Standards, Codes, & Certifications Related to Laminated Veneer Lumber (LVL): A Case Study

Dr. Adam Scouse
Dr. Steve Kelley
Dr. Traci Rider
Dr. Yuan Yao

Forest Biomaterials Department

NC State University

Green Buildings and Sustainable Materials Project

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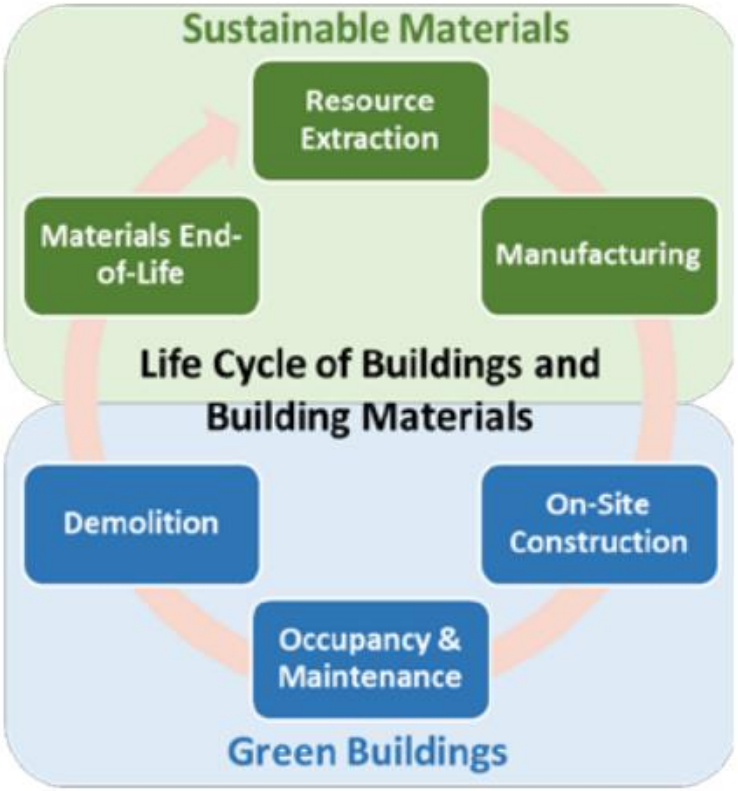
Lecture Objectives:

1. Introduce laminated veneer lumber (LVL) as a product
2. Describe how LVL is made and used
3. Review the standards that pertain to LVL throughout the product's life cycle

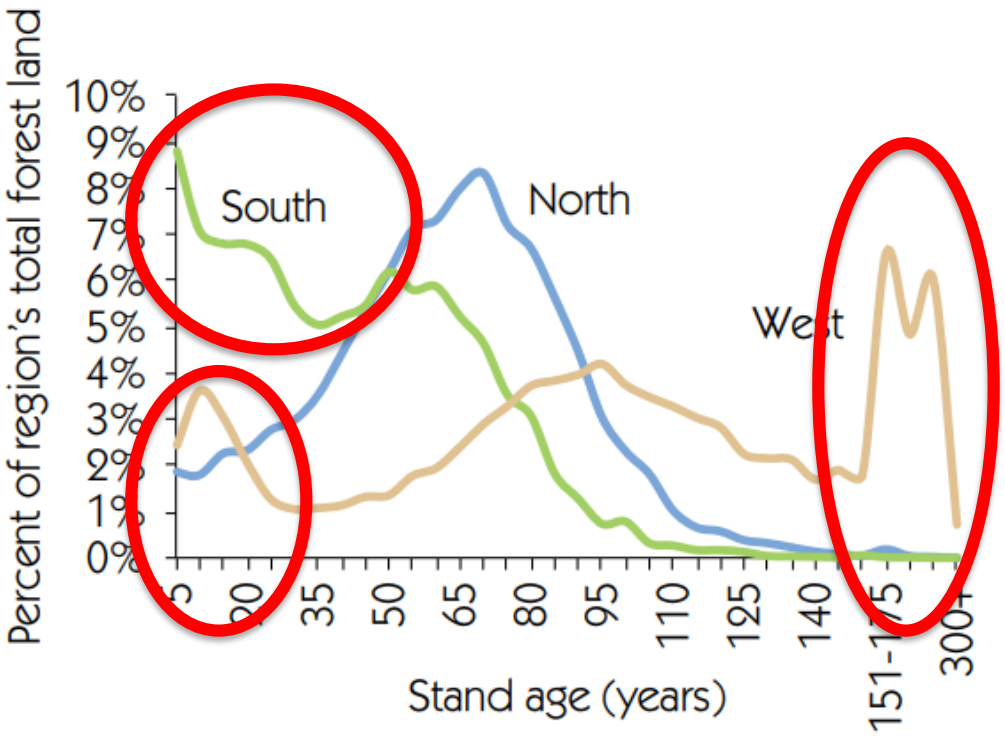


*https://www.fpl.fs.fed.us/labnotes/?p=24837

Introduction to LVL:

*https://www.fpl.fs.fed.us/labnotes/?p=1233

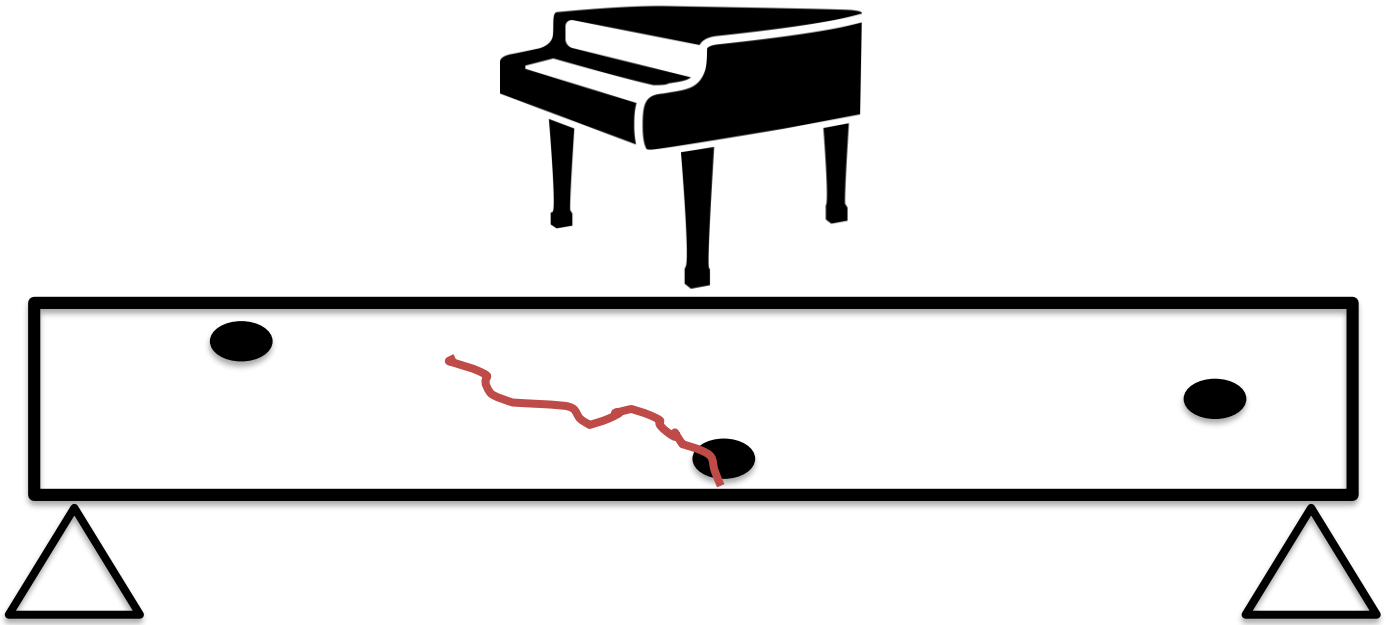
Introduction to LVL:



