**DOWELS INTO CONCRETE** - **Item No.**

**ALUMINUM BRIDGE MOUNTED SIGN SUPPORT STRUCTURES - Item No.**

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| Special Provision No. 999F29 November 2022 |

**REQUIREMENTS FOR INSTALLATION OF METALLIC DOWELS AND ANCHORS INTO CONCRETE**

**1.0 SCOPE**

This Special Provision covers the requirements for the installation of metallic dowels and aluminum bridge mounted sign support structure anchors in concrete.

**2.0 REFERENCES**

This Special Provision refers to the following standards, specifications, or publications:

**Ontario Provincial Standard Specifications, Construction:**

OPSS 905 Steel Reinforcement for Concrete

OPSS 915 Sign Support Structures

**Ontario Provincial Standard Specifications, Materials:**

OPSS 1440 Steel Reinforcement for Concrete

**Ontario Ministry of Transportation Publications:**

Designated Sources for Materials (DSM) Manual

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

**ASTM International:**

F593-17 Stainless Steel Bolts, Hex Cap Screws, and Studs

**3.0 DEFINITIONS**

For the purpose of this Special Provision the following definitions apply:

**Adhesive** means an adhesive comprised of chemical components that cure when blended together; such as epoxies, polyurethanes, polyesters, methyl methacrylate’s or vinyl esters, that is used to secure a dowel or anchor in concrete.

**Anchor** means a post-installed, stainless steel threaded bar anchorage inserted into hardened concrete, that transfers loads to the concrete by the bond between the anchor and the adhesive and the bond between the adhesive and the concrete.

**Cartridge System** means two-component adhesives packaged in a cartridge for use with either manually or power-driven dispensers. Metering and mixing of the components are automatically controlled as the adhesive is dispensed through a manifold and disposable mixing nozzle.

**Dowel** means a post-installed deformed reinforcing steel bar, or stainless steel reinforcing bar, inserted into hardened concrete, that transfers loads to the concrete by the bond between the dowel and the adhesive and the bond between the adhesive and the concrete.

**Dowel Type** means a dowel differentiated by bar size, orientation of embedment (horizontal, vertical, or other), and embedment length.

**Manufacturer’s Printed Installation Instructions (MPII)** means published instructions for correct installation of dowels and anchors under all covered installation conditions as supplied in product packaging by the manufacturer of the adhesive. The MPII includes information on storage conditions, and shelf life of the adhesive, and restrictions on installation conditions.

**Piston Plug** means a device on the end of a flexible injection tube equaling the hole diameter, which facilitates injection of liquid adhesive into a drilled hole.

**Pull Test** means a test consisting of the application of a specified tensile axial load for a specified time period to installed dowels or anchors selected for testing.

**4.0 DESIGN AND SUBMISSION REQUIREMENTS**

**4.1 Submission Requirements**

**4.1.1 Dowel and Anchor**

Submission requirements for the certification of the manufacturer of metallic dowels and anchors shall be according to OPSS 905.

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

The adhesive’s MPII shall be submitted to the Contract Administrator at least 7 Days prior to drilling of any dowel or anchor holes.

**5.0 MATERIALS**

**5.01 Adhesive**

The adhesive shall be an approved cartridge system supplied from a source named on the ministry’s DSM, suitable for the application. Adhesive cartridges shall be stored according to the MPII.

**5.02 Anchors**

Anchors used for aluminum bridge mounted sign support structures shall be as specified in the Contract Documents.

The complete anchorage assembly shall include anchor studs, nuts, and hardened washers. The studs, nuts, and washers shall be alloy 304 or 316 stainless steel, according to ASTM F593. The anchor assembly shall be new, clean, and free of deleterious material.

**5.03 Dowels**

Dowels shall be according to OPSS 1440. The dowel type shall be as specified in the Contract Documents.

Dowels shall be new, clean, and free of deleterious material.

**6.0 EQUIPMENT - Not Used**

**7.0 CONSTRUCTION**

**7.01 Operational Constraint**

Dowels and anchors shall not be installed in concrete less than 21 Days old.

