

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

(REV 3-4-17)

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.

416-2 Materials.

416-2.1 Adhesive Bonded Anchors and Dowels: Use adhesive bonding material systems which meet the requirements of Section 937 and are included on the Approved Product List. Use anchors and dowels installed in positions ranging from vertically downward to horizontal.

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: Store materials delivered to the job site in the original unopened containers within an appropriate facility capable of maintaining storage conditions consistent with the manufacturer's recommendations.

416-2.2 Undercut Anchor Systems: Use undercut anchor systems which meet the requirements of Section 937.

Obtain all 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.

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 and undercut 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 Undercut Anchor Systems: Ensure concrete members receiving 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 on the Plans and the manufacturer's instructions, 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 Undercut Anchor Systems: Install undercut anchor systems in accordance with the manufacturer's recommendations and the Plans. Pay specific attention to any requirements and limitations due to anchor position.

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 E-488 except that the test equipment support clearance requirements of ASTM E-488 do not apply. The opening in the reaction base shall be approximately equal to the drilled hole diameter for the anchor to preclude

concrete or masonry failure, but allow bond failure for the adhesive-bonded anchors and dowels or slip failure for 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 traffic railing applications using Type HSHV adhesives. The Engineer may also require testing of installed anchors and dowels for other applications.

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

Field testing of undercut anchors having marked setting indicators is not required unless directed by Engineer. Inspect each 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.

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 or undercut anchor type, 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.

416-8 Basis of Payment.

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