Iowa Department of Transportation

MINUTES
OF
IOWA D.O.T. SPECIFICATION COMMITTEE MEETING

May 14, 2009

Members Present:	John Adam	Statewide Operations Bureau
	Jim Berger	Office of Materials
	Roger Bierbaum	Office of Contracts
	Eric Johnsen, Secretary	Specifications Section
	Bruce Kuehl	District 6 - Construction
	Doug McDonald	District 1 - Marshalltown RCE
	Gary Novey	Office of Bridges & Structures
	Dan Redmond	District 4 - Materials
	Tom Reis, Chair	Specifications Section
Members Not Present:	Donna Buchwald	Office of Local Systems
	Troy Jerman	Office of Traffic & Safety
	Mike Kennerly	Office of Design
	John Smythe	Office of Construction
Advisory Members Present:	Brian Moore	Wapello County
	Lisa Rold	FHWA
Others Present:	Ahmad Abu-Hawash	Office of Bridges & Structures
	LeRoy Bergmann	Office of Local Systems
	Mark Bortle	Office of Construction
	Daniel Harness	Office of Design
	Tom Jacobson	Office of Construction
	Deanna Maifield	Office of Design

Tom Reis, Specifications Engineer, opened the meeting. The following items were discussed in accordance with the agenda dated May 8, 2009:

1. Article 1102.19, D, 5, b, Placement of EEO/AA Notices and Posters.

The Office of Contracts requested a change to update the publication number reference for the EEO posting.

2. Article 2301.14, Placing Concrete.

The Office of Construction requested a change to clarify that material collected in the paver grout box shall not to be used in the pavement.

3. Article 2310.03, A, Equipment.
Article 2310.03, B, Preparation of Surface.
Article 2310.03, C, 1, c, Joints.
Article 2310.03, C, 2, a, Hot Mix Asphalt Stress Relief Course.
Article 2310.04, D, Pavement Scarification.
Article 2310.05, D, Pavement Scarification.

The Office of Construction requested changes to revise the preparation of surface language, sawing requirements for bonded overlays, and compaction requirements for HMA stress relief course.

4. Article 2413.02, B, Class HPC-O High Performance Concrete.

The Office of Materials requested changes to clarify the intent to achieve a low w/c.

5. Article 2513.03, B, Cast-in-Place and Slip Form.

The Office of Materials requested a change to require PCC Level III Certified Technician to oversee development of mix design.

6. Article 2526.01, J, Pavement Overlays (PCC and HMA).
Article 2526.01, K, PCC Overlays.

The Office of Construction requested changes to more thoroughly describe staking requirements and requirements for developing a profile grade when not provided.

7. Article 2528.13, A, 4, Temporary Traffic Signals.
Article 2528.13, A, 5, Temporary Floodlighting.

The Office of Construction requested changes to clarify that the Contractor needs to independently supply power for temporary traffic signals and temporary floodlighting, without tying into any existing highway power circuits.

8. Article 4161.03, Treatment.
Article 4161.03, B, Seasoning.

The Office of Materials requested changes to allow Pentachlorophenol for treating timber piling.

9. DS-01120, Backfilling and Compaction of Culverts by Flooding.

The Office of Design requested changes in conjunction with modifications to Standard Road Plan RF-30A.

10. SS-01032, Concrete Drilled Shafts.

The Office of Bridges and Structures requested changes to the specifications for Concrete Drilled Shafts.

SPECIFICATION REVISION SUBMITTAL FORM

Submitted by: Roger Bierbaum	**Office:** Contracts	**Item 1**
Submittal Date: 2009.04.27	**Proposed Effective Date:** October 2009	
Article No.: 1102.19, D, 5, b **Title:** Equal Employment Opportunity and Affirmative Action Requirement	**Other:**	

Specification Committee Action: Approved as is

Deferred:	**Not Approved:**	**Approved Date:** 05/14/2009	**Effective Date:** 10/20/2009

Specification Committee Approved Text:

1102.19, D, 5, b, Placement of EEO/AA Notices and Posters.

Replace the entire article:

b. ~~Form EEOC P/E 1~~ Publication OFCCP 1420, stating "Equal Employment Opportunity is THE LAW".

Comments: None

Specification Section Recommended Text:

Comments:

Member's Requested Change: **(Do not use 'Track Changes', or 'Mark-Up'. Use ~~Strikeout~~ and Highlight.)**

5. Placement of EEO/AA Notices and Posters.
The Contractor shall place the following notices and posters on a bulletin board at the project site in areas readily accessible to employees and potential employees.

a. Notice provided by the Iowa DOT listing the names, addresses, and phone numbers of the Contractor and all approved subcontractors.

b. ~~Form EEOC-P/E-1~~ Publication OFCCP 1420, stating "Equal Employment Opportunity is THE LAW".

Reason for Revision: The publication number of a required posting has been changed. This will make the specification requirement current.

County or City Input Needed (X one)	**Yes**	**No** X
Comments:		

Industry Input Needed (X one)			**Yes**	**No** X	
Industry Notified:	**Yes**	**No** X	**Industry Concurrence:**	**Yes**	**No**
Comments:					

SPECIFICATION REVISION SUBMITTAL FORM

Submitted by: John Smythe / Kevin Merryman	**Office:** Construction	**Item 2**
Submittal Date: March 26, 2009	**Proposed Effective Date:** October 2009	
Article No.: 2301.14 **Title:** Placing Concrete	**Other:**	

Specification Committee Action: Deferred to June meeting

Deferred: X	**Not Approved:**	**Approved Date:**	**Effective Date:**

Specification Committee Approved Text:

2301.14, Placing Concrete.

Add as the fifth paragraph:

Concrete shall be placed and consolidated in a manner that will prevent material retained in the grout box, of the finishing machine, from being incorporated into the pavement. At headers, concrete screeded over the header during finishing shall be removed.

Comments:

Specification Section Recommended Text:

Comments:

Member's Requested Change (Redline/Strikeout):

2301.14 PLACING CONCRETE.

The contract documents will show the width in which it is contemplated that the pavement will be constructed, and unless otherwise shown, the pavement shall be constructed in a single pass.

Pavement constructed using ready mixed concrete shall be placed in single lane widths only and in compliance with the following provisions, unless otherwise permitted by the Engineer. Permission will be based on evaluation of type, quality, and quantity of equipment to be used and its anticipated rate of production.

At the Contractor's option, pavements may be placed in single traffic lane widths under the following conditions:

The Contractor shall submit a proposed plan of operation for the approval of the Engineer. Any additional dowels, tie bars, or extra concrete, required to conform to the approved, modified method of operation, shall be furnished by the Contractor without extra compensation.

The concrete shall be deposited upon the supporting surface in a manner which will minimize segregation and disturbance of reinforcement. Except when welded wire fabric reinforcement is used, concrete shall be deposited to the full depth of the pavement in a single operation. When welded wire fabric is used, Article 2301.12 shall also apply.

The operation of vibrating units shall be substantially as recommended by the manufacturer and in a manner which complies with the requirements of Article 2301.07, A.

Concrete shall be placed and consolidated in a manner that will prevent material retained in the grout box of the finishing machine from being incorporated into the pavement. At headers, concrete screeded over the header during finishing shall be promptly removed.

Vertical edges of pavements and backs of curbs shall be cured in accordance with Article 2301.19.

All honeycombed areas on pavement edges shall be satisfactorily repaired immediately after removal of forms.

The Contractor shall backfill behind curbs, as directed by the Engineer, to prevent a flow of water in this area and subsequent undermining of pavement.

Reason for Revision: The change clarifies that the material collected in the paver grout box is not to be used in the pavement.

County or City Input Needed (X one)			**Yes**	**No** X	
Comments:					
Industry Input Needed (X one)			**Yes** X	**No**	
Industry Notified:	**Yes** X	**No**	**Industry Concurrence:**	**Yes** X	**No**
Comments:					

SPECIFICATION REVISION SUBMITTAL FORM

Submitted by: John Smythe / Kevin Merryman	**Office:** Construction	**Item 3**
Submittal Date: March 26, 2009	**Proposed Effective Date:** October 2009	
Article No.: 2310 **Title:** Portland Cement Concrete Overlay	**Other:**	

Specification Committee Action: Deferred to June meeting

Deferred: X	**Not Approved:**	**Approved Date:**	**Effective Date:**

Specification Committee Approved Text:

2310.03, A, Equipment.

Replace the paragraph:

~~Surface preparation equipment used~~ Equipment used to prepare the existing pavement surface shall be subject to approval of the Engineer and shall comply with the following:

2310.03, B, Preparation of Surface.

Replace the entire article:

If full depth base repair is included in the project, it shall be completed prior to ~~surface preparation~~ preparation of the existing pavement surface.

~~Surface preparation~~ When required, preparation of the existing pavement shall include the entire ~~surface~~ area to be resurfaced. Materials removed in the preparation operation may be placed in the shoulder area unless otherwise specified in the contract documents.

1. ~~Bonded Overlays~~ Surface Preparation.

For Bonded Overlays, ~~T~~the surface shall be prepared by shot blasting~~,~~ or ~~shall be scarified and followed by either shot blasting or sand blasting~~ scarification. Scarification shall be to a nominal depth of 1/4 inch (5 mm). In either case, the preparation shall be of an extent to remove all dirt, oil, and other foreign materials, as well as any laitance or loose material from the surface and edges against which new concrete is to be placed.

2. ~~Unbonded Overlays~~ Pavement Scarification.

For unbonded overlays and whitetopping, pavement scarification shall meet the requirements of Section 2214.

When placement of a new HMA stress relief layer is included as part of the contract for unbonded overlays, pavement scarification will not be required.

~~When jointing is specified in which panels are smaller than a normal lane width, the entire surface shall be scarified to create a roughened surface. This will not apply when a new HMA stress relief layer is constructed as a part of this contract.~~

Any high spots found in the existing HMA pavement shall be trimmed at the direction of the Engineer. This work would be accomplished during the scarification operation, only at isolated locations, and would be considered incidental to the ~~surface preparation~~ pavement scarification.

~~**3. Whitetopping.**~~

~~When jointing is specified in which panels are smaller than a normal lane width, the entire~~

~~surface shall be scarified using a cold milling operation to create a roughened surface. Any high spots found in the existing HMA pavement shall be trimmed at the direction of the Engineer. This work would be accomplished during the scarification operation, only at isolated locations, and would be considered incidental to the surface preparation.~~

2310.03, C, 1, c, Joints.

Replace the second paragraph:

Joints shall be sawed in the resurfacing directly over existing ~~transverse~~ joints. ~~Transverse~~ jJoints shall be sawed to the full depth of new resurfacing concrete, including depressions created in the existing surface, and as specified in the widening areas. ~~Transverse~~ jJoints shall be sawed as soon as possible without causing excessive raveling. ~~Joints shall be sawed directly over existing longitudinal joints to a depth of one-half the overlay thickness, with a maximum depth of 3 inches (75 mm).~~

2310.03, C, 2, a, Hot Mix Asphalt Stress Relief Course.

Replace the paragraph:

Compaction shall be in accordance with Article 2303.03, E, 2, Class ~~1C~~ II Compaction except only static steel wheeled rollers shall be used.

2310.04, D, Pavement Scarification.

Add new articles:

1. Measurement by Weight (Mass).
The quantity of Pavement Scarification will be determined in accordance with Article 2214.06, A, 1.

2. Measurement by Area.
The quantity of Pavement Scarification will be determined in accordance with Article 2214.06, A, 2.

2310.04, D, Hot Mix Asphalt Stress Relief Course.

Renumber article:

~~D~~ E, Hot Mix Asphalt Stress Relief Course.

2310.05, D, Pavement Scarification.

Add a new article:

1. Measurement by Weight (Mass).
The Contractor will be paid the contract unit price for Pavement Scarification in accordance with Article 2214.07, A, 1.

2. Measurement by Area.
The Contractor will be paid the contract unit price for Pavement Scarification in accordance with Article 2214.07, A, 2.

2310.05, D, Hot Mix Asphalt Stress Relief Course.

Renumber article:

~~D~~ E, Hot Mix Asphalt Stress Relief Course.

Comments:

Specification Section Recommended Text:

Comments:

Member's Requested Change (Redline/Strikeout):

2310.03 CONSTRUCTION.

A. Equipment.
~~Surface preparation equipment used~~ Equipment used to prepare the existing pavement surface shall be subject to approval of the Engineer and shall comply with the following:

1. Scarifying or Shotblasting Equipment.
Equipment shall be a power operated, capable of uniformly scarifying or removing the existing surface to depths required in a satisfactory manner. Other types of removal devices may be used if their operation is suitable and if they can be demonstrated to the satisfaction of the Engineer. The contract documents will include a pay item for such work.

2. Sand Blasting Equipment.
Sand blasting equipment shall be capable of removing rust, oil, and concrete laitance from the existing surface of the pavement.

B. Preparation of Surface.
If full depth base repair is included in the project, it shall be completed prior to ~~surface preparation~~ preparation of the existing pavement surface.

~~Surface preparation~~ When required, preparation of the existing pavement shall include the entire ~~surface~~ area to be resurfaced. Materials removed in the preparation operation may be placed in the shoulder area unless otherwise specified in the contract documents.

1. ~~Bonded Overlays~~ Surface Preparation.
For Bonded Overlays, ~~T~~the surface shall be prepared by shot blasting~~,~~ or ~~shall be scarified and followed by either shot blasting or sand blasting~~ scarification. Scarification shall be to a nominal depth of 1/4 inch (5 mm). In either case, the preparation shall be of an extent to remove all dirt, oil, and other foreign materials, as well as any laitance or loose material from the surface and edges against which new concrete is to be placed.

2. ~~Unbonded Overlays~~ Pavement Scarification.
For unbonded overlays and whitetopping, pavement scarification shall meet the requirements of Section 2214.

When placement of a new HMA stress relief layer is included as part of the contract for unbonded overlays, pavement scarification will not be required.

