Mechanical Properties of Oriented Strand Board (OSB) Including Softwood Strands Obtained from an Innovative Strander-Canter

Rosilei Garcia, Alain Cloutier
Irsan Alipraja, Roger Hernández, Ahmed Koubaa

PTF BPI 2025
18-19 September 2025
Kuchl, Austria

Corepan Bois
Research Consortium on Wood-Based Panels

UNIVERSITÉ LAVAL

Presentation Content

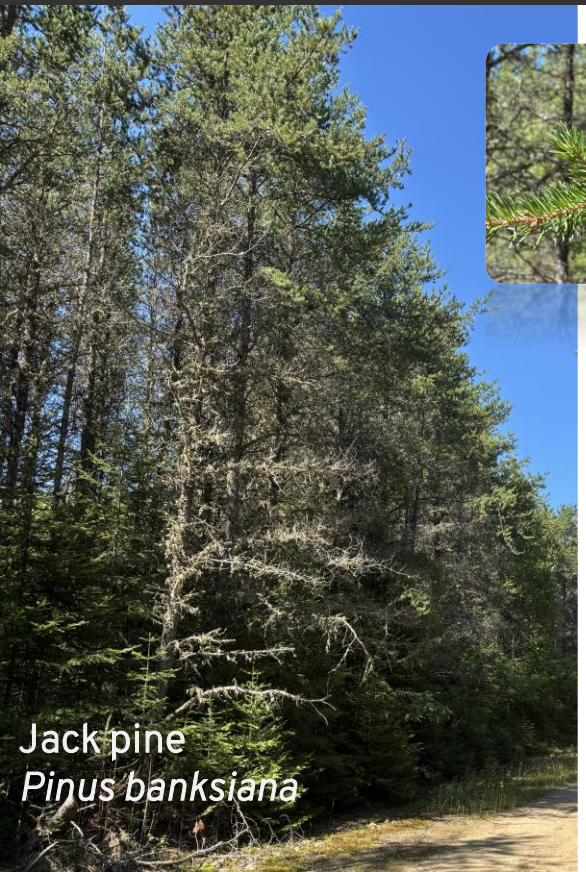
Corepan Bois
Research Consortium on
Wood-Based Panels

- Introduction
- Objectives
- Materials and Methods
- Results
- Conclusions
- Future Work & Recommendations

UNIVERSITÉ LAVAL

Introduction

Corepan Bois
Research Consortium on Wood-Based Panels



- Canada is a major producer of **softwood lumber**
- **Jack pine** is one of the most important commercial softwood species in Eastern Canada
- Softwood logs are processed using **chipper-canters**, which produce wood chips as a co-product for pulp mills
- Declining demand for newsprint and print paper has led to an **oversupply of wood chips** → economic losses for sawmills and raising environmental concerns
- Utilizing a novel **strander-canter** that can simultaneously produce log cants and OSB strands as co-products could address these issues

UNIVERSITÉ LAVAL

Objectives

Corepan Bois
Research Consortium on Wood-Based Panels

1. Evaluate the quality of **jack pine strands** produced by a novel strander-canter machine
2. Produce **OSB panels** with jack pine strands and assess their mechanical and physical properties
3. Compare their properties with those of OSB panels made from **industrial strands** and verify their **conformity with standard** requirements

UNIVERSITÉ LAVAL

Materials and Methods

Corepan Bois
Research Consortium on Wood-Based Panels

OSB Strands Production by Strander-Canter

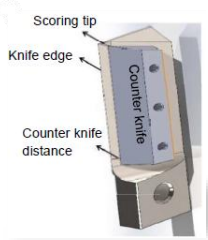
Strander-canter
(DK-SPEC, Lévis, QC, Canada)

- **Cutterhead:** 900 mm diameter
  33 straight knives in a spiral pattern
- **Knife settings:**
  - Knives offset radially by 0.9 mm (nominal strand thickness)
  - Cutting speed: 25 m/s
  - Nominal strand length: 102 mm

