PERFORMANCE MODIFIED WOOD FROM TREES NATIVE TO THE PACIFIC NORTHWEST FOR EXTERIOR CONSTRUCTION

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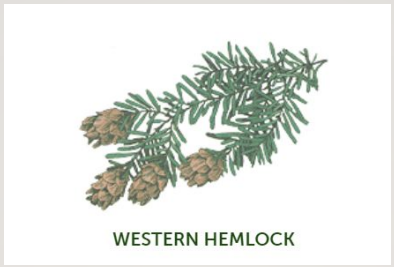
PROJECT OBJECTIVES

- Hydrothermal treat selected native wood species to determine suitability for exterior use
- These species are;

1. Western Hemlock
2. Douglas Fir
3. Red Alder
4. Blue-stained Ponderosa pine

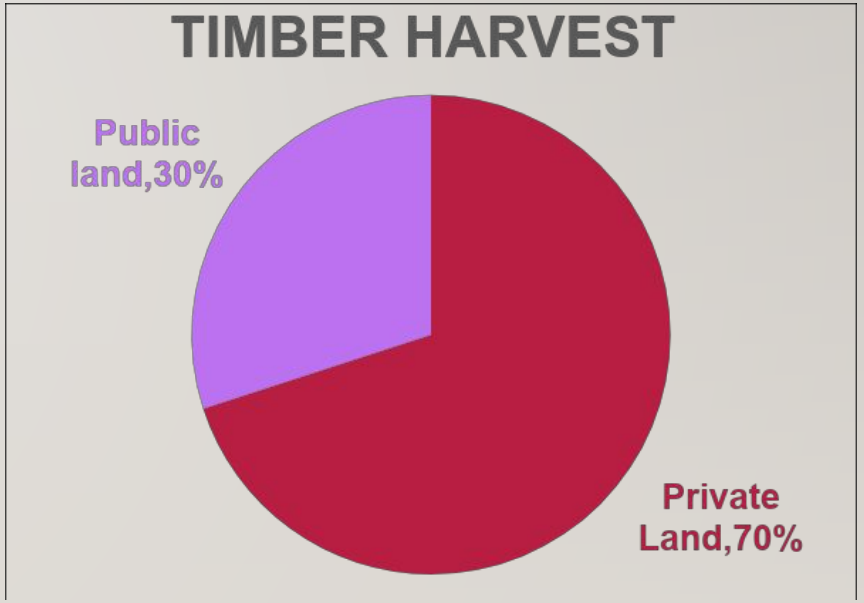
FORESTS ECOLOGY OF WASHINGTON STATE



Source: Washington Forest Protection Association

TIMBER HARVESTED IN WASHINGTON STATE

- Nearly 70% of the timber harvested in Washington State comes from privately owned forests (WFPA, 2023).
- About 60% of these can be classified as being managed by "industrial private forest landowners" (WFPA, 2023)
- The other 40% consists of small family tree farmers and private individuals (WFPA, 2023).



(WFPA, 2023)

