BUILDINGENERGY BOSTON

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WoodWorks
WOOD PRODUCTS COUNCIL

Alexandra Davis

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Climate Emergency

Guest Edited by Architecture 2030

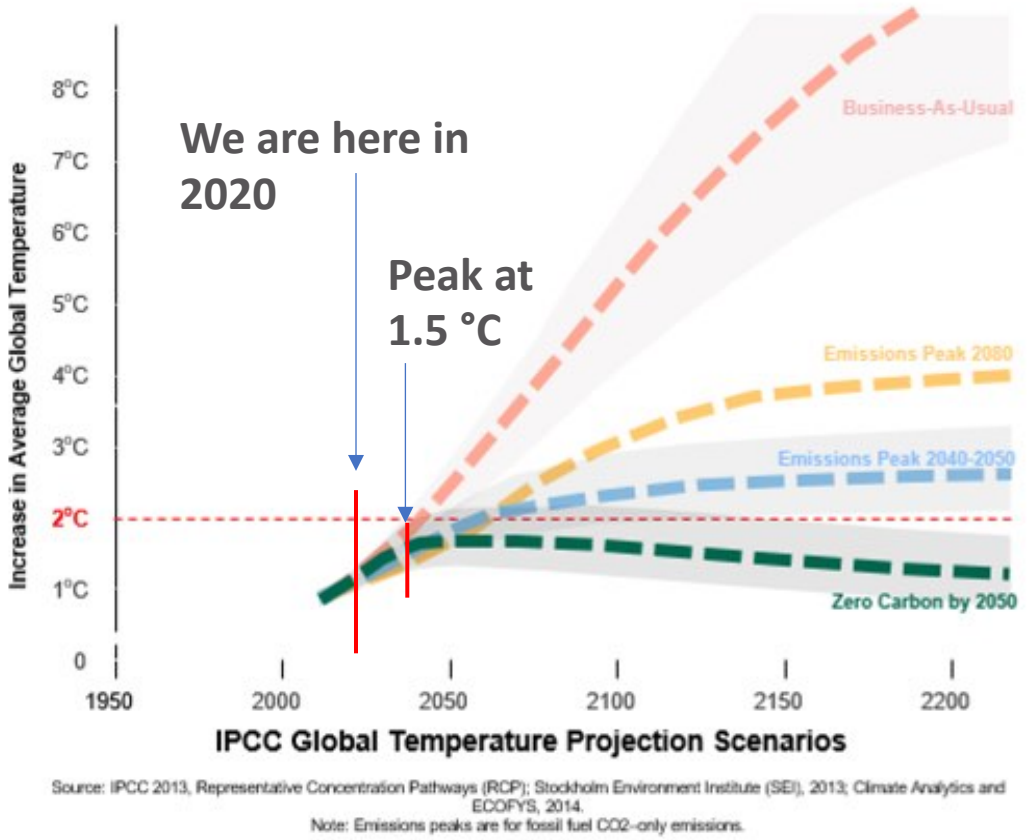
ARCHITECT

architectmagazine.com
The Journal of TheAmerican Institute of Architects

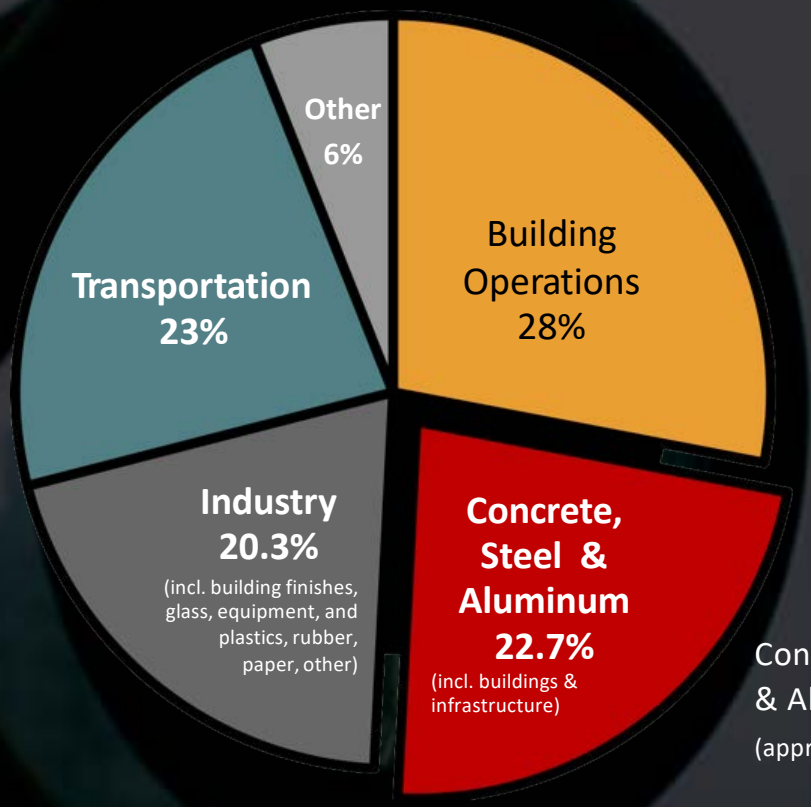
Time to quit.

