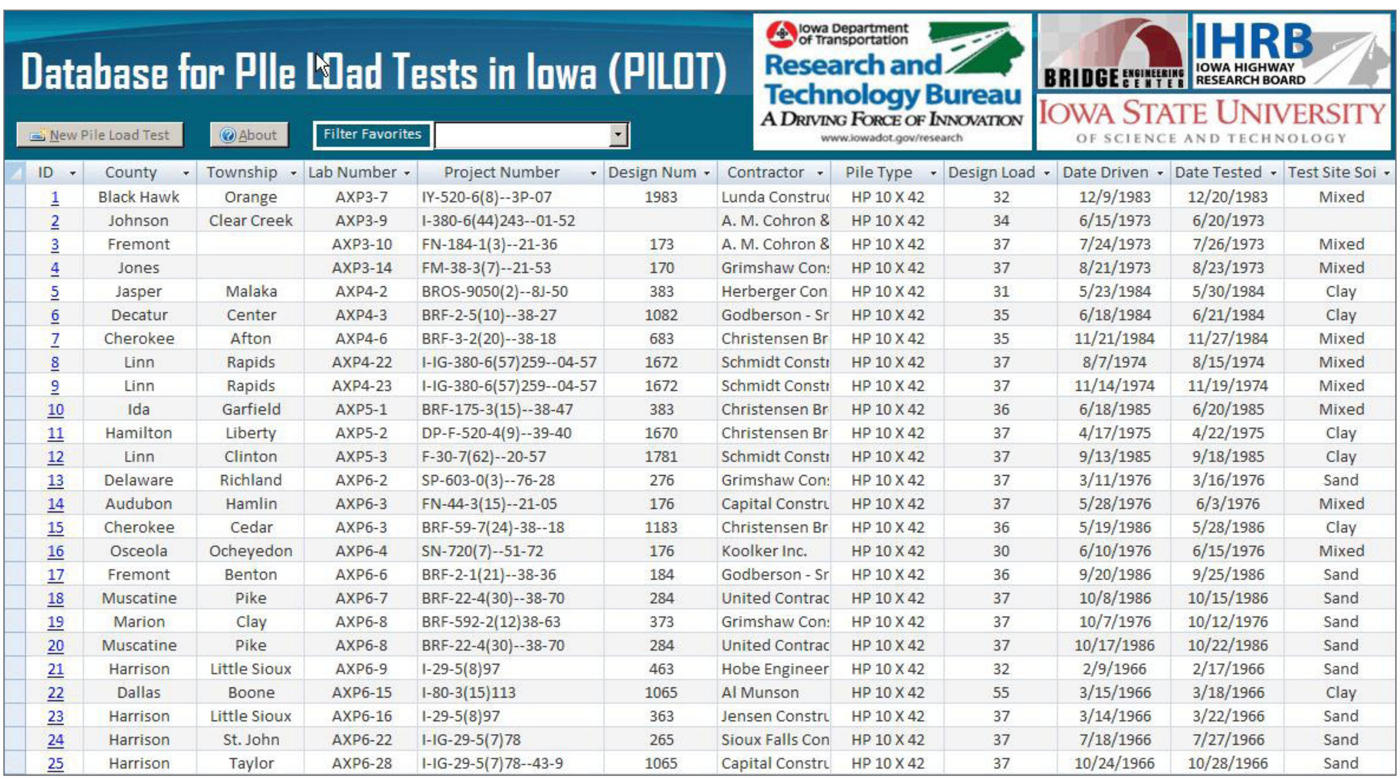
Development of LRFD Procedures for Bridge Pile Foundations in Iowa

Volume I: An Electronic Database for PIle LOad Tests (PILOT)

BRIDGE ENGINEERING CENTER

Final Report
June 2010
(Updated January 2011)



ID	County	Township	Lab Number	Project Number	Design Num	Contractor	Pile Type	Design Load	Date Driven	Date Tested	Test Site Soi
1	Black Hawk	Orange	AXP3-7	IY-520-6(8)--3P-07	1983	Lunda Construc	HP 10 X 42	32	12/9/1983	12/20/1983	Mixed
2	Johnson	Clear Creek	AXP3-9	I-380-6(44)243--01-52		A. M. Cohron &	HP 10 X 42	34	6/15/1973	6/20/1973	
3	Fremont		AXP3-10	FN-184-1(3)--21-36	173	A. M. Cohron &	HP 10 X 42	37	7/24/1973	7/26/1973	Mixed
4	Jones		AXP3-14	FM-38-3(7)--21-53	170	Grimshaw Con:	HP 10 X 42	37	8/21/1973	8/23/1973	Mixed
5	Jasper	Malaka	AXP4-2	BROS-9050(2)--8J-50	383	Herberger Con	HP 10 X 42	31	5/23/1984	5/30/1984	Clay
6	Decatur	Center	AXP4-3	BRF-2-5(10)--38-27	1082	Godberson - Sr	HP 10 X 42	35	6/18/1984	6/21/1984	Clay
7	Cherokee	Afton	AXP4-6	BRF-3-2(20)--38-18	683	Christensen Br	HP 10 X 42	35	11/21/1984	11/27/1984	Mixed
8	Linn	Rapids	AXP4-22	I-IG-380-6(57)259--04-57	1672	Schmidt Constr	HP 10 X 42	37	8/7/1974	8/15/1974	Mixed
9	Linn	Rapids	AXP4-23	I-IG-380-6(57)259--04-57	1672	Schmidt Constr	HP 10 X 42	37	11/14/1974	11/19/1974	Mixed
10	Ida	Garfield	AXP5-1	BRF-175-3(15)--38-47	383	Christensen Br	HP 10 X 42	36	6/18/1985	6/20/1985	Mixed
11	Hamilton	Liberty	AXP5-2	DP-F-520-4(9)--39-40	1670	Christensen Br	HP 10 X 42	37	4/17/1975	4/22/1975	Clay
12	Linn	Clinton	AXP5-3	F-30-7(62)--20-57	1781	Schmidt Constr	HP 10 X 42	37	9/13/1985	9/18/1985	Clay
13	Delaware	Richland	AXP6-2	SP-603-0(3)--76-28	276	Grimshaw Con:	HP 10 X 42	37	3/11/1976	3/16/1976	Sand
14	Audubon	Hamlin	AXP6-3	FN-44-3(15)--21-05	176	Capital Constru	HP 10 X 42	37	5/28/1976	6/3/1976	Mixed
15	Cherokee	Cedar	AXP6-3	BRF-59-7(24)-38--18	1183	Christensen Br	HP 10 X 42	36	5/19/1986	5/28/1986	Clay
16	Osceola	Ocheyedon	AXP6-4	SN-720(7)--51-72	176	Koolker Inc.	HP 10 X 42	30	6/10/1976	6/15/1976	Mixed
17	Fremont	Benton	AXP6-6	BRF-2-1(21)--38-36	184	Godberson - Sr	HP 10 X 42	36	9/20/1986	9/25/1986	Sand
18	Muscatine	Pike	AXP6-7	BRF-22-4(30)--38-70	284	United Contrac	HP 10 X 42	37	10/8/1986	10/15/1986	Sand
19	Marion	Clay	AXP6-8	BRF-592-2(12)38-63	373	Grimshaw Con:	HP 10 X 42	37	10/7/1976	10/12/1976	Sand
20	Muscatine	Pike	AXP6-8	BRF-22-4(30)--38-70	284	United Contrac	HP 10 X 42	37	10/17/1986	10/22/1986	Sand
21	Harrison	Little Sioux	AXP6-9	I-29-5(8)97	463	Hobe Engineer	HP 10 X 42	32	2/9/1966	2/17/1966	Sand
22	Dallas	Boone	AXP6-15	I-80-3(15)113	1065	Al Munson	HP 10 X 42	55	3/15/1966	3/18/1966	Clay
23	Harrison	Little Sioux	AXP6-16	I-29-5(8)97	363	Jensen Constru	HP 10 X 42	37	3/14/1966	3/22/1966	Sand
24	Harrison	St. John	AXP6-22	I-IG-29-5(7)78	265	Sioux Falls Con	HP 10 X 42	37	7/18/1966	7/27/1966	Sand
25	Harrison	Taylor	AXP6-28	I-IG-29-5(7)78--43-9	1065	Capital Constru	HP 10 X 42	37	10/24/1966	10/28/1966	Sand

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The mission of the Bridge Engineering Center (BEC) is to conduct research on bridge technologies to help bridge designers/owners design, build, and maintain long-lasting bridges.

About the Institute for Transportation

The mission of the Institute for Transportation (InTrans) at Iowa State University is to develop and implement innovative methods, materials, and technologies for improving transportation efficiency, safety, reliability, and sustainability while improving the learning environment of students, faculty, and staff in transportation-related fields.

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16. Abstract

For well over 100 years, the Working Stress Design (WSD) approach has been the traditional basis for geotechnical design with regard to settlements or failure conditions. However, considerable effort has been put forth over the past couple of decades in relation to the adoption of the Load and Resistance Factor Design (LRFD) approach into geotechnical design. With the goal of producing engineered designs with consistent levels of reliability, the Federal Highway Administration (FHWA) issued a policy memorandum on June 28, 2000, requiring all new bridges initiated after October 1, 2007, to be designed according to the LRFD approach. Likewise, regionally calibrated LRFD resistance factors were permitted by the American Association of State Highway and Transportation Officials (AASHTO) to improve the economy of bridge foundation elements. Thus, projects TR-573, TR-583 and TR-584 were undertaken by a research team at Iowa State University's Bridge Engineering Center with the goal of developing resistance factors for pile design using available pile static load test data.

To accomplish this goal, the available data were first analyzed for reliability and then placed in a newly designed relational database management system termed PIle LOad Tests (PILOT), to which this first volume of the final report for project TR-573 is dedicated. PILOT is an amalgamated, electronic source of information consisting of both static and dynamic data for pile load tests conducted in the State of Iowa. The database, which includes historical data on pile load tests dating back to 1966, is intended for use in the establishment of LRFD resistance factors for design and construction control of driven pile foundations in Iowa. Although a considerable amount of geotechnical and pile load test data is available in literature as well as in various State Department of Transportation files, PILOT is one of the first regional databases to be exclusively used in the development of LRFD resistance factors for the design and construction control of driven pile foundations. Currently providing an electronically organized assimilation of geotechnical and pile load test data for 274 piles of various types (e.g., steel H-shaped, timber, pipe, Monotube, and concrete), PILOT (http://srg.cce.iastate.edu/lrfd/) is on par with such familiar national databases used in the calibration of LRFD resistance factors for pile foundations as the FHWA's Deep Foundation Load Test Database. By narrowing geographical boundaries while maintaining a high number of pile load tests, PILOT exemplifies a model for effective regional LRFD calibration procedures.

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DEVELOPMENT OF LRFD PROCEDURES FOR BRIDGE PILES IN IOWA
VOLUME I: AN ELECTRONIC DATABASE FOR PILE LOAD TESTS (PILOT)

Final Report
June 2010
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1. INTRODUCTION

Over a twenty-four year period defined by the years from 1966 to 1989, information concerning 264 pile static load tests (SLTs) conducted in the State of Iowa on steel H-shaped, timber, pipe, Monotube, and concrete piles (Figure 1.1) was collected by the Iowa Department of Transportation (Iowa DOT). During this time period, the entirety of the aforementioned collected information, although not always wholly available, included details concerning the site location, subsurface conditions, pile type, hammer characteristics, end-of-driving (EOD) blow count, and static load test results. All of this information was stored by the Iowa DOT in hardcopy format, making its usage for the Load and Resistance Factor Design (LRFD) resistance factor calibration process cumbersome and almost impractical. As a part of research project *TR-573: Development of LRFD Design Procedures for Bridge Piles in Iowa*, which is directed at the development of LRFD procedures for bridge piles in the State of Iowa, the electronic database for PIle LOad Tests (PILOT) was developed using Microsoft Office Access™ and in conjunction with the Iowa DOT to allow for the efficient performance of reference and/or analysis procedures on the amassed dataset.

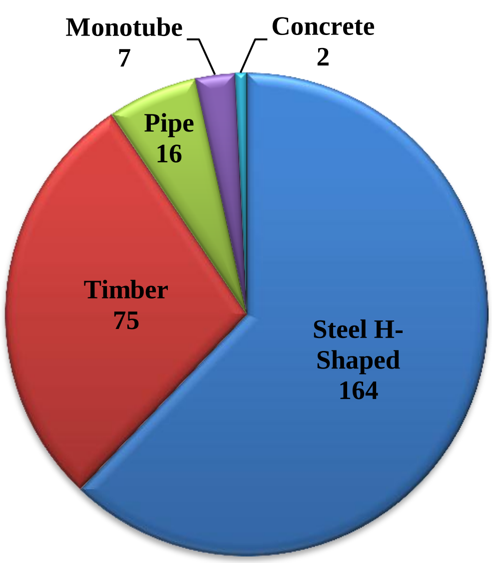


Figure 1.1: Distribution of Historical Pile SLTs by Pile Type

Even though an abundance of geotechnical and deep foundation load test data is currently available in literature as well as in various State DOT files, the electronic assimilation of such data has been sparsely documented. In fact, the Federal Highway Administration's (FHWA's) Deep Foundation Load Test Database (DFLTD) is the lone electronic database that has been encountered to date (Kalavar & Early, 2000). Consisting of more than 1500 deep foundation load test records from nearly 850 sites from various parts of the world, the DFLTD provides an economical source of information for feasibility studies, foundation design, as well as research and development activities. However, it is important to note that the DFLTD, like all of the databases summarized by Roling (2010), lacks a distinct system by which the quality of a given deep foundation load test may be assessed.

In an effort to match the comprehensiveness of the DFLTD while still maintaining the desired regional characteristics and for verification of the regionally calibrated LRFD resistance factors recommended by AbdelSalam et al. (2010), PILOT was extended to include ten additional load tests on steel H-shaped piles, the most commonly used pile type within the State of Iowa (AbdelSalam et al., 2010). In addition to simply driving and statically load testing the piles to failure, most of the test piles were instrumented with strain gauges and dynamically monitored during driving and restrikes using the Pile Driving Analyzer (PDA) device. Moreover, the subsurface conditions at the location of each of the test piles were characterized using various laboratory tests (e.g., moisture content, grain-size distribution, Atterberg limits, consolidation, and Triaxial Consolidated-Undrained compression tests) and in-situ tests (e.g., Standard Penetration Test (SPT), Cone Penetration Test (CPT), and Borehole Shear Test (BST)). In some cases, ground instrumentation (i.e., push-in pressure cells) was used to capture horizontal stress and porewater pressure data near the test pile during driving and static load testing. The reader is referred to Ng et al. (2010) for more detailed information concerning these ten additional pile load tests.

With the inclusion of this additional information, PILOT contains adequate data for the development of regionally calibrated LRFD resistance factors for the following three different sources of estimates for pile resistance: static analysis methods (e.g., α-Tomlinson, Nordlund and Thurman, Meyerhof SPT, Schmertmann CPT, etc.), dynamic analysis methods (e.g., Wave Equation Analysis Approach (WEAP), PDA, CAse Pile Wave Analysis Program (CAPWAP)), and dynamic pile driving formulas (e.g., Engineering News Record (ENR), Gates, FHWA Modified Gates, Janbu, etc.). Furthermore, as more pile load test data are regularly collected in the future and added to the database, PILOT can only become invaluable on account of the high quality assurance provisions and its ability to continue to improve foundation design and construction practices.

In the following sections of this report, the importance of PILOT will be detailed together with a brief description of the structure and key parameters used in the development of this database. A detailed description of the historical dataset upon which the database was originally fashioned will also be provided, before a comprehensive review of all fields contained within the database is given. Therefore, this report serves as a user guide for PILOT, which is available to any user via the project web site (http://srg.cce.iastate.edu/lrfd/).

2. BACKGROUND

To determine friction pile lengths and end-bearing capacities, Iowa DOT bridge designers have used a simple methodology based on tables found in *Foundation Soils Information Chart: Pile Foundation* (Dirks & Kam, 1989; revised 1994) and corresponding soil information. Wave equation concepts were used to develop the end bearing chart, while the skin friction chart was adopted from G. Meyerhoff's semi-empirical relationship and M. J. Tomlinson's 1979 research. Meyerhoff's semi-empirical relationship, which was established in 1976, elucidates the fact that the unit skin friction varies linearly with the SPT N-value number up to a value of 50 blows per foot, at which point the unit skin friction becomes a constant 1 ton per square foot value. Tomlinson's 1979 research correlated adhesion and cohesion values for different pile materials and pile embedment. Using these techniques as a basis, adjustments were ultimately made via SLT data collected from pile SLTs conducted during the time period spanning 1965 to 1987 before the final version of the charts, which underwent a relatively minor update in 1994, was released.

This approach for designing piles was simple, efficient, and compatible with working stress design (WSD) procedures. However, it has long been recognized that standard bridge design specifications based on WSD cannot ensure the consistent, reliable performance of structures. Since the foundation is a critical element of any bridge system, ensuring the system's uniform performance requires a consistent and reliable design of the foundation, including footings supported by piles. The LRFD method has been progressively developed since the mid-1980s with this sole purpose of ensuring the uniform reliability of bridge systems throughout the United States by unifying the design of superstructure and foundation elements.

In a response to this documented reliability of the LRFD approach over the more traditional WSD approach, the FHWA issued a policy memorandum on June 28, 2000, requiring all new bridges initiated after October 1, 2007, to be designed according to the LRFD approach. This approach for designing foundation elements has substantially more challenges associated with it than, for example, the design of superstructure elements following the same design approach. These challenges develop mainly from the inherently high variability of soil properties across, as well as within, regions and the ability to predict the realistic pile resistance and driving stresses. Since the foundation is a critical element of the bridge system, conservative LRFD resistance factors have been recommended for their design (AASHTO, 2007) to ensure safe foundation design practices. In this process, soil variability expected at the national level was given consideration, contributing to the conservativeness of the recommended LRFD resistance factors. However, for economical reasons, an unnecessarily conservative design method should not be adopted since foundation systems typically account for as much as thirty percent of the total bridge cost. Consequently, regionally calibrated LRFD resistance factors have been permitted by the American Association of State Highway and Transportation Officials (AASHTO) in order to improve the economy of the bridge foundation elements.

3. SIGNIFICANCE OF PILOT

In response to AASHTO's permittance of regionally calibrated LRFD resistance factors for the design of driven pile foundations, many states across the nation have made an effort to develop regionally calibrated LRFD resistance factors for the design and construction control of driven pile foundations. More specifically, Florida (McVay et al., 2000), Illinois (Long et al., 2009), Washington (Allen, 2005), and Wisconsin (Long et al., 2009) have all published studies recommending LRFD resistance factors for the design of driven pile foundations by means of static analysis methods and the construction control of driven pile foundations by means of dynamic analysis methods and dynamic pile driving formulas. While these studies provide valuable information including the identification of available regional pile load test data, in all cases, except for the State of Florida study, the reported LRFD resistance factor calibrations were accomplished through the use of national databases such as the DFLTD. Such procedures were adopted due to the absence of quality assurance provisions and required geotechnical and load test data for the regionally reported static pile load tests.

According to McVay et al. (2000), the University of Florida has been collecting pile load test data for the Florida DOT since 1989. The resultant database, termed PILEUF, contains data for 247 piles of various types (e.g., square concrete, round concrete, pipe, and steel H-shaped), with 180 of those piles being located in the State of Florida. Although it is unknown as to whether PILEUF exists in an electronic form, its general characteristics resemble those of PILOT. With the goal of becoming a model database for an effective regional LRFD calibration process that can be refined as more data becomes available, PILOT is based on a well-defined hierarchical classification scheme, in addition to an appealing user-friendly interface, that has not yet been seen with other databases such as DFLTD and PILEUF. Furthermore, imposition of a strict acceptance criterion for each of the three hierarchical pile load test dependability classifications, expounded in the subsequent section, ensures that the resulting data available in PILOT for LRFD regional calibration is of superior quality and consistency. These aforementioned qualities delineate the importance of establishing databases such as PILOT at the state and national levels.

4. KEY TERMINOLOGY USED FOR DATA QUALITY ASSURANCE

As mentioned previously, an estimate of a pile's resistance can be achieved through the use of static and/or dynamic methods. Employing a static method requires a detailed site investigation for the evaluation of soil parameters, while for a dynamic method driving record information and reported pile driving equipment characteristics are typically required. Consequently, it was determined during the formulation of PILOT that a well-defined hierarchical classification scheme would be required to clearly identify those pile load tests containing sufficient information for the estimation of pile resistance by means of both static and dynamic methods. Furthermore, based upon the reality that not every pile load test yielded dependable results, an additional level in the hierarchical classification scheme was deemed necessary for initial separation of the reliable pile load tests from the entirety of the PILOT database.

The unique classification system developed for PILOT catalogs pile load tests as "reliable," "usable-static," and "usable-dynamic." The first tier of the hierarchical system, which was originally termed by Dirks and Kam (1989; revised 1994), assigns the reliable classification to a pile static load test that has achieved the displacement based criteria for pile resistance, as defined by Davisson (1972), prior to the pull-out of any anchor piles. The second tier assigns the usable-static classification, which identifies those pile load tests possessing sufficient information for the prediction of pile resistance by means of static methods, to a reliable pile static load test that has soil boring information and SPT data within one hundred feet of the test pile. Furthermore, the third tier assigns the usable-dynamic classification, which identifies those pile load tests containing sufficient information for the prediction of pile resistance by means of dynamic methods, to a usable-static pile load test that has complete driving records and information concerning characteristics of the pile driving equipment for the test pile under consideration.

As a final means of ensuring data quality and consistency within PILOT, distinct classification rules, which were missing from the numerous databases presented by Roling (2010) were established for generalization of the soil profile located along the test pile embedded length. In other words, a test pile is classified as being embedded in a sand soil profile when at least 70% of the soil located along the shaft of the pile is classified as a sand or non-cohesive material according to the Unified Soil Classification System (USCS). Likewise, a test pile is classified as being embedded in a clay soil profile when at least 70 percent of the soil located along the shaft of the pile is classified as a clay or cohesive material according to the USCS. However, when neither of the aforementioned classifications is achieved, the test pile is classified as being embedded in a mixed soil profile. In light of the key terminology defined in this subsection, a descriptive summary of the historical data subset upon which PILOT was originally fashioned is presented below.

5. DESCRIPTIVE SUMMARY OF PILOT HISTORICAL DATA SUBSET

A descriptive summary of the 264 pile SLTs conducted in the State of Iowa on steel H-shaped, timber, pipe, Monotube, and concrete piles is provided as a function of pile type in the following subsections.

5.1 Steel H-Pile SLTs

Of the 264 pile SLTs conducted by the Iowa DOT, 164 were performed on H-shaped steel piles. A distribution of the number of static pile load tests conducted on the various sizes of steel H-shaped piles has been provided in Figure 5.1. Likewise, a distribution indicating the various embedded lengths for the 164 steel H-shaped test piles is depicted in Figure 5.2, for which the mean and standard deviation are 53.20 and 18.56 feet, respectively.

Of considerable interest and value to the objectives of this research project is the fact that a total of 139 steel H-pile load tests were classified in PILOT as reliable, with 80 of those being classified as usable-static and 32 of those 80 being grouped as usable-dynamic. For the 80 usable-static steel H-pile load tests, distributions amongst Iowa’s five predominant soil regions, the predominant soil medium encountered along the shaft of the pile, and Iowa’s 99 counties have been provided in Figure 5.3, Figure 5.4, and Figure 5.5, respectively. Likewise, for the 32 usable-dynamic steel H-pile load tests, distributions amongst Iowa’s five predominant soil regions, the predominant soil medium encountered along the shaft of the pile, and Iowa’s 99 counties have been provided in Figure 5.6, Figure 5.7, and Figure 5.8, respectively.

Lastly, to assist with future investigations concerning the effect of soil setup on pile resistance, the time interval between the EOD condition and the actual SLT was established for each of the 80 usable-static steel H-pile load tests. With this information, distributions for both the usable-static and usable-dynamic data subsets were generated and have been provided in Figure 5.9 and Figure 5.10, respectively. More specifically, the usable-static distribution of Figure 5.9 possesses a mean of 4.9 days and a standard deviation of 2.2 days, whereas the usable-dynamic distribution of Figure 5.10 possesses a mean of 4.6 days and a standard deviation of 1.7 days. When considering only those steel H-piles embedded in a clay soil profile, for which the influence of soil setup is greatest on account of a characteristically slow time rate of consolidation, the mean and standard deviation for the distribution of the time interval between the EOD condition and the actual SLT become 4.4days and 1.9 days, respectively, for the usable-static records and 3.7 days and 1.3 days, respectively, for the usable-dynamic records.

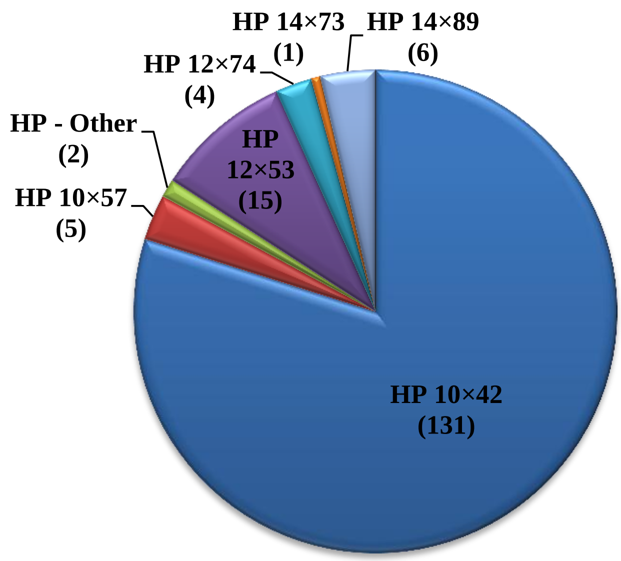


Figure 5.1: Distribution of Historical Steel H-Pile SLTs by Pile Size

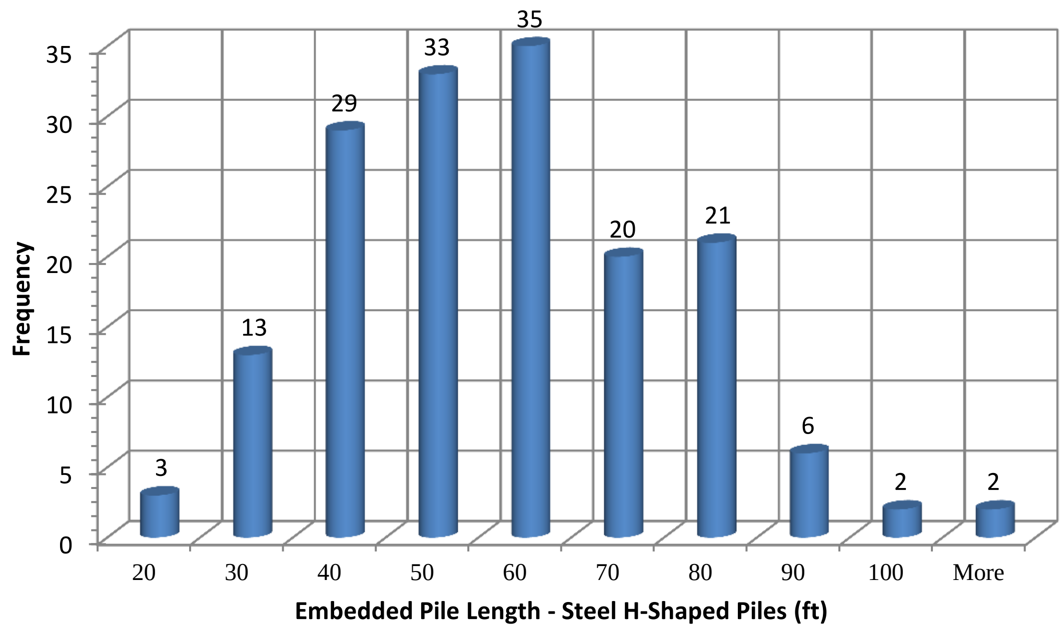


Figure 5.2: Distribution of Embedded Pile Lengths for Historical Steel H-Pile Dataset

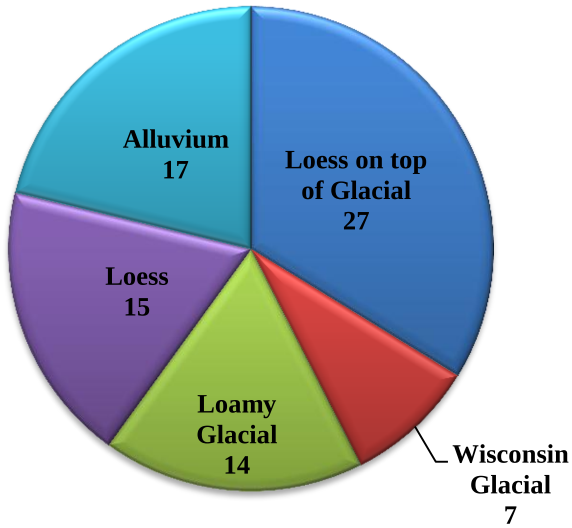


Figure 5.3: Distribution of Historical Usable-Static Steel H-Pile SLTs amongst Iowa's Predominant Soil Regions

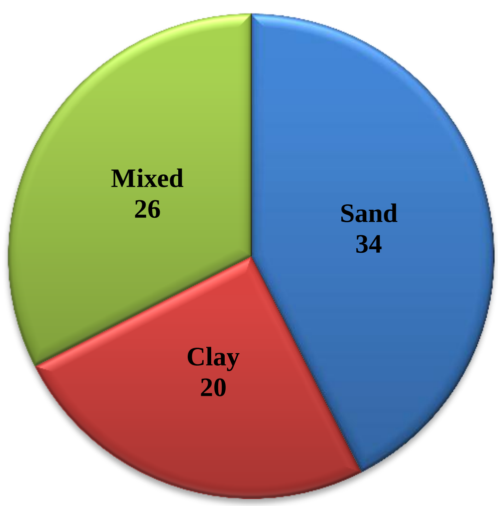


Figure 5.4: Distribution of Historical Usable-Static Steel H-Pile SLTs by Test Site Soil Classification

