State Of Arts Of Hardwood Cross-laminated Timbers (HCLTs) and PRG 320 Inclusion of Hardwood Lumber in CLTs

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July 25th 2023

SUSTAINABLE BIOMATERIALS

VIRGINIA TECH

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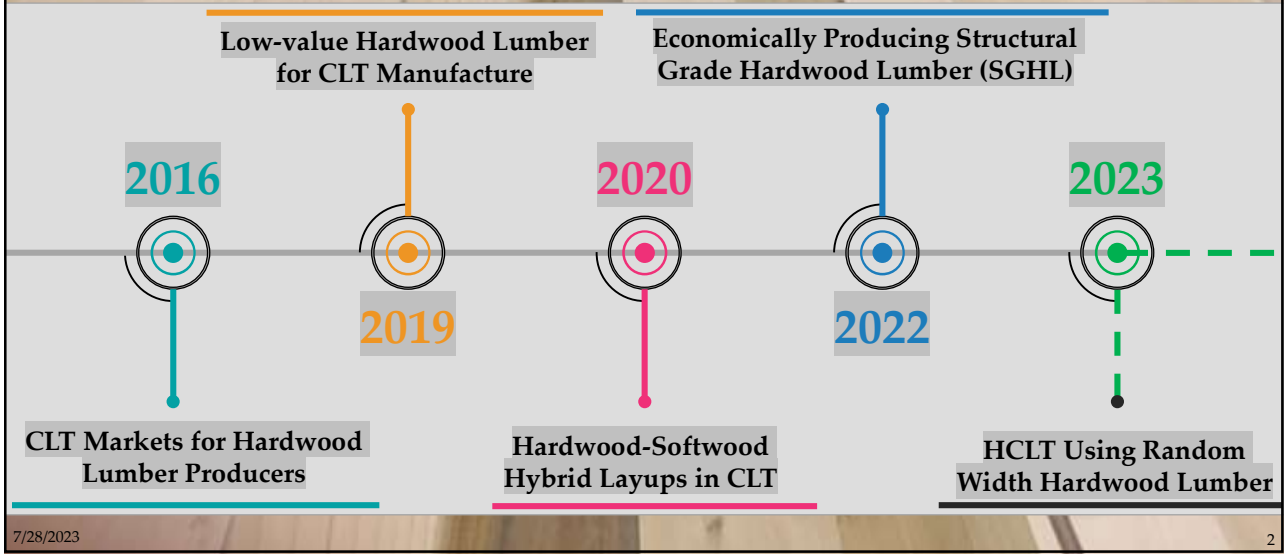
Our Route to Commercial Hardwood CLTs



