WOOD IN GREEN BUILDING

Environmental Performance of Wood in Residential and Commercial Construction

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Premise

- Wood is a green building material but current “green building standards” and the public perception don’t fully recognize this scientific fact.
- The disconnect between science and practice of wood being green requires expanded research and education effort.
Outline

- Green building guidelines, standards, and practice
- CORRIM’s effort to document wood as green based on product and building life-cycle studies
- Example of a whole building and wall assembly life-cycle studies comparing wood to steel and concrete construction
- Educational needs
- Benefits to using wood products for green building
Examples of green building guidelines, registrations and certifications:

– LEED (Leadership in Energy and Environmental Design) of the USGBC
– Green Globes™ of the Green Building Initiative
– NAHB Model Green Home Building Guidelines
Green Globe™ and LEED certifications are vying to be the U.S. federal government environmental rule for green building.

There is an estimated $200 billion in government-financed construction up for green certification in U.S.

Adoption of green standards could influence how much wood goes into buildings, compared with other materials such as steel, plastics, and cement.

Examples of Green Building to Certification Standards

Blakely Hall
LOCATION: Issaquah, Washington
FLOOR SPACE: 7,000 ft²
BUDGET: $1,500,000 USD
CONSTRUCTION DATES: 2004-2005
OWNER: Issaquah Highlands Council & Port Blakely Communities
ARCHITECT: Webber + Thompson, PLLC Architects
LANDSCAPE ARCHITECT: Jane Garrison
STRUCTURAL ENGINEER: Coughlin Porter Lundeen
MECHANICAL ENGINEER: Pro Staff Mechanical
ELECTRICAL ENGINEER: North Star Electric
CIVIL ENGINEER: Coughlin Porter Lundeen
COMMISSIONING AGENT: Abacus Engineering

Green Globes™ and LEED certified

Kelley Engineering Center
Oregon State University
LEED certified
Examples of Wood Green Buildings
-before green certification programs-

Oregon State University
Halsell Student Residence—wood, four-story building, first of its type in 100 years in Corvallis. Built in 2002.

Oregon State University
Washington State Law Mandates Green Building

April 21, 2005 Olympia, Washington

Washington's Gov. Christine Gregoire signed the high performance green buildings bill into law which, according to the governor's office, makes Washington the first state to require that new public buildings meet "green building" standards of energy efficiency, water conservation and other environmental standards.

Standard follows LEED for buildings greater than $5 million.
How to Get Green*

- Green Building Guidelines say to “incorporate environmental issues into project’s decision-making process.”
- Green Building Guidelines say to base “the selection of building material on their environmental impact.”

* National Association of Home Builders
Environmental Issues of Building Green
To Determine Whether a Material or Home is Green*

- Is it a renewable resource?
- Does it use resource efficient material?
- Does environmental data such as energy consumption and CO$_2$ emissions exist for material (use Life-Cycle Inventory)?
- Is Life-Cycle Analysis (LCA) used to analyze product or building?
- Are there comparisons of environmental impacts to select best material, building design, wall assembly, etc.?

* National Association of Home Builders
NAHB Guidelines—Use Life Cycle Analyses to Assess Projects

ENVIRONMENTAL ISSUES

- Raw Material
- Product Manufacture
- Construction Process
- Maintenance & Operation
- Building Demolition
- Product Disposal or Reuse
Disconnected Between Green Building Guidelines and Scientific Facts

**LEED example:**

- LEED credit MR6c—materials from rapidly renewable sources are given environmental credit
  - Gives credit for materials that fully renew in less than 10 years, i.e., cork flooring, bamboo flooring, wool carpeting, cotton insulation, and a wide range of agricultural products—science shows that the environmental impact of these products is no better than for wood and often is worse than for wood. LEED is now considering changing this credit to a “biobased” credit which would include wood building products.
Demonstrating Wood is a Green Building Material

Easy to say but can it be proved!

CORRIM
Developing Unbiased, Sound Environmental Data

Consortium for Research on Renewable Industrial Materials

National effort to document the environmental performance of all wood products.
CORRIM, Inc.

- A non-profit corporation formed by 15 research institutions to conduct life-cycle inventory (LCI) and life-cycle assessment (LCA) studies of wood products.
To develop a public database and models of environmental performance measures over the life cycles of all wood products.

To examine a range of management, product, and process alternatives to identify strategies to improve environmental performance of wood products and residential and commercial buildings.
CORRIM’s research follows Life-Cycle Inventory (LCI) and Life-Cycle Assessment (LCA) international protocol of ISO 14040s Standards
CORRIM Provides Environmental Data for Wood Products

Life cycle inventory (LCI) data for wood building materials

Athena™ EIE
LCA software to assess performance

US LCI Database
Environmental database of all US materials and processes

Life cycle assessment of home buildings
CORRIM'S Initial Effort Targets Structural Wood Products and Home Construction

Phase 1 Report
July 2004

Reports, presentations, publications, and news releases available on: www.corrim.org
Overview CORRIM’s Phase 1 Research

