



Product Evaluation Report to 8th Edition (2023) FBC

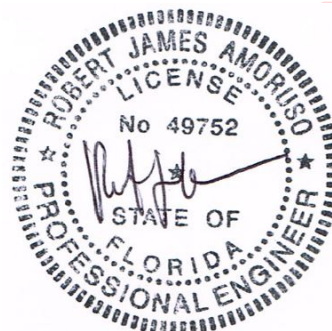
Date:	June 1, 2023
PTC Report No.:	1551
Report Revision No.:	6
PTC Project No.:	422-0609
Product Mfg.:	Permatherm, Inc. 269 Industrial Park Rd. Monticello, GA 31064
Product Name:	E.P.S. Core/Galvanized Steel Skin Structural Insulated Panels (SIPs)
Product Category:	Structural Components
Product Sub-Category:	Structural Wall
Compliance Method:	Product Approval Rule 61G20-3.005(2)(b) - Product Evaluation Report by a Licensed Professional Engineer
Prepared By:	Robert J. Amoruso, P.E. Florida P.E. License Number 49752 PTC Product Design Group, LLC FBPE Certification of Authorization No. 25935

CERTIFICATE OF INDEPENDENCE

PTC Product Design Group, LLC and Robert J. Amoruso, P.E. do not have, nor will acquire, any financial interest in the company manufacturing or distributing product(s) covered by this Product Evaluation Report. PTC Product Design Group, LLC and Robert J. Amoruso, P.E. do not have, nor will acquire any financial interest in any other entity involved in the approval process or testing of the product(s) covered by this Product Evaluation Report.

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Product Evaluation
Report No. 1551



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SCOPE

PTC Product Design Group, LLC was contracted by Permatherm, Inc. to perform an engineering analysis of their Structural Insulated Panels (SIPs) used as structural wall panels. The analysis was performed to determine the allowable design pressure at various panel lengths based on testing conducted on two standard lengths (8' and 20' nominal) for three panel thicknesses (4 in, 6 in, and 8 in). This analysis will determine design pressure capacity of the panel based on testing and calculated allowable values for the following conditions:

1. 8', 10', 12', 14', 16', 18' and 20' Load Span Tables.
2. Nominal 4", 6" and 8" thick panels covered.
3. Deflection limits based on the following in accordance with the 8th Edition (2023) FBC, Table 1604.3.
 - a. L/120
 - b. L/180
 - c. L/240
 - d. L/360

The following parameters were also tested. Where applicable, an allowable design value was engineered. Otherwise, specific test results are shown and may be used in the design of structural systems employing this product.

1. Wall Panel Compression Load
2. Wall Panel Concentrated Load
3. Core to Skin Adhesive Bond Strength
4. Core Shear Modulus
5. Sheet Metal Fastener Withdrawal from SIP panel.
6. Wall Connections
 - a. Roof to Wall
 - b. Wall to Substrate
7. Racking (In-Plane Shear) Load

DESCRIPTION OF PRODUCT - INSTALLATION REQUIREMENTS

See Reference 1.a for a description of the product, its installation and other pertinent data related to its approved use.

The SIPs are manufactured using expanded polystyrene (EPS) foam insulation (Type I) as the core material and G-60 Galvanized Steel 26-gauge white Centria as the skin material. The EPS physical properties must meet ASTM C 578 (which includes a minimum density of 1 pound per cubic foot). The 26-gauge metal must have a minimum thickness of 0.018 in.

LIMITATIONS OF USE

1. See Reference 1.a and this Product Evaluation Document.
2. When used as a component in a wall assembly, it shall meet the applicable requirements of the 8th Edition (2023) FBC - Building, Chapter 14 and/or 8th Edition (2023) FBC - Residential, Chapter 6.

8th Edition (2023) CODE CONFORMANCE - STRUCTURAL PERFORMANCE

Section R610 of the 8th Edition (2023) FRC contains specific code conformance requirements for areas outside of the High Velocity Hurricane Zone (HVHZ) for material or structural adequacy of a Structural Insulated Panel when used in wall applications. Those requirements are generally specific to SIPs comprised of wood face materials. The Permatherm panels are comprised of metal face material.

