October 17, 2012

Mr. Stuart Wentworth

QUICK MOUNT PV
2700 Mitchell Drive, Bldg. 2
Walnut Creek, CA 94598

Subject: Quick Hook - Curved Tile Mount with 6" Base Plate

Dear Mr. Wentworth:

As requested, Applied Materials & Engineering, Inc. (AME) has completed load-testing the Curved Tile Mount with 6" base plate (see Appendix A). The purpose of our testing was to evaluate the tensile, shear and compressive load capacity of the Curved Tile Mount with 6" base plate attached to a commercially available 2"x4" Douglas Fir rafter.

SAMPLE DESCRIPTION

Fifteen (15) mockup samples were delivered to our laboratory on September 20, 2012. Mockup configuration consisted of three 16" long rafters at 7"o.c., screwed to 1/2" Structural 1 plywood. The Curved Tile Mount with 6" base plate is attached through the plywood into the rafter with two 5/16"x3-1/2" lag bolts.

TEST PROCEDURES & RESULTS

1. Tensile Strength

Four samples were tested for tensile strength on October 9, 2012 using a United Universal testing machine. Samples were rigidly attached to the testing machine and a tensile load was applied to the hook at a constant rate of axial deformation of 0.05 in./min. without shock until failure occurred. Based on the above testing, the average ultimate tensile load of the Curved Tile Mount with 6" base plate in Douglas Fir was determined to be 1246 lbf. Deflection at maximum load was measured as 4.5 inches.

The specific gravity and moisture content of the rafter was tested in accordance with ASTM D2395, Method A (oven-dry). The average specific gravity and moisture content was determined to be 0.400 and 14.0%, respectively. Detailed results are provided in Table I. Test setup is illustrated in Figure 1 of Appendix B.
2. Shear Strength Parallel to Rafter

Three samples were tested for shear strength on October 9, 2012 using a United Universal testing machine. Samples were rigidly attached to the testing machine and a shear load was applied to the hook. The samples were loaded parallel to rafter at a constant rate of axial deformation of 0.09 in./min. without shock until failure occurred. Based on the above testing, the average ultimate shear load, parallel to rafter, of the Curved Tile Mount with 6" base plate in Douglas Fir was determined to be 1341 lbf. Deflection at maximum load was measured as 2.2 inches.

The specific gravity and moisture content of the rafter was tested in accordance with ASTM D2395, Method A (oven-dry). The average specific gravity and moisture content was determined to be 0.392 and 15.4%, respectively. Detailed results are provided in Table II. Test setup is illustrated in Figure 2 of Appendix B.

3. Shear Strength Perpendicular to Rafter

Four samples were tested for shear strength on October 9, 2012 using a United Universal testing machine. Samples were rigidly attached to the testing machine and a shear load was applied to the hook. The samples were loaded perpendicular to rafter at a constant rate of axial deformation of 0.09 in./min. without shock until failure occurred. Based on the above testing, the average ultimate shear load, perpendicular to rafter, of the Curved Tile Mount with 6" base plate in Douglas Fir was determined to be 584 lbf. Deflection at maximum load was measured as 3.5 inches.

The specific gravity and moisture content of the rafter was tested in accordance with ASTM D2395, Method A (oven-dry). The average specific gravity and moisture content was determined to be 0.511 and 14.9%, respectively. Detailed results are provided in Table III. Test setup is illustrated in Figure 3 of Appendix B.

4. Compression

Four samples were tested in compression on October 9, 2012 using a United Universal testing machine. Samples were rigidly attached to the testing machine and a compressive load was applied to the hook at a constant rate of axial deformation of 0.09 in./min. without shock until failure occurred. Based on the above testing, the average ultimate compressive load of the Curved Tile Mount with 6" base plate in Douglas Fir was determined to be 692 lbf. Deflection at maximum load was measured as 2.3 inches.

The specific gravity and moisture content of the rafter was tested in accordance with ASTM D2395, Method A (oven-dry). The average specific gravity and moisture content was determined to be 0.400 and 14.4%, respectively. Detailed results are provided in Table IV. Test setup is illustrated in Figure 4 of Appendix B.
If you have any questions regarding the above, please do not hesitate to call the undersigned.

