632	-2.24963	-0.03196	-1.92911	-1.98508	-0.00386	-1.44254	-1.65666	-0.01478	-1.2958	-1.43226	-0.00942	-0.66132	-0.83359	-0.01189	-0.14169	-0.10518	0.00252	0.039325	0	-0.00271
12/10/2009 14:21	-1.71253	-2.31962	-0.04191	-1.94024	-2.03811	-0.00676	-1.43703	-1.67371	-0.01634	-1.29959	-1.43609	-0.00942	-0.67256	-0.83549	-0.01125	-0.13403	-0.11269	0.001473	0.046816	0.007523	-0.00271
12/10/2009 14:22	-1.71253	-2.28368	-0.03943	-1.86234	-2.03053	-0.01161	-1.40033	-1.69835	-0.02057	-1.28823	-1.44375	-0.01074	-0.66507	-0.83549	-0.01176	-0.14169	-0.11833	0.001613	0.044943	0.011285	-0.00232
12/10/2009 14:23	-1.87335	-2.41042	-0.03707	-1.79743	-2.09302	-0.0204	-1.37464	-1.72867	-0.02444	-1.28633	-1.46289	-0.01219	-0.66881	-0.84694	-0.0123	-0.14169	-0.11081	0.002131	0.043071	0.013166	-0.00206
12/10/2009 14:24	-1.49306	-1.9621	-0.03238	-1.44134	-1.84304	-0.02773	-1.1269	-1.50504	-0.0261	-1.10448	-1.2408	-0.00941	-0.5995	-0.74966	-0.01037	-0.12446	-0.10893	0.001072	0.044943	0.009404	-0.00245
12/10/2009 14:25	-1.45522	-1.94507	-0.03381	-1.41723	-1.84873	-0.02979	-1.12323	-1.51073	-0.02675	-1.09691	-1.23506	-0.00954	-0.59388	-0.74012	-0.01009	-0.12637	-0.10518	0.001463	0.048689	0.007523	-0.00284
12/10/2009 14:26	-1.44386	-1.91859	-0.03277	-1.42836	-1.86198	-0.02993	-1.10488	-1.53347	-0.02958	-1.09501	-1.22932	-0.00927	-0.59201	-0.74012	-0.01022	-0.1302	-0.11269	0.001209	0.046816	0.007523	-0.00271
12/10/2009 14:27	-2.16848	-0.6661	0.103707	-1.84936	-0.81837	0.071168	-1.15076	-1.14114	0.000664	-1.11964	-1.35568	-0.01629	-0.60699	-0.80688	-0.0138	-0.13786	-0.11269	0.001737	0.037453	0.003762	-0.00233
12/10/2009 14:28	-1.6501	-1.53266	0.008106	-2.01442	-1.42638	0.040591	-1.32326	-1.32499	-0.00012	-1.12722	-1.24846	-0.00837	-0.60137	-0.75729	-0.01076	-0.12637	-0.12396	0.000167	0.044943	0.003762	-0.00284
12/10/2009 14:29	-2.74923	-0.53365	0.152938	-3.30127	-0.59674	0.18669	-1.78567	-0.9933	0.054696	-1.24845	-1.33845	-0.00621	-0.63884	-0.80497	-0.01147	-0.13403	-0.12772	0.000436	0.037453	-0.00188	-0.00272
12/10/2009 14:30	-2.70005	-0.53175	0.149674	-3.29757	-0.57022	0.188265	-1.78567	-0.98382	0.05535	-1.23898	-1.3327	-0.00647	-0.63322	-0.80688	-0.01199	-0.13403	-0.11081	0.001603	0.043071	0.009404	-0.00232
12/10/2009 14:31	-2.71896	-0.51851	0.151894	-3.25678	-0.57591	0.185057	-1.80402	-0.96297	0.058056	-1.23898	-1.32313	-0.00581	-0.63135	-0.80879	-0.01225	-0.13403	-0.12208	0.000825	0.039325	-0.00188	-0.00284
12/10/2009 14:32	-2.70194	-0.51283	0.151111	-3.19745	-0.57401	0.181092	-1.782	-0.93265	0.05863	-1.21246	-1.30016	-0.00605	-0.62947	-0.79735	-0.01159	-0.1302	-0.11833	0.00082	0.044943	0.001881	-0.00297
12/10/2009 14:33	-2.67546	-0.50905	0.149544	-3.15666	-0.58348	0.177623	-1.7765	-0.92886	0.058511	-1.20867	-1.29824	-0.00618	-0.62947	-0.79925	-0.01172	-0.13403	-0.10893	0.001732	0.044943	0.011285	-0.00232
12/10/2009 14:34	-2.45981	-0.75693	0.117547	-2.85073	-0.75776	0.144475	-1.68292	-0.94592	0.050874	-1.17268	-1.25229	-0.0055	-0.61074	-0.77636	-0.01143	-0.12637	-0.17843	-0.00359	0.048689	-0.00564	-0.00375
12/10/2009 14:35	-21.0338	19.98646	2.831567	-43.0214	36.69979	5.503041	-27.5465	27.07962	3.770762	-4.75908	1.731498	0.448035	-0.42902	-1.97406	-0.10665	-0.19722	-0.18594	0.000779	0.013108	-0.01881	-0.0022
12/10/2009 14:36	-20.981	19.99026	2.828187	-42.6022	36.46125	5.457636	-27.4516	27.03959	3.761449	-4.82344	1.821536	0.458693	-0.41404	-1.99504	-0.10913	-0.1953	-0.17467	0.001424	0.013108	-0.01128	-0.00168
12/10/2009 14:37	-20.9301	19.97696	2.823756	-42.3999	36.29142	5.43195	-27.4023	26.95764	3.75239	-4.84048	1.863682	0.462778	-0.39718	-1.99885	-0.11056	-0.19147	-0.16903	0.001549	0.011236	-0.02633	-0.00259
12/10/2009 14:38	-20.9169	19.96556	2.822059	-42.1572	36.11968	5.40334	-27.291	26.98813	3.746811	-4.83101	1.888587	0.463844	-0.39156	-1.99885	-0.11095	-0.19147	-0.16528	0.001808	0.011236	-0.01317	-0.00168
12/10/2009 14:39	-20.8924	19.96746	2.820499	-41.8905	35.88117	5.368468	-27.1359	26.66414	3.713739	-4.81965	1.898166	0.463721	-0.38781	-1.99313	-0.11081	-0.18764	-0.16528	0.001544	0.016854	-0.0094	-0.00181
12/10/2009 14:40	-20.932	19.97886	2.824018	-41.7121	35.82775	5.352466	-27.0775	26.63556	3.707734	-4.81776	1.810042	0.457508	-0.38406	-1.98741	-0.11068	-0.19147	-0.17279	0.00129	0.016854	-0.01881	-0.00246
12/10/2009 14:41	-20.9791	20.04536	2.83186	-41.6422	35.84301	5.348695	-27.0592	26.62222	3.705553	-4.82155	1.827283	0.458959	-0.38219	-1.9855	-0.11067	-0.18956	-0.15964	0.002065	0.020599	-0.00752	-0.00194
12/10/2009 14:42	-20.8811	19.95416	2.8188	-41.6606	35.85637	5.350887	-27.0811	26.68892	3.711669	-4.82344	1.844525	0.46028	-0.37282	-1.98169	-0.11106	-0.18764	-0.15964	0.001933	0.014981	-0.00564	-0.00142
12/10/2009 14:43	-20.8623	20.03016	2.822745	-41.5135	35.79913	5.336779	-27.0282	26.6508	3.705385	-4.81019	1.857935	0.460291	-0.37095	-1.9855	-0.11145	-0.18764	-0.1634	0.001673	0.022472	-0.00188	-0.00168
12/10/2009 14:44	-20.8415	20.00926	2.819871	-41.3958	35.72853	5.32378	-26.9917	26.62031	3.700761	-4.81208	1.867514	0.461083	-0.3747	-1.97788	-0.11067	-0.18381	-0.14086	0.002965	0.024344	-0.00376	-0.00194
12/10/2009 14:45	-16.7349	14.96529	2.188218	-33.2463	27.96704	4.225467	-22.1436	21.0776	2.9835	-4.30477	1.597401	0.407419	-0.38781	-1.8215	-0.09897	-0.16658	-0.14838	0.001257	0.028089	0	-0.00194
12/10/2009 14:46	-22.2756	21.4554	3.018688	-43.5068	37.79149	5.611904	-28.1523	28.04982	3.879552	-4.93701	2.059092	0.482931	-0.3391	-1.99694	-0.11444	-0.17424	-0.14838	0.001785	0.028089	-0.0094	-0.00259
12/10/2009 14:47	-21.8064	20.75223	2.937762	-41.0242	35.39274	5.274953	-26.6449	26.15914	3.644989	-4.77423	1.957554	0.464685	-0.33535	-1.94546	-0.11114	-0.17807	-0.13898	0.002698	0.031835	0.003762	-0.00194
12/10/2009 14:48	-21.3146	20.37028	2.877446	-40.224	34.70786	5.172439	-26.216	25.70373	3.583944	-4.72312	1.94606	0.460364	-0.33535	-1.92829	-0.10996	-0.17233	-0.13147	0.00282	0.03558	-0.00188	-0.00259
12/10/2009 14:49	-21.0828	20.11567	2.843869	-39.7677	34.1852	5.104865	-25.9093	25.34934	3.538311	-4.6758	1.932649	0.456171	-0.33348	-1.91304	-0.10903	-0.16467	-0.12208	0.00294	0.033707	-0.00188	-0.00246
12/10/2009 14:50	-20.8151	19.87246	2.808607	-39.2985	33.80183	5.046013	-25.6592	25.09404	3.503424	-4.64172	1.930734	0.453687	-0.32973	-1.89969	-0.10837	-0.16084	-0.11457	0.003194	0.039325	0.003762	-0.00245
12/10/2009 14:51	-20.6757	19.70716	2.787569	-39.0832	33.54054	5.013115	-25.5077	24.89019	3.478893	-4.62279	1.930734	0.452381	-0.32599	-1.89016	-0.10797	-0.15701	-0.11645	0.0028	0.043071	0.007523	-0.00245
12/10/2009 14:52	-20.5362	19.61027	2.771253	-38.8477	33.36508	4.984744	-25.3342	24.80446	3.461003	-4.60197	1.934565	0.451208	-0.32599	-1.88062	-0.10731	-0.16275	-0.1202	0.002937	0.039325	0.016927	-0.00155
12/10/2009 14:53	-20.4457	19.50388	2.757663	-38.6986	33.17437	4.96129	-25.2119	24.61586	3.439541	-4.58304	1.923071	0.449108	-0.32599	-1.87109	-0.10666	-0.16084	0.274225	0.030032	0.052434	0.02257	-0.00206
12/10/2009 14:54	-42.7406	62.3786	7.256227	-101.62	136.058	16.40656	-80.8533	129.8503	14.54457	-12.9144	23.52998	2.515706	3.776666	-3.58136	-0.50791	0.365732	0.266711	-0.00684	0.106741	0.094042	-0.00088
12/10/2009 14:55	-60.0441	63.85604	8.552649	-132.013	138.3208	18.66075	-104.447	133.1986	16.40434	-17.4647	24.78249	2.916267	4.83053	-3.82918	-0.59777	0.54765	0.281738	-0.01836	0.125468	0.107208	-0.00126
12/10/2009 14:56	-59.859	63.58007	8.520821	-131.428	137.6261	18.57245	-104.131	132.6171	16.3424	-17.6063	24.85754	2.931221	4.824903	-3.87874	-0.6008	0.545735	0.272346	-0.01887	0.132958	0.103446	-0.00204
12/10/2009 14:57	-59.7973	63.45167	8.507698	-130.676	137.1066	18.48466	-103.584	131.987	16.26111	-17.6422	24.64588	2.919087	4.811776	-3.99311	-0.60779	0.553395	0.276103	-0.01914	0.129213	0.103446	-0.00178
12/10/2009 14:58	-60.1918	63.18913	8.516809	-130.748	136.7058	18.46197	-103.604	131.5631	16.23322	-17.8574	24.66319	2.935138	4.710505	-4.02552	-0.60304	0.539991	0.281738	-0.01783	0.131086	0.099685	-0.00217
12/10/2009 14:59	-60.1301	63.19105	8.512682	-130.553	136.5871	18.44033	-103.53	131.5028	16.22397	-17.8971	24.7113	2.941196	4.699253	-4.04267	-0.60344	0.545735	0.287373	-0.01783	0.131086	0.097804	-0.0023
12/10/2009 15:00	-59.9525	63.50916	8.52238	-130.258	136.8225	18.43615	-103.184	131.6758	16.21201	-17.7574	24.94413	2.947624	4.796772	-3.96642	-0.60491	0.55914	0.304278	-0.01759	0.136704	0.107208	-0.00204
12/10/2009 15:01	-59.9973	63.49958	8.524816	-130.126	136.7855	18.42451	-103.275	131.6739	16.21819	-17.7687	24.99031	2.951594	4.804274	-3.96452	-0.6053	0.57063	0.309912	-0.018	0.138576	0.118493	-0.00139
12/10/2009 15:02	-59.9375	63.47466	8.518966	-130.066	136.7097	18.41516	-103.252	131.6408	16.2143	-17.78	25.00763	2.953572	4.804274	-3.96452	-0.6053	0.564885	0.319304	-0.01695	0.144194	0.118493	-0.00177
12/10/2009 15:03	-59.9263	63.48808	8.519118	-129.967	136.7778	18.41301	-103.194	131.6369	16.21007	-17.7612	25.09423	2.958246	4.815526	-3.95689	-0.60555	0.576375	0.324939	-0.01736	0.157303	0.122255	-0.00242
12/10/2009 15:04	-59.8197	63.41334	8.506601	-129.873	136.6455	18.3974	-103.121	131.5767	16.20082	-17.7781	25.10962	2.960481	4.83053	-3.95499	-0.60645	0.58212	0.324939	-0.01775	0.15543	0.13354	-0.00151
12/10/2009 15:05	-59.8122	63.40376	8.505424	-129.817	136.6104	18.39112	-103.088	131.5942	16.1998	-17.7895	25.12694	2.962459	4.841782	-3.95308	-0.6071	0.58978	0.332452	-0.01776	0.157303	0.131659	-0.00177

TS	5A1 Comp. Strain	5B1 Tensile Strain	Moment (k*ft)	5A2 Comp. Strain	5B2 Tensile Strain	Moment (k*ft)	5A3 Comp. Strain	5B3 Tensile Strain	Moment (k*ft)	5A4 Comp. Strain	5B4 Tensile Strain	Moment (k*ft)	5A5 Comp. Strain	5B5 Tensile Strain	Moment (k*ft)	5A6 Comp. Strain	5B6 Tensile Strain	Moment (k*ft)	5A7 Comp. Strain	5B7 Tensile Strain	Moment (k*ft)
12/10/2009 15:06	-59.6813	63.36543	8.493743	-129.637	136.5988	18.37786	-103.013	131.5417	16.19097	-17.7932	25.15581	2.964712	4.83428	-3.9588	-0.60697	0.595525	0.341844	-0.01751	0.151685	0.129779	-0.00151
12/10/2009 15:07	-59.7617	63.33094	8.496912	-129.676	136.5424	18.3767	-103.044	131.5611	16.19442	-17.8065	25.19429	2.968281	4.845533	-3.95308	-0.60736	0.599355	0.347479	-0.01739	0.159176	0.13354	-0.00177
12/10/2009 15:08	-59.7935	63.32519	8.498709	-129.669	136.4957	18.37298	-103.027	131.565	16.19357	-17.8065	25.22508	2.970406	4.836156	-3.95118	-0.60658	0.603185	0.353114	-0.01726	0.162921	0.135421	-0.0019
12/10/2009 15:09	-59.7038	63.27153	8.48881	-129.483	136.4295	18.35558	-102.979	131.5514	16.18929	-17.8084	25.2424	2.971732	4.849284	-3.94736	-0.60722	0.6051	0.811449	0.014244	0.168539	0.146706	-0.00151
12/10/2009 15:10	-64.4697	83.50173	10.21426	-143.217	187.922	22.85803	-118.484	194.7529	21.6223	-19.8034	39.018	4.060359	6.391114	-4.13226	-0.72641	0.903846	0.97676	0.005033	0.20412	0.229466	0.00175
12/10/2009 15:11	-97.6136	106.4487	14.08613	-207.553	232.1826	30.3543	-173.393	239.0698	28.47173	-28.2391	47.84113	5.251712	10.40177	-4.66023	-1.03971	1.635465	0.984274	-0.04495	0.279029	0.274608	-0.00031
12/10/2009 15:12	-97.2778	106.0429	14.03494	-206.85	231.6162	30.26672	-172.995	238.7525	28.42238	-28.4972	48.07499	5.28567	10.38299	-4.73838	-1.04381	1.650788	0.98991	-0.04562	0.297756	0.276489	-0.00147
12/10/2009 15:13	-97.1572	105.9637	14.02114	-206.611	231.4242	30.23693	-172.84	238.6494	28.40452	-28.6234	48.22575	5.304789	10.38862	-4.77649	-1.04683	1.658449	1.014332	-0.04446	0.295884	0.280251	-0.00108
12/10/2009 15:14	-97.1293	105.9019	14.01495	-206.46	231.3113	30.21873	-172.748	238.5919	28.39421	-28.6931	48.35332	5.318406	10.40364	-4.79555	-1.04918	1.671857	1.01621	-0.04526	0.299629	0.285893	-0.00095
12/10/2009 15:15	-97.133	105.869	14.01294	-206.355	231.2024	30.20399	-172.654	238.5344	28.38377	-28.7459	48.43837	5.327918	10.41491	-4.80889	-1.05088	1.675688	1.014332	-0.04565	0.295884	0.282131	-0.00095
12/10/2009 15:16	-97.1794	105.8594	14.01548	-206.286	231.1311	30.19429	-172.571	238.5344	28.37804	-28.776	48.53309	5.336536	10.42054	-4.81652	-1.05179	1.689096	1.023725	-0.04593	0.303375	0.287774	-0.00108
12/10/2009 15:17	-97.1831	105.8342	14.014	-206.194	231.0381	30.1815	-172.467	238.459	28.36564	-28.808	48.60847	5.34395	10.42993	-4.81842	-1.05257	1.689096	1.027482	-0.04567	0.312738	0.306584	-0.00042
12/10/2009 15:18	-97.211	105.8342	14.01592	-206.148	230.9589	30.17285	-172.375	238.4055	28.3556	-28.8287	48.67226	5.349784	10.42993	-4.82224	-1.05284	1.704419	1.040632	-0.04582	0.305247	0.297179	-0.00056
12/10/2009 15:19	-97.2314	105.8826	14.02066	-206.082	230.8935	30.16381	-172.296	238.3499	28.34628	-28.8438	48.73992	5.355494	10.43556	-4.82224	-1.05322	1.702503	1.055661	-0.04465	0.320229	0.302822	-0.0012
12/10/2009 15:20	-97.2666	105.8806	14.02296	-205.981	230.8302	30.15245	-172.202	238.3043	28.33666	-28.8514	48.79791	5.360017	10.44307	-4.82033	-1.05361	1.715911	1.732004	0.001111	0.318357	0.314107	-0.00029
12/10/2009 15:21	-107.496	140.1408	17.09402	-232.548	309.7415	37.43346	-200.047	331.4749	36.69018	-32.7847	67.48499	6.921473	13.28839	-4.77268	-1.24673	2.279069	1.795886	-0.03335	0.402631	0.438251	0.002459
12/10/2009 15:22	-137.27	152.3125	19.98944	-284.463	328.8294	42.3347	-242.053	346.6056	40.63425	-39.4673	70.87316	7.616645	15.69927	-5.15766	-1.43972	2.83271	1.812796	-0.0704	0.456942	0.462704	0.000398
12/10/2009 15:23	-136.96	151.9675	19.94428	-283.804	328.4445	42.26267	-241.868	346.3469	40.60366	-39.8357	71.20122	7.66472	15.68047	-5.17672	-1.43974	2.846121	1.810917	-0.07146	0.458815	0.472109	0.000918
12/10/2009 15:24	-136.948	151.948	19.94205	-283.56	328.3478	42.23915	-241.75	346.3206	40.59369	-39.9635	71.4303	7.689354	15.69927	-5.21864	-1.44393	2.863363	1.829706	-0.07135	0.473797	0.475871	0.000143
12/10/2009 15:25	-136.843	151.8388	19.92727	-283.472	328.2471	42.22606	-241.681	346.2863	40.58651	-40.065	71.61085	7.708822	15.71055	-5.23961	-1.44616	2.874858	1.835342	-0.07176	0.470051	0.496562	0.00183
12/10/2009 15:26	-136.753	151.8349	19.92078	-283.248	328.1584	42.20455	-241.609	346.2276	40.57754	-40.1326	71.74675	7.722874	15.71994	-5.25485	-1.44786	2.895933	1.844737	-0.07256	0.485034	0.498443	0.000926
12/10/2009 15:27	-136.699	151.909	19.92221	-283.008	328.0456	42.18015	-241.501	346.1488	40.56466	-40.1571	71.86906	7.733003	15.7237	-5.26247	-1.44865	2.899764	1.859768	-0.07179	0.486907	0.490919	0.000277
12/10/2009 15:28	-136.605	151.7706	19.90618	-282.848	327.9348	42.16144	-241.446	346.0882	40.55663	-40.2153	71.9739	7.744262	15.73122	-5.2701	-1.44969	2.911259	1.859768	-0.07258	0.492525	0.496562	0.000279
12/10/2009 15:29	-136.5	151.6731	19.89221	-282.703	327.7757	42.14046	-241.361	345.9952	40.54433	-40.2379	72.0671	7.752252	15.74062	-5.27772	-1.45087	2.915091	1.857889	-0.07298	0.488779	0.500324	0.000797
12/10/2009 15:30	-136.605	151.7043	19.9016	-282.638	327.7334	42.13309	-241.331	345.9426	40.53866	-40.2773	72.12341	7.758862	15.73686	-5.29297	-1.45166	2.922754	1.871042	-0.0726	0.496271	0.507848	0.000799
12/10/2009 15:31	-136.602	151.6478	19.89745	-282.509	327.6709	42.11988	-241.275	345.8941	40.53147	-40.3112	72.19913	7.766424	15.7425	-5.29487	-1.45218	2.932334	1.869163	-0.07339	0.498144	0.507848	0.00067
12/10/2009 15:32	-136.508	151.6439	19.8907	-282.426	327.5682	42.10701	-241.192	345.9406	40.52891	-40.3281	72.26126	7.771881	15.7425	-5.31774	-1.45376	2.939997	1.863526	-0.07431	0.505635	0.504086	-0.00011
12/10/2009 15:33	-136.839	151.4802	19.90226	-282.748	327.3103	42.11147	-241.31	345.5425	40.50959	-40.4953	72.08651	7.771363	15.65792	-5.38825	-1.45279	2.922754	1.859768	-0.07338	0.496271	0.505967	0.000669
12/10/2009 15:34	-136.846	151.4353	19.89968	-282.74	327.3345	42.11254	-241.383	345.5505	40.5152	-40.5085	72.1467	7.776426	15.65792	-5.39778	-1.45344	2.934249	1.861647	-0.07404	0.511253	0.524777	0.000934
12/10/2009 15:35	-136.903	151.5113	19.90886	-282.558	327.2841	42.09655	-241.347	345.591	40.51546	-40.5273	72.20301	7.78161	15.67296	-5.39968	-1.45461	2.930418	2.100274	-0.0573	0.500016	0.509729	0.00067
12/10/2009 15:36	-136.565	155.1399	20.13596	-282.021	339.2261	42.88382	-241.014	363.9028	41.75657	-40.3882	76.54629	8.071821	15.75566	-5.15575	-1.44348	2.961071	2.671524	-0.01999	0.514999	0.579327	0.00444
12/10/2009 15:37	-175.943	197.891	25.80519	-358.812	423.7466	54.01893	-308.571	450.5362	52.4001	-49.6983	93.40708	9.878357	20.56974	-5.46066	-1.79684	4.051313	2.692195	-0.09382	0.647971	0.688429	0.002793
12/10/2009 15:38	-175.568	197.4899	25.75168	-357.797	423.255	53.91492	-308.349	450.2749	52.3667	-50.4166	93.88665	9.961044	20.5735	-5.59977	-1.8067	4.087723	2.697833	-0.09594	0.661081	0.694072	0.002277
12/10/2009 15:39	-175.426	197.3601	25.7329	-357.41	423.0215	53.87209	-308.241	450.1865	52.35315	-50.7935	94.1596	10.0059	20.58291	-5.66647	-1.81196	4.106885	2.712867	-0.09623	0.662954	0.699715	0.002538
12/10/2009 15:40	-175.353	197.2717	25.72175	-357.09	422.8679	53.83938	-308.083	450.0774	52.33475	-50.981	94.37211	10.03352	20.60172	-5.70458	-1.81589	4.131797	2.724142	-0.09717	0.661081	0.699715	0.002667
12/10/2009 15:41	-175.359	197.2166	25.71833	-356.956	422.743	53.82154	-308.025	450.0239	52.32704	-51.1123	94.52809	10.05334	20.60737	-5.73316	-1.81825	4.147128	2.726021	-0.0981	0.674191	0.714764	0.002801
12/10/2009 15:42	-175.324	197.2147	25.7158	-356.775	422.6426	53.80208	-307.936	449.9725	52.31735	-51.221	94.67433	10.07095	20.61301	-5.75222	-1.81995	4.158626	2.739176	-0.09798	0.677937	0.716645	0.002672
12/10/2009 15:43	-175.236	197.1282	25.70378	-356.58	422.53	53.78083	-307.871	449.9272	52.30973	-51.3054	94.80887	10.08606	20.63182	-5.76746	-1.82231	4.168207	2.746693	-0.09813	0.683556	0.72417	0.002804
12/10/2009 15:44	-175.196	197.1026	25.69925	-356.444	422.4214	53.764	-307.792	449.8573	52.29947	-51.3729	94.90246	10.09718	20.63559	-5.78461	-1.82375	4.177789	2.741055	-0.09918	0.685429	0.712883	0.001895
12/10/2009 15:45	-175.141	197.0613	25.69262	-356.278	422.3231	53.74575	-307.71	449.7976	52.28968	-51.4291	95.00581	10.10819	20.64688	-5.79224	-1.82505	4.18737	2.756089	-0.0988	0.687301	0.714764	0.001896
12/10/2009 15:46	-175.116	196.9414	25.68258	-356.134	422.2126	53.72818	-307.64	449.8017	52.28512	-51.4835	95.09746	10.11827	20.65064	-5.80367	-1.8261	4.193119	3.601825	-0.04082	0.687301	0.714764	0.001896
12/10/2009 15:47	-214.179	243.462	31.5903	-432.595	516.3306	65.50294	-374.392	553.5138	64.052	-60.6731	112.4961	11.95363	25.81416	-5.87608	-2.18753	5.293206	3.645056	-0.11377	0.831516	0.895352	0.004407
12/10/2009 15:48	-214.351	242.5719	31.54072	-431.675	514.111	65.28627	-374.331	553.2815	64.03178	-62.4544	113.2494	12.12858	25.84241	-6.15046	-2.20842	5.39671	3.661972	-0.11975	0.844626	0.900996	0.003891
12/10/2009 15:49	-214.161	242.332	31.51105	-430.919	513.3145	65.17907	-372.645	553.0241	63.89762	-62.937	113.6485	12.18945	25.85936	-6.25144	-2.21656	5.436963	3.675129	-0.12162	0.857737	0.917926	0.004155
12/10/2009 15:50	-214.002	242.1576	31.48801	-430.611	512.8945	65.12883	-371.204	552.8609	63.7869	-63.2886	113.9421	12.23398	25.88384	-6.31241	-2.22246	5.459964	3.660092	-0.12424	0.853991	0.910402	0.003894
12/10/2009 15:51	-214.271	241.8246	31.48364	-430.599	512.2707	65.08496	-370.439	552.3754	63.70056	-63.7169	113.8618	12.25801	25.77837	-6.46674	-2.22583	5.454214	3.660092	-0.12385	0.822151	0.885947	0.004404
12/10/2009 15:52	-214.199	241.7869	31.47604	-430.228	512.0545	65.04438	-370.176	552.1976	63.67013	-63.902	114.0379	12.28294	25.78591	-6.51056	-2.22938	5.471465	3.699564	-0.12231	0.833389	0.897234	0.004407
12/10/2009 15:53	-213.866	241.9177	31.46209	-429.676	512.1023	65.00961	-369.635	552.2896	63.63913	-63.9207	114.4352	12.31166	25.88196	-6.46103	-2.23259	5.502134	3.695805	-0.12469	0.835262	0.889709	0.003758
12/10/2009 15:54	-213.705	241.8048	31.44317	-429.318	511.7198	64.95847	-369.476	552.1997	63.62198	-64.0348	114.5781	12.32939	25.89891	-6.47627	-2.23481	5.523219	3.707083	-0.12537	0.842753	0.897234	0.003761
12/10/2009 15:55	-213.649	241.8048	31.4393	-429.06	511.6907	64.9387	-369.343	552.0888	63.60512	-64.1302	114.7327	12.34665	25.91963	-6.4858	-2.2369	5.53472	3.72024	-0.12525	0.844626	0.895352	0.003502
12/10/2009 15:56	-213.594	241.8266	31.43705	-428.793	511.5867	64.91306	-369.178	552.0469	63.59083	-64.1826	114.8951	12.36148	25.94788	-6.47436	-2.23806	5.555805	3.744675	-0.12502	0.846499	0.902877	0.003892
12/10/2009 15:57	-213.596	241.8642	31.43978	-428.652	511.5306	64.89943	-369.075	552.0239	63.58214	-64.2499	115.0341	12.37572	25.96483	-6.48199	-2.23976	5.567306	3.748434	-0.12555	0.848372	0.916045	0.004671
12/10/2009 15:58	-213.547	241.9098	31.43965	-428.531	511.4183	64.88332	-368.964	551.98	63.57142	-64.3135	115.1515	12.38821	25.97802	-6.49151	-2.24133	5.580724	3.752194	-0.12622	0.846499	0.917926	0.004931