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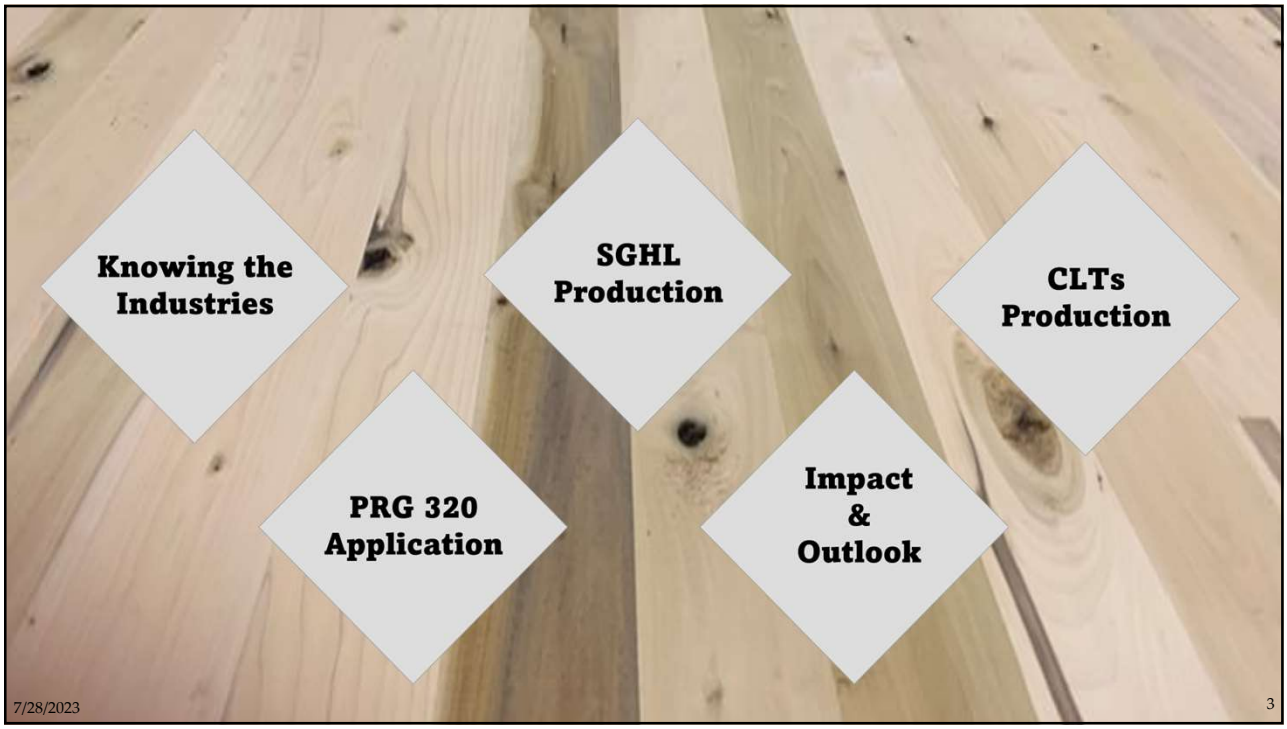
Knowing the Industries
SGHL Production
CLTs Production
PRG 320 Application
Impact & Outlook
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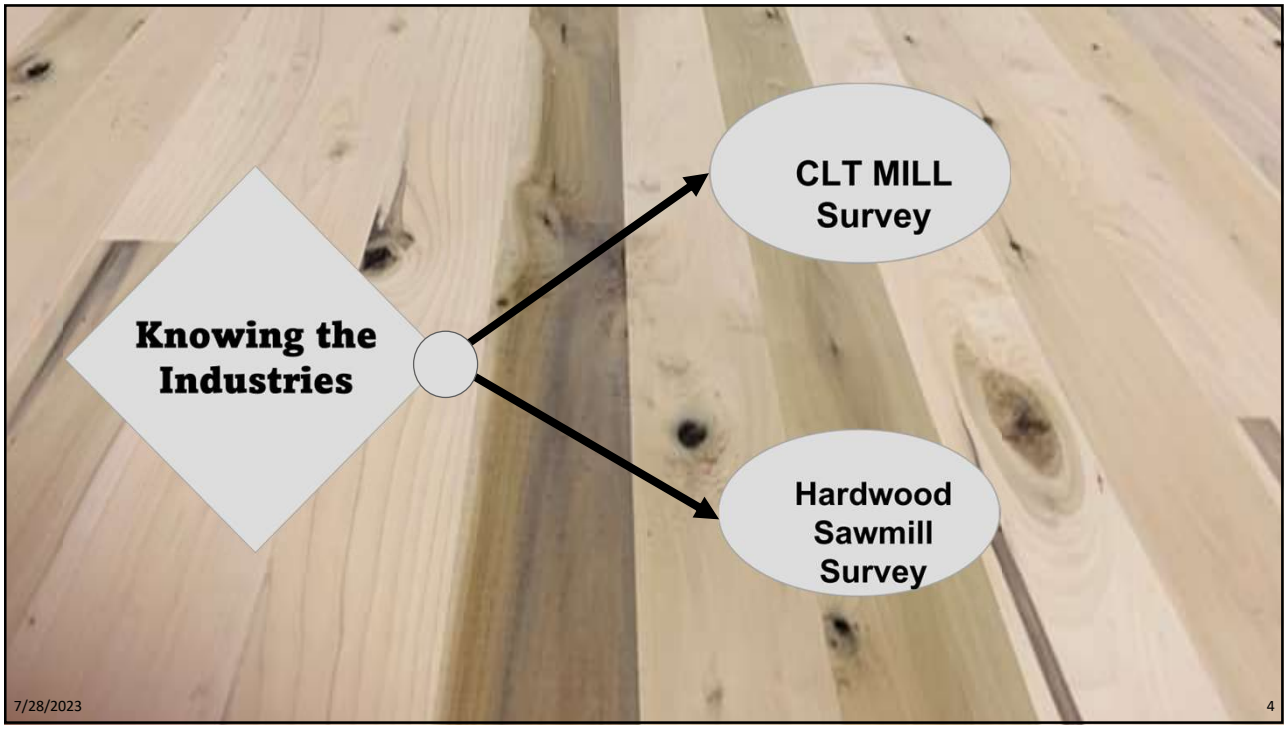
Knowing the Industries
CLT MILL Survey
Hardwood Sawmill Survey
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CLT Mill Survey

Technology
Adequate technology to use hardwood lumber
Need some adjustments

Lumber
Various dimension
Higher moisture content
Hard to work with multiple species at once
Not enough volume

Cost
Increase press time and glue volume
Increase transportation due to higher density

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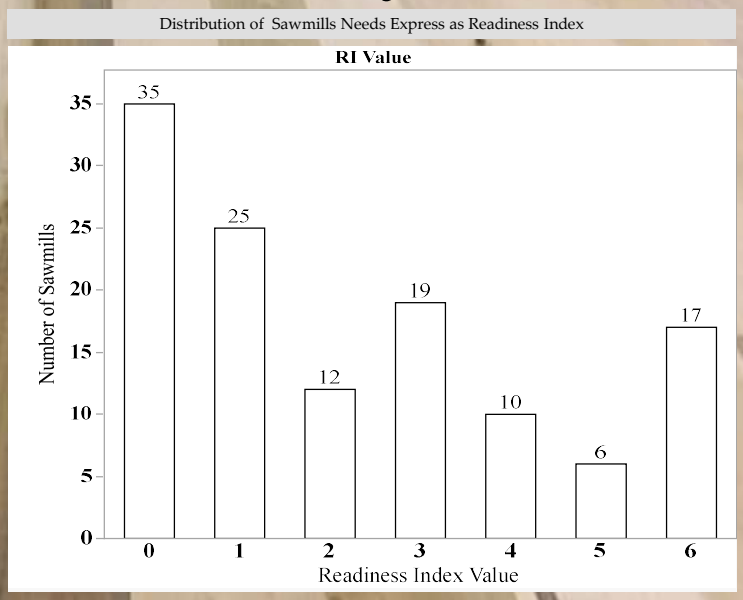
Hardwood Sawmill Survey

Do you have SGHL:
- Sawing capacity
- Drying capacity
- Surfacing capacity
- Grading capacity
- Sorting capacity
- Inventory space

