



August 1, 2008

TO: PARTIES INTERESTED IN HEADED ENDS OF CONCRETE REINFORCEMENT

SUBJECT: Proposed Revisions to the Acceptance Criteria for Headed Ends of Concrete Reinforcement, Subject AC347-0808-R1 (RK/BG)

Dear Madam or Sir:

The revisions proposed 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 revisions are as proposed in the attached letter from Wiss, Janney, Elstner Associates, Inc., dated April 14, 2008, requesting the conditions of acceptance of the cyclic tension and monotonic tension test of Section 4.1 to be revised. It is proposed that Section 4.1.7 be revised to require the yield strength of the test specimens be evaluated at Stage 2 for compliance with the stated requirements, and not at Stage 4, as currently required.

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 3275, or Brian Gerber, Principal Structural Engineer, at extension 3255. You may also reach us by e-mail at es@icc-es.org.

Yours very truly,

A handwritten signature in black ink that reads "Russ Krivchuk". The signature is written in a cursive, slightly slanted style.

Russ Krivchuk
Senior Staff Engineer

RK/cm:raf

Enclosures

cc: Evaluation Committee

Via Email: rkrivchuk@icc-es.org

April 14, 2008

Mr. Russ Krivchuk
Senior Staff Engineer
ICC Evaluation Service, Inc.
5360 Workman Mill Road
Whittier, California 90601

Re: Expedited Change to AC347 - Headed Ends of Concrete Reinforcement

Dear Mr. Krivchuk:

Wiss, Janney, Elstner Associates, Inc (WJE) has been performing laboratory testing on headed deformed reinforcing bars in accordance with AC347, as issued by the ICC Evaluation Service (ICC ES) with an effective date of January 1, 2007. Through our use of AC347, we have found an inconsistency in AC347 that, in our opinion, possibly leads to a technically incorrect assessment of the product samples being tested. Therefore, we believe that the inconsistent wording should be corrected as soon as is possible.

The inconsistency arises in "Conditions of Acceptance" Paragraph 4.1.7.1. It is suggested that the following changes be made to this paragraph to remove this inconsistency:

"The ~~Stage 4~~ Stage 2 yield strength, Stage 4 tensile strength and Stage 4 elongation of each tested headed bar assembly shall comply with the requirements of Sections 7.3.1, 7.3.2 and Table 1 of ASTM A 970 [2006 edition] with the yield and tensile stress based on the nominal cross sectional area of the reinforcing bar."

The reason for these changes is as follows. Four stages of test loads are prescribed by Table 1 of AC347. Load Stage 1 consists of elastic load cycles that take place at load levels below the yield strength of the headed bar. Loading Stages 2 and 3 both consist of inelastic load cycles that strain the headed reinforcing bar beyond actual yield strength during each load cycle. At the time of Stage 4, the headed reinforcing bar has been subject to loading Stages 1, 2 and 3. Therefore, the yield strength of the sample under test is actually developed during the first tensile excursion of Stage 2 cyclic loading, not during Stage 4 as inadvertently implied by the current wording of Paragraph 4.1.7.1.

In further support of this line of reasoning, we also offer the following comments. Paragraph 4.1.7.1 references Section 7.3 of ASTM A 970-06, which in turn anticipates that the headed reinforcing bar will be tested in monotonic tension, without application of any prior inelastic cyclic loads. Consequently, the AC 347 Stage 4 tensile test to failure, which has been preceded by the prescribed inelastic cycling of Stages 2 and 3, is not the same as the monotonic tension test anticipated by ASTM A 970-06. This is because the headed reinforcing bar has yielded prior to Stage 4. As a result, yield strength of the headed reinforcing bar cannot be established from Stage 4 loading. Yield strength should instead be established at the start of Stage 2 loading.

Headquarters & Laboratories—Northbrook Illinois

Allianta | Austin | Boston | Chicago | Cleveland | Dallas | Denver | Detroit | Honolulu | Houston
Los Angeles | Minneapolis | New Haven | New York | Princeton | San Francisco | Seattle | Washington, DC

In conclusion, it is requested that ICC ES consider implementing an expedited change to AC347, using wording as suggested above, to correct the inadvertent inconsistency described herein at the earliest possible time.

If you have any question, please feel free to contact the undersigned by email or telephone.

Sincerely,

WISS, JANNEY, ELSTNER ASSOCIATES, INC.

