WHOLE TREES®
ARCHITECTURE & STRUCTURES
www.wholetrees.com

Wooden Cities

Stoddard, WI
Madison, WI

February, 2013

Roald Gundersen, AIA, Co-Founder and Principal

WholeTrees Main Office at Driftless Farm
134 acres of sustainable managed forest

Satellite Office in Madison, WI

Architects have **Four** common structural materials to choose from:

1- Steel
2- Concrete
3- Processed Wood
4- Round & Milled Timbers

WholeTrees® offers a 5th option

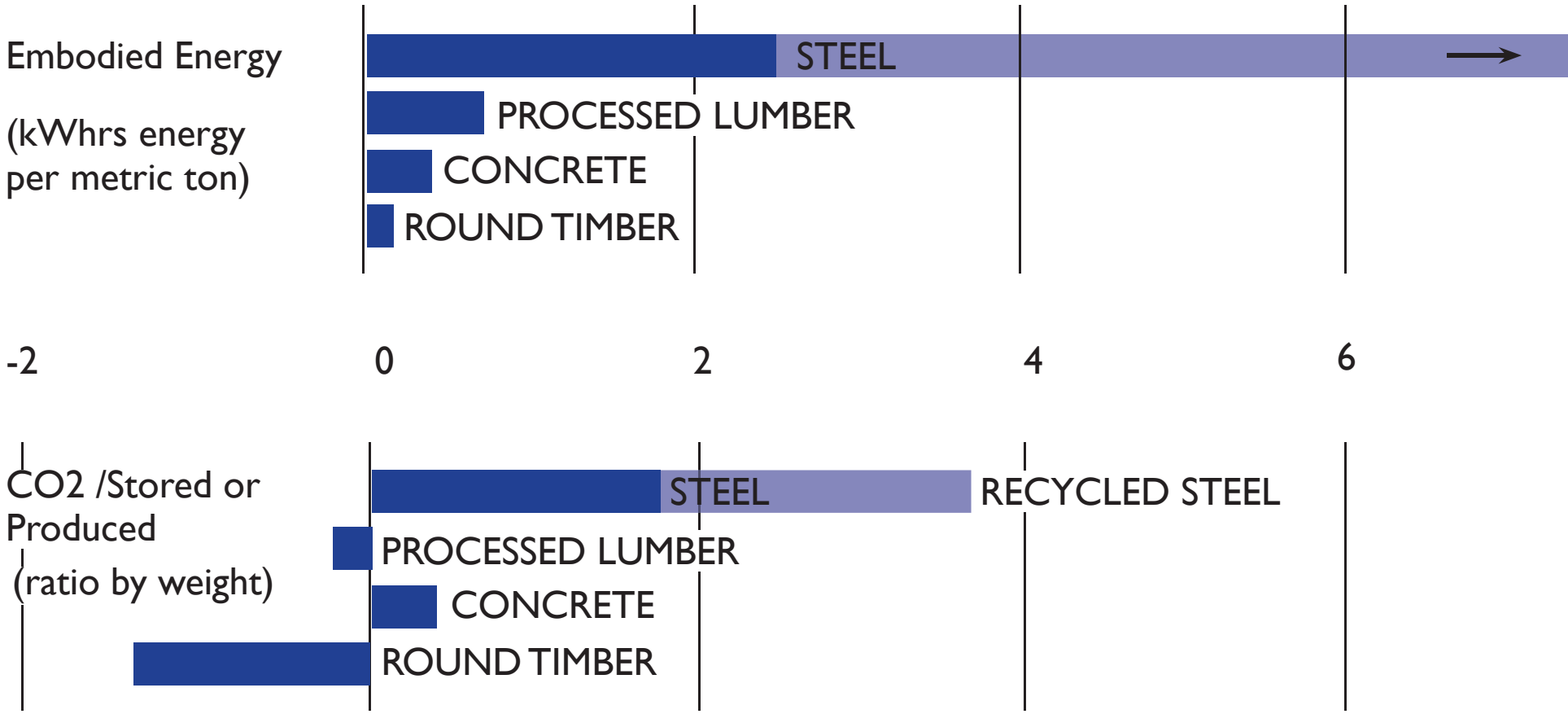
Builiding-shed Issues
Inherent in Creating Structural Systems

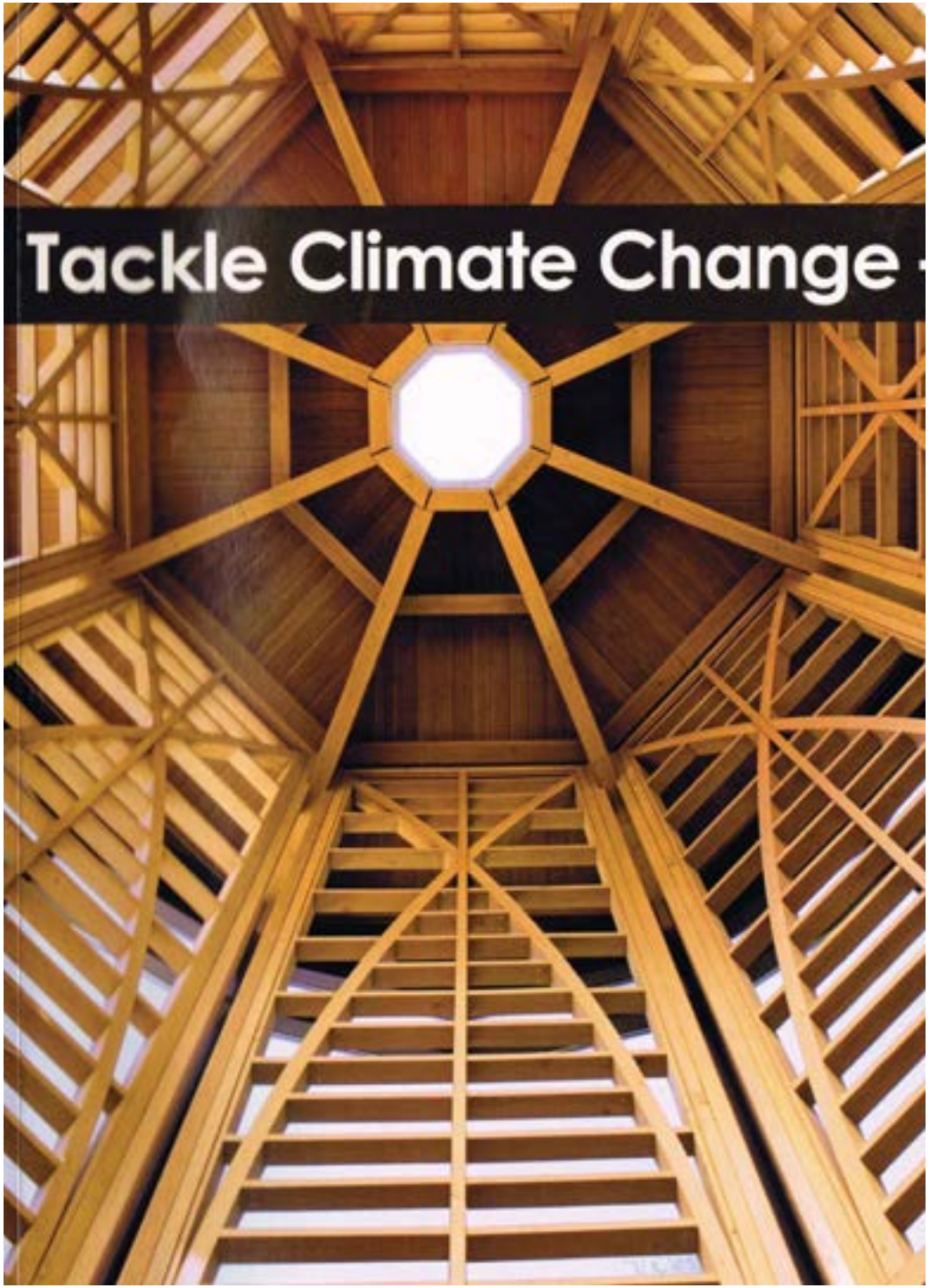
Solutions
in Round Timber Structural Systems

1- Depleted Resources
2- Degraded the Environment
3- High Energy Use and Climate Change
4- Pollution
5- Export of Jobs & Industry
6- Cost Volatility
7- Strength&Durability
8- Damage to Communities

1- Regenerates Resources
2- Enhances the Environment
3- Reduces Energy/ Stabilizes Climate
4- Reduces Pollution
5- Produces Local Jobs & Industry
6- Stabilizes Costs
7- Enhances Strength&Durability
8- Builds Local Community

Comparative Resource Use Across Structural Materials





Green Building Codes: UK, EU, Canada

Tackle Climate Change – Use Wood

Governments around the world are implementing policies that encourage greater use of forest products.

UNITED KINGDOM – Changes in national building regulations are encouraging multi-story wood buildings; the largest timber-frame building in the United Kingdom is nine stories.

