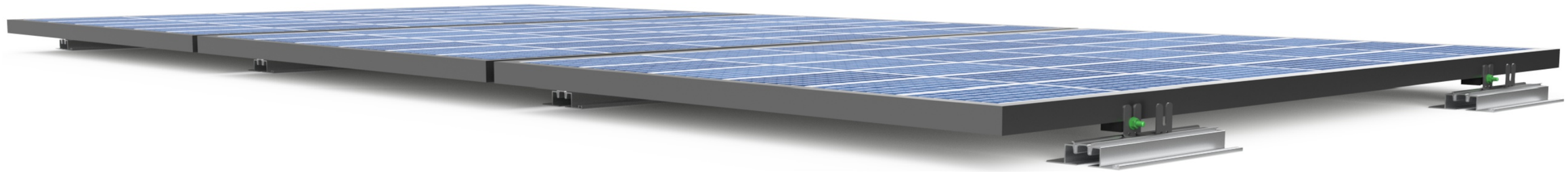
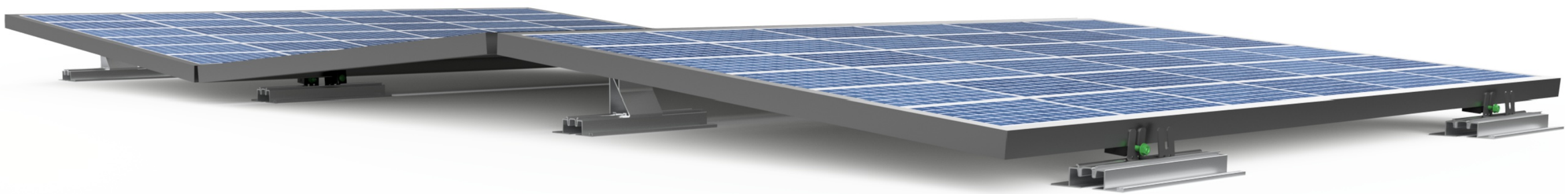
***Data extrapolated from 11-24 Boeing Wind Tunnel testing and mechanical BallastRack hydraulic load testing.**





Specifications:

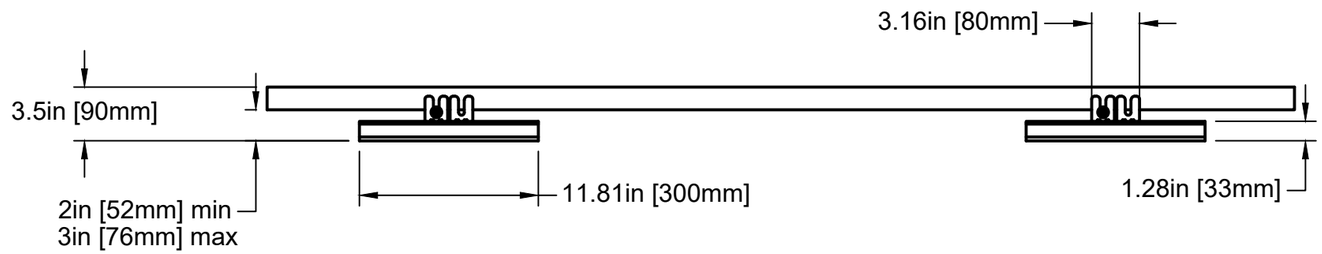
- Designed for ballasted deployment of solar modules on flat roofs.
- Utilizes indusrial strength polyurethane adhesive to provide maximum hold-down.

	PROJECT IntegraRack			
	TITLE IR-00MBDB / IR-05MDB Solar Racking System			
APPROVED	SIZE	CODE	DWG NO	REV
CHECKED	B			
DRAWN Paul Budge 9/24/2025	SCALE	WEIGHT	SHEET 1/4	

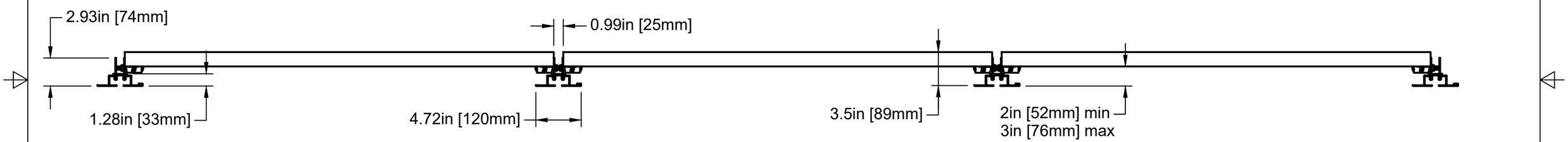
IR-00MBDB / IR-05MDB Solar Racking System		
	Module size up to 24 sqft	Module size up to 34 sqft
Maximum Snow Load		
	100psf	65psf
Maximum Wind Speed (Polyurethane Bonded)		
2 Base Mounts per panel	120mph	100mph
3 Base Mounts per panel	150mph	120mph

