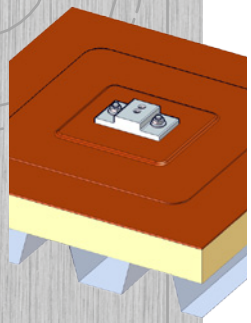

Engineer's Test Report

CARUSO TURLEY SCOTT
consulting structural engineers

memo

Date: February 23, 2011

To: **Mr. Brian Stearns**
Eco Fasten
289 Harrel Street
Morrisville, VT 05661

Copy:

From: Paul Scott/Kelli LeVasseur

Per the request of Brian Stearns at Eco Fasten, CTS was asked to review the Eco Fasten Eco 65 fastener and the application of the full scale load testing done by AB Engineering LLC, dated 12-10-07 (pgs A1 – A3 attached). The full scale load testing was done per ASTM D1761-06.

The information supplied was a document that provided an explanation of the testing for the plate and screws. CTS reviewed these documents and agree with the methodologies. It is the opinion of CTS that the screws will bend when resisting shear loads and therefore result in a pullout failure. Therefore, the pullout values will govern the allowable loads of the attachment for both pullout and shear.

Based on our analysis of the data, it is our opinion that the Eco Fasten Eco 65 fastener is sufficient to resist the seismic or wind forces as listed in the table below.

YOUR VISION IS OUR MISSION

Material	Screw Size	Maximum Allowable Pullout/Shear Load (lbs)
7/16" OSB	#14 x 1.5"	448
5/8" OSB	#14 x 1.5"	726
1/2" CDX Plywood	#14 x 1.5"	655
5/8" CDX Plywood	#14 x 1.5"	617
3/4" CDX Plywood	#14 x 1.5"	755
2x10 Spruce	#14 x 2"	1155
22 Gage Steel Deck	#14 x 2"	542

*A safety factor of 3.0 has been applied to the tested values per AISI and SDI recommendations to obtain the allowable values in the table above.

Please contact CTS with any questions regarding this letter.

Respectfully,

REGISTERED PROFESSIONAL ENGINEER Paul G Scott S3325 Exp. 12/31/11 STRUCTURAL STATE OF CALIFORNIA

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Engineer's Test Report

ABEngineering LLC
Design, Controls, Engineering Services
117 Hanon Drive, Williston, VT 05495-8851

At the request of Alpine SnowGuards we tested the roof mount base plate using the apparatus and methods described in ASTM D1761-06. The ASTM test was modified as required to accommodate multiple fasteners.

These tests determined the maximum pullout or lateral force the roof mount base plate would sustain in a given material. The actual performance of the roof mount base plate in a given installation may be different.
The roof mount base plate (Figure 1) as tested was made of an unpainted stainless steel with two countersunk bosses for stainless steel 5/16" flathead socket cap screws. These screws are welded on the backside to prevent rotation in an installed roof mount base plate. There are eight 5/16" diameter holes for attaching the base plate to the roof.

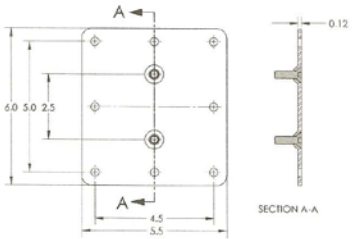
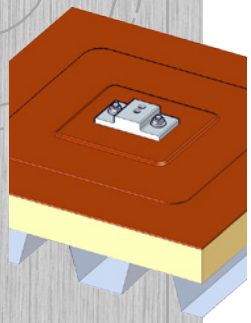


Figure 1 - Roof Mount Base Plate

The roof mount base plate was fastened to the decking material using 8 square drive #14 x 1.5" or #14 x 2" long screws from Triangle Fastener Company (Figure 2). A new roof mount base plate, screws, and test material was used for every test.