**7.02 Proof of Process**

When the Contract Administrator determines that in-situ pull testing is not possible due to insufficient clearance for proper positioning of the testing device or dowels too short to fit the testing device grips, a proof of process installation and pull testing shall be carried out in lieu of in-situ pull testing.

Dowels or anchors shall not be installed into the work until the Contract Administrator has accepted the proof of process installation procedure, including personnel, and provided notification in writing.

The purpose of proof of process installation is to demonstrate to the Contract Administrator that the dowel or anchor installation material and methods used in the work are capable of meeting the pull test requirements as specified in the Contract Documents.

The proof of process installation shall be installed at another location in the work subject to the approval of the Contract Administrator. The proof of process installation shall be carried out using the same personnel, equipment, materials, and methods intended for use in the work, and shall be in the same orientation (vertical or horizontal) required for the work.

An approved proof of process installation procedure for dowel types or anchors shall be valid for the work for 120 Days from the date of acceptance. After 120 Days, proof of process installation shall be repeated using the same personnel, materials, dowel type or anchor, and process to re-qualify the proof of process installation procedure.

Re-qualification of the proof of process installation procedure shall be required when any personnel, materials, dowel type or anchor, and process changes. The Contract Administrator may at any time require a re‑qualification of the proof of process installation. When re-qualification is required, and it has been deemed acceptable by the Contract Administrator, it shall be valid for 120 Days from the date of re-qualification.

Upon the successful completion of a proof of process installation procedure, the approved personnel shall be permitted to install dowel types or anchors using the accepted installation procedure.

**7.03 Installation**

**7.03.01 Drill Holes**

Holes shall be drilled straight at the locations specified in the Contract Documents. The drill holes dimensions and depths shall be as specified in the Contract Documents. The drill hole diameter shall not be greater than 1.5 times the diameter of the dowel or anchor. Core drilling of the holes shall not be permitted.

Existing reinforcement, utility ducts, post tensioning hardware, and any unsound concrete in the vicinity of the dowel locations shall be located prior to the drilling of any holes. Steel reinforcement and other existing embedments shall not be cut or damaged by the drilling process. If any of the above is encountered during drilling operations, the Contract Administrator shall be notified immediately.

The drilling operations shall not cause spalling, cracking, or other damage to the surrounding concrete. Any damage shall be repaired in a manner acceptable to the Contract Administrator.

Holes that are started but not completed shall be cleaned and filled with a proprietary patching material from the Owner’s pre-qualified products list in a manner acceptable to the Contract Administrator.

**7.03.02 Cleaning Drill Holes**

Immediately prior to installation of dowels and/or anchors, drill holes shall be thoroughly cleaned and free of debris according to the MPII. At a minimum, the drill hole shall be cleaned with compressed air followed by a cleaning brush and a second jet of compressed air.

**7.03.03 Installing Dowels and Anchors**

Each cartridge system shall be tested for proper mixing on a disposable surface prior to injecting any adhesive into the drill hole. The test material shall not be incorporated into the work.

A piston plug shall be used for adhesive injection for dowels and anchors installed in the horizontal and overhead directions.

Dowels and anchors shall be installed in the positions specified in the Contract Documents. The adhesive shall be placed according to the MPII and shall completely fill the drill hole once the dowel or anchor is installed. All excess adhesive shall be struck-off flush with the concrete surface and removed from the surrounding concrete surface area.

Dowels and anchors shall be maintained in the proper position, protected from being disturbed during the setting of the adhesive, and loss of adhesive from the holes shall be prevented.

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

An MTO form PH-CC-701, Request to Proceed, shall be submitted to the Contract Administrator after:

a) The installation of all dowels in a lot are ready for testing and prior to placement of concrete;

b) The installation of all anchors in a lot are ready for testing and prior to the installation of sign support structures.

Access to the dowels and anchors for pull testing shall be provided to the Contract Administrator. The Contract Administrator shall be allowed 5 Business Days to carry out the pull testing.

Until the pull tests have been completed and the lots are accepted into the work, installation of formwork or attachment of anything to the dowels or anchors (such as steel reinforcement or utility ducts) shall not be permitted.

