2017

Wood Studio Workshop

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UMass STEM Ed Science and Engineering Saturday Seminars

Wood Studio Workshop

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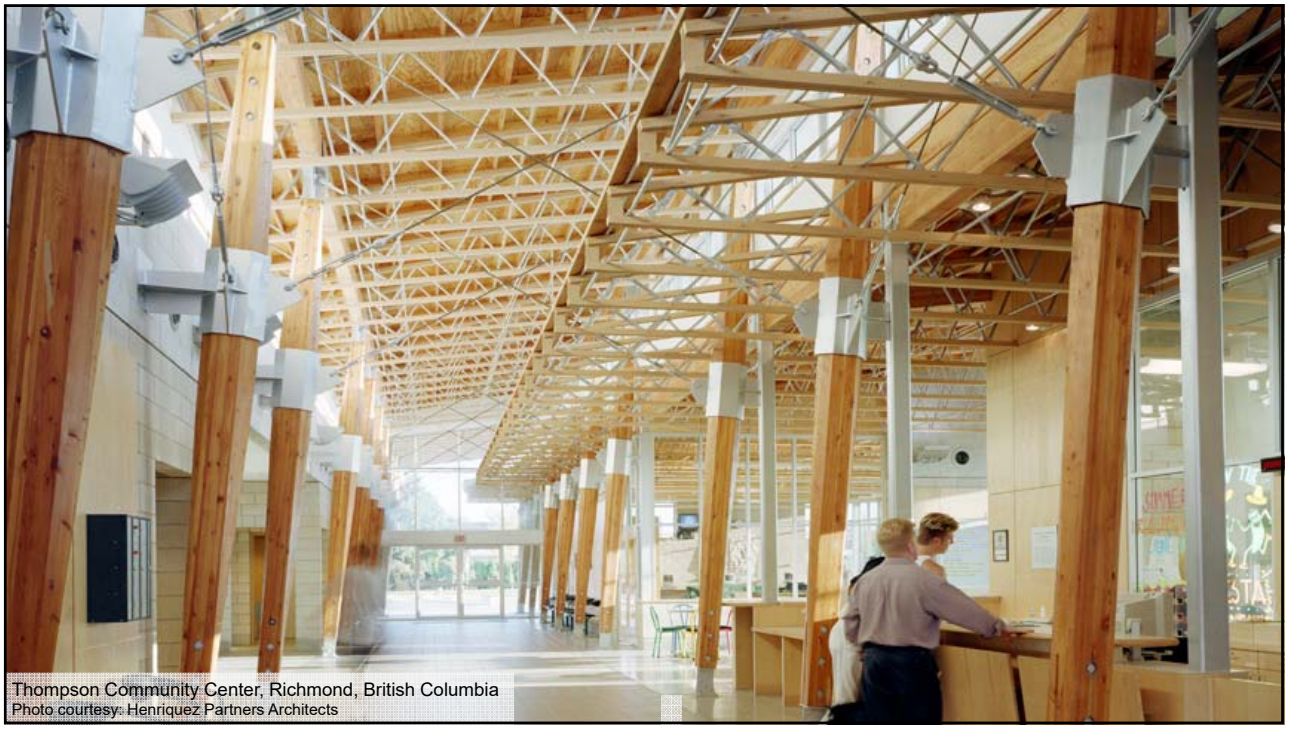
Photo credit: A. Schreyer


Thompson Community Center, Richmond, British Columbia
Photo courtesy: Henriquez Partners Architects

21st century timber engineering

"high-tech"

"bold and beautiful"

"eco-friendly"

"revolutionary"

"new"

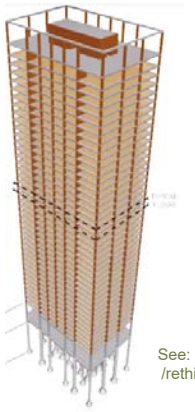





Prince George Airport, British Columbia
Photo credit: McFarlane Green Biggar (MBG) Architects

42 stories proposed!

