Structural Lumber “Waste” Comes Into Its Own: Riding the Mass Timber and Construction 4.0 Waves

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MASS TIMBER @MSU

The Structural Lumber Reuse Imperative

Source: http://thegreenproject.org/our-story/landfill/

That's about:
- 219 million end tables
- 11 million dining tables
- 5.4 million picnic tables
- 839 MSU STEM Building projects!

Focus on high-volume, low-value materials

Location	Number of Abandoned Homes	Approximate Volume of Salvageable Lumber	Equivalent # of Trees
Michigan	225,946	1,096,552,000 BF	1,624,521
Midwestern US	1,379,720	6,694,401,000 BF	9,917,632
United States	5,813,286	28,205,676,000 BF	41,786,186

Data Sources and Notes:
- MSU Center for Community and Economic Development (2016). Muskegon, Michigan Deconstruction Economic Cluster Feasibility Study.
- US Census Bureau (2016). American Community Survey, Vacant Housing Units.
- BF=board foot = a piece of lumber 12"x12"x1"
- Tree equivalent is a tree of 24" diameter producing 4 16' logs (Scribner)

Opportunities and Challenges

Material Costs

- Salvaged lumber ~$833/mbf harvesting + transport cost
- “Normal” virgin material pricing
  - MI Stumpage ~$160/mbf
  - Random length lumber futures ~$450/mbf Great Lakes states
- Carbon valuation as an impetus for Decarbonization?

Times are Anything But Normal…

Source: https://www.nahb.org/news-and-economics/housing-economics/National-Statistics/Framing-Lumber-Prices

Uncertainty Abounds

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Will the Spike in Lumber Prices Hurt the Mass Timber Movement?

These timber towers are built of the same wood as single family houses.

By Lloyd Alter Published May 7, 2021 04:18PM EDT Fact checked by Haley Mast

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Homebuyers aren't seeing savings from falling lumber prices – here's why

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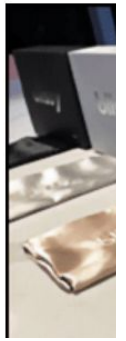
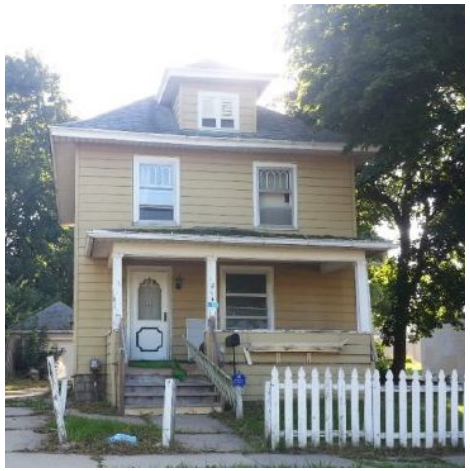
rices hit a record high on May 7, at $1,670.50 per thousand
t on a closing basis.

more than six times their pandemic low in April of last year.

products, used as inputs to steel building materials, jumped
the first few months of 2021 and have yet to



Labor Costs



524 Baker St., Lansing - Demolition	
Floor Area:	1,100 SF
Labor:	4 workers (1 excavator operator, 1 ground person, 2 truck drivers)
Time:	40 worker hours - 4 ppl x 8 hours demolition: 32 hrs - 2 ppl x 4 hours restoration: 8 hrs
Unit Time:	0.036 worker hours/SF
Job Potential:	100 1,200 SF homes = 2.08 FT jobs

1214 Massachusetts Ave., Lansing - Deconstruction	
Floor Area:	1,232 SF
Labor:	6 workers (5 workers, 1 de-nailer)
Time:	260 worker hours - 5 ppl x 3-4 days deconstruction: 134 hrs - 1 ppl x 126 hours de-nailing
Unit Time:	0.211 worker hours/SF
Job Potential:	100 1,200 SF homes = 12.17 FT jobs

Source: Anuranjita, A. (2017). Life Cycle Assessment Framework for Demolition and Deconstruction of Buildings. MS Report, Michigan State University.