FRANCE – The government recently announced measures encouraging the building sector to increase the use of timber tenfold by 2020.

NEW ZEALAND – As part of its promotion of a carbon-neutral public service, the government is requiring that wood or wood-based products be considered as the main structural materials for new government-funded buildings up to four floors.

CANADA – The governments of British Columbia and Quebec have recently announced policies encouraging the use of more wood.

The BC government's "Wood First" policy will require wood to be the primary building material in all new public buildings. The province's building code has also been changed to allow six-story multi-family residential buildings, up from four stories.

In Quebec, the government's wood-use strategy encourages all levels of government to commit to adopting a charter to use wood in all public buildings.

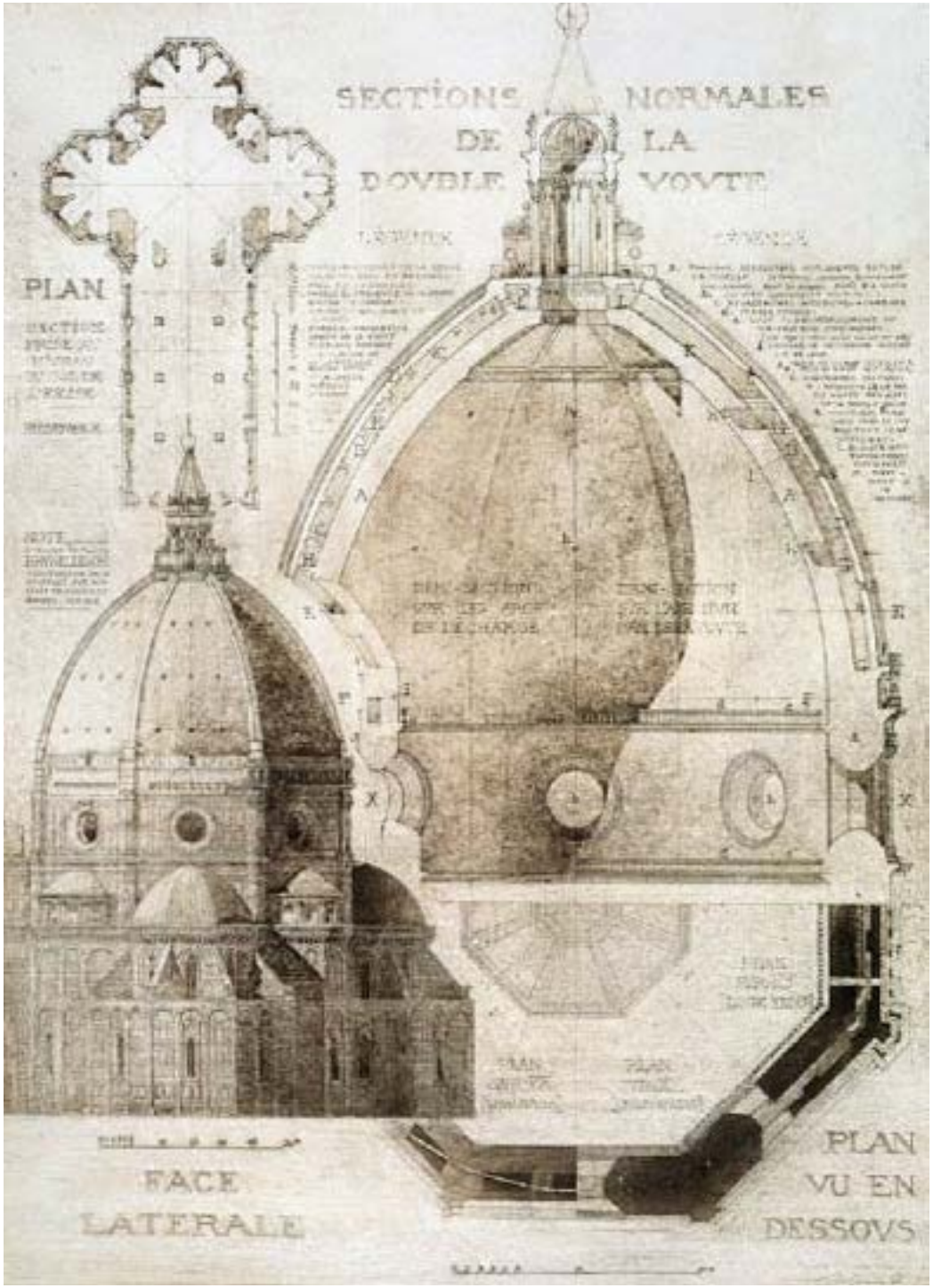
UNITED STATES AND CANADA – Both governments are encouraging increased production and use of bioenergy from woody biomass, as evidenced by (among other things) their research into the widespread production and use of cellulosic ethanol.

EUROPEAN UNION – Members of the EU have agreed that 20 percent of their total energy output will come from renewable energy sources (i.e., biomass, biogas, wind, solar, hydro and geothermal energy) by 2020.

In recent years, there has been an increasing focus on 'responsible use' as an appropriate strategy for addressing a wide range of environmental issues. It is a common-sense mantra we must now take up with respect to climate change:

Choose wood products from sustainably managed forests over materials that require large amounts of fossil fuels to manufacture. Extend their lives through recycling and reuse to maximize the carbon storage potential. Manage forests to reduce the risk of wildfire, insects and disease, and encourage the use of forest debris to produce clean bioenergy.

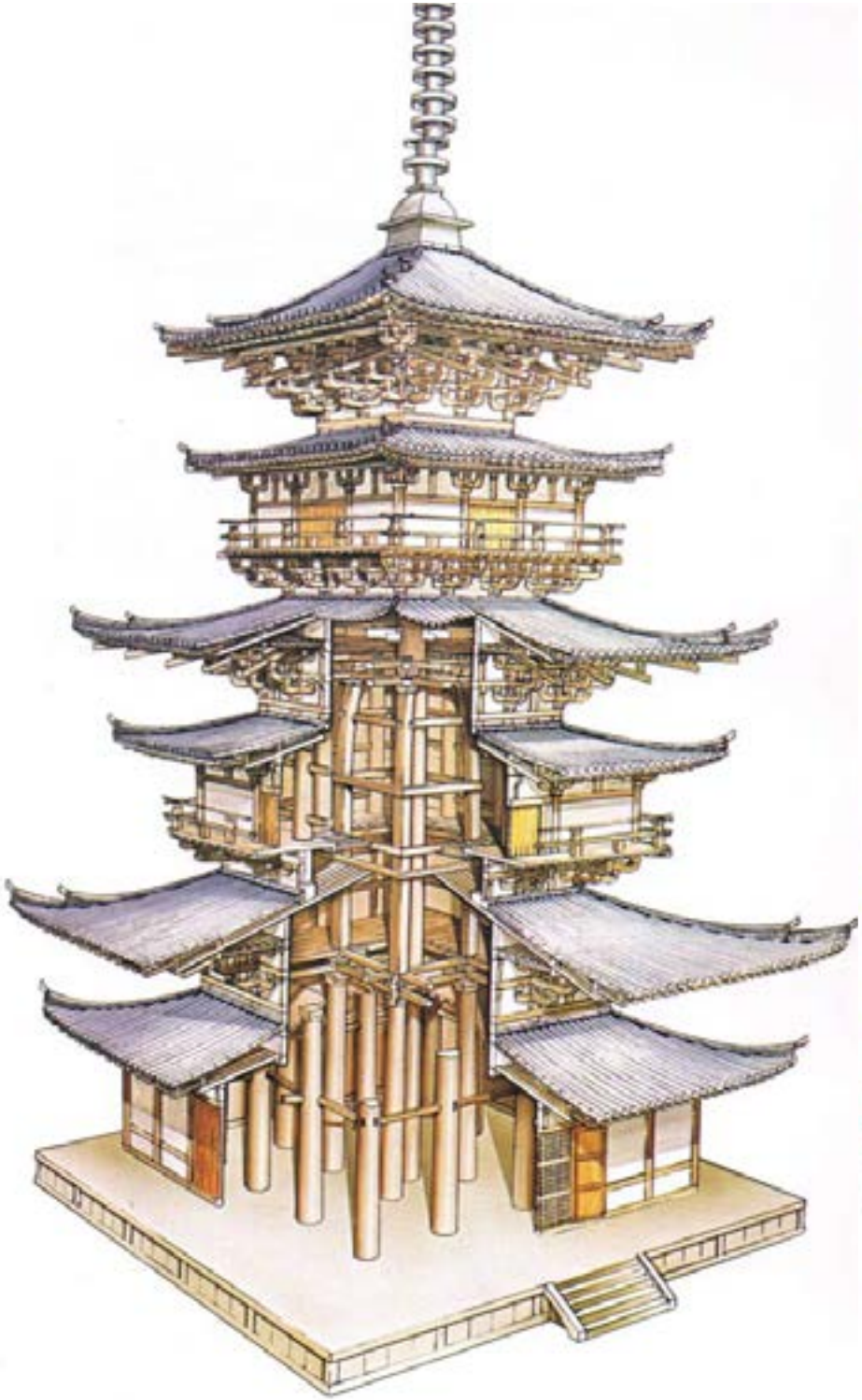
In other words, make sound environmental choices today that maximize the potential of forests and forest products to be part of the climate change solution.