~~When jointing is specified in which panels are smaller than a normal lane width, the entire surface shall be scarified to create a roughened surface. This will not apply when a new HMA stress relief layer is constructed as a part of this contract.~~

Any high spots found in the existing HMA pavement shall be trimmed at the direction of the Engineer. This work would be accomplished during the scarification operation, only at isolated locations, and would be considered incidental to the ~~surface preparation~~ pavement scarification.

~~**3. Whitetopping.**~~
~~When jointing is specified in which panels are smaller than a normal lane width, the entire surface shall be scarified using a cold-milling operation to create a roughened surface.~~

~~Any high spots found in the existing HMA pavement shall be trimmed at the direction of the Engineer. This work would be accomplished during the scarification operation, only at isolated locations, and would be considered incidental to the surface preparation.~~

C. Placing and Finishing Overlay.
Section 2317 shall apply to all PCC Pavement bid items of a Primary project if any individual PCC Pavement bid item for that project is 5000 square yards (4200 m^2) or greater. Section 2316 shall apply to all other Primary projects and when specifically required for other projects.

The placing equipment shall be controlled to the proper elevation by string line. Cross sections shall be taken and a grade line established. The Engineer will review and approve the new grade lines. Information detailing the pavement design thicknesses at the various survey points and material quantities will also be provided. During construction, these grades shall not be altered solely to account for concrete overruns. Some overrun is normal and only with approval of the Engineer will they be adjusted.

1. Bonded Overlays.

a. Surface Cleaning.
Prior to placing concrete onto the surface, the entire surface shall be cleaned with an air blast. After cleaning, no traffic will be permitted on the cleaned surface except that necessary for overlay construction.

b. Surface Condition.
The prepared surface shall be dry to allow some absorption of the concrete mortar.

c. Joints.
The exact location of each contraction and expansion joint in the existing pavement and the joint to be sawed at each full depth patch shall be identified on both sides by a reliable method.

Joints shall be sawed in the resurfacing directly over existing ~~transverse~~ joints. ~~Transverse~~ jJoints shall be sawed to the full depth of new resurfacing concrete, including depressions created in the existing surface, and as specified in the widening areas. ~~Transverse~~ jJoints shall be sawed as soon as possible without causing excessive raveling. ~~Joints shall be sawed directly over existing longitudinal joints to a depth of one-half the overlay thickness, with a maximum depth of 3 inches (75 mm).~~

2. Unbonded Overlays.

a. Hot Mix Asphalt Stress Relief Course.
Compaction shall be in accordance with Article 2303.03, E, 2, Class ~~1C~~ II Compaction except only static steel wheeled rollers shall be used.

b. Surface Cleaning.
The Contractor shall clean the existing surface of all loose or adhering foreign material prior to placement of the PCC over HMA pavement. Normally this will be accomplished with a power broom and shall be available during paving operations to clean loose material that may be tracked onto the surface by the construction equipment.

c. Surface Condition.
The prepared surface shall be dry when concrete is placed on the surface of the HMA pavement to allow some absorption of the concrete mortar. If the surface of the HMA is above 110ºF (40ºC), the Contractor

may apply water to the surface of the HMA ahead of the paving operation in order to cool the surface. The water shall be applied far enough in advance of the paving operation that the surface will dry from evaporation before concrete is placed. No water shall be applied to the surface of the pavement when the HMA surface temperature is below 100ºF (38ºC).

d. Joints.
When jointing is specified in which panels are smaller than a normal lane width, the joints shall be 1/8 inch (3 mm) wide with no cleaning or sealing required.

3. Whitetopping.

a. Surface Cleaning.
The Contractor shall clean the existing surface of all loose or adhering foreign material prior to placement of the PCC over HMA pavement. Normally this will be accomplished with a power broom and shall be available during paving operations to clean loose material that may be tracked onto the surface by the construction equipment.

b. Surface Condition.
The prepared surface shall be dry when concrete is placed on the surface of the HMA pavement to allow some absorption of the concrete mortar. If the surface of the HMA is above 110ºF (40ºC), the Contractor may apply water to the surface of the HMA ahead of the paving operation in order to cool the surface. The water shall be applied far enough in advance of the paving operation that the surface will dry from evaporation before concrete is place. No water shall be applied to the surface of the pavement when the HMA surface temperature is below 100ºF (38ºC).

c. Joints.
When jointing is specified in which panels are smaller than a normal lane width, the joints shall be 1/8 inch (3 mm) wide with no cleaning or sealing required.

D. Limitation of Operations.
At forecasted air temperatures below 55°F (13°C) the opening time shall be determined using the maturity method. Resurfacing concrete shall not be placed when the air or pavement temperature is below 40°F (4°C).

The Contractor will be permitted to use the shoulders for construction activities. It will be the Contractor's responsibility to repair the shoulders at no additional cost as deemed necessary by the Engineer, to restore the shoulders to a condition acceptable for shoulder work. The Contractor may elect to limit the use and vehicle loadings to minimize this work and its cost.

Bonded concrete overlays shall be placed between June 1 and September 30.

Unbonded overlay and whitetopping materials shall not be placed on any HMA when the pavement surface temperature exceeds 120° F (50°C).

2310.04 METHOD OF MEASUREMENT.
The quantity of the various items of work involved in the construction of PCC overlay will be measured by the Engineer in accordance with the following provisions:

A. Portland Cement Concrete Overlay, Furnish Only.
The quantity of resurfacing concrete furnished will be measured in cubic yards (cubic meters), using a count of batches incorporated. This quantity will include concrete placed in widening sections and partial depth patches.

B. Portland Cement Concrete Overlay, Placement Only.
The quantity of Portland Cement Concrete Overlay, Placement Only, in square yards (square meters), will be the quantity shown in the contract documents. The area of PCC overlay placement will be determined from the longitudinal surface and the nominal pavement width, including widening sections.

C. Surface Preparation.
The quantity of Surface Preparation, in square yards (square meters), will be the quantity shown in the contract documents. The area of surface preparation will be determined from the longitudinal surface and the nominal width of existing pavement.

D. Pavement Scarification

1. Measurement by Weight (Mass).
The quantity of Pavement Scarification will be determined in accordance with Section 2214.06, A, 1.

2. Measurement by Area.
The quantity of Pavement Scarification will be determined in accordance with Section 2214.06, A, 2.

~~D~~E. Hot Mix Asphalt Stress Relief Course.

1. Measurement by Weight (Mass).
When measurement is by weight (mass), the quantity of Hot Mix Asphalt Stress Relief Course will be expressed in tons (megagrams) and determined from the weight (mass) of individual loads, including fillets, measured to the nearest 0.01 tons (0.01 Mg). Loads may be weighed in trucks, weigh hoppers, or from the weight (mass) from batch plants computed by count of batches in each truck and batch weight (mass). Article 2001.07 shall apply.

The asphalt binder will be measured in accordance with Article 2303.05, B.

2. Measurement by Area.
When payment is based on square yards (square meters), the quantity of Hot Mix Asphalt Stress Relief Course, in square yards (square meters), will be the quantity shown in the contract documents.

The quantity of asphalt binder used will not be measured separately for payment.

2310.05 BASIS OF PAYMENT.
For the performance of acceptable work, measured as provided above, the Contractor will be paid the contract unit price in accordance with the following provisions:

A. Portland Cement Concrete Overlay, Furnish Only.
The Contractor will be paid the contract unit price per cubic yards (cubic meters) for Portland Cement Concrete, Furnish Only, as measured above. This payment shall be full compensation for furnishing all raw materials, and for proportioning, mixing, and delivery of concrete to the paving machine.

B. Portland Cement Concrete Overlay, Placement Only.
The Contractor will be paid the contract unit price per square yard (square meter) for Portland Cement Concrete Overlay, Placement Only. This payment shall be full compensation for furnishing all materials, labor, and equipment necessary to place, finish, texture, and cure the concrete, including the placement of tie bars for widening, if required; sawing, cleaning, and sealing the joints, if required; and surface cleaning.

C. Surface Preparation.

The Contractor will be paid the contract unit price per square yard (square meter) for Surface Preparation. This payment shall be full compensation for preparation of the existing pavement, sandblasting or shot blasting, and for removal of the existing pavement surface material in accordance with Article 1104.08.

D. Pavement Scarification

1. Measurement by Weight (Mass).
The contractor will be paid the contract unit price for Pavement Scarification in accordance with Section 2214.07, A, 1.

2. Measurement by Area.
The contractor will be paid the contract unit price for Pavement Scarification in accordance with Section 2214.07, A, 2.

~~D~~E. Hot Mix Asphalt Stress Relief Course.
The Contractor will be paid for the asphalt binder in accordance with Article 2303.06, B.

1. Measurement by Weight (Mass).
The Contractor will be paid the contract unit price per ton (megagram) for Hot Mix Asphalt Stress Relief Course as measured above. This payment shall be full compensation for furnishing and placing the HMA stress relief course. The Contractor will be paid separately for the asphalt binder in accordance with Article 2303.06, B.

2. Measurement by Area.
The Contractor will be paid the contract unit price per square yard (square meter) for Hot Mix Asphalt Stress Relief Course constructed. This payment shall be full compensation for furnishing and placing the HMA stress relief course, including the cost of the asphalt binder.

Reason for Revision: Revises preparation of surface language to require the Surface Preparation item only for Bonded Overlays and Pavement Scarification for Unbonded Overlays and Whitetopping. Also, revises joint sawing requirements for bonded overlays and compaction requirements for HMA stress relief course.

County or City Input Needed (X one)			**Yes**	**No** X	
Comments:					
Industry Input Needed (X one)			**Yes** X	**No**	
Industry Notified:	**Yes** X	**No**	**Industry Concurrence:**	**Yes** X	**No**
Comments:					

SPECIFICATION REVISION SUBMITTAL FORM

Submitted by: Jim Berger	**Office:** Materials	**Item 4**
Submittal Date: 2009.04.30	**Proposed Effective Date:** October, 2009	
Article No.: 2413.02, B **Title:** Class HPC-O High Performance Concrete (Materials)	**Other:**	

Specification Committee Action: Approved as is.

Deferred:	**Not Approved:**	**Approved Date:** 05/14/2009	**Effective Date:** 10/20/2009

Specification Committee Approved Text:

2413.02, B, Class HPC-O High Performance Concrete.

Replace the second indented paragraph:

A mid-range water reducing admixture meeting the requirements of Materials I.M. 403, Appendix C, shall be used. The intent of the mid-range water reducer is to achieve a workable, dense, and low w/c ratio concrete. Other admixtures, or combinations of admixtures and dosages, may be approved by the Engineer to achieve a workable low w/c ratio mix.

Comments: Materials wanted to clarify the intent to contractors.

Specification Section Recommended Text:

Comments:

Member's Requested Change: **(Do not use 'Track Changes', or 'Mark-Up'. Use ~~Strikeout~~ and Highlight.**

B. Class HPC-O High Performance Concrete.
Class HPC-O shall meet the requirements of Materials I.M. 529 and the following requirements:

The slump, measured in accordance with Materials I.M. 317 shall be 1 inch (25 mm) to 3 inches (75 mm) with a maximum of 4 inches (100 mm). Testing for slump of concrete from a continuous mixer shall commence within 2 to 4 minutes after the concrete is discharged. Testing for slump of concrete from ready mix shall be done prior to placement.

A mid-range water reducing admixture meeting the requirements of Materials I.M. 403, Appendix C, shall be used. The intent of the mid-range water reducer is to achieve a workable, dense, low water to cementitious material (w/c) ratio concrete. Other admixtures or combinations of admixtures and dosages may be approved by the Engineer to achieve a workable low w/c ratio mix.

Air content shall be the same as required for Class O PCC.

Type IS or Type IP cement shall be used. If Type I/II is used, 25% replacement with ground granulated blast furnace slag shall be required.

Fly ash substitution rate shall not exceed 15% replacement by weight.

Reason for Revision: There is some confusion as to the intent of the HPC-O mix. The revision hopefully clarifies that the intent is to achieve a low w/c. Some brands of mid-range admixtures appear to be less effective at maintaining slump over long hauls. The change will allow those admixture suppliers that don't have a long lasting mid-range, to propose combinations that can achieve the same properties.					
County or City Input Needed (X one)			**Yes**	**No** X	
Comments:					
Industry Input Needed (X one)			**Yes**	**No**	
Industry Notified:	**Yes**	**No**	**Industry Concurrence:**	**Yes**	**No**
Comments:					

SPECIFICATION REVISION SUBMITTAL FORM

Submitted by: Jim Berger	**Office:** Materials	**Item 5**
Submittal Date: 2009.04.03	**Proposed Effective Date:** October 2009	
Article No.: 2513.03, B **Title:** Cast-in-Place and Slip Form (Concrete Barrier, Concrete)	**Other:**	

Specification Committee Action: Deferred to June meeting

Deferred: X	**Not Approved:**	**Approved Date:**	**Effective Date:**

Specification Committee Approved Text:

2513.03, B, Cast-in-Place and Slip Form.

Replace the second paragraph:

Class BR mix design shall be submitted to the District Materials Engineer for approval at least 7 calendar days prior to placement. Personnel overseeing the development of the mix design shall be Iowa DOT PCC Level III Certified Technicians. Section 2403 shall apply, except the concrete shall meet the following mix design requirements:

Comments:

Specification Section Recommended Text:

Comments:

Member's Requested Change (Redline/Strikeout):

B. Cast-in-Place and Slip Form.
Class C concrete in accordance with Materials I.M. 529 shall be used for cast-in-place. Class BR in accordance with Materials I.M. 529 shall be used for slip form.