Therefore, this product is not fully addressed in the code. Section 1708 of the 8th Edition (2023) FBC was used to determine an acceptable means by which to ascertain the structural adequacy of the Structural Insulated Panel.

In conformance with Section 1708.2 of the 8th Edition (2023) FBC, the structural adequacy of the Structural Insulated Panel was determined by testing using the test protocols listed in Reference 2.a & 2.b (see Reference 4.a and 4.b for list). Additionally, that tested performance was evaluated in Reference 3.a and reported in this Product Evaluation Report.

See Reference 3.b for an Equivalency Evaluation to the 8th Edition (2023) FBC/FRC for Testing Standards listed in Reference 4.a and 4.b.

The product described herein has demonstrated compliance with the 8th Edition (2023) Florida Building Code, Section 1708.2 for loading not to exceed that reported in this Product Evaluation Report.

This report does not evaluate the product specified herein for use in the High Velocity Hurricane Zone.

8th Edition (2023) CODE CONFORMANCE - PLASTICS

The SIPs are manufactured using expanded polystyrene (EPS) foam insulation (Type I) as the core material and G-60 Galvanized Steel 26-gauge white Centria as the skin material. The EPS physical properties must meet ASTM C 578 (which includes a minimum density of 1 pound per cubic foot). The 26-gauge metal must have a minimum thickness of 0.018 in.

The SIP core is comprised of EPS which conforms to 8th Edition (2023) FBC, Table 1508.2 and 8th Edition (2023) FRC, Table R906.2 per Reference 2.a testing to ASTM C578 (see Reference 3.b for Testing Standards Equivalency Evaluation) as roof insulation.

Core and face materials are as follows:

- Materials
 - Core
 - Meets ASTM C 578-08, Standard for Rigid, Cellular Thermal Insulation with minimum core density of not less than 1 pound per cubic foot.
 - Face
 - G-60 Galvanized Steel 26-gauge white Centria as the skin material.
 - Metal face material not covered in the FRC.

[Prescriptive SIP requirements in 8th Edition (2023) FRC, Section R906 and 8th Edition (2023) FBC are used for comparison purposes only as it relates to the core material. The product shown herein is not intended to meet the prescriptive requirements of this section.]

The SIP core is comprised of EPS which conforms to 8th Edition (2023) FRC, Section R906.2 per Reference 2.a testing to ASTM C578 (see Reference 3.b for Testing Standards Equivalency Evaluation) as core material insulation.

SUPPORTING DOCUMENTS

1. Drawings

- a. Drawing No. PERM0001, Original Issue, dated 6/26/18, signed and sealed by Robert J. Amoruso, P.E.

2. Testing

- a. Architectural Testing Report No. 87559.02-119-16 Revision 1, dated 07/10/09, *Performance Test Report: 4 in, 6 in, and 8 in SIPs*.
- b. FARABAUGH ENGINEERING AND TESTING, INC. REPORT NO. T153-07, DATED 3/26/07, *ASTM E72-02 Racking Load Test*.

3. Reports

- a. PTC Product Design Group, LLC Report No. 1560, Rev. 3, Dated 4/14/15, *E.P.S. Core/Galvanized Steel Skin Structural Insulated Panels (SIPs) - Structural Design Parameter Evaluation*.
 - i. Report reviewed requirements for AISI S100-16, S1-18 in conformance with the 8th Edition (2023) FBC and 8th Edition (2023) FRC and found the existing analysis in conformance with those requirements of AISI S100-16, S1-18.
- b. PTC Product Design Group, LLC Report No. 1551-EER, Rev. 6, Dated 6/1/2023, *E.P.S. Core/Galvanized Steel Skin Structural Insulated Panels (SIPs) - Equivalency Evaluation to Current Edition of FBC*.