Il Duomo, Fillipo Brunalleschi
Florance, Italy, 1436

Borgund stave-church
Norway 1150 AD

Reconstructed Mandan Lodge at On-A-Slant Village
Bismarck ND, circa 1575



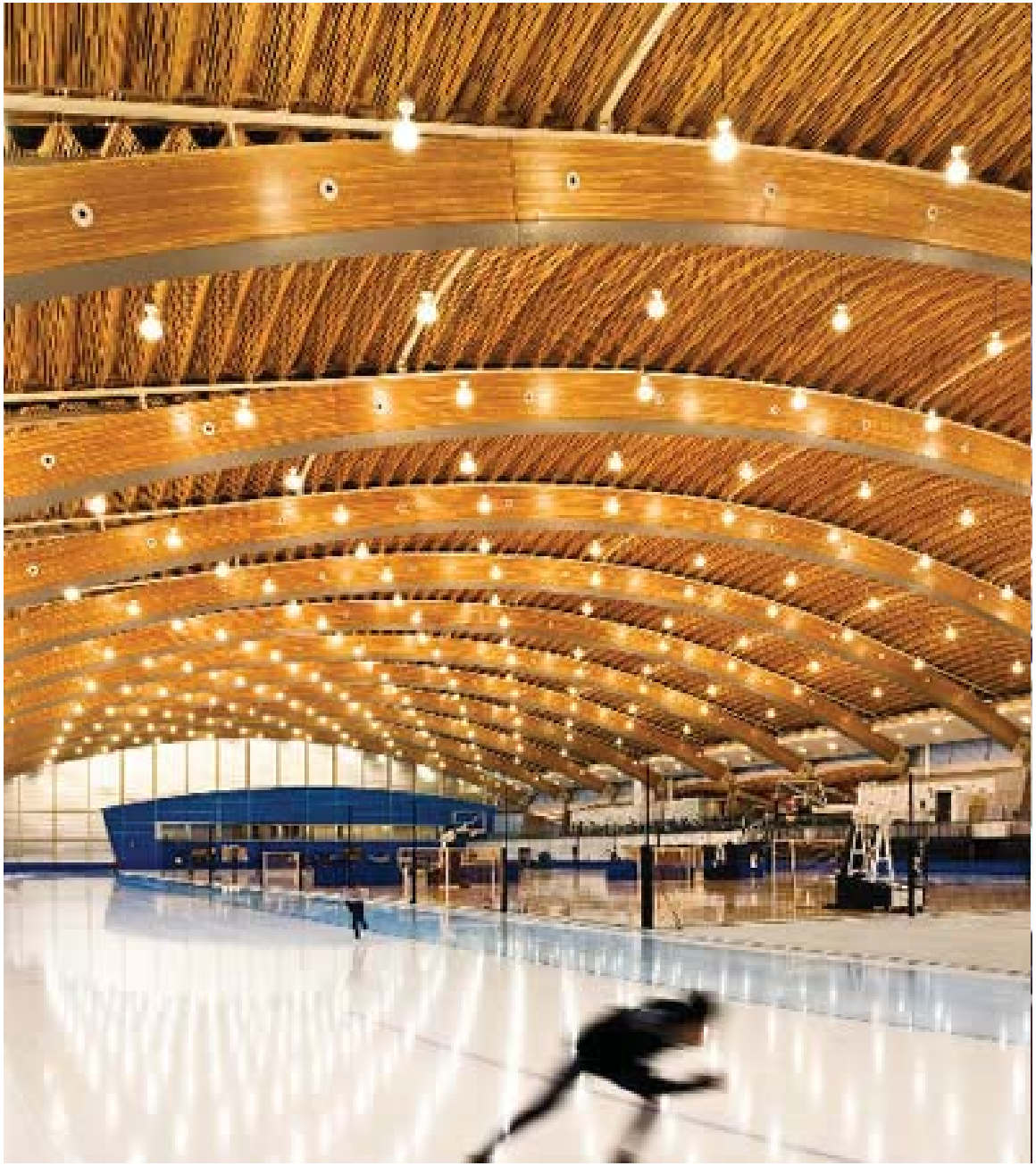
Trees "invented"
tall structures

Kakushiji Temple
Nara Japan 8th Century

Tall Structures

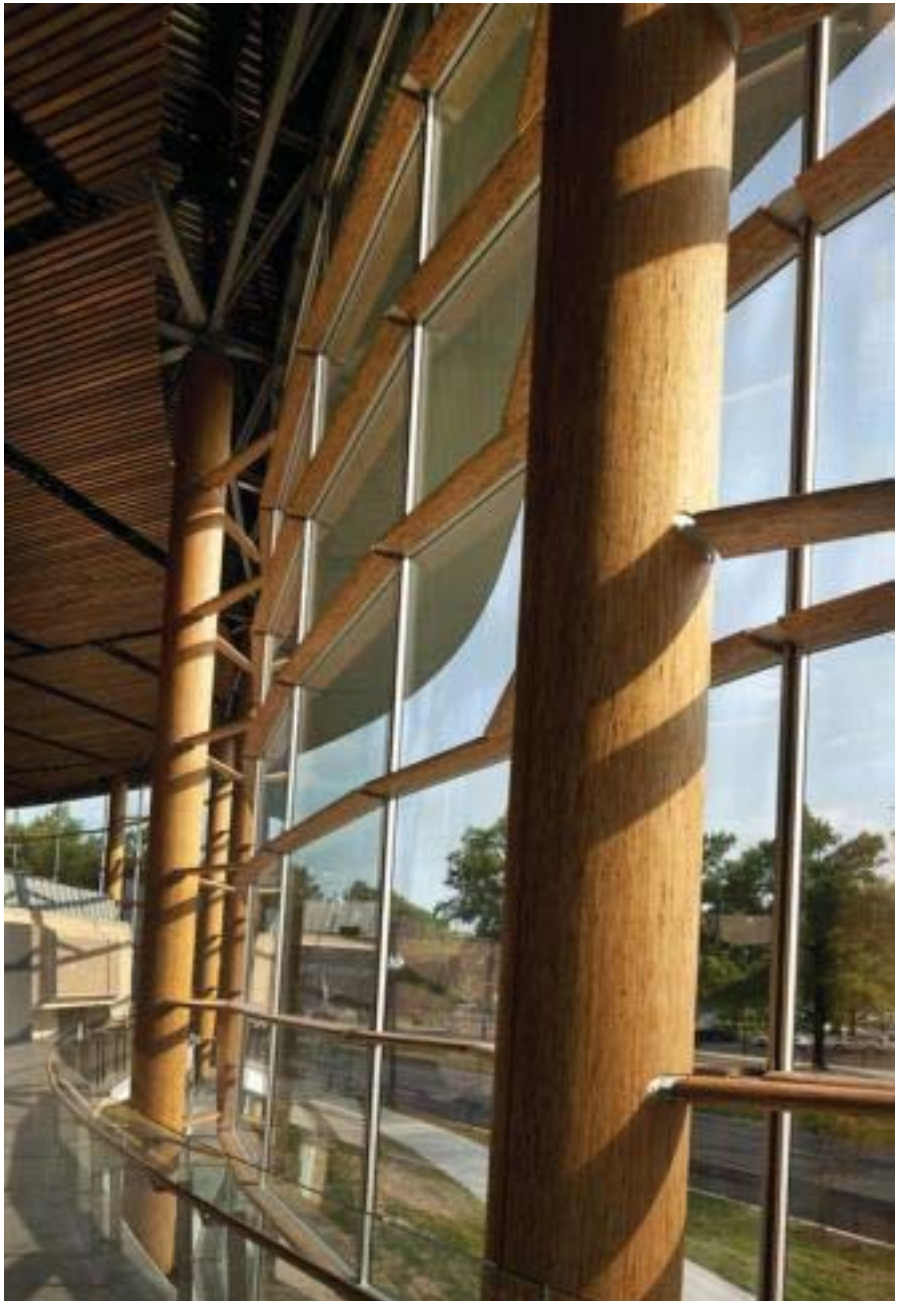
Lifecyle Tower, Austria by CREE

Long Spans



Olympic Oval, BC,
Cannon Designs

Curvilinear Designs



Arena Stage, Washington DC,
Bing Thom Architects

Gridshell Structures

Savill Gardens Gridshell, England
Glen Howells Architects

Gridshell Structures

Metropol Parasol, Seville, Spain
Jurgen Mayer H.

