Lesson 4 – Inspector's Role Transcript

Welcome to the Pile Driving Inspector Course. This is Lesson 4 – Inspector's Role. To begin, select the start button or press Shift+N on your keyboard.

The following is a short video of an Inspector watching a burning cushion. The pile appears to be near cutoff.

In this lesson, we will cover the following topics:

- 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

Your functions as inspector are:

1. To know the specifications, both the State Standard Specifications and the job Plans and Specifications.
2. To record and document activity relative to the Plans and Specifications.
3. Raise a red flag soon enough to make a difference if work is performed outside of those specifications.
4. Keep the Project Administrator informed. Call hi/her when judgment is needed to interpret a Specification.

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.

Earlier, we mentioned that one of your roles is to 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.

If you observe that something is going to be performed outside of the approved plans and specifications, notify the Contractor and immediately notify the Project Administrator. For example, if you observed that the template construction does not appear to be in accordance with the approved plans & specifications, don't wait until the pile is set and ready for driving, or worse yet the pile is driven, to say something.

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 January 2015 Workbook Version of the Standard Specifications and Supplements.

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.

The "Project Administrator" or PA is the CEI (firm or FDOT) responsible for the everyday construction activity at the project under the direction of the resident Engineer. As inspector you would report to a Project

Administrator. If a specification clarification or applicability decision is needed, contact the PA. It is not the Inspector's responsibility to make these decisions. The Inspector monitors for conformance. Notify the PA and document work performed outside of the plans or specifications.

For work or items requiring Approval, contact the Project Administrator. The Inspector does not approve a change in process, procedure or equipment. This is the PA's responsibility. Contact PA soon enough to make a difference and to minimize impacts to cost or schedule. Most PAs would welcome getting a brief update at the end of the day on where the project stands and having the opportunity to discuss significant events that occurred during the day.

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 nonconformance 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.

This is an example of a checklist of the items needed to perform the inspector duties. We will review some of the documents that you need to 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?

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?

The following items should be checked on the Structural Plan Sheets. 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?

Report of Core Borings: Compare with the Pile Data Table. Do any "Notes" contain changes to the specifications or specification applications? Foundation Layout**:** Does the foundation layout match the Pile Installation Plan relating to number, sequencing, elevations, etc.?

Next, we will discuss pay quantities. In FDOT projects you will see that there is a particular way to handle the method of measurement and payment of pile related items.

Let's Review some specification excerpts related to method of measurement. 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: 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.

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.

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. Note: Here, build up means "Splice" or extension of the pile. 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.

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.

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 re-driven.

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.

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.

Now let's review the specification 455-11.3.1 Steel piling: 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. Point Protectors: The quantity to be paid for will be each for the total of point protectors authorized, furnished, and properly installed.

Specification 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.

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.

Specification 455-11.5 Dynamic Load Tests: No payment will be made for dynamic load tests used to evaluate the integrity of a pre-planned epoxy-bonded dowel splice. 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 re-drives.

Specification 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, 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.

Specification 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.

Specification 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 piling items; however, work in addition to settlement monitoring will be paid for as Unforeseeable Work when such additional work is ordered by the Engineer.

Specification 455-11.2 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.

Specification 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.

Specification 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.

Specification 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.

Specification 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.

Specification 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. Specification 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.

Specification 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.

Specification 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.

Specification 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.

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.

Let us review these: 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.

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.

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. long are popularly known as build-ups, leaving the name of splice to the extensions longer than 5 ft. when you will need to 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 dowels, placing a form, pouring epoxy and attaching the sections must not be different between the production piles and the 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 depends. If the splice is ordered to complete a pile that went below cut-off, and does not need to 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 feet 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. Preforming: We pay 30% of the Drilled hole depth in feet.

