SECTION 5 – BRIDGES

5.1 INTRODUCTION *(Rev. 01-21-14)*

When assigned to a bridge project, the PE/S must become familiar with the SP, plans and specifications governing the project. A review should be made to contemplate work so as to anticipate and discuss with the AE anything that is not understood. Project personnel should keep themselves informed as to the contractor's program and the rate of progress so that the project is completed within the time that is specified and to the least inconvenience to the general public and other projects in the same area. A PE/S should feel free at all times to take up their problems with the AE. The PE/S in the study of the contemplated work should check all elevations between the substructure and the superstructure in relation to the details on the plans. A check of all vertical and horizontal controls should be made bringing to the attention of the AE and the contractor any discrepancies discovered.

Frequent and continuous references to the specifications and SP are a practice that the PE/S must follow. As each phase of the work begins, the PE/S should refer to that portion of the specifications covering such work. If the contractor questions your interpretation of the plans, SP or specifications, consult your AE. A contractor's statement that something was permitted on another job should not affect your judgment or decision if it is contrary to the specifications.

Inspection of the work in all of its phases is desirable. The time to correct improper work is at the beginning. Do not wait until the work has been completed. The PE/S should not issue instructions directly to the workers or in any way act as a foreman on the work. Instructions should be given directly to the prime contractor or to its representative in charge of the work.

The provisions of the specifications are to be enforced, but a PE/S should remember that the management of the work is the responsibility of the contractor. If the contractor attempts to use any method which the PE/S has a reason to believe will impair the quality of the work, it should be communicated with the AE.

It should be borne in mind that it is not within the scope of the authority of the PE/S to alter or enlarge upon the plans or specifications. Consent to any violation of them should not be given under any circumstances. If conditions should arise, which would indicate that it is impractical to enforce the specifications to the letter, or if instructions are disregarded, the PE/S should get in touch with the AE.

5.2 SAFETY *(Rev. 01-01-02)*

One of the basic requirements when working on bridges, as well as other construction projects, is to have a thorough knowledge and understanding of safety precautions to be used for the particular phase of work involved. Be alert to the activities around you and keep your attention centered on the safety precautions necessary for your own activity.

5.3 STAKING OUT THE WORK *(Rev. 01-01-02)*

Section 105.08 of the SS outlines construction engineering. Regardless of who is staking

the work, control stakes for bridges should consist of sufficient control for the centerline of the roadway, centerline of the piers and bents, and the neat lines of abutments. It may be desirable to stake curb lines and any other permanent working lines that may affect the horizontal control of the units of the structure. Particular attention must be given to setting horizontal control stakes for structures that are located on curves or structures on which the centerline does not coincide with the centerline of the road approach. After the structure is properly located, permanent hubs that shall be available at any time should be set beyond the limits of the work and properly protected. The crew staking the work must check the horizontal and vertical leading measurements of substructure against the measurements of the superstructure to ensure the work will fit satisfactorily.

After the centerline of the road is established for a railroad grade separation, the stations of the piers and substructure units should be located. The location of the piers shall be made with a direct measurement of the dimensions given on the plans starting at the centerline of the track in each direction to the centerline of the adjacent piers.

After the structure is staked, it is important to double check all leading dimensions. Accuracy of measurements, both horizontal and vertical, is of particular importance in bridge construction.

A temporary benchmark should be established and located conveniently near the bridge site for use during construction. As soon as the first bridge seat or top of pier is established and completed the elevation for all other points on the structure shall be established using the first completed substructure unit as a benchmark.

When the structure is a grade separation the clearance points as shown on the plans should be checked and recorded in the Field Book, and if necessary, the elevation of this structure shall be adjusted to maintain the proper clearances. The DO should be consulted in regard to any minor adjustments necessary. They in turn should advise the CO whenever an adjustment is necessary.

Upon completion of the work, a sketch shall be recorded in the Field Book showing the actual measured horizontal and vertical clearances.

Before any elevations are set, a check should be made between two benchmarks and if more than one is not available, a check should be made between the available benchmark and an object of known elevation.

5.4 BRIDGE SEATS *(Rev. 01-01-02)*

The elevation of the bridge seats is one of the most critical elevations governing vertical control of the construction and they must always be checked before they are established.

The first step in determining these elevations is to determine the profile grade elevation for the intersection of the centerline of beam or girder with the centerline of the bearing.

For structures on a curve, this grade elevation should be determined for the intersection of the edge of the beam at the side where the floor is the lowest and the centerline of the

bearing.

The following items should be considered in finding the difference between profile grade elevations and the bridge seat elevations:

1. Amount of crown or superelevation.

2. Depth of floor.

3. Depth of beam or girder (Minus thickness of top flange if it is encased).

4. Splice plates (on older structures with beams spliced over piers)

5. Shims.

6. Height of shoe assembly.

5.5 FOUNDATION EXCAVATION *(Rev. 01-01-02)*

Poor foundations are a potential cause of bridge failure. A careful examination must be made of the foundation soil at the location of each footing. Where pilings are not used, the foundation soil should be firm and unyielding. In general, any soil which does not require the use of a pick in removal should be regarded with caution and before proceeding with the placing of the concrete for the footing, the use of piling should be discussed with the AE. The CO should be consulted before any consideration is given to redesign the footing.

In general, excavation shall be carried to the elevation shown on the plans. If solid rock is encountered at a higher elevation than shown on the plans, the excavation should be stopped and an investigation made to determine the advisability of revising the elevations given in the plans. If solid rock is encountered either at a higher or a lower elevation than anticipated, or if the bearing value of the supporting subsoil appears inadequate, a thorough investigation will be made. A report, along with direct recommendations to properly correct the conditions, will be sent to the CO for approval.

When foundations do not require piling and excavation in clay soils is being made by mechanical methods, extreme care should be exercised so that the soil below the bottom of the foundation is not disturbed. Generally, the lower portion of the excavation should be completed by hand methods. Clam buckets with long teeth will loosen material to a depth of several inches and special care must be exercised so that they do not disturb the material below the bottom of the footing.

Before foundations that do not require piling are poured, the contractor shall make sufficient tests holes in accordance with Section 206.08 of the SS showing the subsoil conditions below the bottom of the footing elevation. In addition to the nature of the subsoil encountered, the bearing value of the soil conditions can be estimated in accordance with the following table and the PE/S's estimated value of the soil should be

noted. If the foundation conditions encountered are such that it appears as if a footing redesign may be required, the AE will be contacted.

Before piling are driven in foundations requiring piling, soundings (normally a rod may be driven) in lieu of test holes shall be made in accordance with Section 206.08 of the SS showing subsoil conditions below the bottom of footing elevation. This information can be placed on the back of the pile driving record.

Character of Soil	Safe working loads in tons per square feet
Loam, silt or quicksand	(1/2 to 1)
Soft or wet clay	(1 to 2)
Fine sand or medium clay	(2 to 4)
Hard dry clay, gravel or coarse sand	(4 to 6)
Hardpan or very dry clay	(6 to 8)
Cemented gravel	(8 to 10)
Rock (poor brick masonry)	(5 to 10)
Rock (best brick masonry	(10 to 20)
Rock (best ashlar masonry)	(20 to 30)
Very hard bedrock	(30 to 100)

5.6 COFFERDAMS *(Rev. 04-08-09)*

The purpose of a cofferdam is to provide a protected area within which an abutment or a pier can be built. A cofferdam in general is a structure consisting of steel or wooden sheeting driven into the ground below the bottom of the footing elevation and braced to resist pressure. It should be practically watertight and be capable of being dewatered.

Foundations adjacent to railroad tracks generally require cofferdams. The extent and strength required, if not set out on plans, should be discussed at the pre-construction conference with representatives of the Railroad. The contractor's drawings for cofferdams on railroad grade separations must be approved by the Railroad before work is started. The contractor will submit these drawings to the Railroad for approval.

Per Section 206.09 of the SS the requirement to prepare working drawings for cofferdams is the responsibility of the contractor and they must be signed and stamped by a professional engineer. The contractor must obtain the approval of the Engineer for the proposed cofferdam plan and installation procedure prior to the start of cofferdam construction.

5.7 DRIVEN PILING *(Rev. 10-23-09)*

5.7.1 Introduction

Driven piling is covered by section 701 of the Standard Specifications and any applicable special provisions that may be included in the contract documents.

Inspection of pile driving operations is a critical part of the construction of bridge

structures and other structures requiring deep foundations. For pile driving operations for permanent structures or temporary structures that will carry live traffic, full time, on-site inspection and documentation of pile driving operations is expected unless otherwise directed. The person responsible for inspecting pile driving operations must be very familiar with the portions of the contract documents and these instructions that apply to pile driving and must understand how to inspect and document the work done by the contractor.

The Department has previously used the load factor or allowable stress design method for structures and the required capacity of a pile was referred to as the ultimate pile capacity or ultimate bearing capacity. Load resistance factor design, LRFD, is now used and the capacity of a pile is referred to as the nominal driving resistance. The terms bearing capacity and nominal driving resistance will be used interchangeably throughout these instructions.

The length of piling shown on the plans is an estimate based on soil boring data and historical information from surrounding jobs with similar soils. The contractor is responsible for furnishing sufficient lengths of piling to obtain the required penetration and bearing or nominal driving resistance specified.

Pile driving operations are to be documented on form ***IC 225, Pile Driving Record***.

This section will first discuss piling operations in general and then specific instructions for inspection will be given.

5.7.2 Types of Piling

The two most common types of piling used for permanent bridge structures are steel pipe piles, also known as steel shell piles, and steel H-piles. Steel pipe piles are usually filled with concrete after being driven.

Other types of piling used are steel sheet piling, timber piling and precast, prestressed concrete piling. Steel sheet piling is typically used for temporary earth retention and for cofferdams. Timber piling is typically used for temporary bridges and other temporary works. Precast prestressed concrete piling was installed on a few projects; however, it is not currently in use in Indiana.

The contractor must provide mill test certifications for steel piling prior to driving. The mill test certifications should be delivered to the job along with the piling and a mill sticker should be attached to each pile (see Figure 1). The heat number shown on the sticker should match a heat number shown on the mill test certifications.

Timber piles have a stamp in the shape of the State of Indiana hammered into their ends to indicate they have been inspected and accepted. Untreated timber piles are stamped on one end while treated timber piles are stamped on both ends.

Before use, all piling delivered to the jobsite should be inspected for damage and rejected if necessary.

Figure 1. Pile Mill Sticker

5.7.3 Pile Driving Equipment

Piles may be driven with gravity, steam, air, diesel, hydraulic, or vibratory pile hammers. The limitations and uses for each type of hammer are described in the Standard Specifications section 701.04. The most commonly used type of hammer is the single acting diesel hammer. Figures 2 and 3 show a sketch and photo of a single acting diesel hammer.

The typical pile hammer will include the striker plate (impact block), hammer cushion (pad), the helmet (drive head or cap), and the leads. Other items, or appurtenances, that may be used include followers, jets, collars (on timber piles only), and pile tips. Each of these items is described in detail in section **701.04**.

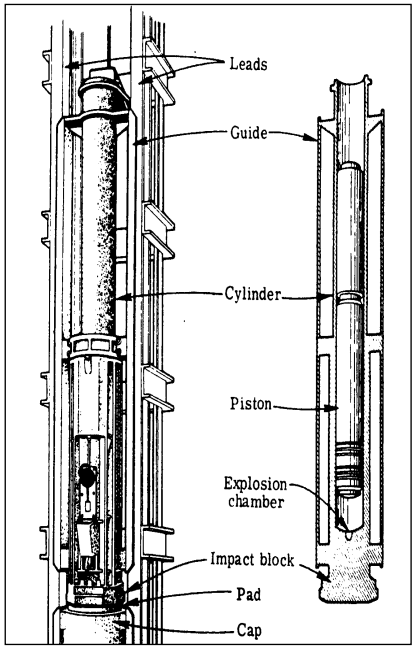


Figure 2.
Sketch of a Single Acting Diesel Hammer

Figure 3.
Photo of a Single Acting Diesel Hammer

5.7.3.1 Approval of Pile Driving Equipment

At least 15 days before pile driving begins, the contractor must submit data about the proposed pile driving equipment for approval to the Office of Geotechnical Engineering, OGE and the PE/S. Form ***IC 740, Pile and Driving Equipment Data***, is to be used by the contractor for this submittal and is available on the Department's website. The OGE will return approved forms to the contractor and the PE/S.

The OGE will use either the Wave Equation Analysis Method or the Alternate Method as described in **701.04** to determine if the proposed pile driving system is acceptable for use. The contractor may only use an approved pile driving system. No changes to the approved system may be made without written approval from the OGE. When applicable, the OGE will also send an approved pile driving chart to the PE/S for use in determining the bearing of driven piling.