Figure 2 - TFC #14x1.5" Screw



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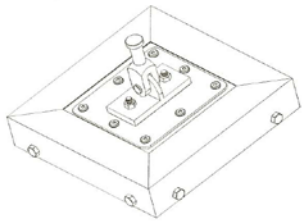

Figure 3 - Pullout Test Fixture

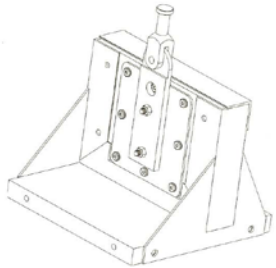

Figure 4 - Lateral Test Fixture

Representative samples were tested for pullout and lateral strength using fixtures shown in Figure 3 (pullout) and Figure 4 (lateral). Loads were applied slowly, a typical test pullout test would take 5 minutes from first load to failure. Pullout testing was performed using 4 samples and the results averaged. Lateral testing was performed using a single sample. Tests were performed on a recently calibrated Tineous Olsen testing machine. The table below lists the resulting maximum load.

Material	Screw Size	Maximum Tensile Load lb (kN)	Maximum Transverse Load lb (kN)
7/16" OSB	#14 x 1.5"	1343 (6.0)	4290 (19.0)
5/8" OSB	#14 x 1.5"	2176 (9.7)	4810 (21.4)
1/2" CDX Plywood	#14 x 1.5"	1963 (8.7)	4590 (20.4)
5/8 CDX Plywood	#14 x 1.5"	1850 (8.2)	5020 (22.3)
3/4" CDX Plywood	#14 x 1.5"	2263 (10.0)	5300 (23.6)
2x10 Spruce	#14 x 2"	3465 (15.4)	6126 (27.2)
22 ga Steel	#14 x 1.5"	1625 (7.4)	2520 (11.2)

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The typical pullout failure mode was a progressive failure of each fastener in the decking material. The applied force would reach a maximum value and one fastener would fail, followed by local bending of the roof mount base plate and pullout or failure of each additional fastener at a progressively lower load (Figure 5). While somewhat deformed by the test, the roof mount base plate was still in a serviceable condition.

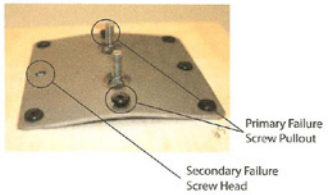


Figure 5 - Typical Pullout Test Result

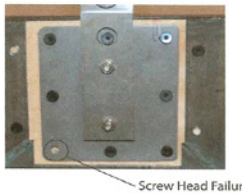
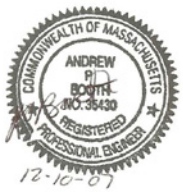
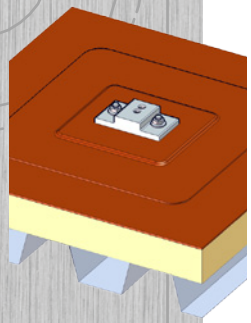


Figure 6 - Typical Transverse Loading Test Result

The typical transverse failure mode was slipping of the plate relative to the base material, followed by localized crushing of the base material around the fastener, and ultimately failure of the fastener due to bending forces on the head of the fastener. Again, the failure was progressive and as the applied load reached a maximum value, one fastener would fail, followed by the of each additional fastener at a progressively lower load. (Figure 6). The roof mount base plate had slight marking of the steel around the screw holes due to the hardened screw threads and was in a servicable condition after the test.





Fastener Pull-out Comparison

To determine the Eco 65 ultimate pull out capacity for your project you will first need to know the single fastener pull out capacity of the fastener you plan to use when fasted in to your roof deck. The best way to determine this is to do an onsite pull test. If an onsite test is not possible contact the fastener manufacturer and ask for their published pull out data. The estimated Eco 65 ultimate load will be 4 times the single fastener pull out capacity.

(Single Screw Pullout Capacity) x 4 = Eco 65 Ultimate Pullout Capacity

For example:
Fastener = Triangle #14-13 Concealer

Roof Deck = 5/8" CDX Plywood

Single Fastener Ultimate Pullout
Capacity in 5/8" CDX Plywood = 483 lbs

Eco 65 Estimated Ultimate
Pullout Capacity = 483 lbs x 4 = 1932 lbs

This process determines the expected ultimate load; appropriate safety factor must still be applied. Each plate must be fastened with eight fasteners.