Pile Driving Inspector's Qualification Course

Student Guide

January 2015

PREFACE

Engineers and Contractors have been designing and constructing roadways, structures, and bridges throughout Florida for years. Quality was expected to be achieved partially through the monitoring of construction by the Department's Inspection staff. In the mid 1990s, the Federal government adopted 23 CFR 637B, which in general, requires that qualified personnel perform all sampling and testing on transportation projects.

The Florida Department of Transportation, in its continuing efforts to ensure quality in both design and construction, developed a program for qualifying Inspectors, which is the Construction Training Qualification Program (CTQP). To achieve the Quality goals of the Department, it was determined that a Pile Driving Inspector's Qualification course be developed to provide for qualification of personnel as Pile Driving Inspectors. It was felt that a course of instruction specifically developed for inspection of driven piles during construction would increase the overall quality of the installation.

The course was developed originally developed in 1999 and has undergone some revisions since then, with the last revision done in July 2012. The present version of the class is based on the January 2015 FDOT specifications.

Juan F. Castellanos, PE
Florida Department of Transportation

I. INTRODUCTION

The Pile Driving Inspector Qualification course is a stand-alone training course developed to provide a basis for state qualification of personnel as inspectors of Pile Driving construction on FDOT projects. The goal of this course is to provide Inspectors with the practical knowledge, accepted standard Industry practices and SSRBC Specifications for fulfilling the role of a Pile Driving Inspector. This course is designed to be the most benefit to Contractor, FDOT, and CEI personnel involved in performing inspection of driven pile construction operations. Presentation of the course is an interactive format, utilizing Adult Learning Techniques, so that the students are actively involved in the learning experience.

II. COURSE ORGANIZATION

Instructors using an Instructor’s Guide Workbook will present the course using various visual aids such as computer generated slides, videos, class exhibits, handouts, and other presentation aid tools.

All students will be provided with a copy of the Student Workbook, which will serve as the primary course workbook and a laptop computer to use for the course. The workbook follows the course content in sequential Lesson order as presented by the Instructors. The lower half of the pages in the Student Workbook are used to present select reference material, comments, illustrations, etc. that relate to the subject slide content. Student exercises are designed to promote interaction in the classroom, and to illustrate or detail procedures or processes. The class exercises are contained within the workbook in the applicable lesson. The course is divided into 10 Lessons of instruction and information. The presentation sequence of the Lessons follows the Student Workbook.

The course is typically designed to run from:

Day 1 & 2 – 8:00 AM to 5:00 PM
Day 3 – 8:00 AM to 12:00 PM Review and Written Examination
All students should be advised to bring or be supplied calculators that can perform basic math, in particular work with negative numbers (a +/- function), a built in “Pi” (π) function, and square root functions.

Provider Required Course Exhibits/ Materials

Providers/Instructors are to provide the following classroom materials and exhibits, in addition to class manuals, computers, printers, exams, etc.

- Set of hammer cushions for classroom display (polymer, hammortex, aluminum, micarta, steel plate).
- Plywood Pile cushion
- Saximeter, with means to project a demonstration of its use.

III. TARGET AUDIENCE

The primary audience is Contractor, FDOT, and CEI personnel involved in performing Pile Driving inspection on FDOT projects. Experienced and inexperienced inspectors as well as, project management and construction managers in responsible charge of projects are encouraged to attend. To become a qualified pile driving inspector, the candidate must pass a written examination. In addition, a minimum pile driving on-site experience is required, which includes a minimum of 15 driven piles with at least ten piles driven with open end Diesel hammers. Please refer to the CTQM manual, chapter 6. Prior to attend the class, FDOT employees must complete courses in Basic Construction Plan Reading, Basic Construction Math, FDOT On-Line Pile Driving Tutorial and Module B, Pile Program Tutorial, in addition to having high school algebra level math skills and any other requirements listed in the Construction Training Qualification Manual.

IV. COURSE GOAL AND OBJECTIVES

Course Goal

The goal of this course is to provide potential Pile Inspectors with a basic knowledge and working understanding of the role, responsibilities and duties of a Pile Inspector. This course is based upon existing FDOT Standard Specifications and procedures, and applicable construction industry procedures and standards.

Course Objectives

- Explain the Inspector’s role, duties, and responsibilities.
- Describe the Pile Driving System components.
- Recognize key inspection elements of the Contract Documents.
- Identify proper Communication and Coordination with the Engineer and Contractor.

- Identify the key elements of a Pile Installation Plan.
- Recognize and identify Pile Driving system components and tools.
- Verify tip elevations, cutoff elevations, pile penetration, and length driven for vertical and battered piles.
- Perform inspection of pile driving operations and verify compliance to construction tolerances.
- Understand the pile acceptance procedures based on Driving Criteria and the Specifications.

V. RECCOMMENDATIONS TO STUDENTS

Students are recommended to become familiar with the content of the manuals including lessons attachments and the appendices. In several chapters full scale attachments are included at the end of the lessons that allows student a better view of some slides. Lessons attachments are as follows:

- Lesson 3 Construction Plan examples and a Pile Installation Plan example.
- Lesson 4 Sample Inspector's Tool checklist, Piles Payment Summary Tables, Exercise Forms
- Lesson 5 Pile Inspector's checklist and Typical Saximeter™ Quick Reference Card
- Lesson 6 Pile Inspector's checklist and Design Standard 20600 for pick points and support points
- Lesson 7 Pile Inspector's checklist

Also there are important items in the Appendices such as the specifications, Pile Payment summary tables, Pile Inspector's checklist and blank forms of the Pile Installation plan and the Pile Driving record with instructions. Students will be able to refer to these specifications during the exam.

Homework exercises are included in one presentation. However the slides are divided internally into homework 1 and homework 2 to be assigned to the students by the instructors on days 1 and 2 respectively.

AGENDA
PILE DRIVING INSPECTOR'S QUALIFICATION COURSE

Agenda	Reference Document	Course Lesson	Instructor Guide Summary
		Day 1	
8:00-8:30	Student Manual	1. Welcome & Introduction a. Presentation	Introduction of Instructors, Students. Discuss course rules, restrooms, breaks, and agenda. Play Pile Video.
8:30-9:30	Student Manual Chapter 2	2. Equipment & Tools a. Presentation	Explain the different components of the pile driving system, equipment and tools. Review the various pile & hammer types, cushions and other tools.
9:30-9:45	**BREAK**		
9:45-11:00	Student Manual Chapter 2	2. Equipment & Tools (Continued)	
11:00-12:00 (5-10 min. break, as needed.)	Student Manual Chapter 3	3. Construction Documents a. Presentation b. Pile Drive Program	Review sample Plan Set, pointing out and discussing significant items of importance to the Inspector. Review and explain the sample Pile Installation Plan and its' requirements and significance. Begin use of Pile Drive Program on computer.
12:00-1:00	**LUNCH**		
1:00-2:30 (5-10 min. break, as needed.)	Student Manual Chapter 3	3. Construction Documents (Continued)	
2:30-4:30 (5-10 min. break, as needed.)	Student Manual Chapter 4	4. Inspector's Role a. Presentation	Review the Inspector's role and responsibility. Explain the various items and documents that the Inspector must have in their "Tool Box" before going to the site. Review Pay Quantities and Inspector Math.
4:30-5:00	Test Pile	5. Test Pile Program a. Presentation b. Saximeter Demonstration	Test Pile program. Perform Saximeter demonstration.

5:00-Class Dismissal - assign Homework Day 1			

AGENDA
PILE DRIVING INSPECTOR'S QUALIFICATION COURSE

Agenda	Reference Document	Course Lesson	Instructor Guide Summary
Day 2			
8:00-8:30	Homework	Homework Review	Review Homework
8:30-10:00 10-15 min. Stretch Break (when convenient)	Student Manual Chapter 5	5. Test Pile Program (Continued)	Review the Test Pile program, Driving Criteria Letter and Authorized Pile Length Letter.
10:30-12:00 10-15 min. Stretch Break (when convenient)	Student Manual Chapter 6	6. Contractor, Equipment & Piles Arrive On-site a. Presentation b. Checklist Handout 7. Begin Pile Driving	Explain the various responsibilities and duties required of the Inspector when the Contractor and equipment arrive on-site. Introduce the Pile Driving Inspector's Checklist.
12:00-1:00	**LUNCH**		
1:00-3:00 10-15 min. Stretch Break (when convenient)	Student Manual Chapter 7	7. Begin Pile Driving (Continued) a. Presentation b. Pile Drive Program	Explain the various responsibilities and duties required of the Inspector as pile driving begins. Discuss the various items to check and verify. Enter data in the Pile Drive Program.
3:00-5:00 10-15 min. Stretch Break (when convenient)	Student Manual Chapter 8	8. Piles Bearing & Acceptance a. Presentation b. When to Stop exercises	Explain the "When to Stop Driving" issues. Review the Acceptance Determination Chart. Conduct the class exercises on When to Stop.
5:00-Class Dismissal - assign Homework Day 2			

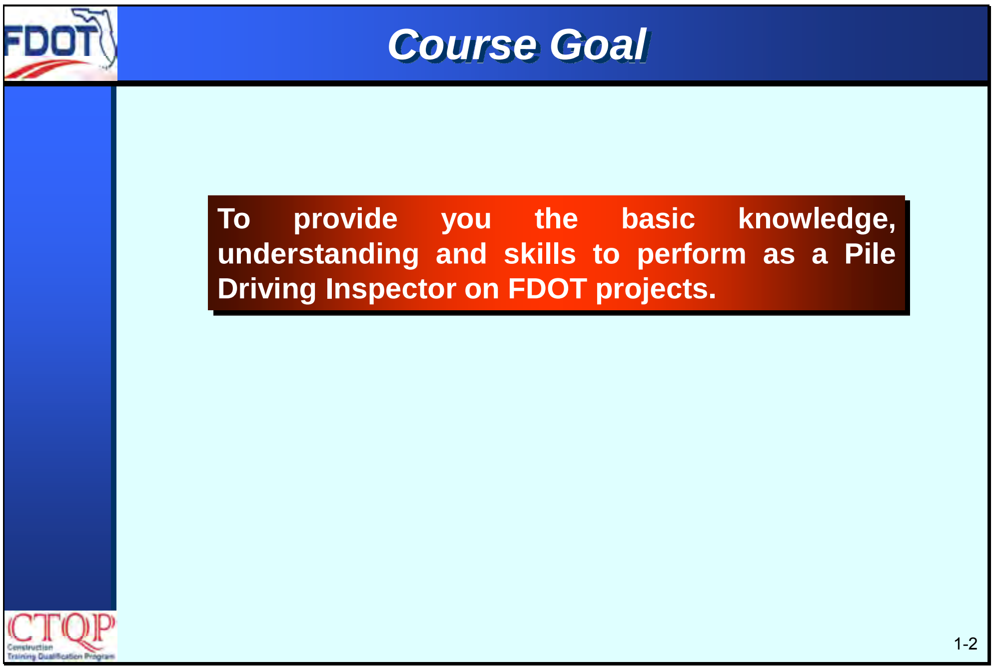
AGENDA
PILE DRIVING INSPECTOR'S QUALIFICATION COURSE

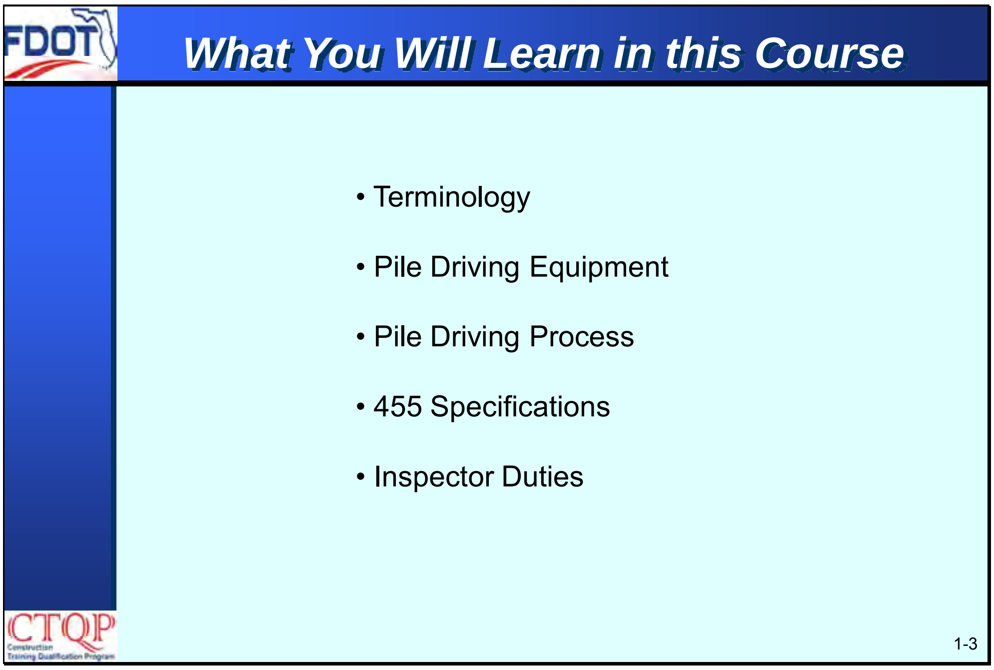
Agenda	Reference Document	Course Lesson	Instructor Guide Summary
Day 3			
8:00-8:45	Homework	Homework Review and Review Questions.	Review Homework
8:45-9:00	Break		
9:00-12:00		Examination	30 minutes to complete the bubble sheets and 2 ½ hours maximum time to complete the test

TABLE OF CONTENTS

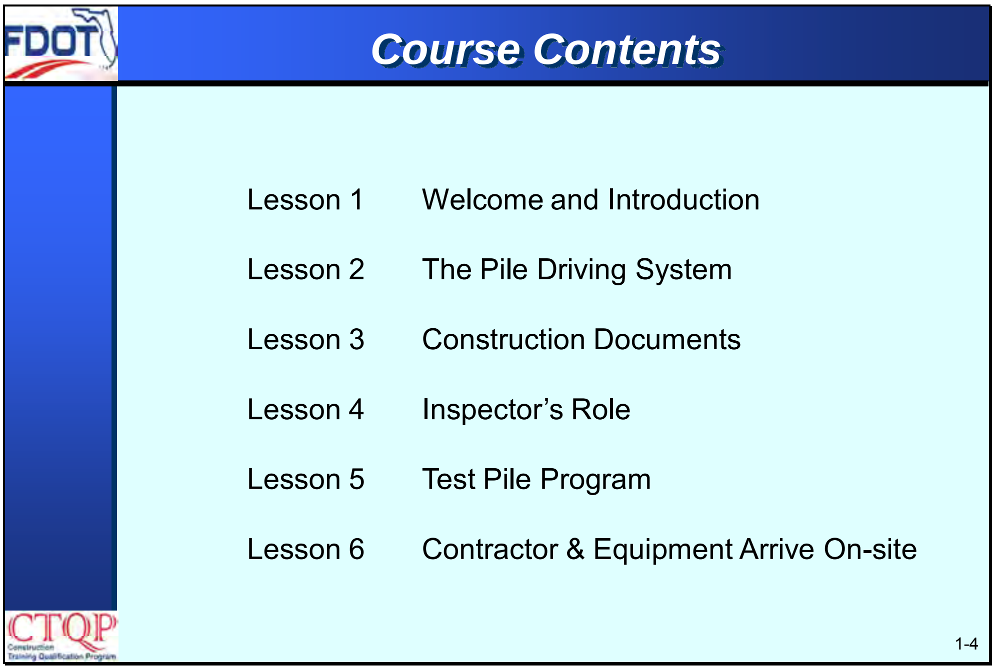
TABLE OF CONTENTS (CONTINUED)

Welcome to the Pile Driving Inspector Course. This is a course designed to assist students to understand the specifications and inspection practices in FDOT projects. The course and examination are based on the January 2015 Workbook Version of the FDOT Standard Specifications of Roadway and Bridge Construction.


Course Goal
To provide you the basic knowledge, understanding and skills to perform as a Pile Driving Inspector on FDOT projects.
1-2



The pertinent 455 Specifications will be covered in detail. The specification version the course is based upon is the January 2015 Workbook.



Lesson 1 - Welcomes you to the course

Lesson 2 - This lesson includes a detailed review of the equipment used in driving of piles.

Lesson 3 - This lesson provides for a look at the most common construction documents associated with driven pile projects, from the Inspector's view point. A sample Plan Set and typical Pile Installation Plan are reviewed.

Lesson 4 - In this lesson, the Inspector's role, duties and responsibilities are reviewed together with Inspector functions.

Lesson 5 - An overview and familiarization with "Test Piles', their purpose, installation and testing.

Lesson 6 - This covers the Inspector's duties when equipment and piles show up on-site.

Course Contents

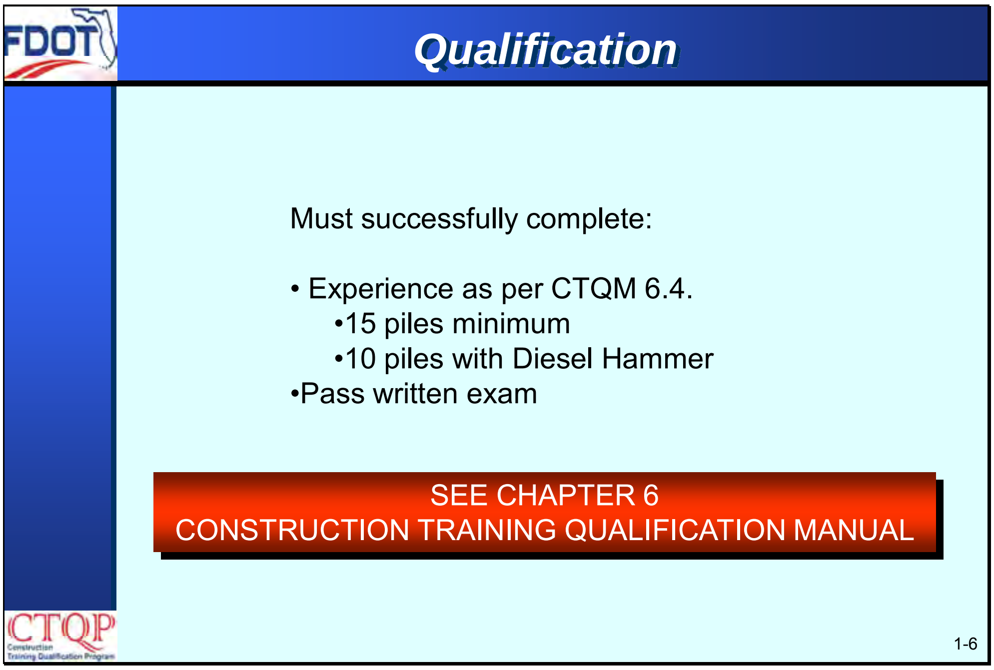
1-5

Lesson 7 - The Inspector's duties during the driving of the pile are reviewed together with applicable 455 specifications.

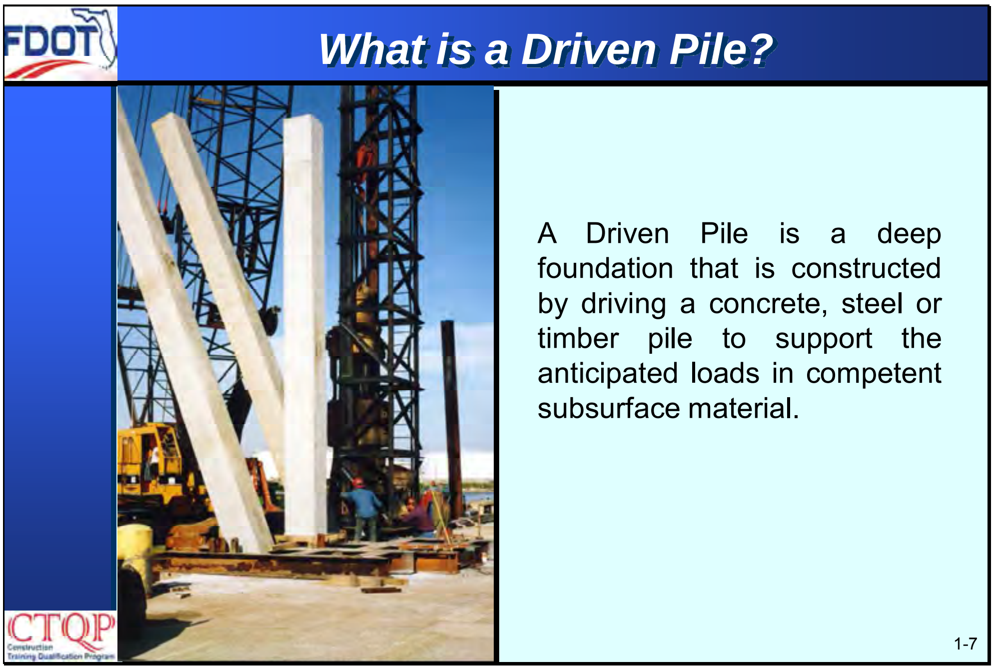
Lesson 8 - Reviews the "When to Stop" decision the Inspector must make.

Homework – Practice exercises to help you prepare for the exam.

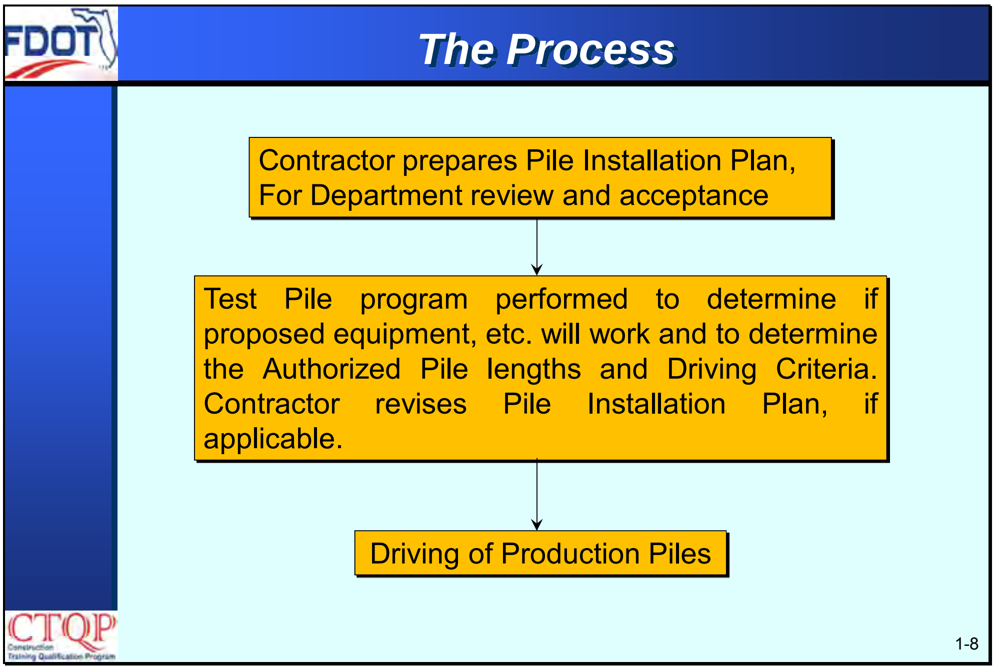
Appendix- includes the applicable January 455 specifications, payment summary tables, checklist and blank used forms.



To be able to inspect driven piles in FDOT projects you must be qualified CTQP Pile Driving inspector. CTQP stands for Construction Training Qualification Program.
Chapter 6 of the Construction Training Qualification manual (CTQM) provides details on the qualification requirements. Please refer to this chapter for more details



We have two main types of foundations. Shallow foundations and deep foundations. Shallow foundations are typically used in structures under relatively good soils and not heavily loaded. For example 1 to 2 story residential buildings are typically founded in shallow foundations if there are no unsuitable materials underneath the foundation level. For heavier loads or if soils are not competent, then the use of deep foundations is required.
A Driven Pile is a deep foundation that is constructed by driving a concrete, steel or timber pile to support the anticipated loads in competent subsurface material.
Other types of deep foundations are drilled shafts, auger cast piles and micropiles which are not covered on this course..

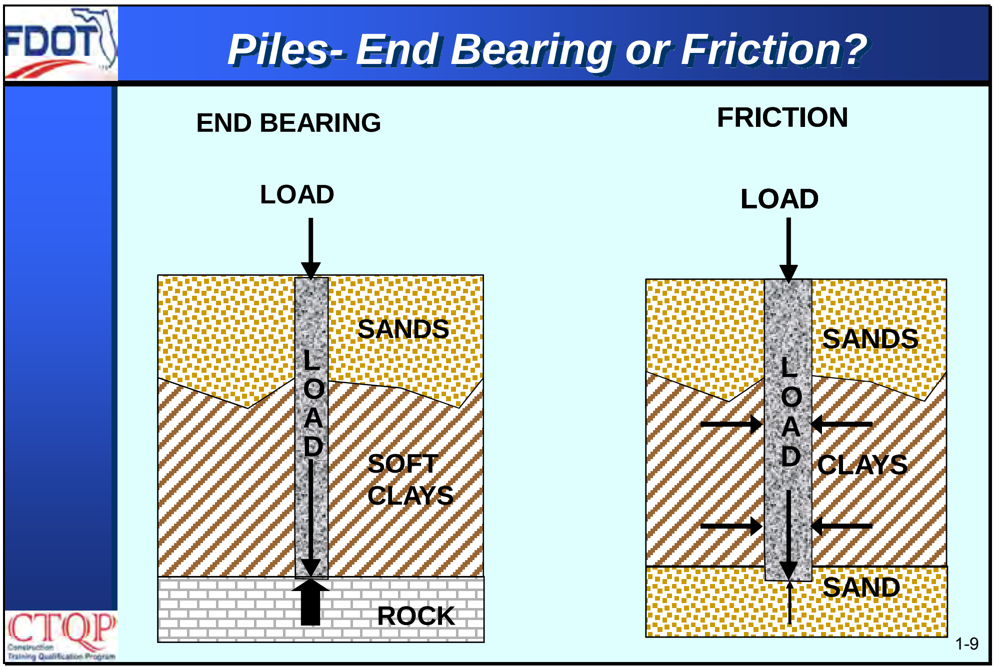


This slide illustrates the 3 main phases of a driven pile project. We will review each of these in detail in this course.

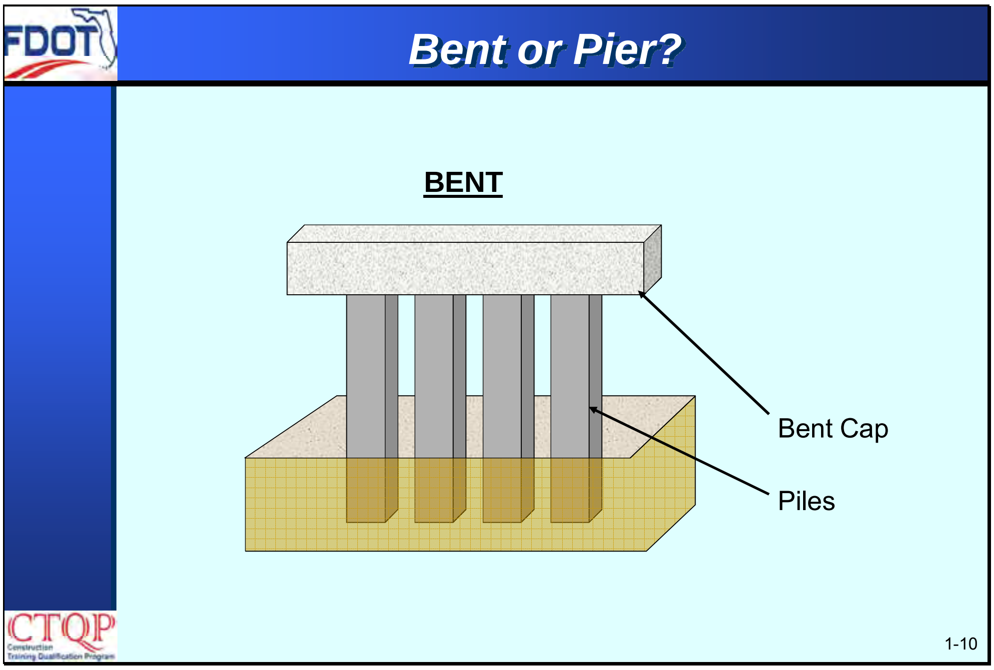
First of all, before any pile construction begins, the Contractor prepares a Pile Installation Plan (PIP) and submits it to the Department for review.

Then, the Test Pile program is performed to determine if the proposed equipment will work and to determine the Authorized Pile lengths and Driving Criteria. Contractor revises Pile Installation Plan, if applicable. The Pile Installation Plan will be accepted based on field performance.

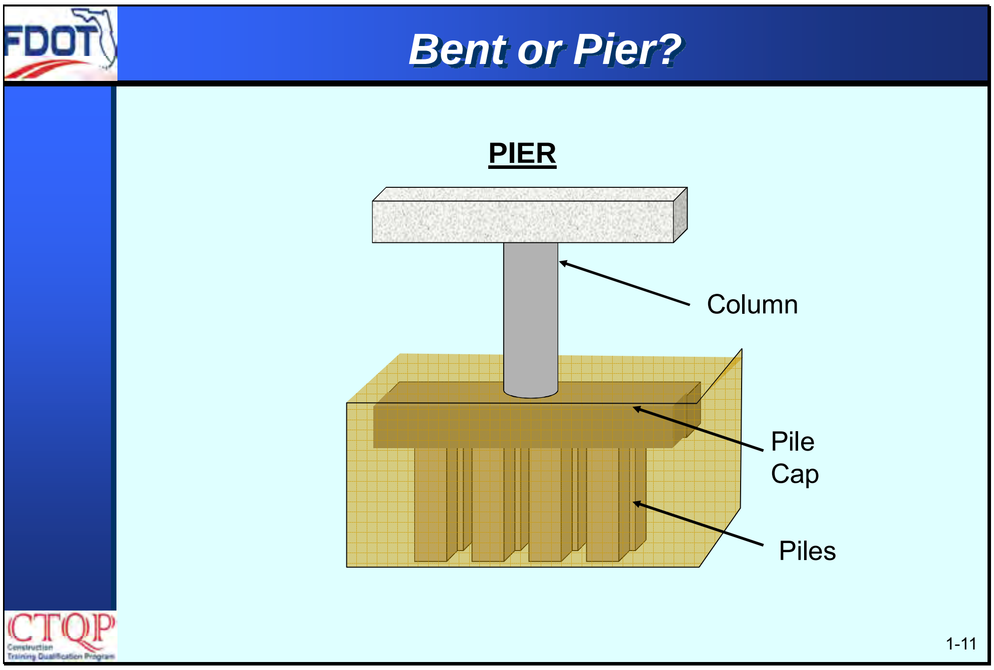
After the test pile program is performed, pile lengths are ordered and te process continues with the Driving of Production Piles



When we talk about piles we talk about two types depending on the mechanics of how the load is transferred. We often talk about piles as predominantly "end bearing" or "friction" piles, all piles have some of both.



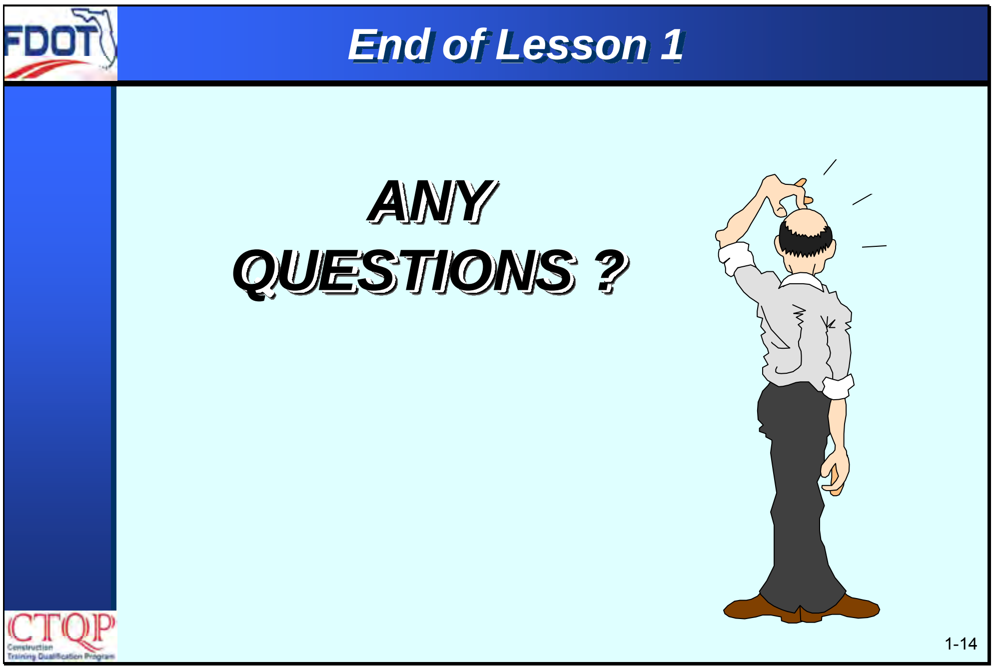
In a Bent, the piles rise above the ground surface to a specified elevation. At this elevation, the piles are tied together with a bent cap.

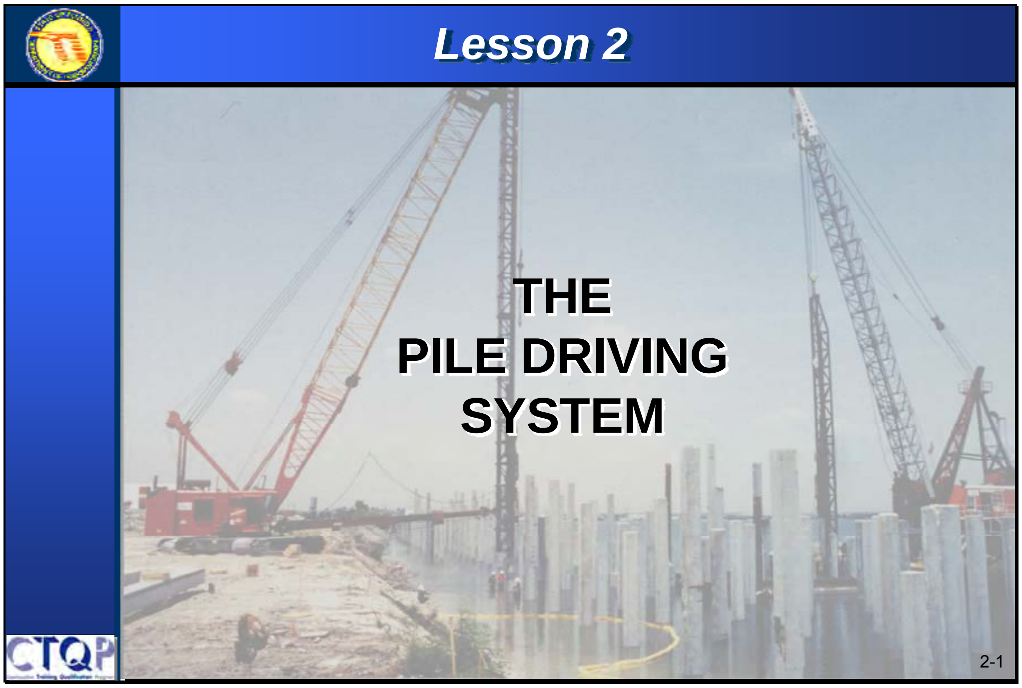


In a Pier, the pile tops generally are at or below existing grade. At this elevation, the piles are tied together with a pile cap (footing). Then a column is constructed from the pile cap up to the required beam seat elevation, where it is finished for connection to the structure.


FDOT
Introduction Video
Introduction to
Pile Driving
Construction Inspection
CTQP
1-12


FDOT
Introduction Video
Introduction to
Pile Driving
Construction Inspection
CTQP
1-13


FDOT
End of Lesson 1
ANY
QUESTIONS ?
CTQP
1-14

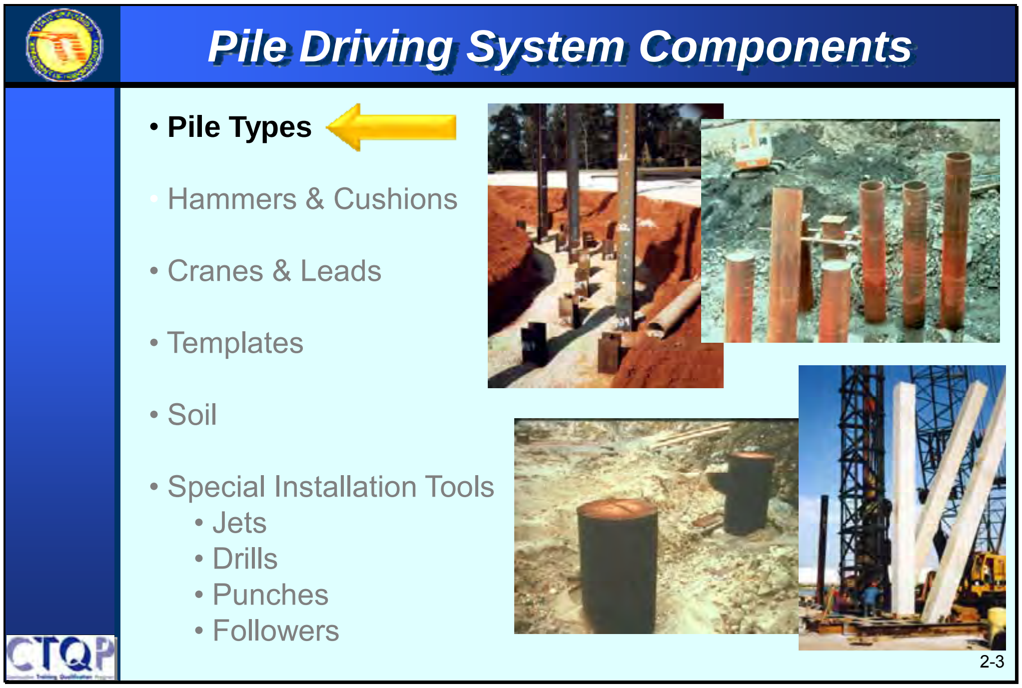

Lesson 2
THE
PILE DRIVING
SYSTEM
CTQP
2-1

Learning Outcomes

- Identify Pile Installation Equipment and Tools
- Identify various pile types
- Use Pile Driving Equipment terminology
- Interpret 455 specifications related to the pile driving system

CTQP

2-2


Pile Driving System Components
• Pile Types
• Hammers & Cushions
• Cranes & Leads
• Templates
• Soil
• Special Installation Tools
• Jets
• Drills
• Punches
• Followers
CTQP
2-3

Pile Types

Concrete Piles

Pipe Piles

Steel H-Piles

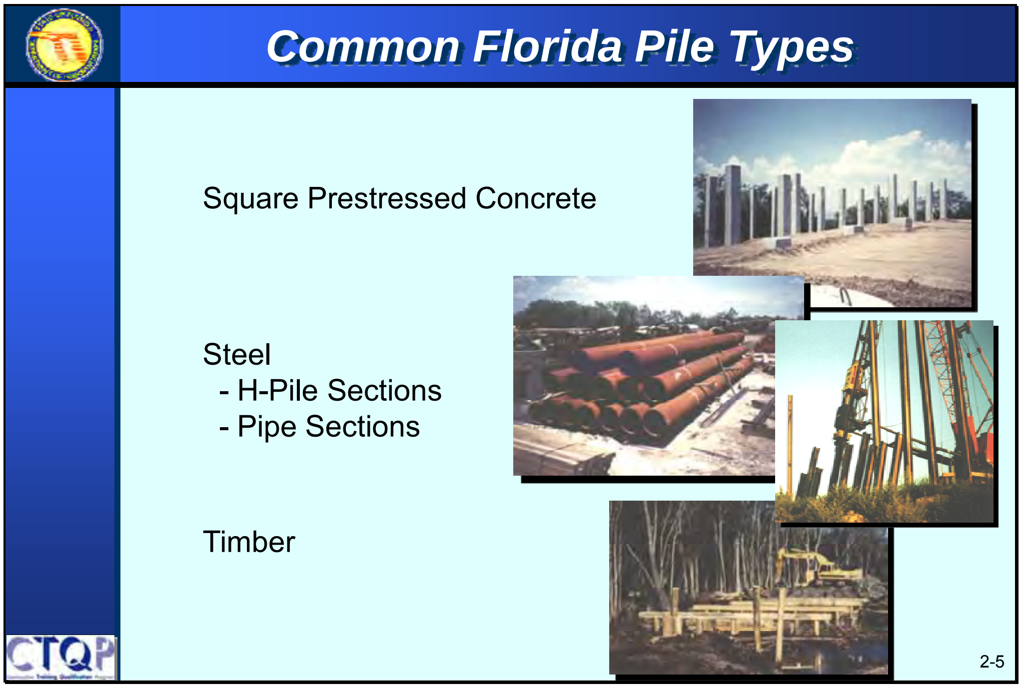
Composite Piles

Hollow Core Cylinder Piles

Steel Sheet Piles

Timber Piles

2-4


Common Florida Pile Types
Square Prestressed Concrete
Steel
- H-Pile Sections
- Pipe Sections
Timber
CTQP
2-5

B. Piling

455-3 Description.

Furnish and install concrete, steel, or wood piling including driving, jetting, preformed pile holes, cutting off, splicing, dynamic load testing, and static load testing of piling.

455-4 Classification.

The Department classifies piling as follows:

(1) Treated timber piling.
(2) Prestressed concrete piling.
(3) Steel piling.
(4) Test piling.

This course

(5) Sheet piling.
    (a) Concrete sheet piling.
    (b) Steel sheet piling.
(6) Polymeric Piles (see Section 471 for requirements).

2-6

455-7 Prestressed Concrete Piling

455-7.1 Description: Provide prestressed concrete piles that are manufactured, cured, and driven in accordance with the requirements of the Contract Documents. Provide piles full length without splices when transported by barge or the pile length is less than or equal to 120 feet. When piles are transported by truck and the pile length exceeds 120 feet but is less than the maximum length for a three point pick-up according to Index 20600, and splicing is desired, provide minimal splices. Include the cost of the splices in the cost of the pile.

2-7

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455-7 Prestressed Concrete Piling

455-7.3.1 Time of Driving Piles: Drive prestressed concrete piles at any time after the concrete has been cured in accordance with Section 450, and the concrete compressive strength is equal to or greater than the specified 28 day compressive strength.

450-16.3 Shipping: Do not ship precast prestressed concrete products to the project site prior to the completion of the 72 hour curing period and attainment of the required 28-day strength.

2-8

Prestressed Concrete Piling

- Square PSC are displacement piles & the most common
- Typically where limestone or dense stratum is <125’
- Used in corrosive environments
- Used as friction piles, end bearing piles, and combination of both

2-9

Prestressed Concrete Piling

Applications of Prestressed Concrete Piles

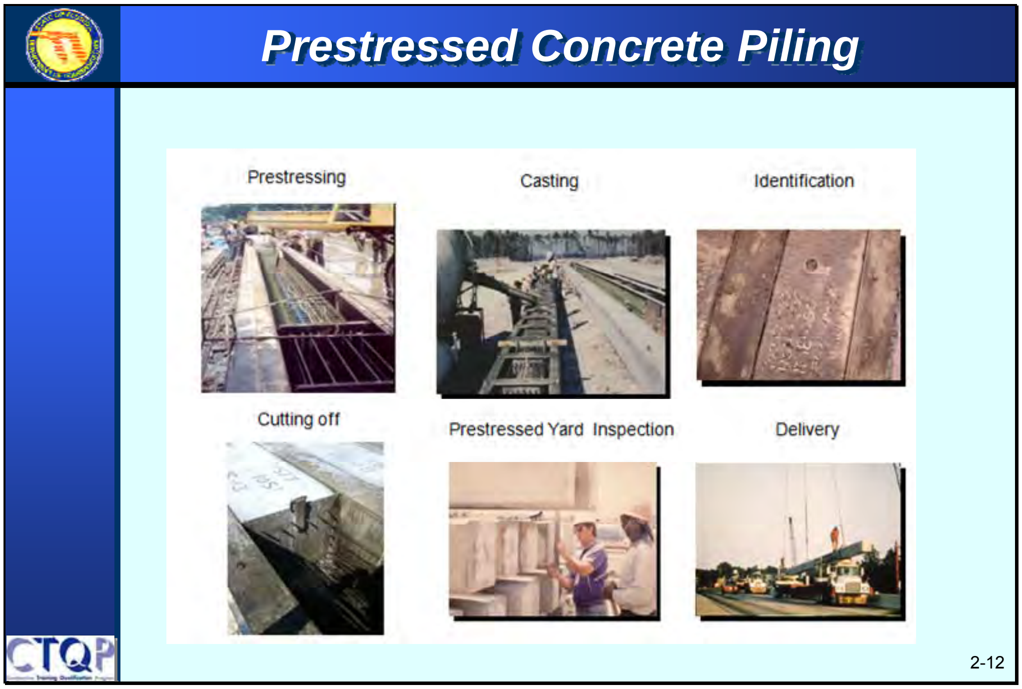
TYPE	SIZE	STRUCTURE TYPE	DESCRIPTION / APPLICATION
CONCRETE			
Prestressed Solid	Fender, 10", 14", 18", 20", 24", 30" square	Bridges, buildings, pipelines, towers, retaining earth structures	Square concrete piles are displacement piles and are the most common in Florida. Typically used where geotechnical information suggests limestone stratum or other dense stratum exists no deeper than 125' below ground (rule of thumb). Also used in highly corrosive environments (i.e. saltwater or other). Concrete piles are used as friction piles, end bearing piles and combination of both. Voided piles are made to reduce pile weight for handling. Voided piles should have solid ends to protect the pile from damage during driving. Concrete or other displacement piles driven in a group sometimes densify the soils in the immediate area of the pile group.
Prestressed w/voided center and solid ends	Typically 11' solid ends 18" dia voids		

2-10

Prestressed Concrete Piling

- Voided piles are made to reduce pile weight
- Voided piles have solid ends for protection during driving
- Driven as a group can sometimes densify soils in the immediate area

2-11


Prestressed Concrete Piling
Prestressing
Casting
Identification
Cutting off
Prestressed Yard Inspection
Delivery
CTQP
2-12

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Cylinder Piles

- Least common of the piles.
- 54” or 60” diameter
- Manufactured for specific project needs.
- Used in corrosive environments.
- Used when project is accessible by large barges and cranes.
- Very heavy, requires larger than typical barges, cranes and driving equipment.

2-13

455-8 Steel Piling

455-8.1 Description: Furnish, splice, drive, and cut off structural steel shapes to form bearing piles. Include in this work the installation of bracing members of structural steel by bolting or welding, construction of splices and the filling of pipe piles with the specified materials.

2-14

Steel Piling

TYPE	SIZE	STRUCTURE TYPE	DESCRIPTION/APPLICATION
STEEL H Pile Pipe open ended Pipe closed ended	Depends upon availability from steel manufacturer. Typical H Pile 14 x 74 (14" depth x 74 lbs./ft. weight) Typical pipe diameters: 10"-48"	Bridges, building, pipelines, towers, retaining earth structures, & others	H-piles and open end pipe piles are non-displacement types, closed end pipe is another type of displacement pile. Not as common as concrete piles in Florida. Usually used where long pile over 125' are required (rule-of-thumb) and where geotechnical information shows extremely variable subsurface conditions or very long piles are needed. The benefit to steel piles is the ease of splice. Non displacement piles are also sometimes used in areas where a large number of piles are required in a small area such as under a bascule bridge pier.

2-15

Steel Piling- Pipe Piles

- Closed Ended are displacement piles; Open Ended not
- Typically used where pile lengths over 125’ are needed
- Higher lateral capacity than H-Piles
- Ease of splicing is big advantage
- Non displacement piles are often used where a large number of piles are needed in a small area, (i.e. under a Bascule bridge pier).

2-16

Steel Piling- H Piles

- Are non-displacement piles
- Not as common as concrete
- Typically used where pile lengths over 125' are needed or extremely variable subsurface conditions exist
- Ease of splicing is big advantage
- Non displacement piles are often used where a large number of piles are needed in a small area, (i.e. under a Bascule bridge pier).

2-17

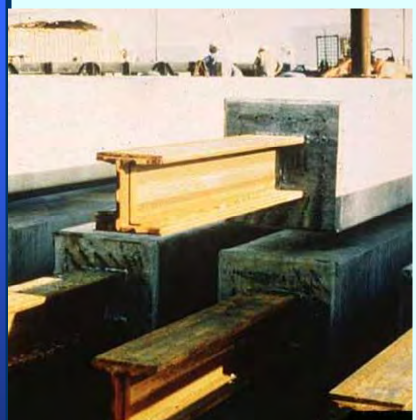

Steel Piling- H Piles
85'
85'
90'
135'
175'
185'
2-18

Composite Piles

TYPE	SIZE	STRUCTURE TYPE	DESCRIPTION/APPLICATION
COMPOSITE			
Square concrete w/H -pile extension on tip (stinger pile)	14", 18", 20", 24", 30" Steel H-pile cast into and extending 5' to 10' beyond tip of concrete section	Bridges, buildings, pipelines, towers, retaining earth structures, & others	Stinger piles are used in very hard strata to obtain penetration of the stinger and provide tension and lateral stability. Breakage of this pile type can be a problem. The stinger will not help the rest of the pile penetrate deeper. Concrete filled pipes increase stiffness of the pile.
Pipe pile filled w/concrete	same as above listed pipe sections		
Shell or mandrel driven piles (filled with concrete)	This shell driven with steel mandrel is backfilled with concrete		

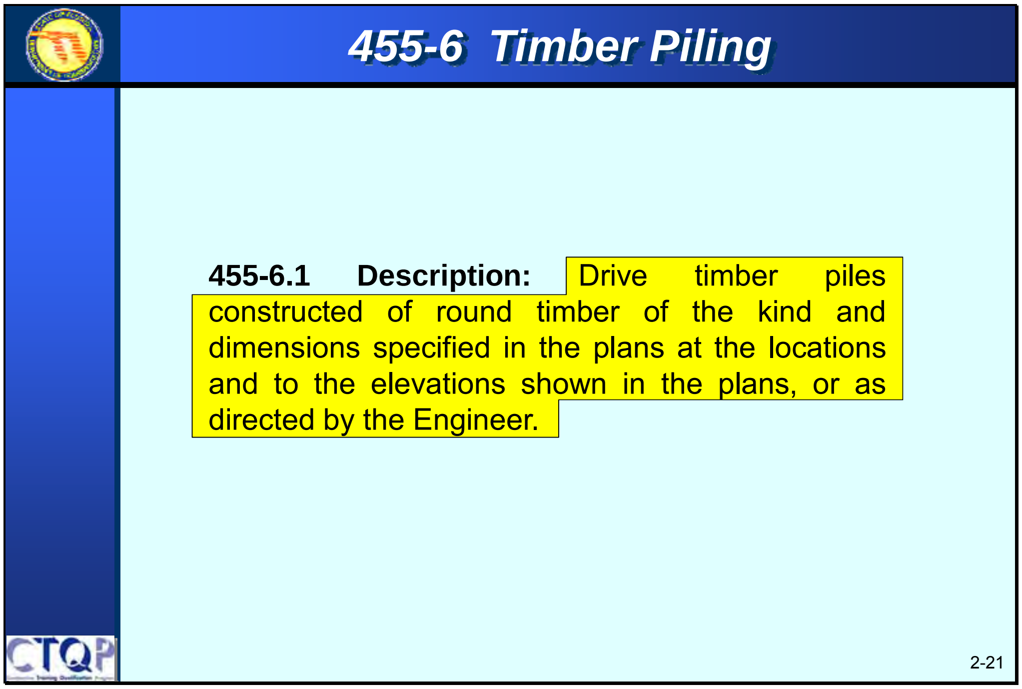
2-19

Composite Piles



- Used in very hard strata to obtain penetration of the stinger and provide tension and lateral stability
- Breakage can be a problem
- The stinger will not help the rest of the pile penetrate deeper
- Concrete filled pipes increase stiffness of pile
- Shell or mandrel driven piles are backfilled with concrete

2-20


455-6 Timber Piling
455-6.1 Description: Drive timber piles constructed of round timber of the kind and dimensions specified in the plans at the locations and to the elevations shown in the plans, or as directed by the Engineer.
CTQP
2-21

455-6 Timber Piling

- Typically 8” tip and 12” butt diameters
- Common lengths 15’ to 50’
- Typically made from pressure treated southern pine or Douglas fir woods
- FDOT project use includes temporary structures, docking & fender systems, detour bridges & Bailey bridges

2-22

455-9 Sheet Piling

- Concrete or Steel
- Utilized for retaining systems, such as cofferdams & bulkheads
- For retaining systems, steel sheet piles are driven in the ground using either impact or vibratory hammers

2-23

Learning Outcome

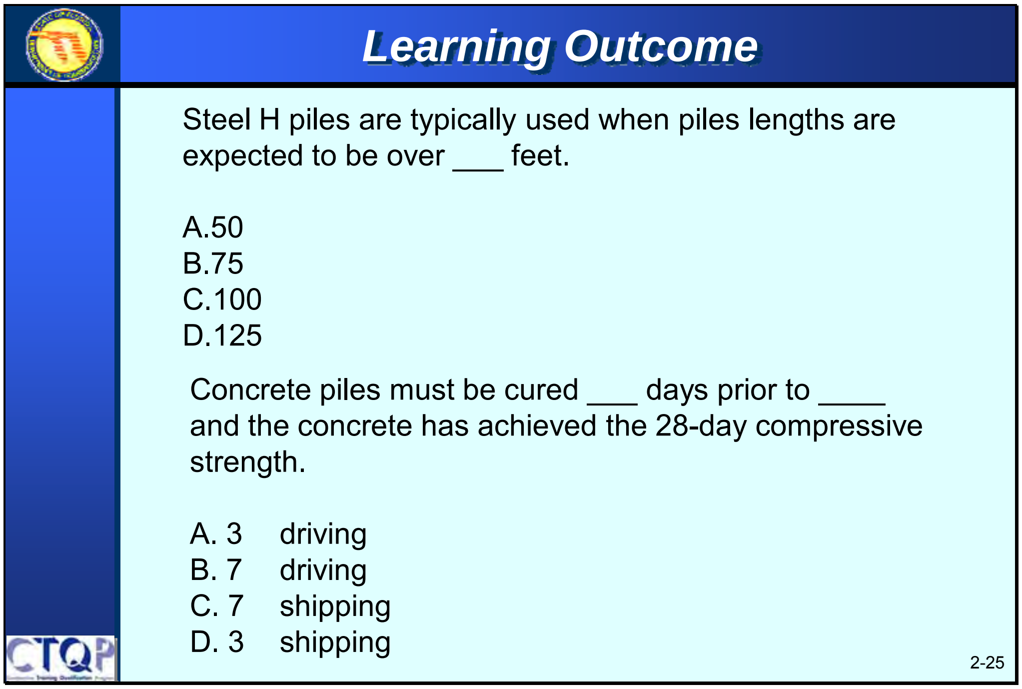
Square prestressed concrete piles are considered non-displacement piles.

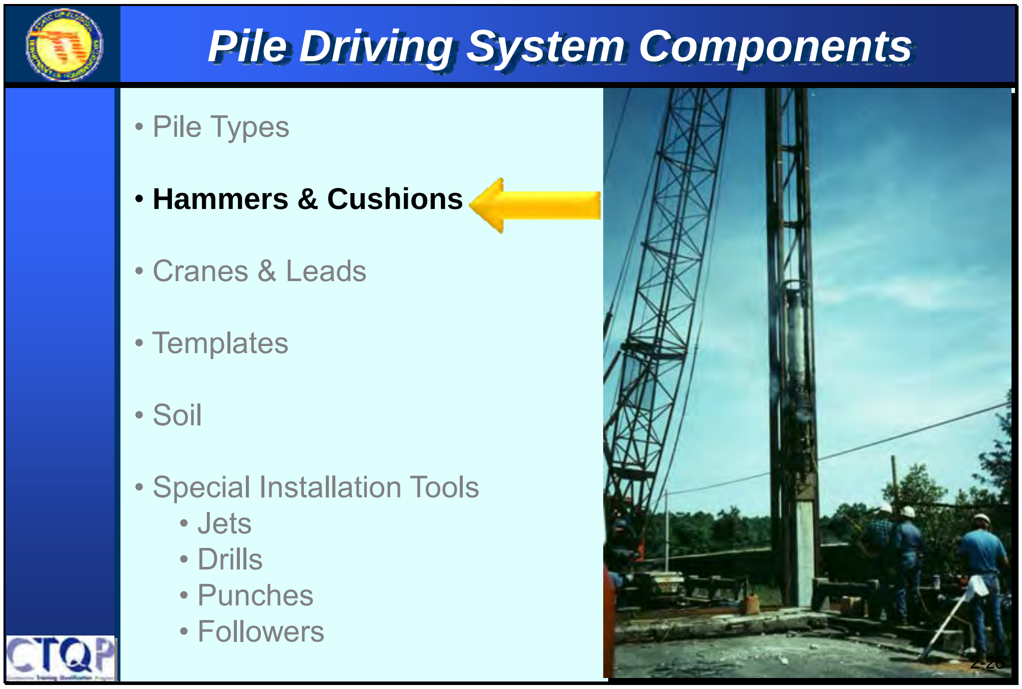
True False

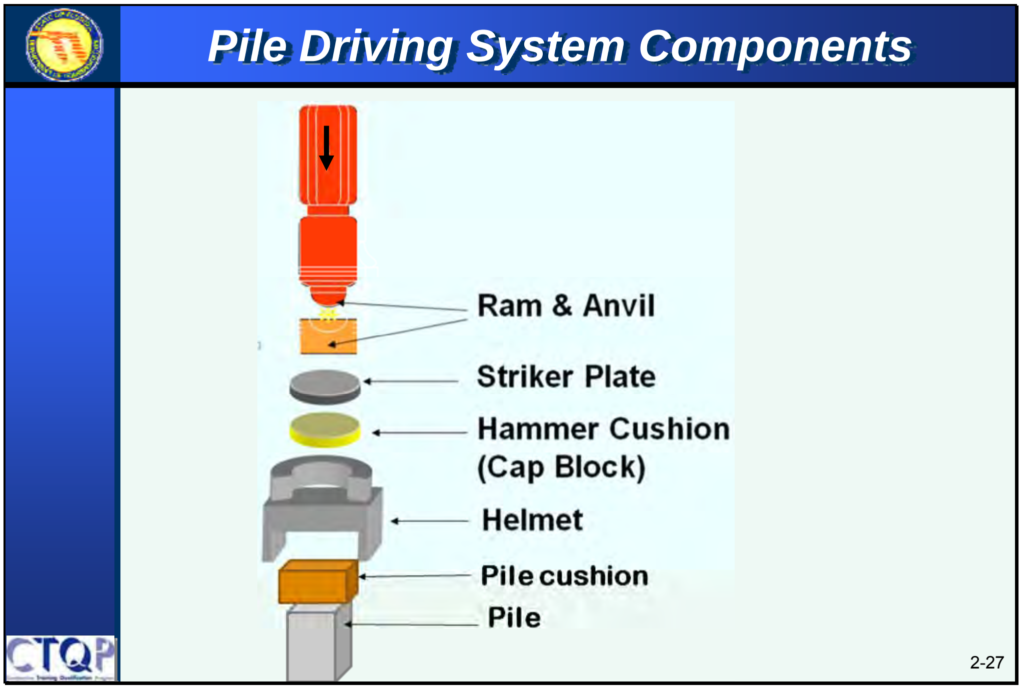
Timber piles are used for which of the following on which type of projects?

A. Temporary structures
B. Docking & fender systems
C. Light commercial
D. All of the above

2-24


Learning Outcome
Steel H piles are typically used when piles lengths are expected to be over ___ feet.
A.50
B.75
C.100
D.125
Concrete piles must be cured ___ days prior to ____ and the concrete has achieved the 28-day compressive strength.
A. 3 driving
B. 7 driving
C. 7 shipping
D. 3 shipping
CTQP
2-25


Pile Driving System Components
• Pile Types
• Hammers & Cushions
• Cranes & Leads
• Templates
• Soil
• Special Installation Tools
• Jets
• Drills
• Punches
• Followers
CTQP


Pile Driving System Components
Ram & Anvil
Striker Plate
Hammer Cushion
(Cap Block)
Helmet
Pile cushion
Pile
2-27

Hammers

- Air/Steam
- Diesel
    - Open end
    - Closed end
- Hydraulic
- Vibratory

2-28

455-5.2 Pile Hammers

455-5.2 Pile Hammers: All equipment is subject to satisfactory field performance. Use a variable energy hammer to drive concrete piles. Hammers will be rated based on the theoretical energy of the ram at impact. Supply driving equipment which provides the required resistance at a blow count ranging from 3 blows per inch (36 blows per foot) to 10 blows per inch (120 blows per foot) at the end of initial drive, unless approved otherwise by the Engineer after satisfactory field trial.

2-29

455-5.2 Pile Hammers

455-5.2 Pile Hammers: (Continued)

…. When the Engineer determines the stroke height or bounce chamber pressure readings do not adequately determine the energy of the hammer, provide and maintain a device to measure the velocity of the ram at impact. Determine the actual hammer energy in the field so that it is consistent with the hammer energy used for each bearing capacity determination. When requested, furnish to the Engineer all technical specifications and operating instructions related to hammer equipment.

2-30

In this slide we see an air/steam single acting hammer. This hammer has the following advantages:

- Same stroke each impact
- Consistent operation rate
- Low impact velocity
- More efficient than diesel
- Cleaner exhaust than diesel

This hammer has the following disadvantages:

- Additional support
  equipment required
- Heaviest hammer
- Not as dependable as diesel
- Thick hammer cushion
  stack required

Single acting air/steam hammers are essentially gravity, or drop hammers, for which the hoist line has been replaced by a pressurized medium, being either steam or air. While originally developed for steam power, most of these hammers today operate on compressed air. To lift the ram weight with motive pressure, a simple one-cylinder steam engine principle is used. During the upstroke cycle, the ram is raised by externally produced air or steam pressure acting against a piston housed in the hammer cylinder.

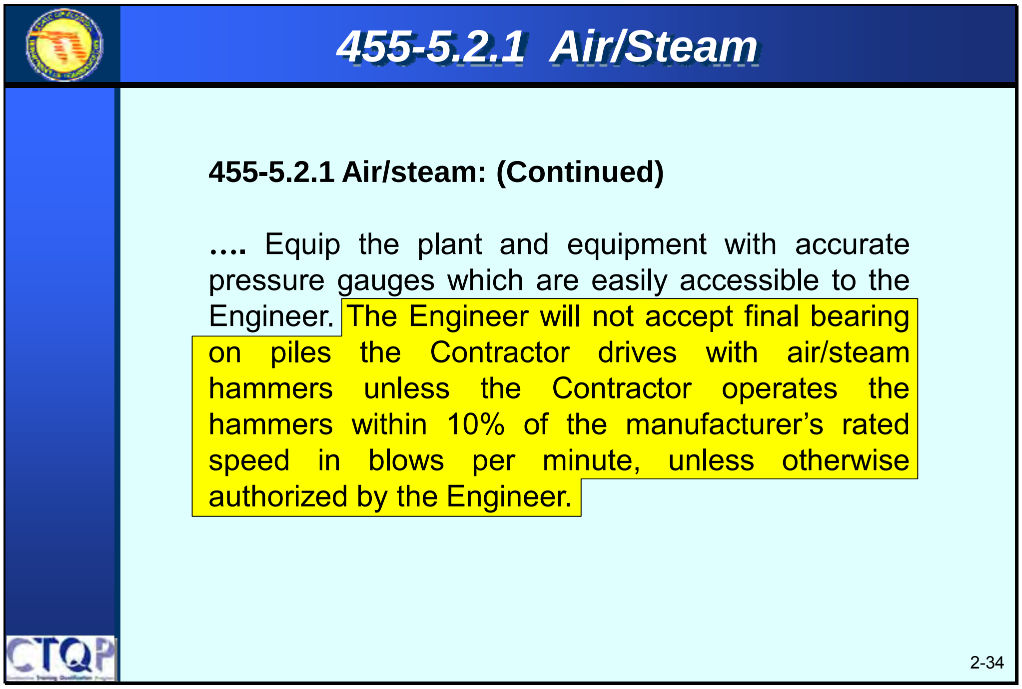
The piston, in turn, is connected to the ram by a rod. During the downstroke cycle, the ram falls by gravity (less friction) to impact the striker plate and hammer cushion. Just before impact, the pressure valve is activated and pressure again enters the cylinder. These hammers must be equipped with at least two strokes, one full stroke and another of lesser height called short stroke.

The stroke is controlled by the use of a device called slide bar shown in this picture. The slide bar has cams that trip the valves at fix ed locations. The maximum stroke of single acting air/steam hammers generally ranges from 2 to 5 feet. Single acting air/steam hammers have the advantages of moderate cost and relatively simple operation and maintenance. They are versatile for many pile types, particularly large concrete and steel pipe piles.

455-5.2.1 Air/Steam

455-5.2.1 Air/steam: 455-5.2.1 Air/steam: Variable energy air/steam hammers shall be capable of providing at least two ram stroke lengths. The short ram stroke length shall be approximately half of the full stroke for hammers with strokes up to 4 feet and no more than 2 feet for hammers with maximum strokes lengths over 4 feet. Operate and maintain air/steam hammers within the manufacturer's specified ranges. Use a plant and equipment for steam and air hammers with sufficient capacity to maintain, under working conditions, the hammer, volume and pressure specified by the manufacturer.

2-33


455-5.2.1 Air/Steam
455-5.2.1 Air/steam: (Continued)
…. Equip the plant and equipment with accurate pressure gauges which are easily accessible to the Engineer. The Engineer will not accept final bearing on piles the Contractor drives with air/steam hammers unless the Contractor operates the hammers within 10% of the manufacturer’s rated speed in blows per minute, unless otherwise authorized by the Engineer.
2-34

Open-End Diesel Hammer

Advantages

- Very Simple; dependable
- No additional support equipment required
- Lightest net weight per ft.-lb. of energy
- Readily available

Disadvantages

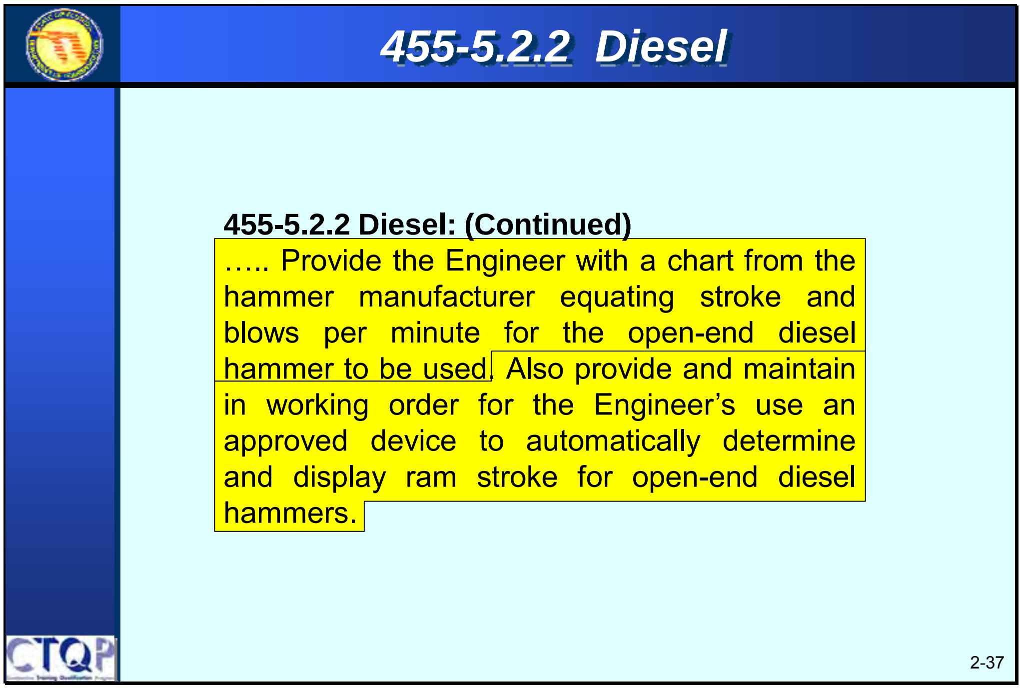
- Delivered energy variable
- Less efficient energy transfer
- Produces higher pile stresses
- Dirty exhaust spray
- Difficult to spot operation problems

2-35

455-5.2.2 Diesel

455-5.2.2 Diesel: Variable energy diesel hammers shall have at least three fuel settings that will produce reduced strokes. Operate and maintain diesel hammers within the manufacturer's specified ranges. Determine the rated energy of diesel hammers using measured ram stroke length multiplied by the weight of the ram for open end hammers and by methods recommended by the manufacturer for closed end hammers.

2-36


455-5.2.2 Diesel
455-5.2.2 Diesel: (Continued)
….. Provide the Engineer with a chart from the hammer manufacturer equating stroke and blows per minute for the open-end diesel hammer to be used. Also provide and maintain in working order for the Engineer's use an approved device to automatically determine and display ram stroke for open-end diesel hammers.
CTQP
2-37

Closed-End Diesel (Double Acting)

Advantages

- No additional support equipment required
- Drives piles faster
- Lightweight

Disadvantages

- Lowest efficiency
- Most difficult to spot operation problems

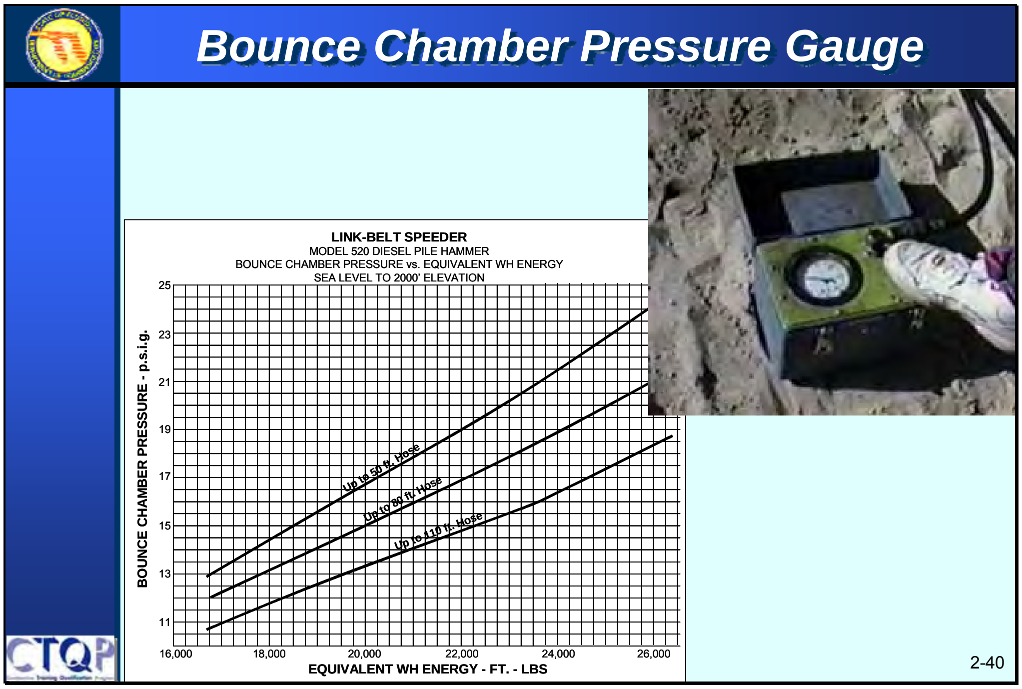
2-38

Closed-End Diesel (Double Acting)

455-5.2.2 Diesel: (Continued)

….. Equip closed-end (double acting) diesel hammers with a bounce chamber pressure gauge, in good working order, mounted near ground level so the Engineer can easily read. Also, provide the Engineer with a chart, calibrated to actual hammer performance within 30 days prior to initial use, equating bounce chamber pressure to either equivalent energy or stroke for the closed-end diesel hammer to be used.

2-39


Bounce Chamber Pressure Gauge
LINK-BELT SPEEDER
MODEL 520 DIESEL PILE HAMMER
BOUNCE CHAMBER PRESSURE vs. EQUIVALENT WH ENERGY
SEA LEVEL TO 2000' ELEVATION
BOUNCE CHAMBER PRESSURE - p.s.i.g.
25
23
21
19
17
15
13
11
Up to 50 ft. Hose
Up to 80 ft. Hose
Up to 110 ft. Hose
16,000
18,000
20,000
22,000
24,000
26,000
EQUIVALENT WH ENERGY - FT. - LBS
2-40

Hydraulic Hammer

Advantage

- Controllable variable stroke
- High efficiency blow
- Low impact velocity
- Light weight
- Clean running, quiet

Disadvantage

- Need hydraulic power pack and hoses
- Need dedicated person for hydraulic controls
- Repairability / high tech
- Expertise in hammer operation needed

2-41

455-5.2.3 Hydraulic

455-5.2.3 Hydraulic: Variable energy hydraulic hammers shall have at least three hydraulic control settings that provide for predictable energy or equivalent ram stroke. The shortest stroke shall be a maximum of 2 feet for the driving of concrete piles. The remaining strokes shall include full stroke and approximately halfway between minimum and maximum stroke.

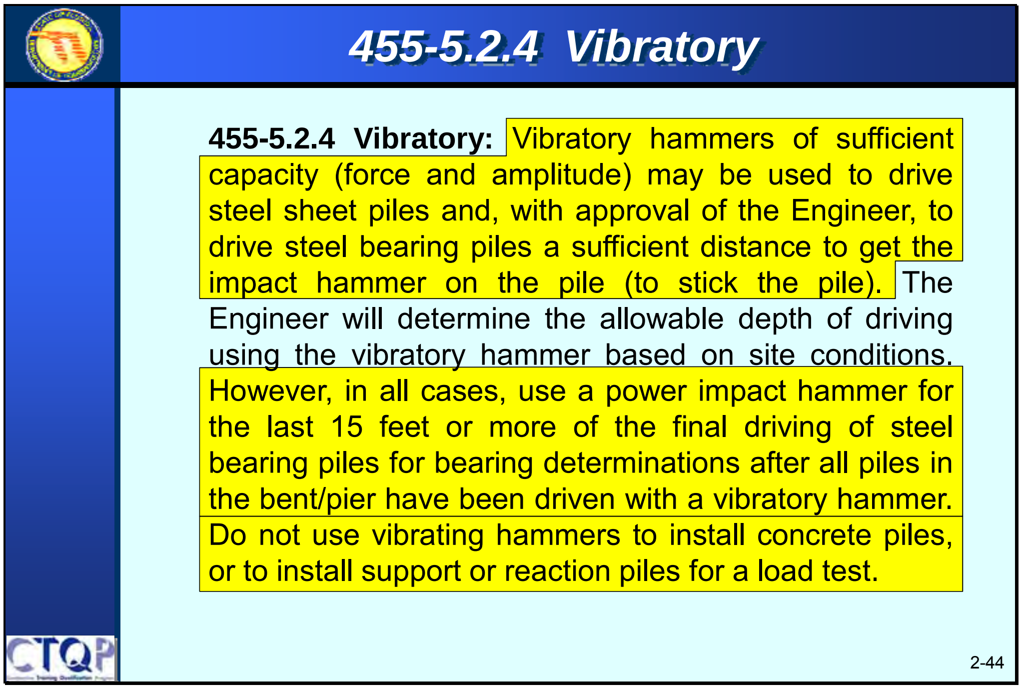
Supply hammer instrumentation with electronic read out, and control unit that allows the operator to read and adjust the hammer energy or equivalent ram stroke. When pressure measuring equipment is required to determine hammer energy, calibrate the pressure measuring equipment before use.

2-42

Vibratory Hammer

- Generally used for driving and extracting sheet piles and non-displacement H-piles and pipe piles.
- Not impact hammers.

2-43


455-5.2.4 Vibratory
455-5.2.4 Vibratory: Vibratory hammers of sufficient capacity (force and amplitude) may be used to drive steel sheet piles and, with approval of the Engineer, to drive steel bearing piles a sufficient distance to get the impact hammer on the pile (to stick the pile). The Engineer will determine the allowable depth of driving using the vibratory hammer based on site conditions. However, in all cases, use a power impact hammer for the last 15 feet or more of the final driving of steel bearing piles for bearing determinations after all piles in the bent/pier have been driven with a vibratory hammer. Do not use vibrating hammers to install concrete piles, or to install support or reaction piles for a load test.
CTQP
2-44

Learning Outcomes

Which of the following hammers is NOT to be used to drive concrete piles?

A. Vibratory
B. Diesel
C. Hydraulic
D. Air/Steam

A bounce chamber pressure gauge is to be provided for which of the following hammers?

A. Air/Steam
B. Open end diesel
C. Closed end diesel
D. Hydraulic

2-45

Learning Outcomes

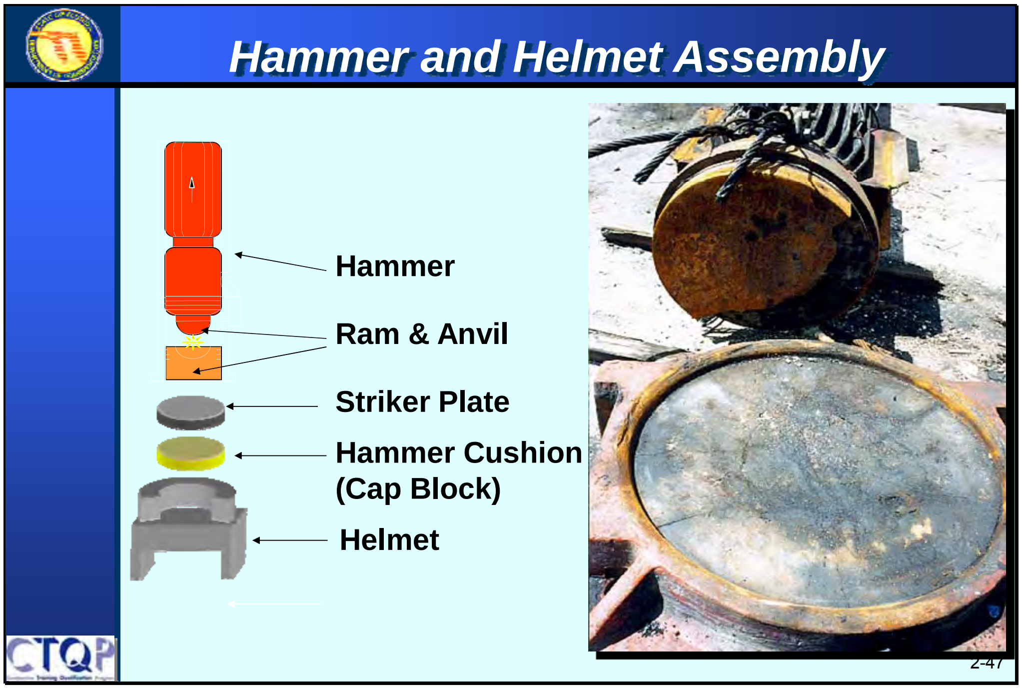
A “scale” or “jumpstick” is to be provided for which hammer?

A. Closed end diesel
B. Open end diesel
C. Hydraulic
D. Not required on any hammer

A diesel hammer is to have a least ___ fuel settings that produce reduced strokes.

A. 2
B. 3
C. 4
D. None required

2-46

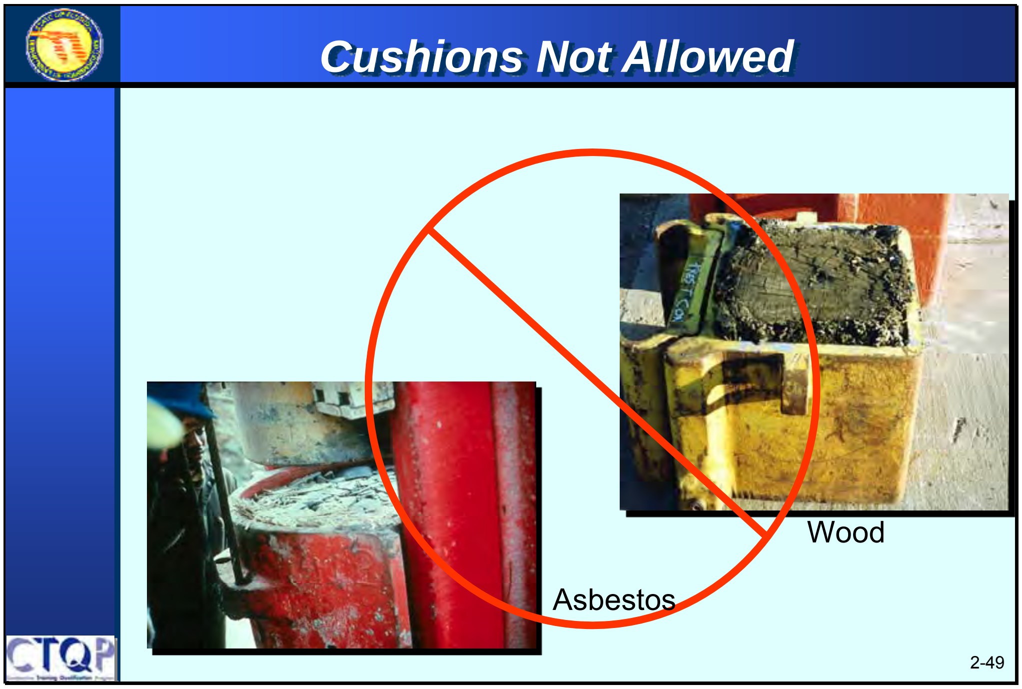


Hammer and Helmet Assembly
Hammer
Ram & Anvil
Striker Plate
Hammer Cushion
(Cap Block)
Helmet
CTQP
2-47

Hammer Cushions

- Used on all impact hammers except gravity (drop) hammers.
- Must be made of durable manufactured (man-made) materials.
- Wood, & asbestos not allowed.
- Striker plate must be used

2-48


Cushions Not Allowed
Wood
Asbestos
CTQP
2-49

455-5.3 Cushions & Pile Helmet

455-5.3.1 Capblock: Provide a capblock (also called the hammer cushion) as recommended by the hammer manufacturer. Use commercially manufactured capblocks constructed of durable manmade materials with uniform known properties. Do not use wood chips, wood blocks, rope, or other material which permit excessive loss of hammer energy. Do not use capblocks constructed of asbestos materials. Obtain the Engineer's approval for all proposed capblock materials and proposed thickness for use.

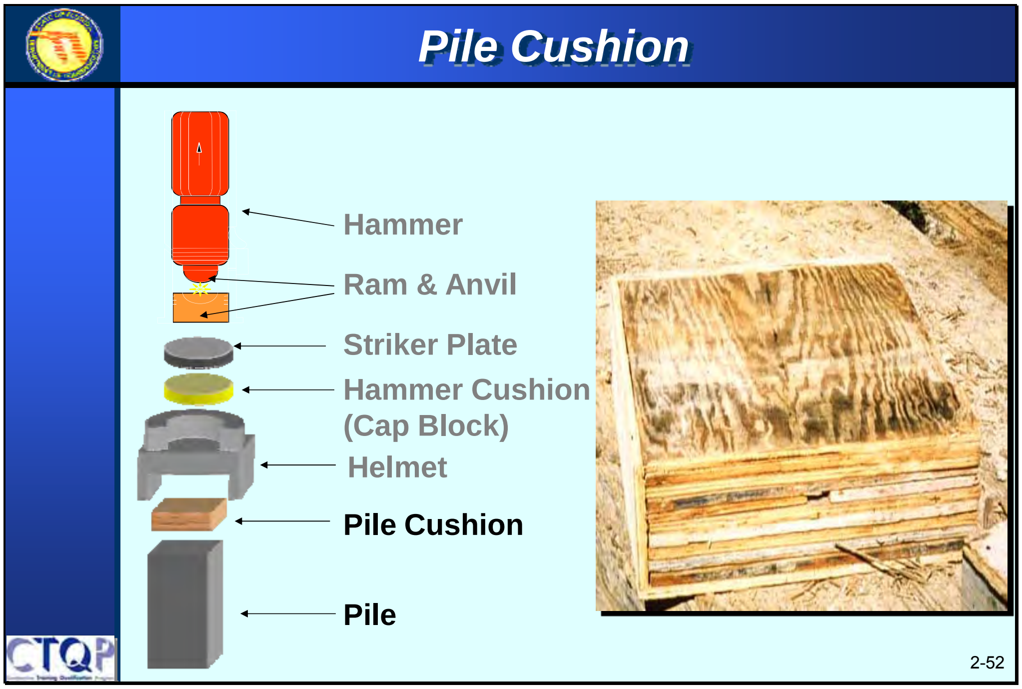
2-50

455-5.3 Cushions & Pile Helmet

455-5.3.1 Capblock: (Continued)

…. Maintain capblocks in good condition, and change them when charred, melted, or otherwise significantly deteriorated. The Engineer will inspect the capblock before driving begins and weekly or at appropriate intervals determined by the Engineer based on field trial. Replace or repair any hammer cushion which loses more than 25% of its original thickness, in accordance with the manufacturer's instructions, before permitting further driving.

2-51


Pile Cushion
Hammer
Ram & Anvil
Striker Plate
Hammer Cushion
(Cap Block)
Helmet
Pile Cushion
Pile
2-52

Pile Cushion

- Used with concrete piles.
- Made of pine plywood or oak lumber
- Replaced if compressed to more than one-half original thickness.
- Replaced if charred,starts to burn, splintered, or per the Engineers instruction.

2-53

455-5.3 Cushions & Pile Helmet

455-5.3.2 Pile Cushion: Provide a pile cushion that is adequate to protect the pile from being overstressed in compression and tension during driving. Use a pile cushion sized so that it will fully fill the lateral dimensions of the pile helmet minus one inch but does not cover any void or hole extending through the top of the pile. Determine the thickness based upon the hammer-pile-soil system. For driving concrete piles, use a pile cushion made from pine plywood or oak lumber. Alternative materials may be used with the approval of the Engineer. Obtain the Engineer's approval for all pile cushions….

2-54

455-5.3 Cushions & Pile Helmet

2-55

455-5.3 Cushions & Pile Helmet

455-5.3.2 Pile Cushion: (Continued)

…. Do not use materials previously soaked, saturated or treated with oil. Maintain pile cushions in good condition and change when charred, splintered, excessively compressed, or otherwise deteriorated to the point it will not protect the pile against overstressing in tension and/or compression. Protect cushions from the weather, and keep them dry. Do not soak the cushions in any liquid. Replace the pile cushion if, during the driving of any pile, the cushion is either compressed more than one-half the original thickness or begins to burn….

2-56

455-5.3 Cushions & Pile Helmet

455-5.3.2 Pile Cushion: (Continued)

…. Provide a new cushion for each pile unless approved otherwise by the Engineer after satisfactory field trial.

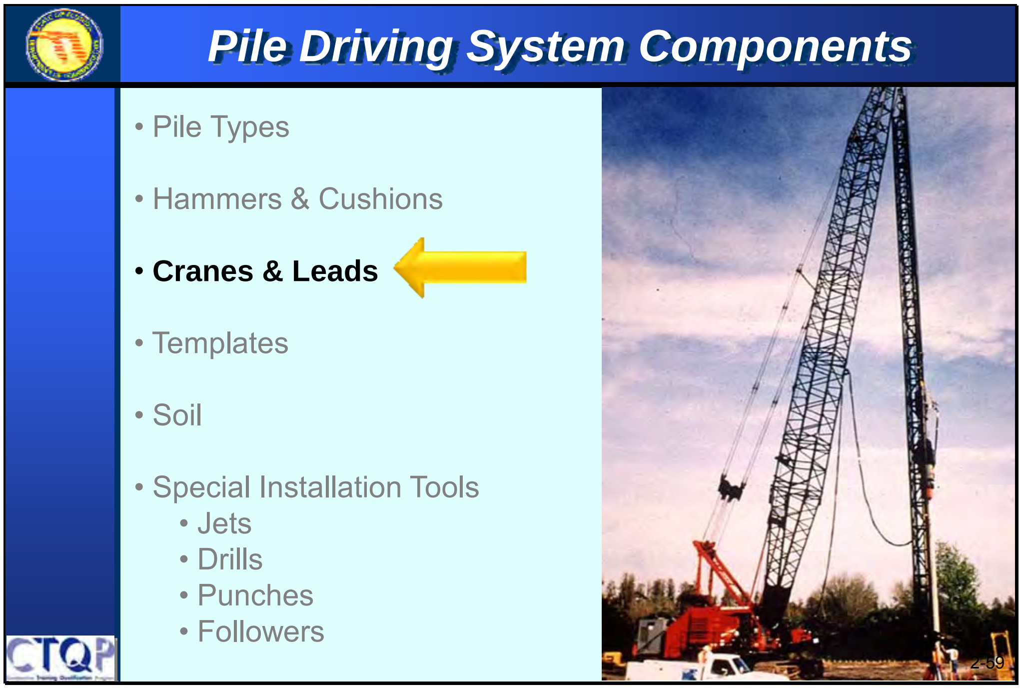
Reuse pile cushions in good condition to perform all set-checks and redrives. Use the same cushion to perform the set-check or redrive as was used during the initial driving, unless this cushion is unacceptable due to deterioration, in which case use a similar cushion.

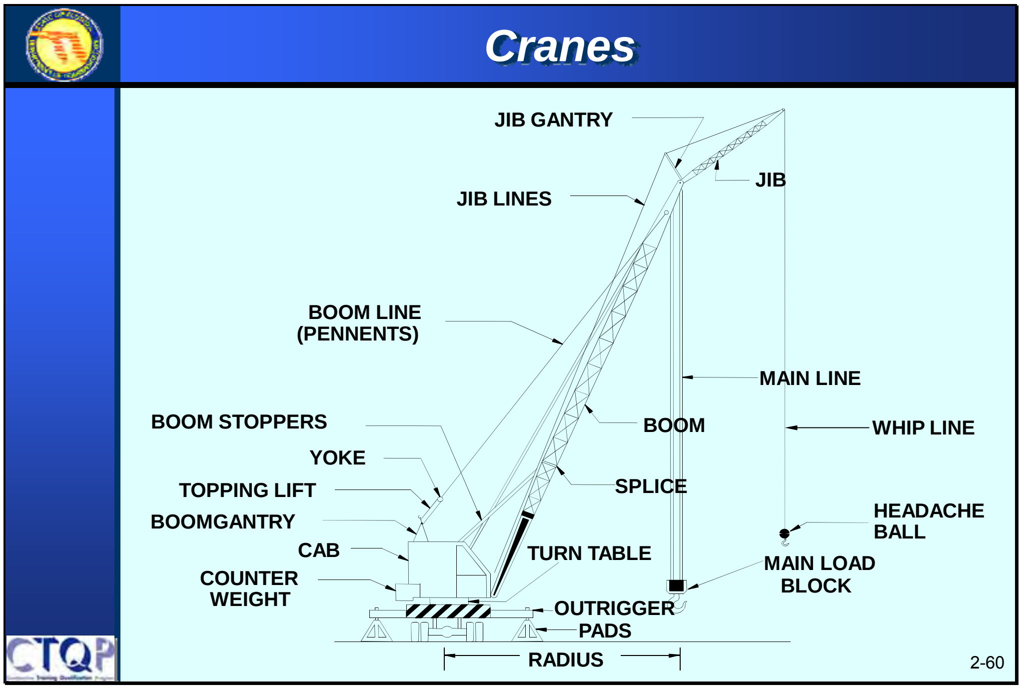
2-57

455-5.3 Cushions & Pile Helmet

455-5.3.3 Pile Helmet: Provide a pile helmet suitable for the type and size of piling being driven. Use a pile helmet deep enough to adequately contain the required thickness of pile cushion and to assist in maintaining pile-hammer alignment. Use a pile helmet that fits loosely over the pile head and is at least 1 inch larger than the pile dimensions. Use a pile helmet designed so that it will not restrain the pile from rotating.

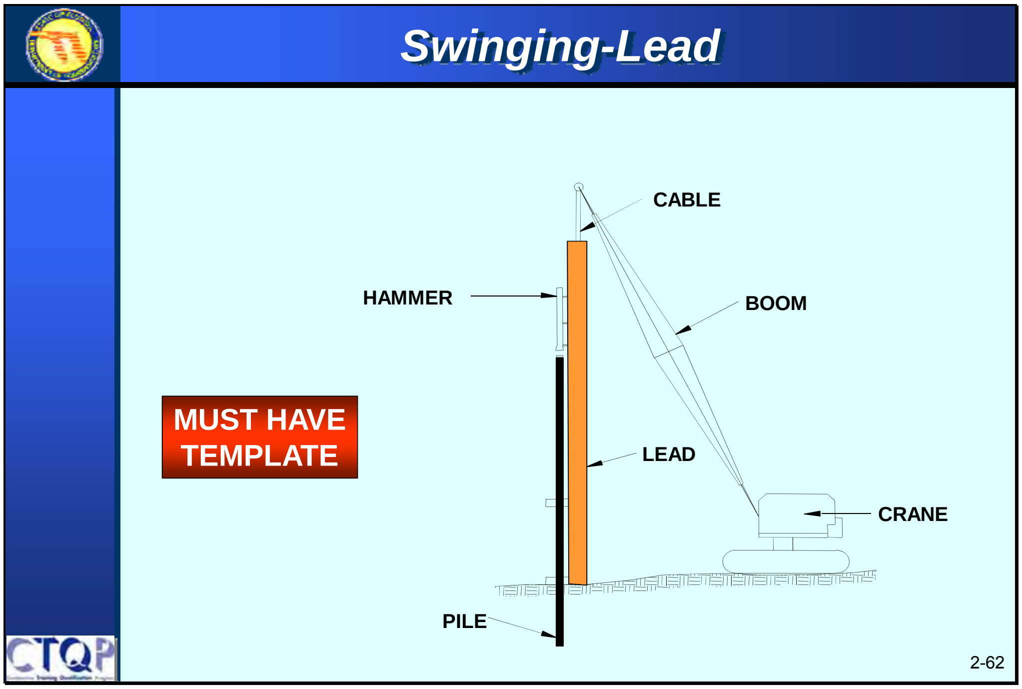
2-58

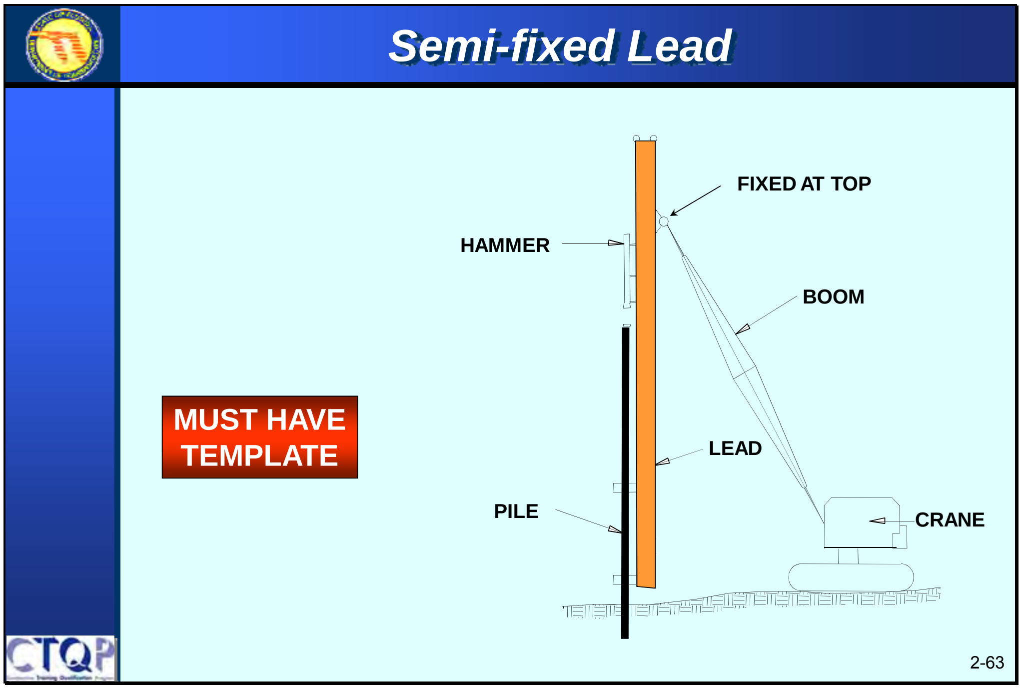

Pile Driving System Components
• Pile Types
• Hammers & Cushions
• Cranes & Leads
• Templates
• Soil
• Special Installation Tools
• Jets
• Drills
• Punches
• Followers
CTQP
2-59

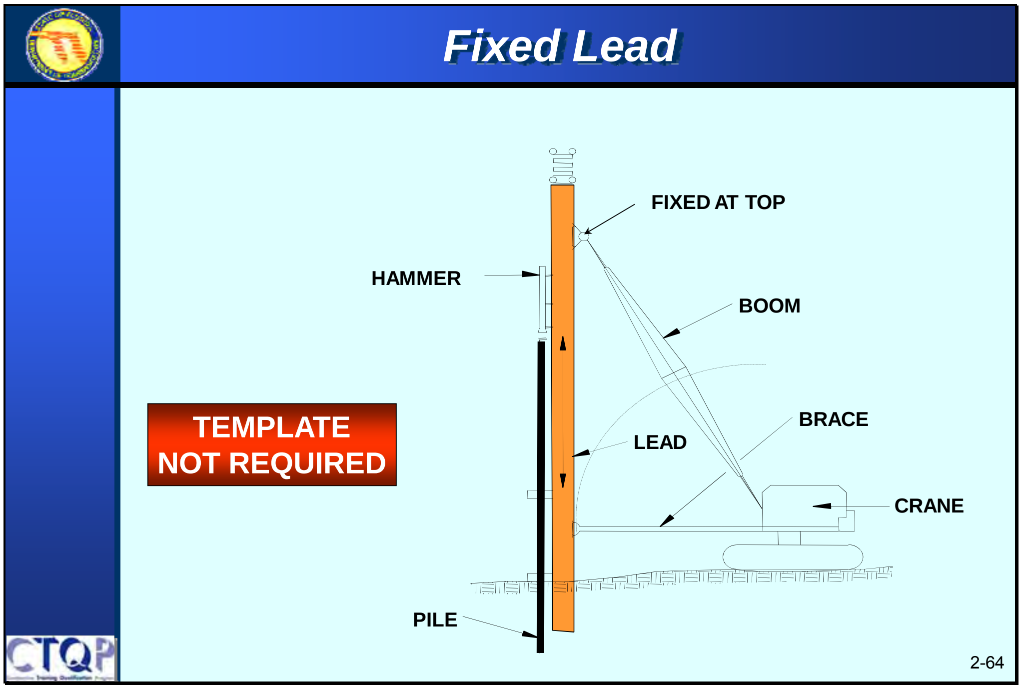

Cranes
JIB GANTRY
JIB
JIB LINES
BOOM LINE
(PENNENTS)
MAIN LINE
BOOM STOPPERS
BOOM
WHIP LINE
YOKE
TOPPING LIFT
SPLICE
HEADACHE
BALL
BOOMGANTRY
CAB
TURN TABLE
MAIN LOAD
BLOCK
COUNTER
WEIGHT
OUTRIGGER
PADS
RADIUS
2-60

Leads

2-61


Swinging-Lead
MUST HAVE TEMPLATE
CABLE
HAMMER
BOOM
LEAD
CRANE
PILE
2-62


Semi-fixed Lead
FIXED AT TOP
HAMMER
BOOM
MUST HAVE TEMPLATE
LEAD
PILE
CRANE
2-63


Fixed Lead
FIXED AT TOP
HAMMER
BOOM
BRACE
TEMPLATE
NOT REQUIRED
LEAD
CRANE
PILE
2-64

Fixed Lead

2-65

455-5.4 Leads

455-5.4 Leads: Provide pile leads constructed in a manner which offers freedom of movement to the hammer and that have the strength and rigidity to hold the hammer and pile in the correct position and alignment during driving. When using followers, use leads that are long enough and suitable to maintain position and alignment of the hammer, follower, and pile throughout driving.

2-66

Pile Driving System Components

- Pile Types
- Hammers & Cushions
- Cranes & Leads
- **Templates**
- Soil
- Special Installation Tools
  - Jets
  - Drills
  - Punches
  - Followers

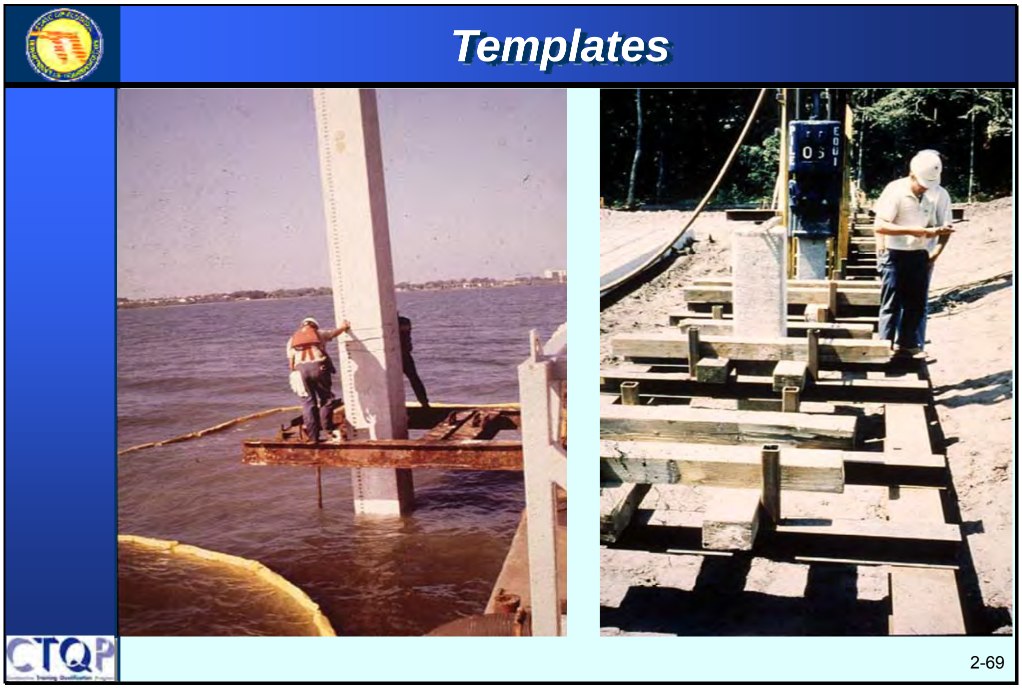
CTQP

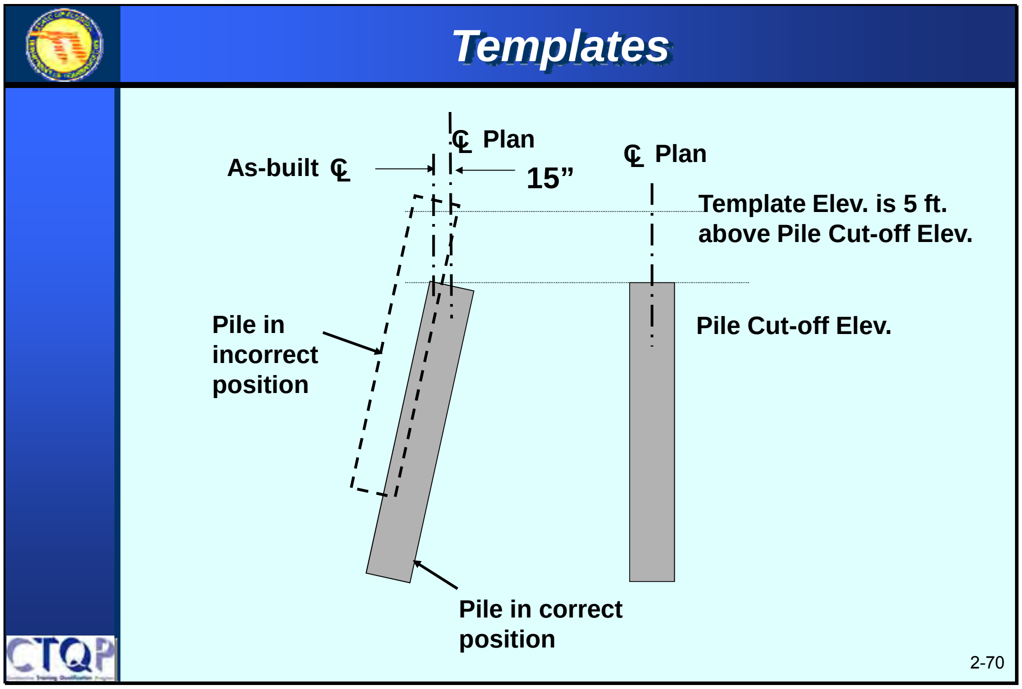
2-67

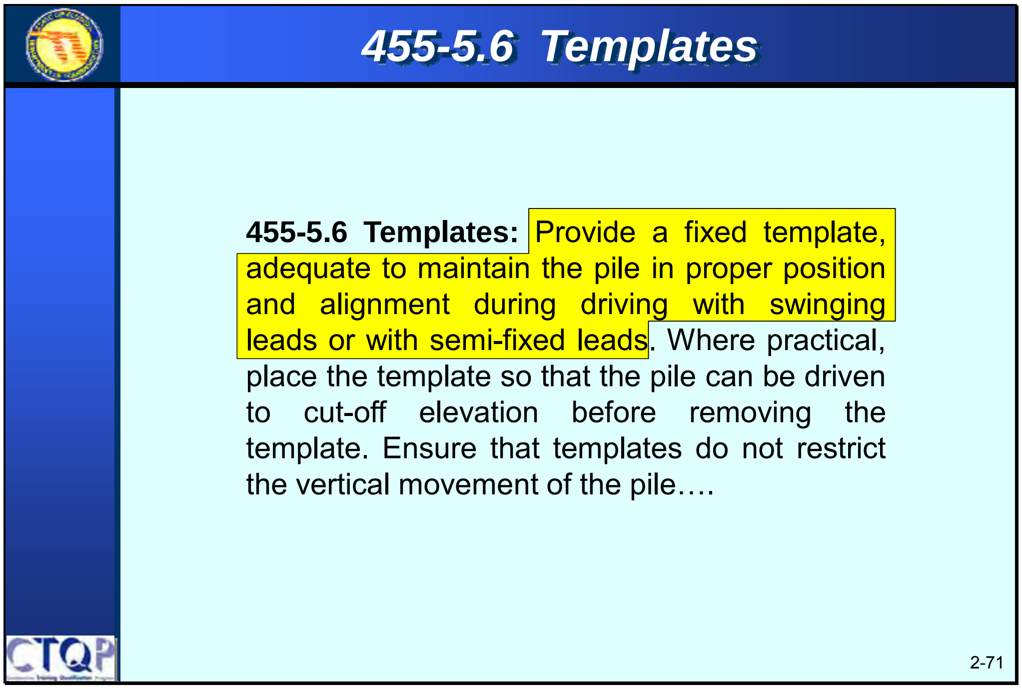
Templates

Required for all pile driving systems <u>except</u> where fixed leads are utilized.

2-68


Templates
2-69


Templates
Ⅽ Plan
As-built Ⅽ
15”
Ⅽ Plan
Template Elev. is 5 ft.
above Pile Cut-off Elev.
Pile in
incorrect
position
Pile Cut-off Elev.
Pile in correct
position
2-70


455-5.6 Templates
455-5.6 Templates: Provide a fixed template, adequate to maintain the pile in proper position and alignment during driving with swinging leads or with semi-fixed leads. Where practical, place the template so that the pile can be driven to cut-off elevation before removing the template. Ensure that templates do not restrict the vertical movement of the pile….
2-71

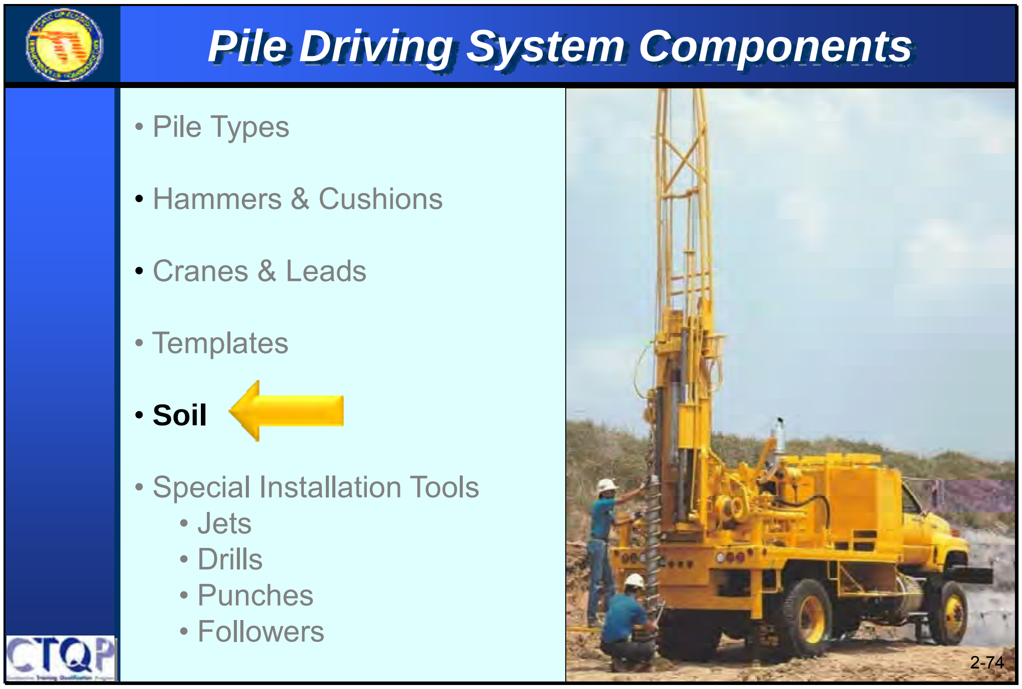
455-5.6 Templates

455-5.6 Templates: (Continued)

…Supply a stable reference close to the pile, which is satisfactory in the opinion of the Engineer, for determination of the pile penetration. At the time of driving piles, furnish the Engineer with elevations of the original ground and template at each pile or pile group location. Note the highest and lowest elevation at each required location and the ground elevation at all piles.

2-72


Acceptable Template?
CTQP
2-73


Pile Driving System Components
• Pile Types
• Hammers & Cushions
• Cranes & Leads
• Templates
• Soil
• Special Installation Tools
• Jets
• Drills
• Punches
• Followers
CTQP
2-74

Standard Penetration Test (SPT)

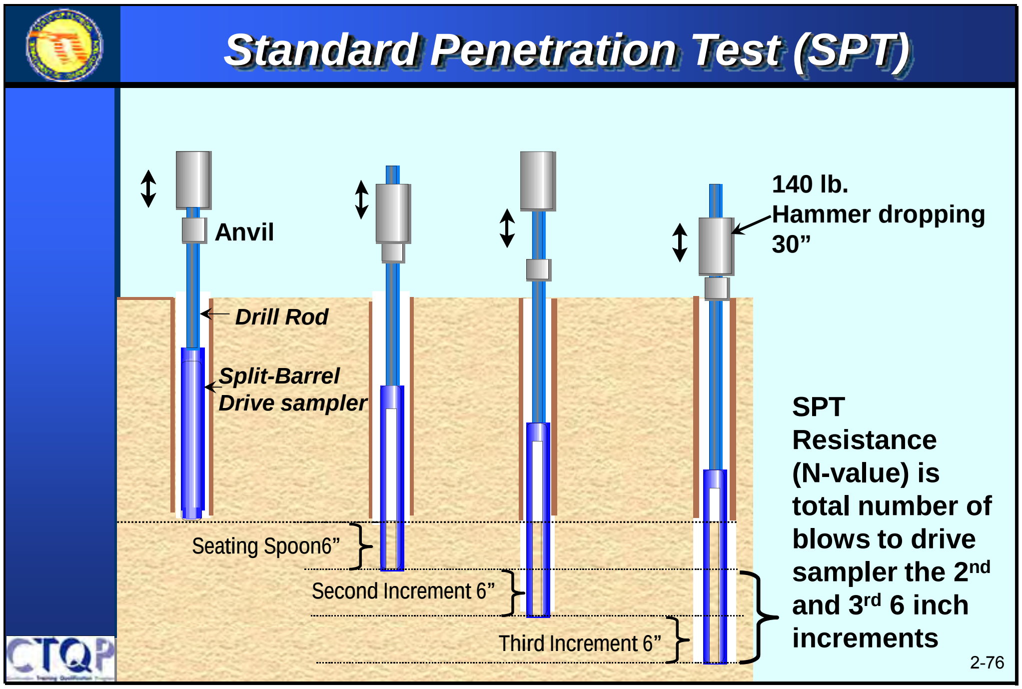
Automatic Hammer

Increased safety

Most Efficient SPT Hammer

Most Consistent blow

2-75



Standard penetration Test- SPT.
This is a pictorial illustration of the SPT Test. The Standard Penetration Test is a field test performed during the advancement of a soil boring to obtain an approximate measure of the dynamic soil resistance, as well as a disturbed drive sample (split barrel type). The test is the most common In situ test worldwide, and you will see this information presented in your Report of Core Boring plans. In lesson 3 we will show you a typical Report of Core Boring plan.

The SPT is conducted at the bottom of a borehole that has been prepared using either flight augers or rotary wash drilling meth ods. At regular depth intervals, the drilling process is interrupted to perform the SPT. G enerally, tests are taken every 2.5 feet at depths shallower than 10 feet and at intervals of 5.0 feet thereafter. However, for FDOT bridge projects is required to test every 2.5 to 3.0 ft maximum interval.

The SPT involves the driving of a ho llow thick-walled tube into the ground and measuring the number of blows to advance the split-barrel sampler a vertical distance of 1 foot. A drop weight system is used for the pounding where a 140-lb hammer repeatedly falls from 30 inches to achieve three successive increments of 6-inches each. The first increment is recorded as a “seating”, while the number of blows to advance the second and third increments ar e summed to give the N-value ("blow count") or SPT-resistance (reported in blows per foot). If the sampler cannot be driven 18 inches, the number of blows per each 6 inch increment and per each partial increment is recorded on the boring log t ogether with the penetration, reported to the nearest inch. For partial increments, the depth of penetration is recorded in addition to the number of blows. Occasionally, a l onger split-spoon is used and a fourth 6 inch increment is driven. This is to merely obtain additional soil sample and is not considered in the “N” value.

Pile Driving System Components

- Pile Types
- Hammers & Cushions
- Cranes & Leads
- Templates
- **Soil**
- **Special Installation Tools**
  - **Jets**
  - **Drills**
  - **Punches**
  - **Followers**

2-77

Jetting

2-78

455-5.7 Water Jets

455-5.7 Water Jets: Use jet pumps, supply lines, and jet pipes that provide adequate pressure and volume of water to freely erode the soil. Do not perform jetting without prior approval by the Engineer or unless allowed by the plans.

Do not perform jetting in the embankment or for end bents. Where conditions warrant, with approval by the Engineer, perform jetting on the holes first, place the pile therein, then drive the pile to secure the last few feet of penetration. Only use one jet for prejetting or jetting through piles constructed with a center jet-hole….

2-79

455-5.7 Water Jets

455-5.7 Water Jets: (Continued)

…. Use two jets when using external jets. When jetting and driving, position the jets slightly behind the advancing pile tip (approximately 3 feet or as approved by the Engineer). When using water jets in the driving, determine the pile bearing only from the results of driving after withdrawing the jets, except where using jets to continuously eliminate soil resistance through the scour zone, ensure that they remain in place as directed by the Engineer and operating during pile bearing determination….

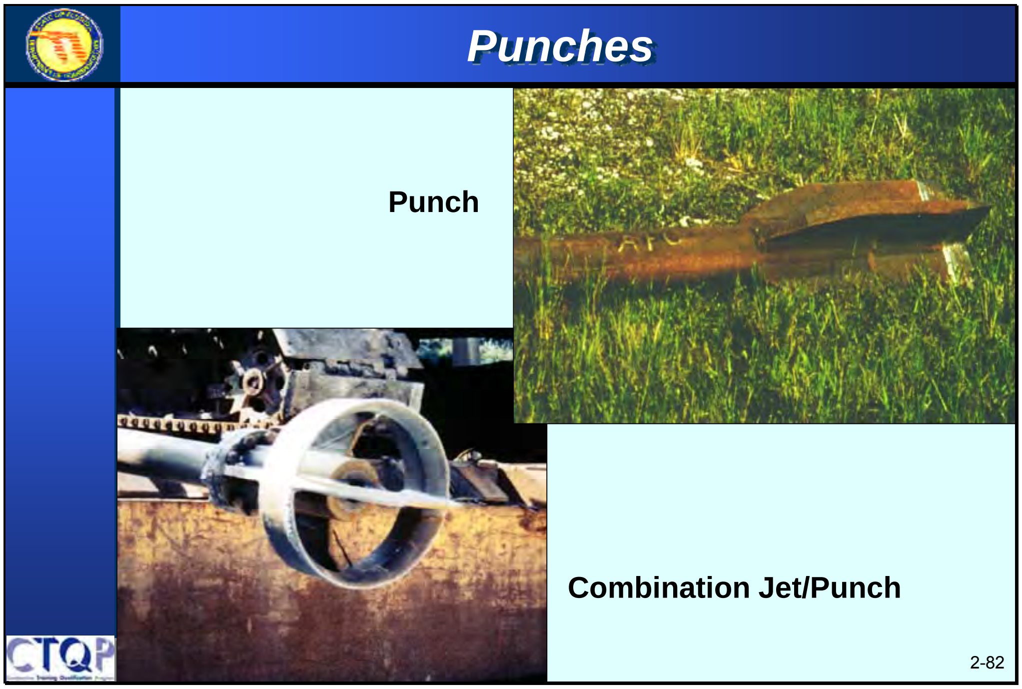
2-80

455-5.7 Water Jets

455-5.7 Water Jets: (Continued)

…. Where practical, perform jetting on all piles in a pile group before driving begins. When large pile groups or pile spacing and batter make this impractical, or when the plans specify a jet-drive sequence, set check a sufficient number of previously driven piles in a pile group to confirm their capacity after completing all jetting.

2-81


Punches
Punch
Combination Jet/Punch
2-82

Soil augers or drills is one of the tools frequently used to install piles. Predrilling is used to perform the following:

-Install piles by preforming holes or predrilling through soils with obstructions, such as old timbers, boulders, and riprap.
-Install piles through soil embankments.
-Drill a starter hole.
-To assist in the advancement of the piles through very dense materials that prevent the piles to reach a minimum penetration.
-To reduce pile heave when displacement piles are driven at close spacings.
-To predrill holes in order to minimize vibrations
--Where jetting or punching are not allowed by the Contract documents.

Drilling/Augering

2-84

Followers

- Generally used for water projects.
- Only when authorized in writing by Engineer or in contract documents.

2-85

Followers

455-5.5 Followers: *Use followers only for underwater driving. Obtain the Engineer's approval for the type of follower, when used, and the method of connection to the leads and pile. Use followers constructed of steel with an adequate cross-section to withstand driving stresses. When driving concrete piles, ensure that the cross-sectional area of the follower is at least 18% of the cross-sectional area of the pile. When driving steel piles, ensure that the cross-sectional area of the follower is greater than or equal to the cross-sectional area of the pile. Provide a pile helmet at the lower end of the follower sized according to the requirements of 455-5.3.3.*

2-86

Followers

455-5.5 Followers: (continued) *….Use followers constructed that maintain the alignment of the pile, follower, and hammer and still allow the pile to be driven within the allowable tolerances. Use followers designed with guides adapted to the leads that maintain the hammer, follower, and the piles in alignment.*

Use information from driving full length piles described in 455-5.1.2 compared to driving piles with the follower and/or dynamic load tests described in 455-5.13 to evaluate the adequacy of the follower and to establish the blow count criteria when using the follower.

2-87

Learning Outcome

Which of the following leads does not require the use of a template?

A. Swinging
B. Semi-fixed
C. Fixed
D. None require the use of a template

2-88

Learning Outcome

When jetting & driving, the jets should be positioned approx. ___ ft. behind the pile tip.

A. 2
B. 3
C. 4
D. 5

Jetting in the embankment is permitted when ____.

