Draft Final Report

Insitu Rock Shear Device

(DEVELOPMENT OF A NEW INSITU SHEAR STRENGTH MEASURING DEVICE)

BD-545, RPWO # 1
UF Project 00030884

Submitted by:

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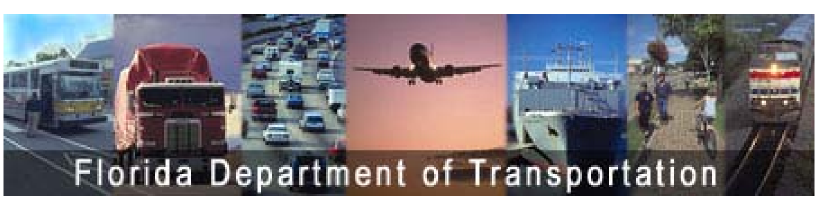

Peter Lai, P.E., Project Manager
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Disclaimer

The opinions, findings, and conclusions expressed in this publication are those of the author and not necessarily those of the State of Florida Department of Transportation.

SI (MODERN METRIC) CONVERSION FACTORS (FROM FHWA)

Table 0-1. Approximate conversions to SI units

SYMBOL	WHEN YOU KNOW	MULTIPLY BY	TO FIND	SYMBOL
		LENGTH		
in	inches	25.4	millimeters	Mm
ft	feet	0.305	meters	M
yd	yards	0.914	meters	M
mi	miles	1.61	kilometers	Km
SYMBOL	WHEN YOU KNOW	MULTIPLY BY	TO FIND	SYMBOL
		AREA		
in^2	Square inches	645.2	square millimeters	mm^2
ft^2	Square feet	0.093	square meters	m^2
yd^2	square yard	0.836	square meters	m^2
ac	acres	0.405	hectares	Ha
mi^2	square miles	2.59	square kilometers	km^2
SYMBOL	WHEN YOU KNOW	MULTIPLY BY	TO FIND	SYMBOL
		VOLUME		
fl oz	fluid ounces	29.57	milliliters	Ml
gal	gallons	3.785	liters	L
ft^3	cubic feet	0.028	cubic meters	m^3
yd^3	cubic yards	0.765	cubic meters	m^3
		NOTE: volumes greater than 1000 L shall be shown in m^3		
SYMBOL	WHEN YOU KNOW	MULTIPLY BY	TO FIND	SYMBOL
		MASS		
oz	ounces	28.35	grams	G
lb	pounds	0.454	kilograms	Kg
T	short tons (2000 lb)	0.907	megagrams (or "metric ton")	Mg (or "t")
SYMBOL	WHEN YOU KNOW	MULTIPLY BY	TO FIND	SYMBOL
		TEMPERATURE (exact degrees)		
^oF	Fahrenheit	5 (F-32)/9 or (F-32)/1.8	Celsius	^oC
SYMBOL	WHEN YOU KNOW	MULTIPLY BY	TO FIND	SYMBOL
		ILLUMINATION		
fc	foot-candles	10.76	lux	Lx
fl	foot-Lamberts	3.426	candela/m^2	cd/m^2
SYMBOL	WHEN YOU KNOW	MULTIPLY BY	TO FIND	SYMBOL
		FORCE and PRESSURE or STRESS		
lbf	Pound force	4.45	newtons	N
lbf/in^2	Pound force per square inch	6.89	kilopascals	kPa

Table 0-2. Approximate conversions to English units

SYMBOL	WHEN YOU KNOW	MULTIPLY BY	TO FIND	SYMBOL
LENGTH				
mm	millimeters	0.039	inches	In
m	meters	3.28	feet	Ft
m	meters	1.09	yards	Yd
km	kilometers	0.621	miles	Mi
SYMBOL	WHEN YOU KNOW	MULTIPLY BY	TO FIND	SYMBOL
AREA				
mm^2	square millimeters	0.0016	square inches	in^2
m^2	square meters	10.764	square feet	ft^2
m^2	square meters	1.195	square yards	yd^2
ha	hectares	2.47	acres	Ac
km^2	square kilometers	0.386	square miles	mi^2
SYMBOL	WHEN YOU KNOW	MULTIPLY BY	TO FIND	SYMBOL
VOLUME				
mL	milliliters	0.034	fluid ounces	fl oz
L	liters	0.264	gallons	Gal
m^3	cubic meters	35.314	cubic feet	ft^3
m^3	cubic meters	1.307	cubic yards	yd^3
SYMBOL	WHEN YOU KNOW	MULTIPLY BY	TO FIND	SYMBOL
MASS				
g	grams	0.035	ounces	Oz
kg	kilograms	2.202	pounds	Lb
Mg (or "t")	megagrams (or "metric ton")	1.103	short tons (2000 lb)	T
SYMBOL	WHEN YOU KNOW	MULTIPLY BY	TO FIND	SYMBOL
TEMPERATURE (exact degrees)				
^oC	Celsius	1.8C+32	Fahrenheit	^oF
SYMBOL	WHEN YOU KNOW	MULTIPLY BY	TO FIND	SYMBOL
ILLUMINATION				
lx	lux	0.0929	foot-candles	Fc
cd/m^2	$candela/m^2$	0.2919	foot-Lamberts	Fl
SYMBOL	WHEN YOU KNOW	MULTIPLY BY	TO FIND	SYMBOL
FORCE and PRESSURE or STRESS				
N	newtons	0.225	Pound force	Lbf
kPa	kilopascals	0.145	Pound force per square inch	lbf/in^2

*SI is the symbol for the International System of Units. Appropriate rounding should be made to comply with Section 4 of ASTM E380.(Revised March 2003

Table 0-3. Technical Report Documentation Page

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<tr><td colspan="4">16. Abstract
A new device has been designed to measure the insitu rock shear strength in cored holes. Limited field data indicate that shear strengths obtained by the Rock Shear Device are in good agreement with McVay's laboratory square root^2 method.</td></tr>
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EXECUTIVE SUMMARY

This project involved the development and testing of an insitu rock shear device. Foreseeable problems associated with undulating rock formations led to the development of a second device designed specifically to provide data on the irregularities, cavities and voids within the core holes.

The development process was dynamic with extensive laboratory tests performed on simulated rock samples (Gator rock) to arrive at the present prototype designs. The prototypes were then built and tested in the laboratory and exhibited encouraging results. However, preliminary field tests exposed minor problems with the instrumentation and its mechanical attributes. Thus, necessary design changes were completed and the devices have been successfully tested at the Fuller Warren Bridge in Jacksonville and the 17th Street Bridge in Miami. The success of the program was evaluated based on the following criteria:

i. the efficiency of the equipment with regards to their ease of operation, their limitations and possible areas for future development.

ii. the validity of the results, based on the equipment designs and accuracy of the measuring instruments' operational characteristics in producing results with an acceptable margin of error.

iii. the validity of the results based on theoretical assumptions versus actual test conditions - whether in the field or in the laboratory.

With respect to (i), the operation is relatively simple, requiring two operators. The data reduction and interpretation however requires the involvement of an experienced geotechnical engineer. Considering (ii), the instrumentation and data collection system needs only minor improvement regarding output signal electrical noise.

With respect to (iii), the level of accuracy of input information such as the depth of stud penetration has been shown to be insignificant in determining the strength envelope as long as

the penetration remains relatively constant with changes in normal pressure application. This assumption fails in very soft vuggy rock and is likewise difficult to retrieve and test in the lab.

The approaches used to arrive at the contact area of the studs for stress determination were based on assumed penetration values and those proposed from modeling. The limited results to date show that McVay's theoretical predictions (based on compression and split tensile tests on rock cores) and the field data are similar (i.e., within 10%). This indicates that the philosophy of using a constant penetration depth with varying applied pressures is sound.

At both sites the determinations, i.e., data reduction and analyses, show a show a general shear strength range from a high of 300 psi to a low of 20 psi. These ranges are typical of Florida limestone and the variations are consistent with those seen in the core samples with intermittent bedding of clay intrusions.

While two different analysis techniques were used to develop a proposed Florida Method, one exceeded expectations and exhibited the greatest potential. Thus, this procedure will be used in future tests for validation purposes. It also shows that McVay's laboratory model (square root-square root method) is directly correlated to the insitu determination of rock shear strength.

In summary, based on the results to date, the validity of the testing method and simple theories that govern the derivation of the strength envelope of rock are sound. This is based on the satisfactory comparison of the lab and field methods for determining the shear strength of Florida limestone.

CHAPTER 1
INTRODUCTION

Background

The following provides an overview of the general characteristics and geology of Florida limestone formations that influence its load response behavior.

Florida Limestone and Geology

The upper stratum of soil material of Florida is generally made up of sand with some clay fraction overlying limestone. This simplification however was made more complicated by numerous climatic and geological events due predominantly by the hydraulic forces. The Ice Age and other climatic events induced changes in the sea levels that resulted in the submergence and exposure of the Florida basin. These processes led to the deposition of carbonate sediments that formed limestone which were further altered by the outwash sediment depositions from the mountains and periodic erosion and weathering.

The highlands of the northern peninsula and panhandle of Florida consist of the dissected, sedimentary remains of Neogene fluvial, deltaic, and shallow water marine systems. Transported southward from the southeastern coastal plain and the southern Appalachians, silici-clastic sediments filled the Gulf trough and spilled onto the carbonate platform of Florida. This silici-clastic invasion into the clear, carbonate producing, shallow waters, covered the limestone platform and formed a spine of clayey sand on the peninsula. “Subsequent sea level fluctuations and associated near-shore, coast parallel currents reworked and reshaped these deposits, leaving the elongated system of upland ridges we see today.” (Schmidt, et.al., 1978).

The Florida peninsula acquired its present shape during the last ice age, some 15,000–20,000 years ago. A north to south river orientation dominates the peninsula, reflecting near shore marine environment that contributed to the basic landform present today. Relict beach ridges separate swales previously occupied by shallow lagoons. "When the sea level dropped, these lagoons became valleys, and streams eroded the sands and clays, creating several coast-parallel river systems seen today as the St. Johns, Kissimmee, and Withlacoochee Rivers" (Schmidt, et.al.,1979).

The topography of south Florida is typical of peninsular Florida's general geology. Biscayne Bay separates Miami Beach, located on the Atlantic Ridge, from the mainland (downtown Miami sits on a western ridge). To the west of southeastern coastal counties of Dade, Broward and Palm Beach and the east of the Gulf coast of Florida (where the Gulf Coast ridge is located) sits the immense "shallow lagoon" of the Everglades. Similar features, on a smaller scale, occur in many areas of Florida.

Composition of Florida Limestone

Sedimentary rocks, including Florida limestone, formed as wind, water and ice transported minerals, fragmented rock, and the remains of certain organisms which were deposited into sedimentary layers. As sediments accumulate, pressure and/or chemical reactions harden the deposits. The sedimentary rocks include two major divisions, detrital and chemical. Pressure on deposited solid products of chemical and mechanical weathering, generally form detrital sedimentary rocks. Limestone belongs to the chemical sedimentary rock, composed primarily of the mineral calcite (calcium carbonate, $CaCO_3$) hardened underwater by chemical cementing action, rather than pressure. Limestone represents about 10% of all sedimentary rocks, and most formations, including Florida limestone, have a marine biochemical origin.

Because of the varied deposition and erosion processes that occurred during Florida's geologic history, Florida limestone has a highly heterogeneous nature. Even within the same formation, it may include coral, shell, chert, strongly cemented carbonates, crystalline deposits, oolites, and lime mud. It may also include zones of weak cementation, poor consolidation, detrital weathering products, and inclusions of clay, sand, and organic matter deposited in karst features and/or interbedded layers. The carbonate matrix may also contain impurities, including iron, silica, and magnesium. The dolomitic limestone (dolomite, $CaMg(CO_3)_2$) sometimes found in Florida forms when magnesium ions, transported through limestone beds by ground water, replace some of the calcium in the calcite matrix. Groundwater may convey carbonic acids (dissolved carbon dioxide) and organic acids that dissolve the calcite matrix, forming karst features such as cavities and fissures. Because of the greater influence of weathering processes and lesser consolidation stresses, Florida limestone found near the surface tends to be weaker than that found at depth.

Mechanical Properties of Florida's Limestone

Florida limestone are generally weaker than many other sedimentary rocks, and often including zones of unconsolidated carbonates and karst features, the mechanical properties of Florida limestone vary significantly. Mechanical properties may vary between and within recognized formation units, and both laterally and vertically at a given site, often almost randomly. Because of this inherent variability, the FDOT performs a detailed investigation of the limestone at each site where it may affect the structure under design. This investigation typically consists of SPT blow counts and strength tests of core samples. The competency of the limestone also plays an important role in core retrieval and in the drilling of a corehole to perform insitu tests, both of which may affect the quality of the respective test results. Testing and sampling techniques add further variation. Reported parameters usually include the SPT N-value (ASTM D1586), core recovery, ROC (%), rock quality designation, RQD (%) and laboratory tests. Laboratory tests are usually limited to the unconfined compressive strength, q_u (ASTM D2938) and splitting tensile strength, q_t (ASTM D3967). Unconfined compressive strengths vary from less than 50 psi to as much as 10,000 psi, but the majority of values fall between 500 psi and 2000 psi. A few projects have included pullout tests of small diameter (< 6") concrete plugs used to model a shaft's side shear. Drilled shafts designed using these test results typically have a high capacity, and FDOT routinely performs load tests during the construction phase of each project to verify design assumptions.

Limestone Drainage Conditions

Most engineers assume Florida Limestone behaves as a drained material. Limestone typically has a permeability similar to very fine sand, in the range of 10^{-3} to 10^{-5} ft./sec., and a porosity of 5 to 15%. According to Johnston and Chiu (1981) the dissipation of pore water pressure caused by loading "may be described by the coefficient of consolidation, c_v" which varies inversely with the coefficient of volume change, m_v, and directly with permeability. For a relatively incompressible material like soft limestone, the coefficient of volume change (m_v), the reciprocal of the constrained modulus, may be several orders of magnitude smaller than clay. This combination results in " a c_v value that is several orders of magnitude larger than for clays" Johnston and Chiu (1981), and leads to a more rapid pore water dissipation rate. Johnston, (1987) further indicated that laboratory "specimens did not contain the fissures, joints and seams encountered in the field," which will lead to a further increase in drainage. Of course, the presence of clay in the limestone matrix, a common occurrence in Florida, will significantly reduce drainage capability.

Load Response: Drilled Shafts Socketed in Limestone

The ultimate drilled shaft capacity is generally expressed as:

$$Qu = Qs + Qp - W$$

Where Qs is the side friction, Qp the point resistance and W the weight of the shaft. The ultimate side resistance in rock is found from the unit side shear, f_s, multiplied by the perimeter area of the shaft. The ultimate point resistance in rock is found from a representative value of tip bearing pressure, q_{tip}, multiplied by the cross sectional end area of the shaft. The spatial variation of Florida's limestone with respect to formation depth and strength has created uncertainties for designers regarding the relative contribution of end bearing for a socketed drilled shaft's resistance. The prediction of unit side shear on socketed drilled shafts is therefore of utmost importance for design. An accurate value for unit side shear is required so that the strength of the rock is properly represented in the design calculations. This will offset the necessity of including large safety factors that significantly increase the diameter and or length of the shaft, resulting in unnecessary cost of construction.

The method presently used by the Florida Department of Transportation incorporates the recommendation by Professor M. C. McVay (1992) which relates the ultimate side friction to the rock's material properties; q_u and q_t (unconfined compression strength and split tensile strength respectively). The q_u and q_t values are determined in the laboratory and a statistical approach is used to determine the mean, upper bound and lower bound values for these two parameters for design. To account for the high spatial variability of the rock quality, the percent recovery is applied to the ultimate side friction as an "uncertainty factor" to obtain the design ultimate side friction.

The accuracy of this method is dependent on the level of recovery and the quality of the rock samples recovered. In far too frequent situations (locations, depths, etc.), inadequate numbers of samples are recovered and/or very poor sample recoveries are made. In either case, the laboratory determination of q_u and q_t is suspect. The designer is therefore left to make value judgments regarding what design values to use. The cost of these value judgments could result in unnecessary cost overruns.

Hence, the objective of this FDOT sponsored research project was to develop an insitu approach to determine the ultimate side friction of corehole rock surfaces, without the levels of uncertainties encountered using the current methodology. Three methods have been identified which attempt to measure the shear strength of rock insitu; the Iowa Borehole Shear Test Device, the Pressuremeter Test and the Pull-Out Test. Some levels of success have been obtained with these instruments, however their limitations (discussed in Chapter 2) led to the development and implementation of a new insitu rock shear strength testing device.

Scope

The goal of this project was to design and build a corehole device capable of measuring insitu, the shear strength of rock. The concept involves the axial pulling of a laterally pressurized cylinder composed of retractable shear studs. It can provide a direct measurement of the shear strength mobilized along the corehole wall as input for the design of drilled shafts. Due to the presence of voids and inconsistencies in the corehole walls, a second device had to be built to detect and map their locations.

Based on the above goals, the study was divided into the following six tasks:

Literature review
Design/modify laboratory equipment for preliminary testing
Perform laboratory tests on components
Design/build a prototype rock shear device
Perform field tests
Analyze final test results, propose operational testing method and prepare final report

.

CHAPTER 2
REVIEW OF LITERATURE

Review of Previous Insitu and Empirical Determination of Rock Shear Strength

Several references have been found that investigated the measurement of rock shear strength.

The following are the ones most often cited in the literature:

- the insitu measurement of shear strength of rocks from Iowa State University using a borehole direct shear device developed by Handy (1975).
- the insitu measurement of shear strength by Parra, et. al., (1990) using the pull out test.
- the insitu measurement of shear strength using the pressuremeter test (Briaud, (1992), Haberfield, et.al., 1989).
- the theoretical prediction of rock shear strength for design of drilled shafts by McVay et. al. (1992)

Insitu Measurements Using Handy's Rock Borehole Shear Test

The Rock Borehole Shear Test (RBST) was developed by Handy (1975) as a complementary instrument to his soil testing "Iowa Borehole Shear Device" (IBSD).

The test requires a borehole, in which two diametrically opposed serrated plates are expanded, again similar to the IBSD. The plates engage the rock with a controlled pressure, while a separately controlled force is applied to cause shearing displacement axially along the hole (See Figure 2-1).

In the RBST, the shear plate contact pressure is maintained constant while the shearing stress is increased to failure, at which time the normal and shear stress (forces) are read and tabulated. The hydraulic gauge pressures are converted to normal shearing stresses by means of calibration data; the expansion forces divided by one plate area equals the normal stress, and the shearing force divided by two plate areas equal the nominal shearing stress. The plate is then removed cleaned rotated and the test repeated.

Sequential RBST's at different normal stresses of closely spaced intervals within a test produced linear failure envelopes when compared with most laboratory tests. In homogenous rocks the correlation coefficient "r" of the linear envelopes is generally about 0.99. In highly varied rocks the RBST generates multiple failure envelopes and allows evaluations of both c and φ, for which the means, standard deviations, and confidence limits on the means and individual values can be obtained.

The following are some of the inferences and principles by which the RBST operates:

Linear Mode of failure envelopes stemming from different modes of rock behavior, i.e. dilatant, nondilatant, and ductile, may be defined as a function of applied normal stress (Protod, et. al., 1966).

Comparative Triaxial tests show close agreement of friction angles (φ), but some loss of cohesion (c) in the RBST, probably due to incomplete seating of the shear plate teeth. This loss amounts to about 25%, and either may be corrected for or left as an additional safety factor in a design.

The minimum seating force required, after Evans and Murrell (1958) is: $F = 2bdq_u(f + \tan \beta)$ Where; F is the force to cause penetration, b is wedge length, d is penetration depth, q_u is the unconfined compression strength, f is the coefficient of friction between rock and steel and β is half the wedge angle

The measured extent of the rock damage from wedge penetrations appears to be less than predicted from theory. Even with full plastic failure, the tooth spacing of 10 times the tooth depth leaves about 60% to 80% of the confined (by adjacent teeth) surface unfractured, depending on the friction angle (φ). Since friction still develops along the fractures, only cohesion should be appreciably affected. The extent of the plastic failure during seating will be reduced if the rock is compressible (Engle, 1976).

The ratio of shear to normal force for teeth to slip along the tooth surfaces may be found using Patton (1966). The angle of inclination I = (90-β), where β is half the apex angle. Then;

$$\tan (\varphi_s + i) = \tan (\varphi_s + 90 - \beta) = \tau_{max}/\sigma_n$$

Where τ_{max} is the nominal normal shear stress, σ_n is the nominal normal stress and φ_s is the friction angle between the wedge surface and the rock. Substituting $\beta = 30^o$ and $\tau_{max} = c + \sigma n \tan \varphi$, slip may occur if

$$\sigma_n/c < 1/((\tan (\varphi_s = 60^o) - \tan \varphi)$$

For an estimated value of $\varphi_s = 20^o$ and a value of $\varphi = 35^o$,

$\sigma_n/c < 0.2$ for slip, or the normal stress need only exceed one – fifth of the rock cohesion for tooth slip to be prevented.

Pull Out Test

This research by Parra, et. al., (1990) involved assessment of the maximum side friction along a rock socket borehole via a small anchor cast with fluidized grout (Figure 2-2). The test is performed by pulling up on the anchor and measuring both the force and the displacement, which in turn allows for the development of a T-Z curve at the particular location. The method essentially applies the same principles used to perform a load test of a socketed drilled shaft. In the pullout test an anchor is cast (between 2 to 6 feet long) at a specified depth, allowing three to five days for the grout to achieve maximum strength and then pulling the plug to failure (defined as the force required to overcome the resisting force).

It is assumed that scale effects (difference of side shear surface area of the anchor compared to full size shaft) is negligible provided the diameter of the anchor exceeded 5 inches. It is not known however the extent to which the anchor's length to diameter ratio affects the maximum side shear (note, the authors commented that this aspect needs further investigation).

There was some agreement between the T-Z values obtained from the pullout tests and load tests. Similar results were seen with respect to the displacements needed to mobilize the maximum side shear. The observed range was between 0.1 and 0.2 inches. The results of the pullout test also appeared to compare reasonably well with McVay's theoretical prediction model. Concerns however had been expressed about the effects of increased side shear readings during the pullout due to Poisson effects; the application of the pulling force on the bottom plate resulted in a vertical compression of the grout which results in a lateral expansion of the plug. This increased the normal contact between plug and the corehole, resulting in higher friction and hence an increase in the observed shear resistance.

The Pressuremeter Test

The Pressuremeter is comprised of two main parts; the down hole probe and the surface control unit. The probe consists of expandable tubing that is pressurized using water, its pressure controlled by the surface unit. Both volume and pressure is recorded with each increase in pressure at the test depth. The pressure is generally increased at regular intervals and held for a minute. The readings are usually recorded every 30 seconds before moving to the next test depth.

The pressure is measured using a pressure transducer at the surface and the volume measured using an LVDT in the probe. The resulting plot of pressure versus Volume/Volume Change is shown in Figure 2-3. The plot is typically "S" shaped with clear points of inflexion;

AB – Portion over which the membrane expands to the surface of the core wall

BC – Linear Elastic expansion phase (the Initial Pressure p_o is represented by point B)

CD – Plastic deformation Phase (the Yield Pressure p_y is defined by point C)

The pressure approached after yielding is considered the Limiting Pressure p_L. The initial at-rest horizontal stress can be theoretically determined using the straight line portions of the curve AB and BC and is defined by their point of intersection.

The current design procedure for determining unit side shear for drilled shaft design involves the use of empirical data that relates the unit side shear to limit pressure using factors such as; the soil type, the method of installation and the type of pile / shaft.

The equation for the equivalent limited pressure, P_{Le} (Briaud, 1992), is given by:

$$P_{Le} = \frac{1}{2}a \int_{-a}^{a} P_{L(z)} dz$$

where “a” is the height of the layer. For a drilled shaft “a” is estimated as the diameter of the shaft, or B/2. The average unit side shear can now be determined and the ultimate side resistance derived from:

$$Q_s = P \int_0^h f_{su} \, dz$$

where “P” is the perimeter of the drilled shaft.

A plot of the pressuremeter data on a log scale (Figure 2-4) can also be used to determine the undrained shear strength of the rock as proposed by Gibson and Anderson (1961) and later refined by Mair and Wood (1987).

Theoretical Prediction Using Laboratory Test Results

Drilled shafts are generally socket into the limestone rock to carry large axial and or lateral loads (Crapps, et. al., 1986, Gupton, et. al., 1984, Patton, 1966, Rowe, 1987). Florida Limestone has been known to be highly variable with respect to depth and the concentration of caverns and voids within very small spatial areas. These factors have created uncertainties for designers resulting in the nominal use of tip resistance and a more significant reliance on skin resistance. The fact that determination of the mean skin friction along the length of the drilled shaft is more reliably acquired compared to the tip resistance has also been an important factor in drilled shaft design. The accurate prediction of skin resistance is therefore key to a successful deep foundation design.

A number of relationships involving the skin resistance of rocks have been reviewed and correlated with field data from load tests by Drennon, et. al., (1972), McVay et. al. (1992) and

Schmertmann, 1977). The relationships (by correlation of field and or laboratory data with strength data available) indicated that the skin friction (f_{su}) can be expressed as a constant times the unconfined compressive strength (q_u). This assumes a constant angle of internal friction or a power curve relationship for a variable angle of internal friction. The constant and variable methods are used depending on the database's location and type of rock under investigation. The resulting correlations assume that the characteristics of the rock material can be represented by Coulombic parameters (φ and c) while the value of the skin friction is assumed to be approximately equal to the rock's cohesion.

Numerical analyses by researchers have evaluated the maximum skin friction mobilized at the rock-shaft interface (Duncan, et. al., Davis, et. al., Ewy, et. al., Ingraffea, et. al.,). Often, a simple elasto-plastic bi-linear model is used to characterize the rock by assigning a constant element stiffness with Young's Modulus and Poisson's Ratio. Failure is determined from a significant reduction in element stiffness and described by a Mohr-Coulomb strength envelope in cohesion versus friction angle stress space.

Typical results are summarized in Figure 2-5. The initial and final stress states are illustrated; starting at the top of the shaft where the overburden stresses are minimal to the bottom of the shaft where the geostatic stresses are maximum. The elements are failed through shear from the top (where the load is applied) and progress to the bottom of the shaft as each successive element has reached its minimum stiffness and the load is transferred downward. The growth of the Mohr circles can be seen to be limited to a single strength envelope. As shown, the pole is used to determine the maximum shear stress on the vertical plane (since rock/shaft interface is vertical) and shown to be in close agreement with the rock's cohesion (between 5% and 10%).

By verifying that the skin friction is in close agreement with the cohesion, the problem now becomes that of predicting the cohesion value for the rock. This can be accomplished by performing multiple triaxial tests on representative rock samples at different confining pressures. A less expensive method is to utilize unconfined compression tests and split tension tests, both simpler to perform and far less time consuming. By representing these values on a Mohr's circle, and using basic trigonometry, a relationship for the skin friction can be derived with respect to "c" and "φ". See Figure. 2-6.

From the above figure the following relationship was derived;

$$f_{su} = \tfrac{1}{2}\sqrt{q_u}\sqrt{q_t}$$

The rock's skin friction can therefore be determined (predicted) with knowledge of its unconfined compressive strength and its split tension strength. In the development of the above relationship, the tensile strength (q_t) determined from the split tensile test agreed with the uniaxial tension test which assumes a major principal stress of zero (Jaeger and Cook, 1969). The high variability rock strengths require that sufficient sampling be performed in the vicinity of the shaft's embedment depth to quantify the mean of the formation. The recommendation is that a relationship be used to evaluate the expected error in the mean in order to assess the level of accuracy of the prediction for skin friction design values. The following is the recommended error relationship:

$$E = t\frac{\sigma}{\sqrt{n}}$$

Where E = standard error of the mean; n = number of laboratory specimens tested; σ = standard deviation of strength test; and t = confidence level from student "t" distribution.

For design purposes, in according to the FDOT's Soils and Foundation Handbook (2006), the % recovery obtained from the rock core sampling is used as a reduction factor to account for the spatial variability of the formation in the vicinity of the drilled shaft, that is; $(f_{su})_{design}$ = % REC x f_{su}. To reduce the prediction error and to obtain a reliable and conservative value for the design skin friction, the following method has been recommended:

- Find the mean values and standard deviations of both the q_u and q_t strength tests.
- Establish the upper and lower bounds of each type of test by using the mean values +/- the standard deviations.
- Discount all the data that are larger or smaller than the established upper and lower bounds, respectively.
- Recalculate the mean values of both q_u and q_t strength using the data set that fall within the boundaries.
- Multiply the derived ultimate skin friction f_{su} by the mean %REC (in decimal) to account for spatial variability.
- Use the mean value as the design upper bound and the mean minus one standard deviation as the lower bound skin frictions.

While each of the above methods has proven to contribute to foundation design methodologies, FDOT was interested in the further development of a complementary source for rock strength data. This was the impetus for this project.

The proposed insitu device was expected to provide the following:

- To reduce the problem of corehole irregularity and nonconformance that affects the pressuremeter test.
- To measure normal and shear forces, as well as displacement.
- To eliminate the effects of normal force reduction along the length of shear plate (due to length/stiffness ratio of plate) as experienced in the RBST.

- To acquire and test fewer quantity and quality of laboratory samples that in practice, has not been consistently possible. This can result in insufficient design data at a particular location.

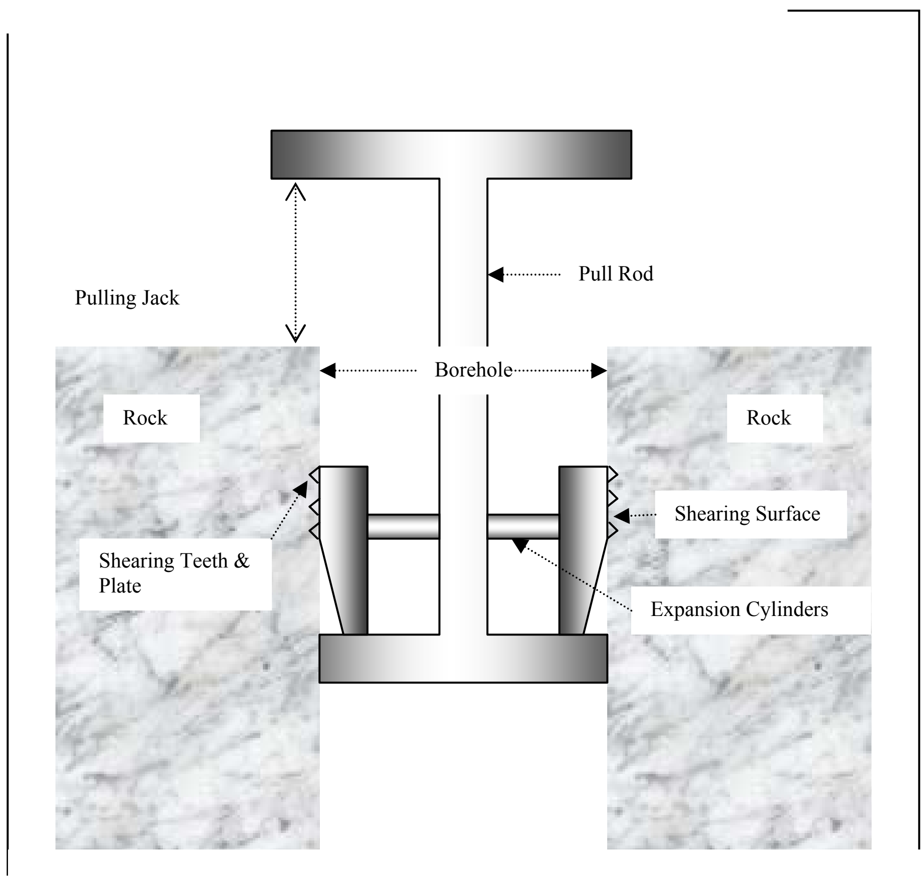

Figure 2-1. Schematic of Rock Borehole Shear Test (Handy, 1975)

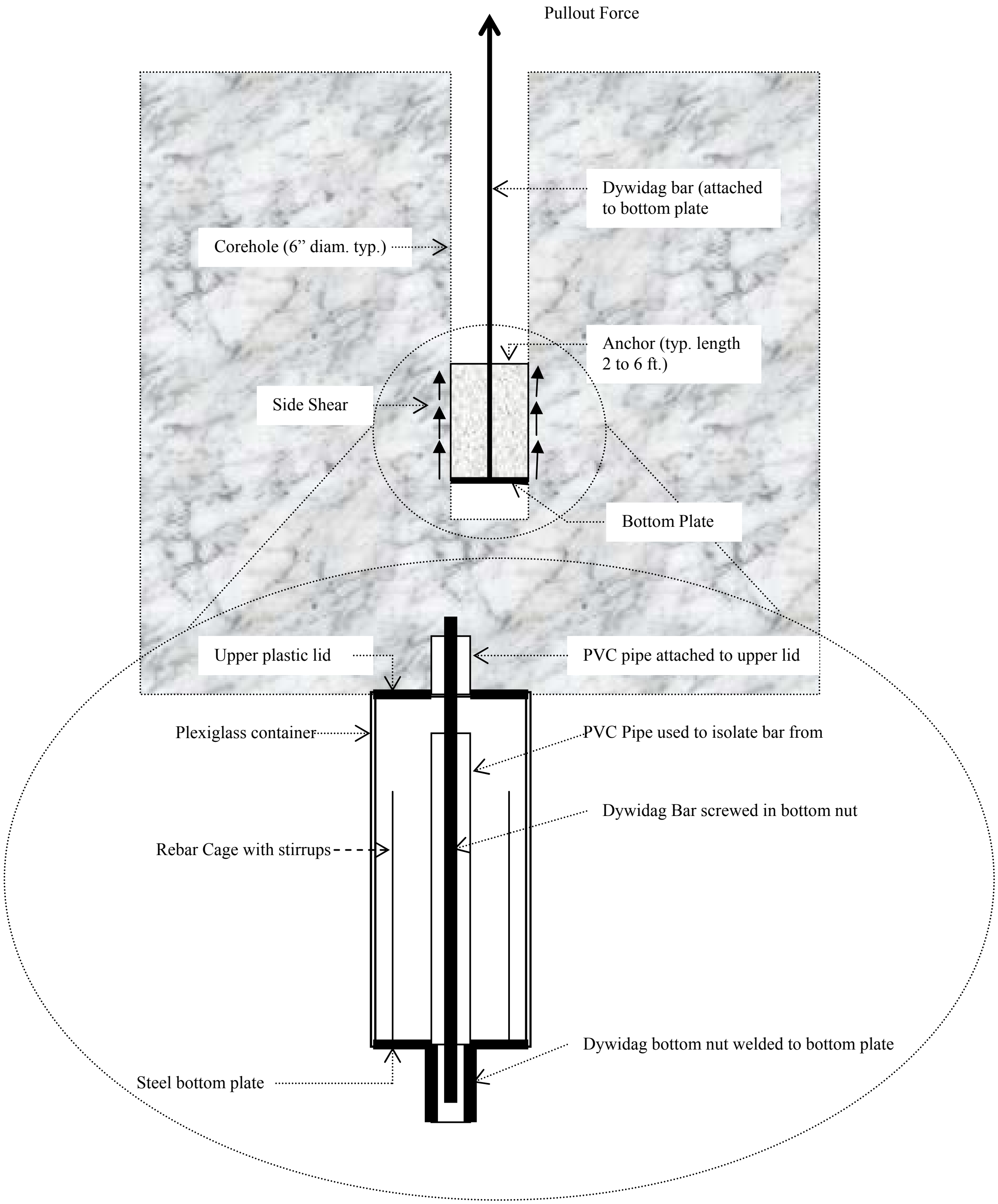

Figure 2-2. Schematic of Pull-Out Test Setup and Anchor Casting Detail (Parra, et. al., 1990)

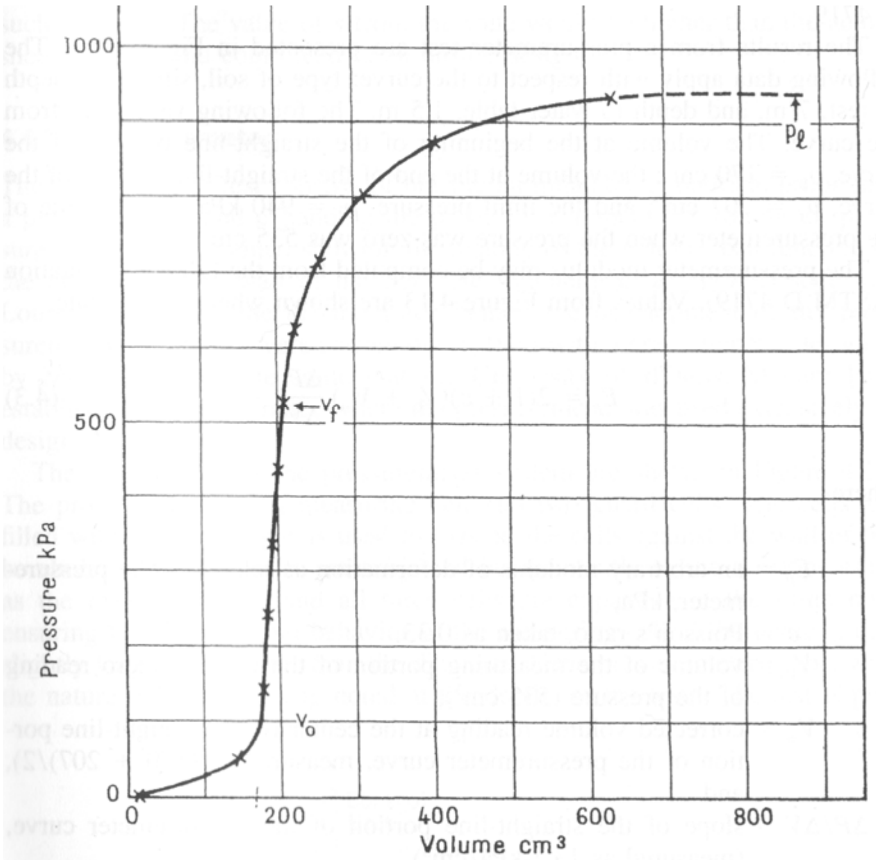

Figure 2-3. Typical Pressuremeter Curve (from Baguelin, et. al., 1978)

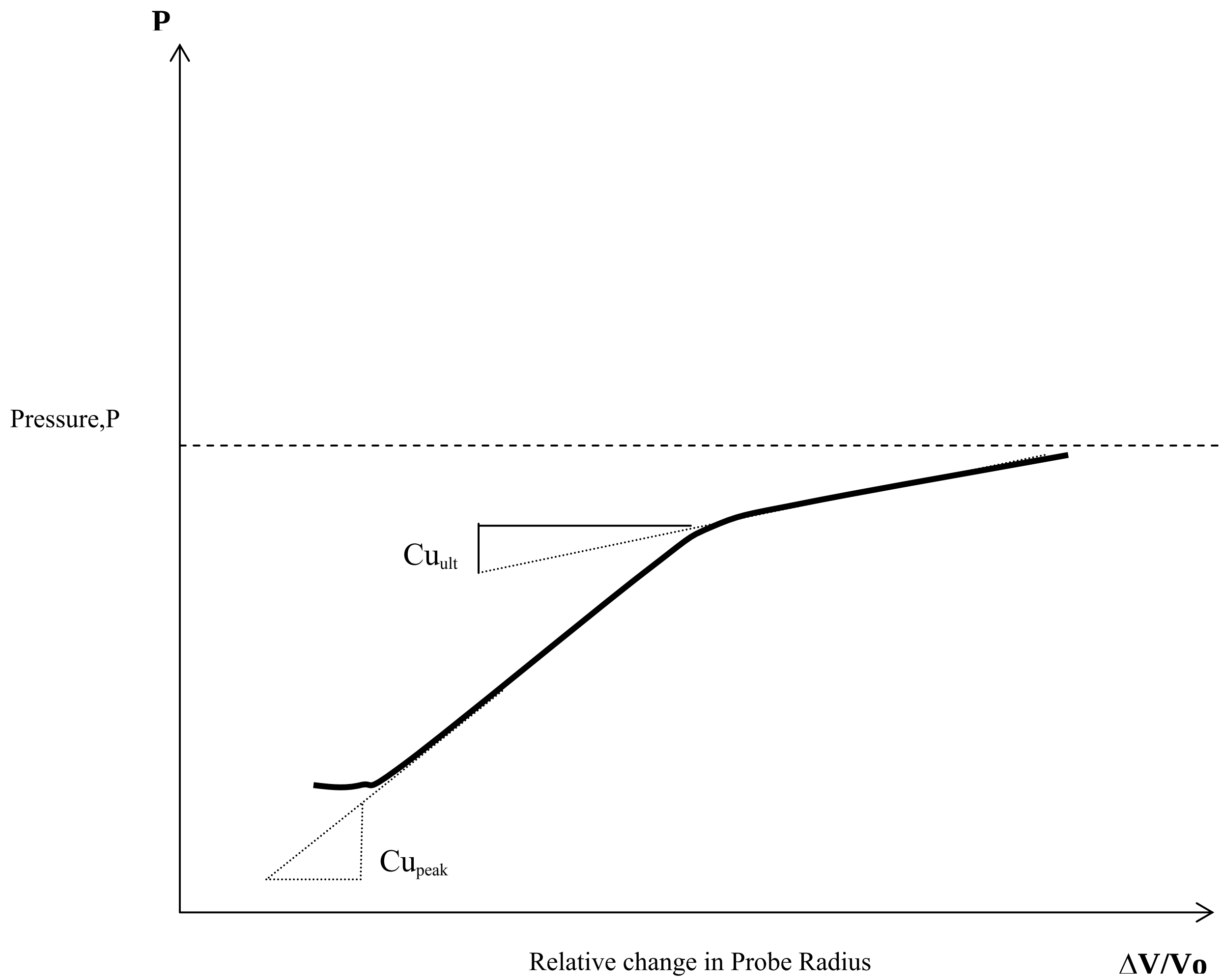

Figure 2-4. Pressuremeter Curve Illustrating Peak and Ultimate Shear Strength (Mair & Wood 1987).

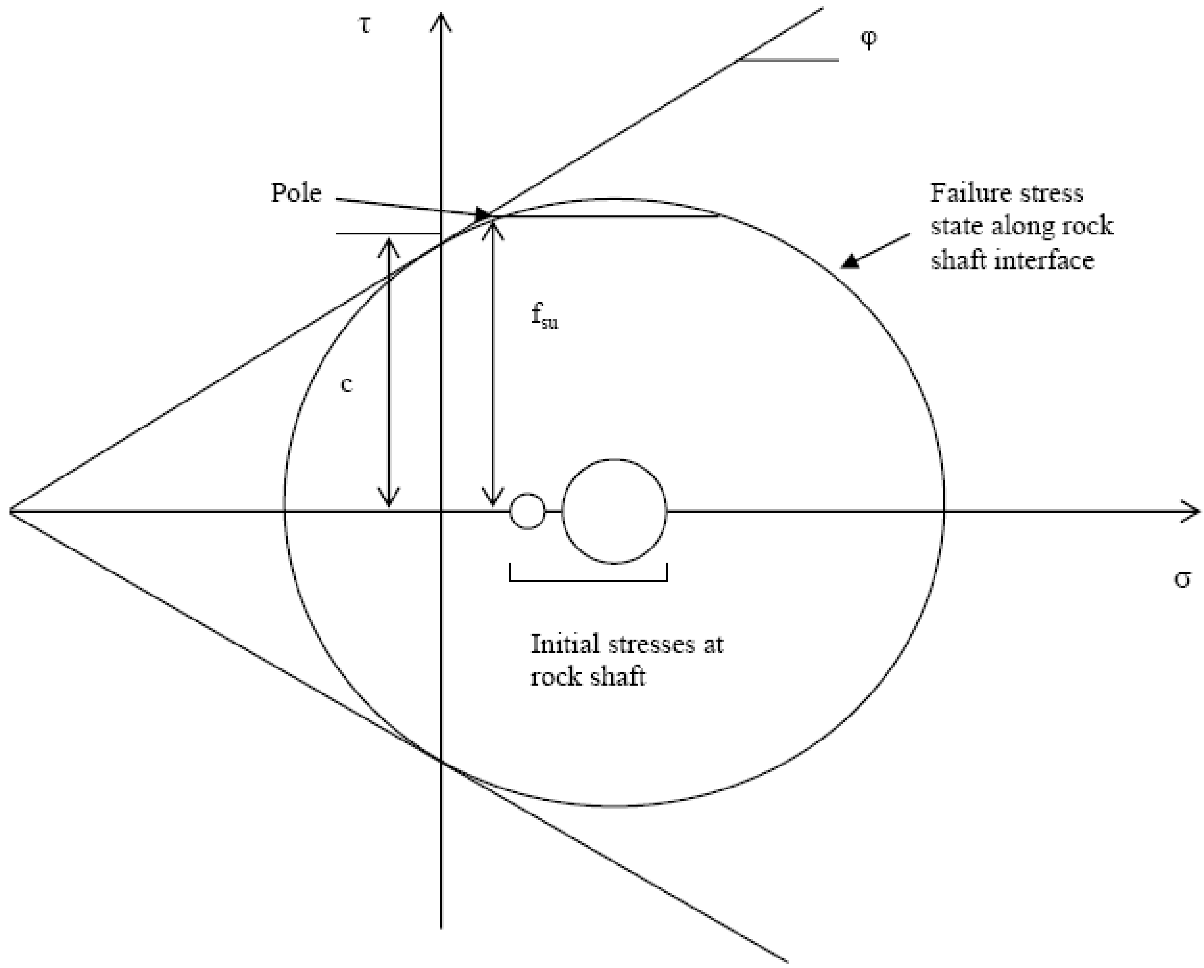

Figure 2-5. Cohesion and Shear Strength at Rock/Shaft Interface (McVay et. al., 1992)

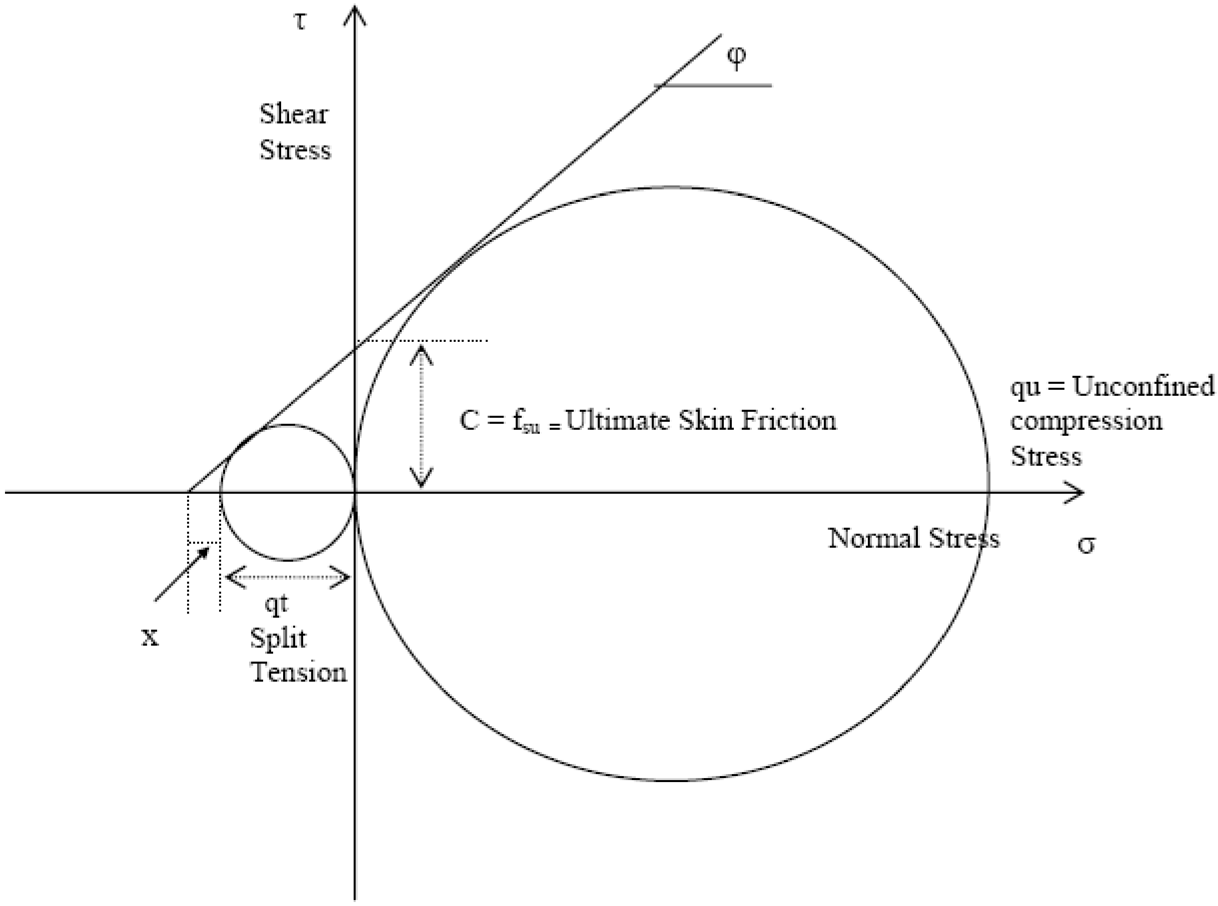

Figure 2-6. Mohr-Coulomb Strength Envelope, Florida Limestone (McVay et. al., 1992).

CHAPTER 3
EQUIPMENT DEVELOPMENT

The previous chapter outlined the importance of determining the shear strength of Florida limestone for the design of drilled shafts. This fact led directly in defining the scope of this project, i.e., the design and construction of a corehole shear device capable of measuring the shear strength of Florida limestone. This requires acquiring data from the axial pulling force of a laterally pressurized cylinder with shear studs. It provides a direct measure of the shear strength mobilized at the corehole wall and can be used as input for the design of drilled shafts.

The proposed device development process was divided into the following six tasks:

1. Literature review
2. Design/modify laboratory equipment for preliminary testing
3. Perform laboratory test
4. Design/build direct shear device
5. Perform laboratory/field testing
6. Analyze final tests results and prepare final report

For Task 2, the following effects were being investigated:

The contact shape of the shear studs
The spacing and arrangement of the shear studs
The size of the shear studs
Displacement and its measurement
The requirement of normal load (seating force) for stud "biting" into a variety of rock
Seating damage
Surface Irregularities

Figures 3-1 to 3-12 show the Direct Shear laboratory equipment and setup used in conjunction with Gator rock (mix design by weight of 15% crushed limestone; 20% cement and 20% water) along with the various loading heads and shear boxes to conduct the above tests.

For Task 3, i.e., Perform laboratory Direct Shear Tests, it included the following:

Standard Direct Shear tests; initially done with little success until the samples were sawn to initiate a failure surface (simulation of discontinuities).

Direct Shear tests using a Wire Mesh interface

Shear tests using Studs; tests were carried out using four different types (shape of contact surface) of studs.

Details of the testing procedure are provided in Chapters 4 and 5.

The objective at this stage of the research was to design a stud that would penetrate into a corehole wall's surface under reasonable normal pressures yet constrained such that it would limit the penetration in lower strength rocks. This is to avoid creating a bearing rather than a shear failure. Reference was also made to the work done by Evans and Murrell (1958) regarding the response of rocks (soft and hard – shale, limestone and diorite) to loading (static and dynamic) using circular rods with pointed ends. Several pointed end shapes were tested; 30^o, 60^o, 90^o and 120^o apex angles. Quasi static indentation tests were conducted using an Instron Universal Testing Machine at a loading rate of 0.0254 mm/min. in conjunction with displacement probes and force transducer instrumentation.

The force penetration relationships were analyzed and the indentation process was observed by means of a 500 power microscope that permitted a clear distinction between the chipping and crushing process. The target penetration depth was measured by means of a profilometer. In soft rock, crater volume is considered to be the pointed end embedded to its maximum. In the harder rocks, the volume and net surface area of the craters were determined by stereotatic measurements (optical) and a program written to compute the penetration depth/volume.

A number of observations and conclusions were made regarding this research. Pertinent were the following:

1. Rock penetration occurs as a result of crushing and chipping (see Figure 3-11) with an initial fracture in the direction of loading. Small angle points (heads) lead to larger chipping zones and smaller crushing zones with minute secondary radial fractures. Large

angle points substantially suppress the chipping regime and increase the size of the other features of penetration (for example crushing).

2. The force required to produce the same penetration in all three rock types increase significantly with point angle, i.e., from 60^o to 120^o.
3. Increased loading at the same location increased penetration but significantly less than the initial penetration caused by the first load.
4. Increase loading at different location produced very marginal increase in penetration for all three point angles and rock strength. The author stated, " A tenfold increase in the input energy for a 60^o conical penetrator acting on a virgin shale or limestone resulted in a 5 to 1 ratio for the peak force, but nearly identical values of the maximum penetration for the two cases.
5. The above results confirmed the existence of an optimal input energy level to achieve a given penetration in a particular rock and point head configuration.
6. Conical point heads produced significantly higher penetration than wedge shaped heads for the same input energy levels for both limestone and shale but less significant in diorite.

Based on the above, the decision was therefore made to use conical point heads for the prototype design of the studs. In addition, a configuration was formulated to limit maximum penetration regardless of applied pressure. That is to say, once the conical points reached their maximum penetration depth, the surface area of the studs increases dramatically, thereby reducing the contact stress. It was found that the stud point pattern that would produce minimal deleterious effect on the shearing process (regardless of the orientation of the points with respect to the direction of shearing) consists of four conically shaped point heads equally spaced on the stud's surface.

With respect to Task 4, "Design and Build the Prototype Rock Shear Device", the instrument that was ultimately designed and constructed was based primarily on the literature review, laboratory tests and the performance of a mock-up laboratory model.

It is important to note that there was a legitimate concern by FDOT that one or more studs might not make contact with the rock face due to the presence of surface fissures in along the corehole. This concern led to the development of an additional piece of equipment referred to as a Corehole Mapping Device (CMD). The rationale is that it will allow pre-evaluation of a corehole's surface condition prior to shear testing.

Constructability issues (in particular, assembly) were addressed in the laboratory by using transparent plastic pipes to create a 1:1 scale model/prototype. This effort helped ensure construction of the actual prototype was not burdened by unanticipated problems.

The Rock Shear Device

The rock shear device system includes a jack for application of the vertical force, strain instrumentation inside the cell/probe, pressure transducers for the cell pressure and the shear element, electrical cables and pressure source/tubing. For the prototype device, data collection was obtained using a laptop computer and data logger.

A number of adjustments were made throughout the design/construction and preliminary testing phase which led to a more refined design.

The main features of the device are shown in Figures 3-13 to 3-25.

The following are the changes and or enhancements made during initial testing:

- the reaction beam and assembly was replaced by a stiff but relatively lightweight tripod assembly capable supporting over 10,000 lbs.
- the pressure supply jack was replaced by a hollow cylinder jack with a remote controlled winch and pulley system necessary for lowering and retracting the probe. It includes an assembly of drill rods connected to the probe and jack via threaded adapters.
- the hydraulic hollow cylinder (controlled by the hydraulic jacks) applies a vertical force to the probe via 1.25 inch diameter AW rods. The AW rods are attached to a load cell nut that measures the corresponding force during probe movement.
- the above items were further altered after preliminary tests showed potential problems. The pressure supplied by the jack is now measured directly from the jack using a pressure transducer. This pressure is converted to force using the area of the jack's inner cylinder.
- the transducer, load cell and LVDT were initially located in the upper cylinder of the probe. However while field testing below the water table, signal drift due to water pressure/temperature led to the relocation of these instruments at the surface to ensure reproducible results. However all electrical leads from these instruments to the data collecting system were spliced and sealed to allow for submerged testing.
- the metal strips (spring steel, aka the Chinese lantern), shown in Figure 3-17, now completely protects the rubber membrane from puncture while still maintain flexibility. This allows for the non-uniform movement of the studs resulting from corehole wall imperfections.
- the steel studs shown in Figure 3-18 were precisely machined with four contact points each with apex angles shaped at 60^o from point to base. The studs were case hardened to protect from wear and surface damage.

- the compressed air supply is controlled by regulators to provide air pressure to the shear studs and to the fixing spikes located within the datum base.
- the data collection system was setup using a laptop computer. The system, NIDAQ 6.3, is compatible with Labview and commonly used spreadsheet software such as Excel and can be operable by field technicians. The data from the pressure transducers and LVDT are displayed in three windows that are converted to stresses and displacement respectively using voltage calibration relationships.

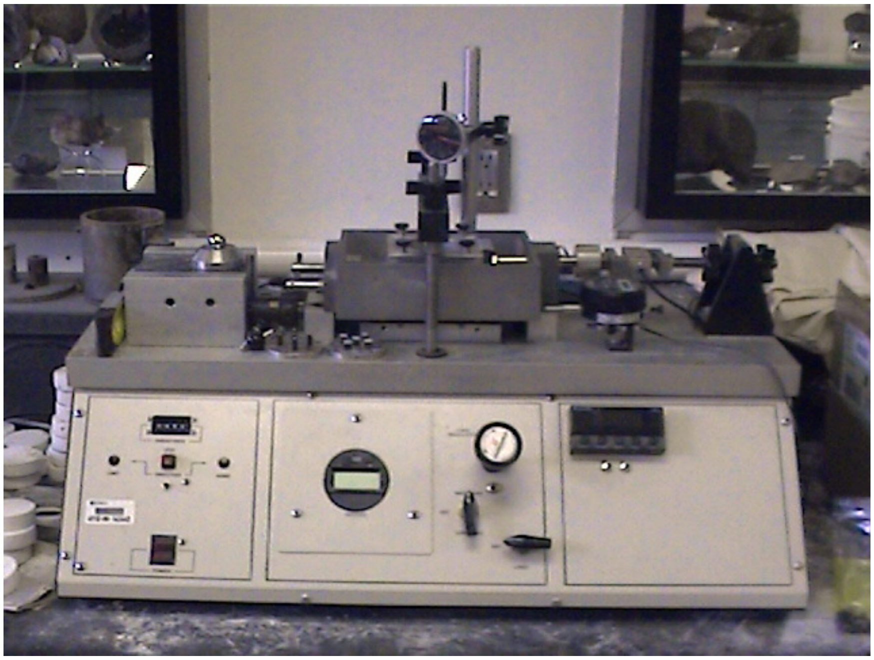

Figure 3-1. Electronic Direct Shear Machine.

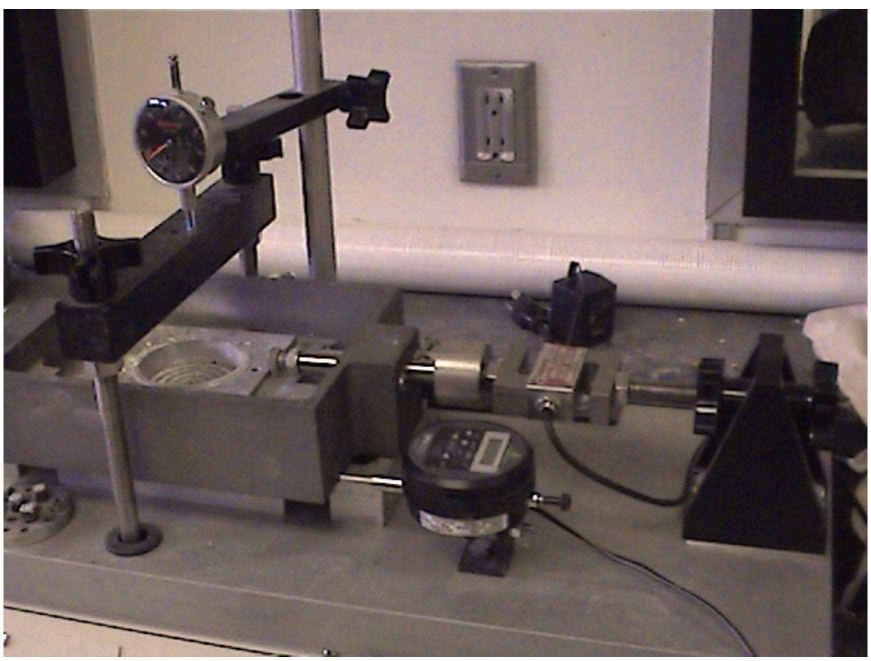

Figure 3-2. Vertical Loading Cross Arm, Horizontal Load Cell and Dial Gauges.

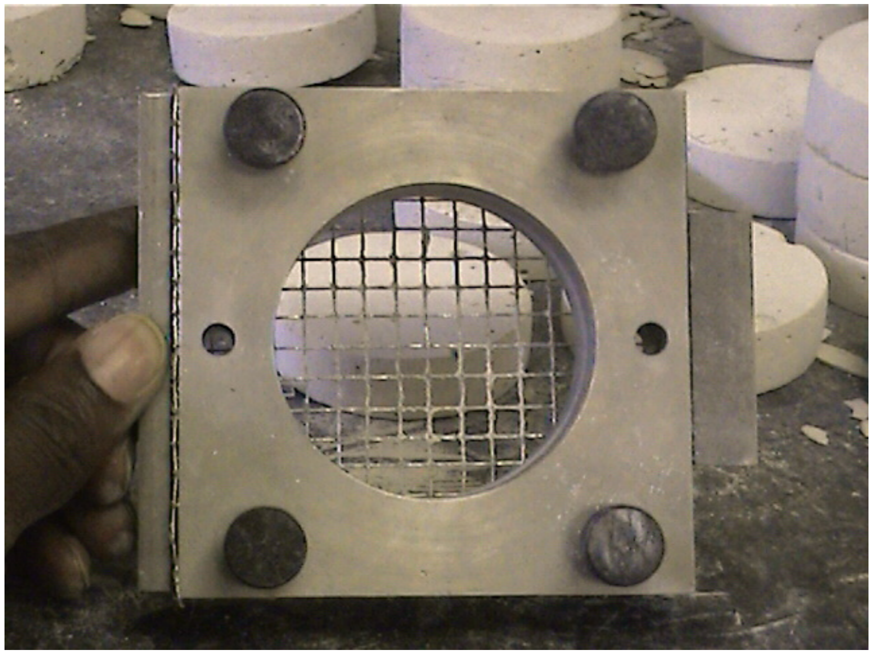

Figure 3-3. Modified Upper Specimen Frame showing Wire Mesh Shear Element.

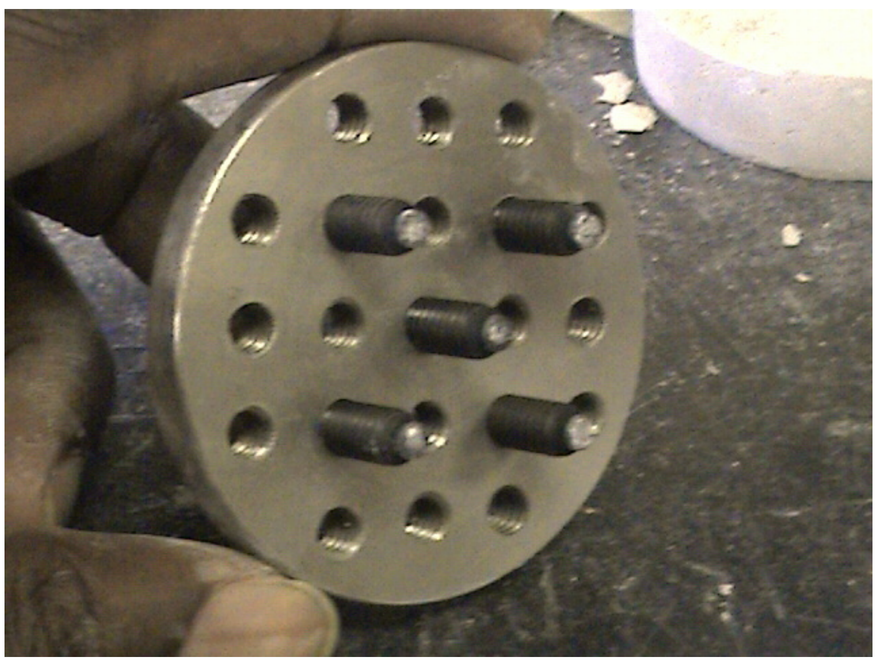

Figure 3-4. Load Assembly showing “5” Flat Head Shear Stud Arrangement.

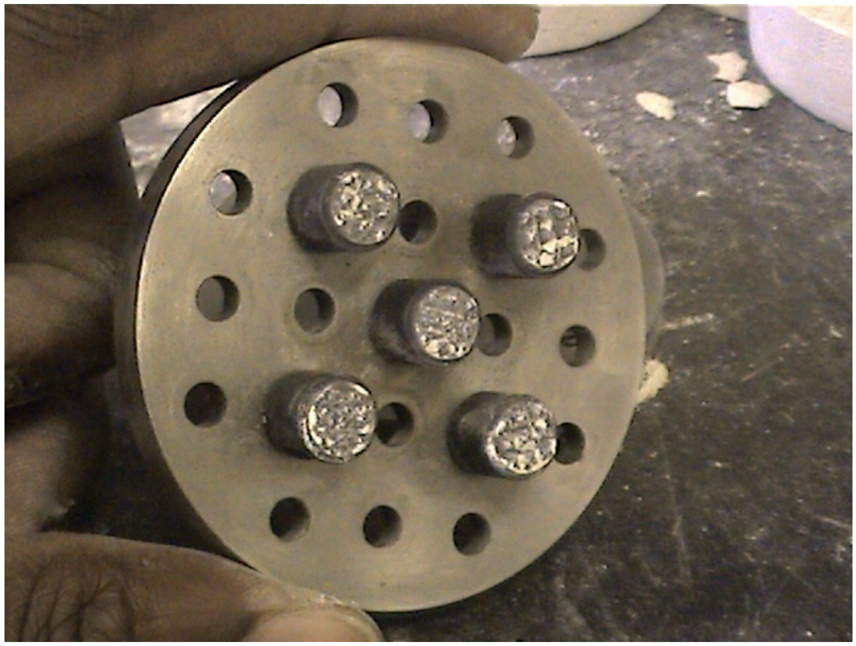

Figure 3-5. Load Assembly showing “5” Multiple Head Shear Stud Arrangement.

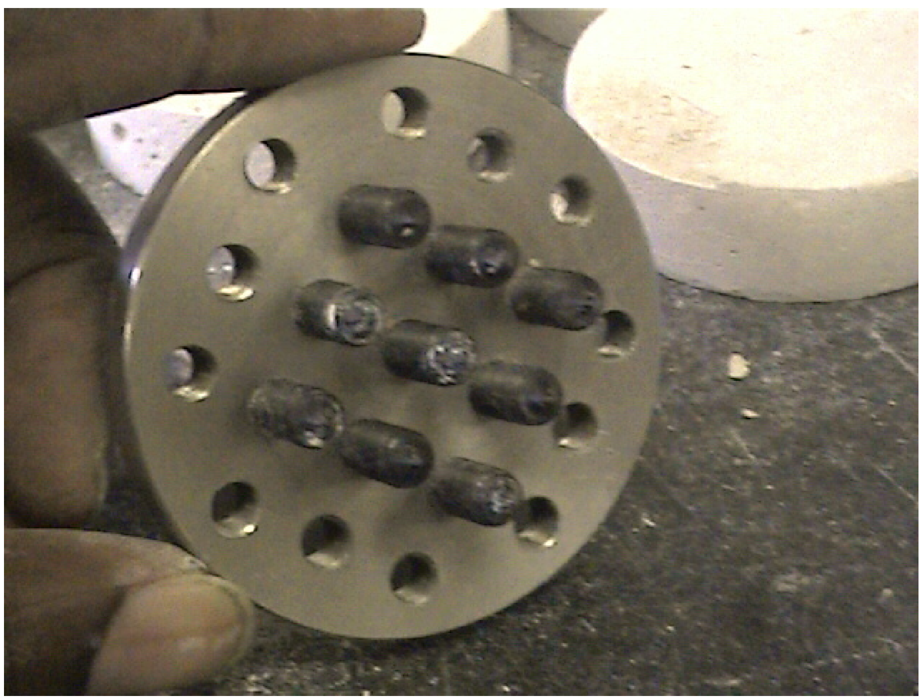

Figure 3-6. Load Assembly showing “9” Point Head Shear Stud Arrangement.

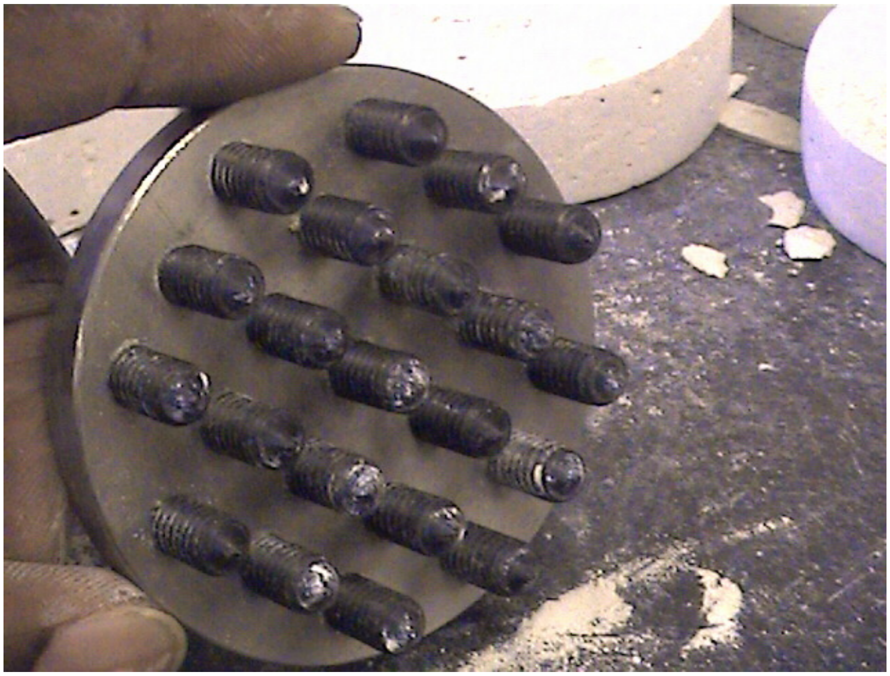

Figure 3-7. Load Assembly showing “21” Point Head Shear Stud Arrangement.

Figure 3-8. Direct Shear Sample Showing Predetermined Shear Plane.

Figure 3-9. Sheared Wire Mesh Gator Rock Sample Showing some Edge Effects

Figure 3-10. Sheared Multiple Head Gator Rock Sample Showing End Effects.

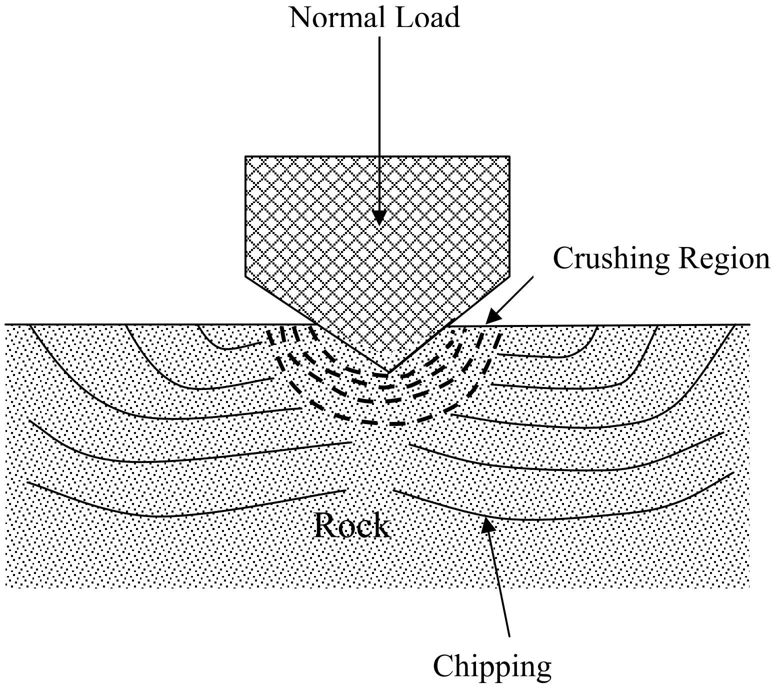

Figure 3-11. Fracture Pattern developing under a Cone or Wedge (Evans and Murrell (1958) and Gnirk, et.al., (1963).

Figure 3-12. Shear Studs from left to right:
Flat Head, Serrated Head, Pointed Head, and Multiple Head.

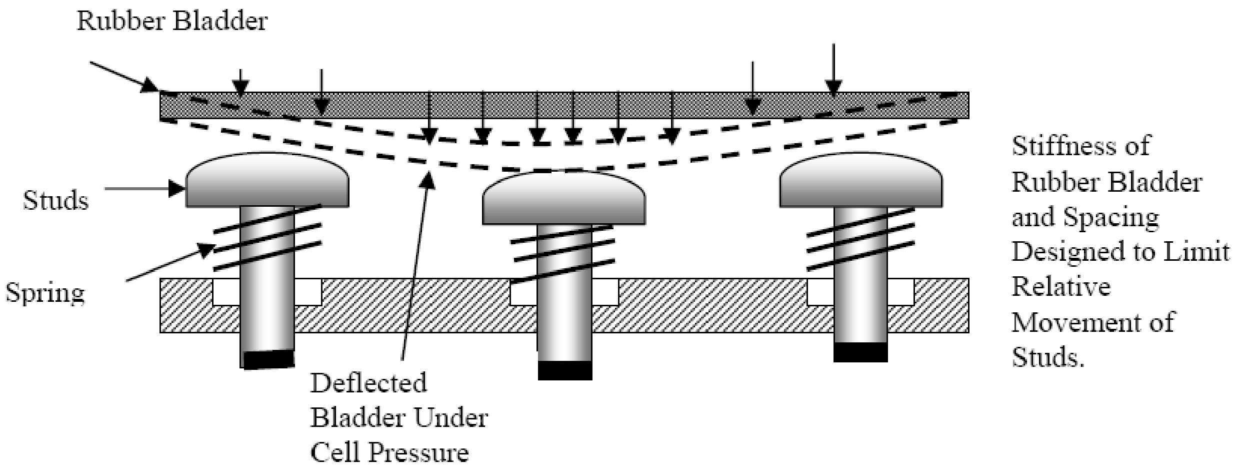

Figure 3-13. Rubber Bladder and Shear Studs.

Figure 3-14. Lightweight Tripod Assembly.

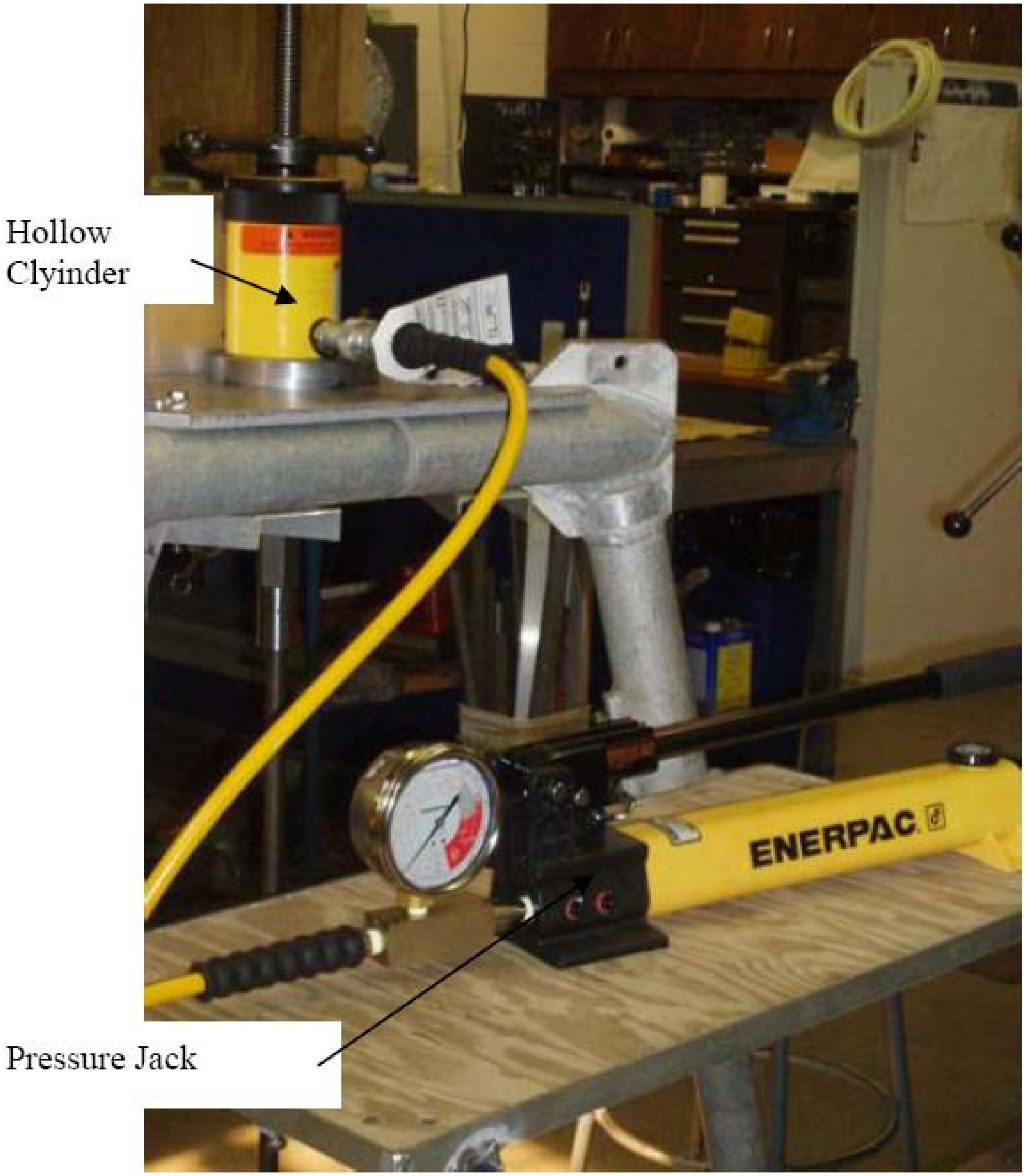

Figure 3-15. Jack and Cylinder Arrangement.

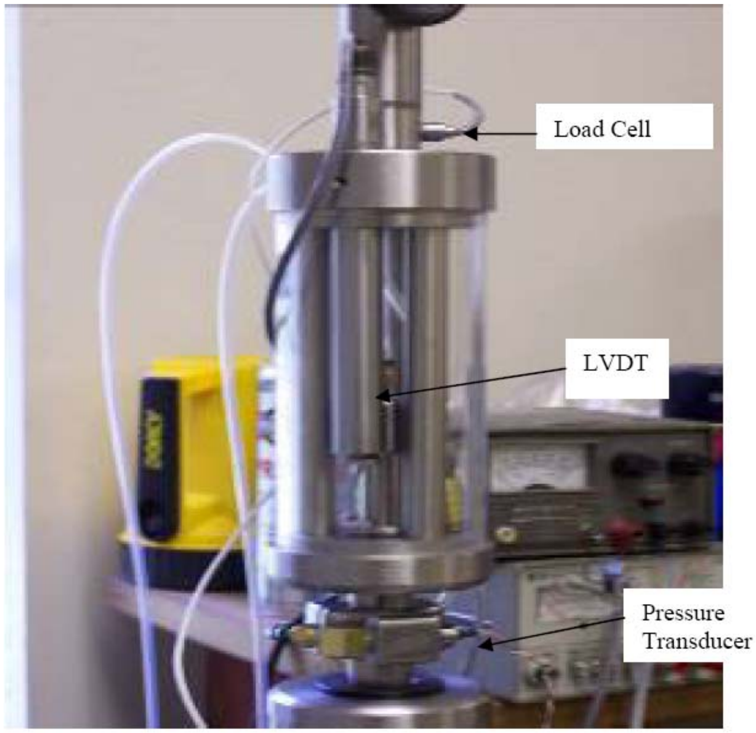

Figure 3-16. Probe Head with Instrumentation.

Figure 3-17. Probe and Inner Rubber Bladder/Chinese Lantern Assembly.

Figure 3-18. Expanded Metal Studs.

Figure 3-19. Compressed Air Supply Regulator.

Figure 3-20. Extended Steel Spikes used for Displacement Measurement.

Figure 3-21. Tripod, Hydraulic Jack and Rod Setup.

Figure 3-22. Probe and the hardware used for Calibration.

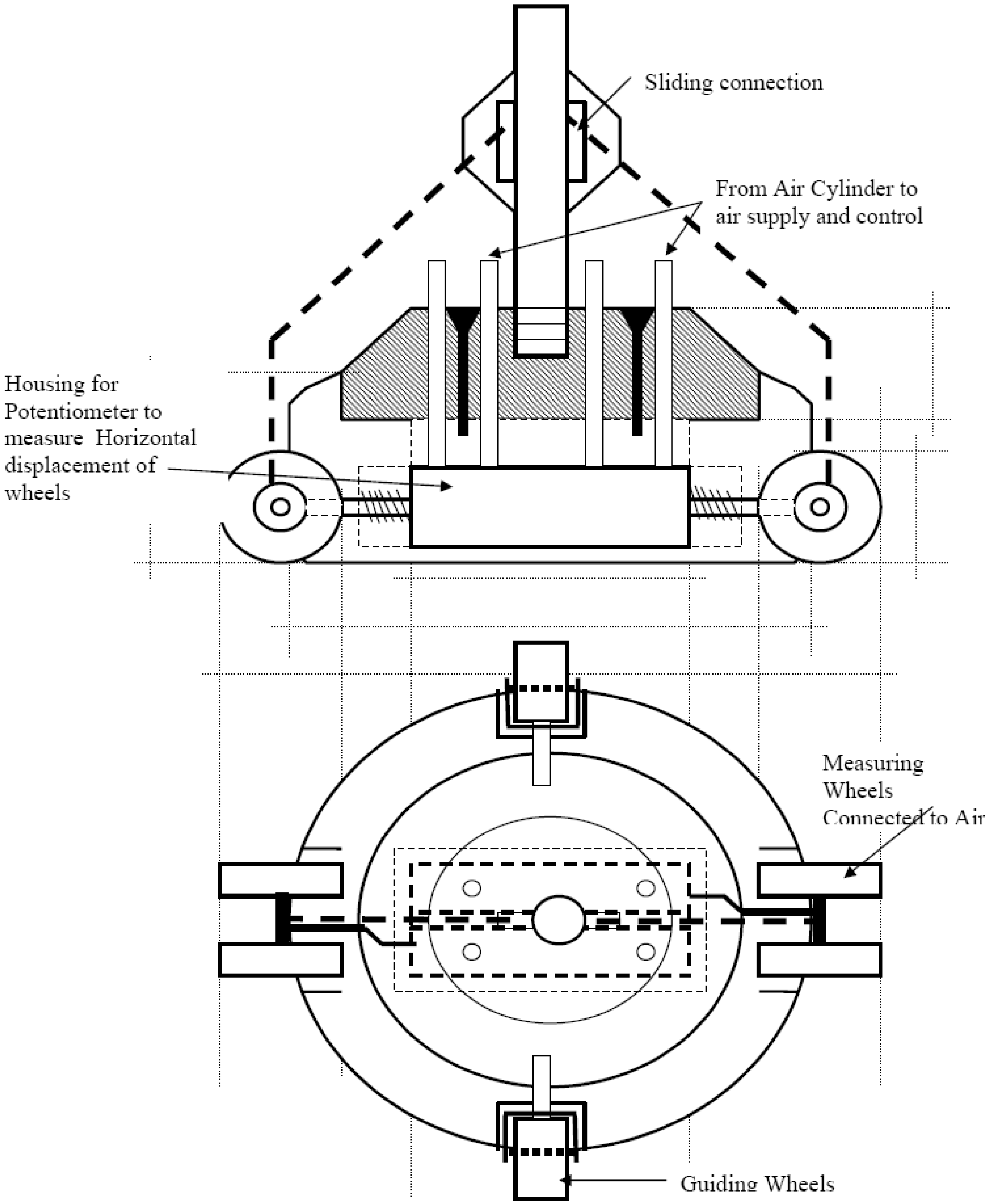

Figure 3-23. Initial Design Schematic of the Corehole Mapping Device (CMD).

Figure 3-24. Corehole Mapping Device (CMD) Showing Measuring and Feeler Wheels.

Figure 3-25. Air Cylinder Controlled Measuring Wheels During Calibration.

CHAPTER 4
TESTING PHASE

In order to verify the operational characteristics of the device, two series of tests were performed. The first involved laboratory testing using Gator Rock (cement/sand mixture (20% cement/20% water by weight of aggregate; crushed limestone passing #10 standard sieve with a Cu of 4) designed specifically to simulate the properties of Florida's soft limestone. The second was to conduct field tests using the equipment in coreholes at bridge locations that also had drilled shaft load test data. A computer model of the stud/rock loading environment to determine the stress distribution was also performed to attempt to help validate the device.

At the conclusion of this phase it was envisaged that sufficient data would be generated to arrive at conclusions regarding;

The efficiency of the equipment in regards to their ease of operation, limitations and possible areas for future development.

The validity of the results, based on the equipment designs and accuracy of the measuring instruments' acceptable margins of errors.

The validity of the results based on theoretical assumptions made versus true testing conditions whether in the field or in the laboratory

Rock Shear Device (RSD)

The scope and the sequence of work were as follows;

Build the device as shown in Figure 4-1

Setup instrumentation and data collection software and electronics

Calibrate sensors including, load cell, pressure transducer and LVDT

Prepare Gator rock samples in a large container by coring appropriate size holes to accommodate the probe

Measure load and displacement at four different normal pressures

Compare the relationship between vertical load and displacement

Compare the relationship between normal stress and vertical (shear) stress

Determine the shear strength of the Gator rock (cohesion and angle of internal friction) and compare it to the theoretical derivation (McVay, ASCE, 1992).

The following section will briefly look at the methods and procedures used to address the objectives. Details of the devices' operations are provided in Appendix D.

Summary of Testing Procedure

The laboratory setup is shown in Figure 4-2. The compressed air supply is connected to the regulator with the valves closed. The supply lines from the regulator are connected to the appropriate lines on the probe (one to the lower datum spikes and one to the central expandable chamber). The data collection system connected to the computer and probe. The cylinder from the hydraulic jack is placed on top of the tripod with the threaded ¾" steel rod suspended through the center hole of the cylinder.

The threaded rod is then connected to the probe adapter rod and the probe lowered into the test hole. On the desktop, the shear-test icon is clicked and opened to initiate the data collecting system. A zero reading is taken (by clicking the start button) prior to the application of pressure and force to ensure that all the measuring instruments are connected and activated (e.g., low waveform and not flat lines in the respective windows indicate active instruments).

The valve to the pressure chamber is now opened and the first normal pressure of about 10 psi is applied to the studs and allowed to seat for 20 seconds. The start button is again clicked and the pressure immediately applied to the jack until the cylinder inner tube extends to about ¾" above its initial position - corresponding to the displacement of the probe. The stop button is clicked and the data collection terminated and saved. The jack valve is released to deflate the inner tube of the cylinder for the next test. The process is repeated for 3 additional pressure levels using 5 psi increments. At the completion of the four tests, the probe is raised to another level in the corehole.

Using the calibration relationships derived earlier for each instrument, the stresses are calculated and plots of shear stress versus normal stresses are computed to determine the strength parameters. This is repeated in all the test holes and the data analyzed and comparisons made.

Corehole Mapping Device (CMD)

The scope and the sequence of work were as follows;

Build the device as shown in Figure 4-3.

Setup instrumentation and data collection software and electronics

Calibrate measuring instruments including, the Hall Sensors and the String Potentiometer.

Prepare gator rock samples by coring appropriate size holes to accommodate the CMD

Measure wheel deflection and height at two orthogonal positions within the hole by rotating the CMD 90 degrees after the first test (a test starts at the bottom of the hole and is completed at the top)

The data display window shows a plot of the wheel defection versus height/depth

Check for abnormally high deflections (voids).

Determine all the locations within the run where deflections are abnormally large and ensure that these locations are avoided during shear testing.

The following section reviews the methods and procedures used to accomplish the above procedures.

Brief Testing Procedures

The laboratory setup is as shown in Figure 4-4. The compressed air supply is connected to the regulator with the valves closed. The supply line from the regulator is connected to the dual action valve that controls the direction of the air springs attached to the measuring wheel. The

String Potentiometer is extended over the small pulley and attached to the CMD via a nut at the base of the extended threaded rod adapter.

The data collection system is connected to the computer and CMD. The cylinder from the hydraulic jack is placed on top of the tripod with the threaded ½" steel rod suspended through the center hole of the cylinder.

On the computer's Desktop, the mapper-test icon is clicked and opened to initiate the data collecting system. The initial plots are noted showing the two vertical axes and the initial ground or datum level.

The valve is then opened and the pressure adjusted to about 10 psi to ensure that the wheels are fully extended outwards i.e., that the dual action valve is in the outward position. The CMD is lowered to the bottom of the testing hole and the start button clicked while raising the device slowly to the top of the corehole. The stop button is clicked and the data collection terminated and saved. The process is repeated by rotating the device 90 degrees and lowering it back to the bottom of the hole. At the completion of the two tests the plots are analyzed for depressions and/or voids for future shear test reference.

FEM Theoretical Model

A two dimensional model of the test was performed as shown schematically in Figure 4-5. The modeling was done using Adina Finite Element Software. Other researchers have investigated this topic and the results are mixed, (Chan, et.al., (1970).

The boundary conditions are also shown in the figure. The rock is assumed to be coulombic, homogenous and isotropic and infinite in relation to the loading surface. To ensure rigidity of the stud the elastic modulus was inputted approximately 10 times the typical modulus of steel. Displacement control loading was modeled to ensure that under the loading environment, no element within the stud was displaced relative to each other, i.e., that actual movement of the stud relative to the rock acts as a rigid body.

Typical normal stresses were applied and a predetermined displacement was programmed into the model for analysis. The resulting shear stresses within the rock material at each normal pressure were plotted and surface to surface contact (contact pairs) compared to the Mohr's failure envelope derived from the laboratory and field test results. To date the models have not converged to a solution, due to the large strain levels produced. It was obvious that more work needs to be done in this area and another program, FLAC 3D was suggested as a potential solution.

Figure 4-1. Rock Shear Device.

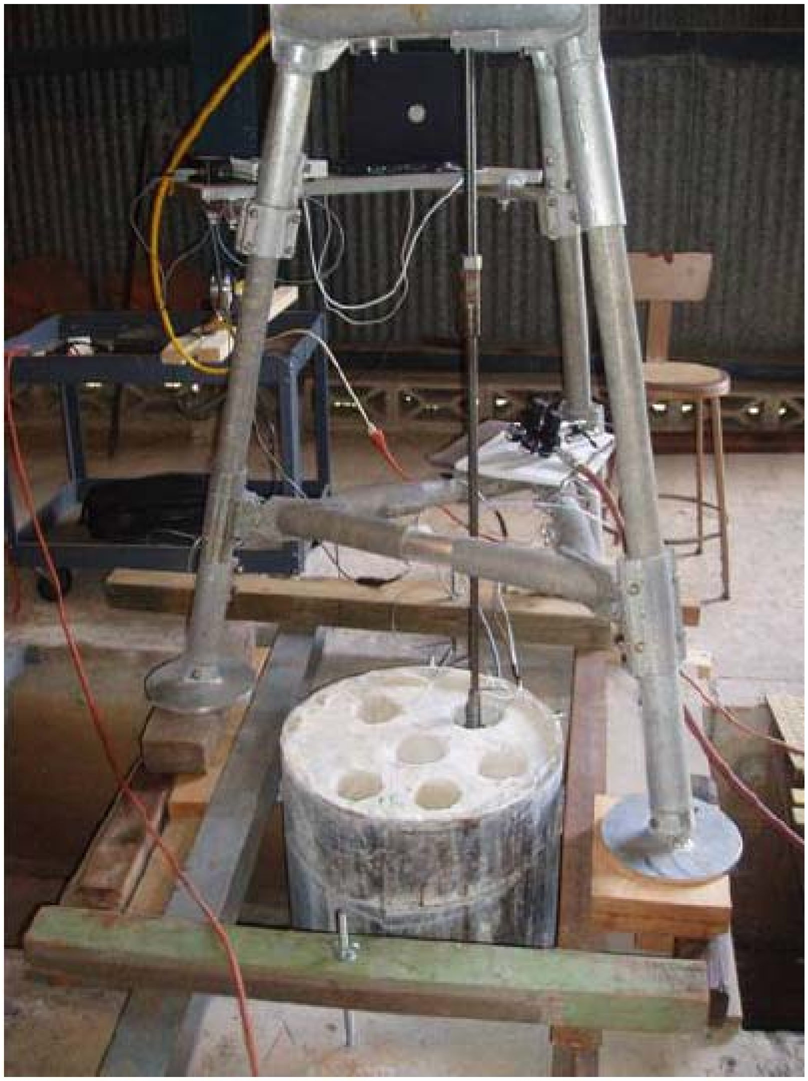

Figure 4-2. Laboratory Test Setup.

Figure 4-3. Corehole Mapping Device.

Figure 4-4. Laboratory CMD Setup.

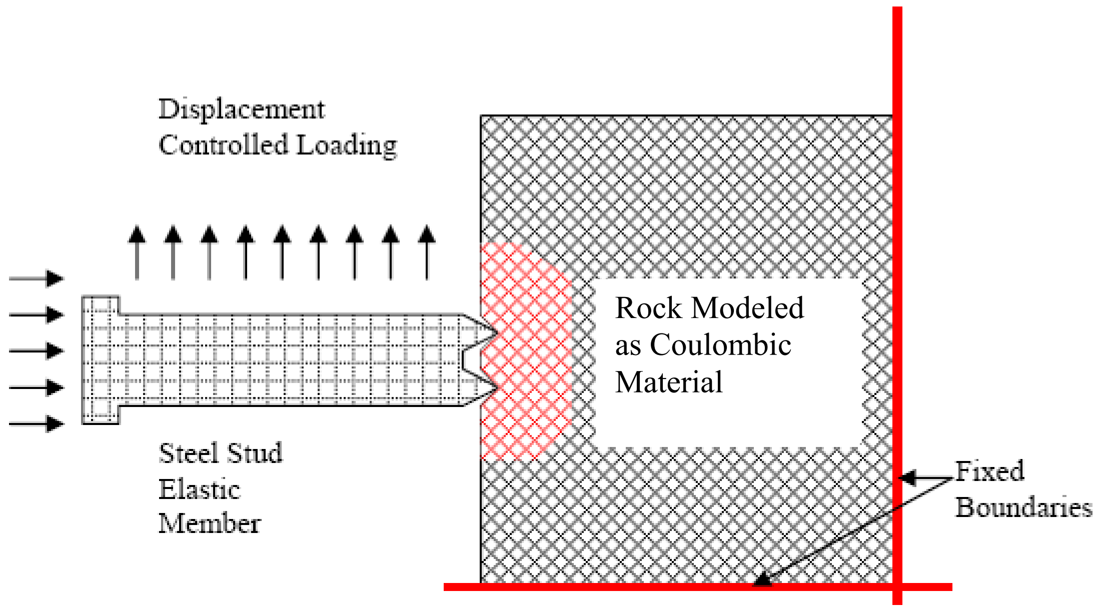

Figure 4-5. Finite Element Model of Shear Test.

CHAPTER 5
LABORATORY AND PSEUDO FIELD TEST RESULTS

DIRECT SHEAR DEVICE TESTING

Preliminary Testing Setup

The tests were performed on Gator rock coupons carefully shaped to fit the 2.5" diameter direct shear sample housing. The samples were soaked and placed in the sample box of the device. The vertical loading arm was secured and lowered in contact with the sample via the upper frame containing the various shear studs. The dial gauge was zeroed and a vertical load applied to the sample. The horizontal dial gauge was adjusted in place using clamps and a horizontal load applied with a preset rate of strain of 0.14 cm/s. The horizontal load was measured using a load cell and digital readings of pressure load and displacement were recorded with each successive increase in the vertical load application.

The results were, for the most part, consistent with direct shear theory as it relates to normal and shear stresses.

The minor inconsistencies observed in several of the results were attributed to the following:

End effects due to stress concentration around the circumference of the sample (see Figure 3-10).

Edge effects due to stress concentration created by the vertically loaded studs at the edge of the samples (see Figure 3-9).

Non-symmetrical application of the normal load via the cross arm of the instrument. This could be observed during some tests with the tilting of the loading head.

Pseudo-Field Rock Shear Device Tests

The preliminary tests were carried out at the Coastal Engineering Laboratory. The setup is as shown in Figure 4-2. During the testing, several problems were identified and addressed;

1. The steel drum containing the gator rock was being lifted up with the application of the vertical load during testing
2. Deflections at the support of the tripod were affecting the measurement of vertical load and displacement
3. Leaks were detected at the connections of several pressure lines (horizontal pressure)
4. At the initial stage of testing, the dial gauge used to detect slippage of the probe from its base position was not yet installed. A number of readings indicated that the LVDT was not engaged while testing, i.e. slipping was occurring.
5. The spring steel used to construct the Chinese lantern was deforming after a number of use. This affects the sliding mechanism designed to prevent problems with the spring action of the studs. The problem was confirmed when a number of the shear stud heads were observed in direct contact with the expanding rubber membrane.
6. The spring steels strips were initially welded in place at both ends. Thus, any damage to the rubber chamber by the shear studs could not be repaired in the field. Repair would involve cutting and discarding of the spring steels and re-welding the attachments - leading to delays and associated costs.
7. Reduction of the data collected indicated that there was sensor drift in zero reading (compared to that at calibration) in a number of the test results.

The following measures were subsequently taken to solve the above problems:

Item (1): I beams were placed above welded plate extensions on the drums and bolted down to the concrete floor.

Item (2): the legs of the tripod that are supported across the side wall were reinforced and placed in contact with the spanning I beams to eliminate the observed deflections.

Item (3): all pneumatic tubing were redone and checked for leaks.

Item (4): the contact spike pressure and fixity of the spikes was improved. A potentiometer was added to measure and record any displacement.

Items (5 & 6): the entire pressure chamber with a protective spring steel "Chinese lantern" was redesigned and rebuilt. The width and thickness of the individual steel sheet has been increased to improve resistance to yield and to allow for more overlapping of each steel sheet during expansion thus preventing direct contact between the studs and the expanding rubber. The ends of each spring steel sheet is now connected to the sliding mechanism by screws (instead of welding) to allow for field repairs to be made.

With the above listed adjustments made, a number of tests were again carried out and the results analyzed. A linear relationship was found to exist between the applied normal stress and the shear stress. This relationship can be used to derive the strength parameters (apparent cohesion and angle of internal friction) of the rock. The indications are that this particular Gator Rock mix has a cohesion value ranging from 240 psi to 300 psi, and angle of internal friction ranging from 32 degrees to 34 degrees. The operation of the equipment is discussed in more detail in Appendix D.

Corehole Mapping Device (CMD) Testing

The device was tested in two phases. The first involved testing in the coreholes created in the Gator rock for the rock shear device and the other in a Plexiglas transparent tube lined with man-made undulations (Figure 5-4).

The pneumatic fittings were secured to the device and compressed air set to an initial pressure of 8 psi. The direction control level is adjusted to ensure that the wheels are in the "out" position so that as they travel along the walls of the corehole, the air pressure acts as a spring. The String Potentiometer was connected near the top of the device via a small pulley and the data collection system initialized. The test was performed by clicking the start button on the acquisition screen and raising the CMD to the top of the hole with care to ensure alignment was maintained vertically.

The results indicated that for the majority of the tests, the contour lines of the plots mimicked the surface contour of the test holes. However, there were sections on the plots that varied slightly from the actual wall surface geometry. The reason was that the probe could tilt, thereby creating spurious data. The alignment problem was addressed by adding another set of feeler wheels at the top of the probe to reduce the tilting problem.

Results

Laboratory Testing Results

The results of the laboratory tests were divided into three different sections:

1. Direct shear tests of the Gator rock coupons for the development and design of the shear studs,
2. Prototype equipment tests at the Coastal lab (the Pseudo-field tests).
3. Mapping device tests in both the gator rock and Plexiglas contoured container.

Item 1 Direct shear tests

The results are shown in Appendix B and summarized in Table 5-1. As expected, an increase in the normal stress resulted in an increase in the shear stress at failure in all cases. There were however limitations regarding the applied normal stresses associated with the loading environment. That is to say, the problem with end and edge effects dominated at the higher vertical loading ranges. The adverse effects were due to problems associated with the proximity of the loaded area to the boundary of the sample and container. In addition, end effects were primarily caused by stress concentration created during loading between the sample and the rigid wall, edge effects on the other hand is caused by the proximity of the load (stud) to the sample edge. Both effects have led to apparent failures and deflections that appeared to have compromised the results. The application of the normal load could not be maintained at a horizontal position throughout some of the tests, resulting in an unsymmetrical load application and to uneven distribution of the load on the respective shear heads. This resulted in an erroneous assumption of the stress distribution during data reduction.

The measurements of vertical displacements which could have been used to estimate stud penetration and hence contact areas for stress calculations appeared inconsistent with expectations especially at the higher load applications where edge and end effects were significant and the loading arm tilting. The penetration results are also shown in tables; the values ranged from 0.1mm to 0.5mm depending on the stud type used and the number of stud arrangement.

From the plots of the Shear Stress versus Normal Stress, the apparent cohesion (shear strength) of the gator rock ranged from 150 psi to 230 psi with a mean of about 200 psi. The angle of internal friction was deduced to range from 17 degrees to 34 degrees with a mean of 27.9 degrees. Though no obvious trends were seen in these results, the arrangements that involved 9 studs or more (studs close to edge of sample) appeared to have resulted in more deviation from the trend lines or contained discarded data points (boundary effects).

Item 2. Tests using prototype Rock Shear Device in cored Gator Rock

The tests were carried out as discussed earlier and a representative plot of the results are shown in Figure B-4 of Appendix B. The figure includes plots of deduced shear stresses versus normal stresses. The variation of load pressure and displacement versus time are consistent with expectations; i.e., where the load and displacement peaks at a point (then decrease or remain constant) and the pressure held relatively constant throughout the test.

The shear stress versus normal stress plots represent the shear envelope of the sample and are used to determine the apparent cohesion (shear strength) and the angle of internal friction. The deduced average penetration at the operating pressures were used to calculate contact areas from the normal loads and the shear forces. This average penetration value was obtained from the load versus penetration relationship developed by modeling the results of the direct shear device, the gator rock and the studs used in the prototype.

The cohesion values ranged from 185 psi to 300 psi and the angle of internal friction ranged from 22 degrees to 36 degrees. These values as expected are comparable to those obtained using the direct shear machine with the gator rock.

The data points showed very good cluster about the trend line. This is reflected in R^2 values in excess of 95%. The variations seen in the deduction of the coulombic parameters are significant enough to warrant a discussion; notwithstanding the fact that the rock samples are hardly likely to have the same properties throughout (due to inconsistencies in the mix and its compaction), the differences could be attributed to the unaccounted variations in the penetration depths of the studs during testing.

The determination of the penetration depth and hence the contact area calculations is essential to the accuracy of the data reduction. The relationship between the applied force and penetration depth was investigated/modeled in the laboratory using available rock samples with known unconfined compressive strengths and the results are discussed in Chapter 6 below.

Item 3 Laboratory tests results using the corehole mapping device

The measuring wheels are limited to ¾” total displacement on either side of the device and the wheels will not detect fractures or voids less than ½” in width. This level of detection is adequate for the purposes of identifying voids/fractures that could affect the use of the shear test device at a particular depth.

The alternative use of the device is to identify or map voids within a rock formation through the use of coreholes around an existing or proposed drilled shaft location. The logs of the coring would provide general areas where cavities or voids may exist in the rock formation (based on recoveries versus core run) but would not necessarily identify an area that is significantly fractured. Theoretically, the CMD would identify within the low recovery areas (known from the logs) the actual height and distribution of the voids in an area. However, the depth and continuity of the void cannot be established beyond ¾”. The correlation of the mapping information obtained at all the cored locations could lead to some presumptive extrapolation of the data. This information could prove useful in determining the frequency and distribution of cavities/voids for estimation of an applicable factor of safety.

The anticipated problem in the field is the possible effect of the ground water and suspended fines on the sliding mechanisms of the testing wheels. During the tests, the sliding motion of the wheels is dependent on the air spring pressure and a smooth travel rod (stainless steel). If the rod is smeared by fines between the rods and the bearings (as is expected in the field), the accuracy of the recorded defections could be affected.