Distribution of forest land by region and stand age, 2012.

*https://www.fia.fs.fed.us/library/brochures/docs/2012/ForestFacts_1952-2012_English.pdf

Introduction to LVL:



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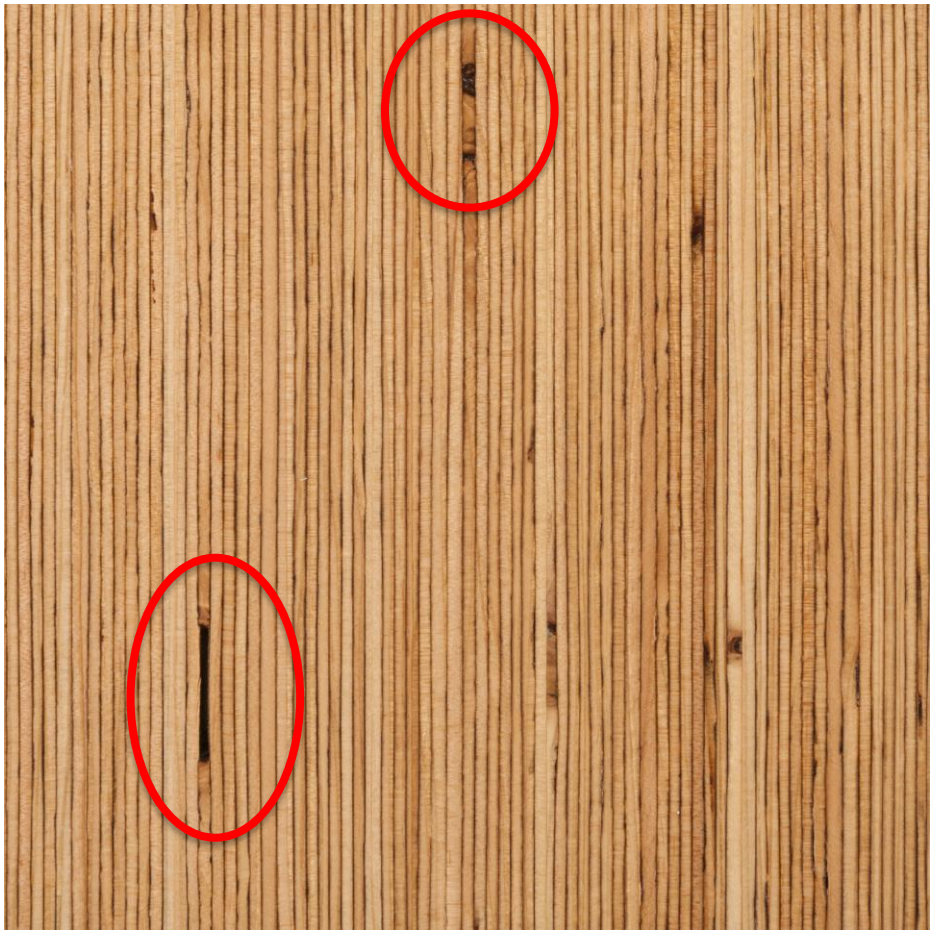
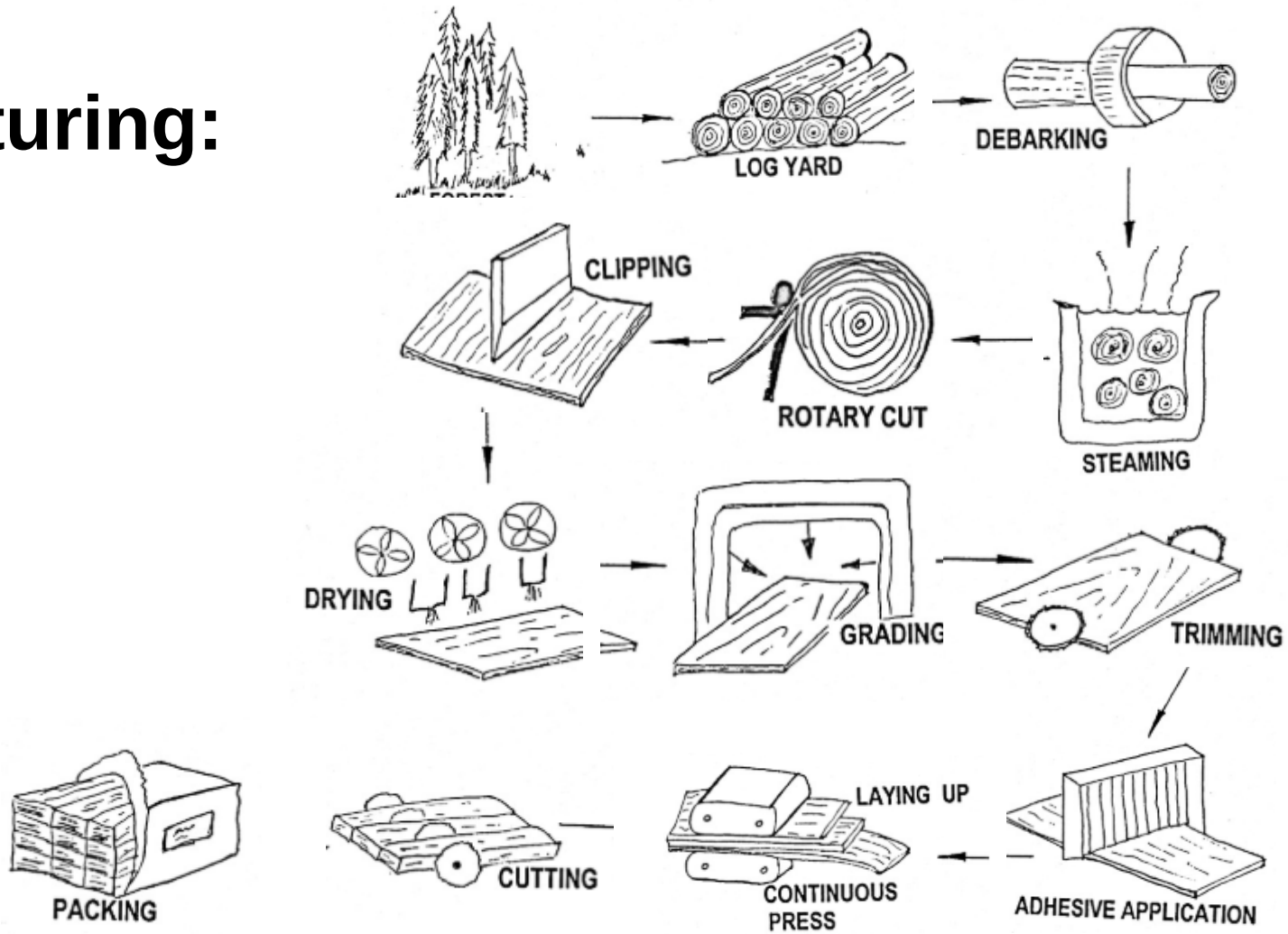


