New Markets for Hardwoods

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NHLA Convention
About the speaker

- Native from Costa Rica. Grew up farming coffee, cattle, and trees
- BS in Industrial Engineering. Graduate degrees from Purdue University in Indiana.
- Henry has been with Virginia Tech since 2008. His efforts focus on research in new products and markets for wood products
- Recently selected as VP of the Society of Wood Science and Technology
- Associate Director of the Center for Forest Products Business
Agenda

• The hardwood industry: current challenges
• Mass timber markets for hardwood lumber
• Access mats
• Thermally modified wood
• Export markets for hardwood
• Bioenergy
• Others
• Moving forward
The hardwood industry

• 2020 production: 7.26 billion BF
  • Current markets: Pallets (42%), exports (17%), railway ties (11%), flooring (9%), cabinets (6%), millwork (6%), furniture (5%) and board road/mat timbers (4%)\(^1\).

• Current challenges:
  • Labor
  • Logistics
  • Production volumes
  • Prices
  • Sustainability
  • Carbon markets
  • Competition from substitutes products

\(^1\)Harwood Market Report 2021
Why Mass Timber?

- Advantages
  - Renewable materials
    - Reduction of greenhouse gas emissions
    - Substitution for concrete or steel
    - Carbon sequestration: zero emissions
  - Construction times
  - Aesthetics
- Preferred to low to mid-rise buildings
- Challenges
  - Manufacturing and logistical limitations
  - Current capacity
  - Limited species
  - Land use and impacts
  - Building codes

Mass timber structure at the University of Massachusetts Amherst, USA
Global Mass Timber Market

• Global market in 2018 was about US$660 million. Expected to grow 13% between 2020-2025

• Europe accounts for 60% of global mass timber market

• By 2025, mass timber is expected to be US$1.4 billion of the US$14 trillion World construction industry
Mass Timber Market in the USA

- Softwood species primarily dominate structural lumber markets, but some hardwood species were used in the past.
- In the US, 38.41 billion board feet (bf) of softwood lumber were consumed in 2017. But only 24.4 billion bf of softwood lumber was produced in the same period.
- It is estimated that the CLT industries will consume more than 17% of the total lumber production volume of 2017 by 2025.
- In 2017, 7.87 billion bf of hardwood lumber was consumed in the US, and 8.32 billion bf of hardwood lumber was produced.
Mass Timber Products

- Glue-laminated beams
- Mass plywood
- Cross-laminated timber (CLT)
- Engineered lumber
  - LVL, OSL, PSL
- Preference is to use softwood lumber (conifers)
  - Pine, Spruce, Doug Fir and other conifers
  - Lower production cost
  - Focus on higher production volumes than hardwoods
  - Structural grades might be available only for softwood lumber
  - Easier to bond

Glue-laminated beam at Zip-o-Log in Oregon, USA
Structural grade hardwood lumber

NHLA oversees appearance grades for hardwood lumber

NELMA, SPIB and WWPA.

- Have developed structural grading rules for most commercial hardwood species

Why the market does not offer structural graded hardwood lumber?

- Cost
- Availability
- Culture of using softwood lumber for structural applications

NDS. American Wood Council. NELMA oversees grading rules for Red Maple
Mass timber research at Virginia Tech

- Poplar lumber. Why?
  - One of the top commercial hardwood species in the USA
  - Used in the past for structural applications
- Log yield studies
  - Virginia-Carolina
  - Allegany Wood Products
- Grade comparison
  - Blue Ridge Lumber
- Custom certification for yellow poplar CLT panels
  - Smartlam
  - APA
- Hybrid and hardwood veneered-CLT panels
  - Texas CLT
  - Danzer Veneer
  - AWP
• Goal: study low-grade hardwood logs potential to produce a mixed grade: NHLA grade and NELMA grade (SGHL)
• Methods
  • Species selection: yellow poplar (SG=0.43, MOR=10150 lbf/in² and MOE=1.58 lb/in²×10^6)
  • Log yield study. Include two sawmills (pilot study and complete study) in the eastern US
  • F3 US Forest Service grade logs
    • 12, 13, 14, and 15 inches diameter logs. Total of 126 logs in two samples
  • Samples
    • Control: NHLA grade
    • Test: NHLA + NELMA
NHLA vs structural grade comparison

• Methods:

Test log sawing method
NHLA vs structural grade comparison

• Grade comparison

NHLA grade results (only 8/4)

