The Evolution of The Art

Then (circa 1990s)...

The Evolution of The Art

… And Now

Design/build by: Modcell

LILAC Affordable Ecological Co-housing, Leeds, England

Principles of Ecological & Social Justice

Environmental Toxicity & Waste

Global Climate Impact

Principles of Ecological & Social Justice

Racial, Gender, & Economic Justice: Climate Justice

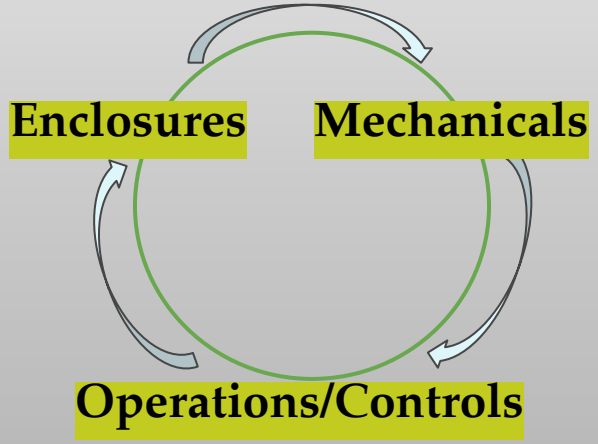
"It's abundantly clear that we will not build the power necessary to win unless we embed justice—particularly racial but also gender and economic justice—at the center of our low-carbon policies." Naomi Klein

Intersectionality: intersections are the focus

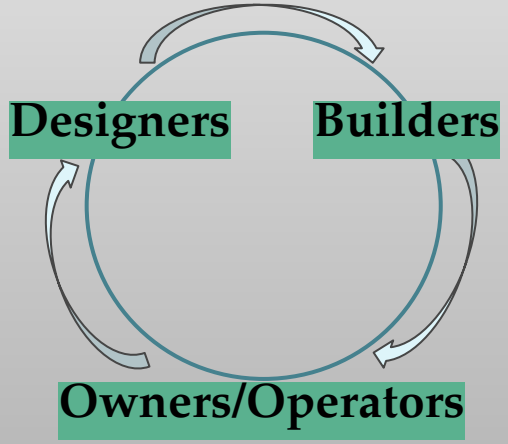
- Builders & Designers for Climate Justice, ADPSR Architects, Designers, Planners for Social Responsibility
- "Green" movement meets social justice movements
- 350.org, Sierra Club endorses Black Lives Matter platform

