Section 5:

Bridges

SECTION 5 – BRIDGES

5.1 INTRODUCTION

When assigned a bridge contract, the PEMS must become familiar with the contract documents and specifications governing the work. A review should be made of the work. Anything not understood should be discussed with the AE. Contract personnel should keep themselves informed of the Contractor's schedule and the rate of progress so the contract is completed on time with the least amount of inconvenience to the traveling public and other contracts in the area. At any time, the PEMS should discuss problems with the AE.

The PEMS must make frequent reference to the SS and contract documents as each phase of the work begins. If the Contractor questions the intent of the contract documents or SS, consult the AE. A Contractor's statement that something was permitted on another job should not affect judgment or reaching a determination if the statement is contrary to the SS.

Inspection of the work, in all phases, is required. The time to correct improper work is when it occurs. Do not wait until the work has been completed. The PEMS should never act as a foreman for the work. Instructions should be given directly to the Contractor or to their representative in charge of the work.

During the review of the work, the PEMS should compare all elevations between the substructure and the superstructure with the details in the plans. A check of all vertical and horizontal controls should be made. Any discrepancies must be brought to the attention of the AE and the Contractor.

The provisions of the SS must be enforced. The PEMS should remember that the management of the work is the responsibility of the Contractor. If the Contractor attempts to use any method which the PEMS has a reason to believe will impair the quality of the work, communication with the AE should occur.

The PEMS does not have the authority to alter or enlarge upon the contract documents or SS. Consent to any work in violation of them should not be given under any circumstances. If conditions should arise, which would indicate that it is impractical to enforce the SS to the letter, or if instructions are disregarded, the PEMS should immediately contact the AE.

5.1.1 Bridge Inspection

Bridge inspections are required to be performed by the Department's Bridge Inspection Office, or their authorized representative, on each bridge within the construction limits of a contract. Portions of each bridge replaced, reconstructed, or repaired and subsequently used for maintenance of traffic will be inspected within 60 days of being opened to traffic. The PEMS must notify the Bridge Inspection Office by email after each phase and when construction has been completed for each bridge included in the contract. This notification is intended to assist the Bridge Inspection Office in scheduling inspections.

The email notification should include the:

a) contract number,
b) DES number,
c) New Bridge Inventory number, and
d) structure number.

Bridge inspections will normally occur no less than seven days after notification by the PEMS. Access, coordination, and cooperation for the required bridge inspections should be provided to the Bridge Inspection team.

5.2 SAFETY

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 any phase of work involved. Be alert to the surrounding activities and keep attention centered on the safety precautions necessary for the current activity.

5.3 STAKING OUT THE WORK

Construction engineering is outlined in 105.08 of the SS. Control stakes for bridge work 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 should be set beyond the limits of the work and properly protected. The staking crew must check the horizontal and vertical leading measurements of the 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 , and if necessary, the elevation of this structure should be adjusted to

maintain the proper clearances. The DO should be consulted on any minor adjustments necessary. The DO in turn should advise the CO whenever an adjustment is necessary.

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

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

5.4 BRIDGE SEATS

The elevation of the bridge seats is one of the most critical elevations governing vertical control of the construction. Bridge seat elevations 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 bridge deck
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 bearing assembly.

5.5 FOUNDATION EXCAVATION

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. When piling is not used, the foundation soil should be firm and unyielding. The PEMS must reference the Geotechnical Report for identification, recommendations, and precautions for soils within the contract. These precautions are based on the borings and explorations of GS for the specific contract. If this situation is present and before proceeding with the placing of the concrete for the footing, the use of piling should be discussed with the AE. Before any consideration is given to redesign the footing, contact CO.

As determined from the Geotechnical Report, 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, GS contacted, and an investigation made to determine the

appropriateness 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 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. Excavators 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 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. The PEMS' 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.

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 AND FOUNDATION SEALS

The purpose of a cofferdam is to provide a protected area within which an abutment or a pier can be built. In general, a cofferdam is a structure consisting of steel or wooden sheeting driven into the ground to a depth below the bottom of the footing elevation and braced above the excavation to resist lateral 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.

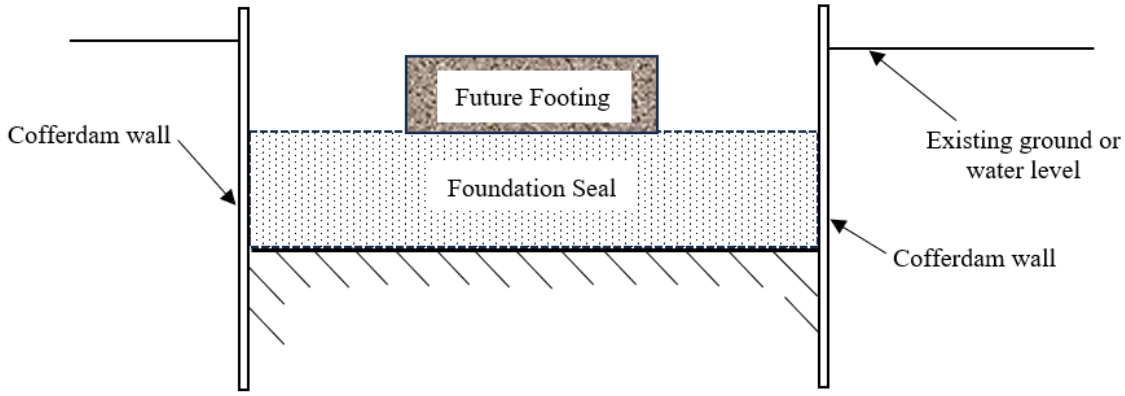
The requirement to prepare working drawings for cofferdams is the responsibility of the Contractor, in accordance with 206.09 of the SS. The working drawings must be signed and stamped by a professional engineer. The Contractor must obtain the approval of the Engineer for the proposed cofferdam plan and installation procedure prior to the start of cofferdam construction.

Foundation seals may be necessary when water within a cofferdam cannot be pumped out sufficiently for the foundation to be poured. A foundation seal should only be utilized when:

1. it is specified within the plans,
2. it is requested and approved for use, or
3. as directed.

Discuss the use of foundation seals with the AE prior to installation. Foundation seals are required to be constructed using class A concrete. If the foundation seal is added to the contract, payment will be made at a unit price per cubic yard equal to 75% of the contract price per cubic yard for class B concrete in footings.

When the seal has hardened sufficiently to withstand the hydrostatic pressure, the cofferdam can be dewatered, and the remaining structure placed in dry conditions. A basic diagram of a foundation seal is shown below.



Basic Diagram of a Foundation Seal for a Cofferdam

5.7 DRIVEN PILING

5.7.1 Introduction

Driven piling is covered in 701 of the SS 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 piling portions of the contract documents and the instructions that apply to pile driving. They must understand how to inspect and document the work performed 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 the IC-225**,** Pile Driving Record form available on the Departments website.

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 work. Precast prestressed concrete piling has been installed on a few projects however, it is not normally used in Indiana.

The Contractor must provide mill test certifications for steel piling prior to driving. The mill test certifications are to 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 701.04 of the SS. 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 components that may be used include followers, jets, collars (on timber piles only), and pile tips. Each of these components is described in detail in 701.04 of the SS.