The pile hammer should have a data plate attached to it that provides the name of the hammer manufacturer, the hammer model, the hammer serial number, rated energy of the hammer (foot·pounds or Newton·meters), hammer weight (pounds or kilograms), and ram weight (pounds or kilograms). A sample data plate is shown in **Figure 4**. Check the information on this plate against that data submitted on the approved IC 740. The website www.pilebuck.com has links to several pile hammer manufacturer websites and may also be used to check pile hammer information.

Figure 4. Pile Hammer Data Plate

5.7.4 Test Piles

Test piles are driven and used to determine the required driving criteria for other piles in the same foundation or structure.

There are 3 methods used by the Department to determine the driving criteria for piling:

1. Dynamic Formula – An indicator pile is driven to the planned tip elevation or bearing, whichever occurs first. This provides an estimate of the pile capacity and the driving criteria for the remaining piling is set based on the results from the indicator pile.

2. Dynamic Pile Load Test (PDA) – A test pile is monitored during the driving operation to obtain measurements of the actual stresses in the pile and the energy imparted to the pile by the hammer. This method provides a more accurate estimate of the pile capacity than the dynamic formula.

3. Static Load Test – A pile is driven and then loaded to failure to determine the actual capacity of the pile. When used in conjunction with a PDA test, this provides the best means of estimating pile capacity and determining driving criteria.

The information obtained by a PDA test or a PDA and static load test can be used to refine the estimated pile lengths shown in the plans, and in many cases can be used to reduce the required pile length. There are additional costs associated with dynamic load and static load testing, so it is not used in every contract. The OGE evaluates each site and determines which pile testing methods are appropriate.

Test piles are typically also used as production piles, except that they are longer per **701.05**. If no test pile is indicated on the plans or contract documents, all piles must be driven to the nominal driving resistance using the dynamic formula and driving criteria provided by OGE.

Each type of test pile is discussed in further detail below.

5.7.4.1 Indicator Test Piles

When the method for driving piling is specified as the dynamic formula, an approved pile driving chart will be provided to the PE/S by the OGE along with the approved ***IC 740, Pile and Driving Equipment Data Form***. The pile driving chart is project specific because it is tied to the hammer and job specific criteria. Nominal driving resistance or bearing can be determined from the chart by observing the hammer stroke height and the length of pile penetration per 20 blows.

If an indicator test pile is shown on the plans, it must be the first pile driven at the particular bent or pier. The pile used as the indicator test pile is usually driven in a production pile location and, if it remains in satisfactory condition, it is subsequently used as a production pile. The indicator test pile is driven to the estimated tip elevation or nominal driving resistance, whichever occurs first. The nominal driving resistance is recorded using the approved pile driving chart.

When the estimated tip elevation or nominal driving resistance is reached, pile driving is stopped and a minimum wait time for restrike, as defined in the contract, begins. The

indicator test pile must not be cut off before restriking. Before restriking, it is important that the hammer is warmed up by striking a fixed object at least 20 times. The goal of the restrike is to determine if the indicator pile has gained or lost capacity due to soil setup or relaxation. The restrike ends when the pile has been struck 20 times, or when the pile has penetrated an additional 3 in., whichever occurs first.

The restrike nominal driving resistance is then determined from the supplied pile driving chart. If the nominal driving resistance observed during restrike is equal to or greater than that required on the plans, the nominal resistance obtained when the pile was first driven will be used as the criteria for production piles in that bent or pier.

If the nominal resistance observed during the restrike is less than that required on the plans, the contractor must continue to drive the pile until the required nominal resistance is obtained. The restrike procedure is then repeated. If the required nominal driving resistance observed during the second restrike is still less than that required on the plans, pile driving operations must stop and the OGE should be contacted for further guidance. This process is repeated for each indicator test pile shown in the plans.

5.7.4.2 Dynamic Load Test Piles

When the method for driving piling is specified as the dynamic pile load test (PDA testing), then measurements will be taken of acceleration and strain near the pile head as it is driven in order to evaluate the performance of the pile driving system, to determine pile integrity, to calculate pile installation stresses, and to estimate static pile capacity.

A PDA test is typically performed on the first pile that is driven on the contract. Additional tests may also be required in the contract. A pile used as a dynamic test pile is usually driven in a production pile location and, if it remains in satisfactory condition, it is subsequently used as a production pile. Typically, the OGE will arrange for a pile driving analysis consultant to perform much of the testing and analysis required for a PDA test. The PDA testing equipment is attached to the pile by either the PDA consultant or the contractor, either before or after the pile is placed into the leads. An example of the PDA equipment attached to a pile and the PDA data collector are shown in **Figures 5** and **6**.

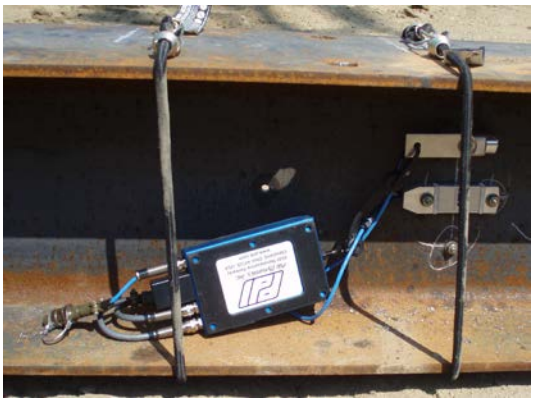


Figure 5. PDA Gages attached to Pile

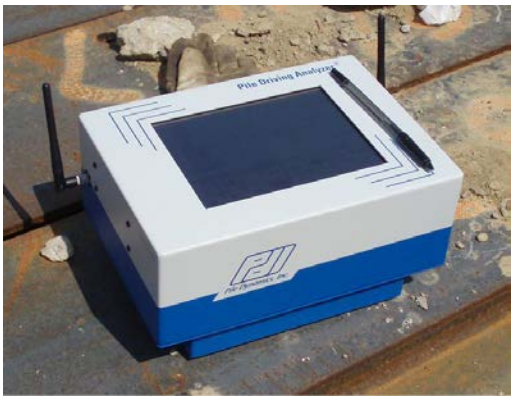


Figure 6. PDA Data Collector

The pile used in the dynamic pile load test is driven until the PDA consultant directs the contractor to stop driving. The pile must not be cut off at this time. The pile is then restruck after waiting the minimum time defined in the contract. After the restrike is completed, the PDA consultant will provide the contractor and the PE/S with the final driving criteria to be used, usually within two business days. After completion of the initial PDA test, the PDA consultant will provide preliminary driving criteria and the contractor may drive production piling before the final driving criteria has been received. However, any piles driven during this time are at the contractor's risk and may need to be re-driven if the final driving criteria are not met. A good example for when this may occur is if the piles are deep enough that they will need to be spliced. The contractor could drive the bottom sections before the final driving criteria have been received.

5.7.4.3 Static Pile Load Test

When the method for driving piling is specified in the contract as a static load test, then 3 types of tests will be performed on the pile: axial compression, axial tension, and lateral load.

A static pile load test is performed on a pile in a location indicated on the plans. This type of test is only occasionally specified in contracts and is done prior to driving any production piling. For the static pile load test, the contractor must design and submit for approval a reaction frame capable of placing the required load on the test pile. Some example setups are shown in the referenced ASTM D 1143; a copy of which may be obtained from the District Testing Engineer. A PDA consultant will direct and analyze the loading of the static test pile. Before the static pile load test begins, the PDA consultant will analyze the static test pile as it is driven by means of a dynamic pile load test as described previously.

The pile used for the static load test is not able to be subsequently used as a production pile as it is loaded to failure as part of the test. However, up to 2 of the piles used in the reaction frame may subsequently be driven and used as production piling, provided they remain in satisfactory condition.

5.7.5 Pilot Holes

Pilot holes, if required in the contract, are made prior to driving piling. There are three types of pilot holes: prebored, predrilled, and cored. Each is further described below.

5.7.5.1 Prebored Holes

Prebored holes are typically specified when difficult driving conditions are anticipated. Prebored holes are slightly smaller than the dimension of the pile being driven and are paid by the linear foot.

5.7.5.2 Predrilled Holes

Predrilled holes are typically used to reduce or eliminate downdrag forces from acting on the piling. They are also used when driving piling through newly constructed embankments. Predrilled holes are slightly larger than the dimensions of the pile being driven. The cost of predrilled holes is included in the cost of the piling items unless specified otherwise in the contract.

5.7.5.3 Cored Holes in Rock

Cored holes in rock are done to accommodate pile placement through rock and are paid by the linear foot.

5.7.6 Production Piles

5.7.6.1 Layout and Preparation

Once the bottom of the footing is prepared, the location of the piles is laid out. Piling is required to be driven in a certain order within a foundation as described in section **701.09**. This is necessary to minimize disturbance and heaving of previously installed piling.

In some instances, water infiltration may be a problem, and a cofferdam and possibly a foundation seal may be required in order to provide a relatively dry work area. **Figure 7** shows a cofferdam with the locations of piles marked.

Figure 7. Pile Locations Marked at the Bottom of Footing

Prior to driving, the contractor must mark the piles in 1 ft increments. This allows the inspector and the contractor to determine the approximate length of penetration and to determine the penetration per given number of blows while driving. **Figure 8** shows a pile marked in 1 ft increments.

The ground can be used as a reference for measuring penetration, but there are also other options. Using the ground can be difficult and inaccurate if the surrounding soil heaves as the pile is driven. The pile gate may also be lowered and obstruct the view of the pile. A better way to measure penetration is to use a fixed point on the leads as a reference. One thing to be aware of when using a mark on the leads is that the leads tend to jump around as the pile is driven if they are not toed firmly in the ground. Another method that is commonly used to measure penetration is to drive a lath a few inches away from the base of the pile being driven. The lath can be pushed toward the pile to the point where it is actually touching the pile as it penetrates. This provides for a solid reference to measure penetration. The inspector should have a good idea how far the production piles will be driven based on data obtained from the test pile.

Figure 8. Steel H-Pile Marked in 1 ft Increments

5.7.6.2 Alignment

Piles are driven either vertically plumb or battered to a specified angle. The batter angle will be shown on the plans and is typically a rate of 1 horizontal to 4 vertical. Steel H-piling must be oriented as shown on the plans since it has a weak axis and a strong axis and is designed with a specific orientation for those axes. Steel pipe piling and timber piling may be driven without consideration given to their orientation. Tolerances are provided in the specifications for pile alignment.

5.7.6.3 Pile Tips

Generally pipe piles are fitted with an end plate or a conical tip welded to the bottom. H-piles sometimes require pile shoes. Conical tips and pile shoes are paid per each. End plates are not paid separately. Check to verify that the pile shoes provided meet the specifications. **Figures 9** and **10** show pile shoes.

Figure 9 Tip (Bottom) of Pile Shoe

Figure 10 Top (Connection Side) of Pile Shoe

5.7.6.4 Driving

Pile alignment must be checked by the contractor during the first several feet of driving so that corrections can be made as necessary. **Figure 11** shows checking of the vertical alignment with a four foot level.

Figure 11 Checking Pile Alignment

Piling must be driven until the required bearing is obtained in accordance with the driving criteria. All piling must also be driven to the minimum tip elevation, if given, or to a minimum penetration of 10 ft below the bottom of footing elevation. If driving conditions are encountered that make this difficult, the PE/S should contact the OGE for guidance.

Single acting diesel hammers are equipped with graduated rings or grooves on the ram in order to visually determine hammer stroke. **Figure 12** shows the piston extending from the top of the hammer. A dark ring is on the piston for reference. Communicate with the contractor before driving to make measurements and understand the reference rings on the ram while the pile hammer is still on the ground.

Figure 12. Piston Extending from the Top of the Hammer.
(Note ring on the piston)

Beginning at least 10 ft above the estimated pile tip elevation, the blow counts per each foot of penetration are to be recorded on the IC 225. Driving can be stopped once the pile has reached both the minimum tip elevation and the blow count for the required nominal resistance.

5.7.6.5 Practical Refusal

On occasion, the pile will reach practical refusal before the minimum tip elevation can be reached. Practical refusal is defined in **701.08** as a minimum of 20 blows per inch of penetration. Driving must be stopped when a pile reaches practical refusal in order to avoid damaging the pile.

5.7.6.6 Soil Heave

Soil heave occurs when driving a pile causes upward movement in the surrounding soil.

Some soil types, particularly loose granular soils, are more susceptible to soil heave. Soil heave can cause upward movement in previously driven piles and can also reduce the bearing capacity of those piles. The contractor is required to take elevation readings on the piling to determine if soil heave is occurring. Any pile that has heaved more than 1/4 inch must be re-driven to the required bearing and tip elevation.