https://www.trustile.com/materials/stain-grade-wood/lvl

Introduction to LVL:

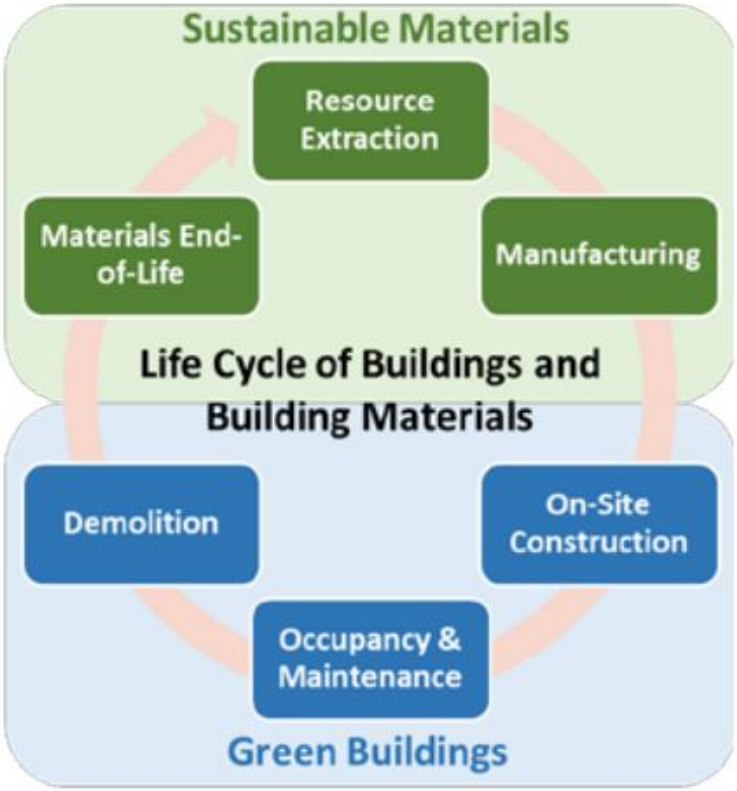
*https://www.weyerhaeuser.com/woodproducts/engineered-lumber/microllam-lvl/microllam-lvl-headers/
*https://pacificwoodtech.com/products/

LVL Manufacturing:



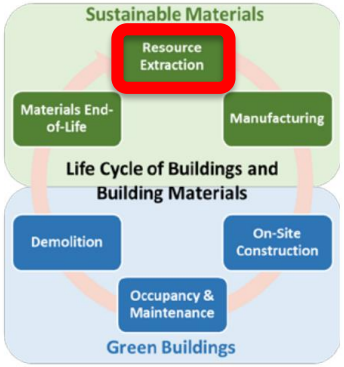
*http://factsheets.okstate.edu/documents/fapc-163-laminated-veneer-lumber-lvl-as-a-construction-material/

Standards, codes, and certifications associated with LVL:



*https://www.fpl.fs.fed.us/labnotes/?p=24837

Resource Extraction:



- State laws
  - Example: Oregon Department of Forestry, Administrative Rule 629
    - Establishes 100 foot riparian areas around large lakes
    - Requires competitive bidding for timber sales in excess of $25,000 from state land
    - Manages invasive insects and disease

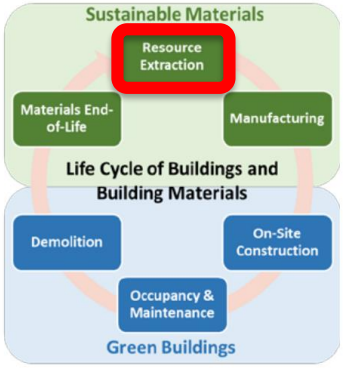
*https://www.oregon.gov/odf/pages/index.aspx

Resource Extraction:

- Sustainable Forestry Initiative: Forest Management Standard

- Programme for the Endorsement of Forest Certification Schemes (umbrella organization)
  - Endorses SFI and other nationally based certification systems in other countries

- Forest Stewardship Council: Principles and Criteria for Forest Stewardship



Goals:

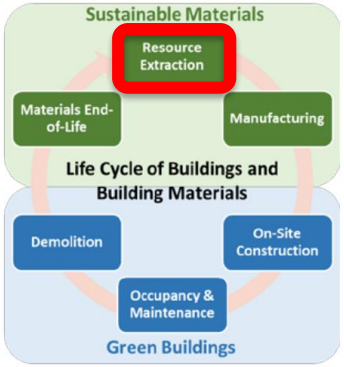
- Ensure forestry practices comply with and local laws and international treaties
- Enhance the social and economic welfare of workers
- Promote long term economic viability of forests
- Address environmental impacts and emphasize conservation

*www.sfiprogram.org
*www.peft.co.uk
*www.fsc.org

Sustainability Certification: Chain of Custody

Many of the manufacturers that use logs, lumber, and other wood products aren't necessarily involved with growing the trees. How do they ensure they are buying sustainable fiber?

