



PERFORMANCE TEST REPORT

Rendered to:

TERRACORE PANELS, LLC

PACIFIC BEDROCK INDUSTRIAL CO. LTD.

**PRODUCT: Granite Stone Faced Aluminum Honeycomb Panel System
(Alternate Fiberglass Product)**

Report No.: H0981.02-106-31

Report Date: 07/20/17

Test Record Retention Date: 06/12/21



PERFORMANCE TEST REPORT

Rendered to:

TERRACORE PANELS, LLC
2030 Irving Blvd.
Dallas, Texas 75207

PACIFIC BEDROCK INDUSTRIAL CO. LTD.
Lenan Innovative Industrial Zone
Sanjiang Village Leping Town
Sanshui District, Foshan City, Guangdong Province
China

Report No.: H0981.02-106-31
Test Start Date: 05/01/17
Test Completion Date: 06/12/17
Report Date: 07/20/17
Test Record Retention Date: 06/12/21

Products: Granite Stone Faced Aluminum Honeycomb Panel System - Alternate Fiberglass

Project Summary: Architectural Testing, Inc., an Intertek company ("Intertek-ATI"), was contracted by TerraCore Panels, LLC to evaluate two variations of their granite stone faced aluminum honeycomb panel system (edge sealed and unsealed test conditions) with an alternate fiberglass product layer. The product description, test procedures, and test results are reported herein.

Test Methods: The test specimens were evaluated in general accordance with the following methods.

ASTM C666/C666M-15, Standard Test Method for Resistance of Concrete to Rapid Freezing and Thawing

ASTM C297/C297M-16, Standard Test Method for Flatwise Tensile Strength of Sandwich Constructions.

Product Description: The test specimens were submitted to Intertek-ATI by TerraCore Panels, LLC and consisted of full thickness, granite stone faced aluminum honeycomb panel assembly specimens inclusive of an alternate fiberglass product layer and precut to specified test dimensions with fully-cured edge seal on half of the provided test specimens. The test materials were tested as received with the exception of preconditioning as required for the individual test methods.

Test Procedures and Test Results: The testing procedures and results obtained from testing are reported as follows. All conditioning of test specimens and test conditions were at standard laboratory conditions unless otherwise reported. Refer to the test related photos in Appendix A.

ASTM C666 - Freeze/Thaw Resistance

The freeze-thaw resistance evaluation was conducted in accordance with the procedures detailed in ASTM C666, Procedure B, on a total of forty-eight, 2 in. square x nominal 1.0 in. full sandwich thickness granite stone-faced honeycomb panel specimens (20 edge-sealed, 20 unsealed). The specimens were exposed in an Espec environmental chamber (ICN: 005615) to a repeating freezing and thawing cycle consisting of the following parameters:

- Temperature Hold: 1 hour 15 minutes at +4.0°C
- Temperature Ramp: 1 hour 15 minutes to -18.0°C
- Temperature Hold: 1 hour 15 minutes at -18.0°C
- Temperature Ramp: 1 hour 15 minutes to +4.0°C

The specimens were placed in a stainless steel tub and elevated approximately 0.125 in. off the bottom of the tub with a minimum 0.125 in. between each specimen. Specimens were surrounded by air during the freezing phase, and immersed in water during the thawing phase.

Upon completion of 25, 50, 75 and 100 full cycles, six sealed edge and six unsealed edge specimens were removed from exposure cycling, visually evaluated for evidence of stone facing deterioration and/or delamination of bond layers not evidenced prior to exposure cycling. Specimens were then air dried and five of each were mounted to aluminum pull-tab fixtures with a high performance 2-part epoxy (Loctite EA E-40HT) for flatwise tensile evaluation as detailed in the procedures presented in the ASTM C297 - Flatwise Tensile Bond Strength (one representative specimen was retained for post-test completion visual reference).

