APA

Product Advisory

SP-1186 JULY 2018

Product Advisory: Performance of Flexible Structural Sheathing

(Independent Evaluations of Published Design Values)

SUMMARY

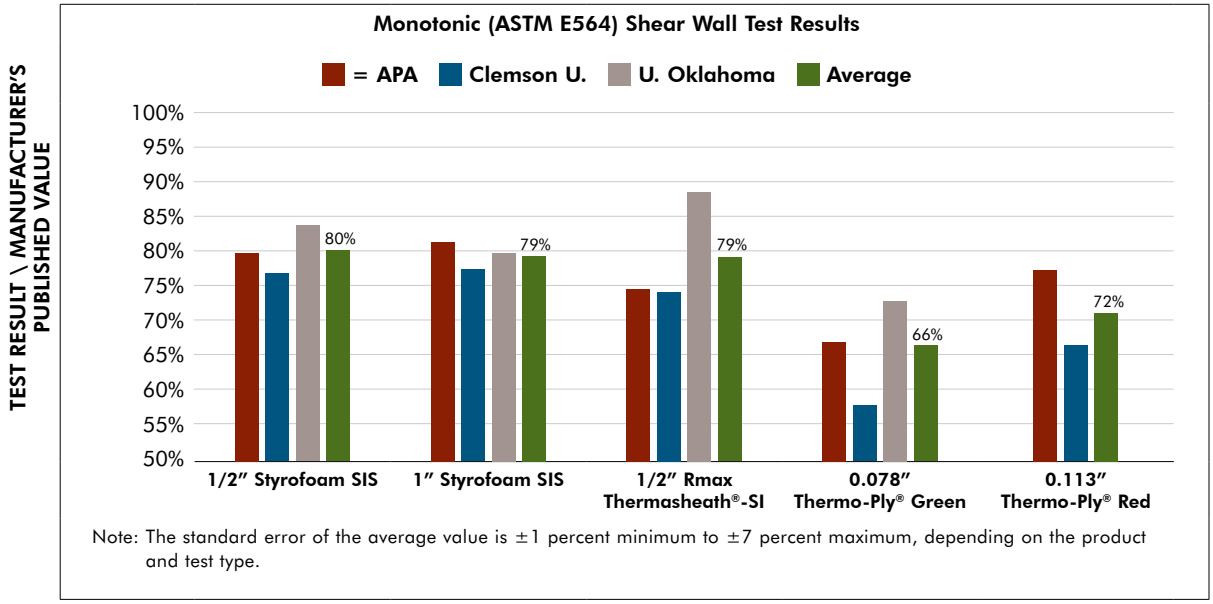
Tests were performed at three independent laboratories to measure the lateral load (shear wall) performance of five different flexible structural sheathing materials. **The results were compared directly with the values published in the manufacturers' product evaluation reports based on the same referenced ASTM test standards.** Test results from all labs consistently show that the tested flexible structural sheathing materials overstate their lateral load resistances by as much as 42 percent when compared to their published design values. Some of those products are as thin as 0.078 inch, but claim shear wall values that are higher than those for 15/32-inch-thick wood structural panels. These overstated lateral load design properties published by the manufacturers raise a question related to the safety and reliability of a structure designed with these products.

APA TEST SERIES

Figures 1 and 2 on the next page show the percentage of the ultimate lateral loads achieved from testing, as compared to the published ultimate lateral loads from the product evaluation reports. For light-frame walls constructed with wood structural panels (plywood or oriented strand board), the ultimate lateral loads are required by the product standard to meet or exceed 100 percent of the published design values.