CURRENT PRACTICE

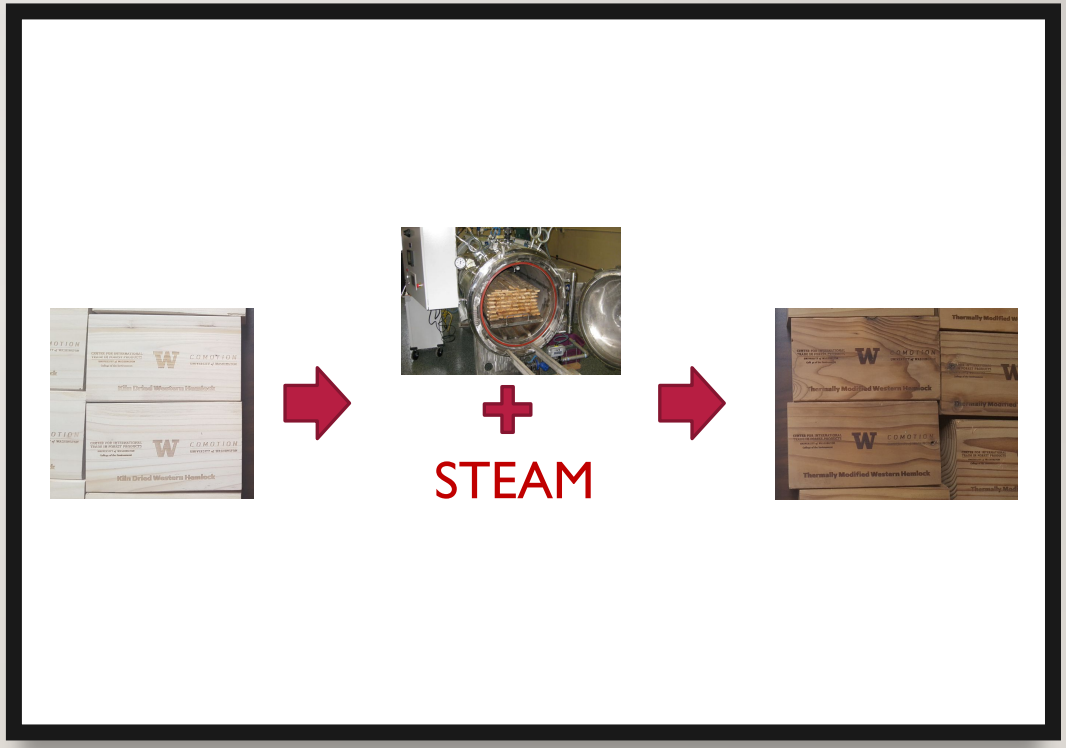
The prevailing option available for exterior woodwork is Hem fir and Southern yellow pine

These wood products are pressure treated with Alkaline Copper Quaternary (ACQ); Chemical modification

Hydrothermal modification is an alternative method of modification

WHAT IS HYDROTHERMAL MODIFICATION?

- Thermal modification is a treatment that uses heat to alter the chemical composition of timber.
- Hydrothermal treatment adds steam for more effective heat transfer



WHAT IS HYDROTHERMAL MODIFICATION?

Result

- Pros

  Improved stability, reduced water absorption, Increased durability, and decay resistance.

- Cons

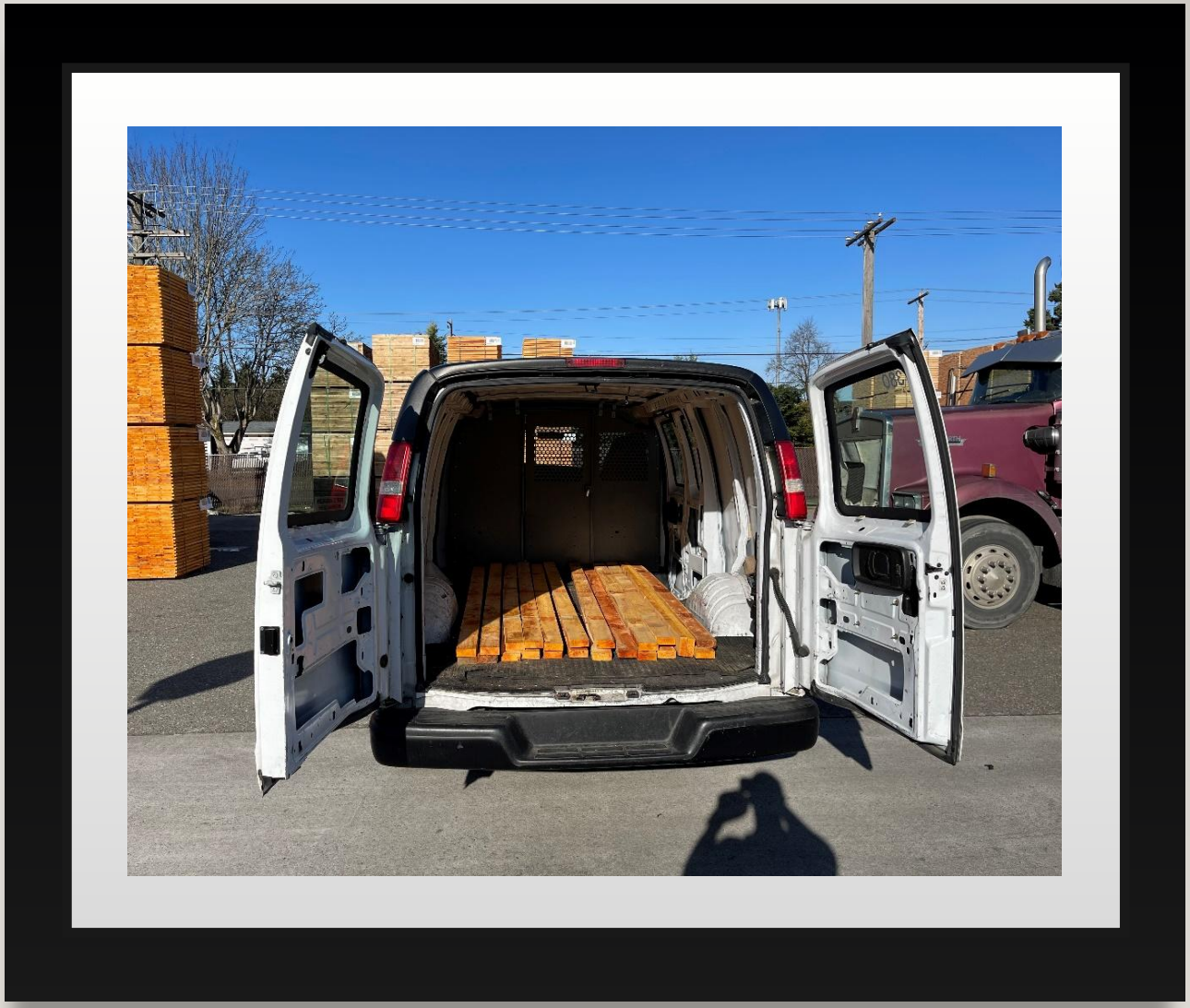
  Strength? Cost?

