

## **INSTALLATION OF POST-INSTALLED ANCHOR SYSTEMS AND DOWELS FOR STRUCTURAL APPLICATIONS IN CONCRETE ELEMENTS.**

**(REV 8-20-24)**

SECTION 416 is deleted and the following substituted:

### **SECTION 416 INSTALLATION OF POST-INSTALLED ANCHOR SYSTEMS AND DOWELS FOR STRUCTURAL APPLICATIONS IN CONCRETE ELEMENTS**

#### **416-1 Description.**

Prepare and install post-installed anchor systems and dowels in hardened concrete as indicated in the Plans, as directed by the Engineer, and in accordance with the manufacturer's instructions and this Section.

Post-installed anchors and dowels in this Section are intended for use in structural applications where designated in the Plans. Requirements provided in this Section are not applicable for anchoring conduit(s) unless specifically called for in the Plans.

#### **416-2 Materials.**

Meet the following requirements:

Adhesive Bonding Material Systems\* .....Section 937

Undercut Anchor Systems\* .....Section 937

Screw Anchors\* ..... Section 937

\*Use products listed on the Department's Approved Product List (APL).

**416-2.1 Adhesive Bonded Anchors and Dowels:** Use anchors and dowels installed in positions ranging from vertically downward to horizontal. Do not use material from containers which are damaged or have been previously opened. Use only full packages of components. Combining of adhesive bonding components from bulk supplies is not permitted.

**416-2.1.1 Type HV Adhesives:** Use Type HV adhesive bonding materials for all installations other than constructing doweled pile splices. Do not use Type HV adhesives as a substitute for Type HSHV adhesives.

**416-2.1.2 Type HSHV Adhesives:** Use higher strength Type HSHV adhesive bonding materials for installation of traffic railing reinforcement and anchor bolts into existing concrete bridge decks and approach slabs. Type HSHV adhesives may be used as a substitute for Type HV adhesives provided the length and diameter of the anchor bolt and drilled hole remain as designed for the Type HV adhesive.

**416-2.1.3 Storage of Materials:** The adhesive bonding material system shall be delivered to the project site in original unopened containers with the manufacturer's label identifying the product. Store materials delivered to the job site within an appropriate facility capable of maintaining storage conditions consistent with the manufacturer's recommendations.

**416-2.2 Screw Anchors and Undercut Anchor Systems:** Obtain all screw anchors or undercut anchor systems from the same manufacturer per anchor type. Submit proposed anchor systems meeting the loads shown in the plans to the Engineer for capacity verification and approval.

Install anchors in concrete members having a minimum compressive strength of 2,500 psi or as recommended by the manufacturer, whichever is greater.

### **416-3 Equipment.**

Install adhesive-bonded anchor systems with equipment conforming to the manufacturer's recommendation for the type of system installed.

### **416-4 Preparing of Concrete Members.**

**416-4.1 Adhesive-Bonded Anchors and Dowels:** Ensure that concrete members receiving adhesive-bonded anchors or dowels are structurally sound and free of cracks in the vicinity of the anchor or dowel to be installed. Unless other equipment is recommended by the adhesive manufacturer, drill holes to the diameter required by the manufacturer, but as a minimum, not less than 105% of the diameter including deformations, nor more than 150% of the nominal diameter of the steel bar anchor or dowel, using a rotary hammer drill and bit.

Use a metal detector specifically designed for locating steel in concrete to avoid conflicts with existing steel reinforcement whenever placement tolerances and edge clearances permit. Perform core drilling through existing steel reinforcement only when approved by the Engineer. Dry the drilled holes completely prior to cleaning and installing the anchors or dowels.

Clean and prepare drilled holes in accordance with the manufacturer's recommendations, but as a minimum, use oil free compressed air to remove loose particles from drilling, brush inside surface to free loose particles trapped in pores, then use compressed air again to remove the remaining loose particles. Use a non-metallic bristle brush and avoid over-brushing to prevent polishing the inside surface of the drilled hole.

**416-4.2 Screw Anchors and Undercut Anchor Systems:** Ensure concrete members receiving screw anchors and undercut anchor systems are structurally sound in the vicinity of the anchor to be installed. Installation in the vicinity of non-structural cracks is permitted at the discretion of the Engineer.

