



May 9, 2011

Revised on 12/13/2011 to Include Tensile Strength Tests

Mr. Stewart Wentworth
QUICK MOUNT PV
936 Detroit Avenue, Suite D
Concord, CA 94518-2539

Project Number 111204C

Subject: Low Slope Mount QMLSH-12 Hardware Load Testing

Dear Mr. Wentworth:

As requested, Applied Materials & Engineering, Inc. (AME) has completed load-testing the QMLSH-12 hardware. The purpose of our testing was to evaluate the shear and tensile load capacity of the QMLSH-12 hardware attached to a commercially available 2"x4" Douglas Fir rafter.

SAMPLE DESCRIPTION

Nine (9) mockup samples were delivered to our laboratory on April 20, 2011. Mockup configuration consisted of three 16" long rafters at 7"o.c., screwed to 1/2" Structural 1 plywood. The 12" (finished height) Quick Mount Standoff (QMSO) hardware is attached through the plywood into the rafter with two 5/16"x3" lag bolts torqued to 15ft-lbs. Product hardware details are provided in Appendix B.

TEST PROCEDURES & RESULTS

1. Shear Strength Parallel to Rafter

Three samples were tested for shear strength on May 5, 2011 using a United Universal testing machine. Samples were rigidly attached to the testing machine and a shear load was applied to the 5/16"x1" machine bolt connected to the aluminum standoff. The samples were loaded parallel to rafter at a constant rate of axial deformation of 0.01 in./min. without shock until failure occurred. Based on the above testing, the average ultimate shear load, parallel to rafter, of the QMLSH-12 hardware in Douglas Fir was determined to be 519 lbf.

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 0.477 and 11.5%, respectively. Detailed results are provided in Table I. Test setup and mode of failure are provided in Appendix A.

2. Shear Strength Perpendicular to Rafter

Three samples were tested for shear strength on May 5, 2011 using a United Universal testing machine. Samples were rigidly attached to the testing machine and a shear load was applied to the 5/16"x1" machine bolt connected to the aluminum standoff. The samples were loaded perpendicular to rafter at a constant rate of axial deformation of 0.01 in./min. without shock until failure occurred. Based on the above testing, the average ultimate shear load, perpendicular to rafter, of the QMLSH-12 hardware in Douglas Fir was determined to be 377 lbf.

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 0.467 and 11.4%, respectively. Detailed results are provided in Table II. Test setup and mode of failure are provided in Appendix A.

3. Tensile Strength

Three samples were tested for tensile strength on June 29, 2011 using a United Universal testing machine. Samples were rigidly attached to the testing machine and a tensile load was applied to the 5/16"x1" machine bolt connected to the aluminum post. The samples were loaded in tension 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 QMLSH-12 hardware in Douglas Fir was determined to be 3031 lbf.


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 0.436 and 20.9%, respectively. Detailed results are provided in Table III. Test setup is shown in Appendix C.

If you have any questions regarding the above, please do not hesitate to call the undersigned.

Respectfully Submitted,

APPLIED MATERIALS & ENGINEERING, INC.

Reviewed By:


Mohammed Faiyaz
Laboratory Manager



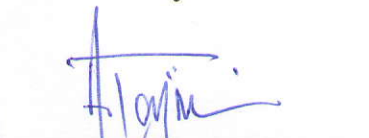

Armen Tajirian, Ph.D., P.E.
Principal

TABLE I
LOW SLOPE MOUNT QMLSH-12
12" FINISHED HEIGHT
SHEAR LOAD PARALLEL TO RAFTER TEST RESULTS
PROJECT NUMBER 111204C

SAMPLE ID	ULTIMATE SHEAR LOAD PARALLEL TO RAFTER (LBF)	RAFTER MOISTURE CONTENT (%)	RAFTER SPECIFIC GRAVITY	FAILURE MODE¹.
12PARA-1	553	11.3	0.472	AL Base Collar Cracked
12PARA-2	484	11.8	0.479	AL Base Collar Cracked
12PARA-3	520	11.4	0.480	AL Base Collar Cracked
AVERAGE	519	11.5	0.477	..

¹ Upper bolt.

