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February 2, 2009

TO: PARTIES INTERESTED IN EVALUATION REPORTS ON COMPOSITE LIGHT GAGE STEEL AND MASONRY LINTELS

SUBJECT: Proposed Acceptance Criteria for Composite Light Gage Steel and Masonry Lintels, Subject AC409-0209-R1 (ME/BG)

Dear Madam or Sir:

The draft of the subject new acceptance criteria, enclosed with this letter, is being posted on the ICC-ES web site to allow for public comment. The proposed acceptance criteria is intended to address requirements for composite light gage steel and masonry lintels. This acceptance criteria applies to light gage steel shapes installed over wall openings of masonry construction to reinforce the masonry lintel, with the masonry and steel shapes compositely resisting gravity loads, as an alternative to the requirements for reinforced masonry lintels in the 2006 *International Building Code*[®] (IBC) and the 2006 *International Residential Code*[®] (IRC).

ICC-ES staff has the following comments on the draft:

1. More details regarding lintel load testing, as specified in Section 4.1, are needed. Staff questions whether Section 4.1 can adequately address the verification of design equations and assumptions used in the structural analysis of the composite action of the cold rolled light gage steel and the solid grouted masonry, or whether additional tests are required. Typically, multiple configurations modeled to result in each possible failure mode, such as shear or flexure, are needed.
2. Section 3.2.4 of the draft criteria states that provisions regarding safety factors are outlined in Chapters 17, 19 and 22 of the IBC. Staff questions whether this reference can properly address the safety factor issue, and requests more information regarding the safety factor and/or phi factor to be used in engineering analysis of test results.
3. Staff seeks comments on the minimum galvanization coating weight necessary for the corrosion protection of the steel shapes. AISI indicates corrosion resistance must comply with ASTM A 1003 as a minimum. For exterior exposure, IBC Table 1507.4.3(2) specifies minimum corrosion-resistant coatings.
4. Staff wonders about the content of any evaluation report published in accordance with this proposed criteria. Will the content only cover load/span tables and/or design stresses and design methodology?

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 in preparing revisions to the criteria that may be considered at a future Evaluation Committee meeting. Comments received 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 Brian Gerber, S.E., principal structural engineer, at extension 3260. You may also reach us by e-mail at es@icc-es.org.

Yours very truly,



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

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Enclosure

cc: Evaluation Committee

PROPOSED ACCEPTANCE CRITERIA FOR COMPOSITE LIGHT GAGE STEEL AND MASONRY LINTELS

AC409

Proposed February 2009

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 ACCEPTANCE CRITERIA FOR COMPOSITE LIGHT GAGE STEEL AND MASONRY LINTELS

1 1.0 INTRODUCTION

2 1.1 **Purpose:** The purpose of this acceptance criteria is to establish
3 requirements for composite light gage steel and masonry lintels to be recognized in
4 an ICC Evaluation Service, Inc. (ICC-ES), evaluation report under the 2006
5 *International Building Code*[®] (IBC) and the 2006 *International Residential Code*[®]
6 (IRC). Bases of recognition are IBC Section 104.11 and IRC Section R104.11.

7 The reason for the development of this criteria is to provide a guideline for the
8 evaluation of composite light gage steel and masonry lintel systems, since such
9 systems are alternatives to the reinforced masonry lintels defined in the IBC and
10 IRC.

11 1.2 **Scope:** This acceptance criteria applies to composite lintels over
12 masonry wall openings supporting gravity loads, composed of solid grouted concrete
13 masonry units, a cold rolled light gage steel shape and reinforcing bars. This
14 acceptance criteria emphasizes the structural design characteristics of the light gage
15 steel reinforced masonry lintel and requires verification of design equations and
16 assumptions used in the structural analysis of the composite action of the cold rolled
17 light gage steel and the solid grouted masonry. The concrete masonry shall have a
18 specified compressive strength of masonry (f'_m) as determined in accordance with
19 the IBC. This criteria is applicable to load-bearing and nonload-bearing walls of
20 residential and nonresidential buildings. Composite lintels used with the masonry
21 walls shall be designed and constructed in accordance with the applicable sections

22 of the IBC and IRC. Use of the composite lintel system is applicable under the IRC,
23 when an engineered design is submitted to the code official in accordance with
24 Section R301.1.3 of the IRC for each project.

25 **1.3 Codes and Referenced Standards:**

26 **1.3.1** 2006 *International Building Code*[®] (IBC).

27 **1.3.2** 2006 *International Residential Code*[®] (IRC).

28 **1.3.3** ASTM C 90-03, Specification for Loadbearing Concrete
29 Masonry Units, ASTM International.

30 **1.3.4** ASTM C 1314-03b, Test Method for Compressive Strength of
31 Masonry Prisms, ASTM International.

32 **1.3.5** AISI-NAS, North American Specification for Design of Cold-
33 formed Steel Structural Members, 2001 edition with 2004 Supplement.