Architecture has 10 years to kick its CO2 habit and get on the right side of climate change. Energy efficiency was just the first step. The next is to cut emissions from building materials.

architectmagazine.com



Source: IPCC 2013, Representative Concentration Pathways (RCP); Stockholm Environment Institute (SEI), 2013; Climate Analytics and ECOFYS, 2014.
Note: Emissions peaks are for fossil fuel CO2-only emissions.



Concrete 11.1%, Steel 10.1% & Aluminum 1.5%

(approximate, 2017)

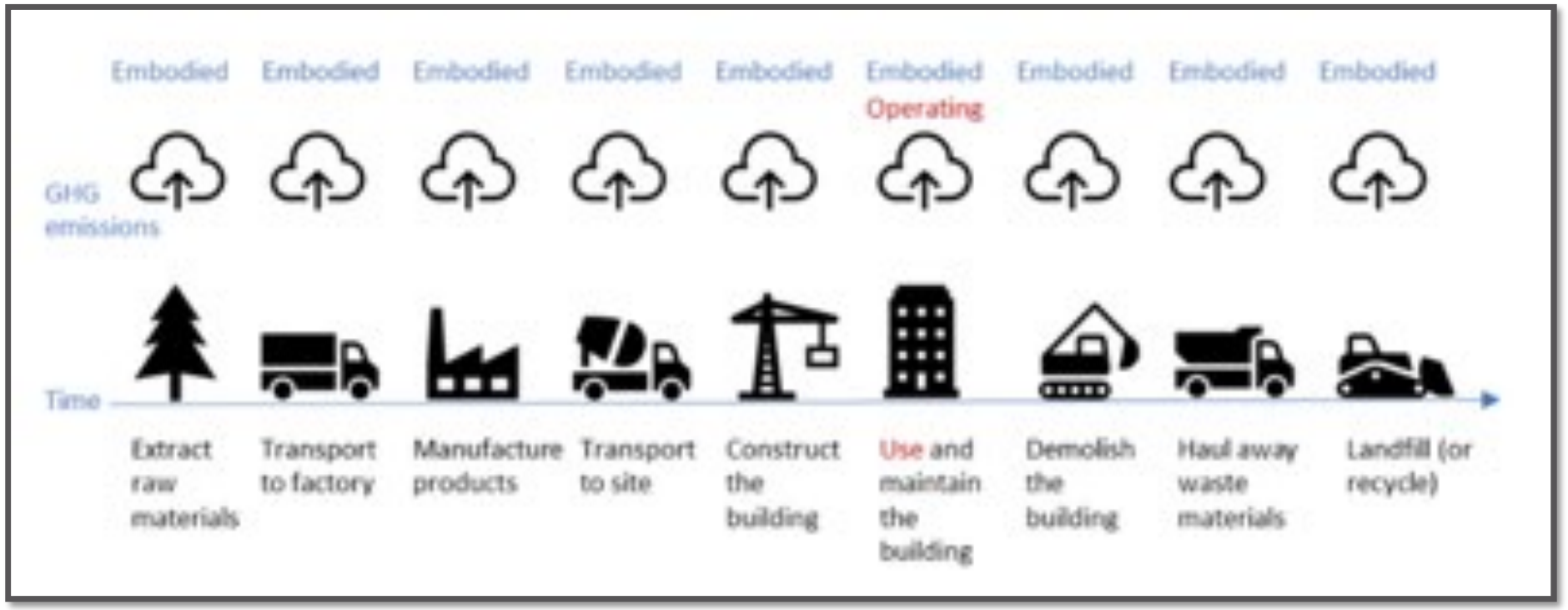
Global CO_2 Emissions by Sector

Source: IEA, Global ABC

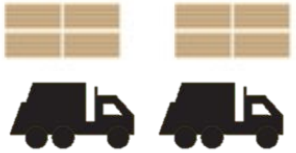
Edward Mazria
Architecture 2030

Embodied Carbon

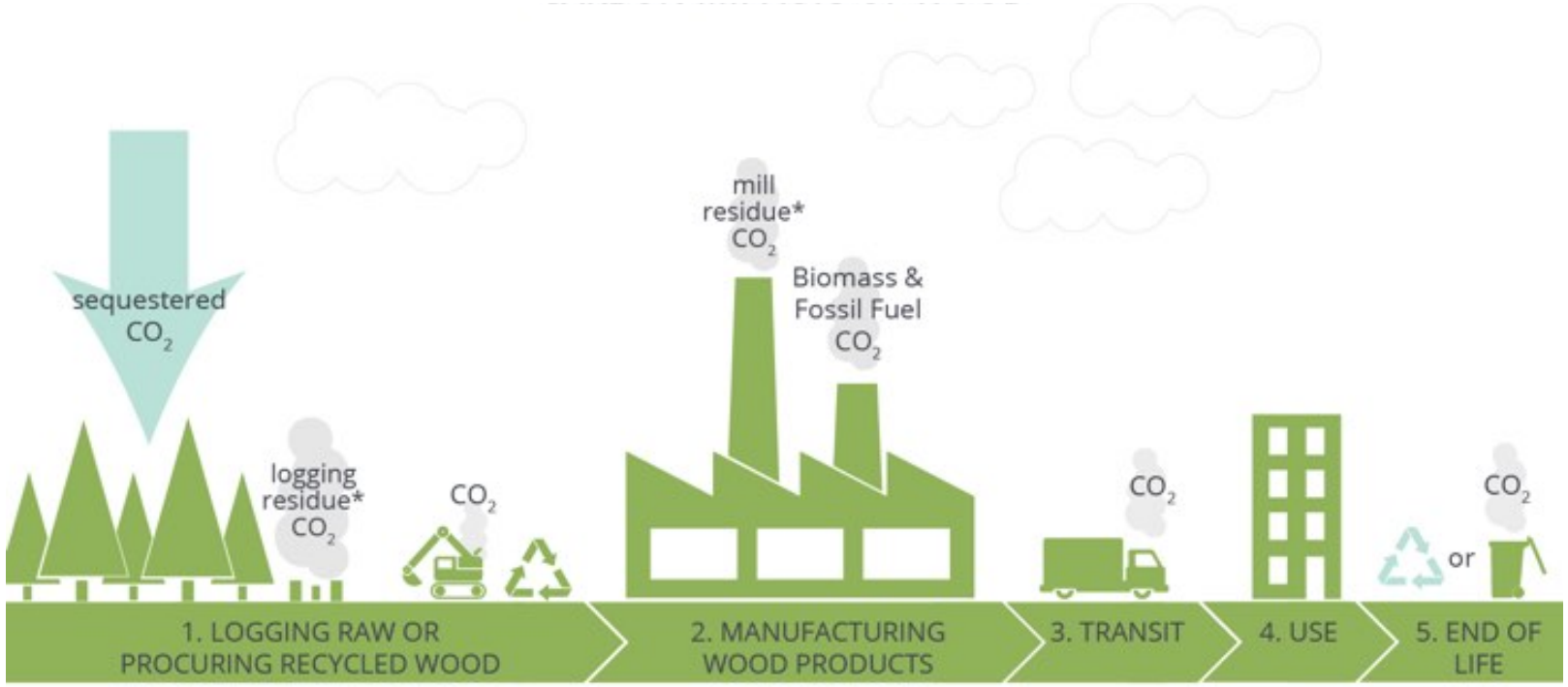
The emissions associated with building construction, including extracting, transporting, and manufacturing materials.



