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 a renewable resource?
US Forest Land:
Forest Area in the United States 1630 – 2012

Forest Area has been stable for over 100 years

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

Volume of Trees has been growing for 60+ years!

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.
US Forest Lands

44% Publicly Owned
56% Privately Owned
(42% Family Owned, 14% Owned by Corporations, Partnerships & Tribes)

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.
Economic value of forest products is motivation for private landowners to keep land forested.
US Forest Harvest by Owner

Deforestation is the permanent conversion of forest land to non-forest 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.

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”.

Photos: Oregon Forest Resources Institute
National Forest Management Act of 1976
National Forests of the United States
National Forests of the United States

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

1st 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:

  - FSC
  - SFI
  - CSA
  - ATFS
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
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
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.”

2018 Report
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
Feature Stairs
Encouraging Exercise
## Biophilic Design Patterns
### Nature in the Space

<table>
<thead>
<tr>
<th>Pattern</th>
<th>Stress Reduction</th>
<th>Cognitive Performance</th>
<th>Emotion, Mood &amp; Preference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visual Connection w/ Nature</td>
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<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Non-Visual Connection w/ Nature (smell, touch)</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
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<tr>
<td>Non-Rhythmic Sensory Stimuli</td>
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<tr>
<td>Thermal &amp; Airflow Variability</td>
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<tr>
<td>Presence of Water</td>
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<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Dynamic &amp; Diffuse Light</td>
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<tr>
<td>Connection w/ Natural Systems</td>
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<td></td>
<td>✓</td>
</tr>
</tbody>
</table>

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

**Natural Analogues**

<table>
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</thead>
<tbody>
<tr>
<td>Biomorphic Forms &amp; Patterns</td>
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<tr>
<td>Material Connection w/ Nature</td>
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<tr>
<td>Complexity &amp; Order</td>
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<td></td>
<td>✓</td>
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</table>

**Nature of the Space**

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<td>Prospect</td>
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<td>Refuge</td>
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<td>Mystery</td>
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<tr>
<td>Risk/ Peril</td>
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<td></td>
<td>✓</td>
</tr>
</tbody>
</table>

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 offices—might 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

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

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

“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

IIIB
- 3 Story heavy timber over podium
- 87,460 sf
- Traditional heavy timber
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 2nd Generation
Cottonwood Valley Charter School E-Pod

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

- 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
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

Photos: courtesy of HDR © 2017 Jon Adrian
Healthcare Facilities
Spa-Like Dental Office
Blue Ridge Orthodontics

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

Photo: Mark Herboth

- 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

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

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

Photo: Andrew Pogue
Multifamily – Structural Warmth is a Value-Add