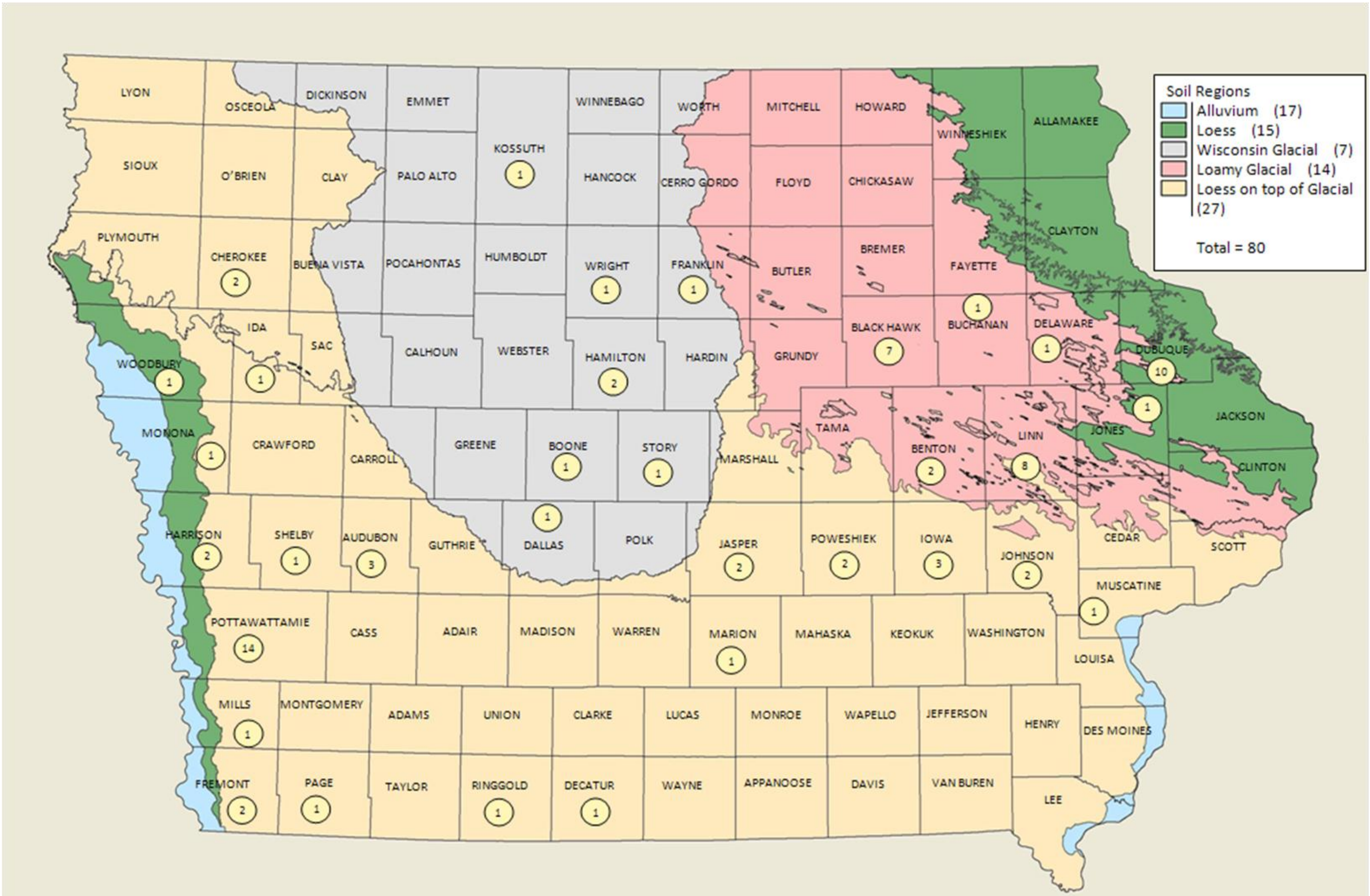


Figure 5.5: Distribution of Historical Usable-Static Steel H-Pile SLTs amongst Iowa's Predominant Soil Regions and 99 Counties

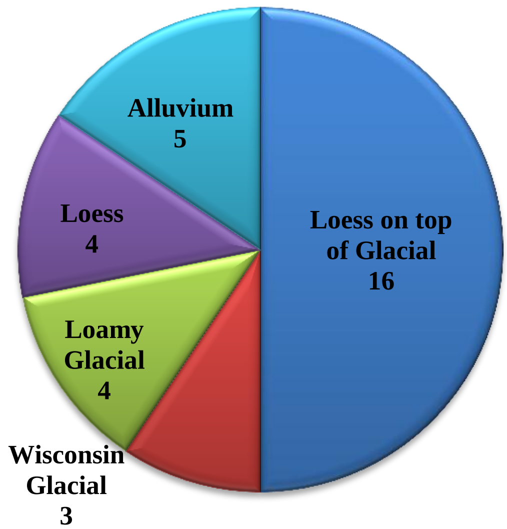


Figure 5.6: Distribution of Historical Usable-Dynamic Steel H-Pile SLTs amongst Iowa's Predominant Soil Regions

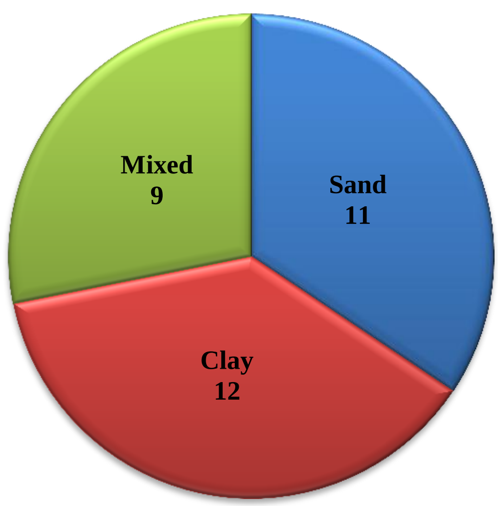


Figure 5.7: Distribution of Historical Usable-Dynamic Steel H-Pile SLTs by Test Site Soil Classification

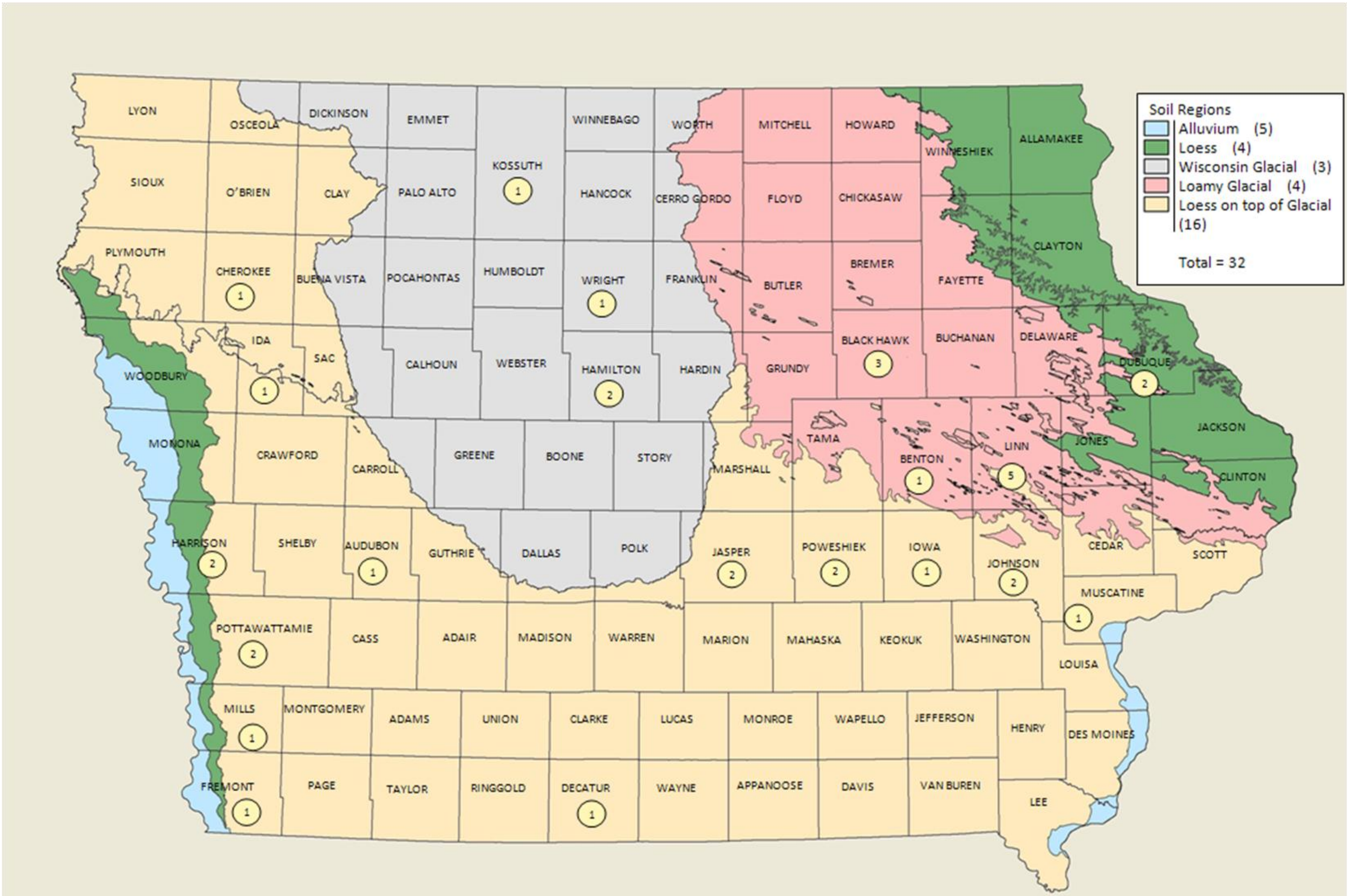


Figure 5.8: Distribution of Historical Usable-Dynamic Steel H-Pile SLTs amongst Iowa's Predominant Soil Regions and 99 Counties

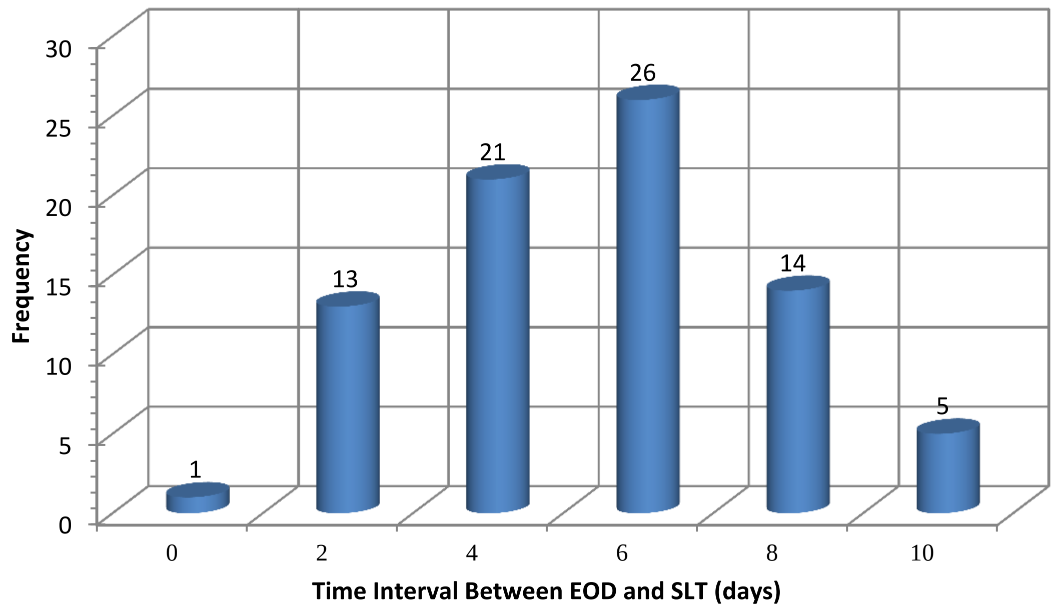


Figure 5.9: Distribution of Time Interval between EOD and SLT for Historical Usable-Static Steel H-Pile SLTs

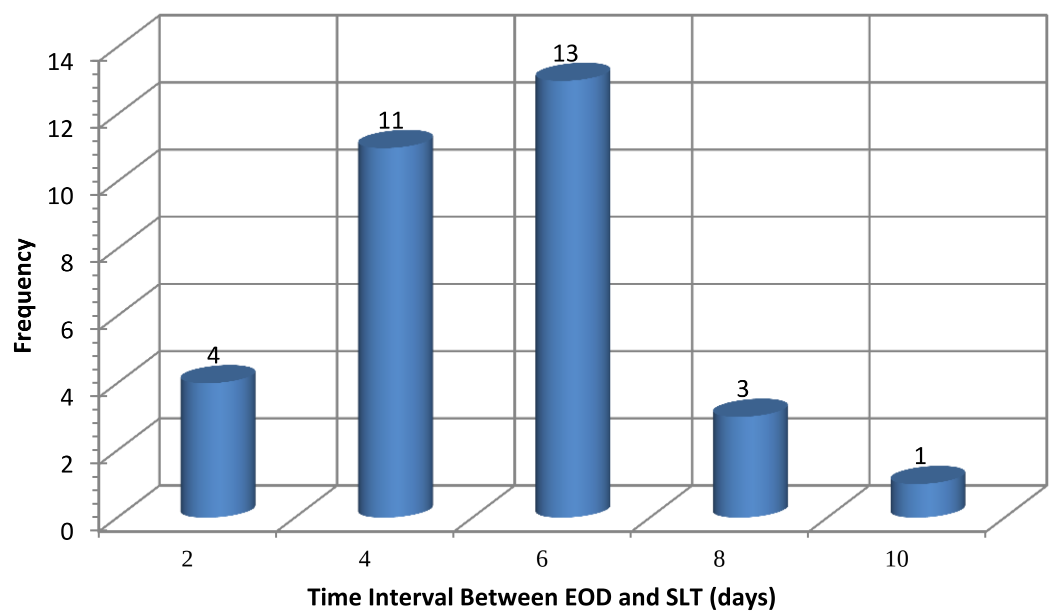


Figure 5.10: Distribution of Time Interval between EOD and SLT for Historical Usable-Dynamic Steel H-Pile SLTs

5.2 Timber Pile SLTs

Of the 264 pile SLTs conducted by the Iowa DOT, 75 were performed on timber piles. For the entirety of this timber pile load test data subset, it was presumed that all test piles were 10 inches in diameter as a consequence of inadequate size classification information. This assumption follows that made by Dirks and Kam (1989; revised 1994) in their derivation of the skin friction and end bearing design charts found in *Foundation Soils Information Chart: Pile Foundation*. The various embedded lengths for these 75 timber piles have been provided in the distribution presented in Figure 5.11, for which the mean and standard deviation are 29.00 and 10.68 feet.

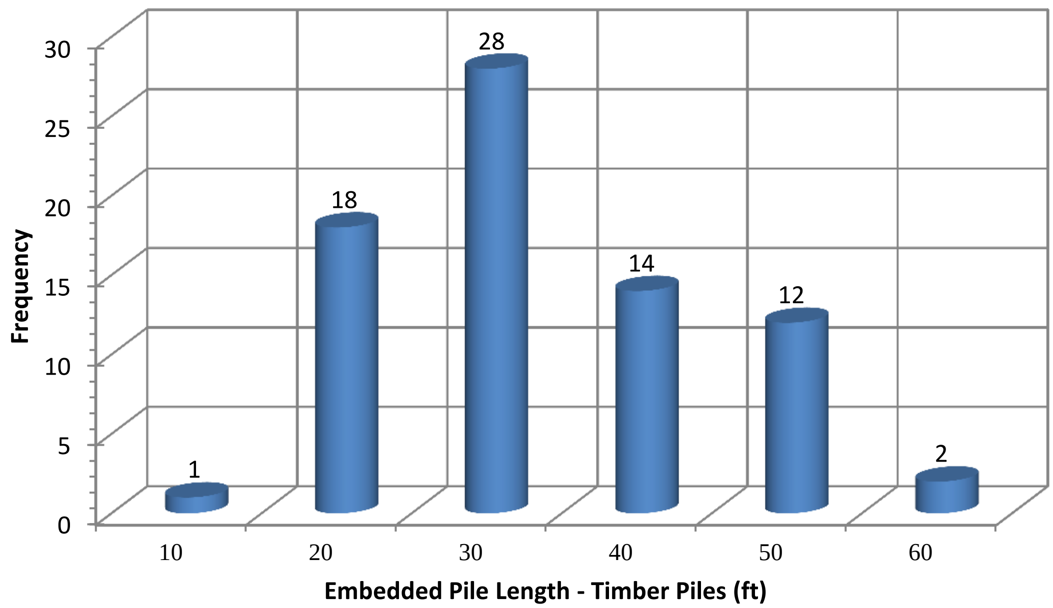


Figure 5.11: Distribution of Embedded Pile Lengths for Historical Timber Pile Dataset

Out of the 75 total timber pile SLTs conducted by the Iowa DOT, 47 were classified in PILOT as reliable, with 24 of those being classified as usable-static and 9 of those 24 being grouped as usable-dynamic. For the 24 usable-static timber pile load tests, distributions amongst Iowa's five predominant soil regions, the predominant soil medium encountered along the shaft of the pile, and Iowa's 99 counties have been provided in Figure 5.12, Figure 5.13, and Figure 5.14, respectively. Similarly, for the 9 usable-dynamic timber pile load tests, distributions amongst Iowa's five predominant soil regions, the predominant soil medium encountered along the shaft of the pile, and Iowa's 99 counties have been provided in Figure 5.15, Figure 5.16, and Figure 5.17, respectively.

To finish, distributions of the time interval between the EOD condition and the actual SLT for both the usable-static and usable-dynamic timber pile data subsets have been provided in Figure 5.18 and Figure 5.19, respectively. More specifically, the usable-static distribution of Figure 5.18 possesses a mean of 5.8 days and a standard deviation of 2.7 days, whereas the usable-dynamic distribution of Figure 5.19 possesses a mean of 5.0 days and a standard deviation of 3.2 days.

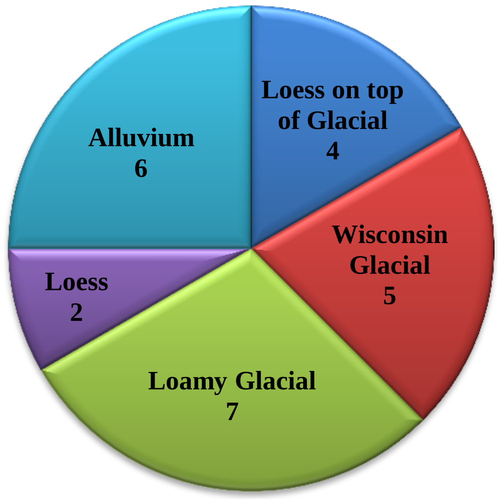


Figure 5.12: Distribution of Historical Usable-Static Timber Pile SLTs amongst Iowa's Predominant Soil Regions

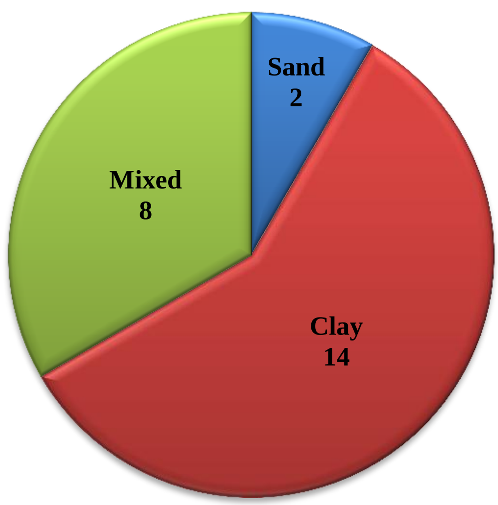


Figure 5.13: Distribution of Historical Usable-Static Timber Pile SLTs by Test Site Soil Classification

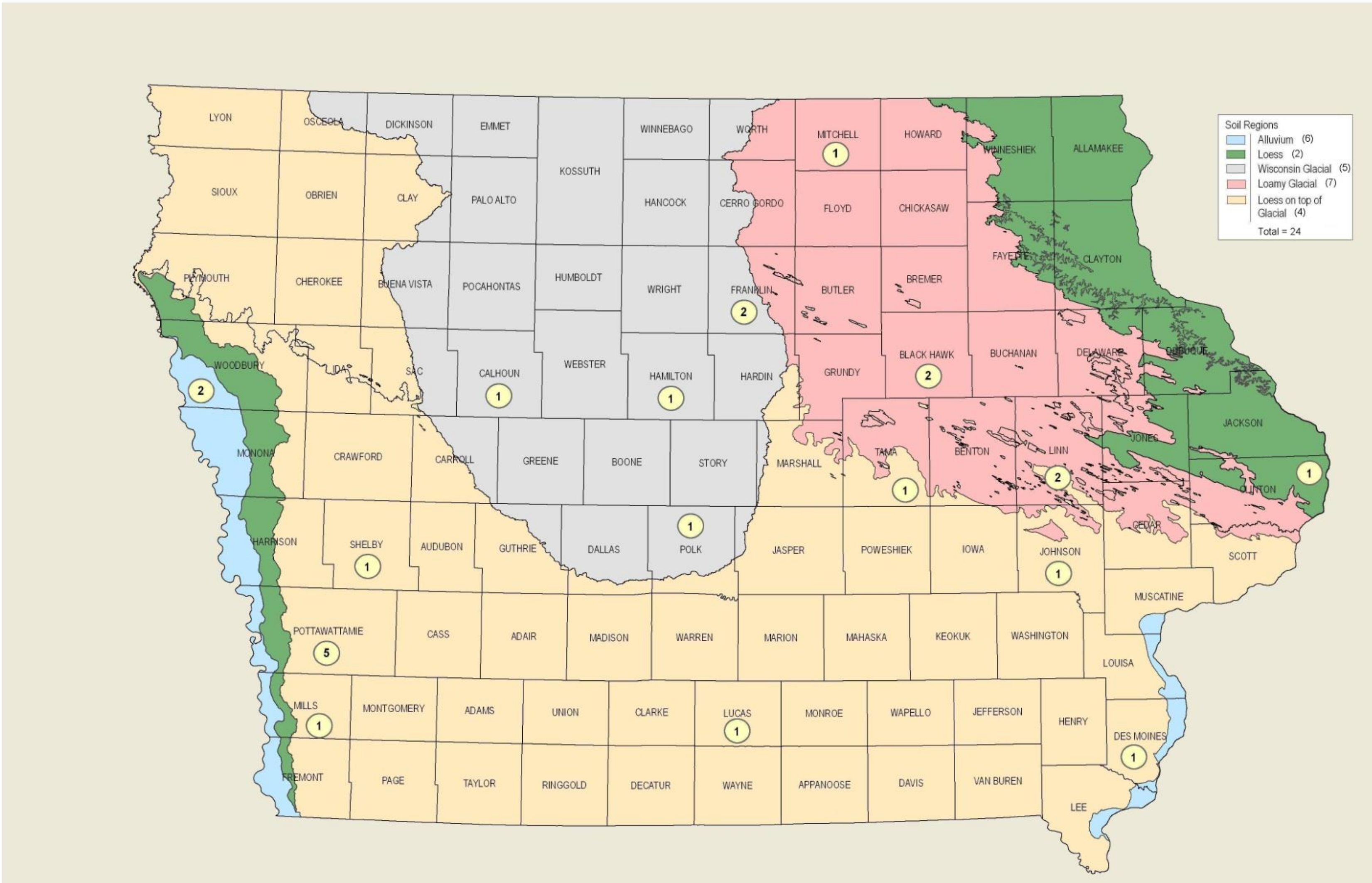


Figure 5.14: Distribution of Historical Usable-Static Timber Pile SLTs amongst Iowa's Predominant Soil Regions and 99 Counties

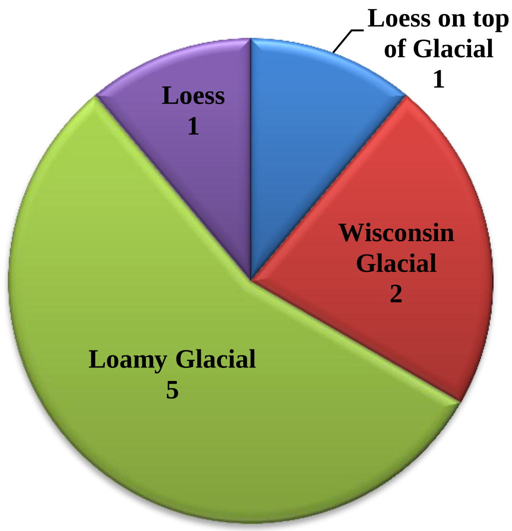


Figure 5.15: Distribution of Historical Usable-Dynamic Timber Pile SLTs amongst Iowa's Predominant Soil Regions

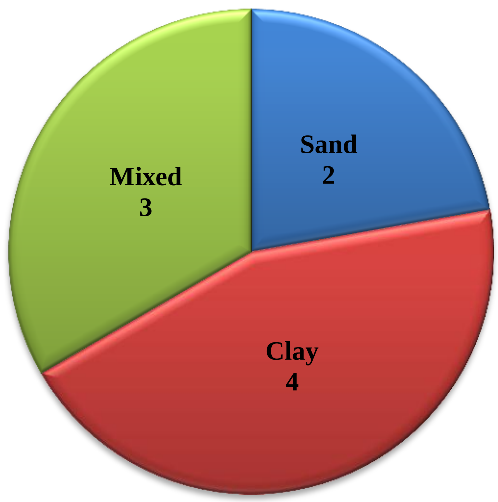


Figure 5.16: Distribution of Historical Usable-Dynamic Timber Pile SLTs by Test Site Soil Classification

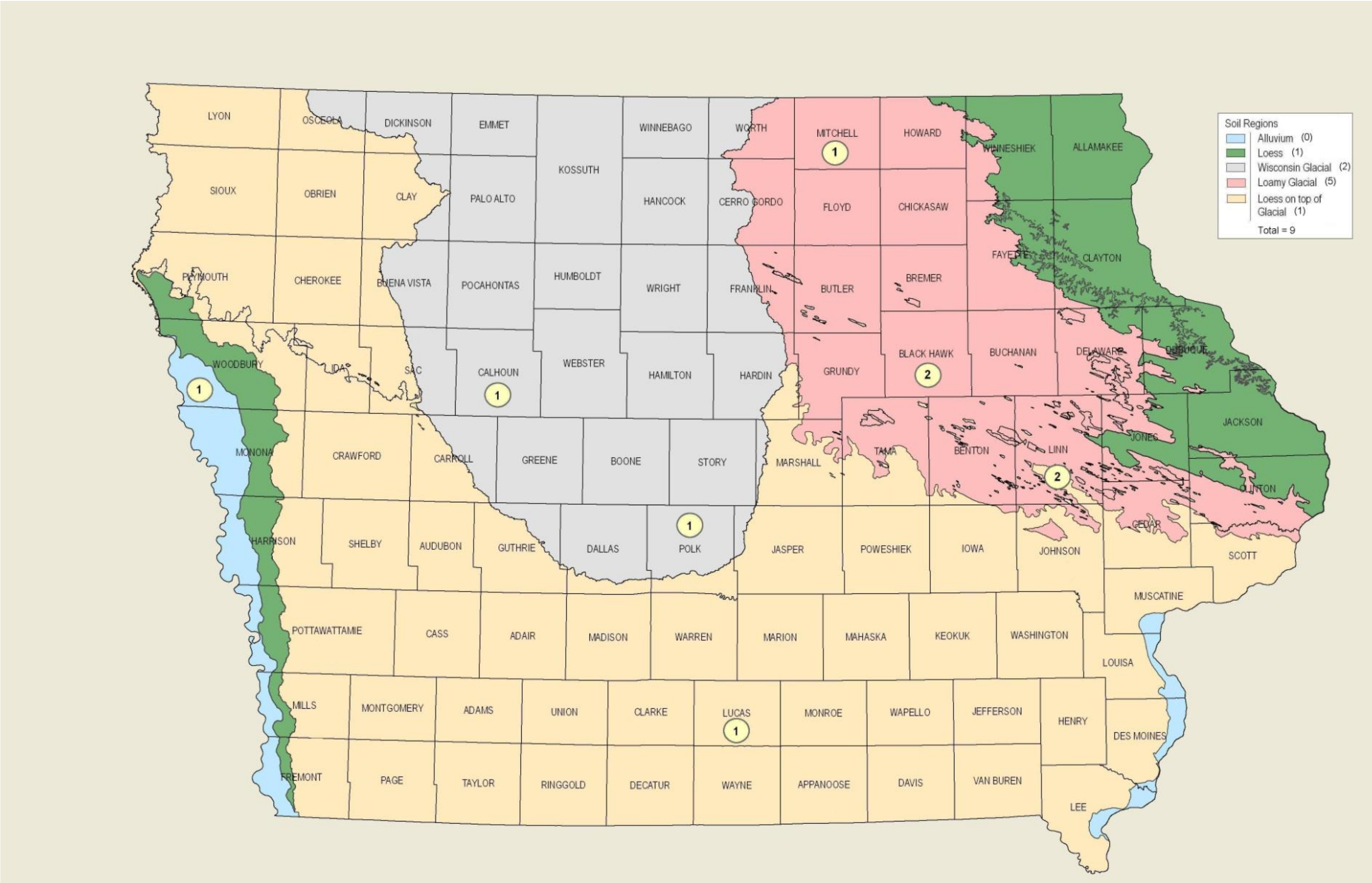


Figure 5.17: Distribution of Historical Usable-Dynamic Timber Pile SLTs amongst Iowa's Predominant Soil Regions and 99 Counties