MultiBallast DB - Flat Configuration Dimensions

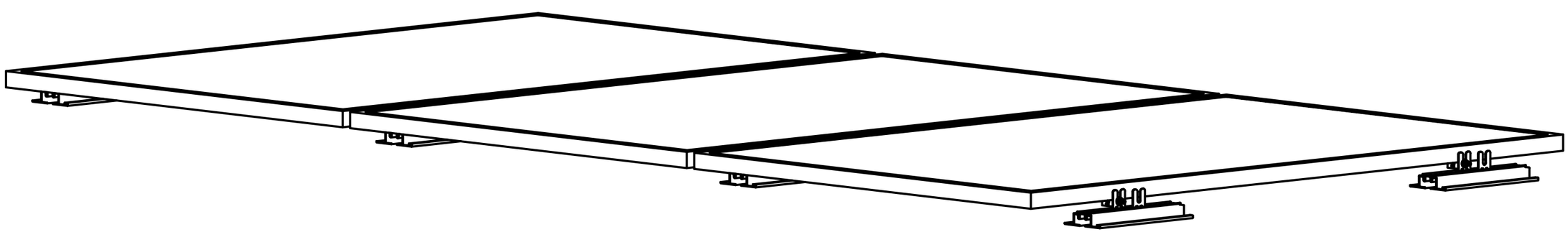
POLYURETHANE BONDED



Front View



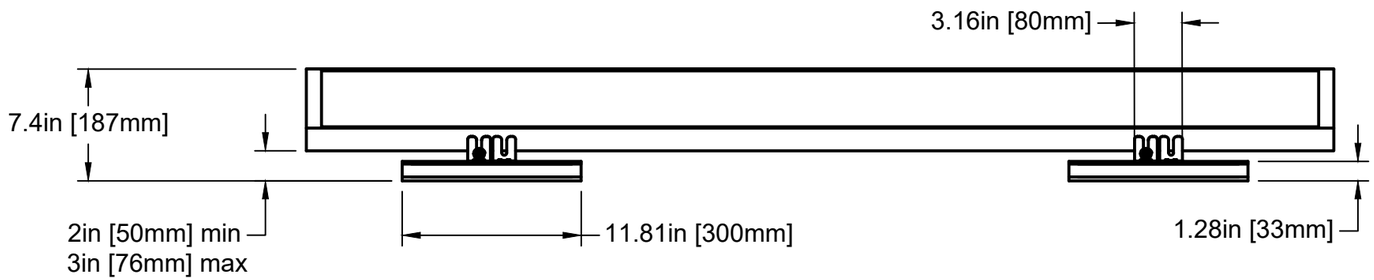
Side View



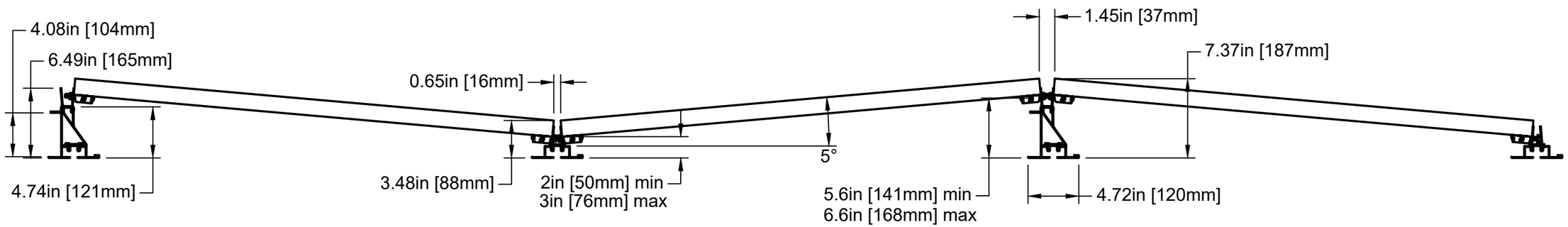
Isometric View

MultiBallast DB - W Configuration Dimensions

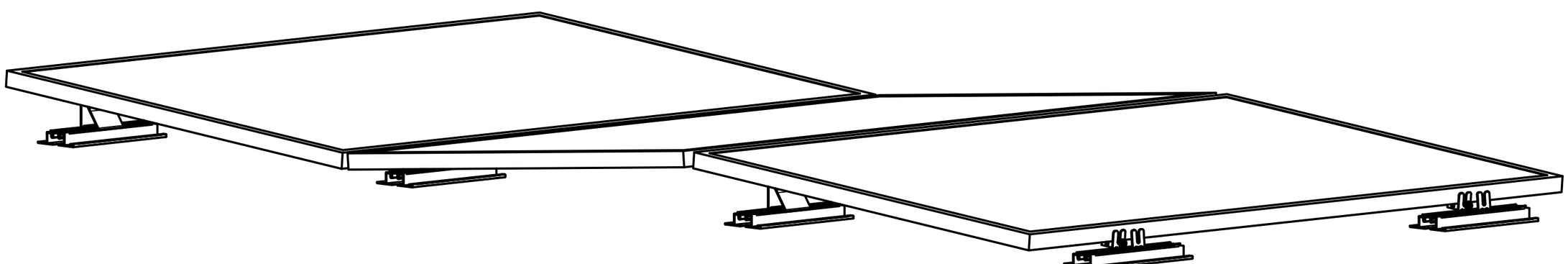
POLYURETHANE BONDED



Front View



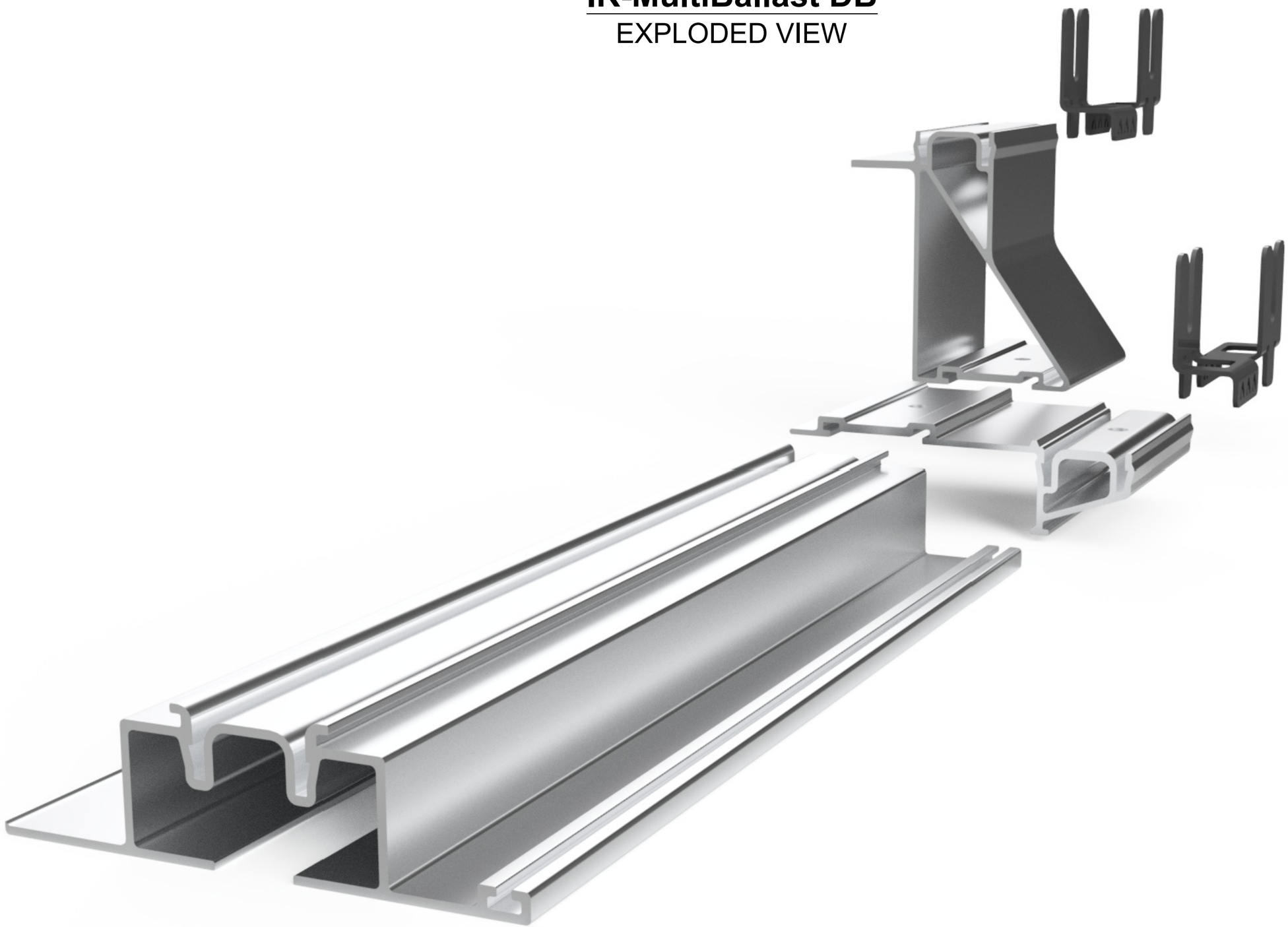
Side View



Isometric View

IR-MultiBallast DB

EXPLODED VIEW



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Mr. Paul Budge
Diversi-Tech Corp – IntegraRack
PO Box 910758
St. George, UT 84791

Subject: Witness of Wind Tunnel Testing on IntegraRack Products at the George E Boeing Aeronautics Department (Kirsten Wind Tunnel) at the University of Washington

Dear My. Budge,

This letter summarizes the wind tunnel testing that was witnessed at the Kirsten Wind Tunnel (KWT) on November 8th, 2024. Testing took place at KWT on the University of Washington campus at 3900 7th Ave NE, Seattle, WA. Cara Winter was the manager of the facility and testing was performed and overseen by Test Engineers Stuart Dickson and Miguel Salguero. A detailed analysis and calculations of test data is outside the purview of this report and can be provided by KWT personnel.

The wind tunnel data summarized in this report, mechanical material stress testing and solar mount adhesion testing performed by PNL, and simulated wind/snow load model data was extrapolated on product datas sheets by IntegraRack for various product configurations and solar angles for the following IntegraRack solar panel products: TileBallast, BallastRack, BallastRack DR, MultiBallast, MultiBallast DB, H Module Brack, and the IR-F2 Bonding Clamp.

A total of 8 runs were performed on IntegraRack products. Test Runs 1 through 3 were performed with the IR-D1 bracket (See Figures 1-4) with an installed 18 SF solar panel on a simulated roof incline. Run 1 was performed to tare KWT's system through the full 0 to 110 degree rotation of the test platform with the simulated roof and panel installed. The roof surface had been installed at an approximate 5 – 6 degree incline (See Figure 1). The solar panel was mounted at 0 degrees relative to the roof surface with a general height of 5 in from the roof surface. at all four corners of the panel. Test Runs 4 and 5 were performed on the same panel and bracket with the panel height adjusted and installed at an angle with the front corners set to 3-1/2 in. and the back corners set to a height of 6 in. from the roof surface.

Test Runs 2 through 5 included rotating the test setup from 0 to 110 degrees while KWT instrumentation recorded test data. Wind speed was increased until limitations of KWT instrumentation prevented it from being increased further. Four load cells, Omega model LC103B-250 lb Class N10, were installed between the IntegraRack bracket and the roof surface to monitor and record loads applied to the brackets throughout testing (See Figures 5-10). The load cells were labeled LC0-1, LC0-2, LC5-3, and LC5-4 with LC0 being installed at the leading edge and LC5 being installed at the back edge.

The maximum load at a bracket recorded during Test Runs 2 and 3 was 75.015 lbf at a wind speed of 157.67 MPH when the panel was at a rotation point of 60 degrees. No damage or deformation was noted

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to any bracket during or after the test runs and all hardware was found to be secure upon completion of each test (See Figures 11-13).

Test Runs 6 through 8 were performed on the IR Ballast Racks (See Figures 14-32). The simulated roof structure was removed and the frames and panel were mounted directly to the KWT test platform. These runs were performed at a set angle with no platform rotation during the test run. Two load cells were used for the test setups and were mounted at the brackets at the leading edge of the test platform at the wind intake side.

Run 6 was performed on the IR18C with the solar panel at an approximate 18 degree angle (Figures 24-25). The maximum load at a bracket recorded during Test Run 6 was 168.59 lbf at a wind speed of 101.59 MPH. Runs 7 and 8 were performed on the IR30C with the solar panel at a 30 degree angle (Figures 30-32) with Run 7 having the solar panel mounted and aligned with the wind direction to produce maximum forces on the frame and Run 8 being run in an orientation 90 degrees offset from Run 7. The maximum load at a bracket was during Test Run 7 and was 183.38 lbf at a wind speed of 81.138 MPH. Run 7 was stopped when the drag limit of the KWT test apparatus was reached. The solar frame experienced shaking under wind load but no damage was found to any part and all bolts were found to still be tight and in place after the test run. Run 8 was pitch limited by the KWT test apparatus. Similar to Run 7 the frame and solar panel had experienced shaking under load but no damage to the frame or panel was noted and all bolts and connections remained tight.

Test data tables provided by KWT and photos of testing throughout the Test Runs have been attached.