Class BR mix design shall be submitted to the District Materials Engineer for approval at least 7 calendar days prior to placement. Personnel overseeing the development of the mix design shall be an Iowa DOT PCC Level III Certified Technician. Section 2403 shall apply, except the concrete shall meet the following mix design requirements:

Reason for Revision:

County or City Input Needed (X one)	**Yes**	**No**
Comments:		

Industry Input Needed (X one)			**Yes** Sent to IRMCA	**No**	
Industry Notified:	**Yes** X	**No**	**Industry Concurrence:**	**Yes** X	**No**

Comments: Typically has been a Level III person developing the mix designs. Sometimes we get

personnel with little knowledge trying to develop the mix and they want the DOT to determine proportions. Since it is their mix it would be better to have the producer develop a mix with their own personnel who has been certified. Most ready mix producers have certified PCC III personnel.

SPECIFICATION REVISION SUBMITTAL FORM

Submitted by: John Smythe / Kevin Merryman	**Office:** Construction	**Item 6**
Submittal Date: April 21, 2009	**Proposed Effective Date:** October 2009	
Article No.: 2526.01 **Title:** Description (Construction Survey)	**Other:**	

Specification Committee Action: Deferred to June meeting

Deferred: X	**Not Approved:**	**Approved Date:**	**Effective Date:**

Specification Committee Approved Text:

2526.01, J, Pavement Overlays (PCC and HMA).

Rename article:

J. ~~Pavement~~ HMA Overlays ~~(PCC and HMA)~~.

2526.01, K, PCC Overlays.

Add article:

Locations and elevations shall be marked with metal pin or tack in a wood hub (only tack one side), flat, and lath. Elevations on both sides of the pavement at 50 foot (10 m) intervals on straight and level sections and at 25 foot (10 m) intervals on horizontal and vertical curves. Flats shall be clearly marked with the station location, cut/fill information, and offset distance to the edge of pavement. Pavement cross slope information shall be included for superelevated curves.

Elevations of pavement centerline, and both edges at bridges and existing pavement, shall be taken at 10 foot (3 m) intervals for 100 feet (30 m). Final elevations shall be submitted to the Engineer for approval.

When a new profile grade is not included in the contract documents the Contractor shall:

1. Obtain elevations of the existing pavement at centerline and both pavement edges for bonded overlays and projects including mainline pavement scarification.

Obtain elevations of the existing pavement at centerline, quarter points, and both pavement edges for unbonded overlays and whitetopping projects when a stress relief course and pavement scarification are not included.

Elevations shall be taken at 100 foot (30 m) intervals on straight and level sections and at 50 foot (10 m) intervals on horizontal and vertical curves.

2. Design a smooth profile grade line based on these elevations to provide the required pavement or shoulder thickness as detailed in the contract documents. This grade line shall tie into existing bridges, adjacent pavement and ramps, and provide the required pavement crown. This proposed grade line shall be submitted to the Engineer for approval.

Reference and preserve existing control points located at each Point of Intersection (P.I.).
Method used to reference points shall be approved by the Engineer.
Control Points shall be reset after the work is complete.

2526.01, K, Structural Walls.

Renumber article:

~~**K**~~ **L. Structural Walls.**

Comments:

Specification Section Recommended Text:

Comments:

Member's Requested Change (Redline/Strikeout):

2526.01 DESCRIPTION.

J. ~~Pavement~~ HMA Overlays ~~(PCC and HMA)~~

Reference and preserve existing control points located at each Point of Intersection (P.I.).

Method used to reference points shall be approved by the Engineer.

Control Points shall be reset after the work is complete.

K. PCC Overlays

Locations and elevations shall be marked with metal pin or tack in a wood hub (only tack one side), flat, and lath. Elevations on both sides of the pavement at 50 foot (10 m) intervals on straight and level sections and at 25 foot (10 m) intervals on horizontal and vertical curves. The flat shall be clearly marked with the station location, cut/fill information, and offset distance to the edge of pavement. Pavement cross slope information shall be included in superelevated curves.

Elevations of pavement centerline, and both edges at bridges and existing pavement, shall be taken at 10 foot (3 m) intervals for 100 feet (30 m). Final elevations shall be submitted to the Engineer for approval.

When a new profile grade is not included in the contract documents the Contractor shall:

1. Obtain elevations of the existing pavement at centerline and both pavement edges for bonded overlays and projects including mainline pavement scarification.

Obtain elevations of the existing pavement at centerline, quarter points, and both pavement edges for unbonded overlays and whitetopping projects when a stress relief course and pavement scarification are not included.

Elevations shall be taken at 100 foot (30 m) intervals on straight and level sections and at 50 foot (10 m) intervals on horizontal and vertical curves.

2. Design a smooth profile grade line based on these elevations to provide the required pavement or shoulder thickness as detailed in the contract documents. This grade line shall tie into existing bridges, adjacent pavement and ramps, and provide the required pavement crown. This proposed grade line shall be submitted to the Engineer for approval.

Reference and preserve existing control points located at each Point of Intersection (P.I.).

Method used to reference points shall be approved by the Engineer.

Control Points shall be reset after the work is complete.

~~KL~~. Structural Walls.
Survey requirements for structural walls shall include the following work types:

Mechanically Stabilized Earth (MSE) Walls
Cast in Place (CIP) Retaining Walls
Soil Nail Walls
Tie Back Walls
Noise Walls
Modular Block Retaining Walls
Segmental Retaining Walls

Locations and elevations shall be marked with a metal pin or a wood hub, flat, and lath. The flat shall be clearly marked with the station location, cut/fill elevation, and offset distance to face of wall.

Reason for Revision: Current specification language does not adequately describe survey requirements for PCC overlays. The changes more thoroughly describe staking requirements and requirements for developing a profile grade when one is not provided.

County or City Input Needed (X one)			**Yes**	**No** X	
Comments:					
Industry Input Needed (X one)			**Yes** X	**No**	
Industry Notified:	**Yes** X	**No**	**Industry Concurrence:**	**Yes**	**No**
Comments:					

SPECIFICATION REVISION SUBMITTAL FORM

Submitted by: John Smythe / Mark Bortle	**Office:** Construction	**Item 7**
Submittal Date: March 2, 2009	**Proposed Effective Date:** October 20, 2009	
Article No.: 2528.13 **Title:** Basis of Payment (Traffic Control)	**Other:**	

Specification Committee Action: Approved as is

Deferred:	**Not Approved:**	**Approved Date:** 05/14/2009	**Effective Date:** 10/20/2009

Specification Committee Approved Text:

2528.13, A, 4, Temporary Traffic Signals.

Replace the paragraph:

The Contractor will be paid the contract unit price for each group installation operated by a common control unit, normally four signal heads at the same traffic control area. This payment shall be full compensation for furnishing, installing, maintaining and servicing the controller, signal heads, traffic detection system, and signal operator, costs for electrical energy, and the cost of removing temporary traffic signal materials from the construction site. The Contractor shall supply their own breaker box and power meter and shall not connect to existing Contracting Authority owned circuits to supply power for temporary traffic signals.

2528.13, A, 5, Temporary Floodlighting.

Add as the third sentence:

The Contractor shall supply their own breaker box and power meter and shall not connect to existing Contracting Authority owned circuits to supply power for temporary floodlighting.

Comments: Construction noted there have been a couple of cases of this happening. Construction also noted safety concerns if temporary traffic signals or floodlighting would overload a circuit to existing lighting or signals.

Specification Section Recommended Text:

Comments:

Member's Requested Change: **(Do not use 'Track Changes', or 'Mark-Up'. Use ~~Strikeout~~ and Highlight.)**

2528.13 BASIS OF PAYMENT.

4. Temporary Traffic Signals.

The Contractor will be paid the contract unit price for each group installation operated by a common control unit, normally four signal heads at the same traffic control area. This payment shall be full compensation for furnishing, installing, maintaining and servicing the controller, signal heads, traffic detection system, and signal operator, all costs for electrical energy, and the cost of removing all temporary traffic signal materials from the construction site. The Contractor shall supply their own breaker box and power meter and shall not connect to any existing Department owned circuits to supply power for the temporary traffic signals.

5. Temporary Floodlighting.

The Contractor will be paid the contract unit price for each Temporary Floodlighting Luminaire installed. This payment shall be full compensation for furnishing, installing, maintaining and servicing the temporary floodlighting units, all costs for electrical energy, and the cost of removing all lighting materials from the construction site. The Contractor shall supply their own breaker box and power meter and shall not connect to any existing Department owned circuits to supply power for the temporary floodlighting.					
Reason for Revision: To clarify that the Contractor needs to independently supply power for temporary traffic signals and temporary floodlighting, without connecting into any existing Department owned circuits.					
County or City Input Needed (X one)			**Yes**	**No** X	
Comments:					
Industry Input Needed (X one)			**Yes**	**No** X	
Industry Notified:	**Yes**	**No** X	**Industry Concurrence:**	**Yes**	**No**
Comments:					

SPECIFICATION REVISION SUBMITTAL FORM

Submitted by: Jim Berger	**Office:** Materials	**Item 8**
Submittal Date: 5/1/2009	**Proposed Effective Date:** 5/14/09	
Section No.: 4161 **Title:** Preservative Treatment	**Other:**	

Specification Committee Action: Approved as is

Deferred:	**Not Approved:**	**Approved Date:** 05/14/2009	**Effective Date:** 10/20/2009

Specification Committee Approved Text:

4161.03, Treatment.

Replace the first paragraph and Tables 1 and 2:

Except as provided herein, preservative treatment shall be in accordance with requirements and recommendations of AWPA Standards ~~C1~~ U1 and T1 and the applicable AWPA Commodity Specifications listed in the following tables for various materials and usages:

TABLE 1: MINIMUM PRESERVATIVE RETENTION REQUIREMENTS
(lb./cu.ft. of wood)
(kilograms per cubic meter of wood)

	Retention					
Material and Usage	**Creosote[2]**	**Pentachloro-phenol[2]**	**Copper Napthenate[2]**	**ACZA[3]**	**CCA[1, 3]**	**AWPA UC-Section-Special Req.**
Lumber and Timber for Structures	~~(192.2)~~ AWPA U1	AWPA U1	AWPA U1	AWPA U1	AWPA U1	AWPA U1
Piles for Foundation:						
Douglas Fir	17 (272)	0.85 (13.6)	0.14 (2.2)	-	-	UC4C-E
Southern Pine	12 (192)	0.60 (9.6)	0.10 (1.6)	-	-	
Post, Guardrail, and Spacer Blocks:						
Sawed Four Sides		0.6 (9.6)	0.075 (1.2)	0.5 (8.0)	0.5 (8.0)	UC4A-B
Posts, Fence, Guide, and Sign:						
Round		0.4 (6.4)	0.055 (0.88)	0.4 (6.4)	0.4 (6.4)	UC4A-B UC4A-A-4.3
Sawed Four Sides		0.5 (8.0)	0.060 (0.96)	0.4 (6.4)	0.4 (6.4)	

NOTE: [1] CCA shall not be used for the treatment of Douglas Fir.
[2] Oil type preservatives
[3] CCA, ACA, and ACZA are waterborne preservatives.
[4] Retentions based on AWPA~~.~~ Use Category and Commodity Specifications for different applications.

TABLE 2: MINIMUM PRESERVATIVE PENETRATION REQUIREMENTS
inches (mm) of wood and/or % of sapwood penetration

	Penetration[1]		
Material and Usage	**Southern Pine**	**Douglas Fir**	**AWPA**

Lumber and Timber for Structures	APWA U1, T1	APWA U1, T1	APWA U1, T1
Piles for Foundation:	~~2.5~~ 3.0 in. (~~63~~ 75 mm) or ~~85~~ 90%	0.75 in. (19 mm) and 85% up to 1.6 in. (40 mm) and 85%	T1-8.5
Post, Guardrail, and Spacer Blocks: Sawed Four Sides	2.5 in. (63 mm) or 85%	**Under 5 in. (125 mm) thick:** 0.4 in. (10 mm) and 90% **5 in. (125 mm) and thicker:** 0.5 in. (13 mm) and 90%	T1-8.1
Posts, Fence, Guide, and Sign: Round	2.0 in. (50 mm) or 85%	3/8 in. (9 mm) and 100% up to 1 in. (25 mm) or 85%	T1-8.2
Sawed Four Sides	2.5 in. (63 mm) or 85%	**Under 5 in. (125 mm) thick:** 0.4 in. (10 mm) and 90% **5 in. (125 mm) and thicker:** 0.5 in. (13 mm) and 90%	T1-8.1

Note: [1]Penetrations based on AWPA~~-~~ Use Category and Commodity Specifications for different applications.

Comments: None

Specification Section Recommended Text:

Comments:

Member's Requested Change: **(Do not use 'Track Changes', or 'Mark-Up'. Use ~~Strikeout~~ and Highlight.)**

Section 4161. Preservative Treatment.

4161.01 DESCRIPTION.
Preservative treatment of timber, lumber, piling, and posts shall meet requirements of applicable sections, within these specifications, which cover the individual materials. Unless otherwise specified, the treatment process and results of treatment shall meet requirements of this section.

4161.02 PRESERVATIVES.
Preservatives used for treatment shall meet requirements of Section 4160. Unless otherwise specified, treatment may be with creosote, pentachlorophenol, chromated copper arsenate (CCA), ammoniacal copper zinc arsenate (ACZA), or Copper Naphthenate.

