

## **ENB-15.47 - Use of Adhesive Anchors in Existing Unreinforced Masonry Buildings - UBC/16/#5**

### **USE OF ADHESIVE ANCHORS IN EXISTING UNREINFORCED MASONRY BUILDINGS**

*Administrative Rule Adopted by Bureau Pursuant to Rule-Making Authority*

ARB-ENB-15.47

**TOPIC:** Structural Design - UBC/16/#5

**CODE:** Structural Specialty Code: 1998 Edition

**APPROVED:** January 1, 2003

**REFERENCE:** Chapters 16 " Structural Specialty Code

**SUBJECT:** Use of Adhesive Anchors in Existing Unreinforced Masonry Buildings

**QUESTION:** What are the acceptable design methods and testing requirements when using adhesive anchors for seismic strengthening of existing unreinforced masonry building?

**RESPONSE:** The Bureau of Development Services (BDS) will accept adhesive anchor installations that follow either a system approved by a nationally recognized evaluation service (Method A) or a system which relies on pre-construction testing of specific anchors in a specific building (Method B), as outlined below.

#### **Method A " International Code Council (ICC) / International Council of Building Officials (ICBO) Approved Adhesive Anchor Systems for Unreinforced Masonry**

Unreinforced masonry adhesive anchor systems with an ICC/ICBO evaluation report will be accepted by BDS for their approved use. Anchor systems that have been approved by ICC/ICBO will be allowed without pre-construction testing.

The following requirements apply to adhesive anchors submitted under Method A:

##### **1. Plan Submittal Requirements**

All of the following information must be clearly provided on the submitted plans:

- a. Adhesive type and ICC/ICBO evaluation report.
- b. The special inspection and field testing requirements for the anchor system.
- c. A bolt installation and configuration diagram indicating how the bolt shall be installed, and the approved adhesive type.

##### **2. Project Construction Requirements**

The adhesive anchor type used during construction shall be the same type identified in the ICC / ICBO evaluation report approved by BDS.

- a. Quality Control During Construction  
The ICC / ICBO evaluation report requirements for special inspection shall be followed.
- b. Test Failures During Construction  
A torque test failure is defined as any movement of the bolt during the torque test. In case of torque test failures during construction, the special inspector shall notify the BDS Special Inspection section and the Engineer of Record (EOR). Subject to prior approval by the BDS, an increased level of testing, as described below, shall be conducted. All failed anchors shall be replaced.

##### **Increased Testing Requirements**

Subject to the approval of BDS, increased anchor testing shall be as follows:

- 1) A minimum of 6 anchors in the immediate vicinity of the failed anchor shall be torque tested.
- 2) In the event of any additional failure, all anchors placed on the same day as the failed anchor shall be tested.

##### **3. Final Summary Report**

The EOR Structural Observation Final Summary Report and the Special Inspection Final Summary Report shall be submitted to BDS at the conclusion of the project.

#### **Method B " Pre-qualified Adhesive Anchor System**

This method involves testing anchor installations prior to construction in order to obtain appropriate load values for specific anchors in a specific building.

## 1. Pre-Permit Application Requirements

In order to pre-qualify an adhesive anchor system with BDS, the following steps must be completed prior to permit application. The load capacity of pre-qualified anchor systems shall be determined using field testing before design completion.

### Field Testing

#### a. General.

The EOR shall develop a field testing program. Separate field testing programs shall be developed for each specific anchor type used on the project. All testing shall be conducted by a City approved testing agency and observed by the EOR.

#### b. Field testing submittal requirements.

The EOR shall submit all the following information to the BDS Engineering Section for approval before conducting the required field tests:

- 1) A description of the anchor testing procedures;
- 2) Drawings showing the test location, and
- 3) Detailed anchor installation methods

#### c. Field test anchor placement.

Test anchors shall be placed in wall and mortar joint locations that replicate the anticipated location of the production anchors.

#### d. Number of field tests required.

At least three (3) field tests shall be conducted per applicable wall per floor. Tests shall be conducted for both shear and tension capacities.

With the prior approval of BDS engineering section, testing quantities may be reduced on larger projects if the EOR determines such a reduction of testing is justified by consistent and representative test results.

