Materials Matter: Design Trends for a Sustainable Future

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The Wood Products Council

Learning Objectives

At the end of this program, participants will be able to:

1. Utilize the Carbon Sequestered in wood to respond to the Architecture 2030 Challenge for Products.
2. Evaluate materials through scientific measurement of ‘green’ through Life Cycle Assessment & Environmental Product Declarations.
3. Evaluate various forestry certifications and building health and safety issues with regard to materials.
4. Recognize the benefits of using wood materials as evidenced in a variety of innovative wood project examples.

Why wood?

Why choose any material?
Life Cycle Assessment – 1960’s

Consider system boundaries...

http://www.epa.gov/nrmrl/std/lca/pdfs/600r06060.pdf

Life Cycle Assessment

From cradle to grave... or cradle to cradle.

Life Cycle Assessment Tools

http://www.bfrl.nist.gov/oae/software/bees/

Life Cycle Assessment Tools

http://www.athenasmi.org/

Environmental Product Declarations

Environmental Facts

Serving Size 1 teaspoon (1.5g)

<table>
<thead>
<tr>
<th>Environmental Facts</th>
<th>Amount Per Serving</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calories 5</td>
<td>Calories from Fat 0</td>
</tr>
<tr>
<td>% Daily Value</td>
<td></td>
</tr>
<tr>
<td>Greenhouse Gases</td>
<td>0%</td>
</tr>
<tr>
<td>Water Pollution</td>
<td>0%</td>
</tr>
<tr>
<td>Acid Rain</td>
<td>0%</td>
</tr>
<tr>
<td>Resource Depletion</td>
<td>0%</td>
</tr>
<tr>
<td>Energy Use</td>
<td>0%</td>
</tr>
<tr>
<td>Solid Waste</td>
<td>0%</td>
</tr>
</tbody>
</table>

*Percent Daily Values are based on a 2,000 calorie diet.

Environmental Product Declarations

The next wave of ‘eco-labeling’....
Life Cycle Assessment - Steel

http://www.steel.org

Life Cycle Assessment - Concrete

http://www.cement.org/basics/howmade.aspx

Life Cycle Assessment-Wood

Carbon Absorbed & Sequestered
**Forestry Practices - Clearcutting**

**Clearcutting ≠ Deforestation**

Scientific practice to help accelerate forest regeneration.

**Deforestation**

- **CONVERSION** to another use
- **Cattle Ranching & Agriculture**

**Sustainable Forestry**

**Fire & Forests**

Cattle Ranching: 65-70%

Agriculture: 25-35%

Logging: 2-3%

Cases of Deforestation in the Brazilian Amazon, 2000-2005

Cattle Ranching: 65-70%

Agriculture: 25-35%

Logging: 2-3%

Shots of deforested land: illegally harvested for timber and agriculture.

Forest fires, regrowth of vegetation, and deforestation. Forests are being cut down for cattle ranching and agriculture in the Brazilian Amazon.
Global Sustainable Forestry Programme for the Endorsement of Forest Certification Schemes

Forest Stewardship Council
Addresses social issues w/ international reach into countries where no legal and institutional framework for social rights and values

Global Umbrella organization supported by 149 governments, covering 85% of the world's forest area

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www.pefc.org

PEFC Certified Forestry

Canadian Standards Association
• Public land
• Rigorous public participation process

Sustainable Forestry Initiative
• Private land
• Public land

American Tree Farm System
• Affordable certification for family & small forest landowners

World-Wide Sustainable Forestry

Note: Standards endorsed by PEFC include those in Australia, Austria, Belgium, Brazil, Canada, Chile, Czech Republic, Denmark, Estonia, Finland, France, Germany, Italy, Luxembourg, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland, United Kingdom and the United States (SFI and ATFS).
Coal Mining = Deforestation

2009 Electric Sector Generation

- 40% Coal
- 22% Gas
- 7% Hydropower
- 21% Nuclear
- 3% Renewables

Think About the Messages...

“Dryers help protect the environment. They save trees from being used…”

Mountain Pine Beetle Epidemic

Glacier National Park 2011

Please consider the environment before printing this e-mail.

Dryers help protect the environment. They save trees from being used…”

Think About the Messages…

Glacier National Park 2011

2009 Renewable Generation

- Wind (62%)
- Other Renewables (14%)
- Geothermal (13%)
- Wood (8%)
- Solar (4%)

Glacier National Park 2011

Glacier National Park 2011
Richmond Oval – Vancouver Olympics


Exceeding Expectations…

Sustainability

Moisture

Durability

Fire

Materials & Moisture

No building material is exempt...

Moisture + Dust/Dirt = Mold

Managing Moisture is key...

No Kick-out Flashing!
Kick out diverter under siding

Old Growth Wood - 1,000 years old

Durability – based on materials?