Respectfully submitted,
PHOENIX NATIONAL LABORATORIES, LLC

Kyle Fleege, P.E.
Project Manager / Mechanical Engineer
Phoenix National Laboratories
Ph: 1.602.431.8887
kyle@pnltest.com
www.pnltest.com

Registered Professional Engineer (Mechanical)
CERTIFICATE NO.
53776
KYLE J.
FLEEGE
DATE SIGNED
11-4-2025
ARIZONA U.S.A.
Expires 09/30/2027

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Test data tables provided by Kirsten Wind Tunnel tests are shown below:

RUN	TEST	TP	PSI	QA	QC	SPEEDMPH	LC0-1	LC0-2	LC5-3	LC5-4	DB	LB
2	2379	3	0.0001	16.775	17.799	84.38	1.1732	0.9254	12.114	13.537	0	0
2	2379	4	9.9998	16.676	17.693	84.13	3.3832	0.1309	13.25	12.918	0	0
2	2379	5	20	16.788	17.813	84.414	6.5054	-1.2426	14.882	15.703	0	0
2	2379	6	30	14.846	15.752	79.391	8.6943	-2.5876	11.917	15.932	0	0
2	2379	7	40	15.216	16.144	80.374	10.566	-3.614	9.2887	17.334	0	0
2	2379	8	50	15.91	16.881	82.19	12.154	-4.7729	5.8138	18.225	0	0
2	2379	9	60	17.543	18.614	86.311	15.831	-4.7168	3.432	19.871	0	0
2	2379	10	70	18.075	19.177	87.609	15.929	-2.9647	1.6713	17.613	0	0
2	2379	11	80	19.807	21.015	91.718	16.576	-0.2715	1.6043	16.188	0	0
2	2379	12	90	26.487	28.103	106.081	20.349	2.4846	2.6014	20.856	0	0
2	2379	13	100	27.443	29.117	107.995	23.246	3.9239	1.6397	26.417	0	0
2	2379	14	110	28.046	29.758	109.19	30.304	4.9443	0.4954	31.084	0	0

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Test data tables provided by Kirsten Wind Tunnel tests are shown below:

RUN	TEST	TP	PSI	QA	QC	SPEEDMPH	LC0-1	LC0-2	LC5-3	LC5-4	DB	LB
3	2379	2	-0.0001	46.765	49.618	141.561	1.1642	2.3972	36.627	39.938	0	0
3	2379	3	10	47.13	50.006	142.153	7.9853	-0.2581	42.362	39.215	0	0
3	2379	4	20	48.375	51.327	144.054	17.809	-5.1282	48.033	50.868	0	0
3	2379	5	30	50.382	53.456	147.043	28.671	-12.013	46.107	61.281	0	0
3	2379	6	40	52.966	56.198	150.773	36.485	-22.577	33.65	68.344	0	0
3	2379	7	50	54.38	57.698	152.791	44.03	-28.356	17.304	72.349	0	0
3	2379	8	60	57.878	61.409	157.674	56.195	-27.306	4.63	75.015	0	0
3	2379	9	70	56.226	59.656	155.402	54.153	-16	-2.0357	62.293	0	0
3	2379	10	80	53.778	57.059	151.975	48.502	-4.0685	-2.0692	49.307	0	0
3	2379	11	90	57.92	61.454	157.771	47.213	3.5417	-0.5077	50.257	0	0
3	2379	12	100	54.454	57.777	152.979	46.905	6.1752	-4.2226	55.18	0	0
3	2379	13	110	36.199	38.408	124.779	34.937	5.9472	-9.3307	38.454	0	0

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Test data tables provided by Kirsten Wind Tunnel tests are shown below:

RUN	TEST	TP	PSI	QA	QC	SPEEDMPH	LC0-1	LC0-2	LC5-3	LC5-4	DB	LB
5	2379	3	0.0003	14.845	15.03	77.742	43.468	45.917	33.192	35.332	0	0
5	2379	4	10	14.115	14.291	75.806	39.406	45.863	32.548	33.352	0	0
5	2379	5	20	14.301	14.479	76.302	41.216	49.171	36.107	33.865	0	0
5	2379	6	30	15.476	15.669	79.377	43.323	49.791	40.199	30.547	0	0
5	2379	7	40	15.792	15.989	80.181	40.37	44.513	37.812	28.348	0	0
5	2379	8	50	15.441	15.633	79.284	34.815	34.07	29.669	27.254	0	0
5	2379	9	60	14.604	14.787	77.107	25.852	21.071	18.666	23.403	0	0
5	2379	10	70	15.452	15.644	79.315	19.532	11.214	10.48	19.561	0	0
5	2379	11	80	15.788	15.985	80.173	13.097	5.1532	4.4544	14.183	0	0
5	2379	12	90	15.937	16.136	80.55	10.261	2.0128	0.5043	11.748	0	0
5	2379	13	100	14.945	15.131	77.998	9.7597	-1.4293	-4.2425	10.805	0	0
5	2379	14	110	15.231	15.421	78.745	10.539	-5.6497	-13.113	8.2362	0	0

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Test data tables provided by Kirsten Wind Tunnel tests are shown below. Blockage corrections to calculate DB and LB ARE APPROXIMATION and were provided by KWT Test Engineers using a simplified version of Shindo's method, outlined in "Simplified Tunnel Correction Method" by Shojiro Shindo, American Institute of Aeronautics and Astronautics, Inc.< Washington DC, 1994: Journal of Aircraft Volume 32, Number 1, Pages 210-213. LB is the lift value and DB is the drag value after wind-off zero values have been subtracted.

RUN	TEST	TP	PSI	QA	QC	SPEEDMPH	LC0-1	LC0-2	LC5-3	LC5-4	DB	LB
6	2379	2	-0.0006	19.964	25.663	101.585	-206.622	-168.586	0.6796	0	244.379	363.911
6	2379	3	-0.0005	19.922	25.611	101.499	-206.361	-167.906	0.5212	0.0001	243.946	363.13
6	2379	4	-0.0005	18.132	23.265	96.748	-185.481	-146.788	-0.5698	0	220.212	326.42
6	2379	5	-0.0004	14.927	19.087	87.632	-146.747	-110.624	1.6089	0	178.639	262.798
6	2379	6	-0.0004	10.021	12.738	71.584	-89.117	-53.252	1.1724	-0.0001	116.858	169.83

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Test data tables provided by Kirsten Wind Tunnel tests are shown below. Blockage corrections to calculate DB and LB ARE APPROXIMATION and were provided by KWT Test Engineers using a simplified version of Shindo's method, outlined in "Simplified Tunnel Correction Method" by Shojiro Shindo, American Institute of Aeronautics and Astronautics, Inc.< Washington DC, 1994: Journal of Aircraft Volume 32, Number 1, Pages 210-213. LB is the lift value and DB is the drag value after wind-off zero values have been subtracted.

RUN	TEST	TP	PSI	QA	QC	SPEEDMPH	LC0-1	LC0-2	LC5-3	LC5-4	DB	LB
7	2379	2	-0.0001	10.101	16.001	80.229	-165.145	-179.17	-0.0654	0	239.012	297.932
7	2379	3	0	10.304	16.363	81.138	-170.329	-183.382	1.6992	0	245.281	304.603
7	2379	4	0	4.9808	7.7789	55.942	-70.106	-82.668	1.1755	0	113.803	142.75

RUN	TEST	TP	PSI	QA	QC	SPEEDMPH	LC0-1	LC0-2	LC5-3	LC5-4	DB	LB
8	2379	2	90.001	10.165	11.329	67.503	-1.1756	-7.5189	-1.3941	0	51.808	28.96
8	2379	3	90	15.002	16.716	81.993	-13.771	-17.132	0.1391	0	76.302	40.688
8	2379	4	90	17.966	20.011	89.723	-21.883	-23.854	0.307	0	91.033	50.149
8	2379	5	90	24.873	27.701	105.599	-45.078	-38.33	-0.174	0	125.875	68.707
8	2379	6	90	27.029	30.099	110.103	-53.423	-43.1	0.5537	0	136.673	76.038
8	2379	7	90	31.751	35.352	119.364	-71.986	-54.265	-0.7512	0	160.314	91.156
8	2379	8	90	39.784	44.294	133.708	-102.541	-76.2	0.5756	0	200.798	112.886

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PHOTOS

Figure 1: Run 1 through 3 simulated roof setup

Figure 2: Run 1 through 3 setup with panel

Figure 3: Bracket at leading edge LC0-1, LC0-2

Figure 4: Bracket at back edge LC5-3, LC5-4

Figure 5: Load Cell Model used for tests

Figure 6: Height from roof to panel, Runs 2 & 3

Figure 7: LC0-1 Location

Figure 8: LC0-2 Location

Figure 9: LC5-3 Location

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PHOTOS

Figure 10: LC5-4 Location

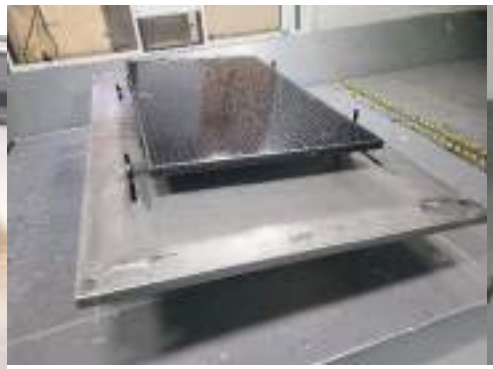

Figure 11: Setup after Run 2, 109 mph winds. No damages or loose hardware noted.

Figure 12: Setup after Run 2, 109 mph winds. No damages or loose hardware noted

Figure 13: Setup after Run 2, 109 mph winds. No damages or loose hardware noted

Figure 14: Setup for Run 6 with IR Ballast Frame

Figure 15: Load cell location at leading edge, LC0-1 & LC0-2

Figure 16: Test setup for Run 6

Figure 17: IR Ballast frame connection to solar panel

Figure 18: IR Ballast frame connection to solar panel

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PHOTOS

Figure 19: Test setup for Run 6

Figure 20: Solar panels total length, Run 6 through 8

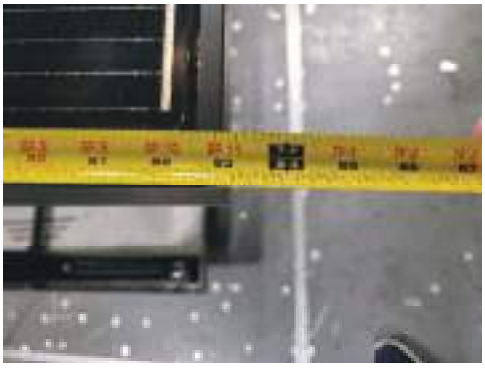

Figure 21: Solar panels total length 83 in.

Figure 22: Solar panels width, Run 6 through 8

Figure 23: Total width 41-1/4 in.