Systems Thinking: Buildings and Context

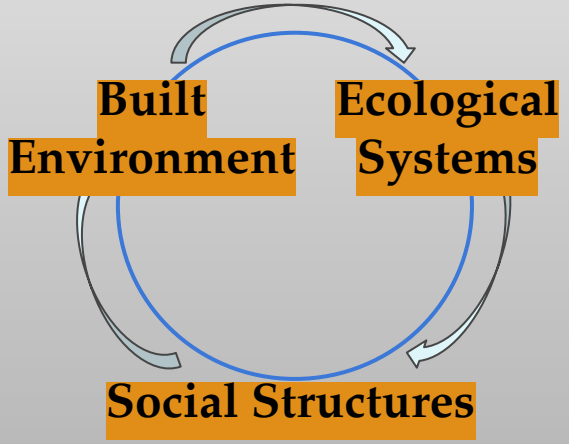
Buildings as a System



Integrated Project Delivery



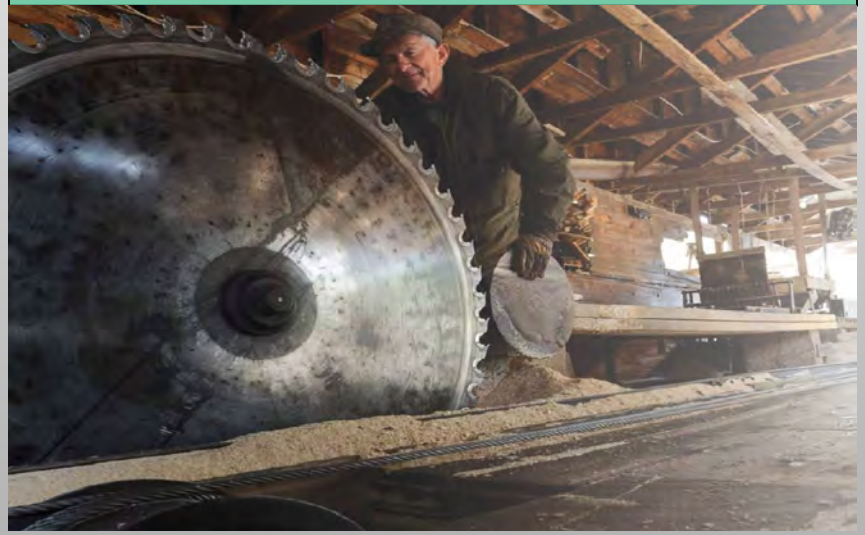
Buildings within a System



Follow "Systems" Pattern in Each Context and Scale

Scale and Social Ecology

Regional Scale: Local Money, Working Landscapes, & Sustainable Silviculture



Industrial Scale: Corporate Profits, Industrial Landscapes & GMO Monoculture

Full Life-Cycle Impacts

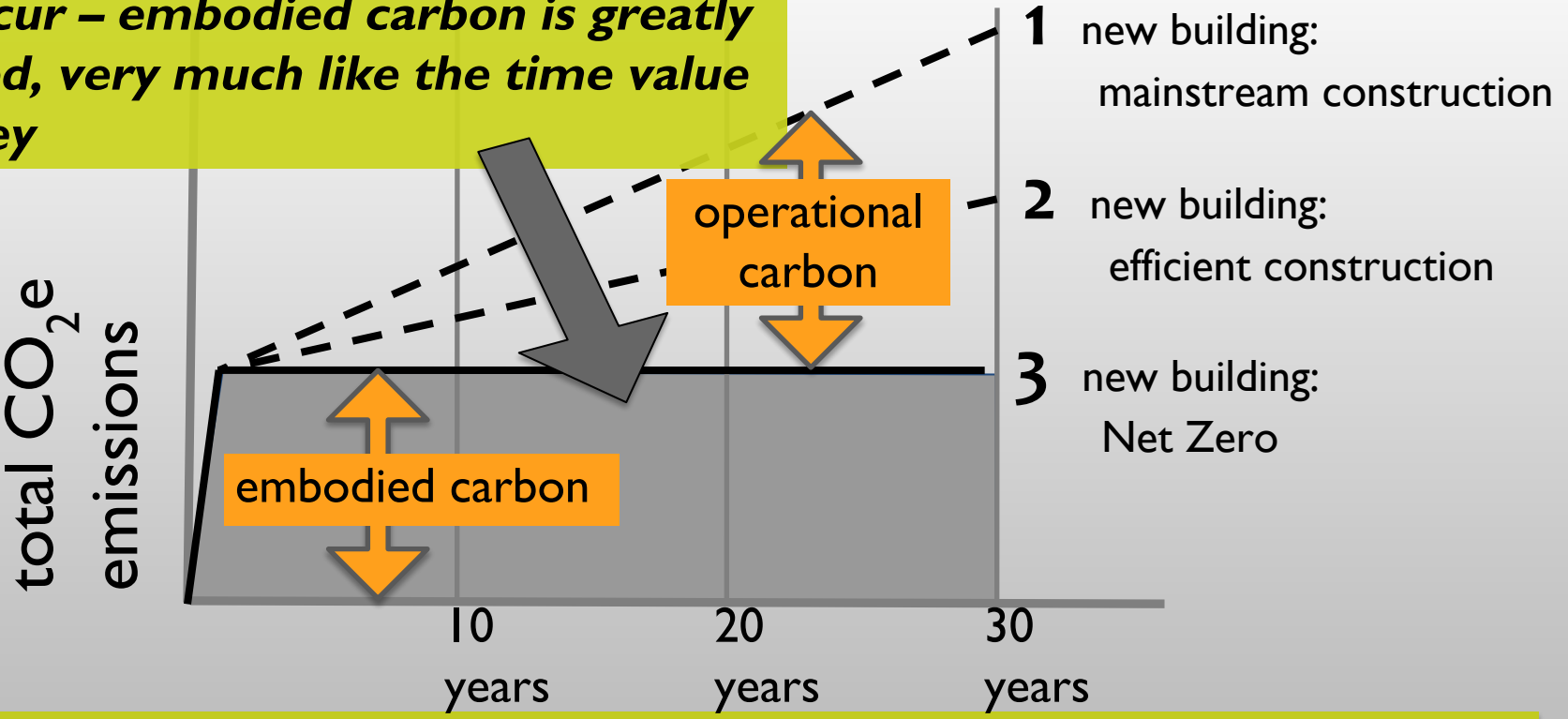
Cradle to grave to cradle; Seed to wall to compost & new growth