4161.03 TREATMENT.
Except as provided herein, preservative treatment shall be in accordance with requirements and recommendations of AWPA Standards ~~C1~~ U1 and T1 and the applicable AWPA Commodity Specifications listed in the following tables for various materials and usages:

TABLE 1: MINIMUM PRESERVATIVE RETENTION REQUIREMENTS
(lb./cu.ft. of wood)
(kilograms per cubic meter of wood)

	Retention					
Material and Usage	**Creosote[2]**	**Pentachloro-phenol [2]**	**Copper Napthenate[2]**	**ACZA[3]**	**CCA[1, 3]**	**AWPA UC-Section-Special Req.**
Lumber and Timber for Structures	~~(192.2)~~ AWPA U1	AWPA U1	AWPA U1	AWPA U1	AWPA U1	AWPA U1

Piles for Foundation: Douglas Fir Southern Pine	17 (272) 12 (192)	0.85 (13.6) 0.60 (9.6)	0.14 (2.2) 0.10 (1.6)	- -	- -	UC4C-E
Post, Guardrail, and Spacer Blocks: Sawed Four Sides		0.6 (9.6)	0.075 (1.2)	0.5 (8.0)	0.5 (8.0)	UC4A-B
Posts, Fence, Guide, and Sign: Round Sawed Four Sides		0.4 (6.4) 0.5 (8.0)	0.055 (0.88) 0.060 (0.96)	0.4 (6.4) 0.4 (6.4)	0.4 (6.4) 0.4 (6.4)	UC4A-B UC4A-A-4.3

NOTE: [1] CCA shall not be used for the treatment of Douglas Fir.
[2] Oil type preservatives
[3] CCA, ACA, and ACZA are waterborne preservatives.
[4] Retentions based on AWPA~~-~~ Use Category and Commodity Specifications for different applications.

TABLE 2: MINIMUM PRESERVATIVE PENETRATION REQUIREMENTS
inches (mm) of wood and/or % of sapwood penetration

	Penetration[1]		
Material and Usage	**Southern Pine**	**Douglas Fir**	**AWPA Material Standard Section**
Lumber and Timber for Structures	APWA U1, T1	APWA U1, T1	APWA U1, T1
Piles for Foundation:	~~2.5~~ 3.0 in. (~~63~~ 75 mm) or ~~85~~ 90%	0.75 in. (19 mm) and 85% up to 1.6 in. (40 mm) and 85%	T1-8.5
Post, Guardrail, and Spacer Blocks: Sawed Four Sides	2.5 in. (63 mm) or 85%	**Under 5 in. (125 mm) thick:** 0.4 in. (10 mm) and 90% **5 in. (125 mm) and thicker:** 0.5 in. (13 mm) and 90%	T1-8.1
Posts, Fence, Guide, and Sign: Round Sawed Four Sides	2.0 in. (50 mm) or 85% 2.5 in. (63 mm) or 85%	3/8 in. (9 mm) and 100% up to 1 in. (25 mm) or 85% **Under 5 in. (125 mm) thick:** 0.4 in. (10 mm) and 90% **5 in. (125 mm) and thicker:** 0.5 in. (13 mm) and 90%	T1-8.2 T1-8.1

Note: [1]Penetrations based on AWPA~~-~~ Use Category and Commodity Specifications for different applications.

Other aspects of the treatment process shall meet the following requirements:

A. Incising.
Coastal Douglas Fir lumber shall be incised.

B. Seasoning.
When sawed material is treated with waterborne preservatives (CCA~~,~~, ACZA), the moisture content prior to treatment, as determined by resistance type moisture meter, shall not be more than 20% if kiln dried or not more than 23% if air dried. The moisture content shall be measured at a depth equivalent to the required penetration up to a maximum of 1.5 inches (38 mm). Unless otherwise specified, lumber 2 inches (50 mm) or less in nominal

thickness that is treated with a waterborne preservative shall be dried after treatment to a moisture content of not more than 20% if kiln dried or not more than 23% if air dried.					
Reason for Revision: New treatment plant requested use of Pentachlorophenol on timber piling. Penta is allowed on piling by the America Wood Protection Association (AWPA), and AASHTO M133. Update to meet AWPA penetration requirement for Southern Pine for timber piling used in Highway Construction (land and fresh water piling).					
County or City Input Needed (X one)			**Yes**	**No**	
Comments:					
Industry Input Needed (X one)			**Yes**	**No**	
Industry Notified:	**Yes**	**No**	**Industry Concurrence:**	**Yes**	**No**
Comments:					

SPECIFICATION REVISION SUBMITTAL FORM

Submitted by: Mike Kennerly	**Office:** Design	**Item 9**
Submittal Date: 5/4/09	**Proposed Effective Date:** October, 2009	
Article No.: DS-01120 **Title**: Backfilling And Compaction Of Culverts By Flooding	**Other:**	

Specification Committee Action: Approved as is

Deferred:	**Not Approved:**	**Approved Date:** 05/14/2009	**Effective Date:** 10/20/2009

Specification Committee Approved Text: See attached draft DS-011XX

Comments: SUDAS has expressed concern with using for storm sewer. If DS is used for storm sewer, it would only be under a roadway.

Specification Section Recommended Text: See attached DS-011XX

Comments:

Member's Requested Change: **(Do not use 'Track Changes', or 'Mark-Up'. Use ~~Strikeout~~ and Highlight.**

01120.02 Materials
See attached Draft DS.

Reason for Revision: Additional changes to those requested by the Office of Materials for the April meeting.

County or City Input Needed (X one)	**Yes**	**No** X
Comments:		

Industry Input Needed (X one)			**Yes**	**No** X	
Industry Notified:	**Yes**	**No**	**Industry Concurrence:**	**Yes**	**No**
Comments:					

Draft DS-01XXX
(Replaces DS-01120)

Iowa Department of Transportation

DEVELOPMENTAL SPECIFICATIONS
FOR
BACKFILLING AND COMPACTION OF CULVERTS BY FLOODING

Effective Date
October 20, 2009

THE STANDARD SPECIFICATIONS, SERIES 2001, ARE AMENDED BY THE FOLLOWING MODIFICATIONS AND ADDITIONS. THESE ARE DEVELOPMENTAL SPECIFICATIONS AND THEY SHALL PREVAIL OVER THOSE PUBLISHED IN THE STANDARD SPECIFICATIONS.

01XXX.01 Description
This specification describes backfill and compaction requirements for culverts using flooding. Sections 2415, 2416 and 2417 of the Standard Specifications shall apply unless modified by this specification.

01XXX.02 Materials
~~Granular~~ Floodable backfill material shall meet the requirements of Section 4134 of the Standard Specifications ~~have 4% or less passing the No. 200 (75 µm) sieve (e.g. washed concrete sand)~~.

Porous backfill material, when required, shall meet the requirements of Section 4131 of the Standard Specifications.

01XXX.03 Construction
When backfilling and compaction by flooding is required, ~~granular~~ backfill may be placed in lifts up to 2 feet (0.6 m) thick. The Contractor shall determine if ~~box or pipe~~ culverts need to be restrained and take appropriate actions to prevent floating of culverts during backfilling, flooding, and compaction.

~~Cohesive soil plugs shall be constructed at the inlet, outlet, and sides (if needed) prior to flooding.~~

Surface flooding each lift shall start at the inlet end of the ~~pipe or box~~ culvert and progress to the outlet. To ensure uniform surface flooding and adequate compaction, water shall be fan-sprayed in successive 6 to 8 foot (1.8 to 2.4 m) increments from a 2 inch (50 mm) diameter hose for 3 minutes within each increment. The hose shall be run fully; however, the water pressure shall be low enough to avoid erosion of cohesive soil plugs.

After flooding, the Contractor shall evaluate the effectiveness of the compaction with a vibratory pan compactor. If the pan compactor produces visible compaction, repeat flooding process until the pan compactor produces no visible compaction.

01XXX.04 Method of Measurement
The quantity of Flooded Backfill, in cubic yards (cubic meters), will be the quantity shown in the contract documents regardless of the compaction method. The quantity measured for payment will not be adjusted unless the quantity of ~~pipe~~ culvert installed is adjusted.

01XXX.05 Basis of Payment
The Contractor will be paid the contract unit price for Flooded Backfill per cubic yard (cubic meters).

~~Water required for flooding~~ Backfill material, subdrains, ~~porous backfill,~~ restraining culverts against floating, and water required for flooding ~~granular backfill~~ will not be measured separately for payment, but will be considered incidental to the contract unit price bid for Flooded Backfill.

SPECIFICATION REVISION SUBMITTAL FORM

Submitted by: Norm McDonald	**Office:** Bridges & Structures	**Item 10**
Submittal Date: 2009.05.01	**Proposed Effective Date:** August letting	
Article No.: SS-01032 **Title:** Concrete Drilled Shafts	**Other:**	

Specification Committee Action: Approved with changes noted below

Deferred:	**Not Approved:**	**Approved Date:** 05/14/2009	**Effective Date:** 08/18/2009

Specification Committee Approved Text: See attached draft SS-010XX, Concrete Drilled Shaft, and draft DS-011XX, Concrete Drilled Shaft for Support Structures.

Comments: Bridges and Structures wanted separate specifications for Concrete Drilled Shafts (intended for bridges only) and Concrete Drilled Shaft for Support Structures. The specification for concrete drilled shafts for support structures eliminates load tests, demo shafts, and test shafts. Bridges and Structures recommended a DS for the specification for concrete drilled shafts for support structures so the use of this specification may be controlled. Ahmad Abu-Hawash will be the controller. A technical memo will be developed to outline the use of the new DS. Bridges and Structures suggested the concrete drilled shaft bid item for the new DS have a different name (Concrete Drilled Shaft for Support Structures) so the cost can be tracked separately from concrete drilled shafts for bridges.

In reviewing the existing specification for concrete drilled shafts, Bridges and Structures suggested some minor changes regarding access pipe specifications.

Specification Section Recommended Text:

Comments:

Member's Requested Change: **(Do not use 'Track Changes', or 'Mark-Up'. Use ~~Strikeout~~ and Highlight.)**
See attached draft SS-010XX.

Reason for Revision:

County or City Input Needed (X one)	**Yes**	**No**
Comments:		
Industry Input Needed (X one)	**Yes**	**No**

Industry Notified:	**Yes**	**No**	**Industry Concurrence:**	**Yes**	**No**
Comments:					

Draft SS-01XXX
(Replaces SS-01032)

Iowa Department of Transportation

SUPPLEMENTAL SPECIFICATIONS
FOR
CONCRETE DRILLED SHAFT

Effective Date
August 18, 2009

THE STANDARD SPECIFICATIONS, SERIES 2001, ARE AMENDED BY THE FOLLOWING MODIFICATIONS AND ADDITIONS. THESE ARE SUPPLEMENTAL SPECIFICATIONS AND THEY SHALL PREVAIL OVER THOSE PUBLISHED IN THE STANDARD SPECIFICATIONS.

01XXX.01 DESCRIPTION
Concrete drilled shaft foundation shall consist of reinforced concrete placed in a drilled shaft and rock socket as shown on the plans.

The elevations, dimensions, and depth of the drilled shafts and rock sockets shall be as specified in the plans. The socket elevation may be adjusted by the Engineer if bearing strata are encountered at different elevations or are judged to be of a different quality.

01XXX.02 Materials
All submittals shall be in electronic format.

A. Slurry
Only mineral or polymer slurries shall be used in the drilling process unless other drilling fluids are approved in writing by the Engineer. The percentage and specific gravity of the material used to make the suspension shall be sufficient to maintain the stability of the excavation and to allow proper concrete placement. In the event of a sudden significant loss of slurry to the excavation, the construction of the foundation shall be stopped until either methods to stop slurry loss or an alternate construction procedure has been approved by the Engineer.

All tests specified below shall be performed when the slurry temperature is above 40°F (4°C).

Mineral slurry or polymer slurry shall be premixed thoroughly with clean, fresh water, and adequate time (as prescribed by the manufacturer) allotted for hydration in slurry tanks. Slurry tanks of adequate capacity will be required for slurry circulation, storage, treatment, and disposal. No excavated slurry pits will be allowed. The Contractor shall draw sample sets from the slurry tanks and test the samples for conformance with the specified material properties prior to introduction into the shaft excavation. A sample set shall be composed of samples taken at mid-height and within 2 feet (0.6 m) of the bottom of the slurry tanks.

The Contractor shall sample and test all slurry in the presence of the Engineer, unless otherwise directed. The date, time, names of the persons sampling and testing the slurry, and the results of the tests shall be recorded. A copy of the recorded slurry test results shall be submitted to the Engineer at the completion of each shaft, and during construction of each shaft when requested by the Engineer.

Sample sets of all slurry, composed of samples taken at mid-height and within 2 feet (0.6 m) of the bottom of the shaft, shall be taken and tested during shaft excavation as necessary to verify the control of the properties of the slurry. As a minimum, sample sets shall be taken and tested at least once every 2 hours after beginning slurry use. When the test results show consistent specified properties, sample sets shall be taken and tested at least once every 4 hours of slurry use. Slurry shall be recirculated, or agitated with the drilling equipment, when tests show that the sample sets do not have consistent specified properties.

When samples are found to be unacceptable, the Contractor shall clean, recirculate, desand, or replace the slurry to maintain the required slurry properties. Cleaning of the bottom of the excavation and placement of the concrete shall not begin until tests show that the sample sets have consistent specified properties.

The Contractor shall demonstrate to the satisfaction of the Engineer that stable conditions are being maintained. If the Engineer determines that stable conditions are not being maintained, the Contractor shall immediately take action to stabilize the shaft. The Contractor shall submit a revised installation plan, which corrects the problem and prevents future instability. The Contractor shall not continue with shaft construction until receiving the Engineer's approval of the revised shaft installation plan.

1. Mineral Slurry

Mineral slurry shall conform to the following requirements:

Property	Test Method	Requirements
Density (lb/ft^3 (kg/m^3))	Slurry Density, Materials I.M. 387	64 to 75 (1030 to 1200)
Viscosity (sec/gal (sec/L))	Marsh Funnel and Cup, Materials I.M. 387	104 to 201 (27.5 to 53)
pH	pH Paper	8 to 11
Sand Content (%)	Sand Content Test, Materials I.M. 387	See note*
* The sand content of mineral slurry prior to placing the reinforcing steel cage and immediately prior to placing concrete shall be less than or equal to 4.0%.		

2. Polymer Slurry

Polymer slurry shall be used in conformance with the manufacturer's recommendations and these Supplemental Specifications. The Contractor shall submit the name and telephone number of the manufacturer's representative to the Engineer. The manufacturer's representative shall provide technical assistance in the use of the polymer slurry as needed.