Respectfully Submitted,

APPLIED MATERIALS & ENGINEERING, INC.

Mohammed Fairuz
Laboratory Manager

Reviewed By:

Armen Tajirian, Ph.D., P.E.
Principal

APPLIED MATERIALS & ENGINEERING, INC.
TABLE I

QUICK HOOK - CURVED TILE MOUNT WITH 6" BASE PLATE

TENSILE LOAD TEST

PROJECT NUMBER 112640C

<table>
<thead>
<tr>
<th>SAMPLE ID</th>
<th>ULTIMATE TENSILE LOAD (LBF)</th>
<th>RAFTER MOISTURE CONTENT (%)</th>
<th>RAFTER SPECIFIC GRAVITY</th>
<th>DEFLECTION AT MAXIMUM LOAD (IN.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pull-1</td>
<td>1447</td>
<td>12.3</td>
<td>0.415</td>
<td>5.8</td>
</tr>
<tr>
<td>Pull-2</td>
<td>1080</td>
<td>15.5</td>
<td>0.422</td>
<td>3.7</td>
</tr>
<tr>
<td>Pull-3</td>
<td>1507</td>
<td>12.4</td>
<td>0.355</td>
<td>5.0</td>
</tr>
<tr>
<td>Pull-4</td>
<td>949</td>
<td>16.0</td>
<td>0.409</td>
<td>3.3</td>
</tr>
<tr>
<td>AVERAGE</td>
<td>1246</td>
<td>14.0</td>
<td>0.400</td>
<td>4.5</td>
</tr>
</tbody>
</table>

Failure Mode for All Samples: Lag Bolt Pull-out, Bent Hook & Base Plate.
TABLE II

QUICK HOOK - CURVED TILE MOUNT WITH 6" BASE PLATE

SHEAR LOAD PARALLEL TO RAFTER TEST RESULTS

PROJECT NUMBER 112640C

<table>
<thead>
<tr>
<th>SAMPLE ID</th>
<th>ULTIMATE SHEAR LOAD PARALLEL TO RAFTER (LBF)</th>
<th>RAFTER MOISTURE CONTENT (%)</th>
<th>RAFTER SPECIFIC GRAVITY</th>
<th>DEFLECTION AT MAXIMUM LOAD (IN.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Para-1</td>
<td>1118</td>
<td>17.5</td>
<td>0.400</td>
<td>2.4</td>
</tr>
<tr>
<td>Para-2</td>
<td>1230</td>
<td>11.4</td>
<td>0.375</td>
<td>1.6</td>
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<tr>
<td>Para-3</td>
<td>1675</td>
<td>17.4</td>
<td>0.402</td>
<td>2.5</td>
</tr>
<tr>
<td>AVERAGE</td>
<td>1341</td>
<td>15.4</td>
<td>0.392</td>
<td>2.2</td>
</tr>
</tbody>
</table>

Failure Mode for All Samples: Bent Hook & Base Plate.
TABLE III
QUICK HOOK - CURVED TILE MOUNT WITH 6" BASE PLATE
SHEAR LOAD PERPENDICULAR TO RAFTER TEST RESULTS
PROJECT NUMBER 112640C

<table>
<thead>
<tr>
<th>SAMPLE ID</th>
<th>ULTIMATE SHEAR LOAD PERPENDICULAR TO RAFTER (LBF)</th>
<th>RAFTER MOISTURE CONTENT (%)</th>
<th>RAFTER SPECIFIC GRAVITY</th>
<th>DEFLECTION AT MAXIMUM LOAD (IN.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perp-1</td>
<td>559</td>
<td>15.9</td>
<td>0.426</td>
<td>3.6</td>
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<tr>
<td>Perp-2</td>
<td>582</td>
<td>15.7</td>
<td>0.612</td>
<td>3.7</td>
</tr>
<tr>
<td>Perp-3</td>
<td>608</td>
<td>13.4</td>
<td>0.598</td>
<td>3.3</td>
</tr>
<tr>
<td>Perp-4</td>
<td>578</td>
<td>14.9</td>
<td>0.405</td>
<td>3.4</td>
</tr>
<tr>
<td>AVERAGE</td>
<td>584</td>
<td>14.9</td>
<td>0.511</td>
<td>3.5</td>
</tr>
</tbody>
</table>