The geotechnical report can be referenced to determine if soil heave is anticipated for a given foundation.

5.7.6.7 Splices and Cut-offs

Depending on the depth of driving, piling may need to be spliced. The Standard Drawings show approved pile splice methods. All welds must be done in accordance with AWS D1.5 and welders must have a valid AWS welding certification. The welder must knock the slag off of the weld so that it may be visually inspected, but ultimately the contractor is responsible if the splice fails.

Piling should not be cut off, unless necessary to drive other piling in the vicinity, until any restrike required has been successfully performed and the PE/S is satisfied that the piles have not heaved or that any heaving has been taken care of by re-seating the pile. **Figure 13** shows the contractor cutting off the pile to the required elevation.

Figure 13. Pile being cut off at the plan elevation.

Once all of the piling in a footing has been cut off to the plan elevation, as shown in **Figure 14**, the next step is to form up the footing, place the reinforcing bars, and place the concrete.

Figure 14. Piles cut-off at plan elevation

5.7.7 Inspection Procedures

The PE/S must ensure that an inspector is on-site during all pile driving operations and that the inspector is familiar with these instructions and the specifications that cover the type of piling operation that will be inspected. The following is a summary of the required inspection procedures.

5.7.7.1 Preparation

Check that the materials to be used in the operation are approved and that any required certifications have been submitted.

Obtain a copy of the approved Pile and Driving Equipment Data form, IC 740 and check that the pile hammer and appurtenances are the same as on the approved form.

Obtain a copy of the approved pile driving criteria for determination of bearing values.

For piling being controlled by PDA or static test results, the driving criteria will specify the number of blows per foot for a given length of piling and a given stroke of the hammer. The PDA driving criteria will be provided by the PDA consultant.

For piling being controlled by either indicator test piles or strictly by the dynamic formula, The OGE will provide the driving criteria. Typically the criteria will specify the maximum penetration required for 20 blows at a given hammer stroke to obtain a given bearing value.

Prepare a copy of the ***IC 225, Pile Driving Record*** for the specific structure and foundation where the piling will be driven. A separate IC 225 must be completed for each pile in a foundation.

5.7.7.2 Test Pile Inspection

Ensure that the correct type and size of piling is being placed. Check the orientation of

the pile as required. Ensure that the piling has been marked in 1 foot increments for its entire length.

If PDA testing is being done, discuss with the PDA consultant how the operation will proceed and what their responsibilities and the inspector's responsibilities are.

For indicator piles, PDA test piles and PDA driving done as part of a static load test, record the number of hammer blows per each foot for the entire length driven. Record the bearing values, the total length driven, penetration depth, and other information as required on the IC 225.

During the driving operation, ensure that the contractor checks for proper alignment of the pile and makes adjustments as necessary.

As the test pile approaches the required minimum tip elevation or bearing, record the number of blows per inch of penetration.

During the test pile restrike, record the number of blows per inch for either 3 inches or 20 blows, whichever occurs first.

Require the contractor to obtain elevations to check for soil heave as necessary and record the data on the IC 225.

5.7.7.3 Production Pile Inspection

Ensure that the correct type and size of piling is being placed. Check the orientation of the pile as required. Ensure that the piling has been marked in 1 foot increments for its entire length.

Obtain the measurement for each section of piling before it is placed in the leads and record the measurement to the nearest 0.1 ft.

Determine the approximate length of each pile to be driven. This approximation can be made from the lengths shown in the plans or from test pile results.

Observe the pile driving operation and when there is at least 10 ft of the pile remaining to be driven, based on the approximate length previously determined, record the number of blows per foot of penetration on the IC 225. Note that in some cases, the number of blows per foot of penetration for the entire length of the pile may be required to be recorded.

During the driving operation, ensure that the contractor checks for proper alignment of the pile and makes adjustments as necessary.

If a minimum tip elevation is shown in the plans, ensure that the pile has also been driven to at least this minimum elevation. If a minimum tip elevation is not given, ensure that the pile is driven at least 10 ft below the bottom of footing elevation.

Direct the contractor to stop driving once the pile has obtained both the minimum bearing value, based on the driving criteria, and the minimum tip elevation.

Require the contractor to obtain elevations to check for soil heave as necessary and record the data on the IC 225.

5.7.7.4 Splices and Cut-offs
Ensure that welding is performed by an AWS certified welder.

Observe splicing and cut-off operations to obtain lengths of piling added or removed. Record the information on the IC 225 in order to obtain the final pay length for each pile.

5.7.8 Inspector's Documentation
Note any driving problems, such as misaligned or damaged piles, unexpected length of piling driven, inability to obtain minimum bearing, practical refusal prior to minimum tip elevation, soil heave or any other unanticipated conditions on the IC 225.

Complete all required information on the IC 225.

5.7.9 Measurement and Payment
Measurement and payment for driven piling and associated items of work is to be done in accordance with the Standard Specifications. Further clarification is provided below for payment of test piles.

For a test pile, whether it remains as a production pile or not, the cost to supply and drive the pile is paid by the linear foot of piling, regardless of the pile type. The cost of the portion of the testing work the contractor is responsible for is paid for by each for the type of test performed. When a restrike of a test pile is required, the cost of the restrike work is paid for by each for each pile restruck. **Example 1** below is given to provide clarification of measurement and payment for a test pile.

Example 1

A dynamic pile load test is required for H piling on the first pile driven in a foundation. Pile tips are also specified. The estimated length of each pile is 95 ft with a minimum tip elevation of 624.00.

The test pile is driven and accepted in accordance with the specifications. However, the required bearing is not achieved until the tip elevation reaches 618.00. In order to reach this length, it is necessary to splice on a second section of H pile. 120 ft total of H pile are placed in the leads. The pile is driven in a location within the foundation for a planned production pile. The final length of piling cut-off total 18.7 ft. Pile driving records, including the required restrike, are kept on an IC 225. The following items are the final measurements and pay items for this test pile:

- *Dynamic Pile Load Test – 1 Each*
- *Test Pile, Dynamic, HP 14 x 84, Production – 101.3 ft (120.0 – 18.7)*

- *Test Pile, Dynamic, Restrike – 1 Each*
- *Pile Shoe, HP 14 x 84, Steel H – 1 Each*

5.8 FILL AROUND STRUCTURE *(Rev. 04-08-09)*

The use of unsatisfactory material and the improper placing of fill material at the end of structures will produce rough riding surfaces and may cause damage to the structure. Rigid inspection should be given at the time of backfilling and while the approaches to the structure are being constructed. Because of varying types of soil, moisture content, topography at site and other variables each structure presents a different problem in securing properly compacted embankments and backfill. It is the responsibility of the PE/S to see that all fills are placed and compacted to a density that will preclude further settlement.

Abutment type structures and arch structures usually require that structure backfill be used for backfill and for fill around the structure. The PE/S should see that the material conforms to, and that it is placed as per specifications.

No fill should be placed around the structure until the walls have been inspected and approved by the PE/S. Fill to required finished grade in front of the abutments, wings, and retaining walls must be made simultaneously with the fill behind them.

In filling over arches, great care must be taken to see that the fill is placed symmetrically from haunches to crown so that the loading on the arch is equally distributed while fill is being placed.

The approach embankment at pile end bents of "spill-through" type structures may be constructed before or after end bent piles are driven. If construction of fill is made before piles are driven special attention should be given to assure the maximum compaction of fill. Coring of holes to receive the piles should be carefully located and drilled to approximately the elevation of the original ground. Any voids around the piling after it is driven should be filled with fine granular material.

The PE/S must give special attention to intermediate bents that fall within the limits of the spill-through slope. Heavy earth moving and compaction equipment will cause sufficient pressures on bents of structures as to cause tipping of the bent. The longitudinal alignment of such bents must be checked as spill-through slopes are constructed.

5.9 FALSEWORK *(Rev. 08-10-17)*

The contractor must prepare working drawings which are signed by a Professional Engineer fixed with the contract number, for any falsework, including stay in place (SIP) deck forms, cofferdams, coping falsework, deck falsework, superstructure falsework for reinforced concrete slabs, and designs for temporary bridge structures on runarounds. These should be submitted to the PE/S for distribution to the appropriate reviewers. Questions about review of shop drawings should be addressed to the AE. The Department's approval of shop drawings in no manner relieves the contractor of the responsibility to construct falsework to support the loading to line and grade.

Several bearing joints of timber upon timber will result as falsework is constructed. These joints will crush together as they are loaded. Anticipated timber crush should be taken into consideration when setting elevations for falsework. In addition, the falsework grades should be set to provide for concrete dead load deflection as given in the plans.

The PE/S shall perform a general check of the falsework, as it is being placed, to determine that it is being placed in substantial compliance with the approved falsework drawings. A general check shall include checking falsework bents, falsework piling bearing capacity, size and spacing of materials, connections and/or joints, and the fit of it. In many cases, it may not be possible to perform a complete and detailed check of the falsework. However, the PE/S should instruct the contractor to correct any observed deviations from the approved falsework plan and to comply with safety requirements.

Stay-in-Place (SIP) Forms for concrete bridge decks can cause bridge deck cracking when not properly installed. SIP forms must be checked to insure the vertical leg of the support angle does not extend above the top of the SIP form (pan) line.

If the vertical leg of the support angle does protrude above the SIP deck line, the Contractor should be notified to take corrective action to rectify the problem.

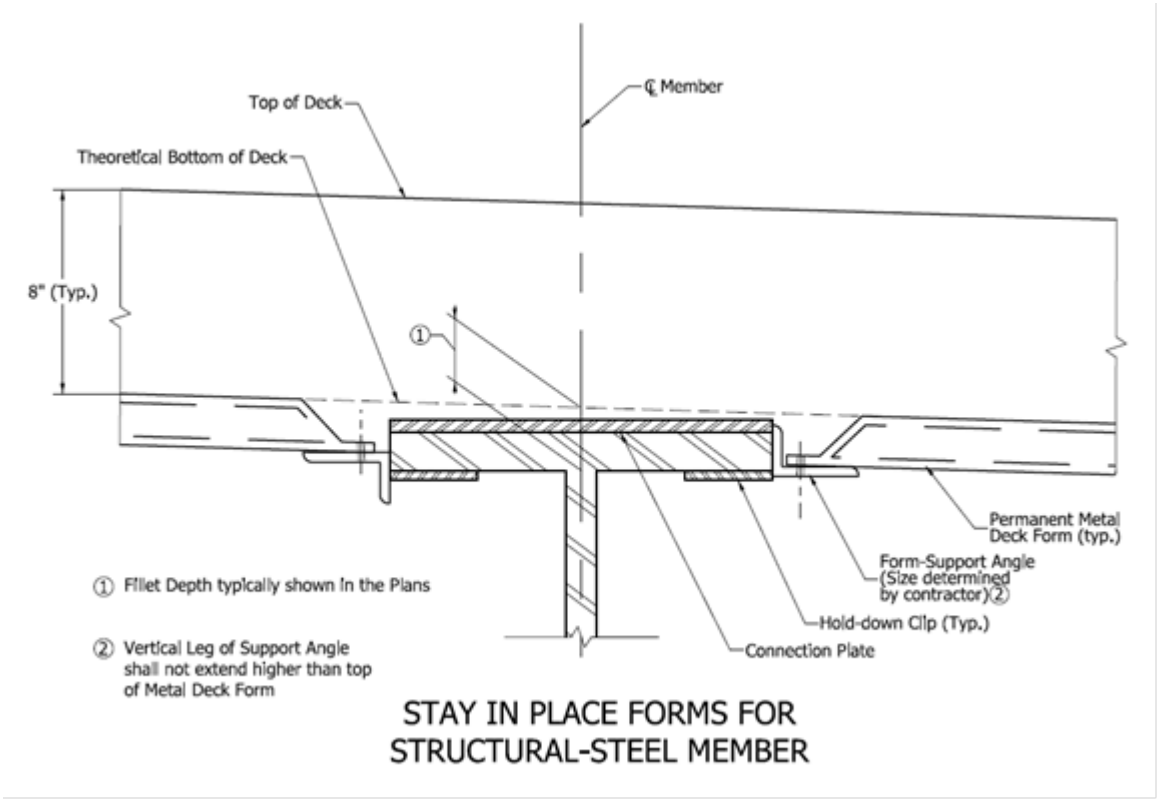
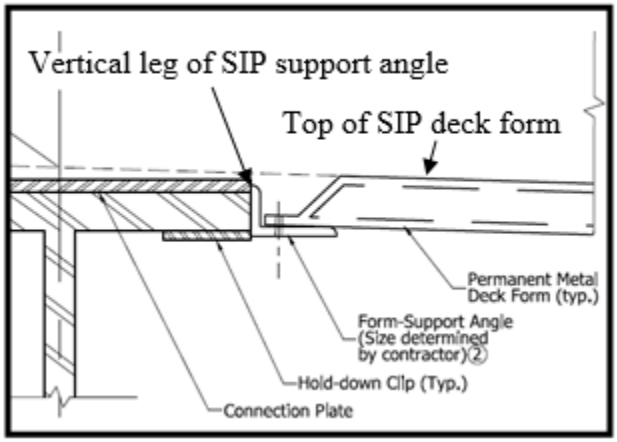


Figure 15a. SIP Form attachement to steel members



Inset of Figure 15a indicates a correct SIP angle support placement in relation to the top of the SIP deck form line. The vertical leg of the support angle does not protrude above the SIP deck form line.

