Wood Buildings: Sustainable Forestry, Biophilic Design and Carbon Footprint

WOODWORKS

Presented by: Mike Romanowski, SE Kate Carrigg, PE December 8, 2022

### **Course Description**

North American Forests are abundant and the place many of us turn to connect with nature, lessen our stress and gain a sense of health and wellbeing. Timber is another significant part of their value – a natural renewable material that, when exposed on the interior of buildings, has the potential to extend its biophilic attributes to the wellbeing of occupants. With an emphasis on case study examples, this presentation will illustrate how utilizing exposed wood in projects aligns with Terrapin Bright Green's *14 Patterns of Biophilic Design*. It will also consider the use of wood construction in the context of North American Forests, including sustainable forest management and overall forest health.

### Learning Objectives

- 1. Discuss the state of our forests in North America and common environmental concerns about specifying wood.
- 2. Learn about different sustainable forestry management systems.
- 3. Explore how wood might contribute to biophilic design and healthy indoor environments.
- 4. Review case study examples where exposed wood structures and finishes contribute to biophilic design.

# Sustainable Forestry

# State of Our Forests



Common Environmental Concerns About Specifying Wood

- 1. Is North America running out of Forests?
- 2. Does specifying wood products contribute to **deforestation?**
- 3. Is wood is a **renewable** resource?

#### **US Forest Land**: Forest **Area** in the United States 1630 – 2012



Source: USDA-Forest Service, US Forest Resource Facts and Historical Trends FS-1035. (2014).

#### State of our Forests: Timber Volume on US Timberland



Source: USDA-Forest Service, US Forest Resource Facts and Historical Trends FS-1035. (2014).

#### **US Forest Lands**

#### **Forest Land Ownership**

This map displays the basic vegetation (forest vs. non-forest) of the conterminous United States as well as ownership (private vs. public). The lands displayed as "public" include Federal and State lands but do not generally include lands owned by local governments and municipalities.



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#### **US Forest Harvest by Owner**



Source: USDA-Forest Service, US Forest Resource Facts and Historical Trends FS-1035. (2014).

#### **Regeneration vs. Deforestation**



Deforestation is the permanent conversion of forest land to nonforest land uses. Worldwide, agricultural expansion is the main driver of deforestation, but in the U.S., the rate of deforestation has been virtually zero for decades.

Source: State of the World's Forests—2020- FAO and UNEP, USDA Forest Service, US Forest Resource Facts and Historical Trends FS-1034 (2014)

# Forest Management

#### **Forests are more than Lumber Factories**



- We can balance the long-term and short-term desires and the multiple uses through responsible forest management.
- Best Management Practices (BMPs)
- State, Federal and Provincial monitoring and forest inventory programs
- Forestry Practices and Laws
- Professional Logger Training and Certification
- Sustainable Forest Management Systems

Photo: Green Diamond Resource Company

#### **Good Forestry = Sustainable Forestry**

"Forestry is the art and science of creating, using and conserving forests. The forestry profession was a pioneer in developing techniques for sustainable management and, later, techniques for the multiple use of forests. [...] The term sustainable forest management is synonymous with good forestry".

> Source: State of the World's Forests 2012. United Nations Food and Agriculture Organization Photos: Oregon Forest Resources Institute



#### **National Forest Management Act of 1976**



#### **National Forests of the United States**

Vancourse in



#### **National Forests of the United States**

U.S. Forest Service manages 188 million acres (294k sq. mi.) of National Forests

1<sup>st</sup> National Forest was the Yellowstone Park Timber and Land Reserve created in 1891

40 states have at least one National Forest

The largest area of National Forests is in Alaska, California, Idaho, Oregon, and Colorado

#### **National Forest Management Act of 1976**

Requires comprehensive land management for all U.S. National Forests in order to:

"Sustain the multiple use of its renewable resources in perpetuity while maintaining the long-term health and productivity of the land."