TABLE II

LOW SLOPE MOUNT QMLSH-12
12" FINISHED HEIGHT

SHEAR LOAD PERPENDICULAR TO RAFTER TEST RESULTS

PROJECT NUMBER 111204C

SAMPLE ID	ULTIMATE SHEAR LOAD PERPENDICULAR TO RAFTER (LBF)	RAFTER MOISTURE CONTENT (%)	RAFTER SPECIFIC GRAVITY	FAILURE MODE
12PERP-1	344	11.3	0.471	Plywood Buckled/Bent Machine Bolt
12PERP-2	330	11.6	0.452	Plywood Buckled/Bent Machine Bolt
12PERP-3	456	11.3	0.477	Plywood Buckled/Bent Machine Bolt
AVERAGE	377	11.4	0.467	..

TABLE III
LOW SLOPE MOUNT QMLSH-12
12" FINISHED HEIGHT
TENSILE LOAD TEST RESULTS
PROJECT NUMBER 111204C

SAMPLE ID	ULTIMATE TENSILE LOAD (LBF)	RAFTER MOISTURE CONTENT (%)	RAFTER SPECIFIC GRAVITY	FAILURE MODE
7PULL-1	2807	20.7	0.402	Lag bolt pull-out
7PULL -2	3283	22.0	0.476	Lag bolt pull-out
7PULL -3	3003	20.0	0.430	Lag bolt pull-out
AVERAGE	3031	20.9	0.436	..