Conclusions

Laboratory

The laboratory Direct Shear equipment can be used successfully to demonstrate the relationship between normal and shear stress to the cohesion or shear strength of Florida Limestone.

The accuracy of the deduced direct shear strength is dependent on the proximity of the applied normal stress to the edge of the sample due to problem of stress concentration that lead to undesirable edge damage (edge effects).

The contact surface of the metallic stud needs a relatively sharp edge to cause damage to the surface of the rock for shearing (predominantly) to occur during testing.

The depth of penetration with normal load application is controlled in part by the apex angle of the teeth of the stud which also minimize the problem of slipping (the use of a 60^{o} apex angle requires only about 25% of the shear strength of the rock for normal loading to prevent slipping – Patton 1966).

The coefficient of friction between Florida Limestone and steel was not known and a value of 0.4 was used based on general information available on the relationship between various material and steel. This value is expected to vary with the mechanical property of the rock and its surface condition under field testing environment.

The preliminary design of the rock shear device particularly the measuring instrumentation was suitable under laboratory environment but was not so under field conditions due to problems with the water pressure and temperature changes at depth, leading to drifting and general mechanical ware.

The determination of the point of shear failure in the laboratory is significantly more defined in the laboratory than in the field due primarily to the condition of the shear surface of the rock; the equipment used to core the gator rock in the laboratory produced a relatively smoother surface than that used in the field.

With respect to the CMD, the use of the Hall Effect theory that indicated the production of a sinusoidal wave form when a Hall sensor is passed across a magnetic field was chosen because of its simplicity and size and the fact that it would be functional under water. The calibration curves show the distance from the magnetic source that the sensor would operate within the "linear" portion of the wave form. The 3rd order fit was used with the best R^2 results, however for our purpose and the level of accuracy required, the 1st order fit was found adequate.

The movement of the measuring wheels is controlled by air springs (reversible) that use a sliding mechanism to facilitate displacement measurements. Under the controlled environment of the laboratory, this mechanism is quite adequate and produces fairly accurate mapping of the test surface as long as the central axis of the cylinder remains near vertical. For the laboratory testing this is one of the limiting factors controlling the accuracy of the results.

The measuring wheels are controlled by two air springs that allow sliding along a horizontal rod through self lubricating cylindrical bearings. The wheels extend with the opening of the air valves to the air springs. One of the wheels is known to extend at a higher pressure (2 psi) than the other due to faults with the alignment of the sliding mechanism that produce more friction on one than the other. This affects the accuracy of the displacement measurement since the displacement of either wheel is not symmetrical under the extension or compression of the spring.

Table 5-1. Summary of Results using Laboratory Direct Shear Machine

Stud Type	Stud Arrangement	Estimated Cohesion (psi)	Estimated Phi (deg)
Mesh	-	195.00	27.40
	-	195.00	32.60
	-	190.00	29.90
	-	200.00	33.50
Pointed Head	21	200.00	34.00
	21	200.00	34.90
	9	200.00	24.70
	5	175.00	21.80
Multiple Head	21	175.00	20.50
	21	190.00	17.70
	5	230.00	34.90
	5	250.00	27.70
Seregated Head	9	195.00	26.60
	9	210.00	24.20
	9	200.00	33.00
	11	200.00	28.80
	5	160.00	16.70
Flat Head	5	175.00	24.20

Figure 5-2. Wider Spring Steel Sheeting with Screwed End Connections.

Figure 5-3. Mapping Device Setup for Gator Rock Test Hole.

Figure 5-4. Showing CMD Test Setup in Transparent Tube.

CHAPTER 6
FIELD TESTS, OBSERVATIONS, CONCLUSIONS AND RECOMMENDATIONS

Fuller Warren and 17th Street Bridge Sites

Tests were conducted at three field sites. The first, Fuller Warren is an existing bridge spanning across Park Avenue in Jacksonville. The second, 17th Street Bridge, is in Miami while the third location is located at the FDOT Kanapaha lot in Gainesville.

Fuller Warren Tests

A number of load tests were done prior to construction. However a load test location was chosen that indicated that the rock formation was approximately 12 m below ground. The site plan is shown schematically in Figure 6-1.

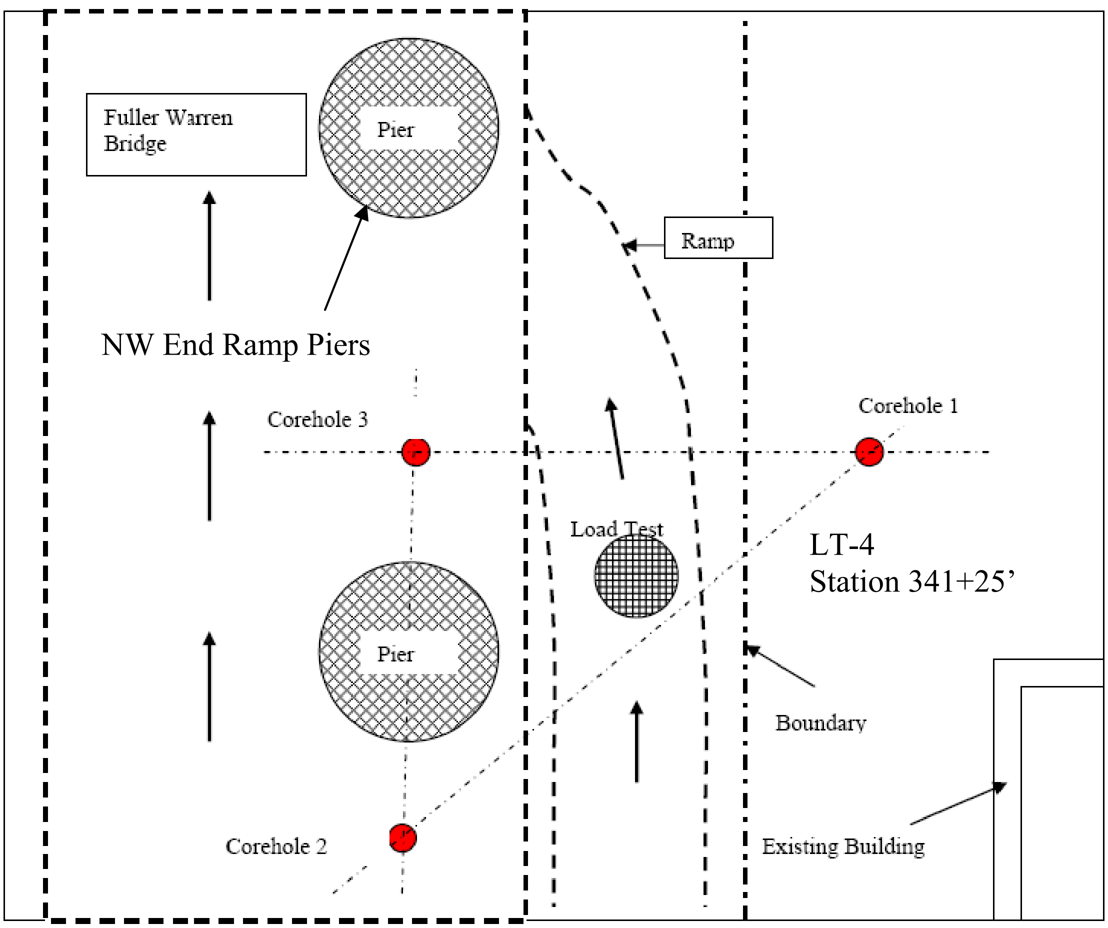

Figure 6-1. Corehole Layout with Respect to Bridge Pier and Load Test Location.

Figure 6-2. Piers at the Fuller Warren Bridge Site.

Figure 6-3. Coring at the Fuller Warren Bridge Site.

Figure 6-4. Core samples retrieved - note the clay intrusions.

Three coreholes were positioned around the pier in close proximity to the test shaft in order to assess the variability of the rock strength and quality around the pier. Each corehole was drilled to a depth of 24 m by Universal Drillers, Jacksonville. Between the depth range of 12 m and 18 m, recoveries varied between 58 and 92% but were about 76% with infrequent areas of discontinuities/cavities filled with clays/silts (Figure 6-4).

The materials encountered were similar in all three locations; the upper 12 m was predominantly clayey sands with the water table approximately 6.2 m below existing ground level. The rock formation was encountered at 12.1 m and although recovery was adequate (approximately 75%), there were intermittent thin layers where the recovery was primarily sandy clays. The upper 12.1 m was therefore cased to prevent corehole wall failure.

The samples were taken to the FDOT laboratory for testing and the results used to predict, theoretically, the insitu shear strength of the rock for future comparison with the rock shear device. Details of the testing procedures can be seen in Appendix D. The preliminary attempts at testing were not successful for a number of reasons; the corehole had to be widen, the wires extending from the load cell, the pressure transducer and the air conduits became tangled and damaged, several of the electronic connectors broke at the soldered ends and the winch support failed resulting in difficulties in lifting the rods out of the hole (15 m). The sensor drift in the instrumentation (load cell and pressure transducer) were significant (possibly due to low water temperature and high pressure at depths) resulting in unstable and unreadable signals. The corrections required re-wiring of the instrument and a change of instrumentation; the load cell and pressure transducer were removed from the instrument and transducers were taken out of the problem environment (the test hole), and placed on the jack and air regulator respectively.

With regards to the drifting and changes in the excitation voltage, the method of measurement has now been adjusted to a ratiometric reading in which the ratio of the output voltage and the excitation voltage is used with the full scale voltage reading to offset the problem. This adjustment was made within the software and the real time data and graph reflects this output. The new setup however has not yet been modified to prevent the amplification of noise in the output; this will have to be done in the future using filters. Other mechanical problems had to be corrected including the use of stiffer springs that are able to retract the studs upon release of the chamber pressure since the fines suspended in the water can clog the shaft of the studs and affect their sliding (retracting) mechanism under the influence of the springs.

Testing

The CMD was first lowered to a depth of 17 m and the operating pressure applied (accounting for the hydrostatic pressure at that depth; this pressure is adjusted as the device is lifted). The mapping is examined in real time and the full deflection of the wheels noted. The test was performed at 0.75 m intervals i.e., two sets with each 1.5 m length of rod which is removed as it emerged from the hole and reached the top of the Tripod. The remote control of the winch was used to advance the CMD to the top of the hole with a smooth rate of ascent. For the purpose of this series of tests, the instrument was severely clogged during testing and the results deemed unusable. With all the rods removed, and the cable still connected to the end adapter, the CMD was unscrewed, removed and the end adapter screwed onto the top of the rock shear testing device. The device was then lowered to a depth of 17 m and the shear tests started. The test was done at each depth location at least 4 times with different normal pressures and the results saved. The device was then lifted to another test depth and the procedure repeated (see Appendix D for detail testing procedures). The real time plots of pressure with time load with time and displacement with time are examined during the tests. Each test was performed using the manual loading jack to displace the shear device by a maximum of ¾" before the test was stopped. Situations that prevented this displacement usually involved the extension of the studs into voids or clay filled voids; this was corrected by lifting the entire device above the problem area.

Discussion of Test Results - Fuller Warren Bridge

Two methods were used to interpret and analyze the results. Because the initial method (i.e., peak stress method) was inconsistent and required the analyzer to often make dubious decisions as to where the peaks occurred, its methodology and results were abandoned and are shown in Appendix A. The primary reason why it was not investigated further was due to two issues. The first was a lack of credible data at the lower strain levels (see figure 6-5 below) and the tests were carried out to very large displacements (0.7"). The original thought was that eventually the plots would peak, enabling one to pick off the appropriate strength value. This did occur, but not consistently. Further, based on FDOT's SMO lab test data, strains at failure were closer to 0.9% or 0.05 - 0.2 inches. Thus, a new method of analyzing the current data was formulated, primarily by Dr. David Horhota, P.E. and Jose Hernando at the State Materials Office. Basically, it concentrated on the initial portions of the plots, i.e., at the appropriate strain levels.

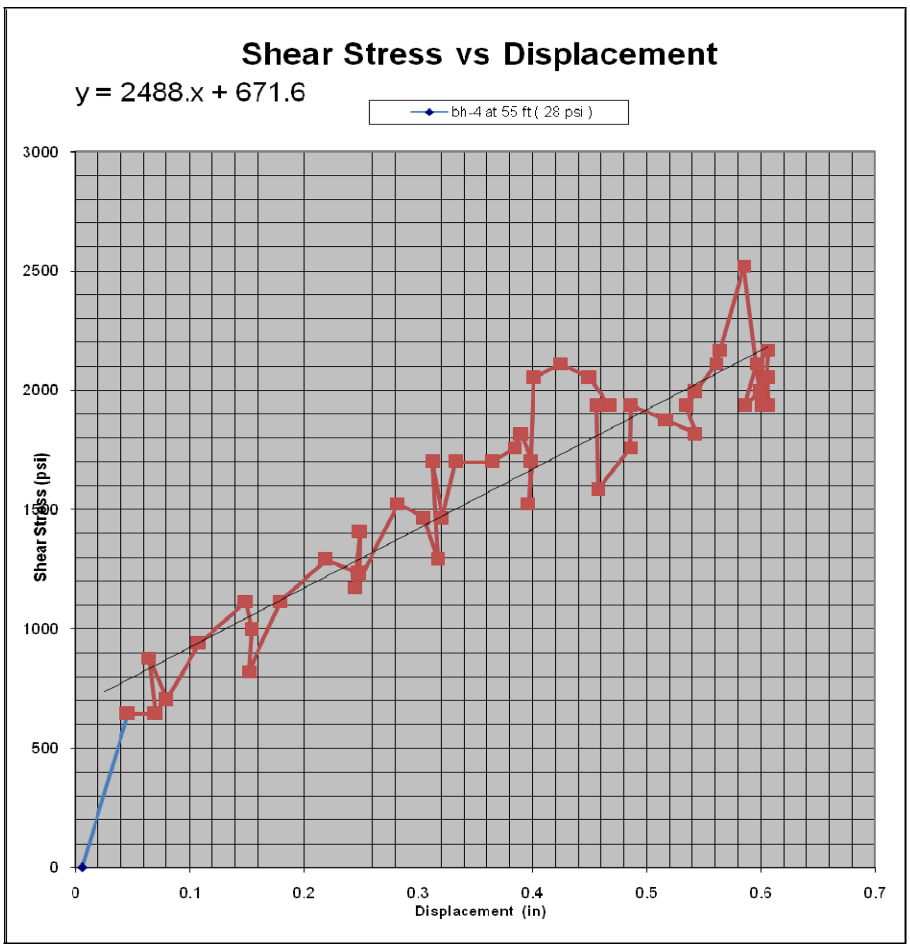

Figure 6-5. Lack of RSD data at low strains (blue line)

The basic premise for this proposed method is as follows.

Individual test results (for the different applied normal pressures) were selected by extrapolating the second slope (the slope derived from the trend line for the red data points in the above plot) back to the Y-intercept. These values were then used as the shear strengths for that particular confining pressure. Once the individual shear strengths were determined for typically 4 confining pressures (e.g., 25, 30, 35, 40 psi) a factor was applied to account for the negative values present at the initial segment (low strains) of the tests. The correction factor fell between 1.17 to 1.19 - a very narrow range. This thus appears to be an artifact of the data collection method and not the test itself, i.e., the initial data were not properly zeroed prior to running each confining pressure test. By applying this correction factor or offset, it allows one to more accurately plot the shear stresses at their corresponding confining pressures. These data are then trended towards the Y-axis and the intercept is the cohesive strength of the rock (i.e, the strength of the rock with no confining pressure). Once this procedure is completed it can be then compared to McVay's F_{su} values. Examples for several tests at the Fuller Warren Bridge site are shown on the following pages.

Unfactored	
26	641
33	925
42	1389
47	1598

From Lab Data:	
Ultimate skin resistance (Fsu)	95
REC (%)	90
Design Fsu	85.5

Note: all strength values are psi

Factored	
26	1321
33	1605
42	2069
47	2278

From Graph:	
Unfactored Y-Intersect	581
Bias	680
Correction Factor	1.17
Factored Y-Intersect	99

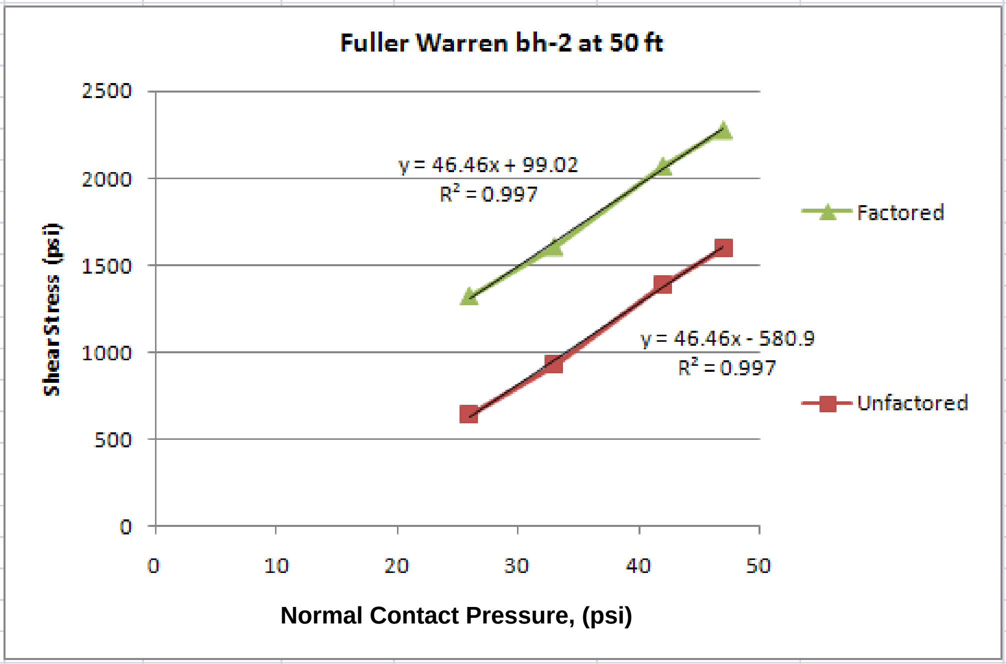

Figure 6-6. RSD Y-Intercept results (85.5 psi) versus McVay's F_{su} prediction (99 psi).

Unfactored	
26	1298
33	2029
42	2900
47	3182

From Lab Data:	
Ultimate skin resistance (Fsu)	200
REC (%)	94
Design Fsu	188

Note: all strength values are psi

Factored	
26	2523
33	3254
42	4125
47	4407

From Graph:	
Uncorrected Y-Intersect	1026
Bias	1225
Correction Factor	1.19
Factored Y-Intersect	198

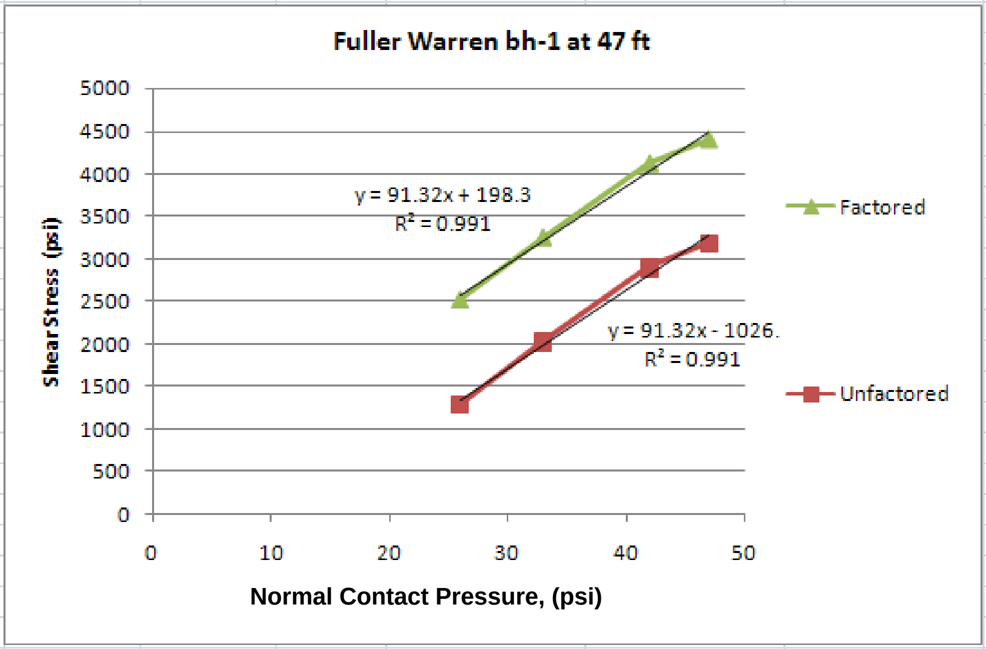

Figure 6-7. RSD Y-Intercept results (198 psi) versus McVay's F_{su} prediction (188 psi).

Unfactored	
26	1832
33	2624
42	3740
47	4533

From Lab Data:	
Ultimate skin resistance (Fsu)	270
REC (%)	94
Design Fsu	253.8

Note: all strength values are psi

Factored	
26	3632
33	4424
42	5540
47	6333

From Graph:	
Unfactored Y-Intersect	1532
Bias	1800
Correction Factor	1.17
Factored Y-Intersect	268

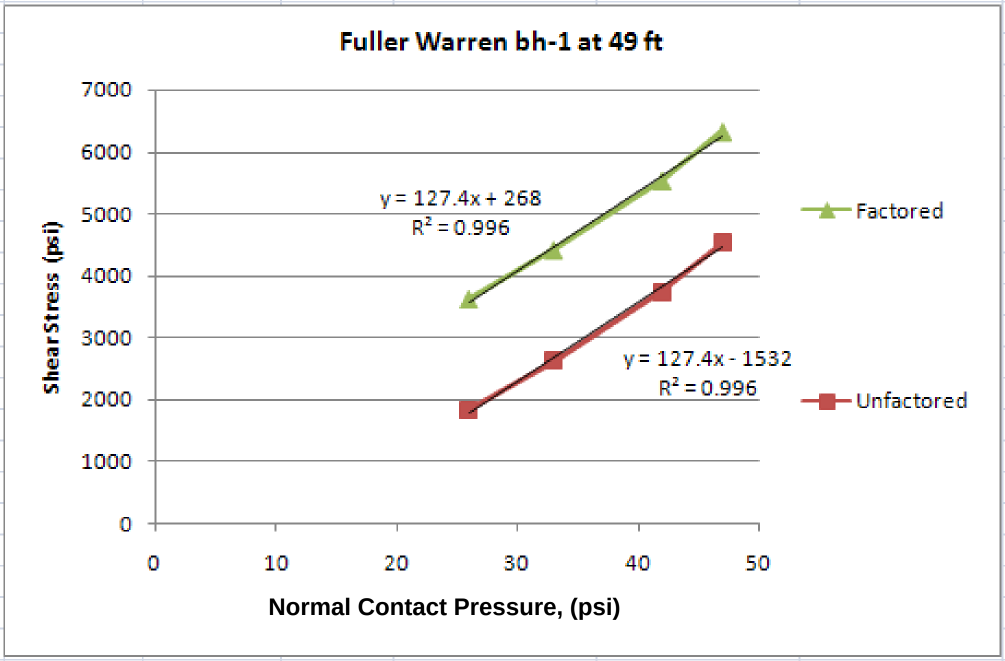

Figure 6-8. RSD Y-Intercept results (268 psi) versus McVay's F_{su} prediction (253.8 psi).

Unfactored	
26	311
33	424
42	611
47	710

From Lab Data:	
Ultimate skin resistance (Fsu)	35
REC (%)	70
Design Fsu	24.5

Note: all strength values are psi

Factored	
26	541
33	654
42	841
47	940

From Graph:	
Unfactored Y-Intersect	197
Bias	230
Correction Factor	1.17
Factored Y-Intersect	33

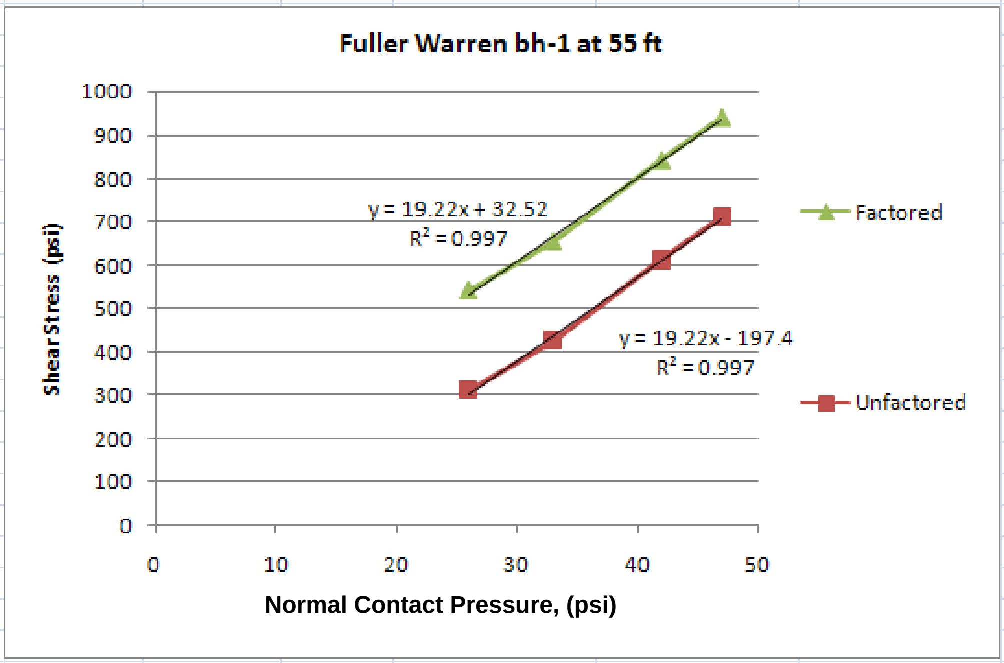

Figure 6-9. RSD Y-Intercept results (24.5 psi) versus McVay's F_{su} prediction (33 psi).

As can be seen, the comparison between the two methods (lab and field) show excellent correlation and based on these limited data, future tests will continue to refine this approach.

17th Street Bridge

Testing was also performed in Miami at the 17th Street Bridge. The location map is shown below.

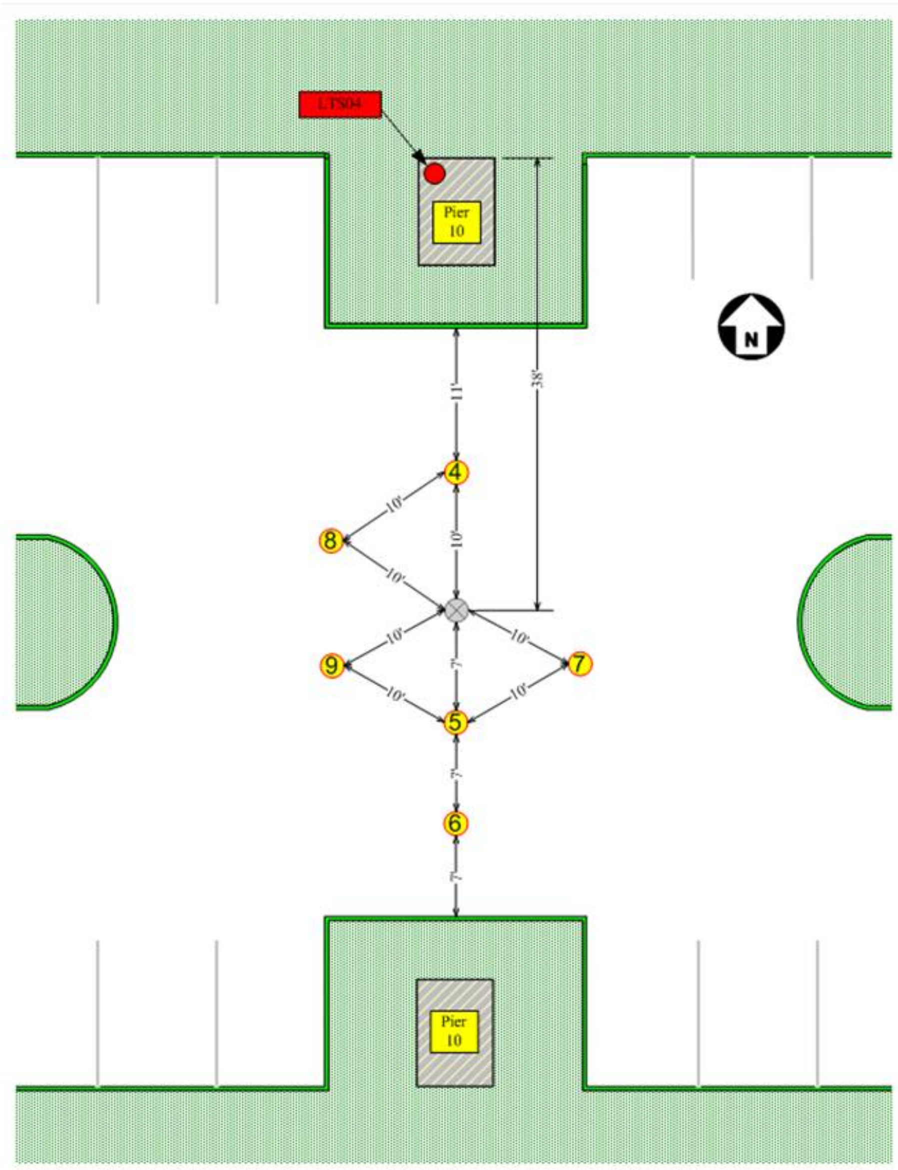

Figure 6-10. 17th Street Bridge test locations.

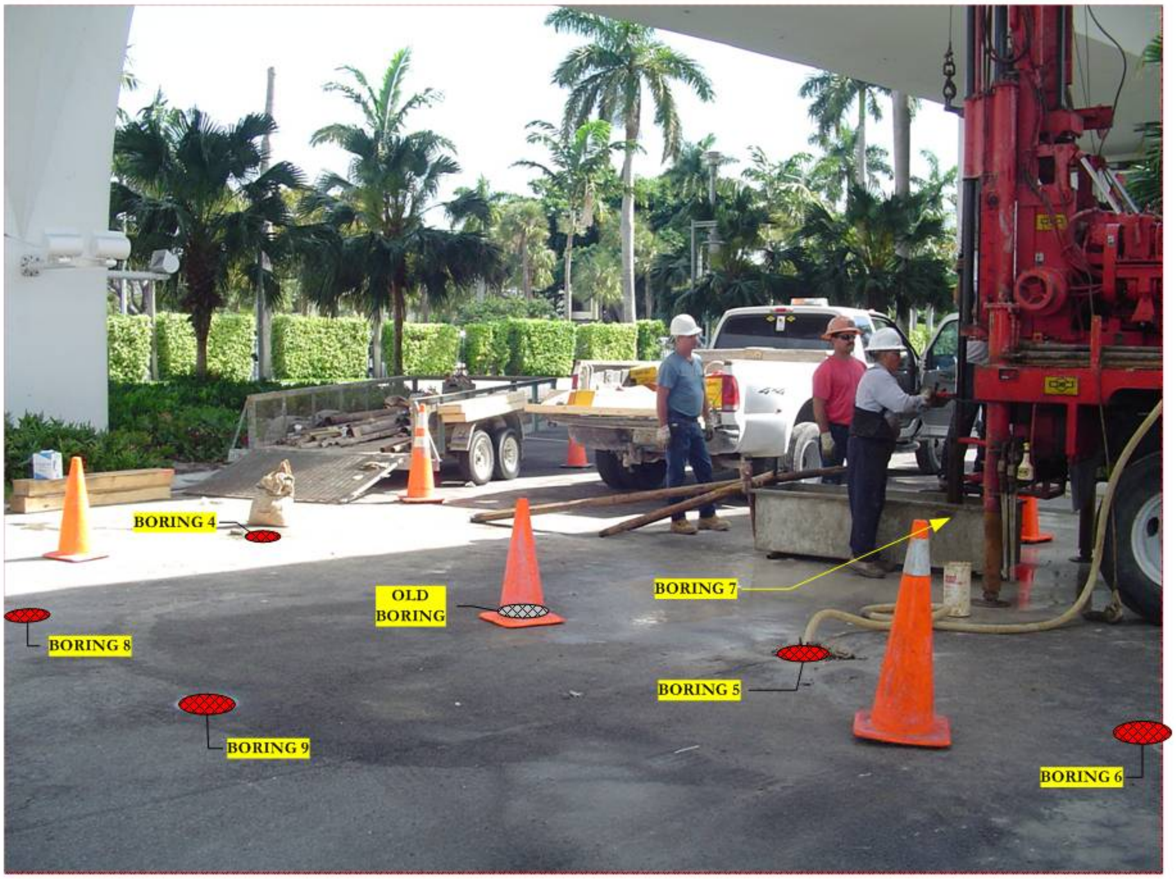

Figure 6-11. 17th Street Bridge boring locations.

The same proposed new analysis method was used for the 17th Street Bridge data, and the results again showed very good correlation with McVay's method.

Unfactored	
26	672
33	1100
42	1649
47	2011

From Lab Data:	
Ultimate skin resistance (Fsu)	190
REC (%)	100
Design Fsu	190

Note: all strength values are psi

Factored	
26	1842
33	2270
42	2819
47	3181

From Graph:	
Unfactored Y-Intersect	981
Bias	1170
Correction Factor	1.19
Factored Y-Intersect	189

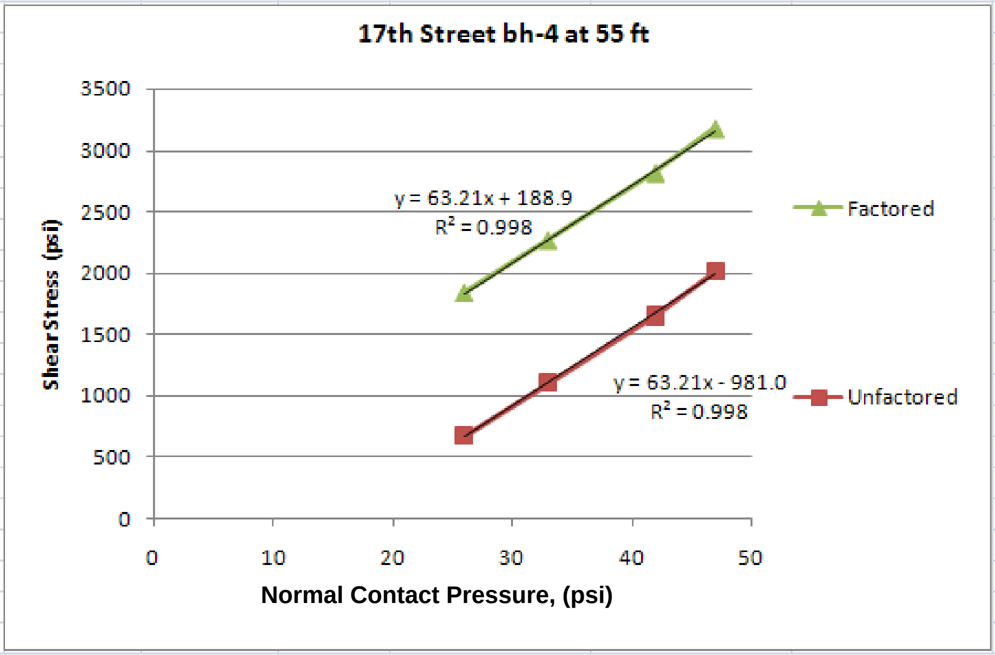

Figure 6-12. RSD Y-Intercept results (190 psi) versus McVay's F_{su} prediction (189 psi).

Unfactored	
26	680
33	1166
42	1780
47	2145

From Lab Data:	
Ultimate skin resistance (Fsu)	217
REC (%)	100
Design Fsu	217

Note: all strength values are psi

Factored	
26	2025
33	2511
42	3125
47	3490

From Graph:	
Unfactored Y-Intersect	1128
Bias	1345
Correction Factor	1.19
Factored Y-Intersect	217

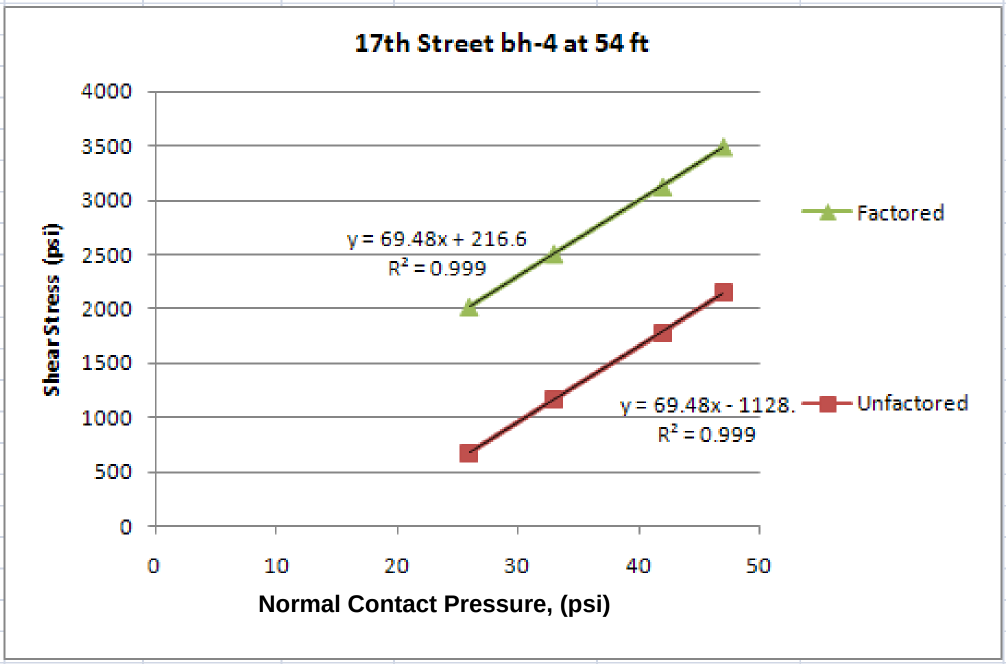

Figure 6-13. RSD Y-Intercept results (217 psi) versus McVay's F_{su} prediction (217 psi).

Kanapaha Test Site

The final site, located in Gainesville consists of extremely poor rock. In fact, some recoveries were on the order of 1%.

Figure 6-14. Field Coring at the Kanapaha Site.

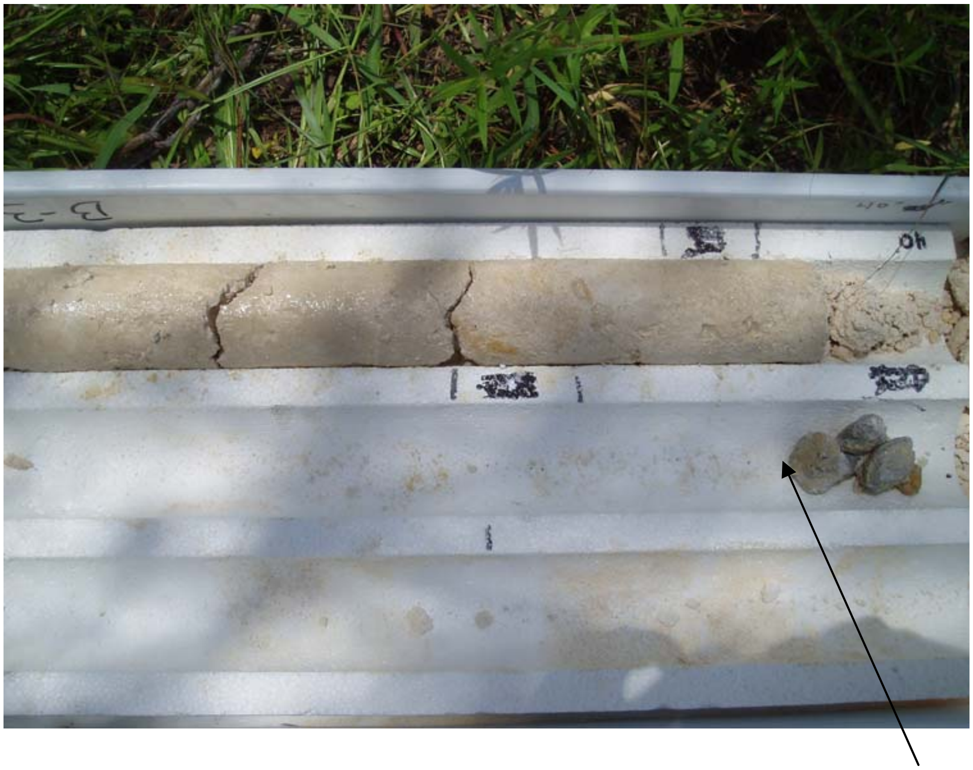

Figure 6-15. Sample Quality and Recovery at the Kanahapa Site.(note the center core run)

Initially, the rock quality was such that insitu testing was problematic. Numerous attempts were tried with limited success. This is true for even the lab tests (unconfined compression and split tensile). However, future tests will be performed at other depths in order to evaluate the device’s ability to test in less than ideal conditions.

Conclusions and Recommendations

The objective of this research was to design, build, test and develop a methodology for determining, insitu, the shear strength of Florida limestone. As in any new equipment development, numerous iterations in the design and construction process prolonged the testing program. However, the above results are very encouraging and FDOT and UF are committed to making several enhancements (some already completed, e.g., a new in-line load cell, membranes, etc.) and to continue to refine the test. At this point, the design of the device and its operational characteristics appear to have been successfully achieved and a tentative method of data analysis proposed. What remains is further testing to refine the test and analysis methods such that a Florida Method (FM) can ultimately be developed.

The following conclusions and recommendations are divided into two sections. The first is related to the operational characteristics (i.e., the physical testing) of the new device, while the second provides an overview of the analysis methodologies.

Operational Equipment Conclusions and Recommendations

After numerous upgrades, the current Rock Shear Device has shown it can be used to determine in real time, the shear strength of Florida limestone.

Due to its rapid testing procedure, numerous tests can be performed at a corehole along its entire length. This provides very useful data on shear strength spatial variability.

The field tests at the drilled shaft locations indicate that the variation in rock strength with depth is relatively large. However the spatial variation and mechanical properties of the rock formation at a particular depth is relatively low. This observation is of course, site specific, and does not portend similar results at other shaft locations.

The determination of a rock's shear strength is not significantly affected by an inaccurate estimation of the depth of penetration of the shear studs, as long as a constant penetration depth is used at each test level for data reduction.

The original design of the probe utilized standard thick walled steel pipe dimensions and it was discovered that after the coreholes were made, the contractor had to use a tricone bit to slightly enlarge the opening so that a partial retraction of a stud (due to clogging) would not jam the device while downhole. Based on this issue, the next probe will be constructed from a pipe that has its diameter turned down (milled) so that the annulus between the corehole wall and probe will be slightly larger, to facilitate insertion and retraction.

The amount of suspended solids in the drilling fluid is highest immediately after coring and its presence increases the potential for interfering with the retraction of the studs. Thus, allowing several minutes to elapse prior to inserting the probe is highly recommended.

Any previous bore logs and current core logs should be reviewed prior to testing. In areas where the recoveries are relatively low (less than 70%), the possibility of encountering problematic zones are likely and careful monitoring of the shearing force during testing is warranted.

In conclusion, the design and operation of the current Rock Shear Device has shown to be a relatively simple, unique, insitu test instrument, which can be used to shear a corehole's surface. Multiple tests in a corehole can be performed in hours and provides the engineer with real-time data on the rock's shear strength.

Data Analysis Conclusions and Recommendations

Two methods of analyzing the data were formulated, with one far exceeding the other in comparison to McVay's theoretical approach.

The first method attempted to use the raw shear stress versus displacement (i.e., strain) plot to identify the peak stress. Then, using this peak value, it is converted into a shear strength. However as can be seen in the typical figure below was no "peak" and or it would likely occur at a displacement greater that 0.5 inches. This is not the expected displacement at peak failure, but rather should occur between 0.05" and 0.2" of displacement.

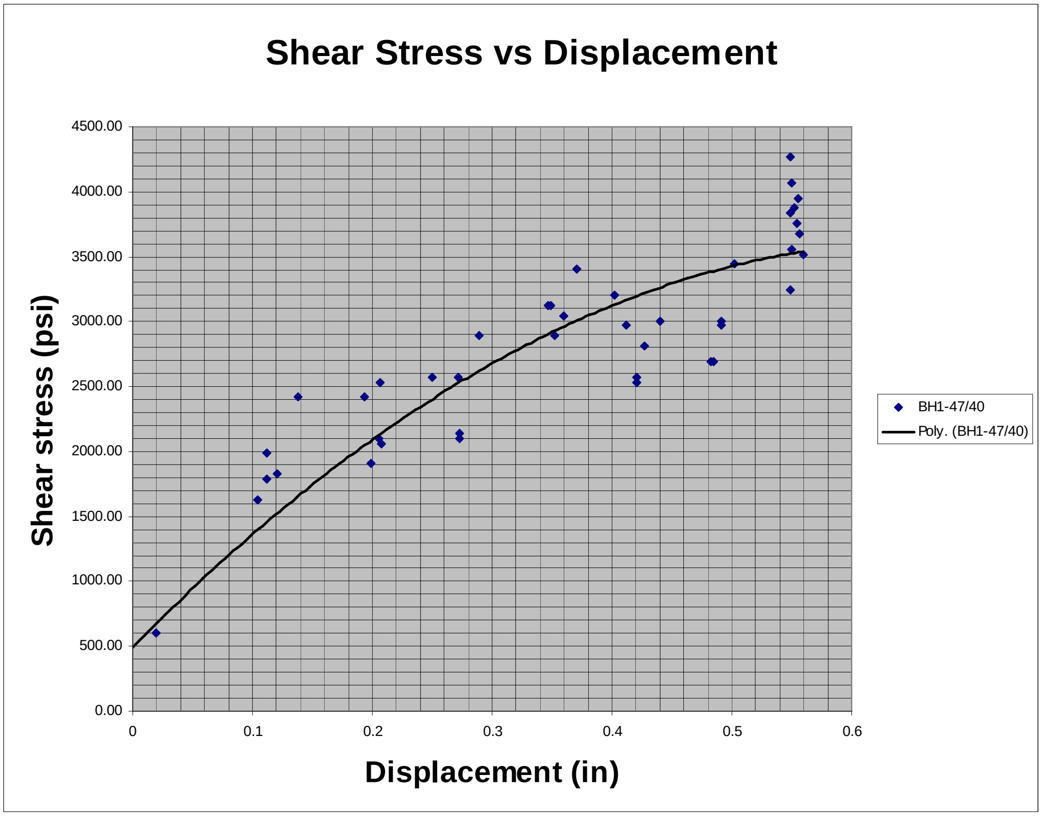

Figure 6-16. Typical Plot of Shear Stress versus Probe Displacement.

After an extensive attempt to extract meaningful data out of such data plots, it was pointed out that the data is more likely a bi-modal plot, with an initial steep slope followed by a second more shallow slope. This is seen in figure 6-17 below.

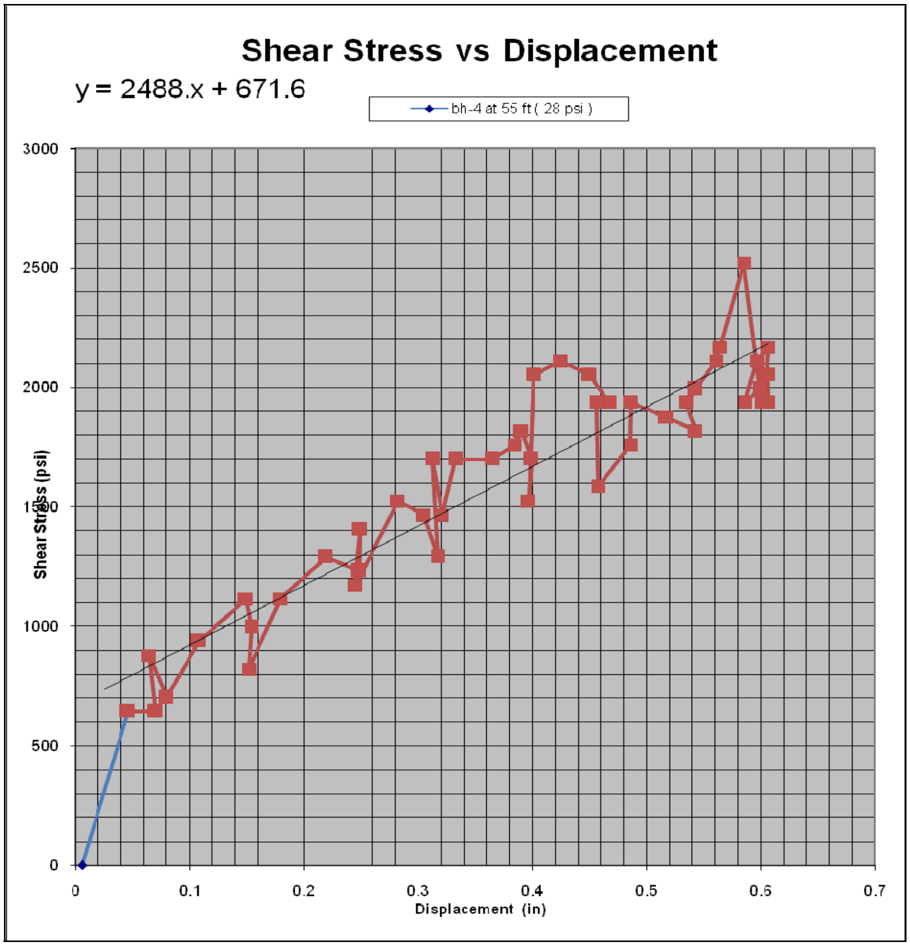

Figure 6-17. New Y-intercept Method for Analyzing RSD Data

Based on this premise, a new procedure was developed, (outlined above) and the limited results showed excellent correlation to McVay's square root method. Currently, a factor must be applied to the raw data to remove the negative intercept values (1.17 - 1.19). However, the software has now been updated to remove this shift automatically and the factor will likely no longer be required. Regardless, the maximum difference between the new RSD data interpretation model and McVay's theoretical approach was 5.3%.

Based on the revised analysis, the FDOT's Rock Shear Device has shown to provide excellent shear strength data for Florida limestone and should be used for any future drilled shaft designs.

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APPENDIX A. METHODS FOR REDUCING RSD DATA

As was discussed, two methods were attempted to ultimately determine the insitu shear strength of the rock. The following is an explanation of the first method, i.e., the peak stress method, that was ultimately discarded due to its inconsistent results. However, it is provided as an example of the effort used in ultimately formulating the much better Y-Intercept Method, proposed by Horhota.

The first method involved measuring the contact stresses between the stud and the rock/gator rock and the depth of penetration of the apex of the stud into the sample surface. This penetration depth will vary with the strength of the rock and the applied pressure. There are empirical relationships available that relate the penetration to the shape of the stud point and the strength of a rock (Evans and Murrell, 1958). The results generally indicated that the penetrations are fairly constant and that the variation of pressure with depth is more significant in the fairly soft limestone (Q_u < 200 psi). This is consistent with previous work done (Evans and Murrell, 1958) that suggested that unless a certain energy/force threshold is reached, the measured penetrations would remain relatively constant with increased normal force/pressure. A correlation between rock strength and penetration (within the test pressure range), has been deduced and adapted based on the samples tested. This data base could be improved with additional testing on more variety of rock strengths.

This analytical approach uses the laboratory model derived as shown in Figure A-17. The important application of this model is the use of a constant depth of penetration with varying normal force at each test level. This explains the good comparison obtained using a single average penetration depth for data reduction (Figure A-3 to A-4) and penetration depths obtained from the model. Figure A-15 shows that the strength envelope is not sensitive to the level of accuracy of the depth of penetration used in its determination. A sensitivity analysis was done on the shear strength determination by increasing/decreasing by 50% the depth of penetration (Figure A-15) used for data reduction. All the points are shown to have clustered along the same strength envelop. The indications are that as long as a single depth of penetration is used at each test level the strength envelope will not be affected by an inaccurate estimation of the penetration depth.

The results when properly analyzed can also be used to determine locations where unusually high penetrations are resulting from significant presences of clays or very soft rocks. In these cases bearing problems are typical and the normal stresses are significantly lower than the shear stresses resulting in erroneously large or negative shear strengths as seen in red numbers in Figures A-3 and A-4.

The problems encountered in the field were limited to mechanical issues; the cored holes were only marginally larger than the device and its relevant attachments (clearance issues). This resulted in difficulties to move the device up and down the hole freely and could have contributed to friction related errors (considered minor) between the sections of the device (not the studs) and the walls of the hole. The fines in suspension at depth (mud intrusion) affected the free retraction of the studs by the springs and the expansion of the internal bladder. These effects are not quantifiable however steps were taken to keep the instrument as water tight as possible to minimize these problems.

By and large, there are a number of factors that may have affected the observed results but within the limits of these experimental errors it would appear that the validity of the method and simple theories that governs quantitatively the derivation of the strength envelope of the rock are relatively sound based on the satisfactory conformance of the methods used to determining the rock shear strength.

The first, comparing McVay's theoretical prediction and that of the device are shown in Figures A-1 and A-2. The values show some vertical variation but generally are within a reasonable range of consistency. Both sets of data show a general reduction in shear strength from a high of about 300 psi to a low of 20 psi. The upper 53 ft. of the rock formation had shear strength values typically above 100 psi (one exception) with a high of about 310 psi from both methods of predictions. Below the 53 ft depth, the shear strength of the formation reduced to an average value of 40 psi. These ranges are typical of Florida Limestone strengths and the levels of variation are consistent with those seen in the core samples with intermittent clay intrusion. The unconfined compression and split tension test results of the samples obtained from all three coreholes are shown in Appendix D. These values were used to determine the shear strength of the rock with depth based on McVay's theoretical prediction that relates the shear strength of the rock with its unconfined compression strength and split tension properties.

The variation with depth of the comparison shown in Figures A-1 and A-2 refers to coreholes 1 and 3 respectively. Only one set of data was obtained from corehole number 2 due to problems with equipment blocking and clogging during the time of testing. The conformance is good (generally within the 10% of each other) and while a number of areas showed differences (as shown in Figures A-3 and A-4), their order of magnitude are very similar. These variations are expected and could be attributed to sectional clay contributions within the test/contact area of the device while testing. The values from the field test appear marginally lower than those predicted by McVay's model and could be considered a marginally more conservative estimation of the rock strength.

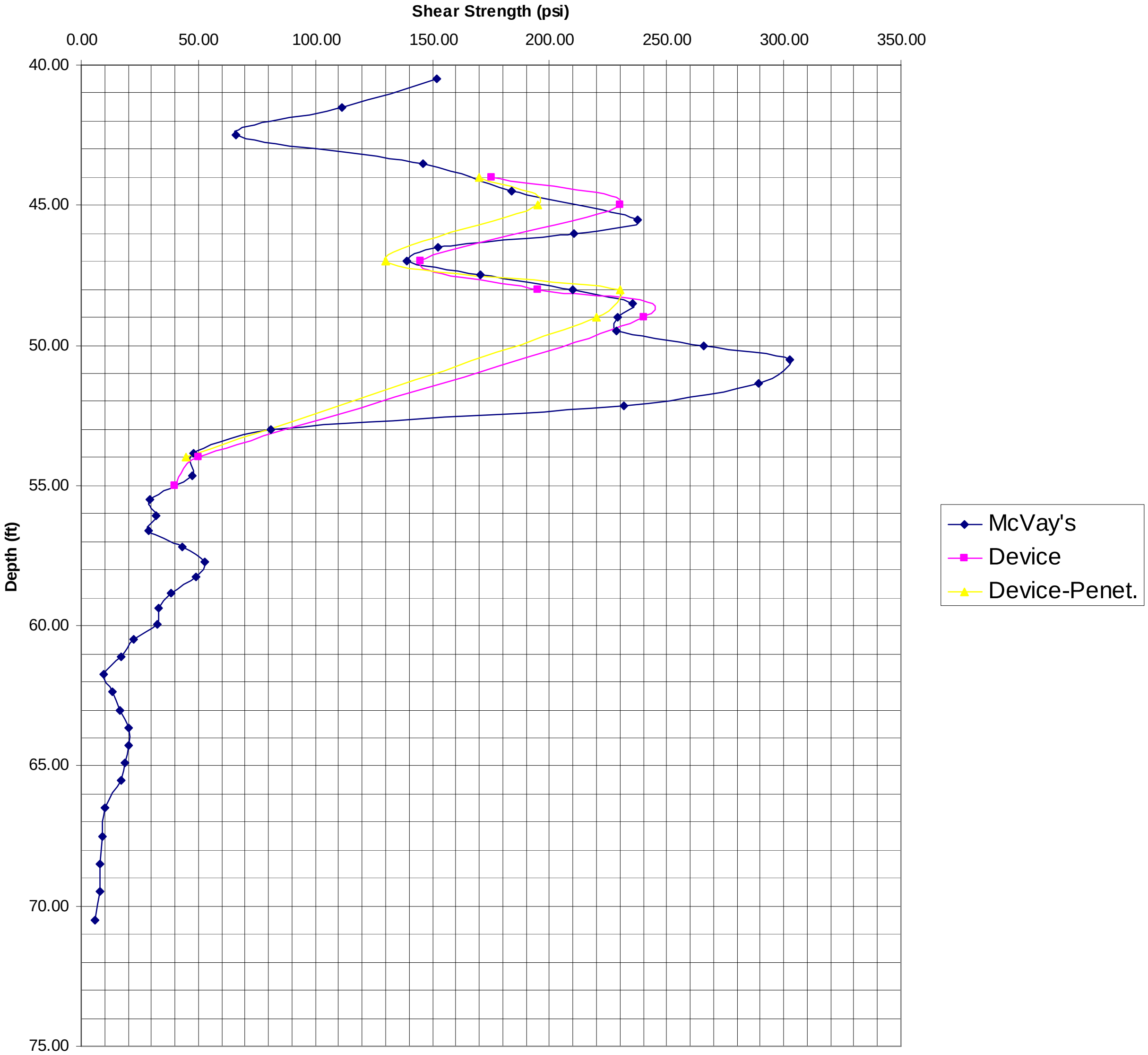


Figure A-1. Comparison of McVay's Shear Strength Prediction with those of the Device for Corehole No. 1.

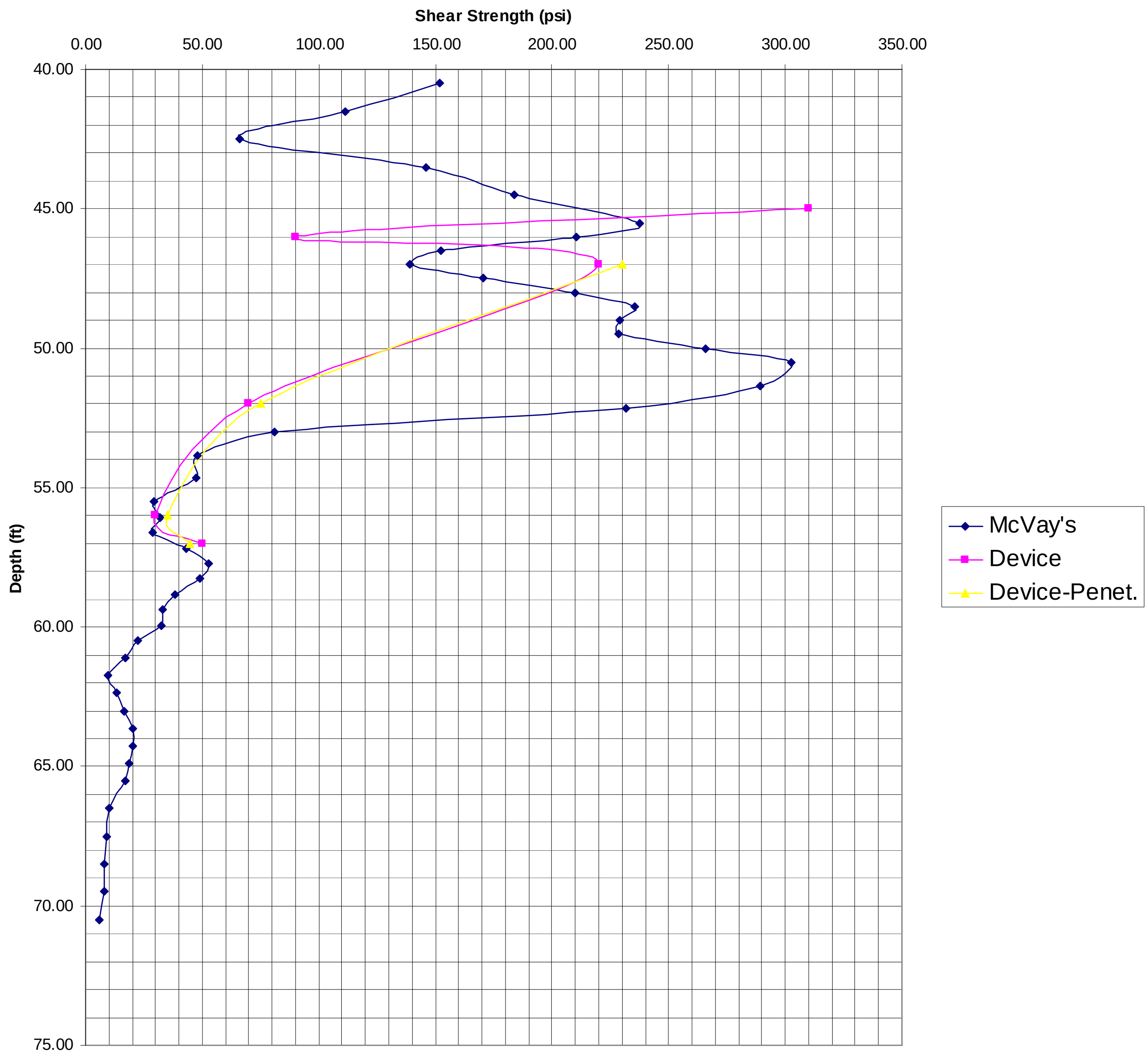


Figure A-2. Comparison of McVay's Shear Strength Prediction with those of the Device for Corehole No. 2.

Depth (ft)	Average Penetration Device Shear (psi)	Model Penetration Device Shear (psi)	McVays (psi)	Average Penetration Device Shear % diff.	Model Penetration Device Shear % diff.
44.00	175.00	170.00	183.5	95.37	92.64
45.00	230.00	195.00	237.5	96.84	82.11
47.00	145.00	130.00	139.28	104.11	93.34
48.00	195.00	230.00	235.67	82.74	97.59
49.00	240.00	220.00	229.15	104.73	96.01
54.00	50.00	45.00	47.73	104.76	94.28
55.00	40.00	50.00	47.55	84.12	105.15

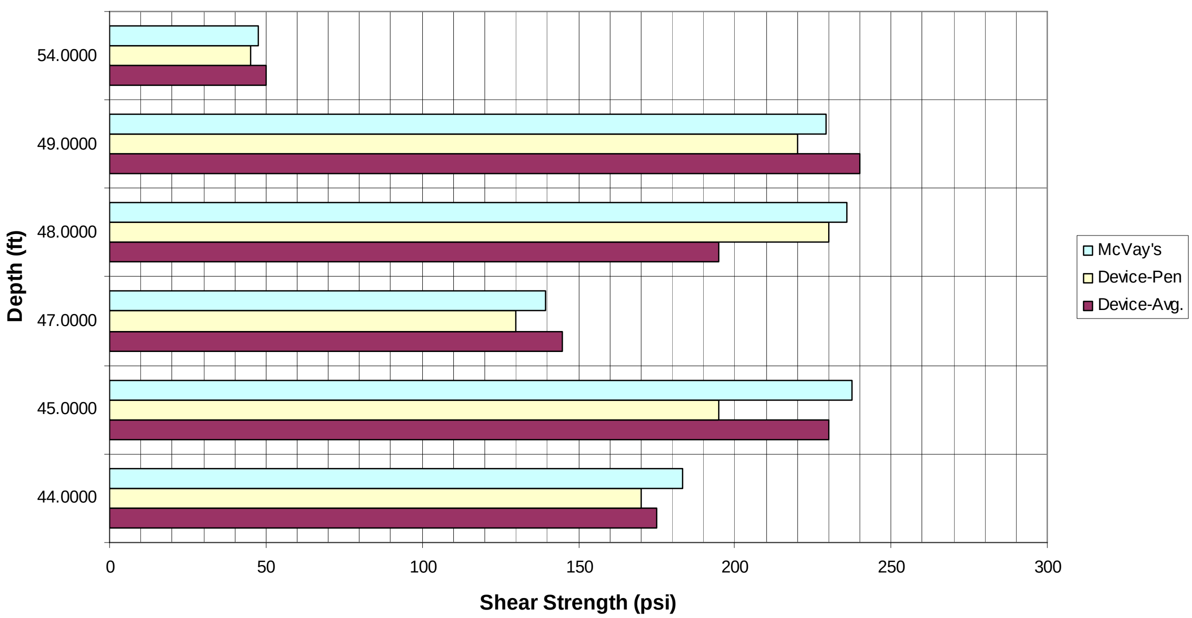


Figure A-3. % Differences and Typical Bar Chart Showing Variation with Depth of Results for Corehole 1.

Depth (ft)	Average Penetration Device Shear (psi)	Model Penetration Device Shear (psi)	McVay's (psi)	Average Penetration % Diff	Model Penetration % Diff.
45.00	310.00	300.00	316.10	98.07	94.91
46.00	90.00	-	83.30	108.04	
47.00	220.00	230.00	240.00	91.67	95.83
52.00	70.00	75.00	70.10	99.86	106.99
56.00	30.00	40.00	38.89	77.14	102.85
57.00	50.00	40.00	40.80	122.55	98.04

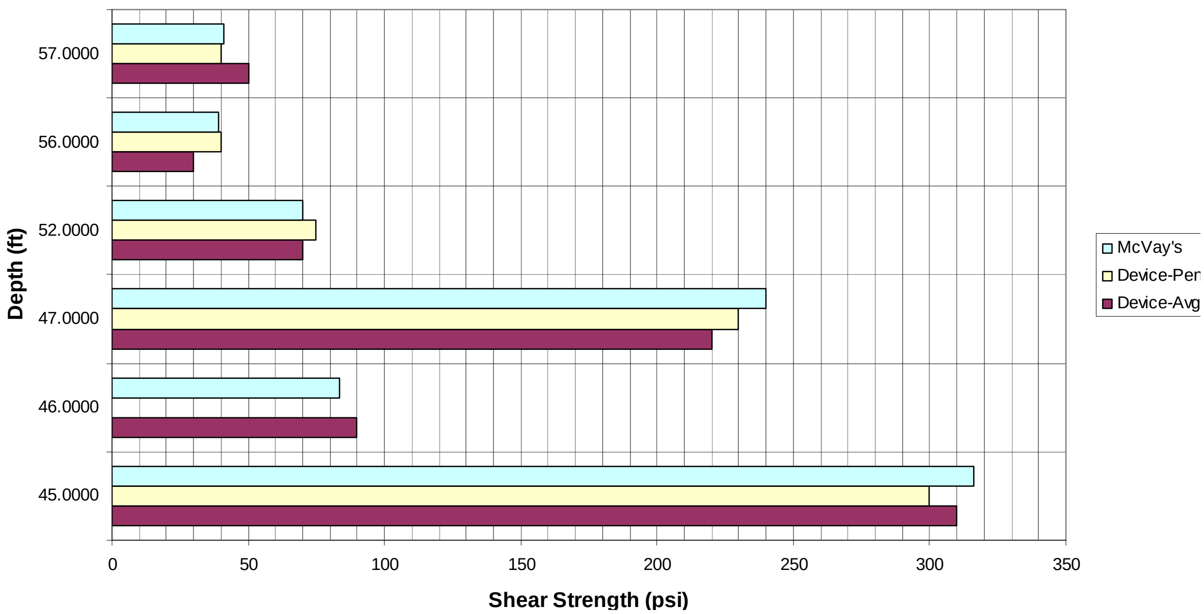


Figure A-4. % Differences and Typical Bar Chart Showing Variation with Depth of Results for Corehole 2.

Laboratory Conditions

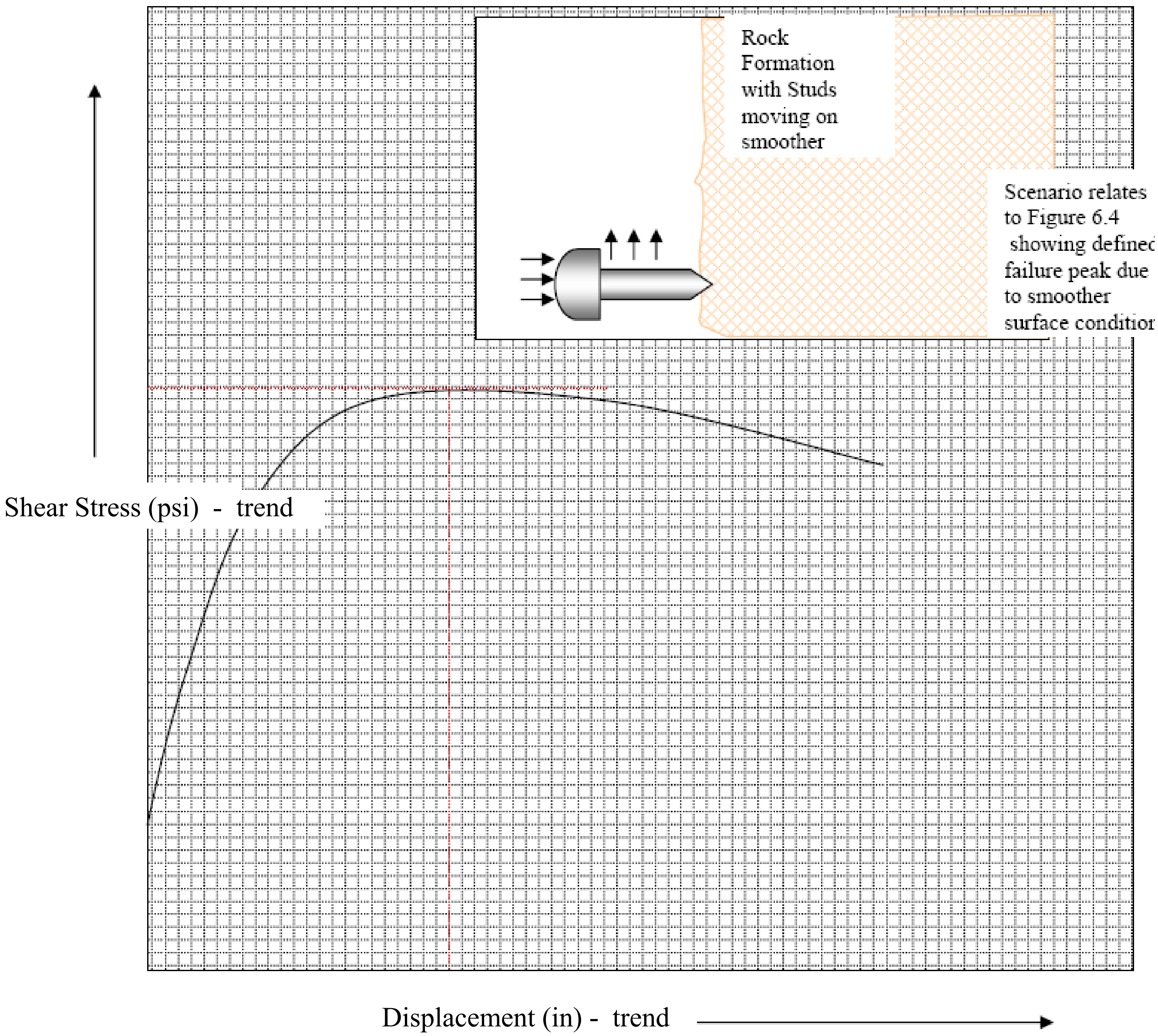


Figure A-5. Shear Stress vs. Displacement (Plot Representation) showing Peak Stress Location

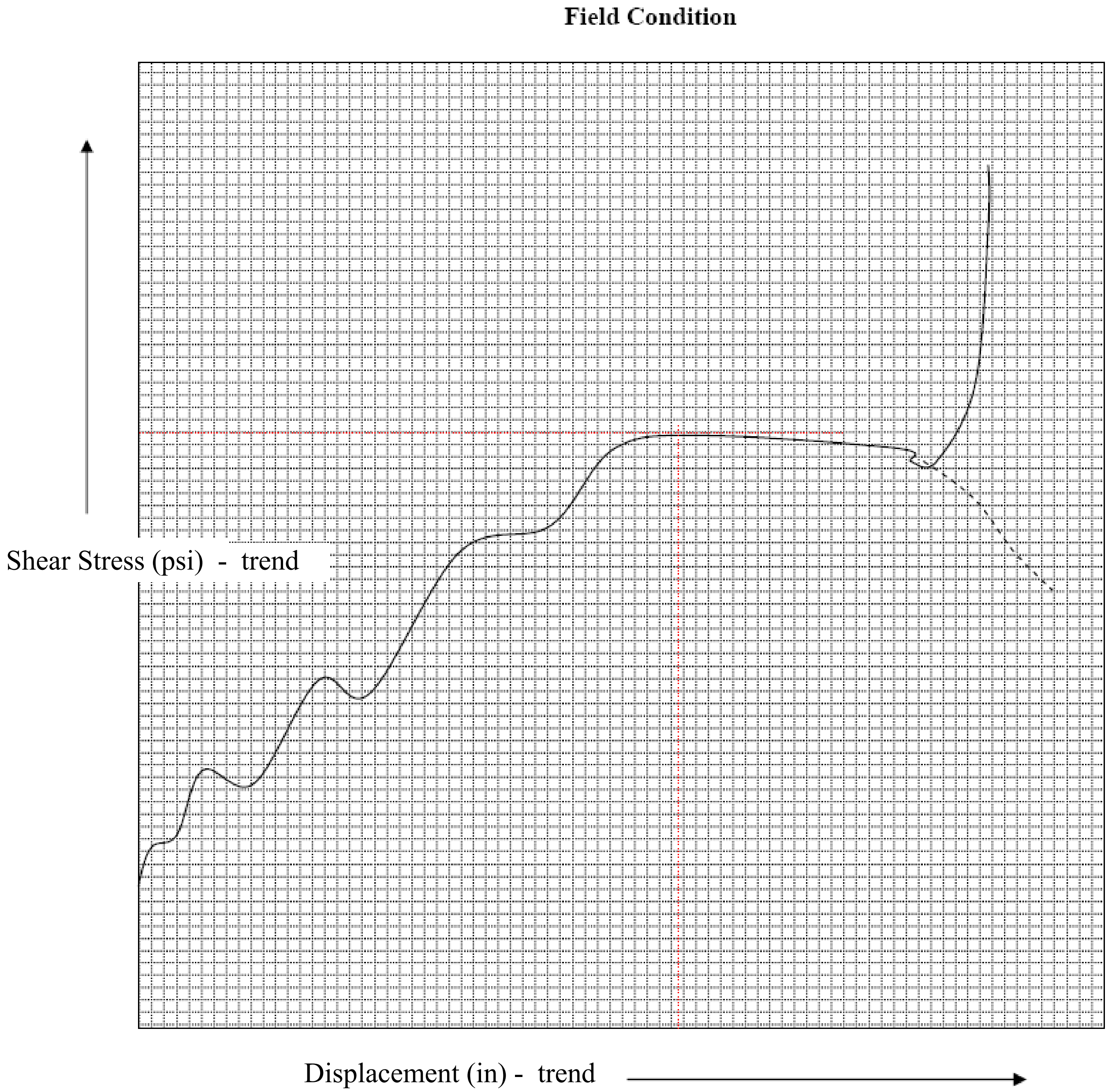


Figure A-6. Shear Stress vs. Displacement (Plot Representation) showing Peak Stress Determination.

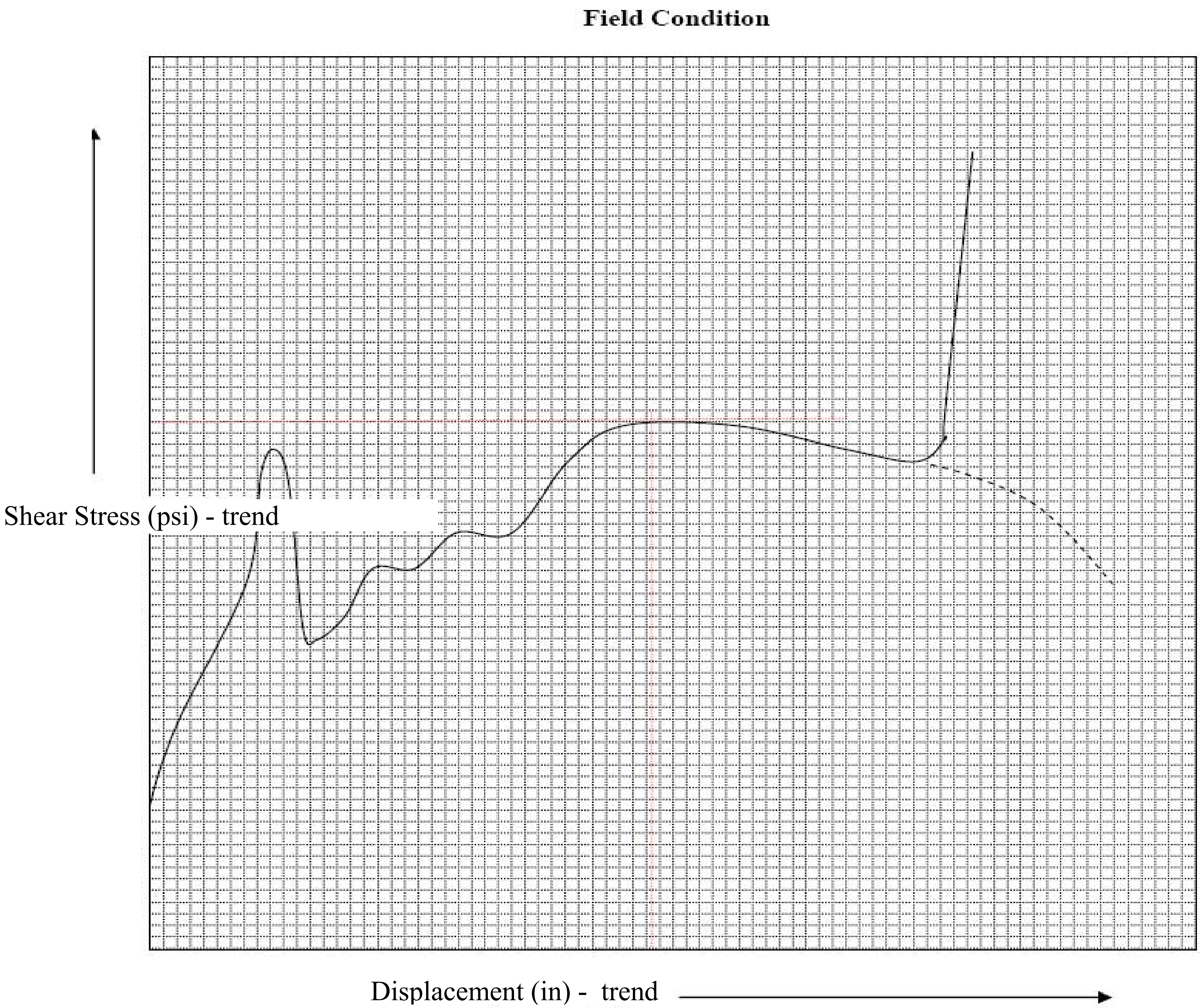


Figure A-7. Shear Stress vs. Displacement (Plot Representation) showing Peak Stress Location.

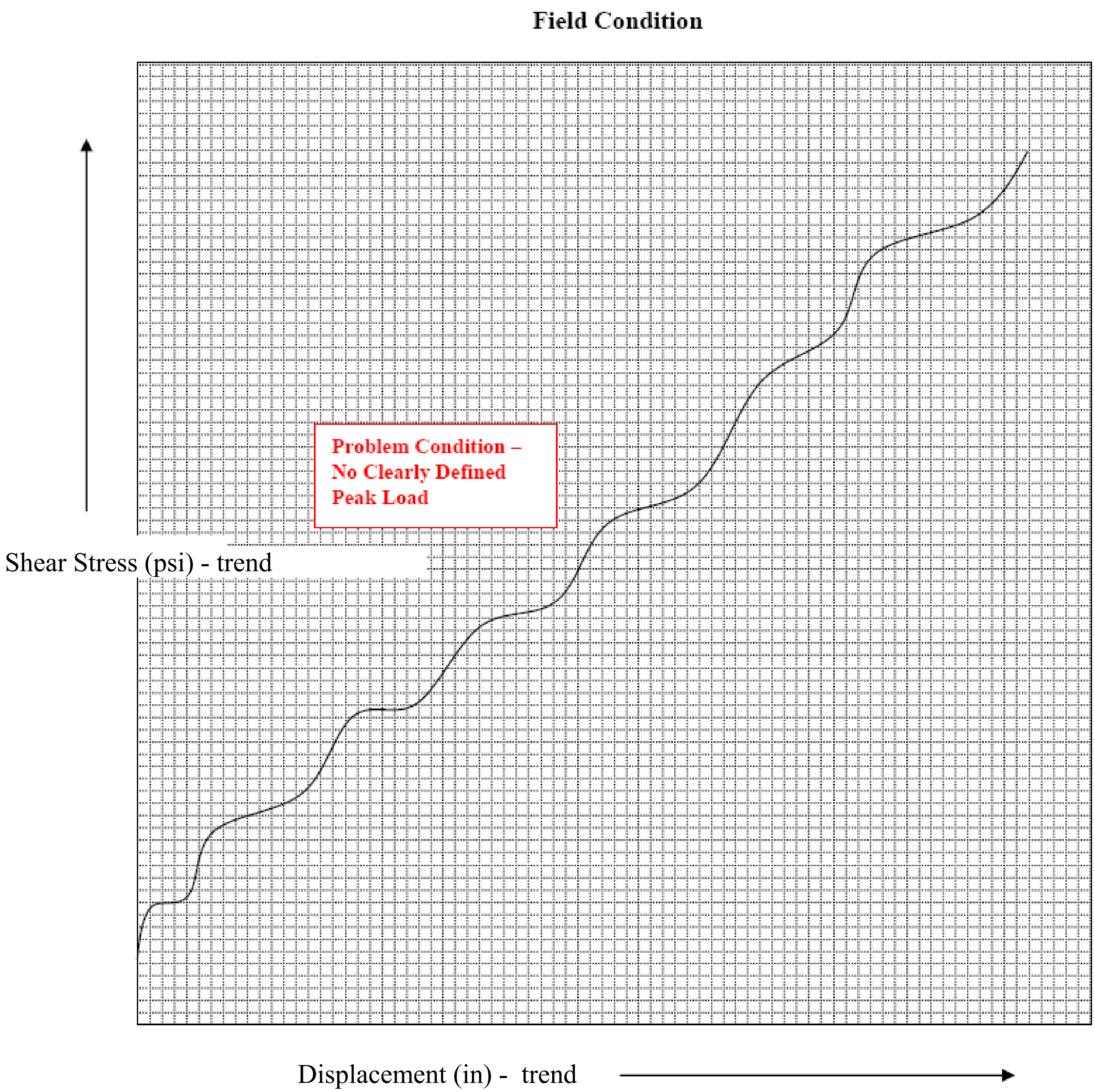
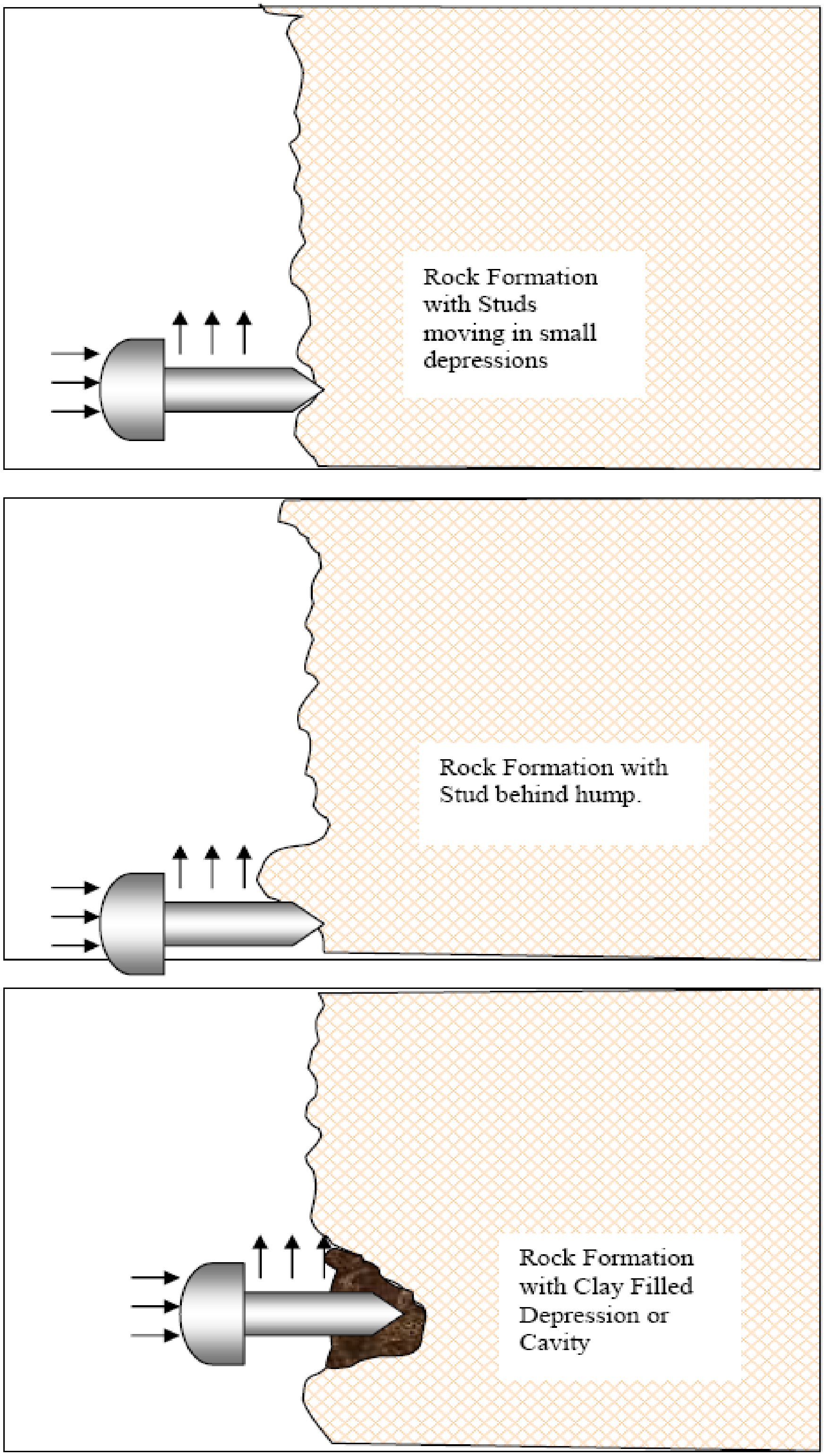


Figure A-8. Shear Stress vs. Displacement (Plot Representation) showing problematic Results



Scenario relates to Figure 6.5 showing multiple small peaks to failure

Scenario relates to Figure 6.6 showing high initial peak before normal shearing

Scenario relates to Figure 6.7 showing erroneously high shear stresses and an increase in shear stress with constant normal stress due to significant bearing problems

Figure A-9. Stud to Rock Typical Scenarios.

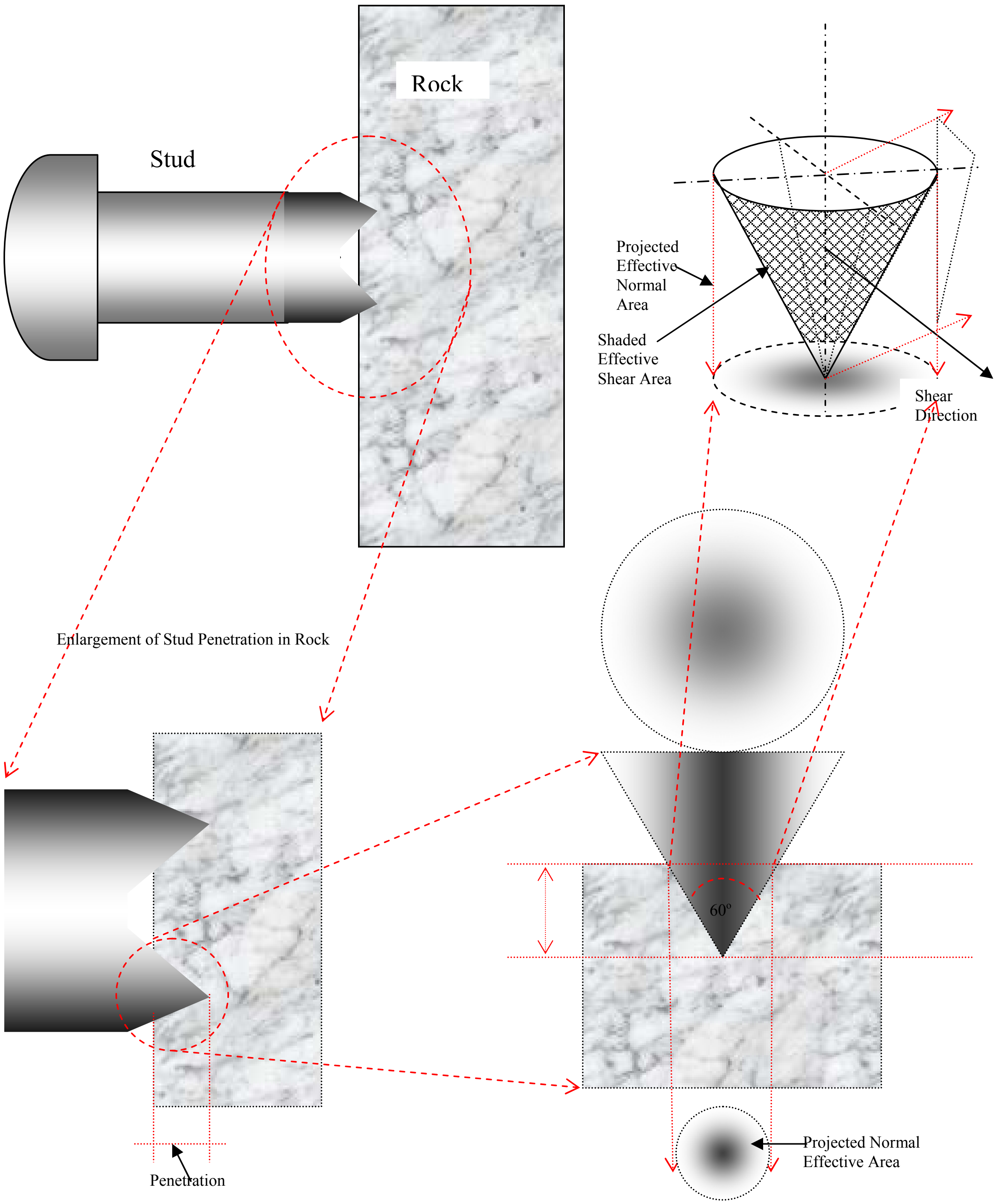


Figure A-10. Effective Area Determination - During Penetration.

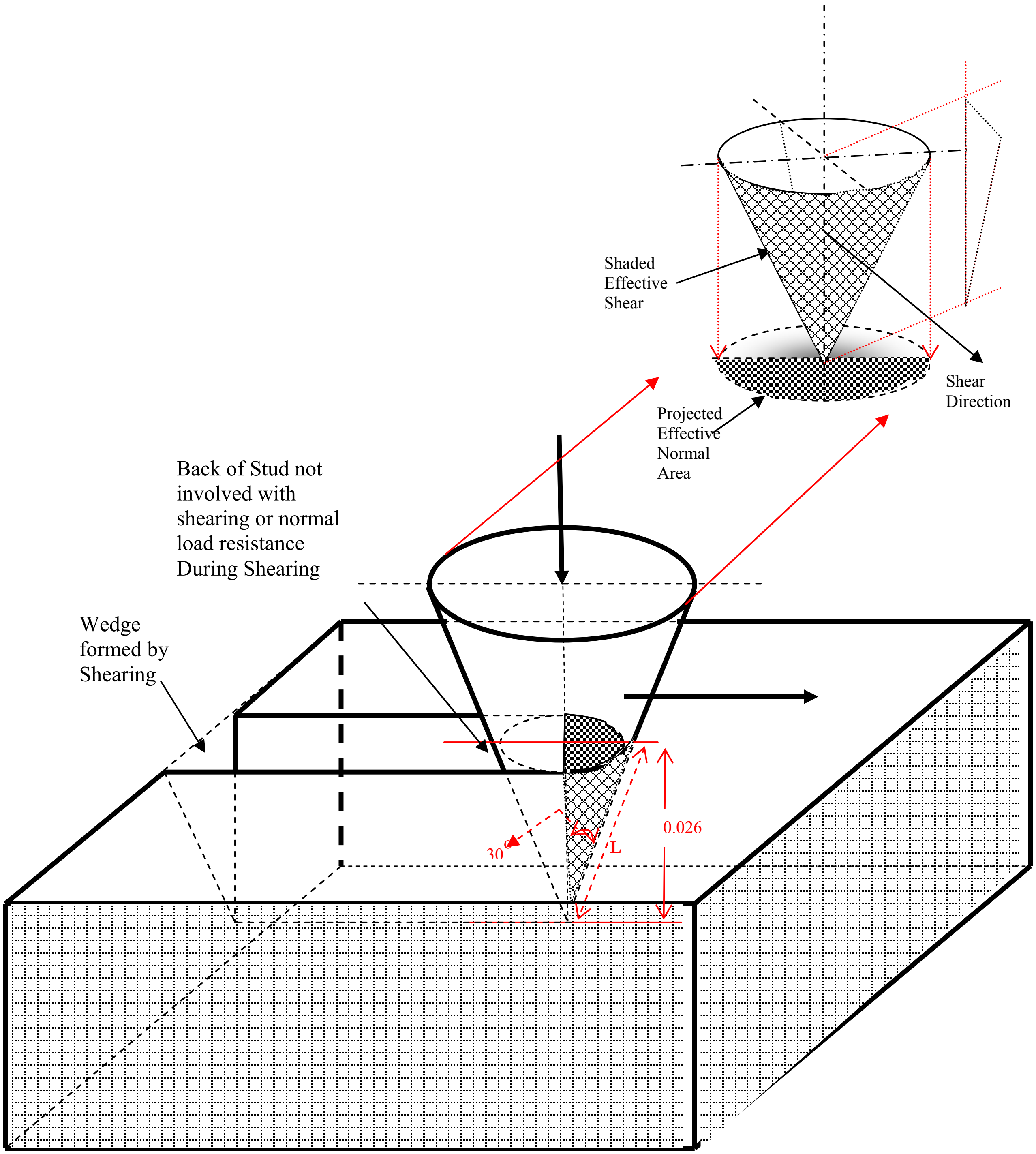


Figure A-11. Effective Area Determination – During Shear

Area calculation example: For a penetration of 0.026”, based on Figure 6.10, the Effective normal area is;

$(4 \times 3.142 \times (\tan 30 \times 0.026)^2)/2 =$ 0.001415993 sq. inch
The force is exerted on 4 **half** conical **x-section** on each studs.
Note also normal pressure
Divided by the stud cap area of 0.1964 gives normal force and
Accounting for water pressure at that depth gives a normal force
= 5.6488 (lbs). The Normal stress is obtained by dividing this
Force by the normal stud area = 5.6488/0.001415993 = 3989.28psi

Effective shear area is; $\{3.142 \times (\tan 30 \times 0.026) \times \sqrt{[(0.026)^2 \tan^2 30 + 0.026^2]} \times 4 \times 42\}/2$
= 0.206017 For Shear force of 433.239,
Shear Stress = 2102.93psi
Half Conical effective shear area ($\Pi rL/2$) where L is the length of the sloping side. Each stud contains 4 conical contact surface (see Figure 6-10) and 42 studs in total.

Table A-1. Section of data reduction table for Corehole 1 at 47’ (40psi applied pressure)

				FULLER WARREN BRIDGE				
				SHEAR DEVICE TEST RESULTS				
		Penetration		(calculated)	**0.03827677**			
		Height H_2O		**29**	(ft)	Unit Wt H_2O	**62.4**	(lb/ft3)
		Length Pipe		**47.5**	(ft)	Unit Wt Rod	**2.96**	(lb/ft)
		Penetration Depth		**0.026**	(in)	Cylinder Bore Area	**4.72**	(in2)
		Stud Cap Area		**0.1964**	(in2)	Shear Stud Area	**0.206069136**	
		No. of Studs		**42**		Normal Stud Area	**0.001415993**	
		Weight of Instrum.		**38**		Qu (psi)	**945.7**	
LVDT	Pressure	Load	Est. Load	Est. Press.	Normal Force	Shear Force	Normal Stress	Shear Stress
(in)	(volts)	(volts)	(psi)	(psi)	(lb)	(lb)	(psi)	(psi)
-0.001	0.0214	0.0006	12.4916	42.8022	5.8035	-175.0038	4098.5673	-849.2481
0.0201	0.0214	0.0043	92.7744	42.7564	5.8035	125.0626	4098.5673	606.8964
0.1203	0.021	0.0074	140.6428	41.9568	5.6488	376.4696	3989.2597	1826.9094
0.1048	0.0211	0.0069	132.1643	42.1278	5.6875	335.9201	4016.5866	1630.1331
0.1116	0.021	0.0073	135.1198	42.024	5.6488	368.3597	3989.2597	1787.5541
0.1115	0.021	0.0078	148.4106	42.0331	5.6488	408.9093	3989.2597	1984.3304
0.1378	0.0212	0.0089	171.9182	42.3139	5.7262	498.1182	4043.9135	2417.2383
0.1937	0.0209	0.0089	183.8926	41.8195	5.6101	498.1182	3961.9328	2417.2383
0.2075	0.0208	0.008	161.8831	41.554	5.5714	425.1291	3934.6058	2063.0409
0.2055	0.021	0.0081	161.358	41.9813	5.6488	433.2390	3989.2597	2102.3962
0.1986	0.021	0.0076	155.6869	41.9111	5.6488	392.6894	3989.2597	1905.6199
0.206	0.021	0.0092	176.7251	42.0362	5.6488	522.4479	3989.2597	2535.3040
0.2496	0.021	0.0093	193.1818	41.9263	5.6488	530.5578	3989.2597	2574.6593
0.2733	0.0208	0.0082	165.5727	41.551	5.5714	441.3489	3934.6058	2141.7515
0.2719	0.0209	0.0093	176.4101	41.847	5.6101	530.5578	3961.9328	2574.6593
0.273	0.021	0.0081	166.5917	42.0026	5.6488	433.2390	3989.2597	2102.3962
0.2892	0.021	0.0101	195.1841	42.0606	5.6488	595.4370	3989.2597	2889.5014

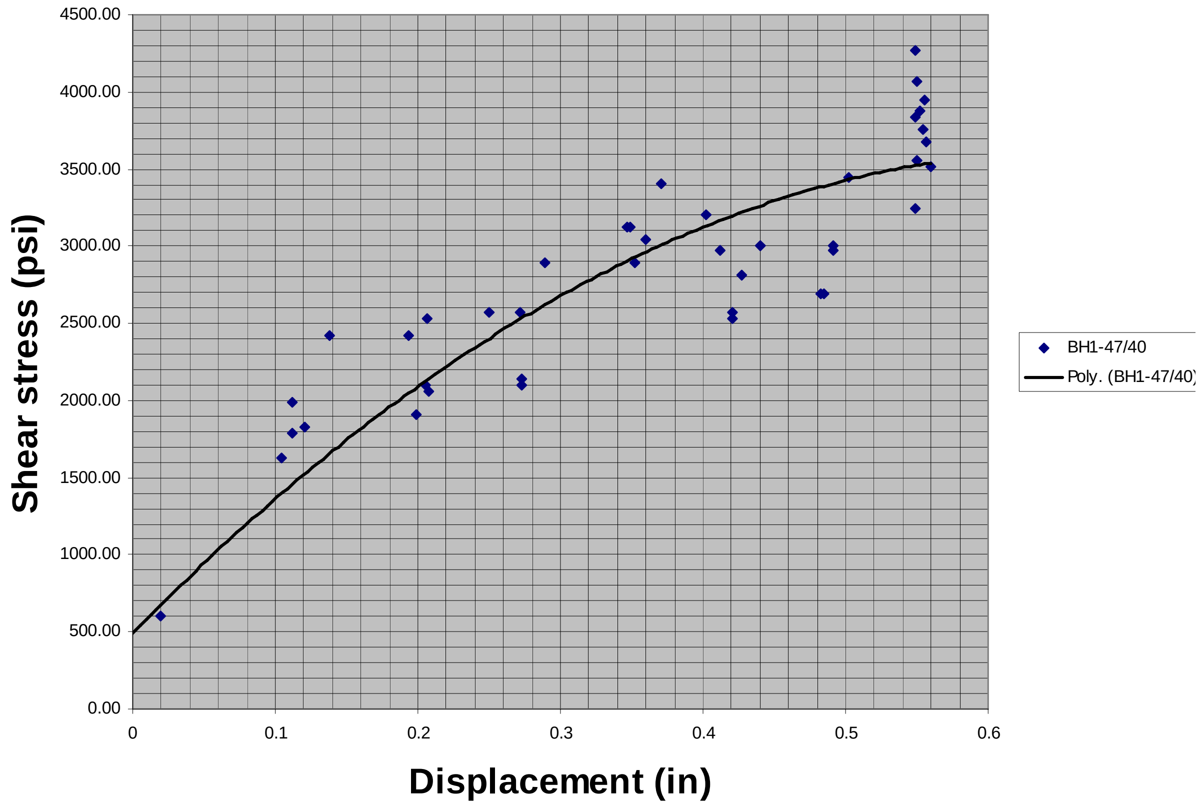


Figure A-12. Peak Shear Stress vs Displacement Curve.

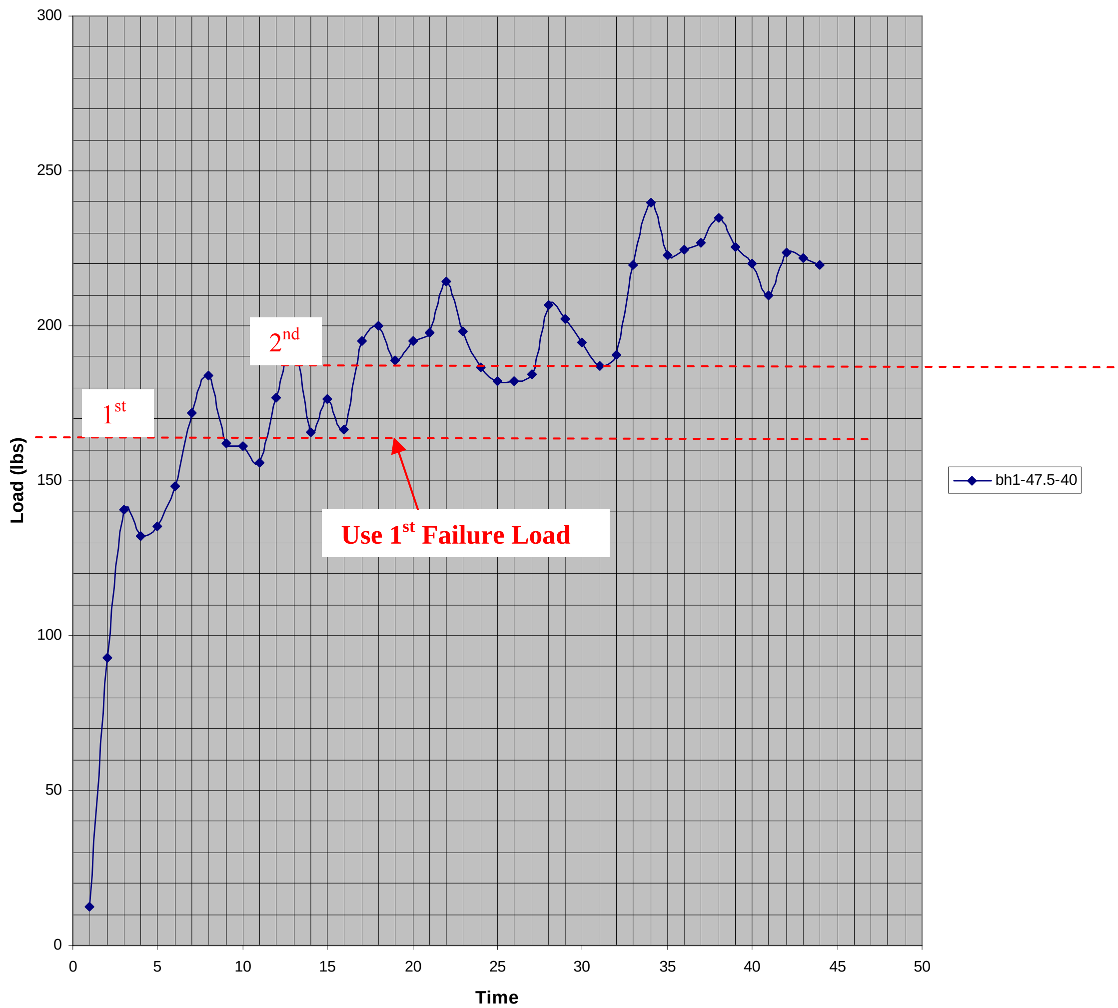


Figure A-13. Determination of Peak Shear Stress using Load vs Time Curve.