Polymer slurry shall conform to the following requirements:

Property	Test Method	Requirements
Density (lb/ft^3 (kg/m^3))	Slurry Density, Materials I.M. 387	62 to 63 (995 to 1010)
Viscosity (sec/gal (sec/L))	Marsh Funnel and Cup ,Materials I.M. 387	136 to 227 (36 to 60) 231 to 252 (61 to 66.5) (dry sand/gravel)
pH	pH Paper	8 to 11
Sand Content (%)	Sand Content Test, Materials I.M. 387	See note *
* The sand content of polymer slurry prior to placing the reinforcing steel cage and immediately prior to placing concrete shall be less than 2.0%.		

The Contractor shall wait 30 minutes, after the last drilling and scouring, to allow contaminants to settle out before taking and testing a sample set of slurry. After the reinforcing steel cage is placed in the excavation, a sample set of slurry shall be taken and tested immediately prior to concrete placement.

B. Concrete

All materials, proportioning, air entraining, mixing, slump, and transporting of PCC shall be in accordance with Section 2403 of the Standard Specifications except as modified herein.

The water/cement ratio shall not exceed 0.45.

The concrete for construction of drilled shafts shall be a Class D PCC mixture with a slump of 8 inches ±1.5 inches (200 mm ±40mm).

Air entrainment shall be used above the frost line. The air content above the frost line shall be 6.5%, ±1.0%. The air content below the frost line shall be 5%, plus 2.5% or minus 2.0%.

The Contractor shall use a mid-range water in accordance with Materials I.M. 403.

Retarder shall be required in accordance with Materials I.M. 403 to maintain workable concrete. Portland cement shall meet the requirements of ASTM C 150 Type I / II and Section 4101, of the Standard Specifications.

Ground Granulated Blast Furnace Slag (GGBFS) shall not be used.

C. Grout
Materials I.M. 388 shall apply.

01XXX.03 Construction
All submittals shall be in electronic format.

A. CONSTRUCTION TOLERANCES.

1. The drilled shaft shall be within 3 inches (75 mm) of plan position at the top of shaft.

2. The vertical alignment of shaft excavation shall not vary from the plan alignment by more than 1/4 inch/foot (20 mm/m of depth).

3. Full depth reinforcing steel cages shall be set at no less than 6 inches (150 mm) above the bottom of the excavated shaft prior to placement of concrete.

4. After all the concrete is placed; the top of the reinforcing steel cage shall be no more than 6 inches (150 mm) above and no more than 2 3/4 inches (70 mm) below plan position.

5. The dimensions of casings are subject to American Pipe Institute tolerances applicable to regular steel pipe.

6. The top elevation of the shaft may have a tolerance of up to plus 1 inch (25 mm) or minus 3 inches (75 mm) from the plan top of shaft elevation. Sufficient reinforcement bar splice length for splices above the shaft shall be attained.

7. Excavation equipment and methods shall be designed so that the completed shaft excavation will have a planar bottom. The cutting edges of excavation equipment shall be normal to the vertical axis of the equipment within a tolerance of 3/8 inch/foot (30 mm/m) of diameter.

Drilled shaft excavations and completed shafts not constructed within the required tolerances are unacceptable. The Contractor shall be responsible for correcting all unacceptable shaft excavations and completed shafts to the satisfaction of the Engineer. Materials and work necessary, including engineering analysis and redesign, to complete corrections for out of tolerance drilled shaft excavations shall be furnished without either cost to the Contracting Authority or an extension of the completion dates of the project.

B. DRILLED SHAFT INSTALLATION PLAN

Two weeks prior to the pre-construction conference, the Contractor shall submit a list containing at least three projects completed in the last three years on which the Contractor has installed drilled shafts of a diameter and length similar to those shown on the plans. The list of projects shall contain names and phone numbers of owner's representatives who can verify the Contractor's participation on those projects. The Contractor shall also submit a signed statement that they have inspected the project site and all the subsurface information made available in the contract documents.

No later than 1 month prior to constructing drilled shafts, the Contractor shall submit a drilled shaft installation plan for review by the Engineer. This plan shall provide information on the following:

1. Name and experience record of firm(s) and associated personnel for the following:
- **a.** driller
- **b.** drilled shaft superintendent
- **c.** site exploration
- **d.** confirmation boring
- **e.** crosshole sonic logging (CSL)
- **f.** name of load cell testing firm, if applicable

2. List of proposed equipment to be used including cranes, drills, augers, bailing buckets, grooving equipment, scouring equipment, final cleaning equipment, core sampling equipment, confirmation boring equipment, tremies or concrete pumps, casing, slurry equipment, airlift pumps, etc.

3. Details of overall construction operation sequence and the sequence of shaft construction in bents or groups.

4. Details of shaft excavation methods.

5. Details of casing and forms, including installation and removal.

6. Details of the type and methods to mix, circulate, desand, test, and dispose of slurry (if applicable). If polymer slurry is proposed, submit data on load transfer and manufacturers requirements for slurry control.

7. Details of methods to clean the shaft excavation, including air lift methods and spin bucket methods as applicable.

8. Details of reinforcement placement including support and cage centering methods.

9. Reinforcing steel cage splicing method, if proposed, including details of dimensions, installation, splice location, support and cage centering methods, and estimated time required for splicing.

10. Details of concrete placement including procedures for tremie or pumping methods and method to prevent slurry intrusion at the discharge end.

11. Concrete mix proposal.

12. Details of methods to control cuttings, water, slurry, etc. with adjacent traffic conditions (vehicular or railroad if applicable).

13. Details of CSL testing including location and attachment methods of the steel access pipes.

14. When a load cell test is specified, details of the test equipment used in the load cell test, and description of load cell test procedures and program in accordance with Materials I.M. 388.

15. Details of methods used to groove the sides of the drilled shaft length within the bedrock supporting stratum and methods of scouring and verification of grooving.

16. Details of final discharge of concrete at top of shaft, of removing contaminated concrete, and verifying concrete uniformity for site specific conditions.

17. When casing is required, details on casing to be used, including specific length/depth of all casing proposed, and specific evaluation and determination of casing (size, depth, etc.) required to prevent any shaft installation procedure from having an effect or impact on adjacent structures, railroads, etc.

The Engineer will evaluate the drilled shaft installation plan for conformance with the contract documents. Within 14 calendar days after receipt of the plan, the Engineer will notify the Contractor of additional information required and/or changes necessary to meet the contract requirements. All procedural approvals given by the Engineer shall be subject to trial in the field and shall not relieve the Contractor of the responsibility to satisfactorily complete the work as detailed in the contract documents.

A pre-drilling conference will be required for this work prior to the start of shaft excavation. The Contracting Authority, Contractor, and drilling staff shall discuss the anticipated shaft process.

C. CONTROL AND DISPOSAL OF MATERIALS

Disposal of excavated material, as well as slurry and/or water removed from the shaft excavation, shall be the responsibility of the Contractor. All slurry and water, displaced during final cleaning and concrete placement, shall be collected and properly disposed off site. Open pits for collection of materials will not be allowed. All excavated material, slurry, water, and other matter shall be controlled by the Contractor so that at no time it enters or encroaches upon the adjacent travel lanes, railroad, water ways, etc.

D. SHAFT EXCAVATION

The drilled shafts shall be constructed by either the wet, dry, or casing method as necessary to produce sound, durable concrete foundation shafts free of defects.

Surface and subsurface obstructions shall be removed by the Contractor. Special tools and/or procedures may be required. No separate payment will be made for removing obstructions.

The Contractor shall extend drilled shaft tip elevations if the Engineer determines that the material encountered during excavation and/or present at tip elevation is unsuitable and/or differs from that anticipated in the design of the drilled shaft.

The Contractor shall maintain a drilling log during shaft and socket excavation. The log shall contain information such as elevation, depth of penetration, drilling time in each of the strata, material description, and remarks. Two copies of the log, signed by the Contractor, shall be furnished to the Engineer within 1 week after completion of the excavation.

1. Wet Method

The wet method consists of keeping the shaft filled with slurry a minimum of 4 feet (1.3 m) above the highest expected water table during drilling and excavation, desanding of the slurry when required, final cleaning of the excavation by means of a bailing bucket, air lift, pump or other approved device and placing shaft concrete which displaces the slurry.

In the event that layers susceptible to cave-ins are encountered which cannot be controlled by slurry, the Contractor shall install temporary removable casing in accordance with Article SS-

01XXX.03, D, 3.

2. Dry Method
The dry method shall be used only at sites where the ground water level and soil and rock conditions are suitable to permit construction of the shaft in a relatively dry excavation, and where the sides and bottom of the shaft can be visually inspected by the Engineer prior to placing the concrete. The dry method consists of drilling the shaft excavation, removing accumulated water and loose material from the excavation, placing the reinforcing cage, and concreting the shaft in a relatively dry excavation.

The dry method shall only be approved by the Engineer when the shaft excavation demonstrates that less than 12 inches (0.305 m) of water accumulates above the base over a 1 hour period when no pumping is permitted; the sides and bottom of the hole remain stable without detrimental caving, sloughing, or swelling between completion of excavation and concrete placement; and any loose material and water can be satisfactorily removed prior to inspection and concrete placement. Less than 3 inches (75 mm) of water will be permitted in the bottom of the shaft excavation at the time of concrete placement. The Contractor shall use the wet or casing method for shafts that do not meet the dry method requirements.

3. Casing Method
The casing method is used to advance the hole through unstable material. Over-reaming to the outside diameter of the casing may be required. Before the casing is to be removed, the level of fresh concrete shall be a minimum of 5 feet (1.5 m) above the bottom of the casing so that fluid trapped behind the casing is displaced upward. As the casing is withdrawn, the concrete level shall be maintained so that fluid trapped behind the casing is displaced upward without contamination or displacing shaft concrete.

The Contractor shall determine the appropriate depth where the temporary casing is terminated to ensure the stability of the shaft. The purpose of the temporary casing is to stabilize the shaft walls during drilling to prevent cave-ins as the result of potential vibrations. The purpose of the casing is also to prevent any shaft installation procedure from having an impact on adjacent structures, railroads, etc.

Permanent casing, if required, will be specified in the contract documents.

After the shaft excavation has been completed, the Contractor shall immediately proceed with shaft construction.

E. GROOVING SIDEWALLS
Grooving, if required, will be identified in the plans. The sidewalls of the drilled shaft within the rock socket shall be grooved so as to produce channels with approximate dimensions of 2 inch (50 mm) depth by 3 inch (75 mm) height at intervals of 1 foot (0.3 m). Prior to grooving, excessive smearing of soft material that occurred on the rock socket wall shall be removed by a method approved by the Engineer and the base of the shaft shall be cleaned by spin bucket and air lift. Grooving shall be performed prior to final cleaning of the base of the shaft.

F. FINAL CLEANING
If a slurry cake builds up on the shaft sidewalls, the Contractor shall remove it prior to concrete placement at no additional cost. If mineral slurry is used, the shaft sidewalls above the rock socket shall be reamed prior to placement of reinforcement. The Contractor shall adjust operations so that the maximum time that the slurry is allowed to remain in the shaft is 24 hours.

The Contractor shall clean the base of each shaft so that a minimum of 50% of the base will have less than 1/2 inch (15mm) of sediment at the time of concrete placement. The maximum depth of sediment or debris at the base of the shaft shall not exceed 1 inch (25mm).

For dry shafts, visual inspection shall be performed by the Engineer.

For slurry shafts, the Contractor shall use an air lift to clean the bottom of the shaft. After a wait period equal to the time to set the reinforcing steel cage and concrete placement setup, the Contractor shall measure the amount of sediment in the bottom of the shaft. If the amount of sediment meets the above requirements, the Contractor shall clean the base of the shaft a second time with the air lift and immediately proceed with shaft construction. If after the described wait period the amount of sediment exceeds the requirements, the Contractor shall clean the shaft by air lift and repeat the above procedure until the sediment accumulation meets the requirements. The Engineer may approve, at no additional cost to the Contracting Authority, an alternate method to clean the bottom of the shaft.

G. EXCAVATION INSPECTION.
The Contractor shall provide equipment for checking the dimensions and alignment of each shaft excavation. The dimensions and alignment of the shaft under construction shall be verified by the Contractor under the direction of the Engineer. Final shaft depths shall be measured with a suitable weighted tape or other approved methods after final cleaning.

H. REINFORCING STEEL CAGE CONSTRUCTION AND PLACEMENT.
The reinforcing steel cage consisting of longitudinal bars, ties, cage stiffener bars, spacers, cage centering devices, and other necessary appurtenances, shall be completely assembled and placed immediately after the shaft excavation is inspected and accepted, and prior to concrete placement. If approved by the Engineer, the reinforcing steel cage, as approximately two equal units, may be joined together in the shaft excavation after the first unit has been inserted.

The reinforcing steel in the shaft shall be tied at intersections and supported so that the reinforcing steel will remain within allowable tolerances given in this specification. Concrete spacers or other approved non-corrosive spacing devices shall be used at sufficient intervals, near the top and bottom and at intervals not exceeding 10 feet (3 m) along the shaft, to ensure concentric spacing for the entire cage length. Spacers shall be constructed of approved material equal in quality and durability to the concrete specified for the shaft. The spacers shall be of adequate dimension to ensure a minimum distance of 3 inches (75 mm) between the cage and the excavated hole. When a full depth reinforcing steel cage is used, it shall be supported at the bottom by approved cylindrical feet to ensure that the bottom of the cage is maintained at the proper distance above the base. When a partial depth reinforcing steel cage is used, the Contractor shall design and furnish a support system.

The elevation of the top of the steel cage shall be checked before and after the concrete is placed. If the reinforcing cage is not maintained within the specified tolerances, corrections shall be made by the Contractor to the satisfaction of the Engineer. No additional shafts shall be constructed until the Contractor has modified the reinforcing cage support in a manner satisfactory to the Engineer.