Use a metal detector specifically designed for locating steel in concrete to avoid conflicts with existing steel reinforcement whenever placement tolerances and edge clearances permit. Perform core drilling through existing steel reinforcement only when approved by the Engineer. Drill, clean and prepare holes in accordance with the manufacturer's recommendations.

### **416-5 Installation Methods.**

**416-5.1 Adhesive-Bonded Anchors and Dowels:** Remove all debris, oils, and any other deleterious material from the anchors and dowels to avoid contamination of the adhesive bonding material. Install anchors or dowels in accordance with the details shown in the Plans and the manufacturer's printed installation instructions (MPII), with particular attention to requirements and limitations due to anchor position, dampness, ambient temperature, and curing.

Use adequate quantities of the adhesive bonding material to fill the drilled hole to within 1/4 inch of the concrete surface measured after placement of the steel bar or anchor. For horizontal and downwardly inclined installations, provide temporary supports to maintain the anchors or dowels in the center of the drilled holes until the adhesive bonding material has cured.

**416-5.2 Screw Anchors and Undercut Anchor Systems:** Install screw anchors and undercut anchor systems in accordance with the MPII and the Plans. Pay specific attention to any requirements and limitations due to anchor position. Do not reuse anchors that have previously been installed.

## **416-6 Field Testing of Post-Installed Anchor Systems and Dowels.**

**416-6.1 General:** Provide an independent testing agency to perform field testing of post-installed anchors or dowels under the direction of a Professional Engineer registered in the State of Florida. Submit test reports for each LOT signed and sealed by the Professional Engineer. Perform restrained static tension tests to prevent damage to the surrounding concrete. A restrained test is defined as a test conducted in accordance with ASTM E488 except that the test equipment support clearance requirements of ASTM E488 do not apply. The opening in the reaction base shall be approximately equal to the drilled hole diameter for the adhesive-bonded anchors to preclude concrete or masonry failure, but allow bond failure for the adhesive-bonded anchors and dowels. The opening in the reaction base shall be ½-inch larger than the drilled hole diameter for the anchors to preclude concrete failure, but allow bond slip for adhesive anchors or pullout failure for screw and undercut anchors. Displacement measurement for field testing is not required.

Divide the post-installed anchors or dowels into LOTs for testing and acceptance. Each LOT must contain a maximum of 100 anchors or dowels, of the same type, manufacturer, diameter, embedment length and adhesive bonding material system (if applicable) installed on the same day. Randomly select four of the anchors or dowels in each LOT for testing, except if there are three or less in the LOT, in which case, test all anchors or dowels, unless otherwise directed by the Engineer. If three consecutive LOTs have no failing tests, sample the next three LOTs at a 2% rate, rounded up to the nearest whole number, and if these LOTs have no failing tests, sample at a rate of 1%, rounded up to the nearest whole number, for the remaining LOTs unless there is a failure; however, regardless of LOT size, sample at least one anchor or dowel per LOT. For every failed field test, perform two additional field tests on adjacent untested anchors or dowels within the LOT. Continue additional field tests until no more test failures occur, or all anchors or dowels within the LOT are tested. For the next LOT after a failed LOT, randomly select four of the anchors or dowels in each LOT for testing, except if there are three or less in the LOT, test all anchors or dowels unless otherwise directed by the Engineer then conform to the sampling rate procedure above including rate reductions as appropriate for subsequent LOTs.

**416-6.1.1 Adhesive-Bonded Anchors:** Field test installed anchors and dowels for applications connecting traffic railings to bridge decks, approach slabs and concrete pavement using Type HSHV adhesives. The Engineer may also require field testing of installed anchors and dowels for other applications. Any field testing of installed anchors which is required by the Engineer and not quantified in the Contract Documents shall be paid for by the Department unless a failure occurs during the field testing.

Test individual anchors and dowels by proof loading in tension to 85% of the specified bond strength in accordance with Section 937 based on the nominal anchor or dowel diameter and embedment depth, but not more than 90% of the yield strength of the anchor or dowel, unless otherwise shown in the Contract Documents.

**416-6.1.2 Screw Anchors and Undercut Anchors:** Field test installed undercut anchors to verify proper installation and capacity in accordance with this Section.