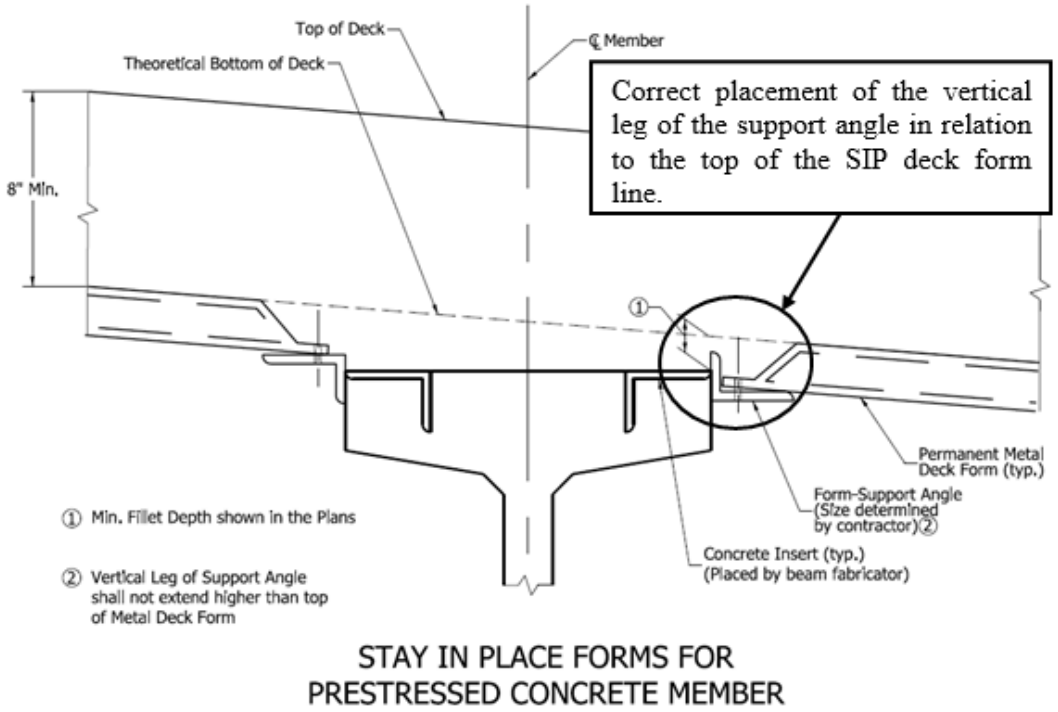


Figure 15. SIP Form attachement to concrete members

If a maximum soil pressure is specified for mudsills on which falsework bents are to be placed, a subsoil investigation must be performed as outlined in Section 5 of these instructions. If a maximum settlement of these mudsills is specified, the CO must be notified prior to mudsill placement.

5.10 FORMS FOR CONCRETE *(Rev. 04-08-09)*

Forms must be checked for proper dimensions, plumbness or required batter, alignment,

bracing, tightness, and for the required form lining on exposed surfaces. The Engineer's checking of the forms should be done progressively as they are built and not wait until they are completed before making necessary inspections for approval before pouring. Copings, curb lines, and handrail or parapet wall forms should be very carefully checked for alignment and for smoothness in a vertical plane. Joints in sectional forms should be smooth and rigid to prevent irregularities in exposed surfaces.

The vertical and horizontal alignment of curbs, copings, and other exposed lines should be carefully checked during the placing of concrete and any improper alignment corrected before completion of pour.

Surface smoothness and alignment of the finished concrete should be secured by proper attention to form work.

Wall forms must be thoroughly and securely tied and braced to insure against bulging surfaces and poor alignment.

Forms should be treated with form release agent in such a manner that the agent does not come in contact with the reinforcing steel. If form lumber will be in close proximity with reinforcing steel already in place, it should be pretreated with the releasing agent before it is placed.

No welding of attachments of any kind for form supports will be permitted on flanges of steel beams or girders in the areas where flanges are designed to carry tensile stress. On simple spans the upper flange will not be in tension. On continuous steel spans the top flange is designed for tension over all piers to points of contraflexure and welding will not be permitted within this area. Due to variations in combinations of span lengths it is impossible to establish a "rule of thumb" method of establishing the location of tensile stress in the flange. The PE/S assigned to construction of a project of continuous steel spans should determine, as early as possible, the proposed method of attaching supporting formwork to the structural steel. If welding of attachments is proposed, the contractor should then make a request through the PE/S for a determination of the limits where welding will be permitted. No form construction requiring welding of attachments to beams shall be permitted at any location on the structural steel until the restricted limits are established.

The gutter line at the base of a curb is the location that gets the full force of drainage and de-icing solutions causing disintegration. Every effort should be made not to destroy the homogeneous mixture of the concrete at this location when removing the curb board supports. The curb board supports must be designed of metal so that their removal will cause no damage to the concrete, and their removal must be accomplished and holes carefully and fully patched before the concrete has set. Wooden legs are not permitted. The removal of the curb board should be made as soon as possible after the concrete has set sufficiently to hold its position. This should be done so that the gutter line may be given a smooth grade and irregularities in the face or top of the curb aligned and smoothed.

5.11 GRADE CONTROLS FOR BRIDGE FLOORS *(Rev. 04-08-09)*

Control grades are required along each beam line to establish the floor bottom elevations, top and bottom of coping elevations, and the finished floor grade at the beam lines. If screed grades at the beam lines and the coping have not been provided in the plans, the PE/S should obtain the floor screed grades by contacting the designer of record. These grades will have been computed for dead load deflection.

As soon as the beams or girders are set in their final positions, elevations should be taken along the beam lines at the screed locations. These elevations subtracted from the screeds give the dimension the floor grade or coping must be set above the point on the beam.

On continuous steel beam or girder units, all the elevations for the entire length of the continuous portion of the bridge must be taken before any concrete floor is poured and all screeds and copings are thereafter set to the dimensions computed. Note that the elevations of the beams and top of screeds at any point will vary as each unit of floor is poured and will not reach their correct final grade elevation until the entire floor is poured. Refer to instructions on the plans for continuous steel beam or girder structures.

If the bridge seats (bearing areas for girders or steel shoes) have been constructed to the correct elevation and the steel properly fabricated, this screed data will produce a smooth floor of correct thickness.

Because floors on steel beams and girder bridges are generally 8 in. in thickness, it is important that bridge seats (bearing areas) be poured to the correct elevation. In practice, a tolerance of plus or minus 1/4 in. in these bridge seat elevations will be satisfactory. Errors in elevations in excess of this tolerance must be corrected. The PE/S should discuss the method of correction with the AE.

Elevations for longitudinal screeds on concrete bridges (slabs, girders, rigid frames, simple spans or continuous spans) are computed in the same manner as described above. However, since this type of bridge is supported on falsework, screed elevations are generally set by direct leveling.

There is always some deflection in each span of the supporting falsework and generally a small amount of settlement (timber take-up in the horizontal joints of the various members) at each falsework bent. Generally some consideration and allowance must be made for such deflection in the falsework, in forming, and in setting the screeds. Since choice of design of falsework is with the contractor, no definite rule as to the exact amount of deflection can be established.

The amount of settlement, timber take-up at the bents varies with the number of horizontal joints, the grade of timber, general workmanship, and the intensity of the load at the bent. In practice at the bents settlement (timber take-up) from 1/8 in. (lightly loaded bents) to 1/4 in. (heavily loaded bents) should be allowed.

In setting longitudinal screed elevations by direct leveling, control points at 8 to 10 ft centers are usually sufficient. For concrete spans which vary from 20 ft to 60 ft, from

three to five control elevations are usually sufficient in each span. The controlling elevations are set at each bearing point, the center of span, and 1/4 points of the span. Other points are obtained by stretching a chalk-line or wire over the control points and working out a smooth curved screed line. In many cases it is advantageous to select control points over the falsework bents.

The PE/S should check each screed or exposed line by carefully sighting directly along the line several times during the placing of the concrete. Any appreciable variation from the smooth line can be seen and corrected. In order to check deflection in falsework during the pouring of any span, the contractor should take rod readings on the control points just before starting the pour, and make frequent checks of each falsework bent after it has received its full load and before the final pass of the strike-off over that bent. If deflection or settlement is in excess of that originally allowed for, the screed should be wedged up as may be necessary to provide a smooth riding floor. However, care must be taken not to increase the floor thickness more than 1/2 inch as this will increase the dead load on the structure, potentially reducing the life of the structure and the ability to add a future wearing course.

5.12 PLACING REINFORCING STEEL *(Rev. 01-01-02)*

The protection of materials delivered to the project that are to be incorporated in the project is a fundamental good construction practice. It is important that we insist on compliance with the specifications in regard to maintaining clean materials so that they perform their proper function. It is necessary that we place special emphasis on our inspection and engineering control to require the contractor to protect reinforcing steel in accordance with the SS, keeping it above the surface of the ground on platforms or skids or other supports, and covered as protection from moisture and other detrimental effects. Supports for the reinforcing bars should be placed at such intervals that long bars will not sag into the ground at the ends and short bars are not permitted to fall through the supports to the ground. As the steel is used the PE/S shall require that the portions remaining for future work shall not be thrown off the supports but shall be restacked and covered. Careful handling of epoxy coated bars is required in order to reduce the amount of nicking and scuffing of these bars.

Reinforcing steel shall be placed in accordance with plans and shall be in place before any concrete is poured. Vertical bars projecting from footings shall be located with extreme care and held in position while concreting is in progress by fastening them to a supporting frame. Frequent inspection should be made during the pouring of concrete to see that bars are not displaced.

Reinforcing bars shall in all cases be held securely in place and care shall be taken to see that no steel comes in contact with the forms. The provisions of the Specifications “Placing and Fastening” must be adhered to. In case there is a delay in depositing concrete, an inspection of the reinforcing steel should be made and when necessary it should be cleaned.

It is essential that we maintain the positioning of reinforcing steel in the deck for compliance with the plans. The PE/S shall check the clearance of the top reinforcing steel

to the finished grade to verify that the steel will have the specified coverage of concrete. This shall be done by passing the strike-off or finishing machine along the screeds and directly measuring the clearance to the steel. This clearance must be checked and the measurements recorded in a field book. An acceptable minimum number of transverse locations are at the centerline of the structure, lane lines, edge line, and gutter line. These transverse locations must be checked every 10 to 15 ft longitudinally. When the top and bottom mats of steel are not tied together with crankshaft bars, it will be necessary to tie the top mat to the forms to prevent longitudinal and lateral movement of the steel.

As soon as the concrete is placed and struck off on the deck and while still plastic, an adequate number of measurements (suggested every third location) shall be taken and recorded in a field book showing the actual depth of concrete over the reinforcing steel. Any movement and any upward lift of the reinforcing steel will cause the reinforcing to be too close to the surface and immediate steps shall be taken to provide additional tie-downs to the forms.

5.13 MIXING CONCRETE *(Rev. 04-08-09)*
Tests must be made during each pour to determine the slump, air content, and the yield tests as per the current Frequency of Sampling and Testing.

A continual policing of transit mix operations is required. The specifications require that the mixing speed of truck mixers shall be in accordance with the manufacturer's rating, and that the number of revolutions of the drum at mixing speed shall be not less than 70 nor more than 100. When transit mix trucks are used, the following items must be checked:

1. Manufacturer's rating plates are legible and in place

2. Revolution counters are attached and in operating condition

3. Mixing speed and number of revolutions are in compliance with the specifications and manufacturer's recommendations

4. Trucks are being used at or below rated capacity

5. Wash water properly drained from the drum

6. Capacity of water storage, old concrete build-up, and general condition of equipment

5.14 PLACING CONCRETE *(Rev. 04-08-09)*
The specifications provide that concrete shall be placed in such a manner so that it has no more than 5 ft of free fall within the forms. Particular attention must be given to methods of placing the concrete in the forms to avoid segregation.

On the first load of concrete, a determination of the air content must be made. The frequency schedule and requirements for the concrete tests must be reviewed thoroughly

before pouring begins.