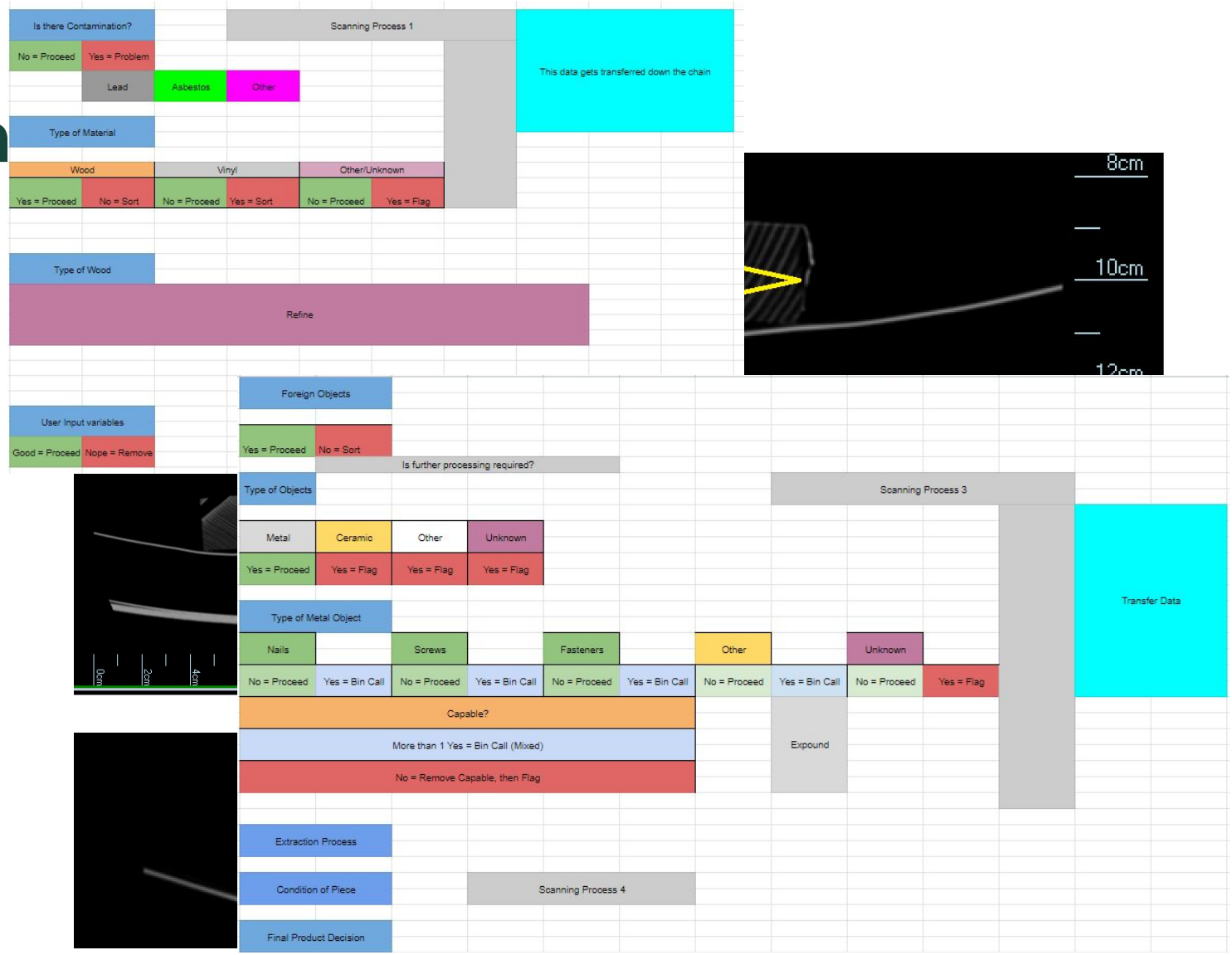
Other Challenges

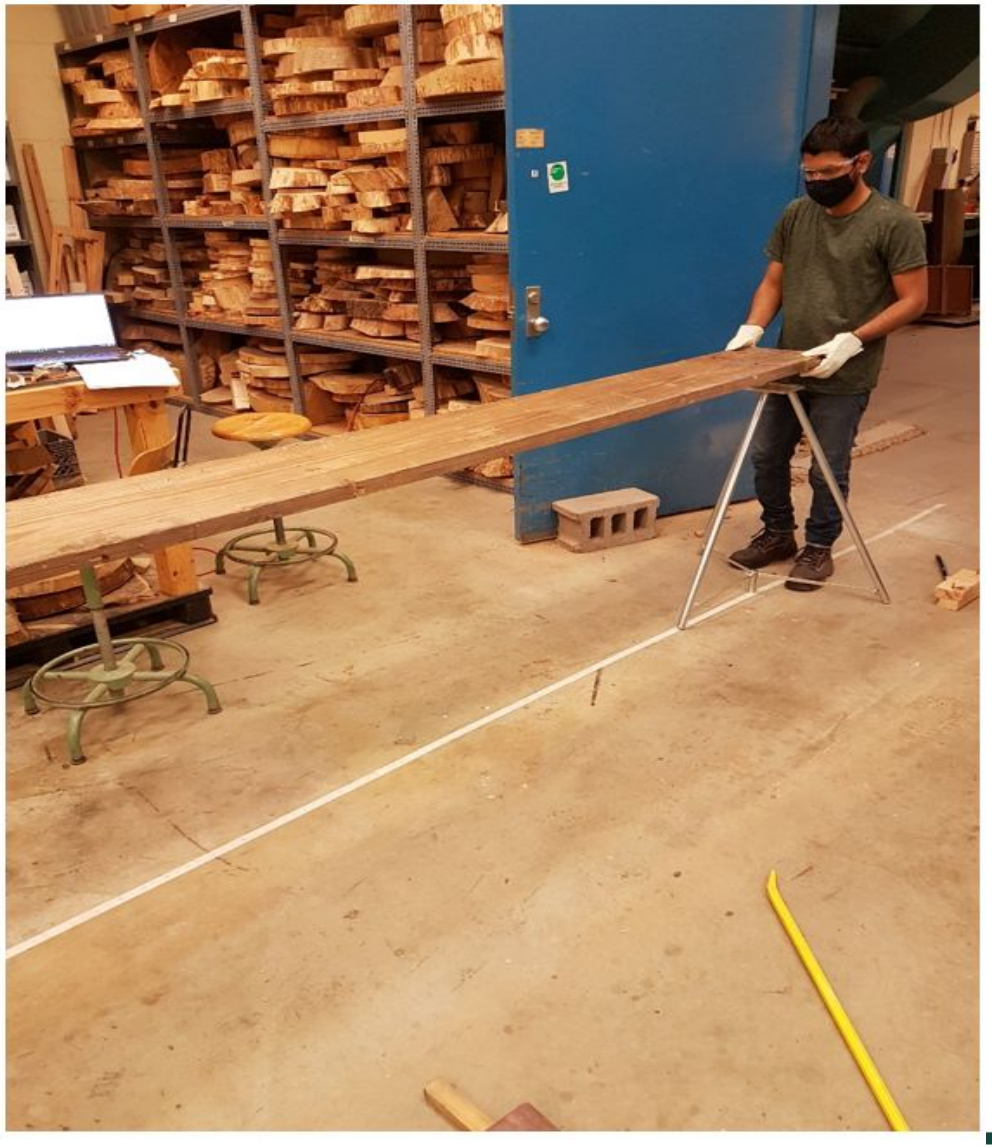
- Fragmented supply chains
- Processing inefficiency
- Regulatory barriers
- Contract vehicle/incentive mismatch
- Entropic and value limitations on realizing circularity

MSU Research Toward Addressing Challenges and Seizing Opportunities

Process Automation (Construction 4.0)

- Requirements analysis:
  - De-nailing
  - Identification of surface contaminants (LBP)
  - Visual grading
  - Dimensioning
  - Damage identification
  - Cutting to length/width
  - Tagging/inventorying