4. References

- a. Testing (Ref. 2.a)
 - i. ASTM A 370-08a Standard Test Methods and Definitions for Mechanical Testing of Steel
 - ii. ASTM C 273-00, Standard Test Method for Shear Properties of Sandwich Core Materials
 - iii. ASTM C297-04 Standard Test Method for Tensile Strength of Sandwich Constructions
 - iv. ASTM C 578-08, Standard for Rigid, Cellular Thermal Insulation
 - v. ASTM D 1037-99, Standard Test Methods for Evaluating Properties of Wood-Base Fiber and Particle Panel Materials
 - vi. ASTM E 72-05, Test Conducting Strength Tests of Panels for Building Construction

- vii. ASTM E 661-03, Standard Test Method for Performance of Wood and Wood-Based Floor and Under Concentrated Static and Impact Load
 - b. Testing (Ref. 2.b)
 - i. ASTM E 72-02, Test Conducting Strength Tests of Panels for Building Construction
 - c. Evaluation (Ref. 3.a)
 - i. AISI-North American Specification for the Design of Cold-Formed Steel Structural Members 2007 Edition, S100-07 / S1-10 and S2-10
 - 1. Ref. 3a evaluation reviewed requirements for AISI S100-16, S1-18 in conformance with the 8th Edition (2023) FBC and 8th Edition (2023) FRC and found the existing analysis in conformance with those requirements of AISI S100-16, S1-18.
 - ii. 8th Edition (2023) Florida Building Code

LOAD-SPAN ENGINEERING ANALYSIS (REFERENCE 3.A)

AISI-North American Specification for the Design of Cold-Formed Steel Structural Members serves as a basis for development of engineering criteria from the reported test results.

The maximum and minimum panel sizes (heights) were tested to determine the allowable loads for spans within these sizes. Load tests performed by Architectural Testing in York, Pennsylvania determined the ultimate (failure) loads for panels having three different thicknesses and two different test spans of 7 ft 8 in and 19 ft 8 in.

Panel lengths shown in the test report are based on the clear distance between supports and not the total panel length. These panels were tested using the procedures of ASTM E 72-05 with the results established in Reference 2.a.

The panel being analyzed is symmetric about its centerline; therefore, the values shown are applicable to both positive and negative design pressures. The analysis only considers transverse loading of the panels.

Table 1604.3 of the 8th Edition (2023) FBC state the deflection limits of the wall panels and served as the basis for the load vs. span tables presented in this report.

The analysis provided the allowable pressure for various deflection requirements. A theoretical modulus of elasticity (E) and shear modulus (G) was determined based on tested values for the 4 in, 6 in, and 8 in thick panels. The lowest value from the 4 in, 6 in, and 8 in panel calculations of E and G was used. Moment of inertia of the panel was calculated based on the inner and outer steel skin only.

The theoretical E and G values, along with the panel strength determined from testing, were used to develop the allowable loads for alternate panel lengths at various deflection limits for each panel thickness. See Reference 3.a for these calculations.

The provided load-span tables are for initial deflection and do not account for long term deflection. The effect on deflection for sustained load and/or creep must be evaluated separately. Safety factors are based on AISI, North American Specification for the Design of Cold-Formed Steel Structural Members S100-2016 Edition, Section K2.1 and supplement S1-18.

For all panel thickness and both panel lengths the tested mode of failure was buckling. Therefore, the ultimate flexural strength of each panel thickness can be determined. However, since none of the panels had a shear failure, the true ultimate shear strength could not be determined. Therefore, when tests are not conducted to failure the highest load achieved for each test is conservatively assumed as the ultimate.

Therefore, the ultimate shear strength that will be used for calculation purposes is the maximum shear strength achieved while testing the 7 ft - 8 in span. Based on a specified safety factor, an allowable flexural and shear strength can be determined from the average ultimate flexural and shear loads. From the allowable strengths maximum design pressures for each condition can be determined at lengths between the tested spans. In addition, the modulus of elasticity and shear modulus can be used to determine the maximum design pressure while limiting the deflection to a certain criterion. The minimum value from the flexural strength, shear strength, or deflection limit results in the maximum design pressure at that span and deflection criteria.

RESULTS - LOAD SPAN TABLES

The Wall Panel Load Span Tables consider Load combinations in accordance with ASCE 7-16 (supplement 1), Section 2.4 and the 8th Edition (2023) FBC, Section 1605.3.1 and

are based on the following:

- For Walls, only wind load (W) is considered in the transverse loading direction.
- Therefore, the Allowable Applied Uniform Pressure in psf in the following tables is without modification to account for other applied loads.
- The total combined transverse load for the site-specific condition must be the same as or lower than those shown in tables 1, 2 or 3.