When belt conveyors or pumps are used, sampling, for air, slump, and yield will be done at the discharge area of the pump or conveyor. In each case, material shall be permitted to drop to the forms where it will then be shoveled into the testing apparatus. As a matter of caution, concrete pumps work under extreme hydraulic pressures; therefore, making of beams and other activities must take place away from these pieces of equipment. Pumping of concrete shall be in accordance with Section 702 of the SS that also requires the contractor to submit a description of its pumping procedures at least 24 hours before concrete placement.

The preparation and the curing of test beams must receive close attention so that the results from test beam breaks will be truly representative of the pour that they represent.

It is sometimes practically impossible to remove all water prior to placing footing concrete. Placing concrete in still water up to 6 in. deep may be allowed. In this case concreting should start at one end of the form and be placed until the surface of the concrete is well above the surface of the water. The concrete should be allowed to work itself forward displacing the water with as little help as possible. The concrete should never be dragged through or shoveled into the water. Just sufficient pumping should be done to keep the surface of the water at the desired depth. The depositing of concrete in running water should never be allowed. The placing of concrete in more than 6 in. of water should be done only with special permission.

5.15 FINISHING CONCRETE SURFACES *(Rev. 04-08-09)*

All concrete surfaces must be finished in accordance with Section 702 of the SS.

The PE/S must give special attention to the construction and finishing of bearing areas of bridge seats and sliding joints. Bearing areas must be finished level and in a true plane (unless otherwise provided) and to the elevation shown on plans. The areas of the bridge seats or tops of piers between bearing areas shall be constructed with a small slope or crown to provide drainage.

5.16 FINISHING BRIDGE DECKS *(Rev. 04-08-09)*

It is the responsibility of the construction personnel to ensure that the deck construction, including the workmanship and materials, is all performed in accordance with the contract documents, specifically Section 704 of the SS.

Items of importance are:

1. Placing and positioning of reinforcing steel, including specified coverage.

2. Uniformity of the concrete with respect to air content and slump.

3. Adequate and immediate curing.

4. Independently supported runways to prevent movement of the steel.

5. Addition of surface water during finishing only when absolutely necessary, and in accordance with specifications.

If possible, the PE/S should be present for a part of the time on all deck pours, preferably at the start of the pour.

To help alleviate the plastic cracking which follows a pattern directly over the reinforcing steel, it will be necessary for the contractor to provide walk boards along adjacent sides to the bulkheads so that pedestrian traffic during the placing of concrete will not be moving the reinforcing steel which extends through the bulkheads. These walk boards shall be so constructed that they will be resting on the forms and not on the reinforcing steel.

Usually some hand finishing on a bridge deck is required to produce a smooth riding surface and to achieve proper profile grade and transverse crown section. However, excessive hand finishing tends to reduce the air content at the surface of air-entrained concrete that leads to spalling, cracking, and other undesirable faults that affect the life of the deck.

The PE/S will make careful observation during the placing of the concrete to ensure that dehydration caused by atmospheric conditions is not causing stress planes or cracks in the fresh concrete.

The concrete surface will be checked with a 10 ft straightedge immediately after the finishing is completed. Particular attention must be given to straightedging at transverse bulkheads and at expansion joints.

Required curing shall be provided immediately after the finishing operation.

After a minimum curing period of the bridge deck or a section thereof, the PE/S will straightedge the previous pour, paying particular attention for irregularities at transverse bulkheads and expansion joints. Any irregularities not within the limits of the specifications shall be corrected. The straightedging will be performed with a 16 ft steel straightedge.

5.17 FINISHING CONSTRUCTION JOINTS *(Rev. 04-08-09)*

Where construction joints are shown on the plans or the Engineer authorizes their location they will be placed in accordance with Section 702 of the SS.

Construction joints as designated on the plans for structures are so located with considerations given to relief of shrinkage stresses in the concrete and workability for finishing operations. The construction joints located for reasons of design stresses are essential and shall be constructed in accordance with plans. Certain construction joints may be marked as “Optional.” The use of these joints is optional to the contractor with considerations given to capability and capacity of the contractor for placing and finishing the concrete in accordance with the specifications. All joints not marked as optional must be placed as shown, unless approval is obtained for relocating or eliminating these joints.

The top edges of a longitudinal construction joint on a bridge deck are not to be rounded with an edging tool. These joints should be carefully worked so as to produce as near a watertight joint as possible.

Horizontal construction joints in piers, abutments, wingwalls, arch skew backs, and similar joints should be cleaned of all laitance (cement residue) and thoroughly wetted before placing new concrete on that already in place.

5.18 CURING CONCRETE *(Rev. 04-11-09)*
Proper curing for the specified length of time is essential to produce acceptable strength and durability in concrete. Attention should be given to obtain curing in accordance with Section 702 of the SS.

Test beams to be used for control of application of loads on concrete must be cured in the same manner and for the same time as the concrete that they represent.

5.19 CONCRETING IN COLD WEATHER *(Rev. 04-11-09)*
The provisions of Section 702 of the SS should be followed for concreting in cold weather. If the contractor elects to use High Early Strength Concrete instead of the specified mixture, the heating and curing period is controlled by test beams. The heating period will be extended, if for any reason the required temperature is not maintained. If test beams control field operations, the discontinuance of heating and curing can be permitted when the modulus of rupture for concrete reaches the value as provided by Section 702 of the SS.

Details as to heating and housing must be discussed in advance of the operation with the contractor and concreting should not be permitted until suitable means for heating and housing have been provided. If a space heater with a blower is used, the extreme hot air should not be blown directly onto the forms or green concrete. A baffle to spread the hot air should be used. Suitable provisions should be made to prevent premature drying of concrete during curing period. Sudden changes of temperature are common in Indiana and it is good practice for the contractor to be prepared for severe conditions.

5.20 EXPANSION JOINTS *(Rev. 04-11-09)*
Expansion joints must be in a true plane and not in a warped surface. The location of the expansion joint should be carefully checked to see that no coping or other projection is so located as to be cracked or broken off by subsequent movement of the structure.

The expansion surface between the bridge deck and the top of the mudwall should be checked carefully just before placing concrete in the deck so that you can be assured that the joint material is properly in place.

Note that many structures are currently designed with integral or semi-integral end bents. These type structures do not have expansion joints since the expansion is taken up in the rotation of the end bents and movement of the approach slabs.

5.21 WATERPROOFING *(Rev. 04-11-09)*

Waterproofing is not normally required on bridges. If waterproofing is called for it shall be in accordance with the applicable sections of the SS.

5.22 STRUCTURAL STEEL ERECTION *(Rev. 04-11-09)*

Structural steel that is delivered to the site has been inspected during fabrication and should be handled with proper care during shipment. Occasionally errors in fabrication do occur and escape detection by the shop inspector or some pieces are damaged during shipment. The PE/S should inspect the steel after it has been delivered to the job site and take whatever action is necessary to assure that the steel is satisfactory before it is erected.

The following schedule should typically be applied for payment of structural steel I-beams and girders as construction progresses:

90%	when erected
5%	when bolting is complete
2%	when all welding and bolting is complete
3%	when painting is complete

If painting is a separate item, then payment should be completed when all welding and bolting is completed.

Partial payment made for steel stockpiled but not erected will be as per Section 111 of the SS.

5.23 STRUCTURAL STEEL CONNECTIONS *(Rev. 04-11-09)*

It is essential that the elevation of the splice joints is established before permanent connections are made.

High tensile bolts and hardened washers are used in field connections of structural steel. It must be noted that with this type of connection the stress in the steel is transmitted through the splice by friction of the plates rather than shear in the bolts. It is important that the contact surfaces of plates are free of rust, oil, burrs, or any other materials that would prevent a tight contact of the metal surfaces. Tightly adhering paint is acceptable.

The PE/S must verify that the bolts are High Tensile Bolts. High Tensile Bolts are manufactured of ASTM A325 high strength carbon steel. They may be easily identified by the markings on the head of the bolts. Bolt heads are marked with three radial lines 120 degrees apart and the symbol A 325. Nuts are marked on one face with three similar circumferential markings 120 degrees apart or, alternatively, with C, 2, D, 2H, or DH. Bolts, nuts and washers delivered to the project must be in containers clearly marked with the contents and must be stored to prevent damage and rust.

It is necessary to ensure that the high-strength bolts used in structural steel erection meet all testing requirements prior to their use.

It is important that all bolts are properly and uniformly tensioned. Generally such bolts are tensioned by use of an impact wrench. The contractor must provide such control of the impact wrenches as is necessary to uniformly tension the bolts to the proper tension as set in Section 711 of the SS.

Impact wrenches and manual torque wrenches must be calibrated at least once each day in a device capable of indicating actual bolt tension in accordance with Section 711 of the SS.

The specifications outline the procedure for inspection of bolted connections.

Occasionally it is necessary to tighten a bolt from the head of the bolt rather than by the nut. In these cases the hardened washer shall be placed under the bolt head. This procedure is to be permitted only when space does not permit wrenches on the nut. The washer is to be placed under the portion of the unit that is to be turned by wrenches.

Beveled washers shall not be used except to correct for bearing surfaces having a slope of more than 1:20 with respect to a plane normal to the axis of the fastener. When beveled washers are necessary they shall conform to Section 910 of the SS.

No pin bolt fasteners shall be installed to breaking tension until the structural steel has been erected and adjusted for transverse and longitudinal positioning, and for elevations at splice joints. A sufficient number of erection bolts and full size drift pins and/or loose pin bolts shall be used to hold joints in correct position until solid tight pin bolts are installed. The installation of pin bolts shall start at the center of a joint and progress concentrically to the outer edges of the connecting plates.

Each fastener shall be installed to a minimum tension in accordance with Section 711 of the SS.

Installation tools used to install pin bolt fasteners to the tension specified shall be tested in the presence of the Engineer by installing a sample fastener in a calibrating device capable of indicating actual bolt tension.

5.24 PAINTING STRUCTURAL STEEL *(Rev. 04-22-14)*

5.24.1 Introduction

Painting of structural steel is covered by section **619** of the Standard Specifications along with any applicable special provisions that may be included in the contract documents.

Proper inspection of structural steel painting is critical, not only to ensure that the steel is protected from corrosion which can weaken the structural members, but also to ensure compliance with laws regarding hazardous materials. On-site inspection and documentation of painting operations is expected to be done at all critical junctures of the operations and should be supplemented by random site checks during the operations.

Note that the structural steel painting industry tends to use the term “coating” for

protective coverings applied to steel components since the coating may not always be paint. For purposes of these instructions, the terms “painting” and “coating” will be used interchangeably.

5.24.2 Types of Paint Systems

The Department uses two systems for painting structural steel members:

1. Structural Steel Paint System – Defined in section **619.09(a)**, this system is used when an entire structure will be painted. This system consists of an inorganic zinc primer, an epoxy intermediate coat, and a polyurethane top coat.

2. Partial Paint System - Defined in section **619.09(b)** is used when only portions of a structure will be painted. This system consists of an organic zinc primer and a waterbourne finish coat.

The two paint systems are not interchangeable and each coat of paint in the respective system must be of a color to produce a distinct contrast with the next coat that is to be applied.

5.24.3 SSPC Certification

The Society for Protective Coatings, SSPC, is a non-profit professional society concerned with the use of coatings to protect steel structures. The organization publishes standards that are recognized world-wide by the coating industry. The Department references these SSPC standards in the Standard Specifications.

For a painting contractor to perform structural steel painting on a Department contract, they must have a valid certification on file with SSPC. The type of certification required for a given structure is based on whether the structure may have a coating that contains hazardous components, such as lead or chromium. Two SSPC certifications are recognized by the Department:

1. A QP 1 certification is the minimum SSPC certification required for work on structures with existing coatings that do not contain hazardous materials.

2. A QP 2 certification is required for work on any structure with existing coatings that do contain hazardous material. A QP 2 certification is also acceptable for QP 1 work.

The pay items in the contract for cleaning the bridge structure will indicate the level of certification required for that particular structure. If the pay item does not indicate the QP level required, contact the AE for further guidance.

A copy of the contractor’s QP certificate should be provided at the preconstruction conference; if not, the PE/S should request a copy. The SSPC certificates typically are valid for one year and there is a phone number for SSPC on the certificate that the PE/S

may use if the validity of the certificate is in question. If work is to continue past the expiration date of a QP certificate, a new certificate is required to continue work past the expiration date. There is no carry-over or "grandfathering" of QP certification.

The contractor must not perform any cleaning or coating work until a valid certificate is provided and the contractor's QCP is approved.