Test Procedures and Test Results: (Continued)

ASTM C666 - Freeze-Thaw Exposure Evaluation

Specimen Details				Post-Exposure Visual Specimen Face Evaluation	Post-Exposure Delamination
F/T Cycles Completed	Facing Stone	Edge Seal	ID		
25	Granite (w/Alternate Fiberglass)	No	25U-1	No Deleterious Effects	None
			25U-2	No Deleterious Effects	None
			25U-3	No Deleterious Effects	None
			25U-4	No Deleterious Effects	None
			25U-5	No Deleterious Effects	None
			25U-6	No Deleterious Effects	None
		Yes	25S-1	No Deleterious Effects	None
			25S-2	No Deleterious Effects	None
			25S-3	No Deleterious Effects	None
			25S-4	No Deleterious Effects	None
			25S-5	No Deleterious Effects	None
			25S-6	No Deleterious Effects	None

50	Granite (w/Alternate Fiberglass)	No	50U-1	No Deleterious Effects	None
			50U-2	No Deleterious Effects	None
			50U-3	No Deleterious Effects	None
			50U-4	No Deleterious Effects	None
			50U-5	No Deleterious Effects	None
			50U-6	No Deleterious Effects	None
		Yes	50S-1	No Deleterious Effects	None
			50S-2	No Deleterious Effects	None
			50S-3	No Deleterious Effects	None
			50S-4	No Deleterious Effects	None
			50S-5	No Deleterious Effects	None
			50S-6	No Deleterious Effects	None

Test Procedures and Test Results: (Continued)

ASTM C666 - Freeze-Thaw Exposure Evaluation (Continued)

Specimen Details				Post-Exposure Visual Specimen Face Evaluation	Post-Exposure Delamination
F/T Cycles Completed	Facing Stone	Edge Seal	ID		
75	Granite (w/Alternate Fiberglass)	No	75U-1	No Deleterious Effects	None
			75U-2	No Deleterious Effects	None
			75U-3	No Deleterious Effects	None
			75U-4	No Deleterious Effects	None
			75U-5	No Deleterious Effects	None
			75U-6	No Deleterious Effects	None
		Yes	75S-1	No Deleterious Effects	None
			75S-2	No Deleterious Effects	None
			75S-3	No Deleterious Effects	None
			75S-4	No Deleterious Effects	None
			75S-5	No Deleterious Effects	None
			75S-6	No Deleterious Effects	None

- Rupture of edge seal was observed in specimen nos. 75S-2 and 75S-5 at 75 cycle completion

100	Granite (w/Alternate Fiberglass)	No	100U-1	No Deleterious Effects	None
			100U-2	No Deleterious Effects	None
			100U-3	No Deleterious Effects	None
			100U-4	No Deleterious Effects	None
			100U-5	No Deleterious Effects	None
			100U-6	No Deleterious Effects	None
		Yes	100S-1	No Deleterious Effects	None
			100S-2	No Deleterious Effects	None
			100S-3	No Deleterious Effects	None
			100S-4	No Deleterious Effects	None
			100S-5	No Deleterious Effects	None
			100S-6	No Deleterious Effects	None

- Rupture of edge seal was observed in specimen nos. 100S-3 and 100S-4 at 100 cycle completion

Test Procedures and Test Results: (Continued)

ASTM C297 - Flatwise Tensile Bond Strength

The tensile bond strength evaluation was conducted on a total of fifty 2 in. square x nominal 1.0 in. full sandwich thickness granite stone faced honeycomb panel specimens (25 edge-sealed, 25 unsealed), in accordance with the procedures detailed in ASTM C297. Five laboratory control specimens and Five post-ASTM C666 freeze-thaw cycling specimens at 25, 50, 75 and 100 exposure cycle completion points were tested.

Aluminum pull tabs were affixed to both the front (stone) and rear (aluminum) panel facings of each specimen using a high performance epoxy adhesive (Loctite EA E-40HT) and allowed to cure for a minimum of 48 hours prior to testing. The length and width of each bond strength test assembly was measured with a 6" x 0.001" digital caliper (ICN: 65688) prior to installation in appropriate test fixtures and evaluation utilizing a SATEC 50 UD Universal Testing Machine (ICN: Y002011). Tensile load was applied to each assembly at a uniform crosshead speed of 0.02 in/min until failure of the specimen was observed. Peak tensile load and failure mode/location was recorded for each specimen. Flatwise bond strength was calculated in accordance with section 13.1. regarding tensile load at failure/calculated cross-sectional area. Mean percent post-freeze-thaw exposure cycling tensile bond strength reduction was determined by evaluation against results of the laboratory control series.

