ICC EVALUATION SERVICE

ICC Evaluation Service, Inc.
Los Angeles Business/Regional Office
5360 Workman Mill Road
Whittier, CA 90601
tel: 562.699.0543
fax: 562.695.4694
www.icc-es.org

February 2, 2009

TO: **PARTIES INTERESTED IN EVALUATION REPORTS ON ADHESIVES FOR MASONRY CONSTRUCTION**

SUBJECT: Proposed Revisions to the Acceptance Criteria for Adhesives for Masonry Construction, Subject AC362-0209 (ME/RK)

Dear Madam or Sir:

Proposed revisions to the subject acceptance criteria, as presented in the enclosed criteria draft, are being posted on the ICC-ES web site to allow for public comment. The following revisions are proposed:

1. Previous revisions to AC362 were approved at the ICC-ES Evaluation Committee hearings in Albany, New York on October 21, 2008. During this meeting, the proposed Section 4.12 (Diagonal Shear Test) was amended by the Evaluation Committee to require the specimens to be assembled with the blocks in intimate contact at the bed joints and the head joints to have the maximum permitted joint width. However, Section 4.12.2 of the criteria (Conditions of Acceptance) requires a strength reduction factor to be applied to the ultimate failure loads as an adjustment for the blocks of the wall assembly being in intimate contact. The requirement that the blocks be assembled with a maximum joint width at the head joints conflicts with the intent of the adjustment factor. Consequently, in response to an inquiry from the affected evaluation report holder, the following revisions to AC362 are proposed:

    a. Revise Section 4.12.1 to require the specimens with adhesive to be assembled with both bed and heads joints having the maximum permitted joint width.

    b. Revise Section 4.12.2 to delete the following words from the first sentence: “multiplied by the strength reduction factor as set forth in Section 4.2.2.4”.

    c. Revise Sections 3.2.1 and 4.2.2.4 to be consistent with the other proposed revisions.

2. During the ICC-ES Evaluation Committee hearings in Albany, New York, on October 21, 2008, a new section, Section 6.15, was added. A question was raised by ICC-ES staff during this hearing in regard to whether open-end concrete blocks are inherently less compact than closed cell unit blocks; because face shells in open-end units subjected to transverse loads essentially cantilever from the webs, whereas face shells of a closed cell units are supported at each end. Staff’s

question during the meeting was whether the adhesive is equal to mortar in connecting the blocks together at the head joints, effectively stabilizing the face shells of open-end units. To resolve the comment, it was proposed that new Section 6.15 be added to require open-end units to be grouted. Recently, the affected evaluation report applicant raised a concern regarding Section 6.15. In accordance with this concern, Mr. James Amrhein provided the attached letter, dated January 23, 2009. In response to the statements in his letter, staff proposes the deletion of Section 6.15.

You are cordially invited to submit written comments, within 30 days of the date of this letter. Please use the comment form on the web site attaching any letters to the form. An explanation of the alternate criteria process can be found on our web site at http://www.icc-es.org/Criteria_Development/alternative_criteria_process.shtml.

All comments received in the 30-day comment period will be considered. During this same 30-day period, however, the draft criteria will be balloted to the Evaluation Committee. If the public comments raise major issues, generate controversy, or require the criteria to be substantially rewritten, then ICC-ES staff may decide to reballot the criteria; or place a revised draft on the web site for further public comment; or put the criteria on the agenda for a future Evaluation Committee meeting.

Correspondence received and a memo outlining staff's resolution of the comments in the correspondence will be posted on the web site shortly after the close of the comment period.

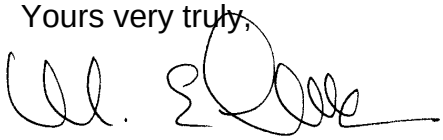
Your cooperation is requested in forwarding to the Los Angeles business/regional office all material directed to the Evaluation Committee. Parties interested in the deliberations of the committee should refrain from communicating, whether in writing or verbally, with committee members. The committee reserves the right to refuse communications that do not comply with this request.

Newly approved acceptance criteria may involve test methods or test protocols that are not currently included in the scope of testing services offered by accredited testing laboratories. As noted in the ICC-ES Rules of Procedure for Evaluation Reports, the scope of the laboratory's accreditation must include the type of testing that is to be reported to ICC-ES. We encourage accredited laboratories to expand their scopes of accreditation to include testing under newly approved acceptance criteria. Please note that testing laboratories must be accredited by the International Accreditation Service (IAS) or by another accreditation body that is a signatory to the International Laboratory Accreditation Cooperation Mutual Recognition Arrangement. For further information, please contact IAS at (562) 699-0541, extension 3309, or send an e-mail to pmccullen@iasonline.org.

Please submit all comments using the form on the web site. Attach any letters to the comment form. If you have any questions (not comments), please contact the

undersigned at (800) 423-6587, extension 3260, or Russ Krivchuk, at extension 3275. You may also reach us by e-mail at es@icc-es.org.

Yours very truly,



Mahmut Ekenel, Ph.D., P.E.
Staff Engineer

ME/rf

Enclosure

cc: Evaluation Committee

AMRHEIN

James E. Amrhein SE

Structural Engineer

2440 Marber Ave.
Long Beach, CA 90815
Tel: 562-596-6872
Email: Amrhein@USA.com

January 23, 2009

Mahmut Ekenel, PhD.
ICC Evaluation Services
5360 Workman Mill Road
Whittier, CA 90601-2298

Re: E mail 1-22-09 Open end units:

Hi Mahmut:

We received your email of 1-22-09 about the construction of masonry with open end units.

The use of open end units with rebar is very common. Yes, the face shell of the open end unit spans from the cross web to the head joint. To increase the stability of the face shell many CMU Manufacturers increase the thickness of the face shell at the cross web, from 1.25 to about 2.25 inches and the shells taper from maximum thickness to the minimum thickness of 1.25 inches. The far end support of an Open End Unit does give support to the face shells. The important point to consider is both Closed End and Open End CMU's must meet the strength requirements in ASTM C 90, specification for CMUs'.