Chain of Custody Certification:
Certification process ensures manufacturers identify and monitor how much of their product comes from certified sources



Goals:

- Ensures manufacturers can identify where raw materials are sourced and that they're sourced legally
- Ensures manufacturers can track certified material through production processes
- Ensures manufactures are documenting what they buy and where from
- If a manufacturer is outsourcing any of their work, certification ensures contractors are following the same standards

Manufacturing Standards for LVL:

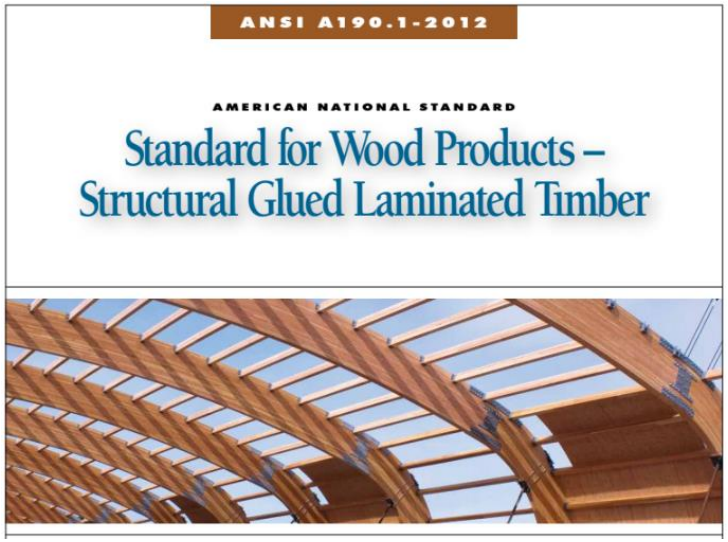
American National Standard Institute's (ANSI) 190.1: Standard for Wood Products – Structural Glued Laminated Timber

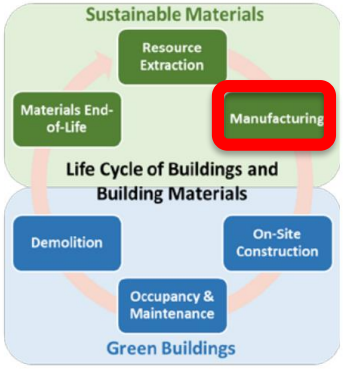
Establishes a quality assurance system which:

- Checks each step of the manufacturing process
- Physically tests finished product
- Visually inspects finished product
- Participates in periodic auditing

Defines tolerances for final products

Defines grade stamps:



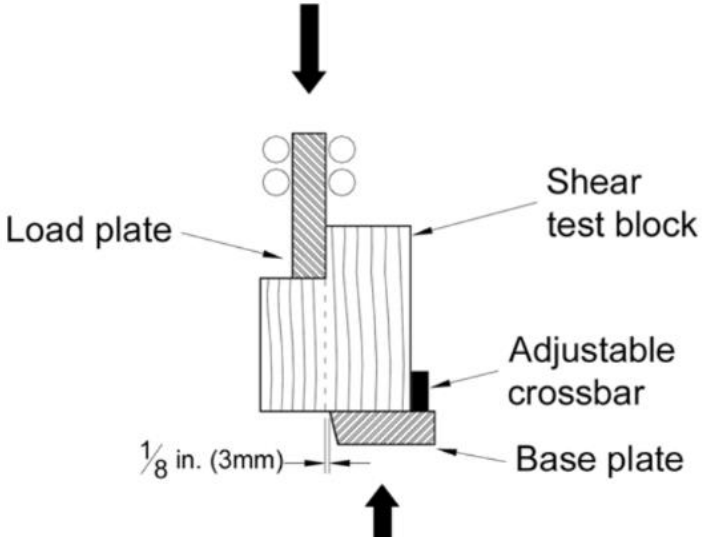


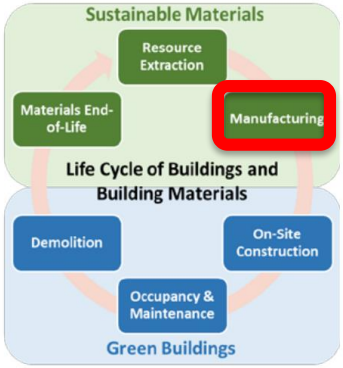
*https://www.apawood.org/apas-history
*http://www.eewp.com/wp-content/uploads/2015/08/Standard-for-Wood-Products-Structural-Glued-Laminated-Timber-ANSI-A190.1-2012.pdf

Manufacturing Standards for LVL:

When it comes to actually testing the product, ASTM provides many of the standards that are relevant for LVL

- American Society for Testing & Materials (ASTM) D143 Standard Test Methods for Small Clear Specimens of Timber provides testing procedures for:
  - Moisture content
  - Specific gravity
  - Static bending
  - Tension parallel to grain
  - Shear parallel to grain





1¾" X 2.0E PWLVL REFERENCE DESIGN VALUES

Depth	Maximum Vertical Shear (lb)			Maximum Bending Moment (ft-lb)			EI (x 10^6 lb-in^2)	Weight (plf)
	100%	115%	125%	100%	115%	125%		
3½"	1164	1338	1455	1181	1358	1476	13	1.6

*ASTM D143. 2014. Standard Test Methods for Small Clear Specimens of Timber. West Conshohocken, PA. 31 p.
*https://pacificwoodtech.com/documents/2-0e-pwlvl-design-values/

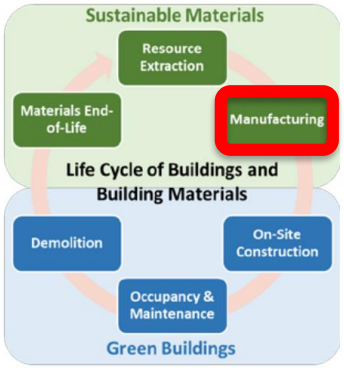
Manufacturing Standards for LVL:

LVL uses adhesives that release low levels of formaldehyde, a material identified on the Living Building Challenge's (LBC) Red List.

Low Formaldehyde Emission Certification:

Manufacturers work with third party parent organizations like the Engineered Wood Association (APA) to test products for formaldehyde emissions

- ASTM E1333 Determining formaldehyde concentrations in air and emission rates from wood products using a large chamber
- Australian/New Zealand Standard 4257.4 – Structural laminated veneer lumber – determination of formaldehyde emissions



Goals:

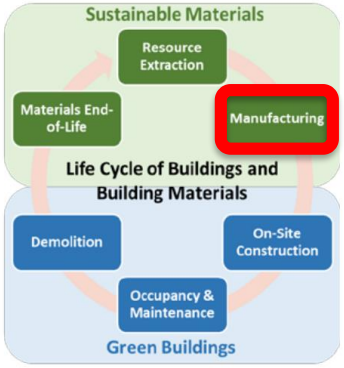
- Ensures that products release acceptable levels of formaldehyde (e.g. less than 0.20 mg per liter)
- Ensures proper testing procedures were followed
- Ensures testing procedures meet national and country specific emission standards

*www.apawood.org

Workplace and Consumer Safety:

Outside of sustainability standards, material safety data sheets (SDS) sheets also serve as a resource to understand the potential hazards associated with products.