FIGURE 1

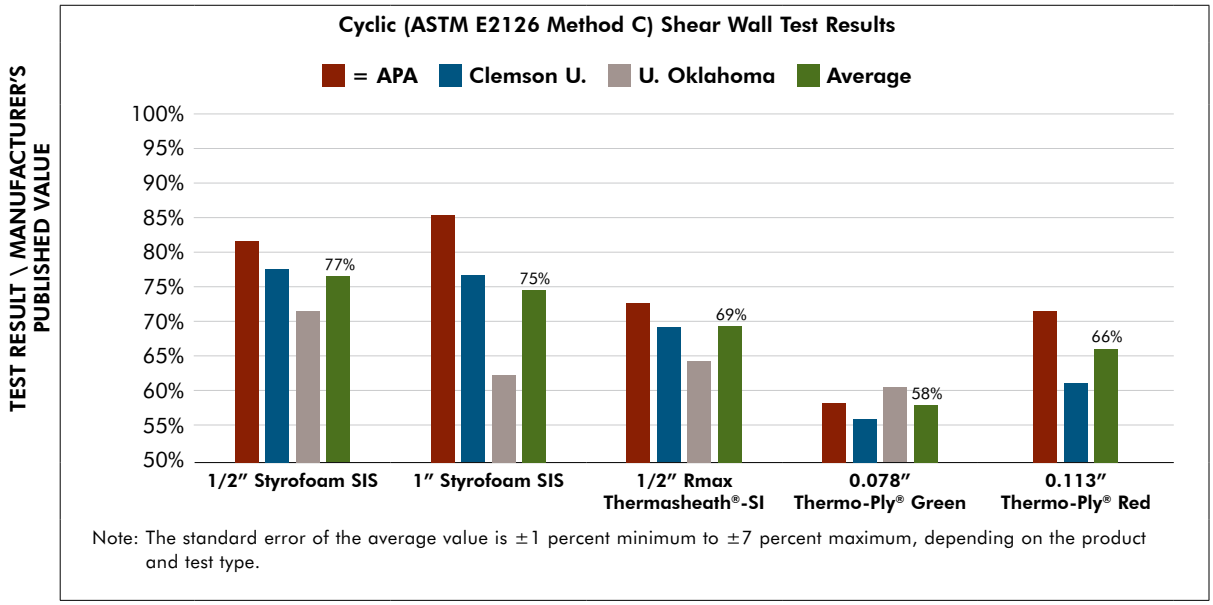
COMPARISON OF TESTED SHEAR WALL RESULTS TO PUBLISHED DESIGN VALUES SUBJECT TO WIND LOADS



Note: The standard error of the average value is ±1 percent minimum to ±7 percent maximum, depending on the product and test type.

FIGURE 2

COMPARISON OF TESTED SHEAR WALL RESULTS TO PUBLISHED DESIGN VALUES SUBJECT TO SEISMIC LOADS



Note: The standard error of the average value is ±1 percent minimum to ±7 percent maximum, depending on the product and test type.

As shown in Figure 1, the published values overstate the lateral load capacities in a range between 20 and 34 percent on average under monotonic (wind) loading. This is equivalent to a reduction in the allowable wind pressure (V_{asd}) from 29.1 pounds per square foot to 19.5 pounds per square foot, which represents approximately a 20-mile-per-hour reduction in the allowable wind speed that can be resisted by the structure.

As shown in Figure 2, the published ultimate lateral loads from the product evaluation reports overstate the ultimate lateral loads by 23 to 42 percent on average under cyclic (seismic) loading. It is also important to note that shear walls constructed with these flexible structural sheathing materials do not behave like conventional light-frame walls under seismic loading. The over-strength, ductility and drift capacities of the walls constructed with these sheathings do not meet the seismic equivalence parameters (SEP) for light-frame walls constructed with wood structural panels in accordance with ASTM D7989, *Standard Practice for Demonstrating Equivalent In-Plane Lateral Seismic Performance to Wood-Frame Shear Walls Sheathed with Wood Structural Panels*. Therefore, the use of the seismic coefficients and factors designated for light-frame walls (response modification coefficient R = 6.5, over-strength factor Ω_g = 3, and deflection amplification factor C_d = 4) for shear walls constructed with these flexible structural sheathing products could underestimate the design seismic force, resulting in an unsafe design.

