ISSUED: NOVEMBER 8, 2012

Durability of SIPs Exposed to Moisture

Question: As with all construction materials, structural insulated panels (SIPs) are occasionally subjected to moisture exposure during the construction process. The construction process includes transportation of the SIPs to the jobsite, temporary storage prior to erection and exposure to the elements prior to being protected with the appropriate wall or roof covering. Virtually all product standards for wood-based products acknowledge that the products may be exposed to moisture during the construction process but must resist this exposure without a negative impact on their structural performance.

While it is well documented that oriented strand board (OSB) sheathing exposed to moisture during construction will perform as intended after it has been allowed to re-dry and reach an equilibrium moisture content, research on the performance of SIPs exposed to moisture is limited. To address this concern, SIPA contracted APA to conduct a series of tests to evaluate the effects of exposure to moisture on OSB-faced SIPs.

Test Program: APA conducted three series of tests subjecting SIPs to various moisture exposure conditions at its Research Center in Tacoma, Washington. These included transverse load tests, lateral load tests and axial load tests as described below.

Transverse Load Tests: Six SIPs, 4-1/2 inches in thickness and 4 feet by 8 feet in overall dimension were supplied to APA by a SIPA member manufacturer. The SIPs were manufactured under an approved quality assurance program. The SIPs included 7/16-inch OSB facings trademarked to meet the APA PRN-610 specification. The expanded polystyrene foam core was 3-5/8 inches thick meeting the requirements of ASTM C578 Type I. The adhesive bonding the facings to the core conformed to ASTM D2559 for adhesives specifically intended for the lamination of SIPs. Each 4-foot by 8-foot panel had a single 1-1/2-inch diameter vertical electrical chase and two horizontal chases through the foam core. In addition, two 4-3/4-inch by 4-3/4-inch cutouts for electrical boxes were routed in one face of each specimen.

Three SIPs were tested in the as-received condition (dry) and three were tested after exposure to moisture cycling in accordance with Section 15.3 of ASTM E72 for wet/dry specimens. The ASTM E72 wetting cycle is six hours of exposure to a water spray on both faces of the SIP followed by 18 hours of drying with the cycle repeated three times. The SIPs exposed to the moisture cycling were then dried under laboratory conditions until they achieved their as-received weight, which took approximately 30 days. Transverse load testing was conducted in accordance with Section 11 of ASTM E72 using a third point loading set-up. The cutouts for the electrical boxes were positioned on the tension face.

The results showed that the mean ultimate load for the moisture cycled specimens was approximately 98 percent of the as-received specimens. The load at a deflection limit of L/360 for the moisture cycled specimens was approximately 97 percent of the as-received specimens. These results indicate that the SIPs retained their transverse load capacity after exposure to simulated construction cycle moisture and drying (see Table 1 below for results).

Lateral Load Tests: A set of six SIPs manufactured as described above for the transverse load testing were supplied to APA and tested under cyclic lateral loading. Three SIPs were tested in the as-received condition (dry) and three were tested after exposure to moisture cycling in accordance with Section 15.3 of ASTM E72 for wet/dry specimens. For the SIPs exposed to the moisture cycling, two SIPs were dried for two weeks and one SIP was dried for four weeks under laboratory conditions to simulate varying degrees of drying.

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The lateral load testing was conducted in accordance with ASTM E2126, Method C, CUREE loading protocol. The reference deformation was set at 2.4 inches and the term α was 0.5. Displacement cycles were added such that the maximum displacement was ± 4.8 inches The top and bottom of the OSB sheathing on all SIPs was restrained with a nominal 2 x 6 SPF full SIP width cap plate and a 2 x 6 SPF full SIP width bottom plate.

The average OSB facing moisture content at time of testing was 5.1 percent for the three as-received SIPs, 7.4 percent for the two-week dried SIPs and 6.6 percent for the four-week dried SIPs, indicating the moisture cycling did result in a slightly increased moisture content of the OSB.

The results showed that the peak load for the SIPs exposed to simulated construction cycle moisture and re-drying was approximately 2 percent higher than the as-received specimens. There was no difference between the peak load results for the specimens re-dried for two weeks versus those re-dried for four weeks. Based on this testing, the SIP cyclic performance was insensitive to the wet-dry cycling and there was no distinguishable difference of the cyclic performance after a two-week or four-week drying (see Table 1 below for results).

Axial Load Tests: A set of six SIPs as described above for the transverse load testing were supplied to by APA and tested under axial (compression) loading. However, to simulate a more extreme exposure to moisture as may occur during a flood situation, three of the SIPs were soaked under tap water for 72 hours based on the National Evaluation Service (NES) protocol for determining flood resistance properties. This is considered to be a more severe moisture exposure than the ASTM E72 protocol. The SIPs exposed to the simulated flood soaking were dried under laboratory conditions until they achieved their as-received weight which took approximately 30 days.

The axial load testing was conducted in accordance with Section 9 of ASTM E72. The cutouts for the electrical junction boxes were positioned on the compression face.

Three SIPs were tested in the as-received condition (dry) and three were tested after exposure to the flood soaking and laboratory drying. The results of this testing showed that the mean ultimate axial load for the moisture cycled specimens was approximately 6 percent higher than the as-received specimens. The load at 1/8 inches deflection for the moisture cycled specimens was approximately 98 percent of the as-received specimens. These results indicate that there is virtually no axial strength loss for the SIPs after simulated flood soaking and this would also be applicable to typical construction cycle moisture exposure (see Table 1 below for results).

Summary: The results of these three test programs indicate that there is no significant loss in strength (transverse, lateral or axial) for SIPs subjected to typical moisture exposure during the construction process.

TABLE 1: SUMMARY TEST RESULTS (A)

	Lateral (cyclic)		Transverse		Axial	
	Peak Load/3.0	Deflection at Peak Load	Peak Load/3.0	Load at 1/8 in. Deflection	Peak Load/3.0	Load at 1/8 in. Deflection
Control	407 plf	2.5 in.	42 psf	26 psf	3,100 plf	3,340 plf
After Moisture Cycling	416 plf	2.6 in.	41 psf	25 psf	3299 plf	3,273 plf
Ratio	1.02	1.06	0.98	0.96	1.06	0.98

(a) All control and moisture cycled values are the average of 3 tests

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