5.24.4 Calendar Date Restrictions

Unless requested by the contractor and approved in the Quality Control Plan (QCP), no field painting is to occur between November 15 and the following April 1. This is due to temperature and humidity sensitivities of the coating materials. There are Department-approved coating materials that the manufacturer recommends for use at lower temperatures, however to allow their use, the contractor needs to include them in their QCP or amend their QCP to include them. If the contractor requests to use a coating material that the manufacturer recommends for use at lower temperatures and includes this in their QCP, and the Department approves the QCP, then the calendar date restrictions shown in section **619.10(a)** are waived and the contractor can paint in temperatures down to the manufacturer's recommended limitations shown on the manufacturer's product data sheet. While the temperature at the time of application applies to the manufacturer's recommended limitations, care should be taken in monitoring both the day and night temperatures when figuring an average, as it applies to all cure times. Also, the SS require all coatings to be applied inside of the containment. Therefore, the ambient conditions inside the containment are the conditions to be monitored, rather than the outside conditions. This commonly is a factor when applying the prime coat after an abrasive blasting operation. For example, if the humidity level is high outside of the containment, it may still be acceptable inside the containment from all of the dry air that was introduced into the containment during the abrasive blasting operation.

5.24.5 Quality Control Plan, QCP

Prior to beginning cleaning and painting operations, the contractor must have an approved quality control plan, QCP, in accordance with ITM 803. The QCP should be submitted to the PE/S at the preconstruction conference, or as soon as possible thereafter, to allow time for review and correction as necessary. Sections 4 and 8 of ITM 803 define the items that the contractor must include in the QCP. A checklist of items to review in the QCP is included at the end of this section.

Review the QCP and provide a written notice of approval or rejection to the contractor. If the QCP is rejected, cite the items that were cause for rejection. No work can begin until the PE/S has furnished written approval of the QCP to the contractor.

5.24.6 Materials

Typically, coating manufacturers will submit samples of each batch of the various components of the paint systems that they anticipate will be used each year to the Office of Materials Management, OMM, for testing. Contract sampling of paint batches is usually not necessary unless the contract calls for a non-standard topcoat color. A non-standard color is a color that is not listed in section **909.02**. Note that the Department's

approved list for Structural Steel Coating Systems lists an approval number (W-xxxxx) for the complete coating system (primer coat + intermediate coat + top coat), and is not an approval number for an individual batch of one of the components of the system. The Department still needs a sample from each batch for testing. The sample submitted must be from the same batch number as that used on the contract. OMM issues an approval "M-number" for each batch that meets specifications. This M-number is the number that is reported on the material records in SiteManager. Contact the Chemistry Lab at OMM for any questions regarding paint samples or the need to sample a batch. It is the contractor's responsibility to ensure that the materials used meet the SS. The contractor should request that all approval numbers appear on the delivery tickets or, if required for other materials, the required certification accompanies the delivery documentation.

5.24.7 Beginning of Cleaning and Waste Residue Sampling

Unless superseded by other contract documents, the specifications allow the contractor to choose the surface preparation method in accordance with section **619.08**. Typically the contractor chooses to use abrasive blasting as the surface preparation method.

The contract documents should contain information either on a plan sheet or in a table or unique special provision in the contract information book on whether or not the existing coating is believed to be hazardous-based (contains lead or other hazardous components). Design memorandum 08-13 informs the designers of the necessary information to include in the contract.

After the contractor establishes containment acceptable to the advertised job conditions (presence or absence of hazardous-based contaminants) the contractor should begin abrasive blasting (cleaning) operations. Obviously, the level of containment is more stringent for anticipated hazardous coatings than for anticipated non-hazardous coatings. The level of containment required is specified in section **619.07(a)** and detailed in SSPC-Guide 6. Except in cases where the contractor is recycling the spent abrasive, the waste residue stream produced by the abrasive blasting operation will contain both the existing coating and a small amount of the spent abrasive blasting media. The waste residue stream thus consists of all of the waste residue (existing coating and spent blast media) for a particular structure that is being disposed of, not just the existing coating.

It is not acceptable to "scrape" a sample of the coating ahead of time and send it off for analysis. This is only a sample of the coating and is thus not representative of the entire waste residue stream that is being disposed of.

If a contract contains more than one structure, the waste residue stream for each structure must be kept separate and not commingled or mixed together. The waste residue stream for each structure will be classified as either non-hazardous or hazardous depending on the laboratory results of the waste residue samples for that particular structure.

5.24.7.1 Waste Residue Sampling Procedure

Regardless of whether the existing coating is advertised as hazardous or non-hazardous the waste residue sampling procedure is identical. The waste residue cannot be labeled or classified as hazardous or non-hazardous until after the following waste residue sampling

procedure is followed. Sampling of a waste residue stream is governed by the SS and IDEM regulations.

After a minimum of 4-6 hours of blasting or typically at the end of the first full day of blasting, the first waste residue sample should be obtained. The sample should be the product of random grab sampling that is representative of the waste residue stream and should be of sufficient quantity that it can be split into two parts. In all waste residue sampling, it is important to remember the term “representative”. The waste residue sample obtained should be representative of the waste residue stream generated for that portion of the structure.

An example of a waste residue sampling procedure follows. Jointly with the contractor's foreman or QC technician, the PE/S should obtain material from four or five spots in the waste debris, either personally, through observation, or jointly. It doesn’t matter who performs the sampling operation (contractor or PE/S) however the PE/S must be present and witness the sample extraction. If there are areas that have red colored paint chips, a proportional amount of that material should be included in the sample. This is true of all visually different areas. There should also be portions of the sample from representative spots in the waste debris, even if it all looks identical. The total size of the sample extraction should be two to four cups (16 – 32 oz) in volume. This should be blended together to be uniform in appearance. This sample must stay in the custody of the Department (which is considered the waste generator) or his representative at all times. The two to four cup sample size should be split, with an 8-12 oz portion (or the sample size required by the lab) being sent to the lab for analysis. An equal or greater amount should be maintained by the Department as a back-up. Both the lab sample and the back-up should be labeled identically and maintained with duplicate documentation. There should also be a copy of all documentation in the project file. Quart size freezer food storage bags seem to work well, labeling the bags with a marker with the following information:

- Sample Number – Use the bridge file number or the last four digits of it, as these are unique to a structure. On interstate, US, and state routes, the last four digits of the structure number can be used. For example, a bridge on I-65, bridge file or structure number I-65-202-2345 becomes sample numbers 2345-1, 2345-2, 2345-3, etc. On local agency projects, the county name combined with the unique structure number could be incorporated into the sample number. The sample numbers for bridge 15 in Grant County would be: Grant 15-1, Grant 15-2, Grant 15-3, etc.
- Sample Date – date the sample is taken
- Sample Location –A brief description of the location should be provided. For example: On Road ___ over ____ or under ____ and the containment number or lot numbers or whatever system you are using to track that area of the structure
- Contract Number/ Project Number or any other information that will help the PE/S re-establish the identity of a misplaced sample.

Place the waste residue sample in the bag. Complete the chain of custody form that the contractor's lab uses. Be sure to indicate that the test is to be a “full TCLP" (the

Department has found that some of the old paints contained high levels of cadmium, chromium, and other metals in addition to high levels of lead which will also cause the waste to be classified as hazardous). Place the sample bag inside of another bag. Fold the chain of custody letter into fourths with the printed side out and place it between the two bags so the sample number can be read. Both bags should have most of the air removed before sealing so they don't burst during shipment. The sealed sample goes into the commercial mail service delivery envelope for whichever commercial mail service the contractor uses. The shipping label should be addressed directly to the lab and be billed to the contractor's account. The contractor is required to provide all of the materials (shipping envelopes, labels, chain of custody forms, etc.) needed, although the PE/S may keep some on hand if desired. The PE/S must take the sealed delivery envelope to the appropriate drop box and send it. The second sample is a backup sample and is retained by the PE/S in the field office in case a question arises regarding the integrity of the sample sent to the lab. A good practice is to package it identically to the lab sample, including a copy of the chain of custody form, for verification, in case it is needed. For convenience, the PE/S may insert a note in the commercial mail service delivery envelope requesting to be copied on a fax of the lab analysis results. In order to maintain the integrity of the sample, the PE/S must always maintain possession of both of the waste residue samples from each sampling milestone from the time the samples are taken to the time the PE/S drops the sample in the commercial mail service company’s drop box.

Repeat the waste sampling procedure outlined above three additional times at the following milestones:

- after approximately 25% of the structure has been cleaned,
- after approximately 50% of the structure has been cleaned, and
- after approximately 75% of the structure has been cleaned.

The four samples must be random and representative of the entire waste residue stream for the entire structure. For example if the contract involves a four span overpassing structure, obtain one sample from the waste residue generated from each span. On a truss, for example, obtain two samples from the waste residue generated from above the bridge deck and obtain the other two samples from the waste residue generated from beneath the bridge deck.

The waste residue may only be classified as non-hazardous when the lab results of all four representative samples taken from the waste residue stream at the milestones listed above for a particular structure are returned indicating that none of the threshold values from the TCLP analysis of the contaminants for any of the samples have been exceeded. The waste residue stream may then be disposed of as special waste in an appropriate landfill. Do not contact IDEM or open an EPA ID number. It is not necessary. The material may be transported by a licensed waste hauler and no additional paperwork is required for the contract files.

If any of the contaminants in any of the four sample results exceed the contaminant threshold values, the entire waste residue stream for that structure is considered hazardous and must be disposed of as such. No additional sampling of the waste residue

stream for that structure is required even if four samples have not been taken. Complete the US EPA Notification of Regulated Waste Activity Form and obtain an EPA ID number from IDEM.

5.24.7.2 Paperwork for Hazardous Waste Residue Disposal

If the sample results are returned indicating that at least one of the contaminants exceeds the threshold values, the entire waste residue stream is hazardous-based and it is necessary to complete the US EPA Notification of Regulated Waste Activity Form (Form number 8700-12, OMB# 2050-0028). This form is completed by either the Department or the entity that owns the structure (ex: county or municipality) or its representative administering the contract. Once completed, this form is submitted to IDEM. IDEM then assigns an EPA ID number (or RCRA ID number). In order to keep things moving, IDEM will cooperate with the Department via email/fax submission of the completed form to issue the EPA ID number ahead of time for use; however IDEM still needs to receive the original hardcopy of the form with an original signature in order to make the assigned EPA ID number active (or valid). The EPA ID number is required in order to transport the waste from the project site and should be provided to the Contractor as soon as the PE/S has it. Section **619.07(b)** requires the Department to provide the EPA ID number to the Contractor within 30 days of the Department receiving notice that the waste from the project site is hazardous. The contractor should refrain from shipping any waste until at least three work days after the PE/S has mailed the completed Regulated Waste Activity Form to IDEM to allow for mailing time. The EPA ID number must be active prior to transporting or shipping any hazardous waste from the project site. In accordance with EPA requirements, section **619.07(b)** provides a maximum time the waste residue may remain on site. The Department is required to obtain the EPA ID number. Therefore, the Department has a responsibility to get the EPA ID number and provide it to the contractor as quickly as possible.

A blank version of the US EPA Notification of Regulated Waste Activity Form is available from the IDEM Office of Land Quality at http://www.in.gov/idem/5029.htm under the Notification of Regulated Waste Activity Form and Instructions. The form is also available from the US EPA at
http://www.epa.gov/osw/inforesources/data/form8700/forms.htm

The Department has met with IDEM and has discussed and agreed to certain formats on how to complete the form. Instructions on how to complete the form are provided at the end of this section. The instructions provided herein in conjunction with the instructions provided with the form must be followed. The form must be filled out, have an original signature (in other than black ink), and the original copy mailed to IDEM at the address indicated in the form directions.

There is a cost associated with opening an EPA ID number. Once a year, IDEM bills the Department for all EPA ID numbers ACTIVATED in the past year. Annual fees are assessed beginning January 1 of the new year for the activities of the previous year. Thus it is imperative for the PE/S to take the necessary steps to update the status of the EPA ID number with IDEM as soon as possible. Payment of these fees is the responsibility of the structure's owner. Payment is handled at the District for state-owned structures or is sent

to the entity that owns the structure for an LPA structure.

If the existing coating was advertised as hazardous, a contractor may present a waste material profile form to the PE/S and request that it be filled out and signed as soon as possible. This form is from the waste treatment facility. This does not need to be signed as soon as possible. The form should only be completed after the results of the TCLP test(s) are known. If the TCLP results are returned showing the waste is hazardous, then a copy of the test results should be attached to the waste material profile form, the form signed by either the PE/S or the AE, and given to the contractor. The treatment facility may not take the waste without this profile form to accompany it. If the TCLP results are returned showing the waste as non-hazardous, a copy of all test results for the waste contained in that waste container should be attached to the waste material profile form. The PE/S should carefully read the waste material profile form and make sure that any sections or attachments that describe the characteristics of the waste are accurately represented; they should match the results from the TCLP tests. Sometimes these have already been filled in by the contractor. The PE/S should check to make sure the form they are signing is accurate. Once the PE/S is satisfied that the waste material profile form is accurate, either the PE/S or AE signs the form and gives it to the contractor.