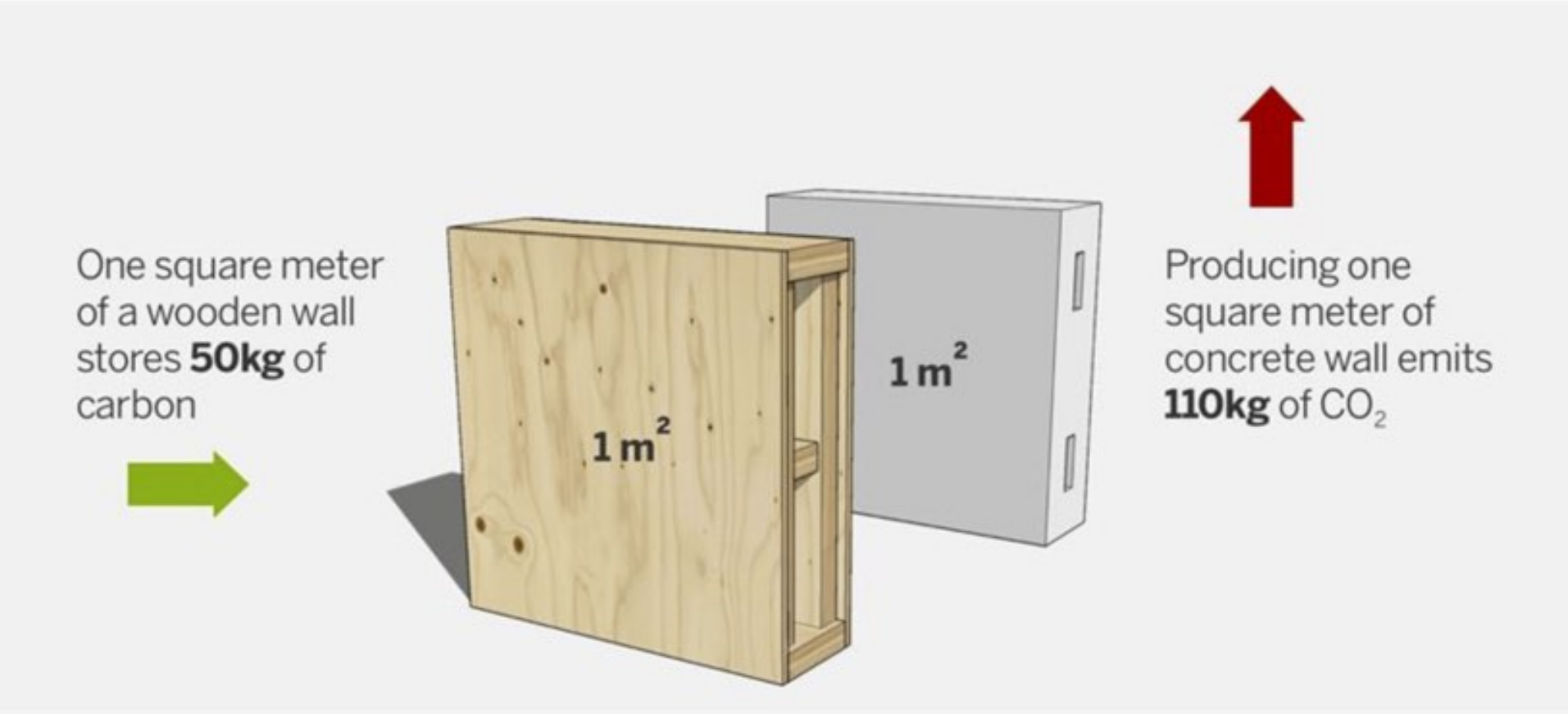
Principles of Procurement

- Carbon Sequestration 
- Timber Sourcing 
- Adhesives 
- Transportation to Site 

