APA Product Advisory
SP-1186C NOVEMBER 2020

Performance of Flexible Structural Sheathing
(Independent Evaluations of Published Design Values)

SUMMARY

This updated Product Advisory combines new tests conducted in 2019 on three flexible structural sheathing materials with tests previously conducted in 2015 through 2018 on five other products. The 2019 tests, like the previous tests, were also performed at three independent laboratories to measure the lateral load (shear wall) performance. **All 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 all eight tested flexible structural sheathing materials overstate their lateral load resistances by as much as 42% 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 flexible sheathing manufacturers raise a question related to the safety and reliability of a structure designed with these products.

TEST RESULTS

Figures 1 and 2 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% of the published design values.

FIGURE 1

COMPARISON OF TESTED SHEAR WALL RESULTS TO MANUFACTURER'S PUBLISHED DESIGN VALUES (AT 100%) SUBJECT TO WIND LOADS

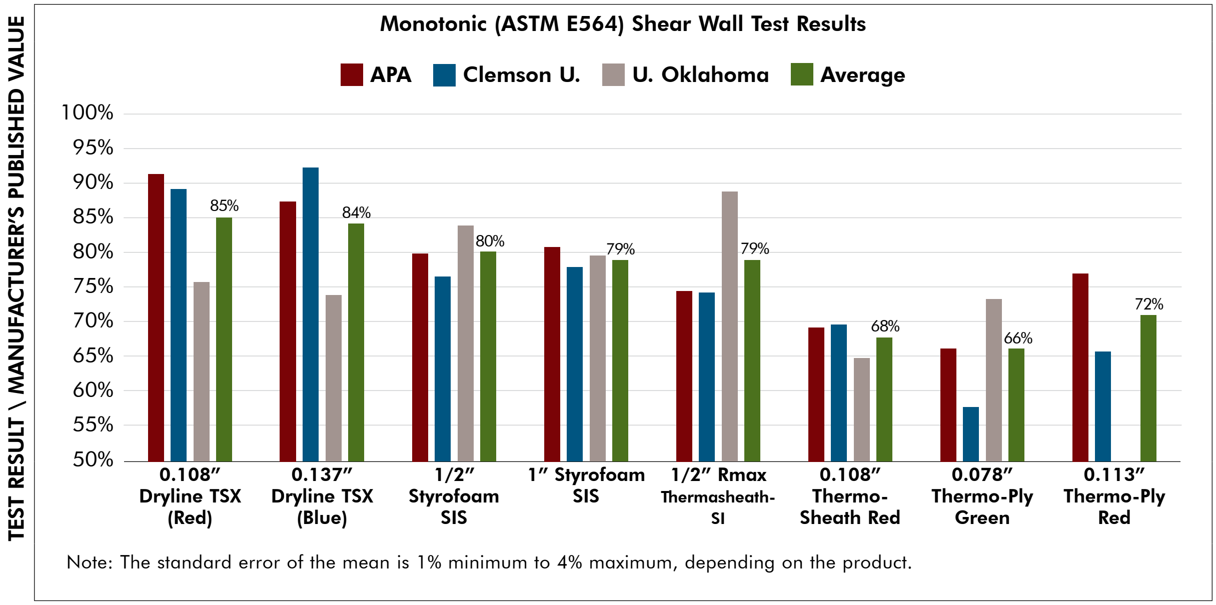
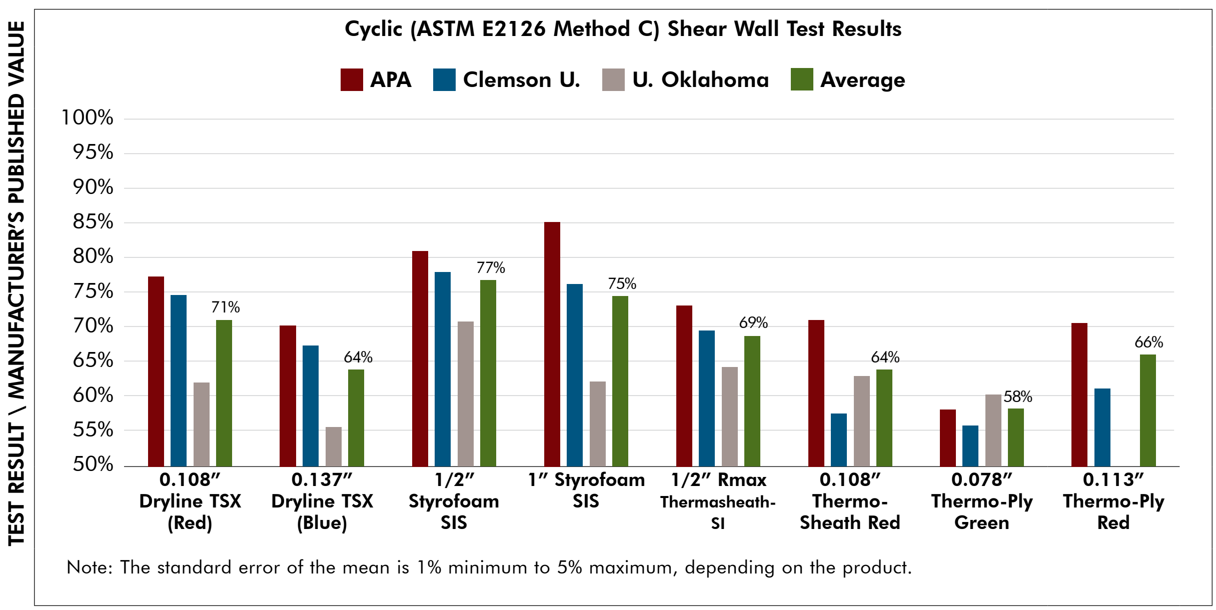