This table summarizes the way the quantities are determined for steel piles. There many similarities to the concrete piles. There is a point protector that may be specified in the plans or required by the Engineer when hard driving conditions are expected. Regarding the items that get converted to linear feet they are done in a similar way as concrete piles with two exceptions: The cost of manufacturing splice is 20 ft of production steel pile (not 30). Driving of a splice is not paid.

Now. Let us do an exercise to apply what we just learned. In this exercise, we have a production pile for which a 60 ft. length was authorized and delivered. The pile did not reach capacity. A total of four set-checks were done within 1 working day of the initial drive, without getting capacity. Then a redrive was done a few days later. Finally a splice, 30 feet long, was ordered and driven. The spliced pile got capacity, with some pile length left that was cut-off. Calculate the total quantities converted into pile feet for all this work.

The original pile length is 60 ft. There is predrilling but this is not getting paid. Therefore we add zero feet. There were 4 set-checks done within working day. In production piles, the first two are free, therefore we would pay two at 10 feet each. This gives us 20 ft. No dynamic load tests were done. Therefore we add zero feet. There was 1 redrive. Therefore we add 20 feet. There was a splice length of 30 ft. ordered. We add these 30 ft. For the labor and materials to manufacture the splice we pay 30 ft. of production pile. The splice was driven. This is a production pile. Therefore we pay 10 ft. of pile for the driving of the splice. We do not pay for cut-off the pile. Therefore we add zero. The total is 170 ft.

Now, you try to work this one on your own. We have a test pile that the original length was 60 ft. There was preforming of 15 ft. There was 1 set-check at 1.5 hour after initial drive. There were no redrives. The pile was driven 10 ft. below cut-off and finally stopped. Then a 10 ft. long splice was ordered to extend the pile to cutoff elevation, without driving it. How many feet of test pile and how many feet of production piles will we have to pay for this pile? Remember how the splices are paid in test piles.

You have 3 minutes to complete this task.

Your time is up! Let's review the exercise. The original pile length is 60 feet. Preforming is paid as 30% of the preformed depth. Then we pay 4.5 ft. In test piles, we have up to 4 set-checks free. Therefore we don't pay for this set-check. In test piles we don't pay for dynamic load tests. There was no redrives. Total so far: 64.5 ft. of test pile. A 10 ft. splice was ordered. This was not a driven splice. Therefore we pay as a production pile length. The manufacture of the splice is 30 ft. of production pile. There was no driving. Therefore no length added for driving. There was no cut-off since the splice was ordered to take the pile to cutoff. In any case we do not pay for cutoff. The total is 40 ft. for production pile, length plus 64.5 of test pile length.

Work this on your own again. This is a production pile. Original length was 70 ft. There was 20 ft. of predrilling to set the pile at the beginning. There were 4 set-checks, all done within one working day of initial drive. There was also 2 redrives. The pile was finally accepted after the second redrive. A 1.0 ft. build up was necessary. How many feet of production pile we will have to pay?

You have 3 minutes to complete this task.

Here is the answer: The original length is 70 ft. Predrilling is not paid. Therefore we add zero for predrilling. We get 2 set checks free. Therefore we will pay for 2 at 10 feet each. That is 20 feet. There was no dynamic load test. The original length is 70 ft. There was a buildup, 1 foot long. Therefore we add 1 foot. There was not splice but a buildup. We will compute it under build up. So we add nothing here. There was no splice driving. For the manufacture of the buildup we pay 9 feet. The total is 140 ft. of production pile.

Please do this on your own. This is a simple case of a concrete test pile. There was no preforming. There were 15 feet predrilling. There was a concrete test pile. No set-checks, no redrives were done.

You have 1 minute to complete this task.

Let's review the answer: The original length is 80 ft. We don't pay for predrilling. No set-checks were done. This is a test pile. Therefore we don't pay for dynamic load test. No redrives were done. No splices were done. No driving of splice was done. We don't pay for cutoff. The total is 80 feet, which equals to the original length requested.