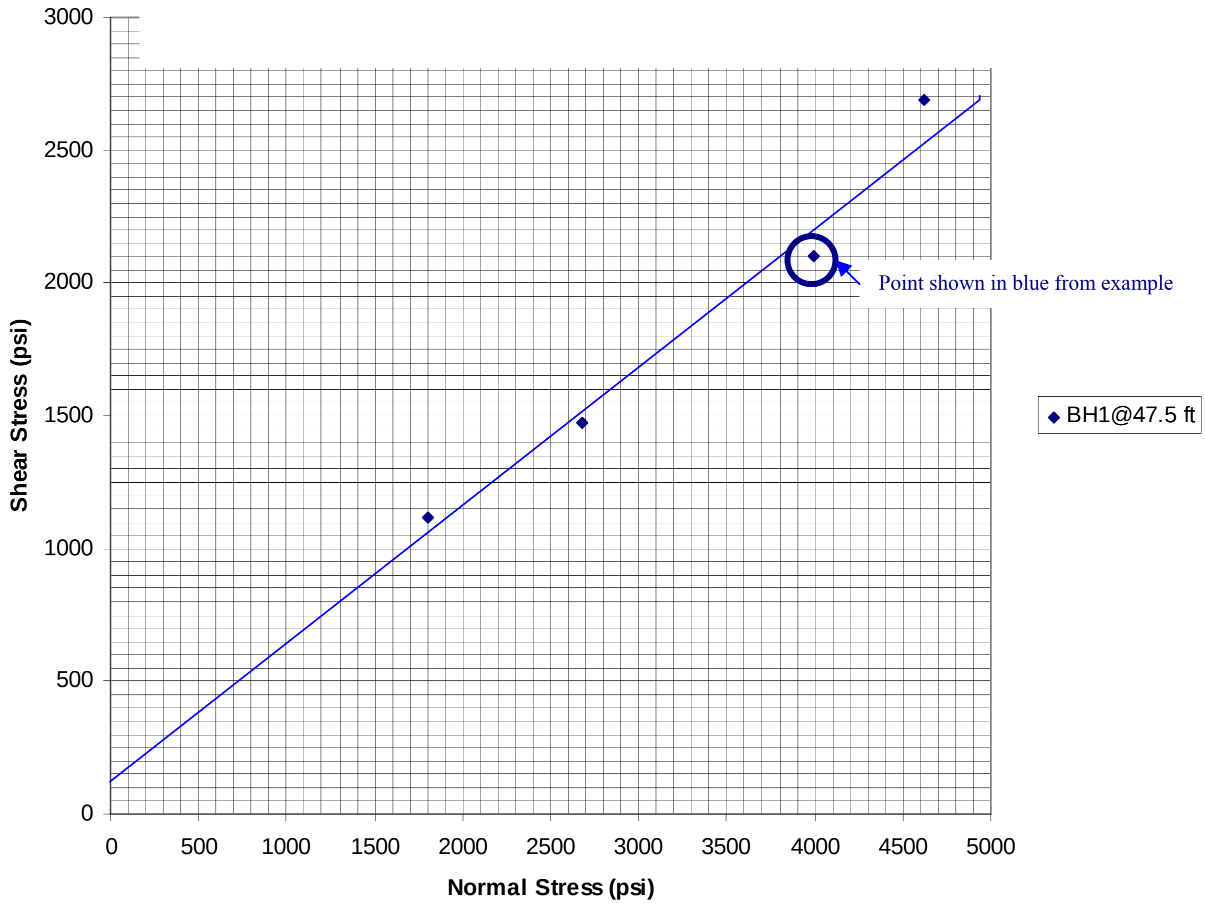


Figure A-14. Shear Stress vs Normal Stress Curve (Failure Envelope).

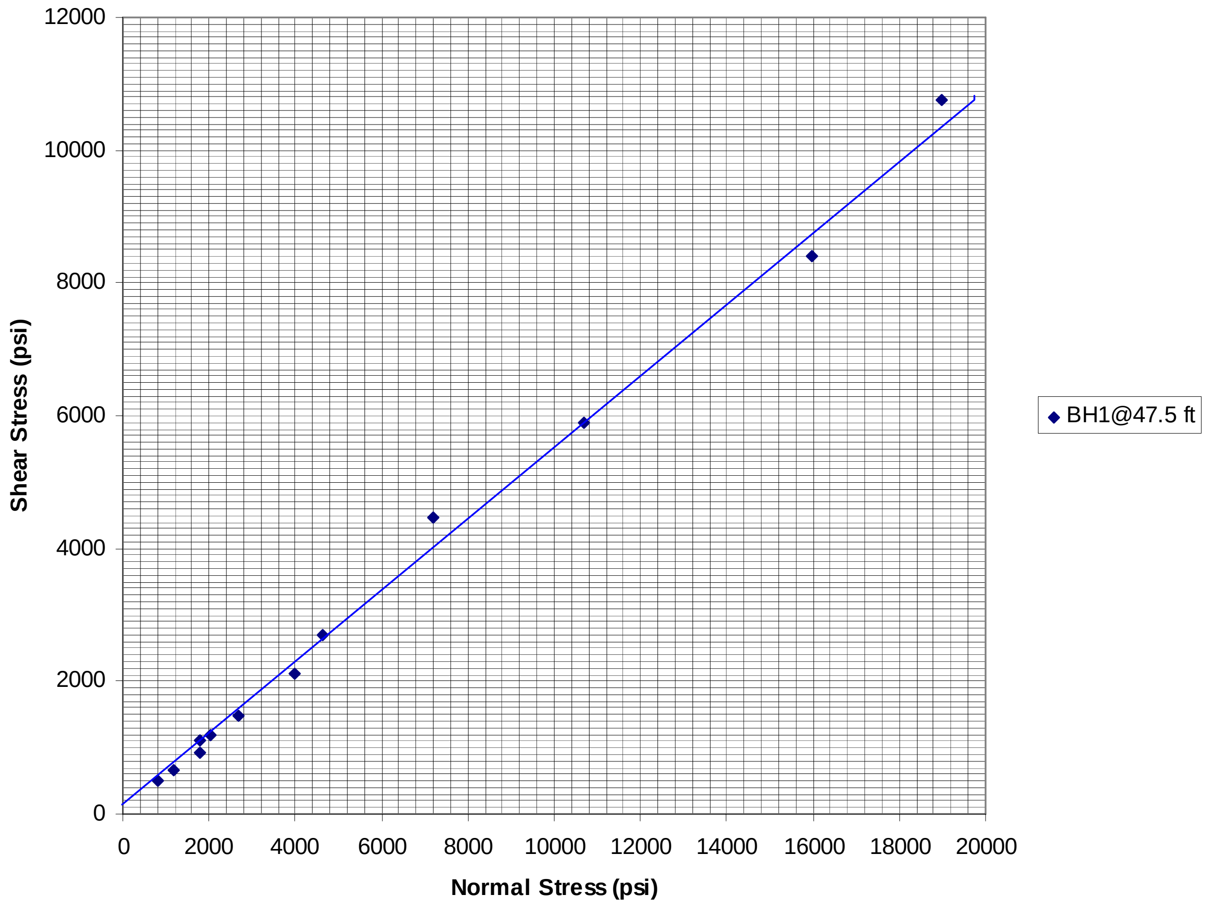


Figure A-15. Non-effect of 50% Decrease and Increase in Depth of Penetration on Failure Envelope.

From the Peak Load (Fig. A-13), the corresponding Shear and Normal Stresses are determined and used as a point on the Shear vs Normal Stress Plot (Fig. A-14) to Determine Su (Cohesion) and Phi.

No. of Contact Points		4			
No. of Studs		5			
Area		4.91	sq.inch		
Qu		300	Psi		
	Normal Force (lb)	Gator 1 Laboratory Penetration (in)	Gator 2 Laboratory Penetration (in)	Gator 3 Laboratory Penetration (in)	Evan's 1962 Predicted Penetration (in)
	0.41	0.0094	0.0092	0.0091	0.0088
	0.61	0.0140	0.0138	0.0135	0.0132
	0.73	0.0167	0.0163	0.0159	0.0158
	0.81	0.0190	0.0170	0.0170	0.0176
	1.02	0.0250	0.0260	0.0230	0.0221
	1.22	0.0290	0.0250	0.0270	0.0265
	1.42	0.0340	0.0350	0.0310	0.0308
	1.63	0.0350	0.0380	0.0340	0.0353
	1.83	0.0410	0.0440	0.0380	0.0396
	2.03	0.0460	0.0480	0.0440	0.0441

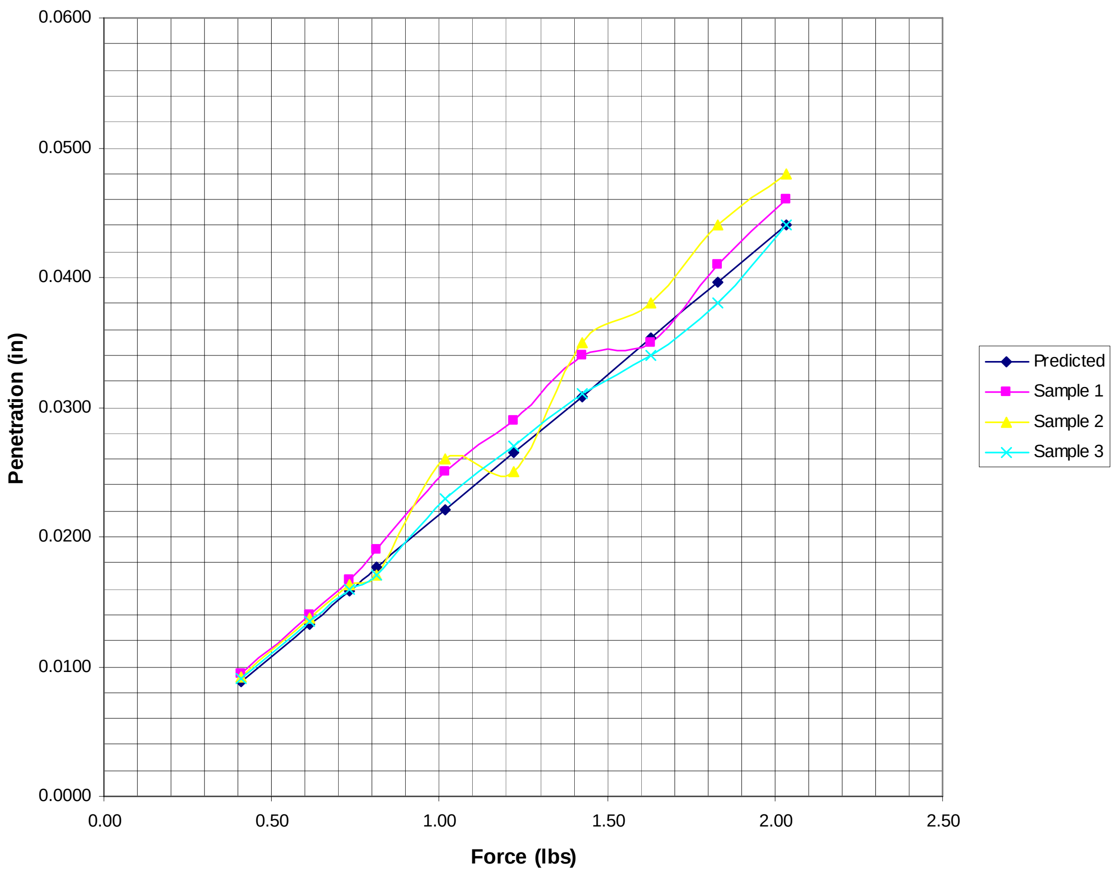


Figure A-16. Predicted and Experimental Penetration Same Locations (Gator Rock)

	4	Cont. Points						
	5	No. of Studs						
Area	4.91	sq.inch						
Qu(psi)	684.5	822	165	256	256	684.5	822	165
	Kanahapa	Fuller Warren	Fuller Warren	Gator Rock	Gator Rock			
Normal	B1 - 4U	B1 - 3U	B1 - 8U	20%/20%	20%/20%	B1 - 4U	B1 - 3U	B1 - 8U
Force	Penetration	Penetration	Penetration	Penetration	Prediction	Prediction	Prediction	Prediction
(lb)	(in)	(in)	(in)	(in)	(in)	(in)	(in)	(in)
0.49	0.0116	0.0065	0.0330	0.0267	0.0125	0.0047	0.0039	0.0193
0.56	0.0132	0.0072	0.0352	0.0253	0.0143	0.0054	0.0045	0.0222
0.79	0.0137	0.0094	0.0414	0.0286	0.0199	0.0075	0.0062	0.0309
1.03	0.0159	0.0116	0.0465	0.0286	0.0262	0.0098	0.0081	0.0406
1.28	0.0174	0.0125	0.0463	0.0289	0.0324	0.0121	0.0101	0.0503
1.47	0.0192	0.0141	0.0471	0.0302	0.0374	0.0140	0.0116	0.0580
1.72	0.0235	0.0162	0.0486	0.0330	0.0436	0.0163	0.0136	0.0677
2.21	0.0231	0.0153	0.0511	0.0328	0.0561	0.0210	0.0175	0.0870
2.45	0.0247	0.0164	0.0532	0.0334	0.0623	0.0233	0.0194	0.0967
2.95	0.0251	0.0169	0.0558	0.0361	0.0748	0.0280	0.0233	0.1160

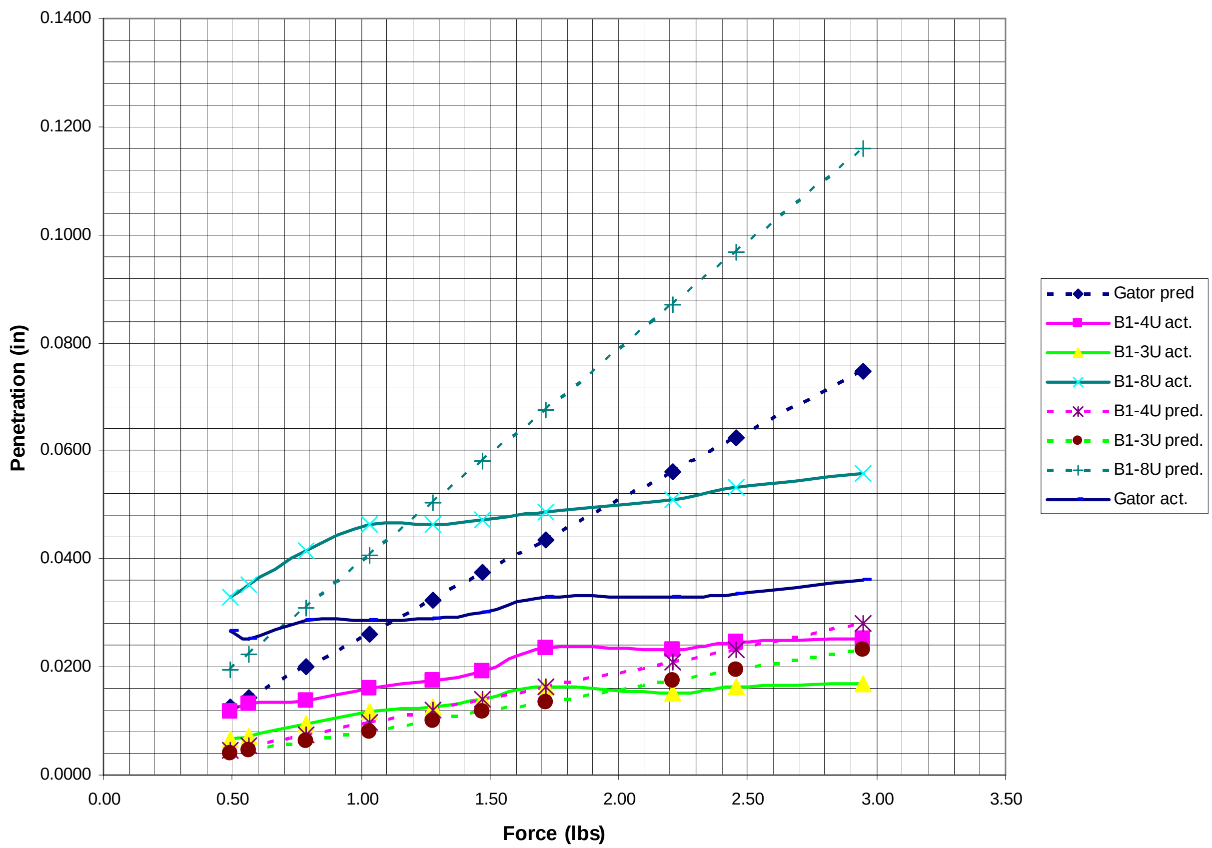


Figure A-17. Predicted and Experimental Penetration – Virgin Locations

Table A.2. Showing Correlation between Rock Strength and Penetration within Normal Force testing ranges used in the field (Fn < 10 lbs)

Unconfined Compression Strength	Penetration range
(psi)	(in)
100 - 200	0.060
200 - 400	0.050
400 - 500	0.040
500 - 600	0.030
600 - 800	0.025
800 - 1000	0.022
1000 - 1400	0.017

<u>Sample Calculations for Predicted Penetrations</u>

$F = 2bdq_u(f + \tan\beta)$

Where;

F = Seating/Penetration Force

B = wedge Length = 0.07874 in.

D = Penetration Depth = D

q_u = Unconfined Compressive Strength = 300 psi

f = Coefficient of Friction between rock and steel = 0.4

β = ½ wedge angle = 30 deg.

Rearranging $\longrightarrow$ $D = F/[2x0.07874x\ q_u\ (0.4+0.57735)] = 6.4972\ F/\ q_u$

For F= 2.03 lbs & q_u = 300psi,

D = 0.04396 inch

Figure A-18. Field Setup of Compressor, Jack and Data Collection System.

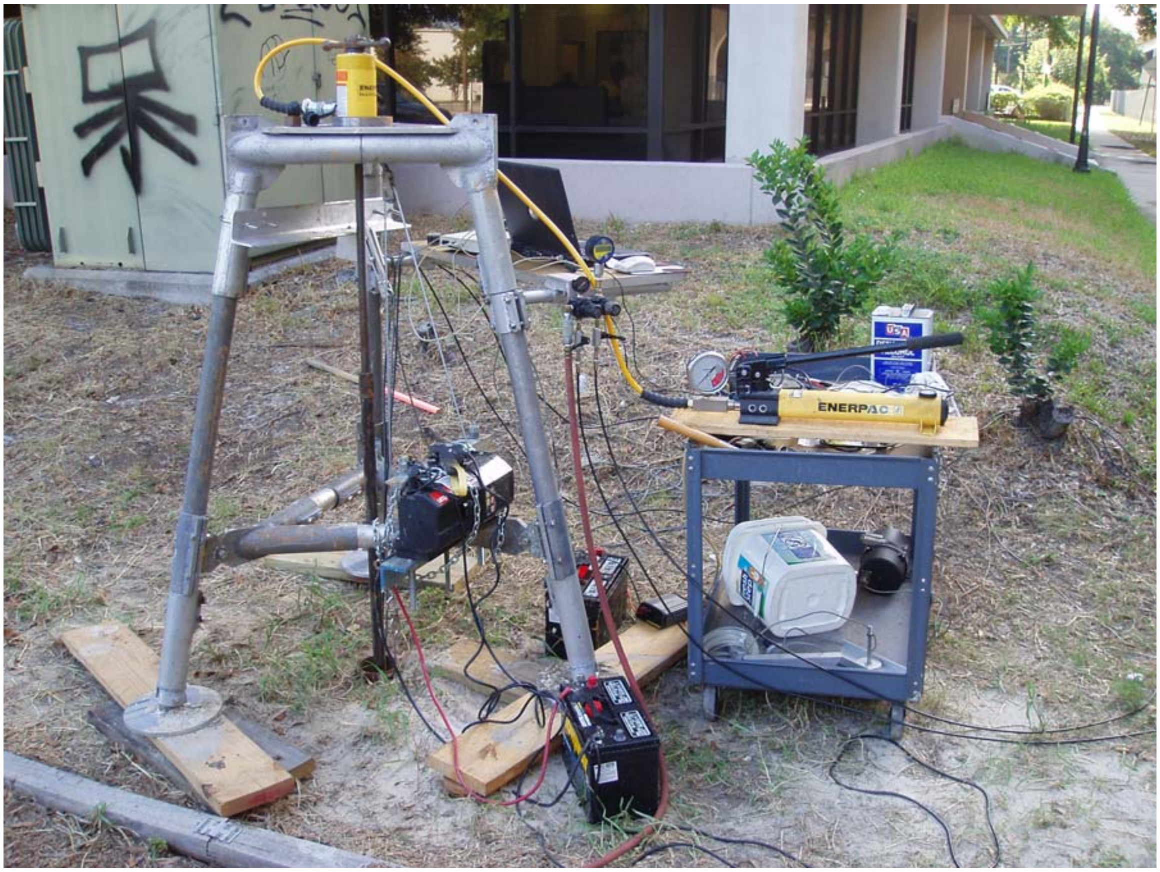


Figure A-19. Field Setup of Winch, Batteries and Compressed Air Regulator.

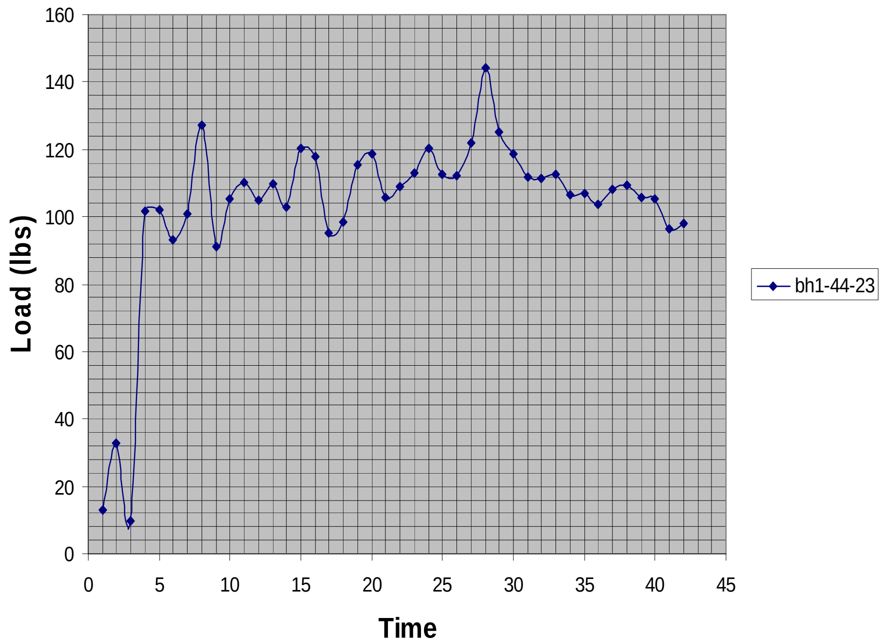


Figure A-20. Load vs Time: BH1@44'(Norm Pressure = 23 psi)

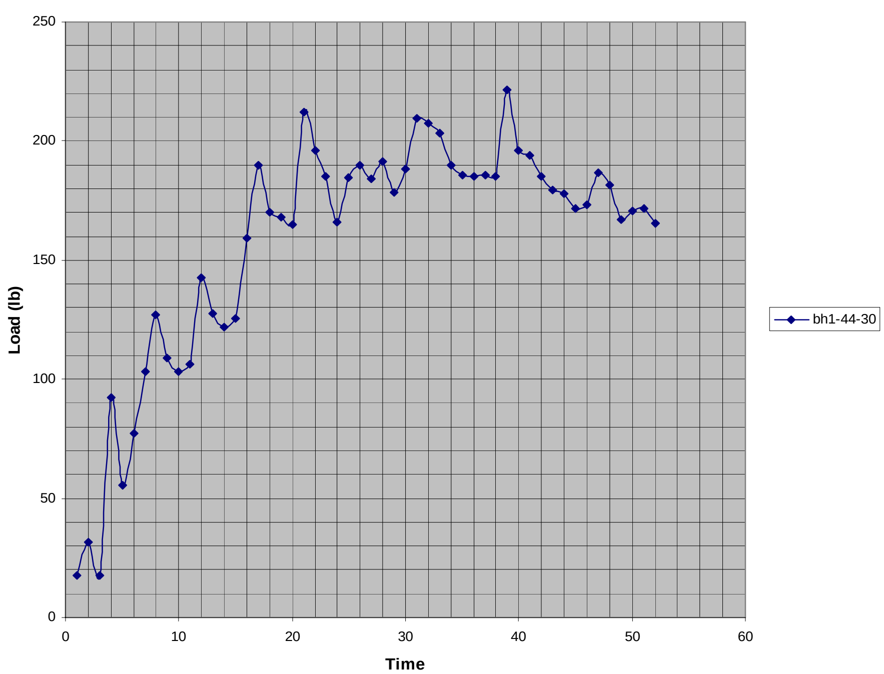


Figure A-21. Load vs Time: BH1@44'(Norm Pressure = 30 psi)

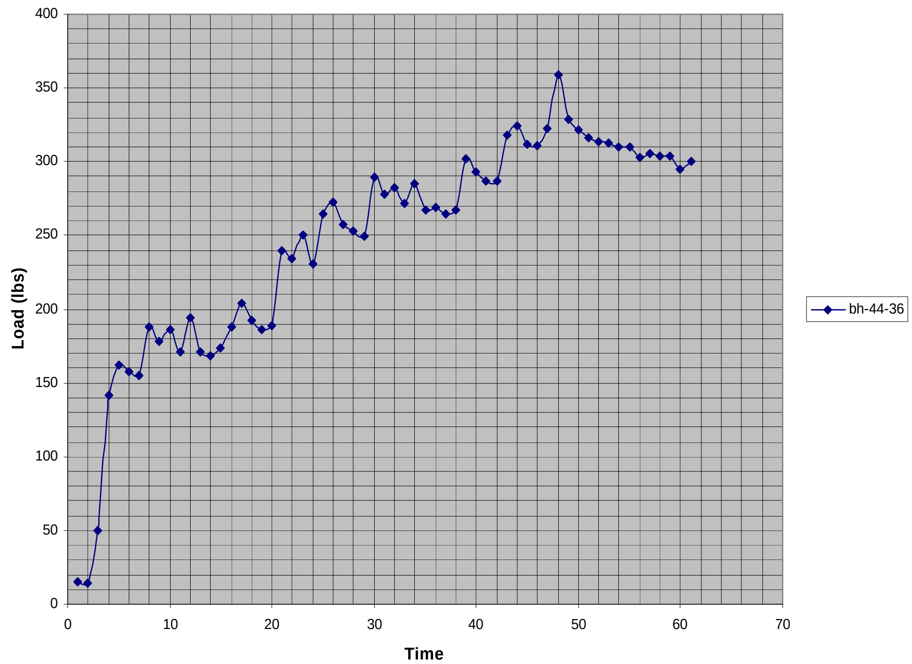


Figure A-22. Load vs Time: BH1@44'(Norm Pressure = 36 psi)

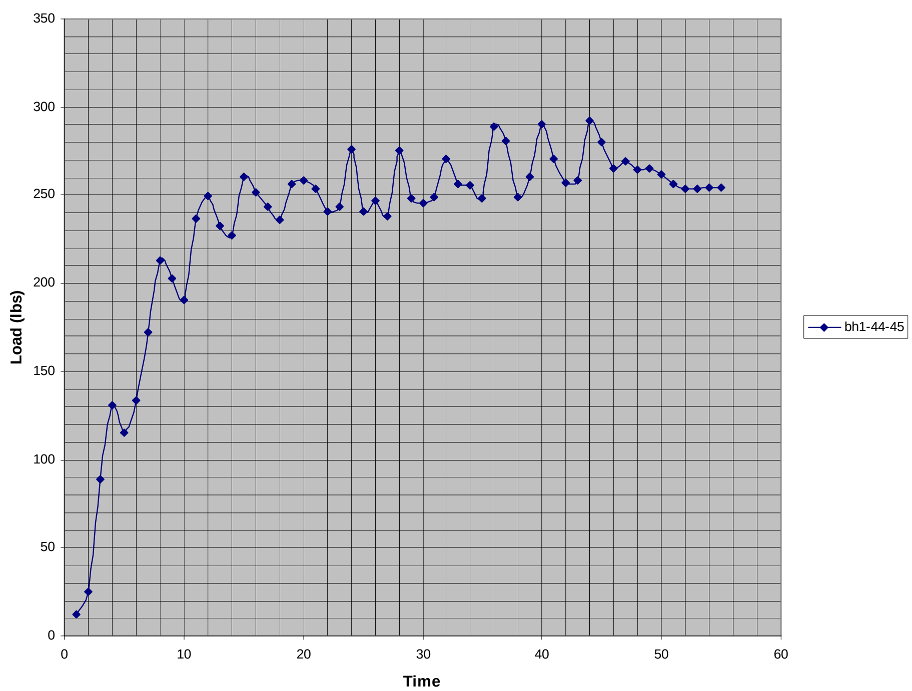


Figure A-23. Load vs Time: BH1@44'(Norm Pressure = 45 psi)

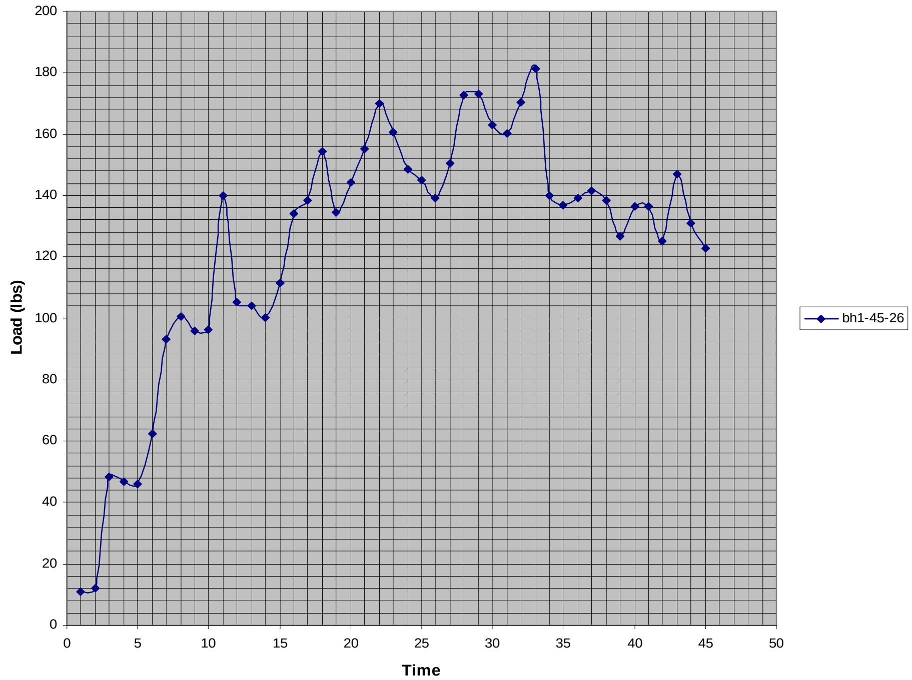


Figure A-24. Load vs Time: BH1@45’(Norm Pressure = 26 psi)

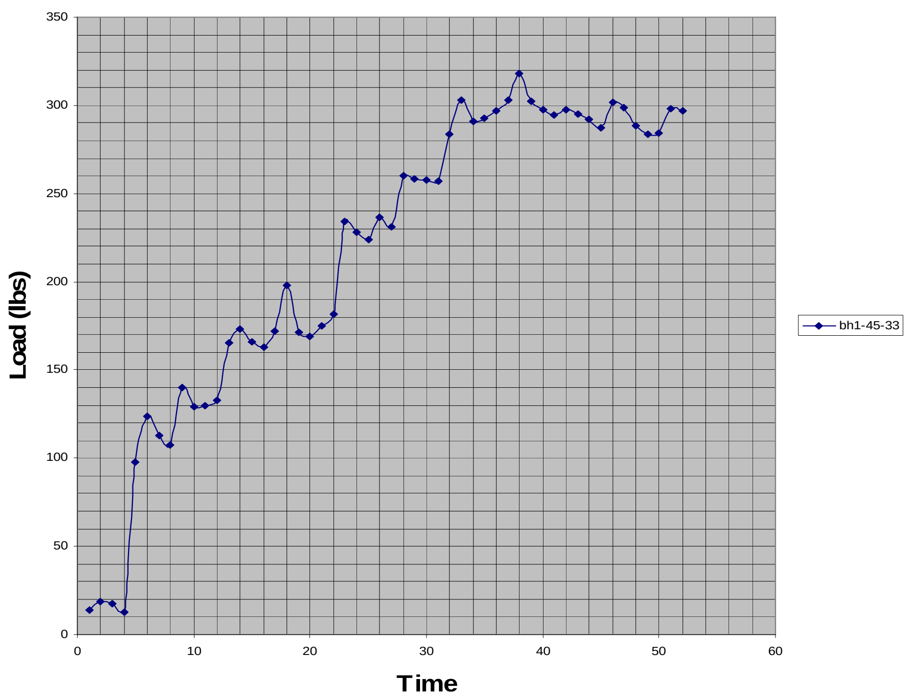


Figure A-25. Load vs Time: BH1@45’(Norm Pressure = 33 psi)

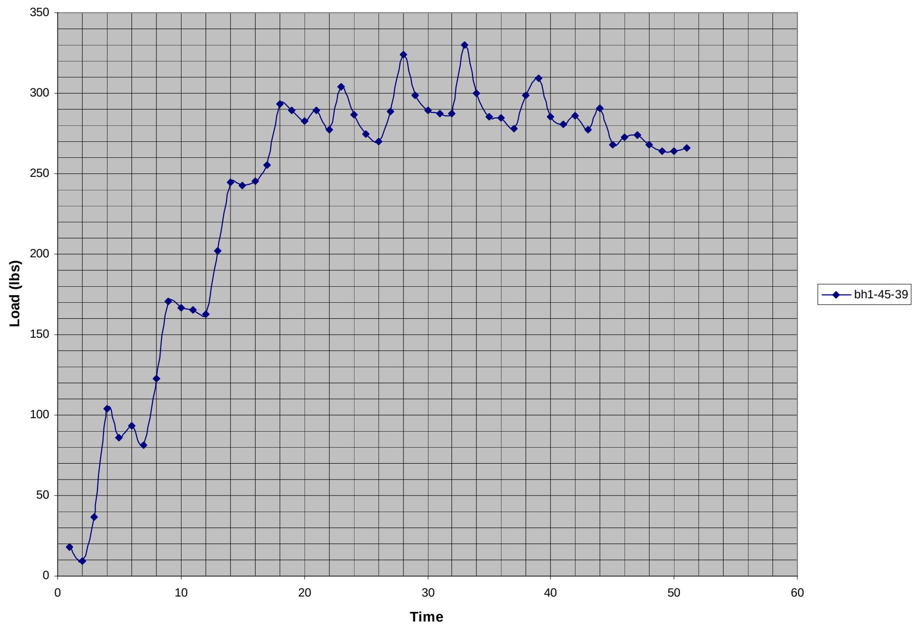


Figure A-26. Load vs Time: BH1@45'(Norm Pressure = 39 psi)

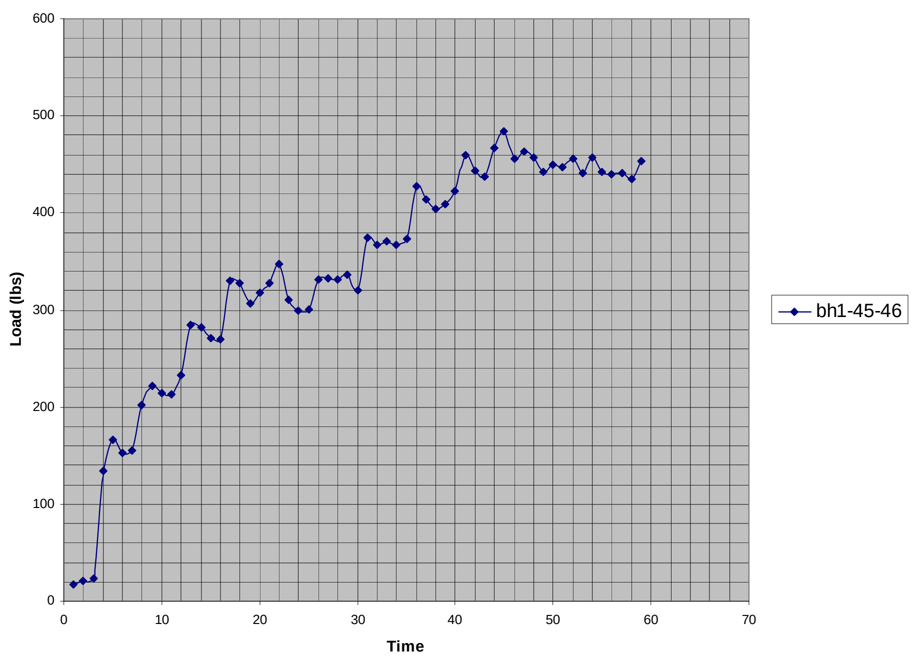


Figure A-27. Load vs Time: BH1@45'(Norm Pressure = 46 psi)

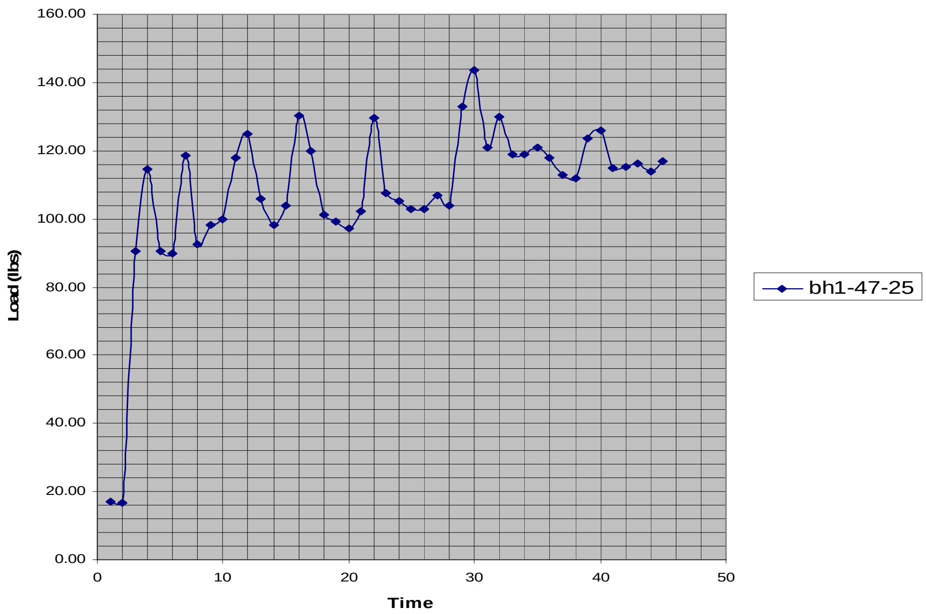


Figure A-28. Load vs Time: BH1@47'(Norm Pressure = 25 psi)

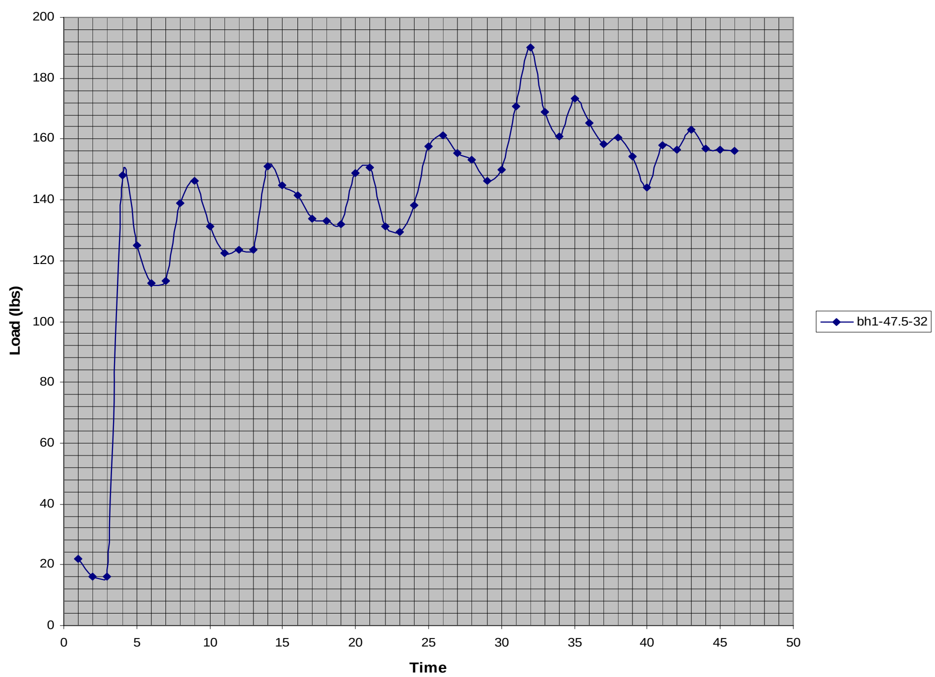


Figure A-29. Load vs Time: BH1@47'(Norm Pressure = 32 psi)

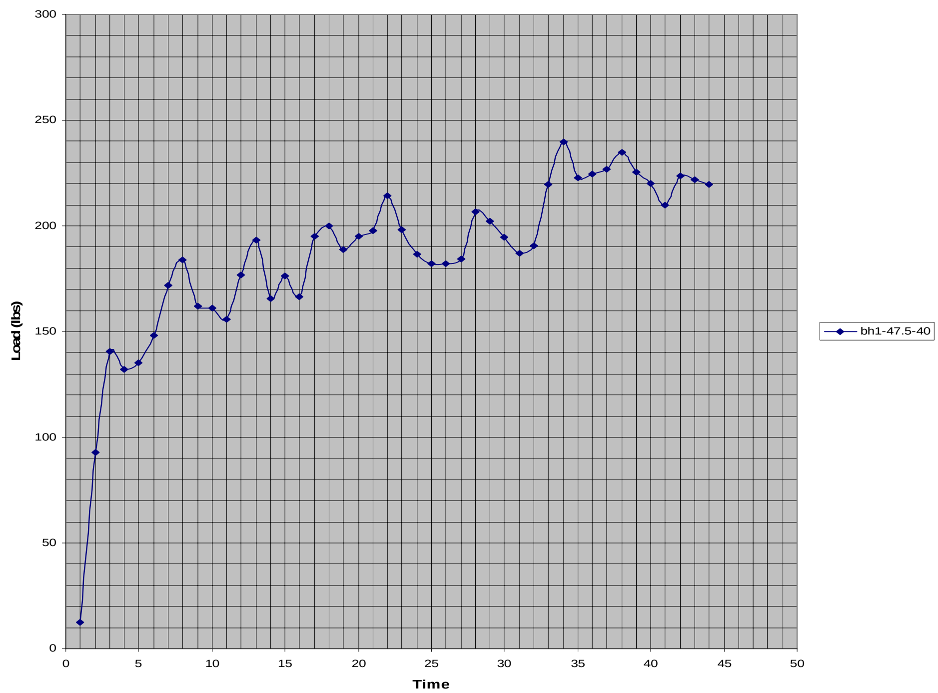


Figure A-30. Load vs Time; BH1@47'(Norm Pressure = 40 psi)

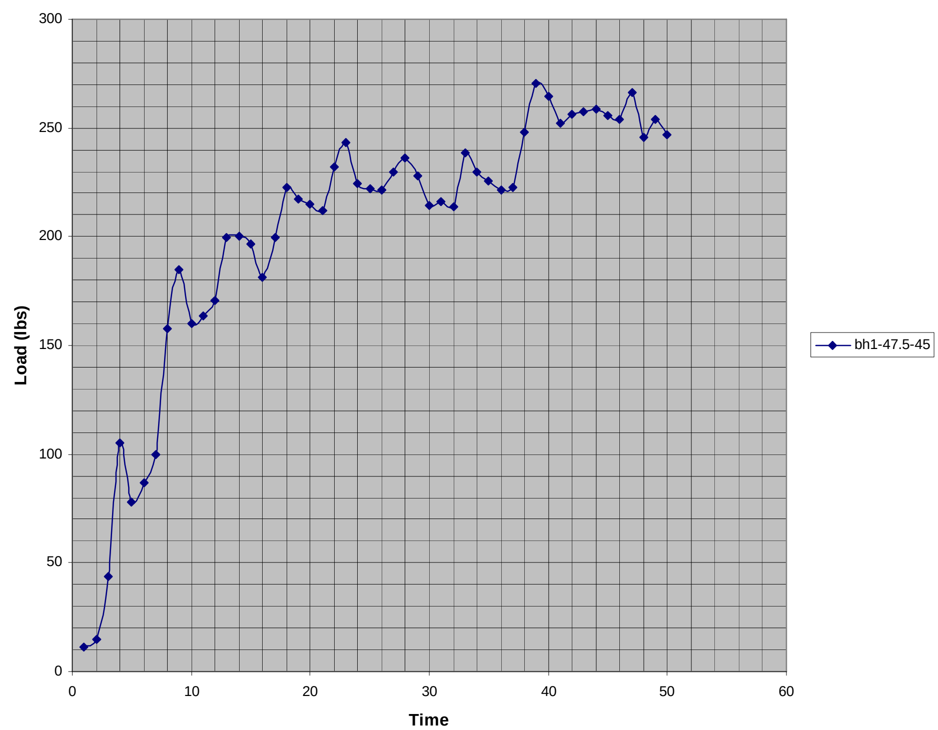


Figure A-31. Load vs Time: BH1@47'(Norm Pressure = 45 psi)

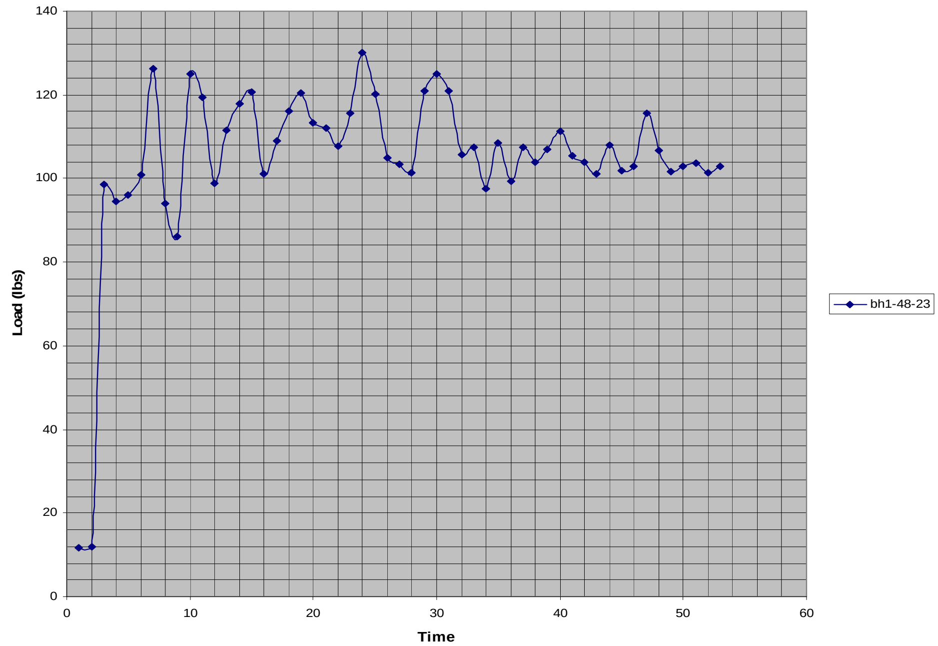


Figure A-32. Load vs Time: BH1@48'(Norm Pressure = 23 psi)

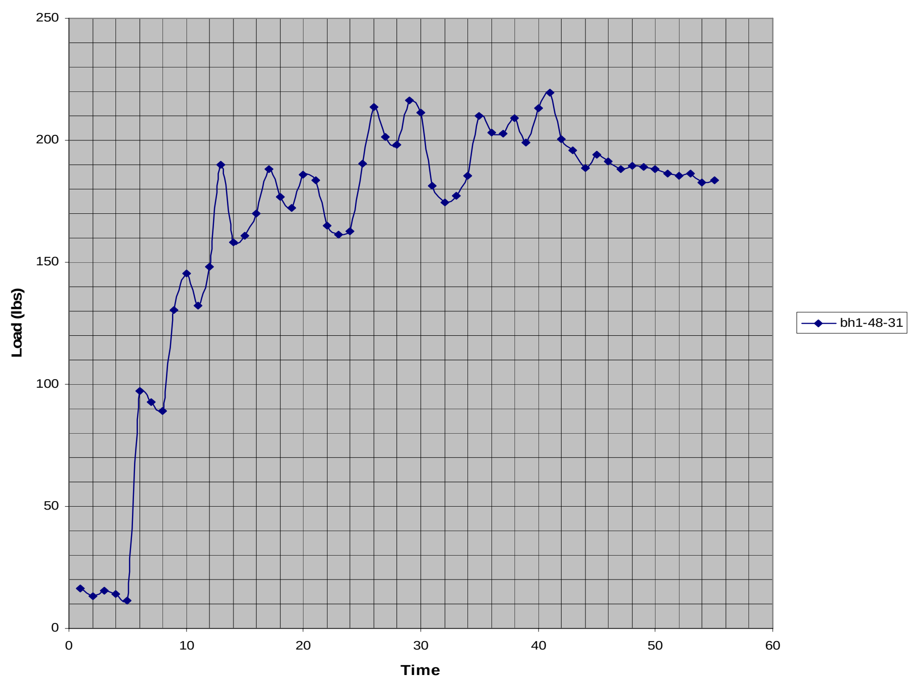


Figure A-33. Load vs Time: BH1@48'(Norm Pressure = 31 psi)

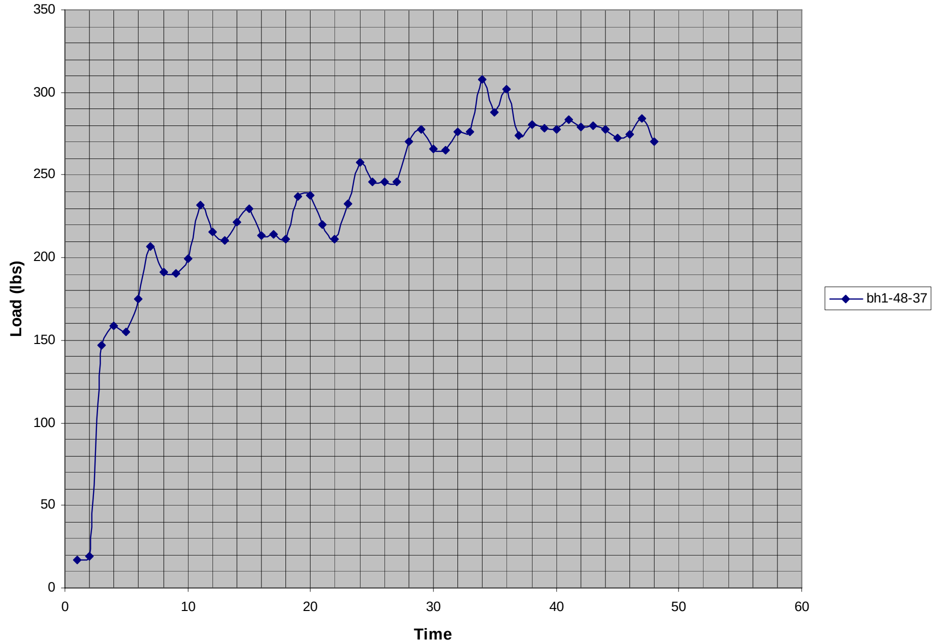


Figure A-34. Load vs Time: BH1@48'(Norm Pressure = 37 psi)

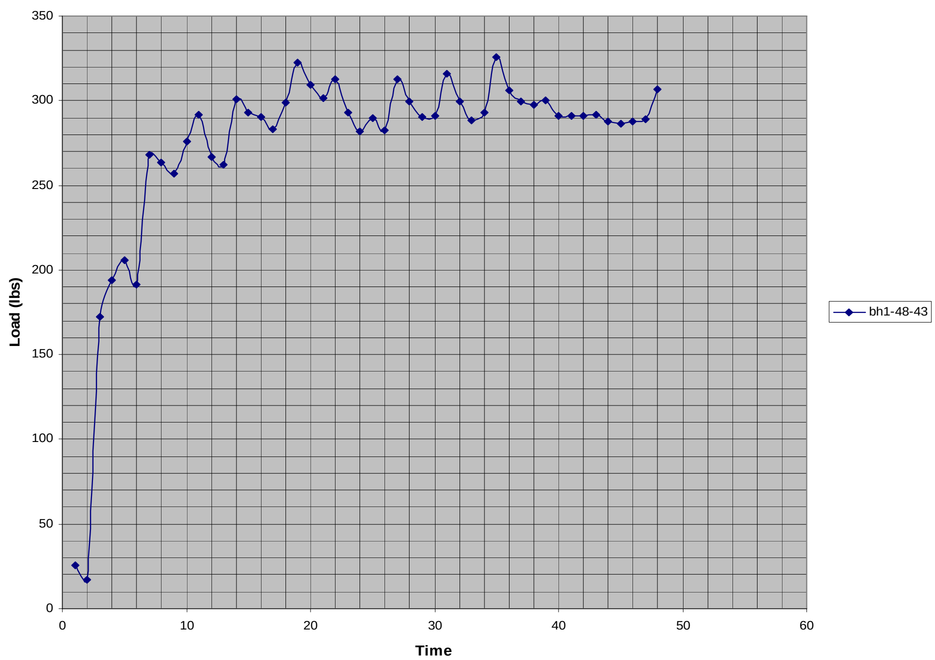


Figure A-35. Load vs Time: BH1@48'(Norm Pressure 43 psi)

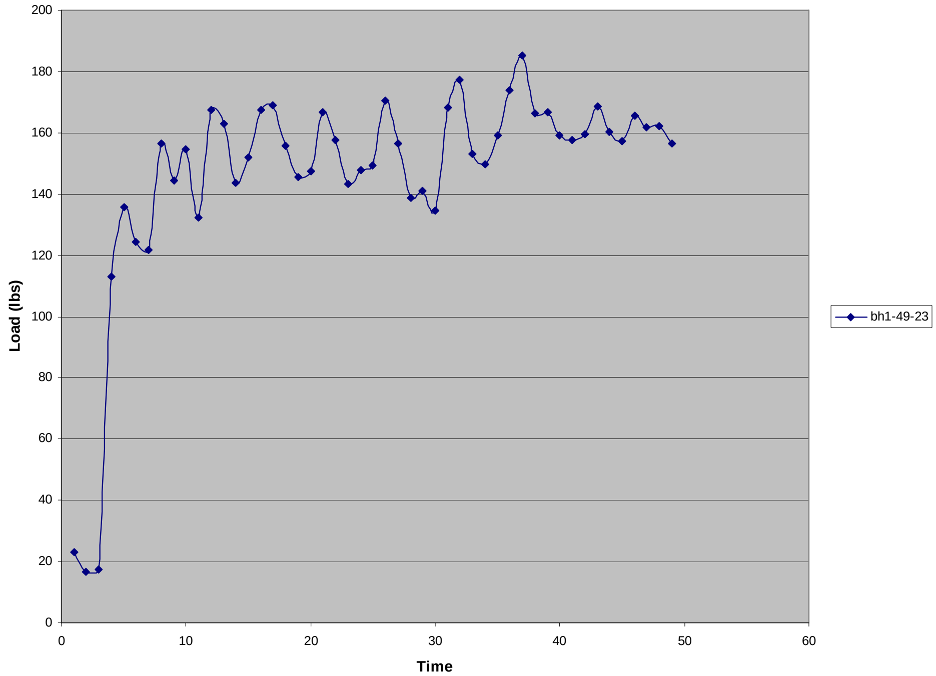


Figure A-36. Load vs Time: BH1@49’(Norm Pressure = 25 psi)

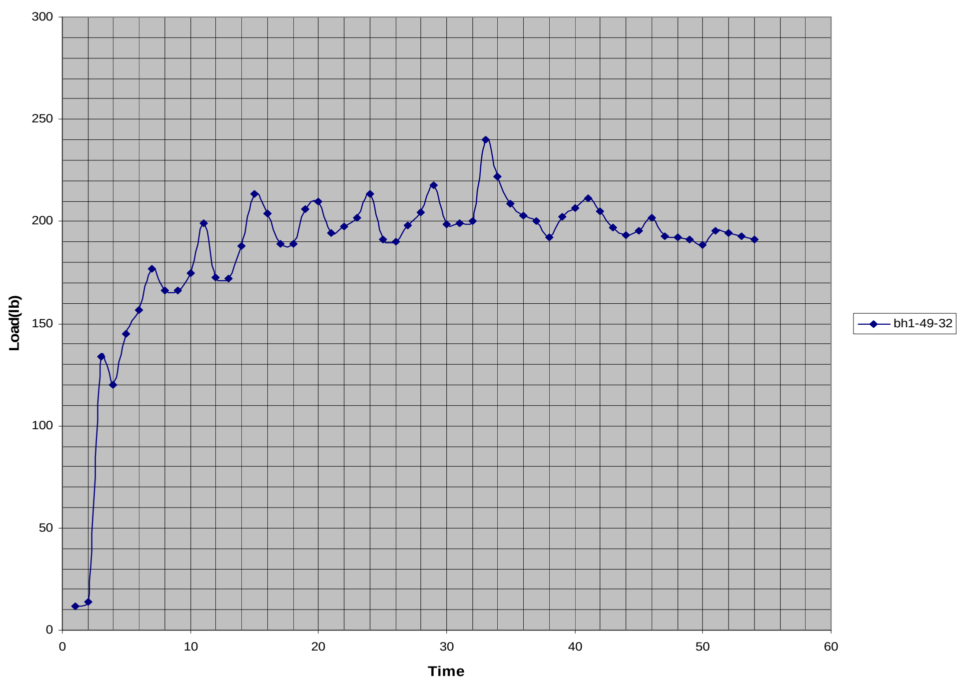


Figure A-37. Load vs Time: BH1@49’(Norm Pressure = 32 psi)

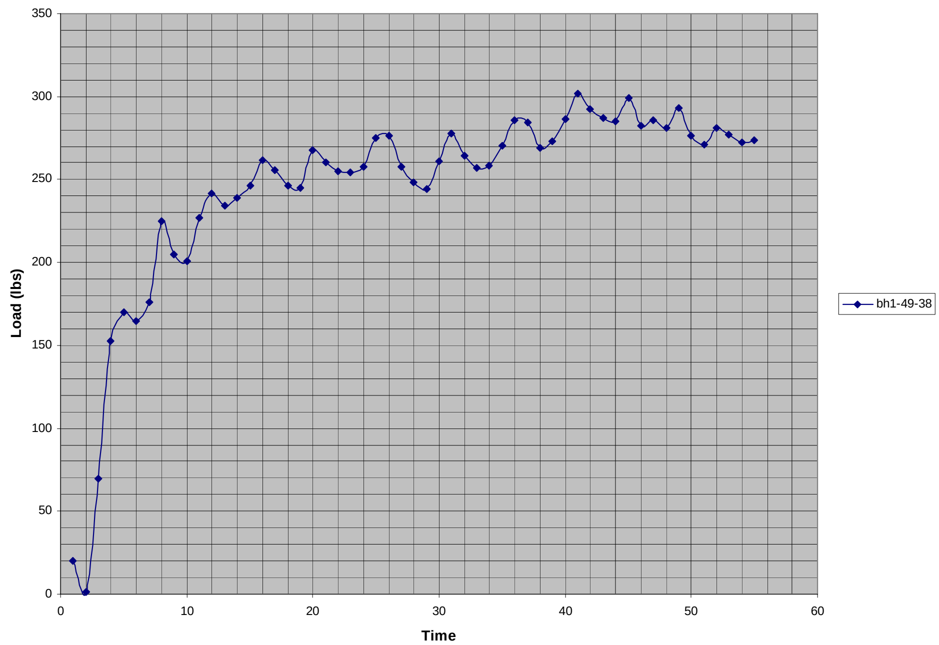


Figure A-38. Load vs Time: BH1@49'(Norm Pressure = 38 psi)

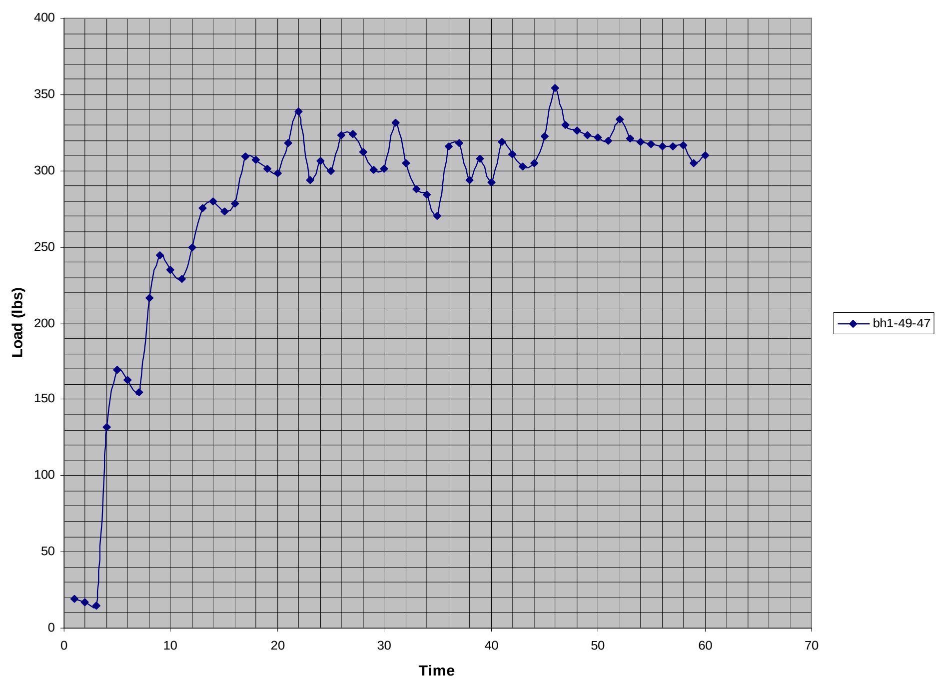


Figure A-39. Load vs Time: BH1@49'(Norm Pressure = 47 psi)

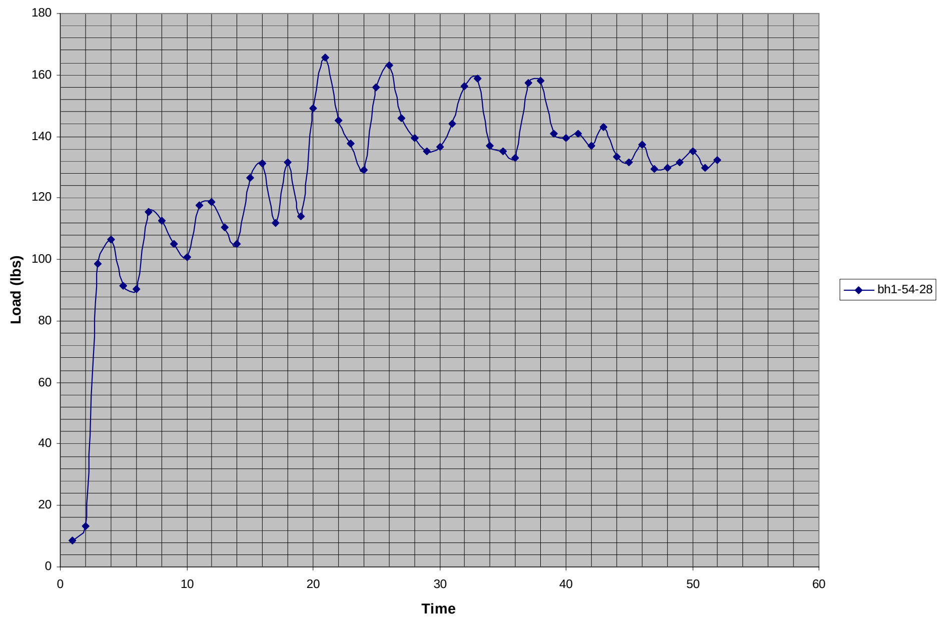


Figure A-40. Load vs Time: BH1@54'(Norm Pressure = 26 psi)

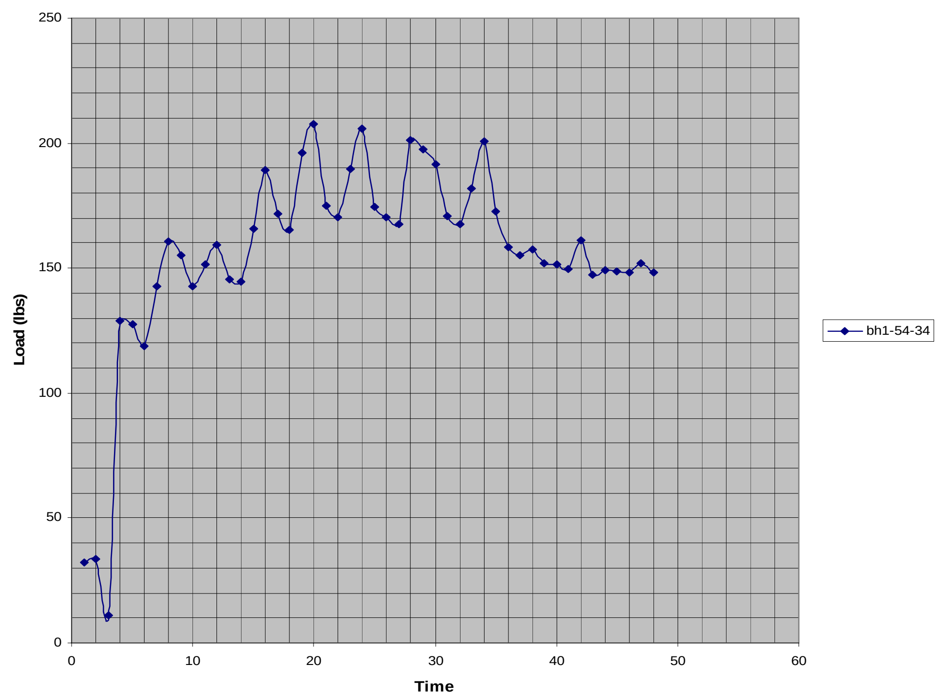


Figure A-41. Load vs Time: BH1@54'(Norm Pressure = 34 psi)

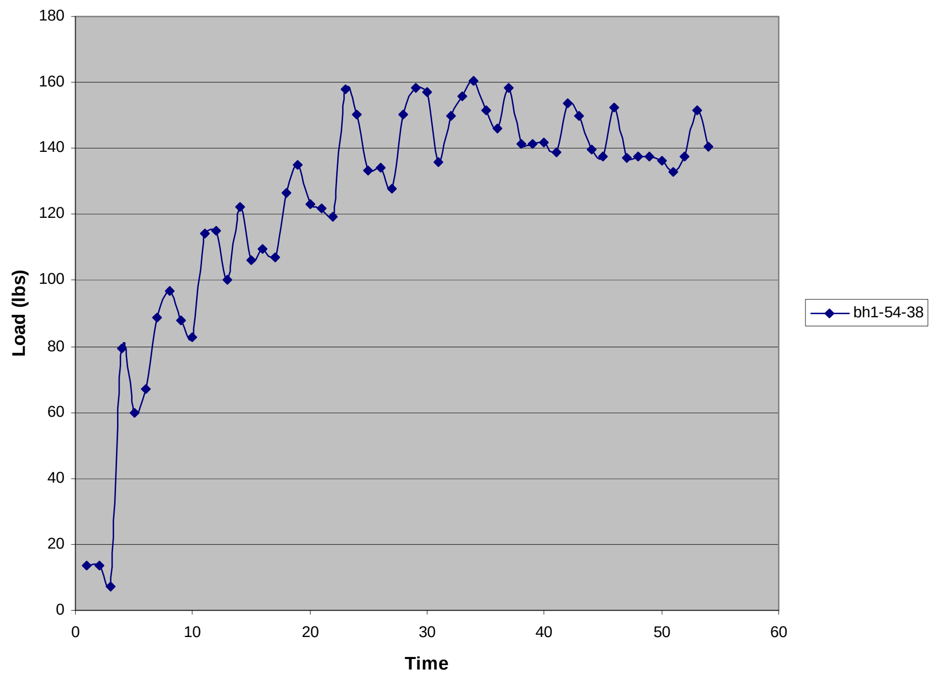


Figure A-42. Load vs Time: BH1@54'(Norm Pressure = 38 psi)

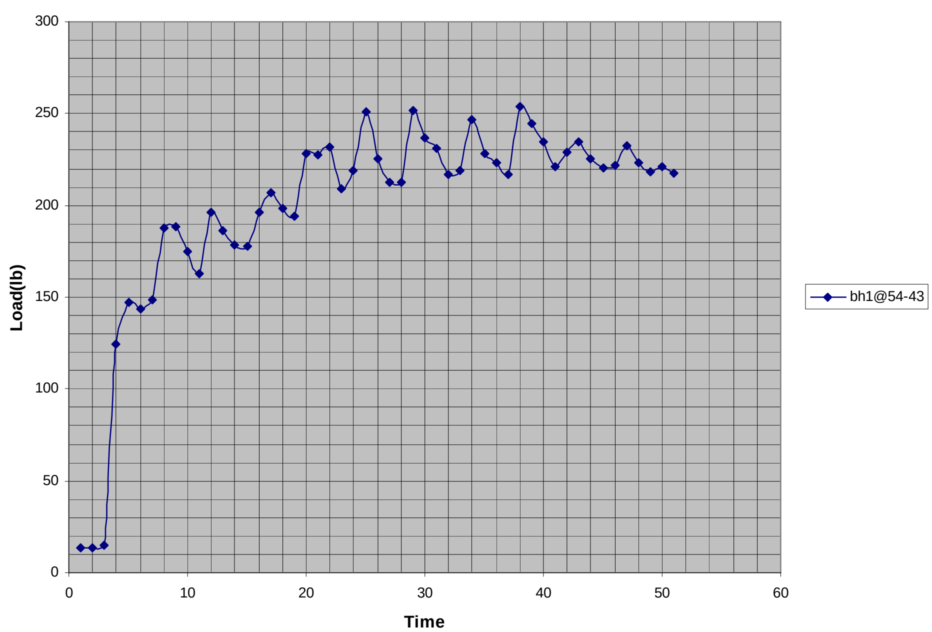


Figure A-43. Load vs Time: BH1@54'(Norm Pressure = 43 psi)

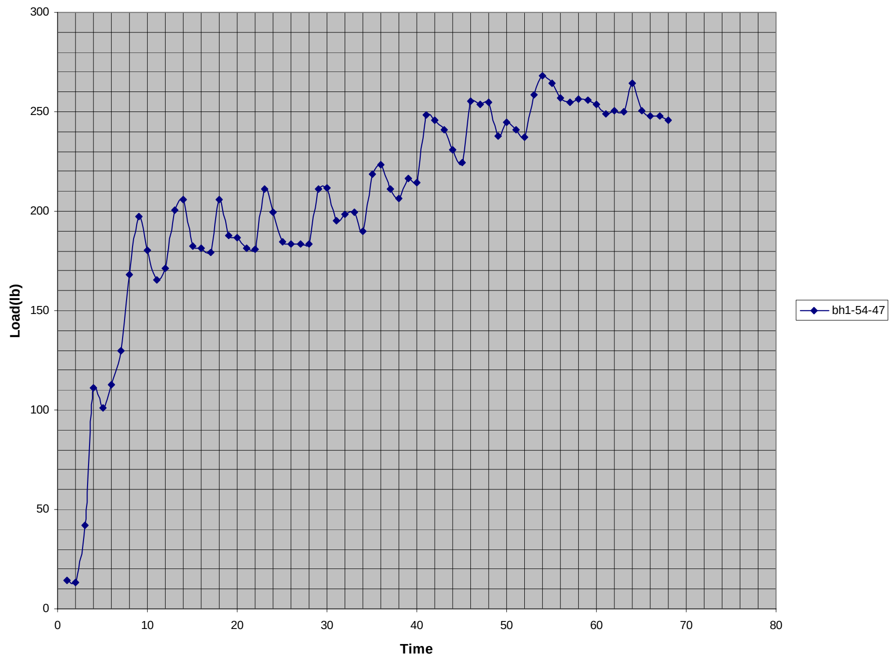


Figure A-44. Load vs Time: BH1@54'(Norm Pressure = 47 psi)

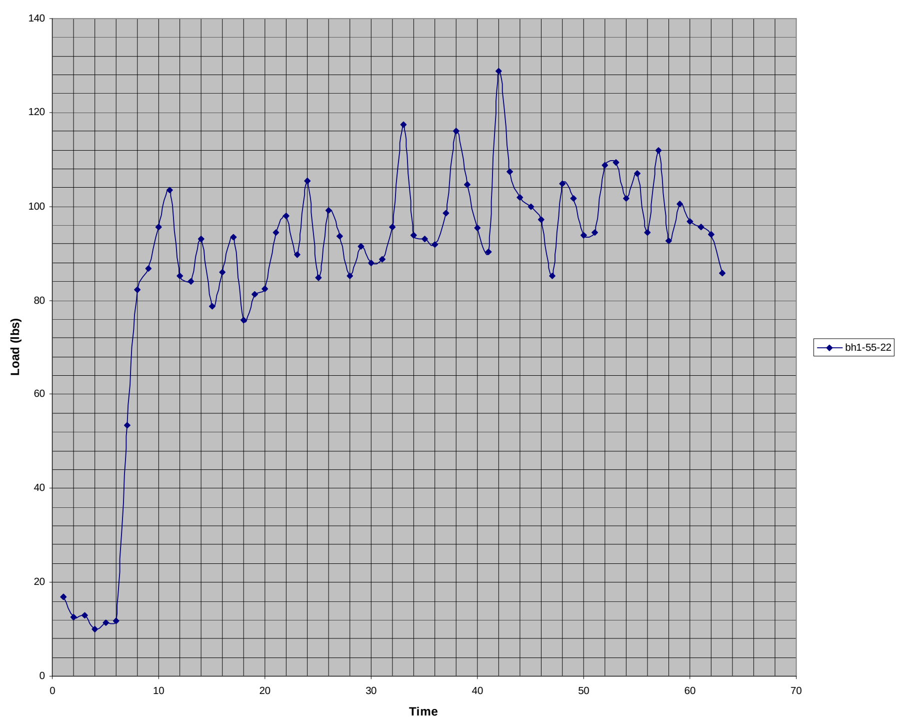


Figure A-45. Load vs Time: BH1@55'(Norm Pressure = 22 psi)

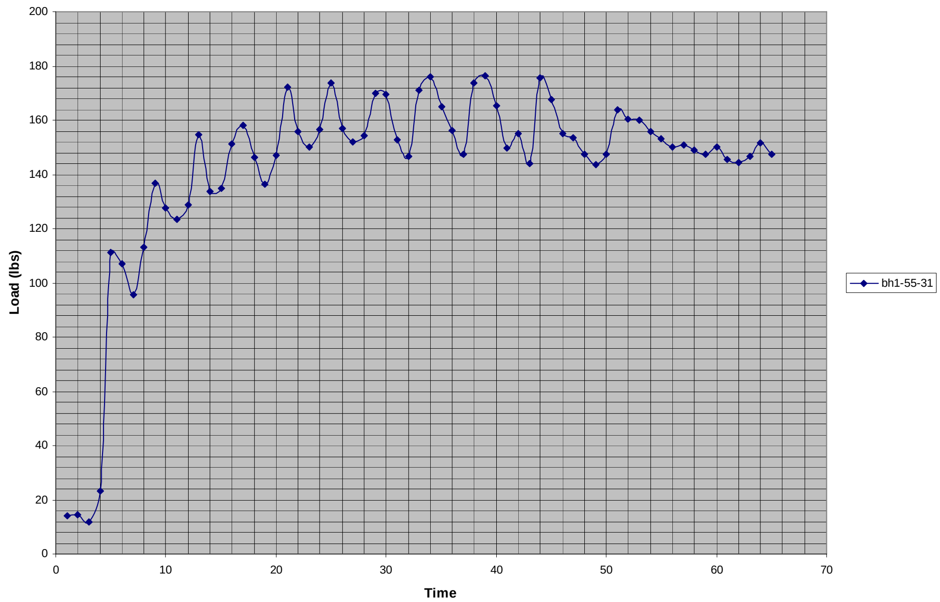


Figure A-46. Load vs Time: BH1@55'(Norm Pressure = 31 psi)

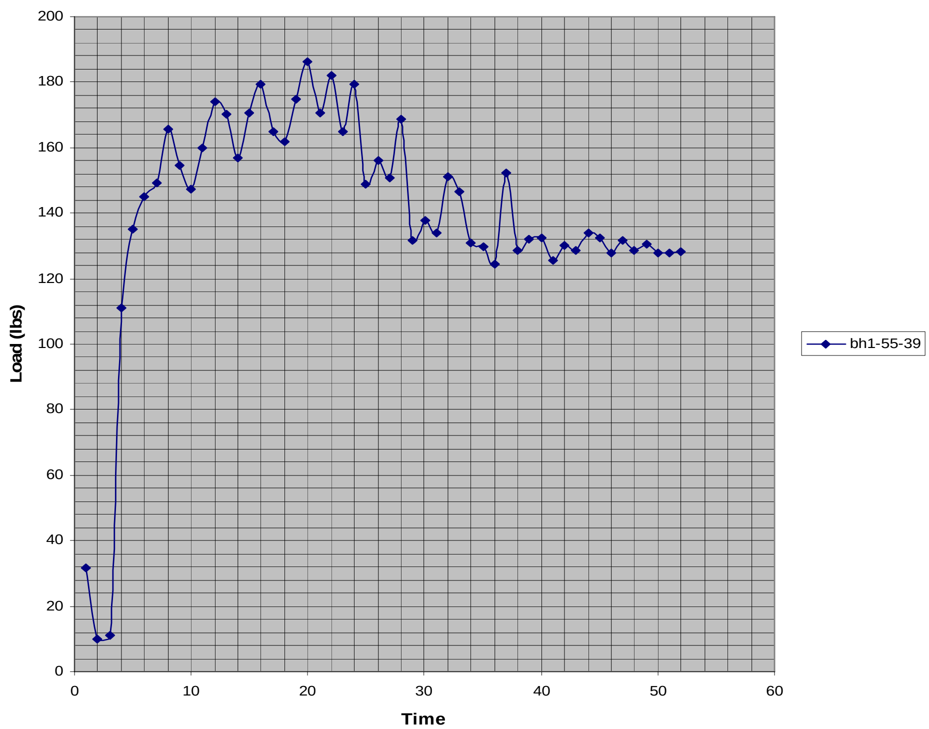


Figure A-47. Load vs Time: BH1@55'(Norm Pressure = 39 psi)

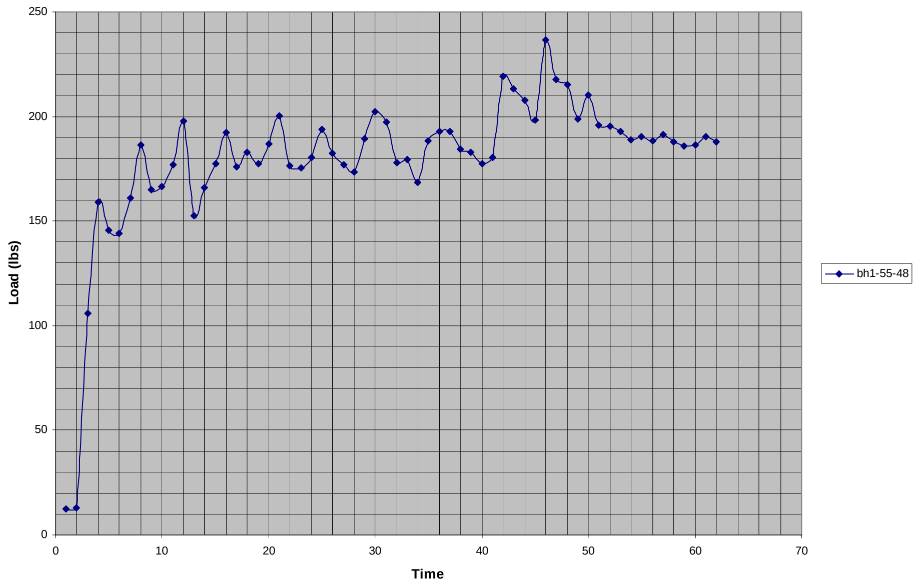


Figure A-48. Load vs Time: BH1@55'(Norm Pressure = 48 psi)

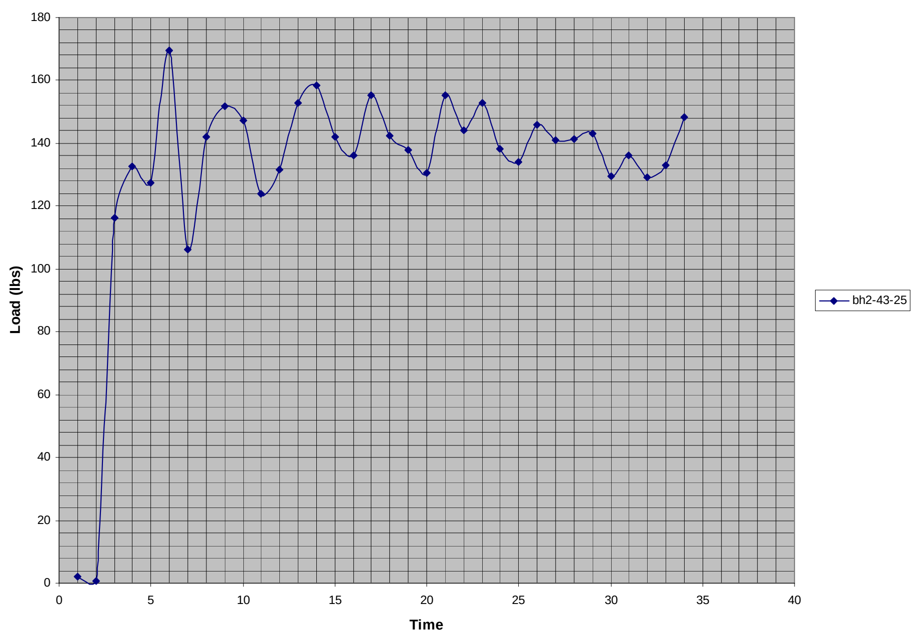


Figure A-49. Load vs Time: BH2@43'(Norm Pressure = 25 psi)

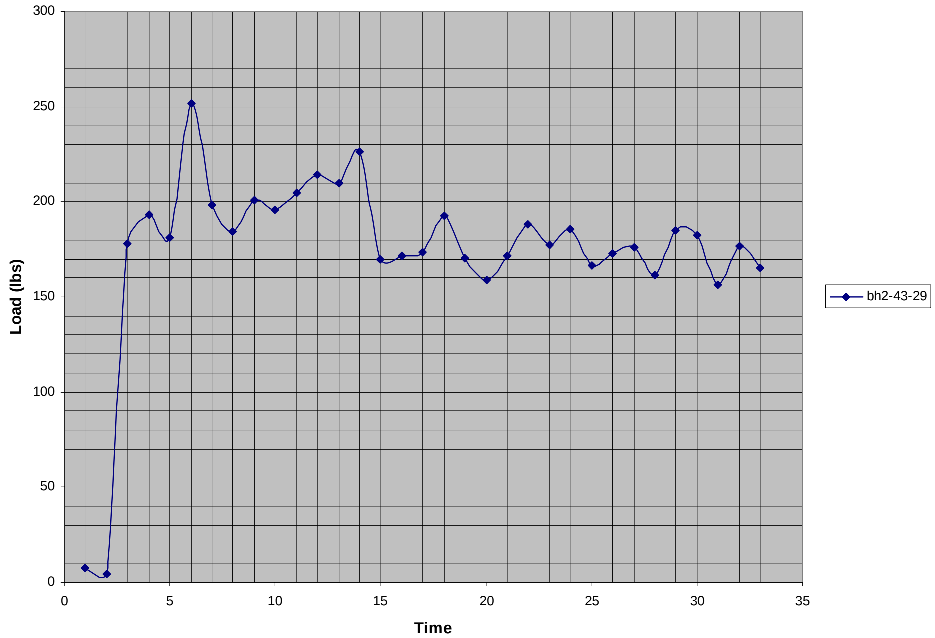


Figure A-50. Load vs Time: BH2@43'(Norm Pressure = 29 psi)

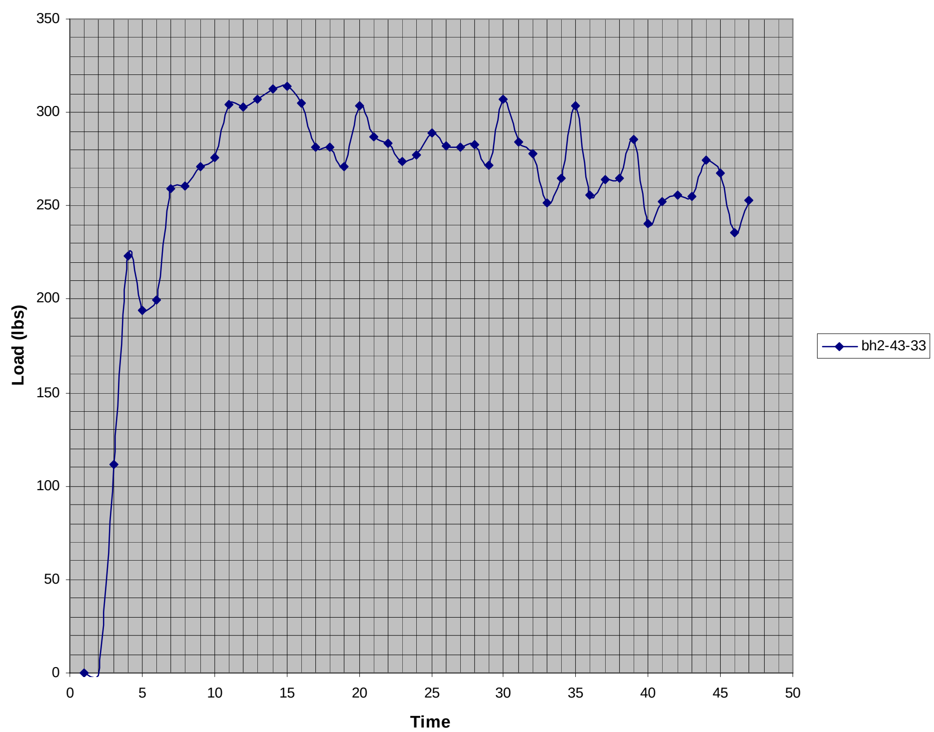


Figure A-51. Load vs Time: BH2@43'(Norm Pressure = 33 psi)

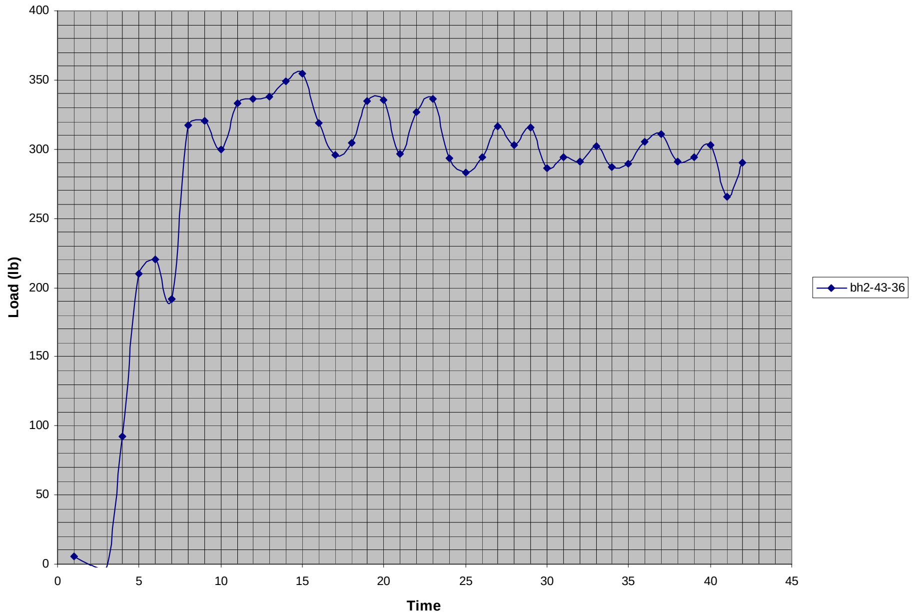


Figure A-52. Load vs Time: BH2@43'(Norm Pressure = 36 psi)

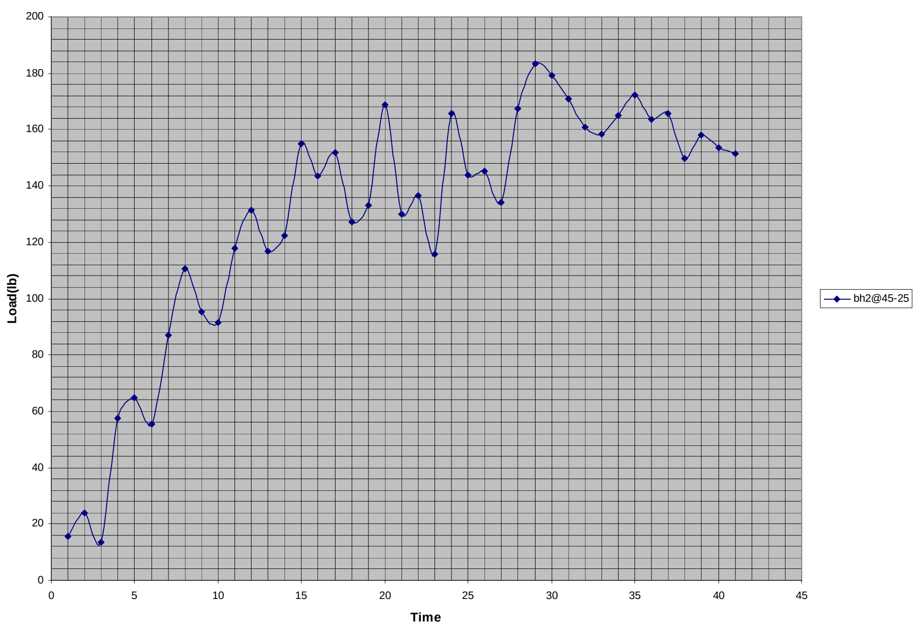


Figure A-53. Load vs Time; BH2@44'(Norm Pressure = 25 psi)

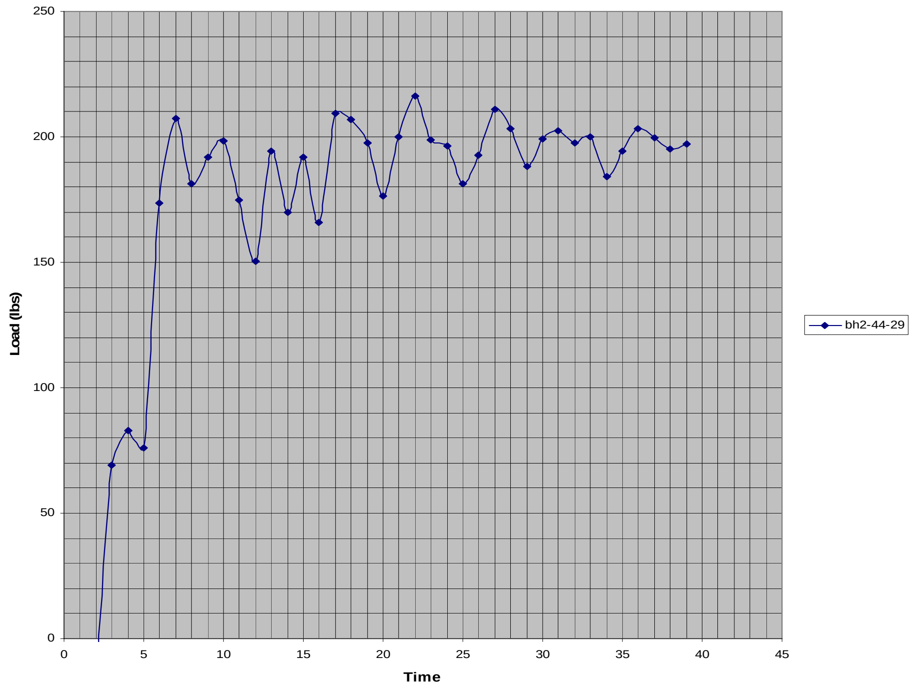


Figure A-54. Load vs Time: BH2@44'(Norm Pressure = 29 psi)

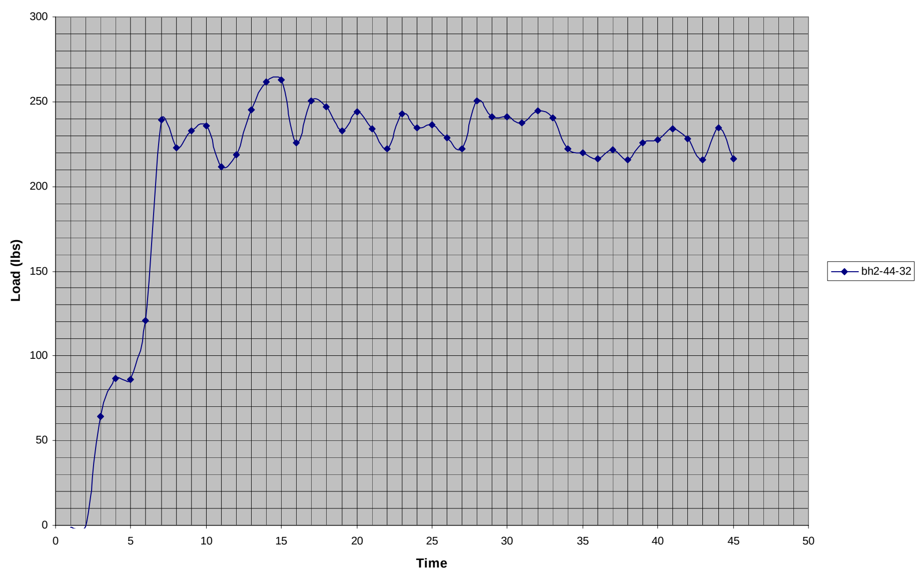


Figure A-55. Load vs Time: BH2@44'(Norm Pressure = 32 psi)

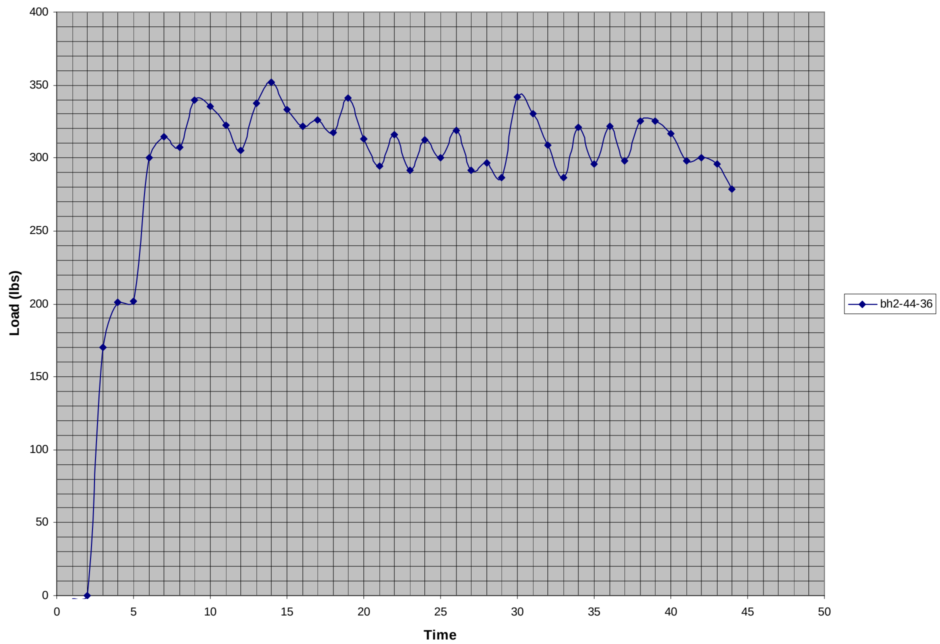


Figure A-56. Load vs Time: BH2@44'(Norm Pressure = 36 psi)

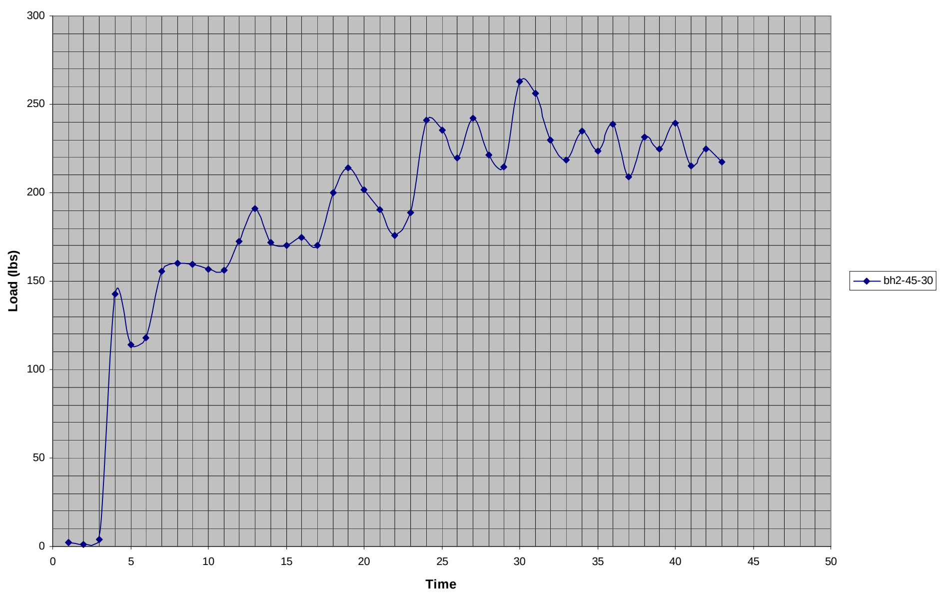


Figure A-57. Load vs Time: BH2@45'(Norm Pressure = 30 psi)

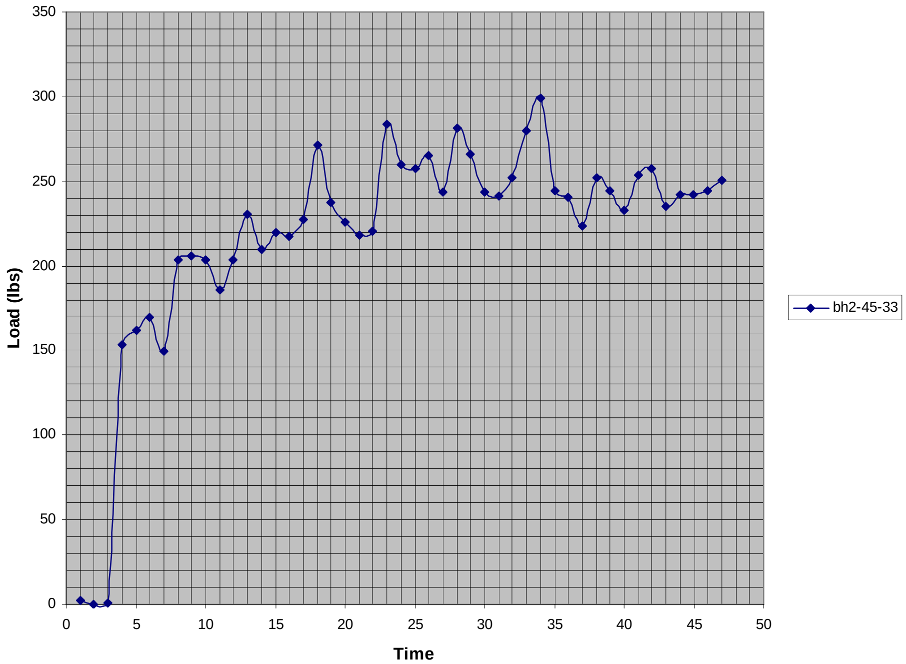


Figure A-58. Load vs Time: BH2@45'(Norm Pressure = 33 psi)

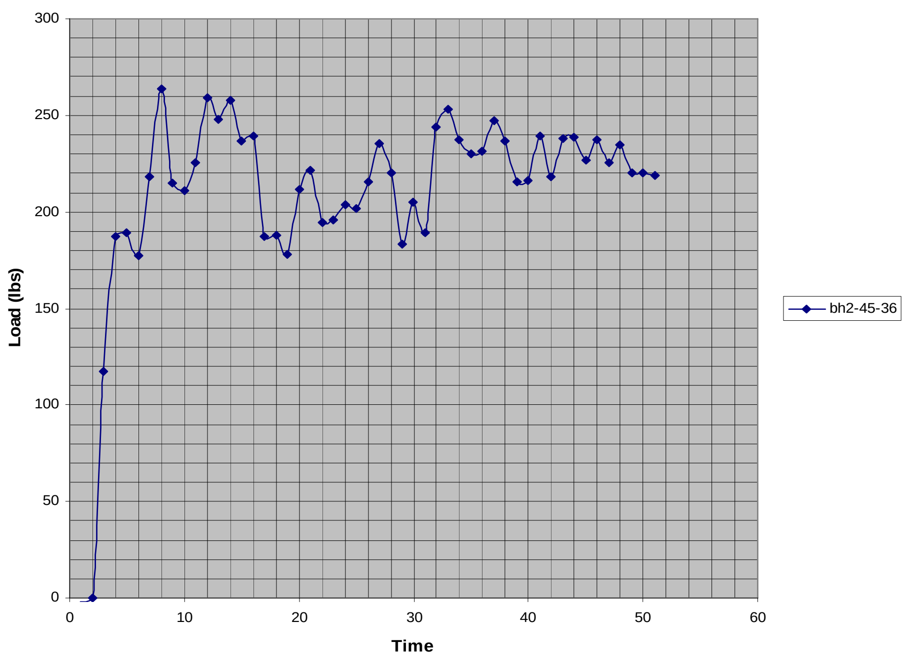


Figure A-59. Load vs Time: BH2@45'(Norm Pressure = 36 psi)

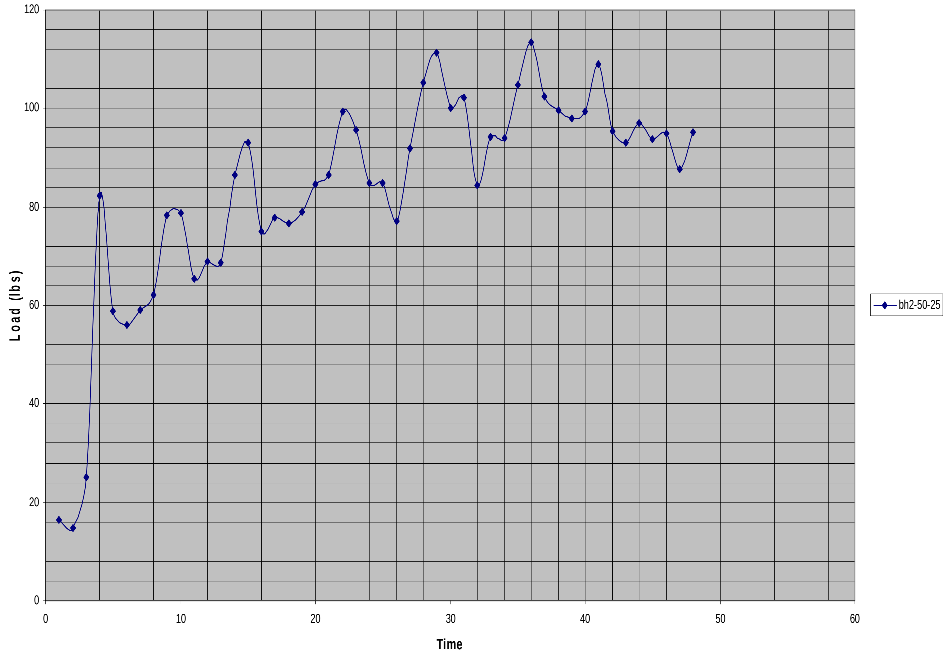


Figure A-60. Load vs Time: BH2@50'(Norm Pressure = 25 psi)