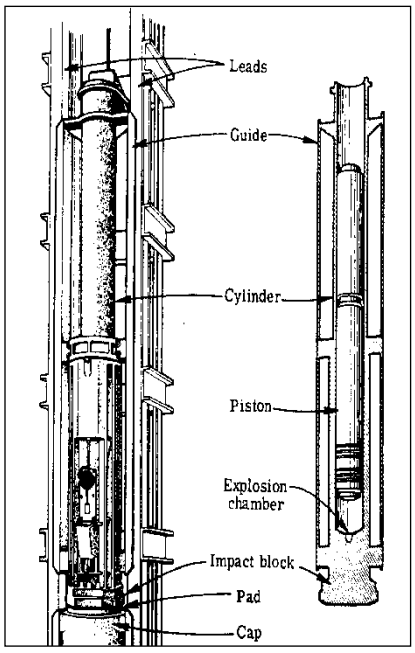


Figure 2.
Sketch of a Single Acting Diesel Hammer

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 on the proposed pile driving equipment to GS and the PEMS for approval. Form IC-740**,** Pile Driving Equipment Data, is used by the Contractor for the submittal and is available on the Department's website. GS will return approved forms to the Contractor and the PEMS.

GS will use either the Wave Equation Analysis Method or the Dynamic Formula 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 GS. When applicable, GS will also send an approved pile driving chart to the PEMS 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. In many cases the information obtained can be used to reduce the required pile length. There are additional costs associated with dynamic load and static load testing, so it should not be used on every contract. GS evaluates each site and determines which pile testing methods are appropriate.

Test piles are also typically used as production piles, except that they are longer than production piles, in accordance with 701.05 of the SS. 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 GS.

5.7.4.1 Indicator Test Piles

When the method for driving piling is specified as the dynamic formula, an approved pile driving chart as well as the approved IC-740, Pile and Driving Equipment Data Form will be provided to the PEMS by GS. 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 GS must be contacted for further guidance. This process is repeated for each indicator test pile shown indicated within 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 for 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, GS 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. Examples 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

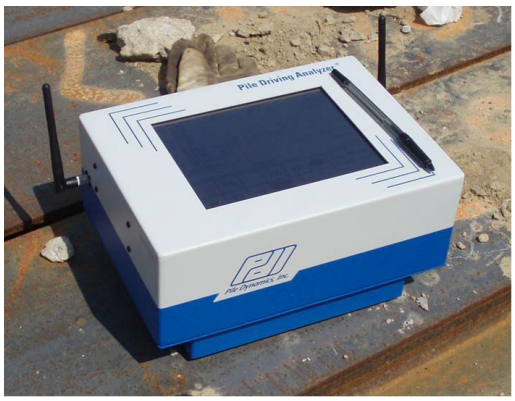


Figure 6. PDA Data Collector

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 PEMS 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 of 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 D1143; a copy of which may be obtained from the DMTE.

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 two 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 dug 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 diameter or diagonal of the pile being driven, stopped just short of the pile tip elevation, 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 greatest dimension of the pile being driven cross section. 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 performed to accommodate pile placement through rock. The holes should be cored to the diameter indicated within the plans 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 701.09. This specific driving order 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 HT 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 an H-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 these piles have a weak axis and a strong axis and are designed with a specific orientation based on those axes. Steel pipe piling and timber piling may be driven without consideration given to their orientation. Tolerances are provided in the SS 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 shoe tips. Conical tips and pile shoe tips are paid per each. End plates are not paid separately. Check to verify that the pile shoe tips provided meet the SS. **Figures 9** and **10** show examples of H-pile shoe tips.

Figure 9.
Bottom of H-Pile Shoe Tip

Figure 10.
Top (Connection Side) of H-Pile Shoe Tip

5.7.6.4 Driving

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

Figure 11. Contractor Checking Pile Alignment

Piling must be driven until the required bearing is obtained, in accordance with the driving criteria. As indicated within the plans, all piling must be driven to the minimum tip elevation or to a minimum penetration of 10 ft below the bottom of footing elevation. If driving conditions are encountered that make this difficult, the PEMS should contact GS 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.

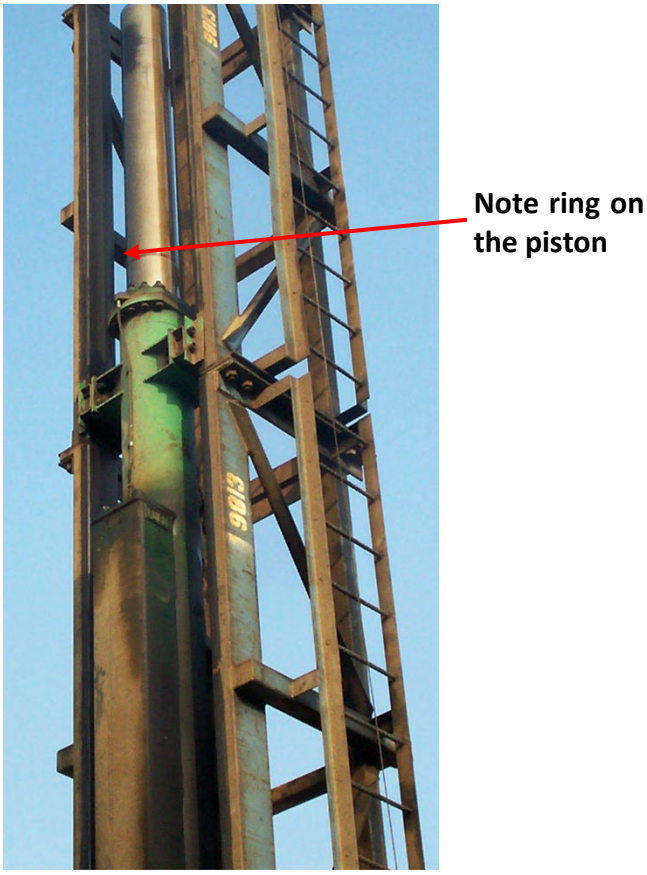


Figure 12. Piston Extending from the Top of the Hammer

Beginning at least 10 ft above the estimated pile tip elevation, the blow counts per each foot of penetration are 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 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 PEMS 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 PEMS must ensure that an HT is on-site during all pile driving operations and that the HT understands the instructions and the specifications that cover the type of piling operation being performed.

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, GS 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 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 HT's responsibilities are.

For indicator piles, PDA test piles and PDA driving performed as part of a static load test, record the number of hammer blows per each foot for the entire length of pile 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 necessary adjustments.

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 necessary adjustments.

If a minimum tip elevation is shown in the plans, ensure that the pile has 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 must be performed in accordance with the SS.

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 pile restruck. **Example 1** below is provided to clarify 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 shoe 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 SS. 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 cut-off length of piling totals 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

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. The PEMS must provide inspection at the time of backfilling and while the approaches to the structure are being constructed to help confirm proper placement, lift thickness, and compaction. Each structure presents a different set of problems for obtaining properly compacted embankments and backfill due to varying soil types, varying moisture content, topography changes, and other variables. It is the responsibility of the PEMS to see that all fills are placed and compacted to proper density to help remove the potential for further settlement.