Intact concentric tree rings preserve the strength of Round Timbers

Artist Giuseppe Penone removes the rings of growth revealing the ‘sapling within’.

WholeTrees® Architecture

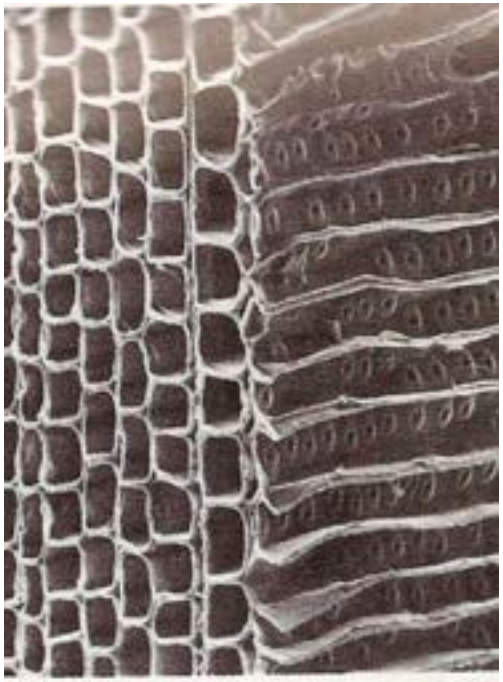
Uses unmilled small diameter round timbers from forest thinning and tree tops

Uses branching and curved aspects of trees to provide axial and lateral bracing

Uses wood's tensile strength

Is dimensionally tolerant and non-modular

Can be structurally oversized



Round timbers:

Are a self-replicating carbon nano-fiber comprised primarily of air, water and sunlight.

Are 50% stronger in bending than milled wood.

Have a weight to strength ratio equal to steel in compression and twice that of steel in tension.

Clean the environment and reduce global warming while being produced.

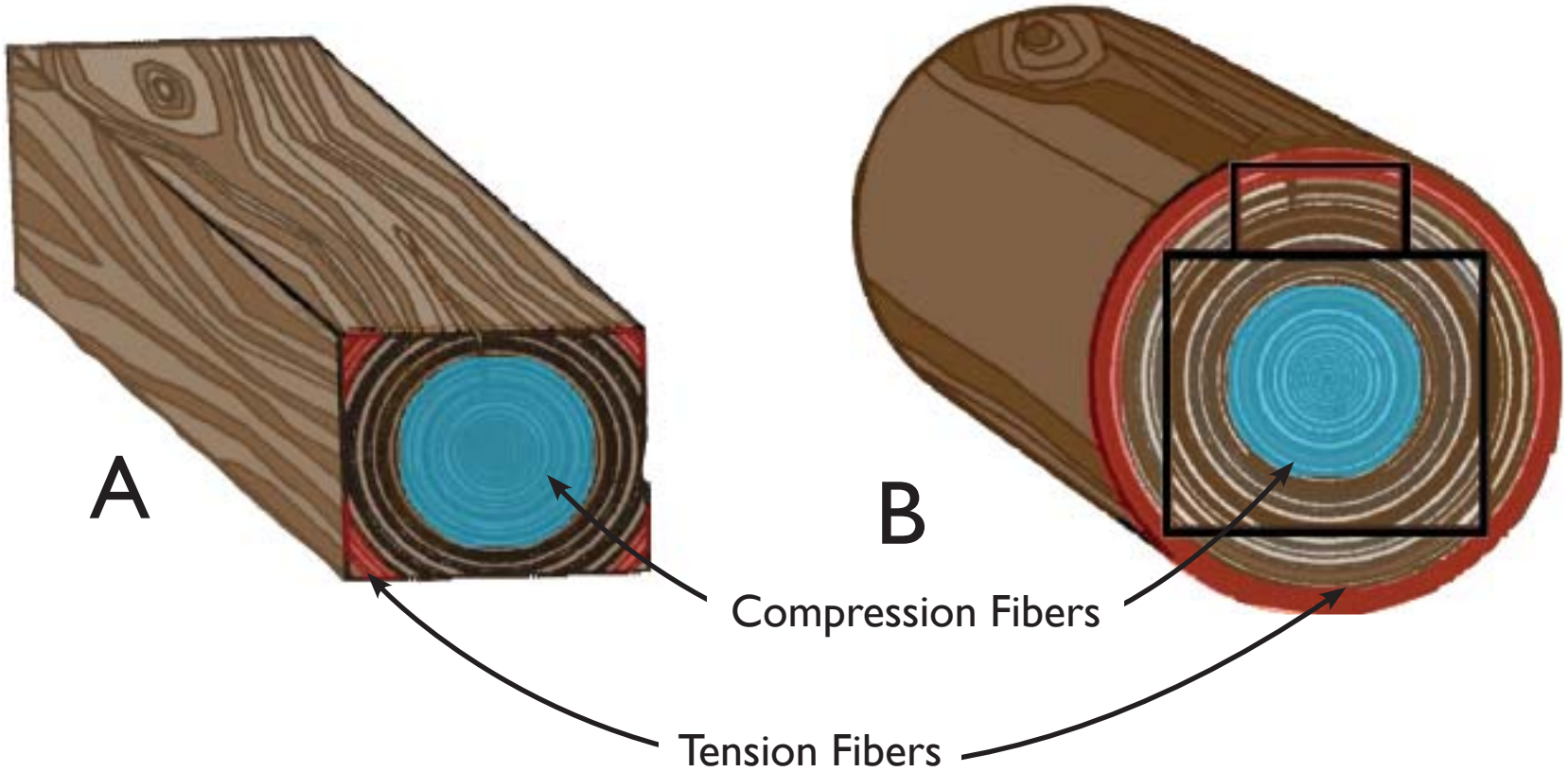
Occur in the backyard, are incredibly cheap to produce and hugely abundant and accessible.

Are safe and effective to use and their waste can be composted or burned for heat.

Have over 200 million years of environmental and structural testing.

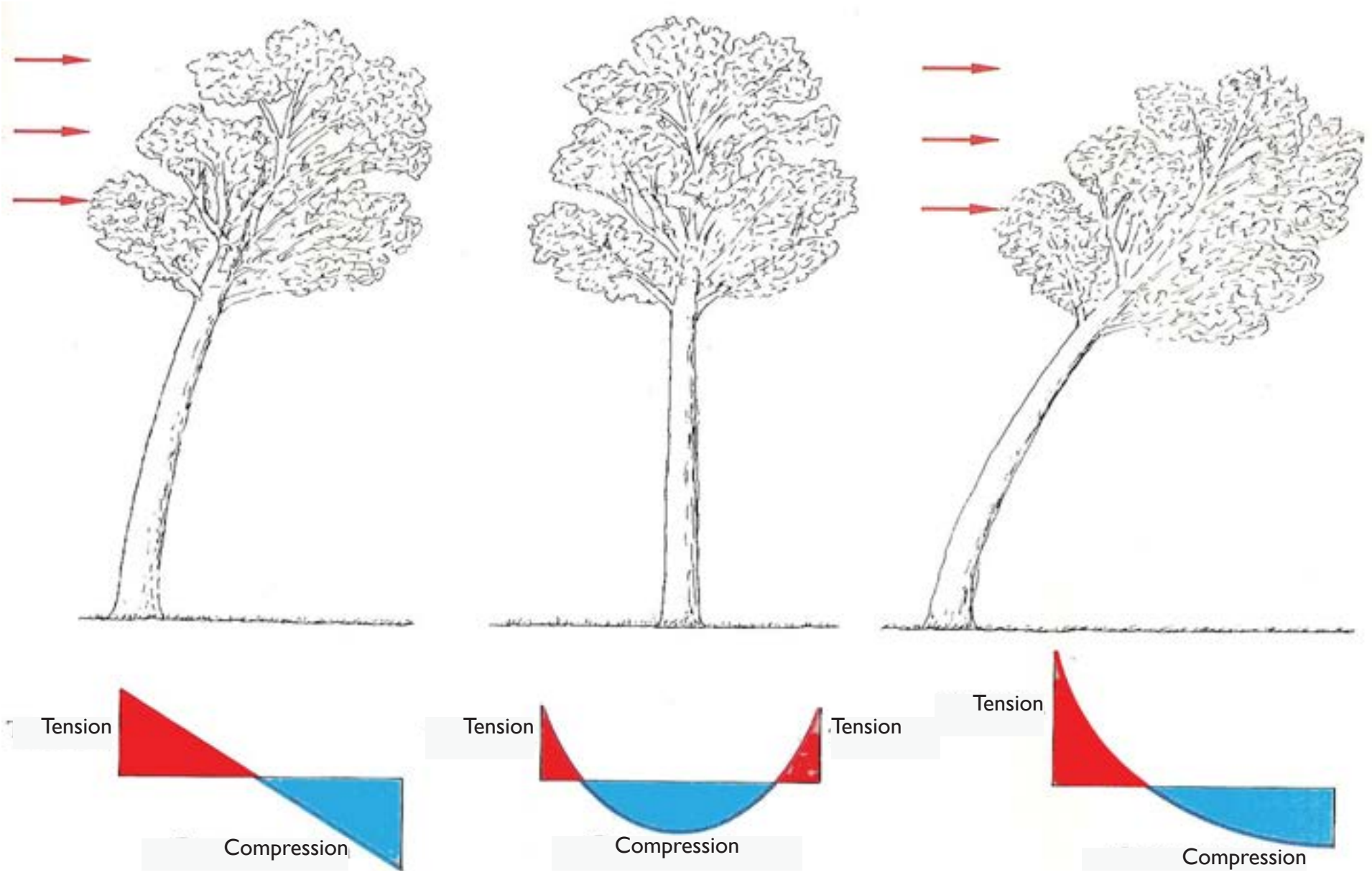
Are not a proprietary material, cannot be patented or be kept as a trade secret.