Field testing of screw anchors, or undercut anchors having marked setting indicators, is not required unless directed by Engineer. Inspect each undercut anchor to ensure the marked setting indicator is visible. If the marked setting indicator is not visible, indicating possible improper installation, perform field testing in accordance with this Section.

Test individual anchors by proof loading in tension to the lesser of 80% of the yield strength of the anchor or 100% of the factored design load, as provided in the Contract Documents. Torque-testing of anchors is not an acceptable method of verifying anchor tension capacity but is acceptable for anchor setting in accordance with the MPII.

**416-6.2 Removal & Replacement of Failed Test Specimens:** Remove all anchors and dowels that fail the field test, in accordance with the manufacturer's recommendation and without damage to the surrounding concrete. For adhesive-bonded anchors, redrill holes to remove adhesive bonding material residue and clean in accordance with 416-4. Reinstall new anchors and dowels in accordance with 416-5. Do not reuse the failed anchors and dowels unless approved by the Engineer. Assign reinstalled anchors into new LOTs only containing reinstalled anchors or dowels of the same diameter, embedment length and adhesive bonding material system, and field test in accordance with 416-6.

**416-7 Acceptance.**

The Engineer will base acceptance of post-installed anchor systems on determining that the material requirements of Section 937, the installation and testing requirements of this Section and the placement requirements of the Plans have been met.

The Contractor shall provide the Engineer with a certification from the manufacturer of the anchor system, confirming that the requirements of this Section are met. The certification shall conform to the requirements of Section 6. Each certification shall cover only one LOT of anchoring materials

**416-8 Basis of Payment.**

The work specified in this Section will not be paid for directly but will be considered as incidental work.

## POST-INSTALLED ANCHOR SYSTEMS FOR STRUCTURAL APPLICATIONS IN CONCRETE ELEMENTS.

(REV 8-20-24)

SECTION 937 is deleted and the following substituted:

### SECTION 937 POST-INSTALLED ANCHOR SYSTEMS FOR STRUCTURAL APPLICATIONS IN CONCRETE ELEMENTS

#### 937-1 General.

Post-installed anchor systems intended for structural applications in concrete elements consist of adhesive-bonded anchor systems.

#### 937-2 Adhesive Bonding Material Systems.

**937-2.1 General:** Adhesive bonding material systems for structural applications shall consist of pre-packaged, 2-part chemical component material systems that automatically proportion and mix the materials for use. Manual proportioning of the components will not be permitted.

The material systems shall be specifically intended for use in structural applications for bonding anchors and dowels to hardened concrete. Applications are limited to anchors and dowels installed in positions ranging from vertically downward to horizontal.

**937-2.2 Approved Product List (APL) Submittal Requirements:** Manufacturers seeking evaluation of products for inclusion on the APL shall submit an application in accordance with Section 6 and include the documentation identified in Table 937-1. Documentation and reports must demonstrate that the product meets the requirements of this Section.

Table 937-1	
Documentation	Requirements
Product Photo	Displays the significant features of the product or each component of the product system.
Technical Data Sheet	Uniquely identifies the product and includes the following information: <ol style="list-style-type: none"><li>1. Product specifications showing the product meets the requirements in Section 937-2</li><li>2. Storage instructions</li><li>3. Recommended installation materials and equipment as applicable</li></ol>
Product Label	For each component of the product system, containing the following information: <ol style="list-style-type: none"><li>1. Manufacturer's name and address</li><li>2. Product Name</li><li>3. Date of Manufacture</li><li>4. Expiration Date</li><li>5. LOT Identification Number</li><li>6. Storage and Handling Requirements</li></ol>