Failure Mode for All Samples: Bent Hook & Base Plate.
TABLE IV

QUICK HOOK - CURVED TILE MOUNT WITH 6" BASE PLATE

COMPRESSION TEST RESULTS

PROJECT NUMBER 112640C

<table>
<thead>
<tr>
<th>SAMPLE ID</th>
<th>ULTIMATE COMPRESSION LOAD (LBF)</th>
<th>RAFTER MOISTURE CONTENT (%)</th>
<th>RAFTER SPECIFIC GRAVITY</th>
<th>DEFLECTION AT MAXIMUM LOAD (IN.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comp-1</td>
<td>727</td>
<td>13.3</td>
<td>0.418</td>
<td>2.5</td>
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<tr>
<td>Comp-2</td>
<td>714</td>
<td>17.9</td>
<td>0.313</td>
<td>2.4</td>
</tr>
<tr>
<td>Comp-3</td>
<td>731</td>
<td>12.3</td>
<td>0.467</td>
<td>2.4</td>
</tr>
<tr>
<td>Comp-4</td>
<td>597</td>
<td>14.2</td>
<td>0.403</td>
<td>2.0</td>
</tr>
<tr>
<td>AVERAGE</td>
<td><strong>692</strong></td>
<td><strong>14.4</strong></td>
<td><strong>0.400</strong></td>
<td><strong>2.3</strong></td>
</tr>
</tbody>
</table>

*Failure Mode for All Samples: Bent Hook.*
REFERENCES


ITEM NO. | DESCRIPTION | QTY.
--- | --- | ---
1 | BASE PLATE, QUICK HOOK, 6" WIDE - 6040-16, MILL | 1
2 | LAG SCREW, HEX HEAD, 5/16" x 3-1/2", 18-8 SS | 2
3 | QUICK HOOK, VERTICAL, 6061-16, MILL | 1
4 | SET SCREW, HEX SOCKET, 10-32 X 5/8", 18-8 SS | 1
5 | SUBFLASHING, QUICK HOOK 20X6 BASE, 9" X 14" X .032" - 2000-MILL | 1

**Quick Mount PV**

**TITLE:** QMOTH: QUICK HOOK-CURVED TILE MOUNT

UNLESS OTHERWISE SPECIFIED: DRAWN & CHECKED: INCHES DRAWN & CHECKED: MILLIMETERS ISSUE: 2 SHEET 1 OF 2
Quick Mount PV

TITLE: QMCH: QUICK HOOK-CURVED TILE MOUNT

BASE PLATE (ITEM 1)

10X Ø.33 CLEARANCE FOR 5/16" HARDWARE

3.75

3.75

3.75

6.00

158.00°

1.50

1.50

1.50

1.50

0.75

3.92

9.00

14.00

1.85

1.25

TWO HANGER STEEL HARDWARE

EIGHT HANGER STEEL HARDWARE

APPLIED MATERIALS & ENGINEERING, INC.
QUICK HOOK - CURVED TILE MOUNT WITH 6" BASE PLATE

PULL-OUT LOAD TEST SETUP

PROJECT NUMBER 112640C

Figure 1a. Tensile Test

Figure 1b. Tensile Test Close-up
QUICK HOOK - CURVED TILE MOUNT WITH 6" BASE PLATE

SHEAR TEST SETUP

PROJECT NUMBER 112640C

Figure 2a. Shear Parallel to Rafter

Figure 2b. Shear Test Close-up

Figure 3a. Shear Perpendicular to Rafter

Figure 3b. Shear Test Close-up
QUICK HOOK - CURVED TILE MOUNT WITH 6" BASE PLATE

COMPRESSIVE LOAD TEST SETUP

PROJECT NUMBER 112640C

Figure 4a. Compression Test

Figure 4b. Compression Test Close-up
REVISION HISTORY
Original report date October 17, 2012

1. Editorially revised on August 7, 2014:
   a) Product designation “Quick Hook USA” replaced with “Quick Hook” throughout the report.
   b) Appendix A mockup photo replaced with product drawings.