BACK TO OUR WORK…

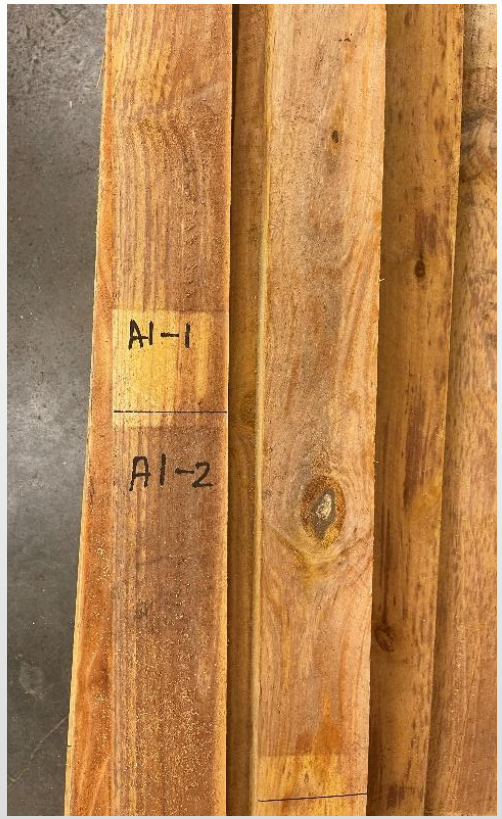
- The focus of the study was the process of sourcing, treating, and testing the **Red alder**.