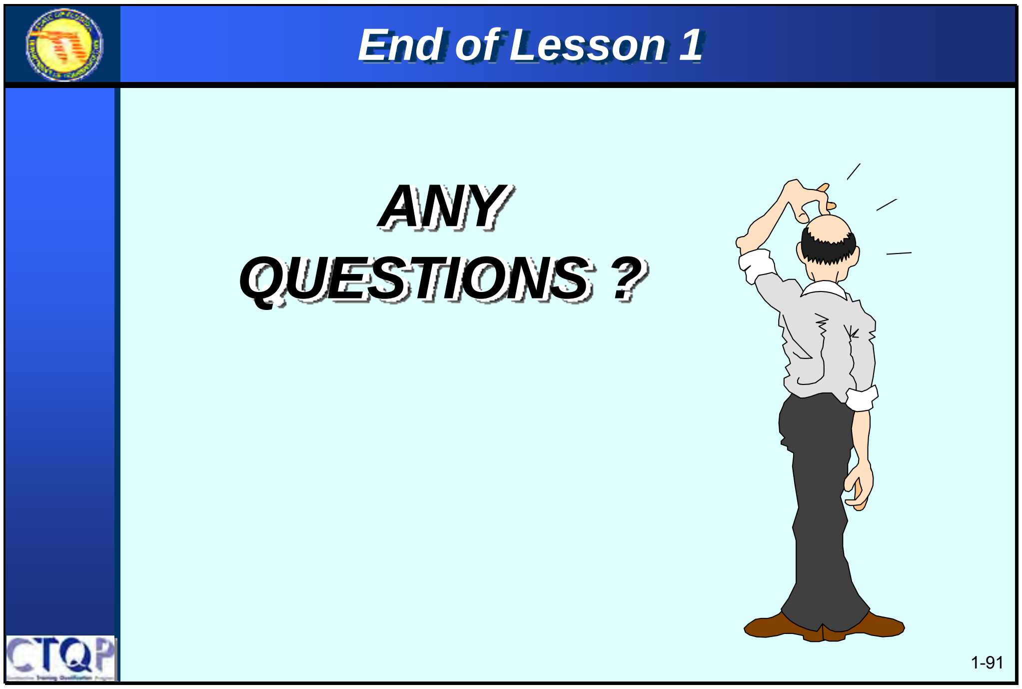
A. Not permitted
B. Anytime
C. Embankment heights are less than 10 feet
D. Embankment heights less than 20 feet

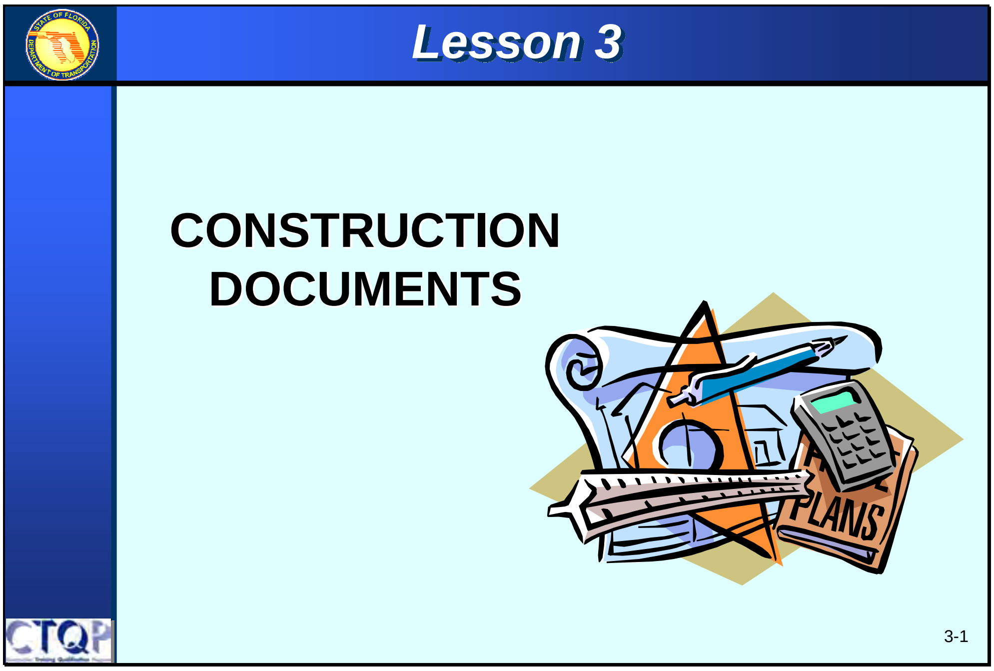
2-89

Learning Outcomes

- Identify Pile Installation Equipment and Tools
- Identify various pile types
- Use Pile Driving Equipment terminology
- Interpret 455 specifications related to the pile driving system

2-90

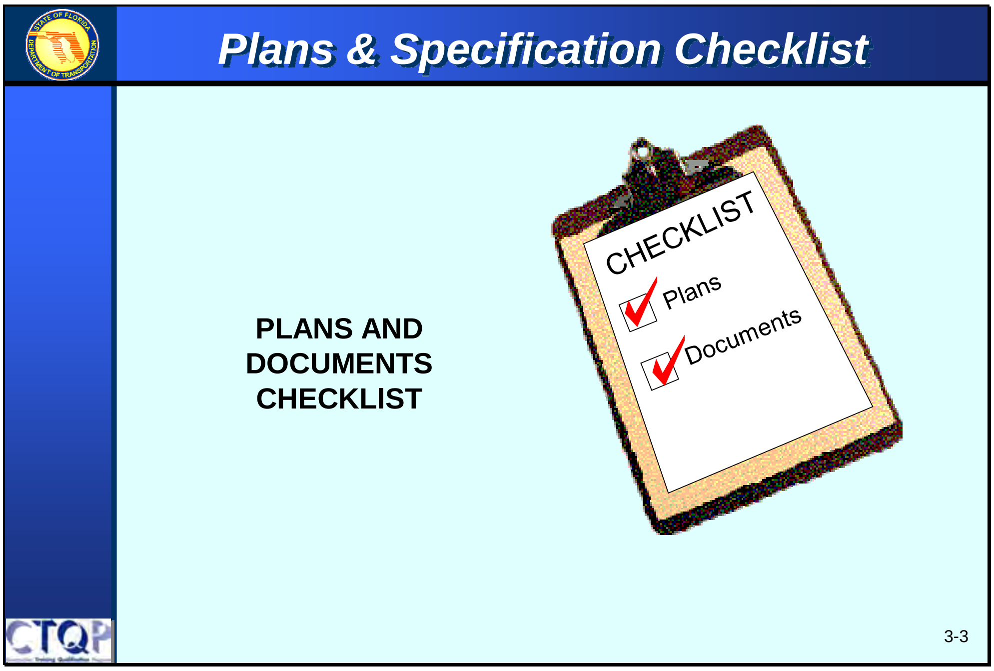

End of Lesson 1
ANY
QUESTIONS ?
CTQP
1-91

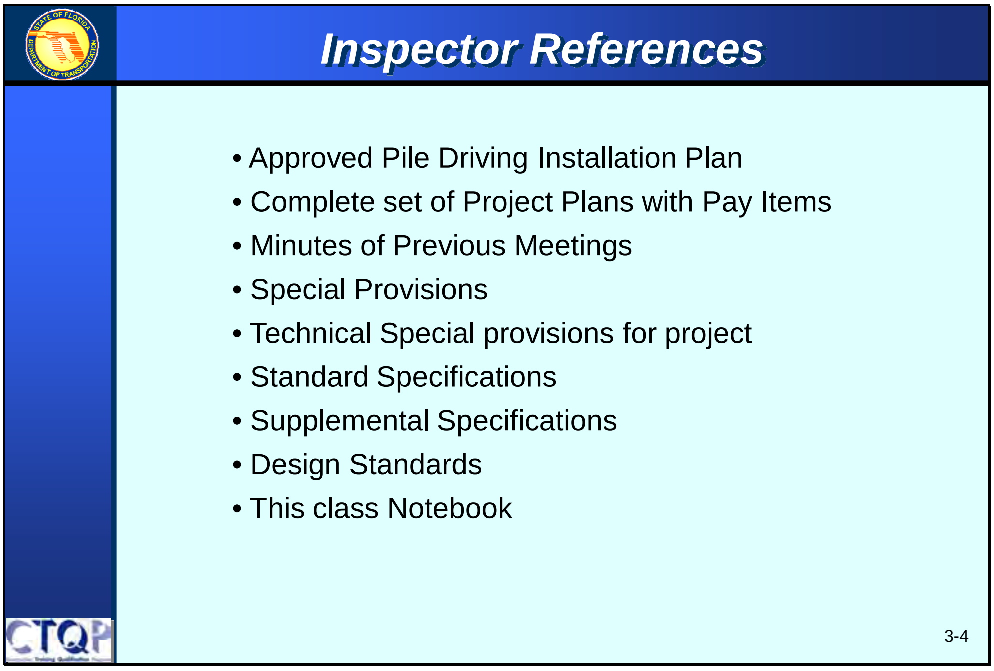

Lesson 3
CONSTRUCTION
DOCUMENTS
PLANS
CTQP
3-1

Learning Outcomes

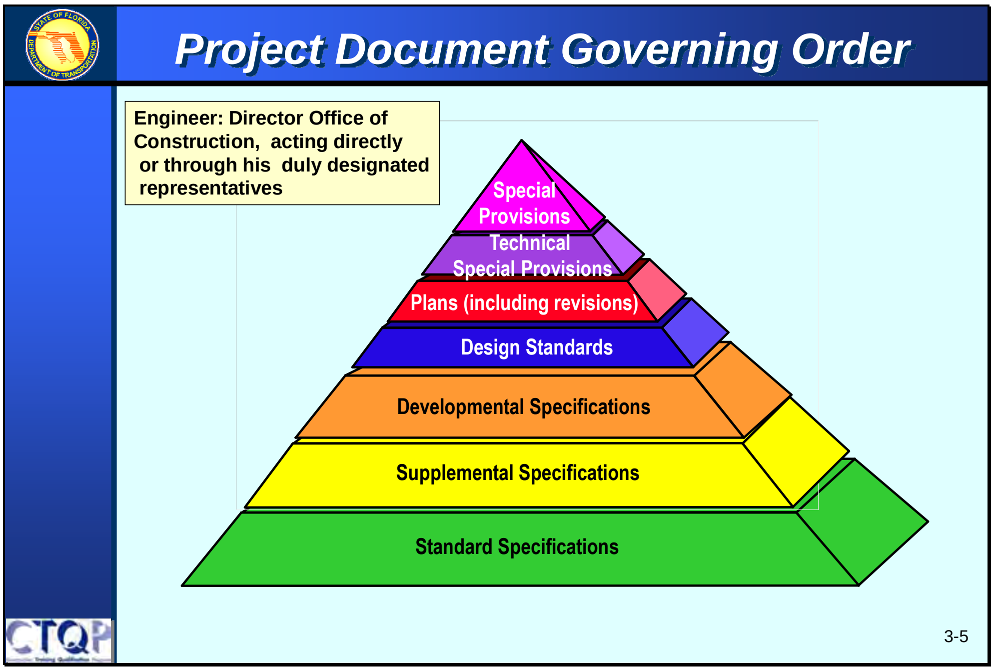
- Locate Plan Sheet Details Related to Pile Driving
- Identify key elements of the Pile Installation Plan
- Learn how to fill the Pile Driving Record
- Identify & interpret applicable 455 Specifications

3-2


Plans & Specification Checklist
PLANS AND DOCUMENTS CHECKLIST
CHECKLIST
Plans
Documents
3-3



Presented here is a brief list of items that the Pile Driving Inspector should have in his or her possession prior to start of the pile driving.


Project Document Governing Order
Engineer: Director Office of Construction, acting directly or through his duly designated representatives
Special Provisions
Technical Special Provisions
Plans (including revisions)
Design Standards
Developmental Specifications
Supplemental Specifications
Standard Specifications
3-5

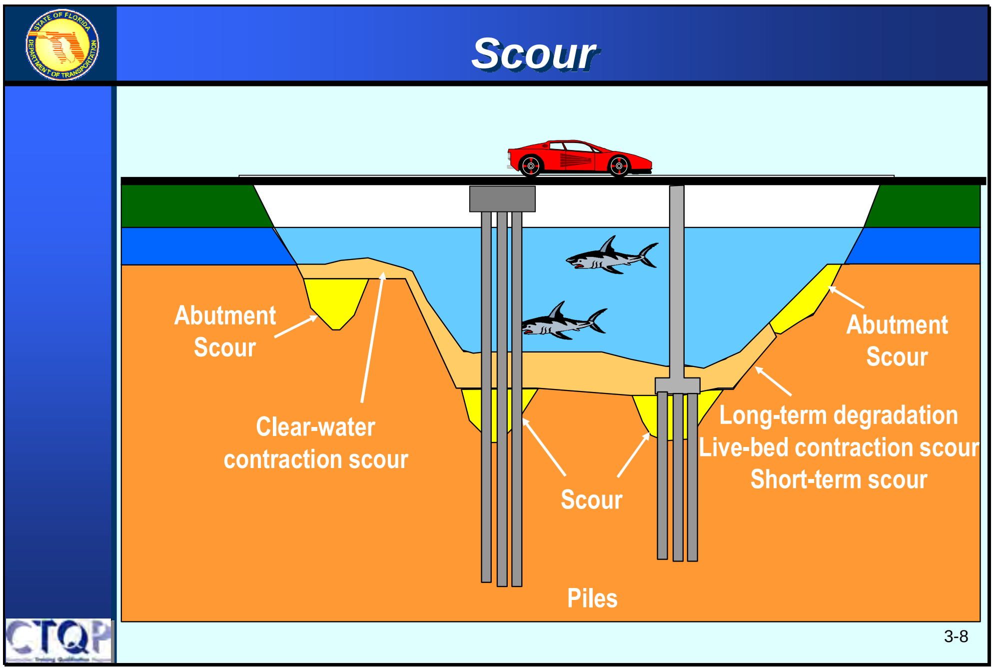
Key Parts of Documents

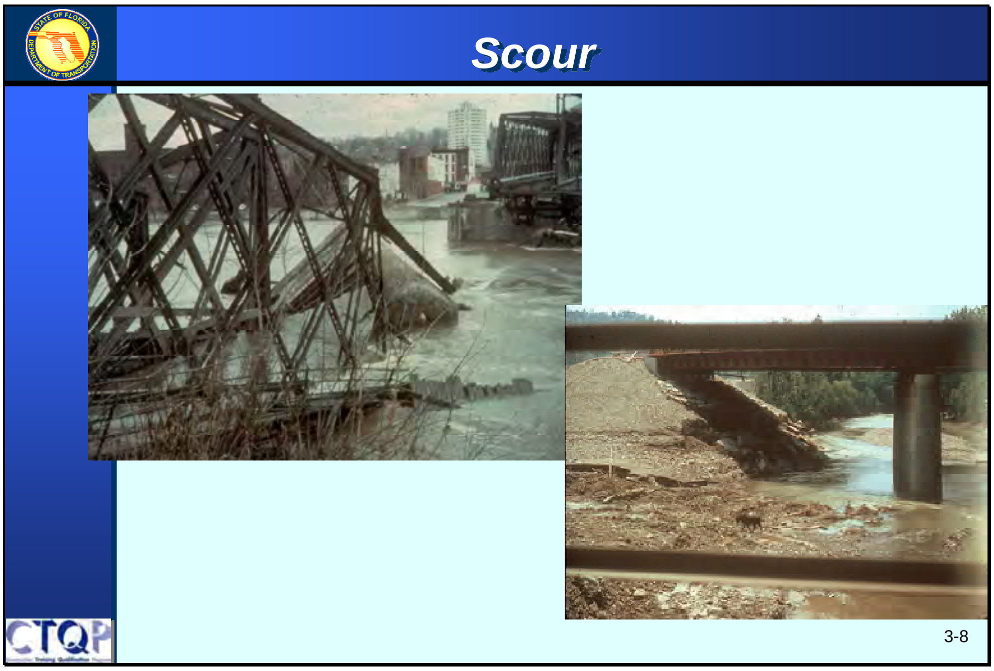
COMPONENT	IMPORTANCE
Plan Revisions	Always check for revised sheets to see if there are any changes that affect the pile installation.
Other Plans	Familiarize yourself with the plans, know where to find things without a lot of time looking.
Key Sheet	Shows what is contained in the plan set, revisions, location, Financial I.D. No.,or FAP No.
Summary of Pay Items	1) Quantities 2) Pay Items
Plan and Profile	Good for project layout- shows location of utilities. Note that all utilities are not necessarily shown and that locations may not be correct.

3-6

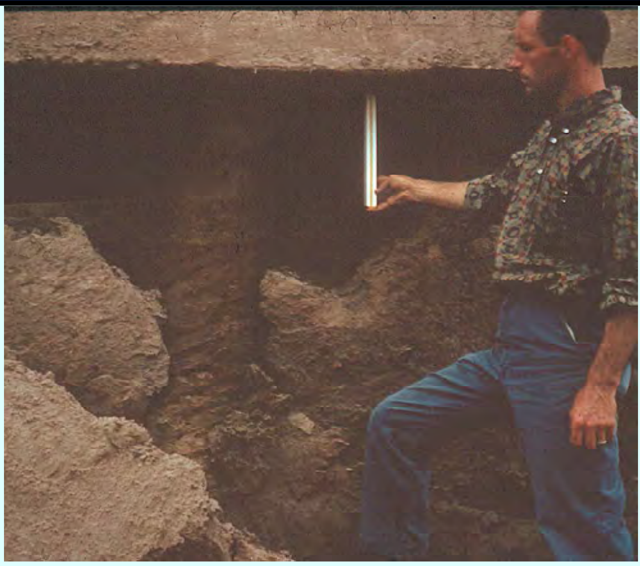
Key Parts of Documents

STRUCTURAL PLANS	IMPORTANCE
General Notes	This sheet may contain notes that change 455 application. Also will have design assumptions made.
Design Standards	Design Standards showing Pile details, typically found in plans.
General Plan & Elevation	Shows layout and elevation of bridge & foundation (one or more sheets) - Will show number of bents/piers. Can tell whether pier or bent.
Report of Core Borings	Shows subsurface conditions used in design of the piles. Useful to know
Foundation Layout	Shows the specific location of production and test piles.
Bent/Pier Plans	Shows specifics of each bent/pier including the Cutoff elevation for the piles.


Scour
Abutment Scour
Clear-water contraction scour
Abutment Scour
Long-term degradation
Live-bed contraction scour
Short-term scour
Scour
Piles
3-8

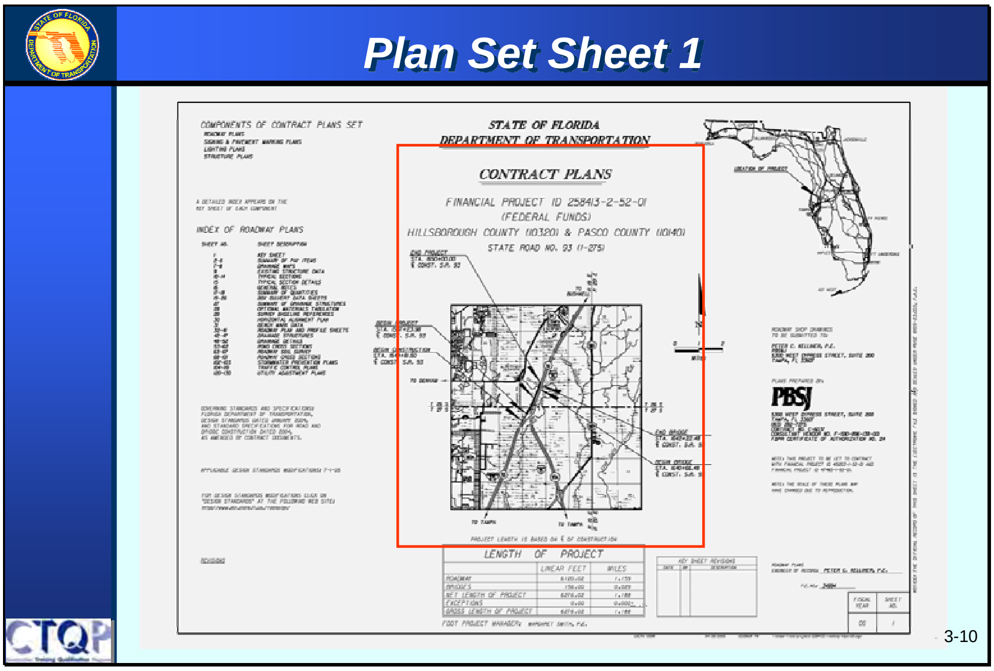

Scour
3-8

Scour

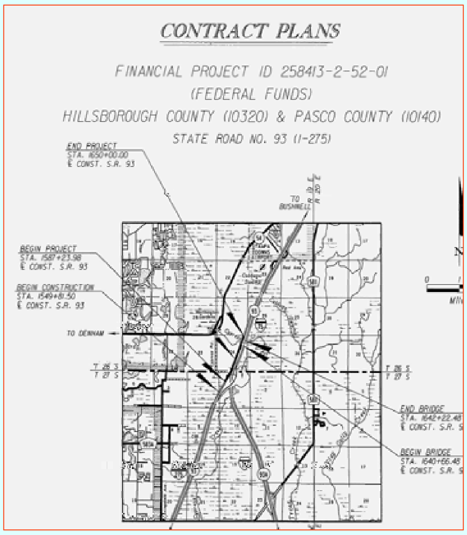


3-8

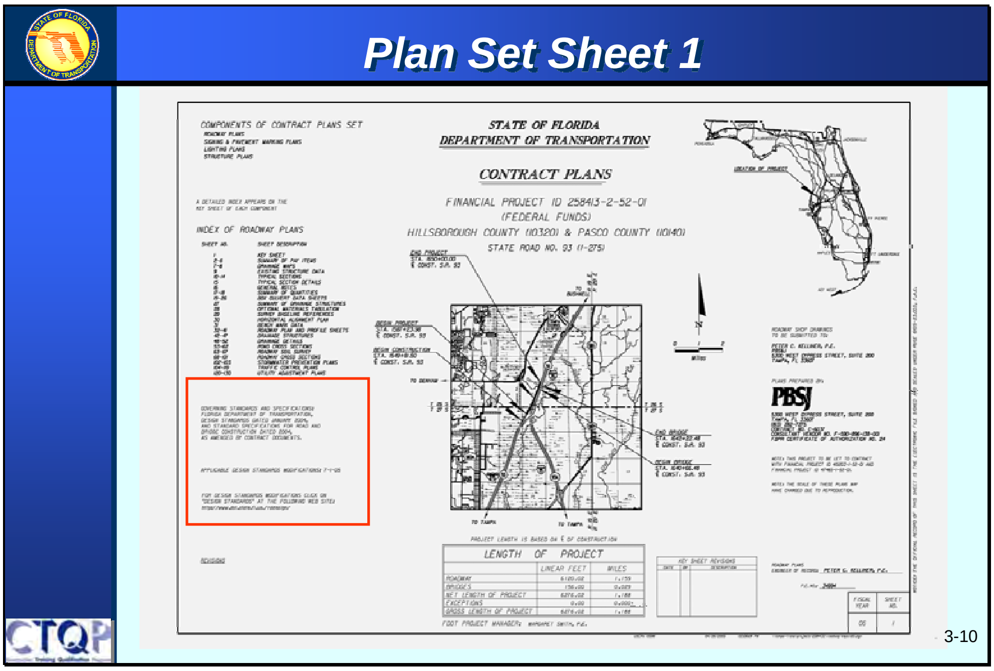

Plan Set Review
3-9

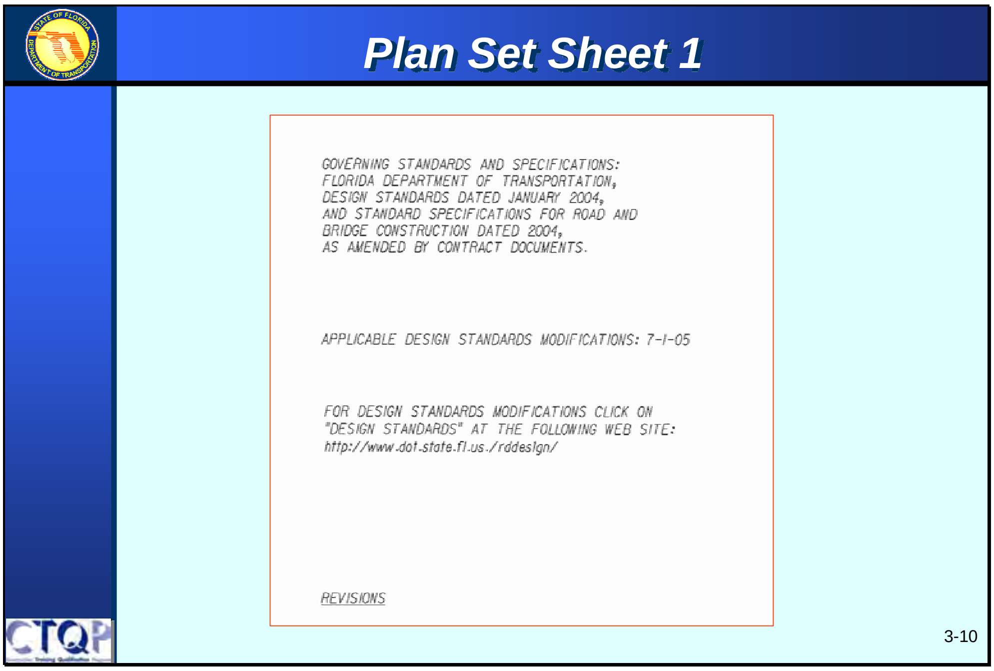

Plan Set Sheet 1
COMPONENTS OF CONTRACT PLANS SET
STATE OF FLORIDA
DEPARTMENT OF TRANSPORTATION
CONTRACT PLANS
FINANCIAL PROJECT ID 258413-2-52-01
(FEDERAL FUNDS)
HILLSBOROUGH COUNTY (10320) & PASCO COUNTY (10140)
STATE ROAD NO. 93 (I-275)
INDEX OF ROADWAY PLANS
PBSJ
LENGTH OF PROJECT
3-10

Plan Set Sheet 1

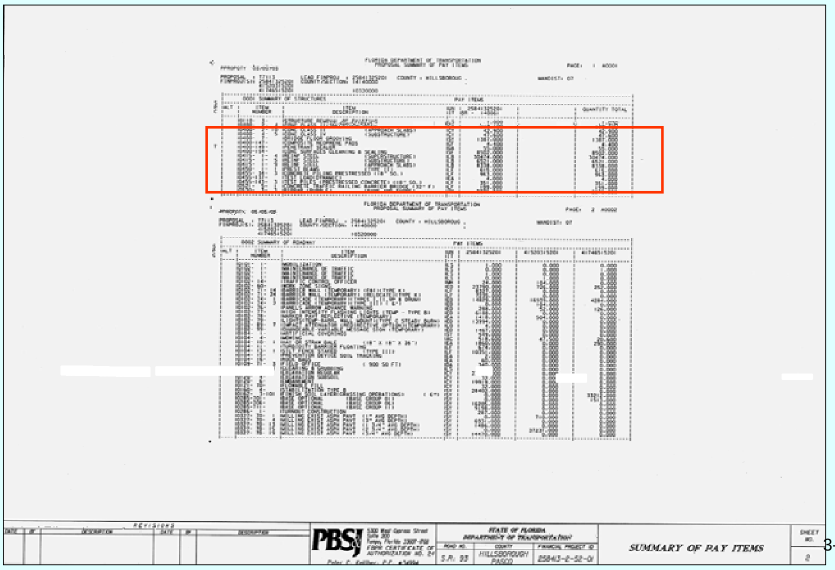


3-10


Plan Set Sheet 1
STATE OF FLORIDA
DEPARTMENT OF TRANSPORTATION
CONTRACT PLANS
FINANCIAL PROJECT ID 258413-2-52-01
(FEDERAL FUNDS)
HILLSBOROUGH COUNTY (10320) & PASCO COUNTY (10140)
STATE ROAD NO. 93 (I-275)
COMPONENTS OF CONTRACT PLANS SET
INDEX OF ROADWAY PLANS
LENGTH OF PROJECT
PBSJ
3-10


Plan Set Sheet 1
GOVERNING STANDARDS AND SPECIFICATIONS:
FLORIDA DEPARTMENT OF TRANSPORTATION,
DESIGN STANDARDS DATED JANUARY 2004,
AND STANDARD SPECIFICATIONS FOR ROAD AND
BRIDGE CONSTRUCTION DATED 2004,
AS AMENDED BY CONTRACT DOCUMENTS.
APPLICABLE DESIGN STANDARDS MODIFICATIONS: 7-1-05
FOR DESIGN STANDARDS MODIFICATIONS CLICK ON
"DESIGN STANDARDS" AT THE FOLLOWING WEB SITE:
http://www.dot.state.fl.us./rddesign/
REVISIONS
3-10

Plan Set Sheet 2



3-11

Plan Set Sheet 2

FLORIDA DEPARTMENT OF TRANSPORTATION
PROPOSAL SUMMARY OF PAY ITEMS

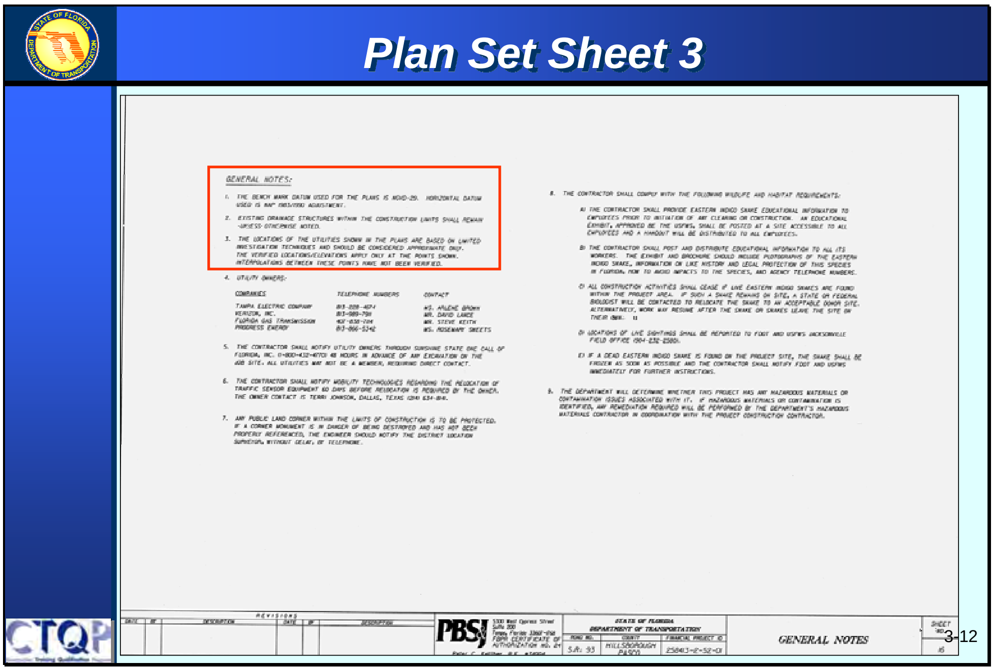
PPROPOTY 05/05/05 PAGE: 1 A0001

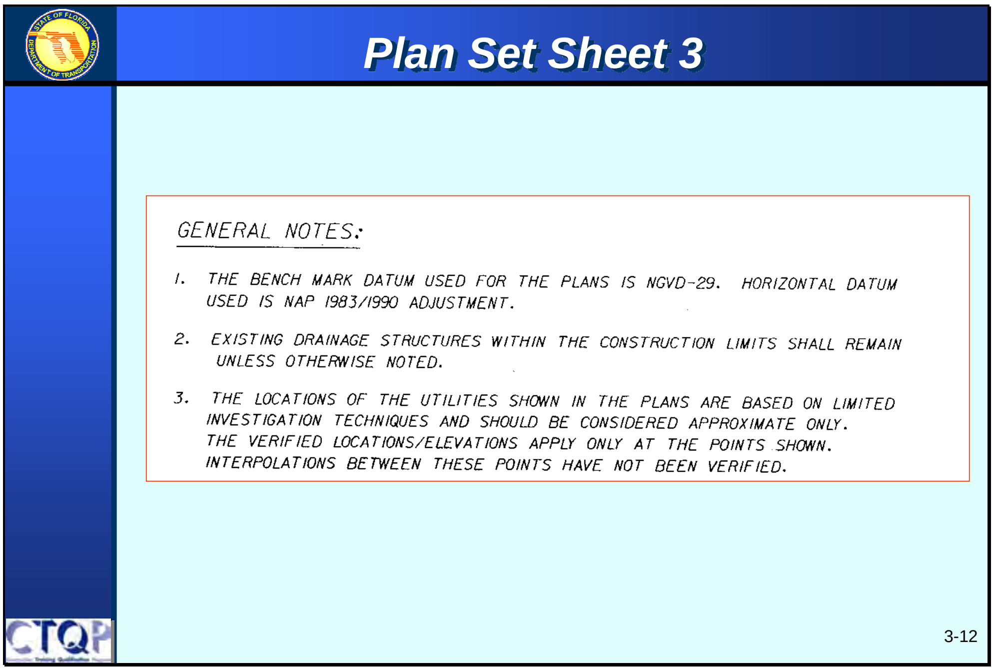
PROPOSAL : T7113 LEAD FINPROJ : 25841325201 COUNTY : HILLSBOROUG MANDIST: 07
FINPROJ(S): 25841325201 COUNTY/SECTION: 14140000
41520315201
41746515201 10320000

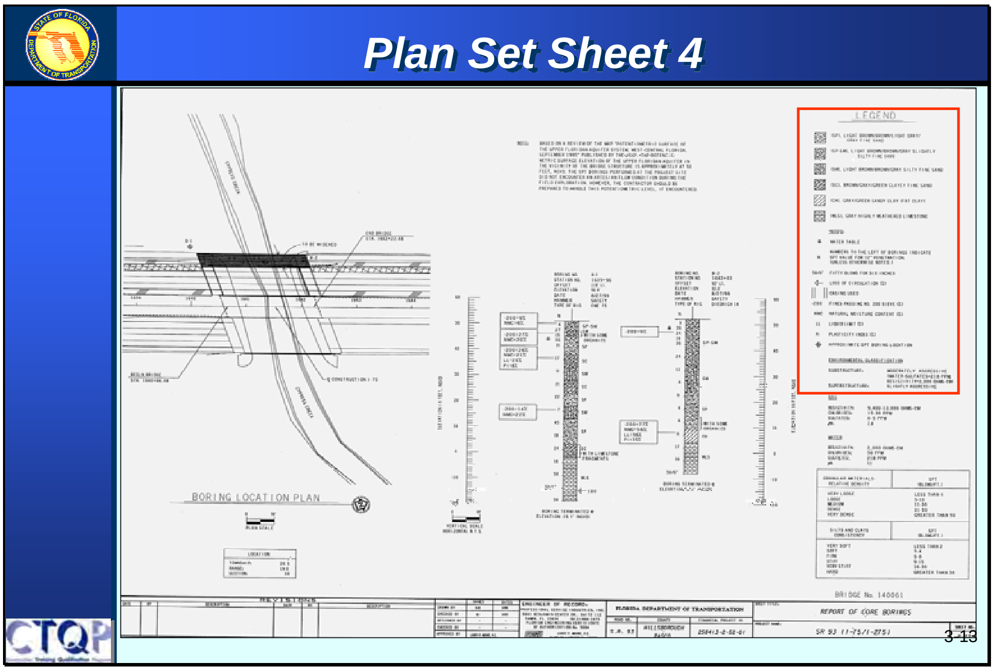
0001 SUMMARY OF STRUCTURES — PAY ITEMS

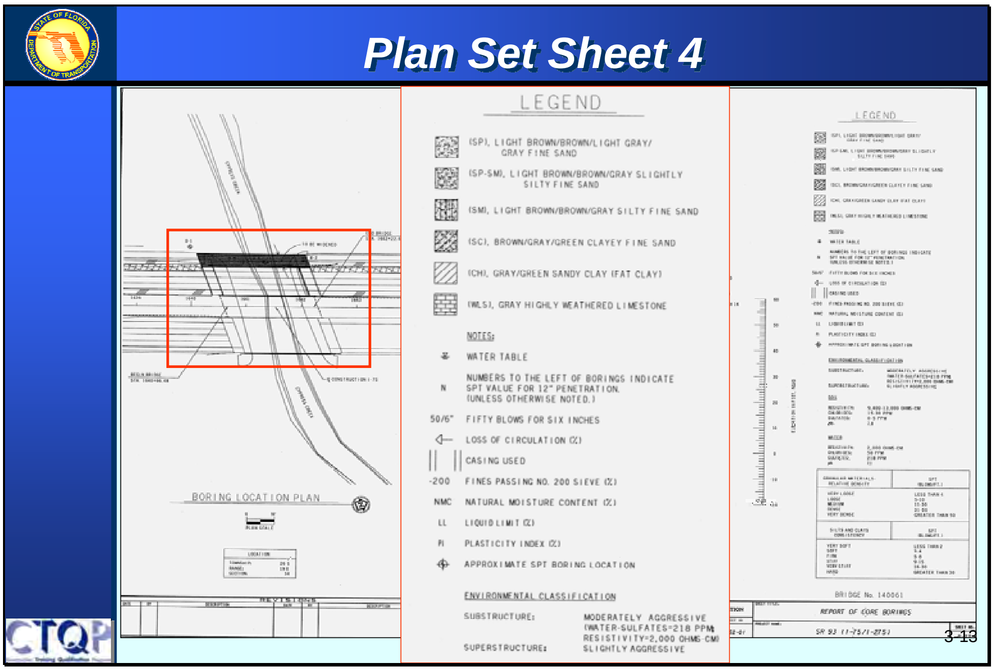
SPC	ALT	ITEM NUMBER	ITEM DESCRIPTION		UNIT	25841325201 BR - 140061		QUANTITY TOTAL
		0110- 3-	STRUCTURE REMOVAL OF EXISTING		LS	1.000		1.000
		0400- 2- 4	CONC CLASS II(SUPERSTRUCTURE)		CY	119.100		119.100
		0400- 2- 10	CONC CLASS II	(APPROACH SLABS)	CY	42.900		42.900
		0400- 4- 5	CONC CLASS IV	(SUBSTRUCTURE)	CY	47.600		47.600
		0400- 7-	BRIDGE FLOOR GROOVING		SY	1387.000		1387.000
		0400-147-	COMPOSITE NEOPRENE PADS		CF	4.400		4.400
T		0400-149-	PENETRANT SEALER		GA	55.000		55.000
		0400-154-	CONC SURFACES CLEANING 8 SEALING		SF	8502.000		8502.000
		0415- 1- 4	REINF STEEL	(SUPERSTRUCTURE)	LB	30474.000		30474.000
		0415- 1- 5	REINF STEEL	(SUBSTRUCTURE)	LB	6521.000		6521.000
		0415- 1- 9	REINF STEEL	(APPROACH SLABS)	LB	8338.000		8338.000
		0450- 1- 1	PREST BEAMS	(TYPE II)	LF	615.000		615.000
		0455- 34- 3	CONCRETE PILING PRESTRESSED (18" SQ.)			963.000		963.000
					EA			
		0455-143- 3	TEST PILES (PRESTRESSED CONCRETE) (18" SQ.)		LF	351.000		351.000
		0521- 5- 1	CONCRETE TRAFFIC RAILING BARRIER BRIDGE (32" F)		LF	199.000		199.000
		0530- 3- 3	RIPRAP (RUBBLE)	(BANK AND SHORE)	TN	2276.300		2276.300

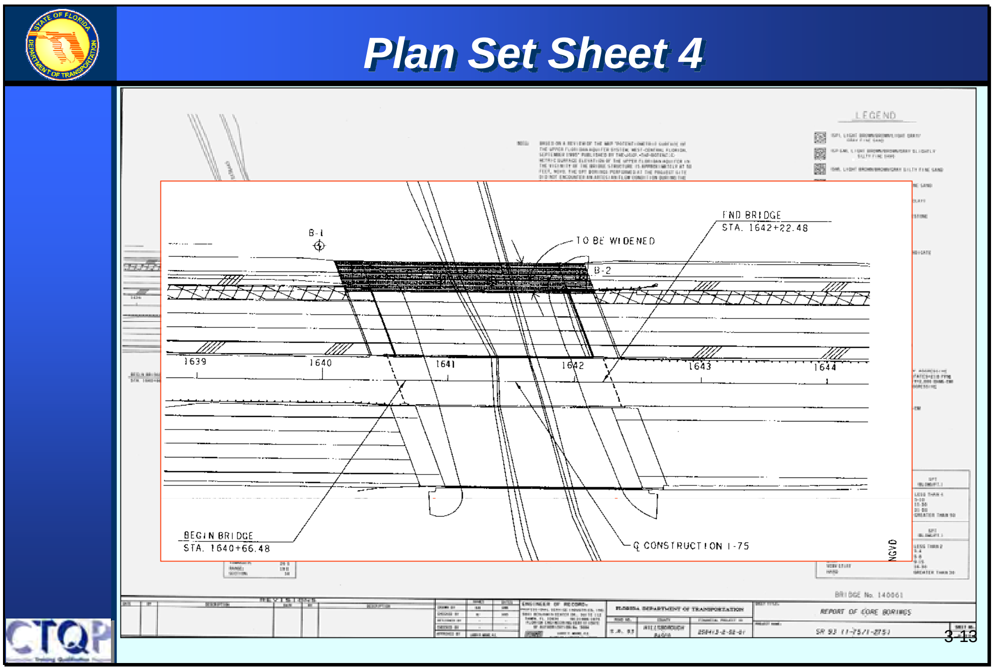
3-11


Plan Set Sheet 3
GENERAL NOTES
3-12

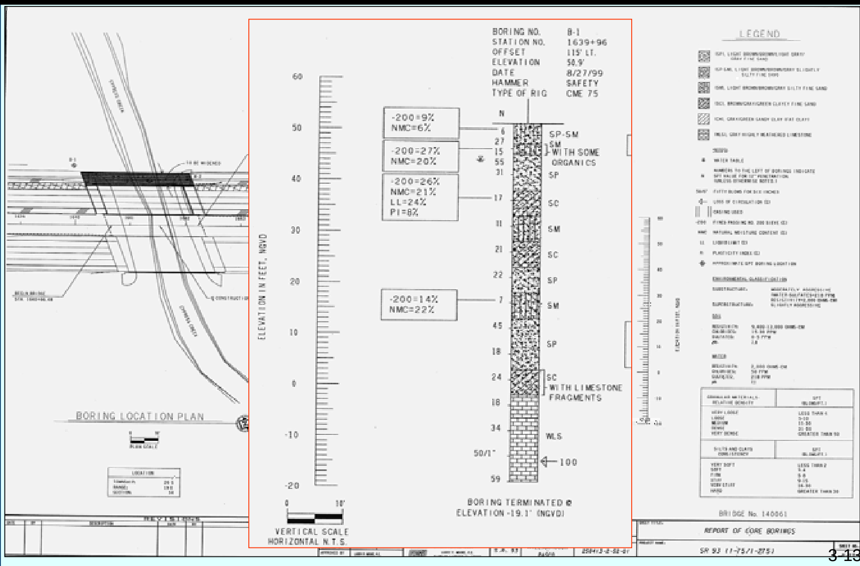

Plan Set Sheet 3
GENERAL NOTES:
1. THE BENCH MARK DATUM USED FOR THE PLANS IS NGVD-29. HORIZONTAL DATUM USED IS NAP 1983/1990 ADJUSTMENT.
2. EXISTING DRAINAGE STRUCTURES WITHIN THE CONSTRUCTION LIMITS SHALL REMAIN UNLESS OTHERWISE NOTED.
3. THE LOCATIONS OF THE UTILITIES SHOWN IN THE PLANS ARE BASED ON LIMITED INVESTIGATION TECHNIQUES AND SHOULD BE CONSIDERED APPROXIMATE ONLY. THE VERIFIED LOCATIONS/ELEVATIONS APPLY ONLY AT THE POINTS SHOWN. INTERPOLATIONS BETWEEN THESE POINTS HAVE NOT BEEN VERIFIED.
3-12


Plan Set Sheet 4
LEGEND
BORING LOCATION PLAN
3-13

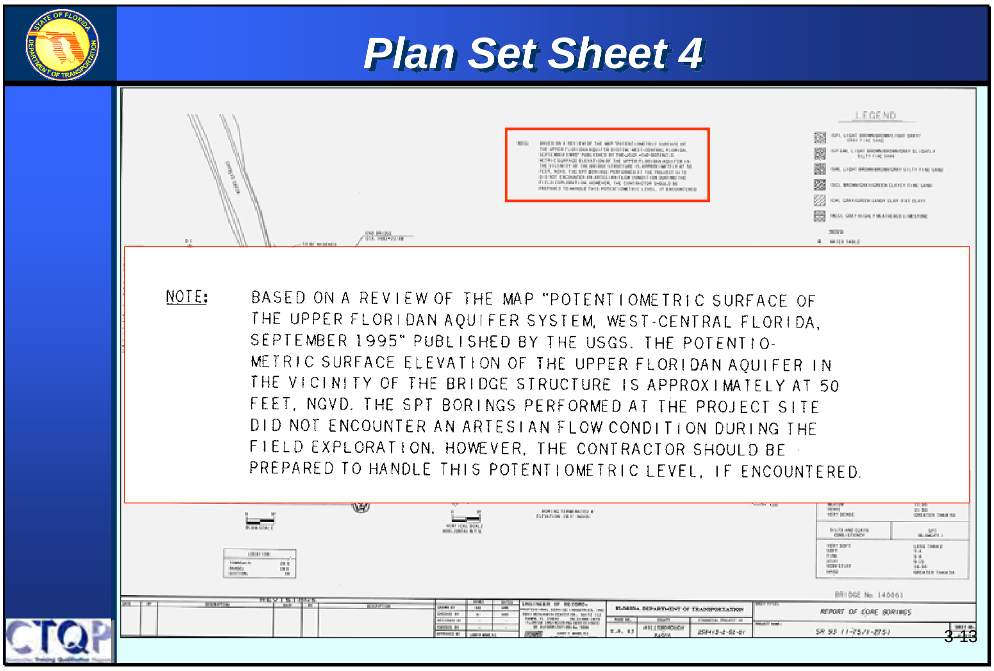

Plan Set Sheet 4
LEGEND
(SP), LIGHT BROWN/BROWN/LIGHT GRAY/ GRAY FINE SAND
(SP-SM), LIGHT BROWN/BROWN/GRAY SLIGHTLY SILTY FINE SAND
(SM), LIGHT BROWN/BROWN/GRAY SILTY FINE SAND
(SC), BROWN/GRAY/GREEN CLAYEY FINE SAND
(CH), GRAY/GREEN SANDY CLAY (FAT CLAY)
(WLS), GRAY HIGHLY WEATHERED LIMESTONE
NOTES:
WATER TABLE
N NUMBERS TO THE LEFT OF BORINGS INDICATE SPT VALUE FOR 12" PENETRATION. (UNLESS OTHERWISE NOTED.)
50/6" FIFTY BLOWS FOR SIX INCHES
LOSS OF CIRCULATION (%)
CASING USED
-200 FINES PASSING NO. 200 SIEVE (%)
NMC NATURAL MOISTURE CONTENT (%)
LL LIQUID LIMIT (%)
PI PLASTICITY INDEX (%)
APPROXIMATE SPT BORING LOCATION
ENVIRONMENTAL CLASSIFICATION
SUBSTRUCTURE: MODERATELY AGGRESSIVE (WATER-SULFATES=218 PPM; RESISTIVITY=2,000 OHMS-CM)
SUPERSTRUCTURE: SLIGHTLY AGGRESSIVE
BORING LOCATION PLAN
REPORT OF CORE BORINGS
3-13


Plan Set Sheet 4
END BRIDGE
STA. 1642+22.48
TO BE WIDENED
B-1
B-2
1639
1640
1641
1642
1643
1644
BEGIN BRIDGE
STA. 1640+66.48
℄ CONSTRUCTION I-75
LEGEND
REPORT OF CORE BORINGS
FLORIDA DEPARTMENT OF TRANSPORTATION
3-13

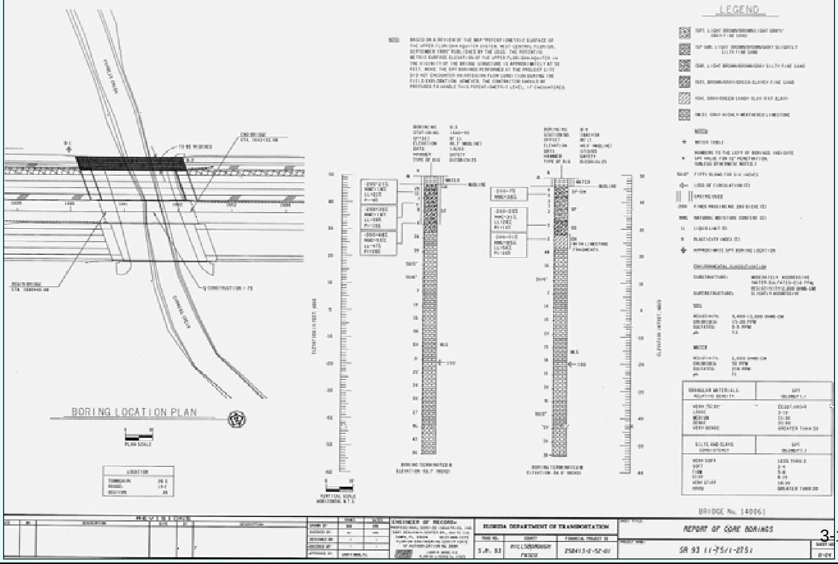
Plan Set Sheet 4



3-13

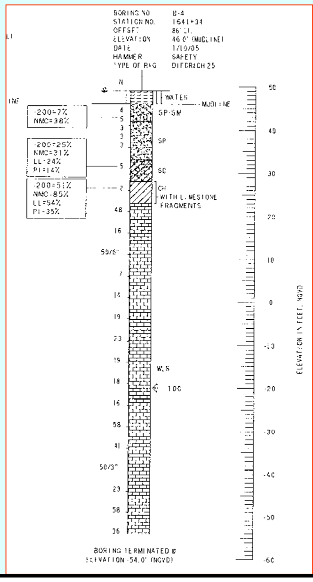

Plan Set Sheet 4
NOTE: BASED ON A REVIEW OF THE MAP "POTENTIOMETRIC SURFACE OF THE UPPER FLORIDAN AQUIFER SYSTEM, WEST-CENTRAL FLORIDA, SEPTEMBER 1995" PUBLISHED BY THE USGS. THE POTENTIOMETRIC SURFACE ELEVATION OF THE UPPER FLORIDAN AQUIFER IN THE VICINITY OF THE BRIDGE STRUCTURE IS APPROXIMATELY AT 50 FEET, NGVD. THE SPT BORINGS PERFORMED AT THE PROJECT SITE DID NOT ENCOUNTER AN ARTESIAN FLOW CONDITION DURING THE FIELD EXPLORATION. HOWEVER, THE CONTRACTOR SHOULD BE PREPARED TO HANDLE THIS POTENTIOMETRIC LEVEL, IF ENCOUNTERED.
LEGEND
REPORT OF CORE BORINGS
3-13

Plan Set Sheet 5

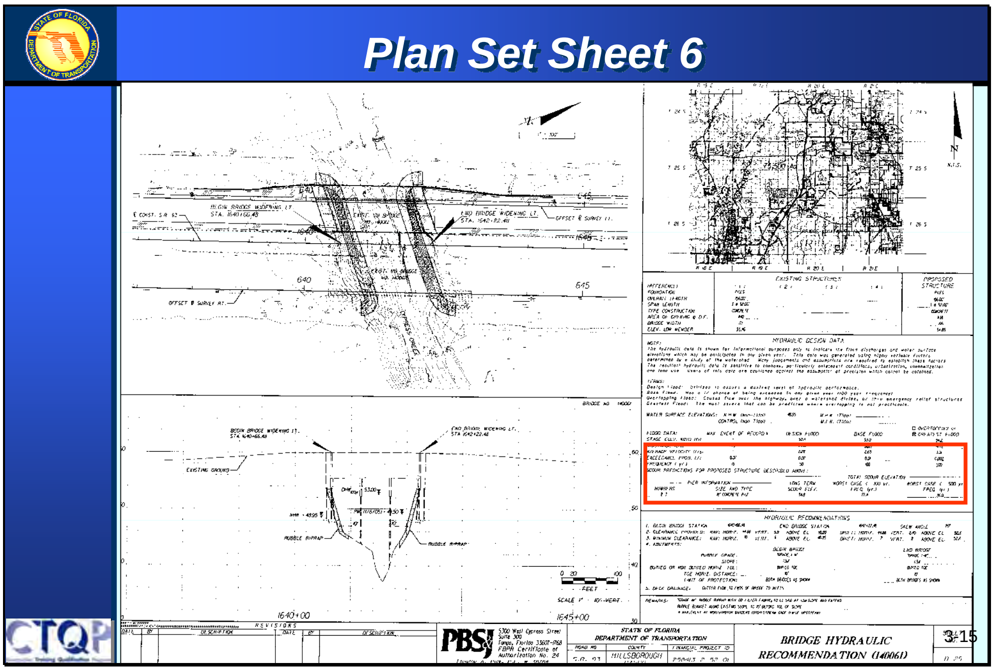


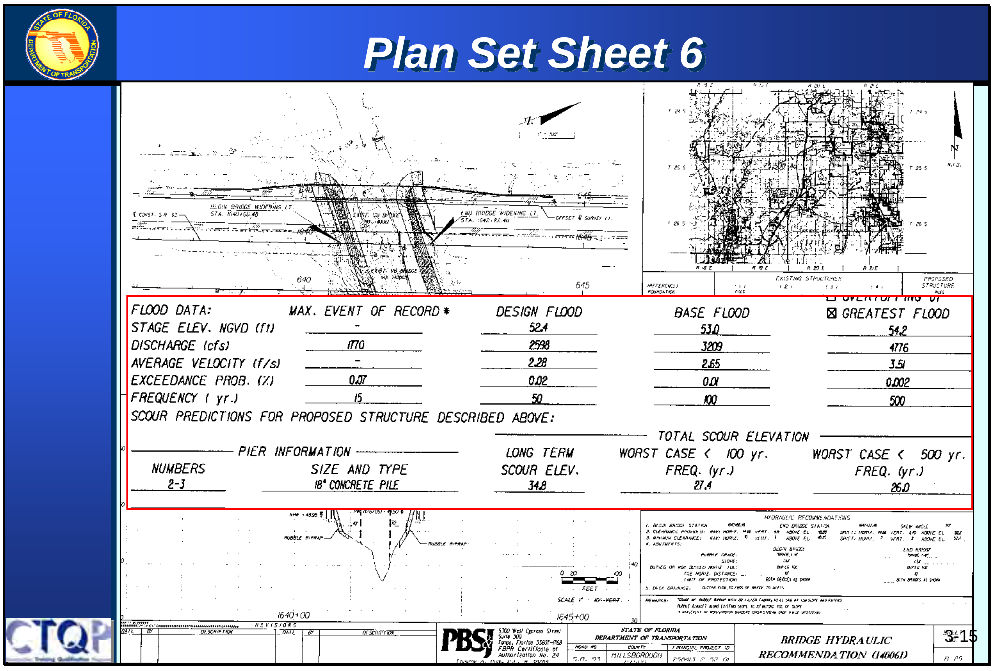
3-14

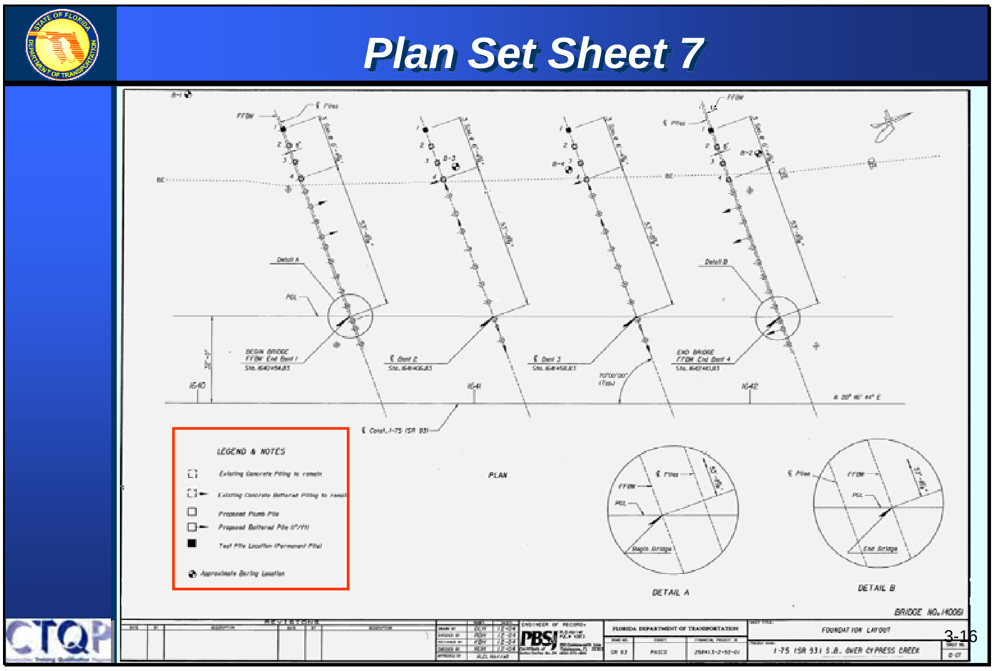
Plan Set Sheet 5

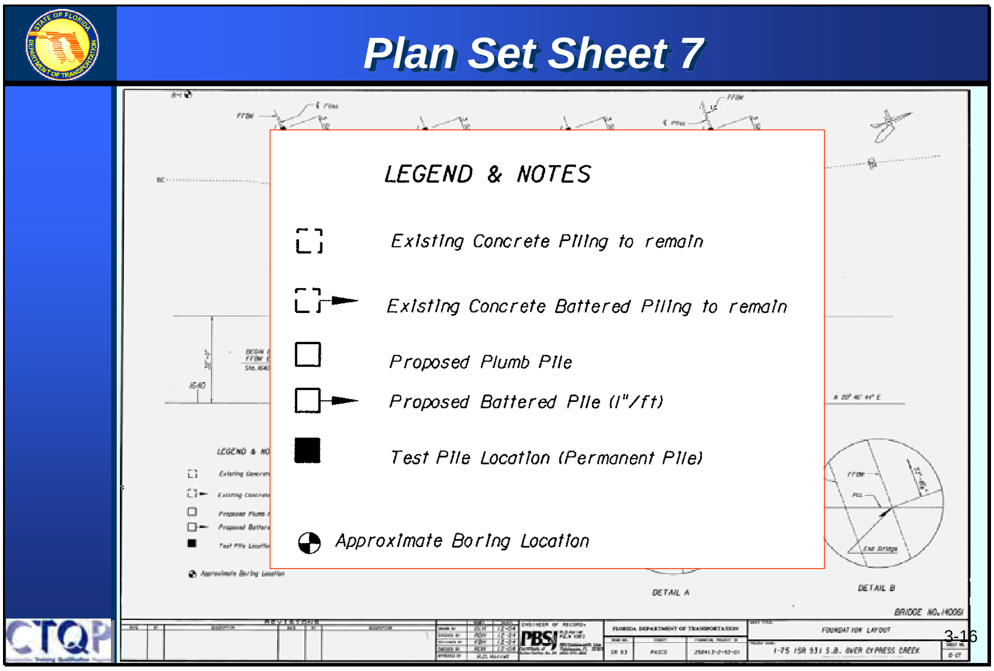


3-14

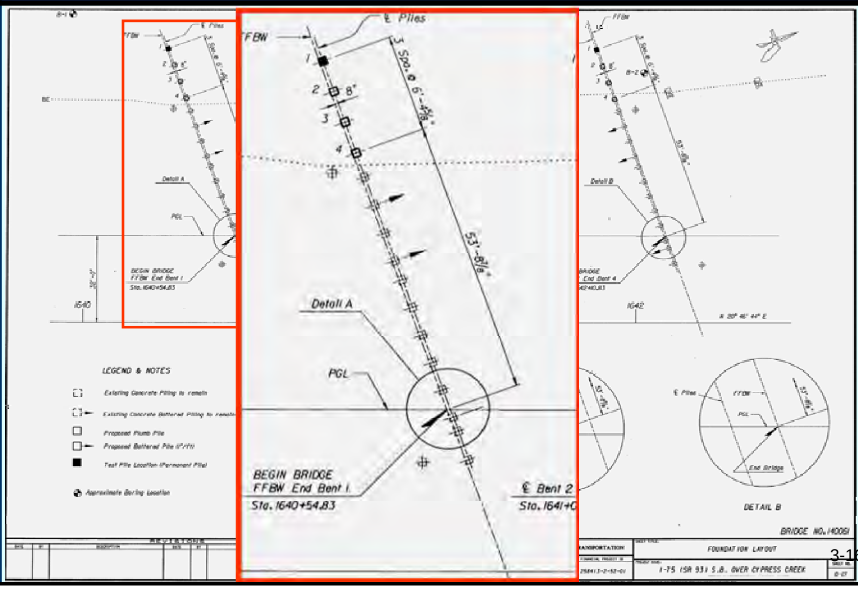

Plan Set Sheet 6
CTQP
PBSJ
STATE OF FLORIDA
DEPARTMENT OF TRANSPORTATION
HILLSBOROUGH
BRIDGE HYDRAULIC
RECOMMENDATION (146061)
3-15


Plan Set Sheet 6
FLOOD DATA:
MAX. EVENT OF RECORD *
DESIGN FLOOD
BASE FLOOD
GREATEST FLOOD
STAGE ELEV. NGVD (ft)
DISCHARGE (cfs)
AVERAGE VELOCITY (f/s)
EXCEEDANCE PROB. (%)
FREQUENCY (yr.)
- 1770 - 0.07 15
52.4 2598 2.28 0.02 50
53.0 3209 2.65 0.01 100
54.2 4776 3.51 0.002 500
SCOUR PREDICTIONS FOR PROPOSED STRUCTURE DESCRIBED ABOVE:
PIER INFORMATION
NUMBERS
SIZE AND TYPE
LONG TERM SCOUR ELEV.
TOTAL SCOUR ELEVATION
WORST CASE < 100 yr. FREQ. (yr.)
WORST CASE < 500 yr. FREQ. (yr.)
2-3
18" CONCRETE PILE
34.8
27.4
26.0
1640+00
1645+00
PBSJ
STATE OF FLORIDA
DEPARTMENT OF TRANSPORTATION
HILLSBOROUGH
BRIDGE HYDRAULIC RECOMMENDATION (140061)
CTQP
3-15


Plan Set Sheet 7
LEGEND & NOTES
Proposed Plumb Pile
PLAN
DETAIL A
DETAIL B
FOUNDATION LAYOUT
3-16

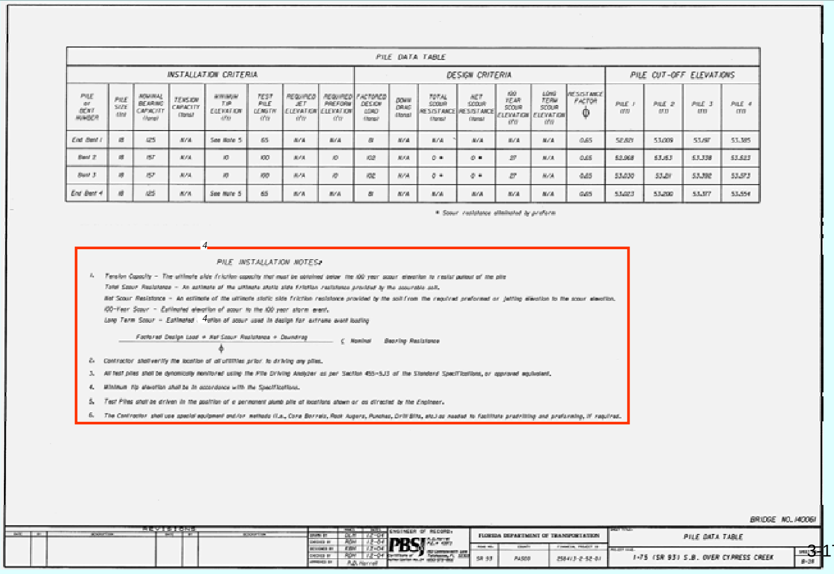

Plan Set Sheet 7
LEGEND & NOTES
Existing Concrete Piling to remain
Existing Concrete Battered Piling to remain
Proposed Plumb Pile
Proposed Battered Pile (1"/ft)
Test Pile Location (Permanent Pile)
Approximate Boring Location
DETAIL A
DETAIL B
3-16

Plan Set Sheet 7



3-16

Plan Set Sheet 8



PILE DATA TABLE																			
INSTALLATION CRITERIA								DESIGN CRITERIA							PILE CUT-OFF ELEVATIONS				
PILE or BENT NUMBER	PILE SIZE (in)	NOMINAL BEARING CAPACITY (tons)	TENSION CAPACITY (tons)	MINIMUM TIP ELEVATION (ft)	TEST PILE LENGTH (ft)	REQUIRED JET ELEVATION (ft)	REQUIRED PREFORM ELEVATION (ft)	FACTORED DESIGN LOAD (tons)	DOWN DRAG (tons)	TOTAL SCOUR RESISTANCE (tons)	NET SCOUR RESISTANCE (tons)	100 YEAR SCOUR ELEVATION (ft)	LONG TERM SCOUR ELEVATION (ft)	RESISTANCE FACTOR ϕ	PILE 1 (ft)	PILE 2 (ft)	PILE 3 (ft)	PILE 4 (ft)
End Bent 1	18	125	N/A	See Note 5	65	N/A	N/A	81	N/A	N/A	N/A	N/A	N/A	0.65	52.821	53.009	53.197	53.385
Bent 2	18	157	N/A	10	100	N/A	10	102	N/A	0 *	0 *	27	N/A	0.65	53.068	53.163	53.338	53.623
Bent 3	18	157	N/A	10	100	N/A	10	102	N/A	0 *	0 *	27	N/A	0.65	53.030	53.211	53.392	53.573
End Bent 4	18	125	N/A	See Note 5	65	N/A	N/A	81	N/A	N/A	N/A	N/A	N/A	0.65	53.023	53.200	53.377	53.554

* Scour resistance eliminated by preform

4

PILE INSTALLATION NOTES:

1. Tension Capacity – The ultimate side friction capacity that must be obtained below the 100 year scour elevation to resist pullout of the pile.
   Total Scour Resistance – An estimate of the ultimate static side friction resistance provided by the scourable soil.
   Net Scour Resistance – An estimate of the ultimate static side friction resistance provided by the soil from the required preformed or jetting elevation to the scour elevation.
   100-Year Scour – Estimated elevation of scour to the 100 year storm event.
   Long Term Scour – Estimated 4 elevation of scour used in design for extreme event loading.

   $$\frac{\text{Factored Design Load + Net Scour Resistance + Downdrag}}{\phi} \le \text{Nominal Bearing Resistance}$$

2. Contractor shall verify the location of all utilities prior to driving any piles.
3. All test piles shall be dynamically monitored using the Pile Driving Analyzer as per Section 455-5.13 of the Standard Specifications, or approved equivalent.
4. Minimum tip elevation shall be in accordance with the Specifications.
5. Test Piles shall be driven in the position of a permanent plumb pile at locations shown or as directed by the Engineer.
6. The Contractor shall use special equipment and/or methods (i.e., Core Barrels, Rock Augers, Punches, Drill Bits, etc.) as needed to facilitate predrilling and preforming, if required.

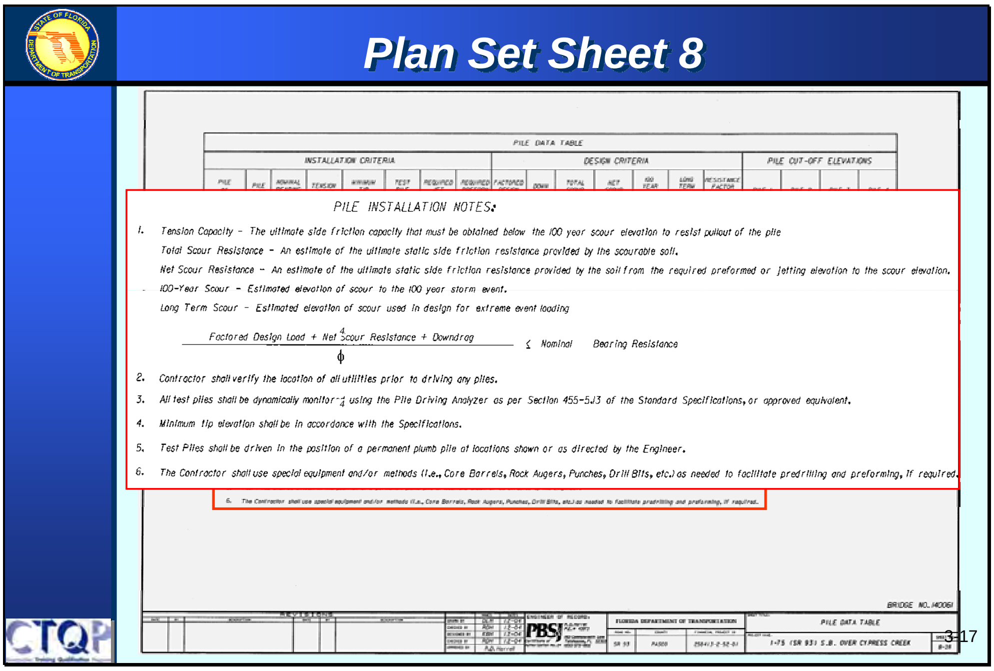
BRIDGE NO. 140061

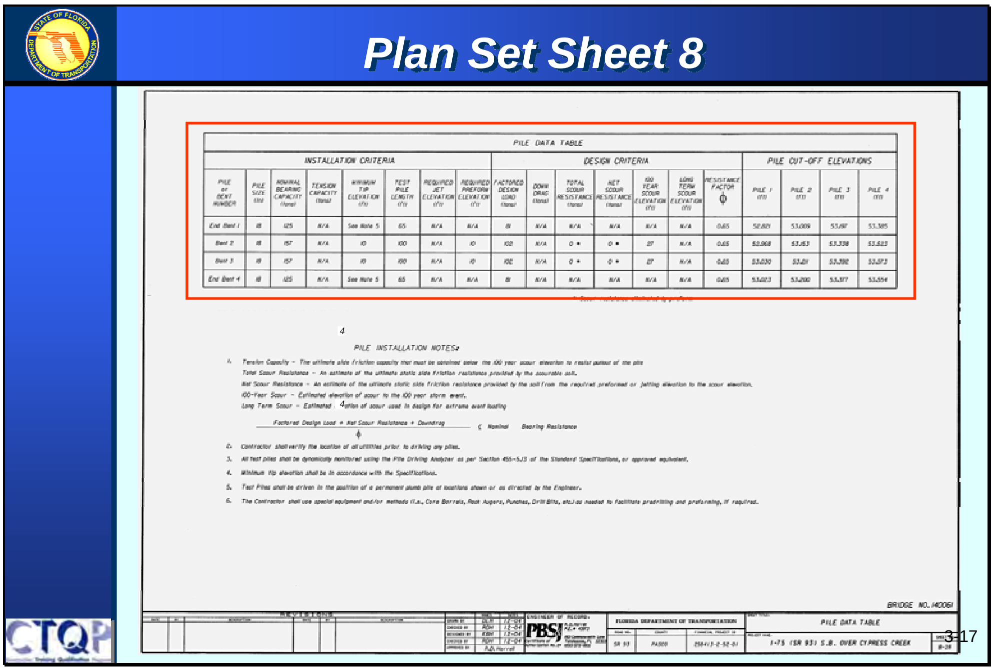
FLORIDA DEPARTMENT OF TRANSPORTATION

PILE DATA TABLE

I-75 (SR 93) S.B. OVER CYPRESS CREEK

3-17


Plan Set Sheet 8
PILE DATA TABLE
INSTALLATION CRITERIA
DESIGN CRITERIA
PILE CUT-OFF ELEVATIONS
PILE INSTALLATION NOTES:
1. Tension Capacity - The ultimate side friction capacity that must be obtained below the 100 year scour elevation to resist pullout of the pile
Total Scour Resistance - An estimate of the ultimate static side friction resistance provided by the scourable soil.
Net Scour Resistance - An estimate of the ultimate static side friction resistance provided by the soil from the required preformed or jetting elevation to the scour elevation.
100-Year Scour - Estimated elevation of scour to the 100 year storm event.
Long Term Scour - Estimated elevation of scour used in design for extreme event loading
Factored Design Load + Net Scour Resistance + Downdrag / ϕ ≤ Nominal Bearing Resistance
2. Contractor shall verify the location of all utilities prior to driving any piles.
3. All test piles shall be dynamically monitored using the Pile Driving Analyzer as per Section 455-5.J3 of the Standard Specifications, or approved equivalent.
4. Minimum tip elevation shall be in accordance with the Specifications.
5. Test Piles shall be driven in the position of a permanent plumb pile at locations shown or as directed by the Engineer.
6. The Contractor shall use special equipment and/or methods (i.e., Core Barrels, Rock Augers, Punches, Drill Bits, etc.) as needed to facilitate predrilling and preforming, if required.
BRIDGE NO. 140061
PILE DATA TABLE
I-75 (SR 93) S.B. OVER CYPRESS CREEK
3-17



PILE DATA TABLE

PILE or BENT NUMBER	INSTALLATION CRITERIA: PILE SIZE (in)	NOMINAL BEARING CAPACITY (tons)	TENSION CAPACITY (tons)	MINIMUM TIP ELEVATION (ft)	TEST PILE LENGTH (ft)	REQUIRED JET ELEVATION (ft)	REQUIRED PREFORM ELEVATION (ft)	DESIGN CRITERIA: FACTORED DESIGN LOAD (tons)	DOWN DRAG (tons)	TOTAL SCOUR RESISTANCE (tons)	NET SCOUR RESISTANCE (tons)	100 YEAR SCOUR ELEVATION (ft)	LONG TERM SCOUR ELEVATION (ft)	RESISTANCE FACTOR ϕ	PILE CUT-OFF ELEVATIONS: PILE 1 (ft)	PILE 2 (ft)	PILE 3 (ft)	PILE 4 (ft)
End Bent 1	18	125	N/A	See Note 5	65	N/A	N/A	81	N/A	N/A	N/A	N/A	N/A	0.65	52.821	53.009	53.197	53.385
Bent 2	18	157	N/A	10	100	N/A	10	102	N/A	0 *	0 *	27	N/A	0.65	52.968	53.163	53.338	53.523
Bent 3	18	157	N/A	10	100	N/A	10	102	N/A	0 *	0 *	27	N/A	0.65	53.030	53.211	53.392	53.573
End Bent 4	18	125	N/A	See Note 5	65	N/A	N/A	81	N/A	N/A	N/A	N/A	N/A	0.65	53.023	53.200	53.377	53.554

PILE INSTALLATION NOTES:

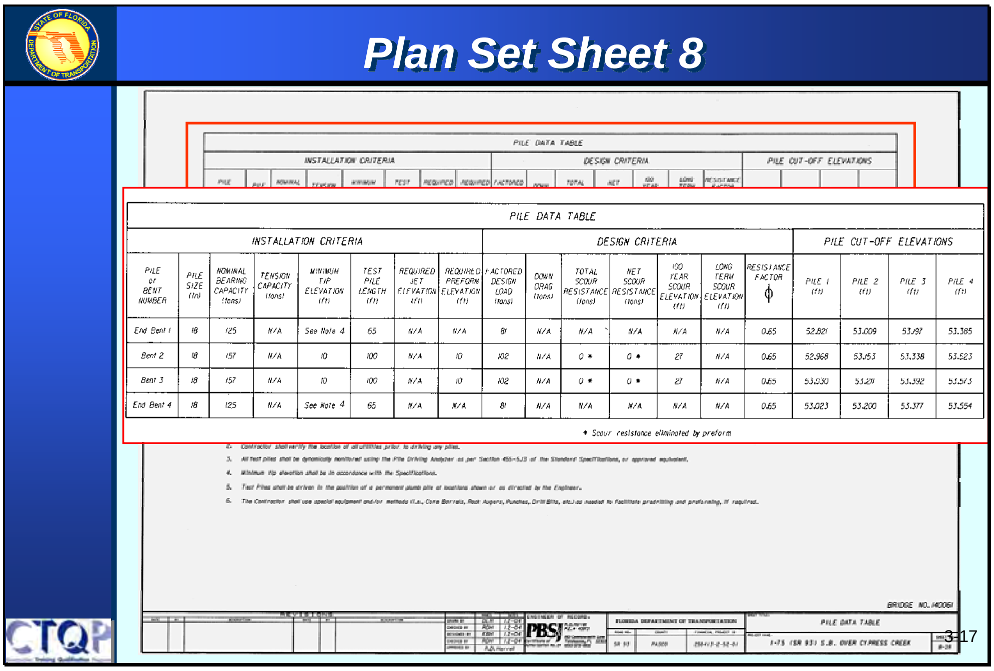
1. Tension Capacity - The ultimate side friction capacity that must be obtained below the 100 year scour elevation to resist pullout of the pile
   Total Scour Resistance - An estimate of the ultimate static side friction resistance provided by the scourable soil.
   Net Scour Resistance - An estimate of the ultimate static side friction resistance provided by the soil from the required preformed or jetting elevation to the scour elevation.
   100-Year Scour - Estimated elevation of scour to the 100 year storm event.
   Long Term Scour - Estimated elevation of scour used in design for extreme event loading

   $\frac{\text{Factored Design Load + Net Scour Resistance + Downdrag}}{\phi} \leq$ Nominal Bearing Resistance
2. Contractor shall verify the location of all utilities prior to driving any piles.
3. All test piles shall be dynamically monitored using the Pile Driving Analyzer as per Section 455-5.13 of the Standard Specifications, or approved equivalent.
4. Minimum tip elevation shall be in accordance with the Specifications.
5. Test Piles shall be driven in the position of a permanent plumb pile at locations shown or as directed by the Engineer.
6. The Contractor shall use special equipment and/or methods (i.e., Core Barrels, Rock Augers, Punches, Drill Bits, etc.) as needed to facilitate predrilling and preforming, if required.

BRIDGE NO. 140061

PILE DATA TABLE

I-75 (SR 93) S.B. OVER CYPRESS CREEK



PILE DATA TABLE

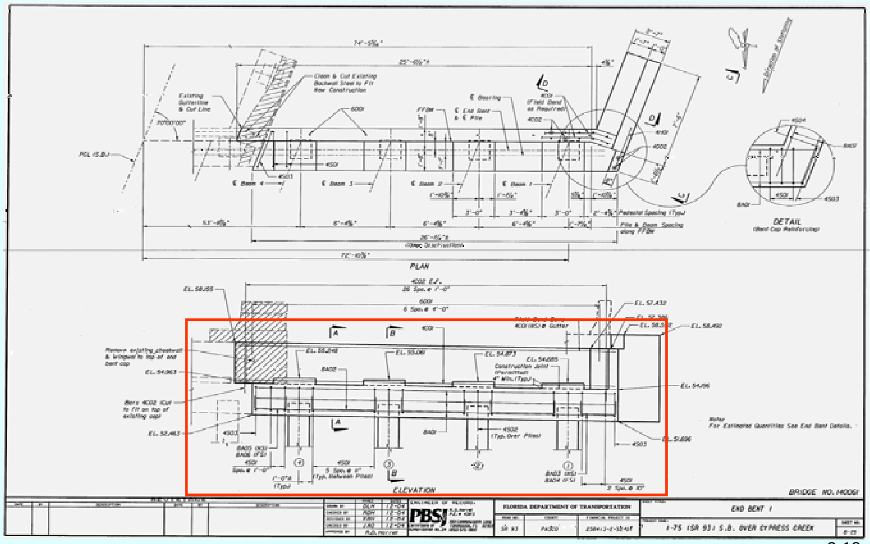
INSTALLATION CRITERIA								DESIGN CRITERIA							PILE CUT-OFF ELEVATIONS			
PILE or BENT NUMBER	PILE SIZE (in)	NOMINAL BEARING CAPACITY (tons)	TENSION CAPACITY (tons)	MINIMUM TIP ELEVATION (ft)	TEST PILE LENGTH (ft)	REQUIRED JET ELEVATION (ft)	REQUIRED PREFORM ELEVATION (ft)	FACTORED DESIGN LOAD (tons)	DOWN DRAG (tons)	TOTAL SCOUR RESISTANCE (tons)	NET SCOUR RESISTANCE (tons)	100 YEAR SCOUR ELEVATION (ft)	LONG TERM SCOUR ELEVATION (ft)	RESISTANCE FACTOR ϕ	PILE 1 (ft)	PILE 2 (ft)	PILE 3 (ft)	PILE 4 (ft)
End Bent 1	18	125	N/A	See Note 4	65	N/A	N/A	81	N/A	N/A	N/A	N/A	N/A	0.65	52.821	53.009	53.197	53.385
Bent 2	18	157	N/A	10	100	N/A	10	102	N/A	0 *	0 *	27	N/A	0.65	52.968	53.153	53.338	53.523
Bent 3	18	157	N/A	10	100	N/A	10	102	N/A	0 *	0 *	27	N/A	0.65	53.030	53.211	53.392	53.573
End Bent 4	18	125	N/A	See Note 4	65	N/A	N/A	81	N/A	N/A	N/A	N/A	N/A	0.65	53.023	53.200	53.377	53.554

* Scour resistance eliminated by preform

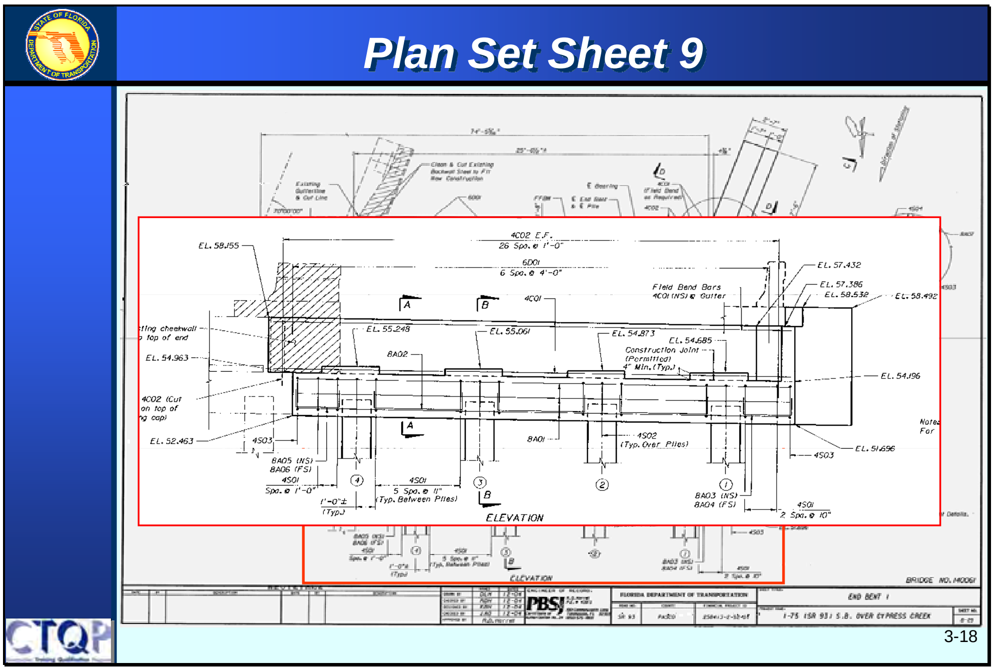
2. Contractor shall verify the location of all utilities prior to driving any piles.
3. All test piles shall be dynamically monitored using the Pile Driving Analyzer as per Section 455-5.13 of the Standard Specifications, or approved equivalent.
4. Minimum tip elevation shall be in accordance with the Specifications.
5. Test Piles shall be driven in the position of a permanent plumb pile at locations shown or as directed by the Engineer.
6. The Contractor shall use special equipment and/or methods (i.e., Core Barrels, Rock Augers, Punches, Drill Bits, etc.) as needed to facilitate predrilling and preforming, if required.

3-17

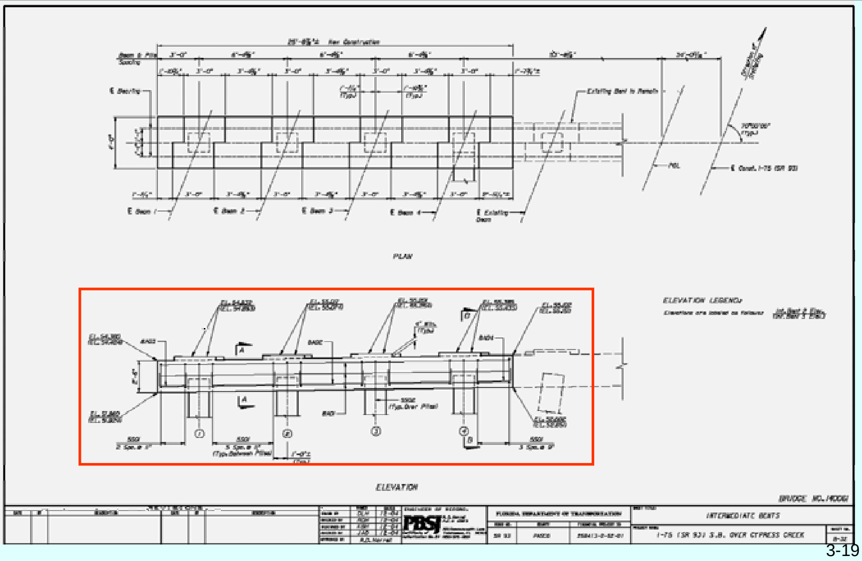
Plan Set Sheet 9



3-18

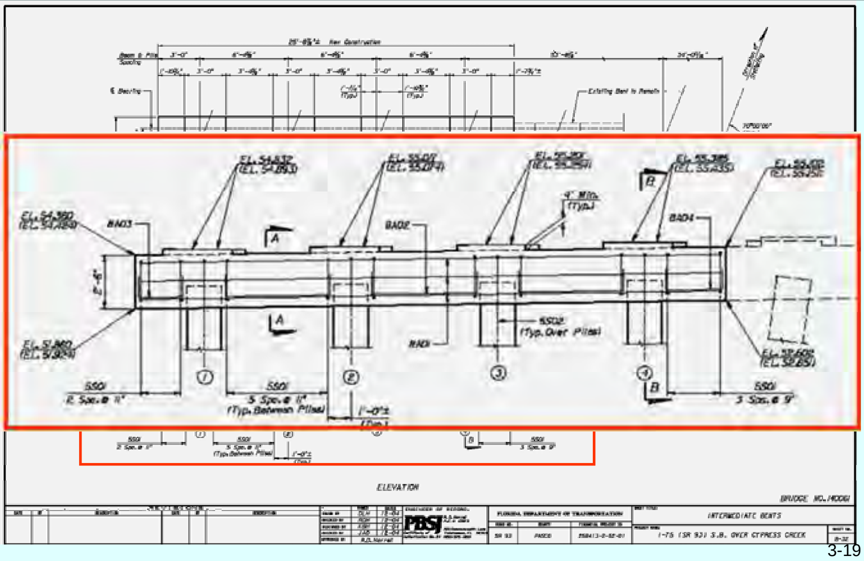

Plan Set Sheet 9
ELEVATION
3-18

Plan Set Sheet 10

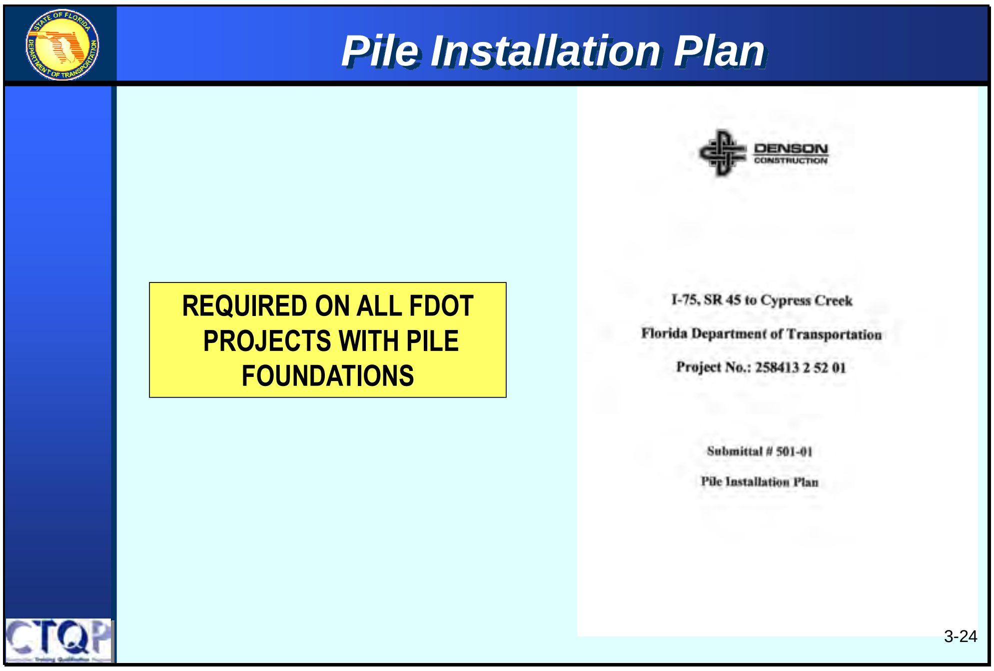


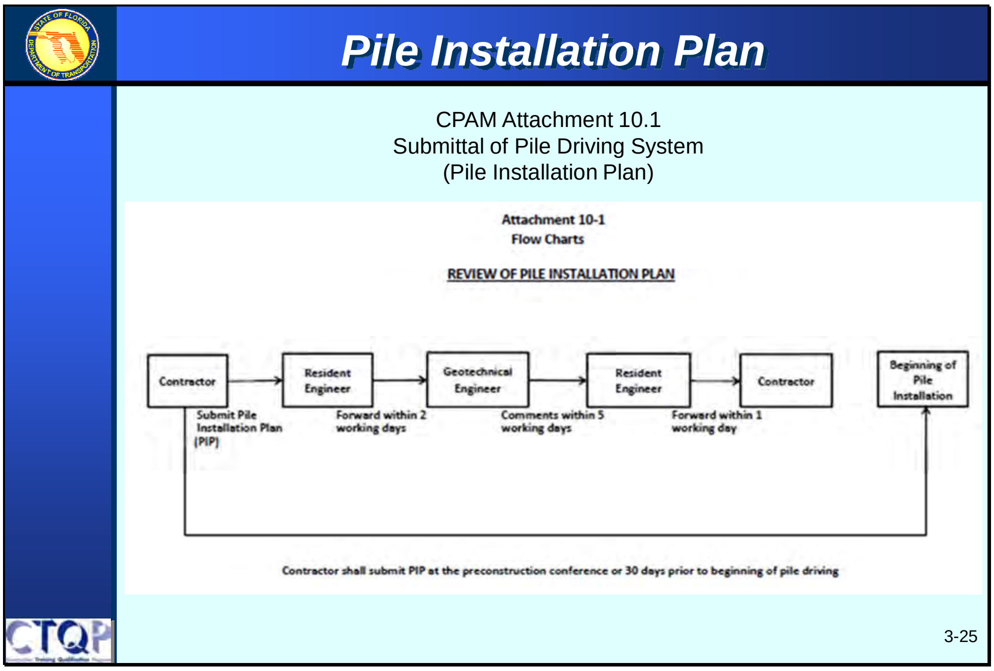
3-19

Plan Set Sheet 10



3-19

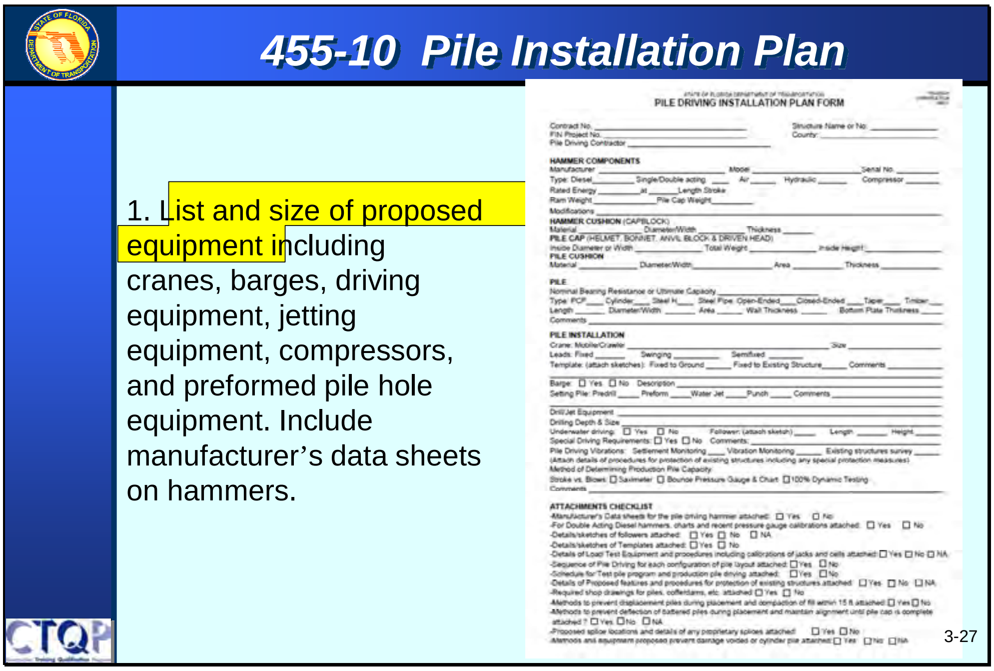

Pile Installation Plan
REQUIRED ON ALL FDOT PROJECTS WITH PILE FOUNDATIONS
DENSON CONSTRUCTION
I-75, SR 45 to Cypress Creek
Florida Department of Transportation
Project No.: 258413 2 52 01
Submittal # 501-01
Pile Installation Plan
CTQP
3-24


Pile Installation Plan
CPAM Attachment 10.1
Submittal of Pile Driving System
(Pile Installation Plan)
Attachment 10-1
Flow Charts
REVIEW OF PILE INSTALLATION PLAN
Contractor
Resident Engineer
Geotechnical Engineer
Resident Engineer
Contractor
Beginning of Pile Installation
Submit Pile Installation Plan (PIP)
Forward within 2 working days
Comments within 5 working days
Forward within 1 working day
Contractor shall submit PIP at the preconstruction conference or 30 days prior to beginning of pile driving
3-25

455-10 Pile Installation Plan

455-10.1 General: Complete the Pile Driving Installation Plan form provided by the Engineer. Return the Pile Driving Installation Plan information to the Engineer at the preconstruction conference or no later than 30 days before driving the first pile. Ensure the Pile Driving Installation Plan information includes the following:

3-26


455-10 Pile Installation Plan
1. List and size of proposed equipment including cranes, barges, driving equipment, jetting equipment, compressors, and preformed pile hole equipment. Include manufacturer's data sheets on hammers.
PILE DRIVING INSTALLATION PLAN FORM
3-27

455-10 Pile Installation Plan

2. Methods to determine hammer energy in the field for determination of pile capacity. Include in the submittal necessary charts and recent calibrations for any pressure measuring equipment.

3-28

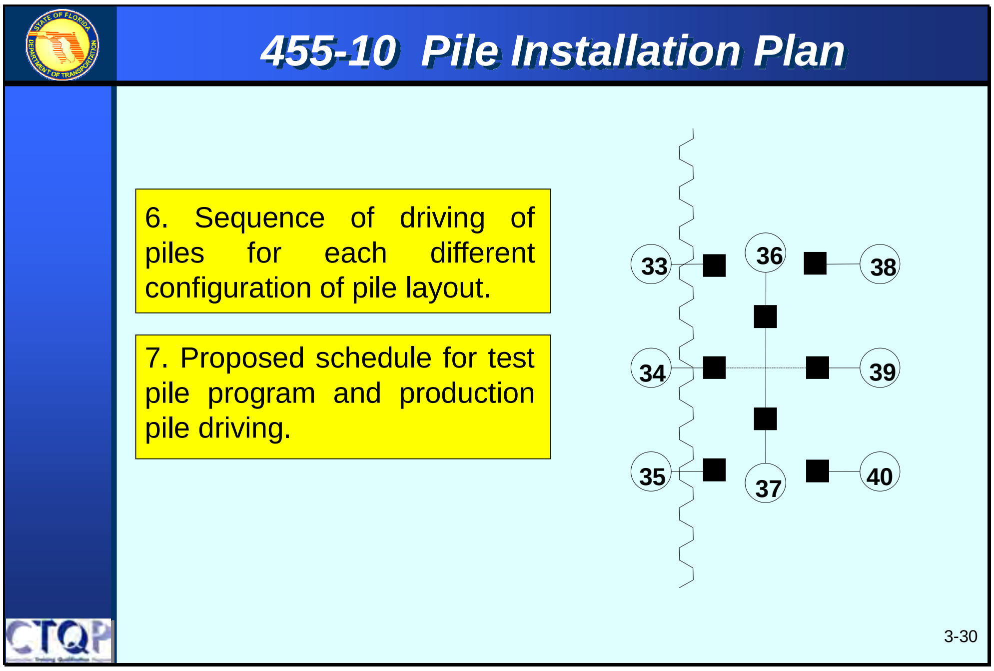
455-10 Pile Installation Plan

3. Detailed drawings of any proposed followers.

4. Detailed drawings of templates.

5. Details of proposed load test equipment and procedures, including recent calibrations of jacks and required load cells.

3-29


455-10 Pile Installation Plan
6. Sequence of driving of piles for each different configuration of pile layout.
7. Proposed schedule for test pile program and production pile driving.
33
36
38
34
39
35
37
40
3-30

455-10 Pile Installation Plan

8. Details of proposed features and procedures for protection of existing structures.

9. Required shop drawings for piles, cofferdams, etc.

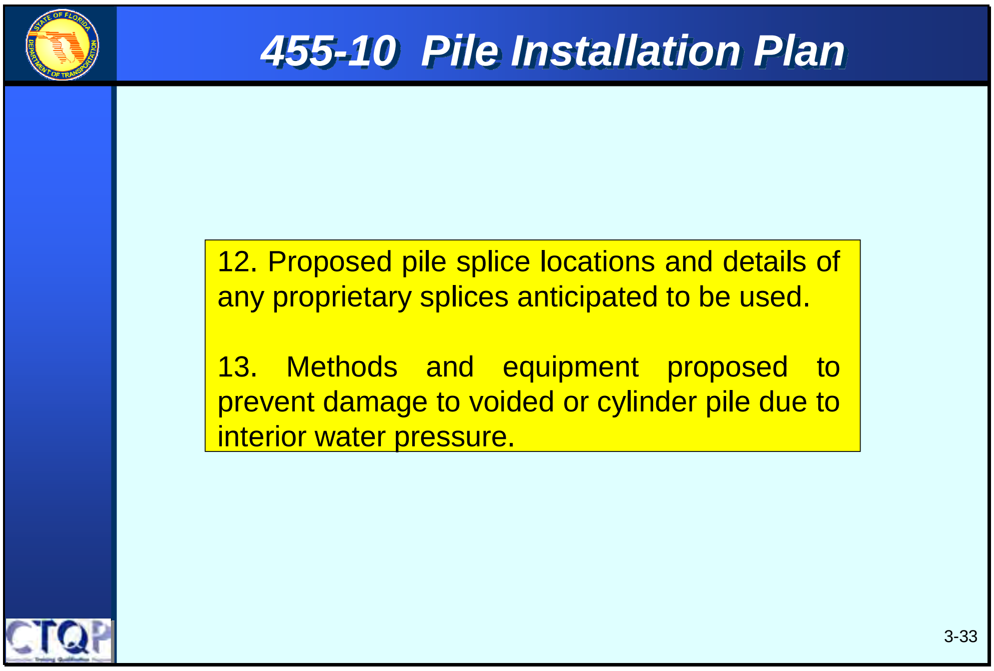
3-31

455-10 Pile Installation Plan

10. Methods and equipment proposed to prevent displacement of piles during placement and compaction of fill within 15 feet of the piles.

11. Methods to prevent deflection of battered piles due to their own weight and to maintain their as-driven position until casting of the pile cap is complete.

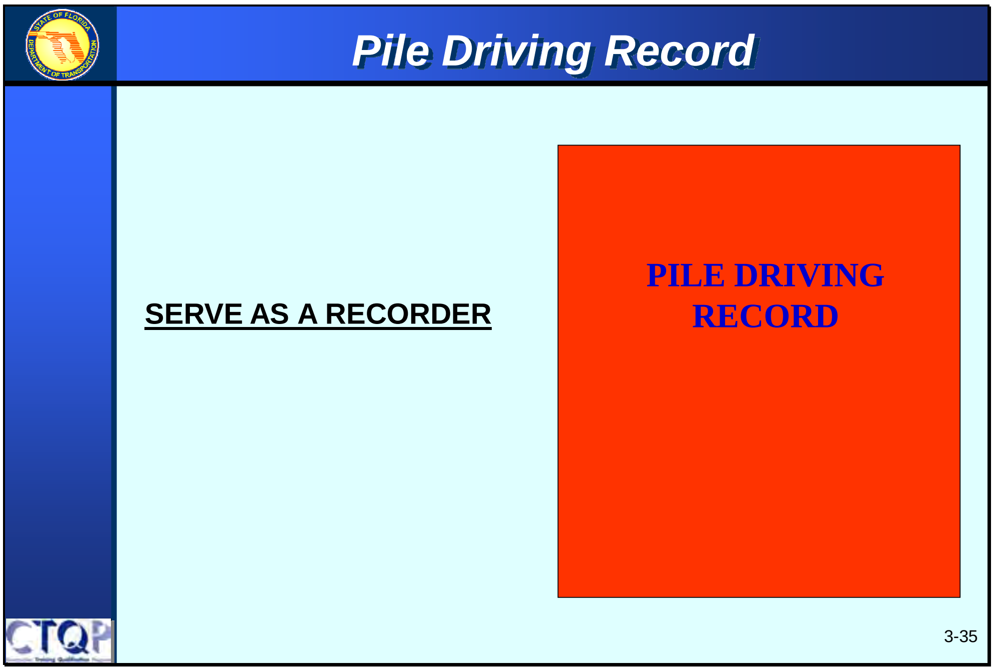
3-32

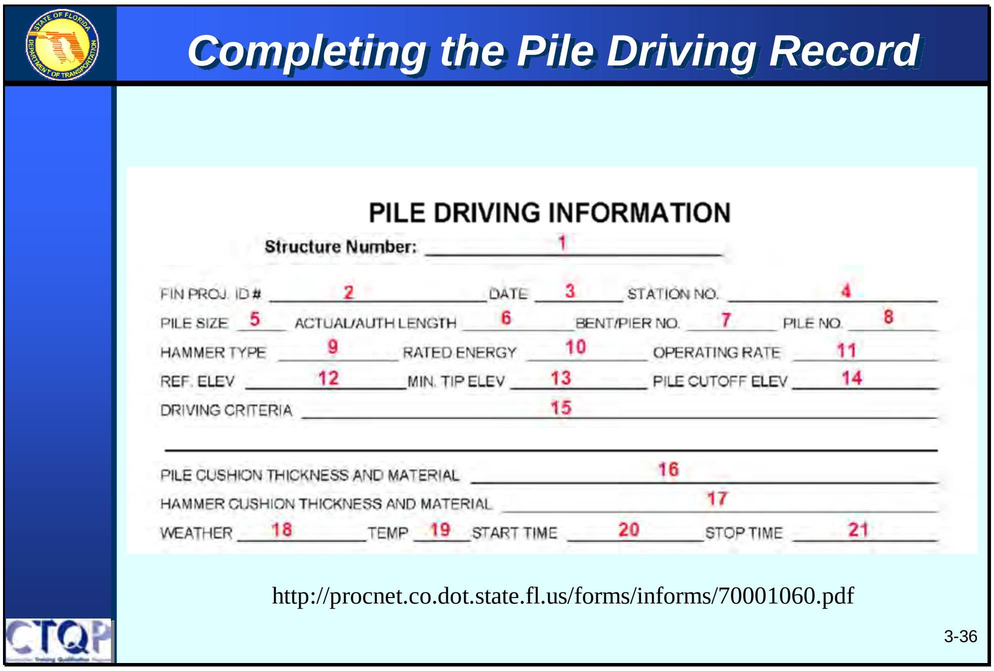

455-10 Pile Installation Plan
12. Proposed pile splice locations and details of any proprietary splices anticipated to be used.
13. Methods and equipment proposed to prevent damage to voided or cylinder pile due to interior water pressure.
3-33

455-10 Pile Installation Plan

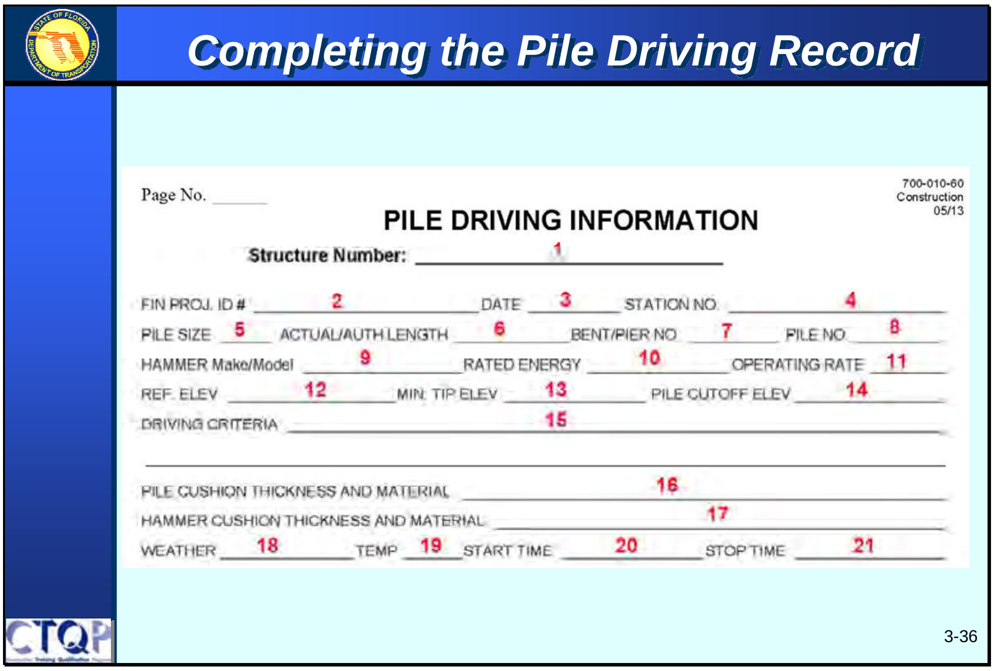
455-10.2 Acceptance of Equipment and Procedures: All equipment and procedures are subject to satisfactory field performance. Make any required changes that may result from unsatisfactory field performance. The Engineer will give final acceptance after the Contractor makes necessary modifications. Do not make any changes in the driving system after acceptance without authorization of the Engineer. A hammer repaired on site or removed from the site and returned is considered to have its performance altered (efficiency increased or decreased), which is considered a change in the driving system and is subject to a Dynamic Load Test in accordance with 455-5.13 at no additional compensation.

3-34

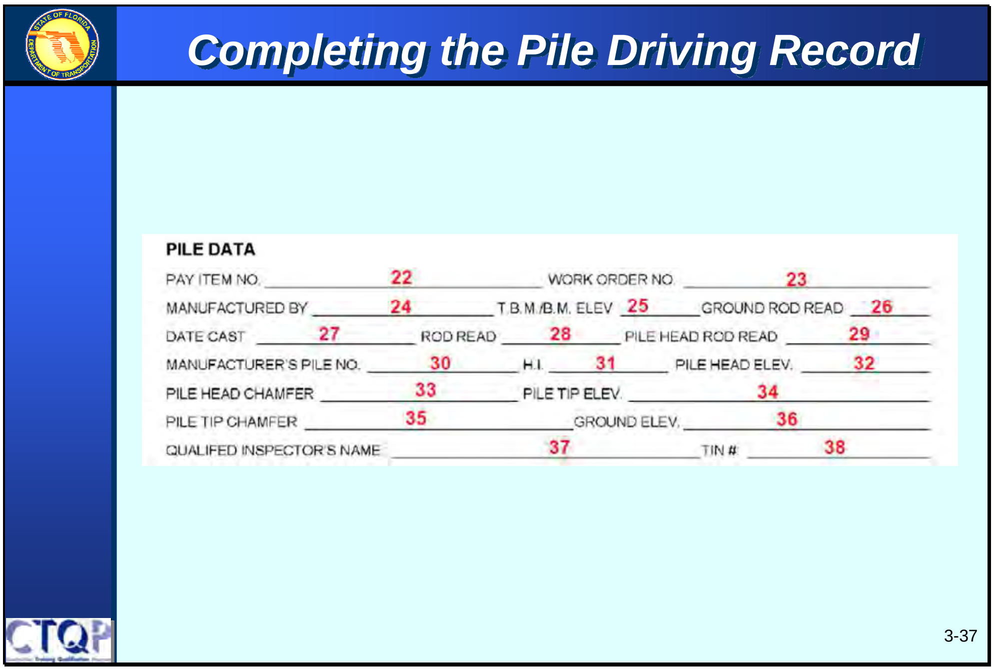

Pile Driving Record
SERVE AS A RECORDER
PILE DRIVING RECORD
3-35



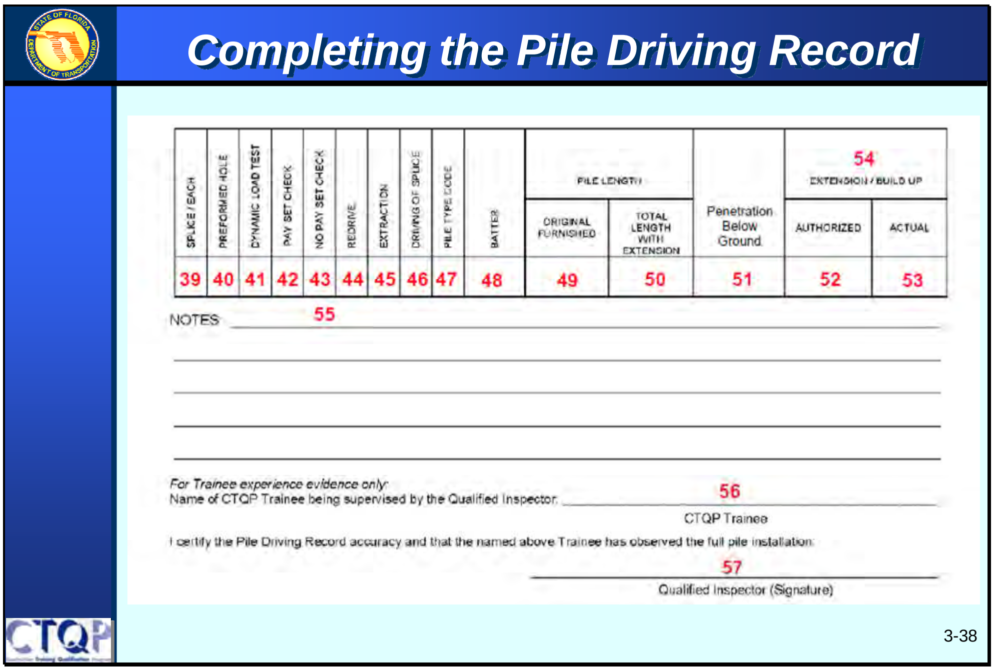
1. *Structure Number – Fill in the Structure Number of bridge. It should be in the structural plans.*
2. *FIN Project ID Number – The financial project number. It should be indicated on plans.*
3. *Date – The date that pile is driven.*
4. *Station Number – Station location of the pile driven to the nearest measured unit.*
5. *Pile Size – Size of the pile driven as indicated in the plans.*
6. *Actual/Authorized Length – Authorized pile length (any deviation in the length from the authorized pile length should be explained in the bottom of the page).*
7. *Bent/Pier Number – Number assigned to the bent/pier, which includes the pile being driven as indicated in the plans.*
8. *Pile Number – Pile number within the bent/pier as indicated in the plans or assigned by the project engineer.*
9. *Hammer Make/Model – Type hammer, including manufacturer name and model number, used to drive the pile. If this type differs from the type accepted in the PIP, explain in the Notes section of the page.*
10. *Rated Energy – As accepted in the PIP. Note any changes from the PIP in the notes section.*
11. *Operating Rate – As approved in the PIP. Note any changes from the PIP in the notes section.*
12. *Reference Elevation – Elevation of the top of the template or reference to the nearest appropriate unit as approved in the PIP.*



13. Minimum Tip Elevation – As indicated in the plans, or authorized by the engineer. Not applicable in all cases.
14. Pile Cutoff Elevation – As authorized by the engineer, or as indicated in the plans.
15. Driving Criteria – Input a summary of the blow count criteria provided by the District or Consultant Geotechnical Engineer. (Referring to a letter is Not enough.)
16. Pile Cushion Thickness and Material – As accepted in the PIP. Note any changes in the "Notes" section.
17. Hammer Cushion Thickness and Material – As accepted in the PIP. Note any changes in the "Notes" section.
18. Weather – Weather conditions at time of driving - does not include temperature (Example: partly cloudy, cloudy, clear, etc.).
19. Temperature – The ambient (air) temperature at the time of driving.
20. Start Time – The time of day that actual driving commences.
21. Stop Time – The time of day that actual driving ceases.



22. Pay Item Number – As indicated by contract documents.
23. Work Order Number – The number of the transfer or release form certified by authorized personnel inspecting the pile casting operation. Concrete pile only.
24. Manufactured By – Name of the company that manufactured the pile being driven.
25. T.B.M./B.M. Elevation – The elevation of the temporary benchmark or benchmark used to establish all pertinent elevations.
26. Ground Rod Reading – Actual level rod reading of shot taken beside the driven pile.
27. Date Cast – As shown on the work order described in number should match the date shown on the pile.
28. Rod Reading – Actual level rod reading of shot taken on the B.M. or T.B.M. described in number 25.
29. Pile Head Rod Reading – Actual level rod reading on top of pile after driving.
30. Manufacturer's Pile Number – As shown on the work order described in number.
31. H.I. – The height of the instrument taking the level reading.
32. Pile Head Elevation – Actual elevation of the pile head after driving.
33. Pile Head Chamfer – Per Standard Index or Plans. Indicate any changes in 'notes' section.
34. Pile Tip Elevation – Actual elevation of the pile tip after driving. Note: Take batter into account.
35. Pile Tip Chamfer – See number 33.
36. Ground Elevation – Actual elevation of ground at the base of the driven pile.
37. For Open Ended Pipe Piles – The length between top of pile and top of the soil plug in feet.
38. Pile Driving Inspector – Printed name of the CTQP qualified technician or engineer present and inspecting the driving of the pile.



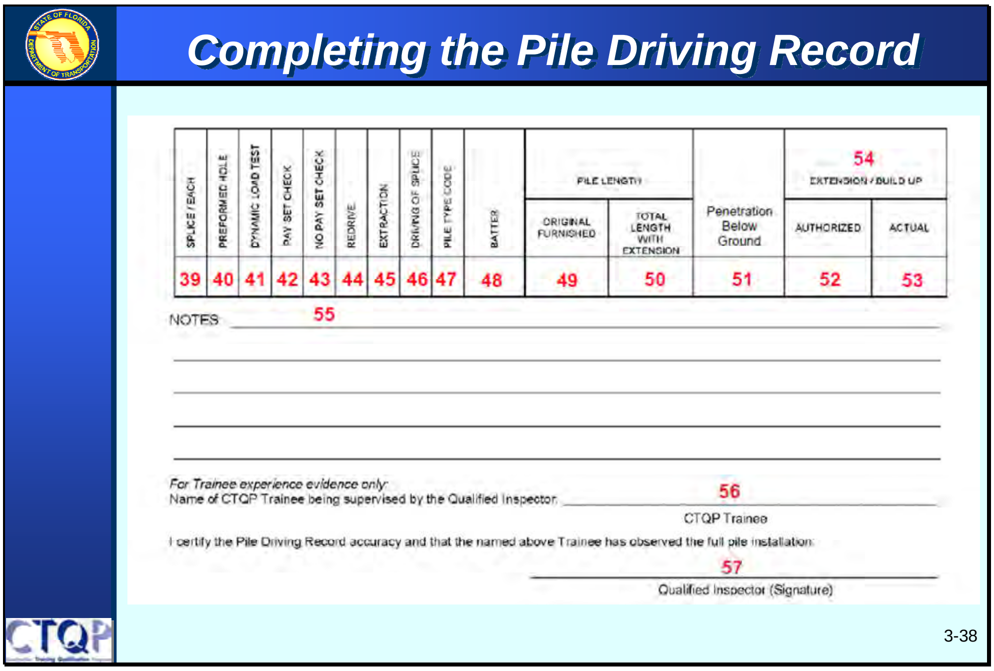
39. TIN # – Training Identification Number of CTQP technician.
40. Splice Each – The number of splices used in the driving of the pile.
41. Preformed Hole – Indicate the length in feet of the preformed hole.

42. Dynamic Load Test – Indicate use of the Pile Dynamic Analyzer with a one (1), nonuse with a zero (0).
43. Pay Set Check – Number of set checks to be paid as per specifications as additional pile length.
44. No Pay Set Check – Number of set checks performed that do not incur in additional compensation as per specifications.
45. Pile Re-drive – Indicate the number of re-drives performed.
46. Extraction – If the pile is extracted, indicate with a (1). If not, indicate with a zero (0). Note details of any extraction in the 'Notes' section.
47. Driving of Splice – If splice was driven indicate with (1), If not, indicate with a zero (0).
48. Pile Type Code: Place the corresponding number in this field.

1. - Prestressed Concrete 2. - Steel

3. - Composite 4. - Timber 5. - Concrete Cylinder Pile

49. Batter - The front end of the batter ratio (xxx.xxx:1). To three decimal places. Example: 001.500:1, 002.000:1 etc.
50. Total Pile Length with Extension(s) – Total length includes the original pile length and the extension/build-ups. To two decimal places.
52. Penetration Below Ground – The actual length of the pile installed below the existing ground. To two decimal places.
53. Extension/Build up, Authorized - The total length of the extension and/or buildup authorized by the engineer. To two decimal places.

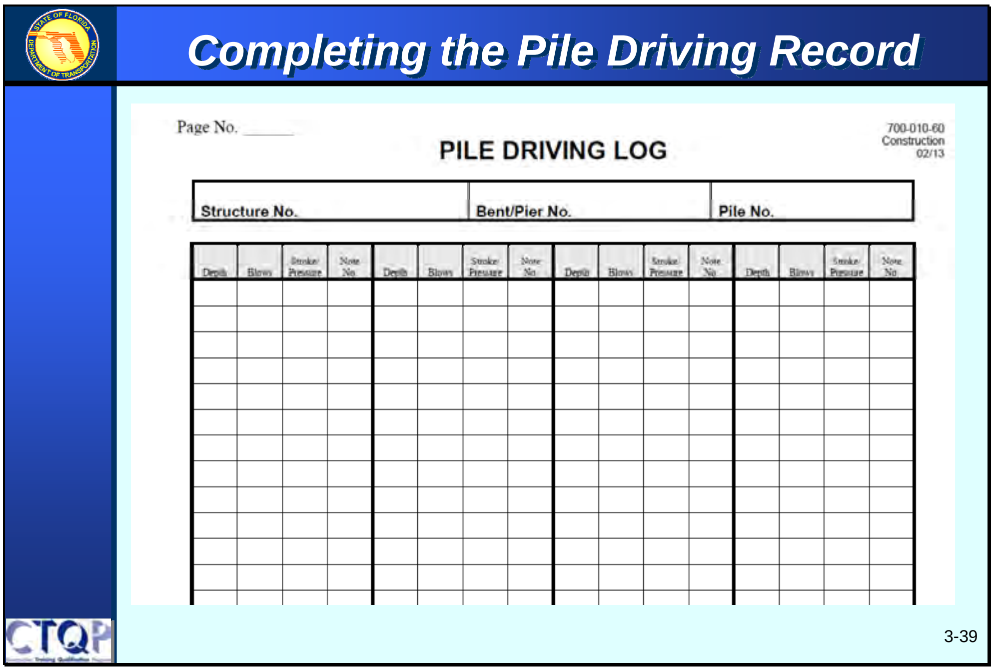


54. Extension/Build up, Actual - The total length of the extension and/or buildup used on the pile. To two decimal places.

55. Extension/Build-up – When the build-up is more than four inches and up to two feet and is poured into a cap, circle the word "build-up" and indicate the number of feet under the "Authorized" and under "Actual". If longer than two feet circle "Extension" and indicate the two feet "Authorized" and "Actual".

56. Notes - Write all information relating to changes to construction documents and site conditions here. Also note all interruptions and milestones in the driving of the pile. If there is insufficient space in this section for all notes, continue the notes on the next (grid) page.

57. Trainee – A person inspecting the pile under full supervision of a qualified inspector, in order to meet the experience requirements of the CTQP qualification.



Depth: The total length (below the reference) of pile driven at any point of the pile driving sequence, in the unit applicable (typically 1 foot intervals).

Blows: The number of blows required to drive the pile one length unit (typically 1 foot).

Stroke/Pressure: Only one number needs to be entered here. This number should be the total length of stroke for a single-acting Diesel hammer, or either the stroke length, or the gauge pressure for an air/steam hammer. Use the "Notes" section to document any change in the fuel setting.

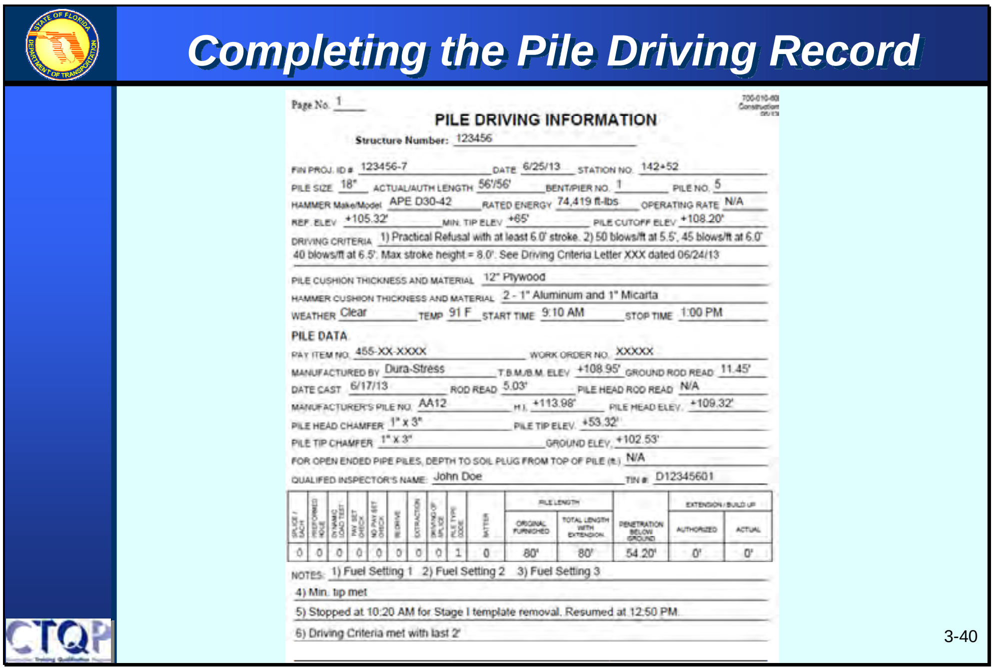
Note Number: When things happen during the driving of the pile that warrant a note, place a number in this column. Correlate the number with a number in the "notes" section of the opposire page, and write the actual note there.

Completing the Pile Driving Record

YES	NO	
☐	☐	Have you filled in all pre-driving data in the Pile Driving Information page of the log?
☐	☐	Have you recorded pile placement data including jetting or preforming depths prior to driving?
☐	☐	Have you recorded an average stroke height (or bounce chamber pressure) for each corresponding foot of driving?
☐	☐	Have you made notes on the log at the corresponding foot marks?
☐	☐	Have you made general notes of observations on the driving log?

3-40

Here is a short checklist of things to ask yourself about the completion of the Pile Driving Record.



Page No. 1

700-010-60 Construction

PILE DRIVING INFORMATION

Structure Number: 123456

FIN PROJ. ID # 123456-7 DATE 6/25/13 STATION NO. 142+52

PILE SIZE 18" ACTUAL/AUTH LENGTH 56'/56' BENT/PIER NO. 1 PILE NO. 5

HAMMER Make/Model APE D30-42 RATED ENERGY 74,419 ft-lbs OPERATING RATE N/A

REF. ELEV +105.32' MIN. TIP ELEV +65' PILE CUTOFF ELEV +108.20'

DRIVING CRITERIA 1) Practical Refusal with at least 6.0' stroke. 2) 50 blows/ft at 5.5', 45 blows/ft at 6.0' 40 blows/ft at 6.5'. Max stroke height = 8.0'. See Driving Criteria Letter XXX dated 06/24/13

PILE CUSHION THICKNESS AND MATERIAL 12" Plywood

HAMMER CUSHION THICKNESS AND MATERIAL 2 - 1" Aluminum and 1" Micarta

WEATHER Clear TEMP 91 F START TIME 9:10 AM STOP TIME 1:00 PM

PILE DATA

PAY ITEM NO. 455-XX-XXXX WORK ORDER NO. XXXXX

MANUFACTURED BY Dura-Stress T.B.M./B.M. ELEV +108.95' GROUND ROD READ 11.45'

DATE CAST 6/17/13 ROD READ 5.03' PILE HEAD ROD READ N/A

MANUFACTURER'S PILE NO. AA12 H.I. +113.98' PILE HEAD ELEV. +109.32'

PILE HEAD CHAMFER 1" x 3" PILE TIP ELEV. +53.32'

PILE TIP CHAMFER 1" x 3" GROUND ELEV. +102.53'

FOR OPEN ENDED PIPE PILES, DEPTH TO SOIL PLUG FROM TOP OF PILE (ft.) N/A

QUALIFED INSPECTOR'S NAME: John Doe TIN # D12345601

SPLICE / EACH	PREFORMED HOLE	DYNAMIC LOAD TEST	PAY SET CHECK	NO PAY SET CHECK	REDRIVE	EXTRACTION	DRIVING OF SPLICE	PILE TYPE CODE	BATTER	PILE LENGTH		PENETRATION BELOW GROUND	EXTENSION / BUILD UP	
										ORIGINAL FURNISHED	TOTAL LENGTH WITH EXTENSION		AUTHORIZED	ACTUAL
0	0	0	0	0	0	0	0	1	0	80'	80'	54.20'	0'	0'

NOTES: 1) Fuel Setting 1 2) Fuel Setting 2 3) Fuel Setting 3

4) Min. tip met

5) Stopped at 10:20 AM for Stage I template removal. Resumed at 12:50 PM.