FIGURE 2

COMPARISON OF TESTED SHEAR WALL RESULTS TO MANUFACTURER'S PUBLISHED DESIGN VALUES (AT 100%) SUBJECT TO SEISMIC LOADS



As shown in Figure 1, the published values overstate the lateral load capacities in a range between 15% and 34% on average under monotonic (wind) loading. This is equivalent to a maximum reduction in the ultimate wind pressure (V_{ult}) from 32 pounds per square foot to 21 pounds per square foot, which represents approximately a 30 miles per hour reduction in the ultimate 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% 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 flexible structural sheathing 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 could underestimate the design seismic force, resulting in an unsafe design.

BACKGROUND

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

- 0.108-inch Dryline® TSX (Red) Structural Sheathing: TER 1407-06 (Monotonic & Cyclic)[a]
- 0.137-inch Dryline® TSX (Blue) Structural Sheathing: TER 1407-07 (Monotonic & Cyclic)[b]
- 1/2-inch SIS: TER 0804-01 (Monotonic & Cyclic)[c]
- 1-inch SIS: TER 0804-01 (Monotonic & Cyclic)[c]
- 1/2-inch R-Max Thermasheath-SI: TER 1207-01 (Monotonic & Cyclic)[d]
- 0.108-inch Thermo-Sheath Red Structural Sheathing: TER 1310-01 (Monotonic & Cyclic)[e]
- 0.078-inch ThermoPly Green: TER 1004-03 (Monotonic & Cyclic)[f]
- 0.113-inch ThermoPly Red: TER 1004-01 (Monotonic & Cyclic)[g]

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). The tests were performed by three established, independent test laboratories between 2015 through 2019. For each of these test series, two to three 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 that references the above ASTM standards.

TYPICAL FAILURE MODES

The typical failure modes for each product are shown in Figures 3 through 9. Fastener head pull-through and sheathing buckling appeared to be the typical failure modes. The sheathing "wrinkle" failure mode of the flexible sheathing products raises a question about the capability of the wall to resist wind loads when the flexible structural sheathing fails due to lateral loads.

FIGURE 3

0.108-inch Dryline® TSX (Red) Structural Sheathing before testing and typical failure mode. 0.108-inch Dryline® TSX (Red) Structural Sheathing could be under-designed up to 29%.