Prentice Women’s Hospital, Chicago

Many Glacier Hotel, Montana

Five Story Wood Structure

Courtesy www.dryflekt.com

www.aquatimber.com

Fulton County Stadium, Atlanta, Georgia. 1965-1997

Horyuji Temple, Ikaruga, Nara, Japan 607-711
12th Century, 1374, 1603

Architect: Bertrand Goldberg – Built 1975

Useful life: 37 years???

Built - 1915

Many Glacier Hotel, Glacier Nat’l Park, MT

1915 - ?
Butler Brothers Building – 9 Stories

Butler Square today…

Architect: Harry W. Jones    Renovated 1974

Structural System = Long Useful Life?

- No Relationship!

Reasons for demolition
- Changing Land values
- Lack of suitability
- Lack of maintenance

Fire

Heavy Timber resists fires through charring and maintains strength

Fire Resistive Construction Resources


Heavy Timber Fire Design

Char protects the inner core.


Biophilia = “love of living systems”
“the connections that human beings subconsciously seek with the rest of life”

Social psychologist Erich Fromm/Edward Wilson 1980s

Emotional connection...
when people see and touch wood...

Recent Study – Univ. of B.C. / FPI

Wood and Human Health

Recent Study – Univ. of B.C. / FPI

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

Wood = Health Benefits

Using wood materials in new ways...

Recreational Facilities

Credit Valley Hospital
Beaverton Library, OR
Prairie Island, MN
Brentwood Station, BC
Bellevue Transit Station
Bridges - Norway

Sentinel Structures

Credit Valley Hospital
Convention Ctr, Vancouver
Sentinel Structures

Recreational Facilities
Aquatic Facilities

Solemar Salt-water Baths
Bad Durreim, Germany

Percy Norman Aquatic Center
Hughes Condon Marler, B.C. LEED Gold

Superior Dome - Michigan

14 Stories; Diameter of 536 ft.; 5.1 acres
781 D.F. beams
108.5 miles of fir decking.
Snow loading to 60 pounds per square foot & 80 mile per hour winds.

Superior Dome - Michigan

David Clark Photography

Healthcare

Thunder Bay Regional Health Sciences Center

Willson Hospice House – Albany, GA

Perkins & Will, Atlanta, GA
Jim Roof Creative Photography

Herrington Recovery Center – Oconomowoc, WI

2010 Green Building Award

Owner: Rogers Memorial Hospital
Arch: TWP Architecture
S.E.: Puiara Wirth Torke, Inc.

Photos: Tom Davenport
Carlo Fidani Peel Regional Cancer Center
Farrow Partnership Architects
Mississauga, Ontario

Cultural Facilities
Lord, Aeck & Sargent Architects, NC
LEED Gold
Blue Ridge Destination Center

Myrick Hixon EcoPark Building - WI
Whole Trees Architecture, Stoddard, WI

Branson Convention Center - MO
Architect: TVSdesign
S.E.: Walter P. Moore
Glulam: TimberWeld Manufacturing

Art Gallery of Ontario – Toronto

Arena Stage at the Mead Center
Bing Thom Architects
Fast+Epp Structural Engineers
StructureCraft Builders
Washington, D.C.
**Arena Stage at the Mead Center**

- Volume of wood used: 8,886 cubic feet of peeled and engineered wood products.
- U.S. and Canadian forests grew this much wood in 1 month.
- Carbon stored in the wood: 272 metric tons of CO₂.
- Avoided greenhouse gas emissions: 660 metric tons of CO₂.
- TOTAL POTENTIAL CARBON BENEFIT: 875 metric tons of CO₂.

**Equivalent to:**
- 129 cars off the road for a year
- 1,480,000 kWh of electricity
- Energy to operate a home for 58 years

**Rupert Station – Vancouver, B.C.**

- Jackson Hole International Airport
  - Jackson, Wyoming
  - Architects: Gensler
  - Project Type: Airport Expansion & Renovation
  - 2010 - LEED Silver Certification
  - Building Size: 115,578 s.f.
  - Const. Cost: $30.6 million

- Raleigh Durham International Airport
  - Stewart Engineering, Inc.
  - Fentress Architects
  - ARUP Engineering
  - Layton Petro Mart --- Greenfield, WI
  - Commercial Wood Design Award 2009
  - Arquitectura, Inc. – Milwaukee, WI
Heavy Timber Braced Frames (HTBF)

Modern Timber Bridges – 100 yr. Life!

Fiber Reinforced Polymer (FRP) Glulam

Fiber Reinforce Polymers (FRP)

FRP use in Blast Resistant testing

Wood Core w/ Fiberglass Epoxy
Wood Core w/ Fiberglass Epoxy

Fiberglass wood composite bridge panels side by side being prepared for prefet/shipping

Office / Midrise

Fiberglass

wood composite bridge panels side by side being prepared for prefet/shipping

Fire Retardant Treated Wood

FRTW cannot provide additional fuel to the fire...

