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| CAIS No. 999-29 November 2022 |

**Administration and Inspection Activities for**

**Installation of Metallic Dowels into Concrete**

(As Specified in SSP 999F29)

**1.0 SCOPE**

This CAIS covers the construction administration and inspection requirements for installation of metallic dowels and aluminum bridge mounted sign support structure anchors into concrete as specified in SSP 999F29, November 2022.

**2.0 REFERENCES**

This CAIS refers to the following standards, specifications, or publications:

**Ontario Provincial Standard Specifications, Construction:**

OPSS 905 Steel Reinforcement for Concrete

OPSS 915 Sign Support Structures

OPSS 1440 Steel Reinforcement for Concrete

**MTO Standard Special Provisions:**

SSP 999F29 Requirements for Installation of Metallic Dowels and Anchors Into Concrete

**Construction Administration and Inspection Specifications (CAIS):**

CAIS 905 Steel Reinforcement for Concrete

CAIS 915 Sign Support Structures

CAIS 1440 Steel Reinforcement for Concrete

**MTO Forms:**

PH-CC-701 Request to Proceed

PH-CC-702 Notice to Proceed

**Ministry of Transportation, Ontario Publications:**

Designated Sources for Materials (DSM) Manual

Pull Test Guide for Testing of Metallic Dowels, of Uncoated, Coated or Stainless Steel

**3.0 DEFINITIONS**

For the purpose of this CAIS, the definitions shall be as specified in SSP 999F29.

**4.0 DESIGN AND SUBMISSION REQUIREMENTS**

**4.1 Submission Requirements**

Administrative Activities:

|  |  |  |  |
| --- | --- | --- | --- |
| 1 | M | After reviewing the Contractor’s submissions, submit with comments to the MTO CSA and MTO Regional Structural Section within 2 days of receipt.  Ensure a final copy of all Contractor submissions is shared with inspection staff and available on site for enforcement, and ensure a final copy is sent to the MTO Regional Structural Section. | - |

**4.1.1 Dowel and Anchor**

Administrative Activities:

|  |  |  |  |
| --- | --- | --- | --- |
| 1 | - | Check submissions for the certification of the manufacturer of metallic dowels and anchors are as specified in CAIS 905. | - |

**4.1.2 Manufacturer’s Printed Installation Instructions (MPII)**

Administrative Activities:

|  |  |  |  |
| --- | --- | --- | --- |
| 1 | - | Receive the adhesive’s MPII prior to the drilling of any dowel or anchor holes. | - |
| 2 | - | Check the MPII can be used as the sole source for product specific installation instructions and that the format, text, pictograms, photos, or other graphic devices used to convey the installation procedures are legible, self-explanatory, and understandable for persons having a secondary school or higher education level. | - |
| 3 | - | Ensure inspectors are knowledgeable in the product specific installation instructions.  Certification as a Post-Installed Concrete Anchor Installation Inspector with the American Concrete Institute (ACI) or at least familiarity with ACI CP-80 is recommended. | - |

**5.0 MATERIALS**

**5.01 Adhesive**

Administrative Activities:

|  |  |  |  |
| --- | --- | --- | --- |
| 1 | - | Check that the adhesive material is listed on the MTO Designated Source for Materials and is suitable for the application, including direction. | - |

**5.02 Anchors**

Administrative Activities:

|  |  |  |  |
| --- | --- | --- | --- |
| 1 | - | Check that the anchors are as specified in the Contract Documents. | - |

**5.03 Dowels**

Administrative Activities:

|  |  |  |  |
| --- | --- | --- | --- |
| 1 | - | Check that the dowels are as specified in OPSS 1440 and the Contract Documents. | - |

**6.0 EQUIPMENT – NOT USED**

**7.0 CONSTRUCTION**

**7.01 Operational Constraint**

Administrative Activities:

|  |  |  |  |
| --- | --- | --- | --- |
| 1 | - | Check that anchors and dowels are not installed in concrete less than 21 Days old. | - |