The next operation shall not proceed until the Contract Administrator has issued a MTO form PH-CC-702, Notice to Proceed.

**8.0 QUALITY ASSURANCE**

**8.01 General**

Installed dowels and anchors shall be accepted based on conformance to the visual acceptance criteria and pull testing criteria.

All dowels, except for dowels installed in the following applications, shall be subjected to in-situ pull testing for acceptance purposes:

a) Concrete box culvert extensions;

b) Re-facing of all structural elements (e.g., abutments, columns, wing walls) less than 2 m in height;

c) Widening of footings;

d) Concrete patches;

e) Concrete pavement repairs;

f) Slip-formed barrier walls; and,

g) When the Contract Administrator determines that in-situ pull testing is not possible due to insufficient clearance for proper positioning of the testing device or dowels too short to fit the testing device grips. A proof of process installation and pull testing shall be carried out in lieu of in-situ pull testing.

**8.02 Visual Acceptance Criteria**

**8.02.01 General**

Completed dowel and anchor installations shall be properly positioned as specified in the Contract Documents and free of any defects and deficiencies up to the date of completion of the placement of concrete or installation of the aluminum bridge mounted sign structure.

Any spalling, cracking, or other damage to the surrounding concrete caused by the installation or removal of dowels or anchors shall be repaired in a manner acceptable to the Contract Administrator.

Any damaged dowels or anchors determined to be rejected by the Contract Administrator shall be cut as close to flush with the concrete face as possible. A replacement dowel or anchor shall be installed at a location determined by the Contract Administrator.

**8.02.02 Horizontal Dowels and Anchors**

Completed horizontal dowel and anchor installations shall not have excessive run-out of adhesive resulting in incomplete coverage of the dowel or anchor in the hole. Dowels and anchors shall be prevented from sag during adhesive cure. Drill holes shall be completely filled with adhesive.

**8.03 Pull Testing Criteria**

**8.03.01 General**

Pull testing shall be carried out by the Contract Administrator according to the Pull Test Guide for Testing of Metallic Dowels, available from Engineering Materials Office, Concrete Section. The pull test shall be modified according to the Contract Administrator, for in-situ testing of anchors to protect the bar threads from damage.

The Contractor may be present during the testing procedure. When requested by the Contractor, the Contract Administrator shall provide documentation of equipment calibration.

An individual dowel or anchor shall not be subjected to more than one pull test.

**8.03.02 Load and Duration Time**

**8.03.02.01 Dowels**

Dowels shall be considered acceptable when they can maintain the load for the duration in time specified in Table 1.

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

Anchors shall be considered acceptable when they can maintain the load for the duration in time specified in Table 2.

**8.03.03 Proof of Process Installation**

The Contract Administrator shall be notified in writing at least 5 Business Days prior to proof of process installation.

The Contract Administrator shall select the location for proof of process installation in another area of the same structural element, or in another comparable structural element.

The number of dowels or anchors required for each proof of process installation shall be five for each dowel type and anchor to be installed in the work. Straight bars shall be installed for proof of process installation.

If any dowel or anchor fails pull testing, the proof of process installation shall be considered unacceptable.

Any installed dowels or anchors used for proof of process installation that fail the pull test shall be removed by the Contractor at no additional cost to the Owner. If directed by the Contract Administrator, any remaining dowels or anchors shall be removed by the Contractor at no additional cost to the Owner. Cutting off dowels flush with the concrete surface is permitted.

**8.03.04 In-Situ Pull Test Requirements**

**8.03.04.01 Lot Size**

Dowels and anchors tested in-situ will be accepted on a lot basis. A lot shall consist of no 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.

A lot shall consist of all anchors installed in a single bridge structure for all aluminum bridge mounted sign support structures to be installed on that bridge.

**8.03.04.02 Dowels**

The Contract Administrator shall randomly select 10 dowels in each lot for testing. All testing shall be completed before concrete is placed.

If two or more dowels fail, the Contract Administrator shall conduct additional pull testing on 20 dowels in the lot. If two or more additional dowels fail, the lot shall be deemed unacceptable and the lot shall be removed and replaced.