BACKGROUND

Monotonic (wind) and cyclic (seismic) shear wall tests were conducted at Clemson University, University of Oklahoma and APA Research Center to evaluate the lateral load resistance of the following five flexible structural sheathing products available in the marketplace. The referenced product evaluation report for each product is provided through a web link:

- 1/2-inch SIS: TER 0804-01 (Monotonic & Cyclic)
- 1-inch SIS: TER 0804-01 (Monotonic & Cyclic)
- 1/2-inch RMax Thermasheath®-SI: TER 1207-01 (Monotonic & Cyclic)
- 0.078-inch Thermo-Ply® Green: TER 1004-03 (Monotonic & Cyclic)
- 0.113-inch Thermo-Ply® Red: TER 1004-01 (Monotonic & Cyclic)

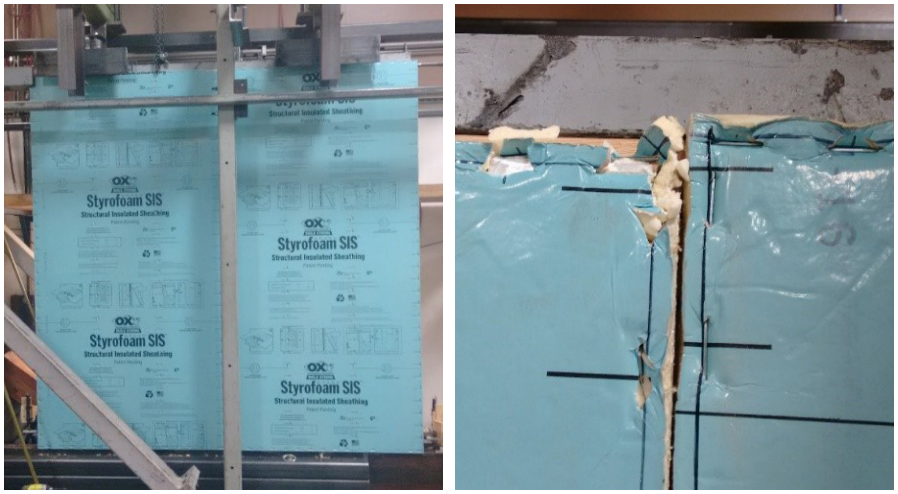
Structural design properties for these flexible structural sheathings were evaluated according to two shear wall test standards listed in the manufacturers' product evaluation reports–ASTM E564, *Standard Practice for Static Load Test for Shear Resistance of Framed Walls for Buildings*, and ASTM E2126, *Standard Test Methods for Cyclic (Reversed) Load Test for Shear Resistance of Vertical Elements of the Lateral Force Resisting Systems for Buildings*, Method C (CUREE). They were performed by three independent test laboratories in 2017 through 2018, except for Thermo-Ply® Red, which was tested in 2015 at Clemson and APA only (see APA Product Advisory SP-1172). For each of these test series, two wall replicates were tested at each laboratory with both cyclic and monotonic loading. Results from these tests were compared directly with the values published in product evaluation reports issued by the product certification agency, which reference the above ASTM standards. Detailed test reports are available to building officials and design engineers from APA upon request.

TYPICAL FAILURE MODES

The typical failure modes for each product are shown in Figures 3 through 6. Fastener pull through appeared to be the typical failure mode for SIS and RMax Thermasheath®-SI (Figures 3 and 4). The sheathing "wrinkle" failure mode of thin Thermo-Ply® products (Figures 5 and 6) raises a question about the capability of the wall to resist transverse wind loads when the flexible structural sheathing fails due to lateral loads.

FIGURE 3

1/2-INCH SIS (FAILURE MODES ARE SIMILAR FOR 1-INCH SIS) BEFORE AND AFTER TESTING. 1/2-INCH AND 1-INCH SIS COULD BE UNDER-DESIGNED BY 20 PERCENT TO 25 PERCENT.



BEFORE **AFTER**

FIGURE 4

1/2-INCH RMAX THERMASHEATH®-SI BEFORE AND AFTER TESTING. 1/2-INCH RMAX THERMASHEATH® COULD BE UNDER-DESIGNED BY 21 PERCENT TO 31 PERCENT.

BEFORE **AFTER**

FIGURE 5

0.078-INCH THERMO-PLY® GREEN BEFORE AND AFTER TESTING. THERMO-PLY® GREEN COULD BE UNDER-DESIGNED BY 34 PERCENT TO 42 PERCENT.

BEFORE **AFTER**

FIGURE 6

0.113-INCH THERMO-PLY® RED BEFORE AND AFTER TESTING. THERMO-PLY® RED COULD BE UNDER-DESIGNED BY 28 PERCENT TO 34 PERCENT.

BEFORE **AFTER**

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