Allowable Span Loads are based on transverse load testing (allowable or nominal wind loading) of the SIPs thus is considered a "working load" and combined using Allowable Stress Design Load Combinations. In accordance with the 8th Edition (2023) FRC, Section R301.2.1.6, design wind loads determined in accordance with ASCE 7-16 (supplement 1) or Section 1609 are permitted to be multiplied by 0.6 for comparison to Allowable Span Loads in this Product Approval Document.

RESULTS - LOAD SPAN TABLES (cont.)

Table 1 *			
Allowable Applied Uniform Pressure 4 in Thick Panel with Safety Factor = 2.27			
Panel Span (ft)	Deflection Limit (in)		Design Pressure (psf)
8	L/120	0.800	67
8	L/180	0.533	67
8	L/240	0.400	53
8	L/360	0.267	35
10	L/120	1.000	43
10	L/180	0.667	43
10	L/240	0.500	42
10	L/360	0.333	28
12	L/120	1.200	30
12	L/180	0.800	30
12	L/240	0.600	30
12	L/360	0.400	23
14	L/120	1.400	22
14	L/180	0.933	22
14	L/240	0.700	22
14	L/360	0.467	20
16	L/120	1.600	17
16	L/180	1.067	17
16	L/240	0.800	17
16	L/360	0.533	17
18	L/120	1.800	13
18	L/180	1.200	13
18	L/240	0.900	13
18	L/360	0.600	13
20	L/120	2.000	11
20	L/180	1.333	11
20	L/240	1.000	11
20	L/360	0.667	11

Table 2 *			
Allowable Applied Uniform Pressure 6 in Thick Panel with Safety Factor = 2.27			
Panel Span (ft)	Deflection Limit (in)		Design Pressure (psf)
8	L/120	0.800	100
8	L/180	0.533	100
8	L/240	0.400	79
8	L/360	0.267	53
10	L/120	1.000	64
10	L/180	0.667	64
10	L/240	0.500	63
10	L/360	0.333	42
12	L/120	1.200	44
12	L/180	0.800	44
12	L/240	0.600	44
12	L/360	0.400	35
14	L/120	1.400	33
14	L/180	0.933	33
14	L/240	0.700	33
14	L/360	0.467	30
16	L/120	1.600	25
16	L/180	1.067	25
16	L/240	0.800	25
16	L/360	0.533	25
18	L/120	1.800	20
18	L/180	1.200	20
18	L/240	0.900	20
18	L/360	0.600	20
20	L/120	2.000	16
20	L/180	1.333	16
20	L/240	1.000	16
20	L/360	0.667	16

* The allowable loads are based on uniform applied loads. For all other loads, an equivalent uniform load shall be determined and then compared to the listed values.

RESULTS - LOAD SPAN TABLES (cont.)

Table 3 *			
Allowable Applied Uniform Pressure 8 in Thick Panel with Safety Factor = 2.50			
Panel Span (ft)	Deflection Limit (in)		Design Pressure (psf)
8	L/120	0.800	115
8	L/180	0.533	115
8	L/240	0.400	106
8	L/360	0.267	70
10	L/120	1.000	75
10	L/180	0.667	75
10	L/240	0.500	75
10	L/360	0.333	56
12	L/120	1.200	52
12	L/180	0.800	52
12	L/240	0.600	52
12	L/360	0.400	47
14	L/120	1.400	38
14	L/180	0.933	38
14	L/240	0.700	38
14	L/360	0.467	38
16	L/120	1.600	29
16	L/180	1.067	29
16	L/240	0.800	29
16	L/360	0.533	29
18	L/120	1.800	23
18	L/180	1.200	23
18	L/240	0.900	23
18	L/360	0.600	23
20	L/120	2.000	19
20	L/180	1.333	19
20	L/240	1.000	19
20	L/360	0.667	19

* The allowable loads are based on uniform applied loads. For all other loads, an equivalent uniform load shall be determined and then compared to the listed values.