Conrad Paulson
Principal



PROPOSED REVISIONS TO THE ACCEPTANCE CRITERIA FOR HEADED ENDS OF CONCRETE REINFORCEMENT

AC347

Proposed August 2008

Previously approved October 2006

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 HEADED ENDS OF CONCRETE REINFORCEMENT (AC347)

1.0 INTRODUCTION

1.1 Purpose: The purpose of this criteria is to establish requirements for headed ends of concrete reinforcement, as mechanical anchorage of deformed steel reinforcing bars, to be recognized in ICC Evaluation Service, Inc. (ICC-ES), evaluation reports under Sections 12.1.1 and 12.6 of the American Concrete Institute ACI 318-05, referenced in Section 1901.2 of the 2006 *International Building Code*[®] (IBC), and Sections 1912.1.1 and 1912.6 of the 1997 *Uniform Building Code*[™] (UBC), and as an alternative to the tension lap splices of reinforcing bars specified in ACI 318 Section 12.15 and UBC Section 1912.15.

The reason for development of this criteria is to establish guidelines for the evaluation of headed ends of concrete reinforcement, since the IBC, UBC and documents referenced by those codes do not specify requirements for the testing and installation of headed ends of concrete reinforcement.

1.2 Scope: This criteria is for headed ends of uncoated, deformed, steel reinforcing bars that develop the yield strength of the reinforcing bars under tensile forces without concrete or headed end damage. Under this criteria, development of the reinforcing bar is based on the headed end of the reinforcing bar bearing on the concrete, and not the bond of the concrete to the reinforcing bars.

As mechanical anchorage, the headed ends are alternatives to the embedment lengths of straight bars or hooks of deformed steel reinforcing bars in reinforced concrete specified in ACI 318 Sections 12.1.1 and 12.6 and UBC Sections 1912.1.1 and 1912.6, for development of reinforcing bars in tension. Related sections in the codes that permit or require mechanical anchorage of reinforcing bars are ACI 318 Sections 12.1.1, 12.10.6, 12.11.2, 12.11.3, 12.11.4 and 12.12.1; and UBC Sections 1912.1.1, 1912.10.6, 1912.11.2, 1912.11.3, 1912.11.4 and 1912.12.1.

This criteria is also applicable to the use of the headed bars as alternates to the tension lap splices of reinforcing bars specified in ACI 318 Section 12.15 and UBC Section 1912.15.

This criteria applies to headed ends that comply with ASTM A 970 and have a net headed bearing area of at least four times the nominal area of the reinforcing bar. Headed bars under this criteria are limited to uncoated, deformed reinforcing bars that have a specified yield strength not exceeding 60 ksi (420 MPa); reinforcing bar size not exceeding a No. 11; installation in normal-weight concrete; spacing between headed bars complying with this criteria; and concrete coverage measured to any portion of the headed bar complying with the concrete cover requirements for reinforcement in the applicable code and this criteria.

This criteria is applicable to reinforcement with a factory-forged headed end; reinforcement with a factory-welded headed end; products that are mechanically attached to the end of reinforcing bars at the jobsite without factory preparation of the reinforcing bars; and products that are, in whole or in part, mechanically attached to the end of the reinforcing bars at a factory.

Use of the headed end on compression reinforcement and epoxy and other coated bars is outside the scope of this criteria.

1.3 Codes and Referenced Standards:

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

1.3.2 1997 *Uniform Building Code*[™] (UBC), International Council of Building Officials.

1.3.3 ASTM A 970-06, Standard Specification for Headed Steel Bars for Concrete Reinforcement, ASTM International.

1.3.4 ASTM A 370-05, Test Methods and Definitions for Mechanical Testing of Steel Products, ASTM International.

1.3.5 ASTM E 8-04, Test Methods for Tension Testing of Metallic Materials, ASTM International.

1.3.6 ACI 318-05, Building Code Requirements for Structural Concrete, American Concrete Institute.

1.4 Definitions:

1.4.1 Anchorage Length: Headed bar anchorage length, L_a , is the distance from the critical section to the concrete bearing face of the headed end of the headed bar.

1.4.2 Critical Section: The critical section is that location on the reinforcing bar where the full bar stress is required.