TS	5A1 Comp. Strain	5B1 Tensile Strain	Moment (k*ft)	5A2 Comp. Strain	5B2 Tensile Strain	Moment (k*ft)	5A3 Comp. Strain	5B3 Tensile Strain	Moment (k*ft)	5A4 Comp. Strain	5B4 Tensile Strain	Moment (k*ft)	5A5 Comp. Strain	5B5 Tensile Strain	Moment (k*ft)	5A6 Comp. Strain	5B6 Tensile Strain	Moment (k*ft)	5A7 Comp. Strain	5B7 Tensile Strain	Moment (k*ft)
12/10/2009 15:59	-213.54	241.8781	31.43686	-428.394	511.3248	64.86746	-368.915	551.9277	63.56444	-64.3826	115.2455	12.39947	25.98555	-6.49342	-2.24198	5.594142	3.755953	-0.12689	0.855864	0.916045	0.004154
12/10/2009 16:00	-213.569	241.89	31.43968	-428.271	511.2728	64.8554	-368.809	551.9025	63.55537	-64.435	115.3492	12.41025	26.01569	-6.49723	-2.24432	5.603726	3.77099	-0.12651	0.857737	0.925451	0.004674
12/10/2009 16:01	-213.544	241.9118	31.43944	-428.189	511.1709	64.84267	-368.734	551.8649	63.54765	-64.4855	115.4255	12.419	26.01192	-6.50485	-2.24459	5.617144	3.778509	-0.12692	0.855864	0.919808	0.004414
12/10/2009 16:02	-213.469	241.9415	31.43637	-427.969	511.1107	64.8233	-368.625	551.8105	63.53633	-64.536	115.5195	12.42897	26.04582	-6.50104	-2.24666	5.626728	4.01159	-0.11149	0.868975	0.927332	0.004028
12/10/2009 16:03	-213.578	243.3034	31.53787	-427.992	519.8789	65.43018	-368.577	568.8547	64.7096	-64.5827	118.76	12.65589	26.04582	-6.26478	-2.23035	5.636312	4.912063	-0.04999	0.872721	0.980005	0.007406
12/10/2009 16:04	-253.837	285.7222	37.24501	-507.217	585.0669	75.39881	-439.952	658.9122	75.85305	-76.8502	138.2418	14.84749	31.3564	-6.66298	-2.62442	7.135515	4.949665	-0.15089	1.033798	1.149316	0.007974
12/10/2009 16:05	-253.577	285.2607	37.19519	-505.875	583.8845	75.22454	-439.244	657.8758	75.73258	-77.9355	138.9495	14.97126	31.39411	-6.8554	-2.64031	7.239057	4.964706	-0.157	1.058147	1.160603	0.007072
12/10/2009 16:06	-253.281	284.8771	37.14828	-505.151	583.1461	75.1236	-438.766	657.3332	75.66219	-78.4334	139.3879	15.03589	31.42239	-6.95066	-2.64884	7.294664	4.991027	-0.15902	1.052528	1.168128	0.00798
12/10/2009 16:07	-253.143	284.6774	37.12496	-504.694	582.6603	75.05852	-438.475	657.1821	75.63163	-78.7074	139.7359	15.07883	31.44125	-7.01734	-2.65474	7.331096	4.998547	-0.16101	1.063766	1.183178	0.008243
12/10/2009 16:08	-253.051	284.5475	37.10968	-504.362	582.2796	75.00935	-438.291	656.8651	75.59706	-78.9722	139.9994	15.11529	31.46765	-7.06306	-2.65972	7.363693	5.022989	-0.16158	1.076877	1.179416	0.007078
12/10/2009 16:09	-252.933	284.3558	37.08826	-504.052	581.9726	74.96675	-438.097	656.6204	75.56678	-79.181	140.2196	15.14491	31.49593	-7.10878	-2.66483	7.392456	5.019229	-0.16382	1.082496	1.18506	0.00708
12/10/2009 16:10	-252.847	284.0602	37.06191	-503.775	581.6802	74.92743	-438.011	656.4672	75.55026	-79.4084	140.3553	15.16997	31.49216	-7.16783	-2.66864	7.405878	5.053071	-0.16241	1.082496	1.196347	0.007859
12/10/2009 16:11	-252.732	284.2	37.06364	-503.521	581.5583	74.90147	-437.84	656.4204	75.53525	-79.5314	140.5932	15.19489	31.5261	-7.17164	-2.67125	7.434641	5.054951	-0.16427	1.089988	1.203872	0.007861
12/10/2009 16:12	-252.619	284.1161	37.05004	-503.339	581.3774	74.87646	-437.757	656.3289	75.52322	-79.6656	140.7564	15.21542	31.53553	-7.19641	-2.67361	7.451899	5.064352	-0.16481	1.089988	1.207635	0.008121
12/10/2009 16:13	-252.547	284.0742	37.04219	-503.14	581.2197	74.85179	-437.64	656.2417	75.50907	-79.7793	140.9059	15.23359	31.55061	-7.20974	-2.67557	7.472992	5.540048	-0.13343	1.101227	1.213279	0.007735
12/10/2009 16:14	-252.49	294.7542	37.77545	-502.952	606.6162	76.59188	-437.53	694.6974	78.15607	-79.9061	148.1537	15.74264	31.71278	-6.8916	-2.66481	7.549694	6.37686	-0.08096	1.125576	1.314869	0.013067
12/10/2009 16:15	-292.811	344.6545	44.0033	-582.84	668.608	86.38569	-509.413	764.1578	87.91275	-92.9934	165.5814	17.84904	36.684	-7.33928	-3.03886	9.293063	6.408831	-0.19909	1.305393	1.46914	0.011303
12/10/2009 16:16	-292.193	343.8773	43.90705	-580.689	666.8512	86.11595	-508.237	762.8514	87.74141	-94.4913	166.5692	18.02064	36.70099	-7.5412	-3.05398	9.415831	6.431398	-0.20601	1.311012	1.495479	0.012733
12/10/2009 16:17	-291.793	343.203	43.83288	-579.598	665.8003	85.96808	-507.642	762.2113	87.65613	-95.2736	167.1205	18.11269	36.69721	-7.63454	-3.06016	9.484889	6.450205	-0.20948	1.329743	1.501123	0.01183
12/10/2009 16:18	-291.663	342.9184	43.80427	-579.11	665.2611	85.89715	-507.354	761.9064	87.6152	-95.7733	167.575	18.17856	36.71043	-7.6993	-3.06554	9.525173	6.461489	-0.21148	1.342855	1.512411	0.011704
12/10/2009 16:19	-291.466	342.6177	43.76988	-578.597	664.7923	85.8294	-507.061	761.6491	87.57722	-96.156	167.8971	18.22721	36.71798	-7.76216	-3.0704	9.563539	6.476534	-0.21309	1.337236	1.5237	0.012871
12/10/2009 16:20	-291.402	342.428	43.75237	-578.261	664.43	85.78117	-506.826	761.368	87.54165	-96.4569	168.2035	18.26913	36.73685	-7.79073	-3.07368	9.584641	6.480296	-0.21429	1.346601	1.53687	0.013134
12/10/2009 16:21	-291.222	342.2	43.72422	-577.95	664.0912	85.73635	-506.641	761.1172	87.51153	-96.6798	168.4565	18.30198	36.75384	-7.8193	-3.07682	9.615334	6.497222	-0.21524	1.367206	1.542514	0.012101
12/10/2009 16:22	-291.087	342.1071	43.70848	-577.714	663.8526	85.70357	-506.498	760.9204	87.48806	-96.873	168.6838	18.331	36.76517	-7.85168	-3.07984	9.636436	6.502864	-0.21631	1.367206	1.550039	0.012621
12/10/2009 16:23	-290.824	342.1535	43.69351	-577.669	663.7354	85.69235	-506.384	760.821	87.47333	-97.0476	168.8735	18.35615	36.76894	-7.87835	-3.08194	9.657538	6.514148	-0.21698	1.370952	1.546277	0.012102
12/10/2009 16:24	-291.108	341.9235	43.69728	-577.47	663.4371	85.65803	-506.296	760.6523	87.45563	-97.2222	169.0455	18.38008	36.77083	-7.90883	-3.08417	9.680558	6.514148	-0.21857	1.374699	1.557565	0.012623
12/10/2009 16:25	-291.034	341.7459	43.67986	-577.289	663.224	85.63081	-506.195	760.5183	87.43941	-97.3652	169.2175	18.40182	36.78971	-7.92787	-3.08679	9.69015	6.527313	-0.21833	1.380318	1.563209	0.012625
12/10/2009 16:26	-290.998	341.5804	43.66598	-577.138	663.0643	85.6094	-506.099	760.3648	87.42219	-97.4933	169.3796	18.42185	36.79537	-7.9393	-3.08797	9.707415	6.499102	-0.22147	1.376572	1.563209	0.012883
12/10/2009 16:27	-291.354	341.425	43.67982	-577.361	662.7255	85.60143	-506.306	760.1075	87.41869	-97.7997	169.2946	18.43714	36.71043	-8.04596	-3.08947	9.703579	6.508506	-0.22065	1.384064	1.566972	0.012626
12/10/2009 16:28	-291.332	341.3645	43.67417	-577.25	662.6084	85.58563	-506.205	760.0794	87.40979	-97.9185	169.433	18.45489	36.71798	-8.07644	-3.09209	9.707415	6.516029	-0.2203	1.391557	1.566972	0.012109
12/10/2009 16:29	-291.316	341.2777	43.66707	-577.161	662.4656	85.56964	-506.143	760.0167	87.40119	-98.0002	169.5753	18.47036	36.71798	-8.09358	-3.09328	9.724681	6.538597	-0.21993	1.395303	1.576379	0.012499
12/10/2009 16:30	-291.404	341.4291	43.68354	-577.099	662.5935	85.57422	-506.172	760.3518	87.42635	-97.9742	169.9924	18.49736	36.81613	-8.02882	-3.09558	9.74962	6.540478	-0.22152	1.395303	1.585786	0.013149
12/10/2009 16:31	-291.08	341.5986	43.67289	-576.593	662.5658	85.53734	-505.783	760.2697	87.39382	-97.9817	170.1269	18.50715	36.85577	-8.02501	-3.09806	9.772641	6.717266	-0.21091	1.410288	1.580142	0.011725
12/10/2009 16:32	-291.044	351.119	44.32761	-576.457	682.1091	86.87701	-506.324	786.0374	89.20983	-98.1042	174.0034	18.7832	37.07285	-7.82883	-3.0995	9.847459	7.738627	-0.14557	1.414035	1.632822	0.015103
12/10/2009 16:33	-334.846	398.031	50.58943	-659.284	754.5874	97.59753	-581.126	870.1292	100.1781	-110.884	195.9113	21.17766	42.58991	-7.8574	-3.48231	11.42273	7.766845	-0.25236	1.597608	1.849192	0.017367
12/10/2009 16:34	-333.692	397.4991	50.47307	-656.506	752.0271	97.22904	-579.539	867.9055	99.91503	-112.641	197.447	21.40495	42.56156	-8.05739	-3.49415	11.56282	7.77625	-0.26138	1.601354	1.852955	0.017368
12/10/2009 16:35	-333.073	397.7844	50.45007	-655.335	750.7873	97.06261	-578.671	866.8072	99.77931	-113.448	198.3928	21.52595	42.54077	-8.16024	-3.49982	11.61271	7.783775	-0.26431	1.610721	1.83414	0.015422
12/10/2009 16:36	-332.839	397.1466	50.38987	-654.602	749.9818	96.9564	-578.132	866.1131	99.69417	-113.993	199.5098	21.64061	42.55022	-8.24024	-3.50599	11.65877	7.796943	-0.26658	1.603228	1.839785	0.016329
12/10/2009 16:37	-332.659	396.8389	50.35622	-653.956	749.3836	96.87051	-577.751	865.6541	99.63616	-114.429	200.6925	21.75241	42.53322	-8.28214	-3.50771	11.69332	7.802587	-0.26857	1.597608	1.847311	0.017237
12/10/2009 16:38	-332.49	396.5843	50.32696	-653.438	748.941	96.80421	-577.431	865.3181	99.59093	-114.766	201.1617	21.80804	42.5351	-8.32214	-3.5106	11.71827	7.810112	-0.26977	1.610721	1.851074	0.016591
12/10/2009 16:39	-332.395	396.3805	50.30633	-653.037	748.5977	96.75285	-577.189	865.0655	99.55675	-115.047	201.6091	21.85834	42.53888	-8.36404	-3.51376	11.74321	7.819517	-0.27085	1.612594	1.851074	0.016462
12/10/2009 16:40	-332.222	396.189	50.28119	-652.63	748.3063	96.70462	-576.973	864.8525	99.52718	-115.282	201.9631	21.89899	42.54644	-8.39451	-3.51638	11.77008	7.821399	-0.27257	1.612594	1.860482	0.017111
12/10/2009 16:41	-332.09	396.024	50.26067	-652.3	748.0494	96.66414	-576.798	864.6659	99.50217	-115.488	202.2633	21.93389	42.55589	-8.41736	-3.51861	11.78927	7.838329	-0.27273	1.62758	1.864245	0.016337
12/10/2009 16:42	-332.035	395.8834	50.2472	-652.002	747.84	96.62912	-576.609	864.51	99.47841	-115.669	202.5318	21.96494	42.55589	-8.4326	-3.51966	11.80271	7.830805	-0.27417	1.635073	1.868008	0.016079
12/10/2009 16:43	-331.949	395.7592	50.23266	-651.766	747.6176	96.59748	-576.507	864.387	99.46287	-115.834	202.7307	21.99003	42.55967	-8.45545	-3.5215	11.81998	8.940831	-0.19874	1.629453	1.869889	0.016597
12/10/2009 16:44	-365.613	441.9151	55.74251	-724.58	836.4273	107.7541	-644.02	975.5347	111.7965	-126.104	229.3863	24.539	47.3318	-7.98882	-3.8187	13.28643	9.027386	-0.294	1.753089	2.1446	0.027025
12/10/2009 16:45	-373.039	440.9809	56.19064	-732.527	836.2544	108.2908	-652.359	976.4117	112.4317	-132.461	233.5563	25.26563	47.70067	-8.24595	-3.86192	13.71454	9.025505	-0.32368	1.796175	2.202931	0.028078
12/10/2009 16:46	-372.397	439.5994	56.05093	-730.843	834.3666	108.0442	-651.542	974.5887	112.2495	-133.987	234.3683	25.42702	47.56258	-8.45545	-3.86684	13.78174	9.023623	-0.32845	1.798048	2.204813	0.028078
12/10/2009 16:47	-372.343	439.1499	56.01617	-729.45	833.5267	107.8901	-650.976	973.9194	112.1642	-134.681	235.0323	25.52081	47.52853	-8.55639	-3.87146	13.82781	9.038676	-0.33059	1.805541	2.208576	0.027821
12/10/2009 16:48	-372.028	438.7826	55.96911	-728.66	832.6585	107.7756	-650.586	973.2077	112.0881	-135.195	235.5444	25.59165	47.49826	-8.62114	-3.87384	13.86429	9.049966	-0.33233	1.803668	2.217984	0.0286
12/10/2009 16:49	-371.726	438.5568	55.93268	-728.026	832.3109	107.7078	-650.226	972.9044	112.0424	-135.553	236.0025	25.64794	47.50393	-8.6021	-3.87292	13.89885	9.063138	-0.3338	1.813034	2.223629	0.028343
12/10/2009 16:50	-371.216	438.2777	55.87821	-727.24	832.055	107.6359	-649.762	972.601	111.9894	-135.698	236.4487	25.68878	47.56636	-8.61353	-3.87802	13.94685	9.068783	-0.33673	1.831767	2.234919	0.027829
12/10/2009 16:51	-371.089	437.9453	55.84646	-726.835	831.6855	107.5825	-649.505	972.4092	111.9584	-135.918	236.7668	25.72588	47.5796	-8.63638	-3.88051	13.97565	9.085718	-0.33754	1.820528	2.246209	0.029384

TS	5A1 Comp. Strain	5B1 Tensile Strain	Moment (k*ft)	5A2 Comp. Strain	5B2 Tensile Strain	Moment (k*ft)	5A3 Comp. Strain	5B3 Tensile Strain	Moment (k*ft)	5A4 Comp. Strain	5B4 Tensile Strain	Moment (k*ft)	5A5 Comp. Strain	5B5 Tensile Strain	Moment (k*ft)	5A6 Comp. Strain	5B6 Tensile Strain	Moment (k*ft)	5A7 Comp. Strain	5B7 Tensile Strain	Moment (k*ft)
12/10/2009 16:52	-370.883	437.7668	55.81991	-726.412	831.3926	107.533	-649.21	972.5742	111.9494	-136.08	237.091	25.75944	47.59095	-8.64019	-3.88156	14.00637	9.089481	-0.33941	1.843007	2.248091	0.027962
12/10/2009 16:53	-370.764	437.5555	55.79713	-725.996	831.0384	107.4799	-648.98	972.3512	111.9182	-136.258	237.3932	25.79263	47.59663	-8.65923	-3.88326	14.02941	9.100771	-0.34022	1.843007	2.261263	0.028872
12/10/2009 16:54	-370.676	437.4385	55.78302	-725.705	830.8854	107.4492	-648.824	972.2441	111.9	-136.426	237.6393	25.82119	47.60609	-8.67447	-3.88497	14.04861	9.098889	-0.34167	1.841134	2.265026	0.029261
12/10/2009 16:55	-370.463	437.1841	55.75075	-725.368	830.5553	107.4032	-648.641	972.0367	111.873	-136.551	237.8855	25.84683	47.60041	-8.6878	-3.88549	14.06589	9.112061	-0.34196	1.843007	2.270671	0.029521
12/10/2009 16:56	-370.556	437.1739	55.75643	-725.283	830.4307	107.3887	-648.527	971.9497	111.8592	-136.684	238.1096	25.87146	47.60798	-8.70494	-3.8872	14.08509	9.112061	-0.34328	1.844881	2.272553	0.029522
12/10/2009 16:57	-370.5	437.1349	55.74988	-725.126	830.2951	107.3685	-648.386	971.8115	111.8399	-136.793	238.3117	25.89291	47.62122	-8.71827	-3.88903	14.10045	9.119588	-0.34382	1.869234	2.276316	0.0281
12/10/2009 16:58	-370.24	436.9954	55.72229	-724.811	830.8941	107.3881	-648.223	971.7178	111.8222	-136.903	238.4999	25.91353	47.62122	-8.72018	-3.88917	14.11965	9.13276	-0.34424	1.871107	2.281961	0.028361
12/10/2009 16:59	-370.418	436.8866	55.72708	-724.769	830.7608	107.376	-648.117	971.5862	111.8058	-137.004	238.69	25.93364	47.63446	-8.7297	-3.89074	14.13309	9.853498	-0.29541	1.861741	2.289488	0.029527
12/10/2009 17:00	-386.415	470.8099	59.17304	-761.704	896.3936	114.4561	-683.646	1058.327	120.2459	-140.292	255.5726	27.32598	49.99399	-8.11453	-4.01115	14.71105	10.17909	-0.31283	1.955408	2.487069	0.0367
12/10/2009 17:01	-416.564	490.8274	62.63595	-812.931	927.8096	120.1608	-730.113	1092.353	125.8022	-152.705	268.832	29.09811	52.79585	-8.20595	-4.21087	15.89981	10.22238	-0.39191	2.1109	2.671485	0.038696
12/10/2009 17:02	-418.216	491.9351	62.82641	-814.453	929.7148	120.3974	-732.446	1095.327	126.1685	-152.988	271.1768	29.27947	52.9625	-8.28785	-4.22802	16.0746	10.24496	-0.40241	2.139002	2.712885	0.039614
12/10/2009 17:03	-417.133	490.6245	62.66118	-812.026	927.2973	120.063	-730.957	1093.185	125.9179	-153.551	272.1008	29.38215	52.9	-8.36213	-4.22884	16.15911	10.24684	-0.40812	2.148369	2.733586	0.040397
12/10/2009 17:04	-416.549	489.8213	62.56543	-810.586	925.8672	119.8649	-730.073	1092.008	125.7757	-153.993	272.7653	29.45855	52.8716	-8.42308	-4.23108	16.20713	10.2619	-0.41039	2.174597	2.739231	0.038976
12/10/2009 17:05	-416.234	489.1858	62.49985	-809.478	924.843	119.7177	-729.423	1091.119	125.6694	-154.337	273.2345	29.51462	52.83183	-8.46879	-4.23149	16.24747	10.26755	-0.41279	2.16523	2.750523	0.040402
12/10/2009 17:06	-415.87	488.7471	62.4444	-808.738	924.085	119.6143	-728.925	1090.486	125.5914	-154.61	273.6252	29.56046	52.81479	-8.50688	-4.23295	16.2782	10.27696	-0.41426	2.172724	2.75805	0.040404
12/10/2009 17:07	-415.576	488.3621	62.39754	-808.023	923.4999	119.5245	-728.518	1090.01	125.5303	-154.938	273.9958	29.60871	52.79396	-8.53544	-4.23348	16.30701	10.28449	-0.41573	2.193331	2.763696	0.039371
12/10/2009 17:08	-415.33	488.0227	62.35718	-807.421	922.9946	119.4481	-728.156	1089.586	125.4761	-155.153	274.2939	29.6441	52.77881	-8.55068	-4.23349	16.32814	10.29578	-0.41641	2.200825	2.780632	0.040023
12/10/2009 17:09	-415.118	487.7475	62.3235	-806.869	922.5913	119.3821	-727.846	1089.225	125.4298	-155.331	274.5678	29.67529	52.77691	-8.57353	-4.23493	16.35119	10.30143	-0.41761	2.206446	2.786278	0.040025
12/10/2009 17:10	-414.952	487.4702	62.29291	-806.393	922.1503	119.3189	-727.551	1088.908	125.3875	-155.501	274.8176	29.70431	52.77123	-8.58686	-4.23546	16.3704	10.30707	-0.41854	2.212066	2.793806	0.040157
12/10/2009 17:11	-414.738	487.2737	62.26454	-806.047	921.7847	119.2697	-727.354	1088.631	125.3548	-155.67	275.0331	29.73084	52.74283	-8.60781	-4.23495	16.38192	10.30895	-0.41921	2.202699	2.805097	0.041583
12/10/2009 17:12	-414.615	487.0192	62.2385	-805.588	921.4524	119.2151	-727.062	1088.411	125.3195	-155.771	275.2487	29.75268	52.76745	-8.61543	-4.23717	16.40305	10.30895	-0.42067	2.212066	2.808861	0.041196
12/10/2009 17:13	-414.513	486.8288	62.21832	-805.294	921.1621	119.1748	-726.86	1088.203	125.2912	-155.907	275.438	29.77512	52.76745	-8.62495	-4.23783	16.42226	10.32213	-0.42108	2.21956	2.812624	0.040938
12/10/2009 17:14	-414.426	486.6551	62.20036	-805.028	920.914	119.1393	-726.672	1087.996	125.264	-156.008	275.6274	29.79516	52.76555	-8.63448	-4.23836	16.43955	10.40306	-0.41669	2.238295	2.823916	0.040425
12/10/2009 17:15	-436.114	509.1613	65.25099	-823.606	940.3106	121.7607	-736.078	1101.899	126.873	-156.461	277.3623	29.94618	53.23899	-8.55258	-4.26538	16.52599	10.42753	-0.42097	2.238295	2.838971	0.041464
12/10/2009 17:16	-439.043	513.767	65.77114	-825.2	943.026	122.0581	-737.165	1103.655	127.0692	-156.787	277.9729	30.01087	53.38967	-8.55258	-4.2744	16.57978	10.43318	-0.42429	2.245789	2.852144	0.041856
12/10/2009 17:17	-436.276	510.6089	65.36208	-823.432	941.1505	121.8066	-736.706	1102.946	126.9886	-157.029	278.2712	30.04817	53.38671	-8.57544	-4.27716	16.60667	10.48588	-0.42251	2.260776	2.854026	0.040951
12/10/2009 17:18	-457.712	531.3019	68.27023	-836.951	956.8618	123.8244	-740.778	1109.794	127.7424	-157.225	278.9848	30.11097	53.63103	-8.54497	-4.29192	16.66622	10.48776	-0.42649	2.270144	2.870963	0.041474
12/10/2009 17:19	-452.147	524.1403	67.3917	-833.789	952.9902	123.3388	-740.056	1108.705	127.6173	-157.543	279.2731	30.15276	53.63103	-8.56401	-4.29323	16.68927	10.5047	-0.42691	2.285132	2.886018	0.041478
12/10/2009 17:20	-450.293	522.2794	67.13527	-832.529	951.7127	123.1637	-739.716	1108.284	127.5648	-157.739	279.521	30.18342	53.66134	-8.57734	-4.29625	16.71616	10.51788	-0.42786	2.287005	2.889782	0.041609
12/10/2009 17:21	-449.27	521.2597	66.99425	-831.621	950.8382	123.0406	-739.491	1108.037	127.5322	-157.924	279.7549	30.21235	53.67081	-8.59067	-4.29782	16.73537	10.51788	-0.42919	2.283258	2.89731	0.042387
12/10/2009 17:22	-448.544	520.4669	66.88946	-830.924	950.1641	122.946	-739.293	1107.837	127.5047	-158.071	279.9807	30.23806	53.69353	-8.6002	-4.30005	16.75843	10.06428	-0.46209	2.298246	2.901074	0.041612
12/10/2009 17:23	-447.996	456.9891	62.46981	-830.358	863.4215	116.9192	-739.132	1017.939	121.2881	-158.208	269.7879	29.54396	53.70869	-9.27243	-4.3475	16.77764	5.476118	-0.78013	2.30012	2.820152	0.035897
12/10/2009 17:24	-251.285	280.4083	36.70204	-409.948	482.4384	61.60017	-361.663	563.7899	63.88272	-114.157	182.1054	20.45059	26.68437	-9.6723	-2.50965	11.20013	5.449794	-0.39694	1.56951	1.958322	0.026839
12/10/2009 17:25	-251.011	280.2007	36.66876	-410.911	483.2039	61.71951	-361.537	564.1757	63.9006	-112.208	180.8612	20.23016	26.60526	-9.37335	-2.48355	11.14832	5.434752	-0.3944	1.547031	1.947032	0.027612
12/10/2009 17:26	-251	280.2087	36.66856	-411.413	483.6529	61.78514	-361.665	564.444	63.92799	-111.708	180.3343	20.15928	26.56005	-9.29147	-2.47478	11.1368	5.42347	-0.39438	1.547031	1.943269	0.027352
12/10/2009 17:27	-250.976	280.2246	36.66805	-411.728	483.9178	61.82512	-361.728	564.6055	63.94345	-111.466	180.0214	20.12094	26.53368	-9.24577	-2.4698	11.11953	3.30862	-0.53918	1.537665	1.93198	0.027219
12/10/2009 17:28	-195.084	211.967	28.09815	-279.002	317.5165	41.17685	-233.144	376.8365	42.1061	-86.8869	134.147	15.25765	16.12031	-8.36784	-1.69038	8.220889	3.278549	-0.34116	1.221103	1.525581	0.021018
12/10/2009 17:29	-194.541	211.555	28.0322	-279.562	318.154	41.25951	-232.973	376.7552	42.0887	-85.8948	133.1198	15.11827	15.98309	-8.19262	-1.66881	8.124998	3.257875	-0.33597	1.198626	1.506767	0.021271
12/10/2009 17:30	-194.301	211.3698	28.00285	-279.981	318.5523	41.3159	-233.088	376.8141	42.10071	-85.5579	132.6112	15.0599	15.92858	-8.12025	-1.66006	8.092396	2.248718	-0.40338	1.191134	1.508649	0.021918

TABLE E.7 Strain gage measurements for pile 6

TS	6A1 Comp. Strain	6B1 Tensile Strain	Moment (k*ft)	6A2 Comp. Strain	6B2 Tensile Strain	Moment (k*ft)	6A3 Comp. Strain	6B3 Tensile Strain	Moment (k*ft)	6A4 Comp. Strain	6B4 Tensile Strain	Moment (k*ft)	6A6 Comp. Strain	6B6 Tensile Strain	Moment (k*ft)	6A6 Comp. Strain	6B6 Tensile Strain	Moment (k*ft)	6A7 Comp. Strain	6B7 Tensile Strain	Moment (k*ft)
12/10/2009 14:14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12/10/2009 14:14	0.507024	3.055022	0.175885	2.148646	4.087064	0.133806	2.31779	1.865757	-0.0312	2.408801	0.139978	-0.15661	1.37033	1.898496	0.036459	0.584832	0.611706	0.001855	0.168728	0.166582	-0.00015
12/10/2009 14:15	0.532651	3.042394	0.173244	2.238271	4.101602	0.128623	2.332224	1.882637	-0.03103	2.41809	0.138087	-0.15739	1.355593	1.902286	0.037737	0.582882	0.609806	0.001859	0.157479	0.149349	-0.00056
12/10/2009 14:16	0.613195	3.233626	0.180885	2.187056	4.350578	0.149345	2.408001	2.051435	-0.02461	2.509117	0.189161	-0.16014	1.401645	1.955348	0.038221	0.606277	0.642104	0.002473	0.170603	0.164667	-0.00041
12/10/2009 14:17	0.679095	3.202956	0.174218	2.377284	4.383291	0.138472	2.485583	2.111453	-0.02583	2.55556	0.21186	-0.16178	1.412698	1.974299	0.038767	0.621873	0.649703	0.001921	0.179977	0.158923	-0.00145
12/10/2009 14:18	0.704724	3.168678	0.170083	2.395575	4.357847	0.135453	2.487387	2.118955	-0.02543	2.546271	0.230777	-0.15984	1.418225	1.978089	0.038647	0.639419	0.664902	0.001759	0.187476	0.164667	-0.00157
12/10/2009 14:19	0.750488	3.16507	0.166675	2.331555	4.410552	0.14351	2.463932	2.124582	-0.02342	2.540698	0.230777	-0.15945	1.420067	1.98188	0.038781	0.643319	0.670601	0.001883	0.183727	0.160838	-0.00158
12/10/2009 14:20	0.746827	3.098319	0.16232	2.302289	4.330586	0.14001	2.409805	2.103951	-0.02111	2.486824	0.251585	-0.1543	1.397961	1.961034	0.038868	0.651117	0.6839	0.002263	0.187476	0.162752	-0.00171
12/10/2009 14:21	0.772456	3.055022	0.157562	2.360821	4.366934	0.138479	2.417022	2.107702	-0.02135	2.509117	0.24591	-0.15623	1.40533	1.962929	0.03849	0.662814	0.6858	0.001587	0.189351	0.158923	-0.0021
12/10/2009 14:22	0.735844	3.051414	0.159841	2.324239	4.297874	0.136237	2.389958	2.109577	-0.01935	2.483109	0.251585	-0.15404	1.407172	1.964824	0.038494	0.662814	0.693399	0.002111	0.187476	0.158923	-0.00197
12/10/2009 14:23	0.78344	3.101927	0.160042	2.377284	4.366934	0.137343	2.44589	2.162094	-0.01959	2.523979	0.228885	-0.15843	1.431119	1.99704	0.039065	0.68231	0.712398	0.002077	0.198725	0.164667	-0.00235
12/10/2009 14:24	0.801746	3.091103	0.158031	2.3846	4.372386	0.137214	2.458519	2.175223	-0.01956	2.523979	0.253477	-0.15673	1.44033	2.015991	0.039737	0.692058	0.721897	0.00206	0.198725	0.168497	-0.00209
12/10/2009 14:25	0.834697	3.080279	0.155009	2.395575	4.366934	0.13608	2.458519	2.184601	-0.01891	2.518406	0.255368	-0.15621	1.445856	2.031152	0.040402	0.701806	0.735196	0.002305	0.2006	0.172326	-0.00195
12/10/2009 14:26	0.87131	3.035178	0.149369	2.362651	4.31423	0.134715	2.43326	2.18085	-0.01742	2.488682	0.242127	-0.15508	1.445856	2.031152	0.040402	0.703756	0.735196	0.00217	0.191226	0.164667	-0.00183
12/10/2009 14:27	0.043928	3.486208	0.237616	0.941625	5.590203	0.320885	1.340025	2.77358	0.098956	2.020563	0.444539	-0.10879	1.375856	1.906076	0.0366	0.676461	0.708598	0.002218	0.183727	0.149349	-0.00237
12/10/2009 14:28	0.675434	3.150637	0.17086	1.938309	4.72134	0.192109	2.027325	2.4622	0.030019	2.276908	0.376437	-0.13119	1.436646	1.98946	0.03816	0.694008	0.733296	0.002712	0.187476	0.153179	-0.00237
12/10/2009 14:29	-0.00366	3.57642	0.247128	0.727685	5.879255	0.355605	1.16506	2.942408	0.122688	1.931402	0.516425	-0.09767	1.377698	1.881441	0.034773	0.68426	0.729497	0.003123	0.185601	0.153179	-0.00224
12/10/2009 14:30	0.025624	3.569203	0.244608	0.771569	5.879255	0.352576	1.166863	2.964919	0.124117	1.927687	0.537235	-0.09598	1.385066	1.881441	0.034264	0.690108	0.733296	0.002981	0.189351	0.153179	-0.0025
12/10/2009 14:31	0.05491	3.560182	0.241964	0.755113	5.873801	0.353336	1.168667	2.989306	0.125676	1.920258	0.54291	-0.09508	1.385066	1.887126	0.034656	0.695957	0.754195	0.00402	0.189351	0.157008	-0.00223
12/10/2009 14:32	0.084195	3.556573	0.239693	0.879453	5.910161	0.347263	1.154237	3.017445	0.128615	1.901683	0.56372	-0.09236	1.381382	1.889021	0.035042	0.709604	0.752295	0.002947	0.19685	0.162752	-0.00235
12/10/2009 14:33	0.11165	3.540335	0.236677	0.87031	5.917433	0.348396	1.130789	3.049336	0.132435	1.883108	0.588313	-0.08938	1.390593	1.890916	0.034537	0.709604	0.763694	0.003734	0.19685	0.166582	-0.00209
12/10/2009 14:34	-3.20744	11.45515	1.012138	-6.95478	30.00345	2.551174	-8.0084	21.02193	2.003922	-2.66369	11.4419	0.973689	0.965084	0.179967	-0.0542	0.502952	0.585109	0.005671	0.069365	-0.01149	-0.00558
12/10/2009 14:35	-15.364	14.97182	2.094036	-25.708	40.08402	4.541532	-27.9681	29.71886	3.982046	-10.9312	18.56788	2.036278	0.300186	-0.27467	-0.03968	0.485406	0.592708	0.007407	0.043119	-0.00383	-0.00324
12/10/2009 14:36	-15.2253	14.84159	2.075476	-25.5008	39.81664	4.508767	-27.8767	29.68114	3.973133	-11.0053	18.84128	2.060265	0.28177	-0.27657	-0.03854	0.501002	0.600307	0.006855	0.050618	-0.00574	-0.00389
12/10/2009 14:37	-15.145	14.75659	2.064067	-25.3462	39.65548	4.486975	-27.8444	29.66039	3.969474	-11.0831	19.00836	2.07717	0.265194	-0.27657	-0.0374	0.504901	0.609806	0.007241	0.054367	0.003829	-0.00349
12/10/2009 14:38	-15.0429	14.70594	2.053518	-25.1044	39.45953	4.456756	-27.6813	29.67359	3.959128	-11.0534	19.03874	2.077221	0.261511	-0.27657	-0.03714	0.520497	0.625005	0.007214	0.061866	0.009574	-0.00361
12/10/2009 14:39	-14.9754	14.64264	2.044489	-25.0462	39.34416	4.444775	-27.5935	29.53402	3.943431	-11.0405	19.1052	2.080913	0.250461	-0.27846	-0.03651	0.524396	0.611706	0.006027	0.059992	0.001915	-0.00401
12/10/2009 14:40	-14.9316	14.61009	2.039219	-24.9771	39.23429	4.432422	-27.5989	29.57363	3.946537	-11.0868	19.16026	2.087911	0.235728	-0.28793	-0.03615	0.506851	0.611706	0.007238	0.046868	-0.00383	-0.0035
12/10/2009 14:41	-14.9298	14.49434	2.031103	-25.0498	39.06949	4.426066	-27.6992	29.54156	3.951251	-11.1905	19.23242	2.100052	0.220994	-0.30688	-0.03644	0.512699	0.615506	0.007097	0.052493	0.001915	-0.00349
12/10/2009 14:42	-14.8641	14.46178	2.024322	-24.9826	39.04569	4.419779	-27.701	29.58117	3.954109	-11.2165	19.30647	2.108954	0.222836	-0.30119	-0.03617	0.518548	0.628805	0.007611	0.052493	0.005744	-0.00323
12/10/2009 14:43	-14.8075	14.48168	2.021791	-24.9117	39.08231	4.417412	-27.6007	29.61701	3.949655	-11.1701	19.33875	2.105986	0.237569	-0.27467	-0.03536	0.541942	0.651603	0.00757	0.061866	0.009574	-0.00361
12/10/2009 14:44	-14.7619	12.74037	1.898443	-23.8732	33.68005	3.972822	-25.9587	25.19982	3.5314	-10.4032	16.49507	1.856748	0.241253	-0.01137	-0.01744	0.563387	0.672501	0.007532	0.076864	0.038294	-0.00266
12/10/2009 14:45	-11.4766	11.47142	1.584068	-19.375	31.57904	3.517285	-20.8999	24.0561	3.103252	-8.55567	16.75507	1.747164	0.283611	-0.19322	-0.03291	0.586781	0.638304	0.003557	0.089988	-0.02298	-0.0078
12/10/2009 14:46	-15.5409	15.00257	2.108373	-26.1825	40.38257	4.594893	-28.993	30.59222	4.113083	-11.8573	20.18002	2.211493	0.173111	-0.35802	-0.03666	0.534144	0.634504	0.006928	0.037495	-0.02298	-0.00417
12/10/2009 14:47	-14.7601	14.41476	2.013898	-24.7316	38.8992	4.392345	-27.3354	29.46801	3.921059	-11.1905	19.51535	2.119583	0.176795	-0.30498	-0.03326	0.538043	0.644003	0.007314	0.037495	-0.01723	-0.00378
12/10/2009 14:48	-14.4645	14.28455	1.984506	-24.3297	38.34627	4.326435	-26.8981	29.07195	3.863531	-11.0182	19.36914	2.097598	0.169428	-0.28793	-0.03157	0.539993	0.642104	0.007049	0.041244	-0.02298	-0.00443
12/10/2009 14:49	-14.2528	14.10009	1.957162	-24.0642	37.85747	4.274365	-26.5862	28.76456	3.820781	-10.9516	19.24381	2.084343	0.162061	-0.28793	-0.03106	0.538043	0.651603	0.007839	0.037495	-0.01915	-0.00391
12/10/2009 14:50	-14.0813	13.92648	1.933338	-23.8514	37.5719	4.239964	-26.3388	28.53638	3.787954	-10.8348	19.08241	2.065146	0.184161	-0.26331	-0.03089	0.547791	0.655402	0.007428	0.039369	-0.01915	-0.00404
12/10/2009 14:51	-13.9298	13.79628	1.913895	-23.6386	37.27354	4.204679	-26.1344	28.36667	3.762131	-10.7682	19.01406	2.055824	0.169428	-0.24815	-0.02883	0.553639	0.664902	0.00768	0.039369	-0.01915	-0.00404
12/10/2009 14:52	-13.835	13.6896	1.89998	-23.6096	37.06854	4.188519	-26.0358	28.24222	3.746734	-10.7348	18.9533	2.049328	0.176795	-0.24058	-0.02881	0.559488	0.676301	0.008063	0.044994	-0.00191	-0.00324
12/10/2009 14:53	-13.7236	13.57387	1.884308	-23.4331	36.86904	4.162569	-25.9031	28.11589	3.728855	-10.7052	18.91343	2.044529	0.184161	-0.23679	-0.02906	0.575084	0.682	0.00738	0.056242	-0.02106	-0.00534
12/10/2009 14:54	-39.502	31.61533	4.909129	-82.9572	128.629	14.60549	-117.309	127.3144	16.88598	-42.6569	105.2186	10.20764	-3.30633	-8.31125	-0.34548	0.522447	0.414129	-0.00748	-0.04499	-0.10339	-0.00403
12/10/2009 14:55	-39.1536	31.29403	4.862897	-82.2067	127.6439	14.48569	-116.497	126.3684	16.76468	-42.6845	105.6627	10.2402	-3.53452	-8.37177	-0.33391	0.51075	0.389432	-0.00837	-0.04124	-0.10148	-0.00416
12/10/2009 14:56	-38.9467	31.15063	4.838716	-81.7093	127.0563	14.41079	-115.874	125.7512	16.67904	-42.6109	105.767	10.24232	-3.62469	-8.38501	-0.3286	0.506851	0.376134	-0.00902	-0.04499	-0.11105	-0.00456
12/10/2009 14:57	-38.8468	31.02176	4.82293	-81.3915	126.5284	14.35241	-115.422	125.1265	16.60475	-42.552	105.7052	10.23399	-3.70198	-8.39068	-0.32365	0.499053	0.366635	-0.00914	-0.05249	-0.1168	-0.00444
12/10/2009 14:58	-38.8087	30.9183	4.813157	-81.3107	126.3493	14.33447	-115.34	124.9515	16.58698	-42.5667	105.7883	10.24073	-3.74062	-8.39825	-0.32151	0.499053	0.368535	-0.00901	-0.05249	-0.11297	-0.00417
12/10/2009 14:59	-38.7597	30.92374	4.81015	-81.2963	126.2225	14.32473	-115.317	124.7516	16.5716	-42.587	105.8636	10.24733	-3.77374	-8.40203	-0.31948	0.502952	0.362836	-0.00967	-0.05062	-0.10722	-0.00391
12/10/2009 15:00	-38.9485	30.79306	4.814159	-81.5926	125.9707	14.3278	-115.517	124.5171	16.56924	-42.679	105.8616	10.25355	-3.87679	-8.50415	-0.31942	0.477608	0.340039	-0.0095	-0.05624	-0.12063	-0.00444
12/10/2009 15:01	-38.914	30.79125	4.811654	-81.6052	125.9185	14.32506	-115.547	124.5441	16.57316	-42.69	105.9408	10.25978	-3.91175	-8.52117	-0.31818	0.46981	0.33434	-0.00935	-0.06187	-0.12637	-0.00445
12/10/2009 15:02	-38.8668	30.73317	4.804387	-81.5333	125.7861	14.31097	-115.549	124.4672	16.56797	-42.6937	106.0181	10.26536	-3.93935	-8.54576	-0.31797	0.471759	0.336239	-0.00935	-0.06561	-0.12828	-0.00433
12/10/2009 15:03	-38.6109	30.72591	4.786219	-81.2388	125.6444	14.28085	-115.396	124.6132	16.56751	-42.6348	106.159	10.27103	-3.90439	-8.48524	-0.31621	0.499053	0.364735	-0.00927	-0.05812	-0.11871	-0.00418
12/10/2009 15:04	-38.6254	30.70595	4.785844	-81.2478	125.7171	14.28649	-115.37	124.6229	16.56635	-42.6514	106.2093	10.27564	-3.92279	-8.48902	-0.3152	0.504901	0.362836	-0.00981	-0.06187	-0.11871	-0.00392
12/10/2009 15:05	-38.5546	30.66783	4.778326	-81.255	125.6332	14.2812	-115.35	124.6325	16.56568	-42.6679	106.2324	10.27838	-3.93199	-8.49659	-0.31509	0.51075	0.362836	-0.01021	-0.05812	-0.11871	-0.00418