Cal Trans, the California Highway Dept. uses a lot of open end units for Their sound walls and even requires thinner face shell walls because they really go heavy on the reinforcing in the cells.

The strength of the adhesive is equivalent or and in my opinion greater to the strength of mortar in connecting the head joints and stabilizing the face shells, this is supported by the version of AC 362 that was approved in February 2007. Specifically the ASTM C1072 Flexural Bond Strength, known as the Bond Wrench Test and ASTM E72 Out of Plane Transverse Load Test with the safety factor of 3.33require the adhesive to be stronger than the mortar to meet the Conditions of Acceptance.

In my opinion the use of an adhesive that meets the requirements of the February 2007 version of AC362 provides high strength bonding of the extended face shell leg to the next CMU. In fact, the strength of that bond will provide even greater stability to the face shells of the corresponding units than mortar.

The strength of the adhesive bond and an Open End CMU that meets the requirements of ASTM C90 provide sufficient stability to the face shell.

Please let us know if we can provide any additional information.

Sincerely,

James E. Amrhein, SE
Consultant to ITW

PROPOSED REVISIONS TO THE ACCEPTANCE CRITERIA FOR ADHESIVES FOR MASONRY CONSTRUCTION

AC362

Proposed February 2009

Previously approved October 2008 and February 2007

PREFACE

Evaluation reports issued by ICC Evaluation Service, Inc. (ICC-ES), are based upon performance features of the International family of codes and other widely adopted code families, including the Uniform Codes, the BOCA National Codes, and the SBCCI Standard Codes. Section 104.11 of the *International Building Code*® reads as follows:

> **The provisions of this code are not intended to prevent the installation of any materials or to prohibit any design or method of construction not specifically prescribed by this code, provided that any such alternative has been approved. An alternative material, design or method of construction shall be approved where the building official finds that the proposed design is satisfactory and complies with the intent of the provisions of this code, and that the material, method or work offered is, for the purpose intended, at least the equivalent of that prescribed in this code in quality, strength, effectiveness, fire resistance, durability and safety.**

Similar provisions are contained in the Uniform Codes, the National Codes, and the Standard Codes.

ICC-ES may consider alternate criteria, provided the report applicant submits valid data demonstrating that the alternate criteria are at least equivalent to the criteria proposed in this document, and otherwise meet the applicable performance requirements of the codes. Notwithstanding that a product, material, or type or method of construction meets the requirements of the criteria proposed in this document, or that it can be demonstrated that valid alternate criteria are equivalent to the criteria in this document and otherwise meet the applicable performance requirements of the codes, ICC-ES retains the right to refuse to issue or renew an evaluation report, if the product, material, or type or method of construction is such that either unusual care with its installation or use must be exercised for satisfactory performance, or malfunctioning is apt to cause unreasonable property damage or personal injury or sickness relative to the benefits to be achieved by the use of the product, material, or type or method of construction.

Acceptance criteria are developed for use solely for purposes of issuing ICC-ES evaluation reports.

PROPOSED REVISIONS TO THE ACCEPTANCE CRITERIA FOR ADHESIVES FOR MASONRY CONSTRUCTION

1.0 INTRODUCTION

1.1 Purpose: The purpose of this acceptance criteria is to establish requirements for masonry adhesives to be recognized in an ICC Evaluation Service, Inc. (ICC-ES), evaluation report under the 2006 *International Building Code*® (IBC) and the 2006 *International Residential Code*® (IRC). Bases of recognition are IBC Section 104.11 and IRC Section R104.11.

The reason for the development of this criteria is to provide guidelines for qualifying adhesive applications in masonry construction, since the IBC and IRC do not describe use of masonry adhesives.

1.2 Scope: The masonry adhesives addressed in this criteria are alternatives to Type M, N, O and S portland cement/lime masonry mortar as addressed in Section 2103.8 of the IBC and Section R607.1 of the IRC. The adhesive shall be used in the head and bed joints of the masonry with the first course of masonry set into a setting bed of code-complying mortar applied to the concrete foundation. This acceptance criteria is limited to the use of masonry adhesives in grouted or ungrouted plain (unreinforced) or solid grouted or partially grouted reinforced, non-fire-resistance-rated masonry construction consisting of open and closed, hollow concrete masonry units complying with ASTM C 90 in bearing walls, nonload-bearing walls, retaining walls, foundation stem walls and piers. Use of the adhesive in prestressed masonry construction is outside the scope of this criteria. This acceptance criteria is applicable to masonry construction designed in accordance with the requirements of IRC Section R606 or IBC Section 2107 (Allowable Stress Design), IBC Section 2108 (Strength Design of Masonry), or IBC Section 2109 (Empirical Design of Masonry), or the ACI 530-05/ASCE 5/TMS 402 Masonry Code for use under either the IBC or IRC, as permitted in IBC Section 2109.1 and IRC Sections R404.1 and R606.1.

1.3 Codes and Referenced Standards:

1.3.1 2006 *International Building Code*® (IBC), International Code Council.

1.3.2 2006 *International Residential Code*® (IRC), International Code Council.

1.3.3 ACI 530-05/ASCE 5-05/TMS 402-05, Building Code Requirements for Masonry Structures, American Concrete Institute.

1.3.4 ASTM C 55-03, Standard Specification for Concrete Brick, ASTM International.

1.3.5 ASTM C 90-03, Specification for Loadbearing Concrete Masonry Units, ASTM International.

1.3.6 ASTM C 129-00, Specification for Nonload-bearing Concrete Masonry Units, ASTM International

1.3.7 ASTM C 140-03, Test Method for Sampling and Testing Concrete Masonry Units and Related Units, ASTM International.

1.3.8 ASTM C 270-04, Specification for Mortar for Unit Masonry, ASTM International.

1.3.9 ASTM C 1072-00a, Standard Test Method for Measurement of Masonry Flexural Bond Strength, ASTM International.

1.3.10 ASTM C 1262-98, Standard Test Method for Evaluating the Freeze-Thaw Durability of Manufactured Concrete Masonry Units and Related Concrete Units, ASTM International.