Table 937-1	
Documentation	Requirements
Safety Data Sheet (SDS)	<p>SDS meeting OSHA requirements for product and manufacturer recommended installation materials as applicable. Non-Hazardous, per RCRA Subtitle C Table 1 of 40 CFR 261.24 "Toxicity Characteristic" and not exude fumes which are hazardous, toxic, or detrimental to persons or property.</p>
Independent Laboratory Test Report	<p>For product or product system, containing the following information:</p> <ol style="list-style-type: none"> <li>1. Minimum Uniform Bond Stress in accordance with Table 937-2.</li> <li>2. Long Term Load (Creep) in accordance with Section 937-2.3</li> <li>3. Density or Average Weight in accordance with FM 5-569.</li> <li>4. Gel Time or Setting Time in accordance with FM 5-569.</li> <li>5. Bond Strength in accordance with FM 5-569.</li> </ol>
Installation Instructions	<p>Each package shall include the manufacturer's instructions for anchor and dowel installation. The instructions shall include the following information:</p> <ol style="list-style-type: none"> <li>1. Diameters of drilled holes for applicable anchor and dowel sizes.</li> <li>2. Cleaning procedure for drilled holes, including a description of permitted and prohibited equipment and techniques.</li> <li>3. Allowable temperature ranges for storage, installation and curing.</li> <li>4. Identification of acceptable mixing/dispensing nozzles.</li> <li>5. Fabrication requirements for anchors and dowels.</li> <li>6. Description of tools permitted or required for installation.</li> <li>7. Method of identifying properly proportioned and mixed adhesive materials.</li> <li>8. Time and temperature schedule for initial set and full-strength cure.</li> <li>9. Special requirements for special installation conditions such as damp holes, or horizontal or near horizontal orientation of the anchor or dowel.</li> </ol>
Manufacturer's Certification Example	Submit an example in accordance with Section 416.
Product Sample	Submit upon request from the Department. If the product is a system, a sample of each component must be submitted.

### 937-2.3 Performance Requirements:

**937-2.3.1 Minimum Uniform Bond Stress:** When tested in accordance with FM 5-568, the adhesive bonding material system, for general use, shall meet the following requirements:

Table 937-2 Minimum Uniform Bond Stress		
	Type HV	Type HSHV
Confined Tension	2,290 psi	3,060 psi
Damp-Hole Installation	1,680 psi	1,830 psi
Elevated Temperature	2,290 psi	3,060 psi
Horizontal Orientation	2,060 psi	2,060 psi
Short Term Cure	1,710 psi	1,710 psi
Specified Bond Strength	1,080 psi	1,830 psi
Maximum Coefficient of Variation for Uniform Bond Stress: 20%.		

### 937-2.3.2 Long Term Load (Creep):

1. The rate of displacement shall decrease during the 42 day application of load.

2. At 42 days, the total displacement due to creep (with load still applied) shall be less than 0.03 inches and during the last 14 days of the 42 day load duration, the total displacement due to creep shall be less than 0.003 inches.

3. After removal of the 42 day load, the uniform bond Stress from a subsequent Confined Tension Test shall not be less than 1,826 psi.

**937-2.4 Product Identification (Fingerprint) Properties:** References for comparison include infrared absorption, density or average weight, gel time or setting time, and bond strength shall be determined in accordance with FM 5-569.

### 937-3 Undercut Anchor Systems.

**937-3.1 General:** The undercut anchor system for permanent applications shall be constructed of Type 316 stainless steel. Undercut anchor systems for temporary applications with an expected service life of less than 3-years, may be zinc-plated or mechanically-galvanized carbon steel.

The undercut anchor sleeve shall form a cone shaped undercut or expand into a preformed cone or reverse cone shaped undercut. Anchors using only self-cutting teeth that are expanded to form the undercut are not permitted.

Undercut anchors with a marked setting indicator not requiring a specified setting torque are permitted. The marked setting indicator shall indicate the displacement of the anchor bolt relative to the anchor sleeve and must be visible above the concrete surface after setting operation is complete.

Requirements provided in this Section are not applicable for anchoring low-weight utility and lighting conduit(s) unless specifically called for in the Plans.

**937-3.2 Approved Product List (APL) Submittal Requirements:** Manufacturers seeking evaluation of products for inclusion on the APL shall submit an application in accordance with

Section 6 and include the documentation identified in Table 937-3. Documentation and reports must demonstrate that the product meets the requirements of this Section.