Human Health and Safety

ASTM 2 Hour Fire Rating for Plastered Straw Bale Wall

Non-toxic, truly zero VOC clay, lime & mineral paints

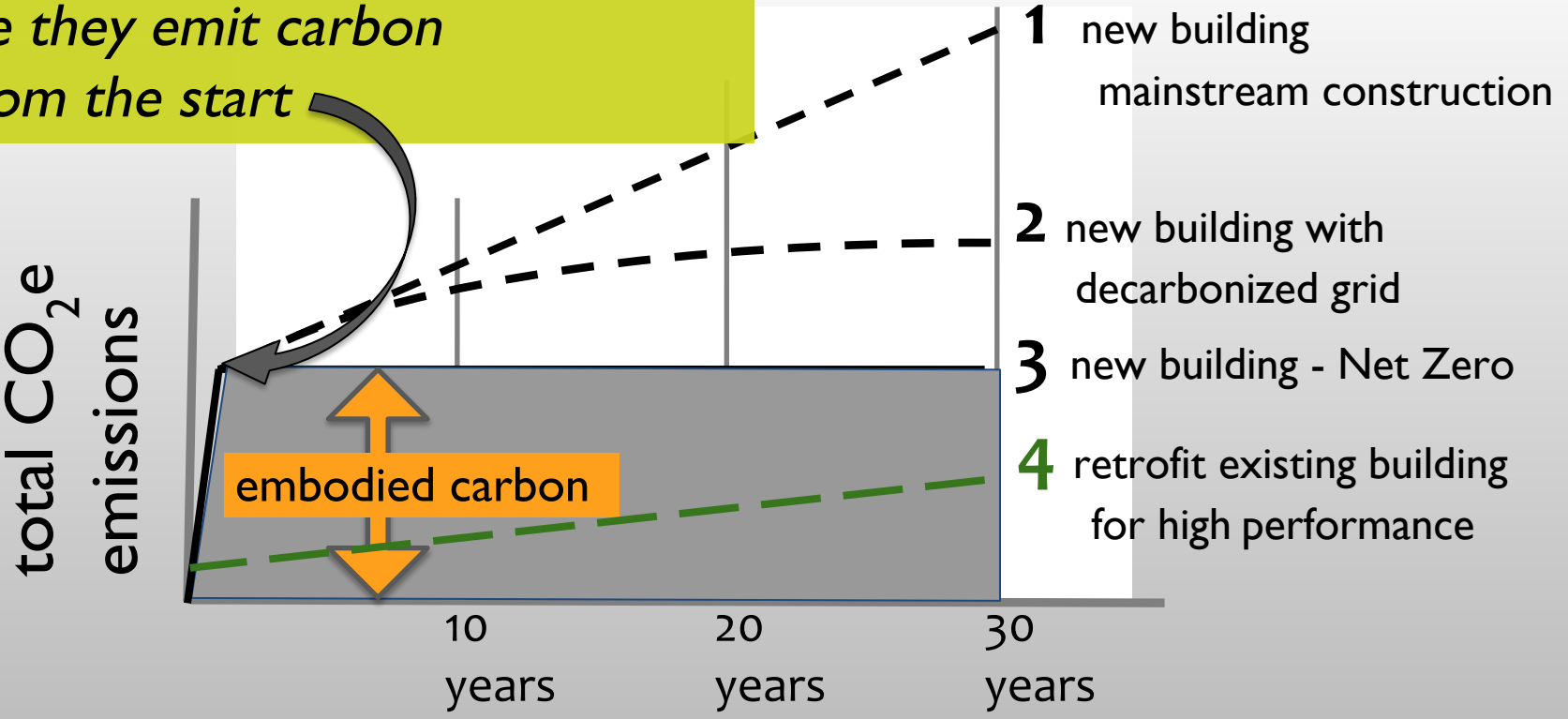
Emissions are hugely amplified by <u>when</u> they occur – embodied carbon is greatly weighted, very much like the time value of money