Round Timber is 50% Stronger than Milled Lumber in Compression and Tension

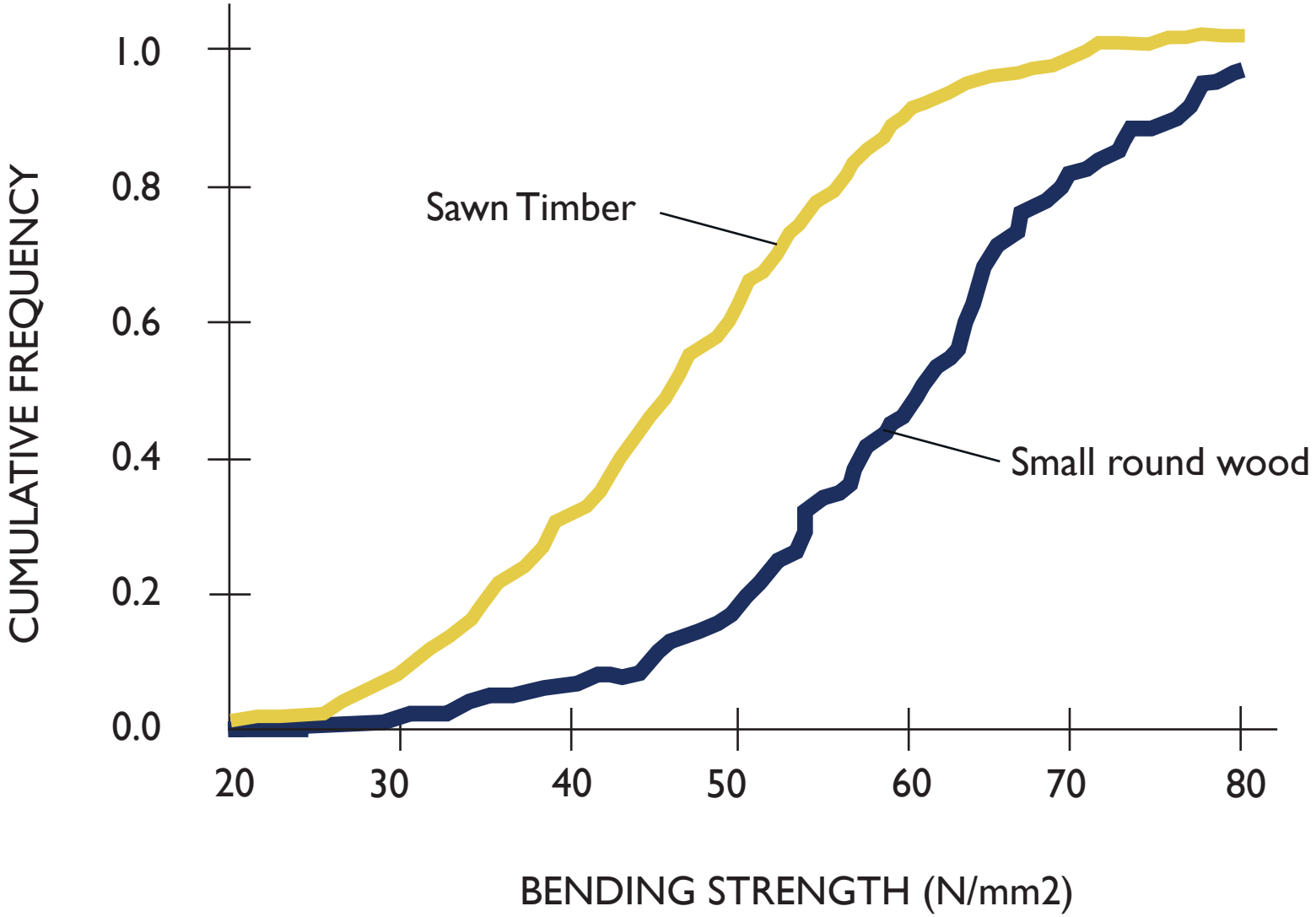


The largest timber (A) that can be milled from any given log (B) will be only 17-33% of the strength of the log.

Trees are Naturally Pre-Stressed
Wind Loads Strengthen Outermost Fibers

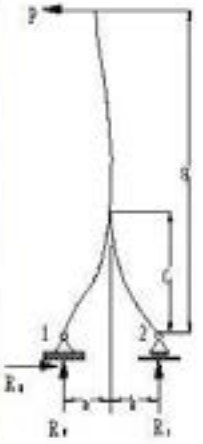


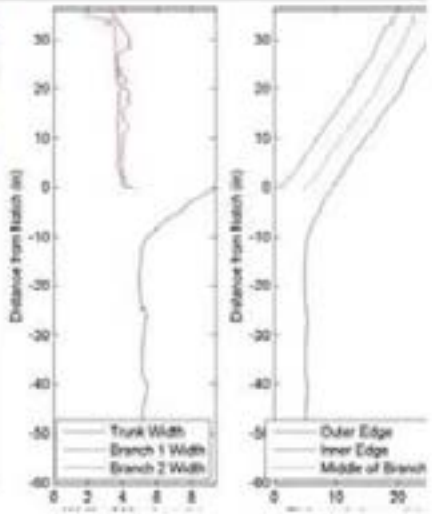
Relative Bending Strength



Testing: Strength of "Y" Branches From the USDA Forest Products Lab....

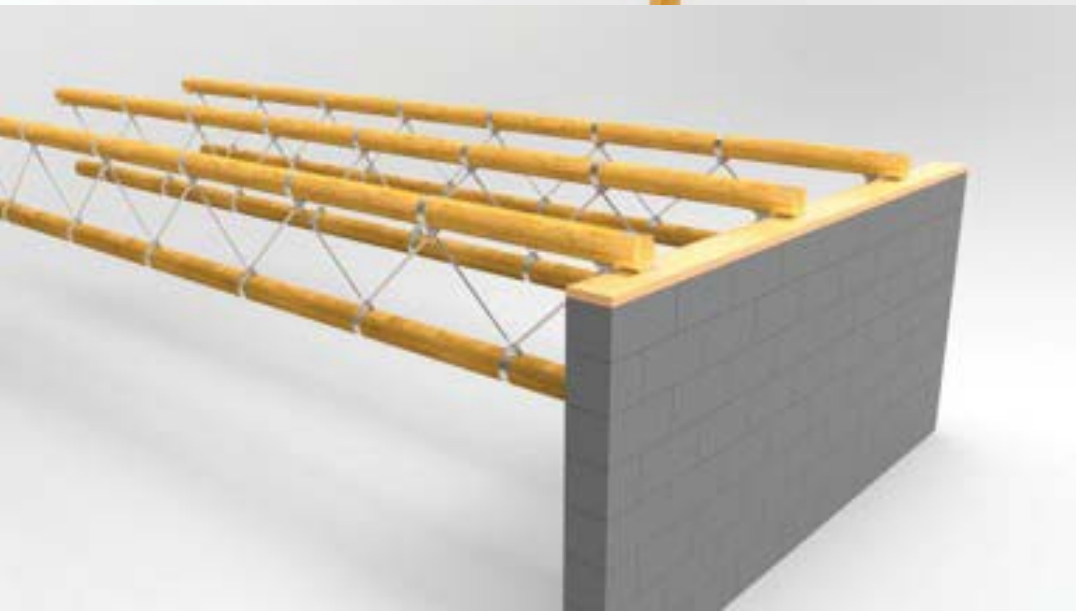
VARIABLES	S3	
	Black Ash	
Date of harvest	07/18/11	
Date of peel	07/18/11	
Found Location:	Rural	
Location: (canopy)	Closed	
Found Location: Description	Driftless Farm (WT)	
Found Location: County	Vernon	
Found Location: Address, City, State	E 2890 Lorenz Road, Stoddard, WI 54658	
Included Bark	No	
Joint Notes		
NOTES: Visual Marks/Rotting/Knots/Bark Intrusion	smooth trunk surface/color fairly uncheckered	
NOTES: POST-KILN		
Diameter (cm)- MAIN TRUNK	18.6	19
Diameter (cm)- SMALLER BRANCH (A)	10.3	10.3
Diameter (cm)- LARGER BRANCH (B)	8.6	10.3
Circumference (cm)- At Base	60.3	
Circumference (cm)- Below Crook	51.7	
Circumference (cm)- At Branches	29.8	34.3
Angle 1 (Perp. to Branch A)	20	10
Total Branching Angle (A+B)	30	
Tree Ring Count (at Base)	27	
Sapwood/Heartwood Ratio (Trunk)	17.3	19
Distance (cm) b/w Branches, at 3'-0"	50.6	
Falcopp SENSOR 1 (@ 2")	22.8	174
Falcopp SENSOR 2 (@ 1'-2")	13.7	94
Falcopp SENSOR 3 (@ 2'-2")	14.3	92
Falcopp SENSOR 4 (@ 3'-2")	13.8	93
Falcopp SENSOR 5 (@ 4'-2")	14.2	94
Data Collection: POST-KILN		
Deflection (+ is bend forward and – is bend backwards)	9.1	140.2
Distance (cm) b/w Branches, at 3'-0"	49	-1.6
NOTES: Post-Kiln Visual Marks/Cracks/Fractures	few small cracks	





Testing: Strength of "Y" Branches From the USDA Forest Products Lab....