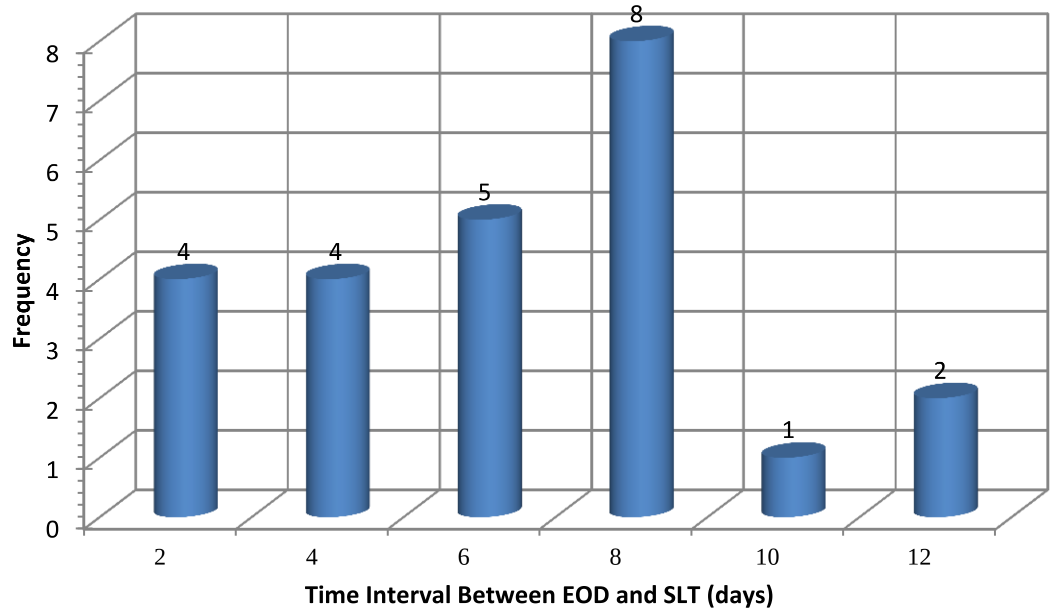


Figure 5.18: Distribution of Time Interval between EOD and SLT for Historical Usable-Static Timber Pile SLTs

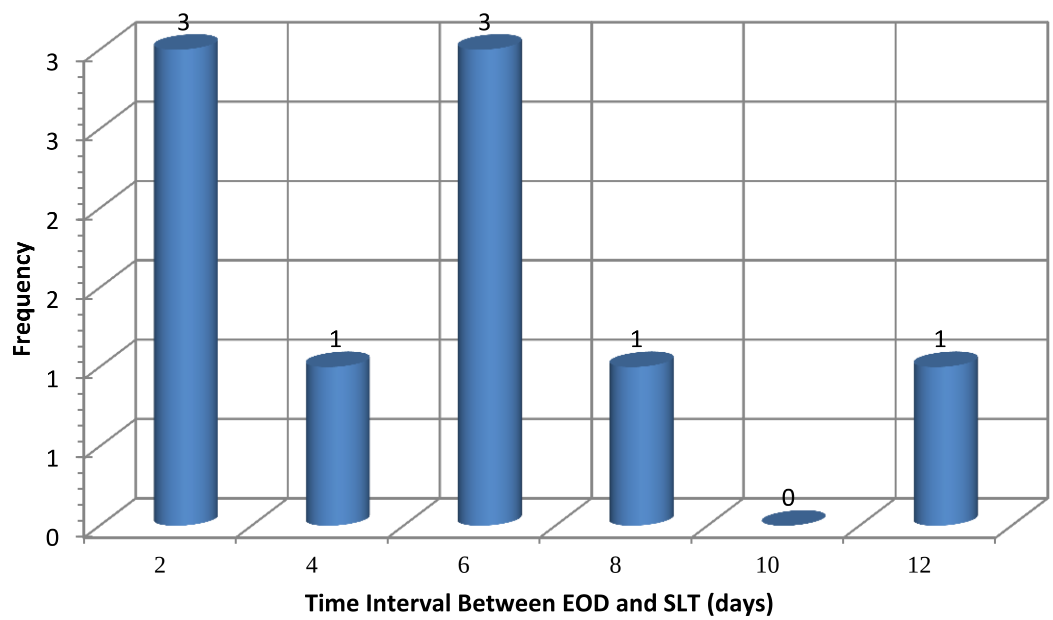


Figure 5.19: Distribution of Time Interval between EOD and SLT for Historical Usable-Dynamic Timber Pile SLTs

5.3 Pipe, Monotube, and Concrete Pile SLTs

Finally, the 25 remaining pile SLTs conducted by the Iowa DOT were performed on steel pipe, Monotube, and prestressed concrete piles. More specifically, sixteen pile SLTs were performed on steel pipe piles, seven were performed on Monotube piles, which are essentially steel pipe piles with fluted walls and a tapered cross-section, and two were performed on prestressed concrete piles. A distribution showing the number of pile SLTs conducted on the various types and sizes of steel pipe, Monotube, and prestressed concrete piles has been provided in Figure 5.20. In addition, the various embedded lengths for these 25 steel pipe, Monotube, and prestressed concrete piles have been provided in the distribution presented in Figure 5.21, for which the mean and standard deviation are 41.47 feet and 16.21 feet, respectively.

Of the 25 total pile SLTs conducted on steel pipe, Monotube, and prestressed concrete piles, 21 were classified in PILOT as reliable (i.e., 15 steel pipe, 5 Monotube, and 1 prestressed concrete pile SLT), with 17 of those being classified as usable-static (i.e., 14 steel pipe and 3 Monotube pile SLTs) and 2 of those 17 being grouped as usable-dynamic (i.e., 2 steel pipe SLTs). For the 17 usable-static steel pipe and Monotube pile load tests, distributions amongst Iowa's five predominant soil regions, the predominant soil medium encountered along the shaft of the pile, and Iowa's 99 counties have been provided in Figure 5.22, Figure 5.23, and Figure 5.24, respectively. As for the two usable-dynamic steel pipe pile load tests, one was performed in Iowa's loess on top of glacial soil region, while the other was performed in the loess soil region. Additionally, one of the two usable-dynamic steel pipe pile load tests was performed in Shelby County, while the other was performed in Woodbury County. Finally, a mixed soil medium was encountered along the shaft of both usable-dynamic steel pipe piles.

To conclude, a distribution of the time interval between the EOD condition and the actual SLT for the usable-static steel pipe and Monotube pile data subset has been provided in Figure 5.25, where the mean and standard deviation are 10.4 and 11.2 days, respectively. As for the two usable-dynamic steel pipe pile load tests, the one driven in Shelby County was statically load tested to failure seven days after the EOD, while the one driven in Woodbury County was statically loaded to failure fourteen days after the EOD.

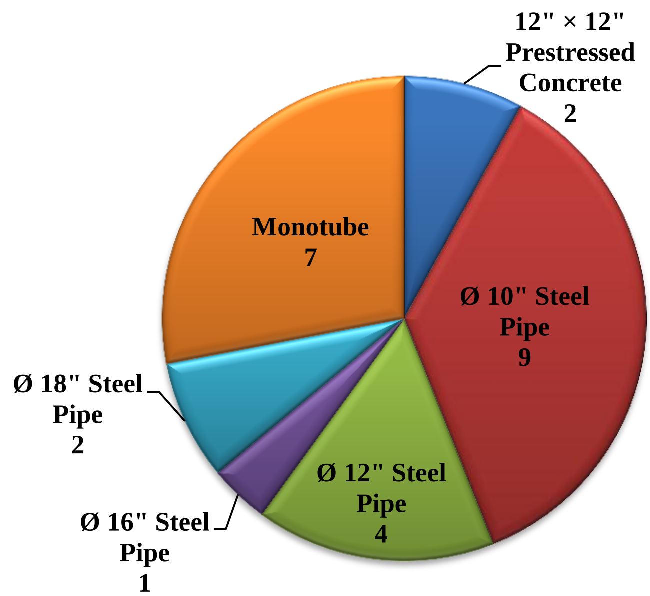


Figure 5.20: Distribution of Historical Steel Pipe, Monotube, and Prestressed Concrete Pile SLTs by Type and Size

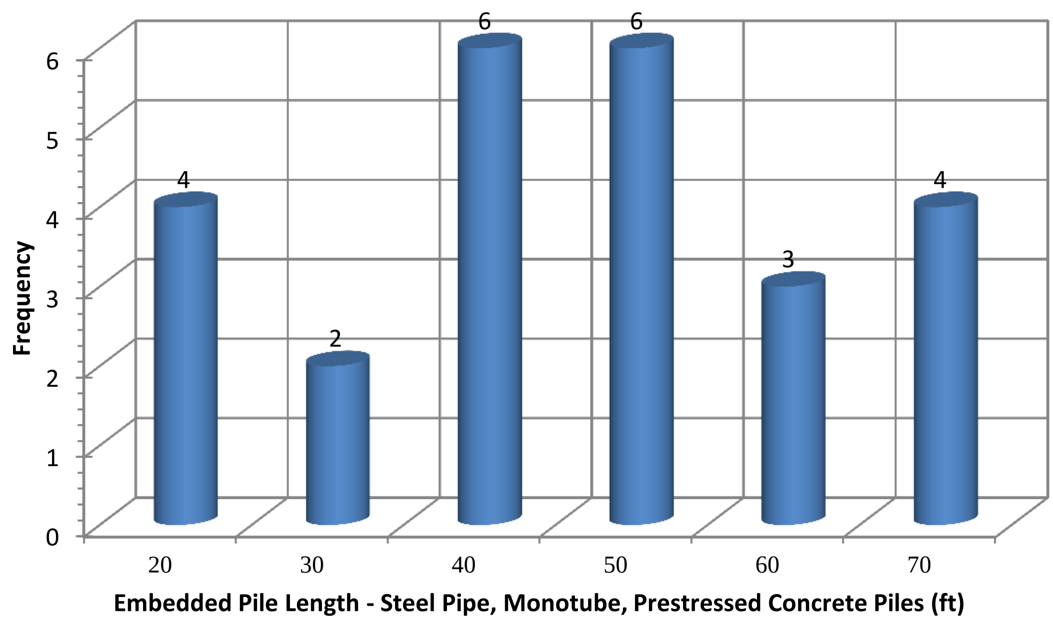


Figure 5.21: Distribution of Embedded Pile Lengths for Historical Steel Pipe, Monotube, and Prestressed Concrete Piles

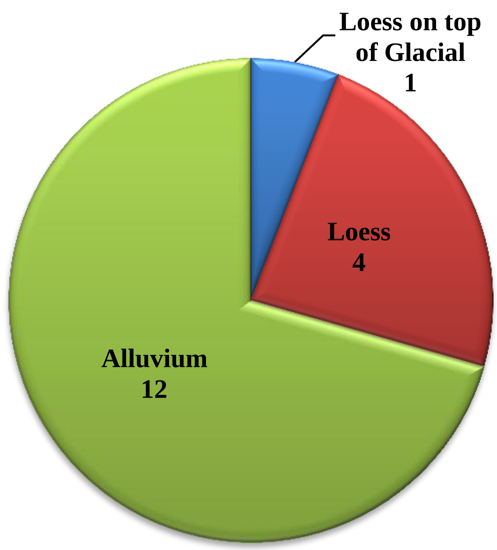


Figure 5.22: Distribution of Historical Usable-Static Steel Pipe, Monotube, and Prestressed Concrete Pile SLTs amongst Iowa's Predominant Soil Regions

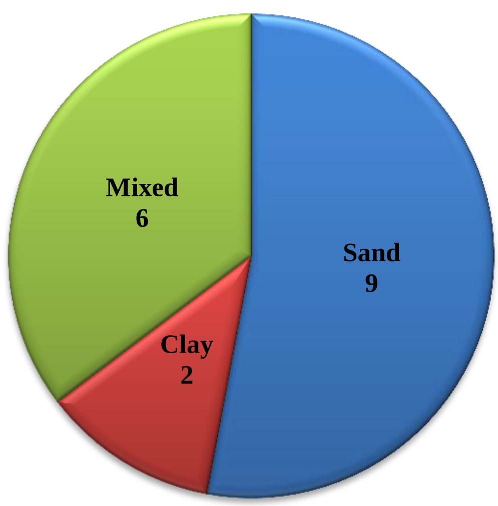


Figure 5.23: Distribution of Historical Usable-Static Steel Pipe and Monotube Pile SLTs by Test Site Soil Classification

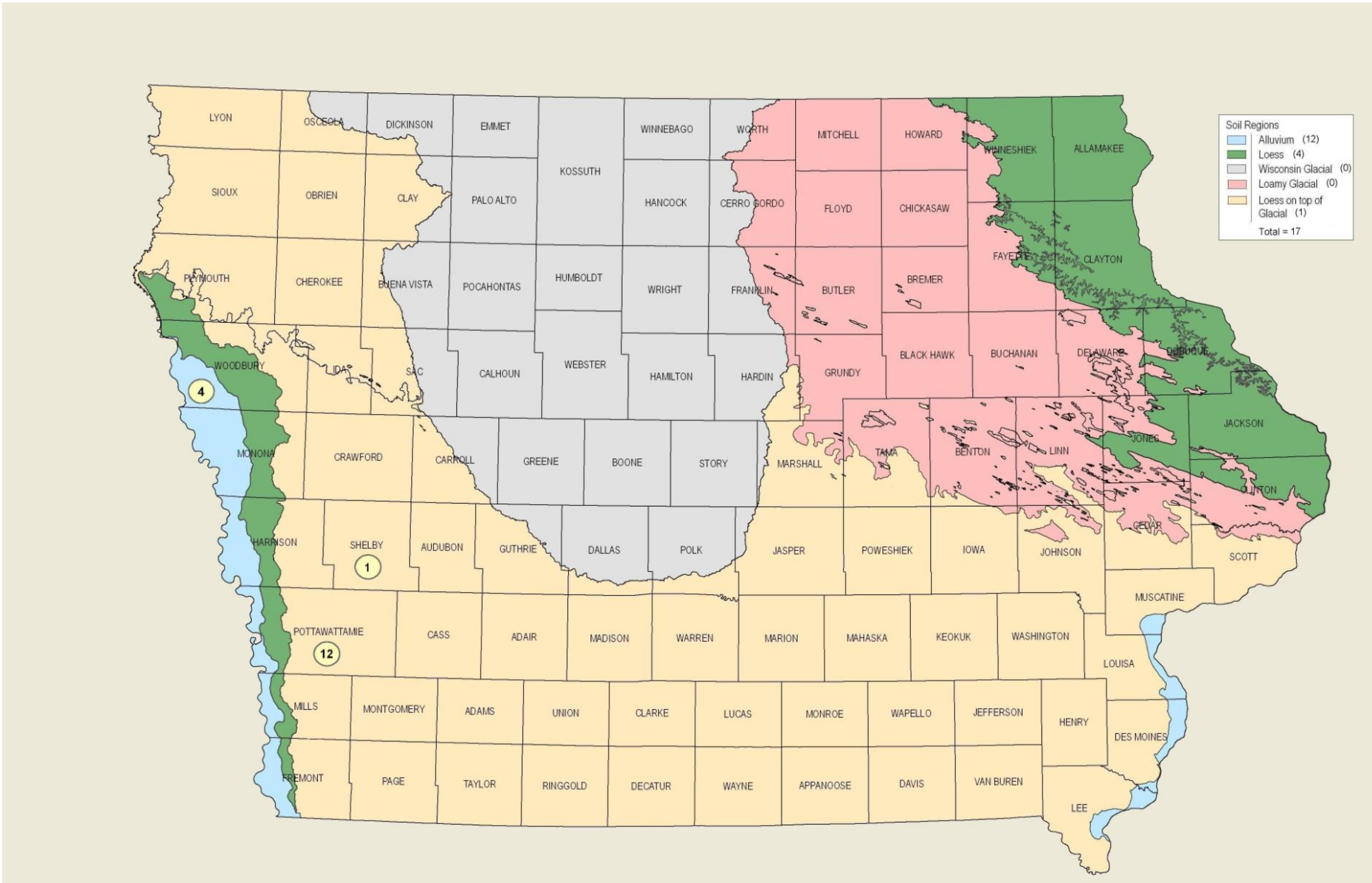


Figure 5.24: Distribution of Historical Usable-Static Steel Pipe and Monotube Pile SLTs amongst Iowa's Predominant Soil Regions and 99 Counties

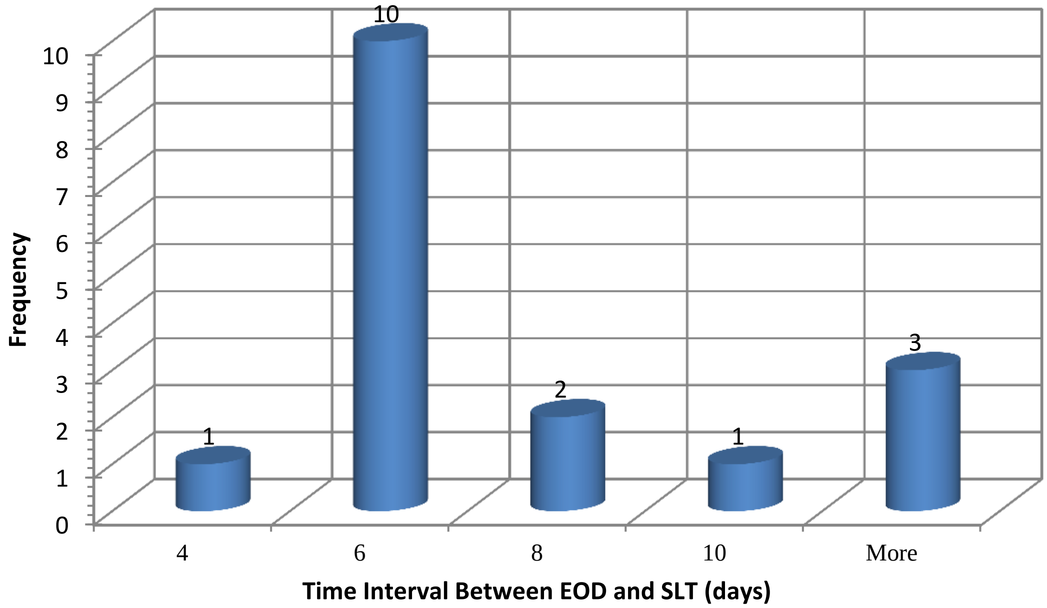


Figure 5.25: Distribution of Time Interval between EOD and SLT for Historical Usable-Static Steel Pipe and Monotube Pile SLTs

6. PILOT USER MANUAL

As alluded to previously, PILOT was developed to provide a means for all past, present, and future Iowa DOT bridge pile load test data to be stored in electronic form for subsequent reference and/or analysis. The purpose of the following user manual is to provide a comprehensive explanation of the many features incorporated into PILOT, the details of how the quality of data was ensured, as well as information on how to add new SLT data and the minimum required extent of details for these new tests.

6.1 Accessing PILOT

To download and save a copy of the most recent version of PILOT, follow the steps listed below:

1) Open the *My Computer* system folder on a computer to which PILOT will be installed.
2) Insert the PILOT CD-ROM into the computer's CD-ROM drive. Once the PILOT CD-ROM has been placed in the computer's CD-ROM drive, the CD drive found in the *My Computer* system folder will display the name PILOT.
3) Open the PILOT CD-ROM by double-clicking with the mouse on the CD drive icon found in the *My Computer* system folder.
4) Drag the PILOT folder found on the PILOT CD-ROM to the Local Disk (C:) drive. The computer will now begin copying the PILOT folder to the Local Disk (C:) drive; note that this process may take a few minutes. (Should one wish to save the PILOT folder to a location other than the Local Disk (C:) drive, simply drag the PILOT folder found on the PILOT CD-ROM to the desired location.)
5) Once the PILOT folder has been successfully copied to the desired location, PILOT can be opened by first double-clicking with the mouse on the recently copied PILOT folder.
6) Upon opening the PILOT folder, locate and open the Database folder by double-clicking with the mouse.
7) Once the Database folder has been successfully opened, locate and open the Microsoft Office Access™ 2007 file named "PILOT.accdb" by double-clicking with the mouse. (Note that PILOT is best viewed at a screen resolution of 1600 by 1200 pixels.)

6.2 Description of PILOT Database Fields

The architecture of PILOT was developed through the use of Microsoft Office Access™ with the goal of delivering an organized storage facility shrouded beneath an appealing user-friendly interface. It was designed to perform efficient filtering, sorting, and querying procedures on the amassed dataset. Consisting of only two main forms, navigation within PILOT is straightforward. The first of these two forms is the PILOT Display Form shown in Figure 6.1. This main form contains a datasheet view of all available records presented in datasheet view and two quick access buttons for the insertion of new pile load tests records. The acquisition of additional details concerning PILOT, along with a drop-down menu featuring a variety of filtering options are also made available on this form. All of these functions for the PILOT Form allow it to successfully function as the nucleus for the entire database.

The second of the two main forms, Pile Load Test Record Form (PLTRF), can be accessed via unique hyperlinked identification numbers, or the "New Pile Load Test" quick-access button located on the PILOT Display Form. Containing detailed information organized into ten groupings for each pile load testPILOT, the PLTRF functions as a user-friendly complement to the PILOT Display Form. As illustrated in Figure 6.2, the PLTRF consists of a series of nine tabbed subforms located in the lower left-hand quadrant. The remaining form space is accompanied by a multitude of informative database fields. These database fields are described in detail in the following subsections.

6.2.1 General Pile Load Test Record Form Information

Described below are various fields included in the general Pile Load Test Record Form (PLTRF) with reference to labels included in Figure 6.2.

A. **ID:** A unique cataloging number automatically assigned by Microsoft Office Access™ to each record within PILOT.

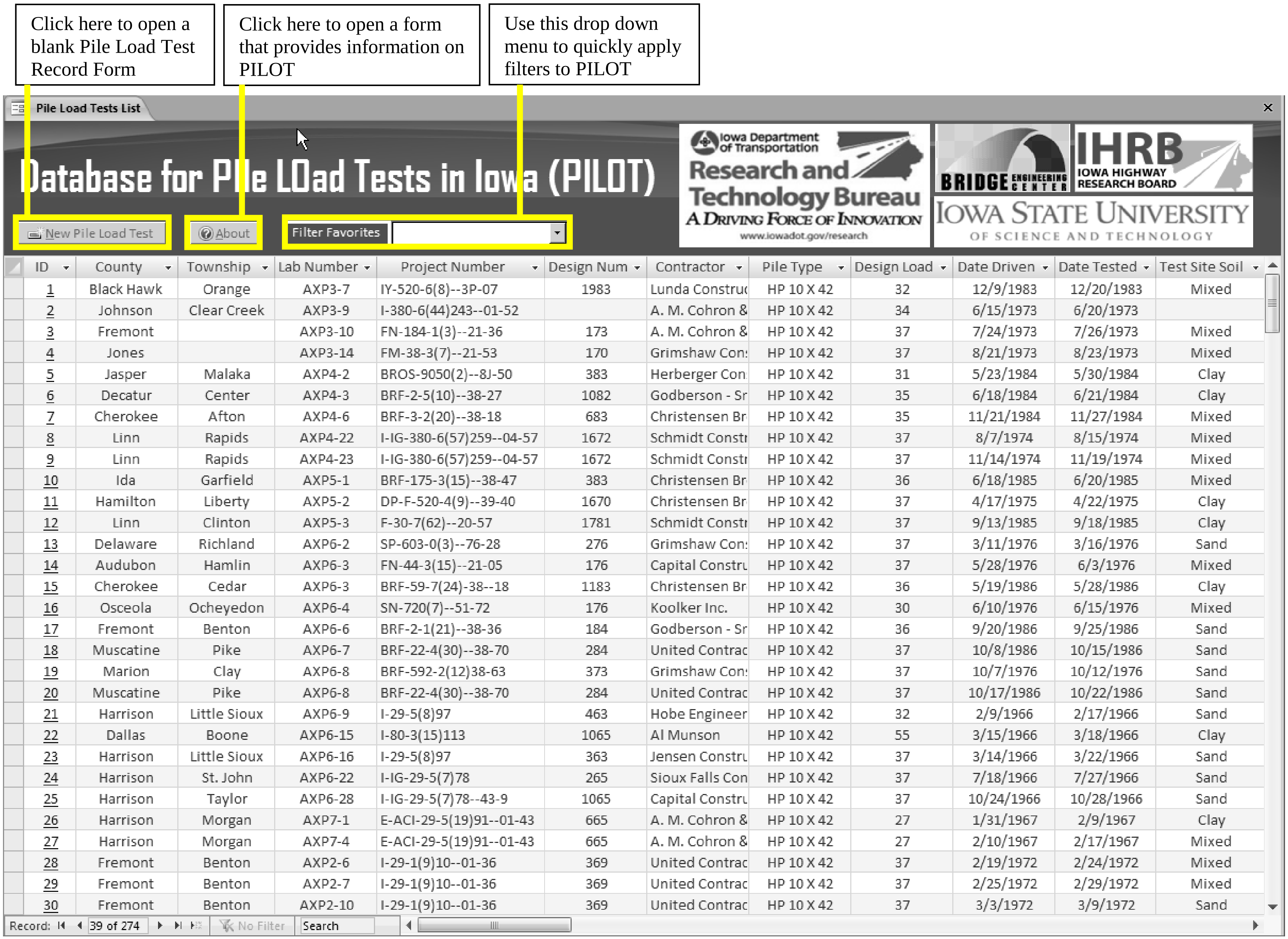
B. **Data Folder Location:** A database field that specifies the location of the pile load test records for each load test contained within the database. The directory housing these various pile load test records, the Pile Load Tests Records Directory, is organized by three volumes. Volume 1 consists of pile load test records for steel H-piles, Volume 2 consists of pile load test records for prestressed concrete, Monotube, and steel pipe piles, Volume 3 consists of pile load test records for timber piles, and Volume 4 consists of pile load test records for those piles tested as a part of IHRB Project TR-583 (Ng et al., 2010). Therefore, the possible entries into this database field are as follows: Volume 1, Volume 2, Volume 3, or Volume 4.

C. **Lab Number:** The identification number used by the Iowa DOT to distinguish between the various test piles (e.g., AXP0-1, AXP1-9, etc.).

D. **Contractor:** The name of the contracting company responsible for the construction of the specified bridge project including driving of the test pile.

E. **Project Number:** The unique Iowa DOT cataloging number assigned to each construction project.

F. **Design Number:** This database field goes hand in hand with the previously described field E (i.e., Project Number). For every construction project in the State of Iowa, in addition to assigning a unique project number, each bridge project within the construction project is assigned a unique design number. The bridge design number corresponding to a specified pile load test is entered into this database field.