The effect on the climate is = time x emissions

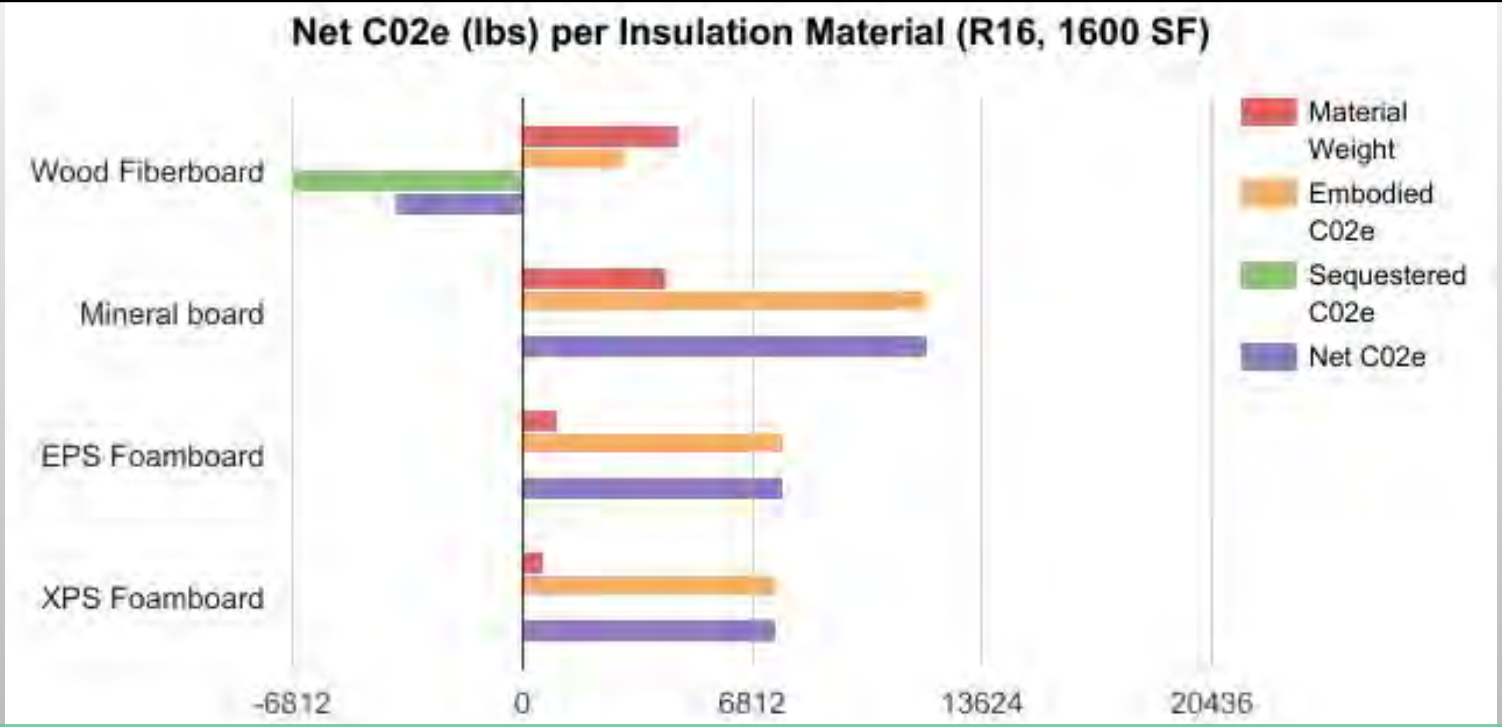
the <u>impact</u> is the shaded area under the curve

1, 2 and 3 all have big climate impacts because they emit carbon right from the start



Embodied and Operational Carbon Emissions

Sustainable agriculture, meet sustainable building.