BEFORE **AFTER**

FIGURE 4

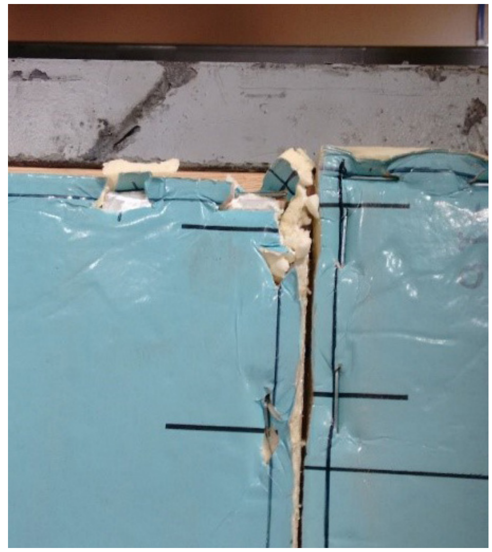
0.137-inch Dryline® TSX (Blue) Structural Sheathing before testing and typical failure mode. 0.137-inch Dryline® TSX (Blue) Structural Sheathing could be under-designed up to 36%.

BEFORE **AFTER**

FIGURE 5

1/2-inch SIS before and after testing (failure modes are similar for 1-inch SIS). 1/2-inch and 1-inch SIS could be under-designed up to 25%.

BEFORE



AFTER

FIGURE 6

1/2-inch R-Max Thermasheath-SI before and after testing. 1/2-inch R-Max Thermasheath could be under-designed up to 31%.

BEFORE

AFTER

FIGURE 7

0.108-inch Thermo-Sheath Red Structural Sheathing before testing and typical failure mode. 0.108-inch Thermo-Sheath Red Structural Sheathing could be under-designed up to 36%.

BEFORE **AFTER**

FIGURE 8

0.078-inch ThermoPly Green before and after testing). 0.078-inch ThermoPly Green could be under-designed up to 42%.

BEFORE **AFTER**

FIGURE 9

0.113-inch ThermoPly Red before and after testing. 0.113-inch ThermoPly Red could be under-designed 34%.

BEFORE **AFTER**

REFERENCES

A copy of the references used for the evaluation at the time of testing is available from APA. The referenced Technical Evaluation Reports (TER) below were issued by DrJEngineering, LLC, Madison, WI.

a. DrJ Engineering, LLC. 2018. *DRYline® TSX (Red) Structural Sheathing*. DrJ Certification TER No. 1407-06. Issued August 11, 2014. Updated January 15, 2018.

b. DrJ Engineering, LLC. 2018. *DRYline® TSX (Blue) Structural Sheathing*. DrJ Certification TER No. 1407-07. Issued August 11, 2014. Updated January 15, 2018.

c. DrJ Engineering, LLC. 2017. *SI-Strong Structural Insulation STYROFOAM SIS™, SIS™ Plus*. DrJ Certification TER No. 0804-01. Issued April 26, 2008. Updated June 23, 2017.

d. DrJ Engineering, LLC. 2017. *Rmax Thermasheath®-SI*. DrJ Certification TER No. 1207-01. Issued July 31, 2012. Updated March 18, 2017.

e. DrJ Engineering, LLC. 2018. *Thermo-Sheath (Red) Structural Sheathing*. DrJ Certification TER No. 1310-01. Issued November 20, 2013. Updated November 14, 2018.

f. DrJ Engineering, LLC. 2017. *Thermo-Ply® Green & Thermo-Ply® Green AMG Structural Sheathing*. DrJ Certification TER No. 1004-03. Issued November 19, 2013. Updated March 28, 2017.

g. DrJ Engineering, LLC. 2015. *Thermo-Ply® Red & Thermo-Ply® Red AMG Structural Sheathing*. DrJ Certification TER No. 1004-01. Issued November 8, 2013. Updated April 2, 2015.

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