34 **1.3.6** ANSI/ASCE 3-91, Standard for the Structural Design of
35 Composite Slabs, American Society of Civil Engineers document.

36 **1.4 Definitions:**

37 **1.4.1 Composite Lintel:** A lintel formed by the following parts: solid
38 grouted concrete masonry units, a cold-rolled light gage steel shape, and reinforcing
39 bars.

40 **1.4.2 Grout:** Grout is defined in, and shall comply with, IBC Section
41 2103.12.

42 **1.4.3 Mortar:** Mortar is defined in Section 2102 of the IBC, shall be
43 Type M or S, and shall comply with Section 2103.8 of IBC.

44 **1.4.4 Concrete Masonry Unit:** A concrete masonry unit (CMU) is
45 defined in Section 2102 of the IBC and shall comply with ASTM C 90.

46 **1.4.5 Base-metal Thickness:** Thickness of the steel of the light gage
47 steel shapes, exclusive of all coating and galvanization thicknesses.

48 **1.4.6 Cold-rolled Light Gage Steel Shape: ???**

49 **2.0 BASIC INFORMATION**

50 **2.1 General:** The following information shall be submitted:

51 **2.1.1 Product Description:** Complete information concerning the
52 composite masonry lintel system, including lintel configurations, material
53 specifications for all components, manufacturing process for the cold-rolled light
54 gage steel shapes, and fully dimensioned drawings of steel shapes with tolerances,
55 and base-metal thickness.

56 **2.1.2 Installation Instructions:** Installation instructions and
57 engineered drawings shall accompany the product to the jobsite. The instructions
58 shall include any special instructions required for the specific product, as well as
59 handling requirements.

60 **2.1.3 Identification:** Cold-rolled light gage steel shapes shall be
61 identified by visible labels bearing the ICC-ES evaluation report number,
62 manufacturer's name and address, product designation, and notice of any product
63 installation limitations. Labels shall be placed on each cold-rolled light gage steel
64 shape.

65 **2.1.4 Field Preparation:** A description of masonry, cold-rolled light
66 gage steel shape placement, and the methods of field-cutting components.

67 **2.2 Testing Laboratories:** Testing laboratories shall comply with Section
68 2.0 of the ICC-ES Acceptance Criteria for Test Reports (AC85) and Section 4.2 of
69 the ICC-ES Rules of Procedure for Evaluation Reports.

70 **2.3 Test Reports:** Test reports shall comply with AC85. The test reports
71 shall be in sufficient detail to identify specimen properties that might affect system
72 performance.

73 **2.4 Product Sampling:** Sampling of the cold-formed light gage steel
74 shapes, masonry units, mortar and grout used in the qualification tests shall comply
75 with Sections 3.1 or 3.2 of AC85. Cold-rolled light gage steel shapes shall be
76 sampled from each manufacturing facility for which recognition is sought.

77 **3.0 TEST AND PERFORMANCE REQUIREMENTS**

78 **3.1 Steel:** The steel used in the production of the steel shapes shall comply
79 with AISI-NAS. The steel shall have a minimum galvanization coating weight
80 complying with ASTM A 1003 (???)

81 **3.2 Composite Lintel Load Resistance Capacities:**

82 **3.2.1 Lintel Design:** Details and examples of the design of the
83 composite lintel to resist gravity loads, including formulas with procedures
84 (engineering analysis), and properties needed for design and analysis, shall be
85 submitted. The engineering analysis shall consider failure modes or limit states,
86 deflections and creep. The engineering analysis shall comply with Chapters 21 and
87 22 of the IBC concerning masonry and steel capacities.

88 **3.2.2 Qualification Test Plan:** The qualification test plan shall specify
89 the qualification tests described in Section 4.0. Qualification tests shall provide data

90 on material properties, including stresses, deformations and/or ductility, creep, and
91 limit states or failure modes to support the rational analysis procedure required by
92 Section 3.2.1. The test plan and preliminary analysis shall be submitted to ICC-ES
93 for review prior to the commencement of any testing. Tests shall simulate the
94 anticipated loading conditions and load levels. The testing details noted in Section
95 4.0 are intended for verification of the engineering analysis procedures, not for
96 establishment of design stresses.

97 **3.2.3 Test Report:** The testing laboratory shall report on the
98 qualification testing performed in accordance with the approved test plan. Any
99 deviations from the test plan shall be noted and explained. In addition to the
100 information required by Section 2.0 of this criteria, the test report shall include the
101 following:

- 102 1. Description of test specimens.
- 103 2. Description of test setup.
- 104 3. Rate and method of loading.
- 105 4. Deformation measurements.
- 106 5. Modes of failure.
- 107 6. Failure loads.
- 108 7. Properties of test specimen components (steel, masonry, etc.).
- 109 8. In addition to the standard reporting and certification of test
110 results, observations shall be reported, and photographs shall be taken and
111 submitted, of specimen response at significant stages of the loading process.

