Durability of SIPs Exposed to Moisture

Like other construction materials, structural insulated panels (SIPs) may encounter moisture during various stages of the construction process. This includes transportation, temporary storage, and exposure to the elements before being covered with appropriate wall or roof materials. Most standards for wood-based products recognize this possibility but require them to maintain structural integrity despite exposure. While it's known that oriented strand board (OSB) sheathing can rebound after moisture exposure, research on how SIPs handle moisture is limited. To address this, SIPA enlisted APA to conduct tests evaluating the impact of moisture exposure on SIPs.

Transverse Load Tests: Six SIPs, measuring 4-1/2 inches thick and 4 feet by 8 feet in size, were provided by a SIPA member manufacturer. The SIPs underwent rigorous manufacturing under an approved quality assurance program, featuring 7/16-inch OSB facings meeting APA PRN-610 standards and a 3-5/8 inch EPS foam core complying with ASTM C578 Type I requirements. Testing included exposure to moisture cycling per ASTM E72 standards, with results indicating minimal loss in load capacity after simulated construction moisture exposure and subsequent drying.

Lateral Load Tests: Another set of six SIPs, identical to those in the transverse load tests, were subjected to cyclic lateral loading. Testing involved both dry and moisture-exposed SIPs, with varying degrees of drying conditions simulated. Results demonstrated consistent load capacity performance after exposure to moisture cycling.

Lateral load testing adhered to ASTM E2126, Method C, using the CUREE loading protocol. The reference deformation was set at 2.4 inches with a term α of 0.5. Displacement cycles were applied to achieve a maximum displacement of ± 4.8 inches. 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.

At the time of testing, the average OSB facing moisture content was 5.1 percent for the as-received SIPs, 7.4 percent for the SIPs dried for two weeks, and 6.6 percent for the SIPs dried for four weeks, indicating a slight increase in moisture content due to the cycling.
Results revealed that the peak load for SIPs exposed to simulated construction moisture and subsequent drying was approximately 2 percent higher than that of the as-received specimens. There was no discernible difference in peak load between SIPs dried for two weeks versus those dried for four weeks, suggesting that cyclic performance remained consistent regardless of the drying duration.

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Axial Load Tests: Conducted on a set of six SIPs, similar to those used in the transverse load testing. However, to simulate more extreme moisture exposure, three SIPs were soaked in tap water for 72 hours, following the National Evaluation Service (NES) protocol for assessing flood resistance properties. This protocol represents a more severe moisture exposure compared to the ASTM E72 standard. The soaked SIPs were then dried under laboratory conditions until they returned to their original weight, a process taking approximately 30 days.

Testing was performed according to Section 9 of ASTM E72, with electrical junction box cutouts positioned on the compression face. Three SIPs were tested in their as-received condition, while three underwent flood soaking followed by drying. Results showed that the mean ultimate axial load for the moisture-cycled specimens was roughly 6 percent higher than for the as-received specimens. Additionally, the load at 1/8 inches deflection for the moisture-cycled specimens was approximately 98 percent of that for the as-received specimens. These findings suggest minimal loss in axial strength for SIPs following simulated flood soaking, a characteristic likely applicable to typical construction cycle moisture exposure as well.

Summary

The outcomes of these three test initiatives suggest that SIPs do not experience notable strength degradation (in transverse, lateral, or axial loading) when exposed to typical moisture conditions encountered during construction.

SUMMARY TEST RESULTS

	Lateral (cyclic)		**Transverse**		**Axial**	
	Peak Load/3.0	Deflection at Peak Load	Peak Load/3.0	Deflection at Peak Load	Peak Load/3.0	Deflection at Peak Load
Control	407 plf	2.5 in	42 psf	26 psf	3,100 plf	3,340 plf
After Moisture Cycling	416 plf	2.6 in	41plf	25 psf	3,299 plf	3,273 plf
Ratio	1.02	1.06	0.98	0.96	1.06	0.98

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

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