**7.02 Proof of Process**

Administrative Activities:

|  |  |  |  |
| --- | --- | --- | --- |
| 1 | - | Review the proof of process installation procedure as specified in SSP 999F29. | - |
| 2 | - | Check if pull testing of anchors and dowels can be conducted in-situ. If anchors and dowels cannot be conducted in-situ, select, and approve a suitable location for proof of process installation in another area of the same structural element, or in another comparable structural element.  Proof of process installation may also be conducted in pre-cast concrete blocks not incorporated into the work. | - |
| 3 | - | Check that anchors and dowels are not installed in the work until the Contractor has approval, in writing from the Contract Administrator, of a successful proof of process installation procedure. | - |
| 4 | - | Check proof of process installation procedures are valid for the entire duration of the work. Repeat proof of process installation and testing every 120 Days as required. | - |
| 5 | - | Check that there are no changes from the approved proof of process installation to personnel, materials, anchor or dowel type, or process without re-qualification of the proof of process installation procedure. | - |

**7.03 Installation**

Inspection Activities:

|  |  |  |  |
| --- | --- | --- | --- |
| 1 | - | Evaluate concrete condition, age, cracks, expansion joints, thickness, etc. Non-destructive test for unsound concrete in the vicinity of the anchor and dowel locations (hammer sounding unless specified otherwise). | 100% |
| 2 | - | Check that the Contractor marks out the anchor and dowel hole locations and completes a covermeter or bar finder survey prior to drilling any holes. Verify anchor and dowel locations and layout are according to specifications. | 50% |

Administrative Activities:

|  |  |  |  |
| --- | --- | --- | --- |
| 1 | - | Verify that adhesive is suitable for the application (dry, water-filled, submerged, overhead). | - |
| 2 | - | Review the manufacturer’s printed installation instructions (MPII). | - |
| 3 | - | Review Safety Data Sheets (SDS) and select appropriate personal protective equipment. | - |
| 4 | - | Verify concrete temperature falls within range for the selected product. | - |

**7.03.01 Drill Holes**

Inspection Activities:

\* Time shall be 100% for horizontal, upwardly inclined and vertical up-hole installations. Time shall be 50% for down-hole installations.

|  |  |  |  |
| --- | --- | --- | --- |
| 1 | - | Check equipment components are adjusted according to the MPII. | \* |
| 2 | - | Determine the proper depth, diameter, and rod/bolt sizes for holes are according to the Contract Documents. | \* |
| 3 | - | Check an appropriate drilling machine and bits are used according to the Contract Documents and MPII. | \* |
| 4 | - | Check drill holes are drilled at the correct locations and are perpendicular to concrete, or as specified in the Contract Documents. | \* |
| 5 | - | Check that drilled hole depth and diameter meet pre-determined specifications. | \* |
| 6 | - | Check that drilling does not hit reinforcing steel or other obstructions or damage the surrounding concrete. | \* |
| 7 | - | Visually inspect debris coming from drill holes during drilling. | 50% |
| 8 | - | Check that holes that are started but not completed are cleaned and filled with a proprietary patching material from the MTO Proprietary Patching Materials list. | 50% |

Administrative Activities:

|  |  |  |  |
| --- | --- | --- | --- |
| 1 | - | Check anchor and dowel location, edge distance and spacing requirements. | - |

**7.03.02 Cleaning Drill Holes**

Inspection Activities:

\* Time shall be 100% for horizontal, upwardly inclined and vertical up-hole installations. Time shall be 50% for down-hole installations.

|  |  |  |  |
| --- | --- | --- | --- |
| 1 | - | Check the appropriate cleaning method and equipment is used, according to the MPII. Check that a minimum cleaning of blow-brush-blow is used according to the Contract Documents if the MPII has a lesser cleaning requirement. | \* |
| 2 | - | Check water-concrete particle slurries are removed. | \* |
| 3 | - | Check drill holes are free of debris following cleaning. | \* |

**7.03.03 Installing Dowels and Anchors**

Inspection Activities:

\* Time shall be 100% for horizontal, upwardly inclined and vertical up-hole installations. Time shall be 50% for down-hole installations.