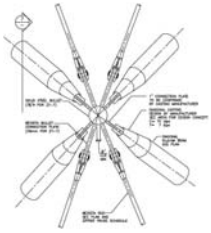
TIMBER TOWER PROJECT
by SOM

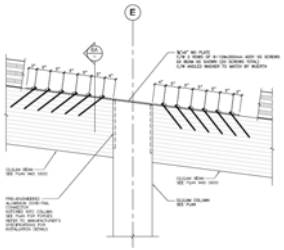


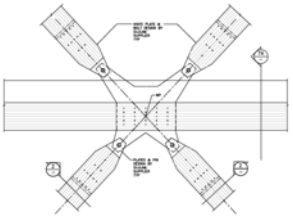
See: http://www.som.com/ideas/videos/rethinking_tall_building_design_the_timber_tower_research_project

Go UMass!

The Design Building is the most technologically advanced CLT structure in the US







Primary drivers

Sustainability ⟸
&
Innovation

Building: one of the biggest culprits of climate change

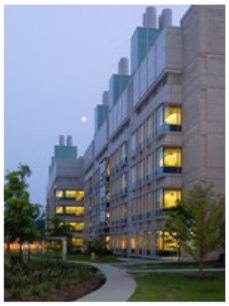
U.S. ENVIRONMENTAL PROTECTION AGENCY

Green Building

You are here: EPA Home » Green Building » Why Build Green?

- Green Building Home
- Basic Information
- Why Build Green?
- Components of Green Building
- Building Types
- Funding Opportunities
- Frequent Questions
- Additional Resources

Why Build Green?



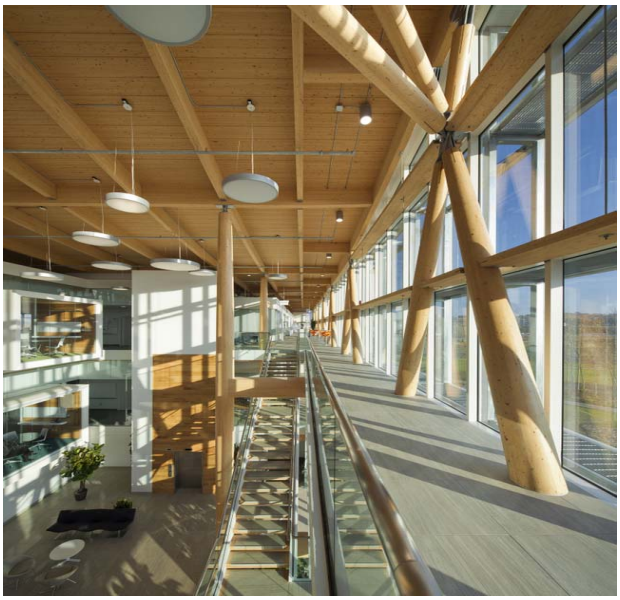
In the United States, buildings account for:

39 percent of total energy use
12 percent of the total water consumption
68 percent of total electricity consumption
38 percent of the carbon dioxide emissions

A list of additional statistics on buildings and the environment (PDF) (7 pp, 66K, About PDF) is available.

The built environment has a vast impact on the natural environment, human health, and the economy. By adopting green building strategies, we can maximize both economic and environmental performance. Green construction methods can be integrated into buildings at any stage, from design and construction, to renovation and deconstruction. However, the most significant benefits can be obtained if the design and construction team takes an integrated approach from the earliest stages of a building project. Potential benefits of green building can include:

Office Building for GlaxoSmithKline Inc., Quebec
Nordic CLT. Photo credit © Stéphane Groleau



"Wood can help to earn points in categories typically found in green building rating systems— including certified wood, recycled/reused/salvaged materials, local sourcing of materials, waste minimization, indoor air quality, advanced building techniques and skills and life cycle impacts" …