When transporting hazardous waste, a copy of the signed manifest must be obtained from the transporter (trucking company) for each and every load removed. As the generator or generator's representative the PE/S must sign each ticket or an authorization form can be sent out with the first pick-up authorizing the contractor's foreman to sign for the generator. The PE/S would still need to be on site for the first pick-up, but after that the PE/S could collect the manifests for his files from the contractor's foreman. The PE/S must keep a running estimate of the tonnage of waste residue shipped (so many waste containers at so many tons per dumpster). The bags that the waste residue was collected in each have a shipping weight that can be used to compute the total weight of waste contained in each dumpster.

When all of the hazardous waste residue has been shipped to the disposal site and the PE/S is comfortable that there are no transportation issues, the Handler ID form that IDEM provided when the EPA ID number was activated should be marked as “INACTIVE” and returned to IDEM so the status of the EPA ID number may be changed to “INACTIVE.” Failure to do this will result in the District or owner continuing to be billed for having an active EPA ID number.

When the hazardous waste residue has been received, treated, and rendered to a “special waste” (normal construction waste) by the treatment facility, the treatment facility issues a certificate indicating the hazardous waste residue has been rendered to a special waste status. These certificates go to the contractor, but the PE/S must request a copy for the contract files. This certificate is a release of liability for the Department and is an important certificate. The certificate should be included in the final construction record for the contract.

5.24.8 Cleaning and Coating Operations

The SS provides requirements in sections **619.11**, **619.12**, and **619.13** for shop painting,

field painting a new steel bridge, and painting an existing steel bridge. These sections indicate the level of cleaning required as well as the paint system to be used.

The contractor will establish containment for a certain section of the structure to be painted. Once containment is set up for an area, all of the operations (cleaning, priming, painting) associated with painting will typically be done before moving the containment to the next section of the structure. Be aware of this as well as the several hold points identified in section **619.04**. Hold points are "stages" in the work in which the contractor must stop or hold up working until the PE/S gives written approval to proceed. Hold points give the Department the opportunity to inspect the work at the various stages and to identify and have problems addressed prior to proceeding. The contractor must provide a minimum of one day's notice to the PE/S in advance of each of the hold points. The PE/S should make an effort to be available and not delay the progress of the work.

5.24.8.1 Cleaning and Surface Preparation

Areas below bridge joints should be carefully checked. If the contractor did not request and receive approval for an alternate cleaning method to remove contaminants in the QCP, the procedure described in the next paragraph is to be followed. An example of an alternate cleaning method is to waive pressure washing and to use solvent cleaning by hand to remove any grease or salts. This might be proposed because pressure washing can cause logistical problems and may not be practical when the structure is over water and when peeling or delaminated paint is present. If containment is utilized, the addition of water creates a very slippery environment that is difficult to dry and causes problems with gathering and cleaning up abrasive blasting residue. If containment is not utilized, the pressure washing may spatter hazardous paint chips throughout the surrounding environment.

Before doing any other cleaning operation, the contractor is required to pressure wash the area in preparation of subsequent surface preparation operations. After pressure washing the area, areas containing grease, oils, or other contaminants not removed by the pressure washing must be removed by solvent cleaning. Solvent cleaning typically consists of applying a degreasing solvent to a clean rag and wiping the contaminated surface to remove the contaminants. After the pressure washing and solvent cleaning have been done, either an abrasive blasting or power tool cleaning is done to remove the existing coating. The amount of the existing coating that is required to be removed is determined by the level of cleaning required in the contract. The levels of cleaning are provided in section **619.08**.

The contractor is required to use a dust collector during all abrasive blast cleaning operations. Using the dust collector provides for a much safer working environment for both the contractor's personnel as well as the Department's personnel along with maintaining a good driving visibility for the motoring public by providing a negative pressure environment inside the containment. Section **619.07** requires the contractor to provide personal protective equipment to the Department personnel in addition to the contractor's personnel.

5.24.8.2 Coating the Structure

Unless the contract documents specify differently, one of the paint systems described in section **619.09** must be used. When an entire structure is being coated, the Structural Steel Paint System as described in section **619.09(a)** is used. Note that each subsequent coat must be a contrasting color to the previous coat. Additional information regarding the paint is presented in section **909.01** and section **909.02**. The Department maintains an approved list of Structural Steel Coating Systems. The Contractor must not mix items from the approved list. All three components listed on a line must be used, that is the approved system. Using a primer from one system and either an intermediate or finish coat from another system is not allowed; it results in the contractor using an unapproved system. Also, the contractor is not to mix batches of "part A" with "part B" from a differing M number or approval number. Typically the contract documents will contain the color number for the finish coat and the PE/S is encouraged to mention this to the contractor at the preconstruction conference so that the correct finish color may be obtained. This is also a good time to agree on the contrasting colors for the intermediate coat (when the finish coat color is established) and then the prime coat. Also, it is recommended to use a contrasting color to the intermediate coat for the caulk. For example, if light green is the specified finish color, use a caulk of a similar light green color, a white intermediate coat, and a gray or green primer.

Once a section of the structure is coated, perform acceptance testing as described in section **619.03** prior to granting permission to proceed or releasing the hold point. If the coating is too thin, or has other defects, now is the time to correct the defects by using the defect repair procedures outlined in the approved QCP. Review the manufacturer's technical data sheets either from what the contractor provided or online at the manufacturer's website to verify the temperature range for the product as well as the required time before recoating, taking humidity and overnight weather information into account.

Striping the outside edges of all structural members prior to painting the fields or the remainder of the structure is good painting practice. When specified in the special provisions, the stripe coat for both the intermediate and finish coat is considered a separate coat and allowed to dry to top coat dry time for that product prior to applying the full field coat. Striping is not required on the prime coat. Striping helps to minimize cracking that often occurs at sharp corners.

5.24.8.3 Coating Concrete Surfaces

Unless specified on the plans, concrete surfaces are no longer sealed. When specified, seal coating shall be performed in all areas adjacent to traffic as described and should be executed while the traffic is restricted. Attention should be paid to not rush this operation and allow time for the material to soak in. Areas away from traffic can be done at the contractor's schedule. A good practice, but not required is to have the contractor brush blast all areas to be sealed when they are cleaning the steel in the adjacent areas. If the contract contains requirements to remove graffiti, this is a good time to do that.

5.24.8.4 Coating Weathering Steel

Weathering steel (or corten or cor-ten) is steel made from a specific group of alloys that was developed to eliminate the need to apply a protective coating. Due to their chemical

compositions, these steels exhibit greater resistance to atmospheric corrosion than other steels. The rust patina that forms on weathering steel becomes the protective coating. For the first several years that the weathering steel is exposed to the atmosphere, water runoff from the weathering steel may result in rust-colored staining of nearby concrete surfaces. This staining looks unsightly and is the primary reason why the plans should show the end 10 feet or other specified length of each steel structural member manufactured of weathering steel that is located at an expansion joint to be coated. Section **619.11** requires that weathering steel be painted using the structural steel painting system in section **619.09(a)** with the exception that the finish coat is a different material, color, and sheen in accordance with section **909.02(e)**. The prime coat and corresponding intermediate coat is from a paint system shown on the approved list. Other than the requirement that the finish coat must be compatible with the chosen intermediate coat, there is no requirement that the finish coat be from an approved list. An approved list for the finish coat for weathering steel does not exist; any material meeting the requirements of section **909.02(e)** and that is compatible with the intermediate coat may be used. The material proposed to be used as the finish coat must be sampled and submitted using the Department's typical sampling and submitting procedures for paint.

5.24.9 Method of Measurement

Partial or complete painting of bridge steel is not measured for payment. The estimated area of steel to be painted is found on the bridge summary table in the contract information book and is furnished on a "for information only" basis.

5.24.10 Basis of Payment

For existing steel bridges to be painted, each structure should have a minimum of two section **619** pay items, clean steel bridge and paint steel bridge that are paid at the lump sum price per structure. Estimate or pro-rate the amount of work that is done each day and enter this on the daily report in SiteManager.

The cost for painting new steel bridges or beams/girders is included in the cost of the structural steel pay item and is not paid for under painting.

5.24.10.1 Pre-Established Remedies for Changed Conditions

Since there is some uncertainty at the time of bid of whether or not the existing coating is actually hazardous, sections **619.18(a)** and **(b)** make provisions for handling a situation where the laboratory analysis has returned results that classify the waste residue stream from the existing coating different from what was advertised in the contract. The pre-established remedies apply only to situations where the contract advertised the existing coating as non-hazardous (or zinc) based and the laboratory analysis has returned results indicating levels of contaminants in excess of the federal threshold limits and thus causing the waste residue stream from the existing coating to be classified as hazardous. Three situations are described in section **619.18(a)** with corresponding percentage adjustments described in section **619.18(b)** to the section **619** pay item unit costs; discovery of hazardous materials but no mill scale, discovery of mill scale but no hazardous materials, and discovery of hazardous materials and mill scale. Mill scale is a residue or impurities that result from the manufacture of the steel and rise to the surface as the molten steel cools. When lead based primers were used, the mill scale could

remain on the steel. When lead based paints were outlawed and zinc based primers became the coating material, the mill scale could no longer remain on the steel because mill scale and the zinc based primers are incompatible. There may be some structures that have varying levels of mill scale which must be removed prior to application of zinc based primer. Removal of mill scale generally can be done along with the removal of the existing coating using the same blasting media. The contractor's rate of progress will be slowed by having to remove mill scale.

If the contract advertises the existing coating as hazardous (or lead) based, the provisions described in sections **619.18(a)** and **(b)** do not apply. The contractor should have already included costs for mill scale removal and hazardous waste disposal in the bid.

Conversely, if the contract documents advertise the existing coating as hazardous (or lead) based and the four laboratory analyses all have results indicating that the levels of contaminants are not above the federal threshold limits, the waste residue stream from the existing coating is classified as non-hazardous. In this situation, the Department does not have a basis for requesting a partial credit for the cleaning item because by the contract documents informing the contractor that the existing coating is anticipated to be hazardous based, the contractor would have brought and set up the containment required to remove hazardous based material. Per the specification, the fourth waste residue sample is taken when the last quarter of the structure is being cleaned. By the time the lab results are returned, in most cases the cleaning operation will be complete. The only area where a credit may be requested is for the disposal cost of the waste residue. The cost for disposal at a hazardous waste facility should have been included in the bid, but since the waste residue is classified as non-hazardous, the waste residue may be disposed in a local landfill at a lower cost.

A few individuals in each district have attended an SSPC bridge coating class. Questions regarding the pre-established remedies for changed conditions can be directed to the field engineer in the Division of Construction Management or to the appropriate individual in the district.

5.24.11 Final Construction Record Documentation

Make a chart or drawing of the sections of a structure at or before the beginning of the cleaning operation showing the assignment of lot numbers to the entire structure based on the estimated square footage of steel and the lot requirements noted in the SS to promote uniformity in QC documentation and to aid in possible future investigations.

Maintain a copy of all of the related items to the EPA ID number, (sample information, chain of custody, lab test results, application, manifests, certifications from treatment facility, all related correspondence, etc.) along with the completed environmental impact study in duplicate in the contract files and as a packet to be given to the District Environmental Department for their archives. As the contract files are destroyed by the District Final Records after ten years, the environmental archive copy must be included with the district shipment of critical archived records for permanent storage in Central Office against future claims for situations such as EPA Superfund clean-ups. This also includes non-hazardous determinations of a waste residue stream from a contract that was

advertised hazardous. Where there is no documentation of the existing coatings being hazardous or any discovery of the same, this documentation should not be archived. It would only take up space without possible purpose.

Final quantities for the cleaning and painting items are based on the square footage of the bridge deck area. This measured quantity is defined in **619.17** as the product of the out-to-out bridge floor length as measured longitudinally along the centerline of the structure and the out-to-out width measured on a line perpendicular to the centerline of the structure. The product should match the unit quantity shown in the schedule of pay items.