Biogenic materials (wood, straw, hemp) have lower embodied CO2e AND sequestration benefits

Natural Building Technologies: We're Advanced

Marketing & Modern Styles

Construction Assemblies

Material Science Innovations

Natural Building Technologies: We've Advanced

- Modern Styles
- Construction Assemblies
- Material Science Innovations

Natural Building Technologies: We've Advanced

- Modern Styles
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- Material Science Innovations
  - MycoFoam

Natural Building Technologies: We've Advanced

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Performance Specifications

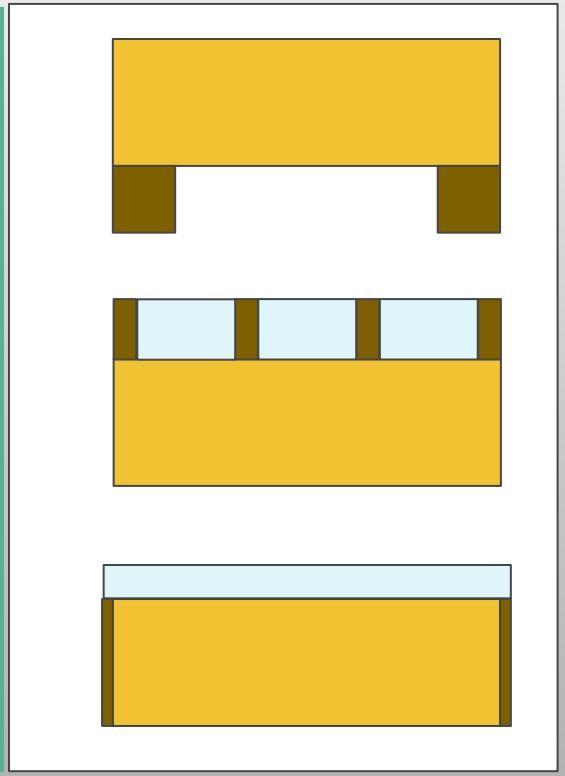
Metric	Standard	Testing Lab	MycoFoam
Density (lbs/ft^3)	ASTM C303	Ecovative	7.6
Compressive Strength (psi)	ASTM C165	Ecovative	18
Compressive Elastic Modulus (psi)	ASTM C165	Ecovative	165
Flexure Strength (psi)	ASTM C203	Ecovative	34
Compostability (days)	ASTM D6400	NSF International	30
Flame Spread	ASTM E84	QAI	20
Smoke Emission	ASTM E84	QAI	50
Thermal Conductivity, at 10°C (W/mK)	ASTM C518	Oak Ridge National Laboratory	0.039
Water Vapor Permeation (dry cup)	ASTM E96	Oak Ridge National Laboratory	30
Moisture Storage at 53.5% RH (%)	ASTM C1498	Oak Ridge National Laboratory	8
Moisture Storage at 75% RH (%)	ASTM C1498	Oak Ridge National Laboratory	12

Technological Advances: Straw

Bale Wrap
1st & 2nd Generation

StrawCell
3rd Generation

Prefab
4th Generation



Guest Blogs

Fresh perspectives from designers, builders, and industry experts

Straw-Bale Walls for Northern Climates

1 Helpful?

A 'third generation' straw-bale technique combines a straw-bale interior wall with an exterior stud wall insulated with cellulose

POSTED ON NOV 17 2014 BY BEN GRAHAM

The mechanical baler was invented in the 1850s (Reynolds, *History of Hay Balers*), and it's been a while now since those folks in the Midwest put up a couple of bale houses. You would think that by now we would have very refined construction techniques for straw-bale construction, given that some of those original buildings are still standing. Well, we are getting there.

Let's call those first bale houses the first generation. The bale houses that came out of the natural building boom in the Southwest during the 1990s I'm going to call the second generation. This was more of a reinvention (along with cob construction), as there was a big gap between the first and second generation, with little continuity or carryover of development.

From that point on, as straw-bale building has spread across the country and the world, there has been a steady development of technique and skill.