- RI =6 have all resources
- RI = 0 have no resources



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Let Us Frist Know About SGHL for CLTs
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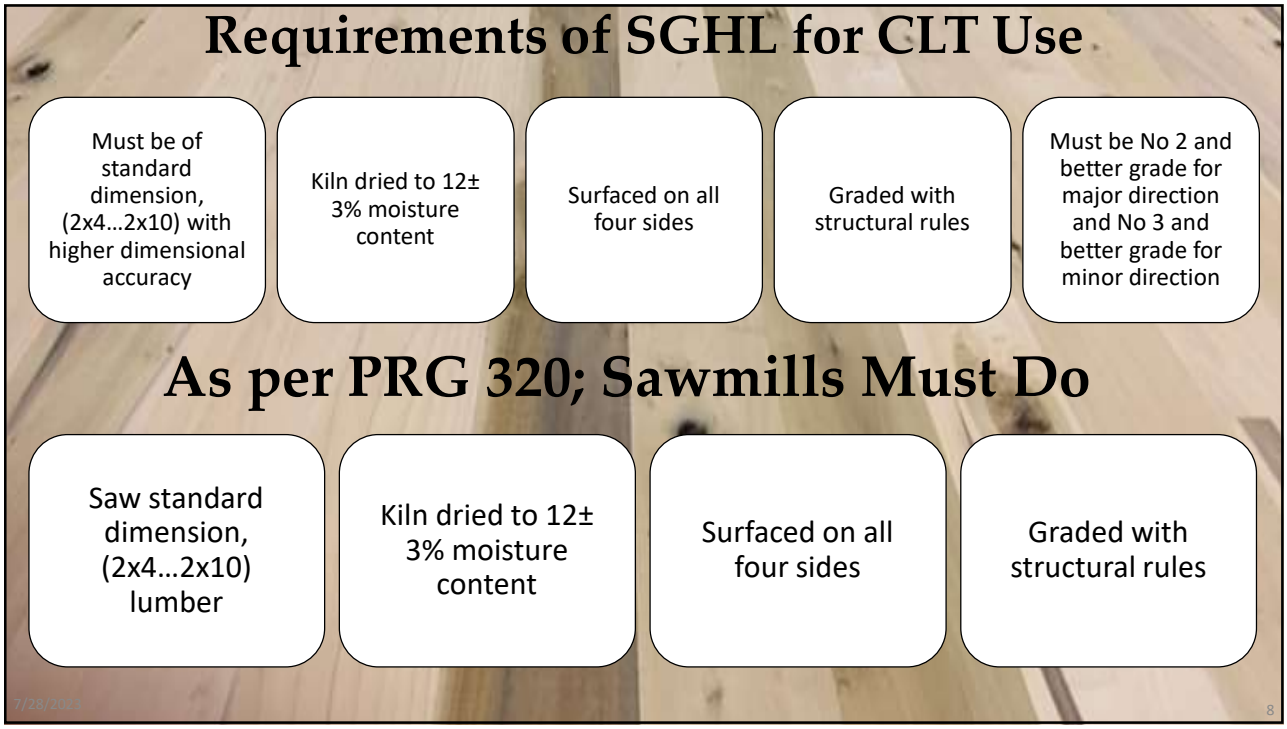
Requirements of SGHL for CLT Use
Must be of standard dimension, (2x4…2x10) with higher dimensional accuracy
Kiln dried to 12± 3% moisture content
Surfaced on all four sides
Graded with structural rules
Must be No 2 and better grade for major direction and No 3 and better grade for minor direction
As per PRG 320; Sawmills Must Do
Saw standard dimension, (2x4…2x10) lumber
Kiln dried to 12± 3% moisture content
Surfaced on all four sides
Graded with structural rules
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Who Provides Grading Service For SGHL ?

SGHL must be graded with exact same rules used to grade softwood lumber so any agencies/grader who has license to grade structural grade lumber can grade

Rules Writing Agencies	Rules for which grading is authorized
Northeastern Lumber Manufacturers Association (NELMA) 272 Tuttle Road, P.O. Box 87A, Cumberland Center, Maine 04021	NELMA, NLGA, NSLB, SPIB, WCLIB, WWPA
Northern Softwood Lumber Bureau (NSLB) 272 Tuttle Road, P.O. Box 87A, Cumberland Center, Maine 04021	NLGA, NSLB, WCLIB, WWPA
Redwood Inspection Service (RIS) 818 Grayson Road, Suite 201, Pleasant Hill, California 94523	RIS, WCLIB, WWPA
Southern Pine Inspection Bureau (SPIB) 4709 Scenic Highway, Pensacola, Florida 32504	NELMA, NLGA, NSLB, SPIB, WCLIB, WWPA
West Coast Lumber Inspection Bureau (WCLIB) 6980 SW Varnes Road, P.O. Box 23145, Tigard, Oregon 97223	NLGA, RIS, SPIB, WCLIB, WWPA
Western Wood Products Association (WWPA) 522 SW Fifth Avenue, Suite 500, Portland, Oregon 97204	NELMA, NLGA, RIS, SPIB, WCLIB, WWPA

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What Should be Avoided to Produce SGHL?

Defects in the ends, end grain knots, end knots, missing wood, mechanical damage, end splits, etc. These are not allowed as it does not allow the lumber to finger join correctly and creates weak finger joints.