RESULTS - WALL PANEL COMPRESSION LOAD

Table 4A				
Allowable Compression Load (lbs) Based On Failure due to Load (SF = 3)				
Size	4" x 12'	4" x 20'	6" x 12'	6" x 20'
Average	3142	3680	2760	3284
Average (lbs/ft)	815	955	716	852

Table 4B				
Allowable Compression Load (lbs) Based On Deflection Limit of 1/8" or Failure due to Load (SF = 3)				
Size	4" x 12'	4" x 20'	6" x 12'	6" x 20'
Average	1428	3680	2760	3284
Average (lbs/ft)	371	955	716	852

Usage Notes for Engineered Test Results:

1. When conformance to the lower of a deflection limit of 1/8" maximum or a Safety Factor of 3, then Table 4B can be used.
2. When conformance to a Safety Factor of 3 only is required, then Table 4A can be used.

Testing Methods:

1. ASTM E72, Section 9

RESULTS - WALL PANEL CONCENTRATED LOAD

Table 5 - Wall Panel Concentrated Load Test Results

4 in Thick Panel (Envelopes 6 in) - Concentrated Load Test Results			
Test No.	Deflection at 200 lb Load (in)	Pass/Fail at 300 lb Load	Observation
1	0.252	Pass	No Puncturing of Face at 300 lb.
2	0.227	Pass	
3	0.215	Pass	

8 in Thick Panel - Concentrated Load Test Results			
Test No.	Deflection at 200 lb Load (in)	Pass/Fail at 300 lb Load	Observation
1	0.102	Pass	No Puncturing of Face at 300 lb.
2	0.128	Pass	
3	0.139	Pass	

Usage Notes for Test Results:

1. Can be used to evaluate concentrated loads on the SIP skins.

Testing Methods:

1. ASTM E661, Section 8.1
2. ASTM E72, Section 13 (simulated by E661 testing)

RESULTS - BOND SHEAR STRENGTH

Table 6 - Bond Strength Test Results						
4 in Thick Panel (Envelopes 6 & 8 in)						
Test No.	Width (in)	Length (in)	Peak Load (lb)	Ultimate Flatwise Tensile Strength (psi)	Elongation at Peak Load (in)	Observation
1	3.965	4.4145	291	18	0.138	Tensile failure of the sandwich core.
2	3.994	3.994	320	20	0.186	
3	3.964	3.972	330	21	0.25	
4	4.163	3.964	338	21	0.181	
5	3.977	3.977	312	20	0.269	
Average			318	20	0.205	

Usage Notes for Test Results:

1. Can be used to determine bond acceptability.

Testing Methods:

1. ASTM C297

RESULTS - TRANSVERSE LOAD, AVERAGE ULTIMATE PRESSURE (psf)

Table 7		
Transverse Load - Average Ultimate Pressure (psf)		
Wall Panel Thickness (in)	Wall Panel Height (ft)	Average Ultimate Pressure (psf)
4	8	165
	20	25
6	8	244
	20	38
8	8	300
	20	50

Usage Notes for Test Results:

1. Demonstrates testing results to ASTM E72, Section 12 when required.

Testing Methods:

1. ASTM E72, Section 12

RESULTS - SHEET METAL SCREW (FASTENER) WITHDRAWAL (lbs)

Table 8 - Fastener Withdrawal			
4 in Thick Panel (Envelopes 6 & 8 in)			
Test No.	Ultimate Load (lb)	Allowable Load = Ultimate Load/SF (lb)	Mode of Failure
1	145	58	Tensile / withdrawal of fastener from panel steel skin or not able to sustain load.
2	176	71	
3	183	74	
4	188	76	
5	188	76	
6	152	61	
7	177	71	
8	136	55	
9	140	56	
10	172	69	
Average	166	67	

Usage Notes for Engineered Test Results:

1. Applicable to No. 10 x 1-1/4" pan-washer head, Type A screw or equal/better.
2. These results represent the withdrawal of a single No. 10 screw from the 26 GA. Galvanized Steel skin of the SIPs.
3. These results can be used as an allowable withdrawal load per fastener in lbs for connections into the SIP skin using a No. 10 x 1-1/4" pan-washer head, Type A screw or equal/better.
4. Safety Factor (SF) = 2.485 used to determine allowable load for use in Allowable Stress Design.
5. Safety Factor based on AISI, North American Specification for Design of Cold-Formed Steel Structural Members S100-2016, Section K2.1.1 and K2.1.2 and supplement S1-18.