Abutment type structures and arch structures usually require that structure backfill be used for backfilling and for fill around the structure. The PEMS must make certain that the material conforms to and is placed in accordance with the SS.

No fill should be placed around the structure until the walls have been inspected and approved. Fill must then be placed to the required finished grade in front of the abutments, wings. Retaining walls must be constructed simultaneously with the fill being placed 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 brought up and placed uniformly so to not induce unbalanced loading on any part of the structure, in accordance with the plan documents and the SS.

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 PEMS 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 that may cause tipping of the bent. The longitudinal alignment of such bents must be checked as spill-through slopes are constructed.

5.9 FALSEWORK

The Contractor must prepare working drawings specific to the contract which are signed by a Professional Engineer 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 PEMS 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 PEMS must 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 should include checking falsework bents, falsework piling bearing capacity, size and spacing of materials, connections and joints, and the general fit of the work. In many cases, it may not be possible to perform a complete and detailed check of the falsework. However, the PEMS should instruct the Contractor to correct any observed deviations from the approved falsework plan and to comply with all 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 ensure 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.

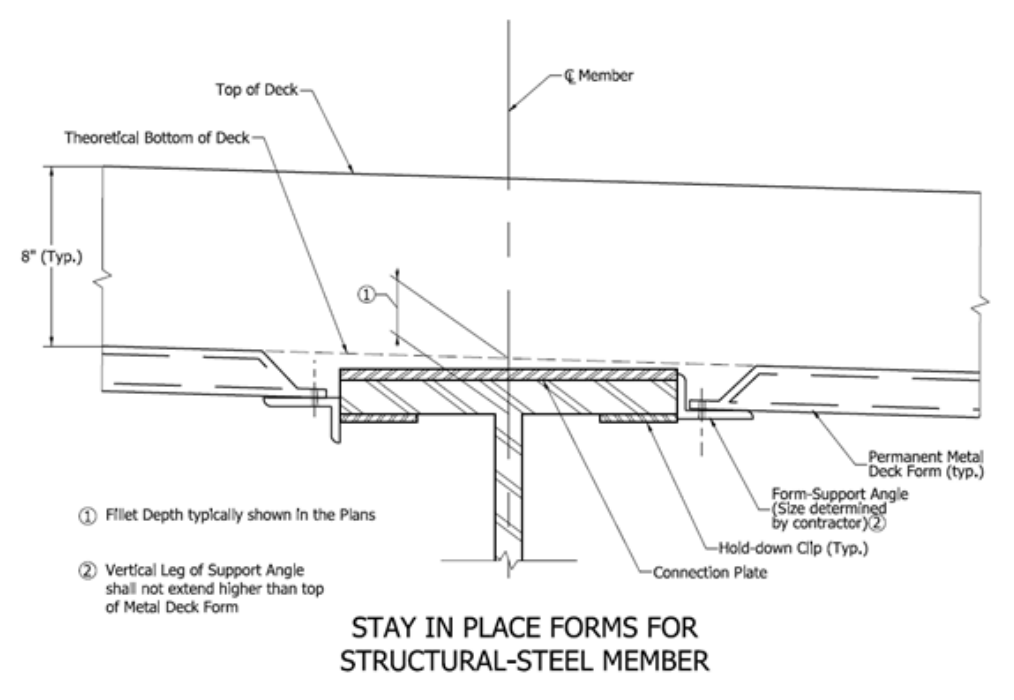
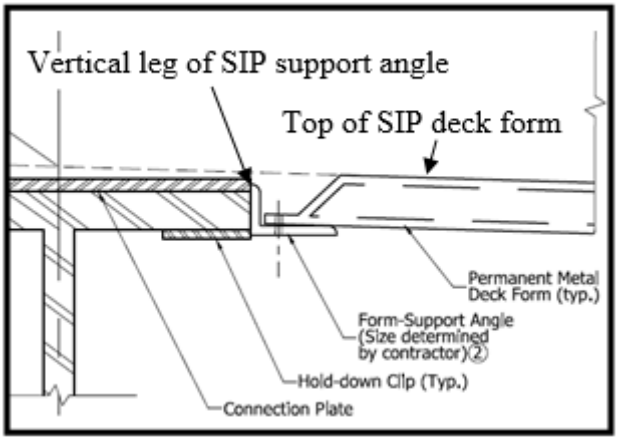


Figure 15a. SIP Form attachement to steel members



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.

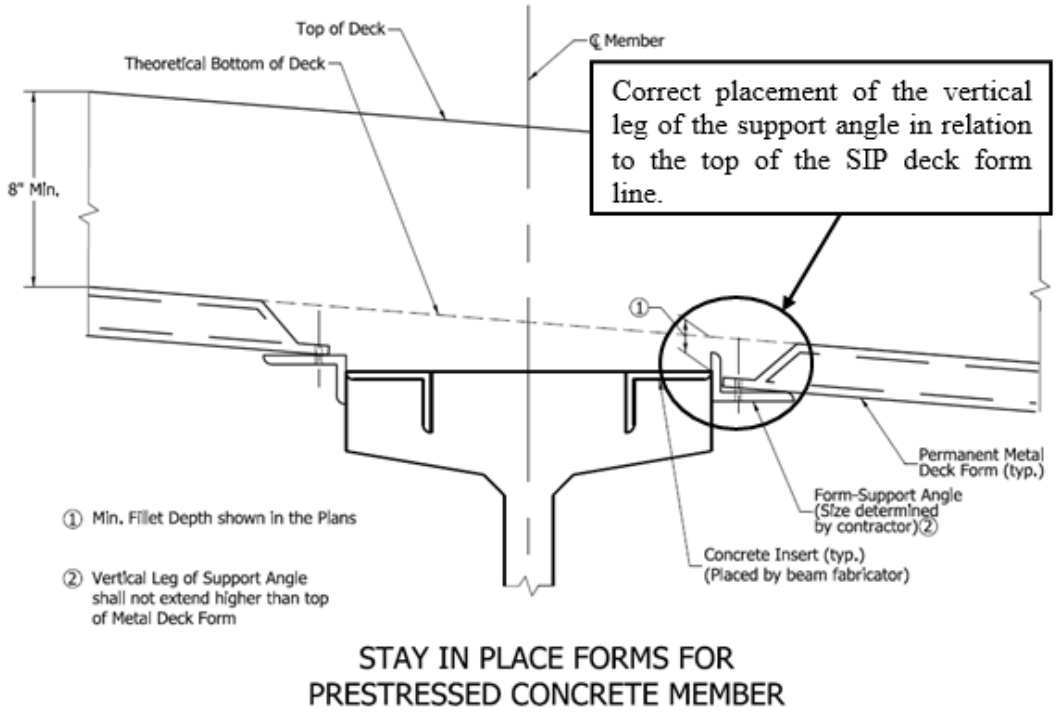


Figure 15. SIP Form attachement to concrete members

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, CO must be notified prior to mudsill placement.

5.10 FORMS FOR CONCRETE

Forms must be checked for proper dimensions, plumbness or required batter, alignment, bracing, tightness, and for the required form lining on exposed surfaces. Checking the forms by the PEMS should be performed progressively as they are built and not delayed until form work has been completed. 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.