|  |  |  |  |
| --- | --- | --- | --- |
| 1 | - | Check adhesive expiration dates. | \* |
| 2 | - | Check adhesive cartridges are stored according to the MPII and storage temperature requirements are met. | \* |
| 3 | - | Check that a proper nozzle is used with a complete mixing element. | \* |
| 4 | - | Check that adhesive cartridges and nozzles are assembled according to the MPII. | \* |
| 5 | - | Confirm that the drill holes are clean prior to adhesive injection. A borescope may be required for inspection of deeper drilled holes. | \* |
| 6 | - | Check that in-situ concrete temperature is in conformance with the requirements of the MPII and establish cure times for the adhesive. A probe thermometer or other temperature measuring device may be required. | \* |
| 7 | - | Check that equipment used is suitable for the installation location (e.g., piston plugs are used for horizontal and overhead applications, flexible tubing may be required for deep holes). | \* |
| 8 | - | Check that the installer ejects and discards initial adhesive and confirms proper mixing prior to any injection in drill holes. Check that test materials are not incorporated into the work. | \* |
| 9 | - | Check that adhesive is injected according to the MPII (rate, application, method, air entrapment is avoided, etc.). | \* |
| 10 | - | Check minimum depth of adhesive fill. | \* |
| 11 | - | Check appropriate adhesive working (gel) time. | \* |
| 12 | - | Check anchors and dowels are installed with the most appropriate technique according to the MPII. | \* |
| 13 | - | Check that anchors and dowels are new, clean, and free of damage or deleterious substances that might interfere with bond (e.g., dust, mud, oil, loose rust, etc.). Check that threads are undamaged and not fouled. | \* |
| 14 | - | Check anchors and dowels are inserted into the drilled hole according to the MPII. Check there are no ‘snapping’ or ‘popping’ sounds, or rebound of inserted anchors and dowels. Require corrective action be taken immediately if air pockets are noted during installation. | \* |
| 15 | - | Check accurate final embedment depth of anchors and dowels based on the length of protruding elements. | 100% |
| 16 | - | Check that adhesive fills drill holes uniformly around the anchor or dowel, approximately flush with the concrete surface.  Check that stoppers or retaining caps (if used) are installed after adhesive injection. The piston plug method shall be used, not the end-cap method.  Note: inspection task 16 is for all anchors and dowels (each) and can be rolled into the Visual Acceptance Criteria tasks. | 100% |
| 17 | - | Check anchors and dowels remain undisturbed until adhesive is fully cured. | 25% |

**7.04 Inspection after Installation of Dowels and Anchors**

Inspection Activities:

|  |  |  |  |
| --- | --- | --- | --- |
| 1 | - | Check that the number and location of installed dowels is according to the Contract Documents. | 50% |

Administrative Activities:

|  |  |  |  |
| --- | --- | --- | --- |
| 1 | - | Receive a MTO form PH-CC-701, Request to Proceed after:   1. The installation of all dowels in a lot are ready for testing and prior to placement of concrete. 2. The installation of all anchors in a lot are ready for testing and prior to the installation of sign support structures. | - |
| 2 | - | Issue a MTO form PH-CC-702, Notice to Proceed if all the requirements of the Contract Documents are met. | - |

**8.0 QUALITY ASSURANCE**

**8.01 General**

Inspection Activities:

|  |  |  |  |
| --- | --- | --- | --- |
| 1 | - | Select the location for Proof of Process Installation when in-situ testing cannot be done. | 100% |
| 2 | - | Check that the installed dowels are conforming to the visual acceptance criteria and pull testing criteria as specified in SSP 999F29. | 100% |

**8.02 Visual Acceptance Criteria**

**8.02.01 General**

Inspection Activities:

|  |  |  |  |
| --- | --- | --- | --- |
| 1 | - | Check that completed anchor and dowel installations are properly positioned according to the Contract Documents and are free of damage to the anchor or dowel or coating. Check that anchor and dowels projections, especially threads, are not fouled by excess adhesive. | 100% |

**8.02.02 Horizontal Dowels and Anchors**

Inspection Activities:

|  |  |  |  |
| --- | --- | --- | --- |
| 1 | - | Check that anchor and dowel installations don’t have excessive run-out of adhesive. | 100% |