1.4.3 Net Headed Bearing Area: The net headed bearing area, A_{brg} , is the surface area of the headed end that bears with direct contact onto the concrete, orthogonal to the reinforcing bar's longitudinal axis, exclusive of the nominal reinforcing bar cross sectional area, A_b , and projected area of any device used to connect the headed end to the bar. Limited features that obstruct the orthogonal surface area of the head from bearing on the concrete are permitted only to the extent specified in Section 3.2.3.

2.0 BASIC INFORMATION

2.1 General: The following general product information shall be submitted:

2.1.1 Product Description: Description of headed bar product shall include dimensions, designations and material specifications.

2.1.2 Installation Instructions: Installation instructions for the headed bars shall include requirements and limitations regarding installation of the product.

2.1.3 Packaging and Identification: The method of packaging of the headed bars shall be described. Labels on packaging shall include the name and address of the evaluation report applicant, product model or name, size, the applicable ICC-ES evaluation report number and the name or logo of the inspection agency, as applicable (see Section 5.2).

For headed bars that are reinforcement with factory forged or welded heads, each headed bar shall be labeled in accordance with Section 15 of ASTM A 970.

For headed bars with mechanically attached heads that are field or factory assembled onto the reinforcement, each component shall be identified by the manufacturer's mark or logo.

PROPOSED REVISIONS TO THE ACCEPTANCE CRITERIA FOR HEADED ENDS OF CONCRETE REINFORCEMENT (AC347)

2.2 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.

2.3 Test Reports: Test reports shall comply with AC85.

2.4 Product Sampling: For tests specified in this criteria, products with welded ends and products with components factory attached to the reinforcing bar ends shall be sampled in accordance with Section 3.1 of AC85. All other products are permitted to be sampled in accordance with Section 3.2 of AC85. The assembly of the test specimens shall comply with Section 3.3 of AC85.

3.0 TEST, PERFORMANCE AND PRODUCT REQUIREMENTS

3.1 Headed Bar Materials, Manufacture and Chemical Composition: The material specifications, bar deformations, manufacturing and chemical composition of the components of the headed bar shall comply with Sections 1.2, 1.4 (except 1.4.6), 5 and 6 of ASTM A 970. For use as reinforcement resisting earthquake-induced flexural and axial forces in frame members and in structural wall boundary elements, the reinforcing bar component of the headed bars shall comply with IBC Section 1908.1.5 and UBC Section 1921.2.5.

3.2 Head Dimensions:

3.2.1 General: The dimensions of the headed end of the bars shall be such that the headed end is sufficiently rigid to ensure uniform bearing of the headed end on the concrete with the headed bars subjected to tensile forces up to a tensile stress in the bar at the specified yield strength based on the headed end concrete bearing strength capacity. Head rigidity shall be assessed in accordance with Section 4.3.

3.2.2 Net Headed Bearing Area: The net headed bearing area, A_{brg} , shall be equal to or greater than four times the nominal cross sectional area of the reinforcing bar.

3.2.3 Obstructions to Head Bearing Area: Obstructions to the head bearing face shall not extend along the longitudinal axis of the reinforcing bar for a distance greater than d_b from the bearing face of the head. As measured from the perimeter of the bar or mechanical connection, obstructions shall occupy not more than one third of A_{brg} or shall extend in the radial direction not more than $0.5d_b$, whichever limit is least restrictive. Bearing surfaces that are not orthogonal to the longitudinal axis of the reinforcing bar shall be treated as obstructions.

3.2.4 Bar Deformations: Obstruction or alteration of the bar deformations, to the extent that the deformations are not engaged by concrete or no longer conform to the requirements of the ASTM standard applicable to the unheaded bar, shall extend along the longitudinal axis of the reinforcing bar for a distance not greater than $2d_b$ from the bearing face of the head.

EXCEPTION: Headed bars that provide A_{brg} of at least $9A_b$ need not comply with the limit on obstructed or altered bar deformations.

3.3 Tensile Tests: Reports of load tests (cyclic tension followed by monotonic tension tests) of the headed bars in

accordance with Section 4.1 of this criteria shall be submitted. In order to verify compliance with the conditions of acceptance in Section 4.1.7.1, tension tests of control reinforcing bar specimens from the same heat as the reinforcing bar of the headed bar load tests shall be conducted in accordance with ASTM A 370 to establish the actual yield and actual tensile strength, final elongation at fracture of the reinforcing bar and strain in the bar at actual yield stress.