6) Driving Criteria met with last 2'

Completing the Pile Driving Record

Page No. 2

700-010-60
Construction
05/13

PILE DRIVING LOG

Structure No. 123456	Bent/Pier No. 1	Pile No. 5

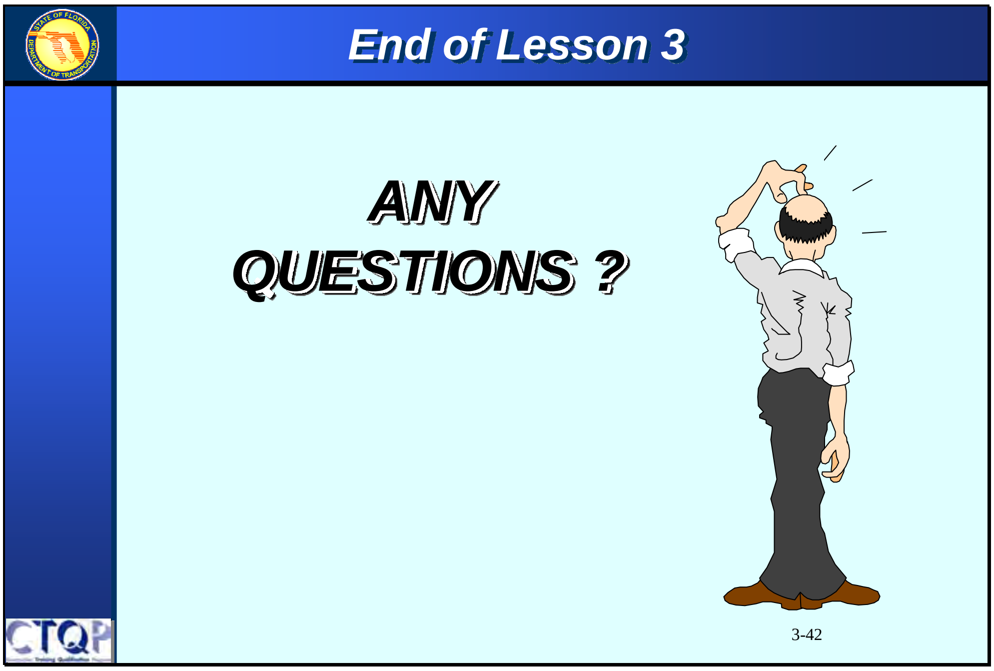
Depth	Blows	Stroke/ Pressure	Note No.	Depth	Blows	Stroke Pressure	Note No.	Depth	Blows	Stroke Pressure	Note No.	Depth	Blows	Stroke Pressure	Note No.
1	-			17	40	4.97		33	19	4.86		49	41	6.23	
2	-			18	30	5.45	2	34	24	4.87	4/1	50	37	6.17	
3	-			19	31	5.40		35	30	4.93		51	49	6.45	
4	-	Pile Set		20	28	5.45		36	32	5.02		52	51	6.46	5
5	13	4.49	1	21	31	5.50		37	34	5.03		53			
6	16	4.59		22	23	5.36		38	35	5.01		54			
7	12	4.35		23	19	5.37		39	31	4.98					
8	20	4.65		24	22	4.87	1	40	38	5.11					
9	25	4.70		25	20	4.84		41	49	5.02	4				
10	15	4.65		26	19	4.90		42	45	5.52	2				
11	10	4.61		27	17	4.81		43	41	6.11	3				
12	11	4.56		28	19	4.92		44	39	6.08					
13	16	4.75		29	20	4.97		45	38	6.13					
14	18	4.83		30	23	4.93		46	36	6.12					
15	19	4.92		31	25	4.99		47	39	6.25					
16	31	4.90		32	27	5.01		48	42	6.21					

3-40

Learning Outcomes

- Locate Plan Sheet Details Related to Pile Driving
- Identify key elements of the Pile Installation Plan, PIP, and covered the specifications requirements regarding the PIP.
- Learn how to fill the Pile Driving Record

3-41


End of Lesson 3
ANY
QUESTIONS ?
3-42

PLAN SET

PLAN SET SHEET 1

COMPONENTS OF CONTRACT PLANS SET

ROADWAY PLANS
SIGNING & PAVEMENT MARKING PLANS
LIGHTING PLANS
STRUCTURE PLANS

STATE OF
DEPARTMENT OF T

CONTRAC

A DETAILED INDEX APPEARS ON THE KEY SHEET OF EACH COMPONENT

FINANCIAL PROJECT
(FEDERAL
HILLSBOROUGH COUNTY (1032
STATE ROAD N

INDEX OF ROADWAY PLANS

SHEET NO.	SHEET DESCRIPTION
1	KEY SHEET
2-6	SUMMARY OF PAY ITEMS
7-8	DRAINAGE MAPS
9	EXISTING STRUCTURE DATA
10-14	TYPICAL SECTIONS
15	TYPICAL SECTION DETAILS
16	GENERAL NOTES
17-18	SUMMARY OF QUANTITIES
19-26	BOX CULVERT DATA SHEETS
27	SUMMARY OF DRAINAGE STRUCTURES
28	OPTIONAL MATERIALS TABULATION
29	SURVEY BASELINE REFERENCES
30	HORIZONTAL ALIGNMENT PLAN
31	BENCH MARK DATA
32-41	ROADWAY PLAN AND PROFILE SHEETS
42-47	DRAINAGE STRUCTURES
48-52	DRAINAGE DETAILS
53-62	POND CROSS SECTIONS
63-67	ROADWAY SOIL SURVEY
68-101	ROADWAY CROSS SECTIONS
102-103	STORMWATER PREVENTION PLANS
104-119	TRAFFIC CONTROL PLANS
120-130	UTILITY ADJUSTMENT PLANS

END PROJECT
STA. 1650+00.00
℄ CONST. S.R. 93

BEGIN PROJECT
STA. 1587+23.98
℄ CONST. S.R. 93

BEGIN CONSTRUCTION
STA. 1549+81.50
℄ CONST. S.R. 93

TO DENHAM

T 26 S
T 27 S

TO TAMPA

GOVERNING STANDARDS AND SPECIFICATIONS:
FLORIDA DEPARTMENT OF TRANSPORTATION,
DESIGN STANDARDS DATED JANUARY 2004,
AND STANDARD SPECIFICATIONS FOR ROAD AND
BRIDGE CONSTRUCTION DATED 2004,
AS AMENDED BY CONTRACT DOCUMENTS.

APPLICABLE DESIGN STANDARDS MODIFICATIONS: 7-1-05

FOR DESIGN STANDARDS MODIFICATIONS CLICK ON "DESIGN STANDARDS" AT THE FOLLOWING WEB SITE:
http://www.dot.state.fl.us./rddesign/

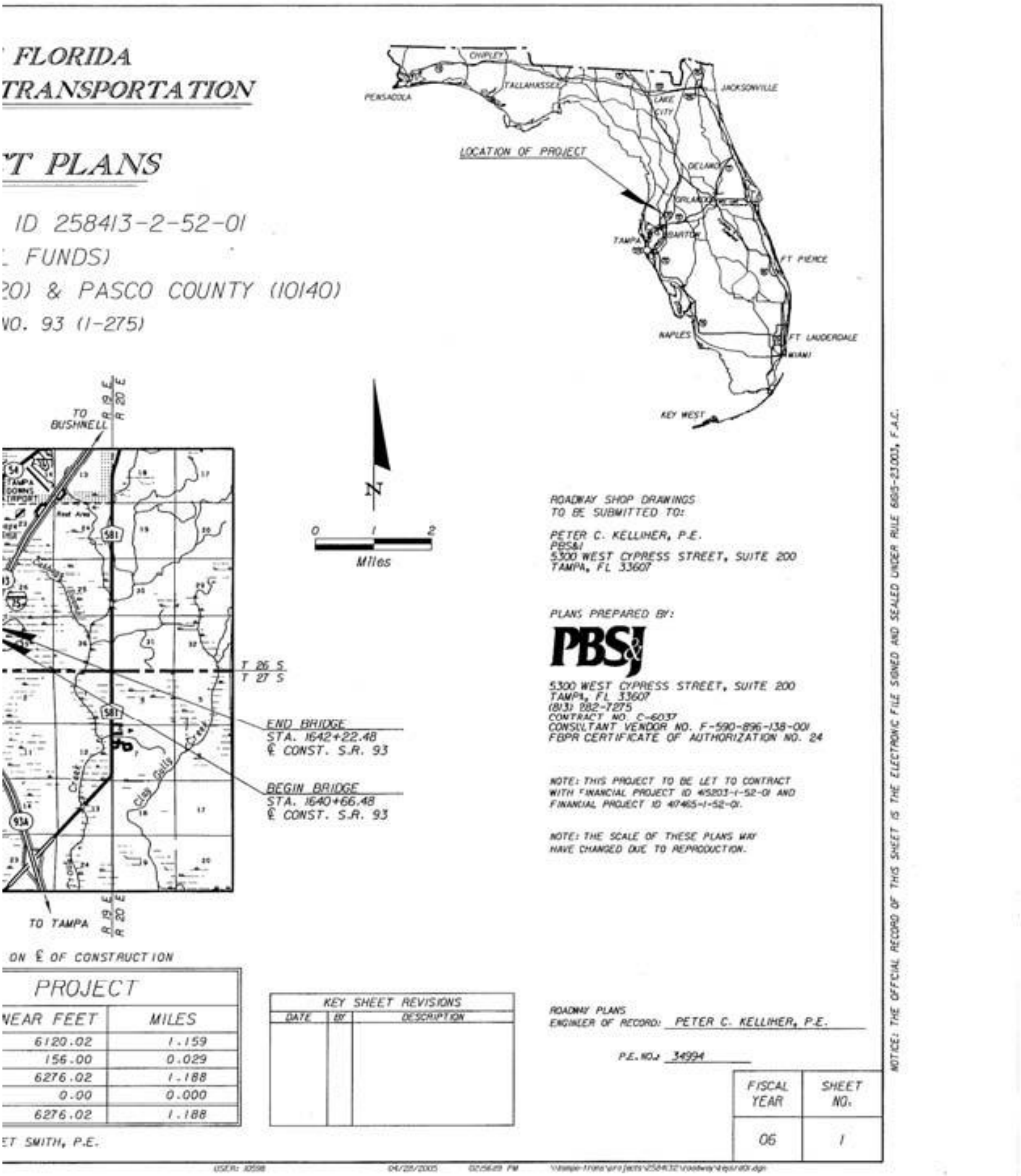
PROJECT LENGTH IS BASED

REVISIONS

LENGTH OF	
	LIN
ROADWAY	
BRIDGES	
NET LENGTH OF PROJECT	
EXCEPTIONS	
GROSS LENGTH OF PROJECT	

FDOT PROJECT MANAGER: MARGARET

PLAN SET SHEET 1



PLAN SET SHEET 2

FLORIDA DEPARTMENT OF TRANSPO
PROPOSAL SUMMARY OF PAY IT

PPROPOTY 05/05/05

PROPOSAL : T7113 LEAD FINPROJ : 258413252O1 COUNTY : HILLSBOROU
FINPROJ(S): 258413252O1 COUNTY/SECTION: 14140000
415203152O1
417465152O1 10320000

0001 SUMMARY OF STRUCTURES P

SPC	ALT	ITEM NUMBER	ITEM DESCRIPTION	UNIT
		0110- 3-	STRUCTURE REMOVAL OF EXISTING	LS
		0400- 2- 4	CONC CLASS II (SUPERSTRUCTURE)	CY
		0400- 2- 10	CONC CLASS II (APPROACH SLABS)	CY
		0400- 4- 5	CONC CLASS IV (SUBSTRUCTURE)	CY
		0400- 7-	BRIDGE FLOOR GROOVING	SY
		0400-147-	COMPOSITE NEOPRENE PADS	CF
T		0400-149-	PENETRANT SEALER	GA
		0400-154-	CONC SURFACES CLEANING & SEALING	SF
		0415- 1- 4	REINF STEEL (SUPERSTRUCTURE)	LB
		0415- 1- 5	REINF STEEL (SUBSTRUCTURE)	LB
		0415- 1- 9	REINF STEEL (APPROACH SLABS)	LB
		0450- 1- 1	PREST BEAMS (TYPE II)	LF
		0455- 34- 3	CONCRETE PILING PRESTRESSED (18" SQ.)	LF
		0455-137-	TEST LOAD(DYNAMIC)	EA
		0455-143- 3	TEST PILES (PRESTRESSED CONCRETE) (18" SQ.)	LF
		0521- 5- 1	CONCRETE TRAFFIC RAILING BARRIER BRIDGE (32" F)	LF
		0530- 3- 3	RIPRAP (RUBBLE) (BANK AND SHORE)	TN

FLORIDA DEPARTMENT OF TRANSPO
PROPOSAL SUMMARY OF PAY IT

PPROPOTY 05/05/05

PROPOSAL : T7113 LEAD FINPROJ : 258413252O1 COUNTY : HILLSBOROU
FINPROJ(S): 258413252O1 COUNTY/SECTION: 14140000
415203152O1
417465152O1 10320000

0002 SUMMARY OF ROADWAY P

SPC	ALT	ITEM NUMBER	ITEM DESCRIPTION	UNIT
		0101- 1-	MOBILIZATION	LS
		0102- 1-	MAINTENANCE OF TRAFFIC	LS
		0102- 1-	MAINTENANCE OF TRAFFIC	LS
		0102- 1-	MAINTENANCE OF TRAFFIC	LS
		0102- 14-	TRAFFIC CONTROL OFFICER	MH
		0102- 60-	WORK ZONE SIGNS	ED
		0102- 71- 14	BARRIER WALL (TEMPORARY) (F&I)(TYPE K)	LF
		0102- 71- 24	BARRIER WALL (TEMPORARY) (RELOCATE)(TYPE K)	LF
		0102- 74- 1	BARRICADE (TEMPORARY)(TYPES I, II, VP & DRUM)	ED
		0102- 74- 2	BARRICADE (TEMPORARY)(TYPE III) (6')	ED
		0102- 76-	PANELS ARROW ADVANCE WARNING	ED
		0102- 77-	HIGH INTENSITY FLASHING LIGHTS (TEMP - TYPE B)	ED
		0102- 78-	MARKER PAVT REFLECTIVE (TEMPORARY)	EA
		0102- 79-	LIGHTS(TEMP-BARR. WALL MOUNT)(TYPE C STEADY BURN)	ED
		0102- 89- 7	IMPACT ATTENUATOR (REDIRECTIVE OPTION)(TEMPORARY)	LO
		0102- 99-	CHANGEABLE-VARIABLE MESSAGE SIGN (TEMPORARY)	ED
		0104- 1-	ARTIFICIAL COVERINGS	SY
		0104- 4-	MOWING	AC
		0104- 10- 1	HAY OR STRAW BALE (18" X 18" X 36")	EA
		0104- 11-	TURBIDITY BARRIER FLOATING	LF
		0104- 13- 1	SILT FENCE STAKED (TYPE III)	LF
		0104- 15-	PREVENTION DEVICE SOIL TRACKING	EA
		0104- 16-	ROCK BAGS	EA
		0109- 71- 3	FIELD OFFICE (900 SQ FT)	DA
		0110- 1- 1	CLEARING & GRUBBING	LS
		0120- 1-	EXCAVATION REGULAR	CY
		0120- 4-	EXCAVATION SUBSOIL	CY
		0120- 6-	EMBANKMENT	CY
		0121- 70-	FLOWABLE FILL	CY
		0160- 4-	STABILIZATION TYPE B	SY
		0162- 3-101	FINISH SOIL LAYER(GRASSING OPERATIONS) (6")	SY
		0285-701-	BASE OPTIONAL (BASE GROUP 01)	SY
		0285-706-	BASE OPTIONAL (BASE GROUP 06)	SY
		0285-711-	BASE OPTIONAL (BASE GROUP 11)	SY
		0286- 1-	TURNOUT CONSTRUCTION	SY
		0327- 70- 1	MILLING EXIST ASPH PAVT (1" AVG DEPTH)	SY
		0327- 70- 4	MILLING EXIST ASPH PAVT (3" AVG DEPTH)	SY
		0327- 70- 13	MILLING EXIST ASPH PAVT (1 3/4" AVG DEPTH)	SY
		0327- 70- 15	MILLING EXIST ASPH PAVT (2 3/4" AVG DEPTH)	SY
		0327- 70- 19	MILLING EXIST ASPH PAVT (3/4" AVG DEPTH)	SY

REVISIONS

DATE	BY	DESCRIPTION	DATE	BY	DESCRIPTION

PBSJ
5300 West Cypress Street
Suite 200
Tampa, Florida 33607-1768
FBPR CERTIFICATE OF
AUTHORIZATION NO. 24
Peter C. Kelliher, P.E. #34994

ROAD
S.R.

PLAN SET SHEET 2

RANSPORTATION
PAY ITEMS PAGE: 1 A0001

SBOROUG . MANDIST: 07

PAY ITEMS

UN IT	25841325201 BR - 140061		QUANTITY TOTAL
LS	1.000		1.000
CY	119.100		119.100
CY	42.900		42.900
CY	47.600		47.600
SY	1387.000		1387.000
CF	4.400		4.400
GA	55.000		55.000
SF	8502.000		8502.000
LB	30474.000		30474.000
LB	6521.000		6521.000
LB	8338.000		8338.000
LF	615.000		615.000
LF	963.000		963.000
EA	4.000		4.000
LF	351.000		351.000
LF	199.000		199.000
TN	2276.300		2276.300

RANSPORTATION
PAY ITEMS PAGE: 2 A0002

SBOROUG . MANDIST: 07

PAY ITEMS

UN IT	25841325201	41520315201	41746515201
LS	1.000	0.000	0.000
LS	0.000	0.000	1.000
LS	1.000	0.000	0.000
LS	0.000	1.000	0.000
MH	24.000	104.000	0.000
ED	23790.000	726.000	252.000
LF	8327.000	0.000	0.000
LF	7235.000	0.000	0.000
ED	14829.000	16939.000	4284.000
ED	0.000	104.000	0.000
ED	288.000	52.000	126.000
ED	6188.000	0.000	0.000
EA	1418.000	504.000	0.000
ED	13994.000	0.000	0.000
LO	4.000	0.000	0.000
ED	1467.000	0.000	0.000
SY	549.000	0.000	0.000
AC	518.600	47.500	20.600
EA	1860.000	0.000	290.000
LF	674.000	0.000	0.000
LF	10351.000	0.000	0.000
EA	2.000	0.000	0.000
EA	60.000	0.000	0.000
DA	340.000	0.000	0.000
LS	1.000	0.000	0.000
CY	23318.000	0.000	0.000
CY	32.000	0.000	0.000
CY	19919.000	0.000	0.000
CY	32.000	0.000	0.000
SY	28402.000	0.000	0.000
SY	0.000	0.000	33212.000
SY	0.000	0.000	1513.000
SY	16205.000	0.000	0.000
SY	9198.000	0.000	0.000
SY	287.000	0.000	0.000
SY	0.000	710.000	0.000
SY	6931.000	0.000	0.000
SY	1486.000	0.000	0.000
SY	0.000	37231.000	0.000
SY	14470.000	0.000	0.000

STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION			SUMMARY OF PAY ITEMS	SHEET NO.
ROAD NO.	COUNTY	FINANCIAL PROJECT ID		
S.R. 93	HILLSBOROUGH PASCO	258413-2-52-01		2

PLAN SET SHEET 3

GENERAL NOTES:

1. THE BENCH MARK DATUM USED FOR THE PLANS IS NGVD-29. HORIZONTAL DATUM USED IS NAP 1983/1990 ADJUSTMENT.

2. EXISTING DRAINAGE STRUCTURES WITHIN THE CONSTRUCTION LIMITS SHALL REMAIN UNLESS OTHERWISE NOTED.

3. THE LOCATIONS OF THE UTILITIES SHOWN IN THE PLANS ARE BASED ON LIMITED INVESTIGATION TECHNIQUES AND SHOULD BE CONSIDERED APPROXIMATE ONLY. THE VERIFIED LOCATIONS/ELEVATIONS APPLY ONLY AT THE POINTS SHOWN. INTERPOLATIONS BETWEEN THESE POINTS HAVE NOT BEEN VERIFIED.

4. UTILITY OWNERS:

COMPANIES	TELEPHONE NUMBERS	CONTACT
TAMPA ELECTRIC COMPANY	813-228-4674	MS. ARLENE BROWN
VERIZON, INC.	813-989-7911	MR. DAVID LANCE
FLORIDA GAS TRANSMISSION	407-838-7114	MR. STEVE KEITH
PROGRESS ENERGY	813-866-5342	MS. ROSEMARY SWEETS

5. THE CONTRACTOR SHALL NOTIFY UTILITY OWNERS THROUGH SUNSHINE STATE ONE CALL OF FLORIDA, INC. (1-800-432-4770) 48 HOURS IN ADVANCE OF ANY EXCAVATION ON THE JOB SITE. ALL UTILITIES MAY NOT BE A MEMBER, REQUIRING DIRECT CONTACT.

6. THE CONTRACTOR SHALL NOTIFY MOBILITY TECHNOLOGIES REGARDING THE RELOCATION OF TRAFFIC SENSOR EQUIPMENT 60 DAYS BEFORE RELOCATION IS REQUIRED BY THE OWNER. THE OWNER CONTACT IS TERRI JOHNSON, DALLAS, TEXAS (214) 634-8141.

7. ANY PUBLIC LAND CORNER WITHIN THE LIMITS OF CONSTRUCTION IS TO BE PROTECTED. IF A CORNER MONUMENT IS IN DANGER OF BEING DESTROYED AND HAS NOT BEEN PROPERLY REFERENCED, THE ENGINEER SHOULD NOTIFY THE DISTRICT LOCATION SURVEYOR, WITHOUT DELAY, BY TELEPHONE.

REVISIONS

DATE	BY	DESCRIPTION	DATE	BY	DESCRIPTION

PBSJ

5300 West Cypress
Suite 200
Tampa, Florida 336
FBPR CERTIFIC
AUTHORIZATION
Peter C. Kelliher, P.E. #34

PLAN SET SHEET 3

8. THE CONTRACTOR SHALL COMPLY WITH THE FOLLOWING WILDLIFE AND HABITAT REQUIREMENTS:

A) THE CONTRACTOR SHALL PROVIDE EASTERN INDIGO SNAKE EDUCATIONAL INFORMATION TO EMPLOYEES PRIOR TO INITIATION OF ANY CLEARING OR CONSTRUCTION. AN EDUCATIONAL EXHIBIT, APPROVED BE THE USFWS, SHALL BE POSTED AT A SITE ACCESSIBLE TO ALL EMPLOYEES AND A HANDOUT WILL BE DISTRIBUTED TO ALL EMPLOYEES.

B) THE CONTRACTOR SHALL POST AND DISTRIBUTE EDUCATIONAL INFORMATION TO ALL ITS WORKERS. THE EXHIBIT AND BROCHURE SHOULD INCLUDE PLOTOGRAPHS OF THE EASTERN INDIGO SNAKE, INFORMATION ON LIKE HISTORY AND LEGAL PROTECTION OF THIS SPECIES IN FLORIDA, HOW TO AVOID IMPACTS TO THE SPECIES, AND AGENCY TELEPHONE NUMBERS.

C) ALL CONSTRUCTION ACTIVITIES SHALL CEASE IF LIVE EASTERN INDIGO SNAKES ARE FOUND WITHIN THE PROJECT AREA. IF SUCH A SNAKE REMAINS ON SITE, A STATE OR FEDERAL BIOLOGIST WILL BE CONTACTED TO RELOCATE THE SNAKE TO AN ACCEPTABLE DONOR SITE. ALTERNATIVELY, WORK MAY RESUME AFTER THE SNAKE OR SNAKES LEAVE THE SITE ON THEIR OWN.

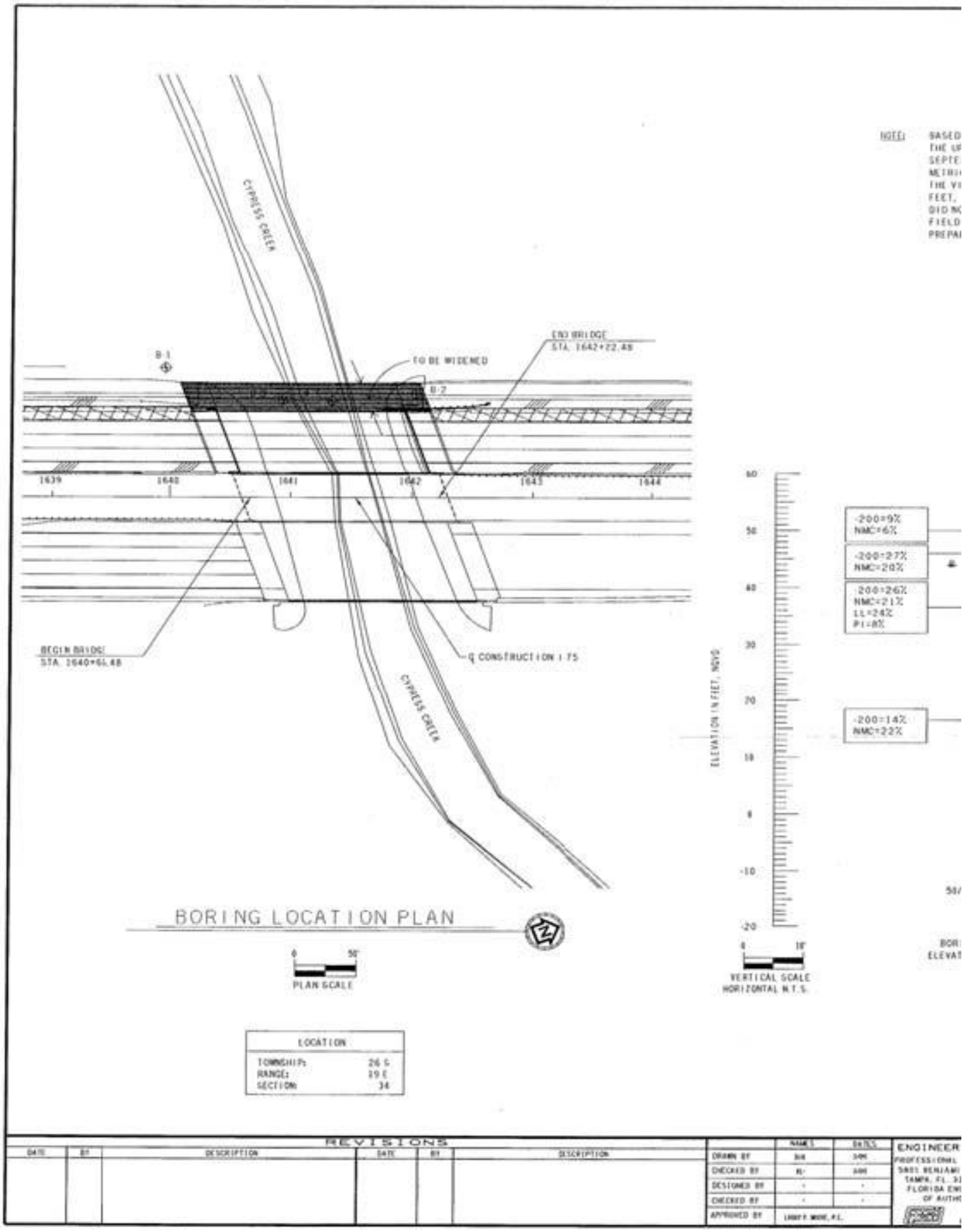
D) LOCATIONS OF LIVE SIGHTINGS SHALL BE REPORTED TO FDOT AND USFWS JACKSONVILLE FIELD OFFICE (904-232-2580).

E) IF A DEAD EASTERN INDIGO SNAKE IS FOUND ON THE PROJECT SITE, THE SNAKE SHALL BE FROZEN AS SOON AS POSSIBLE AND THE CONTRACTOR SHALL NOTIFY FDOT AND USFWS IMMEDIATELY FOR FURTHER INSTRUCTIONS.

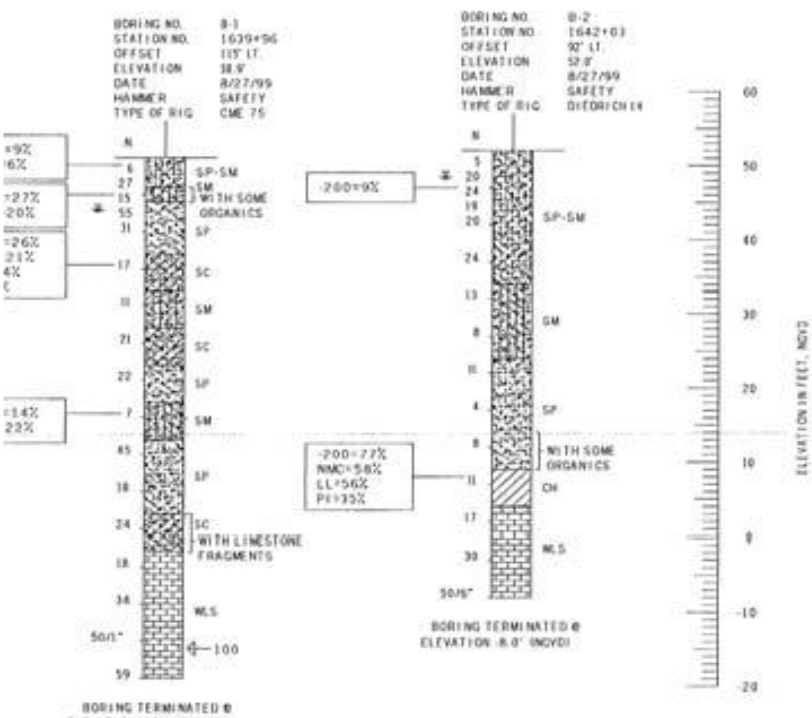
9. THE DEPARTMENT WILL DETERMINE WHETHER THIS PROJECT HAS ANY HAZARDOUS MATERIALS OR CONTAMINATION ISSUES ASSOCIATED WITH IT. IF HAZARDOUS MATERIALS OR CONTAMINATION IS IDENTIFIED, ANY REMEDIATION REQUIRED WILL BE PERFORMED BY THE DEPARTMENT'S HAZARDOUS MATERIALS CONTRACTOR IN COORDINATION WITH THE PROJECT CONSTRUCTION CONTRACTOR.

Cypress Street ida 33607-0768 RTIFICATE OF ATION NO. 24 #34994	STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION			GENERAL NOTES	SHEET NO.
	ROAD NO.	COUNTY	FINANCIAL PROJECT ID		
	S.R. 93	HILLSBOROUGH PASCO	258413-2-52-01		15

PLAN SET SHEET 4



NOTE: BASED ON A REVIEW OF THE MAP "POTENTIOMETRIC SURFACE OF THE UPPER FLORIDAN AQUIFER SYSTEM, WEST-CENTRAL FLORIDA, SEPTEMBER 1995" PUBLISHED BY THE USGS. THE POTENTIOMETRIC SURFACE ELEVATION OF THE UPPER FLORIDAN AQUIFER IN THE VICINITY OF THE BRIDGE STRUCTURE IS APPROXIMATELY AT 50 FEET, NGVD. THE SPT BORINGS PERFORMED AT THE PROJECT SITE DID NOT ENCOUNTER AN ARTESIAN FLOW CONDITION DURING THE FIELD EXPLORATION. HOWEVER, THE CONTRACTOR SHOULD BE PREPARED TO HANDLE THIS POTENTIOMETRIC LEVEL, IF ENCOUNTERED.



LEGEND

(SP), LIGHT BROWN/BROWN/LIGHT GRAY/GRAY FINE SAND

(SP-SM), LIGHT BROWN/BROWN/GRAY SLIGHTLY SILTY FINE SAND

(SM), LIGHT BROWN/BROWN/GRAY SILTY FINE SAND

(SC), BROWN/GRAY/GREEN CLAYEY FINE SAND

(CH), GRAY/GREEN SANDY CLAY (FAT CLAY)

(WLS), GRAY HIGHLY WEATHERED LIMESTONE

NOTES:

WATER TABLE

N NUMBERS TO THE LEFT OF BORINGS INDICATE SPT VALUE FOR 12" PENETRATION, (UNLESS OTHERWISE NOTED.)

50/6" FIFTY BLOWS FOR SIX INCHES

LOSS OF CIRCULATION (%)

CASING USED

-200 FINES PASSING NO. 200 SIEVE (%)

NMC NATURAL MOISTURE CONTENT (%)

LL LIQUID LIMIT (%)

PI PLASTICITY INDEX (%)

APPROXIMATE SPT BORING LOCATION

ENVIRONMENTAL CLASSIFICATION

SUBSTRUCTURE: MODERATELY AGGRESSIVE (WATER-SULFATES=218 PPM, RESISTIVITY=2,000 OHMS-CM)

SUPERSTRUCTURE: SLIGHTLY AGGRESSIVE

SOIL

RESISTIVITY: 9,400-13,000 OHMS-CM
CHLORIDES: 15-30 PPM
SULFATES: 0-5 PPM
pH: 7.8

WATER

RESISTIVITY: 2,000 OHMS-CM
CHLORIDES: 50 PPM
SULFATES: 218 PPM
pH: 7.1

GRANULAR MATERIALS-RELATIVE DENSITY	SPT (BLOWS/FT.)
VERY LOOSE	LESS THAN 4
LOOSE	5-10
MEDIUM	11-30
DENSE	31-50
VERY DENSE	GREATER THAN 50

SILTS AND CLAYS CONSISTENCY	SPT (BLOWS/FT.)
VERY SOFT	LESS THAN 2
SOFT	3-4
FIRM	5-8
STIFF	9-15
VERY STIFF	16-30
HARD	GREATER THAN 30

BRIDGE No. 140061

NOTICE: THE OFFICIAL RECORD OF THIS SHEET IS THE ELECTRONIC FILE SIGNED AND SEALED UNDER RULE 61G15-23.003, F.A.C.

ENGINEER OF RECORD: PROFESSIONAL SERVICE INDUSTRIES, INC. 5801 BENJAMIN CENTER DR., SUITE 112 TAMPA, FL. 33634 (813)886-1075 FLORIDA ENGINEERING CERTIFICATE OF AUTHORIZATION No. 3684 LARRY P. MOORE, P.E. FLORIDA LICENSE No. 47673

FLORIDA DEPARTMENT OF TRANSPORTATION

ROAD NO.	COUNTY	FINANCIAL PROJECT ID
S.R. 93	HILLSBOROUGH PASCO	258413-2-52-01

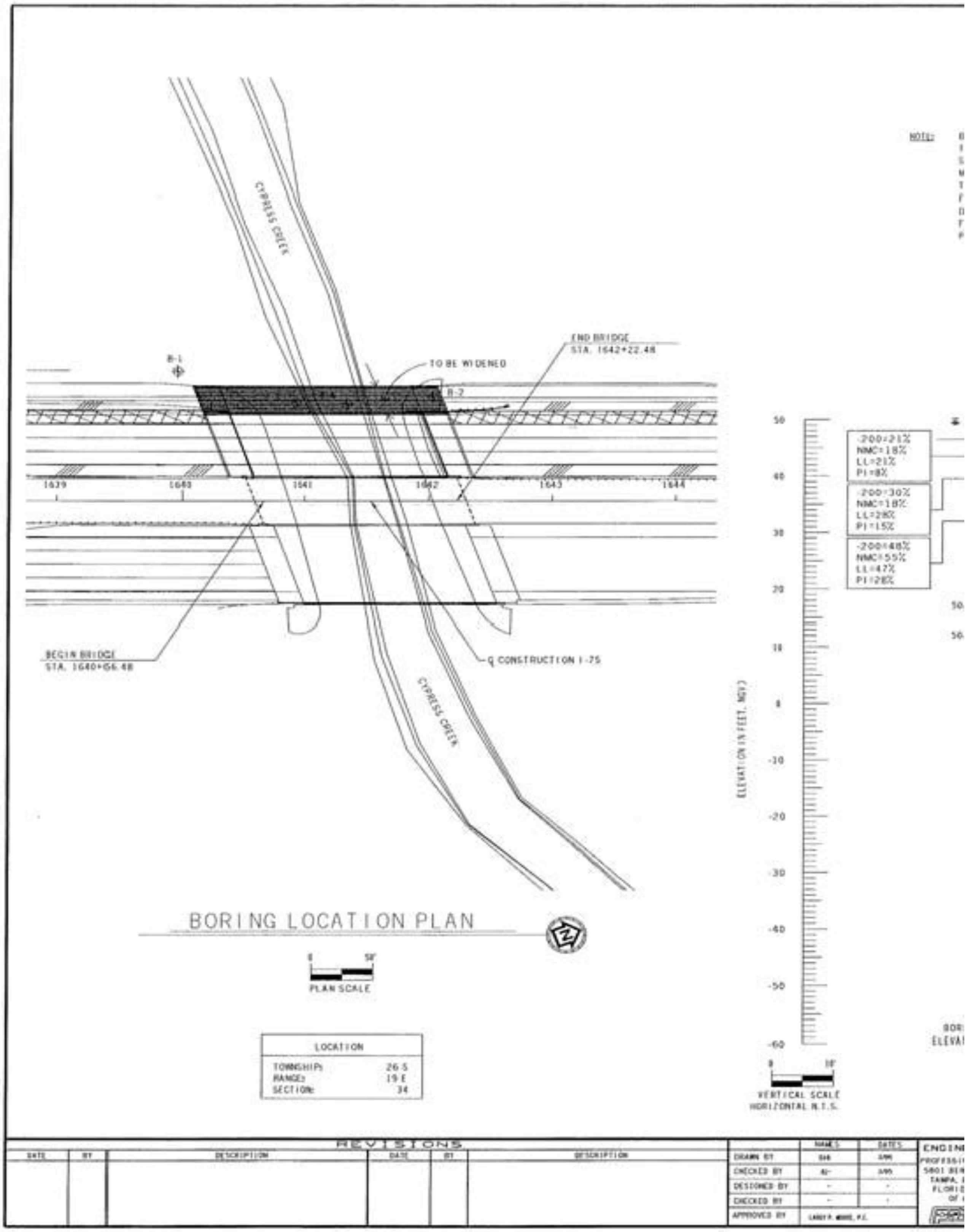
SHEET TITLE: REPORT OF CORE BORINGS

PROJECT NAME: SR 93 (I-75/I-275)

SHEET NO. B-23

PLAN SET SHEET 4

PLAN SET SHEET 5



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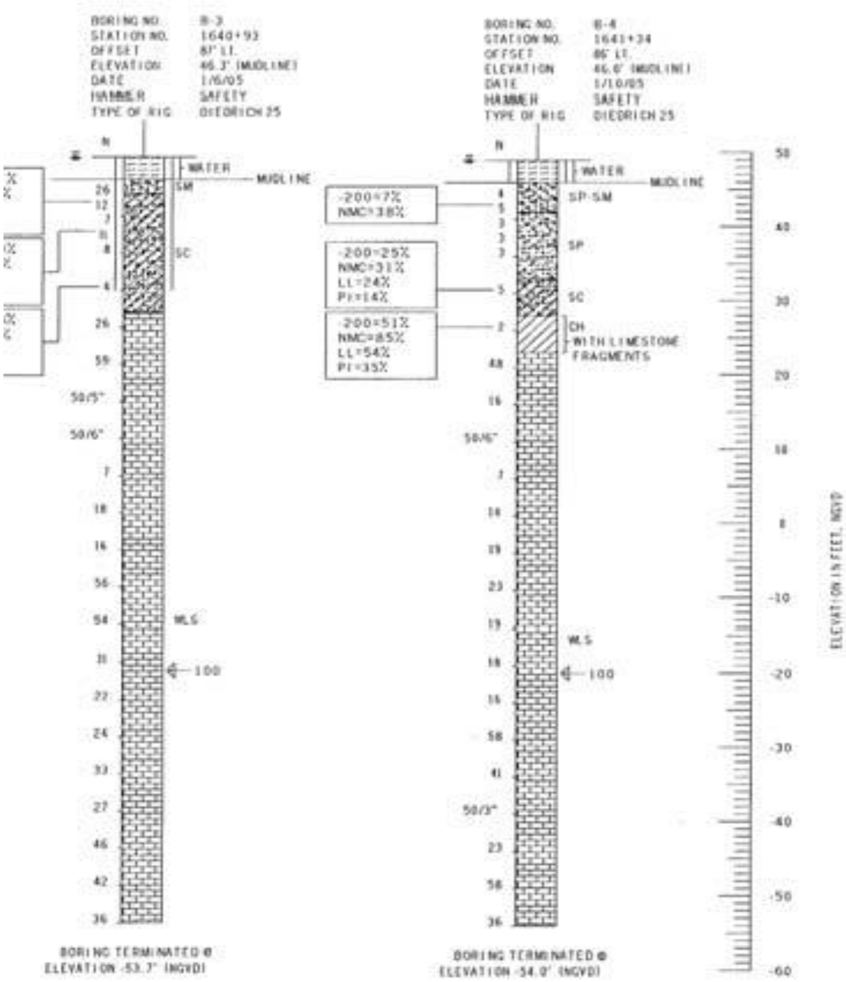


LEGEND

(SP), LIGHT BROWN/BROWN/LIGHT GRAY/GRAY FINE SAND

(SP-SM), LIGHT BROWN/BROWN/GRAY SLIGHTLY SILTY FINE SAND

(SM), LIGHT BROWN/BROWN/GRAY SILTY FINE SAND

(SC), BROWN/GRAY/GREEN CLAYEY FINE SAND

(CH), GRAY/GREEN SANDY CLAY (FAT CLAY)

(WLS), GRAY HIGHLY WEATHERED LIMESTONE

NOTES:

WATER TABLE

N NUMBERS TO THE LEFT OF BORINGS INDICATE SPT VALUE FOR 12" PENETRATION (UNLESS OTHERWISE NOTED.)

50/6" FIFTY BLOWS FOR SIX INCHES

LOSS OF CIRCULATION (%)

CASING USED

-200 FINES PASSING NO. 200 SIEVE (%)

NMC NATURAL MOISTURE CONTENT (%)

LL LIQUID LIMIT (%)

PI PLASTICITY INDEX (%)

APPROXIMATE SPT BORING LOCATION

ENVIRONMENTAL CLASSIFICATION

SUBSTRUCTURE: MODERATELY AGGRESSIVE (WATER-SULFATES=218 PPM; RESISTIVITY=2,000 OHMS-CM)

SUPERSTRUCTURE: SLIGHTLY AGGRESSIVE

SOIL

RESISTIVITY: 9,400-13,000 OHMS-CM
CHLORIDES: 15-30 PPM
SULFATES: 0-5 PPM
pH 7.8

WATER

RESISTIVITY: 2,000 OHMS-CM
CHLORIDES: 50 PPM
SULFATES: 218 PPM
pH 7.1

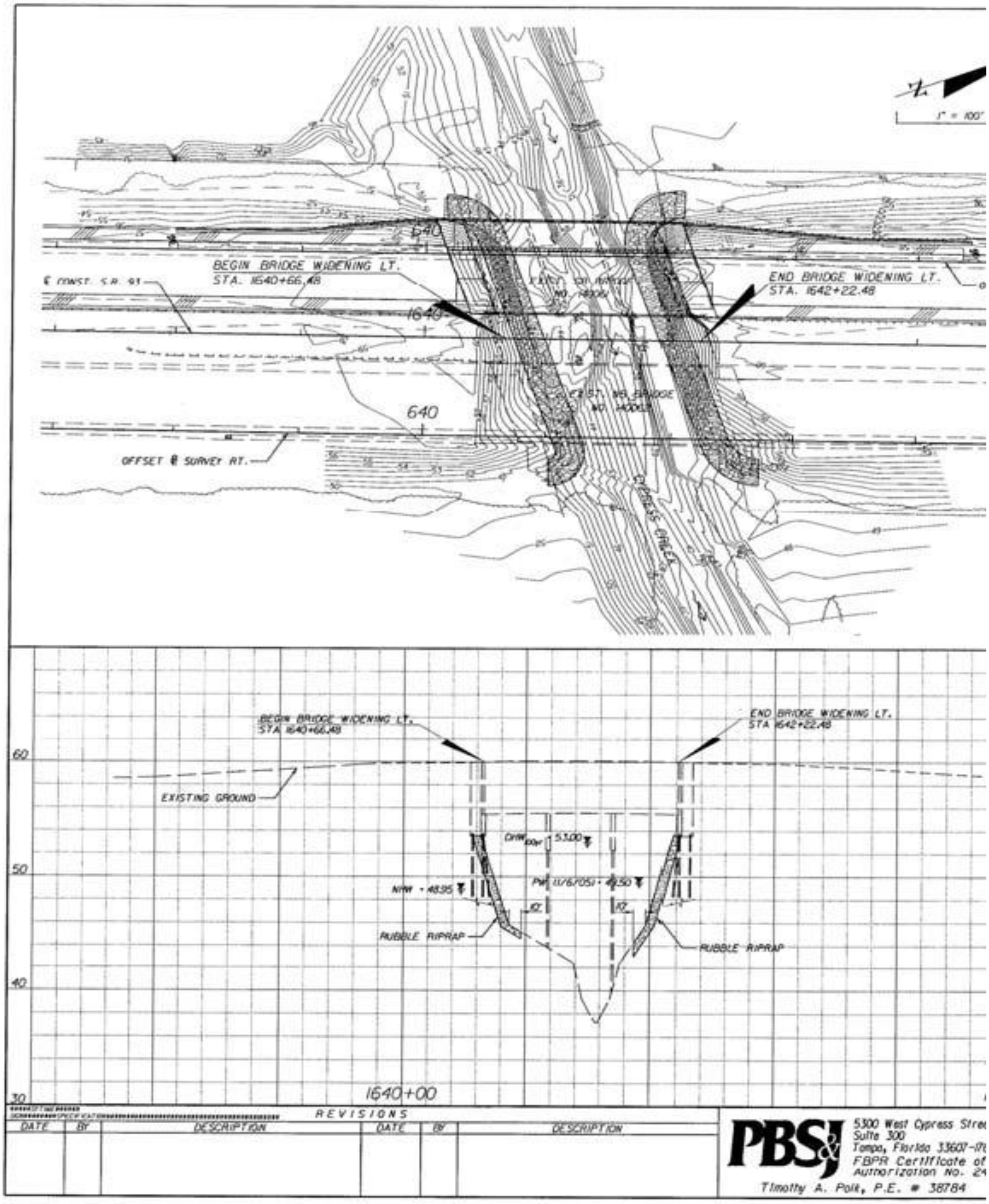
GRANULAR MATERIALS-RELATIVE DENSITY	SPT (BLOWS/FT.)
VERY LOOSE	LESS THAN 4
LOOSE	5-10
MEDIUM	11-30
DENSE	31-50
VERY DENSE	GREATER THAN 50
SILTS AND CLAYS CONSISTENCY	**SPT (BLOWS/FT.)**
VERY SOFT	LESS THAN 2
SOFT	3-4
FIRM	5-8
STIFF	9-15
VERY STIFF	16-30
HARD	GREATER THAN 30

BRIDGE No. 140061

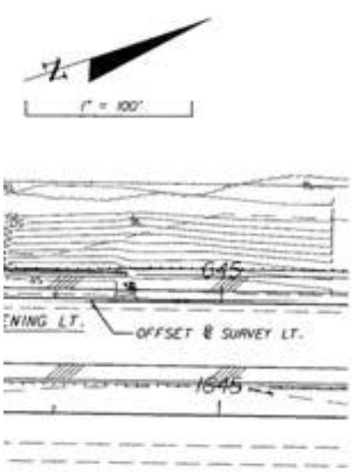
ENGINEER OF RECORD: PROFESSIONAL SERVICE INDUSTRIES, INC. 5801 BENJAMIN CENTER DR., SUITE 112 TAMPA, FL 33634 (813)886-1075 FLORIDA ENGINEERING CERTIFICATE OF AUTHORIZATION No. 3684 LARRY P. MOORE, P.E. FLORIDA LICENSE No. 41977	FLORIDA DEPARTMENT OF TRANSPORTATION			SHEET TITLE: REPORT OF CORE BORINGS	
	ROAD NO.	COUNTY	FINANCIAL PROJECT ID	PROJECT NAME:	SHEET NO.
	S.R. 93	HILLSBOROUGH PASCO	258413-2-52-01	SR 93 (I-75/I-275)	B-24

NOTICE: THE OFFICIAL RECORD OF THIS SHEET IS THE ELECTRONIC FILE SIGNED AND SEALED UNDER RULE 61G15-23.003, F.A.C.

PLAN SET SHEET 6



PLAN SET SHEET 6



(REFERENCE)	EXISTING STRUCTURES (1)	(2)	(3)	(4)	PROPOSED STRUCTURE
FOUNDATION	PILES				PILES
OVERALL LENGTH	156.00'				156.00'
SPAN LENGTH	3 @ 52.00'				3 @ 52.00'
TYPE CONSTRUCTION	CONCRETE				CONCRETE
AREA OF OPENING @ D.F.	840				838
BRIDGE WIDTH	71				85
ELEV. LOW MEMBER	55.45				54.85

HYDRAULIC DESIGN DATA

NOTE:-
The hydraulic data is shown for informational purposes only to indicate the flood discharges and water surface elevations which may be anticipated in any given year. This data was generated using highly variable factors determined by a study of the watershed. Many judgements and assumptions are required to establish these factors. The resultant hydraulic data is sensitive to changes, particularly antecedent conditions, urbanization, channelization and land use. Users of this data are cautioned against the assumption of precision which cannot be obtained.

TERMS:
Design Flood: Utilized to assure a desired level of hydraulic performance.
Base Flood: Has a 1% chance of being exceeded in any given year (100 year frequency)
Overtopping Flood: Causes flow over the highway, over a watershed divide, or thru emergency relief structures.
Greatest Flood: The most severe that can be predicted where overtopping is not practicable.

WATER SURFACE ELEVATIONS: N.H.W. (Non-Tidal) 48.35 M.H.W. (Tidal) ______
CONTROL (Non-Tidal) ______ M.L.W. (Tidal) ______

FLOOD DATA:	MAX. EVENT OF RECORD *	DESIGN FLOOD	BASE FLOOD	☐ OVERTOPPING or ☒ GREATEST FLOOD
STAGE ELEV. NGVD (ft)	-	52.4	53.0	54.2
DISCHARGE (cfs)	870	2598	3209	4176
AVERAGE VELOCITY (f/s)	-	2.28	2.85	3.59
EXCEEDANCE PROB. (%)	0.07	0.02	0.01	0.002
FREQUENCY (yr.)	15	50	100	500

SCOUR PREDICTIONS FOR PROPOSED STRUCTURE DESCRIBED ABOVE:

PIER INFORMATION: NUMBERS	SIZE AND TYPE	LONG TERM SCOUR ELEV.	TOTAL SCOUR ELEVATION: WORST CASE < 100 yr. FREQ. (yr.)	WORST CASE < 500 yr. FREQ. (yr.)
2-3	18" CONCRETE PILE	34.8	27.4	26.0

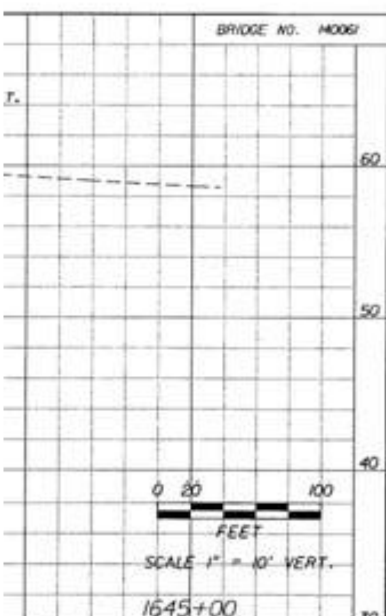
HYDRAULIC RECOMMENDATIONS

1. BEGIN BRIDGE STATION 1640+66.48 END BRIDGE STATION 1642+22.48 SKEW ANGLE 30°
2. CLEARANCE PROVIDED: NAV: HORIZ. 44.88 VERT. 5.3 ABOVE EL. 48.35 DRIFT: HORIZ. 44.88 VERT. 2.45 ABOVE EL. 52.4
3. MINIMUM CLEARANCE: NAV: HORIZ. 15 VERT. 5 ABOVE EL. 48.35 DRIFT: HORIZ. 2 VERT. 2 ABOVE EL. 52.4
4. ABUTMENTS:

	BEGIN BRIDGE	END BRIDGE
RUBBLE GRADE:	"GRADE 1-W"	"GRADE 1-W"
SLOPE:	1.5:1	1.5:1
BURIED OR NON-BURIED HORIZ. TOE:	BURIED TOE	BURIED TOE
TOE HORIZ. DISTANCE:	10'	10'
LIMIT OF PROTECTION:	BOTH BRIDGES AS SHOWN	BOTH BRIDGES AS SHOWN

5. DECK DRAINAGE: GUTTER FLOW TO ENDS OF BRIDGE TO INLETS

REMARKS: "GRADE 1W" RUBBLE RIPRAP WITH D2 FILTER FABRIC, TO EL 54.0 AT 1.5:1 SLOPE AND EXTEND RUBBLE BLANKET ALONG EXISTING SLOPE TO 10' BEYOND TOE OF SLOPE
* MAX. EVENT AT WORTHINGTON GARDENS (SR54) STREAM GAGE 8 MILE UPSTREAM

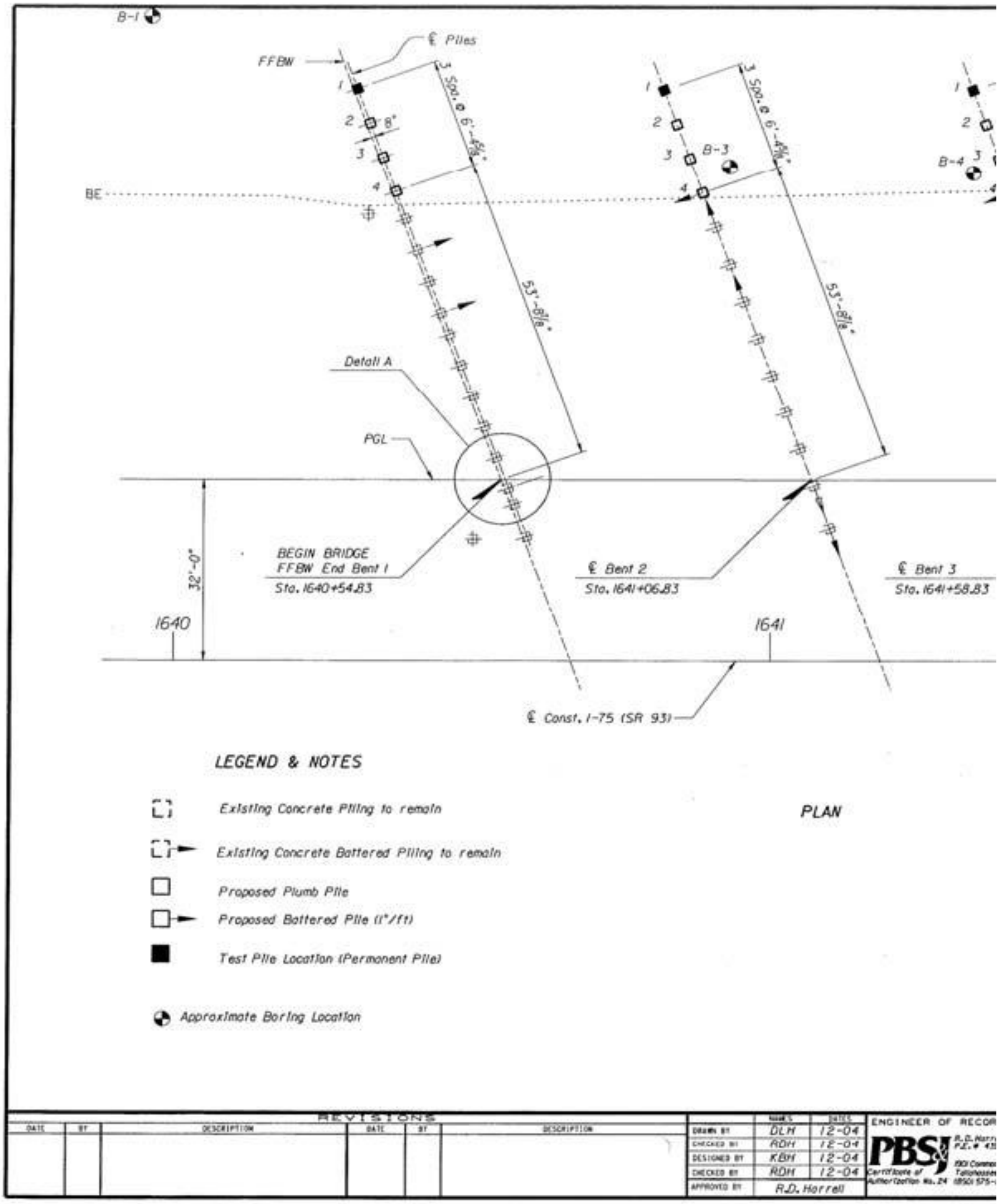


West Cypress Street
300
, Florida 33607-1768
R Certificate of
orization No. 24
.E. # 38784

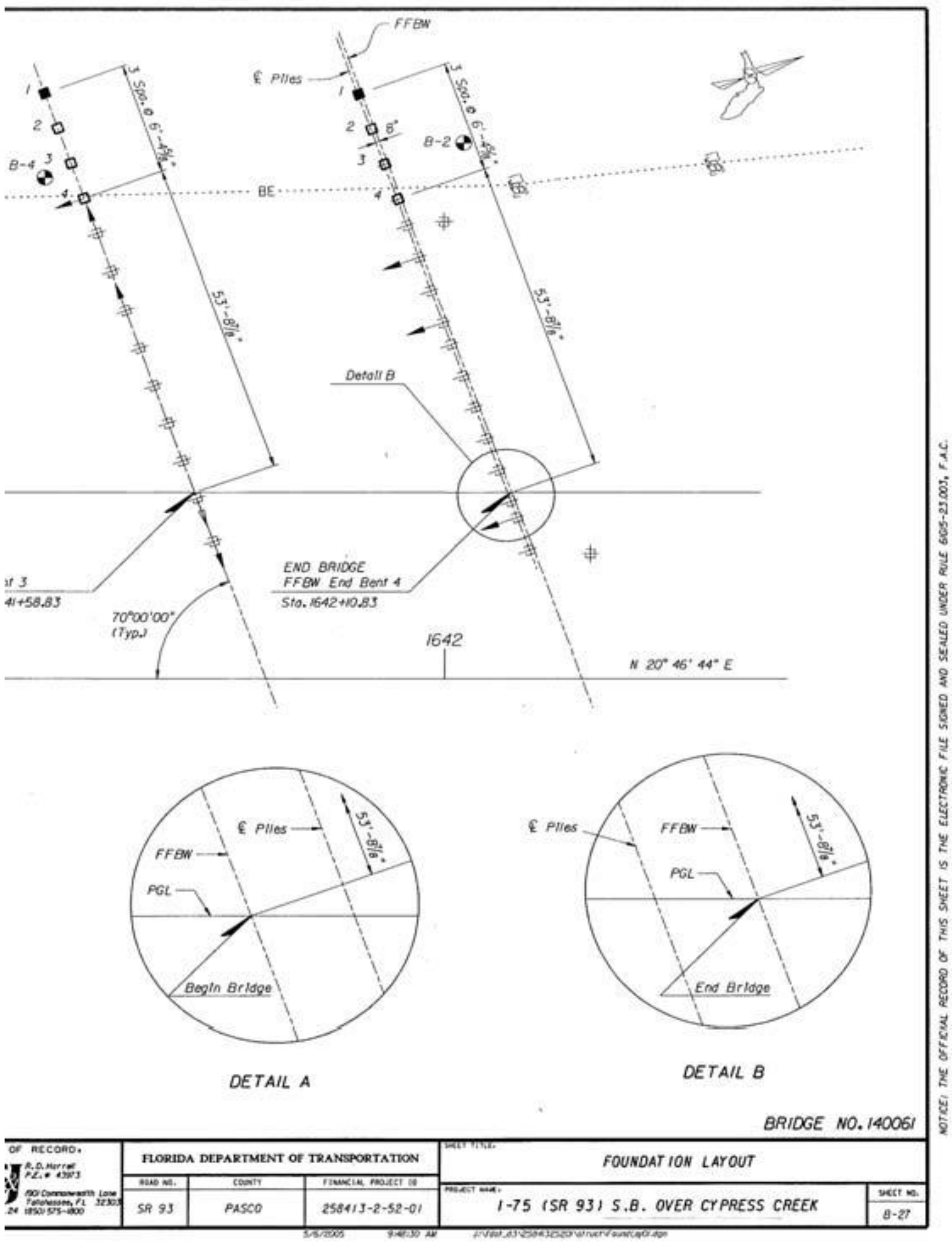
STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION			BRIDGE HYDRAULIC RECOMMENDATION (140061)	SHEET NO.
ROAD NO.	COUNTY	FINANCIAL PROJECT ID		
S.R. 93	HILLSBOROUGH PASCO	258413-2-52-01		B-25

NOTICE: THE OFFICIAL RECORD OF THIS SHEET IS THE ELECTRONIC FILE SIGNED AND SEALED UNDER RULE 61G15-23.003, F.A.C.

PLAN SET SHEET 7



PLAN SET SHEET 7



PLAN SET SHEET 8

PILE DATA									
INSTALLATION CRITERIA									
PILE or BENT NUMBER	PILE SIZE (in)	NOMINAL BEARING CAPACITY (tons)	TENSION CAPACITY (tons)	MINIMUM TIP ELEVATION (ft)	TEST PILE LENGTH (ft)	REQUIRED JET ELEVATION (ft)	REQUIRED PREFORM ELEVATION (ft)	FACTORED DESIGN LOAD (tons)	DOWN DRAG (tons)
End Bent 1	18	125	N/A	See Note 5	65	N/A	N/A	81	N/A
Bent 2	18	157	N/A	10	100	N/A	10	102	N/A
Bent 3	18	157	N/A	10	100	N/A	10	102	N/A
End Bent 4	18	125	N/A	See Note 5	65	N/A	N/A	81	N/A

PILE INSTALLATION NOTES:

1. Tension Capacity - The ultimate side friction capacity that must be obtained below the 100 year scour elevati
   Total Scour Resistance - An estimate of the ultimate static side friction resistance provided by the scourab
   Net Scour Resistance - An estimate of the ultimate static side friction resistance provided by the soil from
   100-Year Scour - Estimated elevation of scour to the 100 year storm event.
   Long Term Scour - Estimated elevation of scour used in design for extreme event loading

$$\frac{\text{Factored Design Load} + \text{Net Scour Resistance} + \text{Downdrag}}{\phi} \leq \text{Nominal Bearing Res.}$$

2. Contractor shall verify the location of all utilities prior to driving any piles.
3. All test piles shall be dynamically monitored using the Pile Driving Analyzer as per Section 455-5J3 of the St
4. Minimum tip elevation shall be in accordance with the Specifications.
5. Test Piles shall be driven in the position of a permanent plumb pile at locations shown or as directed by the E
6. The Contractor shall use special equipment and/or methods (i.e., Core Barrels, Rock Augers, Punches, Drill Bits

REVISIONS					
DATE	BY	DESCRIPTION	DATE	BY	DESCRIPTION

	NAMES	DATES
DRAWN BY	DLH	12-04
CHECKED BY	RDH	12-04
DESIGNED BY	KBH	12-04
CHECKED BY	RDH	12-04
APPROVED BY	R.D. Horrell	

ENGINEER

PBS

Certificate of Authorization No.

PLAN SET SHEET 8

E DATA TABLE

DESIGN CRITERIA						PILE CUT-OFF ELEVATIONS			
DOWN DRAG (tons)	TOTAL SCOUR RESISTANCE (tons)	NET SCOUR RESISTANCE (tons)	100 YEAR SCOUR ELEVATION (ft)	LONG TERM SCOUR ELEVATION (ft)	RESISTANCE FACTOR ϕ	PILE 1 (ft)	PILE 2 (ft)	PILE 3 (ft)	PILE 4 (ft)
N/A	N/A	N/A	N/A	N/A	0.65	52.821	53.009	53.197	53.385
N/A	0 *	0 *	27	N/A	0.65	52.968	53.153	53.338	53.523
N/A	0 *	0 *	27	N/A	0.65	53.030	53.211	53.392	53.573
N/A	N/A	N/A	N/A	N/A	0.65	53.023	53.200	53.377	53.554

* Scour resistance eliminated by preform

cour elevation to resist pullout of the pile
the scourable soil.
e soil from the required preformed or jetting elevation to the scour elevation.

Bearing Resistance

3 of the Standard Specifications, or approved equivalent.

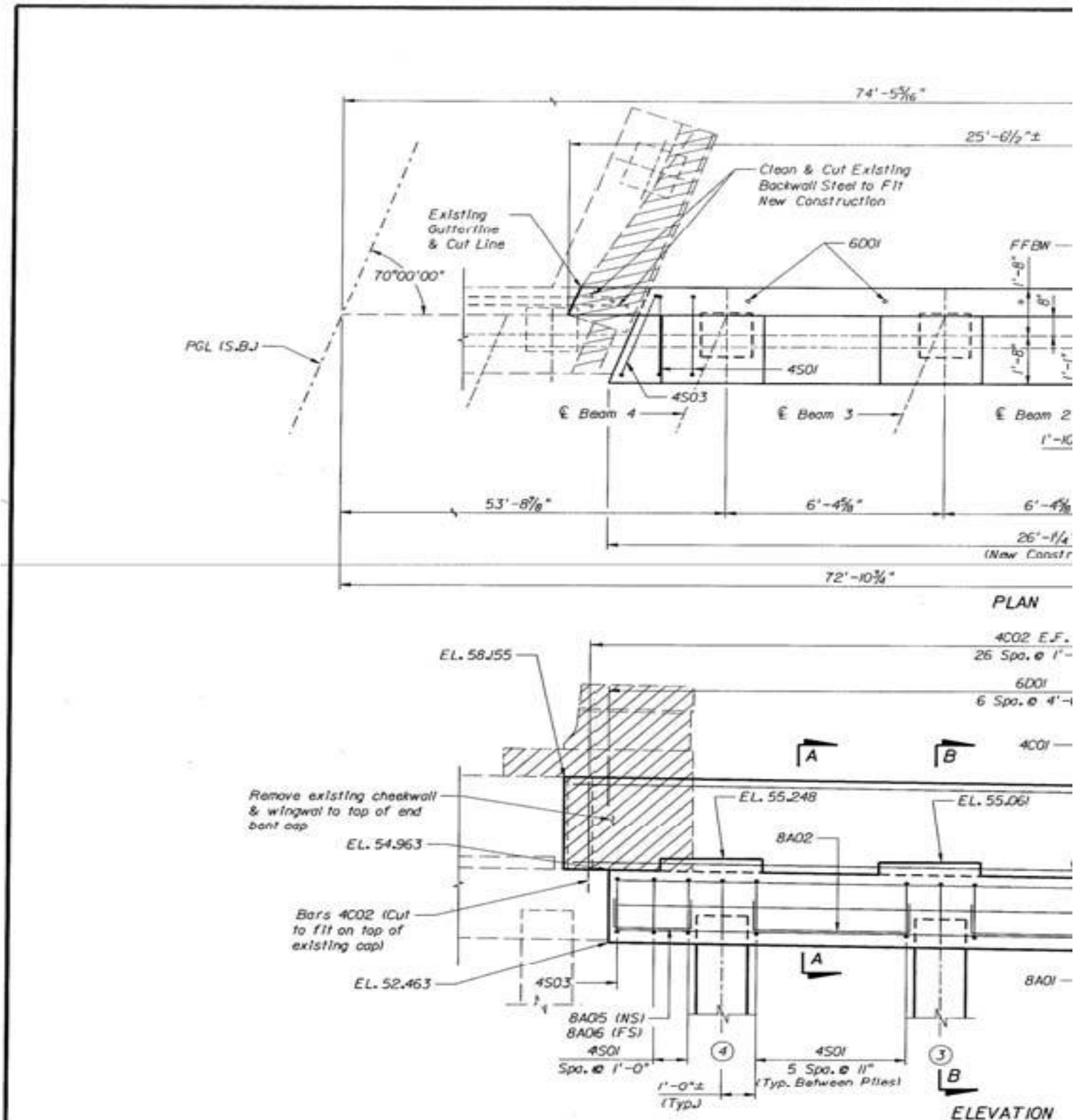
ted by the Engineer.

es, Drill Bits, etc.) as needed to facilitate predrilling and preforming, if required.

BRIDGE NO. 140061

ENGINEER OF RECORD: PBSJ R. D. Horrel P.E. # 43973; 1901 Commonwealth Lane Tallahassee, FL 32303 (850) 575-1800; Certificate of Authorization No. 24	FLORIDA DEPARTMENT OF TRANSPORTATION			SHEET TITLE: PILE DATA TABLE	
	ROAD NO. SR 93	COUNTY PASCO	FINANCIAL PROJECT ID 258413-2-52-01	PROJECT NAME: I-75 (SR 93) S.B. OVER CYPRESS CREEK	SHEET NO. B-28

PLAN SET SHEET 9

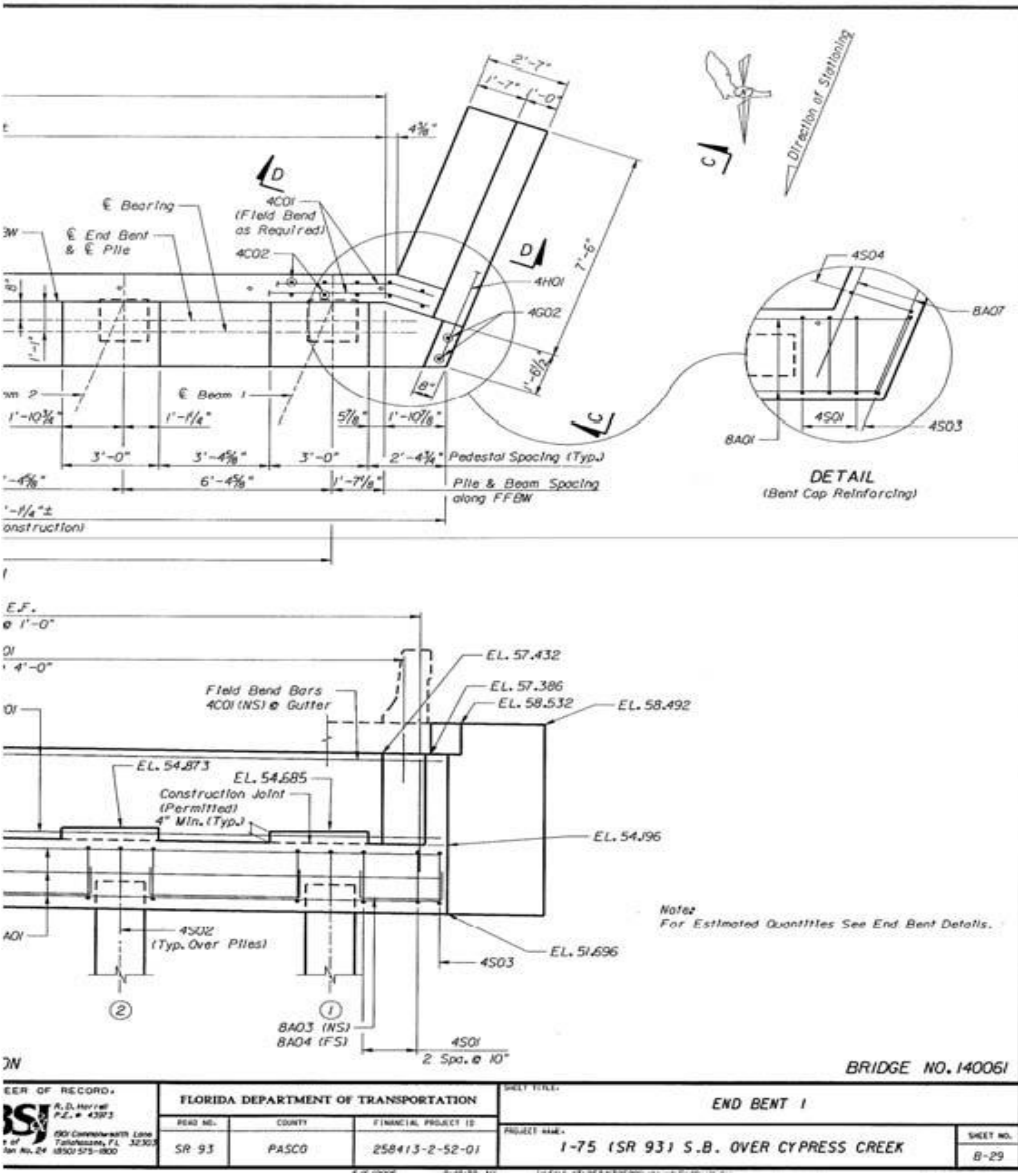


REVISIONS					
DATE	BY	DESCRIPTION	DATE	BY	DESCRIPTION

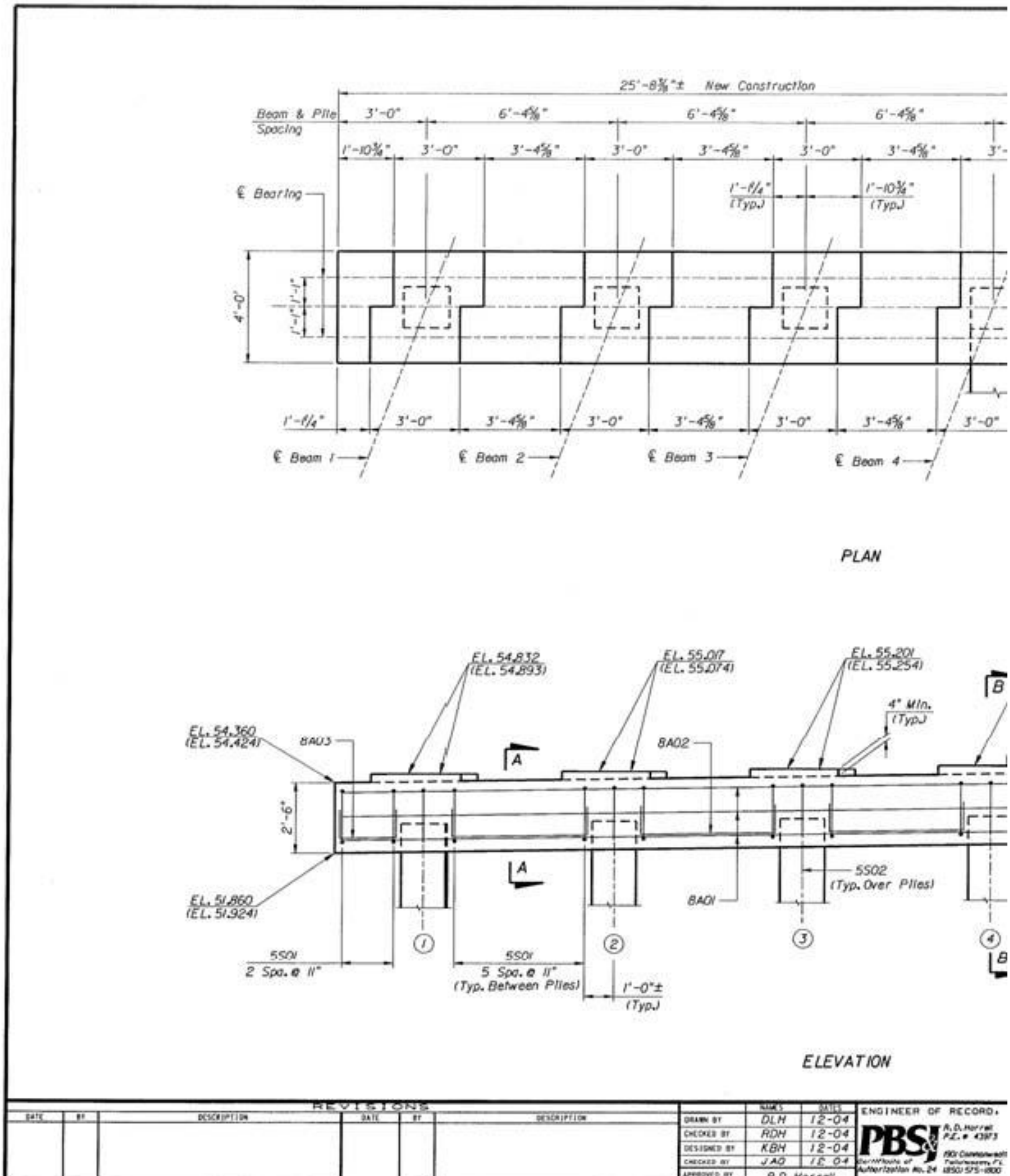
	NAMES	DATES
DRAWN BY	DLH	12-04
CHECKED BY	RDH	12-04
DESIGNED BY	KBH	12-04
CHECKED BY	JAO	12-04
APPROVED BY	R.D. Harrell	

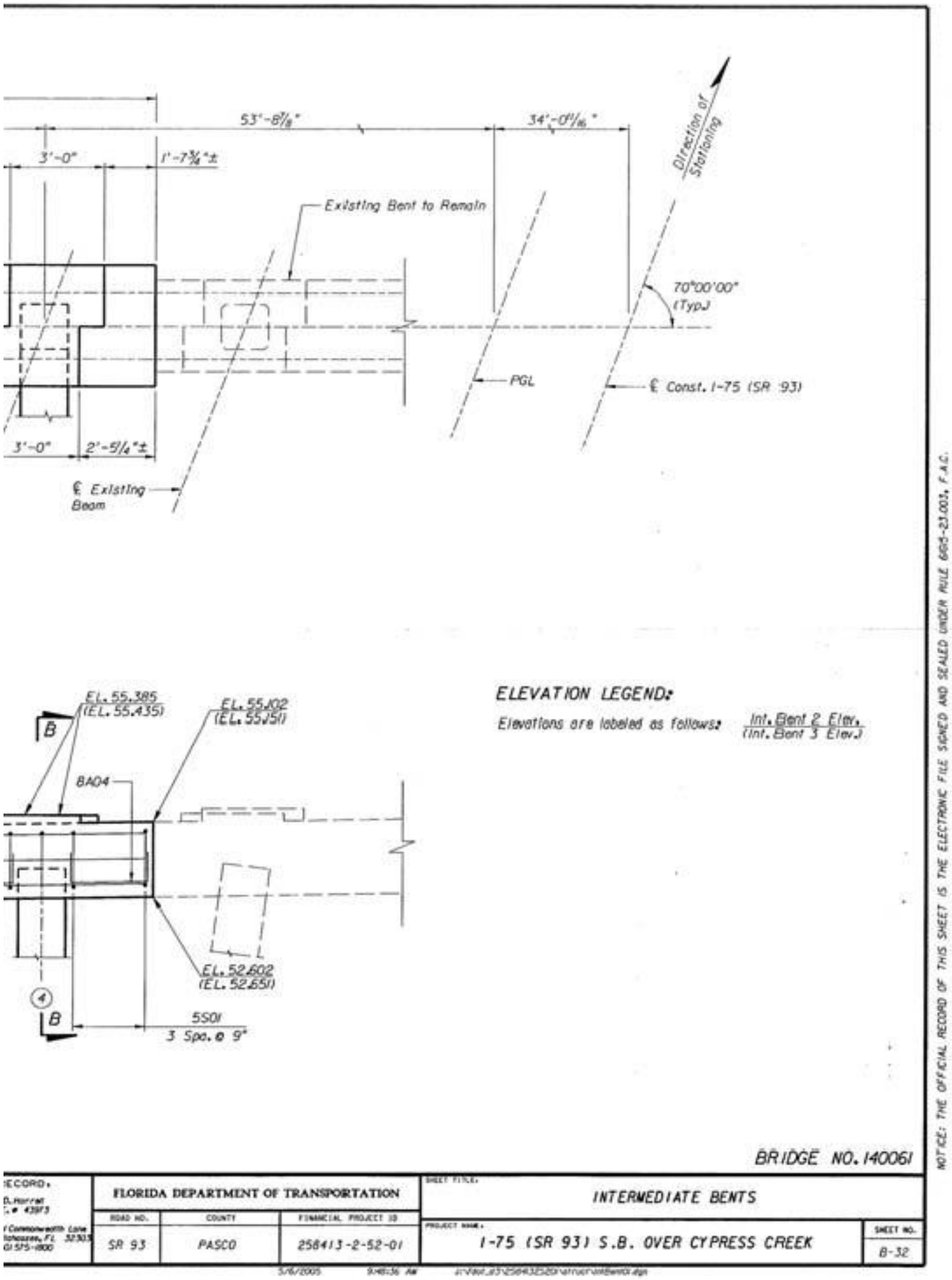
ENGINEER
PBS
Certificate of Authorization No.

PLAN SET SHEET 9



PLAN SET SHEET 10





PLAN SET SHEET 10

PILE INSTALLATION PLAN SAMPLE

DENSON
CONSTRUCTION

I-75, SR 45 to Cypress Creek

Florida Department of Transportation

Project No.: 258413 2 52 01

Submittal # 501-01

Pile Installation Plan

Florida Department of Transportation
I-75, SR 45 to Cypress Creek
Project No.: 258413 2 52 01
PILE INSTALLATION PLAN

Attachment 1

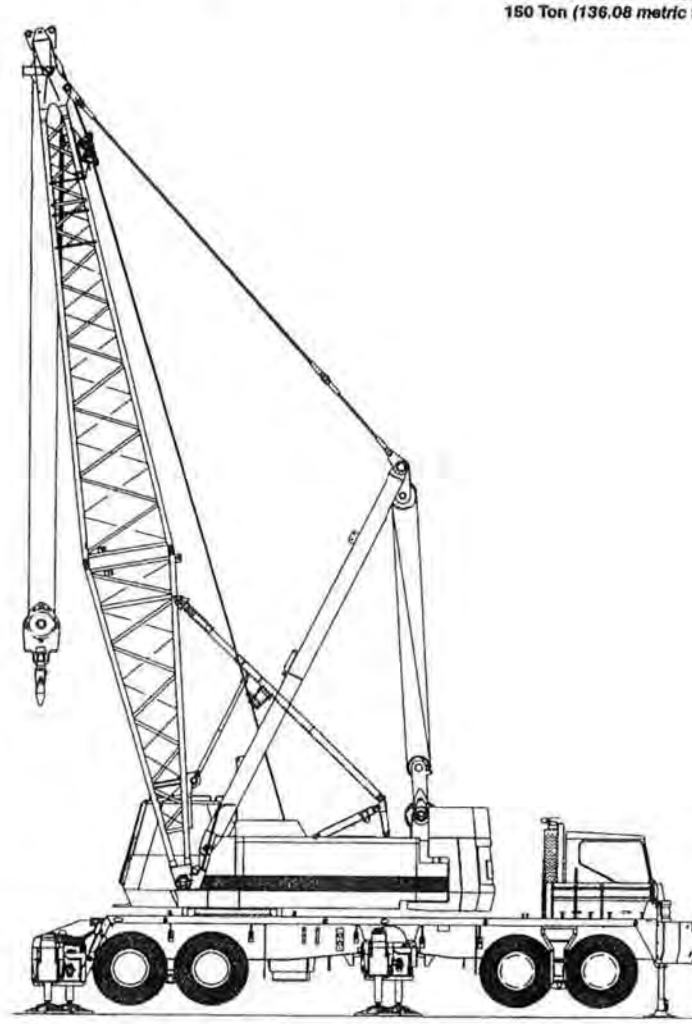
5465 (supersedes 5442)–1205–H9

Technical Data

Specifications & Tube Boom Capacities

HC-238H II

Truck Crane
150 Ton *(136.08 metric ton)*



CAUTION: This material is supplied for reference use only. Operator must refer to in–cab Crane Rating Manual and Operator's Manual to determine allowable crane lifting capacities and assembly and operating procedures.

Link-Belt
CONSTRUCTION EQUIPMENT

Specifications

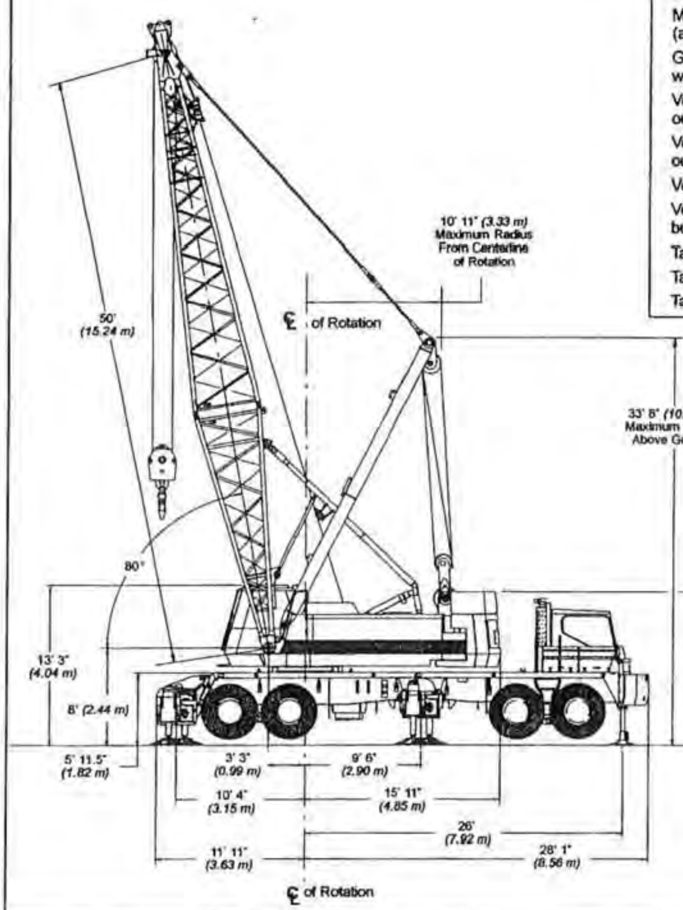
Lattice Boom Truck Crane

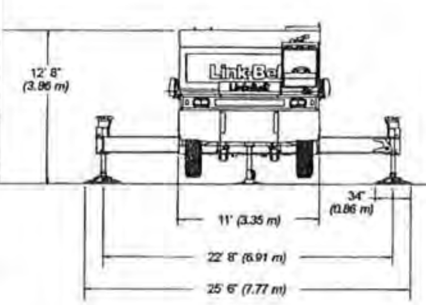
HC–238H II

150–ton *(136.08 metric ton)*

HYLAB Series

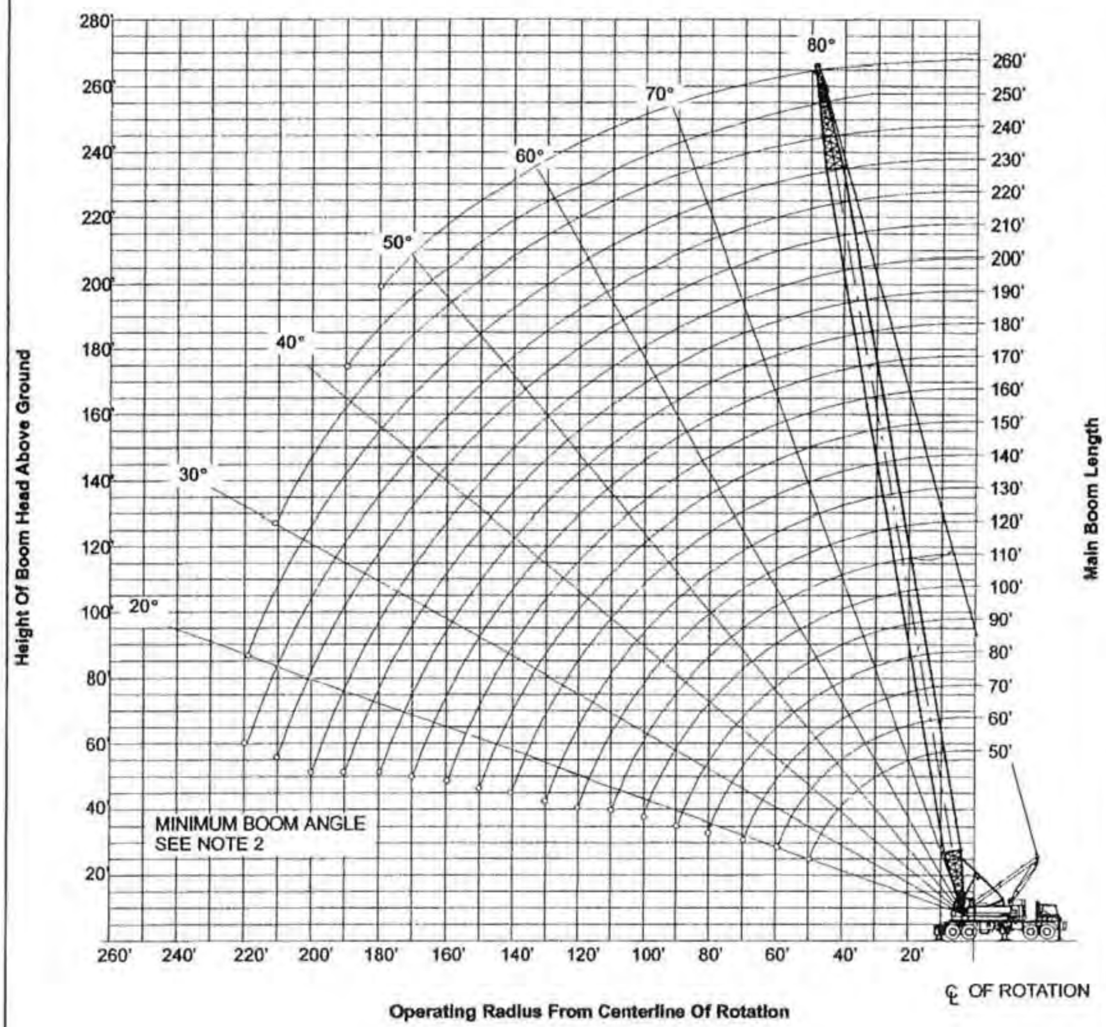
General Dimensions	feet	meters
Minimum ground clearance (at bottom of front bogie beam)	11"	.28
Ground clearance under counter–weigh with machine on tires	5' 9"	1.75
Vehicle turning diameter – Centerline outside front tire	106' 0"	32.30
Vehicle turning diameter – Outside of outer front tire (curb clearance)	107' 3"	32.69
Vehicle clearance over front bumper	111' 8"	34.03
Vehicle clearance over "A" front bumper counterweight	112' 9"	34.36
Tailswing of "AB" counterweight	15' 11"	4.85
Tailswing of "A" counterweight	15'	4.57
Tailswing of "0" counterweight	13' 10"	4.22





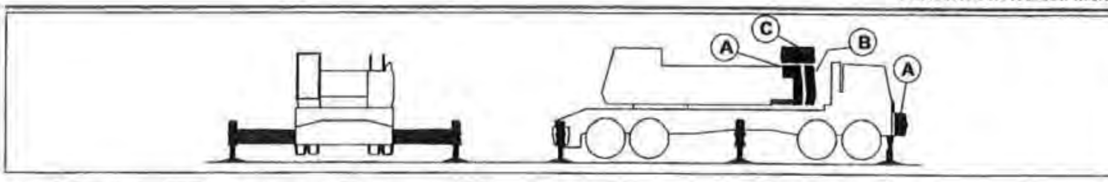
WORKING RANGE DIAGRAM
50' TO 260' MAIN BOOM ON OUTRIGGERS

MAXIMUM BOOM ANGLE
SEE NOTE 2



Notes:

1. **Boom geometry shown is for unloaded condition and crane standing level on firm supporting surface. Boom deflection, subsequent radius and boom angle change must be accounted for when applying load to hook.**
2. **Maximum and minimum boom angles are equal to the values listed in the capacity chart for each boom length.**



Main Boom Capacities – On Outriggers – 35 Ft Hammerhead Boom							
Load Radius (ft)	Boom Angle (deg)	Counterweight Combinations – Upper + Bumper					
		360 Degree Rotation					
		0+0	A+0	AB+0	AB+A	ABC+0	ABC+A
10	82.0				300,000		
11	80.2				267,700		
12	78.4				250,000		
13	76.6				237,100		
14	74.8				221,000		
15	72.9				206,900		
16	71.0				194,400		
17	69.1		PROHIBITED		183,300	PROHIBITED	
18	67.2				173,300		
19	65.2				164,300		
20	63.2				156,200		
25	52.3				124,600		
30	39.1				96,300		
35	17.6				63,900		

Main Boom Capacities -- On Outriggers – 50 Ft Open Throat Tube Boom							
Load Radius (ft)	Boom Angle (deg)	Counterweight Combinations – Upper + Bumper					
		360 Degree Rotation					
		ABC+A	ABC+0	AB+A	AB+0	A+0	0 + 0
12	79.6	264,900	268,700	258,700	261,400	241,100	219,300
13	78.4	252,100	255,400	242,600	242,600	223,700	203,400
14	77.2	241,000	243,400	226,100	226,100	208,500	189,500
15	76.1	228,400	228,400	211,800	211,800	195,200	177,400
16	74.9	214,800	214,800	199,100	199,100	183,400	166,700
17	73.7	202,700	202,700	187,800	187,800	173,000	157,200
18	72.5	191,800	191,800	177,700	177,700	163,700	148,700
19	71.3	181,900	181,900	168,500	168,500	155,300	140,900
20	70.1	173,000	173,000	160,200	160,200	147,600	131,000
25	63.8	138,700	138,700	128,400	128,400	116,600	81,100
30	57.3	115,400	115,400	106,800	106,800	84,000	57,900
35	50.1	98,600	98,600	88,800	83,300	65,100	44,600
40	42.2	85,500	83,500	72,300	67,800	52,700	35,600
50	19.8	48,700	48,700	48,700	48,700	37,600	25,000

Main Boom Capacities – On Outriggers – 60 Ft Open Throat Tube Boom							
Load Radius (ft)	Boom Angle (deg)	Counterweight Combinations – Upper + Bumper					
		360 Degree Rotation					
		ABC+A	ABC+0	AB+A	AB+0	A+0	0 + 0
13.37	80.0	234,700	234,700	234,700	234,700	217,300	197,600
14	79.4	231,700	231,700	225,700	225,700	208,100	189,200
15	78.4	225,900	225,900	211,400	211,400	194,900	177,100
16	77.4	214,400	214,400	198,800	198,800	183,100	166,400
17	76.5	202,300	202,300	187,400	187,400	172,600	157,000
18	75.5	191,400	191,400	177,400	177,400	163,400	148,400
19	74.5	181,600	181,600	168,300	168,300	155,000	140,700
20	73.5	172,800	172,800	160,000	160,000	147,400	131,800
25	68.4	138,500	138,500	128,300	128,300	117,100	81,600
30	63.2	115,300	115,300	106,700	106,700	84,300	58,300
35	57.7	98,500	98,500	89,100	83,600	65,400	44,900
40	51.9	84,300	83,800	72,500	68,000	53,000	36,100
50	38.4	63,400	60,700	52,300	49,000	37,800	25,200
60	18.1	39,900	39,900	39,900	37,700	28,800	18,800

Main Boom Capacities – On Outriggers – 70 Ft Open Throat Tube Boom							
Load Radius (ft)	Boom Angle (deg)	Counterweight Combinations – Upper + Bumper					
		360 Degree Rotation					
		ABC+A	ABC+0	AB+A	AB+0	A+0	0 + 0
15.11	80.0	211,100	211,100	210,200	210,200	193,900	176,400
16	79.3	207,800	207,800	199,100	199,100	183,500	166,900
17	78.4	202,600	202,600	187,800	187,800	173,100	157,400
18	77.6	191,700	191,700	177,800	177,800	163,800	148,900
19	76.7	181,900	181,900	168,600	166,600	155,400	141,100
20	75.9	173,100	173,100	160,300	160,300	147,800	133,900
25	71.6	138,800	138,800	128,600	128,600	118,300	82,900
30	67.3	115,500	115,500	107,000	107,000	85,300	59,300
35	62.8	98,700	98,700	89,800	84,300	66,100	45,500
40	58.0	86,000	84,400	73,100	68,600	53,600	36,700
50	47.6	64,500	61,100	52,800	49,400	38,300	25,700
60	35.4	50,000	47,300	40,800	38,100	29,200	19,300
70	16.7	40,300	38,200	32,700	30,500	23,100	14,800

Main Boom Capacities – On Outriggers – 80 Ft Open Throat Tube Boom							
Load Radius (ft)	Boom Angle (deg)	Counterweight Combinations – Upper + Bumper					
		360 Degree Rotation					
		ABC+A	ABC+0	AB+A	AB+0	A+0	0 + 0
16.84	80.0	189,100	189,100	188,900	188,900	174,200	158,200
17	79.9	188,500	188,500	187,200	187,200	172,600	156,900
18	79.2	185,600	185,600	177,200	177,200	163,300	148,400
19	78.4	181,300	181,300	168,100	168,100	155,000	140,700
20	77.7	172,600	172,600	159,800	159,900	147,300	133,800
25	74.0	138,400	138,400	128,200	128,200	117,900	83,100
30	70.2	115,200	115,200	106,600	106,600	85,400	59,400
35	66.4	98,400	98,400	89,800	84,300	66,200	45,600
40	62.4	85,700	84,300	73,100	68,600	53,600	36,700
50	54.0	64,400	61,100	52,700	49,400	38,300	25,700
60	44.5	49,900	47,300	40,700	38,100	29,200	19,200
70	33.1	40,400	38,200	32,700	30,500	23,100	14,900
80	15.6	33,600	31,700	27,000	25,100	18,900	11,800

Main Boom Capacities – On Outriggers – 90 Ft Open Throat Tube Boom							
Load Radius (ft)	Boom Angle (deg)	Counterweight Combinations – Upper + Bumper					
		360 Degree Rotation					
		ABC+A	ABC+0	AB+A	AB+0	A+0	0 + 0
18.58	80.0	170,000	170,000	170,000	170,000	157,800	143,300
19	79.7	168,900	168,900	167,500	167,500	154,400	140,200
20	79.1	166,300	166,300	159,300	159,300	146,800	133,400
25	75.8	138,000	137,900	127,800	127,800	117,500	83,200
30	72.5	114,800	114,800	106,200	106,200	85,400	59,400
35	69.1	98,000	98,000	89,800	84,300	66,100	45,500
40	65.7	85,400	84,300	73,000	68,500	53,500	36,600
50	58.5	64,300	61,000	52,600	49,300	38,200	25,600
60	50.7	49,800	47,100	40,600	38,000	29,100	19,200
70	41.8	40,300	38,100	32,600	30,400	23,100	14,800
80	31.1	33,500	31,600	26,900	25,100	18,800	11,700
90	14.7	28,400	26,800	22,700	21,100	15,600	9,400

Note: Refer To Page 8 For "Capacity Deductions" Caused By Any Jib Attachment Or Tip Extension.

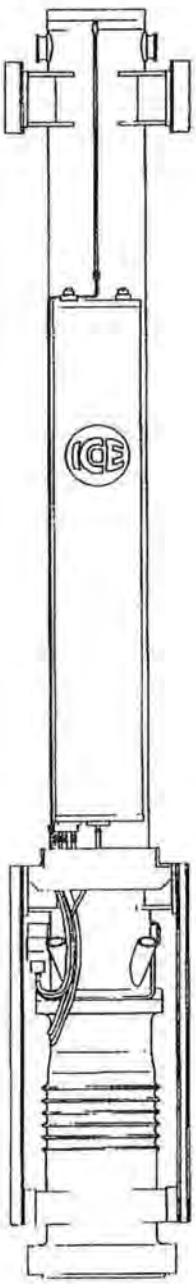
DENSON
CONSTRUCTION

Florida Department of Transportation
I-75, SR 45 to Cypress Creek
Project No.: 258413 2 52 01
PILE INSTALLATION PLAN

Attachment 2

Model 60S

Fuel-Injected Diesel Pile Hammers



Clean • Efficient • Reliable

Designed and engineered for light-weight driven pile applications.

- High-pressure fuel injection provides easy starts even in extreme weather & soft soil conditions.
- Dual injectors optimize fuel atomization and delivery for clean, efficient operation.
- Remote variable fuel pump.
- Operates on vegetable-based fuel & lubricants without modification, contributing to a clean and toxin-free jobsite.
- Hydraulically-operated remote throttle permits precise control of stroke to match hammer energy to any job or pile condition.
- Upper & lower polymeric ram bearings minimize wear and maximize energy transfer.
- Lower cylinder and other critical components are chemically-treated for superior surface hardness and fatique resistance.
- Ferro-chromium alloy forged ram & anvil exceed strength of cast rams & anvils for durability and long life.
- Weighs less than competitive hammers to move more easily from pile to pile.
- Swinging, fixed and sliding lead set-ups available in 16 and 8 ft. sections.
- Four models of light-to-heavy-duty lead spotters for precise pile positioning.

Working Specifications	
Ram	7,000 lbs (3175 kg)
Maximum energy	72,900 ft-lbs (98.9 kNm)
Rated continuous energy	60,000 ft-lbs (81.4 kNm)
Minimum energy	26,000 ft-lbs (35.2 kNm)
Speed (blows per minute)	41-59
Weights	
Bare hammer	13,900 lbs (6305 kg)
Typical weight (w/H-pile cap in 26" leads)	15,900 lbs (7210 kg)
Capacities (adequate for average day of operation)	
Diesel fuel tank	18 gal (70 l)
Lube oil tank	8 gal (20 l)
Dimensions of Hammer	
Width (side to side)	26" (660 mm)
Depth	37.5" (950 mm)
Centerline to front	17" (430 mm)
Centerline to rear	20.5" (520 mm)
Length (hammer only)	17'-0" (5080 mm)
Operating length (top of ram to top of pile)	26'-9" (8050 mm)

INTERNATIONAL CONSTRUCTION EQUIPMENT, INC.

60S-502

Model 60S

Fuel-Injected Diesel Pile Hammers

ICE 60S DIESEL PILE HAMMER BEARING CHART

This chart is based on the Gates formula given below and is provided as a convenience only for those applications where this formula is specified. The Gates formula has been recommended for use by the U.S. DOT Federal Highway Administraion. The formula calculates ultimate pile capacity. The FHWA recommends using a factor of safety of 3.5 with the Gates formula. ICE has no preference for this formula over any other.

Ultimate bearing (tons) = 1/2(1.75*(E)^1/2*log(10N)-100) where E=Hammer energy (ft-lbs) and N=Hammer blows per inch at final penetration.

Blows per Min.	Ram Stroke (feet)	Hammer Energy (ft-lbs)	Pile Set (Blows per inch) 2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
41	8.60	*60,200*	229	267	294	315	332	346	359	370	379	388	396	404	411	417	423	429	434	439	444
42	8.10	*56,700*	221	258	284	304	320	334	347	357	367	375	383	390	397	403	409	415	420	425	429
43	7.70	*53,900*	214	250	275	295	311	325	337	347	356	365	372	379	386	392	398	403	408	413	417
44	7.30	*51,100*	207	242	267	286	302	315	326	337	346	354	361	368	374	380	386	391	396	401	405
45	7.00	*49,000*	202	236	260	279	294	307	319	329	337	345	353	359	366	371	377	382	387	391	396
46	6.70	*46,900*	97	230	254	272	287	300	311	320	329	337	344	351	357	362	368	373	377	382	386
47	6.40	*44,800*	191	224	247	265	279	292	302	312	320	328	335	342	347	353	358	363	368	372	376
48	6.10	*42,700*	185	217	240	257	272	284	294	303	312	319	326	332	338	343	349	353	358	362	366
49	5.80	*40,600*	179	210	232	250	264	275	286	295	303	310	317	323	328	334	339	343	348	352	356
50	5.60	*39,200*	175	206	228	244	258	270	280	289	296	304	310	316	322	327	332	336	341	345	349
51	5.30	*37,100*	169	199	220	236	250	261	271	279	287	294	300	306	312	317	321	326	330	334	338
52	5.10	*35,700*	165	194	215	231	244	255	265	273	281	287	294	299	305	310	314	319	323	327	330
53	4.90	*34,300*	161	189	210	225	238	249	258	267	274	281	287	293	298	303	307	311	315	319	323
54	4.70	*32,900*	156	184	204	220	232	243	252	260	267	274	280	286	291	295	300	304	308	312	315
55	4.50	*31,500*	152	179	199	214	226	237	246	253	261	267	273	278	283	288	292	296	300	304	307
56	4.30	*30,100*	148	174	193	208	220	230	239	247	54	260	266	271	276	280	285	289	292	296	299
57	4.10	*28,700*	143	169	187	202	214	224	232	240	246	253	258	263	268	273	277	281	284	288	291
58	3.90	*27,300*	138	164	182	196	207	217	225	233	239	245	251	256	260	265	269	272	276	279	281
59	3.80	*26,600*	136	161	179	192	204	213	222	229	235	241	247	252	256	261	265	268	272	275	278

CAUTION: Driving at ten blows per inch is considered practical refusal. Driving in excess of ten blows per inch for more than six inches of driving or driving in excess of 20 blows per inch at all is considered improper use and will void the hammer warranty.

LEADS/SPOTTERS

ICE manufactures leads with 20", 26" 32" and 36" guide rails for all ICE and other pile hammers. Standard components are available in 8' increments for swinging, fixed and sliding lead setups. Two designs are available to provide the most cost-effective configuration for every job. **Four models of spotters** and **three spotter power unit sizes** are available.

DRIVE CAPS

ICE offers a drive cap base/insert system for all ICE lead sizes as well as for pipe leads. Drive cap inserts are available for practically any pile type and size. The ICE drive cap system: maintains pile top position under the hammer, protects the hammer from peak stresses,minimizes pile top deformation, and transmits maximum force to pile.

INTERNATIONAL CONSTRUCTION EQUIPMENT, INC.

Corporate offices:
301 Warehouse Drive, Matthews NC 28104
Phones: 704 821-8200, 888 ICEUSA1 (423-8721)
Fax: 704 821-8201
www.iceusa.com **e-mail:** sales@iceusa.com

DENSON
CONSTRUCTION

Florida Department of Transportation
I-75, SR 45 to Cypress Creek
Project No.: 258413 2 52 01
PILE INSTALLATION PLAN

Attachment 3

STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION

700-020-01
CONSTRUCTION
04/99

PILE DRIVING INSTALLATION PLAN FORM

Contract No. ______ Structure Name or No. No: 140061

FIN Project No. 258413-2-52-01 County HILLSBOROUGH / PASCO

Pile Driving Contractor HUBBARD Subcontractor DENSON CONSTRUCTION, INC

______ Pile Driven by ______

HAMMER COMPONENTS

Manufacture ICE Model 60-S Serial No. ______

Type: Diesel ✓ Open/Closed Air ______ Hydraulic ______ Compressor ______

Rated Energy 60,200 ft-lbs at 8.60' Length Stroke

Ram Weight 7000 lbs Pile Cap Weight ______

Modifications N/A

HAMMER CUSHION (CAPBLOCK)

Material Blue Nylon Diameter/Width 22 Area 380 Thickness 2"

PILE CAP (HELMET, BONNET, ANVIL BLOCK & DRIVEN HEAD)

Inside Diameter or Width ______ Total Weight 1200 lbs Inside Height ______

PILE CUSHION

Material LAYERED PLYWOOD Diameter/Width 18" Area 2.25 ⌀ Thickness 8"

PILE

Design Capacity ______ FS ______ Ultimate Capacity ______

Type: PCP ______ Steel: H/Pipe ______ Taper: ______

Length T.B.D Diameter/Width ______ Area ______ Wall Thickness ______

Comments ______

PILE INSTALLATION

Crane: Mobile/Crawler LINK BELT HC-238 OR EQUAL Size ______

Leads: Fixed ______ Swinging X Semifixed ______

Template (Sketch attached) Fixed to Ground X Fixed to Existing Structure ______ Size 6' x 40'

Comments ______

Barge: ○ Yes ⊗ No Description N/A

Setting Pile: Predrill ______ Preform ______ Water Jet X * Punch ______ Comments * if NECESSARY

______

Drill/Jet Equipment T.B.D *

Drilling Depth & Size N/A

Underwaterdriving: ○ Yes ○ No Follower: (Sketch attached) Length N/A Height N/A

Special Driving Requirements: ○ Yes ⊗ No

Pile Driving Vibrations: Monitoring ______ Protection ______ Special Protection ______ Survey ______

Comments ______

Method of Determining Pile Capacity

Stroke vs. Blows: Jump Stick ______ Saximeter X Bounce Pressure Gauge & Chart ______

Comments ______

Details of Load Testing Equipment included: ○ Yes ⊗ No Comments ______

Sequence of Pile Driving attached: ⊗ Yes ○ No Comments ______

Schedule for test pile and production pile driving program attached: ⊗ Yes ○ No Comments ______

______

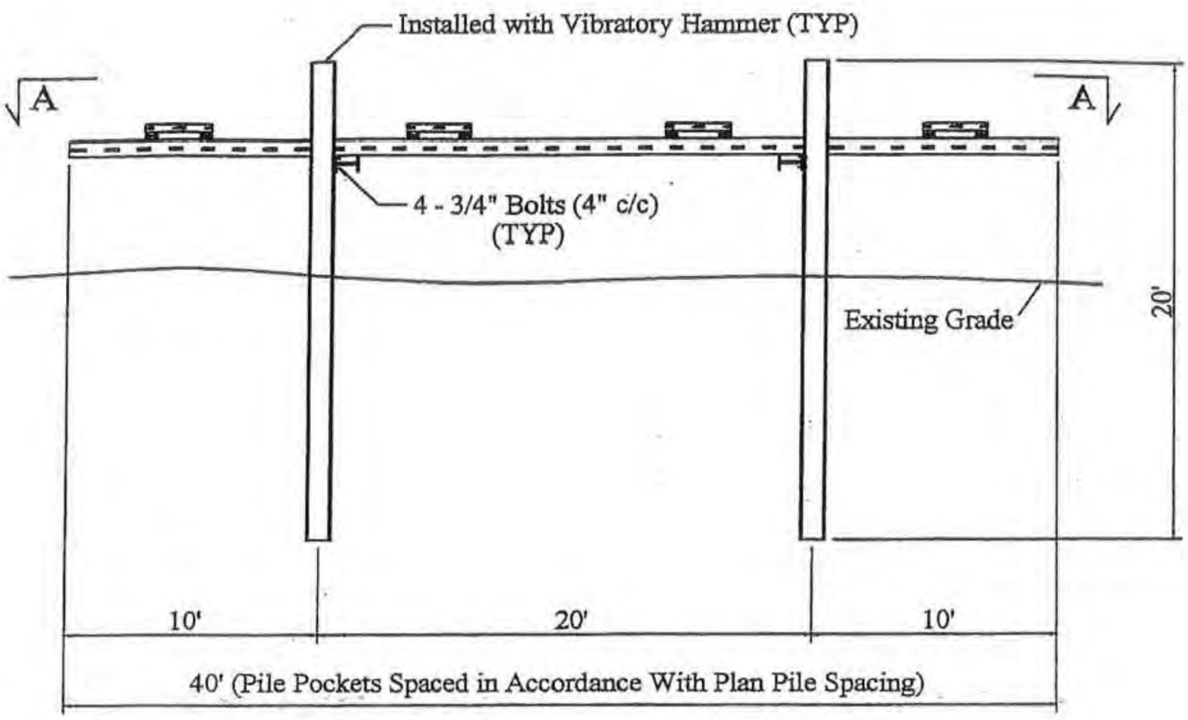
ACCEPTED BY: FDOT REPRESENTATIVE ______

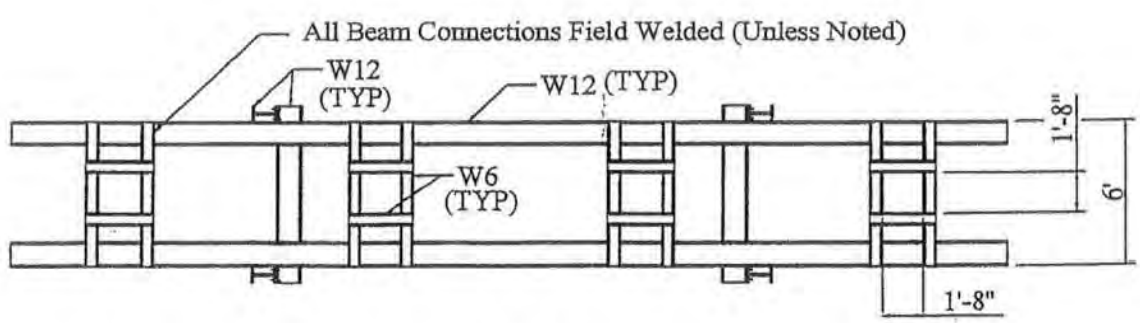
TITLE: ______

DENSON CONSTRUCTION

Florida Department of Transportation
I-75, SR 45 to Cypress Creek
Project No.: 258413 2 52 01
PILE INSTALLATION PLAN

Attachment 4





Section A-A

DENSON CONSTRUCTION

Florida Department of Transportation
I-75, SR 45 to Cypress Creek
Project No. 258413 2 52 01

DENSON
CONSTRUCTION

Florida Department of Transportation
I-75, SR 45 to Cypress Creek
Project No.: 258413 2 52 01
PILE INSTALLATION PLAN

Attachment 5

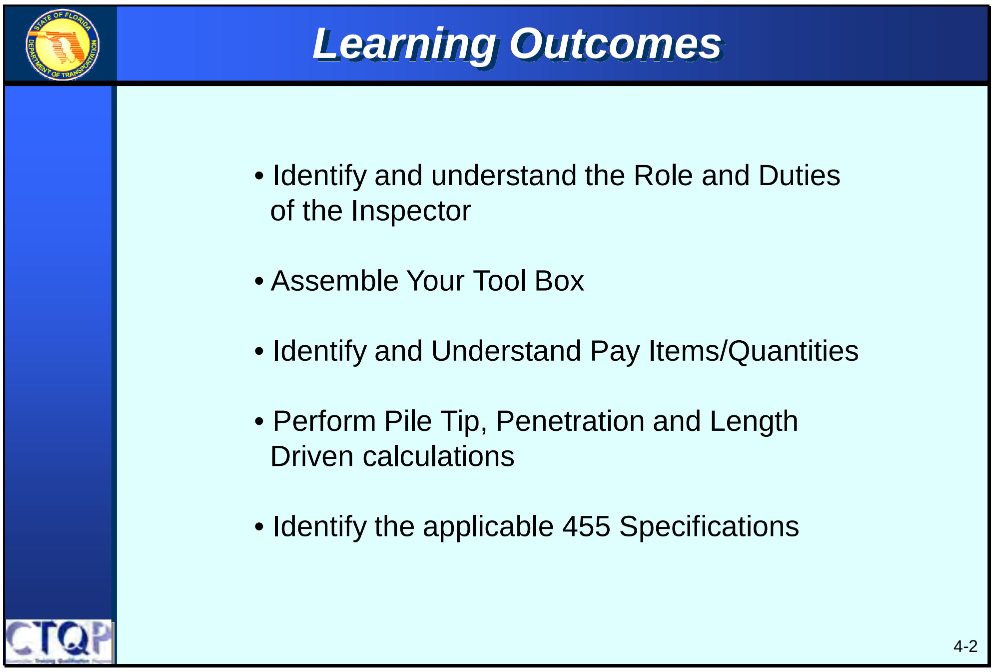
DENSON CONSTRUCTION,INC
PILE DRIVING SEQUENCE

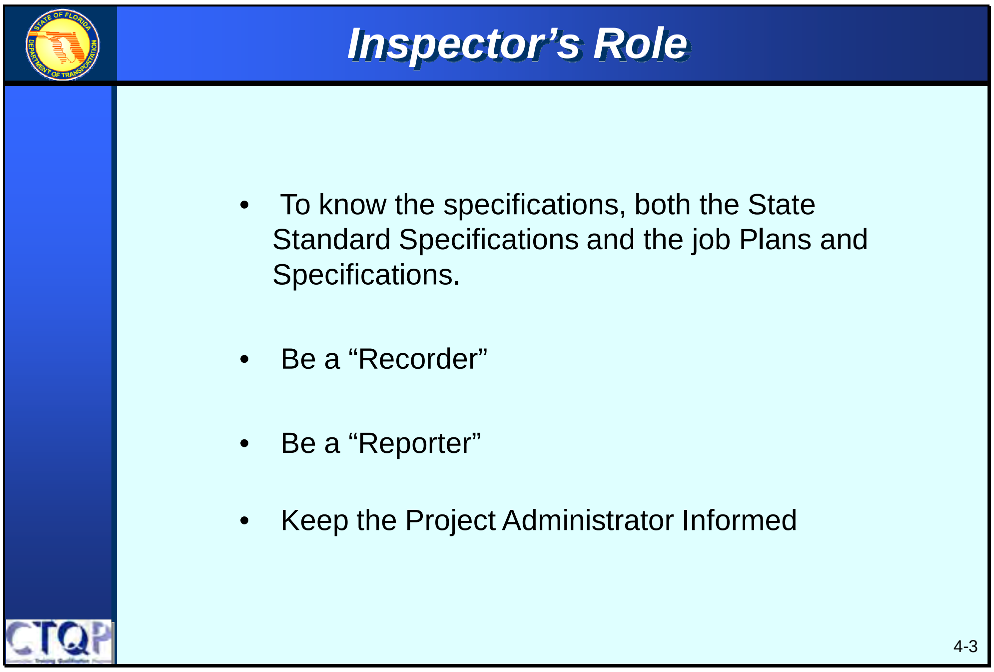
Florida Department of Transportation
I-75 , SR45 to Cypress Creek
Project No.:258413 2 52 01

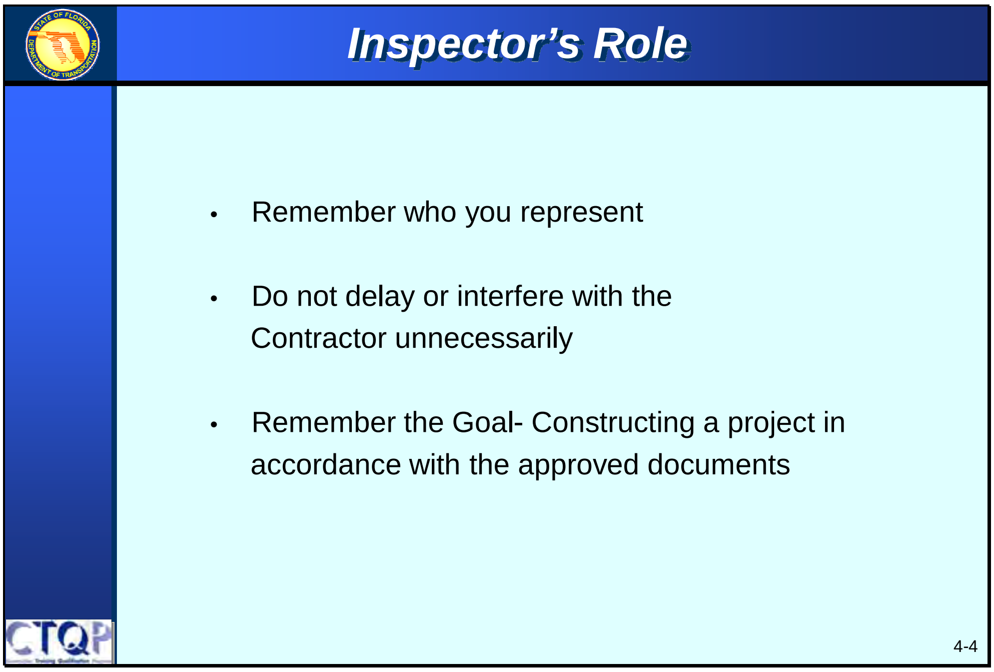
SEQUENSE NUMBER	BENT	PILE NUMBER
1	4	1
2	4	2
3	4	3
4	4	4
5	3	1
6	3	2
7	3	3
8	3	4
9	1	1
10	1	2
11	1	3
12	1	4
13	2	1
14	2	2
15	2	3
16	2	4

NOTES


Lesson 4
INSPECTOR'S
ROLE
4-1


Learning Outcomes
• Identify and understand the Role and Duties of the Inspector
• Assemble Your Tool Box
• Identify and Understand Pay Items/Quantities
• Perform Pile Tip, Penetration and Length Driven calculations
• Identify the applicable 455 Specifications
4-2


Inspector's Role
• To know the specifications, both the State Standard Specifications and the job Plans and Specifications.
• Be a "Recorder"
• Be a "Reporter"
• Keep the Project Administrator Informed
CTQP
4-3



Remember who you are representing and perform your job in a professional manner.

Use common sense- do not delay the Contractor unnecessarily or interfere with their operations. They are responsible for constructing the project and any out of line delays caused by the inspector can be cause for claims.

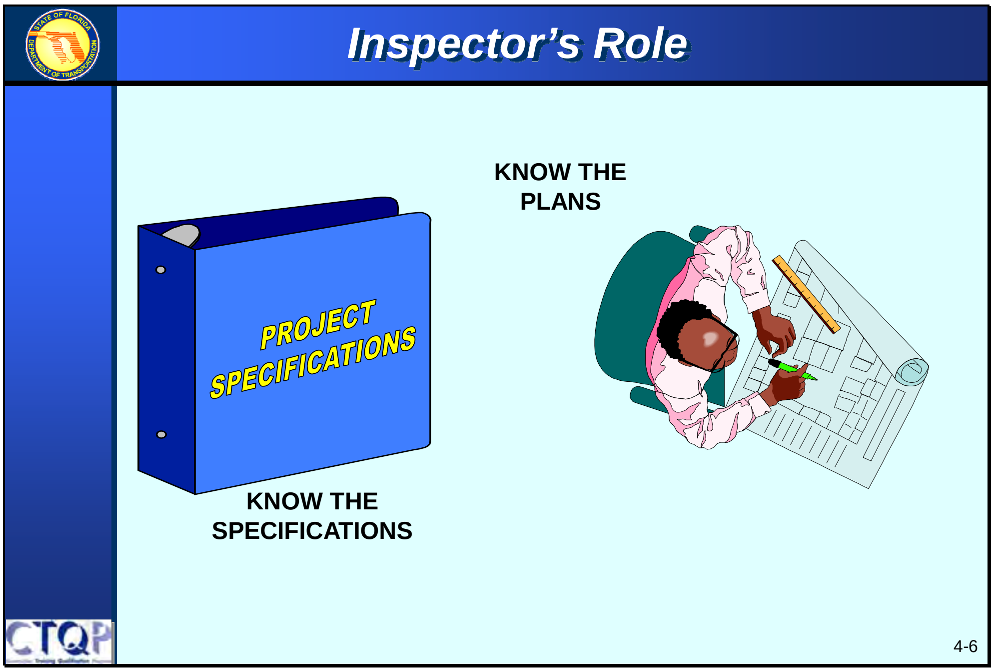
You and the Contractor both have the same goal- getting the project built. The Contractor needs to construct it within the budget and schedule and you are there to ensure that the state gets what it pays for and that the project is constructed in general accordance with the approved plans and specifications.

Inspector’s Role

Keep the Project Administrator Informed

Notify the Project Administrator soon enough that appropriate decisions or Corrective Actions can be made or implemented in a timely fashion to reduce the impact to the project schedule, cost or quality.

4-5



In some projects, the Inspector is brought in at the last moment so it is imperative that you become familiar with the details of the project as quickly as possible.

The Inspector should receive, in advance of the project starting, the approved Plans and Pile Installation Plan. Review these documents for items that affect you.

This course is based upon the July 2014 Workbook Version of the Standard Specifications and Supplements.

INSPECTOR ATTITUDE

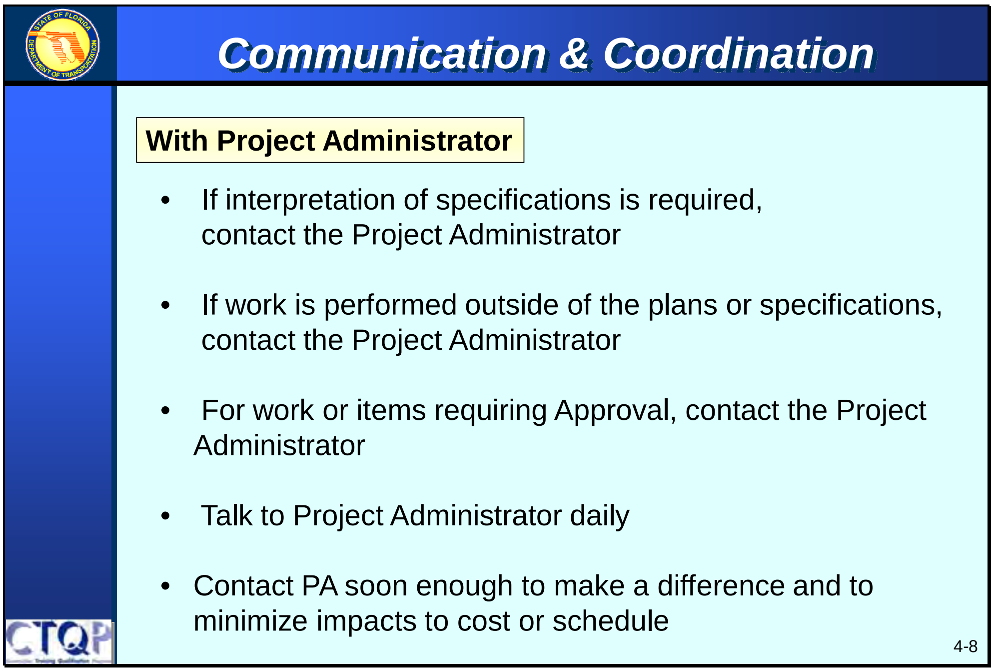
The Inspector should be a recorder. In performing this function the inspector must make accurate and unbiased observations of all important pile driving construction events.