**8.03 Pull Testing Criteria**

**8.03.01 General**

Inspection Activities:

|  |  |  |  |
| --- | --- | --- | --- |
| 1 | - | Check that pull testing is carried out according to the Contract Documents and the Pull Test Guide for Testing of Metallic Dowels, of Uncoated, Coated or Stainless Steel.  For pull testing of anchors, modify the pull test so that the grips do not damage any threads of installed anchors. | 100% |

Administrative Activities:

|  |  |  |  |
| --- | --- | --- | --- |
| 1 | - | At the start of construction, ensure pull testing equipment is available or can be made available for pull testing or proof of process pull testing. | - |
| 2 | - | Review equipment calibration documentation is according to the Contract Documents and the Pull Test Guide for Testing of Metallic Dowels, of Uncoated, Coated or Stainless Steel. Check that calibration test data is not more than 12 months old. | - |
| 3 | - | Schedule anchor and dowel pull testing with the independent laboratory and check that the testing is completed within 5 Business Days of the Contractor’s notice that the lot is ready for testing. | - |

**8.03.02 Load and Duration Time**

**8.03.02.01 Dowels**

Administrative Activities:

|  |  |  |  |
| --- | --- | --- | --- |
| 1 | - | Review the load requirements of Table 1 prior to pull testing and Check that dowels meet the requirements of SSP 999F29. | - |

**8.03.02.02 Aluminum Bridge Mounted Sign Support Structure Anchors**

Administrative Activities:

|  |  |  |  |
| --- | --- | --- | --- |
| 1 | - | Review the load requirements of Table 2 prior to pull testing and Check that anchors meet the requirements of SSP 999F29. | - |

**8.03.03 Proof of Process Installation**

Inspection Activities:

|  |  |  |  |
| --- | --- | --- | --- |
| 1 | - | Check that five anchors or dowels are collected for each anchor or dowel type and for each proof of process installation as specified in SSP 999F29. Check that anchors or dowels for proof of process installation are all straight bars. | 100% |
| 2 | - | Check that the dowels are installed according to the MPII and the Contract Documents | 100% |

Administrative Activities:

|  |  |  |  |
| --- | --- | --- | --- |
| 1 | - | Receive and check notice from the Contractor is provided at least 5 Business Days prior to proof of process installation. | - |

**8.03.04 In-Situ Pull Test Requirements**

**8.03.04.01 Lot Size**

Administrative Activities:

|  |  |  |  |
| --- | --- | --- | --- |
| 1 | - | Check that a lot does not consist of more than 200 dowels of the same type in a single stage. Where a single stage is less than 200 dowels of the same type, the lot shall be the single stage. | - |

**8.03.04.02 Dowels**

Inspection Activities:

|  |  |  |  |
| --- | --- | --- | --- |
| 1 | - | Select 10 random dowels in each lot for testing. If 2 or more dowels fail, conduct additional pull testing on another 20 dowels in the lot. | 100% |
| 2 | - | Review the in-situ pull test results as specified in SSP 999F29. | 100% |

**8.03.04.03 Replacement of Failed Dowels**

Inspection Activities:

|  |  |  |  |
| --- | --- | --- | --- |
| 1 | - | Check that failed dowels are replaced by the Contractor as specified in SSP 999F29. | 100% |

**8.03.04.04 Anchors**

Inspection Activities:

|  |  |  |  |
| --- | --- | --- | --- |
| 1 | - | Select 4 random anchors in each lot for testing. If any anchors fail, reject the entire lot and consult with the MTO Regional Structural Section. | 100% |

**9.0 MEASUREMENT FOR PAYMENT**

Administrative Activities:

|  |  |  |  |
| --- | --- | --- | --- |
| 1 | - | Measurement for payment shall be as specified. | - |

**10.0 BASIS OF PAYMENT**

Administrative Activities:

|  |  |  |  |
| --- | --- | --- | --- |
| 1 | - | Basis of payment shall be as specified. | - |

WARRANT: Always with SSP 999F29, Construction Requirements for Installation of Metallic Dowels and Anchors Into Concrete.