1.3.11 ASTM C 1314-03b, Test Method for Compressive Strength of Masonry Prisms, ASTM International.

1.3.12 ASTM D 1084-97, Standard Test Methods for Viscosity of Adhesives, ASTM International.

1.3.13 ASTM D 1875-03, Standard Test Methods for Density of Adhesives in Fluid Form, ASTM International.

1.3.14 ASTM D 2294-96, Standard Test Methods for Creep Properties of Adhesives in Shear by Tension Loading (Metal-to-Metal), ASTM International.

1.3.15 ASTM D 5155-01, Standard Test Methods for Polyurethane Raw Materials: Determination of the Isocyanate Content of Aromatic Isocyanates, ASTM International.

1.3.16 ASTM E 72-02, Standard Test Methods of Conducting Strength Tests of Panels for Building Construction, ASTM International.

1.3.17 ASTM E 514-90, Standard Test Methods for Water Penetration and Leakage Through Masonry, ASTM International.

1.3.18 ASTM E 518-03, Standard Test Methods for Flexural Bond Strength of Masonry, ASTM International.

1.3.19 ASTM E 519-02, Standard Test Methods for Diagonal Tension (Shear) in Masonry Assemblies, ASTM International

1.3.20 ASTM E 1252-98, Standard Practice for General Techniques for Obtaining Infrared Spectra for Qualitative Analysis, ASTM International.

1.3.21 ASTM G 151-00, Practice for Exposing Nonmetallic Materials in Accelerated Test Devices That Use Laboratory Light Sources, ASTM International.

1.3.22 ASTM G 154-00a, Practice for Operating Fluorescent Light Apparatus for UV Exposure of Nonmetallic Materials, ASTM International.

1.3.23 TEK 10-2B (2005), Control Joints for Concrete Masonry Walls—Empirical Method, National Concrete Masonry Association.

2.0 BASIC INFORMATION

2.1 Product Description: Masonry adhesives shall be described as to generic or trade name, manufacturer's catalog number, shelf life and adhesive name.

2.2 Material Properties: The adhesive used in tests under this criteria shall be tested to establish a standard fingerprint for comparison on a random basis with future production during the required quality control inspections. For quality control requirements, refer to Section 5.0 of this criteria. The following tests shall be performed at 73˚F ± 2˚F

(23.7˚C ± 1.1˚C) to establish a fingerprint:

- Infrared absorption spectroscopy (ASTM E 1252)
- Specific gravity (ASTM D 1875)
- Bond test (ASTM C 1072) as directed by Section 4.2.1.
- Isocyanate (NCO) content (ASTM D 5155)
- Viscosity (ASTM D 1084)

Test methods not described here shall be proposed to, and accepted by, ICC-ES staff before testing begins.

2.3 Installation Instructions: Manufacturer's published instructions for installation and application of the adhesive shall be submitted, including the following:

2.3.1 Complete mixing instructions for the adhesive.

2.3.2 Application instructions, including the application rate, bead size, the thickness of wet and dry film, specifications as to whether the adhesive is to be applied to one or both contact surfaces, and location of application of the adhesive on the block surfaces.

2.3.3 Assembly conditions, including temperature, humidity and time limitations, moisture content of block, block conditions (cleanliness and wetness at the time of installation), block-to-block joint width tolerance at head and bed joints.

2.3.4 Curing conditions of the adhesive, including recommended curing temperature, pressure, time under pressure, and temperature of the assembly under pressure. Limiting temperature should be clarified as that of the glue line or air.

2.3.5 Pot life; storage temperature; maximum storage life.

2.4 Packaging and Identification: A description of the method of packaging and field identification of the masonry adhesive shall be submitted. Identification provisions shall include the evaluation report number, manufacturer's name, product designation, and the name or logo of the inspection agency.

2.5 Testing Laboratories: Testing laboratories shall comply with Section 2.0 of the ICC-ES Acceptance Criteria for Test Reports (AC85) and Section 4.2 of the ICC-ES Rules of Procedure for Evaluation Reports.

2.6 Test Reports: Test reports shall comply with AC85. The test report shall include a statement by the testing laboratory that test specimens of Sections 4.8 and 4.12 are representative of what is described in the manufacturer's published installation instructions.

2.7 Product Sampling: Sampling of the masonry adhesive for tests under this criteria shall comply with Section 3.1 of AC85.

3.0 TEST AND PERFORMANCE REQUIREMENTS

3.1 Fixed Value Tests: Masonry compression strength, flexural bond strength, out-of-plane load and creep tests of concrete masonry assemblies assembled with the masonry adhesive shall be in accordance with, and comply with, Sections 4.1, 4.2, 4.8 and 4.10, respectively. The specimens shall be prepared in accordance with Chapter 21 of the IBC and Section R606 of the IRC, except that the masonry adhesive shall be used in lieu of mortar.

3.2 Comparative Test Data:

3.2.1 Tests of freeze-thaw resistance, high-temperature resistance, wet-dry cycling resistance, ultraviolet light resistance, water penetration and leakage and diagonal tension (shear), as indicated in Sections 4.4, 4.5, 4.6, 4.7, 4.9 and 4.12, respectively, shall be comparative tests conducted on masonry assemblies using a Type M portland cement/lime mortar and masonry adhesive. Masonry test specimens shall be prepared in accordance with Chapter 21 of the IBC and Section R606 of the IRC, except for the masonry adhesive specimens. The Type M portland cement/lime mortar for control masonry specimens shall be proportioned in accordance with Table 1 of ASTM C 270, Table 2103.8(1) of the IBC, and Table R607.1 of the IRC, and tested as required by Section 4.3. Except as noted, five specimens shall be prepared for each test required by this criteria. The flexural bond strength~~ and diagonal tension (shear)~~ test results of the specimens containing masonry adhesive shall be adjusted with the strength reduction factor of Section 4.2.2.4.