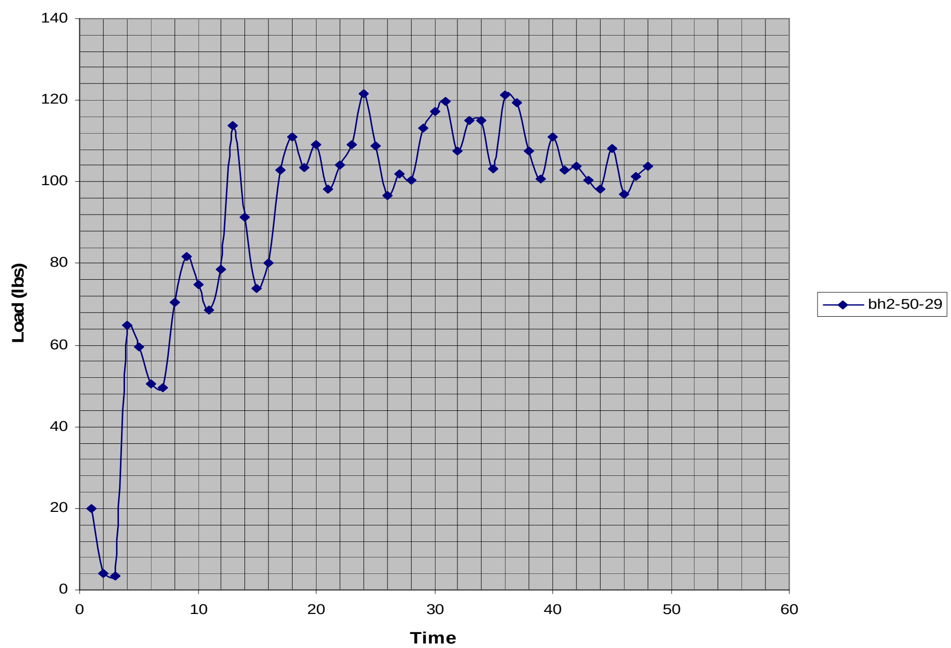


Figure A-61. Load vs Time: BH2@50'(Norm Pressure = 29 psi)

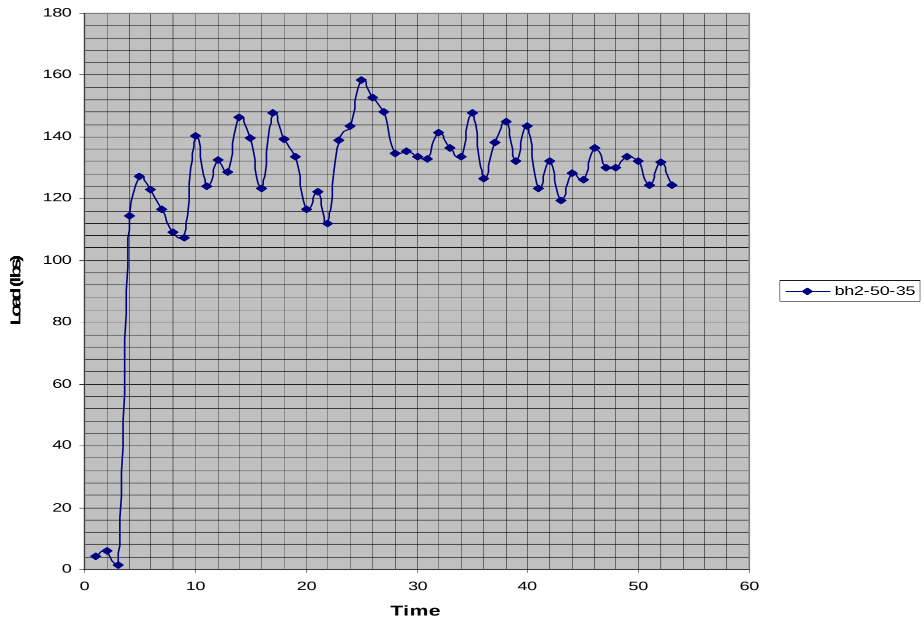


Figure A-62. Load vs Time: BH2@50'(Norm Pressure = 35 psi)

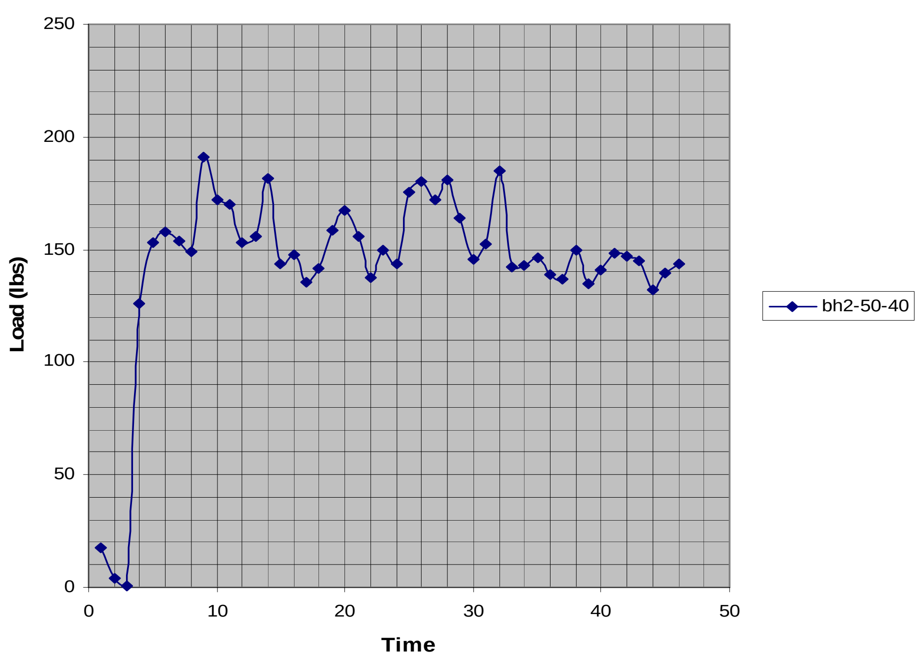


Figure A-63. Load vs Time: BH2@50'(Norm Pressure = 40 psi)

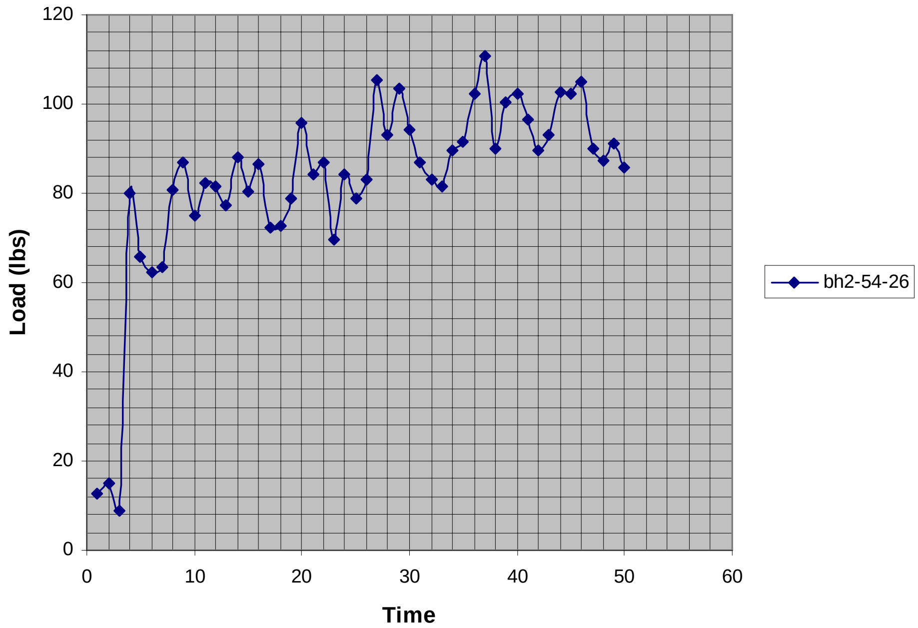


Figure A-64. Load vs Time: BH2@54’(Norm Pressure = 26 psi)

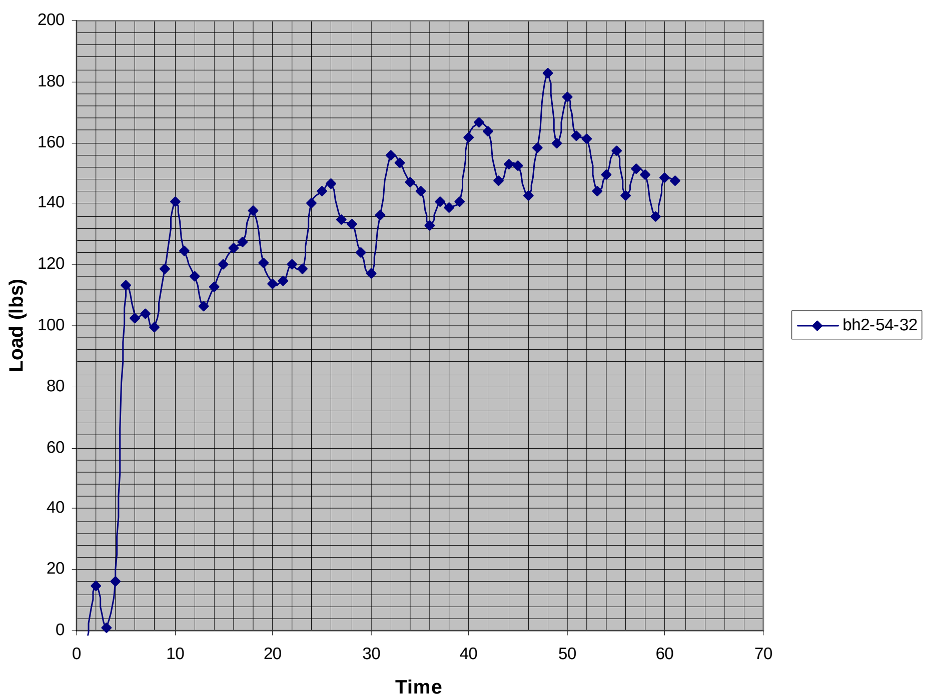


Figure A-65. Load vs Time: BH2@54’(Norm Pressure = 32 psi)

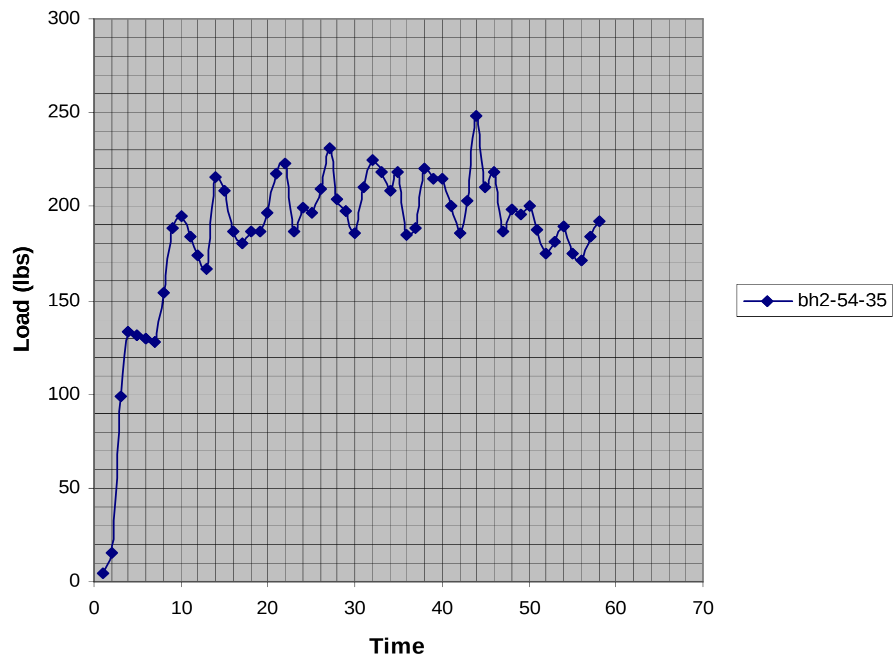


Figure A-66. Shear Stress vs Displacement; BH2@54'(Norm Pressure = 35 psi)

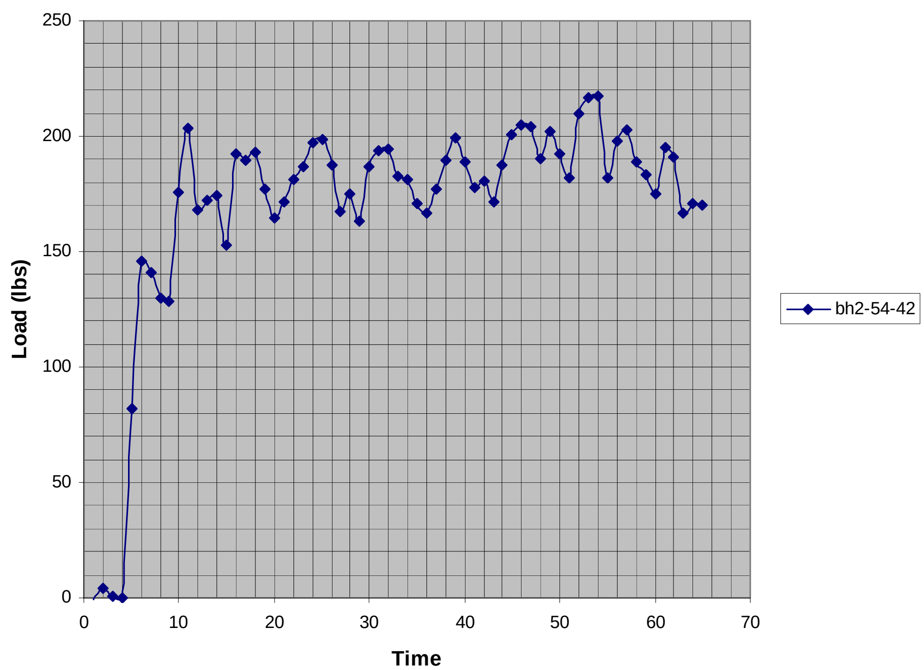


Figure A-67. Load vs Time: BH2@54'(Norm Pressure = 42 psi)

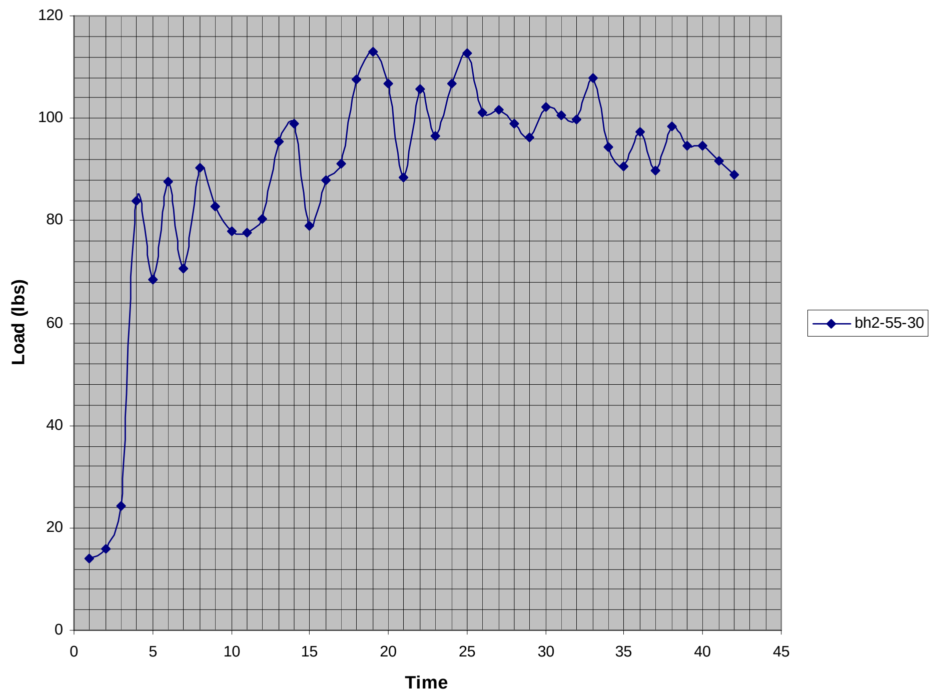


Figure A-68. Load vs Time: BH2@55'(Norm Pressure = 30 psi)

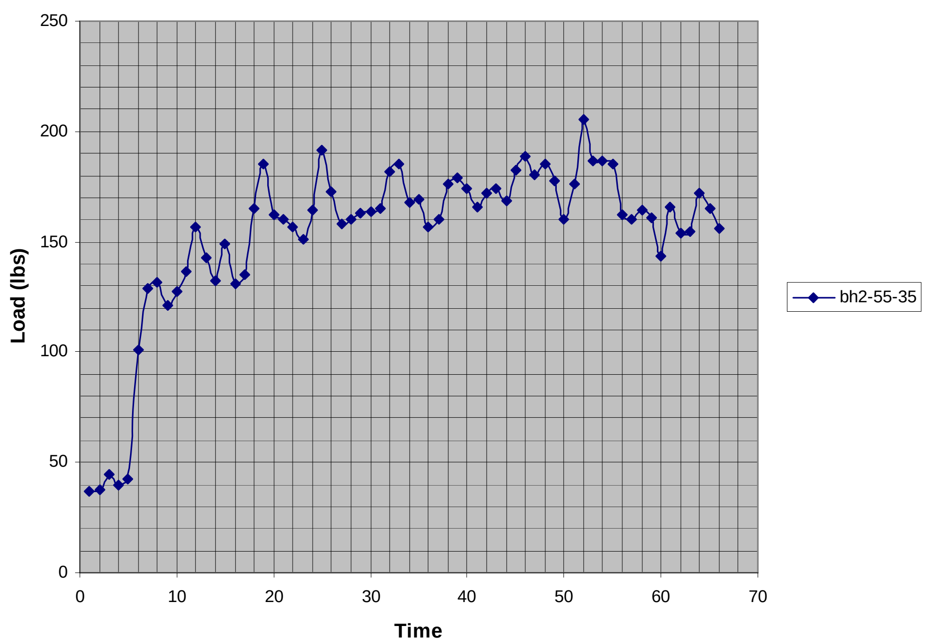


Figure A-69. Load vs Time: BH2@55'(Norm Pressure = 35 psi)

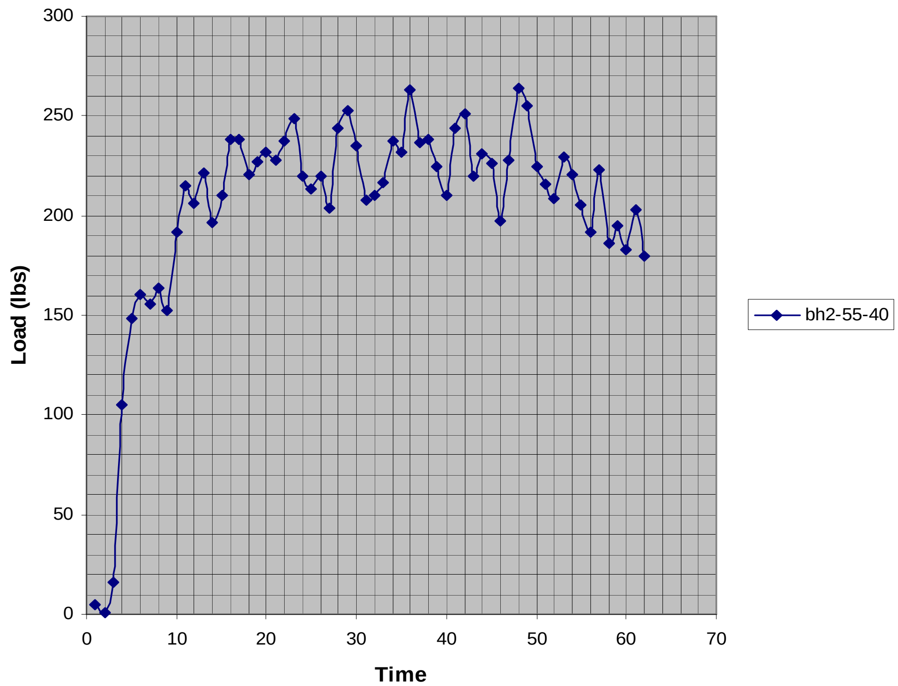


Figure A-70. Load vs Time: BH2@55'(Norm Pressure = 40 psi)

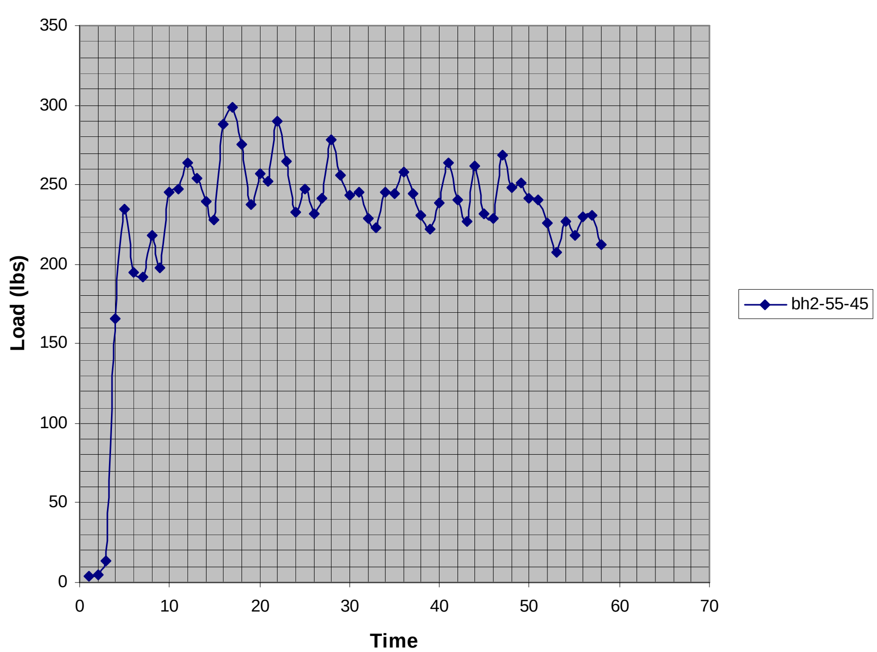


Figure A-71. Load vs Time: BH2@55'(Norm Pressure = 45 psi)

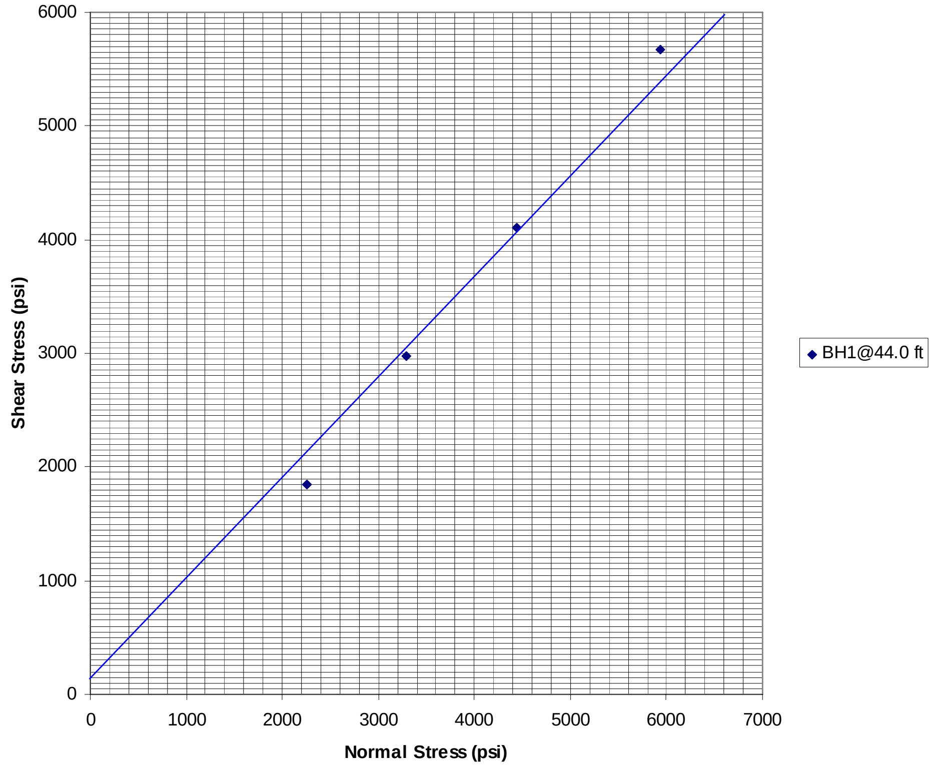


Figure A-72. Shear Stress vs Normal Stress; BH1@44'

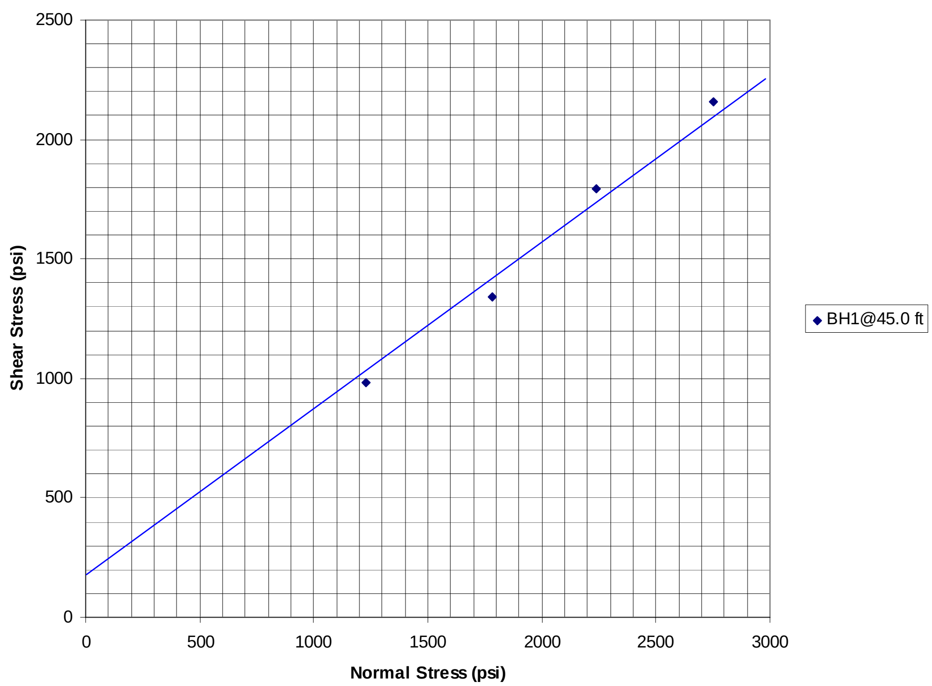


Figure A-73. Shear Stress vs Normal Stress; BH1@45'

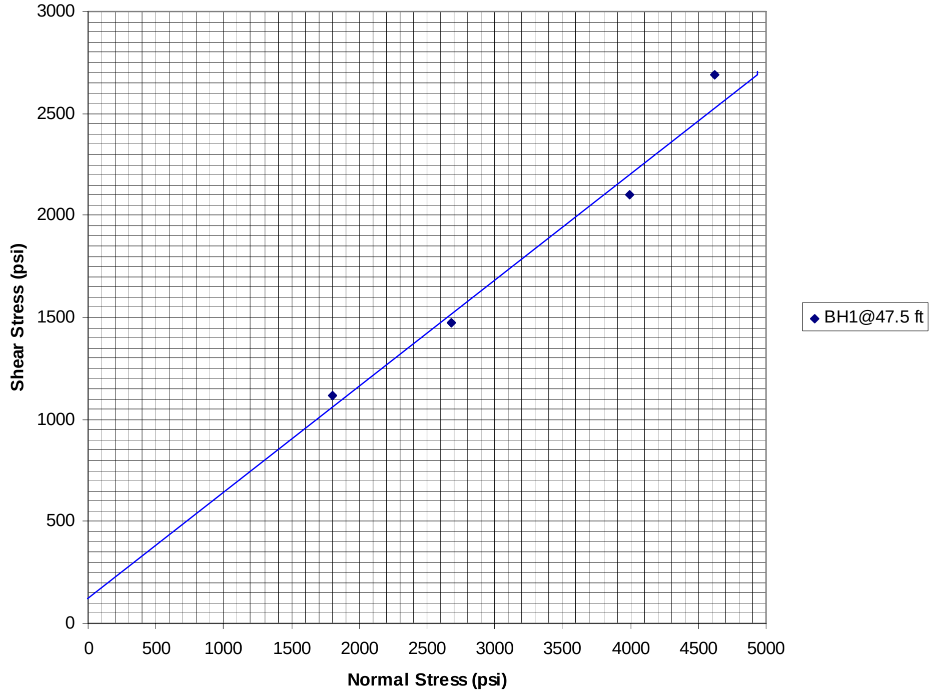


Figure A-74. Shear Stress vs Normal Stress; BH1@47.5’

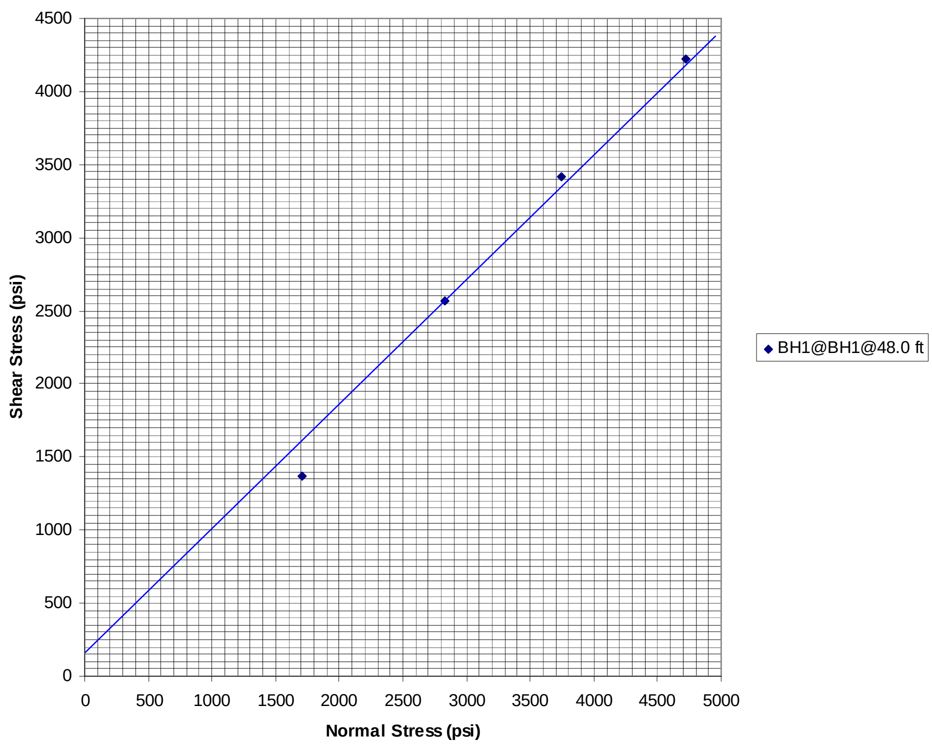


Figure A-75. Shear Stress vs Normal Stress; BH1@48’

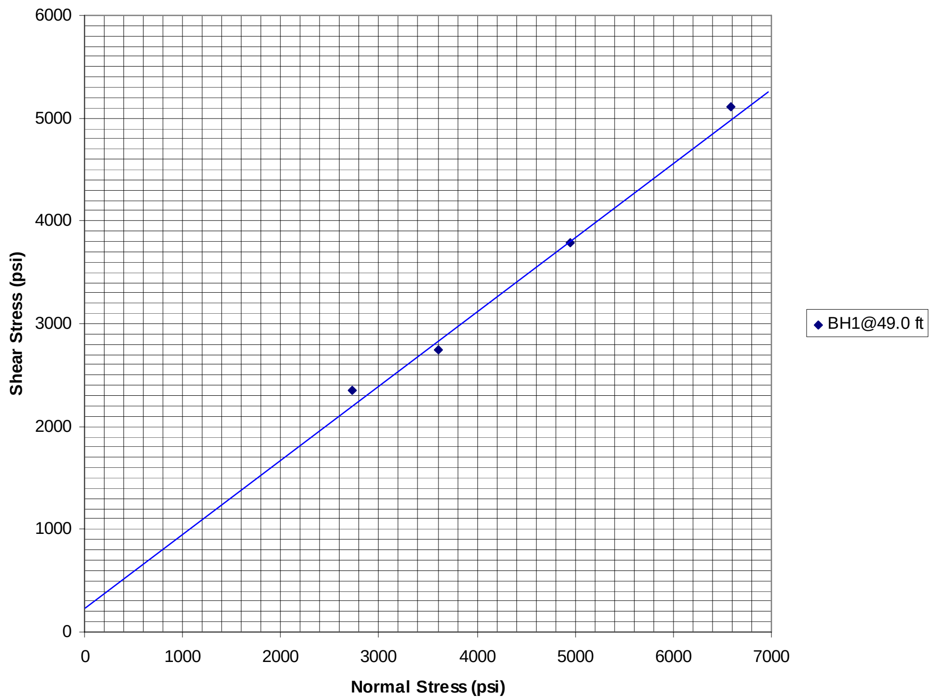


Figure A-76. Shear Stress vs Normal Stress; BH1@49'

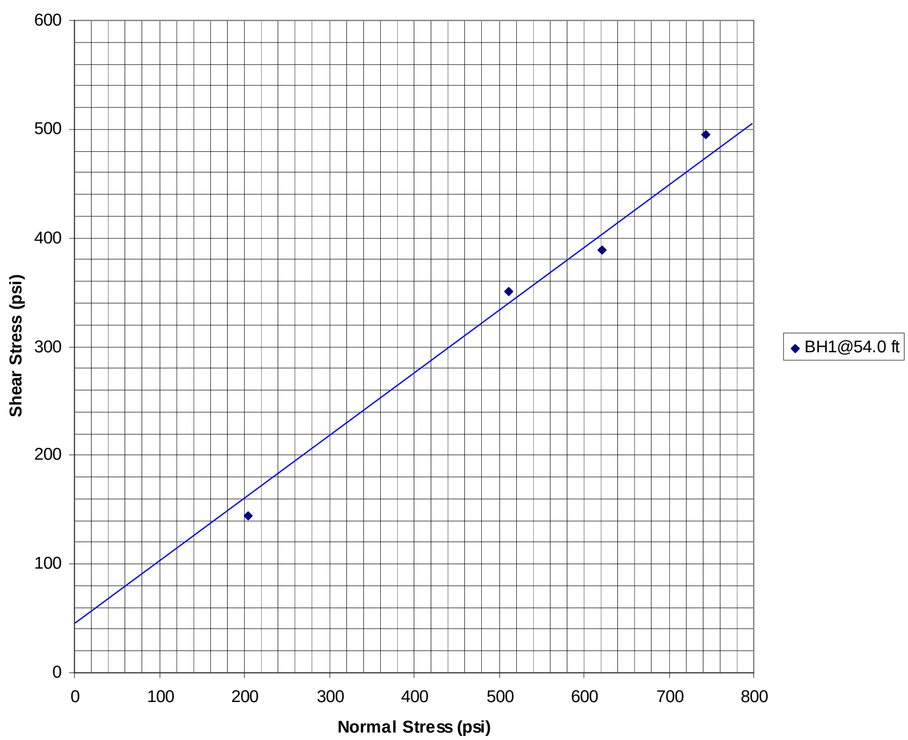


Figure A-77. Shear Stress vs Normal Stress; BH1@54'

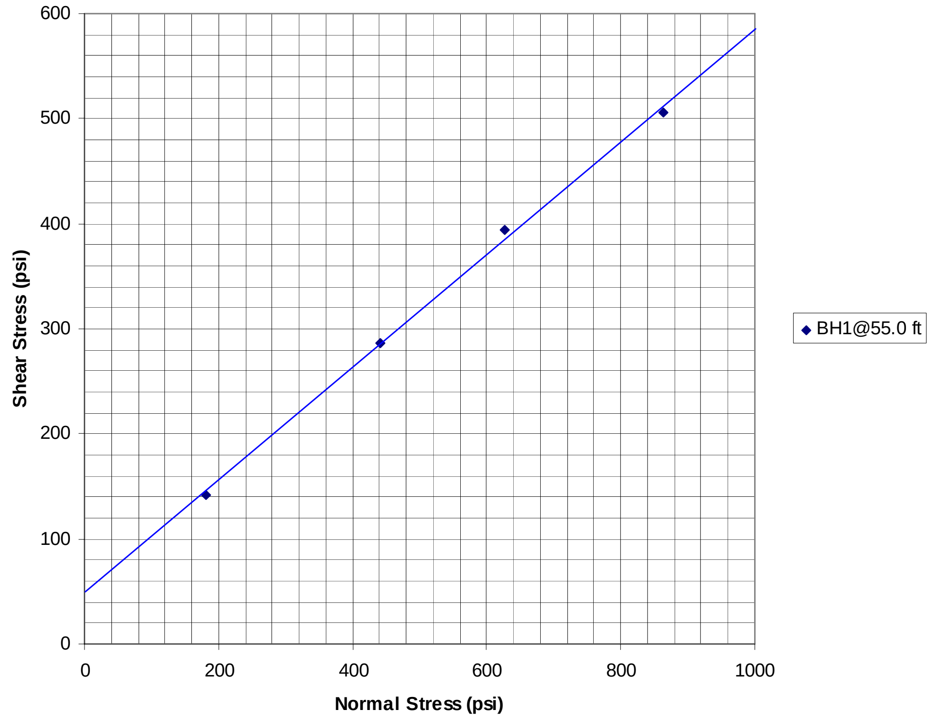


Figure A-78. Shear Stress vs Normal Stress; BH1@55'

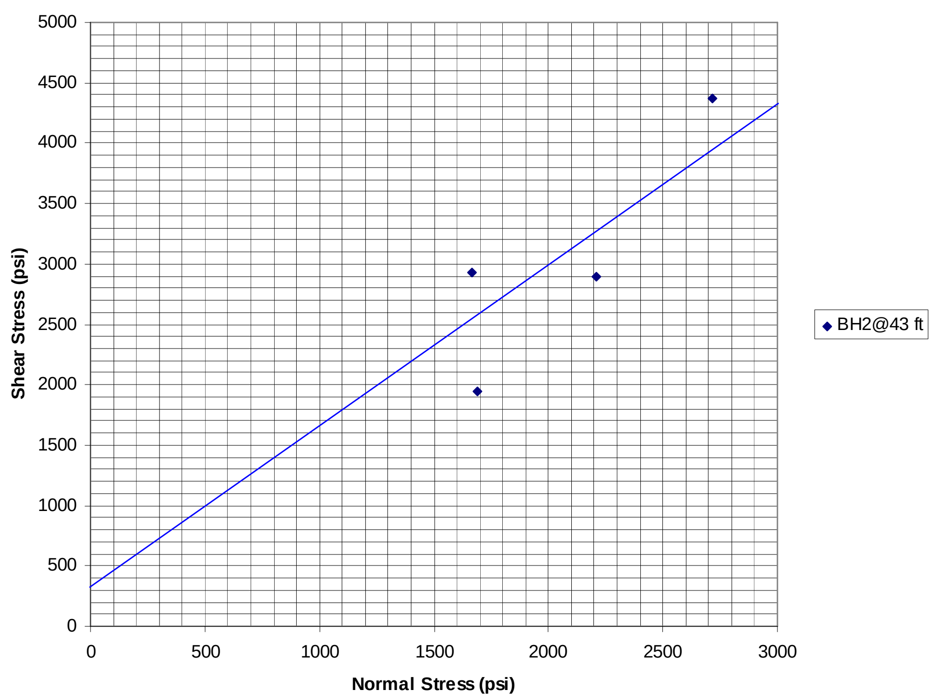


Figure A-79. Shear Stress vs Normal Stress; BH2@43'

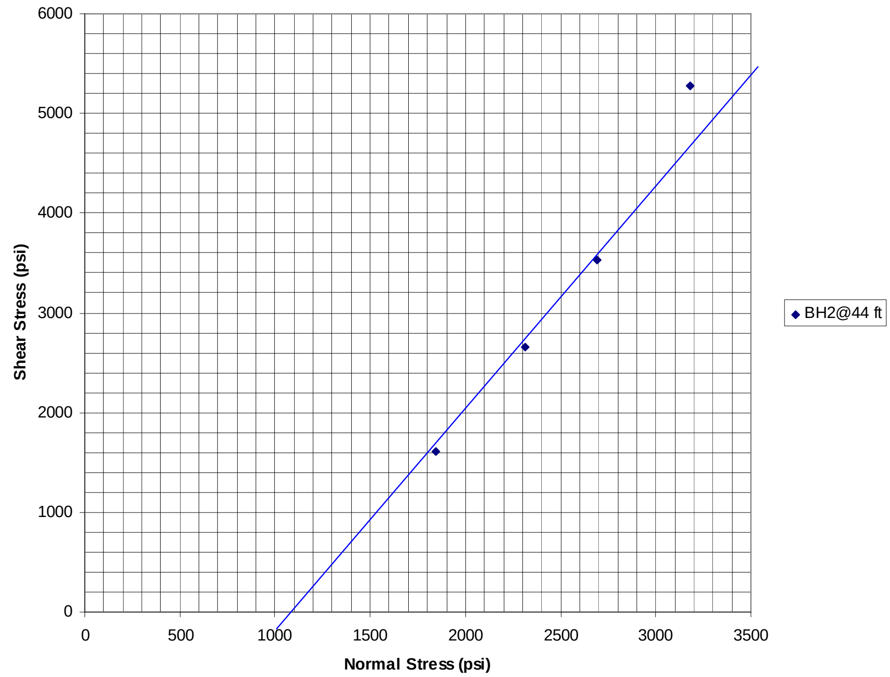


Figure A-80. Shear Stress vs Normal Stress; BH2@44’

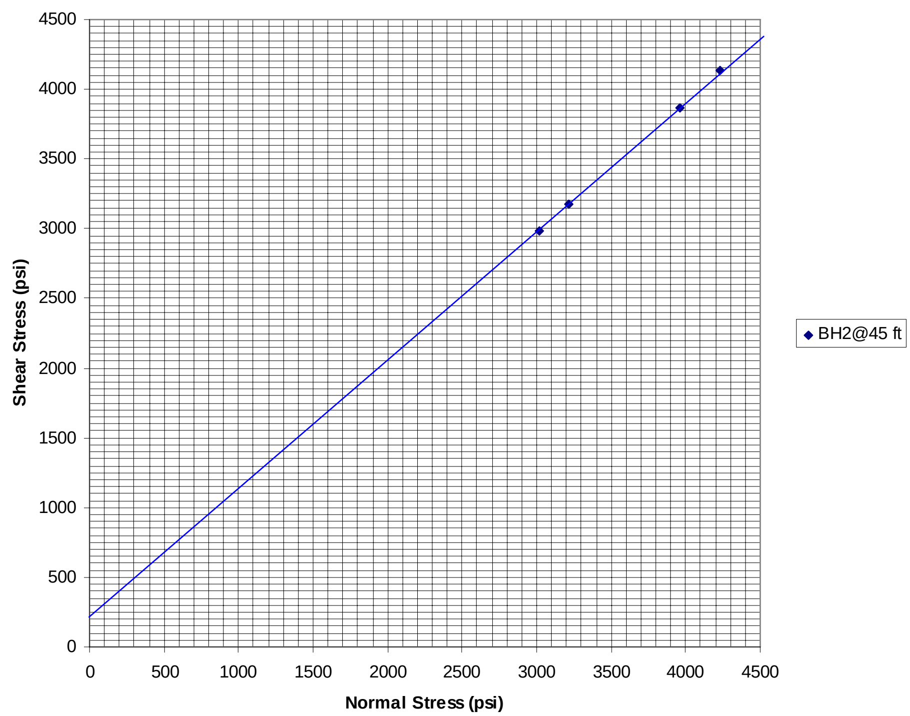


Figure A-81. Shear Stress vs Normal Stress; BH2@45’

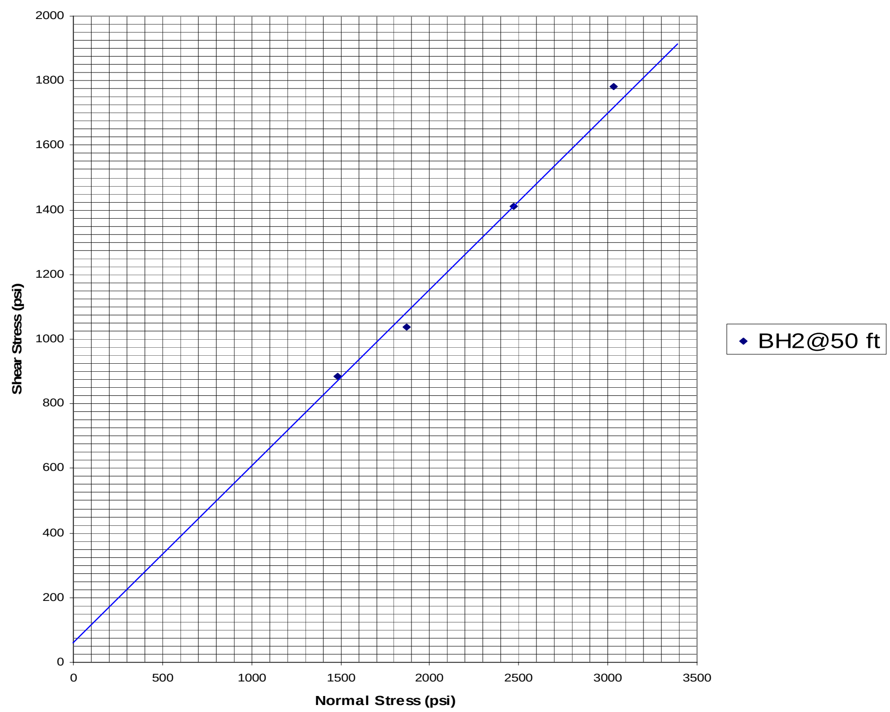


Figure A-82. Shear Stress vs Normal Stress; BH2@50’

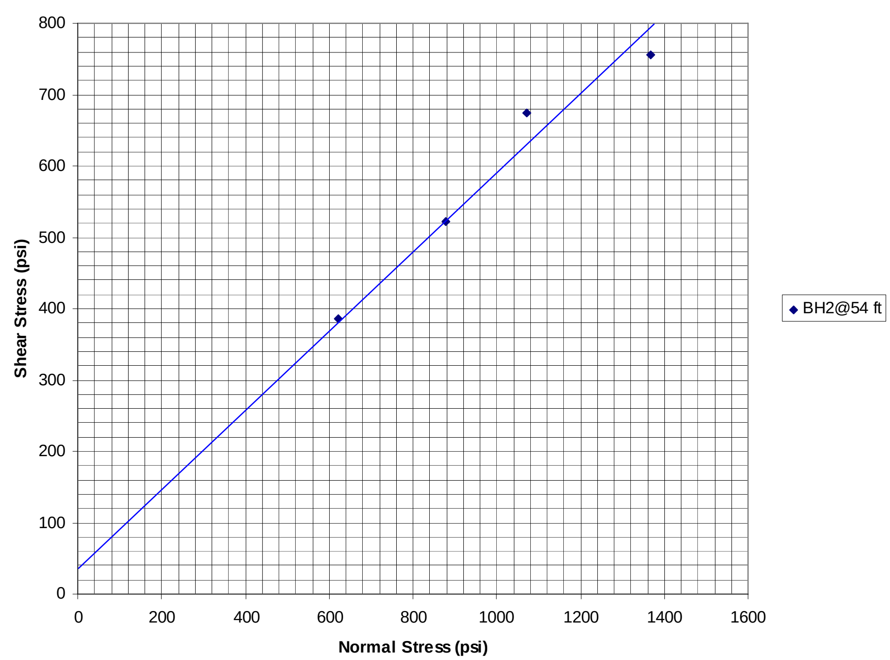


Figure A-83. Shear Stress vs Normal Stress; BH2@54’

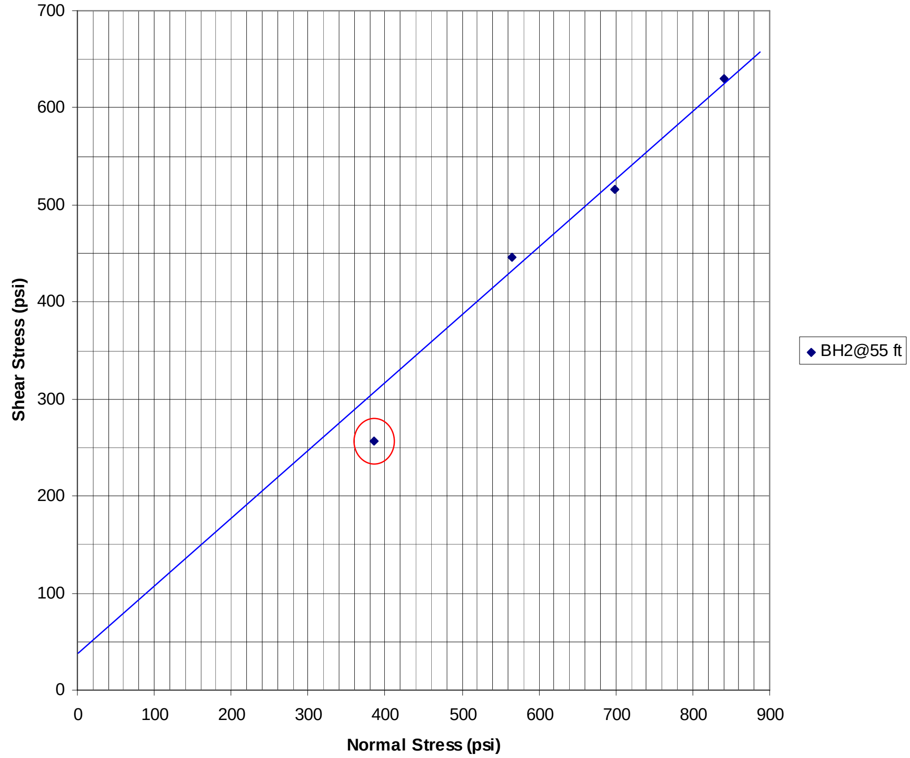


Figure A-84. Shear Stress vs Normal Stress; BH2@55’

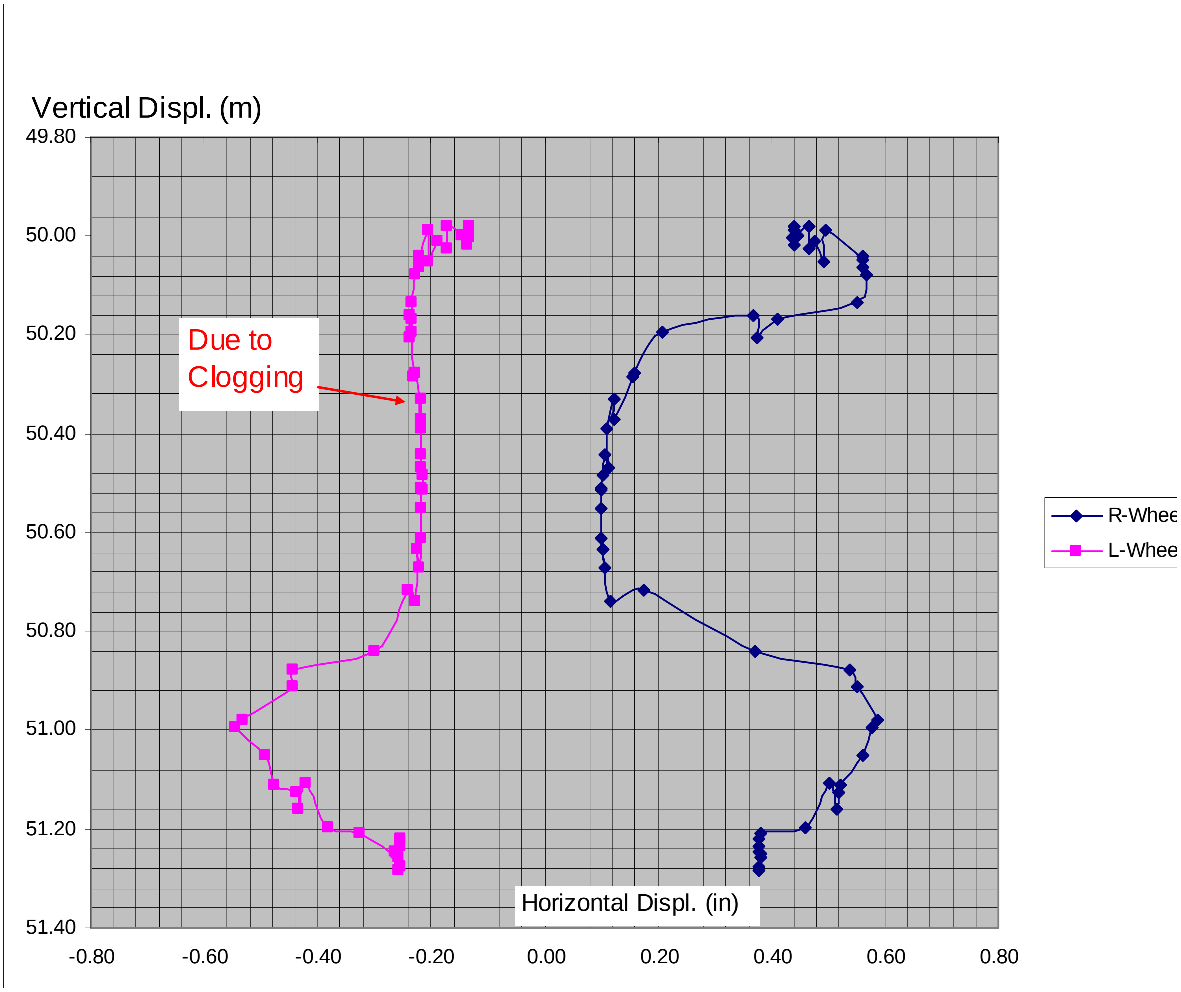


Figure A-85. Mapping Results Corehole 3 @ 51'.

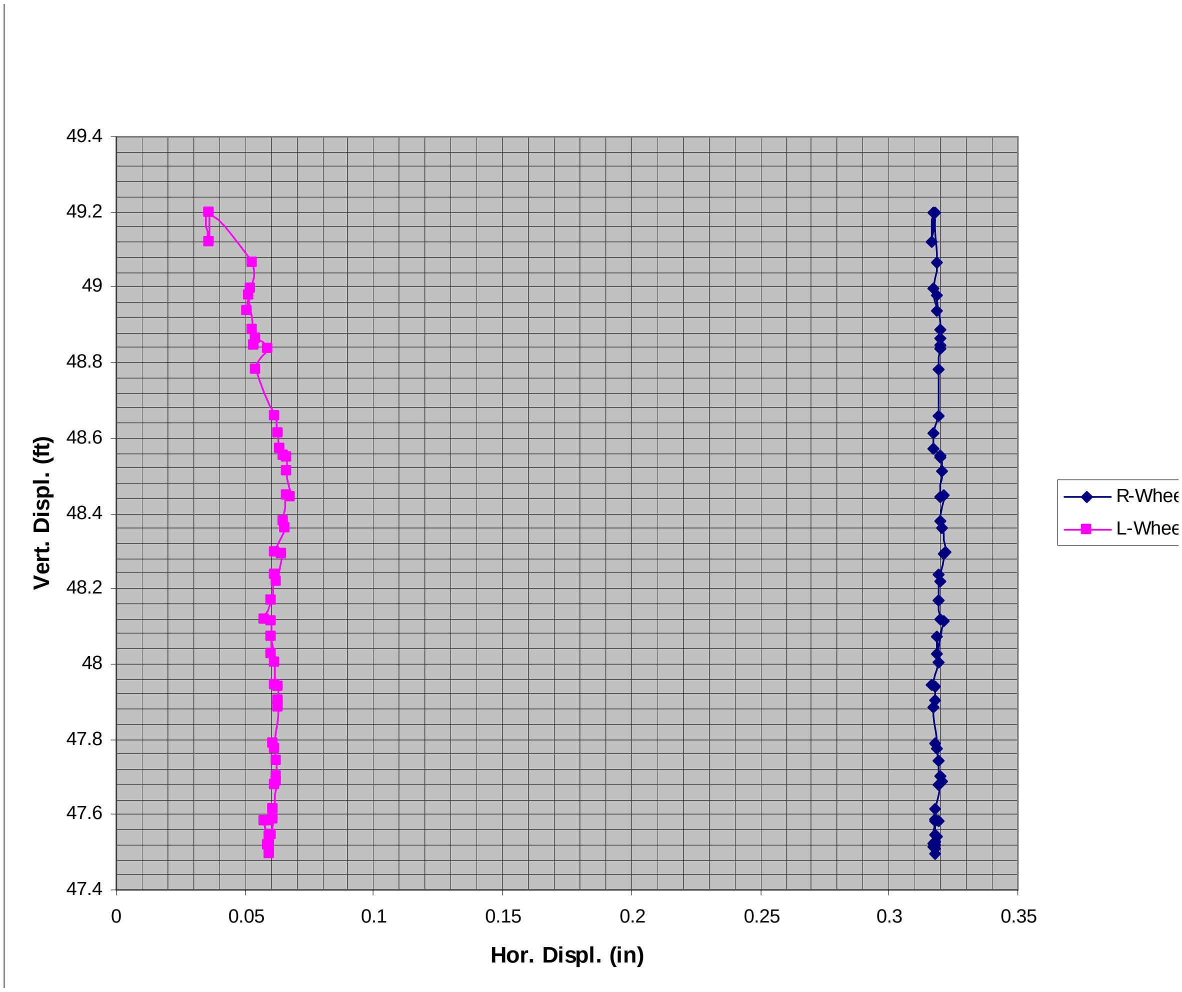


Figure A-86. Mapping Results Corehole 3 @ 49’

APPENDIX B

SAMPLES OF LABORATORY TESTING AND DATA REDUCTION RESULTS

Table B-1. Sample FDOT Laboratory Test Results for Corehole #1

STATE MATERIALS OFFICE	Rock Core	Effective/Revised Date: 4/27/05	
Foundations Laboratory	Unconfined Compression- Split Tensile	By: G.J.	Page 1 of 1

BORING / CORE	SAMP NO.	DEPTH TOP (ft)	DEPTH BOT. (ft)	TEST DATE	LENGTH (in)	DIA. (in)	WET WT. (g)	WET UNIT WT (pcf)	L / D RATIO	CORR. FACTOR
CB-1/1	1T	40.50		8/10/2006	2.3420	2.4850	463.4	155.4	0.94	
	2U				4.8177	2.4610	799.3	132.9	1.96	1.00
	3T				2.4465	2.4200	374.3	126.7	1.01	
	4T				2.3805	2.4200	396.3	137.9	0.98	
	5U		45.50		4.1642	2.4765	751.1	142.6	1.68	1.02
CB-1/2	1U	45.50		8/10/2006	3.6302	2.4545	679.5	150.7	1.48	1.04
	2T				2.4455	2.4625	442.7	144.8	0.99	
	3U				4.5233	2.4315	750.0	136.0	1.86	1.01
	4T				2.3470	2.4250	399.4	140.4	0.97	
	5U				4.6885	2.4535	805.6	138.5	1.91	1.01
	6T				2.1235	2.4700	384.2	143.9	0.86	
	7T				2.5135	2.4600	454.9	145.1	1.02	
	8U				4.8195	2.4570	848.6	141.5	1.96	1.00
	9T				2.5560	2.4640	472.0	147.5	1.04	
	10U		50.50		4.7962	2.4740	892.8	147.5	1.94	1.00
CB-1/3	1T	50.50		8/10/2006	2.4945	2.4510	464.0	150.2	1.02	
	2U				4.7732	2.4630	911.1	152.6	1.94	1.00
	3T				2.4785	2.4495	451.5	147.2	1.01	
	4T			8/11/2006	2.4555	2.4545	388.3	127.3	1.00	
	5T				2.3780	2.4340	355.0	122.2	0.98	
	6T		55.50		2.4080	2.4240	346.0	118.6	0.99	
CB-1/4	1U	55.50		8/14/2006	4.7672	2.3530	693.6	127.5	2.03	1.00
	2T				2.5350	2.3975	384.2	127.9	1.06	
	3T				2.5305	2.4060	353.4	117.0	1.05	
	4U				4.8415	2.4215	758.8	129.6	2.00	1.00
	5T				2.2020	2.4115	341.0	129.2	0.91	
	6U				4.8682	2.4230	766.8	130.1	2.01	1.00
	7T				2.3085	2.4170	345.1	124.1	0.96	
	8U				4.7217	2.4350	727.1	126.0	1.94	1.00
	9T		60.50		2.5060	2.4400	393.8	128.0	1.03	
CB-1/5	1T	60.50		8/14/2006	2.3600	2.0160	227.1	114.8	1.17	
	2T				2.0215	2.1000	207.7	113.0	0.96	
	3T				2.4585	2.2185	285.8	114.6	1.11	
	4U				4.0008	2.0860	420.4	117.1	1.92	1.01
	5U				4.8755	2.2955	597.1	112.7	2.12	1.00
	6T				2.4770	2.4000	349.0	118.6	1.03	
	7U				4.8537	2.4230	680.3	115.8	2.00	1.00
	8U				4.6912	2.4060	665.3	118.8	1.95	1.00
	9T		65.50		2.4465	2.3815	326.2	114.0	1.03	
CB-1/6	1T	65.50		8/15/2006	2.5280	2.3400	328.9	115.3	1.08	
	2T				2.3860	2.2185	296.0	122.3	1.08	
	3U				4.8008	2.3850	675.2	119.9	2.01	1.00
	4T				2.3295	2.4040	344.1	124.0	0.97	
	5T		70.50		2.3140	2.3200	303.5	118.2	1.00	

Table B-2. Sample FDOT Laboratory Test Results for Corehole #1

Project Number:	Fuller Warren	**Location:**	CB-1
Lab Number:		**Date Received:**	8/9/2006
Bridge Number:		**Tested by:**	JC
LIMS Number:			

BORING / CORE	SAMP. NO.	w (%)	DRY UNIT WT (pcf)	MAX. LOAD (lbs)	S. T. STRENGTH (psi)	q (u) (psi)	DISPL. @ FAIL. (in)	STRAIN @ FAIL. (%)	% RECOV. / % RQD	TARE WT. (g)	WET WT. (g)	DRY WT. (g)
CB-1/1	1T	3.35	150.4	3963.2	433.5		0.0640		67/37	427.1	873.8	859.3
	2U	16.73	113.8	1017.4		213.3	0.0497	1.03		431.1	1224.3	1110.6
	3T	23.01	103.0	276.8	29.8		0.0464			410.1	781.1	711.7
	4T	15.60	119.3	799.8	88.4		0.0445			425.5	821.1	767.7
	5U	10.93	128.6	6578.2		1335.3	0.0609	1.46		433	1181.1	1107.4
CB-1/2	1U	8.01	139.5	9815.4		1990.3	0.0699	1.93	94/74	424.3	1098.2	1048.2
	2T	10.47	131.1	1191	125.9		0.0443			418.9	861	819.1
	3U	14.44	118.9	3855		822.8	0.0496	1.10		302.8	1051.7	957.2
	4T	11.77	125.6	896	100.2		0.0512			370.7	769.5	727.5
	5U	14.05	121.4	3453		726.2	0.0672	1.43		435.2	1239.4	1140.3
	6T	11.39	129.1	1814	220.2		0.0509			328.3	711.6	672.4
	7T	11.43	130.2	2473	254.6		0.0558			434.1	887.6	841.1
	8U	11.42	127.0	4494		945.7	0.0522	1.08		368.9	1201.4	1116.1
	9T	11.39	132.4	1875	189.6		0.0411			429.5	900.9	852.7
	10U	#DIV/0!	#DIV/0!	*		#VALUE!	*	#VALUE!				
CB-1/3	1T	8.79	138.1	2483.1	258.6		0.0504		60/48	377.8	840.9	803.5
	2U	8.31	140.9	7533		1575.1	0.0527	1.10		372.3	1279.6	1210
	3T	9.49	134.5	1582	165.9		0.0408			428.2	878.2	839.2
	4T	16.13	109.6	245	25.9		0.0289			427.1	814.5	760.7
	5T	24.16	98.5	112	12.4		0.0213			372.3	726.9	657.9
	6T	31.27	90.4	183	19.9		0.0297			435.2	780.7	698.4
CB-1/4	1U	26.38	100.9	759		174.5	0.0516	1.08	92/77	427.1	1118.4	974.1
	2T	23.05	103.9	181	19.0		0.0223			372.4	756.2	684.3
	3T	30.80	89.5	121	12.7		0.0393			435.3	780.1	698.9
	4U	22.23	106.1	1408		305.7	0.0440	0.91		419	1165.6	1029.8
	5T	22.22	105.7	299	35.9		0.0278			364.9	705.4	643.5
	6U	22.05	106.6	1468		318.3	0.0547	1.12		308.2	1073.8	935.5
	7T	27.86	97.1	215	24.6		0.0356			313.1	657.8	582.7
	8U	25.34	100.5	772		165.1	0.0576	1.22		373.2	1098.8	952.1
	9T	23.43	103.7	267	27.8		0.0440			425.5	819	744.3
CB-1/5	1T	36.30	84.3	109	14.6		0.0336		90/67	315.2	542	481.6
	2T	41.19	80.0	61	9.2		0.0242			431.1	637.8	577.5
	3T	45.34	78.8	29	3.4		0.0173			432.5	716.5	627.9
	4U	37.67	85.1	338		98.4	0.0608	1.52		370.4	789.6	674.9
	5U	36.26	82.7	423		102.3	0.0610	1.25		370.6	965.9	807.5
	6T	33.82	88.7	136	14.5		0.0386			376.5	724.3	636.4
	7U	34.34	86.2	550		119.3	0.0565	1.16		312	990.3	816.9
	8U	29.72	91.6	479		105.1	0.0420	0.90		300.9	965.2	813
	9T	30.54	87.4	119	13.0		0.0401			371.3	697	620.8
CB-1/6	1T	29.23	89.2	51.7	5.6		0.0276		58/38	315.2	643.7	569.4
	2T	27.22	96.1	46	5.5		0.0407			431.3	726.7	663.5
	3U	28.98	93.0	187		41.9	0.0531	1.11		370.4	1045.1	893.5
	4T	21.96	101.7	53	6.0		0.0284			364.9	708.7	646.8
	5T	25.61	94.1	30	3.5		0.0372			432.5	735.6	673.8

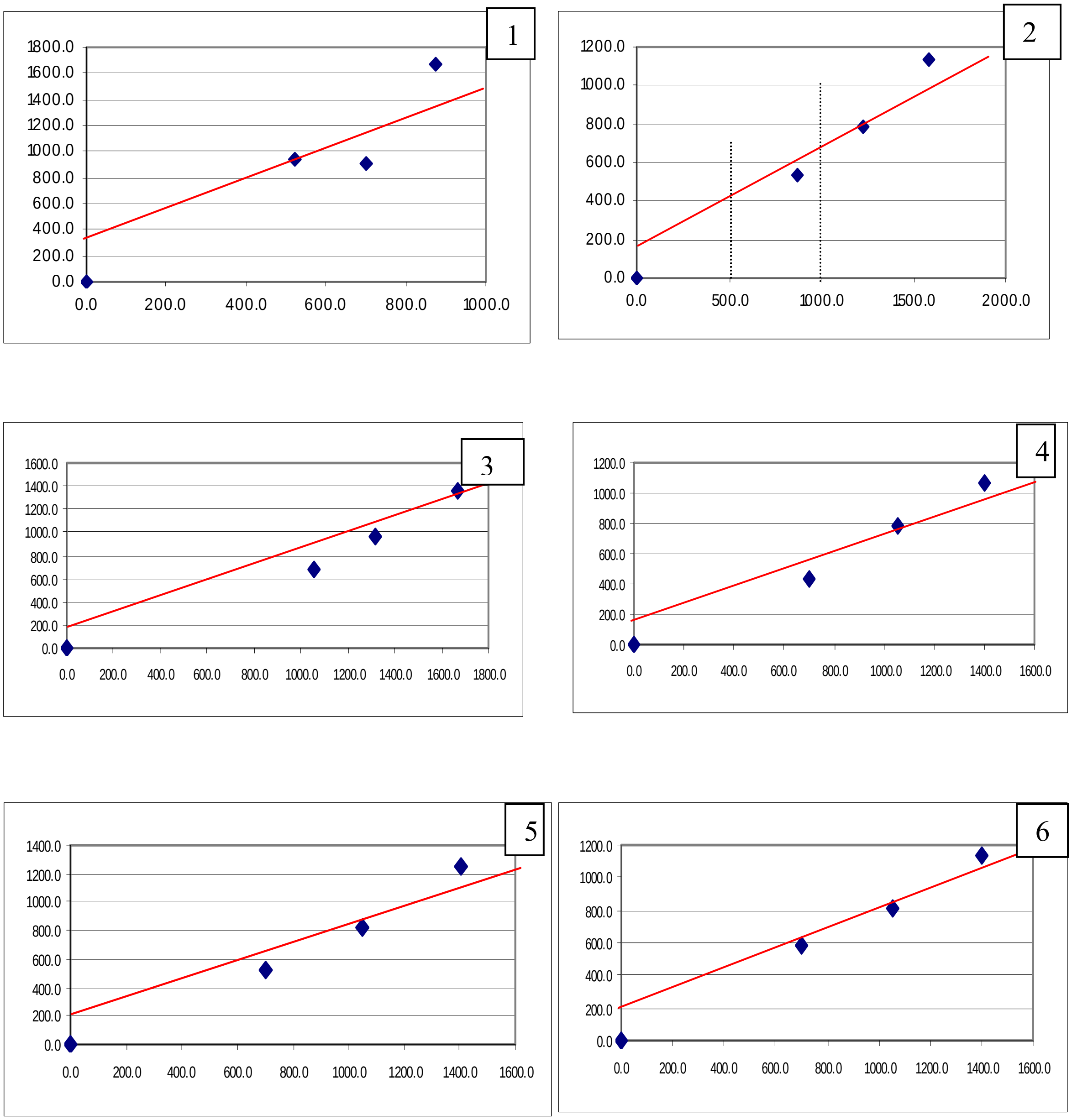


Figure B-1. Direct Shear Test Results on Gator rock samples.

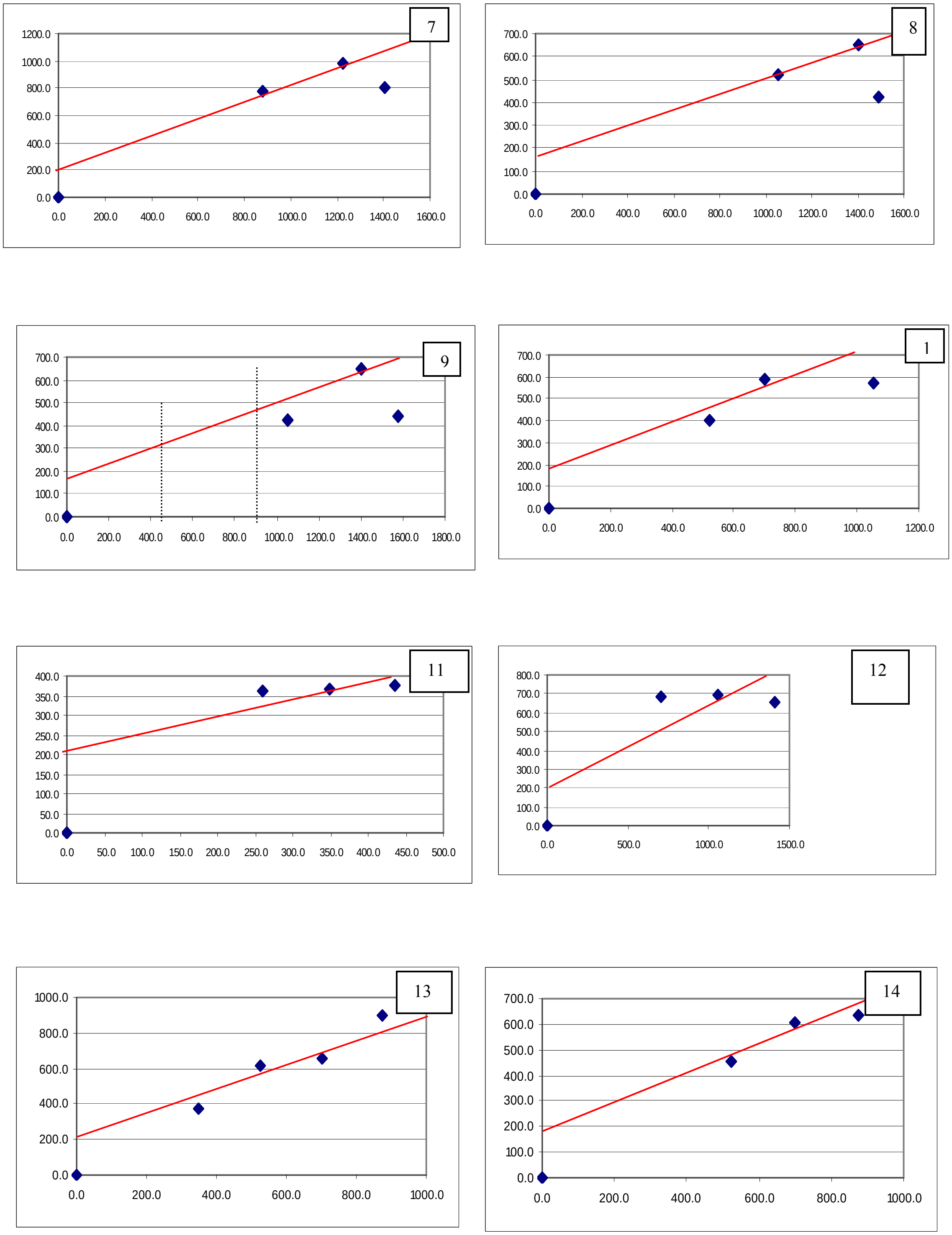


Figure B-2. Direct Shear Test Results on Gator rock samples.

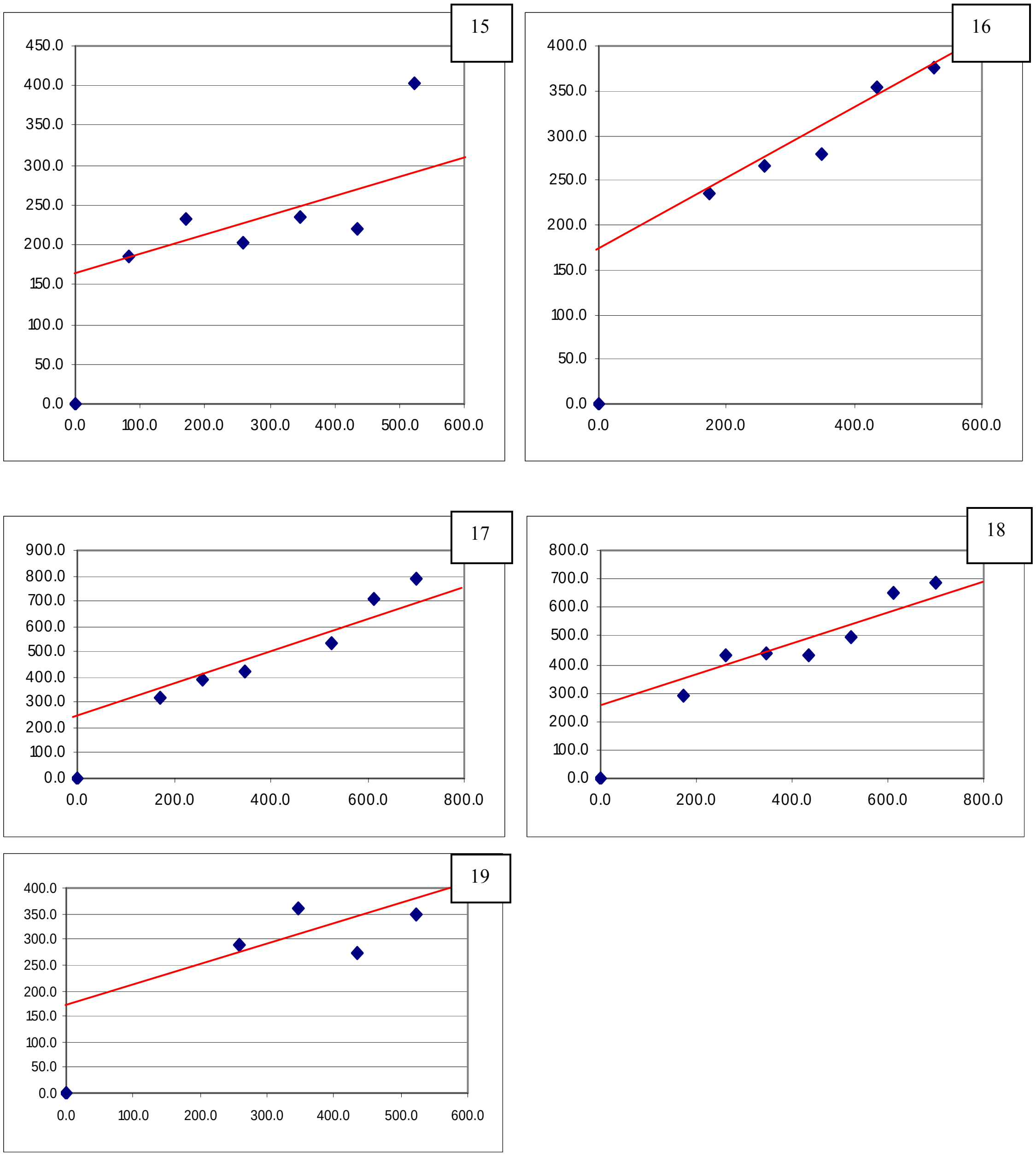


Figure B-3. Direct Shear Test Results on Gator rock samples.

Shear Stress (psi)	Normal Stress (psi)	Shear Stress (psi)	Normal Stress (psi)
320.66	101.13	613.53	288.9
558.29	314.27	871.75	700.93
730.09	530.72	1026.29	915.56
928.73	719.22	1440.83	1099.9
925.28	904.39	556.72	330.77
1068.14	1100.15	739.09	555.59
		944.4	825.92
		974.03	991.06
		1236.9	1293.29

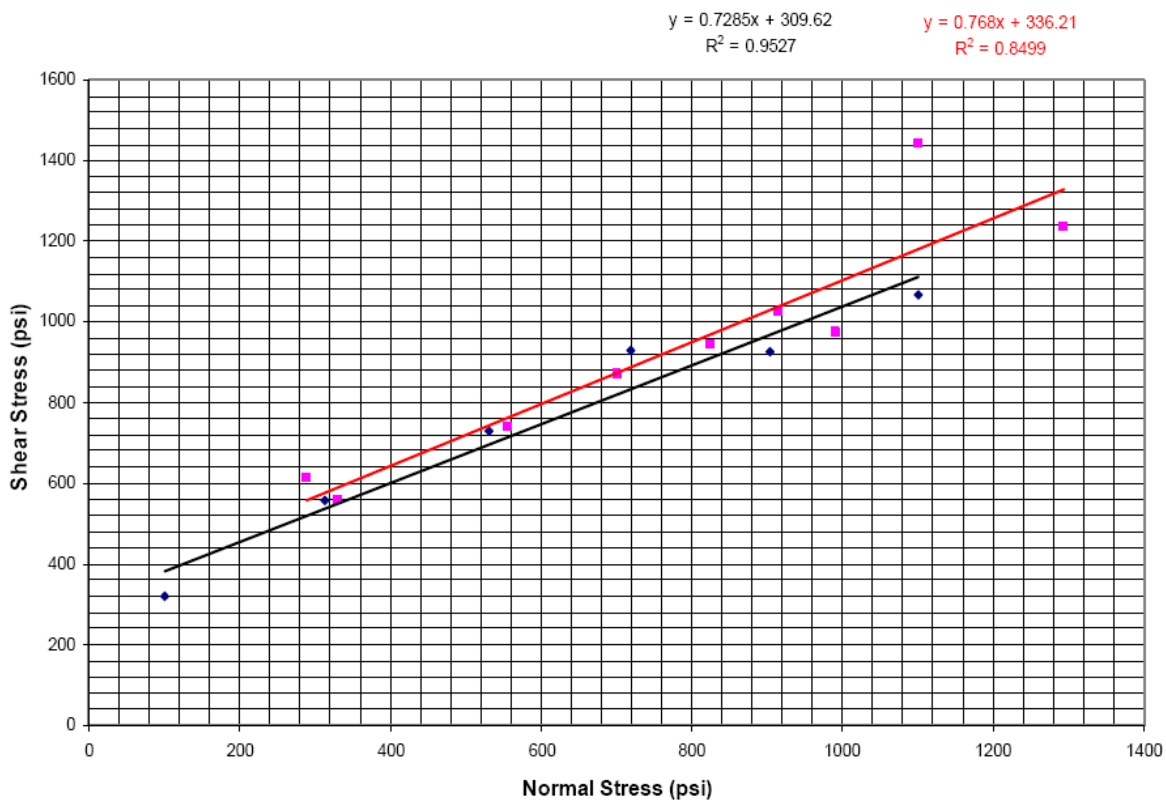


Figure B-4. Prototype Device Representative Laboratory Test Results.

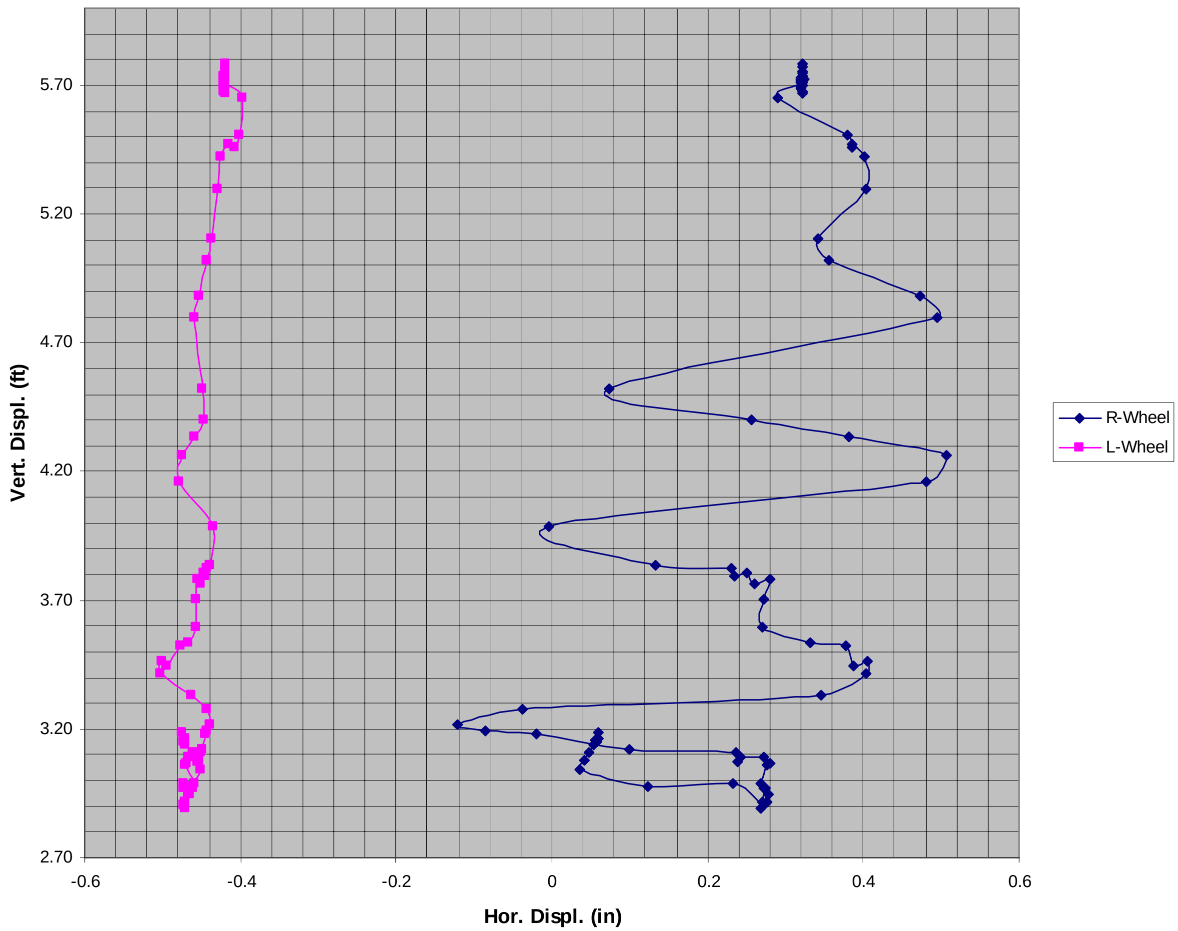


Figure B-5. Mapping Results in Laboratory Contour Mold.

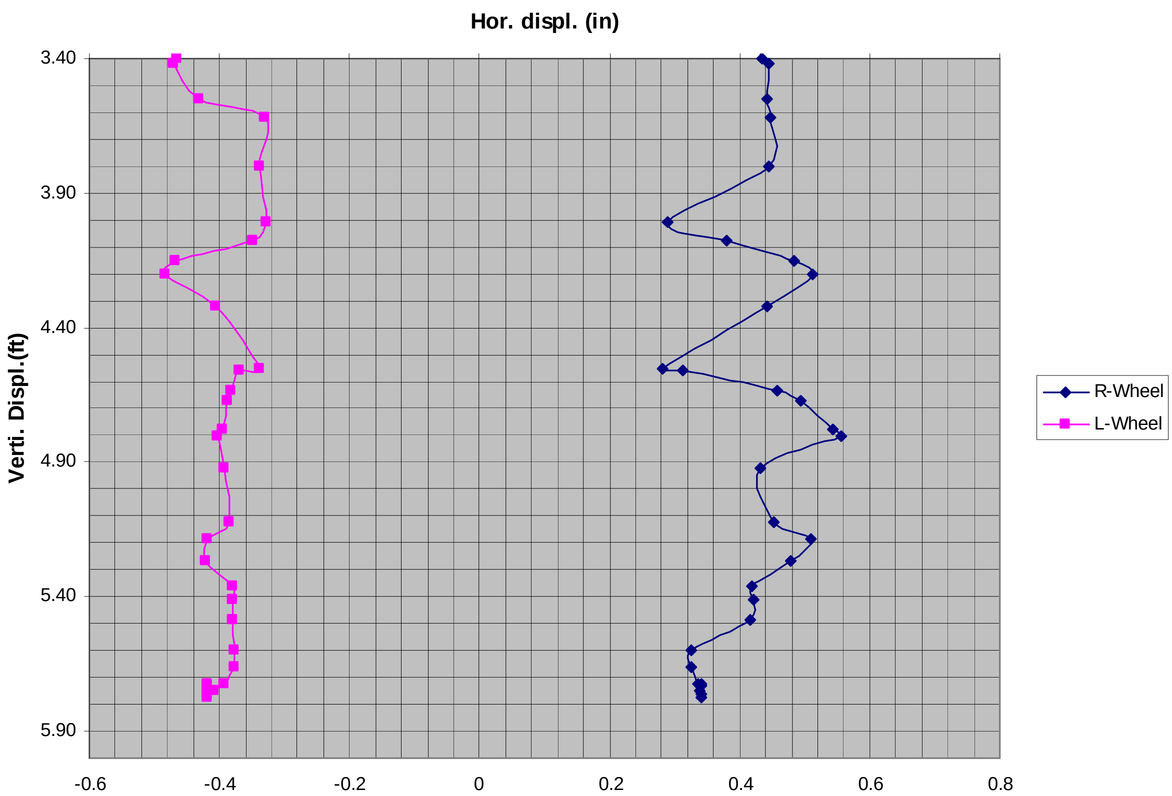


Figure B-6. Mapping Results in Laboratory Contour Mold

APPENDIX C
FIELD AND REDUCTION DATA

Table C-1. Corehole #1 at 44 feet.

FULLER WARREN BRIDGE
SHEAR DEVICE TEST RESULTS

Penetration (calculated)		0.011961528	Max (0.0591)
Height H_2O (ft)	26	Unit Wt H_2O (lb/ft3)	62.4
Length Pipe(ft)	44	Unit Wt Rod (lb/ft)	2.96
Penetration Depth (in)	0.0233	Cylinder Bore Area (in2)	4.72
Stud Cap Area(in2)	0.1964	Shear Stud Area	0.165492416
No. of Studs	42	Normal Stud Area	0.001137173
Weight of Instrum (lbs).	38	qu (psi)	1406.6

LVDT (in)	Pressure (volts)	Load (volts)	Est. Load (psi)	Est. Press. (psi)	Normal Force (lb)	Shear Force (lb)	Normal Stress (psi)	Shear Stress (psi)
0.0012	0.0125	0.0007	13.1031	25.0557	2.6150	-78.2670	2299.5222	-472.9338
0.0087	0.0126	0.0016	32.7464	25.1595	2.6403	-83.5448	2321.8260	-504.8255
-0.0023	0.0125	0.0005	9.8822	25.0343	2.6150	-172.7537	2299.5222	-1043.8771
0.0412	0.0126	0.0049	101.7274	25.2602	2.6403	184.0820	2321.8260	1112.3292
0.1112	0.0125	0.0055	101.9723	24.9092	2.6150	232.7415	2299.5222	1406.3573
0.1194	0.0125	0.0045	93.17	25.0526	2.6150	151.6424	2299.5222	916.3104
0.1227	0.0125	0.0056	100.8071	24.958	2.6150	240.8514	2299.5222	1455.3620
0.2138	0.0124	0.0069	127.158	24.8085	2.5896	346.2801	2277.2184	2092.4229
0.2514	0.0124	0.0049	91.0879	24.781	2.5896	184.0820	2277.2184	1112.3292
0.2442	0.0123	0.0056	105.1375	24.6345	2.5642	240.8514	2254.9147	1455.3620
0.2698	0.0124	0.006	110.2182	24.7871	2.5896	273.2910	2277.2184	1651.3807
0.3618	0.0123	0.0055	104.9961	24.5216	2.5642	232.7415	2254.9147	1406.3573
0.3691	0.0124	0.0058	109.6231	24.8268	2.5896	257.0712	2277.2184	1553.3713
0.3687	0.0124	0.0052	102.7319	24.7078	2.5896	208.4118	2277.2184	1259.3432
0.4043	0.0124	0.0068	120.4907	24.7414	2.5896	338.1702	2277.2184	2043.4182
0.4806	0.0123	0.0064	117.8761	24.543	2.5642	305.7306	2254.9147	1847.3995
0.4998	0.0121	0.0054	95.3391	24.2622	2.5135	224.6316	2210.3071	1357.3526
0.5002	0.0123	0.0056	98.4947	24.5521	2.5642	240.8514	2254.9147	1455.3620
0.5179	0.0122	0.006	115.4488	24.3721	2.5389	273.2910	2232.6109	1651.3807
0.6064	0.0122	0.0068	118.6344	24.3324	2.5389	338.1702	2232.6109	2043.4182
0.6192	0.0122	0.0059	105.8714	24.424	2.5389	265.1811	2232.6109	1602.3760
0.6297	0.0122	0.0063	108.8987	24.3171	2.5389	297.6207	2232.6109	1798.3948
0.6269	0.0123	0.0062	113.0674	24.5643	2.5642	289.5108	2254.9147	1749.3901
0.6854	0.0123	0.007	120.1329	24.6406	2.5642	354.3900	2254.9147	2141.4276
0.6577	0.0122	0.0064	112.5221	24.427	2.5389	305.7306	2232.6109	1847.3995
0.727	0.0124	0.0062	112.0803	24.723	2.5896	289.5108	2277.2184	1749.3901
0.6382	0.0124	0.0069	121.8166	24.7932	2.5896	346.2801	2277.2184	2092.4229
0.7308	0.0123	0.0077	144.0097	24.5247	2.5642	411.1594	2254.9147	2484.4604
0.6435	0.0123	0.0071	125.051	24.6071	2.5642	362.4999	2254.9147	2190.4323
0.6883	0.0123	0.0068	118.7618	24.6437	2.5642	338.1702	2254.9147	2043.4182
0.7355	0.0124	0.0064	111.9886	24.7017	2.5896	305.7306	2277.2184	1847.3995
0.6445	0.0123	0.006	111.345	24.5979	2.5642	273.2910	2254.9147	1651.3807
0.6403	0.0124	0.0064	112.7411	24.7108	2.5896	305.7306	2277.2184	1847.3995
0.7261	0.0124	0.0062	106.5732	24.7444	2.5896	289.5108	2277.2184	1749.3901
0.7182	0.0122	0.006	106.8549	24.4911	2.5389	273.2910	2232.6109	1651.3807
0.6687	0.0123	0.0058	103.6154	24.6925	2.5642	257.0712	2254.9147	1553.3713
0.634	0.0123	0.006	108.0474	24.6834	2.5642	273.2910	2254.9147	1651.3807
0.7362	0.0124	0.0059	109.5219	24.7169	2.5896	265.1811	2277.2184	1602.3760
0.6516	0.0124	0.0061	105.5629	24.8756	2.5896	281.4009	2277.2184	1700.3854
0.6295	0.0123	0.0061	105.198	24.6345	2.5642	281.4009	2254.9147	1700.3854

Table C-2. Corehole #1 at 44/30 feet.

FULLER WARREN BRIDGE
SHEAR DEVICE TEST RESULTS

		Penetration	(calculated)	0.017262341	Max(0/0591)
Height H_2O	26	(ft)	Unit Wt H_2O	62.4	(lb/ft3)
Length Pipe	44	(ft)	Unit Wt Rod	2.96	(lb/ft)
Penetration Depth	0.0233	(in)	Cylinder Bore Area	4.72	(in2)
Stud Cap Area	0.1964	(in2)	Shear Stud Area	0.165492416	
No. of Studs	42		Normal Stud Area	0.001137173	
Weight of Instrum.	38		qu (psi)	1406.6	

LVDT (in)	Pressure (volts)	Load (volts)	Est. Load (psi)	Est. Press. (psi)	Normal Force (lb)	Shear Force (lb)	Normal Stress (psi)	Shear Stress (psi)
-0.004	0.0156	0.001	17.8077	31.2937	3.8146	-132.2042	3354.4337	-798.8536
-0.009	0.0157	0.0017	31.8123	31.4982	3.8533	-75.4349	3388.4608	-455.8208
-0.01	0.0157	0.0009	17.4575	31.3272	3.8533	-140.3141	3388.4608	-847.8583
0.0808	0.0157	0.0045	92.1535	31.37	3.8533	151.6424	3388.4608	916.3104
0.1276	0.0156	0.0027	55.3993	31.1991	3.8146	5.6642	3354.4337	34.2261
0.1265	0.0154	0.0041	77.1109	30.8664	3.7372	119.2028	3286.3794	720.2917
0.1333	0.0155	0.0051	103.1702	31.0709	3.7759	200.3018	3320.4066	1210.3385
0.2226	0.0154	0.0069	126.9984	30.7108	3.7372	346.2801	3286.3794	2092.4229
0.2381	0.0154	0.0056	108.6658	30.7382	3.7372	240.8514	3286.3794	1455.3620
0.2337	0.0154	0.0055	103.3552	30.7199	3.7372	232.7415	3286.3794	1406.3573
0.2425	0.0155	0.0058	106.5662	30.9183	3.7759	257.0712	3320.4066	1553.3713
0.3105	0.0154	0.0074	142.6636	30.7566	3.7372	386.8296	3286.3794	2337.4463
0.3585	0.0153	0.0068	127.8524	30.546	3.6985	338.1702	3252.3523	2043.4182
0.3558	0.0153	0.0064	121.811	30.6467	3.6985	305.7306	3252.3523	1847.3995
0.3531	0.0154	0.0064	125.3115	30.7749	3.7372	305.7306	3286.3794	1847.3995
0.3837	0.0154	0.0087	159.4832	30.8267	3.7372	492.2584	3286.3794	2974.5073
0.4372	0.0153	0.0106	189.7855	30.6772	3.6985	646.3466	3252.3523	3905.5963
0.4514	0.0154	0.0096	169.9178	30.8756	3.7372	565.2475	3286.3794	3415.5494
0.4566	0.0154	0.0089	168.1431	30.7382	3.7372	508.4782	3286.3794	3072.5166
0.4611	0.0154	0.0092	165.1735	30.723	3.7372	532.8079	3286.3794	3219.5307
0.4973	0.0155	0.0117	211.9687	30.903	3.7759	735.5555	3320.4066	4444.6479
0.5263	0.0154	0.01	196.145	30.8969	3.7372	597.6871	3286.3794	3611.5682
0.5218	0.0153	0.0105	185.227	30.6894	3.6985	638.2367	3252.3523	3856.5916
0.5109	0.0153	0.0092	166.1557	30.5795	3.6985	532.8079	3252.3523	3219.5307
0.5284	0.0155	0.0105	184.5349	31.0739	3.7759	638.2367	3320.4066	3856.5916
0.5866	0.0154	0.0105	189.6036	30.7932	3.7372	638.2367	3286.3794	3856.5916
0.5973	0.0154	0.0105	184.1563	30.7138	3.7372	638.2367	3286.3794	3856.5916
0.6	0.0154	0.011	191.5948	30.8908	3.7372	678.7862	3286.3794	4101.6150
0.608	0.0154	0.0094	178.5073	30.7596	3.7372	549.0277	3286.3794	3317.5401
0.608	0.0155	0.0107	188.1496	31.0343	3.7759	654.4565	3320.4066	3954.6010
0.6574	0.0154	0.0116	209.4308	30.7321	3.7372	727.4456	3286.3794	4395.6432
0.6814	0.0155	0.0121	207.4057	31.0343	3.7759	767.9951	3320.4066	4640.6666
0.677	0.0154	0.0108	203.2018	30.8023	3.7372	662.5664	3286.3794	4003.6057
0.6797	0.0155	0.0107	189.9016	31.0312	3.7759	654.4565	3320.4066	3954.6010
0.6728	0.0155	0.0108	185.7182	30.9061	3.7759	662.5664	3320.4066	4003.6057
0.6711	0.0155	0.01	185.3981	30.9671	3.7759	597.6871	3320.4066	3611.5682
0.6715	0.0156	0.0106	185.8834	31.1411	3.8146	646.3466	3354.4337	3905.5963
0.6788	0.0155	0.0101	185.2568	30.9763	3.7759	605.7970	3320.4066	3660.5729
0.7335	0.0156	0.0121	221.2384	31.1136	3.8146	767.9951	3354.4337	4640.6666
0.6477	0.0155	0.0109	196.1621	31.0343	3.7759	670.6763	3320.4066	4052.6104

Table C-3. Corehole #1 at 44/36 feet.

FULLER WARREN BRIDGE
SHEAR DEVICE TEST RESULTS

Penetration	(calculated) 0.0233393		Max(0.0591)	
Height H2O	26	(ft)	Unit Wt H_2O	62.4 (lb/ft3)
Length Pipe	44	(ft)	Unit Wt Rod	2.96 (lb/ft)
Penetration Depth	0.0233	(in)	Cylinder Bore Area	4.72 (in2)
Stud Cap Area	0.1964	(in2)	Shear Stud Area	0.165492416
No. of Studs	42		Normal Stud Area	0.001137173
Weight of Instrum.	38		qu (psi)	1406.6

LVDT (in)	Pressure (volts)	Load (volts)	Est. Load (psi)	Est. Press. (psi)	Normal Force (lb)	Shear Force (lb)	Normal Stress (psi)	Shear Stress (psi)
-0.0153	0.0193	0.0007	15.2841	38.6395	5.2463	-156.5339	4613.4378	-945.8677
-0.0068	0.0191	0.0007	14.3915	38.2946	5.1689	-156.5339	4545.3836	-945.8677
-0.0108	0.0193	0.0024	49.9021	38.5022	5.2463	-18.6656	4613.4378	-112.7880
0.0516	0.0192	0.0067	141.5435	38.496	5.2076	330.0603	4579.4107	1994.4135
0.0957	0.0191	0.0082	162.1631	38.1817	5.1689	451.7089	4545.3836	2729.4838
0.0888	0.019	0.0079	157.9871	38.0627	5.1302	427.3792	4511.3564	2582.4698
0.1003	0.019	0.0082	154.8951	38.0688	5.1302	451.7089	4511.3564	2729.4838
0.1548	0.0189	0.0096	187.7463	37.7575	5.0915	565.2475	4477.3293	3415.5494
0.1937	0.0188	0.0092	178.2573	37.5103	5.0528	532.8079	4443.3021	3219.5307
0.1814	0.0188	0.0097	186.1988	37.6293	5.0528	573.3574	4443.3021	3464.5541
0.1859	0.0188	0.0092	171.36	37.6843	5.0528	532.8079	4443.3021	3219.5307
0.2262	0.0189	0.0106	194.6509	37.7331	5.0915	646.3466	4477.3293	3905.5963
0.2747	0.0188	0.0091	171.2183	37.6171	5.0528	524.6980	4443.3021	3170.5260
0.2694	0.0189	0.0093	168.3364	37.8582	5.0915	540.9178	4477.3293	3268.5354
0.2717	0.0189	0.0096	174.0109	37.7117	5.0915	565.2475	4477.3293	3415.5494
0.2773	0.019	0.0093	187.7795	37.9345	5.1302	540.9178	4511.3564	3268.5354
0.3318	0.0188	0.011	203.9595	37.5713	5.0528	678.7862	4443.3021	4101.6150
0.3357	0.0189	0.0108	191.9929	37.7026	5.0915	662.5664	4477.3293	4003.6057
0.342	0.0189	0.0103	186.2976	37.7636	5.0915	622.0169	4477.3293	3758.5822
0.3522	0.019	0.0102	188.5025	37.9284	5.1302	613.9070	4511.3564	3709.5776
0.3899	0.019	0.0124	239.9699	37.9131	5.1302	792.3248	4511.3564	4787.6807
0.4078	0.0191	0.0127	234.4101	38.1237	5.1689	816.6546	4545.3836	4934.6947
0.4006	0.0189	0.0133	250.2952	37.8948	5.0915	865.3140	4477.3293	5228.7228
0.4019	0.0189	0.0116	230.6797	37.9009	5.0915	727.4456	4477.3293	4395.6432
0.4208	0.019	0.0139	264.8365	38.0932	5.1302	913.9734	4511.3564	5522.7510
0.4388	0.0189	0.0155	272.5093	37.8368	5.0915	1043.7319	4477.3293	6306.8259
0.457	0.019	0.0146	257.5415	37.9894	5.1302	970.7427	4511.3564	5865.7838
0.4494	0.0189	0.0139	252.7445	37.8765	5.0915	913.9734	4477.3293	5522.7510
0.4457	0.0191	0.0132	249.6937	38.1634	5.1689	857.2041	4545.3836	5179.7182
0.458	0.0191	0.0156	289.8108	38.197	5.1689	1051.8418	4545.3836	6355.8306
0.4834	0.019	0.0147	277.6628	38.0169	5.1302	978.8526	4511.3564	5914.7885
0.4768	0.0191	0.0151	282.8226	38.1176	5.1689	1011.2922	4545.3836	6110.8072
0.4792	0.0191	0.0155	271.8486	38.1268	5.1689	1043.7319	4545.3836	6306.8259
0.4841	0.019	0.0159	284.9286	37.9406	5.1302	1076.1715	4511.3564	6502.8447
0.4856	0.019	0.014	266.994	37.9528	5.1302	922.0833	4511.3564	5571.7556
0.5223	0.019	0.0153	268.6705	38.0169	5.1302	1027.5121	4511.3564	6208.8166
0.5148	0.0191	0.0139	264.301	38.2061	5.1689	913.9734	4545.3836	5522.7510
0.5185	0.0191	0.0145	267.2162	38.2488	5.1689	962.6328	4545.3836	5816.7791
0.5456	0.0191	0.0164	301.7502	38.2092	5.1689	1116.7210	4545.3836	6747.8681
0.553	0.0191	0.0168	292.9081	38.2153	5.1689	1149.1606	4545.3836	6943.8869
0.5515	0.0191	0.0157	286.8157	38.2916	5.1689	1059.9517	4545.3836	6404.8353
0.5438	0.0191	0.0156	286.8811	38.1664	5.1689	1051.8418	4545.3836	6355.8306
0.5546	0.0191	0.0182	317.9979	38.2153	5.1689	1262.6993	4545.3836	7629.9525
0.5865	0.0192	0.0186	324.7117	38.4564	5.2076	1295.1389	4579.4107	7825.9712

Table C-4. Corehole #1 at 44/45 feet.