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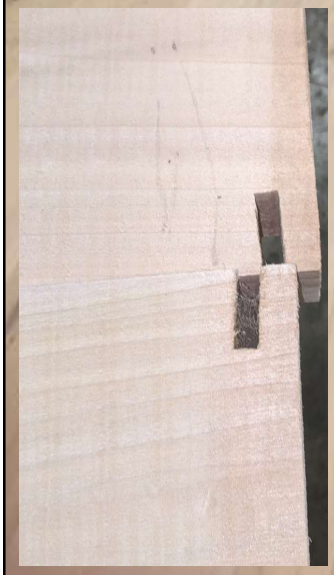
What Should be Avoided to Produce SGHL?



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What Should be Avoided to Produce SGHL?

Large Bark Pockets that go all the way through the board. This creates a weak spots in the cross section of the lamellas.

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What Should be Avoided to Produce SGHL?

Uneven ends on bundles. These must be trimmed evenly or cannot process them through the finger joint line and side pressing process without avoiding gaps on panels.

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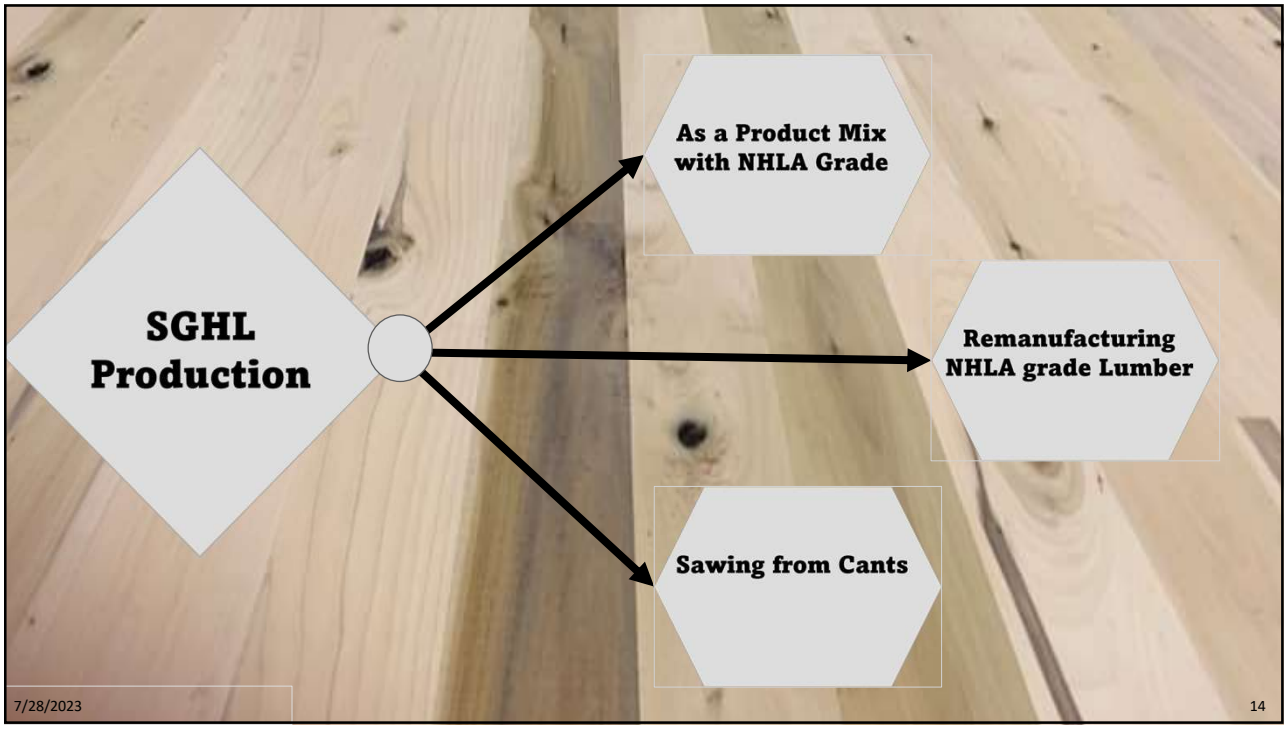

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SGHL as a Product Mix

- Pilot study - 39 logs
- Full scale study - 126 logs
- USFS F3 grade logs of Diameter 12-15
- Two groups “Test” and “Control”
- Control samples NHLA -4/4’’
- Test samples NHLA- 4/4’’ + NELMA -8/4’’
- Cants sawing method
- Graded as rough and green