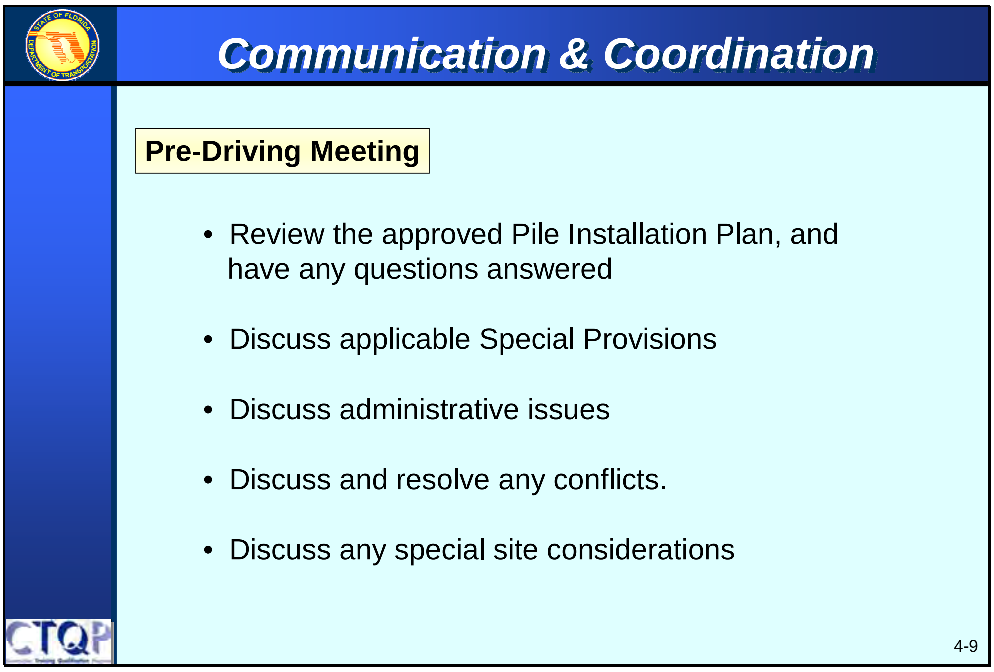
Document events in a complete and a consistent way. This is very important if construction proceeds other than anticipated.

Perform your duties promptly.

The inspector is also a reporter. Complete the forms and reports accurately. Keep the forms and diary up to date. The records kept by the Inspector are the only form of tangible data to make an engineering judgment whenever installation problems arise. Elimination of potential causes can best be made on the basis of accurate and complete data observations.

Keep the Project Administrator informed.

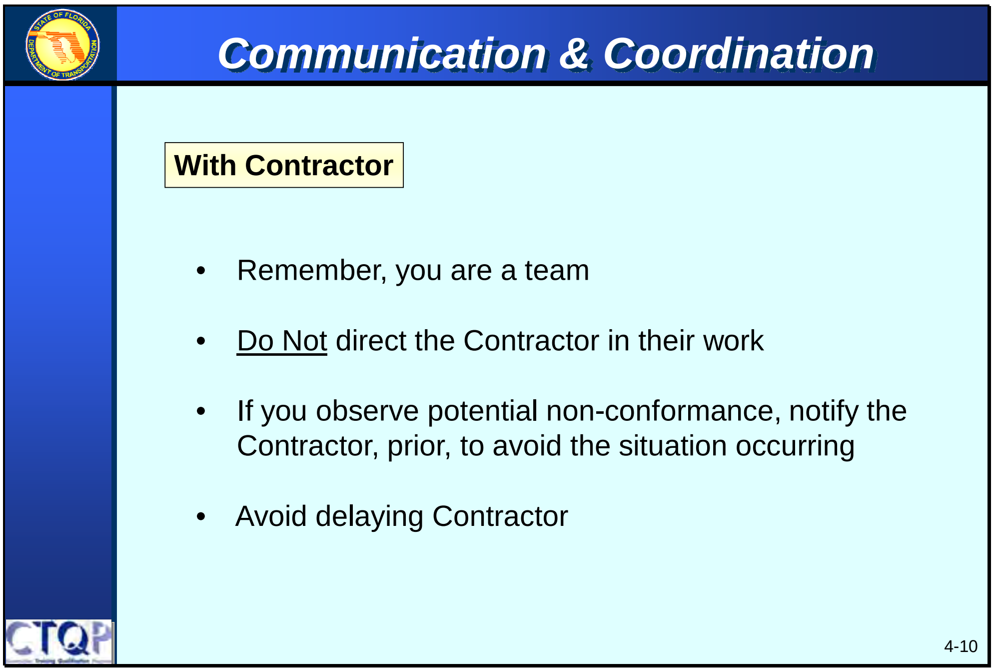

Communication & Coordination
With Project Administrator
• If interpretation of specifications is required, contact the Project Administrator
• If work is performed outside of the plans or specifications, contact the Project Administrator
• For work or items requiring Approval, contact the Project Administrator
• Talk to Project Administrator daily
• Contact PA soon enough to make a difference and to minimize impacts to cost or schedule
4-8



It is essential that a Pre-driving meeting be held and attended by the Project Administrator, Geotechnical Engineer and the Inspector. This is in addition to the general pre-construction meeting. This will allow for going over the Contractor's Installation Plan submitted to see if there are any concerns.

It will alert the Inspector as to potential problem areas that could affect the installation.

This meeting will open up the communication between the team and enhance communication.



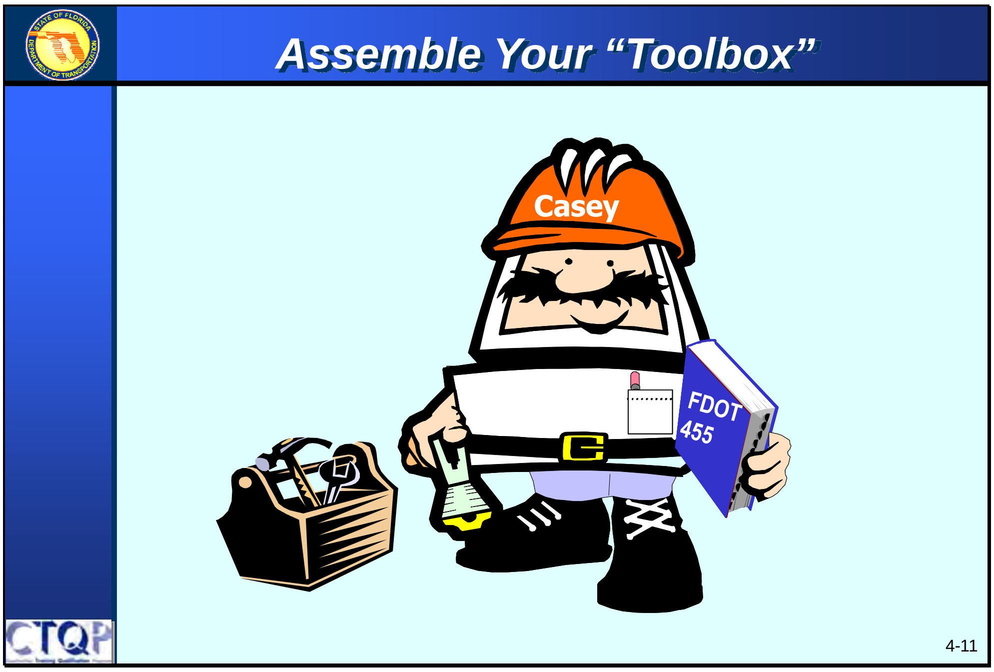
Remember that you are a team.

The Inspector is NOT to direct the Contractor’s work. The Contractor is responsible for building the project. Remember, in a sense, the site belongs to the Contractor, they are the home owner, and the Inspector is, the Inspector.

If you observe potential non conformance and possible conflicts, notify the contractor as soon as possible. Don’t wait until the damage is done. You’ll find that in some cases, the Contractor will begin to appreciate the heads up.

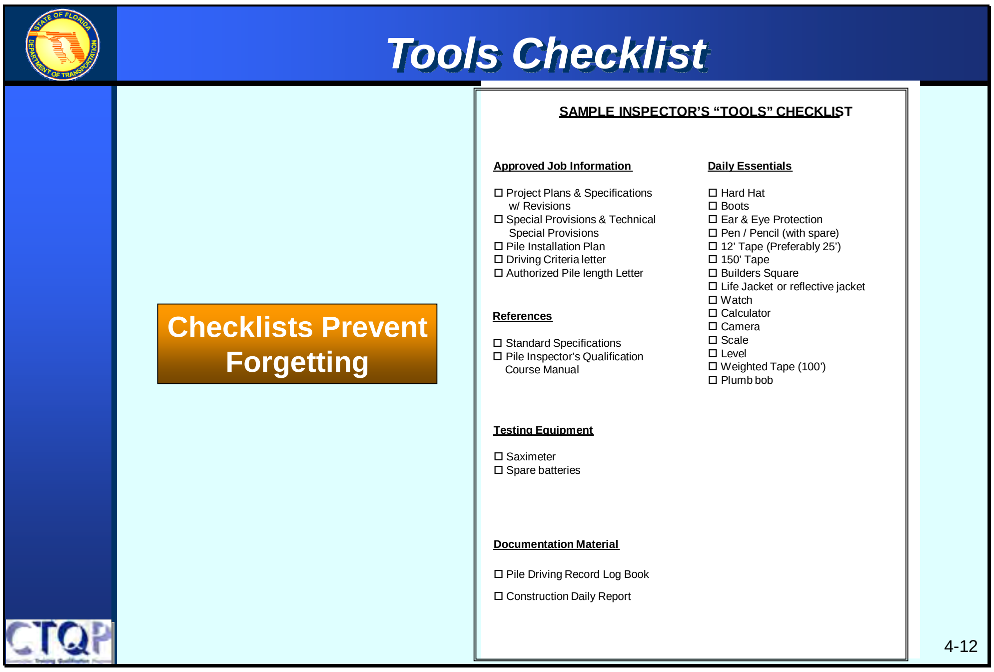
With proper coordination and communication, you can avoid falling into situations that can cause possible delays. For example, if rain is expected tomorrow and the Contractor has their pile cushions stacked up but uncovered, remind the Contractor of the potential for rain. It just may have slipped the Contractor’s mind about not getting the pile cushions wet.

Avoid delaying the contractor.



Prior to going out to the project, it is the Inspector's responsibility to ensure that they have all of the up-to-date project documentation, forms, etc.

Just as any other type of work, you can't do the job properly if you don't have the tools.



Here is a checklist of the items needed to perform the inspector duties

Project Document Check

COMPONENT	CHECK
Plan Revisions	Always check for revised sheets to see if there are any changes that affect the pile construction.
Key Sheet	Does Project ID No., location, etc. agree with the information you were provided?
Summary of Pay Items	Do the pay quantities and items agree?

4-13

Project Document Check

COMPONENT	CHECK
Utilities	Does there appear to be any conflicts with production or test piles? If so, are there provisions for addressing these conflicts?
Traffic Control	Does there appear to be any conflicts with production or test piles? Does the sequence of pile installation conflict? If so, are there provisions for addressing these conflicts?

4-14

Structural Plan Sheet Check

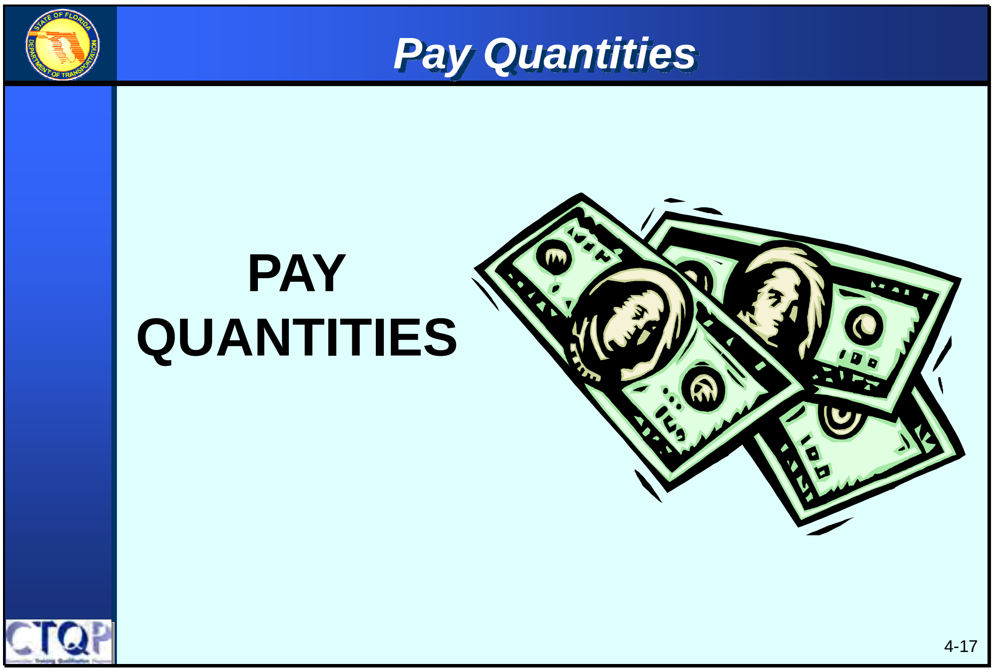
STRUCTURAL PLANS	CHECK
General Notes	Compare with the Pile Data Table. Do any "Notes" contain changes to the specifications or specification applications?
General Plan & Elevation	Does the number of bent/piers or pile locations match the Pile Data Table? Do the elevations shown compare favorably with the Pile Data Table?

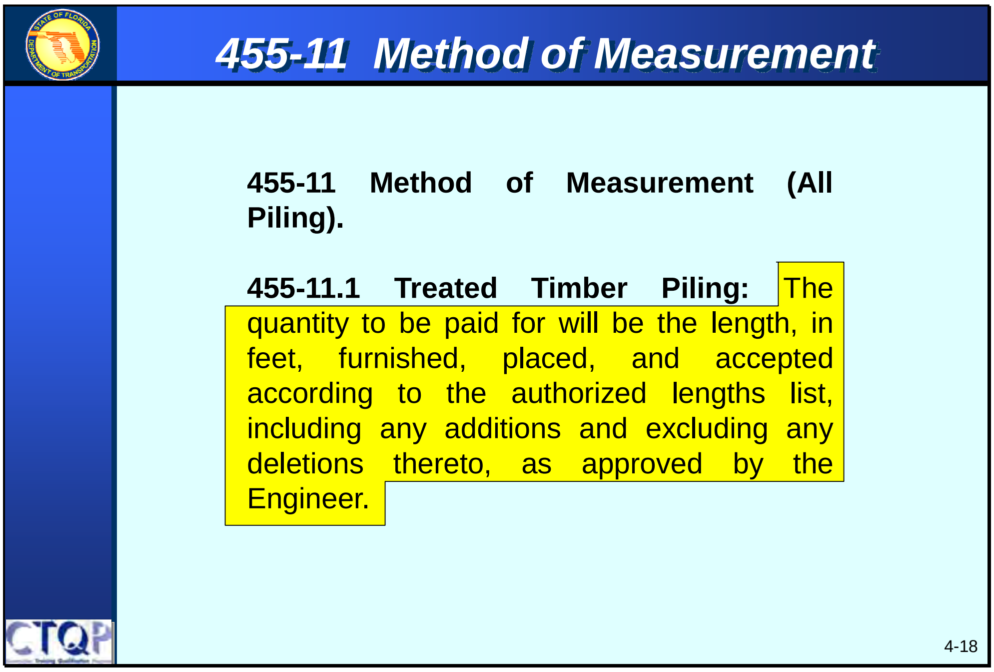
4-15

Structural Plan Sheet Check

STRUCTURAL PLANS	CHECK
Rpt. of Core Borings	Are groundwater tables/piezometric levels shown? Do the boring(s) extend beyond the proposed pile tip elevations?
Foundation Layout	Does the foundation layout match the Pile Installation Plan relating to number, sequencing, elevations, etc.?

4-16


Pay Quantities
PAY
QUANTITIES
4-17


455-11 Method of Measurement
455-11 Method of Measurement (All Piling).
455-11.1 Treated Timber Piling: The quantity to be paid for will be the length, in feet, furnished, placed, and accepted according to the authorized lengths list, including any additions and excluding any deletions thereto, as approved by the Engineer.
CTQP
4-18

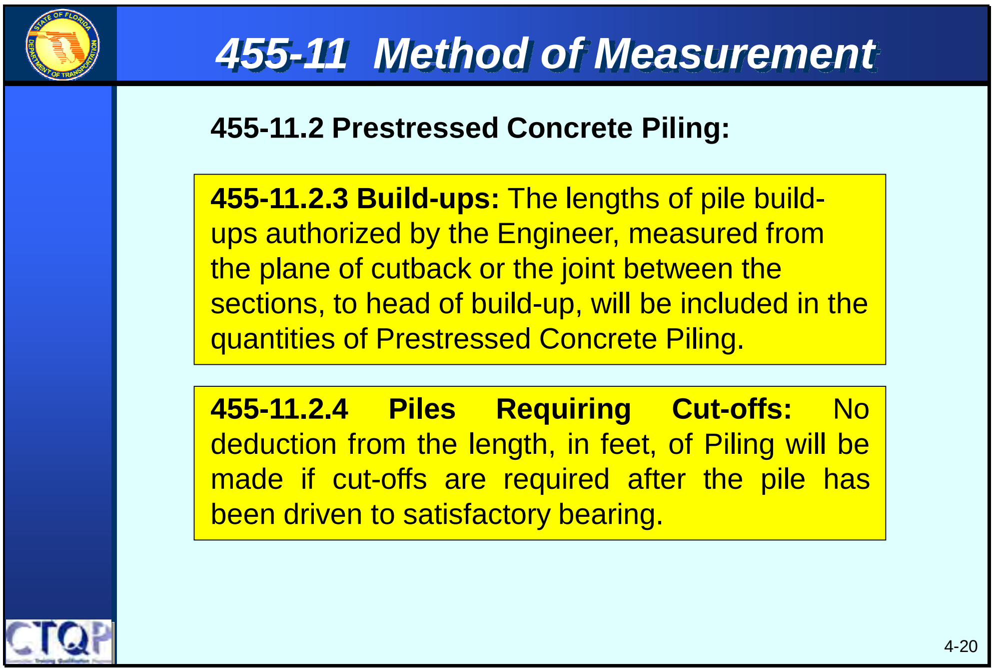
455-11 Method of Measurement

455-11.2 Prestressed Concrete Piling:

455-11.2.1 General: The quantity to be paid for will be the length, in feet, of Prestressed Concrete Piling furnished, driven and accepted according to the authorized lengths list, including any additions and excluding any deletions thereto, as approved by the Engineer.

455-11.2.2 Furnished Length: The furnished length of precast concrete piles will be considered as the overall length from head to tip. Final pay length will be based on the casting length as authorized in accordance with 455-5.14.3 subject to provisions of 455-11.2.3 through 455-11.2.8, 455-11.8, 455-11.9 and 455-11.13.

4-19


455-11 Method of Measurement
455-11.2 Prestressed Concrete Piling:
455-11.2.3 Build-ups: The lengths of pile build-ups authorized by the Engineer, measured from the plane of cutback or the joint between the sections, to head of build-up, will be included in the quantities of Prestressed Concrete Piling.
455-11.2.4 Piles Requiring Cut-offs: No deduction from the length, in feet, of Piling will be made if cut-offs are required after the pile has been driven to satisfactory bearing.
CTQP
4-20

455-11 Method of Measurement

455-11.2.5 Piles Driven Below Cut-off Elevation: Where a pile is driven below cut-off elevation and satisfactory bearing is obtained so that no further driving is required, the length of pile will be measured from cut-off elevation to tip of the pile.

455-11.2.6 Driving of Splice: If a pile is driven below cut-off and satisfactory bearing is not obtained, and additional driving is required after construction of a satisfactory splice, an additional 10 feet of piling will be paid for the additional driving. This compensation for driving of splice, however, will not be allowed for test piles that are spliced and redriven.

4-21

455-11 Method of Measurement

455-11.9.1 Set-Checks/Test Piles: There will be no separate payment for the initial four set-checks performed the day of and the working day following initial driving. For each additional set-check ordered by the Engineer and performed within the following working day of initial driving, an additional quantity of 10 feet of piling will be paid.

455-11.9.2 Set-Check/Production Piles: There will be no separate payment for the initial two set-checks performed the day of and the working day following initial driving. For each additional set-check ordered by the Engineer and performed within the following working day of initial driving, an additional quantity of 10 feet of piling will be paid.

455-11 Method of Measurement

455-11.3 Steel Piling:

455-11.3.1 General: The quantity to be paid for will be the length, in feet, of Steel Piling furnished, spliced, driven and accepted, up to the authorized length, including any additions and excluding any deletions thereto as approved by the Engineer.

455-11.3.2 Point Protectors: The quantity to be paid for will be each for the total of point protectors authorized, furnished, and properly installed.

4-23

455-11 Method of Measurement

455-11.4 Test Piles: The quantity to be paid for of test piles of various types, will be the length, in feet, of Test Piling furnished, driven and accepted, according to the authorized length list, and any additions or deletions thereof as approved by the Engineer.

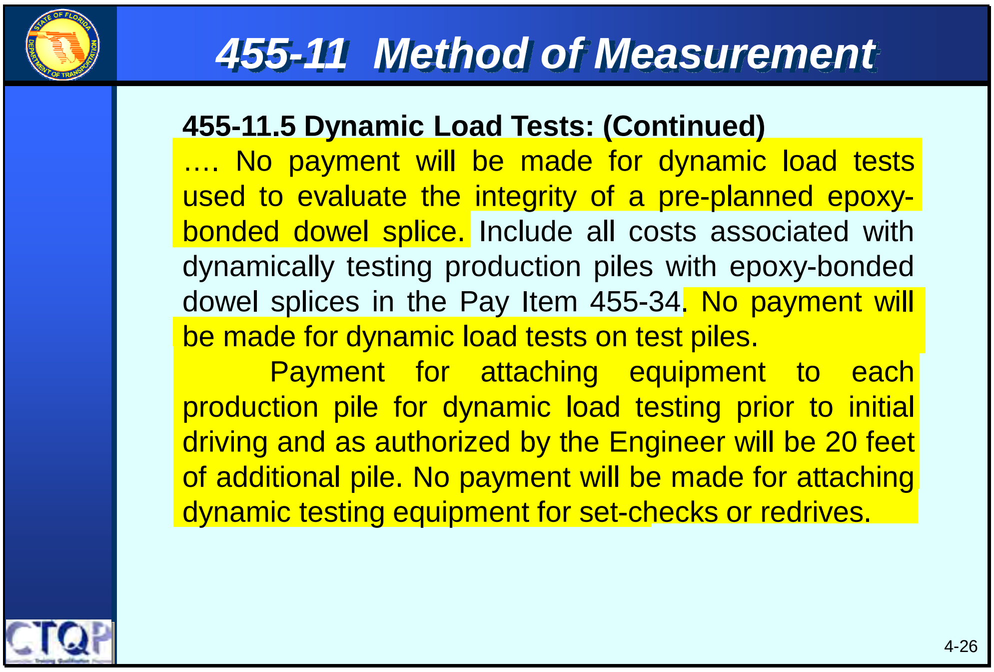
Where a test pile is left in place as a permanent pile, it will be paid for only as Test Piles. Any extensions necessary to continue driving the pile for test purposes, as authorized by the Engineer, will be paid for as Test Piles. Other build-ups made only to incorporate the pile into the structure as a permanent pile will be included in the quantities of regular Piling and will not be paid for as Test Piling.

4-24

455-11 Method of Measurement

455-11.5 Dynamic Load Tests: Payment will be based on the number of dynamic load tests as shown in the plans or authorized by the Engineer, completed and accepted in accordance with the Contract Documents. No separate payment will be made for dynamic load tests used to evaluate the Contractor's driving equipment. This will generally be done on the first test pile or production pile driven on a project with each combination of proposed hammer and pile size and/or a separate pile to evaluate any proposed followers, or piles driven to evaluate proposed changes in the driving system….

4-25


455-11 Method of Measurement
455-11.5 Dynamic Load Tests: (Continued)
…. No payment will be made for dynamic load tests used to evaluate the integrity of a pre-planned epoxy-bonded dowel splice. Include all costs associated with dynamically testing production piles with epoxy-bonded dowel splices in the Pay Item 455-34. No payment will be made for dynamic load tests on test piles.
Payment for attaching equipment to each production pile for dynamic load testing prior to initial driving and as authorized by the Engineer will be 20 feet of additional pile. No payment will be made for attaching dynamic testing equipment for set-checks or redrives.
CTQP
4-26

455-11 Method of Measurement

455-11.8 Pile Splices: The quantity to be paid for authorized drivable splices and build-ups greater than 5 feet in length in concrete piling, and test piling, which are made for the purpose of obtaining authorized pile lengths longer than shown as the maximum length in the Standard Indexes, for obtaining greater lengths than originally authorized by the Engineer, to incorporate test piling in the finished structure, for further driving of test piling, or for splices shown in the Plans, will be 30 feet of additional prestressed concrete piling under Pay Item No. 455-34.

4-27

455-11 Method of Measurement

455-11.8 Pile Splices: (Continued)

For concrete piles, where the build-up is 5 feet or less in length, the quantity to be paid for will be 9 feet of prestressed concrete piling under Pay Item No. 455-34 as compensation for drilling and grouting the dowels and all other costs for which provision has not otherwise been made.

The quantity to be paid for authorized splices in steel piling and test piling for the purpose of obtaining lengths longer than the lengths originally authorized by the Engineer will be 20 feet of additional steel piling.

4-28

455-11 Method of Measurement

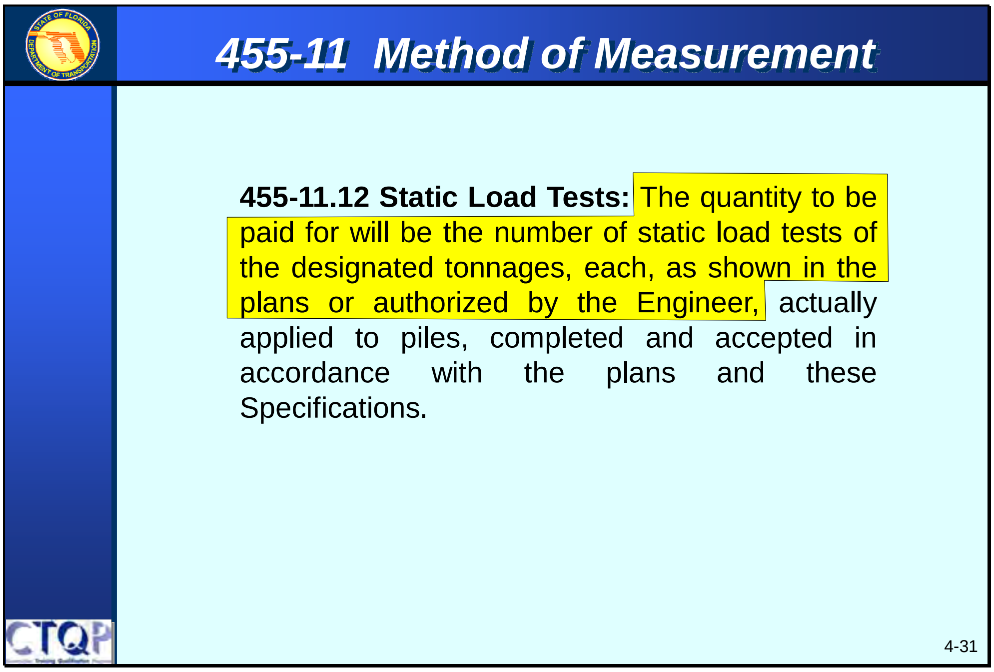
455-11.9.3 Pile Redrive: The quantity to be paid for will be the number of redrives, each, authorized by the Engineer. Payment for any pile redrive (test pile or production pile) ordered by the Engineer will consist of 20 feet of additional piling.

4-29

455-11 Method of Measurement

455-11.11 Protection of Existing Structures: The quantity to be paid for will be at the Contract lump sum price. When the Contract Documents do not include an item for protection of existing structures, the cost of settlement monitoring as required by these Specifications will be included in the cost of the structure; however, work in addition to settlement monitoring will be paid for as Unforeseeable Work when such additional work is ordered by the Engineer.

4-30


455-11 Method of Measurement
455-11.12 Static Load Tests: The quantity to be paid for will be the number of static load tests of the designated tonnages, each, as shown in the plans or authorized by the Engineer, actually applied to piles, completed and accepted in accordance with the plans and these Specifications.
4-31

455-11 Method of Measurement

455-11.13 Preformed Pile Holes: The quantity added to the payment for piling will be 30% of the length of completed Preformed Pile Holes from existing ground or the bottom of any required excavation, whichever is lower, to the bottom of preformed hole acceptably provided, complete for the installation of the bearing piles, regardless of the type of pile (test pile or production pile) installed therein. Only those holes authorized to be paid for, as provided in 455-5.9.3, will be included in the measurement for payment. The Engineer will authorize payment for Preformed Pile Holes only when the pile has been placed in proper position and has achieved the required penetration.

4-32

455-12 Basis of Payment

455-12 Basis of Payment (All Piling).

455-12.1 Treated Timber Piling: Price and payment will be full compensation for furnishing all materials, including collars, metal shoes, copper cover sheets, preservatives and tar, and for wrapping pile clusters with wire cable, where so shown in the plans.

4-33

455-12 Basis of Payment

455-12.2 Prestressed Concrete Piling: Price and payment will be full compensation for the cost of furnishing and placing all reinforcing steel, predrilled holes, furnishing the material for and wrapping pile clusters with wire cable where so shown in the plans and grouting of preformed pile holes when shown in the plans.

4-34

455-12 Basis of Payment

455-12.3 Steel Piling: Price and payment will be full compensation for all labor, equipment, and materials required for furnishing and installing Steel Piling, including welding and painting as specified and the cost of predrilling pile holes described in 455-5.1.1. The cost of any sand or concrete fill and reinforcing steel in pipe piles will be included in the price for Steel Piling…

4-35

455-12 Basis of Payment

455-12.4 Test Piles: Price and payment will be full compensation for all incidentals necessary to complete all the work of this item except splices, build-ups, pile extractions and preformed pile holes authorized by the Engineer and paid for under other pay items or payment methods. The cost of all additional work not listed above necessary to ensure required penetration and attain required bearing of the test piles will be included in the price bid per foot of Test Pile, including driving and all other related costs.

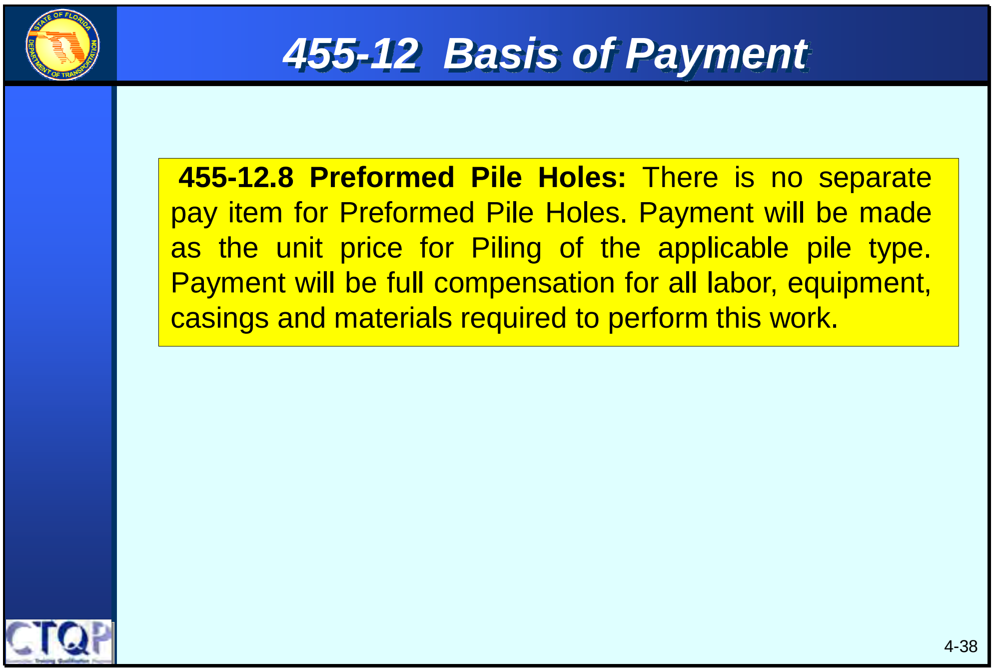
4-36

455-12 Basis of Payment

455-12.5.1 Dynamic Load Tests: All test piles will require dynamic load tests, and include all costs associated with dynamic load tests in the pay items for test piles.

455-12.5.2 Dynamic Load Tests/ Production Piles: Payment will be full compensation for all labor, equipment, materials, instrumentation and installation required to assist the Engineer in performing this work.

4-37


455-12 Basis of Payment
455-12.8 Preformed Pile Holes: There is no separate pay item for Preformed Pile Holes. Payment will be made as the unit price for Piling of the applicable pile type. Payment will be full compensation for all labor, equipment, casings and materials required to perform this work.
4-38

455-12 Basis of Payment

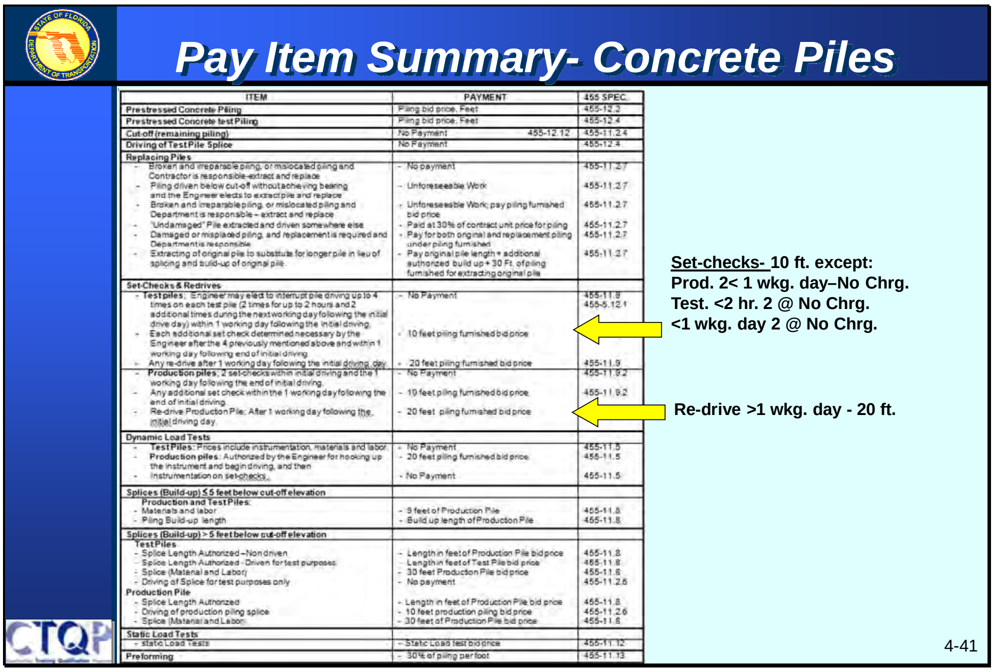
455-12.9 Protection of Existing Structures: Price and payment will be full compensation for all labor, equipment, and materials required to perform this work.

4-39

455-12 Basis of Payment

455-12.12 Pile Cut-Off: Anticipate all piles will require cutting-off, and include all costs associated with pile cut-off in the pay items for piling.

4-40



ITEM	PAYMENT	455 SPEC.
Prestressed Concrete Piling	Piling bid price, Feet	455-12.2
Prestressed Concrete test Piling	Piling bid price, Feet	455-12.4
Cut-off (remaining piling)	No Payment 455-12.12	455-11.2.4
Driving of Test Pile Splice	No Payment	455-12.4
Replacing Piles		
- Broken and irreparable piling, or mislocated piling and Contractor is responsible-extract and replace	- No payment	455-11.2.7
- Piling driven below cut-off without achieving bearing and the Engineer elects to extract pile and replace	- Unforeseeable Work	455-11.2.7
- Broken and irreparable piling, or mislocated piling and Department is responsible – extract and replace	- Unforeseeable Work; pay piling furnished bid price	455-11.2.7
- "Undamaged" Pile extracted and driven somewhere else	- Paid at 30% of contract unit price for piling	455-11.2.7
- Damaged or misplaced piling, and replacement is required and Department is responsible	- Pay for both original and replacement piling under piling furnished	455-11.2.7
- Extracting of original pile to substitute for longer pile in lieu of splicing and build-up of original pile.	- Pay original pile length + additional authorized build up + 30 Ft. of piling furnished for extracting original pile	455-11.2.7
Set-Checks & Redrives		
- **Test piles**; Engineer may elect to interrupt pile driving up to 4 times on each test pile (2 times for up to 2 hours and 2 additional times during the next working day following the initial drive day) within 1 working day following the initial driving.	- No Payment	455-11.9 455-5.12.1
- Each additional set check determined necessary by the Engineer after the 4 previously mentioned above and within 1 working day following end of initial driving	- 10 feet piling furnished bid price	
- Any re-drive after 1 working day following the initial driving day	- 20 feet piling furnished bid price	455-11.9
- **Production piles**; 2 set-checks within initial driving and the 1 working day following the end of initial driving.	- No Payment	455-11.9.2
- Any additional set check within the 1 working day following the end of initial driving	- 10 feet piling furnished bid price	455-11.9.2
- Re-drive Production Pile: After 1 working day following the initial driving day.	- 20 feet piling furnished bid price	
Dynamic Load Tests		
- **Test Piles**: Prices include instrumentation, materials and labor.	- No Payment	455-11.5
- **Production piles**: Authorized by the Engineer for hooking up the instrument and begin driving, and then	- 20 feet piling furnished bid price	455-11.5
- Instrumentation on set-checks.	- No Payment	455-11.5
Splices (Build-up) ≤ 5 feet below cut-off elevation		
Production and Test Piles:		
- Materials and labor	- 9 feet of Production Pile	455-11.8
- Piling Build-up length	- Build up length of Production Pile	455-11.8
Splices (Build-up) > 5 feet below cut-off elevation		
Test Piles		
- Splice Length Authorized – Non driven	- Length in feet of Production Pile bid price	455-11.8
- Splice Length Authorized - Driven for test purposes	- Length in feet of Test Pile bid price	455-11.8
- Splice (Material and Labor)	- 30 feet Production Pile bid price	455-11.6
- Driving of Splice for test purposes only	- No payment	455-11.2.6
Production Pile		
- Splice Length Authorized	- Length in feet of Production Pile bid price	455-11.8
- Driving of production piling splice	- 10 feet production piling bid price	455-11.2.6
- Splice (Material and Labor)	- 30 feet of Production Pile bid price	455-11.6
Static Load Tests		
- static Load Tests	- Static Load test bid price	455-11.12
Preforming	- 30% of piling per foot	455-11.13

This table summarizes the way the quantities are determined for concrete piles. As you can see most of the work items get converted into pile length quantities. For example set-checks, re-drives, dynamic testing, splices, and preforming preforming. Let us review these:

Click to show 1st arrow

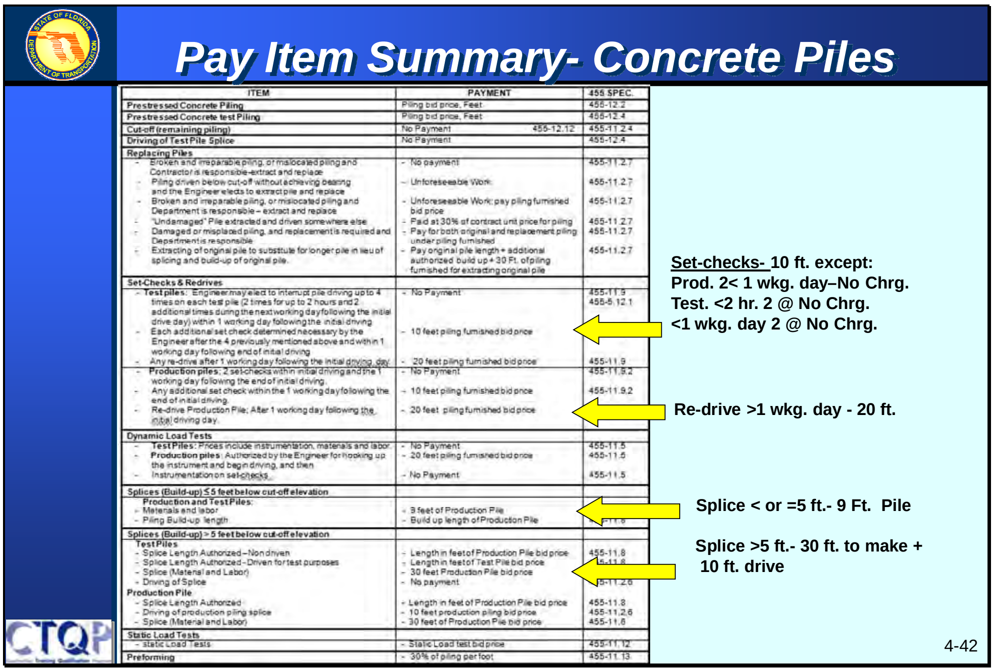
Set-checks: They are paid as 10 ft of piling each. They are paid as test piling for test piles and as production piling for production piles. However there are some free set-checks. For example in test piles we have four set checks for free when:

The first two are performed within two hours of completion of the initial drive, and the other two are done within the working day following the initial drive. For example, today the contractor did the initial drive of the test pile. If we order to do two set-checks today within two hours of finishing the initial drive, those are free. If in addition we order another set-check at 5 pm tomorrow (a working day) then that is also free. If we exceed the four free set-checks we will pay at 10 ft of test pile per set-check above the free four.

In production piles we have two free set checks when they are done within the day following the initial driving day. Beyond this time we pay at 10 feet of production pile.

Click to show 2nd arrow

Re-drives: If we order a redrive after one working day following the day of finishing the initial drive we pay at 20 ft of test piling. They are paid as test piling for test piles and as production piling for production piles.



ITEM	PAYMENT	455 SPEC.
Prestressed Concrete Piling	Piling bid price, Feet	455-12.2
Prestressed Concrete test Piling	Piling bid price, Feet	455-12.4
Cut-off (remaining piling)	No Payment 455-12.12	455-11.2.4
Driving of Test Pile Splice	No Payment	455-12.4
Replacing Piles		
- Broken and irreparable piling, or mislocated piling and Contractor is responsible-extract and replace	- No payment	455-11.2.7
- Piling driven below cut-off without achieving bearing and the Engineer elects to extract pile and replace	- Unforeseeable Work	455-11.2.7
- Broken and irreparable piling, or mislocated piling and Department is responsible – extract and replace	- Unforeseeable Work; pay piling furnished bid price	455-11.2.7
- "Undamaged" Pile extracted and driven somewhere else	- Paid at 30% of contract unit price for piling	455-11.2.7
- Damaged or misplaced piling, and replacement is required and Department is responsible	- Pay for both original and replacement piling under piling furnished	455-11.2.7
- Extracting of original pile to substitute for longer pile in lieu of splicing and build-up of original pile.	- Pay original pile length + additional authorized build up + 30 Ft. of piling furnished for extracting original pile	455-11.2.7
Set-Checks & Redrives		
- **Test piles:** Engineer may elect to interrupt pile driving up to 4 times on each test pile (2 times for up to 2 hours and 2 additional times during the next working day following the initial drive day) within 1 working day following the initial driving	- No Payment	455-11.9 455-5.12.1
- Each additional set check determined necessary by the Engineer after the 4 previously mentioned above and within 1 working day following end of initial driving	- 10 feet piling furnished bid price	
- Any re-drive after 1 working day following the initial driving day	- 20 feet piling furnished bid price	455-11.9
- **Production piles:** 2 set-checks within initial driving and the 1 working day following the end of initial driving.	- No Payment	455-11.9.2
- Any additional set check within the 1 working day following the end of initial driving.	- 10 feet piling furnished bid price	455-11.9.2
- Re-drive Production Pile: After 1 working day following the initial driving day.	- 20 feet piling furnished bid price	
Dynamic Load Tests		
- **Test Piles:** Prices include instrumentation, materials and labor.	- No Payment	455-11.5
- **Production piles:** Authorized by the Engineer for hooking up the instrument and begin driving, and then	- 20 feet piling furnished bid price	455-11.5
- Instrumentation on set-checks	- No Payment	455-11.5
Splices (Build-up) ≤ 5 feet below cut-off elevation		
Production and Test Piles: - Materials and labor - Piling Build-up length	- 9 feet of Production Pile - Build up length of Production Pile	-11.8
Splices (Build-up) > 5 feet below cut-off elevation		
Test Piles - Splice Length Authorized – Non driven - Splice Length Authorized - Driven for test purposes - Splice (Material and Labor) - Driving of Splice	- Length in feet of Production Pile bid price - Length in feet of Test Pile bid price - 30 feet Production Pile bid price - No payment	455-11.8 -11.8 -11.2.6
Production Pile - Splice Length Authorized - Driving of production piling splice - Splice (Material and Labor)	- Length in feet of Production Pile bid price - 10 feet production piling bid price - 30 feet of Production Pile bid price	455-11.8 455-11.2.6 455-11.8
Static Load Tests		
- static Load Tests	- Static Load test bid price	455-11.12
Preforming	- 30% of piling per foot	455-11.13

Splices longer than 5 ft are paid as follows: 30 ft of piling to pay for the materials and labor of attaching the two pieces. In addition we pay for whatever splice length we authorize to attach to the original pile. We also pay for redriving of the splice if we needed for concrete production piles. We will not pay for splice redrive on test piles and on steel piles.

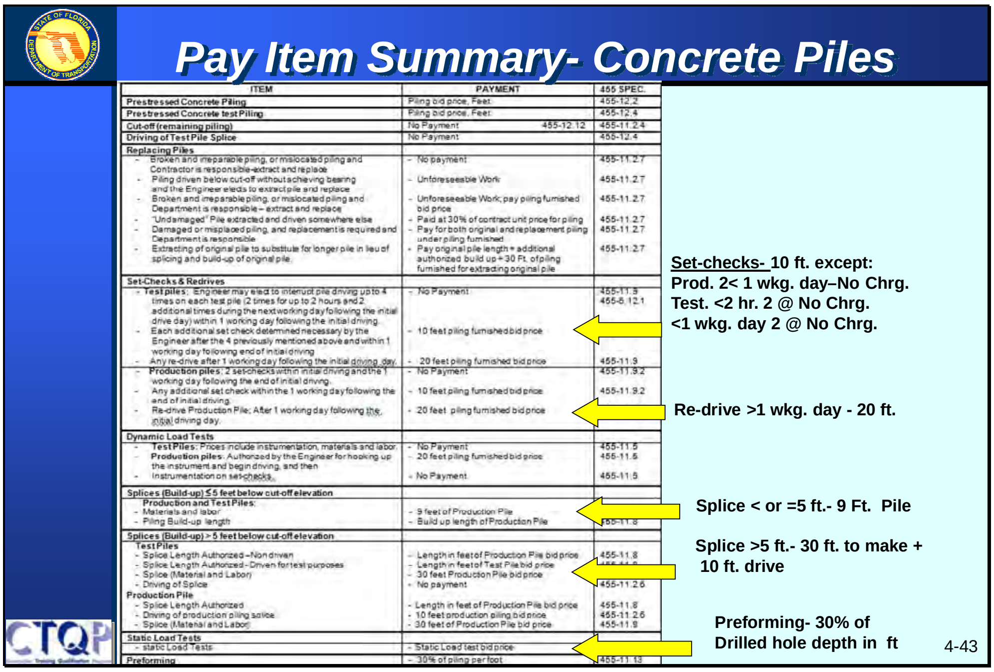
Splices up 5 ft in long are popularly known as build-ups, leaving the name of splice to the extensions longer than 5 ft when you will need order a prefabricated section. Splices 5 ft or shorter are cast in place. There will be also some labor and materials to prepare for building up. In this case we pay 9 ft for manufacturing the splice and the length of pile we are extending.

Please keep in mind that the quantity of feet to be paid of making a splice whether it is for production pile or a test pile will be in terms of production pile. Just because it is a test pile we don't pay the 30 ft as a test pile. The effort and cost of materials and labor for drilling holes, placing dovels, placing a form, pouring epoxy and attaching the sections must not be different between production piles and test piles. This means that the 9 ft (for build ups up to 5 ft) and the 30 ft for the precast splice sections would be as production piles.

The cost of the pile length ordered for the splice will be in terms of production pile for production piles. For test piles, it will depends. If the splice is ordered to complete a pile that went below cut-off, and does not be tested, we pay only as a production pile. For example we have a test pile in a bent that did not reach capacity at the cut-off and the engineer continued driving until he got satisfied with the bearing. The pile ended up above ground but 10 below cutoff. He does not need to drive the pile anymore. All he needs is to extend the pile to cutoff elevation of the plans. In this case we would pay the 10 ft length of the extension as a production pile.

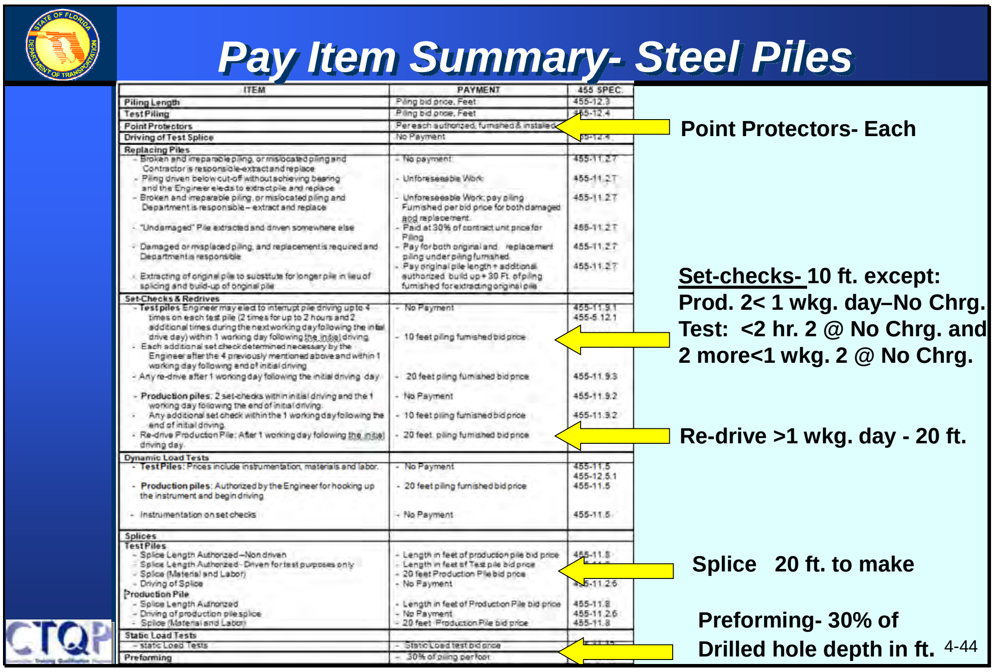
If the splice in a test pile is tested (driven) we would pay as a test pile item.

The reason this is important is that test piles are usually much more expensive than production piles (2 to 3 times).

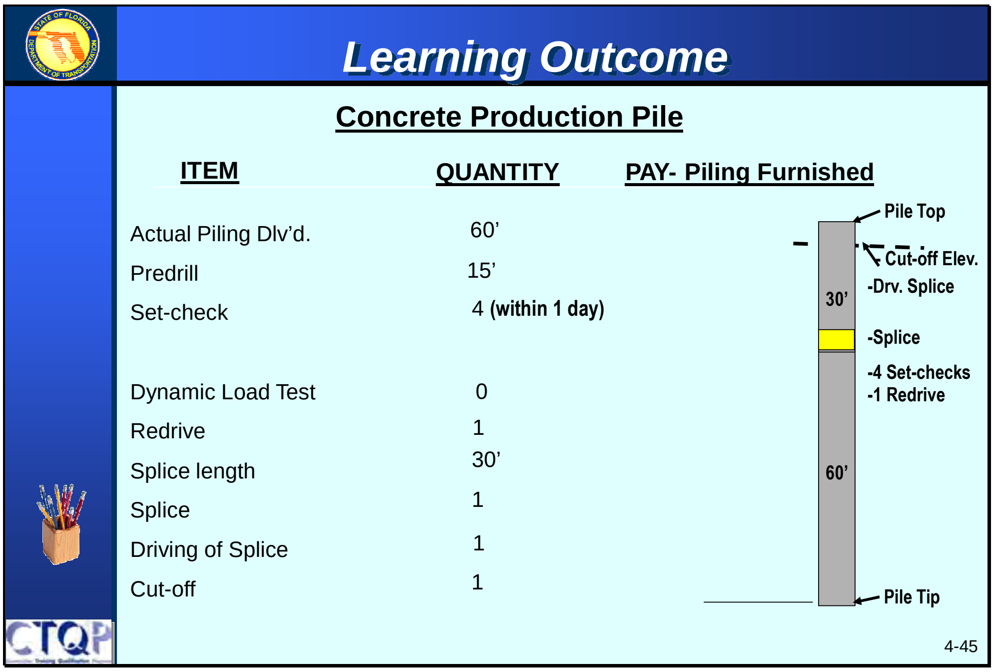


Driving of a splice in production pile is paid at 10 ft. Driving of a Test pile splice is not paid.

Click to show last arrow
Preforming: We pay 30% of the Drilled hole depth in feet



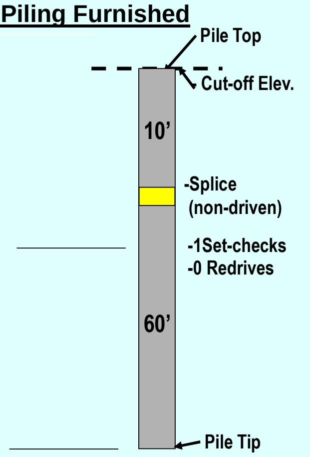
ITEM	PAYMENT	455 SPEC.
Piling Length	Piling bid price, Feet	455-12.3
Test Piling	Piling bid price, Feet	455-12.4
Point Protectors	Per each authorized, furnished & installed	
Driving of Test Splice	No Payment	455-12.4
Replacing Piles		
- Broken and irreparable piling, or mislocated piling and Contractor is responsible-extract and replace	- No payment	455-11.2.7
- Piling driven below cut-off without achieving bearing and the Engineer elects to extract pile and replace	- Unforeseeable Work	455-11.2.7
- Broken and irreparable piling, or mislocated piling and Department is responsible – extract and replace	- Unforeseeable Work; pay piling Furnished per bid price for both damaged and replacement.	455-11.2.7
- "Undamaged" Pile extracted and driven somewhere else	- Paid at 30% of contract unit price for Piling	455-11.2.7
- Damaged or misplaced piling, and replacement is required and Department is responsible	- Pay for both original and replacement piling under piling furnished.	455-11.2.7
- Extracting of original pile to substitute for longer pile in lieu of splicing and build-up of original pile	- Pay original pile length + additional authorized build up + 30 Ft. of piling furnished for extracting original pile	455-11.2.7
Set-Checks & Redrives		
- **Test piles** Engineer may elect to interrupt pile driving up to 4 times on each test pile (2 times for up to 2 hours and 2 additional times during the next working day following the initial drive day) within 1 working day following the initial driving	- No Payment	455-11.9.1 455-5.12.1
- Each additional set check determined necessary by the Engineer after the 4 previously mentioned above and within 1 working day following end of initial driving	- 10 feet piling furnished bid price	
- Any re-drive after 1 working day following the initial driving day	- 20 feet piling furnished bid price	455-11.9.3
- **Production piles**: 2 set-checks within initial driving and the 1 working day following the end of initial driving.	- No Payment	455-11.9.2
- Any additional set check within the 1 working day following the end of initial driving.	- 10 feet piling furnished bid price	455-11.9.2
- Re-drive Production Pile: After 1 working day following the initial driving day.	- 20 feet piling furnished bid price	
Dynamic Load Tests		
- **Test Piles**: Prices include instrumentation, materials and labor.	- No Payment	455-11.5 455-12.5.1
- **Production piles**: Authorized by the Engineer for hooking up the instrument and begin driving	- 20 feet piling furnished bid price	455-11.5
- Instrumentation on set checks	- No Payment	455-11.5
Splices		
Test Piles		
- Splice Length Authorized –Non driven	- Length in feet of production pile bid price	455-11.8
- Splice Length Authorized - Driven for test purposes only	- Length in feet of Test pile bid price	[illegible]
- Splice (Material and Labor)	- 20 feet Production Pile bid price	
- Driving of Splice	- No Payment	455-11.2.6
Production Pile		
- Splice Length Authorized	- Length in feet of Production Pile bid price	455-11.8
- Driving of production pile splice	- No Payment	455-11.2.6
- Splice (Material and Labor)	- 20 feet Production Pile bid price	455-11.8
Static Load Tests		
- static Load Tests	- Static Load test bid price	[illegible]
Preforming	- 30% of piling per foot	


Learning Outcome
Concrete Production Pile
ITEM
QUANTITY
PAY- Piling Furnished
Actual Piling Dlv'd. 60'
Predrill 15'
Set-check 4 (within 1 day)
Dynamic Load Test 0
Redrive 1
Splice length 30'
Splice 1
Driving of Splice 1
Cut-off 1
Pile Top
Cut-off Elev.
-Drv. Splice
30'
-Splice
-4 Set-checks
-1 Redrive
60'
Pile Tip
4-45

Learning Outcome

Concrete Test Pile

ITEM	QUANTITY	PAY- Piling Furnished
Test Pile:		
Actual Piling Dlv’d.	60’	
Preform	15’	
Set-check	1 @ 1½ hr.)	
Dynamic Load Test	1	
Redrive	0	
Production Piling:		
Splice length	10’	
Splice	1	
Driving of Splice	0	
Cut-off	1	

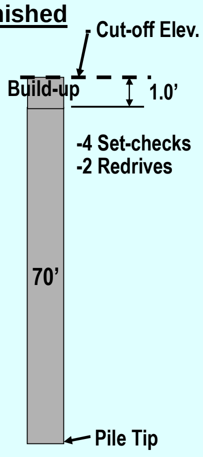


4-46

Learning Outcome

Concrete Production Pile

ITEM	QUANTITY	PAY- Piling Furnished
Actual Piling Dlv'd.	70'	
Predrill	20'	
Set-check	4 (within 1 day)	
Dynamic Load Test	0	
Redrive	2	
Splice length	1'	
Splice	N/A	
Driving of Splice	N/A	
Build-up	1	

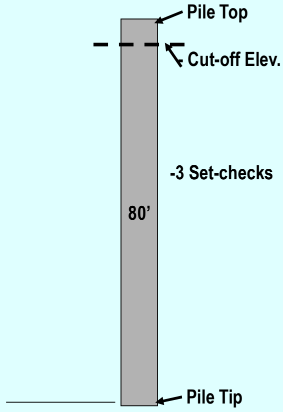


4-47

Learning Outcome

Concrete Test Pile

ITEM	QUANTITY	PAY- Piling Furnished
Actual Piling Dlv'd.	80'	
Predrill	15	
Set-checks (all done within 1 day)	0	
Dynamic Load Test*		
Redrive	0	
Splice length	0	
Splice	N/A	
Driving of Splice	N/A	
Cut-off	N/A	
	1	

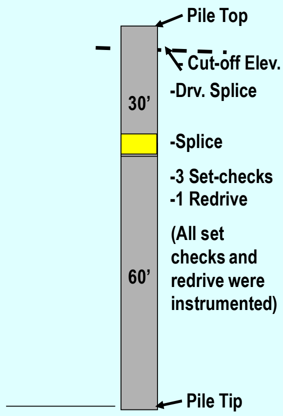


4-48

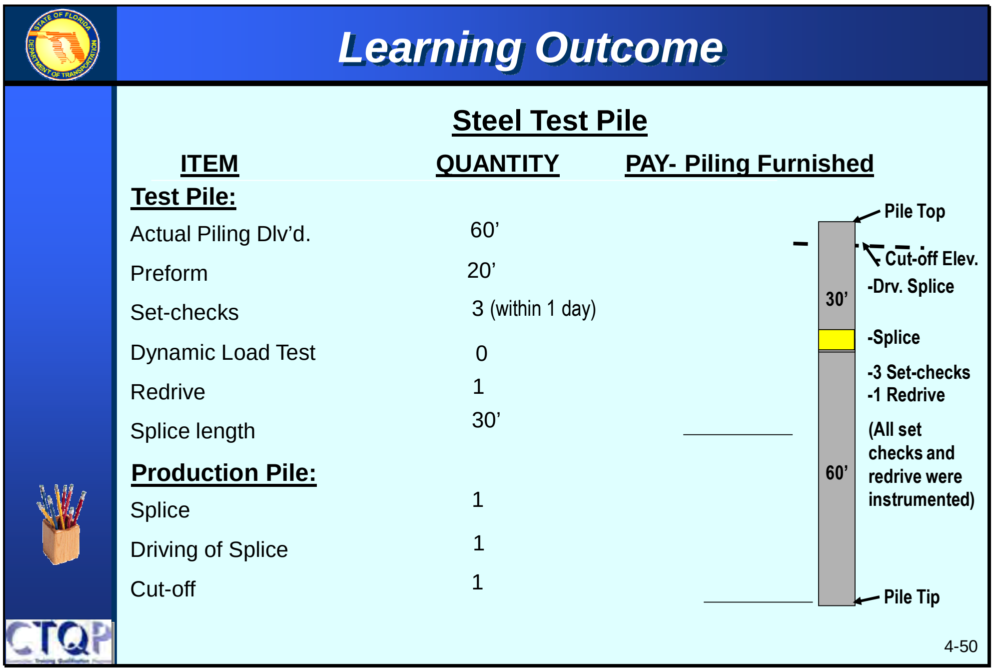
Learning Outcome

Steel Production Pile

ITEM	QUANTITY	PAY- Piling Furnished
Actual Piling Dlv’d.	60’	
Preform	20’	
Set-checks	3 (within 1 day)	
Dynamic Load Test	0	
Redrive	1	
Splice length	30’	
Splice	1	
Driving of Splice	1	
Cut-off	1	



4-49



Learning Outcome
Steel Test Pile
ITEM
QUANTITY
PAY- Piling Furnished
Test Pile:
Actual Piling Dlv'd. 60'
Preform 20'
Set-checks 3 (within 1 day)
Dynamic Load Test 0
Redrive 1
Splice length 30'
Production Pile:
Splice 1
Driving of Splice 1
Cut-off 1
Pile Top
Cut-off Elev.
-Drv. Splice
30'
-Splice
-3 Set-checks
-1 Redrive
(All set checks and redrive were instrumented)
60'
Pile Tip
4-50

Inspector Math

Inspector Math

4-51

Inspector Math

The Inspector needs to determine:

- Tip Elevation
- Penetration
- Length Driven
- "Minimum Tip Target"
- "Cutoff Target"

4-52

Inspector Math

PILE TIP ELEVATION: The elevation of the bottom (or "Tip") of the pile, which is the Reference Elevation minus the length of pile beneath the reference

Tip Elev.= Ref. Elev. - Length below Ref. Elev.

PILE PENETRATION: Is defined as the length of pile that is below the lowest of the following 3 elevations:

1. Ground Surface
2. Bottom of Excavation
3. Scour

4-53

Inspector Math

PILE PENETRATION is computed as:

Penetration= Lowest of

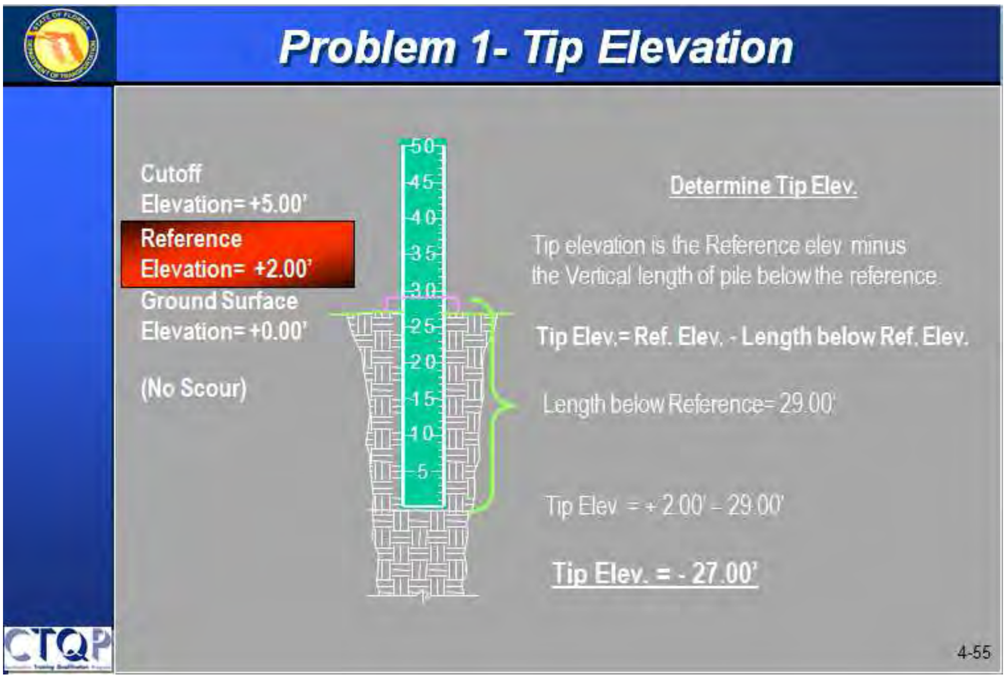
1. Ground Surface
2. Bottom of Excavation
3. Scour

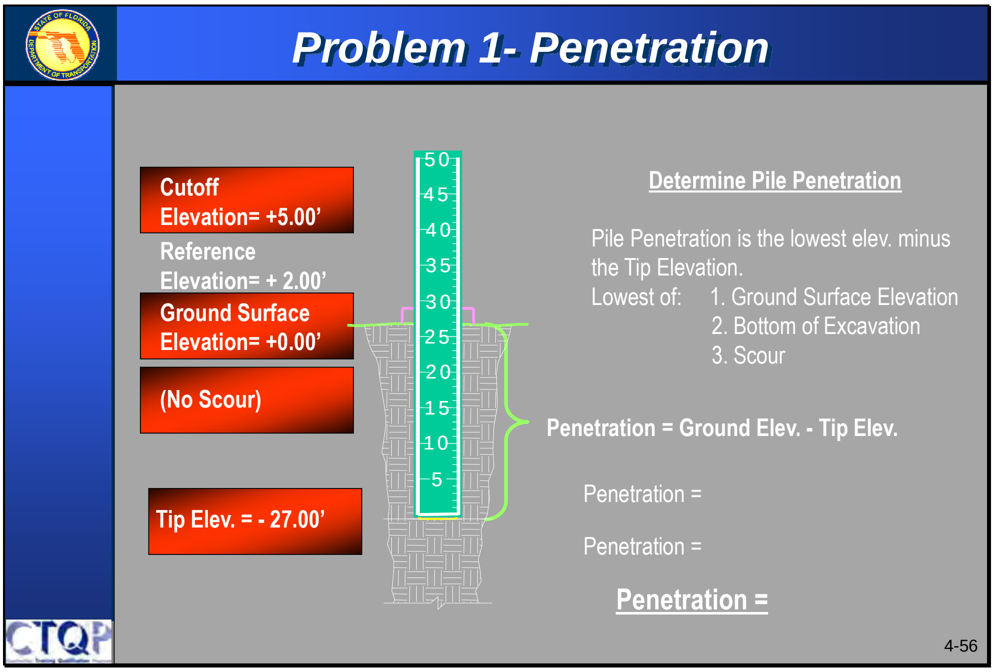
- Tip Elevation

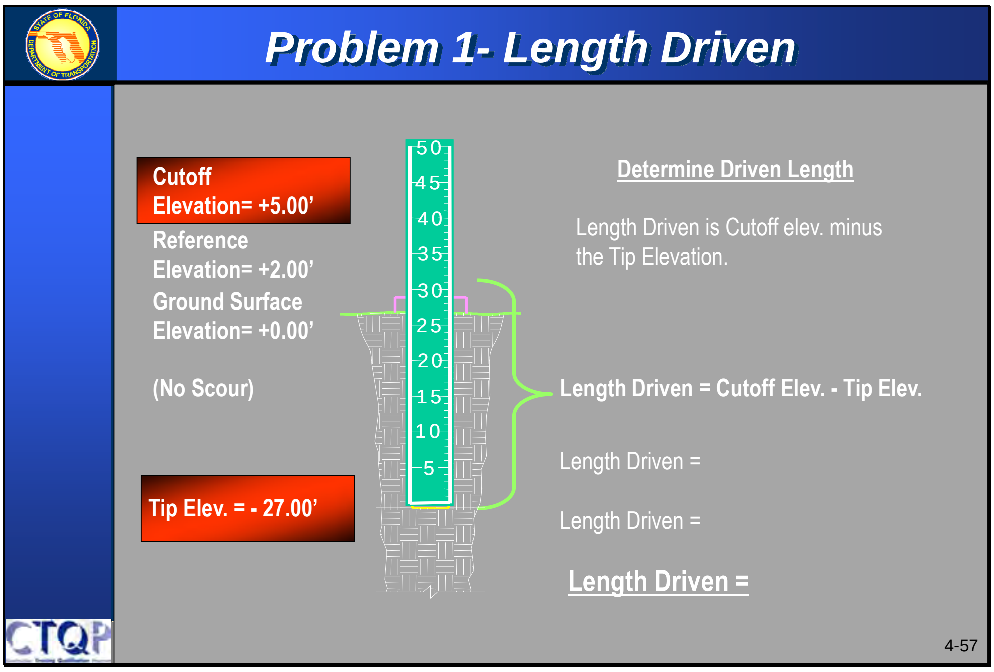
PILE LENGTH DRIVEN: The length of pile between the Cutoff elevation and the Tip elevation.

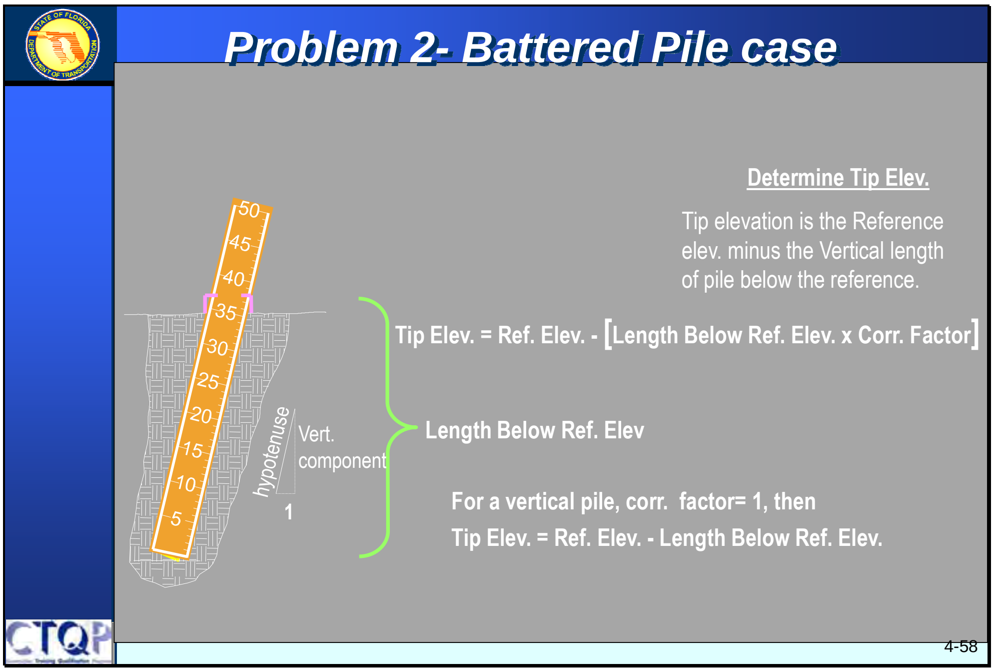
Length Driven = Cutoff Elev. - Tip Elev

4-54

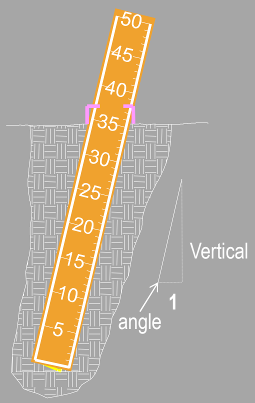

Problem 1- Tip Elevation
Cutoff
Elevation= +5.00'
Reference
Elevation= +2.00'
Ground Surface
Elevation= +0.00'
(No Scour)
50
45
40
35
30
25
20
15
10
5
Determine Tip Elev.
Tip elevation is the Reference elev. minus
the Vertical length of pile below the reference.
Tip Elev.= Ref. Elev. - Length below Ref. Elev.
Length below Reference= 29.00'
Tip Elev. = + 2.00' – 29.00'
Tip Elev. = - 27.00'
4-55


Problem 1- Penetration
Cutoff Elevation= +5.00'
Reference Elevation= + 2.00'
Ground Surface Elevation= +0.00'
(No Scour)
Tip Elev. = - 27.00'
50
45
40
35
30
25
20
15
10
5
Determine Pile Penetration
Pile Penetration is the lowest elev. minus the Tip Elevation.
Lowest of: 1. Ground Surface Elevation
2. Bottom of Excavation
3. Scour
Penetration = Ground Elev. - Tip Elev.
Penetration =
Penetration =
Penetration =
4-56


Problem 1- Length Driven
Cutoff Elevation= +5.00'
Reference Elevation= +2.00'
Ground Surface Elevation= +0.00'
(No Scour)
Tip Elev. = - 27.00'
50
45
40
35
30
25
20
15
10
5
Determine Driven Length
Length Driven is Cutoff elev. minus the Tip Elevation.
Length Driven = Cutoff Elev. - Tip Elev.
Length Driven =
Length Driven =
Length Driven =
CTQP
4-57

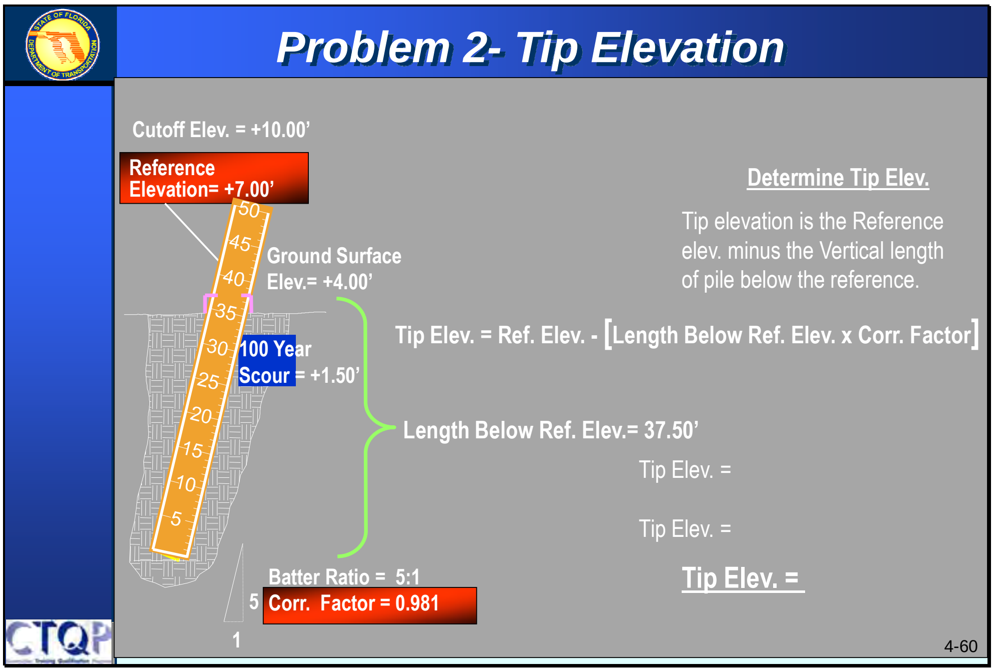

Problem 2- Battered Pile case
Determine Tip Elev.
Tip elevation is the Reference elev. minus the Vertical length of pile below the reference.
Tip Elev. = Ref. Elev. - [Length Below Ref. Elev. x Corr. Factor]
Length Below Ref. Elev
For a vertical pile, corr. factor= 1, then
Tip Elev. = Ref. Elev. - Length Below Ref. Elev.
50
45
40
35
30
25
20
15
10
5
hypotenuse
Vert. component
1
CTQP
4-58

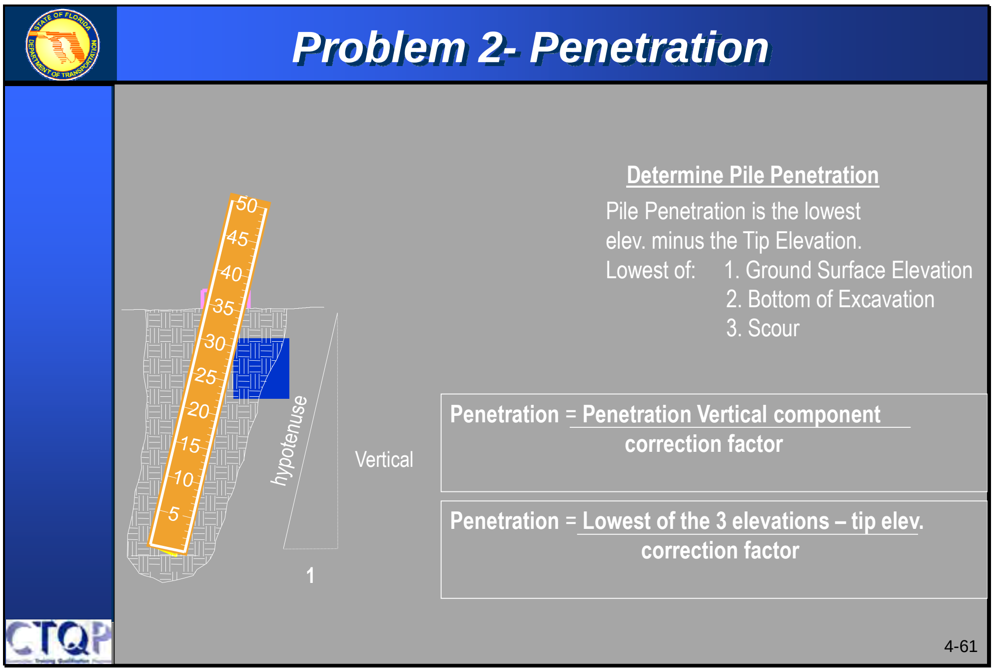
Problem 2- Battered Pile Correction Factors

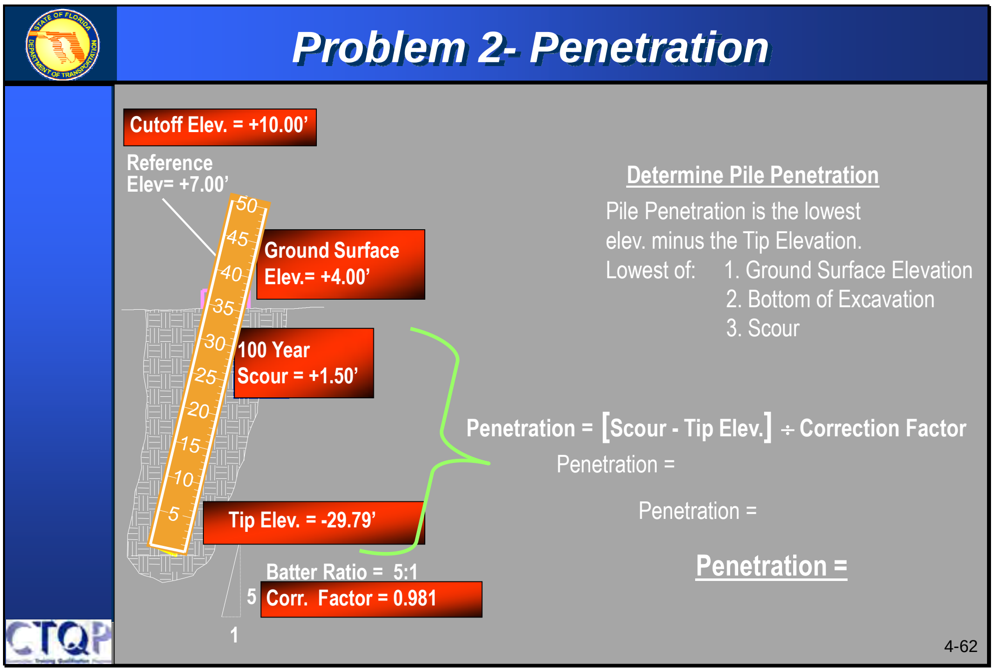


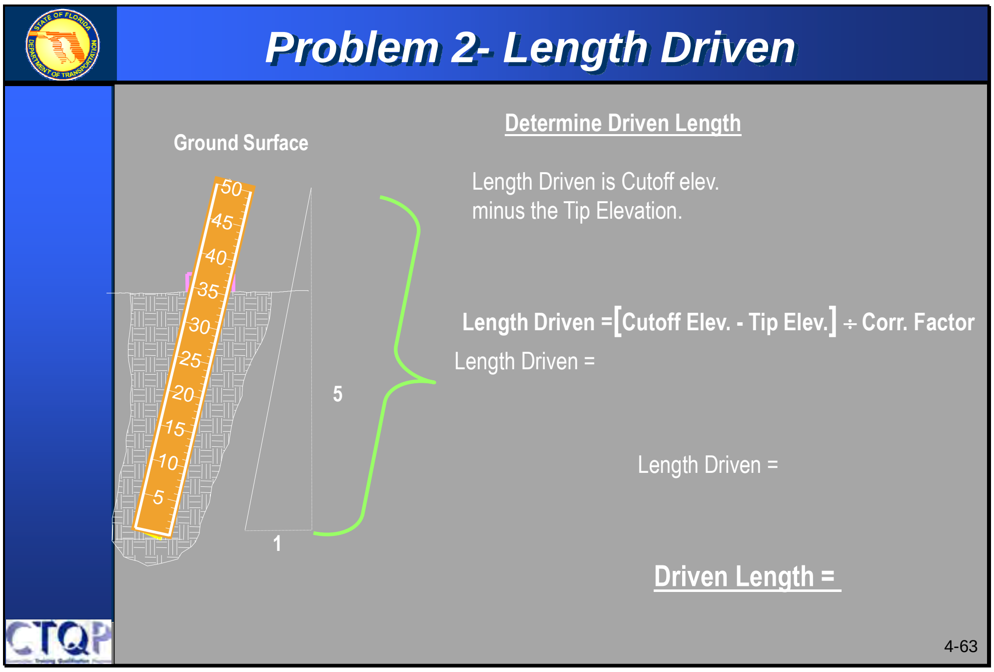
Batter Ratio.	Angle	Corr. Factor
12:1	85.237	0.997
10:1	84.289	0.995
12:2 (6:1)	80.538	0.986
10:2 (5:1)	78.690	0.981
12:3 (4:1)	75.964	0.970
10:3	73.301	0.958
12:4 (3:1)	71.565	0.949
10:4 (5:2)	68.199	0.928
12:5	67.380	0.923

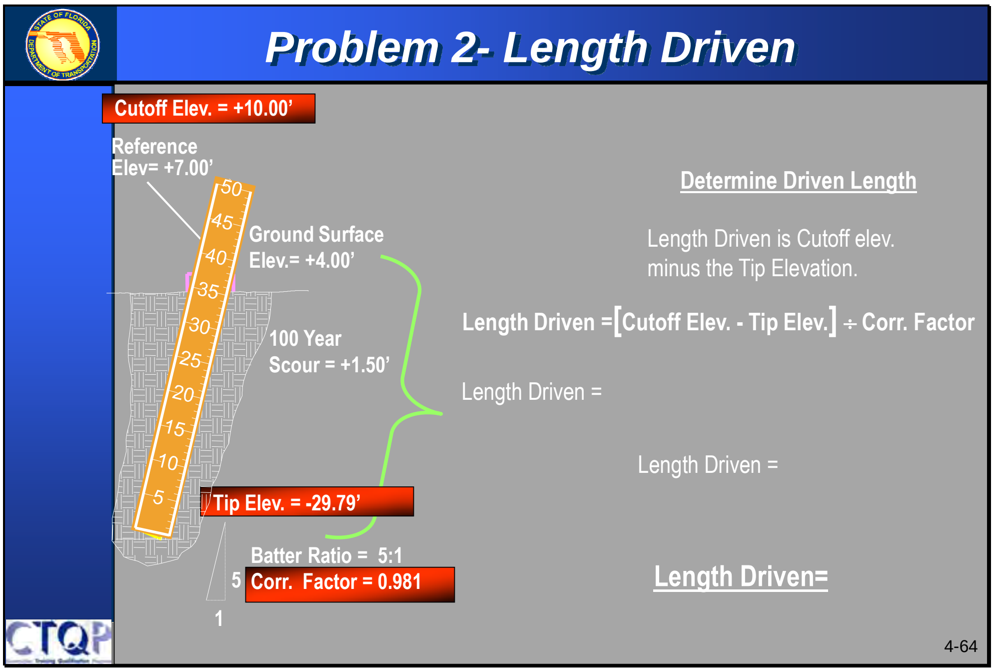
4-59

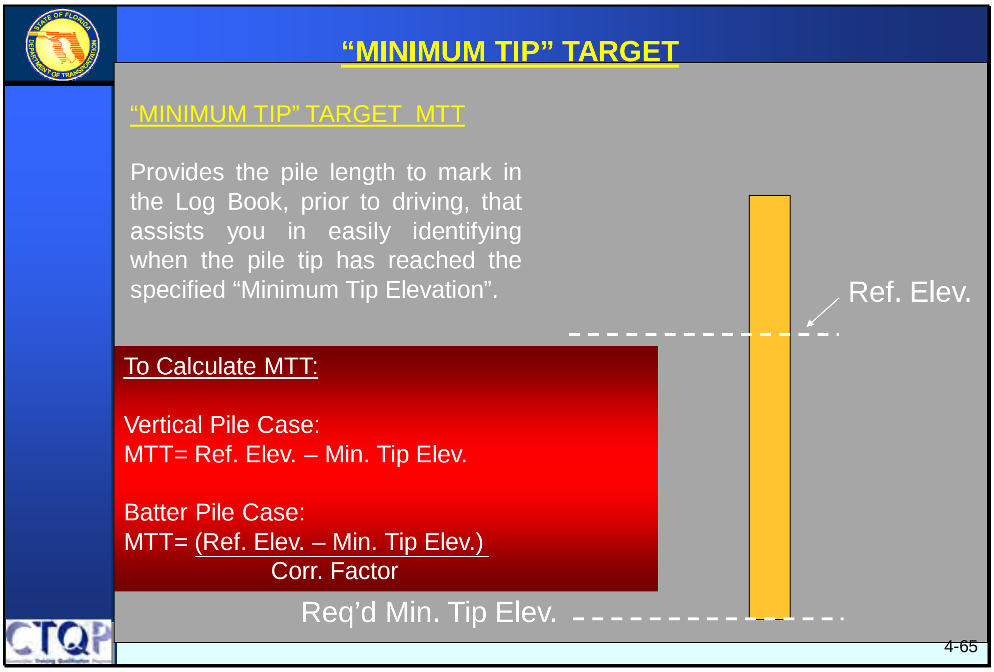

Problem 2- Tip Elevation
Cutoff Elev. = +10.00'
Reference Elevation= +7.00'
Ground Surface Elev.= +4.00'
100 Year Scour = +1.50'
Determine Tip Elev.
Tip elevation is the Reference elev. minus the Vertical length of pile below the reference.
Tip Elev. = Ref. Elev. - [Length Below Ref. Elev. x Corr. Factor]
Length Below Ref. Elev.= 37.50'
Tip Elev. =
Tip Elev. =
Tip Elev. =
Batter Ratio = 5:1
5
1
Corr. Factor = 0.981
50
45
40
35
30
25
20
15
10
5
4-60

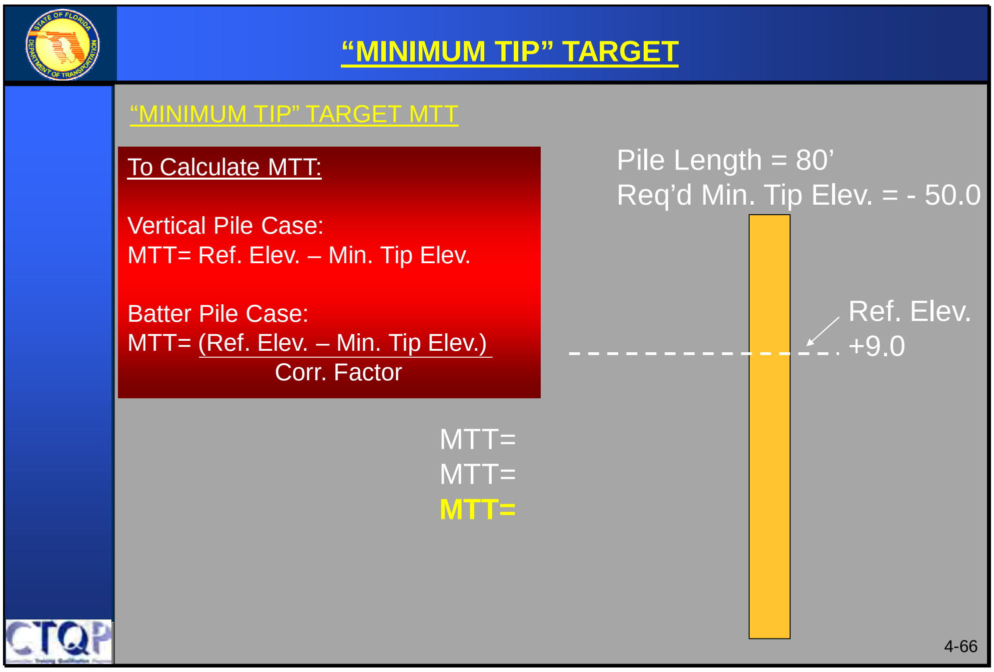

Problem 2- Penetration
Determine Pile Penetration
Pile Penetration is the lowest
elev. minus the Tip Elevation.
Lowest of: 1. Ground Surface Elevation
2. Bottom of Excavation
3. Scour
50
45
40
35
30
25
20
15
10
5
hypotenuse
Vertical
1
Penetration = Penetration Vertical component
correction factor
Penetration = Lowest of the 3 elevations – tip elev.
correction factor
4-61

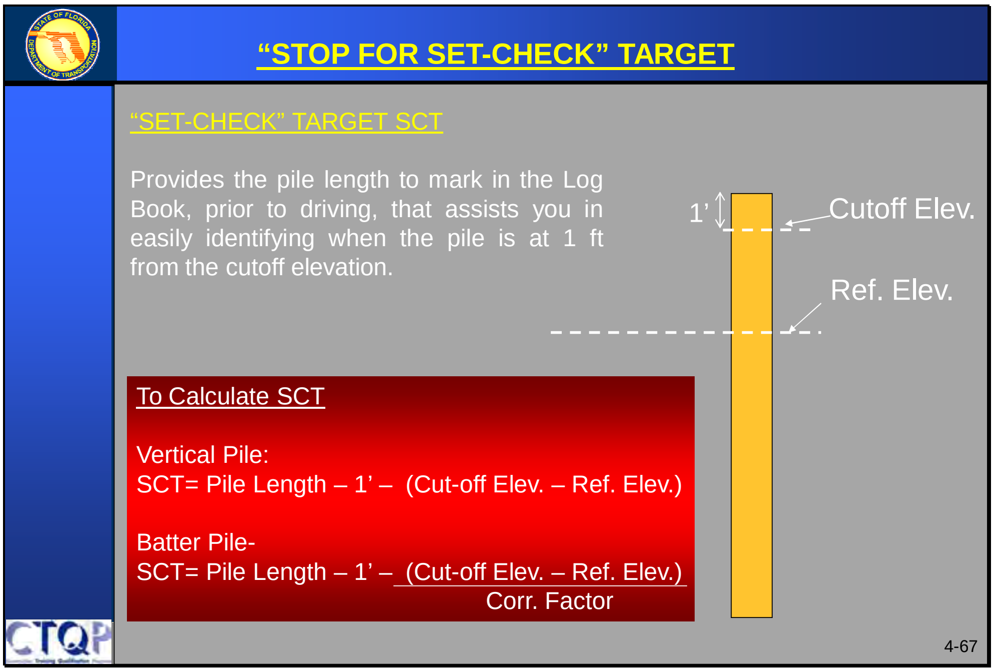

Problem 2- Penetration
Cutoff Elev. = +10.00'
Reference Elev= +7.00'
Ground Surface Elev.= +4.00'
100 Year Scour = +1.50'
Tip Elev. = -29.79'
Batter Ratio = 5:1
5
1
Corr. Factor = 0.981
Determine Pile Penetration
Pile Penetration is the lowest elev. minus the Tip Elevation.
Lowest of: 1. Ground Surface Elevation
2. Bottom of Excavation
3. Scour
Penetration = [Scour - Tip Elev.] ÷ Correction Factor
Penetration =
Penetration =
Penetration =
4-62


Problem 2- Length Driven
Ground Surface
50
45
40
35
30
25
20
15
10
5
5
1
Determine Driven Length
Length Driven is Cutoff elev.
minus the Tip Elevation.
Length Driven =[Cutoff Elev. - Tip Elev.] ÷ Corr. Factor
Length Driven =
Length Driven =
Driven Length =
4-63


Problem 2- Length Driven
Cutoff Elev. = +10.00'
Reference
Elev= +7.00'
50
45
40
35
30
25
20
15
10
5
Ground Surface
Elev.= +4.00'
100 Year
Scour = +1.50'
Tip Elev. = -29.79'
Batter Ratio = 5:1
5
1
Corr. Factor = 0.981
Determine Driven Length
Length Driven is Cutoff elev.
minus the Tip Elevation.
Length Driven =[Cutoff Elev. - Tip Elev.] ÷ Corr. Factor
Length Driven =
Length Driven =
Length Driven=
CTQP
4-64


“MINIMUM TIP” TARGET
“MINIMUM TIP” TARGET MTT
Provides the pile length to mark in the Log Book, prior to driving, that assists you in easily identifying when the pile tip has reached the specified “Minimum Tip Elevation”.
Ref. Elev.
To Calculate MTT:
Vertical Pile Case:
MTT= Ref. Elev. – Min. Tip Elev.
Batter Pile Case:
MTT= (Ref. Elev. – Min. Tip Elev.)
Corr. Factor
Req’d Min. Tip Elev.
CTQP
4-65


"MINIMUM TIP" TARGET
"MINIMUM TIP" TARGET MTT
To Calculate MTT:
Vertical Pile Case:
MTT= Ref. Elev. – Min. Tip Elev.
Batter Pile Case:
MTT= (Ref. Elev. – Min. Tip Elev.)
Corr. Factor
Pile Length = 80'
Req'd Min. Tip Elev. = - 50.0
Ref. Elev.
+9.0
MTT=
MTT=
MTT=
4-66


"STOP FOR SET-CHECK" TARGET
"SET-CHECK" TARGET SCT
Provides the pile length to mark in the Log Book, prior to driving, that assists you in easily identifying when the pile is at 1 ft from the cutoff elevation.
1'
Cutoff Elev.
Ref. Elev.
To Calculate SCT
Vertical Pile:
SCT= Pile Length – 1' – (Cut-off Elev. – Ref. Elev.)
Batter Pile-
SCT= Pile Length – 1' – (Cut-off Elev. – Ref. Elev.)
Corr. Factor
CTQP
4-67

“STOP FOR SET-CHECK” TARGET

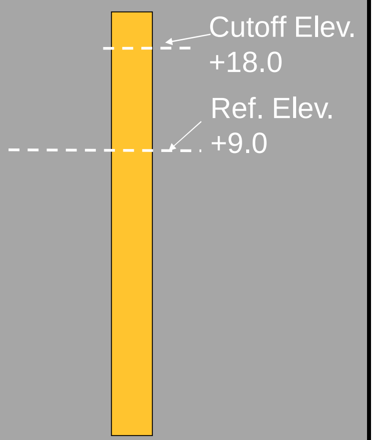
“STOP FOR SET-CHECK” TARGET

Pile Length = 80’

To Calculate SCT

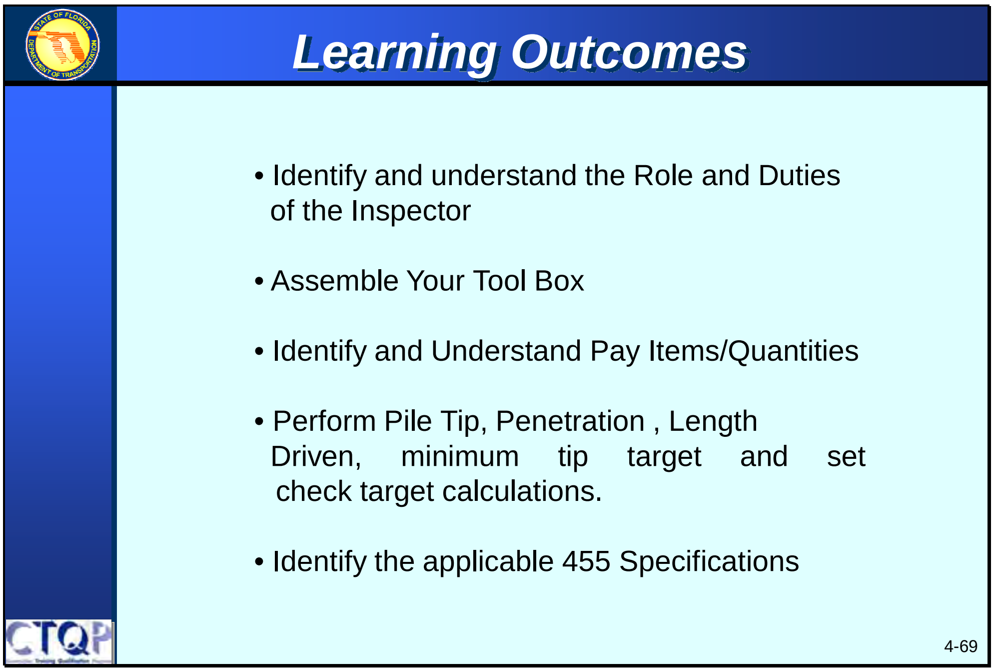
Vertical Pile:
Pile Length – 1’ – (Cut-off Elev. – Ref. Elev.)

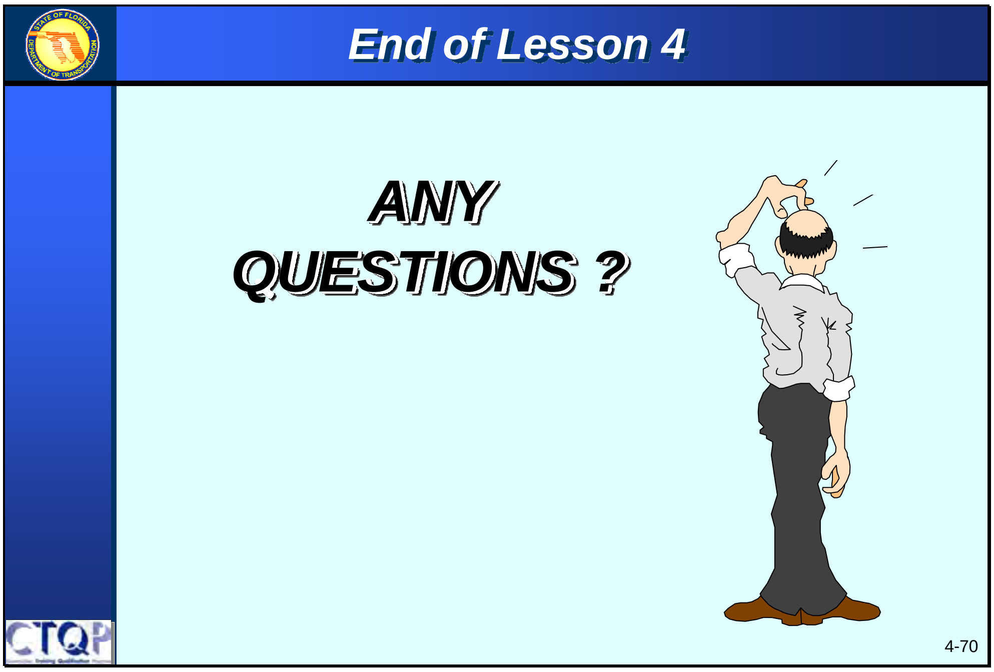
Batter Pile:
$$\text{Pile Length} - 1' - \frac{(\text{Cut-off Elev.} - \text{Ref. Elev.})}{\text{Corr. Factor}}$$



SCT=
SCT=
SCT=

4-68


Learning Outcomes
• Identify and understand the Role and Duties of the Inspector
• Assemble Your Tool Box
• Identify and Understand Pay Items/Quantities
• Perform Pile Tip, Penetration , Length Driven, minimum tip target and set check target calculations.
• Identify the applicable 455 Specifications
4-69


End of Lesson 4
ANY
QUESTIONS ?
CTQP
4-70

SAMPLE INSPECTOR'S "TOOLS" CHECKLIST

Approved Job Information

- ☐ Project Plans & Specifications w/ Revisions
- ☐ Special Provisions & Technical Special Provisions
- ☐ Pile Installation Plan
- ☐ Driving Criteria letter
- ☐ Authorized Pile length Letter

References

- ☐ Standard Specifications
- ☐ Pile Inspector's Qualification Course Manual

Daily Essentials

- ☐ Hard Hat
- ☐ Boots
- ☐ Ear & Eye Protection
- ☐ Pen / Pencil (with spare)
- ☐ 12' Tape (Preferably 25')
- ☐ 150' Tape
- ☐ Builders Square
- ☐ Life Jacket or reflective jacket
- ☐ Watch
- ☐ Calculator
- ☐ Camera
- ☐ Scale
- ☐ Level
- ☐ Weighted Tape (100')
- ☐ Plumb bob

Testing Equipment

- ☐ Saximeter
- ☐ Spare batteries

Documentation Material

- ☐ Pile Driving Record Log Book
- ☐ Construction Daily Report

PRECAST CONCRETE PAYMENT SUMMARY TABLE
Effective 7-1-2014

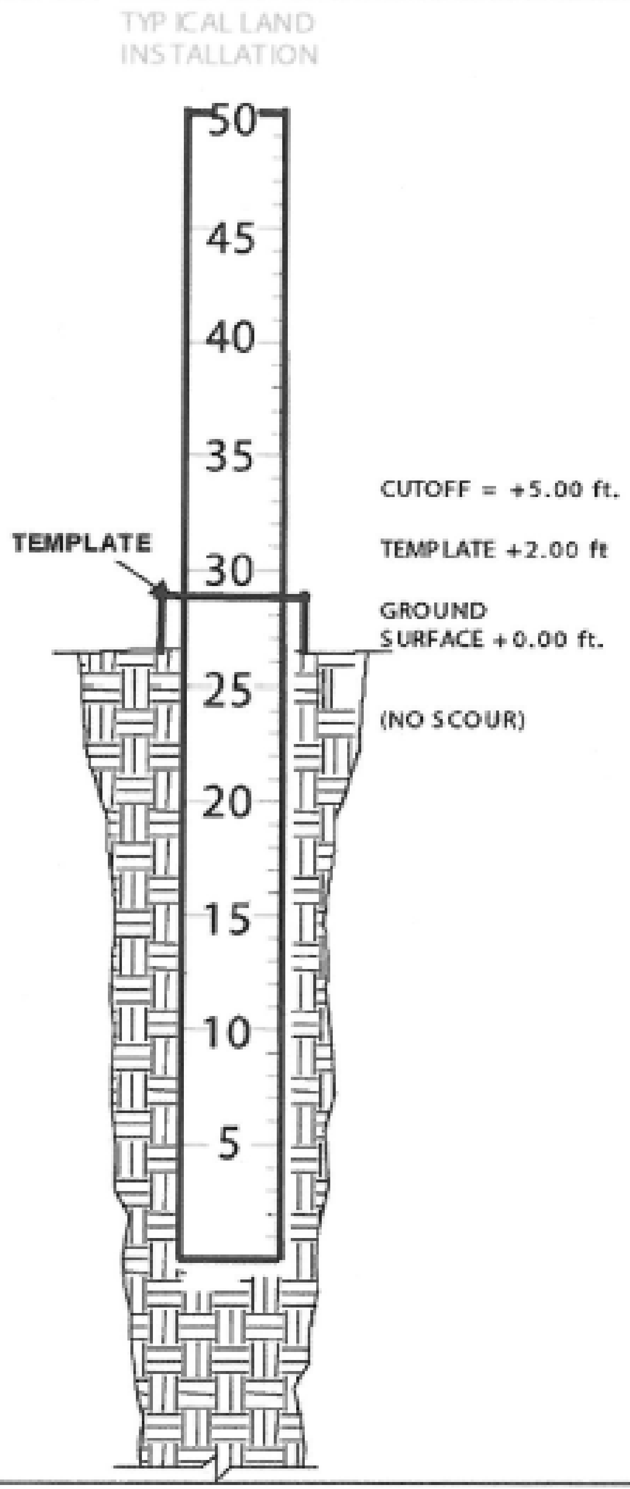
ITEM	PAYMENT	455 SPEC.
Prestressed Concrete Piling	Piling bid price, Feet	455-12.2
Prestressed Concrete test Piling	Piling bid price, Feet	455-12.4
Cut-off (remaining piling)	No Payment 455-12.12	455-11.2.4
Driving of Test Pile Splice	No Payment	455-12.4
Replacing Piles		
- Broken and irreparable piling, or mislocated piling and Contractor is responsible-extract and replace - Piling driven below cut-off without achieving bearing and the Engineer elects to extract pile and replace - Broken and irreparable piling, or mislocated piling and Department is responsible – extract and replace - "Undamaged" Pile extracted and driven somewhere else - Damaged or misplaced piling, and replacement is required and Department is responsible - Extracting of original pile to substitute for longer pile in lieu of splicing and build-up of original pile.	- No payment - Unforeseeable Work - Unforeseeable Work; pay piling furnished bid price - Paid at 30% of contract unit price for piling - Pay for both original and replacement piling under piling furnished - Pay original pile length + additional authorized build up + 30 Ft. of piling furnished for extracting original pile	455-11.2.7 455-11.2.7 455-11.2.7 455-11.2.7 455-11.2.7 455-11.2.7
Set-Checks & Redrives		
- **Test piles**; Engineer may elect to interrupt pile driving up to 4 times on each test pile (2 times for up to 2 hours and 2 additional times during the next working day following the initial drive day) within 1 working day following the initial driving. - Each additional set check determined necessary by the Engineer after the 4 previously mentioned above and within 1 working day following end of initial driving - Any re-drive after 1 working day following the initial driving day.	- No Payment - 10 feet piling furnished bid price - 20 feet piling furnished bid price	455-11.9 455-5.12.1 455-11.9 455-11.9
- **Production piles**; 2 set-checks within initial driving and the 1 working day following the end of initial driving. - Any additional set check within the 1 working day following the end of initial driving. - Re-drive Production Pile; After 1 working day following the initial driving day.	- No Payment - 10 feet piling furnished bid price - 20 feet piling furnished bid price	455-11.9.2 455-11.9.2 455-11.9.3
Dynamic Load Tests		
- **Test Piles:** Prices include instrumentation, materials and labor. - **Production piles**: Authorized by the Engineer for hooking up the instrument and begin driving, and then - Instrumentation on set-checks .	- No Payment - 20 feet piling furnished bid price - No Payment	455-11.5 455-11.5 455-11.5
Splices (Build-up) ≤ 5 feet below cut-off elevation		
Production and Test Piles: - Materials and labor - Piling Build-up length	- 9 feet of Production Pile - Build up length of Production Pile	455-11.8 455-11.8
Splices (Build-up) > 5 feet below cut-off elevation		
Test Piles - Splice Length Authorized –Non driven - Splice Length Authorized - Driven for test purposes - Splice (Material and Labor) - Driving of Splice **Production Pile** - Splice Length Authorized - Driving of production piling splice - Splice (Material and Labor)	- Length in feet of Production Pile bid price - Length in feet of Test Pile bid price - 30 feet Production Pile bid price - No payment - Length in feet of Production Pile bid price - 10 feet production piling bid price - 30 feet of Production Pile bid price	455-11.8 455-11.8 455-11.8 455-11.2.6 455-11.8 455-11.2.6 455-11.8
Static Load Tests		
- static Load Tests	- Static Load test bid price	455-11.12
Preforming	- 30% of piling per foot	455-11.13

STEEL PILE PAYMENT SUMMARY TABLE
Effective 7-1-2012

ITEM	PAYMENT	455 SPEC.
Piling Length	Piling bid price, Feet	455-12.3
Test Piling	Piling bid price, Feet	455-12.4
Point Protectors	Per each authorized, furnished & installed	455-11.3.2
Driving of Test Splice	No Payment	455-12.4
Replacing Piles		
- Broken and irreparable piling, or mislocated piling and Contractor is responsible-extract and replace	- No payment	455-11.2.7
- Piling driven below cut-off without achieving bearing and the Engineer elects to extract pile and replace	- Unforeseeable Work	455-11.2.7
- Broken and irreparable piling, or mislocated piling and Department is responsible – extract and replace	- Unforeseeable Work; pay piling Furnished per bid price for both damaged and replacement.	455-11.2.7
- "Undamaged" Pile extracted and driven somewhere else	- Paid at 30% of contract unit price for Piling	455-11.2.7
- Damaged or misplaced piling, and replacement is required and Department is responsible	- Pay for both original and replacement piling under piling furnished.	455-11.2.7
- Extracting of original pile to substitute for longer pile in lieu of splicing and build-up of original pile	- Pay original pile length + additional authorized build up + 30 Ft. of piling furnished for extracting original pile	455-11.2.7
Set-Checks & Redrives		
- **Test piles** Engineer may elect to interrupt pile driving up to 4 times on each test pile (2 times for up to 2 hours and 2 additional times during the next working day following the initial drive day) within 1 working day following the initial driving.	- No Payment	455-11.9.1 455-5.12.1
- Each additional set check determined necessary by the Engineer after the 4 previously mentioned above and within 1 working day following end of initial driving	- 10 feet piling furnished bid price	455-11.9.1
- Any re-drive after 1 working day following the initial driving day	- 20 feet piling furnished bid price	455-11.9.3
- **Production piles**; 2 set-checks within initial driving and the 1 working day following the end of initial driving.	- No Payment	455-11.9.2
- Any additional set check within the 1 working day following the end of initial driving.	- 10 feet piling furnished bid price	455-11.9.2
- Re-drive Production Pile; After 1 working day following the initial driving day.	- 20 feet piling furnished bid price	455-11.9.3
Dynamic Load Tests		
- **Test Piles:** Prices include instrumentation, materials and labor.	- No Payment	455-11.5 455-12.5.1
- **Production piles**: Authorized by the Engineer for hooking up the instrument and begin driving	- 20 feet piling furnished bid price	455-11.5
- Instrumentation on set checks	- No Payment	455-11.5
Splices		
Test Piles		
- Splice Length Authorized –Non driven	- Length in feet of production pile bid price	455-11.8
- Splice Length Authorized - Driven for test purposes only	- Length in feet of Test pile bid price	455-11.8
- Splice (Material and Labor)	- 20 feet Production Pile bid price	455-11.8
- Driving of Splice	- No Payment	455-11.2.6
Production Pile		
- Splice Length Authorized	- Length in feet of Production Pile bid price	455-11.8
- Driving of production pile splice	- No Payment	455-11.2.6
- Splice (Material and Labor)	- 20 feet Production Pile bid price	455-11.8
Static Load Tests		
- static Load Tests	- Static Load test bid price	455-11.12
Preforming	- 30% of piling per foot	455-11.13

DETERMINING TIP ELEVATION

PROBLEM 1 - PLUMB PILE EXAMPLE



GIVEN:

Furnished Pile Length = ____________
Reference Elevation = ____________
Cut-off Elevation = ____________
Ground Elev. (Excavation) = ____________
Scour Elevation = ____________
Pile Length Below Ref. Elev. = ____________

TIP ELEVATION

Tip Elev. = Ref. Elev. - Length Below Ref. Elev.

= ____________

= ____________

PENETRATION

Penetration = Lowest of 3 Elevations - Tip Elev.
(Natural Ground, Scour, Excavation)

= ____________

= ____________

= ____________

LENGTH DRIVEN

Length Driven = Cut-off Elev. - Tip Elev.

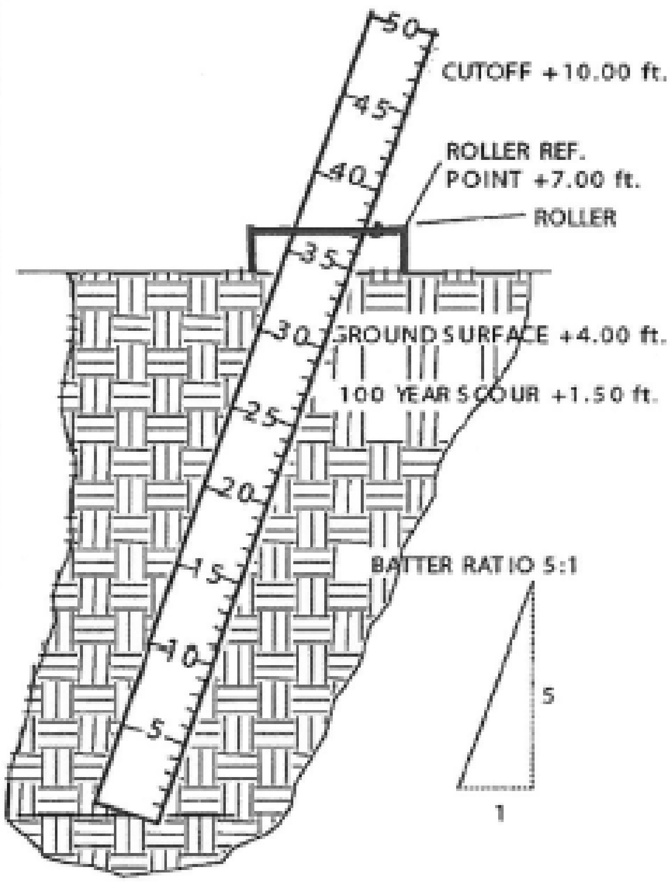
= ____________

= ____________

= ____________

DETERMINING TIP ELEVATION

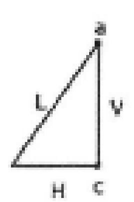
PROBLEM 2 - BATTER PILE EXAMPLE



CALCULATING PILE TIP ELEVATION
OF BATTER PILES

BATTER RATIO = V/H or V:H

BATTER RATIO (V:H)	CORRECTION FACTOR (R)
12:1	.997
10:1	.995
12:2 (6:1)	.986
10:2 (5:1)	.981
12:3 (4:1)	.971
10:3	.958
12:4 (3:1)	.949
10:4 (5:2)	.928
12:5	.923



FORMULA'S

$V = L \cdot R$
$C = a - V$

DEFINITIONS

L = Pile Length Below Reference Point (m)
a = Reference Point Elevation (m)
V = Corrected Pile depth (m)
c = Pile Tip Elevation (m)

GIVEN:

Furnished Pile Length = ______________
Reference Elevation = ______________
Cut-off Elevation = ______________
Ground Elev. (Excavation) = ______________
Scour Elevation = ______________
Pile Length Below Ref. Elev. = ______________
Batter = ______________
Correction Factor = ______________

TIP ELEVATION

Tip Elev. = Ref. Elev. - [Length Below Ref. Elev. X Corr. Factor]

= ______________

= ______________

= ______________

PENETRATION

Penetration = [Lowest of 3 Elevations - Tip Elev.] ÷ Corr. Factor
(Natural Ground, Scour, Excavation)

= ______________

= ______________

= ______________

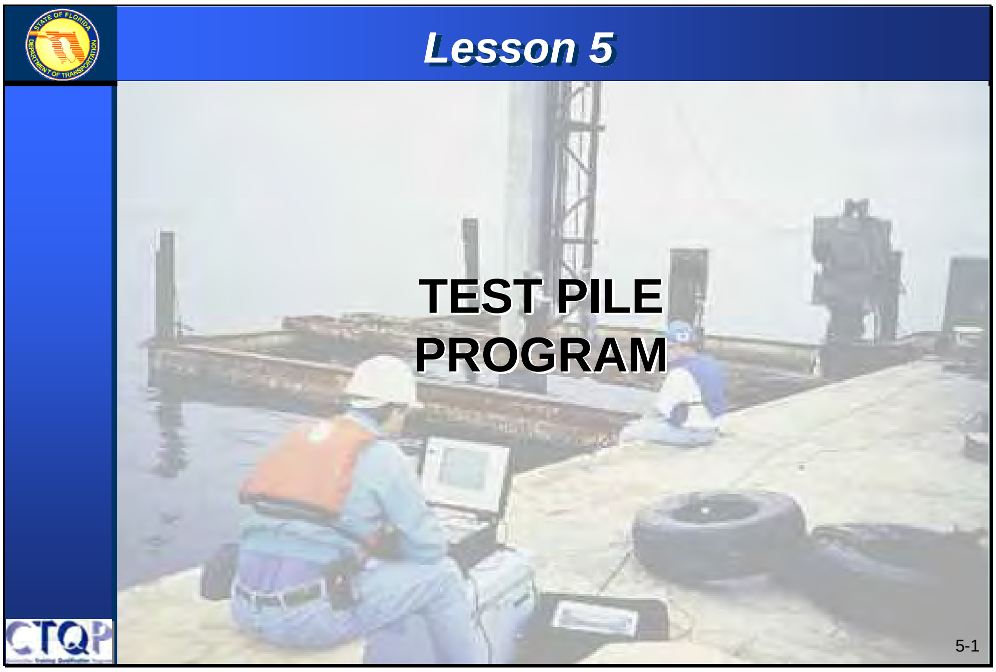
LENGTH DRIVEN

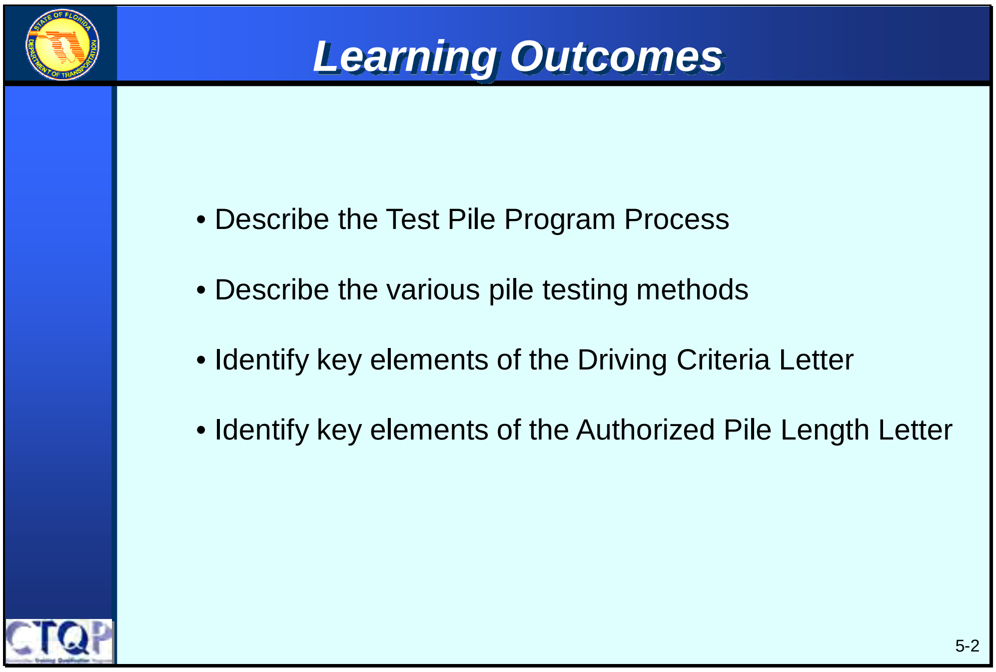
Length Driven = [Cut-off Elev. - Tip Elev.] ÷ Corr. Factor

= ______________

= ______________

= ______________


Lesson 5
TEST PILE
PROGRAM
CTQP
5-1


Learning Outcomes
• Describe the Test Pile Program Process
• Describe the various pile testing methods
• Identify key elements of the Driving Criteria Letter
• Identify key elements of the Authorized Pile Length Letter
5-2

Purpose of Test Piles

Performed in Advance of Production Piles
Geotechnical Engineer will be On-site

455-5.12.1 Description: Drive piles of the same cross-section and type as the permanent piles shown in the plans, in order to determine any or all of the following:

(a) the installation criteria for the piles.
(b) the nature of the soil.
(c) the lengths of permanent piles required for the work.
(d) the driving resistance characteristics of the various soil strata.
(e) the amount of work necessary to obtain minimum required pile penetration.
(f) the ability of the driving system to do the work.
(g) the need for point protection

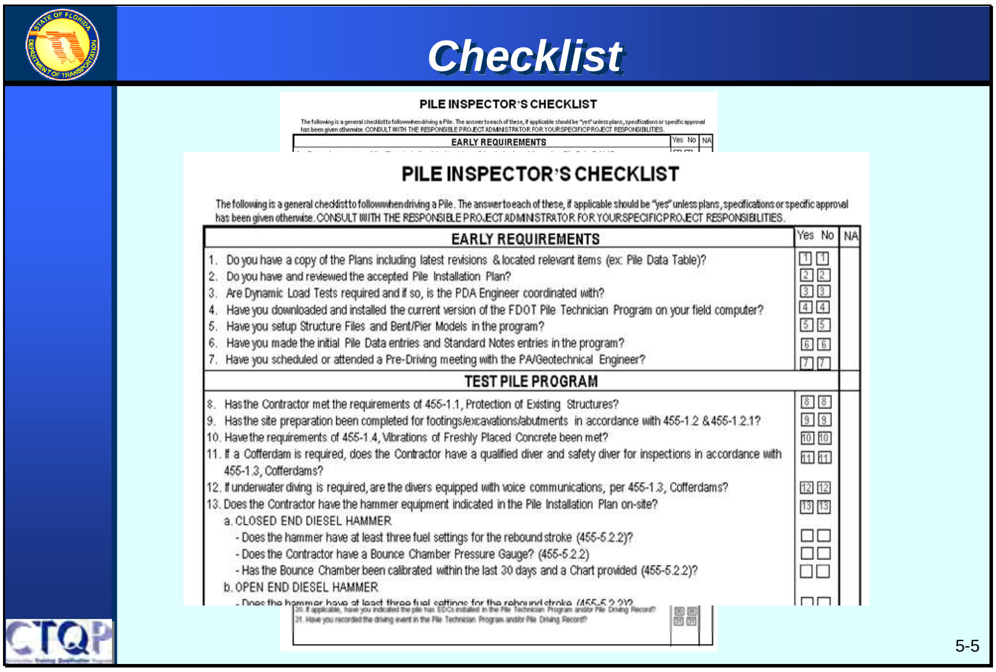
5-3

Inspector’s Role

- Scheduling Geotechnical Engineer
- Piles, Delivery, Handling, Marking
- Equipment Verification
- Establish Template and /or Reference Point Elevation
- Record Driving Event

GEOTECHNICAL ENGINEER WILL MAKE DECISIONS DURING TEST PILES

5-4


Checklist
PILE INSPECTOR'S CHECKLIST
The following is a general checklist to follow when driving a Pile. The answer to each of these, if applicable should be "yes" unless plans, specifications or specific approval has been given otherwise. CONSULT WITH THE RESPONSIBLE PROJECT ADMINISTRATOR FOR YOUR SPECIFIC PROJECT RESPONSIBILITIES.
EARLY REQUIREMENTS
Yes No NA
1. Do you have a copy of the Plans including latest revisions & located relevant items (ex: Pile Data Table)?
2. Do you have and reviewed the accepted Pile Installation Plan?
3. Are Dynamic Load Tests required and if so, is the PDA Engineer coordinated with?
4. Have you downloaded and installed the current version of the FDOT Pile Technician Program on your field computer?
5. Have you setup Structure Files and Bent/Pier Models in the program?
6. Have you made the initial Pile Data entries and Standard Notes entries in the program?
7. Have you scheduled or attended a Pre-Driving meeting with the PA/Geotechnical Engineer?
TEST PILE PROGRAM
8. Has the Contractor met the requirements of 455-1.1, Protection of Existing Structures?
9. Has the site preparation been completed for footings/excavations/abutments in accordance with 455-1.2 & 455-1.2.1?
10. Have the requirements of 455-1.4, Vibrations of Freshly Placed Concrete been met?
11. If a Cofferdam is required, does the Contractor have a qualified diver and safety diver for inspections in accordance with 455-1.3, Cofferdams?
12. If underwater diving is required, are the divers equipped with voice communications, per 455-1.3, Cofferdams?
13. Does the Contractor have the hammer equipment indicated in the Pile Installation Plan on-site?
a. CLOSED END DIESEL HAMMER
- Does the hammer have at least three fuel settings for the rebound stroke (455-5.2.2)?
- Does the Contractor have a Bounce Chamber Pressure Gauge? (455-5.2.2)
- Has the Bounce Chamber been calibrated within the last 30 days and a Chart provided (455-5.2.2)?
b. OPEN END DIESEL HAMMER
5-5

455-5.12 Test Piles

455-5.12.1 Description: (Continued)

… Because test piles are exploratory in nature, drive them harder (within the limits of practical refusal), deeper, and to a greater bearing resistance than required for the permanent piling. Except for test piles which are to be statically (or Statnamically) load tested, drive test piles their full length or to practical refusal. Build up test piles which have been driven their full length and have developed only minimal required bearing, and proceed with further driving….