Forest Resources & Harvesting
PNW and SE

Processing of Structural Materials
PNW and SE
- Lumber
- Plywood
- Glulam
- LVL
- I-joists
- OSB (SE only)

Construction of Virtual Residential Buildings to Code
- Minneapolis wood and steel designs
- Atlanta wood and concrete designs

Building Use and Maintenance

Disposal or Recycle

“Cradle”

“Gate-to-Gate”

“Grave”
Output of CORRIM Study

- Life-cycle inventories (LCIs) of forest, harvesting, and structural wood products.
- Life-cycle assessments (LCAs) of the construction, use, and maintenance of residential buildings.
- Carbon tracking and storage for forest, wood products, and substitution products.
- Biomass (wood) fuel use.
- Sensitivity analyses of LCI and LCA models.
- Benefit cost analyses.
Phase 1-- Collected Forest and Production Data & Studied Residential Buildings

Minneapolis House
Cold Climate

Atlanta House
Warm Climate
Phase 2—Additional Forests and Construction Sites

- Seattle House: Wet Climate
- Minneapolis House: Cold Climate
- S. Cal. House: Great Climate
- Atlanta House: Warm Climate
Example of Whole House Life-Cycle Analyses to Compare Building Materials

- Compared wood- to steel-framed home for cold climate
- Compared wood-framed to concrete block wall home for warm climate
Designed Homes to Local Building Code

Minneapolis House Cold Climate

Compared wood- to steel-framed house designed to same R code. The house is 2,062 sq.ft., two story, concrete basement, sheetrock, insulation, OSB sheathing, wood trusses, vinyl windows, vinyl siding and asphalt roofing.
Designed Homes to Local Building Code

Atlanta House Warm Climate

Compared wood framed to concrete block exterior walls designed to same R code. The house is 2,153 sq.ft., one story, slab on grade, sheetrock, insulation, wood studs, wood trusses, OSB sheathing, vinyl windows, stucco siding and asphalt roofing.
CORRIM’s Life-Cycle Assessment of Wood Products & Buildings

[Diagram showing the life-cycle assessment of wood products and buildings, including processes such as management & harvest, production, construction, and emissions (CO₂, O₂, water & land emissions).]
Life-Cycle Assessment In Terms of Environmental Performance Indices

- Embodied Energy
- Global Warming Potential
- Emissions to Air, Water, and Land
- Resource Use
Although referred to as a wood-framed house, concrete is the dominant mass, with other materials playing lesser roles by mass.
Comparison of Wood- to Steel-Framed House
Comparison of Wood-Framed to Concrete Block House

- Embodied Energy: 116% for Wood, 131% for Concrete
- Global Warming: 123% for Wood, 100% for Concrete
- Air Emissions: 100% for Wood, 151% for Concrete
- Water Emissions: 100% for Wood, 100% for Concrete
- Solid Waste: 100% for Wood, 151% for Concrete
Fossil Fuel Consumption for Warm Climate Exterior Walls

Concrete-framed wall results in 150% more energy use.
Fossil Fuel Consumption for Cold Climate Exterior Walls

Steel-framed wall results in 30% more fossil fuel use.
Comparison of Structural Assemblies
A menu of environmentally rated:

- Wall assemblies
- Floor assemblies
- Roof assemblies

CORRIM is preparing a shopping list of construction options for contractors, designers, and architects to select environmental designs.
CORRIM’s Expanded Effort

- CORRIM to complete Phase 2 research on wood products this fall, it expands upon the initial study:
  - Extends source location of forest resources to other regions
  - Assess home building in other regions
  - Assess low-rise and multi-family homes and commercial buildings
  - Extend wood products to non-structural products such as hardwood flooring and MDF
  - Full product LCI’s and LCA’s
  - Component-by-component construction analyses of walls, floors, roofs and assemblies—a menu of alternative construction options
Educational Issues of Green

- A strong need to educate to correct disconnect between perception of the environmental impact of using wood products in buildings and the scientific evidence of its use.
CORRIM’s Effort to Green Educate

- Work with product and trade associations to promote the “green” of wood products.
- Provide publicly available data and analyses of wood products as a green building material.
- Work with green building certification groups to provide scientific justification of wood as a green building material and to encourage the use of life-cycle assessment in their methodology.
- CORRIM to start developing educational material on wood as a green building material.
Benefits to Using Wood Products

- Wood is a green building material in comparison to other materials
  - Data is available in U.S. LCI Database; however, for use by architects, designers and contractors, it will likely be by using building guidelines, standards and design assessment software (i.e., Athena™, and eventually LEED and Green Globes™)
Benefits to Using Wood Products

- Wood is sustainable and renewable whether for forest, products, or fuel
- Wood is resource efficient
- Wood can store carbon in forest, products, and landfills removing it from the atmosphere as $\text{CO}_2$—reducing global warming
For more information please see:

CORRIM:  www.corrim.org

ATHENA™:  www.athenasml.ca

US LCI database:  www.nrel.gov/ici

NAHB Green Build Guidelines:  www.nahb.org/gbg

LEED:  www.usgbc.org/

Green Globes™:  www.thegbi.com/greenglobes/
Need for Green Building

Which Earth will we have?