Log yield study

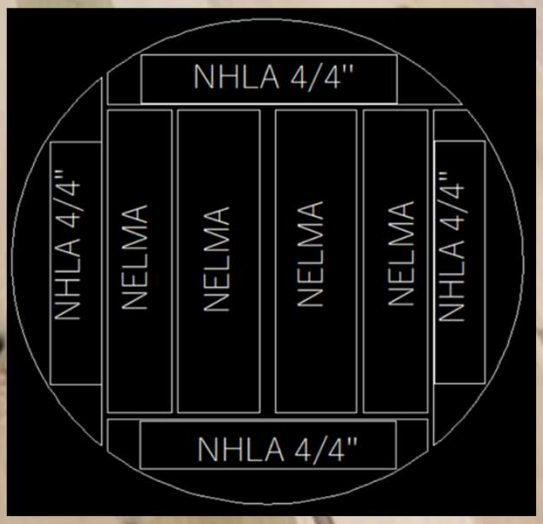

Figure: Generalized log sawing procedure for test samples

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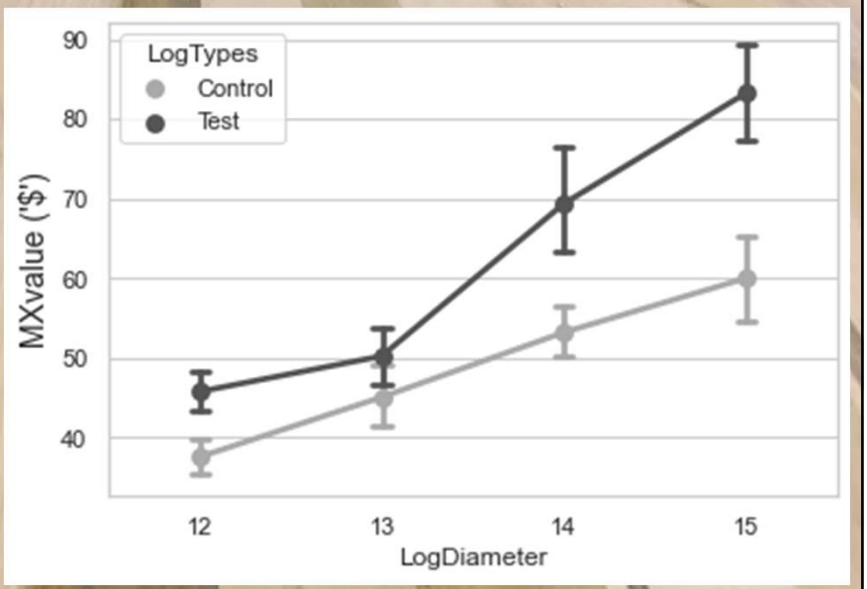
SGHL as a Product Mix

Mix-grade lumber production could add 27 % more revenue than producing only NHLA-grade lumber

- Cant sawing method used



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SGHL by Remanufacturing NHLA Grade Lumber

- Remanufactured from NHLA grade lumber
- Only 2 COM and lower grade lumber was remanufactured
- Remanufacturing SGHL is not an effective method
  - Wood loss %: up to 47%

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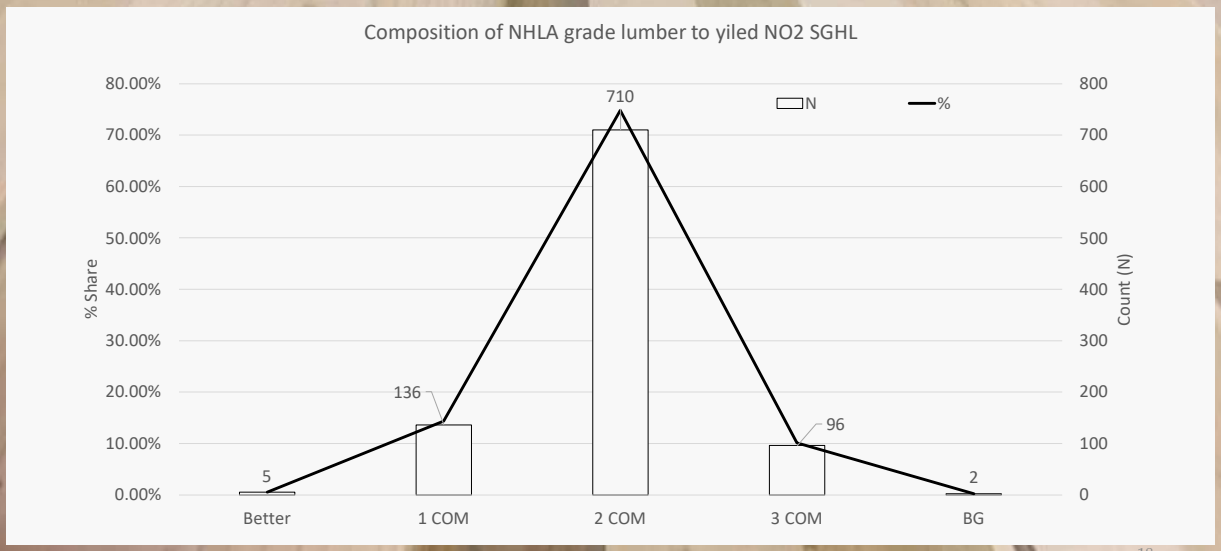
Lumber(SGHL) Production

Composition of the lumber as a NHLA grade lumber



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SGHL from Cants

Cross-section	Length	Number
6x6	12	30
	14	30
	16	30
8x8	12	30
	14	30
	16	30
Total		180