ASTM C297 - Flatwise Tensile Bond Strength

Specimen Details			Bond Area (in ²)	Failure Load (lb _f)	Tensile Strength		Failure Location	
Test Series	Edge Seal	No.			Psi	Psf		
Granite Faced (w/Alternate Fiberglass Product)	No	CU-1	4.02	1,220	303	43,600	Fixturing	
		CU-2	3.99	934	234	33,700	Scrim/Core	
		CU-3	3.99	1,260	317	45,600	Scrim/Core	
		CU-4	3.99	1,650	414	59,600	Fixturing	
		CU-5	4.00	1,050	263	37,900	Scrim/Core	
	Mean		4.00	1,220	306	44,100		
	Unexposed Control	Yes	CS-1	3.97	1,120	283	40,800	Scrim/Core
			CS-2	4.00	1,450	363	52,300	Scrim/Core
			CS-3	4.00	1,590	397	57,200	Alum/Core
			CS-4	4.01	1,730	432	62,200	Fixturing
CS-5			3.99	1,460	365	52,600	Scrim/Core	
Mean		3.99	1,470	368	53,000			

- *Unsealed specimen nos. CU-2 and CU-5 showed light adhesive application at failure bond layer*

Test Procedures and Test Results: (Continued)

ASTM C297 - Flatwise Tensile Bond Strength (Continued)

Specimen Details			Bond Area (in ²)	Failure Load (lbf)	Tensile Strength		Failure Location
Test Series	Edge Seal	No.			Psi	Psf	
Granite Faced (w/Alternate Fiberglass Product) 25 Freeze/Thaw Cycle Completion	No	25U-1	4.00	983	246	35,400	Scrim/Core
		25U-2	4.00	1,380	346	49,800	Scrim/Core
		25U-3	3.98	1,780	447	64,400	Alum/Core
		25U-4	3.99	1,710	428	61,600	Alum/Core
		25U-5	3.99	1,520	382	55,000	Scrim/Core
	Mean		3.99	1,480	370	53,300	
	Bond Strength vs. Control (%)				+20.9		
	Yes	25S-1	3.99	1,440	360	51,800	Scrim/Core
		25S-2	3.99	533	134	19,300	Scrim/Core
		25S-3	3.98	1,670	419	60,300	Scrim/Core
		25S-4	3.96	1,450	365	52,600	Scrim/Core
		25S-5	3.97	1,390	350	50,400	Alum/Core
Mean		3.98	1,300	326	46,900		
Bond Strength vs. Control (%)				-11.4			

Test Procedures and Test Results: (Continued)

ASTM C297 - Flatwise Tensile Bond Strength (Continued)

Specimen Details			Bond Area (in ²)	Failure Load (lb _f)	Tensile Strength		Failure Location	
Test Series	Edge Seal	No.			Psi	Psf		
Granite Faced (w/Alternate Fiberglass Product)	No	50U-1	3.99	1,530	383	55,200	Scrim/Core	
		50U-2	3.99	645	162	23,300	Scrim/Core	
		50U-3	3.98	1,480	372	53,600	Scrim/Core	
		50U-4	4.01	559	140	20,200	Scrim/Core	
		50U-5	4.00	1,740	436	62,800	Fixturing	
	Mean		3.99	1,190	298	42,900		
	Bond Strength vs. Control (%)				-2.6			
	50 Freeze/Thaw Cycle Completion	Yes	50S-1	3.96	1,700	429	61,800	Alum/Core
			50S-2	3.98	1,690	424	61,100	Scrim/Core
			50S-3	4.00	1,270	318	45,800	Scrim/Core
			50S-4	3.95	1,670	422	60,800	Alum/Core
50S-5			3.98	1,640	412	59,300	Alum/Core	
Mean		3.98	1,590	401	57,700			
Bond Strength vs. Control (%)				+9.0				

- Unsealed specimen nos. 50U-2 and 50U-4 showed light adhesive application at failure bond layer

Test Procedures and Test Results: (Continued)