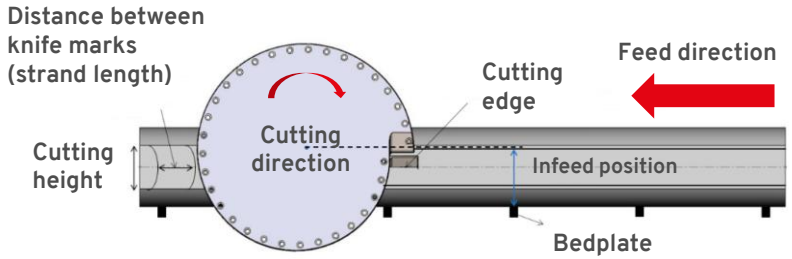
Jack pine logs
(*Pinus banksiana* Lamb.)

- **Frozen** and **unfrozen** conditions
- **Dimensions:** 2.4 m length, 209 mm diameter
- **Average basic density:** 468 kg/m^3
- **Moisture content:** 113.8%

Experimental design for cutting parameters
(8 treatments)



Log Condition	Counter-knife angle (CKA)	Counter-knife and knife edge distance (CKD)	Treatment Label
Frozen	60º	All levels mixed	frozen_logs_60º
Unfrozen	75º	All levels mixed	unfrozen_logs_75º
	90º	6 mm	unfrozen_logs_90º-6
		11 mm	unfrozen_logs_90º-11
		16 mm	unfrozen_logs_90º-16
	105º	6 mm	unfrozen_logs_105º-6
		11 mm	unfrozen_logs_105º-11
		16 mm	unfrozen_logs_105º-16



Materials and Methods

Corepan Bois
Research Consortium on Wood-Based Panels

OSB Panel Manufacturing

1 Panel Specifications

- **Dimensions**: 760 mm × 760 mm × 11 mm
- **Target Density**: 630 kg/m^3
- **PF Resin:**
  - ✓ Surface: 7%
  - ✓ Core: 5%
- **Emulsion Wax:**
  - ✓ Surface: 1%
  - ✓ Core: 0.5%

2 Mat Formation

- **Three-layers**
- **Surface Layers**: Industrial aspen/softwood strands
- **Core Layer**: Jack pine strands (strander-canter)
- **Control**: Panels with only industrial strands

3 Panel Manufacturing

- **Hot pressing**: Dieffenbacher North America Inc. lab press
- **Conditioning**: 20°C, 65% RH
- **Equilibrium at 8% moisture content**: ≤0.05% panel weight change per 24 h (ASTM D1037-12)

4 Experimental Design

- **3 Replicates** per treatment/control
- **Treatments**: 8 + control
- **Total Panels**: 27
- **Statistical Analysis:**
  - ✓ One-way ANOVA
  - ✓ Tukey's test