Quote source: ReTHINK Wood

Carbon sequestration and storage

- Wood and wood products store carbon until they burn or biodegrade

Wood products are carbon negative

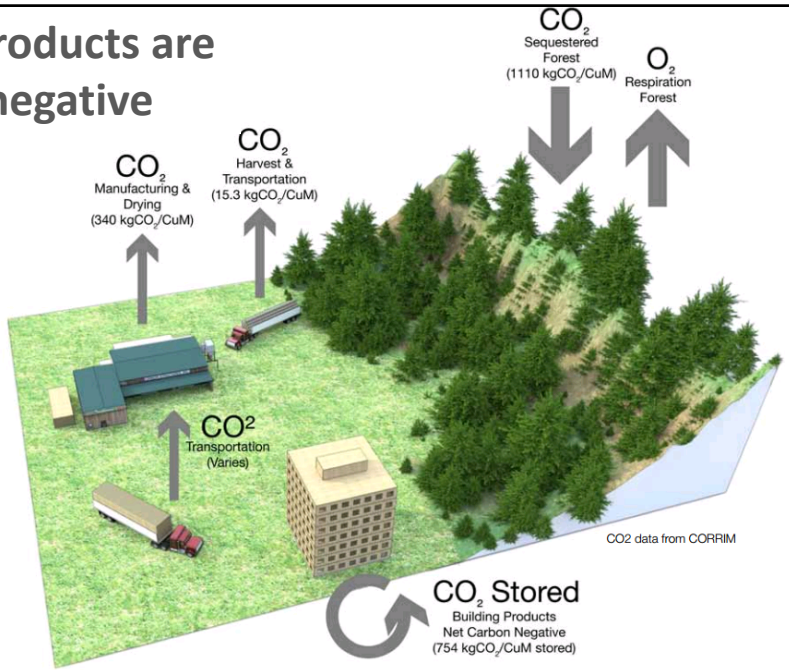


Image courtesy of Joseph Mayo of Mahlum | Architects Inc.

Life Cycle Assessment (LCA)

