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March 20, 2018

Mr. James Bush
ATAS International, Inc.
6612 Snowdrift Road
Allentown, PA 18106

Re: 2017 Castletop Florida Product Approvals
Report No: CAS-2017

Dear Jim:

At your request we have evaluated the wind resistance performance of the ATAS 0.032" aluminum, 0.028" zinc, and 16-ounce copper Castletop roof panel in conjunction with the 2017 Florida Building Code (first printing) and the Florida product approval system. The substantiating calculations and design assumptions are attached to this letter.

A summary of the results is given below:

Shingle Type:	Castletop
Material:	0.032" aluminum, 0.028" zinc, and 16-ounce copper
Roof Slopes:	3:12 through 12:12
Fastener:	(3) 0.150" x 1½" ring shank nails per shingle
Structural Substrate:	⅝" thick (minimum) plywood (½" for reroofing)
Resistance Rating:	See table below

Material	Allowable Wind Pressure (psf)
aluminum	43
zinc	36
copper	58

The *2017 Florida Building Code* prescribes UL 1897-12 test standard for evaluation of roof panel assemblies. The UL 1897-98 version used to evaluate the Castletop panel is equivalent to the referenced standard.

Please note that my investigation has been limited to the conditions discussed, and is based in part on information provided to me. The work was performed

using the standard of care exercised by structural engineers in this area at the time of the work. No expressed or implied warranties are made.

If you have any questions regarding these findings or conclusions, feel free to contact me. Thanks again for allowing me to assist you with this work.

Sincerely,

Christopher S. Blechschmidt
P.E. 61272

Christopher S. Blechschmidt
3-20-18

Wind Resistance Evaluation Calculations

for

Castletop Roofing Shingles
2017 Florida Building Code Product Approval
Report No: CAS-2017

for

ATAS International, Inc.

by

Christopher S. Blechschmidt, P.E.
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Project No: 2012.026 Page:
Project: Castletop Product Approval
Client: ATAS International, Inc.
Cal. By: CSB Date: 3/20/18

Design Assumptions

0.032" aluminum, 0.028" zinc, 16-ounce (0.0216") copper Castletop single

Exposed area = 1.266 ft^2 < 3.0 ft^2, therefore Castletop is a "shingle"

For use in non-HVHZ (HVHZ excluded)

Sloped roof from 3:12 to 12:12

5/8" plywood roof sheathing for new construction, 1/2" sheathing for reroofing

Tested in accordance with UL 1897 procedures (01-41396.03)

5005-H34 aluminum sheet (F_y = 15 ksi, F_u = 20 ksi), EN 988 zinc sheet (F_y = 14.5 ksi, F_u = 21.8 ksi), ASTM B370 - H02 copper sheet (F_y = 30 ksi, F_u = 32 ksi)

0.150" x 1.5" ring shank nails, 3 per shingle

Allowable fastener loads from *NDS for Wood Construction* 2015, *Aluminum Design Manual* 2015, and *APA The Engineered Wood Association* Form TT-039. Fastener pull-over values for zinc and copper determined from aluminum design equation.

Factor of Safety on panel = 2.0 (FBC 1504.9)

Factor of Safety on fastener = 3.0

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Fastener Strengths

Pull-Out

0.150" x 1 1/2" ring shank nail
5/8" plywood

D (in) =	0.150	
t (in) =	0.625	
G =	0.7	(per APA Form No. TT-039)
C_D =	1.6	(wind)
C_M =	1.0	(dry conditions)
C_t =	1.0	(temperature during event no greater than 100° F)

$W' = C_D C_M C_t 1380 G^{5/2} D =$ 135.8 lbs/in (based 2015 NDS)

$P'_{not} =$ 84.9 lbs

0.150" x 1 1/2" ring shank nail
1/2" plywood

D (in) =	0.150	
t (in) =	0.500	
G =	0.7	(per APA Form No. TT-039)
C_D =	1.6	(wind)
C_M =	1.0	(dry conditions)
C_t =	1.0	(temperature during event no greater than 100 degrees F)

$W' = C_D C_M C_t 1380 G^{5/2} D =$ 135.8 lbs/in (based 2015 NDS)

$P'_{not} =$ 67.9 lbs

Pull-Over–0.032 aluminum

0.150" ring shank nail, 3/8" diameter head/washer

C =	1.0
t_1 (in) =	0.032
F_{tu1} (ksi) =	20
F.S. =	3.0
D_{ws} (in) =	0.375
D_h (in) =	0.150

$P_{nov}/\Omega =$ 48.0 lbs

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Pull-Over–0.028" zinc

0.150" ring shank nail, 3/8" diameter head/washer

C =	1.0
t_1 (in) =	0.028
F_{tu1} (ksi) =	21.8
F.S. =	3.0
D_{ws} (in) =	0.375
D_h (in) =	0.150