Figure 24: Run 6 trailing edge leg height

Figure 25: Run 6 leading edge leg height

Figure 26: Frame base support width

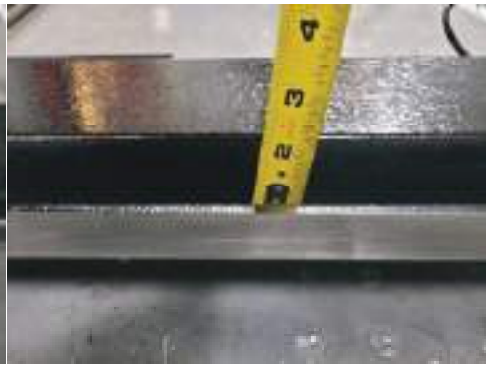

Figure 27: Frame base support height

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PHOTOS

Figure 28: IR Ballast rack leg width 1

Figure 29: IR Ballast rack leg width 2

Figure 30: Runs 7 - 8 Test setup

Figure 31: Run 7 trailing edge leg height

Figure 32: Run 7 Leading edge leg height

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PRELIMINARY LABORATORY TEST REPORT

PNL REF. # 26-251512 **S.O. #** 001 **INDEX** 02

CLIENT	PROJECT/TEST DESCRIPTION	CLIENT ORDER NO.
Diversi-Tech Corporation	Multiballast DB Compression Test	per S.A.

PNL PROJECT NO.	S.O. NO.	TEST DATE	REPORT DATE
26-251512	001	10/13/2025	10/15/2025

TEST CONDITIONS & EQUIPMENT INFORMATION

Temperature:	73 °F ± 5 °F	**Humidity:**	50 % ± 5 %
Equipment Model:	Instron 5989 UTM	**Serial Number:**	B22667
Load Cell:	100 kN (22,481 lbf) [S/N: 158544]	**Test Speed:**	2 in./min.

TEST SPECIMEN INFORMATION

Test Specimen 1:	Multiballast DB	**Dimensions:**	~1-3/8 in. x 11-3/4 in. x 4-3/4 in.
Test Specimen 2:	H-Module Bracket	**Dimensions:**	~2-1/2 in. x 3-1/4 in. x 1 in.

Test Summary: Multiballast DB Base Compression Test

The Multiballast DB base with a H-module bracket was set on top of two 2x4's that had a spacing of 8" between the 2x4's (photos 1 and 2). The H-module bracket was installed on the Multiballast DB base mount using the designed slide rails for installation. Using both of the mounting holes on the H-module the universal test machine (UTM) was bolted to the H-module bracket applied a compression force pushing straight down on the bracket H-module bracket and the Multiballast DB base at a test speed of 2 in./min.

COMPRESSION LOAD TEST DATA

Test No.	Test Specimen	Displacement at Maximum Load (lbf)	Maximum Load (in.)	Observations
1	Multiballast DB base with H-module bracket	0.888	2,653	Test stopped due to permanent deformation to the Multiballast DB base.

TECHNICIAN_____ REVIEWED BY_____

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LABORATORY TEST REPORT

PNL REF. # 26-251512 **S.O. #** 001 **INDEX** 02

CLIENT		PROJECT/TEST DESCRIPTION	CLIENT ORDER NO.
Diversi-Tech Corporation		Multiballast DB Compression Test	per S.A.
PNL PROJECT NO.	S.O. NO.	TEST DATE	REPORT DATE
26-251512	001	10/13/2025	10/15/2025

TEST GRAPHS

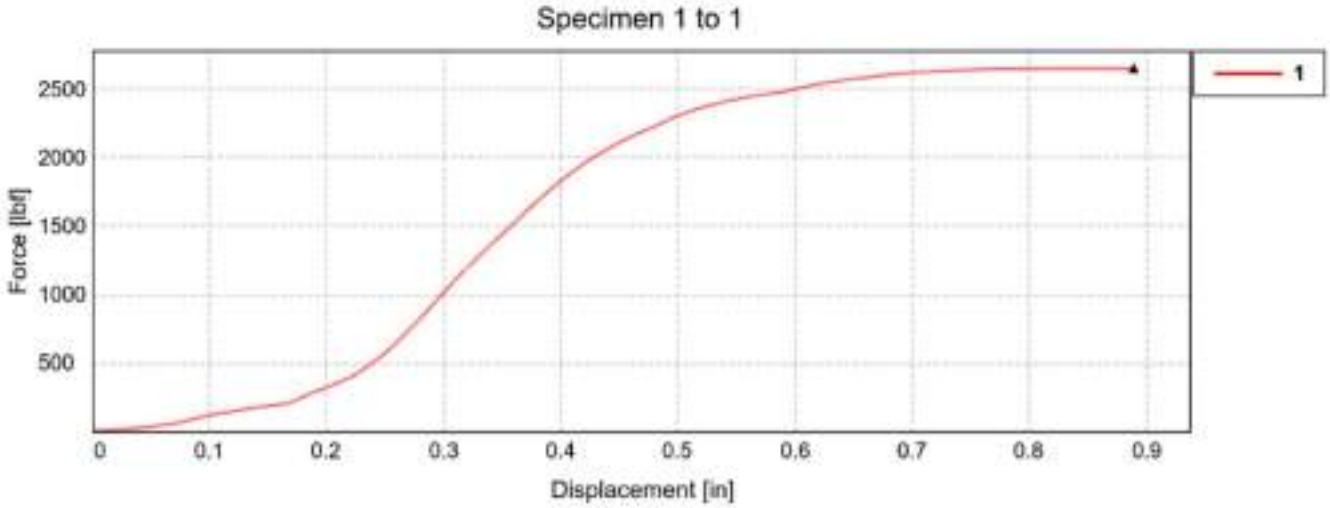

Figure 1: Compressive Force vs Displacement test graph

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LABORATORY TEST REPORT

PNL REF. # 26-251512 **S.O. #** 001 **INDEX** 02

CLIENT		PROJECT/TEST DESCRIPTION	CLIENT ORDER NO.
Diversi-Tech Corporation		Multiballast DB Compression Test	per S.A.
PNL PROJECT NO.	S.O. NO.	TEST DATE	REPORT DATE
26-251512	001	10/13/2025	10/15/2025

PHOTOS

Photo 1: Test setup

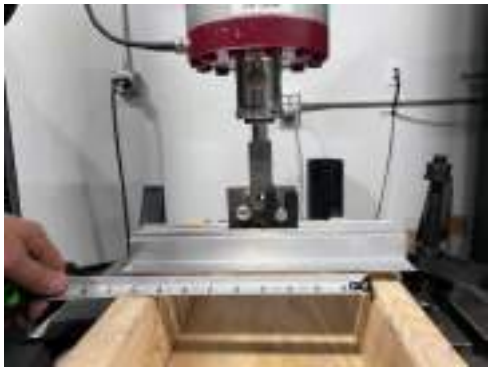

Photo 2: 8" spacing between 2x4's

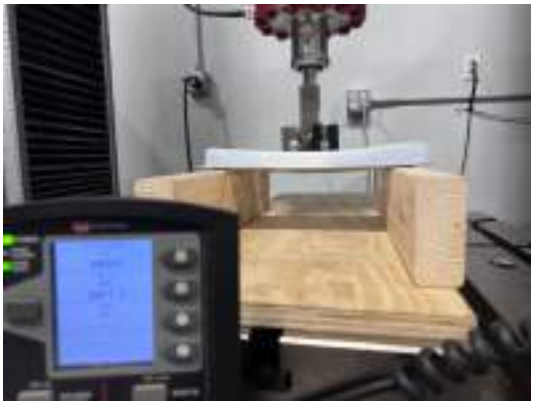

Photo 3: 2477 lbf load applied after test manually stopped

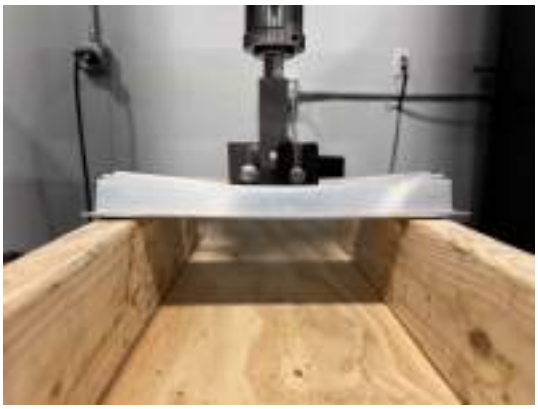

Photo 4: Deformation post testing

Photo 5: Deformation post testing

Photo 6: Deformation post testing

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PRELIMINARY LABORATORY TEST REPORT

PNL REF. # 26-251512 **S.O. #** 001 **INDEX** 01

CLIENT	PROJECT/TEST DESCRIPTION	CLIENT ORDER NO.
Diversi-Tech Corporation	Multiballast DB to Tile Shingle Load Test	per S.A.

PNL PROJECT NO.	S.O. NO.	TEST DATE	REPORT DATE
26-251512	001	10/13/2025	10/15/2025

TEST CONDITIONS & EQUIPMENT INFORMATION

Temperature:	73 °F ± 5 °F	**Humidity:**	50 % ± 5 %
Equipment Model:	Instron 5989 UTM	**Serial Number:**	B22667
Load Cell:	100 kN (22,481 lbf) [S/N: 158544]	**Test Speed:**	Varies (See test summary)

TEST SPECIMEN INFORMATION

Test Specimen 1:	Multiballast DB	**Dimensions:**	~1-3/8 in. x 11-3/4 in. x 4-3/4 in.
Test Specimen 2:	Tile Roof Shingle	**Dimensions:**	~ 1 in. x 23 in. x 17 in.
Test Specimen 3:	H-Module Bracket	**Dimensions:**	~ 2-1/2 in. x 3-1/4 in. x 1 in.
Test Specimen 4:	Tower-Module Bracket	**Dimensions:**	~ 3-3/4 in. x 3-3/16 in. x 3-1/4 in.
Adhesive:	Sikaflex 1a Construction Sealant	**Cure Time:**	Unknown

Test Summary: Multiballast DB to Tile Shingle

The Multiballast DB was bonded to a tile shingle by the client (photo 2) using Sikaflex 1a construction sealant (one part polyurethane, elastomeric sealant/adhesive)(photo 1). It was noted that no surface prep was done on the aluminum bracket or the tile shingle, and the test specimens were left in the bed of a pickup overnight during a storm. The test assembly was then clamped to the table of our universal test machine (UTM) using 2x4's and plywood to give adequate clamping force without prematurely damaging the assembly.

