STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION

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MEMORANDUM TO: Project Engineers
Project Design Engineers

FROM: G. R. Perfetti, P. E.
State Bridge Design Engineer

DATE: June 15, 2007

SUBJECT ADHESIVELY ANCHORED ANCHOR BOLTS OR DOWELS

Effective with the October 2007 letting, the policy for Adhesive Anchor systems has been revised to require field testing for most applications of adhesively bonded anchor bolts or dowels. The number of bolts or dowels to be tested will depend on the location of the anchor and the nature of its loading.

Design Manual section 12-4 and Figure 12-11 have been revised and are attached for your use in determining the level of testing requirements required for various applications. A new project special provision, "Adhesively Anchored Anchor Bolts or Dowels" has been added to the lineup and is attached.

The Design Manual and Standard Notes will be updated at a later date.

GRP/TKK/snj

Attachments
Design Manual Section 12-4
Design Manual Figure 12-11
PSP No. 46 (DOC) (PDF)

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12-4 Adhesively Anchored Anchor Bolts or Dowels

For certain applications, the Contractor has the option of drilling holes in the concrete and filling them with an adhesive bonding material to install anchor bolts or dowels rather than using cast-in-place or preset anchors.

Most applications of adhesively anchored bolts/dowels will require field testing. For a list of these applications, as well as the level of testing required, see Figure 12-11. These anchor bolts/dowels will be tested to a load equal to either 50% or 80% of the yield load of the anchor bolt/dowel. Place the following note on the plans:

> ***The Contractor may use adhesively anchored*** *[anchor bolts/dowels]* ***in place of _____. Level ___ field testing is required, and the yield load of the [anchor bolt/dowels] is____ kips. For Adhesively Anchored Anchor Bolts or Dowels, See Special Provisions.***

If no field testing is required, place the following note on the plans:

> ***The Contractor may use adhesively anchored*** *[anchor bolts/dowels]* ***in place of _____. No field testing is required. For Adhesively Anchored Anchor Bolts or Dowels, See Special Provisions.***

The manufacturer will determine an embedment depth that ensures the adhesive bonding material develops at least 125% of the yield load of the anchor bolt or dowel. The Project Engineer, however, shall be responsible for noting any restrictions on, or special considerations of, the embedment depth of the anchor bolt/dowel such as a 2 inch (50 mm) minimum cover on thin concrete sections. If it is unclear whether there is adequate concrete thickness to develop a reasonable embedment depth, check the manufacturers' catalogs for typical embedment depths.

For bolts, the yield load shown on the plans should be based on the yield stress applied to the tensile stress area of the bolt. For rebar, the yield load is based on the yield stress applied to the cross section area of the bar.

There are a number of approved manufacturers of adhesive bonding systems; refer to the Materials and Tests Unit's approved products list and the respective manufacturer's websites.

The Special Provision for Adhesively Anchored Anchor Bolts or Dowels states that there is no special payment for this system but that it shall be included in the unit contract price for the several pay items.

No Field Testing Required – For non-critical and highly redundant applications

- Sidewalk Dowels
- Cored Slab lateral guides
- Dowels for culvert extensions

Level One Field Testing -- For non-critical applications

- Post attachment to top of parapet for two bar metal rail
- Attachment of cast-in-place wingwall/headwall/curtain wall to precast culverts
- Horizontal dowels used for bridge widening or staged construction between substructure units or bridge decks
- Rubrail attachment to barrier rail
- Anchor bolts for bearing replacements for rehab work

Level Two Field Testing – For critical applications subject to direct traffic loads

- Post attachment to top of parapet for one bar metal rail
- Guardrail attachment to culverts
- Attachment of temporary barrier rails

Do not use Adhesive Bonding Systems for the following applications:

- Overhead applications
- On prestressed members
- Where the edge cover is inadequate to develop the pullout strength
- On very shallow sections of concrete
- Three-bar metal rail post attachments

Uses and Field Testing of Adhesive Bonding Systems

Figure 12 - 11

ADHESIVELY ANCHORED ANCHOR BOLTS OR DOWELS (6-11-07)

1.0 General

Installation and Testing of Adhesively anchored anchor bolts and dowels shall be in accordance with Sections 420-13, 420-21 and 1081-1 of the Standard Specifications except as modified in this provision.

2.0 Installation

Installation of the adhesive anchors shall be in accordance with manufacturer's recommendations and shall occur when the concrete is above 40 degrees Fahrenheit and has reached its 28 day strength.

The anchors shall be installed before the adhesive's initial set ('gel time').

3.0 Field Testing

Replace the third paragraph of Section 420-13 (C) with the following:

> "In the presence of the Engineer, field test the anchor bolt or dowel in accordance with the test level shown on the plans and the following:
>
> Level One Field testing: Test a minimum of 1 anchor but not less than 10% of all anchors to **50%** of the yield load shown on the plans. If less that 60 anchors are to be installed, install and test the required number of anchors prior to installing the remaining anchors. If more than 60 anchors are to be installed, test the first 6 anchors prior to installing the remaining anchors, then test 10% of the number in excess of 60 anchors.
>
> Level Two Field testing: Test a minimum of 2 anchors but not less than 10% of all anchors to **80%** of the yield load shown on the plans. If less that 60 anchors are to be installed, install and test the required number of anchors prior to installing the remaining anchors. If more than 60 anchors are to be installed, test the first 6 anchors prior to installing the remaining anchors, then test 10% of the number in excess of 60 anchors.
>
> Testing should begin only after the Manufacturer's recommended cure time has been reached. For testing, apply and hold the test load for three minutes. If the jack experiences any drop in gage reading, the test must be restarted. For the anchor to be deemed satisfactory, the test load must be held for three minutes with no movement or drop in gage reading."

4.0 Removal and Replacement of Failed Test specimens:

Remove all anchors and dowels that fail the field test without damage to the surrounding concrete. Redrill holes to remove adhesive bonding material residue and clean the hole in accordance with the specifications. For reinstalling replacement anchors or dowels, follow the same procedures as new installations. Do not reuse failed anchors or dowels unless approved by the Engineer.

5.0 Usage

The use of adhesive anchors for overhead installments is not permitted without written permission from the engineer.

6.0 Basis of Payment

No separate measurement or payment will be made for furnishing, installing, and testing anchor bolts/dowels. Payment at the contract unit prices for the various pay items will be full compensation for all materials, equipment, tools, labor, and incidentals necessary to complete the above work.