P_{nov}/Ω = 45.8 lbs

Pull-Over–0.0216" (16 oz) copper

0.150" ring shank nail, 3/8" diameter head/washer

C =	1.0
t_1 (in) =	0.0216
F_{tu1} (ksi) =	37
F.S. =	3.0
D_{ws} (in) =	0.375
D_h (in) =	0.150

P_{nov}/Ω = 59.9 lbs

RECOMMENDED DESIGN VALUES FOR NAIL WITHDRAWAL FROM APA PLYWOOD AND OSB

Two thousand nail-withdrawal tests were conducted by APA – The Engineered Wood Association on plywood and OSB of different thicknesses using three different types of nails (plain, screw and ring-shank) under a variety of moisture-exposure conditions, including installed dry and tested dry, installed dry and tested after wet and redry, and installed wet and tested redry. The withdrawal tests were conducted following the procedures of ASTM D1761, *Standard Test Method for Mechanical Fasteners in Wood*. APA's recommended nail-withdrawal design values are based on results of these tests.

Recommended Nail-Withdrawal Design Values

Nail-withdrawal design values for APA plywood and OSB panels were derived by applying a factor of 5 to the average test results. The design values are expressed as an equivalent specific gravity to solid-sawn lumber following the same approach used by structural composite lumber products.

Dry Applications – For plywood or OSB panels, use a nail-withdrawal resistance equivalent to a specific gravity of 0.40 of solid-sawn lumber (see 2005 NDS Table 11.2C) for both plain-shank nails and screw-shank nails. Use an equivalent specific gravity of 0.70 for ring-shank nails withdrawn from either plywood or OSB (Table 1).

Applications Subject to Wet Service Conditions – Use the dry nail-withdrawal values (based on the equivalent specific gravity shown in Table 1) multiplied by a wet-use factor of 0.75.

Table 1. Recommended Nail-Withdrawal Design Values for Plywood and OSB[(a)]

	Plain-shank or screw-shank nail	Ring-shank nail
Equivalent Specific Gravity	0.40	0.70

(a) Dry use application (moisture content less than 16%). Apply a wet use factor of 0.75 to the dry nail-withdrawal design value for applications subject to wet service conditions.

Reference

APA, 2003, Nail Withdrawal Strength for Plywood and OSB Panels, APA Report T2001-3A, APA – The Engineered Wood Association, Tacoma, WA

Technical Services Division

Disclaimer

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Allowable Pressures Based on Shingle Failure							
Material	Thickness (in)	Test	Report No.	Maximum Pressure (psf)	Exposed Dimensions (in)	$(F.S.)_{panel}$	Allowable Pressure (psf)
Aluminum	0.032	UL 1897	01-41396.03	85	13.5 x 13.5	2.00	43
Zinc	0.028	interpolation	n/a	72	13.5 x 13.5	2.00	36
Copper	0.0216	interpolation	n/a	115	13.5 x 13.5	2.00	58

Notes:
Zinc deformation load = Aluminum deformation load x $F_{y, Zn} / F_{y, Al} * t_{Zn} / t_{Al}$
= 85 psf x 14.5 ksi / 15 ksi * 0.028" / 0.032" = 72 lbs.

Copper deformation load = Aluminum deformation load x $F_{y, Cu} / F_{y, Al} * t_{Cu} / t_{Al}$
= 85 psf x 30 ksi / 15 ksi * 0.0216" / 0.032" = 115 lbs.

Test results showed failure caused by fastener withdraw. Assume that panel fails at same load (conservative).

Allowable Wind Pressure Based on Fastener Failure						
Panel	Controlling Fastener Strength (lbs)	Number Nails per Shingle	Exposed Dimensions (in)	Exposed Area (ft^2)	Tributary Area per Nail (ft^2)	Allowable Pressure (psf)
Aluminum	48	3	13.5 x 13.5	1.266	0.422	114
Zinc	45.8	3	13.5 x 13.5	1.266	0.422	109
Copper	59.9	3	13.5 x 13.5	1.266	0.422	142

For all materials pull-over controls.

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Allowable Pressure Summary

Maximum Allowable Wind Pressures (psf)			
Material	Pressure based on Panel	Pressure based on Nail	Allowable Pressure
Aluminum	43	114	**43**
Zinc	36	109	**36**
Copper	58	142	**58**

Failure mode is shingle failure (disengagement) for all materials.

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Test Report References

Standard	Report Number	Laboratory	Laboratory Location
UL 1897-98	01-41396.03	Architectural Testing	York, PA