3.2.2 Where freeze-thaw tests are not submitted, recognition shall be limited to areas where the average rainfall does not exceed 20 inches (508 mm) annually and the average daily low temperature exceeds 30˚F (-1˚C).

3.2.3 The UV testing may be waived if the adhesive manufacturer can substantiate that the adhesive is unlikely to be exposed to UV light.

3.2.4 Where reports of creep tests are not submitted, recognition shall be limited to applications of the adhesive subject to conditions that do not create flexural tensile stresses due to long-term loads in the adhesive.

3.2.5 Where reports of diagonal tension (shear) tests in accordance with Section 4.12 are not submitted, recognition shall be limited to unreinforced (plain) masonry construction.

3.3 Temperature Effect on Strength Tests: The effects of curing and service temperatures on the bond strength of the masonry adhesive shall be evaluated by conducting flexural bond strength tests on specimens at different temperatures in accordance with Section 4.11.

4.0 TEST METHODS

4.1 Masonry Compression Strength (Prism Test):

4.1.1 Test Specimens and Procedure: Compressive strength of masonry prism specimens shall be tested in accordance with IBC Section 2105.2.2.2 and ASTM C 1314. Specimens shall be prisms of 8-inch-wide (102 mm), two-unit-high, hollow concrete masonry units (CMUs) with masonry adhesive in the bed joint. Specimens with masonry adhesive shall be installed with the maximum joint width specified in the published installation instructions, and cured in accordance with the manufacturer's installation instructions. At least five sets of prisms shall be prepared and tested to determine the strength of the assembly.

4.1.2 Conditions of Acceptance: The average compressive strength of masonry specimens with masonry adhesive shall be equal to or higher than the values given for Type M portland cement/lime mortar in Table 2105.2.2.1.2 of IBC.

4.2 Flexural Bond Strength Tests:

4.2.1 ASTM C 1072 Flexural Bond Strength Test with Minimum Joint Width:

4.2.1.1 Test Specimens: Each test specimen shall consist of ASTM C 55 Grade S concrete bricks assembled in stack bond pattern, using six bricks to obtain five bed joints. The specimens shall have two beads of masonry adhesive per bed joint, applied the length of the joint in accordance with Figure 1, at the minimum bead size as stated in the manufacturer's installation instructions. The specimens shall be assembled with the bricks in intimate contact, and with the adhesive cured in accordance with the manufacturer's installation instructions at a temperature of 73˚F ± 2˚F (23.7˚C ± 1.1˚C). At least five specimens shall be prepared and tested to determine the strength of the system.

4.2.1.2 Procedure: The flexural bond strength shall be tested in accordance with ASTM C 1072, with a relative humidity of 50 ± 2 percent and a temperature of 73˚F ± 2˚F (23.7˚C ± 1.1˚C). The value of the flexural bond strength shall be calculated using the section modulus, assuming a fully bedded area based on the full brick width.

4.2.1.3 Conditions of Acceptance: The average flexural bond strength determined in accordance with ASTM C 1072 shall be equal to, or higher than, the values given for Type M portland cement/lime mortar, normal to bed joints in running or stack bond for solid units in Table 2.2.3.2 of ACI 530-05/ASCE 5-05/TMS 402-05, with an applied safety factor of 3.33.

4.2.2 ASTM C 1072 Flexural Bond Strength Test with Maximum Joint Width:

4.2.2.1 Test Specimens: Test specimens shall be prepared in accordance with Section 4.2.1.1, except the specimens shall be assembled with the maximum joint width specified in the manufacturer's installation instructions.

4.2.2.2 Procedure: The flexural bond strength of masonry specimens with masonry adhesive and maximum joint width shall be tested in accordance with Section 4.2.1.2.

4.2.2.3 Conditions of Acceptance: The average flexural bond strength determined in accordance with ASTM C 1072 shall be equal to, or higher than, the values given for Type M portland cement/lime mortar, normal to bed joints in running or stack bond for solid units in Table 2.2.3.2 of ACI 530-05/ASCE 5-05/TMS 402-05, with an applied safety factor of 3.33.

4.2.2.4 Strength Reduction Factor: The results of tests under Sections 4.2.1 and 4.2.2 shall be used to establish a strength reduction factor. The strength reduction factor shall be the average flexural bond strength of masonry specimens determined in accordance with Section 4.2.2.3 divided by the average flexural bond strength of masonry specimens determined in accordance with Section 4.2.1.3. If the ratio is bigger than one, the ratio shall be reported as one. The strength reduction factors shall be utilized under Sections 4.2.3~~,~~ and 4.4 through 4.7 ~~and 4.12~~ of this criteria.

4.2.3 ASTM E 518 Flexural Bond Strength Test:

4.2.3.1 Test Specimens and Procedure: Flexural bond tests shall be in accordance with ASTM E 518. Each test specimen shall consist of ASTM C 55 Grade S concrete bricks assembled in a stacked bond pattern in accordance with ASTM E 518. The specimen shall have two beads of adhesive per bed joint, applied the length of the joint in accordance with Figure 1, at the minimum bead size as stated in the manufacturer's installation instructions. The specimens shall be assembled with the bricks in intimate contact, and the adhesive cured in accordance with the manufacturer's installation instructions at a temperature of 73˚F ± 2˚F (23.7˚F ± 1.1˚C). At least five specimens shall be prepared and tested to determine the strength of the system. The value of the modulus of rupture shall be calculated using the section modulus, assuming a fully bedded area based on the full brick width.

4.2.3.2 Conditions of Acceptance: The flexural bond strength of masonry specimens determined in accordance with ASTM E 518 and multiplied by the strength reduction factor of Section 4.2.2.4 shall be equal to, or higher than, the values given for Type M portland cement/lime mortar, parallel to bed joints in running or stack bond for solid units in Table 2.2.3.2 of ACI 530-05/ASCE 5-05/TMS 402-05, with an applied safety factor of 3.33.

