FBPE# 26008

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Re: FL 14439, comments by Randy Shackelford received March 15, 2011

Thank you for giving us an opportunity to respond to the referenced comments.

Please find the below responses to the comments for FL # 14439.

1.Comment: General. If this product is considered a wood connector, it should follow all the requirements for determining the allowable load of a wood connector. Per Section 1715.1.2, this will include testing with a factor of safety of 3, testing and recording 1/8" deflection, and calculating the capacity of the fasteners. In this case, for the wood application, it was tested with a factor of safety only with no calculations, and for the masonry/concrete applications it was calculated only without testing.

1. Response: Testing and determination of allowable load for the wood application was done as Mr. Shackelford indicated appropriate. Specifically, testing was completed in accordance with ASTM D1761-88 (2000) in accordance with Section 1715.1.2 of the Florida Building Code. The results of these tests did not vary more than 20 percent from the average ultimate vertical load. The lowest ultimate vertical load was divided by three to determine the allowable load per Section 1715.1.2.1, as described in the "Engineering Methodology" section of the Evaluation Report. Deflections were measured during testing as shown in the laboratory report in appendix B of the evaluation report. Based on the load-deformation data contained in the report, the minimum load at which 1/8" deflection occurred was approximately 1900 lbs. This is substantially higher than the design load rating of 990 lbs. determined based on the lowest ultimate load divided by 3.

As shown in the evaluation for concrete and masonry substrates, qualification by calculation was done using (a) the results from the testing with the claw attached to wood and manufacturer's provided technical data to evaluate the strength of the concrete or masonry attachment of the strap. Other than the slightly greater stiffness of the attachment to concrete/masonry compared to wood, due to increased modulus of elasticity, both attachments are the same. The critical element in the performance of the tie-down based on testing is the Claw and its associated lag screw. The test results for the wood attachment of the claw are valid for both wood and concrete/masonry attachment of the strap.

2. Comment: Masonry/Concrete Application. Since no testing was performed, approved application should be limited to wood only. If calculations for masonry/concrete are to be accepted, then I have the following comments:
a. Anchor used (1/4" Hilti Kwik-Con II) is not an approved anchor so manufacturer's values can not be used without testing verification
b. 1.33 load duration factor was used in the load calculations. This is not permitted by the FBC for a masonry or concrete connection.
c. If calculated values are to be accepted, they should use approved values, such as those contained in Miami-Dade County NOA # 07-0924.03. In that NOA, the allowable shear capacity of the anchor is 367 lbs in concrete and 314 lbs. in concrete block. Allowable load will have to be reduced for masonry because it is impossible to install more than 3 anchors in the strap and maintain the 3" edge distance.

2. Response: As stated above, both attachments are the same other than the slightly greater stiffness of the attachment to concrete/masonry compared to wood. This is due to the increased modulus of elasticity of concrete/masonry compared to wood. The critical element in the performance of the tie-down based on testing is the Claw and its associated lag screw. Thus the test results for the wood attachment of the claw are valid for both wood and concrete/masonry attachment of the strap

Item a: As suggested by Mr. Shackelford, the ¼" Hilti Kwik-Con II does not have a Florida Product approval. As shown in the evaluation, the calculations were performed using data published by the manufacturer and attached to the evaluation. The manufacturer states that the "published load values represent the average test results" and "allowable working loads are based on a safety factor of 4.0" in his technical data. Use of this data in the evaluation is appropriate.

Item b: As stated in Mr. Shackelford's comment, the load combinations stated in section 1605 do not include a 1.33 load increase factor for wind load. Use of the 1.33 factor in our calculations facilitates using materials addressed by separate standards. Two possibilities for calculations to compare strengths using code factors of safety are appropriate – (i) considering normal allowable loads based on a load duration factor (LDF) of 1.0 on the claw design load rating and a factor of safety (FS) of 4 on the Kwik-Con II anchors, or (ii) considering short term wind (LDF) of 1.6 on the claw and a wind (FS) of 3 on the Kwik-Con II anchors. Comparing these two cases, the case of a LDF of1.6 for the claw and a FS of 3 for the Kwik-Con II is more critical for concrete/masonry anchor design.

The basis for the 1.6 LDF is as specified in the "National Design Standard for Wood Construction (NDS)" as referenced in the Florida Building Code.

The basis for the FS of 3 is contained in the ACI 318 code and the FBC. The derivation of the FS of 3 requires use of the ultimate strength provisions of ACI 318, Appendix D, Anchoring to Concrete, and the strength design factors in FBC section 1605.2.1. The strength reduction factor ø for an anchor subject to concrete pullout or pry-out strength, Condition B, is 0.75 per ACI 318 D4.5 c) i); the load factor per FBC for wind W equations 16-4 and 16-6 is 1.6. Combining these factors, the required FS against ultimate strength is 1.6/0.75 = 2.1. For this qualification, the FS of 3 was used.

Items c: As discussed in item A, the Hilti Kwik-Con II does not have a Florida Product approval. The referenced NOA #07-0924.03 issued by the Miami-Dade County Building Code Compliance Office has several differences for the stainless steel anchors used as compared with the manufacturer's data used in the evaluation. Differences include (i) lower allowable loads in the NOA than reported by the manufacturer, (ii) NOA shear strengths in Concrete Block slightly higher than shear strength in Concrete (the Hilti data indicates concrete is stronger), (iii) different spacing and edge distance requirements, (iv) different concrete test strengths, (v) the concrete and masonry used in the two tests are most likely from different sources, and (vi) exclusion of ¼" Kwik Con II embedded 1 ¾" in masonry (since these anchors will most likely be installed in tie-beams, the 1 ¾" embedment is applicable). The same FS of 4 was used in both documents. Based on the differences in results, the testing used to prepare the two documents was different. The manufacturer's data was used since both documents are based on testing, it is published by the manufacturer, and the factor of safety applied to the test results is larger than the minimum required by ACI 318.

3. Comment: Wood Truss Connection. The connection to the truss should be calculated in accordance with the NDS. In accordance with Table 11K and footnote 3, the allowable load of the 3/8" lag screw is 120 pounds. In addition, the NDS needs to be added to the list of standards on the application. If bearing of the hook on the top of the truss is included in the connection calculation, triangle bearing theory should be used. The length of lag screw required needs to be increased. According to Section 11.1.3 of the NDS, the minimum penetration of a lag screw is 4 times the Diameter, NOT including the tapered tip. So the lag screw must be long enough so that the length, subtracting the length of the tip and the thickness of the BPA Claw and BPA Strap, is at least 1.5"

Response: The design of the "claw" used for this tie-down was developed to depend primarily on bearing on a portion of the top of the tied-down member, not on shear from bolts or nails into the roof framing. This concept was used to avoid splitting associated with loading of wood perpendicular to its grain. As a result, the design depends on the lag bolt to (i) hold the claw in place and (ii) provide steel-to-steel connection between the steel claw and the tie-down strap. Due to this unique design, analysis was deemed inappropriate and the strength of the claw design was determined experimentally.

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