5-6

455-5.12 Test Piles

455-5.12.1 Description: (Continued)

…. As a minimum, unless otherwise directed by the Engineer, do not cease driving of test piles until obtaining the required bearing capacity continuously, where the blow count is increasing, for 10 feet unless reaching practical refusal first. For test piles which are to be statically or Statnamically load tested, ignore this minimum and drive these piles as anticipated for the production piles. ….

5-7

455-5.12 Test Piles

455-5.12.1 Description: (Continued)

… When test piles attain practical refusal prior to attaining minimum penetration, perform all work necessary to attain minimum penetration and the required bearing.

Where practical, use water jets to break the pile loose for further driving. Where jetting is impractical, extract the pile and install a Preformed Pile Hole through which driving will continue. The Department will consider the work of extracting the pile to be Unforeseeable Work

5-8

455-5.12 Test Piles

455-5.12.1 Description: (Continued)

When driving test piles other than low displacement steel test piles, have preforming equipment available at the site and water jets as specified in 455-5.7 when jetting is allowed, ready for use, before the test pile driving begins.

5-9

455-5.12 Test Piles

455-5.12.1 Description: (Continued)

When driving test piles other than low displacement steel test piles, have preforming equipment available at the site and water jets as specified in 455-5.7 when jetting is allowed, ready for use, before the test pile driving begins.

5-10

455-5.12 Test Piles

455-5.12.1 Description: (Continued)

The Engineer may elect to interrupt pile driving up to four times on each test pile, two times for up to two hours and two additional times during the next working day of initial driving to determine time effects during the driving of test piles.

Install instruments on test piles when dynamic load tests are included in the Plans or when directed by the Engineer.

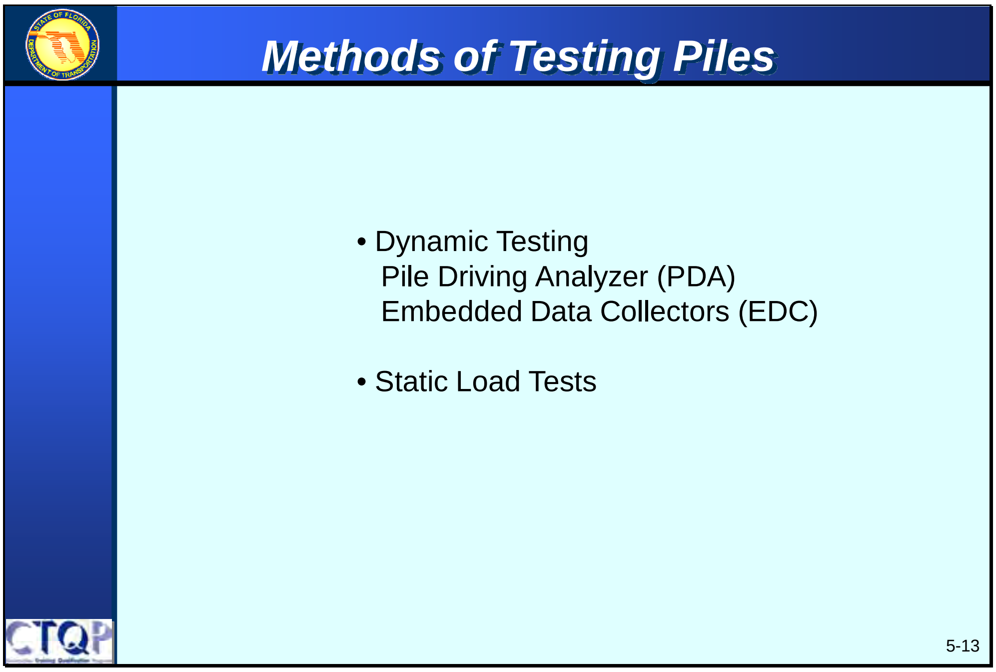
5-11

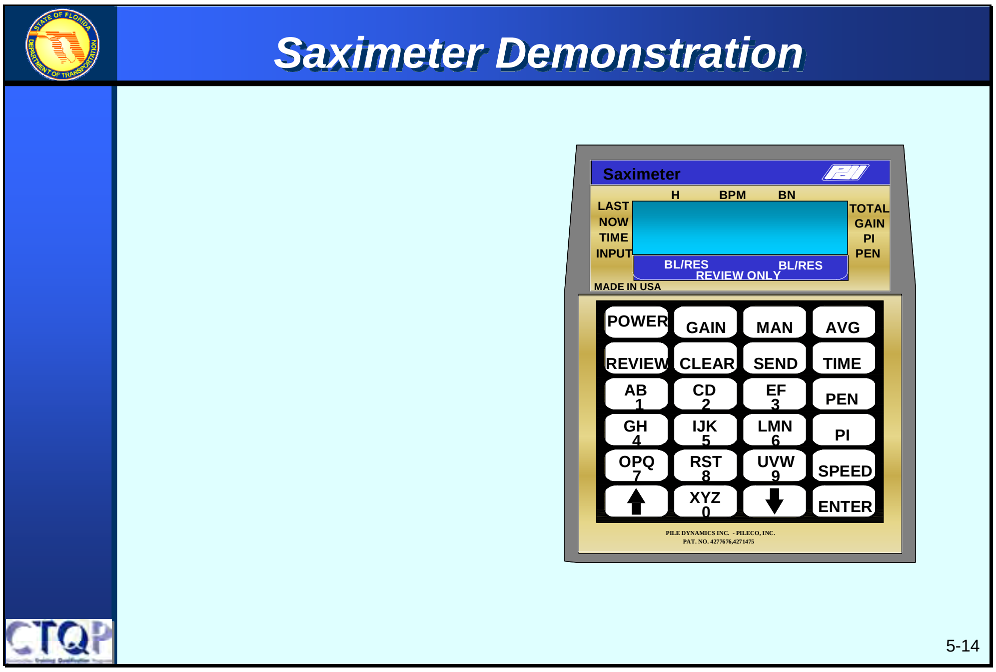
455-5.12 Test Piles

455-5.12.2 Location of Test Piles: Drive all test piles in the position of permanent piles at the designated locations. Ensure that all test piles designated to be statically load tested are plumb. In the event that all the piles are battered at a static load test site, the Engineer will designate an out-of-position location for driving a plumb pile for the static load test.

455-5.12.3 Equipment for Driving: **Use the same hammer and equipment for** driving test piles as for driving the permanent piles. Also use the same equipment to redrive Piles.

5-12


Methods of Testing Piles
• Dynamic Testing
Pile Driving Analyzer (PDA)
Embedded Data Collectors (EDC)
• Static Load Tests
CTQP
5-13


Saximeter Demonstration
Saximeter
H BPM BN
LAST
NOW
TIME
INPUT
TOTAL
GAIN
PI
PEN
BL/RES BL/RES
REVIEW ONLY
MADE IN USA
POWER GAIN MAN AVG
REVIEW CLEAR SEND TIME
AB 1 CD 2 EF 3 PEN
GH 4 IJK 5 LMN 6 PI
OPQ 7 RST 8 UVW 9 SPEED
XYZ 0 ENTER
PILE DYNAMICS INC. - PILECO, INC.
CTQP
5-14

Saximeter Demonstration

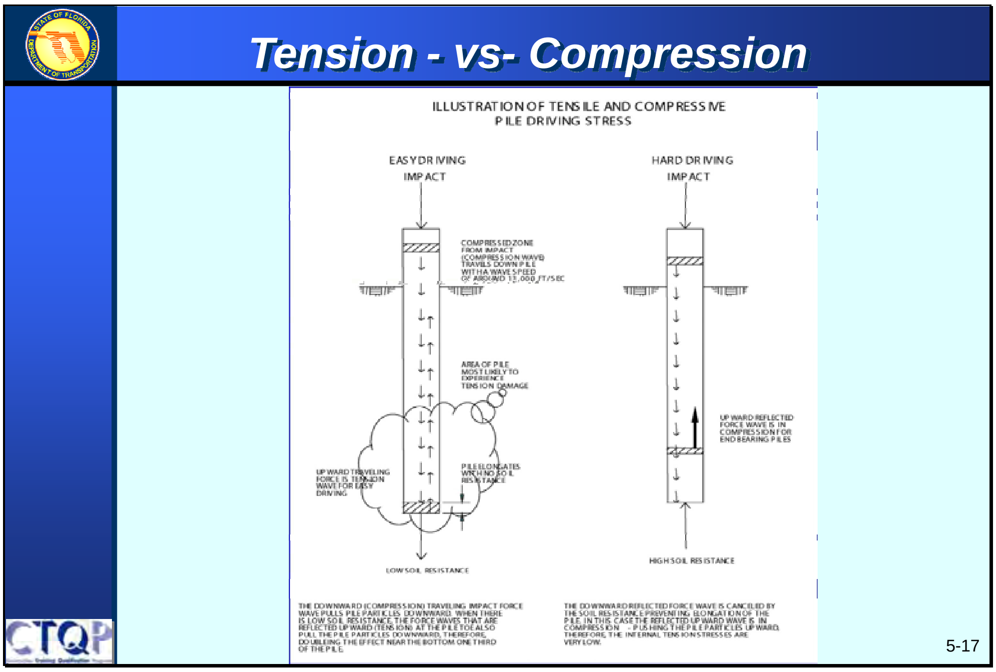
5-15

Pile Driving Analyzer (PDA)

- Generally Performed by the Geotechnical Engineer
- Sensors are Attached to Pile
- As Pile is Driven, Data from the Sensors is Recorded on Computer
- Geotechnical Engineer Interprets Data

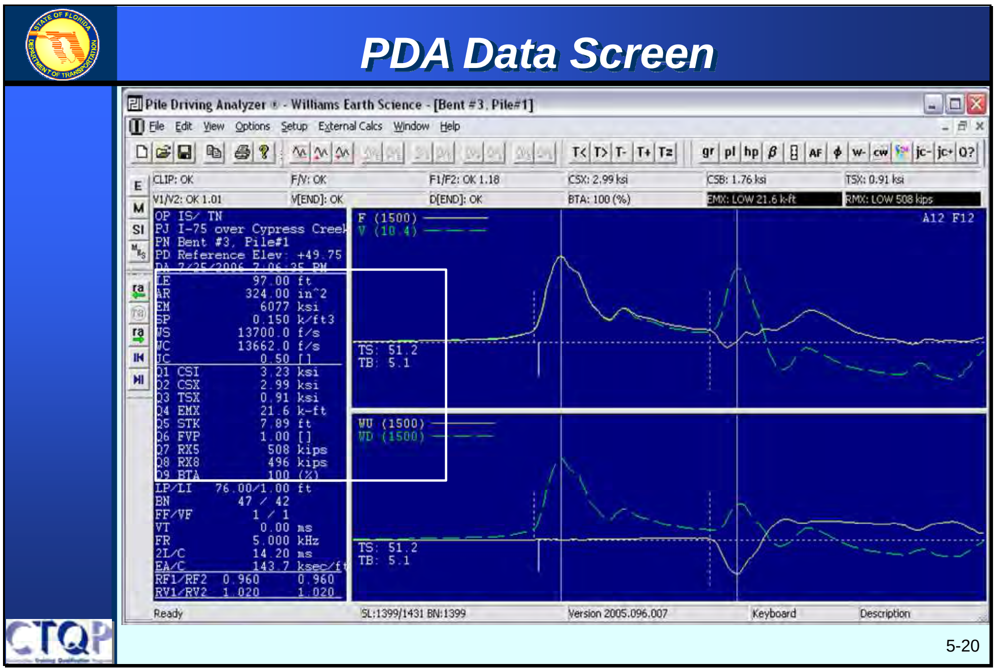
CTQP

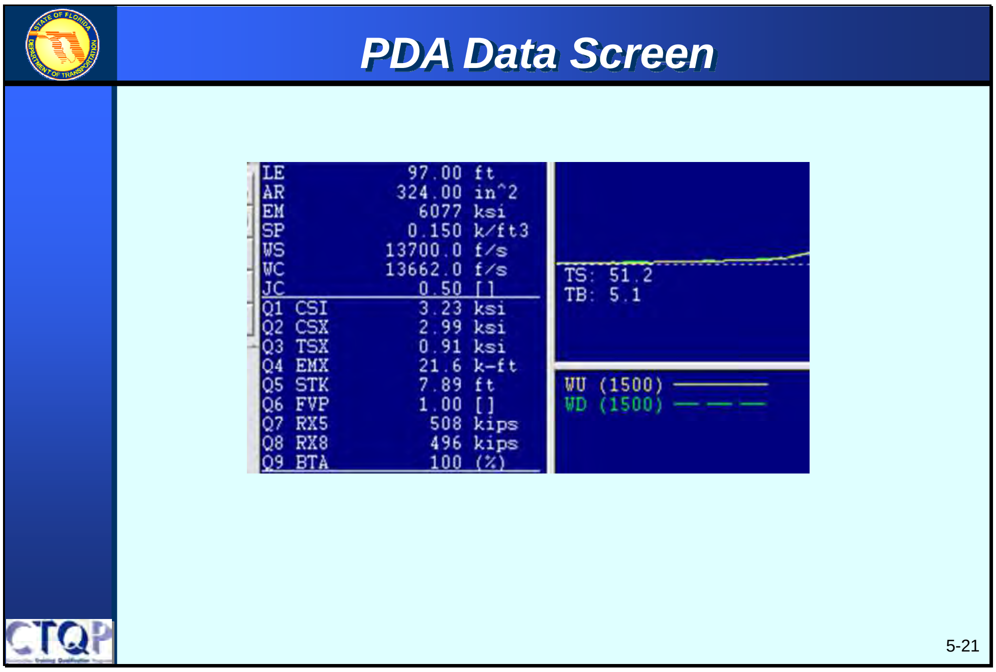
5-16


Tension - vs- Compression
ILLUSTRATION OF TENSILE AND COMPRESSIVE PILE DRIVING STRESS
EASY DRIVING
IMPACT
COMPRESSED ZONE FROM IMPACT (COMPRESSION WAVE) TRAVELS DOWN PILE WITH A WAVE SPEED OF AROUND 13,000 FT/SEC
AREA OF PILE MOST LIKELY TO EXPERIENCE TENSION DAMAGE
UPWARD TRAVELING FORCE IS TENSION WAVE FOR EASY DRIVING
PILE ELONGATES WITH NO SOIL RESISTANCE
LOW SOIL RESISTANCE
HARD DRIVING
IMPACT
UPWARD REFLECTED FORCE WAVE IS IN COMPRESSION FOR END BEARING PILES
HIGH SOIL RESISTANCE
THE DOWNWARD (COMPRESSION) TRAVELING IMPACT FORCE WAVE PULLS PILE PARTICLES DOWNWARD. WHEN THERE IS LOW SOIL RESISTANCE, THE FORCE WAVES THAT ARE REFLECTED UPWARD (TENSION) AT THE PILE TOE ALSO PULL THE PILE PARTICLES DOWNWARD, THEREFORE, DOUBLEING THE EFFECT NEAR THE BOTTOM ONE THIRD OF THE PILE.
THE DOWNWARD REFLECTED FORCE WAVE IS CANCELED BY THE SOIL RESISTANCE PREVENTING ELONGATION OF THE PILE. IN THIS CASE THE REFLECTED UPWARD WAVE IS IN COMPRESSION - PUSHING THE PILE PARTICLES UPWARD. THEREFORE, THE INTERNAL TENSION STRESSES ARE VERY LOW.
CTQP
5-17


Installing Sensors for PDA
CTQP
5-18


Geotechnical Engineer & Inspector
CTQP
5-19

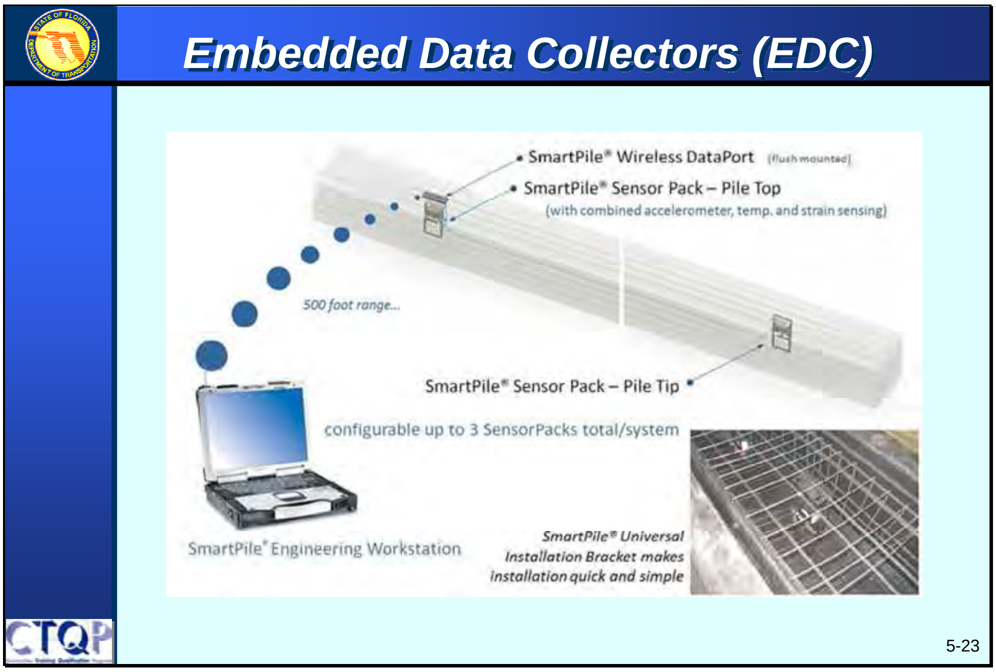

PDA Data Screen
Pile Driving Analyzer - Williams Earth Science - [Bent #3, Pile#1]
5-20


PDA Data Screen
LE 97.00 ft
AR 324.00 in^2
EM 6077 ksi
SP 0.150 k/ft3
WS 13700.0 f/s
WC 13662.0 f/s
JC 0.50 []
Q1 CSI 3.23 ksi
Q2 CSX 2.99 ksi
Q3 TSX 0.91 ksi
Q4 EMX 21.6 k-ft
Q5 STK 7.89 ft
Q6 FVP 1.00 []
Q7 RX5 508 kips
Q8 RX8 496 kips
Q9 BTA 100 (%)
TS: 51.2
TB: 5.1
WU (1500)
WD (1500)
CTQP
5-21

Embedded Data Collectors (EDC)

- Generally Performed by a trained Operator
- Sensors are Attached near the top and near the tip of the Pile
- Sensors are internally attached to the reinforcement at the middle of the cross section.
- As Pile is Driven, Data from the Sensors is Recorded on Computer
- Geotechnical Engineer Interprets Data

5-22

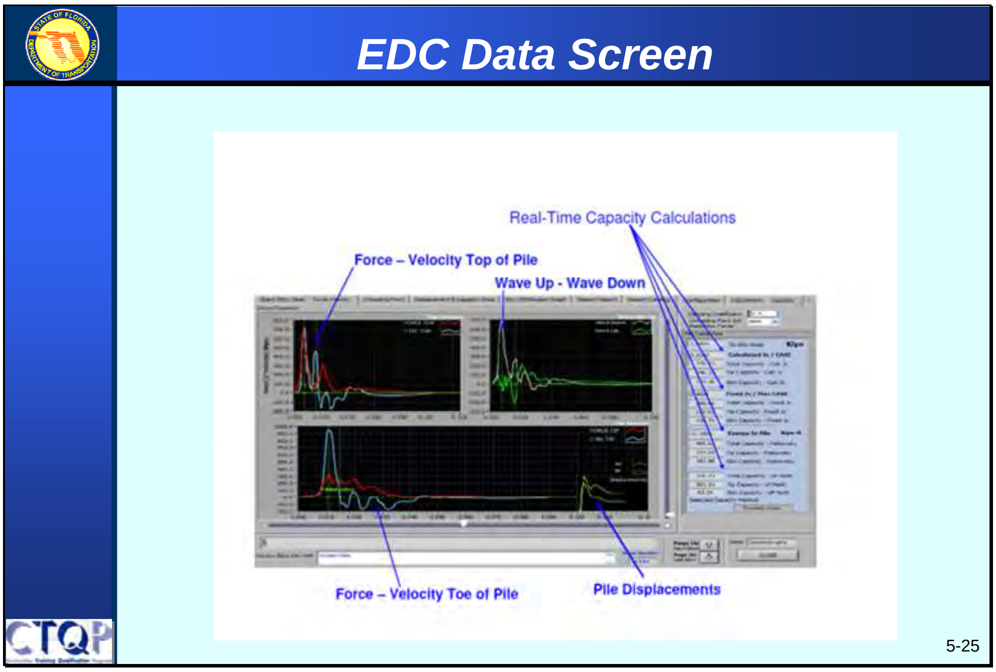

Embedded Data Collectors (EDC)
SmartPile® Wireless DataPort (flush mounted)
SmartPile® Sensor Pack – Pile Top
(with combined accelerometer, temp. and strain sensing)
500 foot range...
SmartPile® Sensor Pack – Pile Tip
configurable up to 3 SensorPacks total/system
SmartPile® Engineering Workstation
SmartPile® Universal Installation Bracket makes installation quick and simple
CTQP
5-23

Embedded Data Collectors (EDC)

- Wireless data transfer
- Antenna connects to laptop PC
- Monitoring concrete piles during driving
- Estimates soil damping for every blow during driving
- Real-time estimates of static resistances, i.e., side, tip and total.

5-24

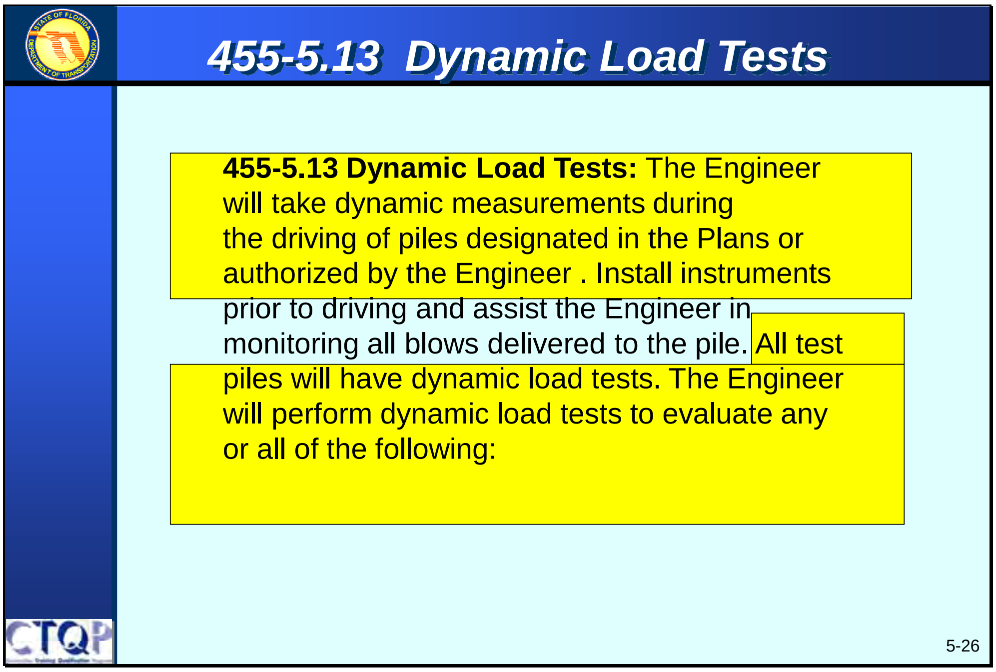
Pictured in this slide is a pile being poured with the embedded gauges.

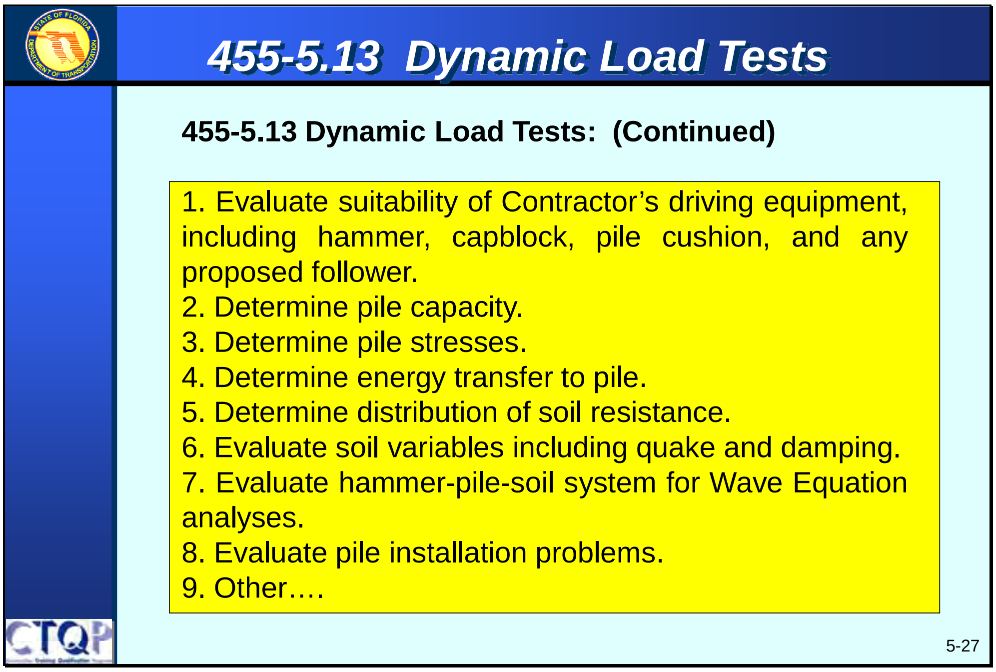


Here is a screen display of EDC data during the instrumentation of one particular blow. The EDC system measure accelerations and strains at top and bottom and can determine stroke, driving stresses, bearing capacity, energy transferred and pile integrity.

With top and tip gauges, accurate assessment of side friction and tip components of pile capacities is possible. In addition, having a strain gauge near the tip of the pile allows for a more accurate direct measurement of the compression stresses at the tip, as opposed to the PDA, which estimates the tip stresses based on readings at the top of the pile. This is a very important feature to control the tip compression stresses on concrete piles that need to be driven through very dense or hard layers, before reaching the required minimum penetration, or piles that are founded on very dense or hard layers.

The new system tracks the change in strain/stress within the pile during driving and may be readily used to assess damage (i.e. and loss of prestress), which may be used to control the hammer (i.e. fuel settings) or stop the driving to prevent further damage. The tip gauges warn the EDC operator when excessive loss of prestress is occurring and the integrity of the pile may be impacted.


455-5.13 Dynamic Load Tests
455-5.13 Dynamic Load Tests: The Engineer will take dynamic measurements during the driving of piles designated in the Plans or authorized by the Engineer . Install instruments prior to driving and assist the Engineer in monitoring all blows delivered to the pile. All test piles will have dynamic load tests. The Engineer will perform dynamic load tests to evaluate any or all of the following:
5-26


455-5.13 Dynamic Load Tests
455-5.13 Dynamic Load Tests: (Continued)
1. Evaluate suitability of Contractor's driving equipment, including hammer, capblock, pile cushion, and any proposed follower.
2. Determine pile capacity.
3. Determine pile stresses.
4. Determine energy transfer to pile.
5. Determine distribution of soil resistance.
6. Evaluate soil variables including quake and damping.
7. Evaluate hammer-pile-soil system for Wave Equation analyses.
8. Evaluate pile installation problems.
9. Other….
CTQP
5-27

455-5.13 Dynamic Load Tests

455-5.13 Dynamic Load Tests: (Continued)

…. Drive the pile to the required penetration and resistance or as directed by the Engineer. Dynamic load testing of a pile may average up to two hours longer than for driving an uninstrumented pile.

When directed by the Engineer, perform instrumented redrives. Do not use a cold diesel hammer for a redrive unless in the opinion of the Engineer it is impractical to do otherwise. Generally, warm up the hammer by driving another pile or applying at least 20 blows to a previously driven pile or to timber mats placed on the ground.

5-28

Static Load Tests

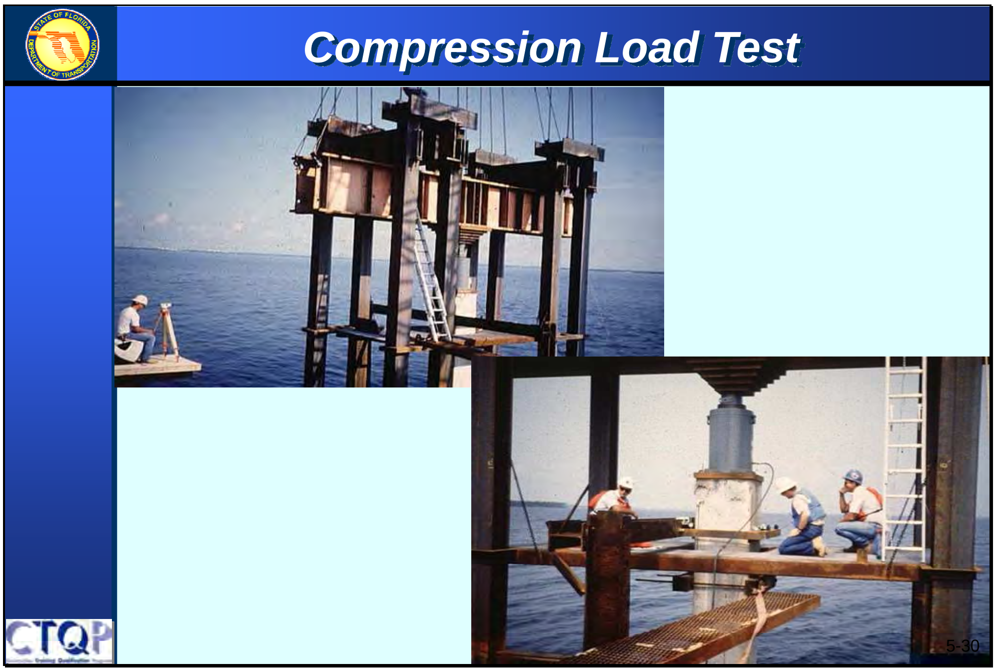
ADVANTAGES

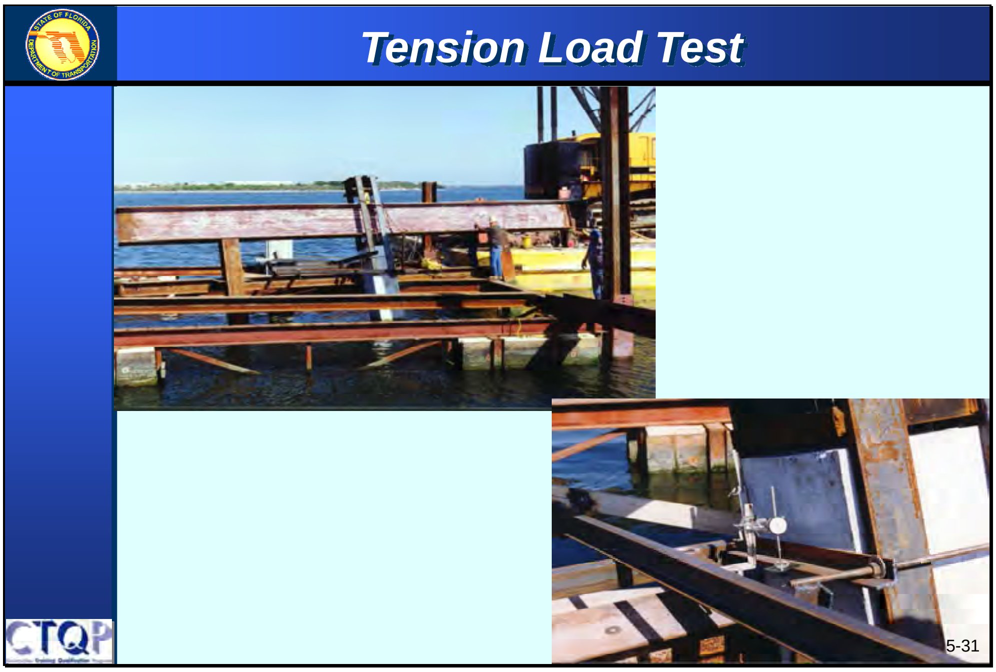
- The load is applied gradually which simulates better the actual load conditions than a dynamic load test.
- Extensive instrumentation possibilities
- Repeatable

DISADVANTAGES

- Time consuming
- Extensive setup & teardown
- Manpower requirements

5-29


Compression Load Test
CTQP
5-30


Tension Load Test
CTQP
5-31

Lateral Load Test

5-32

Learning Outcomes

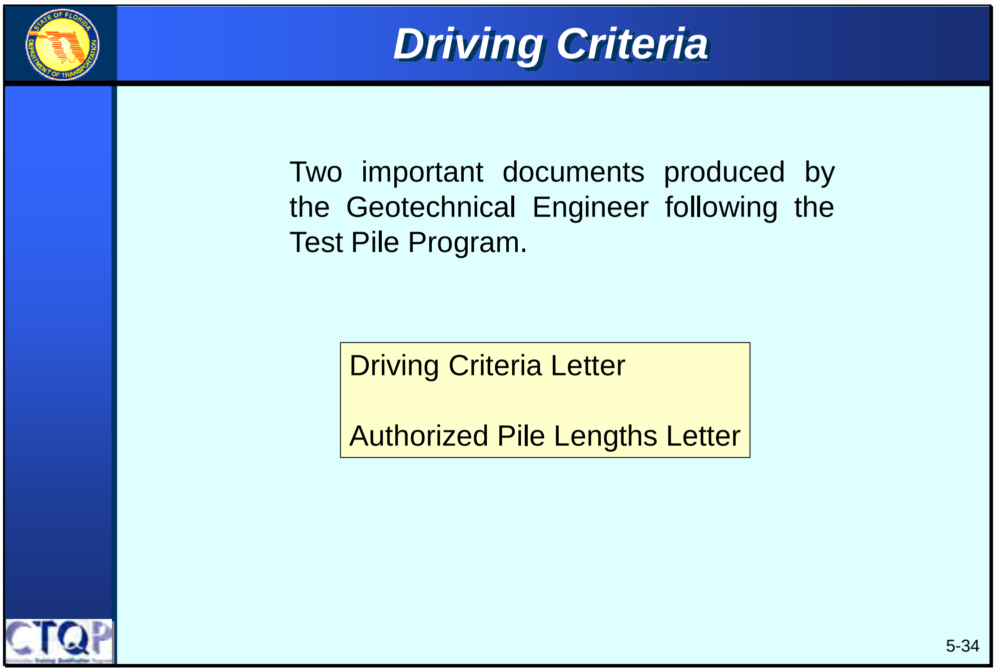
The Saximeter is typically used to determine____.

A. The number of blows per foot
B. The total number of blows on the pile
C. The average stroke height
D. All of the above

Which of the following is not a function of the Pile Inspector during the Test pile program?

A. Verifying equipment matches the Pile Installation Plan
B. Monitoring MOT
C. Recording the pile driving operation
D. Coordinating with the Geotechnical Engineer

5-33



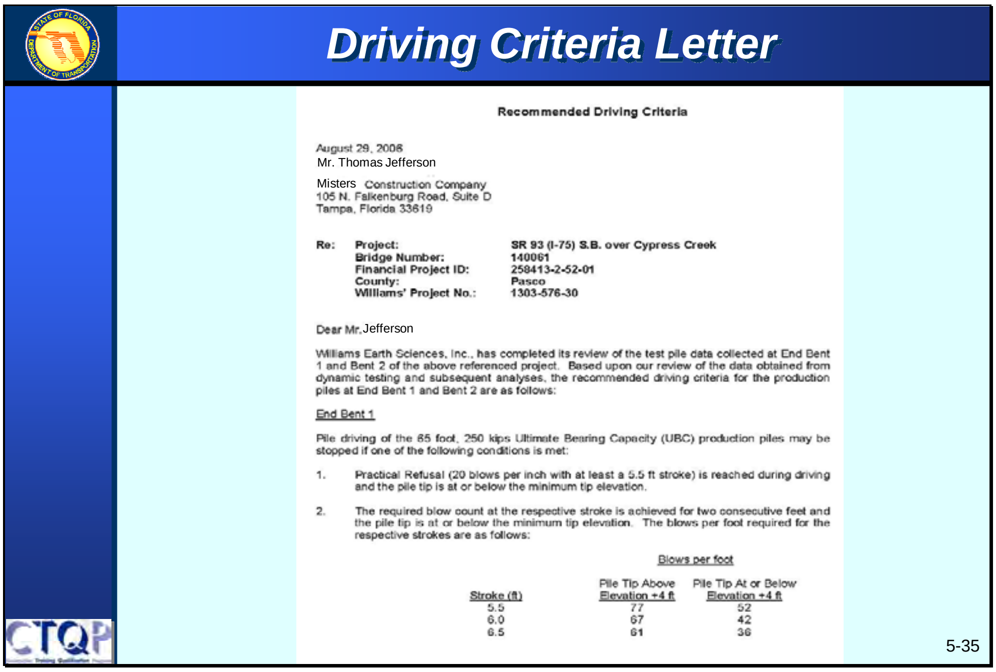
Following the driving and testing of the test pile(s), the Geotechnical Engineer generates several documents written to the Contractor, which are extremely important to the Inspector.

AUTHORIZED LENGTH LETTER

Upon the completion and evaluation of the test pile program, the Department issues an authorized pile length letter. This letter is usually issued as soon as practical after the end of the test pile to permit the Contractor to order piles from the prestressed concrete yard.

DRIVING CRITERIA OVERVIEW

A **driving criteria letter** is issued by the Department which the inspector will use to verify that the production piles for the job will obtain the capacities specified in the plans and are not damaged during installation. The information that was obtained during the test pile program is used to develop this letter. The **driving criteria letter** which the inspector should have a copy of in his possession at all times during pile driving, sets out the parameters for the inspector's construction control. The driving criteria letter will set the required blow counts based on hammer energy (stroke). It will also set parameters for initial driving, such as using a reduced fuel setting to control stresses in the pile during early driving. The driving criteria will also address issues such as allowing for scour resistance, jetting, set-check, redrive information and when to consider that a practical refusal condition has been achieved.



Recommended Driving Criteria

August 29, 2006
Mr. Thomas Jefferson

Misters Construction Company
105 N. Falkenburg Road, Suite D
Tampa, Florida 33619

Re:	**Project:**	**SR 93 (I-75) S.B. over Cypress Creek**
	Bridge Number:	**140061**
	Financial Project ID:	**258413-2-52-01**
	County:	**Pasco**
	Williams' Project No.:	**1303-576-30**

Dear Mr. Jefferson

Williams Earth Sciences, Inc., has completed its review of the test pile data collected at End Bent 1 and Bent 2 of the above referenced project. Based upon our review of the data obtained from dynamic testing and subsequent analyses, the recommended driving criteria for the production piles at End Bent 1 and Bent 2 are as follows:

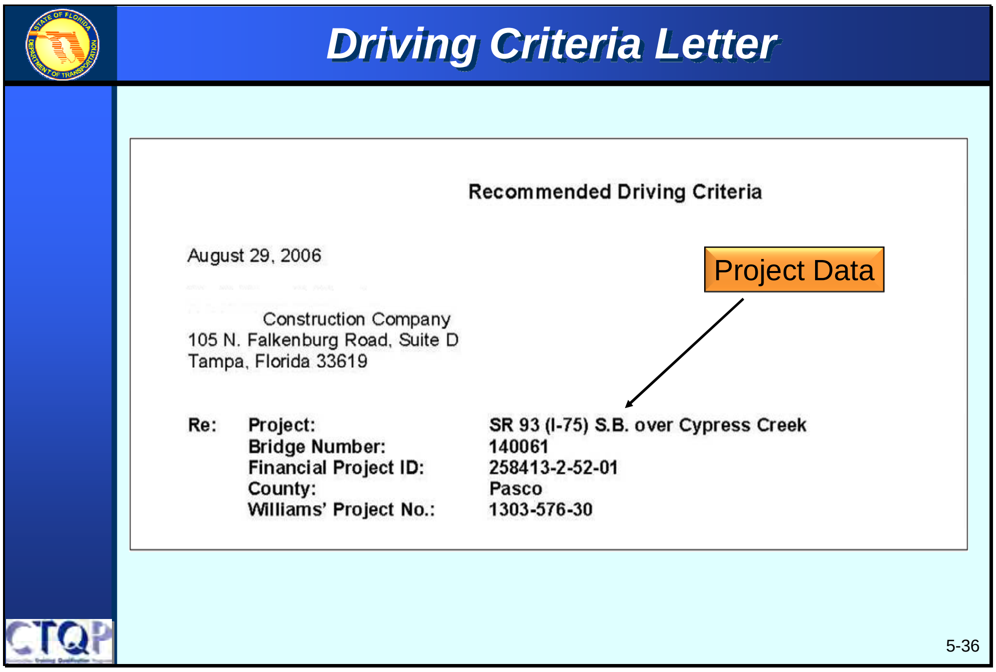
End Bent 1

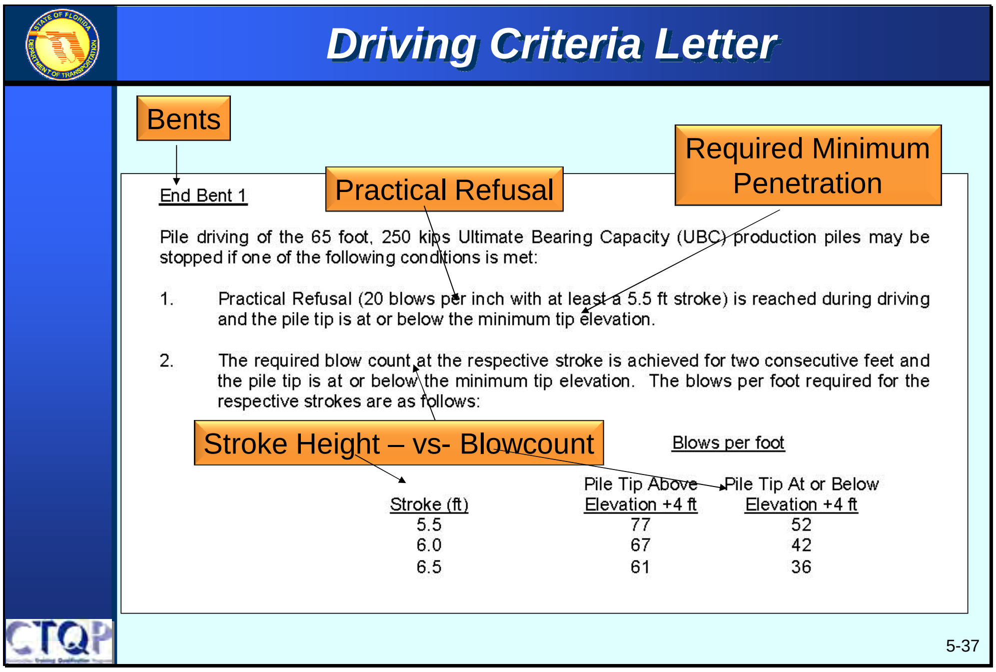
Pile driving of the 65 foot, 250 kips Ultimate Bearing Capacity (UBC) production piles may be stopped if one of the following conditions is met:

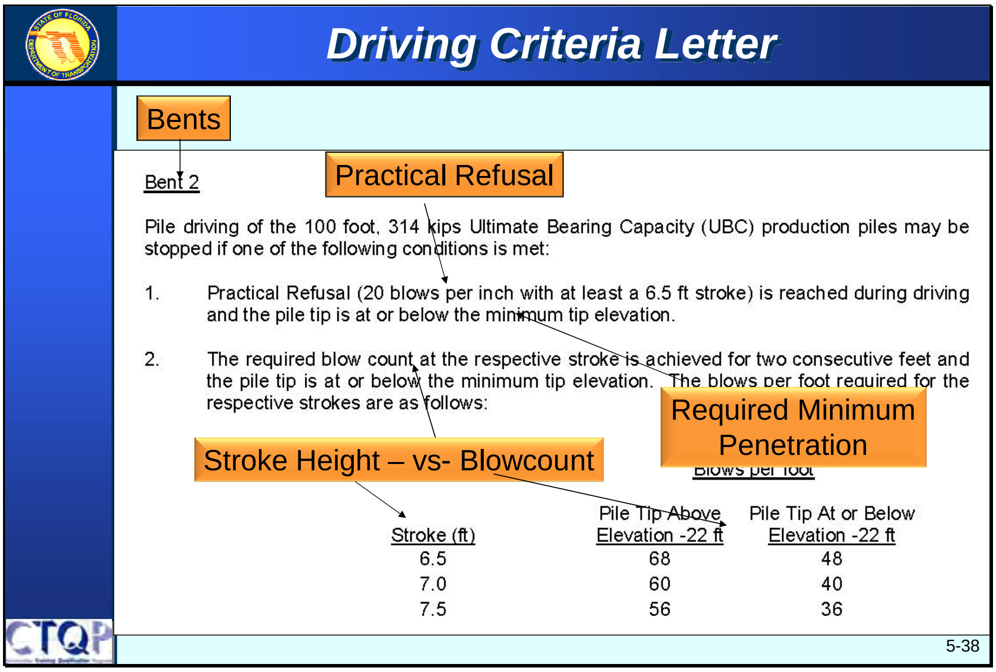
1. Practical Refusal (20 blows per inch with at least a 5.5 ft stroke) is reached during driving and the pile tip is at or below the minimum tip elevation.

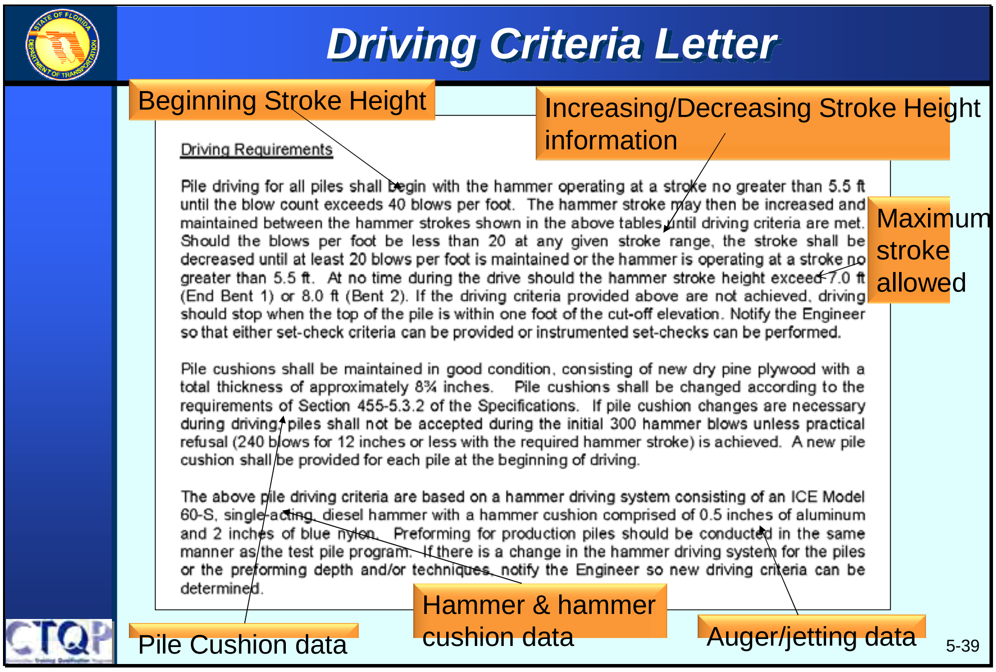
2. The required blow count at the respective stroke is achieved for two consecutive feet and the pile tip is at or below the minimum tip elevation. The blows per foot required for the respective strokes are as follows:

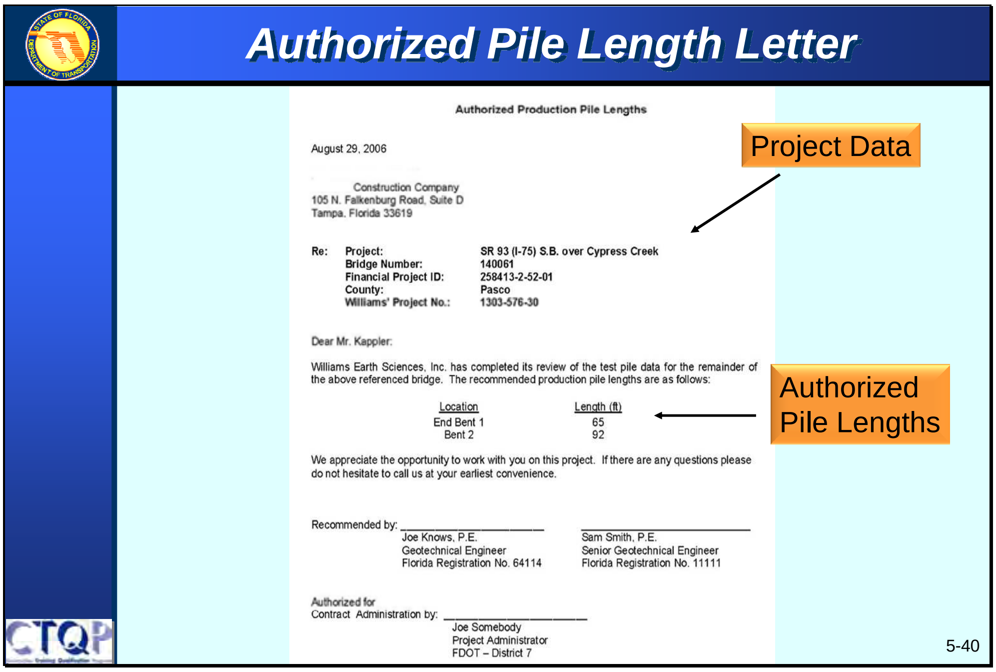
	Blows per foot	
Stroke (ft)	Pile Tip Above Elevation +4 ft	Pile Tip At or Below Elevation +4 ft
5.5	77	52
6.0	67	42
6.5	61	36


Driving Criteria Letter
Recommended Driving Criteria
August 29, 2006
Construction Company
105 N. Falkenburg Road, Suite D
Tampa, Florida 33619
Project Data
Re: Project: SR 93 (I-75) S.B. over Cypress Creek
Bridge Number: 140061
Financial Project ID: 258413-2-52-01
County: Pasco
Williams' Project No.: 1303-576-30
CTQP
5-36


Driving Criteria Letter
Bents
End Bent 1
Practical Refusal
Required Minimum Penetration
Pile driving of the 65 foot, 250 kips Ultimate Bearing Capacity (UBC) production piles may be stopped if one of the following conditions is met:
1. Practical Refusal (20 blows per inch with at least a 5.5 ft stroke) is reached during driving and the pile tip is at or below the minimum tip elevation.
2. The required blow count at the respective stroke is achieved for two consecutive feet and the pile tip is at or below the minimum tip elevation. The blows per foot required for the respective strokes are as follows:
Stroke Height – vs- Blowcount
Blows per foot
Stroke (ft) | Pile Tip Above Elevation +4 ft | Pile Tip At or Below Elevation +4 ft
5.5 | 77 | 52
6.0 | 67 | 42
6.5 | 61 | 36
5-37


Driving Criteria Letter
Bents
Bent 2
Practical Refusal
Pile driving of the 100 foot, 314 kips Ultimate Bearing Capacity (UBC) production piles may be stopped if one of the following conditions is met:
1. Practical Refusal (20 blows per inch with at least a 6.5 ft stroke) is reached during driving and the pile tip is at or below the minimum tip elevation.
2. The required blow count at the respective stroke is achieved for two consecutive feet and the pile tip is at or below the minimum tip elevation. The blows per foot required for the respective strokes are as follows:
Required Minimum Penetration
Stroke Height – vs- Blowcount
Blows per foot
Stroke (ft) | Pile Tip Above Elevation -22 ft | Pile Tip At or Below Elevation -22 ft
6.5 | 68 | 48
7.0 | 60 | 40
7.5 | 56 | 36
5-38


Driving Criteria Letter
Beginning Stroke Height
Increasing/Decreasing Stroke Height information
Maximum stroke allowed
Driving Requirements
Pile driving for all piles shall begin with the hammer operating at a stroke no greater than 5.5 ft until the blow count exceeds 40 blows per foot. The hammer stroke may then be increased and maintained between the hammer strokes shown in the above tables until driving criteria are met. Should the blows per foot be less than 20 at any given stroke range, the stroke shall be decreased until at least 20 blows per foot is maintained or the hammer is operating at a stroke no greater than 5.5 ft. At no time during the drive should the hammer stroke height exceed 7.0 ft (End Bent 1) or 8.0 ft (Bent 2). If the driving criteria provided above are not achieved, driving should stop when the top of the pile is within one foot of the cut-off elevation. Notify the Engineer so that either set-check criteria can be provided or instrumented set-checks can be performed.
Pile cushions shall be maintained in good condition, consisting of new dry pine plywood with a total thickness of approximately 8¾ inches. Pile cushions shall be changed according to the requirements of Section 455-5.3.2 of the Specifications. If pile cushion changes are necessary during driving, piles shall not be accepted during the initial 300 hammer blows unless practical refusal (240 blows for 12 inches or less with the required hammer stroke) is achieved. A new pile cushion shall be provided for each pile at the beginning of driving.
The above pile driving criteria are based on a hammer driving system consisting of an ICE Model 60-S, single-acting, diesel hammer with a hammer cushion comprised of 0.5 inches of aluminum and 2 inches of blue nylon. Preforming for production piles should be conducted in the same manner as the test pile program. If there is a change in the hammer driving system for the piles or the preforming depth and/or techniques, notify the Engineer so new driving criteria can be determined.
Pile Cushion data
Hammer & hammer cushion data
Auger/jetting data
5-39


Authorized Pile Length Letter
Authorized Production Pile Lengths
August 29, 2006
Construction Company
105 N. Falkenburg Road, Suite D
Tampa, Florida 33619
Re: Project: SR 93 (I-75) S.B. over Cypress Creek
Bridge Number: 140061
Financial Project ID: 258413-2-52-01
County: Pasco
Williams' Project No.: 1303-576-30
Dear Mr. Kappler:
Williams Earth Sciences, Inc. has completed its review of the test pile data for the remainder of the above referenced bridge. The recommended production pile lengths are as follows:
Location Length (ft)
End Bent 1 65
Bent 2 92
We appreciate the opportunity to work with you on this project. If there are any questions please do not hesitate to call us at your earliest convenience.
Recommended by:
Joe Knows, P.E.
Geotechnical Engineer
Florida Registration No. 64114
Sam Smith, P.E.
Senior Geotechnical Engineer
Florida Registration No. 11111
Authorized for
Contract Administration by:
Joe Somebody
Project Administrator
FDOT – District 7
Project Data
Authorized Pile Lengths
CTQP
5-40

Learning Outcome

Depth/Ft.	Stroke Height/Ft.	Blows/ Ft.
19-20	6.5	83
20-21	7.0	95
21-22	7.0	89
22-23	7.5	79
23-24	7.5	86
24-25	7.6	86

Did we meet the Stroke vs. Blows for 2 consecutive feet?

Where?

The required blowcount versus its respective stroke is achieved for two consecutive feet, and the pile tip is at or below the minimum tip elevation of −1.0 foot as specified in the plans. The blow counts per foot required for respective stroke heights are as follows:

Stroke (ft)	Blows/foot
7.0	94
7.5	83
8.0	71
9.0	63

5-41

455-5.14 Pile Lengths

455-5.14.1 Test Pile Length: Provide the length of test piles shown in the plans or as directed by the Engineer.

455-5.14.2 Production Pile Length: When shown in the plans, the lengths are based on information available during design and are approximate only. The Engineer will determine final pile lengths in the field which may vary significantly from the lengths or quantities shown in the plans.

5-42

455-5.14 Pile Lengths

455-5.14.3 Authorized Pile Lengths: The authorized pile lengths are the lengths determined by the Engineer based on all information available before the driving of the permanent piles, including, but not limited to, information gained from the driving of test piles, dynamic load testing, static load testing, supplemental soil testing, etc. When authorized by the Department, soil freeze information obtained during set checks and pile redrives may be used to determine authorized pile lengths for sites with extreme soil conditions. ….

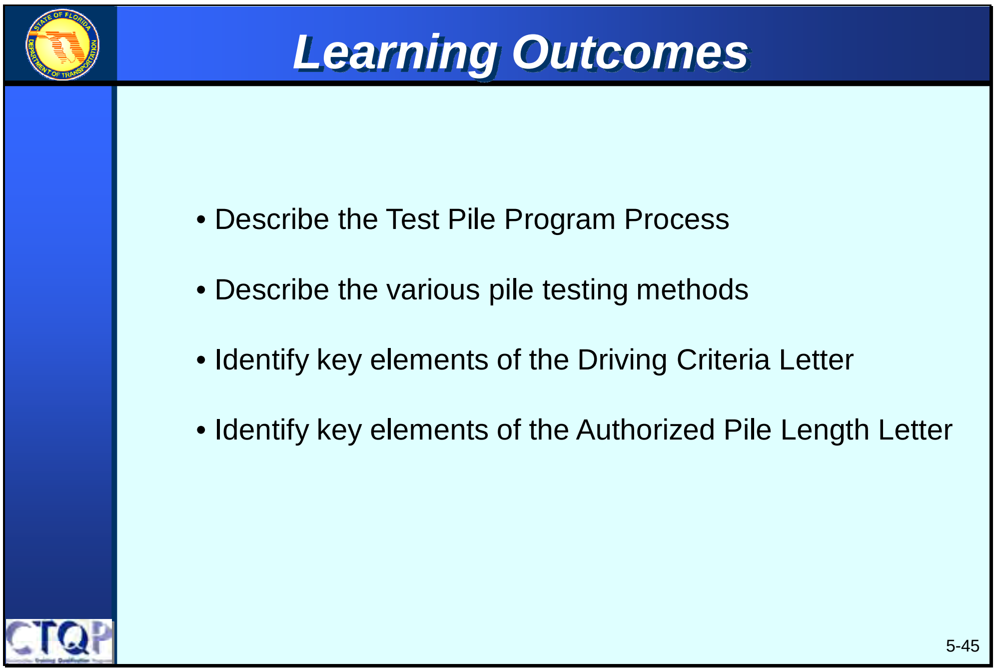
5-43

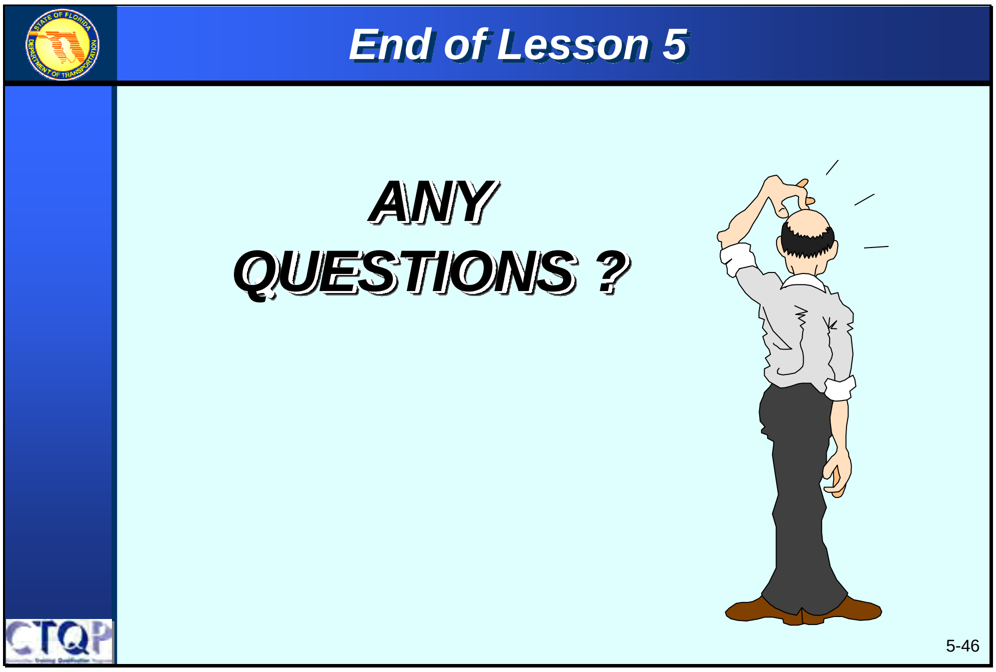
455-5.14 Pile Lengths

455-5.14.3 Authorized Pile Lengths: (Continued)

…. The Contractor may elect to provide piling with lengths longer than authorized to suit his method of installation or schedule. When the Contractor elects to provide longer than authorized pile lengths, the Department will pay for the furnished length as either the originally authorized length or the length between cut-off elevation and the final accepted pile tip elevation, whichever is the longer length.

5-44


Learning Outcomes
• Describe the Test Pile Program Process
• Describe the various pile testing methods
• Identify key elements of the Driving Criteria Letter
• Identify key elements of the Authorized Pile Length Letter
CTQP
5-45


End of Lesson 5
ANY
QUESTIONS ?
5-46

PILE INSPECTOR'S CHECKLIST

The following is a general checklist to follow when driving a Pile. The answer to each of these, if applicable, should "yes" unless plans, specifications, or specific approval has been given otherwise. CONSULT WITH THE RESPONSIBLE PROJECT ADMINISTRATOR FOR YOUR SPECIFIC PROJECT RESPONSIBILITIES.

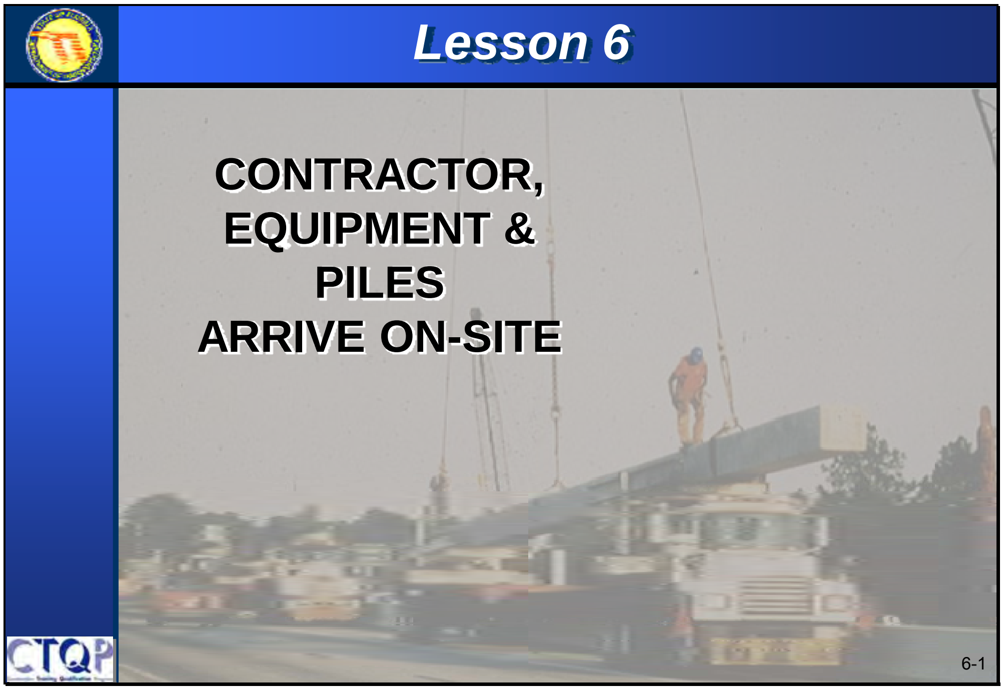
EARLY REQUIREMENTS	Yes	No	NA
1. Do you have a copy of the Plans including latest revisions & located relevant items? (ex: Pile Date Table)	1	1	
2. Do you have and reviewed the accepted Pile Installation Plan?	2	2	
3. Are Dynamic Load Tests required and if so, is the PDA Engineer coordinated with?	3	3	
4. Do you have the current version of the FDOT Pile Driving Record form?	4	4	
5. Have you setup Structure Files and Bent/Pier Models in the program?	5	5	
6. Have you made the Initial Pile Data entries and Standard Notes entries in the program?	6	6	
7. Have you scheduled or attended a Pre-Driving meeting with the PA/Geotechnical Engineer?	7	7	
TEST PILE PROGRAM			
8. Has the Contractor met the requirements of 455-1.1, Protection of Existing Structures (or new 108)?	8	8	
9. Has the site preparation been completed for footings/excavations/abutments in accordance with 455-1.2 & 455-1.2.1?	9	9	
10. Have the requirements of 455-1.4, Vibrations of Freshly Placed Concrete been met?	10	10	
11. If a Cofferdam is required, does the Contractor have a qualified diver and safety diver for inspections in accordance with 455-1.3, Cofferdams?	11	11	
12. If underwater diving is required, are the divers equipped with voice communications, per 455-1.3, Cofferdams?	12	12	
13. Does the Contractor have the hammer equipment indicated in the Pile Installation Plan on-site?	13	13	
a. CLOSED END DIESEL HAMMER			
- Does the hammer have at least three fuel settings for the rebound stroke? (455-5.2.2)	A1	A1	
- Does the Contractor have a Bounce Chamber Pressure Gauge? (455-5.2.2)	A2	A2	
- Has the Bounce Chamber been calibrated within the last 30 days and a Chart provided? (455-5.2.2)	A3	A3	
b. OPEN END DIESEL HAMMER			
- Does the hammer have at least three fuel settings for the rebound stroke? (455-5.2.2)	B1	B1	
- Has the Contractor provided the hammer manufacturer's chart equating stroke and blows per minute? (455-5.2.2)	B2	B2	
- Has the Contractor provided an approved device automatically determine and display ram stroke? (455-5.2.2)	B3	B3	
c. AIR/STEAM HAMMER			
- Does the air plant have gauges that are easy to read? (455-5.2.1)	C1	C1	
- Does the hammer have a slide bar capable of a minimum of two stroke height settings? (455-5.2.1)	C2	C2	
d. HYDRAULIC HAMMER			
- Does the hammer have at least three settings for reduced stroke height? (455-5.2.3)	D1	D1	
- Has pressure measuring equipment been calibrated? (455-5.2.3)	D2	D2	
- Have you been provided a means to determine hammer energy? (455-5.3.1)	D3	D3	
14. Is the cap-block (hammer cushion) in good condition? (455-5.3.1)	14	14	
15. Does the cap-block (hammer cushion) match the Contractor's submittal (type, size, thickness, etc.)? (455-5.3.1)	15	15	
16. Is the pile cushion new? (455-5.3.2)	16	16	
17. Does the pile cushion match the Contractor's submittal (type, size, thickness)? (455-5.3.2)	17	17	
18. Does the pile helmet meet the requirements of 455-5.3.3?	18	18	
19. If required, does the template meet the requirements of 455-5.6?	19	19	
20. Has the Contractor furnished elevations per 455-5.6?	20	20	
21. Is a jet pump at the site, ready for use and of the proper size? (455-5.7)	21	21	
22. If Predrilling or Preforming to be done, does the drill meet the requirements of 455-5.1.1 and 455-5.9?	22	22	
23. Do the leads match the Contractor's submittal and meet the requirements of 455-5.4?	23	23	
24. Has the proper type, size, and length of pile and applicable pile documentation been provided?	24	24	
25. Have you inspected the pile for defects and if observed document and modify the PA?	25	25	
26. Has the Contractor marked the pile in the applicable increments?	26	26	
27. Is the test pile located per the plans and meet the requirements of 455-5.15.2?	27	27	
28. Does the pile meet the axial alignment of 455.5.15.3?	28	28	
29. Have you indicated this is a Test Pile in the Pile Driving Record?	29	29	
30. If applicable, have you indicated the pile has EDCs installed in the Pile Driving Record?	30	30	
31. Have you recorded the driving event in the Pile Driving Record?	31	31	

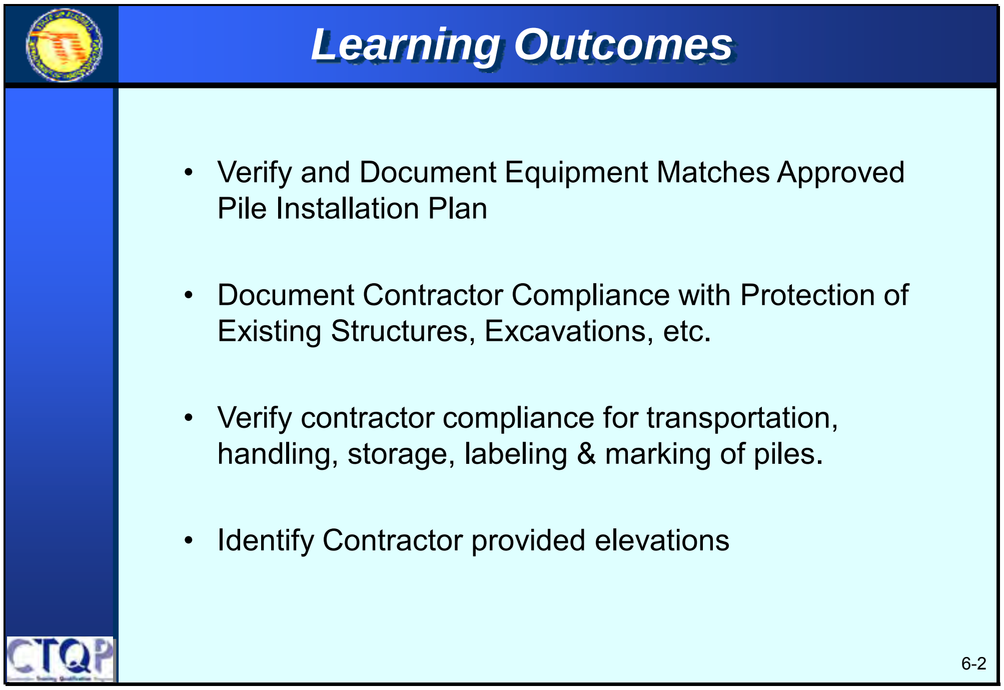
PILE INSPECTOR'S CHECKLIST- PAGE 2

PRODUCTION PILE DRIVING	Yes	No	NA
32. Do you have the Driving Criteria Letter?	32	32	
33. If concrete piles, do you have the authorized Production Pile Lengths Letter?	33	33	
34. Do you have the Accepted Pile Installation Plan?	34	34	
35. Has the Contractor met the requirements for Protection of Existing Structures? (455-1.1 or new 108)	35	35	
36. Has the site preparation been completed for footings/excavations/abutments in accordance with 455-1.2 & 455-1.2.1?	36	36	
37. Have the requirements of 455-1.4, Vibrations of Freshly Placed Concrete been met?	37	37	
38. If a cofferdam is required, have the requirements of 455-1.3, Cofferdams, been met?	38	38	
39. Have you inspected the piles of damage, and if observed, document same and notified the PA? (455-6,7,8,9)	39	39	
40. Does the Contractor's equipment match the accepted Pile Installation Plan or revised Plan from the Test Pile Program?	40	40	
a. cranes			
b. barges			
c. hammer system, including:			
-model, type, serial number			
-capblock cushion type, thickness			
-capblock dimensions, inserts, striker plates			
-variable energy settings			
-hydraulic control indicator, fuel pump setting indicator			
-Saximeter			
-Pile cushion type, thickness			
-follower			
d. Leads			
e. Auger motor and flighting			
f. Auger leads			
g. Punches			
h. Jets and pump			
i. Templates			
-Does the template match the Contractor's submittal?			
-Has a reference been provide to enable determining pile penetration?			
-Can the pile be driven to the cutoff elevation without requiring movement of the template?			
41. Has the Contractor provided an elevation on the template for your use?	41	41	
42. If Predrilling or Preforming, has the Contractor met the plan requirements and you documented the same?	42	42	
43. If grouting of Preformed Pile Holes is required, has this been completed per 455-5.9.5?	43	43	
44. Has the Contractor marked the piles in the correct increments?	44	44	
45. Have you recorded the blows, stroke height/pressure, and applicable notes in the record or program?	45	45	
46. Did splicing of piles meet the requirements of 455-7.7 for concrete and 455-8.3 for steel?	46	46	
47. If specified, has the pile met any Minimum Tip Elevation requirements?	47	47	
48. If no Minimum Tip is specified, has the pile met the Penetration requirements of 455-5.8, Penetration?	48	48	
49. Has the pile met the driving criteria specified in the Driving Criteria Letter?	49	49	
50. Has the pile reached Practical Refusal? (455-5.10.3)	50	50	
51. Do you have a "Setcheck" Criteria?	51	51	
52. If "Setchecks" or "Redrives" are performed, were they documented?	52	52	
53. Have any of the piles "heaved"? (455-5.10.5)	53	53	
54. If so, were they redriven?	54	54	
POST INSTALLATION			
55. Has the Contractor met the tolerances required? (455-5.15, Allowable Tolerances)	55	55	
56. Has the Contractor initiated a plan to protect driven piles from fill placement operations? (455-10)	56	56	
57. Have you been provided the final post-driving elevations and entered them in the Pile Driving Record?	57	57	

Typical Saximeter Quick Reference Card

A. Start Up / Set Up [POWER] key
B. To change Owner Name, use process in G.3, G.4, G.5 and G.6.
C. Change Hammer Type (open ended diesel or other hammers).
    1) To change hammer type, place cursor on that line and press the Up Arrow [8] key (cursor is moved around the screen with the Down Arrow [9] key).
    2) To get to next screen press [ENTER] key.
D. Change Units (English or Metric).
    1) Move cursor to units line by using [9] key. When cursor is on unit line press [8] key and units will change. Also the Alt increment will change to match selected units.
    2) To get to next screen press [ENTER] key.
E. Change Pile Name (PN:)
F. Change Hammer Name (HN:)
G. Change Project Name (PJ:)
    1) Move cursor to desired line with [9] key.
    2) To type pile, hammer and project name, use Alpha-numeric keys to do so.
    3) Each Alpha-numeric key is capable of up to 4 different characters as shown on the keys. Press the key repeatedly until the desired character is displayed. If the next desired character is on a different key, simply press the different key repeatedly until the correct character appears. Repeat as needed. If the next desired character is on the same key, press the [ENTER] key only once to move the cursor to the right. Then repeat above process.
    4) Use [9] key to move to next line. Repeat above process for other Alpha-numeric inputs on this screen or other screens.
    5) If you entered a wrong character use the [8] key to erase or the [CLEAR] key to erase the entire word.
    6) When finished with this screen, press [ENTER] two times to go to the next screen.
H. Measuring Stroke / Blows Per Minute / Blow Count
    1) The top line on the screen will display the average results of the previous penetration increments (from left to right): Last Average stroke "H" (open end diesels only), average "BPM", number of blows in last penetration increment "BN", and total number of blows on pile. For other hammers, stroke is not shown.
    2) The second line now displays the current stroke "H" (for open ended diesels), current "BPM", current blows in this penetration increment "BN" and the GAIN (microphone sensitivity). For other hammers, stroke information is not shown.
    3) The third line displays the "time" and "date" which can be changed with the [TIME] key. Enter time using 24 hour clock. Enter month in two digits (example: April is 04). At the end of the third and fourth line is the "PI" and "PEN". PI is the Penetration Increment. Press the [PI] key to change (example: for English you have a choice of PI = 1 or PI = 0.083 feet). PEN is the Pile Penetration below your reference point. Pile penetration is entered by pressing the [PEN] key, then enter numbers. The PEN is automatically updated every time the [AVG] key is pressed.
I. Average -- Press [AVG] key every time pile passes a foot mark and the "NOW" line will be averaged and displayed in the line above "LAST".
J. Pause Mode - To pause the unit, press the [MAN] key only once. To come out of pause mode, press [CLEAR] key only once.
K. Manual -- To manually count blows, press the [MAN] key twice. Press the [MAN] key each time the hammer strikes the pile.
L. Speed -- To adjust speed, press [SPEED] key and enter the maximum blows per minute of the hammer (as recommended by hammer manufacturer).
M. Gain -- The gain is the microphone sensitivity and can be adjusted anytime while in data mode by simply pressing the [8] or [9] keys. If you want the machine to set the gain automatically press the [GAIN] key. You will see "SA" on screen, this is auto gain.
N. Review -- Press the [REVIEW] key to review the driving data stored in memory.
O. Send -- Press the [SEND] key to send information to the computer with RS 232 port.
P. If the unit is in data mode and does not record impact noise for a period of time, it will ask for pile name "PN?" next to the input on the screen. Therefore, if you stop driving the pile immediately go to Pause Mode.


Lesson 6
CONTRACTOR, EQUIPMENT & PILES ARRIVE ON-SITE
CTQP
6-1


Learning Outcomes
• Verify and Document Equipment Matches Approved Pile Installation Plan
• Document Contractor Compliance with Protection of Existing Structures, Excavations, etc.
• Verify contractor compliance for transportation, handling, storage, labeling & marking of piles.
• Identify Contractor provided elevations
CTQP
6-2

455-1 General

455-1.1 Protection of Existing Structures: When the plans require excavations or foundation construction operations in close proximity to existing structures, take all reasonable precautions to prevent damage to such structures. The requirements described herein apply to all types of structures (on or off the right-of-way) that may be adversely affected by foundation construction operations (including phase construction) due to vibrations, ground loss, ground heave, or dewatering….

6-3

455-1 General

455-1.1 Protection of Existing Structures: (Continued)

…. Survey and monitor structures for settlement in a manner approved by the Engineer, recording elevations to 0.001 foot. Employ a qualified Specialty Engineer to inspect and document the condition of structures prior to and after construction of excavations and foundation construction. Inspect and monitor the following structures:

(1) As shown in the plans.
(2) …
(3) …
(4) within 200 feet of sheet pile installation and extraction operations

6-4

455-1 General

455-1.1 Protection of Existing Structures: (Continued)

(5) for projects with pile driving operations, inspect and document the condition of all structures within a distance, in feet, of pile driving operations equal to 0.25 times the square root of the impact hammer energy, in foot-pounds. Survey and monitor for settlement all structures within a distance, in feet, of pile driving operations equal to 0.5 times the square root of the impact hammer energy, in foot-pounds.

6-5

455-1 General

455-1.1 Protection of Existing Structures: (Continued)

Obtain the Engineer's approval of the number and location of monitoring points. Record elevations:
(1) before beginning construction,
(2) daily during the driving of any casings, piling, or sheeting,
(3) weekly for two weeks after stopping pile driving,
(4) during excavation,
(5) during blasting,
(6) or as directed by the Engineer.

6-6

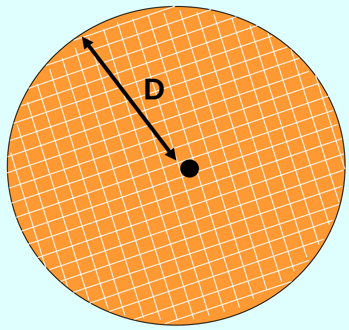
455-1 General

455-1.1 Protection of Existing Structures: (Continued)

…Notify the Engineer of any movements detected and immediately take any remedial measures required to prevent damage to the existing structures.

6-7

Distance for Monitoring Structures

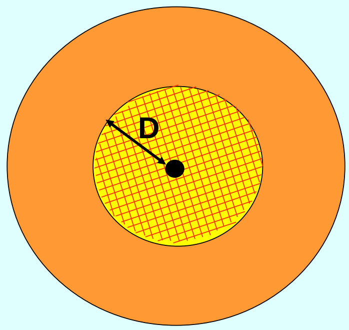


D: Distance from Pile to be monitored for settlement

English **D =** $0.5 \times \sqrt{\text{Hammer Energy (Ft-lbs.)}}$

6-8

Distance for Surveying Structures



Distance from Pile
to be inspected (D)

English **D =** $0.25 \times \sqrt{\text{Hammer Energy (Ft-lbs.)}}$

6-9

455-1 General

455-1.1 Protection of Existing Structures: (Continued)

The Department will make the necessary arrangements to provide right-of-way to the existing structures. Adequately document the condition of the structures and all existing cracks with descriptions and pictures. Prepare two reports documenting the condition of the structures: one report before beginning foundation construction operations and a second report after completing foundation construction operations. The Department will take ownership of both reports. Do not perform pre-driving and post-driving surveys of the condition of bridges owned by the Department except when shown in the Contract Documents.

6-10

455-1 General

455-1.1 Protection of Existing Structures: (Continued)

…. When shown in the Contract Documents, employ a qualified Specialty Engineer to monitor and record vibration levels during the driving of casings, piling, sheeting, or blasting operations. Provide vibration monitoring equipment capable of detecting velocities of 0.1 in/s or less….

6-11

455-1 General

455-1.1 Protection of Existing Structures: (Continued)

…. Upon detecting settlement or heave of 0.005 foot, vibration levels reaching 0.5 in/s, levels otherwise shown in the Contract Documents, or damage to the structure, immediately stop the source of vibrations, backfill any open drilled shaft excavations, and contact the Engineer for instructions.

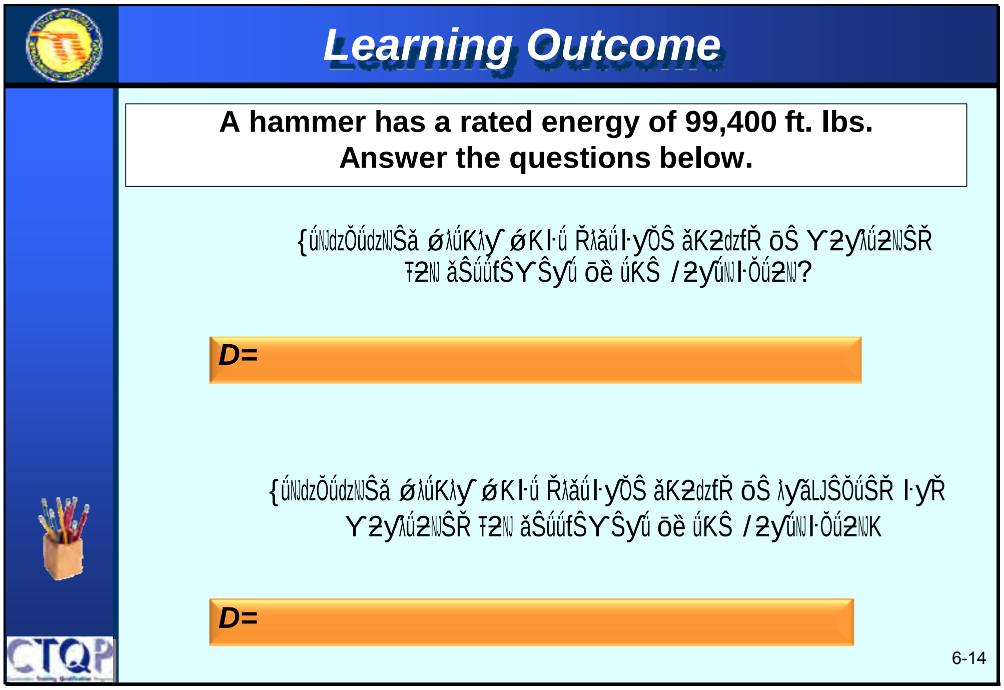
6-12

455-1 General

455-1.1 Protection of Existing Structures: (Continued)

…. When shown in the Contract Documents or when authorized by the Engineer, install the piling to the depth required to minimize the effects of vibrations or ground heave on adjacent structures by approved methods other than driving (preformed holes, predrilling, jetting, etc.). In the event the Department authorizes the use of preformed pile holes to meet this requirement, the Department will pay for this work as described in 455-5.9.3….

6-13


Learning Outcome
A hammer has a rated energy of 99,400 ft. lbs.
Answer the questions below.
D=
D=
CTQP
6-14

Learning Outcome

We are using a hammer with a rated hammer energy of 106,020 ft-lbs. Structures are located at the distances shown below. Which need to be monitored only and which surveyed and monitored?

² KλǑK ăűǈdzǑűdzǈŜă 𝔶ŜŜŘ ăŜűűťŜϒŜ𝔶ű ϒƻ𝔶λűƻǈλ𝔶Ǝ ƻ𝔶ťèK

Structure A	76 ft.
Structure B	140 ft.
Structure C	120 ft.
Structure D	80 ft.
Structure E	96 ft.

D for monitoring =
=

Which structures need both inspection and monitoring?

D for survey =
Therefore, the answer is:

6-15

455-1.2 Excavation

455-1.2 Excavation: Complete all excavation of the foundations prior to installing piles or shafts unless otherwise authorized by the Engineer. After completing pile/shaft installation, remove all loose and displaced materials from around the piles/shafts, leaving a clean, solid surface

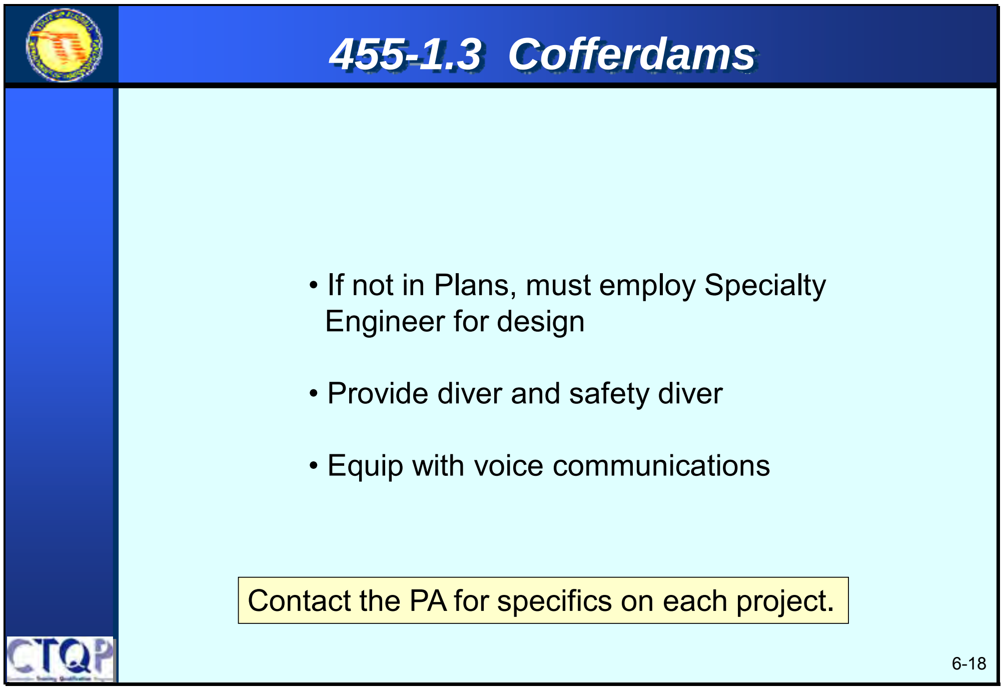
6-16

455-1.2.1 Abutment (End Bent) Fill

455-1.2.1 Abutment (End Bent) Fill: Place and compact the fill before installing end-bent piling/shafts, except when:
(1) driving specified test piling in end bents or,
(2) the plans show uncased piles through proprietary retaining wall fills.

When installing piles/shafts or casing prior to placing fill, take necessary precautions to prevent displacement of piles/shafts during placing and compacting fill materials within 15 feet of the piles/shafts or casing. Reference and check the position of the piles/shafts or casing at three approximately equal intervals during construction of the embankment.

6-17


455-1.3 Cofferdams
• If not in Plans, must employ Specialty Engineer for design
• Provide diver and safety diver
• Equip with voice communications
Contact the PA for specifics on each project.
6-18

455-1.3 Cofferdams

455-1.3 Cofferdams:

Construct cofferdams as detailed in the plans. When cofferdams are not detailed in the plans, employ a Specialty Engineer to design cofferdams, and to sign and seal the plans and specification requirements. Send the designs to the Engineer for his records before beginning construction.

Contact the PA for specifics on each project.

6-19

455-1.3 Cofferdams cont'd

Provide a qualified diver and a safety diver to inspect the conditions of the foundation enclosure or cofferdam when the Contract Documents require a seal for construction. Equip these divers with suitable voice communications, and have them inspect the foundation enclosure and cofferdam periphery including each sheeting indentation and around each piling or drilled shaft to ensure that no layers of mud or other undesirable materials were left above the bottom of seal elevation during the excavation process. Also have the divers check to make sure the surfaces of the piles or drilled shafts are sufficiently clean to allow bond of the concrete down to the minimum bottom of seal elevation.

Contact the PA for specifics on each project.

6-20

455-1.3 Cofferdams cont'd

When required, ensure that there are no mounds of stone, shell, or other authorized backfill material left after placement and grading. Assist the Engineer as required to ensure that the seal is placed as specified and evaluate the adequacy of the foundation soils or rock. Correct any deficiencies found by the divers. Upon completion of inspection by the divers, the Department may also elect to inspect the work before authorizing the Contractor to proceed with subsequent construction operations. Furnish the Engineer a written report by the divers indicating the results of their underwater inspection before requesting authorization to place the seal concrete.

Contact the PA for specifics on each project.

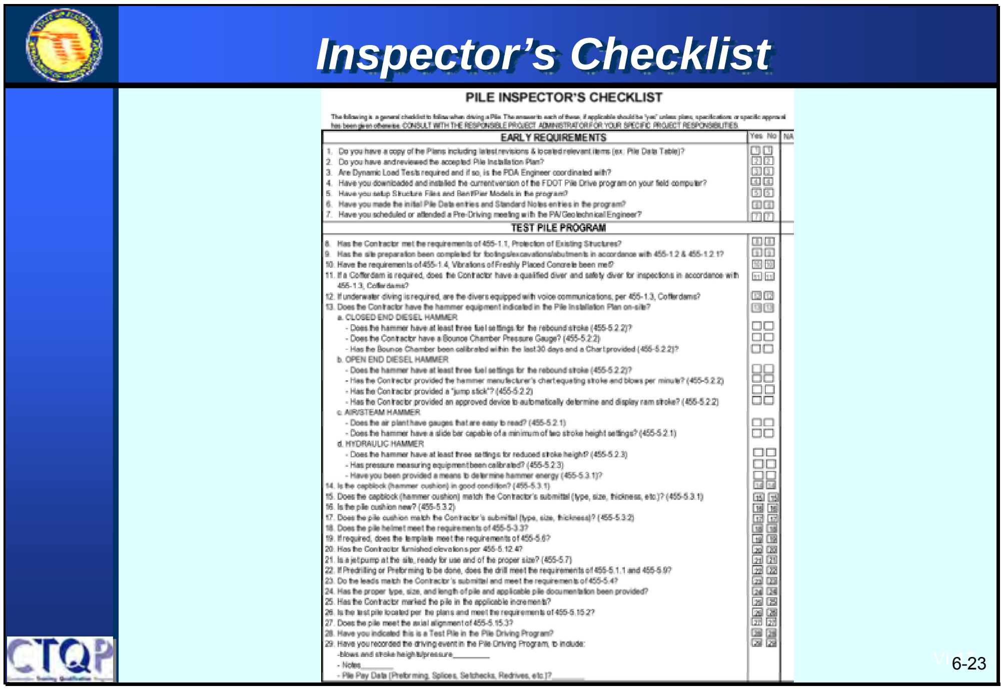
6-21

Inspector Responsibility

VERIFYING,

DOCUMENTING

6-22



PILE INSPECTOR'S CHECKLIST

The following is a general checklist to follow when driving a Pile. The answer to each of these, if applicable should be "yes" unless plans, specifications or specific approval has been given otherwise. CONSULT WITH THE RESPONSIBLE PROJECT ADMINISTRATOR FOR YOUR SPECIFIC PROJECT RESPONSIBILITIES.

EARLY REQUIREMENTS	Yes	No	NA
1. Do you have a copy of the Plans including latest revisions & located relevant items (ex: Pile Data Table)?	1	1	
2. Do you have and reviewed the accepted Pile Installation Plan?	2	2	
3. Are Dynamic Load Tests required and if so, is the PDA Engineer coordinated with?	3	3	
4. Have you downloaded and installed the current version of the FDOT Pile Drive program on your field computer?	4	4	
5. Have you setup Structure Files and Bent/Pier Models in the program?	5	5	
6. Have you made the initial Pile Data entries and Standard Notes entries in the program?	6	6	
7. Have you scheduled or attended a Pre-Driving meeting with the PA/Geotechnical Engineer?	7	7	
TEST PILE PROGRAM			
8. Has the Contractor met the requirements of 455-1.1, Protection of Existing Structures?	8	8	
9. Has the site preparation been completed for footings/excavations/abutments in accordance with 455-1.2 & 455-1.2.1?	9	9	
10. Have the requirements of 455-1.4, Vibrations of Freshly Placed Concrete been met?	10	10	
11. If a Cofferdam is required, does the Contractor have a qualified diver and safety diver for inspections in accordance with 455-1.3, Cofferdams?	11	11	
12. If underwater diving is required, are the divers equipped with voice communications, per 455-1.3, Cofferdams?	12	12	
13. Does the Contractor have the hammer equipment indicated in the Pile Installation Plan on-site?	13	13	
a. CLOSED END DIESEL HAMMER			
- Does the hammer have at least three fuel settings for the rebound stroke (455-5.2.2)?	☐	☐	
- Does the Contractor have a Bounce Chamber Pressure Gauge? (455-5.2.2)	☐	☐	
- Has the Bounce Chamber been calibrated within the last 30 days and a Chart provided (455-5.2.2)?	☐	☐	
b. OPEN END DIESEL HAMMER			
- Does the hammer have at least three fuel settings for the rebound stroke (455-5.2.2)?	☐	☐	
- Has the Contractor provided the hammer manufacturer's chart equating stroke and blows per minute? (455-5.2.2)	☐	☐	
- Has the Contractor provided a "jump stick"? (455-5.2.2)	☐	☐	
- Has the Contractor provided an approved device to automatically determine and display ram stroke? (455-5.2.2)	☐	☐	
c. AIR/STEAM HAMMER			
- Does the air plant have gauges that are easy to read? (455-5.2.1)	☐	☐	
- Does the hammer have a slide bar capable of a minimum of two stroke height settings? (455-5.2.1)	☐	☐	
d. HYDRAULIC HAMMER			
- Does the hammer have at least three settings for reduced stroke height? (455-5.2.3)	☐	☐	
- Has pressure measuring equipment been calibrated? (455-5.2.3)	☐	☐	
- Have you been provided a means to determine hammer energy (455-5.3.1)?	☐	☐	
14. Is the capblock (hammer cushion) in good condition? (455-5.3.1)	14	14	
15. Does the capblock (hammer cushion) match the Contractor's submittal (type, size, thickness, etc)? (455-5.3.1)	15	15	
16. Is the pile cushion new? (455-5.3.2)	16	16	
17. Does the pile cushion match the Contractor's submittal (type, size, thickness)? (455-5.3.2)	17	17	
18. Does the pile helmet meet the requirements of 455-5-3.3?	18	18	
19. If required, does the template meet the requirements of 455-5.6?	19	19	
20. Has the Contractor furnished elevations per 455-5.12.4?	20	20	
21. Is a jet pump at the site, ready for use and of the proper size? (455-5.7)	21	21	
22. If Predrilling or Preforming to be done, does the drill meet the requirements of 455-5.1.1 and 455-5.9?	22	22	
23. Do the leads match the Contractor's submittal and meet the requirements of 455-5.4?	23	23	
24. Has the proper type, size, and length of pile and applicable pile documentation been provided?	24	24	
25. Has the Contractor marked the pile in the applicable increments?	25	25	
26. Is the test pile located per the plans and meet the requirements of 455-5.15.2?	26	26	
27. Does the pile meet the axial alignment of 455-5.15.3?	27	27	
28. Have you indicated this is a Test Pile in the Pile Driving Program?	28	28	
29. Have you recorded the driving event in the Pile Driving Program, to include: -blows and stroke height/pressure________ - Notes________ - Pile Pay Data (Preforming, Splices, Setchecks, Redrives, etc.)?________	29	29	

Checking Equipment

- **Equipment**
- Delivery, Handling & Storage of Piles
- Marking & Location of Piles
- Templates
- Reference Points/Elevations
- Jetting/Preformed Holes
- Splices
- Pile Driving Operations

6-24

Check Hammer

Check Hammer

- Manufacturer
- Model
- Type
- Serial Number
- Energy Rating
- Ram Weight
- Ram Stroke

6-25

Checking Equipment

For air/steam or hydraulic hammer, is the power source correct?

Are calibrated gauges provided for reading pressures?

6-26

Checking Equipment

Typical control panel
On power source

6-27

Checking Equipment

For air/steam, is a slide bar for setting stroke height provided?

6-28

Checking Equipment

For closed end diesel hammers is a calibrated bounce chamber gauge provided?

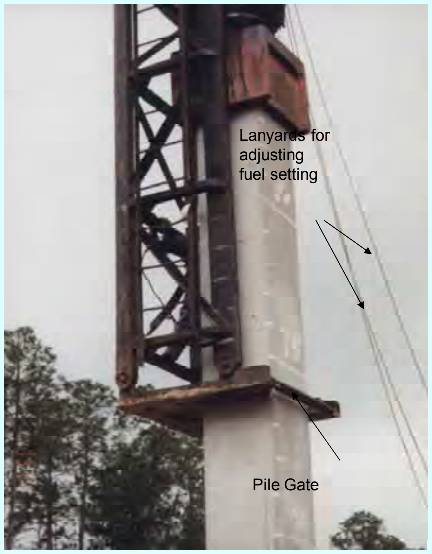
6-29

Check Leads

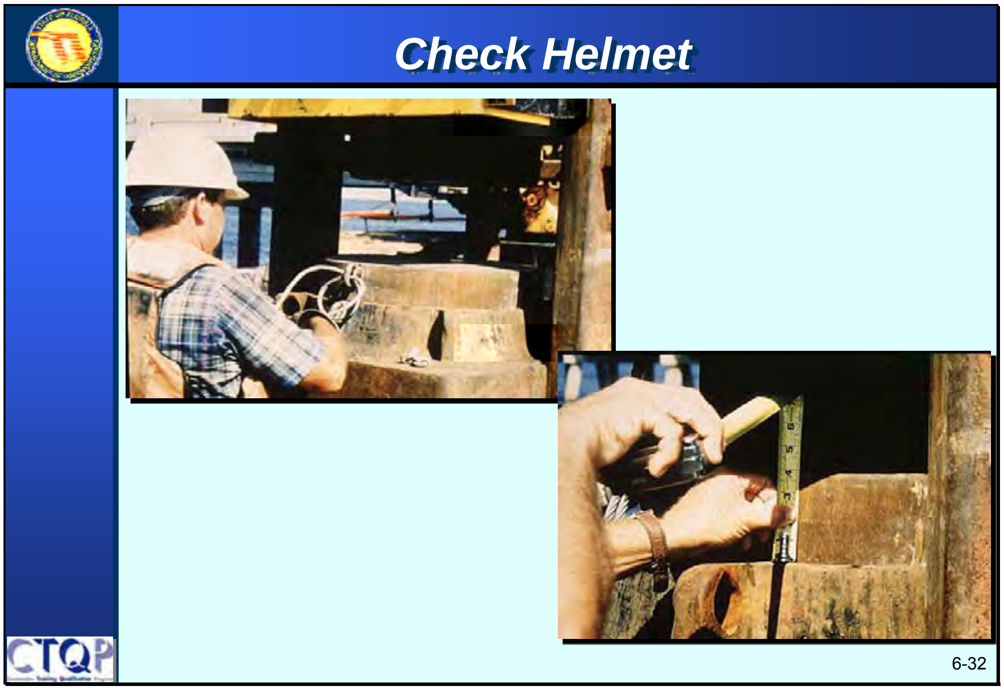
Are the leads the same as specified in the Pile Installation Plan ?

6-30

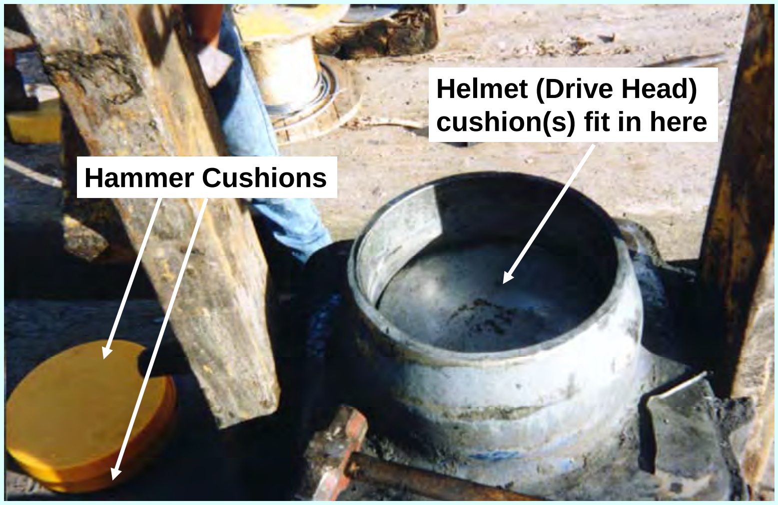
Check Leads



6-31


Check Helmet
CTQP
6-32

Check Hammer Cushions



6-33

Check Hammer Cushions

6-34

Check Hammer Cushions

6-35

Check Pile Cushions

6-36

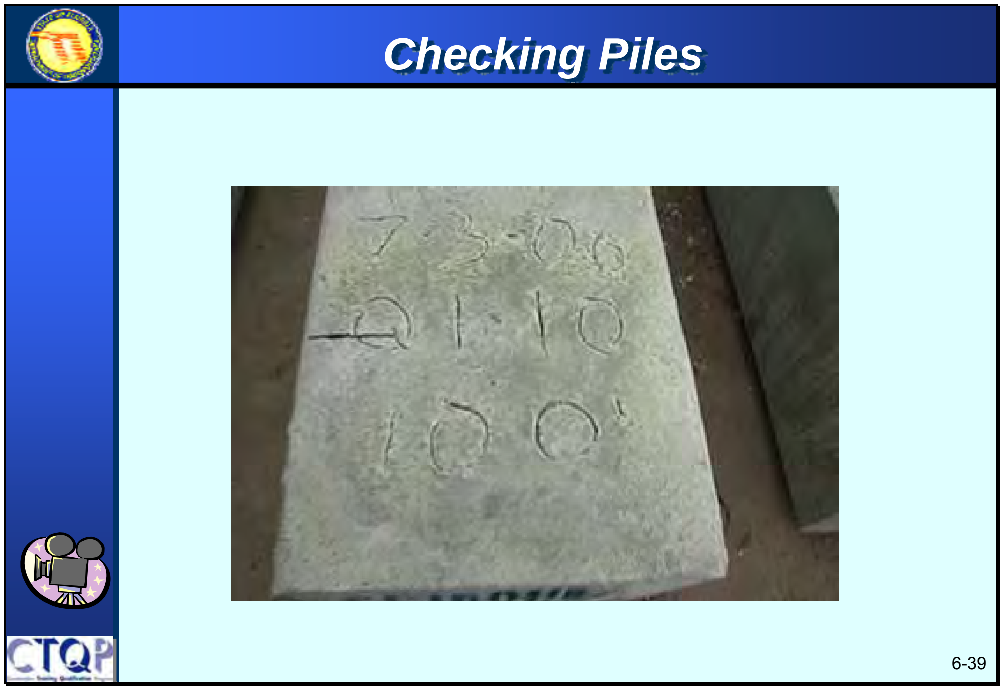
Check Pile Cushions

6-37

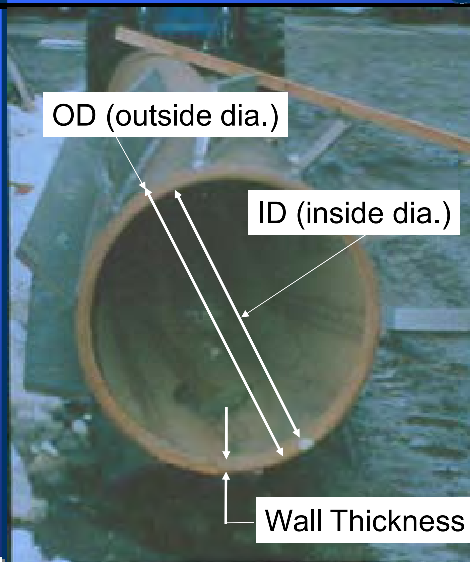
Checking Piles

- Equipment
- **Delivery, Handling & Storage of Piles**
- Marking & Location of Piles
- Templates
- Reference Points/Elevations
- Jetting/Preformed Holes
- Splices
- Pile Driving Operations

6-38


Checking Piles
7-3-06
21-10
100'
6-39

Checking Piles



Compare diameter, length and wall thickness to plan details.

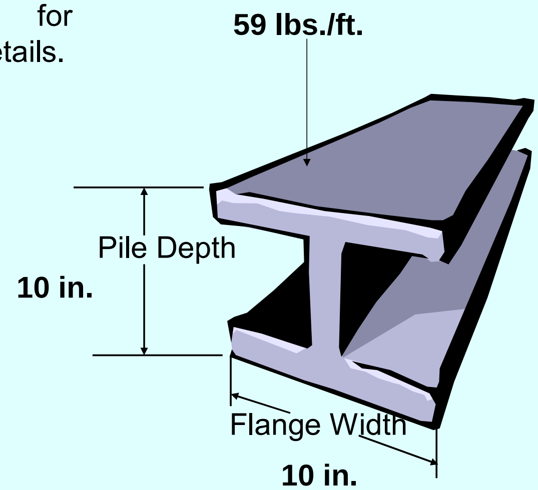
6-40


Piling Storage
CTQP
6-41

Checking Piles

Measure the Pile Depth and Flange Width for comparison to plan details.

10 X 59 =

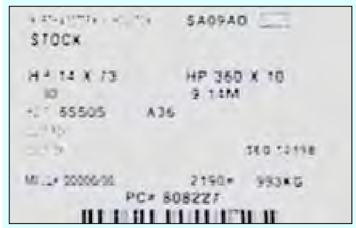


6-42

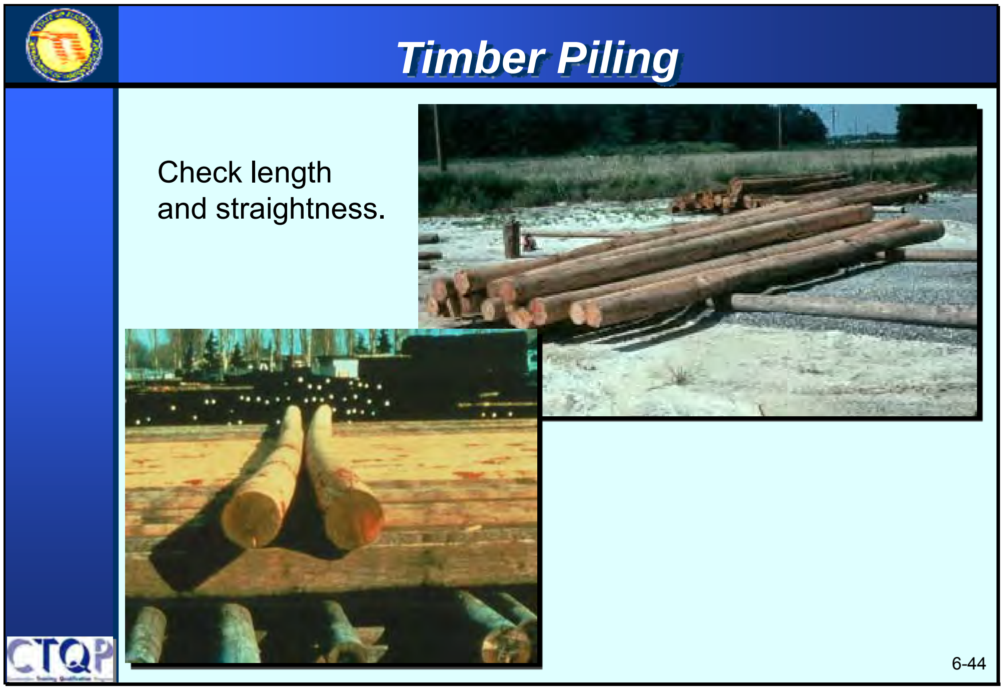
Checking Piles

Typical H Pile sizes include

HP	14x119	(360x114)
	14x102	(360x152)
	14x89	(360x132)
	14x73	(360x108)
	12x84	(310x125)
	12x74	(310x110)
	12x63	(310x93)
	12x53	(310x79)
	10x59	(250x62)
	10x42	(250x62)
	8x36	(200x53)



6-43


Timber Piling
Check length
and straightness.
6-44

Timber Piling

455-6.2 Materials:
Meet the timber piling requirements of Section 953. Treat the piles according to the applicable provisions of Section 955. Treat all cuts and drilled holes in accordance with 470-3.

Physical details for round timber piles are sometimes referred to in the ASTM pile specification, ASTM D25. Regardless of the referenced specifications, the following items should be checked for compliance:

6-45

Timber Piling cont'd

a. The timber should be of the specified species.
b. The piles should have the specified minimum length, and have the correct pile toe and butt sizes. The pile butt must be cut squarely with the pile axis.
c. The twist of spiral grain and the number and distribution of knots should be acceptable.
d. The piles should be acceptably straight.
e. The piles must be pressure treated as specified.
f. The pile butts and/or toe may require banding per the specifications.
g. Steel shoes which may be specified must be properly attached.

6-46

455-7 Prestressed Concrete Piling

455-7.3 Storage and Handling:

455-7.3.1 Time of Driving Piles: Drive prestressed concrete piles at any time after the concrete has been cured in accordance with Section 450, and the concrete compressive strength is equal to or greater than the specified 28 day compressive strength.

455-7.3.2 Storage: Support piles on adequate dunnage both in the prestress yard and at the job site in accordance with the locations shown in the Standard Indexes to minimize undue bending stresses or creating a sweep or camber in the pile.

6-47

Piling Storage

6-48

455-7 Prestressed Concrete Piling

455-7.3.3 Handling: Handle and store piles in the manner necessary to eliminate the danger of fracture by impact or of undue bending stresses in handling or transporting the piles from the forms and into the leads. In general, lift concrete piles by means of a suitable bridge or slings attached to the pile at the locations shown in the Standard Indexes. Construct slings used to handle piles of a fabric material or braided wire rope constructed of six or more wire ropes which will not mar the corners or the surface finish of the piles. Do not use chains to handle piles ….

6-49

455-7 Prestressed Concrete Piling

455-7.3.3 Handling:

…. During transport, support concrete piles at the lifting locations shown in the Standard Indexes or fully support them throughout 80% or more of their length. In handling piles for use in salty or brackish water, exercise special care to avoid damaging the surface and corners of the pile. If an alternate transportation support arrangement is desired, submit calculations, signed and sealed by the Specialty Engineer, for approval by the Engineer prior to transporting the pile. Calculations must show that the pile can be transported without exceeding the bending moments calculated using the support locations shown in the plans….

6-50

455-7 Prestressed Concrete Piling

455-7.4 Cracked Piles: The Engineer will reject any pile that becomes cracked in handling to the point that a transverse or longitudinal crack extends through the pile, shows failure of the concrete as indicated by spalling of concrete on the main body of the pile adjacent to the crack, or which in the opinion of the Engineer will not withstand driving stresses. The Engineer will not reject any pile for the occasional minor surface hairline cracking caused by shrinkage or tensile stress in the concrete from handling….

6-51

Cracked Piles

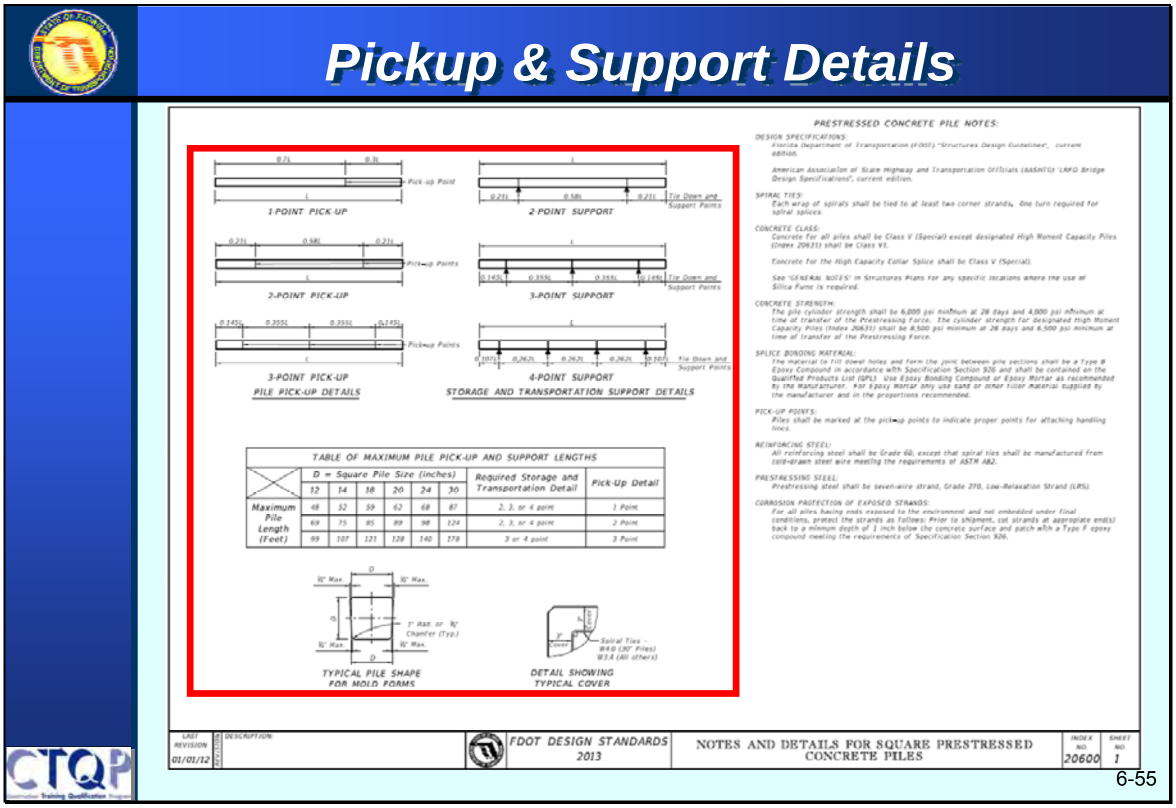
6-52

Two-Point Pick: Concrete Pile

6-53

Three-Point Pick: Concrete Pile

6-54



Pickup & Support Details

TABLE OF MAXIMUM PILE PICK-UP AND SUPPORT LENGTHS

	D = Square Pile Size (inches)						Required Storage and Transportation Detail	Pick-Up Detail
	12	14	18	20	24	30		
Maximum Pile Length (Feet)	48	52	59	62	68	87	2, 3, or 4 point	1 Point
	69	75	85	89	98	124	2, 3, or 4 point	2 Point
	99	107	121	128	140	178	3 or 4 point	3 Point

PRESTRESSED CONCRETE PILE NOTES:

DESIGN SPECIFICATIONS:
Florida Department of Transportation (FDOT) "Structures Design Guidelines", current edition.

American Association of State Highway and Transportation Officials (AASHTO) "LRFD Bridge Design Specifications", current edition.

SPIRAL TIES:
Each wrap of spirals shall be tied to at least two corner strands. One turn required for spiral splices.

CONCRETE CLASS:
Concrete for all piles shall be Class V (Special) except designated High Moment Capacity Piles (Index 20631) shall be Class VI.

Concrete for the High Capacity Collar Splice shall be Class V (Special).

See "GENERAL NOTES" in Structures Plans for any specific locations where the use of Silica Fume is required.

CONCRETE STRENGTH:
The pile cylinder strength shall be 6,000 psi minimum at 28 days and 4,000 psi minimum at time of transfer of the Prestressing Force. The cylinder strength for designated High Moment Capacity Piles (Index 20631) shall be 8,500 psi minimum at 28 days and 6,500 psi minimum at time of transfer of the Prestressing Force.

SPLICE BONDING MATERIAL:
The material to fill dowel holes and form the joint between pile sections shall be a Type B Epoxy Compound in accordance with Specification Section 926 and shall be contained on the Qualified Products List (QPL). Use Epoxy Bonding Compound or Epoxy Mortar as recommended by the Manufacturer. For Epoxy Mortar only use sand or other filler material supplied by the manufacturer and in the proportions recommended.

PICK-UP POINTS:
Piles shall be marked at the pick-up points to indicate proper points for attaching handling lines.

REINFORCING STEEL:
All reinforcing steel shall be Grade 60, except that spiral ties shall be manufactured from cold-drawn steel wire meeting the requirements of ASTM A82.

PRESTRESSING STEEL:
Prestressing steel shall be seven-wire strand, Grade 270, Low-Relaxation Strand (LRS).

CORROSION PROTECTION OF EXPOSED STRANDS:
For all piles having ends exposed to the environment and not embedded under final conditions, protect the strands as follows: Prior to shipment, cut strands at appropriate end(s) back to a minimum depth of 1 inch below the concrete surface and patch with a Type F epoxy compound meeting the requirements of Specification Section 926.

LAST REVISION	REVISION	DESCRIPTION:	FDOT DESIGN STANDARDS		INDEX NO.	SHEET NO.
01/01/12			2013	NOTES AND DETAILS FOR SQUARE PRESTRESSED CONCRETE PILES	20600	1

6-55

Pickup & Support Details

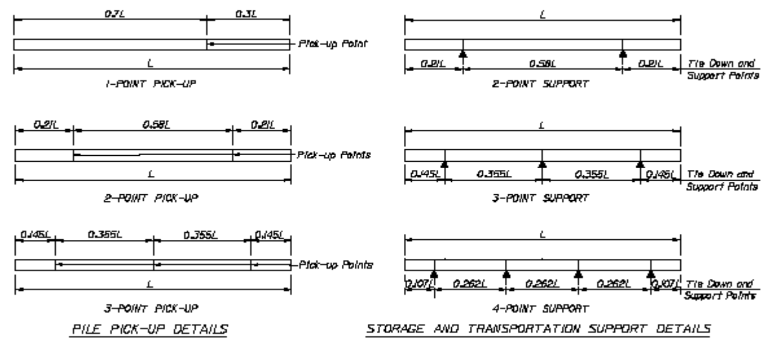
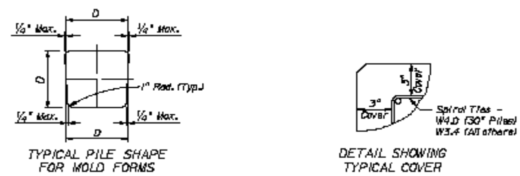
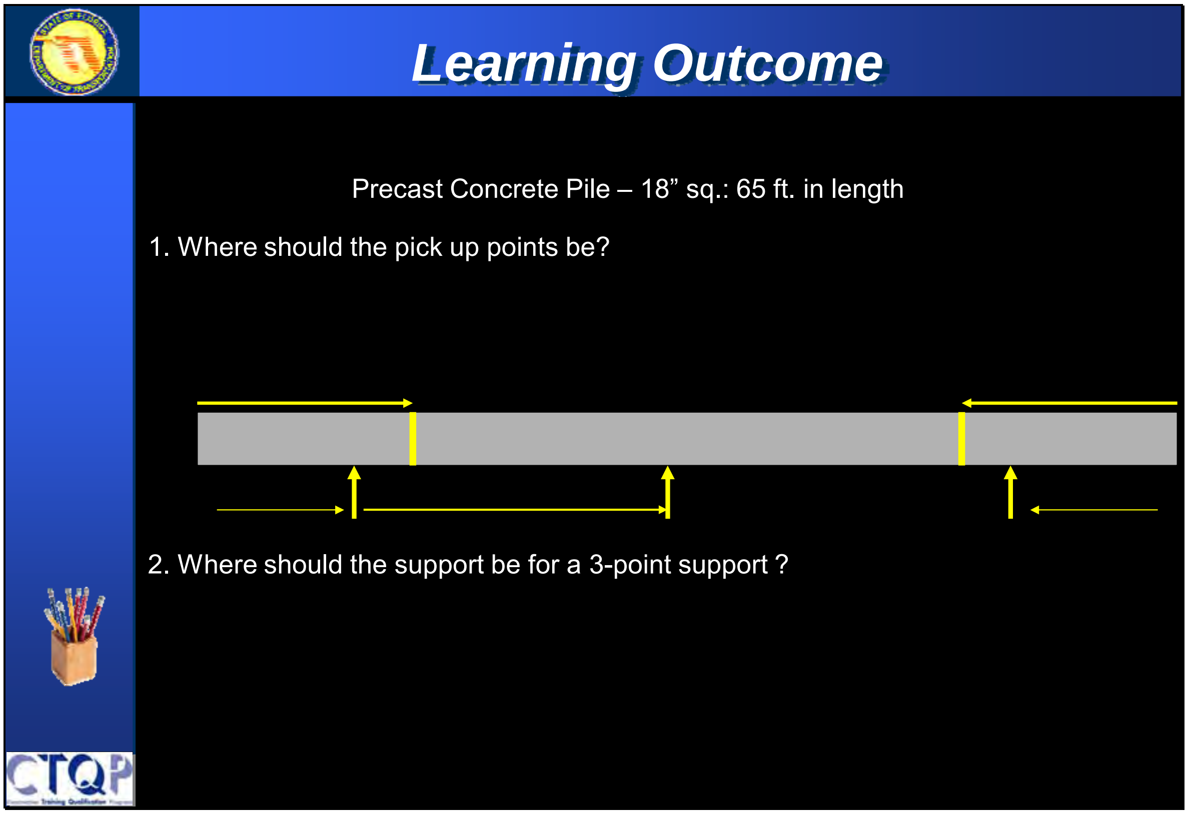


TABLE OF MAXIMUM PILE PICK-UP AND SUPPORT LENGTHS								
	D = Square Pile Size (Inches)						Required Storage and Transportation Detail	Pick-Up Detail
	12	14	18	20	24	30		
Maximum Pile Length (Feet)	48	52	59	62	68	87	2, 3, or 4 point	1 Point
	69	75	85	89	98	124	2, 3, or 4 point	2 Point
	99	107	121	128	140	178	3 or 4 point	3 Point



6-56


Learning Outcome
Precast Concrete Pile – 18” sq.: 65 ft. in length
1. Where should the pick up points be?
2. Where should the support be for a 3-point support ?

Checking Piles

6-58

455-7 Prestressed Concrete Piling

455-7.5 Preparation for Transportation: Cut any strands protruding beyond the ends of the pile flush with the surface of the concrete using an abrasive cutting blade before transporting the piles from the casting yard.

Cut and patch the metal lifting devices in accordance with 450-9.2.1.

6-59

455-7 Prestressed Concrete Piling

450-9.2.1 Inserts and Lifting Devices:
….
450-9.2.1.2 Corrosion Protection:

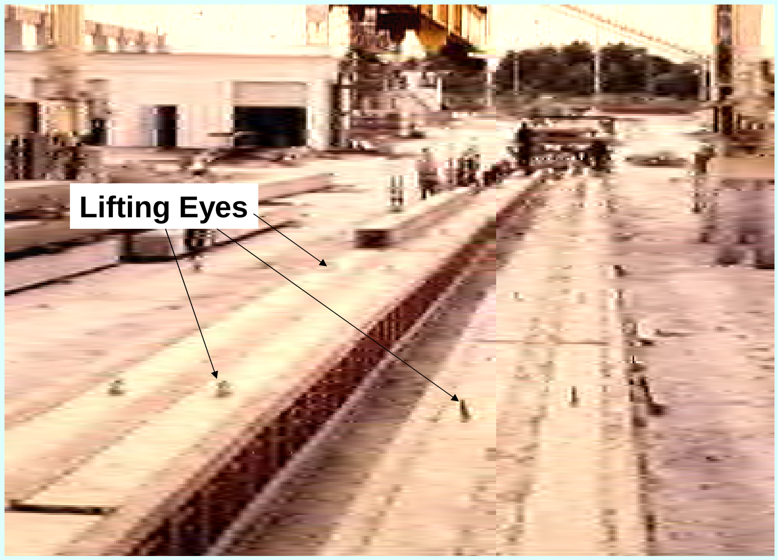
….After lifting operations using flush or protruding metal lifting devices are complete, cut the lifting devices back to a minimum depth of 1 inch below the concrete surface and patch with a Type F epoxy compound meeting the requirements of Section 926. For all square prestressed piling, concrete sheet piling and concrete poles, cut and patch lifting devices before transporting from the casting yard.

6-60

Checking Piles

6-61

Checking Piles



6-62

455-7 Prestressed Concrete Piling

455-7.6 Method of Driving: Unless otherwise directed, drive piles by a hammer or by means of a combination of water jets and hammer when jetting is allowed. When using jets in combination with a hammer, withdraw the jets and drive the pile by the hammer alone, to secure final penetration and to rigidly fix the tip end of the pile. Keep jets in place if they are being used to continuously eliminate the soil resistance in the scour zone.