Carbon Sequestration



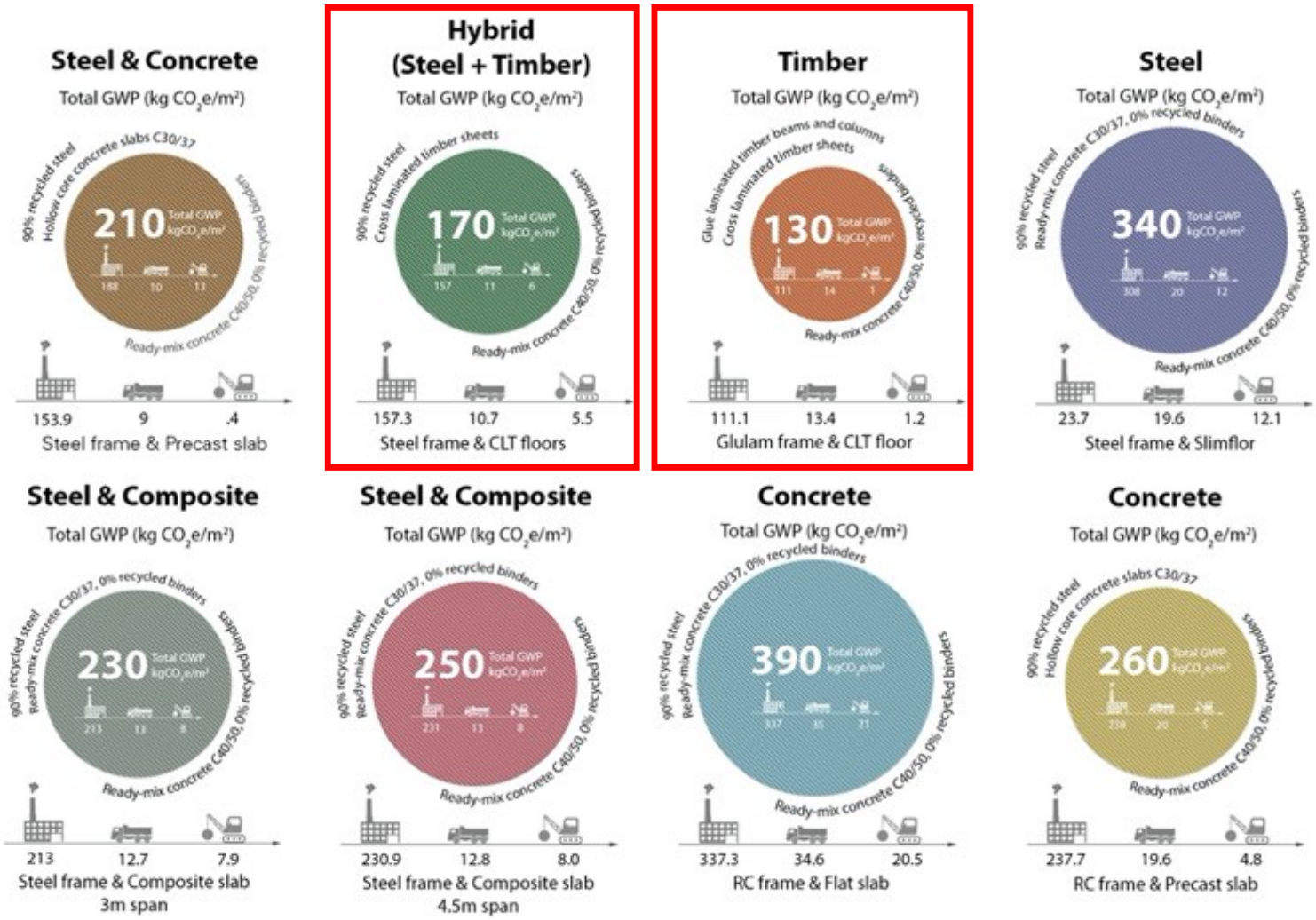
How much carbon does timber store?



Source: Metsä Wood

How do designs compare?