The H-module bracket was installed on the Multiballast DB base mount using the designed slide rails for installation. Using only 1 of the 2 mounting holes on the H-module the UTM was bolted to the H-module bracket (photos 3 and 4) applied a tensile force pulling straight up on the bracket at a test speed of 6 in./min. This led to a failure of the H-module, the interlocking tabs started slipping out of the Multiballast DB base. The H-module bracket was pulled off and the riser bracket was put on (photos 7 and 8) allowing the tensile force to be applied over a more distributed area, with more engagement to the Multiballast DB base and this allowed a high enough load to witness an adhesive failure.

A compression test was also run on this specimen. All table clamps were removed, a fixture was bolted through the H-module (photos 13 and 14) allowing a compressive force to be applied through the H-module, riser, Multiballast DB base, and into the tile substrate at a test speed of 2 in./min. The first cycle load was applied and the test was stopped due to the tile cracking. Test was continued from that point and a compressive force was applied until major permanent deformation was noticed in the H-module and riser bracket.

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LABORATORY TEST REPORT

PNL REF. # 26-251512 **S.O. #** 001 **INDEX** 01

CLIENT	PROJECT/TEST DESCRIPTION	CLIENT ORDER NO.
Diversi-Tech Corporation	Multiballast DB to Tile Shingle Load Test	per S.A.

PNL PROJECT NO.	S.O. NO.	TEST DATE	REPORT DATE
26-251512	001	10/13/2025	10/15/2025

TENSION LOAD TEST DATA

Test No.	Test Specimen	Displacement at Maximum Load (in.)	Maximum Load (lbf)	Glue Contact Area (sq. in.)	Adhesive Strength (lbf/in)	Observations
1	Multiballast DB bonded to tile shingle #1 with H bracket (photo 3)	0.602	594	9.1	N/A	Test stopped when H-Module bracket slipped out of Multiballast DB base. Minor deformation was noted in the “H” bracket @ ~ 450 lbf
2	Multiballast DB bonded to tile shingle #2 with H bracket (photo 4)	0.592	557	9.6	N/A	Test stopped when H-Module bracket slipped out of Multiballast DB base Minor deformation was noted in the “H” bracket @ ~ 430 lbf
3	Multiballast DB bonded to tile shingle #2 with tower bracket (photo 10)	0.205	1,005	9.6	105	3 corners of the Multiballast DB de-bonded, aluminum to elastomeric sealant. The first corner popped @ ~ 1005 lbf, and the next 2 corners popped @ ~ 919 lbf
4	Multiballast DB bonded to tile shingle #1 with Riser bracket (photo 9)	0.215	947	9.1	104	3 corners of the Multiballast DB de-bonded, aluminum to elastomeric sealant. The first corner popped @ ~ 919 lbf, the 2nd corner @ ~ 740 lbf and the 3rd corner @ ~ 336 lbf

COMPRESSION LOAD TEST DATA

Test No.	Test Specimen	Displacement at Maximum Load (lbf)	Maximum Load (in.)	Observations
1	Multiballast DB bonded to tile shingle #2 with tower bracket (photo 15)	0.272	729	Test automatically stopped due to load drop when the tile cracked @ 729 lbf
2	Multiballast DB bonded to tile shingle #2 with tower bracket (photo 16)	0.530	1,353	Initial minor deformation was noted starting @ ~ 850 lbf, test continued until major deformation was witnessed load drop after hitting a max load of 1,353 lbf

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CLIENT		PROJECT/TEST DESCRIPTION	CLIENT ORDER NO.
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PNL PROJECT NO.	S.O. NO.	TEST DATE	REPORT DATE
26-251512	001	10/13/2025	10/15/2025

TEST GRAPHS

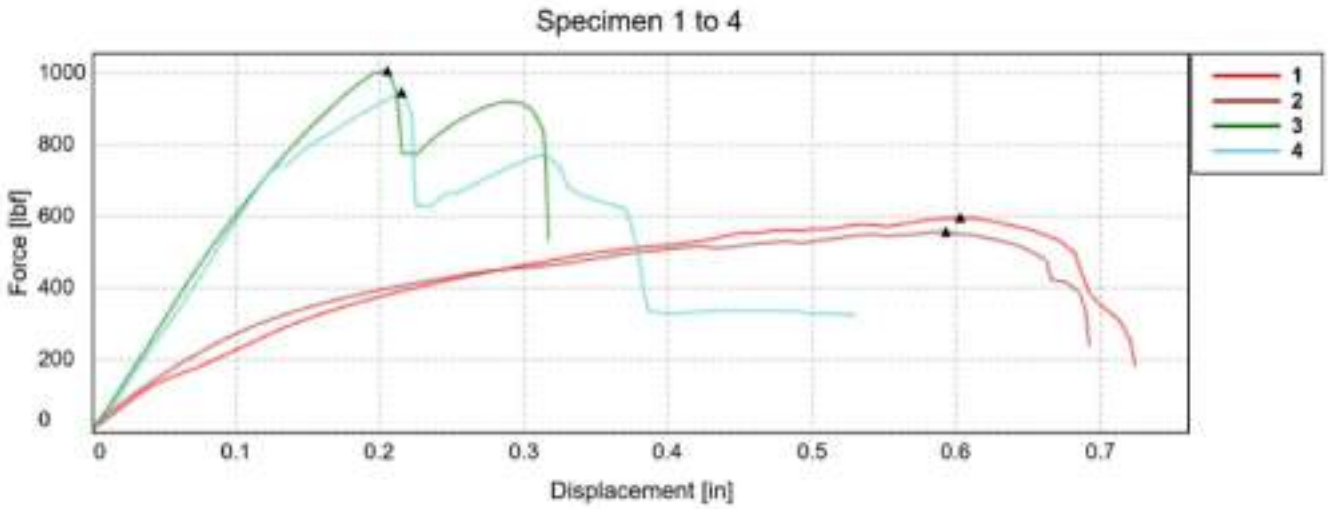

Figure 1: Tension Force vs Displacement test graph

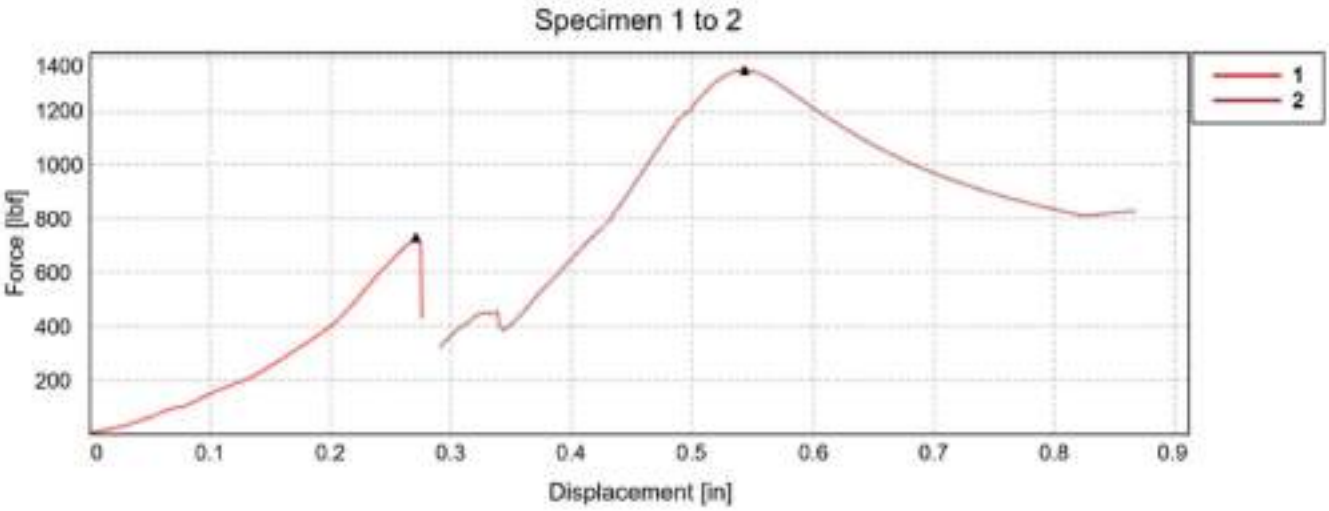

Figure 2: Compression Force vs Displacement test graph

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LABORATORY TEST REPORT

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CLIENT		PROJECT/TEST DESCRIPTION	CLIENT ORDER NO.
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PNL PROJECT NO.	S.O. NO.	TEST DATE	REPORT DATE
26-251512	001	10/13/2025	10/15/2025

PHOTOS

Photo 1: Adhesive used

Photo 2: Test specimens provided by client

Photo 3: Tension test, setup #1

Photo 4: Tension test, setup #2

Photo 5: “H” bracket deformed and slipped out of Multiballast DB base test #1

Photo 6: “H” bracket deformed and slipped out of Multiballast DB base test #2

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LABORATORY TEST REPORT

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PNL PROJECT NO.	S.O. NO.	TEST DATE	REPORT DATE
26-251512	001	10/13/2025	10/15/2025