6-63

Check Templates

6-64

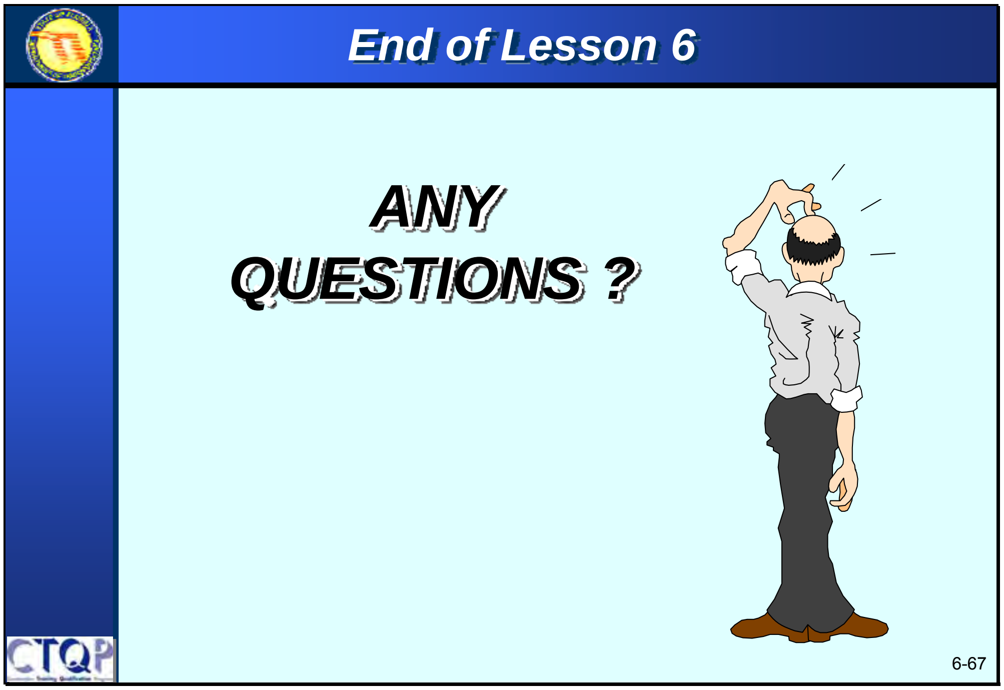
Document Elevations

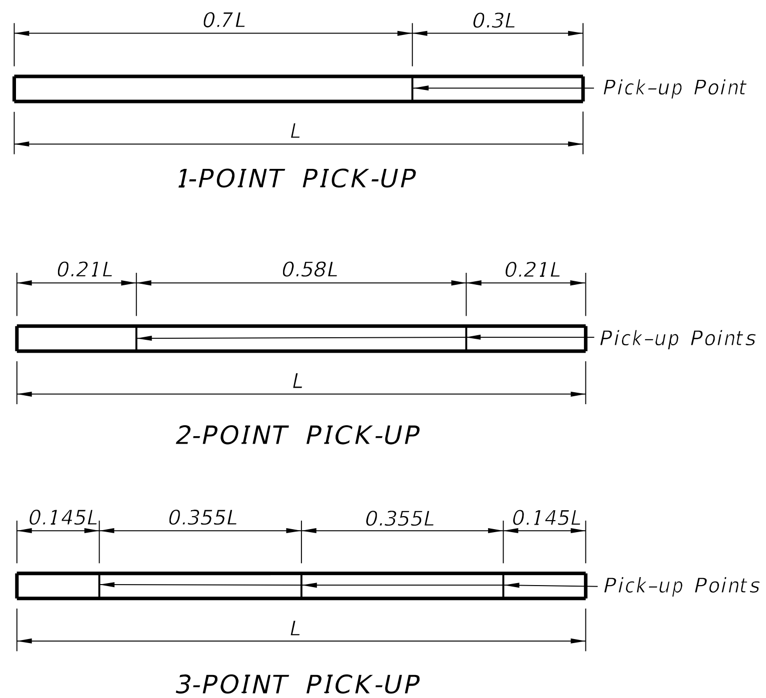
6-65

Learning Outcomes

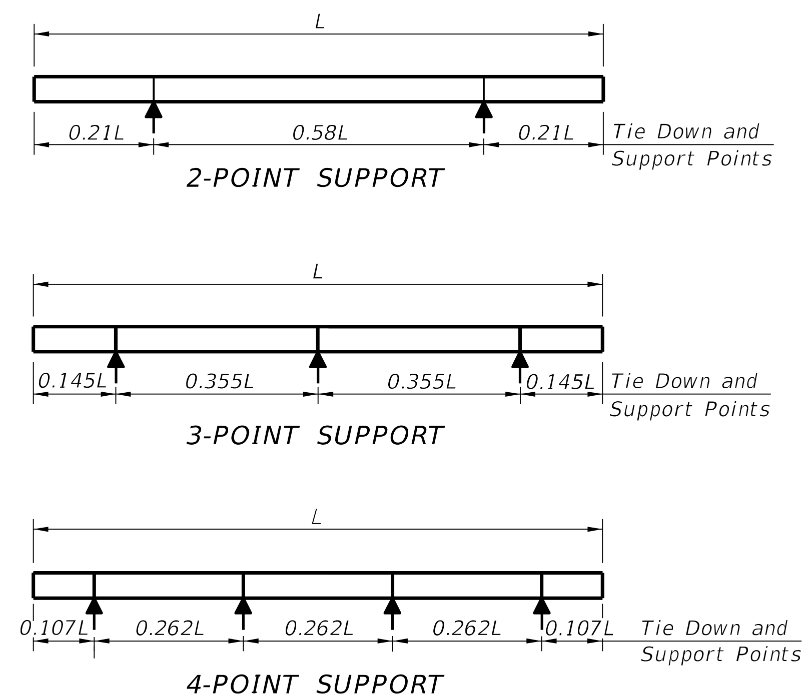
- Verify and Document Equipment Matches Approved Pile Installation Plan
- Document Contractor Compliance with Protection of Existing Structures, Excavations, etc.
- Verify contractor compliance for transportation, handling, storage, labeling & marking of piles.
- Identify Contractor provided elevations

6-66


End of Lesson 6
ANY
QUESTIONS ?
6-67



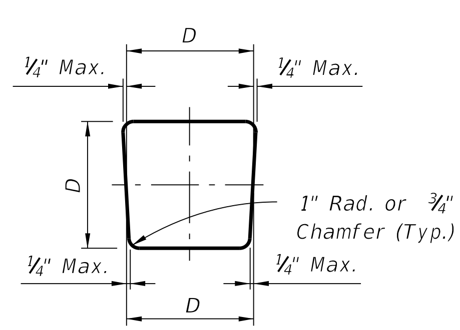
PILE PICK-UP DETAILS



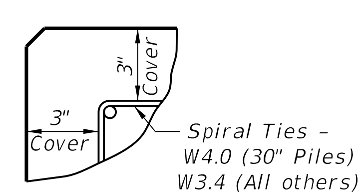
STORAGE AND TRANSPORTATION SUPPORT DETAILS

TABLE OF MAXIMUM PILE PICK-UP AND SUPPORT LENGTHS

	D = Square Pile Size (inches)						Required Storage and Transportation Detail	Pick-Up Detail
	12	14	18	20	24	30		
Maximum Pile Length (Feet)	48	52	59	62	68	87	2, 3, or 4 point	1 Point
	69	75	85	89	98	124	2, 3, or 4 point	2 Point
	99	107	121	128	140	178	3 or 4 point	3 Point



TYPICAL PILE SHAPE FOR MOLD FORMS



DETAIL SHOWING TYPICAL COVER

PRESTRESSED CONCRETE PILE NOTES:

DESIGN SPECIFICATIONS:

Florida Department of Transportation (FDOT) "Structures Design Guidelines", current edition.

American Association of State Highway and Transportation Officials (AASHTO) "LRFD Bridge Design Specifications", current edition.

SPIRAL TIES:

Each wrap of spirals shall be tied to at least two corner strands. One turn required for spiral splices.

CONCRETE CLASS:

Concrete for all piles shall be Class V (Special) except designated High Moment Capacity Piles (Index 20631) shall be Class VI.

Concrete for the High Capacity Collar Splice shall be Class V (Special).

See "GENERAL NOTES" in Structures Plans for any specific locations where the use of Silica Fume is required.

CONCRETE STRENGTH:

The pile cylinder strength shall be 6,000 psi minimum at 28 days and 4,000 psi minimum at time of transfer of the Prestressing Force. The cylinder strength for designated High Moment Capacity Piles (Index 20631) shall be 8,500 psi minimum at 28 days and 6,500 psi minimum at time of transfer of the Prestressing Force.

SPLICE BONDING MATERIAL:

The material to fill dowel holes and form the joint between pile sections shall be a Type B Epoxy Compound in accordance with Specification Section 926 and shall be contained on the Qualified Products List (QPL). Use Epoxy Bonding Compound or Epoxy Mortar as recommended by the Manufacturer. For Epoxy Mortar only use sand or other filler material supplied by the manufacturer and in the proportions recommended.

PICK-UP POINTS:

Piles shall be marked at the pick-up points to indicate proper points for attaching handling lines.

REINFORCING STEEL:

All reinforcing steel shall be Grade 60, except that spiral ties shall be manufactured from cold-drawn steel wire meeting the requirements of ASTM A82.

PRESTRESSING STEEL:

Prestressing steel shall be seven-wire strand, Grade 270, Low-Relaxation Strand (LRS).

CORROSION PROTECTION OF EXPOSED STRANDS:

For all piles having ends exposed to the environment and not embedded under final conditions, protect the strands as follows: Prior to shipment, cut strands at appropiate end(s) back to a minmum depth of 1 inch below the concrete surface and patch with a Type F epoxy compound meeting the requirements of Specification Section 926.

PILE INSPECTOR'S CHECKLIST

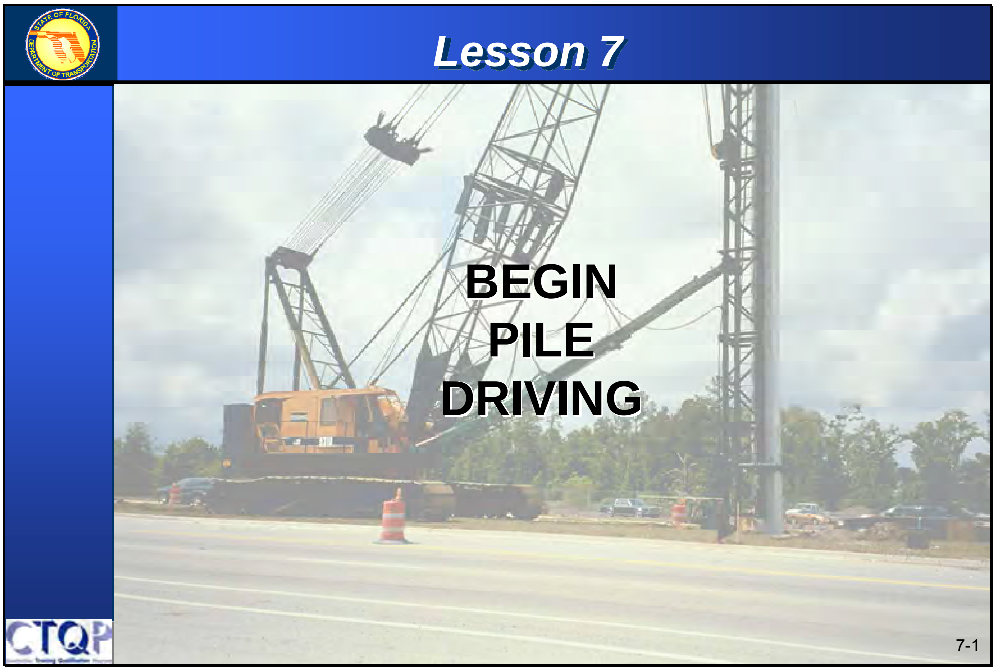
The following is a general checklist to follow when driving a Pile. The answer to each of these, if applicable, should "yes" unless plans, specifications, or specific approval has been given otherwise. CONSULT WITH THE RESPONSIBLE PROJECT ADMINISTRATOR FOR YOUR SPECIFIC PROJECT RESPONSIBILITIES.

EARLY REQUIREMENTS	Yes	No	NA
1. Do you have a copy of the Plans including latest revisions & located relevant items? (ex: Pile Date Table)	1	1	
2. Do you have and reviewed the accepted Pile Installation Plan?	2	2	
3. Are Dynamic Load Tests required and if so, is the PDA Engineer coordinated with?	3	3	
4. Do you have the current version of the FDOT Pile Driving Record form?	4	4	
5. Have you setup Structure Files and Bent/Pier Models in the program?	5	5	
6. Have you made the Initial Pile Data entries and Standard Notes entries in the program?	6	6	
7. Have you scheduled or attended a Pre-Driving meeting with the PA/Geotechnical Engineer?	7	7	

TEST PILE PROGRAM	Yes	No	NA
8. Has the Contractor met the requirements of 455-1.1, Protection of Existing Structures (or new 108)?	8	8	
9. Has the site preparation been completed for footings/excavations/abutments in accordance with 455-1.2 & 455-1.2.1?	9	9	
10. Have the requirements of 455-1.4, Vibrations of Freshly Placed Concrete been met?	10	10	
11. If a Cofferdam is required, does the Contractor have a qualified diver and safety diver for inspections in accordance with 455-1.3, Cofferdams?	11	11	
12. If underwater diving is required, are the divers equipped with voice communications, per 455-1.3, Cofferdams?	12	12	
13. Does the Contractor have the hammer equipment indicated in the Pile Installation Plan on-site?	13	13	
a. CLOSED END DIESEL HAMMER			
- Does the hammer have at least three fuel settings for the rebound stroke? (455-5.2.2)	A1	A1	
- Does the Contractor have a Bounce Chamber Pressure Gauge? (455-5.2.2)	A2	A2	
- Has the Bounce Chamber been calibrated within the last 30 days and a Chart provided? (455-5.2.2)	A3	A3	
b. OPEN END DIESEL HAMMER			
- Does the hammer have at least three fuel settings for the rebound stroke? (455-5.2.2)	B1	B1	
- Has the Contractor provided the hammer manufacturer's chart equating stroke and blows per minute? (455-5.2.2)	B2	B2	
- Has the Contractor provided an approved device automatically determine and display ram stroke? (455-5.2.2)	B3	B3	
c. AIR/STEAM HAMMER			
- Does the air plant have gauges that are easy to read? (455-5.2.1)	C1	C1	
- Does the hammer have a slide bar capable of a minimum of two stroke height settings? (455-5.2.1)	C2	C2	
d. HYDRAULIC HAMMER			
- Does the hammer have at least three settings for reduced stroke height? (455-5.2.3)	D1	D1	
- Has pressure measuring equipment been calibrated? (455-5.2.3)	D2	D2	
- Have you been provided a means to determine hammer energy? (455-5.3.1)	D3	D3	
14. Is the cap-block (hammer cushion) in good condition? (455-5.3.1)	14	14	
15. Does the cap-block (hammer cushion) match the Contractor's submittal (type, size, thickness, etc.)? (455-5.3.1)	15	15	
16. Is the pile cushion new? (455-5.3.2)	16	16	
17. Does the pile cushion match the Contractor's submittal (type, size, thickness)? (455-5.3.2)	17	17	
18. Does the pile helmet meet the requirements of 455-5.3.3?	18	18	
19. If required, does the template meet the requirements of 455-5.6?	19	19	
20. Has the Contractor furnished elevations per 455-5.6?	20	20	
21. Is a jet pump at the site, ready for use and of the proper size? (455-5.7)	21	21	
22. If Predrilling or Preforming to be done, does the drill meet the requirements of 455-5.1.1 and 455-5.9?	22	22	
23. Do the leads match the Contractor's submittal and meet the requirements of 455-5.4?	23	23	
24. Has the proper type, size, and length of pile and applicable pile documentation been provided?	24	24	
25. Have you inspected the pile for defects and if observed document and modify the PA?	25	25	
26. Has the Contractor marked the pile in the applicable increments?	26	26	
27. Is the test pile located per the plans and meet the requirements of 455-5.15.2?	27	27	
28. Does the pile meet the axial alignment of 455.5.15.3?	28	28	
29. Have you indicated this is a Test Pile in the Pile Driving Record?	29	29	
30. If applicable, have you indicated the pile has EDCs installed in the Pile Driving Record?	30	30	
31. Have you recorded the driving event in the Pile Driving Record?	31	31	

PILE INSPECTOR'S CHECKLIST- PAGE 2

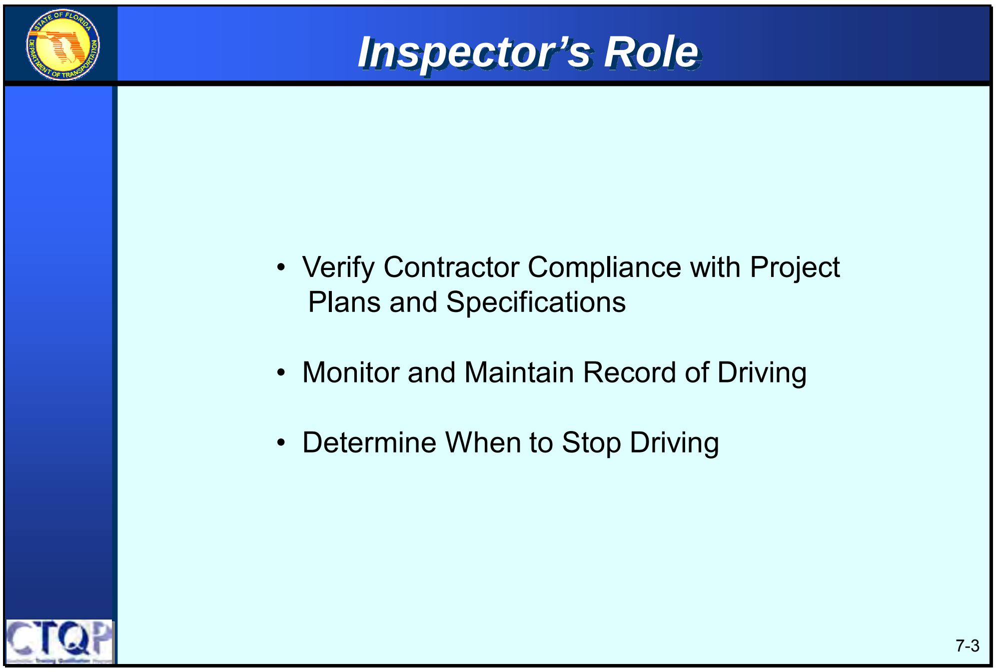
PRODUCTION PILE DRIVING	Yes	No	NA
32. Do you have the Driving Criteria Letter?	32	32	
33. If concrete piles, do you have the authorized Production Pile Lengths Letter?	33	33	
34. Do you have the Accepted Pile Installation Plan?	34	34	
35. Has the Contractor met the requirements for Protection of Existing Structures? (455-1.1 or new 108)	35	35	
36. Has the site preparation been completed for footings/excavations/abutments in accordance with 455-1.2 & 455-1.2.1?	36	36	
37. Have the requirements of 455-1.4, Vibrations of Freshly Placed Concrete been met?	37	37	
38. If a cofferdam is required, have the requirements of 455-1.3, Cofferdams, been met?	38	38	
39. Have you inspected the piles of damage, and if observed, document same and notified the PA? (455-6,7,8,9)	39	39	
40. Does the Contractor's equipment match the accepted Pile Installation Plan or revised Plan from the Test Pile Program?	40	40	
a. cranes			
b. barges			
c. hammer system, including:			
-model, type, serial number			
-capblock cushion type, thickness			
-capblock dimensions, inserts, striker plates			
-variable energy settings			
-hydraulic control indicator, fuel pump setting indicator			
-Saximeter			
-Pile cushion type, thickness			
-follower			
d. Leads			
e. Auger motor and flighting			
f. Auger leads			
g. Punches			
h. Jets and pump			
i. Templates			
-Does the template match the Contractor's submittal?			
-Has a reference been provide to enable determining pile penetration?			
-Can the pile be driven to the cutoff elevation without requiring movement of the template?			
41. Has the Contractor provided an elevation on the template for your use?	41	41	
42. If Predrilling or Preforming, has the Contractor met the plan requirements and you documented the same?	42	42	
43. If grouting of Preformed Pile Holes is required, has this been completed per 455-5.9.5?	43	43	
44. Has the Contractor marked the piles in the correct increments?	44	44	
45. Have you recorded the blows, stroke height/pressure, and applicable notes in the record or program?	45	45	
46. Did splicing of piles meet the requirements of 455-7.7 for concrete and 455-8.3 for steel?	46	46	
47. If specified, has the pile met any Minimum Tip Elevation requirements?	47	47	
48. If no Minimum Tip is specified, has the pile met the Penetration requirements of 455-5.8, Penetration?	48	48	
49. Has the pile met the driving criteria specified in the Driving Criteria Letter?	49	49	
50. Has the pile reached Practical Refusal? (455-5.10.3)	50	50	
51. Do you have a "Setcheck" Criteria?	51	51	
52. If "Setchecks" or "Redrives" are performed, were they documented?	52	52	
53. Have any of the piles "heaved"? (455-5.10.5)	53	53	
54. If so, were they redriven?	54	54	
POST INSTALLATION			
55. Has the Contractor met the tolerances required? (455-5.15, Allowable Tolerances)	55	55	
56. Has the Contractor initiated a plan to protect driven piles from fill placement operations? (455-10)	56	56	
57. Have you been provided the final post-driving elevations and entered them in the Pile Driving Record?	57	57	


Lesson 7
BEGIN
PILE
DRIVING
CTQP
7-1

Learning Outcomes

- Monitor and verify proper marking of the piles per contract documents and standards
- Verify & document contractor compliance with applicable tolerances
- Monitor, verify and document pile driving operations
- Identify applicable 455 specifications

7-2


Inspector's Role
• Verify Contractor Compliance with Project Plans and Specifications
• Monitor and Maintain Record of Driving
• Determine When to Stop Driving
CTQP
7-3

Inspector's Checklist

33. Has the Contractor met the requirements for Protection of Existing Structures? (455-1.1)
34. Has the site preparation been completed for footings/excavations/abutments in accordance with 455-1.2 & 455-1.2.1?
35. Have the requirements of 455-1.4, Vibrations of Freshly Placed Concrete been met?
36. If a cofferdam is required, have the requirements of 455-1.3, Cofferdams, been met?
37. Have you inspected the piles for damage, and if observed, document same and notified the PA (455-6,7,8,9)?
38. Does the Contractor's equipment match the accepted Pile Installation Plan or revised Plan from the Test Pile Program?
    a. cranes
    b. barges
    c. hammer system, including:
        - model, type, serial number
        - capblock cushion type, thickness
        - capblock dimensions, inserts, striker plates
        - variable energy settings
        - jump stick, hydraulic control indicator, fuel pump setting indicator
        - Saximeter
        - Pile cushion type, thickness
        - follower
    d. Leads
    e. Auger motor and flighting
    f. Auger leads
    g. Punches
    h. Jets and pump
    i. Templates
        - Does the template match the Contractor's submittal?
        - Is it within 5 ft of the cutoff elevation, ground surface elevation or 5 ft from the water, whichever is lower?
        - Can the pile be driven to the cutoff elevation without requiring movement of the template?
39. Has the Contractor provided an elevation on the template for your use?
40. If Predrilling or Preforming, has the Contractor met the plan requirements and you documented same?

7-4

455-5.15 Allowable Driving Tolerances

455-5.15.1 General: Meet the tolerances described in this Subarticle to the piles that are free standing without lateral restraint (after the template is removed). After the piles are driven, do not move the piles laterally to force them to be within the specified tolerances. The Contractor may move battered piles laterally to overcome the dead load deflections caused by the pile's weight. When this is necessary, submit calculations signed and sealed by a Specialty Engineer to the Engineer that verify the amount of dead load deflection prior to moving any piles.

7-5

455-5.15 Allowable Driving Tolerances

455-5.15.2 Position: Ensure that the final position of the pile head at cut-off elevation is no more than 3 inches laterally in the X or Y coordinate from the plan position indicated in the plans.

455-5.15.3 Axial Alignment: Ensure that the axial alignment of the driven piles does not deviate by more than 1/4 in/ft from the vertical or batter line indicated in the plans.

CTQP

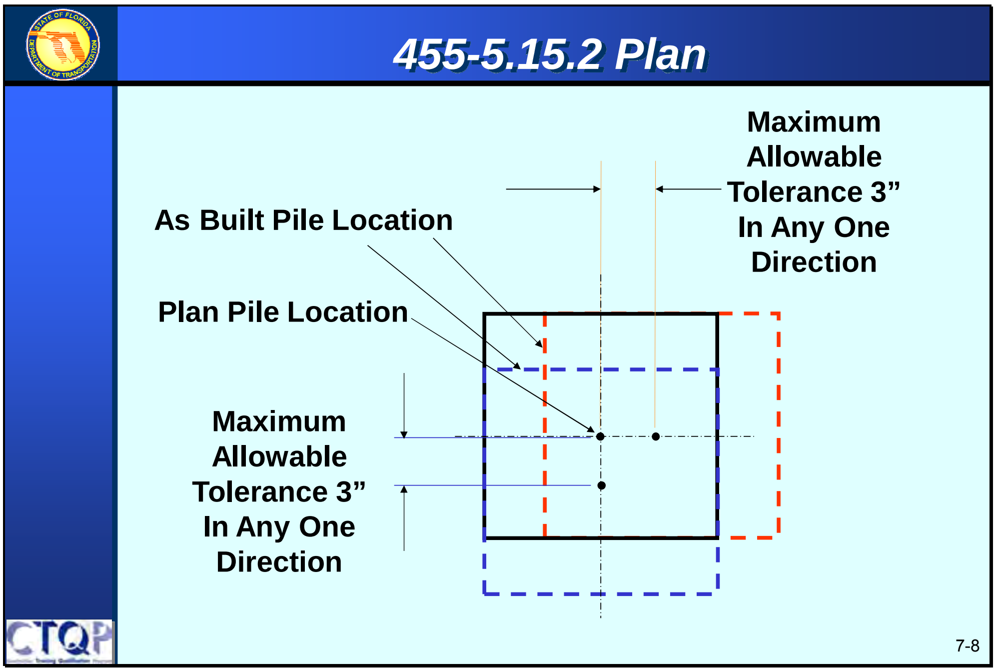
7-6

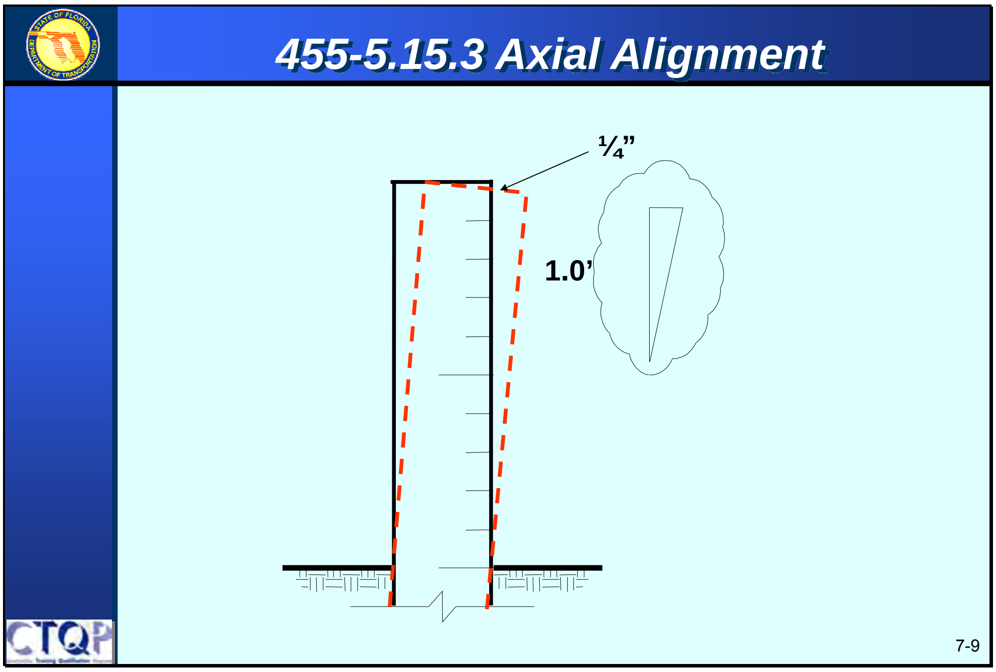
455-5.15 Allowable Driving Tolerances

455-5.15.4 Elevation: Ensure that the final elevation of the pile head is no more than 1-1/2 inches above, or more than 4 inches below, the elevation shown in the Plans, however in no case shall the pile be embedded less than 8 inches into the cap or footing.

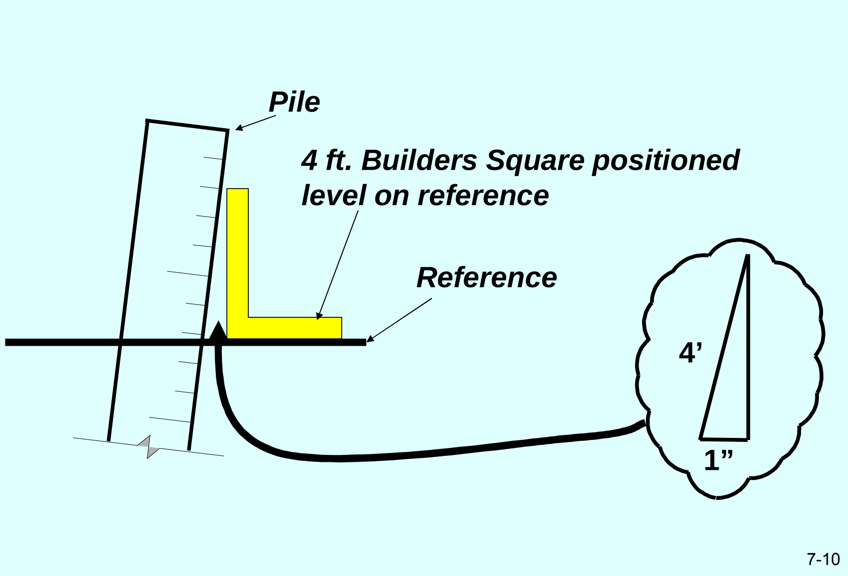
For fender piles, cut off piles at the elevation shown on the plans to a tolerance of +0.0”/-2.0” using sawing or other means as approved by the Engineer to provide a smooth level cut.

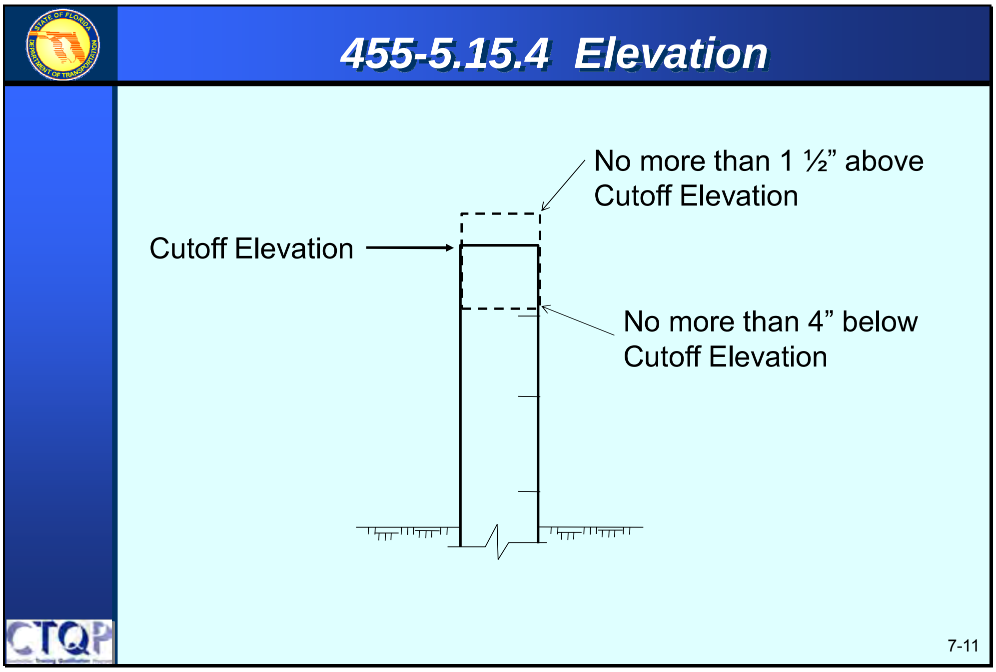
7-7


455-5.15.2 Plan
Maximum Allowable Tolerance 3" In Any One Direction
As Built Pile Location
Plan Pile Location
Maximum Allowable Tolerance 3" In Any One Direction
CTQP
7-8


455-5.15.3 Axial Alignment
¼"
1.0'
CTQP
7-9

Checking Axial Alignment




455-5.15.4 Elevation
No more than 1 ½" above Cutoff Elevation
Cutoff Elevation
No more than 4" below Cutoff Elevation
7-11

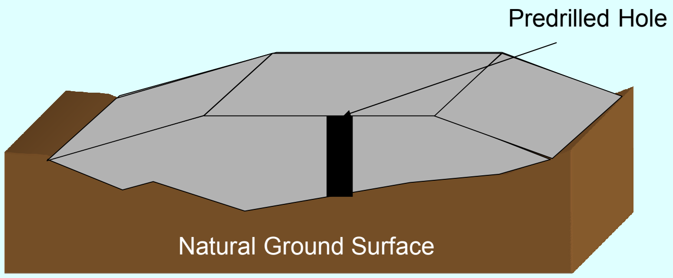
455-5.1 Site Preparation

455-5.1.1 Predrilling of Pile Holes: Predrilled pile holes are either starter holes to the depth described in this section or holes drilled through embankment/fill material down to the natural ground surface. When using low displacement steel piling such as structural shapes, drive them through the compacted fill without the necessity of drilling holes through the fill except when the requirements for predrilling are shown in the plans. When using concrete or other high displacement piles, drill pile holes through fill, new or existing, to at least the elevation of the natural ground surface.

7-12

Predrilling through Fill

Natural Ground is defined as " the ground surface prior to any roadway construction"



7-13

455-5.1 Site Preparation

455-5.1.1 Predrilling of Pile Holes (continued):

Use the range of drill diameters listed below for square concrete piles

12 inch square piles	15 to 17 inches
14 inch square piles	18 to 20 inches
18 inch square piles	22 to 26 inches
20 inch square piles	24 to 29 inches
24 inch square piles	30 to 34 inches
30 inch square piles	36 to 43 inches

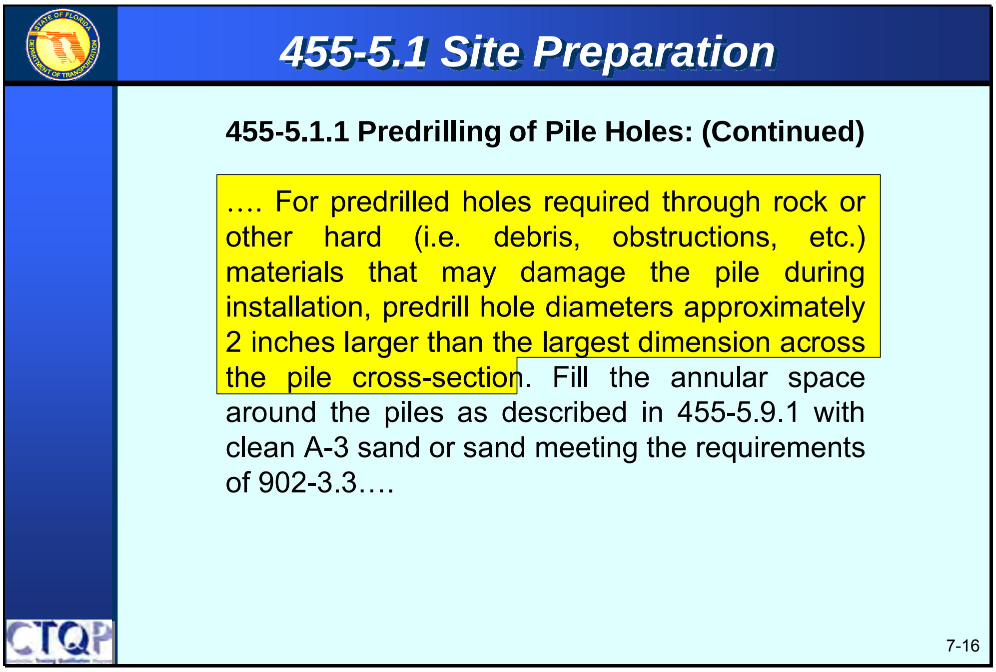
7-14

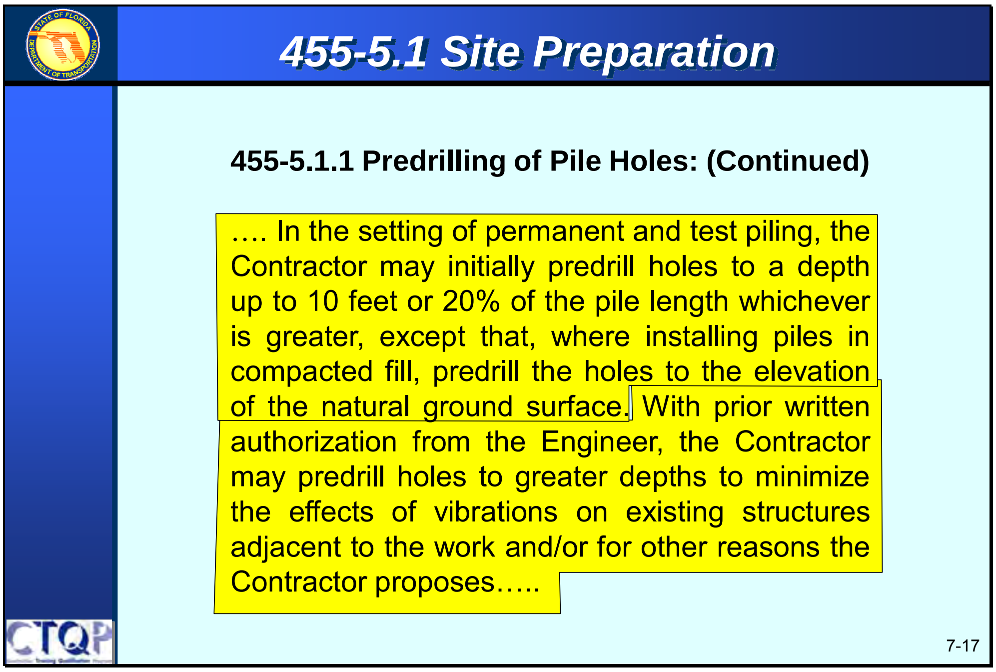
455-5.1 Site Preparation

455-5.1.1 Predrilling of Pile Holes: (Continued)

…For other pile sizes, use the diameter of the drills shown in the plans or approved by the Engineer. Accurately drill the pile holes with the hole centered over the plan location of the piling. Maintain the location and vertical alignment within the tolerances allowed for the piling.

7-15


455-5.1 Site Preparation
455-5.1.1 Predrilling of Pile Holes: (Continued)
…. For predrilled holes required through rock or other hard (i.e. debris, obstructions, etc.) materials that may damage the pile during installation, predrill hole diameters approximately 2 inches larger than the largest dimension across the pile cross-section. Fill the annular space around the piles as described in 455-5.9.1 with clean A-3 sand or sand meeting the requirements of 902-3.3….
CTQP
7-16


455-5.1 Site Preparation
455-5.1.1 Predrilling of Pile Holes: (Continued)
…. In the setting of permanent and test piling, the Contractor may initially predrill holes to a depth up to 10 feet or 20% of the pile length whichever is greater, except that, where installing piles in compacted fill, predrill the holes to the elevation of the natural ground surface. With prior written authorization from the Engineer, the Contractor may predrill holes to greater depths to minimize the effects of vibrations on existing structures adjacent to the work and/or for other reasons the Contractor proposes…..
7-17

455-5.1 Site Preparation

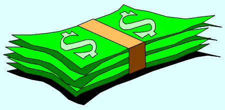
455-5.1.1 Predrilling of Pile Holes: (Continued)

…. Perform such work the Engineer allows but does not require at no expense to the Department. When the Engineer requires such work, the Department will pay for such work as Preformed Pile Holes as described in 455-5.9.

7-18

455-5.9 Preformed Pile Holes

455-5.9.1 Description: Preformed Pile Holes serve as a penetration aid when all other pile installation methods fail to produce the desired penetration and when authorized by the Engineer to minimize the effects of vibrations on adjacent structures. Preformed Pile Holes are necessary when the presence of rock or strong strata of soils will not permit the installation of piles to the desired penetration by driving or a combination of jetting and driving, when determined necessary by the Engineer, or when authorized by the Engineer to minimize the effects of vibrations on adjacent existing structures….



7-19

455-5.9 Preformed Pile Holes

455-5.9.1 Description: (Continued)

…. The Engineer may require preformed holes for any type of pile. Drive all piles installed in Preformed Pile Holes to determine that the bearing requirements have been met.

For preformed holes which are required through material that caves during driving to the extent that the preformed hole does not serve its intended purpose, case the hole from the surface through caving material. After installing the pile to the bottom of the casing, remove the casings unless shown otherwise in the Plans. Determine bearing of the pile after removing the casing unless shown otherwise in the Plans….

7-20

455-5.9.1 Description: (Continued)

….Fill all voids between the pile and soil remaining after driving through preformed holes with clean A-3 sand or sand meeting the requirements of 902-3.3, after the pile has achieved the required minimum tip elevation, unless grouting of preformed pile holes is shown in the plans. If pile driving is interrupted during sand placement, drive the pile at least 20 additional blows after filling all of the voids between the pile and soil with sand at no additional compensation.

7-21

455-5.9 Preformed Pile Holes

455-5.9.2 Provisions for Use of Preformed Pile Holes:

The Department generally anticipates the necessity for Preformed Pile Holes and includes directions in the Contract Documents. The Department will pay for Preformed Piles Holes when the Contractor establishes that the required results cannot be obtained when driving the load bearing piles with specified driving equipment, or if jetting is allowed, while jetting the piles and then driving or while jetting the piles during driving.

7-22

455-5.9 Preformed Pile Holes

455-5.9.3 Conditions Under Which Payment Will Be Made:

a) Inability to drive piles to the required penetration with driving and jetting equipment.

(b) To penetrate a hard layer or layers of rock or strong stratum that the Engineer considers not sufficiently thick to support the structure.

(c) To obtain greater penetration into dense (strong) material and into dense material containing holes, cavities or unstable soft layers.

7-23

455-5.9 Preformed Pile Holes

455-5.9.3 Conditions Under Which Payment Will Be Made (cont'd):

(d) To obtain penetration into a stratum in which it is desired to found the structure.
(e) To minimize the effects of vibrations or heave on adjacent existing structures.
(f) To minimize the effects of ground heave on adjacent piles.

7-24

455-5.9 Preformed Pile Holes

455-5.9.4 Construction Methods: Construct Preformed Pile Holes by drilling, or driving and withdrawing a suitable punch or chisel at the locations of the piles. Construct a hole that is equal to or slightly greater than the largest pile dimension for the entire length of the hole and of sufficient depth to obtain the required penetration. Carefully form the preformed hole by using a drill or punch guided by a template or other suitable device, and do not exceed the minimum dimensions necessary to achieve the required penetration of the pile….

7-25

455-5.9 Preformed Pile Holes

455-5.9.4 Construction Methods: (Continued)

…. When the plans call for grouting the Preformed Pile Holes, provide the minimum dimension of the pile hole that is 2 inches larger than the largest pile dimension. Construct the holes at the plan position of the pile and the tolerances in location, and ensure the hole is straight and that the batter is the same as specified for the pile. Loose material may remain in the preformed pile hole if the conditions in 455-5.9.3 are satisfied.

7-26

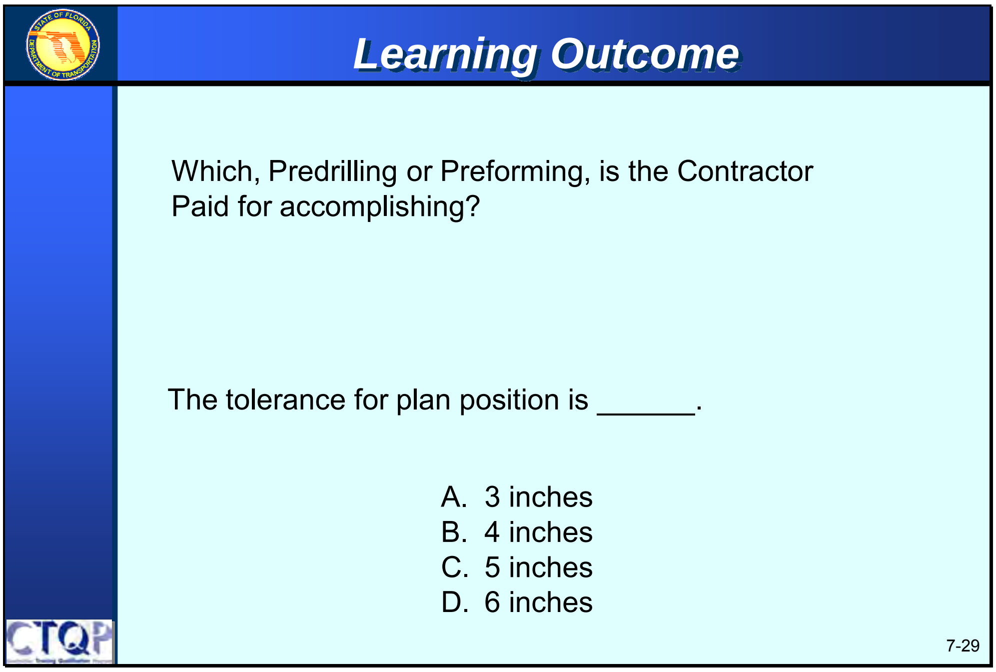
455-5.9 Preformed Pile Holes

7-27

455-5.9 Preformed Pile Holes

455-5.9.5 Grouting of Pile Holes: Grout Preformed Pile Holes for bearing piles, when the plans require grouting after driving. Clean the Preformed Pile Holes, and fill them with cement grout as shown in the plans. Use grout that has a minimum compressive strength of 3,000 psi at 28 days or as specified. Pump the grout through three or more grout pipes initially placed at the bottom of the preformed hole. The Contractor may raise the grout pipes when necessary to prevent clogging and to complete the grouting operations.

7-28


Learning Outcome
Which, Predrilling or Preforming, is the Contractor Paid for accomplishing?
The tolerance for plan position is ______.
A. 3 inches
B. 4 inches
C. 5 inches
D. 6 inches
7-29

Learning Outcome

For each of the following situations, answer which holes, **Predrilled holes or Preformed holes,** are to have hole diameters approximately 2 inches larger than the largest dimension across the pile cross-section?

a. When drilling through rock or other hard materials ? ________

b. When plans call for grouting the preformed holes ? _________

The tolerance for axial alignment for driven piles is ______.

A. 2 inches/ft.
B. 1 inch/ft.
C. ½ inch/ft.
D. ¼ inch/ft.

7-30

Verify Marking of the Piles

English mark
in 1 ft. intervals

7-31

Verify Marking of the Piles

7-32

455-6 Timber Piles

455-6.5 Cutting Off: Saw off the tops of all timber piles at the elevation indicated in the plans. Saw off piles which support timber caps to the exact plane of the superimposed structure so that they exactly fit it. Withdraw and replace broken, split, or misplaced piles

.

455-6.6 Build-ups: The Engineer will not permit splices or build-ups for timber piles. Extract piles driven below plan elevation and drive a longer pile.

7-33

455-7 Prestressed Concrete Piling

455-7 Prestressed Concrete Piling:

455-7.1 General: Provide prestressed concrete piles that are manufactured, cured, and driven in accordance with the requirements of the Contract Documents. Provide piles full length without splices when transported by barge or the pile length is less than or equal to 120 feet. When piles are transported by truck and the pile length exceeds 120 feet but is less than the maximum length for a three point pick-up according to Index 20600, and splicing is desired, provide minimal splices. Include the cost of the splices in the cost of the pile.

7-34

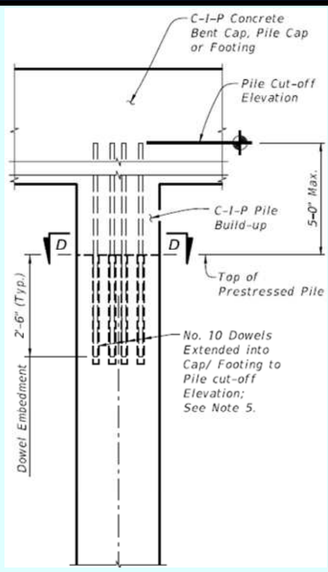
455-7 Prestressed Concrete Piling

455-7.7 Extensions and Build-ups Used to Increase Production Lengths:

455-7.7.1 General: Where splices and build-ups for concrete piles are necessary, construct such splices and build-ups in accordance with Standard Index 20601.

7-35

455-7 Prestressed Concrete Piling



UNFORESEEN
REINFORCED C-I-P
PILE BUILD-UP DETAIL

7-36

455-7 Prestressed Concrete Piling

455-7.7.2 Extensions to be Driven or Those 21 feet or Longer:

Construct extensions to be driven or extensions 21 feet or longer in length in accordance with the details shown in the plans and in a manner including the requirements, sequences, and procedures outlined below:

7-37

Constructing Splice- Concrete Piling

7-38

Constructing Splice- Concrete Piling

7-39

Constructing Splice- Concrete Piling

7-40


Constructing Splice- Concrete Piling
CTQP
7-41

Constructing Splice- Concrete Piling

(a) Cast a splice section in accordance with Section 450 with the dowel steel in the correct position and alignment.

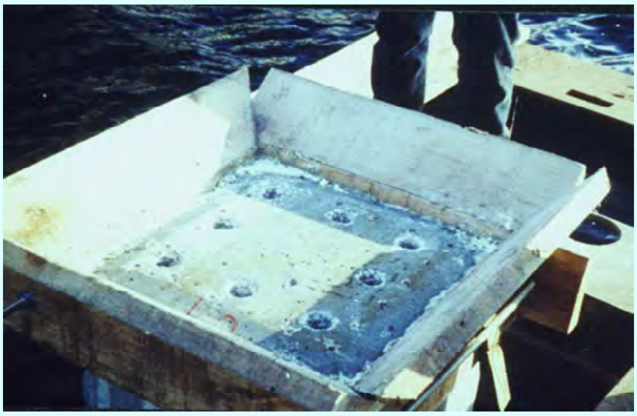
(b) Drill dowel holes using an approved steel template that will position and align the drill bit during drilling. Drill holes a minimum of 2 inches deeper than the length of the dowel to be inserted

(c) Clean the drilled dowel holes by inserting a high pressure air hose to the bottom of the hole and blowing the hole clean from the bottom upward. Eliminate any oil, dust, water, and other deleterious materials from the holes and the concrete

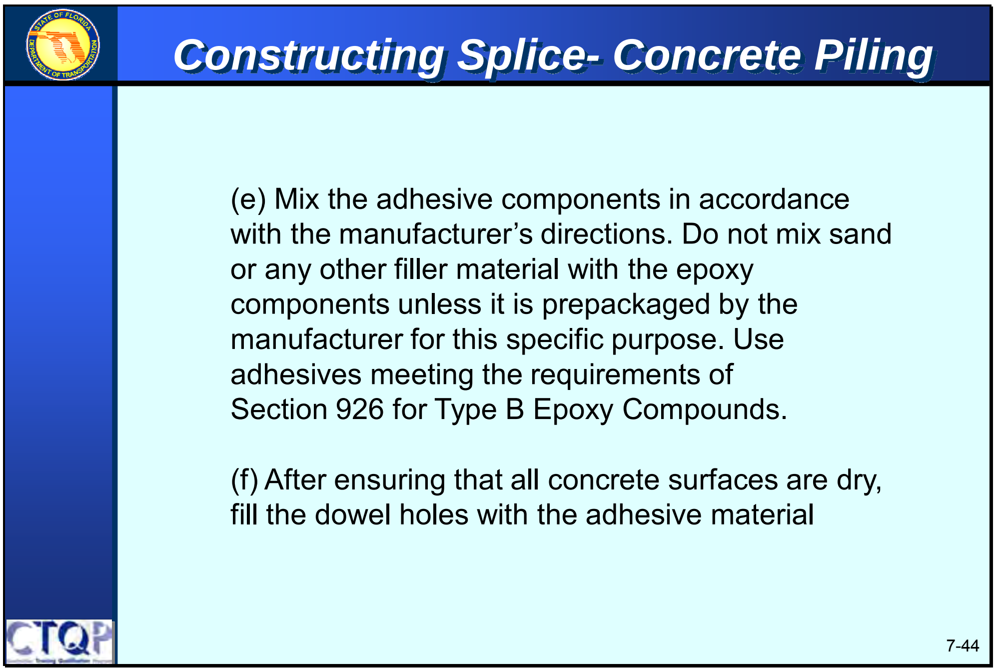
(d) Place forms around joints between the pile sections

7-42

Constructing Splice- Concrete Piling



7-43


Constructing Splice- Concrete Piling
(e) Mix the adhesive components in accordance with the manufacturer’s directions. Do not mix sand or any other filler material with the epoxy components unless it is prepackaged by the manufacturer for this specific purpose. Use adhesives meeting the requirements of Section 926 for Type B Epoxy Compounds.
(f) After ensuring that all concrete surfaces are dry, fill the dowel holes with the adhesive material
CTQP
7-44


Constructing Splice- Concrete Piling
7-45

Constructing Splice- Concrete Piling

(g) Insert the dowels of the spliced section into the adhesive filled holes of the bottom section and position the spliced section so that the axes of the two sections are in concentric alignment and the ends of the abutting sections are spaced 1/2 inch apart. The Contractor may use small steel spacers of the required thickness provided they have 3 inches or more of cover after completing the splice. Fill the space between the abutting sections completely with the adhesive.

7-46

Constructing Splice- Concrete Piling

7-47

Constructing Splice- Concrete Piling

(h) Secure the spliced sections in alignment until the adhesive is cured in accordance with the manufacturer's directions for the time appropriate with the prevailing ambient temperatures. Do not utilize the crane to secure the pile extension during the adhesive cure time. Utilize alignment braces to maintain the proper pile alignment during the epoxy cure time.

(i) After curing is completed, remove alignment braces and forms and clean and dress the spliced area to match the pile dimensions.

7-48


Constructing Splice- Concrete Piling
CTQP
7-49

Constructing Splice- Concrete Piling

7-50

455-7 Prestressed Concrete Piling

455-7.7.3 Precast Reinforced Build-ups: Construct Precast Reinforced Buildups in accordance with the requirements of this Subarticle, Section 346, and Section 400. Provide the same material for the form surfaces for precast build-ups as was used to form the prestressed piles. Use concrete of the same mix as used in the prestressed pile and dimension the cross-section the same as piling being built up. Install build-ups as specified in 455-7.7.2(b) through 455-7.7.2(i).

7-51

455-7 Prestressed Concrete Piling

455-7.8 Pre-Planned Splices: Splices shall be made by the doweled splice method contained in the Standard Indexes or may be made using proprietary splices which are listed on the Department's Approved Product List (APL). Splice test piles in the same manner as the production piles. Include in the pile installation plan, the chosen method of splicing and the approximate locations of the splice….

7-52

455-7 Prestressed Concrete Piling

455-7.8 Pre-Planned Splices (continued)

Generally, place the splice at approximately the midpoint between the estimated pile tip and the ground surface, considering scour if applicable. Stagger the splice location between adjacent piles by a minimum of 10 feet. Obtain the Engineer's approval prior to constructing any pile sections. Construct piles which are to be spliced using the doweled splice with preformed dowel holes in the bottom section and embedded dowels in the upper section.

....

7-53

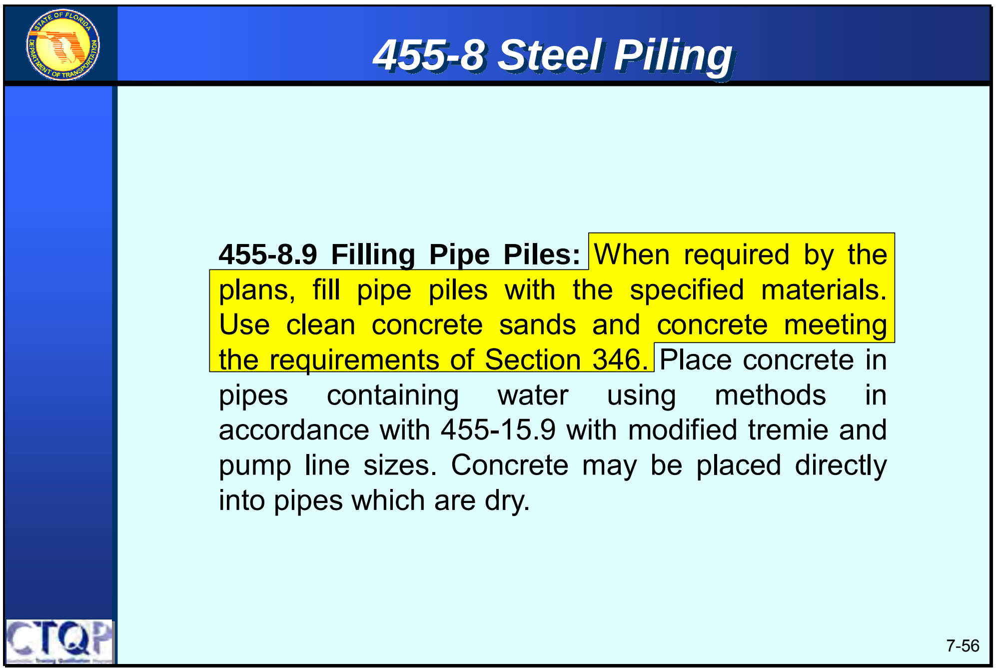
455-8 Steel Piling

455-8.3 Pile Splices: Order and use the full authorized pile length where practicable. Do not splice to obtain authorized lengths less than 40 feet except when shown in the plans. Locate all splices in the authorized pile length in portions of the pile expected to be at least 15 feet below the final ground surface after driving. When it is not practicable to provide authorized pile lengths longer than 40 feet in a single length, use no more than one field splice per additional 40 feet of authorized pile length. Shop splices may be used to join single lengths of pile which are at least 20 feet in length. One shorter segment of pile may be used to achieve the authorized pile length when needed

7-54

Splice- Steel Pile

7-55


455-8 Steel Piling
455-8.9 Filling Pipe Piles: When required by the plans, fill pipe piles with the specified materials. Use clean concrete sands and concrete meeting the requirements of Section 346. Place concrete in pipes containing water using methods in accordance with 455-15.9 with modified tremie and pump line sizes. Concrete may be placed directly into pipes which are dry.
7-56

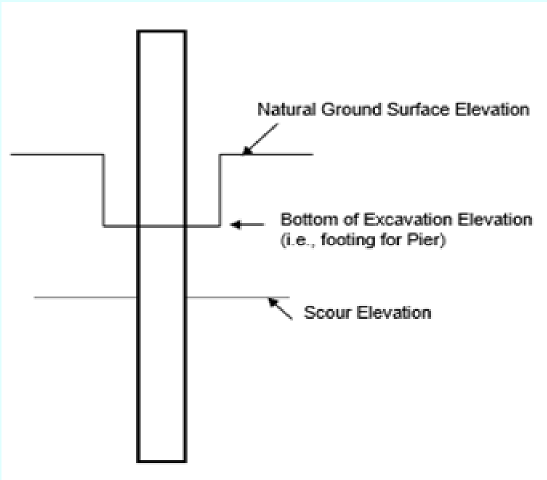
455-5.8 Penetration

455-5.8 Penetration Requirements: Measure the penetration of piles from the elevation of natural ground, scour elevation shown in the plans, or the bottom of excavation, whichever is lower. When the Contract Documents show a minimum pile tip elevation or a minimum depth of penetration, drive the tip of the pile to this minimum elevation or this minimum penetration depth. In all such cases, the Engineer will accept the bearing of a pile only if the Contractor achieves the required bearing when the tip of the pile is at or below the specified minimum tip elevation or depth of penetration and below the bottom of the preformed or predrilled pile hole….

7-57

455-5.8 Penetration

455-5.8 Penetration Requirements: (Continued)



7-58

455-5.8 Penetration

455-5.8 Penetration Requirements: (Continued)

…. When the plans do not show a minimum depth of penetration, scour elevation, or minimum tip elevation, ensure that the required penetration is at least 10 feet into firm bearing material or at least 20 feet into soft material unless otherwise permitted by the Engineer. If a scour elevation is shown in the plans, achieve these penetrations below the scour elevation. The Engineer may accept a penetration between 15 and 20 feet when there is an accumulation of five consecutive feet or more of firm bearing material.…

7-59

455-5.8 Penetration

455-5.8 Penetration Requirements: (Continued)

…. Firm bearing material is any material offering a driving resistance greater than or equal to 30 tons/ft2 of gross pile area as determined by the Wave Equation (455-5.11.2). Soft material is any material offering less than these resistances.

The gross pile area is the actual pile tip cross-sectional area for solid concrete piles, the product of the width and depth for H piles, and the area within the outside perimeter for pipe piles and voided concrete piles….

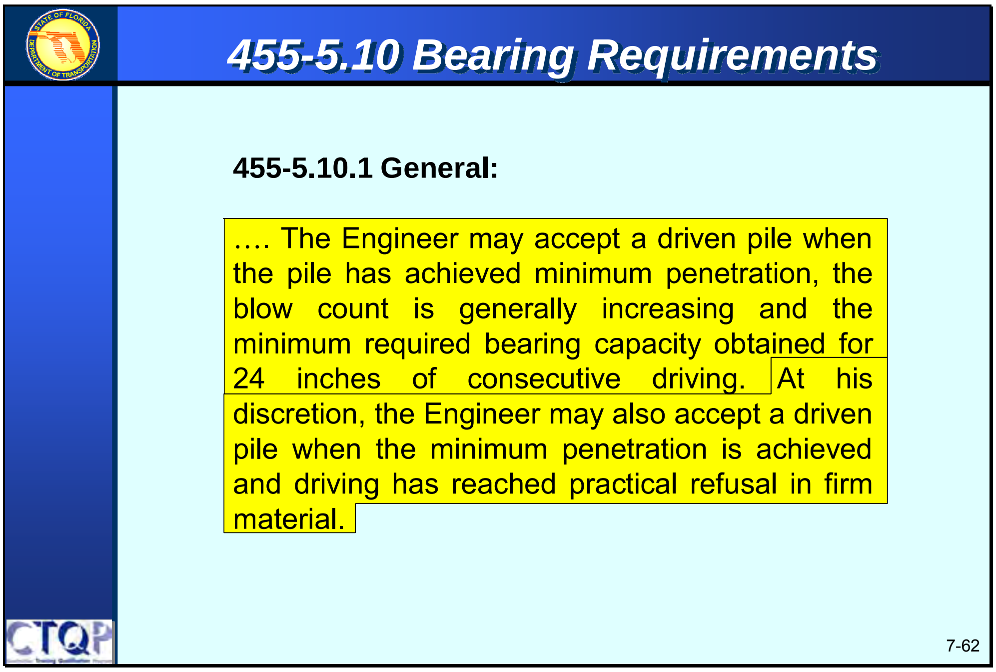
7-60

455-5.8 Penetration

455-5.8 Penetration Requirements: (Continued)

…. Do not drive piles beyond practical refusal (20 blows per inch). To meet the requirements in this Subarticle, provide penetration aids, such as jetting or preformed pile holes, when piles cannot be driven to the required penetration without reaching practical refusal.

7-61



455-5.10 Bearing Requirements

455-5.10.1 General:

…. The Engineer may accept a driven pile when the pile has achieved minimum penetration, the blow count is generally increasing and the minimum required bearing capacity obtained for 24 inches of consecutive driving. At his discretion, the Engineer may also accept a driven pile when the minimum penetration is achieved and driving has reached practical refusal in firm material.

7-62

Data Recording

The Pile Driving Record, which includes:

- Hammer blows for each interval
- Stroke Height or bounce chamber pressure for each interval
- Making appropriate notes concerning driving operations

7-63

Data Recording

7-64

Check Hammer Settings

Check Driving Criteria Letter for driving requirements.

Driving Requirements

Pile driving for all piles should begin and be maintained with a stroke height of 5 to 6 feet (approximate fuel pressure of 150 psi). The stroke may be increased when the blowcount is greater than 35 blows per foot by increasing the stroke height in approximate one-foot intervals (about 50 psi). Should the blows per foot be less than 25, the stroke should be decreased by approximately one foot (about 50 psi).

Stroke (in parenthesis setting) reduction

Recommended stroke height of 5 to 6 ft (approx. fuel pressure of 150 psi)

7-65

Fuel Settings- OED

4-setting fuel pump
for Open-end Diesel
hammer (lanyards)

7-66

Fuel Settings- OED

Adjustable pressure pump for changing fuel setting

7-67

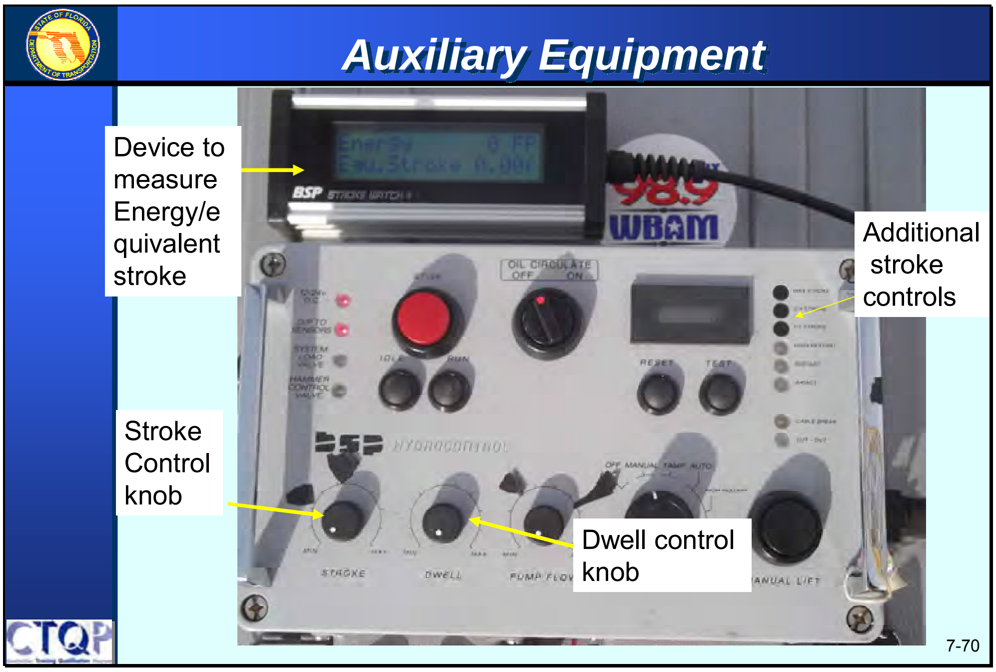
Fuel Settings- OED

7-68

Stroke Height Setting

Slide Bar-
2 Stroke Height Settings for Air Hammer

7-69


Auxiliary Equipment
Device to measure Energy/equivalent stroke
Additional stroke controls
Stroke Control knob
Dwell control knob
Energy 0 FP
BSP
WBAM
OIL CIRCULATE
OFF ON
RESET
TEST
IDLE
RUN
STROKE
DWELL
PUMP FLOW
HYDROCONTROL
7-70

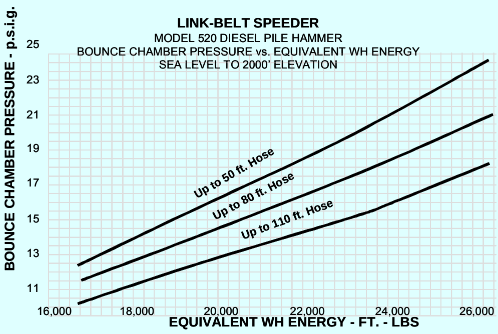
Auxiliary Equipment

Bounce Chamber Pressure Gauge- Closed-end Diesel

7-71

Auxiliary Equipment

Bounce Chamber Pressure Gauge- Closed-end Diesel



7-72

Common Problems- OED

Common Problems	Indicators
Water in fuel	Hollow sound, white smoke
Fuel lines clogged	No smoke or little gray smoke
Fuel pump malfunctioning	Inconsistent ram strokes, little gray smoke or black smoke
Fuel injectors malfunctioning	Inconsistent ram strokes, little gray smoke or black smoke
Oil low	Blows per minute rate is lower than specified
Oil pump malfunctioning	Blows per minute rate is lower than specified
Water in combustion chamber	Hollow sound, white smoke
Piston rings worn	Low strokes
Tripping device broken	Pawl does not engage piston Pawl engages but doesn't lift piston
Over heating	Paint and oil on cooling fins start to burn/sound changes

7-73

Common Problems- Closed-end Diesel

Common Problems	Indicators
Water in fuel	Hollow sound, white smoke
Fuel lines clogged	No smoke or little gray smoke
Fuel pump malfunctioning	Inconsistent ram strokes, little gray smoke or black smoke
Fuel injectors malfunctioning	Inconsistent ram strokes, little gray smoke or black smoke
Oil low	Blows per minute rate is lower than specified
Oil pump malfunctioning	Blows per minute rate is lower than specified
Water in combustion chamber	Hollow sound, white smoke
Piston rings worn	Low strokes
Tripping device broken	Pawl does not engage piston Pawl engages but doesn't lift piston
Over heating	Paint and oil on cooling fins start to burn/sound changes
Oil build up in bounce chamber	Not visible from exterior

7-74

Common Problems- Air/Steam

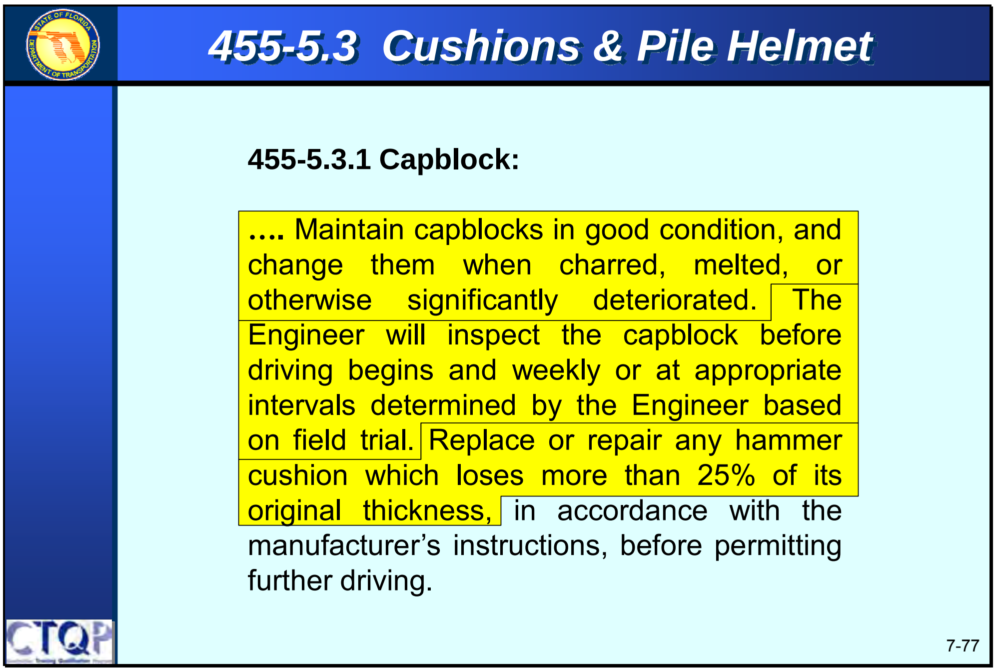
Common Problems	Indicators
Air trip mechanism or hammer malfunctioning	erratic operation rates or air valve sticking open or closed
Cushion stack height incorrect (affects timing of trip mechanism air valve)	erratic operation rates
Compressor not supplying correct pressure & volume of air to hammer	blows per minute rate is varying either faster or slower than the manufacturer specified
Air supply lines either kinked or tangled in leads, boom, or other	visually evident
Moisture in air ices up hammer	ice crystals exiting exhaust ports of hammer
Lack of lubricant in air supply lines	erratic operation rates
Packing around air chest worn allowing air blow by	ram raises slowly- blows/minute rate slower than specified by manufacturer- air leaking around piston shaft & air chest
Nylon slide bar worn	visually evident
Ram columns insufficiently greased	visually evident

7-75

Common Problems- Hydraulic

Common Problems	Indicators
Hoses getting caught in leads	visually evident
Fittings leaking	hydraulic fluid leaking
Electrical connections	erratic performance
Sensors	erratic performance

7-76


455-5.3 Cushions & Pile Helmet
455-5.3.1 Capblock:
…. Maintain capblocks in good condition, and change them when charred, melted, or otherwise significantly deteriorated. The Engineer will inspect the capblock before driving begins and weekly or at appropriate intervals determined by the Engineer based on field trial. Replace or repair any hammer cushion which loses more than 25% of its original thickness, in accordance with the manufacturer's instructions, before permitting further driving.
7-77

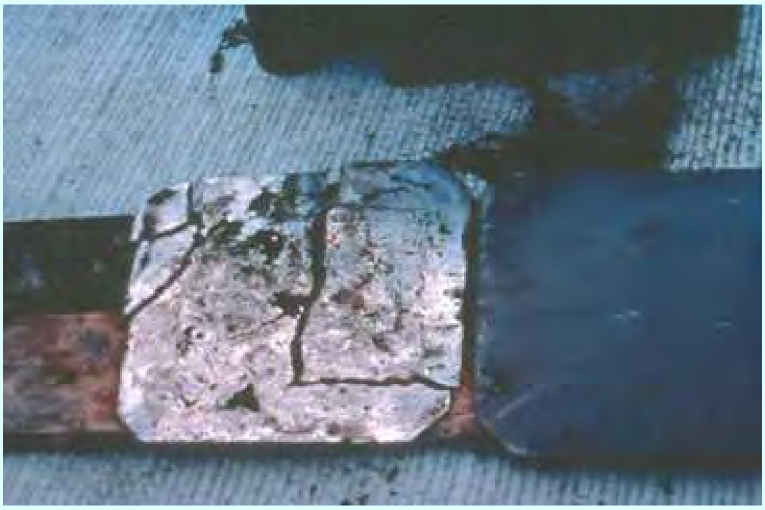
Check Hammer Cushions

The Driving Criteria Letter may specify a different inspection schedule.

The above pile driving criteria are based on a hammer driving system consisting of an ICE Model 60-S, single-acting, diesel hammer with a hammer cushion comprised of 0.5 inches of aluminum and 2 inches of blue nylon. Hammer cushions should be inspected on weekly, or appropriate intervals and maintained in accordance with 455-5.3.1. Preforming for the production piles should be conducted in the same manner as the test pile program. If there is a change in the driving system for the piles or the preforming depth and/or techniques, notify the Engineer so new driving criteria can be determined.

7-78

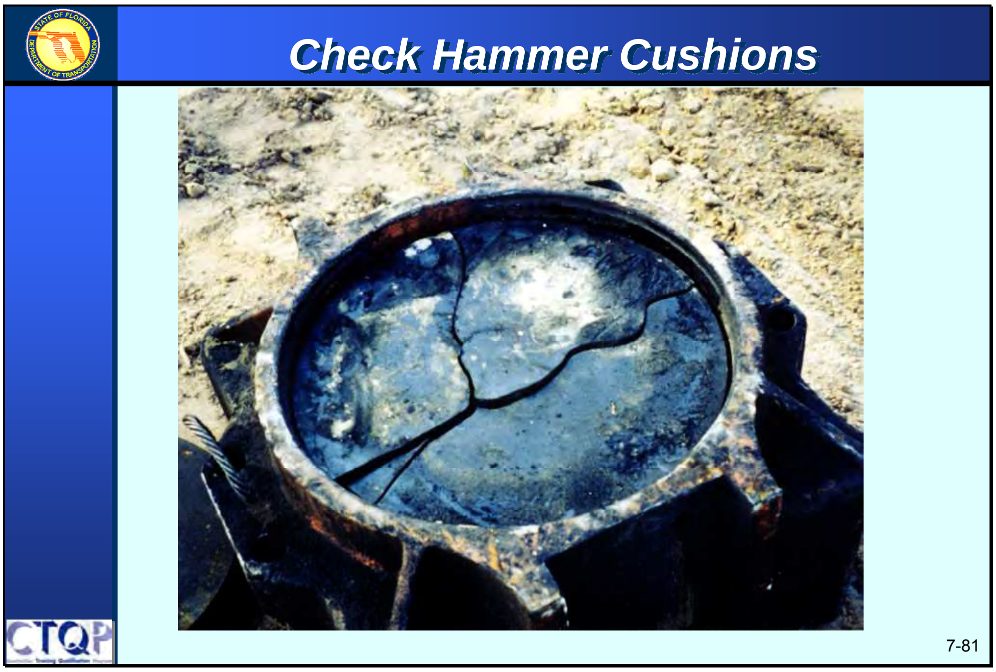
Check Hammer Cushions



7-79

Check Hammer Cushions

7-80


Check Hammer Cushions
CTQP
7-81

455-5.3 Cushions & Pile Helmet

455-5.3.2 Pile Cushion:

…. Maintain pile cushions in good condition and change when charred, splintered, excessively compressed, or otherwise deteriorated to the point it will not protect the pile against overstressing in tension and/or compression. Protect cushions from the weather, and keep them dry. Do not soak the cushions in any liquid. Replace the pile cushion if, during the driving of any pile, the cushion is either compressed more than one-half the original thickness or begins to burn….

7-82

455-5.3 Cushions & Pile Helmet

455-5.3.2 Pile Cushion: (Continued)

…. Provide a new cushion for each pile unless approved otherwise by the Engineer after satisfactory field trial.

Reuse pile cushions in good condition to perform all set-checks and redrives. Use the same cushion to perform the set-check or redrive as was used during the initial driving, unless this cushion is unacceptable due to deterioration, in which case use a similar cushion.

7-83

Check Pile Cushion

The Driving Criteria Letter may specify a different inspection schedule.

Pile cushions shall be maintained in good condition, consisting of new dry pine plywood with a total thickness of approximately 8¾ inches. Pile cushions shall be changed according to the requirements of Section 455-5.3.2 of the Specifications. If pile cushion changes are necessary during driving, piles shall not be accepted during the initial 300 hammer blows unless practical refusal (240 blows for 12 inches or less with the required hammer stroke) is achieved. A new pile cushion shall be provided for each pile at the beginning of driving.

The above pile driving criteria are based on a hammer driving system consisting of an ICE Model 60-S, single-acting, diesel hammer with a hammer cushion comprised of 0.5 inches of aluminum and 2 inches of blue nylon. Preforming for production piles should be conducted in the same manner as the test pile program. If there is a change in the hammer driving system for the piles or the preforming depth and/or techniques, notify the Engineer so new driving criteria can be determined.

7-84

Check Pile Cushion

Question 1: Why might you want a new pile cushion at the start of each pile?

Question 2: Would you want to use a new cushion for set-checks/re-strikes?

7-85

Check Pile Cushion

Question 1: Why might you want a new pile cushion at the start of each pile?

This replicates the Test Pile Program and provides for consistency

Question 2: Would you want to use a new cushion for set-checks/re-strikes?

NO- New cushions compress, so you don't want a new one here. Will throw the blow count out of whack.

CTQP

7-86

Check Pile Cushion

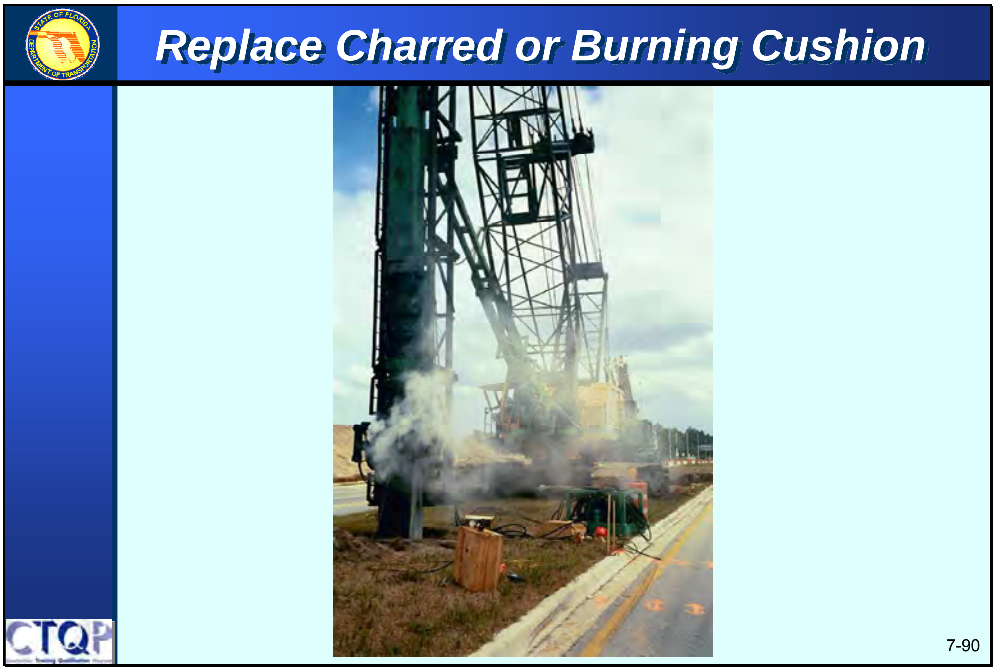
7-87

Check Pile Cushion

7-88

Check Pile Cushion

7-89


Replace Charred or Burning Cushion
CTQP
7-90

Replace Charred or Burning Cushion

7-91


Replace Charred or Burning Cushion
CTQP
7-92

Burning Cushion

7-93

Pile Damage During Driving

7-94

Pile Damage During Driving

7-95

Steel Piles

Typical causes of damage	Possible indicators during driving	Types of damage
• Transporting • Steel Strength • Lifting • Driving (Compression) • Welding • Splices	• Pile moving out of position during driving • Abrupt blow count change	• Bending • Buckling • Accordion • Splitting

7-96

Pile Damage During Driving

7-97

Concrete Piles

Typical causes of damage	Possible indicators during driving	Types of damage
• Casting/stressing • Concrete Strength • Concrete Curing • Transporting • Lifting • Driving (major cause) • Post driving Construction	• Cushions burning or compressed • Puffs of concrete dust coming out of side of pile • Pile walking out of position • Hammer pile alignment bad • Abrupt blow count change	• Spalling- slabbing • Microcracks • Transverse cracks • Longitudinal cracks • Combination cracks • Tip damage

7-98

455-5.10.5 Pile Heave

455-5.10.5 Pile Heave: Pile heave is the upward movement of a pile from its originally driven elevation. Drive the piles in an approved sequence to minimize the effects of heave and lateral displacement of the ground. Monitor piles previously driven in a pile group for possible heave during the driving of the remaining piles. When required by the Engineer, take elevation measurements to determine the magnitude of the movement of piles and the ground surface resulting from the driving process….

7-99

455-5.10.5 Pile Heave

455-5.10.5 Pile Heave: (Continued)

…. Redrive all piles that have heaved 1/4 inch or more unless the Engineer determines that the heave is not detrimental to pile capacity. The Department will pay for all work in conjunction with redriving piles due to pile heave under the Pile Redrive
Item.

7-100

Learning Outcome

Unless otherwise approved by the Engineer, used pile cushions may be utilized to drive up to how many additional piles?

A. None
B. 1
C. 2
D. No limit

Pile “Heave” refers to ___________.

A. The unloading of piles from the transport vehicle.
B. The downward movement of a previously driven pile.
C. The upward movement of a previously driven pile.
D. The act of loading the pile into fixed leads.

7-101

Learning Outcome

Hammer cushions should be inspected before driving begins and at approx. _____ intervals during driving.

A. daily
B. hourly
C. weekly
D. monthly

True or False: Pile cushions are to be replaced when they are Compressed more than 25% of their original thickness?

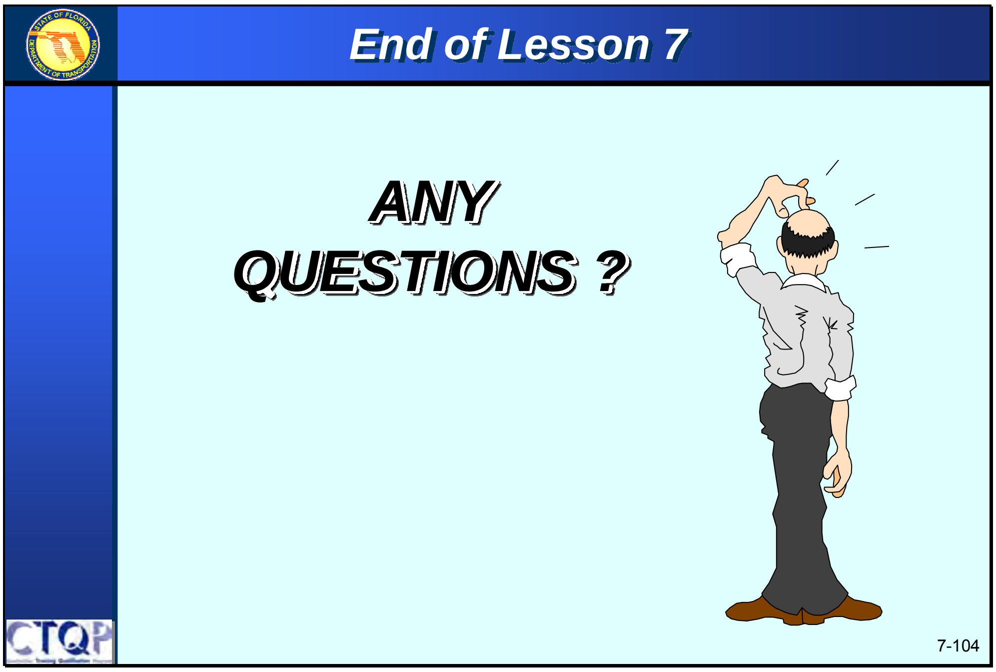
A. True
B. False

7-102

Learning Outcomes

- Monitor and verify proper marking of the piles per contract documents and standards
- Verify & document contractor compliance with applicable tolerances
- Monitor, verify and document pile driving operations
- Identify applicable 455 specifications

7-103


End of Lesson 7
ANY
QUESTIONS ?
7-104

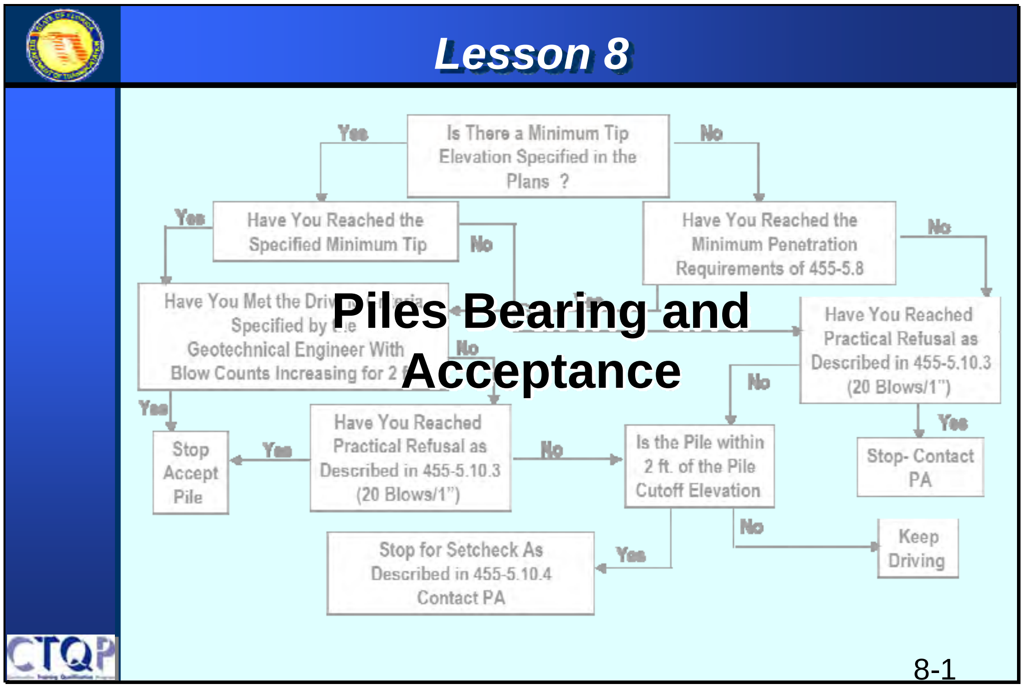
PILE INSPECTOR'S CHECKLIST

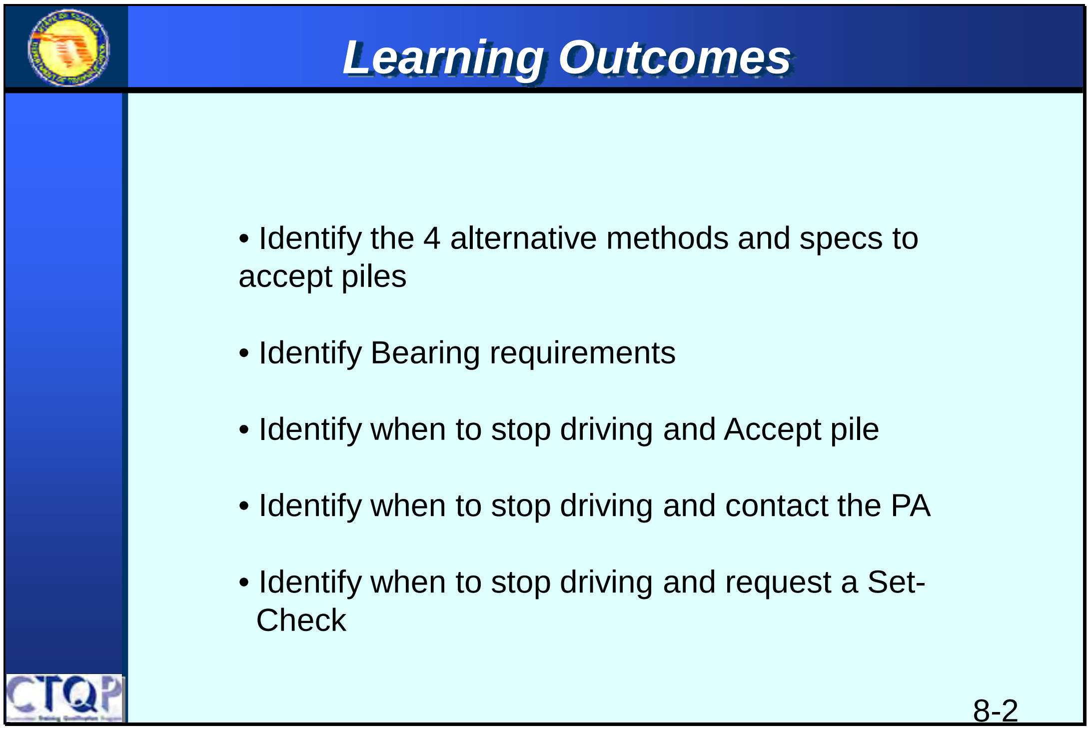
The following is a general checklist to follow when driving a Pile. The answer to each of these, if applicable, should "yes" unless plans, specifications, or specific approval has been given otherwise. CONSULT WITH THE RESPONSIBLE PROJECT ADMINISTRATOR FOR YOUR SPECIFIC PROJECT RESPONSIBILITIES.

EARLY REQUIREMENTS	Yes	No	NA
1. Do you have a copy of the Plans including latest revisions & located relevant items? (ex: Pile Date Table)	1	1	
2. Do you have and reviewed the accepted Pile Installation Plan?	2	2	
3. Are Dynamic Load Tests required and if so, is the PDA Engineer coordinated with?	3	3	
4. Do you have the current version of the FDOT Pile Driving Record form?	4	4	
5. Have you setup Structure Files and Bent/Pier Models in the program?	5	5	
6. Have you made the Initial Pile Data entries and Standard Notes entries in the program?	6	6	
7. Have you scheduled or attended a Pre-Driving meeting with the PA/Geotechnical Engineer?	7	7	
TEST PILE PROGRAM			
8. Has the Contractor met the requirements of 455-1.1, Protection of Existing Structures (or new 108)?	8	8	
9. Has the site preparation been completed for footings/excavations/abutments in accordance with 455-1.2 & 455-1.2.1?	9	9	
10. Have the requirements of 455-1.4, Vibrations of Freshly Placed Concrete been met?	10	10	
11. If a Cofferdam is required, does the Contractor have a qualified diver and safety diver for inspections in accordance with 455-1.3, Cofferdams?	11	11	
12. If underwater diving is required, are the divers equipped with voice communications, per 455-1.3, Cofferdams?	12	12	
13. Does the Contractor have the hammer equipment indicated in the Pile Installation Plan on-site?	13	13	
a. CLOSED END DIESEL HAMMER			
- Does the hammer have at least three fuel settings for the rebound stroke? (455-5.2.2)	A1	A1	
- Does the Contractor have a Bounce Chamber Pressure Gauge? (455-5.2.2)	A2	A2	
- Has the Bounce Chamber been calibrated within the last 30 days and a Chart provided? (455-5.2.2)	A3	A3	
b. OPEN END DIESEL HAMMER			
- Does the hammer have at least three fuel settings for the rebound stroke? (455-5.2.2)	B1	B1	
- Has the Contractor provided the hammer manufacturer's chart equating stroke and blows per minute? (455-5.2.2)	B2	B2	
- Has the Contractor provided an approved device automatically determine and display ram stroke? (455-5.2.2)	B3	B3	
c. AIR/STEAM HAMMER			
- Does the air plant have gauges that are easy to read? (455-5.2.1)	C1	C1	
- Does the hammer have a slide bar capable of a minimum of two stroke height settings? (455-5.2.1)	C2	C2	
d. HYDRAULIC HAMMER			
- Does the hammer have at least three settings for reduced stroke height? (455-5.2.3)	D1	D1	
- Has pressure measuring equipment been calibrated? (455-5.2.3)	D2	D2	
- Have you been provided a means to determine hammer energy? (455-5.3.1)	D3	D3	
14. Is the cap-block (hammer cushion) in good condition? (455-5.3.1)	14	14	
15. Does the cap-block (hammer cushion) match the Contractor's submittal (type, size, thickness, etc.)? (455-5.3.1)	15	15	
16. Is the pile cushion new? (455-5.3.2)	16	16	
17. Does the pile cushion match the Contractor's submittal (type, size, thickness)? (455-5.3.2)	17	17	
18. Does the pile helmet meet the requirements of 455-5.3.3?	18	18	
19. If required, does the template meet the requirements of 455-5.6?	19	19	
20. Has the Contractor furnished elevations per 455-5.6?	20	20	
21. Is a jet pump at the site, ready for use and of the proper size? (455-5.7)	21	21	
22. If Predrilling or Preforming to be done, does the drill meet the requirements of 455-5.1.1 and 455-5.9?	22	22	
23. Do the leads match the Contractor's submittal and meet the requirements of 455-5.4?	23	23	
24. Has the proper type, size, and length of pile and applicable pile documentation been provided?	24	24	
25. Have you inspected the pile for defects and if observed document and modify the PA?	25	25	
26. Has the Contractor marked the pile in the applicable increments?	26	26	
27. Is the test pile located per the plans and meet the requirements of 455-5.15.2?	27	27	
28. Does the pile meet the axial alignment of 455.5.15.3?	28	28	
29. Have you indicated this is a Test Pile in the Pile Driving Record?	29	29	
30. If applicable, have you indicated the pile has EDCs installed in the Pile Driving Record?	30	30	
31. Have you recorded the driving event in the Pile Driving Record?	31	31	

PILE INSPECTOR'S CHECKLIST- PAGE 2

PRODUCTION PILE DRIVING	Yes	No	NA
32. Do you have the Driving Criteria Letter?	32	32	
33. If concrete piles, do you have the authorized Production Pile Lengths Letter?	33	33	
34. Do you have the Accepted Pile Installation Plan?	34	34	
35. Has the Contractor met the requirements for Protection of Existing Structures? (455-1.1 or new 108)	35	35	
36. Has the site preparation been completed for footings/excavations/abutments in accordance with 455-1.2 & 455-1.2.1?	36	36	
37. Have the requirements of 455-1.4, Vibrations of Freshly Placed Concrete been met?	37	37	
38. If a cofferdam is required, have the requirements of 455-1.3, Cofferdams, been met?	38	38	
39. Have you inspected the piles of damage, and if observed, document same and notified the PA? (455-6,7,8,9)	39	39	
40. Does the Contractor's equipment match the accepted Pile Installation Plan or revised Plan from the Test Pile Program?	40	40	
a. cranes			
b. barges			
c. hammer system, including:			
-model, type, serial number			
-capblock cushion type, thickness			
-capblock dimensions, inserts, striker plates			
-variable energy settings			
-hydraulic control indicator, fuel pump setting indicator			
-Saximeter			
-Pile cushion type, thickness			
-follower			
d. Leads			
e. Auger motor and flighting			
f. Auger leads			
g. Punches			
h. Jets and pump			
i. Templates			
-Does the template match the Contractor's submittal?			
-Has a reference been provide to enable determining pile penetration?			
-Can the pile be driven to the cutoff elevation without requiring movement of the template?			
41. Has the Contractor provided an elevation on the template for your use?	41	41	
42. If Predrilling or Preforming, has the Contractor met the plan requirements and you documented the same?	42	42	
43. If grouting of Preformed Pile Holes is required, has this been completed per 455-5.9.5?	43	43	
44. Has the Contractor marked the piles in the correct increments?	44	44	
45. Have you recorded the blows, stroke height/pressure, and applicable notes in the record or program?	45	45	
46. Did splicing of piles meet the requirements of 455-7.7 for concrete and 455-8.3 for steel?	46	46	
47. If specified, has the pile met any Minimum Tip Elevation requirements?	47	47	
48. If no Minimum Tip is specified, has the pile met the Penetration requirements of 455-5.8, Penetration?	48	48	
49. Has the pile met the driving criteria specified in the Driving Criteria Letter?	49	49	
50. Has the pile reached Practical Refusal? (455-5.10.3)	50	50	
51. Do you have a "Setcheck" Criteria?	51	51	
52. If "Setchecks" or "Redrives" are performed, were they documented?	52	52	
53. Have any of the piles "heaved"? (455-5.10.5)	53	53	
54. If so, were they redriven?	54	54	
POST INSTALLATION			
55. Has the Contractor met the tolerances required? (455-5.15, Allowable Tolerances)	55	55	
56. Has the Contractor initiated a plan to protect driven piles from fill placement operations? (455-10)	56	56	
57. Have you been provided the final post-driving elevations and entered them in the Pile Driving Record?	57	57	


Lesson 8
Piles Bearing and Acceptance
Is There a Minimum Tip Elevation Specified in the Plans ?
Yes
No
Have You Reached the Specified Minimum Tip
Have You Reached the Minimum Penetration Requirements of 455-5.8
Geotechnical Engineer With
Have You Reached Practical Refusal as Described in 455-5.10.3 (20 Blows/1")
Stop Accept Pile
Is the Pile within 2 ft. of the Pile Cutoff Elevation
Stop- Contact PA
Keep Driving
Stop for Setcheck As Described in 455-5.10.4 Contact PA
CTQP
8-1


Learning Outcomes
• Identify the 4 alternative methods and specs to accept piles
• Identify Bearing requirements
• Identify when to stop driving and Accept pile
• Identify when to stop driving and contact the PA
• Identify when to stop driving and request a Set-Check
CTQP
8-2

Acceptance Methods

- Standard Test Pile and Driving Criteria
- 100% Instrumented Piles with Test Piles
- 100% Instrumented Piles without Test Piles
- Driving Criteria without Test Piles

8-3

Acceptance Methods

Standard Test Pile and Driving Criteria:

- It's how our Standards Specifications have been written so far.
- Test Piles are driven first and monitored. Information is obtained during the Dynamic Load Testing to determine production pile lengths and driving criteria.
- Piles will be accepted when at least 24" consecutive driving achieves a blow count (generally increasing) that meets or exceeds the blow count criteria and the minimum penetration/minimum tip elevation requirements are met.

8-4

Acceptance Methods

100% Instrumented piles with Test Piles

• All Piles, test piles and production piles are dynamically tested and monitored.

•Test Piles are driven first to determine production pile lengths.

•No Driving Criteria is required.

•The PDA/EDC operator will stop the driving at 6” of capacity if the minimum penetration/minimum tip elevation requirements are met.

8-5

Acceptance Methods

100% Instrumented piles without Test Piles

- No Test Piles. All production pile lengths are already indicated in the plans.
- All production piles are dynamically tested and monitored.
- No Production lengths letter is required. No Driving Criteria is required.
- The PDA/EDC operator will stop the driving at 6” of capacity if the minimum penetration/minimum tip elevation requirements are met.

8-6

Acceptance Methods

Driving Criteria without test piles:

• No Test Piles. All production pile lengths are already indicated in the plans.

• The first production pile of every bent or pier is monitored to establish driving criteria.

• Piles will be accepted when at least 24" consecutive driving achieves a blow count (generally increasing) that meets or exceeds the blow count criteria and the minimum penetration/minimum tip elevation requirements are met.

8-7

455-5.10 Bearing Requirements

455-5.10.1 General:

…. The Engineer may accept a driven pile when the pile has achieved minimum penetration, the blow count is generally increasing and the minimum required bearing capacity obtained for 24 inches of consecutive driving. At his discretion, the Engineer may also accept a driven pile when the minimum penetration is achieved and driving has reached practical refusal in firm material.

8-8

455-5.10 Bearing Requirements

455-5.10.2 Blow Count Criteria: The Engineer will determine the number of blows required to provide the required bearing according to the methods described herein. Determine the pile bearing by computing the penetration per blow with less than 1/4 inch rebound averaged through 12 inches each of penetration. When it is considered necessary by the Engineer, determine the average penetration per blow by averaging the penetration per blow through the last 10 to 20 blows of the hammer.

8-9

455-5.10 Bearing Requirements

455-5.10.3 Practical Refusal: Practical refusal is defined as 20 blows per inch with the hammer operating at the highest setting or setting determined by the Engineer and less than 1/4 inch rebound per blow. Stop driving as soon as the Engineer determines that the pile has reached practical refusal. The Engineer will generally make this determination within 2 inches of driving. When the required pile penetration cannot be achieved by driving without exceeding practical refusal, use other penetration aids such as jetting or Preformed Pile Hole.

8-10

455-5.10 Bearing Requirements

455-5.10.4 Set-checks and Pile Redrive:

(a) Set-checks: In the event that the Contractor has driven the pile to approximately 12 inches above cut-off without reaching the required resistance, the Engineer may require the Contractor to interrupt driving to perform a set-check. Provide an engineer's level or other suitable equipment for elevation determinations to determine accurate pile penetration during the set-checks. In the event the results of the initial set-checks are not satisfactory, the Engineer may direct additional set-checks. The Engineer may accept the pile as driven when a set-check shows that the Contractor has achieved the minimum required pile bearing and has met all other requirements of this Section.

8-11

455-5.10 Bearing Requirements

455-5.10.4 Set-checks and Pile Redrive:

(b) Pile Redrive: Pile redrive consists of redriving the pile after the following working day from initial driving to determine time effects, to reestablish pile capacity due to pile heave, or for other reasons determined by the Engineer. Redrive piles as directed by the Engineer.

8-12

What Determines When to Stop Driving

- Driving Criteria Letter
- Minimum Tip Elevation
- Penetration Requirements
- Practical Refusal
- Cutoff Elevation

8-13

Driving Criteria Letter

…..may be stopped if one of the following….

End Bent 1

Pile driving of the 65 foot, 250 kips Ultimate Bearing Capacity (UBC) production piles may be stopped if one of the following conditions is met:

1. Practical Refusal (20 blows per inch with at least a 5.5 ft stroke) is reached during driving and the pile tip is at or below the minimum tip elevation.

2. The required blow count at the respective stroke is achieved for two consecutive feet and the pile tip is at or below the minimum tip elevation. The blows per foot required for the respective strokes are as follows:

	Blows per foot	
Stroke (ft)	Pile Tip Above Elevation +4 ft	Pile Tip At or Below Elevation +4 ft
5.5	77	52
6.0	67	42
6.5	61	36

Practical refusal (20 blows per inch with at least a 7.0 foot stroke)……and tip is at or below the minimum tip elevation of –1.0 foot….

The required blowcount versus its respective stroke is achieved for two consecutive feet… and tip at or below the minimum tip elevation of –1.0 foot…

8-14

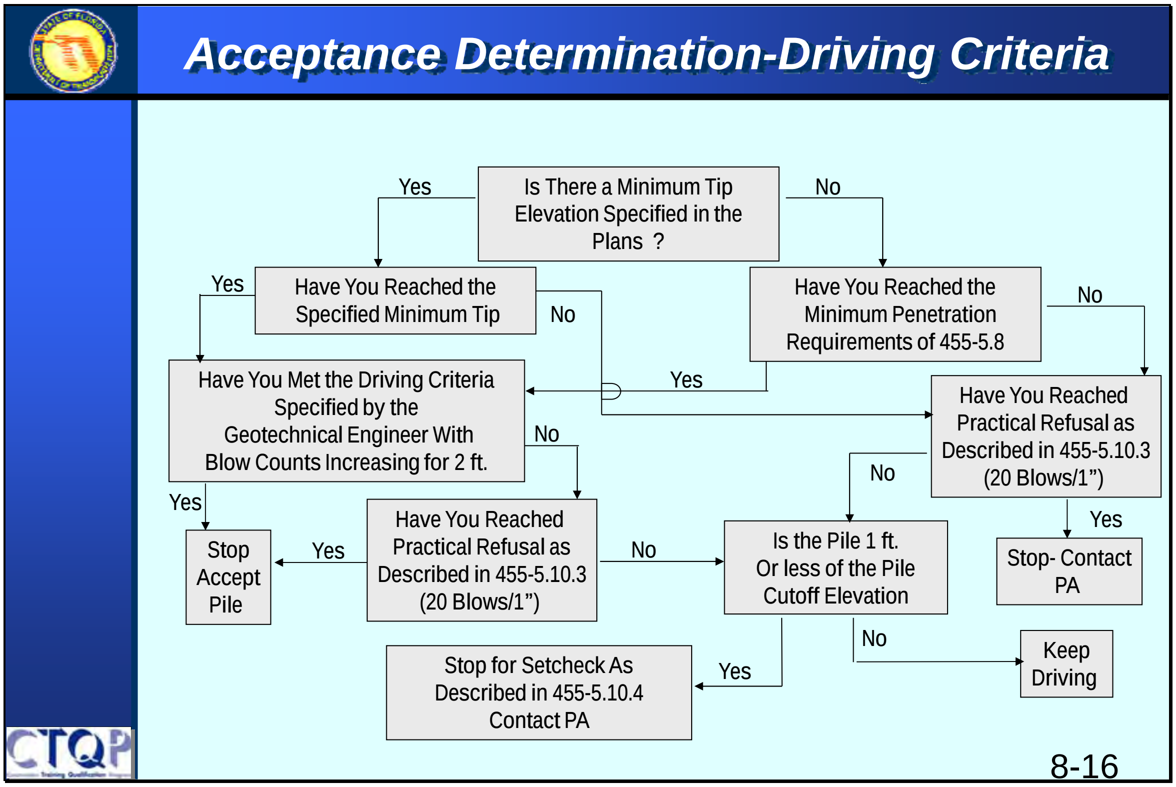
Cutoff Elevation

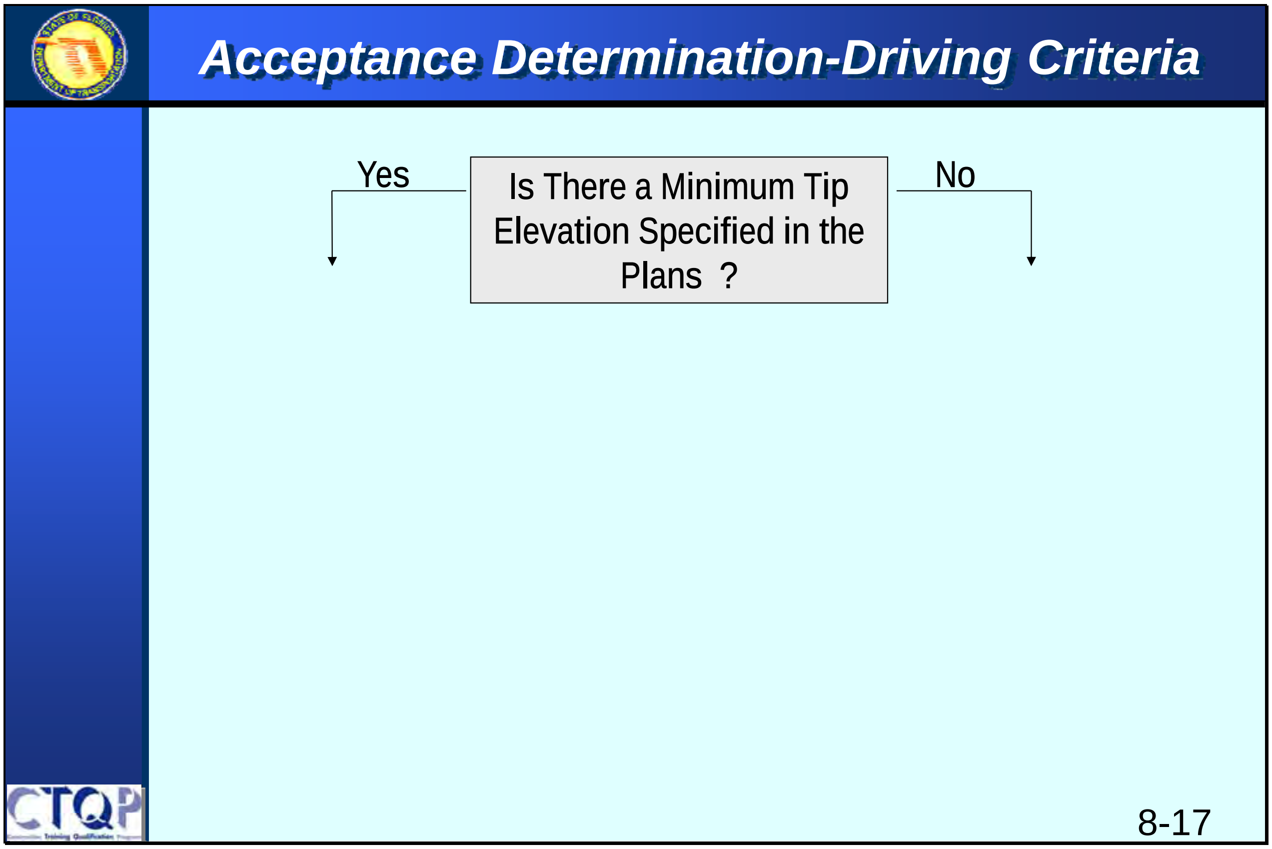
This decision is not as much as a “Pile Acceptance”, but:

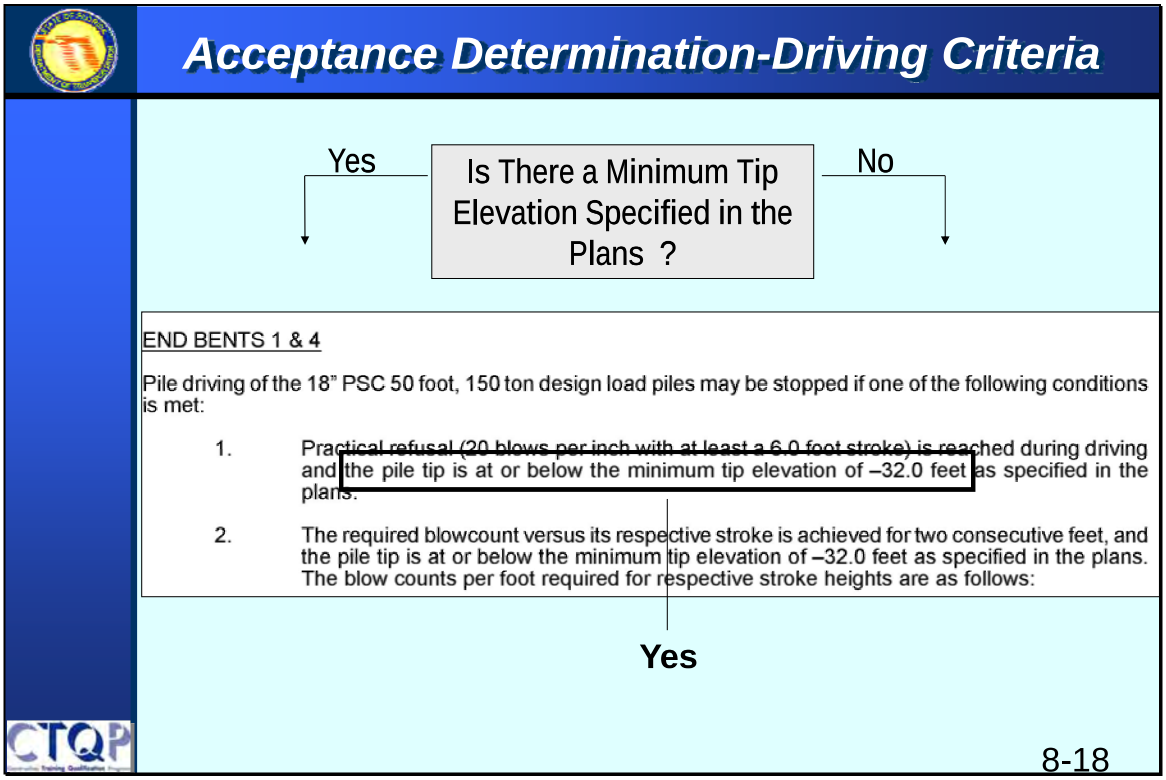
- Avoid potentially driving pile past the cutoff elevation
- Potentially perform Set-Check
- Can have financial ramifications

NEED TO THINK

8-15


Acceptance Determination-Driving Criteria
Is There a Minimum Tip Elevation Specified in the Plans ?
Yes
No
Have You Reached the Specified Minimum Tip
Yes
No
Have You Reached the Minimum Penetration Requirements of 455-5.8
No
Yes
Have You Met the Driving Criteria Specified by the Geotechnical Engineer With Blow Counts Increasing for 2 ft.
Have You Reached Practical Refusal as Described in 455-5.10.3 (20 Blows/1")
No
Yes
No
Stop Accept Pile
Yes
Have You Reached Practical Refusal as Described in 455-5.10.3 (20 Blows/1")
No
Is the Pile 1 ft. Or less of the Pile Cutoff Elevation
Yes
Stop- Contact PA
No
Keep Driving
Yes
Stop for Setcheck As Described in 455-5.10.4 Contact PA
CTQP
8-16


Acceptance Determination-Driving Criteria
Yes
Is There a Minimum Tip Elevation Specified in the Plans ?
No
8-17


Acceptance Determination-Driving Criteria
Yes
Is There a Minimum Tip Elevation Specified in the Plans ?
No
END BENTS 1 & 4
Pile driving of the 18" PSC 50 foot, 150 ton design load piles may be stopped if one of the following conditions is met:
1. Practical refusal (20 blows per inch with at least a 6.0 foot stroke) is reached during driving and the pile tip is at or below the minimum tip elevation of –32.0 feet as specified in the plans.
2. The required blowcount versus its respective stroke is achieved for two consecutive feet, and the pile tip is at or below the minimum tip elevation of –32.0 feet as specified in the plans. The blow counts per foot required for respective stroke heights are as follows:
Yes
CTQP
8-18

Acceptance Determination-Driving Criteria

Yes | Is There a Minimum Tip Elevation Specified in the Plans ? | No

NO

INTERMEDIATE BENTS 2 & 3

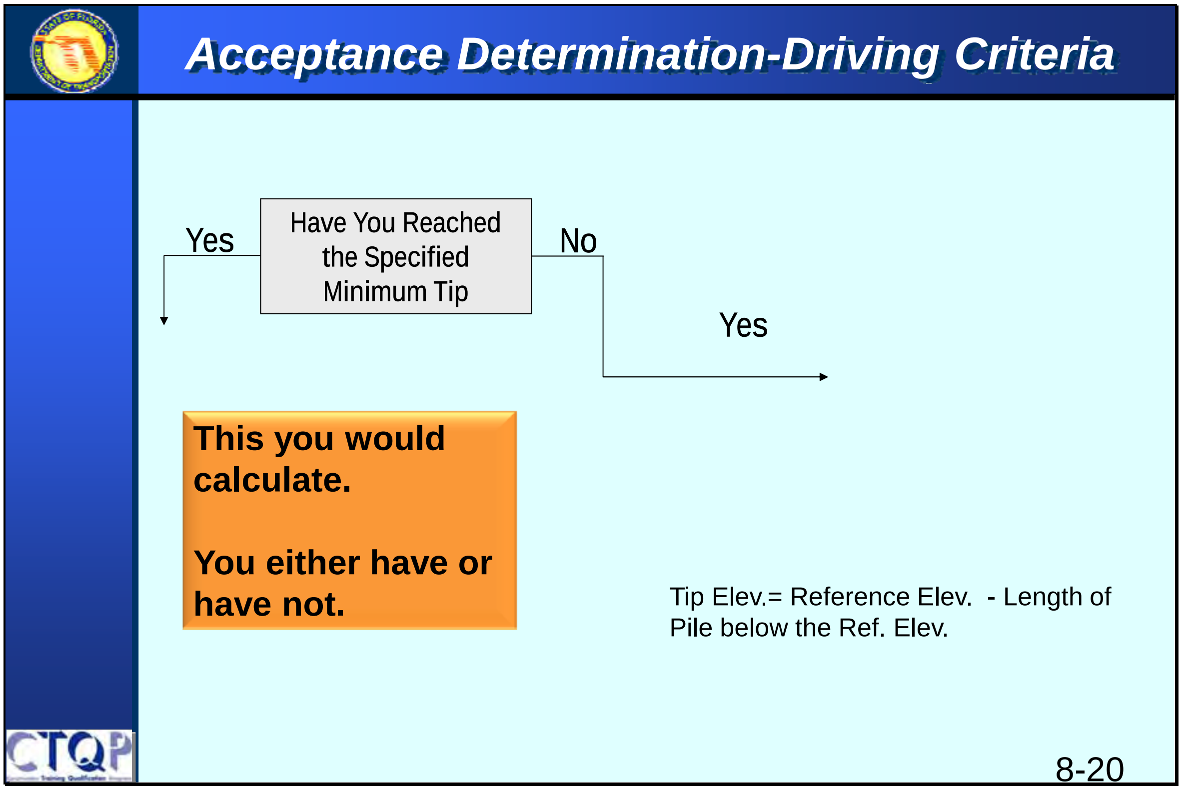
Pile driving of the 18" PSC 50 foot, 180 ton design load piles may be stopped if one of the following conditions is met:

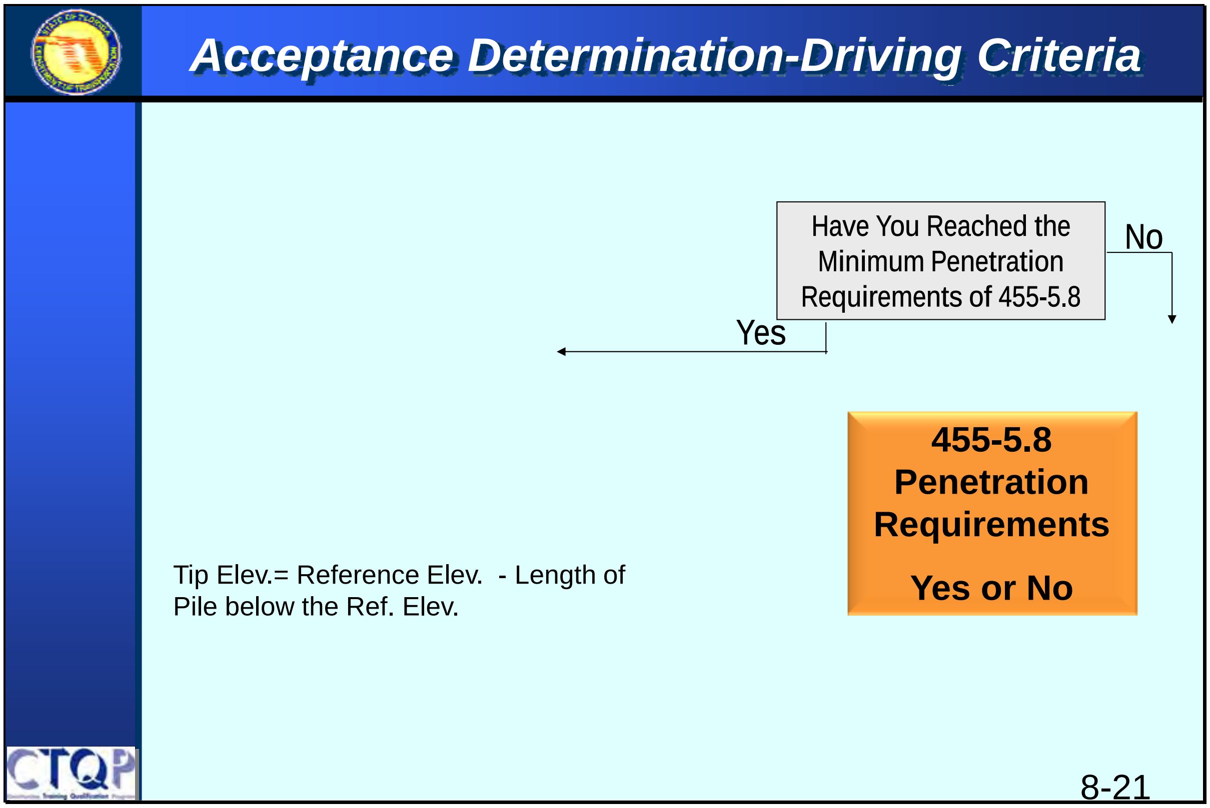
1. Practical refusal (20 blows per inch with at least a 6.0 foot stroke) is reached during driving and the pile has achieved the minimum penetration requirements specified in 455-5.8.