ASTM C297 - Flatwise Tensile Bond Strength (Continued)

Specimen Details			Bond Area (in ²)	Failure Load (lb _f)	Tensile Strength		Failure Location	
Test Series	Edge Seal	No.			Psi	Psf		
Granite Faced (w/Alternate Fiberglass Product)	No	75U-1	4.00	1,690	422	60,800	Alum/Core	
		75U-2	3.99	819	205	29,500	Scrim/Core	
		75U-3	3.98	1,260	316	45,500	Fixturing	
		75U-4	4.00	1,000	251	36,100	Scrim/Core	
		75U-5	3.96	1,340	338	48,700	Scrim/Core	
	Mean		3.99	1,220	306	44,100		
	Bond Strength vs. Control (%)				0.0			
	75 Freeze/Thaw Cycle Completion	Yes	75S-1	3.99	904	226	32,500	Scrim/Core
			75S-2	3.97	432	109	15,700	Scrim/Core
			75S-3	4.00	1,320	329	47,400	Scrim/Core
			75S-4	3.97	996	251	36,100	Scrim/Core
75S-5			3.96	1,250	315	45,400	Scrim/Core	
Mean		3.98	979	246	35,400			
Bond Strength vs. Control (%)				-33.2				

- Sealed specimen no. 75S-2 showed light adhesive application at failure bond layer

Test Procedures and Test Results: (Continued)

ASTM C297 - Flatwise Tensile Bond Strength (Continued)

Specimen Details			Bond Area (in ²)	Failure Load (lb _f)	Tensile Strength		Failure Location
Test Series	Edge Seal	No.			Psi	Psf	
Granite Faced (w/Alternate Fiberglass Product) 100 Freeze/Thaw Cycle Completion	No	100U-1	3.98	449	113	16,30	Scrim/Core
		100U-2	3.97	1,540	387	55,700	Scrim/Core
		100U-3	3.96	1,680	423	60,900	Scrim/Core
		100U-4	3.88	1,090	281	40,500	Scrim/Core
		100U-5	4.00	446	112	16,100	Scrim/Core
	Mean		3.96	1,040	263	37,900	
	Bond Strength vs. Control (%)				-14.1		
	Yes	100S-1	3.97	1,310	331	47,700	Scrim/Core
		100S-2	3.97	1,140	286	41,200	Scrim/Core
		100S-3	3.99	840	210	30,200	Scrim/Core
		100S-4	3.98	39	10	1,440	Scrim/Core
		100S-5	3.97	894	225	32,400	Scrim/Core
Mean		3.98	845	212	30,500		
Bond Strength vs. Control (%)				-42.4			

- Unsealed specimen no. 100U-1 and Sealed specimen nos. 100S-4 and 100S-5 showed light adhesive application at failure bond layer

Intertek-ATI will service this report for the entire test record retention period. Test records that are retained such as detailed drawings, datasheets, representative samples of test specimens, or other pertinent project documentation will be retained by Intertek-ATI for the entire test record retention period.

Results obtained are tested values and were secured using the designated test methods. This report does not constitute certification of this product nor an opinion or endorsement by this laboratory. It is the exclusive property of the client so named herein and relates only to the specimens tested. This report may not be reproduced, except in full, without the written approval of Intertek-ATI.

For INTERTEK-ATI:

Scott D. Scallorn
Project Engineer
Components / Materials Testing

Joseph M. Brickner
Laboratory Supervisor
Components / Materials Testing

SDS:jmb/kf

Attachments (pages) This report is complete only when all attachments listed are included.
Appendix A - Photographs (5)



Revision Log

<u>Rev. #</u>	<u>Date</u>	<u>Page(s)</u>	<u>Revision(s)</u>
0	07/20/17	N/A	Original report issue