	SPECIES	PROGRESS
	Red Alder	Modified & Analyzed

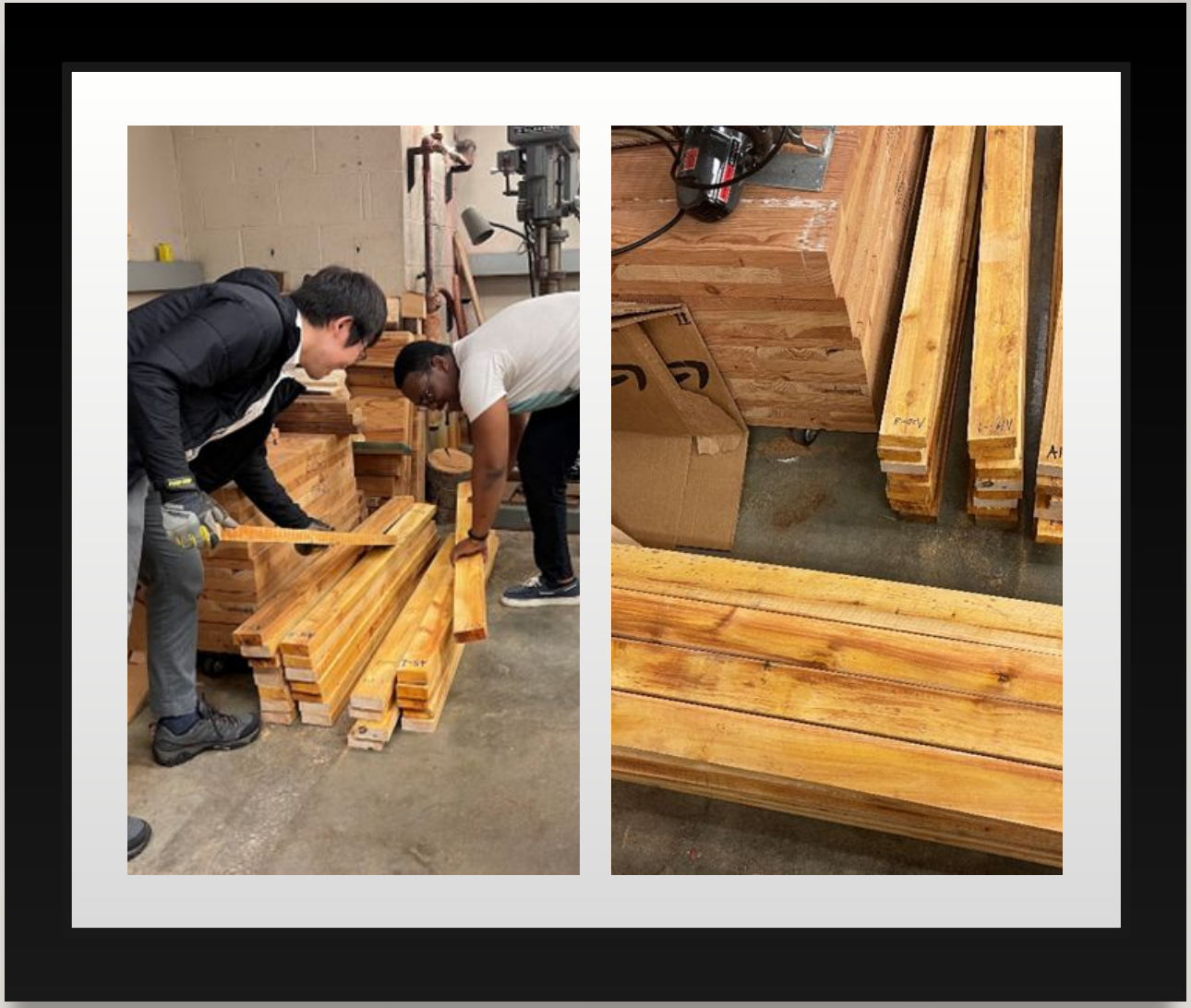
- Northwest Hardwoods in centralia donated Red Alder for the Research Work.



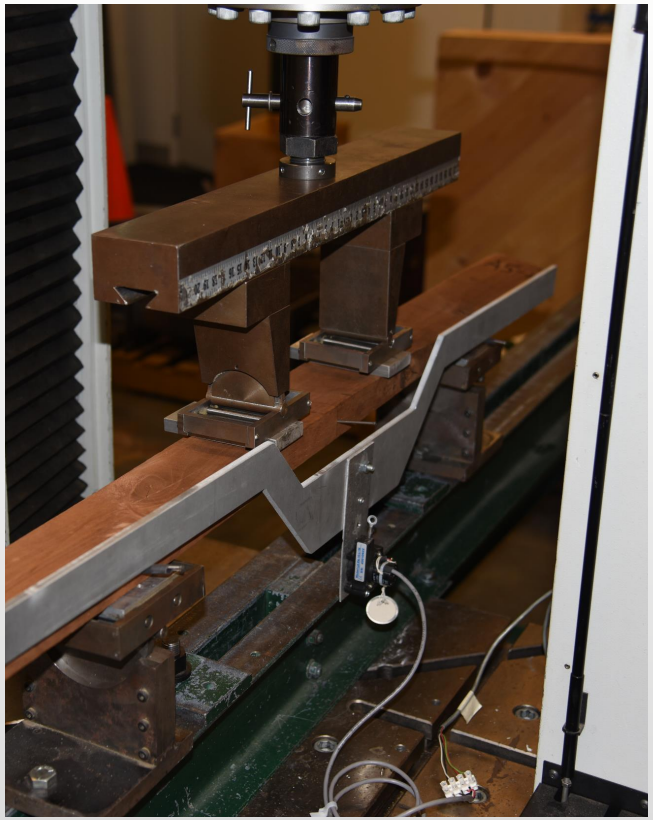
- Coded and cut the wood in preparation



- One set was modified (Kiln in Montana) the other is the control



WSU CONDUCTED STATIC TESTS ON OUR WOOD



Designation: D 198 – 99

Standard Test Methods of Static Tests of Lumber in Structural Sizes[1]