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

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

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

Forms should be treated with form release agent so the agent does not come in contact with the reinforcing steel. If form lumber will be in close proximity with reinforcing steel already placed, the lumber 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 areas where beam 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 the points of contraflexure. 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 PEMS 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 request, through the PEMS, for a determination of the limits where welding will not be permitted on the flanges. 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 potential disintegration of the concrete. Every effort should be made preserve 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. Their removal must be accomplished and any 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 performed so that the gutter line may be given a smooth grade and any irregularities in the face or top of the curb can be aligned and smoothed.

5.11 GRADE CONTROLS FOR BRIDGE DECKS

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 PEMS 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 computed screed grades produce 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. 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 final and proper 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 PEMS 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 the choice of design of falsework is the responsibility of the Contractor, no definite rule as to the exact amount of deflection can be established.

The amount of settlement, or 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, bent 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, three to five control elevations are usually sufficient in each span. The controlling elevations are set at each bearing point, at the center of span, and at quarter 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 PEMS 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 of concrete before the final pass of the strike-off over that bent.

If deflection or settlement is in excess of that originally allowed, the screed should be raised as necessary to provide a smooth riding floor. However, care must be taken not to increase the floor thickness more than 1/2 in. as this will increase the dead load on the structure. This additional concrete could potentially reducing the life of the structure and the ability to add a future wearing course.

5.12 PLACING REINFORCING STEEL

The protection of materials to be incorporated in the contract is a fundamentally good construction practice. It is important to insist on compliance with the SS in order to maintain clean materials that will perform their proper function. It is necessary that special emphasis be placed on inspection and engineering control and to require the Contractor to protect reinforcing steel in accordance with the SS. This process involves keeping reinforcing steel above the surface of the ground on platforms, skids, or other supports.

Reinforcing steel must also be covered to protect against moisture and other detrimental effects. Supports for the reinforcing bars should be placed at intervals so that long bars will not sag onto 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 PEMS must require that the reinforcing steel portions remaining for future work are not thrown off the supports. These remaining portions must 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 is called out within the plans using a system of numbers. The Standard Drawings indicate the numbering system utilized. In general, straight reinforcing bars are identified using number designations based on the diameter of the bar itself. The industry standard for straight bar designations is based approximately on increasing bar diameters in 1/8 in. increments. The chart below indicates standard bar designations, diameters, and weight per foot.

Standard Reinforcing Bar Designations and Physical Characteristics		
Bar Size Designation	Bar Diameter (inches)	Bar Weight (lbs/ft)
#3	0.375	0.376
#4	0.500	0.668
#5	0.625	1.043
#6	0.750	1.502
#7	0.875	2.044
#8	1.000	2.670
#9	1.128	3.400
#10	1.270	4.303
#11	1.410	5.313
#14	1.693	7.650
#18	2.257	13.600

The Standard Drawings also include information concerning the designation of bent reinforcing bars. Bent bars are given a numeric bar mark, for example “588”. The last two digits, in this case “88”, designate the bar mark indicated within the plans. This bar mark is specific to the bend pattern of the bar. The digits preceding the last two digits indicate the size of the bar, in this case “5” indicates a number 5 bar size should be used. Reinforcing steel used for epoxy coated bars generally meets either ASTM A615 or ASTM A706. These may be identified by mill marks of ”S” or ”W”, respectively. Bars meeting both specifications are marked with ”S” and ”W”.

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 and placed with extreme care. They must be held securely in position by fastening them to a supporting frame while concrete is being placed. Frequent inspection must be made during the concrete pour to confirm that bars are not displaced.

In all cases, reinforcing bars shall be held securely in place and supported properly in accordance with the SS. Care shall be taken to confirm that no steel comes in contact with the forms. The “Placing and Fastening” provisions of the SS must be followed. In case there is a delay in placing concrete, an inspection of the reinforcing steel should be made. Clean the reinforcement as needed.

It is essential to maintain the positioning of reinforcing steel in the deck for compliance with the plans. The PEMS must check the clearance between the top mat of reinforcing steel and the finished grade to verify that the steel will have the specified coverage of concrete. This can be accomplished by passing the finishing machine along the screeds and directly measuring the clearance from the bottom of the strike off roller to the steel. This clearance must be checked and the measurements recorded. An acceptable minimum number of transverse locations would include the centerline of the structure, lane lines, edge lines, and gutter lines. 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 spacing 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 deck concrete has been placed and struck off and while the concrete is still in a plastic state, an adequate number of measurements (suggested at every third screen grade location) shall be taken showing the actual depth of concrete over the reinforcing steel. Record these measurements. Any movement or upward lift of the reinforcing steel will cause the reinforcing to be too close to the surface. Immediate steps must be taken by the Contractor to provide corrective action which may include additional tie-downs to the forms.

5.13 MIXING CONCRETE

One of the first tasks of the PEMS prior to any bridge pour is to check the concrete mixture information for SS conformance. Components of the mix must be checked for conformance to the Contractor's submitted mix design as well as adherence to 702 of the SS.

Tests must be made during each pour to determine the slump, air content, and yield of the concrete mix as per the Frequency of Sampling and Testing Manual. The manual is available on the Department's Division of Materials and Tests website at: https://www.in.gov/indot/doing-business-with-indot/contractorsconstruction/division-of-materials-and-tests/. As soon as practical, at least one water/cement ratio test is required to be performed on concrete used for the superstructure or for silica fume modified overlay concrete. Test results must be within the limits indicated within the SS.

The PEMS must perform continual monitoring of the transit mix operations. The SS 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 comply with the SS and manufacturer's recommendations
4. Trucks are being used at or below rated capacity
5. Capacity of water storage, old concrete build-up, and general condition of equipment.

5.14 PLACING CONCRETE

The SS direct that concrete shall be placed so there is no more than 5 ft of free fall within the forms. This requirement is to help prevent segregation of the concrete mix. Particular attention must be given to methods of placing the concrete in the forms to avoid segregation.

On the first load of concrete, determination of the air content must be made. The frequency schedule and requirements for the concrete tests must be reviewed thoroughly before pouring begins. The Frequency of Sampling and Testing Manual should be used to help determine the testing requirements.

When belt conveyors or pumps are used, sampling for air, slump, and yield will be performed 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 pressure. Therefore, making of beams and other activities must be performed at a safe distance from these pieces of equipment. Pumping of concrete shall be in accordance with 702 of the SS which 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 results from test beam breaks will be representative of the pour.

In some cases, it may be impossible to remove all water prior to placing footing concrete. Placing concrete into still water up to 6 in. deep may be allowed. In such cases, the concrete placement operation should start at one end of the form and continue to progress toward the opposite side of the form until the surface of the concrete is well above the surface of the water. The concrete should be allowed to work itself forward and displace the water with as little help as possible. The concrete should never be dragged through or shoveled into the water. Sufficient pumping should be maintained to keep the surface of the water at the desired depth. The depositing of concrete in moving water should never be allowed. The placing of concrete in more than 6 in. of still water should be performed only with special permission. The AE should be contacted for questions concerning placing concrete into water.

5.15 FINISHING CONCRETE SURFACES

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

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

5.16 FINISHING BRIDGE DECKS

It is the responsibility of the Department's field staff to ensure that bridge deck construction, including the workmanship and materials, is performed in accordance with the contract documents and 704 of the SS.