Testing Methods:

1. ASTM D1037

RESULTS - PANEL CONNECTIONS (lbs)

Table 9 - Panel Connections			
Test No.	Ultimate Load (lb)	Allowable Load = Ultimate Load/SF (lb)	Mode of Failure
1	1421	568	Roof Panel pulled away from Wall Panel due to 1/4" screw withdrawal.
2	1506	602	
3	1555	622	
Average	1494	598	
Per anchor connection = Allowable Load/No. Anchors		299	Applicable to both roof to wall and wall to slab - 2 anchors each.

Usage Notes for Engineered Test Results:

1. Wall to Roof Connection:
 - a. Applicable to No. 14 (1/4" dia.) screws with 1-1/2" washers, 8" on center or equal/better.
 - b. At least three threads must pass through Wall C-Section Cap.
 - c. See Detail "C1" on Drawing No. PFF00001.
2. Wall to Substrate Connection:
 - a. Applicable to 1/2" dia. bolts, 18" on center, 6" edge distance.
 - b. Connection allowable above applicable to fastener to C-Section Cap ONLY.
 - c. Connection capacity to substrate MUST be engineered.
 - d. See Detail "C2" & "C3" on Drawing No. PFF00001.
3. Safety Factor (SF) = 2.5 used to determine allowable load for use in Allowable Stress Design.
4. Safety Factor based on AISI, North American Specification for Design of Cold-Formed Steel Structural Members S100-2016, Section K2.1.1 and K2.1.2 and supplement S1-18.

Testing Methods:

1. Universal Testing Machine - Tensile/Withdrawal testing.

RESULTS - CORE SHEAR MODULUS

Table 10 - Core Shear Modulus					
4 in Thick Panel					
Test No.	Loading Plate Weight (lb) (not inc. in Total Load)	Peak Load (lb)	Total Load (lb)	Tangent Modulus, S (lb/in)	Core Shear Modulus, G (psi)
1	3.82	185	189	818	117
2	3.96	179	183	867	124
3	3.8	212	216	840	120
4	3.82	200	204	699	100
Average			198	806	115
6 in Thick Panel					
Test No.	Loading Plate Weight (lb) (not inc. in Total Load)	Peak Load (lb)	Total Load (lb)	Tangent Modulus, S (lb/in)	Core Shear Modulus, G (psi)
1	5.8	256	262	1091	156
2	5.8	251	257	1158	166
3	5.78	287	293	1198	172
4	5.8	247	253	1168	167
Average			266	1154	165
8 in Thick Panel					
Test No.	Loading Plate Weight (lb) (not inc. in Total Load)	Peak Load (lb)	Total Load (lb)	Tangent Modulus, S (lb/in)	Core Shear Modulus, G (psi)
1	7.68	380	388	1527	219
2	7.7	399	407	1578	226
3	7.68	420	428	1490	214
4	7.68	407	414	1463	210
5	7.68	404	412	1633	234
Average			410	1538	221

Usage Notes for Test Results:

1. Can be used in engineering analysis.

Testing Methods:

1. ASTM C273

RESULTS - RACKING (IN-PLANE SHEAR) LOADING

Table 11 - Allowable Racking Load

Basis for Limitation	Allowable Racking Load (lb/linear ft)
Deflection @ L/240	242
Deflection @ L/120	391
Ultimate Working Load/SF	261

Notes:

- 1) Deflection Limits based on 8th Edition (2023) FBC, Table 1604.3.
- 2) Safety Factor = 2 based on AISI S100-2016, Section K2.1.2 and supplement S1-18 Safety Factor for ASD Design.

Usage Notes for Test Results:

1. Can be used in engineering analysis.

Testing Methods:

2. ASTM E72, Section 14