FULLER WARREN BRIDGE
SHEAR DEVICE TEST RESULTS

Penetration	(calculated) 0.0315611				
Height H_2O	26	(ft)	Unit Wt H_2O	62.4	(lb/ft3)
Length Pipe	44	(ft)	Unit Wt Rod	2.96	(lb/ft)
Penetration Depth	0.0233	(in)	Cylinder Bore Area	4.72	(in2)
Stud Cap Area	0.1964	(in2)	Shear Stud Area	0.165492416	
No. of Studs	42		Normal Stud Area	0.001137173	
Weight of Instrum.	38		qu (psi)	1406.6	

LVDT (in)	Pressure (volts)	Load (volts)	Est. Load (psi)	Est. Press. (psi)	Normal Force (lb)	Shear Force (lb)	Normal Stress (psi)	Shear Stress (psi)
0.0026	0.0236	0.0006	11.9246	47.1114	6.9101	-164.6438	6076.6048	-994.8724
0.0092	0.0237	0.0012	25.1674	47.4929	6.9488	-115.9844	6110.6320	-700.8442
0.0235	0.0236	0.0047	89.1012	47.1084	6.9101	167.8622	6076.6048	1014.3198
0.1163	0.0236	0.0071	131.0439	47.2121	6.9101	362.4999	6076.6048	2190.4323
0.1217	0.0236	0.0061	115.3806	47.1694	6.9101	281.4009	6076.6048	1700.3854
0.1196	0.0235	0.0066	133.5284	47.0351	6.8715	321.9504	6042.5777	1945.4088
0.1505	0.0235	0.0087	172.2599	47.087	6.8715	492.2584	6042.5777	2974.5073
0.188	0.0235	0.0116	213.1098	46.9741	6.8715	727.4456	6042.5777	4395.6432
0.1914	0.0234	0.0102	202.6044	46.7391	6.8328	613.9070	6008.5506	3709.5776
0.1455	0.0234	0.0095	190.8982	46.7269	6.8328	557.1376	6008.5506	3366.5447
0.1713	0.0233	0.0117	236.9665	46.6933	6.7941	735.5555	5974.5234	4444.6479
0.2696	0.0231	0.0124	249.7214	46.1928	6.7167	792.3248	5906.4691	4787.6807
0.2592	0.0232	0.0113	232.8547	46.4278	6.7554	703.1159	5940.4963	4248.6291
0.26	0.0232	0.0126	226.9515	46.3454	6.7554	808.5446	5940.4963	4885.6900
0.2727	0.0234	0.0132	260.6091	46.8398	6.8328	857.2041	6008.5506	5179.7182
0.3007	0.0232	0.0131	251.8566	46.3424	6.7554	849.0942	5940.4963	5130.7135
0.2944	0.0231	0.0136	243.6903	46.2111	6.7167	889.6437	5906.4691	5375.7369
0.3033	0.0231	0.0122	236.2665	46.147	6.7167	776.1050	5906.4691	4689.6713
0.3096	0.0232	0.0142	256.3954	46.3149	6.7554	938.3031	5940.4963	5669.7650
0.3459	0.0231	0.0134	258.5332	46.147	6.7167	873.4239	5906.4691	5277.7275
0.3456	0.0231	0.0143	253.576	46.1531	6.7167	946.4130	5906.4691	5718.7697
0.338	0.0232	0.0132	240.8365	46.3485	6.7554	857.2041	5940.4963	5179.7182
0.3454	0.0233	0.0126	243.335	46.6414	6.7941	808.5446	5974.5234	4885.6900
0.376	0.0232	0.0152	276.3736	46.3637	6.7554	1019.4022	5940.4963	6159.8119
0.3898	0.0231	0.0132	240.8771	46.26	6.7167	857.2041	5906.4691	5179.7182
0.3843	0.0232	0.0138	246.9885	46.3881	6.7554	905.8635	5940.4963	5473.7463
0.3783	0.0232	0.013	238.3798	46.3668	6.7554	840.9843	5940.4963	5081.7088
0.4252	0.0233	0.0148	275.3098	46.5346	6.7941	986.9625	5974.5234	5963.7931
0.4282	0.0231	0.014	248.3121	46.2996	6.7167	922.0833	5906.4691	5571.7556
0.4371	0.0232	0.0133	245.2762	46.4431	6.7554	865.3140	5940.4963	5228.7228
0.4277	0.0232	0.0129	248.9544	46.4492	6.7554	832.8744	5940.4963	5032.7041
0.4437	0.0233	0.0149	270.8451	46.5773	6.7941	995.0724	5974.5234	6012.7978
0.4601	0.0232	0.0139	256.6567	46.3973	6.7554	913.9734	5940.4963	5522.7510
0.4696	0.0233	0.013	255.426	46.6842	6.7941	840.9843	5974.5234	5081.7088
0.4676	0.0233	0.0127	248.5851	46.614	6.7941	816.6546	5974.5234	4934.6947
0.4873	0.0233	0.0158	289.205	46.5377	6.7941	1068.0616	5974.5234	6453.8400
0.5147	0.0232	0.0161	280.7951	46.4003	6.7554	1092.3913	5940.4963	6600.8541
0.5122	0.0233	0.0133	249.1179	46.5499	6.7941	865.3140	5974.5234	5228.7228
0.5196	0.0233	0.0141	260.1634	46.559	6.7941	930.1932	5974.5234	5620.7603
0.5519	0.0233	0.0158	290.6166	46.556	6.7941	1068.0616	5974.5234	6453.8400
0.5585	0.0233	0.0154	270.584	46.5285	6.7941	1035.6220	5974.5234	6257.8213
0.5569	0.0232	0.0149	257.2718	46.4248	6.7554	995.0724	5940.4963	6012.7978
0.5537	0.0232	0.0142	258.2668	46.4736	6.7554	938.3031	5940.4963	5669.7650
0.5895	0.0233	0.0159	292.5502	46.5438	6.7941	1076.1715	5974.5234	6502.8447
0.5911	0.0233	0.0154	280.0365	46.6231	6.7941	1035.6220	5974.5234	6257.8213
0.5895	0.0233	0.0146	264.8821	46.6323	6.7941	970.7427	5974.5234	5865.7838

Table C-5. Corehole #1 at 45/26 feet.

FULLER WARREN BRIDGE
SHEAR DEVICE TEST RESULTS

Penetration	(calculated) 0.024255156				
Height H_2O	27	(ft)	Unit Wt H_2O	62.4	(lb/ft3)
Length Pipe	45	(ft)	Unit Wt Rod	2.96	(lb/ft)
Penetration Depth	0.0343	(in)	Cylinder Bore Area	4.72	(in2)
Stud Cap Area	0.1964	(in2)	Shear Stud Area	0.358636506	
No. of Studs	42		Normal Stud Area	0.002464352	
Weight of Instrum.	38		qu (psi)	822.8	

LVDT (in)	Pressure (volts)	Load (volts)	Est. Load (psi)	Est. Press. (psi)	Normal Force (lb)	Shear Force (lb)	rmal Stud Stress (psi)	Shear Stress (psi)
-0.0042	0.0142	0.0005	10.8756	28.3883	3.1877	-175.7137	1293.5396	-489.9494
-0.0015	0.0142	0.0006	12.0886	28.3639	3.1877	-167.6038	1293.5396	-467.3362
-0.0084	0.0141	0.0026	48.2052	28.1869	3.1490	-5.4058	1277.8378	-15.0731
0.1149	0.014	0.0023	46.7701	28.0465	3.1103	-29.7355	1262.1360	-82.9125
0.1217	0.0138	0.0025	45.8423	27.6833	3.0330	-13.5157	1230.7324	-37.6862
0.125	0.0138	0.0033	62.3443	27.6345	3.0330	51.3636	1230.7324	143.2190
0.1706	0.0139	0.0046	93.1161	27.7322	3.0717	156.7923	1246.4342	437.1901
0.2442	0.0137	0.0056	100.4495	27.4606	2.9943	237.8914	1215.0307	663.3217
0.2453	0.0139	0.0052	95.7382	27.7352	3.0717	205.4518	1246.4342	572.8690
0.2514	0.0139	0.0052	96.3034	27.8268	3.0717	205.4518	1246.4342	572.8690
0.2926	0.0139	0.0076	140.1488	27.7108	3.0717	400.0894	1246.4342	1115.5848
0.3646	0.0138	0.0059	105.1545	27.5399	3.0330	262.2211	1230.7324	731.1612
0.3694	0.0138	0.0056	104.0458	27.5552	3.0330	237.8914	1230.7324	663.3217
0.3639	0.0137	0.0055	100.3506	27.485	2.9943	229.7815	1215.0307	640.7085
0.3988	0.0138	0.0057	111.4829	27.5246	3.0330	246.0013	1230.7324	685.9348
0.4599	0.0138	0.007	134.1244	27.5735	3.0330	351.4300	1230.7324	979.9059
0.4867	0.0139	0.0077	138.4545	27.8359	3.0717	408.1994	1246.4342	1138.1980
0.4817	0.0139	0.0083	154.4097	27.7871	3.0717	456.8588	1246.4342	1273.8769
0.4885	0.0139	0.0071	134.6775	27.842	3.0717	359.5399	1246.4342	1002.5190
0.4872	0.0139	0.0073	144.4112	27.8268	3.0717	375.7597	1246.4342	1047.7454
0.5185	0.0139	0.0084	155.2005	27.8176	3.0717	464.9687	1246.4342	1296.4901
0.5641	0.014	0.009	169.9558	27.9794	3.1103	513.6281	1262.1360	1432.1691
0.5754	0.014	0.009	160.6679	28.0038	3.1103	513.6281	1262.1360	1432.1691
0.592	0.014	0.0085	148.5167	27.9153	3.1103	473.0786	1262.1360	1319.1033
0.5741	0.014	0.0077	144.9526	28.0313	3.1103	408.1994	1262.1360	1138.1980
0.5755	0.0139	0.0077	139.0642	27.8573	3.0717	408.1994	1246.4342	1138.1980
0.5747	0.0139	0.0086	150.3101	27.8756	3.0717	481.1885	1246.4342	1341.7164
0.6344	0.0141	0.0101	172.8601	28.1533	3.1490	602.8370	1277.8378	1680.9138
0.6614	0.0139	0.0097	173.189	27.8817	3.0717	570.3974	1246.4342	1590.4612
0.6647	0.014	0.0089	163.0679	28.077	3.1103	505.5182	1262.1360	1409.5559
0.6725	0.0139	0.0092	160.0975	27.8756	3.0717	529.8479	1246.4342	1477.3954
0.6762	0.014	0.009	170.2833	28.0404	3.1103	513.6281	1262.1360	1432.1691
0.7184	0.0139	0.0102	181.3629	27.8726	3.0717	610.9470	1246.4342	1703.5269
0.7383	0.0139	0.008	139.9316	27.9	3.0717	432.5291	1246.4342	1206.0375
0.6309	0.0139	0.0075	136.6767	27.7078	3.0717	391.9795	1246.4342	1092.9717
0.7026	0.0139	0.0076	139.2209	27.7291	3.0717	400.0894	1246.4342	1115.5848
0.661	0.014	0.008	141.5216	27.9885	3.1103	432.5291	1262.1360	1206.0375
0.7348	0.0139	0.008	138.2833	27.7261	3.0717	432.5291	1246.4342	1206.0375
0.639	0.014	0.0072	126.8708	27.9702	3.1103	367.6498	1262.1360	1025.1322
0.6853	0.0139	0.0077	136.4671	27.8085	3.0717	408.1994	1246.4342	1138.1980
0.697	0.014	0.0079	136.4839	27.9366	3.1103	424.4192	1262.1360	1183.4243
0.6551	0.0139	0.0071	125.0566	27.7749	3.0717	359.5399	1246.4342	1002.5190
0.7119	0.014	0.0082	146.8155	27.9855	3.1103	448.7489	1262.1360	1251.2638
0.6392	0.0139	0.0071	131.0414	27.8512	3.0717	359.5399	1246.4342	1002.5190
0.6351	0.0139	0.0066	122.7966	27.8878	3.0717	318.9904	1246.4342	889.4533

Table C-6. Corehole #1 at 45/33 feet.

FULLER WARREN BRIDGE
SHEAR DEVICE TEST RESULTS

		Penetration		(calculated)	0.03433834			
		Height H_2O		27	(ft)	Unit Wt H_2O	62.4	(lb/ft3)
		Length Pipe		45	(ft)	Unit Wt Rod	2.96	(lb/ft)
		Penetration Depth		0.0343	(in)	Cylinder Bore Area	4.72	(in2)
		Stud Cap Area		0.1964	(in2)	Shear Stud Area	0.358636506	
		No. of Studs		42		Normal Stud Area	0.002464352	
		Weight of Instrum.		38		qu (psi)	822.8	
LVDT (in)	Pressure (volts)	Load (volts)	Est. Load (psi)	Est. Press. (psi)	Normal Force (lb)	Shear Force (lb)	Normal Stress (psi)	Shear Stress (psi)
-0.0061	0.0174	0.0007	14.1348	34.7056	4.4260	-159.4939	1795.9967	-444.7231
-0.0079	0.0174	0.001	18.5748	34.7514	4.4260	-135.1642	1795.9967	-376.8836
-0.0048	0.0175	0.0008	17.2563	34.959	4.4647	-151.3840	1811.6985	-422.1099
-0.0071	0.0175	0.0006	12.7962	34.9284	4.4647	-167.6038	1811.6985	-467.3362
0.0225	0.0174	0.0052	97.942	34.7331	4.4260	205.4518	1795.9967	572.8690
0.1272	0.0173	0.0068	123.4599	34.6263	4.3873	335.2102	1780.2949	934.6796
0.1122	0.0174	0.0057	112.6102	34.7392	4.4260	246.0013	1795.9967	685.9348
0.1117	0.0172	0.0053	107.4548	34.4859	4.3486	213.5617	1764.5932	595.4822
0.1838	0.0172	0.0069	140.1526	34.3913	4.3486	343.3201	1764.5932	957.2927
0.238	0.0172	0.0068	129.1198	34.4249	4.3486	335.2102	1764.5932	934.6796
0.2342	0.0173	0.0072	129.9371	34.6477	4.3873	367.6498	1780.2949	1025.1322
0.2453	0.0173	0.007	132.8959	34.5714	4.3873	351.4300	1780.2949	979.9059
0.2668	0.0173	0.0085	165.4359	34.5805	4.3873	473.0786	1780.2949	1319.1033
0.3257	0.0173	0.0098	172.9646	34.5988	4.3873	578.5073	1780.2949	1613.0743
0.3275	0.0174	0.0093	165.7208	34.7179	4.4260	537.9578	1795.9967	1500.0085
0.3281	0.0173	0.0083	163.0702	34.55	4.3873	456.8588	1780.2949	1273.8769
0.3297	0.0173	0.0086	172.1915	34.5866	4.3873	481.1885	1780.2949	1341.7164
0.3712	0.017	0.01	197.7999	33.961	4.2712	594.7271	1733.1896	1658.3006
0.4115	0.0173	0.0092	171.5376	34.5683	4.3873	529.8479	1780.2949	1477.3954
0.4308	0.0173	0.0097	169.2533	34.6263	4.3873	570.3974	1780.2949	1590.4612
0.4171	0.0172	0.0097	174.7152	34.3486	4.3486	570.3974	1764.5932	1590.4612
0.4295	0.0172	0.0103	181.5469	34.3883	4.3486	619.0569	1764.5932	1726.1401
0.4695	0.0172	0.013	233.8465	34.3944	4.3486	838.0243	1764.5932	2336.6954
0.482	0.0172	0.0126	227.9329	34.3089	4.3486	805.5846	1764.5932	2246.2427
0.4859	0.0172	0.0116	223.8285	34.4493	4.3486	724.4856	1764.5932	2020.1112
0.4756	0.0173	0.0126	236.451	34.669	4.3873	805.5846	1780.2949	2246.2427
0.4758	0.0172	0.0129	231.1589	34.3638	4.3486	829.9144	1764.5932	2314.0822
0.5048	0.0172	0.0137	259.8396	34.4035	4.3486	894.7936	1764.5932	2494.9875
0.5216	0.0173	0.0141	258.4233	34.5164	4.3873	927.2332	1780.2949	2585.4401
0.5173	0.0172	0.0145	257.5492	34.4401	4.3486	959.6728	1764.5932	2675.8927
0.5153	0.0172	0.0146	257.3252	34.4096	4.3486	967.7827	1764.5932	2698.5059
0.5152	0.0173	0.0159	283.6475	34.5714	4.3873	1073.2115	1780.2949	2992.4770
0.545	0.0173	0.0173	303.1055	34.6751	4.3873	1186.7501	1780.2949	3309.0612
0.5392	0.0173	0.0156	291.0062	34.6446	4.3873	1048.8818	1780.2949	2924.6375
0.5535	0.0173	0.0166	292.4792	34.6812	4.3873	1129.9808	1780.2949	3150.7691
0.5422	0.0173	0.0159	296.6811	34.611	4.3873	1073.2115	1780.2949	2992.4770
0.534	0.0172	0.016	302.7328	34.3181	4.3486	1081.3214	1764.5932	3015.0901
0.5723	0.0173	0.018	317.7336	34.5714	4.3873	1243.5195	1780.2949	3467.3533
0.569	0.0172	0.0169	302.3458	34.376	4.3486	1154.3105	1764.5932	3218.6085
0.5718	0.0173	0.0163	297.7067	34.5744	4.3873	1105.6511	1780.2949	3082.9296
0.5685	0.0173	0.0171	294.4115	34.6202	4.3873	1170.5303	1780.2949	3263.8349
0.5789	0.0173	0.0158	297.3001	34.6721	4.3873	1065.1016	1780.2949	2969.8638
0.5648	0.0174	0.0157	295.115	34.7362	4.4260	1056.9917	1795.9967	2947.2506
0.562	0.0174	0.0164	292.2525	34.7911	4.4260	1113.7610	1795.9967	3105.5428
0.5623	0.0173	0.0166	287.4036	34.5744	4.3873	1129.9808	1780.2949	3150.7691
0.5704	0.0173	0.0159	301.658	34.6965	4.3873	1073.2115	1780.2949	2992.4770
0.5763	0.0172	0.0168	298.7283	34.4981	4.3486	1146.2006	1764.5932	3195.9954

Table C-7. Corehole #1 at 45/39 feet.

FULLER WARREN BRIDGE

SHEAR DEVICE TEST RESULTS

Penetration	(calculated)	0.04319932			
Height H_2O	27 (ft)		Unit Wt H_2O	62.4	(lb/ft3)
Length Pipe	45 (ft)		Unit Wt Rod	2.96	(lb/ft)
Penetration Depth	0.0343 (in)		Cylinder Bore Area	4.72	(in2)
Stud Cap Area	0.1964 (in2)		Shear Stud Area	0.358636506	
No. of Studs	42		Normal Stud Area	0.002464352	
Weight of Instrum.	38		qu (psi)	822.8	

LVDT (in)	Pressure (volts)	Load (volts)	Est. Load (psi)	Est. Press. (psi)	NormalForce (lb)	Shear Force (lb)	Normal Stress (psi)	Shear Stress (psi)
-0.0017	0.0204	0.0009	18.0007	40.8063	5.5868	-143.2741	2267.0503	-399.4968
-0.009	0.0203	0.0005	9.0128	40.5652	5.5481	-175.7137	2251.3485	-489.9494
0.0016	0.0202	0.0018	36.4394	40.4889	5.5094	-70.2850	2235.6467	-195.9783
0.0705	0.0202	0.0052	103.9519	40.4889	5.5094	205.4518	2235.6467	572.8690
0.126	0.0203	0.0045	86.0187	40.6507	5.5481	148.6824	2251.3485	414.5769
0.1213	0.0202	0.0051	93.3752	40.4981	5.5094	197.3418	2235.6467	550.2559
0.1304	0.0202	0.0045	81.2669	40.4096	5.5094	148.6824	2235.6467	414.5769
0.1425	0.0202	0.0066	122.3438	40.3211	5.5094	318.9904	2235.6467	889.4533
0.213	0.0201	0.009	170.7768	40.2844	5.4707	513.6281	2219.9449	1432.1691
0.2248	0.0203	0.0091	166.6667	40.5866	5.5481	521.7380	2251.3485	1454.7822
0.2168	0.0202	0.009	165.56	40.379	5.5094	513.6281	2235.6467	1432.1691
0.2199	0.0202	0.0083	162.9046	40.4035	5.5094	456.8588	2235.6467	1273.8769
0.2286	0.0202	0.0106	202.0996	40.492	5.5094	643.3866	2235.6467	1793.9796
0.2784	0.0202	0.0132	244.7826	40.3363	5.5094	854.2441	2235.6467	2381.9217
0.2672	0.0203	0.0131	242.6481	40.5438	5.5481	846.1342	2251.3485	2359.3085
0.2809	0.0202	0.0129	245.0369	40.4157	5.5094	829.9144	2235.6467	2314.0822
0.274	0.0202	0.0135	255.0398	40.4614	5.5094	878.5738	2235.6467	2449.7612
0.3018	0.0202	0.0152	293.3985	40.3974	5.5094	1016.4422	2235.6467	2834.1849
0.3137	0.0202	0.015	289.5548	40.3455	5.5094	1000.2223	2235.6467	2788.9585
0.3185	0.0202	0.0151	282.6727	40.5011	5.5094	1008.3322	2235.6467	2811.5717
0.3083	0.0201	0.0154	289.2337	40.2509	5.4707	1032.6620	2219.9449	2879.4112
0.3144	0.0201	0.0146	277.363	40.2753	5.4707	967.7827	2219.9449	2698.5059
0.3181	0.0202	0.0157	303.9568	40.4218	5.5094	1056.9917	2235.6467	2947.2506
0.3316	0.0202	0.0154	286.3892	40.3119	5.5094	1032.6620	2235.6467	2879.4112
0.338	0.0201	0.015	274.3739	40.1288	5.4707	1000.2223	2219.9449	2788.9585
0.3469	0.0202	0.0151	269.8826	40.4126	5.5094	1008.3322	2235.6467	2811.5717
0.3401	0.0202	0.0162	288.4029	40.4431	5.5094	1097.5412	2235.6467	3060.3164
0.367	0.0203	0.0179	323.9788	40.5133	5.5481	1235.4096	2251.3485	3444.7401
0.3724	0.0201	0.0154	298.8204	40.2753	5.4707	1032.6620	2219.9449	2879.4112
0.3769	0.0201	0.0147	289.3223	40.2112	5.4707	975.8926	2219.9449	2721.1191
0.3714	0.0202	0.0157	287.1106	40.3363	5.5094	1056.9917	2235.6467	2947.2506
0.3653	0.0201	0.0151	287.3784	40.2142	5.4707	1008.3322	2219.9449	2811.5717
0.3909	0.0201	0.0185	330.1784	40.199	5.4707	1284.0690	2219.9449	3580.4191
0.3972	0.0202	0.0161	299.8179	40.3577	5.5094	1089.4313	2235.6467	3037.7033
0.397	0.0202	0.0151	285.2541	40.4187	5.5094	1008.3322	2235.6467	2811.5717
0.4024	0.0201	0.015	284.3672	40.1654	5.4707	1000.2223	2219.9449	2788.9585
0.4027	0.0202	0.0147	278.1827	40.4553	5.5094	975.8926	2235.6467	2721.1191
0.4022	0.0202	0.0169	298.3616	40.3516	5.5094	1154.3105	2235.6467	3218.6085
0.4267	0.02	0.0169	309.4919	40.083	5.4320	1154.3105	2204.2431	3218.6085
0.4185	0.0201	0.0152	285.5259	40.1715	5.4707	1016.4422	2219.9449	2834.1849
0.4367	0.0202	0.016	280.3941	40.4248	5.5094	1081.3214	2235.6467	3015.0901
0.4241	0.0201	0.0155	285.8511	40.2326	5.4707	1040.7719	2219.9449	2902.0243
0.4303	0.0201	0.0155	277.196	40.1959	5.4707	1040.7719	2219.9449	2902.0243
0.4208	0.0201	0.0157	290.9388	40.2264	5.4707	1056.9917	2219.9449	2947.2506
0.418	0.0201	0.0144	268.3226	40.1715	5.4707	951.5629	2219.9449	2653.2796
0.4204	0.0201	0.0149	272.7979	40.2753	5.4707	992.1124	2219.9449	2766.3454
0.4247	0.0202	0.0144	273.9945	40.3363	5.5094	951.5629	2235.6467	2653.2796

Table C-8. Corehole #1 at 45/46 feet.

FULLER WARREN BRIDGE
SHEAR DEVICE TEST RESULTS

Penetration	(calculated) 0.053588055		
Height H_2O	27 (ft)	Unit Wt H_2O	62.4 (lb/ft3)
Length Pipe	45 (ft)	Unit Wt Rod	2.96 (lb/ft)
Penetration Depth	0.0343 (in)	Cylinder Bore A	4.72 (in2)
Stud Cap Area	0.1964 (in2)	Shear Stud Area	0.358636506
No. of Studs	42	Normal Stud Area	0.002464352
Weight of Instrum.	38	qu (psi)	822.8

LVDT (in)	Pressure (volts)	Load (volts)	Est. Load (psi)	Est. Press. (psi)	Normal Force (lb)	Shear Force (lb)	Normal tress (psi)	Shear Stress (psi)
0.0027	0.0238	0.0009	17.0546	47.5814	6.9024	-143.2741	2800.9110	-399.4968
0.0067	0.0238	0.001	20.3846	47.676	6.9024	-135.1642	2800.9110	-376.8836
-0.0097	0.0238	0.0011	22.8635	47.5997	6.9024	-127.0543	2800.9110	-354.2704
0.0389	0.0238	0.0071	134.4253	47.6272	6.9024	359.5399	2800.9110	1002.5190
0.1053	0.0236	0.0088	165.8751	47.2182	6.8250	497.4083	2769.5074	1386.9427
0.101	0.0236	0.0083	152.8496	47.2213	6.8250	456.8588	2769.5074	1273.8769
0.1071	0.0236	0.0082	155.5695	47.2488	6.8250	448.7489	2769.5074	1251.2638
0.1486	0.0236	0.0112	202.5342	47.2121	6.8250	692.0460	2769.5074	1929.6585
0.1799	0.0235	0.012	222.3525	46.9558	6.7863	756.9252	2753.8056	2110.5638
0.1658	0.0235	0.0112	214.015	47.0931	6.7863	692.0460	2753.8056	1929.6585
0.1792	0.0234	0.0113	213.259	46.8978	6.7477	700.1559	2738.1039	1952.2717
0.1797	0.0235	0.0122	233.3427	47.0229	6.7863	773.1450	2753.8056	2155.7901
0.2108	0.0236	0.0154	284.488	47.1725	6.8250	1032.6620	2769.5074	2879.4112
0.2203	0.0236	0.0135	281.8974	47.2427	6.8250	878.5738	2769.5074	2449.7612
0.2165	0.0236	0.0141	271.5561	47.148	6.8250	927.2332	2769.5074	2585.4401
0.2099	0.0236	0.0136	270.409	47.2091	6.8250	886.6837	2769.5074	2472.3743
0.228	0.0236	0.0179	329.8588	47.2274	6.8250	1235.4096	2769.5074	3444.7401
0.2393	0.0237	0.0176	328.0824	47.3342	6.8637	1211.0798	2785.2092	3376.9006
0.2477	0.0237	0.0154	306.7877	47.3861	6.8637	1032.6620	2785.2092	2879.4112
0.2382	0.0237	0.0175	318.2552	47.322	6.8637	1202.9699	2785.2092	3354.2875
0.2443	0.0236	0.0163	327.8407	47.1908	6.8250	1105.6511	2769.5074	3082.9296
0.2583	0.0238	0.0184	347.8351	47.5692	6.9024	1275.9591	2800.9110	3557.8059
0.2695	0.0236	0.0171	310.8159	47.3006	6.8250	1170.5303	2769.5074	3263.8349
0.2698	0.0236	0.015	299.111	47.1877	6.8250	1000.2223	2769.5074	2788.9585
0.2662	0.0237	0.0162	300.2422	47.3922	6.8637	1097.5412	2785.2092	3060.3164
0.2903	0.0237	0.0175	331.3935	47.3189	6.8637	1202.9699	2785.2092	3354.2875
0.2947	0.0236	0.017	332.956	47.1877	6.8250	1162.4204	2769.5074	3241.2217
0.2979	0.0237	0.0181	331.0117	47.3525	6.8637	1251.6294	2785.2092	3489.9664
0.2917	0.0236	0.018	336.1613	47.3006	6.8250	1243.5195	2769.5074	3467.3533
0.2993	0.0237	0.0167	320.8638	47.3159	6.8637	1138.0907	2785.2092	3173.3822
0.3076	0.0237	0.0201	375.0085	47.3159	6.8637	1413.8274	2785.2092	3942.2296
0.3162	0.0238	0.0186	367.4275	47.5356	6.9024	1292.1789	2800.9110	3603.0322
0.3226	0.0237	0.0197	370.6838	47.3342	6.8637	1381.3878	2785.2092	3851.7770
0.322	0.0238	0.0203	366.6501	47.5051	6.9024	1430.0473	2800.9110	3987.4559
0.3223	0.0236	0.019	373.7692	47.2976	6.8250	1324.6185	2769.5074	3693.4849
0.3384	0.0238	0.0234	427.6709	47.5631	6.9024	1681.4543	2800.9110	4688.4638
0.3459	0.0237	0.0233	413.7968	47.4471	6.8637	1673.3444	2785.2092	4665.8507
0.3454	0.0237	0.0221	404.2489	47.496	6.8637	1576.0255	2785.2092	4394.4928
0.3479	0.0237	0.0218	409.3723	47.3891	6.8637	1551.6958	2785.2092	4326.6533
0.3568	0.0238	0.023	423.0291	47.56	6.9024	1649.0147	2800.9110	4598.0112
0.3659	0.0237	0.0258	459.1105	47.4624	6.8637	1876.0920	2785.2092	5231.1796
0.3691	0.0237	0.0225	443.3224	47.4227	6.8637	1608.4651	2785.2092	4484.9454
0.3695	0.0237	0.0243	437.4182	47.3098	6.8637	1754.4434	2785.2092	4891.9822
0.3757	0.0238	0.024	467.2595	47.5021	6.9024	1730.1137	2800.9110	4824.1428
0.3873	0.0238	0.0251	484.3594	47.5051	6.9024	1819.3226	2800.9110	5072.8875
0.4056	0.0238	0.0254	456.3329	47.5051	6.9024	1843.6524	2800.9110	5140.7270
0.4044	0.0238	0.0247	463.2296	47.5509	6.9024	1786.8830	2800.9110	4982.4349

Table C-9. Corehole #1 at 47/25 feet.

FULLER WARREN BRIDGE

SHEAR DEVICE TEST RESULTS

Penetration	(calculated) 0.017275202				
Height H_2O	29	(ft)	Unit Wt H_2O	62.4	(lb/ft3)
Length Pipe	47.5	(ft)	Unit Wt Rod	2.96	(lb/ft)
Penetration Depth	0.026	(in)	Cylinder Bore Area	4.72	(in2)
Stud Cap Area	0.1964	(in2)	Shear Stud Area	0.206069136	
No. of Studs	42		Normal Stud Area	0.001415993	
Weight of Instrum.	38		qu (psi)	945.7	

LVDT (in)	Pressure (volts)	Load (volts)	Est. Load (psi)	Est. Press. (psi)	Normal Force (lb)	Shear Force (lb)	nal Stud Stress (psi)	Shear Stress (psi)
0.0067	0.0132	0.0009	17.0622	26.3009	2.6306	-150.6741	1857.7604	-731.1824
-0.0047	0.0132	0.0008	16.7240	26.4901	2.6306	-158.7840	1857.7604	-770.5376
0.0096	0.0132	0.0045	90.6639	26.4840	2.6306	141.2824	1857.7604	685.6069
0.1130	0.0131	0.0057	114.4188	26.2764	2.5919	238.6013	1830.4335	1157.8700
0.1267	0.0131	0.0048	90.4872	26.2215	2.5919	165.6121	1830.4335	803.6727
0.1271	0.0131	0.0042	89.7356	26.1147	2.5919	116.9527	1830.4335	567.5411
0.1855	0.0131	0.0061	118.7179	26.2917	2.5919	271.0409	1830.4335	1315.2910
0.2446	0.0130	0.0050	92.4762	25.9102	2.5532	181.8319	1803.1066	882.3832
0.2515	0.0129	0.0052	98.1772	25.8614	2.5145	198.0518	1775.7797	961.0937
0.2422	0.0130	0.0054	99.7603	25.9041	2.5532	214.2716	1803.1066	1039.8042
0.2506	0.0129	0.0063	117.7712	25.8705	2.5145	287.2607	1775.7797	1394.0016
0.3100	0.0131	0.0069	124.9599	26.2795	2.5919	335.9201	1830.4335	1630.1331
0.3675	0.0130	0.0056	105.9564	26.0140	2.5532	230.4914	1803.1066	1118.5147
0.3583	0.0130	0.0052	98.1342	25.9529	2.5532	198.0518	1803.1066	961.0937
0.3637	0.0130	0.0056	103.8271	26.0750	2.5532	230.4914	1803.1066	1118.5147
0.3673	0.0130	0.0067	130.1214	26.0933	2.5532	319.7003	1803.1066	1551.4226
0.4231	0.0131	0.0064	119.8456	26.1147	2.5919	295.3706	1830.4335	1433.3568
0.4525	0.0129	0.0052	101.3626	25.8400	2.5145	198.0518	1775.7797	961.0937
0.4386	0.0130	0.0054	99.2372	25.9255	2.5532	214.2716	1803.1066	1039.8042
0.4400	0.0129	0.0051	97.3190	25.8248	2.5145	189.9418	1775.7797	921.7385
0.4491	0.0129	0.0051	102.2270	25.7820	2.5145	189.9418	1775.7797	921.7385
0.5140	0.0128	0.0068	129.5539	25.6874	2.4758	327.8102	1748.4527	1590.7778
0.5450	0.0130	0.0057	107.5287	26.0414	2.5532	238.6013	1803.1066	1157.8700
0.5425	0.0129	0.0058	105.2979	25.8950	2.5145	246.7112	1775.7797	1197.2253
0.5316	0.0130	0.0057	102.8633	25.9224	2.5532	238.6013	1803.1066	1157.8700
0.5544	0.0130	0.0058	102.7754	26.0933	2.5532	246.7112	1803.1066	1197.2253
0.5465	0.0130	0.0054	106.7937	26.0109	2.5532	214.2716	1803.1066	1039.8042
0.5468	0.0130	0.0056	103.8464	25.9224	2.5532	230.4914	1803.1066	1118.5147
0.5753	0.0130	0.0069	132.8875	25.9346	2.5532	335.9201	1803.1066	1630.1331
0.6445	0.0131	0.0074	143.7661	26.1177	2.5919	376.4696	1830.4335	1826.9094
0.6615	0.0130	0.0068	120.8808	25.9316	2.5532	327.8102	1803.1066	1590.7778
0.6553	0.0130	0.0067	129.9672	25.9774	2.5532	319.7003	1803.1066	1551.4226
0.6708	0.0131	0.0067	119.0669	26.2642	2.5919	319.7003	1830.4335	1551.4226
0.6689	0.0130	0.0066	118.7574	25.9957	2.5532	311.5904	1803.1066	1512.0673
0.6806	0.0131	0.0068	120.7871	26.1483	2.5919	327.8102	1830.4335	1590.7778
0.6751	0.0131	0.0061	117.9747	26.1116	2.5919	271.0409	1830.4335	1315.2910
0.6683	0.0130	0.0061	112.9485	25.9285	2.5532	271.0409	1803.1066	1315.2910
0.6670	0.0131	0.0064	111.9538	26.1544	2.5919	295.3706	1830.4335	1433.3568
0.6691	0.0130	0.0069	123.5274	25.9285	2.5532	335.9201	1803.1066	1630.1331
0.6692	0.0131	0.0068	125.7872	26.1971	2.5919	327.8102	1830.4335	1590.7778
0.6638	0.0131	0.0061	114.9327	26.1177	2.5919	271.0409	1830.4335	1315.2910
0.6700	0.0130	0.0059	115.1984	26.0537	2.5532	254.8211	1803.1066	1236.5805
0.6625	0.0131	0.0065	116.0826	26.1391	2.5919	303.4805	1830.4335	1472.7121
0.6685	0.0130	0.0062	113.8119	26.0811	2.5532	279.1508	1803.1066	1354.6463
0.6736	0.0132	0.0062	116.7544	26.3283	2.6306	279.1508	1857.7604	1354.6463

Table C-10. Corehole #1 at 47.5/32 feet.

FULLER WARREN BRIDGE
SHEAR DEVICE TEST RESULTS

		Penetration	(calculated)	0.026048009				
		Height H_2O	29	(ft)	Unit Wt H_2O		62.4	(lb/ft3)
		Length Pipe	47.5	(ft)	Unit Wt Rod		2.96	(lb/ft)
		Penetration Depth	0.026	(in)	Cylinder Bore Area		4.72	(in2)
		Stud Cap Area	0.1964	(in2)	Shear Stud Area	0.206069136		
		No. of Studs	42		Normal Stud Area	0.001415993		
		Weight of Instrum.	38		qu (psi)	945.7		

LVDT (in)	Pressure (volts)	Load (volts)	Est. Load (psi)	Est. Press. (psi)	Normal Force (lb)	Shear Force (lb)	Normal Stress (psi)	Shear Stress (psi)
0.0011	0.0166	0.0011	22.0773	33.2682	3.9462	-134.4543	2786.8755	-652.4719
-0.0071	0.0167	0.0008	15.924	33.4544	3.9849	-158.7840	2814.2024	-770.5376
-0.0007	0.0165	0.0008	16.0911	33.1004	3.9075	-158.7840	2759.5486	-770.5376
0.08	0.0166	0.007	148.0045	33.2896	3.9462	344.0300	2786.8755	1669.4884
0.1176	0.0161	0.0062	125.0951	32.2214	3.7527	279.1508	2650.2409	1354.6463
0.1034	0.0163	0.0057	112.4791	32.6273	3.8301	238.6013	2704.8947	1157.8700
0.109	0.0163	0.0053	113.4049	32.6975	3.8301	206.1617	2704.8947	1000.4490
0.1295	0.0165	0.0063	138.772	32.9173	3.9075	287.2607	2759.5486	1394.0016
0.2062	0.0162	0.0077	146.2524	32.4168	3.7914	400.7994	2677.5678	1944.9752
0.2203	0.0161	0.0065	131.2089	32.1787	3.7527	303.4805	2650.2409	1472.7121
0.2217	0.0162	0.0064	122.3797	32.3099	3.7914	295.3706	2677.5678	1433.3568
0.224	0.0162	0.0065	123.7186	32.3405	3.7914	303.4805	2677.5678	1472.7121
0.2262	0.0163	0.0062	123.5121	32.5053	3.8301	279.1508	2704.8947	1354.6463
0.2276	0.0164	0.0074	150.8242	32.7525	3.8688	376.4696	2732.2216	1826.9094
0.2912	0.0162	0.0073	144.7264	32.3893	3.7914	368.3597	2677.5678	1787.5541
0.3349	0.0162	0.0078	141.3278	32.3069	3.7914	408.9093	2677.5678	1984.3304
0.313	0.0163	0.0071	133.9235	32.5877	3.8301	352.1399	2704.8947	1708.8436
0.3173	0.0164	0.0068	133.2264	32.8043	3.8688	327.8102	2732.2216	1590.7778
0.3159	0.0163	0.007	132.0888	32.5999	3.8301	344.0300	2704.8947	1669.4884
0.3292	0.0163	0.0075	148.7943	32.6975	3.8301	384.5795	2704.8947	1866.2647
0.4124	0.0162	0.0078	150.7633	32.3679	3.7914	408.9093	2677.5678	1984.3304
0.4245	0.0163	0.0074	131.3915	32.6243	3.8301	376.4696	2704.8947	1826.9094
0.4189	0.0162	0.0067	129.5483	32.4931	3.7914	319.7003	2677.5678	1551.4226
0.4245	0.0162	0.0077	138.2446	32.4778	3.7914	400.7994	2677.5678	1944.9752
0.4353	0.0163	0.0082	157.4969	32.609	3.8301	441.3489	2704.8947	2141.7515
0.4795	0.0163	0.0085	161.4143	32.5053	3.8301	465.6786	2704.8947	2259.8172
0.5143	0.0163	0.0086	155.3401	32.5114	3.8301	473.7885	2704.8947	2299.1725
0.5013	0.0162	0.0084	153.0765	32.487	3.7914	457.5687	2677.5678	2220.4620
0.5074	0.0163	0.0073	146.1663	32.5724	3.8301	368.3597	2704.8947	1787.5541
0.5075	0.0165	0.0081	150.0418	32.902	3.9075	433.2390	2759.5486	2102.3962
0.518	0.0164	0.009	170.7098	32.8501	3.8688	506.2281	2732.2216	2456.5935
0.5558	0.0163	0.0105	190.0166	32.5816	3.8301	627.8767	2704.8947	3046.9224
0.5798	0.0163	0.0096	169.0635	32.5449	3.8301	554.8875	2704.8947	2692.7251
0.584	0.0163	0.0083	160.8192	32.5205	3.8301	449.4588	2704.8947	2181.1067
0.5827	0.0164	0.0094	173.2262	32.844	3.8688	538.6677	2732.2216	2614.0146
0.5837	0.0164	0.0094	165.1366	32.8562	3.8688	538.6677	2732.2216	2614.0146
0.5854	0.0164	0.0088	158.3812	32.8135	3.8688	490.0083	2732.2216	2377.8830
0.5838	0.0165	0.0084	160.5918	32.9142	3.9075	457.5687	2759.5486	2220.4620
0.5839	0.0165	0.0082	154.4777	32.9539	3.9075	441.3489	2759.5486	2141.7515
0.5963	0.0164	0.0073	143.9852	32.8684	3.8688	368.3597	2732.2216	1787.5541
0.5854	0.0164	0.008	157.9001	32.899	3.8688	425.1291	2732.2216	2063.0409
0.5846	0.0164	0.0089	156.6019	32.7464	3.8688	498.1182	2732.2216	2417.2383
0.5843	0.0164	0.0089	163.0991	32.8715	3.8688	498.1182	2732.2216	2417.2383
0.5833	0.0165	0.0082	156.6797	33.0638	3.9075	441.3489	2759.5486	2141.7515
0.5813	0.0165	0.0084	156.5794	33.0454	3.9075	457.5687	2759.5486	2220.4620
0.5849	0.0165	0.008	156.1849	32.9905	3.9075	425.1291	2759.5486	2063.0409

Table C-11. Corehole #1 at 47.5/40 feet.

FULLER WARREN BRIDGE
SHEAR DEVICE TEST RESULTS

Penetration	(calculated)	0.038276771
Height H_2O	29 (ft)	
Length Pipe	47.5 (ft)	
Penetration Depth	0.026 (in)	
Stud Cap Area	0.1964 (in2)	
No. of Studs	42	
Weight of Instrum.	38	
Unit Wt H_2O	62.4 (lb/ft3)	
Unit Wt Rod	2.96 (lb/ft)	
Cylinder Bore Area	4.72 (in2)	
Shear Stud Area	0.206069136	
Normal Stud Area	0.001415993	
qu (psi)	945.7	

LVDT (in)	Pressure (volts)	Load (volts)	Est. Load (psi)	Est. Press. (psi)	Normal Force (lb)	Shear Force (lb)	Normal Stress (psi)	Shear Stress (psi)
-0.0014	0.0214	0.0006	12.4916	42.8022	5.8035	-175.0038	4098.5673	-849.2481
0.0201	0.0214	0.0043	92.7744	42.7564	5.8035	125.0626	4098.5673	606.8964
0.1203	0.021	0.0074	140.6428	41.9568	5.6488	376.4696	3989.2597	1826.9094
0.1048	0.0211	0.0069	132.1643	42.1278	5.6875	335.9201	4016.5866	1630.1331
0.1116	0.021	0.0073	135.1198	42.024	5.6488	368.3597	3989.2597	1787.5541
0.1115	0.021	0.0078	148.4106	42.0331	5.6488	408.9093	3989.2597	1984.3304
0.1378	0.0212	0.0089	171.9182	42.3139	5.7262	498.1182	4043.9135	2417.2383
0.1937	0.0209	0.0089	183.8926	41.8195	5.6101	498.1182	3961.9328	2417.2383
0.2075	0.0208	0.008	161.8831	41.554	5.5714	425.1291	3934.6058	2063.0409
0.2055	0.021	0.0081	161.358	41.9813	5.6488	433.2390	3989.2597	2102.3962
0.1986	0.021	0.0076	155.6869	41.9111	5.6488	392.6894	3989.2597	1905.6199
0.206	0.021	0.0092	176.7251	42.0362	5.6488	522.4479	3989.2597	2535.3040
0.2496	0.021	0.0093	193.1818	41.9263	5.6488	530.5578	3989.2597	2574.6593
0.2733	0.0208	0.0082	165.5727	41.551	5.5714	441.3489	3934.6058	2141.7515
0.2719	0.0209	0.0093	176.4101	41.847	5.6101	530.5578	3961.9328	2574.6593
0.273	0.021	0.0081	166.5917	42.0026	5.6488	433.2390	3989.2597	2102.3962
0.2892	0.021	0.0101	195.1841	42.0606	5.6488	595.4370	3989.2597	2889.5014
0.3468	0.0208	0.0107	200.1307	41.6822	5.5714	644.0965	3934.6058	3125.6329
0.3603	0.0208	0.0105	188.8995	41.6639	5.5714	627.8767	3934.6058	3046.9224
0.3492	0.021	0.0107	195.0709	41.9752	5.6488	644.0965	3989.2597	3125.6329
0.3522	0.0209	0.0101	197.9129	41.8622	5.6101	595.4370	3961.9328	2889.5014
0.3703	0.021	0.0114	214.1865	41.9202	5.6488	700.8658	3989.2597	3401.1197
0.402	0.0211	0.0109	198.3429	42.1522	5.6875	660.3163	4016.5866	3204.3434
0.4274	0.0209	0.0099	186.7048	41.7249	5.6101	579.2172	3961.9328	2810.7908
0.4203	0.021	0.0092	182.3559	42.0454	5.6488	522.4479	3989.2597	2535.3040
0.4208	0.021	0.0093	182.1097	41.9904	5.6488	530.5578	3989.2597	2574.6593
0.4123	0.0211	0.0103	184.5784	42.1735	5.6875	611.6569	4016.5866	2968.2119
0.4397	0.0211	0.0104	206.8607	42.2681	5.6875	619.7668	4016.5866	3007.5671
0.4912	0.021	0.0104	202.3188	41.9416	5.6488	619.7668	3989.2597	3007.5671
0.4913	0.0209	0.0103	194.4917	41.8622	5.6101	611.6569	3961.9328	2968.2119
0.4851	0.021	0.0096	187.0131	42.0118	5.6488	554.8875	3989.2597	2692.7251
0.4822	0.0211	0.0096	190.7696	42.2498	5.6875	554.8875	4016.5866	2692.7251
0.5026	0.021	0.0115	219.8489	42.0606	5.6488	708.9757	3989.2597	3440.4750
0.5494	0.021	0.0136	239.8021	42.0698	5.6488	879.2837	3989.2597	4266.9354
0.5505	0.021	0.0118	222.5972	42.0942	5.6488	733.3054	3989.2597	3558.5407
0.5488	0.0211	0.0125	224.5565	42.1949	5.6875	790.0747	4016.5866	3834.0275
0.5555	0.0212	0.0128	226.824	42.3841	5.7262	814.4045	4043.9135	3952.0933
0.55	0.0211	0.0131	234.838	42.201	5.6875	838.7342	4016.5866	4070.1591
0.5523	0.0211	0.0126	225.5158	42.1979	5.6875	798.1846	4016.5866	3873.3828
0.5539	0.0213	0.0123	220.1129	42.5855	5.7648	773.8549	4071.2404	3755.3170
0.5489	0.0212	0.011	209.661	42.378	5.7262	668.4262	4043.9135	3243.6987
0.5594	0.0211	0.0117	223.4878	42.2376	5.6875	725.1955	4016.5866	3519.1855
0.5568	0.0212	0.0121	222.0877	42.3383	5.7262	757.6351	4043.9135	3676.6065
0.5498	0.0211	0.0118	219.6862	42.2864	5.6875	733.3054	4016.5866	3558.5407

Table C-12. Corehole #1 at 47.5/40 feet.

FULLER WARREN BRIDGE
SHEAR DEVICE TEST RESULTS

Penetration (calculated)	0.038276771		
Height H_2O	29 (ft)	Unit Wt H_2O	62.4 (lb/ft3)
Length Pipe	47.5 (ft)	Unit Wt Rod	2.96 (lb/ft)
Penetration Depth	0.026 (in)	Cylinder Bore Area	4.72 (in2)
Stud Cap Area	0.1964 (in2)	Shear Stud Area	0.206069136
No. of Studs	42	Normal Stud Area	0.001415993
Weight of Instrum.	38	qu (psi)	945.7

LVDT (in)	Pressure (volts)	Load (volts)	Est. Load (psi)	Est. Press. (psi)	Normal Force (lb)	Shear Force (lb)	Normal Stress (psi)	Shear Stress (psi)
-0.0014	0.0214	0.0006	12.4916	42.8022	5.8035	-175.0038	4098.5673	-849.2481
0.0201	0.0214	0.0043	92.7744	42.7564	5.8035	125.0626	4098.5673	606.8964
0.1203	0.021	0.0074	140.6428	41.9568	5.6488	376.4696	3989.2597	1826.9094
0.1048	0.0211	0.0069	132.1643	42.1278	5.6875	335.9201	4016.5866	1630.1331
0.1116	0.021	0.0073	135.1198	42.024	5.6488	368.3597	3989.2597	1787.5541
0.1115	0.021	0.0078	148.4106	42.0331	5.6488	408.9093	3989.2597	1984.3304
0.1378	0.0212	0.0089	171.9182	42.3139	5.7262	498.1182	4043.9135	2417.2383
0.1937	0.0209	0.0089	183.8926	41.8195	5.6101	498.1182	3961.9328	2417.2383
0.2075	0.0208	0.008	161.8831	41.554	5.5714	425.1291	3934.6058	2063.0409
0.2055	0.021	0.0081	161.358	41.9813	5.6488	433.2390	3989.2597	2102.3962
0.1986	0.021	0.0076	155.6869	41.9111	5.6488	392.6894	3989.2597	1905.6199
0.206	0.021	0.0092	176.7251	42.0362	5.6488	522.4479	3989.2597	2535.3040
0.2496	0.021	0.0093	193.1818	41.9263	5.6488	530.5578	3989.2597	2574.6593
0.2733	0.0208	0.0082	165.5727	41.551	5.5714	441.3489	3934.6058	2141.7515
0.2719	0.0209	0.0093	176.4101	41.847	5.6101	530.5578	3961.9328	2574.6593
0.273	0.021	0.0081	166.5917	42.0026	5.6488	433.2390	3989.2597	2102.3962
0.2892	0.021	0.0101	195.1841	42.0606	5.6488	595.4370	3989.2597	2889.5014
0.3468	0.0208	0.0107	200.1307	41.6822	5.5714	644.0965	3934.6058	3125.6329
0.3603	0.0208	0.0105	188.8995	41.6639	5.5714	627.8767	3934.6058	3046.9224
0.3492	0.021	0.0107	195.0709	41.9752	5.6488	644.0965	3989.2597	3125.6329
0.3522	0.0209	0.0101	197.9129	41.8622	5.6101	595.4370	3961.9328	2889.5014
0.3703	0.021	0.0114	214.1865	41.9202	5.6488	700.8658	3989.2597	3401.1197
0.402	0.0211	0.0109	198.3429	42.1522	5.6875	660.3163	4016.5866	3204.3434
0.4274	0.0209	0.0099	186.7048	41.7249	5.6101	579.2172	3961.9328	2810.7908
0.4203	0.021	0.0092	182.3559	42.0454	5.6488	522.4479	3989.2597	2535.3040
0.4208	0.021	0.0093	182.1097	41.9904	5.6488	530.5578	3989.2597	2574.6593
0.4123	0.0211	0.0103	184.5784	42.1735	5.6875	611.6569	4016.5866	2968.2119
0.4397	0.0211	0.0104	206.8607	42.2681	5.6875	619.7668	4016.5866	3007.5671
0.4912	0.021	0.0104	202.3188	41.9416	5.6488	619.7668	3989.2597	3007.5671
0.4913	0.0209	0.0103	194.4917	41.8622	5.6101	611.6569	3961.9328	2968.2119
0.4851	0.021	0.0096	187.0131	42.0118	5.6488	554.8875	3989.2597	2692.7251
0.4822	0.0211	0.0096	190.7696	42.2498	5.6875	554.8875	4016.5866	2692.7251
0.5026	0.021	0.0115	219.8489	42.0606	5.6488	708.9757	3989.2597	3440.4750
0.5494	0.021	0.0136	239.8021	42.0698	5.6488	879.2837	3989.2597	4266.9354
0.5505	0.021	0.0118	222.5972	42.0942	5.6488	733.3054	3989.2597	3558.5407
0.5488	0.0211	0.0125	224.5565	42.1949	5.6875	790.0747	4016.5866	3834.0275
0.5555	0.0212	0.0128	226.824	42.3841	5.7262	814.4045	4043.9135	3952.0933
0.55	0.0211	0.0131	234.838	42.201	5.6875	838.7342	4016.5866	4070.1591
0.5523	0.0211	0.0126	225.5158	42.1979	5.6875	798.1846	4016.5866	3873.3828
0.5539	0.0213	0.0123	220.1129	42.5855	5.7648	773.8549	4071.2404	3755.3170
0.5489	0.0212	0.011	209.661	42.378	5.7262	668.4262	4043.9135	3243.6987
0.5594	0.0211	0.0117	223.4878	42.2376	5.6875	725.1955	4016.5866	3519.1855
0.5568	0.0212	0.0121	222.0877	42.3383	5.7262	757.6351	4043.9135	3676.6065
0.5498	0.0211	0.0118	219.6862	42.2864	5.6875	733.3054	4016.5866	3558.5407

Table C-13. Corehole #1 at 47.5/45 feet.

FULLER WARREN BRIDGE
SHEAR DEVICE TEST RESULTS

		Penetration		(calculated)	0.044922837			
		Height H_2O		29 (ft)		Unit Wt H_2O	62.4 (lb/ft3)	
		Length Pipe		47.5 (ft)		Unit Wt Rod	2.96 (lb/ft)	
		Penetration Depth		0.026 (in)		Cylinder Bore Area	4.72 (in2)	
		Stud Cap Area		0.1964 (in2)		Shear Stud Area	0.206069136	
		No. of Studs		42		Normal Stud Area	0.001415993	
		Weight of Instrum.		38		qu (psi)	945.7	

LVDT (in)	Pressure (volts)	Load (volts)	Est. Load (psi)	Est. Press. (psi)	Normal Force (lb)	Shear Force (lb)	Normal Stress (psi)	Shear Stress (psi)
-0.0149	0.0239	0.0005	11.2259	47.8439	6.7709	-183.1137	4781.7402	-888.6034
-0.0049	0.0238	0.0007	14.8651	47.6211	6.7322	-166.8939	4754.4133	-809.8929
-0.0033	0.0238	0.0022	43.6162	47.5509	6.7322	-45.2454	4754.4133	-219.5640
0.0237	0.0238	0.005	105.2506	47.676	6.7322	181.8319	4754.4133	882.3832
0.1289	0.0236	0.004	78.1474	47.2701	6.6548	100.7329	4699.7594	488.8306
0.1207	0.0237	0.0041	86.6654	47.3525	6.6935	108.8428	4727.0863	528.1859
0.1185	0.0236	0.005	99.74	47.2518	6.6548	181.8319	4699.7594	882.3832
0.1774	0.0237	0.0073	157.7493	47.4013	6.6935	368.3597	4727.0863	1787.5541
0.2145	0.0233	0.0101	184.6404	46.614	6.5387	595.4370	4617.7787	2889.5014
0.2067	0.0234	0.0077	160.0086	46.8825	6.5774	400.7994	4645.1056	1944.9752
0.2216	0.0234	0.0085	163.6175	46.7544	6.5774	465.6786	4645.1056	2259.8172
0.2106	0.0234	0.0093	170.5642	46.8581	6.5774	530.5578	4645.1056	2574.6593
0.258	0.0234	0.0108	199.5856	46.8245	6.5774	652.2064	4645.1056	3164.9882
0.2986	0.0232	0.0107	200.2844	46.5011	6.5000	644.0965	4590.4518	3125.6329
0.2899	0.0233	0.0096	196.9306	46.5804	6.5387	554.8875	4617.7787	2692.7251
0.2973	0.0233	0.0091	181.0566	46.6933	6.5387	514.3380	4617.7787	2495.9488
0.2954	0.0235	0.011	199.8255	46.9741	6.6161	668.4262	4672.4325	3243.6987
0.3326	0.0234	0.0112	222.7915	46.8459	6.5774	684.6460	4645.1056	3322.4092
0.3535	0.0232	0.0109	217.0316	46.3546	6.5000	660.3163	4590.4518	3204.3434
0.3534	0.0233	0.0112	214.7375	46.617	6.5387	684.6460	4617.7787	3322.4092
0.3572	0.0234	0.0118	212.1626	46.8123	6.5774	733.3054	4645.1056	3558.5407
0.3483	0.0234	0.0116	231.8482	46.8184	6.5774	717.0856	4645.1056	3479.8302
0.3932	0.0233	0.0127	243.2444	46.6445	6.5387	806.2946	4617.7787	3912.7381
0.4031	0.0231	0.0117	224.5409	46.1135	6.4614	725.1955	4563.1249	3519.1855
0.4097	0.0232	0.0115	221.816	46.4431	6.5000	708.9757	4590.4518	3440.4750
0.3967	0.0231	0.0122	221.5057	46.1837	6.4614	765.7450	4563.1249	3715.9618
0.4085	0.0232	0.0126	229.9071	46.321	6.5000	798.1846	4590.4518	3873.3828
0.4247	0.0232	0.0131	236.2618	46.3576	6.5000	838.7342	4590.4518	4070.1591
0.4451	0.0232	0.0128	228.0659	46.4431	6.5000	814.4045	4590.4518	3952.0933
0.436	0.0233	0.0119	214.598	46.5499	6.5387	741.4153	4617.7787	3597.8960
0.4511	0.0233	0.0115	216.1388	46.6475	6.5387	708.9757	4617.7787	3440.4750
0.4494	0.0234	0.011	213.8433	46.8062	6.5774	668.4262	4645.1056	3243.6987
0.4667	0.0234	0.0122	238.6342	46.849	6.5774	765.7450	4645.1056	3715.9618
0.4937	0.0232	0.0125	229.4427	46.4675	6.5000	790.0747	4590.4518	3834.0275
0.4992	0.0233	0.0121	225.5861	46.6475	6.5387	757.6351	4617.7787	3676.6065
0.4948	0.0234	0.0116	221.6753	46.7513	6.5774	717.0856	4645.1056	3479.8302
0.4931	0.0234	0.0113	222.3586	46.8276	6.5774	692.7559	4645.1056	3361.7645
0.5073	0.0235	0.0128	248.1423	46.9741	6.6161	814.4045	4672.4325	3952.0933
0.5262	0.0234	0.0152	270.2996	46.8001	6.5774	1009.0422	4645.1056	4896.6195
0.5179	0.0235	0.0136	264.5616	46.9863	6.6161	879.2837	4672.4325	4266.9354
0.5268	0.0235	0.014	251.8775	46.9283	6.6161	911.7233	4672.4325	4424.3564
0.5273	0.0236	0.0137	256.0786	47.1328	6.6548	887.3936	4699.7594	4306.2906
0.5411	0.0236	0.0142	257.3403	47.145	6.6548	927.9431	4699.7594	4503.0669
0.5278	0.0236	0.0129	258.7346	47.1999	6.6548	822.5144	4699.7594	3991.4486
0.5321	0.0236	0.0129	255.6732	47.148	6.6548	822.5144	4699.7594	3991.4486
0.531	0.0235	0.0136	253.9465	47.0748	6.6161	879.2837	4672.4325	4266.9354
0.543	0.0237	0.0151	266.0529	47.4868	6.6935	1000.9322	4727.0863	4857.2643

Table C-14. Corehole #1 at 48/23 feet.

FULLER WARREN BRIDGE

SHEAR DEVICE TEST RESULTS

Penetration	(calculated)	0.011725305			
Height H_2O	30	(ft)	Unit Wt H_2O	62.4	(lb/ft3)
Length Pipe	48	(ft)	Unit Wt Rod	2.96	(lb/ft)
Penetration Depth	0.025	(in)	Cylinder Bore Area	4.72	(in2)
Stud Cap Area	0.1964	(in2)	Shear Stud Area	0.1905225	
No. of Studs	42		Normal Stud Area	0.001309165	
Weight of Instrum.	38		qu (psi)	1260.4	

LVDT (in)	Pressure (volts)	Load (volts)	Est. Load (psi)	Est. Press. (psi)	Normal Force (lb)	Shear Force (lb)	Normal Stress (psi)	Shear Stress (psi)
-0.0155	0.0127	0.0006	11.6648	25.4036	2.3520	-176.4838	1796.5614	-926.3149
0.0028	0.0126	0.0006	11.8272	25.2632	2.3133	-176.4838	1767.0046	-926.3149
0.063	0.0126	0.0053	98.4859	25.2083	2.3133	204.6817	1767.0046	1074.3175
0.1144	0.0125	0.0049	94.4793	24.9031	2.2746	172.2420	1737.4478	904.0509
0.1155	0.0124	0.0049	96.1665	24.8848	2.2359	172.2420	1707.8910	904.0509
0.1103	0.0125	0.0051	100.8922	24.9794	2.2746	188.4618	1737.4478	989.1842
0.2138	0.0125	0.0061	126.3656	24.9855	2.2746	269.5609	1737.4478	1414.8507
0.2412	0.0124	0.0051	94.0132	24.8115	2.2359	188.4618	1707.8910	989.1842
0.2377	0.0125	0.0046	86.2137	24.9641	2.2746	147.9123	1737.4478	776.3510
0.2599	0.0124	0.0062	125.1053	24.8695	2.2359	277.6708	1707.8910	1457.4173
0.3417	0.0124	0.0059	119.4428	24.8146	2.2359	253.3411	1707.8910	1329.7174
0.3695	0.0125	0.005	98.9112	24.9062	2.2746	180.3519	1737.4478	946.6176
0.3873	0.0126	0.0062	111.4791	25.132	2.3133	277.6708	1767.0046	1457.4173
0.3696	0.0124	0.006	117.8174	24.8482	2.2359	261.4510	1707.8910	1372.2840
0.4433	0.0125	0.0061	120.584	24.9245	2.2746	269.5609	1737.4478	1414.8507
0.4927	0.0124	0.0053	101.2321	24.8177	2.2359	204.6817	1707.8910	1074.3175
0.49	0.0124	0.0058	109.0286	24.7719	2.2359	245.2312	1707.8910	1287.1507
0.4866	0.0124	0.0061	116.1264	24.8634	2.2359	269.5609	1707.8910	1414.8507
0.5293	0.0124	0.0062	120.4061	24.8787	2.2359	277.6708	1707.8910	1457.4173
0.6211	0.0123	0.0058	113.2121	24.6834	2.1972	245.2312	1678.3342	1287.1507
0.6226	0.0124	0.0062	111.957	24.7169	2.2359	277.6708	1707.8910	1457.4173
0.6234	0.0125	0.006	107.6105	24.9458	2.2746	261.4510	1737.4478	1372.2840
0.6234	0.0123	0.0065	115.5215	24.6956	2.1972	302.0005	1678.3342	1585.1173
0.6473	0.0123	0.0071	130.0132	24.6864	2.1972	350.6599	1678.3342	1840.5171
0.6779	0.0124	0.0067	120.1013	24.7749	2.2359	318.2203	1707.8910	1670.2506
0.7093	0.0124	0.006	104.9032	24.778	2.2359	261.4510	1707.8910	1372.2840
0.6534	0.0125	0.0054	103.3167	24.9092	2.2746	212.7916	1737.4478	1116.8841
0.7267	0.0124	0.0057	101.3813	24.8329	2.2359	237.1213	1707.8910	1244.5841
0.6423	0.0124	0.0065	120.9567	24.8817	2.2359	302.0005	1707.8910	1585.1173
0.7201	0.0124	0.0071	125.1327	24.897	2.2359	350.6599	1707.8910	1840.5171
0.6942	0.0124	0.0066	121.0372	24.8085	2.2359	310.1104	1707.8910	1627.6839
0.6377	0.0123	0.006	105.7783	24.6406	2.1972	261.4510	1678.3342	1372.2840
0.7157	0.0124	0.0062	107.5107	24.8909	2.2359	277.6708	1707.8910	1457.4173
0.6288	0.0125	0.0053	97.5762	24.9062	2.2746	204.6817	1737.4478	1074.3175
0.6876	0.0124	0.0062	108.4396	24.723	2.2359	277.6708	1707.8910	1457.4173
0.7215	0.0124	0.0057	99.4472	24.8665	2.2359	237.1213	1707.8910	1244.5841
0.7146	0.0124	0.006	107.5955	24.7444	2.2359	261.4510	1707.8910	1372.2840
0.6214	0.0124	0.0057	103.9088	24.8787	2.2359	237.1213	1707.8910	1244.5841
0.662	0.0124	0.0057	106.9622	24.7993	2.2359	237.1213	1707.8910	1244.5841
0.7408	0.0124	0.0063	111.3476	24.8085	2.2359	285.7807	1707.8910	1499.9840
0.6575	0.0125	0.0056	105.554	24.9062	2.2746	229.0114	1737.4478	1202.0174
0.6429	0.0124	0.0058	103.8594	24.9001	2.2359	245.2312	1707.8910	1287.1507
0.7048	0.0125	0.0054	101.0517	25.0496	2.2746	212.7916	1737.4478	1116.8841
0.7367	0.0125	0.0058	107.9664	24.9672	2.2746	245.2312	1737.4478	1287.1507
0.7228	0.0125	0.0054	101.7749	24.9245	2.2746	212.7916	1737.4478	1116.8841
0.6598	0.0125	0.0053	102.8628	25.0313	2.2746	204.6817	1737.4478	1074.3175
0.645	0.0125	0.0064	115.6365	25.0649	2.2746	293.8906	1737.4478	1542.5506

Table C-15. Corehole #1 at 48/31 feet.

FULLER WARREN BRIDGE
SHEAR DEVICE TEST RESULTS

Penetration	(calculated) 0.018906093				
Height H_2O	30	(ft)	Unit Wt H_2O	62.4	(lb/ft3)
Length Pipe	48	(ft)	Unit Wt Rod	2.96	(lb/ft)
Penetration Depth	0.025	(in)	Cylinder Bore Area	4.72	(in2)
Stud Cap Area	0.1964	(in2)	Shear Stud Area	0.1905225	
No. of Studs	42		Normal Stud Area	0.001309165	
Weight of Instrum.	38		qu (psi)	1260.4	

LVDT (in)	Pressure (volts)	Load (volts)	Est. Load (psi)	Est. Press. (psi)	Normal Force (lb)	Shear Force (lb)	Normal Stress (psi)	Shear Stress (psi)
-0.0018	0.0164	0.0008	16.4515	32.8867	3.7837	-160.2640	2890.1626	-841.1816
-0.0068	0.0164	0.0007	13.2425	32.8928	3.7837	-168.3739	2890.1626	-883.7483
-0.0049	0.0164	0.0007	15.4315	32.8074	3.7837	-168.3739	2890.1626	-883.7483
-0.0056	0.0165	0.0007	13.9856	32.9325	3.8224	-168.3739	2919.7194	-883.7483
0.0052	0.0164	0.0005	11.5495	32.8318	3.7837	-184.5937	2890.1626	-968.8816
0.0397	0.0165	0.0049	97.3178	32.9478	3.8224	172.2420	2919.7194	904.0509
0.1266	0.0161	0.0048	92.9428	32.2275	3.6676	164.1321	2801.4922	861.4843
0.1152	0.0162	0.0045	89.1234	32.4107	3.7063	139.8024	2831.0490	733.7843
0.1415	0.0161	0.0067	130.5766	32.1787	3.6676	318.2203	2801.4922	1670.2506
0.2351	0.016	0.0073	145.6005	32.0536	3.6289	366.8797	2771.9354	1925.6504
0.2321	0.0161	0.0067	132.3459	32.2703	3.6676	318.2203	2801.4922	1670.2506
0.2341	0.0161	0.008	148.1182	32.2764	3.6676	423.6491	2801.4922	2223.6170
0.2861	0.0161	0.0099	189.7926	32.2581	3.6676	577.7372	2801.4922	3032.3833
0.3303	0.0161	0.0083	157.9638	32.2581	3.6676	447.9788	2801.4922	2351.3169
0.3231	0.0162	0.0082	160.8629	32.3435	3.7063	439.8689	2831.0490	2308.7503
0.3282	0.0162	0.0088	169.9231	32.4625	3.7063	488.5283	2831.0490	2564.1501
0.4125	0.0161	0.01	188.1601	32.2733	3.6676	585.8471	2801.4922	3074.9499
0.426	0.0161	0.0095	176.6357	32.3008	3.6676	545.2976	2801.4922	2862.1167
0.4297	0.0162	0.0096	172.4129	32.3771	3.7063	553.4075	2831.0490	2904.6833
0.4265	0.0162	0.0102	186.1252	32.4595	3.7063	602.0670	2831.0490	3160.0832
0.4805	0.0161	0.0103	183.5158	32.1604	3.6676	610.1769	2801.4922	3202.6498
0.5245	0.0161	0.0088	165.0358	32.2275	3.6676	488.5283	2801.4922	2564.1501
0.5213	0.0161	0.0083	161.2464	32.2947	3.6676	447.9788	2801.4922	2351.3169
0.5246	0.0161	0.0088	162.8522	32.2642	3.6676	488.5283	2801.4922	2564.1501
0.5426	0.0161	0.0103	190.2699	32.1665	3.6676	610.1769	2801.4922	3202.6498
0.6021	0.0161	0.0122	213.7962	32.2611	3.6676	764.2650	2801.4922	4011.4161
0.5866	0.0161	0.0111	201.4263	32.2398	3.6676	675.0561	2801.4922	3543.1830
0.5959	0.0162	0.0111	197.9865	32.4168	3.7063	675.0561	2831.0490	3543.1830
0.5994	0.0162	0.0113	216.5587	32.4229	3.7063	691.2759	2831.0490	3628.3163
0.6588	0.0162	0.0111	211.2884	32.4259	3.7063	675.0561	2831.0490	3543.1830
0.6791	0.0161	0.0096	181.308	32.3008	3.6676	553.4075	2801.4922	2904.6833
0.6701	0.0162	0.0097	174.6373	32.4137	3.7063	561.5174	2831.0490	2947.2500
0.6823	0.0161	0.0099	177.3113	32.3008	3.6676	577.7372	2801.4922	3032.3833
0.6738	0.0163	0.0104	185.6336	32.6487	3.7450	618.2868	2860.6058	3245.2165
0.7005	0.0162	0.0116	209.9657	32.4381	3.7063	715.6056	2831.0490	3756.0163
0.6761	0.0162	0.0116	203.1552	32.432	3.7063	715.6056	2831.0490	3756.0163
0.6897	0.0163	0.0108	202.6294	32.5541	3.7450	650.7264	2860.6058	3415.4831
0.7102	0.0162	0.0113	208.8966	32.4381	3.7063	691.2759	2831.0490	3628.3163
0.6659	0.0162	0.0115	199.0278	32.374	3.7063	707.4957	2831.0490	3713.4496
0.6949	0.0161	0.0112	213.0422	32.2947	3.6676	683.1660	2801.4922	3585.7497
0.6964	0.0163	0.0123	219.3297	32.6029	3.7450	772.3749	2860.6058	4053.9828
0.6353	0.0162	0.0116	200.5918	32.4442	3.7063	715.6056	2831.0490	3756.0163
0.6905	0.0162	0.0111	195.8282	32.3496	3.7063	675.0561	2831.0490	3543.1830
0.73	0.0162	0.0105	188.4115	32.3679	3.7063	626.3967	2831.0490	3287.7831
0.635	0.0161	0.0108	194.1713	32.2092	3.6676	650.7264	2801.4922	3415.4831
0.7033	0.0163	0.0105	191.1555	32.5816	3.7450	626.3967	2860.6058	3287.7831
0.6922	0.0162	0.0099	188.3558	32.4961	3.7063	577.7372	2831.0490	3032.3833

Table C-16. Corehole #1 at 48/37 feet.

FULLER WARREN BRIDGE
SHEAR DEVICE TEST RESULTS

Penetration	(calculated)	0.025488483			
Height H_2O	30	(ft)	Unit Wt H_2O	62.4	(lb/ft3)
Length Pipe	48	(ft)	Unit Wt Rod	2.96	(lb/ft)
Penetration Depth	0.025	(in)	Cylinder Bore Area	4.72	(in2)
Stud Cap Area	0.1964	(in2)	Shear Stud Area	0.1905225	
No. of Studs	42		Normal Stud Area	0.001309165	
Weight of Instrum.	38		qu (psi)	1260.4	

LVDT (in)	Pressure (volts)	Load (volts)	Est. Load (psi)	Est. Press. (psi)	Normal Force (lb)	Shear Force (lb)	Normal Stress (psi)	Shear Stress (psi)
-0.0152	0.0197	0.0009	17.0021	39.4421	5.0606	-152.1541	3865.5367	-798.6150
-0.0041	0.0197	0.0009	19.4993	39.3994	5.0606	-152.1541	3865.5367	-798.6150
0.0486	0.0196	0.0071	146.7478	39.2865	5.0219	350.6599	3835.9799	1840.5171
0.0954	0.0194	0.0078	159.0269	38.7249	4.9445	407.4293	3776.8663	2138.4837
0.0956	0.0194	0.008	155.4138	38.8073	4.9445	423.6491	3776.8663	2223.6170
0.1053	0.0195	0.0086	175.1442	38.966	4.9832	472.3085	3806.4231	2479.0169
0.1766	0.0193	0.0113	206.854	38.5998	4.9058	691.2759	3747.3095	3628.3163
0.1867	0.0193	0.0101	191.2829	38.5266	4.9058	593.9570	3747.3095	3117.5166
0.1835	0.0194	0.0103	190.7736	38.8684	4.9445	610.1769	3776.8663	3202.6498
0.1818	0.0194	0.0098	199.0775	38.847	4.9445	569.6273	3776.8663	2989.8166
0.2424	0.0193	0.0123	232.1926	38.6883	4.9058	772.3749	3747.3095	4053.9828
0.2538	0.0194	0.0116	215.7153	38.7921	4.9445	715.6056	3776.8663	3756.0163
0.259	0.0193	0.0108	210.7177	38.6059	4.9058	650.7264	3747.3095	3415.4831
0.2649	0.0194	0.0116	221.7851	38.7402	4.9445	715.6056	3776.8663	3756.0163
0.2822	0.0195	0.0111	229.2901	38.9111	4.9832	675.0561	3806.4231	3543.1830
0.3182	0.0193	0.0112	213.1099	38.5846	4.9058	683.1660	3747.3095	3585.7497
0.3279	0.0193	0.0114	213.8288	38.6029	4.9058	699.3858	3747.3095	3670.8830
0.308	0.0193	0.0105	210.9705	38.6639	4.9058	626.3967	3747.3095	3287.7831
0.3321	0.0194	0.0122	237.018	38.8012	4.9445	764.2650	3776.8663	4011.4161
0.3685	0.0194	0.012	237.4128	38.7524	4.9445	748.0452	3776.8663	3926.2828
0.3731	0.0194	0.0115	220.1	38.7738	4.9445	707.4957	3776.8663	3713.4496
0.3704	0.0195	0.0115	211.1705	38.9843	4.9832	707.4957	3806.4231	3713.4496
0.3678	0.0195	0.0124	232.5528	38.9813	4.9832	780.4848	3806.4231	4096.5494
0.4203	0.0194	0.0135	257.4749	38.7829	4.9445	869.6938	3776.8663	4564.7826
0.4336	0.0195	0.0126	245.9143	39.0667	4.9832	796.7046	3806.4231	4181.6827
0.4015	0.0195	0.0124	245.6341	38.9203	4.9832	780.4848	3806.4231	4096.5494
0.4352	0.0194	0.0134	245.8851	38.8958	4.9445	861.5839	3776.8663	4522.2159
0.4382	0.0195	0.0149	270.4661	38.9172	4.9832	983.2324	3806.4231	5160.7156
0.4548	0.0194	0.0145	277.5055	38.8836	4.9445	950.7928	3776.8663	4990.4490
0.4529	0.0196	0.0139	265.7998	39.1369	5.0219	902.1334	3835.9799	4735.0491
0.4493	0.0194	0.0147	265.3817	38.8867	4.9445	967.0126	3776.8663	5075.5823
0.4529	0.0196	0.0141	276.0351	39.1186	5.0219	918.3532	3835.9799	4820.1824
0.4665	0.0195	0.0155	276.1432	39.0454	4.9832	1031.8919	3806.4231	5416.1155
0.4839	0.0196	0.0171	307.9311	39.1156	5.0219	1161.6503	3835.9799	6097.1818
0.4806	0.0195	0.016	287.8513	38.9355	4.9832	1072.4414	3806.4231	5628.9487
0.4852	0.0195	0.0162	302.2954	39.0179	4.9832	1088.6612	3806.4231	5714.0820
0.4906	0.0196	0.014	274.1926	39.2865	5.0219	910.2433	3835.9799	4777.6158
0.4894	0.0197	0.0154	280.3351	39.4513	5.0606	1023.7820	3865.5367	5373.5488
0.488	0.0196	0.0147	278.3382	39.1491	5.0219	967.0126	3835.9799	5075.5823
0.4932	0.0196	0.0146	277.6325	39.1491	5.0219	958.9027	3835.9799	5033.0157
0.4819	0.0196	0.0151	283.6362	39.1583	5.0219	999.4522	3835.9799	5245.8489
0.4945	0.0196	0.0143	279.1094	39.2987	5.0219	934.5730	3835.9799	4905.3157
0.4875	0.0196	0.0151	280.0345	39.2743	5.0219	999.4522	3835.9799	5245.8489
0.4874	0.0196	0.0149	277.6545	39.1522	5.0219	983.2324	3835.9799	5160.7156
0.491	0.0196	0.0146	272.3146	39.2224	5.0219	958.9027	3835.9799	5033.0157
0.4887	0.0197	0.014	274.9569	39.3292	5.0606	910.2433	3865.5367	4777.6158
0.4883	0.0196	0.0144	284.0889	39.1858	5.0219	942.6829	3835.9799	4947.8824

Table C-17. Corehole #1 at 47.5/40 feet.

FULLER WARREN BRIDGE
SHEAR DEVICE TEST RESULTS

Penetration	(calculated)	0.03167194			
Height H_2O	30	(ft)	Unit Wt H_2O	62.4	(lb/ft3)
Length Pipe	48	(ft)	Unit Wt Rod	2.96	(lb/ft)
Penetration Depth	0.025	(in)	Cylinder Bore Area	4.72	(in2)
Stud Cap Area	0.1964	(in2)	Shear Stud Area	0.1905225	
No. of Studs	42		Normal Stud Area	0.001309165	
Weight of Instrum.	38		qu (psi)	1260.4	

LVDT (in)	Pressure (volts)	Load (volts)	Est. Load (psi)	Est. Press. (psi)	Normal Force (lb)	Shear Force (lb)	Normal Stress (psi)	Shear Stress (psi)
0.0049	0.0226	0.0012	25.731	45.2284	6.1828	-127.8244	4722.6836	-670.9150
-0.0027	0.0226	0.0009	17.296	45.2071	6.1828	-152.1541	4722.6836	-798.6150
0.0563	0.0226	0.0082	172.3013	45.1674	6.1828	439.8689	4722.6836	2308.7503
0.0904	0.0225	0.0103	194.1372	45.0728	6.1441	610.1769	4693.1268	3202.6498
0.0896	0.0225	0.0098	205.5985	44.908	6.1441	569.6273	4693.1268	2989.8166
0.0796	0.0226	0.0096	191.3601	45.1186	6.1828	553.4075	4722.6836	2904.6833
0.1412	0.0226	0.0127	268.3267	45.1308	6.1828	804.8146	4722.6836	4224.2494
0.1526	0.0224	0.0143	263.4574	44.7371	6.1054	934.5730	4663.5700	4905.3157
0.1338	0.0225	0.0136	256.786	44.9568	6.1441	877.8037	4693.1268	4607.3492
0.1503	0.0224	0.0144	275.8173	44.8988	6.1054	942.6829	4663.5700	4947.8824
0.185	0.0223	0.0158	291.8485	44.6242	6.0667	1056.2216	4634.0132	5543.8154
0.185	0.0223	0.0143	266.9547	44.5631	6.0667	934.5730	4634.0132	4905.3157
0.1762	0.0223	0.0128	262.1228	44.6577	6.0667	812.9245	4634.0132	4266.8160
0.1985	0.0223	0.0149	300.8985	44.6303	6.0667	983.2324	4634.0132	5160.7156
0.2217	0.0223	0.0146	293.1793	44.5448	6.0667	958.9027	4634.0132	5033.0157
0.2297	0.0224	0.0142	290.1117	44.7645	6.1054	926.4631	4663.5700	4862.7491
0.2245	0.0224	0.014	282.8531	44.7066	6.1054	910.2433	4663.5700	4777.6158
0.2254	0.0224	0.0149	299.1107	44.789	6.1054	983.2324	4663.5700	5160.7156
0.2491	0.0223	0.0166	322.4409	44.6394	6.0667	1121.1008	4634.0132	5884.3486
0.2531	0.0223	0.0163	309.4171	44.5814	6.0667	1096.7711	4634.0132	5756.6487
0.2487	0.0223	0.015	301.5555	44.5631	6.0667	991.3423	4634.0132	5203.2823
0.2298	0.0223	0.0153	312.348	44.6791	6.0667	1015.6721	4634.0132	5330.9822
0.284	0.0223	0.0158	293.282	44.5204	6.0667	1056.2216	4634.0132	5543.8154
0.2777	0.0223	0.0151	281.5904	44.6181	6.0667	999.4522	4634.0132	5245.8489
0.2732	0.0224	0.0154	289.9799	44.7127	6.1054	1023.7820	4663.5700	5373.5488
0.2772	0.0223	0.0143	282.6218	44.6364	6.0667	934.5730	4634.0132	4905.3157
0.3071	0.0224	0.0173	312.7413	44.8256	6.1054	1177.8701	4663.5700	6182.3151
0.3216	0.0223	0.0162	299.7499	44.7005	6.0667	1088.6612	4634.0132	5714.0820
0.3149	0.0224	0.0144	290.2857	44.7035	6.1054	942.6829	4663.5700	4947.8824
0.3165	0.0224	0.0155	291.3076	44.8042	6.1054	1031.8919	4663.5700	5416.1155
0.3208	0.0224	0.0171	315.6694	44.8378	6.1054	1161.6503	4663.5700	6097.1818
0.3347	0.0224	0.0152	299.6844	44.7554	6.1054	1007.5622	4663.5700	5288.4156
0.3314	0.0224	0.0154	288.6144	44.7951	6.1054	1023.7820	4663.5700	5373.5488
0.3462	0.0224	0.0154	293.012	44.7066	6.1054	1023.7820	4663.5700	5373.5488
0.358	0.0224	0.0171	325.7502	44.7798	6.1054	1161.6503	4663.5700	6097.1818
0.3678	0.0223	0.0155	305.9301	44.6821	6.0667	1031.8919	4634.0132	5416.1155
0.3688	0.0225	0.016	299.6084	44.9232	6.1441	1072.4414	4693.1268	5628.9487
0.3583	0.0224	0.0153	297.3945	44.8958	6.1054	1015.6721	4663.5700	5330.9822
0.3657	0.0224	0.0168	300.4479	44.8378	6.1054	1137.3206	4663.5700	5969.4819
0.373	0.0223	0.0156	291.2257	44.676	6.0667	1040.0018	4634.0132	5458.6821
0.36	0.0224	0.0149	291.3069	44.8469	6.1054	983.2324	4663.5700	5160.7156
0.3578	0.0225	0.0145	290.9557	45.085	6.1441	950.7928	4693.1268	4990.4490
0.3765	0.0225	0.0155	291.717	44.9232	6.1441	1031.8919	4693.1268	5416.1155
0.3718	0.0225	0.0145	287.9789	44.9965	6.1441	950.7928	4693.1268	4990.4490
0.3664	0.0225	0.0154	286.4619	44.9019	6.1441	1023.7820	4693.1268	5373.5488
0.3609	0.0224	0.0153	287.9257	44.8439	6.1054	1015.6721	4663.5700	5330.9822
0.3672	0.0226	0.0154	289.1582	45.1125	6.1828	1023.7820	4722.6836	5373.5488

Table C-18. Corehole #1 at 49/26 feet.

FULLER WARREN BRIDGE
SHEAR DEVICE TEST RESULTS

Penetration	(calculated) 0.012873465				
Height H_2O	31	(ft)	Unit Wt H_2O	62.4	(lb/ft3)
Length Pipe	49	(ft)	Unit Wt Rod	2.96	(lb/ft)
Penetration Depth	0.022	(in)	Cylinder Bore Area	4.72	(in2)
Stud Cap Area	0.1964	(in2)	Shear Stud Area	0.147540624	
No. of Studs	42		Normal Stud Area	0.001013818	
Weight of Instrum.	38		qu (psi)	1417.5	

LVDT (in)	Pressure (volts)	Load (volts)	Est. Load (psi)	Est. Press. (psi)	Normal Force (lb)	Shear Force (lb)	Normal Stress (psi)	Shear Stress (psi)
-0.0001	0.0141	0.0011	22.9909	28.2083	2.8086	-138.8943	2770.3359	-941.3971
-0.0088	0.0141	0.0008	16.7551	28.251	2.8086	-163.2240	2770.3359	-1106.2989
0.0039	0.0141	0.0009	17.4727	28.254	2.8086	-155.1141	2770.3359	-1051.3316
0.0249	0.0141	0.0057	112.8811	28.2235	2.8086	234.1613	2770.3359	1587.0969
0.1074	0.0141	0.0072	135.7789	28.2601	2.8086	355.8098	2770.3359	2411.6059
0.1057	0.0139	0.0065	124.431	27.897	2.7312	299.0405	2694.0012	2026.8350
0.1066	0.014	0.0059	121.7232	28.0648	2.7699	250.3811	2732.1685	1697.0315
0.1598	0.0139	0.0077	156.6054	27.8726	2.7312	396.3594	2694.0012	2686.4422
0.2196	0.0141	0.0077	144.3241	28.1137	2.8086	396.3594	2770.3359	2686.4422
0.207	0.014	0.008	154.5632	27.9244	2.7699	420.6891	2732.1685	2851.3439
0.2228	0.014	0.0072	132.332	27.9977	2.7699	355.8098	2732.1685	2411.6059
0.2493	0.0139	0.0085	167.4611	27.8817	2.7312	461.2386	2694.0012	3126.1802
0.3005	0.0139	0.009	163.0814	27.7688	2.7312	501.7881	2694.0012	3401.0165
0.309	0.014	0.0071	143.5945	27.9366	2.7699	347.6999	2732.1685	2356.6386
0.307	0.0139	0.0079	151.8031	27.8695	2.7312	412.5792	2694.0012	2796.3767
0.3276	0.014	0.0088	167.6449	27.9489	2.7699	485.5683	2732.1685	3291.0820
0.3883	0.014	0.0088	168.9726	28.0526	2.7699	485.5683	2732.1685	3291.0820
0.4147	0.0139	0.0083	155.6814	27.7749	2.7312	445.0188	2694.0012	3016.2457
0.4038	0.0139	0.0081	145.6409	27.8542	2.7312	428.7990	2694.0012	2906.3112
0.4087	0.014	0.0073	147.4929	28.0831	2.7699	363.9197	2732.1685	2466.5731
0.4221	0.014	0.0088	166.684	28.0129	2.7699	485.5683	2732.1685	3291.0820
0.4766	0.0139	0.0088	157.811	27.72	2.7312	485.5683	2694.0012	3291.0820
0.5095	0.0139	0.0081	143.4302	27.8817	2.7312	428.7990	2694.0012	2906.3112
0.5117	0.0139	0.0075	147.7831	27.8115	2.7312	380.1395	2694.0012	2576.5076
0.5052	0.0141	0.0077	149.2828	28.1808	2.8086	396.3594	2770.3359	2686.4422
0.5348	0.014	0.0094	170.4501	27.9397	2.7699	534.2277	2732.1685	3620.8856
0.5995	0.0139	0.0087	156.5419	27.8817	2.7312	477.4584	2694.0012	3236.1148
0.6163	0.0139	0.0071	138.5949	27.8451	2.7312	347.6999	2694.0012	2356.6386
0.6118	0.014	0.0081	141.1506	27.9977	2.7699	428.7990	2732.1685	2906.3112
0.6107	0.014	0.0071	134.7688	27.9092	2.7699	347.6999	2732.1685	2356.6386
0.6585	0.014	0.0087	168.1917	27.9733	2.7699	477.4584	2732.1685	3236.1148
0.7164	0.0139	0.0097	177.4578	27.8634	2.7312	558.5574	2694.0012	3785.7874
0.7046	0.0139	0.0083	153.1079	27.7688	2.7312	445.0188	2694.0012	3016.2457
0.7141	0.0139	0.008	149.6367	27.7474	2.7312	420.6891	2694.0012	2851.3439
0.7218	0.0139	0.0092	159.1278	27.723	2.7312	518.0079	2694.0012	3510.9511
0.708	0.0139	0.0091	174.0959	27.8207	2.7312	509.8980	2694.0012	3455.9838
0.6391	0.014	0.0097	185.3737	27.9458	2.7699	558.5574	2732.1685	3785.7874
0.6363	0.0139	0.0089	166.2448	27.8146	2.7312	493.6782	2694.0012	3346.0493
0.6784	0.0138	0.0089	166.9185	27.6589	2.6925	493.6782	2655.8338	3346.0493
0.7439	0.0139	0.009	159.0734	27.8726	2.7312	501.7881	2694.0012	3401.0165
0.6526	0.0139	0.0081	157.7021	27.7108	2.7312	428.7990	2694.0012	2906.3112
0.6557	0.0139	0.0082	159.7034	27.8573	2.7312	436.9089	2694.0012	2961.2785
0.7384	0.0139	0.0096	168.5429	27.8787	2.7312	550.4475	2694.0012	3730.8201
0.7236	0.0139	0.0088	160.2393	27.7596	2.7312	485.5683	2694.0012	3291.0820
0.6502	0.0139	0.0086	157.2479	27.723	2.7312	469.3485	2694.0012	3181.1475
0.6498	0.0139	0.0095	165.6787	27.8542	2.7312	542.3376	2694.0012	3675.8529
0.6767	0.0139	0.0087	161.874	27.7139	2.7312	477.4584	2694.0012	3236.1148

Table C-19. Corehole #1 at 49/32 feet.

FULLER WARREN BRIDGE
SHEAR DEVICE TEST RESULTS

Penetration	(calculated) 0.016775379			
Height H_2O	31 (ft)	Unit Wt H_2O	62.4	(lb/ft3)
Length Pipe	49 (ft)	Unit Wt Rod	2.96	(lb/ft)
Penetration Depth	0.022 (in)	Cylinder Bore Area	4.72	(in2)
Stud Cap Area	0.1964 (in2)	Shear Stud Area	0.147540624	
No. of Studs	42	Normal Stud Area	0.001013818	
Weight of Instrum.	38	qu (psi)	1417.5	

LVDT (in)	Pressure (volts)	Load (volts)	Est. Load (psi)	Est. Press. (psi)	Normal Force (lb)	Shear Force (lb)	Normal Stress (psi)	Shear Stress (psi)
0.0017	0.0165	0.0006	11.7464	33.0393	3.7373	-179.4438	3686.3521	-1216.2334
-0.0037	0.0166	0.0007	13.9538	33.1065	3.7760	-171.3339	3724.5194	-1161.2661
0.0647	0.0165	0.0067	133.5735	33.0119	3.7373	315.2603	3686.3521	2136.7695
0.1042	0.0162	0.006	120.2145	32.4717	3.6212	258.4910	3571.8500	1751.9987
0.097	0.0164	0.0078	144.8276	32.725	3.6986	404.4693	3648.1847	2741.4094
0.1178	0.0163	0.0078	156.5942	32.6334	3.6599	404.4693	3610.0174	2741.4094
0.1822	0.0163	0.0096	176.9037	32.5816	3.6599	550.4475	3610.0174	3730.8201
0.1997	0.0161	0.0088	166.1722	32.2123	3.5825	485.5683	3533.6827	3291.0820
0.2119	0.0163	0.0088	165.9739	32.5449	3.6599	485.5683	3610.0174	3291.0820
0.2029	0.0162	0.0093	174.4372	32.3862	3.6212	526.1178	3571.8500	3565.9183
0.2616	0.0162	0.0107	198.9046	32.4137	3.6212	639.6565	3571.8500	4335.4600
0.2866	0.0161	0.0087	172.7247	32.2947	3.5825	477.4584	3533.6827	3236.1148
0.2743	0.0162	0.0086	171.9779	32.4442	3.6212	469.3485	3571.8500	3181.1475
0.2872	0.0163	0.0098	187.9572	32.5266	3.6599	566.6673	3610.0174	3840.7546
0.3193	0.0163	0.0107	213.6124	32.551	3.6599	639.6565	3610.0174	4335.4600
0.3462	0.0164	0.0099	203.8462	32.8837	3.6986	574.7772	3648.1847	3895.7219
0.3496	0.0164	0.0103	189.1793	32.786	3.6986	607.2169	3648.1847	4115.5909
0.3482	0.0164	0.01	188.7837	32.7189	3.6986	582.8871	3648.1847	3950.6892
0.3653	0.0163	0.0102	206.1266	32.6884	3.6599	599.1070	3610.0174	4060.6237
0.4146	0.0162	0.0105	209.7777	32.374	3.6212	623.4367	3571.8500	4225.5255
0.4388	0.0162	0.0108	194.4702	32.3099	3.6212	647.7664	3571.8500	4390.4272
0.4281	0.0162	0.0101	197.2567	32.4503	3.6212	590.9970	3571.8500	4005.6564
0.4253	0.0162	0.0099	201.7367	32.4961	3.6212	574.7772	3571.8500	3895.7219
0.4719	0.0164	0.0112	213.2482	32.7189	3.6986	680.2060	3648.1847	4610.2963
0.4985	0.0162	0.0099	191.3648	32.4046	3.6212	574.7772	3571.8500	3895.7219
0.4927	0.0162	0.0097	190.0632	32.4137	3.6212	558.5574	3571.8500	3785.7874
0.5096	0.0163	0.0097	198.2393	32.6518	3.6599	558.5574	3610.0174	3785.7874
0.5039	0.0164	0.0106	204.3836	32.7403	3.6986	631.5466	3648.1847	4280.4927
0.5319	0.0164	0.0119	217.7615	32.7219	3.6986	736.9753	3648.1847	4995.0671
0.5504	0.0163	0.0105	198.3935	32.6121	3.6599	623.4367	3610.0174	4225.5255
0.5575	0.0163	0.0113	199.0575	32.667	3.6599	688.3159	3610.0174	4665.2636
0.5541	0.0164	0.0105	200.4392	32.7921	3.6986	623.4367	3648.1847	4225.5255
0.5915	0.0164	0.013	240.1664	32.7036	3.6986	826.1843	3648.1847	5599.7070
0.6013	0.0163	0.0125	222.0683	32.6823	3.6599	785.6347	3610.0174	5324.8707
0.6068	0.0164	0.0113	208.5725	32.8593	3.6986	688.3159	3648.1847	4665.2636
0.6114	0.0163	0.0105	202.6543	32.5999	3.6599	623.4367	3610.0174	4225.5255
0.6156	0.0163	0.0103	200.2356	32.6701	3.6599	607.2169	3610.0174	4115.5909
0.6074	0.0164	0.0104	192.2053	32.7708	3.6986	615.3268	3648.1847	4170.5582
0.6051	0.0164	0.0115	202.1042	32.8379	3.6986	704.5357	3648.1847	4775.1981
0.6081	0.0164	0.011	206.3825	32.7799	3.6986	663.9862	3648.1847	4500.3618
0.6101	0.0164	0.012	211.1197	32.8837	3.6986	745.0852	3648.1847	5050.0344
0.6146	0.0164	0.011	205.1815	32.7555	3.6986	663.9862	3648.1847	4500.3618
0.6131	0.0164	0.0104	197.1196	32.8288	3.6986	615.3268	3648.1847	4170.5582
0.6232	0.0164	0.0109	193.3955	32.8471	3.6986	655.8763	3648.1847	4445.3945
0.613	0.0166	0.0107	195.2335	33.1156	3.7760	639.6565	3724.5194	4335.4600
0.6167	0.0165	0.011	201.5917	32.9142	3.7373	663.9862	3686.3521	4500.3618
0.6116	0.0165	0.0103	192.8733	32.9478	3.7373	607.2169	3686.3521	4115.5909

Table C-20. Corehole #1 at 49/38 feet.

FULLER WARREN BRIDGE

SHEAR DEVICE TEST RESULTS

Penetration	(calculated)	0.022805609			
Height H_2O	31	(ft)	Unit Wt H_2O	62.4	(lb/ft3)
Length Pipe	49	(ft)	Unit Wt Rod	2.96	(lb/ft)
Penetration Depth	0.022	(in)	Cylinder Bore Area	4.72	(in2)
Stud Cap Area	0.1964	(in2)	Shear Stud Area	0.147540624	
No. of Studs	42		Normal Stud Area	0.001013818	
Weight of Instrum.	38		qu (psi)	1417.5	

LVDT (in)	Pressure (volts)	Load (volts)	Est. Load (psi)	Est. Press. (psi)	Normal Force (lb)	Shear Force (lb)	Normal Stress (psi)	Shear Stress (psi)
-0.0148	0.0201	0.001	20.0071	40.1013	5.1303	-147.0042	5060.3764	-996.3643
-0.0076	0.02	0.0001	1.0677	39.9792	5.0916	-219.9934	5022.2090	-1491.0697
-0.0004	0.0199	0.0037	69.7599	39.8694	5.0529	71.9632	4984.0417	487.7517
0.0703	0.0199	0.0081	152.4664	39.8785	5.0529	428.7990	4984.0417	2906.3112
0.0989	0.0199	0.008	169.7322	39.7992	5.0529	420.6891	4984.0417	2851.3439
0.0963	0.0199	0.0081	164.5126	39.7046	5.0529	428.7990	4984.0417	2906.3112
0.1011	0.0199	0.0091	175.8779	39.7504	5.0529	509.8980	4984.0417	3455.9838
0.1343	0.0198	0.0108	224.7828	39.552	5.0142	647.7664	4945.8744	4390.4272
0.1654	0.0197	0.0102	204.4979	39.4299	4.9755	599.1070	4907.7070	4060.6237
0.1753	0.0198	0.0097	200.5471	39.5337	5.0142	558.5574	4945.8744	3785.7874
0.1849	0.0196	0.012	227.0607	39.2773	4.9368	745.0852	4869.5397	5050.0344
0.2382	0.0198	0.0121	241.5604	39.5093	5.0142	753.1951	4945.8744	5105.0016
0.2266	0.0197	0.0116	234.3131	39.4665	4.9755	712.6456	4907.7070	4830.1653
0.2337	0.0198	0.0126	238.9665	39.5764	5.0142	793.7446	4945.8744	5379.8379
0.2276	0.0198	0.0132	246.1447	39.5306	5.0142	842.4041	4945.8744	5709.6415
0.2482	0.0198	0.0141	261.5714	39.5337	5.0142	915.3932	4945.8744	6204.3469
0.2572	0.0197	0.0141	255.354	39.4177	4.9755	915.3932	4907.7070	6204.3469
0.2528	0.0198	0.0119	245.9851	39.5032	5.0142	736.9753	4945.8744	4995.0671
0.2609	0.0198	0.0122	245.2314	39.5856	5.0142	761.3050	4945.8744	5159.9689
0.2721	0.0198	0.0142	267.7675	39.5154	5.0142	923.5031	4945.8744	6259.3141
0.2975	0.0197	0.0137	260.5	39.4574	4.9755	882.9536	4907.7070	5984.4778
0.2915	0.0197	0.0131	255.1081	39.4482	4.9755	834.2942	4907.7070	5654.6743
0.3098	0.0198	0.0124	254.0296	39.5825	5.0142	777.5248	4945.8744	5269.9034
0.3042	0.0197	0.0142	257.9087	39.4665	4.9755	923.5031	4907.7070	6259.3141
0.3029	0.0198	0.0152	275.3628	39.6039	5.0142	1004.6022	4945.8744	6808.9867
0.3258	0.0198	0.0139	276.2533	39.5703	5.0142	899.1734	4945.8744	6094.4123
0.3239	0.0197	0.0137	257.677	39.4604	4.9755	882.9536	4907.7070	5984.4778
0.3441	0.0199	0.0138	248.3219	39.8938	5.0529	891.0635	4984.0417	6039.4451
0.323	0.0198	0.0133	244.1109	39.5734	5.0142	850.5140	4945.8744	5764.6088
0.3338	0.0198	0.0129	261.2536	39.61	5.0142	818.0744	4945.8744	5544.7397
0.3635	0.0198	0.0137	277.819	39.552	5.0142	882.9536	4945.8744	5984.4778
0.3631	0.0198	0.0134	264.4196	39.5215	5.0142	858.6239	4945.8744	5819.5760
0.3739	0.0197	0.0138	256.6661	39.3078	4.9755	891.0635	4907.7070	6039.4451
0.3735	0.0197	0.0135	258.3333	39.3872	4.9755	866.7338	4907.7070	5874.5433
0.3685	0.0198	0.0142	270.2829	39.6832	5.0142	923.5031	4945.8744	6259.3141
0.3931	0.0197	0.015	286.0346	39.4726	4.9755	988.3823	4907.7070	6699.0522
0.3907	0.0197	0.015	284.6327	39.3323	4.9755	988.3823	4907.7070	6699.0522
0.3902	0.0197	0.0141	269.3004	39.4177	4.9755	915.3932	4907.7070	6204.3469
0.4121	0.02	0.0152	273.0471	40.0952	5.0916	1004.6022	5022.2090	6808.9867
0.4011	0.0197	0.0143	286.6441	39.4604	4.9755	931.6130	4907.7070	6314.2814
0.414	0.0198	0.0162	301.7241	39.5123	5.0142	1085.7012	4945.8744	7358.6593
0.4162	0.0196	0.0148	292.6324	39.259	4.9368	972.1625	4869.5397	6589.1177
0.4317	0.0197	0.0146	286.8626	39.4604	4.9755	955.9427	4907.7070	6479.1832
0.4191	0.0197	0.015	285.0535	39.4543	4.9755	988.3823	4907.7070	6699.0522
0.4263	0.0198	0.0151	299.3173	39.5062	5.0142	996.4922	4945.8744	6754.0195
0.4156	0.0197	0.0149	282.2306	39.3017	4.9755	980.2724	4907.7070	6644.0850
0.413	0.0197	0.0159	286.0122	39.4696	4.9755	1061.3715	4907.7070	7193.7576

Table C-21. Corehole #1 at 49/47 feet.