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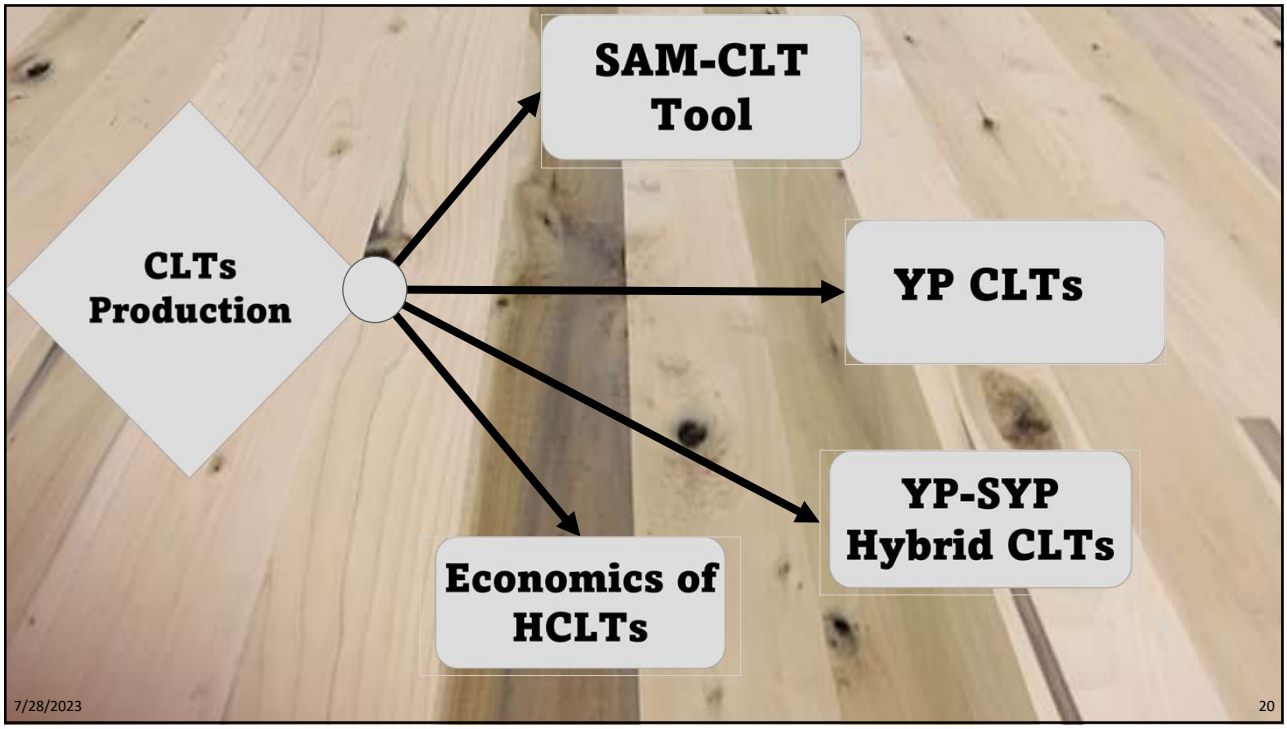

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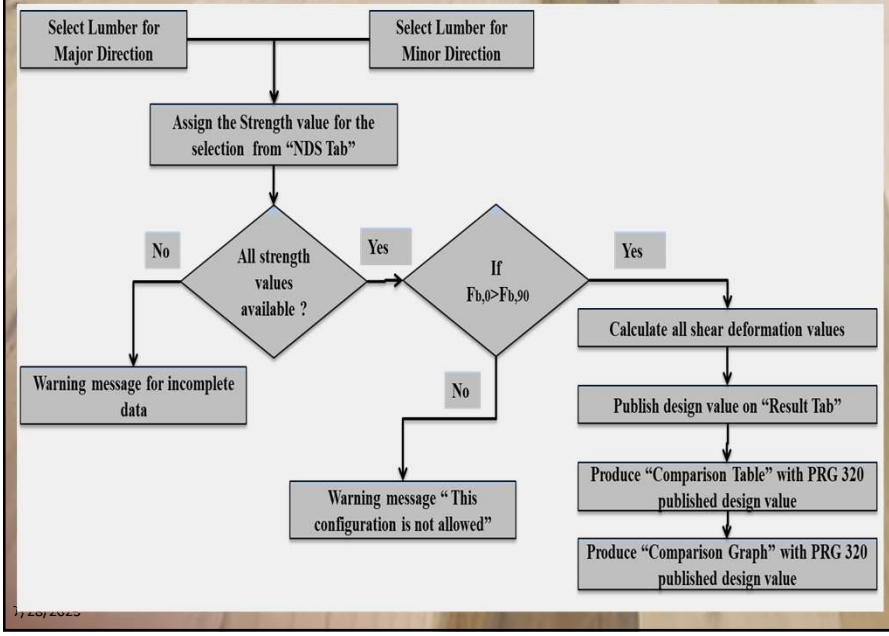
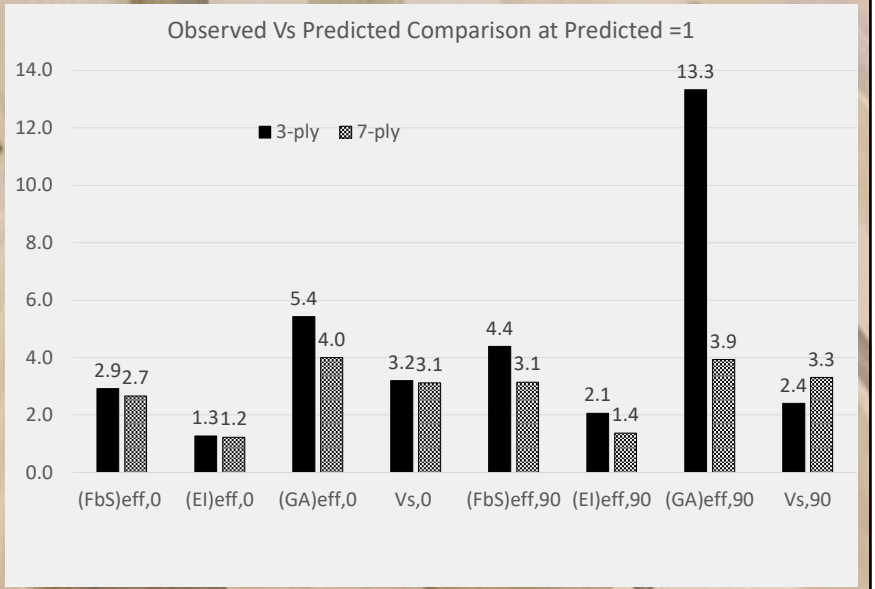
SAM-CLT: Excel Based Tool