The Northeast gets a lot of rain

When straw-bale construction reached the Northeast, builders quickly realized the climate-specific designs

Image 1 of 5

An exterior stud wall provides room for more insulation. Without an exterior stud wall, most straw-bale walls have an R-value of R-33 or less.

StrawCell: Ennis Hill

- Air Tight - <1 ACH50
- Cheaper & Faster - less prep, easier plastering
- Easier - Standard framing/"dry-in", interior plaster only
- More Durable - rainscreen assembly
- More Insulating - R50
- Doubled size of original house, heat load remained the same

Prefabricated Straw Panels

Controlled construction processes, efficiency, streamlined design

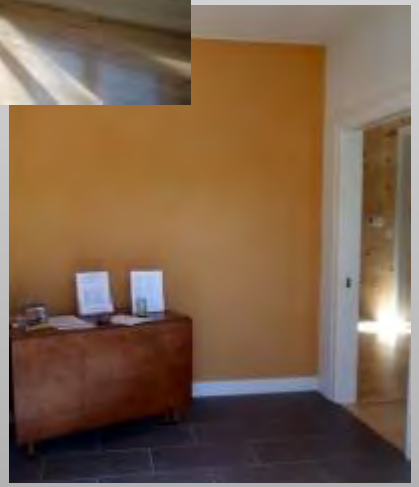
Canada's Greenest Home
Endeavour Center, Ontario Canada

Prefabricated Straw Panels

Canada, Europe, Australia: Large Multi-Unit Developments, Commercial & Institutional, Passive House & Affordable Housing

Natural Paints and Plasters

Bioshield Clay Paint



Kreidezeit Clay Paint
& Auro Lime Paint
Endeavour Center

Canada's Greenest
Home

Plaster as an Air Barrier

Not your Grandparents' plaster!

- Thicker and more rugged - designed to be an AB, not just a finish
- Air-tight - achieve < 0.6 ACH50
- Liquid-applied - flexible application
- Hard and durable - 1+" solid masonry
- Inspectable and repairable - no hidden membranes , simple repairs