Items of importance are:

1. Placing and positioning of reinforcing steel, including specified concrete coverage over the reinforcement.

2. Consistency of air content and slump within the concrete mix.

3. Adequate and immediate curing.

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

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

When possible, the PEMS should be present for all or part of the deck pour, 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 during the placing of concrete, pedestrian traffic will not be stepping on and moving the reinforcing steel which extends through the bulkheads. These walk boards shall be constructed to rest 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. The loss of air-entraining leads to spalling, cracking, and other undesirable faults that affect the life of the deck.

The PEMS will make careful observation during the placing of the concrete to ensure that dehydration, brought on 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 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 PEMS will straightedge the previous pour, paying particular attention for irregularities at transverse bulkheads and expansion joints. Any irregularities not within the limits of the SS shall be corrected. Straightedging will be performed with a 16 ft steel straightedge supplied and operated by the Contractor.

When deck sealing is called for on the plans, the concrete surface shall be completely cleaned, dry, and dust free prior to the sealer application. A non-epoxy PCC sealer is the only sealer material allowed to be placed on prepared PCC surfaces.

5.17 FINISHING CONSTRUCTION JOINTS

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

Construction joints designated on the plans for structures are located with consideration for the relief of shrinkage stresses in the concrete and the workability for finishing operations. Construction joints located for reasons of design stresses are essential and must be constructed in accordance with the plans. Certain construction joints may be marked as "Optional." The placement of these joints is optional to the Contractor with consideration for the capability and capacity of the Contractor to place and finish the concrete in accordance with the SS. 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 bridge decks are not to be rounded with an edging tool. These joints should be carefully worked to produce, as nearly as possible, a watertight joint.

Horizontal construction joints surfaces in piers, abutments, wingwalls, arch skew backs, and similar joints should be cleaned of all cement residue and thoroughly wetted before placing new concrete on the existing surface.

5.18 CURING CONCRETE

Proper curing time is essential to produce acceptable strength and durability in concrete. Attention should be given to obtain curing in accordance with 702 of the SS.

Test beams used for controlling the application of loads on concrete must be cured in the same manner, and for the same time as the concrete it represents.

5.19 CONCRETING IN COLD WEATHER

The provisions of 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 within 702 of the SS.

Details as to housing and heating methods for concrete placed in cold weather must be discussed in advance of the operation with the Contractor. Concrete operations should not be permitted until suitable means for housing and heating 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 the curing period. Sudden changes in temperature are common in Indiana. It is good practice for the Contractor to be prepared for severe conditions.

5.20 BRIDGE EXPANSION JOINTS

Bridge expansion joints must be constructed in a true plane and not warped. The location of an expansion joint should be carefully checked so no coping or other projection is built in a location where it could be cracked or broken off by subsequent movement of the structure.

The PEMS should carefully check the surface between the bridge deck and the adjoining bridge approach pavement to see that the transition is properly formed and smooth once poured.

Many structures are designed with integral or semi-integral end bents. These type structures do not have expansion joints. The expansion in these structures is taken up in the rotation of the end bents and the movement of the approach slabs.

The joint manufacturer must prepare and submit working drawings. Those drawings are required to include details of the assembly, installation instructions, manufacturer's specifications for joint materials, a statement of compatibility of the joint material and the substrate, and joint setting data.

5.20.1 Pre-Compressed Foam Joint

When use of a pre-compressed foam joint, PCF, is specified, the existing joint and the adjacent concrete must be removed to the limits indicated on the plans. Additional concrete may need to be removed to ensure there is sound concrete adjacent to the joint area. Based on the measurement of the opening, taken by the Contractor, and movement and mean size opening information, taken from the plans, the joint manufacturer is required to select the appropriate joint model. PCF joints are required to be selected from the Department's list of approved PCF Bridge Joints.

PCF joints are required to be fabricated, delivered, and installed in lengths no less than 6 feet in accordance with the Specifications. Sections can be spliced using silicone sealant in accordance with the manufacturer's recommendations.

The areas of joint installation must be sound, clean, dry, and frost free in accordance with the SS. All bridge deck patching and curing must be complete prior to installation of the joint. A manufacturer's recommended and field applied joint adhesive is required for adherence with the substrate. Prior to the adhesive curing, the Contractor is required to apply a corner bead of silicone sealant along the entire length of the joint. The silicone bead is required to be tooled to blend with the substrate.

5.21 WATERPROOFING

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

Structural steel delivered to the job site has been inspected during fabrication and should be handled with proper care during shipment. Occasionally, errors in fabrication occur that escape detection by the shop inspector. Pieces may also be damaged during shipment.

The PEMS should inspect the steel after it has been delivered to the job site and take necessary action to see that the steel is in satisfactory condition 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 the structural steel coating is complete.

If structural steel coating is a separate item, then payment should be completed when all welding and bolting has been completed.

Partial payment made for structural steel that has been stockpiled but not erected will be as per 111 of the SS.

5.23 STRUCTURAL STEEL CONNECTIONS

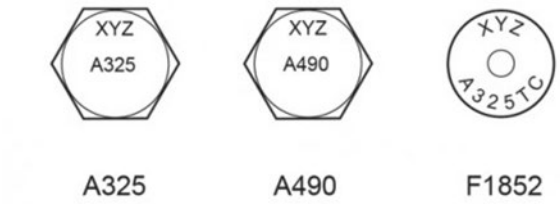
It is essential that the elevation of the splice joints is established before permanent connections are made.

High tensile bolts and nuts and hardened washers are used for field connections of structural steel. When using this type of connection, it must be noted that the stress in the steel is transmitted through the splice by friction of the plates rather than through 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 coating is acceptable.

The PEMS must verify that the bolts, washers, and nuts are as shown on the plans. High Tensile Bolts are manufactured of ASTM A325 high strength carbon steel. Grade A490 or F1852 may be furnished at no additional cost when grade A325 is shown on the plans.

Each bolt may be identified by the markings on the head of the bolts. Bolt heads are marked according to the table below.

Bolt Grade	Identification Markings on Bolt Head	Typical Bolt Head
A325	A325	
A490	A490	
F1852	A325 TC	



ASTM Typical Bolt Head Markings ("XYZ" indicates Manufacturer marking)

Nuts meeting the requirements of ASTM A563 or ASTM A194 are acceptable for use with A325 bolts.

The table below identifies acceptable nut types.

Nuts for A325, 490, and F1852 Bolts	
Type 1 Galvanized for Painted Steel	**Type 3** Weathering Steel
2H*, DH	DH3

***Note:** 2H heavy hex inch nuts may be used in place of A563/A563M DH nuts on Type 1 A325, A490, and F1852 bolts

A563 Grade **DH** A563 Grade **DH3** A194 Grade **2H**

ASTM typical Nut Markings

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 control of the impact wrenches to uniformly tension the bolts to the proper requirements in accordance with 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 711 of the SS.

Procedures for inspection of bolted connections are outlined within the SS.

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 rather than under the nut. This procedure is permitted only when working space does not permit wrenches to be placed on the nut. The washer must always be placed under the portion of the unit turned by the wrench.