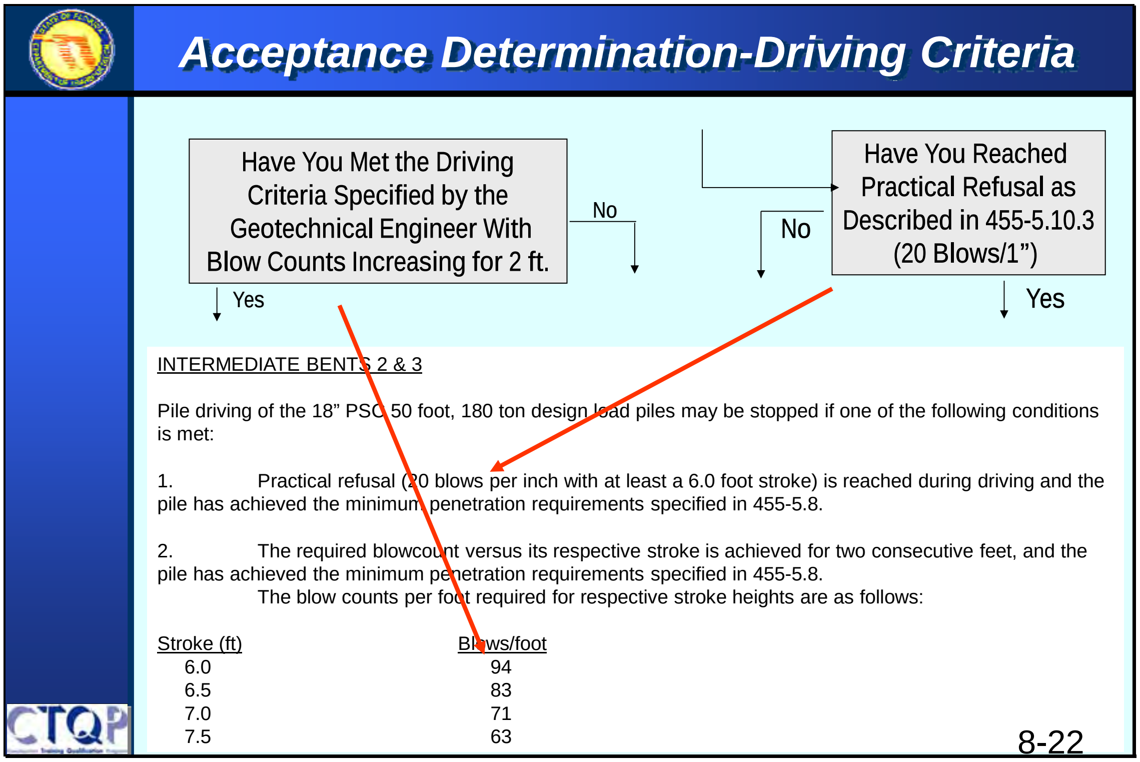
2. The required blowcount versus its respective stroke is achieved for two consecutive feet, and the pile has achieved the minimum penetration requirements specified in 455-5.8.
The blow counts per foot required for respective stroke heights are as follows:

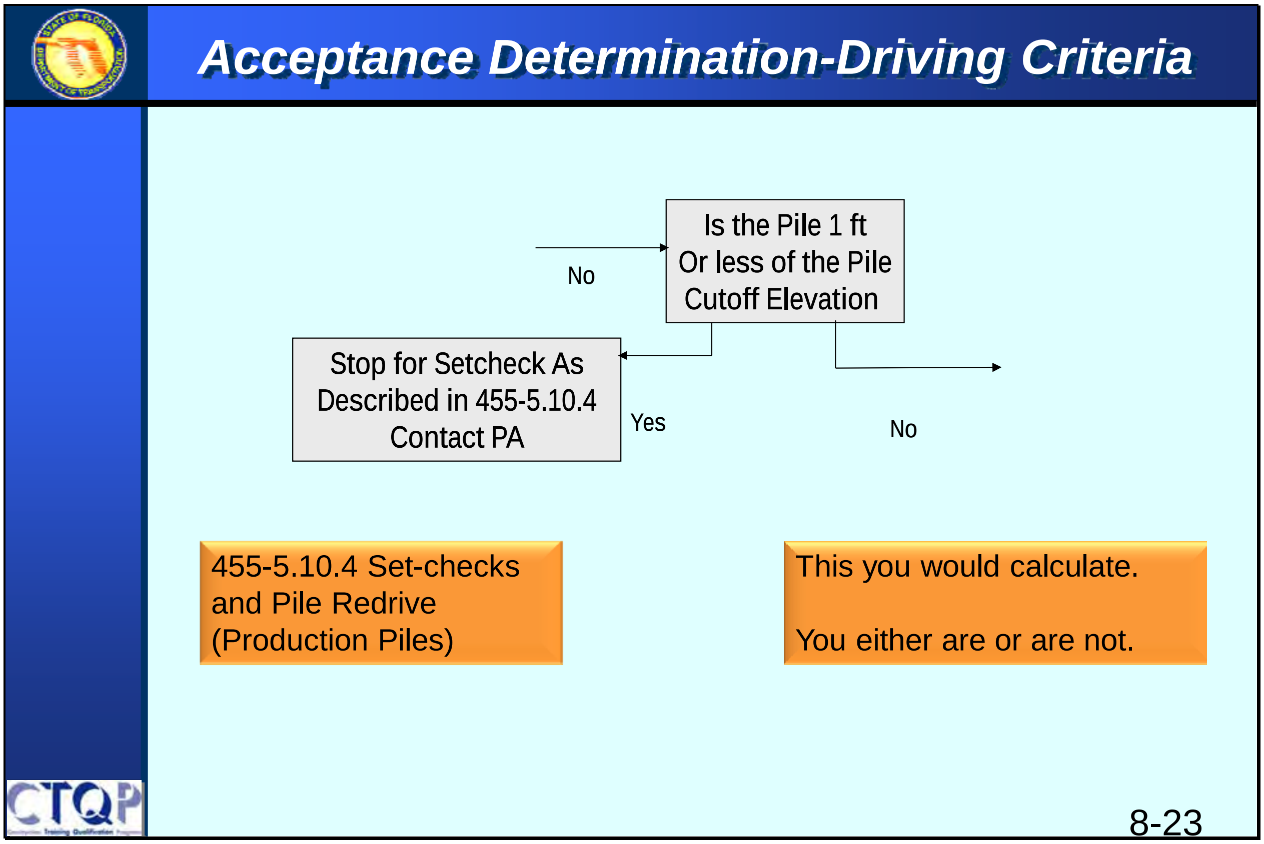
CTQP

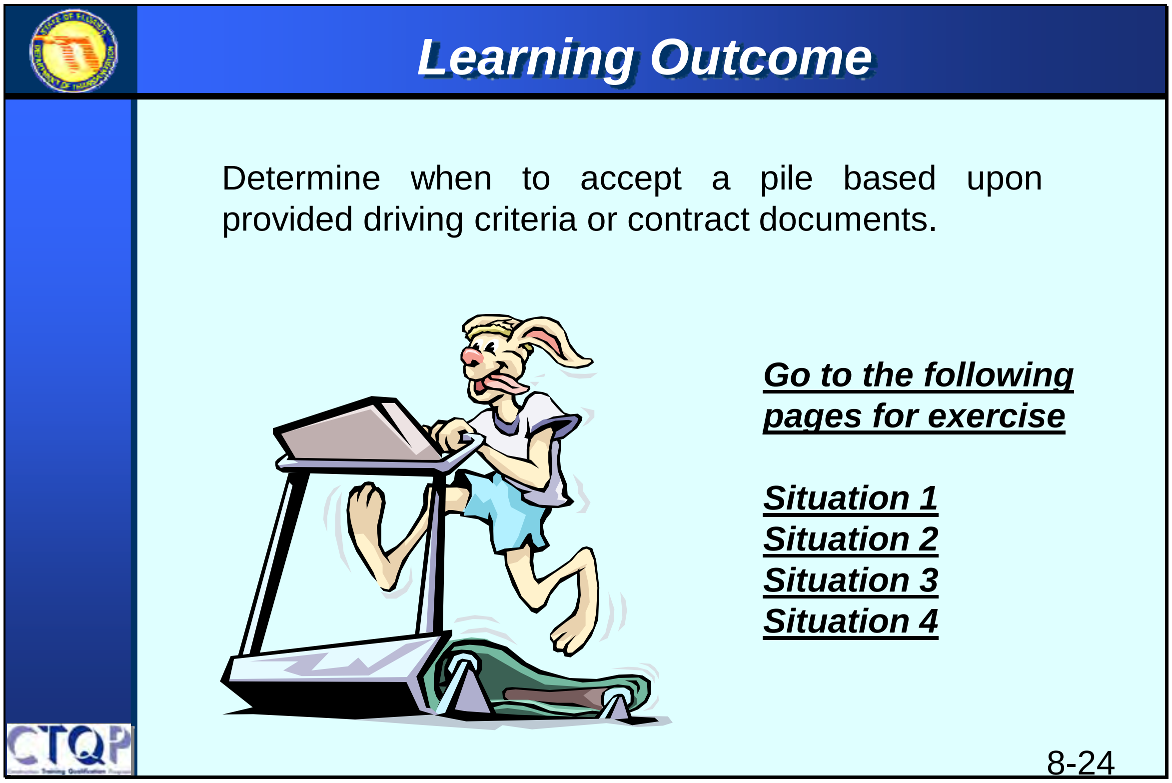
8-19


Acceptance Determination-Driving Criteria
Have You Reached the Specified Minimum Tip
Yes
No
Yes
This you would calculate.
You either have or have not.
Tip Elev.= Reference Elev. - Length of Pile below the Ref. Elev.
CTQP
8-20


Acceptance Determination-Driving Criteria
Have You Reached the Minimum Penetration Requirements of 455-5.8
No
Yes
455-5.8 Penetration Requirements
Yes or No
Tip Elev.= Reference Elev. - Length of Pile below the Ref. Elev.
8-21


Acceptance Determination-Driving Criteria
Have You Met the Driving Criteria Specified by the Geotechnical Engineer With Blow Counts Increasing for 2 ft.
No
Yes
Have You Reached Practical Refusal as Described in 455-5.10.3 (20 Blows/1")
No
Yes
INTERMEDIATE BENTS 2 & 3
Pile driving of the 18" PSC 50 foot, 180 ton design load piles may be stopped if one of the following conditions is met:
1. Practical refusal (20 blows per inch with at least a 6.0 foot stroke) is reached during driving and the pile has achieved the minimum penetration requirements specified in 455-5.8.
2. The required blowcount versus its respective stroke is achieved for two consecutive feet, and the pile has achieved the minimum penetration requirements specified in 455-5.8.
The blow counts per foot required for respective stroke heights are as follows:
Stroke (ft) Blows/foot
6.0 94
6.5 83
7.0 71
7.5 63
CTQP
8-22


Acceptance Determination-Driving Criteria
Is the Pile 1 ft
Or less of the Pile
Cutoff Elevation
No
Stop for Setcheck As
Described in 455-5.10.4
Contact PA
Yes
No
455-5.10.4 Set-checks
and Pile Redrive
(Production Piles)
This you would calculate.
You either are or are not.
8-23



We will now work out four examples. We will decide at every of the four scenarios what to do next. We will work through the Acceptance Determination Chart based upon given information. The first Driving Criteria Letter is to be used for Situations 1 to 3. The second Driving Criteria Letter is to be used for Situation 4.

Situation 1

Situations 1-3

January 12, 2000

Mr. Jerry Dean Haig
Tanstaafl Construction Company
P. O. Box 9112
Medium City, Florida 36789

Subject: Driving Criteria for Pile Class When to Stop Driving
Some County, Florida
Financial Project ID: 1234567-89-10
Williams Project Number: C444445

Dear Mr. Haig:

Williams Earth Sciences, Inc. has completed the review of the test pile data for the subject bridge. The recommended driving criteria is as follows:

END BENTS 1 & 4

Pile driving of the 18" PSC 50 foot, 150 ton design load piles may be stopped if one of the following conditions is met:

1. Practical refusal (20 blows per inch with at least a 6.0 foot stroke) is reached during driving and the pile tip is at or below the minimum tip elevation of –32.0 feet as specified in the plans.

2. The required blowcount versus its respective stroke is achieved for two consecutive feet, and the pile tip is at or below the minimum tip elevation of –32.0 feet as specified in the plans. The blow counts per foot required for respective stroke heights are as follows:

Stroke (ft)	Blows/foot
6.0	78
6.5	65
7.0	58
7.5	52

8-25

Here is the driving criteria letter. Is there a minimum tip specified? If so, what is it?

Situation 1

Situations 1-3

January 12, 2000

Mr. Jerry Dean Haig
Tanstaafl Construction Company
P. O. Box 9112
Medium City, Florida 36789

Subject: Driving Criteria for Pile Class When to Stop Driving
Some County, Florida
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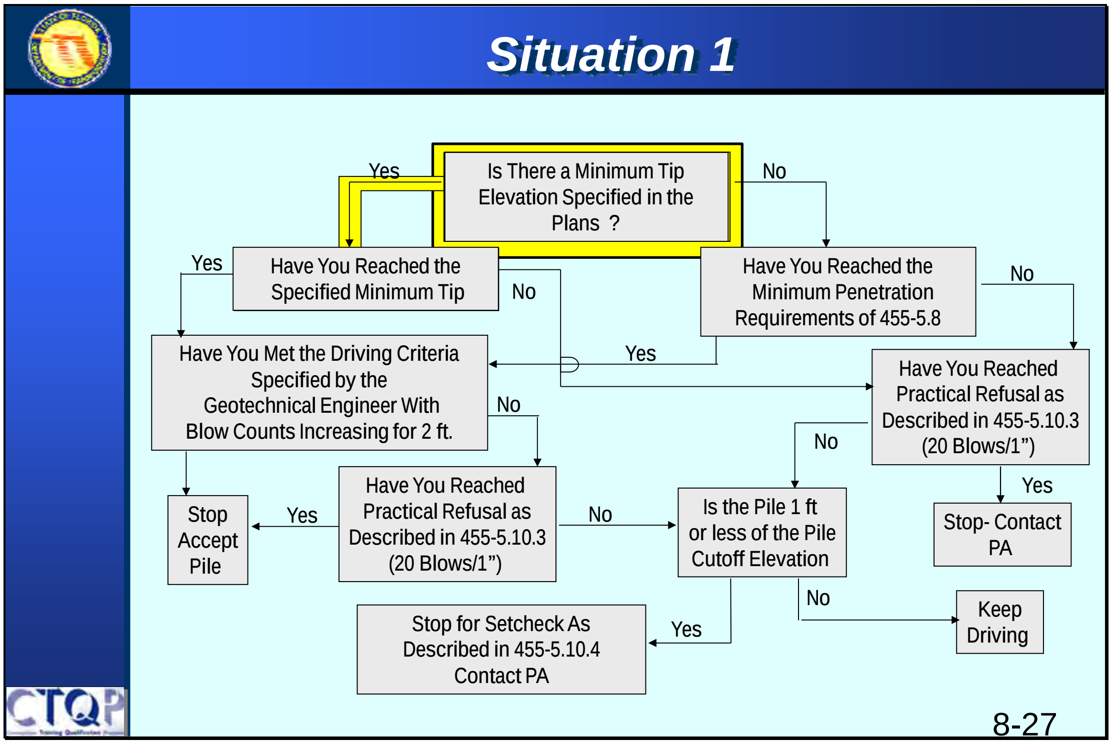
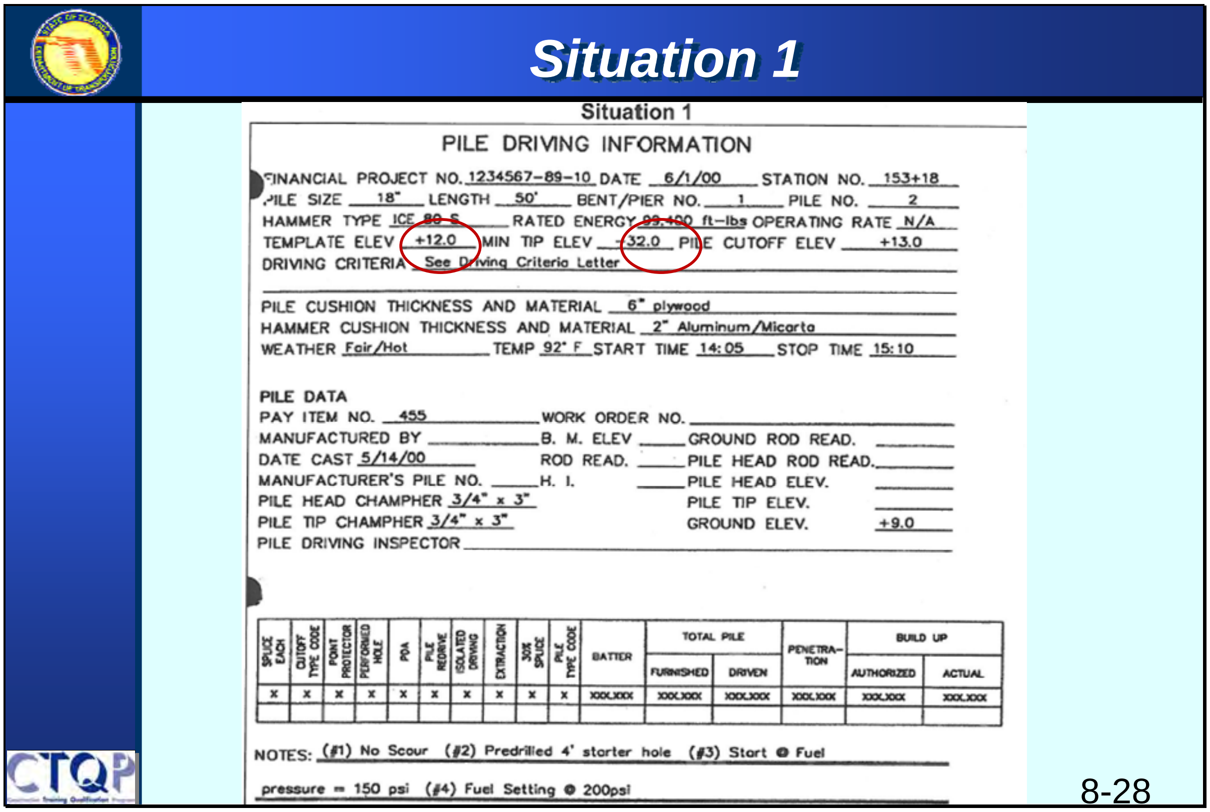
2. The required blowcount versus its respective stroke is achieved for two consecutive feet, and the pile tip is at or below the minimum tip elevation of –32.0 feet as specified in the plans. The blow counts per foot required for respective stroke heights are as follows:

Stroke (ft)	Blows/foot
6.0	78
6.5	65
7.0	58
7.5	52

8-26

Here is the minimum tip elevation requirement.


Situation 1
Is There a Minimum Tip Elevation Specified in the Plans ?
Yes
No
Have You Reached the Specified Minimum Tip
Have You Reached the Minimum Penetration Requirements of 455-5.8
Yes
No
No
Have You Met the Driving Criteria Specified by the Geotechnical Engineer With Blow Counts Increasing for 2 ft.
Yes
Have You Reached Practical Refusal as Described in 455-5.10.3 (20 Blows/1")
No
No
Have You Reached Practical Refusal as Described in 455-5.10.3 (20 Blows/1")
Yes
Stop Accept Pile
Yes
No
Is the Pile 1 ft or less of the Pile Cutoff Elevation
Stop- Contact PA
No
Keep Driving
Yes
Stop for Setcheck As Described in 455-5.10.4 Contact PA
CTQP
8-27



Situation 1

PILE DRIVING INFORMATION

FINANCIAL PROJECT NO. 1234567-89-10 DATE 6/1/00 STATION NO. 153+18
PILE SIZE 18" LENGTH 50' BENT/PIER NO. 1 PILE NO. 2
HAMMER TYPE ICE 80-S RATED ENERGY 99,400 ft-lbs OPERATING RATE N/A
TEMPLATE ELEV +12.0 MIN TIP ELEV -32.0 PILE CUTOFF ELEV +13.0
DRIVING CRITERIA See Driving Criteria Letter

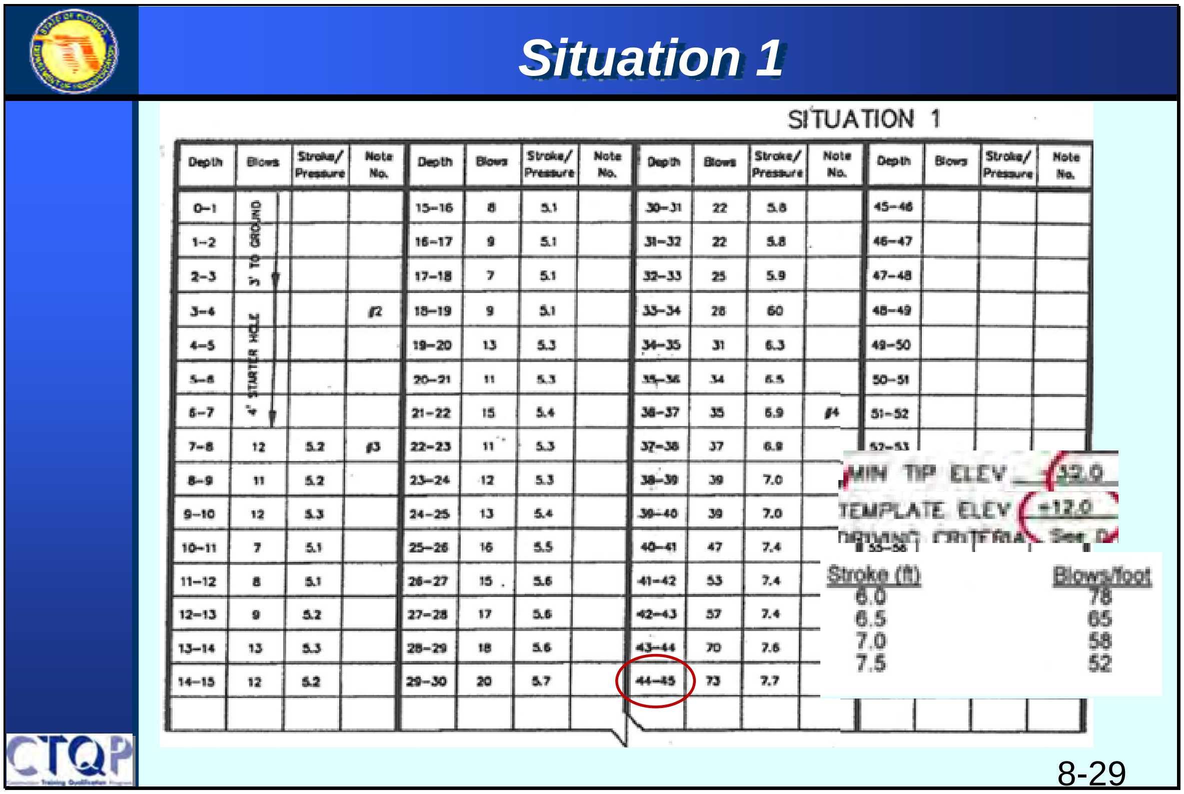
PILE CUSHION THICKNESS AND MATERIAL 6" plywood
HAMMER CUSHION THICKNESS AND MATERIAL 2" Aluminum/Micarta
WEATHER Fair/Hot TEMP 92° F START TIME 14:05 STOP TIME 15:10

PILE DATA
PAY ITEM NO. 455 WORK ORDER NO.
MANUFACTURED BY B. M. ELEV GROUND ROD READ.
DATE CAST 5/14/00 ROD READ. PILE HEAD ROD READ.
MANUFACTURER'S PILE NO. H. I. PILE HEAD ELEV.
PILE HEAD CHAMPHER 3/4" x 3" PILE TIP ELEV.
PILE TIP CHAMPHER 3/4" x 3" GROUND ELEV. +9.0
PILE DRIVING INSPECTOR

SPLICE EACH	CUTOFF TYPE CODE	POINT PROTECTOR	PERFORMED HOLE	PDA	PILE REDRIVE	ISOLATED DRIVING	EXTRACTION	30% SPLICE	PILE TYPE CODE	BATTER	TOTAL PILE		PENETRATION	BUILD UP	
											FURNISHED	DRIVEN		AUTHORIZED	ACTUAL
X	X	X	X	X	X	X	X	X	X	XXX.XXX	XXX.XXX	XXX.XXX	XXX.XXX	XXX.XXX	XXX.XXX

NOTES: (#1) No Scour (#2) Predrilled 4' starter hole (#3) Start @ Fuel pressure = 150 psi (#4) Fuel Setting @ 200psi

Here is the pile information from the driving record. The template elevation is the reference elevation.



SITUATION 1

Depth	Blows	Stroke/ Pressure	Note No.	Depth	Blows	Stroke/ Pressure	Note No.	Depth	Blows	Stroke/ Pressure	Note No.	Depth	Blows	Stroke/ Pressure	Note No.
0–1	3' TO GROUND			15–16	8	5.1		30–31	22	5.8		45–46			
1–2				16–17	9	5.1		31–32	22	5.8		46–47			
2–3				17–18	7	5.1		32–33	25	5.9		47–48			
3–4	4" STARTER HOLE		#2	18–19	9	5.1		33–34	28	60		48–49			
4–5				19–20	13	5.3		34–35	31	6.3		49–50			
5–6				20–21	11	5.3		35–36	34	6.5		50–51			
6–7				21–22	15	5.4		36–37	35	6.9	#4	51–52			
7–8	12	5.2	#3	22–23	11	5.3		37–38	37	6.9		52–53			
8–9	11	5.2		23–24	12	5.3		38–39	39	7.0					
9–10	12	5.3		24–25	13	5.4		39–40	39	7.0					
10–11	7	5.1		25–26	16	5.5		40–41	47	7.4					
11–12	8	5.1		26–27	15	5.6		41–42	53	7.4					
12–13	9	5.2		27–28	17	5.6		42–43	57	7.4					
13–14	13	5.3		28–29	18	5.6		43–44	70	7.6					
14–15	12	5.2		29–30	20	5.7		44–45	73	7.7					

MIN TIP ELEV 12.0

TEMPLATE ELEV +12.0

DRIVING CRITERIA See

Stroke (ft)	Blows/foot
6.0	78
6.5	65
7.0	58
7.5	52

Here is the blow count information with strokes and depth (below template) information. Make the decision: At the depth the pile tip is now, can we stop and accept the pile?

(Hint: compute what is the pile tip elevation, then see if the blow count criterion is met.)

Situation 1

SITUATION 1

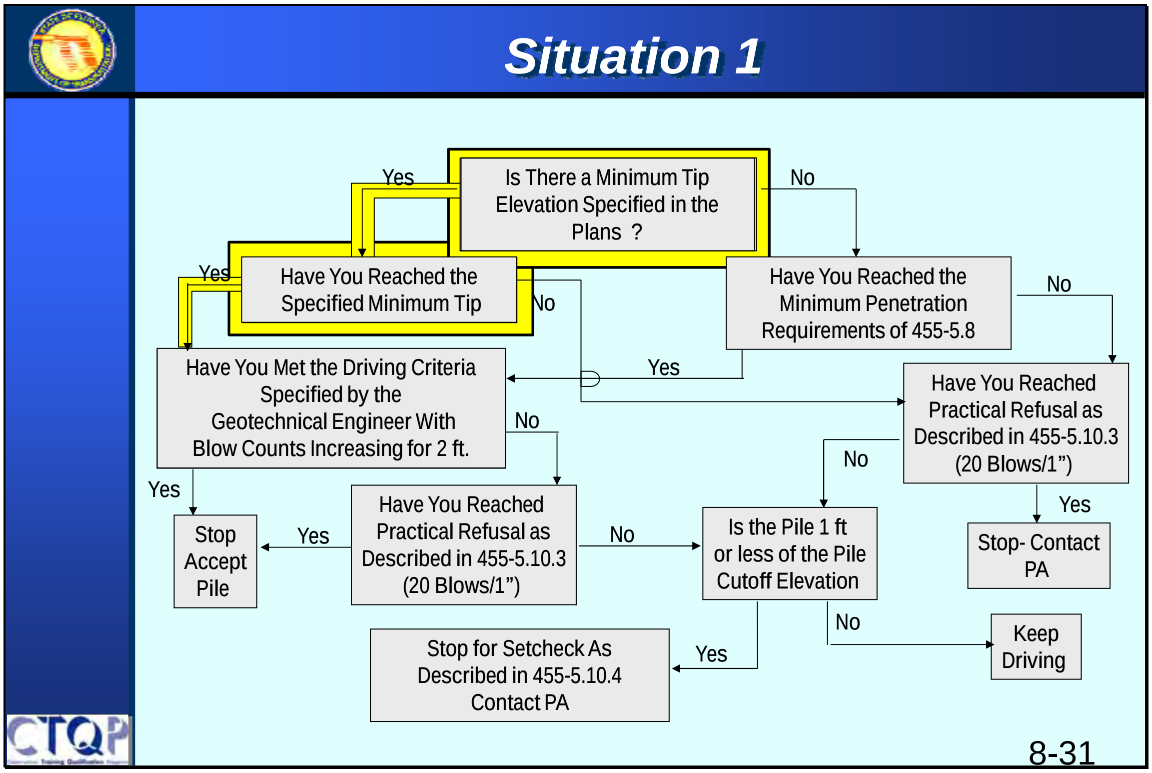
Depth	Blows	Stroke/ Pressure	Note No.	Depth	Blows	Stroke/ Pressure	Note No.	Depth	Blows	Stroke/ Pressure	Note No.	Depth	Blows	Stroke/ Pressure	Note No.
0–1	3' TO GROUND			15–16	8	5.1		30–31	22	5.8		45–46			
1–2				16–17	9	5.1		31–32	22	5.8		46–47			
2–3				17–18	7	5.1		32–33	25	5.9		47–48			
3–4	4' STARTER HOLE		#2	18–19	9	5.1		33–34	28	60		48–49			
4–5				19–20	13	5.3		34–35	31	6.3		49–50			
5–6				20–21	11	5.3		35–36	34	6.5		50–51			
6–7				21–22	15	5.4		36–37	35	6.9	#4	51–52			
7–8	12	5.2	#3	22–23	11	5.3		37–38	37	6.9					
8–9	11	5.2		23–24	12	5.3		38–39	39	7.0					
9–10	12	5.3		24–25	13	5.4		39–40	39	7.0					
10–11	7	5.1		25–26	16	5.5		40–41	47	7.4		55–56			
11–12	8	5.1		26–27	15	5.6		41–42	53	7.4					
12–13	9	5.2		27–28	17	5.6		42–43	57	7.4					
13–14	13	5.3		28–29	18	5.6		43–44	70	7.6					
14–15	12	5.2		29–30	20	5.7		44–45	73	7.7					

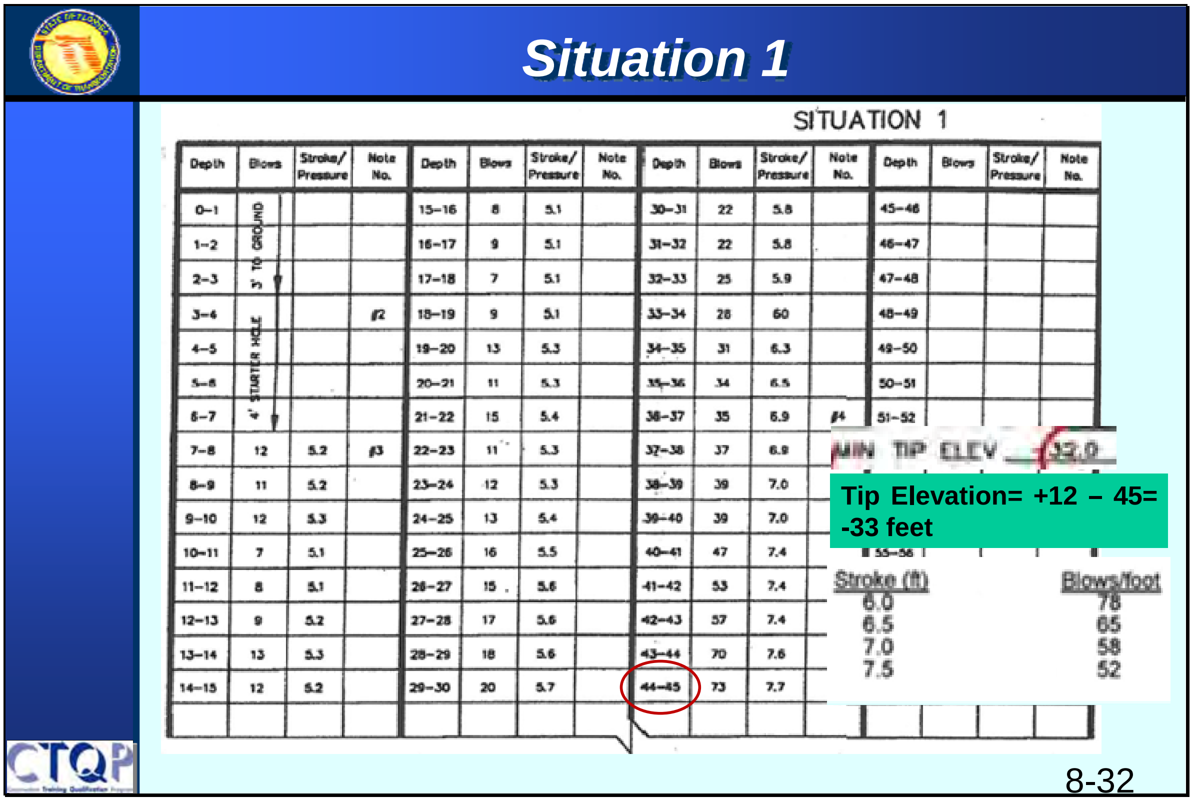
MIN TIP ELEV ___ [illegible]

Tip Elevation= +12 – 45= -33 feet

Stroke (ft)	Blows/foot
6.0	78
6.5	65
7.0	58
7.5	52

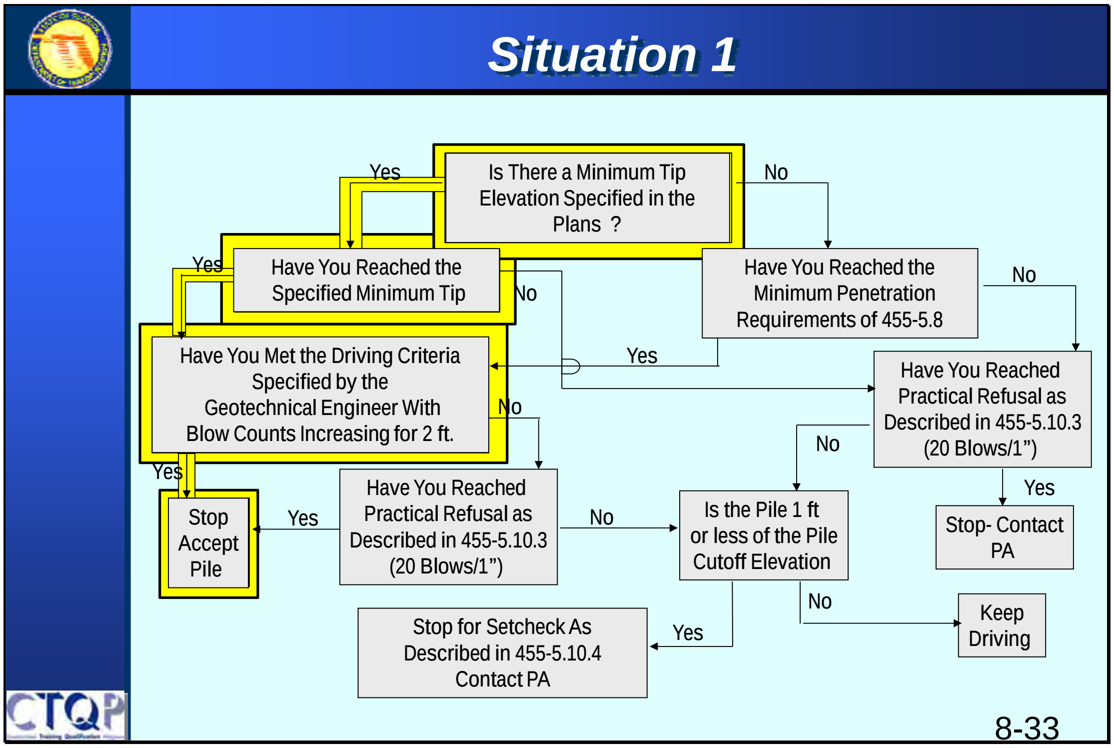
8-30


Situation 1
Is There a Minimum Tip Elevation Specified in the Plans ?
Yes
No
Have You Reached the Specified Minimum Tip
Have You Reached the Minimum Penetration Requirements of 455-5.8
Yes
No
No
Have You Met the Driving Criteria Specified by the Geotechnical Engineer With Blow Counts Increasing for 2 ft.
Yes
Have You Reached Practical Refusal as Described in 455-5.10.3 (20 Blows/1")
No
No
Yes
Have You Reached Practical Refusal as Described in 455-5.10.3 (20 Blows/1")
Stop Accept Pile
Yes
No
Is the Pile 1 ft or less of the Pile Cutoff Elevation
Yes
Stop- Contact PA
No
Keep Driving
Stop for Setcheck As Described in 455-5.10.4 Contact PA
Yes
8-31

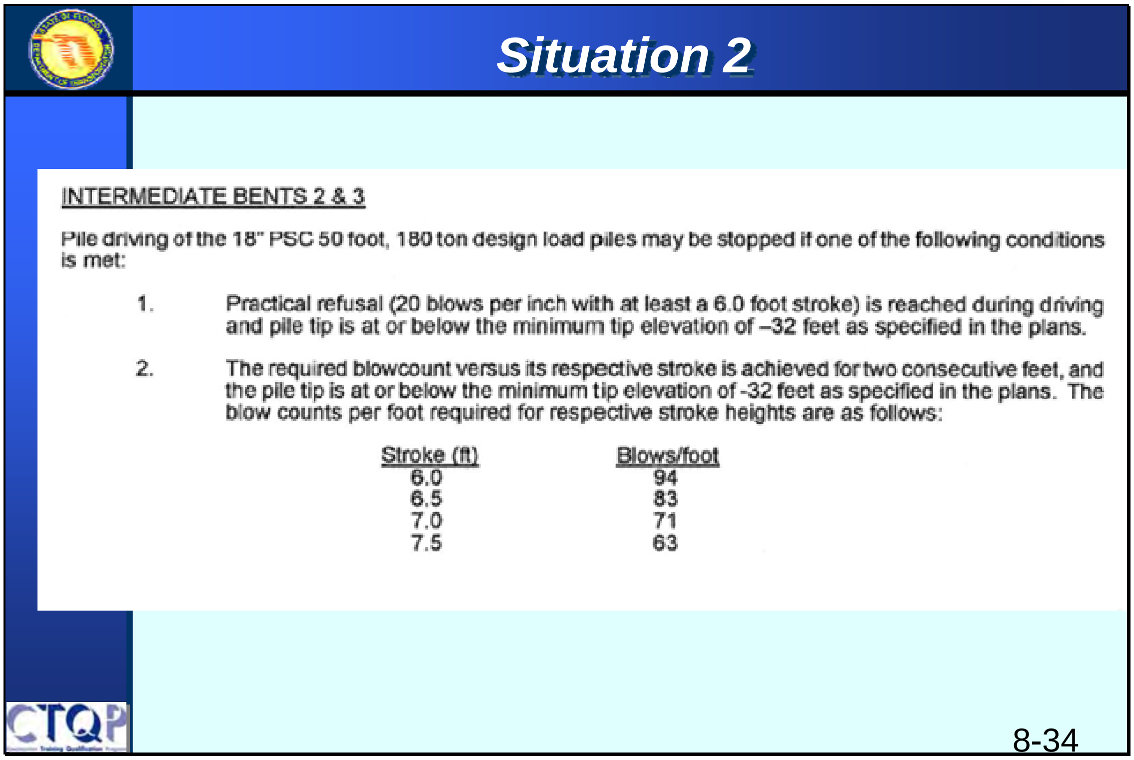


Depth	Blows	Stroke/ Pressure	Note No.	Depth	Blows	Stroke/ Pressure	Note No.	Depth	Blows	Stroke/ Pressure	Note No.	Depth	Blows	Stroke/ Pressure	Note No.
0–1	3' TO GROUND			15–16	8	5.1		30–31	22	5.8		45–46			
1–2				16–17	9	5.1		31–32	22	5.8		46–47			
2–3				17–18	7	5.1		32–33	25	5.9		47–48			
3–4	4' STARTER HOLE		#2	18–19	9	5.1		33–34	28	60		48–49			
4–5				19–20	13	5.3		34–35	31	6.3		49–50			
5–6				20–21	11	5.3		35–36	34	6.5		50–51			
6–7				21–22	15	5.4		36–37	35	6.9	#4	51–52			
7–8	12	5.2	#3	22–23	11	5.3		37–38	37	6.9					
8–9	11	5.2		23–24	12	5.3		38–39	39	7.0					
9–10	12	5.3		24–25	13	5.4		39–40	39	7.0					
10–11	7	5.1		25–26	16	5.5		40–41	47	7.4		55–56			
11–12	8	5.1		26–27	15	5.6		41–42	53	7.4					
12–13	9	5.2		27–28	17	5.6		42–43	57	7.4					
13–14	13	5.3		28–29	18	5.6		43–44	70	7.6					
14–15	12	5.2		29–30	20	5.7		44–45	73	7.7					

Stroke (ft)	Blows/foot
6.0	78
6.5	65
7.0	58
7.5	52



We met minimum tip and blow count criterion therefore the pile can be accepted.



Now work out situation 2. Criteria are given above. Driving Record is shown in the next couple of slides. Question is, for the pile at the current tip (see record next couple of slides), can the pile be accepted or what should we do?

Situation 2

Situation 2

PILE DRIVING INFORMATION

FINANCIAL PROJECT NO. 1234567-89-10 DATE 6/5/00 STATION NO. 153+58
PILE SIZE 18" LENGTH 50' BENT/PIER NO. 2 PILE NO. 5
HAMMER TYPE ICE 80 S RATED ENERGY 99,400 ft-lbs OPERATING RATE N/A
TEMPLATE ELEV +12.0 MIN TIP ELEV -32.0 PILE CUTOFF ELEV +13.0
DRIVING CRITERIA See Driving Criteria Letter

PILE CUSHION THICKNESS AND MATERIAL 6" plywood
HAMMER CUSHION THICKNESS AND MATERIAL 2" Aluminum/Micarta
WEATHER Fair/Hot TEMP 91° F START TIME 09:10 STOP TIME 10:20

PILE DATA
PAY ITEM NO. 455 WORK ORDER NO. ____
MANUFACTURED BY ____ B. M. ELEV ____ GROUND ROD READ. ____
DATE CAST 5/14/00 ROD READ. ____ PILE HEAD ROD READ. ____
MANUFACTURER'S PILE NO. ____ H. I. ____ PILE HEAD ELEV. ____
PILE HEAD CHAMPHER 3/4" x 3" PILE TIP ELEV. ____
PILE TIP CHAMPHER 3/4" x 3" GROUND ELEV. +8.0
PILE DRIVING INSPECTOR ____

SPLICE EACH	CUTOFF TYPE CODE	POINT PROTECTOR	PERFORMED HOLE	PDA	PILE REDRIVE	ISOLATED DRIVING	EXTRACTION	30X SPLICE	PILE TYPE CODE	BATTER	TOTAL PILE		PENETRA-TION	BUILD UP	
											FURNISHED	DRIVEN		AUTHORIZED	ACTUAL
X	X	X	X	X	X	X	X	X	X	XXX.XXX	XXX.XXX	XXX.XXX	XXX.XXX	XXX.XXX	XXX.XXX

NOTES: (#1) Scour elev = -8 Ft (#2) 4' Starter Hole (#3) Start @ Fuel pressure = 150 psi (#4) Increase to Fuel pressure = 200psi (#5) Stop & Check for Practical Refusal

8-35

Situation 2

Situation 2

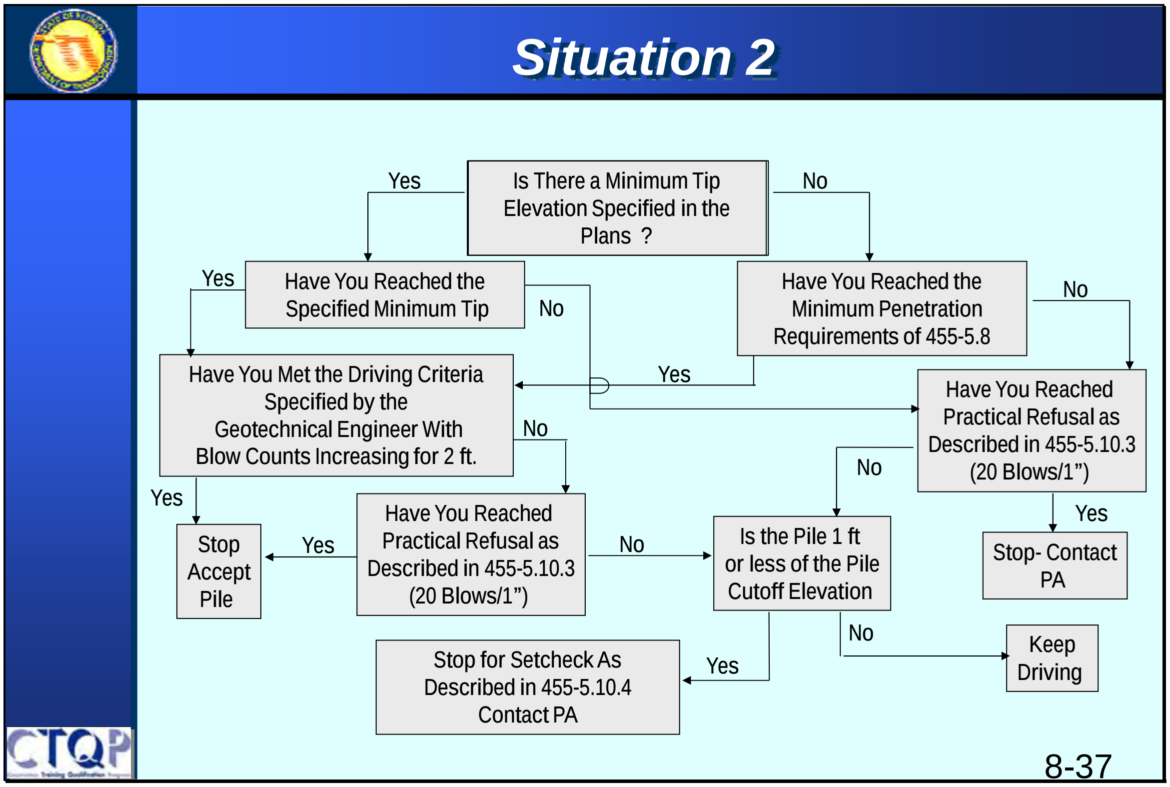
Depth	Blows	Stroke/ Pressure	Note No.	Depth	Blows	Stroke/ Pressure	Note No.	Depth	Blows	Stroke/ Pressure	Note No.	Depth	Blows	Stroke/ Pressure	Note No.
0–1				15–16	11	5.1		30–31	15	5.5					
1–2	4" TO GROUND			16–17	10	5.2		31–32	17	5.6					
2–3				17–18	8	5.1		32–33	19	5.7					
3–4				18–19	9	5.1		33–34	21	5.8					
4–5			#2	19–20	13	5.2		34–35	19	5.9					
5–6	4" STARTER HOLE			20–21	11	5.2		35–36	22	6.0					
6–7				21–22	9	5.1		36–37	19	6.0					
7–8				22–23	7	5.1		37–38	20	6.0					
8–9	7	5.1	#3	23–24	8	5.1		38–39	18	5.9					
9–10	9	5.2		24–25	10	5.3		39–40	17	5.8					
10–11	10	5.3		25–26	15	5.4		40–41	18	6.0					
11–12	10	5.3		26–27	13	5.3		41–42	20	5.9					
12–13	9	5.2		27–28	17	5.4		42–43	23	6.1					
13–14	7	5.1		28–29	15	5.6		43–44	48	6.9	#4				
14–15	5	5.0		29–30	13	5.5		+0"–1"	20	7.5	#5				
								+1"–2"	22	7.5					

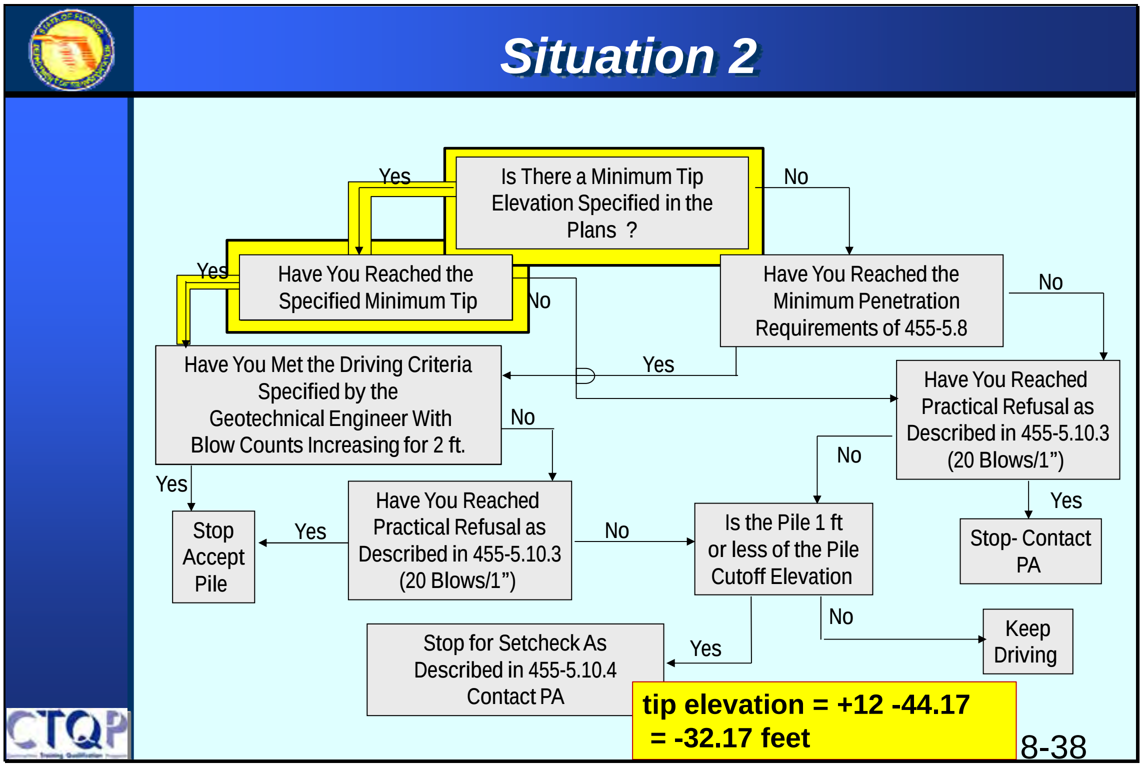
TEMPLATE ELEV +12.0

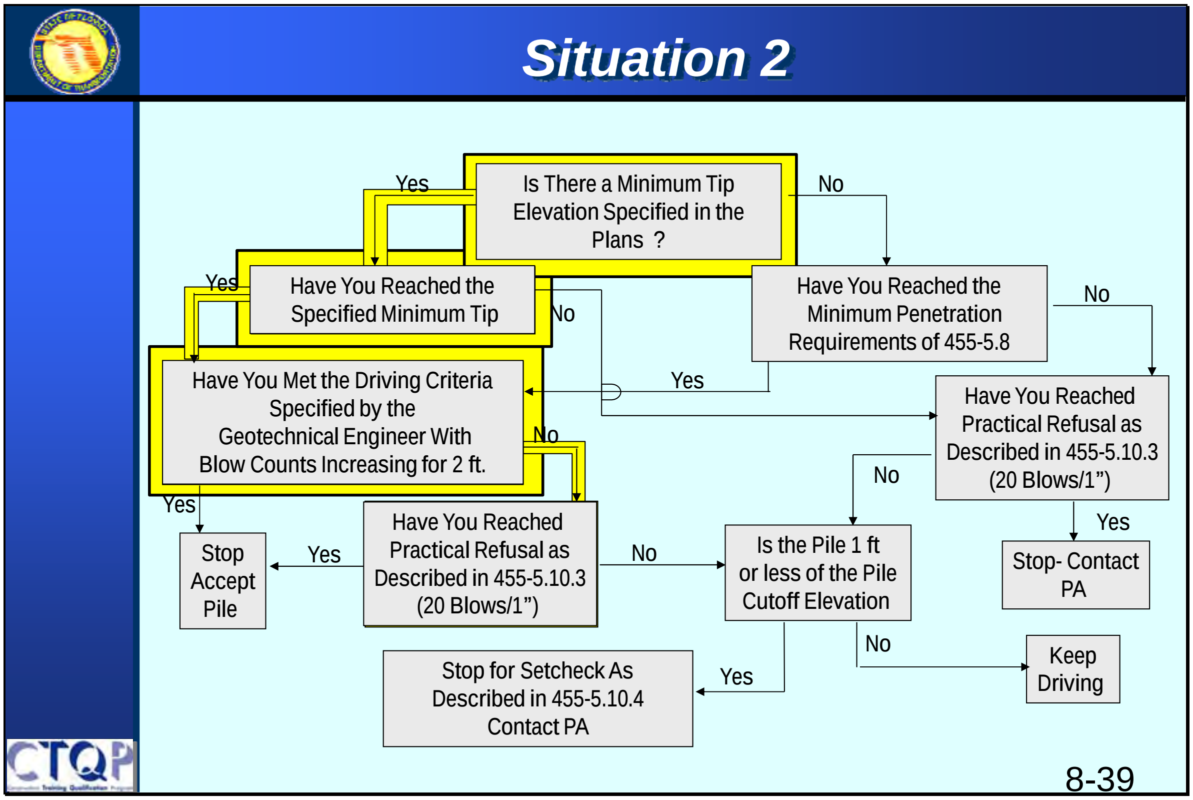
MIN TIP ELEV -32.0

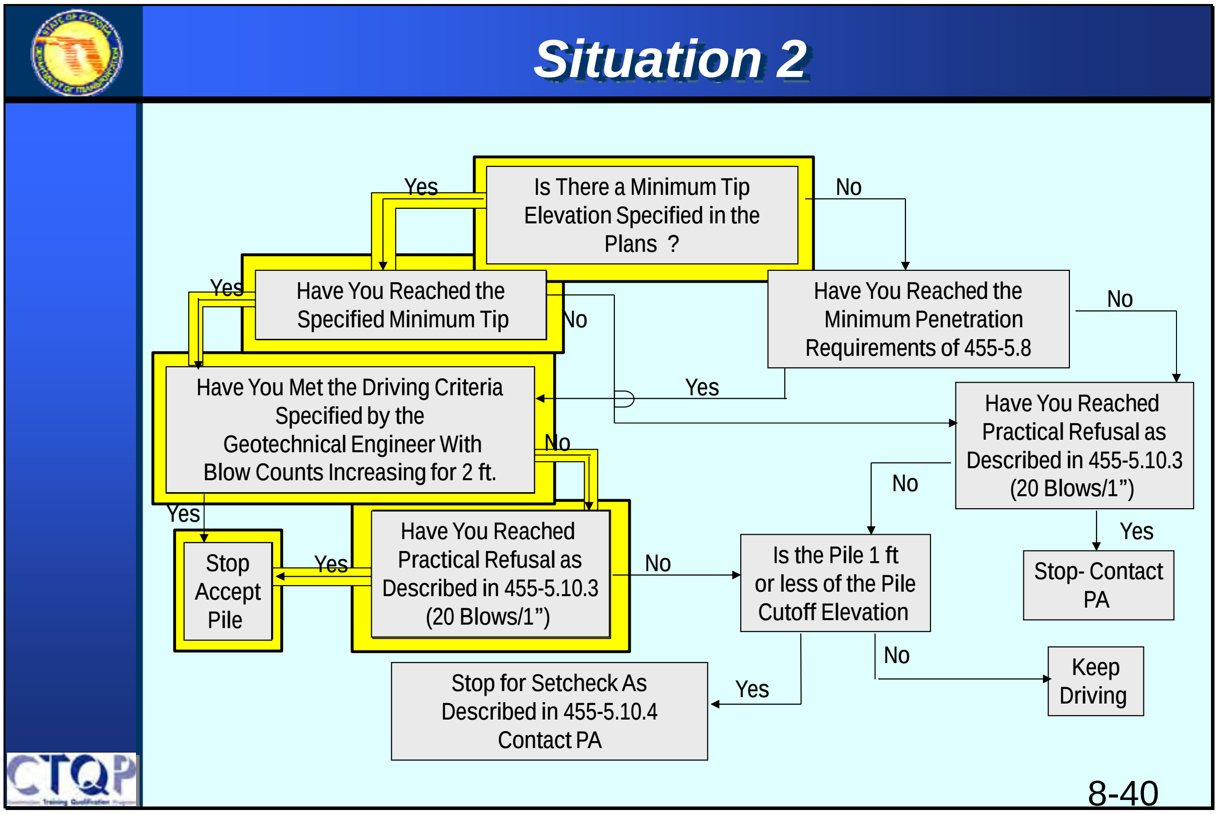
Stroke (ft)	Blows/foot
6.0	94
6.5	83
7.0	71
7.5	63

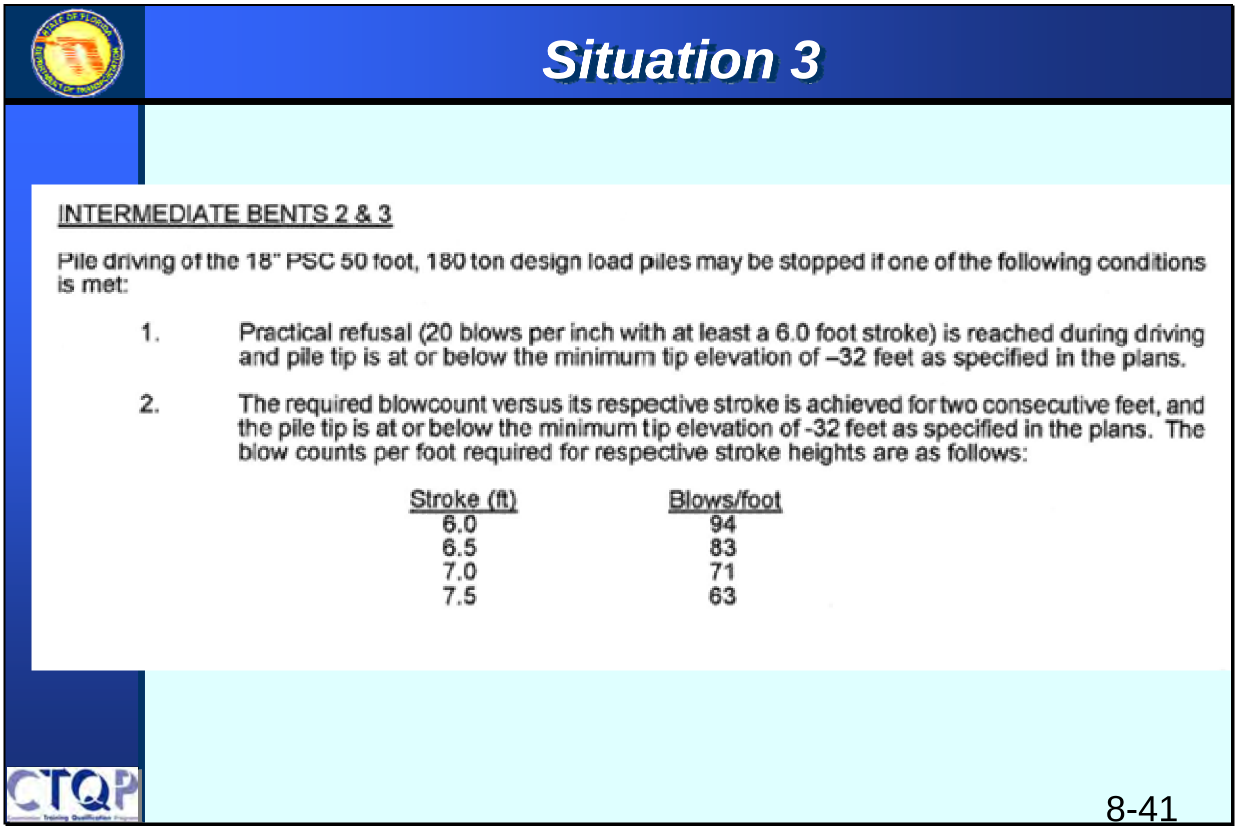
8-36


Situation 2
Is There a Minimum Tip Elevation Specified in the Plans ?
Yes
No
Have You Reached the Specified Minimum Tip
Yes
No
Have You Reached the Minimum Penetration Requirements of 455-5.8
No
Yes
Have You Met the Driving Criteria Specified by the Geotechnical Engineer With Blow Counts Increasing for 2 ft.
Have You Reached Practical Refusal as Described in 455-5.10.3 (20 Blows/1")
No
Yes
Stop Accept Pile
Yes
Have You Reached Practical Refusal as Described in 455-5.10.3 (20 Blows/1")
No
Is the Pile 1 ft or less of the Pile Cutoff Elevation
No
Yes
Stop- Contact PA
No
Keep Driving
Yes
Stop for Setcheck As Described in 455-5.10.4 Contact PA
8-37


Situation 2
Is There a Minimum Tip Elevation Specified in the Plans ?
Yes
No
Have You Reached the Specified Minimum Tip
Yes
No
Have You Reached the Minimum Penetration Requirements of 455-5.8
No
Have You Met the Driving Criteria Specified by the Geotechnical Engineer With Blow Counts Increasing for 2 ft.
Yes
Have You Reached Practical Refusal as Described in 455-5.10.3 (20 Blows/1")
No
Yes
Stop Accept Pile
Yes
Have You Reached Practical Refusal as Described in 455-5.10.3 (20 Blows/1")
No
Is the Pile 1 ft or less of the Pile Cutoff Elevation
No
Yes
Stop- Contact PA
Stop for Setcheck As Described in 455-5.10.4 Contact PA
Yes
No
Keep Driving
tip elevation = +12 -44.17
= -32.17 feet
8-38


Situation 2
Is There a Minimum Tip Elevation Specified in the Plans ?
Yes
No
Have You Reached the Specified Minimum Tip
Yes
No
Have You Reached the Minimum Penetration Requirements of 455-5.8
No
Yes
Have You Met the Driving Criteria Specified by the Geotechnical Engineer With Blow Counts Increasing for 2 ft.
No
Yes
Have You Reached Practical Refusal as Described in 455-5.10.3 (20 Blows/1")
No
Yes
Stop- Contact PA
Stop Accept Pile
Yes
Have You Reached Practical Refusal as Described in 455-5.10.3 (20 Blows/1")
No
Is the Pile 1 ft or less of the Pile Cutoff Elevation
No
Keep Driving
Yes
Stop for Setcheck As Described in 455-5.10.4 Contact PA
8-39


Situation 2
Is There a Minimum Tip Elevation Specified in the Plans ?
Yes
No
Have You Reached the Specified Minimum Tip
Yes
No
Have You Reached the Minimum Penetration Requirements of 455-5.8
No
Have You Met the Driving Criteria Specified by the Geotechnical Engineer With Blow Counts Increasing for 2 ft.
Yes
No
Have You Reached Practical Refusal as Described in 455-5.10.3 (20 Blows/1")
No
Yes
Yes
Stop Accept Pile
Yes
Have You Reached Practical Refusal as Described in 455-5.10.3 (20 Blows/1")
No
Is the Pile 1 ft or less of the Pile Cutoff Elevation
Stop- Contact PA
No
Keep Driving
Yes
Stop for Setcheck As Described in 455-5.10.4 Contact PA
CTQP
8-40



INTERMEDIATE BENTS 2 & 3

Pile driving of the 18" PSC 50 foot, 180 ton design load piles may be stopped if one of the following conditions is met:

1. Practical refusal (20 blows per inch with at least a 6.0 foot stroke) is reached during driving and pile tip is at or below the minimum tip elevation of –32 feet as specified in the plans.

2. The required blowcount versus its respective stroke is achieved for two consecutive feet, and the pile tip is at or below the minimum tip elevation of -32 feet as specified in the plans. The blow counts per foot required for respective stroke heights are as follows:

Stroke (ft)	Blows/foot
6.0	94
6.5	83
7.0	71
7.5	63

Now work out situation 3. Criteria are given above. Driving Record is shown in the next couple of slides. Question is, for the pile at the current tip (see record next couple of slides), can the pile be accepted or what should we do?

Situation 3

Situation 3

PILE DRIVING INFORMATION

FINANCIAL PROJECT NO. 1234567-89-10 DATE 6/5/00 STATION NO. 153+58
PILE SIZE 18" LENGTH 50' BENT/PIER NO. 2 PILE NO. 7
HAMMER TYPE ICE 80 S RATED ENERGY 99,400 ft-lbs OPERATING RATE N/A
TEMPLATE ELEV +12.0 MIN TIP ELEV -32.0 PILE CUTOFF ELEV +13.0
DRIVING CRITERIA See Driving Criteria Letter

PILE CUSHION THICKNESS AND MATERIAL 6" plywood
HAMMER CUSHION THICKNESS AND MATERIAL 2" Aluminum/Micarta
WEATHER Fair/Hot TEMP 93° F START TIME 13:20 STOP TIME 14:10

PILE DATA
PAY ITEM NO. 455 WORK ORDER NO.
MANUFACTURED BY B. M. ELEV GROUND ROD READ.
DATE CAST 5/14/00 ROD READ. PILE HEAD ROD READ.
MANUFACTURER'S PILE NO. H. I. PILE HEAD ELEV.
PILE HEAD CHAMPHER 3/4" x 3" PILE TIP ELEV.
PILE TIP CHAMPHER 3/4" x 3" GROUND ELEV. +8.0
PILE DRIVING INSPECTOR

SPLICE EACH	CUTOFF TYPE CODE	POINT PROTECTOR	PERFORMED HOLE	PDA	PILE REDRIVE	ISOLATED DRIVING	EXTRACTION	30E SPLICE	PILE TYPE CODE	BATTER	TOTAL PILE		PENETRA-TION	BUILD UP	
											FURNISHED	DRIVEN		AUTHORIZED	ACTUAL
X	X	X	X	X	X	X	X	X	X	XXX.XXX	XXX.XXX	XXX.XXX	XXX.XXX	XXX.XXX	XXX.XXX

NOTES: (#1) Scour elev = -8 Ft (#2) 4' Starter Hole (#3) Start @ Fuel pressure = 150 psi (#4) Increase to Fuel pressure = 200psi

8-42

Situation 3

Situation 3

Depth	Blows	Stroke/ Pressure	Note No.	Depth	Blows	Stroke/ Pressure	Note No.	Depth	Blows	Stroke/ Pressure	Note No.	Depth	Blows	Stroke/ Pressure	Note No.
0–1	4' TO GROUND			15–16	10	5.3		30–31	11	5.3		45–46			
1–2				16–17	8	5.1		31–32	12	5.4		46–47			
2–3				17–18	7	5.1		32–33	11	5.3		47–48			
3–4				18–19	8	5.1		33–34	13	5.4		48–49			
4–5	4" STARTER HOLE		#2	19–20	10	5.2		34–35	11	5.3					
5–6				20–21	9	5.1		35–36							
6–7				21–22	8	5.1		36–37							
7–8				22–23	9	5.1		37–38							
8–9	8	5.2	#3	23–24	10	5.2		38–39							
9–10	9	5.2		24–25	12	5.3		39–40							
10–11	12	5.3		25–26	11	5.3		40–41							
11–12	10	5.2		26–27	12	5.3		41–42				56–57			
12–13	12	5.7		27–28	10	5.2		42–43				57–58			
13–14	11	5.2		28–29	13	5.4		43–44				58–59			
14–15	9	5.2		29–30	14	5.4		44–45				59–60			

PILE CUTOFF ELEV +13.0

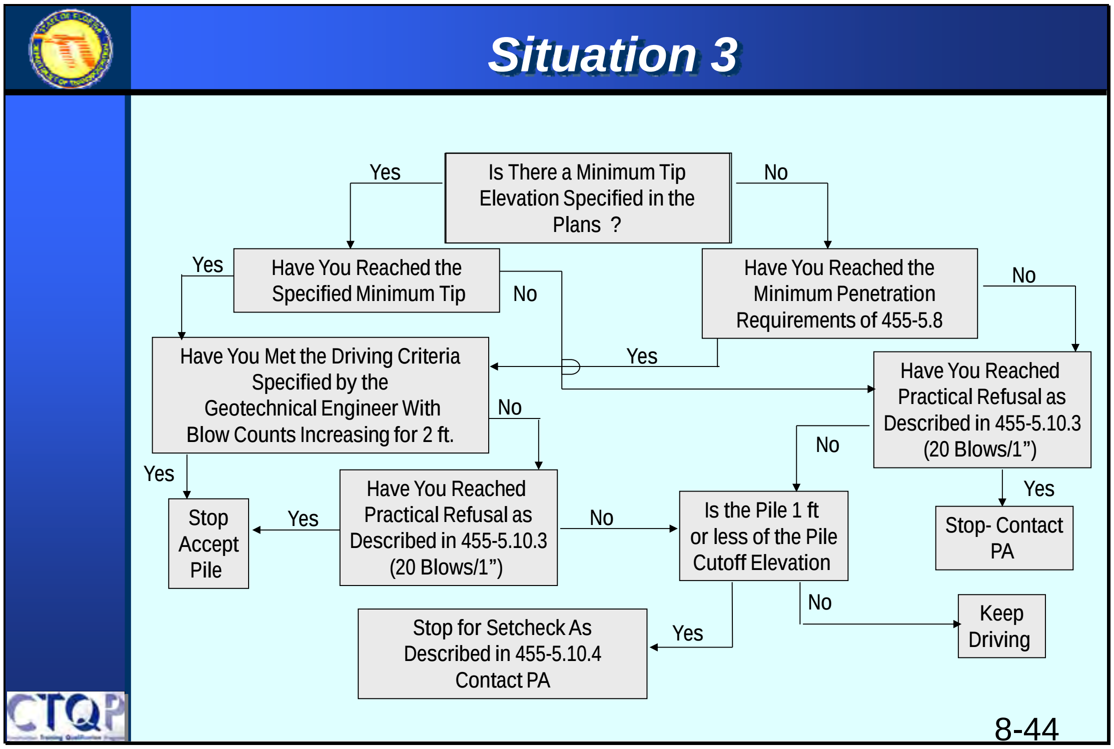
MIN TIP ELEV –32.0

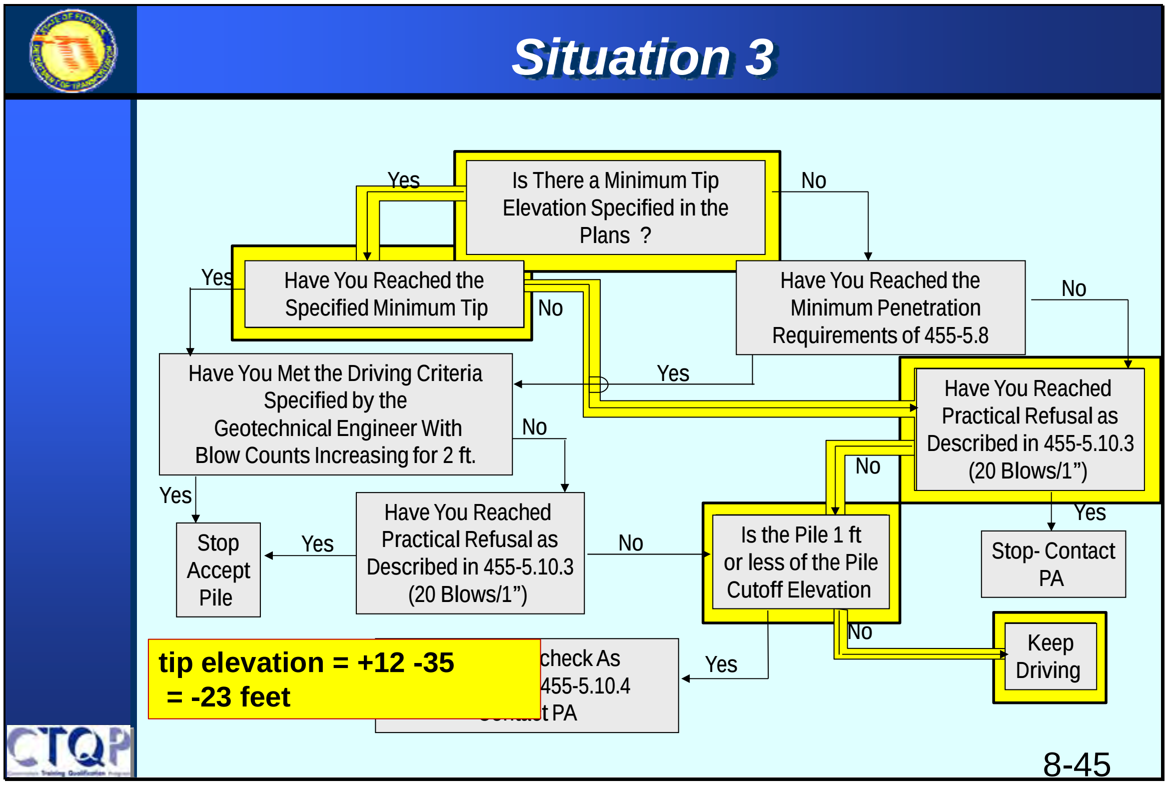
TEMPLATE ELEV +12.0

Stroke (ft)	Blows/foot
6.0	94
6.5	83
7.0	71
7.5	63

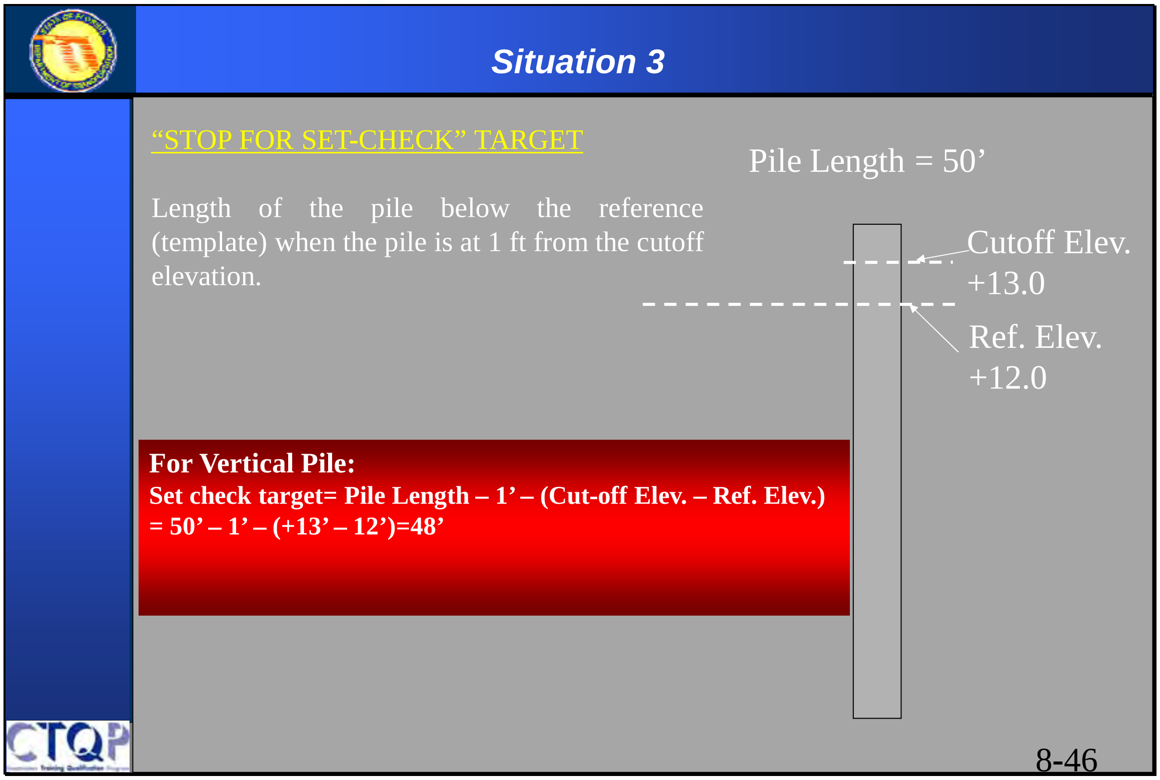
LENGTH 50'

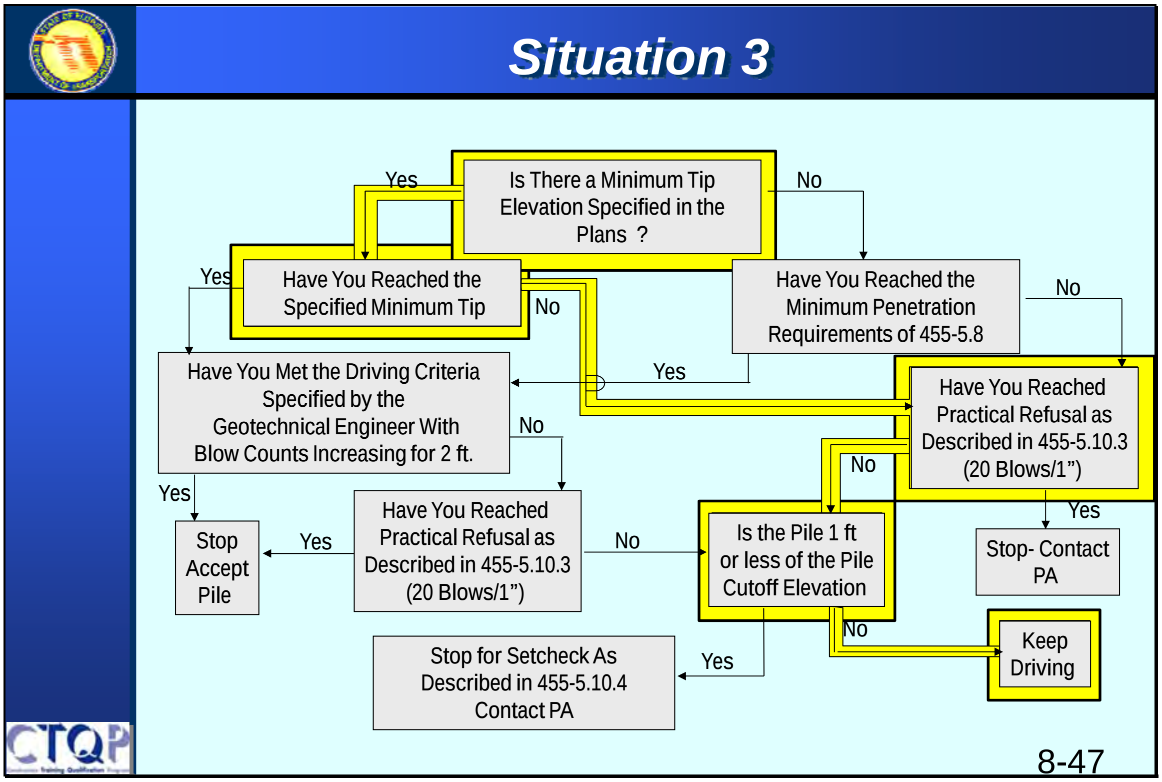
8-43


Situation 3
Is There a Minimum Tip Elevation Specified in the Plans ?
Yes
No
Have You Reached the Specified Minimum Tip
Have You Reached the Minimum Penetration Requirements of 455-5.8
Yes
No
No
Have You Met the Driving Criteria Specified by the Geotechnical Engineer With Blow Counts Increasing for 2 ft.
Yes
Have You Reached Practical Refusal as Described in 455-5.10.3 (20 Blows/1")
No
Yes
Stop Accept Pile
Yes
Have You Reached Practical Refusal as Described in 455-5.10.3 (20 Blows/1")
No
Is the Pile 1 ft or less of the Pile Cutoff Elevation
No
Yes
Stop- Contact PA
No
Keep Driving
Yes
Stop for Setcheck As Described in 455-5.10.4 Contact PA
CTQP
8-44

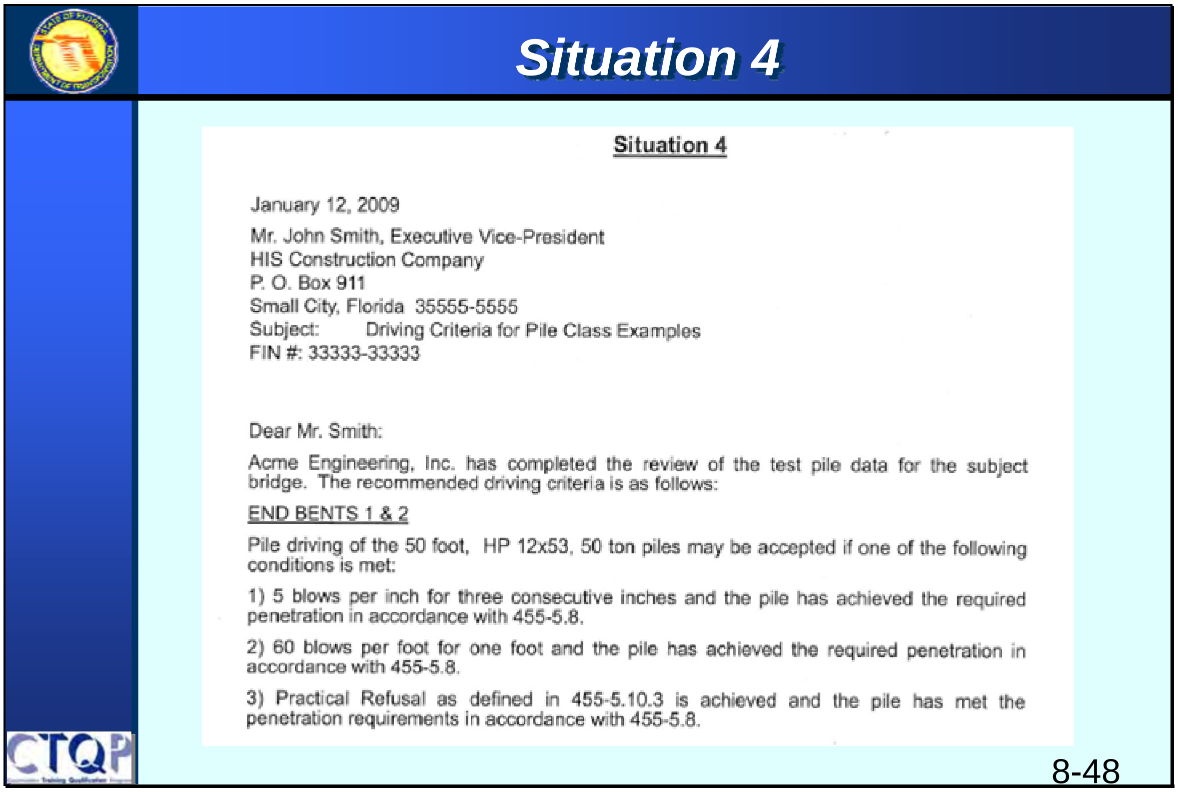


Is the pile 1 ft or less of the pile cutoff elevation? At this point is useful to compute the set-check target as we did in lesson 4.


Situation 3
"STOP FOR SET-CHECK" TARGET
Length of the pile below the reference (template) when the pile is at 1 ft from the cutoff elevation.
Pile Length = 50'
Cutoff Elev. +13.0
Ref. Elev. +12.0
For Vertical Pile:
Set check target= Pile Length – 1' – (Cut-off Elev. – Ref. Elev.)
= 50' – 1' – (+13' – 12')=48'
8-46



Here is where we are in the flow chart. Since the pile is not 1 ft or less from the cut-off elevation we keep driving.



Situation 4

January 12, 2009

Mr. John Smith, Executive Vice-President
HIS Construction Company
P. O. Box 911
Small City, Florida 35555-5555
Subject: Driving Criteria for Pile Class Examples
FIN #: 33333-33333

Dear Mr. Smith:

Acme Engineering, Inc. has completed the review of the test pile data for the subject bridge. The recommended driving criteria is as follows:

END BENTS 1 & 2

Pile driving of the 50 foot, HP 12x53, 50 ton piles may be accepted if one of the following conditions is met:

1) 5 blows per inch for three consecutive inches and the pile has achieved the required penetration in accordance with 455-5.8.

2) 60 blows per foot for one foot and the pile has achieved the required penetration in accordance with 455-5.8.

3) Practical Refusal as defined in 455-5.10.3 is achieved and the pile has met the penetration requirements in accordance with 455-5.8.

Now work out situation 4. Blow count Criteria are given above. The next slide shows the firm material definition for this scenario and additional driving requirements.

Situation 4

Driving Requirements:

The blow count criterion and practical refusal must be achieved at a minimum stroke of 5 ft.

Firm bearing material is a material that offers a driving resistance of 15 blow/ft at a minimum stroke of 5.0 ft.

8-49

Here are additional requirements and the definition of firm bearing material. Driving Record is shown in the next couple of slides. Can you guess why they are giving us a “firm material” definition? Question is, for the pile at the current tip (see record next couple of slides), can the pile be accepted or what should we do?

Situation 4

PILE DRIVING INFORMATION

FINANCIAL PROJECT NO. 1234567-89-10 DATE 6/1/00 STATION NO. 153+58
PILE SIZE HP12X53 LENGTH 50' BENT/PIER NO. 2 PILE NO. 7
HAMMER TYPE ICE 80 S RATED ENERGY 99,400 ft-lbs OPERATING RATE N/A
TEMPLATE ELEV +112.0 MIN TIP ELEV N/A PILE CUTOFF ELEV +113.0
DRIVING CRITERIA 1) 5 blows per inch for three consecutive inches and the pile has achieved the required penetration in accordance with 455-5.8.
PILE CUSHION THIC 2) 60 blows per foot for one foot and the pile has achieved the required penetration in accordance with 455-5.8.
HAMMER CUSHION
WEATHER Fair/Hot TEMP 92 F START TIME 14:05 STOP TIME 15:10

PILE DATA
PAY ITEM NO. 455 WORK ORDER NO.
MANUFACTURED BY B. M. ELEV GROUND ROD READ.
DATE CAST ROD READ. PILE HEAD ROD READ.
MANUFACTURER'S PILE NO. H. I. PILE HEAD ELEV.
PILE HEAD CHAMPHER PILE TIP ELEV.
PILE TIP CHAMPHER GROUND ELEV. +108.0
PILE DRIVING INSPECTOR

SPLICE EACH	CUTOFF TYPE CODE	POINT PROTECTOR	PERFORMED HOLE	PDA	PILE REDRIVE	ISOLATED DRIVING	EXTRACTION	30% SPLICE	PILE TYPE CODE	BATTER	TOTAL PILE		PENETRATION	BUILD UP	
											FURNISHED	DRIVEN		AUTHORIZED	ACTUAL
X	X	X	X	X	X	X	X	X	X	XXX.XXX	XXX.XXX	XXX.XXX	XXX.XXX	XXX.XXX	XXX.XXX

NOTES: (#1) Scour elev. = None (#2) Pile set 8' below Ref. Elev.
(#3) Start @ Fuel Pressure= 150 psi (#4) Fuel Setting @200 psi, pile marked in inches

8-50

Situation 4

Depth	Blows	Stroke/ Pressure	Note No.	Depth	Blows	Stroke/ Pressure	Note No.	Depth	Blows	Stroke/ Pressure	Note No.	Depth	Blows	Stroke/ Pressure	Note No.
0-1	Pile set to 8'			15-16	10	5.3		30-31	11	5.3					
1-2				16-17	8	5.1		31-32	12	5.4					
2-3				17-18	7	5.1		32-33	11	5.3					
3-4				18-19	8	5.1		33-34	13	5.4					
4-5			#2	19-20	10	5.2		34-35	11	5.5					
5-6				20-21	9	5.1		35-35'8"	10	6.0	#4				
6-7				21-22	8	5.1		35'8"-35'9"	6	6.0					
7-8				22-23	9	5.1		35'9"-35'10"	7	6.0					
8-9	8	5.2	#3	23-24	10	5.2		35'10"-35'11"	7	6.0					
9-10	9	5.2		24-25	12	5.3									
10-11	12	5.3		25-26	11	5.3									
11-12	10	5.2		26-27	12	5.3									
12-13	12	5.7		27-28	10	5.2									
13-14	11	5.2		28-29	13	5.4									
14-15	9	5.2		29-30	14	5.4									

TEMPLATE ELEV +112.0

GROUND ELEV. +108.0

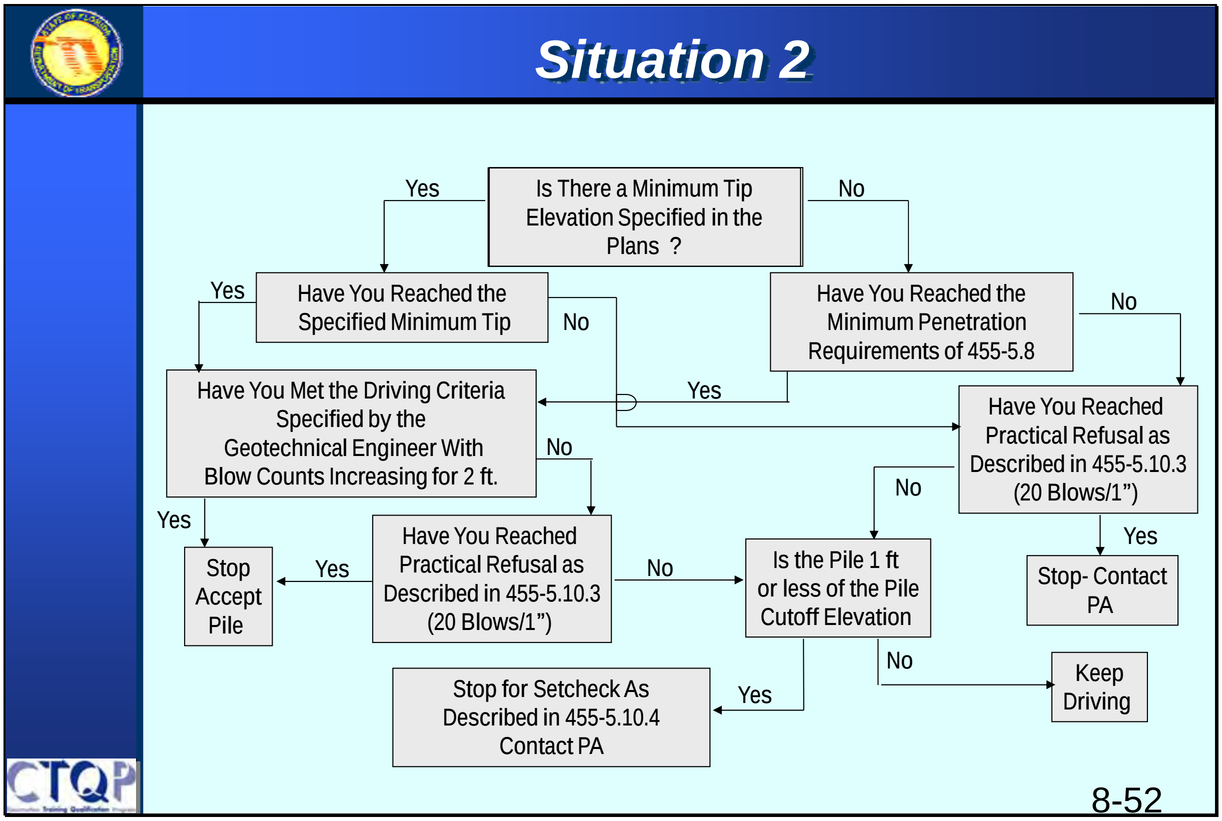
PILE CUTOFF ELEV +113.0

Scour elev. = None

1) 5 blows per inch for three consecutive inches and the pile has achieved the required penetration in accordance with 455-5.8.

2) 60 blows per foot for one foot and the pile has achieved the required penetration in accordance with 455-5.8.

8-51


Situation 2
Is There a Minimum Tip Elevation Specified in the Plans ?
Yes
No
Have You Reached the Specified Minimum Tip
Have You Reached the Minimum Penetration Requirements of 455-5.8
Yes
No
No
Have You Met the Driving Criteria Specified by the Geotechnical Engineer With Blow Counts Increasing for 2 ft.
Yes
Have You Reached Practical Refusal as Described in 455-5.10.3 (20 Blows/1")
No
No
Yes
Stop Accept Pile
Yes
Have You Reached Practical Refusal as Described in 455-5.10.3 (20 Blows/1")
No
Is the Pile 1 ft or less of the Pile Cutoff Elevation
Yes
Stop- Contact PA
No
Keep Driving
Yes
Stop for Setcheck As Described in 455-5.10.4 Contact PA
8-52

Situation 4

The elevation from which penetration should be counted is **+ 108 ft** which is the ground elevation.

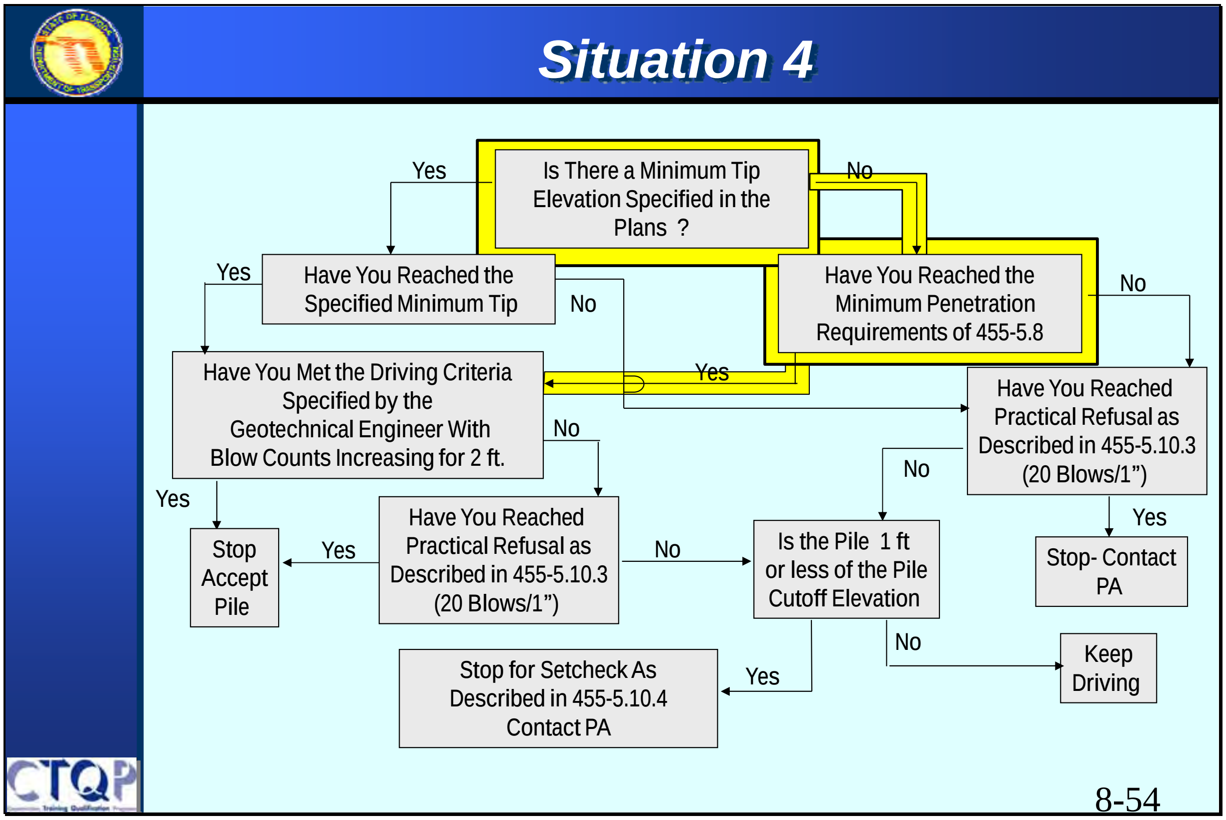
For soft material specs require at least 20 ft penetration. The minimum penetration tip elevation would be: +108 - 20= **+ 88 ft**

Pile tip =at 35'-11" below template. This is 35.92' below template.

Therefore the tip elevation is:

Tip El= Ref El – Length below reference= +112 – 35.92 = **-76.08 ft**. Pile is below the penetration requirements

8-53


Situation 4
Is There a Minimum Tip Elevation Specified in the Plans ?
Yes
No
Have You Reached the Specified Minimum Tip
Yes
No
Have You Reached the Minimum Penetration Requirements of 455-5.8
No
Yes
Have You Met the Driving Criteria Specified by the Geotechnical Engineer With Blow Counts Increasing for 2 ft.
No
Have You Reached Practical Refusal as Described in 455-5.10.3 (20 Blows/1")
No
Yes
Yes
Stop Accept Pile
Yes
Have You Reached Practical Refusal as Described in 455-5.10.3 (20 Blows/1")
No
Is the Pile 1 ft or less of the Pile Cutoff Elevation
Stop- Contact PA
No
Keep Driving
Yes
Stop for Setcheck As Described in 455-5.10.4 Contact PA
8-54

Situation 4

Depth	Blows	Stroke/ Pressure	Note No.	Depth	Blows	Stroke/ Pressure	Note No.	Depth	Blows	Stroke/ Pressure	Note No.	Depth	Blows	Stroke/ Pressure	Note No.
0-1	Pile set to 8'			15-16	10	5.3		30-31	11	5.3					
1-2				16-17	8	5.1		31-32	12	5.4					
2-3				17-18	7	5.1		32-33	11	5.3					
3-4				18-19	8	5.1		33-34	13	5.4					
4-5			#2	19-20	10	5.2		34-35	11	5.5					
5-6				20-21	9	5.1		35-35'8"	10	6.0	#4				
6-7				21-22	8	5.1		35'8"-35'9"	6	6.0					
7-8				22-23	9	5.1		35'9"-35'10"	7	6.0					
8-9	8	5.2	#3	23-24	10	5.2		35'10"-35'11"	7	6.0					
9-10	9	5.2		24-25	12	5.3									
10-11	12	5.3		25-26	11	5.3									
11-12	10	5.2		26-27	12	5.3									
12-13	12	5.7		27-28	10	5.2									
13-14	11	5.2		28-29	13	5.4									
14-15	9	5.2		29-30	14	5.4									

TEMPLATE ELEV +112.0

GROUND ELEV. +108.0

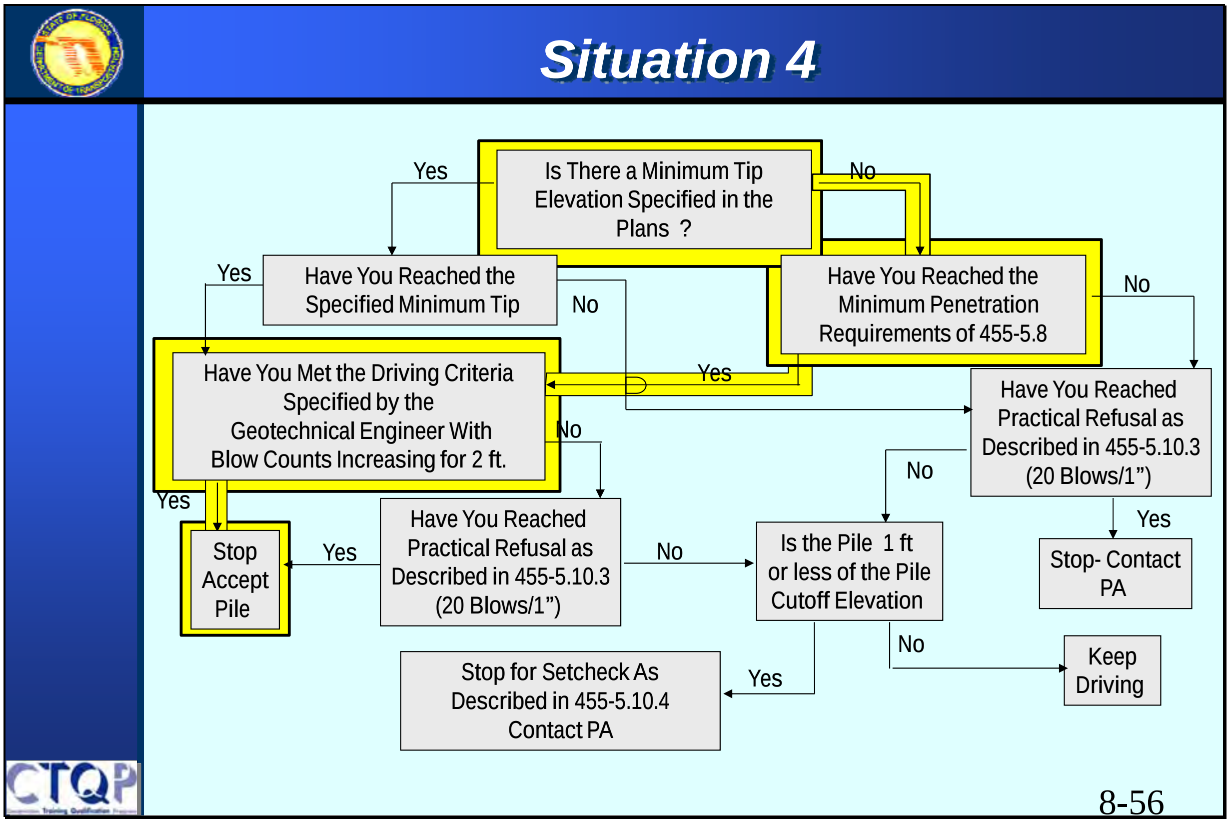
PILE CUTOFF ELEV +113.0

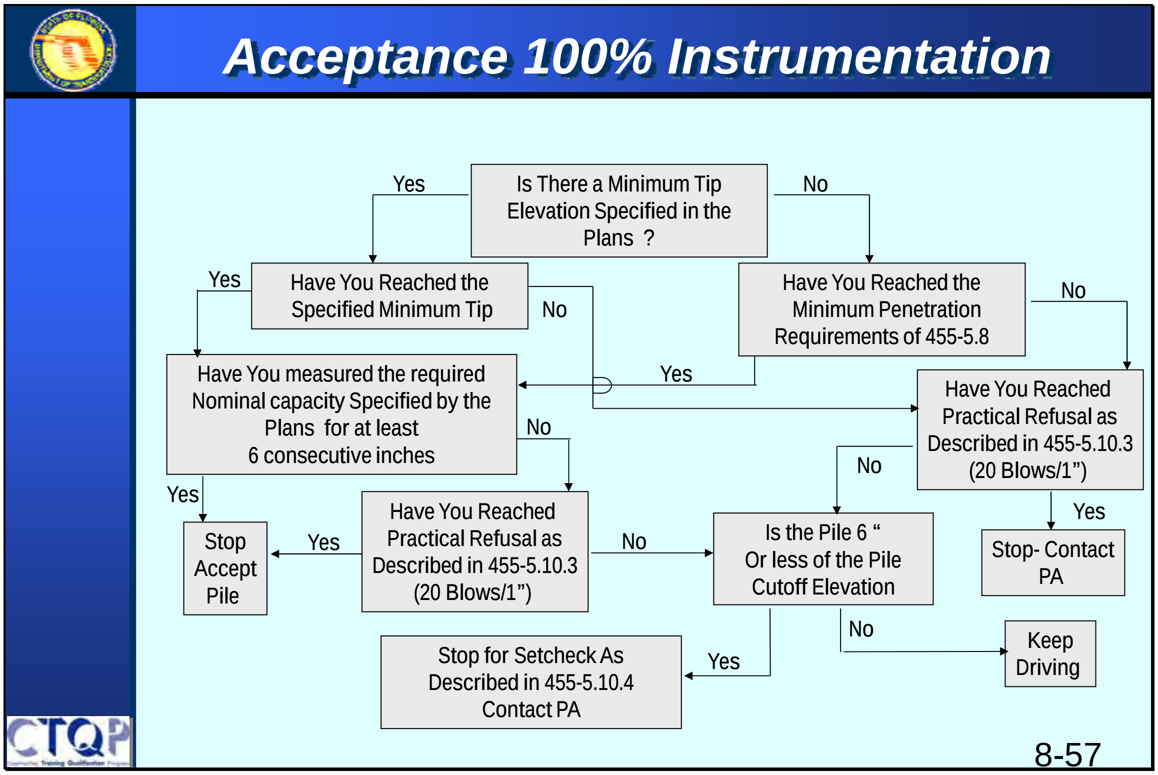
Scour elev. = None

1) 5 blows per inch for three consecutive inches and the pile has achieved the required penetration in accordance with 455-5.8.

2) 60 blows per foot for one foot and the pile has achieved the required penetration in accordance with 455-5.8.

8-55


Situation 4
Is There a Minimum Tip Elevation Specified in the Plans ?
Yes
No
Have You Reached the Specified Minimum Tip
Yes
No
Have You Reached the Minimum Penetration Requirements of 455-5.8
No
Yes
Have You Met the Driving Criteria Specified by the Geotechnical Engineer With Blow Counts Increasing for 2 ft.
No
Yes
Have You Reached Practical Refusal as Described in 455-5.10.3 (20 Blows/1")
No
Yes
Stop- Contact PA
Stop Accept Pile
Yes
Have You Reached Practical Refusal as Described in 455-5.10.3 (20 Blows/1")
No
Is the Pile 1 ft or less of the Pile Cutoff Elevation
No
Keep Driving
Yes
Stop for Setcheck As Described in 455-5.10.4 Contact PA
CTQP
8-56



Here is the flow chart when 100% instrumentation is used.

Learning Outcomes

• Covered the 4 alternative methods and specs to accept piles

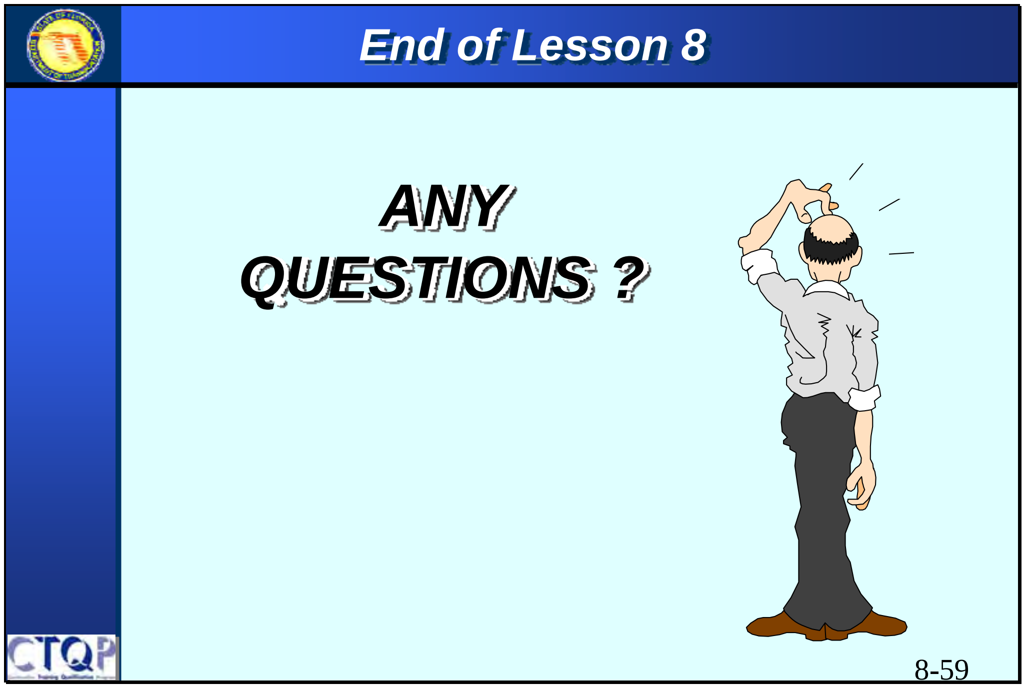
•Covered the Bearing requirements

• Learned and practiced when to stop driving and Accept pile

• Learned when to stop driving, when to accept the pile and when to contact the PA

• Identified when to stop driving and request a Set-Check

8-58


End of Lesson 8
ANY
QUESTIONS ?
CTQP
8-59

Homework 1

1. The scour elevation can normally be found on the bridge hydraulics sheet and in the Pile Data Table.

True ____ False _____

2. The Required Nominal Bearing Resistance Resistance will normally be shown in the Pile Data Table. Where is the Pile Data Table found?

A. The Contractor's Pile Installation Plan
B. The Special Provisions
C. The Standard Specifications
D. The Plans
E. None of the Above

Homework 1

3. On what type of hammer you may see see a jump stick and what can it be used for in FDOT projects?

A. Air hammer to verify stroke height
B. Double acting Diesel to control the pressure
C. Single acting Diesel to verify stroke height
D. Vibratory hammer to estimate the amount.
E. Single acting Diesel but cannot be used to verify stroke height

Homework 1

4. What are the three types of Leads?

5. When using which of the above leads, is a template not required?

6. What are the three basic pile hammer types?

Homework 1

PROBLEM 7 (PLUMB PILE)

Furnished Pile Length = **55 ft.**
Reference Elevation = **+ 4.0 ft.**
Cut-off Elevation = **-0.50 ft.**
Preformed Hole Elevation = **-30.0 ft.**

Ground Elevation = **- 15.00 ft.**
Scour Elevation = **- 20.00 ft.**
Pile Length Below
Ref. Elev. = **43.0 ft.**

Ref. Elev.- Length Below Ref. Elev.

TIP ELEVATION:
Tip Elev. =

Lowest of 3 Elev. - Tip Elev.

PENETRATION:
Penetration =

Cut-off Elev.- Tip Elev.

LENGTH DRIVEN:
Length Driven =

Homework 1

PROBLEM 8: BATTERED PILE (5:2)

Furnished Pile Length = **60 ft.**
Reference Elevation = **+8.76 ft.**
Cut-off Elevation = **+4.00 ft.**

Ground Elev. (Excav.) = **-5.72 ft.**
Scour Elev. = **-9.92 ft.**
Pile Length Below Ref. Elev. = **57 ft.**

Batter = 5:2
Corr. Factor = 0.928

Ref. Elev.- [Length Below Ref. Elev. X Corr. Factor]

TIP ELEVATION:
Tip Elev. =

[Lowest of 3 Elev. - Tip Elev.] ÷ Corr. Factor

PENETRATION:
Penetration =

[Cut-off Elev. - Tip Elev.] ÷ Corr. Factor

LENGTH DRIVEN:
Length Driven =

Homework 1

9. ….The delivered length of each of the piles at End Bent 1 originally was 100 feet and Pile 4 was a driven splice.

*Assume set-checks performed within 1 day. of end of initial drive.
Pile 4 was a production pile.

Bent 1 Pile #	Length of Pile Below Cut-off	Predrill Length	# of Set-Checks*	# of Redrives	Length of Cut-off (ft.)	Length of Splice** (ft.)
1	94.12	20'	1	0	5.88	-
2	89.27	20'	0	0	10.73	-
3	96.77	20'	2	1	3.23	-
4	119.98	20'	2	1	-	20

Bent 1 Pile #	Length of Pile provided	Predrill Length	Set-Checks*	# of Redrives	Length of Splice** (ft.)	Splice Labor	Driven Splice	Cut-off (ft.)
1								
2								
3								
4								

Homework 1

10. ….The delivered length of each of the piles was 80 feet. Pile 3 was a driven splice.

*Assume set-checks performed within 1 day of end of initial drive.
Pile 3 was a production pile

Int.Bent 5 Pile #	Length of Pile Below Cut-off	Preform Length	# of Set-Checks*	# of Redrives	Length of Cut-off (ft.)	Length of Splice** (ft.)
1	69.27	25'	0	0	10.73	-
2	76.77	25'	3	1	3.23	-
3	99.98	25'	3	1	-	20
4	74.12	25'	1	0	5.88	-

Int.Bent 5 Pile #	Length of Pile provided	Preform	Set-Checks*	Redrives	Length of Splice** (ft.)	Splice Labor	Driven Splice	Cut-off (ft.)
1								
2								
3								
4								

PAID

Homework 2

11. True or False: If a pile reaches 20 blows in less than 1 inch, it is correct to stop the pile without going to the full inch to consider it practical refusal.

True **____**   False _____

12. True or False: If the saximeter fails in a production pile driven with and open Diesel hammer, the Contractor can continue driving, and the inspector will estimate the stroke based on a formula that correlates blows per minute vs. stroke, or use the jumpstick.

True **____**   False _____

Homework 2

13. The Contractor is normally paid for a preformed pile hole?

***True*____** False _____

14. When is the best time to check the hammer cushion?

A. At lunch when the Contractor is not working.
B. Between piles
C. At the end of the day
D. When the hammer is apart for repair or maintenance
E. None of the above

Homework 2

15. The Contractor is assembling his capblock and you observe him putting a timber hammer cushion into the capblock. What should you do?

A. Check the Pile Installation Plan to see if it is the right material
B. Inform the Contractor that timber hammer cushions are not permitted by the specifications
C. Ask the Contractor to provide the proper documentation to evaluate the timber hammer cushion
D. Request the District Geotechnical Engineer to evaluate the change
E. The Standard Specifications do not address this.

Homework 2

16. You have just informed the Contractor that he has reached the required blow count and should stop driving. The pile top is three feet above the cut-off elevation. The Contractor wishes to drive the pile to cut-off. What should you do?

A. This is the Contractor's option, however, he is not paid for the additional driving. Make note in driving log and in daily report.
B. This is not allowed. If the Contractor continues, leave the site immediately and document to the Project Engineer.
C. Advise the Contractor that it is not recommended and that if he continues, any damage to the pile including loss of bearing is his responsibility, continue recording and document.
D. This is the Contractor's option. If the Inspector permits additional driving, continue to document and pay the Contractor for the additional drive.
E. None of the above

Homework 2

17. Compute penetration for the following:

Scour El=-20 ft
Existing mudline (ground) elevation= -5 ft
Preformed Hole elevation= -30 ft
Tip elevation at the end of driving= -55
Cut-off elevation= + 5.0 ft

Penetration=

Homework 2

PROBLEM 18 (PLUMB PILE)

Furnished Pile Length = **55 ft.**
Reference Elevation = **+ 37.50 ft.**
Cut-off Elevation = **+41.50 ft.**

Ground Elevation = **+33.00 ft.**
Scour Elevation = **- None ft.**
Pile Length Below
Ref. Elev. = **39.0 ft.**

Ref. Elev.- Length Below Ref. Elev.

TIP ELEVATION:
Tip Elev. =

Lowest of 3 Elev. - Tip Elev.

PENETRATION:
Penetration =

Cut-off Elev.- Tip Elev.

LENGTH DRIVEN:
Length Driven =

Homework 2

PROBLEM 19: BATTERED PILE (5:2)

Furnished Pile Length = **60 ft.**
Reference Elevation = **+7.00 ft.**
Cut-off Elevation = **+10.00 ft.**

Ground Elev. (Excav.) = **+10.00 ft.**
Scour Elev. = **+1.50 ft.**
Pile Length Below Ref. Elev. = **47.5 ft.**

Batter = 5:1
Corr. Factor = 0.981

Ref. Elev.- [Length Below Ref. Elev. X Corr. Factor]

TIP ELEVATION:
Tip Elev. =

[Lowest of 3 Elev. - Tip Elev.] ÷ Corr. Factor

PENETRATION:
Penetration =

[Cut-off Elev. - Tip Elev.] ÷ Corr. Factor

LENGTH DRIVEN:
Length Driven =

Homework 2

20. The delivered length of each of the concrete piles at End Bent 1 originally was 80 feet and Pile 3 was a non-driven splice.

*Assume first all set-checks performed within 1 day of end of initial drive
Pile 3 was a production pile.

Bent 1 Pile #	Length of Pile Below Cut-off	Predrill Length	# of Set-Checks*	# of Redrives	Length of Cut-off (ft.)	Length of Splice** (ft.)
1	74.12	15’	3	0	5.88	-
2	69.27	15’	1	2	10.73	-
3	99.98	15’	4	1	-	10

Bent 1 Pile #	Length of Pile provided	Predrill Length	Set-Checks*	# of Redrives	Length of Splice** (ft.)	Splice Labor	Driven Splice	Cut-off (ft.)
1								
2								
3								

PAID

Homework

End of homework

APPENDICES

- January 2015 Workbook for Piles
- Precast Concrete Pile Payment Summary Table
- Steel Pile Payment Summary Table
- Pile Inspector's Checklist
- Pile Driving Installation Plan Form
- Pile Driving Record
- Pile Driving Record instructions
- Design Standard 20600

SECTION 455
STRUCTURES FOUNDATIONS

Index

A. GENERAL

455-1 General Requirement.

The Contractor may examine available soil samples and/or rock cores obtained during the soil boring operations at the appropriate District Materials Office.

455-1.1 Protection of Existing Structures: When the Plans require excavation or foundation construction operations in close proximity to existing structures, take all reasonable precautions to prevent damage to such structures. The requirements described herein apply to all types of structures (on or off the right-of-way) that may be adversely affected by foundation construction operations (including phase construction) due to vibrations, ground loss, ground heave, or dewatering. Protect utilities as described in-the applicable provisions of Section 7.

Survey and monitor structures for settlement in a manner approved by the Engineer, recording elevations to 0.001 foot. Employ a qualified Specialty Engineer to inspect and document the condition of structures prior to and after construction of excavations and foundation construction. Inspect and monitor the following structures:

(1) as shown in the Plans.

(2) within a distance of ten shaft diameters or the estimated depth of drilled shaft excavation, whichever is greater.

(3) within a distance of three times the depth of other excavations.

(4) within 200 feet of sheet pile installation and extraction operations

(5) for projects with pile driving operations, inspect and document the condition of all structures within a distance, in feet, of pile driving operations equal to 0.25 times the square root of the impact hammer energy, in foot-pounds. Survey and monitor for settlement all structures within a distance, in feet, of pile driving operations equal to 0.5 times the square root of the impact hammer energy, in foot-pounds.

Obtain the Engineer's approval of the number and location of monitoring points. Record elevations:

(1) before beginning construction,
(2) daily during the driving of any casings, piling, or sheeting,
(3) weekly for two weeks after stopping pile driving,
(4) during excavation,
(5) during blasting,
(6) or as directed by the Engineer.

Notify the Engineer of any movements detected and immediately take any remedial measures required to prevent damage to the existing structures.

The Department will make the necessary arrangements to provide right of way entry to the existing structures.

Adequately document the condition of the structures and all existing cracks with descriptions and pictures. Prepare two reports documenting the condition of the structures: one report before beginning foundation construction operations and a second report after completing foundation construction operations. The Department will take ownership of both reports. Do not perform pre-driving and post-driving surveys of the condition of bridges owned by the Department except when shown in the Contract Documents.

When shown in the Contract Documents, employ a qualified Specialty Engineer to monitor and record vibration levels during the driving of casings, piling, sheeting, or blasting operations. Provide vibration monitoring equipment capable of detecting velocities of 0.1 inches per second or less.

Upon detecting settlement or heave of 0.005 feet, vibration levels reaching 0.5 inches per second, levels otherwise shown in the Contract Documents, or damage to the structure, immediately stop the source of vibrations, backfill any open excavations, and contact the Engineer for instructions.

When excavating for construction, the Contractor is responsible for evaluating the need for, design of, and providing any necessary precautionary features to protect adjacent structures from damage, including, but not limited to, selecting construction methods and procedures that will prevent damaging caving of the shaft excavation and monitoring and controlling the vibrations from construction activities, including driving of casings, driving of sheeting, and blasting. When sheeting and shoring are not detailed in the Plans, employ a qualified Specialty Engineer to design the sheeting and shoring, and to sign and seal the plans and specification requirements. Send these designs to the Engineer for his record before beginning construction.

When shown in the Contract Documents or when authorized by the Engineer, install the piling to the depth required to minimize the effects of vibrations or ground heave on adjacent structures by approved methods other than driving (preformed holes, predrilling, jetting, etc.). In the event the Department authorizes the use of preformed pile holes to meet this requirement, the Department will pay for this work as described in 455-5.9.3.

When shown in the Plans or directed by the Engineer, install a piezometer near the right of way line and near any structure that may be affected by lowering the ground water when dewatering is required. Monitor the piezometer and record the ground water elevation level daily. Notify the Engineer of any ground water lowering near the structure of 12 inches or more.

455-1.2 Excavation: Complete all excavation of the foundations prior to installing piles or shafts unless otherwise authorized by the Engineer. After completing pile/shaft installation, remove all loose and displaced materials from around the piles/shafts, leaving a clean, solid surface. Compact the soil surface on which concrete is to be placed or which will support the forming system for the concrete to support the load of the plastic concrete without settling or causing the concrete to crack, or as shown in the Contract Documents. The Engineer will not require the Contractor to compact for excavations made below water for seals or when the footing or cap or forming system (including supports) does not rest on the ground surface.

455-1.2.1 Abutment (End Bent) Fill: Place and compact the fill before installing end-bent piling/shafts, except when:

(1) driving specified test piling in end bents or,

(2) the Plans show uncased piles through proprietary retaining wall fills.

When installing piles/shafts or casing prior to placing fill, take necessary precautions to prevent displacement of piles/shafts during placing and compacting fill materials within 15 feet of the piles/shafts or casing. Reference and check the position of the piles/shafts or casing at three approximately equal intervals during construction of the embankment.

Place embankment material in 6 inch loose lifts in the 15 foot area around the piles/shafts or casing. Compact embankment material within the 15 foot area adjacent to the piles/shafts or casing to the required density with compaction equipment weighing less than 1,000 pounds. When installing piles/shafts prior to the completion of the surrounding fills, do not cap them until placing the fills as near to final grade as possible, leaving only the necessary working room for construction of the caps.

Provide permanent casings installed prior to placement of the fill, for all drilled shafts through mechanically stabilized fills (for example, behind proprietary retaining walls) for shafts installed after fill placement. Install temporary casings through the completed conventional fill when permanent casings are not required.

Provide permanent casings, if required, before the fill is placed extending a sufficient distance into the existing ground to provide stability to the casings during construction of the abutment fill.

455-1.3 Cofferdams: Construct cofferdams as detailed in the Plans. When cofferdams are not detailed in the Plans, employ a qualified Specialty Engineer to design cofferdams, and to sign and seal the plans and specification requirements. Send the designs to the Engineer for his records before beginning construction.

Provide a qualified diver and a safety diver to inspect the conditions of the foundation enclosure or cofferdam when the Contract Documents require a seal for construction. Equip these divers with suitable voice communications, and have them inspect the foundation enclosure and cofferdam periphery including each sheeting indentation and around each piling or drilled shaft to ensure that no layers of mud or other undesirable materials were left above the bottom of seal elevation during the excavation process. Also have the divers check to make sure the surfaces of the piles or drilled shafts are sufficiently clean to allow bond of the concrete down to the minimum bottom of seal elevation. When required, ensure that there are no mounds of stone, shell, or other authorized backfill material left after placement and grading. Assist the Engineer as required to ensure that the seal is placed as specified and evaluate the adequacy of the foundation soils or rock. Correct any deficiencies found by the divers. Upon completion of inspection by the divers, the Department may also elect to inspect the work before authorizing the Contractor to proceed with subsequent construction operations. Furnish the Engineer a written report by the divers indicating the results of their underwater inspection before requesting authorization to place the seal concrete.

455-1.4 Vibrations on Freshly Placed Concrete (Drilled Shafts and Piers): Ensure that freshly placed concrete is not subjected to vibrations greater than 1.5 inches per second from pile driving and/or drilled shaft casing installation sources located within the greater dimension of three shaft diameters (measured from the perimeter of the shaft closest to the vibration source) or 30 feet (from the nearest outside edge of freshly placed concrete to the vibration source) until that concrete has attained its final set as defined by ASTM C403 except as required to remove temporary casings before the drilled shaft elapsed time has expired.

455-2 Static Compression Load Tests.

455-2.1 General: Employ a professional testing laboratory, or Specialty Engineer with prior load test experience on at least three projects, to conduct the load test in compliance with these Specifications, to record all data, and to furnish reports of the test results to the Engineer except when the Contract Documents show that the Department will supply a Geotechnical Engineer to provide these services.

Perform the load test by applying a load up to the load required in the Contract Documents or to the failure load, whichever occurs first.

Do not apply test loads to piles sooner than 48 hours (or the time interval shown in the Plans) after driving of the test pile or reaction piles, whichever occurs last.

Allow up to four weeks after the last load test for the analysis of the load test data and to provide all the estimated production tip elevations. If the Contractor is willing to construct production foundation elements in areas designated by the Engineer, tip elevations will be determined in these areas beginning seven days after the receipt of the load test data which represents the designated area.

Do not begin static load testing of drilled shafts until the concrete has attained a compressive strength of 3,400 psi. The Contractor may use high early strength concrete to obtain this strength at an earlier time to prevent testing delays.

Load test piles/shafts in the order directed by the Engineer. The Department will furnish certain load test equipment and/or personnel when shown in the Plans. Inspect all equipment to be furnished by the Department at least 30 days prior to use, and notify the Engineer of any equipment that is not in satisfactory operating condition. The Department will consider any necessary repairs ordered by the Engineer to place the equipment in satisfactory operating condition as Unforeseeable Work. Provide the remainder of the equipment and personnel needed to conduct the load tests. Unless shown otherwise in the Contract Documents, provide all equipment, materials, labor, and technical personnel required to conduct the load tests, including determination of anchor reaction member depths. In this case, provide a loading apparatus designed to accommodate the maximum load plus an adequate safety factor.

While performing the load test, provide safety equipment, and employ safety procedures consistent with the latest approved practices for this work. Include with these safety procedures, adequate support for the load test plates and jack to prevent them from falling in the event of a release of load due to hydraulic failure, test pile/shaft failure, or any other cause.

Include in the bid the cost of transporting load test equipment and instrumentation supplied by the Department from their storage location to the job site and back. Handle these items with care. The Contractor is responsible for the safe return of these items. After completion of the static load tests, return all Department furnished equipment in satisfactory operating condition. Repair all damage to the test equipment furnished by the Department to the satisfaction of the Engineer. Clean all areas of rust on structural steel items, and recoat those areas in accordance with Section 560. Return all load test equipment supplied by the Department within 30 days after completing the load tests.

The Contractor is responsible for the equipment from the time it leaves its storage area until the time it is returned. During this time, insure the equipment against loss or damage for the replacement cost thereof (the greater of $150,000 or the amount shown in the Plans) or for the full insurable value if replacement cost insurance is not available.