TS	6A1 Comp. Strain	6B1 Tensile Strain	Moment (k*ft)	6A2 Comp. Strain	6B2 Tensile Strain	Moment (k*ft)	6A3 Comp. Strain	6B3 Tensile Strain	Moment (k*ft)	6A4 Comp. Strain	6B4 Tensile Strain	Moment (k*ft)	6A6 Comp. Strain	6B6 Tensile Strain	Moment (k*ft)	6A6 Comp. Strain	6B6 Tensile Strain	Moment (k*ft)	6A7 Comp. Strain	6B7 Tensile Strain	Moment (k*ft)
12/10/2009 15:06	-38.4366	30.58798	4.764669	-81.1023	125.5847	14.26731	-115.228	124.6421	16.55785	-42.6661	106.3058	10.28332	-3.93015	-8.47011	-0.31339	0.516598	0.366635	-0.01035	-0.05437	-0.11488	-0.00418
12/10/2009 15:07	-38.4693	30.57527	4.766048	-81.2263	125.5045	14.27033	-115.264	124.694	16.56398	-42.6882	106.3464	10.28764	-3.94119	-8.47011	-0.31263	0.522447	0.372334	-0.01036	-0.05062	-0.10914	-0.00404
12/10/2009 15:08	-38.4275	30.51175	4.758781	-81.1939	125.4057	14.26128	-115.189	124.6863	16.55824	-42.6992	106.3715	10.29014	-3.95039	-8.472	-0.31212	0.524396	0.370435	-0.01063	-0.07686	-0.11297	-0.00249
12/10/2009 15:09	-38.384	30.39197	4.747505	-81.237	125.1633	14.24752	-115.15	124.6152	16.55066	-42.7103	106.3927	10.29237	-3.96695	-8.47579	-0.31124	0.522447	0.374234	-0.01023	-0.12748	-0.08999	0.002588
12/10/2009 15:10	-55.5313	40.40797	6.622551	-133.096	208.0901	23.5516	-210.1	242.7724	31.26115	-65.3192	168.3356	16.12885	-3.03211	-16.69	-0.94278	1.093688	0.714298	-0.02619	-0.19122	-0.1436	0.003287
12/10/2009 15:11	-57.9016	40.02786	6.759929	-136.945	209.2261	23.89567	-215.88	241.593	31.57872	-67.4119	169.813	16.3753	-3.17382	-17.1016	-0.96141	1.14828	0.693399	-0.0314	-0.18185	-0.12063	0.004226
12/10/2009 15:12	-57.7281	39.83691	6.73477	-136.531	208.5092	23.81765	-215.323	240.86	31.48965	-67.5016	170.1708	16.40618	-3.27136	-17.2149	-0.9625	1.158029	0.678201	-0.03312	-0.1781	-0.11871	0.004099
12/10/2009 15:13	-57.663	39.67689	6.719232	-136.436	208.1526	23.78643	-215.136	240.5181	31.45314	-67.5839	170.4112	16.42846	-3.33209	-17.2847	-0.96313	1.15218	0.672501	-0.03311	-0.18185	-0.11105	0.004887
12/10/2009 15:14	-57.6322	39.54232	6.707822	-136.379	207.8663	23.76274	-215.043	240.2882	31.43088	-67.6498	170.6008	16.4461	-3.38178	-17.3451	-0.96387	1.156079	0.661102	-0.03417	-0.18934	-0.11297	0.005272
12/10/2009 15:15	-57.6033	39.43503	6.698419	-136.375	207.616	23.74522	-214.939	240.133	31.41294	-67.7029	170.7318	16.45881	-3.41674	-17.3904	-0.96458	1.15413	0.655402	-0.03443	-0.18559	-0.11488	0.004881
12/10/2009 15:16	-57.5834	39.32411	6.68939	-136.377	207.3676	23.7282	-214.868	239.9817	31.39764	-67.7542	170.8315	16.46923	-3.45723	-17.432	-0.96466	1.156079	0.647803	-0.03509	-0.19122	-0.11105	0.005534
12/10/2009 15:17	-57.5636	39.24411	6.682495	-136.359	207.1818	23.71415	-214.794	239.8913	31.38631	-67.7835	170.9449	16.47908	-3.48851	-17.4622	-0.96458	1.15413	0.647803	-0.03495	-0.19122	-0.11297	0.005402
12/10/2009 15:18	-57.5473	39.15683	6.675347	-136.354	207.032	23.70344	-214.743	239.7872	31.37557	-67.8347	171.0329	16.48869	-3.51796	-17.4943	-0.96476	1.156079	0.638304	-0.03574	-0.18934	-0.11488	0.00514
12/10/2009 15:19	-57.5383	39.08592	6.669828	-136.382	206.8689	23.69414	-214.707	239.7184	31.36834	-67.8622	171.1052	16.49558	-3.54188	-17.515	-0.96455	1.15413	0.640204	-0.03548	-0.18934	-0.11297	0.005272
12/10/2009 15:20	-57.522	39.00955	6.663434	-136.375	206.7286	23.68397	-214.656	239.6614	31.36085	-67.8896	171.1697	16.50192	-3.56948	-17.5358	-0.96407	1.15023	0.630705	-0.03586	-0.18934	-0.10914	0.005537
12/10/2009 15:21	-75.4423	45.04268	8.316903	-193.661	290.6472	33.4311	-320.842	369.3883	47.64562	-97.4172	225.5055	22.29089	-0.98146	-26.3816	-1.75334	2.04134	1.371692	-0.04622	-0.22496	-0.13786	0.006013
12/10/2009 15:22	-76.1462	44.73683	8.344384	-195.521	291.4916	33.61778	-324.784	371.1427	48.0388	-99.2646	228.1485	22.60086	-0.97778	-26.8263	-1.78429	2.123244	1.396393	-0.05017	-0.20996	-0.12637	0.005771
12/10/2009 15:23	-76.0202	44.51656	8.32048	-195.238	290.8227	33.55205	-324.381	370.6437	47.97659	-99.5355	228.7017	22.65775	-1.06984	-26.9714	-1.78795	2.132995	1.394493	-0.05098	-0.21559	-0.12254	0.006423
12/10/2009 15:24	-76.0562	44.40006	8.314924	-195.162	290.5297	33.52663	-324.25	370.3419	47.94666	-99.7118	229.0673	22.69515	-1.11402	-27.0713	-1.79179	2.136895	1.377392	-0.05243	-0.21371	-0.12828	0.005897
12/10/2009 15:25	-76.0058	44.30358	8.304784	-195.014	290.1885	33.49281	-324.054	370.1286	47.91846	-99.8318	229.3242	22.72117	-1.16926	-27.1372	-1.79253	2.144695	1.371692	-0.05336	-0.21559	-0.12637	0.006159
12/10/2009 15:26	-75.9014	44.14886	8.286896	-194.849	289.9187	33.46284	-323.829	369.8872	47.88624	-99.9245	229.4804	22.73835	-1.20608	-27.2032	-1.79454	2.144695	1.346991	-0.05506	-0.21371	-0.13211	0.005633
12/10/2009 15:27	-76.0166	44.08151	8.290201	-194.898	289.593	33.44374	-323.826	369.7444	47.87615	-100.041	229.6345	22.75702	-1.26315	-27.254	-1.79411	2.131044	1.352691	-0.05373	-0.22684	-0.12828	0.006803
12/10/2009 15:28	-75.968	44.00142	8.281317	-194.884	289.3367	33.42508	-323.706	369.6297	47.85994	-100.099	229.7748	22.77072	-1.29814	-27.2861	-1.79391	2.131044	1.33559	-0.05491	-0.22496	-0.13211	0.006409
12/10/2009 15:29	-76.103	43.77391	8.274932	-194.807	288.8589	33.38678	-323.729	369.2837	47.83767	-100.253	229.7472	22.77947	-1.38098	-27.3539	-1.79287	2.113494	1.314689	-0.05514	-0.22871	-0.1436	0.005875
12/10/2009 15:30	-76.0508	43.76845	8.270952	-194.933	288.776	33.38975	-323.716	369.2093	47.83161	-100.323	229.8598	22.79202	-1.42149	-27.4066	-1.79372	2.111543	1.305189	-0.05566	-0.23246	-0.14169	0.006266
12/10/2009 15:31	-75.9986	43.68108	8.261317	-194.837	288.5583	33.36808	-323.699	369.169	47.82768	-100.375	229.9507	22.80193	-1.4491	-27.4443	-1.79441	2.109593	1.303289	-0.05566	-0.23996	-0.14552	0.006519
12/10/2009 15:32	-75.8978	43.69929	8.255614	-194.718	288.5814	33.36146	-323.53	369.3179	47.82632	-100.368	230.1247	22.81344	-1.44174	-27.4556	-1.7957	2.134945	1.32609	-0.05583	-0.22871	-0.13211	0.006668
12/10/2009 15:33	-75.8366	43.71203	8.252268	-194.606	288.4986	33.34802	-323.429	369.3923	47.82443	-100.372	230.2492	22.82228	-1.44358	-27.4688	-1.79648	2.150546	1.324189	-0.05704	-0.22309	-0.13211	0.00628
12/10/2009 15:34	-75.8096	43.67198	8.24764	-194.676	288.383	33.34487	-323.427	369.4185	47.82612	-100.428	230.3223	22.83122	-1.46199	-27.4877	-1.79651	2.158346	1.33369	-0.05692	-0.22309	-0.1302	0.006412
12/10/2009 15:35	-75.7807	43.57916	8.239244	-194.678	288.2635	33.33674	-323.423	369.4004	47.82464	-100.473	230.3955	22.8394	-1.4896	-27.5121	-1.7963	2.158346	1.33179	-0.05706	-0.22496	-0.1302	0.006541
12/10/2009 15:36	-84.3516	48.44478	9.166747	-227.479	368.9425	41.17013	-391.24	486.0385	60.55728	-120.238	277.6094	27.46281	1.497437	-32.6679	-2.35838	2.831179	2.344638	-0.03359	-0.24371	-0.13594	0.007439
12/10/2009 15:37	-93.1574	47.89277	9.73649	-250.281	371.5766	42.92591	-431.677	488.3342	63.50702	-132.436	282.029	28.60996	2.236197	-33.5166	-2.46797	3.231018	2.407354	-0.05686	-0.22496	-0.1168	0.007467
12/10/2009 15:38	-93.0354	47.58127	9.706569	-249.723	370.7114	42.82768	-430.969	487.5641	63.40505	-132.808	282.6396	28.67777	2.099859	-33.7218	-2.47271	3.260275	2.407354	-0.05888	-0.20996	-0.11105	0.006828
12/10/2009 15:39	-92.9708	47.42462	9.691298	-249.514	370.228	42.77989	-430.629	487.1821	63.35517	-133.034	283.0945	28.72474	2.016952	-33.8516	-2.47595	3.270028	2.395951	-0.06034	-0.20809	-0.10914	0.006831
12/10/2009 15:40	-92.9081	47.33172	9.680552	-249.382	369.8308	42.74341	-430.346	486.8618	63.31357	-133.167	283.334	28.75049	1.95247	-33.9344	-2.47722	3.281731	2.394051	-0.06128	-0.20247	-0.09382	0.0075
12/10/2009 15:41	-92.8758	47.22972	9.671283	-249.294	369.5236	42.71612	-430.116	486.6544	63.28336	-133.283	283.5515	28.77348	1.895358	-34.0153	-2.47886	3.279781	2.380747	-0.06206	-0.21184	-0.09765	0.007882
12/10/2009 15:42	-92.8345	47.16597	9.664034	-249.158	369.2986	42.69117	-429.92	486.4696	63.25705	-133.384	283.6912	28.7901	1.841932	-34.0698	-2.47894	3.297335	2.39025	-0.06261	-0.20434	-0.09191	0.007761
12/10/2009 15:43	-92.7897	47.08947	9.655658	-249.013	369.0559	42.6644	-429.704	486.3033	63.23067	-133.454	283.8409	28.80529	1.810613	-34.1188	-2.48015	3.297335	2.375046	-0.06366	-0.20434	-0.08616	0.008158
12/10/2009 15:44	-92.7556	47.01115	9.6479	-248.98	368.8603	42.64863	-429.53	486.1699	63.20948	-133.519	283.9407	28.81666	1.766399	-34.1677	-2.48048	3.281731	2.354141	-0.06403	-0.22121	-0.11105	0.007604
12/10/2009 15:45	-92.7215	46.9128	9.638758	-248.925	368.6353	42.62929	-429.387	486.02	63.18927	-133.59	284.0645	28.82937	1.725869	-34.2128	-2.4808	3.289533	2.331335	-0.06614	-0.21746	-0.11105	0.007345
12/10/2009 15:46	-92.6641	47.56487	9.679808	-248.859	375.5968	43.1053	-429.313	500.7871	64.20347	-133.658	290.6209	29.28737	1.677971	-34.8092	-2.51866	3.273929	2.5746	-0.04827	-0.22309	-0.12254	0.006941
12/10/2009 15:47	-110.889	46.7416	10.88099	-300.795	416.3171	49.50119	-537.966	592.2175	78.01492	-167.873	334.6769	34.69032	5.487364	-40.7561	-3.19212	4.555575	3.612406	-0.06511	-0.20622	-0.08233	0.008552
12/10/2009 15:48	-110.776	46.37008	10.84758	-299.967	415.5197	49.38904	-536.347	590.6336	77.79387	-168.421	335.8471	34.80892	5.210818	-41.192	-3.20312	4.553624	3.568685	-0.06799	-0.21934	-0.07276	0.010118
12/10/2009 15:49	-110.708	46.25171	10.83472	-299.635	415.1191	49.33842	-535.73	589.8229	77.69631	-168.666	336.3547	34.86089	5.063334	-41.41	-3.20799	4.577036	3.534469	-0.07197	-0.20059	-0.07467	0.009692
12/10/2009 15:50	-110.644	46.15337	10.82349	-299.416	414.8527	49.30496	-535.155	589.7164	77.64827	-168.869	336.7516	34.90225	4.943506	-41.5753	-3.21113	4.543869	3.464135	-0.07453	-0.22684	-0.09765	0.008918
12/10/2009 15:51	-110.662	46.07143	10.81907	-299.355	414.4995	49.27634	-534.791	589.2944	77.59402	-168.987	337.0256	34.92932	4.856863	-41.6937	-3.21332	4.549722	3.456532	-0.07546	-0.21746	-0.08425	0.009196
12/10/2009 15:52	-110.622	45.96399	10.80894	-299.232	414.3416	49.25696	-534.509	589.0292	77.55624	-169.093	337.2553	34.95247	4.766535	-41.7876	-3.21356	4.539967	3.426118	-0.07689	-0.21371	-0.08808	0.008673
12/10/2009 15:53	-110.706	45.66718	10.79425	-299.355	413.9372	49.23752	-534.556	588.6448	77.53298	-169.306	337.3359	34.97273	4.639341	-41.9134	-3.21347	4.495095	3.365291	-0.07799	-0.22684	-0.09956	0.008785
12/10/2009 15:54	-110.503	45.51059	10.76938	-299.041	413.6984	49.19937	-534.585	588.1937	77.50379	-169.374	337.5112	34.98953	4.58404	-41.9942	-3.21523	4.502899	3.351985	-0.07945	-0.22496	-0.09191	0.009185
12/10/2009 15:55	-110.446	45.35037	10.75437	-298.952	413.7754	49.19856	-534.645	587.9577	77.49164	-169.449	337.6684	35.00657	4.604317	-42.06	-3.22117	4.500948	3.357687	-0.07892	-0.22684	-0.08808	0.009678
12/10/2009 15:56	-110.267	45.5634	10.75675	-298.672	413.7458	49.17719	-534.424	587.9222	77.47396	-169.438	337.9182	35.02208	4.591414	-42.0844	-3.22196	4.528261	3.357687	-0.0808	-0.21184	-0.08425	0.008808
12/10/2009 15:57	-110.269	45.49421	10.75209	-298.609	413.5959	49.16249	-534.274	587.7447	77.45138	-169.49	338.0331	35.03359	4.558234	-42.152	-3.22434	4.530212	3.359588	-0.08081	-0.21559	-0.08616	0.008934
12/10/2009 15:58	-110.296	45.42866	10.74942	-298.592	413.3867	49.14687	-534.077	587.6257	77.42956	-169.554	338.156	35.04652	4.51215	-42.1952	-3.22414	4.528261	3.353886	-0.08107	-0.21559	-0.08042	0.009331

TS	6A1 Comp. Strain	6B1 Tensile Strain	Moment (k*ft)	6A2 Comp. Strain	6B2 Tensile Strain	Moment (k*ft)	6A3 Comp. Strain	6B3 Tensile Strain	Moment (k*ft)	6A4 Comp. Strain	6B4 Tensile Strain	Moment (k*ft)	6A6 Comp. Strain	6B6 Tensile Strain	Moment (k*ft)	6A6 Comp. Strain	6B6 Tensile Strain	Moment (k*ft)	6A7 Comp. Strain	6B7 Tensile Strain	Moment (k*ft)
12/10/2009 15:59	-110.279	45.46143	10.75057	-298.512	413.438	49.14488	-533.992	587.4941	77.41461	-169.597	338.2729	35.05755	4.477128	-42.2347	-3.22445	4.538016	3.346282	-0.08226	-0.20996	-0.07659	0.009207
12/10/2009 16:00	-110.26	45.4232	10.74657	-298.548	413.3236	49.13945	-533.865	587.3605	77.39657	-169.649	338.3616	35.06726	4.432889	-42.2722	-3.22399	4.536065	3.336778	-0.08279	-0.20809	-0.07659	0.009077
12/10/2009 16:01	-110.244	45.30849	10.73755	-298.476	413.3137	49.13382	-533.788	587.2185	77.38144	-169.721	338.418	35.0761	4.397866	-42.3324	-3.22572	4.532163	3.31967	-0.0837	-0.20809	-0.07659	0.009077
12/10/2009 16:02	-110.267	45.35401	10.74229	-298.479	413.2309	49.12834	-533.663	587.1078	77.36521	-169.771	338.5026	35.0854	4.353628	-42.3643	-3.22487	4.524359	3.31967	-0.08316	-0.21371	-0.06701	0.010126
12/10/2009 16:03	-117.54	48.34275	11.45064	-331.547	485.8073	56.4208	-605.736	694.6633	89.76469	-189.86	386.5551	39.78911	8.111655	-47.0637	-3.80868	5.482374	4.8957	-0.0405	-0.19872	-0.03829	0.011074
12/10/2009 16:04	-124.774	45.2029	11.73327	-355.363	494.0054	58.6307	-647.762	697.6856	92.87434	-204.91	392.5757	41.2436	9.404965	-48.5835	-4.00286	6.042433	4.802532	-0.08559	-0.17622	-0.02681	0.010314
12/10/2009 16:05	-124.908	45.37768	11.75456	-355	493.543	58.57369	-646.236	696.2295	92.66847	-205.432	393.5706	41.34831	9.216758	-48.8912	-4.01111	6.009257	4.677042	-0.09196	-0.1706	-0.01915	0.010454
12/10/2009 16:06	-124.847	45.27208	11.74309	-354.651	492.7063	58.49189	-645.319	695.3242	92.54266	-205.684	394.1546	41.40603	9.087601	-49.0638	-4.01411	5.981936	4.593384	-0.09585	-0.1781	-0.01532	0.011236
12/10/2009 16:07	-124.747	45.21382	11.73218	-354.461	492.3901	58.45694	-644.791	694.8396	92.47281	-205.901	394.5555	41.44865	8.987968	-49.1838	-4.01552	5.966324	4.52874	-0.09923	-0.17435	-0.02489	0.010317
12/10/2009 16:08	-124.662	45.11186	11.71924	-354.305	491.9858	58.41823	-644.326	694.3509	92.40698	-206.068	394.8486	41.4804	8.882802	-49.2851	-4.01525	5.927294	4.462196	-0.10113	-0.19872	-0.04021	0.010942
12/10/2009 16:09	-124.667	45.09548	11.71848	-354.089	491.8037	58.39078	-643.941	693.96	92.35337	-206.201	395.0887	41.50617	8.814538	-49.2926	-4.01106	5.929246	4.424171	-0.10389	-0.18372	-0.02106	0.011228
12/10/2009 16:10	-124.592	45.04632	11.70993	-353.956	491.6736	58.37263	-643.683	693.6625	92.31505	-206.307	395.3045	41.52841	8.748119	-49.3583	-4.011	5.909731	4.370937	-0.10622	-0.19122	-0.02489	0.011481
12/10/2009 16:11	-124.498	44.95165	11.69688	-353.849	491.5255	58.35497	-643.477	693.4395	92.28545	-206.43	395.4429	41.54642	8.689081	-49.4277	-4.01172	5.884362	4.310098	-0.10867	-0.18934	-0.03638	0.010559
12/10/2009 16:12	-124.455	44.91706	11.69154	-353.754	491.3754	58.3381	-643.294	693.2249	92.258	-206.524	395.624	41.56542	8.630044	-49.4615	-4.00997	5.874604	4.300592	-0.10865	-0.18934	-0.02489	0.011352
12/10/2009 16:13	-124.404	44.87155	11.68483	-353.689	491.2153	58.32252	-643.107	693.0273	92.23142	-206.611	395.7502	41.58014	8.580232	-49.5084	-4.00977	5.866798	4.273975	-0.10995	-0.18372	-0.01532	0.011625
12/10/2009 16:14	-133.465	47.68328	12.50441	-396.002	575.1671	66.96936	-732.046	800.1542	105.7656	-232.03	446.7638	46.85618	13.85765	-53.7756	-4.66863	7.108072	6.097535	-0.06976	-0.16122	0.024891	0.012847
12/10/2009 16:15	-139.617	46.82537	12.86988	-413.249	579.8626	68.5531	-755.927	799.3463	107.3583	-244.707	452.5014	48.12732	14.66112	-54.8456	-4.79795	7.44186	5.814165	-0.11236	-0.15935	0.03638	0.013511
12/10/2009 16:16	-139.534	46.56858	12.84639	-412.28	579.0028	68.42681	-753.804	798.1519	107.1293	-245.073	453.486	48.22054	14.34526	-55.0873	-4.79283	7.426244	5.604977	-0.12572	-0.1481	0.045953	0.013395
12/10/2009 16:17	-139.447	46.35187	12.82543	-411.658	578.3952	68.34195	-752.899	797.4112	107.0157	-245.295	454.0719	48.27629	14.131	-55.2278	-4.78774	7.402819	5.456648	-0.13434	-0.14623	0.034465	0.012473
12/10/2009 16:18	-139.454	46.38465	12.82818	-411.46	577.9725	68.29915	-752.097	796.7288	106.9132	-245.469	454.4728	48.31598	13.97585	-55.329	-4.78401	7.379395	5.334946	-0.14113	-0.15185	0.03638	0.012993
12/10/2009 16:19	-139.456	46.31362	12.8234	-411.328	577.5621	68.26166	-751.518	796.2927	106.8431	-245.613	454.7853	48.34751	13.82256	-55.4208	-4.77977	7.348163	5.217049	-0.14711	-0.16122	0.019147	0.012451
12/10/2009 16:20	-139.493	46.09874	12.81114	-411.174	577.107	68.2196	-751.036	795.8587	106.7799	-245.738	454.9909	48.37033	13.69882	-55.4957	-4.7764	7.332547	5.139087	-0.15141	-0.15373	0.03255	0.012858
12/10/2009 16:21	-139.458	46.08053	12.80743	-410.955	576.9424	68.19313	-750.666	795.5695	106.7344	-245.854	455.1883	48.39197	13.57139	-55.5632	-4.77226	7.311075	5.06683	-0.15492	-0.16497	0.028721	0.01337
12/10/2009 16:22	-139.435	46.01315	12.80119	-410.809	576.7088	68.16692	-750.291	795.3147	106.6909	-245.942	455.3692	48.41053	13.48459	-55.61	-4.7695	7.291555	5.004082	-0.1579	-0.1631	0.024891	0.012977
12/10/2009 16:23	-139.569	45.88933	12.80195	-410.968	576.3411	68.15253	-750.174	794.9823	106.6599	-246.12	455.4021	48.42507	13.34054	-55.6812	-4.76447	7.25642	4.90901	-0.16204	-0.16872	0.015318	0.012704
12/10/2009 16:24	-139.671	45.81103	12.80353	-410.958	576.1461	68.13838	-750.037	794.8204	106.6393	-246.213	455.5296	48.4403	13.2519	-55.743	-4.76262	7.231044	4.859573	-0.1637	-0.1781	0.011488	0.013087
12/10/2009 16:25	-139.648	45.75094	12.79779	-410.809	576.0648	68.12247	-749.872	794.6715	106.6176	-246.292	455.6633	48.45499	13.17988	-55.773	-4.75972	7.223236	4.80063	-0.16723	-0.17997	0.013403	0.013348
12/10/2009 16:26	-139.809	45.88933	12.81849	-410.89	576.1237	68.13215	-749.644	794.7297	106.6059	-246.273	455.8915	48.46941	13.14849	-55.8048	-4.75975	7.238852	4.802532	-0.16818	-0.17435	0.017232	0.013224
12/10/2009 16:27	-139.582	45.83288	12.79892	-410.547	575.9755	68.09821	-749.365	794.6045	106.578	-246.319	456.0273	48.48194	13.09678	-55.8329	-4.75812	7.240804	4.775912	-0.17015	-0.16872	0.015318	0.012704
12/10/2009 16:28	-139.632	45.79829	12.79996	-410.623	575.7927	68.09086	-749.244	794.4858	106.5615	-246.373	456.128	48.49266	13.04692	-55.8723	-4.75739	7.2369	4.743589	-0.17211	-0.17247	0.007659	0.012434
12/10/2009 16:29	-139.681	45.74548	12.79974	-410.698	575.6017	68.08283	-749.061	794.393	106.5424	-246.435	456.198	48.50173	12.98414	-55.8929	-4.75448	7.232996	4.728378	-0.17289	-0.16497	0.019147	0.01271
12/10/2009 16:30	-139.632	45.6162	12.78739	-410.601	575.4352	68.0647	-748.979	794.3088	106.5309	-246.486	456.3214	48.51377	12.93982	-55.8479	-4.74832	7.234948	4.715069	-0.17394	-0.16872	0.026806	0.013497
12/10/2009 16:31	-140.159	42.22163	12.58945	-408.016	561.9626	66.95557	-748.769	793.9765	106.4935	-246.563	456.3502	48.5211	12.88073	-55.8816	-4.74657	7.234948	4.675141	-0.1767	-0.16122	0.019147	0.012451
12/10/2009 16:32	-145.933	43.6556	13.08704	-430.9	623.7308	72.79968	-801.68	886.9593	116.5644	-258.582	495.4038	52.04656	16.23706	-58.8855	-5.1856	7.910368	6.407547	-0.10374	-0.14248	0.082333	0.015518
12/10/2009 16:33	-157.56	41.51755	13.74203	-466.955	655.5652	77.48596	-869.967	912.0383	123.0086	-283.187	511.8673	54.88143	20.03769	-60.5926	-5.56579	8.960757	6.633887	-0.16062	-0.10686	0.10148	0.014381
12/10/2009 16:34	-157.546	41.24286	13.7221	-465.342	655.0752	77.34078	-867.186	909.8985	122.6696	-283.767	512.7455	54.98213	19.84352	-60.8303	-5.5688	8.986141	6.436077	-0.17603	-0.09748	0.114884	0.014659
12/10/2009 16:35	-157.516	41.05368	13.70696	-464.603	654.513	77.25097	-865.691	908.7322	122.4859	-284.083	513.223	55.03688	19.68264	-60.9575	-5.56648	8.972472	6.291528	-0.18506	-0.10311	0.116798	0.01518
12/10/2009 16:36	-157.507	40.92817	13.69769	-464.009	654.0601	77.17873	-864.603	907.8757	122.3517	-284.313	513.6528	55.08243	19.53841	-61.0492	-5.56285	8.958804	6.13367	-0.19501	-0.11248	0.109139	0.015298
12/10/2009 16:37	-157.5	40.8354	13.6908	-463.62	653.7389	77.1297	-863.59	907.3136	122.2429	-284.496	513.9726	55.11714	19.41083	-61.1147	-5.55856	8.945136	6.040479	-0.2005	-0.11061	0.107225	0.015037
12/10/2009 16:38	-157.502	40.76264	13.6859	-463.322	653.4775	77.0911	-862.914	906.813	122.1617	-284.653	514.1948	55.14331	19.31283	-61.1802	-5.55632	8.935373	5.924468	-0.20784	-0.11061	0.103395	0.014772
12/10/2009 16:39	-157.5	40.68625	13.6805	-463.123	653.2325	77.06042	-862.401	906.3849	122.0967	-284.787	514.3983	55.16662	19.21853	-61.2289	-5.55317	8.927563	5.859808	-0.21176	-0.11061	0.114884	0.015565
12/10/2009 16:40	-157.472	40.6135	13.67353	-462.876	653.0802	77.03285	-861.892	906.016	122.0361	-284.916	514.5644	55.18699	19.12978	-61.2775	-5.5504	8.931468	5.79705	-0.21636	-0.09936	0.120628	0.015185
12/10/2009 16:41	-157.456	40.54074	13.66741	-462.756	652.7962	77.005	-861.466	905.7241	121.9866	-285.035	514.6849	55.20349	19.05952	-61.3131	-5.54801	8.925611	5.724784	-0.22095	-0.09936	0.128287	0.015714
12/10/2009 16:42	-157.447	40.47345	13.66215	-462.691	652.578	76.98542	-861.157	905.4585	121.9469	-285.153	514.8053	55.21999	18.98372	-61.3542	-5.54561	8.906085	5.662027	-0.22393	-0.11061	0.130202	0.016623
12/10/2009 16:43	-157.45	40.71899	13.67935	-462.58	656.5002	77.24849	-860.869	914.5019	122.5513	-285.244	518.4762	55.47964	18.9227	-61.5732	-5.55651	8.908037	5.850299	-0.21107	-0.11248	0.114884	0.015695
12/10/2009 16:44	-174.063	40.53347	14.81327	-522.468	747.7134	87.6788	-985.2	1028.156	138.9791	-320.222	569.6244	61.42482	26.27382	-65.329	-6.32321	10.63438	8.022579	-0.18029	-0.03374	0.224025	0.017794
12/10/2009 16:45	-174.543	40.04969	14.81306	-520.568	749.5309	87.67315	-981.261	1024.53	138.4569	-322.019	570.7603	61.62729	26.11458	-65.6337	-6.33325	10.70274	7.737201	-0.20471	-0.03562	0.218281	0.017526
12/10/2009 16:46	-174.461	39.90966	14.79768	-519.576	748.985	87.56698	-978.609	1022.812	138.1552	-322.669	571.2236	61.70411	25.86091	-65.7739	-6.32542	10.67931	7.470862	-0.22147	-0.05249	0.206792	0.017898
12/10/2009 16:47	-174.649	39.83873	14.80579	-518.924	748.4872	87.48759	-977.626	1021.479	137.9954	-322.995	571.5443	61.74879	25.70539	-65.8562	-6.32037	10.69298	7.280628	-0.23555	-0.04687	0.216366	0.018171
12/10/2009 16:48	-174.614	39.71507	14.79482	-518.441	748.1881	87.43358	-976.588	1020.622	137.8646	-323.246	571.7958	61.78344	25.55727	-65.9216	-6.31466	10.69298	7.149371	-0.24461	-0.05062	0.212537	0.018165
12/10/2009 16:49	-174.672	39.42049	14.7785	-518.212	747.8326	87.39325	-976.087	1019.782	137.772	-323.603	571.8398	61.81116	25.37399	-66.0095	-6.30807	10.6461	6.932519	-0.25634	-0.06749	0.195304	0.01814
12/10/2009 16:50	-174.735	39.42412	14.78312	-517.895	747.3788	87.34001	-975.015	1019.101	137.651	-323.766	572.0516	61.83698	25.25365	-66.0562	-6.30299	10.63634	6.803173	-0.2646	-0.06561	0.195304	0.018011
12/10/2009 16:51	-174.72	39.31502	14.7745	-517.724	747.0233	87.30368	-974.109	1018.537	137.5495	-323.94	572.1417	61.85524	25.15368	-66.103	-6.29932	10.6422	6.744208	-0.26907	-0.05812	0.201048	0.01789