ID	County	Township	Lab Number	Project Number	Design Num	Contractor	Pile Type	Design Load	Date Driven	Date Tested	Test Site Soil
1	Black Hawk	Orange	AXP3-7	IY-520-6(8)--3P-07	1983	Lunda Construc	HP 10 X 42	32	12/9/1983	12/20/1983	Mixed
2	Johnson	Clear Creek	AXP3-9	I-380-6(44)243--01-52		A. M. Cohron &	HP 10 X 42	34	6/15/1973	6/20/1973	
3	Fremont		AXP3-10	FN-184-1(3)--21-36	173	A. M. Cohron &	HP 10 X 42	37	7/24/1973	7/26/1973	Mixed
4	Jones		AXP3-14	FM-38-3(7)--21-53	170	Grimshaw Con:	HP 10 X 42	37	8/21/1973	8/23/1973	Mixed
5	Jasper	Malaka	AXP4-2	BROS-9050(2)--8J-50	383	Herberger Con	HP 10 X 42	31	5/23/1984	5/30/1984	Clay
6	Decatur	Center	AXP4-3	BRF-2-5(10)--38-27	1082	Godberson - Sr	HP 10 X 42	35	6/18/1984	6/21/1984	Clay
7	Cherokee	Afton	AXP4-6	BRF-3-2(20)--38-18	683	Christensen Br	HP 10 X 42	35	11/21/1984	11/27/1984	Mixed
8	Linn	Rapids	AXP4-22	I-IG-380-6(57)259--04-57	1672	Schmidt Constr	HP 10 X 42	37	8/7/1974	8/15/1974	Mixed
9	Linn	Rapids	AXP4-23	I-IG-380-6(57)259--04-57	1672	Schmidt Constr	HP 10 X 42	37	11/14/1974	11/19/1974	Mixed
10	Ida	Garfield	AXP5-1	BRF-175-3(15)--38-47	383	Christensen Br	HP 10 X 42	36	6/18/1985	6/20/1985	Mixed
11	Hamilton	Liberty	AXP5-2	DP-F-520-4(9)--39-40	1670	Christensen Br	HP 10 X 42	37	4/17/1975	4/22/1975	Clay
12	Linn	Clinton	AXP5-3	F-30-7(62)--20-57	1781	Schmidt Constr	HP 10 X 42	37	9/13/1985	9/18/1985	Clay
13	Delaware	Richland	AXP6-2	SP-603-0(3)--76-28	276	Grimshaw Con:	HP 10 X 42	37	3/11/1976	3/16/1976	Sand
14	Audubon	Hamlin	AXP6-3	FN-44-3(15)--21-05	176	Capital Constru	HP 10 X 42	37	5/28/1976	6/3/1976	Mixed
15	Cherokee	Cedar	AXP6-3	BRF-59-7(24)--38--18	1183	Christensen Br	HP 10 X 42	36	5/19/1986	5/28/1986	Clay
16	Osceola	Ocheyedon	AXP6-4	SN-720(7)--51-72	176	Koolker Inc.	HP 10 X 42	30	6/10/1976	6/15/1976	Mixed
17	Fremont	Benton	AXP6-6	BRF-2-1(21)--38-36	184	Godberson - Sr	HP 10 X 42	36	9/20/1986	9/25/1986	Sand
18	Muscatine	Pike	AXP6-7	BRF-22-4(30)--38-70	284	United Contrac	HP 10 X 42	37	10/8/1986	10/15/1986	Sand
19	Marion	Clay	AXP6-8	BRF-592-2(12)38-63	373	Grimshaw Con:	HP 10 X 42	37	10/7/1976	10/12/1976	Sand
20	Muscatine	Pike	AXP6-8	BRF-22-4(30)--38-70	284	United Contrac	HP 10 X 42	37	10/17/1986	10/22/1986	Sand
21	Harrison	Little Sioux	AXP6-9	I-29-5(8)97	463	Hobe Engineer	HP 10 X 42	32	2/9/1966	2/17/1966	Sand
22	Dallas	Boone	AXP6-15	I-80-3(15)113	1065	Al Munson	HP 10 X 42	55	3/15/1966	3/18/1966	Clay
23	Harrison	Little Sioux	AXP6-16	I-29-5(8)97	363	Jensen Constru	HP 10 X 42	37	3/14/1966	3/22/1966	Sand
24	Harrison	St. John	AXP6-22	I-IG-29-5(7)78	265	Sioux Falls Con	HP 10 X 42	37	7/18/1966	7/27/1966	Sand
25	Harrison	Taylor	AXP6-28	I-IG-29-5(7)78--43-9	1065	Capital Constru	HP 10 X 42	37	10/24/1966	10/28/1966	Sand
26	Harrison	Morgan	AXP7-1	E-ACI-29-5(19)91--01-43	665	A. M. Cohron &	HP 10 X 42	27	1/31/1967	2/9/1967	Clay
27	Harrison	Morgan	AXP7-4	E-ACI-29-5(19)91--01-43	665	A. M. Cohron &	HP 10 X 42	27	2/10/1967	2/17/1967	Mixed
28	Fremont	Benton	AXP2-6	I-29-1(9)10--01-36	369	United Contrac	HP 10 X 42	37	2/19/1972	2/24/1972	Mixed
29	Fremont	Benton	AXP2-7	I-29-1(9)10--01-36	369	United Contrac	HP 10 X 42	37	2/25/1972	2/29/1972	Mixed
30	Fremont	Benton	AXP2-10	I-29-1(9)10--01-36	369	United Contrac	HP 10 X 42	37	3/3/1972	3/9/1972	Sand

Figure 6.1: PILOT Display Form (Microsoft Office Access™ 2007)

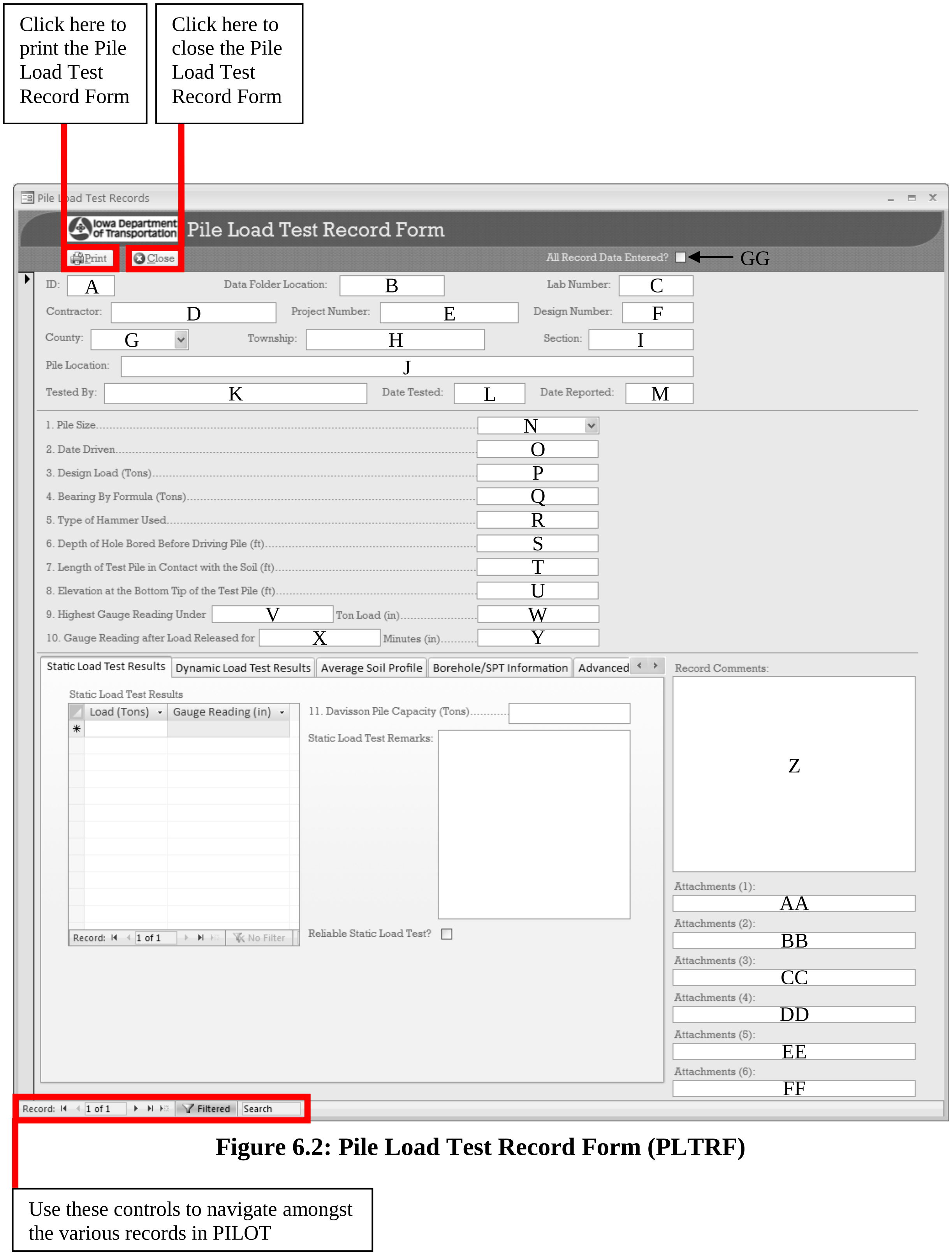


Figure 6.2: Pile Load Test Record Form (PLTRF)

G. **County:** This database field utilizes a drop-down menu for simple selection of the Iowa County in which the specified bridge construction project is located.

H. **Township:** This field allows one to manually enter the name of the township corresponding to the location of the specified Iowa bridge construction project.

I. **Section:** This numerical database field allows one to manually enter the section number in which the specified Iowa bridge construction project is located.

J. **Pile Location:** This text database field allows one to manually enter a short description of the test pile location in relation to the features of the bridge under construction. For instance, a typical description will specify if the test pile was located near an abutment or a pier. Furthermore, either the pile number or a detailed narrative identifying the exact location of the pile within the abutment or pier is usually provided.

K. **Tested By:** This text database field allows one to manually enter the names of those people who were responsible for carrying out the pile load test on the specified pile.

L. **Date Tested:** In this database field, which has been formatted to accept dated entries of the form: Month/Day/Year (e.g., 3/8/1984), the date on which the pile static load test was conducted on the specified pile is specified.

M. **Date Reported:** In this database field, which has been formatted to accept dated entries of the form: Month/Day/Year (e.g., 3/8/1984), the date on which the pile load test results for the specified pile were reported to the Iowa DOT is specified.

N. **1. Pile Size:** This database field utilizes a drop-down menu for simple selection of the test pile type and size. The options available for selection in this database field are as follows: Steel H-Piles (10×42, 10×57, 12×53, 12×74, 14×73, 14×89, and Steel H – a generic option that may be utilized for instances where the exact Steel H pile size is unknown), Monotube Piles, Steel Pipe Piles (10”, 12”, 16”, and 18” outside diameter), and Timber Piles (18’, 20’, 25’, 30’, 34’, 35’, 40’, 45’, 50’, 55’, and 60’ length or Timber – a generic option that may be utilized for instances where the exact timber pile length is unknown).

O. **2. Date Driven:** In this database field, which has been formatted to accept dated entries of the form Month/Day/Year (e.g., 3/8/1984), the date on which the specified test pile was driven is included.

P. **3. Design Load (Tons):** This database field specifies the total sum of all design loads for which any given pile in the structure is anticipated to support based on the superstructure loading evaluation accomplished using either WSD or LRFD principles. In other words, the given pile must possess a bearing resistance equal to or greater than this value to ensure the safety of the structure. For all piles driven prior to October 1, 2007, the reported value in this field corresponds to the WSD design load while LRFD design load is included for all piles driven after this date, since it corresponds to the FHWA's mandate on the use of LRFD for all new bridge construction.

Q. **4. Bearing by Formula (Tons):** This database field specifies the anticipated bearing resistance for a given pile as determined through the use of the Iowa DOT Modified ENR dynamic pile driving formula, which is supplied in Article 2501.13 of the Iowa Department of Transportation Standard Specifications, Series 2008 (Iowa DOT, 2008) and is discussed in more detail in Chapter 3 of AbdelSalam et al. (2010).

R. **5. Type of Hammer Used:** This database field contains information about the type of hammer used for driving the test pile. Examples of possible entries into this database field include: Gravity, Kobe K-13, and Delmag D-12; the last two examples specify both a brand and series number.

S. **6. Depth of Hole Bored before Driving Pile (ft):** The depth, in feet, of the hole bored to initiate pile driving of the specified test pile. (A value of zero in this field indicates that no hole was bored prior to driving.)

T. **7. Length of Test Pile in Contact with the Soil (ft):** The length, in feet, of the test pile in direct contact with the soil.

U. **8. Elevation at the Bottom Tip of the Test Pile (ft):** The elevation, in feet, at which the toe of the driven test pile resides with reference to the mean sea level datum.

V & W. **9. Highest Gauge Reading Under ### Ton Load (in):** Based upon the SLT results for the specified pile (the location of the SLT results for each record in the database is shown in Figure 6.3), the maximum load experienced by the pile is recorded where the number signs (i.e., ###) appear in the above statement and the displacement gauge reading, in inches, corresponding to this maximum applied load is included in database field W.

X & Y. **10. Gauge Reading after Load Released for ### Minutes (in):** The final entry into each record's static load test table shows a load of zero tons and a corresponding non-zero gauge reading. This gauge reading represents the rebound of the specified pile after the release of the maximum applied vertical load for a given period of time. The time between the release of the maximum applied load to the pile and the subsequent recording of the final gauge reading is added where the number signs (i.e., ###) appear in the above statement. The final gauge reading, in inches, is then specified in database field Y.

Z. **Record Comments:** Any pertinent additional information regarding the record as a whole is included in this text database field.

AA - FF. **Attachments (1) – (6):** These six hyperlink database fields were created so that important information related to each pile load test could be easily accessed from the PLTRF. The hyperlinked text descriptions found within these database fields maintain a direct path to the file of interest.

To add a new hyperlink to the PLTRF, follow the steps outlined below:

1) Open the desired PLTRF to which a new hyperlink will be added.

2) Position the cursor over the preferred location, Attachments (1) – (6), for the new hyperlink.

3) Right click with the mouse and select Hyperlink-Edit Hyperlink…

4) Locate the file to which the hyperlink will be tied and provide a concise but meaningful description of the file in the "Text to display:" option.

GG. **All Record Data Entered?:** This yes/no database field was created mostly for the one(s) responsible for the data entry procedures, so that an easy distinction could be made between those records still requiring data to be entered and those that had been termed complete. When all available information has been entered for a specific record, this field receives a check mark.

6.2.2 Static Load Test Results Tab of PLTRF

As illustrated in Figure 6.3, the first of nine tabs encountered on the PLTRF (i.e., Static Load Test Results) houses those results related to a pile static load test. Most importantly, this tab contains a table which displays the load versus displacement results obtained during static load testing of the pile. The remaining fields contained within this tab are elucidated below.

A. **11. Davisson Pile Capacity (Tons):** Utilizing the static load test results supplied for each pile, shown in Figure 6.3, the Davisson failure criterion was utilized to determine the ultimate pile capacity (i.e., the dependable pile resistance). The Davisson failure criterion states that the ultimate load of a pile subjected to a vertical load test is the load which the displacement of the pile exceeds the elastic compression of the pile by $0.15 + D/120$ inches, where *D* is the pile depth or diameter (Davisson, 1972). The elastic compression of the pile is simply the length of the pile divided by its elastic modulus and cross-sectional area (i.e., the pile stiffness), then multiplied by the applied load. The Davisson pile capacity established for each pile SLT is provided in this numerical database field.

B. **Static Load Test Remarks:** Any additional comments or information relating to the pile SLT results are supplied in this text database field. Examples of information presented in this database field include the time duration step used for each load increment and pertinent test reliability information such as observed pile punching, pulling out of anchor piles, or no observed yielding of the test pile.

C. **Reliable Static Load Test?:** This yes/no database field receives a checkmark if the SLT data for the specified pile is considered reliable. A reliable test is one in which the test pile reached its displacement-based capacity (i.e., the Davisson pile capacity) with no anchor piles being pulled out prior to its achievement. If the SLT data for a specified test pile does not meet this criterion, then the test is considered unreliable and this database field is left unchecked.

6.2.3 Dynamic Load Test Results Tab of PLTRF

As illustrated in Figure 6.4, the second of nine tabs included on the PLTRF (i.e., Dynamic Load

Test Results) houses those results obtained from a dynamic pile load test using PDA. The fifteen fields contained within this tab are described below.

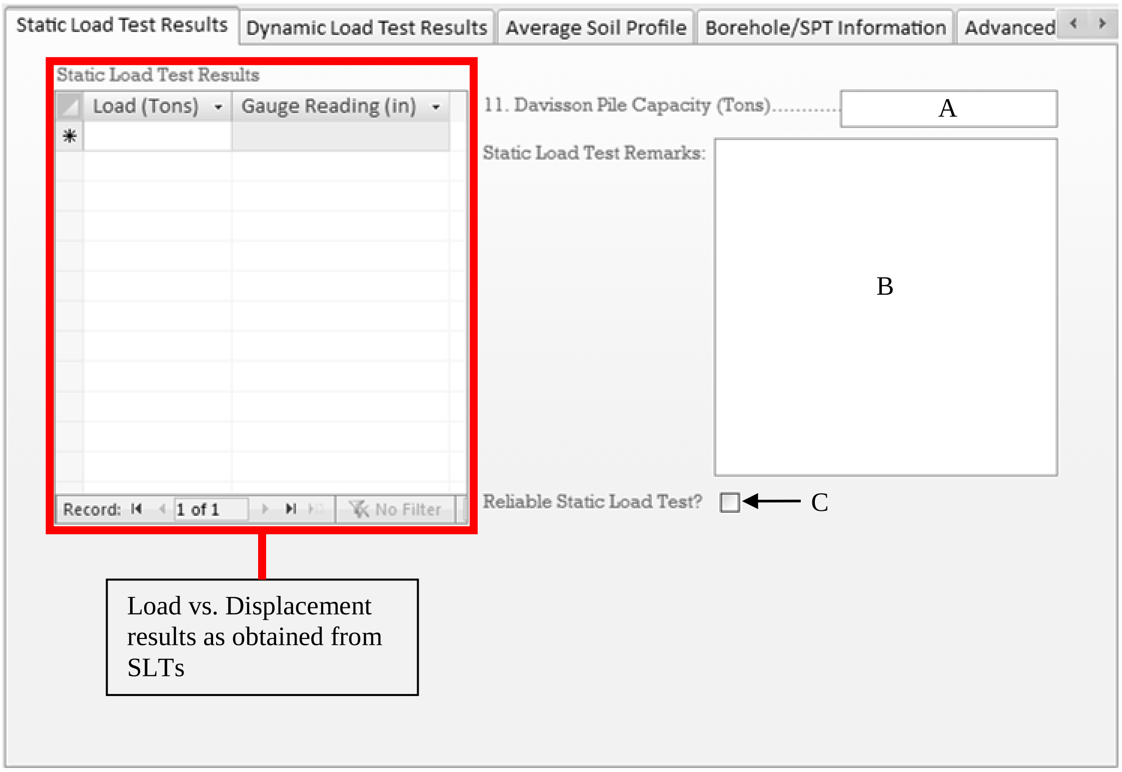


Figure 6.3: Static Load Test Results Tab of PLTRF

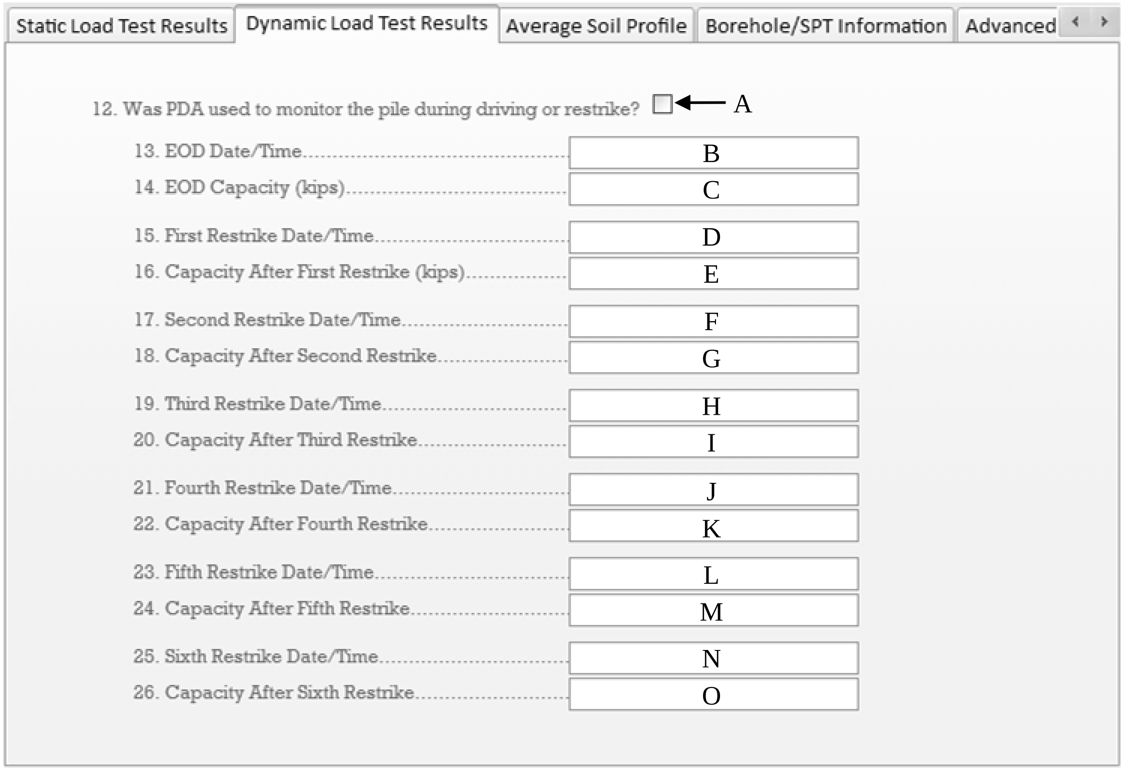


Figure 6.4: Dynamic Load Test Results Tab of PLTRF

A. **12. Was PDA used to monitor the pile during driving or restrike?:** This yes/no database field receives a checkmark when the PDA device is used to monitor the installation of the test pile, which must be instrumented with accelerometers and strain transducers near the pile head, and assess its bearing resistance at either the EOD or BOR conditions; otherwise, this database field is left unchecked.

B. **13. EOD Date/Time:** In this database field, which has been formatted to accept dated entries of the form: Month/Day/Year Time-of-Day (e.g., 3/8/1984 10:12:55 AM), the date and time at which the EOD condition was achieved is input.

C. **14. EOD Capacity (kips):** The maximum static pile resistance estimate, in units of kips, provided by PDA at the EOD (i.e., RMX).

D. **15. First Restrike Date/Time:** In this database field, which has been formatted to accept dated entries of the form: Month/Day/Year Time-of-Day (e.g., 3/8/1984 10:12:55 AM), the date and time corresponding to the beginning of the first restrike are added.

E. **16. First Restrike Capacity (kips):** This field represents the maximum static pile resistance estimate, in units of kips, provided by PDA at the beginning of the first restrike (i.e., RMX).

F. **17. Second Restrike Date/Time:** In this database field, which has been formatted to accept dated entries of the form: Month/Day/Year Time-of-Day (e.g., 3/8/1984 10:12:55 AM), the date and time corresponding to the beginning of the second restrike are inserted.

G. **18. Second Restrike Capacity (kips):** This field represents the maximum static pile resistance estimate, in units of kips, provided by PDA at the beginning of the second restrike (i.e., RMX).

H. **19. Third Restrike Date/Time:** In this database field, which has been formatted to accept dated entries of the form: Month/Day/Year Time-of-Day (e.g., 3/8/1984 10:12:55 AM), the date and time corresponding to the beginning of the third restrike are input.

I. **20. Third Restrike Capacity (kips):** This field represents the maximum static pile resistance estimate, in units of kips, provided by PDA at the beginning of the third restrike (i.e., RMX).

J. **21. Fourth Restrike Date/Time:** In this database field, which has been formatted to accept dated entries of the form: Month/Day/Year Time-of-Day (e.g., 3/8/1984 10:12:55 AM), the date and time corresponding to the fourth restrike are added.

K. **22. Fourth Restrike Capacity (kips):** This field represents the maximum static pile resistance estimate, in units of kips, provided by PDA at the beginning of the fourth restrike (i.e., RMX).

L. **23. Fifth Restrike Date/Time:** In this database field, which has been formatted to accept dated entries of the form: Month/Day/Year Time-of-Day (e.g., 3/8/1984 10:12:55 AM), the date and time corresponding to the fifth restrike are inserted.

M. **24. Fifth Restrike Capacity (kips):** This field represents the maximum static pile resistance estimate, in units of kips, provided by PDA at the beginning of the fifth restrike (i.e., RMX).

N. **25. Sixth Restrike Date/Time:** In this database field, which has been formatted to accept dated entries of the form: Month/Day/Year Time-of-Day (e.g., 3/8/1984 10:12:55 AM), the date and time corresponding to the sixth restrike are input.

O. **26. Sixth Restrike Capacity (kips):** This field represents the maximum static pile resistance estimate, in units of kips, provided by PDA at the beginning of the sixth restrike (i.e., RMX).

6.2.4 Average Soil Profile Tab of PLTRF

As illustrated in Figure 6.5, the third of nine tabs included on the PLTRF (i.e., Average Soil Profile) houses information concerning various soil parameters characteristic of the average soil profile found at the location of the test pile. The various soil parameters included in the table provided in this tab include thickness, an average SPT blow count (NAVG), and a nominal unit skin friction value specified by the design chart found in the *Iowa LRFD Bridge Design Manual* (Iowa DOT, 2010) for each soil layer, as well as a total soil layer nominal skin friction value resulting from the multiplication of the soil layer thickness by the nominal unit skin friction value.

A. **27. Total Sum of Soil Layer Thicknesses (ft):** This database field refers to the average soil profile table illustrated in Figure 6.5. Based upon the average soil layer data found in this table, the sum of the thicknesses of the various soil strata identified in the table is reported in this field.

B. **28. Calculated Total Skin Friction Using Design Charts (Tons):** This field refers to the average soil profile table illustrated in Figure 6.5. Based upon the average soil layer data found in this table, the sum of the total skin friction values listed for each of the various soil strata identified in the table is reported in this database field.

C. **29. Calculated End Bearing Using Design Charts (Tons):** The value input into this field is determined through the use of the average soil profile table illustrated in Figure 6.5 and the design chart found in the *Iowa LRFD Bridge Design Manual* (Iowa DOT, 2010). Based upon the average blow count (i.e., NAVG) value obtained for the soil layer in which the test pile toe resides and the aforementioned design chart, a nominal end bearing value is established and recorded into this database field.

D. **30. Total Pile Capacity Using Design Charts (Tons):** The value input into this database field is the result of the addition of the value found in the database field marked with a number 28 (i.e., Calculated Total Skin Friction Using Design Charts) and the value found in the database field marked with a number 29 (i.e., Calculated End Bearing Using Design Charts).

E. **31. Capacity Ratio:** The value entered into this database field is the result of dividing the value found in the database field marked with a number 11 (i.e., Davisson Pile Capacity) by the value found in the database field marked with a number 3 (i.e., Design Load).

F. **Test Site Soil Classification:** This database field utilizes a drop-down menu for simple selection of the predominant soil medium (i.e., sand, clay, or, mixed) encountered along the shaft of the test pile. When at least two soil types are present along the shaft of the test pile and none account for 70 percent or more of the soil profile encountered along the shaft of the test pile, then a mixed soil classification is used to describe the predominant soil medium.

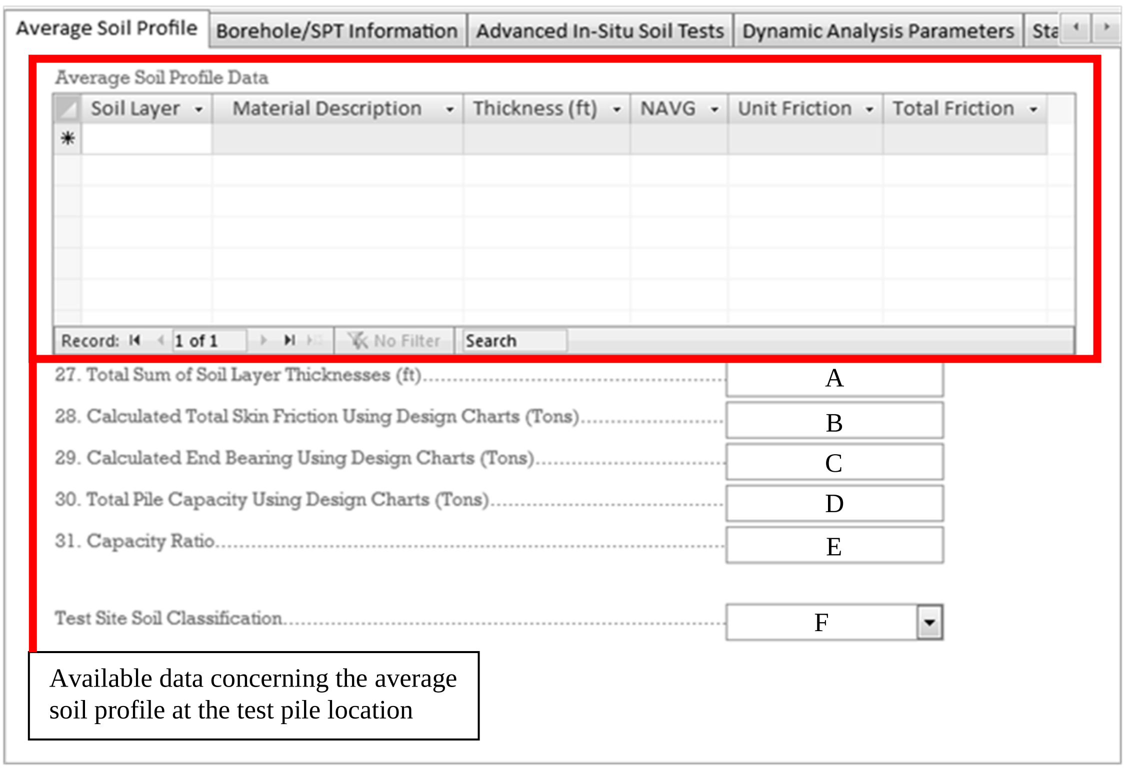


Figure 6.5: Average Soil Profile Tab of PLTRF

6.2.5 Borehole/SPT Information Tab of PLTRF

As illustrated in Figure 6.6, the fourth of nine tabs included on the PLTRF (i.e., Borehole/SPT Information) houses information concerning the availability of borehole and SPT data at the location of the test pile. Most importantly, this tab possesses a table that displays the available borehole and SPT data at the test pile location. The remaining fields contained within this tab are described below.

A. **32. Total Number of Boreholes:** The total number of boreholes drilled for the corresponding construction project. This information is taken from the relevant project Situation Plan Sheet.

B. **33. Total Number of Borehole with SPT Data:** The total number of boreholes possessing soil penetration data or SPT N-values. This information is taken from the relevant project Sounding Data Plan Sheet.

C. **34. Borehole(s) near Test Pile Location:** This yes/no database field receives a checkmark if a borehole is located within 100 feet of the specified test pile location. If no borehole is located within 100 feet of the test pile location, the field is left without a checkmark.

D. **35. Borehole Number(s) near Test Pile Location:** When the Borehole(s) at Test Pile Location database field is checked, the identification number associated with each of the boreholes located within 100 feet of the test pile location is reported in this text database field. Otherwise, if no boreholes are located within 100 feet the test pile location, the word "None" is entered into this database field. When a borehole or boreholes are located within 100 feet of the location of the test pile, the resulting soil profiles are displayed in the table identified in Figure 6.6.

E. **36. SPT Data Available near Test Pile Location:** When any of the boreholes listed in the Borehole(s) at Test Pile Location database field possess SPT data, then the identification number of such boreholes is repeated in this database field, and the resulting data, soil profile and SPT values are entered into the table identified in Figure 6.6. If none of the boreholes listed in the Borehole(s) at Test Pile Location database field have SPT data, then the word "None" appears in this database field. Although, if the soil profile at the test pile location matches that of any of the boreholes with SPT data, even though these boreholes are not located at or within 100 feet of the test pile location, the resulting information for such boreholes is also provided in the table identified in Figure 6.6.

F. **Usable-Static Test?:** This yes/no database field receives a checkmark if a checkmark already exists in the Reliable Load Test? database field and if there is acceptable SPT data available at or within 100 feet of the test pile location.

6.2.6 Advanced In-Situ Soil Tests Tab of PLTRF

As illustrated in Figure 6.7, the fifth of nine tabs included on the PLTRF (i.e., Advanced In-Situ Soil Tests) houses those results obtained from advanced in-situ soil tests such as the CPT and the BST, as well as horizontal stress and porewater pressure data collected from push-in pressure cells. The twelve fields contained within this tab are described below.