3.4 Bend Tests: For welded headed bars, report(s) of bend tests in accordance with Section 4.2 of this criteria shall be submitted.

3.5 Structural Design and Installation: Structural design and installation provisions in the evaluation report shall be consistent with this section of the criteria.

3.5.1 General: The installation parameters of the headed bars (including the concrete compressive strength, headed bar spacing, concrete coverage and headed bar anchorage length) shall be such that the reinforcing bar tensile force based on the headed end concrete bearing strength exceeds the tensile force at specified yield strength, f_y , of the reinforcing bar. For products with a net headed bearing area greater than $4A_b$, but less than $9A_b$, the analysis of the headed bars shall be in accordance with Section 3.5.2. For products with a net headed bearing area equal to, or greater than, $9A_b$, the products shall be installed in accordance with Section 3.5.3. The minimum anchorage length and minimum lapped splice length of the headed bars shall comply with Section 3.5.4.

3.5.2 Headed Bars with Net Headed Bearing Area Less than $9A_b$: The headed bars shall be placed so that c_f/d_b is equal to, or greater than, 2.5 and the installation parameters shall satisfy equation 1:

$$f_{c,bear} \times A_{brg} \geq f_y \times A_b, \text{ pounds (N)} \quad (1)$$

where:

$$f_{c,bear} = 0.6 f'_c \omega_t (2c_b) / (A_{brg})^{0.5} \leq 8f'_c, \text{ psi (Pa)}$$

$$\omega_t = 0.6 + 0.4 (c_2/c_b) \leq 2.0.$$

f'_c = Specified 28-day concrete compressive strength with the maximum value of f'_c to be used in the calculation limited to 6000 psi (41.3 MPa), psi (MPa).

c_b = The minimum of half the center-to-center reinforcing bar spacing or the least overall concrete cover dimension measured to the center of the reinforcing bar (see Section 6.4 regarding the minimum concrete cover), inches (mm).

c_2 = Dimension orthogonal to c_b , inches (mm). If c_b is determined by half the center-to-center reinforcing bar spacing, c_2 is the lesser of the concrete cover in the orthogonal direction measured to center of the reinforcing bar or half the center-to-center reinforcing bar spacing orthogonal to c_b . c_2 must always be equal to, or greater than, c_b (see Section 6.4 regarding the minimum concrete cover).

A_{brg} = Net headed bearing area as defined in Section 1.4.3, square inches (mm^2).

A_b = Nominal cross sectional area of the rebar, square inches (mm^2).

PROPOSED REVISIONS TO THE ACCEPTANCE CRITERIA FOR HEADED ENDS OF CONCRETE REINFORCEMENT (AC347)

f_y = Specified yield strength of the rebar, psi (MPa).

3.5.3 Headed Bars with Minimum Net Headed Bearing Area of $9A_b$: Headed bars with a minimum net headed bearing area of $9A_b$ can be considered to develop the yield strength in the reinforcing bars without exceeding the concrete bearing strength, provided the anchorage length complies with Section 3.5.4; the bar is placed so that c_b/d_b is equal to, or greater than, 3; and the minimum concrete compressive strength is 4,000 psi (27.6 MPa).

3.5.4 Installation Requirements:

3.5.4.1 Minimum Anchorage Length: The minimum anchorage length, L_a , of headed bars shall be $8d_b$ or 6 inches (152 mm), whichever is greater.

3.5.4.2 Lapped Splices: For use of headed bars as an alternative to the code requirements for lapped splices of deformed bar reinforcement, the minimum lap length, L_s , as measured between bearing faces of opposing heads of the headed bars, shall be in accordance with equation 2 (see Figure 1 for additional details):

$$L_s = 1.3 (L_a + s_b \tan 35^\circ) \quad (2)$$

where:

L_a = Minimum anchorage length, inches (mm).

s_b = Centerline spacing between lapped headed bars, inches (mm).

3.5.4.3 Longitudinal headed deformed reinforcing bars extending from members, such as but not limited to beams, corbels, or brackets, that are terminated in an adjacent member shall be extended to the far face of the confined region of the adjacent member.

4.0 TEST METHODS

4.1 Cyclic Tension Followed by Monotonic Tension Tests:

4.1.1 The cyclic tension tests of headed bars shall be in accordance with Stages 1, 2 and 3 described in Table 1. After the third stage, the specimens shall be monotonically tested in tension to failure, as noted as Stage 4 in Table 1.