#### e. Field test design and installation requirements for anchor placement.

All of the following applies to the adhesive anchor tests at this phase:

- 1) The masonry walls shall support the test apparatus. (See ASTM E 488, Fig 1 for test apparatus details). The clear distance between the anchor and the test apparatus support shall be at least equal to the anchor embedment depth.
- 2) Only non-impact electric drills shall be used to drill anchor installation holes.
- 3) Anchors shall be installed into cleaned installation holes. Installation holes shall be cleaned with oil-free compressed air and a nylon brush.
- 4) Anchor bolt nuts shall only be tightened with non-impact tools.
- 5) Anchors shall be loaded incrementally in accordance with ASTM 488. Initial pre-load shall be 300 lbs.

#### f. Field tests results.

Field test anchor system failure shall constitute either the first:

- 1) movement of brick; or
- 2) spalling or flaking of brick or mortar or;
- 3) any bolt slippage; or
- 4) significant drop in the test pressure gage.

#### g. Field testing agency report.

A testing report shall be prepared by the testing agency and provided to BDS and the EOR.

The testing report shall be typed and include all the following information:

- 1) Date of test
- 2) Testing lab and technicians name
- 3) Test locations
- 4) Anchor description
- 5) Specific adhesive product name and number
- 6) Wall thickness and embedment depth
- 7) Anchor distance from nearest corner
- 8) Condition of brick and mortar
- 9) Brick orientation at test location
- 10) Test equipment and set up
- 11) Loading procedure, loading increments and rate of loading
- 12) Description of anchor movement or elongation
- 13) Mode of failure in each test

**h. Anchor design strength determination.**

The EOR shall evaluate the test values and shall eliminate values determined to be excessively high or low from the sampling.

For resisting factored seismic loads, the anchor bolt design strength shall be determined from the average failure load multiplied by a strength reduction factor of 0.35.

**i. EOR field testing summary report.**

At the completion of the testing program, a testing program summary report shall be prepared by the EOR. The EOR summary report shall include:

- 1) The testing agency test reports; and
- 2) The EOR conclusions and recommendations regarding anchor system design strength.

EOR testing summary report shall be submitted to BDS for review with the project design calculations.

**2. Plan Requirements**

The following information must be clearly provided on the plans submitted to BDS for review:

- a. A bolt installation and configuration diagram indicating wall thickness, adhesive type, anchor embedment, use of non-impact tools, hole cleaning requirements.
- b. The plan notes regarding special inspection shall indicate that 20% of the anchors shall be torque tested by a special inspector using a torque wrench with values as set below.

Anchor Diameter (In inches)	Foot-Pounds
1/2	40
5/8	50
3/4	60

No visible deformation or elongation of the anchorage is permitted with the torque tests.

- c. The anchor bolt design strength.

**3. Project Construction Requirements****a. Anchor Type.**

The adhesive type used during construction shall be the same as that used in the testing program. If different anchor bolts or adhesive systems are to be used for construction, they shall be prequalified by the testing procedure outlined above. No bolts shall be installed for construction until they have been pre-qualified and approved by BDS.

**b. Quality Control During Construction.**

For Method B, special inspection in accordance with Section 1701 of the OSSC and BDS of Portland Special Inspection Program Administrative Rules is required prior to and during placement of the anchor and adhesive into the drilled hole. In addition, a minimum of 20% of the anchors installed shall be torque tested as described on the construction plans. Other trades shall not use vibratory or other equipment that can have a negative effect on the integrity of the mortar joints of the masonry construction.

**c. Test Failures During Construction.**

A torque test failure is defined as any movement of the bolt during the torque test. In case of torque test failures during construction, the special inspector shall notify the BDS Special Inspection section and the EOR. Subject to prior approval by the BDS, an increased level of testing, as described below, shall be conducted. All failed anchors shall be replaced.

**Increased testing requirements.**

Subject to the approval of BDS increased anchor testing shall be as follows:

- 1) A minimum of 6 anchors in the immediate vicinity of the failed anchor shall be torque tested.
- 2) In the event of any additional failure, all anchors placed on the same day as the failed anchor shall be tested.

#### **4. Final Summary Report**

The EOR Structural Observation Final Summary Report and the Special Inspection Final Summary Report shall be submitted to BDS at the conclusion of the project.

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#### **HISTORY**

New January 1, 2003

Filed for inclusion in PPD September 29, 2004