Table 937-3	
Documentation	Requirements
Product Photo	Displays the significant features of the product or each component of the product system.
Technical Data Sheet	Uniquely identifies the product and includes the following information: <ol style="list-style-type: none"> <li>1. Product specifications showing the product meets the requirements in Section 937-3</li> <li>2. Storage instructions</li> <li>3. Recommended installation materials and equipment as applicable</li> </ol>
Product Label	For each component of the product system, containing the following information: <ol style="list-style-type: none"> <li>1. Manufacturer's name and address</li> <li>2. Product Name</li> <li>3. Anchor material grade</li> <li>4. LOT Identification Number</li> </ol>
Safety Data Sheet (SDS)	SDS meeting OSHA requirements for product and manufacturer recommended installation materials as applicable. Non-Hazardous, per RCRA Subtitle C Table 1 of 40 CFR 261.24 "Toxicity Characteristic" and not exude fumes which are hazardous, toxic, or detrimental to persons or property.
Installation Instructions	Each package shall include the manufacturer's instructions. The instructions shall include the following information: <ol style="list-style-type: none"> <li>1. Diameters of drilled holes for applicable anchor and dowel sizes.</li> <li>2. Cleaning procedure for drilled holes, including a description of permitted and prohibited equipment and techniques.</li> <li>3. Description of tools permitted or required for installation.</li> </ol>
Product Sample	Submit upon request from the Department. If the product is a system, a sample of each component must be submitted.

**937-3.3 Minimum Performance Requirements:** Provide undercut anchor systems designed in accordance with ACI CODE-318, Chapter 17. Provide only undercut anchor systems qualified for use in cracked concrete, meeting the assessment criteria of Qualification of Post-Installed Mechanical Anchors in Concrete (ACI CODE-355.2) as specified in ACI CODE-318, Chapter 17. Use only Category 1 undercut anchors as defined in ACI CODE-318, Chapter 17.



## 937-4 Screw Anchors

**937-4.1 General:** Screw anchors for permanent applications shall be constructed of Type 316 stainless steel or mechanically-galvanized carbon steel. Screw anchors for temporary applications with an expected service life of less than 3-years, may be zinc-plated carbon steel.

**937-4.2 Approved Product List (APL) Submittal Requirements:** Manufacturers seeking evaluation of products for inclusion on the APL shall submit an application in accordance with Section 6 and include the documentation identified in Table 937-4. Documentation and reports must demonstrate that the product meets the requirements of this Section.

Table 937-4	
Documentation	Requirements
Product Photo	Displays the significant features of the product or each component of the product system.
Technical Data Sheet	Uniquely identifies the product and includes the following information: <ol style="list-style-type: none"><li>1. Product specifications showing the product meets the requirements of Section 937-4</li><li>2. Storage instructions</li><li>3. Recommended installation materials and equipment as applicable</li></ol>
Product Label	For each component of the product system, containing the following information: <ol style="list-style-type: none"><li>1. Manufacturer's name and address</li><li>2. Product Name</li><li>3. Anchor material grade</li><li>4. LOT Identification Number</li></ol>
Safety Data Sheet (SDS)	SDS meeting OSHA requirements for product and manufacturer recommended installation materials as applicable. Non-Hazardous, per RCRA Subtitle C Table 1 of 40 CFR 261.24 "Toxicity Characteristic" and not exude fumes which are hazardous, toxic, or detrimental to persons or property.
Independent Laboratory Test Report	For product or product system, containing the following information: <ol style="list-style-type: none"><li>1. Minimum Uniform Bond Stress in Accordance with Table 937-2.</li><li>2. Density or Average Weight in accordance with FM 5-569.</li><li>3. Gel Time or Setting Time in accordance with FM 5-569.</li><li>4. Bond Strength in accordance with FM 5-569.</li></ol>
Installation Instructions	Each package shall include the manufacturer's instructions. The instructions shall include the following information:

Table 937-4	
Documentation	Requirements
	<ol style="list-style-type: none"> <li>1. Diameters of drilled holes for applicable anchor and dowel sizes.</li> <li>2. Cleaning procedure for drilled holes, including a description of permitted and prohibited equipment and techniques.</li> <li>3. Description of tools permitted or required for installation.</li> </ol>
Product Sample	Submit upon request from the Department. If the product is a system, a sample of each component must be submitted.

**937-4.3 Minimum Performance Requirements:** Use screw anchors designed in accordance with ACI CODE-318, Chapter 17. Use only screw anchors qualified for use in cracked concrete, meeting the assessment criteria of Qualification of Post-Installed Mechanical Anchors in Concrete (ACI CODE-355.2) as specified in ACI CODE-318, Chapter 17.