4.1.2 At least five specimens shall be tested for each bar size and head type for which recognition is sought.

Where the interface between the bar and the head is potentially affected by bar deformation shape, size or pattern (such as spiral, diamond and bamboo), the evaluation report needs to be limited to the bar deformation pattern used in the tests, unless five additional specimens for at least three different bar deformation patterns are tested in each bar size and head type. For headed end products that have substantially the same design for all bar diameters, all bar diameters need not be tested to determine the effects of bar deformation pattern, if tests of the smallest and largest bar size demonstrate compliance with Section 4.1.7.

4.1.3 In order to conduct Stages 2 and 3, a reference strain shall be measured on the reinforcing bar of each headed bar test specimen, remote from the bar to headed end connection or affected zone. The reference strain shall be used to determine the tension loads in Stages 2 and 3.

The tensile loads in Stages 2 and 3 shall be based on the first cycle load that results in $2e_y$ and $5e_y$ strain in the bar, respectively. The zero strain (i.e., baseline strain) reading shall be taken at zero applied load prior to the start of the cyclic load test, and shall not be rezeroed during the test. The reference strain shall be recorded throughout stages 1 through 3, and as far into Stage 4 as practicable. For purposes of this criteria, the affected zone is that portion of the bar where any property of the bar, including physical, metallurgical or material characteristics, has been altered by the manufacture, fabrication or installation of the headed end of the bar. Examples of affected zones are heat affected zones, bar upset zones, sections of the bar affected by threading or other machining, and significant sharp marks or notches left in the bar by gripping during manufacture, fabrication or installation of the headed end.

4.1.4 Although the headed bar test specimens shall not include concrete, the test fixture shall load the bearing face of the headed end of the test specimens in a uniform manner that simulates the bearing of the headed end onto concrete.

4.1.5 The Stage 4, monotonic tension tests shall include recordings of tension and elongation of the headed bars in accordance with Sections 7.1 through 7.4 of ASTM A 970, except as modified by this criteria.

For headed bars having the reinforcing bar hot- or cold-worked adjacent to the head as a result of the head manufacturing process, the location of marks for measuring elongation after fracture shall be located as described herein. The mark closest to the headed end of the reinforcing bar shall be located at a point that is on the hot- or cold-worked portion of the reinforcing bar, approximately $1/2$ inch (12.7 mm) away from the transition point between the hot- or cold-worked reinforcing bar and unaffected reinforcing bar. The second mark shall be located on unaffected reinforcing bar, away from the headed end and beyond the transition point.

4.1.6 The slip of the head-to-bar connection shall be monitored during the Stages 1 through 4 testing. Slip of the head-to-reinforcing bar connection shall be reported in the form of load-slip graphs.

4.1.7 Conditions of Acceptance:

4.1.7.1 The Stage 4 2 yield strength, Stage 4 tensile strength and Stage 4 elongation of each tested headed bar assembly shall comply with the requirements of Sections 7.3.1, 7.3.2 and Table 1 of ASTM A 970 with the yield and tensile stress based on the nominal cross sectional area of the reinforcing bar.

4.1.7.2 The Stage 4 failure mode of each tested headed bar assembly shall comply with the conditions of acceptance of Section 7.3.3 of ASTM A 970.

4.2 Bend Test of Welded Headed Products:

4.2.1 Bend tests of welded headed assemblies shall be conducted in accordance with Section 7.5 of ASTM A 970.

4.2.2 At least three specimens shall be tested for each bar size and head type.

4.2.3 Conditions of acceptance of each specimen are as specified in Section 7.5.2 of ASTM A 970.

PROPOSED REVISIONS TO THE ACCEPTANCE CRITERIA FOR HEADED ENDS OF CONCRETE REINFORCEMENT (AC347)

4.3 Head Rigidity: The rigidity of the headed ends shall be assessed in accordance with either Section 4.3.1 or 4.3.2:

4.3.1 Analysis: It shall be demonstrated using an engineering analysis that the head material does not yield when the head is subjected to a concrete bearing stress associated with the specified yield strength of the reinforcing bar.