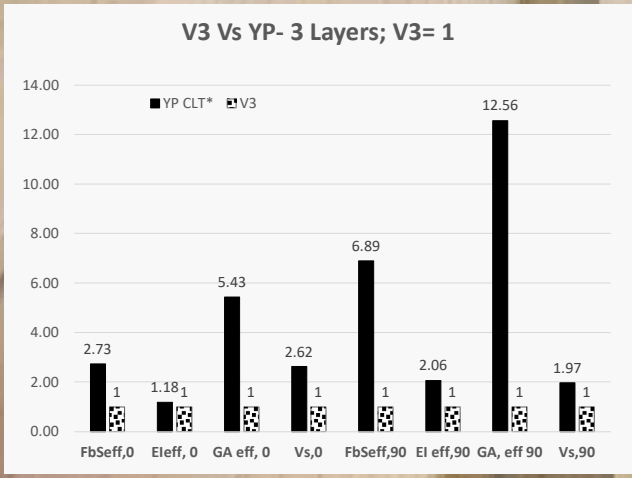
The SAM-CLT tool provides a user-friendly and efficient approach to evaluating the minimum design value of custom CLTs using different lumber species and thicknesses
Link: https://cfpb.vt.edu

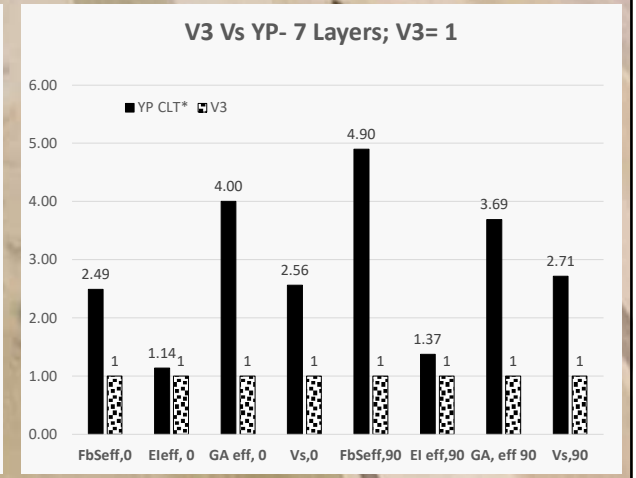
Production and Mechanical Properties of YP CLTs

- Manufactured at SmartLam, Dothan, Alabama 9/21
- Nominal 2x6 No. 2 Yellow Poplar lumber
- All panels exceed the minimum design value required by PRG 320 predicted using Shear Analogy Method



How Observed Value Compare with V3 Grade CLTs?





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SYP-YP Hybrid CLTs

- Lumber were remanufactured to meet PRG 320 standard and shipped to CLT mill
- CLTs were pressed under PRG 320 Standard at Texas CLT facility
- Samples were tested at VT Laboratory
- All panels exceed the minimum design value required by PRG 320 predicted using Shear Analogy Method

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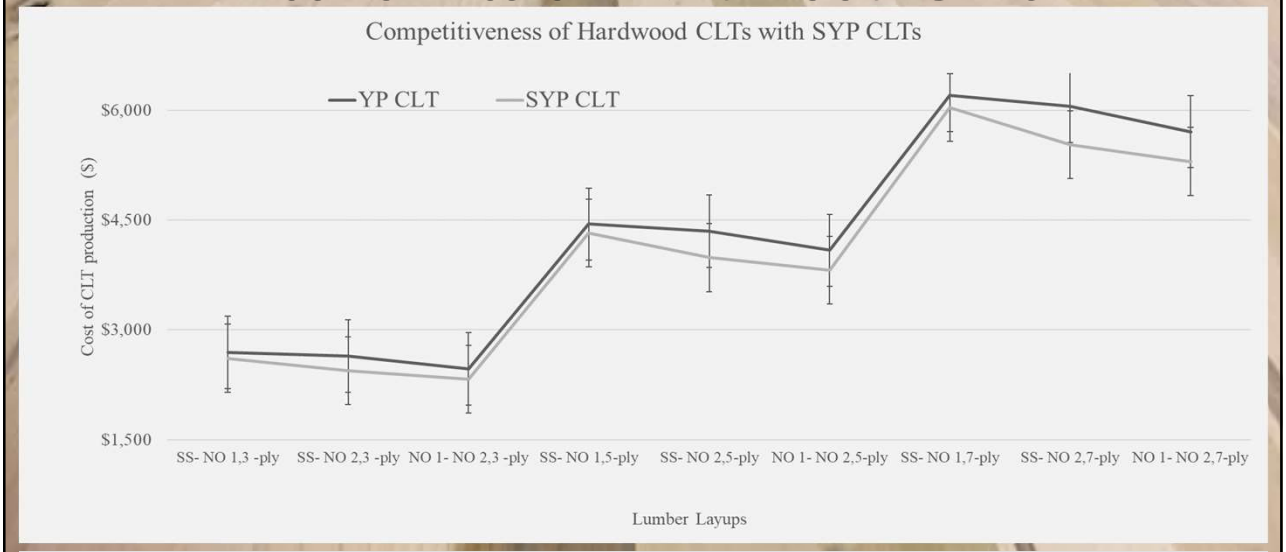
Economics of Hardwood CLTs



At 40% cost-share of lumber at referenced price, Hardwood CLTs Production cost was up to 7% higher compared to SYP CLTs using same grade of lumber to lay ups