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 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 alignment, longitudinal alignment, and for elevations at splice joints. A sufficient number of erection bolts, full size drift pins, and 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 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 COATING STRUCTURAL STEEL

5.24.1 Introduction

The structural steel coating industry utilizes the term "coating" for protective coverings applied to steel components since a "coating" may not always be paint. **For purposes of these instructions, the terms "painting" and "coating" will be used interchangeably.**

Coating of structural steel will be covered in the contract documents as well as in 619 of the SS.

Proper inspection of structural steel coating is critical to help confirm that the steel is protected from corrosion, which can weaken the structural members. Proper inspection is also critical to ensure compliance with laws regulating the generation and disposal of hazardous materials. On-site inspection and documentation of coating operations must be performed for all critical junctures of the operations and should be supplemented by random site checks during the operations.

For structures built prior to 1995, the assumption should be made that mill scale is present on the existing steel. All mill scale must be removed as part of the cleaning operations. Mill scale is a residue on the surface of the steel resulting from impurities introduced during the manufacturing process of the steel. These impurities rise to the surface as the molten steel cools. In the past, when lead-based primers were used, the mill scale could remain on the steel. When lead-based coatings were outlawed and zinc-based primers became the predominant coating material, the mill scale could no longer remain on the steel because mill scale and the zinc-based primers are incompatible.

5.24.2 Types of Coat Systems

The Department uses two systems for coating structural steel members:

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

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

The two coating systems are not interchangeable and each coat, in their respective systems, must be of a color to produce a distinct contrast with the next coat to be applied.

5.24.3 SSPC Certification

The 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 SS.

For a contractor to perform structural steel coating 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. **QP 1** certification is the minimum SSPC certification required for work on structures with existing coatings that do not contain hazardous materials.

2. **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.

Contract pay items for cleaning bridge structures will indicate the level of certification required for a 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 pre-construction conference. If the certification is not provided, the PEMS should request a copy. Certifications from SSPC are typically valid for one year. There is a phone number for SSPC on the certification that the PEMS may use if the validity of the certification is in question. If work is to continue past the expiration date of a QP certification, a new certification is required to continue work past the expiration date. There is no carry-over or "grandfathering" of QP certifications.

The Contractor must not perform any cleaning or coating work until a valid certification is provided and the Contractor's QCP has been approved.

5.24.4 Calendar Date Restrictions

Unless requested by the Contractor and approved in the QCP, no field coating 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. To allow their use, the Contractor is required 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 619.10(a) are waived and the Contractor can coat the structure in temperatures as low as the manufacturer's recommended limitations shown on the 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 calculating an average temperature, as it applies to all cure times. Also, the SS require all coatings to be applied inside 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 due to the dry air introduced into the containment during the abrasive blasting operation.

5.24.5 Quality Control Plan, QCP

Prior to beginning cleaning and coating operations, the Contractor must have an approved QCP in accordance with ITM 803. The QCP should be submitted to the PEMS at the pre-construction conference, or as soon as possible thereafter, to allow time for review and any necessary correction. ITM 803, sections 4 and 8, define the items that must be included in the QCP. A checklist of items to review within the QCP is included at the end of this section.

The PEMS is required to review the QCP and provide a written notice of approval or rejection to the Contractor. If the QCP is rejected, cite the items that gave cause for rejection. No work can begin until the PEMS 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 coating systems they anticipate using each year to the M&T for testing. Contract sampling of coating 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 909.02 of the SS. 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. M&T issues an approval "M-number" for each batch that meets SS. This M-number is the number that is reported on the material record within AWP. Contact the Chemistry Lab at M&T for any questions regarding coating 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 Stream Sampling

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

The contract documents should contain information on whether the existing coating is believed to be hazardous-based (contains lead or other hazardous components) on a plan sheet, in a table, or in a unique special provision within the CIB.

After the Contractor establishes containment acceptable for the job conditions (presence or absence of hazardous-based contaminants), they should begin abrasive blasting (cleaning) operations. 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 619.07(a) and detailed in SSPC-Guide 6. Except in cases where the Contractor is recycling the spent abrasive, the waste 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 stream thus consists of all of the waste stream (existing coating and spent blast media) for a particular structure, not just the existing coating.

It is not acceptable to "scrape" a sample of the coating and send it off for analysis prior to blasting operations. This process produces a sample of only the coating. It is not representative of the entire waste stream comprised of coating and spent blast media.

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

5.24.7.1 Waste Stream Sampling Procedure

Regardless of whether the existing coating is advertised as hazardous or non-hazardous, the waste stream sampling procedure is identical. The waste cannot be labeled or classified as hazardous or non-hazardous until after the waste stream sampling procedure is followed. Sampling of the waste stream is governed by the SS and IDEM regulations.

The waste stream sample should be obtained at the end of the first full day of blasting for a particular bridge. The sample should be the product of random grab sampling that is representative of the waste stream. In all waste sampling, it is important to remember the term "representative". The waste sample obtained should be representative of the waste stream generated for that portion of the structure.

The PEMS should witness the gathering of the material from four or five spots in the waste debris. If there are areas that have red colored 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 (considered as the waste generator) or its representative at all times. The sample should be labeled appropriately and maintained. There should also be a copy of all documentation in the contract 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 the number. On interstate, US, and state routes, the last four digits of the structure number can be used. For example, for multiple samples of 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 PEMS re-establish the identity of a misplaced sample.

Place the waste stream 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 coatings 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 seen and read. Both bags should have most of the air removed before sealing so they don't burst during shipment. The sealed sample goes into a 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 PEMS may keep some on hand if desired. The PEMS must take the sealed delivery envelope to the appropriate drop box and send it.

For convenience, the PEMS may insert a note in the commercial mail service delivery envelope requesting to be copied on the lab analysis results. In order to maintain the integrity of the sample, the PEMS must always maintain possession of the waste stream sample from each bridge from the time the sample is taken until the time the PEMS drops the sample in the commercial mail service company’s drop box.

The waste stream may only be classified as non-hazardous when the lab results for the sample for a particular structure are returned indicating threshold values from the TCLP analysis have not been exceeded. The waste 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 the sample exceed threshold values, the entire waste stream for that structure is considered hazardous and must be disposed of as such. No additional sampling of the waste stream for that structure is required. Finally, 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 Stream Disposal

If the sample results indicate a single contaminant exceeds the threshold values, the entire waste stream is considered to be hazardous-based. In these cases, it will be 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 owning 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 the process 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 to transport the waste from the project site and should be provided to the Contractor as soon as the PEMS obtains it. In accordance with the SS, the Department is required 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. To allow for mailing delays, the Contractor must not ship any waste until at least three work days after the PEMS has mailed the completed Regulated Waste Activity Form to IDEM. The EPA ID number must be active prior to transporting or shipping any hazardous waste from the project site. In accordance with EPA requirements, 619.07(b) provides a maximum time the waste 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.

Information and instructions on obtaining an EPA ID number for the waste stream can be found on the IDEM website at https://www.in.gov/idem/waste/waste-industries/waste-transportation/how-to-obtain-a-new-rcra-id-number/. Information can also be obtained from the US EPA. For additional questions, contact ES, Environmental Policy section.