Notify the Engineer at the preconstruction conference, or no later than 30 days before beginning test pile installation, of the proposed testing schedule so that items supplied by the Department may be reserved. Notify the Department at least ten working days before pick-up or return of the equipment. During pick-up, the Department will complete a checklist of all equipment placed in the Contractor's possession. The Department will later use this checklist to verify that the Contractor has returned all equipment. Provide personnel and equipment to load or unload the equipment at the Department's storage location. Provide lifting tongs or nylon slings to handle Department owned test girders. Do not perform cutting, welding, or drilling on Department owned girders, jacks, load cells, or other equipment.

455-2.2 Loading Apparatus: Provide an apparatus for applying the vertical loads as described in one of the following:

(1) As shown and described in the Contract Documents.

(2) As supplied by the Contractor, one of the following devices designed to accommodate a load at least 20% higher than that shown in the Contract Documents or described herein for test loads:

(a) Load Applied by Hydraulic Jack Acting Against Weighted Box or Platform: Construct a test box or test platform, resting on a suitable support, over the pile, and load it with earth, sand, concrete, pig iron, or other suitable material with a total weight greater than the anticipated maximum test load. Locate supports for the weighted box or platform at least 6 feet or three pile/shaft diameters, whichever is greater, measured from the edge of the pile or shaft to the edge of the supports. Insert a hydraulic jack with pressure gauge between the test pile or shaft and the underside of the reaction beam, and apply the load to the pile or shaft by operating the jack between the reaction beam and the top of the pile or shaft.

(b) Load Applied to the Test Pile or Shaft by Hydraulic Jack Acting Against Anchored Reaction Member: Construct reaction member anchorages as far from the test piles/shafts as practical, but in no case closer than the greater of 3 pile/shaft diameters or 6 feet from the edge of the test pile/shaft. Attach a girder(s) of sufficient strength to act as a reaction beam to the upper ends of the anchor piles or shafts. Insert a hydraulic jack with pressure gauges between the head of the test pile/shaft and the underside of the reaction beam, and apply the test load to the pile/shaft by operating the jack between the reaction beam and the pile/shaft head.

If using drilled shafts with bells as reaction member anchorages, locate the top of the bell of any reaction shaft anchorage at least three shaft diameters below the bottom of the test shaft.

(c) Combination Devices: The Contractor may use a combination of devices (a) and (b), as described above, to apply the test load to the pile or shaft.

(d) Other systems proposed by the Contractor and approved by the Engineer: When necessary, provide horizontal supports for loading the pile/shaft, and space them so that the ratio of the unsupported length to the minimum radius of gyration of the pile does not exceed 120 for steel piles, and the unsupported length to the least cross-section dimension does not exceed 20 for concrete piles or drilled shafts. Ensure that horizontal supports provide full support without restraining the vertical movement of the pile in any way.

When required by the Contract Documents, apply a horizontal load to the shaft either separately or in conjunction with the vertical load. Apply the load to the test shaft by hydraulic jacks, jacking against Contractor provided reaction devices. After receiving the Engineer's approval of the proposed method of load application, apply the horizontal load in increments, and relieve it in decrements as required by the Contract Documents.

455-2.2.1 Modified Quick Test:

(a) Loading Procedure: Apply vertical loads concentric with the longitudinal axis of the tested pile/shaft to accurately determine and control the load acting on the pile/shaft at any time. Place the load on the pile/shaft continuously, in increments equal to approximately 5% of the maximum test load specified until approaching the failure load, as indicated by the measuring apparatus and/or instruments. Then, apply increments of approximately 2.5% until the pile/shaft "plunges" or attains the limiting load. The Engineer may elect to stop the loading increments when he determines the Contractor has met the failure criteria or when a settlement equal to 10% of the pile/shaft width or diameter is reached. Apply each load increment immediately after taking and verifying the complete set of readings from all gauges and instruments. Apply each increment of load within the minimum length of time practical, and immediately take the readings. Complete the addition of a load increment and the completion of the readings within 5 to 15 minutes. The Engineer may elect to hold the maximum applied load up to one hour.

Remove the load in decrements of about 10% of the maximum test load. Remove each decrement of load within the minimum length of time practical, and immediately take the readings. Complete the removal of a load decrement and the taking of the readings within 5 to 15 minutes. The Engineer may also require up to two reloading cycles with five loading increments and three unloading decrements. Record the final recovery of the pile/shaft until movement is essentially complete for a period up to one hour after the last unload interval.

(b) Failure Criteria and Nominal Resistance: Use the criteria described herein to establish the failure load. The failure load is defined as the load that causes a pile/shaft top deflection equal to the calculated elastic compression plus 0.15 inches plus 1/120 of the pile/shaft minimum width or the diameter in inches for piles/shafts 24 inches or less in width, and equal to the calculated elastic compression plus 1/30 of the pile/shaft minimum width or diameter for piles/shafts greater than 24 inches in width. Consider the nominal resistance of any pile/shaft so tested as either the maximum applied load or the failure load, whichever is smaller.

455-2.3 Measuring Apparatus: Provide an apparatus for measuring movement of the test piles/shafts that consists of all of the following devices:

(1) Wire Line and Scale: Stretch a wire as directed by the Engineer between two supports located at a distance at least:

(a) 10 feet from the center of the test pile but not less than 3.5 times the pile diameter or width.

(b) 12 feet from the centerline of the shaft to be tested but not less than three shaft diameters.

Locate the wire supports as far as practical from reaction beam anchorages. At over-water test sites, the Contractor may attach the wire line as directed by the Engineer to the sides of the service platform. Mount the wire with a pulley on one support and a weight at the end of the wire to provide constant tension on the wire. Ensure that the wire passes across the face of a scale mounted on a mirror attached to the test pile/shaft so that readings can be made directly from the scale. Use the scale readings as a check on an average of the dial readings. When measuring both horizontal and vertical movement, mount separate wires to indicate each movement, horizontal or vertical. Measure horizontal movements from two reference wires set normal to each other in a horizontal.

(2) Wooden Reference Beams and Dial Gauges: Attach wooden reference beams as detailed in the Plans or approved by the Engineer to independent supports. For piles, install the greater of 3.5 times the pile diameter or width or 10 feet from the centerline of the test pile. For drilled shafts, install at the greater of three shaft diameters or 12 feet from the centerline of

the shaft to be tested. Locate the reference beam supports as far as practical from reaction beam anchorages. For over-water test sites, the Contractor may attach the reference beams as directed by the Engineer between two diagonal platform supports. Attach dial gauges, with their stems resting either on the top of the pile/shaft or on lugs or similar reference points on the pile/shaft, to the fixed beams to record the movement of the pile/shaft head. Ensure that the area on the pile/shaft or lug on which the stem bears is a smooth surface which will not cause irregularities in the dial readings.

For piles, the minimum acceptable method for measuring vertical movement is two dial gauges, each with 0.001 inch divisions and with 2 inch minimum travel, placed at 180 degrees or at the diagonal corners of the pile.

For shafts, ensure that three dial gauges, each with 0.001 inch divisions and with 2 inch minimum travel, placed at 120 degree intervals around the shaft, are the minimum acceptable method for measuring vertical movement. Ensure that four dial gauges, each with 0.001 inch divisions and with 2 inch minimum travel, placed at 90 degree intervals are the minimum required for measuring horizontal movement.

(3) Survey Level: As a check on the dial gauges, determine the elevation of a point near the top of the test pile/shaft (on plan datum) by survey level at each load and unload interval during the load test. Unless approved otherwise by the Engineer, level survey precision is 0.001 foot. Alternately, the surveyor may read an engineer’s 50 scale attached near the pile/shaft head. Determine the first elevation before applying the first load increment; make intermediate readings immediately before a load increment or an unload decrement, and after the final unload decrement that completely removes the load. Make a final reading at the time of the last recovery reading or as directed by the Engineer.

For over-water test sites, when shown in the Plans or directed by the Engineer, the Contractor shall drive an H pile through a 36 inch casing to provide a stable support for the level and to protect it against wave action interfering with level measurements. Provide a suitable movable jig for the surveyor to stand. Use a jig that has a minimum of three legs, has a work platform providing at least 4 feet width of work area around the casing, and is approved by the Engineer before use. The described work platform may be supported by the protective casing when approved by the Engineer.

455-2.4 Load Test Instrumentation:

(1) General: The intent of the load test instrumentation is to measure the test load on top of the pile/shaft and, when provided in the Contract Documents, its distribution between side friction and end bearing to provide evaluation of the preliminary design calculations and settlement estimates and to provide information for final pile/shaft length design. Ensure that the instrumentation is as described in the Contract Documents.

When requested by the Engineer, provide assistance during installation of any instrumentation supplied by the Department. Supply 110 V, 60 Hz, 30 A of AC electric power in accordance with the National Electric Code (NEC) to each test pile/shaft site during the installation of the instrumentation, during the load testing, and during any instrumented redrives ordered by the Engineer.

Place all of the internal instrumentation on the rebar cage before installation in the test shaft. Construct the rebar cage at least two days before it is required for construction of the test shaft. Provide assistance during installation of instrumentation supplied by the Department, including help to string, place, and tie the instrumentation and any assistance needed in moving or repositioning the cage to facilitate installation. Place the rebar cage in one segment complete with its instrumentation. The Engineer may require multiple lift points and/or a suitable “stiffleg” (length of H pile or other suitable section) to get the cage in a vertical position without causing damage to the instrumentation. Successfully demonstrate the lifting and handling procedures before the installing instrumentation.

(2) Hydraulic Jack and Load Cell: Provide hydraulic jack(s) of adequate size to deliver the required test load to the pile/shaft unless shown otherwise in the Plans. Before load testing begins, furnish a certificate from a reputable testing laboratory showing a calibration of gauge readings for all stages of jack loading and unloading for jacks provided. Ensure that the jack has been calibrated within the preceding six months unless approved otherwise. Recalibrate the jack after completing load testing if so directed by the Engineer. Ensure that the accuracy of the gauge is within 5% of the true load.

Provide an adequate load cell approved by the Engineer that has been calibrated within the preceding six months. Provide an approved electrical readout device for the load cell. Before beginning load testing, furnish a certificate from a reputable testing laboratory showing a calibration of readings for all stages of loading and unloading for load cells furnished by the Contractor. Ensure that the accuracy of the load cell is within 1% of the true load.

If the Department supplies the Contractor with the jack and/or load cell, have the equipment calibrated and include the cost in the cost for static load test.

(3) Telltales: When shown in the Contract Documents, provide telltales that consist of an unstressed steel rod placed, with appropriate clearance and greased for reducing friction and corrosion, inside a constant-diameter pipe that rests on a flat plate attached to the end of the pipe at a point of interest shown in the Plans. Construct telltales in accordance with details shown in the Contract Documents. Install dial gauges reading to 0.001 inch with 1 inch minimum travel as directed by the Engineer to measure the movement of the telltale with respect to the top of the pile/shaft.

(4) Embedded Strain Gauges: When shown in the Contract Documents, provide strain gauges which shall be placed in the test shaft to measure the distribution of the load. Ensure that the type, number, and location of the strain gauges are as shown in the Plans or as directed by the Engineer. Use strain gauges that are waterproof and have suitable shielded cable that is unspliced within the shaft.

455-2.5 Support Facilities: Furnish adequate facilities for making load and settlement readings 24 hours per day. Provide such facilities for the instrumented area, and include lighting and shelter from rain, wind, and direct sunlight.

455-2.6 Load Test Personnel Furnished by the Contractor: Provide a certified welder, together with necessary cutting and welding equipment, to assist with the load test setup and to make any necessary adjustments during the load test. Provide personnel to operate the jack, generators, and lighting equipment, and also provide one person with transportation to assist as required during load test setup and conducting of the load tests. Provide qualified personnel, as determined by a Specialty Engineer or testing lab, required to read the dial gauges, take level measurements, and conduct the load test, except when the Contract Documents show that the Department will provide these personnel.

455-2.7 Cooperation by the Contractor: Cooperate with the Department, and ensure that the Department has access to all facilities necessary for observation of the conduct and the results of the test.

455-2.8 Required Reports: Submit a preliminary static load test report to the Engineer within five days after completing the load test. When the Contract Documents do not require internal instrumentation, submit the final report within ten days after completing the load test. Furnish the final report of test results for internally instrumented shafts within 30 days after completing the load test. Include in the report of the load test the following information:

(1) A tabulation of the time of, and the amount of, the load and settlement readings, and the load and recovery readings taken during the loading and unloading of the pile/shaft.

(2) A graphic representation of the test results, during loading and unloading of pile/shaft top movement as measured by the average of the dial gauge readings, from wireline readings and from level readings.

(3) A graphic representation of the test results, when using telltales, showing pile/shaft compression and pile/shaft tip movement.

(4) The estimated failure and safe loads according to the criteria described herein.

(5) Remarks concerning any unusual occurrences during the loading of the pile/shaft.

(6) The names of those making the required observations of the results of the load test, the weather conditions prevailing during the load test, and the effect of weather conditions on the load test.

(7) All supporting data including jack and load cell calibrations and certificates and other equipment requiring calibration.

(8) When the Contract Document requires internal instrumentation of the pile/shaft, furnish all of the data taken during the load test together with instrument calibration certifications. In addition, provide a report showing an analysis of the results of axial load and lateral load tests in which soil resistance along and against the pile/shaft is reported as a function of deflection.

Provide the necessary report(s) prepared by the Specialty Engineer responsible for collection and interpretation of the data, except when the Contract Documents show that the Department will provide a Geotechnical Engineer.

455-2.9 Disposition of Loading Material: After completing all load tests, clean, remove all rust and debris from Department equipment, repaint all areas having damage to the paint in accordance with Section 560, and return all load test equipment supplied by the Department to its designated storage area. Repair any structural damage to Department owned equipment to the satisfaction of the Engineer. Notify the Department at least ten working days in advance so that arrangements can be made to unload the equipment. Remove all equipment and materials, which remains the Contractor’s property, from the site. Clean up and restore the site to the satisfaction of the Engineer.

455-2.10 Disposition of Tested Piles/Shafts: After completing testing, cut off the tested piles/shafts, which are not to be incorporated into the final structure, and any reaction piles/shafts at an elevation 24 inches below the finished ground surface. Take ownership of the cut-offs and provide areas for their disposal.

B. PILING

455-3 Description.

Furnish and install concrete, steel, or wood piling including driving, jetting, preformed pile holes, cutting off, splicing, dynamic load testing, and static load testing of piling.

455-4 Classification.

The Department classifies piling as follows:

(1) Treated timber piling.
(2) Prestressed concrete piling.
(3) Steel piling.
(4) Test piling.
(5) Sheet piling.
    (a) Concrete sheet piling.
    (b) Steel sheet piling.
(6) Polymeric Piles (see Section 471 for requirements).

455-5 General Requirements.

455-5.1 Site Preparation:

455-5.1.1 Predrilling of Pile Holes: Predrilled pile holes are either starter holes to the depth described in this section or holes drilled through embankment/fill material down to the natural ground surface. When using low displacement steel piling such as structural shapes, drive them through the compacted fill without the necessity of drilling holes through the fill except when the requirements for predrilling are shown in the Plans. When using concrete or other high displacement piles, drill pile holes through fill, new or existing, to at least the elevation of the natural ground surface. Use the range of drill diameters listed below for square concrete piles.

12 inch square piles	15 to 17 inches
14 inch square piles	18 to 20 inches
18 inch square piles	22 to 26 inches
20 inch square piles	24 to 29 inches
24 inch square piles	30 to 34 inches
30 inch square piles	36 to 43 inches

For other pile sizes, use the diameter of the drills shown in the Plans or approved by the Engineer. Accurately drill the pile holes with the hole centered over the Plan location of the piling. Maintain the location and vertical alignment within the tolerances allowed for the piling.

For predrilled holes required through rock or other hard (i.e. debris, obstructions, etc.) materials that may damage the pile during installation, predrill hole diameters approximately 2 inches larger than the largest dimension across the pile cross-section. Fill the annular space around the piles as described in 455-5.9.1 with clean A-3 sand or sand meeting the requirements of 902-3.3.

In the setting of permanent and test piling, the Contractor may initially predrill holes to a depth up to 10 feet or 20% of the pile length whichever is greater, except that, where installing piles in compacted fill, predrill the holes to the elevation of the natural ground surface. With prior written authorization from the Engineer, the Contractor may predrill holes to greater depths to minimize the effects of vibrations on existing structures adjacent to the work and/or for other reasons the Contractor proposes. Perform such work the Engineer allows but does not require at no expense to the Department. When the Engineer requires such work, the Department will pay for such work as Preformed Pile Holes as described in 455-5.9.

455-5.1.2 Underwater Driving: Underwater driving is defined as any driving through water which is above the pile head at the time of driving.

When conducting underwater driving, provide a diver equipped with voice communications to aid in placing the hammer back on the pile for required cushion changes or for subsequent redriving, to attach or recover instrumentation the Engineer is using, to inspect the condition of the pile, or for other assistance as required.

Select one of the following methods for underwater driving:

(a) Accomplish underwater driving using conventional driving equipment and piling longer than authorized so that the piling will extend above the water surface during final driving. When choosing this option, furnish a pile hammer that satisfies the requirements of this Section for use with the longer pile.

(b) Accomplish underwater driving using an underwater hammer that meets the requirements of this Section and is approved by the Engineer. When choosing this option, provide at least one pile longer than authorized at each pile group, extending above the water surface at final driving. At each group location, drive the longer pile first. The Engineer will evaluate the adequacy of the underwater driving system. The Engineer may use the pile tip elevation of the longer pile that the Contractor has driven and the Engineer has accepted, to evaluate the acceptability of the piles driven with the underwater hammer.

(c) Accomplish underwater driving using conventional driving equipment with a suitable approved pile follower. When choosing this option, provide at least one pile longer than required at each pile group, extending above the water surface at final driving. At each group location, drive the full length pile first without using the follower. The Engineer will evaluate the adequacy of the follower used for underwater driving. The Engineer may choose to perform a dynamic load test on the first pile the Contractor drives with the follower in each group. The Engineer may use the pile tip elevation of the longer pile, that the Contractor has driven and the Engineer has accepted, to evaluate the acceptability of the piles driven with the follower.

Prior to use, submit details of the follower for the Engineer's evaluation and approval along with the information required in 455-10. Include the weight, cross-section details, stiffness, type of materials, and dimensions of the follower.

455-5.2 Pile Hammers: All equipment is subject to satisfactory field performance. Use a variable energy hammer to drive concrete piles. Hammers will be rated based on the theoretical energy of the ram at impact. Supply driving equipment which provides the required resistance at a blow count ranging from 3 blows per inch (36 blows per foot) to 10 blows per inch (120 blows per foot) at the end of initial drive, unless approved otherwise by the Engineer after satisfactory field trial. When the Engineer determines the stroke height or bounce chamber pressure readings do not adequately determine the energy of the hammer, provide and maintain a device to measure the velocity of the ram at impact. Determine the actual hammer energy in the field so that it is consistent with the hammer energy used for each bearing capacity determination. When requested, furnish to the Engineer all technical specifications and operating instructions related to hammer equipment.

455-5.2.1 Air/steam: Variable energy air/steam hammers shall be capable of providing at least two ram stroke lengths. The short ram stroke length shall be approximately half of the full stroke for hammers with strokes up to 4 feet and no more than 2 feet for hammers with maximum strokes lengths over 4 feet. Operate and maintain air/steam hammers within the manufacturer's specified ranges. Use a plant and equipment for steam and air hammers with sufficient capacity to maintain, under working conditions, the hammer, volume and pressure specified by the manufacturer. Equip the plant and equipment with accurate pressure gauges which are easily accessible to the Engineer. The Engineer will not accept final bearing on piles the Contractor drives with air/steam hammers unless the Contractor operates the hammers within 10% of the manufacturer's rated speed in blows per minute, unless otherwise authorized by the Engineer.

455-5.2.2 Diesel: Variable energy diesel hammers shall have at least three fuel settings that will produce reduced strokes. Operate and maintain diesel hammers within the manufacturer's specified ranges. Determine the rated energy of diesel hammers using measured ram stroke length multiplied by the weight of the ram for open end hammers and by methods recommended by the manufacturer for closed end hammers.

Provide the Engineer with a chart from the hammer manufacturer equating stroke and blows per minute for the open-end diesel hammer to be used. Also provide and maintain in working order for the Engineer's use an approved device to automatically determine and display ram stroke for open-end diesel hammers.

Equip closed-end (double acting) diesel hammers with a bounce chamber pressure gauge, in good working order, mounted near ground level so the Engineer can easily read. Also, provide the Engineer with a chart, calibrated to actual hammer performance within 30 days prior to initial use, equating bounce chamber pressure to either equivalent energy or stroke for the closed-end diesel hammer to be used.

455-5.2.3 Hydraulic: Variable energy hydraulic hammers shall have at least three hydraulic control settings that provide for predictable energy or equivalent ram stroke. The shortest stroke shall be a maximum of 2 feet for the driving of concrete piles. The remaining strokes shall include full stroke and approximately halfway between minimum and maximum stroke.

Supply hammer instrumentation with electronic read out, and control unit that allows the operator to read and adjust the hammer energy or equivalent ram stroke. When pressure measuring equipment is required to determine hammer energy, calibrate the pressure measuring equipment before use.

455-5.2.4 Vibratory: Vibratory hammers of sufficient capacity (force and amplitude) may be used to drive steel sheet piles and, with approval of the Engineer, to drive steel bearing piles a sufficient distance to get the impact hammer on the pile (to stick the pile). The Engineer will determine the allowable depth of driving using the vibratory hammer based on site conditions. However, in all cases, use a power impact hammer for the last 15 feet or more of the final driving of steel bearing piles for bearing determinations after all piles in the bent/pier have been driven with a vibratory hammer. Do not use vibrating hammers to install concrete piles, or to install support or reaction piles for a load test.

455-5.3 Cushions and Pile Helmet:

455-5.3.1 Capblock: Provide a capblock (also called the hammer cushion) as recommended by the hammer manufacturer. Use commercially manufactured capblocks constructed of durable manmade materials with uniform known properties. Do not use wood chips, wood blocks, rope, or other material which permit excessive loss of hammer energy. Do not use capblocks constructed of asbestos materials. Obtain the Engineer's approval for all proposed capblock materials and proposed thickness for use. Maintain capblocks in good condition, and change them when charred, melted, or otherwise significantly deteriorated. The Engineer will inspect the capblock before driving begins and weekly or at appropriate intervals determined by the Engineer based on field trial. Replace or repair any hammer cushion which loses more than 25% of its original thickness, in accordance with the manufacturer's instructions, before permitting further driving.

455-5.3.2 Pile Cushion: Provide a pile cushion that is adequate to protect the pile from being overstressed in compression and tension during driving. Use a pile cushion sized so that it will fully fill the lateral dimensions of the pile helmet minus one inch but does not cover any void or hole extending through the top of the pile. Determine the thickness based upon the hammer-pile-soil system. For driving concrete piles, use a pile cushion made from pine plywood or oak lumber. Alternative materials may be used with the approval of the Engineer. Obtain the Engineer's approval for all pile cushions. Do not use materials previously soaked, saturated or treated with oil. Maintain pile cushions in good condition and change when charred, splintered, excessively compressed, or otherwise deteriorated to the point it will not protect the pile against overstressing in tension and/or compression. Protect cushions from the weather, and keep them dry. Do not soak the cushions in any liquid. Replace the pile cushion, if during the driving of any pile, the cushion is either compressed more than one-half the original thickness or begins to burn. Provide a new cushion for each pile unless approved otherwise by the Engineer after satisfactory field trial.

Reuse pile cushions in good condition to perform all set-checks and redrives. Use the same cushion to perform the set-check or redrive as was used during the initial driving, unless this cushion is unacceptable due to deterioration, in which case use a similar cushion.

455-5.3.3 Pile Helmet: Provide a pile helmet suitable for the type and size of piling being driven. Use a pile helmet deep enough to adequately contain the required thickness of pile cushion and to assist in maintaining pile-hammer alignment. Use a pile helmet that fits loosely over the pile head and is at least 1 inch larger than the pile dimensions. Use a pile helmet designed so that it will not restrain the pile from rotating.

455-5.4 Leads: Provide pile leads constructed in a manner which offers freedom of movement to the hammer and that have the strength and rigidity to hold the hammer and pile in the correct position and alignment during driving. When using followers, use leads that are long enough and suitable to maintain position and alignment of the hammer, follower, and pile throughout driving.

455-5.5 Followers: Use followers only for underwater driving. Obtain the Engineer's approval for the type of follower, when used, and the method of connection to the leads and pile. Use followers constructed of steel with an adequate cross-section to withstand driving stresses. When driving concrete piles, ensure that the cross-sectional area of the follower is at least 18% of the cross-sectional area of the pile. When driving steel piles, ensure that the cross-sectional area of the follower is greater than or equal to the cross-sectional area of the pile. Provide a pile helmet at the lower end of the follower sized according to the requirements of 455-5.3.3. Use followers constructed that maintain the alignment of the pile, follower, and hammer and still allow the pile to be driven within the allowable tolerances. Use followers designed with guides adapted to the leads that maintain the hammer, follower, and the piles in alignment.

Use information from driving full length piles described in 455-5.1.2 compared to driving piles with the follower and/or dynamic load tests described in 455-5.13 to evaluate the adequacy of the follower and to establish the blow count criteria when using the follower.

455-5.6 Templates and Ground Elevations: Provide a fixed template, adequate to maintain the pile in proper position and alignment during driving with swinging leads or with semi-fixed leads. Where practical, place the template so that the pile can be driven to cut-off elevation before removing the template. Ensure that templates do not restrict the vertical movement of the pile.

Supply a stable reference close to the pile, which is satisfactory in the opinion of the Engineer, for determination of the pile penetration. At the time of driving piles, furnish the Engineer with elevations of the original ground and template at each pile or pile group location. Note the highest and lowest elevation at each required location and the ground elevation at all piles.

455-5.7 Water Jets: Use jet pumps, supply lines, and jet pipes that provide adequate pressure and volume of water to freely erode the soil. Do not perform jetting without prior approval by the Engineer or unless allowed by the Plans.

Do not perform jetting in the embankment or for end bents. Where conditions warrant, with approval by the Engineer, perform jetting on the holes first, place the pile therein, then drive the pile to secure the last few feet of penetration. Only use one jet for prejetting or jetting through piles constructed with a center jet-hole. Use two jets when using external jets. When jetting and driving, position the jets slightly behind the advancing pile tip (approximately 3 feet or as approved by the Engineer). When using water jets in the driving, determine the pile bearing only from the results of driving after withdrawing the jets, except where using jets to continuously eliminate soil resistance through the scour zone, ensure that they remain in place as directed by the Engineer and operating during pile bearing determination. Where practical, perform jetting on all piles in a pile group before driving begins. When large pile groups or pile spacing and batter make this impractical, or when the Plans specify a jet-drive sequence, set check a sufficient number of previously driven piles in a pile group to confirm their capacity after completing all jetting.

455-5.8 Penetration Requirements: Measure the penetration of piles from the elevation of natural ground, scour elevation shown in the Plans, or the bottom of excavation, whichever is lower. When the Contract Documents show a minimum pile tip elevation or a minimum depth of penetration, drive the tip of the pile to this minimum elevation or this minimum penetration depth. In all such cases, the Engineer will accept the bearing of a pile only if the Contractor achieves the required bearing when the tip of the pile is at or below the specified minimum tip elevation or depth of penetration and below the bottom of the preformed or predrilled pile hole.

When the Plans do not show a minimum depth of penetration, scour elevation, or minimum tip elevation, ensure that the required penetration is at least 10 feet into firm bearing material or at least 20 feet into soft material unless otherwise permitted by the Engineer. If a scour elevation is shown in the Plans, achieve these penetrations below the scour elevation. The Engineer may accept a penetration between 15 feet and 20 feet when there is an accumulation of five consecutive feet or more of firm bearing material. Firm bearing material is any material offering a driving resistance greater than or equal to 30 tons per square foot of gross pile area as determined by the Dynamic Load Testing (455-5.11.4). Soft material is any material offering less than these resistances. The gross pile area is the actual pile tip cross-sectional area for solid concrete piles, the product of the width and depth for H piles, and the area within the outside perimeter for pipe piles and voided concrete piles.

Do not drive piles beyond practical refusal (20 blows per inch). To meet the requirements in this Subarticle, provide penetration aids, such as jetting or preformed pile holes, when piles cannot be driven to the required penetration without reaching practical refusal.

If the Contractor encounters unforeseeable, isolated obstructions that the Contractor cannot practically penetrate by driving, jetting, or preformed pile holes, and the Contractor must remove the pile to obtain the required pile penetration, the Department will pay the costs for such removal as Unforeseeable Work.

455-5.9 Preformed Pile Holes:

455-5.9.1 Description: Preformed pile holes serve as a penetration aid when all other pile installation methods fail to produce the desired penetration and when authorized by the Engineer to minimize the effects of vibrations on adjacent structures. Preformed pile holes are necessary when the presence of rock or strong strata of soils will not permit the installation of piles to the desired penetration by driving or a combination of jetting and driving, when determined necessary by the Engineer, or when authorized by the Engineer to minimize the effects of vibrations on adjacent existing structures. The Engineer may require preformed holes for any type of pile. Drive all piles installed in preformed pile holes to determine that the bearing requirements have been met.

For preformed holes which are required through material that caves during driving to the extent that the preformed hole does not serve its intended purpose, case the hole from the surface through caving material. After installing the pile to the bottom of the casing, remove the casings unless shown otherwise in the Plans. Determine bearing of the pile after removing the casing unless shown otherwise in the Plans. Fill all voids between the pile and soil remaining after driving through preformed holes with clean A-3 sand or sand meeting the requirements of 902-3.3, after the pile has achieved the required minimum tip elevation, unless grouting of preformed pile holes is shown in the Plans. If pile driving is interrupted during sand placement, drive the pile at least 20 additional blows after filling all of the voids between the pile and soil with sand at no additional compensation.

455-5.9.2 Provisions for Use of Preformed Pile Holes: The Department generally anticipates the necessity for preformed pile holes and includes directions in the Contract Documents. The Department will pay for preformed pile holes when the Contractor establishes that the required results cannot be obtained when driving the load bearing piles with specified driving equipment, or if jetting is allowed, while jetting the piles and then driving or while jetting the piles during driving.

455-5.9.3 Conditions Under Which Payment Will Be Made: The Department will make payment for preformed pile holes shown in the Plans, required by the Engineer or where the Contractor demonstrates that such work is necessary to achieve the required penetration of the pile. The Department considers, but does not limit to, the following conditions as reasons for preformed pile holes:

(a) Inability to drive piles to the required penetration with driving and jetting equipment.

(b) To penetrate a hard layer or layers of rock or strong stratum that the Engineer considers not sufficiently thick to support the structure.

(c) To obtain greater penetration into dense (strong) material and into dense material containing holes, cavities or unstable soft layers.

(d) To obtain penetration into a stratum in which it is desired to found the structure.

(e) To minimize the effects of vibrations or heave on adjacent existing structures.

(f) To minimize the effects of ground heave on adjacent piles.

455-5.9.4 Construction Methods: Construct preformed pile holes by drilling, or driving and withdrawing a suitable punch or chisel at the locations of the piles. Construct a hole that is equal to or slightly greater than the largest pile dimension for the entire length of the hole and of sufficient depth to obtain the required penetration. Carefully form the preformed hole by using a drill or punch guided by a template or other suitable device, and do not exceed the minimum dimensions necessary to achieve the required penetration of the pile. When the Plans call for grouting the preformed pile holes, provide the minimum dimension of the pile hole that is 2 inches larger than the largest pile dimension. Construct the holes at the Plan position of the pile and the tolerances in location, and ensure the hole is straight and that the batter is the same as specified for the pile. Loose material may remain in the preformed pile hole if the conditions in 455-5.9.3 are satisfied.

455-5.9.5 Grouting of Pile Holes: Grout preformed pile holes for bearing piles, when the Plans require grouting after driving. Clean the preformed pile holes, and fill them with cement grout as shown in the Plans. Use grout that has a minimum compressive strength of 3,000 psi at 28 days or as specified. Pump the grout through three or more grout pipes initially placed at the bottom of the preformed hole. The Contractor may raise the grout pipes when necessary to prevent clogging and to complete the grouting operations. Maintain the grout pipes below the surface of the previously placed grout. Continue grouting until the grout reaches the ground surface all around the pile. Provide divers to monitor grouting operations when the water depth is such that it is impractical to monitor from the ground surface. When grouting is shown in the Plans, include the cost in the price for piles. In the event that the Engineer determines the Contractor must grout and the required grouting is not shown in the Plans, the Department will pay for the grouting work as Unforeseeable Work.

455-5.10 Bearing Requirements:

455-5.10.1 General: Drive piles to provide the bearing capacities required for carrying the loads shown in the Plans. For all types of bearing piles, consider the driving resistance as determined by the methods described herein sufficient for carrying the specified loads as the minimum bearing which is accepted for any type of piles. Determine pile bearing using the method described herein or as shown in the Plans.

The Engineer may accept a driven pile when the pile has achieved minimum penetration, the blow count is generally increasing and the minimum required bearing capacity obtained for 24 inches of consecutive driving. At his discretion, the Engineer may also accept a driven pile when the minimum penetration is achieved and driving has reached practical refusal in firm material.

455-5.10.2 Blow Count Criteria: The Engineer will determine the number of blows required to provide the required bearing according to the methods described herein. Determine the pile bearing by computing the penetration per blow with less than 1/4 inches rebound averaged through 12 inches each of penetration. When it is considered necessary by the Engineer, determine the average penetration per blow by averaging the penetration per blow through the last 10 to 20 blows of the hammer.

455-5.10.3 Practical Refusal: Practical refusal is defined as 20 blows per inch with the hammer operating at the highest setting or setting determined by the Engineer and less than 1/4 inches rebound per blow. Stop driving as soon as the Engineer determines that the pile has reached practical refusal. The Engineer will generally make this determination within 2 inches of driving. When the required pile penetration cannot be achieved by driving without exceeding practical refusal, use other penetration aids such as jetting or preformed pile holes.

455-5.10.4 Set-checks and Pile Redrive:

(a) Set-checks: In the event that the Contractor has driven the pile to approximately 12 inches above cut-off without reaching the required resistance, the Engineer may require the Contractor to interrupt driving to perform a set-check. Provide an engineer's level or other suitable equipment for elevation determinations to determine accurate pile penetration during the set-checks. In the event the results of the initial set-checks are not satisfactory, the Engineer may direct additional set-checks. The Engineer may accept the pile as driven when a set-check shows that the Contractor has achieved the minimum required pile bearing and has met all other requirements of this Section.

(b) Pile Redrive: Pile redrive consists of redriving the pile after the following working day from initial driving to determine time effects, to reestablish pile capacity due to pile heave, or for other reasons determined by the Engineer. Redrive piles as directed by the Engineer.

(c) Uninstrumented Set-Checks and Uninstrumented Pile Redrive: The Engineer may consider the pile to have sufficient bearing resistance when the specified set-check criteria is met through the last 10 to 20 blows of the hammer at the specified minimum stroke and the total penetration is less than six inches with less than 1/4 inches rebound per blow. When the total penetration during a set-check or redrive is greater than six inches or pile rebound exceeds 1/4 inches per blow, the Engineer may consider the pile to have sufficient bearing resistance when the specified blow count criteria is achieved in accordance with 455-5.10.1.

(d)Instrumented Set-Checks and Instrumented Pile Redrive: When considered necessary by the Engineer, dynamic load tests will be used to determine whether the pile bearing is sufficient. The Engineer may consider the pile to have sufficient bearing resistance when dynamic measurements demonstrate the static pile resistance during at least one hammer blow exceeds the required pile resistance, the average static pile resistance during the next five hammer blows exceeds 95% of the required pile resistance and the static pile resistance during all subsequent blows exceeds 90% of the required pile resistance.

455-5.10.5 Pile Heave: Pile heave is the upward movement of a pile from its originally driven elevation. Drive the piles in an approved sequence to minimize the effects of heave and lateral displacement of the ground. Monitor piles previously driven in a pile group for possible heave during the driving of the remaining piles. When required by the Engineer, take elevation measurements to determine the magnitude of the movement of piles and the ground surface resulting from the driving process. Redrive all piles that have heaved 1/4 inches or more unless the Engineer determines that the heave is not detrimental to pile capacity. The Department will pay for all work in conjunction with redriving piles due to pile heave under the pile redrive item.

455-5.10.6 Piles with Insufficient Bearing: In the case that the Engineer determines that the safe bearing capacity of any pile is less than the required bearing capacity, the Contractor may splice the pile and continue driving or may extract the pile and drive a pile of greater length, or, if so ordered by the Engineer, drive additional piles until reducing the required bearing per pile to the determined bearing capacity of the piles already driven.

455-5.11 Methods to Determine Pile Capacity:

455-5.11.1 General: Dynamic load tests using Embedded Data Collector (EDC) equipment and the UF Method of analysis, or an externally mounted instrument system and signal matching analyses will be used to determine pile capacity for all structures or projects unless otherwise shown on the Plans. When necessary, the Engineer may require static load tests to confirm pile capacities. When the Contract Documents do not include items for static load tests, the Engineer will consider all required static load testing Unforeseeable Work. Notify the Engineer two working days prior to placement of piles within the template and at least one working day prior to driving piles. Do not drive piles without the presence of the Engineer.

If the internally mounted system fails to communicate properly with the receiving system, allow the Engineer sufficient time to mobilize back-up equipment for performing dynamic load testing.

455-5.11.2 Wave Equation:

(a) General: Use Wave Equation Analysis for Piles (WEAP) programs to evaluate the suitability of the proposed driving system (including the hammer, follower, capblock and pile cushions) as well as to estimate the driving resistance, in blows per 12 inches or blows per inch, to achieve the pile bearing requirements and to evaluate pile driving stresses.

The Engineer may modify the scour resistance shown in the Plans if the dynamic load test is used to determine the actual soil resistance through the scour zone. Also, the Engineer may make modifications in scour resistance when the Contractor proposes drilling and/or jetting to reduce the soil resistance in the scour zone.

Use Wave Equation Analyses to show the hammer is capable of driving to a resistance equal to at least 2.0 times the factored design load plus the scour and down drag resistance (if applicable) shown in the Contract Documents, without overstressing the piling in compression or tension and without reaching practical refusal (20 blows per inch). Ensure that the hammer provided also meets the requirements described in 455-5.2.

(b) Required Equipment For Driving: Hammer approval is solely based on satisfactory field trial including dynamic load test results and Wave Equation Analysis. Supply a hammer system that meets the requirements described in the specifications based on the above analysis. Obtain approval from the Engineer for the pile driving system based on satisfactory field performance.

In the event piles require different hammer sizes, the Contractor may elect to drive with more than one size hammer or with a variable energy hammer, provided the hammer is properly sized and cushioned, will not damage the pile, and will develop the required resistance.

(c) Maximum Allowed Pile Stresses:

(1) General: The maximum allowed driving stresses for concrete, steel, and timber piles are given below. In the event Wave Equation analyses show that the hammer will overstress the pile, modify the driving system or method of operation as required to prevent overstressing the pile. In such cases provide additional cushioning or make other appropriate agreed upon changes. For penetration of weak soils by concrete piles, use thick cushions and/or reduced stroke to control tension stresses during driving.

(2) Concrete Piles: Use the wave equation to evaluate the proposed pile cushioning. Use the following equations to determine the maximum allowed pile stresses as predicted by the wave equation, and measured during driving when driving prestressed concrete piling:

$$s_{apc} = 0.7\, f_c' - 0.75\, f_{pe} \qquad (1)$$

$$s_{apt} = 6.5\,(f_c')^{0.5} + 1.05\,f_{pe}$$ (2a) for piles less than 50 feet long

$$s_{apt} = 3.25\,(f_c')^{0.5} + 1.05\,f_{pe}$$ (2b) for piles 50 feet long and greater

$$s_{apt} = 500$$ (2c) within 20 feet of a mechanical splice

where:

s_{apc}= maximum allowed pile compressive stress, psi
s_{apt}= maximum allowed pile tensile stress, psi
f'_c= specified minimum compressive strength of concrete, psi
f_{pe}= effective prestress (after all losses) at the time of driving, psi, taken as 0.8 times the initial prestress force (f_{pe}= 0 for dowel spliced piles).

(3) Steel Piles: Ensure the maximum pile compression and tensile stresses as predicted by the Wave Equation, and/or measured during driving are no greater than 0.9 times the yield strength (0.9 f_y) of the steel.

(4) Timber Piles: Ensure the maximum pile compression and tensile stresses as predicted by the wave equation, and/or measured during driving are no greater than 3.6 ksi for Southern Pine and Pacific Coast Douglas Fir and 0.9 of the ultimate parallel to the grain strength for piles of other wood.

455-5.11.3 Temporary Piles: Submit for the Engineers review, an analysis signed and sealed by a Specialty Engineer which establishes the pile lengths for temporary piles, and submit for the Engineers approval, a Wave Equation analysis signed and sealed by a Specialty Engineer which establishes the driving criteria for temporary piles at least five working days prior to driving temporary production piles. The required driving resistance is equal to the sum of the factored design load plus the scour and down drag resistances shown in the Plans, divided by the appropriate resistance factor or the nominal bearing resistance shown in the Plans, whichever is higher.

The maximum resistance factor is 0.45 when only wave equation analysis is performed. However, a larger resistance factor may be applicable when additional testing is provided by the Specialty Engineer in accordance with Section 3.5.6 of Volume 1 of the FDOT Structures Manual.

455-5.11.4 Dynamic Load Tests: Dynamic load testing consists of estimating pile capacity by the analysis of electronic data collected from blows of the hammer during driving of an instrumented pile.

455-5.11.5 Static Load Tests: Static load testing consists of applying a static load to the pile to determine its capacity. Use The Modified Quick Test Procedure in accordance with 455-2.2.1.

455-5.11.6 Fender Pile Installation: For piles used in fender systems, regardless of type or size of pile, either drive them full length or jet the piles to within 2 feet of cutoff and drive to cutoff elevation to seat the pile. The Engineer will not require a specific driving resistance unless noted in the Plans. Use methods and equipment for installation that do not damage the piles. If the method or equipment used causes damage to the pile, modify the methods or equipment at no expense to the Department.

455-5.11.7 Structures Without Test Piles: For projects without test piles, the Engineer will dynamically test the first pile(s) in each bent or pier at locations shown in the Plans to determine the blow count criteria for the remaining piles. When locations are not shown in the Plans, allow for dynamic load tests at 5% of the piles at each bent or pier (rounded up to the next whole number). If the Engineer requires additional dynamic load tests for comparison purposes, the Contractor will be paid for an additional dynamic load test as authorized by the Engineer in accordance with 455-11.5.

When using externally mounted instruments, allow the Engineer one working day after driving the dynamic load tested piles for the Engineer to complete the signal matching analyses and determine the driving criteria for the subsequent piles in the bent or pier.

455-5.12 Test Piles:

455-5.12.1 Description: Drive piles of the same cross-section and type as the permanent piles shown in the Plans, in order to determine any or all of the following:

(a) the installation criteria for the piles.

(b) the nature of the soil.

(c) the lengths of permanent piles required for the work.

(d) the driving resistance characteristics of the various soil strata.

(e) the amount of work necessary to obtain minimum required pile penetration.

(f) the ability of the driving system to do the work.

(g) the need for point protection.

Because test piles are exploratory in nature, drive them harder (within the limits of practical refusal), deeper, and to a greater bearing resistance than required for the permanent piling. Except for test piles which are to be statically or Statnamically load tested, drive test piles their full length or to practical refusal. Splice test piles which have been driven their full length and have developed only minimal required bearing, and proceed with further driving.

As a minimum, unless otherwise directed by the Engineer, do not cease driving of test piles until obtaining the required bearing capacity continuously, where the blow count is increasing, for 10 feet unless reaching practical refusal first. For test piles which are to be statically or Statnamically load tested, ignore this minimum and drive these piles as anticipated for the production piles.

When test piles attain practical refusal prior to attaining minimum penetration, perform all work necessary to attain minimum penetration and the required bearing. Where practical, use water jets to break the pile loose for further driving. Where jetting is impractical, extract the pile and install a preformed pile hole through which driving will continue. The Department will consider the work of extracting the pile to be Unforeseeable Work.

When driving test piles other than low displacement steel test piles, have preforming equipment available at the site and water jets as specified in 455-5.7 when jetting is allowed, ready for use, before the test pile driving begins.

The Engineer may elect to interrupt pile driving up to four times on each test pile, two times for up to two hours and two additional times during the next working day of initial driving to determine time effects during the driving of test piles.

Install instruments on test piles when dynamic load tests are included in the Plans or when directed by the Engineer.

455-5.12.2 Location of Test Piles: Drive all test piles in the position of permanent piles at the designated locations. Ensure that all test piles designated to be statically load tested are plumb. In the event that all the piles are battered at a static load test site, the Engineer will designate an out-of-position location for driving a plumb pile for the static load test.

455-5.12.3 Equipment for Driving: Use the same hammer and equipment for driving test piles as for driving the permanent piles. Also use the same equipment to redrive piles.

455-5.13 Dynamic Load Tests: The Engineer will take dynamic measurements during the driving of piles designated in the Plans or authorized by the Engineer. Install instruments prior to driving and assist the Engineer in monitoring all blows delivered to the pile. All test piles will have dynamic load tests. The Engineer will perform dynamic load tests to evaluate any or all of the following:

1. Evaluate suitability of Contractor's driving equipment, including hammer, capblock, pile cushion, and any proposed follower.
2. Determine pile capacity.
3. Determine pile stresses.
4. Determine energy transfer to pile.
5. Determine distribution of soil resistance.
6. Evaluate soil variables including quake and damping.
7. Evaluate hammer-pile-soil system for Wave Equation analyses.
8. Evaluate pile installation problems.
9. Other.

Either install EDCs in the piles in accordance with Design Standards, Index No. 20602 or attach instruments (strain transducers to measure force and accelerometers to measure acceleration) with bolts to the pile for dynamic load testing.

Make each pile to be dynamically tested with externally attached instruments available to drill holes for attaching instrumentation and for wave speed measurements. Support the pile with timber blocks placed at appropriate intervals. Ensure that the pile is in a horizontal position and does not contact adjacent piles. Provide a sufficient clear distance at the sides of the pile for drilling the holes. The Engineer will furnish the equipment, materials, and labor necessary for drilling holes and taking the wave speed measurements. If the Engineer directs dynamic load testing, instrumented set-checks or instrumented redrives, provide the Engineer safe access to the top of the piles for drilling the attachment holes. After placing the leads provide the Engineer reasonable means of access to the piles to attach the instruments and for removal of the instruments after completing the pile driving.

The Engineer will monitor the stresses in the piles with the dynamic test equipment during driving to ensure the Contractor does not exceed the maximum allowed stresses. If necessary, add additional cushioning, replace the cushions, or reduce the hammer stroke to maintain stresses below the maximum allowable. If dynamic test equipment measurements indicate non-axial driving, immediately realign the driving system. If the cushion is compressed to the point that a change in alignment of the hammer will not correct the problem, add cushioning or change the cushion as directed by the Engineer.

Drive the pile to the required penetration and resistance or as directed by the Engineer. Dynamic load testing of a pile may average up to two hours longer than for driving an uninstrumented pile.

When directed by the Engineer, perform instrumented set-checks or redrives. Do not use a cold diesel hammer for a set-check or redrive unless in the opinion of the Engineer it is impractical to do otherwise. Generally, warm up the hammer by driving another pile or applying at least 20 blows to a previously driven pile or to timber mats placed on the ground.

For steel production piles, the Engineer may accept instrumented set-checks or redrives for the purpose of meeting the requirements for 100% dynamic testing.

455-5.14 Pile Lengths:

455-5.14.1 Test Pile Length: Provide the length of test piles shown in the Plans or as directed by the Engineer.

455-5.14.2 Production Pile Length

455-5.14.2.1 Structures With Test Piles: When test pile lengths are shown in the Plans, the production pile lengths are based on information available during design and are approximate only. The Engineer will determine final pile lengths in the field which may vary significantly from the lengths or quantities shown in the Plans.

455-5.14.2.2 Structures Without Test Piles: Authorized lengths are provided as Production Pile Order Lengths in the Pile Data Table in the Structure Plans. Use these lengths for furnishing the permanent piling for the structure.

455-5.14.3 Authorized Pile Lengths: The authorized pile lengths are the lengths determined by the Engineer based on all information available before the driving of the permanent piles, including, but not limited to, information gained from the driving of test piles, dynamic load testing, static load testing, supplemental soil testing, etc. When authorized by the Department, soil freeze information obtained during set checks and pile redrives may be used to determine authorized pile lengths for sites with extreme soil conditions. The Contractor may elect to provide piling with lengths longer than authorized to suit his method of installation or schedule. When the Contractor elects to provide longer than authorized pile lengths, the Department will pay for the furnished length as either the originally authorized length or the length between cut-off elevation and the final accepted pile tip elevation, whichever is the longer length.

Within five working days after driving all the test piles, completing all load tests, completing all redrives, and receiving all test reports, the Engineer will furnish the Contractor an itemized list of authorized pile lengths. Use these lengths for furnishing the permanent piling for the structure. If the Contractor is willing to start his pile driving operations in zones consisting of at least four test piles designated by the Engineer, and if the Contractor so requests in writing at the beginning of the test pile program, the Department will furnish pile lengths for these designated phases within five working days after driving all the test piles, completing all load tests, completing all redrives, and receiving all test reports for those designated zones. The Engineer will furnish the driving criteria for piles within three working days of furnishing pile lengths.

On multiple phase projects, the Engineer will not furnish pile lengths on subsequent phases until completing the piling on initial phases.

455-5.15 Allowable Driving Tolerances:

455-5.15.1 General: Meet the tolerances described in this Subarticle to the piles that are free standing without lateral restraint (after the template is removed). After the piles are driven, do not move the piles laterally to force them to be within the specified tolerances. The Contractor may move battered piles laterally to overcome the dead load deflections caused by the pile's weight. When this is necessary, submit calculations signed and sealed by a Specialty Engineer to the Engineer that verify the amount of dead load deflection prior to moving any piles.

455-5.15.2 Position: Ensure that the final position of the pile head at cut-off elevation is no more than 3 inches laterally in the X or Y coordinate from the Plan position indicated in the Plans.

455-5.15.3 Axial Alignment: Ensure that the axial alignment of the driven piles does not deviate by more than 1/4 inches per foot from the vertical or batter line indicated in the Plans.

455-5.15.4 Elevation: Ensure that the final elevation of the pile head is no more than 1-1/2 inches above, or more than 4 inches below, the elevation shown in the Plans, however in no case shall the pile be embedded less than 8 inches into the cap or footing.

For fender piles, cut off piles at the elevation shown in the Plans to a tolerance of plus 0.0 inches to minus 2.0 inches using sawing or other means as approved by the Engineer to provide a smooth level cut.

455-5.15.5 Deviation From Above Tolerances: When the Contractor has failed to meet the above tolerances, the Contractor may propose a redesign to incorporate out of tolerance piles into pile caps or footings, at no expense to the Department. Ensure the Contractor's Engineer of Record performs any redesign and signs and seals the redesign drawings and computations. Do not begin any proposed construction until the redesign has been reviewed for acceptability and approved by the Engineer.

455-5.16 Disposition of Pile Cut-offs, Test Piles, and Load Test Materials:

455-5.16.1 Pile Cut-offs:

(a) Steel Piling: Unless shown otherwise in the Plans, the Department will retain ownership of cut-off sections, or portions of cut-off sections, and unused piling 20 feet long or longer that are not damaged. Deliver them to the Department's nearest maintenance yard. Ensure that sections of piles delivered to the maintenance yard are straight and undamaged. Cut off the damaged portions prior to delivery. Take ownership of cut-off sections less than 20 feet long. Remove them from the job, and dispose of them.

(b) Other Pile Types: Upon completion of all work under the Contract in connection with piling, unless shown otherwise in the Plan, take ownership of any unused cut-off lengths remaining, and remove them from the right-of-way. Provide areas for their disposal.

455-5.16.2 Test Piles: Where so directed by the Plans or the Engineer, cut off, or build-up as necessary, test piles, and leave them in place as permanent piles. Extract and replace test piles driven in permanent position and found not suitable for use due to actions of the Contractor at no expense to the Department. Pull, or cut off at an elevation 2 feet below the ground surface or bottom of proposed excavation, test piles driven out of permanent position, and dispose of the removed portion of the test pile.

When test piles are required to be driven in permanent pile positions, the Contractor may elect to drive the test pile out of position, with the approval of the Engineer, provided that a replacement pile is furnished and driven by the Contractor at no expense to the Department in the position that was to be occupied by the test pile. Under this option, the Department will pay for the test pile in the same manner as if it were in permanent position.

Unless otherwise directed in the Plans or by the Engineer, retain ownership of test piles that are pulled or cut off and provide areas for their disposal.

455-6 Timber Piling.

455-6.1 Description: Drive timber piles constructed of round timber of the kind and dimensions specified in the Plans at the locations and to the elevations shown in the Plans, or as directed by the Engineer.

455-6.2 Materials: Meet the timber piling requirements of Section 953. Treat the piles according to the applicable provisions of Section 955. Treat all cuts and drilled holes in accordance with 470-3.

455-6.3 Preparation for Driving:

455-6.3.1 Caps: Protect the heads of timber piles during driving, using a cap of approved type, that will distribute the hammer blow over the entire cross-section of the pile. When necessary cut the head of the pile square before beginning pile driving.

455-6.3.2 Collars: Provide collars or bands to protect piles against splitting and brooming at no expense to the Department.

455-6.3.3 Shoes: Provide piles shod with metal shoes, of a design satisfactory to the Engineer, at no expense to the Department. Shape pile tips to receive the shoe and install according to the manufacturer's directions.

455-6.4 Storage and Handling: Store and handle piles in the manner necessary to avoid damage to the piling. Take special care to avoid breaking the surface of treated piles. Do not use cant dogs, hooks, or pike holes when handling and storing the piling.

455-6.5 Cutting Off: Saw off the tops of all timber piles at the elevation indicated in the Plans. Saw off piles which support timber caps to the exact plane of the superimposed structure so that they exactly fit it. Withdraw and replace broken, split, or misplaced piles.

455-6.6 Build-ups: The Engineer will not permit splices or build-ups for timber piles. Extract piles driven below Plan elevation and drive a longer pile.

455-6.7 Pile Heads:

455-6.7.1 Piles with Timber Caps: On piles wider than the timber caps, dress off to a slope of 45 degrees the part of the pile head projecting beyond the sides of the cap. Coat the cut surface with the required preservative over which place a sheet of copper, of a weight of 10 ounces per square foot or greater, meeting the requirements of ASTM B370. Provide a cover measuring at least 4 inches more in each dimension greater than the diameter of the pile. Bend the cover down over the pile and fasten the edges with large head copper nails or three wraps of No. 12 copper wire.

455-6.7.2 Fender and Bulkhead Piles: First paint the heads of fender piles and of bulkhead piles with preservative and then cover with copper as provided above for piles supporting timber caps.

455-7 Prestressed Concrete Piling.

455-7.1 Description: Provide prestressed concrete piles that are manufactured, cured, and driven in accordance with the requirements of the Contract Documents. Provide piles full length without splices when transported by barge or the pile length is less than or equal to 120 feet. When piles are transported by truck and the pile length exceeds 120 feet but is less than the maximum length for a three point pick-up according to Design Standards, Index No. 20600, and splicing is desired, provide minimal splices. Include the cost of the splices in the cost of the pile.

455-7.2 Manufacture: Fabricate piles in accordance with Section 450. When EDCs will be used for dynamic load testing, supply and install in square prestressed concrete piles in accordance with Design Standards, Index No 20602. Ensure the EDCs are installed by personnel approved by the manufacturer.

455-7.3 Storage and Handling:

455-7.3.1 Time of Driving Piles: Drive prestressed concrete piles at any time after the concrete has been cured in accordance with Section 450, and the concrete compressive strength is equal to or greater than the specified 28 day compressive strength.

455-7.3.2 Storage: Support piles on adequate dunnage both in the prestress yard and at the job site in accordance with the locations shown in the Standard Indexes to minimize undue bending stresses or creating a sweep or camber in the pile.

455-7.3.3 Handling: Handle and store piles in the manner necessary to eliminate the danger of fracture by impact or of undue bending stresses in handling or transporting the piles from the forms and into the leads. In general, lift concrete piles by means of a suitable bridge or slings attached to the pile at the locations shown in the Standard Indexes. Construct slings used to handle piles of a fabric material or braided wire rope constructed of six or more wire ropes which will not mar the corners or the surface finish of the piles. Do not use chains to handle piles. During transport, support concrete piles at the lifting locations shown in the Standard Indexes or fully support them throughout 80% or more of their length. In handling piles for use in salty or brackish water, exercise special care to avoid damaging the surface and corners of the pile. If an alternate transportation support arrangement is desired, submit calculations, signed and sealed by the Specialty Engineer, for approval by the Engineer prior to transporting the pile. Calculations must show that the pile can be transported without exceeding the bending moments calculated using the support locations shown in the Plans.

455-7.4 Cracked Piles: The Engineer will reject any pile that becomes cracked in handling to the point that a transverse or longitudinal crack extends through the pile, shows failure of the concrete as indicated by spalling of concrete on the main body of the pile adjacent to the crack, or which in the opinion of the Engineer will not withstand driving stresses. The Engineer will not reject any pile for the occasional minor surface hairline cracking caused by shrinkage or tensile stress in the concrete from handling.

Do not drive piling with irreparable damage, which is defined as any cracks that extend through the pile cross-sectional area that are, or will be, below ground or water level at the end of driving. Such cracks are normally evidenced by emitting concrete dust during their opening and closing with each hammer blow. Remove and replace broken piles or piles cracked to the extent described above at no expense to the Department. The Engineer will accept cracks less than 0.005 inches which do not extend through the pile. Using approved methods, cut off and splice or build-up to cut-off elevation piles with cracks greater than 0.005 inches at the pile head or above ground or water level, and piles with cracks above ground or water level which extend through the cross-sectional area of the pile. The Engineer, at his discretion, may require correction of pile damage or pile cracks by cutting down the concrete to the plane of sound concrete below the crack and rebuilding it to cut-off elevation, or the Engineer may reject the pile. Extract and replace rejected piles that cannot be repaired, at no expense to the Department.

Take appropriate steps to prevent the occurrence of cracking, whether due to handling or driving. When cracking occurs during driving, take immediate steps to prevent additional cracking by using thicker cushions or reducing the ram stroke length. Revise handling and transporting equipment and procedures as necessary to prevent cracking during handling and transportation.

455-7.5 Preparation for Transportation: Cut any strands protruding beyond the ends of the pile flush with the surface of the concrete using an abrasive cutting blade before transporting the piles from the casting yard.

Cut and patch the metal lifting devices in accordance with 450-9.2.1.

455-7.6 Method of Driving: Unless otherwise directed, drive piles by a hammer or by means of a combination of water jets and hammer when jetting is allowed. When using jets in combination with a hammer, withdraw the jets and drive the pile by the hammer alone to secure final penetration and to rigidly fix the tip end of the pile. Keep jets in place if they are being used to continuously eliminate the soil resistance in the scour zone.

455-7.7 Extensions and Build-ups Used to Increase Production Lengths:

455-7.7.1 General: Where splices and build-ups for concrete piles are necessary, construct splices and build-ups in accordance with Design Standards, Index No. 20601.

These requirements are not applicable to specially designed piling. Make splices for special pile designs as shown in the Plans.

455-7.7.2 Extensions to be Driven or Those 21 feet or Longer: Construct extensions to be driven or extensions 21 feet or longer in length in accordance with the details shown in the Plans and in a manner including the requirements, sequences, and procedures outlined below:

(a) Cast a splice section in accordance with Section 450 with the dowel steel in the correct position and alignment.

(b) Drill dowel holes using an approved steel template that will position and align the drill bit during drilling. Drill holes a minimum of 2 inches deeper than the length of the dowel to be inserted.

(c) Clean the drilled dowel holes by inserting a high pressure air hose to the bottom of the hole and blowing the hole clean from the bottom upward. Eliminate any oil, dust, water, and other deleterious materials from the holes and the concrete surfaces to be joined.

(d) Place forms around joints between the pile sections.

(e) Mix the adhesive components in accordance with the manufacturer’s directions. Do not mix sand or any other filler material with the epoxy components unless it is prepackaged by the manufacturer for this specific purpose. Use adhesives meeting the requirements of Section 926 for Type B Epoxy Compounds.

(f) After ensuring that all concrete surfaces are dry, fill the dowel holes with the adhesive material.

(g) Insert the dowels of the spliced section into the adhesive filled holes of the bottom section and position the spliced section so that the axes of the two sections are in concentric alignment and the ends of the abutting sections are spaced 1/2 inches apart. The Contractor may use small steel spacers of the required thickness provided they have 3 inches or more of cover after completing the splice. Fill the space between the abutting sections completely with the adhesive.

(h) Secure the spliced sections in alignment until the adhesive is cured in accordance with the manufacturer’s directions for the time appropriate with the prevailing ambient temperatures. Do not utilize the crane to secure the pile extension during the adhesive cure time. Utilize alignment braces to maintain the proper pile alignment during the epoxy cure time.

(i) After curing is completed, remove alignment braces and forms and clean and dress the spliced area to match the pile dimensions.

455-7.7.3 Precast Reinforced Build-ups: Construct precast reinforced build-ups in accordance with the requirements of this Subarticle, Section 346, and Section 400. Provide the same material for the form surfaces for precast build-ups as was used to form the prestressed piles. Use concrete of the same mix as used in the prestressed pile and dimension the cross-section the same as piling being built up. Install build-ups as specified in 455-7.7.2(b) through 455-7.7.2(i). Apply to the build-ups the same surface treatment or sealant applied to the prestressed piles.

455-7.8 Pre-Planned Splices: Splices shall be made by the doweled splice method contained in the Standard Indexes or may be made using proprietary splices which are listed on the Department's Approved Product List (APL). Splice test piles in the same manner as the production piles. Include in the pile installation plan, the chosen method of splicing and the approximate locations of the splice. Generally, place the splice at approximately the midpoint between the estimated pile tip and the ground surface, considering scour if applicable. Stagger the splice location between adjacent piles by a minimum of 10 feet. Obtain the Engineer's approval prior to constructing any pile sections. Construct piles which are to be spliced using the doweled splice with preformed dowel holes in the bottom section and embedded dowels in the upper section.

When electing to use dowel splices, assist the Engineer in performing a dynamic load test on each dowel spliced pile to verify the splicing integrity at the end of driving. Replace any damaged pile splices in accordance with 455-11.2.7. Provide the Engineer 48 hours advance notification prior to driving piles with epoxy-bonded dowel splices.

Mechanical pile splices shall be capable of developing the following capacities in the pile section unless shown otherwise in the Plans and capable of being installed without damage to the pile or splice:

a) Compressive strength = (Pile Cross sectional area) x (28 day concrete strength)

b) Tensile Strength = (Pile Cross sectional area) x 900 psi

Pile Size (inches)	Bending Strength (kip-feet)
18	245
20	325
24	600
30	950

455-7.9 Pile Cut-offs: After the completion of driving, cut piles off which extend above the cut-off elevation with an abrasive saw. Make the cut the depth necessary to cleanly cut through the prestressed strands. Take ownership and dispose of cut-off sections not used elsewhere as allowed by this Section.

455-8 Steel Piling.

455-8.1 Description: Furnish, splice, drive, and cut off structural steel shapes to form bearing piles. Include in this work the installation of bracing members of structural steel by bolting or welding, construction of splices and the filling of pipe piles with the specified materials.

455-8.2 Material: For the material in steel piles, pile bracing, scabs, wedges, and splices, meet the requirements of Section 962.

455-8.3 Pile Splices: Order and use the full authorized pile length where practicable. Do not splice to obtain authorized lengths less than 40 feet except when shown in the Plans. Locate all splices in the authorized pile length in portions of the pile expected to be at least 15 feet below the final ground surface after driving. When it is not practicable to provide authorized pile lengths longer than 40 feet in a single length, use no more than one field splice per additional 40 feet of authorized pile length. Shop splices may be used to join single lengths of pile which are at least 20 feet in length. One shorter segment of pile may be used to achieve the authorized pile length when needed.

Where the pile length authorized is not sufficient to obtain the required bearing value or penetration, order an additional length of pile and splice it to the original length.

Make all splices in accordance with details shown in the Plans and in compliance with the general requirements of AWS D1.1 or American Petroleum Institute Specification 5L (API 5L).

455-8.4 Welding: Make all welded connections to steel piles by electric arc welding, in accordance with details shown in the Plans and in compliance with the general requirements of AWS D1.5. Electroslag welding is not permitted. Welds will be inspected by visual methods.

455-8.5 Pile Heads and Tips: Cut off all piles at the elevation shown in the Plans. If using a cutting torch, make the surface as smooth as practical.

Where foundation material is so dense that the Contractor cannot drive the pile to the required penetration and firmly seat it without danger of crumpling the tip, reinforce the tips with approved cast steel point protectors, as shown in the Plans or required by the Engineer. Construct point protectors in one piece of cast steel meeting the requirements of ASTM A27, Grade 65-35 heat treated to provide full bearing for the piles. Attach points by welding according to the recommendations of the manufacturer.

455-8.6 Pile Bent Bracing Members: Place structural steel sway and cross bracing, and all other steel tie bracing, on steel pile bents and bolt or weld in place as indicated in the Plans. Where piles are not driven into position in exact alignment as shown in the Plans, the Engineer may require the use of fills and shims between the bracing and the flanges of the pile. Furnish and place all fills and shims required to square and line up faces of flanges for cross bracing at no additional expense to the Department.

455-8.7 Coating: Coat exposed parts of steel piling, wedging, bracing, and splices in accordance with the provisions for coating structural steel as specified in Section 560.

455-8.8 Storage and Handling: While handling or transporting the piles from the point of origin and into the leads, store and handle in the manner necessary to avoid damage due to bending stresses. In general, lift steel piles by means of a suitable bridge or a sling attached to the pile at appropriate points to prevent damage. Lift the pile from the horizontal position in a manner that will prevent damage due to bending of the flanges and/or web.

455-8.9 Filling Pipe Piles: When required by the Plans, fill pipe piles with the specified materials. Use clean concrete sands and concrete meeting the requirements of Section 346. Place concrete in pipes containing water using methods in accordance with 455-15.9 with modified tremie and pump line sizes. Concrete may be placed directly into pipes which are dry. Construct and place reinforcement cages in accordance with 455-16. Reinforcement cages may be installed before concrete placement or after concrete placement is completed if proper alignment and position is obtainable.

455-9 Sheet Piling.

455-9.1 Description: Leave permanent piling in place as part of the finished work and generally remove temporary piling after each construction phase.

455-9.2 Materials: Meet the following requirements:

Concrete ....Section 346
Bar Reinforcement ....Section 931

Prestressing Reinforcement ....Section 933
Steel Sheet Piles* ....Section 962
*For temporary steel sheet piles meet the requirements specified in the Plans.

455-9.3 Steel Sheet Piling: Drive steel sheet piling and cut off true to line and grade. Install steel sheet piling with a suitable hammer. Remove and replace any section damaged during handling and installation at no additional expense to the Department.

455-9.3.1 Method of Installation: Where rock or strong material is encountered such that the sheet piles cannot be set to grade by driving, remove the strong material by other acceptable means, such as excavation and backfilling or by punching. When the Plans do not indicate the existence of rock or strong material, work of removing, drilling or punching the strong material or rock will be paid for as Unforeseeable Work.

455-9.4 Concrete Sheet Piling:

455-9.4.1 Description: Ensure that concrete sheet piling is of prestressed concrete construction and manufactured, cured, and installed in accordance with the requirements of the Contract Documents. Use these piles in bulkheads and abutments and at other locations as shown in the Plans.

455-9.4.2 Manufacture of Piles: Ensure that the piles are fabricated in accordance with Section 450.

455-9.4.3 Method of Installation: Jet concrete sheet piling to grade where practical. The Engineer will require a minimum of two jets. Provide water at the nozzles of sufficient volume and pressure to freely erode material adjacent to the piles. Where encountering rock or strong material, such that the sheet piles cannot be set to grade by jetting, remove the strong materials by other acceptable means, such as excavation and backfilling, drilling or by punching with a suitable punch. When the Plans do not indicate the existence of rock or strong material and the piles cannot be set by jetting, the Department will pay for the work of removing, drilling or punching the strong material or rock as Unforeseeable Work.

455-9.4.4 Grouting and Caulking: Concrete sheet piles are generally detailed to have tongues and grooves on their lower ends, and double grooves on their upper ends. Where so detailed, after installation, clean the grooves of all sand, mud, or debris, and fully grout the grooves. Use approved plastic bags (sheaths) which will meet the shape and length of the groove to be grouted to contain the plastic grout within the double grooves. Provide grout composed of one part cement and two parts sand. The Contractor may use clean local sand or sand meeting the requirements of Section 902 in this grout. In lieu of sand-cement grout, the Contractor may use concrete meeting the requirements of Section 347, using small gravel or crushed stone coarse aggregate. Deposit the grout through a grout pipe placed within a watertight plastic sheath (bag) extending the full depth of the double grooves and which, when filled, completely fills the slot formed by the double grooves.

455-9.5 Storage and Handling: Handle and store all sheet piles in a manner to prevent damage. Handle long sheet piles with fabric slings or braided wire rope constructed of six or more wire ropes placed at appropriate lift points to prevent damage due to excessive bending.

455-10 Pile Installation Plan.

455-10.1 General: Complete the Pile Driving Installation Plan form provided by the Engineer. Return the Pile Driving Installation Plan information to the Engineer at the preconstruction conference or no later than 30 days before driving the first pile. Ensure the Pile Driving Installation Plan information includes the following:

1. List and size of proposed equipment including cranes, barges, driving equipment, jetting equipment, compressors, and preformed pile hole equipment. Include manufacturer's data sheets on hammers.

2. Methods to determine hammer energy in the field for determination of pile capacity. Include in the submittal necessary charts and recent calibrations for any pressure measuring equipment.

3. Detailed drawings of any proposed followers.

4. Detailed drawings of templates.

5. Details of proposed load test equipment and procedures, including recent calibrations of jacks and required load cells.

6. Sequence of driving of piles for each different configuration of pile layout.

7. Proposed schedule for test pile program and production pile driving.

8. Details of proposed features and procedures for protection of existing structures.

9. Required shop drawings for piles, cofferdams, etc.

10. Methods and equipment proposed to prevent displacement of piles during placement and compaction of fill within 15 feet of the piles.

11. Methods to prevent deflection of battered piles due to their own weight and to maintain their as-driven position until casting of the pile cap is complete.

12. Proposed pile splice locations and details of any proprietary splices anticipated to be used.

13. Methods and equipment proposed to prevent damage to voided or cylinder piles due to interior water pressure.

455-10.2 Acceptance of Equipment and Procedures: All equipment and procedures are subject to satisfactory field performance. Make any required changes that may result from unsatisfactory field performance. The Engineer will give final acceptance after the Contractor makes necessary modifications. Do not make any changes in the driving system after acceptance without authorization of the Engineer. A hammer repaired on site or removed from the site and returned is considered to have its performance altered (efficiency increased or decreased), which is considered a change in the driving system and is subject to a dynamic load test in accordance with 455-5.13 at no additional compensation.

455-11 Method of Measurement (All Piling).

455-11.1 Treated Timber Piling: The quantity to be paid for will be the length, in feet, furnished, placed, and accepted according to the authorized lengths list, including any additions and excluding any deletions thereto, as approved by the Engineer.

455-11.2 Prestressed Concrete Piling:

455-11.2.1 General: The quantity to be paid for will be the length, in feet, of prestressed concrete piling furnished, driven and accepted according to the authorized lengths list, including any additions and excluding any deletions thereto, as approved by the Engineer.

455-11.2.2 Furnished Length: The furnished length of precast concrete piles will be considered as the overall length from head to tip. Final pay length will be based on the casting length as authorized in accordance with 455-5.14.3 subject to provisions of 455-11.2.3 through 455-11.2.8, 455-11.8, 455-11.9 and 455-11.13.

455-11.2.3 Build-ups: The lengths of pile build-ups authorized by the Engineer, measured from the plane of cutback or the joint between the sections, to head of build-up, will be included in the quantities of piling.

455-11.2.4 Piles Requiring Cut-offs: No adjustments in the length, in feet, of piling will be made if cut-offs are required after the pile has been driven to satisfactory bearing.

455-11.2.5 Piles Driven Below Cut-off Elevation: Where a pile is driven below cut-off elevation and satisfactory bearing is obtained so that no further driving is required, the length of pile will be measured from cut-off elevation to tip of the pile.

455-11.2.6 Driving of Splice: If a pile is driven below cut-off and satisfactory bearing is not obtained, and additional driving is required after construction of a satisfactory splice, an additional 10 feet of piling will be paid for the additional driving. This compensation for driving of splice, however, will not be allowed for test piles that are spliced and redriven.

455-11.2.7 Replacing Piles: In the event a pile is broken or otherwise damaged by the Contractor to the extent that the damage is irreparable, in the opinion of the Engineer, the Contractor shall extract and replace the pile at no additional expense to the Department. In the event that a pile is mislocated by the Contractor, the Contractor shall extract and replace the pile at no expense to the Department except when a design change proposed by the Contractor is approved by the Department as provided in 455-5.15.5.

In the event that a pile is driven below cut-off without obtaining the required bearing, and the Engineer elects to have the pile pulled and a longer pile substituted, it will be paid for as Unforeseeable Work. In the event a pile is damaged or mislocated, and the damage or mislocation is determined to be the Department's responsibility, the Engineer may elect to have the pile extracted, and it will be paid for as Unforeseeable Work. If the extracted pile is undamaged and driven elsewhere the pile will be paid for at 30% of the Contract unit price for Piling. When the Department determines that it is responsible for damaged or mislocated pile, and a replacement pile is required, compensation will be made under the item for piling, for both the original pile and replacement pile.

The Contractor may substitute a longer pile in lieu of splicing and building-up a pile. In this event, the Contractor will be paid for the original authorized length of the pile, plus any additional length furnished by the Contractor up to the authorized length of the build-up, as piling. The Contractor will be paid 30 feet of piling as full compensation for extracting the original pile.

455-11.2.8 Underwater Driving: When the Contractor selects one of the optional underwater driving methods, payment will be made by selecting the applicable method from the following:

(a) Using a pile longer than the authorized length: Payment for piling will be made only for the authorized length at that location unless the length of pile from cut-off elevation to the final tip elevation is greater than the authorized length, in which case payment for piling will be made from cut-off elevation to final tip elevation. No payment will be made for pile splice, when this option is selected, unless the pile is physically spliced and the splice is driven below cut-off elevation to achieve bearing. When making and driving a pile splice below cut-off elevation to achieve bearing, the length to be paid for piling will be the length between cut-off elevation and final pile tip elevation.

(b) Using an underwater hammer: Payment for piling and pile splices will be in accordance with 455-11.2.1 through 455-11.2.7 and 455-11.9.2. The Contractor shall furnish additional lengths required to provide the full length confirmation pile at no expense to the Department. Payment for piling for the full length confirmation pile will be the authorized length of the pile, unless the length driven below cut-off elevation is greater than the authorized length, in which case the length to be paid for will be the length between cut-off elevation and the final tip elevation. Splices in confirmation piles will be paid for only when the splice is driven below cut-off elevation.

(c) Using a pile follower: When a pile follower is used with a conventional pile driving system, the method of payment will be the same as shown above in 455-11.9.2.

455-11.3 Steel Piling:

455-11.3.1 General: The quantity to be paid for will be the length, in feet, of steel piling furnished, spliced, driven and accepted, up to the authorized length, including any additions and excluding any deletions thereto as approved by the Engineer.

455-11.3.2 Point Protectors: The quantity to be paid for will be each for the total of point protectors authorized, furnished, and properly installed.

455-11.4 Test Piles: The quantity to be paid for of test piles of various types, will be the length, in feet, of test piling furnished, driven and accepted, according to the authorized length list, and any extensions thereof as approved by the Engineer.

Where a test pile is left in place as a permanent pile, it will be paid for only as test piles. Any extensions necessary to continue driving the pile for test purposes, as authorized by the Engineer, will be paid for as test piles. Other extensions of piles, additional length paid for splicing and build-ups will be included in the quantities of regular piling and will not be paid for as test piling.

455-11.5 Dynamic Load Tests: Payment will be based on the number of dynamic load tests as shown in the Plans or authorized by the Engineer, completed and accepted in accordance with the Contract Documents. No separate payment will be made for dynamic load tests used to evaluate the Contractor’s driving equipment. This will generally be done on the first test pile or production pile driven on a project with each combination of proposed hammer and pile size and/or a separate pile to evaluate any proposed followers, or piles driven to evaluate proposed changes in the driving system. No payment will be made for dynamic load tests used to evaluate the integrity of a pre-planned epoxy-bonded dowel splice. Include all costs associated with dynamically testing production piles with epoxy-bonded dowel splices under Pay Item No. 455-34. No payment will be made for dynamic load tests on test piles.

Payment for attaching equipment to each production pile for dynamic load testing prior to initial driving and as authorized by the Engineer will be 20 feet of additional pile. No payment will be made for attaching dynamic testing equipment for set-checks or redrives.

455-11.6 Steel Sheet Piling: The quantity to be paid for will be the plan quantity area, in square feet, measured from top of pile elevation to the bottom of pile elevation and beginning and end wall limits as shown in the Plans with no allowance for variable depth surface profiles. Approved alternate support structures would be paid for as plan quantity computed for sheet pile. Sheet piling used in cofferdams and to incorporate the Contractor’s specific means and methods, and not ordered by the Engineer, will be paid for as required in Section 125.

455-11.7 Concrete Sheet Piling: The quantity to be paid for will be the product of the number of such piles satisfactorily completed, in place, times their lengths in feet as shown in the Plans or authorized by the Engineer. This quantity will be based upon piles 2-1/2 feet wide.

When the Engineer approves, the Contractor may furnish the concrete sheet piling in widths wider than shown in the Plans; then the number of piles shall be the actual number of units completed times the width used divided by the width in the Plans.

455-11.8 Pile Splices: The quantity to be paid for authorized drivable splices and build-ups greater than 5 feet in length in concrete piling, and test piling, which are made for the purpose of obtaining authorized pile lengths longer than shown as the maximum length in the

Standard Indexes, for obtaining greater lengths than originally authorized by the Engineer, to incorporate test piling in the finished structure, for further driving of test piling, or for splices shown in the Plans, will be 30 feet of additional prestressed concrete piling under Pay Item No. 455-34.

For concrete piles and test piles, where the build-up is 5 feet or less in length, the quantity to be paid for will be 9 feet of prestressed concrete piling under Pay Item No. 455-34 as compensation for drilling and grouting the dowels and all other costs for which provision has not otherwise been made.

The quantity to be paid for authorized splices in steel piling and test piling for the purpose of obtaining lengths longer than the lengths originally authorized by the Engineer will be 20 feet of additional steel piling under Pay Item No. 455-35.

455-11.9 Set-Checks and Redrives:

455-11.9.1 Set Checks/Test Piles: There will be no separate payment for the initial four set-checks performed the day of and the working day following initial driving. For each additional set-check ordered by the Engineer and performed within the following working day of initial driving, an additional quantity of 10 feet of piling will be paid.

455-11.9.2 Set Checks/Production Piles: There will be no separate payment for the initial two set-checks performed the day of and the working day following initial driving. For each additional set-check ordered by the Engineer and performed within the following working day of initial driving, an additional quantity of 10 feet of piling will be paid.

455-11.9.3 Redrives: The quantity to be paid for will be the number of redrives, each, authorized by the Engineer. Payment for any pile redrive (test pile or production pile) ordered by the Engineer will consist of 20 feet of additional piling.

455-11.10 Pile Extraction: Piles authorized to be extracted by the Engineer and successfully extracted as provided in 455-11.2.7 will be paid for as described in 455-11.2.7. No payment for extraction will be made for piles shown in the Plans to be extracted or piling damaged or mislocated by the Contractor that are ordered to be extracted by the Engineer.

455-11.11 Protection of Existing Structures: The quantity to be paid for will be at the Contract lump sum price. When the Contract Documents do not include an item for protection of existing structures, the cost of settlement monitoring as required by these Specifications will be included in the cost of the structure; however, work in addition to settlement monitoring will be paid for as Unforeseeable Work when such additional work is ordered by the Engineer.

455-11.12 Static Load Tests: The quantity to be paid for will be the number of static load tests of the designated tonnages, each, as shown in the Plans or authorized by the Engineer, actually applied to piles, completed and accepted in accordance with the Plans and these Specifications.

455-11.13 Preformed Pile Holes: The quantity added to the payment for piling will be 30% of the length of completed preformed pile holes from existing ground or the bottom of any required excavation, whichever is lower, to the bottom of preformed hole acceptably provided, complete for the installation of the bearing piles, regardless of the type of pile (test pile or production pile) installed therein. Only those holes authorized to be paid for, as provided in 455-5.9.3, will be included in the measurement for payment. The Engineer will authorize payment for preformed pile holes only when the pile has been placed in proper position and has achieved the required penetration.

455-12 Basis of Payment (All Piling).

455-12.1 Treated Timber Piling: Price and payment will be full compensation for furnishing all materials, including collars, metal shoes, copper cover sheets, preservatives and tar, and for wrapping pile clusters with wire cable, where so shown in the Plans.

455-12.2 Prestressed Concrete Piling: Price and payment will be full compensation for the cost of furnishing and placing all reinforcing steel, predrilled holes, furnishing the material for and wrapping pile clusters with wire cable where so shown in the Plans and grouting of preformed pile holes when shown in the Plans.

455-12.3 Steel Piling: Price and payment will be full compensation for all labor, equipment, and materials required for furnishing and installing steel piling, including welding and painting as specified and the cost of predrilling pile holes described in 455-5.1.1. The cost of any sand or concrete fill and reinforcing steel in pipe piles will be included in the price for steel piling.

Bracing and other metal parts attached to or forming a part of piling or bracing and not otherwise classified, will be measured and paid for as provided in Section 460.

455-12.4 Test Piles: Price and payment will be full compensation for all incidentals necessary to complete all the work of this item except splices, build-ups, pile extractions and preformed pile holes authorized by the Engineer and paid for under other pay items or payment methods. The cost of all additional work not listed above necessary to ensure required penetration and attain required bearing of the test piles will be included in the price bid per foot of test pile, including driving and all other related costs.

455-12.5 Dynamic Load Tests:

455-12.5.1 Dynamic Load Tests/ Test Piles: All test piles will require dynamic load tests, and include all costs associated with dynamic load tests in the pay items for test piles.

455-12.5.2 Dynamic Load Tests/ Production Piles: Payment will be full compensation for all labor, equipment, materials, instrumentation and installation required to assist the Engineer in performing this work.

455-12.6 Steel Sheet Piling:

455-12.6.1 Permanent Sheet Piling: Price and payment will be full compensation for all labor, equipment, and materials required for furnishing and installing steel sheet piling including preformed holes and coating, but will not include furnishing and placing anchors when an anchored wall system is designed and detailed in the Plans. In such cases, furnishing and installing anchors will be paid for separately.

455-12.6.2 Temporary Sheet Piling: For critical temporary steel sheet pile walls, walls which are necessary to maintain the safety of the traveling public or structural integrity of nearby structures, roadways and utilities during construction, that are detailed in the Plans, price and payment will be full compensation for all labor, equipment, and materials required for furnishing and installing steel sheet piling including preformed holes when shown in the Plans, and including wales, anchor bars, dead men, soil anchors, proof tests, creep tests, and other incidental items when an anchored wall system is required. Removal of the sheet piling, anchors, and incidentals will be included in the cost per square foot for steel sheet piling (critical temporary). When the temporary steel sheet pile walls are not detailed in the Plans, the cost of furnishing and installation shall be incidental to cost of other related items and no separate payment shall be made. If the wall is not shown in the Plans, but deemed to be critical as determined by the Engineer, then a design shall be furnished by the Department and paid for separately under steel sheet piling (critical temporary).

455-12.7 Concrete Sheet Piling: Price and payment will be full compensation for furnishing all materials, including reinforcing steel, grouting, plastic filter fabric, preformed holes and installation.

455-12.8 Preformed Pile Holes: There is no separate pay item for preformed pile holes. Payment will be made as the unit price for piling of the applicable pile type. Payment will be full compensation for all labor, equipment, casings and materials required to perform this work.

455-12.9 Protection of Existing Structures: Price and payment will be full compensation for all labor, equipment, and materials required to perform this work.

455-12.10 Point Protectors: Price and payment will be full compensation for all labor, equipment, and materials required to perform this work.

455-12.11 Static Load Tests: Price and payment will be full compensation for all labor, equipment, and materials required to perform this work.

455-12.12 Pile Cut-Off: Anticipate all piles will require cutting-off, and include all costs associated with pile cut-off in the pay items for piling.

455-12.13 Payment Items: Payment will be made under:

Item No. 455- 2-	Treated Timber Piling - per foot.
Item No. 455- 14-	Concrete Sheet Piling - per foot.
Item No. 455- 18-	Protection of Existing Structures - lump sum.
Item No. 455- 34-	Prestressed Concrete Piling - per foot.
Item No. 455- 35-	Steel Piling - per foot.
Item No. 455- 36-	Concrete Cylinder Piling - per foot.
Item No. 455-119-	Test Loads - each.
Item No. 455-120-	Point Protection - each.
Item No. 455-133-	Sheet Piling - per square foot.
Item No. 455-143-	Test Piles (Prestressed Concrete) - per foot.
Item No. 455-144-	Test Piles (Steel) - per foot.
Item No. 455-145-	Test Piles (Concrete Cylinder) - per foot.

C. DRILLED SHAFTS

455-13 Description.

Construct drilled shaft foundations consisting of reinforced concrete drilled shafts without bell footings.

455-14 Materials.

455-14.1 Concrete: For all concrete materials, meet the requirements of Section 346. Use concrete that is specified in the Plans.

455-14.2 Reinforcing Steel: Meet the reinforcing steel requirements of Section 415. Ensure that reinforcing steel is in accordance with the sizes, spacing, dimensions, and the details shown in the Plans.

455-15 Construction Methods and Equipment.

455-15.1 General Requirements:

455-15.1.1 Templates: Provide a fixed template, adequate to maintain shaft position and alignment during all excavation and concreting operations, when drilling from a barge. Do not use floating templates (attached to a barge). The Engineer will not require a template for shafts drilled on land provided the Contractor demonstrates satisfactorily to the

PRECAST CONCRETE PAYMENT SUMMARY TABLE

Effective 7-1-2014

ITEM	PAYMENT	455 SPEC.
Prestressed Concrete Piling	Piling bid price, Feet	455-12.2
Prestressed Concrete test Piling	Piling bid price, Feet	455-12.4
Cut-off (remaining piling)	No Payment 455-12.12	455-11.2.4
Driving of Test Pile Splice	No Payment	455-12.4
Replacing Piles		
- Broken and irreparable piling, or mislocated piling and Contractor is responsible-extract and replace	- No payment	455-11.2.7
- Piling driven below cut-off without achieving bearing and the Engineer elects to extract pile and replace	- Unforeseeable Work	455-11.2.7
- Broken and irreparable piling, or mislocated piling and Department is responsible – extract and replace	- Unforeseeable Work; pay piling furnished bid price	455-11.2.7
- "Undamaged" Pile extracted and driven somewhere else	- Paid at 30% of contract unit price for piling	455-11.2.7
- Damaged or misplaced piling, and replacement is required and Department is responsible	- Pay for both original and replacement piling under piling furnished	455-11.2.7
- Extracting of original pile to substitute for longer pile in lieu of splicing and build-up of original pile.	- Pay original pile length + additional authorized build up + 30 Ft. of piling furnished for extracting original pile	455-11.2.7
Set-Checks & Redrives		
- **Test piles**; Engineer may elect to interrupt pile driving up to 4 times on each test pile (2 times for up to 2 hours and 2 additional times during the next working day following the initial drive day) within 1 working day following the initial driving.	- No Payment	455-11.9 455-5.12.1
- Each additional set check determined necessary by the Engineer after the 4 previously mentioned above and within 1 working day following end of initial driving	- 10 feet piling furnished bid price	455-11.9
- Any re-drive after 1 working day following the initial driving day.	- 20 feet piling furnished bid price	455-11.9
- **Production piles**; 2 set-checks within initial driving and the 1 working day following the end of initial driving.	- No Payment	455-11.9.2
- Any additional set check within the 1 working day following the end of initial driving.	- 10 feet piling furnished bid price	455-11.9.2
- Re-drive Production Pile; After 1 working day following the initial driving day.	- 20 feet piling furnished bid price	455-11.9.3
Dynamic Load Tests		
- **Test Piles:** Prices include instrumentation, materials and labor.	- No Payment	455-11.5
- **Production piles**: Authorized by the Engineer for hooking up the instrument and begin driving, and then	- 20 feet piling furnished bid price	455-11.5
- Instrumentation on set-checks .	- No Payment	455-11.5
Splices (Build-up) ≤ 5 feet below cut-off elevation		
Production and Test Piles:		
- Materials and labor	- 9 feet of Production Pile	455-11.8
- Piling Build-up length	- Build up length of Production Pile	455-11.8
Splices (Build-up) > 5 feet below cut-off elevation		
Test Piles		
- Splice Length Authorized –Non driven	- Length in feet of Production Pile bid price	455-11.8
- Splice Length Authorized - Driven for test purposes	- Length in feet of Test Pile bid price	455-11.8
- Splice (Material and Labor)	- 30 feet Production Pile bid price	455-11.8
- Driving of Splice	- No payment	455-11.2.6
Production Pile		
- Splice Length Authorized	- Length in feet of Production Pile bid price	455-11.8
- Driving of production piling splice	- 10 feet production piling bid price	455-11.2.6
- Splice (Material and Labor)	- 30 feet of Production Pile bid price	455-11.8
Static Load Tests		
- static Load Tests	- Static Load test bid price	455-11.12
Preforming	- 30% of piling per foot	455-11.13

STEEL PILE PAYMENT SUMMARY TABLE

Effective 7-1-2012

ITEM	PAYMENT	455 SPEC.
Piling Length	Piling bid price, Feet	455-12.3
Test Piling	Piling bid price, Feet	455-12.4
Point Protectors	Per each authorized, furnished & installed	455-11.3.2
Driving of Test Splice	No Payment	455-12.4
Replacing Piles		
- Broken and irreparable piling, or mislocated piling and Contractor is responsible-extract and replace	- No payment	455-11.2.7
- Piling driven below cut-off without achieving bearing and the Engineer elects to extract pile and replace	- Unforeseeable Work	455-11.2.7
- Broken and irreparable piling, or mislocated piling and Department is responsible – extract and replace	- Unforeseeable Work; pay piling Furnished per bid price for both damaged and replacement.	455-11.2.7
- "Undamaged" Pile extracted and driven somewhere else	- Paid at 30% of contract unit price for Piling	455-11.2.7
- Damaged or misplaced piling, and replacement is required and Department is responsible	- Pay for both original and replacement piling under piling furnished.	455-11.2.7
- Extracting of original pile to substitute for longer pile in lieu of splicing and build-up of original pile	- Pay original pile length + additional authorized build up + 30 Ft. of piling furnished for extracting original pile	455-11.2.7
Set-Checks & Redrives		
- **Test piles** Engineer may elect to interrupt pile driving up to 4 times on each test pile (2 times for up to 2 hours and 2 additional times during the next working day following the initial drive day) within 1 working day following the initial driving.	- No Payment	455-11.9.1 455-5.12.1
- Each additional set check determined necessary by the Engineer after the 4 previously mentioned above and within 1 working day following end of initial driving	- 10 feet piling furnished bid price	455-11.9.1
- Any re-drive after 1 working day following the initial driving day	- 20 feet piling furnished bid price	455-11.9.3
- **Production piles**; 2 set-checks within initial driving and the 1 working day following the end of initial driving.	- No Payment	455-11.9.2
- Any additional set check within the 1 working day following the end of initial driving.	- 10 feet piling furnished bid price	455-11.9.2
- Re-drive Production Pile; After 1 working day following the initial driving day.	- 20 feet piling furnished bid price	455-11.9.3
Dynamic Load Tests		
- **Test Piles:** Prices include instrumentation, materials and labor.	- No Payment	455-11.5 455-12.5.1
- **Production piles**: Authorized by the Engineer for hooking up the instrument and begin driving	- 20 feet piling furnished bid price	455-11.5
- Instrumentation on set checks	- No Payment	455-11.5
Splices		
Test Piles		
- Splice Length Authorized –Non driven	- Length in feet of production pile bid price	455-11.8
- Splice Length Authorized - Driven for test purposes only	- Length in feet of Test pile bid price	455-11.8
- Splice (Material and Labor)	- 20 feet Production Pile bid price	455-11.8
- Driving of Splice	- No Payment	455-11.2.6
Production Pile		
- Splice Length Authorized	- Length in feet of Production Pile bid price	455-11.8
- Driving of production pile splice	- No Payment	455-11.2.6
- Splice (Material and Labor)	- 20 feet Production Pile bid price	455-11.8
Static Load Tests		
- static Load Tests	- Static Load test bid price	455-11.12
Preforming	- 30% of piling per foot	455-11.13

PILE INSPECTOR'S CHECKLIST

The following is a general checklist to follow when driving a Pile. The answer to each of these, if applicable, should "yes" unless plans, specifications, or specific approval has been given otherwise. CONSULT WITH THE RESPONSIBLE PROJECT ADMINISTRATOR FOR YOUR SPECIFIC PROJECT RESPONSIBILITIES.

EARLY REQUIREMENTS

1. Do you have a copy of the Plans including latest revisions & located relevant items? (ex: Pile Date Table)
2. Do you have and reviewed the accepted Pile Installation Plan?
3. Are Dynamic Load Tests required and if so, is the PDA Engineer coordinated with?
4. Do you have the current version of the FDOT Pile Driving Record form?
5. Have you setup Structure Files and Bent/Pier Models in the program?
6. Have you made the Initial Pile Data entries and Standard Notes entries in the program?
7. Have you scheduled or attended a Pre-Driving meeting with the PA/Geotechnical Engineer?

Yes	No	NA
1	1	
2	2	
3	3	
4	4	
5	5	
6	6	
7	7	

TEST PILE PROGRAM

8. Has the Contractor met the requirements of 455-1.1, Protection of Existing Structures (or new 108)?
9. Has the site preparation been completed for footings/excavations/abutments in accordance with 455-1.2 & 455-1.2.1?
10. Have the requirements of 455-1.4, Vibrations of Freshly Placed Concrete been met?
11. If a Cofferdam is required, does the Contractor have a qualified diver and safety diver for inspections in accordance with 455-1.3, Cofferdams?
12. If underwater diving is required, are the divers equipped with voice communications, per 455-1.3, Cofferdams?
13. Does the Contractor have the hammer equipment indicated in the Pile Installation Plan on-site?
    a. CLOSED END DIESEL HAMMER
       - Does the hammer have at least three fuel settings for the rebound stroke? (455-5.2.2)
       - Does the Contractor have a Bounce Chamber Pressure Gauge? (455-5.2.2)
       - Has the Bounce Chamber been calibrated within the last 30 days and a Chart provided? (455-5.2.2)
    b. OPEN END DIESEL HAMMER
       - Does the hammer have at least three fuel settings for the rebound stroke? (455-5.2.2)
       - Has the Contractor provided the hammer manufacturer's chart equating stroke and blows per minute? (455-5.2.2)
       - Has the Contractor provided an approved device automatically determine and display ram stroke? (455-5.2.2)
    c. AIR/STEAM HAMMER
       - Does the air plant have gauges that are easy to read? (455-5.2.1)
       - Does the hammer have a slide bar capable of a minimum of two stroke height settings? (455-5.2.1)
    d. HYDRAULIC HAMMER
       - Does the hammer have at least three settings for reduced stroke height? (455-5.2.3)
       - Has pressure measuring equipment been calibrated? (455-5.2.3)
       - Have you been provided a means to determine hammer energy? (455-5.3.1)
14. Is the cap-block (hammer cushion) in good condition? (455-5.3.1)
15. Does the cap-block (hammer cushion) match the Contractor's submittal (type, size, thickness, etc.)? (455-5.3.1)
16. Is the pile cushion new? (455-5.3.2)
17. Does the pile cushion match the Contractor's submittal (type, size, thickness)? (455-5.3.2)
18. Does the pile helmet meet the requirements of 455-5.3.3?
19. If required, does the template meet the requirements of 455-5.6?
20. Has the Contractor furnished elevations per 455-5.6?
21. Is a jet pump at the site, ready for use and of the proper size? (455-5.7)
22. If Predrilling or Preforming to be done, does the drill meet the requirements of 455-5.1.1 and 455-5.9?
23. Do the leads match the Contractor's submittal and meet the requirements of 455-5.4?
24. Has the proper type, size, and length of pile and applicable pile documentation been provided?
25. Have you inspected the pile for defects and if observed document and modify the PA?
26. Has the Contractor marked the pile in the applicable increments?
27. Is the test pile located per the plans and meet the requirements of 455-5.15.2?
28. Does the pile meet the axial alignment of 455.5.15.3?
29. Have you indicated this is a Test Pile in the Pile Driving Record?
30. If applicable, have you indicated the pile has EDCs installed in the Pile Driving Record?
31. Have you recorded the driving event in the Pile Driving Record?

Yes	No	NA
8	8	
9	9	
10	10	
11	11	
12	12	
13	13	
A1	A1	
A2	A2	
A3	A3	
B1	B1	
B2	B2	
B3	B3	
C1	C1	
C2	C2	
D1	D1	
D2	D2	
D3	D3	
14	14	
15	15	
16	16	
17	17	
18	18	
19	19	
20	20	
21	21	
22	22	
23	23	
24	24	
25	25	
26	26	
27	27	
28	28	
29	29	
30	30	
31	31	

PILE INSPECTOR'S CHECKLIST- PAGE 2

PRODUCTION PILE DRIVING	Yes	No	NA
32. Do you have the Driving Criteria Letter?	32	32	
33. If concrete piles, do you have the authorized Production Pile Lengths Letter?	33	33	
34. Do you have the Accepted Pile Installation Plan?	34	34	
35. Has the Contractor met the requirements for Protection of Existing Structures? (455-1.1 or new 108)	35	35	
36. Has the site preparation been completed for footings/excavations/abutments in accordance with 455-1.2 & 455-1.2.1?	36	36	
37. Have the requirements of 455-1.4, Vibrations of Freshly Placed Concrete been met?	37	37	
38. If a cofferdam is required, have the requirements of 455-1.3, Cofferdams, been met?	38	38	
39. Have you inspected the piles of damage, and if observed, document same and notified the PA? (455-6,7,8,9)	39	39	
40. Does the Contractor's equipment match the accepted Pile Installation Plan or revised Plan from the Test Pile Program?	40	40	
a. cranes			
b. barges			
c. hammer system, including:			
-model, type, serial number			
-capblock cushion type, thickness			
-capblock dimensions, inserts, striker plates			
-variable energy settings			
-hydraulic control indicator, fuel pump setting indicator			
-Saximeter			
-Pile cushion type, thickness			
-follower			
d. Leads			
e. Auger motor and flighting			
f. Auger leads			
g. Punches			
h. Jets and pump			
i. Templates			
-Does the template match the Contractor's submittal?			
-Has a reference been provide to enable determining pile penetration?			
-Can the pile be driven to the cutoff elevation without requiring movement of the template?			
41. Has the Contractor provided an elevation on the template for your use?	41	41	
42. If Predrilling or Preforming, has the Contractor met the plan requirements and you documented the same?	42	42	
43. If grouting of Preformed Pile Holes is required, has this been completed per 455-5.9.5?	43	43	
44. Has the Contractor marked the piles in the correct increments?	44	44	
45. Have you recorded the blows, stroke height/pressure, and applicable notes in the record or program?	45	45	
46. Did splicing of piles meet the requirements of 455-7.7 for concrete and 455-8.3 for steel?	46	46	
47. If specified, has the pile met any Minimum Tip Elevation requirements?	47	47	
48. If no Minimum Tip is specified, has the pile met the Penetration requirements of 455-5.8, Penetration?	48	48	
49. Has the pile met the driving criteria specified in the Driving Criteria Letter?	49	49	
50. Has the pile reached Practical Refusal? (455-5.10.3)	50	50	
51. Do you have a "Setcheck" Criteria?	51	51	
52. If "Setchecks" or "Redrives" are performed, were they documented?	52	52	
53. Have any of the piles "heaved"? (455-5.10.5)	53	53	
54. If so, were they redriven?	54	54	
POST INSTALLATION			
55. Has the Contractor met the tolerances required? (455-5.15, Allowable Tolerances)	55	55	
56. Has the Contractor initiated a plan to protect driven piles from fill placement operations? (455-10)	56	56	
57. Have you been provided the final post-driving elevations and entered them in the Pile Driving Record?	57	57	

PILE DRIVING INSTALLATION PLAN FORM

Contract No. ____________________ Structure Name or No. ____________________

FIN Project No. ____________________ County ____________________

Pile Driving Contractor ____________________

HAMMER COMPONENTS

Manufacturer ____________ Model ____________ Serial No. ____________

Type: Diesel ______ Single/Double acting ______ Air ______ Hydraulic ______ Compressor ______

Rated Energy ____________ at ______ Length Stroke

Ram Weight ____________ Pile Cap Weight ____________

Modifications ____________________

HAMMER CUSHION (CAPBLOCK)

Material ____________ Diameter/Width ____________ Thickness ____________

PILE CAP (HELMET, BONNET, ANVIL BLOCK & DRIVEN HEAD)

Inside Diameter or Width ____________ Total Weight ____________ Inside Height ____________

PILE CUSHION

Material ____________ Diameter/Width ____________ Area ______ Thickness ____________

PILE

Nominal Bearing Resistance or Ultimate Capacity ____________________

Type: PCP ___ Cylinder ___ Steel H ___ Steel Pipe: Open-Ended ___ Closed-Ended ___ Taper ___ Timber ___

Length ______ Diameter/Width ______ Area ______ Wall Thickness ______ Bottom Plate Thickness ______

Comments ____________________

PILE INSTALLATION

Crane: Mobile/Crawler ____________________ Size ____________

Leads: Fixed ____________ Swinging ____________ Semifixed ____________

Template (attach sketches) Fixed to Ground ____________ Fixed to Existing Structure ____________ Comments ______

____

Barge: ☐ Yes ☐ No Description ____________________

Setting Pile: Predrill ______ Preform ______ Water Jet ______ Punch ______ Vibratory hammer ______

Comments ____________________

Drill/Jet Equipment ____________________

Drilling Depth & Size ____________________

Underwater driving: ☐ Yes ☐ No Follower: (attach sketch) ____________ Length ______ Height ______

Special Driving Requirements: ☐ Yes ☐ No Comments ____________________

Pile Driving Vibrations: Settlement Monitoring ______ Vibration Monitoring ______ Existing structures survey ______

(Attach details of procedures for protection of existing structures including any special protection measures)

Comments ____________________

Method of Determining Production Pile Capacity

Stroke vs. Blows: Saximeter ______ Bounce Pressure Gauge & Chart ______ 100% Dynamic Testing ______

Comments ____________________

ATTACHMENTS CHECKLIST

- Manufacturer’s Data sheets for the pile driving hammer attached: ☐ Yes ☐ No
- For Double Acting Diesel hammers, charts and recent pressure gauge calibrations attached: ☐ Yes ☐ No ☐ NA
- Details/sketches of followers attached: ☐ Yes ☐ No ☐ NA
- Details/sketches of Templates attached: ☐ Yes ☐ No ☐ NA
- Details of Load Test Equipment and procedures including calibrations of jacks and cells attached: ☐ Yes ☐ No ☐ NA
- Sequence of Pile Driving for each configuration of pile layout attached: ☐ Yes ☐ No
- Schedule for Test pile program and production pile driving attached: ☐ Yes ☐ No
- Details of Proposed features and procedures for protection of existing structures attached: ☐ Yes ☐ No ☐ NA
- Required shop drawings for piles, cofferdams, etc. attached: ☐ Yes ☐ No
- Methods to prevent displacement piles during placement and compaction of fill within 15 ft attached: ☐ Yes ☐ No
- Methods to prevent deflection of battered piles during placement and maintain alignment until pile cap is complete attached: ☐ Yes ☐ No ☐ NA
- Proposed splice locations and details of any proprietary splices attached: ☐ Yes ☐ No ☐ NA
- Methods and equipment proposed prevent damage voided or cylinder pile attached: ☐ Yes ☐ No ☐ NA

PILE DRIVING RECORD

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PILE DRIVING INFORMATION

Structure Number: ________________________

FIN PROJ. ID # ____________ DATE ________ STATION NO. ____________

PILE SIZE ______ ACTUAL/AUTH LENGTH ________ BENT/PIER NO. ________ PILE NO. ________

HAMMER Make/Model ____________ RATED ENERGY ____________ OPERATING RATE ________

REF. ELEV ____________ MIN. TIP ELEV ____________ PILE CUTOFF ELEV ____________

DRIVING CRITERIA ____

____

PILE CUSHION THICKNESS AND MATERIAL ________________________

HAMMER CUSHION THICKNESS AND MATERIAL ________________________

WEATHER ________ TEMP ______ START TIME ____________ STOP TIME ____________

PILE DATA

PAY ITEM NO. ____________________ WORK ORDER NO. ____________

MANUFACTURED BY ____________ T.B.M./B.M. ELEV ________ GROUND ROD READ ________

DATE CAST ____________ ROD READ ________ PILE HEAD ROD READ ____________

MANUFACTURER'S PILE NO. ____________ H.I. ________ PILE HEAD ELEV. ____________

PILE HEAD CHAMFER ________________ PILE TIP ELEV. ________________

PILE TIP CHAMFER ____________________ GROUND ELEV. ____________

FOR OPEN ENDED PIPE PILES, DEPTH TO SOIL PLUG FROM TOP OF PILE (ft.) ____________

QUALIFED INSPECTOR'S NAME: ________________________ TIN #: ____________

SPLICE / EACH	PREFORMED HOLE	DYNAMIC LOAD TEST	PAY SET CHECK	NO PAY SET CHECK	REDRIVE	EXTRACTION	DRIVING OF SPLICE	PILE TYPE CODE	BATTER	PILE LENGTH		PENETRATION BELOW GROUND	EXTENSION / BUILD UP	
										ORIGINAL FURNISHED	TOTAL LENGTH WITH EXTENSION		AUTHORIZED	ACTUAL

NOTES: ____

____

____

____

____

For Trainee experience evidence only:
Name of CTQP Trainee being supervised by the Qualified Inspector: ________________________
CTQP Trainee

I certify the Pile Driving Record accuracy and that the named above Trainee has observed the full pile installation:

____
Qualified Inspector (Signature)

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PILE DRIVING LOG

Structure No.	Bent/Pier No.	Pile No.

Depth	Blows	Stroke/ Pressure	Note No.	Depth	Blows	Stroke/ Pressure	Note No.	Depth	Blows	Stroke/ Pressure	Note No.	Depth	Blows	Stroke/ Pressure	Note No.

GENERAL INSTRUCTIONS FOR "FIELD BOOK PAGES"

- Provide required information on cover sheet as outlined in Chapter 6 of the Preparation and Documentation Manual.
- Write "Table of Contents" on one of the first few pages of the book and number each page accordingly.
- Show **ALL** surveying work and sketches/diagrams on the "Grid Sheets".
- If the "Notes" section on the "Pile Driving Information Sheet" has insufficient space, continue your notes on additional pages immediately following.
- If a pile is longer than the "Pile Driving Log Sheet" provides for, continue recording the log on an additional "Pile Driving Log Sheet ".
- From the forms website you will need to print as many sheets as needed to document all pile driving criteria on the "Pile Driving Information Sheet" and the "Pile Driving Log Sheet".

Page No. ______

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PILE DRIVING INFORMATION

Structure Number: ______ 1 ______

FIN PROJ. ID # ____ 2 ____ DATE ____ 3 ____ STATION NO. ____ 4 ____

PILE SIZE __ 5 __ ACTUAL/AUTH LENGTH ____ 6 ____ BENT/PIER NO. ____ 7 ____ PILE NO. ____ 8 ____

HAMMER Make/Model ____ 9 ____ RATED ENERGY ____ 10 ____ OPERATING RATE ____ 11 ____

REF. ELEV ____ 12 ____ MIN. TIP ELEV ____ 13 ____ PILE CUTOFF ELEV ____ 14 ____

DRIVING CRITERIA ____ 15 ____

PILE CUSHION THICKNESS AND MATERIAL ____ 16 ____

HAMMER CUSHION THICKNESS AND MATERIAL ____ 17 ____

WEATHER ____ 18 ____ TEMP __ 19 __ START TIME ____ 20 ____ STOP TIME ____ 21 ____

PILE DATA

PAY ITEM NO. ____ 22 ____ WORK ORDER NO. ____ 23 ____

MANUFACTURED BY ____ 24 ____ T.B.M./B.M. ELEV ____ 25 ____ GROUND ROD READ ____ 26 ____

DATE CAST ____ 27 ____ ROD READ ____ 28 ____ PILE HEAD ROD READ ____ 29 ____

MANUFACTURER'S PILE NO. ____ 30 ____ H.I. ____ 31 ____ PILE HEAD ELEV. ____ 32 ____

PILE HEAD CHAMFER ____ 33 ____ PILE TIP ELEV. ____ 34 ____

PILE TIP CHAMFER ____ 35 ____ GROUND ELEV. ____ 36 ____

FOR OPEN ENDED PIPE PILES, DEPTH TO SOIL PLUG FROM TOP OF PILE (ft.) ____ 37 ____

QUALIFED INSPECTOR'S NAME: ____ 38 ____ TIN #: ____ 39 ____

SPLICE / EACH	PREFORMED HOLE	DYNAMIC LOAD TEST	PAY SET CHECK	NO PAY SET CHECK	REDRIVE	EXTRACTION	DRIVING OF SPLICE	PILE TYPE CODE	BATTER	PILE LENGTH		PENETRATION BELOW GROUND	55 EXTENSION / BUILD UP	
										ORIGINAL FURNISHED	TOTAL LENGTH WITH EXTENSION		AUTHORIZED	ACTUAL
40	41	42	43	44	45	46	47	48	49	50	51	52	53	54

NOTES: ____ 56 ____

For Trainee experience evidence only:
Name of CTQP Trainee being supervised by the Qualified Inspector: ____ 57 ____
CTQP Trainee

I certify the Pile Driving Record accuracy and that the named above Trainee has observed the full pile installation:

____ 58 ____
Qualified Inspector (Signature)

INSTRUCTIONS FOR "FIELD BOOK PAGE"

NOTE: These sheets may be re-printed as necessary to be used for all test piles and production piles.

Attach a copy of the Pile Driving Installation Plan (PIP) ***Form # 700-020-01*** and the Production Pile Length Letter to the blank pages in the front of the book.

1. ***Structure Number*** – Structure Number of bridge.

2. ***FIN Project ID Number*** – As indicated on plans.

3. ***Date*** – Date that pile is driven.

4. ***Station Number*** – Station location of the pile driven to the nearest measured unit.

5. ***Pile Size*** – Size of the pile driven as indicated in the plans.

6. ***Actual/Authorized Length*** – Authorized pile length (any deviation in the length from the authorized pile length should be explained in the bottom of the page).

7. ***Bent/Pier Number*** – Number assigned to the bent/pier, which includes the pile being driven - as indicated in the plans.

8. ***Pile Number*** – Pile number within the bent/pier as indicated in the plans or assigned by the project engineer.

9. ***Hammer Make/Model*** – Type hammer, including manufacturer name and model number, used to drive the pile. If this type differs from the type accepted in the PIP, explain in the Notes section of the page.

10. ***Rated Energy*** – As accepted in the PIP. Note any changes from the PIP in the notes section.

11. ***Operating Rate*** – As approved in the PIP. Note any changes from the PIP in the notes section.

12. ***Reference Elevation*** – Elevation of the top of the template or reference to the nearest appropriate unit as approved in the PIP.

13. ***Minimum Tip Elevation*** – As indicated in the plans, or authorized by the engineer. Not applicable in all cases.

14. ***Pile Cutoff Elevation*** – As authorized by the engineer, or as indicated in the plans.

15. ***Driving Criteria*** – Input a summary of the blow count criteria provided by the District or Consultant Geotechnical Engineer. (Referring to a letter is Not enough.)

16. ***Pile Cushion Thickness and Material*** – As accepted in the PIP. Note any changes in the "Notes" section.

17. ***Hammer Cushion Thickness and Material*** – As accepted in the PIP. Note any changes in the "Notes" section.

18. ***Weather*** – Weather conditions at time of driving - does not include temperature (Example: partly cloudy, cloudy, clear, etc.).

19. ***Temperature*** – The ambient (air) temperature at the time of driving.

20. ***Start Time*** – The time of day that actual driving commences.

21. ***Stop Time*** – The time of day that actual driving ceases.

22. ***Pay Item Number*** – As indicated by contract documents.

23. ***Work Order Number*** – The number of the transfer or release form certified by authorized personnel inspecting the pile casting operation. Concrete pile only.

24. ***Manufactured By*** – Name of the company that manufactured the pile being driven.

25. ***T.B.M./B.M. Elevation*** – The elevation of the temporary benchmark or benchmark used to establish all pertinent elevations.

26. ***Ground Rod Reading*** – Actual level rod reading of shot taken beside the driven pile.

27. ***Date Cast*** – As shown on the work order described in number should match the date shown on the pile.

28. ***Rod Reading*** – Actual level rod reading of shot taken on the B.M. or T.B.M. described in number 25.

29. ***Pile Head Rod Reading*** – Actual level rod reading on top of pile after driving.

30. ***Manufacturer's Pile Number*** – As shown on the work order described in number 23. Should match the number on the pile.

31. ***H.I.*** – The height of the instrument taking the level reading.

32. ***Pile Head Elevation*** – Actual elevation of the pile head after driving.

33. ***Pile Head Chamfer*** – Per Standard Index or Plans. Indicate any changes in 'notes' section.

34. ***Pile Tip Elevation*** – Actual elevation of the pile tip after driving. Note: Take batter into account.

35. ***Pile Tip Chamfer*** – See number 33.

36. ***Ground Elevation*** – Actual elevation of ground at the base of the driven pile.

37. ***FOR OPEN ENDED PIPE PILES –*** The length between top of pile and top of the soil plug in feet.

38. ***Pile Driving Inspector*** – Printed name of the CTQP qualified technician or engineer present and inspecting the driving of the pile.

39. ***TIN #*** – Training Identification Number of CTQP technician.

40. ***Splice Each*** – The number of splices used in the driving of the pile.

41. ***Preformed Hole*** – Indicate the length in feet of the preformed hole.

42. ***Dynamic Load Test*** – Indicate use of the Pile Dynamic Analyzer with a one (1), nonuse with a zero (0).

43. ***Pay Set Check*** – Number of set checks to be paid as per specifications as additional pile length.

44. ***No Pay Set Check*** – Number of set checks performed that do not incur in additional compensation as per specifications.

45. ***Pile Re-drive*** – Indicate the number of re-drives performed.

46. ***Extraction*** – If the pile is extracted, indicate with a (1). If not, indicate with a zero (0). Note details of any extraction in the 'Notes' section.

47. ***Driving of Splice*** – If splice was driven indicate with (1), If not, indicate with a zero (0).

48. ***Pile Type Code***: Place the corresponding number in this field.

1. - Prestressed Concrete	*2.* - Steel	*5.* - Concrete Cylinder Pile
3. - Composite	*4.* - Timber	

49. ***Batter*** - The front end of the batter ratio (xxx.xxx:1). To three decimal places. Example: 001.500:1, 002.000:1 etc.

50. ***Original Furnished Pile*** – The total length of the pile as furnished.

51. ***Total Pile Length with Extension(s)*** – Total length includes the original pile length and the extension/build-ups. To two decimal places.

52. ***Penetration Below Ground*** – The actual length of the pile installed below the existing ground. To two decimal places.

53. ***Extension/Build up, Authorized*** - The total length of the extension and/or buildup authorized by the engineer. To two decimal places.

54. ***Extension/Build up, Actual*** - The total length of the extension and/or buildup used on the pile. To two decimal places.

55. ***Extension/Build-up*** – When the build-up is more than four inches and up to two feet and is poured into a cap, circle the word "build-up" and indicate the number of feet under the "Authorized" and under "Actual". If longer than two feet circle "Extension" and indicate the two feet "Authorized" and "Actual".

56. ***Notes*** - Write all information relating to changes to construction documents and site conditions here. Also note all interruptions and milestones in the driving of the pile. If there is insufficient space in this section for all notes, continue the notes on the next (grid) page.

57. ***Trainee*** – A person inspecting the pile under full supervision of a qualified inspector, in order to meet the experience requirements of the CTQP qualification.

58. ***Qualified Inspector*** – Signature of the CTQP qualified Technician or Engineer present and supervising Trainee.

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PILE DRIVING LOG

Structure No.	Bent/Pier No.	Pile No.

Depth	Blows	Stroke/ Pressure	Note No.	Depth	Blows	Stroke/ Pressure	Note No.	Depth	Blows	Stroke/ Pressure	Note No.	Depth	Blows	Stroke/ Pressure	Note No.
1	2	3	4												

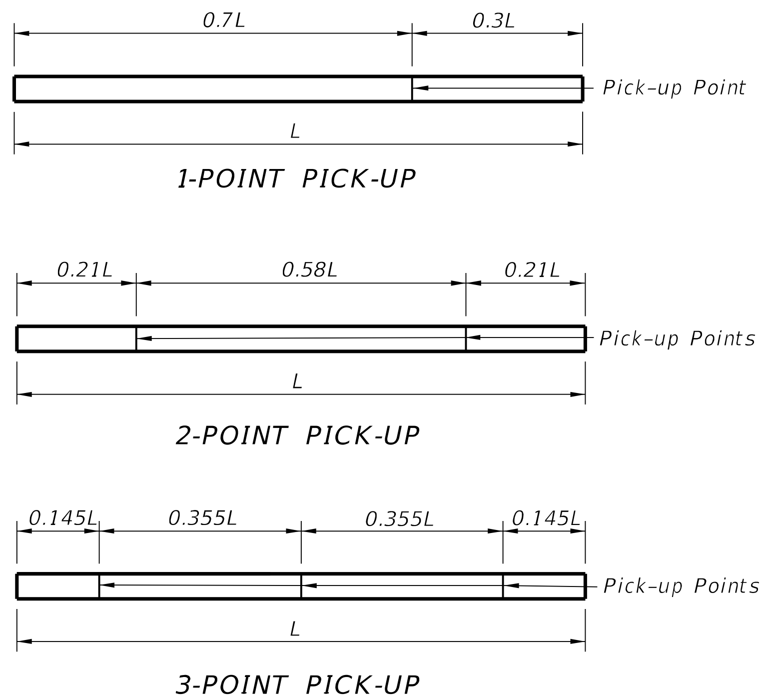
INSTRUCTIONS FOR "PILE DRIVING LOG"

1. ***Depth*** – The total length of pile driven at any point of the pile driving sequence, in the unit applicable.

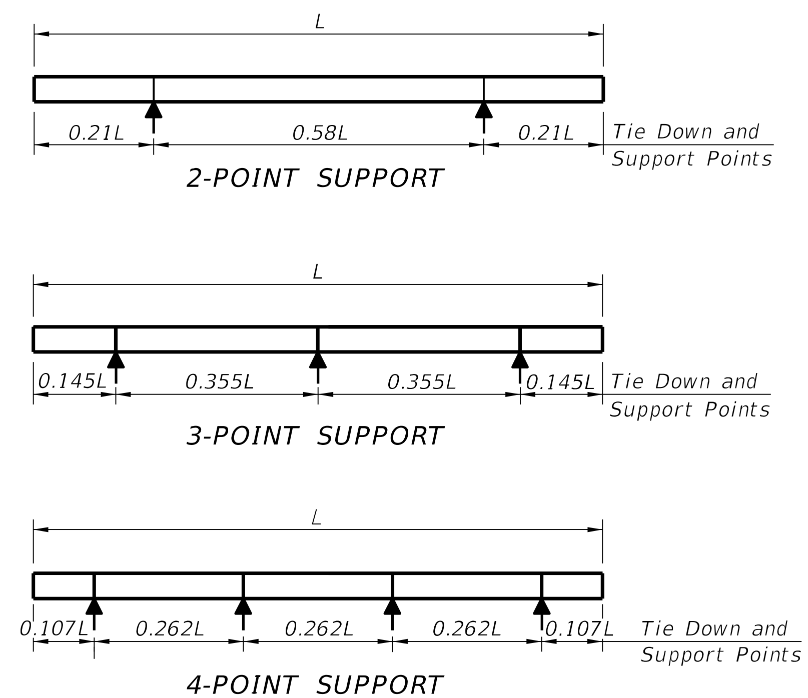
2. ***Blows*** – The number of blows required to drive the pile a length of one unit. This unit will correspond to the unit in the "depth" column.

3. ***Stroke/Pressure*** – Only one number need be entered here. This number should be the total length of stroke for a single-acting diesel hammer, or either the stroke length or the gauge pressure for an air/steam hammer. Use the "Notes" section to document any change in the fuel setting.

4. ***Note Number*** – When things happen during the driving of the pile that warrant a note, place a number in this column. Correlate the number with a number in the ‘notes’ section of the opposite page, and write the actual note there.



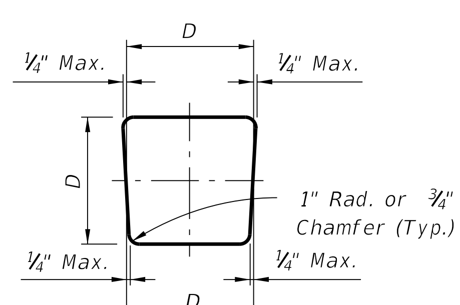
PILE PICK-UP DETAILS



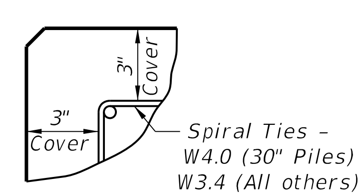
STORAGE AND TRANSPORTATION SUPPORT DETAILS

TABLE OF MAXIMUM PILE PICK-UP AND SUPPORT LENGTHS

	D = Square Pile Size (inches)						Required Storage and Transportation Detail	Pick-Up Detail
	12	14	18	20	24	30		
Maximum Pile Length (Feet)	48	52	59	62	68	87	2, 3, or 4 point	1 Point
	69	75	85	89	98	124	2, 3, or 4 point	2 Point
	99	107	121	128	140	178	3 or 4 point	3 Point



TYPICAL PILE SHAPE
FOR MOLD FORMS



DETAIL SHOWING
TYPICAL COVER

PRESTRESSED CONCRETE PILE NOTES:

DESIGN SPECIFICATIONS:
Florida Department of Transportation (FDOT) "Structures Design Guidelines", current edition.

American Association of State Highway and Transportation Officials (AASHTO) "LRFD Bridge Design Specifications", current edition.

SPIRAL TIES:
Each wrap of spirals shall be tied to at least two corner strands. One turn required for spiral splices.

CONCRETE CLASS:
Concrete for all piles shall be Class V (Special) except designated High Moment Capacity Piles (Index 20631) shall be Class VI.

Concrete for the High Capacity Collar Splice shall be Class V (Special).

See "GENERAL NOTES" in Structures Plans for any specific locations where the use of Silica Fume is required.

CONCRETE STRENGTH:
The pile cylinder strength shall be 6,000 psi minimum at 28 days and 4,000 psi minimum at time of transfer of the Prestressing Force. The cylinder strength for designated High Moment Capacity Piles (Index 20631) shall be 8,500 psi minimum at 28 days and 6,500 psi minimum at time of transfer of the Prestressing Force.

SPLICE BONDING MATERIAL:
The material to fill dowel holes and form the joint between pile sections shall be a Type B Epoxy Compound in accordance with Specification Section 926 and shall be contained on the Qualified Products List (QPL). Use Epoxy Bonding Compound or Epoxy Mortar as recommended by the Manufacturer. For Epoxy Mortar only use sand or other filler material supplied by the manufacturer and in the proportions recommended.

PICK-UP POINTS:
Piles shall be marked at the pick-up points to indicate proper points for attaching handling lines.

REINFORCING STEEL:
All reinforcing steel shall be Grade 60, except that spiral ties shall be manufactured from cold-drawn steel wire meeting the requirements of ASTM A82.

PRESTRESSING STEEL:
Prestressing steel shall be seven-wire strand, Grade 270, Low-Relaxation Strand (LRS).

CORROSION PROTECTION OF EXPOSED STRANDS:
For all piles having ends exposed to the environment and not embedded under final conditions, protect the strands as follows: Prior to shipment, cut strands at appropiate end(s) back to a minmum depth of 1 inch below the concrete surface and patch with a Type F epoxy compound meeting the requirements of Specification Section 926.