4.3.2 Tests: A minimum of three specimens of each bar size and head type shall be subjected to a minimum tension force, applied as described in Section 4.1.4, equal to $f_y \times A_b$, for a minimum of 60 seconds prior to release of the applied load. The value of f_y shall be the specified yield strength of the reinforcing bar. Following release of the applied load, the heads of the test specimens visually examined and measured, shall not exhibit a residual deformation in excess of 0.05 inch (1.27 mm) as compared to the profile of the specimen measured prior to load application.

5.0 QUALITY CONTROL

5.1 The products shall be manufactured under an approved quality control program, with quality documentation complying with the ICC-ES Acceptance Criteria for Quality Documentation (AC10) submitted for each manufacturing facility.

The quality documentation, as it relates to manufacturing, shall include the tolerance for physical and chemical properties, acceptance test standards, fabrication geometric tolerance and other aspects of the controls on the production of the headed bar system. The quality program shall include production testing that is in accordance with Section 8 of ASTM A 970. Records of all tests shall be kept and logged in a register for inspection and audit purposes in accordance with the quality control manual.

5.2 The quality control program shall include inspections by a third-party inspection agency accredited by the

International Accreditation Service (IAS) or otherwise acceptable to ICC-ES, for products that include components that are factory-attached to reinforcing bar (including, but not limited to, friction-welded headed ends) and to reinforcing bar that is factory-prepared for field assembly, such as threading of the ends of the reinforcing bar.

6.0 EVALUATION REPORT RECOGNITION

6.1 The evaluation report shall indicate that special inspection shall be provided at the jobsite as required by IBC Section 1704 and UBC Section 1701, as applicable. The evaluation report shall include statements that, in addition to verifying placement of the headed end of the reinforcing bar, the special inspector shall verify field preparation of components (including preparation of reinforcing bar ends) and assembly of the components resulting in reinforcing bar with a headed end.

6.2 The evaluation report shall include the net headed bearing area for each size headed end reinforcing bar consistent with Sections 1.4.3 and 3.2 of this criteria and shall include design and installation information details consistent with Section 3.5 of this criteria.

6.3 The evaluation report shall specify the use and limitations of use of the headed ends of reinforcement bars consistent with Sections 1.1 and 1.2 of this criteria.

6.4 The evaluation report shall include a condition of use that requires the minimum concrete cover to be in accordance with applicable code and measured from the outer surface of the headed end of the headed bars.

6.5 The evaluation report shall include requirements that headed bar calculations and installation details for each project shall be submitted to the code official for approval, with this information prepared by a registered design professional when required by the statutes of the jurisdiction in which the headed bars are installed. ■

PROPOSED REVISIONS TO THE ACCEPTANCE CRITERIA FOR
HEADED ENDS OF CONCRETE REINFORCEMENT (AC347)

TABLE 1—DESCRIPTION OF CYCLIC TENSION TESTS

STAGE	MAXIMUM LOAD	MINIMUM LOAD	CYCLES
1	$0.95 f_y$	$0.05 f_y$	20
2	$2 e_y$	$0.05 f_y$	4
3	$5 e_y$	$0.05 f_y$	4
4	Load in tension to failure		

Notes:

f_y is the specified yield strength of the bar.

e_y is the strain of the reinforcing bar at actual yield stress.

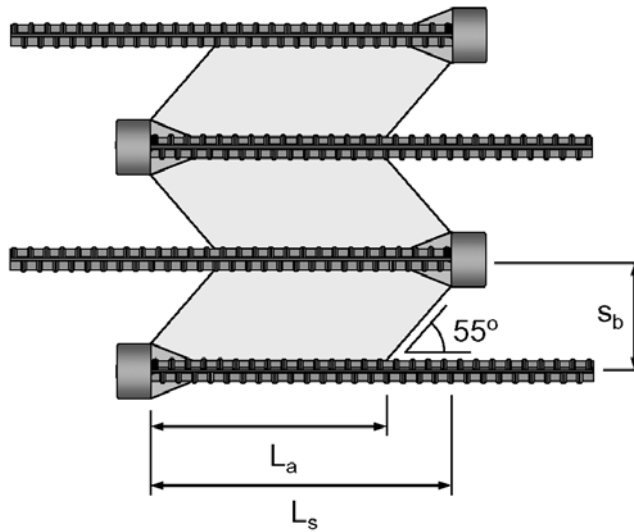


FIGURE 1—LAPPED SPLICES