Plans are required to address:

- Best available scientific information
- Public Participation
- Social, Economic, Ecological Sustainability
- Ecological Diversity

#### Sustainable Forestry Management Systems

- Wood from well-managed forests is sustainable over the long term.
- Forest certification shows that the wood comes from well-managed forests
- The major North American programs are:



### **Sustainable Forestry Management Systems**



### Similarities:

- Biological diversity
- Wildlife habitats / species diversity
- Special sites/values
- Soil & water resources
- Sustainable harvests
- Prevent illegal or unauthorized sources

- Protect from deforestation and conversion
- Aboriginal rights and/or involvement
- Independent audit required
- Audit of forest planning and practices
- Public disclosure required
- Chain of custody and label option





### Resources

#### **US Forest Resource Facts and Historical Trends**

https://www.fia.fs.fed.us/library/brochures/docs/2012/ForestFacts 1952-2012 English.pdf

Contains much of the numbers from our forestry slides such as the acres of forested land and volume of trees in the US.

#### ThinkWood CEU The Impact of Wood Use on North American Forests

https://1r4scx402tmr26fqa93wk6an-wpengine.netdna-ssl.com/wpcontent/uploads/2020/08/Think-Wood-CEU-The-Impact-of-Wood-Use-on-North-American-Forests-Dec2019.pdf



#### **Biophilia** A human tendency to interact or be closely associated with other forms of life in nature



#### The Business Case for Healthy Buildings ULI Report

Global Wellness Real Estate Industry:

- \$134 billion industry in 2017
- 6.4% annual increase since 2015
- \$180 billion industry by 2022

Healthy Bldgs ROI (Survey of 200 Canadian Bldg Owners):

- · 46% easier to lease
- 28% command premium rents
- 38% of those who reported value in healthy bldgs said they are worth 7% more than conventional ones

Millennials:

- 78% say workplace quality is important
- · 69% would trade other benefits for good workplace

"Health and wellness-focused environments...can help reduce company operating costs and increase revenues and profits."



#### Study of Wood vs. Non-Wood Finishes Wood and Human Health

- Univ. of British Colombia & FPInnovations study
- 4 rooms: white furnishings vs. wood furnishings; plants vs. no plants

"Stress, as measured by sympathetic nervous system activation, was lower in the wood room in all periods of the study."

Source: Wood and Human Health https://www.woodworks.org/wp-content/uploads/2014-SE-WSF-Fell-Healthy-Buildings.pdf



#### Feature Stairs Encouraging Exercise



#### **Biophilic Design Patterns Nature in the Space**

Pattern	Stress Reduction	Cognitive Performance	Emotion, Mood & Preference
Visual Connection w/ Nature	$\checkmark$	$\checkmark$	$\checkmark$
Non-Visual Connection w/ Nature (smell, touch)	$\checkmark$	$\checkmark$	$\checkmark$
Non-Rhythmic Sensory Stimuli	$\checkmark$	$\checkmark$	
Thermal & Airflow Variability	$\checkmark$	$\checkmark$	$\checkmark$
Presence of Water	$\checkmark$	$\checkmark$	$\checkmark$
Dynamic & Diffuse Light	$\checkmark$		
Connection w/ Natural Systems			$\checkmark$

#### **Biophilic Design Patterns** Natural Analogues

Nature of the Space

	Pattern	Stress Reduction	Cognitive Performance	Emotion, Mood & Preference
al Analogues	Biomorphic Forms & Patterns			$\checkmark$
	Material Connection w/ Nature		$\checkmark$	$\checkmark$
Natura	Complexity & Order	$\checkmark$		$\checkmark$
lce	Prospect	$\checkmark$	$\checkmark$	$\checkmark$
he Spa	Refuge		$\checkmark$	
ure of t	Mystery			$\checkmark$
Nati	Risk/ Peril			$\checkmark$

Source: Terrapin Bright Green: 14 Patterns of Biophilic Design, 2014

#### Visual Connection with Nature Biophilic Pattern

 Bringing nature inside the building & providing views outside



#### Non-Visual Connection with Nature Biophilic Pattern

Other sensory connections to nature:

- Soft feel of wood might this contribute to this biophilic pattern?
- Smell of wood in officesmight this contribute to this biophilic pattern?
- Smell of wood has surprised some designers who didn't consider it in design