- Identify product hazards and provide first aid measures
- Provide relevant handling, storage, and fire-fighting measures
- Identify a product's physical and chemical properties
- Provide relevant disposal and transportation considerations



Laminated Veneer Lumber (LVL)

2. Hazard(s) Identification

Signal Word: DANGER

Product Classification (GHS)	Hazard Statement(s)	Pictogram(s)
HEALTH Carcinogenicity- Category 1A	Dusts may cause nasopharyngeal cancer and/or cancer of the nasal cavities and paranasal sinuses	

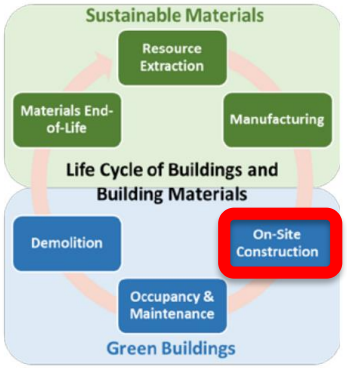
HMIS Rating (Scale 0-4):	**Health =**	2*	**Fire =**	1	**Physical Hazard =** 0
NFPA Rating (Scale 0-4):	**Health =**	1	**Fire =**	1	**Reactivity =** 0

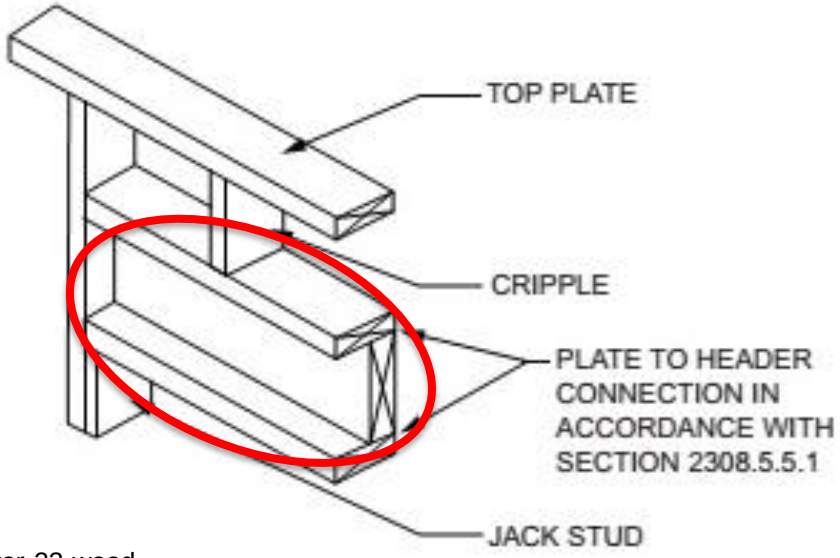
*https://pacificwoodtech.com/wp-content/uploads/2019/01/PWC_LVL_SDS_2015.pdf

Construction Standards for LVL:

International Building Code: Chapter 23, Wood.

- LVL must be manufactured according to:
  - ANSI 190.1: Standard for Wood Products – Structural Glued Laminated Timber
  - ASTM D3737 Establishing Allowable Properties for Glulam
- Establishes rules for conventional light-frame construction
  - Provides allowable roof spans based on lumber size and species
  - Establishes nailing patterns for attaching sheathing to walls



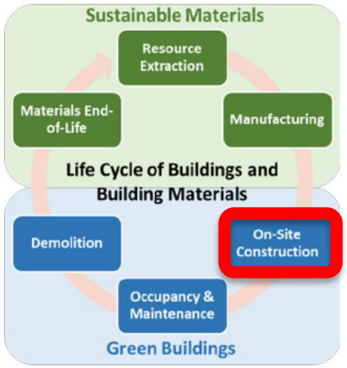


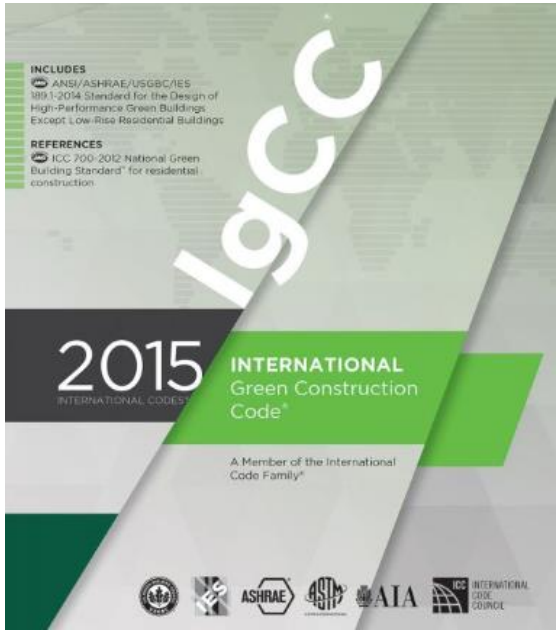
*https://codes.iccsafe.org/content/IBC2018/chapter-23-wood

Green Building Standards for LVL:

International Green Construction Code

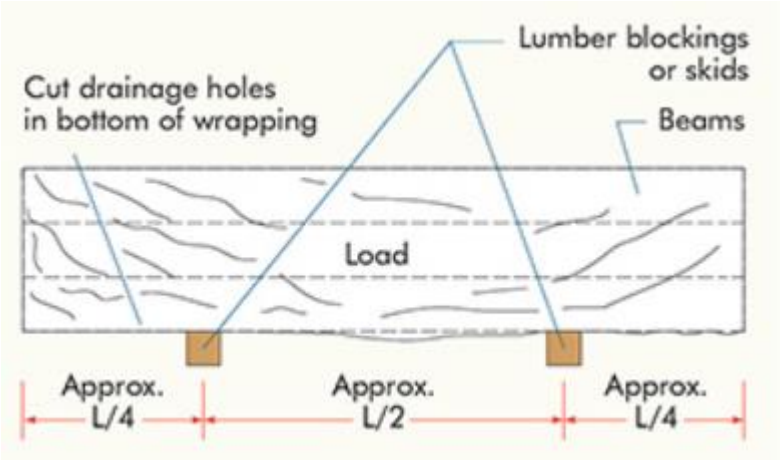
- LVL should be SFI, FSC, or PEFC certified
- Raw materials and LVL should be sourced within 500 miles
- Use life-cycle assessment (LCA) to show a 20% improvement in environmental performance:
  - Energy use, ozone depletion, acidification potential, eutrophication, smog
- Formaldehyde emissions fall under specified levels