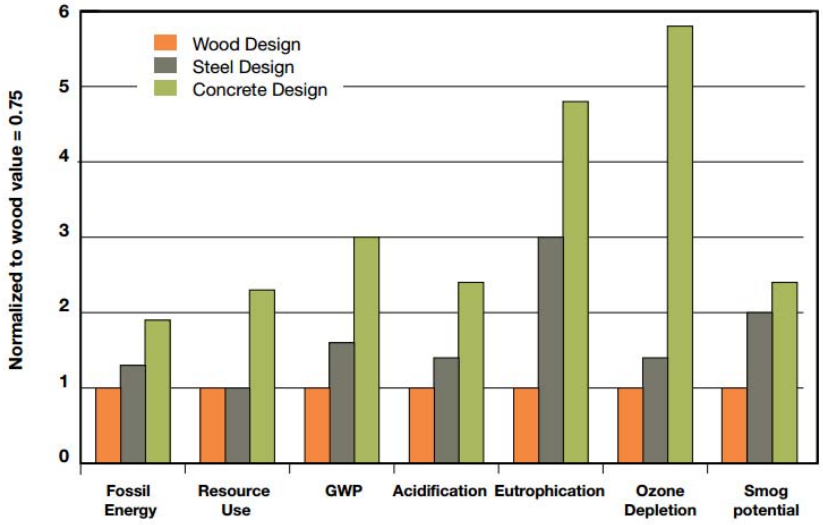


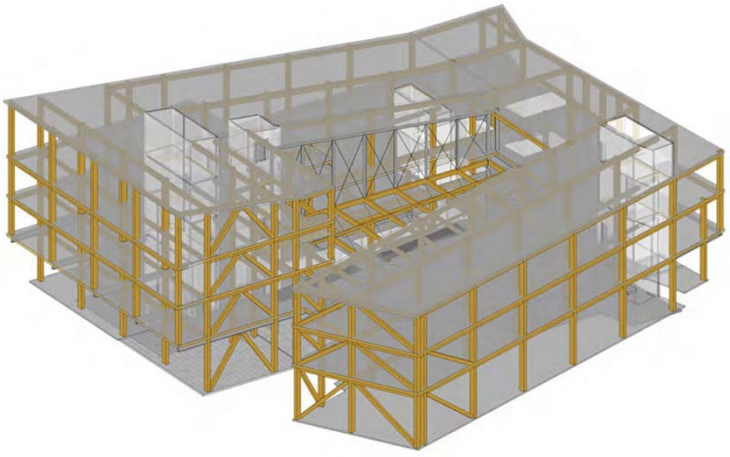
Image source: ReTHINK WOOD® – Building Green with Wood (Module 2)

Healthy Indoor Environment

- Stress reducing effects
  http://woodworks.org/wp-content/uploads/Wood-Human-Health11.pdf
- Humidity control
- Advanced adhesives with minimal to no off-gasing

Image source: Prof. DDI Michael Flach

UMass Design Building



Carbon Summary

Volume of wood products used (m^3):
2081 m^3 (73482 ft^3) of lumber and sheathing

U.S. and Canadians forests grow this much wood in:
6 minutes

Carbon stored in the wood:
1463 metric tons of CO_2

Avoided greenhouse gas emissions:
1218 metric tons of CO_2

Total potential carbon benefit:
2681 metric tons of CO_2

Equivalent to:

512 cars off the road for a year

Energy to operate a home for **228** years

reTHINK WOOD

Primary drivers

Sustainability
&
Innovation ⟵

Mass Timber

Cross Laminated Timber (CLT)

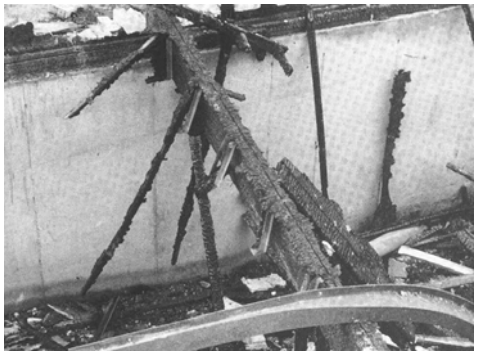
Glulam

Parallel Strand Lumber

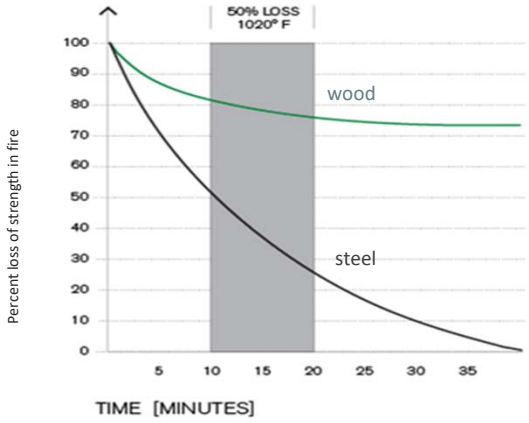
Wood Concrete Composites

Fire Safety with Mass Timber

Char protects the inner core



Large trees remain after forest fire



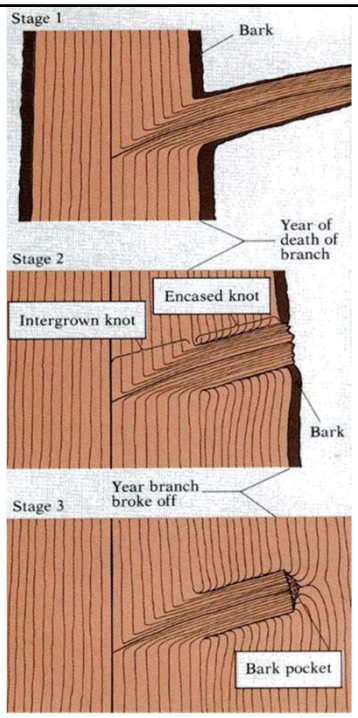
Let's make some Glulam beams!