...To a building near you.



WholeTrees®
Engineered Products Include

Branched Columns

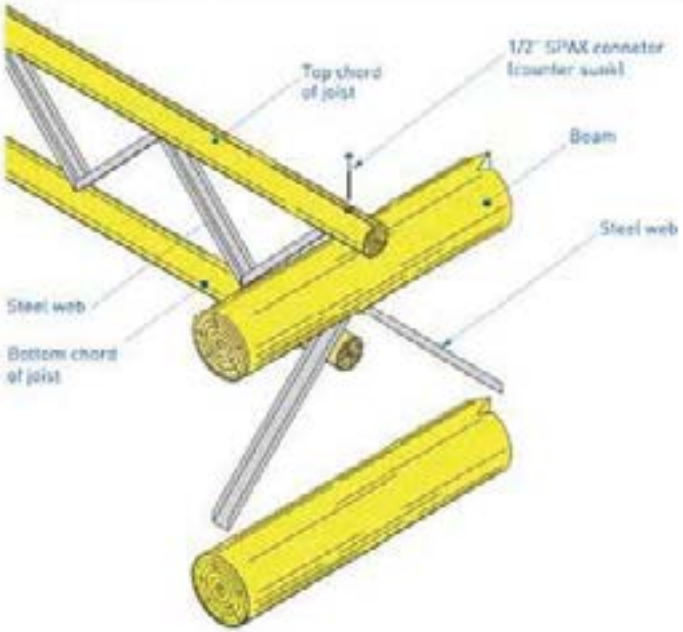
Column and Beam Assemblies

Open-web Truss Assemblies

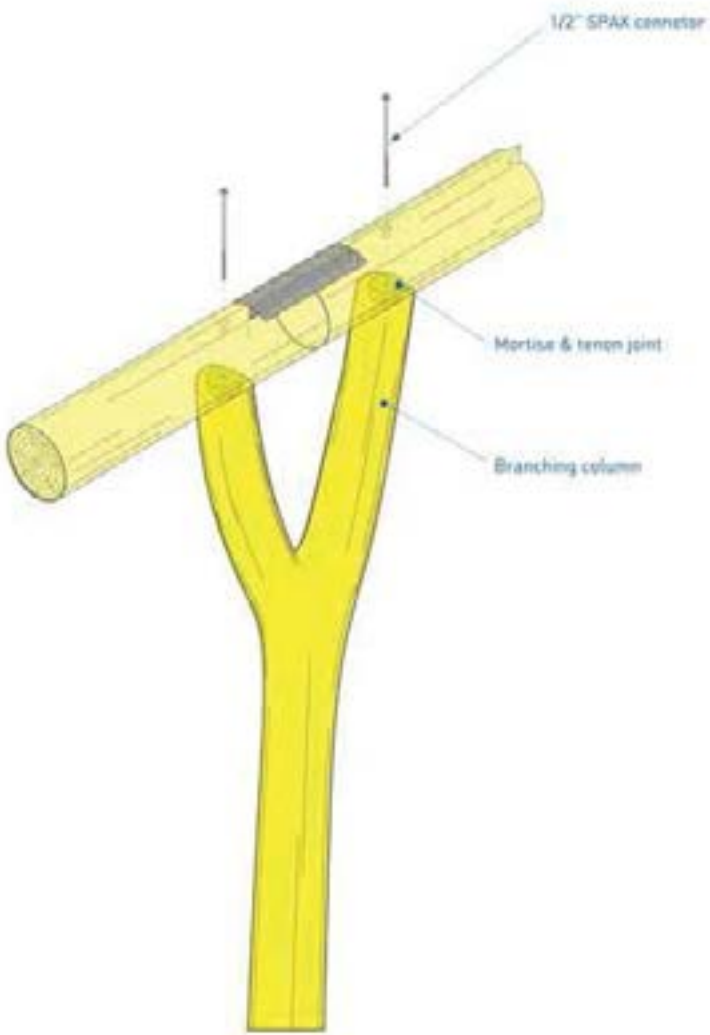
Custom Assemblies

Connection Details

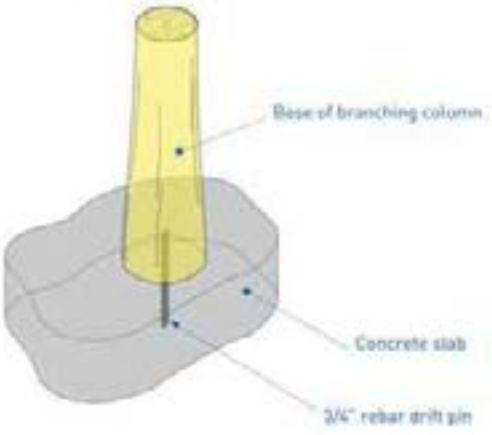
1 JOIST TO BEAM



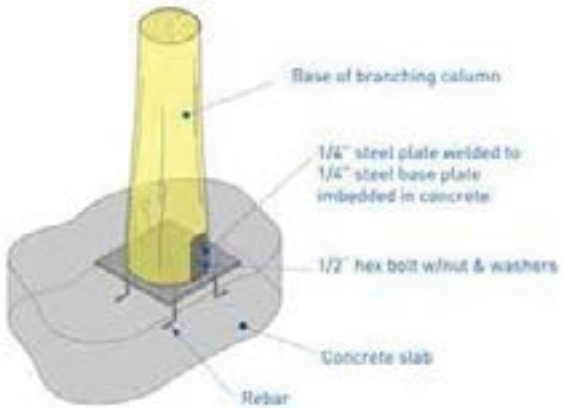
2 BRANCHIN COLUMN TO BEAM



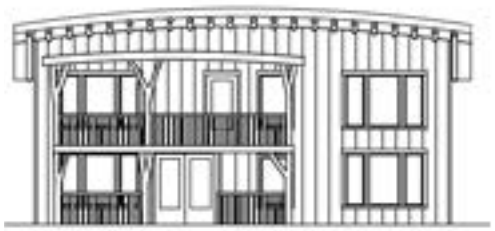
4a DRIFT PIN



4b PLATE



Continuing Testing: Life Cycle Analysis



The "Driftless"

1. SDR construction current practice

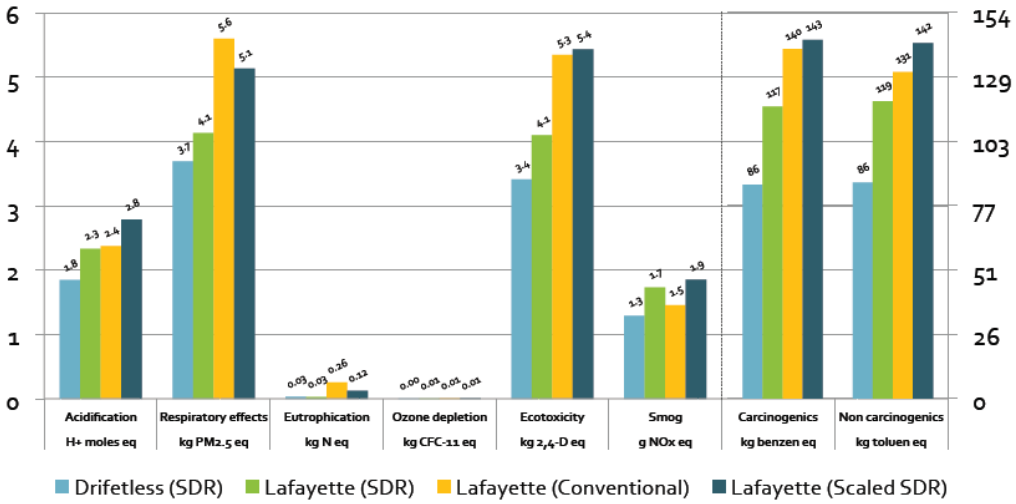
The current best practice is based on one producer. Harvest is manual from a small private forest collocated with production facility. Electricity is from on-site solar PV. Wood is air dried outdoors.