I. CONCRETE PLACEMENT.
Shaft concrete shall be placed within 24 hours of the start of excavation of the rock socket. Concrete shall be placed as soon as possible after reinforcing steel placement. The Contractor shall coordinate batching and delivery of the concrete with the batch plant so that the time limits, as stated in the Standard Specifications, between batching and delivery are not exceeded. Concrete placement shall be continuous. Concrete placement shall continue after the shaft excavation is full until good quality concrete is evident at the top of shaft. Remove a sufficient volume of concrete to ensure elimination of all contaminated concrete at the top of shaft before continuing with column construction. Concrete shall be placed either through a tremie or concrete pump.

1. Placement of Concrete by Tremie:
The tremie used to deposit concrete shall be constructed so that it is watertight and will readily discharge concrete. The tremie shall not be ~~less~~more than ~~10~~ 12 inches (~~250~~ 300 mm) in diameter, and there shall be no aluminum parts in contact with concrete. The discharge end of the tremie shall be constructed to prevent water or slurry intrusion and permit the free flow of concrete during placement operations. The tremie shall have sufficient mass that it will rest on the

shaft bottom before start of concrete placement. The length of the tremie shall be sufficient to extend to the bottom of the shaft. The discharge orifice shall be maintained between 5 feet and 10 feet (1.5 m and 3.0 m) below the surface of the fluid concrete. The tremie shall be supported so that it can be raised to increase the discharge of concrete and lowered to reduce the discharge of concrete. The flow of the concrete shall be continuous and the concrete in the tremie shall maintain a positive pressure differential at all times to prevent introduction of air pockets or contaminants into the concrete.

2. Placement of Concrete by Pump
Concrete pumps and lines may be used for concrete placement. All pump lines shall have a minimum 4 inch (100 mm) diameter and be constructed with watertight joints. Concrete placement shall not begin until the pump line discharge orifice is at the shaft base elevation.

A plug or similar device shall be used to separate the concrete from the fluid in the hole until pumping begins. The plug shall either be removed from the excavation or be of a material, approved by the Engineer, which will not be a detriment to the shaft if not removed.

The discharge orifice shall be maintained between 5 feet and 10 feet (1.5 m and 3.0 m) below the surface of the fluid concrete. When lifting the pump line during concreting, the Contractor shall temporarily reduce the line pressure until the orifice has been repositioned at a higher level in the excavation.

The pumping operation shall be performed in a manner that prevents introduction of air pockets into the concrete. If breaking of the pump line is required, the discharge orifice shall be temporarily positioned 3 feet to 5 feet (1.0 m to 1.5 m) below the surface of the fluid concrete in the hole. Additional methods to eliminate introduction of air into the concrete may be proposed by the Contractor.

The elapsed time from the beginning of concrete placement in the shaft to the completion of the placement shall not exceed 3 hours. All admixtures, when approved for use, shall be adjusted for the conditions encountered on the job so the concrete remains in a workable plastic state throughout the 3 hour placement limit. For construction of shafts larger than 6 feet (2 m) in diameter, the Contractor may propose placement time over 3 hours provided the Contractor submits trial mix documentation that all concrete in the shaft will retain a minimum 4 inch (100 mm) slump for the entire placement period.

All temporary casing shall be removed.

J. CROSSHOLE SONIC LOG (CSL) TESTING.
The Contractor shall coordinate with an independent testing agency to perform CSL testing in accordance with ASTM D 6760; and provide analysis and interpretation on each completed shaft.

The procedure in ASTM D 6760 will be followed with the following exceptions:

1. Plastic access ducts and drilled boreholes will not be allowed unless approved by the Engineer.

2. A minimum of 4 access ducts are required.

3. The Crosshole Sonic Log (CSL) testing shall be performed after the shaft concrete has cured at least 48 hours but no later than 7 calendar days.

4. The access ducts shall be grouted after approval of the testing results by the Engineer.

5. The waterfall diagram (which is a nesting of ultrasonic pulses in an ultrasonic profile) shall be included in the report.

The Contractor shall furnish and install one access pipe per 1 foot (0.3 m) of shaft diameter but no less than four per shaft, with external couplings for CSL testing. The access pipes shall be 2 inch (51 mm) diameter, Schedule 40 pipe conforming to ASTM A 53, Grade A or B, Type E, F, or S. The access pipes shall have a round, regular inside diameter free of defects and obstructions, including all pipe joints, in order to permit the unobstructed passage of 1 3/8 inch (35 mm) maximum diameter source and receiver probes used for the CSL tests. The access pipes shall be watertight and free from corrosion with clean internal and external faces to ensure a good bond between the concrete and the access pipes. The access pipes shall be fitted with a watertight cap on the bottom and a removable, watertight cap on the top to prevent debris from entering the pipes. Any joints required to achieve the specified length shall also be watertight.

The Contractor shall securely attach the access pipes to the interior of the reinforcing cage such that each pipe is equally spaced within the reinforcing cage. If a partial depth reinforcing cage is specified, the Contractor shall design and furnish a support system to secure and properly align the CSL access pipes.

The access pipes shall be installed in straight alignment and parallel to the vertical axis of the reinforcing cage. The access pipes shall have 2 inches (50 mm) concrete cover at the bottom of the shaft ~~extend to the bottom of the shaft~~ or extend to the top plate of a load cell placed at the bottom of the shaft. When a load cell is located above the bottom of the shaft, the access pipes shall be fitted with watertight slip joints between the load cell bearing plates. The access pipe shall extend at least 2 feet (600 mm) above either the top of the continuous concrete placement operation or the top of the shaft. Care shall be taken to prevent damaging the access pipes during the reinforcing steel cage installation.

The access pipes shall be filled with clean water prior to concrete placement. Each access pipe shall be resealed immediately after water placement to prevent debris from entering the pipe. The Contractor, prior to CSL testing, shall flush any access pipes containing debris, refill with water of similar temperature, and reseal. Water of similar temperature shall be used to avoid debonding of access pipes with surrounding concrete. All access pipes shall be dewatered and filled with grout after the tests are completed, and the shaft has been accepted by the Engineer. The grout shall meet the requirements of Materials I.M. 388.

The test results, analysis, and interpretation submittal for the shafts shall be provided to the Engineer by the Contractor within 7 calendar days of testing. The Engineer will determine final acceptance of each shaft, based on the CSL test results and analysis for the tested shafts, and will provide a response to the Contractor within 5 working days after receiving the test results and analysis submittal.

The Contractor shall not commence subsequent shaft excavations until receiving the Engineer’s approval and acceptance of the first shaft; based on the results, analysis, and interpretation of the CSL testing for the first shaft.

The Contractor shall not commence subsequent construction of the structure until receiving the Engineer’s approval and acceptance of the supporting shaft; based on the results, analysis, and interpretation of the CSL testing for the supporting shaft.

For all shafts determined to be unacceptable, the Contractor shall submit a plan for remedial action to the Engineer for approval. All remedial correction procedures and designs shall be submitted to the Engineer for approval. The Contractor shall not begin repair operations until receiving the Engineer’s approval of the remedial action plan.

K. DEMONSTRATION SHAFT

The Contractor shall demonstrate equipment and methods, prior to construction of the first production

drilled shaft by installing a non-production drilled shaft. This shaft shall be installed on site at a location to be determined by the Engineer.

The demonstration shaft shall be constructed a minimum of 3 feet (1 m) into bedrock and will require a reinforcing steel cage, designed by the Contractor, to adequately support the CSL tubes. The demonstration shaft shall be constructed in accordance with the requirements of these Supplemental Specifications with special emphasis on slurry control and disposal, method of scouring, air lift pump usage, concrete delivery and coordination with the batch plant, concrete slump at the point of delivery, concrete placement, and shall include one break of the concrete pump line.

If installation of the demonstration shaft does not demonstrate the adequacy of the Contractor's equipment and methods to construct drilled shafts to the requirements of these Supplemental Specifications, the Engineer will require the Contractor to make appropriate alterations in equipment and/or methods to eliminate the unsatisfactory results. The Contractor may be required to perform additional demonstration shafts until an adequate procedure is demonstrated and approved by the Engineer. Construction of production drilled shafts shall not begin until the Engineer approves of Contractor's methodology and reviews the CSL report. The Engineer will complete the review process within 5 working days.

If the Contractor has demonstrated sufficient experience in the construction of drilled shaft foundations in soil/rock and under conditions similar to those at this site, and if other applicable factors indicate it to be acceptable, the "Demonstration Shaft" item will be deleted from the contract.

L. TEST SHAFT

When required in the contract documents, a test shaft shall be installed at the location indicated in the plans. The final selected depth of the test shaft shall be based on the confirmation boring.

1. Confirmation Boring and Sampling.

Prior to installation of the test shaft, a confirmation boring shall be completed by the Contractor at the test shaft location to a depth 10 feet (3 m) below the bottom elevation as shown in the plans or a minimum of 30 feet (10 m) into the bedrock, whichever is greater.

Standard penetration tests shall be performed in accordance with ASTM D 1586 in the soil overlying bedrock. Standard penetration tests shall be performed on 5 foot (1.5 m) centers. Moisture contents shall be determined on the soil samples. The soil sampling and testing shall continue with split barrel (spoon) sampling, in accordance with ASTM D 1586, until the top of bedrock is encountered. Rock shall be cored using double barrel diamond coring methods producing a minimum 1.75 inches (44.4 mm) core in accordance with ASTM D 2113, or other approved sampling method. Records shall be kept, including Percent Core Recovery and Rock Quality Designation in accordance with ASTM D 2113 and D 6032. Rock samples shall be preserved at their natural moisture content and condition, and transported to the laboratory for classification by a Professional Engineer licensed in the State of Iowa.

Representative samples of intact rock shall be tested for unconfined compressive strength in accordance with ASTM D 2938 except that stress and strain shall be recorded in accordance with ASTM D 2166, up to 20% strain or failure, whichever occurs first. A stress-strain plot shall be prepared in addition to listing of the unconfined compressive strength. One unconfined compression test will be performed for every 3 feet (1.0 m) of rock core. Testing and coring shall be performed by the Contractor's geotechnical drilling and testing firm. Test samples will be selected by the Engineer. Installation of the test shaft shall not begin until the results of the confirmation boring have been submitted and reviewed, and incorporated in the proposed load test program to be submitted in accordance with Materials I.M. 388. The Engineer will complete the review of the confirmation boring report and the proposed load test program report within 7 calendar days after submittal.

2. Load Cell Test

When required by the contract documents, the Contractor shall furnish all materials and labor necessary to conduct a load cell test in accordance with Materials I.M. 388.

Telltale casings shall be installed to allow measurement of shaft movement during load cell testing.

The Contractor shall use the utmost care in handling the rebar cage/test equipment assembly so as not to damage the load cell and instrumentation during installation.

After the CSL test has been approved and the concrete has reached a minimum required strength of 3500 psi (24 MPa), the load cell shall be internally pressurized, creating an upward force on the shaft and an equal, but downward force. The total load for a given internal pressure is found from the load cell's calibration, which shall be performed prior to its shipment to the site. During the period required to perform the load test, no casings may be vibrated into place or steel piles installed within 200 feet (60 m) of the load test.

If the test shaft is a production shaft, the load/deflection curve shall be monitored and testing shall be stopped so that the capacity of the shaft is not compromised. The load cell shall then be unloaded and reloaded to verify that the test shaft has at least the design capacity. If the test shaft is not a production shaft, the load cell test shall be continued until ultimate capacity is reached or the capacity of the load cell is reached.

If the test shaft is a production shaft, the hydraulic lines and load cell cavities shall be grouted upon completion of the load cell test. The grout shall meet the requirements of Materials I.M. 388.

The Contractor shall supply 4 printed copies and 1 electronic copy of the report for each load test, as prepared by the approved firm in Materials I.M. 388 within 14 calendar days of the test completion. Field results shall be provided upon completion of the test. The report shall include, but not be limited to, the following:

a. Load distributions, skin friction, and end bearing for the various strata instrumented by the strain gauges.

b. Summary of drilled shaft's dimensions, elevations, areas, and masses. Boring logs, test data, and other relevant information from the confirmation boring. Log of the Contractor's installation along with actual mapping of the shaft profile.

c. Load movement for end bearing and upward shear.

d. Equivalent top load movement curve.

e. Side shear creep limit curve.

f. End bearing creep limit curve.

g. Side shear load transfer for each zone/layer identified in the confirmation boring report, where strain gauges were installed, or as modified by the Engineer and the approved firm in Materials I.M. 388.

h. Plots of mobilized side shear load transfer versus vertical displacement for each zone/layer identified in the confirmation boring report, where strain gauges were installed. Layers may be modified in final load test design, if approved of by the Engineer.

i. Tables with test data.

If the test shaft is determined to be unacceptable by the Engineer, the Contractor shall submit a plan

for remedial action to the Engineer for approval and the Engineer may require another load cell test on another shaft. Construction of the production shafts shall not begin until Engineer approves of Contractor's methodology, reviews CSL report and reviews load cell test results. Prior to commencement of the load cell test, any cavities or inclusions shall be repaired and the repairs shall be approved by the Engineer. The Engineer will complete the review process within 14 calendar days of the load test report submittal. The load test results will be used to evaluate the shaft capacities within the bedrock and to define the final bottom elevation of the remaining productions shafts. The final bottom elevation of the remaining production shafts may vary from what is shown on the plans.

Once the load cell test has been completed and approved by the Engineer, the Contractor shall clean up the test shaft site. If the test shaft is a production shaft, site cleanup shall include whatever measures are required to incorporate the test shaft into the foundation, subject to approval by the Engineer. If the test shaft is not a production shaft, the test shaft shall be removed 3 feet (1 m) below final ground level and the area cleared in accordance with Article 1104.08 of the Standard Specifications.

01XXX.04 METHOD OF MEASUREMENT.

A. Concrete Drilled Shaft
The Engineer will measure in feet (meters), to the nearest 6 inches (0.15 m), the length of Concrete Drilled Shafts constructed.