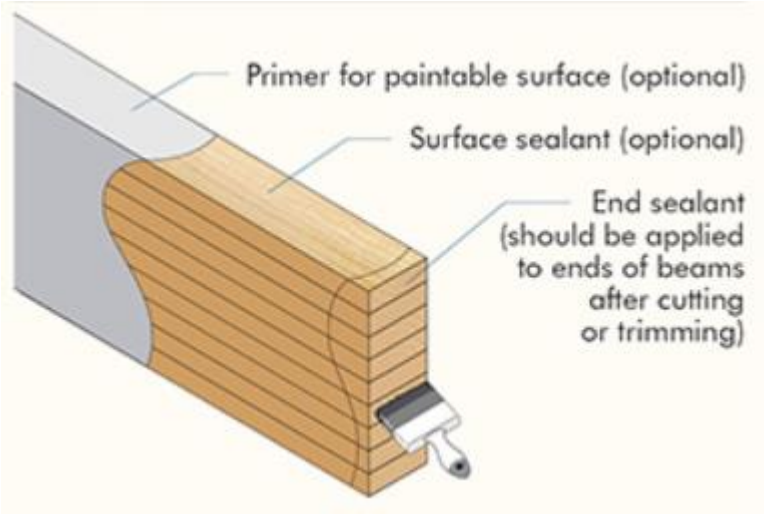


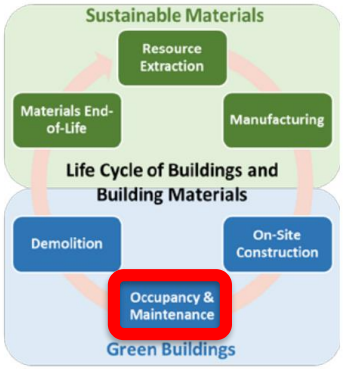


*https://shop.iccsafe.org/2015-international-green-construction-coder-igccr-43415.html

Operation/Maintenance Recommendations:



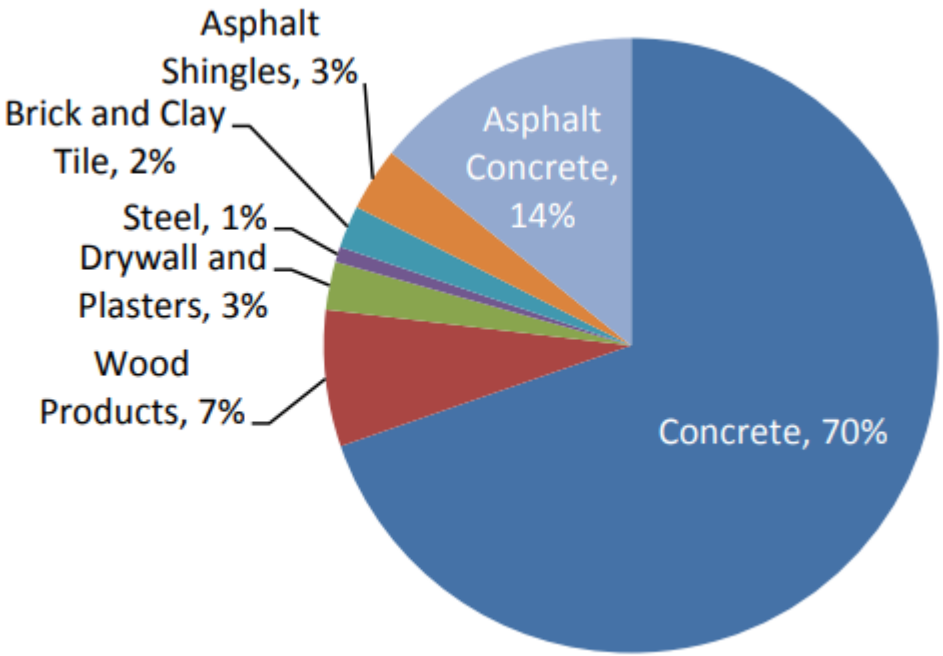


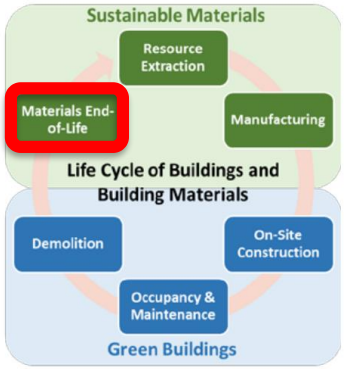


http://www.apawood.org/buildertips/pages/R540.html

LVL's End-of-Life:

- State Regulations: North Carolina General Statute 130A Article 9
- 2014 construction and demolition debris was 534 tons, of which:
- ASTM E3073 – Standard for Development of Waste Management Plan for Construction, Deconstruction, or Demolition Projects





https://www.epa.gov/sites/production/files/2016-12/documents/construction_and_demolition_debris_generation_2014_11302016_508.pdf

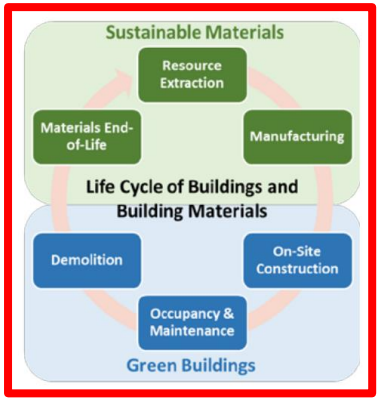
Life-cycle Assessment of LVL:

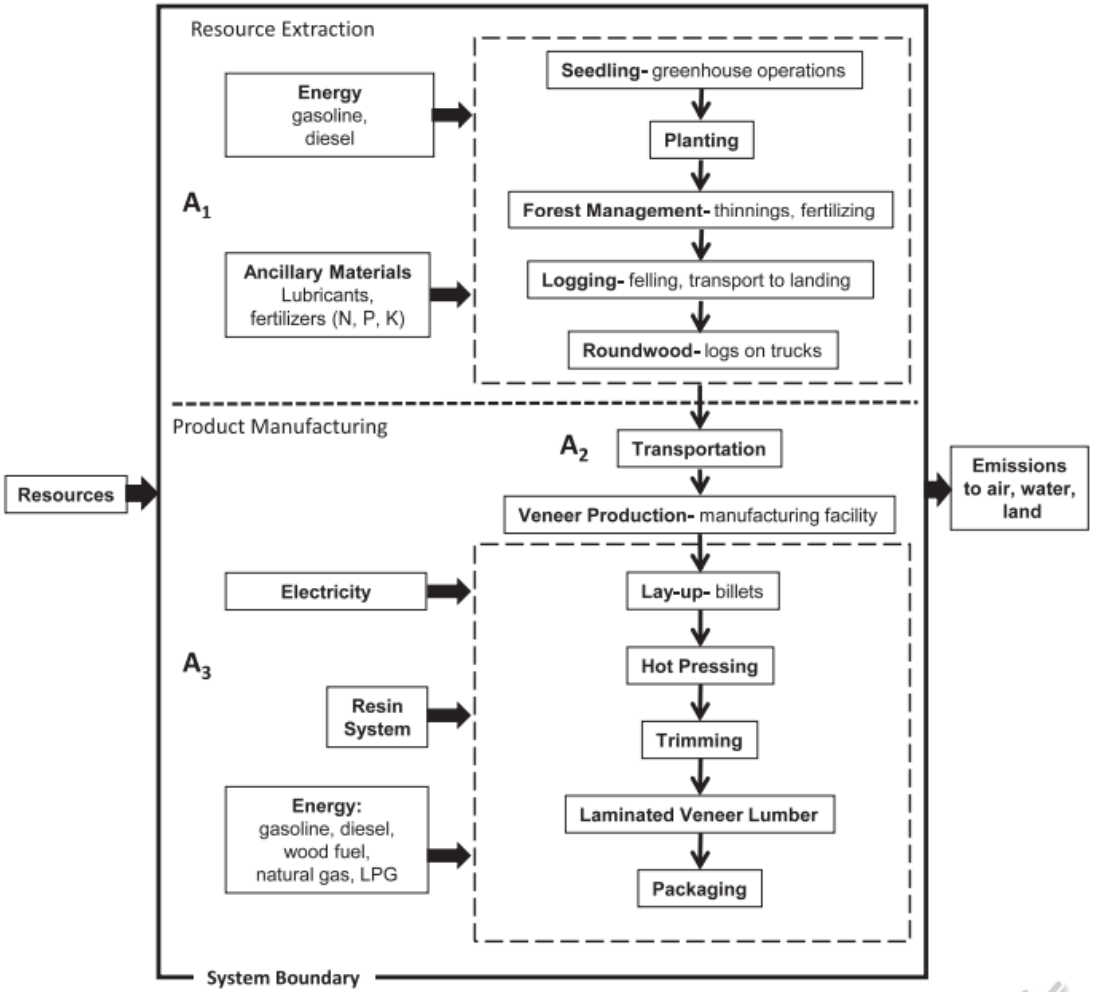
1 cubic meter of LVL requires:

- 9,980 MJ of energy (over 1/3rd of which is renewable)
- 1330 liters of fresh water

1 cubic meter of LVL generates:

- 339 kg of CO2 eq.
- 3.26 kg of SO2 eq.
- 0.122 kg of N eq.
- 35.6 kg of ozone eq.



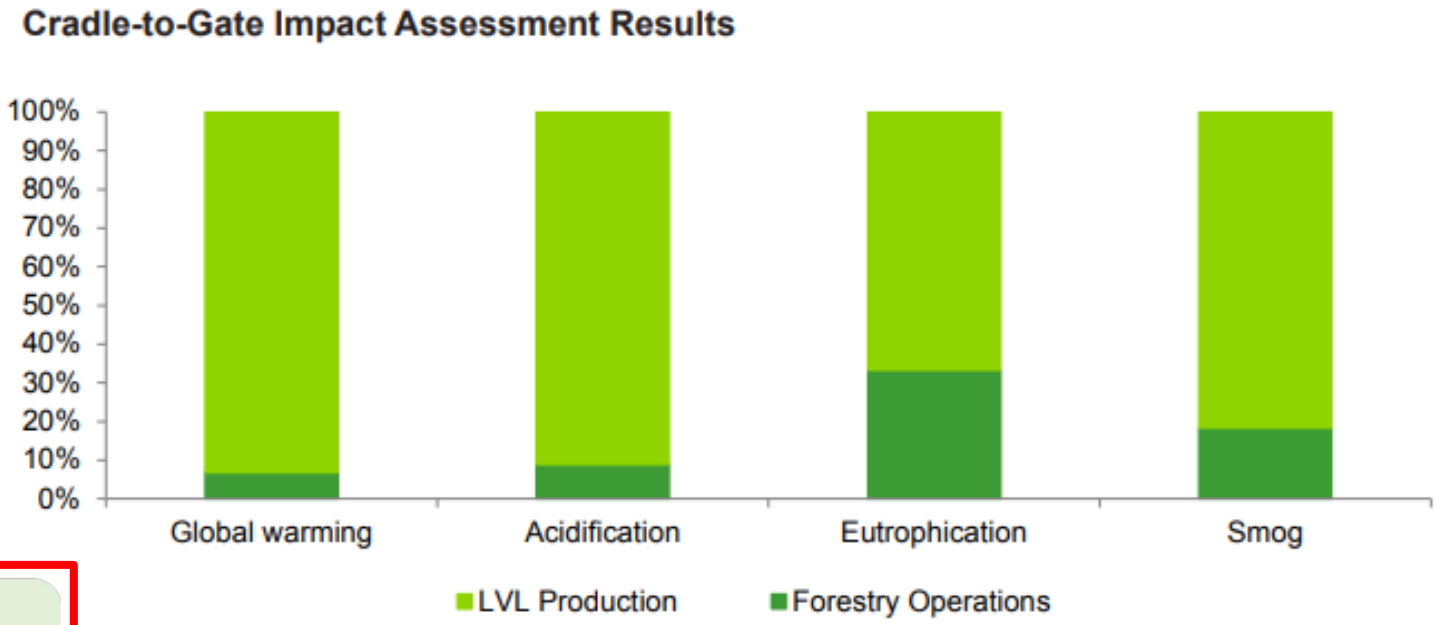


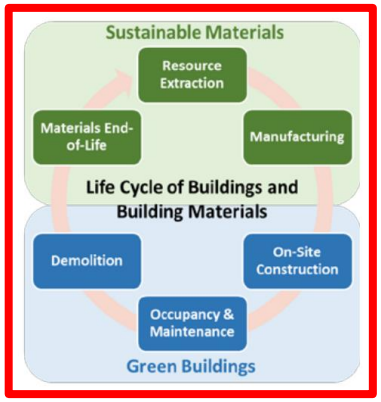
https://corrim.org/wp-content/uploads/2018/03/lca-cradle-to-gate-laminated-veneer-lumber-us.pdf