UNIVERSITÉ LAVAL

Materials and Methods

Corepan Bois
Research Consortium on Wood-Based Panels

Mechanical and Physical Properties

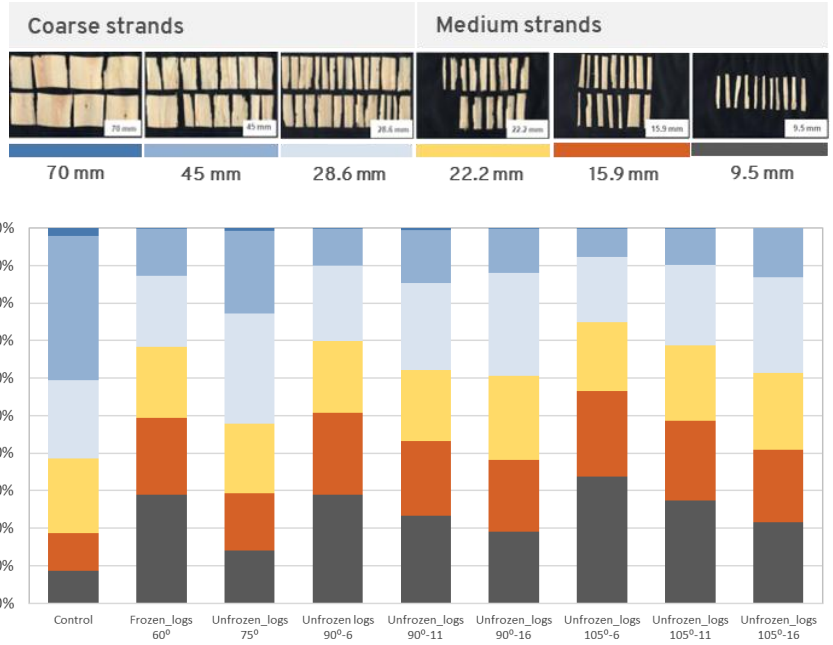
- **Bending properties** (CSA O325:21, ASTM D3043-17):
  2 specimens/panel (355 mm x 115 mm), parallel and perpendicular directions
  - MOE = Modulus of elasticity
  - MOR = Modulus of rupture
  - EI/b = Bending stiffness per mm of specimen width
  - S_bI/cb = Maximum moment per mm of specimen width
- **Internal bond (IB) strength** (ASTM D1037-12 (2020)):
  8 specimens/panel (50 x 50 mm)
- **Thickness swelling and water absorption after 24 h of water immersion**
  (CSA O325:21): 4 specimens/panel (150 x 150 mm)

UNIVERSITÉ LAVAL

Results

Corepan Bois
Research Consortium on Wood-Based Panels

Strand Size Distribution



Control

- high proportion of **coarse strands** → exceeding 60%
- Slenderness ratio: 205

Strander-canter treatments

- high proportion of **medium strands** → 60.5% to 74.9% depending on the treatment
- Slenderness ratio: 113

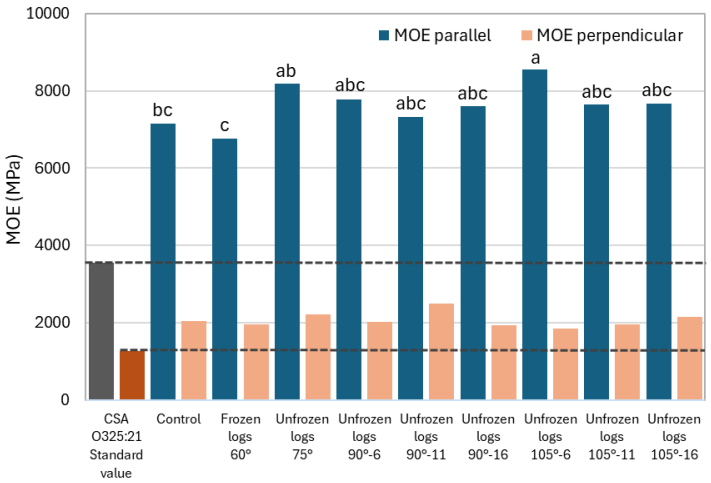
UNIVERSITÉ LAVAL

Results

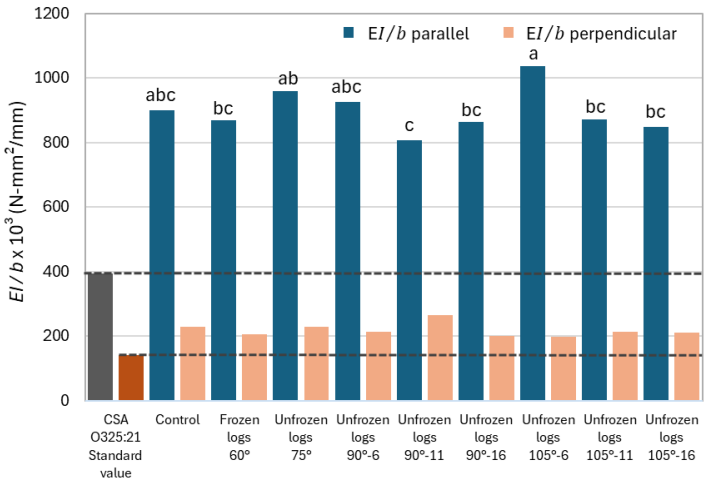
Corepan Bois
Research Consortium on
Wood-Based Panels