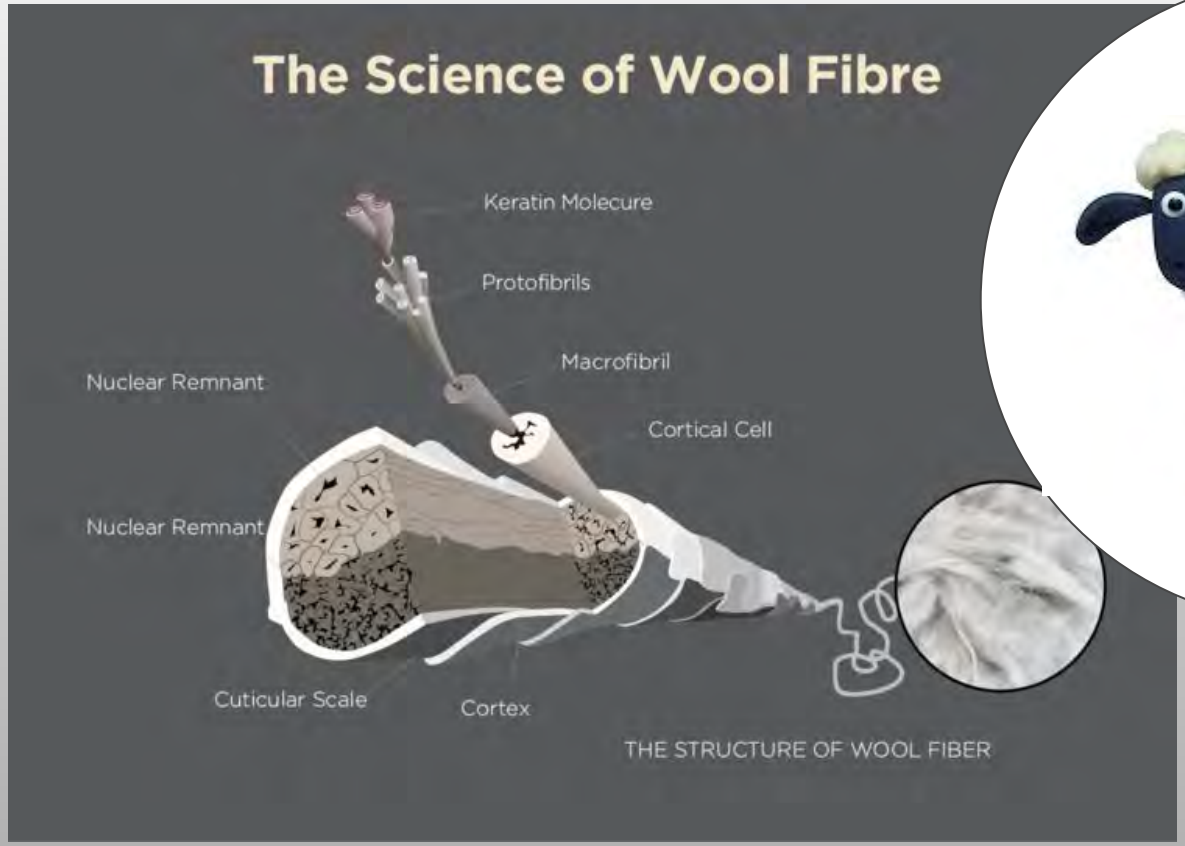
Hempcrete - Hemp and Lime

- Cast or spray insulation - R-3/in
- Flexible install, cures hard
- Ultra-low CO_2e / C-negative
- Moisture-durable, vapor open
- Fire retardant, no chemicals
- Floors, walls, roofs, foundations