PHOTOS

Photo 7: Tension test setup with riser bracket

Photo 8: Tension test setup with riser bracket

Photo 9: Tension test, setup #3

Photo 10: Tension test, setup #4

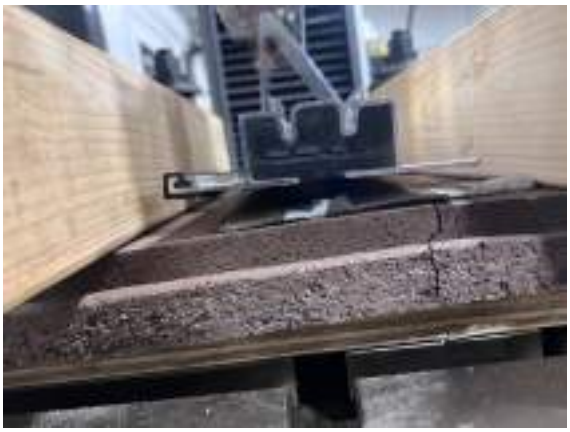

Photo 11: Tension test #2 adhesive failure, aluminum to adhesive

Photo 12: Tension test #4 adhesive failure, aluminum to adhesive

CLIENT		PROJECT/TEST DESCRIPTION	CLIENT ORDER NO.
Diversi-Tech Corporation		Multiballast DB to Tile Shingle Load Test	per S.A.
PNL PROJECT NO.	S.O. NO.	TEST DATE	REPORT DATE
26-251512	001	10/13/2025	10/15/2025

PHOTOS

Photo 13: Compression test setup

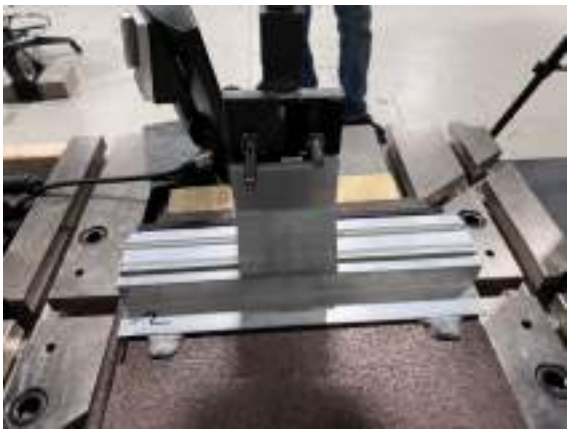

Photo 14: Compression test setup

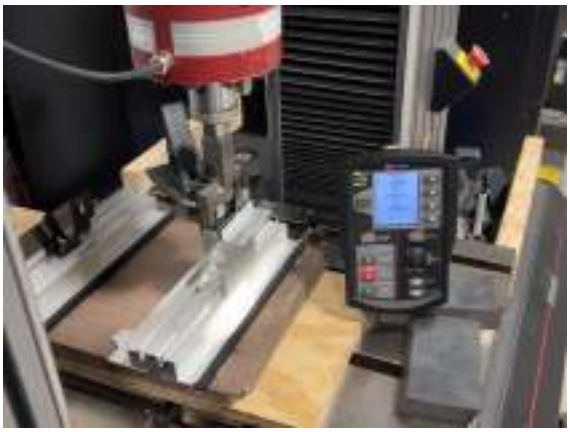

Photo 15: Compression test #1 near max load before tile broke

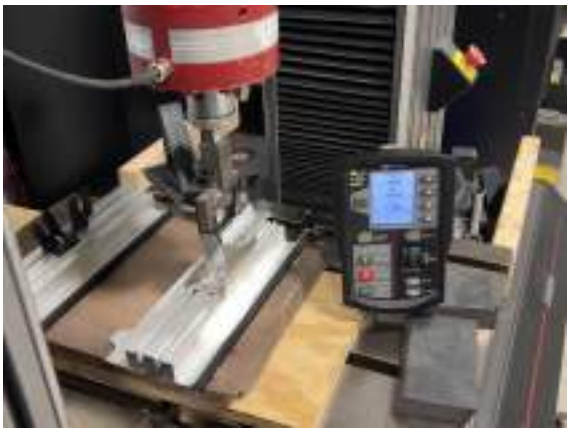

Photo 16: Compression test #2

Photo 17: Compression test #2, permanent deformation visible

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PRELIMINARY LABORATORY TEST REPORT

PNL REF. # 26-251512 **S.O. #** 001 **INDEX** 04

CLIENT	PROJECT/TEST DESCRIPTION	CLIENT ORDER NO.
Diversi-Tech Corporation	Multiballast to Concrete Block Load Test	per S.A.

PNL PROJECT NO.	S.O. NO.	TEST DATE	REPORT DATE
26-251512	001	10/13/2025	10/15/2025

TEST CONDITIONS & EQUIPMENT INFORMATION

Temperature:	73 °F ± 5 °F	**Humidity:**	50 % ± 5 %
Equipment Model:	Instron 5989 UTM	**Serial Number:**	B22667
Load Cell:	100 kN (22,481 lbf) [S/N: 158544]	**Test Speed:**	2 in/min

TEST SPECIMEN INFORMATION

Test Specimen 1:	Multiballast DB	**Dimensions:**	~ 1-3/8 in. x 11-3/4 in. x 4-3/4 in.
Test Specimen 2:	Concrete Block	**Dimensions:**	3-1/2 in. x 7-1/2 in. x 15-1/2 in.
Test Specimen 3:	H-Module Bracket	**Dimensions:**	~ 2-1/2 in. x 3-1/4 in. x 1 in.
Test Specimen 4:	8°, 13°, 20° Riser Mount	**Dimensions:**	~ 5-3/4 in. x 5-1/2 in. x 3-3/16 in.

Test Summary: Multiballast DB to Concrete Block

The Multiballast was installed on the concrete block by sliding the mounting bracket over the block. On the wide side of the block, there was a H-module bracket installed on one of the slide rails, and a 8°, 13°, 20° riser mount with a H-module bracket installed on top of that on the other rail. Test specimen was provided to us assembled by the client (photo 1). The test assembly was then clamped to the table of our universal test machine (UTM) plywood to give adequate clamping force without prematurely damaging the assembly (photo 2).

The UTM was then bolted to the H-module bracket which was installed the riser mount installed on the Multiballast base mount using the designed slide rails for installation. Using only 1 of the 2 mounting holes on the H-module the UTM was bolted to the H-module bracket (photo 3) and applied a compressive force pushing straight down on the bracket at a speed of 2 in/min. Compressive testing was done using the same method on the other H-module bracket without the riser mount (photo 5), and a 3rd test was done on the side of the assembly using a steel block about the same width as the H-module bracket to apply load directly through the Multiballast and block (photo 9).

COMPRESSION LOAD TEST DATA

Test No.	Test Specimen	Displacement at Maximum Load (lbf)	Maximum Load (in.)	Observations
1	Multiballast to concrete block with riser mount and H-module bracket (Photo 1)	0.775	535	8°, 13°, 20° Multiballast riser bracket started deforming and test stopped, minor deformation @ ~430 lbf and major deformation @ ~520 lbf
2	Multiballast to concrete block with H-module bracket (Photo 5)	0.185	2,750	Test manually stopped @ 2000 lbf, minor deformation noted in H-module bracket.
3	Multiballast to concrete block (Photo 9)	0.099	2,371	Test manually stopped @ 2000 lbf, no deformation was noted.

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LABORATORY TEST REPORT

PNL REF. # 26-251512 **S.O. #** 001 **INDEX** 04

CLIENT		PROJECT/TEST DESCRIPTION	CLIENT ORDER NO.
Diversi-Tech Corporation		Multiballast DB to Concrete Block Load Test	per S.A.
PNL PROJECT NO.	S.O. NO.	TEST DATE	REPORT DATE
26-251512	001	10/13/2025	10/15/2025

TEST GRAPHS

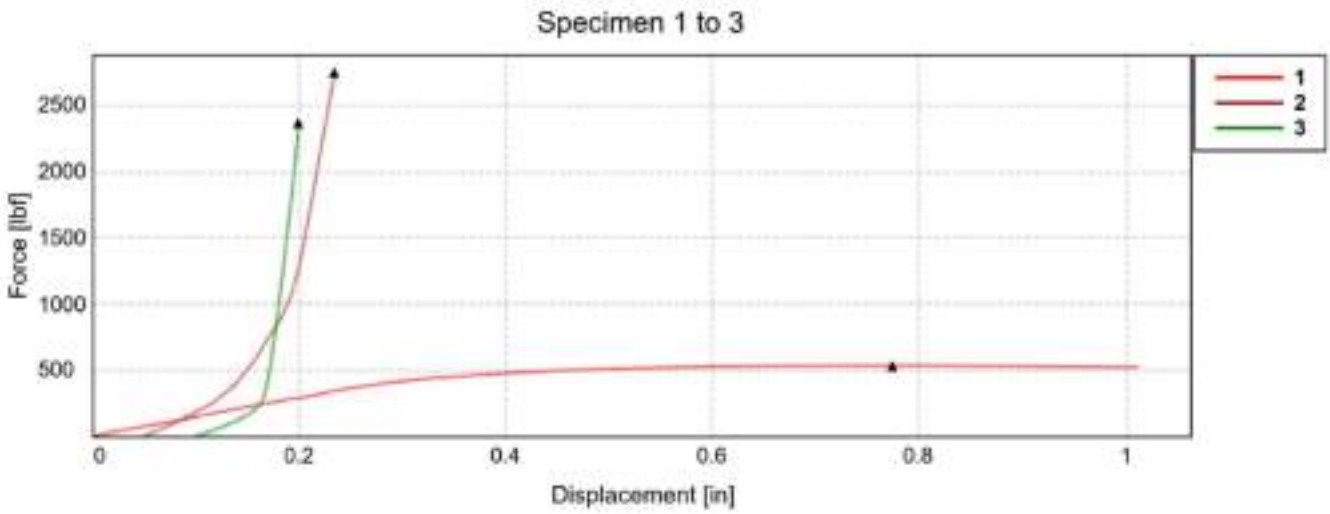

Figure 1: Compressive Force vs Displacement test graph

CLIENT		PROJECT/TEST DESCRIPTION	CLIENT ORDER NO.
Diversi-Tech Corporation		Multiballast DB to Concrete Block Load Test	per S.A.
PNL PROJECT NO.	S.O. NO.	TEST DATE	REPORT DATE
26-251512	001	10/13/2025	10/15/2025