This standard is issued under the fixed designation D 198; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

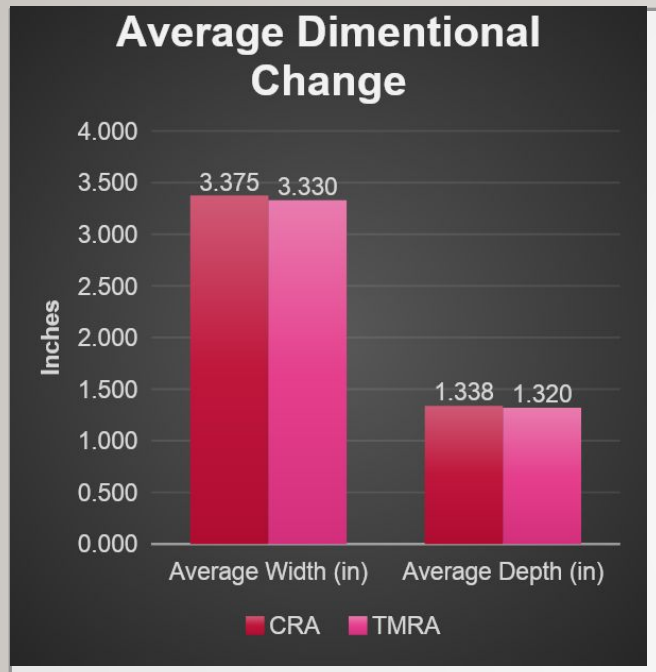
INTRODUCTION

Numerous evaluations of structural members of solid sawn lumber have been conducted in accordance with ASTM Test Methods D 198 – 27. While the importance of continued use of a satisfactory standard should not be underestimated, the original standard (1927) was designed primarily for sawn material such as solid wood bridge stringers and joists. With the advent of laminated timbers, wood-plywood composite members, and even reinforced and prestressed timbers, a procedure adaptable to a wider variety of wood structural members is required.

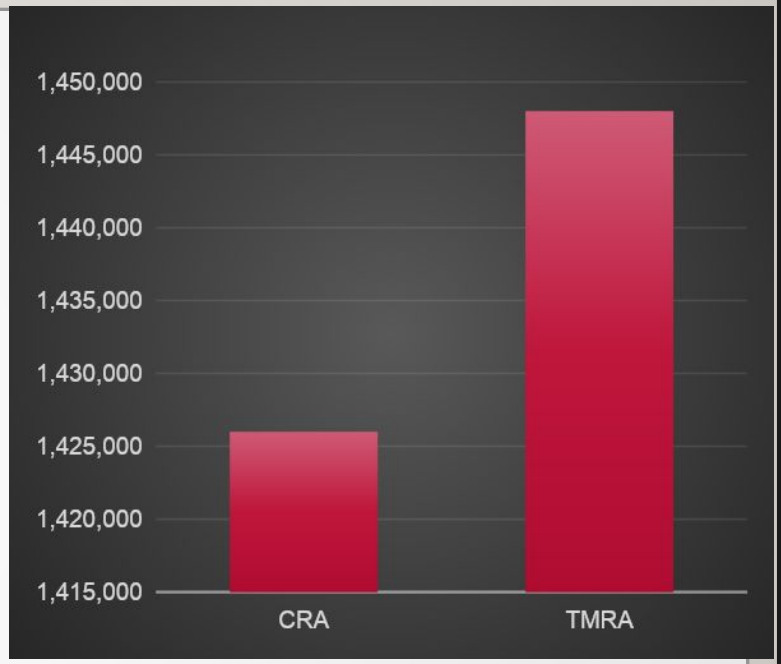
The present standard expands the original standard to permit its application to wood members of all types. It provides methods of evaluation under loadings other than flexure in recognition of the increasing need for improved knowledge of properties under such loadings as tension to reflect the increasing use of dimensions lumber in the lower chords of trusses. The standard establishes practices that will permit correlation of results from different sources through the use of a uniform procedure. Provision is made for varying the procedure to take account of special problems.