4.3 Type M Portland Cement/Lime Mortar Compressive Strength:

4.3.1 Test Specimens and Procedure: Compressive strength of Type M portland cement/lime mortar, which will be used for the comparison tests under this criteria, shall be evaluated in accordance with ASTM C 270. Specimens shall be 2-inch cubes (51 mm); and five specimens (minimum), cured in accordance with ASTM C 270, shall be tested at the age of 28 days.

4.3.2 Conditions of Acceptance: The minimum average compressive strength of the Type M portland cement/lime mortar shall be 2,500 psi (17 MPa) at 28 days, as set forth in Table 2103.8(2) of the IBC.

4.4 Freeze-thaw Testing:

4.4.1 Test Specimens: Each specimen shall consist of an ASTM C 55 Grade S concrete brick having a nominal length of 8 inches (203 mm), a width of 4 inches (102 mm) and a height of 2 inches (51 mm), that is cut into two approximately equal halves as shown in Figure 2. The cut brick halves shall be bonded together at uncut ends, with the cut ends (cut face A and cut face B) being the outside ends (see Figure 3). Five specimens each shall be prepared for masonry adhesive and Type M portland cement/lime mortar constructed assemblies. The compressive strength of the mortar used in the test specimens shall be tested as required by Section 4.3 of this criteria. Freeze-thaw specimens with the masonry adhesive shall have two beads of adhesive applied at the minimum bead size set forth in the manufacturer's installation instructions. Each bead shall be 1 inch (25.4 mm) away from the corresponding concrete

brick face (see Figure 3), and shall be cured in accordance with manufacturer's installation instructions. Specimens shall be assembled with the joints in intimate contact. Specimens with Type M portland cement/lime mortar shall be cured for 28 days in accordance with Section 6.4.1 of ASTM C 270 prior to the freeze-thaw exposure.

4.4.2 Procedure: Masonry specimens with masonry adhesives and Type M portland cement/lime mortar shall both be subjected to freeze-thaw conditions in accordance with the procedure outlined in ASTM C 1262. Specimens shall be placed in the container with one of the 4-inch-by-8-inch (102 mm by 203 mm) faces of the specimen placed in water. At the end of every 12 ± 2 cycles, each specimen shall be removed from the container and weighed, with residue collected in accordance with Section 8.3 of ASTM C 1262. To continue the freeze-thaw exposure cycles, the specimen shall be returned to the container, and placed with the previously water exposed side facing down. If a specimen has a mass loss of 3 percent of the initial weight (calculated in accordance with Section 8.3 of ASTM C 1262), then the specimen shall be removed and weighed at the end of every nine cycles, as set forth above. Freeze-thaw conditioning of each specimen shall be stopped either when the mass loss is 5 percent of the initial weight (calculated in accordance with Section 8.3 of ASTM C 1262) or the specimen completes 100 cycles, whichever occurs first. After completion of freeze-thaw cycles, specimens shall be subjected to flexural bond strength testing in accordance with the procedure addressed in ASTM C 1072. Specimens shall be placed on the ASTM C 1072 testing apparatus such that the water-exposed portion of the bed-joint is in pure tension.

4.4.3 Conditions of Acceptance: The average flexural bond strength of the specimens with masonry adhesive, multiplied by the strength reduction factor as stated in Section 4.2.2.4, shall be equal to, or greater than the flexural bond strength of masonry specimens with Type M portland cement/lime mortar. At least three out of the five Type M portland cement/lime mortar specimens shall exhibit a failure at the bond line. Only the Type M portland cement/lime masonry specimens which failed at the bond line shall be used in flexural bond strength calculations.

Notice: If less than three Type M portland cement/lime mortar specimens exhibit a failure mode of bond failure, the evaluation report shall have a statement in accordance with Section 3.2.2 of this acceptance criteria.

4.5 High-temperature Test:

4.5.1 Test Specimens: The high-temperature test specimens shall be prepared as described in Section 4.4.1. At least five specimens shall be prepared with the masonry adhesive, and five specimens with Type M portland cement/lime mortar prepared as control specimens.

4.5.2 Procedure: The specimens shall be exposed to a high temperature of 150˚F (66˚C) in an oven for 60 minutes, followed by cooling at laboratory conditions of 70˚F ± 5˚F (21.1˚C ± 2.77˚C) for 60 minutes. The ramp time for changing of temperatures from low to high and high to low shall be approximately 10 minutes. This cycle shall be repeated for 100 cycles. After completion of 100 cycles, the specimens shall be cooled to the standard temperature and subjected to flexural bond strength testing in accordance with ASTM C 1072.

4.5.3 Conditions of Acceptance: The average flexural bond strength of the specimens with masonry adhesive, multiplied by the strength reduction factor as stated in Section 4.2.2.4, shall be equal to, or greater than, the average flexural bond strength of control specimens with Type M portland cement/lime mortar.

4.6 Wet/Dry Test:

4.6.1 Test Specimens: The wet/dry test specimens shall be prepared as described in Section 4.4.1. At least five specimens shall be prepared with the masonry adhesive, and five specimens with Type M portland cement/lime mortar prepared as control specimens

4.6.2 Procedure: The specimens shall be immersed in water having a temperature of 73˚F ± 2˚F (23.7˚C ± 1.1˚C) for a minimum of 60 minutes, followed by air drying at laboratory conditions of 73˚F ± 2˚F (23.7˚C ± 1.1˚C) for 60 minutes. This cycle shall be repeated for 100 cycles. If the wet/dry cycling needs to be temporarily stopped, the specimens shall be maintained in the immersed water condition. After completion of 100 cycles, the specimens shall be subjected to flexural bond strength testing in accordance with ASTM C 1072.

4.6.3 Conditions of Acceptance: The average flexural bond strength exhibited by specimens with masonry adhesive, multiplied by the strength reduction factor as stated in Section 4.2.2.4, shall be equal to, or greater than, the average flexural bond strength of control specimens with Type M portland cement/lime mortar.