Bending Properties of OSB Panels

Modulus of elasticity (MOE)



Bending stiffness per mm of specimen width (*EI/b*)



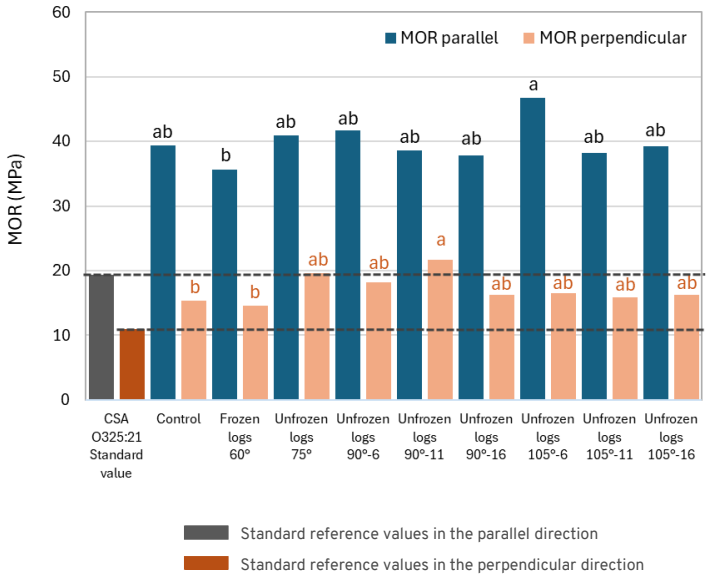
UNIVERSITÉ LAVAL

Results

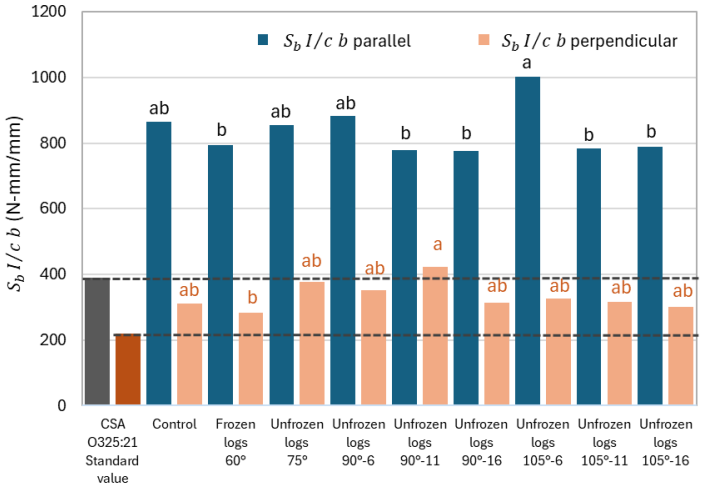
Corepan Bois
Research Consortium on Wood-Based Panels

Bending Properties of OSB Panels

Modulus of rupture (MOR)



Maximum moment per mm of specimen width ($S_b I/cb$)

