Q-05-NA

Using thermally modified wood for manufacturing mass timber elements with improved dimensional stability

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Anticipated Start Date: *August 2024* | **Expected Duration:** *12 Months*

Need & Industrial Relevance | Goals & Objectives

Need & Industrial Relevance

The growing interest in using mass timber structures necessitates addressing the durability of these products. An approach towards enhancing the durability and dimensional stability is wood thermal modification. Despite the proven effectiveness of this process on wood durability, questions raise on the mechanical performance of thermally modified wood products. Also, limited research is available on the gluing and bonding performance of these products. Thus, there is a need to assess the durability, mechanical and bonding performance of laminated thermally modified wood products.

Research Roadmap Topics

TOPIC 2024-09: Improved dimensional stability so that EWP can compete with non-wood options.

Long Term Goals

Improving the dimensional stability and durability of engineered wood products.

Objectives

The specific objectives of the project are to:

1) Testing the mechanical performance and dimensional stability of thermally modified Western hemlock
2) Preparing laminated thermally-modified wood samples.
3) Assessing the shear strength and bonding quality of the laminated samples.
4) Effect of surface treatments on the bonding performance of the laminated samples.

Materials and Methods

Materials

Thermally modified Western hemlock treated at 190°C, 212°C, and 230°C.

Dimensional Stability Assessment
treated and untreated samples are submerged in water at room temperature. The samples are weighed, and their dimensions are measured before and after immersion in water for 24 h. Finally, all samples will be oven-dried at 103 ± 2 °C for 24 h, and their dimensions and weight will be measured again. The volumetric swelling coefficient and water absorption will then be calculated, accordingly.

Mechanical Properties
Static bending test will be performed. Alternative option includes nondestructive stress-wave methods for MOE prediction.

Lamination and bonding assessment

- Two types of planing condition to produce surface with different roughness
- Lamination using one-component polyurethane (PUR) [or other options suggested by WBC members].
- Block shear samples for testing the “Shear Strength of Adhesive Bonds”
- Evaluation of percent wood failure (PWF)

Outcomes and Deliverables

Expected Outcome	Deliverable (s)	2024				2025										
		A	S	O	N	D	J	F	M	A	J	J	A	S	O	N
Dimensional stability and mechanical performance of Western hemlock treated at different temperatures	Properties of control and treated wood prior to lamination.															
Preparing laminated samples using control and thermally modified wood samples.	Sample preparation															
Applying different surface treatments	Sample preparation															
Testing dimensional stability	Post-lamination properties: dimensional stability															
Mechanical and bonding performance evaluation	Post-lamination properties: mechanical and bonding performance															
Documentation	Project progress/summary report															

Expected Practical Implications/Impacts

The project outcome will be used to assess the effectiveness of using thermally modified wood in manufacturing laminated products. The project could be expanded in next years by: (1) studying methods to improve the mechanical properties; (2) methods to enhance the bonding performance (e.g. different surface treatments); (3) preparing thermally modified wood veneer and manufacturing veneer-based product using the thermally modified wood; (4) conducting the methodology on other wood species of interest. Some of the beneficial impacts of the project include:

1. A baseline towards improving the durability and dimensional stability of engineered wood products,
2. Proposing thermal modification, as an environmentally friendly method and feasible at industrial scale, to enhance the durability and dimensional stability,
3. Providing a database for the bonding performance of laminated thermally-modified wood,
4. Helpful skills gained by graduate student,
5. Offering industry a feasibility study on the opportunities and challenges of applying thermal modification in manufacturing of laminated wood products.

Budget

Budget justification & request for funding

Funds are requested to support a Graduate Research Assistant ($ 17,300).

$ 1,400 was requested for materials and supplies (e.g. resin).

- No fund is requested for the thermally modified wood samples and testing equipment.
- Thermally modified Western hemlock is already provided.
- All testing and analysis will be conducted at OSU.

BUDGET	AMOUNT
First Year Expenses	
GRA & Benefits	$ 17,300
Tuition & Fees	
Materials/Supplies	$ 1,400
Travel	
Other (specify):	
YEAR 1 TOTAL:	$ 18,700
Expected future request amounts:	

Thank You

Questions?