5.24.12 Bridge Painting Quality Control Plan Checklist

Signed and Dated Letter of Transmittal with space for INDOT Approval Signature
Names, Qualifications, Phone Number(s), Duties, and Employer of QC Personnel (QC Manager, QC Site Manager, QC Technician)
Type of Painting (New Steel, Existing Steel on Entire Structure, Beam Ends, etc.) and Paint System proposed for Use
Copy of the Traffic Maintenance and Management Plan and Contact Information for the Worksite Traffic Supervisor
Work Schedule showing planned start and stop dates and any contract date restrictions
Detailed Description of the Containment (including level of containment) and Waste Residue Disposal and Handling
Detailed Description of the Cleaning and Blasting procedures and equipment for each structure including dust collector manufacturer specifications (in order to validate the proposed dust collector's capability to maintain the proper environment in the size of containment proposed)
Spill/Waste Contingency Plan including a list of the tools that will be maintained on site solely for this purpose, where they will be stored, and the name and contact information of the onsite person certified in hazardous component (lead) abatement (if necessary)
Waste Training Program including a history of training dates for all job personnel.
Waste Container Labeling (what will the label read, when will it be placed, etc.) In addition to the information required in the SS, IDEM has requested that the sample date and sample number of the first sample at each structure be included on that label
The exact location of the waste residue storage area and the method of collection and agreed method of transportation to the storage area, if necessary. Sometimes the site characteristics do not allow a safe location for a roll-off dumpster or disposal container
Name of the testing facility that will be analyzing the waste samples and how the samples are to be transported and the necessary materials to be furnished to the PE/S
Both Special Waste and Hazardous Waste Disposal Plans should be included. The appropriate plan will be implemented once a determination (non-hazardous or hazardous) of the waste residue stream is made
Where will other project-generated waste (spent solvents, empty cans, etc.) be disposed. This should include a statement of understanding that these will not be co-mingled with any waste residue stream until it is determined to be Special Waste. At that time normal non-hazardous (special) construction waste and debris may be co-mingled for disposal purposes, if desired
Copy of the Health and Safety Plan with documented training for each employee. This should

include a list of PPE provided and the necessary monitoring that will be observed per OSHA and IDEM for the employees. Also a statement of the required environmental testing that will be done before, during, and after operations on an advertised hazardous removal or at discovery of an existing hazardous material
Proposed materials, origin of materials, storage of materials, and material safety data sheets (MSDSs) for all materials to be used on the job including paint, caulk, thinners, sealers, etc.
Weather limitations of all materials should be shown on the MSDSs
Request to work outside the dates shown in the specifications, if desired. If the weather and temperature limitations, as recommended by the manufacturer, are requested to supersede the SS, this must be done in writing. If not, the limitations as stated in the SS apply
Paint information (storage, mixing, thinning, curing time, etc…) and system shall be shown in the MSDSs. The color of each coat shall also be stated and comply with the contract requirements
Copy of Contractor's SSPC-QP 1 or QP 2 certificate; also individual required certifications for lead abatement, QC/QA, worksite traffic supervisor, etc.
Painting procedure and proposed equipment
Description of the material and amount if the paint is to be thinned should be included in the MSDSs
Proof of contact with IDEM, local air pollution control board, and any other regulatory agency. This should be a statement from the local governing municipality or county stating that they have no regulations that exceed IDEM's or a statement advising that there are. This can be valid for 2 years and maintained on file for any work that falls in the same jurisdiction
Proposed methods and frequencies of sampling, testing, calibrating, construction control, monitoring, etc. Any methods that are identified by reference name or number should also include a description of the importance and all job specific information
Provide the references listed in section 8.1 of ITM 803 at the project site and mention where they are located
Describe the method provided to allow the PE/S to access the work area
List of the QC Instrumentation to be used with serial numbers and date of last calibration
List which of the following QC inspection points listed in section 8.5 of ITM 803 will be performed
Sample of the QC recording forms that comply with the SS. QC testing showing locations and frequencies and how the dry film thickness is to be obtained for each lot for all coats
Describe surface profile testing, surface profile requirements, and documentation on the QC recording form
Describe the film thickness testing and the film thickness requirements
Describe the method used to determine the random location for checking the coating thickness within each lot
A statement indicating that if there are defective areas, the contractor will propose a repair procedure for review and approval by the PE/S

5.24.13 Department Instructions for Completing the Regulated Waste Activity Form

Section 1 – Reason for Submittal. Generally the box marked "To provide Initial Notification of Regulated Waste Activity (to obtain an EPA ID Number for hazardous waste, universal waste, or used oil activities)" is selected as the reason for the submittal.

Section 2 – Site EPA ID Number. Leave Blank. This is provided by IDEM.

Section 3 – Site Name. For uniformity, the following naming convention has been agreed to between IDEM and the Department and should be used.

- Interstate Bridges – the words "INDOT BRIDGE" followed by the bridge structure number (without dashes.) Ex.: for structure I-69-22-4423, the site name would be shown as: INDOT BRIDGE I 69 22 4423
- US Highway Bridges – the words "INDOT BRIDGE" followed by the bridge structure number (without dashes.) Ex.: for structure 50-15-0569C, the site name would be shown as: INDOT BRIDGE 50 15 0569 C
- State Bridges – the words "INDOT BRIDGE" followed by the bridge structure number (without dashes.) Ex.: for structure 13-48-5622A, the site name would be shown as: INDOT BRIDGE 13 48 5622 A
- County Bridges – All Indiana counties except for Marion use the same format for naming the bridges located in their county, County Name xx xx; Marion County is Marion County xx xxxx x

  There are two scenarios for the site name for a county bridge:

  1. If the bridge spans another street - the name of the county followed by the county bridge number. Ex.: for Johnson County #15 over Main Street, the site name would be shown as: Johnson County 00 15.

  2. If the bridge spans anything other than another street (a river, stream, ditch, railroad, etc.) - the name of the county followed by the name of the feature crossed followed by the county bridge number. Ex.: for Marion County #4901 that crosses Buck Creek, the site name would be shown as: Marion County Buck Creek Bridge 00 4901 0.

- Toll Road Bridges – the words "TOLL ROAD BRIDGE" followed by the bridge number (with dashes.) Ex.: for structure 53-2, the site name would be shown as: TOLL ROAD BRIDGE 53-2

Section 4 – Site Location Information. Since bridges do not have street addresses, the following convention has been agreed to between IDEM and the Department and should be used for the street address.

- Interstate Bridges – the name of the interstate first and then the name of the entity of the feature that the bridge spans followed by the reference post number. Ex.: for structure I-69-77-3589, the site location should be shown as: I 69 & US Hwy 31 RP 235 plus 58
- US Highway Bridges – the name of the US highway first and then the name of the entity of the feature that the bridge spans followed by the reference post number. Ex.: for structure 52-46-6571, the site location should be shown as: US Hwy 52 & White River RP 145 plus 08
- State Bridges – the name of the state highway first and then the name of the entity

of the feature that the bridge spans followed by the reference post number. Ex.: for structure 72-87-2445, the site location should be shown as: SR 72 & NS Railroad RP 42 plus 94

- County Bridges – the street name of the bridge first and then the name of the entity that the bridge crosses. If further clarification and more specific information is needed, the longitude and latitude (degrees, minutes, seconds) can be added, especially if the bridge spans a river, road, etc… in multiple locations in the county. Ex.: for the Post Road bridge over Grassy Creek, the site location should be shown as Post Rd & Grassy Creek or Post Rd & Grassy Creek 86 35 27 37 44 50
- Toll Road Bridges – the name of the interstate first and then the log mile. Ex.: I 90 LOG MILE 53
- For the City, Town, or Village – the name of the nearest city, town, or village in the county where the bridge is located
- For the County Name – the name of the county where the bridge is located. For bridges that are on the county line, enter the name of the county who is the "lead" agency for the project
- For the Zip Code – the zip code of the city used for the bridge city, town, or village.

Section 5 – Site Land Type. Check the appropriate box. Typically this will be "State", "County", or "Municipal"

Section 6 – North American Industry Classification System (NAICS) Code(s) for the Site. Use the six digit code 238320, since bridge painting is one of the illustrative examples listed in the NAICS information. The NAICS website, www.naics.com may be viewed if other codes are desired.

Section 7 – Site Mailing Address. Enter the address of the entity that owns or is responsible for the bridge.

Section 8 – Site Contact Person. This is the person who IDEM will contact or send communications to regarding the bridge. This typically is the PE/S. There should also be a contact name and address for the person who will be doing the follow-up paperwork after the contract is completed. This could be the same PE/S or it might be the AE or a County Engineer. Around the end of the calendar year, a status form is generally sent to verify that this EPA ID Number was issued for a one-time generator (the owner). Failure to complete this form and return it in a timely fashion is considered an IDEM violation. After that form is returned, the billing will be sent to the waste generator (the owner). There is also the possibility of a site visit/inspection by an IDEM representative, prior to closing the EPA ID Number and, if so, there will be inspection forms for the contact person to sign. If necessary, a change form can be requested from IDEM to correct or change the contact person for all further communications.

Section 9 – Operator and Legal Owner of the Site. This is the entity that is responsible for and has authority over the bridge. It will be one of the following: INDOT, Indiana Toll Road Concession Company (ITRCC), or the name of the County/Municipality. The

owner and operator are usually the same entity. The Date Became Operator and Date Became Owner is a required entry. This is typically the year the bridge was constructed or the date the current owner obtained the bridge.

Section 10 – Type of Regulated Waste Activities. For subpart A, question 1, select the level of generation anticipated for the contract. Most bridge painting jobs that do not recycle the blast media are considered a large quantity generator or LQG. The remaining questions in subpart A, B, and C are typically "No" answers.

Section 11 – Description of Hazardous Waste. Follow the directions on the form regarding the order in which they are to be listed. The waste codes entered in part A will also be entered in part B. Typically lead is the contaminant, although other contaminants may be present that exceed the threshold levels. The PE/S is advised to check the lab report to make sure that all of the contaminants that exceed the threshold values are listed in the order stated in the instructions. Two of the more common waste codes for contaminants present in the bridge painting waste residue stream are chromium (waste code D007) and lead (waste code D008). The waste codes may be obtained from the 40 CFR 261.24.

Section 12 – Comments. Enter any other information pertinent to the site. Comments are not required but are encouraged to clarify any confusing entries or information. Please restate any information that is not clearly written.

Section 13 – Certification. The person who has the authority to sign this document. The PE/S should check with their AE or DCD for the District's procedures regarding signing. This is the section that needs the original signature (in other than black ink) and, when IDEM is in receipt of this form, makes the assigned EPA ID number active.

5.25 RAILINGS *(Rev. 04-11-09)*

Most bridge contracts now specify concrete railing. The line and grade of the railing should not follow any unevenness of the superstructure. The railings must be as per Section 706 of the SS.

Concrete railings should not be placed until the falsework for all spans under RC slab structures have been removed. Coping forms may remain in-place while bridge rail is being cast on superstructures supported by structural members. Slip forming method may be permitted to place concrete railing providing the contractor has demonstrated the ability to produce barrier rail that conforms to the specifications. This demonstration should be performed in the presence of the Engineer and include the sawing of the wall to ensure adequate consolidation of the concrete around the reinforcing steel.

Particular attention should be paid to the rubbing or sealing provisions set out for the railing. If the railing is not in compliance with the design, or does not present a uniform appearance of smoothness or color, or is not otherwise a workmanlike job, it may have to be removed and replaced at the contractor's expense. A minimal amount of small air bubbles on a surface are an inherent part of the concrete and an acceptable part of the finished surface.

5.26 CONCRETE STRUCTURAL MEMBERS *(Rev. 04-11-09)*

Concrete structural members are inspected during production at the plant. If the PE/S has not received test reports for bearing pads before the structural members arrive at the job site the DMTE should be contacted to verify that the bearing pads have been sampled. Care shall be taken when handling and shipping precast members so as to protect them from damage. Section 707 of the SS addresses handling and shipping.

The erection of members should normally commence at the centerline of the structure and proceed out to the curb. Any shifting of the members must be done while they are held free of the supports by the hoisting device. Members must be set to proper line and grade with uniform bearing on bridge seats, mortar joints, or bearing pads as required by the plans.

Partial payment for concrete structural members stockpiled, but not erected, shall be as per Section 111 of the SS.

5.27 BRIDGE DECK OVERLAYS *(Rev. 04-11-09)*

Bridge deck overlays are typically placed with latex Modified Portland Cement Concrete. Other types of material, such as MicroSilica Modified structural concrete, may be used as allowed by SP. Bridge deck overlays are controlled by Section 722 of the SS.

5.28 TEMPORARY BRIDGES *(Rev. 04-11-09)*

When the contract specifies a temporary bridge, the structure must be built as per Section 713 of the SS. The contractor must submit detailed plans for the proposed temporary bridge, signed by and bearing the seal of a registered professional engineer. CO will approve these plans prior to construction of the temporary structure.

The PE/S must perform a general check of the temporary bridge as it is being placed to determine that it is being placed in compliance with the drawings and as per issued permits. A general check will include checking bents, bearing capacity, size and spacing of materials, and connections and/or joints.

The PE/S will document that the temporary bridge was built as per the bridge standard plans, contract plans, or approved contractor’s temporary bridge plan, whichever the case may be.

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