RESULTS

Specimen no.	Average Width (in)	Average Depth (in)	Density (lb.ft-3)	Modulus of Rupture (psi)	Apparent Modulus of Elasticity (psi)	Max. Load (lbf)	MC	SG
CRA	3.375	1.338	31.2	7,930	1,426,000	1,777	15.6%	0.49
TMRA	3.330	1.320	28.6	4,880	1,448,000	1,049.7	11.8%	0.47
Change	0.046	0.018	2.623	3050.000	-22000.000	727.383	0.038	0.016
% change	1.35%	1.35%	8.40%	38.46%	-1.54%	40.93%	24.27%	3.36%


Average Dimentional Change
4.000
3.500
3.000
2.500
2.000
1.500
1.000
0.500
0.000
Inches
3.375
3.330
1.338
1.320
Average Width (in)
Average Depth (in)
CRA
TMRA


9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
7,930
4,880
CRA
TMRA


1,450,000
1,445,000
1,440,000
1,435,000
1,430,000
1,425,000
1,420,000
1,415,000
CRA
TMRA

1.35%

38.46%

1.54%

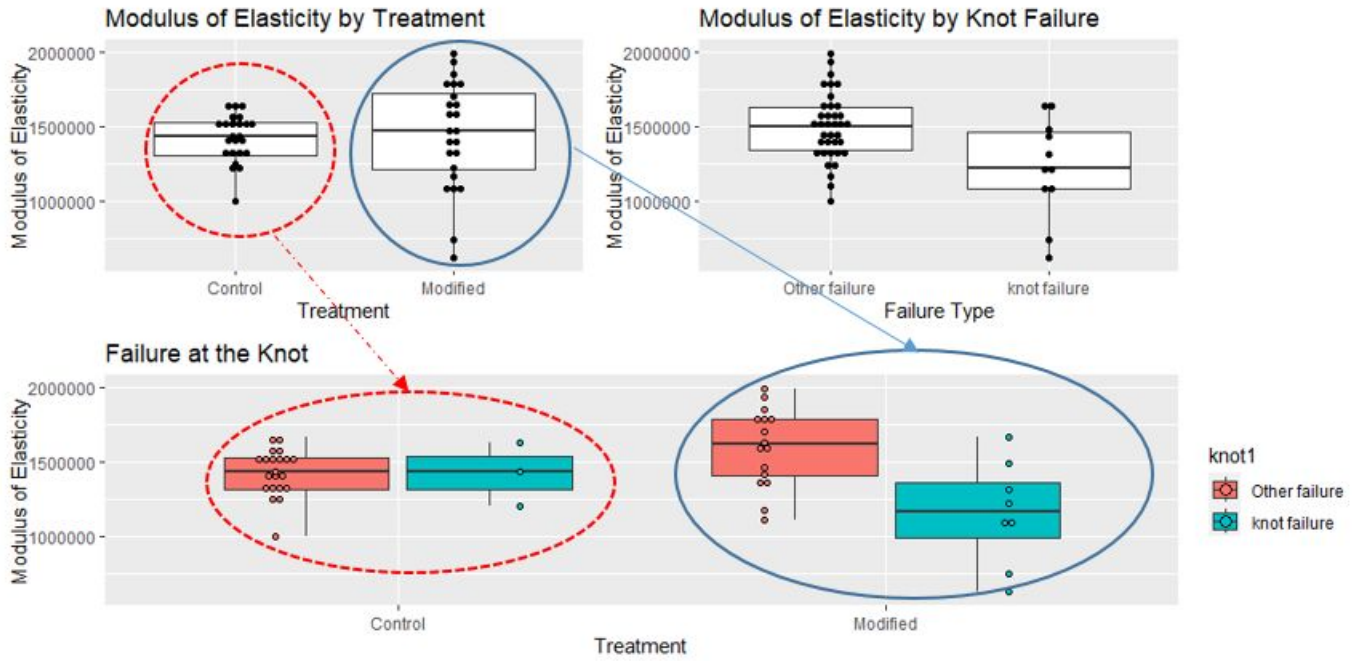


Figure 10: Box Plot Graph of MOE

		Df	Sum Sq	Mean Sq	F value	P value (Pr(>F))
1.	**Treatment**	1	5.742e+09	5.742e+09	0.102	0.7511
2.	**Failure Type**	1	7.000e+11	7.000e+11	12.420	0.0010 **
3.	**Treatment and Failure Type**	1	3.315e+11	3.315e+11	5.882	0.0195 *
	Residuals	44	2.480e+12	5.636e+10		