4.7 Ultraviolet (UV) Light Exposure Test:

4.7.1 Test Specimens: The UV light exposure test specimens shall be prepared as described in Section 4.4.1, except that at least six specimens with the masonry adhesive shall be prepared. Six specimens with Type M portland cement/lime mortar shall be prepared as control specimens.

4.7.2 Procedure: The general procedures for UV testing are defined in ASTM G 151, and operating procedures for fluorescent UV light are defined in ASTM G 154. The specimens shall be subjected to 500 hours of fluorescent UV light exposure. The specimens shall be positioned so that one of the 4-inch-by-8-inch (102 mm by 203 mm) faces of the specimen faces the light-source. After completion of 500 hours of UV exposure, the specimens shall be subjected to flexural bond strength testing in accordance with ASTM C 1072. Specimens shall be placed on the ASTM C 1072 testing apparatus to put the UV-light-exposed bed-joint in pure tension.

4.7.3 Conditions of Acceptance: The average flexural bond strength exhibited by specimens with masonry adhesive, adjusted with the strength reduction factor as stated in Section 4.2.2.4, shall be equal to, or greater than, the average flexural bond strength of the control specimens.

4.8 Out-of-plane Transverse Load Testing:

4.8.1 Test Specimens: Each specimen for the out-of-plane transverse load tests shall be a wall assembly, three blocks wide and thirteen units high, with masonry adhesive in the bed and head joints. At least three specimens shall be

tested. The masonry units shall be hollow, ungrouted, closed-end, nominally 8-inch-thick (203 mm) ASTM C 90 concrete masonry units. The wall specimens shall be constructed on an inverted steel channel to provide a level base for the initial course that shall also facilitate any necessary movement of the specimens within the testing laboratory. The specimens shall be constructed in running bond pattern. The masonry adhesive shall be applied in accordance with the manufacturer's published installation instructions. Specimens with masonry adhesive shall be cured, and assembled with the maximum joint width, as specified in the manufacturer's published installation instructions.

4.8.2 Procedure: Tests shall be conducted with the specimen oriented vertically in accordance with ASTM E 72 for out-of-plane loading using the bag method.

4.8.3 Conditions of Acceptance: The average modulus of rupture of the specimens shall be equal to, or higher than, the values given in Table 3.1.8.2.1 of ACI 530-05/ASCE 5-05/TMS 402-05 for Type M portland cement/lime mortar, normal to bed joints for hollow ungrouted masonry with an applied safety factor of 3.33.

4.9 Water Penetration and Leakage Tests:

4.9.1 Test Specimens and Procedure: Tests for masonry with masonry adhesive and Type M portland cement/lime mortar shall be conducted in accordance with ASTM E 514. Tests shall be of three specimens with masonry adhesive and three specimens with Type M portland cement/lime mortar. Test specimens shall be ungrouted. Test specimens shall be constructed using ASTM C 90, 8-inch-wide (203 mm) hollow CMUs.

4.9.2 Conditions of Acceptance: The tests results shall be reported in accordance with Section 9 of ASTM E 514. The tests results for masonry with masonry adhesive shall demonstrate equal or better performance in terms of water penetration and leakage when compared to the results for masonry with Type M portland cement/lime mortar.

4.10 Creep Testing:

4.10.1 Test Specimens: Each specimen shall consist of a pair of $^1/_2$-inch-wide, $^1/_4$-inch-thick, $4^1/_2$-inch-long (13 mm by 6 mm by 114 mm) pieces of maple. The gluing face of each piece of maple shall be planed, unsanded and free of dust. The wood is to be straight-grain and free from defects, including knots, bird's-eye, short grain, decay, and any unusual discolorations. The grain direction shall be parallel to the $4^1/_2$-inch (114 mm) length of the maple piece. The pieces of wood are to have a moisture content of between 8 and 10 percent, based on oven dry-weight. The adhesive being tested shall be applied to one half of the assembly using the adhesive manufacturer's installation instructions, with the wood spaced apart at the maximum joint width. All excess adhesive is to be removed from all edges prior to its setting, to provide as close as possible to a $^1/_2$-inch-by-$^1/_2$-inch (13 mm by 13 mm) glue area. Specimens shall be cured in accordance with the manufacturer's installation instructions. Five specimens shall be tested for each test group in Section 4.10.2.

4.10.2 Test Procedure: The test procedure shall be in accordance with ASTM D 2294, under both of the following conditions:

4.10.2.1 Room Temperature Testing: Tests specimens shall be loaded with 45 pounds (6.2 N) at 73˚F ± 2˚F (23.7˚C ± 1.1˚C) for a thirty-day period. The specimen displacement due to creep shall be measured daily for seven days, followed by weekly measurements for the remainder of the thirty-day period.

4.10.2.2 Elevated Temperature Testing: Tests specimens shall be loaded with 45 pounds (6.2 N) at 158˚F ± 5˚F (70˚C ± 2.7˚C) for a seven-day period. The sample displacement due to creep shall be measured hourly for the first eight hours, followed by twice-daily measurements for the remainder of the seven-day period.

4.10.3 Conditions of Acceptance: The specimen shall sustain the applied load with a maximum total allowable creep under room temperature testing of 0.001 inch (0.025 mm) during the thirty-day period. The specimen shall sustain the applied load with a maximum total allowable creep under elevated temperature testing of 0.002 inch (0.05 mm) during the first hour, and 0.003 inch (0.076 mm) during the seven-day period.

4.11 Temperature Effect on Strength:

4.11.1 Curing Temperature Effect on Strength:

4.11.1.1 Test Specimens and Procedure: Test specimens shall be prepared in accordance with Section 4.2.1.1, except they shall be cured at minimum and maximum temperatures as set forth in the manufacturer's installation instructions. If the minimum and maximum ambient temperatures as set forth in the manufacturer's installation instructions are below 40ºF (4.4ºC) or above 100ºF (37.8ºF C) as defined by Sections 2104.3 and 2104.4 of the IBC, then the concrete bricks and masonry adhesive must be conditioned at the minimum and maximum temperature for 24 hours prior to assembly of the test specimens, with the assembled specimens cured at the minimum and maximum temperatures as set forth in the manufacturer's installation instructions. Test procedure shall be in accordance with Section 4.2.1.2. At least five specimens shall be prepared and tested for each group.