<table>
<thead>
<tr>
<th>Lumber Grade</th>
<th>Lumber Count</th>
<th>Measured (bf)</th>
<th>Yield (percentage)</th>
</tr>
</thead>
<tbody>
<tr>
<td>FAS</td>
<td>8</td>
<td>120</td>
<td>2.54%</td>
</tr>
<tr>
<td>1 common</td>
<td>41</td>
<td>581</td>
<td>13.02%</td>
</tr>
<tr>
<td>2A common</td>
<td>53</td>
<td>772</td>
<td>16.83%</td>
</tr>
<tr>
<td>2B common</td>
<td>162</td>
<td>2415</td>
<td>51.43%</td>
</tr>
<tr>
<td>3A common</td>
<td>4</td>
<td>52</td>
<td>1.27%</td>
</tr>
<tr>
<td>3B common</td>
<td>41</td>
<td>626</td>
<td>13.02%</td>
</tr>
<tr>
<td>BG</td>
<td>6</td>
<td>89</td>
<td>1.90%</td>
</tr>
<tr>
<td>Total</td>
<td>315</td>
<td>4655</td>
<td>100.00%</td>
</tr>
</tbody>
</table>

Lumber grade using NELMA rules (only 8/4)

<table>
<thead>
<tr>
<th>Lumber Grade</th>
<th>lumber Count</th>
<th>Measured bf</th>
<th>Yield Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>S. SELECTS</td>
<td>62</td>
<td>881</td>
<td>19.64%</td>
</tr>
<tr>
<td>Number 1</td>
<td>54</td>
<td>765</td>
<td>17.06%</td>
</tr>
<tr>
<td>Number 2</td>
<td>111</td>
<td>1612</td>
<td>35.94%</td>
</tr>
<tr>
<td>Number 3</td>
<td>76</td>
<td>1047</td>
<td>23.34%</td>
</tr>
<tr>
<td>economy</td>
<td>12</td>
<td>180</td>
<td>4.01%</td>
</tr>
<tr>
<td>Total</td>
<td>315</td>
<td>4485</td>
<td>100.00%</td>
</tr>
</tbody>
</table>
NHLA vs structural grade comparison

- Economic analysis results:
  - Control vs test sample
    - Control: only NHLA grade (all 4/4)
    - Test: [(all 4/4) + (8/4>1 Common)+ NELMA (8/4)]

<table>
<thead>
<tr>
<th>Diameter</th>
<th>Control</th>
<th>Test</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>Average Recovery</td>
</tr>
<tr>
<td>12</td>
<td>15</td>
<td>$36.40</td>
</tr>
<tr>
<td>13</td>
<td>15</td>
<td>$44.12</td>
</tr>
<tr>
<td>14</td>
<td>15</td>
<td>$52.43</td>
</tr>
<tr>
<td>15</td>
<td>15</td>
<td>$59.03</td>
</tr>
</tbody>
</table>

Types
- Control
- Test

MGAL1-Revenue LS Means

Dia

- 12
- 13
- 14
- 15
Structural grading workshop

• Training on structural grades for hardwood lumber
  • October 13, 2021. Buckhannon, WV
Current capacity of hardwood sawmills to produce SGHL

• Are sawmills (HW only or HW+SW) ready to produce structural grade hardwood lumber (SGHL)?
  • VT Surveyed 124 hardwood sawmills on:
    • Current capacity
    • Awareness
    • Collaborations
    • Required resources
  • Only 10% are ready
  • 60% of mills would produce SGHL if price was 5% higher than NHLA grade
  • 50% of mills would produce SGHL if demand was at least 5 MMBF
Hardwood CLT production and testing

• Yellow poplar as raw material for Cross-Laminated Timber (CLT)
  • First yellow poplar CLT study was conducted by Virginia Tech in 2012
  • Custom certification with Smartlam
    • Panels produced between Sept 15-16, 2021
    • Test with APA dates to be TBD
  • Industry involvement:
    • Donors: AWP, Blueridge Lumber Co., Turman Lumber Co., Northwest Hardwoods, Meherrin River Forest Products, NELMA
    • Leadership: AHMI, NHLA and HMA

• National hardwood industry effort to create a custom certification and include a hardwood CLT grade into the CLT standard
Other options for hardwoods into Mass Timber

• Texas CLT and Danzer Veneer
• Softwood CLT core with hardwood veneers
  • Does not require structural grade hardwood
• Hybrid CLT
  • Preliminary work conducted by IKD, Conversation Plinth in Indianapolis, IN
  • Exploring possibilities with yellow poplar, red oak, and southern yellow pine
Non-structural CLT market

- Access roads mats are a requirement to avoid erosion, soil and water damage
  - Energy projects
  - Construction
- Traditional access mats have been made using hardwood lumber (bolted mats)
  - CLT access road mats do not require structural grading rules
- Southern Yellow Pine CLT mats
  - At least three CLT mills produce these mats
  - Substitute to bolted mats
  - Business model: pooled mats
  - Over 300 million bf per year
- Energy projects (natural gas) have been suspended/canceled
Non-structural CLT market

• VT is partnering with Mississippi State University to test durability of hardwood CLT access mats