Wool Insulation

R 4/inch - Thermal Resistance
Flame spread - Class A
Smoke Developed - Class A

Wool Insulation



What's New With Wood

Strong in Construction Market

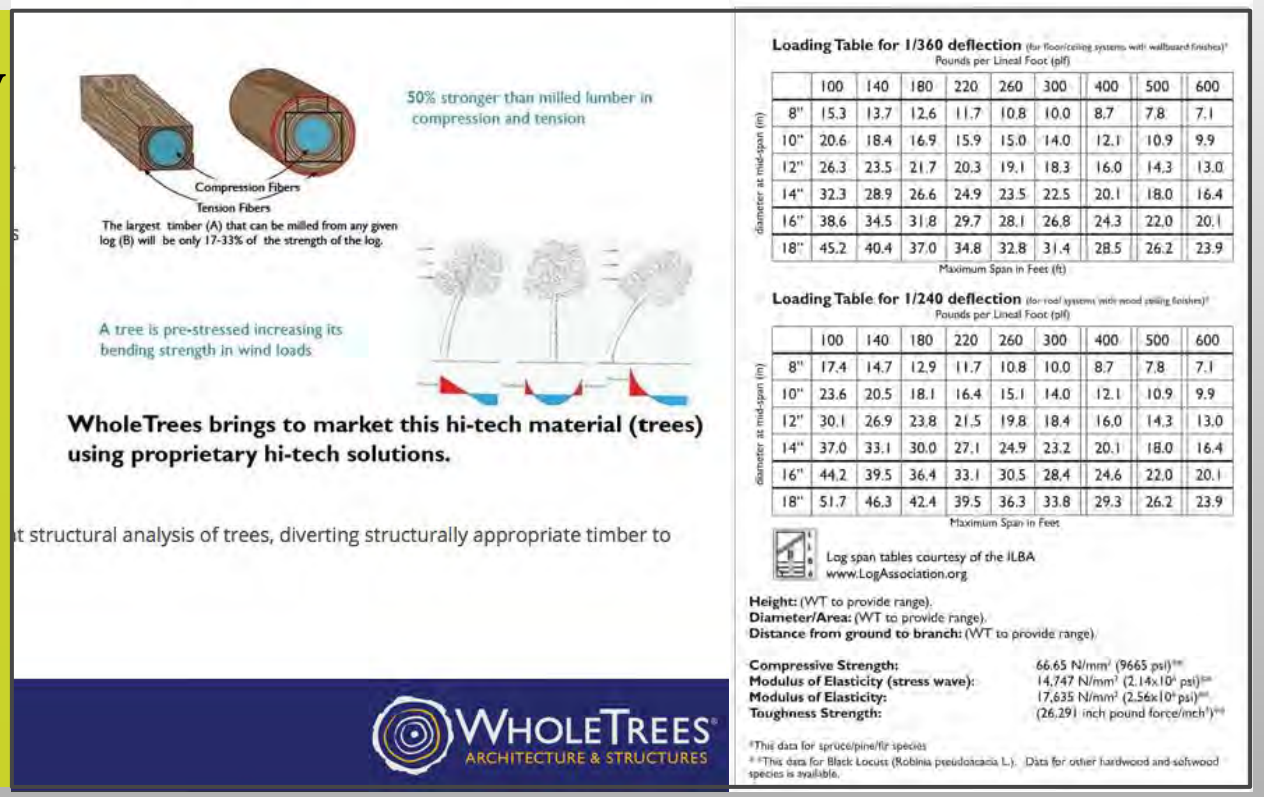
Carbon Sequestering

Regenerative Harvesting

Round Wood Technology

Broadening Industry Acceptance

- Engineered Standards
- Stable Material
- Consistent Drying Process



	100	140	180	220	260	300	400	500	600
8"	15.3	13.7	12.6	11.7	10.8	10.0	8.7	7.8	7.1
10"	20.6	18.4	16.9	15.9	15.0	14.0	12.1	10.9	9.9
12"	26.3	23.5	21.7	20.3	19.1	18.3	16.0	14.3	13.0
14"	32.3	28.9	26.6	24.9	23.5	22.5	20.1	18.0	16.4
16"	38.6	34.5	31.8	29.7	28.1	26.8	24.3	22.0	20.1
18"	45.2	40.4	37.0	34.8	32.8	31.4	28.5	26.2	23.9

	100	140	180	220	260	300	400	500	600
8"	17.4	14.7	12.9	11.7	10.8	10.0	8.7	7.8	7.1
10"	23.6	20.5	18.1	16.4	15.1	14.0	12.1	10.9	9.9
12"	30.1	26.9	23.8	21.5	19.8	18.4	16.0	14.3	13.0
14"	37.0	33.1	30.0	27.1	24.9	23.2	20.1	18.0	16.4
16"	44.2	39.5	36.4	33.1	30.5	28.4	24.6	22.0	20.1
18"	51.7	46.3	42.4	39.5	36.3	33.8	29.3	26.2	23.9

Compressive Strength:	66.65 N/mm² (9665 psi)[a,b]
Modulus of Elasticity (stress wave):	14,747 N/mm² (2.14x10⁶ psi)[a,b]
Modulus of Elasticity:	17,635 N/mm² (2.56x10⁶ psi)[a,b]
Toughness Strength:	(26,291 inch pound force/inch³)[a,b]

[a] This data for spruce/pine/fir species
[a,b] This data for Black Locust (Robinia pseudoacacia L.). Data for other hardwood and softwood species is available.

Wood Science Technology

Underused Species

- Black Locust
- Tamarack
- Cedar

Factors in Specification

- Durability
- Cost
- Beauty
- Carbon Impact

Wood Science Technology

Window/Door Frames

- 2″ insulation cavity
- Thermally-broken cleats

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Uw-.123(R8)

Wood Science Technology

Finishes

- Thermal Treatment
- Shou Sugi-Ban
- Non-Toxic Preservatives
- Oil Finishes

Insulating Fiberboard Sheathing

Make	Scheider Multitherm 110/140	Scheider Top 140-220	Gutex Multitherm	Gutex Ultratherm	SonoClimate Eco4
U(R) value	.038/.04 (R 3.8/3.6)		.039(R3.7)	.042(R3.4)	(R2.7)
Connection	T&G/Butt		T&G	T&G	Butt Joint
Density	6.9/8.7lbs/cuft				16.5lbs/cuft
Perm	46.6		44	44	25.9
Water Resistant	NO	YES(parafin)	YES	YES (1%parafin)	YES(

Data-Driven & Proof-Positive

- **Mid-Stream Quality Control**
- **Post-Occ. Commissioning**
- **Ongoing Monitoring**