TS	6A1 Comp. Strain	6B1 Tensile Strain	Moment (k*ft)	6A2 Comp. Strain	6B2 Tensile Strain	Moment (k*ft)	6A3 Comp. Strain	6B3 Tensile Strain	Moment (k*ft)	6A4 Comp. Strain	6B4 Tensile Strain	Moment (k*ft)	6A6 Comp. Strain	6B6 Tensile Strain	Moment (k*ft)	6A6 Comp. Strain	6B6 Tensile Strain	Moment (k*ft)	6A7 Comp. Strain	6B7 Tensile Strain	Moment (k*ft)
12/10/2009 16:52	-174.596	39.5405	14.78156	-517.405	746.8853	87.27213	-973.33	1018.331	137.4815	-323.987	572.4331	61.87858	25.10555	-66.116	-6.2969	10.65977	6.694754	-0.2737	-0.06187	0.208707	0.018677
12/10/2009 16:53	-174.554	39.29866	14.76195	-517.205	746.5549	87.23563	-972.772	1017.912	137.4141	-324.099	572.5044	61.89124	25.03706	-66.1403	-6.29385	10.67149	6.624377	-0.27937	-0.05249	0.210622	0.018162
12/10/2009 16:54	-174.589	39.18774	14.75672	-517.082	746.1284	87.19763	-972.448	1017.452	137.36	-324.23	572.5883	61.90609	24.95745	-66.1721	-6.29054	10.66368	6.550197	-0.28395	-0.05812	0.210622	0.018551
12/10/2009 16:55	-174.593	39.26956	14.76261	-516.915	746.2601	87.19515	-972.118	1017.419	137.3349	-324.32	572.733	61.92228	24.91488	-66.1908	-6.2889	10.67149	6.506451	-0.28751	-0.05249	0.218281	0.018691
12/10/2009 16:56	-174.556	39.25865	14.75931	-516.731	746.051	87.16804	-971.885	1017.207	137.3042	-324.432	572.8357	61.93712	24.85379	-66.2114	-6.2861	10.67149	6.453195	-0.29118	-0.05437	0.214451	0.018556
12/10/2009 16:57	-174.526	39.14047	14.74908	-516.57	745.7124	87.13363	-971.47	1016.85	137.2509	-324.529	572.8818	61.94698	24.7927	-66.2357	-6.28356	10.66368	6.401841	-0.29419	-0.05624	0.218281	0.01895
12/10/2009 16:58	-174.626	39.10592	14.75362	-516.729	745.5096	87.13065	-971.368	1016.696	137.2332	-324.636	572.9384	61.95827	24.73717	-66.2656	-6.28179	10.65977	6.318155	-0.2997	-0.05999	0.208707	0.018548
12/10/2009 16:59	-174.661	39.08228	14.75442	-516.612	745.2232	87.10266	-971.021	1016.528	137.1977	-324.72	573.0118	61.96918	24.68719	-66.2787	-6.27924	10.65977	6.29343	-0.3014	-0.05249	0.218281	0.018691
12/10/2009 17:00	-189.252	40.58621	15.8654	-575.812	837.7278	97.57465	-1096.41	1135.888	154.0925	-355.551	628.3331	67.91613	32.68117	-69.775	-7.0724	12.35737	8.96444	-0.23421	0.03187	0.335084	0.02093
12/10/2009 17:01	-193.514	40.488	16.15281	-581.154	841.3363	98.19246	-1105.52	1134.454	154.6222	-362.674	595.2184	66.12196	33.45255	-71.2598	-7.22815	12.6231	8.84646	-0.2607	0.037495	0.346573	0.021335
12/10/2009 17:02	-194.439	40.62623	16.22624	-582.565	842.7293	98.38606	-1107.44	1134.973	154.7908	-366.975	600.1886	66.76189	33.50447	-71.835	-7.27143	12.66609	8.688523	-0.27457	0.020622	0.338914	0.021971
12/10/2009 17:03	-194.336	40.41888	16.20479	-580.715	841.1961	98.15252	-1103.96	1132.936	154.4101	-367.357	600.4603	66.80707	33.33572	-72.0609	-7.27538	12.69735	8.5363	-0.28723	0.033745	0.358062	0.022387
12/10/2009 17:04	-194.227	40.25883	16.18624	-579.811	840.175	98.01962	-1101.98	1131.536	154.1766	-367.595	600.614	66.83408	33.19294	-72.1953	-7.2748	12.69735	8.393594	-0.29708	0.033745	0.358062	0.022387
12/10/2009 17:05	-194.227	40.0806	16.17256	-578.124	840.6441	97.93557	-1100.44	1130.475	153.9966	-367.754	600.7088	66.85159	33.07426	-72.3036	-7.27409	12.69539	8.250893	-0.3068	0.03562	0.356147	0.022126
12/10/2009 17:06	-194.241	39.91693	16.16361	-577.483	840.1325	97.85596	-1099.21	1129.634	153.8541	-367.884	600.8015	66.86695	32.98155	-72.3783	-7.27284	12.68172	8.100585	-0.31623	0.024371	0.352318	0.022638
12/10/2009 17:07	-194.248	39.88601	16.16196	-577.088	839.5169	97.78623	-1098.37	1128.947	153.7486	-367.996	600.8731	66.87968	32.8944	-72.4474	-7.27159	12.68172	7.997845	-0.32332	0.026246	0.354232	0.02264
12/10/2009 17:08	-194.248	39.78599	16.15505	-576.662	839.0663	97.72501	-1097.04	1128.359	153.616	-368.099	600.9426	66.89155	32.81838	-72.4922	-7.26944	12.67586	7.885595	-0.33066	0.029996	0.359977	0.022778
12/10/2009 17:09	-194.248	39.69325	16.14865	-576.34	838.67	97.67613	-1096.15	1127.888	153.5219	-368.191	601.0142	66.90286	32.73679	-72.5482	-7.26767	12.66413	7.786665	-0.33868	0.022497	0.344658	0.022238
12/10/2009 17:10	-194.241	39.61142	16.14252	-576.08	838.2244	97.62742	-1095.44	1127.296	153.4326	-368.275	601.0605	66.91184	32.66633	-72.5725	-7.26448	12.66218	7.712469	-0.34167	0.028121	0.359977	0.022908
12/10/2009 17:11	-194.25	39.52777	16.13735	-575.869	837.8657	97.58811	-1095.01	1126.943	153.378	-368.352	601.1174	66.92107	32.60515	-72.6135	-7.2631	12.65632	7.678224	-0.34363	0.026246	0.363807	0.023301
12/10/2009 17:12	-194.289	39.43503	16.13361	-575.776	837.3501	97.54606	-1094.53	1126.598	153.3213	-368.43	601.1806	66.93086	32.53655	-72.6472	-7.26068	12.65045	7.575493	-0.35032	0.024371	0.354232	0.02277
12/10/2009 17:13	-194.318	39.33139	16.12851	-575.641	836.9109	97.50644	-1094.15	1126.607	153.2954	-368.502	601.2185	66.93843	32.48278	-72.6714	-7.25864	12.64655	7.505105	-0.35491	0.022497	0.352318	0.022767
12/10/2009 17:14	-194.35	39.23683	16.12416	-575.543	836.4547	97.46817	-1093.73	1127.047	153.2972	-368.567	601.2733	66.94669	32.42716	-72.705	-7.25712	12.65045	7.457545	-0.35846	0.033745	0.367636	0.023048
12/10/2009 17:15	-202.574	46.32455	17.18112	-593.709	862.2233	100.5009	-1124.63	1155.404	157.3876	-373.156	609.0336	67.79917	33.57309	-73.1979	-7.37025	12.87125	7.809495	-0.34941	0.03562	0.38487	0.024108
12/10/2009 17:16	-203.757	44.86063	17.16169	-592.92	859.3076	100.2452	-1123.4	1151.564	157.0374	-374.214	609.0885	67.87597	33.71959	-73.3117	-7.38822	12.91424	7.777153	-0.35461	0.058117	0.392529	0.023084
12/10/2009 17:17	-203.23	46.15155	17.21446	-591.527	862.7496	100.3866	-1121.46	1157.171	157.2906	-374.436	610.586	67.99465	33.67323	-73.4275	-7.39301	12.9201	7.822812	-0.35186	0.050618	0.382965	0.022941
12/10/2009 17:18	-211.809	49.71118	18.05237	-604.035	872.9031	101.9509	-1140.24	1165.226	159.1428	-377.998	614.0571	68.48013	34.49856	-73.7728	-7.47382	13.0901	7.976917	-0.35296	0.061866	0.409763	0.024015
12/10/2009 17:19	-210.632	47.75797	17.83632	-601.186	869.4962	101.5191	-1136.81	1163.055	158.7563	-378.294	614.1247	68.50526	34.47074	-73.8512	-7.47731	13.0862	7.917938	-0.35676	0.059992	0.404018	0.023748
12/10/2009 17:20	-210.449	47.07125	17.77627	-599.752	867.9906	101.3162	-1134.9	1162.007	158.552	-378.5	614.2471	68.52794	34.44106	-73.9034	-7.47887	13.09987	7.898913	-0.35901	0.069365	0.413593	0.023762
12/10/2009 17:21	-210.423	46.57404	17.74014	-598.635	866.4406	101.1321	-1133.83	1161.228	158.4243	-378.702	614.3779	68.55086	34.40767	-73.9501	-7.47978	13.08815	7.82852	-0.36306	0.063741	0.405933	0.023621
12/10/2009 17:22	-210.461	46.37736	17.72921	-598.059	865.556	101.0312	-1132.92	1160.593	158.3179	-378.863	614.456	68.56742	34.37429	-73.9986	-7.48083	13.09987	7.786665	-0.36676	0.063741	0.402104	0.023357
12/10/2009 17:23	-188.313	33.72883	15.32724	-533.592	787.8339	91.21616	-1013.47	1063.593	143.3765	-361.868	587.0087	65.49963	28.86316	-72.1991	-6.97618	12.02719	5.44714	-0.45421	0.041244	0.38487	0.02372
12/10/2009 17:24	-117.52	21.85929	9.621169	-299.952	442.7383	51.26684	-511.998	607.2811	77.26227	-229.022	401.8069	43.54522	-8.72845	-54.4858	-3.15857	0.214431	-14.373	-1.00695	-0.73671	-0.45759	0.019267
12/10/2009 17:25	-117.752	21.95349	9.643678	-300.52	443.5476	51.36192	-512.58	607.8175	77.33946	-227.955	400.8697	43.40689	-9.21371	-54.1823	-3.10412	-0.08967	-14.892	-1.02178	-0.78732	-0.50546	0.019457
12/10/2009 17:26	-117.872	21.98428	9.654052	-300.788	444.0575	51.4156	-513.007	608.1108	77.38915	-227.508	400.4031	43.34384	-9.4067	-54.0192	-3.07954	-0.30214	-15.2026	-1.02856	-0.82669	-0.53609	0.020059
12/10/2009 17:27	-117.929	21.99334	9.658617	-300.912	444.361	51.44515	-513.284	608.3204	77.42276	-227.247	400.12	43.30624	-9.56292	-51.5131	-2.89576	-0.4074	-18.1487	-1.22466	-0.84356	-0.63373	0.014484
12/10/2009 17:28	-84.8835	17.75996	7.085333	-210.167	296.7725	34.99333	-321.542	400.5298	49.84358	-171.959	318.8654	33.88093	-21.8828	-47.6623	-1.77952	-5.87208	-23.2965	-1.20278	-1.08536	-0.91515	0.011749
12/10/2009 17:29	-85.0111	17.86674	7.10151	-210.526	297.118	35.04196	-321.59	400.6876	49.85781	-171.195	318.0561	33.77233	-22.1431	-47.4597	-1.74757	-6.2323	-23.7371	-1.20833	-1.13221	-0.95726	0.012076
12/10/2009 17:30	-85.0794	17.89389	7.108097	-210.786	297.3573	35.07641	-321.744	400.8717	49.88113	-170.847	317.6324	33.719	-22.2861	-47.3508	-1.73018	-6.43089	-24.015	-1.2138	-1.15845	-0.98407	0.012037

TS	6A1 Comp. Strain	6B1 Tensile Strain	Moment (k*ft)	6A2 Comp. Strain	6B2 Tensile Strain	Moment (k*ft)	6A3 Comp. Strain	6B3 Tensile Strain	Moment (k*ft)	6A4 Comp. Strain	6B4 Tensile Strain	Moment (k*ft)	6A6 Comp. Strain	6B6 Tensile Strain	Moment (k*ft)	6A6 Comp. Strain	6B6 Tensile Strain	Moment (k*ft)	6A7 Comp. Strain	6B7 Tensile Strain	Moment (k*ft)
12/10/2009 16:52	-174.596	39.5405	14.78156	-517.405	746.8853	87.27213	-973.33	1018.331	137.4815	-323.987	572.4331	61.87858	25.10555	-66.116	-6.2969	10.65977	6.694754	-0.2737	-0.06187	0.208707	0.018677
12/10/2009 16:53	-174.554	39.29866	14.76195	-517.205	746.5549	87.23563	-972.772	1017.912	137.4141	-324.099	572.5044	61.89124	25.03706	-66.1403	-6.29385	10.67149	6.624377	-0.27937	-0.05249	0.210622	0.018162
12/10/2009 16:54	-174.589	39.18774	14.75672	-517.082	746.1284	87.19763	-972.448	1017.452	137.36	-324.23	572.5883	61.90609	24.95745	-66.1721	-6.29054	10.66368	6.550197	-0.28395	-0.05812	0.210622	0.018551
12/10/2009 16:55	-174.593	39.26956	14.76261	-516.915	746.2601	87.19515	-972.118	1017.419	137.3349	-324.32	572.733	61.92228	24.91488	-66.1908	-6.2889	10.67149	6.506451	-0.28751	-0.05249	0.218281	0.018691
12/10/2009 16:56	-174.556	39.25865	14.75931	-516.731	746.051	87.16804	-971.885	1017.207	137.3042	-324.432	572.8357	61.93712	24.85379	-66.2114	-6.2861	10.67149	6.453195	-0.29118	-0.05437	0.214451	0.018556
12/10/2009 16:57	-174.526	39.14047	14.74908	-516.57	745.7124	87.13353	-971.47	1016.85	137.2509	-324.529	572.8818	61.94698	24.7927	-66.2357	-6.28356	10.66368	6.401841	-0.29419	-0.05624	0.218281	0.01895
12/10/2009 16:58	-174.626	39.10592	14.75362	-516.729	745.5096	87.13065	-971.368	1016.696	137.2332	-324.636	572.9384	61.95827	24.73717	-66.2656	-6.28179	10.65977	6.318155	-0.2997	-0.05999	0.208707	0.018548
12/10/2009 16:59	-174.661	39.08228	14.75442	-516.612	745.2232	87.10266	-971.021	1016.528	137.1977	-324.72	573.0118	61.96918	24.68719	-66.2787	-6.27924	10.65977	6.29343	-0.3014	-0.05249	0.218281	0.018691
12/10/2009 17:00	-189.252	40.58621	15.8654	-575.812	837.7278	97.57465	-1096.41	1135.888	154.0925	-355.551	628.3331	67.91613	32.68117	-69.775	-7.0724	12.35737	8.96444	-0.23421	0.03187	0.335084	0.02093
12/10/2009 17:01	-193.514	40.488	16.15281	-581.154	841.3363	98.19246	-1105.52	1134.454	154.6222	-362.674	595.2184	66.12196	33.45255	-71.2598	-7.22815	12.6231	8.84646	-0.2807	0.037495	0.346573	0.021335
12/10/2009 17:02	-194.439	40.62623	16.22624	-582.565	842.7293	98.38606	-1107.44	1134.973	154.7908	-366.975	600.1886	66.76189	33.50447	-71.835	-7.27143	12.66609	8.688523	-0.27457	0.020622	0.338914	0.021971
12/10/2009 17:03	-194.336	40.41888	16.20479	-580.715	841.1961	98.15252	-1103.96	1132.936	154.4101	-367.357	600.4603	66.80707	33.33572	-72.0609	-7.27538	12.69735	8.5363	-0.28723	0.033745	0.358062	0.022387
12/10/2009 17:04	-194.227	40.25883	16.18624	-579.811	840.175	98.01962	-1101.98	1131.536	154.1766	-367.595	600.614	66.83408	33.19294	-72.1953	-7.2748	12.69735	8.393594	-0.29708	0.033745	0.358062	0.022387
12/10/2009 17:05	-194.227	40.0806	16.17256	-578.124	840.6441	97.93557	-1100.44	1130.475	153.9966	-367.754	600.7088	66.85159	33.07426	-72.3036	-7.27409	12.69539	8.250893	-0.3068	0.03562	0.356147	0.022126
12/10/2009 17:06	-194.241	39.91693	16.16361	-577.483	840.1325	97.85596	-1099.21	1129.634	153.8541	-367.884	600.8015	66.86695	32.98155	-72.3783	-7.27284	12.68172	8.100585	-0.31623	0.024371	0.352318	0.022638
12/10/2009 17:07	-194.248	39.88601	16.16196	-577.088	839.5169	97.78623	-1098.37	1128.947	153.7486	-367.996	600.8731	66.87968	32.8944	-72.4474	-7.27159	12.68172	7.997845	-0.32332	0.026246	0.354232	0.02264
12/10/2009 17:08	-194.248	39.78599	16.15505	-576.662	839.0563	97.72501	-1097.04	1128.359	153.616	-368.099	600.9426	66.89155	32.81838	-72.4922	-7.26944	12.67586	7.885595	-0.33066	0.029996	0.359977	0.022778
12/10/2009 17:09	-194.248	39.69325	16.14865	-576.34	838.67	97.67613	-1096.15	1127.888	153.5219	-368.191	601.0142	66.90286	32.73679	-72.5482	-7.26767	12.66413	7.786665	-0.33868	0.022497	0.344658	0.022238
12/10/2009 17:10	-194.241	39.61142	16.14252	-576.08	838.2244	97.62742	-1095.44	1127.296	153.4326	-368.275	601.0605	66.91184	32.66633	-72.5725	-7.26448	12.66218	7.712469	-0.34167	0.028121	0.359977	0.022908
12/10/2009 17:11	-194.25	39.52777	16.13735	-575.869	837.8657	97.58811	-1095.01	1126.943	153.378	-368.352	601.1174	66.92107	32.60615	-72.6135	-7.2631	12.65632	7.678224	-0.34363	0.026246	0.363807	0.023301
12/10/2009 17:12	-194.289	39.43503	16.13361	-575.776	837.3501	97.54606	-1094.53	1126.598	153.3213	-368.43	601.1806	66.93086	32.53655	-72.6472	-7.26068	12.65045	7.575493	-0.35032	0.024371	0.354232	0.02277
12/10/2009 17:13	-194.318	39.33139	16.12851	-575.641	836.9109	97.50644	-1094.15	1126.607	153.2954	-368.502	601.2185	66.93843	32.48278	-72.6714	-7.25864	12.64655	7.505105	-0.35491	0.022497	0.352318	0.022767
12/10/2009 17:14	-194.35	39.23683	16.12416	-575.543	836.4547	97.46817	-1093.73	1127.047	153.2972	-368.567	601.2733	66.94669	32.42716	-72.705	-7.25712	12.65045	7.457545	-0.35846	0.033745	0.367636	0.023048
12/10/2009 17:15	-202.574	46.32455	17.18112	-593.709	862.2233	100.5009	-1124.63	1155.404	157.3876	-373.156	609.0336	67.79917	33.57309	-73.1979	-7.37025	12.87125	7.809495	-0.34941	0.03562	0.38487	0.024108
12/10/2009 17:16	-203.757	44.86063	17.16169	-592.92	859.3076	100.2452	-1123.4	1151.564	157.0374	-374.214	609.0885	67.87597	33.71959	-73.3117	-7.38822	12.91424	7.777153	-0.35461	0.058117	0.392529	0.023084
12/10/2009 17:17	-203.23	46.15155	17.21446	-591.527	862.7496	100.3866	-1121.46	1157.171	157.2906	-374.436	610.586	67.99465	33.67323	-73.4275	-7.39301	12.9201	7.822812	-0.35186	0.050618	0.382955	0.022941
12/10/2009 17:18	-211.809	49.71118	18.05237	-604.035	872.9031	101.9509	-1140.24	1165.226	159.1428	-377.998	614.0571	68.48013	34.49856	-73.7728	-7.47382	13.0901	7.976917	-0.35296	0.061866	0.409763	0.024015
12/10/2009 17:19	-210.632	47.75797	17.83632	-601.186	869.4962	101.5191	-1136.81	1163.055	158.7563	-378.294	614.1247	68.50526	34.47074	-73.8512	-7.47731	13.0862	7.917938	-0.35676	0.059992	0.404018	0.023748
12/10/2009 17:20	-210.449	47.07125	17.77627	-599.752	867.9906	101.3162	-1134.9	1162.007	158.552	-378.5	614.2471	68.52794	34.44106	-73.9034	-7.47887	13.09987	7.898913	-0.35901	0.069365	0.413593	0.023762
12/10/2009 17:21	-210.423	46.57404	17.74014	-598.635	866.4406	101.1321	-1133.83	1161.228	158.4243	-378.702	614.3779	68.55086	34.40767	-73.9501	-7.47978	13.08815	7.82852	-0.36306	0.063741	0.405933	0.023621
12/10/2009 17:22	-210.461	46.37736	17.72921	-598.059	865.556	101.0312	-1132.92	1160.593	158.3179	-378.863	614.456	68.56742	34.37429	-73.9986	-7.48083	13.09987	7.786665	-0.36676	0.063741	0.402104	0.023357
12/10/2009 17:23	-188.313	33.72883	15.32724	-533.592	787.8339	91.21616	-1013.47	1063.593	143.3765	-361.868	587.0087	65.49963	28.86316	-72.1991	-6.97618	12.02719	5.44714	-0.45421	0.041244	0.38487	0.02372
12/10/2009 17:24	-117.52	21.85929	9.621169	-299.952	442.7383	51.26684	-511.998	607.2811	77.26227	-229.022	401.8069	43.54522	-8.72845	-54.4858	-3.15857	0.214431	-14.373	-1.00695	-0.73671	-0.45759	0.019267
12/10/2009 17:25	-117.752	21.95349	9.643678	-300.52	443.5476	51.36192	-512.58	607.8175	77.33946	-227.955	400.8697	43.40689	-9.21371	-54.1823	-3.10412	-0.08967	-14.892	-1.02178	-0.78732	-0.50546	0.019457
12/10/2009 17:26	-117.872	21.98428	9.654052	-300.788	444.0575	51.4156	-513.007	608.1108	77.38915	-227.508	400.4031	43.34384	-9.4067	-54.0192	-3.07954	-0.30214	-15.2026	-1.02856	-0.82669	-0.53609	0.020059
12/10/2009 17:27	-117.929	21.99334	9.658617	-300.912	444.361	51.44515	-513.284	608.3204	77.42276	-227.247	400.12	43.30624	-9.56292	-51.5131	-2.89576	-0.4074	-18.1487	-1.22466	-0.84356	-0.63373	0.014484
12/10/2009 17:28	-84.8835	17.75996	7.085333	-210.167	296.7725	34.99333	-321.542	400.5298	49.84358	-171.959	318.8654	33.88093	-21.8828	-47.6623	-1.77952	-5.87208	-23.2965	-1.20278	-1.08536	-0.91515	0.011749
12/10/2009 17:29	-85.0111	17.86674	7.10151	-210.526	297.118	35.04196	-321.59	400.6876	49.85781	-171.195	318.0561	33.77233	-22.1431	-47.4597	-1.74757	-6.2323	-23.7371	-1.20833	-1.13221	-0.95726	0.012076
12/10/2009 17:30	-85.0794	17.89389	7.108097	-210.786	297.3573	35.07641	-321.744	400.8717	49.88113	-170.847	317.6324	33.719	-22.2861	-47.3508	-1.73018	-6.43089	-24.015	-1.2138	-1.15845	-0.98407	0.012037

TABLE E.8 Strain gage measurements for pile 7

TS	7A1 Comp. Strain	7B1 Tensile Strain	Moment (k*ft)	7A2 Comp. Strain	7B2 Tensile Strain	Moment (k*ft)	7A3 Comp. Strain	7B3 Tensile Strain	Moment (k*ft)	7A4 Comp. Strain	7B4 Tensile Strain	Moment (k*ft)	7A7 Comp. Strain	7B7 Tensile Strain	Moment (k*ft)	7A7 Comp. Strain	7B7 Tensile Strain	Moment (k*ft)	7A7 Comp. Strain	7B7 Tensile Strain	Moment (k*ft)
12/10/2009 14:14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12/10/2009 14:14	0.737733	-3.25431	-0.27556	-2.15427	-1.44626	0.048873	-2.89066	-0.74757	0.147935	-1.64595	-0.96489	0.047012	-0.44904	-0.43555	0.000931	-0.20706	-0.14052	0.004593	-0.06369	-0.06668	-0.00021
12/10/2009 14:15	0.722676	-3.26926	-0.27556	-2.20643	-1.41972	0.054306	-2.94191	-0.74948	0.15134	-1.66417	-0.96296	0.048403	-0.46382	-0.44667	0.001184	-0.2109	-0.13103	0.005513	-0.0579	-0.06483	-0.00048
12/10/2009 14:16	0.764082	-3.19638	-0.27339	-2.16544	-1.33633	0.057232	-2.8321	-0.68623	0.148126	-1.57669	-0.92437	0.045029	-0.42317	-0.40961	0.000936	-0.18981	-0.12533	0.004451	-0.0579	-0.06113	-0.00022
12/10/2009 14:17	0.784785	-3.18891	-0.2743	-2.18408	-1.41025	0.053416	-2.84491	-0.69198	0.148614	-1.57487	-0.94174	0.043704	-0.42502	-0.40775	0.001192	-0.18789	-0.11773	0.004843	-0.06176	-0.06298	-8.4E-05
12/10/2009 14:18	0.732086	-3.25805	-0.27543	-2.25301	-1.37424	0.060661	-2.87419	-0.70732	0.149576	-1.5931	-0.94946	0.04443	-0.42871	-0.41517	0.000935	-0.19364	-0.12153	0.004978	-0.05404	-0.06298	-0.00062
12/10/2009 14:19	0.713265	-3.3141	-0.278	-2.33871	-1.4292	0.062783	-2.96021	-0.78015	0.150486	-1.70426	-1.0112	0.047841	-0.46382	-0.45223	0.0008	-0.21665	-0.13862	0.005386	-0.0772	-0.06853	0.000598
12/10/2009 14:20	0.781021	-3.30476	-0.28204	-2.33685	-1.49364	0.058206	-3.0023	-0.79932	0.152069	-1.68057	-1.02278	0.045406	-0.47306	-0.45594	0.001182	-0.21665	-0.14242	0.005124	-0.06948	-0.07039	-6.3E-05
12/10/2009 14:21	0.771611	-3.44303	-0.29093	-2.42255	-1.56186	0.059412	-3.10295	-0.81082	0.158223	-1.74436	-1.02857	0.04941	-0.48045	-0.47076	0.000669	-0.22815	-0.14622	0.005656	-0.06562	-0.06853	-0.0002
12/10/2009 14:22	0.65492	-3.42622	-0.28172	-2.37039	-1.46142	0.062745	-2.99315	-0.75523	0.15448	-1.66417	-1.00155	0.045739	-0.45643	-0.43741	0.001313	-0.20515	-0.13293	0.004985	-0.07141	-0.06853	0.000198
12/10/2009 14:23	0.707619	-3.36455	-0.2811	-2.42814	-1.4671	0.066339	-3.01145	-0.7859	0.153627	-1.68057	-1.02664	0.04514	-0.46382	-0.44667	0.001184	-0.21281	-0.13672	0.005252	-0.07141	-0.06853	0.000198
12/10/2009 14:24	0.715147	-3.40006	-0.28407	-2.43932	-1.48985	0.065541	-3.04073	-0.79932	0.154722	-1.69697	-1.04401	0.045074	-0.46382	-0.44853	0.001056	-0.21665	-0.13862	0.005386	-0.07334	-0.06483	0.000587
12/10/2009 14:25	0.700091	-3.43182	-0.28522	-2.48776	-1.51448	0.067184	-3.07367	-0.8089	0.156334	-1.72431	-1.07102	0.045096	-0.48045	-0.47076	0.000669	-0.2224	-0.14812	0.005128	-0.06369	-0.06483	-7.9E-05
12/10/2009 14:26	0.378263	-2.97401	-0.2314	-3.45643	-0.34502	0.214777	-4.1917	-0.32396	0.266985	-1.95757	-1.19837	0.052407	-0.5636	-0.56528	-0.00012	-0.278	-0.1842	0.006475	-0.08878	-0.0778	0.000758
12/10/2009 14:27	0.468598	-3.39071	-0.2664	-2.9982	-1.13733	0.128453	-3.59704	-0.59806	0.207015	-1.97397	-1.11926	0.059	-0.53034	-0.52451	0.000402	-0.25499	-0.16521	0.006198	-0.08299	-0.07594	0.000486
12/10/2009 14:28	-0.43657	-2.94785	-0.17335	-4.36718	-0.21611	0.286543	-4.5631	-0.2492	0.297783	-2.11429	-1.21766	0.061893	-0.58762	-0.5764	0.000774	-0.28183	-0.1842	0.00674	-0.08685	-0.0815	0.000369
12/10/2009 14:29	-0.41587	-2.97588	-0.17671	-4.38767	-0.22938	0.287041	-4.6125	-0.24153	0.301722	-2.12887	-1.22538	0.062366	-0.58577	-0.58382	0.000135	-0.27992	-0.18609	0.006476	-0.08492	-0.08335	0.000108
12/10/2009 14:30	-0.4121	-3.01138	-0.17942	-4.42119	-0.24644	0.288177	-4.65275	-0.25303	0.303706	-2.14345	-1.23503	0.062707	-0.59316	-0.58752	0.000389	-0.278	-0.19559	0.005689	-0.07913	-0.08891	-0.00068
12/10/2009 14:31	-0.39141	-3.05063	-0.18356	-4.4305	-0.27109	0.287118	-4.67653	-0.25303	0.305348	-2.16167	-1.24468	0.063299	-0.60425	-0.58752	0.001155	-0.29142	-0.19559	0.006615	-0.08492	-0.08891	-0.00028
12/10/2009 14:32	-0.35754	-3.10295	-0.18951	-4.43795	-0.29763	0.285801	-4.74056	-0.26645	0.308841	-2.22362	-1.27362	0.065577	-0.61349	-0.60976	0.000257	-0.29909	-0.20129	0.006751	-0.08492	-0.08521	-2E-05
12/10/2009 14:33	-0.17689	-3.19825	-0.20856	-4.16232	-0.51562	0.251727	-4.50639	-0.33354	0.288046	-2.14709	-1.22924	0.063358	-0.6024	-0.58752	0.001027	-0.28375	-0.19179	0.006348	-0.08878	-0.10558	-0.00116
12/10/2009 14:34	-11.6838	7.220897	1.304966	-35.3914	32.99252	4.720447	-40.4784	27.68124	4.704962	-12.6934	8.597358	1.469672	-1.11975	-1.05638	0.004374	-0.52339	-0.42535	0.006768	-0.15054	-0.15744	-0.00048
12/10/2009 14:35	-11.1619	6.863255	1.244249	-34.9436	32.55368	4.65924	-40.6527	27.79689	4.724975	-13.1661	8.974335	1.528325	-1.16039	-1.05452	0.007308	-0.53106	-0.43105	0.006904	-0.14089	-0.15559	-0.00102
12/10/2009 14:36	-11.0192	6.638572	1.218889	-34.7881	32.30566	4.631389	-40.758	27.83544	4.734904	-13.3588	9.138668	1.552971	-1.17148	-1.06194	0.007561	-0.53681	-0.43484	0.007039	-0.16019	-0.1593	6.14E-05
12/10/2009 14:37	-10.884	6.479427	1.198571	-34.6179	32.0939	4.605017	-40.7398	27.91832	4.739372	-13.4388	9.235336	1.565165	-1.18256	-1.06194	0.008327	-0.53873	-0.43674	0.00704	-0.16212	-0.1593	0.000195
12/10/2009 14:38	-10.7206	6.309054	1.175533	-34.4605	31.84399	4.576907	-40.6999	27.77183	4.726504	-13.497	9.283671	1.572517	-1.18626	-1.06564	0.008326	-0.54256	-0.44054	0.007043	-0.16212	-0.1593	0.000195
12/10/2009 14:39	-10.6455	6.183619	1.16169	-34.3958	31.75242	4.566115	-40.7344	27.77761	4.729284	-13.5752	9.318472	1.580315	-1.21027	-1.08603	0.008577	-0.55215	-0.44813	0.00718	-0.16405	-0.15744	0.000456
12/10/2009 14:40	-10.6117	6.153664	1.157289	-34.3828	31.73335	4.563903	-40.7943	27.83351	4.737277	-13.6333	9.355207	1.586866	-1.21766	-1.08232	0.009343	-0.55407	-0.45573	0.006788	-0.16405	-0.1593	0.000328
12/10/2009 14:41	-10.5535	6.06193	1.146938	-34.3643	31.62461	4.55512	-40.8524	27.79689	4.738759	-13.6951	9.374542	1.592467	-1.2269	-1.09344	0.009213	-0.55982	-0.45573	0.007185	-0.16405	-0.1593	0.000328
12/10/2009 14:42	-10.5047	6.048826	1.142663	-34.2995	31.60172	4.549068	-40.8269	27.81616	4.738335	-13.7188	9.422878	1.597435	-1.22505	-1.08973	0.009341	-0.5579	-0.45383	0.007184	-0.16212	-0.15559	0.00045
12/10/2009 14:43	-10.4727	5.96271	1.134515	-34.2643	31.46057	4.536897	-40.8542	27.76798	4.736889	-13.7588	9.432545	1.600863	-1.23429	-1.08788	0.010107	-0.55407	-0.45003	0.007181	-0.16212	-0.1593	0.000195
12/10/2009 14:44	-8.07032	3.38554	0.790782	-27.4518	24.06099	3.555856	-33.5873	21.6367	3.812032	-12.197	7.708184	1.374029	-1.21766	-1.06008	0.010878	-0.54448	-0.43864	0.007306	-0.15826	-0.15374	0.000312
12/10/2009 14:45	-11.16	6.588019	1.22512	-35.8873	33.44857	4.786159	-42.6963	29.22145	4.964382	-14.564	10.34328	1.719312	-1.29895	-1.12494	0.012012	-0.57707	-0.47852	0.006803	-0.16598	-0.16485	7.75E-05
12/10/2009 14:46	-10.191	5.605158	1.090389	-34.294	31.14965	4.517479	-41.3878	28.04553	4.792886	-14.4168	10.12284	1.693933	-1.32667	-1.13606	0.013157	-0.58666	-0.48801	0.006809	-0.1544	-0.16671	-0.00085
12/10/2009 14:47	-9.91684	5.354326	1.054147	-33.6202	30.44015	4.421993	-40.7543	27.55404	4.715229	-14.3186	10.00101	1.678749	-1.3359	-1.13606	0.013795	-0.59049	-0.48801	0.007074	-0.1544	-0.16485	-0.00072
12/10/2009 14:48	-9.77223	5.135325	1.029047	-33.2351	29.90619	4.358554	-40.3676	27.18401	4.662994	-14.2459	9.896596	1.666522	-1.35438	-1.14903	0.014175	-0.59049	-0.49371	0.006681	-0.16598	-0.17041	-0.00031
12/10/2009 14:49	-9.61258	4.970613	1.006657	-32.8352	29.47143	4.300938	-40.0227	26.8853	4.618563	-14.1896	9.809583	1.656627	-1.35438	-1.17127	0.01264	-0.59241	-0.4975	0.006551	-0.16598	-0.16485	7.75E-05
12/10/2009 14:50	-9.53933	4.841468	0.992686	-32.6278	29.18542	4.266881	-39.8538	26.68296	4.59294	-14.1696	9.745775	1.650842	-1.36731	-1.15274	0.014812	-0.59624	-0.49371	0.007078	-0.15633	-0.16856	-0.00084
12/10/2009 14:51	-9.45856	4.747887	0.980651	-32.4279	28.96616	4.237942	-39.6505	26.53266	4.568527	-14.1368	9.699369	1.64538	-1.37655	-1.16571	0.014554	-0.60583	-0.4975	0.007477	-0.15826	-0.17411	-0.00109
12/10/2009 14:52	-9.40597	4.654307	0.970561	-32.2927	28.75644	4.214135	-39.5161	26.3708	4.548078	-14.1259	9.652964	1.641424	-1.38579	-1.16941	0.014936	-0.60583	-0.4956	0.007609	-0.16791	-0.16485	0.000211
12/10/2009 14:53	-21.1203	24.75417	3.166651	-68.917	96.64492	11.4285	-108.594	119.84	15.76845	-52.279	79.85176	9.120798	-0.3973	1.646182	0.141059	0.868603	0.30954	-0.03859	0.09071	0.203758	0.007804
12/10/2009 14:54	-26.5254	24.47232	3.520302	-87.3572	97.56638	12.76501	-139.745	122.5575	18.10636	-66.2609	83.10333	10.3104	-0.23469	1.807493	0.140969	1.267481	0.279155	-0.06822	0.12931	0.209316	0.005523
12/10/2009 14:55	-26.3251	24.16417	3.485205	-86.9399	96.79945	12.68326	-139.216	121.9708	18.02932	-66.4928	83.06804	10.32397	-0.33078	1.813056	0.147986	1.261728	0.265861	-0.06874	0.13124	0.205611	0.005134
12/10/2009 14:56	-26.0556	23.91992	3.449737	-86.5096	96.27986	12.6177	-138.731	121.5175	17.96455	-66.5772	82.98374	10.32398	-0.40469	1.803785	0.152448	1.255974	0.244972	-0.06979	0.11966	0.201906	0.005677
12/10/2009 14:57	-25.9638	23.83162	3.43731	-86.354	96.13114	12.59669	-138.58	121.3742	17.94424	-66.6815	82.94257	10.32833	-0.46936	1.787097	0.15576	1.236797	0.231678	-0.06938	0.11966	0.205611	0.005933
12/10/2009 14:58	-25.9039	23.77338	3.429154	-86.2844	95.98435	12.58175	-138.535	121.2938	17.93562	-66.7606	82.91512	10.3319	-0.50632	1.775972	0.157543	1.232962	0.224082	-0.06964	0.11773	0.201906	0.005811
12/10/2009 14:59	-26.0144	23.73768	3.434314	-86.2789	95.92641	12.57737	-138.509	121.1761	17.92566	-66.8935	82.86415	10.33756	-0.56545	1.75743	0.160345	1.213784	0.210789	-0.06924	0.12931	0.196349	0.004628
12/10/2009 15:00	-25.99	23.67381	3.428225	-86.4254	95.84336	12.58175	-138.686	121.1662	17.93724	-66.9618	82.87199	10.34282	-0.59132	1.751868	0.161747	1.208031	0.206991	-0.0691	0.12738	0.200054	0.005017
12/10/2009 15:01	-25.9376	23.63999	3.422273	-86.4071	95.76032	12.57475	-138.668	121.0976	17.93128	-67.0211	82.85042	10.34542	-0.61164	1.746306	0.162766	1.209949	0.199395	-0.06976	0.12352	0.200054	0.005283
12/10/2009 15:02	-26.0893	23.45964	3.42029	-86.5664	95.61161	12.57549	-138.86	120.8837	17.92976	-67.1811	82.67791	10.34455	-0.68925	1.692535	0.164411	1.169676	0.174707	-0.06868	0.11773	0.196349	0.005427
12/10/2009 15:03	-26.0443	23.39577	3.41278	-86.5334	95.43394	12.56095	-138.782	120.7778	17.91705	-67.2116	82.66418	10.34571	-0.71327	1.692535	0.166069	1.163923	0.16901	-0.06868	0.1158	0.188939	0.005049
12/10/2009 15:04	-26.0275	23.34693	3.408245	-86.4913	95.37987	12.55431	-138.747	120.7503	17.9127	-67.2476	82.66026	10.34792	-0.73544	1.692535	0.1676	1.165841	0.165212	-0.06907	0.11387	0.188939	0.005182
12/10/2009 15:05	-25.8777	23.44461	3.404651	-86.3998	95.59423	12.56278	-138.683	120.8445	17.91479	-67.2781	82.79749	10.35951	-0.75761	1.729618	0.17169	1.165841	0.186101	-0.06763	0.10808	0.192644	0.005837