PHOTOS

Photo 1: Compression test, setup #1

Photo 2: Compression test, setup #1

Photo 3: Compression test #1 post test

Photo 4: Compression test #1 post test

Photo 5: Compression test, setup #2

Photo 6: Compression test, setup #2

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LABORATORY TEST REPORT

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CLIENT		PROJECT/TEST DESCRIPTION	CLIENT ORDER NO.
Diversi-Tech Corporation		Multiballast DB to Concrete Block Load Test	per S.A.
PNL PROJECT NO.	S.O. NO.	TEST DATE	REPORT DATE
26-251512	001	10/13/2025	10/15/2025

PHOTOS

Photo 7: Compression test #2 post test

Photo 8: Compression test, setup #3

Photo 9: Compression test, setup #3

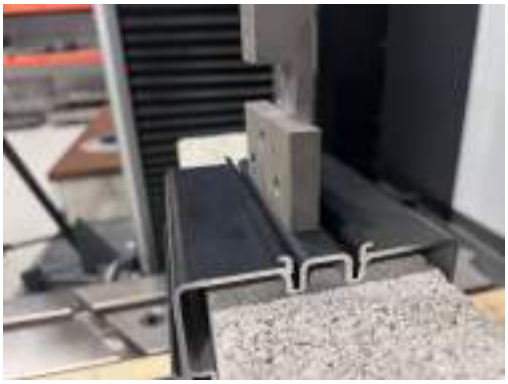

Photo 10: Compression test #3 post test

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PRELIMINARY LABORATORY TEST REPORT

PNL REF. # 26-251512 **S.O. #** 001 **INDEX** 03

CLIENT	PROJECT/TEST DESCRIPTION	CLIENT ORDER NO.
Diversi-Tech Corporation	Multiballast DB to Metal Roof Load Test	per S.A.

PNL PROJECT NO.	S.O. NO.	TEST DATE	REPORT DATE
26-251512	001	10/13/2025	10/15/2025

TEST CONDITIONS & EQUIPMENT INFORMATION

Temperature:	73 °F ± 5 °F	**Humidity:**	50 % ± 5 %
Equipment Model:	Instron 5989 UTM	**Serial Number:**	B22667
Load Cell:	100 kN (22,481 lbf) [S/N: 158544]	**Test Speed:**	6 in./min.

TEST SPECIMEN INFORMATION

Test Specimen 1:	Multiballast DB	**Dimensions:**	~ 1-3/8 in. x 11-3/4 in. x 4-3/4 in.
Test Specimen 2:	Metal Roof	**Dimensions:**	~ 1 in. x 23 in. x 17 in.
Test Specimen 3:	H-Module Bracket	**Dimensions:**	~ 2-1/2 in. x 3-1/4 in. x 1 in.
Test Specimen 4:	Tower-Module Bracket	**Dimensions:**	~ 3-3/4 in. x 3-3/16 in. x 3-1/4 in.
Adhesive:	Sikaflex 1a Construction Sealant	**Cure Time:**	Unknown

Test Summary: Multiballast DB to Metal Roof

The Multiballast DB was bonded to a piece of sheet metal used for roofing (~29 gauge .016") by the client using Sikaflex 1a construction sealant (one part polyurethane, elastomeric sealant/adhesive)(photos 1 & 2). It was noted that no surface prep was done on the aluminum bracket or the metal roof, and the test specimens were left in the bed of a pickup overnight during a storm. The test assembly was then clamped to the table of our universal test machine (UTM) using 2x4's and plywood to give adequate clamping force without prematurely damaging the assembly.

The H-module bracket was installed on the Multiballast DB base mount using the designed slide rails for installation. Using only 1 of the 2 mounting holes on the H-module the UTM was bolted to the H-module bracket (photos 3 & 4) and applied a tensile force pulling straight up on the bracket at a test speed of 6 in./min.

TENSION LOAD TEST DATA

Test No.	Test Specimen	Displacement at Maximum Load (in.)	Maximum Load (lbf)	Glue Contact Area (sq. in.)	Adhesive Strength (lbf/in)	Observations
1	Multiballast DB bonded to metal roof #1 with H-module (Photo 3)	0.782	520	5.1	N/A	@ ~410 lbf deformation was noted in the "H" bracket, and @ ~520 lbf test stopped when "H" bracket slipped out of aluminum extrusion.
2	Multiballast DB bonded to metal roof #2 with H-module (Photo 4)	0.652	510	5.1	100	@ ~430 lbf deformation was noted in the "H" bracket, and @ ~520 lbf test stopped when 2 corners of the Multiballast DB de-bonded, aluminum to elastomeric sealant

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LABORATORY TEST REPORT

PNL REF. # 26-251512 **S.O. #** 001 **INDEX** 03

CLIENT		PROJECT/TEST DESCRIPTION	CLIENT ORDER NO.
Diversi-Tech Corporation		Multiballast DB to Metal Roof Load Test	per S.A.
PNL PROJECT NO.	S.O. NO.	TEST DATE	REPORT DATE
26-251512	001	10/13/2025	10/15/2025

TEST GRAPHS

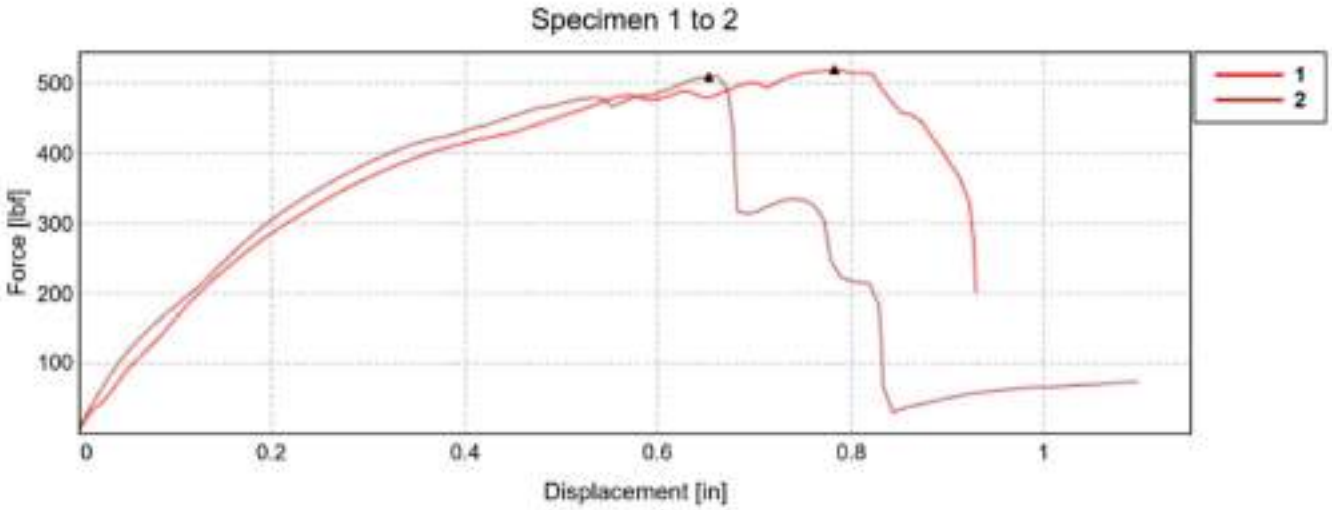

Figure 1: Tensile Force vs Displacement test graph

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LABORATORY TEST REPORT

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CLIENT		PROJECT/TEST DESCRIPTION	CLIENT ORDER NO.
Diversi-Tech Corporation		Multiballast DB to Metal Roof Load Test	per S.A.
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26-251512	001	10/13/2025	10/15/2025

PHOTOS

Photo 1: Adhesive used

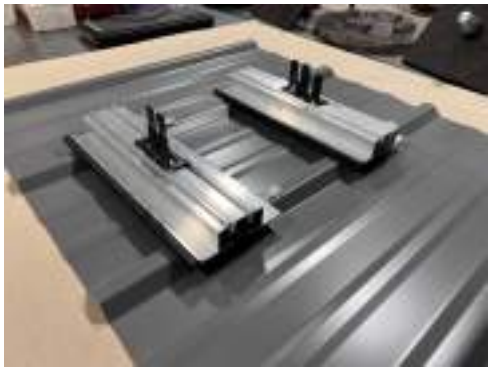

Photo 2: Test specimens provided by client

Photo 3: Tension test, setup #1

Photo 4: Tension test, setup #2

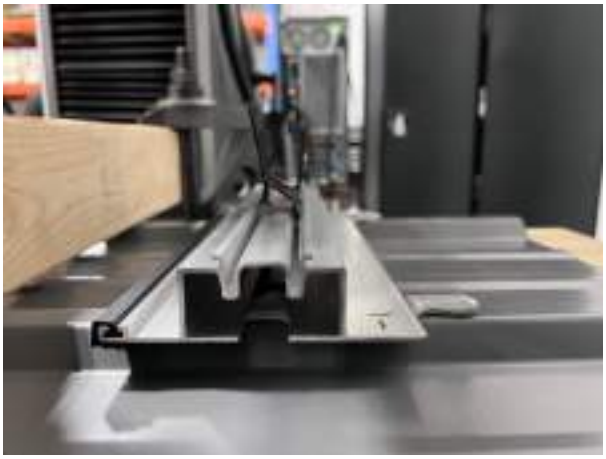

Photo 5: Tension test #1 “H” bracket slipped out

Photo 6: Tension test #2 adhesive failure, aluminum to adhesive interface

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PRELIMINARY LABORATORY TEST REPORT

PNL REF. # 26-251512 **S.O. #** 001 **INDEX** 05

CLIENT	PROJECT/TEST DESCRIPTION	CLIENT ORDER NO.
Diversi-Tech Corporation	Multiballast DB to Cement Board Load Test	per S.A.