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PRG 320 Change Application

- YP CLT Test data manufactured at SmartLam and tested by APA was used to apply for change in PRG 320
- Purposed change was passed by subcommittee and suggested to use value obtained from SAM-CLT tool
- Final Vote will begin after August 1st
- Hardwood (YP) will be included in new version of the PRG 320

Grade	Layups	Major Strength Direction				Minor Strength Direction			
		FbSeff,0	EIeff, 0	GA eff, 0	Vs,0	FbSeff,90	EI eff,90	GA, eff 90	Vs,90
VH1	3	1625	88	0.49	1490	220	3.38	0.49	495
MAJ/MIN	5	3745	337	0.98	2480	1915	87.98	0.98	1490
YP-NO2	7	6625	836	1.46	3475	4405	337.5	1.46	2480

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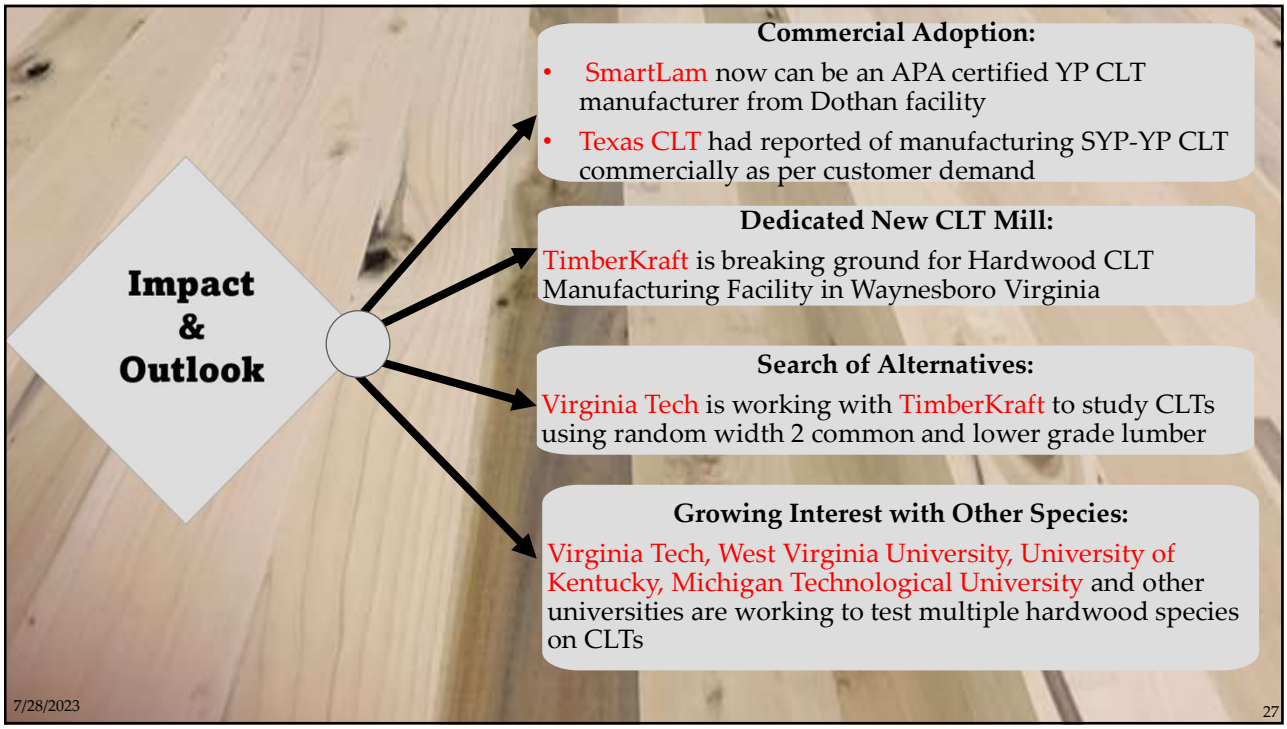
Impact
&
Outlook
Commercial Adoption:
• SmartLam now can be an APA certified YP CLT manufacturer from Dothan facility
• Texas CLT had reported of manufacturing SYP-YP CLT commercially as per customer demand
Dedicated New CLT Mill:
TimberKraft is breaking ground for Hardwood CLT Manufacturing Facility in Waynesboro Virginia
Search of Alternatives:
Virginia Tech is working with TimberKraft to study CLTs using random width 2 common and lower grade lumber
Growing Interest with Other Species:
Virginia Tech, West Virginia University, University of Kentucky, Michigan Technological University and other universities are working to test multiple hardwood species on CLTs
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Acknowledgements
TURMAN LUMBER COMPANY
American Appalachain Hardwood Lumber & Logs
AWP
NWH
NORTHWEST HARDWOODS
MEHERRIN RIVER FOREST PRODUCTS
FOREST SERVICE
US
DEPARTMENT OF AGRICULTURE
NeLMA
Northeastern Lumber Manufacturers Association
R.S. COLEMAN LUMBER Company
PRIME LUMBER COMPANY
CLT
APA
SOLID
APPALACHIAN HARDWOOD
BLUE RIDGE LUMBER CO., LLC
SMARTLAM
NORTH AMERICA
All the projects were funded by Wood Innovation Grants in 2016, 2019, 2020, 2022, and 2023
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Thank You !!!

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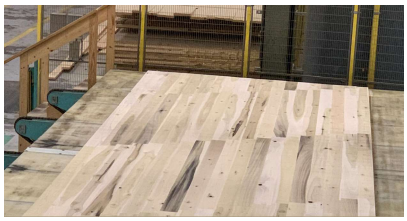

Questions or Comments Please!!!

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