TS	7A1 Comp. Strain	7B1 Tensile Strain	Moment (k*ft)	7A2 Comp. Strain	7B2 Tensile Strain	Moment (k*ft)	7A3 Comp. Strain	7B3 Tensile Strain	Moment (k*ft)	7A4 Comp. Strain	7B4 Tensile Strain	Moment (k*ft)	7A7 Comp. Strain	7B7 Tensile Strain	Moment (k*ft)	7A7 Comp. Strain	7B7 Tensile Strain	Moment (k*ft)	7A7 Comp. Strain	7B7 Tensile Strain	Moment (k*ft)
12/10/2009 15:06	-25.8272	23.40516	3.398438	-86.2496	95.46097	12.54322	-138.501	120.819	17.90052	-67.1793	82.79749	10.35268	-0.70957	1.738889	0.169014	1.186936	0.184202	-0.06922	0.10808	0.192644	0.005837
12/10/2009 15:07	-25.7879	23.39389	3.394946	-86.235	95.38952	12.53728	-138.491	120.7758	17.8968	-67.208	82.77593	10.35318	-0.71142	1.733326	0.168757	1.192689	0.182303	-0.06975	0.11387	0.190792	0.00531
12/10/2009 15:08	-25.7617	23.34317	3.389636	-86.191	95.28524	12.52705	-138.409	120.6738	17.88412	-67.2296	82.74652	10.35264	-0.73913	1.718493	0.169647	1.179265	0.180404	-0.06895	0.12352	0.196349	0.005027
12/10/2009 15:09	-28.715	32.56789	4.230272	-94.8749	129.099	15.4606	-158.201	176.7404	23.12051	-75.6053	122.0665	13.64501	0.208826	3.255826	0.21033	1.848593	1.00085	-0.05852	0.250903	0.598333	0.023983
12/10/2009 15:10	-40.1637	40.52002	5.569481	-134.398	157.798	20.16989	-233.938	218.7523	31.24856	-109.41	146.1243	17.63916	2.778304	4.079397	0.089813	3.500225	1.234473	-0.1564	0.499888	0.737275	0.016387
12/10/2009 15:11	-39.9061	40.22032	5.531011	-133.815	157.1122	20.08226	-233.253	218.177	31.16157	-109.748	146.1699	17.66566	2.680306	4.092383	0.097474	3.509817	1.21358	-0.15851	0.507608	0.735423	0.015726
12/10/2009 15:12	-39.8183	40.10911	5.517278	-133.648	156.8544	20.05295	-233.027	217.9333	31.12915	-109.928	146.1738	17.67835	2.619289	4.097948	0.10207	3.504062	1.202183	-0.1589	0.517259	0.739128	0.015315
12/10/2009 15:13	-39.7511	40.03372	5.507434	-133.566	156.6824	20.03545	-232.925	217.7955	31.11256	-110.058	146.1877	17.68828	2.571216	4.101658	0.105644	3.509817	1.196485	-0.15969	0.507608	0.740981	0.016109
12/10/2009 15:14	-39.7287	39.95268	5.500293	-133.517	156.5359	20.02196	-232.867	217.6756	31.10033	-110.181	146.1937	17.69717	2.537935	4.097948	0.107685	3.507899	1.186988	-0.16021	0.517259	0.742833	0.015571
12/10/2009 15:15	-39.6839	39.8754	5.491866	-133.499	156.4246	20.01302	-232.829	217.5858	31.09149	-110.273	146.1976	17.70383	2.506503	4.099803	0.109983	3.504062	1.177491	-0.1606	0.507608	0.735423	0.015726
12/10/2009 15:16	-39.6522	39.8019	5.484602	-133.479	156.3035	20.00329	-232.779	217.4959	31.0818	-110.345	146.1877	17.70806	2.484316	4.101658	0.111643	3.502143	1.173692	-0.16073	0.517259	0.739128	0.015315
12/10/2009 15:17	-39.6204	39.73216	5.477597	-133.477	156.2156	19.99709	-232.768	217.416	31.07557	-110.421	146.1857	17.71321	2.456582	4.097948	0.113301	3.504062	1.164195	-0.16152	0.519189	0.735423	0.014926
12/10/2009 15:18	-39.5924	39.67939	5.472022	-133.476	156.1316	19.99117	-232.756	217.3601	31.07087	-110.473	146.1877	17.71691	2.421453	4.097948	0.115726	3.504062	1.160396	-0.16178	0.52112	0.740981	0.015177
12/10/2009 15:19	-39.5719	39.62851	5.467091	-133.494	156.0456	19.98649	-232.827	217.3002	31.07165	-110.532	146.1917	17.72124	2.404813	4.097948	0.116875	3.504062	1.156598	-0.16204	0.519189	0.744686	0.015566
12/10/2009 15:20	-44.4888	53.92864	6.793616	-150.915	209.565	24.88345	-270.425	304.9685	39.71862	-126.091	199.6656	22.48654	4.559248	6.150071	0.109812	4.760881	2.364752	-0.1654	0.773978	1.346816	0.039542
12/10/2009 15:21	-54.6709	58.16582	7.788954	-182.57	221.0125	27.85873	-330.104	320.1605	44.88685	-151.328	208.1031	24.81102	6.673924	6.485989	-0.01297	6.021842	2.381851	-0.25126	0.978589	1.320877	0.023628
12/10/2009 15:22	-54.4308	57.86885	7.751882	-182.075	220.4116	27.78308	-329.561	319.6785	44.81536	-151.914	208.2576	24.8621	6.555492	6.472997	-0.00569	6.033359	2.338155	-0.25507	0.972798	1.319024	0.023899
12/10/2009 15:23	-54.3247	57.62108	7.727455	-181.831	220.127	27.74659	-329.564	319.5524	44.80759	-152.319	208.39	24.89924	6.459269	6.493413	0.002357	6.021842	2.330555	-0.2548	0.972798	1.320877	0.024027
12/10/2009 15:24	-54.2577	57.50571	7.714865	-181.865	219.957	27.73721	-329.413	319.4284	44.78859	-152.543	208.4822	24.92107	6.405607	6.504548	0.00683	6.035279	2.321056	-0.25639	0.986311	1.32273	0.023223
12/10/2009 15:25	-54.2055	57.4433	7.706959	-181.74	219.8226	27.71927	-329.408	319.288	44.77856	-152.697	208.4943	24.93249	6.357496	6.504548	0.010151	6.035279	2.311557	-0.25704	0.98245	1.326435	0.023745
12/10/2009 15:26	-54.3135	57.23337	7.699921	-181.854	219.4629	27.70236	-329.427	318.9748	44.75823	-152.952	208.3458	24.9399	6.248325	6.454438	0.014228	5.994969	2.27736	-0.25662	0.992102	1.317171	0.022439
12/10/2009 15:27	-54.2502	57.1199	7.68772	-181.783	219.3424	27.68909	-329.45	318.8854	44.75369	-153.067	208.3458	24.94781	6.205767	6.447014	0.016653	5.994969	2.267861	-0.25728	0.98052	1.317171	0.023239
12/10/2009 15:28	-54.079	56.97428	7.665847	-181.68	219.1171	27.66648	-329.352	318.7532	44.73777	-153.175	208.3639	24.95648	6.179862	6.456293	0.019082	5.99305	2.262162	-0.25754	0.976659	1.311613	0.023121
12/10/2009 15:29	-54.0101	57.11234	7.670622	-181.51	219.3108	27.66809	-329.168	318.8528	44.73199	-153.18	208.5143	24.96723	6.194665	6.496269	0.02075	6.016084	2.273561	-0.25834	0.98245	1.320877	0.023361
12/10/2009 15:30	-53.9784	56.9913	7.660083	-181.447	219.2139	27.65707	-329.124	318.7796	44.72388	-153.249	208.5243	24.97267	6.16876	6.504548	0.023179	6.021842	2.271661	-0.25887	0.992102	1.32273	0.022823
12/10/2009 15:31	-53.9691	56.9081	7.653697	-181.39	219.044	27.64137	-329.053	318.7491	44.71685	-153.25	208.5404	24.9739	6.133804	6.50826	0.025862	6.018003	2.269761	-0.25874	0.98052	1.32273	0.023622
12/10/2009 15:32	-53.9207	57.05938	7.660799	-181.363	219.0479	27.63979	-328.988	318.7654	44.71352	-153.257	208.6166	24.97965	6.148407	6.534244	0.026634	6.037198	2.271661	-0.25993	0.992102	1.32273	0.022823
12/10/2009 15:33	-53.8742	56.96861	7.651321	-181.338	219.0973	27.64147	-329.028	318.7349	44.71411	-153.331	208.6447	24.9867	6.128063	6.541668	0.028551	6.037198	2.269761	-0.26006	0.994032	1.326435	0.022945
12/10/2009 15:34	-53.8761	56.9497	7.650144	-181.356	219.0578	27.63998	-329.043	318.6922	44.71222	-153.398	208.6407	24.99105	6.103999	6.537956	0.029956	6.035279	2.265962	-0.26019	1.001753	1.328288	0.02254
12/10/2009 15:35	-53.8184	59.15708	7.798533	-181.284	228.4523	28.28351	-328.943	335.7498	45.88277	-153.427	220.0094	25.77776	6.1077	7.150469	0.071981	6.050635	2.701035	-0.23122	0.998823	1.552484	0.038149
12/10/2009 15:36	-68.5841	74.90497	9.904845	-228.964	282.8463	35.32951	-423.292	418.1811	58.08566	-191.834	267.4181	31.70151	10.75416	9.319012	-0.09907	8.613815	3.546589	-0.34978	1.513319	2.054646	0.037367
12/10/2009 15:37	-68.2537	74.52164	9.855579	-228.284	282.0648	35.22863	-422.439	417.4303	57.97498	-192.657	267.8336	31.78702	10.56895	9.391437	-0.08128	8.652224	3.516184	-0.35453	1.526833	2.060206	0.036818
12/10/2009 15:38	-68.0978	74.25978	9.826741	-228.083	281.6511	35.18622	-422.26	417.1366	57.94234	-193.12	268.0566	31.83437	10.4245	9.380294	-0.07208	8.644542	3.48578	-0.3561	1.528764	2.063912	0.036941
12/10/2009 15:39	-67.9475	74.18768	9.811386	-227.872	281.4493	35.1577	-422.111	416.8677	57.91348	-193.422	268.1802	31.86377	10.35042	9.43415	-0.06325	8.656065	3.478179	-0.35742	1.524902	2.065765	0.037335
12/10/2009 15:40	-67.979	74.10229	9.80767	-227.769	281.2534	35.13708	-421.895	416.6609	57.88431	-193.587	268.2471	31.87973	10.28005	9.406293	-0.06031	8.663747	3.453476	-0.35966	1.528764	2.063912	0.036941
12/10/2009 15:41	-67.9103	73.99604	9.795594	-227.675	281.1056	35.12037	-421.794	416.5369	57.86876	-193.753	268.3424	31.89776	10.22635	9.456435	-0.05315	8.673349	3.462977	-0.35966	1.546138	2.067618	0.035997
12/10/2009 15:42	-67.8639	73.94481	9.788855	-227.579	280.9617	35.10382	-421.681	416.3735	57.8497	-193.894	268.389	31.91075	10.17635	9.475006	-0.04841	8.669508	3.453476	-0.36006	1.546138	2.069471	0.036125
12/10/2009 15:43	-67.8212	73.8765	9.781193	-227.506	280.8218	35.08914	-421.581	416.2349	57.83326	-194.008	268.4275	31.92124	10.13376	9.475006	-0.04547	8.679111	3.445875	-0.36124	1.549999	2.073177	0.036114
12/10/2009 15:44	-67.786	73.81958	9.774829	-227.43	280.7039	35.07573	-421.49	416.0985	57.81754	-194.121	268.4438	31.9302	10.05968	9.482434	-0.03985	8.671429	3.438274	-0.36124	1.546138	2.07503	0.036509
12/10/2009 15:45	-67.7507	73.65831	9.761262	-227.376	280.5561	35.06185	-421.429	415.9847	57.80545	-194.247	268.4539	31.93958	10.03931	9.497291	-0.03742	8.67527	3.428773	-0.36216	1.542277	2.069471	0.036391
12/10/2009 15:46	-82.0506	91.21154	11.96004	-275.496	344.4395	42.79329	-516.788	515.939	71.28765	-232.258	329.5792	38.78284	14.63947	12.49744	-0.14786	11.84502	4.901666	-0.47929	2.156225	2.864515	0.048892
12/10/2009 15:47	-81.7508	90.69374	11.9036	-274.147	343.0111	42.60156	-515.995	513.9484	71.09552	-234.895	330.8024	39.04925	14.12606	12.68327	-0.09959	11.97569	4.823735	-0.49369	2.179394	2.873782	0.047933
12/10/2009 15:48	-81.5546	90.47864	11.87521	-273.569	342.5021	42.52651	-515.501	513.2738	71.01488	-235.493	331.1241	39.11279	13.88143	12.75946	-0.07745	11.99107	4.776216	-0.49803	2.179394	2.873782	0.047933
12/10/2009 15:49	-81.4953	90.3435	11.86179	-273.239	342.1647	42.48042	-515.158	512.7968	70.95826	-235.848	331.3659	39.15397	13.73688	12.79105	-0.06529	11.99683	4.747705	-0.5004	2.196771	2.871929	0.046605
12/10/2009 15:50	-81.3787	90.27117	11.84875	-272.947	341.9506	42.44551	-514.875	512.5425	70.92116	-236.135	331.5667	39.18765	13.61828	12.84309	-0.05351	12.00452	4.730599	-0.50211	2.194841	2.870076	0.046611
12/10/2009 15:51	-81.2769	90.19313	11.83633	-272.727	341.7749	42.41821	-514.632	512.3009	70.88772	-236.345	331.7306	39.21342	13.52377	12.88397	-0.04416	12.01028	4.719195	-0.50329	2.206425	2.871929	0.045939
12/10/2009 15:52	-81.2528	90.01611	11.82245	-272.631	341.5427	42.3955	-514.538	512.0929	70.86688	-236.561	331.8495	39.23655	13.43482	12.88955	-0.03764	12.00452	4.696386	-0.50447	2.208356	2.871929	0.045805
12/10/2009 15:53	-81.3843	90.08463	11.83625	-271.147	341.3286	42.27831	-513.876	511.8912	70.80725	-236.858	332.9153	39.33066	13.49597	13.06982	-0.02942	12.11214	4.749606	-0.50822	2.229595	2.897877	0.046131
12/10/2009 15:54	-81.4472	90.00089	11.83482	-271.161	341.1913	42.2698	-513.967	511.6055	70.79378	-237.073	333.0116	39.35211	13.42185	13.10884	-0.02161	12.11982	4.743904	-0.50915	2.239249	2.892317	0.04508
12/10/2009 15:55	-81.6397	89.80104	11.83431	-271.441	340.8278	42.264	-514.033	511.221	70.77183	-237.292	332.9276	39.36147	13.29769	13.09398	-0.01406	12.09676	4.715393	-0.50963	2.233456	2.896023	0.045736
12/10/2009 15:56	-81.7063	89.75346	11.83562	-271.636	340.7147	42.26967	-513.883	511.1433	70.75607	-237.419	333.0096	39.37585	13.24581	13.11814	-0.00881	12.10253	4.709691	-0.51032	2.233456	2.892317	0.04548
12/10/2009 15:57	-81.7582	89.69446	11.83513	-271.913	340.5067	42.27449	-513.69	510.9795	70.73146	-237.502	333.0608	39.38512	13.19948	13.14044	-0.00408	12.10637	4.700188	-0.51124	2.229595	2.892317	0.045747
12/10/2009 15:58	-81.6249	89.81437	11.83421	-271.741	340.5955	42.26873	-513.291	511.074	70.71049	-237.493	333.2904	39.40037	13.23099	13.21478	-0.00112	12.15441	4.726798	-0.51272	2.252764	2.901584	0.044787

TS	7A1 Comp. Strain	7B1 Tensile Strain	Moment (k*ft)	7A2 Comp. Strain	7B2 Tensile Strain	Moment (k*ft)	7A3 Comp. Strain	7B3 Tensile Strain	Moment (k*ft)	7A4 Comp. Strain	7B4 Tensile Strain	Moment (k*ft)	7A7 Comp. Strain	7B7 Tensile Strain	Moment (k*ft)	7A7 Comp. Strain	7B7 Tensile Strain	Moment (k*ft)	7A7 Comp. Strain	7B7 Tensile Strain	Moment (k*ft)
12/10/2009 15:59	-81.7285	89.76298	11.83781	-272.052	340.4501	42.28017	-513.117	510.9543	70.69015	-237.557	333.358	39.40945	13.19763	13.23708	0.002723	12.17363	4.722996	-0.51431	2.24311	2.907144	0.045837
12/10/2009 16:00	-81.7415	89.70398	11.83464	-272.107	340.2725	42.27167	-512.992	510.8618	70.67516	-237.633	333.3826	39.41641	13.15872	13.25195	0.006436	12.17363	4.721095	-0.51444	2.245041	2.90529	0.045576
12/10/2009 16:01	-81.6749	89.67924	11.82833	-272.103	340.1998	42.26641	-512.833	510.8072	70.66043	-237.666	333.4626	39.42419	13.15131	13.29841	0.010155	12.19669	4.730599	-0.51537	2.262418	2.914558	0.045016
12/10/2009 16:02	-81.8322	91.02878	11.93235	-272.295	346.7395	42.73106	-512.791	526.4323	71.7361	-237.721	342.2675	40.03581	13.12166	13.82069	0.048253	12.20822	5.188692	-0.48455	2.270142	3.127706	0.059196
12/10/2009 16:03	-96.4413	106.8575	14.03342	-321.436	408.8241	50.40884	-611.748	614.1813	84.62415	-279.046	399.3715	46.83016	16.70659	16.34367	-0.02505	15.40319	6.190559	-0.63593	2.990382	3.715301	0.05004
12/10/2009 16:04	-96.5742	106.9969	14.05222	-320.362	407.6535	50.25389	-609.425	612.9618	84.37962	-280.14	400.6256	46.99226	16.23376	16.54452	0.021451	15.46857	6.120212	-0.6453	3.001968	3.717155	0.049368
12/10/2009 16:05	-96.5668	106.8155	14.03919	-319.992	406.6935	50.16206	-608.298	612.0907	84.24165	-280.593	401.1481	47.05965	15.97419	16.65425	0.046944	15.48973	6.072682	-0.65005	3.021279	3.715301	0.047907
12/10/2009 16:06	-96.6314	106.7448	14.03877	-319.735	405.9113	50.0903	-607.635	611.67	84.16689	-281.023	401.5006	47.11364	15.80177	16.73423	0.064366	15.50511	6.046065	-0.65294	3.025141	3.717155	0.047769
12/10/2009 16:07	-96.6369	106.6398	14.0319	-319.573	405.4416	50.04672	-607.184	611.3114	84.11099	-281.311	401.6437	47.14337	15.65345	16.78444	0.078071	15.50896	6.015646	-0.65531	3.030935	3.717155	0.047369
12/10/2009 16:08	-96.5871	106.5195	14.02016	-319.321	405.0618	50.0031	-606.843	610.9869	84.06507	-281.537	401.7598	47.16698	15.53295	16.83094	0.089598	15.51473	5.998535	-0.65689	3.038659	3.715301	0.046708
12/10/2009 16:09	-96.552	106.4909	14.01576	-319.121	404.7964	49.97098	-606.569	610.7094	84.02696	-281.651	401.8635	47.18205	15.44211	16.89232	0.100106	15.53396	5.985227	-0.65914	3.046383	3.720862	0.046658
12/10/2009 16:10	-96.5668	106.4107	14.01124	-318.947	404.5044	49.93882	-606.322	610.4981	83.99538	-281.797	401.932	47.19682	15.35127	16.91278	0.107788	15.53588	5.964314	-0.66071	3.050245	3.720862	0.046292
12/10/2009 16:11	-96.5428	106.3591	14.00603	-318.73	404.3431	49.91268	-606.157	610.3038	83.97053	-281.942	402.019	47.21287	15.27341	16.96113	0.116501	15.54357	5.95861	-0.66164	3.061832	3.720862	0.045492
12/10/2009 16:12	-96.5373	106.3076	14.00209	-318.604	404.141	49.89008	-605.975	610.1331	83.94622	-282.067	402.0813	47.22579	15.20297	16.98717	0.123161	15.55319	5.949104	-0.66296	3.065694	3.720862	0.045225
12/10/2009 16:13	-96.552	111.343	14.3607	-318.523	425.4357	51.35439	-605.906	649.486	86.6579	-282.231	423.8995	48.74321	15.25488	17.96561	0.187118	15.68972	6.819914	-0.61227	3.112041	4.115723	0.069283
12/10/2009 16:14	-110.598	123.631	16.16849	-367.626	471.881	57.94997	-707.485	717.0261	98.33196	-325.53	472.6845	55.09958	18.13833	20.28226	0.147993	18.50198	7.479775	-0.76085	3.942486	4.547695	0.041777
12/10/2009 16:15	-110.158	123.1502	16.10494	-366.041	470.7186	57.7603	-705.225	715.11	98.04369	-327.143	473.2279	55.24847	17.55408	20.52236	0.204896	18.56163	7.367574	-0.77271	3.967594	4.542133	0.03966
12/10/2009 16:16	-109.932	122.8207	16.06658	-365.222	469.8474	57.64365	-704.155	714.0426	97.89615	-327.714	473.2909	55.29219	17.21099	20.65638	0.23783	18.58664	7.299113	-0.77916	3.990771	4.534717	0.037548
12/10/2009 16:17	-109.961	122.7001	16.06028	-365.005	469.4408	57.60062	-703.621	713.4396	97.81769	-328.194	473.3307	55.32812	16.9458	20.742	0.262046	18.58279	7.245867	-0.78257	3.984977	4.534717	0.037948
12/10/2009 16:18	-109.985	122.5507	16.05162	-364.632	468.9722	57.54251	-702.91	712.9212	97.73278	-328.489	473.3874	55.35236	16.7548	20.80901	0.279856	18.59049	7.207834	-0.78573	3.98884	4.529155	0.037297
12/10/2009 16:19	-110.015	122.5124	16.05101	-364.46	468.7019	57.51197	-702.322	712.3443	97.65241	-328.756	473.358	55.36879	16.59719	20.83693	0.292663	18.60011	7.15649	-0.78994	3.996566	4.523593	0.03638
12/10/2009 16:20	-110.085	122.1523	16.03098	-364.369	468.221	57.47248	-702.209	711.9669	97.61852	-329.1	473.3496	55.39192	16.40064	20.87044	0.308544	18.57895	7.118458	-0.7911	3.996566	4.516177	0.035868
12/10/2009 16:21	-110.07	122.0297	16.0215	-364.106	468.0023	57.43921	-701.865	711.6351	97.5719	-329.299	473.4105	55.4099	16.28939	20.91511	0.319307	18.57895	7.101343	-0.79228	3.998497	4.514323	0.035607
12/10/2009 16:22	-109.899	122.2193	16.02278	-364.123	468.0064	57.44068	-701.501	711.453	97.53422	-329.348	473.5573	55.42343	16.19112	20.98026	0.330588	18.58857	7.09754	-0.79321	4.006223	4.519885	0.035457
12/10/2009 16:23	-110.02	122.0776	16.02138	-363.784	467.8103	57.40375	-701.135	711.3142	97.49932	-329.431	473.6476	55.43538	16.13179	21.0361	0.338538	18.61166	7.093737	-0.79507	4.012017	4.519885	0.035057
12/10/2009 16:24	-109.989	121.978	16.01234	-363.586	467.6515	57.37913	-700.924	711.106	97.47044	-329.56	473.6853	55.44686	16.05948	21.06775	0.345714	18.62128	7.082327	-0.79652	4.023606	4.519885	0.034257
12/10/2009 16:25	-109.991	121.821	16.00163	-363.484	467.4575	57.35873	-700.72	710.7851	97.4342	-329.673	473.7042	55.45599	15.97975	21.09753	0.353273	18.6309	7.065213	-0.79836	4.023606	4.523593	0.034513
12/10/2009 16:26	-110.009	121.9972	16.01506	-363.374	467.5483	57.35739	-700.501	710.8589	97.42414	-329.736	473.8595	55.47103	15.93896	21.15152	0.359815	18.64052	7.072819	-0.7985	4.027469	4.525447	0.034375
12/10/2009 16:27	-109.974	121.8478	16.00234	-363.355	467.2388	57.33472	-700.349	710.7028	97.40287	-329.847	473.8994	55.48149	15.87407	21.1813	0.366351	18.65206	7.06141	-0.80009	4.039058	4.529155	0.033831
12/10/2009 16:28	-110.013	121.7578	15.99879	-363.381	466.9994	57.31998	-700.186	710.4946	97.37727	-329.944	473.9036	55.48843	15.80362	21.20178	0.372627	18.65399	7.05	-0.80101	4.046783	4.529155	0.033297
12/10/2009 16:29	-110.02	121.6697	15.99322	-363.338	466.562	57.28682	-700.096	710.4035	97.36272	-330.013	473.9854	55.49887	15.77396	21.24087	0.377373	18.67323	7.042394	-0.80286	4.054509	4.532863	0.03302
12/10/2009 16:30	-110.096	121.7731	16.00557	-363.328	466.5847	57.28767	-699.907	710.293	97.34407	-330.082	474.0463	55.50786	15.7239	21.28369	0.383784	18.67708	7.053803	-0.80234	4.056441	4.538425	0.033271
12/10/2009 16:31	-110.09	125.7559	16.28011	-363.207	483.4268	58.44195	-700.748	738.199	99.32845	-330.636	486.3115	56.39269	15.87036	21.78262	0.408114	18.81177	7.455053	-0.78394	4.114385	4.664501	0.037974
12/10/2009 16:32	-124.605	139.4958	18.23047	-414.768	540.6611	65.95192	-807.739	822.6473	112.5432	-374.07	543.7112	63.35311	19.04358	25.04553	0.414306	21.56795	8.717957	-0.88702	5.082146	5.411756	0.022753
12/10/2009 16:33	-123.931	138.8464	18.13916	-412.604	538.7442	65.67021	-804.57	819.9773	112.1402	-375.494	543.4651	63.4344	18.16244	25.35666	0.496607	21.61223	8.575294	-0.89992	5.113055	5.402484	0.019979
12/10/2009 16:34	-123.733	138.5082	18.10214	-411.786	537.5898	65.53405	-803.049	818.5381	111.9359	-376.059	543.0067	63.44178	17.68947	25.54112	0.541988	21.61223	8.493502	-0.90557	5.114987	5.395067	0.019333
12/10/2009 16:35	-123.662	138.2431	18.0789	-411.369	536.7653	65.44837	-802.044	817.5641	111.7992	-376.514	543.0534	63.4764	17.44466	25.65291	0.566604	21.62378	8.436439	-0.9103	5.124646	5.385795	0.018027
12/10/2009 16:36	-123.606	138.0722	18.0633	-411.015	536.3166	65.39298	-801.29	816.87	111.6993	-376.79	543.151	63.50219	17.20913	25.76284	0.59045	21.62763	8.398397	-0.9132	5.134306	5.38394	0.017232
12/10/2009 16:37	-123.548	137.9358	18.04984	-410.73	535.8951	65.34415	-800.649	816.2928	111.6152	-377.191	543.3038	63.54043	17.02925	25.84855	0.608784	21.63341	8.36416	-0.91596	5.140101	5.378377	0.016448
12/10/2009 16:38	-123.498	137.736	18.03263	-410.548	535.2607	65.28779	-800.076	815.8037	111.5419	-377.448	543.3675	63.5626	16.8605	25.92122	0.625449	21.64111	8.335629	-0.91846	5.145897	5.382086	0.016304
12/10/2009 16:39	-123.451	137.6342	18.0223	-410.405	534.9853	65.25891	-799.777	815.3984	111.4933	-377.657	543.4354	63.58172	16.72699	25.98085	0.638781	21.64881	8.312804	-0.92057	5.149761	5.380232	0.015909
12/10/2009 16:40	-123.44	137.5458	18.01545	-410.27	534.7224	65.23149	-799.445	815.0526	111.4465	-377.85	543.4905	63.59879	16.60831	26.05166	0.651861	21.65844	8.293784	-0.92254	5.157488	5.378377	0.015248
12/10/2009 16:41	-123.44	137.4613	18.00961	-410.148	534.4908	65.20705	-799.197	814.7354	111.4074	-378.017	543.5308	63.61312	16.49335	26.09079	0.662498	21.66229	8.269058	-0.92452	5.161352	5.378377	0.014981
12/10/2009 16:42	-123.454	137.3922	18.00585	-410.064	534.2988	65.18804	-798.957	814.4491	111.3711	-378.186	543.5924	63.62902	16.38766	26.14483	0.673524	21.66229	8.253841	-0.92557	5.172943	5.376523	0.014053
12/10/2009 16:43	-136.991	156.7983	20.27988	-455.633	607.4329	73.38194	-894.785	924.1252	125.5568	-413.678	609.1202	70.60227	20.11971	29.52625	0.64932	24.51628	9.851792	-1.01227	6.179542	6.3075	0.008833
12/10/2009 16:44	-139.143	156.4089	20.4015	-460.189	607.7454	73.71796	-903.961	923.9551	126.1784	-424.682	613.6844	71.67695	18.88775	30.13977	0.776711	24.91889	9.709098	-1.04991	6.289681	6.329756	0.002766
12/10/2009 16:45	-138.66	155.9174	20.33424	-458.758	606.2741	73.51766	-901.529	921.7912	125.8612	-425.818	613.9891	71.77642	18.18841	30.33	0.838117	24.92852	9.577822	-1.05964	6.303207	6.313064	0.00068
12/10/2009 16:46	-138.495	155.7034	20.30811	-457.854	605.5164	73.40291	-900.225	920.6816	125.6946	-426.396	614.1436	71.82698	17.85269	30.51464	0.874037	24.94779	9.526455	-1.06451	6.314801	6.313064	-0.00012
12/10/2009 16:47	-138.353	155.5435	20.28722	-457.134	604.8812	73.30938	-899.333	919.5609	125.5556	-426.807	613.914	71.83952	17.63569	30.62468	0.896612	24.95742	9.46938	-1.06912	6.330259	6.30379	-0.00183
12/10/2009 16:48	-138.248	155.3295	20.26526	-456.543	604.4761	73.24066	-898.716	919.1159	125.4824	-427.157	613.9226	71.86427	17.38531	30.69369	0.918658	24.96512	9.425623	-1.07267	6.336056	6.298226	-0.00261
12/10/2009 16:49	-138.17	155.1214	20.24546	-456.18	603.9655	73.18033	-898.246	918.2459	125.3898	-427.453	613.8818	71.88185	17.18317	30.7683	0.937762	24.95356	9.391379	-1.07424	6.33992	6.292662	-0.00326
12/10/2009 16:50	-138.074	154.9923	20.22998	-455.975	603.5119	73.13485	-897.772	917.8121	125.3272	-427.674	613.8647	71.89694	17.007	30.84291	0.955073	24.95934	9.427526	-1.07214	6.34765	6.290807	-0.00392
12/10/2009 16:51	-138.265	154.682	20.22169	-456.126	602.9359	73.10555	-897.698	917.2464	125.283	-427.948	613.708	71.90404	16.80301	30.84664	0.989411	24.93237	9.381867	-1.07343	6.345717	6.283389	-0.0043