Why is Glulam strong?

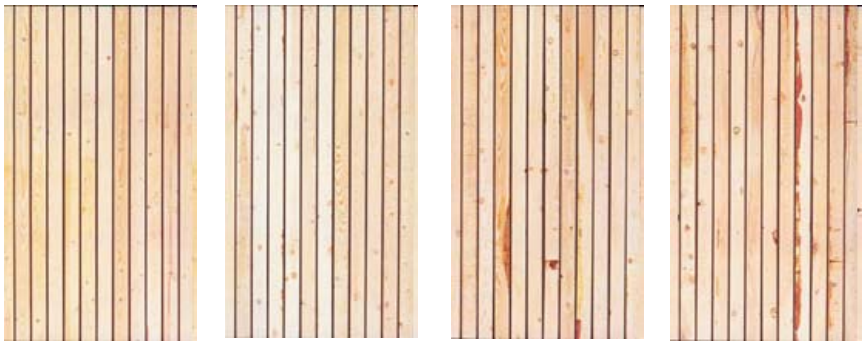
1) Defects are dispersed

Glulam

Wood knots



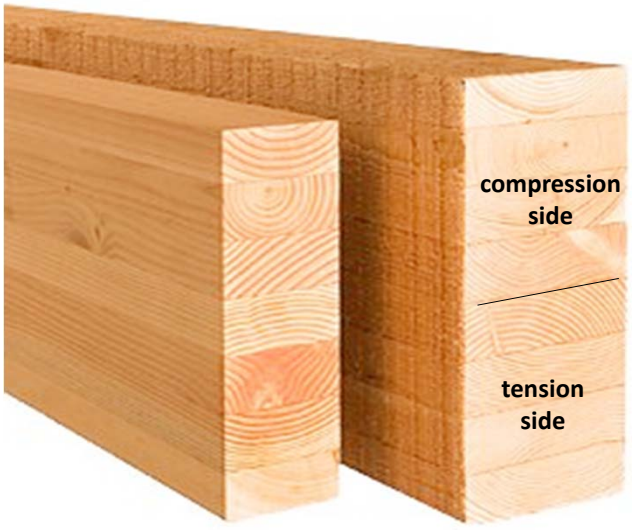
Stress grades



Select Structural | No. 1 | No. 2 | No. 3

Why is Glulam strong?