#### Material Connection with Nature Biophilic Pattern

 Wood can be used as an extension of the outside environment to the interior



#### Dynamic & Diffuse Light / Complexity & Order Biophilic Patterns



## **Office Buildings**

#### **People Will Pay More for a Connection to Nature**

- People pay more for good views of nature (obvious w/ real estate prices)
- Potential for better leasing velocity and/or higher leasing rates for offices w/ natural wood materials

Source: WoodWorks: Mass Timber Cost and Design Optimization Checklists https://www.woodworks.org/wpcontent/uploads/wood\_solution\_paper-Mass-Timber-Design-Cost-Optimization-Checklists.pdf



#### Workplaces: Wellness + Wood = Productivity

"Those in workplaces with a higher proportion of **visible wood feel more connected to nature** and rate their working environment far more positively."

These people report:

- · lower stress levels
- higher concentration
- improved overall mood

"Wood in the workplace is associated with higher productivity and reduced sick leave."

Report based on survey of 1,000 typical Australians working indoors

Workplaces: Wellness+ Wood = Productivity



A report prepared for Forest & Wood Products Australia\* by Andrew Knox, Howard Parry-Husbands, Pollinate\*\* February 2018



# Heavy Timber Revolution: California's Hip New Commercial Building ICE Block I



IIIB

- 3 Story heavy timber over podium
- 87,460 sf
- Traditional heavy timber

"The **building sold itself** because of its unique character. There was no competition. **A lot of the credit goes to the fact that it is a timber building**."

- Mike Heller, Heller Pacific

Location: Sacramento, CA Architect: RMW Architecture & Interiors Engineer: Buehler Engineering

#### Tech Companies Invest in Healthy Corporate Campuses Microsoft Silicon Valley Campus



#### **Connecting with Nature & Targeting Environmental Goals** Microsoft Silicon Valley Campus



## Schools

#### Wood Grain Pattern – Can it Stimulate our Senses? Might Wood Help Increase Ability to Think and Learn?



#### A Living/ Learning Destination for Students Adohi Hall, University of Arkansas



Location: Fayetteville, AR Architect: Leers Weinzapfel Associates; Mackey Mitchell Architects; Modus Studio (AOR) Structural Engineer: Equilibrium Consulting; Engineering Consultants, Inc. IIIB

- 202,000 sf
- 708 bed student housing
- CLT and glulam framing

"...the wood-based construction system we developed forges a bond between setting, human comfort, and sustainability." – Andrea Leers, Leers Weinzapfel

#### Healthier Learning Environment for the 2<sup>nd</sup> Generation Cottonwood Valley Charter School E-Pod



VB

- 6,400 sf
- Wood trusses and framing w/ SIPs
- Operable wall extends multipurpose space outdoors
- Design echoes the simple shed structures of industrial and agricultural buildings in the area

Location: Socorro, NM Architect: Environmental Dynamics, Inc. Structural Engineer: Walla Engineering, Ltd.

## Hospitality

#### Rethinking the Resort and Going Vertical with Mass Timber Penticton Lakeside Resort



- 6-story, 70 suites
- 127,600 sf
- CLT panels, glulam beams
  & columns
- Cost savings from exposing wood (warmth of wood & less finishes)
- Resorts typically have wide open spaces whereas designers here provided grandeur with the vertical open atrium

Location: Penticton, BC Architect: HDR & CEI Architecture Structural Engineer: RJC Consulting Engineers

### **Healthcare Facilities**

#### **Spa-Like Dental Office** Blue Ridge Orthodontics



Location: Asheville, NC Architect: Clark Nexsen Structural Engineer: Kloesel Engineering VB

- 7,500 sf
- Spa-like experience to reduce patient stress
- T&G pine roof/soffit soars over glazing that brings in natural daylight
- Patient chairs positioned w/ views of nature outside

### **Multifamily Residential**

#### Innovative, Sustainable, Tall Timber Multifamily Carbon 12



Location: Portland, OR Architect: Path Architecture Structural Engineer: Munzing Structural Engineering

- 42,000 sf
- 8-story tower
- 14 condos + 2 retail units
- CLT and glulam framing
- Each unit has light & ventilation from 3 sides

#### Multifamily – Structural Warmth is a Value-Add