The "Lafayette"

2. Conventional stud-frame construction
3. SDR best practice with same design.
4. SDR with substitutions for harvest, transportation and kiln-drying from national forest products industry to approximate larger scale production

Normalized Impact Assessment

TRACI method: Product life cycle emissions / U.S. annual per capita emissions (2008)



Yale School of Forestry Masters Candidate, Christopher Cooke, conducted a comparative LCA or Life Cycle analysis in 2010.

An LCA takes a systematic account of all the materials and energy required in the life cycle of a product from manufacture to disposal.

This LCA compared two residential (conventional and passive solar) and two building materials (stick framed and round timber) and assess their lifetime impacts.

Conclusion:
Round timber construction "has significant benefit over con-ventional construction in most

Round Timbers are Renewable.

Forest Cullings make use of an abundant resource ...

... that is replenished in 20-30 years as opposed to 40-80 years for conventionally harvested timber.

Create jobs and income from forests

Use waste from managed forests

Create an extra crop to which adds value to forests

Restore forest health

Tree Peeling Process

Round Timbers are Cost Stabilizing

Unlike steel and concrete which fluctuate with the commodities market, round timbers are ...

Low Energy

Non-Commodity

Regionally Sourced

Renewable

Round Timber Assembly in Fairfield Iowa

Forest Stakeholders

Forest Land is Owned by:

- National Forests
- State Forests
- Municipalities
- Universities
- Public Schools
- Tribes
- Individuals

Building Codes

International Building Code
Type IV Heavy Timber Construction

Construction Specifiers Institute
Section 06130 Heavy Timbers

Wisconsin ILBA
2304.10 Heavy Timber Construction

Minnesota State Building Code
602.4 Heavy Timber Construction

South Dakota Building Building Code
602.4 Heavy Timber Construction

LEED Credits Applicable to Round Wood Structures

-Materials & Resources (1 Credit)
-Rapidly Renewable Resources (1 Credit)
-Regional Materials (2 Credit)
-Credified Wood (1 Credit)

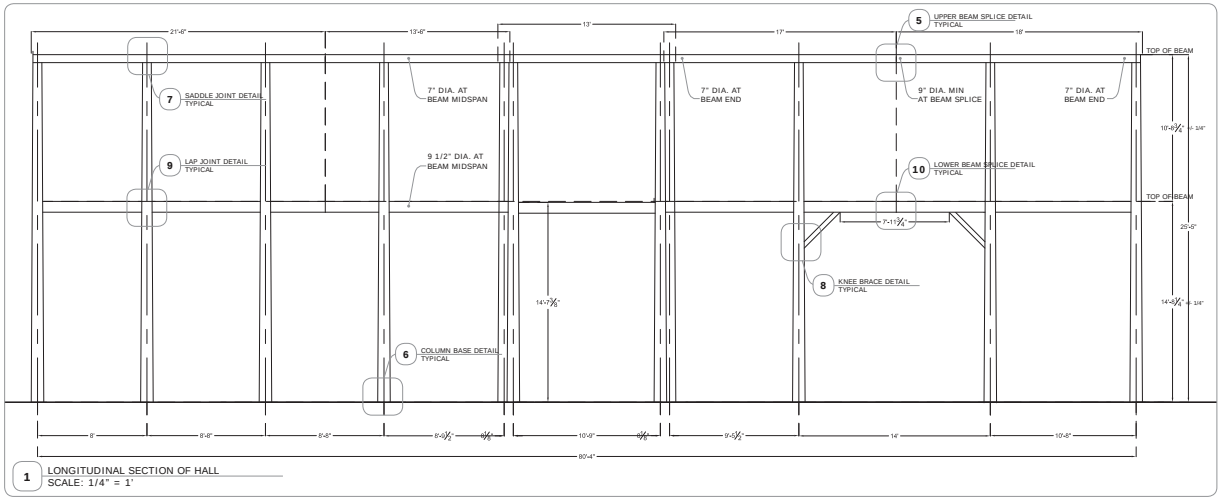
} **9 credits possible**

Potential Additional Credits:

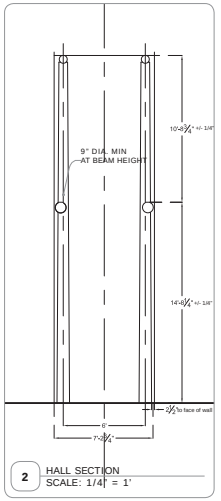
Construction Waste Management (2 Credits)
Material Reuse (2 Credits)
Carbon Credits (Future Points)

Living Building Challenge

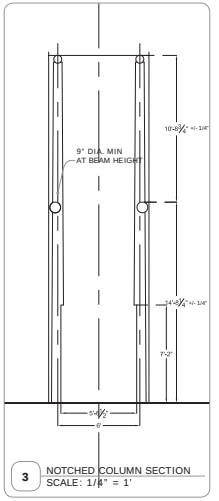
Sustainable Living Center
Maharishi University, Fairfield IA



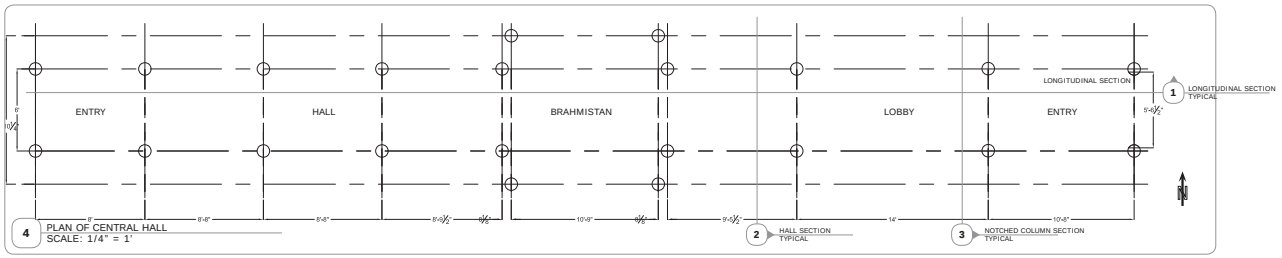
1 LONGITUDINAL SECTION OF HALL
SCALE: 1/4" = 1'



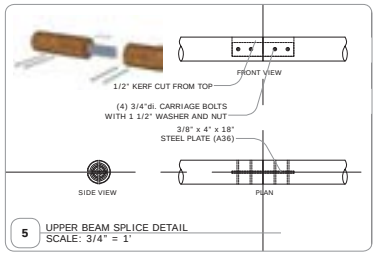
2 HALL SECTION
SCALE: 1/4" = 1'



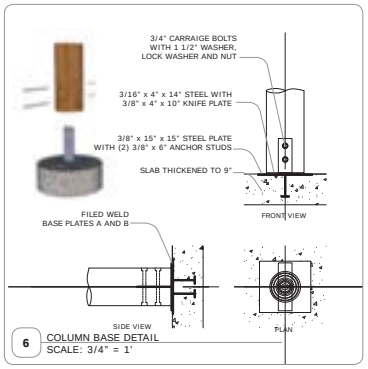
3 NOTCHED COLUMN SECTION
SCALE: 1/4" = 1'



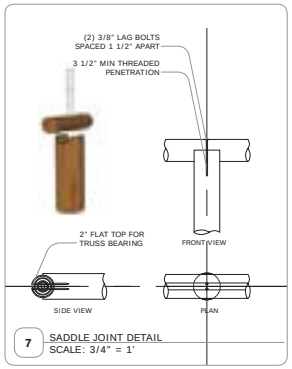
4 PLAN OF CENTRAL HALL
SCALE: 1/4" = 1'



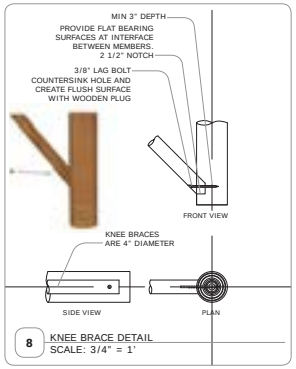
5 UPPER BEAM SPLICE DETAIL
SCALE: 3/4" = 1'



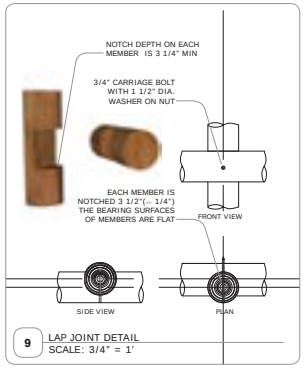
6 COLUMN BASE DETAIL
SCALE: 3/4" = 1'