A. **37. Were Push-In Pressure Cells used to monitor lateral earth and porewater pressure?:** This yes/no database field receives a checkmark if one or more push-in pressure cells were installed near the location of the test pile for acquisition of horizontal stress and porewater pressure data; otherwise, this database field is left unchecked.

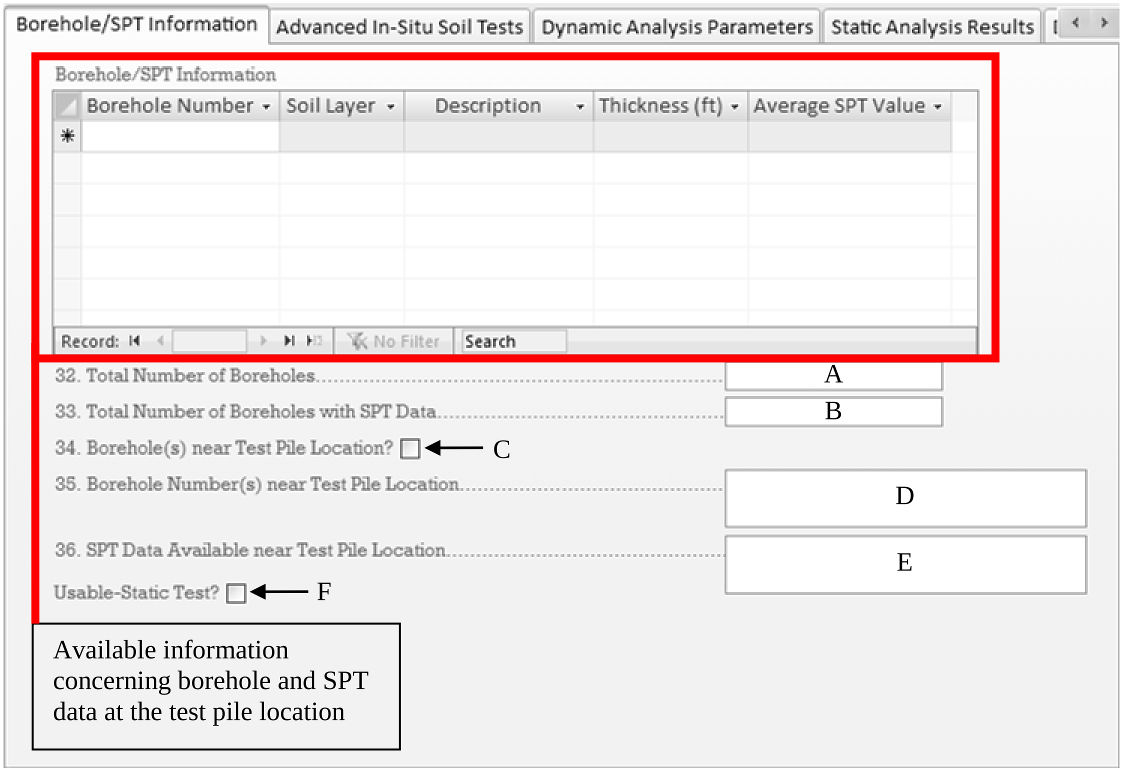


Figure 6.6: Borehole/SPT Information Tab of PLTRF

B. **38. Number of Pressure Cells Used:** When the database field marked with a number 37 (i.e., Were Push-In Pressure Cells used to monitor lateral earth and porewater pressure?) is checked, the total number of push-in pressure cells installed near the location of the test pile is reported in this text database field.

C. **39. Depth of Pressure Cells:** When the database field marked with a number 37 (i.e., Were Push-In Pressure Cells used to monitor lateral earth and porewater pressure?) is checked, the depths to which each of the push-in pressure cells identified in the database field marked with a number 38 (i.e., Number of Pressure Cells Used) were installed are reported in this text database field.

D. **40. Complete Pressure Cell Data:** This hyperlink database field allows for the establishment of a direct path to the file(s) holding all data acquired from the installed push-in pressure cells. The reader is referred to Section 6.2.1 for instructions on how to add a new hyperlink to the PLTRF.

E. **41. Was a Cone Penetration Test (CPT) Performed?:** This yes/no database field receives a checkmark if one or more CPTs were performed near the location of the test pile; otherwise, this database field is left unchecked.

F. **42. Number of CPT Soundings:** When the database field marked with a number 41 (i.e., Was a Cone Penetration Test (CPT) Performed?) is checked, the total number of soundings performed near the location of the test pile is reported in this text database field.

G. **43. Number of Pore Pressure Dissipation Tests:** When the database field marked with a number 41 (i.e., Was a Cone Penetration Test (CPT) Performed?) is checked, the number of pore pressure dissipation tests conducted in conjunction with each of the CPT soundings identified in the database field marked with a number 42 (i.e., Number of CPT Soundings) is reported in this text database field.

H. **44. Complete CPT Data:** This hyperlink database field allows for the establishment of a direct path to the file(s) holding all data acquired from the various CPTs performed near the location of the test pile. The reader is referred to Section 6.2.1 for instructions on how to add a new hyperlink to the PLTRF.

I. **45. Was a Borehole Shear Test (BST) Performed?:** This yes/no database field receives a checkmark if one or more BSTs were performed near the location of the test pile; otherwise, this database field is left unchecked.

J. **46. Number of BSTs Performed:** When the database field marked with a number 45 (i.e., Was a Borehole Shear Test (BST) Performed?) is checked, the total number of BSTs performed near the location of the test pile is reported in this text database field.

K. **47. Depths of BSTs:** When the database field marked with a number 45 (i.e., Was a Borehole Shear Test (BST) Performed?) is checked, the depths at which each of the BSTs identified in the database field marked with a number 46 (i.e., Number of BSTs Performed) were performed are reported in this text database field.

L. **48. Complete BST Data:** This hyperlink database field allows for the establishment of a direct path to the file(s) holding all data acquired from the various BSTs performed near the location of the test pile. The reader is referred to Section 6.2.1 for instructions on how to add a new hyperlink to the PLTRF.

6.2.7 Dynamic Analysis Parameters Tab of PLTRF

As illustrated in Figure 6.8, the sixth of nine tabs included on the PLTRF (i.e., Dynamic Analysis Parameters) houses information necessary for the prediction of pile resistance by means of dynamic methods (e.g., WEAP, PDA, CAPWAP, and dynamic pile driving formulas). The eleven fields contained within this tab are described below.

A. **49. Water Table Location:** The elevation at which the groundwater table is encountered at the site of the test pile is included in this database field. Such information is taken from the relevant Sounding Data Plan Sheet.

B. **50. Driven Pile Length (ft):** The total length of pile, in units of feet, placed in the leads of the pile driving rig is inserted into this database field.

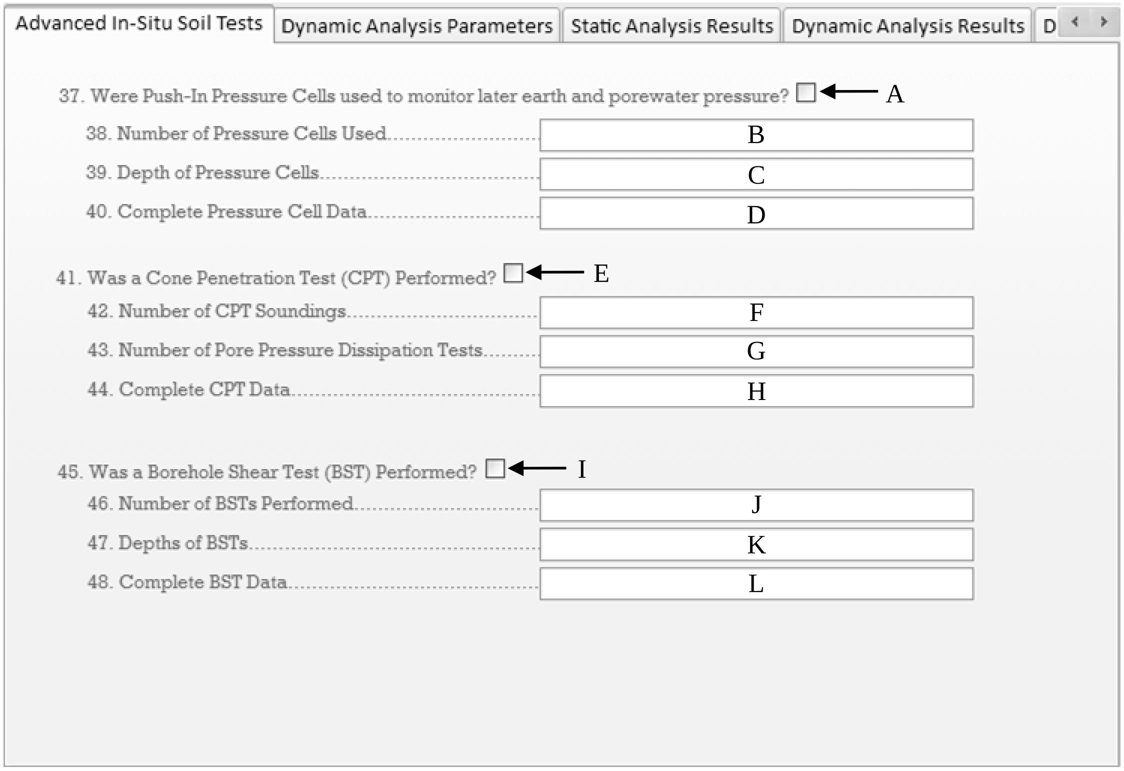


Figure 6.7: Advanced In-Situ Soil Tests Tab of PLTRF

C. **51. Pile Cross-Sectional Area (square inches):** The total cross-sectional area, in units of square inches, of the pile driven for load testing purposes is inserted into this database field.

D. **52. Pile Weight (lb):** The total weight, in units of pounds, of the pile driven for load testing purposes is inserted into this database field. This pile weight should be in agreement with the length of pile specified in the database field marked with the number 50 (i.e., Driven Pile Length).

E. **53. Hammer (Ram) Weight (lb):** This numerical database field presents the total dynamic weight, in units of pounds, of the hammer used for driving the test pile. The dynamic weight of the hammer is determined by taking the total static weight of the hammer less such deductions resulting from air resistance, lead friction, etc.

F. **54. Cap Weight (lb):** The total weight of the cap, in units of pounds, used while driving the test pile is inserted into this database field.

G. **55. Anvil Weight (lb):** The total weight of the anvil, in units of pounds, used while driving the test pile is inserted into this database field.

H. **56. Hammer Stroke (ft):** The average height above the pile head, in units of feet, from which the hammer is dropped during the final five to ten blows of driving is recorded in this database field.

I. **57. Developed Hammer Energy (ft-tons):** The total developed energy, in units of foot-pounds, imparted by the hammer to the test pile is recorded in this database field. Simply put, the total developed energy is determined by multiplying the hammer (ram) weight with the hammer stroke.

J. **58. Average Number of Blows per Foot of Pile Penetration (blows/ft):** The average number of blows needed to advance the test pile tip one foot near the end of driving is recorded in this database field. This value is determined from the average penetration of the test pile over the last five to ten blows (i.e., five blows for gravity hammers and 10 blows for steam or diesel hammers) as recorded on the "Log of Piling Driven" record.

K. **Usable-Dynamic Test?:** This yes/no database field receives a checkmark if a checkmark already exists in the Usable-Static Test? database field and if complete driving records and information concerning characteristics of the pile driving equipment are available for the test pile.

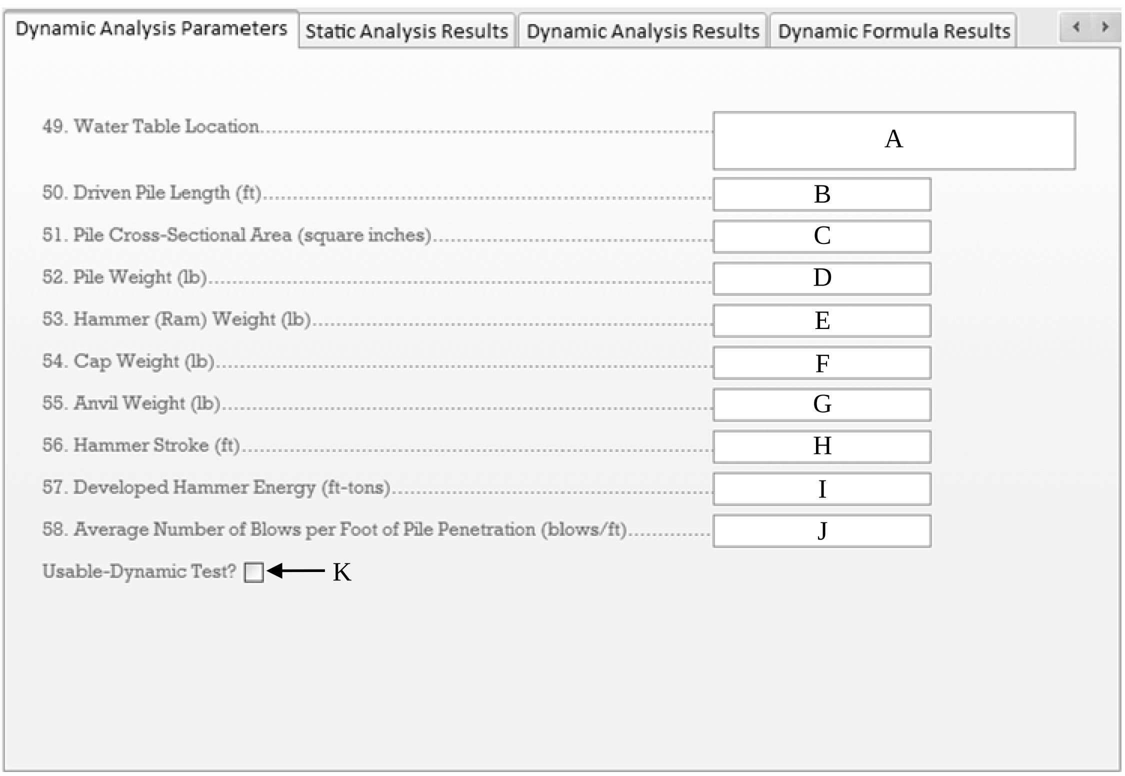


Figure 6.8: Dynamic Analysis Parameters Tab of PLTRF

6.2.8 Static Analysis Results Tab of PLTRF

As illustrated in Figure 6.9, the seventh of nine tabs included on the PLTRF (i.e., Static Analysis Results) displays the results obtained from the application of five static analysis methods upon the given test pile. The five static analysis methods displayed on this tab were chosen by AbdelSalam (2010) in response to an in-depth literature review of the most common and well-performing methods. The five fields contained within this tab are described below.

A. **59. Pile Capacity by Iowa Blue Book Method (Tons):** The nominal pile capacity, in tons, predicted by the Iowa Blue Book static analysis method (Dirks and Kam 1989, revised 1994; AbdelSalam et al. 2010) is placed in this field.

B. **60. Pile Capacity by SPT Method (Tons):** The nominal pile capacity, in tons, predicted by the SPT-Meyerhof static analysis method (Meyerhof, 1976) is placed in this field.

C. **61. Pile Capacity by Alpha-API Method (Tons):** The nominal pile capacity, in tons, predicted by the α-API (American Petroleum Institute) static analysis method (API, 1984) is placed in this field.

D. **62. Pile Capacity by Beta Method (Tons):** The nominal pile capacity, in tons, predicted by the β static analysis method (Burland, 1973) is placed in this field.

E. **63. Pile Capacity by Nordlund Method (Tons):** The nominal pile capacity, in tons, predicted by the Nordlund static analysis method (Nordlund, 1963) is placed in this field.

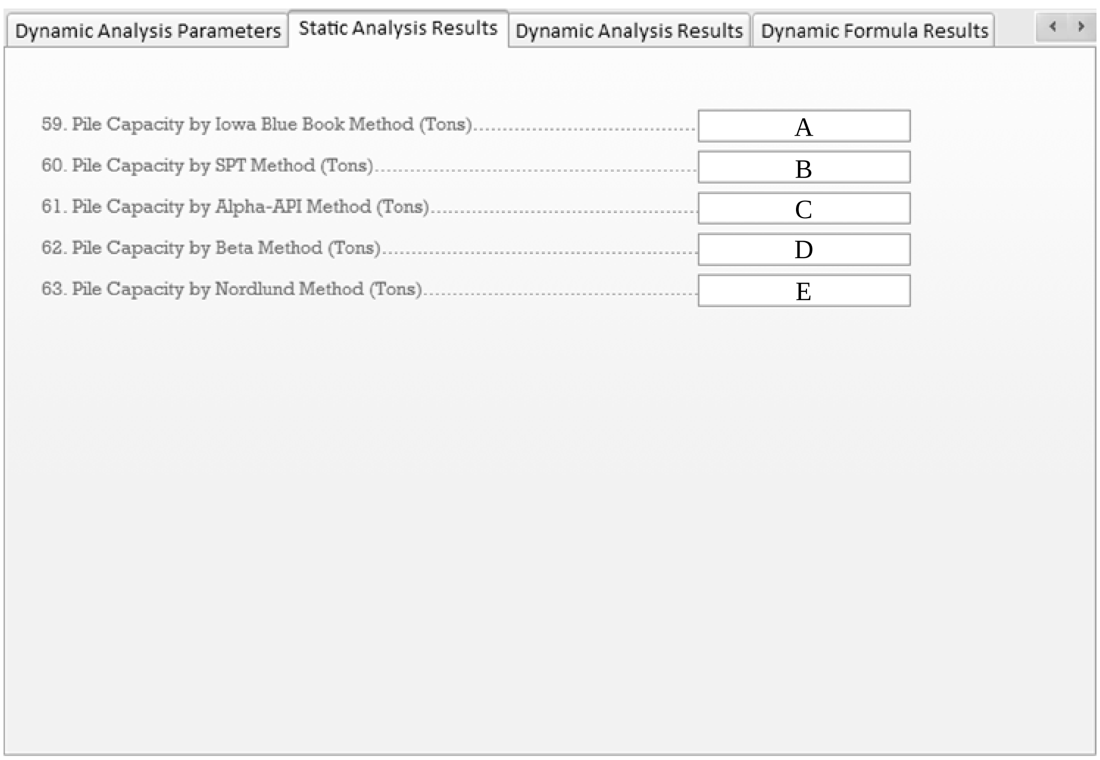


Figure 6.9: Static Analysis Results Tab of PLTRF

6.2.9 Dynamic Analysis Results Tab of PLTRF

As illustrated in Figure 6.10, the eighth of nine tabs included on the PLTRF (i.e., Dynamic Analysis Results) displays the results obtained from the application of three dynamic analysis methods upon the given test pile. The three dynamic analysis methods displayed on this tab were chosen by Ng (2011) in response to an in-depth literature review of the most common and well-performing methods. The fields contained within this tab are described below.

A. **64. Pile Capacity by WEAP (Tons):** The nominal pile capacity, in tons, as predicted by the Wave Equation Analysis Program (Pile Dynamics, Inc., 2005) is placed in this field.

B. **65. Shaft Quake used in WEAP Analysis:** The elastic compression limit or quake, in units of inches, for soil located along the shaft of the test pile that was used to determine the WEAP pile capacity is placed in this field.

C. **66. Toe Quake used in WEAP Analysis:** The elastic compression limit or quake, in units of inches, for soil located at the toe of the test pile that was used to determine the WEAP pile resistance is placed in this field.

D. **67. Shaft Damping Factor used in WEAP Analysis:** The damping factor for soil located along the shaft of the test pile that was used to determine the WEAP pile resistance is placed in this field.

E. **68. Toe Damping Factor used in WEAP Analysis:** The damping factor for soil located at the toe of the test pile that was used to determine the WEAP pile capacity is placed in this field.

F. **69. Pile Capacity from PDA (Tons):** The nominal pile capacity, in tons, as predicted by PDA (Pile Dynamics, Inc., 1992) is placed in this field.

G. **70. Case Damping Factor used by PDA:** The Case damping factor utilized by PDA to predict the ultimate capacity of the test pile is reported in this field.

H. **71. Pile Capacity from CAPWAP (Tons):** The nominal pile capacity, in tons, as predicted by the CAse Pile Wave Analysis Program (Pile Dynamics, Inc., 2000) is placed in this field.

I. **72. Smith Shaft Damping Factor Calculated by CAPWAP:** The damping factor for soil located along the shaft of the test pile that was calculated by CAPWAP in predicting the pile capacity is placed in this field.

J. **73. Smith Toe Damping Factor Calculated by CAPWAP:** The damping factor for soil located at the toe of the test pile that was calculated by CAPWAP in predicting the pile capacity is placed in this field.

K. **74. Shaft Quake Calculated by CAPWAP:** The elastic compression limit or quake, in units of inches, for soil located along the shaft of the test pile that was calculated by CAPWAP in predicting the pile capacity is placed in this field.

L. **75. Toe Quake Calculated by CAPWAP:** The elastic compression limit or quake, in units of inches, for soil located at the toe of the test pile that was calculated by CAPWAP in predicting the pile capacity is placed in this field.

M. **76. Case Shaft Damping Factor Calculated by CAPWAP:** The Case damping factor for soil located along the shaft of the test pile that was calculated by CAPWAP in predicting the pile capacity is reported in this field.

N. **77. Case Toe Damping Factor Calculated by CAPWAP:** The Case damping factor for soil located at the toe of the test pile that was calculated by CAPWAP in predicting the pile capacity is reported in this field.

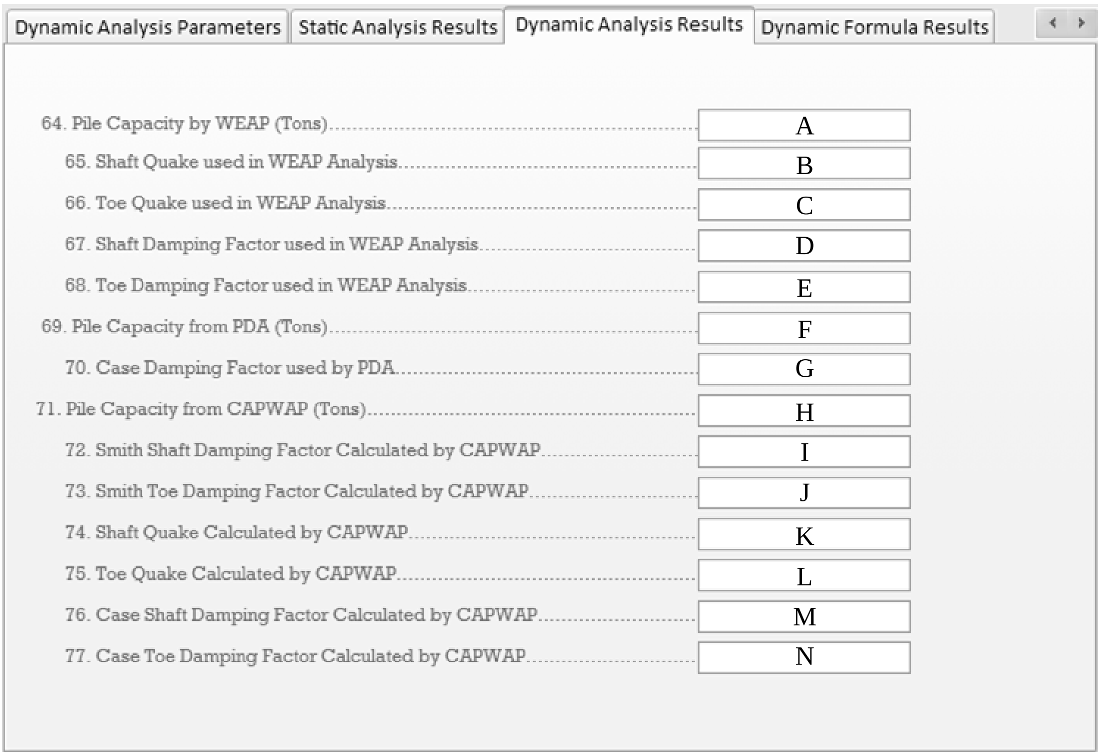


Figure 6.10: Dynamic Analysis Results Tab of PLTRF

6.2.10 Dynamic Formula Results Tab of PLTRF

As illustrated in Figure 6.11, the final tab included on the PLTRF (i.e., Dynamic Formula Results) displays the results obtained from the application of seven dynamic pile driving formulas upon the given test pile. The seven dynamic pile driving formulas displayed on this tab were chosen as a consequence of the results obtained from the in-depth literature review of the most common and well-performing formulas presented by Roling (2010). The fields contained within this tab are described below.

A. **78. Pile Capacity by ENR Formula (Tons):** The nominal pile capacity, in tons, as predicted by the Engineering News Record formula (Wellington, 1893) is reported in this field.

B. **79. Pile Capacity by Iowa DOT Modified ENR Formula (Tons):** The nominal pile capacity, in tons, as predicted by the Iowa DOT Modified Engineering News Record formula (Iowa DOT, 2008) is reported in this field.

C. **80. Pile Capacity by Gates Formula (Tons):** The nominal pile capacity, in tons, as predicted by the Gates formula (Gates, 1957) is reported in this field.

D. **81. Pile Capacity by FHWA Modified Gates Formula (Tons):** The nominal pile capacity, in tons, as predicted by the FHWA Modified Gates formula (AASHTO, 2007) is reported in this field.

E. **82. Pile Capacity by Janbu Formula (Tons):** The nominal pile capacity, in tons, as predicted by the Janbu formula (Bowles, 1996) is reported in this field.

F. **83. Pile Capacity by Pacific Coast Uniform Building Code Formula (Tons):** The nominal pile capacity, in tons, as predicted by the Pacific Coast Uniform Building Code formula (Bowles, 1996) is reported in this field.

G. **84. Pile Capacity by Washington Department of Transportation Formula (Tons):** The nominal pile capacity, in tons, as predicted by the Washington State Department of Transportation formula (Allen, 2005) is reported in this field.

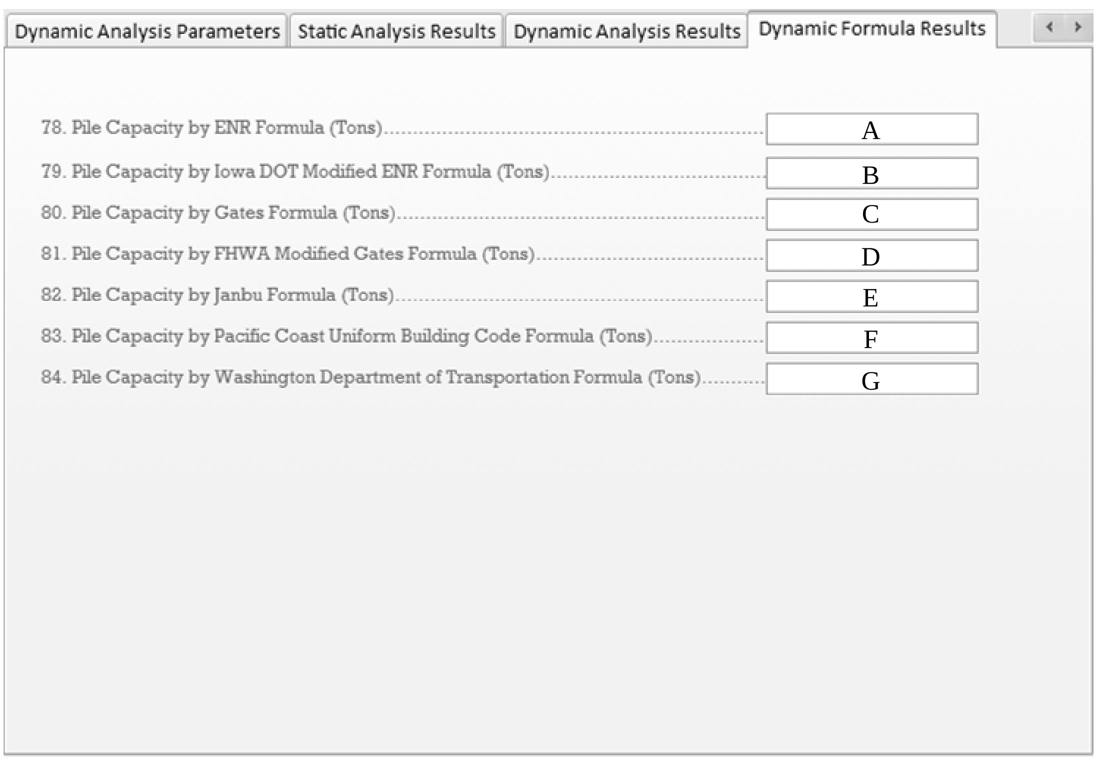


Figure 6.11: Dynamic Formula Results Tab of PLTRF

6.3 Disclaimer Notice

PILOT was established as part of a research project (i.e., *TR-573: Development of LRFD Design Procedures for Bridge Piles in Iowa*) funded by the Iowa Highway Research Board (IHRB). Neither the IHRB nor the authors of this report make any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information contained in PILOT. If a problem arises during the usage of PILOT or more knowledge is required, contact Iowa DOT or those currently maintaining the database via http://srg.cce.iastate.edu/lrfd/.