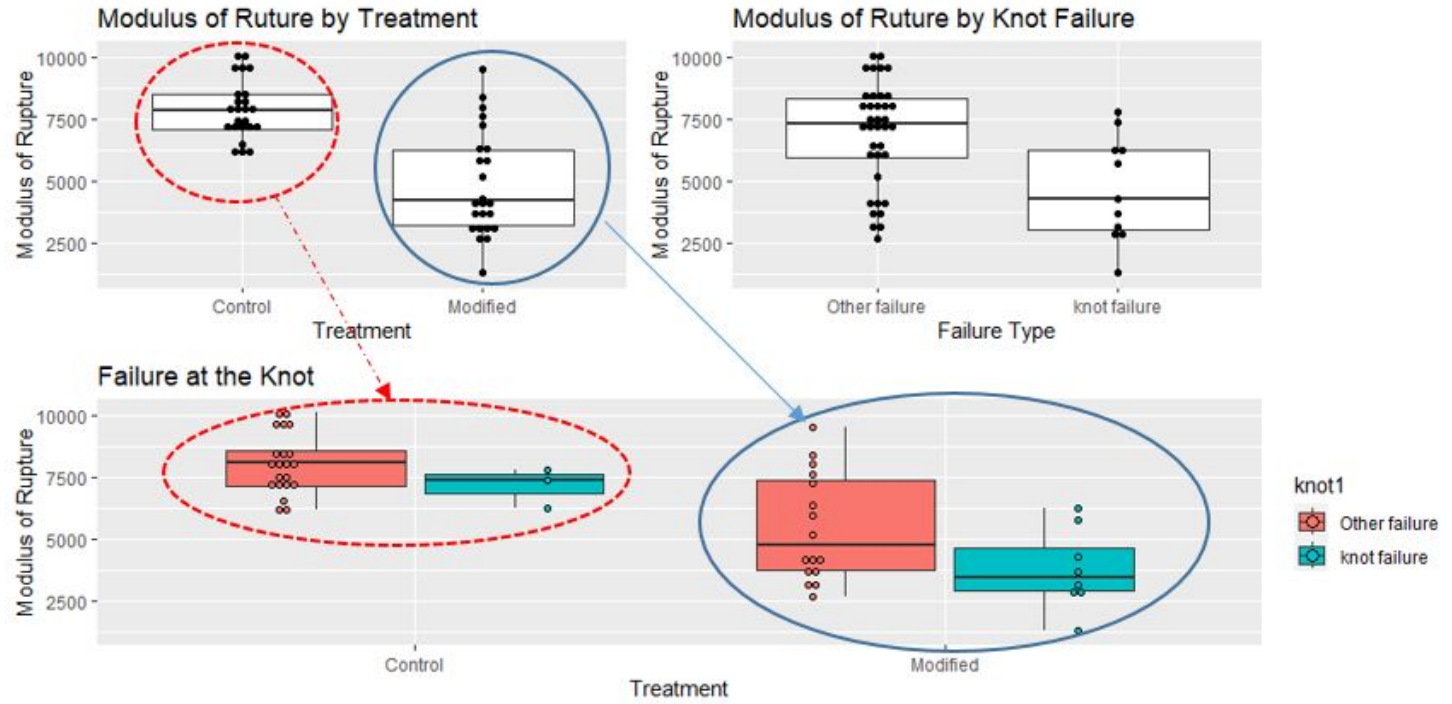


Figure 11: Box Plot Graph of MOR

		Df	Sum Sq	Mean Sq	F value	P value (Pr(>F))
1.	**Treatment**	1	6349038	6349038	49.292	1.07e-08 ***
2.	**Failure Type**	1	703770	703770	5.464	0.024 *
3.	**Treatment and Failure Type**	1	52961	52961	0.411	0.525
	Residuals	44	5667356	128804		