2) Layup is engineered

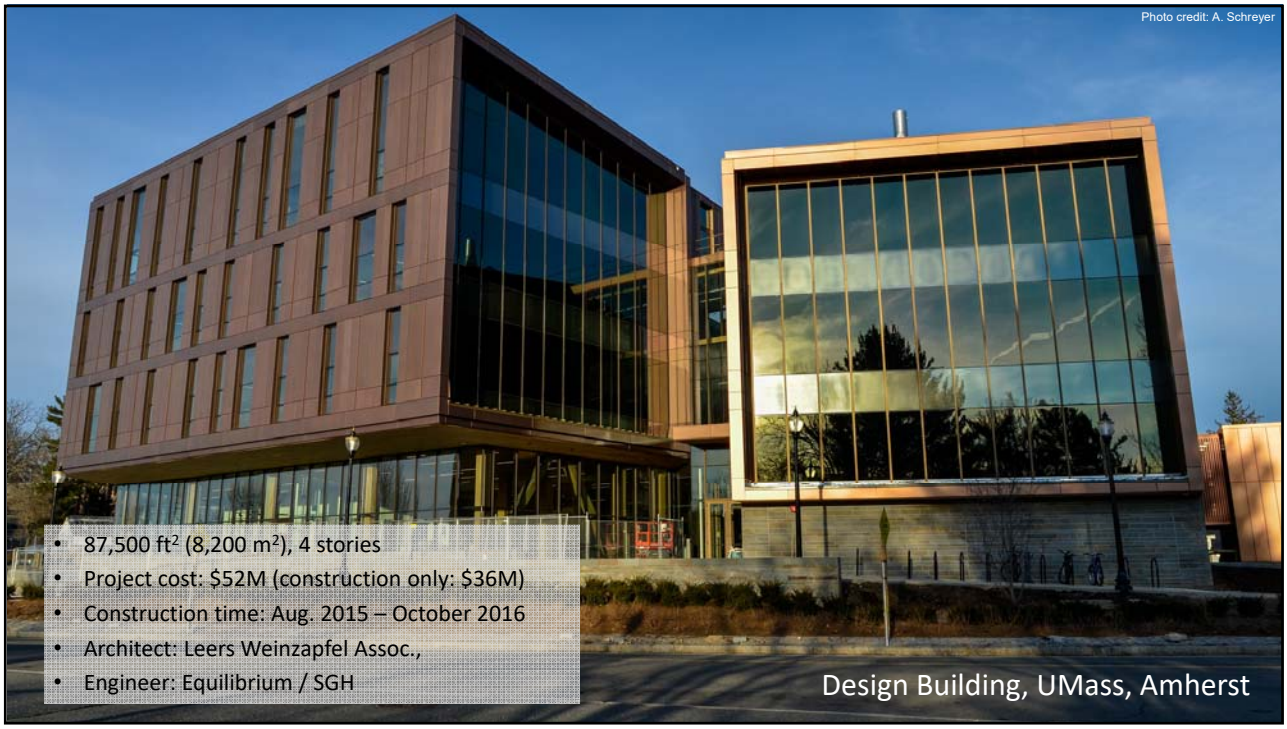


L1 - STRONG

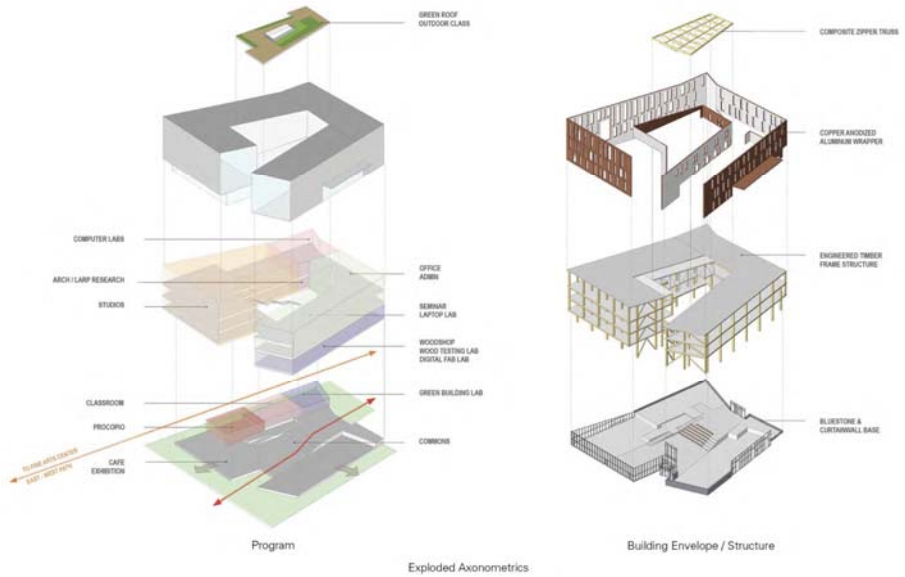
Different species have different strengths

Wood Species	Bending Strength (kPa)
White Ash	103,000
Black Spruce	74,000
Douglas-Fir	85,000
Eastern Hemlock	61,000