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APPENDIX A: SUMMARY OF PILOT HISTORICAL DATASET

Table A.1: PILOT Historical Steel H-Pile Dataset Summary (Records 1-18)

ID #	County	Township	Lab #	Project #	Design #	Contractor	Pile Type	Design Load (tons)
1	Black Hawk	Orange	AXP3-7	IY-520-6(8)--3P-07	1983	Lunda Construction Co.	HP 10 X 42	32.00
2	Johnson	Clear Creek	AXP3-9	I-380-6(44)243--01-52		A. M. Cohron & Son	HP 10 X 42	34.00
3	Fremont		AXP3-10	FN-184-1(3)--21-36	173	A. M. Cohron & Son	HP 10 X 42	37.00
4	Jones		AXP3-14	FM-38-3(7)--21-53	170	Grimshaw Construction Co.	HP 10 X 42	37.00
5	Jasper	Malaka	AXP4-2	BROS-9050(2)--8J-50	383	Herberger Construction Co.	HP 10 X 42	31.00
6	Decatur	Center	AXP4-3	BRF-2-5(10)--38-27	1082	Godberson - Smith	HP 10 X 42	35.00
7	Cherokee	Afton	AXP4-6	BRF-3-2(20)--38-18	683	Christensen Brothers Inc.	HP 10 X 42	35.00
8	Linn	Rapids	AXP4-22	I-IG-380-6(57)259--04-57	1672	Schmidt Construction Co.	HP 10 X 42	37.00
9	Linn	Rapids	AXP4-23	I-IG-380-6(57)259--04-57	1672	Schmidt Construction Co.	HP 10 X 42	37.00
10	Ida	Garfield	AXP5-1	BRF-175-3(15)--38-47	383	Christensen Brothers Inc.	HP 10 X 42	36.00
11	Hamilton	Liberty	AXP5-2	DP-F-520-4(9)--39-40	1670	Christensen Brothers Inc.	HP 10 X 42	37.00
12	Linn	Clinton	AXP5-3	F-30-7(62)--20-57	1781	Schmidt Construction Co.	HP 10 X 42	37.00
13	Delaware	Richland	AXP6-2	SP-603-0(3)--76-28	276	Grimshaw Construction Co.	HP 10 X 42	37.00
14	Audubon	Hamlin	AXP6-3	FN-44-3(15)--21-05	176	Capital Construction Co.	HP 10 X 42	37.00
15	Cherokee	Cedar	AXP6-3	BRF-59-7(24)-38--18	1183	Christensen Brothers Inc.	HP 10 X 42	36.00
16	Osceola	Ocheyedon	AXP6-4	SN-720(7)--51-72	176	Koolker Inc.	HP 10 X 42	30.00
17	Fremont	Benton	AXP6-6	BRF-2-1(21)--38-36	184	Godberson - Smith	HP 10 X 42	36.00
18	Muscatine	Pike	AXP6-7	BRF-22-4(30)--38-70	284	United Contractors Inc.	HP 10 X 42	37.00

Table A.1: PILOT Historical Steel H-Pile Dataset Summary (Records 1-18) – Continued

ID #	Date Driven	SLT Date	Soil Type	Bored Hole Depth (ft)	Embedded Pile Length (ft)	Pile Toe Elevation (ft)	Hammer Type	Ram Weight (lbs)	Cap Weight (lbs)	Anvil Weight (lbs)	Pile Weight (lbs)
1	12/9/1983	12/20/1983	Mixed	28.00	36.00	835.63	Kobe K-13	2870		885	
2	6/15/1973	6/20/1973		0.00	22.00		Gravity				
3	7/24/1973	7/26/1973	Mixed	0.00	47.00	908.85	Gravity				
4	8/21/1973	8/23/1973	Mixed	0.00	51.00	759.68	Gravity				
5	5/23/1984	5/30/1984	Clay	9.00	27.00	831.37	Gravity				
6	6/18/1984	6/21/1984	Clay	0.00	53.00	965.60	Gravity #732	7000	1640		2310
7	11/21/1984	11/27/1984	Mixed	0.00	39.00	1296.85	Gravity #386	4500	1140		2310
8	8/7/1974	8/15/1974	Mixed	4.00	54.00	33.35	Kobe K-13	2870	660	885	2520
9	11/14/1974	11/19/1974	Mixed	0.00	45.00	41.16	Kobe K-13				
10	6/18/1985	6/20/1985	Mixed	0.00	52.30	1115.20	Gravity #386	4850	1140		2310
11	4/17/1975	4/22/1975	Clay	8.00	58.00	1136.20	Delmag D-12				
12	9/13/1985	9/18/1985	Clay	0.00	23.78	820.00	Kobe K-13	2870	1710	885	1260
13	3/11/1976	3/16/1976	Sand	0.00	57.00	925.78	Diesel				
14	5/28/1976	6/3/1976	Mixed	0.00	30.00	1199.06	Delmag D-15				
15	5/19/1986	5/28/1986	Clay	0.00	43.10	1328.05	Delmag D16-32				
16	6/10/1976	6/15/1976	Mixed	0.00	35.95	1437.17	Gravity				
17	9/20/1986	9/25/1986	Sand	8.00	58.00	862.04	Gravity #732	7000	1398		2856
18	10/8/1986	10/15/1986	Sand	0.00	63.00	549.60	Kobe K-13	2870	800	885	2730

Table A.1: PILOT Historical Steel H-Pile Dataset Summary (Records 1-18) – Continued

ID #	Hammer Stroke (ft)	EOD Blow Count (blows/ft)	Davisson Pile Capacity (tons)	Reliable Pile Load Test	Usable-Static Pile Load Test	Usable-Dynamic Pile Load Test
1			60.00	✓		
2			14.00	✓		
3			47.00	✓	✓	
4			39.00	✓	✓	
5			34.00	✓		
6	5.0	7.70	59.00	✓	✓	✓
7	8.0	10.90	88.00	✓	✓	✓
8	7.0	34.29	85.00	✓	✓	✓
9						
10	7.0	4.80	58.00	✓	✓	✓
11			46.00	✓	✓	
12	6.0	45.70	102.00	✓	✓	✓
13			138.00*	✓	✓	
14			56.00	✓	✓	
15			136.00*	✓	✓	
16			21.00	✓		
17	5.5	13.30	66.00	✓	✓	✓
18	5.5	34.29				

*Extrapolation of the load-displacement results according to the procedure outlined in the 1999 FHWA report by Paikowsky and Tolosko (1999)

Table A.2: PILOT Historical Steel H-Pile Dataset Summary (Records 19-36)

ID #	County	Township	Lab #	Project #	Design #	Contractor	Pile Type	Design Load (tons)
19	Marion	Clay	AXP6-8	BRF-592-2(12)38-63	373	Grimshaw Construction Co.	HP 10 X 42	37.00
20	Muscatine	Pike	AXP6-8	BRF-22-4(30)--38-70	284	United Contractors Inc.	HP 10 X 42	37.00
21	Harrison	Little Sioux	AXP6-9	I-29-5(8)97	463	Hobe Engineering Co.	HP 10 X 42	32.00
22	Dallas	Boone	AXP6-15	I-80-3(15)113	1065	Al Munson	HP 10 X 42	55.00
23	Harrison	Little Sioux	AXP6-16	I-29-5(8)97	363	Jensen Construction Co.	HP 10 X 42	37.00
24	Harrison	St. John	AXP6-22	I-IG-29-5(7)78	265	Sioux Falls Construction Co.	HP 10 X 42	37.00
25	Harrison	Taylor	AXP6-28	I-IG-29-5(7)78--43-9	1065	Capital Construction Co.	HP 10 X 42	37.00
26	Harrison	Morgan	AXP7-1	E-ACI-29-5(19)91--01-43	665	A. M. Cohron & Son	HP 10 X 42	27.00
27	Harrison	Morgan	AXP7-4	E-ACI-29-5(19)91--01-43	665	A. M. Cohron & Son	HP 10 X 42	27.00
28	Fremont	Benton	AXP2-6	I-29-1(9)10--01-36	369	United Contractors Inc.	HP 10 X 42	37.00
29	Fremont	Benton	AXP2-7	I-29-1(9)10--01-36	369	United Contractors Inc.	HP 10 X 42	37.00
30	Fremont	Benton	AXP2-10	I-29-1(9)10--01-36	369	United Contractors Inc.	HP 10 X 42	37.00
31	Allamakee	Fairview	AXP0-2	BRF-76-2(11)--2B-03	479	Brennan Construction	HP 10 X 42	37.00
32	Audubon	Sharon	AXP0-3	BRF-44-3(17)--38-05	280	A. M. Cohron & Son	HP 10 X 42	37.00
33	Benton	Polk	AXP0-4	EACI-380-7(2)282--08-06	877	A. M. Cohron & Son	HP 10 X 42	34.00
34	Dubuque	Dubuque	AXP1-2	BRF-561-4(5)--38--31	1479	Lunda Construction Co.	HP 10 X 42	50.00
35	Clinton	Dewitt	AXP1-4	FFD-561-2(5)--2N-23	277	Lunda Construction Co.	HP 10 X 42	38.00
36	Dubuque	Dubuque	AXP1-5	BRF-561-4(5)--38-31	1479	Lunda Construction Co.	HP 10 X 42	46.00

Table A.2: PILOT Historical Steel H-Pile Dataset Summary (Records 19-36) – Continued

ID #	Date Driven	SLT Date	Soil Type	Bored Hole Depth (ft)	Embedded Pile Length (ft)	Pile Toe Elevation (ft)	Hammer Type	Ram Weight (lbs)	Cap Weight (lbs)	Anvil Weight (lbs)	Pile Weight (lbs)
19	10/7/1976	10/12/1976	Sand	0.00	21.80	652.55	Gravity				
20	10/17/1986	10/22/1986	Sand	0.00	59.00	554.30	Kobe K-13	2870	800	885	2730
21	2/9/1966	2/17/1966	Sand	0.00	57.50	970.20	McKiernan-Terry DE-30	2800	1070		
22	3/15/1966	3/18/1966	Clay	0.00	24.50	969.70	Gravity				
23	3/14/1966	3/22/1966	Sand	0.00	39.00	975.78	Delmag D-22	4850	1224	1147	2520
24	7/18/1966	7/27/1966	Sand	24.00	78.00	947.60	Gravity	3050	820		3738
25	10/24/1966	10/28/1966	Sand	16.50	58.00	967.56	Delmag D-12	2750	1190	754	2520
26	1/31/1967	2/9/1967	Clay	18.00	40.00	981.43	Delmag D-12	2750	970	754	2520
27	2/10/1967	2/17/1967	Mixed	18.00	65.00	956.43	Delmag D-12	2750	970	754	3570
28	2/19/1972	2/24/1972	Mixed	8.00	40.00	900.00	Delmag D-12				
29	2/25/1972	2/29/1972	Mixed	8.00	60.00	880.00	Delmag D-12				
30	3/3/1972	3/9/1972	Sand	8.00	73.00	863.00	Delmag D-12				
31	5/30/1980	6/4/1980	Mixed	0.00	58.20	540.70	Gravity				
32	6/20/1980	6/24/1980	Clay	0.00	39.60	1197.20	Delmag D-12				
33	10/28/1980	10/30/1980	Clay	0.00	37.00	886.75	Delmag D-12				
34	2/18/1981	2/25/1981	Sand	0.00	57.00	549.08	Delmag D-12	2750	1050	810	2520
35	3/24/1981	3/31/1981	Sand	23.00	60.00	536.20	Kobe K-13				
36	4/6/1981	4/14/1981	Mixed	0.00	58.50	557.50	Kobe K-13				

Table A.2: PILOT Historical Steel H-Pile Dataset Summary (Records 19-36) – Continued

ID #	Hammer Stroke (ft)	EOD Blow Count (blows/ft)	Davisson Pile Capacity (tons)	Reliable Pile Load Test	Usable-Static Pile Load Test	Usable-Dynamic Pile Load Test
19			49.00	✓	✓	
20	4.5	40.00	60.00	✓	✓	✓
21			57.00	✓		
22			29.00	✓		
23		15.48	107.00*	✓		
24	13.0	22.90	92.00	✓	✓	✓
25		35.60	112.00*	✓	✓	✓
26		9.23	34.00	✓		
27		52.17	90.00*	✓		
28			53.00	✓		
29			73.00	✓		
30			78.00	✓		
31			59.00	✓		
32			86.00*	✓	✓	
33			106.00	✓	✓	
34	5.0	36.90	112.00	✓	✓	✓
35						
36			110.00*	✓	✓	

*Extrapolation of the load-displacement results according to the procedure outlined in the 1999 FHWA report by Paikowsky and Tolosko (1999)

Table A.3: PILOT Historical Steel H-Pile Dataset Summary (Records 37-54)

ID #	County	Township	Lab #	Project #	Design #	Contractor	Pile Type	Design Load (tons)
37	Dubuque	Dubuque	AXP1-6	BRF-561-4(5)--38-31	1579	Lunda Construction Co.	HP 10 X 42	48.00
38	Iowa	Honey Creek	AXP1-7	BRF-21-3(6)38-48	179	A. M. Cohron & Son	HP 10 X 42	33.00
39	Iowa	Honey Creek	AXP1-8	BRF-21-3(6)38-48	179	A. M. Cohron & Son	HP 10 X 42	33.00
40	Linn	Washington	AXP1-9	I-380-6(77)280--01-05	2777	Schmidt Construction Co.	HP 10 X 42	37.00
41	Jackson	Monmouth	AXP1-11	BRF-64-2(25)--38-49	1078	Grimshaw Construction Co.	HP 10 X 42	37.00
42	Linn	Rapids	AXP7-4	EACI-380-6(68)263	1276	Lunda Construction Co.	HP 10 X 42	32.00
43	Linn	Rapids	AXP7-5	EACI-380-6(68)263--08-57	1276	Lunda Construction Co.	HP 10 X 42	34.00
44	Linn	Rapids	AXP7-6	EACI-380-6(68)263--08-57	1276	Lunda Construction Co.	HP 10 X 42	34.00
45	Buchanan	Madison	AXP7-7	F-187-1(4)--20-10	275		HP 10 X 42	35.00
46	Iowa	Honey Creek	AXP7-7	BRF-212-2(5)--38-40	1586	Taylor Construction Co.	HP 10 X 42	37.00
47	Jones	Rome	AXP7-8	FN-38-3(17)--21-53	275	Grimshaw Construction Co.	HP 10 X 42	37.00
48	Black Hawk	East Waterloo	AXP1-12	I-380-7(60)309--01-07	6277	Weldon Brothers Inc.	HP 10 X 42	37.00
49	Black Hawk	East Waterloo	AXP1-13	I-380-7(62)309--01-07	2077	United Contractors Inc.	HP 10 X 42	37.00
50	Clinton	Eden	AXP2-1	BRF-F-67-2(29)--2P-23	179	Shappert Engineering	HP 10 X 42	37.00
51	Johnson	West Lucas	AXP2-4	F-518-4(24)--20-52	1080	Grimshaw Construction Co.	HP 10 X 42	37.00
52	Franklin	Mott	AXP2-5	L-20-252	182	Winnebago Constructors Inc.	HP 10 X 42	33.00
53	Fremont	Benton	AXP2-5	I-29-1(9)10--01-36	369	United Contractors Inc.	HP 10 X 42	37.00
54	Fremont	Benton	AXP2-8	I-29-1(9)10--01-36	369	United Contractors Inc.	HP 10 X 42	37.00

Table A.3: PILOT Historical Steel H-Pile Dataset Summary (Records 37-54) – Continued

ID #	Date Driven	SLT Date	Soil Type	Bored Hole Depth (ft)	Embedded Pile Length (ft)	Pile Toe Elevation (ft)	Hammer Type	Ram Weight (lbs)	Cap Weight (lbs)	Anvil Weight (lbs)	Pile Weight (lbs)
37	6/19/1981	6/25/1981	Sand	0.00	75.00	537.50	Kobe K-25				
38	7/14/1981	7/16/1981	Mixed	0.00	43.00	724.64	Delmag D-12				
39	7/17/1981	7/21/1981	Mixed	0.00	55.00	712.64	Delmag D-12				
40	8/4/1981	8/11/1981	Sand	0.00	72.00	684.37	Kobe K-13				
41	9/29/1981	10/8/1981	Sand	0.00	47.30	642.20	Kobe K-13				
42	3/3/1977	3/8/1977	Clay	0.00	23.50	65.78	Kobe K-13	2870	1720	885	1092
43	4/14/1977	4/19/1977	Mixed	0.00	36.00	55.00	Delmag D-22	4850	2100	1600	1932
44	4/15/1977	4/20/1977	Mixed	0.00	36.50	54.00	Delmag D-22	4850	2100	1600	1932
45	4/26/1977	4/29/1977	Sand	0.00	42.20	990.69	Diesel				
46	5/8/1987	5/12/1987	Sand	0.00	48.00	714.10	Gravity #3007	5240	1050		2100
47	6/2/1977	6/7/1977	Sand	11.00	47.00	696.09	Kobe K-13				
48	10/29/1981	11/3/1981	Sand	0.00	42.00	789.20	Gravity #289	5050	1504		1848
49	12/23/1981	12/29/1981	Clay	0.00	35.50	785.45	Kobe K-13				
50	1/5/1982	1/7/1982	Sand	0.00	60.00	500.54	Delmag D-15				
51	9/20/1982	9/23/1982	Clay	8.00	29.50	688.75	Kobe K-13	2870	2334	885	1680
52	9/22/1982	9/30/1982	Sand	0.00	31.75	960.48	Gravity				
53	2/19/1972	2/23/1972	Mixed	8.00	40.00	900.00	Delmag D-12				
54	2/26/1972	3/1/1972	Mixed	8.00	60.00	880.00	Delmag D-12				

Table A.3: PILOT Historical Steel H-Pile Dataset Summary (Records 37-54) – Continued

ID #	Hammer Stroke (ft)	EOD Blow Count (blows/ft)	Davisson Pile Capacity (tons)	Reliable Pile Load Test	Usable-Static Pile Load Test	Usable-Dynamic Pile Load Test
37			185.00*	✓	✓	
38			49.00	✓	✓	
39			81.00	✓	✓	
40			125.00*	✓	✓	
41						
42	6.0	19.20	41.00	✓	✓	✓
43	4.5	21.80	71.00	✓	✓	✓
44	4.5	24.00	68.00	✓	✓	✓
45			62.00	✓	✓	
46	7.5	10.90	82.00	✓	✓	✓
47						
48	7.0	9.60	72.00	✓	✓	✓
49			136.00*	✓	✓	
50						
51	6.5	35.56	95.00	✓	✓	✓
52			31.00	✓	✓	
53			52.00	✓		
54			67.00	✓		

*Extrapolation of the load-displacement results according to the procedure outlined in the 1999 FHWA report by Paikowsky and Tolosko (1999)

Table A.4: PILOT Historical Steel H-Pile Dataset Summary (Records 55-72)

ID #	County	Township	Lab #	Project #	Design #	Contractor	Pile Type	Design Load (tons)
55	Fremont	Benton	AXP2-9	I-29-1(9)10--01-36	369	United Contractors Inc.	HP 10 X 42	37.00
56	Linn	Rapids	AXP2-12	I-380-6(38)261--01-57	1770	Cramer Brothers	HP 10 X 42	37.00
57	Hamilton	Marion	AXP2-13	FN-175-7(9)--21-40	472	Winnebago Constructors Inc.	HP 10 X 42	35.00
58	Dallas	Grant and Jefferson	AXP2-23	FN-141-7(4)--21-77	3770	Cramer Brothers	HP 10 X 42	37.00
59	Monona	Center	AXP3-1	FN-175-1(8)--21-67	671	Capital Construction Co.	HP 10 X 42	36.00
60	Monona	Maple	AXP3-4	FN-175-1(8)--21-67	1571	Capital Construction Co	HP 10 X 42	37.00
61	O'Brien	Dale and Highland	AXP3-5	FN-59-8(1)--21-71	1669 Group 3	Cunningham & Reese Corporation	HP 10 X 42	37.00
62	Kossuth	Ledyard	AXP7-8	BRF-169-8(28)--38-55	185	Winnebago Constructors Inc.	HP 10 X 42	37.00
63	Jasper	Washington and Mound Prairie	AXP7-9	BRF-117-1(11)--38-50	785	Herberger Construction Co.	HP 10 X 42	37.00
64	Jasper	Mound Prairie	AXP7-10	BRF-117-1(11)--38-50	785	Herberger Construction Co.	HP 10 X 42	37.00
65	Allamakee	Taylor	AXP7-11	GRF-364-1(8)28-03	484	Brennan Construction	HP 10 X 42	37.00
66	Black Hawk	West Waterloo	AXP7-12	IX-218-7(70)--3P-07	1684	Cramer Brothers	HP 10 X 42	37.00
67	Audubon	Exira	AXP8-8	BRF-71-4(4)--38-05	378	A. M. Cohron & Son	HP 10 X 42	37.00
68	Mills	Lyons	AXP9-2	I-29-1(8)27--01-65	366	A. M. Cohron & Son	HP 10 X 42	37.00
69	Mills	Lyons	AXP9-3	I-29-1(8)27--01-65	366	A. M. Cohron & Son	HP 10 X 42	37.00
70	Mills	Platteville	AXP9-4	F-FG-34-1(7)--24-65	468	Jensen Construction Co.	HP 10 X 42	17.00
71	Fremont	Benton and Scott	AXP9-7	I-29-1(10)20--01-36	1366	Jensen Construction Co.	HP 10 X 42	37.00
72	Fremont	Benton and Scott	AXP9-8	I-29-1(10)20--01-36	1366	Jensen Construction Co.	HP 10 X 42	37.00

Table A.4: PILOT Historical Steel H-Pile Dataset Summary (Records 55-72) – Continued

ID #	Date Driven	SLT Date	Soil Type	Bored Hole Depth (ft)	Embedded Pile Length (ft)	Pile Toe Elevation (ft)	Hammer Type	Ram Weight (lbs)	Cap Weight (lbs)	Anvil Weight (lbs)	Pile Weight (lbs)
55	3/2/1972	3/8/1972	Mixed	8.00	75.00	865.00	Delmag D-12				
56	5/24/1972	5/25/1972	Sand	8.00	34.00	108.76	Gravity				
57	7/28/1972	8/1/1972	Clay	8.00	57.00	1022.43	Gravity #2107	4500	1000		2772
58	12/21/1972	12/28/1972	Mixed	0.00	35.00	832.10	Gravity				
59	1/19/1973	1/25/1973	Mixed	8.00	38.00	1037.33	Delmag D-12				
60	3/30/1973	4/5/1973	Mixed	8.00	35.00	1063.53	Delmag D-12				
61	5/18/1973	5/23/1973		0.00	40.00	1490.00	Delmag D-12				
62	6/4/1987	6/9/1987	Mixed	0.00	45.00	1074.55	MKT DE-30B	2800	940	800	1974
63	6/22/1987	6/24/1987	Mixed	0.00	63.00	768.12	Gravity #203	4810	1040		2730
64	6/30/1987	7/1/1987	Mixed	0.00	71.00	762.56	Gravity #203	4810	1040		3150
65	7/10/1987	7/21/1987	Sand	8.00	56.00	572.15	Gravity				
66	10/15/1987	10/20/1987	Mixed	0.00	42.50	811.33	Mitsubishi M-145	2970	1920	870	1890
67	12/8/1978	12/12/1978	Clay	0.00	32.00	1162.92	Delmag D-12	2750	1980	810	1470
68	9/24/1969	9/30/1969	Mixed	14.50	73.00	890.19	Delmag D-12				
69	9/19/1969	10/2/1969	Mixed	14.50	73.00	890.19	Delmag D-12				
70	10/9/1969	10/14/1969	Sand	26.00	78.00	903.61	Delmag D-12	2750	1370	754	3360
71	11/19/1969	11/24/1969	Mixed	0.00	63.00	883.13	Delmag D-12	2750	1370	754	
72	11/18/1969	11/25/1969	Mixed	0.00	63.00	883.13	Delmag D-12	2750	1370	754	2730

Table A.4: PILOT Historical Steel H-Pile Dataset Summary (Records 55-72) – Continued

ID #	Hammer Stroke (ft)	EOD Blow Count (blows/ft)	Davisson Pile Capacity (tons)	Reliable Pile Load Test	Usable-Static Pile Load Test	Usable-Dynamic Pile Load Test
55			90.00	✓		
56			114.00*	✓	✓	
57	8.0	11.40	84.00	✓	✓	✓
58			56.00	✓	✓	
59			34.00	✓	✓	
60			38.00	✓		
61			60.00	✓		
62	5.0	20.90	50.00	✓	✓	✓
63	6.0	13.30†	33.00	✓	✓	✓
64	6.0	15.00	61.00	✓	✓	✓
65						
66	6.5	32.00	90.00	✓	✓	✓
67		23.70	70.00	✓	✓	✓
68			76.00	✓		
69						
70		30.00	64.00	✓	✓	✓
71			57.00	✓		
72		42.48	53.00	✓		

*Extrapolation of the load-displacement results according to the procedure outlined in the 1999 FHWA report by Paikowsky and Tolosko (1999)

†From a back-calculated pile penetration value as shown in the example provided in Appendix B

Table A.5: PILOT Historical Steel H-Pile Dataset Summary (Records 73-90)

ID #	County	Township	Lab #	Project #	Design #	Contractor	Pile Type	Design Load (tons)
73	Johnson	Liberty	AXP9-9	FN-518-4(18)--21-52	2078	Grimshaw Construction Co.	HP 10 X 42	37.00
74	Benton	Taylor	AXP9-13	BRF-101-1(9)--38-06	878	United Contractors Inc.	HP 10 X 42	37.00
75	Mills	Glenwood	AXP2-14	F-FG-34-1(19)--24-65	268	A. M. Cohron & Son	HP 10 X 42	37.00
76	Shelby	Union	AXP0-1	F-FG-59-4(4)-24-83	568	United Contractors Inc.	HP 10 X 42	37.00
77	Shelby	Union	AXP0-2	F-FG-59-4(4)-24-83	568	United Contractors Inc.	HP 10 X 42	37.00
78	Polk		AXP0-5	I-80-3(26)125--01-77		Jensen Construction Co.	HP 10 X 42	34.00
79	Polk		AXP0-6	I-80-3(26)125--01-77		Jensen Construction Co.	HP 10 X 42	34.00
80	Dubuque	Dubuque	AXP1-3	BRF-561-4(5)--38-31	1479	Lunda Construction Co.	HP 12 X 74	72.00
81	Black Hawk	Cedar Falls	AXP2-1	U-20-6(5)--40-07	1369	Hobe Engineering Co.	HP 12 X 53	50.00
82	Polk	Jefferson	AXP2-11	S-2646(4)--50-77	572	K. S. Kramme Inc.	HP 10 X 42	35.00
83	Woodbury	Sioux City	AXP2-17	I-129-6(2)145	173A	Christensen Brothers Inc.	HP 12 X 74	
84	Polk	Douglas	AXP2-2	FM-RS77(20)--55-77	1282	K. S. Kramme Inc.	HP 10 X 57	50.00
85	Black Hawk	Cedar Falls	AXP2-2	U-20-6(5)--40-07	1369	Hobe Engineering Co.	HP 12 X 53	50.00
86	Woodbury	Sioux City	AXP2-20	I-129-6(2)145	173A	Christensen Brothers Inc.	HP 12 X 74	
87	Woodbury	89N (Range 47W)	AXP2-21	T-733-7(5)--46-97		Herberger Construction Co.	HP 10 X 42	37.00
88	Woodbury	89N (Range 47W)	AXP2-22	T-733-7(5)--46-97		Herberger Construction Co.	HP 10 X 42	37.00
89	Polk	Douglas	AXP2-3	FM-RS77(20)--55-77	1282	K. S. Kramme Inc.	HP 10 X 57	50.00
90	Black Hawk	Cedar Falls	AXP2-3	U-20-6(5)--40-07	1369	Hobe Engineering Co.	HP 12 X 53	50.00

Table A.5: PILOT Historical Steel H-Pile Dataset Summary (Records 73-90) – Continued

ID #	Date Driven	SLT Date	Soil Type	Bored Hole Depth (ft)	Embedded Pile Length (ft)	Pile Toe Elevation (ft)	Hammer Type	Ram Weight (lbs)	Cap Weight (lbs)	Anvil Weight (lbs)	Pile Weight (lbs)
73	7/11/1979	7/17/1979	Mixed	10.00	46.70	561.70	Kobe K-13	2870	2060	885	2520
74	8/17/1979	9/19/1979	Sand	0.00	55.00	700.00	Kobe K-13	2870	680	885	2520
75	7/26/1972	7/28/1972	Mixed	8.00	70.00	901.33	Mitsubishi Diesel				3444
76	5/25/1970	6/2/1970	Mixed	0.00	49.00	1219.39	Kobe K-13	2860	1120	750	2100
77	5/22/1970	6/3/1970	Mixed	0.00	49.00	1219.39	Delmag D-12	2750	1380	754	2100
78	8/17/1970	8/21/1970	Clay	0.00	30.00		Delmag D-12				
79	8/24/1970	8/31/1970	Clay	0.00	41.00	136.70	Delmag D-12				
80	3/11/1981	3/18/1981	Sand	0.00	72.00	509.00	Kobe K-42				
81	1/31/1972	2/3/1972	Sand	0.00	39.70	810.00	Gravity				
82	5/12/1972	5/17/1972	Mixed	8.00	55.00	47.05	Gravity				
83	11/14/1972	11/29/1972		0.00	134.90	964.10	Delmag D-22				
84	8/5/1982	8/17/1982	Mixed	11.00	47.00	844.05	Diesel M-14S				
85	2/2/1972	2/4/1972	Sand	0.00	43.00	810.00	Gravity				
86	11/14/1972	12/8/1972		0.00	103.60	995.20	Delmag D-12 & D-22				
87	12/15/1972	12/19/1972		0.00	25.10	1065.30	Gravity				
88	12/13/1972	12/20/1972		0.00	21.80	1070.00	Gravity				
89	8/13/1982	8/16/1982	Clay	11.00	77.00	814.05	Diesel M-14S				
90	2/4/1972	2/8/1972	Sand	0.00	64.70	785.00	Gravity #733	4000	1031		3975

Table A.5: PILOT Historical Steel H-Pile Dataset Summary (Records 73-90) – Continued

ID #	Hammer Stroke (ft)	EOD Blow Count (blows/ft)	Davisson Pile Capacity (tons)	Reliable Pile Load Test	Usable-Static Pile Load Test	Usable-Dynamic Pile Load Test
73	7.0	30.00†	116.00*	✓	✓	✓
74	6.5	34.30	75.00	✓	✓	✓
75			154.00*	✓		
76		30.97	263.00*	✓	✓	✓
77		53.33	177.00*	✓	✓	✓
78			47.00	✓		
79			67.00	✓		
80			253.00*	✓	✓	
81			45.00	✓	✓	
82						
83			315.00*	✓		
84			62.00	✓		
85			64.00	✓	✓	
86			231.00*	✓		
87						
88						
89			96.00	✓		
90	10.0	25.90†	95.00	✓	✓	✓