B. Reinforcing Steel
Reinforcing Steel will be measured in accordance with Section 2404 of the Standard Specifications.

C. Load Cell Test
The Engineer will count the number of load cell tests.

D. Demonstration Shaft
The Engineer will measure in feet (meters), to the nearest 6 inches (0.15 m), the length of the approved Demonstration Shaft constructed.

01XXX.05 BASIS OF PAYMENT

A. Concrete Drilled Shaft
For the number of feet (meters) of Concrete Drilled Shaft the Contractor will be paid the contract unit price per foot (meter). This payment shall be full compensation for all equipment, labor, and materials (except reinforcing steel) necessary to satisfactorily construct the shafts; including drilling and excavation of shaft and rock socket, casing, installation and removal of temporary casing, furnishing and placing concrete, CSL pipe and testing, shaft inspection, disposal of excavated materials and water, and all other materials.

B. Reinforcing Steel
Reinforcing Steel will be paid for in accordance with Section 2404 of the Standard Specifications.

C. Load Cell Test
The Contractor will be paid the contract unit price for Load Cell Test per each test. This shall constitute full compensation for all costs including performing confirmation boring and testing and all costs incurred during the procurement; installation; instrumentation with strain gauges and telltales; conducting of the test; and subsequent removal of test apparatus, appurtenances, grouting cell tubes, and reporting.

D. Demonstration Shaft
For the number of feet (meters) of demonstration shaft drilled the Contractor will be paid the contract unit price per foot (meter). This payment shall be full compensation for all equipment, labor, and materials necessary to satisfactorily construct the approved shaft; including drilling and excavation of

drilled shaft and rock socket, installation and removal of temporary casing, furnishing and placing reinforcing bars, furnishing, and placing concrete, CSL pipe and testing, shaft inspection, disposal of excavated materials and water, and all other materials.

Draft DS-01XXX
(New)

Iowa Department of Transportation

DEVELOPMENTAL SPECIFICATIONS
FOR
CONCRETE DRILLED SHAFT FOR SUPPORT STRUCTURES

Effective Date
August 18, 2009

THE STANDARD SPECIFICATIONS, SERIES 2001, ARE AMENDED BY THE FOLLOWING MODIFICATIONS AND ADDITIONS. THESE ARE SUPPLEMENTAL SPECIFICATIONS AND THEY SHALL PREVAIL OVER THOSE PUBLISHED IN THE STANDARD SPECIFICATIONS.

01XXX.01 DESCRIPTION
Concrete drilled shaft foundation shall consist of reinforced concrete placed in a drilled shaft that is seated in bedrock or soil and with or without rock socket as shown on the plans. The reference to “rock” and “rock socket” through out this document is only applicable to shafts that are seated into bedrock with rock socket as specified on the plans.

The elevations, dimensions, and depth of the drilled shafts and possible rock sockets shall be as specified in the plans. The bottom of shaft elevation may be adjusted by the Design Engineer if bearing strata are encountered at different elevations or are judged to be of a different quality.

01XXX.02 Materials
All submittals shall be in electronic format.

A. Slurry
Only mineral or polymer slurries shall be used in the drilling process unless other drilling fluids are approved in writing by the Engineer. The percentage and specific gravity of the material used to make the suspension shall be sufficient to maintain the stability of the excavation and to allow proper concrete placement. In the event of a sudden significant loss of slurry to the excavation, the construction of the foundation shall be stopped until either methods to stop slurry loss or an alternate construction procedure has been approved by the Engineer.

All tests specified below shall be performed when the slurry temperature is above 40°F (4°C).

Mineral slurry or polymer slurry shall be premixed thoroughly with clean, fresh water, and adequate time (as prescribed by the manufacturer) allotted for hydration in slurry tanks. Slurry tanks of adequate capacity will be required for slurry circulation, storage, treatment, and disposal. No excavated slurry pits will be allowed. The Contractor shall draw sample sets from the slurry tanks and test the samples for conformance with the specified material properties prior to introduction into the shaft excavation. A sample set shall be composed of samples taken at mid-height and within 2 feet (0.6 m) of the bottom of the slurry tanks.

The Contractor shall sample and test all slurry in the presence of the Engineer, unless otherwise directed. The date, time, names of the persons sampling and testing the slurry, and the results of the tests shall be recorded. A copy of the recorded slurry test results shall be submitted to the Engineer

at the completion of each shaft, and during construction of each shaft when requested by the Engineer.

Sample sets of all slurry, composed of samples taken at mid-height and within 2 feet (0.6 m) of the bottom of the shaft, shall be taken and tested during shaft excavation as necessary to verify the control of the properties of the slurry. As a minimum, sample sets shall be taken and tested at least once every 2 hours after beginning slurry use. When the test results show consistent specified properties, sample sets shall be taken and tested at least once every 4 hours of slurry use. Slurry shall be recirculated, or agitated with the drilling equipment, when tests show that the sample sets do not have consistent specified properties.

When samples are found to be unacceptable, the Contractor shall clean, recirculate, desand, or replace the slurry to maintain the required slurry properties. Cleaning of the bottom of the excavation and placement of the concrete shall not begin until tests show that the sample sets have consistent specified properties.

The Contractor shall demonstrate to the satisfaction of the Engineer that stable conditions are being maintained. If the Engineer determines that stable conditions are not being maintained, the Contractor shall immediately take action to stabilize the shaft. The Contractor shall submit a revised installation plan, which corrects the problem and prevents future instability. The Contractor shall not continue with shaft construction until receiving the Engineer's approval of the revised shaft installation plan.

1. Mineral Slurry

Mineral slurry shall conform to the following requirements:

Property	Test Method	Requirements
Density (lb/ft^3 kg/m^3))	Slurry Density, Materials I.M. 387	64 to 75 (1030 to 1200)
Viscosity (sec/gal (sec/L))	Marsh Funnel and Cup, Materials I.M. 387	104 to 201 (27.5 to 53)
pH	pH Paper	8 to 11
Sand Content (%)	Sand Content Test, Materials I.M. 387	See note*
* The sand content of mineral slurry prior to placing the reinforcing steel cage and immediately prior to placing concrete shall be less than or equal to 4.0%.		

2. Polymer Slurry

Polymer slurry shall be used in conformance with the manufacturer's recommendations and these Supplemental Specifications. The Contractor shall submit the name and telephone number of the manufacturer's representative to the Engineer. The manufacturer's representative shall provide technical assistance in the use of the polymer slurry as needed.

Polymer slurry shall conform to the following requirements:

Property	Test Method	Requirements
Density (lb/ft^3 kg/m^3))	Slurry Density, Materials I.M. 387	62 to 63 (995 to 1010)
Viscosity (sec/gal (sec/L))	Marsh Funnel and Cup ,Materials I.M. 387	136 to 227 (36 to 60) 231 to 252 (61 to 66.5) (dry sand/gravel)
pH	pH Paper	8 to 11
Sand Content (%)	Sand Content Test, Materials I.M. 387	See note *
* The sand content of polymer slurry prior to placing the reinforcing steel cage and immediately prior to placing concrete shall be less than 2.0%.		

The Contractor shall wait 30 minutes, after the last drilling and scouring, to allow contaminants to settle out before taking and testing a sample set of slurry. After the reinforcing steel cage is placed in the excavation, a sample set of slurry shall be taken and tested immediately prior to concrete placement.

B. Concrete

All materials, proportioning, air entraining, mixing, slump, and transporting of PCC shall be in accordance with Section 2403 of the Standard Specifications except as modified herein.

The water/cement ratio shall not exceed 0.45.

The concrete for construction of drilled shafts shall be a Class D PCC mixture with a slump of 8 inches ±1.5 inches (200 mm ±40mm).

The Contractor shall use a mid-range water in accordance with Materials I.M. 403.

Retarder shall be required in accordance with Materials I.M. 403 to maintain workable concrete. Portland cement shall meet the requirements of ASTM C 150 Type I / II and Section 4101, of the Standard Specifications.

Ground Granulated Blast Furnace Slag (GGBFS) shall not be used.

C. Grout
Materials I.M. 388 shall apply.

011XX.03 Construction
All submittals shall be in electronic format.

A. CONSTRUCTION TOLERANCES.

1. The drilled shaft shall be within 3 inches (75 mm) of plan position at the top of shaft.

2. The vertical alignment of shaft excavation shall not vary from the plan alignment by more than 1/4 inch/foot (20 mm/m of depth).

3. Full depth reinforcing steel cages shall be set at no less than 6 inches (150 mm) above the bottom of the excavated shaft prior to placement of concrete.

4. After all the concrete is placed; the top of the reinforcing steel cage shall be no more than 6 inches (150 mm) above and no more than 2 3/4 inches (70 mm) below plan position.

5. The dimensions of casings are subject to American Pipe Institute tolerances applicable to regular steel pipe.

6. The top elevation of the shaft may have a tolerance of up to plus 1 inch (25 mm) or minus 3 inches (75 mm) from the plan top of shaft elevation. Sufficient reinforcement bar splice length for splices above the shaft shall be attained.

7. Excavation equipment and methods shall be designed so that the completed shaft excavation will have a planar bottom. The cutting edges of excavation equipment shall be normal to the vertical axis of the equipment within a tolerance of 3/8 inch/foot (30 mm/m) of diameter.

Drilled shaft excavations and completed shafts not constructed within the required tolerances are unacceptable. The Contractor shall be responsible for correcting all unacceptable shaft excavations and completed shafts to the satisfaction of the Engineer. Materials and work necessary, including engineering analysis and redesign, to complete corrections for out of tolerance drilled shaft excavations shall be furnished without either cost to the Contracting Authority or an extension of the completion dates of the project.

B. DRILLED SHAFT INSTALLATION PLAN
Two weeks prior to the pre-construction conference, the Contractor shall submit a list containing at least three projects completed in the last three years on which the Contractor has installed drilled

shafts of a diameter and length similar to those shown on the plans. The list of projects shall contain names and phone numbers of owner's representatives who can verify the Contractor's participation on those projects. The Contractor shall also submit a signed statement that they have inspected the project site and all the subsurface information made available in the contract documents.

No later than 1 month prior to constructing drilled shafts, the Contractor shall submit a drilled shaft installation plan for review by the Engineer. This plan shall provide information on the following:

1. Name and experience record of firm(s) and associated personnel for the following:
- **a.** driller
- **b.** drilled shaft superintendent
- **c.** site exploration
- **d.** confirmation boring
- **e.** crosshole sonic logging (CSL)

2. List of proposed equipment to be used including cranes, drills, augers, bailing buckets, grooving equipment, scouring equipment, final cleaning equipment, core sampling equipment, confirmation boring equipment, tremies or concrete pumps, casing, slurry equipment, airlift pumps, etc.

3. Details of overall construction operation sequence and the sequence of shaft construction in bents or groups.

4. Details of shaft excavation methods.

5. Details of casing and forms, including installation and removal.

6. Details of the type and methods to mix, circulate, desand, test, and dispose of slurry (if applicable). If polymer slurry is proposed, submit data on load transfer and manufacturers requirements for slurry control.

7. Details of methods to clean the shaft excavation, including air lift methods and spin bucket methods as applicable.

8. Details of reinforcement placement including support and cage centering methods.

9. Reinforcing steel cage splicing method, if proposed, including details of dimensions, installation, splice location, support and cage centering methods, and estimated time required for splicing.

10. Details of concrete placement including procedures for tremie or pumping methods and method to prevent slurry intrusion at the discharge end.

11. Concrete mix proposal.

12. Details of methods to control cuttings, water, slurry, etc. with adjacent traffic conditions (vehicular or railroad if applicable).

13. Details of CSL testing including location and attachment methods of the steel access pipes.

14. Details of methods used to groove the sides of the drilled shaft length within the bedrock supporting stratum, if present, and methods of scouring and verification of grooving.

15. Details of final discharge of concrete at top of shaft, of removing contaminated concrete, and verifying concrete uniformity for site specific conditions.

16. When casing is required, details on casing to be used, including specific length/depth of all casing proposed, and specific evaluation and determination of casing (size, depth, etc.) required to prevent any shaft installation procedure from having an effect or impact on adjacent structures, railroads, etc.

The Engineer will evaluate the drilled shaft installation plan for conformance with the contract documents. Within 14 calendar days after receipt of the plan, the Engineer will notify the Contractor of additional information required and/or changes necessary to meet the contract requirements. All procedural approvals given by the Engineer shall be subject to trial in the field and shall not relieve the Contractor of the responsibility to satisfactorily complete the work as detailed in the contract documents.

A pre-drilling conference will be required for this work prior to the start of shaft excavation. The Contracting Authority, Contractor, and drilling staff shall discuss the anticipated shaft process.

C. CONTROL AND DISPOSAL OF MATERIALS

Disposal of excavated material, as well as slurry and/or water removed from the shaft excavation, shall be the responsibility of the Contractor. All slurry and water, displaced during final cleaning and concrete placement, shall be collected and properly disposed off site. Open pits for collection of materials will not be allowed. All excavated material, slurry, water, and other matter shall be controlled by the Contractor so that at no time it enters or encroaches upon the adjacent travel lanes, railroad, water ways, etc.

D. SHAFT EXCAVATION

The drilled shafts shall be constructed by either the wet, dry, or casing method as necessary to produce sound, durable concrete foundation shafts free of defects.

Surface and subsurface obstructions shall be removed by the Contractor. Special tools and/or procedures may be required. No separate payment will be made for removing obstructions.

The Contractor shall extend drilled shaft tip elevations if the Engineer determines that the material encountered during excavation and/or present at tip elevation is unsuitable and/or differs from that anticipated in the design of the drilled shaft.

The Contractor shall maintain a drilling log during shaft and possible socket excavation. The log shall contain information such as elevation, depth of penetration, drilling time in each of the strata, material description, and remarks. Two copies of the log, signed by the Contractor, shall be furnished to the Engineer within 1 week after completion of the excavation.