FULLER WARREN BRIDGE
SHEAR DEVICE TEST RESULTS

Penetration	(calculated) 0.030609436				
Height H_2O	31	(ft)	Unit Wt H_2O	62.4	(lb/ft3)
Length Pipe	49	(ft)	Unit Wt Rod	2.96	(lb/ft)
Penetration Depth	0.022	(in)	Cylinder Bore Area	4.72	(in2)
Stud Cap Area	0.1964	(in2)	Shear Stud Area	0.147540624	
No. of Studs	42		Normal Stud Area	0.001013818	
Weight of Instrum.	38		qu (psi)	1417.5	

LVDT (in)	Pressure (volts)	Load (volts)	Est. Load (psi)	Est. Press. (psi)	Normal Force (lb)	Shear Force (lb)	Normal Stress (psi)	Shear Stress (psi)
0.0015	0.0245	0.001	19.1885	49.0005	6.8329	-147.0042	6739.7395	-996.3643
-0.0006	0.0245	0.0009	17.1695	48.909	6.8329	-155.1141	6739.7395	-1051.3316
0.0005	0.0245	0.0008	15.0562	49.031	6.8329	-163.2240	6739.7395	-1106.2989
0.0507	0.0245	0.0062	131.6185	49.0158	6.8329	274.7108	6739.7395	1861.9332
0.1035	0.0242	0.0083	169.0676	48.3566	6.7168	445.0188	6625.2374	3016.2457
0.0937	0.0242	0.0088	162.9194	48.4115	6.7168	485.5683	6625.2374	3291.0820
0.0982	0.0242	0.0082	154.6827	48.3688	6.7168	436.9089	6625.2374	2961.2785
0.1255	0.0242	0.0113	216.8287	48.3383	6.7168	688.3159	6625.2374	4665.2636
0.1564	0.0241	0.013	244.5437	48.1582	6.6781	826.1843	6587.0701	5599.7070
0.1535	0.0241	0.0121	234.8171	48.2284	6.6781	753.1951	6587.0701	5105.0016
0.1607	0.0242	0.0118	229.1882	48.3963	6.7168	728.8654	6625.2374	4940.0999
0.1649	0.0242	0.0134	249.671	48.4878	6.7168	858.6239	6625.2374	5819.5760
0.1984	0.024	0.0135	275.5324	47.9812	6.6394	866.7338	6548.9027	5874.5433
0.2075	0.0241	0.0136	279.7916	48.1948	6.6781	874.8437	6587.0701	5929.5106
0.2075	0.0241	0.0139	272.957	48.1521	6.6781	899.1734	6587.0701	6094.4123
0.2044	0.0241	0.0146	278.2249	48.1185	6.6781	955.9427	6587.0701	6479.1832
0.2207	0.0242	0.0158	309.0912	48.3535	6.7168	1053.2616	6625.2374	7138.7903
0.2351	0.0242	0.0151	306.9458	48.381	6.7168	996.4922	6625.2374	6754.0195
0.2318	0.0241	0.0148	301.4118	48.2681	6.6781	972.1625	6587.0701	6589.1177
0.2315	0.0242	0.015	298.6462	48.4756	6.7168	988.3823	6625.2374	6699.0522
0.2348	0.0242	0.0175	318.1742	48.3474	6.7168	1191.1299	6625.2374	8073.2337
0.2499	0.0242	0.0182	338.5878	48.4298	6.7168	1247.8993	6625.2374	8458.0046
0.1999	0.0241	0.0143	293.8285	48.2437	6.6781	931.6130	6587.0701	6314.2814
0.2621	0.0242	0.0165	306.7565	48.3779	6.7168	1110.0309	6625.2374	7523.5611
0.2526	0.0242	0.0156	300.0282	48.3413	6.7168	1037.0418	6625.2374	7028.8558
0.2579	0.0243	0.016	323.4196	48.5885	6.7555	1069.4814	6663.4048	7248.7248
0.2809	0.0242	0.016	324.0655	48.4725	6.7168	1069.4814	6625.2374	7248.7248
0.286	0.0242	0.016	312.2653	48.4695	6.7168	1069.4814	6625.2374	7248.7248
0.2767	0.0242	0.016	300.3266	48.3657	6.7168	1069.4814	6625.2374	7248.7248
0.2855	0.0242	0.0155	301.4779	48.4207	6.7168	1028.9319	6625.2374	6973.8885
0.2965	0.0243	0.018	331.1991	48.5794	6.7555	1231.6795	6663.4048	8348.0700
0.3093	0.0241	0.0152	305.0209	48.2864	6.6781	1004.6022	6587.0701	6808.9867
0.3178	0.0243	0.0142	288.2526	48.5122	6.7555	923.5031	6663.4048	6259.3141
0.3118	0.0243	0.0139	284.1601	48.5977	6.7555	899.1734	6663.4048	6094.4123
0.3059	0.0242	0.0146	270.3774	48.4146	6.7168	955.9427	6625.2374	6479.1832
0.3234	0.0242	0.0171	316.3141	48.4359	6.7168	1158.6903	6625.2374	7853.3647
0.3362	0.0242	0.016	318.5819	48.3596	6.7168	1069.4814	6625.2374	7248.7248
0.3368	0.0241	0.0159	293.7966	48.2406	6.6781	1061.3715	6587.0701	7193.7576
0.3352	0.0243	0.0167	308.0716	48.5061	6.7555	1126.2507	6663.4048	7633.4957
0.3457	0.0243	0.0147	292.7321	48.6312	6.7555	964.0526	6663.4048	6534.1504
0.3617	0.0243	0.0169	318.7382	48.677	6.7555	1142.4705	6663.4048	7743.4302
0.3704	0.0243	0.016	311.0679	48.616	6.7555	1069.4814	6663.4048	7248.7248
0.3785	0.0242	0.0155	302.452	48.4664	6.7168	1028.9319	6625.2374	6973.8885
0.3757	0.0242	0.0167	305.3265	48.3657	6.7168	1126.2507	6625.2374	7633.4957
0.3754	0.0243	0.0177	322.4456	48.6862	6.7555	1207.3498	6663.4048	8183.1683
0.3842	0.0243	0.0192	354.5103	48.6099	6.7555	1328.9983	6663.4048	9007.6772
0.3958	0.0243	0.0185	330.0806	48.5733	6.7555	1272.2290	6663.4048	8622.9064

Table C-22. Corehole #1 at 54/28 feet.

FULLER WARREN BRIDGE
SHEAR DEVICE TEST RESULTS

Penetration	(calculated) 0.077861918		
Height H_2O	36 (ft)	Unit Wt H_2O	62.4 (lb/ft3)
Length Pipe	54 (ft)	Unit Wt Rod	2.96 (lb/ft)
Penetration Depth	0.078 (in)	Cylinder Bore Area	4.72 (in2)
Stud Cap Area	0.1964 (in2)	Shear Stud Area	1.854622224
No. of Studs	42	Normal Stud Area	0.01274394
Weight of Instrum.	38	qu (psi)	218.23

LVDT (in)	Pressure (volts)	Load (volts)	Est. Load (psi)	Est. Press. (psi)	Normal Force (lb)	Shear Force (lb)	Normal Stress (psi)	Shear Stress (psi)
-0.0129	0.015	0.0005	8.758	30.0729	2.7313	-202.3537	214.3242	-109.1078
-0.0019	0.015	0.0007	13.4255	30.079	2.7313	-186.1339	214.3242	-100.3622
0.021	0.015	0.005	98.5349	29.9417	2.7313	162.5919	214.3242	87.6685
0.1057	0.015	0.0049	106.6152	29.9478	2.7313	154.4820	214.3242	83.2957
0.1049	0.0149	0.0048	91.536	29.7708	2.6926	146.3721	211.2879	78.9229
0.0988	0.0148	0.0046	90.4655	29.667	2.6539	130.1523	208.2516	70.1773
0.1384	0.0148	0.0058	115.5025	29.5969	2.6539	227.4712	208.2516	122.6509
0.2137	0.0147	0.0059	112.4448	29.4931	2.6153	235.5811	205.2152	127.0238
0.232	0.0147	0.0058	105.1344	29.4504	2.6153	227.4712	205.2152	122.6509
0.2187	0.0148	0.0052	100.8253	29.5175	2.6539	178.8118	208.2516	96.4141
0.2385	0.0147	0.0061	117.5862	29.3252	2.6153	251.8009	205.2152	135.7694
0.3287	0.0147	0.0063	118.6902	29.3435	2.6153	268.0207	205.2152	144.5150
0.3379	0.0148	0.0054	110.2645	29.5938	2.6539	195.0316	208.2516	105.1597
0.3376	0.0147	0.0056	105.1811	29.4015	2.6153	211.2514	205.2152	113.9053
0.3335	0.0147	0.0063	126.6607	29.3954	2.6153	268.0207	205.2152	144.5150
0.399	0.0147	0.0071	131.3794	29.371	2.6153	332.8999	205.2152	179.4974
0.4419	0.0147	0.0059	111.9416	29.4046	2.6153	235.5811	205.2152	127.0238
0.4546	0.0147	0.0066	131.5249	29.4076	2.6153	292.3504	205.2152	157.6334
0.4541	0.0146	0.0059	114.102	29.2611	2.5766	235.5811	202.1789	127.0238
0.4985	0.0147	0.008	149.0503	29.3558	2.6153	405.8891	205.2152	218.8527
0.5542	0.0147	0.0092	165.8281	29.313	2.6153	503.2079	205.2152	271.3264
0.552	0.0146	0.0082	145.3369	29.2703	2.5766	422.1089	202.1789	227.5983
0.5569	0.0147	0.0073	137.7585	29.3771	2.6153	349.1197	205.2152	188.2430
0.5552	0.0147	0.0072	128.9246	29.3771	2.6153	341.0098	205.2152	183.8702
0.5945	0.0147	0.008	156.0127	29.487	2.6153	405.8891	205.2152	218.8527
0.6417	0.0146	0.0087	163.0697	29.2734	2.5766	462.6584	202.1789	249.4623
0.6576	0.0147	0.0079	146.1092	29.4504	2.6153	397.7792	205.2152	214.4799
0.6576	0.0147	0.0077	139.5212	29.4259	2.6153	381.5594	205.2152	205.7343
0.6543	0.0147	0.0069	135.1689	29.4229	2.6153	316.6801	205.2152	170.7518
0.6526	0.0146	0.0073	136.5605	29.2856	2.5766	349.1197	202.1789	188.2430
0.6579	0.0147	0.0081	144.1975	29.313	2.6153	413.9990	205.2152	223.2255
0.6809	0.0147	0.0082	156.1701	29.3771	2.6153	422.1089	205.2152	227.5983
0.6779	0.0147	0.0082	158.8928	29.31	2.6153	422.1089	205.2152	227.5983
0.7486	0.0146	0.0077	137.0476	29.2886	2.5766	381.5594	202.1789	205.7343
0.727	0.0147	0.0072	135.1636	29.313	2.6153	341.0098	205.2152	183.8702
0.6356	0.0147	0.0076	132.8961	29.3344	2.6153	373.4494	205.2152	201.3615
0.7148	0.0147	0.0083	157.4625	29.4748	2.6153	430.2188	205.2152	231.9711
0.6653	0.0146	0.0082	158.298	29.3008	2.5766	422.1089	202.1789	227.5983
0.66	0.0147	0.0077	140.9799	29.3863	2.6153	381.5594	205.2152	205.7343
0.7035	0.0147	0.0075	139.4674	29.313	2.6153	365.3395	205.2152	196.9887
0.7283	0.0147	0.0081	140.9736	29.3497	2.6153	413.9990	205.2152	223.2255
0.6639	0.0148	0.0079	137.0819	29.5175	2.6539	397.7792	208.2516	214.4799
0.6747	0.0147	0.008	142.976	29.3863	2.6153	405.8891	205.2152	218.8527
0.7345	0.0147	0.0077	133.2325	29.4931	2.6153	381.5594	205.2152	205.7343
0.7355	0.0148	0.0069	131.4673	29.5206	2.6539	316.6801	208.2516	170.7518
0.6814	0.0147	0.0071	137.2273	29.4534	2.6153	332.8999	205.2152	179.4974
0.6265	0.0147	0.0074	129.3849	29.4534	2.6153	357.2296	205.2152	192.6159

Table C-23. Corehole #1 at 54/34 feet.

FULLER WARREN BRIDGE
SHEAR DEVICE TEST RESULTS

	Penetration			(calculated)	0.109982669			
	Height H_2O			36 (ft)		Unit Wt H_2O	62.4 (lb/ft3)	
	Length Pipe			54 (ft)		Unit Wt Rod	2.96 (lb/ft)	
	Penetration Depth			0.0591 (in)		Cylinder Bore Area	4.72 (in2)	
	Stud Cap Area			0.1964 (in2)		Shear Stud Area	1.064734229	
	No. of Studs			42		Normal Stud Area	0.007316266	
	Weight of Instrum.			38		qu (psi)	218.5	
LVDT (in)	Pressure (volts)	Load (volts)	Est. Load (psi)	Est. Press. (psi)	Normal Force (lb)	Shear Force (lb)	NormalStress (psi)	Shear Stress (psi)
-0.0152	0.018	0.0017	32.4251	36.0881	3.8922	-105.0349	531.9895	-98.6489
-0.0138	0.0181	0.0017	33.6045	36.1766	3.9309	-105.0349	537.2784	-98.6489
0.002	0.018	0.0005	11.2057	36.0179	3.8922	-202.3537	531.9895	-190.0509
0.0486	0.0181	0.0069	128.8332	36.1278	3.9309	316.6801	537.2784	297.4264
0.1002	0.0176	0.0068	127.4611	35.2855	3.7374	308.5702	510.8341	289.8096
0.0884	0.0177	0.0057	118.7499	35.3374	3.7761	219.3613	516.1229	206.0244
0.101	0.0177	0.0072	142.6578	35.3191	3.7761	341.0098	516.1229	320.2770
0.1656	0.0176	0.0076	160.6211	35.2397	3.7374	373.4494	510.8341	350.7443
0.1999	0.0175	0.0077	155.2883	35.0383	3.6987	381.5594	505.5452	358.3611
0.1942	0.0175	0.008	142.6604	35.0841	3.6987	405.8891	505.5452	381.2116
0.2144	0.0176	0.0083	151.3884	35.1604	3.7374	430.2188	510.8341	404.0621
0.3042	0.0175	0.0083	159.0962	34.9498	3.6987	430.2188	505.5452	404.0621
0.3078	0.0175	0.0078	145.3989	35.0322	3.6987	389.6693	505.5452	365.9780
0.3043	0.0175	0.0078	144.4573	34.9498	3.6987	389.6693	505.5452	365.9780
0.3274	0.0176	0.0081	165.8528	35.2458	3.7374	413.9990	510.8341	388.8285
0.3766	0.0175	0.01	189.3637	35.0719	3.6987	568.0871	505.5452	533.5483
0.3878	0.0175	0.0096	171.583	34.9559	3.6987	535.6475	505.5452	503.0810
0.4072	0.0176	0.009	165.4311	35.1695	3.7374	486.9881	510.8341	457.3800
0.403	0.0176	0.0101	196.0296	35.2306	3.7374	576.1970	510.8341	541.1651
0.4711	0.0176	0.0109	207.5772	35.1848	3.7374	641.0763	510.8341	602.0998
0.4758	0.0176	0.0087	175.1268	35.2458	3.7374	462.6584	510.8341	434.5295
0.4798	0.0175	0.009	170.2429	35.0261	3.6987	486.9881	505.5452	457.3800
0.5005	0.0177	0.0102	189.7746	35.3191	3.7761	584.3070	516.1229	548.7820
0.5521	0.0176	0.0108	205.711	35.1482	3.7374	632.9664	510.8341	594.4830
0.5635	0.0176	0.0092	174.7158	35.2184	3.7374	503.2079	510.8341	472.6136
0.5666	0.0176	0.0099	170.3002	35.2519	3.7374	559.9772	510.8341	525.9315
0.5585	0.0176	0.0088	167.4488	35.2947	3.7374	470.7683	510.8341	442.1463
0.5937	0.0178	0.0108	201.1799	35.5358	3.8148	632.9664	521.4118	594.4830
0.6233	0.0177	0.0111	197.3293	35.4686	3.7761	657.2961	516.1229	617.3335
0.6234	0.0177	0.0105	191.5712	35.4076	3.7761	608.6367	516.1229	571.6325
0.6284	0.0176	0.0089	170.5844	35.2977	3.7374	478.8782	510.8341	449.7631
0.6251	0.0177	0.0091	167.4721	35.316	3.7761	495.0980	516.1229	464.9968
0.6312	0.0176	0.0106	181.8239	35.2947	3.7374	616.7466	510.8341	579.2493
0.6901	0.0177	0.0109	200.9385	35.371	3.7761	641.0763	516.1229	602.0998
0.716	0.0177	0.0098	172.8423	35.435	3.7761	551.8673	516.1229	518.3146
0.7098	0.0177	0.009	158.589	35.4747	3.7761	486.9881	516.1229	457.3800
0.7152	0.0177	0.0084	155.2271	35.435	3.7761	438.3287	516.1229	411.6790
0.7004	0.0177	0.0088	157.5567	35.3618	3.7761	470.7683	516.1229	442.1463
0.722	0.0177	0.0082	152.075	35.4106	3.7761	422.1089	516.1229	396.4453
0.709	0.0177	0.0086	151.688	35.4045	3.7761	454.5485	516.1229	426.9126
0.7054	0.0177	0.0084	149.4313	35.4137	3.7761	438.3287	516.1229	411.6790
0.7163	0.0178	0.0088	161.0013	35.548	3.8148	470.7683	521.4118	442.1463
0.7135	0.0178	0.0085	147.174	35.6426	3.8148	446.4386	521.4118	419.2958
0.7063	0.0177	0.0082	149.1351	35.493	3.7761	422.1089	516.1229	396.4453
0.7164	0.0178	0.0079	148.8054	35.6029	3.8148	397.7792	521.4118	373.5948
0.7003	0.0178	0.0085	148.1499	35.5998	3.8148	446.4386	521.4118	419.2958
0.7175	0.0179	0.0088	152.0947	35.8074	3.8535	470.7683	526.7006	442.1463

Table C-24. Corehole #1 at 54/38 feet.

FULLER WARREN BRIDGE
SHEAR DEVICE TEST RESULTS

Penetration	(calculated) 0.132994787		
Height H_2O	36 (ft)	Unit Wt H_2O	62.4 (lb/ft3)
Length Pipe	54 (ft)	Unit Wt Rod	2.96 (lb/ft)
Penetration Depth	0.0591 (in)	Cylinder Bore Area	4.72 (in2)
Stud Cap Area	0.1964 (in2)	Shear Stud Area	1.064734229
No. of Studs	42	Normal Stud Area	0.007316266
Weight of Instrum.	38	qu (psi)	218.5

LVDT (in)	Pressure (volts)	Load (volts)	Est. Load (psi)	Est. Press. (psi)	Normal Force (lb)	Shear Force (lb)	Normal Stress (psi)	Shear Stress (psi)
-0.0134	0.02	0.0006	13.3975	39.9213	4.6661	-194.2438	637.7668	-182.4341
-0.0075	0.02	0.0006	13.4261	40.0403	4.6661	-194.2438	637.7668	-182.4341
-0.0022	0.0199	0.0003	7.4147	39.7137	4.6274	-218.5735	632.4779	-205.2846
0.0726	0.0198	0.0037	79.5586	39.6374	4.5887	57.1632	627.1890	53.6878
0.1129	0.0197	0.0028	59.7715	39.3872	4.5500	-15.8259	621.9002	-14.8638
0.1239	0.0196	0.0035	66.9172	39.2132	4.5113	40.9434	616.6113	38.4541
0.1337	0.0197	0.0044	88.6276	39.3719	4.5500	113.9325	621.9002	107.0056
0.231	0.0195	0.0052	96.8652	39.079	4.4726	178.8118	611.3224	167.9403
0.2648	0.0195	0.0048	87.7978	39.079	4.4726	146.3721	611.3224	137.4729
0.2451	0.0197	0.0045	82.8984	39.32	4.5500	122.0424	621.9002	114.6224
0.267	0.0196	0.0058	114.321	39.2773	4.5113	227.4712	616.6113	213.6413
0.3481	0.0196	0.0062	114.8383	39.1827	4.5113	259.9108	616.6113	244.1086
0.3726	0.0197	0.0055	100.3841	39.3536	4.5500	203.1415	621.9002	190.7908
0.3936	0.0197	0.0062	122.2492	39.3658	4.5500	259.9108	621.9002	244.1086
0.4961	0.0197	0.0058	105.9847	39.3811	4.5500	227.4712	621.9002	213.6413
0.5009	0.0197	0.0054	109.4539	39.3475	4.5500	195.0316	621.9002	183.1739
0.49	0.0197	0.0055	106.9383	39.3262	4.5500	203.1415	621.9002	190.7908
0.5215	0.0197	0.0066	126.5354	39.3231	4.5500	292.3504	621.9002	274.5759
0.6124	0.0197	0.007	134.813	39.378	4.5500	324.7900	621.9002	305.0433
0.6172	0.0197	0.0069	123.183	39.4024	4.5500	316.6801	621.9002	297.4264
0.6184	0.0197	0.0068	121.7758	39.4879	4.5500	308.5702	621.9002	289.8096
0.625	0.0197	0.0065	119.2367	39.4208	4.5500	284.2405	621.9002	266.9591
0.6591	0.0197	0.0089	157.8714	39.378	4.5500	478.8782	621.9002	449.7631
0.7107	0.0198	0.0082	150.4177	39.552	4.5887	422.1089	627.1890	396.4453
0.6804	0.0198	0.007	133.5079	39.5428	4.5887	324.7900	627.1890	305.0433
0.701	0.0197	0.0076	134.3202	39.4696	4.5500	373.4494	621.9002	350.7443
0.7039	0.0197	0.0068	127.8794	39.4696	4.5500	308.5702	621.9002	289.8096
0.6923	0.0198	0.0084	150.4908	39.5917	4.5887	438.3287	627.1890	411.6790
0.7276	0.0197	0.0083	158.1399	39.3506	4.5500	430.2188	621.9002	404.0621
0.6536	0.0197	0.0087	157.2363	39.4848	4.5500	462.6584	621.9002	434.5295
0.6286	0.0197	0.0078	135.972	39.433	4.5500	389.6693	621.9002	365.9780
0.6791	0.0197	0.0086	149.9995	39.3323	4.5500	454.5485	621.9002	426.9126
0.6606	0.0197	0.009	155.915	39.3811	4.5500	486.9881	621.9002	457.3800
0.6516	0.0197	0.0091	160.3343	39.3994	4.5500	495.0980	621.9002	464.9968
0.6209	0.0197	0.0084	151.4523	39.4177	4.5500	438.3287	621.9002	411.6790
0.6887	0.0197	0.0081	145.9782	39.4848	4.5500	413.9990	621.9002	388.8285
0.7106	0.0197	0.0092	158.2315	39.3231	4.5500	503.2079	621.9002	472.6136
0.7172	0.0197	0.0081	141.3757	39.4055	4.5500	413.9990	621.9002	388.8285
0.6834	0.0197	0.0079	141.5167	39.3658	4.5500	397.7792	621.9002	373.5948
0.7416	0.0197	0.0074	141.676	39.4574	4.5500	357.2296	621.9002	335.5106
0.6374	0.0198	0.0081	138.8452	39.6039	4.5887	413.9990	627.1890	388.8285
0.6311	0.0197	0.0089	153.672	39.4269	4.5500	478.8782	621.9002	449.7631
0.6941	0.0198	0.0082	149.7374	39.5672	4.5887	422.1089	627.1890	396.4453
0.6933	0.0197	0.0077	139.6274	39.494	4.5500	381.5594	621.9002	358.3611
0.6277	0.0198	0.0076	137.3386	39.5367	4.5887	373.4494	627.1890	350.7443
0.6556	0.0198	0.0083	152.4335	39.6924	4.5887	430.2188	627.1890	404.0621
0.6347	0.0197	0.0076	136.9416	39.4452	4.5500	373.4494	621.9002	350.7443

Table C-25. Corehole #1 at 54/43 feet.

FULLER WARREN BRIDGE
SHEAR DEVICE TEST RESULTS

Penetration	(calculated)	0.159458722			
Height H_2O	36	(ft)	Unit Wt H_2O	62.4	(lb/ft3)
Length Pipe	54	(ft)	Unit Wt Rod	2.96	(lb/ft)
Penetration Depth	0.0591	(in)	Cylinder Bore Ar	4.72	(in2)
Stud Cap Area	0.1964	(in2)	Shear Stud Area	1.064734229	
No. of Studs	42		Normal Stud Area	0.007316266	
Weight of Instrum.	38		qu (psi)	218.5	

LVDT (in)	Pressure (volts)	Load (volts)	Est. Load (psi)	Est. Press. (psi)	Normal Force (lb)	Shear Force (lb)	Normal Stress (psi)	Shear Stress (psi)
-0.0083	0.0225	0.0006	13.4488	45.0545	5.6334	-194.2438	769.9883	-182.4341
-0.0016	0.0225	0.0007	13.5301	44.9477	5.6334	-186.1339	769.9883	-174.8173
0.0015	0.0226	0.0008	15.1398	45.1125	5.6721	-178.0240	775.2772	-167.2004
0.0511	0.0225	0.0064	124.0953	44.9934	5.6334	276.1306	769.9883	259.3423
0.0989	0.0222	0.0078	147.4669	44.4349	5.5174	389.6693	754.1217	365.9780
0.1033	0.0222	0.0071	143.5173	44.3922	5.5174	332.8999	754.1217	312.6601
0.1041	0.0222	0.007	148.4538	44.4502	5.5174	324.7900	754.1217	305.0433
0.1426	0.0221	0.0096	187.4784	44.2457	5.4787	535.6475	748.8329	503.0810
0.2	0.0218	0.0091	188.3642	43.6445	5.3626	495.0980	732.9663	464.9968
0.1969	0.0219	0.0083	174.6062	43.7239	5.4013	430.2188	738.2551	404.0621
0.1992	0.0219	0.0088	162.5776	43.8246	5.4013	470.7683	738.2551	442.1463
0.2447	0.0219	0.0095	195.9493	43.7513	5.4013	527.5376	738.2551	495.4641
0.2784	0.0219	0.0093	185.9026	43.7452	5.4013	511.3178	738.2551	480.2305
0.2696	0.0219	0.0093	178.5798	43.8093	5.4013	511.3178	738.2551	480.2305
0.2671	0.022	0.0095	178.0024	44.0016	5.4400	527.5376	743.5440	495.4641
0.315	0.022	0.0095	196.2622	43.9436	5.4400	527.5376	743.5440	495.4641
0.3518	0.0219	0.0099	206.7179	43.8826	5.4013	559.9772	738.2551	525.9315
0.3475	0.0221	0.0106	198.459	44.145	5.4787	616.7466	748.8329	579.2493
0.3462	0.0221	0.0106	194.2985	44.1084	5.4787	616.7466	748.8329	579.2493
0.38	0.022	0.0126	228.1522	43.965	5.4400	778.9446	743.5440	731.5860
0.405	0.0221	0.0121	227.1346	44.1359	5.4787	738.3951	748.8329	693.5018
0.4038	0.0221	0.0119	231.757	44.2091	5.4787	722.1753	748.8329	678.2682
0.4011	0.0221	0.0107	208.8162	44.3007	5.4787	624.8565	748.8329	586.8661
0.4176	0.0221	0.0119	219.1302	44.1542	5.4787	722.1753	748.8329	678.2682
0.4371	0.0221	0.0138	250.937	44.1206	5.4787	876.2635	748.8329	822.9880
0.4575	0.0221	0.0126	225.0415	44.2671	5.4787	778.9446	748.8329	731.5860
0.4435	0.0221	0.0108	212.7404	44.2824	5.4787	632.9664	748.8329	594.4830
0.4487	0.0222	0.0114	212.3524	44.319	5.5174	681.6258	754.1217	640.1840
0.4738	0.0222	0.0137	251.953	44.3617	5.5174	868.1536	754.1217	815.3712
0.4952	0.0222	0.0121	237.0502	44.4227	5.5174	738.3951	754.1217	693.5018
0.4931	0.0221	0.0123	230.7299	44.2274	5.4787	754.6149	748.8329	708.7355
0.5052	0.0222	0.0115	216.54	44.319	5.5174	689.7357	754.1217	647.8008
0.501	0.0223	0.011	218.6517	44.5509	5.5560	649.1862	759.4106	609.7166
0.5542	0.0222	0.013	246.6903	44.322	5.5174	811.3843	754.1217	762.0533
0.565	0.0222	0.0121	228.0245	44.4624	5.5174	738.3951	754.1217	693.5018
0.5636	0.0221	0.0126	223.4832	44.2579	5.4787	778.9446	748.8329	731.5860
0.5673	0.0222	0.0114	216.8599	44.4472	5.5174	681.6258	754.1217	640.1840
0.5768	0.0222	0.0137	254.1393	44.3892	5.5174	868.1536	754.1217	815.3712
0.6075	0.0223	0.0126	244.4674	44.554	5.5560	778.9446	759.4106	731.5860
0.6116	0.0223	0.0124	234.4515	44.615	5.5560	762.7248	759.4106	716.3523
0.6063	0.0222	0.0126	220.9177	44.4563	5.5174	778.9446	754.1217	731.5860
0.6116	0.0222	0.012	228.9374	44.3434	5.5174	730.2852	754.1217	685.8850
0.604	0.0223	0.0125	234.7059	44.5662	5.5560	770.8347	759.4106	723.9692
0.6106	0.0223	0.0114	225.5388	44.5387	5.5560	681.6258	759.4106	640.1840
0.6062	0.0223	0.0116	220.2383	44.5967	5.5560	697.8456	759.4106	655.4177
0.6076	0.0223	0.0123	221.5606	44.6425	5.5560	754.6149	759.4106	708.7355
0.6042	0.0223	0.0131	232.3159	44.5479	5.5560	819.4942	759.4106	769.6702

Table C-26. Corehole #1 at 55/22 feet.

FULLER WARREN BRIDGE
SHEAR DEVICE TEST RESULTS

Penetration	(calculated)	0.028344991			
Height H_2O	37	(ft)	Unit Wt H_2O	62.4	(lb/ft3)
Length Pipe	55	(ft)	Unit Wt Rod	2.96	(lb/ft)
Penetration Depth	0.0591	(in)	Cylinder Bore Area	4.72	(in2)
Stud Cap Area	0.1964	(in2)	Shear Stud Area	1.064734229	
No. of Studs	42		Normal Stud Area	0.007316266	
Weight of Instrum.	38		qu (psi)	305	

LVDT (in)	Pressure (volts)	Load (volts)	Est. Load (psi)	Est. Press. (psi)	Normal Force (lb)	Shear Force (lb)	Normal Stress (psi)	Shear Stress (psi)
-0.0039	0.0116	0.0009	16.9245	23.1574	1.3306	-172.8741	181.8697	-162.3636
0.0041	0.0115	0.0007	12.5781	23.0781	1.2919	-189.0939	176.5809	-177.5973
0.0031	0.0116	0.0007	12.9635	23.1361	1.3306	-189.0939	181.8697	-177.5973
-0.0128	0.0116	0.0005	10.0515	23.2917	1.3306	-205.3137	181.8697	-192.8310
-0.0065	0.0116	0.0006	11.3251	23.1361	1.3306	-197.2038	181.8697	-185.2141
-0.0094	0.0116	0.0006	11.8736	23.2002	1.3306	-197.2038	181.8697	-185.2141
-0.0057	0.0116	0.0028	53.3999	23.1819	1.3306	-18.7859	181.8697	-17.6438
0.0394	0.0116	0.004	82.2796	23.2765	1.3306	78.5329	181.8697	73.7582
0.0343	0.0116	0.0042	86.7184	23.2795	1.3306	94.7527	181.8697	88.9919
0.0335	0.0115	0.0046	95.6762	23.0628	1.2919	127.1923	176.5809	119.4592
0.0372	0.0116	0.0055	103.408	23.1086	1.3306	200.1815	181.8697	188.0107
0.1259	0.0116	0.0045	85.2407	23.1727	1.3306	119.0824	181.8697	111.8424
0.1616	0.0116	0.004	84.1223	23.1697	1.3306	78.5329	181.8697	73.7582
0.1513	0.0116	0.0049	93.1104	23.2765	1.3306	151.5220	181.8697	142.3097
0.1603	0.0116	0.0043	78.7406	23.1971	1.3306	102.8626	181.8697	96.6087
0.1655	0.0117	0.0042	85.9668	23.3039	1.3693	94.7527	187.1586	88.9919
0.2311	0.0116	0.0047	93.4943	23.1941	1.3306	135.3022	181.8697	127.0761
0.2806	0.0116	0.0037	75.7717	23.2551	1.3306	54.2032	181.8697	50.9077
0.2812	0.0116	0.0044	81.3848	23.2002	1.3306	110.9725	181.8697	104.2256
0.287	0.0117	0.0043	82.4829	23.4382	1.3693	102.8626	187.1586	96.6087
0.3059	0.0116	0.0047	94.4471	23.1452	1.3306	135.3022	181.8697	127.0761
0.372	0.0116	0.005	97.9112	23.2521	1.3306	159.6319	181.8697	149.9266
0.4152	0.0115	0.0045	89.7526	23.0689	1.2919	119.0824	176.5809	111.8424
0.4047	0.0116	0.0054	105.4611	23.2673	1.3306	192.0716	181.8697	180.3939
0.4141	0.0116	0.0046	84.8155	23.249	1.3306	127.1923	181.8697	119.4592
0.4275	0.0116	0.0054	99.1092	23.1727	1.3306	192.0716	181.8697	180.3939
0.4882	0.0116	0.0054	93.6111	23.1178	1.3306	192.0716	181.8697	180.3939
0.538	0.0117	0.0046	85.1958	23.3375	1.3693	127.1923	187.1586	119.4592
0.5349	0.0116	0.005	91.4797	23.249	1.3306	159.6319	181.8697	149.9266
0.5349	0.0116	0.005	87.9799	23.1941	1.3306	159.6319	181.8697	149.9266
0.5464	0.0116	0.0046	88.7765	23.1056	1.3306	127.1923	181.8697	119.4592
0.5513	0.0116	0.0055	95.6136	23.1483	1.3306	200.1815	181.8697	188.0107
0.6162	0.0116	0.0063	117.3257	23.1208	1.3306	265.0607	181.8697	248.9454
0.6731	0.0116	0.0053	93.7777	23.1941	1.3306	183.9617	181.8697	172.7771
0.6787	0.0116	0.0049	93.0088	23.2521	1.3306	151.5220	181.8697	142.3097
0.6789	0.0117	0.0051	91.922	23.3711	1.3693	167.7418	187.1586	157.5434
0.6788	0.0117	0.0053	98.5605	23.3985	1.3693	183.9617	187.1586	172.7771
0.7238	0.0115	0.0068	116.0808	23.014	1.2919	305.6102	176.5809	287.0296
0.697	0.0116	0.0057	104.6154	23.2826	1.3306	216.4013	181.8697	203.2444
0.7243	0.0117	0.0055	95.3356	23.3558	1.3693	200.1815	187.1586	188.0107
0.643	0.0117	0.0048	90.3214	23.307	1.3693	143.4121	187.1586	134.6929
0.6753	0.0116	0.0074	128.8368	23.2734	1.3306	354.2696	181.8697	332.7306
0.628	0.0115	0.0059	107.407	23.0811	1.2919	232.6211	176.5809	218.4781
0.6342	0.0117	0.0053	101.813	23.4474	1.3693	183.9617	187.1586	172.7771
0.6777	0.0116	0.0056	99.9838	23.1361	1.3306	208.2914	181.8697	195.6276
0.6821	0.0115	0.0054	97.2632	23.0384	1.2919	192.0716	176.5809	180.3939
0.6907	0.0116	0.0048	85.2022	23.2246	1.3306	143.4121	181.8697	134.6929

Table C-27. Corehole #1 at 55/31 feet.

FULLER WARREN BRIDGE
SHEAR DEVICE TEST RESULTS

		Penetration		(calculated)	0.06873503			
		Height H_2O		37 (ft)		Unit Wt H_2O		62.4 (lb/ft3)
		Length Pipe		55 (ft)		Unit Wt Rod		2.96 (lb/ft)
		Penetration Depth		0.0591 (in)		Cylinder Bore Area		4.72 (in2)
		Stud Cap Area		0.1964 (in2)		Shear Stud Area	1.064734229	
		No. of Studs		42		Normal Stud Area	0.007316266	
		Weight of Instrum.		38		qu (psi)	305	
LVDT (in)	Pressure (volts)	Load (volts)	Est. Load (psi)	Est. Press. (psi)	Normal Force (lb)	Shear Force (lb)	Normal Stress (psi)	Shear Stress (psi)
-0.0051	0.0167	0.0007	14.0439	33.4849	3.3040	-189.0939	451.6018	-177.5973
-0.0075	0.0167	0.0007	14.5171	33.3811	3.3040	-189.0939	451.6018	-177.5973
0.0058	0.0167	0.0006	11.9734	33.3659	3.3040	-197.2038	451.6018	-185.2141
0.0047	0.0167	0.0012	23.0847	33.3506	3.3040	-148.5444	451.6018	-139.5131
0.0345	0.0167	0.0058	111.115	33.4574	3.3040	224.5112	451.6018	210.8612
0.0535	0.0166	0.0056	107.0331	33.2896	3.2653	208.2914	446.3129	195.6276
0.054	0.0166	0.0049	95.7937	33.2621	3.2653	151.5220	446.3129	142.3097
0.0539	0.0166	0.0055	113.1576	33.1828	3.2653	200.1815	446.3129	188.0107
0.1298	0.0165	0.0068	136.9392	32.9478	3.2266	305.6102	441.0240	287.0296
0.1804	0.0162	0.0069	127.7884	32.4717	3.1106	313.7201	425.1574	294.6464
0.1725	0.0164	0.006	123.6073	32.7464	3.1880	240.7310	435.7352	226.0949
0.1888	0.0163	0.0065	128.8638	32.6151	3.1493	281.2805	430.4463	264.1791
0.2519	0.0163	0.0079	154.6448	32.6426	3.1493	394.8192	430.4463	370.8148
0.2749	0.0162	0.0073	133.798	32.4503	3.1106	346.1597	425.1574	325.1137
0.2765	0.0162	0.0074	134.688	32.4351	3.1106	354.2696	425.1574	332.7306
0.281	0.0163	0.0077	151.1515	32.5358	3.1493	378.5994	430.4463	355.5811
0.3465	0.0162	0.0086	158.1592	32.4717	3.1106	451.5885	425.1574	424.1326
0.39	0.0163	0.0077	146.3296	32.5755	3.1493	378.5994	430.4463	355.5811
0.3875	0.0164	0.0074	136.4302	32.7708	3.1880	354.2696	435.7352	332.7306
0.4051	0.0162	0.0076	147.0553	32.4747	3.1106	370.4894	425.1574	347.9643
0.464	0.0162	0.0094	172.0784	32.432	3.1106	516.4677	425.1574	485.0673
0.4797	0.0163	0.0084	155.7789	32.5114	3.1493	435.3687	430.4463	408.8989
0.4895	0.0162	0.0082	150.0629	32.4839	3.1106	419.1489	425.1574	393.6653
0.5039	0.0163	0.0082	156.7355	32.6487	3.1493	419.1489	430.4463	393.6653
0.561	0.0163	0.0095	173.8375	32.551	3.1493	524.5776	430.4463	492.6841
0.5745	0.0163	0.0085	156.8222	32.5236	3.1493	443.4786	430.4463	416.5158
0.5752	0.0162	0.0085	151.9259	32.4595	3.1106	443.4786	425.1574	416.5158
0.5913	0.0163	0.0086	154.4341	32.6579	3.1493	451.5885	430.4463	424.1326
0.6573	0.0163	0.0096	169.8196	32.5694	3.1493	532.6875	430.4463	500.3009
0.6753	0.0163	0.0093	169.3701	32.551	3.1493	508.3578	430.4463	477.4504
0.6793	0.0163	0.008	152.7093	32.6518	3.1493	402.9291	430.4463	378.4316
0.6827	0.0163	0.0082	146.5022	32.6853	3.1493	419.1489	430.4463	393.6653
0.6901	0.0163	0.0097	170.9478	32.5541	3.1493	540.7974	430.4463	507.9178
0.6934	0.0163	0.0095	176.1449	32.6487	3.1493	524.5776	430.4463	492.6841
0.6532	0.0163	0.0087	164.9272	32.6518	3.1493	459.6984	430.4463	431.7494
0.6602	0.0163	0.0086	156.2914	32.6151	3.1493	451.5885	430.4463	424.1326
0.6452	0.0163	0.0075	147.572	32.5755	3.1493	362.3795	430.4463	340.3474
0.7195	0.0163	0.0099	173.6825	32.6914	3.1493	557.0172	430.4463	523.1514
0.7345	0.0162	0.0095	176.5144	32.487	3.1106	524.5776	425.1574	492.6841
0.7244	0.0163	0.0089	165.2627	32.5694	3.1493	475.9182	430.4463	446.9831
0.7305	0.0163	0.0085	149.752	32.6212	3.1493	443.4786	430.4463	416.5158
0.7361	0.0163	0.0082	155.0119	32.6426	3.1493	419.1489	430.4463	393.6653
0.6536	0.0163	0.0076	143.937	32.667	3.1493	370.4894	430.4463	347.9643
0.6835	0.0163	0.0099	175.6178	32.5144	3.1493	557.0172	430.4463	523.1514
0.7035	0.0163	0.0088	167.5848	32.6365	3.1493	467.8083	430.4463	439.3663
0.7385	0.0163	0.0088	154.9529	32.6395	3.1493	467.8083	430.4463	439.3663
0.707	0.0163	0.0085	153.4668	32.6548	3.1493	443.4786	430.4463	416.5158

Table C-28. Corehole #1 at 55/39 feet.

FULLER WARREN BRIDGE
SHEAR DEVICE TEST RESULTS

Penetration (calculated)	0.096760772		
Height H_2O	37 (ft)	Unit Wt H_2O	62.4 (lb/ft3)
Length Pipe	55 (ft)	Unit Wt Rod	2.96 (lb/ft)
Penetration Depth	0.0591 (in)	Cylinder Bore Area	4.72 (in2)
Stud Cap Area	0.1964 (in2)	Shear Stud Area	1.064734229
No. of Studs	42	Normal Stud Area	0.007316266
Weight of Instrum.	38	qu (psi)	305

LVDT (in)	Pressure (volts)	Load (volts)	Est. Load (psi)	Est. Press. (psi)	Normal Force (lb)	Shear Force (lb)	Normal Stress (psi)	Shear Stress (psi)
-0.0013	0.0205	0.0015	31.6769	40.9223	4.7744	-124.2147	652.5786	-116.6626
-0.0033	0.0204	0.0005	10.0866	40.8612	4.7357	-205.3137	647.2897	-192.8310
-0.003	0.0205	0.0006	11.2216	40.9253	4.7744	-197.2038	652.5786	-185.2141
0.0194	0.0204	0.0055	111.1296	40.8002	4.7357	200.1815	647.2897	188.0107
0.0764	0.0202	0.0068	135.2453	40.376	4.6584	305.6102	636.7120	287.0296
0.0759	0.0202	0.0073	145.0734	40.3668	4.6584	346.1597	636.7120	325.1137
0.0771	0.0202	0.0073	149.2159	40.3638	4.6584	346.1597	636.7120	325.1137
0.1344	0.02	0.0082	165.6761	39.9915	4.5810	419.1489	626.1342	393.6653
0.1703	0.0199	0.0086	154.5305	39.732	4.5423	451.5885	620.8454	424.1326
0.1745	0.0199	0.008	147.3869	39.8694	4.5423	402.9291	620.8454	378.4316
0.1658	0.02	0.0082	159.7573	40.0952	4.5810	419.1489	626.1342	393.6653
0.2243	0.0199	0.0086	174.2084	39.7839	4.5423	451.5885	620.8454	424.1326
0.2454	0.0198	0.0089	170.2168	39.6435	4.5036	475.9182	615.5565	446.9831
0.257	0.0198	0.0086	157.0552	39.6191	4.5036	451.5885	615.5565	424.1326
0.2664	0.02	0.0092	170.6188	39.9274	4.5810	500.2479	626.1342	469.8336
0.3208	0.0199	0.0093	179.2889	39.7259	4.5423	508.3578	620.8454	477.4504
0.3525	0.0198	0.0088	164.8113	39.5917	4.5036	467.8083	615.5565	439.3663
0.35	0.0199	0.0086	161.7133	39.8999	4.5423	451.5885	620.8454	424.1326
0.3521	0.02	0.0091	174.9485	39.9213	4.5810	492.1380	626.1342	462.2168
0.4133	0.02	0.0093	186.2598	39.9304	4.5810	508.3578	626.1342	477.4504
0.4311	0.0198	0.0094	170.5579	39.5947	4.5036	516.4677	615.5565	485.0673
0.439	0.0198	0.0095	181.8969	39.6802	4.5036	524.5776	615.5565	492.6841
0.4341	0.02	0.009	165.0077	39.9213	4.5810	484.0281	626.1342	454.5999
0.5068	0.0199	0.0097	179.3513	39.7412	4.5423	540.7974	620.8454	507.9178
0.5313	0.0199	0.0079	149.0245	39.7473	4.5423	394.8192	620.8454	370.8148
0.5389	0.0199	0.0081	156.2739	39.8022	4.5423	411.0390	620.8454	386.0484
0.5327	0.0198	0.0086	150.6283	39.6863	4.5036	451.5885	615.5565	424.1326
0.5878	0.0199	0.0092	168.6739	39.787	4.5423	500.2479	620.8454	469.8336
0.6404	0.0197	0.0068	131.7853	39.5001	4.4649	305.6102	610.2676	287.0296
0.6322	0.0197	0.0073	137.9185	39.4238	4.4649	346.1597	610.2676	325.1137
0.6499	0.0197	0.0074	133.9978	39.4848	4.4649	354.2696	610.2676	332.7306
0.6446	0.0198	0.0088	151.1134	39.5184	4.5036	467.8083	615.5565	439.3663
0.7	0.0197	0.008	146.65	39.3689	4.4649	402.9291	610.2676	378.4316
0.6604	0.0195	0.0075	130.7806	39.0881	4.3875	362.3795	599.6899	340.3474
0.723	0.0196	0.0074	129.9094	39.1186	4.4262	354.2696	604.9788	332.7306
0.6425	0.0197	0.007	124.4589	39.3231	4.4649	321.8300	610.2676	302.2632
0.6925	0.0197	0.0078	152.1041	39.3262	4.4649	386.7093	610.2676	363.1979
0.6722	0.0196	0.0072	128.8133	39.1827	4.4262	338.0498	604.9788	317.4969
0.6321	0.0196	0.0076	131.8916	39.2773	4.4262	370.4894	604.9788	347.9643
0.6772	0.0197	0.0076	132.5063	39.3262	4.4649	370.4894	610.2676	347.9643
0.7387	0.0197	0.0069	125.4866	39.4879	4.4649	313.7201	610.2676	294.6464
0.635	0.0198	0.0071	130.1051	39.552	4.5036	329.9399	615.5565	309.8801
0.695	0.0198	0.0074	128.5953	39.5184	4.5036	354.2696	615.5565	332.7306
0.7117	0.0198	0.007	133.8257	39.555	4.5036	321.8300	615.5565	302.2632
0.6406	0.0199	0.0072	132.3998	39.7778	4.5423	338.0498	620.8454	317.4969
0.6446	0.0199	0.0073	128.0269	39.7565	4.5423	346.1597	620.8454	325.1137
0.6662	0.0199	0.0074	131.7068	39.7595	4.5423	354.2696	620.8454	332.7306

Table C-29. Corehole #1 at 54/48 feet.

FULLER WARREN BRIDGE
SHEAR DEVICE TEST RESULTS

		Penetration	(calculated)	0.134677951		(Max 0.0591)		
		Height H_2O	37	(ft)		Unit Wt H_2O	62.4	(lb/ft3)
		Length Pipe	55	(ft)		Unit Wt Rod	2.96	(lb/ft)
		Penetration Depth	0.0591	(in)		Cylinder Bore Area	4.72	(in2)
		Stud Cap Area	0.1964	(in2)		Shear Stud Area	1.064734229	
		No. of Studs	42			Normal Stud Area	0.007316266	
		Weight of Instrum.	38			qu (psi)	305	
LVDT (in)	Pressure (volts)	Load (volts)	Est. Load (psi)	Est. Press. (psi)	Normal Force (lb)	Shear Force (lb)	Normal Stress (psi)	Shear Stress (psi)
0.0049	0.0248	0.0006	12.3138	49.6658	6.4383	-197.2038	879.9997	-185.2141
-0.007	0.0248	0.0007	13.1521	49.5987	6.4383	-189.0939	879.9997	-177.5973
0.0073	0.0249	0.0056	106.077	49.736	6.4770	208.2914	885.2885	195.6276
0.0718	0.0248	0.0082	159.1172	49.5163	6.4383	419.1489	879.9997	393.6653
0.0835	0.0247	0.0072	145.3795	49.3667	6.3996	338.0498	874.7108	317.4969
0.0826	0.0247	0.0075	143.9524	49.3698	6.3996	362.3795	874.7108	340.3474
0.0932	0.0247	0.0075	161.2224	49.4034	6.3996	362.3795	874.7108	340.3474
0.159	0.0245	0.0089	186.2043	49.0585	6.3222	475.9182	864.1331	446.9831
0.1679	0.0245	0.0084	165.2116	48.9456	6.3222	435.3687	864.1331	408.8989
0.1719	0.0245	0.0081	166.4049	48.9792	6.3222	411.0390	864.1331	386.0484
0.1822	0.0244	0.0097	176.8519	48.851	6.2835	540.7974	858.8442	507.9178
0.2324	0.0245	0.01	197.6317	49.028	6.3222	565.1271	864.1331	530.7683
0.2491	0.0245	0.0081	152.6468	48.9334	6.3222	411.0390	864.1331	386.0484
0.2563	0.0245	0.0085	165.7764	48.9608	6.3222	443.4786	864.1331	416.5158
0.2541	0.0245	0.0093	177.339	48.9883	6.3222	508.3578	864.1331	477.4504
0.3335	0.0245	0.0097	192.2307	48.9364	6.3222	540.7974	864.1331	507.9178
0.3449	0.0245	0.0097	175.8046	48.9303	6.3222	540.7974	864.1331	507.9178
0.3443	0.0245	0.0093	182.7462	48.9578	6.3222	508.3578	864.1331	477.4504
0.3483	0.0244	0.0092	177.2577	48.8937	6.2835	500.2479	858.8442	469.8336
0.3764	0.0245	0.0092	186.9295	49.0249	6.3222	500.2479	864.1331	469.8336
0.4298	0.0245	0.0104	200.0739	49.0127	6.3222	597.5668	864.1331	561.2356
0.4364	0.0245	0.0092	176.6739	49.1012	6.3222	500.2479	864.1331	469.8336
0.4362	0.0245	0.009	175.3278	49.0127	6.3222	484.0281	864.1331	454.5999
0.4347	0.0245	0.0094	180.4763	49.0249	6.3222	516.4677	864.1331	485.0673
0.5013	0.0245	0.0105	193.9602	49.0005	6.3222	605.6767	864.1331	568.8524
0.5114	0.0245	0.0104	182.245	49.0829	6.3222	597.5668	864.1331	561.2356
0.5103	0.0245	0.0094	176.7355	49.0738	6.3222	516.4677	864.1331	485.0673
0.5138	0.0245	0.0098	173.3677	49.0066	6.3222	548.9073	864.1331	515.5346
0.5291	0.0245	0.0108	189.1363	48.97	6.3222	630.0064	864.1331	591.7029
0.5745	0.0245	0.0107	202.3471	49.0432	6.3222	621.8965	864.1331	584.0861
0.584	0.0246	0.0106	197.409	49.1958	6.3609	613.7866	869.4219	576.4693
0.5874	0.0245	0.0101	178.1209	49.031	6.3222	573.2370	864.1331	538.3851
0.5852	0.0246	0.0092	179.2288	49.2325	6.3609	500.2479	869.4219	469.8336
0.5856	0.0246	0.0092	168.3902	49.2935	6.3609	500.2479	869.4219	469.8336
0.6154	0.0246	0.0102	188.4193	49.2355	6.3609	581.3470	869.4219	546.0019
0.633	0.0246	0.0111	192.7025	49.263	6.3609	654.3361	869.4219	614.5534
0.6492	0.0246	0.0097	192.9395	49.1562	6.3609	540.7974	869.4219	507.9178
0.6529	0.0247	0.0102	184.2486	49.3515	6.3996	581.3470	874.7108	546.0019
0.605	0.0246	0.0096	182.7053	49.1287	6.3609	532.6875	869.4219	500.3009
0.6514	0.0246	0.01	177.5534	49.1531	6.3609	565.1271	869.4219	530.7683
0.6287	0.0247	0.0097	180.3338	49.3759	6.3996	540.7974	874.7108	507.9178
0.6961	0.0246	0.0126	219.2969	49.2477	6.3609	775.9846	869.4219	728.8060
0.6449	0.0246	0.0123	213.308	49.2538	6.3609	751.6549	869.4219	705.9555
0.6887	0.0246	0.0112	207.8514	49.2294	6.3609	662.4460	869.4219	622.1703
0.7291	0.0246	0.0104	198.396	49.2599	6.3609	597.5668	869.4219	561.2356
0.7216	0.0246	0.0133	236.8101	49.2294	6.3609	832.7540	869.4219	782.1238
0.6686	0.0246	0.0126	217.6804	49.2355	6.3609	775.9846	869.4219	728.8060

Table C-30. Corehole #2 at 43/25 feet.

FULLER WARREN BRIDGE

SHEAR DEVICE TEST RESULTS

Penetration	(calculated)	0.022006359	Max. (0.0591)		
Height H_2O	22	(ft)	Unit Wt H_2O	62.4	(lb/ft3)
Length Pipe	43	(ft)	Unit Wt Rod	2.96	(lb/ft)
Penetration Depth	0.0291	(in)	Cylinder Bore Are:	4.72	(in2)
Stud Cap Area	0.1964	(in2)	Shear Stud Area	0.258138173	
No. of Studs	42		Normal Stud Area	0.001773783	
Weight of Instrum.	38		qu (psi)	884	

LVDT (in)	Pressure (volts)	Load (volts)	Est. Load (psi)	Est. Press. (psi)	Normal Force (lb)	Shear Force (lb)	Normal Stress (psi)	Shear Stress (psi)
0.0023	0.0128	0.0001	1.9837	25.6569	3.0715	-202.2334	1731.6346	-783.4306
-0.0009	0.0128	0	0.7375	25.5135	3.0715	-210.3433	1731.6346	-814.8475
0.0265	0.0128	0.007	116.25	25.605	3.0715	357.3500	1731.6346	1384.3362
0.0895	0.0128	0.008	132.73	25.5776	3.0715	438.4491	1731.6346	1698.5053
0.0896	0.0127	0.0076	127.466	25.4189	3.0328	406.0094	1709.8198	1572.8377
0.1352	0.0127	0.0102	169.632	25.3548	3.0328	616.8670	1709.8198	2389.6774
0.1998	0.0128	0.0064	106.306	25.5654	3.0715	308.6906	1731.6346	1195.8348
0.2023	0.0126	0.0085	142.038	25.2571	2.9942	478.9986	1688.0050	1855.5899
0.22	0.0126	0.0091	151.931	25.2663	2.9942	527.6580	1688.0050	2044.0914
0.3069	0.0126	0.0088	147.404	25.2846	2.9942	503.3283	1688.0050	1949.8406
0.3263	0.0126	0.0074	123.803	25.1961	2.9942	389.7896	1688.0050	1510.0039
0.3154	0.0125	0.0079	131.611	25.0679	2.9555	430.3392	1666.1902	1667.0884
0.341	0.0125	0.0092	152.949	25.0801	2.9555	535.7679	1666.1902	2075.5083
0.3935	0.0125	0.0095	158.518	24.9977	2.9555	560.0976	1666.1902	2169.7590
0.404	0.0125	0.0085	142.14	25.0008	2.9555	478.9986	1666.1902	1855.5899
0.424	0.0125	0.0082	136.087	25.0649	2.9555	454.6689	1666.1902	1761.3392
0.4185	0.0125	0.0093	155.238	24.9916	2.9555	543.8778	1666.1902	2106.9252
0.4856	0.0125	0.0086	142.521	24.9886	2.9555	487.1085	1666.1902	1887.0068
0.5095	0.0125	0.0083	137.817	24.9397	2.9555	462.7788	1666.1902	1792.7561
0.49	0.0125	0.0078	130.568	24.9947	2.9555	422.2293	1666.1902	1635.6715
0.4976	0.0124	0.0093	155.288	24.8115	2.9168	543.8778	1644.3754	2106.9252
0.5216	0.0124	0.0086	144.047	24.7932	2.9168	487.1085	1644.3754	1887.0068
0.5708	0.0124	0.0092	153	24.7475	2.9168	535.7679	1644.3754	2075.5083
0.5918	0.0123	0.0083	138.249	24.6467	2.8781	462.7788	1622.5606	1792.7561
0.5819	0.0124	0.0081	134.18	24.7597	2.9168	446.5590	1644.3754	1729.9222
0.5892	0.0125	0.0088	145.879	24.9275	2.9555	503.3283	1666.1902	1949.8406
0.5907	0.0123	0.0085	141.123	24.6223	2.8781	478.9986	1622.5606	1855.5899
0.6001	0.0123	0.0085	141.479	24.6681	2.8781	478.9986	1622.5606	1855.5899
0.5838	0.0123	0.0086	143.081	24.5827	2.8781	487.1085	1622.5606	1887.0068
0.5934	0.0123	0.0078	129.5	24.6254	2.8781	422.2293	1622.5606	1635.6715
0.5849	0.0123	0.0082	136.265	24.5094	2.8781	454.6689	1622.5606	1761.3392
0.5863	0.0123	0.0077	129.093	24.6864	2.8781	414.1194	1622.5606	1604.2546
0.5807	0.0122	0.008	133.162	24.485	2.8394	438.4491	1600.7458	1698.5053
0.5838	0.0122	0.0089	148.345	24.4881	2.8394	511.4382	1600.7458	1981.2575

Table C-31. Corehole #2 at 43/29 feet.

FULLER WARREN BRIDGE

SHEAR DEVICE TEST RESULTS

Penetration	(calculated) 0.029116297	Max. (0.0591)	
Height H_2O	22 (ft)	Unit Wt H_2O	62.4 (lb/ft3)
Length Pipe	43 (ft)	Unit Wt Rod	2.96 (lb/ft)
Penetration Depth	0.0291 (in)	Cylinder Bore Area	4.72 (in2)
Stud Cap Area	0.1964 (in2)	Shear Stud Area	0.258138173
No. of Studs	42	Normal Stud Area	0.001773783
Weight of Instrum.	38	qu (psi)	884

LVDT (in)	Pressure (volts)	Load (volts)	Est. Load (psi)	Est. Press. (psi)	Normal Force (lb)	Shear Force (lb)	Normal Stress (psi)	Shear Stress (psi)
-0.0023	0.0151	0.0005	7.5279	30.1828	3.9615	-169.7937	2233.3751	-657.7630
-0.0094	0.0151	0.0003	4.6286	30.2622	3.9615	-186.0135	2233.3751	-720.5968
0.0535	0.0151	0.0107	177.694	30.1828	3.9615	657.4165	2233.3751	2546.7619
0.0697	0.0151	0.0116	193.3602	30.1157	3.9615	730.4056	2233.3751	2829.5141
0.0676	0.015	0.0109	181.2037	30.0516	3.9228	673.6363	2211.5603	2609.5958
0.0836	0.015	0.0151	251.6251	30.079	3.9228	1014.2522	2211.5603	3929.1060
0.132	0.015	0.0119	198.0143	29.9905	3.9228	754.7353	2211.5603	2923.7649
0.0832	0.015	0.0111	184.5861	30.079	3.9228	689.8561	2211.5603	2672.4296
0.0843	0.0151	0.0121	201.117	30.1279	3.9615	770.9551	2233.3751	2986.5987
0.1679	0.015	0.0118	196.056	30.018	3.9228	746.6254	2211.5603	2892.3480
0.1871	0.015	0.0123	204.5757	29.9051	3.9228	787.1749	2211.5603	3049.4325
0.1939	0.015	0.0129	214.4434	29.9326	3.9228	835.8344	2211.5603	3237.9340
0.1956	0.015	0.0126	209.8148	29.9997	3.9228	811.5046	2211.5603	3143.6832
0.2455	0.0149	0.0136	226.4982	29.8746	3.8841	892.6037	2189.7455	3457.8523
0.2598	0.015	0.0102	169.9118	29.9203	3.9228	616.8670	2211.5603	2389.6774
0.2758	0.0149	0.0103	171.3614	29.8441	3.8841	624.9769	2189.7455	2421.0943
0.2689	0.0149	0.0104	173.396	29.8868	3.8841	633.0868	2189.7455	2452.5112
0.3228	0.0148	0.0116	192.7753	29.6701	3.8454	730.4056	2167.9307	2829.5141
0.3536	0.0149	0.0102	170.039	29.78	3.8841	616.8670	2189.7455	2389.6774
0.3413	0.0149	0.0096	159.1795	29.8959	3.8841	568.2075	2189.7455	2201.1759
0.3445	0.0149	0.0103	171.3106	29.8318	3.8841	624.9769	2189.7455	2421.0943
0.3666	0.0149	0.0113	188.0703	29.7922	3.8841	706.0759	2189.7455	2735.2634
0.4038	0.0149	0.0106	177.1091	29.8837	3.8841	649.3066	2189.7455	2515.3450
0.4099	0.015	0.0111	185.7814	29.9478	3.9228	689.8561	2211.5603	2672.4296
0.4099	0.0149	0.01	166.4785	29.8532	3.8841	600.6471	2189.7455	2326.8436
0.4058	0.0149	0.0104	172.5822	29.8441	3.8841	633.0868	2189.7455	2452.5112
0.4056	0.015	0.0105	175.8375	29.9661	3.9228	641.1967	2211.5603	2483.9281
0.4039	0.015	0.0097	161.2649	29.9265	3.9228	576.3174	2211.5603	2232.5928
0.4082	0.015	0.0111	185.0693	30.015	3.9228	689.8561	2211.5603	2672.4296
0.4069	0.015	0.0109	182.2464	30.0546	3.9228	673.6363	2211.5603	2609.5958
0.4032	0.015	0.0094	156.6617	30.0089	3.9228	551.9877	2211.5603	2138.3421
0.3996	0.015	0.0106	176.8039	29.9905	3.9228	649.3066	2211.5603	2515.3450
0.4005	0.0151	0.0099	165.2069	30.1645	3.9615	592.5372	2233.3751	2295.4266

Table C-32. Corehole #2 at 43/33 feet.

FULLER WARREN BRIDGE
SHEAR DEVICE TEST RESULTS

Penetration	(calculated) 0.035088644	Max. (0.0591)	
Height H_2O	22 (ft)	Unit Wt H_2O	62.4 (lb/ft3)
Length Pipe	43 (ft)	Unit Wt Rod	2.96 (lb/ft)
Penetration Depth	0.0291 (in)	Cylinder Bore Area	4.72 (in2)
Stud Cap Area	0.1964 (in2)	Shear Stud Area	0.258138173
No. of Studs	42	Normal Stud Area	0.001773783
Weight of Instrum.	38	qu (psi)	884

LVDT (in)	Pressure (volts)	Load (volts)	Est. Load (psi)	Est. Press. (psi)	Normal Force (lb)	Shear Force (lb)	Normal Stress (psi)	Shear Stress (psi)
-0.0085	0.0173	0	-0.1017	34.6202	4.8128	-210.3433	2713.3008	-814.8475
-0.0057	0.0174	-0.0001	-1.119	34.8094	4.8515	-218.4532	2735.1156	-846.2645
0.0177	0.0173	0.0067	111.8758	34.5531	4.8128	333.0203	2713.3008	1290.0855
0.0568	0.0172	0.0134	223.014	34.4493	4.7741	876.3839	2691.4860	3395.0185
0.0714	0.0172	0.0116	193.996	34.4035	4.7741	730.4056	2691.4860	2829.5141
0.0755	0.0172	0.012	199.5402	34.4279	4.7741	762.8452	2691.4860	2955.1818
0.0688	0.0172	0.0155	258.9241	34.4615	4.7741	1046.6919	2691.4860	4054.7737
0.0776	0.0171	0.0156	260.4246	34.2418	4.7354	1054.8018	2669.6712	4086.1906
0.0944	0.0172	0.0163	271.1315	34.4157	4.7741	1111.5711	2691.4860	4306.1089
0.0935	0.0173	0.0165	275.5821	34.5042	4.8128	1127.7909	2713.3008	4368.9428
0.0966	0.0173	0.0183	304.2441	34.5836	4.8128	1273.7692	2713.3008	4934.4472
0.1261	0.0171	0.0182	302.7182	34.2112	4.7354	1265.6593	2669.6712	4903.0303
0.127	0.0172	0.0184	306.9145	34.3181	4.7741	1281.8791	2691.4860	4965.8641
0.1181	0.0172	0.0187	312.3824	34.3699	4.7741	1306.2088	2691.4860	5060.1148
0.1262	0.0172	0.0188	313.8574	34.4676	4.7741	1314.3187	2691.4860	5091.5317
0.1466	0.0172	0.0183	305.1851	34.4737	4.7741	1273.7692	2691.4860	4934.4472
0.1622	0.0172	0.0169	281.5587	34.4157	4.7741	1160.2305	2691.4860	4494.6104
0.1479	0.0172	0.0169	281.4824	34.4127	4.7741	1160.2305	2691.4860	4494.6104
0.1528	0.0172	0.0162	270.8263	34.3944	4.7741	1103.4612	2691.4860	4274.6920
0.1567	0.0171	0.0182	303.8118	34.2692	4.7354	1265.6593	2669.6712	4903.0303
0.1666	0.0172	0.0172	286.6197	34.4554	4.7741	1184.5602	2691.4860	4588.8611
0.1771	0.0172	0.017	283.6187	34.4096	4.7741	1168.3404	2691.4860	4526.0273
0.1812	0.0172	0.0164	273.4967	34.3455	4.7741	1119.6810	2691.4860	4337.5259
0.1858	0.0173	0.0166	277.1335	34.5103	4.8128	1135.9008	2713.3008	4400.3597
0.184	0.0171	0.0173	288.9086	34.2845	4.7354	1192.6701	2669.6712	4620.2781
0.1998	0.0172	0.0169	281.7367	34.4859	4.7741	1160.2305	2691.4860	4494.6104
0.2157	0.0172	0.0169	281.3044	34.4584	4.7741	1160.2305	2691.4860	4494.6104
0.2168	0.0172	0.017	282.6014	34.4737	4.7741	1168.3404	2691.4860	4526.0273
0.2136	0.0172	0.0163	271.5384	34.3059	4.7741	1111.5711	2691.4860	4306.1089
0.2068	0.0172	0.0184	307.0671	34.3608	4.7741	1281.8791	2691.4860	4965.8641
0.224	0.0173	0.0171	284.3816	34.6263	4.8128	1176.4503	2713.3008	4557.4442
0.2358	0.0172	0.0167	277.9219	34.4493	4.7741	1144.0107	2691.4860	4431.7766
0.2512	0.0172	0.0151	251.4725	34.315	4.7741	1014.2522	2691.4860	3929.1060
0.24	0.0173	0.0159	265.0278	34.5653	4.8128	1079.1315	2713.3008	4180.4413
0.2626	0.0172	0.0182	303.3031	34.431	4.7741	1265.6593	2691.4860	4903.0303
0.2804	0.0172	0.0153	255.5417	34.434	4.7741	1030.4721	2691.4860	3991.9398
0.2723	0.0172	0.0159	264.3666	34.3852	4.7741	1079.1315	2691.4860	4180.4413
0.2809	0.0172	0.0159	264.7481	34.4096	4.7741	1079.1315	2691.4860	4180.4413
0.2668	0.0172	0.0171	285.6787	34.4005	4.7741	1176.4503	2691.4860	4557.4442
0.2421	0.0172	0.0144	240.8165	34.3547	4.7741	957.4829	2691.4860	3709.1876
0.2744	0.0172	0.0151	252.3372	34.4432	4.7741	1014.2522	2691.4860	3929.1060
0.2761	0.0171	0.0153	255.796	34.2448	4.7354	1030.4721	2669.6712	3991.9398
0.275	0.0172	0.0153	255.1347	34.4279	4.7741	1030.4721	2691.4860	3991.9398
0.2699	0.0172	0.0165	274.7683	34.3455	4.7741	1127.7909	2691.4860	4368.9428
0.2801	0.0172	0.016	267.1896	34.3486	4.7741	1087.2414	2691.4860	4211.8582
0.2774	0.0172	0.0141	235.7809	34.3211	4.7741	933.1532	2691.4860	3614.9369
0.2802	0.0172	0.0152	252.7441	34.4462	4.7741	1022.3622	2691.4860	3960.5229

Table C-33. Corehole #2 at 43/36 feet.

FULLER WARREN BRIDGE
SHEAR DEVICE TEST RESULTS

Penetration	(calculated) 0.038729092	Max. (0.0591)	
Height H_2O	23 (ft)	Unit Wt H_2O	62.4 (lb/ft3)
Length Pipe	43 (ft)	Unit Wt Rod	2.96 (lb/ft)
Penetration Depth	0.03873 (in)	Cylinder Bore Area	4.72 (in2)
Stud Cap Area	0.1964 (in2)	Shear Stud Area	0.457257932
No. of Studs	42	Normal Stud Area	0.003142024
Weight of Instrum.	38	qu (psi)	884

LVDT (in)	Pressure (volts)	Load (volts)	Est. Load (psi)	Est. Press. (psi)	NormalForce (lb)	Shear Force (lb)	Normal Stress (psi)	Shear Stress (psi)
-0.0054	0.0187	0.0003	5.3662	37.4676	5.2694	-186.0135	1677.0802	-406.8022
-0.0105	0.0187	0	-0.5595	37.318	5.2694	-210.3433	1677.0802	-460.0101
-0.0086	0.0188	-0.0001	-1.4496	37.5622	5.3081	-218.4532	1689.3954	-477.7460
0.0039	0.0187	0.0055	92.0896	37.3302	5.2694	235.7015	1677.0802	515.4672
0.0693	0.0186	0.0126	210.1454	37.2051	5.2307	811.5046	1664.7650	1774.7197
0.073	0.0186	0.0132	219.9876	37.2356	5.2307	860.1641	1664.7650	1881.1354
0.0677	0.0186	0.0115	191.3765	37.1502	5.2307	722.2957	1664.7650	1579.6242
0.091	0.0185	0.0191	317.5451	37.0891	5.1920	1338.6484	1652.4498	2927.5564
0.1006	0.0187	0.0192	320.4444	37.3241	5.2694	1346.7583	1677.0802	2945.2924
0.1099	0.0186	0.018	300.175	37.1838	5.2307	1249.4395	1664.7650	2732.4610
0.1178	0.0185	0.02	333.1095	37.0922	5.1920	1411.6375	1652.4498	3087.1800
0.1212	0.0185	0.0202	336.67	37.0983	5.1920	1427.8574	1652.4498	3122.6519
0.1311	0.0186	0.0203	337.611	37.2173	5.2307	1435.9673	1664.7650	3140.3879
0.1372	0.0186	0.0209	348.9537	37.1258	5.2307	1484.6267	1664.7650	3246.8036
0.1455	0.0186	0.0213	354.7014	37.1593	5.2307	1517.0663	1664.7650	3317.7474
0.1636	0.0186	0.0191	319.0202	37.1441	5.2307	1338.6484	1664.7650	2927.5564
0.158	0.0186	0.0177	295.5718	37.257	5.2307	1225.1098	1664.7650	2679.2531
0.1642	0.0186	0.0183	304.5239	37.1654	5.2307	1273.7692	1664.7650	2785.6688
0.1746	0.0186	0.0201	334.7372	37.1166	5.2307	1419.7474	1664.7650	3104.9160
0.1863	0.0186	0.0201	335.6019	37.2997	5.2307	1419.7474	1664.7650	3104.9160
0.1878	0.0186	0.0178	296.7416	37.2509	5.2307	1233.2197	1664.7650	2696.9891
0.1961	0.0185	0.0196	326.6244	37.0128	5.1920	1379.1979	1652.4498	3016.2362
0.197	0.0186	0.0202	336.6192	37.1593	5.2307	1427.8574	1664.7650	3122.6519
0.2315	0.0186	0.0176	293.3592	37.1929	5.2307	1216.9998	1664.7650	2661.5172
0.2186	0.0186	0.017	283.2372	37.1593	5.2307	1168.3404	1664.7650	2555.1015
0.2241	0.0186	0.0176	293.9695	37.196	5.2307	1216.9998	1664.7650	2661.5172
0.2238	0.0186	0.019	316.4769	37.1899	5.2307	1330.5385	1664.7650	2909.8205
0.2669	0.0186	0.0182	303.1505	37.1502	5.2307	1265.6593	1664.7650	2767.9329
0.2519	0.0186	0.0189	315.7903	37.1441	5.2307	1322.4286	1664.7650	2892.0845
0.2446	0.0186	0.0172	286.2128	37.1868	5.2307	1184.5602	1664.7650	2590.5734
0.252	0.0186	0.0177	294.4273	37.1929	5.2307	1225.1098	1664.7650	2679.2531
0.2532	0.0186	0.0175	291.4009	37.1258	5.2307	1208.8899	1664.7650	2643.7812
0.2526	0.0185	0.0181	302.235	37.083	5.1920	1257.5494	1652.4498	2750.1969
0.2486	0.0186	0.0172	286.9503	37.2845	5.2307	1184.5602	1664.7650	2590.5734
0.2519	0.0186	0.0174	289.697	37.141	5.2307	1200.7800	1664.7650	2626.0453
0.2525	0.0186	0.0183	305.0579	37.2631	5.2307	1273.7692	1664.7650	2785.6688
0.2452	0.0186	0.0186	310.653	37.1349	5.2307	1298.0989	1664.7650	2838.8767
0.2461	0.0185	0.0175	291.1212	37.0708	5.1920	1208.8899	1652.4498	2643.7812
0.2511	0.0185	0.0177	294.3765	37.0891	5.1920	1225.1098	1652.4498	2679.2531
0.2583	0.0185	0.0182	302.7691	37.0617	5.1920	1265.6593	1652.4498	2767.9329
0.2589	0.0185	0.0159	265.511	37.0617	5.1920	1079.1315	1652.4498	2360.0060
0.2501	0.0186	0.0174	289.875	37.1105	5.2307	1200.7800	1664.7650	2626.0453

Table C-34. Corehole #2 at 44/25 feet.

FULLER WARREN BRIDGE

SHEAR DEVICE TEST RESULTS

		Penetration		(calculated)	0.022461715	Max. (0.0591)			
		Height H_2O		24 (ft)		Unit Wt H_2O		62.4 (lb/ft3)	
		Length Pipe		44 (ft)		Unit Wt Rod		2.96 (lb/ft)	
		Penetration Depth		0.0281 (in)		Cylinder Bore Area		4.72 (in2)	
		Stud Cap Area		0.1964 (in2)		Shear Stud Area		0.240701554	
		No. of Studs		42		Normal Stud Area		0.001653968	
		Weight of Instrum.		38		qu (psi)		884	
LVDT (in)	Pressure (volts)	Load (volts)	Est. Load (psi)	Est. Press. (psi)	Normal Force (lb)	Shear Force (lb)	Normal Stress (psi)	Shear Stress (psi)	
-0.003	0.0134	0.0004	6.002	26.896	3.1335	-180.8636	1894.5341	-751.4020	
0.0017	0.0135	0.0001	2.0427	27.0882	3.1722	-205.1934	1917.9292	-852.4804	
-0.0063	0.0135	0	-0.4323	26.9875	3.1722	-213.3033	1917.9292	-886.1732	
0.0305	0.0132	0.0083	138.3506	26.4657	3.0561	459.8188	1847.7439	1910.3274	
0.0799	0.0134	0.0076	126.5755	26.7098	3.1335	403.0494	1894.5341	1674.4780	
0.0848	0.0133	0.0067	111.3671	26.5694	3.0948	330.0603	1871.1390	1371.2430	
0.1208	0.0133	0.008	132.5266	26.5999	3.0948	435.4891	1871.1390	1809.2491	
0.1984	0.0132	0.0069	114.7242	26.4657	3.0561	346.2801	1847.7439	1438.6285	
0.2142	0.0132	0.0071	117.8269	26.4107	3.0561	362.4999	1847.7439	1506.0141	
0.2034	0.0132	0.0091	151.855	26.4016	3.0561	524.6980	1847.7439	2179.8696	
0.2885	0.0132	0.0083	137.5368	26.4657	3.0561	459.8188	1847.7439	1910.3274	
0.3145	0.0132	0.0074	124.0323	26.4443	3.0561	386.8296	1847.7439	1607.0924	
0.2983	0.0132	0.0085	142.0128	26.4016	3.0561	476.0386	1847.7439	1977.7130	
0.3212	0.0133	0.0088	147.2009	26.6396	3.0948	500.3683	1871.1390	2078.7913	
0.4197	0.0132	0.0076	127.4148	26.3894	3.0561	403.0494	1847.7439	1674.4780	
0.4175	0.0132	0.0078	130.0089	26.3436	3.0561	419.2693	1847.7439	1741.8635	
0.417	0.0132	0.0077	127.5165	26.3527	3.0561	411.1594	1847.7439	1708.1707	
0.4349	0.0131	0.01	166.453	26.2642	3.0174	597.6871	1824.3488	2483.1046	
0.5106	0.0133	0.0093	155.5172	26.5358	3.0948	540.9178	1871.1390	2247.2552	
0.5199	0.0132	0.009	149.1847	26.4168	3.0561	516.5881	1847.7439	2146.1769	
0.5291	0.0132	0.0088	145.9293	26.4077	3.0561	500.3683	1847.7439	2078.7913	
0.5208	0.0132	0.0089	148.9812	26.4718	3.0561	508.4782	1847.7439	2112.4841	
0.5549	0.0132	0.0092	153.915	26.426	3.0561	532.8079	1847.7439	2213.5624	
0.6113	0.0132	0.0098	162.6128	26.4168	3.0561	581.4673	1847.7439	2415.7191	
0.612	0.0132	0.0098	162.8671	26.3558	3.0561	581.4673	1847.7439	2415.7191	
0.6221	0.0131	0.0093	155.7461	26.2001	3.0174	540.9178	1824.3488	2247.2552	
0.6154	0.0132	0.0088	146.5143	26.4351	3.0561	500.3683	1847.7439	2078.7913	
0.6138	0.0131	0.0091	151.3718	26.2825	3.0174	524.6980	1824.3488	2179.8696	
0.6167	0.0131	0.0091	151.2701	26.2001	3.0174	524.6980	1824.3488	2179.8696	
0.6147	0.0132	0.0087	145.319	26.3405	3.0561	492.2584	1847.7439	2045.0985	
0.6277	0.0131	0.009	150.5071	26.2581	3.0174	516.5881	1824.3488	2146.1769	
0.6148	0.0131	0.0085	140.8684	26.2673	3.0174	476.0386	1824.3488	1977.7130	
0.6192	0.0131	0.0081	134.2306	26.249	3.0174	443.5990	1824.3488	1842.9419	
0.6193	0.0132	0.0086	143.3861	26.4351	3.0561	484.1485	1847.7439	2011.4057	
0.6133	0.0131	0.0086	142.6232	26.1971	3.0174	484.1485	1824.3488	2011.4057	

Table C-35. Corehole #2 at 44/29 feet.

FULLER WARREN BRIDGE
SHEAR DEVICE TEST RESULTS

	Penetration	calculated)	0.02814966		Max. (0.0591)				
	Height H_2O		24	(ft)	Unit Wt H_2O	62.4	(lb/ft3)		
	Length Pipe		44	(ft)	Unit Wt Rod	2.96	(lb/ft)		
	Penetration Depth		0.0281	(in)	Cylinder Bore Area	4.72	(in2)		
	Stud Cap Area		0.1964	(in2)	Shear Stud Area	0.240701554			
	No. of Studs		42		Normal Stud Area	0.001653968			
	Weight of Instrum.		38		qu (psi)	884			
LVDT (in)	Pressure (volts)	Load (volts)	Est. Load (psi)	Est. Press. (psi)	Normal Force (lb)	Shear Force (lb)	Normal Stress (psi)	Shear Stress (psi)	
0.0021	0.0154	-0.0001	-2.1872	30.7627	3.9074	-221.4132	2362.4358	-919.8659	
-0.0069	0.0154	-0.0005	-8.9521	30.7382	3.9074	-253.8528	2362.4358	-1054.6370	
0.048	0.0154	0.0042	69.1753	30.7291	3.9074	127.3127	2362.4358	528.9235	
0.1089	0.0153	0.005	83.1121	30.5948	3.8687	192.1919	2339.0407	798.4657	
0.0952	0.0152	0.0046	76.1691	30.4086	3.8300	159.7523	2315.6456	663.6946	
0.1364	0.0153	0.0104	173.7521	30.5368	3.8687	630.1268	2339.0407	2617.8757	
0.1779	0.0152	0.0124	207.1444	30.4605	3.8300	792.3248	2315.6456	3291.7313	
0.1813	0.0152	0.0109	181.4071	30.4514	3.8300	670.6763	2315.6456	2786.3396	
0.1839	0.0152	0.0115	191.9869	30.4147	3.8300	719.3357	2315.6456	2988.4963	
0.2455	0.0151	0.0119	198.3703	30.2316	3.7913	751.7753	2292.2506	3123.2674	
0.2737	0.0152	0.0105	174.6167	30.4025	3.8300	638.2367	2315.6456	2651.5685	
0.2463	0.0151	0.009	150.4308	30.1889	3.7913	516.5881	2292.2506	2146.1769	
0.3012	0.0152	0.0117	194.5046	30.4209	3.8300	735.5555	2315.6456	3055.8819	
0.3478	0.0151	0.0102	169.9627	30.2469	3.7913	613.9070	2292.2506	2550.4902	
0.357	0.0152	0.0115	192.0632	30.3232	3.8300	719.3357	2315.6456	2988.4963	
0.36	0.0152	0.01	166.0207	30.3323	3.8300	597.6871	2315.6456	2483.1046	
0.3522	0.0151	0.0125	209.1535	30.2622	3.7913	800.4347	2292.2506	3325.4241	
0.4258	0.0152	0.0124	206.7375	30.3964	3.8300	792.3248	2315.6456	3291.7313	
0.434	0.0151	0.0119	197.6582	30.2561	3.7913	751.7753	2292.2506	3123.2674	
0.4269	0.0151	0.0106	176.4479	30.2316	3.7913	646.3466	2292.2506	2685.2613	
0.4267	0.0151	0.012	199.998	30.2927	3.7913	759.8852	2292.2506	3156.9602	
0.4563	0.0151	0.013	216.1728	30.2957	3.7913	840.9843	2292.2506	3493.8880	
0.5004	0.0151	0.0119	198.879	30.2927	3.7913	751.7753	2292.2506	3123.2674	
0.5102	0.0151	0.0118	196.1832	30.2896	3.7913	743.6654	2292.2506	3089.5746	
0.5134	0.0151	0.0109	181.4325	30.2988	3.7913	670.6763	2292.2506	2786.3396	
0.491	0.0151	0.0116	192.7753	30.1706	3.7913	727.4456	2292.2506	3022.1891	
0.5158	0.0152	0.0127	211.1118	30.3171	3.8300	816.6546	2315.6456	3392.8096	
0.5409	0.0152	0.0122	203.3041	30.311	3.8300	776.1050	2315.6456	3224.3457	
0.5437	0.0152	0.0113	188.2992	30.3171	3.8300	703.1159	2315.6456	2921.1107	
0.5469	0.0151	0.012	199.3113	30.2377	3.7913	759.8852	2292.2506	3156.9602	
0.5454	0.0151	0.0121	202.4649	30.2561	3.7913	767.9951	2292.2506	3190.6530	
0.5494	0.0152	0.0119	197.5311	30.3232	3.8300	751.7753	2315.6456	3123.2674	
0.5472	0.0151	0.012	200.1506	30.1859	3.7913	759.8852	2292.2506	3156.9602	
0.5514	0.0152	0.011	184.1538	30.311	3.8300	678.7862	2315.6456	2820.0324	
0.5472	0.0152	0.0117	194.5046	30.3079	3.8300	735.5555	2315.6456	3055.8819	
0.5517	0.0151	0.0122	203.3296	30.2927	3.7913	776.1050	2292.2506	3224.3457	
0.5593	0.0151	0.012	199.6165	30.2072	3.7913	759.8852	2292.2506	3156.9602	
0.5515	0.0151	0.0117	194.9624	30.2347	3.7913	735.5555	2292.2506	3055.8819	
0.5498	0.0151	0.0118	197.2767	30.2072	3.7913	743.6654	2292.2506	3089.5746	

Table C-36. Corehole #2 at 44/32 feet.

FULLER WARREN BRIDGE
SHEAR DEVICE TEST RESULTS

Penetration	(calculated) 0.032700025	Max. (0.0591)	
Height H_2O	24 (ft)	Unit Wt H_2O	62.4 (lb/ft3)
Length Pipe	44 (ft)	Unit Wt Rod	2.96 (lb/ft)
Penetration Depth	0.0281 (in)	Cylinder Bore Are	4.72 (in2)
Stud Cap Area	0.1964 (in2)	Shear Stud Area	0.240701554
No. of Studs	42	Normal Stud Area	0.001653968
Weight of Instrum.	38	qu (psi)	884

LVDT (in)	Pressure (volts)	Load (volts)	Est. Load (psi)	Est. Press. (psi)	Normal Force (lb)	Shear Force (lb)	Normal Stress (psi)	Shear Stress (psi)
-0.0009	0.017	-0.0001	-0.8901	33.964	4.5265	-221.4132	2736.7572	-919.8659
-0.0081	0.017	0	-0.5595	33.9854	4.5265	-213.3033	2736.7572	-886.1732
0.0382	0.0169	0.0039	64.1906	33.8511	4.4878	102.9830	2713.3621	427.8452
0.0992	0.0169	0.0052	86.3674	33.8633	4.4878	208.4118	2713.3621	865.8513
0.1125	0.0169	0.0052	85.8587	33.8481	4.4878	208.4118	2713.3621	865.8513
0.1186	0.0169	0.0072	120.777	33.8237	4.4878	370.6098	2713.3621	1539.7069
0.1458	0.0168	0.0143	239.0871	33.6741	4.4491	946.4130	2689.9670	3931.8941
0.1802	0.0168	0.0134	222.836	33.6467	4.4491	873.4239	2689.9670	3628.6591
0.1792	0.0168	0.014	232.8817	33.5032	4.4491	922.0833	2689.9670	3830.8158
0.1912	0.0168	0.0141	235.6283	33.5673	4.4491	930.1932	2689.9670	3864.5085
0.2371	0.0167	0.0127	211.5187	33.488	4.4104	816.6546	2666.5719	3392.8096
0.2257	0.0168	0.0131	218.4108	33.5124	4.4491	849.0942	2689.9670	3527.5807
0.239	0.0167	0.0147	245.1908	33.3567	4.4104	978.8526	2666.5719	4066.6652
0.2398	0.0167	0.0157	261.7217	33.314	4.4104	1059.9517	2666.5719	4403.5930
0.2516	0.0167	0.0158	262.9933	33.433	4.4104	1068.0616	2666.5719	4437.2858
0.2654	0.0167	0.0135	225.7861	33.3811	4.4104	881.5338	2666.5719	3662.3519
0.2693	0.0167	0.015	250.735	33.3048	4.4104	1003.1823	2666.5719	4167.7435
0.2527	0.0166	0.0148	246.9456	33.2865	4.3717	986.9625	2643.1768	4100.3580
0.2817	0.0167	0.014	232.9834	33.3262	4.4104	922.0833	2666.5719	3830.8158
0.3081	0.0166	0.0146	244.0464	33.2286	4.3717	970.7427	2643.1768	4032.9724
0.3151	0.0166	0.014	233.7718	33.2743	4.3717	922.0833	2643.1768	3830.8158
0.3223	0.0166	0.0133	222.3273	33.198	4.3717	865.3140	2643.1768	3594.9663
0.3109	0.0166	0.0146	242.7747	33.1797	4.3717	970.7427	2643.1768	4032.9724
0.3572	0.0166	0.0141	234.4076	33.2865	4.3717	930.1932	2643.1768	3864.5085
0.3658	0.0166	0.0142	236.2133	33.1614	4.3717	938.3031	2643.1768	3898.2013
0.3655	0.0166	0.0137	228.6599	33.2072	4.3717	897.7536	2643.1768	3729.7374
0.376	0.0166	0.0133	221.9459	33.2438	4.3717	865.3140	2643.1768	3594.9663
0.3724	0.0167	0.015	250.4552	33.3201	4.4104	1003.1823	2666.5719	4167.7435
0.4072	0.0166	0.0145	240.8928	33.1187	4.3717	962.6328	2643.1768	3999.2796
0.4185	0.0165	0.0145	241.1725	33.0882	4.3330	962.6328	2619.7818	3999.2796
0.4157	0.0166	0.0142	237.2814	33.2224	4.3717	938.3031	2643.1768	3898.2013
0.4104	0.0166	0.0147	244.5041	33.1187	4.3717	978.8526	2643.1768	4066.6652
0.4164	0.0167	0.0144	240.5113	33.3598	4.4104	954.5229	2666.5719	3965.5869
0.4213	0.0166	0.0133	222.3782	33.1095	4.3717	865.3140	2643.1768	3594.9663
0.4183	0.0167	0.0132	219.7841	33.3964	4.4104	857.2041	2666.5719	3561.2735
0.4263	0.0166	0.013	216.478	33.1553	4.3717	840.9843	2643.1768	3493.8880
0.424	0.0166	0.0133	221.539	33.1339	4.3717	865.3140	2643.1768	3594.9663
0.4086	0.0166	0.013	215.8676	33.1187	4.3717	840.9843	2643.1768	3493.8880
0.4156	0.0166	0.0135	225.6335	33.1767	4.3717	881.5338	2643.1768	3662.3519
0.4217	0.0166	0.0136	227.4646	33.1614	4.3717	889.6437	2643.1768	3696.0446
0.4088	0.0166	0.014	234.0515	33.1431	4.3717	922.0833	2643.1768	3830.8158
0.4336	0.0165	0.0137	228.3548	33.0973	4.3330	897.7536	2619.7818	3729.7374
0.4215	0.0166	0.0129	215.4607	33.1584	4.3717	832.8744	2643.1768	3460.1952
0.4282	0.0165	0.0141	234.611	33.0515	4.3330	930.1932	2619.7818	3864.5085
0.4164	0.0165	0.013	216.1219	33.0668	4.3330	840.9843	2619.7818	3493.8880

Table C-37. Corehole #2 at 44/36 feet.

FULLER WARREN BRIDGE
SHEAR DEVICE TEST RESULTS

Penetration	(calculated)	0.03895677	Max. (0.0591)		
Height H_2O	24	(ft)	Unit Wt H_2O	62.4	(lb/ft3)
Length Pipe	44	(ft)	Unit Wt Rod	2.96	(lb/ft)
Penetration Depth	0.0281	(in)	Cylinder Bore Area	4.72	(in2)
Stud Cap Area	0.1964	(in2)	Shear Stud Area	0.240701554	
No. of Studs	42		Normal Stud Area	0.001653968	
Weight of Instrum.	38		qu (psi)	884	

LVDT (in)	Pressure (volts)	Load (volts)	Est. Load (psi)	Est. Press. (psi)	NormalForce (lb)	Shear Force (lb)	NormalStress (psi)	Shear Stress (psi)
-0.0032	0.0191	-0.0001	-2.0346	38.1451	5.3391	-221.4132	3228.0540	-919.8659
-0.011	0.0191	0	-0.1017	38.1787	5.3391	-213.3033	3228.0540	-886.1732
0.0556	0.019	0.0102	170.039	38.0322	5.3004	613.9070	3204.6589	2550.4902
0.0679	0.019	0.012	200.7609	38.0291	5.3004	759.8852	3204.6589	3156.9602
0.0583	0.019	0.0121	201.9308	37.9406	5.3004	767.9951	3204.6589	3190.6530
0.0932	0.0189	0.018	299.9461	37.846	5.2617	1246.4795	3181.2638	5178.5269
0.1105	0.0189	0.0189	314.1881	37.7514	5.2617	1319.4686	3181.2638	5481.7619
0.1082	0.019	0.0184	307.3468	38.0749	5.3004	1278.9191	3204.6589	5313.2980
0.1044	0.019	0.0204	339.8236	37.9284	5.3004	1441.1172	3204.6589	5987.1535
0.1145	0.0188	0.0201	335.5256	37.6873	5.2230	1416.7874	3157.8687	5886.0752
0.1406	0.0189	0.0194	322.6824	37.7392	5.2617	1360.0181	3181.2638	5650.2258
0.113	0.0189	0.0183	305.3886	37.7392	5.2617	1270.8092	3181.2638	5279.6052
0.1381	0.0189	0.0202	337.4839	37.8246	5.2617	1424.8974	3181.2638	5919.7680
0.1425	0.0189	0.0211	351.7767	37.7789	5.2617	1497.8865	3181.2638	6223.0030
0.1607	0.0189	0.02	333.491	37.7483	5.2617	1408.6775	3181.2638	5852.3824
0.1518	0.0189	0.0193	321.7668	37.7636	5.2617	1351.9082	3181.2638	5616.5330
0.158	0.0189	0.0196	326.014	37.8246	5.2617	1376.2379	3181.2638	5717.6113
0.155	0.0189	0.019	317.0619	37.8552	5.2617	1327.5785	3181.2638	5515.4546
0.165	0.0189	0.0205	341.0444	37.8979	5.2617	1449.2271	3181.2638	6020.8463
0.1839	0.0189	0.0188	313.1453	37.7331	5.2617	1311.3587	3181.2638	5448.0691
0.1868	0.019	0.0176	294.1221	37.907	5.3004	1214.0398	3204.6589	5043.7558
0.2002	0.0188	0.0189	315.6886	37.6751	5.2230	1319.4686	3157.8687	5481.7619
0.1946	0.0189	0.0175	291.4518	37.785	5.2617	1205.9299	3181.2638	5010.0630
0.1824	0.0189	0.0187	312.4332	37.7178	5.2617	1303.2488	3181.2638	5414.3763
0.207	0.0189	0.018	300.353	37.7026	5.2617	1246.4795	3181.2638	5178.5269
0.2149	0.0188	0.0191	318.5624	37.6812	5.2230	1335.6884	3157.8687	5549.1474
0.2142	0.0189	0.0175	291.7061	37.7514	5.2617	1205.9299	3181.2638	5010.0630
0.2075	0.0188	0.0178	296.3093	37.6293	5.2230	1230.2597	3157.8687	5111.1413
0.2208	0.0189	0.0172	286.2382	37.727	5.2617	1181.6002	3181.2638	4908.9846
0.2303	0.0189	0.0205	342.0871	37.7483	5.2617	1449.2271	3181.2638	6020.8463
0.2447	0.0189	0.0198	330.1086	37.7697	5.2617	1392.4577	3181.2638	5784.9969
0.2383	0.0189	0.0185	308.771	37.7483	5.2617	1287.0290	3181.2638	5346.9908
0.2357	0.0189	0.0172	286.5179	37.843	5.2617	1181.6002	3181.2638	4908.9846
0.2514	0.0188	0.0193	321.3599	37.6598	5.2230	1351.9082	3157.8687	5616.5330
0.2354	0.0188	0.0177	295.6735	37.5317	5.2230	1222.1498	3157.8687	5077.4485
0.2434	0.0189	0.0193	321.5888	37.8399	5.2617	1351.9082	3181.2638	5616.5330
0.2385	0.0188	0.0179	298.3439	37.6995	5.2230	1238.3696	3157.8687	5144.8341
0.2533	0.0189	0.0195	325.3782	37.8002	5.2617	1368.1280	3181.2638	5683.9185
0.2456	0.0189	0.0195	325.1747	37.7514	5.2617	1368.1280	3181.2638	5683.9185
0.242	0.0189	0.019	317.0365	37.7087	5.2617	1327.5785	3181.2638	5515.4546
0.2472	0.0189	0.0179	298.1913	37.8918	5.2617	1238.3696	3181.2638	5144.8341
0.2445	0.0188	0.018	299.8444	37.6263	5.2230	1246.4795	3157.8687	5178.5269
0.2433	0.0188	0.0178	295.8515	37.6141	5.2230	1230.2597	3157.8687	5111.1413
0.246	0.0189	0.0167	278.7866	37.7026	5.2617	1141.0507	3181.2638	4740.5208

Table C-38. Corehole #2 at 45/30 feet.

FULLER WARREN BRIDGE

SHEAR DEVICE TEST RESULTS

		Penetration	(calculated)	0.01971815	Max. (0.0591)			
		Height H_2O	24	(ft)	Unit Wt H_2O	62.4	(lb/ft3)	
		Length Pipe	45	(ft)	Unit Wt Rod	2.96	(lb/ft)	
		Penetration Depth	0.0241	(in)	Cylinder Bore Area	4.72	(in2)	
		Stud Cap Area	0.1964	(in2)	Shear Stud Area	0.177051797		
		No. of Studs	42		Normal Stud Area	0.001216602		
		Weight of Instrum.	38		qu (psi)	1287.5		
LVDT (in)	Pressure (volts)	Load (volts)	Est. Load (psi)	Est. Press. (psi)	Normal Force (lb)	Shear Force (lb)	Normal Stress (psi)	Shear Stress (psi)
-0.0045	0.0157	0.0001	2.4415	31.3791	4.0235	-208.1534	3307.1433	-1175.6636
-0.0138	0.0157	0.0001	1.3988	31.3547	4.0235	-208.1534	3307.1433	-1175.6636
-0.0029	0.0156	0.0002	3.7385	31.2571	3.9848	-200.0434	3275.3378	-1129.8583
0.0601	0.0154	0.0086	142.9029	30.8023	3.9074	481.1885	3211.7266	2717.7837
0.0777	0.0153	0.0068	114.0375	30.5429	3.8687	335.2102	3179.9210	1893.2890
0.088	0.0154	0.0071	117.8014	30.7749	3.9074	359.5399	3211.7266	2030.7048
0.0948	0.0154	0.0093	155.4664	30.8512	3.9074	537.9578	3211.7266	3038.4205
0.1604	0.0154	0.0096	160.0442	30.7688	3.9074	562.2875	3211.7266	3175.8363
0.1625	0.0154	0.0096	159.5355	30.7047	3.9074	562.2875	3211.7266	3175.8363
0.1726	0.0154	0.0094	156.8143	30.8145	3.9074	546.0677	3211.7266	3084.2258
0.1754	0.0155	0.0094	156.4582	30.9122	3.9461	546.0677	3243.5322	3084.2258
0.1696	0.0155	0.0103	172.2007	30.9671	3.9461	619.0569	3243.5322	3496.4732
0.1994	0.0154	0.0115	190.8933	30.8878	3.9074	716.3757	3211.7266	4046.1363
0.2311	0.0154	0.0103	171.7429	30.8512	3.9074	619.0569	3211.7266	3496.4732
0.2351	0.0155	0.0102	170.2933	31.0068	3.9461	610.9470	3243.5322	3450.6679
0.2244	0.0155	0.0105	174.8965	31.0984	3.9461	635.2767	3243.5322	3588.0837
0.2204	0.0156	0.0102	170.0898	31.1136	3.9848	610.9470	3275.3378	3450.6679
0.2497	0.0155	0.012	199.8454	31.016	3.9461	756.9252	3243.5322	4275.1626
0.2652	0.0156	0.0128	214.1382	31.1655	3.9848	821.8045	3275.3378	4641.6047
0.281	0.0156	0.0121	201.8291	31.1594	3.9848	765.0351	3275.3378	4320.9679
0.2858	0.0156	0.0114	190.6898	31.1899	3.9848	708.2658	3275.3378	4000.3310
0.2785	0.0157	0.0105	175.7358	31.3517	4.0235	635.2767	3307.1433	3588.0837
0.2819	0.0156	0.0113	188.757	31.1045	3.9848	700.1559	3275.3378	3954.5258
0.3099	0.0155	0.0145	241.2488	30.9702	3.9461	959.6728	3243.5322	5420.2942
0.3109	0.0156	0.0141	235.374	31.1655	3.9848	927.2332	3275.3378	5237.0731
0.2844	0.0156	0.0132	219.4281	31.1014	3.9848	854.2441	3275.3378	4824.8258
0.3206	0.0156	0.0145	242.3678	31.1167	3.9848	959.6728	3275.3378	5420.2942
0.3213	0.0156	0.0133	221.3864	31.2601	3.9848	862.3540	3275.3378	4870.6310
0.3156	0.0156	0.0129	214.8757	31.1319	3.9848	829.9144	3275.3378	4687.4100
0.33	0.0156	0.0158	262.6881	31.2052	3.9848	1065.1016	3275.3378	6015.7626
0.364	0.0156	0.0154	256.3046	31.1808	3.9848	1032.6620	3275.3378	5832.5415
0.3483	0.0156	0.0138	229.5501	31.1319	3.9848	902.9035	3275.3378	5099.6573
0.3537	0.0156	0.0131	218.5125	31.138	3.9848	846.1342	3275.3378	4779.0205
0.3528	0.0156	0.0141	234.8908	31.2021	3.9848	927.2332	3275.3378	5237.0731
0.3567	0.0156	0.0134	223.3701	31.254	3.9848	870.4639	3275.3378	4916.4363
0.3661	0.0156	0.0143	238.6039	31.1991	3.9848	943.4530	3275.3378	5328.6836
0.3487	0.0156	0.0125	209.0772	31.1869	3.9848	797.4747	3275.3378	4504.1889
0.3486	0.0156	0.0139	231.4066	31.254	3.9848	911.0134	3275.3378	5145.4626
0.3457	0.0156	0.0135	224.7434	31.2784	3.9848	878.5738	3275.3378	4962.2415
0.3558	0.0156	0.0144	239.1888	31.193	3.9848	951.5629	3275.3378	5374.4889
0.3502	0.0156	0.0129	215.4352	31.1899	3.9848	829.9144	3275.3378	4687.4100
0.3446	0.0156	0.0135	224.4636	31.2449	3.9848	878.5738	3275.3378	4962.2415
0.3629	0.0156	0.013	217.4444	31.2326	3.9848	838.0243	3275.3378	4733.2152

Table C-39. Corehole #2 at 45/33 feet.