H0981.02-106-31

APPENDIX A

Photographs

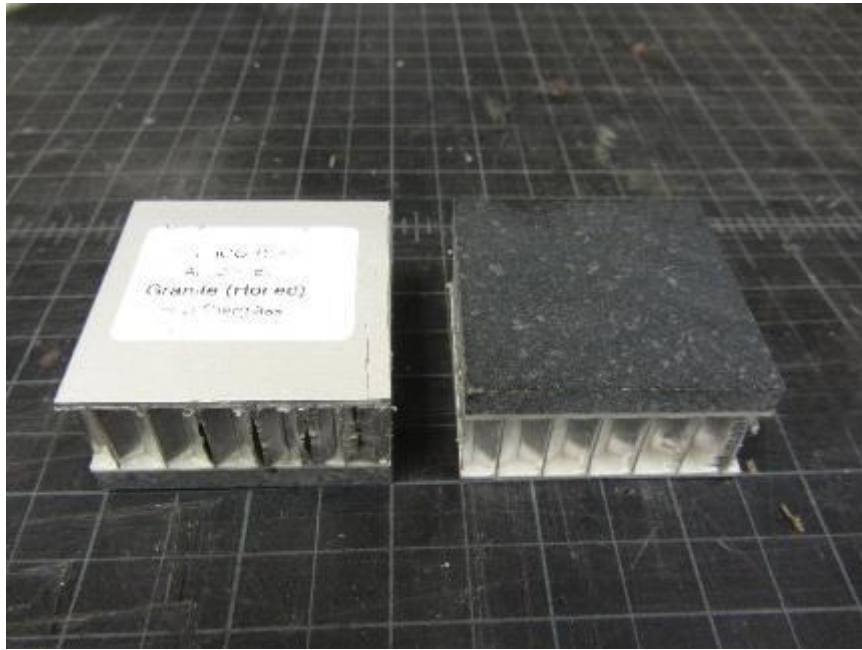


Photo No. 1

Typical Granite Faced Unsealed Edge Honeycomb Core Panel Specimen Pretest Condition



Photo No. 2

Typical Granite Faced Sealed Edge Honeycomb Core Panel Specimen Pretest Condition



Photo No. 3
ASTM C297 Flatwise Tensile Bond Strength Test Apparatus – Unsealed Specimen



Photo No. 4
ASTM C297 Flatwise Tensile Bond Evaluation Loading Detail – Sealed Specimen

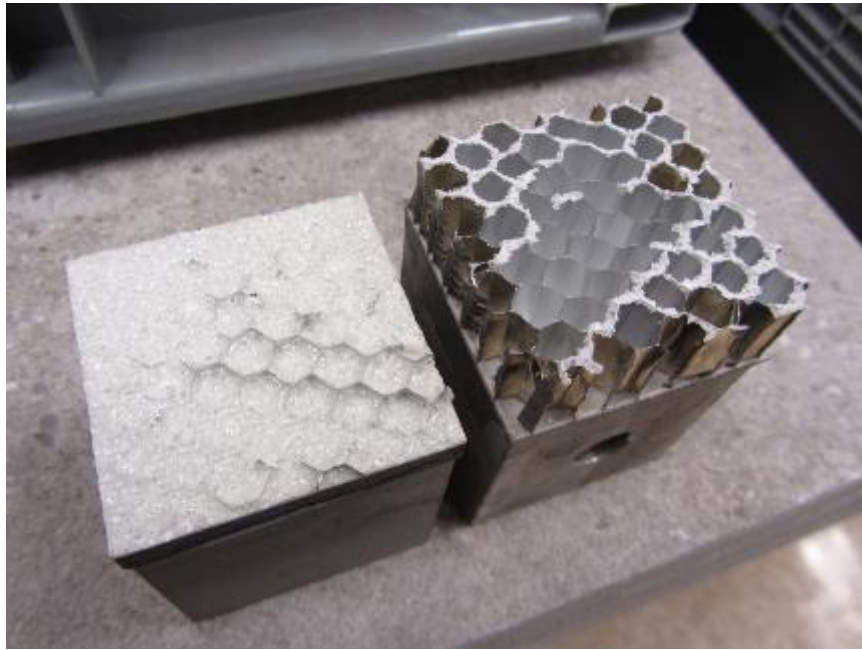


Photo No. 5
Fiberglass Scrim / Honeycomb Core Bond Failure Mode Detail



Photo No. 6
Aluminum Rear Face / Honeycomb Core Bond Failure Mode Detail



Photo No. 7
Representative High-Exposure Cycling (100 Cycles Completed) Unsealed Edge Specimen
Showing Deformation of Honeycomb Core from Interior Water Freezing/Expansion