4.11.1.2 Conditions of Acceptance: Conditions of acceptance shall be in accordance with Section 4.2.1.3.

4.11.2 Service Temperature Effect on Strength:

4.11.2.1 Test Specimens and Procedure: Test specimens shall be prepared and cured in accordance with Section 4.2.1.1. The test procedure shall be in accordance with Section 4.2.1.2, except the tests shall be flexural bond tests performed with the specimens at two different specimen temperatures: the minimum and maximum temperatures recommended for use of the adhesive by the adhesive manufacturer. At least five specimens shall be prepared and tested for each group. Test samples shall be conditioned to reach the manufacturer's recommended temperature, and maintained in the conditioner at the stated temperature for not less than 24 hours.

4.11.2.2 Conditions of Acceptance: Conditions of acceptance are as noted in Section 4.2.1.3.

4.12 Diagonal Tension (Shear) Tests

4.12.1 Test Specimens and Procedure: Diagonal tension (shear) tests of masonry with masonry adhesive and

masonry with Type M portland cement/lime mortar shall be conducted in accordance with ASTM E 519. At least three specimens with masonry adhesive and three specimens with Type M portland cement/lime mortar shall be tested. Test specimens shall be ungrouted. Test specimens shall be constructed using ASTM C 90, 8-inch-thick (203 mm) hollow closed-end CMUs in running bond pattern. The specimens with the adhesive shall be assembled ~~with the bed joints in intimate contact~~ with the maximum permitted head and bed joint width, and the adhesive cured in accordance with the manufacturer's installation instructions at a temperature of 73˚F ± 2˚F (23.7˚F ± 1.1˚C). The ultimate shear stress, ultimate shear strain and modulus of rigidity for each specimen shall be reported in accordance with ASTM E 519.

4.12.2 Conditions of Acceptance: The average ultimate shear stress of the specimens with masonry adhesive, ~~multiplied by the strength reduction factor as set forth in Section 4.2.2.4~~, shall be equal to, or greater than, the average shear stress of masonry specimens with Type M portland cement/lime mortar. The average ultimate shear strain and modulus of rigidity of the specimens with masonry adhesive shall be equal (±10 percent) to the average ultimate shear strain and modulus of rigidity of masonry specimens with Type M portland cement/lime mortar.

5.0 QUALITY CONTROL

5.1 The adhesive shall be manufactured under an approved quality control program with inspections by an inspection agency accredited by the International Accreditation Service (IAS) or otherwise acceptable to ICC-ES.

5.2 Quality documentation complying with the ICC-ES Acceptance Criteria for Quality Documentation (AC10) shall be submitted. The quality control program shall be sufficient to demonstrate that adhesive production takes place under minimum quality standards and that the adhesive continues to comply with specifications and fingerprint information noted in Section 2.2 of this criteria.

5.3 Special inspection is required at the jobsite. The special inspection shall be periodic special inspection and shall include the following:

a. Verification that the adhesive is labeled in accordance with the evaluation report.

b. Verification that the adhesive is used within its storage life.

c. Verification that the adhesive is dispensed as specified by the adhesive manufacturer.

d. Observation that the adhesive bead is being applied per the manufacturer's recommended installation instructions, including the following:

1. Moisture content of block
2. Cleanliness of block
3. Adhesive bead size
4. Adhesive bead location

e. Verification that head and bead joints meet the manufacturer's requirements for maximum allowable joint width.

f. Verification that control joints are placed in compliance with NCMA TEK notes: TEK 10-2B.

g. All applicable items in Table 1704.5.1 and Table 1704.5.3 of the 2006 IBC.

6.0 EVALUATION REPORT RECOGNITION

The evaluation report shall include the following:

6.1 General information required by Sections 2.1, 2.3, and 2.4.

6.2 A statement that the masonry adhesive can be used in lieu of masonry mortar Types M, N, S, and O for head and bed joints of hollow concrete block masonry, except that the first course of masonry shall be set into a setting bed of code-complying mortar applied to the concrete foundation.

6.3 A statement that limits the use of masonry with adhesives to masonry wall construction in Seismic Design Categories A and B.

6.4 A statement that use of joint reinforcement and anchors for anchored veneer installed in the bed-joint is outside the scope of the evaluation report.

6.5 A statement that limits the use to masonry walls for non-fire-resistance-rated construction.

6.6 A statement that special inspection shall be provided for installations under the IBC and IRC conforming to IBC Section 1704 and Section 5.3 of this criteria.

6.7 A statement that cold and hot weather construction of masonry walls with masonry adhesive shall be in compliance with IBC Sections 2104.3 and 2104.4, respectively, and in accordance with manufacturer's instructions.

6.8 A statement that design of shear walls with masonry adhesive shall be in compliance with Section 2.2 of the ACI 530-05/ASCE 5-05/TMS 402-05 for masonry laid with Type M, N, S and O portland cement–lime mortar.

6.9 A statement that use of adhesives in unreinforced lintels is outside the scope of this criteria.

6.10 A statement that walls using the adhesive shall be constructed with vertical control joints in accordance with TEK document 10-2B.