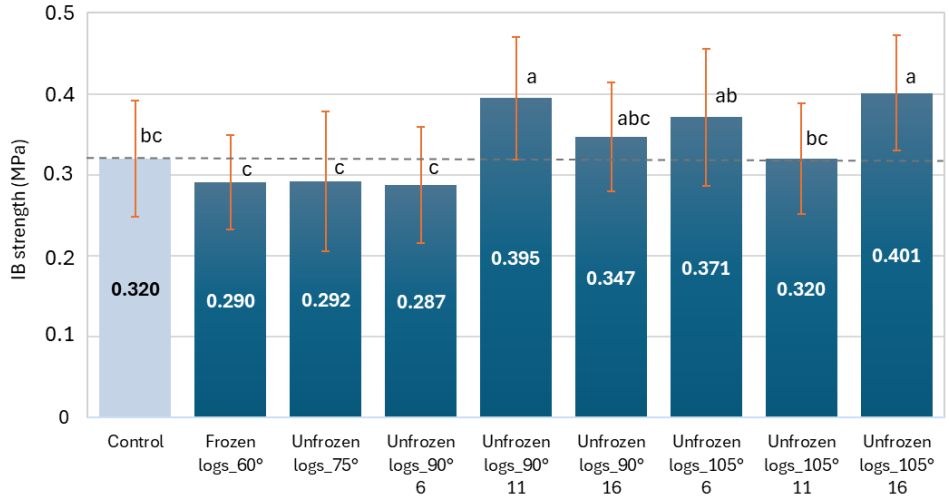


UNIVERSITÉ LAVAL

Results

Corepan Bois
Research Consortium on Wood-Based Panels

Internal Bond Strength of OSB Panels



Jack pine strands (strander-canter)

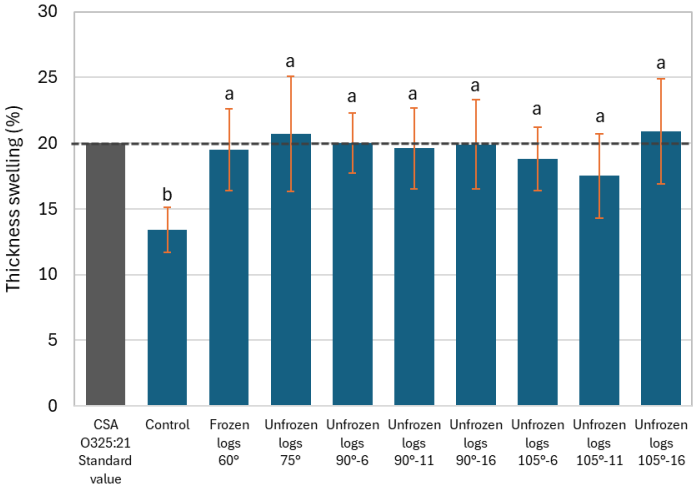
- **Lower slenderness ratio** → lower specific surface area
- **More adhesive** per unit of wood surface → increased adhesion

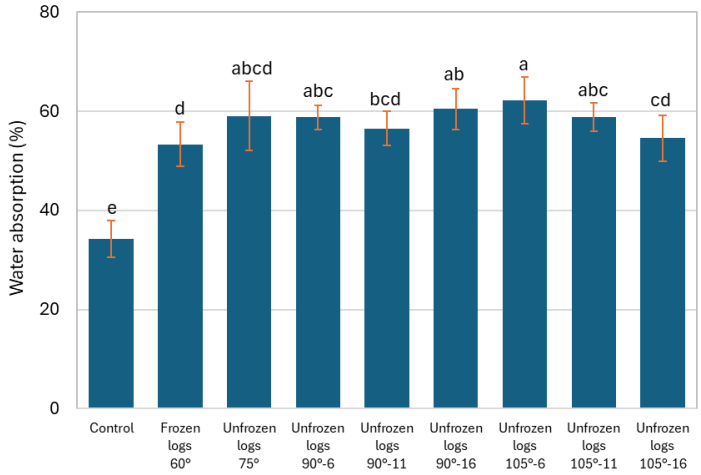
UNIVERSITÉ LAVAL

Results

Corepan Bois
Research Consortium on
Wood-Based Panels

Thickness Swelling and Water Absorption of OSB Panels





UNIVERSITÉ LAVAL

Conclusions

Corepan Bois
Research Consortium on Wood-Based Panels

OSB Panels with Jack Pine Strands in the Core Layer

- **Bending properties** exceeded CSA O325:21 standards → In some cases, jack pine strands enhanced overall panel performance in comparison to the control panels
- **IB strength** was comparable to control panels → certain treatments showed improved IB due to better adhesive coverage
- **Higher thickness swelling** and water absorption → Anatomical structure of jack pine wood and increased panel porosity from thicker strands