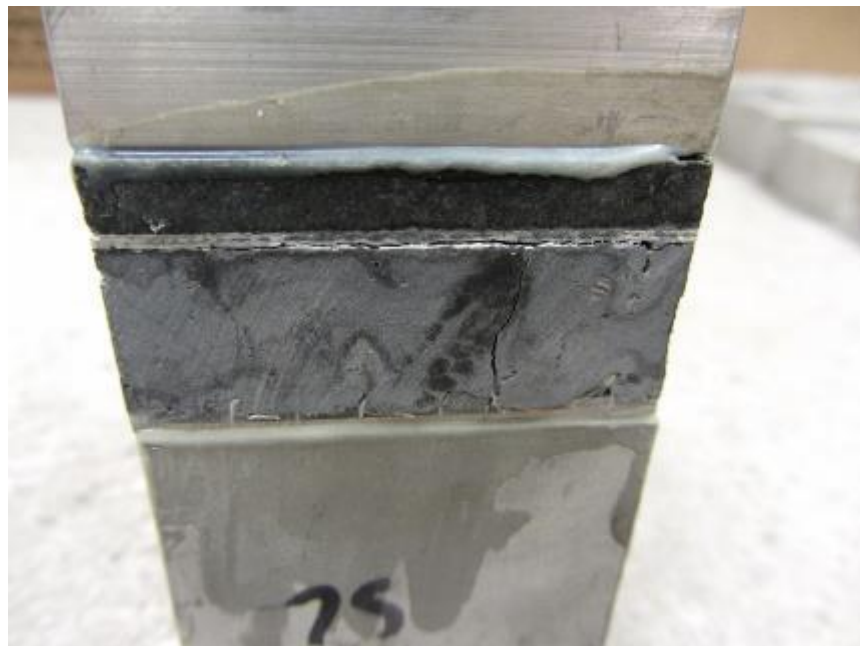


Photo No. 8
75-Cycle Sealed Edge Specimen Exhibiting Cracking from F/T Cycling

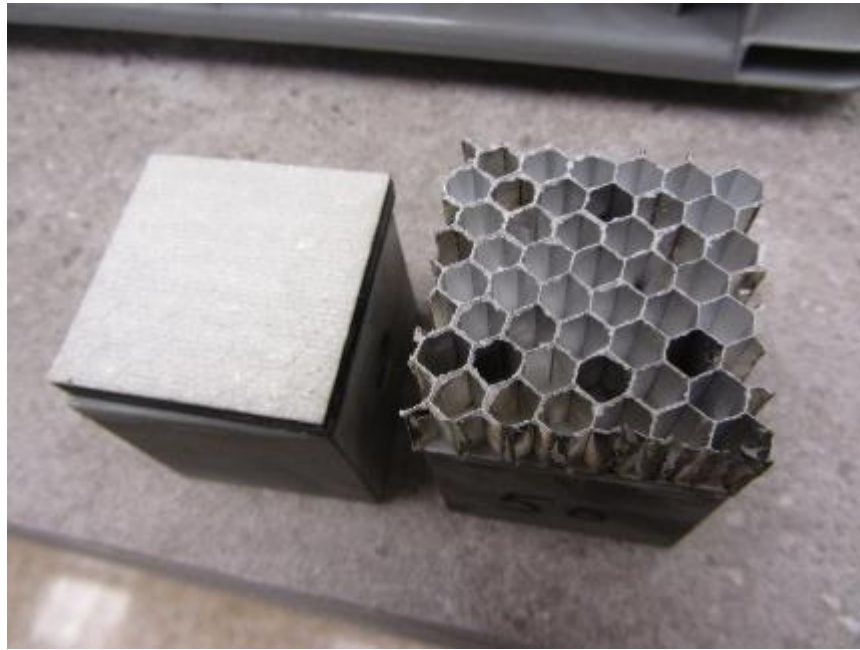


Photo No. 9
Representative Light Adhesive Application Bond Layer Detail – Unsealed Specimen



Photo No. 10
Representative Light Adhesive Application Bond Layer Detail – Sealed Specimen