FULLER WARREN BRIDGE
SHEAR DEVICE TEST RESULTS

Penetration	(calculated)	0.024130875	Max. (0.0591)	
Height H_2O	21 (ft)	Unit Wt H_2O	62.4	(lb/ft3)
Length Pipe	45 (ft)	Unit Wt Rod	2.96	(lb/ft)
Penetration Depth	0.0241 (in)	Cylinder Bore /	4.72	(in2)
Stud Cap Area	0.1964 (in2)	ıear Stud Area	0.177051797	
No. of Studs	42	Normal Stud Area	0.001216602	
Weight of Instrum.	38	qu (psi)	1287.5	

LVDT (in)	Pressure (volts)	Load (volts)	Est. Load (psi)	Est. Press. (psi)	Normal Force (lb)	Shear Force (lb)	Normal Stress (psi)	Shear Stress (psi)
-0.0003	0.0173	0.0001	2.1872	34.6538	4.8979	-208.1534	4025.8956	-1175.6636
0.0061	0.0173	0	0.1017	34.5683	4.8979	-216.2633	4025.8956	-1221.4689
-0.0016	0.0173	0.0001	0.941	34.5927	4.8979	-208.1534	4025.8956	-1175.6636
0.0327	0.0173	0.0092	153.6353	34.5592	4.8979	529.8479	4025.8956	2992.6153
0.0718	0.017	0.0097	161.5955	34.0831	4.7818	570.3974	3930.4789	3221.6416
0.0685	0.0171	0.0102	169.9118	34.1227	4.8205	610.9470	3962.2845	3450.6679
0.0644	0.0171	0.009	149.3118	34.1533	4.8205	513.6281	3962.2845	2901.0047
0.0951	0.017	0.0122	203.355	33.9366	4.7818	773.1450	3930.4789	4366.7731
0.11	0.017	0.0124	205.9999	34.0861	4.7818	789.3648	3930.4789	4458.3837
0.1236	0.0169	0.0122	203.8128	33.8511	4.7431	773.1450	3898.6734	4366.7731
0.1188	0.0171	0.0111	185.756	34.2112	4.8205	683.9361	3962.2845	3862.9153
0.1215	0.017	0.0122	203.4822	34.0587	4.7818	773.1450	3930.4789	4366.7731
0.1561	0.017	0.0138	230.491	34.0007	4.7818	902.9035	3930.4789	5099.6573
0.1673	0.0171	0.0126	210.0691	34.2357	4.8205	805.5846	3962.2845	4549.9942
0.1733	0.017	0.0132	219.3518	34.0098	4.7818	854.2441	3930.4789	4824.8258
0.1706	0.0171	0.0131	217.5461	34.135	4.8205	846.1342	3962.2845	4779.0205
0.1616	0.017	0.0136	227.1594	34.0617	4.7818	886.6837	3930.4789	5008.0468
0.2053	0.017	0.0163	271.6656	34.077	4.7818	1105.6511	3930.4789	6244.7889
0.2029	0.0171	0.0142	237.1797	34.2021	4.8205	935.3431	3962.2845	5282.8784
0.2063	0.017	0.0136	225.8878	34.077	4.7818	886.6837	3930.4789	5008.0468
0.2017	0.0171	0.0131	218.1819	34.1288	4.8205	846.1342	3962.2845	4779.0205
0.2203	0.0171	0.0132	220.2673	34.1685	4.8205	854.2441	3962.2845	4824.8258
0.2459	0.017	0.017	283.3389	34.0831	4.7818	1162.4204	3930.4789	6565.4257
0.2582	0.0171	0.0156	259.5091	34.1227	4.8205	1048.8818	3962.2845	5924.1521
0.2544	0.017	0.0155	257.7797	34.0709	4.7818	1040.7719	3930.4789	5878.3468
0.2445	0.0171	0.0159	265.5619	34.1166	4.8205	1073.2115	3962.2845	6061.5678
0.2493	0.0171	0.0146	243.2834	34.1838	4.8205	967.7827	3962.2845	5466.0994
0.2697	0.0171	0.0169	281.4315	34.1441	4.8205	1154.3105	3962.2845	6519.6205
0.2666	0.0171	0.016	265.9942	34.254	4.8205	1081.3214	3962.2845	6107.3731
0.2779	0.0171	0.0146	243.9192	34.1502	4.8205	967.7827	3962.2845	5466.0994
0.2813	0.017	0.0145	240.9436	34.0526	4.7818	959.6728	3930.4789	5420.2942
0.2776	0.0171	0.0151	251.8286	34.1746	4.8205	1008.3322	3962.2845	5695.1257
0.2862	0.0172	0.0168	279.9819	34.3608	4.8592	1146.2006	3994.0901	6473.8152
0.3019	0.0171	0.0179	298.9034	34.2082	4.8205	1235.4096	3962.2845	6977.6731
0.3155	0.017	0.0147	244.3007	34.0403	4.7818	975.8926	3930.4789	5511.9047
0.3094	0.0171	0.0144	240.3078	34.1136	4.8205	951.5629	3962.2845	5374.4889
0.3156	0.0171	0.0134	223.7261	34.1624	4.8205	870.4639	3962.2845	4916.4363
0.3117	0.017	0.0151	252.2355	34.0526	4.7818	1008.3322	3930.4789	5695.1257
0.3085	0.0171	0.0147	244.6567	34.1044	4.8205	975.8926	3962.2845	5511.9047
0.3171	0.017	0.014	232.8308	34.077	4.7818	919.1233	3930.4789	5191.2679
0.302	0.0171	0.0152	253.6088	34.1411	4.8205	1016.4422	3962.2845	5740.9310
0.3052	0.017	0.0154	257.4999	34.019	4.7818	1032.6620	3930.4789	5832.5415
0.3111	0.0171	0.0141	235.1451	34.1563	4.8205	927.2332	3962.2845	5237.0731
0.3247	0.0171	0.0145	241.7829	34.2051	4.8205	959.6728	3962.2845	5420.2942
0.3013	0.017	0.0145	242.3678	34.0678	4.7818	959.6728	3930.4789	5420.2942
0.3053	0.0171	0.0147	244.2752	34.1563	4.8205	975.8926	3962.2845	5511.9047
0.3053	0.0172	0.015	250.2009	34.3028	4.8592	1000.2223	3994.0901	5649.3205

Table C-40. Corehole #2 at 45/36 feet.

FULLER WARREN BRIDGE

SHEAR DEVICE TEST RESULTS

Penetration	(calculated)	0.02616199	Max. (0.0591)		
Height H_2O	24	(ft)	Unit Wt H_2O	62.4	(lb/ft3)
Length Pipe	45	(ft)	Unit Wt Rod	2.96	(lb/ft)
Penetration Depth	0.0241	(in)	Cylinder Bore Area	4.72	(in2)
Stud Cap Area	0.1964	(in2)	Shear Stud Area	0.177051797	
No. of Studs	42		Normal Stud Area	0.001216602	
Weight of Instrum.	38		qu (psi)	1287.5	

LVDT (in)	Pressure (volts)	Load (volts)	Est. Load (psi)	Est. Press. (psi)	Normal Force (lb)	Shear Force (lb)	Normal Stress (psi)	Shear Stress (psi)
-0.0109	0.019	-0.0001	-1.704	38.02	5.3004	-224.3732	4356.7272	-1267.2741
-0.0063	0.019	0	-0.2035	38.0963	5.3004	-216.2633	4356.7272	-1221.4689
0.0072	0.0191	0.0071	117.6234	38.2336	5.3391	359.5399	4388.5327	2030.7048
0.0762	0.0188	0.0112	187.4345	37.6354	5.2230	692.0460	4293.1160	3908.7205
0.0549	0.0188	0.0113	189.113	37.611	5.2230	700.1559	4293.1160	3954.5258
0.0601	0.0188	0.0106	177.4651	37.6415	5.2230	643.3866	4293.1160	3633.8889
0.0769	0.0188	0.0131	218.0548	37.6141	5.2230	846.1342	4293.1160	4779.0205
0.0987	0.0187	0.0158	263.6291	37.3791	5.1843	1065.1016	4261.3105	6015.7626
0.0968	0.0187	0.0129	215.1555	37.3058	5.1843	829.9144	4261.3105	4687.4100
0.1031	0.0186	0.0127	211.1118	37.2875	5.1456	813.6946	4229.5049	4595.7994
0.0956	0.0187	0.0135	225.6844	37.3058	5.1843	878.5738	4261.3105	4962.2415
0.1298	0.0187	0.0155	258.9496	37.3394	5.1843	1040.7719	4261.3105	5878.3468
0.1316	0.0186	0.0149	247.912	37.1288	5.1456	992.1124	4229.5049	5603.5152
0.1418	0.0186	0.0155	258.1103	37.1807	5.1456	1040.7719	4229.5049	5878.3468
0.1403	0.0187	0.0142	236.4676	37.4279	5.1843	935.3431	4261.3105	5282.8784
0.1648	0.0186	0.0143	239.1634	37.2784	5.1456	943.4530	4229.5049	5328.6836
0.1816	0.0186	0.0112	187.053	37.1593	5.1456	692.0460	4229.5049	3908.7205
0.1948	0.0186	0.0113	187.994	37.2204	5.1456	700.1559	4229.5049	3954.5258
0.1881	0.0186	0.0107	178.2535	37.2448	5.1456	651.4965	4229.5049	3679.6942
0.1843	0.0186	0.0127	211.7222	37.1319	5.1456	813.6946	4229.5049	4595.7994
0.2378	0.0186	0.0133	221.7933	37.1807	5.1456	862.3540	4229.5049	4870.6310
0.2478	0.0185	0.0117	194.5555	37.0037	5.1069	732.5955	4197.6993	4137.7468
0.2454	0.0186	0.0117	195.6745	37.138	5.1456	732.5955	4229.5049	4137.7468
0.2537	0.0186	0.0122	203.6856	37.1746	5.1456	773.1450	4229.5049	4366.7731
0.2437	0.0187	0.0121	201.9054	37.3363	5.1843	765.0351	4261.3105	4320.9679
0.2476	0.0186	0.0129	215.4607	37.1868	5.1456	829.9144	4229.5049	4687.4100
0.2773	0.0186	0.0141	235.6538	37.199	5.1456	927.2332	4229.5049	5237.0731
0.3043	0.0185	0.0132	220.3436	37.0373	5.1069	854.2441	4197.6993	4824.8258
0.2936	0.0186	0.011	183.0093	37.2448	5.1456	675.8262	4229.5049	3817.1100
0.2952	0.0185	0.0123	205.0844	37.0312	5.1069	781.2549	4197.6993	4412.5784
0.305	0.0186	0.0114	189.3928	37.1105	5.1456	708.2658	4229.5049	4000.3310
0.3083	0.0185	0.0146	244.1481	37.0434	5.1069	967.7827	4197.6993	5466.0994
0.3393	0.0185	0.0152	253.3036	36.9915	5.1069	1016.4422	4197.6993	5740.9310
0.3383	0.0185	0.0143	237.5357	37.0861	5.1069	943.4530	4197.6993	5328.6836
0.3471	0.0186	0.0138	230.2622	37.1258	5.1456	902.9035	4229.5049	5099.6573
0.3413	0.0186	0.0139	231.6609	37.2845	5.1456	911.0134	4229.5049	5145.4626
0.3637	0.0186	0.0148	247.4543	37.1075	5.1456	984.0025	4229.5049	5557.7100
0.368	0.0185	0.0142	236.671	36.9671	5.1069	935.3431	4197.6993	5282.8784
0.3793	0.0185	0.0129	215.6387	37.0434	5.1069	829.9144	4197.6993	4687.4100
0.385	0.0186	0.013	216.3762	37.1136	5.1456	838.0243	4229.5049	4733.2152
0.3793	0.0185	0.0143	239.0617	36.9793	5.1069	943.4530	4197.6993	5328.6836
0.3654	0.0185	0.0131	218.3345	37.0373	5.1069	846.1342	4197.6993	4779.0205
0.382	0.0185	0.0143	237.8409	37.0891	5.1069	943.4530	4197.6993	5328.6836
0.3668	0.0186	0.0143	238.8582	37.1166	5.1456	943.4530	4229.5049	5328.6836
0.3807	0.0186	0.0136	226.7017	37.1136	5.1456	886.6837	4229.5049	5008.0468
0.3831	0.0185	0.0143	237.6375	37.0525	5.1069	943.4530	4197.6993	5328.6836
0.3686	0.0187	0.0135	225.7352	37.3119	5.1843	878.5738	4261.3105	4962.2415

Table C-41. Corehole #2 at 50/25 feet.

FULLER WARREN BRIDGE
SHEAR DEVICE TEST RESULTS

Penetration	(calculated) 0.024171171		Max. (0.0591)	
Height H_2O	29 (ft)		Unit Wt H_2O	62.4 (lb/ft3)
Length Pipe	50 (ft)		Unit Wt Rod	2.96 (lb/ft)
Penetration Depth	0.0293 (in)		Cylinder Bore Area	4.72 (in2)
Stud Cap Area	0.1964 (in2)		Shear Stud Area	0.261698658
No. of Studs	42		Normal Stud Area	0.001798249
Weight of Instrum.	38		qu (psi)	727.9

LVDT (in)	Pressure (volts)	Load (volts)	Est. Load (psi)	Est. Press. (psi)	Normal Force (lb)	Shear Force (lb)	Normal Stress (psi)	Shear Stress (psi)
-0.0113	0.0137	0.001	16.4037	27.3324	2.8241	-149.9642	1570.4446	-573.0416
0.0047	0.0137	0.0009	14.8778	27.308	2.8241	-158.0741	1570.4446	-604.0311
0.0113	0.0137	0.0014	25.0467	27.3415	2.8241	-117.5246	1570.4446	-449.0837
0.0676	0.0134	0.0049	82.1965	26.7953	2.7080	166.3220	1505.8906	635.5479
0.115	0.0133	0.0035	58.8499	26.6152	2.6693	52.7834	1484.3726	201.6953
0.1191	0.0133	0.0034	55.9252	26.6549	2.6693	44.6735	1484.3726	170.7058
0.1289	0.0134	0.0035	59.155	26.7464	2.7080	52.7834	1505.8906	201.6953
0.115	0.0134	0.0037	62.2106	26.8288	2.7080	69.0032	1505.8906	263.6742
0.1872	0.0134	0.0047	78.3054	26.7067	2.7080	150.1022	1505.8906	573.5690
0.2404	0.0133	0.0047	78.8395	26.5358	2.6693	150.1022	1484.3726	573.5690
0.2531	0.0134	0.0039	65.4368	26.8288	2.7080	85.2230	1505.8906	325.6532
0.2531	0.0133	0.0041	68.9718	26.5328	2.6693	101.4428	1484.3726	387.6321
0.2523	0.0133	0.0041	68.6158	26.6366	2.6693	101.4428	1484.3726	387.6321
0.2636	0.0133	0.0052	86.5708	26.6549	2.6693	190.6518	1484.3726	728.5164
0.3249	0.0133	0.0056	93.1069	26.5816	2.6693	223.0914	1484.3726	852.4743
0.3814	0.0133	0.0045	75.0755	26.5084	2.6693	133.8824	1484.3726	511.5900
0.3689	0.0134	0.0047	77.7968	26.7129	2.7080	150.1022	1505.8906	573.5690
0.3753	0.0133	0.0046	76.576	26.5847	2.6693	141.9923	1484.3726	542.5795
0.3864	0.0133	0.0047	79.0429	26.5694	2.6693	150.1022	1484.3726	573.5690
0.3803	0.0133	0.0051	84.638	26.6671	2.6693	182.5418	1484.3726	697.5269
0.4141	0.0134	0.0052	86.3928	26.8197	2.7080	190.6518	1505.8906	728.5164
0.4805	0.0133	0.006	99.3378	26.5236	2.6693	255.5310	1484.3726	976.4322
0.5066	0.0133	0.0057	95.5229	26.606	2.6693	231.2013	1484.3726	883.4637
0.5031	0.0133	0.0051	84.7397	26.6366	2.6693	182.5418	1484.3726	697.5269
0.5085	0.0133	0.0051	84.8923	26.6121	2.6693	182.5418	1484.3726	697.5269
0.5021	0.0134	0.0046	77.0847	26.7434	2.7080	141.9923	1505.8906	542.5795
0.511	0.0134	0.0055	91.7844	26.7098	2.7080	214.9815	1505.8906	821.4848
0.5534	0.0133	0.0063	105.238	26.7006	2.6693	279.8607	1484.3726	1069.4006
0.6092	0.0134	0.0067	111.2908	26.7129	2.7080	312.3003	1505.8906	1193.3585
0.6452	0.0134	0.006	100.177	26.7373	2.7080	255.5310	1505.8906	976.4322
0.6481	0.0134	0.0061	102.2116	26.722	2.7080	263.6409	1505.8906	1007.4216
0.6159	0.0134	0.0051	84.3074	26.7312	2.7080	182.5418	1505.8906	697.5269
0.6435	0.0134	0.0057	94.2768	26.8258	2.7080	231.2013	1505.8906	883.4637
0.6299	0.0133	0.0056	93.9207	26.6243	2.6693	223.0914	1484.3726	852.4743
0.6018	0.0134	0.0063	104.7294	26.8929	2.7080	279.8607	1505.8906	1069.4006
0.6918	0.0134	0.0068	113.5289	26.7312	2.7080	320.4102	1505.8906	1224.3480
0.7353	0.0134	0.0061	102.4659	26.841	2.7080	263.6409	1505.8906	1007.4216
0.6501	0.0134	0.006	99.6175	26.8105	2.7080	255.5310	1505.8906	976.4322
0.7302	0.0134	0.0059	97.8881	26.8288	2.7080	247.4211	1505.8906	945.4427
0.6311	0.0134	0.006	99.4395	26.8227	2.7080	255.5310	1505.8906	976.4322
0.7229	0.0134	0.0065	108.9511	26.783	2.7080	296.0805	1505.8906	1131.3795
0.6863	0.0135	0.0057	95.294	26.9265	2.7467	231.2013	1527.4086	883.4637
0.7381	0.0134	0.0056	93.0306	26.8441	2.7080	223.0914	1505.8906	852.4743
0.6356	0.0134	0.0058	97.0489	26.8777	2.7080	239.3112	1505.8906	914.4532
0.7389	0.0134	0.0056	93.7427	26.8868	2.7080	223.0914	1505.8906	852.4743
0.633	0.0135	0.0057	94.938	26.9295	2.7467	231.2013	1527.4086	883.4637
0.7131	0.0134	0.0053	87.6136	26.8929	2.7080	198.7617	1505.8906	759.5058

Table C-42. Corehole #2 at 50/29 feet.

FULLER WARREN BRIDGE
SHEAR DEVICE TEST RESULTS

Penetration (calculated)	0.02935198		Max. (0.0591)		
Height H_2O	29	(ft)	Unit Wt H_2O	62.4	(lb/ft3)
Length Pipe	50	(ft)	Unit Wt Rod	2.96	(lb/ft)
Penetration	0.0293	(in)	Cylinder Bore Area	4.72	(in2)
Stud Cap Ar	0.1964	(in2)	Shear Stud Area	0.261698658	
No. of Studs	42		Normal Stud Area	0.001798249	
Weight of Instrum.	38		qu (psi)	727.9	

LVDT (in)	Pressure (volts)	Load (volts)	Est. Load (psi)	Est. Press. (psi)	Normal Force (lb)	Shear Force (lb)	Normal Stress (psi)	Shear Stress (psi)
0.2792	0.0157	0.0012	20.0471	31.3395	3.5979	-133.7444	2000.8048	-511.0626
0.2744	0.0156	0.0002	4.0691	31.1716	3.5592	-214.8434	1979.2867	-820.9574
0.2737	0.0156	0.0002	3.3316	31.251	3.5592	-214.8434	1979.2867	-820.9574
0.2887	0.0157	0.0039	64.8518	31.3028	3.5979	85.2230	2000.8048	325.6532
0.3897	0.0153	0.0036	59.562	30.6436	3.4432	60.8933	1914.7327	232.6848
0.3869	0.0154	0.003	50.6353	30.839	3.4819	12.2339	1936.2507	46.7479
0.3926	0.0154	0.0029	49.5747	30.8145	3.4819	4.1240	1936.2507	15.7584
0.4017	0.0155	0.0042	70.4469	30.9336	3.5206	109.5527	1957.7687	418.6216
0.5212	0.0149	0.0049	81.8405	29.7708	3.2884	166.3220	1828.6607	635.5479
0.5156	0.0149	0.0045	74.7195	29.8929	3.2884	133.8824	1828.6607	511.5900
0.5337	0.015	0.0041	68.4886	29.9966	3.3271	101.4428	1850.1787	387.6321
0.5271	0.0151	0.0047	78.6869	30.195	3.3658	150.1022	1871.6967	573.5690
0.6051	0.015	0.0068	113.9358	29.96	3.3271	320.4102	1850.1787	1224.3480
0.6474	0.015	0.0055	91.2758	29.9448	3.3271	214.9815	1850.1787	821.4848
0.6522	0.015	0.0044	74.0328	30.0546	3.3271	125.7725	1850.1787	480.6006
0.6401	0.0151	0.0048	80.1874	30.1279	3.3658	158.2121	1871.6967	604.5585
0.6714	0.0151	0.0062	102.8474	30.2011	3.3658	271.7508	1871.6967	1038.4111
0.7218	0.015	0.0067	111.0874	30.0394	3.3271	312.3003	1850.1787	1193.3585
0.7701	0.015	0.0062	103.3815	30.0668	3.3271	271.7508	1850.1787	1038.4111
0.7663	0.0151	0.0065	109.0528	30.1553	3.3658	296.0805	1871.6967	1131.3795
0.772	0.0151	0.0059	98.2696	30.2713	3.3658	247.4211	1871.6967	945.4427
0.7726	0.0151	0.0062	104.0427	30.2988	3.3658	271.7508	1871.6967	1038.4111
0.7822	0.0151	0.0065	109.1037	30.2072	3.3658	296.0805	1871.6967	1131.3795
0.845	0.0151	0.0073	121.5908	30.134	3.3658	360.9597	1871.6967	1379.2953
0.885	0.0151	0.0065	108.9511	30.1309	3.3658	296.0805	1871.6967	1131.3795
0.8885	0.0151	0.0058	96.7182	30.1553	3.3658	239.3112	1871.6967	914.4532
0.8859	0.0152	0.0061	101.9318	30.3262	3.4045	263.6409	1893.2147	1007.4216
0.898	0.0152	0.006	100.5331	30.4361	3.4045	255.5310	1893.2147	976.4322
0.9138	0.0151	0.0068	113.1474	30.2194	3.3658	320.4102	1871.6967	1224.3480
0.9594	0.015	0.007	117.1148	30.0974	3.3271	336.6300	1850.1787	1286.3269
0.979	0.0151	0.0072	119.8869	30.2927	3.3658	352.8498	1871.6967	1348.3059
1.0157	0.0152	0.0065	107.654	30.314	3.4045	296.0805	1893.2147	1131.3795
0.925	0.0152	0.0069	115.1311	30.314	3.4045	328.5201	1893.2147	1255.3374
0.9331	0.0151	0.0069	114.9531	30.2835	3.3658	328.5201	1871.6967	1255.3374
0.9985	0.0152	0.0062	103.3306	30.4636	3.4045	271.7508	1893.2147	1038.4111
0.9441	0.0152	0.0073	121.3111	30.3629	3.4045	360.9597	1893.2147	1379.2953
0.9877	0.0151	0.0072	119.3528	30.192	3.3658	352.8498	1871.6967	1348.3059
0.9751	0.0152	0.0064	107.4252	30.4117	3.4045	287.9706	1893.2147	1100.3901
0.9318	0.0151	0.006	100.6348	30.1981	3.3658	255.5310	1871.6967	976.4322
0.9667	0.0152	0.0067	111.1128	30.4514	3.4045	312.3003	1893.2147	1193.3585
1.0064	0.0152	0.0062	102.9491	30.4056	3.4045	271.7508	1893.2147	1038.4111
0.938	0.0152	0.0062	103.8138	30.4056	3.4045	271.7508	1893.2147	1038.4111
0.9829	0.0153	0.006	100.5331	30.5307	3.4432	255.5310	1914.7327	976.4322
0.9695	0.0152	0.0059	98.0916	30.4422	3.4045	247.4211	1893.2147	945.4427
0.9284	0.0152	0.0065	108.2644	30.4636	3.4045	296.0805	1893.2147	1131.3795
1.013	0.0153	0.0058	97.0997	30.5277	3.4432	239.3112	1914.7327	914.4532
0.9059	0.0153	0.0061	101.3469	30.6131	3.4432	263.6409	1914.7327	1007.4216

Table C-43. Corehole #2 at 50/35 feet.

FULLER WARREN BRIDGE
SHEAR DEVICE TEST RESULTS

Penetration	(calculated) 0.040058985	Max. (0.0591)	
Height H_2O	29	Unit Wt H_2O	62.4 (lb/ft3)
Length Pipe	50 (ft)	Unit Wt Rod	2.96 (lb/ft)
Penetration Depth	0.0293 (in)	Cylinder Bore Area	4.72 (in2)
Stud Cap Area	0.1964 (in2)	Shear Stud Area	0.261698658
No. of Studs	42	Normal Stud Area	0.001798249
Weight of Instrum.	38	qu (psi)	727.9

LVDT (in)	Pressure (volts)	Load (volts)	Est. Load (psi)	Est. Press. (psi)	NormalForce (lb)	Shear Force (lb)	Normal Stress (psi)	Shear Stress (psi)
0.2718	0.0182	0.0003	4.3065	36.4635	4.5653	-206.7335	2538.7549	-789.9679
0.2701	0.0183	0.0004	6.1037	36.5307	4.6040	-198.6236	2560.2729	-758.9784
0.2728	0.0183	0.0001	1.3733	36.5154	4.6040	-222.9534	2560.2729	-851.9469
0.3078	0.0182	0.0069	114.5232	36.3292	4.5653	328.5201	2538.7549	1255.3374
0.3491	0.018	0.0075	127.1427	35.963	4.4879	377.1795	2495.7189	1441.2743
0.3699	0.0181	0.0072	122.8582	36.2163	4.5266	352.8498	2517.2369	1348.3059
0.3638	0.018	0.007	116.5553	36.0881	4.4879	336.6300	2495.7189	1286.3269
0.3607	0.018	0.0065	109.1037	36.0851	4.4879	296.0805	2495.7189	1131.3795
0.3669	0.018	0.0061	107.249	36.079	4.4879	263.6409	2495.7189	1007.4216
0.381	0.0181	0.0084	140.2326	36.2682	4.5266	450.1687	2517.2369	1720.1796
0.4362	0.0179	0.0074	124.1891	35.8745	4.4492	369.0696	2474.2009	1410.2848
0.4618	0.018	0.008	132.6538	35.9966	4.4879	417.7291	2495.7189	1596.2217
0.4633	0.018	0.0077	128.7118	35.9569	4.4879	393.3994	2495.7189	1503.2532
0.4498	0.0181	0.0088	146.3108	36.1614	4.5266	482.6083	2517.2369	1844.1375
0.4732	0.018	0.0084	139.495	36.0118	4.4879	450.1687	2495.7189	1720.1796
0.4558	0.0181	0.0072	123.1553	36.1858	4.5266	352.8498	2517.2369	1348.3059
0.4766	0.018	0.0089	147.8876	36.0668	4.4879	490.7182	2495.7189	1875.1269
0.5116	0.018	0.0083	139.1135	36.0271	4.4879	442.0588	2495.7189	1689.1901
0.5425	0.0179	0.008	133.5185	35.8806	4.4492	417.7291	2474.2009	1596.2217
0.553	0.0179	0.007	116.6824	35.8592	4.4492	336.6300	2474.2009	1286.3269
0.5526	0.018	0.0073	122.4047	35.9081	4.4879	360.9597	2495.7189	1379.2953
0.5555	0.018	0.0065	111.9598	36.0118	4.4879	296.0805	2495.7189	1131.3795
0.5527	0.018	0.0083	138.8847	36.0088	4.4879	442.0588	2495.7189	1689.1901
0.5554	0.018	0.0086	143.437	35.9905	4.4879	466.3885	2495.7189	1782.1585
0.5869	0.018	0.0095	158.213	35.9508	4.4879	539.3776	2495.7189	2061.0638
0.6245	0.018	0.0092	152.5671	35.9569	4.4879	515.0479	2495.7189	1968.0954
0.6356	0.0181	0.0089	147.9893	36.1644	4.5266	490.7182	2517.2369	1875.1269
0.6383	0.018	0.0081	134.6884	36.0759	4.4879	425.8390	2495.7189	1627.2111
0.6425	0.018	0.0081	135.2479	36.0363	4.4879	425.8390	2495.7189	1627.2111
0.6423	0.0181	0.008	133.5185	36.1248	4.5266	417.7291	2517.2369	1596.2217
0.6364	0.0181	0.008	133.0098	36.2621	4.5266	417.7291	2517.2369	1596.2217
0.6365	0.0182	0.0085	141.2498	36.3048	4.5653	458.2786	2538.7549	1751.1690
0.6838	0.018	0.0082	136.4177	36.0759	4.4879	433.9489	2495.7189	1658.2006
0.726	0.018	0.008	133.5948	36.0881	4.4879	417.7291	2495.7189	1596.2217
0.7356	0.018	0.0089	147.6587	35.9233	4.4879	490.7182	2495.7189	1875.1269
0.7384	0.0181	0.0076	126.5755	36.1156	4.5266	385.2894	2517.2369	1472.2638
0.7288	0.018	0.0083	138.0454	35.96	4.4879	442.0588	2495.7189	1689.1901
0.7379	0.018	0.0087	144.8866	36.0057	4.4879	474.4984	2495.7189	1813.1480
0.7294	0.0182	0.0079	132.3232	36.3567	4.5653	409.6192	2538.7549	1565.2322
0.7386	0.0181	0.0086	143.4116	36.1278	4.5266	466.3885	2517.2369	1782.1585
0.7328	0.0181	0.0074	123.2185	36.1095	4.5266	369.0696	2517.2369	1410.2848
0.734	0.0181	0.0079	132.1706	36.1522	4.5266	409.6192	2517.2369	1565.2322
0.7355	0.0181	0.0072	119.5563	36.2072	4.5266	352.8498	2517.2369	1348.3059
0.7301	0.018	0.0077	128.4066	36.0393	4.4879	393.3994	2495.7189	1503.2532
0.7485	0.0181	0.0076	126.1177	36.1736	4.5266	385.2894	2517.2369	1472.2638
0.7406	0.018	0.0082	136.3669	36.0851	4.4879	433.9489	2495.7189	1658.2006
0.7374	0.018	0.0078	130.1614	36.0454	4.4879	401.5093	2495.7189	1534.2427

Table C-44. Corehole #2 at 50/40 feet.

FULLER WARREN BRIDGE
SHEAR DEVICE TEST RESULTS

		Penetration		(calculated)	0.049384441	Max. (0.0591)		
		Height H_2O		29 (ft)		Unit Wt H_2O	62.4 (lb/ft3)	
		Length Pipe		50 (ft)		Unit Wt Rod	2.96 (lb/ft)	
		Penetration Depth		0.0293 (in)		Cylinder Bore	4.72 (in2)	
		Stud Cap Area		0.1964 (in2)		hear Stud Area	0.261698658	
		No. of Studs		42		Normal Stud Area	0.001798249	
		Weight of Instrum.		38		qu (psi)	727.9	
LVDT (in)	Pressure (volts)	Load (volts)	Est. Load (psi)	Est. Press. (psi)	Normal Force (lb)	Shear Force (lb)	Normal Stress (psi)	Shear Stress (psi)
0.2778	0.0209	0.001	17.5077	41.789	5.6101	-149.9642	3119.7411	-573.0416
0.2784	0.0208	0.0003	4.3743	41.6517	5.5714	-206.7335	3098.2231	-789.9679
0.2811	0.0208	0	0.5086	41.6364	5.5714	-231.0633	3098.2231	-882.9363
0.2929	0.0208	0.0076	125.991	41.6913	5.5714	385.2894	3098.2231	1472.2638
0.34	0.0207	0.0092	152.821	41.3862	5.5327	515.0479	3076.7051	1968.0954
0.3559	0.0207	0.0095	158.086	41.4747	5.5327	539.3776	3076.7051	2061.0638
0.3505	0.0207	0.0092	154.042	41.4563	5.5327	515.0479	3076.7051	1968.0954
0.362	0.0207	0.0089	149.134	41.4624	5.5327	490.7182	3076.7051	1875.1269
0.384	0.0207	0.0115	190.995	41.3587	5.5327	701.5757	3076.7051	2680.8533
0.4298	0.0207	0.0103	172.124	41.4075	5.5327	604.2569	3076.7051	2308.9796
0.4286	0.0207	0.0102	170.115	41.4563	5.5327	596.1470	3076.7051	2277.9901
0.4271	0.0207	0.0092	153.305	41.435	5.5327	515.0479	3076.7051	1968.0954
0.4405	0.0207	0.0093	155.797	41.4228	5.5327	523.1578	3076.7051	1999.0848
0.4782	0.0207	0.0109	181.433	41.4106	5.5327	652.9163	3076.7051	2494.9164
0.5261	0.0205	0.0086	143.641	41.0932	5.4553	466.3885	3033.6691	1782.1585
0.5218	0.0206	0.0089	147.735	41.2122	5.4940	490.7182	3055.1871	1875.1269
0.5348	0.0206	0.0081	135.807	41.1206	5.4940	425.8390	3055.1871	1627.2111
0.5162	0.0206	0.0085	141.402	41.2976	5.4940	458.2786	3055.1871	1751.1690
0.5571	0.0206	0.0095	158.696	41.139	5.4940	539.3776	3055.1871	2061.0638
0.5865	0.0206	0.01	167.013	41.2397	5.4940	579.9271	3055.1871	2216.0112
0.6092	0.0206	0.0094	155.975	41.1878	5.4940	531.2677	3055.1871	2030.0743
0.6067	0.0205	0.0082	137.308	41.0901	5.4553	433.9489	3033.6691	1658.2006
0.6049	0.0206	0.009	149.414	41.1481	5.4940	498.8281	3055.1871	1906.1164
0.6112	0.0206	0.0086	143.641	41.261	5.4940	466.3885	3055.1871	1782.1585
0.6308	0.0207	0.0105	175.253	41.3068	5.5327	620.4767	3076.7051	2370.9585
0.6508	0.0206	0.0108	180.314	41.1451	5.4940	644.8064	3055.1871	2463.9270
0.6635	0.0206	0.0103	172.175	41.1176	5.4940	604.2569	3055.1871	2308.9796
0.6812	0.0206	0.0109	181.127	41.2305	5.4940	652.9163	3055.1871	2494.9164
0.6727	0.0206	0.0098	163.91	41.2915	5.4940	563.7073	3055.1871	2154.0322
0.684	0.0206	0.0087	145.37	41.2946	5.4940	474.4984	3055.1871	1813.1480
0.6758	0.0207	0.0091	152.186	41.3099	5.5327	506.9380	3076.7051	1937.1059
0.6957	0.0206	0.0111	185.197	41.1878	5.4940	669.1361	3055.1871	2556.8954
0.7602	0.0206	0.0085	142.14	41.1145	5.4940	458.2786	3055.1871	1751.1690
0.7546	0.0206	0.0086	143.284	41.1054	5.4940	466.3885	3055.1871	1782.1585
0.7556	0.0206	0.0088	146.082	41.2519	5.4940	482.6083	3055.1871	1844.1375
0.7525	0.0206	0.0083	138.859	41.2	5.4940	442.0588	3055.1871	1689.1901
0.7554	0.0206	0.0082	136.672	41.2946	5.4940	433.9489	3055.1871	1658.2006
0.7469	0.0207	0.009	149.744	41.3709	5.5327	498.8281	3076.7051	1906.1164
0.7638	0.0206	0.0081	134.892	41.2702	5.4940	425.8390	3055.1871	1627.2111
0.7579	0.0206	0.0085	140.868	41.2366	5.4940	458.2786	3055.1871	1751.1690
0.7507	0.0207	0.0089	148.167	41.4075	5.5327	490.7182	3076.7051	1875.1269
0.7469	0.0207	0.0088	147.226	41.3221	5.5327	482.6083	3076.7051	1844.1375
0.7511	0.0207	0.0087	145.014	41.3739	5.5327	474.4984	3076.7051	1813.1480
0.7622	0.0207	0.0079	132.196	41.3465	5.5327	409.6192	3076.7051	1565.2322
0.7507	0.0207	0.0084	139.368	41.4899	5.5327	450.1687	3076.7051	1720.1796
0.7484	0.0208	0.0086	143.437	41.551	5.5714	466.3885	3098.2231	1782.1585

Table C-45. Corehole #2 at 54/26 feet.

FULLER WARREN BRIDGE

SHEAR DEVICE TEST RESULTS

Penetration	(calculated) 0.044253756		Max. (0.0591)		
Height H_2O	33	(ft)	Unit Wt H_2O	62.4	(lb/ft3)
Length Pipe	54	(ft)	Unit Wt Rod	2.96	(lb/ft)
Penetration Depth	0.044	(in)	Cylinder Bore Area	4.72	(in2)
Stud Cap Area	0.1964	(in2)	Shear Stud Area	0.590162496	
No. of Studs	42		Normal Stud Area	0.004055271	
Weight of Instrum.	38		qu (psi)	376	

LVDT (in)	Pressure (volts)	Load (volts)	Est. Load (psi)	Est. Press. (psi)	Normal Force (lb)	Shear Force (lb)	Normal Stress (psi)	Shear Stress (psi)
0.2802	0.0141	0.0008	12.6966	28.2723	2.6384	-178.0240	650.6106	-301.6526
0.2643	0.0141	0.0009	14.8269	28.2235	2.6384	-169.9141	650.6106	-287.9107
0.2743	0.0141	0.0005	8.8935	28.2296	2.6384	-202.3537	650.6106	-342.8780
0.3087	0.014	0.0048	80.0094	27.9489	2.5997	146.3721	641.0688	248.0201
0.3787	0.014	0.0038	65.8556	28.0068	2.5997	65.2731	641.0688	110.6019
0.3968	0.014	0.0036	62.1938	27.9214	2.5997	49.0533	641.0688	83.1183
0.3809	0.0139	0.0037	63.5433	27.7963	2.5610	57.1632	631.5269	96.8601
0.3901	0.0139	0.0047	80.9319	27.8939	2.5610	138.2622	631.5269	234.2782
0.4646	0.0139	0.0052	86.8252	27.7444	2.5610	178.8118	631.5269	302.9873
0.5223	0.0139	0.0045	75.1264	27.7779	2.5610	122.0424	631.5269	206.7946
0.5131	0.014	0.0049	82.2728	27.9672	2.5997	154.4820	641.0688	261.7619
0.52	0.0139	0.0047	81.4647	27.7688	2.5610	138.2622	631.5269	234.2782
0.5179	0.0139	0.0046	77.2881	27.8115	2.5610	130.1523	631.5269	220.5364
0.5902	0.0138	0.0053	87.995	27.546	2.5223	186.9217	621.9851	316.7291
0.6391	0.0138	0.0048	80.2891	27.5643	2.5223	146.3721	621.9851	248.0201
0.6464	0.0139	0.0052	86.6217	27.7169	2.5610	178.8118	631.5269	302.9873
0.6503	0.0138	0.0043	72.278	27.665	2.5223	105.8226	621.9851	179.3110
0.6416	0.0139	0.0044	72.6086	27.8817	2.5610	113.9325	631.5269	193.0528
0.6551	0.0138	0.0047	78.7886	27.6528	2.5223	138.2622	621.9851	234.2782
0.6798	0.0138	0.0058	95.9299	27.6376	2.5223	227.4712	621.9851	385.4382
0.7408	0.0139	0.005	84.1294	27.8146	2.5610	162.5919	631.5269	275.5037
0.7731	0.0138	0.0052	86.9523	27.5216	2.5223	178.8118	621.9851	302.9873
0.7755	0.0139	0.0042	69.7857	27.8298	2.5610	97.7127	631.5269	165.5692
0.7682	0.0138	0.0051	84.282	27.5887	2.5223	170.7018	621.9851	289.2455
0.7733	0.0138	0.0047	79.0175	27.6437	2.5223	138.2622	621.9851	234.2782
0.7795	0.0139	0.005	83.1121	27.7413	2.5610	162.5919	631.5269	275.5037
0.8011	0.0138	0.0063	105.2634	27.5033	2.5223	268.0207	621.9851	454.1473
0.8336	0.0137	0.0056	93.1323	27.4789	2.4836	211.2514	612.4433	357.9546
0.8733	0.0138	0.0062	103.5849	27.5643	2.5223	259.9108	621.9851	440.4055
0.9036	0.0137	0.0057	94.4039	27.4026	2.4836	219.3613	612.4433	371.6964
0.9095	0.0137	0.0052	86.8252	27.4911	2.4836	178.8118	612.4433	302.9873
0.908	0.0138	0.005	83.2647	27.6772	2.5223	162.5919	621.9851	275.5037
0.9105	0.0137	0.0049	81.6116	27.4697	2.4836	154.4820	612.4433	261.7619
0.904	0.0138	0.0054	89.4447	27.5216	2.5223	195.0316	621.9851	330.4709
0.9186	0.0138	0.0055	91.3521	27.546	2.5223	203.1415	621.9851	344.2128
0.9653	0.0137	0.0061	102.4913	27.3965	2.4836	251.8009	612.4433	426.6637
0.9891	0.0137	0.0066	110.6042	27.4331	2.4836	292.3504	612.4433	495.3727
0.9764	0.0137	0.0054	90.1313	27.4819	2.4836	195.0316	612.4433	330.4709
0.9347	0.0137	0.006	100.4822	27.3629	2.4836	243.6910	612.4433	412.9218
1.0015	0.0138	0.0061	102.4659	27.5918	2.5223	251.8009	621.9851	426.6637
0.9271	0.0137	0.0058	96.6165	27.4789	2.4836	227.4712	612.4433	385.4382
1.0002	0.0136	0.0054	89.6481	27.2835	2.4449	195.0316	602.9014	330.4709
0.9129	0.0137	0.0056	93.1323	27.4941	2.4836	211.2514	612.4433	357.9546
0.9909	0.0137	0.0062	102.7457	27.3415	2.4836	259.9108	612.4433	440.4055
0.9631	0.0137	0.0061	102.1607	27.4728	2.4836	251.8009	612.4433	426.6637
0.9262	0.0138	0.0063	105.0854	27.5063	2.5223	268.0207	621.9851	454.1473
0.9983	0.0138	0.0054	90.1059	27.5491	2.5223	195.0316	621.9851	330.4709

Table C-46. Corehole #2 at 54/32 feet.

FULLER WARREN BRIDGE
SHEAR DEVICE TEST RESULTS

Penetration	(calculated) 0.060969673	Max. (0.0591)	
Height H_2O	33 (ft)	Unit Wt H_2O	62.4 (lb/ft3)
Length Pipe	54 (ft)	Unit Wt Rod	2.96 (lb/ft)
Penetration Depth	0.044 (in)	Cylinder Bore Area	4.72 (in2)
Stud Cap Area	0.1964 (in2)	Shear Stud Area	0.590162496
No. of Studs	42	Normal Stud Area	0.004055271
Weight of Instrum.	38 (lbs.)	qu (psi)	376

LVDT (in)	Pressure (volts)	Load (volts)	Est. Load (psi)	Est. Press. (psi)	Normal Force (lb)	Shear Force (lb)	Normal Stress (psi)	Shear Stress (psi)
0.2798	0.0168	-0.0002	-2.8196	33.6711	3.6832	-259.1231	908.2402	-439.0707
0.2608	0.0169	0.0009	14.6489	33.7718	3.7219	-169.9141	917.7820	-287.9107
0.2657	0.0168	0	0.763	33.6222	3.6832	-242.9033	908.2402	-411.5871
0.2786	0.0168	0.001	16.3274	33.6222	3.6832	-161.8042	908.2402	-274.1689
0.3243	0.0165	0.0068	113.0202	33.0699	3.5671	308.5702	879.6147	522.8564
0.3782	0.0165	0.0061	102.415	32.9112	3.5671	251.8009	879.6147	426.6637
0.3822	0.0165	0.0062	104.0681	32.9997	3.5671	259.9108	879.6147	440.4055
0.368	0.0165	0.006	99.5666	32.9997	3.5671	243.6910	879.6147	412.9218
0.3888	0.0164	0.0071	118.6153	32.899	3.5284	332.8999	870.0728	564.0818
0.4443	0.0164	0.0084	140.6395	32.8318	3.5284	438.3287	870.0728	742.7254
0.4777	0.0164	0.0075	124.4392	32.8471	3.5284	365.3395	870.0728	619.0491
0.4832	0.0165	0.007	116.301	32.9844	3.5671	324.7900	879.6147	550.3400
0.4853	0.0166	0.0064	106.4587	33.1309	3.6058	276.1306	889.1565	467.8891
0.4903	0.0165	0.0068	112.7913	33.0576	3.5671	308.5702	879.6147	522.8564
0.4999	0.0166	0.0072	120.1412	33.2347	3.6058	341.0098	889.1565	577.8236
0.5218	0.0165	0.0075	125.5837	32.9936	3.5671	365.3395	879.6147	619.0491
0.5577	0.0165	0.0077	127.6691	32.9875	3.5671	381.5594	879.6147	646.5327
0.5839	0.0166	0.0083	137.5113	33.1553	3.6058	430.2188	889.1565	728.9836
0.5875	0.0165	0.0072	120.421	32.902	3.5671	341.0098	879.6147	577.8236
0.6025	0.0165	0.0068	113.9103	33.0821	3.5671	308.5702	879.6147	522.8564
0.5963	0.0166	0.0069	114.4698	33.14	3.6058	316.6801	889.1565	536.5982
0.608	0.0166	0.0072	120.2429	33.1248	3.6058	341.0098	889.1565	577.8236
0.6034	0.0166	0.0071	118.4881	33.2102	3.6058	332.8999	889.1565	564.0818
0.6295	0.0166	0.0084	140.3597	33.2255	3.6058	438.3287	889.1565	742.7254
0.6554	0.0165	0.0087	144.3526	33.0851	3.5671	462.6584	879.6147	783.9509
0.6752	0.0165	0.0088	146.4888	32.9722	3.5671	470.7683	879.6147	797.6927
0.6964	0.0165	0.0081	134.9935	33.0302	3.5671	413.9990	879.6147	701.5000
0.6827	0.0166	0.008	133.137	33.1736	3.6058	405.8891	889.1565	687.7581
0.6899	0.0166	0.0075	124.1849	33.1462	3.6058	365.3395	889.1565	619.0491
0.6892	0.0167	0.007	117.2928	33.3079	3.6445	324.7900	898.6983	550.3400
0.683	0.0165	0.0082	136.2906	33.0973	3.5671	422.1089	879.6147	715.2418
0.7171	0.0165	0.0093	155.6444	33.0576	3.5671	511.3178	879.6147	866.4017
0.7518	0.0167	0.0092	153.6607	33.3323	3.6445	503.2079	898.6983	852.6599
0.7835	0.0165	0.0088	146.8703	33.0851	3.5671	470.7683	879.6147	797.6927
0.7768	0.0166	0.0086	143.9965	33.1706	3.6058	454.5485	889.1565	770.2090
0.7718	0.0166	0.008	132.8064	33.2316	3.6058	405.8891	889.1565	687.7581
0.778	0.0166	0.0085	140.8429	33.137	3.6058	446.4386	889.1565	756.4672
0.7762	0.0166	0.0083	138.7575	33.198	3.6058	430.2188	889.1565	728.9836
0.7907	0.0166	0.0084	140.7158	33.2224	3.6058	438.3287	889.1565	742.7254
0.8012	0.0166	0.0097	161.8244	33.1675	3.6058	543.7574	889.1565	921.3690
0.8298	0.0166	0.01	166.6565	33.1339	3.6058	568.0871	889.1565	962.5945
0.8486	0.0166	0.0098	163.7827	33.1339	3.6058	551.8673	889.1565	935.1108
0.8465	0.0166	0.0089	147.735	33.1614	3.6058	478.8782	889.1565	811.4345
0.8456	0.0165	0.0092	153.0503	33.0638	3.5671	503.2079	879.6147	852.6599
0.8476	0.0166	0.0092	152.5926	33.2469	3.6058	503.2079	889.1565	852.6599
0.8462	0.0166	0.0085	142.4197	33.1767	3.6058	446.4386	889.1565	756.4672
0.8429	0.0166	0.0095	158.3402	33.2041	3.6058	527.5376	889.1565	893.8854

Table C-47. Corehole #2 at 54/35 feet.

FULLER WARREN BRIDGE
SHEAR DEVICE TEST RESULTS

Penetration	(calculated)	0.075011043	Max. (0.0591)				
Height H_2O	33	(ft)	Unit Wt H_2O		62.4	(lb/ft3)	
Length Pipe	54	(ft)	Unit Wt Rod		2.96	(lb/ft)	
Penetration Depth	0.044	(in)	Cylinder Bore /		4.72	(in2)	
Stud Cap Area	0.1964	(in2)	hear Stud Area	0.590162496			
No. of Studs	42		Normal Stud Area	0.004055271			
Weight of Instrum.	38		qu (psi)		376		

LVDT (in)	Pressure (volts)	Load (volts)	Est. Load (psi)	Est. Press. (psi)	Normal Force (lb)	Shear Force (lb)	Normal SStress (psi)	Shear Stress (psi)
0.2754	0.0187	0.0003	4.8321	37.4218	4.4184	-218.5735	1089.5350	-370.3616
0.2616	0.0187	0.0009	15.7679	37.4371	4.4184	-169.9141	1089.5350	-287.9107
0.2734	0.0186	0.0059	98.4985	37.2326	4.3797	235.5811	1079.9932	399.1800
0.345	0.0186	0.0076	132.933	37.141	4.3797	373.4494	1079.9932	632.7909
0.3507	0.0185	0.0079	131.001	37.0678	4.3410	397.7792	1070.4514	674.0163
0.3585	0.0185	0.0078	129.805	37.0586	4.3410	389.6693	1070.4514	660.2745
0.3509	0.0186	0.0077	127.898	37.141	4.3797	381.5594	1079.9932	646.5327
0.369	0.0186	0.0092	154.428	37.1776	4.3797	503.2079	1079.9932	852.6599
0.4135	0.0185	0.0113	188.325	36.9701	4.3410	673.5159	1070.4514	1141.2380
0.4341	0.0185	0.0117	194.912	36.9762	4.3410	705.9555	1070.4514	1196.2053
0.4241	0.0186	0.011	184.001	37.2021	4.3797	649.1862	1079.9932	1100.0126
0.445	0.0185	0.0104	173.854	37.0037	4.3410	600.5268	1070.4514	1017.5617
0.4318	0.0185	0.01	166.835	37.0525	4.3410	568.0871	1070.4514	962.5945
0.4548	0.0185	0.013	215.995	37.022	4.3410	811.3843	1070.4514	1374.8489
0.476	0.0184	0.0125	208.619	36.8603	4.3023	770.8347	1060.9095	1306.1398
0.4851	0.0185	0.0109	187.071	36.9945	4.3410	641.0763	1070.4514	1086.2708
0.4886	0.0185	0.0108	180.1	36.9335	4.3410	632.9664	1070.4514	1072.5290
0.4827	0.0185	0.0112	186.951	36.9243	4.3410	665.4060	1070.4514	1127.4962
0.4869	0.0184	0.0112	186.951	36.8938	4.3023	665.4060	1060.9095	1127.4962
0.4988	0.0185	0.0118	196.972	37.0861	4.3410	714.0654	1070.4514	1209.9471
0.5314	0.0185	0.0131	217.572	37.0251	4.3410	819.4942	1070.4514	1388.5907
0.5294	0.0185	0.0134	222.531	37.0251	4.3410	843.8239	1070.4514	1429.8162
0.5263	0.0185	0.0112	186.875	37.019	4.3410	665.4060	1070.4514	1127.4962
0.5284	0.0185	0.0119	199.082	37.0708	4.3410	722.1753	1070.4514	1223.6889
0.5255	0.0185	0.0118	196.768	37.0434	4.3410	714.0654	1070.4514	1209.9471
0.5661	0.0184	0.0126	209.179	36.8694	4.3023	778.9446	1060.9095	1319.8816
0.5769	0.0185	0.0139	231.356	36.9579	4.3410	884.3734	1070.4514	1498.5252
0.5968	0.0185	0.0122	203.737	36.9366	4.3410	746.5050	1070.4514	1264.9144
0.5807	0.0184	0.0118	197.455	36.8236	4.3023	714.0654	1060.9095	1209.9471
0.5876	0.0184	0.0111	185.425	36.8908	4.3023	657.2961	1060.9095	1113.7544
0.5827	0.0184	0.0126	210.044	36.7687	4.3023	778.9446	1060.9095	1319.8816
0.5944	0.0186	0.0135	224.845	37.1014	4.3797	851.9338	1079.9932	1443.5580
0.641	0.0184	0.0131	218.716	36.8908	4.3023	819.4942	1060.9095	1388.5907
0.6413	0.0184	0.0125	208.492	36.845	4.3023	770.8347	1060.9095	1306.1398
0.6377	0.0185	0.0131	218.741	36.9182	4.3410	819.4942	1070.4514	1388.5907
0.6387	0.0184	0.0111	184.459	36.8969	4.3023	657.2961	1060.9095	1113.7544
0.629	0.0184	0.0113	188.528	36.8908	4.3023	673.5159	1060.9095	1141.2380
0.6361	0.0184	0.0132	219.962	36.8938	4.3023	827.6041	1060.9095	1402.3325
0.6461	0.0183	0.0129	214.672	36.6802	4.2636	803.2744	1051.3677	1361.1071
0.672	0.0184	0.0129	214.443	36.7992	4.3023	803.2744	1060.9095	1361.1071
0.6722	0.0184	0.012	199.973	36.8725	4.3023	730.2852	1060.9095	1237.4308
0.6823	0.0184	0.0112	186.036	36.8084	4.3023	665.4060	1060.9095	1127.4962
0.6796	0.0184	0.0122	203.253	36.8358	4.3023	746.5050	1060.9095	1264.9144
0.7151	0.0183	0.0149	247.963	36.6985	4.2636	965.4724	1051.3677	1635.9434
0.7341	0.0184	0.0126	210.451	36.726	4.3023	778.9446	1060.9095	1319.8816
0.7362	0.0184	0.0131	218.64	36.7046	4.3023	819.4942	1060.9095	1388.5907
0.7221	0.0185	0.0112	187.155	36.9274	4.3410	665.4060	1070.4514	1127.4962

Table C-48. Corehole #2 at 54/42 feet.

FULLER WARREN BRIDGE

SHEAR DEVICE TEST RESULTS

Penetration	(calculated)	0.096407416	Max. (0.0591)		
Height H_2C	33	(ft)	Unit Wt H_2O	62.4	(lb/ft3)
Length Pipe	54	(ft)	Unit Wt Rod	2.96	(lb/ft)
Penetratio	0.044	(in)	Cylinder Bore Are:	4.72	(in2)
Stud Cap /	0.1964	(in2)	Shear Stud Area	0.590162496	
No. of Stu	42		Normal Stud Area	0.004055271	
Weight of Instrum.	38		qu (psi)	376	

LVDT (in)	Pressure (volts)	Load (volts)	Est. Load (psi)	Est. Press. (psi)	Normal Force (lb)	Shear Force (lb)	Normal Stress (psi)	Shear Stress (psi)
0.2676	0.0218	0	-0.356	43.6079	5.6179	-242.9033	1385.3319	-411.5871
0.2758	0.0218	0.0003	4.4252	43.6323	5.6179	-218.5735	1385.3319	-370.3616
0.2821	0.0218	0	0.5099	43.6201	5.6179	-242.9033	1385.3319	-411.5871
0.2798	0.0219	0	-0.2948	43.8093	5.6566	-242.9033	1394.8738	-411.5871
0.3018	0.0218	0.0047	81.7802	43.6659	5.6179	138.2622	1385.3319	234.2782
0.353	0.0217	0.0087	145.8022	43.3302	5.5792	462.6584	1375.7901	783.9509
0.3584	0.0216	0.0085	141.0464	43.2173	5.5405	446.4386	1366.2483	756.4672
0.3685	0.0216	0.0078	130.136	43.2966	5.5405	389.6693	1366.2483	660.2745
0.3648	0.0217	0.0075	128.4514	43.3515	5.5792	365.3395	1375.7901	619.0491
0.3725	0.0216	0.0102	175.8198	43.2386	5.5405	584.3070	1366.2483	990.0781
0.4116	0.0215	0.0122	203.7111	43.0799	5.5018	746.5050	1356.7064	1264.9144
0.4224	0.0215	0.0101	167.8009	42.9609	5.5018	576.1970	1356.7064	976.3363
0.4263	0.0216	0.0104	172.5313	43.1654	5.5405	600.5268	1366.2483	1017.5617
0.4227	0.0216	0.0104	174.1081	43.2051	5.5405	600.5268	1366.2483	1017.5617
0.4201	0.0216	0.0089	152.5818	43.2844	5.5405	478.8782	1366.2483	811.4345
0.4325	0.0216	0.0115	192.0632	43.2051	5.5405	689.7357	1366.2483	1168.7217
0.4655	0.0216	0.0114	189.5454	43.1227	5.5405	681.6258	1366.2483	1154.9799
0.4823	0.0215	0.0116	192.9533	43.0311	5.5018	697.8456	1356.7064	1182.4635
0.4776	0.0215	0.0106	177.3125	43.0219	5.5018	616.7466	1356.7064	1045.0453
0.4831	0.0216	0.0096	164.8058	43.1837	5.5405	535.6475	1366.2483	907.6272
0.4863	0.0216	0.0103	171.5649	43.1898	5.5405	592.4169	1366.2483	1003.8199
0.4836	0.0216	0.0109	181.1019	43.2356	5.5405	641.0763	1366.2483	1086.2708
0.5021	0.0216	0.0111	186.7173	43.2478	5.5405	657.2961	1366.2483	1113.7544
0.5408	0.0217	0.0118	197.4548	43.3302	5.5792	714.0654	1375.7901	1209.9471
0.5348	0.0218	0.0119	198.879	43.5255	5.6179	722.1753	1385.3319	1223.6889
0.5467	0.0216	0.0112	187.1802	43.2722	5.5405	665.4060	1366.2483	1127.4962
0.5467	0.0217	0.01	167.038	43.3058	5.5792	568.0871	1375.7901	962.5945
0.5394	0.0217	0.0105	175.0745	43.3546	5.5792	608.6367	1375.7901	1031.3035
0.5391	0.0216	0.0098	163.5283	43.2264	5.5405	551.8673	1366.2483	935.1108
0.565	0.0217	0.0112	186.8496	43.3515	5.5792	665.4060	1375.7901	1127.4962
0.5931	0.0216	0.0116	193.5891	43.2386	5.5405	697.8456	1366.2483	1182.4635
0.5947	0.0217	0.0117	194.4029	43.3088	5.5792	705.9555	1375.7901	1196.2053
0.5928	0.0216	0.011	182.9076	43.2783	5.5405	649.1862	1366.2483	1100.0126
0.5905	0.0217	0.0109	181.1782	43.3241	5.5792	641.0763	1375.7901	1086.2708
0.5972	0.0217	0.0102	170.6748	43.3454	5.5792	584.3070	1375.7901	990.0781
0.5928	0.0217	0.01	166.9871	43.3729	5.5792	568.0871	1375.7901	962.5945
0.5993	0.0216	0.0106	177.338	43.2752	5.5405	616.7466	1366.2483	1045.0453
0.6199	0.0216	0.0114	189.4437	43.2386	5.5405	681.6258	1366.2483	1154.9799
0.6489	0.0216	0.0119	199.1333	43.263	5.5405	722.1753	1366.2483	1223.6889
0.6479	0.0217	0.0113	188.7061	43.3485	5.5792	673.5159	1375.7901	1141.2380
0.6416	0.0216	0.0107	177.694	43.1715	5.5405	624.8565	1366.2483	1058.7872
0.6357	0.0216	0.0108	180.695	43.2814	5.5405	632.9664	1366.2483	1072.5290
0.6397	0.0217	0.0103	171.7683	43.3729	5.5792	592.4169	1375.7901	1003.8199
0.6345	0.0217	0.0112	187.2565	43.3607	5.5792	665.4060	1375.7901	1127.4962
0.638	0.0217	0.012	200.6592	43.44	5.5792	730.2852	1375.7901	1237.4308
0.6669	0.0217	0.0123	204.6775	43.4797	5.5792	754.6149	1375.7901	1278.6562
0.6884	0.0217	0.0122	203.8891	43.3149	5.5792	746.5050	1375.7901	1264.9144

Table C-49. Corehole #2 at 55/30 feet.

FULLER WARREN BRIDGE

SHEAR DEVICE TEST RESULTS

Penetration	(calculated)	0.049469498	Max. (0.0591)		
Height H_2O	34	(ft)	Unit Wt H_2O	62.4	(lb/ft3)
Length Pipe	55	(ft)	Unit Wt Rod	2.96	(lb/ft)
Penetration Depth	0.0591	(in)	Cylinder Bore Are	4.72	(in2)
Stud Cap Area	0.1964	(in2)	Shear Stud Area	1.064734229	
No. of Studs	42		Normal Stud Area	0.007316266	
Weight of Instrum.	38		qu (psi)	376	

LVDT (in)	Pressure (volts)	Load (volts)	Est. Load (psi)	Est. Press. (psi)	Normal Force (lb)	Shear Force (lb)	Normal Stress (psi)	Shear Stress (psi)
0.2707	0.0154	0.0008	14.0639	30.7413	3.0563	-180.9840	417.7441	-169.9805
0.2692	0.0153	0.001	15.8951	30.5216	3.0176	-164.7642	412.4553	-154.7468
0.2654	0.0153	0.0015	24.3639	30.5429	3.0176	-124.2147	412.4553	-116.6626
0.348	0.015	0.0049	83.8341	29.957	2.9015	151.5220	396.5887	142.3097
0.3805	0.015	0.0041	68.6124	29.9692	2.9015	86.6428	396.5887	81.3751
0.3746	0.0151	0.0053	87.6899	30.1309	2.9402	183.9617	401.8775	172.7771
0.3829	0.015	0.0042	70.5995	30.0272	2.9015	94.7527	396.5887	88.9919
0.4198	0.0149	0.0051	90.2242	29.8166	2.8629	167.7418	391.2998	157.5434
0.5125	0.0149	0.0049	82.8746	29.8013	2.8629	151.5220	391.2998	142.3097
0.5118	0.015	0.0045	77.8002	29.9295	2.9015	119.0824	396.5887	111.8424
0.5005	0.015	0.0045	77.6942	29.9112	2.9015	119.0824	396.5887	111.8424
0.5133	0.0149	0.0048	80.34	29.8105	2.8629	143.4121	391.2998	134.6929
0.5465	0.015	0.0056	95.3858	29.9112	2.9015	208.2914	396.5887	195.6276
0.6244	0.0148	0.0059	99.0071	29.6884	2.8242	232.6211	386.0109	218.4781
0.6342	0.0148	0.0047	78.9992	29.6823	2.8242	135.3022	386.0109	127.0761
0.653	0.0148	0.0053	87.8933	29.6457	2.8242	183.9617	386.0109	172.7771
0.6382	0.0148	0.0055	91.0723	29.6579	2.8242	200.1815	386.0109	188.0107
0.658	0.0149	0.0065	107.7303	29.7983	2.8629	281.2805	391.2998	264.1791
0.739	0.0149	0.0068	112.9694	29.7098	2.8629	305.6102	391.2998	287.0296
0.7745	0.0148	0.0064	106.8148	29.6793	2.8242	273.1706	386.0109	256.5622
0.7786	0.0149	0.0053	88.5037	29.7189	2.8629	183.9617	391.2998	172.7771
0.7716	0.0148	0.0063	105.7212	29.6213	2.8242	265.0607	386.0109	248.9454
0.7826	0.0149	0.0058	96.6419	29.7128	2.8629	224.5112	391.2998	210.8612
0.8043	0.0148	0.0064	106.7131	29.6274	2.8242	273.1706	386.0109	256.5622
0.8566	0.0147	0.0068	112.6387	29.3527	2.7855	305.6102	380.7221	287.0296
0.8885	0.0147	0.0061	101.2197	29.4931	2.7855	248.8409	380.7221	233.7117
0.8691	0.0148	0.0061	101.5758	29.6945	2.8242	248.8409	386.0109	233.7117
0.8896	0.0148	0.0059	98.9817	29.7006	2.8242	232.6211	386.0109	218.4781
0.9121	0.0148	0.0058	96.1842	29.5694	2.8242	224.5112	386.0109	210.8612
0.9024	0.0148	0.0061	102.1861	29.6945	2.8242	248.8409	386.0109	233.7117
0.892	0.0148	0.006	100.6348	29.5755	2.8242	240.7310	386.0109	226.0949
0.8939	0.0149	0.006	99.6429	29.8044	2.8629	240.7310	391.2998	226.0949
0.894	0.0148	0.0065	107.9084	29.6884	2.8242	281.2805	386.0109	264.1791
0.8909	0.0149	0.0057	94.4294	29.7281	2.8629	216.4013	391.2998	203.2444
0.8975	0.0149	0.0054	90.6908	29.7372	2.8629	192.0716	391.2998	180.3939
0.8923	0.0148	0.0058	97.3032	29.6701	2.8242	224.5112	386.0109	210.8612
0.8943	0.0149	0.0054	89.6736	29.8349	2.8629	192.0716	391.2998	180.3939
0.8974	0.0149	0.0059	98.4222	29.8105	2.8629	232.6211	391.2998	218.4781
0.8967	0.0149	0.0057	94.76	29.8135	2.8629	216.4013	391.2998	203.2444
0.8964	0.0149	0.0057	94.6074	29.841	2.8629	216.4013	391.2998	203.2444
0.8983	0.0149	0.0055	91.6827	29.8532	2.8629	200.1815	391.2998	188.0107
0.8979	0.0149	0.0053	88.9106	29.8685	2.8629	183.9617	391.2998	172.7771

Table C-50. Corehole #2 at 55/35 feet.

FULLER WARREN BRIDGE
SHEAR DEVICE TEST RESULTS

Penetration	(calculated)	0.070865871	Max. (0.0591)		
Height H_2O	34	(ft)	Unit Wt H_2O	62.4	(lb/ft3)
Length Pipe	55	(ft)	Unit Wt Rod	2.96	(lb/ft)
Penetration Depth	0.0591	(in)	Cylinder Bore /	4.72	(in2)
Stud Cap Area	0.1964	(in2)	hear Stud Area	1.064734229	
No. of Studs	42		Normal Stud Area	0.007316266	
Weight of Instrum.	38		qu (psi)	376	

LVDT (in)	Pressure (volts)	Load (volts)	Est. Load (psi)	Est. Press. (psi)	Normal Force (lb)	Shear Force (lb)	Normal Stress (psi)	Shear Stress (psi)
0.3126	0.0186	0.0021	36.9337	37.2326	4.2946	-75.5553	586.9877	-70.9616
0.2978	0.0185	0.0022	37.7377	36.964	4.2559	-67.4454	581.6989	-63.3448
0.3178	0.0185	0.0027	44.3027	37.0739	4.2559	-26.8958	581.6989	-25.2606
0.3061	0.0185	0.0023	40.0032	37.0617	4.2559	-59.3355	581.6989	-55.7280
0.3227	0.0185	0.0026	42.675	37.0678	4.2559	-35.0058	581.6989	-32.8775
0.3242	0.0185	0.0059	101.0889	37.08	4.2559	232.6211	581.6989	218.4781
0.3803	0.0181	0.0072	128.6053	36.2255	4.1011	338.0498	560.5434	317.4969
0.403	0.0181	0.0079	131.8145	36.2011	4.1011	394.8192	560.5434	370.8148
0.4198	0.0181	0.0073	120.9296	36.1797	4.1011	346.1597	560.5434	325.1137
0.4131	0.0181	0.0075	127.1943	36.1492	4.1011	362.3795	560.5434	340.3474
0.4139	0.0181	0.0082	136.5195	36.1705	4.1011	419.1489	560.5434	393.6653
0.4721	0.018	0.0094	156.4582	36.0393	4.0624	516.4677	555.2546	485.0673
0.4999	0.0181	0.0086	142.9538	36.1095	4.1011	451.5885	560.5434	424.1326
0.5108	0.0181	0.0076	132.3385	36.195	4.1011	370.4894	560.5434	347.9643
0.4935	0.0182	0.0089	149.0575	36.3292	4.1398	475.9182	565.8323	446.9831
0.5049	0.0181	0.0078	130.8227	36.2896	4.1011	386.7093	560.5434	363.1979
0.5159	0.0181	0.0081	135.4005	36.2743	4.1011	411.0390	560.5434	386.0484
0.5429	0.0181	0.0099	165.0288	36.1644	4.1011	557.0172	560.5434	523.1514
0.5645	0.018	0.0111	184.9676	36.0149	4.0624	654.3361	555.2546	614.5534
0.5667	0.0181	0.0097	162.3839	36.2621	4.1011	540.7974	560.5434	507.9178
0.5746	0.0181	0.0096	160.3748	36.2041	4.1011	532.6875	560.5434	500.3009
0.5628	0.0182	0.0094	156.7125	36.314	4.1398	516.4677	565.8323	485.0673
0.5723	0.0181	0.0091	150.8632	36.198	4.1011	492.1380	560.5434	462.2168
0.602	0.0181	0.0099	164.2404	36.2041	4.1011	557.0172	560.5434	523.1514
0.6177	0.0181	0.0115	191.6054	36.2438	4.1011	686.7757	560.5434	645.0208
0.6358	0.0181	0.0104	172.633	36.1339	4.1011	597.5668	560.5434	561.2356
0.6315	0.0181	0.0095	158.1876	36.1858	4.1011	524.5776	560.5434	492.6841
0.6261	0.0182	0.0096	160.1713	36.4513	4.1398	532.6875	565.8323	500.3009
0.6419	0.0183	0.0098	163.1723	36.5642	4.1785	548.9073	571.1211	515.5346
0.6396	0.0181	0.0098	163.8335	36.256	4.1011	548.9073	560.5434	515.5346
0.6402	0.0182	0.0099	165.3409	36.3079	4.1398	557.0172	565.8323	523.1514
0.6566	0.0182	0.0109	181.8903	36.4635	4.1398	638.1163	565.8323	599.3198
0.6709	0.0183	0.0111	185.1965	36.5734	4.1785	654.3361	571.1211	614.5534
0.6758	0.0182	0.0101	167.6483	36.3292	4.1398	573.2370	565.8323	538.3851
0.6844	0.0182	0.0102	169.3269	36.4025	4.1398	581.3470	565.8323	546.0019
0.6729	0.0181	0.0094	156.4582	36.2896	4.1011	516.4677	560.5434	485.0673
0.675	0.0182	0.0096	160.4765	36.3964	4.1398	532.6875	565.8323	500.3009
0.6942	0.0182	0.0106	176.1172	36.4391	4.1398	613.7866	565.8323	576.4693
0.7048	0.0182	0.0107	179.0419	36.4269	4.1398	621.8965	565.8323	584.0861
0.7063	0.0183	0.0104	174.0827	36.5825	4.1785	597.5668	571.1211	561.2356
0.7104	0.0183	0.01	165.9698	36.5093	4.1785	565.1271	571.1211	530.7683
0.7165	0.0183	0.0103	171.6921	36.5673	4.1785	589.4569	571.1211	553.6188
0.7187	0.0182	0.0104	173.7521	36.4696	4.1398	597.5668	565.8323	561.2356
0.7027	0.0183	0.0101	168.3859	36.6253	4.1785	573.2370	571.1211	538.3851
0.7077	0.0182	0.0109	182.2464	36.4055	4.1398	638.1163	565.8323	599.3198
0.7234	0.0183	0.0113	189.0622	36.5032	4.1785	670.5559	571.1211	629.7871
0.7071	0.0182	0.0108	180.6696	36.3933	4.1398	630.0064	565.8323	591.7029

Table C-51. Corehole #2 at 55/40 feet.

FULLER WARREN BRIDGE
SHEAR DEVICE TEST RESULTS

Penetration	(calculated) 0.088250424	Max. (0.0591)		
Height H_2O	34 (ft)	Unit Wt H_2O	62.4	(lb/ft3)
Length Pipe	55 (ft)	Unit Wt Rod	2.96	(lb/ft)
Penetration Depth	0.0591 (in)	Cylinder Bore Area	4.72	(in2)
Stud Cap Area	0.1964 (in2)	Shear Stud Area	1.064734229	
No. of Studs	42	Normal Stud Area	0.007316266	
Weight of Instrum.	38	qu (psi)	376	

LVDT (in)	Pressure (volts)	Load (volts)	Est. Load (psi)	Est. Press. (psi)	Normal Force (lb)	Shear Force (lb)	Normal Stress (psi)	Shear Stress (psi)
0.2772	0.0209	0.0003	4.6795	41.8073	5.1845	-221.5335	708.6316	-208.0646
0.2751	0.021	0.0001	0.8542	41.9111	5.2232	-237.7534	713.9204	-223.2983
0.2623	0.021	0.001	16.4291	42.0301	5.2232	-164.7642	713.9204	-154.7468
0.2913	0.021	0.0062	105.4584	42.0118	5.2232	256.9508	713.9204	241.3286
0.3246	0.0208	0.0089	148.6251	41.6364	5.1458	475.9182	703.3427	446.9831
0.3328	0.0207	0.0096	160.7817	41.4838	5.1071	532.6875	698.0539	500.3009
0.3374	0.0207	0.0094	155.9242	41.3343	5.1071	516.4677	698.0539	485.0673
0.3351	0.0207	0.0098	163.3758	41.4808	5.1071	548.9073	698.0539	515.5346
0.342	0.0207	0.0091	152.1093	41.4686	5.1071	492.1380	698.0539	462.2168
0.3568	0.0207	0.0115	191.6308	41.3343	5.1071	686.7757	698.0539	645.0208
0.389	0.0207	0.0129	214.8503	41.3221	5.1071	800.3144	698.0539	751.6565
0.3811	0.0207	0.0124	206.5086	41.3617	5.1071	759.7648	698.0539	713.5723
0.387	0.0206	0.0133	221.2846	41.2061	5.0685	832.7540	692.7650	782.1238
0.3813	0.0207	0.0118	196.6409	41.438	5.1071	711.1054	698.0539	667.8713
0.3981	0.0206	0.0126	210.2725	41.2885	5.0685	775.9846	692.7650	728.8060
0.41	0.0206	0.0143	238.2224	41.2763	5.0685	913.8530	692.7650	858.2921
0.4188	0.0206	0.0143	238.5785	41.2915	5.0685	913.8530	692.7650	858.2921
0.4215	0.0207	0.0132	220.598	41.3495	5.1071	824.6441	698.0539	774.5070
0.4285	0.0206	0.0136	227.1849	41.2275	5.0685	857.0837	692.7650	804.9743
0.4145	0.0207	0.0139	232.1696	41.3923	5.1071	881.4134	698.0539	827.8248
0.4233	0.0207	0.0136	227.4646	41.319	5.1071	857.0837	698.0539	804.9743
0.4325	0.0207	0.0142	237.256	41.4289	5.1071	905.7431	698.0539	850.6753
0.445	0.0207	0.0149	248.3952	41.4258	5.1071	962.5124	698.0539	903.9931
0.4622	0.0207	0.0128	219.7161	41.496	5.1071	792.2045	698.0539	744.0396
0.4529	0.0207	0.0121	213.0183	41.377	5.1071	735.4351	698.0539	690.7218
0.446	0.0206	0.0132	219.6061	41.2427	5.0685	824.6441	692.7650	774.5070
0.4439	0.0207	0.0122	203.7111	41.3221	5.1071	743.5450	698.0539	698.3386
0.4591	0.0207	0.0146	243.7666	41.3617	5.1071	938.1827	698.0539	881.1426
0.4807	0.0206	0.0151	252.2864	41.261	5.0685	978.7322	692.7650	919.2268
0.4732	0.0207	0.0141	235.1706	41.3831	5.1071	897.6332	698.0539	843.0585
0.4866	0.0207	0.0123	207.4851	41.3678	5.1071	751.6549	698.0539	705.9555
0.4833	0.0207	0.0125	209.9562	41.435	5.1071	767.8747	698.0539	721.1891
0.4737	0.0207	0.013	216.3762	41.3068	5.1071	808.4243	698.0539	759.2733
0.5001	0.0207	0.0142	237.2051	41.3099	5.1071	905.7431	698.0539	850.6753
0.4984	0.0206	0.0138	231.5514	41.1969	5.0685	873.3035	692.7650	820.2080
0.5313	0.0205	0.0158	263.1967	41.0962	5.0298	1035.5016	687.4761	972.5446
0.52	0.0205	0.0142	236.3404	41.0718	5.0298	905.7431	687.4761	850.6753
0.5224	0.0206	0.0143	238.6039	41.2244	5.0685	913.8530	692.7650	858.2921
0.5079	0.0205	0.0135	224.6162	41.0901	5.0298	848.9738	687.4761	797.3575
0.5118	0.0206	0.0126	210.3743	41.1786	5.0685	775.9846	692.7650	728.8060
0.5229	0.0206	0.0146	244.1226	41.2	5.0685	938.1827	692.7650	881.1426
0.546	0.0206	0.015	250.735	41.2061	5.0685	970.6223	692.7650	911.6100
0.5507	0.0206	0.0132	219.8859	41.1115	5.0685	824.6441	692.7650	774.5070
0.5431	0.0206	0.0139	231.0506	41.1512	5.0685	881.4134	692.7650	827.8248
0.5431	0.0206	0.0136	226.4473	41.1145	5.0685	857.0837	692.7650	804.9743
0.5507	0.0206	0.0118	197.3785	41.1451	5.0685	711.1054	692.7650	667.8713
0.5492	0.0205	0.0137	228.1259	41.0321	5.0298	865.1936	687.4761	812.5911

Table C-52. Corehole #2 at 55/45 feet.

FULLER WARREN BRIDGE

SHEAR DEVICE TEST RESULTS

		Penetration		(calculated)	0.106303614	x penet(0.0591)		
		Height H_2O		34 (ft)		Unit Wt H_2O	62.4 (lb/ft3)	
		Length Pipe		55 (ft)		Unit Wt Rod	2.96 (lb/ft)	
		Penetration Depth		0.0591 (in)		Cylinder Bore A	4.72 (in2)	
		Stud Cap Area		0.1964 (in2)		Shear Stud Area	1.064734229	
		No. of Studs		42		Normal Stud Area	0.007316266	
		Weight of Instrum.		38		qu (psi)	376	
LVDT (in)	Pressure (volts)	Load (volts)	Est. Load (psi)	Est. Press. (psi)	Normal Force (lb)	Shear Force (lb)	Normal Stress (psi)	Shear Stress (psi)
0.2742	0.0235	0.0002	3.5096	47.0595	6.1906	-229.6434	846.1420	-215.6815
0.2781	0.0236	0.0003	4.7304	47.1084	6.2293	-221.5335	851.4309	-208.0646
0.2608	0.0236	0.0008	13.3518	47.2304	6.2293	-180.9840	851.4309	-169.9805
0.3154	0.0234	0.01	165.8935	46.8886	6.1519	565.1271	840.8532	530.7683
0.3224	0.0235	0.0141	234.5348	46.9253	6.1906	897.6332	846.1420	843.0585
0.3303	0.0234	0.0113	195.2931	46.8307	6.1519	670.5559	840.8532	629.7871
0.3213	0.0234	0.0112	192.1358	46.8062	6.1519	662.4460	840.8532	622.1703
0.3217	0.0235	0.0131	218.4617	46.9314	6.1906	816.5342	846.1420	766.8901
0.328	0.0234	0.0119	197.9125	46.8368	6.1519	719.2153	840.8532	675.4881
0.3419	0.0234	0.0147	245.496	46.852	6.1519	946.2926	840.8532	888.7595
0.3464	0.0234	0.0143	247.6601	46.8276	6.1519	913.8530	840.8532	858.2921
0.3633	0.0234	0.0159	264.1886	46.8398	6.1519	1043.6115	840.8532	980.1615
0.364	0.0234	0.0153	254.2192	46.794	6.1519	994.9521	840.8532	934.4605
0.3581	0.0234	0.0144	239.5449	46.7544	6.1519	921.9629	840.8532	865.9090
0.3551	0.0234	0.0136	228.3084	46.8001	6.1519	857.0837	840.8532	804.9743
0.3643	0.0234	0.0173	288.1965	46.8215	6.1519	1157.1501	840.8532	1086.7972
0.3676	0.0233	0.0179	298.6745	46.5896	6.1132	1205.8096	835.5643	1132.4982
0.3842	0.0233	0.0165	275.1752	46.5316	6.1132	1092.2709	835.5643	1025.8625
0.3803	0.0234	0.0141	237.4657	46.791	6.1519	897.6332	840.8532	843.0585
0.3813	0.0234	0.0154	256.6607	46.8276	6.1519	1003.0620	840.8532	942.0773
0.3726	0.0234	0.0151	251.7014	46.8703	6.1519	978.7322	840.8532	919.2268
0.3991	0.0233	0.0174	290.231	46.6597	6.1132	1165.2600	835.5643	1094.4140
0.4142	0.0234	0.0159	264.3157	46.8123	6.1519	1043.6115	840.8532	980.1615
0.4177	0.0234	0.014	233.0088	46.7055	6.1519	889.5233	840.8532	835.4416
0.4116	0.0233	0.0148	247.1745	46.6262	6.1132	954.4025	835.5643	896.3763
0.4182	0.0233	0.0139	232.017	46.614	6.1132	881.4134	835.5643	827.8248
0.4267	0.0234	0.0145	241.5031	46.7116	6.1519	930.0728	840.8532	873.5258
0.4418	0.0233	0.0167	278.3797	46.5987	6.1132	1108.4907	835.5643	1041.0962
0.4512	0.0233	0.0154	256.2029	46.5651	6.1132	1003.0620	835.5643	942.0773
0.4467	0.0233	0.0146	243.6649	46.6079	6.1132	938.1827	835.5643	881.1426
0.4421	0.0234	0.0147	245.4705	46.7818	6.1519	946.2926	840.8532	888.7595
0.4459	0.0233	0.0137	228.6091	46.6872	6.1132	865.1936	835.5643	812.5911
0.4471	0.0233	0.0134	222.7088	46.6872	6.1132	840.8639	835.5643	789.7406
0.4535	0.0234	0.0147	245.1399	46.791	6.1519	946.2926	840.8532	888.7595
0.4734	0.0233	0.0147	244.6059	46.5133	6.1132	946.2926	835.5643	888.7595
0.4795	0.0233	0.0155	258.3392	46.5407	6.1132	1011.1719	835.5643	949.6941
0.4886	0.0233	0.0147	244.733	46.6018	6.1132	946.2926	835.5643	888.7595
0.4909	0.0233	0.0138	230.6436	46.6079	6.1132	873.3035	835.5643	820.2080
0.482	0.0233	0.0133	222.0222	46.5255	6.1132	832.7540	835.5643	782.1238
0.492	0.0233	0.0143	238.375	46.5957	6.1132	913.8530	835.5643	858.2921
0.502	0.0232	0.0158	263.3239	46.4431	6.0745	1035.5016	830.2754	972.5446
0.5219	0.0232	0.0145	240.8419	46.4553	6.0745	930.0728	830.2754	873.5258
0.5078	0.0232	0.0136	226.7271	46.4766	6.0745	857.0837	830.2754	804.9743
0.5118	0.0232	0.0157	261.798	46.4492	6.0745	1027.3917	830.2754	964.9278
0.5109	0.0232	0.0139	231.3303	46.4705	6.0745	881.4134	830.2754	827.8248
0.5187	0.0232	0.0137	228.5582	46.3088	6.0745	865.1936	830.2754	812.5911
0.5449	0.0232	0.0161	268.156	46.3607	6.0745	1059.8313	830.2754	995.3952

APPENDIX D
OPERATIONS AND MAINTENANCE

Rock Shear Device: Components and Descriptions

The following are the main components of the equipment
The Shear Device
The 10,000 psi Hydraulic Jack and Cylinder with 1” thick steel base plate containing threaded steel hook (circular)
The Winch (60’ capacity) with tripod attachment and pulley with closing hook connector
Data Collection System (includes Laptop, Electronic Box, NIDAQ Hardware and Software
1 1/4” Steel Rods (60’ – 5’lengths)
1” Threaded Rod (5’)
Steel Rod to Threaded rod connector
Shear Device adaptor with cable connector for winch and threaded connector to Steel Rods
Inverter
Marine Rechargeable Batteries (2)
12 volt DC Supply
200 psi Regulator
60’ air conduit with male and female detachable connectors (2)
Air Compressor (175 psi capacity)
Sturdy Aluminum Tripod (5’ high)
Specialized Tool Kit with key tools assembled for all required activities

Component Description

The RSD is comprised of the upper and lower chambers. The upper chamber and connectors house the electronic measurement instruments and the lower chamber houses the expandable rubber bladder, steel sheet Chinese lantern and steel hardened shear studs with stainless steel springs. The cylindrical lower chamber is made in two halves that are held together by screws and both ends. The two halves facilitate easy assembly and maintenance.

The Hydraulic Jack and hollow cylinder is used to lift the device and connecting rods during testing. A 500 psi pressure transducer is connected to the jack via pipe threads at the chamber designated for housing a measuring device. The cylinder contains a 1.06” central hole which facilitates the threaded rods connected to the steel rods. The inner tube of the cylinder moves up under pressure from the jack and applies the pressure to the rods. The inner tube is also connected to an LVDT via a removable split connector controlled by screws. The base Figure of the cylinder sits on an aluminum top plate fixed to the tripod. The top plate contains a central hole about 3 ½” in diameter with two slots to allow for shifting of the cylinder to expose the central hole when necessary.

The winch is used to lower and lift the device and connecting rods at the start and end of testing respectively or to lift the device to a new testing location in the core hole. It is remote control operated and is capable of lifting over 10 tons. It is secured to the tripod via "I" sections and threaded bolts along with chains for added security. It has an operating capacity of 60' with an additional 3' wrapped around the core that should never be unwounded during use. The top of the winch cable is connected to a close ended hook that runs over a pulley that is secured to the top plate of the tripod via a circular closed hook threaded to the 1" thick steel base plate of the cylinder.

The data collection system includes a laptop computer with the NIDAQ/Labview data collecting software along with Microsoft Excel for storage of the raw data. The NIDAQ hardware was configured to run the required measuring instruments for use in both the shear test and the mapping device. The transducers etc. are connected to the Hardware and an electronic box containing filters, resistors and connections to a 12 volt supplier.

The 1 1/4" outer diameter steel rods supplied in 5' lengths are used to provide a rigid extension of the device to the testing depths. The rods have removable double ended threads convenient and flexible for use with other connectors.

The 5' thread rod is used through the hollow cylinder for adjustment of the device at any depths within 5 foot i.e., 2.1' or 43.4'. This is required for the flexibility of testing at the encountered depth of the rock.

One of the removable tapered box threads of the steel rods was used to form the connector to the 1" threaded rods by welding a cut end to 3" nut that fits the threaded rod.

The RSTD adaptor has a ½ - 28 female threaded end connected to a male box thread that connects to the rods. This piece also carries a swinging "U" hook that is connected to a 2 foot cable with metal loops at both ends. The free end is connected to the winch by the hook.

The voltage supply on site is provided by 2 low maintenance marine batteries; one supplies the winch and the other supplies the electronic data collection system. An inverter is used to convert the DC voltage supplied from the battery to an AC voltage to the computer and the voltmeter.

The battery operated compressed air supply is connected to a 200psi regulator that controls the two pressure lines to the device. The regulated pressure is connected to the device via two 60' long air conduits that have reusable snap connectors at both ends.

The aluminum framed tripod has been upgraded be more user-friendly; it now carries a mount for the jack, the string pot and winch in a more convenient manner with respect to assembling and disassembling.

The customized tool kit carries all the necessary tools for assembling the setup on site and also tools for maintenance and repairs. It has two compartments; the lower one is used for all the sensitive data collection hardware and wires and the upper used for basic tools such as spanners, wrenches, pliers, screw drivers, hammers allen-keys, plumbing and electrical tapes etc. The kit has a retractable handle and can be carried around on its two rear wheels.

Rock Shear Testing: Field Operation

Guidelines to the proper operation and use of the device are listed below. For safety of use it is important that the following guidelines and sequence of operations be observed:

Load the compressor and the tripod into the back of the pickup truck using a fork-lift. Check and ensure that all relevant tools are replaced in the tool kit and placed the kit inside the pickup on the back seat. Lay the shear device and the mapping device gently on the floor of the pickup alongside the back seat. Load the rods, winch, batteries and jack and air conduits in the back of the pickup in an orderly manner conducive for quick setup. Before mobilizing to site ensure that the batteries are fully charged, that the motor for the compressor meet the required oil and gas levels. Take along an additional supply of oil and gasoline sufficient for the compressor to carryout a day's work. Ensure that the vehicle has a tarpaulin or similar plastic cover in case of inclement weather.

On reaching the site, backup pickup truck about 10' from corehole location. Carefully unload the tripod (heavy, may require two people) from the back and setup over corehole. Use the 2x12 inch lumbers below each base plate and level tripod (this process could require more lumber). Check that the center hole in the top plate of tripod is centrally aligned with the corehole (the use of a plumb line may be necessary). Unload the tool kit from the pickup rear seat and place beside the tripod and open.

Mount the winch at the right corner horizontal support of the tripod using the three threaded rods and steel sections attached to the winch. The winch is secured with a lock wrench and the large adjustable spanner. Use the provided chain to wrap around the body of the winch as close as possible without covering the cable outlet area for added security.

Mount the Jack on the right leg of the tripod using the provided 4" screws and the connection plates. Place the cylinder on the top plate over the center hole and connect the pressure hose from the jack to the cylinder and secure. Ensure that the circular hook screwed into the cylinder base plate is inside one of the slots in the top plate; this slot allows the sliding movement of the cylinder from the center hole when required. The small adjustable spanner is required here.

Mount the String Potentiometer on the center leg of the tripod by sliding the groves from the attached support plate through the two exposed nuts and then tighten. Ensure that the small rod with the attached string pulley is fully retracted. Small adjustable spanner is required here.

Unload the two batteries from the truck and place them at the base of the tripod below the laptop platform. Connect one battery directly to the winch using the battery leads from the winch and ensure that the positive and negative leads from the winch go to the positive and negative terminal of the battery respectively. Connect the inverter to the other battery via the positive and negative leads, again ensuring proper connection. Plug the surge protector into the inverter and ensure that both are in the off positions.

Connect the regulator to the top plate using the provided mount and the two screws; a Phillips screw driver is required here.

Connect the hose from the Air Compressor to the regulator and secure (click sound). Check the valve under the cylinder of the compressor to ensure that it is closed (not tightened).

Remove the laptop from its case and place on the platform connected to the tripod. Plug the power cord into the computer and the other end into the surge protector. Place the NIdaq hardware onto the platform along with the electronic black box and the 12 volt power supply. Plug the mouse into the laptop and place on the platform with the mouse pad. Plug the power cords from the NIdaq hardware and the 12 volt supply into the surge protector. Connect the power line from the black box to the 12 volt supply ensuring that the red and black wires connect to the red and black terminals respectively.

Connect the 200psi pressure transducer from the regulator to the black box using the eight connector end on the right side of the box. Connect the 500psi pressure transducer to the black box using the eight connector end on the left side of the black box. Connect the LVDT end cap to the LVDT which is secured on the Cylinder and the other end to the black box using the three pin end connector. Connect the eight pin (with double wires) male connector from the Nidaq hardware to the black box and secure. Connect the four pin single wire from the Nidaq hardware to the four pin round connector on the black box.

Turn on the inverter and the surge protector. Power on the computer and wait until Microsoft windows is completely loaded. Plug in the white cord from the Nidaq hardware into the laptop and power on the hardware. Turn on the 12 volt supply. Double click the Icon labeled Shear Test on the desktop front panel and wait until the screen shows the static graph plots. Click on the "arrow" icon to start a test run to ensure that all instrumentation are engaged; notice a pause and then the generation of the active graphs reflecting the waveforms produced by noise. If static lines are seen in any of the graphs then something is wrong and the connections and wires need checking. Stop the test by clicking the red "stop" icon and saving as "check1" etc. At this stage zero the graphs using the allotted boxes on the screen for zeroing. The electronic setup is now complete and ready for testing.

Slide the hollow cylinder to the side of the top plate center hole along one of the slots to allow the rods to be lowered through there. Extend the cable from the winch and connect the pulley to the circular steel hook attached to the cylinder base Figure.

Place the shear device beside the core hole between the tripod legs and screw the "rod to shear device" adaptor to the top of the shear device. Connect the closed hook from the winch to the adaptor (with 2' cable end) at the end of the cable hook. Connect the 60' air lines to the air lines of the device and the other ends to the regulator. Plug the winch remote control in and lift the device up and then lower into the hole until only the rod connector is above ground.

Lower one of the rods through the center hole of the top plate and screw onto the rod adaptor from the device. With the first rod secured, use plastic clips to tie the air lines to the rods as the device is lowered down the hole with the winch remote. Make at least one tie on each 5' length of rod until the required depth is reached. Slide the cylinder back to the center (this will require some effort), and lower the 5' threaded rod onto the rods connected to the device. Connect these rods using the provided rod adaptor and place the depth adjusting cross piece on the top then whine it down to the top of the cylinder. The setup is now ready for testing.

Turn the key on the compressor to the on position and slide the choke forward to ignite the engine then return it to its original rest position; the key will return to the run position once the engine is started. Allow the compressor to stabilize to its maximum pressure before opening the compressor valve to the regulator. Push the "on" button on the electronic dial gauge attached to the regulator and set the initial test pressure; make sure to allow for the water pressure at the depth of testing.

Open the regulator valve then push the adjusting knob down and turn to the right to set the test pressure. Allow 10 seconds for the pressure to be stabilized in the system and for the shear studs to be fully engaged by the expanding pressurized bladder.

Click the "arrow" button on the front panel of the laptop and begin testing and simultaneously start applying load to the shear device via the jack. Carefully note the LVDT reading while loading; stop loading when the LVDT reading indicate about 0.75 to 0.9 inch displacement. Click the "stop" button on the front panel and open the pressure valve on the jack to lower the cylinder piston back to its zero position. Return the jack valve to its closed position and prepare the handle for the next test.

Turn the regulator pressure adjusting knob to the left and zero the shear device pressure (the threaded rod should then fall back to its zero position on the cylinder). Use the handle bar on the threaded rod to lift the shear device about ½" from its original position by turning it about two revolutions to the right.

Set the second test pressure (increase by about 5 psi) and repeat the testing procedure. For each location carry out at least 4 tests about 1/2" apart. At the end of testing a location, use the winch to lift the shear device to its new testing location. If necessary unscrew the threaded rod and remove one of the 5' rods and then replace the threaded rod. This will require shifting the cylinder to remove the 5' rod through the center hole of the top plate.

At the end of testing remove each rod and cut all plastic clip and place rods on the back of the truck; use a rag to wipe the water off the rods as they are lifted by the winch so as to reduce rusting.

CMD: Components and Descriptions

The components and their corresponding descriptions are similar to the direct shear device except for the following:
This is replaced by the mapping device

The jack and cylinder is not used in this test; the cylinder is kept in the shifted position throughout the test.

The 5' threaded rod is completely removed from setup during this test.

A pressure directional regulator is included to extend and retract the measuring

wheels.

CMD Test: Field Operation

Items 1 to 8 are repeated for the mapping test. The following is the remaining steps for carrying out the mapping operation:

Remove the laptop from its case and place on the platform connected to the tripod. Plug the power cord into the computer and the other end into the surge protector. Place the NIdaq hardware onto the platform along with the electronic **blue box** and the 12 volt power supply. Plug the mouse into the laptop and place on the platform with the mouse pad. Plug the power cords from the NIdaq hardware and the 12 volt supply into the surge protector. Connect the power line from the blue box to the 12 volt supply ensuring that the red and black wires connect to the red and black terminals respectively.

Connect the String Pot to the blue box using the four connector end on the right side of the box. Connect the electrical cord from the mapper to the blue box using the six connector end on the left side of the black box. Connect the male ended connector from the Nidaq hardware to the blue box and secure.

Turn on the inverter and the surge protector. Power on the computer and wait until Microsoft windows is completely loaded. Plug in the white cord from the Nidaq hardware into the laptop and power on the hardware. Turn on the 12 volt supply. Double click the Icon labeled Mapping Test on the desktop front panel and wait until the screen shows the static graph plots. Click on the "arrow" icon to start a test run to ensure that all instrumentation are engaged; extend the string from the pot and check if the height of the graph varies with the extension. If the graph remains in one vertical level during this test then something is wrong and the connections and wires need checking. Otherwise stop the test by clicking the red "stop" icon and save it as "map1" etc. The electronic setup is now complete and ready for testing.

Slide the hollow cylinder to the side of the top Plate center hole along one of the slots to allow the rods to be lowered through there. Extend the cable from the winch and connect the pulley to the circular steel hook attached to the cylinder base Figure.

Place the CMD beside the core hole between the tripod legs and connect the string pot to the closed hook on the adaptor. Connect the closed hook from the winch to the adaptor (with 2' cable end) at the end of the cable hook. Connect the 60' air lines to the air lines of the device and the other ends to the regulator. Plug the winch remote control in and lift the device up and then lower into the hole until only the rod connector is above ground.

Lower one of the rods through the center hole of the top plate and screw onto the rod adaptor from the device. With the first rod secured, use plastic clips to tie the air lines to the rods as more rods are added and the device is lowered down the hole with the winch remote. Make at least one tie on each 5' length of rod until the required depth is reached.

Turn the key on the compressor to the on position and slide the choke forward to ignite the engine then return it to its original rest position; the key will return to the run position once the engine is started. Allow the compressor to stabilize to its maximum pressure before opening the compressor valve to the regulator. Push the "on" button on the electronic dial gauge attached to the regulator and set the air spring pressure; make sure to allow for the water pressure at the depth of testing.

Open the regulator valve then push the adjusting knob down and turn to the right to set the test pressure. Allow 10 seconds for the pressure to be stabilized in the system and for the measuring wheels to be in full contact to the core wall surface.

Click the "arrow" button on the front panel of the laptop and begin testing by simultaneously clicking the winch remote into the lifting operational position. Allow the mapping to occur slowly and be alert for any abrupt stopping of the device due to extension of the mapping or positioning wheels into a crack or void. At the end of a five foot run stop the test, save the data and remove the extended rod above the top plate. While testing, carefully observe the displacement graph and note where full extension of the mapping wheels has occurred (about ¾" extension). If necessary, reduce the air spring pressure as the device is lifted to allow for the reduced water pressure (about 2 psi every 5' run).

At the end of testing remove each rod and cut all plastic clips and place rods on the back of the truck; use a rag to wipe the water off the rods as they are lifted by the winch so as to reduce rusting.

Rock Shear Device: Maintenance

On completion of the field testing, the likely hood is that the device would have been submerged. The device is not water sealed and soil suspensions and would have gotten inside the chamber wetting all the parts including the rubber bladder and the hardened studs. The other parts are all stainless steel and would not be affected by the moisture however the rubber will lose its elasticity and become brittle if the soil in suspension is left to dry on its surface persistently and the studs would begin to rust within 24 hrs. of exposure to moisture without immediate (within 2 to 3 hrs. after testing) cleaning and drying.

The device should be given an initial power wash to remove mud etc. from the internal and external surfaces, wiped and dried. Place the device on a table and open the split chamber at the top and bottom connections using a Phillips screw driver. The studs with the springs attached should be placed in a bucket of water and allow to be soaked free of mud. Remove the springs from the studs, wipe and dry with a clean piece of cloths and replace the dried springs. Take the body of the device to the power hose and wash cleanly; this will require making space between the Chinese Lantern steel sheets and washing the rubber bladder as best as possible. Dry the body of the device and place it on the table alongside the spilt chamber semi circular covers. Use the wooden stud templates to hold the spring fitted studs in place during the assembling of the two semi-circular chamber covers. When assembling the chamber covers make sure to match the dotted marks on the covers to those on the circular supporting Figures at the top and bottom. This is very important otherwise the screws will not match nor fit the respective threaded holes.

Corehole Mapping Device: Maintenance

Maintenance of this device generally does not require disassembling; all the relevant parts are either aluminum or stainless steel. For continuing operation the collection of mud particles on parts such as the traveling rods will affect the sliding mechanism of the wheel support. Clogging of the instrument with lumps of mud (wet or dry) could also affect the movement of the measuring wheel. Areas around the spring controlled guiding wheels should be power washed periodically (after every set of tests) to allow for unobstructed movement.

The distance between the magnetic field sensor (Hall Sensor) and the magnet is fixed; the embedded sensor in the plastic rod and the glued magnet in the arms of the measuring wheel should not be interfered with or adjusted. This distance was set by calibration and it allows the instrument to operate within the linear portion of the sinusoidal wave produced when the Hall Sensor passes through the magnetic field.

To disassemble, the arms of the measuring wheels have to be unscrewed and removed from both sides. The top Figure which supports the core of the instrument can then be unscrewed and lifted out from the cylindrical body to expose (but not separate) the compressed air conduits, the electrical wiring and the air spring cylinders. This should not be pressure washed but should be wiped with a wet cloth where necessary and brushed and cleaned (from clogs) with an appropriate small tool.

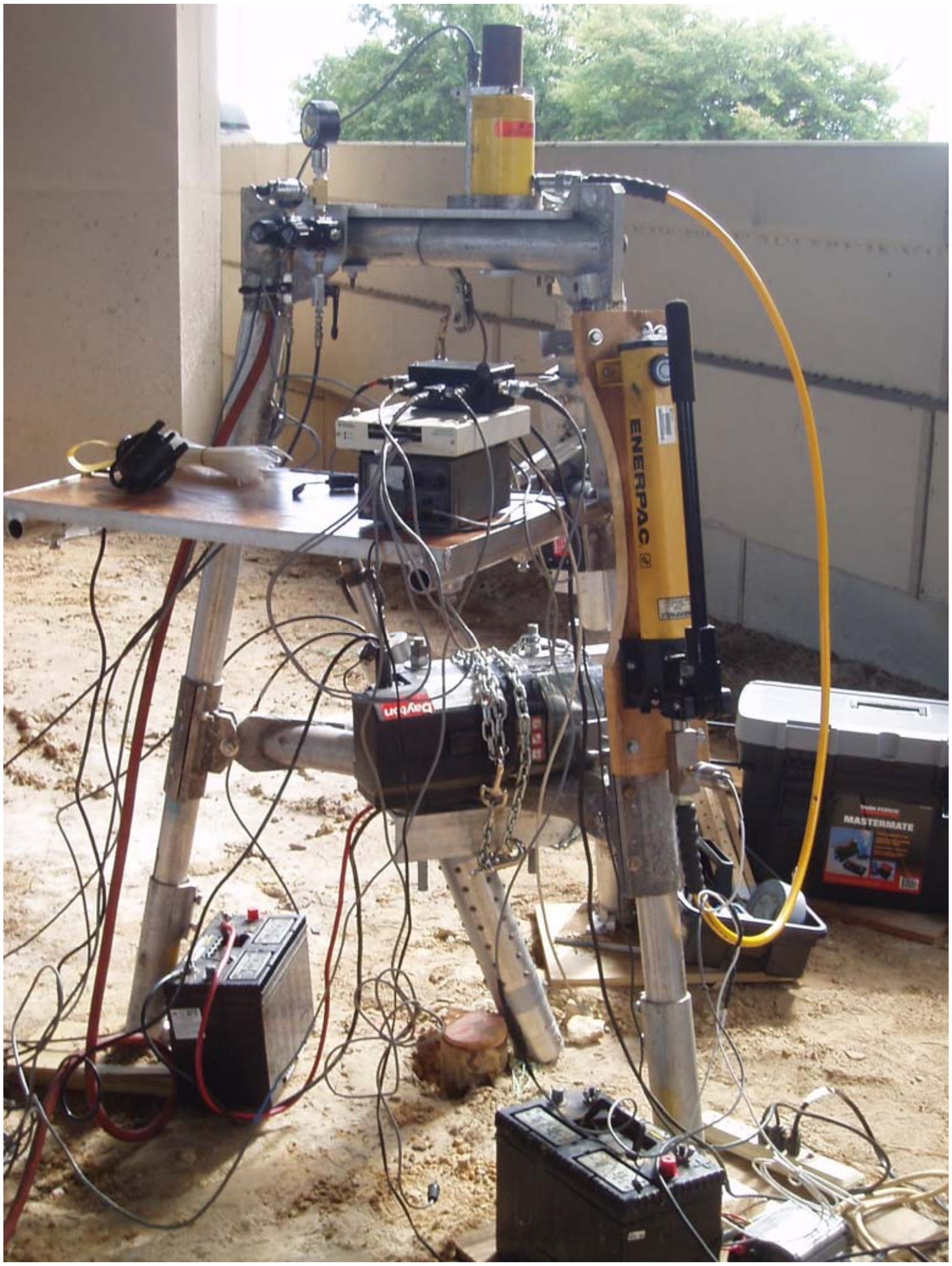


Figure D-1. Photo Showing Complete Component Setup in the Field.

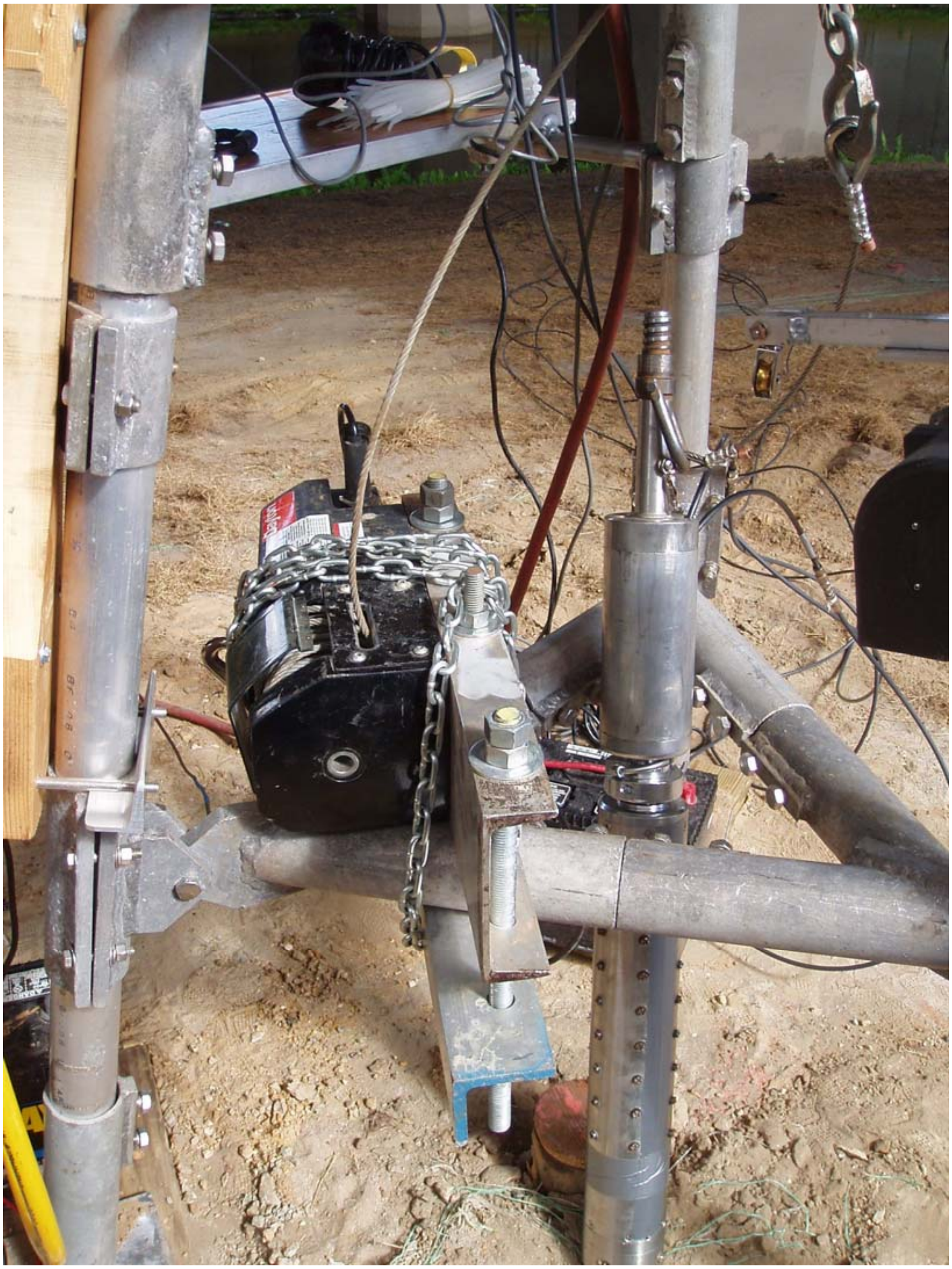


Figure D-2. Photo showing Shear Device Taped and Ready for Testing.