Salvaged Lumber Mechanical Properties – Southern/Eastern SPF

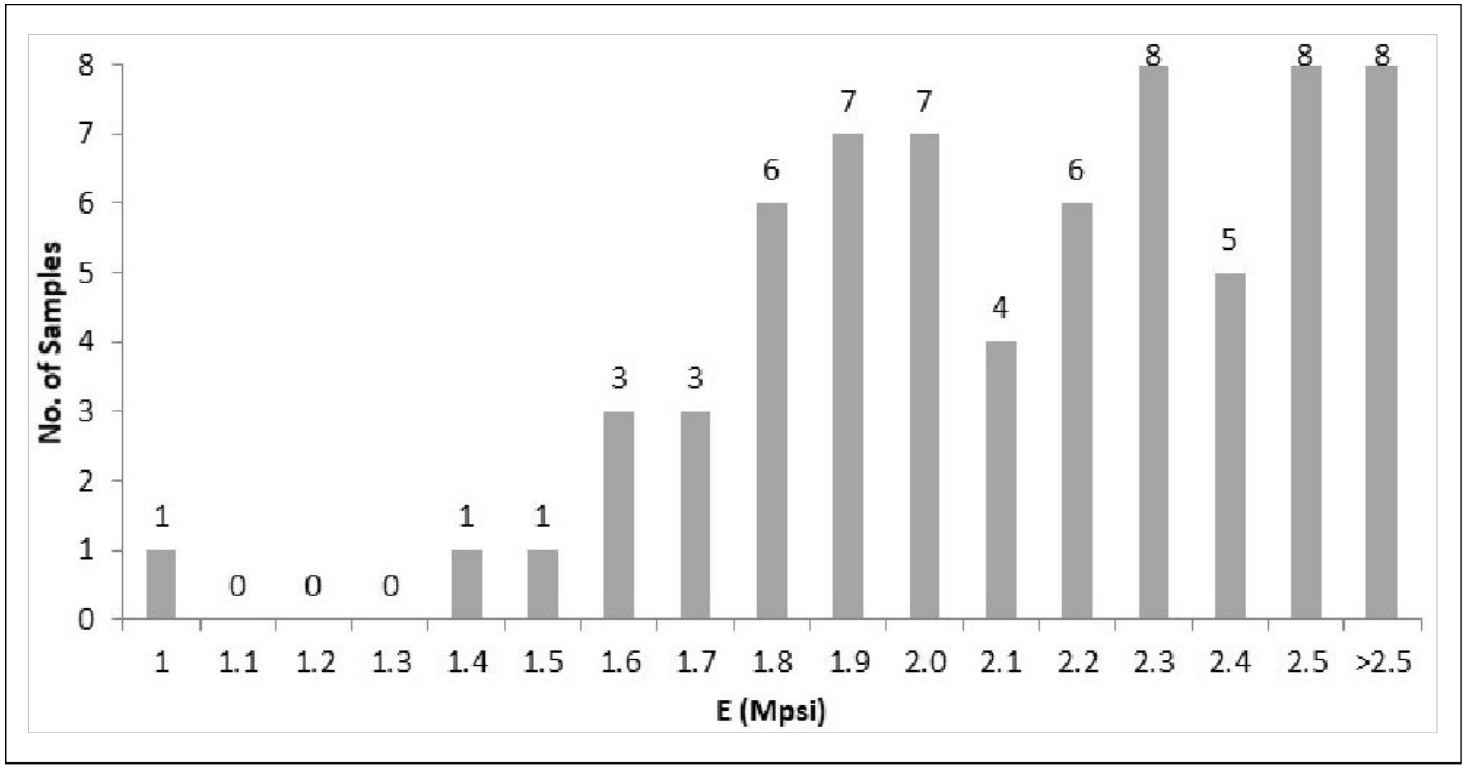


Figure 3. Flexural Modulus of Elasticity Results

Salvaged Lumber Mechanical Properties – Southern/Eastern SPF

Table 5. Lamination Grade Results

	Number of Samples Passing			
	E Only (n=68)		E Plus Visual (n=27)	
Grade	Number	%	Number	%
E1	59	86.8	N/A	N/A
E2	65	95.6	N/A	N/A
E3	67	98.5	N/A	N/A
V1	62	91.2	N/A	N/A
V2	67	98.5	N/A	N/A
V3	67	98.5	N/A	N/A
302-24 SPF	60	86.9	21	81.5
2.0E6 SPF	60	86.9	21	77.7
1.8E3 SPF	65	95.6	27	100
1.4E2 SPF	67	98.5	27	100

Prelim Product Results (major axis):
- MOE – 18,000 psi
- Max Flexural Load – 7,000-13,000 lbf

Thank You!

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