TS	7A1 Comp. Strain	7B1 Tensile Strain	Moment (k*ft)	7A2 Comp. Strain	7B2 Tensile Strain	Moment (k*ft)	7A3 Comp. Strain	7B3 Tensile Strain	Moment (k*ft)	7A4 Comp. Strain	7B4 Tensile Strain	Moment (k*ft)	7A7 Comp. Strain	7B7 Tensile Strain	Moment (k*ft)	7A7 Comp. Strain	7B7 Tensile Strain	Moment (k*ft)	7A7 Comp. Strain	7B7 Tensile Strain	Moment (k*ft)
12/10/2009 16:52	-138.157	154.6107	20.20932	-455.81	602.6511	73.06406	-897.2	916.7344	125.2133	-428.12	613.6952	71.915	16.6695	30.897	0.982104	24.94008	9.351428	-1.07606	6.349582	6.27597	-0.00508
12/10/2009 16:53	-138.166	154.5433	20.2053	-455.69	602.4782	73.04387	-896.946	916.5108	125.1803	-428.272	613.7252	71.92756	16.55454	30.90073	0.990297	24.94393	9.334306	-1.07751	6.345717	6.27597	-0.00481
12/10/2009 16:54	-137.976	154.6204	20.19749	-455.214	602.4381	73.00823	-896.25	916.2694	125.1156	-428.311	613.8175	71.93666	16.49706	31.00705	1.001604	24.98054	9.35333	-1.07872	6.355379	6.281534	-0.0051
12/10/2009 16:55	-137.937	154.5934	20.19297	-455.066	602.4065	72.99583	-896.119	916.1889	125.101	-428.433	613.9691	71.95486	16.42474	31.05554	1.009943	24.99402	9.345721	-1.08018	6.370837	6.285243	-0.00591
12/10/2009 16:56	-137.935	154.5568	20.19032	-455.007	602.2862	72.98346	-895.934	915.8021	125.0616	-428.549	613.9119	71.95958	16.33945	31.09099	1.018278	25.00173	9.328599	-1.08189	6.378566	6.279679	-0.00683
12/10/2009 16:57	-137.828	154.4681	20.17675	-454.911	602.0626	72.96141	-895.614	915.7127	125.0333	-428.63	613.9848	71.9702	16.2727	31.15627	1.027392	25.02099	9.334306	-1.08283	6.382431	6.285243	-0.00671
12/10/2009 16:58	-137.972	154.4122	20.18287	-454.98	601.7378	72.94375	-895.443	915.3171	124.9942	-428.735	613.9569	71.97556	16.19112	31.17119	1.034053	25.01714	9.313379	-1.08401	6.386296	6.283389	-0.0071
12/10/2009 16:59	-144.982	167.8484	21.59426	-479.65	656.3021	78.41315	-948.271	1002.185	134.6372	-443.431	660.2934	76.18853	18.45923	33.51274	1.039122	26.52193	10.65095	-1.09655	6.894518	7.053151	0.01095
12/10/2009 17:00	-154.635	174.7108	22.73429	-511.253	683.7726	82.49088	-1012.68	1038.115	141.5635	-476.691	687.5192	80.36379	19.57234	35.45399	1.096287	28.60353	10.95543	-1.21822	7.590263	7.383352	-0.01428
12/10/2009 17:01	-154.655	174.6237	22.72967	-512.127	685.4265	82.6654	-1016.03	1040.358	141.9498	-480.363	690.7165	80.83796	18.86177	35.91328	1.177041	28.80981	10.91737	-1.23509	7.656977	7.405614	-0.01728
12/10/2009 17:02	-153.95	173.8849	22.62997	-510.272	683.5141	82.40535	-1012.63	1037.526	141.5191	-481.376	690.8446	80.9167	18.26075	36.128	1.233351	28.83295	10.84886	-1.24142	7.673372	7.401903	-0.01874
12/10/2009 17:03	-153.602	173.4807	22.57803	-509.241	682.4096	82.25796	-1010.99	1035.752	141.2836	-481.9	690.7968	80.94958	17.87124	36.28298	1.270937	28.85608	10.78606	-1.24735	7.684969	7.394483	-0.02005
12/10/2009 17:04	-153.343	173.179	22.53933	-508.474	681.5616	82.14649	-1009.8	1034.426	141.1102	-482.251	690.723	80.96875	17.63754	36.40062	1.295189	28.85608	10.72897	-1.25129	7.6927	7.388917	-0.02097
12/10/2009 17:05	-153.139	172.9489	22.50935	-507.87	680.9786	82.06452	-1008.76	1033.39	140.9664	-482.515	690.6861	80.9844	17.39459	36.48839	1.318018	28.85994	10.69853	-1.25366	7.70623	7.383352	-0.02229
12/10/2009 17:06	-152.984	172.8174	22.48957	-507.397	680.4618	81.99618	-1007.99	1032.596	140.8588	-482.725	690.6275	80.99484	17.17761	36.56308	1.338151	28.86379	10.66237	-1.25642	7.713961	7.379642	-0.02308
12/10/2009 17:07	-152.86	172.6531	22.46967	-506.973	680.1094	81.94262	-1007.37	1031.887	140.7673	-482.91	690.5776	81.0042	17.00514	36.62657	1.354439	28.86379	10.63383	-1.25839	7.721692	7.374076	-0.024
12/10/2009 17:08	-152.763	172.5081	22.45299	-506.623	679.7251	81.8919	-1006.91	1031.265	140.6922	-483.055	690.5407	81.01165	16.83454	36.69193	1.370727	28.86572	10.60528	-1.26049	7.729423	7.370366	-0.02479
12/10/2009 17:09	-152.677	172.3746	22.43786	-506.342	679.3642	81.84761	-1006.38	1030.647	140.6129	-483.197	690.4777	81.01707	16.66023	36.73301	1.385595	28.85994	10.59006	-1.26114	7.721692	7.366656	-0.02451
12/10/2009 17:10	-152.619	172.278	22.42716	-506.038	679.0824	81.80718	-1005.84	1030.185	140.5442	-483.316	690.5059	81.02722	16.55268	36.7853	1.396629	28.86572	10.57674	-1.26246	7.72749	7.368511	-0.02478
12/10/2009 17:11	-152.571	172.1581	22.41561	-505.864	678.7472	81.772	-1005.41	1029.701	140.4811	-483.408	690.4668	81.03092	16.43216	36.82825	1.407913	28.86765	10.5501	-1.26443	7.739087	7.366656	-0.02571
12/10/2009 17:12	-152.557	172.046	22.40686	-505.759	678.4612	81.74503	-1005	1029.247	140.4212	-483.47	690.4451	81.03369	16.32091	36.86747	1.4183	28.86572	10.53868	-1.26509	7.74102	7.361091	-0.02623
12/10/2009 17:13	-152.546	171.9396	22.39877	-505.689	678.1879	81.72135	-1004.64	1028.834	140.3675	-483.558	690.4972	81.04335	16.22078	36.90295	1.427661	28.87343	10.51585	-1.2672	7.742953	7.361091	-0.02636
12/10/2009 17:14	-152.796	172.4481	22.45111	-519.612	695.1063	83.85026	-1037.91	1060.304	144.8365	-492.375	706.006	82.72252	17.41128	37.58464	1.392538	29.57716	10.95353	-1.28556	7.903378	7.53733	-0.02527
12/10/2009 17:15	-152.23	172.4965	22.41543	-519.604	697.5895	84.02111	-1040.01	1064.868	145.2964	-496.513	711.379	83.37906	17.39088	37.94139	1.418573	29.83747	11.04297	-1.29736	8.003888	7.620814	-0.02644
12/10/2009 17:16	-152.307	172.4655	22.41858	-517.868	695.6414	83.76684	-1035.99	1061.372	144.7776	-496.709	710.8999	83.35953	17.07561	37.99556	1.444074	29.82204	10.99159	-1.29984	8.009687	7.617103	-0.0271
12/10/2009 17:17	-152.203	173.3009	22.46906	-528.64	711.2473	85.58767	-1063.87	1088.945	148.6056	-504.735	726.0026	84.95607	18.26631	38.89037	1.423649	30.63775	11.4274	-1.32606	8.268703	7.843444	-0.02935
12/10/2009 17:18	-151.893	173.0282	22.42884	-524.526	706.9917	85.00988	-1053.9	1081.54	147.4067	-505.505	724.859	84.93027	17.65053	38.98005	1.472346	30.58568	11.33415	-1.32891	8.280301	7.845299	-0.03003
12/10/2009 17:19	-151.975	173.0108	22.4333	-523.376	705.8746	84.85344	-1051.21	1079.044	147.0483	-505.646	724.5273	84.91708	17.36121	39.06599	1.49825	30.58568	11.29989	-1.33127	8.289966	7.841589	-0.03095
12/10/2009 17:20	-152.017	172.9566	22.43246	-522.688	705.2207	84.76081	-1049.92	1077.493	146.8524	-505.762	724.2305	84.90464	17.13866	39.13512	1.518384	30.57796	11.25802	-1.33363	8.295765	7.837878	-0.03161
12/10/2009 17:21	-152.033	172.8909	22.42906	-522.339	704.6977	84.70061	-1048.87	1076.382	146.7031	-505.888	723.997	84.89723	16.905	39.15754	1.536061	30.55096	11.20283	-1.33557	8.291899	7.886116	-0.02801
12/10/2009 17:22	-152.083	157.2051	21.34969	-521.954	622.4159	78.9942	-1047.93	956.1571	138.339	-505.934	680.8431	81.9215	16.7752	37.64254	1.440443	30.57603	9.60636	-1.44751	8.299631	7.383352	-0.06325
12/10/2009 17:23	-57.5474	64.94771	8.455666	-225.87	310.8541	37.04932	-506.952	538.0153	72.13263	-371.346	491.0737	59.53163	-12.2846	34.77633	3.248548	19.39868	2.868234	-1.14107	5.385453	4.48095	-0.06244
12/10/2009 17:24	-58.4458	65.49702	8.555595	-227.55	312.4392	37.27471	-507.082	538.2284	72.1563	-368.757	488.4586	59.17237	-12.8302	34.90327	3.294971	19.17546	2.750434	-1.1338	5.298516	4.391958	-0.06258
12/10/2009 17:25	-58.7768	65.77927	8.597929	-228.19	313.1626	37.36877	-507.29	538.488	72.18855	-368.041	487.4891	59.05605	-13.0513	34.9686	3.314748	19.09271	2.756134	-1.12769	5.271469	4.351171	-0.06353
12/10/2009 17:26	-58.987	65.98955	8.62695	-228.518	313.6188	37.42294	-507.392	538.6357	72.2058	-367.641	486.8392	58.98354	-13.1951	35.00034	3.326862	19.03691	2.716235	-1.12659	5.246354	4.327069	-0.06346
12/10/2009 17:27	-24.5783	27.85188	3.619182	-136.223	193.8574	22.78497	-341.425	375.4934	49.48783	-313.427	404.9562	49.58898	-21.7499	34.03717	3.850902	15.65703	0.725454	-1.03071	4.044852	3.027618	-0.07022
12/10/2009 17:28	-25.4284	28.41975	3.717061	-137.927	194.9197	22.97595	-341.392	374.9554	49.44847	-310.982	402.494	49.25025	-22.1289	34.08943	3.880669	15.44934	0.649486	-1.02161	3.969526	2.957186	-0.06988
12/10/2009 17:29	-25.9414	28.8015	3.778823	-138.574	195.5217	23.06213	-341.315	374.7541	49.4292	-310.136	401.4156	49.11739	-22.2889	34.12116	3.893907	15.36281	0.605804	-1.01866	3.946349	2.923825	-0.07058
12/10/2009 17:30	-26.2952	29.04975	3.820382	-139.032	195.9133	23.12078	-341.362	374.6905	49.42808	-309.628	398.6957	48.89455	-22.4011	34.24248	3.910027	15.30128	-0.12913	-1.06514	3.925103	2.278876	-0.11364

TABLE E.9 Strain gage measurements for pile 8

TS	8A1 Comp. Strain	8B1 Tensile Strain	Moment (k*ft)	8A2 Comp. Strain	8B2 Tensile Strain	Moment (k*ft)	8A3 Comp. Strain	8B3 Tensile Strain	Moment (k*ft)	8A4 Comp. Strain	8B4 Tensile Strain	Moment (k*ft)	8A8 Comp. Strain	8B8 Tensile Strain	Moment (k*ft)	8A8 Comp. Strain	8B8 Tensile Strain	Moment (k*ft)	8A8 Comp. Strain	8B8 Tensile Strain	Moment (k*ft)
12/10/2009 14:14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12/10/2009 14:14	2.431796	-1.47703	-0.26982	-0.20203	0.121935	0.022363	-0.38837	1.047005	0.099082	0.207289	0.456394	0.017195	0.258195	0.185194	-0.00504	0.270937	0.195196	-0.00523	-0.09005	-0.04452	0.003143
12/10/2009 14:15	2.54088	-1.59867	-0.28575	-0.18349	0.052526	0.016292	-0.39405	1.061964	0.100507	0.203486	0.458257	0.017586	0.261857	0.189013	-0.00503	0.265331	0.191406	-0.0051	-0.0843	-0.03871	0.003147
12/10/2009 14:16	2.54088	-1.56636	-0.28352	-0.20759	0.069409	0.019121	-0.38647	1.11619	0.103727	0.224405	0.484338	0.017943	0.265519	0.19474	-0.00489	0.274674	0.197091	-0.00536	-0.08047	-0.04452	0.002482
12/10/2009 14:17	2.552363	-1.56086	-0.28392	-0.21315	0.060029	0.018857	-0.377	1.149848	0.105396	0.233914	0.497378	0.018187	0.271013	0.200468	-0.00487	0.272805	0.195196	-0.00536	-0.07472	-0.03677	0.00262
12/10/2009 14:18	2.552363	-1.61578	-0.28772	-0.23353	-0.01688	0.014955	-0.35427	1.168546	0.105118	0.258637	0.516008	0.017766	0.282	0.206196	-0.00523	0.276543	0.193301	-0.00575	-0.06706	-0.04064	0.001823
12/10/2009 14:19	2.546621	-1.63668	-0.28877	-0.22241	-0.05253	0.011727	-0.32964	1.189115	0.104838	0.273852	0.517871	0.016844	0.287494	0.213833	-0.00508	0.274674	0.198987	-0.00522	-0.06514	-0.02129	0.003027
12/10/2009 14:20	2.590639	-1.60247	-0.28944	-0.22797	-0.00188	0.015607	-0.33153	1.220904	0.107163	0.289066	0.540226	0.017337	0.29665	0.219561	-0.00532	0.276543	0.191406	-0.00588	-0.06514	-0.02323	0.002894
12/10/2009 14:21	2.646139	-1.59487	-0.29275	-0.20388	0.035642	0.016534	-0.34101	1.271392	0.111302	0.29287	0.560719	0.018489	0.307638	0.223379	-0.00582	0.285885	0.195196	-0.00626	-0.0594	-0.03871	0.001428
12/10/2009 14:22	2.684416	-1.63858	-0.29841	-0.19091	0.037518	0.015768	-0.32964	1.30879	0.113099	0.315692	0.581211	0.018328	0.309469	0.231016	-0.00542	0.289623	0.195196	-0.00652	-0.06131	-0.02323	0.002629
12/10/2009 14:23	2.720779	-1.61578	-0.29935	-0.18534	0.144447	0.022765	-0.32964	1.346189	0.11568	0.321397	0.594252	0.018835	0.318625	0.238653	-0.00552	0.295228	0.198987	-0.00664	-0.05748	-0.01742	0.002765
12/10/2009 14:24	2.751401	-1.60247	-0.30054	-0.15754	0.09192	0.01722	-0.32206	1.385459	0.117868	0.338513	0.618471	0.019325	0.329613	0.250109	-0.00549	0.291491	0.198987	-0.00639	-0.05556	-0.0271	0.001965
12/10/2009 14:25	2.703554	-1.57396	-0.29527	-0.17052	0.073161	0.016821	-0.32775	1.400418	0.119293	0.342317	0.620334	0.019191	0.333275	0.24629	-0.006	0.297097	0.200882	-0.00664	-0.05365	-0.01935	0.002367
12/10/2009 14:26	4.252085	-3.39634	-0.52796	1.173397	-1.15917	-0.16101	-0.00758	0.562738	0.039368	0.114103	0.441491	0.022599	0.294819	0.219561	-0.00519	0.282148	0.187616	-0.00653	-0.05556	-0.01548	0.002767
12/10/2009 14:27	3.275825	-2.13272	-0.37334	0.363296	-0.26262	-0.04321	-0.14019	1.073183	0.083758	0.285263	0.577485	0.020172	0.329613	0.240563	-0.00615	0.295228	0.193301	-0.00704	-0.05173	-0.02129	0.002101
12/10/2009 14:28	4.663701	-3.80862	-0.58483	1.390311	-1.35609	-0.18958	0.028418	0.523475	0.034173	0.108398	0.486201	0.026079	0.305806	0.223379	-0.00569	0.297097	0.187616	-0.00756	-0.0479	-0.00387	0.003039
12/10/2009 14:29	4.667531	-3.75922	-0.58169	1.419976	-1.31859	-0.18904	0.060626	0.527214	0.032208	0.129317	0.50483	0.025921	0.309469	0.232926	-0.00528	0.289623	0.187616	-0.00704	-0.04598	-0.00194	0.003041
12/10/2009 14:30	4.682847	-3.74023	-0.58143	1.436662	-1.2792	-0.18747	0.092834	0.560868	0.032308	0.140728	0.527185	0.026677	0.316794	0.238653	-0.00539	0.295228	0.187616	-0.00743	-0.0364	0.001935	0.002647
12/10/2009 14:31	4.715395	-3.68133	-0.57961	1.453348	-1.11604	-0.17736	0.11178	0.586477	0.031387	0.159745	0.549541	0.026907	0.324119	0.236744	-0.00603	0.297097	0.189511	-0.00743	-0.03066	-0.00581	0.001715
12/10/2009 14:32	4.715395	-3.66993	-0.57883	1.501553	-1.24544	-0.18962	0.119358	0.540302	0.029057	0.173057	0.543952	0.025602	0.331444	0.238653	-0.00641	0.312046	0.185721	-0.00872	-0.02491	0.015484	0.002788
12/10/2009 14:33	12.5539	-24.1342	-2.53253	11.41599	-22.7304	-2.35707	5.506657	-17.2067	-1.56787	-0.66175	-3.17868	-0.17374	0.060427	-0.1661	-0.01564	0.250382	0.10044	-0.01035	-0.04598	-0.01742	0.001972
12/10/2009 14:34	31.73912	-26.7524	-4.03759	46.29764	-30.615	-5.30917	44.11209	-28.6232	-5.02081	5.630199	-6.45947	-0.83453	-0.23438	-0.3131	-0.00543	0.231697	0.09665	-0.00932	-0.05365	-0.00968	0.003035
12/10/2009 14:35	30.69612	-25.994	-3.91324	45.90473	-30.3503	-5.26378	44.90905	-28.8444	-5.09109	6.153763	-6.65107	-0.8839	-0.24903	-0.32646	-0.00535	0.226091	0.092859	-0.0092	-0.04598	-0.01161	0.002373
12/10/2009 14:36	30.18431	-25.5986	-3.85062	45.73823	-30.2067	-5.24237	45.3219	-28.9689	-5.12819	6.363204	-6.75152	-0.90529	-0.25635	-0.32264	-0.00458	0.226091	0.089069	-0.00946	-0.03832	0	0.002645
12/10/2009 14:37	29.70141	-25.1616	-3.78712	45.47632	-29.9439	-5.20615	45.56275	-29.0061	-5.14738	6.58027	-6.82035	-0.92503	-0.26001	-0.32646	-0.00459	0.22796	0.089069	-0.00959	-0.03449	-0.01548	0.001312
12/10/2009 14:38	29.36284	-24.9327	-3.74794	45.33228	-29.8786	-5.1917	45.71759	-29.0377	-5.16025	6.736411	-6.86127	-0.93863	-0.25818	-0.32455	-0.00458	0.229828	0.092859	-0.00945	-0.03257	0.001935	0.002382
12/10/2009 14:39	29.24164	-24.8154	-3.73148	45.23687	-29.7816	-5.17842	45.84567	-29.0581	-5.1705	6.84495	-6.88731	-0.94792	-0.25635	-0.33028	-0.0051	0.231697	0.090964	-0.00971	-0.02682	0.007742	0.002386
12/10/2009 14:40	29.22048	-24.6962	-3.72179	45.3117	-29.7126	-5.17882	46.02919	-29.0451	-5.18227	6.942067	-6.90033	-0.95552	-0.24903	-0.32264	-0.00508	0.233565	0.087174	-0.01011	-0.02491	0.003871	0.001987
12/10/2009 14:41	29.22818	-24.6413	-3.71853	45.24061	-29.5747	-5.16439	46.03684	-29.06	-5.18383	6.999195	-6.91522	-0.96049	-0.24536	-0.32646	-0.0056	0.250382	0.087174	-0.01127	-0.01916	0.011613	0.002124
12/10/2009 14:42	29.15701	-24.507	-3.70435	45.19759	-29.5448	-5.15936	46.11522	-29.0804	-5.19065	7.071558	-6.94312	-0.96741	-0.24353	-0.32837	-0.00586	0.25412	0.089069	-0.01139	-0.02108	0.009677	0.002123
12/10/2009 14:43	29.07621	-20.1248	-3.39627	44.03233	-25.1535	-4.7758	45.45571	-25.2633	-4.88163	7.294367	-6.39994	-0.9453	-0.21424	-0.2711	-0.00393	0.255988	0.102335	-0.01061	-0.01341	0.02129	0.002395
12/10/2009 14:44	21.64496	-18.9524	-2.80238	35.25775	-23.1841	-4.03416	37.53289	-23.2858	-4.19822	6.530763	-6.15437	-0.87564	-0.15381	-0.29019	-0.00941	0.272805	0.092859	-0.01242	-0.00383	0.027096	0.002135
12/10/2009 14:45	30.35747	-24.7832	-3.80628	47.76662	-30.6896	-5.41572	49.01234	-30.4946	-5.48825	7.732395	-7.33744	-1.04025	-0.2417	-0.31501	-0.00506	0.2672	0.094755	-0.0119	-0.00958	0.025161	0.002398
12/10/2009 14:46	27.33182	-23.0782	-3.47973	45.12838	-29.3434	-5.14068	47.94892	-29.6733	-5.35815	7.972374	-7.28536	-1.05322	-0.22522	-0.29401	-0.00475	0.269068	0.098545	-0.01177	0	0.009677	0.000668
12/10/2009 14:47	26.77228	-22.6448	-3.41119	44.30351	-28.9127	-5.05401	47.36374	-29.2923	-5.29146	7.993325	-7.23328	-1.05107	-0.21424	-0.28828	-0.00511	0.272805	0.106125	-0.01151	0.001916	0.038709	0.00254
12/10/2009 14:48	26.41274	-22.4365	-3.372	43.79108	-28.5136	-4.99109	46.91631	-28.9689	-5.23825	7.997134	-7.18306	-1.04787	-0.20874	-0.28064	-0.00496	0.284017	0.10044	-0.01267	0.001916	0.034838	0.002273
12/10/2009 14:49	26.22241	-22.1867	-3.34161	43.36098	-28.1928	-4.93925	46.53773	-28.7031	-5.19377	7.99142	-7.13842	-1.04439	-0.20325	-0.27682	-0.00508	0.278411	0.102335	-0.01215	0.003832	0.04258	0.002675
12/10/2009 14:50	25.99556	-22.0106	-3.3138	43.06928	-27.9801	-4.90444	46.25669	-28.4819	-5.1591	7.99142	-7.09564	-1.04144	-0.19593	-0.26919	-0.00506	0.289623	0.109915	-0.0124	0.00958	0.04258	0.002278
12/10/2009 14:51	26.02824	-21.9898	-3.31462	42.86547	-27.8216	-4.87943	46.0311	-28.337	-5.13352	7.989515	-7.05286	-1.03835	-0.18494	-0.26346	-0.00542	0.291491	0.10802	-0.01266	0.011496	0.030967	0.001344
12/10/2009 14:52	25.83792	-21.8024	-3.28854	42.6542	-27.6817	-4.85519	45.83229	-28.1752	-5.10863	7.995229	-7.01752	-1.03631	-0.17945	-0.24628	-0.00461	0.297097	0.115601	-0.01253	0.01916	0.034838	0.001082
12/10/2009 14:53	65.12825	-52.6633	-8.13098	132.0483	-84.6388	-14.9576	212.2184	-120.031	-22.9347	79.29716	-49.896	-8.91802	-3.14667	-0.49255	0.18321	0.28028	0.363867	0.00577	0.017244	0.032903	0.001081
12/10/2009 14:54	62.91108	-51.6396	-7.90727	130.5983	-83.9788	-14.8119	212.0527	-119.717	-22.9016	81.06602	-50.2739	-9.06621	-3.29855	-0.6109	0.185524	0.274674	0.371448	0.00668	0.017244	0.050322	0.002283
12/10/2009 14:55	61.96447	-50.9677	-7.79554	129.9077	-83.3334	-14.7197	211.674	-119.405	-22.8539	81.66671	-50.3863	-9.11543	-3.34795	-0.66817	0.184962	0.2672	0.373343	0.007327	0.022992	0.04258	0.001352
12/10/2009 14:56	61.25413	-50.4124	-7.70818	129.358	-83.0291	-14.6608	211.3801	-119.112	-22.8134	82.02601	-50.4453	-9.14431	-3.37357	-0.70444	0.184246	0.276543	0.373343	0.006682	0.024908	0.054193	0.002021
12/10/2009 14:57	61.10511	-50.2768	-7.68854	129.1716	-82.9654	-14.6428	211.3131	-119.011	-22.8018	82.29452	-50.4841	-9.16552	-3.39919	-0.73307	0.184038	0.269068	0.375238	0.007329	0.026824	0.052257	0.001756
12/10/2009 14:58	60.99673	-50.1846	-7.67469	129.0746	-82.8115	-14.6262	211.2914	-118.953	-22.7963	82.51669	-50.5283	-9.18391	-3.40651	-0.75216	0.183226	0.2672	0.380924	0.00785	0.02874	0.054193	0.001757
12/10/2009 14:59	61.07221	-50.2561	-7.68483	129.0746	-82.9093	-14.6329	211.3111	-118.889	-22.7932	82.70023	-50.5541	-9.19836	-3.41932	-0.76743	0.183056	0.269068	0.382819	0.007852	0.032572	0.061935	0.002027
12/10/2009 15:00	61.04899	-50.3239	-7.68791	129.046	-82.9222	-14.6319	211.3407	-118.818	-22.7904	82.85672	-50.5725	-9.21043	-3.42481	-0.77889	0.182644	0.2672	0.38661	0.008243	0.032572	0.061935	0.002027
12/10/2009 15:01	61.05092	-50.2599	-7.68363	129.0061	-82.6917	-14.6132	211.3289	-118.741	-22.7843	82.99969	-50.5854	-9.22119	-3.43396	-0.7808	0.183144	0.2672	0.388505	0.008374	0.03832	0.067741	0.002031
12/10/2009 15:02	60.84772	-50.1902	-7.66479	128.7645	-82.7341	-14.5994	211.1277	-118.603	-22.7608	83.05766	-50.6186	-9.22748	-3.4486	-0.80561	0.182441	0.2672	0.384714	0.008112	0.040237	0.069676	0.002032
12/10/2009 15:03	60.95803	-50.1902	-7.6724	128.7132	-82.6751	-14.5918	211.0962	-118.608	-22.759	83.14074	-50.6186	-9.23322	-3.45225	-0.81516	0.182035	0.263462	0.38661	0.008501	0.044069	0.071612	0.001901
12/10/2009 15:04	60.91545	-50.1639	-7.66765	128.7151	-82.6031	-14.587	211.0449	-118.542	-22.7509	83.23155	-50.626	-9.24	-3.45774	-0.81897	0.182151	0.270937	0.392295	0.008377	0.042153	0.073547	0.002167
12/10/2009 15:05	60.61549	-50.3276	-7.65825	128.2472	-82.9037	-14.5755	210.5381	-118.747	-22.7301	83.10596	-50.7843	-9.24087	-3.49617	-0.87624	0.18085	0.257857	0.379029	0.008364	0.040237	0.069676	0.002032

TS	8A1 Comp. Strain	8B1 Tensile Strain	Moment (k*ft)	8A2 Comp. Strain	8B2 Tensile Strain	Moment (k*ft)	8A3 Comp. Strain	8B3 Tensile Strain	Moment (k*ft)	8A4 Comp. Strain	8B4 Tensile Strain	Moment (k*ft)	8A8 Comp. Strain	8B8 Tensile Strain	Moment (k*ft)	8A8 Comp. Strain	8B8 Tensile Strain	Moment (k*ft)	8A8 Comp. Strain	8B8 Tensile Strain	Moment (k*ft)
12/10/2009 15:06	60.75483	-50.4312	-7.67501	128.2986	-82.8613	-14.5761	210.5164	-118.69	-22.7247	83.16006	-50.7643	-9.2446	-3.50349	-0.8896	0.180433	0.257857	0.380924	0.008495	0.036404	0.069676	0.002297
12/10/2009 15:07	60.73548	-50.3521	-7.66822	128.2396	-82.8152	-14.5688	210.4592	-118.606	-22.7149	83.21996	-50.7643	-9.24874	-3.51081	-0.89915	0.180279	0.265331	0.388505	0.008503	0.03832	0.065806	0.001897
12/10/2009 15:08	60.73548	-50.2448	-7.66081	128.175	-82.758	-14.5604	210.3251	-118.416	-22.6926	83.2644	-50.7458	-9.25053	-3.51264	-0.90869	0.179747	0.263462	0.3904	0.008762	0.03832	0.069676	0.002164
12/10/2009 15:09	93.93468	-77.1331	-11.8086	196.7865	-130.869	-22.6176	329.4898	-202.152	-36.6985	141.2687	-89.2582	-15.9129	-4.9671	0.30166	0.363695	0.362498	0.833901	0.03254	0.055565	0.090967	0.002444
12/10/2009 15:10	95.11098	-76.502	-11.8462	201.6776	-131.568	-23.0035	337.383	-202.597	-37.274	148.154	-90.4867	-16.473	-5.34939	0.07064	0.374137	0.351286	0.843377	0.033968	0.051733	0.090967	0.002708
12/10/2009 15:11	94.42932	-76.0544	-11.7682	201.0372	-131.124	-22.9287	336.9615	-202.136	-37.2131	148.8052	-90.6714	-16.5307	-5.42256	-0.021	0.372862	0.334469	0.839587	0.034868	0.049817	0.073547	0.001638
12/10/2009 15:12	94.16836	-75.8915	-11.739	200.7673	-130.968	-22.8992	336.7981	-201.932	-37.1878	149.1084	-90.7938	-16.5601	-5.46645	-0.07446	0.372202	0.334469	0.845273	0.03526	0.047901	0.075483	0.001904
12/10/2009 15:13	93.96194	-75.7753	-11.7167	200.5841	-130.882	-22.8806	336.7295	-201.803	-37.1741	149.3979	-90.8779	-16.5859	-5.49389	-0.11646	0.371196	0.340075	0.849064	0.035135	0.049817	0.077418	0.001905
12/10/2009 15:14	93.79447	-75.6892	-11.6992	200.4375	-130.849	-22.8682	336.665	-201.751	-37.1661	149.6326	-90.9364	-16.6061	-5.5195	-0.1451	0.370987	0.330732	0.852854	0.036041	0.044069	0.087096	0.00297
12/10/2009 15:15	93.67959	-75.5936	-11.6847	200.3353	-130.723	-22.8525	336.6166	-201.625	-37.1541	149.8321	-90.9821	-16.6231	-5.53779	-0.17182	0.370405	0.334469	0.849064	0.035522	0.045985	0.077418	0.00217
12/10/2009 15:16	93.60559	-75.5075	-11.6736	200.2524	-130.621	-22.8397	336.5904	-201.573	-37.1487	150.0043	-91.0242	-16.6378	-5.55242	-0.18901	0.370229	0.328863	0.85475	0.036301	0.045985	0.073547	0.001903
12/10/2009 15:17	93.50045	-75.3876	-11.6581	200.1907	-130.559	-22.8311	336.5702	-201.498	-37.1421	150.153	-91.0571	-16.6504	-5.56522	-0.21764	0.369136	0.3326	0.862331	0.036567	0.042153	0.079354	0.002568
12/10/2009 15:18	93.40114	-75.3464	-11.6484	200.1136	-130.606	-22.8291	336.546	-201.401	-37.1337	150.2899	-91.0863	-16.6619	-5.5762	-0.22719	0.369234	0.362498	0.866122	0.034764	0.044069	0.092902	0.003371
12/10/2009 15:19	93.33689	-75.2696	-11.6387	200.0557	-130.533	-22.8201	336.5339	-201.301	-37.126	150.4151	-91.1119	-16.6723	-5.58351	-0.24246	0.368685	0.330732	0.871808	0.03735	0.036404	0.090967	0.003766
12/10/2009 15:20	127.5898	-102.124	-15.8569	268.0096	-180.328	-30.9481	448.4373	-288.107	-50.8426	206.091	-129.341	-23.1544	-6.27482	1.147546	0.512356	0.426031	1.358949	0.064398	0.059397	0.116128	0.003916
12/10/2009 15:21	127.1039	-101.525	-15.7819	269.916	-180.777	-31.1107	452.9576	-290.277	-51.3044	210.5019	-131.281	-23.5928	-6.51073	0.962318	0.515854	0.405476	1.385487	0.067649	0.059397	0.10258	0.002981
12/10/2009 15:22	126.377	-101.126	-15.7042	269.5253	-180.566	-31.0692	452.7724	-290.094	-51.279	211.1725	-131.692	-23.6674	-6.52536	0.842018	0.508559	0.448455	1.387383	0.064813	0.055565	0.100644	0.003112
12/10/2009 15:23	125.7991	-101.148	-15.6658	269.0623	-180.68	-31.0451	452.4824	-290.34	-51.276	211.4296	-132.114	-23.7143	-6.6241	0.72745	0.507467	0.435375	1.374113	0.0648	0.036404	0.108386	0.004969
12/10/2009 15:24	125.4975	-101.01	-15.6355	268.8201	-180.555	-31.0197	452.3466	-290.179	-51.2555	211.7402	-132.277	-23.747	-6.67347	0.649163	0.505471	0.424163	1.372218	0.065443	0.036404	0.094838	0.004034
12/10/2009 15:25	125.1116	-100.535	-15.5761	268.6775	-180.188	-30.9846	452.252	-289.72	-51.2173	211.9954	-132.279	-23.7648	-6.70639	0.637706	0.506952	0.420425	1.387383	0.066748	0.034488	0.116128	0.005635
12/10/2009 15:26	125.4642	-100.555	-15.6018	268.8553	-179.999	-30.9838	452.5091	-289.558	-51.2238	212.407	-132.355	-23.7984	-6.70273	0.605246	0.504459	0.422294	1.394965	0.067142	0.030656	0.114192	0.005766
12/10/2009 15:27	125.3486	-100.412	-15.5839	268.7186	-179.867	-30.9652	452.4495	-289.433	-51.2111	212.5949	-132.426	-23.8163	-6.72467	0.582334	0.504392	0.424163	1.391174	0.066751	0.036404	0.116128	0.005503
12/10/2009 15:28	125.3897	-100.183	-15.5709	268.5174	-179.632	-30.9351	452.433	-289.259	-51.198	212.8027	-132.456	-23.8327	-6.73016	0.553693	0.502794	0.422294	1.400652	0.067535	0.036404	0.116128	0.005503
12/10/2009 15:29	125.186	-100.153	-15.5548	268.6014	-179.507	-30.9323	452.4207	-289.175	-51.1913	212.955	-132.524	-23.8479	-6.74844	0.534599	0.502738	0.420425	1.398756	0.067533	0.03832	0.125805	0.006039
12/10/2009 15:30	125.0861	-100.035	-15.5398	268.5193	-179.498	-30.926	452.3857	-289.124	-51.1853	213.0955	-132.562	-23.8602	-6.75759	0.511686	0.501788	0.4279	1.402547	0.067279	0.032572	0.119999	0.006035
12/10/2009 15:31	125.0058	-99.9032	-15.5251	268.5096	-179.349	-30.915	452.3507	-289.104	-51.1816	213.2123	-132.62	-23.8723	-6.76673	0.488774	0.500837	0.422294	1.408234	0.068058	0.032572	0.119999	0.006035
12/10/2009 15:32	125.0333	-99.9255	-15.5286	268.4549	-179.345	-30.911	452.3404	-289.057	-51.1776	213.333	-132.654	-23.883	-6.77404	0.473499	0.500288	0.429769	1.413921	0.067935	0.030656	0.129676	0.006835
12/10/2009 15:33	124.9902	-99.9293	-15.5259	268.4295	-179.444	-30.9161	452.3445	-289.001	-51.174	213.4557	-132.692	-23.8941	-6.7777	0.462043	0.499749	0.4279	1.419608	0.068456	0.034488	0.135483	0.006972
12/10/2009 15:34	124.9138	-99.8733	-15.5167	268.4022	-179.368	-30.909	452.3384	-288.932	-51.1688	213.5527	-132.726	-23.9032	-6.78867	0.452496	0.499848	0.426031	1.413921	0.068193	0.034488	0.129676	0.006571
12/10/2009 15:35	145.4624	-125.019	-18.671	306.0445	-226.895	-36.7881	519.0509	-374.653	-61.6911	244.277	-166.436	-28.351	-6.88376	1.861789	0.603692	0.504515	1.874572	0.094573	0.049817	0.150967	0.006882
12/10/2009 15:36	157.5959	-125.466	-19.5394	333.0533	-229.115	-38.8057	560.8409	-378.225	-64.8224	266.0518	-170.391	-30.127	-7.42131	1.439725	0.611664	0.502646	1.923862	0.098105	0.059397	0.137418	0.005386
12/10/2009 15:37	156.7881	-124.954	-19.4483	332.3913	-228.725	-38.7331	560.4493	-377.862	-64.7703	266.8409	-170.979	-30.2221	-7.52918	1.258305	0.606587	0.478353	1.927654	0.100043	0.061313	0.141289	0.005521
12/10/2009 15:38	156.2996	-124.643	-19.3931	332.0652	-228.515	-38.696	560.3488	-377.707	-64.7526	267.2784	-171.327	-30.2763	-7.58585	1.139908	0.602327	0.467142	1.925758	0.100686	0.065145	0.158709	0.006459
12/10/2009 15:39	155.945	-124.546	-19.3619	331.8084	-228.415	-38.6714	560.2022	-377.476	-64.7266	267.6241	-171.568	-30.3168	-7.62607	1.059705	0.599567	0.461536	1.937133	0.101858	0.067061	0.160644	0.00646
12/10/2009 15:40	155.7756	-124.402	-19.3402	331.6266	-228.348	-38.6543	560.0996	-377.286	-64.7064	267.8878	-171.733	-30.3464	-7.65532	0.998599	0.597368	0.450324	1.940925	0.102894	0.074725	0.154838	0.00553
12/10/2009 15:41	155.5846	-124.239	-19.3158	331.4606	-228.141	-38.6285	560.0577	-377.166	-64.6952	268.1156	-171.873	-30.3718	-7.67909	0.939403	0.594922	0.448455	1.946612	0.103416	0.082389	0.172257	0.006203
12/10/2009 15:42	155.4171	-124.075	-19.293	331.2966	-228.084	-38.6132	559.9656	-377.059	-64.6815	268.2795	-172.017	-30.393	-7.70469	0.878299	0.592471	0.444718	1.952299	0.104066	0.09197	0.154838	0.00434
12/10/2009 15:43	155.3108	-123.994	-19.28	331.1702	-227.809	-38.5855	559.8965	-376.885	-64.6647	268.4653	-172.083	-30.4104	-7.70834	0.849656	0.590746	0.452192	1.957987	0.103943	0.095802	0.185806	0.006213
12/10/2009 15:44	155.2025	-123.881	-19.2647	331.0596	-227.735	-38.5728	559.8274	-376.771	-64.6521	268.6072	-172.164	-30.4258	-7.72114	0.815285	0.589257	0.446586	1.961778	0.104592	0.10155	0.174193	0.005014
12/10/2009 15:45	155.1138	-126.069	-19.4096	330.9529	-232.721	-38.9096	559.7792	-387.76	-65.4073	268.7331	-175.97	-30.6972	-7.73211	1.105535	0.61005	0.448455	2.062257	0.111398	0.11113	0.176128	0.004487
12/10/2009 15:46	185.3961	-147.996	-23.0136	394.2395	-278.213	-46.4185	657.2387	-464.889	-77.4589	318.087	-211.484	-36.5555	-8.3829	1.000509	0.647723	0.517595	2.551407	0.140391	0.132207	0.191613	0.004101
12/10/2009 15:47	183.636	-147.182	-22.8359	392.913	-277.409	-46.2714	655.9798	-463.857	-77.3007	317.6072	-212.723	-36.608	-8.49806	0.586152	0.62707	0.424163	2.579847	0.148804	0.134123	0.191613	0.003968
12/10/2009 15:48	182.8105	-146.602	-22.7389	392.3417	-276.987	-46.2028	655.6333	-463.388	-77.2444	317.8027	-213.35	-36.6647	-8.5858	0.35703	0.61731	0.394265	2.591223	0.151653	0.132207	0.193548	0.004234
12/10/2009 15:49	182.4305	-146.442	-22.7016	391.9522	-276.798	-46.1628	655.4568	-462.991	-77.2049	318.0144	-213.727	-36.7054	-8.63332	0.208105	0.610311	0.431637	2.595016	0.149335	0.136039	0.214839	0.005439
12/10/2009 15:50	182.0129	-146.137	-22.6517	391.7026	-276.456	-46.1221	655.257	-462.677	-77.1694	318.2482	-214.024	-36.742	-8.67353	0.093551	0.605179	0.424163	2.606392	0.150636	0.143703	0.212903	0.004777
12/10/2009 15:51	181.7081	-145.88	-22.613	391.5328	-276.313	-46.1005	655.1571	-462.446	-77.1465	318.4579	-214.266	-36.7732	-8.70826	0.001909	0.601251	0.426031	2.608288	0.150638	0.147535	0.214839	0.004646
12/10/2009 15:52	181.3697	-145.489	-22.5626	391.3371	-276.151	-46.0757	655.1804	-462.392	-77.1444	318.7199	-214.508	-36.808	-8.73019	-0.084	0.596834	0.411082	2.619664	0.152455	0.157116	0.205161	0.003317
12/10/2009 15:53	181.4113	-145.396	-22.5591	391.427	-273.965	-45.931	655.1719	-462.586	-77.1572	319.2421	-214.75	-36.8607	-8.71557	-0.11837	0.593453	0.418557	2.638625	0.153248	0.168612	0.21871	0.003458
12/10/2009 15:54	181.0353	-145.166	-22.5172	391.2053	-274.531	-45.9548	654.9806	-462.448	-77.1345	319.4336	-214.919	-36.8856	-8.73202	-0.17946	0.590371	0.407345	2.642417	0.154284	0.17436	0.240001	0.004531
12/10/2009 15:55	180.7979	-145.086	-22.4953	390.9397	-274.678	-45.9466	654.7723	-462.313	-77.1108	319.5405	-215.088	-36.9047	-8.75396	-0.2501	0.587009	0.411082	2.642417	0.154026	0.182025	0.226452	0.003067
12/10/2009 15:56	180.6337	-144.914	-22.4721	390.9577	-274.941	-45.966	654.6702	-462.122	-77.0906	319.6655	-215.215	-36.922	-8.76858	-0.29973	0.584592	0.409214	2.650001	0.154678	0.189689	0.241936	0.003607
12/10/2009 15:57	180.5011	-144.802	-22.4552	390.8579	-275.109	-45.9708	654.5002	-462.201	-77.0843	319.7663	-215.439	-36.9444	-8.78686	-0.38564	0.579924	0.411082	2.636729	0.153633	0.191605	0.230323	0.002673
12/10/2009 15:58	180.1252	-144.986	-22.442	390.6083	-275.815	-46.0022	654.1218	-462.044	-77.0473	319.6876	-215.553	-36.9469	-8.83072	-0.45246	0.57834	0.396133	2.650001	0.155581	0.191605	0.234194	0.00294