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 (not signed with 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 calendar year for the activities of the previous year. Thus it is imperative for the PEMS 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 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 PEMS 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 PEMS or the AE and given to the Contractor. The treatment facility may not accept 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 PEMS 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. The waste material profile should match the results from the TCLP tests. Sometimes these have already been filled in by the Contractor. The PEMS should check to make sure the form they are signing is accurate. Once the PEMS is satisfied that the waste material profile form is accurate, either the PEMS or AE signs the form and provides 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 PEMS must sign each ticket or an authorization form can be sent out with the first pick-up which authorizes the Contractor's foreman to sign for the generator. The PEMS is still required to be on site for the first pick-up. After the first pick-up, the PEMS could collect the manifests for his files from the Contractor's foreman. The PEMS must keep a running estimate of the tonnage of waste shipped (so many waste containers at so many tons per dumpster). Each bag of the collected waste has a shipping weight that can be used to compute the total weight of waste contained in each dumpster.

When all of the hazardous waste stream has been shipped to the disposal site and the PEMS is comfortable that there are no transportation issues, the Handler ID form (provided by IDEM 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 has been received, treated, and rendered to a “special waste” (normal construction waste) by the treatment facility, the treatment facility will issue a certificate indicating the hazardous waste has been rendered to a special waste status. These certificates are retained by the Contractor, but the PEMS must request a copy for the contract files. This certificate is a release of liability for the Department and is an important document to retain. The certificate should be included in the document files for the contract.

5.24.8 Cleaning and Coating Operations

The SS provides requirements in 619.11, 619.12, and 619.13 for shop-application of a coat of primer for new steel, field coating new steel bridge, and coating existing steel bridge. These sections indicate the level of cleaning required as well as the coating system to be used.

The Contractor shall establish containment for a certain section of the structure to be coated. Once containment is set up for an area, all associated operations (cleaning, priming, coating) will typically be performed before moving the containment to the next section of the structure.

There are several hold points identified in 619.04. Hold points are "stages" in a specific work activity in which the Contractor must stop work on that specific activity until the PEMS provides written approval to proceed. Hold points allow 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 PEMS in advance of each hold point. The PEMS should make every effort to be available for the review of the hold point and not delay the progress of the work.

5.24.8.1 Cleaning and Surface Preparation

Areas below bridge joints should be carefully checked. Contractors may request an alternate cleaning method within their QCP. An example of a requested alternate cleaning method would involve waiving pressure washing and utilizing hand solvent cleaning to remove grease and salts. This new process might be requested because pressure washing would cause logistical problems for the Contractor. The new process may be more practical for a structure over water or when peeling or delaminated coating is present. If containment is utilized, the addition of water can create a very slippery environment that is difficult to dry and can causes problems with gathering and cleaning abrasive blasting materials. If containment is not utilized, the pressure washing may undesirably spatter hazardous coating chips throughout the surrounding environment.

Before performing any other cleaning operation, the Contractor shall 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 involves applying a degreasing solvent to a clean rag and wiping the affected surface to remove the contaminants. After the pressure washing and solvent cleaning have been completed, either an abrasive blasting or power tool cleaning shall be performed to remove the existing coating. The amount of existing coating required to be removed is determined by the level of cleaning required in the contract. The levels of cleaning are provided in 619.08 of the SS.

The Contractor shall use a dust collector during all abrasive blast cleaning operations. Using the dust collector provides a much safer working environment for both the Contractor's personnel as well as the Department's personnel. Use of a dust collector also provides better driving visibility for the traveling public. The Contractor shall provide personal protective equipment to Department personnel in in accordance with 619.07 of the SS.

5.24.8.2 Coating the Structure

Unless the contract documents specify differently, one of the coating systems described in 619.09 must be used. When an entire structure is being coated, the Structural Steel Coat System as described in 619.09(a) is used. Note that each subsequent coat must be a contrasting color to the previous coat. Additional information regarding the coating is presented in 909.1 and 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 for the approved system. Using a primer from one system and either an intermediate or finish coat from another system is not allowed. Also, the Contractor shall 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 PEMS should discuss this with the Contractor at the pre-construction conference. This is also the proper time to agree on the contrasting colors for the intermediate coat (when the finish coat color is established) and 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 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 provided by the Contractor or obtained online from the manufacturer's website to verify the temperature range for the product and the required time before recoating, taking the contract's humidity and overnight weather information into account.

Striping the outside edges of all structural members prior to coating the fields or the remainder of the structure is good practice. When specified in the CIB, the stripe coat for both the intermediate and finish coat is considered a separate coat and must be allowed to dry to the same requirements as the top coat dry time for that product before 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 and should be executed while the traffic is restricted. This operation should progress slowly to allow the material to soak in. Do not rush. Areas away from traffic can be performed at the Contractor's schedule. Good practice, but not required, is to have the Contractor brush blast all areas to be sealed as they are cleaning the steel in the adjacent areas. If the contract contains requirements to remove graffiti, this is also a good time to perform that operation.

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 ends of each steel structural member manufactured of weathering steel located at an expansion joint to be coated. Weathering steel, in accordance with 619.11, must be coated using the structural steel coating

system specified in 619.09(a), with the exception that the finish coat is a different material, color, and sheen in accordance with 909.02(e). The prime coat and corresponding intermediate coat shall be from a 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 and any material meeting the requirements of 909.02(e) and compatible with the intermediate coat may be used. The material proposed to be used by the Contractor as the finish coat must be sampled and submitted using the Department's typical sampling and submitting procedures for coatings.

5.24.9 Method of Measurement

Partial or complete coating of bridge steel will not be measured for payment. The estimated area of steel to be coated is found on the bridge summary table within the CIB and is furnished on a "for information only" basis.

5.24.10 Basis of Payment

Coating of existing steel bridges should have a minimum of two pay items from 619 of the SS, Clean Steel Bridge and Coat Steel Bridge. Both items are paid at the lump sum price per structure. Estimate or pro-rate the amount of work that is completed each day and enter this on the Daily within AWP.

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

5.24.10.1 Pre-Established Remedies for Changed Conditions

Since there is some uncertainty at the time of bid concerning whether existing coating is actually hazardous, 619.20(a) and (b) make provisions for handling situations in which the laboratory analysis results classify the waste stream from the existing coating differently from what was indicated in the contract. The pre-established remedies apply only to situations where the contract identified the existing coating as non-hazardous, or zinc based, and the laboratory analysis indicate levels of contaminants in excess of the federal threshold limits, thus causing the waste stream from the existing coating to be classified as hazardous. Three situations are described with corresponding percentage adjustments. The three situations involve discovery of hazardous materials but no mill scale, discovery of mill scale but no hazardous materials, and discovery of hazardous materials and mill scale.

Structures exhibit varying levels of mill scale which must be removed prior to application of zinc-based primers. Removal of mill scale generally can be performed 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 619.20(a) and (b) do not apply. The Contractor should have already included costs for mill scale removal and hazardous waste disposal in their bid.

Conversely, if the contract documents advertise the existing coating as hazardous, or lead based, and the laboratory analyses indicate the levels of contaminants are not above the federal threshold limits, the waste stream is classified as non-hazardous. In this situation, the Department has no basis for requesting a partial credit for the cleaning item. This situation occurs because by the contract documents informing the Contractor that the existing coating was anticipated to be hazardous based, the Contractor would have brought and set up the containment required to remove hazardous based material.