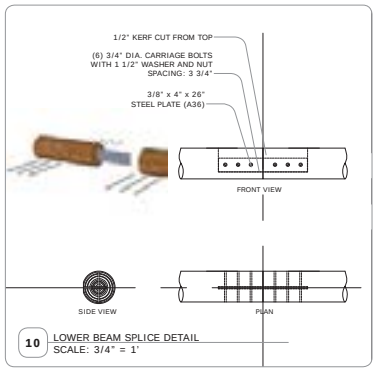
7 SADDLE JOINT DETAIL
SCALE: 3/4" = 1'



8 KNEE BRACE DETAIL
SCALE: 3/4" = 1'



9 LAP JOINT DETAIL
SCALE: 3/4" = 1'



10 LOWER BEAM SPLICE DETAIL
SCALE: 3/4" = 1'

*** NOTE * ALL TIMBERS ARE ASPEN, TREATED WITH TIM-BOR AND FINISHED WITH SYMPHONY URETHANE**

MAHARISHI UNIVERSITY
SUSTAINABLE LIVING CENTER

Approval Drawings 1.8.09

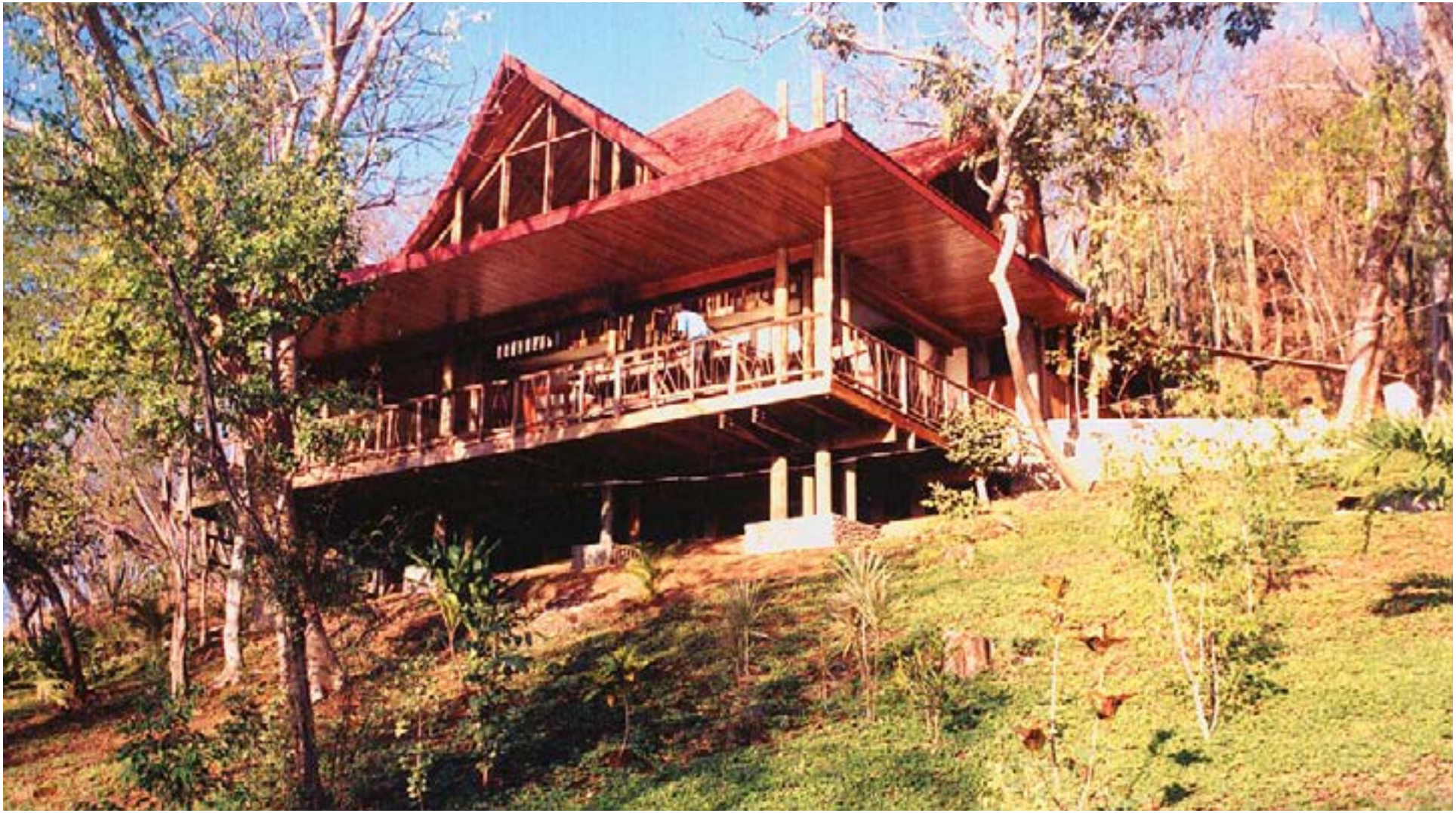
SHEET NO 1

Sustainable Living Center
Maharishi University, Fairfield IA

Faster Construction

6-8 weeks fabrication
3 days delivered and erected on site

Living Building Challenge
Maharishi University Sustainable Living Center



Punta Vista, Costa Rica

Punta Vista, Costa Rica

Chrysalis Residence

Bookend Residence: Thigmomorphogenesis

Kara Woods Residence: Non-linearity

Tussen Taak Residence

Medici Restaurant, Normal IL

Myric Hixon Ecopark Atrium

Myric Hixon Ecopark Stair

Myric Hixon Ecopark Climbing Structure

Sustainable Living Center Construction

Maharishi University Sustainable Living Building ,
Fairfield, IA, 2010

La Crosse Area Residence

Underhill Residence, Ridgeway, WI

Organic Valley Headquarters- Pavilion

Re-Purposed Barn
Philadelphia Community Farm

Re-Purposed Barn
Philadelphia Community Farm

Native American Heritage Center
Calhoun County, Iowa

Native American Heritage Center

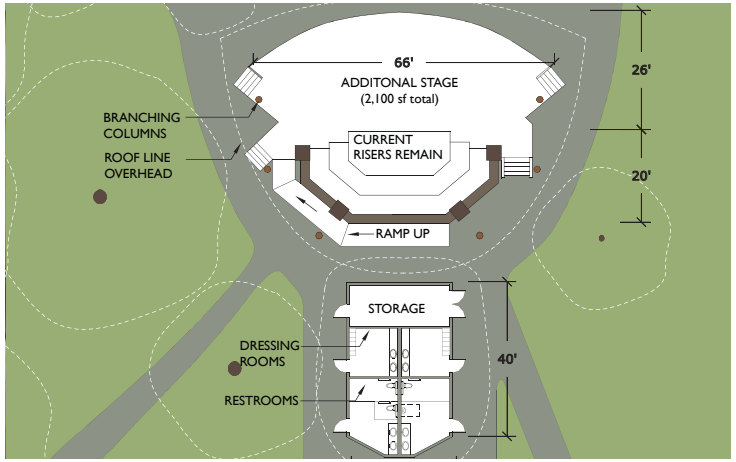
Calhoun County, Iowa

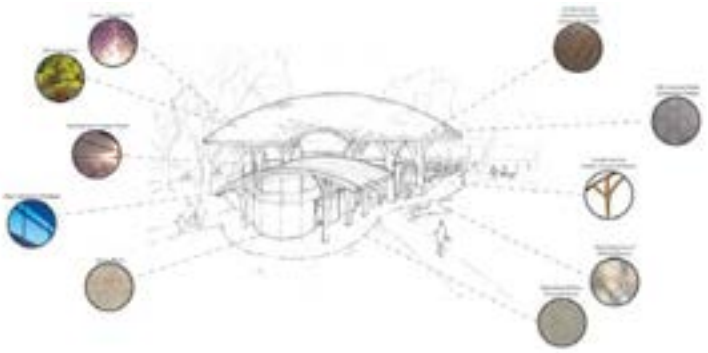
Overnight Volunteer Facility
Angelic Organics Learning Center

Case Study: Mixed Use Urban In fill Building

Case Study: Big Box Store

Case Study: Bandshell





Our Collaborative Process

WholeTrees Project Designers and Structural Engineers work with:

Architects
Engineers
General Contractors
Other Materials Specifiers

Then source from

Regional Inventory or Supply Chains

And provide to our clients:

Prefabrication and Processing
Fireproofing
Shipping and Installation

We are trying to save paper. For a PDF copy of this slide show email info@wholetrees.com.

Additional Resources

USDA Forest Products Lab	www.fpl.fs.fed.us
American Wood Council	www.awc.org
Canadian Wood Council	www.cwc.ca
Wood Works	www.woodworks.org
Wood Works! Alberta	www.wood-works.org
Whole Trees Architecture and Structures	www.wholetrees.com