APPENDIX A

LOW SLOPE MOUNT QMLSH-12
12" FINISHED HEIGHT

SHEAR TEST SETUP

PROJECT NUMBER 111204C

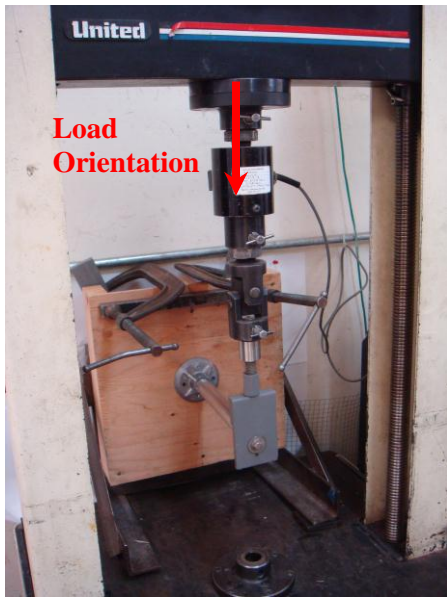


Figure 1a. Shear Parallel to Rafter

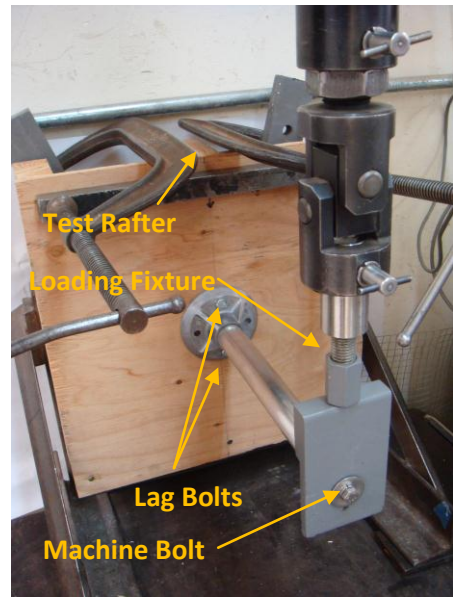


Figure 1b. Shear Test Close-up



Figure 2a. Shear Perpendicular to Rafter

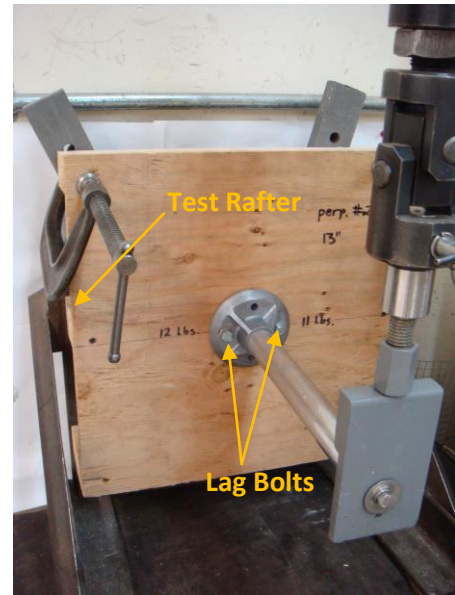


Figure 2b. Shear Test Close-up

LOW SLOPE MOUNT QMLSH-12
12" FINISHED HEIGHT

FAILURE MODES

PROJECT NUMBER 111204C



Figure 3. Cracked Aluminum Base Collar
Shear Parallel to Rafter



Figure 4. Buckled Plywood
Shear Perpendicular to Rafter

APPENDIX B

LOW SLOPE MOUNT QMLSH-12
12" FINISHED HEIGHT

HARWARE SPECIFICATION

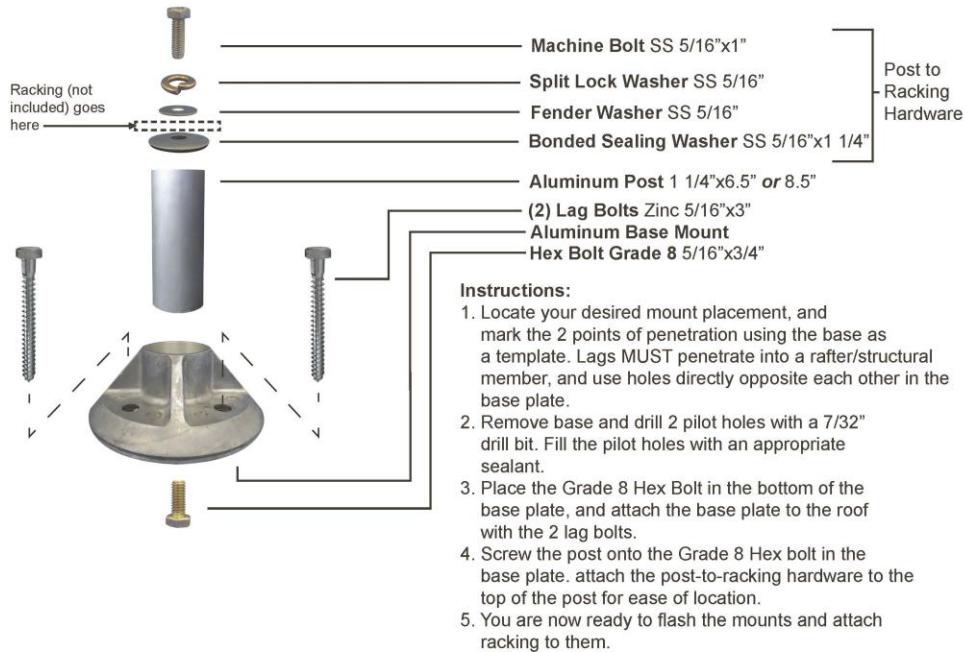
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Quick Mount PV[®]

*Your **Solution** in Mounting Products*

Solar • H₂O • Conduit • HVAC • Custom

Low Slope Mount Specifications



IMPORTANT-PLEASE READ:
This product DOES NOT include flashing, and therefore is not waterproof by itself. As the installer, it is your responsibility to make sure all roof penetrations are flashed properly!

Lag pull-out (withdrawal) capacities (lbs) in typical lumber:

	Specific Gravity	Lag Bolt Specifications	
		2/ea 5/16" shaft per 2.5" thread depth	5/16" shaft per 1" thread depth
Douglas Fir, Larch	.50	1330	266
Douglas Fir, South	.46	1175	235
Engelmann Spruce, Lodgepole Pine (MSR 1650 f & higher)	.46	1175	235
Hem, Fir	.43	1060	212
Hem, Fir, (North)	.46	1175	235
Southern Pine	.55	1535	307
Spruce, Pine, Fir	.42	1025	205
Spruce, Pine, Fir (E of 2 million psi and higher grades of MSR and MEL)	.50	1330	266

Sources: Uniform Building Code; American Wood Council
 Notes: 1) Thread must be embedded in a rafter or other structural roof member.
 2) Pull-out values incorporate a 1.6 safety factor recommended by the American Wood Council.
 3) See IBC for required edge distances.

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APPENDIX C

LOW SLOPE MOUNT QMLSH-12
12" FINISHED HEIGHT

LOAD TEST SETUP

PROJECT NUMBER 111204C



Tensile Test

Report Revision History

12/13/2011

Page 2: Tensile strengths tests added

Pages 1 & 3: Editorial revision

Page 5: Table III added

Page 11: Appendix C added