*Extrapolation of the load-displacement results according to the procedure outlined in the 1999 FHWA report by Paikowsky and Tolosko (1999)

†From a back-calculated pile penetration value as shown in the example provided in Appendix B

Table A.6: PILOT Historical Steel H-Pile Dataset Summary (Records 91-108)

ID #	County	Township	Lab #	Project #	Design #	Contractor	Pile Type	Design Load (tons)
91	Black Hawk	Cedar Falls	AXP2-4	U-20-6(5)--40-07	1369	Hobe Engineering Co.	HP 12 X 53	50.00
92	Clayton	Jefferson	AXP3-16	FN-52-2(3)21-22	3072 Group 4	K. S. Kramme Inc.	HP 12 X 53	46.00
93	Story	Lincoln	AXP3-2	FM-85(10)--55-85	582	Christensen Brothers Inc.	HP 10 X 42	25.00
94	Washington	Iowa	AXP3-6	EACF-218-3(9)--2K-92	1883	Grimshaw Construction Co.	HP 10 X 42	36.00
95	Pocahontas	Cedar	AXP4-1	BROS-76-F0-(1)--81-76	183	Graves Construction Co.	HP 12 X 53	43.00
96	Story	Franklin	AXP4-15	BR-810-0(26)--74-85	1173	Christensen Brothers Inc.	HP 10 X 42	37.00
97	Muscatine	Orono	AXP4-20	SN-280(11)--51-70	374	Fox Construction Co.	HP 10 X 57	
98	Muscatine	Orono	AXP4-21	SN-280(11)--51-70	374	Fox Construction Co.	HP 10 X 57	50.00
99	Wright	Liberty and Eagle Grove	AXP4-4	BRF-3-4(20)--38-99	382	Winnebago Constructors Inc.	HP 10 X 42	37.00
100	Woodbury	Willow	AXP4-5	BROS-9097(15)--8J-97	383	Elk Horn Construction Co.	HP 12 X 53	38.00
101	Pottawattamie	77N (Range 39W)	AXP5-1	I-80-1(21)40	664	Hobe Engineering Co.	HP 10 X 42	30.00
102	Poweshiek	Deep River	AXP5-2	BRF-21-2(9)--38-79	184	Herberger Construction Co.	HP 10 X 42	32.00
103	Page	Colfax	AXP5-3	L-208(1)--73-73	774	A. M. Cohron & Son	HP 10 X 42	37.00
104	Pottawattamie	Layton	AXP5-5	I-80-1(38)47	363	Hobe Engineering Co.	HP 10 X 42	55.00
105	Franklin	Morgan	AXP4-17	I-IG-35-6(38)161--04-35	2170	Welden Brothers Inc.	HP 10 X 42	37.00
106	Pottawattamie	Knox	AXP5-6	FN-83-1(6)--21-78	275	A. M. Cohron & Son	HP 10 X 42	34.00
107	Pottawattamie	Minden	AXP5-6	I-IG-80-1(19)30	1363	Cunningham & Reese Corporation	HP 10 X 42	48.00
108	Taylor	Clayton	AXP5-7	RF-2-3(10)--35-87	472	Lauritsen Construction Co.	HP 10 X 42	37.00

Table A.6: PILOT Historical Steel H-Pile Dataset Summary (Records 91-108) – Continued

ID #	Date Driven	SLT Date	Soil Type	Bored Hole Depth (ft)	Embedded Pile Length (ft)	Pile Toe Elevation (ft)	Hammer Type	Ram Weight (lbs)	Cap Weight (lbs)	Anvil Weight (lbs)	Pile Weight (lbs)
91	2/7/1972	2/9/1972	Mixed	0.00	68.00	785.00	Gravity				
92	10/25/1973	10/30/1973	Sand	0.00	36.00	565.00	Delmag D-12				3180
93	6/7/1983	6/9/1983	Clay	0.00	48.10	30.61	Gravity				
94	12/8/1983	12/13/1983	Mixed	5.00	53.00	571.50	Kobe K-13	2870	1980	885	2520
95	2/16/1984	2/22/1984		0.00	41.00	28.52	Gravity				
96	4/19/1974	4/26/1974	Mixed	0.00	48.00	831.83	Mitsubishi Diesel				2100
97	7/31/1974	8/6/1974	Sand	0.00	35.00	540.00	Gravity				
98	8/7/1974	8/13/1974	Sand	0.00	50.00	525.00	Gravity				
99	7/3/1984	7/10/1984	Sand	26.00	31.00	1039.00	Gravity #777	6900	1040		2478
100	8/27/1984	8/30/1984	Mixed	0.00	73.50	910.19	Gravity				
101	4/7/1965	4/13/1965	Mixed	0.00	52.00	1085.36	Gravity				
102	7/15/1985	7/18/1985	Clay	0.00	43.00	772.60	Gravity #203	4810	1040		1890
103	4/17/1975	4/24/1975	Mixed	22.00	34.00	917.67	Delmag D-12				
104	5/25/1965	6/1/1965	Clay	25.00	75.60	1226.33	Gravity #733	4040	1000		
105	6/28/1974	7/2/1974	Clay	0.00	48.00	1192.66	Gravity				
106	7/30/1975	8/5/1975	Mixed	8.00	36.00	1087.00	Gravity #769	4800	1228		2016
107	6/17/1965	6/23/1965	Clay	20.00	59.20	1139.22	Gravity				
108	10/31/1975	11/4/1975	Clay	0.00	37.40	1089.56	Gravity				

Table A.6: PILOT Historical Steel H-Pile Dataset Summary (Records 91-108) – Continued

ID #	Hammer Stroke (ft)	EOD Blow Count (blows/ft)	Davisson Pile Capacity (tons)	Reliable Pile Load Test	Usable-Static Pile Load Test	Usable-Dynamic Pile Load Test
91			73.00	✓	✓	
92		15.48				
93			57.00	✓		
94			68.00	✓		
95			66.00	✓		
96	7.0	29.09	86.00	✓	✓	
97			44.00	✓		
98			97.00	✓		
99	5.0	7.30	52.00	✓	✓	✓
100			70.00	✓		
101			92.00*	✓		
102	5.0	13.30	65.00	✓	✓	✓
103			91.00	✓	✓	
104			110.00*	✓		
105			48.00	✓		
106	8.0	6.70	74.00	✓	✓	✓
107			183.00*	✓		
108						

*Extrapolation of the load-displacement results according to the procedure outlined in the 1999 FHWA report by Paikowsky and Tolosko (1999)

Table A.7: PILOT Historical Steel H-Pile Dataset Summary (Records 109-126)

ID #	County	Township	Lab #	Project #	Design #	Contractor	Pile Type	Design Load (tons)
109	Poweshiek	Sugar Creek	AXP6-1	BRF-146-2(13)--38-79	584	A. M. Cohron & Son	HP 12 X 53	46.00
110	Polk	Walnut	AXP6-1	I-235-2(66)77	764	Jensen Construction Co.	HP 10 X 42	55.00
111	Pottawattamie	Pleasant	AXP6-10	I-80-1(36)34	1663	A. M. Cohron & Son	HP 10 X 42	37.00
112	Pottawattamie	Hazel	AXP6-11	RF-183-1(4)--35-78	375	Capital Construction Co.	HP 10 X 42	37.00
113	Pottawattamie	Pleasant	AXP6-11	I-80-1(36)34	1663	A. M. Cohron & Son	HP 10 X 42	37.00
114	Pottawattamie	Pleasant	AXP6-13	I-80-1(36)34	1663	A. M. Cohron & Son	HP 10 X 42	37.00
115	Pottawattamie	Pleasant	AXP6-14	I-80-1(36)34	1663	A. M. Cohron & Son	HP 10 X 42	37.00
116	Pottawattamie	Minden	AXP6-18	I-IG-80N-1(45)11	1764	A. M. Cohron & Son	HP 10 X 42	37.00
117	Woodbury	Sioux City	AXP6-2	BRM-M-5900(1)--8B-97	385	Christensen Brothers Inc.	Steel H	47.00
118	Pottawattamie	Knox	AXP6-2	I-IG-80-1(35)27	1263	Capital Construction Co.	HP 10 X 42	37.00
119	Harrison	Morgan	AXP6-23	I-29-5(10)91--43-10	765	Sioux Falls Construction Co.	HP 12 X 53	59.00
120	Pottawattamie	Minden	AXP6-24	I-IG-80N-1(45)11--78-20	1764	A. M. Cohron & Son	HP 10 X 42	30.00
121	Polk	Walnut	AXP6-26	I-80-3(18)125	1065	Schmidt Construction Co.	HP 10 X 42	37.00
122	Polk	Walnut	AXP6-27	I-80-3(18)125	1065	Schmidt Construction Co.	HP 10 X 42	37.00
123	Pottawattamie	Boomer	AXP6-3	78-20-I-80N-1(17)5	4164	Hobe Engineering Co.	HP 10 X 42	35.00
124	Woodbury	Sioux City	AXP6-4	BRM-M-5900(1)-8B-97	385	Christensen Brothers Inc.	Steel H	47.00
125	Pottawattamie	Rockford	AXP6-4	I-IG-80N-1(16)0	464	Cunningham & Reese Corporation	HP 10 X 42	37.00
126	Pottawattamie	Cresent	AXP6-5	I-680-1(373)0--01-78	672	United Contractors Inc.	HP 10 X 42	37.00

Table A.7: PILOT Historical Steel H-Pile Dataset Summary (Records 109-126) – Continued

ID #	Date Driven	SLT Date	Soil Type	Bored Hole Depth (ft)	Embedded Pile Length (ft)	Pile Toe Elevation (ft)	Hammer Type	Ram Weight (lbs)	Cap Weight (lbs)	Anvil Weight (lbs)	Pile Weight (lbs)
109	3/28/1986	4/1/1986	Clay	6.00	51.00	743.72	Delmag D-12	2750	970	754	2915
110	12/20/1965	1/4/1966	Clay	0.00	24.00	1053.00	Gravity				
111	2/11/1966	2/23/1966	Clay	0.00	42.00	1250.56	Delmag D-12				
112	11/19/1976	12/2/1976	Clay	20.00	83.00	909.78	Delmag D-15	3300	1520	810	4410
113	2/14/1966	2/23/1966	Clay	0.00	41.00	1259.50	Gravity				
114	2/25/1966	3/10/1966	Clay	0.00	57.30	1243.20	Gravity				
115	2/25/1966	3/16/1966	Clay	0.00	57.50	1243.06	Delmag D-12				
116	4/9/1966	4/19/1966	Clay	0.00	62.00	1059.01	Single Action Diesel				
117	5/16/1986	5/21/1986		0.00	50.00	1048.00	DE-30B				
118	1/4/1966	1/13/1966	Clay	23.60	72.70	1124.15	Delmag D-12				
119	7/26/1966	8/3/1966	Sand	0.00	59.00	943.77	Link Belt 520		2140	1180	3180
120	8/2/1966	8/9/1966	Clay	15.00	87.30	1051.68	Delmag D-12				
121	8/27/1966	9/6/1966	Clay	20.00	82.50	1118.00	Link Belt Diesel #312		1415	1188	3570
122	8/27/1966	9/8/1966	Clay	20.00	62.90	1140.10	Link Belt Diesel #312		1415	1188	2730
123	1/7/1966	1/15/1966	Clay	14.41	62.00	1095.41	McKiernan-Terry DE-30				
124	5/16/1986	6/4/1986		0.00	69.00	1027.00	DE-30B				
125	1/14/1966	1/21/1966	Clay	0.00	36.00	957.50	McKiernan-Terry DE-30				
126	6/30/1976	7/7/1976	Sand	0.00	59.00	926.05	Kobe K-13	2870	1680	885	2562

Table A.7: PILOT Historical Steel H-Pile Dataset Summary (Records 109-126) – Continued

ID #	Hammer Stroke (ft)	EOD Blow Count (blows/ft)	Davisson Pile Capacity (tons)	Reliable Pile Load Test	Usable-Static Pile Load Test	Usable-Dynamic Pile Load Test
109	4.5	48.00†	88.00	✓	✓	✓
110						
111			56.00	✓		
112	7.0	64.00				
113			82.00	✓		
114			327.00*	✓		
115			108.00	✓		
116			58.00	✓		
117						
118			88.00	✓		
119		60.00	87.00	✓		
120			128.00*	✓		
121		60.00	149.00*	✓		
122		92.31	312.00*	✓		
123			51.00	✓		
124						
125			25.00	✓		
126	5.5	25.00				

*Extrapolation of the load-displacement results according to the procedure outlined in the 1999 FHWA report by Paikowsky and Tolosko (1999)

†From a back-calculated pile penetration value as shown in the example provided in Appendix B

Table A.8: PILOT Historical Steel H-Pile Dataset Summary (Records 127-144)

ID #	County	Township	Lab #	Project #	Design #	Contractor	Pile Type	Design Load (tons)
127	Pottawattamie	Boomer	AXP6-5	78-20-I-80N-1(17)5	4164	Hobe Engineering Co.	HP 10 X 42	35.00
128	Ringgold	Waubonsie	AXP6-6	FN-2-4(8)--21-80	275	A. M. Cohron & Son	HP 10 X 42	37.00
129	Pottawattamie	77N (Range 43W)	AXP6-8	I-80N-1(17)5	3964	Christensen Brothers Inc.	HP 10 X 42	30.00
130	Pottawattamie	Lewis	AXP7-10	I-80-1(1)0--01-78	1367	Brogan Construction Co.	HP 12 X 53	
131	Pottawattamie	Cresent	AXP7-1	I-680-1(17)3--01-78	772	Elk Horn Construction Co.	HP 10 X 42	37.00
132	Woodbury	Sioux City	AXP7-11	U-520-1(13)--40-97	374	Hobe Engineering Co.	HP 10 X 42	37.00
133	Pottawattamie	Kane	AXP7-12	I-29-3(1)54--01-78	1367	Brogan Construction Co.	HP 10 X 42	
134	Pottawattamie	Lewis	AXP7-14	I-80-1(1)0--01-78	1367	Brogan Construction Co.	HP 10 X 42	
135	Pottawattamie	Lewis	AXP7-16	I-80-1(1)0--01-78	1367	Brogan Construction Co.	HP 12 X 53	
136	Pottawattamie	Lewis	AXP7-18	I-80-1(1)0--01-78	1367	Brogan Construction Co.	HP 10 X 42	
137	Pottawattamie	Kane	AXP7-2	I-29-3(1)54--01-78	1367	Brogan Construction Co.	HP 10 X 42	
138	Pottawattamie	Lewis	AXP7-21	I-80-1(1)0--01-78	1367	Brogan Construction Co.	HP 10 X 42	
139	Pottawattamie	Lewis	AXP7-23	I-80-1(1)0--01-78	1367	Brogan Construction Co.	HP 12 X 53	
140	Pottawattamie	Lewis	AXP7-25	I-80-1(1)0--01-78	1367	Brogan Construction Co.	HP 10 X 42	
141	Pottawattamie	Lewis	AXP7-27	I-80-1(1)0--01-78	1367	Brogan Construction Co.	HP 10 X 42	
142	Pottawattamie	Lewis	AXP7-29	I-80-1(1)0--01-78	1367	Brogan Construction Co.	HP 10 X 42	
143	Pottawattamie	Kane	AXP7-5	I-29-3(1)54--01-78	1367	Brogan Construction Co.	HP 10 X 42	
144	Scott		AXP7-6	BROS-9082(2)--57-82	5286	Civil Constructors	HP 12 X 53	40.00

Table A.8: PILOT Historical Steel H-Pile Dataset Summary (Records 127-144) – Continued

ID #	Date Driven	SLT Date	Soil Type	Bored Hole Depth (ft)	Embedded Pile Length (ft)	Pile Toe Elevation (ft)	Hammer Type	Ram Weight (lbs)	Cap Weight (lbs)	Anvil Weight (lbs)	Pile Weight (lbs)
127	1/17/1966	1/24/1966	Clay	14.41	77.00	1080.41	McKiernan-Terry DE-30				
128	7/14/1976	7/16/1976	Mixed	8.00	52.00	973.58	Gravity				
129	2/3/1966	2/11/1966	Clay	6.00	59.00	1123.73	McKiernan-Terry DE-30				
130	2/22/1967	2/27/1967	Mixed	5.00	18.50	952.00	Gravity				
131	1/26/1976	2/1/1977	Clay	29.00	66.00	912.00	M14 Diesel				
132	12/2/1977	12/7/1977	Clay	0.00	81.00	1103.34	Delmag D-22				
133	2/24/1967	3/1/1967	Sand	5.00	65.60	913.00	Gravity				
134	2/28/1967	3/4/1967	Mixed	5.00	16.00	952.90	Gravity				
135	3/2/1967	3/6/1967	Mixed	5.00	52.60	917.90	Gravity				
136	3/3/1967	3/8/1967	Mixed	5.00	49.00	921.50	Gravity				
137	2/9/1967	2/15/1967	Mixed	5.00	24.50	954.00	Gravity				
138	3/6/1967	3/11/1967	Sand	5.00	46.30	922.40	Gravity				
139	3/11/1967	3/15/1967	Sand	5.00	67.50	903.00	Gravity				
140	3/17/1967	3/17/1967	Sand	5.00	67.40	903.10	Gravity				
141	3/14/1967	3/22/1967	Sand	5.00	66.50	902.40	Gravity				
142	3/24/1967	3/24/1967	Sand	5.00	85.10	883.80	Gravity				
143	2/18/1967	2/22/1967	Sand	5.00	47.30	931.20	Gravity				
144	4/24/1987	4/30/1987	Clay	0.00	72.00	563.75	Delmag D-15				

Table A.8: PILOT Historical Steel H-Pile Dataset Summary (Records 127-144) – Continued

ID #	Hammer Stroke (ft)	EOD Blow Count (blows/ft)	Davisson Pile Capacity (tons)	Reliable Pile Load Test	Usable-Static Pile Load Test	Usable-Dynamic Pile Load Test
127			79.00	✓		
128			130.00*	✓	✓	
129			73.00	✓		
130			15.00*	✓	✓	
131			85.00	✓		
132			61.00	✓		
133			95.00*	✓	✓	
134			9.00	✓	✓	
135			82.00	✓	✓	
136			57.00*	✓	✓	
137			34.00*	✓	✓	
138			23.00*	✓	✓	
139			103.00	✓	✓	
140			79.00	✓	✓	
141			74.00	✓	✓	
142						
143			61.00*	✓	✓	
144			143.00*	✓		

*Extrapolation of the load-displacement results according to the procedure outlined in the 1999 FHWA report by Paikowsky and Tolosko (1999)

Table A.9: PILOT Historical Steel H-Pile Dataset Summary (Records 145-162)

ID #	County	Township	Lab #	Project #	Design #	Contractor	Pile Type	Design Load (tons)
145	Pottawattamie	Lewis	AXP7-7	I-80-1(1)0--01-78	1367	Brogan Construction Co.	HP 10 X 42	
146	Shelby	Center	AXP7-9	BRF-44-2(13)--38-83	1875	A. M. Cohron & Son	HP 10 X 42	37.00
147	Woodbury	Woodbury	AXP8-1	TQF-520-1(15)--29-97	474	Hobe Engineering Co.	HP 10 X 42	37.00
148	Linn	Rapids	AXP8-2	I-IG-380-6(56)264--01-57	274	Lunda Construction Co.	HP 14 X 73	62.00
149	Pottawattamie	Lewis	AXP8-2	I-IG-80-1(54)3--4-78	3665	Jensen Construction Co.	HP 10 X 42	55.00
150	Osceola	Ocheyedan	AXP8-4	F-9-2(5)--20-72	275	Graves Construction Co.	HP 10 X 42	37.00
151	Pottawattamie	Lewis	AXP8-4	F-29-1(2)--20-78	3465	Jensen Construction Co.	HP 10 X 42	37.00
152	Woodbury	Woodbury	AXP8-5	TQFS-980-0(5)--23-97	1476	Christensen Brothers Inc.	HP 10 X 42	37.00
153	Page	Morton	AXP8-7	SOS-FM-73(1)--70-73	1878	A. M. Cohron & Son	HP 10 X 42	37.00
154	Boone	Des Moines	AXP9-10	FN-17-2(4)--21-08	276	Godberson - Smith	HP 12 X 53	46.00
155	Boone	Des Moines	AXP9-11	FN-17-2(4)--21-08	276	Godberson - Smith	HP 12 X 53	46.00
156	Dubuque	Dubuque	AXP9-14	BRF-561(2)--38-31	777	Lunda Construction Co.	HP 14 X 89	150.00
157	Dubuque	Dubuque	AXP9-15	BRF-561(2)--38-31	777	Lunda Construction Co.	HP 14 X 89	150.00
158	Dubuque	Dubuque	AXP9-16	BRF-561(2)--38-31	777	Lunda Construction Co.	HP 14 X 89	150.00
159	Dubuque	Dubuque	AXP9-17	BRF-561(2)--38-31	777	Lunda Construction Co.	HP 14 X 89	150.00
160	Dubuque	Dubuque	AXP9-3	BRF-561(2)--38-31	777	Lunda Construction Co.	HP 14 X 89	150.00
161	Dubuque	Dubuque	AXP9-4	BRF-561(2)--38-31	777	Lunda Construction Co.	HP 14 X 89	150.00
162	Woodbury	Sioux City	AXP9-6	IIG-F-29-7(13)150--0B-97	2076	Christensen Brothers Inc.	HP 10 X 42	55.00

Table A.9: PILOT Historical Steel H-Pile Dataset Summary (Records 145-162) – Continued

ID #	Date Driven	SLT Date	Soil Type	Bored Hole Depth (ft)	Embedded Pile Length (ft)	Pile Toe Elevation (ft)	Hammer Type	Ram Weight (lbs)	Cap Weight (lbs)	Anvil Weight (lbs)	Pile Weight (lbs)
145	2/20/1967	2/24/1967	Clay	5.00	18.50	952.00	Gravity				
146	6/14/1977	6/16/1977	Mixed	0.00	48.00	1135.50	Delmag D-12				
147	1/3/1978	1/11/1978	Clay	0.00	71.00	1082.14	Mitsubishi M-14				
148	1/16/1978	1/19/1978	Sand	0.00	65.00	21.50	Kobe K-35				
149	6/18/1968	6/22/1968	Mixed	0.00	71.60	899.60	Delmag D-22	4850	1390	1147	3108
150	5/18/1978	5/23/1978	Clay	0.00	47.00	1447.00	Gravity				
151	7/26/1968	7/30/1968	Sand	20.50	77.50	897.40	Delmag D-22	4850	1390	1147	4200
152	6/6/1978	6/8/1978	Clay	0.00	98.00	1049.89	McKiernan-Terry DE-30				
153	8/17/1978	8/22/1978		0.00	66.00	908.90	Gravity				
154	7/28/1979	8/1/1979	Mixed	0.00	46.00	967.90	Mitsubishi M-145-S				
155	7/28/1979	8/6/1979	Mixed	0.00	46.00	967.90	Diesel				
156	10/27/1979	11/5/1979	Sand	0.00	59.00	505.00	Kobe K-42				
157	10/27/1979	11/6/1979	Sand	0.00	59.00	505.00	MKT V-20				
158	11/9/1979	11/13/1979	Sand	0.00	73.60	490.40	Kobe K-42	9260	2420	3700	9790
159	11/9/1979	11/14/1979	Sand	0.00	66.60	497.40	MKT V-20				
160	3/9/1979	3/13/1979	Sand	12.00	93.00	500.00	Kobe K-13				
161	3/13/1979	3/20/1979	Sand	23.00	86.00	490.00	Kobe K-35				
162	5/1/1979	5/8/1979	Mixed	0.00	33.00	1056.00	McKiernan-Terry DE-30				

Table A.9: PILOT Historical Steel H-Pile Dataset Summary (Records 145-162) – Continued

ID #	Hammer Stroke (ft)	EOD Blow Count (blows/ft)	Davisson Pile Capacity (tons)	Reliable Pile Load Test	Usable-Static Pile Load Test	Usable-Dynamic Pile Load Test
145			19.00	✓	✓	
146			67.00	✓	✓	
147			105.00*	✓	✓	
148			134.00*	✓	✓	
149		20.87				
150						
151		11.43	100.00*	✓	✓	✓
152			184.00*	✓		
153			169.00*	✓		
154						
155			31.00	✓	✓	
156			143.00	✓	✓	
157			180.00	✓	✓	
158	6.0	60.00	291.00	✓	✓	✓
159			265.00	✓	✓	
160			445.00*	✓	✓	
161			422.00*	✓	✓	
162			76.00	✓		

*Extrapolation of the load-displacement results according to the procedure outlined in the 1999 FHWA report by Paikowsky and Tolosko (1999)

Table A.10: PILOT Historical Steel H-Pile Dataset Summary (Records 163-164)

ID #	County	Township	Lab #	Project #	Design #	Contractor	Pile Type	Design Load (tons)
163	Woodbury	Sioux City	AXP9-7	IIG-F-29-7(13)150--0B-97	2076	Christensen Brothers Inc.	HP 10 X 42	55.00
164	Monona		AXP9-5	BRF-37-1(6)--38-67	277		HP 12 X 74	

Table A.10: PILOT Historical Steel H-Pile Dataset Summary (Records 163-164) – Continued

ID #	Date Driven	SLT Date	Soil Type	Bored Hole Depth (ft)	Embedded Pile Length (ft)	Pile Toe Elevation (ft)	Hammer Type	Ram Weight (lbs)	Cap Weight (lbs)	Anvil Weight (lbs)	Pile Weight (lbs)
163	5/4/1979	5/8/1979	Mixed	0.00	40.00	1049.00	McKiernan-Terry DE-30				
164			Mixed		76.00						

Table A.10: PILOT Historical Steel H-Pile Dataset Summary (Records 145-162) – Continued

ID #	Hammer Stroke (ft)	EOD Blow Count (blows/ft)	Davisson Pile Capacity (tons)	Reliable Pile Load Test	Usable-Static Pile Load Test	Usable-Dynamic Pile Load Test
163			166.00	✓		
164						

Table A.11: PILOT Historical Timber Pile Dataset Summary (Records 165-182)

ID #	County	Township	Lab #	Project #	Design #	Contractor	Pile Type	Design Load (tons)
165	Plymouth	American	AXP0-1	0-750404-K	Sewer Plant	Graves Construction Co.	Timber	35.00
166	Johnson	Madison	AXP0-4	I-IG-380-6(5)243--04-52	468	United Contractors Inc.	Timber	40.00
167	Pottawattamie	James	AXP0-5	FM-78(28)--55-78	1580	Capitol Construction Co.	Timber	20.00
168	Greene	Franklin & Greenbrier	AXP0-7	L-12.0-4.05-70--73-37	None	Christensen Brothers Inc.	Timber	15.00
169	Des Moines	Burlington	AXP1-1	U-UG-534-9(12)--44-29	769	Schmidt Construction Co.	Timber	40.00
170	Scott	Sheridan	AXP1-1	FFD-561-1(2)--2N-82	880	Lunda Construction Co.	Timber	20.00
171	Des Moines	Burlington	AXP1-3	U-UG-534-9(12)--44-29	769	Schmidt Construction Co.	Timber	20.00
172	Carroll	Maple River	AXP1-10	RRS-30-2(37)--46-14	479	Cramer Brothers	Timber	40.00
173	Linn	Washington	AXP2-6	I-380-6(74)273--01-57	782	Iowa Construction Co.	Timber	20.00
174	Linn	Rapids	AXP2-7	F-30-7(64)--20-57	481	Cramer Brothers	Timber	20.00
175	Linn	Rapids	AXP2-15	I-380-6(40)260-01-57	1870	Cramer Brothers	Timber	20.00
176	Johnson	West Lucas	AXP3-1	FN-518-4(24)--21-52	3480	Lunda Construction Co.	Timber	40.00
177	Grundy	Pleasant Valley	AXP3-2	S-1871(5)--50-38	171	Taylor Construction Co.	Timber	19.00
178	Iowa	Troy	AXP3-3	BRF-149-2(34)--38-48	183	Grimshaw Construction Co.	Timber	20.00
179	Hamilton	Freedom - Independence	AXP3-3	DP-F250-4(13)39-40	1369	Herberger Construction Co.	Timber	40.00
180	Black Hawk	Waterloo	AXP3-4	IX520-6(8)--07-05	1983	Lunda Construction Co.	Timber	40.00
181	Black Hawk	Waterloo	AXP3-5	IX-520-6(8)--3P-07	1983	Lunda Construction Co.	Timber	40.00
182	Calhoun	Center	AXP3-6	SN-3088(4)--51-13	273	Godberson - Smith	Timber	19.00

Table A.11: PILOT Historical Timber Pile Dataset Summary (Records 165-182) – Continued

ID #	Date Driven	SLT Date	Soil Type	Bored Hole Depth (ft)	Embedded Pile Length (ft)	Pile Toe Elevation (ft)	Hammer Type	Ram Weight (lbs)	Cap + Anvil + Pile Weight (lbs)
165	3/17/1980	3/19/1980		2.00	29.00	1164.50	Linkbelt 440		
166	6/18/1970	6/23/1970	Clay	0.00	15.60	791.81	Kobe K-13	2870	
167	12/10/1980	12/16/1980	Clay	8.00	40.00	235.38	Diesel		
168	12/7/1970	12/14/1970		0.00	36.22	933.28	Gravity		
169	4/1/1971	4/8/1971	Clay	10.00	19.60	536.60	Gravity		
170	1/16/1981	1/20/1981	Clay	0.00	37.00	731.29	Kobe K-13		
171	6/8/1971	6/15/1971		15.00	22.80	544.03	Kobe K-13		
172	9/3/1981	9/8/1981	Clay	0.00	36.75	1206.50	M-14 Diesel		
173	12/8/1982	12/14/1982	Clay	0.00	27.80	769.78	Kobe K-13		
174	12/17/1982	12/21/1982	Clay	0.00	18.00	114.80	Gravity #168	5685	1610
175	11/15/1972	11/21/1972	Mixed	0.00	27.00	121.89	Gravity #168	5700	1690
176	1/4/1983	1/6/1983	Clay	0.00	27.50	715.22	Kobe K-13		
177	3/12/1973	3/16/1973	Sand	8.00	28.00	821.79	Gravity		
178	7/15/1983	7/19/1983	Clay	8.00	33.00	731.14	Gravity		
179	3/23/1973	4/2/1973	Clay	0.00	24.00	1056.00	Delmag D-12		
180	8/23/1983	8/25/1983	Sand	0.00	10.00	846.28	Delmag D-15	3300	2376
181	8/17/1983	8/29/1983	Sand	0.00	16.75	840.79	Diesel	3300	2535
182	5/24/1973	5/30/1973		0.00	43.20	97.62	Mitsubishi M14S		