Per the SS, the fourth waste stream sample is taken when the last quarter of the structure is being cleaned. By the time the lab results are returned, and in most cases, the cleaning operation has been completed. The only operation which a credit may be requested is for the disposal cost of the waste stream. The cost for disposal at a hazardous waste facility should have been included in the bid, but since the waste stream is classified as non-hazardous, the waste stream 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 appropriate FE in CM or to the appropriate individual that have attended the SSPC coating class within the District.

5.24.11 Construction Documentation

Make a chart or drawing of the sections of a structure 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 for 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 Services for their records. The environmental records copy must be included with the archived records for permanent storage. This also includes non-hazardous determinations of a waste 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.

Final quantities for the cleaning and coating 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 Coating 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 Coating (New Steel, Existing Steel on Entire Structure, Beam Ends, etc.) and Coating 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 Stream 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 stream 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 PEMS.
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 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 mixed with any waste 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 safety data sheets (SDSs) for all materials to be used on the job including coating, caulk, thinners, sealers, etc.

Weather limitations of all materials should be shown on the SDSs.
Request to work outside the dates shown in the SS, 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.
Coating 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.
Coating procedure and proposed equipment.
Description of the material and amount if the coating 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 PEMS 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 PEMS.

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 "lead" county 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 coating 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 that IDEM will contact or send communications to regarding the bridge. This typically is the PEMS. There should also be a contact name and address for the person who will be preparing the follow-up paperwork after the contract is completed. This could be the same PEMS 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 coating 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 PEMS is advised to check the lab report to make sure that all contaminants exceeding 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 coating 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 clear.

Section 13 – Certification. The person with the authority to sign this document. The PEMS should check with their AE or DCD for the District's procedures regarding signing. This is the section that requires 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

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 in accordance with 706 of the SS. If either class A or C concrete is used in slipformed railing, water reducing admixture will not be required in the mix.

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 in accordance with the SS. 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 require removal and replacement at the Contractor's expense. A minimal amount of small air bubbles on a surface are an inherent characteristic of the concrete and an acceptable part of the finished surface.

5.26 CONCRETE STRUCTURAL MEMBERS

Concrete structural members are inspected during production at the plant. If the PEMS 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 to protect them from damage in accordance with 707 of the SS.

The erection of concrete 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. If the method of lifting the structural member in the field differs from the method shown on the beam fabrication working drawings, the Contractor must submit working drawings and calculations for the alternate method prior to lifting, in accordance with the SS. 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 in accordance with 111 of the SS.

5.27 BRIDGE DECK OVERLAYS

Several types of overlay mixes may be used for bridge deck overlays in accordance with the contract documents. Bridge deck overlays shall be in accordance with 722 of the SS.

A mix design for bridge deck overlays is required to be submitted to the Engineer a minimum of seven calendar days prior to use and calibration of the mobile mixer. Trial batch demonstrations are required for Prepackaged concrete patching material, CPM, Ordinary Portland cement-based concrete, OPCC, Rapid hardening cement-based concrete, RHCC, LMC-Very Early Strength, LMC-VE, and Silica Fume Modified Concrete, SFMC, overlays.

The trial batch demonstration for all mix types involves a demonstration and verification of the mix design, simulating the placement properties, delivery time, discharge rate, slump loss with time, air content and compressive strength. It should also involve a meeting between the Contractor, material suppliers, and the Department to discuss the mixing, delivery, placement, finishing, curing, and compressive testing. Representatives from either the LMC-VE or SFMC producers are required to attend the trial batch demonstration and be present at the start-up for the initial deck placement. M&T will have the option of waiving the producer representative

attendance requirements if the Contractor provides sufficient evidence of adequate experience with producing and placing the required mix.

5.27.1 Preparation of the Deck Floor

Existing deck overlays shall be removed. In addition to the overlay removal, the plans should indicate an additional depth to be removed. If the plans are silent on an additional depth to be removed, an additional depth of 1/2 in. should be removed.

For existing decks without a previous overlay, removal shall be performed with a milling machine for a depth as indicated on the plans. If the plans are silent on the removal depth, the milling depth shall be to 1/2 in.

After initial surface removal and cleanup, either hydrodemolition or hand chipping will be required to remove any remaining unsound concrete. Hydrodemolition will be indicated within the contract documents if this method is intended to be used. The use of hydrodemolition, and the associated requirements for the equipment calibration and process cleanup, is described fully within 722 of the SS.

Regardless of the method of removal, operations shall stop when it is determined that sound concrete is being removed. Any changes in equipment or operations should be agreed upon before operations are resumed. In locations where the deck is determined to be unsound for more than half of its original depth, the concrete should be removed to full depth, except for limited areas as determined by the Engineer.

When removing deck material adjacent to reinforcing bars, if the bars have been exposed for a length greater than 2.0 ft and the bond between the bars and adjacent concrete has been destroyed, the concrete adjacent to the bars shall be removed to a minimum clearance of 1 in. around the entire periphery of the exposed bar.

After removal operations, the entire deck, including the areas around and under exposed reinforcing bars, is required to be heavily sand blasted to expose fine and coarse aggregates and to remove small amounts of remaining unsound concrete or laitance layers from the exposed surface. The surface is then required to the thoroughly cleaned of all dust, chips, water and foreign materials in order to achieve a firm, solid surface for the overlay to adhere. Water blasting, at a minimum pressure stated within the SS, may be used in lieu of sandblasting when hydrodemolition is specified in the contract documents. Sandblasting or water blasting will be performed in two passes with the second pass performed at right angles to the first pass.

5.27.2 Bridge Deck Patching

A vacuum device is required to remove all water from prepared cavities. Patching of bridge decks can be made using either bridge deck patching concrete, overlay concrete, or concrete patching material from the Department's approved list for Rapid Setting Patch Materials. Consolidation by internal vibration is required.

Full depth patching is required to be performed prior to overlay operations. Epoxy resin adhesive is required to be used to coat the surfaces of prepared cavities and all exposed reinforcing bars within the cavity.

For full depth patched decks, equipment can be operated on the deck once a modulus of rupture of 550 psi has been reached for the patching material.

For partial depth patches utilizing overlay concrete, cavity surfaces are required to be coated with a bond coat, in accordance with the SS, except when hydrodemolition is used. Cavities are required to be filled at the time of overlay placement.

For partial depth patching utilizing rapid setting patch material, all patching materials are required to be approved by the overlay supplier for compatibility with the overlay materials to be used. Placement and curing shall be in accordance with the manufacturer's recommendations.

5.28 TEMPORARY BRIDGES

When the contract specifies a temporary bridge, the structure must be built in accordance with 713 of the SS. The Contractor must submit detailed plans for the proposed temporary bridge. The plans must be signed by and bear the seal of a registered professional engineer. CO will approve these plans prior to construction of the temporary structure. It should be noted that a temporary bridge open to the public is required to be inspected at least every 24 months, in accordance with the National Bridge Inspection standards. Contact the District Bridge Inspection group for further information and guidance.

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

The PEMS will document that the temporary bridge was built as per the bridge standard plans, contract plans, or approved temporary bridge plans from the Contractor, whichever the case may be.