• US Forest Service/Wood Innovations Grant
  • Control: bolted CLT mats and SYP CLT mats
  • Test: Yellow poplar and Red Oak CLT access mats

• Industrial partner: Sterling Lumber and Superior Mat Company
Thermally modified wood (TMW)

- TMW performance tests at Virginia Tech
  - ASTM D143: static bending, hardness, shrinkage
  - ASTM D4442: MC measurements
  - AWPA E10: for decay resistance
  - Opportunity for hardwood species
    - Poplar, Ash, Red Oak, Maple

- Test applied on Ash, Yellow Poplar, and Red Maple samples from three TMW east coast manufacturers

- Work funded through an USDA/Wood Innovations Grant
Thermally modified wood (TMW)

- TMW performance results implications
  - Siding or shingles: excellent materials
  - Dimensional stability: excellent choices
  - Flooring: hardness
  - Decking: MOE and MOR
  - Outdoor furniture: good potential but more test needed

<table>
<thead>
<tr>
<th>Test (compared to published literature)</th>
<th>Ash</th>
<th>Yellow Poplar</th>
<th>Red Maple</th>
</tr>
</thead>
<tbody>
<tr>
<td>MOE (change)</td>
<td>-8%</td>
<td>+15%</td>
<td>+20%</td>
</tr>
<tr>
<td>Hardness (change)</td>
<td>-47%</td>
<td>+13%</td>
<td>+4%</td>
</tr>
<tr>
<td>MOR (change)</td>
<td>-66%</td>
<td>+7%</td>
<td>-14%</td>
</tr>
<tr>
<td>Equ. MC (%)</td>
<td>5.46</td>
<td>5.22</td>
<td>5.40</td>
</tr>
<tr>
<td>Shrinkage (change)</td>
<td>-83%</td>
<td>-85%</td>
<td>-82%</td>
</tr>
<tr>
<td>Decay resistance (% weight loss) to G. trabeum and T. versicolor</td>
<td>1.14% and 0.74%</td>
<td>2.08% and 1.77%</td>
<td>1.6% and 1.06%</td>
</tr>
</tbody>
</table>
Thermally modified wood (TMW)

• Marketing study. Knowledge of architects and customers on Technical aspects of TMW
  • Bending strength, MOE, hardness, shrinkage, and visual aspects
  • 146 responses were obtained
    • Only 22 respondents indicated have worked with TMW
Thermally modified wood (TMW)

- Marketing study results

**Architect’s familiarity on technical aspects of TMW**

- Aspect (color, smell)
- Non-toxic Material
- Species Availability
- Product Pricing
- Dimensional Stability
- Strength

**Customer’s interest on technical aspects**

- Strength Performance
- Stability
- Durability
- Eco-Friendly
- Technical Support
- Specie availability
- Visual aspects
- None, I specify its use

**Customer’s intended applications**

- Indoor Furniture
- Flooring
- Outdoor Furniture
- Door/window Frames
- Roofing
- Moulding
- Decking
- Other
- Indoor Furniture

**Customer’s intended applications (values)**

- 0
- 5
- 10
- 15
Thermally modified wood (TMW)

• As result, Virginia Tech is offering training to architects on TMW
  • At least 4 workshops in the east and west coast
  • Partnering with the American Institute of Architects, University of Minnesota, TWM industry, and Grid Architects

• Training funded through an USDA/Wood Innovations Grant
Export markets for hardwood

- International market research at Virginia Tech since 2010
  - Potential of US hardwood lumber in Central America, 2010-2012
  - South East Asia and Western Europe, 2012-2013
  - Social housing in South America, 2014-2016
  - Easter European markets for US hardwood lumber, 2017-2019
  - Methyl bromide transition to vacuum and steam treatment technology, 2021-2024
- Projects funded through USDA/FSMIP
Bioenergy

• European Union (EU)+UK markets still hot for pellets
  • 29 million metric tons in 2018, 30.8 in 2020
    • USA supplies 24% of that market. Potential to supply 65%
  • Hardwoods are preferred
  • USA continues to be the biggest pellet exporter to the EU

• Issues
  • Competition from solar panels and carbon credits
  • Subsidies for biomass are fading out in some states

Typical feedstock sourcing portfolio in the US Southeast (Idaho National Laboratory 2017)
Others

• Niche markets
  • Live-edge boards
  • Urban wood
    • Logistics is challenging

• Low value hardwood timber
  • Basswood, Sycamore, Beech, Blackgum, Sweetgum
    • Potential for CLT

https://www.etsy.com/C
Moving forward

• Make sure we don’t lose our current markets
  • Grade, industrial, and export markets

• Look beyond appearance grades
  • Add structural grading
  • Re-evaluate product mix: ROI

• Continue to innovate
  • New product development
  • Process improvements

• Alternative international markets

McAfee Knob. Catawba, VA.
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