Table 4 ANOVA Table of MOR analysis

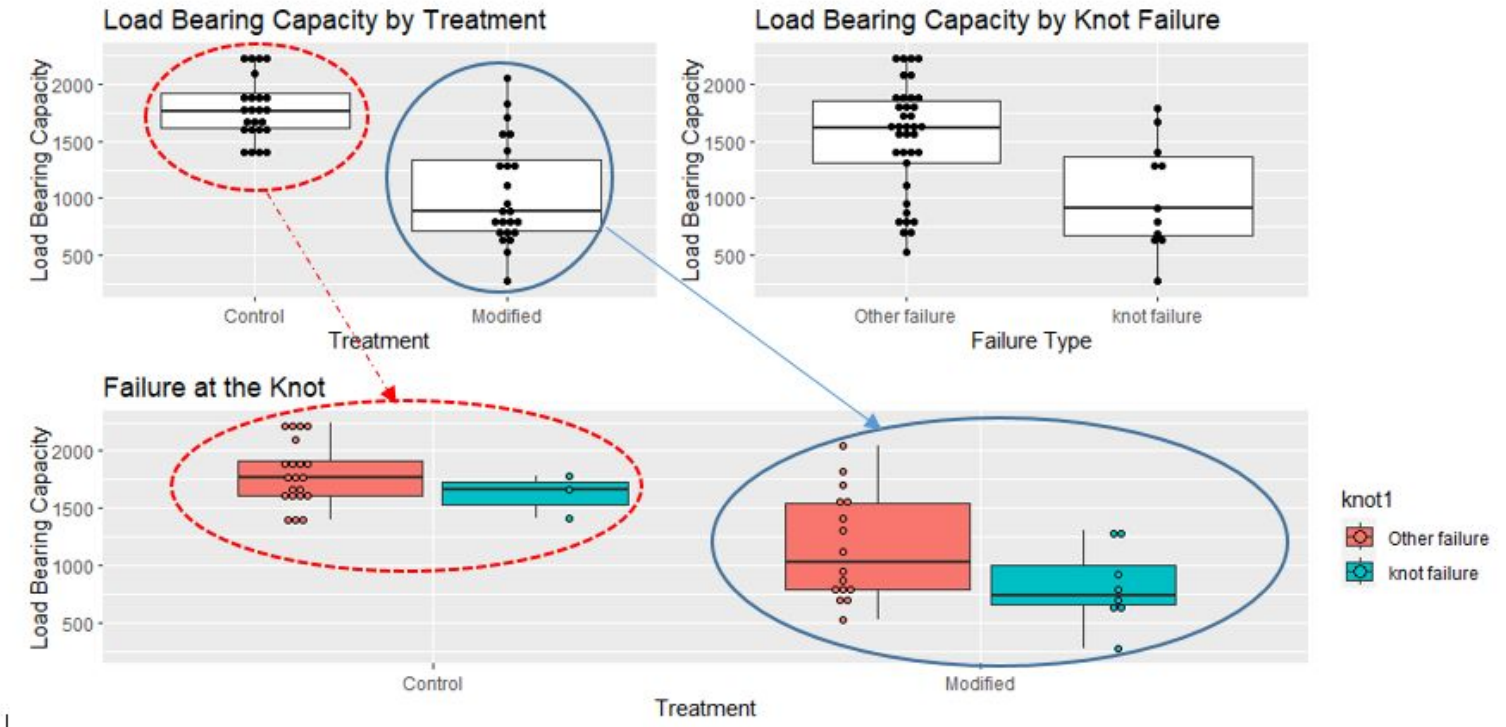


Figure 12: Box Plot Graph of Max Load

		Df	Sum Sq	Mean Sq	F value	Pr(>F)
1.	**Treatment**	1	111477552	111477552	41.269	8.02e-08 ***
2.	**Failure Type**	1	16105219	16105219	5.962	0.0187 *
3.	**Treatment and Failure Type**	1	1040590	1040590	0.385	0.5380
	Residuals	44	118854937	2701249		

Table 5: ANOVA Table of Max Load analysis

CONCLUSIONS AND RECOMMENDATIONS

- Clear wood use is essential to optimize mechanical performance.
- Availability, not cost is the limiting factor for further testing and potential adoption


CENTER FOR INTERNATIONAL TRADE IN FOREST PRODUCTS
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College of the Environment
COMOTION
UNIVERSITY of WASHINGTON
Kiln Dried Western Hemlock
Thermally Modified Western Hemlock


THANK YOU