Now let's do one with steel piles. Please work it on your own. This is a production steel pile. The original length was 60 ft. There was a preformed hole, 20 feet deep. There were 3 set-checks performed within 1 working day of initial drive. There was also a redrive. There was a splice of 30 ft. ordered. The splice was driven.

You have 2 minutes to complete this task.

Let's review the answer: The original length is 60 ft. The preformed hole is paid at 30% of the preformed depth. That gives 6 feet. There were 3 set-checks. We have 2 for free. Therefore we pay for 1 at 10 feet. There was no dynamic load test. There was a redrive that is paid at 20 feet. There was a splice of 30 ft ordered. We add this to the length of the pile. To construct the splice we pay 20 feet on steel piles. The splice was driven. However we do not pay for driving of the splice on steel piles. We don't pay for cutoff. The total is 146 feet. Of steel production pile.

Same input as before but this time this is a steel pile. The splice was driven and instrumented. How many feet of test pile and production pile do we pay?

You have 2 minutes to complete this task.

Let's review the answer: The original length is 60 ft. The preformed hole is paid at 30% of the preformed depth. That gives 6 feet. There were 3 set-checks. We have up to 4 for free in test piles. Therefore we add zero feet. No dynamic load test is paid on test piles. There was a redrive that is paid at 20 feet. There was a splice of 30 ft. ordered. We add this to the length of the pile. Since this length is added and tested we will pay this 30 ft. as test pile length. To construct the splice we pay 20 feet on steel piles. This is paid as production pile length. The

splice was driven. However we do not pay for driving of the splice on steel piles nor test piles. We don't pay for cutoff. The total is 116 feet of steel test pile plus… 20 feet of steel production pile.

We are going to cover some essential and basic mathematical operations that the inspector needs to be familiar with. The Inspector needs to know how to determine:

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

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. 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 and 3. Scour.

The PILE PENETRATION is computed as the lowest elevation of: 1. the Ground Surface, 2. The Bottom of Excavation, and 3. Scour elevation minus the Tip elevation. The bottom of excavation here refers to the excavation performed for the construction of piers, footings or pile caps. Preformed holes or predrilling are not included in this definition.

Penetration is an important calculation to perform since in many instances the piles need to meet certain minimum penetration for the piles to be acceptable. We will cover this specification requirement later. For the time being we will learn in how to compute penetration.

Scour elevation refers to the 100 year scour elevation that as we saw before it is included in the Pile Data Table and the Bridge Hydraulics sheet. PILE LENGTH DRIVEN: The length of pile between the Cutoff elevation and the Tip elevation and it is computed as the cutoff elevation minus the tip elevation.

We are going to work out a vertical pile. The first exercise is to determine the pile tip elevation of this pile. The reference elevation is at +2 feet. The foot mark at the template reads 29 ft which means there are 29 feet of pile below the template or reference elevation. Note: The template elevation is usually used as the reference elevation. There are exceptions, for example when there is no template because the contractor uses fixed leads, or because the driving went past the template elevation. In these cases a line is used as a reference elevation.

You have 10 seconds to complete this task.

Let's review the answer: Tip elevation is equal to the Reference elevation minus the length below the reference elevation. The reference elevation is +2 ft., which was given. The length below the reference elevation is 29 ft. Tip elevation then is equal to +2 – 29. Tip elevation is equal to -27.

Now, determine the pile penetration of the same pile.

You have 20 seconds to complete this task.

Let's review the answer: The Ground surface is zero, and there is no scour elevation. Based on the drawing there is no excavation either. Therefore we will use the ground surface elevation. The tip elevation is -27 ft., as computed in the previous exercise. Penetration is Ground Elevation minus the tip elevation. Penetration is equal to +zero minus parenthesis minus 27. Tip elevation is equal to + zero plus 27. Remember that when subtracting a negative number, the product of minus times minus in the parenthesis becomes positive. Then penetration is 27 feet.