PNL PROJECT NO.	S.O. NO.	TEST DATE	REPORT DATE
26-251512	001	10/13/2025	10/15/2025

TEST CONDITIONS & EQUIPMENT INFORMATION

Temperature:	73 °F ± 5 °F	**Humidity:**	50 % ± 5 %
Equipment Model:	Instron 5989 UTM	**Serial Number:**	B22667
Load Cell:	100 kN (22,481 lbf) [S/N: 158544]	**Test Speed:**	Varies (See test summary)

TEST SPECIMEN INFORMATION

Test Specimen 1:	Multiballast DB	**Dimensions:**	~ 1-3/8 in. x 11-3/4 in. x 4-3/4 in.
Test Specimen 2:	Cement Board	**Dimensions:**	~ 3/8 in. x 13 in. x 15-1/2 in.
Test Specimen 3:	H-Module Bracket	**Dimensions:**	~ 2-1/2 in. x 3-1/4 in. x 1 in.
Test Specimen 4:	Tower-Module Bracket	**Dimensions:**	~ 3-3/4 in. x 3-3/16 in. x 3-1/4 in.
Adhesive:	Sikaflex 1a Construction Sealant	**Cure Time:**	Unknown

Test Summary: Multiballast DB to Cement Board

The Multiballast DB was bonded to a cement board by the client using Sikaflex 1a construction sealant (one part polyurethane, elastomeric sealant/adhesive) (photos 1 & 2). It was noted that no surface prep was done on the aluminum bracket or the cement board, and the test specimens were left in the bed of a pickup overnight during a storm. The test assembly was then clamped to the table of our universal test machine (UTM) using 2x4's and plywood to give adequate clamping force without prematurely damaging the assembly (photos 3 & 6).

The H-module bracket was installed on the Multiballast DB base mount using the designed slide rails for installation. Using only 1 of the 2 mounting holes on the H-module the UTM was bolted to the H-module bracket and applied an upwards tensile force on the bracket at a test speed of 6 in./min. This led to a failure of the H-module, bolted connection between the UTM and the H-module bracket started slipping (photos 4 & 5). The H-module was then pulled off and the riser bracket was put on, allowing the tensile force to be distributed over more area and with more engagement to the Multiballast DB base mount. This allowed a high enough load to witness an adhesive failure (photos 6 & 7).

A shear racking "lateral load" test was also run on this specimen. A test fixture (Photo 8) was used that allowed us to clamp the test specimen at a 90-degree angle to the UTM crosshead. The specimen was clamped to the fixture using c-clamps and some flat steel to distribute the clamping force across the whole board (photo 9). Using only 1 of the 2 mounting holes on the H-module, the UTM was bolted to the H-module bracket, and a downward compressive force was applied at a test speed of 1 in./min on the side of the side of the H-module bracket until an adhesive failure was witnessed (photo 12).

TECHNICIAN_____ REVIEWED BY_____

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LABORATORY TEST REPORT

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TENSION LOAD TEST DATA

Test No.	Test Specimen	Displacement at Maximum Load (in.)	Maximum Load (lbf)	Glue Contact Area (sq. in.)	Adhesive Strength (lbf/in)	Observations
1	Multiballast DB bonded to cement board #1 with H bracket (Photo 3)	0.622	525	8.5	N/A	@ ~450 lbf the “H” bracket started to deform and @ ~519 lbf the bolt clamping the “H” bracket to the UTM started slipping
2	Multiballast DB bonded to cement board #1 with Riser bracket (Photo 6)	0.222	821	7.8	106	@ ~821 lbf the Multiballast DB de-bonded, elastomeric sealant to cement board bond

LATERAL LOAD “SHEAR RACKING” TEST DATA

Test No.	Test Specimen	Displacement at Maximum Load (lbf)	Maximum Load (in.)	Observations
1	Multiballast DB bonded to cement board #2 with tower bracket (Photo 8)	0.517	678	@ ~450 lbf the “H” bracket tab pulled out and the teeth sections engaged, load increased up to max load then deformation started. @ 0.83 in. Displacement is 1st adhesive drop. 2nd adhesive drop triggered end of test, aluminum to adhesive bond

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TEST GRAPHS

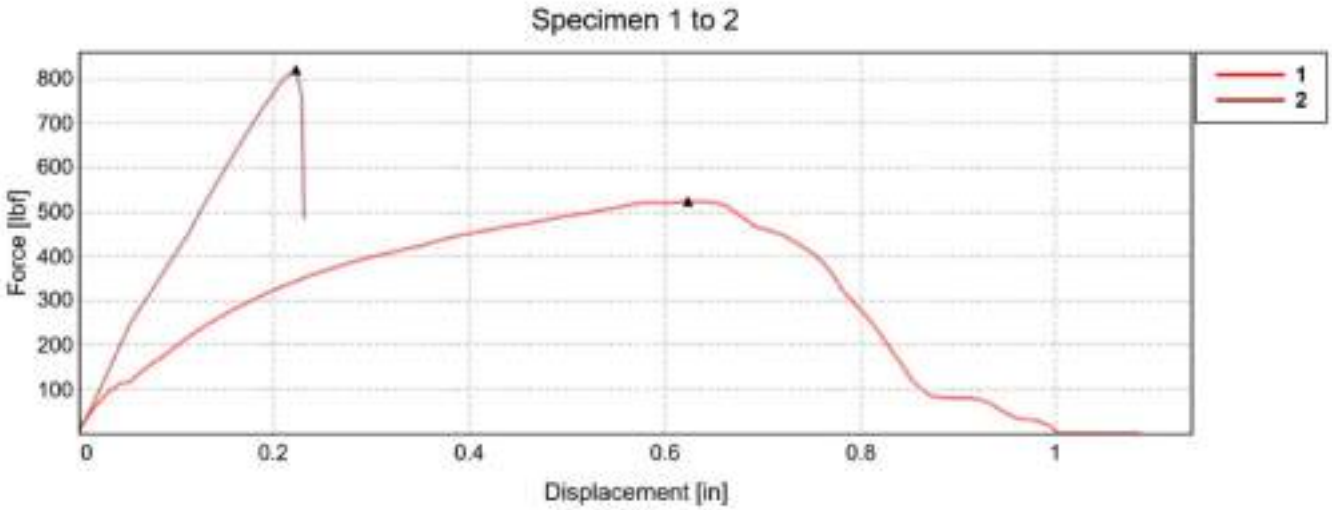

Figure 1: Tensile Force vs Displacement test graph

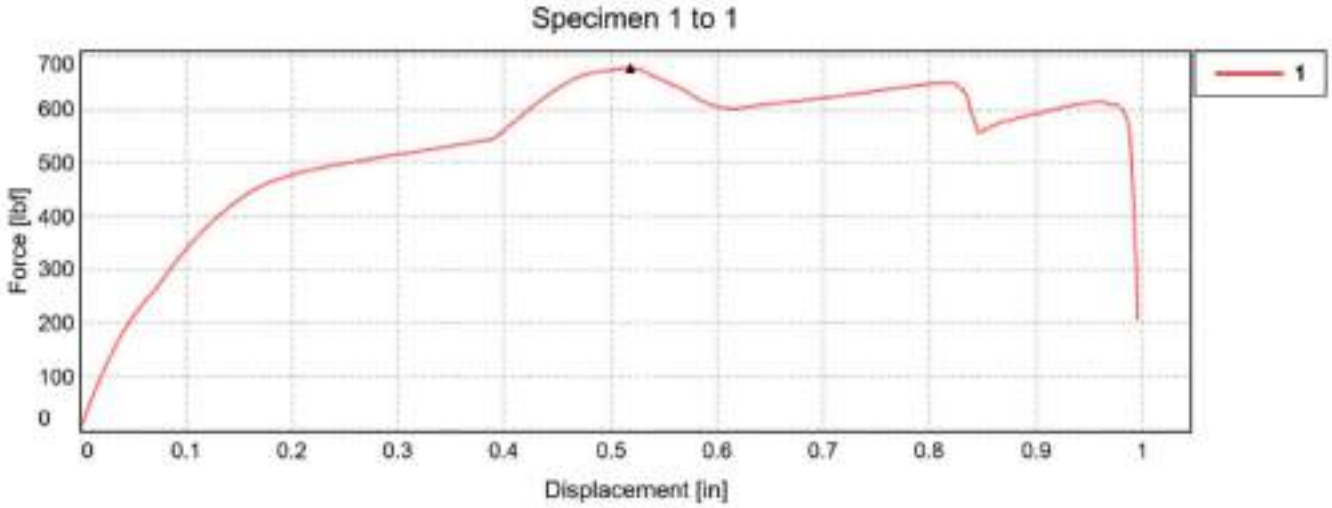

Figure 2: Lateral Load "Shear Racking" Compressive Force vs Displacement test graph

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PHOTOS

Photo 1: Adhesive used

Photo 2: Test specimens provided by client

Photo 3: Tension test, setup #1

Photo 4: Approximate load before bolt slipped, 520 lbf

Photo 5: Bolt slipping out of “H” bracket

Photo 6: Tension test, setup #2

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PHOTOS

Photo 7: De-bond between the adhesive to cement board interface

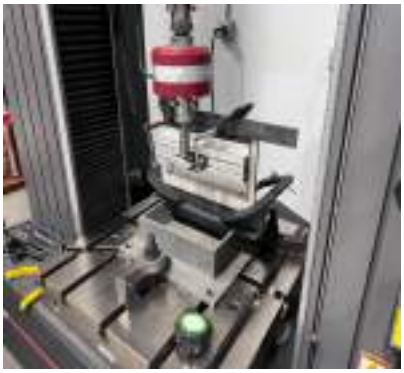

Photo 8: Lateral load test, setup #3

Photo 9: UTM bolted to specimen

Photo 10: “H” bracket deformation post test

Photo 11: “H” bracket deformation post test

Photo 12: De-bond between the aluminum to adhesive interface