Fire-retardant process is throughout the material.

Podium Structure

Photo: Matthew Todd

FRTW cannot provide additional fuel to the fire...

Fire-retardant process is throughout the material.

Marselle Condos

Seattle, WA

PB Architects

Trussed Shear Walls

Photo: Matthew Todd
NEESWood Project
Midply Walls

http://www.youtube.com/watch?v=lLhg8YxtzIU

Mid-Ply Shearwalls

Cross Laminated Timber (CLT)

Photos provided by FPInnovations

How does CLT work?

Nine Story Wood Building in UK

Saved 23 weeks...


Carbon storage = 210 years of 10% reduction in CO2
Melbourne Victoria Harbour at Docklands

Lead Lease – Australia 10 Stories

Post Tensioning
- Moment connections for Heavy Timber
- Rapid erection
- Lightweight
- Low carbon footprint
- Earthquake resistant

OFFICE: 3555 Hayden, Culver City, CA

Eric Owen Moss Architects
San Diego, CA

2009 CA Commercial Design Award Winner
Tom Bonner Photography

One Realtor Center
Tyler, TX

Ken Killian Architects
Garland, TX

Glulam Shapes = Infinite Possibilities

Credit Valley Hospital, Ontario

Norway Bridge

Art Gallery of Ontario - Gehry

Richmond, Qul
Glulam with LVL Tension Lamination

- LVL Tension Lam
  - Full length, no finger joints
  - Greater tensile strength = 3000 psi

Glulam Floor Beams - EWS C415 & Y117

University & School Facilities

- Roosevelt University, CA
- Bethel University, MN

Univ. of British Columbia

- Michael Smith Building

EL Dorado High School – WOW!

- $2.7 million savings due to use of wood framing!
- CADM Architects
- Photos by W.I. Bell & Dennis Ivy

Main Street Corridor – 24 ft wide

Richmond Christian School
Structural Insulated Panels (SIPs)

Inspirational Projects

Cathedral of Christ the Light, CA
- 110 feet tall
- Designed for a 1000 yr. earthquake event
- Designed for building life of 300 years

Belmont Abbey College Chapel

The Bishop's Chapel at Roslyn Retreat Center
Richmond, VA
Bartzen + Ball, PLLC - Architects

Industrial
Panelized Roofs

Construction Savings:
- Batt insulation Savings
- Construction Detail Savings
- Construction Time Savings
- Safer Construction

Panelized Roofs

Climate Change Advantage

What is Next?! .. Wood Sky Scraper

A design concept of a 36-storey building out of CLT & concrete (Infill CLT walls and floors)

30 stories - tallest timber structure ???

Life Cycle Tower

Passivhuis standard ...
All components - local and prefabricated.

CREE designed structure to be built in Dornburn, Austria

HBV floor panels

Composite action – reinforced concrete and wood
- Alternatives for:
  - Reinforced-concrete floors
  - Conventional steel composite systems
  - Flexural and two-way load bearing planks
  - Pre-stressed steel concrete hollow box floor

The Case for Tall Wood Buildings

How Mass Timber Offers a Safe, Economical, and Environmentally Friendly Alternative for Tall Building Structures

www.woodworks.org

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1/27/2013
**Construction Materials Price Index**

Change in producer prices. December 2003 = 100

![Graph showing construction materials price index from 2004 to 2012.](image)


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**The benefits of using wood…**

- **Cost**
- Faster construction time
- Easy to work with
- Aesthetics
- Sustainability
- Carbon
- Renewable

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**Wood is Good!**

WOOD is the ONLY material:

Renewable & provides assurance of **Environmental Responsibility** regarding production.

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**Forest Land Ownership**

This map displays the land ownership (state & ownership) of the conterminous United States. Ownership data (state & ownership) was obtained from the USDA Forest Service, Forest Inventory and Analysis National Woodland Owner Survey. Forests: University of Maryland, MODIS Vegetation Continuous Fields; Public Ownership: University of California Santa Barbara Managed Area Database; States: ESRI Data and Maps.

A forest that stays…

Is a forest that pays.

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**Wood Cube vs. Concrete Cube**

- **450 kg** Sequesters 1 ton of GHGs
- **450 kg** -22% size Generated 2 tons of GHGs

http://www.youtube.com/watch?v=YHbD_X45tBA

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**Michael Green: The beauty and impact of a wooden skyscraper**

**Michael Green!**
The Future???

“The 21st Century will be built in wood.”

Andrew Waugh
Waugh-Thistleton Architects
Architect behind the world’s tallest modern timber residential building

How can you help?

Questions?
This concludes The American Institute of Architects Continuing Education Systems Course

THANK YOU!

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Resources - FPL