TS	8A1 Comp. Strain	8B1 Tensile Strain	Moment (k*ft)	8A2 Comp. Strain	8B2 Tensile Strain	Moment (k*ft)	8A3 Comp. Strain	8B3 Tensile Strain	Moment (k*ft)	8A4 Comp. Strain	8B4 Tensile Strain	Moment (k*ft)	8A8 Comp. Strain	8B8 Tensile Strain	Moment (k*ft)	8A8 Comp. Strain	8B8 Tensile Strain	Moment (k*ft)	8A8 Comp. Strain	8B8 Tensile Strain	Moment (k*ft)
12/10/2009 15:59	179.9432	-144.925	-22.4252	390.4545	-275.958	-46.0015	654.0049	-461.858	-77.0265	319.7663	-215.643	-36.9586	-8.84535	-0.49636	0.576318	0.398002	2.646209	0.155191	0.191605	0.251614	0.004142
12/10/2009 16:00	179.781	-144.648	-22.3949	390.2788	-276.372	-46.0179	653.8965	-461.663	-77.0055	319.859	-215.731	-36.971	-8.85997	-0.546	0.573901	0.396133	2.644313	0.155189	0.185857	0.255485	0.004806
12/10/2009 16:01	179.9412	-144.369	-22.3867	390.5064	-276.205	-46.0222	654.1771	-461.072	-76.984	320.1756	-215.643	-36.9868	-8.82158	-0.53073	0.572306	0.403608	2.667065	0.156243	0.19927	0.245807	0.003212
12/10/2009 16:02	198.4734	-169.655	-25.4114	426.0972	-327.142	-51.995	718.3101	-548.47	-87.444	346.8961	-251.891	-41.3335	-8.88556	0.131735	0.622451	0.442849	3.211265	0.1911	0.203102	0.261292	0.004017
12/10/2009 16:03	210.2865	-170.488	-26.2843	456.7758	-330.19	-54.3231	755.8088	-549.784	-90.1232	370.9094	-259.016	-43.4828	-9.57457	-1.36298	0.566834	0.381184	3.296598	0.201247	0.206934	0.245807	0.002683
12/10/2009 16:04	197.8403	-169.35	-25.3466	424.3454	-327.886	-51.9255	753.6066	-547.414	-89.8076	371.6743	-259.954	-43.6004	-9.66777	-1.8573	0.539145	0.317652	3.294701	0.205501	0.19927	0.25742	0.004014
12/10/2009 16:05	197.1615	-168.944	-25.2718	424.0803	-327.579	-51.886	752.9224	-546.753	-89.7147	372.2195	-260.439	-43.6715	-9.71894	-2.15883	0.521863	0.287754	3.304183	0.20822	0.203102	0.261292	0.004017
12/10/2009 16:06	196.7805	-168.724	-25.2302	423.9959	-327.2	-51.854	752.5792	-546.303	-89.66	372.6854	-260.853	-43.7322	-9.75731	-2.36684	0.510153	0.261594	3.294701	0.209371	0.201186	0.259356	0.004015
12/10/2009 16:07	196.4809	-168.545	-25.1972	423.8855	-326.719	-51.8132	752.2404	-545.897	-89.6085	373.0699	-261.178	-43.7813	-9.7829	-2.53477	0.500328	0.244777	3.304183	0.211186	0.195437	0.251614	0.003878
12/10/2009 16:08	196.1277	-168.202	-25.1491	423.765	-326.37	-51.7807	752.0246	-545.847	-89.5902	373.2775	-261.548	-43.8211	-9.82858	-2.69506	0.492417	0.226091	3.307975	0.212738	0.195437	0.255485	0.004145
12/10/2009 16:09	196.0682	-168.119	-25.1393	423.7449	-326.099	-51.7606	751.8433	-545.315	-89.541	373.5949	-261.677	-43.8519	-9.82675	-2.7962	0.485309	0.222354	3.323146	0.214043	0.195437	0.253549	0.004011
12/10/2009 16:10	195.9392	-167.987	-25.1213	423.6726	-326.071	-51.7537	751.6621	-545.002	-89.5069	373.8371	-261.851	-43.8806	-9.84503	-2.89542	0.479722	0.220485	3.33642	0.215089	0.197354	0.259356	0.00428
12/10/2009 16:11	195.8182	-167.893	-25.1065	423.6304	-325.795	-51.7317	751.5218	-544.776	-89.4816	374.0447	-262.018	-43.9065	-9.8633	-2.99273	0.474266	0.203668	3.334524	0.216118	0.195437	0.269034	0.00508
12/10/2009 16:12	195.717	-167.801	-25.0931	423.5882	-325.704	-51.7226	751.4376	-544.521	-89.4582	374.2421	-262.161	-43.93	-9.87609	-3.07478	0.469485	0.196194	3.353487	0.217943	0.195437	0.261292	0.004546
12/10/2009 16:13	217.1552	-195.438	-28.4807	461.7633	-379.949	-58.1022	829.7859	-635.604	-101.154	410.1779	-303.135	-49.239	-10.0533	-3.30946	0.465521	0.308309	3.93	0.25	0.214598	0.270969	0.003891
12/10/2009 16:14	223.4303	-193.118	-28.7537	480.3769	-379.356	-59.3461	849.5426	-634.598	-102.448	429.6548	-308.52	-50.9551	-10.4535	-5.45928	0.344744	-0.01868	4.000173	0.277416	0.205018	0.270969	0.004553
12/10/2009 16:15	221.9869	-192.443	-28.6075	479.7725	-378.377	-59.2368	847.5939	-633.679	-102.25	431.3868	-309.624	-51.1509	-10.5229	-6.18395	0.299514	-0.15695	4.062759	0.29128	0.195437	0.243872	0.003343
12/10/2009 16:16	220.805	-192.326	-28.5178	479.154	-377.978	-59.1666	846.8671	-633.194	-102.167	432.1101	-310.339	-51.2502	-10.6417	-6.68926	0.272832	-0.22234	4.070346	0.296318	0.187773	0.240001	0.003605
12/10/2009 16:17	220.3567	-192.158	-28.4753	478.9674	-377.783	-59.1403	846.2848	-632.617	-102.086	432.7554	-310.807	-51.3271	-10.6947	-7.01148	0.254246	-0.24663	4.064656	0.297602	0.176277	0.247743	0.004933
12/10/2009 16:18	219.9581	-192.101	-28.4439	478.6856	-377.55	-59.1047	846.0047	-632.16	-102.036	433.2528	-311.147	-51.3848	-10.7312	-7.2517	0.240186	-0.27653	4.081725	0.300844	0.178193	0.240001	0.004267
12/10/2009 16:19	219.8206	-191.463	-28.3903	478.6998	-376.683	-59.0458	846.0287	-631.55	-101.995	433.8222	-311.316	-51.4358	-10.7312	-7.3985	0.230053	-0.28774	4.104484	0.303189	0.178193	0.259356	0.005603
12/10/2009 16:20	219.6094	-191.529	-28.3803	478.6836	-376.287	-59.0174	846.8364	-631.251	-102.03	434.2621	-311.54	-51.4817	-10.7367	-7.5453	0.220299	-0.30082	4.117761	0.305008	0.178193	0.261292	0.005736
12/10/2009 16:21	219.4162	-191.432	-28.3602	478.5761	-376.009	-58.9908	848.1456	-631.006	-102.104	434.5951	-311.744	-51.5187	-10.7513	-7.68065	0.211964	-0.31576	4.131037	0.306956	0.180109	0.261292	0.005604
12/10/2009 16:22	219.2568	-191.406	-28.3475	478.5112	-375.678	-58.9634	848.5835	-630.742	-102.116	434.9385	-311.918	-51.5544	-10.7623	-7.79122	0.205089	-0.32324	4.13483	0.307734	0.183941	0.253549	0.004805
12/10/2009 16:23	219.201	-191.318	-28.3376	478.5274	-375.47	-58.9503	848.7806	-630.564	-102.117	435.2325	-312.095	-51.587	-10.7732	-7.89797	0.198477	-0.33445	4.138623	0.30877	0.187773	0.265163	0.005342
12/10/2009 16:24	218.9858	-191.23	-28.3166	478.4889	-375.206	-58.9293	848.8485	-630.381	-102.109	435.4854	-312.24	-51.6144	-10.7824	-7.99137	0.19266	-0.34566	4.150003	0.310329	0.189689	0.259356	0.004809
12/10/2009 16:25	219.1034	-191.216	-28.3237	478.5396	-375.178	-58.9309	848.866	-630.186	-102.097	435.7054	-312.388	-51.6398	-10.7933	-8.08096	0.187232	-0.355	4.148106	0.310843	0.195437	0.263227	0.004679
12/10/2009 16:26	218.9041	-191.212	-28.3097	478.4788	-374.937	-58.91	848.8923	-630.019	-102.087	435.9337	-312.52	-51.6647	-10.8007	-8.16293	0.182078	-0.355	4.150003	0.310974	0.195437	0.27484	0.005481
12/10/2009 16:27	218.8225	-191.221	-28.3047	478.4423	-374.945	-58.9081	848.8923	-629.849	-102.075	436.1434	-312.647	-51.6879	-10.808	-8.23727	0.177451	-0.36621	4.159486	0.312402	0.19927	0.282583	0.005751
12/10/2009 16:28	218.695	-191.232	-28.2967	478.4038	-374.8	-58.8954	848.8616	-629.699	-102.063	436.3347	-312.762	-51.709	-10.8116	-8.30589	0.172967	-0.37181	4.165176	0.313182	0.205018	0.280647	0.005221
12/10/2009 16:29	218.5834	-191.19	-28.2861	478.3957	-374.75	-58.8914	848.8791	-629.553	-102.054	436.5239	-312.861	-51.729	-10.8153	-8.36879	0.168877	-0.37555	4.180349	0.314487	0.216514	0.27484	0.004026
12/10/2009 16:30	218.6252	-191.272	-28.2947	478.42	-374.724	-58.8913	848.8791	-629.439	-102.046	436.6843	-312.983	-51.7484	-10.8244	-8.4355	0.164902	-0.37555	4.195522	0.315535	0.220347	0.296131	0.005231
12/10/2009 16:31	231.1537	-211.483	-30.5546	500.1816	-417.243	-63.3285	891.0916	-704.679	-110.154	456.7653	-343.198	-55.2203	-10.6819	-7.74165	0.202961	-0.2784	4.658321	0.340774	0.228011	0.311616	0.005771
12/10/2009 16:32	247.0268	-217.37	-32.0566	540.1069	-430.82	-67.0217	947.5295	-723.608	-115.356	499.768	-360.564	-59.3875	-11.4565	-9.5066	0.1346	-0.37555	4.958025	0.368169	0.251004	0.300002	0.003382
12/10/2009 16:33	244.9709	-216.422	-31.8493	539.396	-429.551	-66.885	945.9725	-721.59	-115.109	505.0879	-361.526	-59.8211	-11.5643	-10.2269	0.092319	-0.4372	4.988375	0.37452	0.254837	0.298067	0.002984
12/10/2009 16:34	243.8722	-216.052	-31.7479	538.8388	-429.105	-66.8157	945.6149	-720.408	-115.003	506.3941	-362.332	-59.9669	-11.6118	-10.6442	0.066794	-0.47831	5.024417	0.379845	0.256753	0.30968	0.003654
12/10/2009 16:35	243.1739	-215.783	-31.6811	538.5336	-428.627	-66.7617	945.7504	-719.646	-114.96	507.2409	-362.872	-60.0627	-11.6483	-10.9509	0.048142	-0.51754	5.02252	0.382423	0.262501	0.315487	0.003658
12/10/2009 16:36	242.6457	-215.574	-31.6302	538.3082	-428.332	-66.7258	945.6327	-718.821	-114.895	512.8109	-363.228	-60.4717	-11.6666	-11.1871	0.033097	-0.53809	5.043387	0.385282	0.266333	0.313551	0.003259
12/10/2009 16:37	242.2936	-215.435	-31.5964	538.2099	-428.013	-66.697	945.4706	-718.191	-114.84	514.1	-363.534	-60.5818	-11.6867	-11.3814	0.021071	-0.55864	5.06615	0.388271	0.268249	0.319358	0.003528
12/10/2009 16:38	242.0015	-215.315	-31.5679	538.0932	-427.793	-66.6737	945.3173	-717.662	-114.793	514.9145	-363.809	-60.657	-11.7031	-11.4881	0.014842	-0.57359	5.06615	0.389303	0.273998	0.3271	0.003666
12/10/2009 16:39	241.7575	-215.166	-31.5408	538.0584	-427.602	-66.6582	945.1863	-717.299	-114.759	515.4915	-364.048	-60.7134	-11.7141	-11.6253	0.006131	-0.58106	5.087017	0.391259	0.27783	0.323229	0.003134
12/10/2009 16:40	241.5374	-215.055	-31.5179	538.001	-427.394	-66.6398	945.0708	-716.918	-114.725	515.9561	-364.27	-60.7607	-11.725	-11.751	-0.00179	-0.59788	5.104089	0.393599	0.283578	0.336778	0.003672
12/10/2009 16:41	241.3334	-214.964	-31.4976	537.9437	-427.157	-66.6195	944.9687	-716.691	-114.702	516.3457	-364.421	-60.7981	-11.7287	-11.8691	-0.00969	-0.60161	5.100295	0.393595	0.293159	0.340649	0.003278
12/10/2009 16:42	241.1794	-216.696	-31.6065	537.8884	-430.235	-66.8282	944.9021	-723.025	-115.135	516.6937	-366.586	-60.9715	-11.736	-11.7738	-0.00261	-0.60722	5.172381	0.398957	0.298907	0.34452	0.003149
12/10/2009 16:43	273.8191	-245.267	-35.8318	634.4356	-485.045	-77.2761	1043.67	-809.754	-127.939	578.1344	-409.265	-68.1587	-11.5771	-12.2234	-0.04461	-0.88932	5.955899	0.472515	0.318069	0.305809	-0.00085
12/10/2009 16:44	269.8917	-243.133	-35.4134	635.1662	-482.368	-77.1418	1042.312	-806.525	-127.623	582.5908	-411.636	-68.63	-11.6191	-13.1204	-0.10363	-1.11162	6.03938	0.493623	0.310404	0.294196	-0.00112
12/10/2009 16:45	268.1028	-242.335	-35.2348	634.5813	-481.32	-77.0291	1041.031	-805.104	-127.436	583.9618	-412.58	-68.7899	-11.7031	-13.6136	-0.13188	-1.19382	6.10389	0.50375	0.308488	0.288389	-0.00139
12/10/2009 16:46	267.5462	-241.948	-35.1696	634.3711	-480.746	-76.9749	1040.484	-803.951	-127.319	584.8402	-413.26	-68.8974	-11.747	-13.9601	-0.15277	-1.23491	6.141836	0.509206	0.316152	0.301938	-0.00098
12/10/2009 16:47	266.9092	-241.584	-35.1006	633.984	-480.325	-76.9191	1040.689	-802.176	-127.21	585.6154	-413.693	-68.9808	-11.7762	-14.2343	-0.16968	-1.26106	6.155118	0.511928	0.316152	0.296131	-0.00138
12/10/2009 16:48	266.3226	-241.193	-35.0331	633.7572	-480.187	-76.894	1040.457	-801.521	-127.149	586.1906	-414.124	-69.0503	-11.8018	-14.4532	-0.18303	-1.27974	6.175989	0.514659	0.318069	0.30968	-0.00058
12/10/2009 16:49	266.0353	-241.117	-35.008	633.5803	-479.695	-76.8478	1040.106	-800.986	-127.088	586.6184	-414.465	-69.1034	-11.8164	-14.6436	-0.19516	-1.29656	6.20445	0.517784	0.321901	0.311616	-0.00071
12/10/2009 16:50	265.6275	-240.945	-34.968	633.2974	-479.68	-76.8272	1039.809	-800.542	-127.037	586.985	-414.771	-69.1498	-11.8292	-14.8073	-0.20558	-1.31337	6.219629	0.519992	0.335314	0.313551	-0.0015
12/10/2009 16:51	265.3423	-241.141	-34.9618	633.0789	-479.432	-76.7951	1039.527	-800.181	-126.992	587.2569	-415.07	-69.1892	-11.8511	-14.9653	-0.21497	-1.32644	6.221526	0.521026	0.33723	0.315487	-0.0015

TS	8A1 Comp. Strain	8B1 Tensile Strain	Moment (k*ft)	8A2 Comp. Strain	8B2 Tensile Strain	Moment (k*ft)	8A3 Comp. Strain	8B3 Tensile Strain	Moment (k*ft)	8A4 Comp. Strain	8B4 Tensile Strain	Moment (k*ft)	8A8 Comp. Strain	8B8 Tensile Strain	Moment (k*ft)	8A8 Comp. Strain	8B8 Tensile Strain	Moment (k*ft)	8A8 Comp. Strain	8B8 Tensile Strain	Moment (k*ft)
12/10/2009 16:52	265.0671	-240.735	-34.9148	632.9187	-479.191	-76.7674	1039.289	-799.824	-126.951	587.5245	-415.297	-69.2233	-11.8547	-15.0967	-0.22379	-1.33018	6.242397	0.522724	0.341062	0.301938	-0.0027
12/10/2009 16:53	264.9024	-240.522	-34.8887	632.8063	-479.001	-76.7465	1039.129	-799.498	-126.918	587.7753	-415.509	-69.2553	-11.8657	-15.2185	-0.23144	-1.34326	6.238602	0.523365	0.339146	0.30968	-0.00203
12/10/2009 16:54	264.5429	-240.858	-34.8871	632.4713	-479.257	-76.741	1038.708	-799.603	-126.896	587.7943	-415.829	-69.2786	-11.9114	-15.3746	-0.23906	-1.36754	6.2405	0.525172	0.339146	0.313551	-0.00177
12/10/2009 16:55	264.2577	-240.795	-34.8631	632.334	-479.112	-76.7215	1038.641	-799.458	-126.881	588.0134	-416.029	-69.3076	-11.9223	-15.4774	-0.2454	-1.37314	6.2405	0.525559	0.333398	0.315487	-0.00124
12/10/2009 16:56	263.9484	-240.592	-34.8277	632.1593	-478.807	-76.6884	1038.416	-799.183	-126.847	588.1842	-416.187	-69.3303	-11.9333	-15.5821	-0.25187	-1.37875	6.244295	0.526208	0.331482	0.315487	-0.0011
12/10/2009 16:57	264.2517	-240.42	-34.8368	632.4693	-478.543	-76.6916	1038.733	-798.73	-126.837	588.6036	-416.156	-69.3571	-11.8894	-15.6106	-0.25687	-1.37128	6.259474	0.52674	0.344895	0.319358	-0.00176
12/10/2009 16:58	264.079	-240.377	-34.8219	632.3403	-478.504	-76.68	1038.645	-798.522	-126.817	588.7933	-416.278	-69.3787	-11.8913	-15.6791	-0.26147	-1.36754	6.287935	0.528446	0.341062	0.332907	-0.00056
12/10/2009 16:59	296.2484	-271.215	-39.1712	697.9261	-539.155	-85.394	1140.275	-897.652	-140.675	645.8703	-459.714	-76.3169	-11.8164	-15.0186	-0.22105	-1.14338	6.917913	0.556459	0.381301	0.352263	-0.002
12/10/2009 17:00	298.531	-269.834	-39.2334	707.1127	-539.585	-86.0577	1150.476	-899.304	-141.493	660.1654	-466.529	-77.7741	-12.22	-15.9837	-0.2598	-1.2648	7.092499	0.576892	0.381301	0.346456	-0.00241
12/10/2009 17:01	297.5694	-269.991	-39.1779	708.8017	-540.732	-86.2535	1153.53	-901.533	-141.858	664.5066	-469.895	-78.3061	-12.3077	-16.5375	-0.29198	-1.33392	7.168408	0.586903	0.38705	0.338714	-0.00334
12/10/2009 17:02	295.992	-268.969	-38.9984	707.6918	-539.273	-86.0762	1151.875	-899.753	-141.621	665.7737	-470.902	-78.4631	-12.3662	-16.9942	-0.31947	-1.37688	7.193079	0.591572	0.381301	0.332907	-0.00334
12/10/2009 17:03	295.0268	-268.346	-38.8888	706.9422	-538.374	-85.9624	1150.678	-898.46	-141.449	666.5439	-471.531	-78.5597	-12.3954	-17.3634	-0.34293	-1.41237	7.221545	0.595987	0.379385	0.334843	-0.00307
12/10/2009 17:04	294.3242	-267.9	-38.8095	706.3821	-537.735	-85.8796	1149.795	-897.426	-141.317	667.2117	-472.016	-78.6393	-12.4118	-17.6621	-0.36242	-1.44599	7.24242	0.599749	0.381301	0.350327	-0.00214
12/10/2009 17:05	293.8013	-267.564	-38.7502	706.2937	-537.138	-85.8323	1149.083	-896.592	-141.21	667.7601	-472.493	-78.7101	-12.4228	-17.917	-0.37926	-1.43852	7.24242	0.599233	0.354475	0.336778	-0.00122
12/10/2009 17:06	293.4016	-267.292	-38.7039	706.1231	-536.623	-85.785	1148.591	-895.921	-141.13	668.2104	-472.902	-78.7693	-12.4283	-18.132	-0.39372	-1.44226	7.250011	0.600015	0.321901	0.365812	0.003031
12/10/2009 17:07	293.0585	-267.051	-38.6635	705.8726	-536.18	-85.7371	1148.137	-895.384	-141.061	668.5903	-473.25	-78.8196	-12.4319	-18.2576	-0.40214	-1.45907	7.274682	0.602878	0.321901	0.358069	0.002497
12/10/2009 17:08	292.7456	-266.853	-38.6283	705.6242	-535.863	-85.6981	1147.728	-894.878	-140.998	668.9211	-473.561	-78.8639	-12.4356	-18.4098	-0.41239	-1.47214	7.265193	0.603126	0.319985	0.354198	0.002362
12/10/2009 17:09	292.5378	-266.692	-38.6029	705.4074	-535.493	-85.6576	1147.284	-894.347	-140.931	669.1837	-473.815	-78.8996	-12.4429	-18.562	-0.42239	-1.48335	7.278478	0.604817	0.321901	0.356134	0.002363
12/10/2009 17:10	292.2835	-266.507	-38.5725	705.2179	-535.174	-85.6225	1147.006	-893.968	-140.886	669.4526	-474.058	-78.9349	-12.441	-18.7065	-0.4325	-1.49456	7.284171	0.605983	0.318069	0.356134	0.002628
12/10/2009 17:11	292.011	-266.404	-38.5466	704.9969	-534.96	-85.5924	1146.743	-893.589	-140.841	669.6981	-474.287	-78.9677	-12.441	-18.8416	-0.44182	-1.50203	7.287967	0.606761	0.323817	0.361941	0.002632
12/10/2009 17:12	291.7689	-266.291	-38.5221	704.778	-534.721	-85.5608	1146.496	-893.202	-140.797	669.9201	-474.489	-78.997	-12.4374	-18.95	-0.44956	-1.51324	7.297456	0.60819	0.319985	0.371618	0.003564
12/10/2009 17:13	291.5731	-266.219	-38.5036	704.5927	-534.56	-85.5369	1146.266	-892.803	-140.754	670.1251	-474.667	-79.0233	-12.4356	-19.0603	-0.4573	-1.52445	7.306944	0.609618	0.321901	0.373554	0.003566
12/10/2009 17:14	288.8396	-262.109	-38.0312	720.1878	-549.371	-87.6358	1185.673	-933.454	-146.28	693.6286	-492.403	-81.87	-12.1853	-18.4878	-0.43505	-1.41611	7.568846	0.620218	0.335314	0.381296	0.003174
12/10/2009 17:15	286.2504	-261.952	-37.8416	719.2573	-546.119	-87.3471	1184.796	-926.76	-145.758	698.3568	-493.098	-82.2444	-12.262	-18.969	-0.46297	-1.43292	7.597314	0.623344	0.346811	0.400652	0.003717
12/10/2009 17:16	286.5468	-262.819	-37.9219	718.0633	-549.012	-87.4644	1181.954	-935.572	-146.17	701.771	-496.203	-82.6944	-12.3187	-18.9938	-0.46077	-1.46281	7.686516	0.631565	0.344895	0.394845	0.003448
12/10/2009 17:17	281.4583	-257.653	-37.2141	728.8829	-552.795	-88.4724	1210.146	-948.024	-148.975	739.1644	-505.713	-85.9321	-12.2109	-19.2353	-0.48489	-1.39929	7.855434	0.638841	0.369805	0.412266	0.002931
12/10/2009 17:18	282.0022	-258.131	-37.2846	726.6584	-551.131	-88.2039	1204.793	-943.333	-148.282	738.8214	-505.826	-85.9162	-12.3442	-19.669	-0.50562	-1.46841	7.89719	0.646494	0.373637	0.416137	0.002934
12/10/2009 17:19	282.1735	-258.291	-37.3075	725.7903	-550.281	-88.0854	1202.648	-941.524	-148.009	738.5776	-505.962	-85.9088	-12.4027	-19.9809	-0.52311	-1.4983	7.914272	0.649736	0.377469	0.418073	0.002803
12/10/2009 17:20	282.2944	-258.379	-37.3219	725.2983	-549.698	-88.0112	1201.355	-940.301	-147.835	738.4697	-506.098	-85.9108	-12.4374	-20.2528	-0.53949	-1.51884	7.927558	0.652072	0.375553	0.416137	0.002801
12/10/2009 17:21	282.3044	-258.417	-37.3253	724.9182	-549.283	-87.9563	1200.402	-939.369	-147.705	738.4007	-506.204	-85.9133	-12.4611	-20.4658	-0.55255	-1.54126	7.937048	0.654274	0.379385	0.421944	0.002938
12/10/2009 17:22	255.8813	-235.977	-33.9523	653.1571	-480.67	-78.2665	1096.422	-837.373	-133.487	707.4174	-483.682	-82.2199	-12.8118	-22.7358	-0.68504	-1.79155	7.631476	0.650458	0.379385	0.421944	0.002938
12/10/2009 17:23	60.60582	-79.6865	-9.68418	278.9902	-186.176	-32.1097	692.6195	-480.098	-80.951	600.279	-397.296	-68.8611	-11.7305	-27.3184	-1.07601	-2.34066	6.978638	0.643298	0.463697	0.514853	0.003531
12/10/2009 17:24	62.67102	-81.0395	-9.92013	280.8221	-187.519	-32.329	691.8304	-479.518	-80.8565	598.0747	-396.069	-68.6243	-11.6227	-27.4703	-1.09393	-2.3556	6.988126	0.644984	0.459865	0.514853	0.003796
12/10/2009 17:25	63.7107	-81.7037	-10.0377	281.7442	-188.378	-32.4518	691.5247	-479.229	-80.8154	596.9898	-395.384	-68.5021	-11.5734	-27.5842	-1.1052	-2.37241	6.967252	0.644703	0.465613	0.52066	0.0038
12/10/2009 17:26	64.41749	-82.1583	-10.1179	282.3943	-189.054	-32.5434	691.2938	-479.035	-80.7862	596.2406	-394.879	-68.4156	-11.5369	-27.7267	-1.11756	-2.38174	6.97674	0.646003	0.467529	0.559373	0.00634
12/10/2009 17:27	-10.5367	-17.9237	-0.50992	122.475	-72.9053	-13.4868	518.8117	-338.634	-59.1883	549.834	-357.234	-62.6136	-10.6874	-29.0519	-1.26768	-2.45458	6.802158	0.638979	0.526932	0.584537	0.003976
12/10/2009 17:28	-8.85269	-19.1115	-0.70815	124.5631	-75.0245	-13.7772	517.6242	-337.659	-59.039	547.0003	-355.381	-62.2901	-10.6399	-29.2038	-1.28144	-2.48259	6.773694	0.638948	0.526932	0.588408	0.004244
12/10/2009 17:29	-7.82334	-19.9259	-0.83542	125.9106	-76.1899	-13.9507	516.911	-337.115	-58.9522	545.361	-354.437	-62.1118	-10.6198	-29.3082	-1.29004	-2.49006	6.781285	0.639988	0.530764	0.576794	0.003177
12/10/2009 17:30	-64.924	59.57872	8.594243	-39.5672	58.57489	6.77461	371.978	-201.937	-39.6165	505.6162	-310.786	-56.3351	-9.28764	-30.4793	-1.46283	-2.44151	6.701587	0.631135	0.624659	0.661963	0.002575