Figure D-3. Photo Showing Hydraulic Jack Connected to Leg of Tripod.

Figure D-4. Photos Showing Remote Controlled Winch with Tripod Connector.

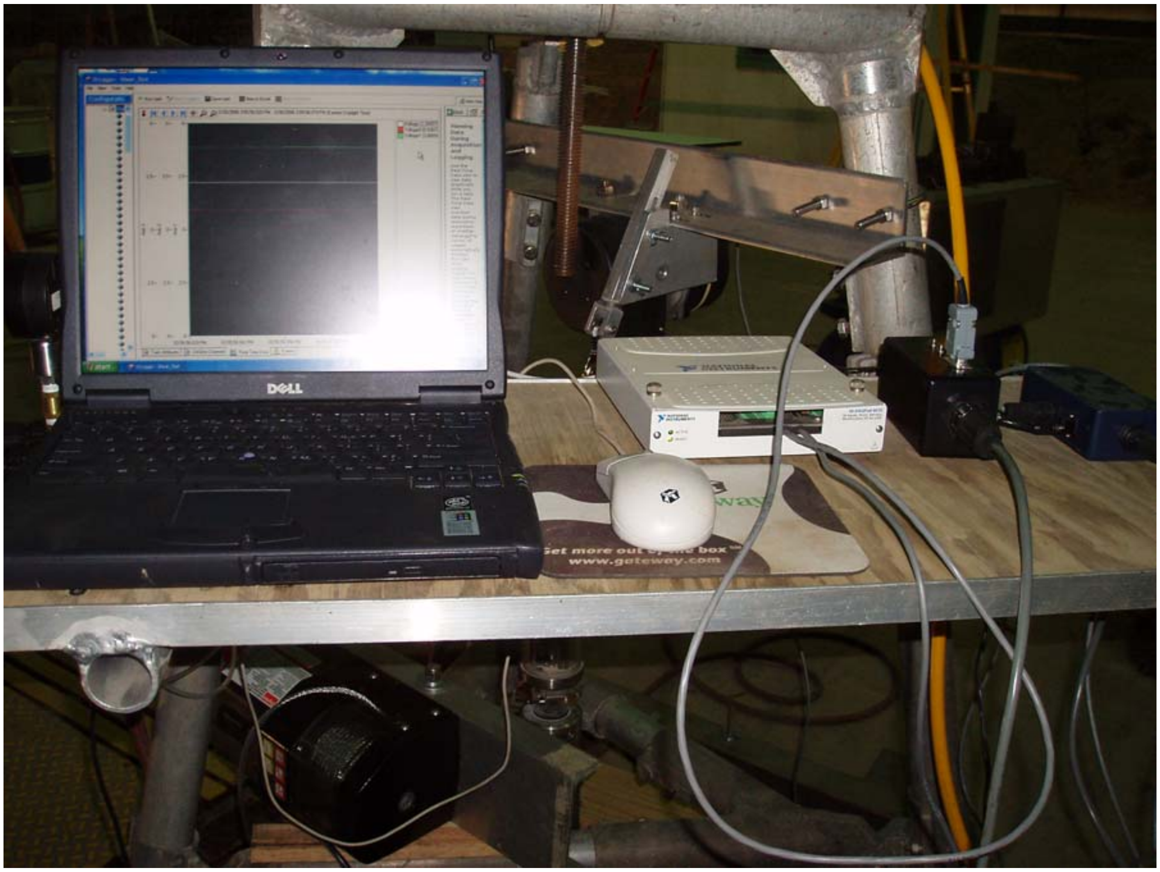


Figure D-5. Photos Showing Data Collection System with Laptop Computer and NiDaq Hardware.

Figure D-6. 6 foot Threaded Rod used for Shallow Testing Depths

Figure D-7. Photo Showing Shear Device Adaptor with Cable and Connector.

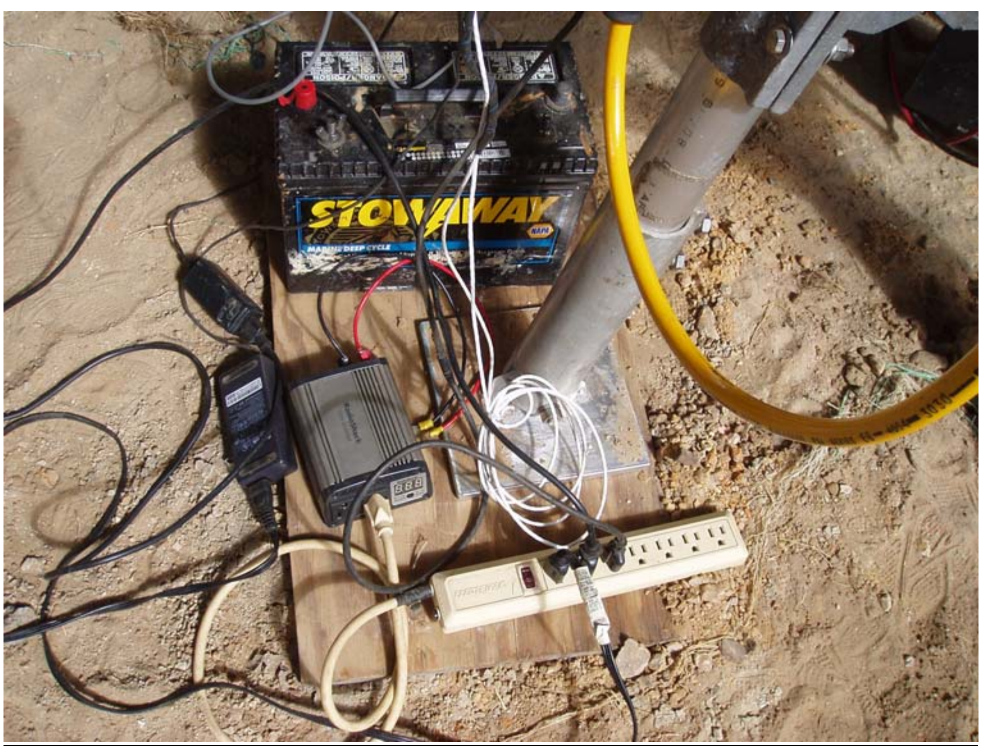


Figure D-8. Photo Showing Power Supply System including Batteries, Inverter etc.

Figure D-9. Photo Showing Air Regulator with Pressure Transducer and Digital Dial Gauge and Electronic Connector to Black Box.

Figure D-10. Photo Showing 175 psi Air Compressor.

Figure D-11. Photos Showing Mobile Tool Kit.

Figure D-12. Photo showing Data Collection connection Setup in Field.

Figure D-13. Photo Showing Winch Cable and Pulley Setup on Tripod.

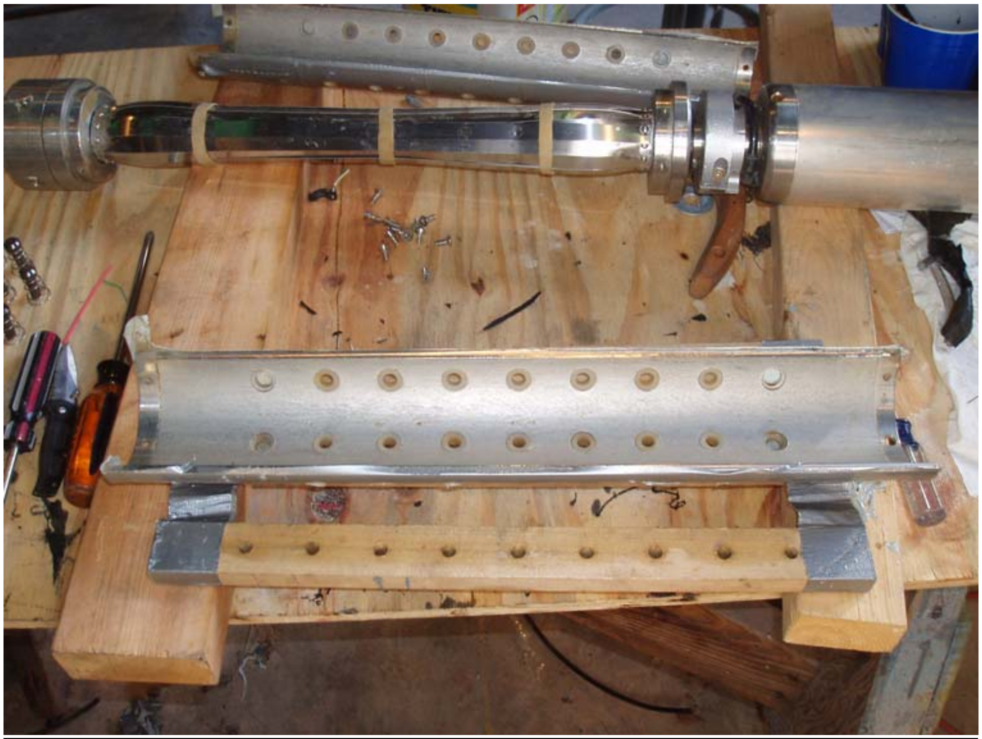


Figure D-14. Photo Showing Disassembled RSD with Chinese Lantern and Split Chamber Cylinder.

Figure D-15. Photo Showing Tapered Springs and on and off Studs.

Figure D-16. Photos Showing Wooden Template Used to Aid in Reassembling Device.

Figure D-18. Photo Showing Partially Reassembled Device.

Figure D-19. Photo Showing Cylinder with Base plate, Closed Hook and LVDT.

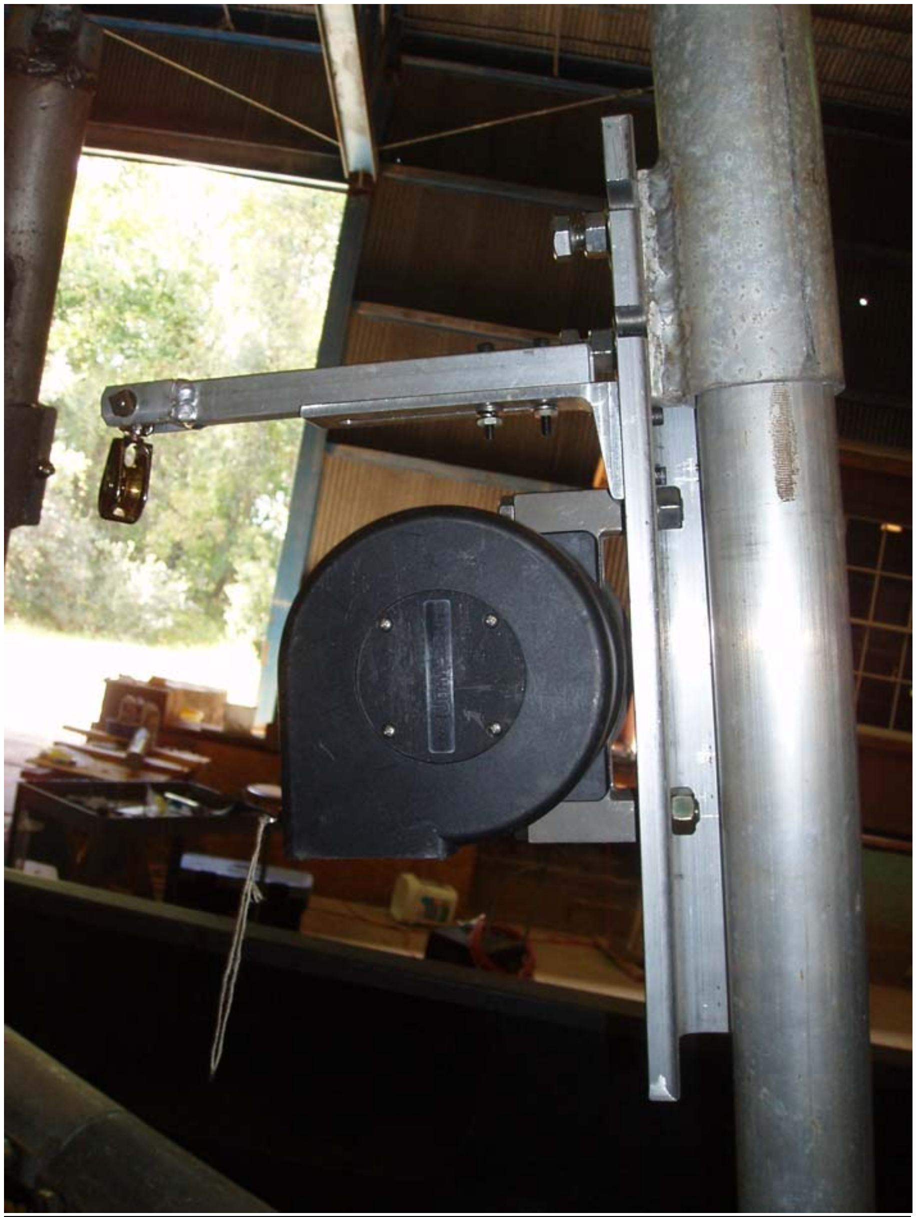


Figure D-20. Photo Showing String Pot and Pulley Connection.

Figure D-21. Photo Showing Jack and LVDT with Steel Base Plate attached to Tripod Top.

Figure D-22. Photo Showing Pressure Reversible Unit attached to Regulator.

APPENDIX E
17TH STREET BRIDGE SUMMARY RESULTS

Depth (ft)	Average Penet. Device Shear (psi)	Cal. Penet. Device Shear (psi)	McVays	Average Penet. Device Shear % diff.	Cal. Penet. Device Shear % diff.
54.0000	100	100	138	72.46	72.46
54.5000	102	102	105	97.14	97.14
55.0000	110	110	105	104.76	104.76
55.5000	130	130	139	93.53	93.53
58.5000	180	180	197	91.37	91.37
59.5000	420	420	169	248.52	248.52
60.5000	125	125	169	73.96	73.96

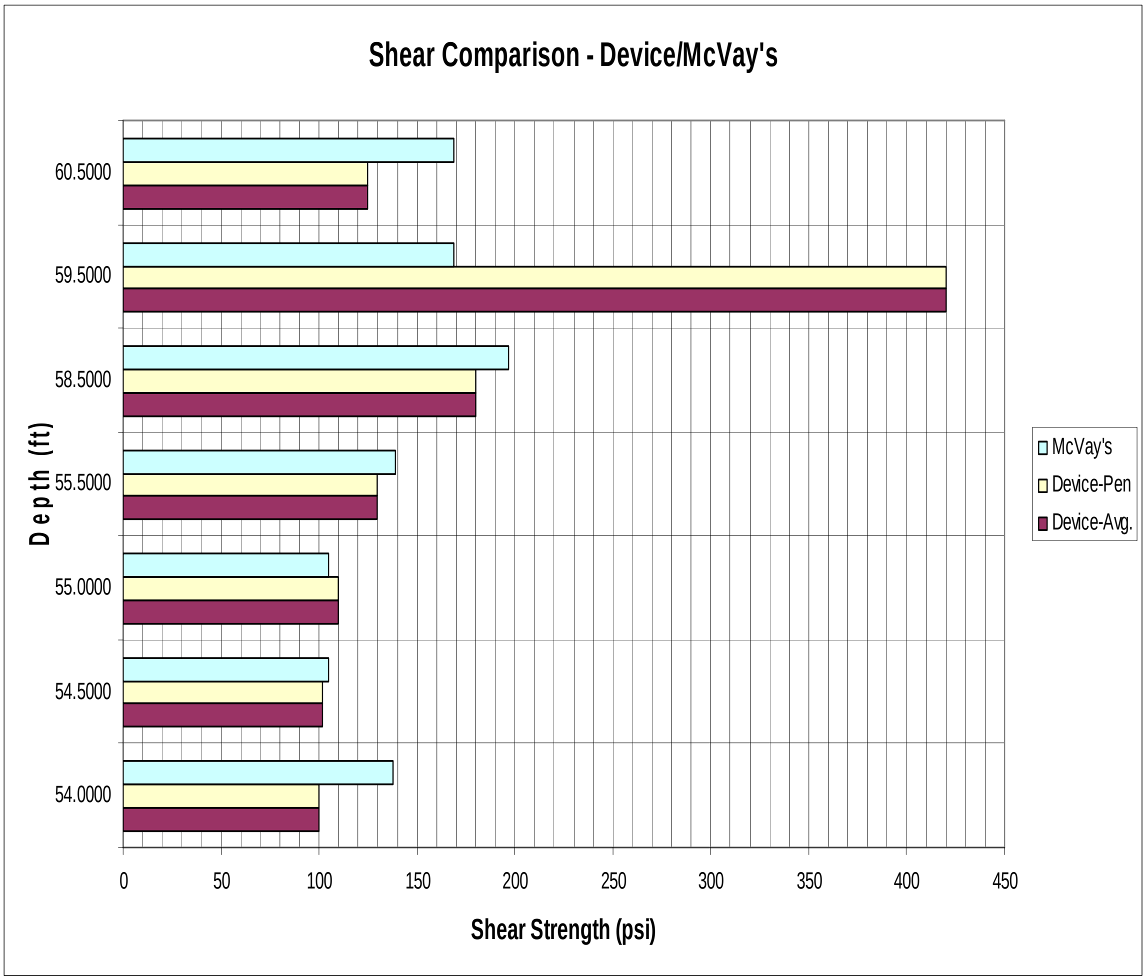


Figure E-1a. Corehole No. 4 Comparison Results: Device Shears vs McVay's Bar Chart

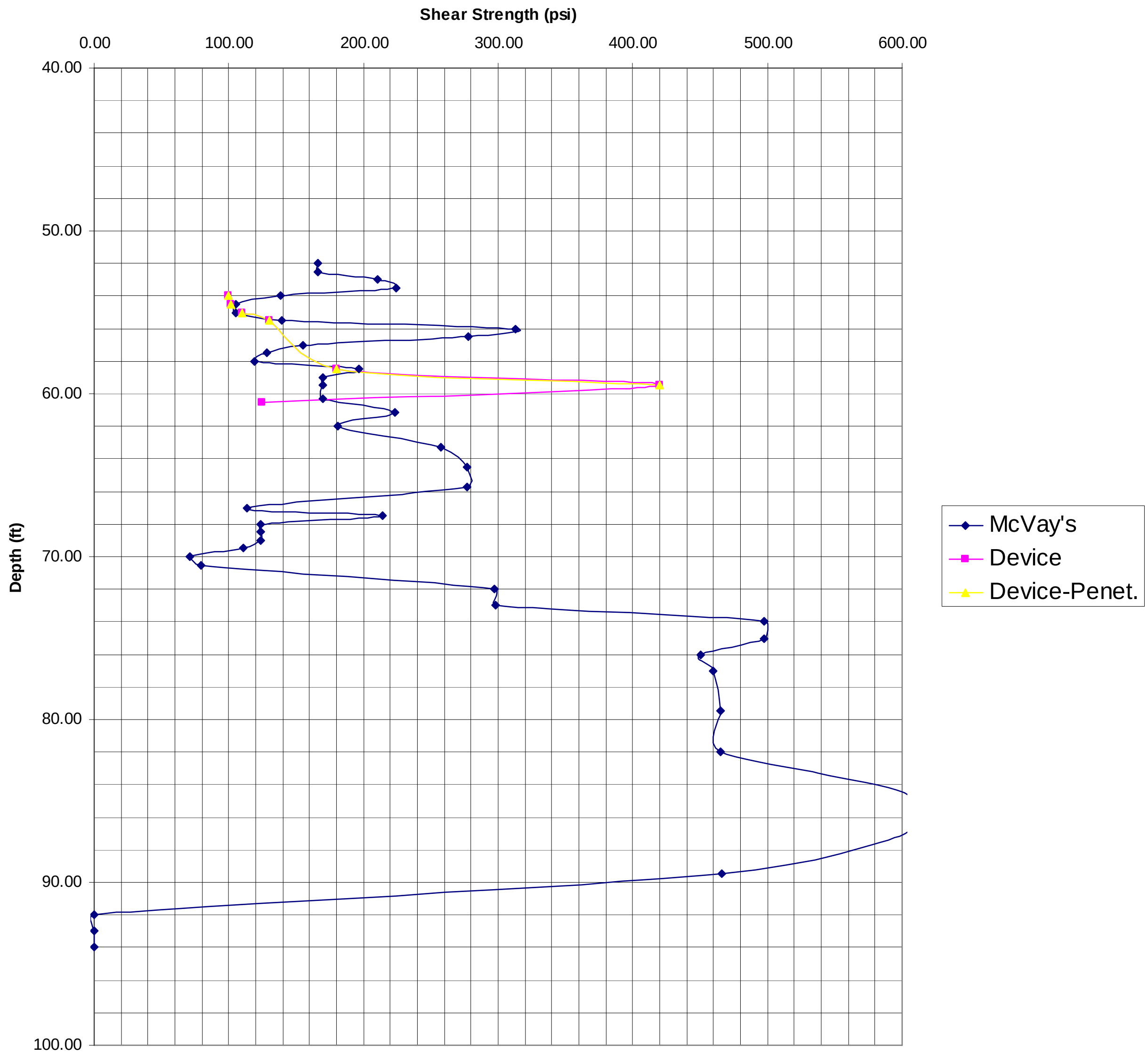


Figure E-1b. Corehole No. 4 Comparison Results: Device Shears vs McVay's Plot

Depth (ft)	Average Penet. Device Shear (psi)	Cal. Penet. Device Shear (psi)	McVays	Average Penet. Device Shear % diff.	Cal. Penet. Device Shear % diff.
57.00	325	325	316.7	102.62	102.62
57.50	162	162	169	95.86	95.86
58.00	160	160	169	94.67	94.67
58.50	135	135	169	79.88	79.88
59.00	175	175	182	96.15	96.15
59.50	135	135	147	91.84	91.84
60.00	135	135	147	91.84	91.84
61.00	170	170	170	100.00	100.00

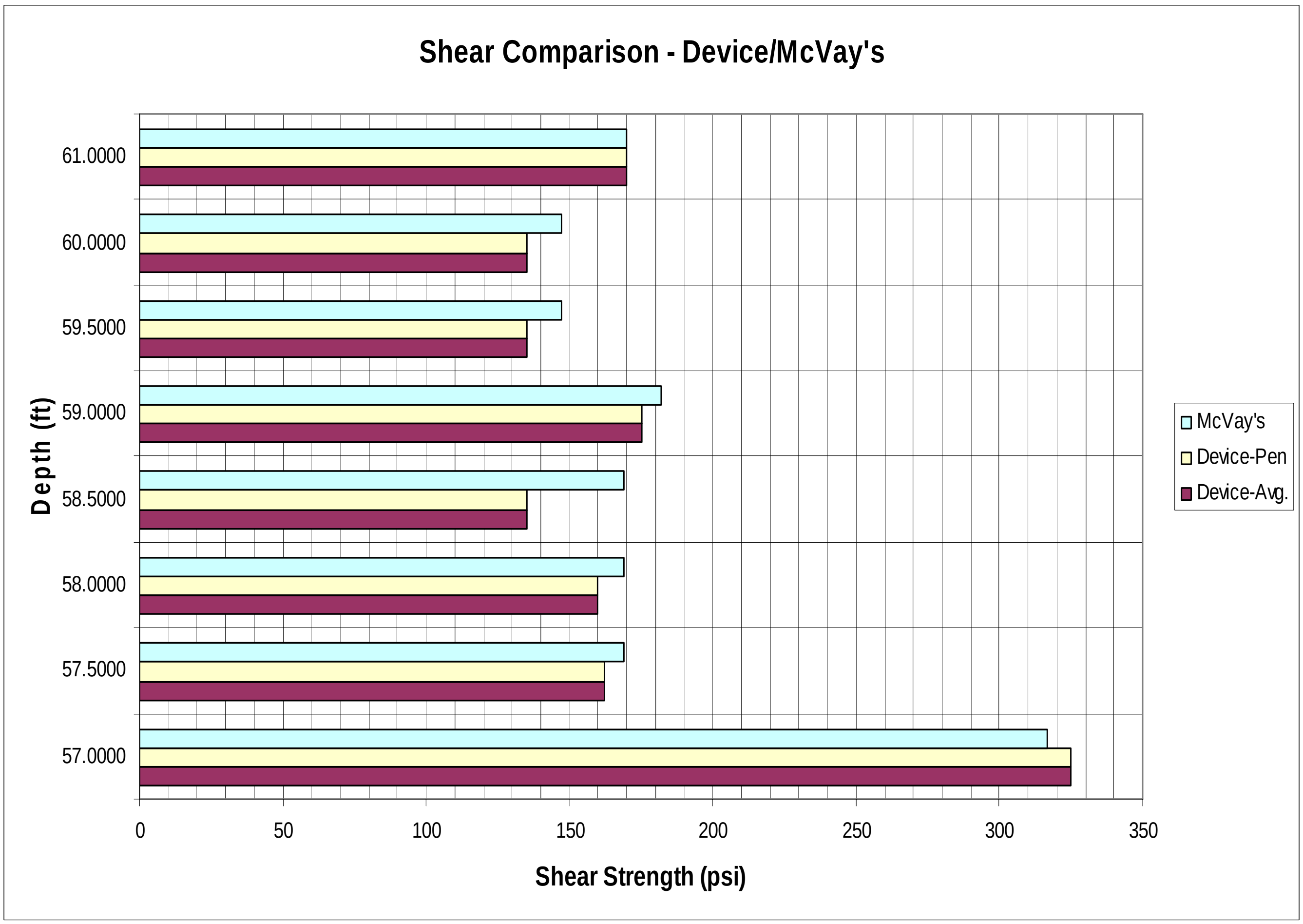


Figure E-2a. Corehole No.5 Comparison Results: Device Shears vs McVay's Shear Bar Chart

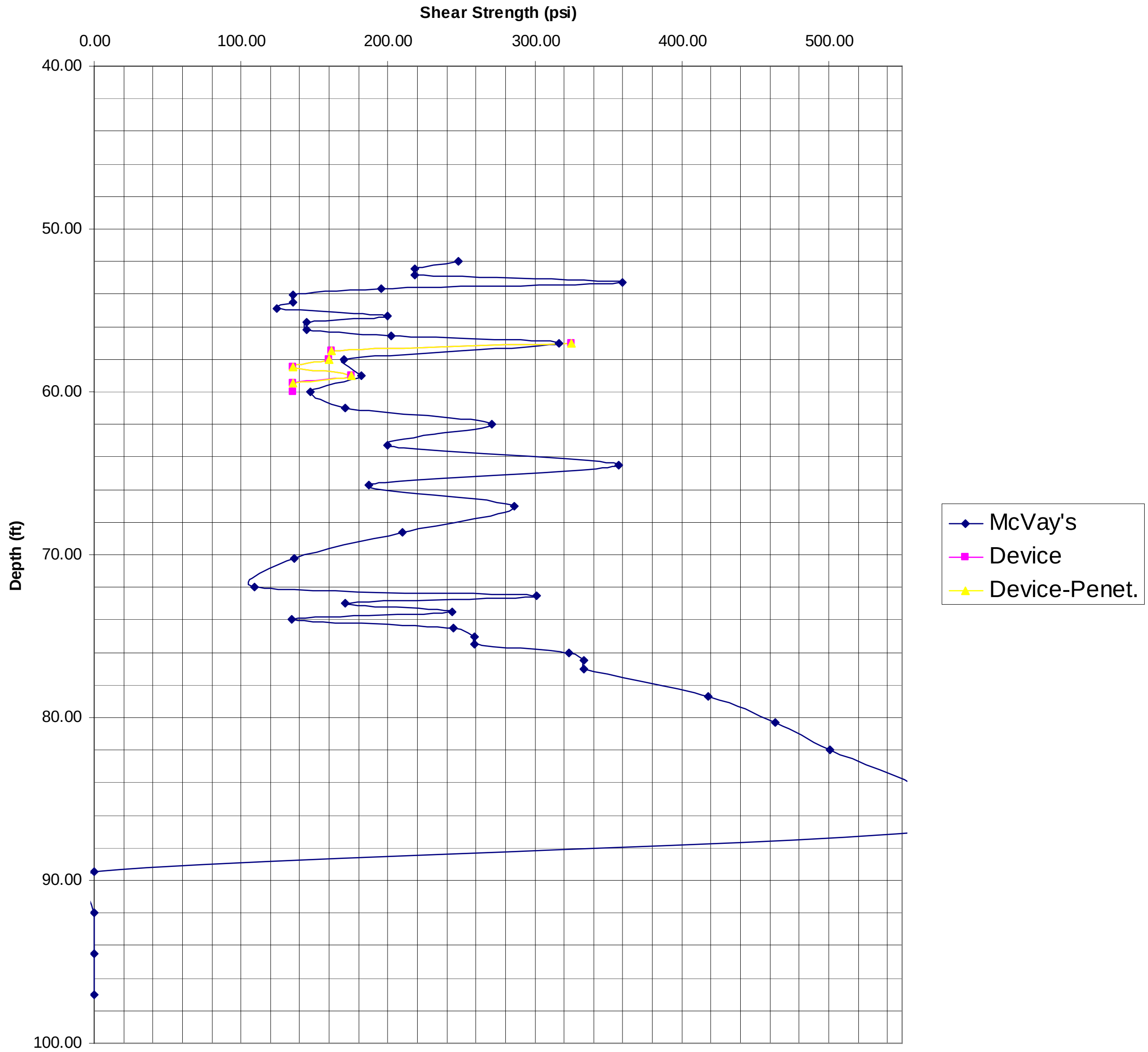


Figure E-2b. Corehole No.5 Comparison Results: Device Shears vs McVay's Plot

Depth (ft)	Average Penetration. Device Shear (psi)	Model Penetration Device Shear (psi)	McVays (psi)	Average Penet. Device Shear % diff.	Model Penetration Device Shear % diff.
56.50	152	152	155.7	97.62	97.62
57.50	210	210	224.7	93.46	93.46
58.50	260	260	294	88.44	88.44

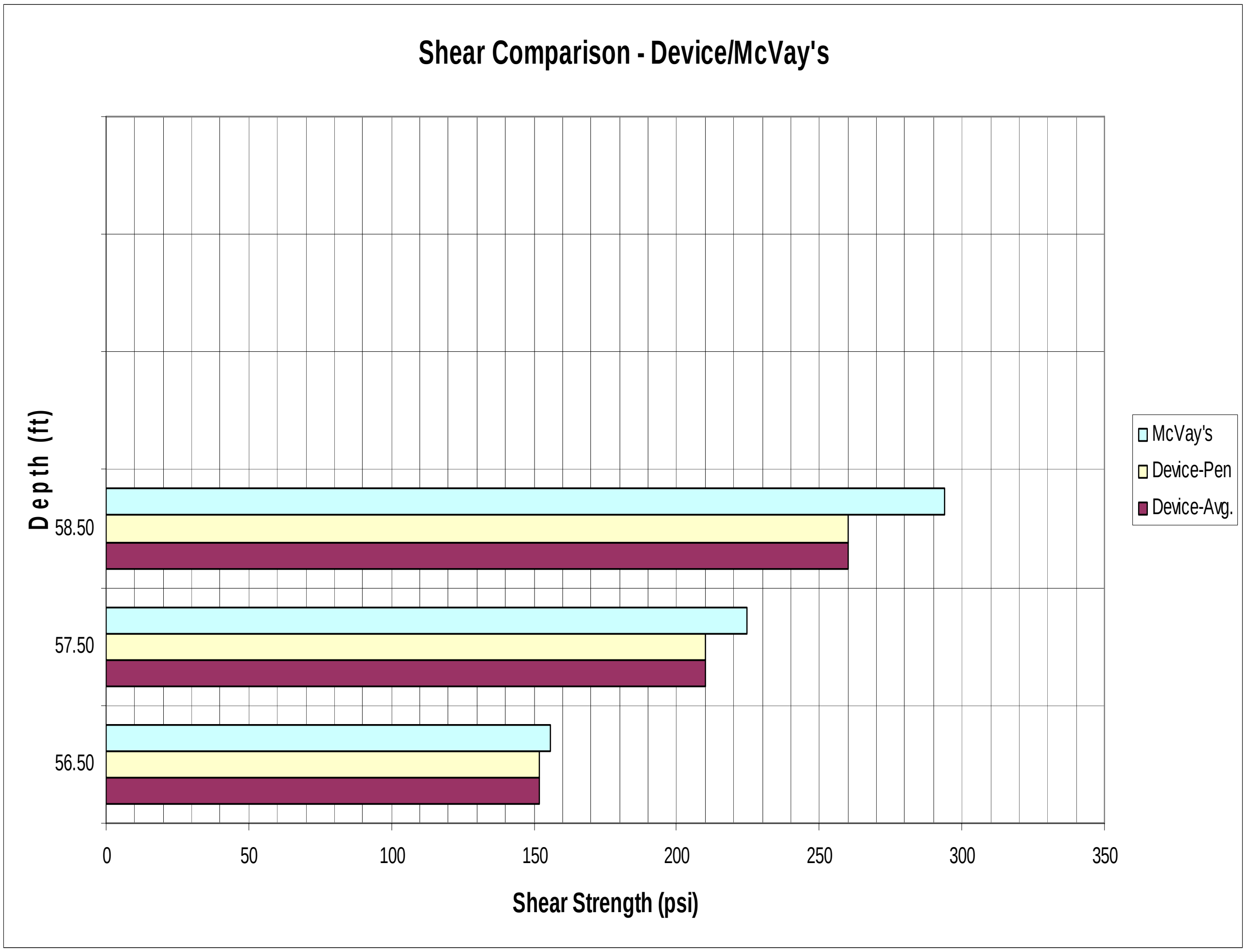


Figure E-3a. Corehole No.8 Comparison Results: Device Shears vs McVay's Bar Chart

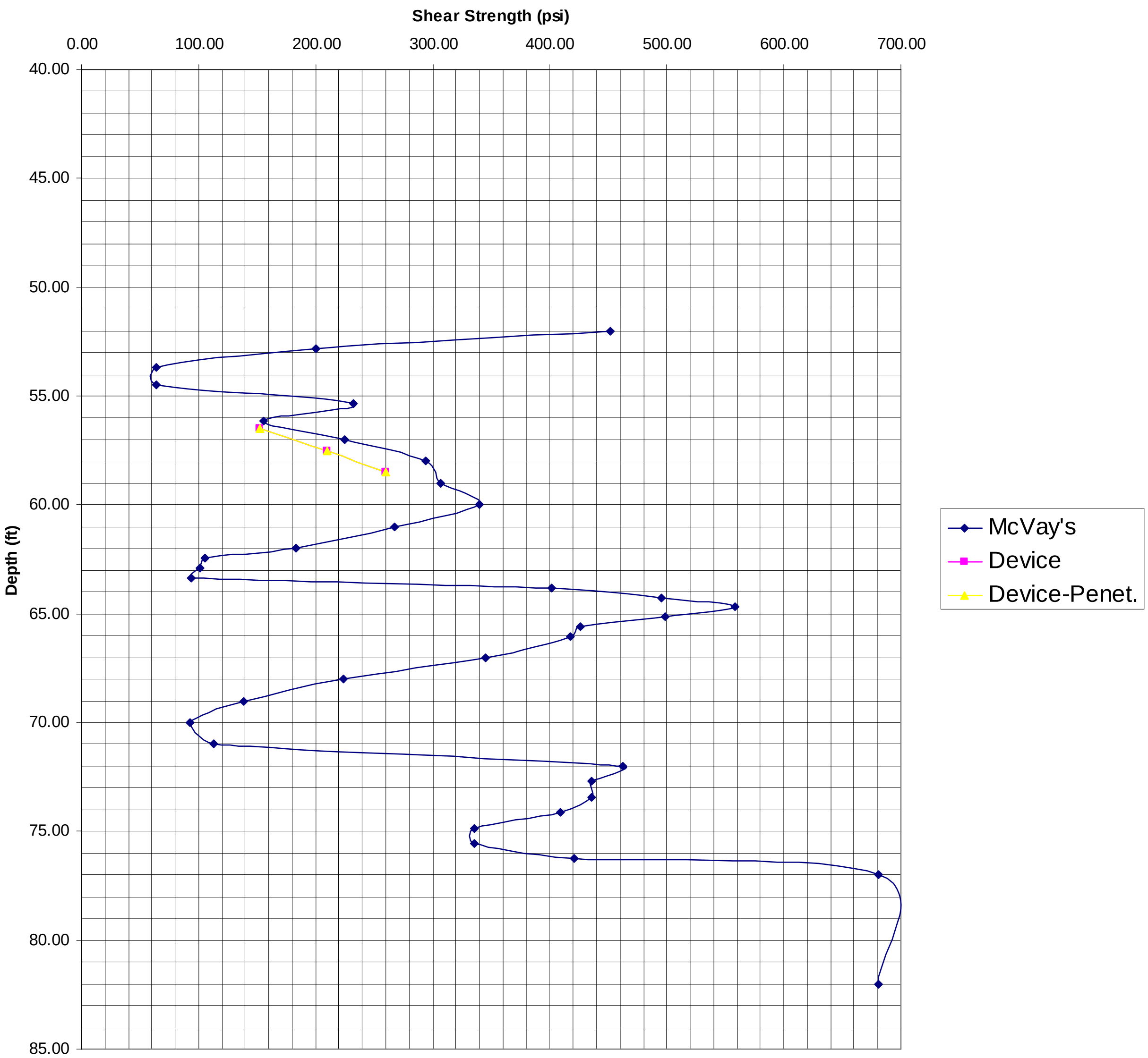


Figure E-3b. Corehole No.8 Comparison Results: Device Shears vs McVay's Shear Plot

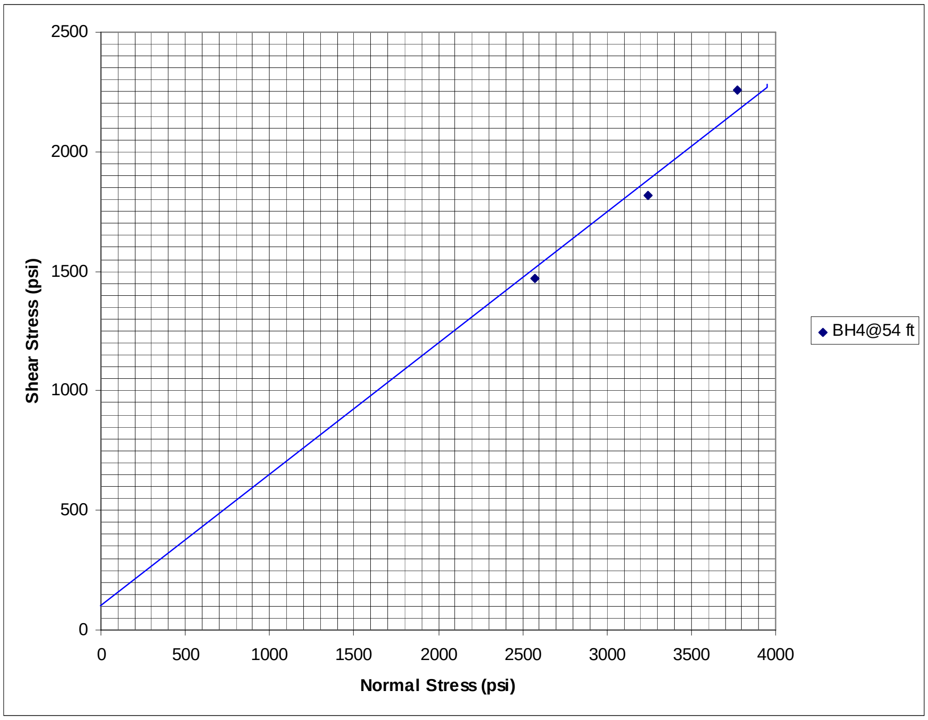


Figure E-1. Shear Stress vs Normal Stress; BH4@54’

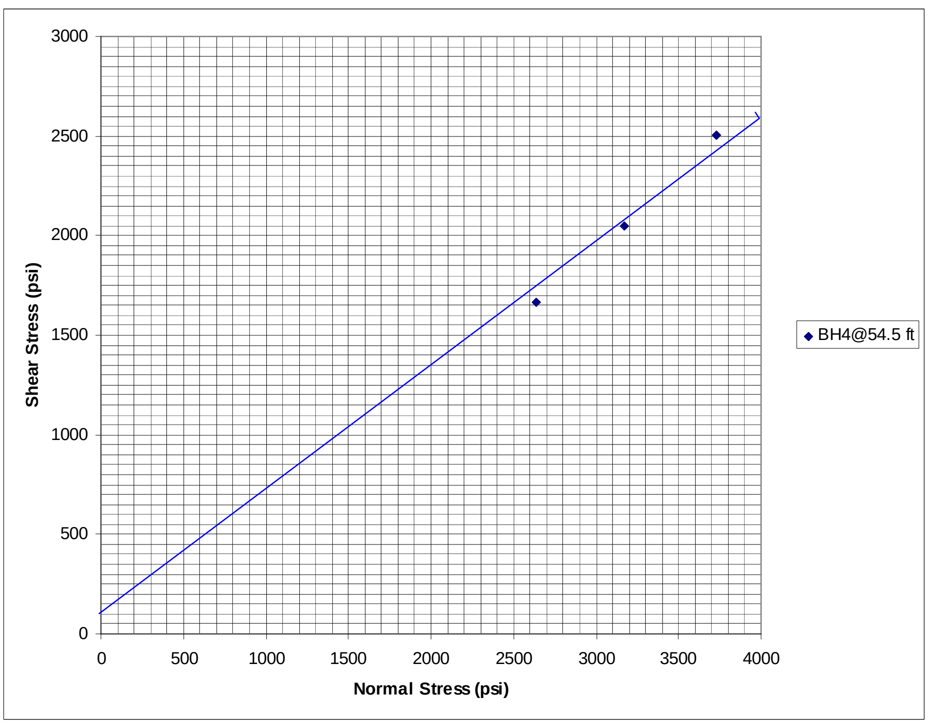


Figure E-2. Shear Stress vs Normal Stress; BH4@54.5’

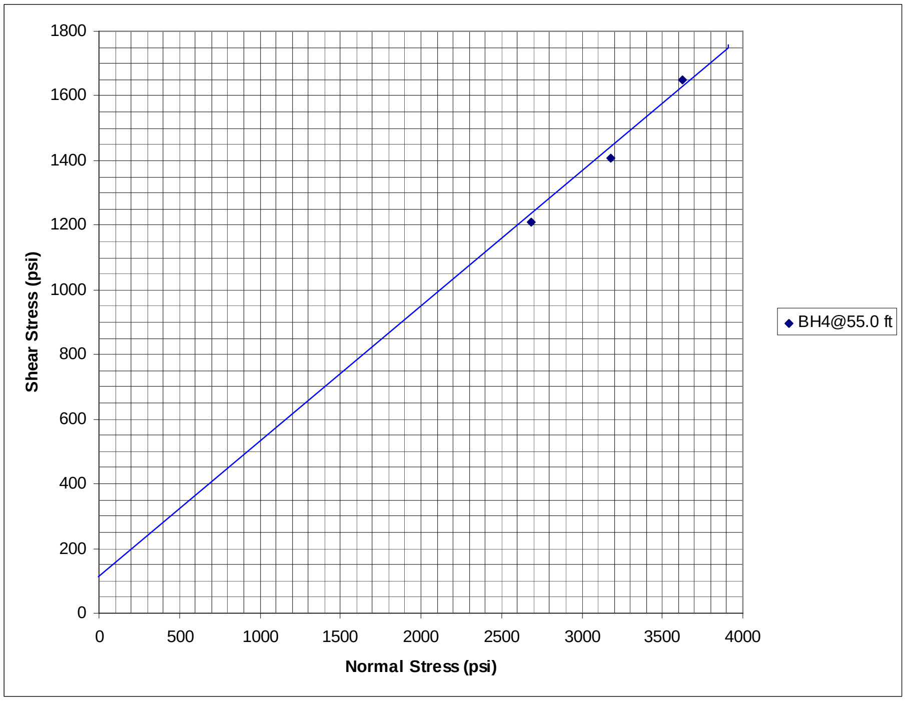


Figure E-3. Shear Stress vs Normal Stress; BH4@55.0’

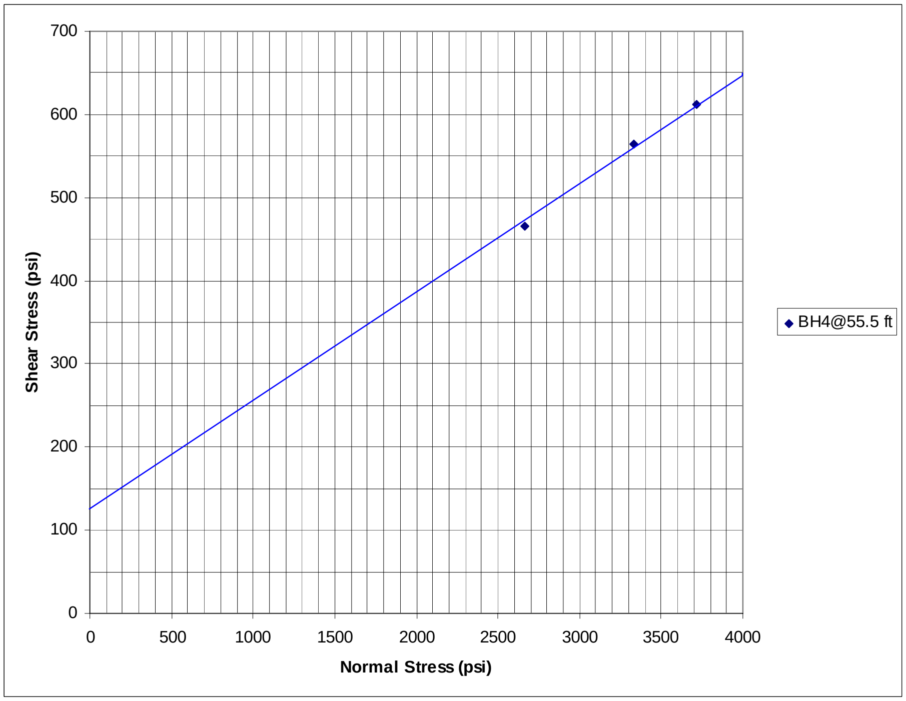


Figure E-4. Shear Stress vs Normal Stress; BH4@55.5’

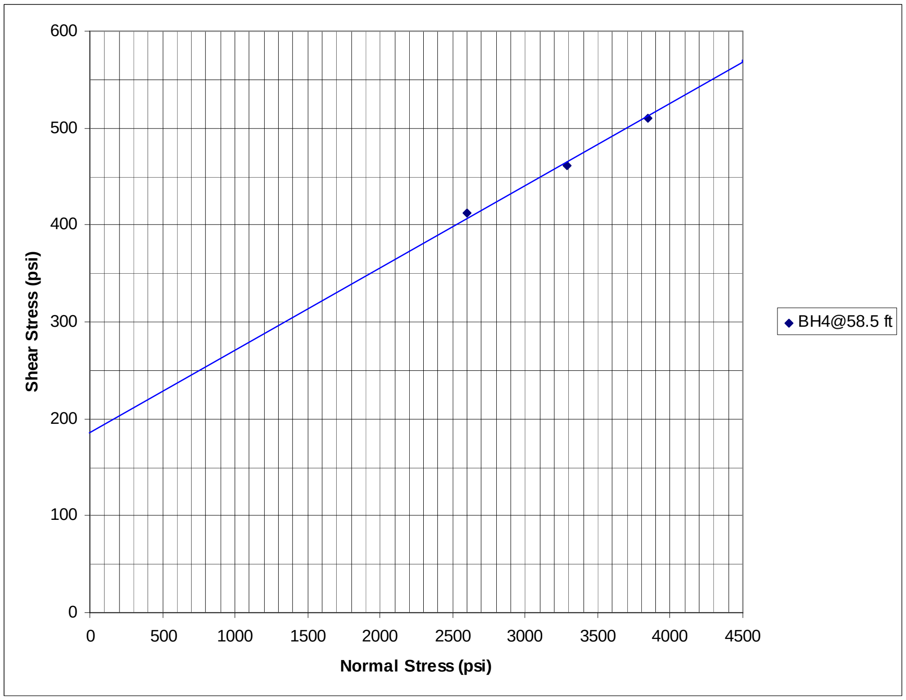


Figure E-4. Shear Stress vs Normal Stress; BH4@58.5'

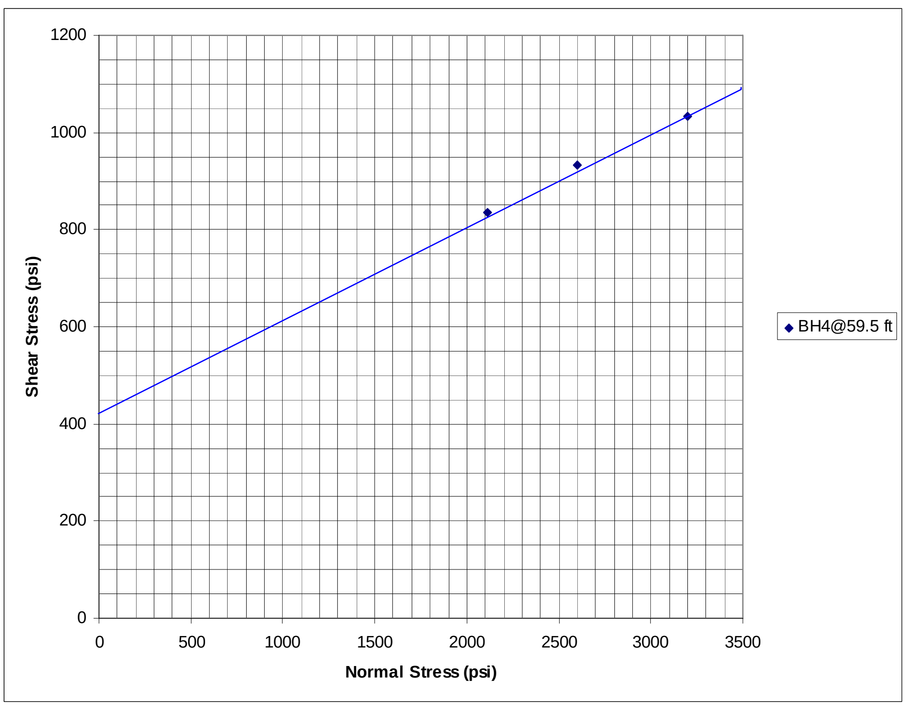


Figure E-5. Shear Stress vs Normal Stress; BH4@59.5'

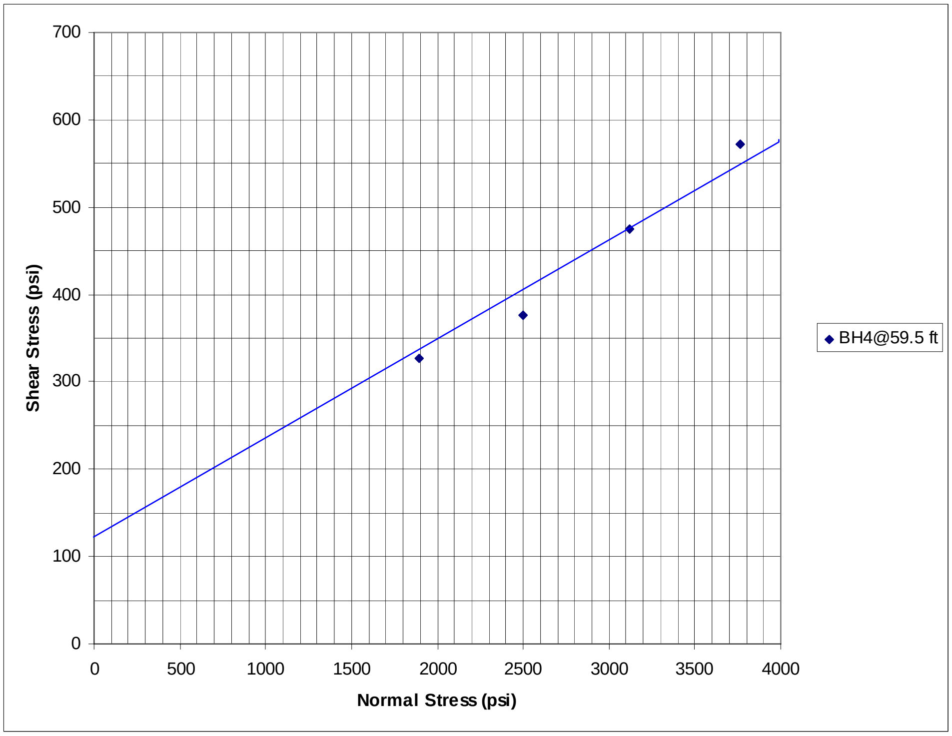


Figure E-6. Shear Stress vs Normal Stress; BH4@60.5’

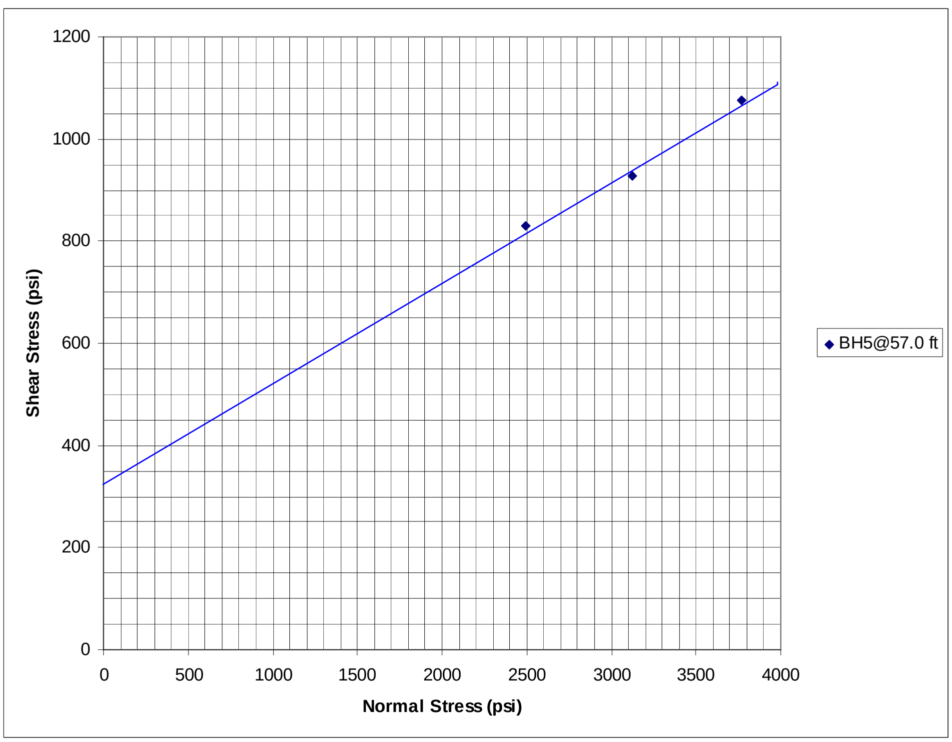


Figure E-7. Shear Stress vs Normal Stress; BH5@57.0’

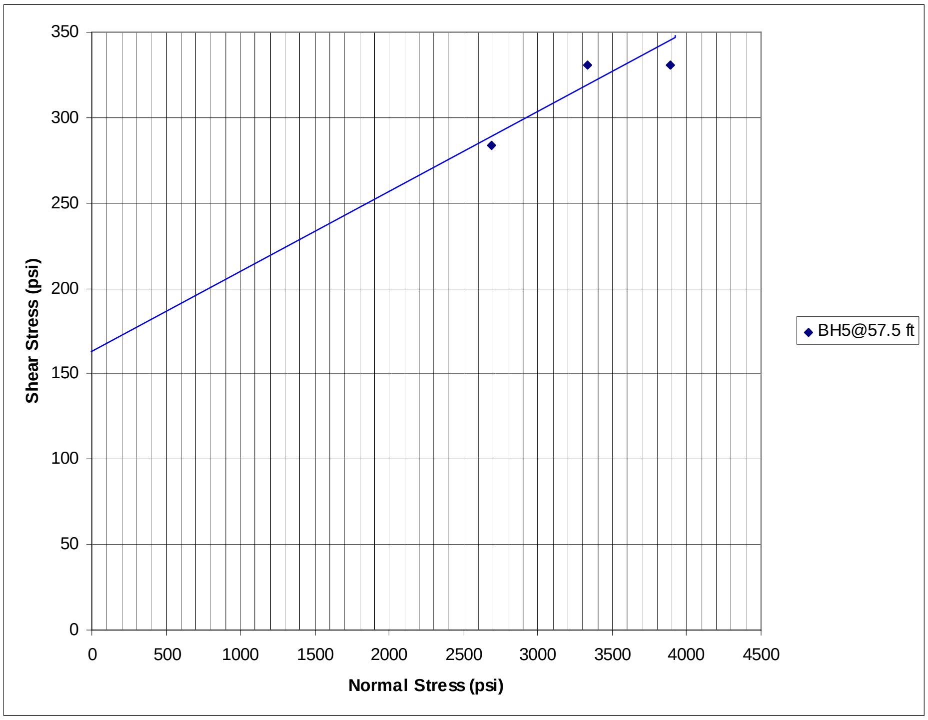


Figure E-8. Shear Stress vs Normal Stress; BH5@57.5’

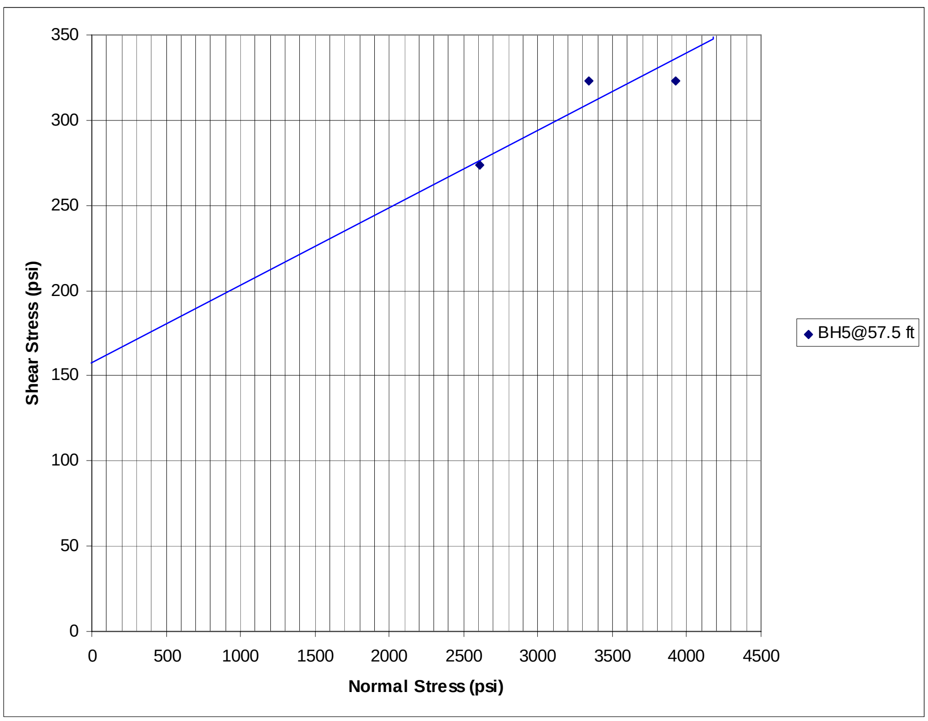


Figure E-9. Shear Stress vs Normal Stress; BH5@58.0’

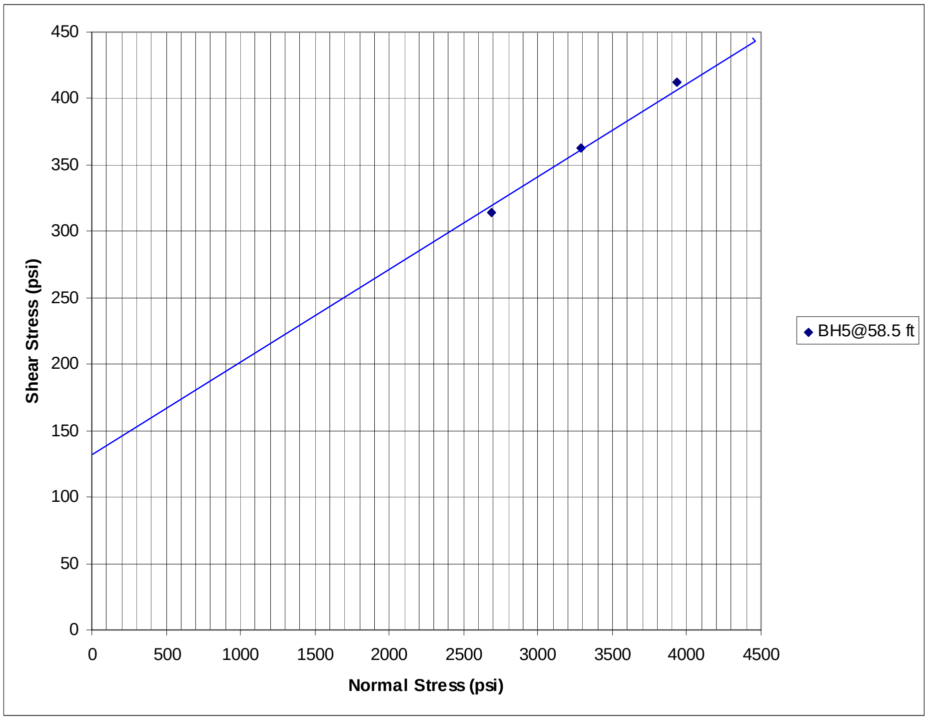


Figure E-10. Shear Stress vs Normal Stress; BH5@58.5’

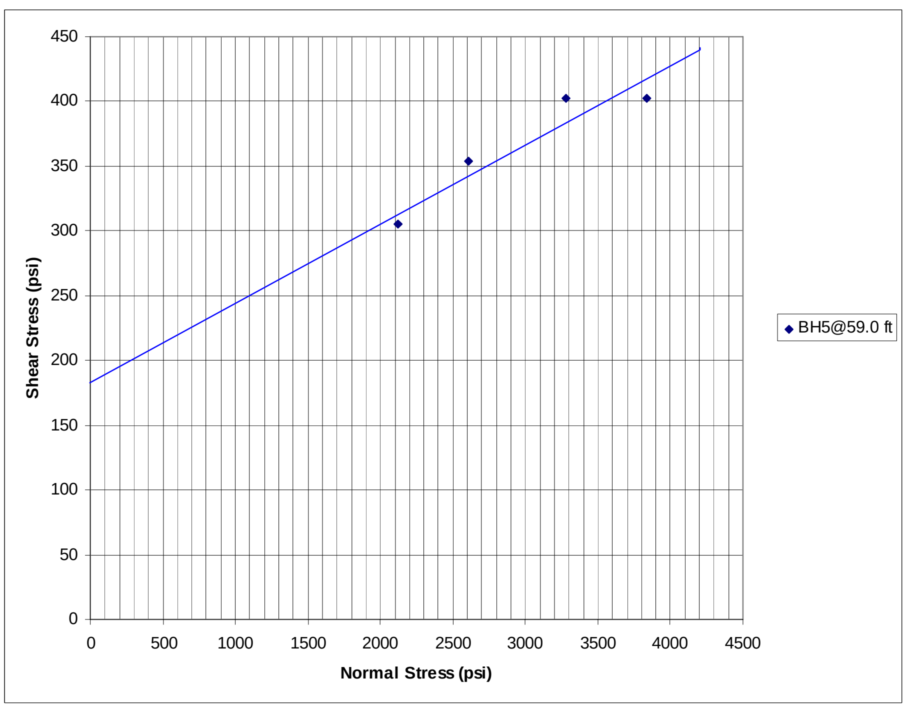


Figure E-11. Shear Stress vs Normal Stress; BH5@59.0’

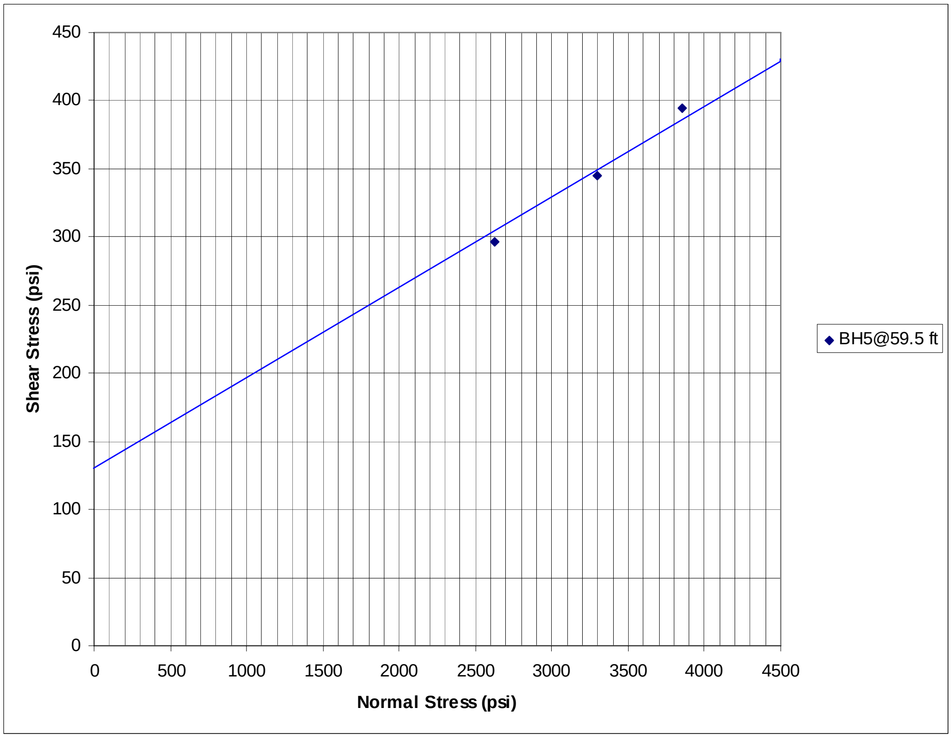


Figure E-12. Shear Stress vs Normal Stress; BH4@59.5’

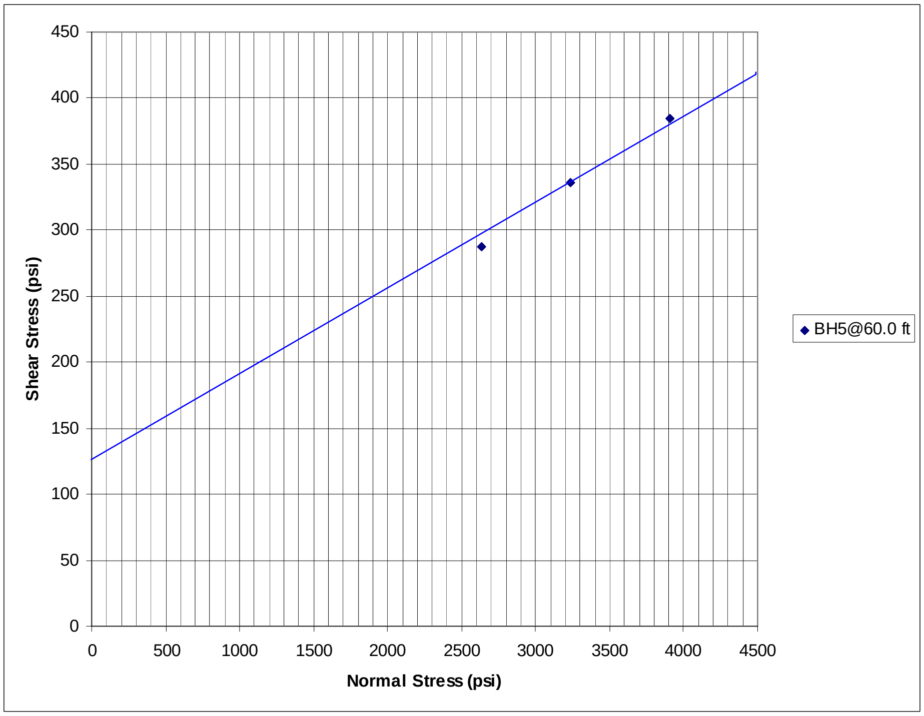


Figure E-13. Shear Stress vs Normal Stress; BH5@60.0’

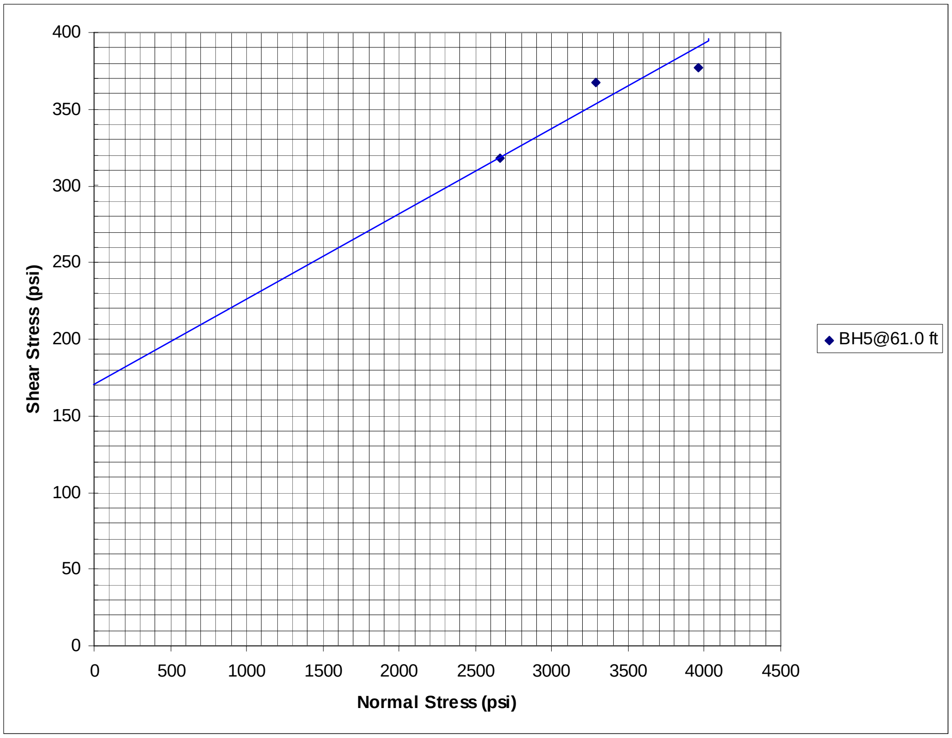


Figure E-14. Shear Stress vs Normal Stress; BH5@61.0’

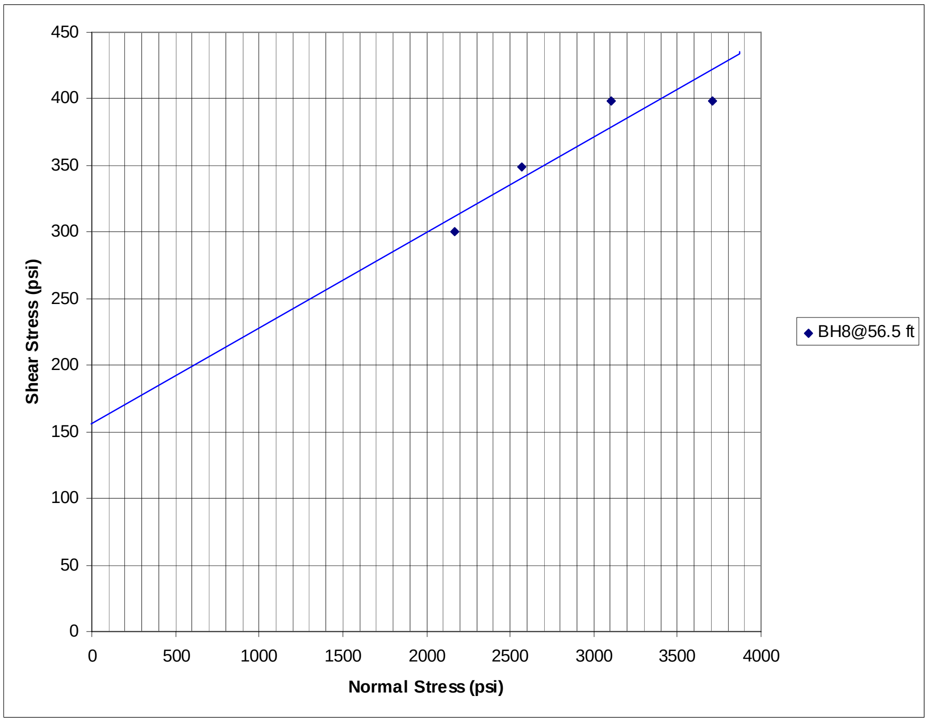


Figure E-15. Shear Stress vs Normal Stress; BH8@56.5’

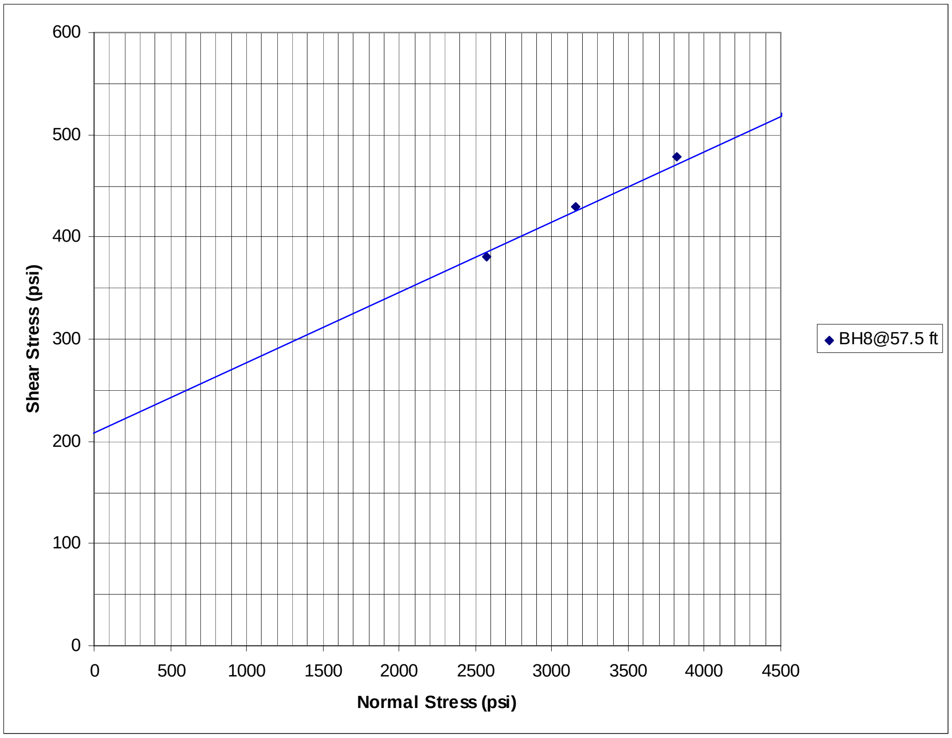


Figure E-16. Shear Stress vs Normal Stress; BH8@57.5’

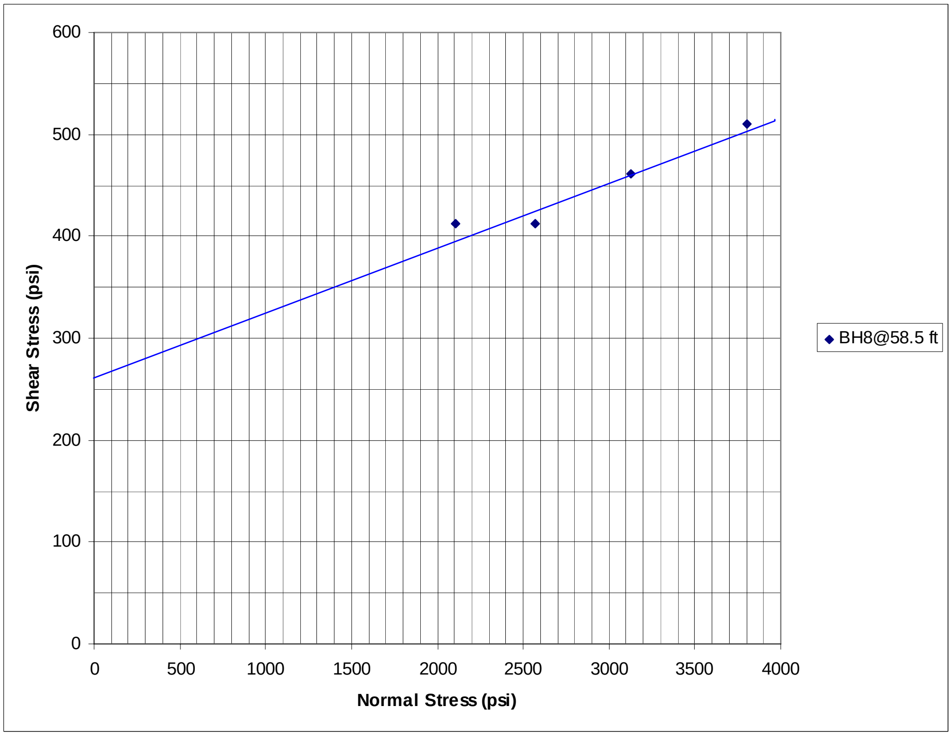


Figure E-17. Shear Stress vs Normal Stress; BH8@58.5’

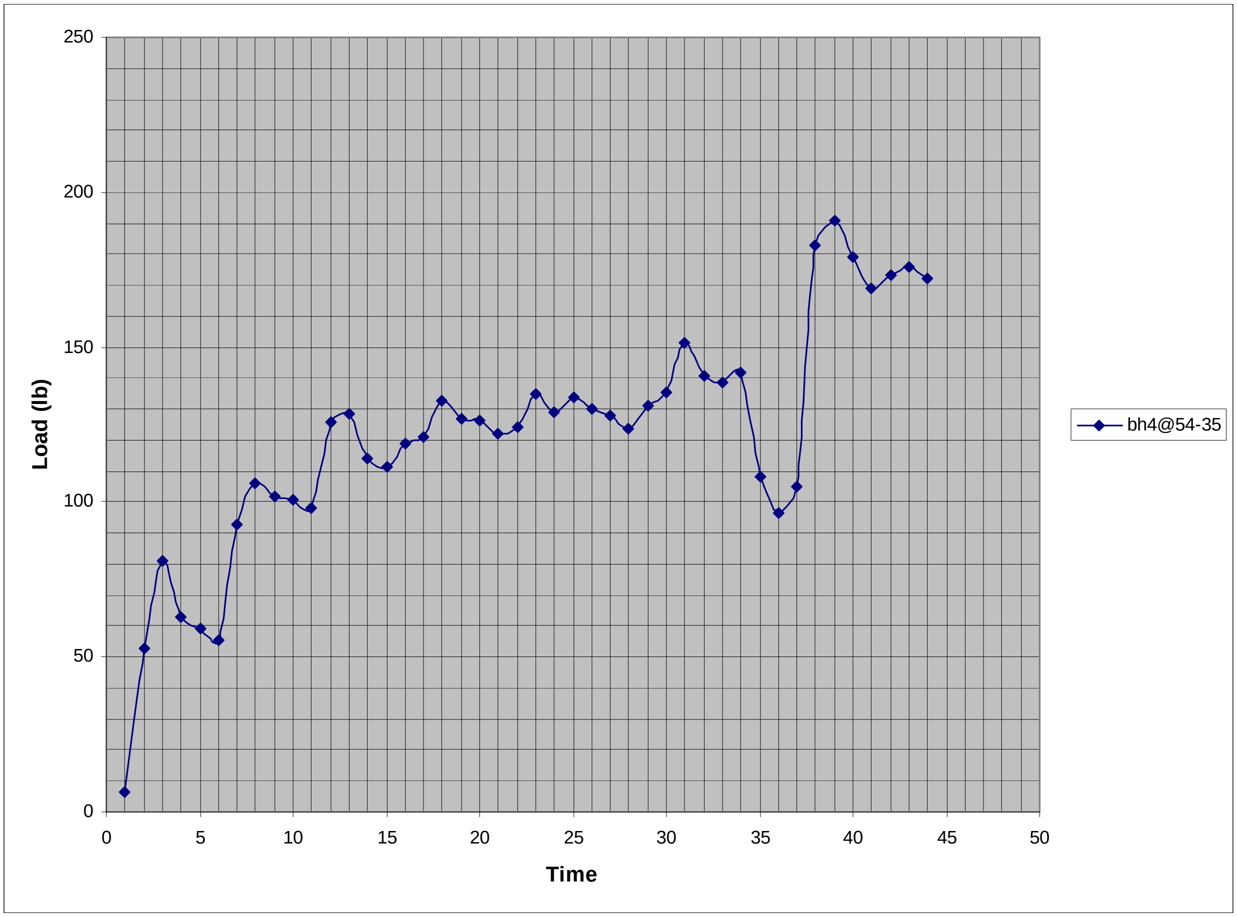


Figure E-18. Sample of Load vs Time Plot: BH4@54'(Norm Pressure = 35psi)

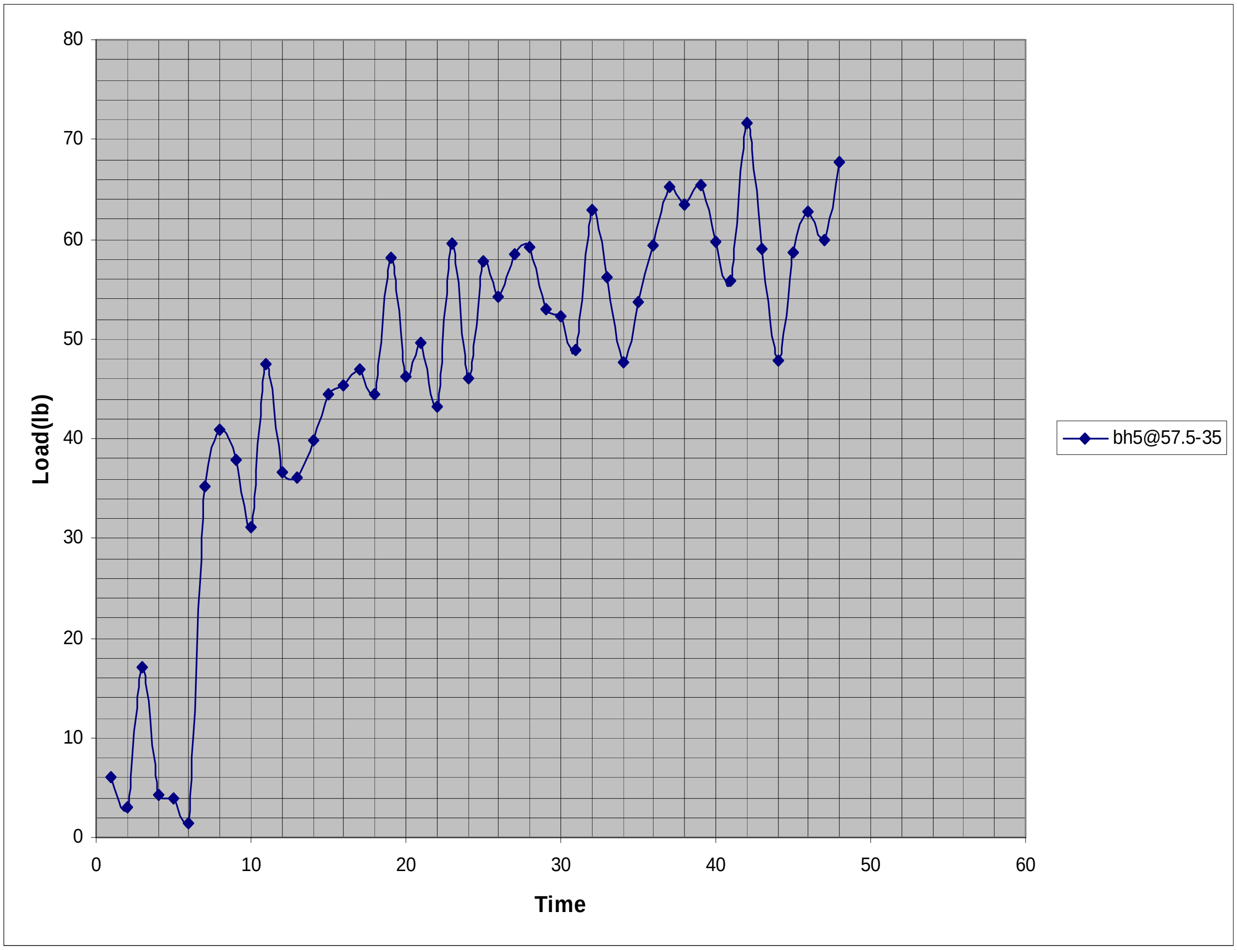


Figure E-19. Sample of Load vs Time Plot: BH5@57.5'(Norm Pressure = 35psi)

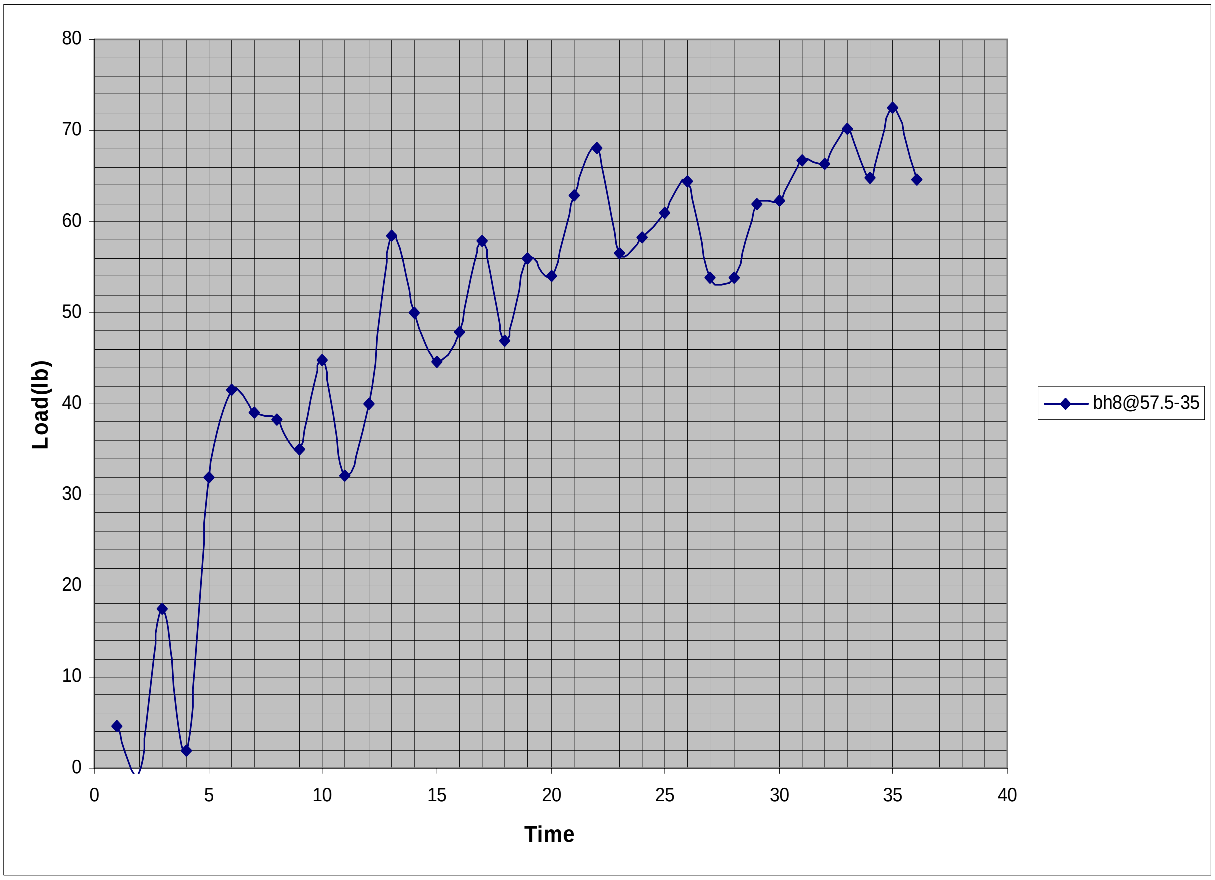


Figure E-20. Sample of Load vs Time Plot: BH8@57.5’(Norm Pressure = 35psi)

Table E-1. Sample of Data Reduction Corehole #4 at 54/35 feet.

17th STREET

SHEAR DEVICE TEST RESULTS

Penetration (calculated)		0.017025248	Max (0.0591)
Height H_2O (ft)	46	Unit Wt H_2O (lb/ft3)	62.4
Length Pipe(ft)	54	Unit Wt Rod (lb/ft)	2.96
Penetration Depth (in)	0.0233	Cylinder Bore Area (in2)	4.72
Stud Cap Area(in2)	0.1964	Shear Stud Area	0.165492416
No. of Studs	42	Normal Stud Area	0.001137173
Weight of Instrum (lbs).	38	qu (psi)	1406.6

LVDT (in)	Pressure (volts)	Load (volts)	Est. Load (psi)	Est. Press. (psi)	Normal Force (lb)	Shear Force (lb)	Normal Stress (psi)	Shear Stress (psi)
-0.0172	0.0185	0.0004	6.279	37.0464	3.7112	-210.4636	3263.5459	-1271.7419
-0.0122	0.0185	0.0029	52.6141	37.0434	3.7112	-7.7160	3263.5459	-46.6247
0.0271	0.0185	0.0048	80.9002	36.9579	3.7112	146.3721	3263.5459	884.4643
0.0669	0.0185	0.0036	62.9667	37.0373	3.7112	49.0533	3263.5459	296.4081
0.0729	0.0185	0.0031	59.2649	37.019	3.7112	8.5038	3263.5459	51.3846
0.0721	0.0185	0.003	55.6782	37.0006	3.7112	0.3939	3263.5459	2.3800
0.0884	0.0185	0.0052	92.5171	36.9549	3.7112	178.8118	3263.5459	1080.4831
0.1148	0.0184	0.0063	105.9803	36.8908	3.6859	268.0207	3241.2421	1619.5346
0.1576	0.0184	0.0059	101.9242	36.8542	3.6859	235.5811	3241.2421	1423.5159
0.1499	0.0184	0.0061	100.9145	36.8297	3.6859	251.8009	3241.2421	1521.5252
0.1542	0.0184	0.0055	98.3191	36.7931	3.6859	203.1415	3241.2421	1227.4971
0.1646	0.0184	0.0067	125.6317	36.8236	3.6859	300.4603	3241.2421	1815.5534
0.2075	0.0185	0.0072	128.6952	36.9518	3.7112	341.0098	3263.5459	2060.5768
0.2282	0.0183	0.0066	113.8623	36.6832	3.6605	292.3504	3218.9384	1766.5487
0.2414	0.0184	0.0066	111.5675	36.7748	3.6859	292.3504	3241.2421	1766.5487
0.2292	0.0184	0.0068	118.9902	36.8145	3.6859	308.5702	3241.2421	1864.5580
0.2392	0.0184	0.0069	121.153	36.7779	3.6859	316.6801	3241.2421	1913.5627
0.2691	0.0184	0.0079	132.5012	36.726	3.6859	397.7792	3241.2421	2403.6096
0.2992	0.0184	0.0075	126.9465	36.7687	3.6859	365.3395	3241.2421	2207.5909
0.3108	0.0183	0.0074	126.526	36.6161	3.6605	357.2296	3218.9384	2158.5862
0.3005	0.0183	0.0073	122.1758	36.6649	3.6605	349.1197	3218.9384	2109.5815
0.3052	0.0183	0.0073	124.3445	36.5795	3.6605	349.1197	3218.9384	2109.5815
0.312	0.0183	0.0075	134.7508	36.6314	3.6605	365.3395	3218.9384	2207.5909
0.3288	0.0183	0.0074	129.1481	36.6314	3.6605	357.2296	3218.9384	2158.5862
0.3528	0.0184	0.0076	133.8596	36.7107	3.6859	373.4494	3241.2421	2256.5955
0.3675	0.0184	0.0078	130.1956	36.7412	3.6859	389.6693	3241.2421	2354.6049
0.3731	0.0183	0.0075	127.9828	36.6375	3.6605	365.3395	3218.9384	2207.5909
0.3564	0.0183	0.0071	123.5037	36.6131	3.6605	332.8999	3218.9384	2011.5721
0.3564	0.0183	0.0073	131.0399	36.6283	3.6605	349.1197	3218.9384	2109.5815
0.377	0.0183	0.0078	135.5704	36.5703	3.6605	389.6693	3218.9384	2354.6049
0.3954	0.0183	0.009	151.2563	36.6832	3.6605	486.9881	3218.9384	2942.6612
0.3861	0.0181	0.008	140.5911	36.1919	3.6098	405.8891	3174.3308	2452.6143
0.4257	0.0183	0.0081	138.4702	36.668	3.6605	413.9990	3218.9384	2501.6190
0.4229	0.0183	0.0082	141.817	36.6588	3.6605	422.1089	3218.9384	2550.6237
0.6051	0.0152	0.0065	108.1627	30.372	2.8742	284.2405	2527.5212	1717.5440

Table E-2. Sample of Data Reduction Corehole #5 at 57.5/35 feet.

17th STREET

SHEAR DEVICE TEST RESULTS

Penetration (calculated)		0.016681273	Max (0.0591)
Height H_2O (ft)	49.5	Unit Wt H_2O (lb/ft3)	62.4
Length Pipe(ft)	57.5	Unit Wt Rod (lb/ft)	2.96
Penetration Depth (in)	0.0233	Cylinder Bore Area (in2)	4.72
Stud Cap Area(in2)	0.1964	Shear Stud Area	0.165492416
No. of Studs	42	Normal Stud Area	0.001137173
Weight of Instrum (lbs).	38	qu (psi)	1406.6

LVDT (in)	Pressure (volts)	Load (volts)	Est. Load (psi)	Est. Press. (psi)	Normal Force (lb)	Shear Force (lb)	Normal Stress (psi)	Shear Stress (psi)
-0.0129	0.0183	0.0004	6.0783	36.6466	3.5860	-110.4118	3153.4528	-667.1715
-0.0132	0.0183	0.0002	3.0487	36.61	3.5860	-237.0434	3153.4528	-1432.3523
-0.017	0.0183	0.001	17.1455	36.5429	3.5860	-172.1642	3153.4528	-1040.3148
-0.0157	0.0183	0.0003	4.2472	36.5978	3.5860	-228.9335	3153.4528	-1383.3476
-0.0195	0.0184	0.0002	3.9928	36.7138	3.6114	-237.0434	3175.7566	-1432.3523
-0.0168	0.0183	0.0001	1.5005	36.6283	3.5860	-245.1534	3153.4528	-1481.3570
-0.0097	0.0184	0.0021	35.2743	36.7351	3.6114	-82.9553	3175.7566	-501.2633
0.0581	0.0183	0.0025	40.9457	36.6314	3.5860	-50.5157	3153.4528	-305.2445
0.0882	0.0184	0.0023	37.8938	36.7687	3.6114	-66.7355	3175.7566	-403.2539
0.1003	0.0184	0.0019	31.0272	36.8206	3.6114	-99.1751	3175.7566	-599.2727
0.0918	0.0184	0.0028	47.4054	36.8969	3.6114	-26.1859	3175.7566	-158.2305
0.099	0.0185	0.0021	36.6054	36.9213	3.6367	-82.9553	3198.0604	-501.2633
0.1072	0.0185	0.0022	36.1136	36.9213	3.6367	-74.8454	3198.0604	-452.2586
0.1012	0.0185	0.0024	39.8775	36.9549	3.6367	-58.6256	3198.0604	-354.2492
0.1063	0.0185	0.0026	44.4297	37.0708	3.6367	-42.4058	3198.0604	-256.2399
0.1551	0.0186	0.0027	45.32	37.1349	3.6621	-34.2958	3220.3642	-207.2352
0.202	0.0186	0.0028	46.9985	37.2234	3.6621	-26.1859	3220.3642	-158.2305
0.218	0.0187	0.0027	44.4044	37.3302	3.6875	-34.2958	3242.6679	-207.2352
0.2182	0.0187	0.0035	58.1886	37.4828	3.6875	30.5834	3242.6679	184.8023
0.2185	0.0188	0.0028	46.1847	37.5072	3.7128	-26.1859	3264.9717	-158.2305
0.2208	0.0187	0.003	49.6434	37.4828	3.6875	-9.9661	3242.6679	-60.2211
0.2195	0.0188	0.0026	43.26	37.6873	3.7128	-42.4058	3264.9717	-256.2399
0.2263	0.0189	0.0036	59.5111	37.7453	3.7382	38.6933	3287.2755	233.8070
0.2356	0.0188	0.0028	46.0067	37.6293	3.7128	-26.1859	3264.9717	-158.2305
0.2739	0.0189	0.0035	57.7563	37.788	3.7382	30.5834	3287.2755	184.8023
0.3037	0.0189	0.0033	54.1704	37.8368	3.7382	14.3636	3287.2755	86.7930
0.3356	0.0189	0.0035	58.5192	37.7941	3.7382	30.5834	3287.2755	184.8023
0.3516	0.019	0.0035	59.155	37.9772	3.7636	30.5834	3309.5793	184.8023
0.3591	0.019	0.0032	52.8988	38.0139	3.7636	6.2537	3309.5793	37.7883
0.3594	0.019	0.0031	52.2884	38.0566	3.7636	-1.8562	3309.5793	-11.2164
0.3563	0.0191	0.0029	48.8825	38.1085	3.7889	-18.0760	3331.8831	-109.2258
0.3532	0.0191	0.0038	63.0207	38.2061	3.7889	54.9131	3331.8831	331.8164
0.3545	0.0191	0.0034	56.1032	38.2092	3.7889	22.4735	3331.8831	135.7976
0.3556	0.0191	0.0029	47.7106	38.1848	3.7889	-18.0760	3331.8831	-109.2258
0.3619	0.0191	0.0032	53.6363	38.2031	3.7889	6.2537	3331.8831	37.7883
0.3962	0.0191	0.0036	59.4602	38.2519	3.7889	38.6933	3331.8831	233.8070
0.429	0.0191	0.0039	65.157	38.1726	3.7889	63.0230	3331.8831	380.8211

Table E-3. Sample of Data Reduction Corehole #8 at 57.5/35 feet.

17th STREET

SHEAR DEVICE TEST RESULTS

Penetration (calculated)		0.016329808	Max (0.0591)
Height H_2O (ft)	49.5	Unit Wt H_2O (lb/ft3)	62.4
Length Pipe(ft)	57.5	Unit Wt Rod (lb/ft)	2.96
Penetration Depth (in)	0.0233	Cylinder Bore Area (in2)	4.72
Stud Cap Area(in2)	0.1964	Shear Stud Area	0.165492416
No. of Studs	42	Normal Stud Area	0.001137173
Weight of Instrum (lbs).	38	qu (psi)	1406.6

LVDT (in)	Pressure (volts)	Load (volts)	Est. Load (psi)	Est. Press. (psi)	Normal Force (lb)	Shear Force (lb)	Normal Stress (psi)	Shear Stress (psi)
-0.0104	0.0183	0.0003	4.5592	36.5154	3.5860	-114.4668	3153.4528	-691.6738
-0.016	0.0182	0	-0.356	36.4818	3.5607	-253.2633	3131.1491	-1530.3617
-0.0222	0.0182	0.0011	17.5481	36.4391	3.5607	-164.0543	3131.1491	-991.3102
-0.0074	0.0182	0.0001	1.9837	36.3018	3.5607	-245.1534	3131.1491	-1481.3570
-0.02	0.0182	0.0019	31.8918	36.3689	3.5607	-99.1751	3131.1491	-599.2727
0.0301	0.0181	0.0025	41.6069	36.2774	3.5353	-50.5157	3108.8453	-305.2445
0.0611	0.0182	0.0023	39.0128	36.5001	3.5607	-66.7355	3131.1491	-403.2539
0.0772	0.0181	0.0023	38.2499	36.2865	3.5353	-66.7355	3108.8453	-403.2539
0.0885	0.0181	0.0021	35.0454	36.2621	3.5353	-82.9553	3108.8453	-501.2633
0.0822	0.0182	0.0027	44.7605	36.3353	3.5607	-34.2958	3131.1491	-207.2352
0.0818	0.0181	0.0019	32.1716	36.2774	3.5353	-99.1751	3108.8453	-599.2727
0.0804	0.0182	0.0024	40.081	36.3598	3.5607	-58.6256	3131.1491	-354.2492
0.1229	0.0181	0.0035	58.4938	36.2102	3.5353	30.5834	3108.8453	184.8023
0.1886	0.0182	0.003	50.0758	36.3018	3.5607	-9.9661	3131.1491	-60.2211
0.2122	0.0181	0.0027	44.6588	36.2377	3.5353	-34.2958	3108.8453	-207.2352
0.2204	0.0182	0.0029	47.9395	36.4025	3.5607	-18.0760	3131.1491	-109.2258
0.2116	0.0181	0.0035	57.858	36.2438	3.5353	30.5834	3108.8453	184.8023
0.2154	0.0181	0.0028	46.8713	36.2072	3.5353	-26.1859	3108.8453	-158.2305
0.2118	0.0182	0.0034	56.0269	36.433	3.5607	22.4735	3131.1491	135.7976
0.1777	0.0182	0.0032	54.0178	36.3414	3.5607	6.2537	3131.1491	37.7883
0.2638	0.0182	0.0038	62.7918	36.3262	3.5607	54.9131	3131.1491	331.8164
0.308	0.0182	0.0041	68.0817	36.3048	3.5607	79.2428	3131.1491	478.8304
0.3496	0.0181	0.0034	56.561	36.2651	3.5353	22.4735	3108.8453	135.7976
0.3363	0.0182	0.0035	58.1886	36.491	3.5607	30.5834	3131.1491	184.8023
0.3444	0.0181	0.0037	61.037	36.2011	3.5353	46.8032	3108.8453	282.8117
0.3444	0.0182	0.0039	64.4195	36.4391	3.5607	63.0230	3131.1491	380.8211
0.3432	0.0182	0.0032	53.9415	36.3964	3.5607	6.2537	3131.1491	37.7883
0.3486	0.0182	0.0032	53.8906	36.4727	3.5607	6.2537	3131.1491	37.7883
0.355	0.0182	0.0037	61.9526	36.4666	3.5607	46.8032	3131.1491	282.8117
0.3852	0.0183	0.0037	62.3086	36.6588	3.5860	46.8032	3153.4528	282.8117
0.3427	0.0183	0.004	66.7592	36.6039	3.5860	71.1329	3153.4528	429.8258
0.4542	0.0183	0.004	66.3269	36.5764	3.5860	71.1329	3153.4528	429.8258
0.4686	0.0183	0.0042	70.1926	36.5612	3.5860	87.3527	3153.4528	527.8351
0.4774	0.0184	0.0039	64.7501	36.7809	3.6114	63.0230	3175.7566	380.8211