112 **3.2.4 Design Criteria Report:** A design criteria report shall be
113 submitted and shall include a complete analysis and interpretation of the
114 qualification test results presented in the independent laboratory test report. The
115 actual strengths for the cold rolled light gage steel, masonry units, mortar and grout
116 used in the test specimens must be used in the design equations in the analysis, to
117 verify that the design stresses or characteristic strengths used in the analysis and
118 design are qualified by the lintel load test data. Provisions concerning safety factors
119 or strength reduction factors are outlined in Chapters 17, 19 and 22 of the IBC, and
120 an appropriate design analysis, shall be used.

121 **4.0 QUALIFICATION TESTS AND ENGINEERING ANALYSIS**

122 **4.1 Lintel Load Tests:**

123 **4.1.1 General:** Tests shall demonstrate the applicability of the design
124 provisions to be representative configurations, and for anticipated uses with design
125 procedures as noted in the IBC.

126 **4.1.2 Test Methods:**

- 127 1. Three specimens shall be tested for each lintel configuration or
128 span.
- 129 2. Coupon tests or mill certificates shall be provided to establish
130 the base-metal thickness and actual physical properties of the steel shape used in
131 the lintel tests.
- 132 3. The mortar and grout mix design(s) shall be documented. A
133 minimum of three mortar tests in accordance with ASTM C 270 and a minimum of

134 three grout tests in accordance with ASTM C 1019 shall be done for each wall
135 thickness tested, to show compliance with the IBC.

136 4. Concrete masonry units used in the tests shall be verified as
137 complying with ASTM C 90.

138 5. Compressive strength of masonry prism specimens shall be
139 tested in accordance with IBC Section 2105.2.2.2 and ASTM C 1314. Masonry prism
140 tests shall be conducted at the same time (± 1 day) as the lintel load tests.

141 6. Masonry shall be constructed over the cold-rolled light gage
142 steel shape in accordance with the manufacturer's published installation instructions.
143 Lintels shall be constructed so that there are minimum 2 inches of bearing provided
144 at each end of the cold-rolled light gage light gage steel shape. The solid grouted
145 composite section shall be provided with a minimum beam length of 8 inches at
146 each end of the lintel span.

147 7. A minimum of three tests shall be conducted for each wall
148 thickness.

149 8. Tests shall be conducted as four-point bending (third-point
150 loading). A pinned end condition (i.e., no restraint to rotation at the end bearing)
151 shall be used.

152 9. Loading shall start with P_1 equal to 500 pounds (2225 N). The
153 load shall be held for one full minute. Load, P_1 , shall be increased by 200 pounds
154 (890 N) and the new load held for another full minute. This loading regime shall
155 continue until failure. Failure is defined as the inability to support additional load.

156 10. Tests shall be done in a manner that will provide a load-
157 deflection curve. Tests shall be closely observed and recorded for crack formation
158 and failure mode. Deflections corresponding to failure loads shall be documented.

159 **4.2 Engineering Analysis:**

160 **4.2.1** An engineering analysis, prepared and signed by a registered
161 design professional, shall be submitted and shall include a complete analysis and
162 interpretation of the qualification testing results presented in the independent
163 laboratory test report. Analysis shall consider the recommendations cited in Section
164 3.2.4 of ASCE 3. Design stresses (shear and moment capacities) or characteristic
165 strengths used in the analysis and design shall be qualified by the test data.
166 Procedures or provisions cited in the IBC, and an appropriate design analysis, shall
167 be used to assign design stresses or characteristic strengths that provide the degree
168 of safety required by the IBC.

169 **4.2.2** The average maximum strength from each set of tests indicated
170 in Section 4.1.2 may be the average peak test value, provided the peak test value
171 for each test is within 15 percent of the average. Otherwise, the lowest peak test
172 value shall be used.

173 **5.0 QUALITY CONTROL**

174 **5.1** Quality documentation complying with the ICC-ES Acceptance Criteria
175 for Quality Documentation (AC10) shall be submitted.

176 **5.2** Third-party follow up inspections are not required for the manufacturing
177 of the cold-rolled light gage steel shapes under this acceptance criteria.

178 **5.3** Installation of elements requiring special inspection under the IBC shall
179 comply with Section 1704 and other applicable sections of that code.

180 **6.0 EVALUATION REPORT RECOGNITION**

181 The evaluation report shall include the following:

182 **6.1** Basic information required by Section 2.0, including a description of the
183 steel shapes, installation procedures, and packaging and identification information.

184 **6.2** Design stresses (shear and moment capacities) and deflections based
185 on analysis of data as provided in Section 4.2.

186 **6.3** Use of composite lintels where coupling beams are used is outside the
187 scope of this criteria.

188 **6.4** Design for out-of-plane load resistance shall be based on noncomposite
189 provisions in the IBC. ■

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