Replacement dowels shall be accepted by pull testing, proof of process installation, or other means, as directed by the Contract Administrator. Additional pull testing shall be according to the Quality Assurance Section. The Contractor shall be charged the cost of the additional pull test according to the Basis of Payment Section.

**8.03.04.03 Replacement of Failed Dowels**

Any installed dowels that fail the pull test shall be removed and replaced. In lieu of removal, dowels may be cut off flush with the concrete surface.

The Contractor shall install the new dowel in a location approved by the Contract Administrator.

**8.03.04.04 Anchors**

The Contract Administrator shall randomly select four anchors in each lot for testing. All testing shall be completed before installation of aluminum bridge mounted sign support structures.

If any anchors fail, the lot shall be deemed unacceptable, and the aluminum bridge mounted sign support structures shall not be installed without prior approval of the Contract Administrator. Unacceptable lots may be subject to additional testing and/or removal and replacement at the discretion of the Contract Administrator.

Replacement anchors shall be accepted by pull testing, proof of process installation, or other means, as directed by the Contract Administrator. Additional pull testing shall be according to the Quality Assurance Section. The Contractor shall be charged the cost of the additional pull test according to the Basis of Payment Section

**9.0 MEASUREMENT FOR PAYMENT**

For measurement purposes, a count shall be made of the number of dowels installed.

**10.0 BASIS OF PAYMENT**

**10.01 Dowels Into Concrete - Item**

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment, and Material to do the work, except that payment for the reinforcing steel bars or stainless steel reinforcing bars used as the dowels shall be according to OPSS 905.

The cost of additional pull testing shall be at no additional cost to the Owner and shall be a lump sum of $1,000 per mobilization to the Contract with an additional cost of $50 per dowel.

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

Payment shall be at the Contract price for the tender item “Aluminum Bridge Mounted Sign Support Structures”, according to OPSS 915.

The cost of additional pull testing shall be at no additional cost to the Owner and shall be a lump sum of $1,000 per mobilization to the Contract with an additional cost of $50 per anchor.

**TABLE 1**

**Dowel Pull Test Loads**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **DOWELS** | | | | | | |
|  | **Specified Embedment Depth**  **Less Than or Equal to 160 mm** | | **Embedment Depth**  **161 mm to 205 mm** | | **Embedment Depth Greater Than 205 mm** | |
| **Dowel**  **Size** | **Test Loads**  **kN** | **Duration**  **Seconds** | **Test Loads**  **kN** | **Duration**  **Seconds** | **Test Loads kN** | **Duration Seconds** |
| 10M | 20 | 15 | 25 | 15 | \* | \*\* |
| 15M | 40 | 15 | 50 | 15 | \* | \*\* |
| 20M | 60 | 15 | 75 | 15 | \* | \*\* |
| 25M | 100 | 15 | 120 | 15 | \* | \*\* |
| 30M | 140 | 15 | 175 | 15 | \* | \*\* |
| 35M | 190 | 15 | 240 | 15 | \* | \*\* |

[\* Designer Fill-In for Table 1, See Notes to Designer]

**TABLE 2**

**Anchor Pull Test Loads**

|  |  |  |
| --- | --- | --- |
| **ANCHORS** | | |
| **Anchor Type** | **Test Loads**  **kN** | **Duration**  **Seconds** |
| \*\*\* | \* | \*\* |
| \*\*\* | \* | \*\* |
| \*\*\* | \* | \*\* |
| \*\*\* | \* | \*\* |
| \*\*\* | \* | \*\* |
| \*\*\* | \* | \*\* |

[\* Designer Fill-In for Table 2, See Notes to Designer]

NOTES TO DESIGNER:

\* Designer to specify the load, in kN, that the dowel/anchor is to be held at for the specified time before release.

Fill in the required test load based on the job specific design requirements. The test load shall usually be no more than 85% of the required tensile capacity at Ultimate Limit State (ULS).

\*\* Designer to specify the time, in seconds, that the dowel/anchor is to be held at for the specified load before release.

\*\*\* Designer to consult with the Structures Office before specifying any proprietary anchorage products.

WARRANT: Always with this tender item.