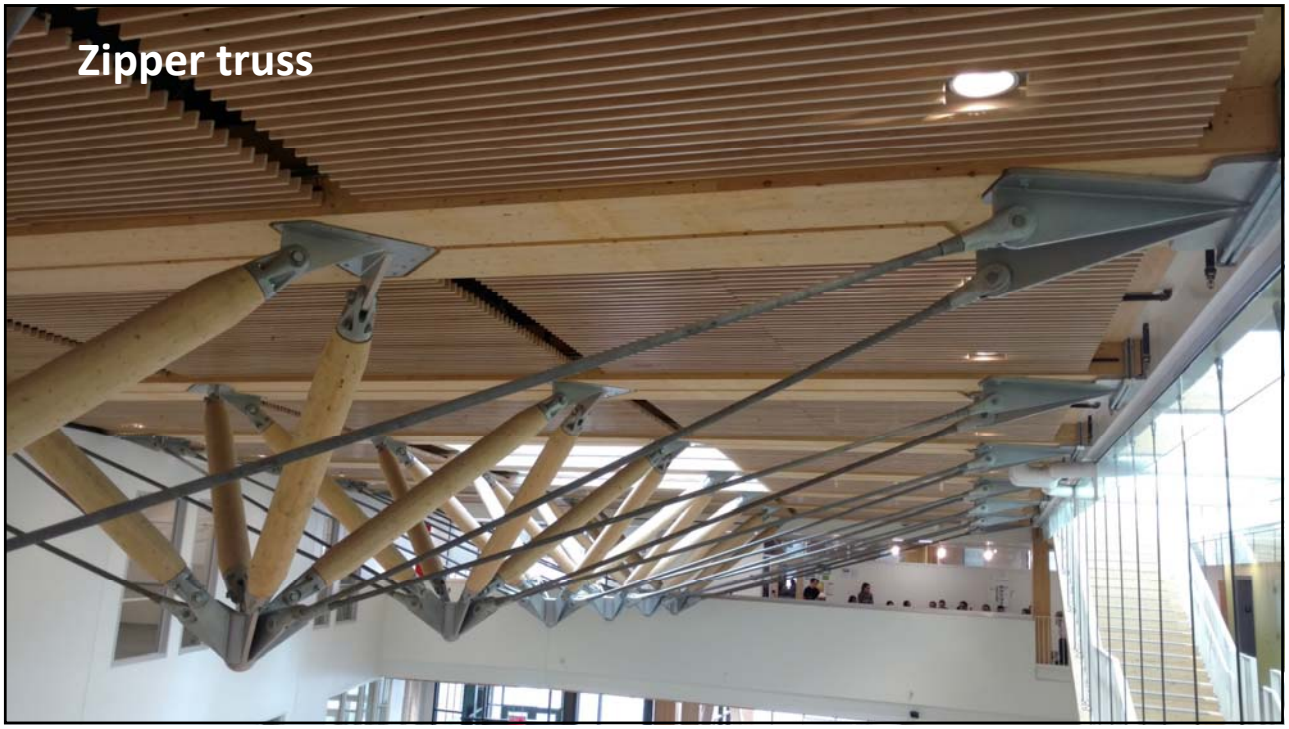
Design Building Tour

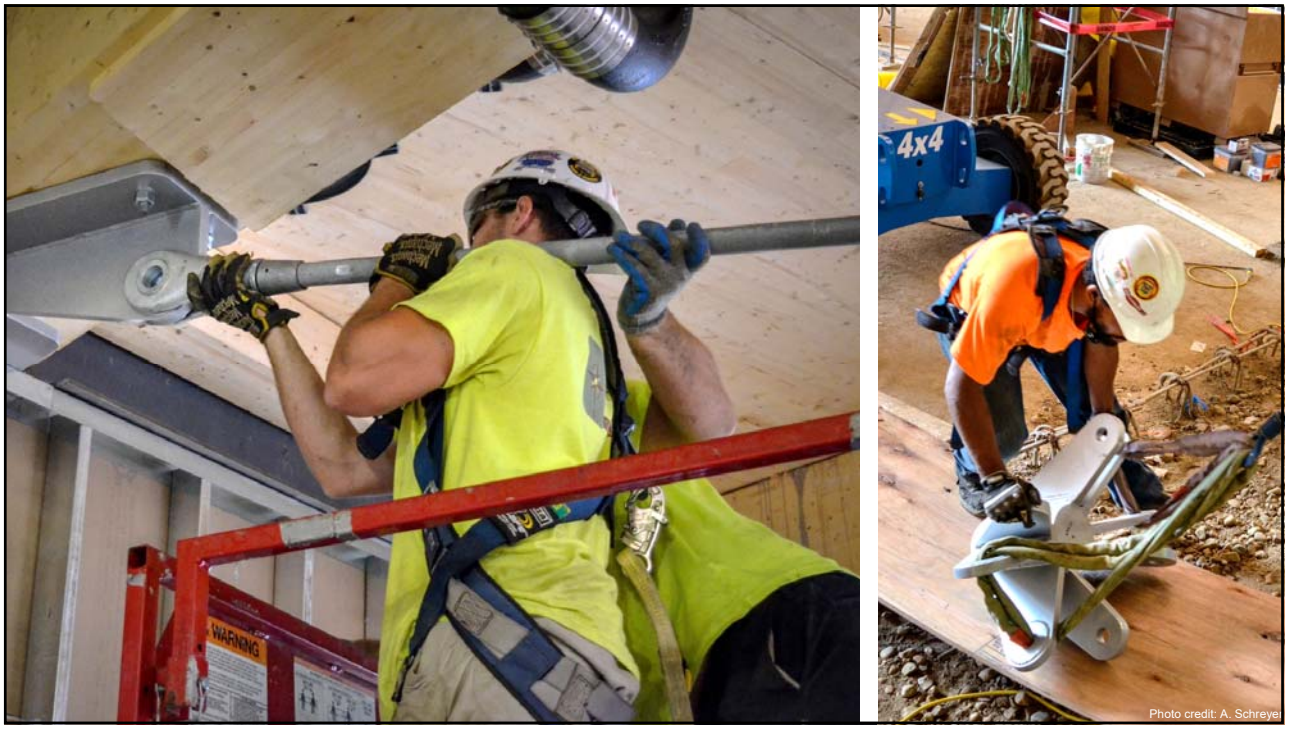


Building Layout



Exploded Axonometrics


Zipper truss


WARNING
4x4
Photo credit: A. Schreyer

FAST glulam column installation

Design Building in Construction: 1 work day

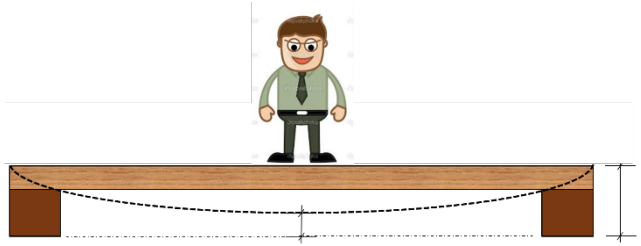
The Design Building Floors are Special


CLT-Concrete Composite Flooring
Photo credit: A. Schreyer


12060 12_070 1138-089
3736LBS
Photo credit: A. Schreyer

- Why go to all the extra trouble to connect the concrete to the wood?
- Because it's much stronger and stiffer that way
- And it all has to do with **Composite Action**

Composite Action … in action!



Case			Measurements		Calculations	
			Height from floor to top UNLOADED (mm)	Height from floor to top LOADED (mm)	Deflection, Δ (unloaded height – loaded height)	Comparisons
A		One wood plank only				n/a
B		Two wood planks *unconnected*				Δ_A = _____ x Δ_B
C		Two wood planks laid side by side				Δ_B = _____ x Δ_C
D		Two wood planks *connected*				Δ_B = _____ x Δ_D
E		Two wood planks with HardiePlank *unconnected*				Δ_D = _____ x Δ_E
F		Two wood planks with HardiePlank *connected*				Δ_E = _____ x Δ_F