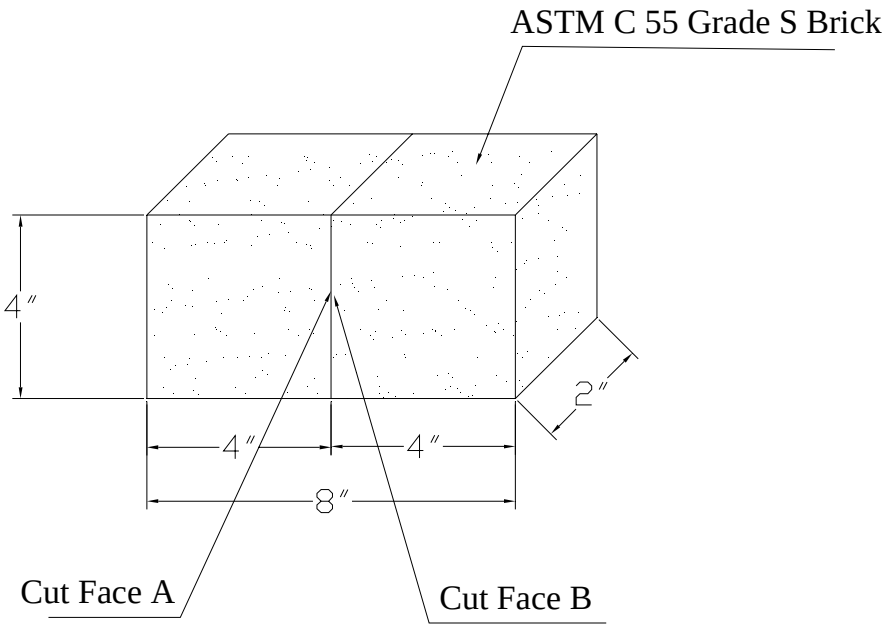
6.11 A statement that masonry construction with masonry adhesive shall be limited to the adhesive temperature range that will be within the temperatures as tested in Section 4.11.

6.12 A statement that, for use under the IRC, masonry construction with masonry adhesive is limited to structures engineered under IRC Section R301.1.3.

6.13 If reports of complying creep tests are not submitted, the evaluation report shall limit use to applications of the adhesive subject to conditions that do not create flexural tensile stresses due to long-term loads in the adhesive.

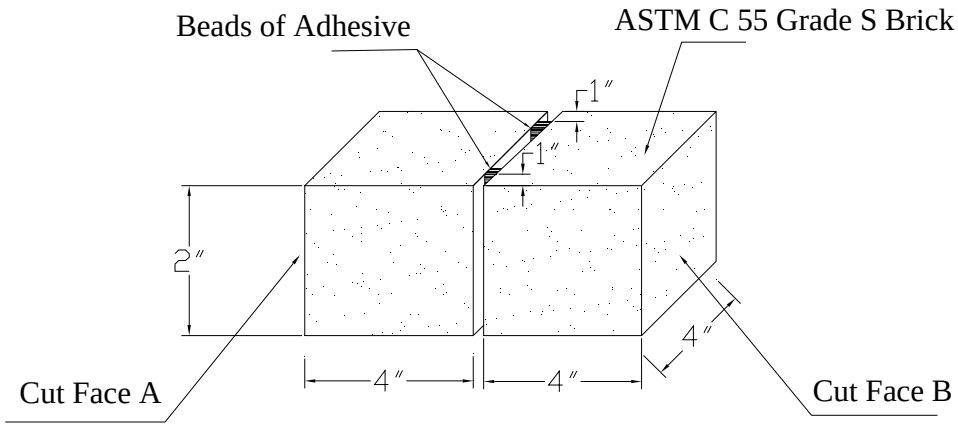
6.14 If reports of complying diagonal tension (shear) tests in accordance with Section 4.12 are not submitted, masonry wall construction with masonry adhesive shall be limited to unreinforced (plain) masonry construction

~~**6.15** A statement that for partially grouted masonry construction the open-end units shall be grouted.~~ ■



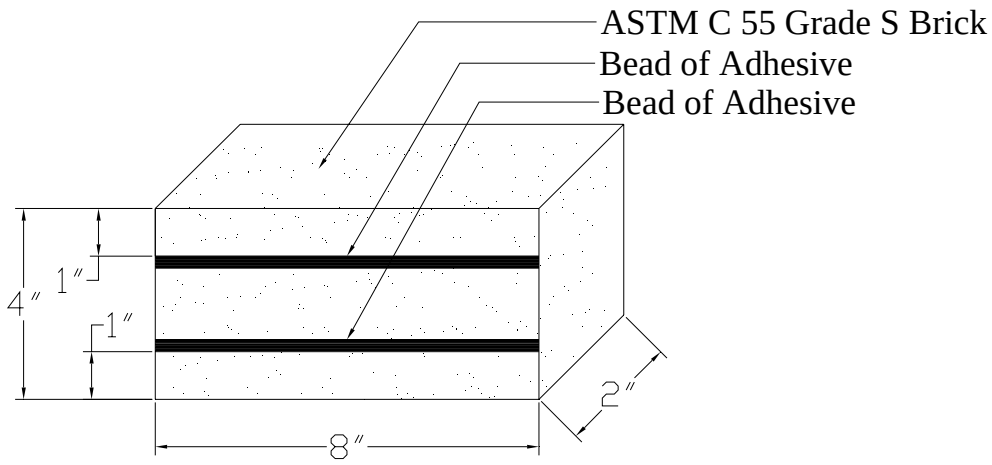
For **SI:** 1 inch = 25.4 mm.

**FIGURE 1—APPLICATION OF BEAD OF ADHESIVE ON ASTM C 55 GRADE S CONCRETE BRICK
(BEAD SIZE SHALL BE IN ACCORDANCE WITH THE MANUFACTURER'S INSTALLATION INSTRUCTION)**



For **SI:** 1 inch = 25.4 mm.

FIGURE 2—PREPARATION OF FREEZE & THAW TEST SPECIMEN USING ASTM C 55 GRADE S CONCRETE BRICK



For **SI:** 1 inch = 25.4 mm.

FIGURE 3—PREPARATION OF FREEZE/THAW TEST SPECIMEN USING ASTM C 55 GRADE S CONCRETE BRICK

(TEST SPECIMEN SHALL BE PLACED IN THE CONTAINER IN ACCORDANCE WITH SECTION 4.4.1; BEAD APPLICATION SHALL BE SIMILAR TO WHAT IS SHOWN IN FIGURE 1, AND BEAD SIZE SHALL BE IN ACCORDANCE WITH THE MANUFACTURER'S INSTALLATION INSTRUCTION)