Penetration must always end up a positive number because it is a length. It is not an elevation. If you end up with a negative number you must have done something wrong.

Now, determine the driven length of the same pile.

You have 20 seconds to complete this task.

Let's review the answer: Length driven is equal to cutoff elevation minus the tip elevation. The cut-off elevation is +5 ft., which was given, the tip elevation is -27 computed earlier. The length driven is then + 5 minus parenthesis minus 27. The length driven is then + 5 + 27. The length driven is 32 feet.

As in the case of penetration, the length driven must always end up a positive number because it is a length. It is not an elevation. If you end up with a negative number you must have done something wrong.

Now we are going to study the case of a battered pile, which is a pile that is inclined. When the pile is battered the length we see below template is larger than the vertical distance. The triangle illustrates that. What we are reading is a hypotenuse value but we also need to compute the vertical component.

To do this, we use correction factors. These are factors that correspond to the sinus of the angle, a trigonometrical function. These are values less than 1.0, except in the case of a vertical pile where the correction factor is 1. Numerical values of these correction factors will be shown in the next slide.

Tip elevation is computed as: Reference elevation minus parenthesis length below reference elevation times the correction factor parenthesis. Note that for a vertical pile, the angle will be 90 degrees and then sinus if 90 is 1. Therefore for a vertical pile, the correction factor is 1, and the formula becomes simply as: Reference elevation minus length below reference elevation as we saw in the previous exercise.

Batter ratios are expressed in terms of a vertical distance ratio to a horizontal distance. For example a batter of 12 to 2 means the pile is inclined at a ratio of 12 ft. vertical per 2 feet of horizontal distance. We are showing here the corresponding angle in degrees and the correction factor.

Let‘s determine now the tip elevation for this battered pile.

You have 20 seconds to complete this task.

Let’s review the answer: Tip Elevation is equal to the reference elevation minus parenthesis length below reference elevation times the correction factor parenthesis. Reference Elevation is + 7 feet. This is a 5 to 1 battered pile and the correction factor is 0.981. Length below reference elevation is 37.50 feet. Therefore, the Tip Elevation is equal to plus 7 minus parenthesis 37.5 times 0.981. Tip Elevation is equal plus 7 minus 36.79 feet. Tip Elevation is equal to minus 29.79 feet.

Penetration is computed along the alignment of the pile, not just in the vertical direction. To compute penetration for a battered pile, we first compute the vertical component of the penetration similar to what we did in the vertical case and then we divide it by the correction factor to obtain the actual length penetrated along the actual alignment of the pile.

Let us determine now the penetration of this battered pile.

You have 30 seconds to complete this task.

Let’s review the answer: In this case there is no excavation. So we go for the lowest between the ground surface and the scour. In this case there is scour elevation at +1.5 feet, lower than the ground elevation at + 4 feet. Therefore we will use the scour elevation to compute penetration. The tip elevation computed earlier was -29.79 feet. The correction factor for this batter of 5 to 1 is 0.981. The penetration is then equal to the scour

elevation minus the tip elevation divided by the correction factor. Substituting the values penetration is equal to bracket plus 1.5 minus parenthesis minus 29.79 parenthesis bracket and this difference divided by 0.981. Resolving, the Tip Elevation is equal to 31.29 divided by 0.981. Note how the product of minus times minus changes the negative 29.79 into a plus sign. Tip Elevation is equal plus 31.9 feet. Remember, if you get a negative answer for penetration, you did something wrong.

The length of pile driven is computed along the alignment of the pile, not just in the vertical direction. To compute penetration for a battered pile, we first compute the vertical component of the length driven similar to what we did in the vertical case and then we divide it by the correction factor to obtain the actual length penetrated along the actual alignment of the pile.

Therefore: Length Driven is equal to parenthesis Cutoff Elevation minus the Tip Elevation parenthesis divided by the Correction factor.