Table A.11: PILOT Historical Timber Pile Dataset Summary (Records 165-182) – Continued

ID #	Hammer Stroke (ft)	EOD Blow Count (blows/ft)	Davisson Pile Capacity (tons)	Reliable Pile Load Test	Usable-Static Pile Load Test	Usable-Dynamic Pile Load Test
165						
166			46.00	✓	✓	
167			93.00	✓		
168			69.00	✓		
169			35.00	✓	✓	
170						
171			66.00	✓		
172						
173			66.00	✓		
174	7.0	4.54†	38.00	✓	✓	✓
175	7.0	2.80†	47.00	✓	✓	✓
176						
177			71.00	✓		
178			44.00	✓		
179			38.00	✓		
180	5.5	21.80	44.00	✓	✓	✓
181	6.0	60.00	100.00	✓	✓	✓
182						

†From a back-calculated pile penetration value as shown in the example provided in Appendix B

Table A.12: PILOT Historical Timber Pile Dataset Summary (Records 183-200)

ID #	County	Township	Lab #	Project #	Design #	Contractor	Pile Type	Design Load (tons)
183	Calhoun	Center	AXP3-7	SN-3088(4)--51-13	273	Godberson - Smith	Timber	19.00
184	Pottawattamie	T77N R38	AXP3-8	FN-83-1(4)--21-78	1772	Godberson - Smith	Timber	15.00
185	Palo Alto	Freedom	AXP3-11	SN-3121(1)--51-74	173	Graves Construction Co.	Timber	18.00
186	Howard	Jamestown	AXP3-12	SN-2923(7)--51-45	373	Combs Construction Co.	Timber	40.00
187	Howard	Jamestown	AXP3-13	SN-2923(7)--51-45	373	Combs Construction Co.	Timber	40.00
188	Franklin	Marion	AXP3-15	I-35-6(16)166--01-35	4470	Herberger Construction Co.	Timber	20.00
189	Franklin	Scott	AXP3-18	I-35-6(16)166--01-35	4370	United Contractors Inc.	Timber	40.00
190	Appanoose	Taylor	AXP3-19	DPF-5-1(1)--39-04	170	United Contractors Inc.	Timber	21.00
191	Franklin	Scott	AXP4-1	I-IG-35-6(37)165--04-35	2370	Herberger Construction Co.	Timber	40.00
192	Franklin	Scott	AXP4-2	I-35-6(16)166--01-35	4270	Herberger Construction Co.	Timber	40.00
193	Clinton	DeWitt	AXP4-3	F-FG-30-9(27)--24-23	1569	Jensen Construction Co.	Timber	40.00
194	Clinton	DeWitt	AXP4-4	F-FG-30-9(27)--24-23	1969	United Contractors Inc.	Timber	40.00
195	Franklin	Scott	AXP4-5	I-IG-35-6(38)161--04-35	2070	Welden Brothers Inc.	Timber	40.00
196	Franklin	Morgan	AXP4-6	I-IG-35-6(38)161--04-35	2270	Welden Brothers Inc.	Timber	40.00
197	Hamilton	Independence	AXP4-9	DP-F-520-4(9)--39-40	1570	Welden Brothers Inc.	Timber	40.00
198	Franklin	Oakland	AXP4-10	I-IG-35-6(39)156--04-35	2770	A. M. Cohron & Son	Timber	20.00
199	Franklin	Oakland	AXP4-11	I-IG-35-6(39)156--04-35	2770	A. M. Cohron & Son	Timber	20.00
200	Franklin	Morgan	AXP4-18	I-IG-35-6(14)155--04-35	3270	K. S. Kramme Inc.	Timber	40.00

Table A.12: PILOT Historical Timber Pile Dataset Summary (Records 183-200) – Continued

ID #	Date Driven	SLT Date	Soil Type	Bored Hole Depth (ft)	Embedded Pile Length (ft)	Pile Toe Elevation (ft)	Hammer Type	Ram Weight (lbs)	Cap + Anvil + Pile Weight (lbs)
183	5/24/1973	5/31/1973		0.00	43.20	97.62	Mitsubishi M14S		
184	6/11/1973	6/14/1973	Clay	0.00	26.00	1267.08	Mitsubishi M14S		
185	8/8/1973	8/14/1973	Mixed	6.00	15.20	1180.54	Gravity		
186	8/8/1973	8/15/1973	Clay	6.00	42.00	934.11	Delmag D-15		
187	8/8/1973	8/16/1973	Clay	6.00	42.00	934.11	Delmag D-15		
188	10/18/1973	10/25/1973	Clay	0.00	33.00	1193.36	Delmag D-12	2750	
189	11/8/1973	11/20/1973	Clay	0.00	23.00	1191.45	Kobe K-13		
190	12/11/1973	12/18/1973	Clay	0.00	21.00	965.34	Kobe K13	2870	
191	12/20/1973	1/8/1974	Mixed	0.00	18.60	1206.00	Delmag D-12		
192	12/12/1973	1/15/1974	Clay	0.00	29.00	1185.45	Delmag D-12		
193	1/25/1974	2/5/1974	Clay	0.00	19.00	649.55	Gravity		
194	1/29/1974	2/6/1974		0.00	24.50	606.10	Gravity		
195	2/1/1974	2/12/1974	Clay	0.00	22.00	1220.00	Gravity		
196	2/4/1974	2/14/1974	Sand	0.00	23.00	1207.00	Gravity		
197	2/19/1974	2/26/1974	Clay	0.00	18.00	1136.50	Gravity		
198	4/9/1974	4/11/1974	Sand	0.00	16.00	1132.50	Gravity		
199	4/9/1974	4/16/1974	Mixed	0.00	16.00	1132.50	Gravity		
200	7/15/1974	7/19/1974	Clay	0.00	20.00	1159.86	Gravity		

Table A.12: PILOT Historical Timber Pile Dataset Summary (Records 183-200) – Continued

ID #	Hammer Stroke (ft)	EOD Blow Count (blows/ft)	Davisson Pile Capacity (tons)	Reliable Pile Load Test	Usable-Static Pile Load Test	Usable-Dynamic Pile Load Test
183			55.00	✓		
184						
185			36.00	✓		
186						
187						
188			68.00	✓	✓	
189			34.00	✓		
190	5.5	15.00				
191						
192			56.00	✓		
193			32.00	✓	✓	
194						
195			42.00	✓		
196			30.00	✓		
197			42.00	✓	✓	
198						
199			39.00	✓		
200	10.0	5.45	30.00	✓	✓	

Table A.13: PILOT Historical Timber Pile Dataset Summary (Records 201-218)

ID #	County	Township	Lab #	Project #	Design #	Contractor	Pile Type	Design Load (tons)
201	Calhoun	Lincoln	AXP4-19	FN-7-4(1)--21-13	370	Cunningham & Reese Corporation	Timber	40.00
202	Pottawattamie	Layton	AXP5-2	I-80-1(38)47	1063	Herberger Construction Co.	Timber	20.00
203	Pottawattamie	Knox	AXP5-3	I-80-1(21)40	964	Hobe Engineering Co.	Timber	20.00
204	Pottawattamie	Layton	AXP5-4	I-80-1(38)47	363	Hobe Engineering Co.	Timber	20.00
205	Benton	Eldorado	AXP5-5	FN-218-6(10)--21-06	173	Grimshaw Construction Co.	Timber	40.00
206	Lucas	Jackson	AXP5-4	RFG-34-6(14)--17-59	173	Herberger Construction Co.	Timber	40.00
207	Iowa	Troy	AXP5-4	BRF-F-149-2(38)--2P-48	1083	Grimshaw Construction Co.	Timber	20.00
208	Story	Grant & Milford	AXP5-9	I-IG-35-5(8)113	863	Herberger Construction Co.	Timber	20.00
209	Woodbury		AXP5-11	U-604(3)	663	Godberson - Smith	Timber	20.00
210	Des Moines	Flint River	AXP5-21	F-301(5)	165	Schmidt Construction Co.	Timber	20.00
211	Fremont	Riverton	AXP6-1	FN-42-1(1)--21-36	372	A. M. Cohron & Son	Timber	20.00
212	Tama	Salt Creek	AXP6-7	RF-212-1(2)35-86	575	V & S Construction	Timber	20.00
213	Pottawattamie	Crescent	AXP6-9	I-680-1(117)73--01-78	772	Elkhorn Construction	Timber	21.00
214	Pottawattamie	Crescent	AXP6-10	I-680-1(117)--01-78	772	Elkhorn Construction	Timber	21.00
215	Polk	Lee	AXP6-20	I-235-2(61)83	465	United Contractors Inc.	Timber	20.00
216	Adair	T-75-N R-32-W	AXP6-25	F-92-3(1)--1-1	1365	Combs Construction Co.	Timber	40.00
217	Polk	Delaware	AXP6-29	I-IG-235-2(62)84	665	United Contractors Inc.	Timber	20.00
218	Polk	Des Moines	AXP6-30	I-235-2(67)78-01-77	1264	Herberger Construction Co.	Timber	40.00

Table A.13: PILOT Historical Timber Pile Dataset Summary (Records 201-218) – Continued

ID #	Date Driven	SLT Date	Soil Type	Bored Hole Depth (ft)	Embedded Pile Length (ft)	Pile Toe Elevation (ft)	Hammer Type	Ram Weight (lbs)	Cap + Anvil + Pile Weight (lbs)
201	7/31/1974	8/5/1974	Mixed	0.00	17.00	1189.31	Gravity #383	3700	1345
202	4/7/1965	4/14/1965	Clay	0.00	36.00	1293.00	Delmag Single Action Diesel		
203	5/5/1965	5/11/1965		0.00	33.00	1217.73	Gravity		
204	5/6/1965	5/12/1965		0.00	33.50	1243.85	Gravity		
205	5/16/1975	5/28/1975	Clay	0.00	22.60	892.68	Kobe K-13		
206	5/20/1975	5/22/1975	Clay	0.00	27.70	720.00	Delmag D-12	2750	3190
207	10/2/1985	10/8/1985	Clay	8.00	46.83	722.21	Kobe K-13	2870	
208	9/2/1965	9/10/1965		0.00	18.00	961.80	Diesel (Single Action)		
209	12/21/1965	12/28/1965	Mixed	0.00	28.20	1064.73	Gravity #755	3500	2061
210	7/18/1966	7/22/1966	Clay	0.00	22.50	547.94	Gravity	4656	
211	1/26/1976	1/29/1976		0.00	27.00	877.92	Gravity		
212	8/17/1976	8/24/1976	Mixed	0.00	38.00	749.32	Diesel		
213	11/2/1976	11/9/1976	Mixed	0.00	51.20	931.49	Delmag D-12	2750	
214	11/2/1976	11/10/1976	Clay	0.00	42.20	940.69	Delmag D-12	2750	
215	5/12/1966	5/18/1966	Clay	0.00	19.00	55.72	Delmag Diesel		
216	8/4/1966	8/11/1966	Clay	0.00	35.00	1207.81	Gravity		
217	11/9/1966	11/14/1966	Clay	0.00	19.00	136.00	Gravity		
218	11/21/1966	11/29/1966	Clay	0.00	18.00	138.25	Delmag D-12		

Table A.13: PILOT Historical Timber Pile Dataset Summary (Records 201-218) – Continued

ID #	Hammer Stroke (ft)	EOD Blow Count (blows/ft)	Davisson Pile Capacity (tons)	Reliable Pile Load Test	Usable-Static Pile Load Test	Usable-Dynamic Pile Load Test
201	10.0	3.65†	36.00	✓	✓	✓
202						
203			45.00	✓		
204						
205			40.00	✓		
206	4.0	11.16	44.00	✓	✓	✓
207	5.0	34.30				
208						
209	10.0	6.50	55.00	✓	✓	✓
210			47.00	✓		
211						
212			30.00	✓	✓	
213			53.00	✓	✓	
214			52.00	✓	✓	
215						
216						
217			34.00	✓		
218						

†From a back-calculated pile penetration value as shown in the example provided in Appendix B

Table A.14: PILOT Historical Timber Pile Dataset Summary (Records 219-236)

ID #	County	Township	Lab #	Project #	Design #	Contractor	Pile Type	Design Load (tons)
219	Crawford	Denison	AXP6-31	F-FG-59-5(1)24-24	265	A. M. Cohron & Son	Timber	39.00
220	Pottawattamie	Garner	AXP6-32	I-80-1(51)6--01-78	465	Jensen Construction Co.	Timber	20.00
221	Jones	Rome	AXP7-2	FN-38-3(17)--21-53	275	Grimshaw Construction Co.	Timber	20.00
222	Shelby	Jackson	AXP7-3	RF-44-2(10)--35-83	375	Godberson - Smith	Timber	20.00
223	Pottawattamie	Lewis	AXP7-9	I-80-1(1)0--01-78	1367	Brogan Construction Co.	Timber	
224	Louisa	Grandview	AXP7-10	FG-61-3(16)--22-58	477	United Contractors Inc.	Timber	40.00
225	Pottawattamie	Lewis	AXP7-20	I-80-1(1)0--01-78	1367	Brogan Construction Co.	Timber	
226	Hamilton	Rose Grove	AXP7-30	I-35-5(12)140--01-40	166	Christensen Brothers Inc.	Timber	20.00
227	Clayton	Millville	AXP7-31	FN-52-2(1)--21-22	166	Brennan Construction	Timber	23.00
228	Hamilton	Liberty	AXP8-1	F-520-4(7)--20--40	565	Welden Brothers Inc.	Timber	22.00
229	Polk	Franklin	AXP8-3	F-FG-65-4(18)--24-77	676	United Contractors Inc.	Timber	20.00
230	Mills	Oak	AXP8-3	I-IG-29(8)43-04-78	1566	Cunningham & Reese Corporation	Timber	40.00
231	Harrison	Raglan	AXP8-5	FN-75-2(1)-21-43	168	Capitol Construction Co.	Timber	20.00
232	Woodbury	Grange	AXP8-6	TQFS 982-0(97)-23-97	1876	Christensen Brothers Inc.	Timber	20.00
233	Pottawattamie	Washington	AXP8-9	FN-78(8)-55--78	2677	Capitol Construction Co.	Timber	19.00
234	Mills	Platteville	AXP9-1	I-IG-29-2(10)34-04-65	666	Cunningham & Reese Corporation	Timber	40.00
235	Mitchell	Douglas	AXP9-1	F-9-6(7)-20-66	275	United Contractors Inc.	Timber	21.00
236	Linn	College	AXP9-2	FN-30-7(17)--21-57	2678	Lunda Construction Co.	Timber	40.00

Table A.14: PILOT Historical Timber Pile Dataset Summary (Records 219-236) – Continued

ID #	Date Driven	SLT Date	Soil Type	Bored Hole Depth (ft)	Embedded Pile Length (ft)	Pile Toe Elevation (ft)	Hammer Type	Ram Weight (lbs)	Cap + Anvil + Pile Weight (lbs)
219	11/29/1966	12/2/1966	Sand	21.00	21.00	1123.98	Gravity		
220	12/1/1966	12/6/1966	Clay	5.50	21.10	1147.30	Delmag D-12		
221	2/1/1977	2/3/1977	Sand	0.00	28.50	692.50	Kobe K-13		
222	2/7/1977	2/9/1977	Clay	8.00	48.00	1195.7	Diesel		
223	2/21/1967	2/25/1967	Clay	5.00	18.50	952.00	Gravity		
224	8/17/1977	8/23/1977	Clay	25.00	28.00	643.00	Kobe K-13		
225	3/4/1967	3/10/1967	Mixed	5.00	46.00	924.50	Gravity		
226	8/2/1967	8/7/1967	Clay	0.00	22.20	1147.59	Gravity		
227	11/22/1967	11/28/1967		0.00	33.40	565.60	Gravity		
228	4/16/1968	4/24/1968	Mixed	0.00	38.70	1150.13	Gravity	3000	
229	5/2/1978	5/4/1978	Clay	6.70	22.50	932.85	Kobe K-13	2870	2376
230	7/22/1968	7/25/1968	Mixed	3.00	41.00	932.67	Gravity		
231	10/4/1968	10/8/1968		6.00	48.00	988.87	Gravity		
232	6/27/1978	7/6/1978	Clay	0.00	58.00	1046.20	Delmag D-15	3300	
233	12/21/1978	12/27/1978		0.00	48.00	229.8	Delmag D-15		
234	4/2/1969	5/13/1969	Mixed	1.50	49.00	903.71	Gravity		
235	1/18/1979	1/23/1979	Clay	0.00	18.00	1072.56	Delmag D-12	2750	2365
236	2/16/1979	2/20/1979	Clay	0.00	27.00	723.60	Kobe K-13		

Table A.14: PILOT Historical Timber Pile Dataset Summary (Records 219-236) – Continued

ID #	Hammer Stroke (ft)	EOD Blow Count (blows/ft)	Davisson Pile Capacity (tons)	Reliable Pile Load Test	Usable-Static Pile Load Test	Usable-Dynamic Pile Load Test
219						
220			52.00	✓		
221						
222			75.00	✓	✓	
223			43.00	✓	✓	
224						
225			90.00	✓	✓	
226			46.00	✓		
227						
228						
229	5.0	26.67	69.00	✓	✓	✓
230			45.00	✓	✓	
231			58.00	✓		
232			64.00	✓	✓	
233						
234						
235	4.5	16.00	76.00	✓	✓	✓
236			34.00	✓		

Table A.15: PILOT Historical Timber Pile Dataset Summary (Records 237-239)

ID #	County	Township	Lab #	Project #	Design #	Contractor	Pile Type	Design Load (tons)
237	Pottawattamie		AXP9-5	U-192-1(2)--40-78	169		Timber	
238	Pottawattamie		AXP9-6	U-192-1(2)--40-78	169		Timber	
239	Hamilton	Lyon	AXP9-8	FN-175-7(4)-21--40	1176	Godberson - Smith	Timber	40.00

Table A.15: PILOT Historical Timber Pile Dataset Summary (Records 237-239) – Continued

ID #	Date Driven	SLT Date	Soil Type	Bored Hole Depth (ft)	Embedded Pile Length (ft)	Pile Toe Elevation (ft)	Hammer Type	Ram Weight (lbs)	Cap Weight (lbs)	Anvil Weight (lbs)	Pile Weight (lbs)
237	10/27/1969	11/4/1969	Mixed	0.00	21.50	N/A	Gravity				
238	10/27/1969	11/5/1969	Mixed	0.00	31.50	N/A	Gravity				
239	6/13/1979	6/18/1979	Clay	0.00	27.00	1022.10	Diesel				

Table A.15: PILOT Historical Timber Pile Dataset Summary (Records 237-239) – Continued

ID #	Hammer Stroke (ft)	EOD Blow Count (blows/ft)	Davisson Pile Capacity (tons)	Reliable Pile Load Test	Usable-Static Pile Load Test	Usable-Dynamic Pile Load Test
237			53.00	✓	✓	
238						
239			44.00	✓		

Table A.16: PILOT Historical Pipe, Monotube, and Concrete Pile Dataset Summary (Records 240-257)

ID #	County	Township	Lab #	Project #	Design #	Contractor	Pile Type	Design Load (tons)
240	Shelby	Union	AXP0-3	F-FG-59-4(4)-24-83	668	Hobe Engineering Co.	Pipe Ø18"	48.00
241	Woodbury	Sioux City	AXP2-16	I-129-6(2)145	173A	Christensen Brothers Inc.	Pipe Ø 18"	
242	Woodbury	Sioux City	AXP2-18	I-129-6(2)145	173A	Christensen Brothers Inc.	Monotube	
243	Woodbury	Sioux City	AXP2-19	I-129-6(2)145	173A	Christensen Brothers Inc.	Monotube	
244	Franklin	Marion	AXP3-17	I-35-6(16)166--01-35	4570	Herberger Construction Co.	Pipe Ø 16"	35.00
245	Woodbury	Sioux City	AXP4-7	I-129-6(6)145--01-97	173B	Jensen Construction Co.	Monotube	60.00
246	Woodbury	Sioux City	AXP4-8	I-129-6(6)145--01-97	173B	Jensen Construction Co.	Monotube	60.00
247	Woodbury	Sioux City	AXP4-12	I-129-6(6)145--01-97	173B	Jensen Construction Co.	Monotube	60.00
248	Woodbury	Sioux City	AXP4-13	I-129-6(6)145--01-97	173B	Jensen Construction Co.	Monotube	56.00
249	Woodbury	Sioux City	AXP4-14	I-129-6(6)145--01-97	173B	Jensen Construction Co.	Monotube	56.00
250	Pottawattamie	Kane	AXP7-3	I-29-3(1)54--01-78	1367	Brogan Construction Co.	Pipe Ø 10"	
251	Pottawattamie	Kane	AXP7-6	I-29-3(1)54--01-78	1367	Brogan Construction Co.	Pipe Ø 10"	
252	Pottawattamie	Lewis	AXP7-8	I-80-1(1)0--01-78	1367	Brogan Construction Co.	Pipe Ø 10"	
253	Pottawattamie	Lewis	AXP7-11	I-80-1(1)0--01-78	1367	Brogan Construction Co.	Pipe Ø 12"	
254	Pottawattamie	Kane	AXP7-13	I-29-3(1)54--01-78	1367	Brogan Construction Co.	Pipe Ø 10"	
255	Pottawattamie	Lewis	AXP7-15	I-80-1(1)0--01-78	1367	Brogan Construction Co.	Pipe Ø 10"	
256	Pottawattamie	Lewis	AXP7-17	I-80-1(1)0--01-78	1367	Brogan Construction Co.	Pipe Ø 12"	
257	Pottawattamie	Lewis	AXP7-19	I-80-1(1)0--01-78	1367	Brogan Construction Co.	Pipe Ø 10"	

Table A.16: PILOT Historical Pipe, Monotube, and Concrete Pile Dataset Summary (Records 240-257) – Continued

ID #	Date Driven	SLT Date	Soil Type	Bored Hole Depth (ft)	Embedded Pile Length (ft)	Pile Toe Elevation (ft)	Hammer Type	Ram Weight (lbs)	Cap Weight (lbs)	Anvil Weight (lbs)	Pile Weight (lbs)
240	6/2/1970	6/9/1970	Mixed	3.00	47.00	1205.85	Delmag D-12	2750	1900	754	3225
241	11/13/1972	11/27/1972	Mixed	6.83	53.20	964.00	Delmag D-22	4850	1480	1147	7981
242	11/13/1972	12/4/1972	Mixed	0.00	46.10	1052.50	Delmag D-12	2750			
243	11/13/1972	12/6/1972	Mixed	0.00	38.40	160.90	Delmag D-12	2750			
244	11/3/1973	11/8/1973	Clay	0.00	31.00	1158.97	Delmag D-12	2750			
245	1/4/1974	2/12/1974	Sand	0.00	19.00	1073.00	Delmag D-12	2750	880	754	
246	1/4/1974	2/13/1974	Sand	0.00	33.00	1059.00	Delmag D-12	2750	880	754	
247	4/12/1974	4/18/1974	Sand	0.00	32.00	1060.00	Delmag D-12	2750	880	754	
248	4/15/1974	4/23/1974		0.00	34.00	1058.00	Delmag D-12	2750			
249	4/15/1974	4/23/1974		0.00	53.00	1039.00	Delmag D-12	2750			
250	2/9/1967	2/16/1967	Mixed	5.00	24.50	954.00	Gravity				
251	2/18/1967	2/23/1967	Sand	5.00	48.70	929.80	Gravity				
252	2/20/1967	2/24/1967	Clay	5.00	18.50	952.00	Gravity				
253	2/22/1967	2/28/1967	Clay	5.00	18.50	951.60	Gravity				
254	2/24/1967	3/2/1967	Sand	5.00	65.70	912.90	Gravity				
255	2/28/1967	3/5/1967	Mixed	5.00	16.00	952.90	Gravity				
256	3/2/1967	3/7/1967	Mixed	5.00	50.30	920.20	Gravity				
257	3/3/1967	3/9/1967	Mixed	5.00	49.10	921.40	Gravity				

Table A.16: PILOT Historical Pipe, Monotube, and Concrete Pile Dataset Summary (Records 240-257) – Continued

ID #	Hammer Stroke (ft)	EOD Blow Count (blows/ft)	Davisson Pile Capacity (tons)	Reliable Pile Load Test	Usable-Static Pile Load Test	Usable-Dynamic Pile Load Test
240		60.00	100.00	✓	✓	✓
241		480.00	228.00	✓	✓	✓
242						
243						
244	5.5	40.00				
245			78.00	✓	✓	
246			56.00	✓	✓	
247			99.00	✓	✓	
248			48.00	✓		
249			65.00	✓		
250			28.00	✓	✓	
251			34.00	✓	✓	
252			39.00	✓	✓	
253			37.00	✓	✓	
254			65.00	✓	✓	
255			14.00	✓	✓	
256			44.00	✓	✓	
257			40.00	✓	✓	

Table A.17: PILOT Historical Pipe, Monotube, and Concrete Pile Dataset Summary (Records 258-264)

ID #	County	Township	Lab #	Project #	Design #	Contractor	Pile Type	Design Load (tons)
258	Pottawattamie	Lewis	AXP7-22	I-80-1(1)0--01-78	1367	Brogan Construction Co.	Pipe Ø10"	
259	Pottawattamie	Lewis	AXP7-24	I-80-1(1)0--01-78	1367	Brogan Construction Co.	Pipe Ø 12"	
260	Pottawattamie	Lewis	AXP7-26	I-80-1(1)0--01-78	1367	Brogan Construction Co.	Pipe Ø 10"	
261	Pottawattamie	Lewis	AXP7-28	I-80-1(1)0--01-78	1367	Brogan Construction Co.	Pipe Ø 10"	
262	Woodbury	Sioux City	AXP7-32	U-UG-75-4(2)4-97	165	Christensen Brothers Inc.	Pipe Ø 12"	45.00
263	Winnebago	Forest	AXP4-16	SN-2193(3)--51-95	173	Winnebago Constructors Inc.	Concrete	35.00
264	Fremont	Fenton	AXP6-5	BRF-2-1(21)--38-36	184	Godberson - Smith	Concrete	42.00

Table A.17: PILOT Historical Pipe, Monotube, and Concrete Pile Dataset Summary (Records 258-264) – Continued

ID #	Date Driven	SLT Date	Soil Type	Bored Hole Depth (ft)	Embedded Pile Length (ft)	Pile Toe Elevation (ft)	Hammer Type	Ram Weight (lbs)	Cap Weight (lbs)	Anvil Weight (lbs)	Pile Weight (lbs)
258	3/6/1967	3/12/1967	Sand	5.00	46.40	922.50	Gravity				
259	3/11/1967	3/16/1967	Sand	5.00	67.50	903.00	Gravity				
260	3/12/1967	3/18/1967	Sand	5.00	67.50	903.00	Gravity				
261	3/14/1967	3/23/1967	Sand	5.00	66.40	902.50	Gravity				
262	11/29/1967	12/5/1967		0.00	49.00	1031.60	Delmag D-12				
263	5/17/1974	5/23/1974		0.00	38.00	1167.04	McKiernan-Terry DE30				
264	9/18/1986	9/23/1986	Mixed	3.00	24.00	922.04	Gravity				

Table A.17: PILOT Historical Pipe, Monotube, and Concrete Pile Dataset Summary (Records 258-264) – Continued

ID #	Hammer Stroke (ft)	EOD Blow Count (blows/ft)	Davisson Pile Capacity (tons)	Reliable Pile Load Test	Usable-Static Pile Load Test	Usable-Dynamic Pile Load Test
258			37.00	✓	✓	
259			59.00	✓	✓	
260			57.00	✓	✓	
261			53.00	✓	✓	
262			92.00	✓		
263			75.00	✓		
264						

APPENDIX B: BACK-CALCULATION OF PILE PENETRATION

Provided below is an example calculation showing how the pile penetration corresponding to the final 5 to 10 hammer blows was determined from available hammer data and the pile capacity as determined by the Iowa DOT Modified ENR formula.

Given: PILOT Record ID # 67

$$\left.\begin{array}{l}\text{Pile Type} = \text{HP } 10\times42 \\[1em] \text{Pile Length} = 35\text{ ft}\end{array}\right\}\text{ Pile Characteristics}$$

$$\left.\begin{array}{l}\text{Hammer Weight} = 2750\text{ lb} \\[1em] \text{Cap Weight} = 1980\text{ lb} \\[1em] \text{Anvil Weight} = 810\text{ lb} \\[1em] \text{Hammer Energy} = 20{,}000\text{ ft-lb} = 10\text{ ft-ton}\end{array}\right\}\text{ Hammer Characteristics}$$

P = Bearing Capacity = 19.4 ton

Solution:

$$P = \frac{3ES + 0.1}{} \times \frac{W}{W + M}$$

$$M = (Cap\ Weight) + (Anvil\ Weight) + (Pile\ Weight)$$

$$M = (1980\ lb) + (810\ lb) + (42\ \ lb/ft)(35\ ft) = 4260\ lb$$

$$19.4\ ton = \frac{3(10\ ft - ton)}{S + 0.1} \times \frac{2750\ lb}{2750\ lb + 4260\ lb}$$

$$\underline{\underline{S = 0.507\ \ in/blow}}$$