Proof of Concept for a 3D Molded Core Wood Strand Sandwich Panel

Daniel Way, Graduate Research Assistant, Oregon State University
Dr. Arijit Sinha, Assistant Professor of Renewable Materials, Oregon State University
Dr. Frederick Kamke, JELD-WEN Professor of Wood-Based Composites Science, Oregon State University
Dr. John Fujii, Chairman-CEO, Neucor, Inc., Vancouver, WA

Abstract

Sandwich composites are typically produced by bonding high strength facings and a lower strength, lightweight core. Sandwich design has proven to be efficient for applications demanding high strength and low weight. Functionally analogous to and I-beam, increased stiffness of the sandwich composite compared to its constituents is accomplished by separating the facings with a core material. This research presents a laboratory size (0.71 m x 0.76 m) sandwich panel composed of oriented strand board (OSB) facings and a 3D molded core produced using wood strands. 3D molded core sandwich panels (MCPs) were manufactured and subjected to bending, flatwise compression, in-plane shear, mechanical fastener, and small-scale shear wall tests.

Patented, bi-directional corrugated mold

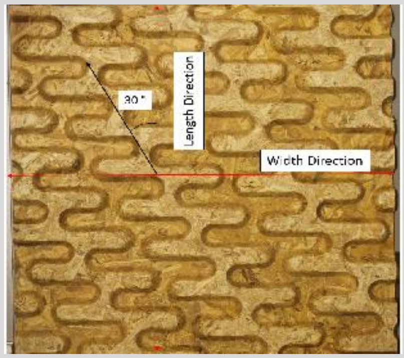
Motivation

- Determine if low cost, resource efficient panel inputs can be used in conjunction with an efficient structural design to create a panel with superior properties for use in building construction.
- Results are expected to determine whether fabrication and mechanical testing of full-size panels is warranted

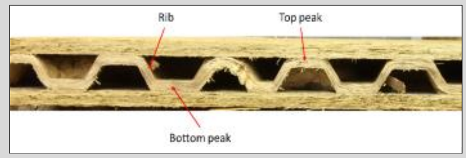
Core Manufacturing and Sandwich Panel Preparation

Commercial OSB strands typical of those used in a three layer panel

Rotating drum blender for blending strands with phenol formaldehyde (PF) adhesive



Bi-directional corrugated core. Corrugations run at an angle to length direction and are offset in both the width and length direction



Side view of sandwich composite structure illustrating primary core regions

Randomly oriented, hand-formed mat

Hot press equipped with core mold

Strong axis of 9.5 mm nominal thickness (3/8 in.) 24/0 Span-Rated OSB facings oriented parallel to core length direction

Phenol resorcinol formaldehyde (PRF) adhesive applied to core for bonding facings and core

Custom clamping system for bonding facings and core

Patents

Fujii, J. (2014). US Patent No. 11,570,745

Bending Test Methods and Results

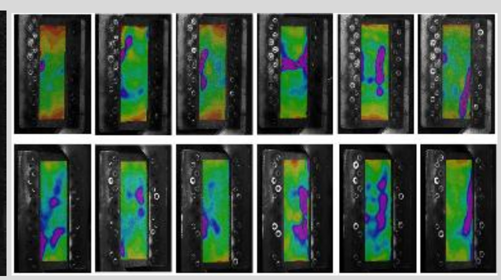
- ASTM D3043-*Method A* (3-pt bending)
- 100 mm wide specimen to reduce variability from bi-directional corrugations
- Minimum span-to-depth ratio not achieved
  - Strong axis- 15.3
  - Weak axis- 14.0

Panel type	Facing orientation	n	Stiffness, EI ($N\text{-}mm^2/mm$)	COV (%)	Strength, MOR (MPa)	COV (%)	Max load/unit width (N/mm)	Max moment/unit width (N-mm/mm)
MCP	Strong	26	1.91×10^7	5.0	12.7	12.3	23.9	3,950
	Weak	33	1.21×10^7	7.5	10.7	14.6	22.0	3,353
OSB	Strong	20	4.17×10^5	18.9	36.8	23.4	15.9	657
	Weak	20	1.39×10^5	26.6	17.1	24.1	7.9	301

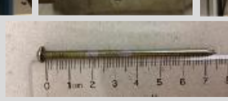
In-Plane Shear Test Methods and Results

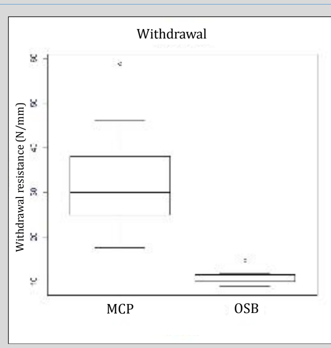
- ASTM D2719-modified
- 380 mm x 610 mm specimen
- Specimen bolted between two sets of steel rails and loaded in tension
- Shear strain measured using digital image correlation (DIC)

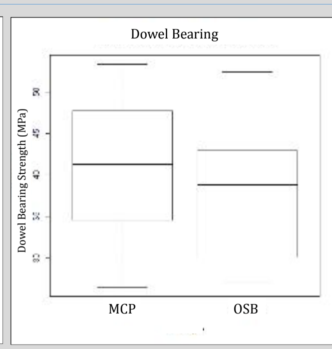
Panel type	Shear stiffness (GPa)	Shear strength (MPa)	Maximum load (kN)	Elastic stiffness (kN/mm/mm)
MCP	0.58	3.68	97.3	3.1×10^4
OSB	1.24	9.18	57.2	1.6×10^4

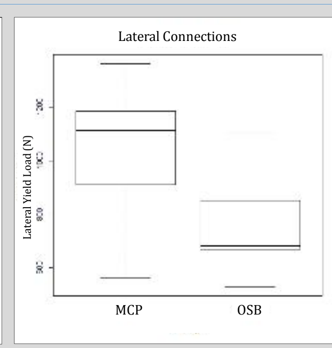


Mechanical Connection Test Methods and Results









Acknowledgments

- **Neucor, Inc**. for financial and technical support and providing the mold. **GP Chemicals** for providing PF adhesive. **Hexion Specialty Chemicals** for providing PRF adhesive