Now, determine the length driven of this battered pile. The batter ratio is 5 to 1.

You have 30 seconds to complete this task.

Let's review the answer: The cut-off elevation is plus 10. The tip elevation as computed earlier is minus 29.79. The length driven is computed as parenthesis cutoff elevation minus tip elevation parenthesis divided by the correction factor. The correction factor for a 5 to 1 batter is 0.981. Length driven is equal to plus 10 minus parenthesis minus 29.79 and this subtraction divided by the correction factor of 0.981. The product minus times minus 29.79 will become plus 29.79. Therefore: Length driven is equal to 39.79 divided by 0.981. Length driven is 40.56 feet. Remember, if you get a negative answer for length driven, you did something wrong.

We will look now at the concept of the minimum tip target. In many cases there will be a minimum tip elevation. Regardless of capacity, a pile cannot be stopped at a tip elevation higher than the minimum pile tip

specified in the plans. The minimum tip target is a value that assist you during driving to verify whether the pile has met the minimum tip elevation required in the plans.

It is a pile length below reference that you can mark in the pile record prior to driving for checking. It can also be used to put a mark in the pile. As long us this mark in the pile is above the minimum tip target you have not reached the minimum tip. Once this mark reaches the reference elevation you know you have reached the required minimum tip elevation.

To calculate the minimum tip target is simple. For the vertical pile case is simply the difference between the reference elevation and the minimum tip elevation. For a batter pile case the minimum target is calculated by calculating the difference between the reference elevation and the minimum tip elevation and then dividing this difference by the correction factor.

Let's determine the minimum tip target for the vertical pile shown here... The minimum tip target is Reference elevation minus the minimum tip elevation.

You have 10 seconds to complete this task.

Let's review the answer: Minimum tip elevation is equal to plus 9 minus parenthesis minus 50. Equals to + 9 + 50. Equals to 59 feet. When the foot mark corresponding to 59 feet reaches the reference elevation at this point the pile tip is at the minimum tip elevation. You can put this mark in your log to keep checking the pile as it is being driven.

The set check target is a length mark that helps you know later on when you only have one foot left before the pile reaches the cut-off. As we will see later on, when we are running out of pile length and we do not get capacity we must stop at about 1 foot above cut off. This is to allow the Engineer to wait and perform set

checks and re-drives before getting into build ups or splicing the pile. In many situations the pile will gain capacity by waiting certain time.

With this calculation when the set check target mark in the pile reaches the reference elevation the pile head is just 1 foot above the cut off elevation. To calculate the set-check target, for vertical pile the formula is: Set check target equals to the Pile length minus one foot minus parenthesis cut off elevation minus reference elevation.

For battered piles we need to introduce the correction factor in the parenthesis. The set check target is equal to Pile lengths minus 1 foot minus parenthesis cutoff elevation minus reference elevation parenthesis but this difference is divided by the correction factor.

Let's determine now the minimum tip target for the vertical pile shown here. For vertical piles, the set check target is equals to the pile length minus 1 foot minus parenthesis Cutoff elevation minus the Reference elevation parenthesis.

You have 10 seconds to complete this task.

Let's review the answer: The set check target is equals to 80 feet minus 1 foot minus parenthesis plus 18 minus parenthesis plus 9. Note that in the last parenthesis the product minus times plus 9 will give you minus 9. Set check target is equal to +79 minus parenthesis plus 18 minus 9. Equals to 79 feet minus 9 feet, equals to 70 feet.

When the foot mark corresponding to 70 feet reaches the reference elevation, at this point the top of the pile is at 1 foot above the cut off elevation. You can put this mark in your log to keep checking the pile as it is being driven.

In this lesson we have covered the following topics:

- 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 calculations, minimum tip target and set check target calculations.
- Identify the applicable 455 Specifications regarding methods of measurement and pay items

This concludes Lesson 4, please continue to lesson 5 by selecting the next lesson button on this page.