1. Wet Method

The wet method consists of keeping the shaft filled with slurry a minimum of 4 feet (1.3 m) above the highest expected water table during drilling and excavation, desanding of the slurry when required, final cleaning of the excavation by means of a bailing bucket, air lift, pump or other approved device and placing shaft concrete which displaces the slurry.

In the event that layers susceptible to cave-ins are encountered which cannot be controlled by slurry, the Contractor shall install temporary removable casing in accordance with Article SS-01XXX.03, D, 3.

2. Dry Method

The dry method shall be used only at sites where the ground water level and soil and rock conditions are suitable to permit construction of the shaft in a relatively dry excavation, and where the sides and bottom of the shaft can be visually inspected by the Engineer prior to placing the concrete. The dry method consists of drilling the shaft excavation, removing accumulated water

and loose material from the excavation, placing the reinforcing cage, and concreting the shaft in a relatively dry excavation.

The dry method shall only be approved by the Engineer when the shaft excavation demonstrates that less than 12 inches (0.305 m) of water accumulates above the base over a 1 hour period when no pumping is permitted; the sides and bottom of the hole remain stable without detrimental caving, sloughing, or swelling between completion of excavation and concrete placement; and any loose material and water can be satisfactorily removed prior to inspection and concrete placement. Less than 3 inches (75 mm) of water will be permitted in the bottom of the shaft excavation at the time of concrete placement. The Contractor shall use the wet or casing method for shafts that do not meet the dry method requirements.

3. Casing Method

The casing method is used to advance the hole through unstable material. Over-reaming to the outside diameter of the casing may be required. Before the casing is to be removed, the level of fresh concrete shall be a minimum of 5 feet (1.5 m) above the bottom of the casing so that fluid trapped behind the casing is displaced upward. As the casing is withdrawn, the concrete level shall be maintained so that fluid trapped behind the casing is displaced upward without contamination or displacing shaft concrete.

The Contractor shall determine the appropriate depth where the temporary casing is terminated to ensure the stability of the shaft. The purpose of the temporary casing is to stabilize the shaft walls during drilling to prevent cave-ins as the result of potential vibrations. The purpose of the casing is also to prevent any shaft installation procedure from having an impact on adjacent structures, railroads, etc.

Permanent casing, if required, will be specified in the contract documents.

After the shaft excavation has been completed, the Contractor shall immediately proceed with shaft construction.

E. GROOVING SIDEWALLS

Grooving, if required, will be identified in the project plans. The sidewalls of the drilled shaft within the possible rock socket shall be grooved so as to produce channels with approximate dimensions of 2 inch (50 mm) depth by 3 inch (75 mm) height at intervals of 1 foot (0.3 m). Prior to grooving, excessive smearing of soft material that occurred on the possible rock socket wall shall be removed by a method approved by the Engineer and the base of the shaft shall be cleaned by spin bucket and air lift. Grooving shall be performed prior to final cleaning of the base of the shaft.

F. FINAL CLEANING

If a slurry cake builds up on the shaft sidewalls, the Contractor shall remove it prior to concrete placement at no additional cost. If mineral slurry is used, the shaft sidewalls above the possible rock socket shall be reamed prior to placement of reinforcement. The Contractor shall adjust operations so that the maximum time that the slurry is allowed to remain in the shaft is 24 hours.

The Contractor shall clean the base of each shaft so that a minimum of 50% of the base will have less than 1/2 inch (15mm) of sediment at the time of concrete placement. The maximum depth of sediment or debris at the base of the shaft shall not exceed 1 inch (25mm).

For dry shafts, visual inspection shall be performed by the Engineer.

For slurry shafts, the Contractor shall use an air lift to clean the bottom of the shaft. After a wait period equal to the time to set the reinforcing steel cage and concrete placement setup, the Contractor shall measure the amount of sediment in the bottom of the shaft. If the amount of sediment meets the above requirements, the Contractor shall clean the base of the shaft a second time with the air lift and immediately proceed with shaft construction. If after the described wait period the amount of sediment

exceeds the requirements, the Contractor shall clean the shaft by air lift and repeat the above procedure until the sediment accumulation meets the requirements. The Engineer may approve, at no additional cost to the Contracting Authority, an alternate method to clean the bottom of the shaft.

G. EXCAVATION INSPECTION.
The Contractor shall provide equipment for checking the dimensions and alignment of each shaft excavation. The dimensions and alignment of the shaft under construction shall be verified by the Contractor under the direction of the Engineer. Final shaft depths shall be measured with a suitable weighted tape or other approved methods after final cleaning.

H. REINFORCING STEEL CAGE CONSTRUCTION AND PLACEMENT.
The reinforcing steel cage consisting of longitudinal bars, ties, cage stiffener bars, spacers, cage centering devices, and other necessary appurtenances, shall be completely assembled and placed immediately after the shaft excavation is inspected and accepted, and prior to concrete placement. If approved by the Engineer, the reinforcing steel cage, as approximately two equal units, may be joined together in the shaft excavation after the first unit has been inserted.

The reinforcing steel in the shaft shall be tied at intersections and supported so that the reinforcing steel will remain within allowable tolerances given in this specification. Concrete spacers or other approved non-corrosive spacing devices shall be used at sufficient intervals, near the top and bottom and at intervals not exceeding 10 feet (3 m) along the shaft, to ensure concentric spacing for the entire cage length. Spacers shall be constructed of approved material equal in quality and durability to the concrete specified for the shaft. The spacers shall be of adequate dimension to ensure a minimum distance of 3 inches (75 mm) between the cage and the excavated hole. When a full depth reinforcing steel cage is used, it shall be supported at the bottom by approved cylindrical feet to ensure that the bottom of the cage is maintained at the proper distance above the base. When a partial depth reinforcing steel cage is used, the Contractor shall design and furnish a support system.

The elevation of the top of the steel cage shall be checked before and after the concrete is placed. If the reinforcing cage is not maintained within the specified tolerances, corrections shall be made by the Contractor to the satisfaction of the Engineer. No additional shafts shall be constructed until the Contractor has modified the reinforcing cage support in a manner satisfactory to the Engineer.

I. CONCRETE PLACEMENT.
Shaft concrete shall be placed within 24 hours of the start of excavation of the rock socket if present. Concrete shall be placed as soon as possible after reinforcing steel placement. The Contractor shall coordinate batching and delivery of the concrete with the batch plant so that the time limits, as stated in the Standard Specifications, between batching and delivery are not exceeded. Concrete placement shall be continuous. Concrete placement shall continue after the shaft excavation is full until good quality concrete is evident at the top of shaft. Remove a sufficient volume of concrete to ensure elimination of all contaminated concrete at the top of shaft before continuing with column construction. Concrete shall be placed either through a tremie or concrete pump.

1. Placement of Concrete by Tremie:
The tremie used to deposit concrete shall be constructed so that it is watertight and will readily discharge concrete. The tremie shall not be more than 12 inches (300 mm) in diameter, and there shall be no aluminum parts in contact with concrete. The discharge end of the tremie shall be constructed to prevent water or slurry intrusion and permit the free flow of concrete during placement operations. The tremie shall have sufficient mass that it will rest on the shaft bottom before start of concrete placement. The length of the tremie shall be sufficient to extend to the bottom of the shaft. The discharge orifice shall be maintained between 5 feet and 10 feet (1.5 m and 3.0 m) below the surface of the fluid concrete. The tremie shall be supported so that it can be raised to increase the discharge of concrete and lowered to reduce the discharge of concrete. The flow of the concrete shall be continuous and the concrete in the tremie shall maintain a positive pressure differential at all times to prevent introduction of air pockets or contaminants into the concrete.

2. Placement of Concrete by Pump
Concrete pumps and lines may be used for concrete placement. All pump lines shall have a minimum 4 inch (100 mm) diameter and be constructed with watertight joints. Concrete placement shall not begin until the pump line discharge orifice is at the shaft base elevation.

A plug or similar device shall be used to separate the concrete from the fluid in the hole until pumping begins. The plug shall either be removed from the excavation or be of a material, approved by the Engineer, which will not be a detriment to the shaft if not removed.

The discharge orifice shall be maintained between 5 feet and 10 feet (1.5 m and 3.0 m) below the surface of the fluid concrete. When lifting the pump line during concreting, the Contractor shall temporarily reduce the line pressure until the orifice has been repositioned at a higher level in the excavation.

The pumping operation shall be performed in a manner that prevents introduction of air pockets into the concrete. If breaking of the pump line is required, the discharge orifice shall be temporarily positioned 3 feet to 5 feet (1.0 m to 1.5 m) below the surface of the fluid concrete in the hole. Additional methods to eliminate introduction of air into the concrete may be proposed by the Contractor.

The elapsed time from the beginning of concrete placement in the shaft to the completion of the placement shall not exceed 3 hours. All admixtures, when approved for use, shall be adjusted for the conditions encountered on the job so the concrete remains in a workable plastic state throughout the 3 hour placement limit. For construction of shafts larger than 6 feet (2 m) in diameter, the Contractor may propose placement time over 3 hours provided the Contractor submits trial mix documentation that all concrete in the shaft will retain a minimum 4 inch (100 mm) slump for the entire placement period.

All temporary casing shall be removed.

J. CROSSHOLE SONIC LOG (CSL) TESTING.
The Contractor shall coordinate with an independent testing agency to perform CSL testing in accordance with ASTM D 6760; and provide analysis and interpretation on each completed shaft.

The procedure in ASTM D 6760 will be followed with the following exceptions:

1. Plastic access ducts and drilled boreholes will not be allowed unless approved by the Engineer.

2. A minimum of 4 access ducts are required.

3. The Crosshole Sonic Log (CSL) testing shall be performed after the shaft concrete has cured at least 48 hours but no later than 7 calendar days.

4. The access ducts shall be grouted after approval of the testing results by the Engineer.

5. The waterfall diagram (which is a nesting of ultrasonic pulses in an ultrasonic profile) shall be included in the report.

The Contractor shall furnish and install one access pipe per 1 foot (0.3 m) of shaft diameter but no less than four per shaft, with external couplings for CSL testing. The access pipes shall be 2 inch (51 mm) diameter, Schedule 40 pipe conforming to ASTM A 53, Grade A or B, Type E, F, or S. The access pipes shall have a round, regular inside diameter free of defects and obstructions, including all pipe joints, in order to permit the unobstructed passage of 1 3/8 inch (35 mm) maximum diameter source and receiver probes used for the CSL tests. The access pipes shall be watertight and free

from corrosion with clean internal and external faces to ensure a good bond between the concrete and the access pipes. The access pipes shall be fitted with a watertight cap on the bottom and a removable, watertight cap on the top to prevent debris from entering the pipes. Any joints required to achieve the specified length shall also be watertight.

The Contractor shall securely attach the access pipes to the interior of the reinforcing cage such that each pipe is equally spaced within the reinforcing cage. If a partial depth reinforcing cage is specified, the Contractor shall design and furnish a support system to secure and properly align the CSL access pipes.

The access pipes shall be installed in straight alignment and parallel to the vertical axis of the reinforcing cage. The access pipes shall have 2 inch (50 mm) concrete cover at the bottom of the shaft or extend to the top plate of a load cell placed at the bottom of the shaft. When a load cell is located above the bottom of the shaft, the access pipes shall be fitted with watertight slip joints between the load cell bearing plates. The access pipe shall extend at least 2 feet (600 mm) above either the top of the continuous concrete placement operation or the top of the shaft. Care shall be taken to prevent damaging the access pipes during the reinforcing steel cage installation.

The access pipes shall be filled with clean water prior to concrete placement. Each access pipe shall be resealed immediately after water placement to prevent debris from entering the pipe. The Contractor, prior to CSL testing, shall flush any access pipes containing debris, refill with water of similar temperature, and reseal. Water of similar temperature shall be used to avoid debonding of access pipes with surrounding concrete. All access pipes shall be dewatered and filled with grout after the tests are completed, and the shaft has been accepted by the Engineer. The grout shall meet the requirements of Materials I.M. 388.

The test results, analysis, and interpretation submittal for the shafts shall be provided to the Engineer by the Contractor within 7 calendar days of testing. The Engineer will determine final acceptance of each shaft, based on the CSL test results and analysis for the tested shafts, and will provide a response to the Contractor within 5 working days after receiving the test results and analysis submittal.

The Contractor shall not commence subsequent shaft excavations until receiving the Engineer’s approval and acceptance of the first shaft; based on the results, analysis, and interpretation of the CSL testing for the first shaft.

The Contractor shall not commence subsequent construction of the structure until receiving the Engineer’s approval and acceptance of the supporting shaft; based on the results, analysis, and interpretation of the CSL testing for the supporting shaft.

For all shafts determined to be unacceptable, the Contractor shall submit a plan for remedial action to the Engineer for approval. All remedial correction procedures and designs shall be submitted to the Engineer for approval. The Contractor shall not begin repair operations until receiving the Engineer’s approval of the remedial action plan.

011XX.04 METHOD OF MEASUREMENT.

A. Concrete Drilled Shaft for Support Structures
The Engineer will measure in feet (meters), to the nearest 6 inches (0.15 m), the length of Concrete Drilled Shafts constructed.

B. Reinforcing Steel
Reinforcing Steel will be measured in accordance with Section 2404 of the Standard Specifications.

011XX.05 BASIS OF PAYMENT

A. Concrete Drilled Shaft for Support Structures

For the number of feet (meters) of Concrete Drilled Shaft the Contractor will be paid the contract unit price per foot (meter). This payment shall be full compensation for all equipment, labor, and materials (except reinforcing steel) necessary to satisfactorily construct the shafts; including drilling and excavation of shaft and possible rock socket, casing, installation and removal of temporary casing, furnishing and placing concrete, CSL pipe and testing, shaft inspection, disposal of excavated materials and water, and all other materials.

B. Reinforcing Steel

Reinforcing Steel will be paid for in accordance with Section 2404 of the Standard Specifications.