Environmental Product Declarations for LVL:

FP Innovation's Environmental Product Declaration for LVL:

- 1 cubic meter of LVL sequesters 600-989 kg of CO_2





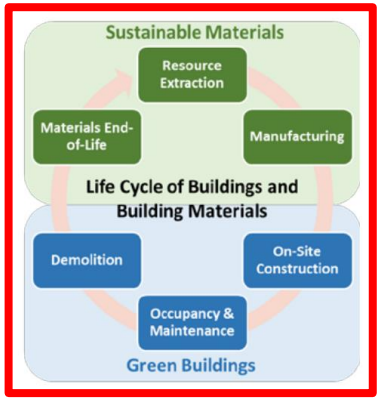
*FP Innovation. 2013. Environmental Product Declaration: Laminated Veneer Lumber (LVL). American Wood Council. 16 p.

Green Verification Reporting for LVL:

The third party parent agency for engineered wood products (the APA), works with manufacturers to verify that their products qualify as a green building material

Goals of reporting:

- Ensure products are made of resource efficient materials
- Ensure structural systems are designed to reduce material usage and emphasize safety
- Ensures building materials are sourced regionally
- Ensures that LCA's have been conducted for relevant products



APA **Green Verification Report**

www.apawood.org

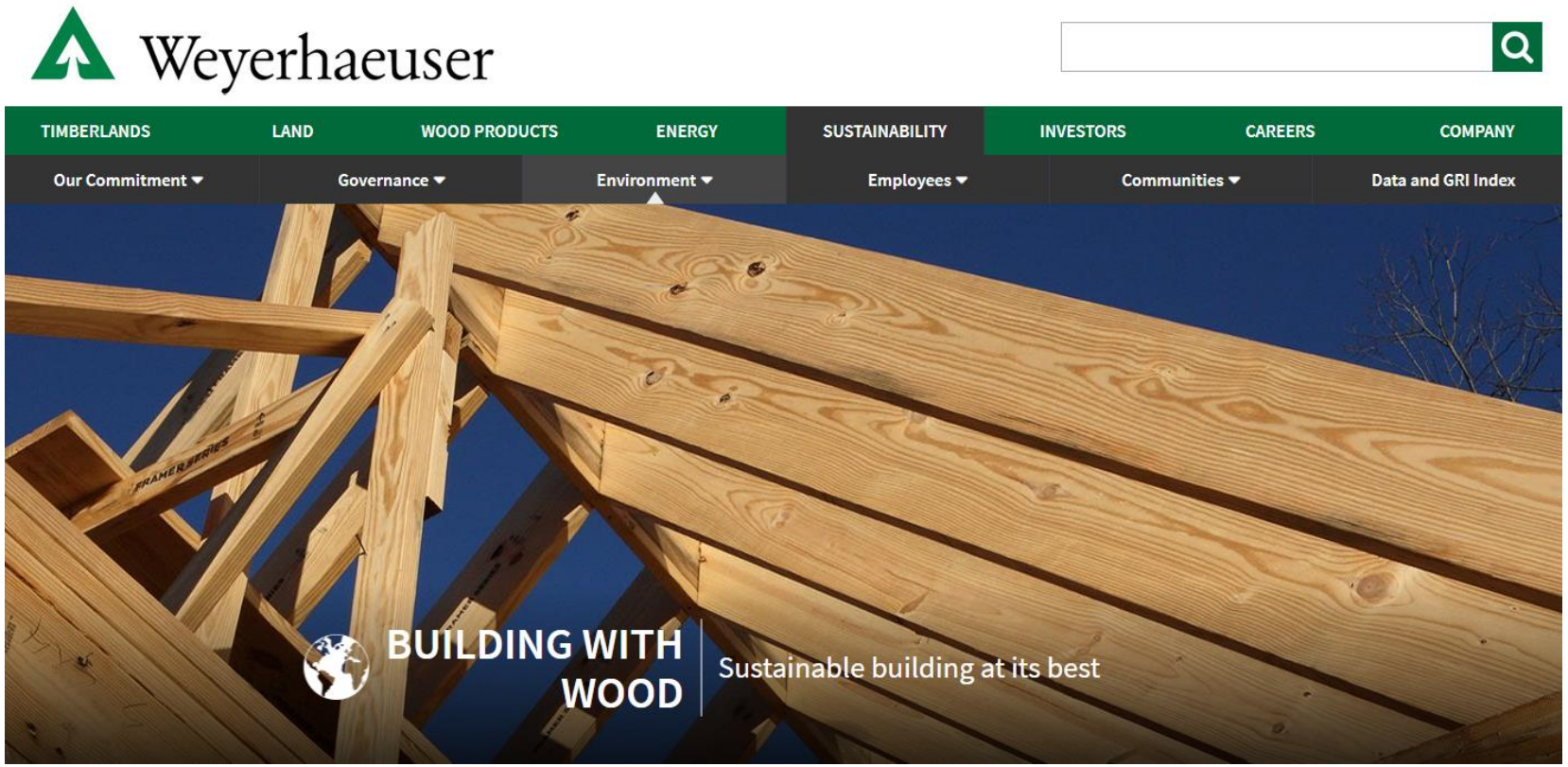
Green product verification:

LVL products listed in this report are qualified for green construction with points specified in Tables 1, 2, 3, 4 and 5, as independently verified by APA as meeting pertinent criteria of the referenced standards shown in Section 1.

*https://pacificwoodtech.com/reports/apa-green-verification-report-gr-l233/

Green Verification Reporting for LVL:

Example:



- **Using our products for LEED points**

  All our wood products can help builders and architects achieve LEED designation for their buildings. Through the alternate compliance path, products with SFI® fiber sourcing certification count as legal, responsible, and, with SFI chain of custody certification, as certified. Find more information on the Sustainable Forestry Initiative's website.

*https://www.weyerhaeuser.com/sustainability/environment/product-stewardship/green-building/

Visit Our Project Website

https://faculty.cnr.ncsu.edu/yuanyao/green-buildings-and-sustainable-materials/

This presentation and video were prepared by the project team (Yuan Yao, Stephen Kelley, Traci Rider, and Adam Scouse) at North Carolina State University using Federal funds under award 70NANB18H277 from the National Institute of Standards and Technology, U.S. Department of Commerce. The statements, findings, conclusions, and recommendations are those of the author(s) and do not necessarily reflect the views of the National Institute of Standards and Technology or the U.S. Department of Commerce.