Strander-Canter Technology

- Demonstrated **technical feasibility** for producing quality strands suitable for the OSB core layer
- Offers potential for **industrial adoption**
- Enables more **efficient use** of softwood sawmill residues
- Opens **new avenues** for producing softwood-based OSB panels

UNIVERSITÉ LAVAL

Future Work & Recommendations

Corepan Bois
Research Consortium on Wood-Based Panels

- Optimize **cutting parameters** of the strander-canter to produce thinner strands
- Explore **other softwood species** for OSB production
  ➔ Particularly those with a more uniform wood structure (e.g., Balsam fir)
- Investigate **pressing strategies** to reduce density gradients between surface and core layers, aiming to decrease the thickness swelling
- Assess the **economic** aspect

UNIVERSITÉ LAVAL

Corepan Bois

Research Consortium on Wood-Based Panels

UNIVERSITÉ LAVAL

Faculté de foresterie, de géographie et de géomatique

UNIVERSITÉ LAVAL

UQAT UNIVERSITÉ DU QUÉBEC EN ABITIBI-TÉMISCAMINGUE

CRMR Centre de recherche sur les matériaux renouvelables

FPInnovations

SEREX L'INNOVATION AU SERVICE DU BOIS

SACOPAN

TAFISA®

ARBEC Division Panneaux OSB Shawinigan

UNIBOARD®

Conseil de recherches en sciences naturelles et en génie du Canada

Natural Sciences and Engineering Research Council of Canada

Canada

Ressources naturelles et Forêts Québec

Conseil de l'industrie forestière du Québec

forests

MDPI

Article

Performance of Oriented Strand Boards Made with Jack Pine Strands Produced by an Innovative Strander-Canter

Rosilei Garcia [1], Alain Cloutier [1,*], Irsan Alipraja [2], Roger E. Hernández [1] and Ahmed Koubaa [3]

[1] Renewable Materials Research Centre (CRMR), Faculty of Forestry, Geography, and Geomatics, Université Laval, Québec, QC G1V 0A6, Canada; rosilei.aparecida-garcia@sbf.ulaval.ca (R.G.); roger.hernandez@sbf.ulaval.ca (R.E.H.)
[2] Department of Forest Products, Bogor Agricultural University, Bogor 16680, West Java, Indonesia; alipraja.thh42@apps.ipb.ac.id
[3] Forest Research Institute, Université du Québec en Abitibi-Témiscamingue (UQAT), Rouyn-Noranda, QC J9X 5E4, Canada; ahmed.koubaa@uqat.ca
* Correspondence: alain.cloutier@sbf.ulaval.ca; Tel.: +1-418-656-2131 (ext. 405851)

Abstract

Canadian sawmills commonly use chipper-canters to process softwood logs into squared lumber and wood chips for pulp mills. However, the declining demand for newsprint and print paper has led to an oversupply of wood chips, resulting in economic losses and environmental concerns. To address this issue, a strander-canter capable of producing both softwood cants and strands for oriented strand board (OSB) presents a promising alternative. This study evaluates the feasibility of using jack pine strands generated by a novel strander-canter equipped with a cutterhead for OSB strand production. Strands were generated from frozen and unfrozen logs under varying cutting parameters and incorporated in the core layer of the panels. Industrial aspen strands were used for the surface layers. OSB panels were assessed for mechanical and physical properties following the CSA O325:21 standard. Strand size distribution and vertical density profiles were also analyzed. The results indicated that panels made from jack pine strands demonstrated bending and internal bond properties that were either comparable to or superior to those of the control panels. However, including jack pine strands in the core layer increased the thickness swelling of the panels.

check for updates

Academic Editors: Roberto Zanuttini and Francesco Negro

Received: 25 June 2025
Revised: 16 July 2025
Accepted: 23 July 2025
Published: 25 July 2025

Keywords: softwood residues; chipper-canter; primary wood processing; strand geometry; cutting parameters; wood-based composite panels; sustainable wood utilization

Scan the QR code for more information

UNIVERSITÉ LAVAL