TABLE E.10: Bending moments for pile 5

Depth (ft)	Moment (k-ft) 5 kips	Moment (k-ft) 10 kips	Moment (k-ft) 15 kips	Moment (k-ft) 20 kips	Moment (k-ft) 30 kips	Moment (k-ft) 40 kips	Moment (k-ft) 50 kips	Moment (k-ft) 60 kips	Moment (k-ft) 70 kips	Moment (k-ft) 80 kips	Moment (k-ft) 90 kips	Moment (k-ft) 100 kips	Moment (k-ft) 110 kips
0.4	0	0	0	0	0	0	0	0	0	0	0	0	0
2.5	0.151	2.820	8.519	14.035	19.989	19.891	25.716	31.47604	31.43637	37.05004	43.70848	44.32761	50.2472
5	0.181	5.324	18.415	30.267	42.335	42.107	53.802	65.04438	64.8233	74.87646	85.70357	86.87701	96.62912
7.5	0.059	3.701	16.214	28.422	40.634	40.529	52.317	63.67013	63.53633	75.52322	87.48806	89.20983	99.47841
10	-0.006	0.461	2.954	5.286	7.617	7.772	10.071	12.28294	12.42897	15.21542	18.331	18.7832	21.96494
12.5	-0.012	-0.111	-0.605	-1.044	-1.440	-1.454	-1.820	-2.22938	-2.24666	-2.67361	-3.07984	-3.0995	-3.51966
15	0.001	0.003	-0.017	-0.046	-0.070	-0.074	-0.098	-0.12231	-0.11149	-0.16481	-0.21631	-0.14557	-0.27417
17.5	-0.003	-0.002	-0.002	-0.001	0.000	0.000	0.003	0.004407	0.004028	0.008121	0.012621	0.015103	0.016079
20	0	0	0	0	0	0	0	0	0	0	0	0	0

TABLE E.11: Bending moments for pile 6

Depth (ft)	Moment (k-ft) 5 kips	Moment (k-ft) 10 kips	Moment (k-ft) 15 kips	Moment (k-ft) 20 kips	Moment (k-ft) 30 kips	Moment (k-ft) 40 kips	Moment (k-ft) 50 kips	Moment (k-ft) 60 kips	Moment (k-ft) 70 kips	Moment (k-ft) 80 kips	Moment (k-ft) 90 kips	Moment (k-ft) 100 kips	Moment (k-ft) 110 kips
1	0	0	0	0	0	0	0	0	0	0	0	0	0
2.5	0.240	1.898	4.804	6.735	8.344	8.256	9.664	10.80894	10.74229	11.69154	12.80119	13.08704	13.66215
5	0.347	3.973	14.311	23.818	33.618	33.361	42.691	49.25696	49.12834	58.3381	68.16692	72.79968	76.98542
7.5	0.129	3.531	16.568	31.490	48.039	47.826	63.257	77.55624	77.36521	92.258	106.6909	116.5644	121.9469
10	-0.092	1.857	10.265	16.406	22.601	22.813	28.790	34.95247	35.0854	41.56542	48.41053	52.04656	55.21999
12.5	0.035	-0.017	-0.318	-0.962	-1.784	-1.796	-2.479	-3.21356	-3.22487	-4.00997	-4.7695	-5.1856	-5.54561
15	0.003	0.008	-0.009	-0.033	-0.050	-0.056	-0.063	-0.07689	-0.08316	-0.10865	-0.1579	-0.10374	-0.22393
17.5	-0.002	-0.003	-0.004	0.004	0.006	0.007	0.008	0.008673	0.010126	0.011352	0.012977	0.015518	0.016623
20	0	0	0	0	0	0	0	0	0	0	0	0	0

TABLE E.12: Bending moments for pile 7

Depth (ft)	Moment (k-ft) 5 kips	Moment (k-ft) 10 kips	Moment (k-ft) 15 kips	Moment (k-ft) 20 kips	Moment (k-ft) 30 kips	Moment (k-ft) 40 kips	Moment (k-ft) 50 kips	Moment (k-ft) 60 kips	Moment (k-ft) 70 kips	Moment (k-ft) 80 kips	Moment (k-ft) 90 kips	Moment (k-ft) 100 kips	Moment (k-ft) 110 kips
1.2	0	0	0	0	0	0	0	0	0	0	0	0	0
2.5	-0.190	0.791	3.420	5.517	7.752	7.661	9.789	11.82245	11.93235	14.00209	16.02278	18.23047	18.00585
5	0.286	3.556	12.575	20.053	27.783	27.640	35.104	42.3955	42.73106	49.89008	57.44068	65.95192	65.18804
7.5	0.309	3.812	17.930	31.129	44.815	44.714	57.850	70.86688	71.7361	83.94622	97.53422	112.5432	111.3711
10	0.066	1.374	10.345	17.678	24.862	24.980	31.911	39.23655	40.03581	47.22579	55.42343	63.35311	63.62902
12.5	0.000	0.011	0.164	0.102	-0.006	0.027	-0.048	-0.03764	0.048253	0.123161	0.330588	0.414306	0.673524
15	0.007	0.007	-0.069	-0.159	-0.255	-0.260	-0.360	-0.50447	-0.48455	-0.66296	-0.79321	-0.88702	-0.92557
17.5	0.000	0.000	0.005	0.015	0.024	0.023	0.036	0.045805	0.059196	0.045225	0.035457	0.022753	0.014053
20	0	0	0	0	0	0	0	0	0	0	0	0	0

TABLE E.13: Bending moments for pile 8

Depth (ft)	Moment (k-ft) 5 kips	Moment (k-ft) 10 kips	Moment (k-ft) 15 kips	Moment (k-ft) 20 kips	Moment (k-ft) 30 kips	Moment (k-ft) 40 kips	Moment (k-ft) 50 kips	Moment (k-ft) 60 kips	Moment (k-ft) 70 kips	Moment (k-ft) 80 kips	Moment (k-ft) 90 kips	Moment (k-ft) 100 kips	Moment (k-ft) 110 kips
0.9	0	0	0	0	0	0	0	0	0	0	0	0	0
2.5	-0.579	-2.802	-7.665	-11.739	-15.704	-15.529	-19.293	-22.5626	-25.4114	-25.0931	-28.3475	-32.0566	-31.6065
5	-0.190	-4.034	-14.599	-22.899	-31.069	-30.911	-38.613	-46.0757	-51.995	-51.7226	-58.9634	-67.0217	-66.8282
7.5	0.029	-4.198	-22.761	-37.188	-51.279	-51.178	-64.681	-77.1444	-87.444	-89.4582	-102.116	-115.356	-115.135
10	0.026	-0.876	-9.227	-16.560	-23.667	-23.883	-30.393	-36.808	-41.3335	-43.93	-51.5544	-59.3875	-60.9715
12.5	-0.006	-0.009	0.182	0.372	0.509	0.500	0.592	0.596834	0.622451	0.469485	0.205089	0.1346	-0.00261
15	-0.009	-0.012	0.008	0.035	0.065	0.068	0.104	0.152455	0.1911	0.217943	0.307734	0.368169	0.398957
17.5	0.003	0.002	0.002	0.002	0.003	0.007	0.004	0.003317	0.004017	0.004546	0.004805	0.003382	0.003149
20	0	0	0	0	0	0	0	0	0	0	0	0	0

APPENDIX F: LABORATORY BENDING TESTS

TABLE F.1: Load and displacement measurements for lab pile 1

	Distance from Left End of Pile		
Total Load	2 ft	3 ft	4 ft
(kips)	Vertical Displacement (in)		
0.1	0.0000	0.0012	0.0013
16.0	0.0120	0.0146	0.0092
23.4	0.0229	0.0251	0.0166
25.4	0.0253	0.0252	0.0174
31.3	0.0384	0.0406	0.0227
38.1	0.0469	0.0516	0.0299
45.5	0.0616	0.0653	0.0359
53.5	0.0698	0.0774	0.0430
62.2	0.0842	0.0886	0.0506
71.2	0.0937	0.1044	0.0579
80.4	0.1076	0.1184	0.0655
89.8	0.1192	0.1336	0.0736
99.8	0.1310	0.1487	0.0799
110.3	0.1432	0.1623	0.0907
121.4	0.1546	0.1765	0.0992
132.8	0.1670	0.1920	0.1089
147.9	0.1832	0.2133	0.1211
163.3	0.2037	0.2369	0.1335
176.1	0.2176	0.2620	0.1441
182.8	0.2246	0.4580	0.1498

TABLE F.2: Bending moments for lab pile 1

Distance from	Total Load (kips)											
Left End	25 kips	50 kips	75 kips	100 kips	125 kips	150 kips	175 kips	200 kips	225 kips	250 kips	275 kips	300 kips
(ft)	Bending Moment (k*ft)											
0.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.5	4.39	5.92	7.60	3.56	4.54	5.22	10.32	12.48	13.84	14.84	15.58	4.35
2	12.43	14.86	21.37	31.16	41.04	51.03	65.91	76.63	86.21	97.01	106.33	28.42
3	31.29	43.40	66.59	90.69	99.59	107.92	119.15	128.28	135.44	77.16	85.09	4.44
4	12.71	20.01	30.06	40.40	60.27	75.64	93.84	108.13	120.96	132.78	141.15	66.43
4.5	6.95	10.77	15.57	20.92	26.44	32.08	35.95	39.68	43.98	50.32	55.44	18.81
5.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

TABLE F.3: Load and displacement measurements for lab pile 2

	Distance from Left End of Pile			
Total Load	1.5 ft	2.5 ft	3.5 ft	4.5 ft
(kips)	Vertical Displacement (in)			
5.0	0.0040	0.0104	-0.0343	0.0194
10.0	0.0120	0.0196	-0.0082	0.0256
20.0	0.0228	0.0336	0.1451	0.0440
30.0	0.0283	0.0462	0.1173	0.0586
40.0	0.0414	0.0601	0.1756	0.0692
50.0	0.0496	0.0706	0.1070	0.0808
60.0	0.0583	0.0832	0.1475	0.0956
70.0	0.0644	0.0923	0.2611	0.1029
80.0	0.0727	0.1047	0.1390	0.1172
90.0	0.0837	0.1170	0.2714	0.1276
100.0	0.0899	0.1278	0.1866	0.1401
110.0	0.0955	0.1395	0.2326	0.1479
120.0	0.1044	0.1499	0.1958	0.1582
130.0	0.1109	0.1604	0.2179	0.1698
140.0	0.1191	0.1690	0.2204	0.1787
150.0	0.1251	0.1786	0.2224	0.1875
160.0	0.1326	0.1871	0.1437	0.1965
170.0	0.1364	0.1956	0.0929	0.2048
180.0	0.1429	0.2027	0.0553	0.2125
190.0	0.1532	0.2113	0.1859	0.2191
200.0	0.1586	0.2204	0.1679	0.2279
210.0	0.1629	0.2313	0.2004	0.2361
220.0	0.1709	0.2402	0.1897	0.2423
230.0	0.1814	0.2496	0.2236	0.2539
240.0	0.1834	0.2588	0.2067	0.2597
250.0	0.1952	0.2675	0.2406	0.2671
260.0	0.1990	0.2766	0.2769	0.2746
270.0	0.2068	0.2866	0.2102	0.2823
280.0	0.2139	0.2979	0.2330	0.2910
290.0	0.2254	0.3084	0.2490	0.3000
300.0	0.2314	0.3221	0.2991	0.3119
303.6	0.2382	0.3298	0.3307	0.3167

TABLE F.4: Bending moments for lab pile 2

Distance from	Total Load (kips)											
Left End	25 kips	50 kips	75 kips	100 kips	125 kips	150 kips	175 kips	200 kips	225 kips	250 kips	275 kips	300 kips
(ft)	Bending Moment (k*ft)											
0.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.5	10.18	18.00	23.32	29.19	35.48	39.09	43.33	47.04	52.74	55.83	59.79	63.55
2	29.05	45.07	58.63	73.02	75.19	76.67	78.48	80.06	10.47	12.10	12.69	14.38
3	29.88	47.84	59.97	75.35	89.83	102.03	111.44	118.93	127.61	131.74	137.10	65.18
4	11.76	21.92	30.20	39.96	47.55	55.19	61.24	66.31	72.08	75.67	78.71	80.58
4.5	6.68	4.52	7.16	8.89	12.90	17.16	20.80	23.68	28.55	31.27	33.12	34.59
5.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

TABLE F.5: Load and displacement measurements for lab pile 3

	Distance from Left End of Pile			
Total Load	1.5 ft	2.5 ft	3.5 ft	4.5 ft
(kips)	Vertical Displacement (in)			
10.0	0.0125	0.0141	0.0169	0.0103
20.0	0.0231	0.0362	0.0395	0.0332
30.0	0.0399	0.0555	0.0580	0.0495
40.0	0.0505	0.0689	0.0738	0.0622
50.0	0.0609	0.0846	0.0886	0.0756
60.0	0.0714	0.0978	0.1021	0.0873
70.0	0.0809	0.1111	0.1165	0.1009
80.0	0.0903	0.1224	0.1312	0.1106
90.0	0.0995	0.1335	0.1424	0.1214
100.0	0.1071	0.1479	0.1526	0.1331
110.0	0.1141	0.1609	0.1646	0.1412
120.0	0.1259	0.1730	0.1765	0.1521
130.0	0.1324	0.1818	0.1839	0.1609
140.0	0.1400	0.1969	0.1972	0.1728
150.0	0.1485	0.2033	0.2062	0.1793
160.0	0.1559	0.2167	0.2170	0.1878
170.0	0.1646	0.2271	0.2269	0.1959
180.0	0.1726	0.2362	0.2363	0.2058
190.0	0.1787	0.2456	0.2459	0.2133
200.0	0.1858	0.2573	0.2555	0.2204
210.0	0.1971	0.2682	0.2646	0.2283
220.0	0.2025	0.2781	0.2748	0.2397
230.0	0.2091	0.2890	0.2846	0.2469
240.0	0.2225	0.2989	0.2949	0.2550
250.0	0.2260	0.3101	0.3069	0.2605
260.0	0.2380	0.3225	0.3175	0.2701
270.0	0.2426	0.3371	0.3306	0.2796
275.0	0.2521	0.3452	0.3363	0.2863

TABLE F.6: Bending moments for lab pile 3

Distance from	Total Load (kips)										
Left End	50 kips	75 kips	100 kips	125 kips	150 kips	175 kips	200 kips	225 kips	250 kips	275 kips	278 kips
(ft)	Bending Moment (k*ft)										
0.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.5	2.98	4.61	4.97	5.12	5.10	5.24	5.66	6.50	7.71	8.65	8.74
2	21.12	31.49	43.99	54.40	56.13	58.04	62.71	67.96	73.65	78.61	78.66
3	52.62	78.65	84.52	83.94	90.19	90.92	90.20	25.41	98.13	6.98	6.42
4	40.21	56.45	80.82	96.27	99.62	100.91	104.17	108.87	113.84	47.50	118.74
4.5	3.28	5.04	4.17	11.01	12.26	13.05	15.30	17.07	19.52	17.89	17.87
5.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

TABLE F.7: Load and displacement measurements for lab pile 4

	Distance from Left End of Pile			
Total Load	1.5 ft	2.5 ft	3.5 ft	4.5 ft
(kips)	Vertical Displacement (in)			
5.0	0.0000	0.0023	-0.0004	0.0003
10.0	0.0000	-0.0004	0.0112	0.0159
20.0	0.0146	0.0205	0.0349	0.0316
30.0	0.0259	0.0360	0.0557	0.0510
40.0	0.0368	0.0512	0.0715	0.0631
50.0	0.0448	0.0659	0.0859	0.0752
60.0	0.0544	0.0784	0.1019	0.0885
70.0	0.0658	0.0894	0.1141	0.1012
80.0	0.0720	0.1015	0.1283	0.1123
90.0	0.0820	0.1135	0.1412	0.1235
100.0	0.0892	0.1218	0.1524	0.1349
110.0	0.0982	0.1332	0.1651	0.1458
120.0	0.1051	0.1448	0.1765	0.1555
130.0	0.1136	0.1549	0.1890	0.1661
140.0	0.1188	0.1638	0.1997	0.1761
150.0	0.1308	0.1730	0.2122	0.1864
160.0	0.1371	0.1825	0.2230	0.1945
170.0	0.1409	0.1941	0.2356	0.2031
180.0	0.1494	0.2040	0.2453	0.2127
190.0	0.1594	0.2121	0.2555	0.2209
200.0	0.1628	0.2226	0.2665	0.2291
210.0	0.1747	0.2326	0.2777	0.2370
220.0	0.1780	0.2415	0.2880	0.2457
230.0	0.1873	0.2509	0.2995	0.2563
240.0	0.1927	0.2612	0.3097	0.2632
250.0	0.2051	0.2706	0.3201	0.2726
260.0	0.2097	0.2821	0.3320	0.2816
270.0	0.2209	0.2941	0.3438	0.2907
280.0	0.2293	0.3103	0.3546	0.3022
290.0	0.2441	0.3253	0.3712	0.3132
295.0	0.2526	0.3387	0.3870	0.3242

TABLE F.8: Bending moments for lab pile 4

Distance from	Total Load (kips)											
Left End	25 kips	50 kips	75 kips	100 kips	125 kips	150 kips	175 kips	200 kips	225 kips	250 kips	275 kips	295 kips
(ft)	Bending Moment (k*ft)											
0.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.5	15.37	30.89	43.52	56.29	69.23	85.31	94.83	106.75	117.54	127.35	139.16	148.01
2	15.80	37.55	52.36	65.15	78.06	90.40	97.74	106.98	116.46	124.21	133.96	141.44
3	17.70	43.14	59.96	75.87	91.91	110.42	121.34	133.61	141.65	119.92	34.96	34.96
4	40.56	58.80	80.75	94.81	99.45	106.25	109.17	44.80	119.61	53.83	59.48	13.33
4.5	8.69	53.35	66.40	79.42	91.15	111.37	120.80	135.33	146.90	146.90	146.90	146.90
5.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

TABLE F.9: Load and displacement measurements for lab pile 5

	Distance from Left End of Pile			
Total Load	1.5 ft	2.5 ft	3.5 ft	4.5 ft
(kips)	Vertical Displacement (in)			
5.0	0.0053	0.0119	0.0092	0.0094
10.0	0.0092	0.0205	0.0192	0.0202
20.0	0.0211	0.0324	0.0343	0.0378
30.0	0.0323	0.0479	0.0501	0.0468
40.0	0.0381	0.0601	0.0640	0.0594
50.0	0.0486	0.0722	0.0767	0.0714
60.0	0.0620	0.0854	0.0881	0.0815
70.0	0.0653	0.0957	0.1002	0.0926
80.0	0.0758	0.1077	0.1110	0.1031
90.0	0.0843	0.1215	0.1241	0.1149
100.0	0.0935	0.1325	0.1362	0.1233
110.0	0.1006	0.1429	0.1453	0.1319
120.0	0.1090	0.1558	0.1565	0.1422
130.0	0.1144	0.1660	0.1682	0.1519
140.0	0.1265	0.1761	0.1789	0.1618
150.0	0.1335	0.1863	0.1906	0.1709
160.0	0.1371	0.1989	0.2014	0.1785
170.0	0.1469	0.2074	0.2118	0.1890
180.0	0.1573	0.2202	0.2219	0.1964
190.0	0.1600	0.2286	0.2335	0.2061
200.0	0.1711	0.2398	0.2417	0.2133
210.0	0.1761	0.2490	0.2511	0.2194
220.0	0.1862	0.2602	0.2611	0.2284
230.0	0.1929	0.2700	0.2682	0.2364
240.0	0.2015	0.2787	0.2796	0.2455
250.0	0.2084	0.2915	0.2895	0.2526
260.0	0.2192	0.3051	0.3006	0.2611
269.0	0.2306	0.3248	0.3159	0.2748

TABLE F.10: Bending moments for lab pile 5

Distance from Left End (ft)	25 kips	50 kips	75 kips	100 kips	125 kips	150 kips	175 kips	200 kips	225 kips	250 kips	275 kips	300 kips
	Total Load (kips)											
	Bending Moment (k*ft)											
0.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.5	4.39	5.92	7.60	3.56	4.54	5.22	10.32	12.48	13.84	14.84	15.58	4.35
2	12.43	14.86	21.37	31.16	41.04	51.03	65.91	76.63	86.21	97.01	106.33	28.42
3	31.29	43.40	66.59	90.69	99.59	107.92	119.15	128.28	135.44	77.16	85.09	4.44
4	12.71	20.01	30.06	40.40	60.27	75.64	93.84	108.13	120.96	132.78	141.15	66.43
4.5	6.95	10.77	15.57	20.92	26.44	32.08	35.95	39.68	43.98	50.32	55.44	18.81
5.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

TABLE F.11: Joint bending moments for lab pile 1- 5

Joint Moment Pile #1		JOINT MOMENT Pile #2		Joint Moment Pile #3		Joint Moment Pile #4		Joint Moment Pile #5	
Load (Kips)	Moment (k-ft.)	Load (kips)	Moment (k-ft.)	Load (kips)	Moment (k-ft.)	Load (kips)	Moment (k-ft.)	Load (Kips)	Moment (k-ft.)
0	0	0	0	0	0	0	0	0	0
25	31.29	25	29.9	50	52.6	25	17.70	25	31.29
50	43.4	50	47.8	75	78.6	50	43.14	50	43.40
75	66.59	75	60	100	84.5	75	59.96	75	66.59
100	90.69	100	75.4	125	83.9	100	75.87	100	90.69
125	99.59	125	89.8	150	90.2	125	91.91	125	99.59
150	107.92	150	102	175	90.9	150	110.42	150	107.92
175	119.15	175	111.4	200	90.2	175	121.34	175	119.15
200	128.28	200	118.9	225	25.4	200	133.61	200	128.28
225	135.44	225	127.6	250	98.1	225	141.65	225	135.44
250	77.16	250	127.6	275	7.0	250	119.92	250	77.16
275	85.09	275	137.1	278	6.4	275	34.96	275	85.09
300	4.44	300	65.2			295	34.96	300	4.44

TABLE F.12: Load and displacement measurements for lab pile 6

	Distance from Left End of Pile			
Total Load	1.5 ft	2.5 ft	3.5 ft	4.5 ft
(kips)	Vertical Displacement (in)			
5.0	-0.0015	0.0003	0.0008	0.0005
10.0	0.0056	0.0111	0.0096	0.0084
20.0	0.0197	0.0307	0.0269	0.0272
30.0	0.0293	0.0466	0.0482	0.0485
40.0	0.0396	0.0652	0.0623	0.0590
50.0	0.0539	0.0776	0.0751	0.0698
60.0	0.0617	0.0889	0.0904	0.0820
70.0	0.0701	0.1072	0.1060	0.0946
80.0	0.0785	0.1151	0.1186	0.1042
90.0	0.0893	0.1318	0.1328	0.1151
100.0	0.1008	0.1473	0.1456	0.1282
110.0	0.1065	0.1587	0.1599	0.1358
120.0	0.1162	0.1739	0.1712	0.1477
130.0	0.1270	0.1829	0.1818	0.1542
140.0	0.1299	0.1983	0.1921	0.1643
150.0	0.1399	0.2106	0.2049	0.1751
160.0	0.1515	0.2204	0.2166	0.1825
170.0	0.1534	0.2305	0.2268	0.1923
180.0	0.1651	0.2420	0.2364	0.2008
190.0	0.1695	0.2527	0.2484	0.2094
200.0	0.1787	0.2639	0.2591	0.2173
210.0	0.1846	0.2743	0.2677	0.2250
220.0	0.1967	0.2867	0.2798	0.2330
230.0	0.1987	0.2955	0.2893	0.2403
240.0	0.2085	0.3076	0.3006	0.2484
250.0	0.2172	0.3177	0.3106	0.2561
260.0	0.2217	0.3275	0.3213	0.2637
270.0	0.2359	0.3420	0.3345	0.2723
280.0	0.2439	0.3538	0.3448	0.2805
290.0	0.2501	0.3678	0.3567	0.2882
300.0	0.2617	0.3831	0.3711	0.2998
302.6	0.2672	0.3937	0.3805	0.3046

TABLE F.13: Load and displacement measurements for lab pile 7

	Distance from Left End of Pile			
Total Load	1.5 ft	2.5 ft	3.5 ft	4.5 ft
(kips)	Vertical Displacement (in)			
5.0	0.0059	0.0062	0.0100	0.0168
10.0	0.0151	0.0131	0.0190	0.0238
20.0	0.0252	0.0367	0.0422	0.0417
30.0	0.0401	0.0549	0.0569	0.0564
40.0	0.0492	0.0679	0.0723	0.0691
50.0	0.0605	0.0840	0.0872	0.0827
60.0	0.0698	0.1010	0.1016	0.0947
70.0	0.0798	0.1151	0.1142	0.1043
80.0	0.0898	0.1294	0.1266	0.1180
90.0	0.0970	0.1412	0.1399	0.1245
100.0	0.1045	0.1526	0.1514	0.1367
110.0	0.1148	0.1655	0.1630	0.1488
120.0	0.1265	0.1761	0.1757	0.1560
130.0	0.1315	0.1878	0.1887	0.1683
140.0	0.1400	0.2025	0.2013	0.1780
150.0	0.1492	0.2127	0.2141	0.1871
160.0	0.1589	0.2231	0.2252	0.1943
170.0	0.1670	0.2376	0.2384	0.2048
180.0	0.1745	0.2480	0.2486	0.2138
190.0	0.1799	0.2595	0.2609	0.2241
200.0	0.1937	0.2728	0.2722	0.2315
210.0	0.2000	0.2852	0.2820	0.2402
220.0	0.2041	0.2970	0.2932	0.2486
230.0	0.2207	0.3100	0.3080	0.2574
234.8	0.2235	0.3216	0.3179	0.2658

TABLE F.14: Load and displacement measurements for lab pile 8

	Distance from Left End of Pile			
Total Load	1.5 ft	2.5 ft	3.5 ft	4.5 ft
(kips)	Vertical Displacement (in)			
5.0	0.0037	0.0066	0.0042	0.0055
10.0	0.0089	0.0123	0.0099	0.0124
20.0	0.0183	0.0263	0.0287	0.0282
30.0	0.0290	0.0424	0.0463	0.0439
40.0	0.0397	0.0607	0.0669	0.0631
50.0	0.0482	0.0748	0.0790	0.0698
60.0	0.0567	0.0875	0.0920	0.0815
70.0	0.0647	0.1009	0.1041	0.0928
80.0	0.0718	0.1141	0.1161	0.1011
90.0	0.0803	0.1248	0.1287	0.1136
100.0	0.0894	0.1355	0.1387	0.1222
110.0	0.1001	0.1477	0.1505	0.1319
120.0	0.1152	0.1721	0.1795	0.1591
130.0	0.1211	0.1836	0.1884	0.1697
140.0	0.1299	0.1933	0.1984	0.1758
150.0	0.1361	0.2029	0.2085	0.1840
160.0	0.1440	0.2138	0.2197	0.1935
170.0	0.1497	0.2235	0.2306	0.2021
180.0	0.1611	0.2334	0.2418	0.2114
190.0	0.1681	0.2448	0.2516	0.2170
200.0	0.1730	0.2572	0.2628	0.2255
210.0	0.1815	0.2685	0.2743	0.2333
220.0	0.1926	0.2796	0.2857	0.2412
230.0	0.1964	0.2911	0.2964	0.2501
240.0	0.2083	0.3033	0.3075	0.2584
250.0	0.2133	0.3131	0.3177	0.2653
260.0	0.2245	0.3269	0.3309	0.2760
270.0	0.2376	0.3429	0.3443	0.2850
279.6	0.2487	0.3676	0.3621	0.2984

TABLE F.15: Load and displacement measurements for lab pile 9

	Distance from Left End of Pile			
Total Load	1.5 ft	2.5 ft	3.5 ft	4.5 ft
(kips)	Vertical Displacement (in)			
5.0	0.0024	0.0005	0.0055	0.0029
10.0	0.0064	0.0075	0.0129	0.0100
20.0	0.0166	0.0256	0.0304	0.0231
30.0	0.0250	0.0400	0.0486	0.0397
40.0	0.0318	0.0557	0.0627	0.0527
50.0	0.0427	0.0650	0.0775	0.0667
60.0	0.0505	0.0778	0.0922	0.0770
70.0	0.0581	0.0913	0.1071	0.0888
80.0	0.0665	0.1032	0.1201	0.1007
90.0	0.0809	0.1236	0.1368	0.1179
100.0	0.0893	0.1352	0.1485	0.1294
110.0	0.0934	0.1448	0.1620	0.1400
120.0	0.1037	0.1559	0.1740	0.1511
130.0	0.1096	0.1673	0.1864	0.1566
140.0	0.1180	0.1778	0.2020	0.1681
150.0	0.1254	0.1886	0.2123	0.1781
160.0	0.1339	0.1993	0.2238	0.1886
170.0	0.1382	0.2098	0.2359	0.1991
180.0	0.1492	0.2206	0.2483	0.2101
190.0	0.1557	0.2308	0.2593	0.2194
200.0	0.1608	0.2371	0.2721	0.2290
210.0	0.1676	0.2514	0.2832	0.2385
220.0	0.1795	0.2610	0.2982	0.2473
230.0	0.1827	0.2729	0.3115	0.2585
240.0	0.1943	0.2845	0.3228	0.2684
250.0	0.1985	0.2948	0.3358	0.2776
260.0	0.2082	0.3055	0.3488	0.2865
270.0	0.2171	0.3164	0.3640	0.2990
279.7	0.2282	0.3360	0.3871	0.3161

APPENDIX G: STEEL AND GROUT TESTING RESULTES

FIGURE G.1: Steel Coupon Test

MATERIALS RESEARCH DIVISION
Modern Industries, Inc.
613 WEST 11th STREET • P.O. BOX 399
ERIE, PENNSYLVANIA 16512-0399
TEL. (814) 455-8061 FAX (814) 451-0686
www.modernind.com
Complete Material Testing and Research Services

Accredited Nadcap
Accredited Nadcap
ISO 9001

Skyline Steel LLC

2000 Cliff Mine Rd, Suite 410
Pittsburgh PA 15275
Attn:Mr. Chris Gabuzda

Certificate of Analysis

Lab ID : M0906536
Sample ID : S-144835

Registered : 08/05/09 10:13:59
Received : 08/05/09 10:13:59

Part Number : Generic
Part Name :
HT# : SAMPLE#1
Mill/Lot# :
Size : 10-3/4"OD X 0.595"
Sample Info : COUPON TESTS
Sample Info :

Submitter : Outside Customer
Purchase Order : 4488-2
Release :
Batch Code 1 :
Batch Code 2 :

Sample Notes:

Tensile Test

Test Method: ASTM A370-09/ASTM E8/E8M - 08
Mechanical/Tension Testing of Metallic Materials

Component	Result	Units	Spec. Min	Spec. Max
Sample ID	SAMPLE#1			
Area	0.0487	sq.in.		
Tensile	159	ksi		
Yield	150	ksi		
Offset	.2%			
Elong	16	%		
Gage	1.00			
R/A	71	%		
Hard	321			
Scale	HBW10/3000			
Comments				

Colby M. Dell - Materials Engineer 8/11/2009 Page 1 of 1

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* The recording of false, fictitious, or fraudulent entries on this document may be punishable as a felony under Federal Statute.* The above certification and data are a result of analyses performed on samples and information received from the customer. * This material has not come in direct contact with mercury or any of its compounds nor any single boundary mercury containing devices.* The above tests were performed in accordance with Our Quality Assurance Program. NO WARRANTY as to the suitability of the material and/or process for any applications expressed or implied.

Result

FIGURE G.2: Steel Coupon Test Result

MATERIALS RESEARCH DIVISION

Modern Industries, Inc.
613 WEST 11th STREET • P.O. BOX 399
ERIE, PENNSYLVANIA 16512-0399
TEL. (814) 455-8061 FAX (814) 451-0686
www.modernind.com
Complete Material Testing and Research Services

Accredited Nadcap Materials Testing Laboratory
Accredited Nadcap ISO/IEC Guide 17025
ISO 9001

Skyline Steel LLC

2000 Cliff Mine Rd, Suite 410
Pittsburgh PA 15275
Attn:Mr. Chris Gabuzda

Certificate of Analysis

Lab ID : M0906536
Sample ID : S-144836

Registered : 08/05/09 10:15:00
Received : 08/05/09 10:15:00

Part Number : Generic
HT# : SAMPLE#2
Mill/Lot# :
Size : 10-3/4"OD X 0.595"
Sample Info : COUPON TESTS
Sample Info :

Part Name :

Submitter : Outside Customer
Purchase Order : 4488-2
Release :
Batch Code 1 :
Batch Code 2 :

Sample Notes:

Tensile Test

Test Method: ASTM A370-09/ASTM E8/E8M - 08
Mechanical/Tension Testing of Metallic Materials

Component	Result	Units	Spec. Min	Spec. Max
Sample ID	SAMPLE#2			
Area	0.0497	sq.in.		
Tensile	163	ksi		
Yield	153	ksi		
Offset	.2%			
Elong	17	%		
Gage	1.00			
R/A	71	%		
Hard	321			
Scale	HBW10/3000			
Comments				

Colby M. Dell

Colby M. Dell - Materials Engineer 8/11/2009

Page 1 of 1

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FIGURE G.3: Steel Coupon Test Result

08/27/2008 09:29 2814560805 HOUSTON SALES OFFICE PAGE 02
08/26/2008 13:26 FAX 2814691143 MTEC MECHANICAL TESTING + SAGINAW 001/006

MTEC
MECHANICAL
TESTING
SERVICES

ISO 9001-2000

CERTIFICATE OF TEST

ATTENTION : DENNIS INCE
CUSTOMER : SAGINAW PIPE CO., INC.
P.O. BOX 96199
HOUSTON, TX 77213

8676 TAUB ROAD
Houston, TX 77064
281/469-2609

LAB# : W0811873

DATE : 08/26/08 12:58:30
PO NO :350849
SAMPLE :10A
QTC : 10.75" X .545" W

TEST DATA

TENSILE

UTS PSI	YS.2%PSI	%EL 4D	%RA	BAR DIA.	ORIEN.	LOC.
125,200	114,400	20.40	67.80	0.347	LONG	MW

MTEC Representative

FIGURE G.4: Steel Coupon Test Result

08/27/2008 09:29 2814560805 HOUSTON SALES OFFICE PAGE 03
08/26/2008 13:27 FAX 2814691143 MTEC MECHANICAL TESTING → SAGINAW 002/008

MTEC
MECHANICAL
TESTING
SERVICES

ISO 9001-2000

CERTIFICATE OF TEST

ATTENTION : DENNIS INCE
CUSTOMER : SAGINAW PIPE CO., INC.
P.O. BOX 96199
HOUSTON, TX 77213

8676 TAUB ROAD
Houston, TX 77064
281/469-2609

LAB# : W0811874

DATE : 08/26/08 12:58:30
PO NO :350849
SAMPLE :10B
QTC : 10.75" X .545" W

TEST DATA

TENSILE

UTS PSI	YS.2%PSI	%EL 4D	%RA	BAR DIA.	ORIEN.	LOC.
125,800	116,900	20.90	67.20	0.349	LONG	MW

MTEC Representative

TABLE G.1: Laboratory Grout Compressive Tests Result

CUBE TEST (2X2) in^2			
NO.	Total Maximum Load (Ibs)	Area (in^2)	Compressive Strength (PSI)
1	23679	4	5919.75
2	20917	4	5229.25
3	16466	4	4116.50
4	27287	4	6821.75
5	14283	4	3570.75
6	22823	4	5705.75
7	10504	4	2626.00
8	15335	4	3833.75
9	17257	4	4314.25
Average Compressive Strength (PSI)			4681.97