Building Structure



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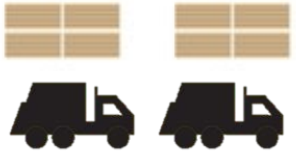
- Transportation to Site 

Sustainable Forestry

Forest Management Certification

- Promotes the ethical harvesting and extraction processes
- Assures the legal right of harvest
- Confirms traceability of wood throughout the supply chain via Chain-of-Custody (COC)

Certification Schemes

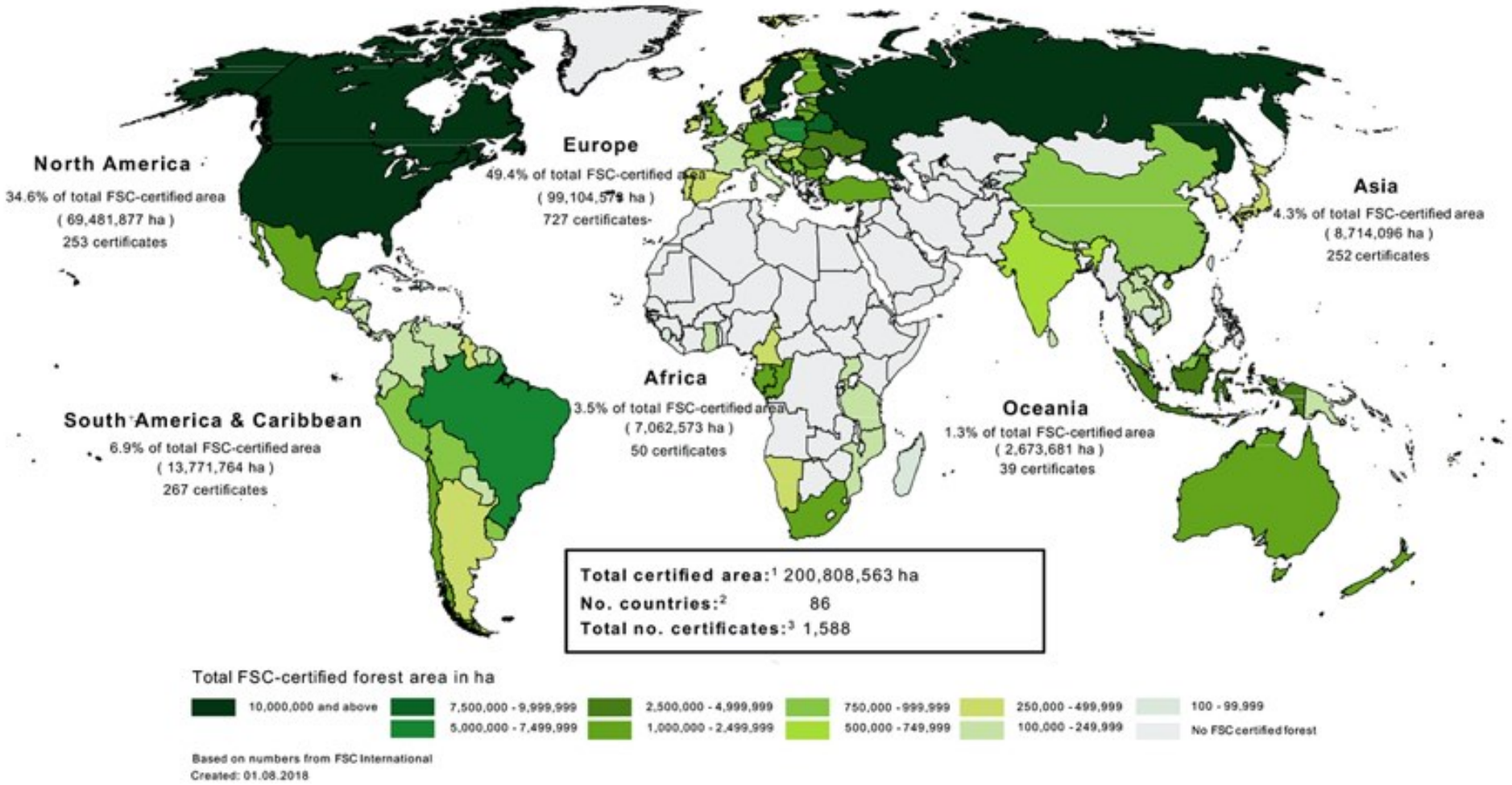
Ensure products come from responsibility managed forests that provide environmental, social and economic benefits

Forest Stewardship Council (FSC)

The Programme for the Endorsement of Forest Certification (PEFC)

Sustainable Forestry Initiative (SFI)

Global FSC-certified forest area



Not all schemes are equal

Some…

- Take a conservation-based approach to preserving forest ecosystems
- Limit clear-cuts to 6 acres, or allow clear-cuts up to 120 acres
- Require all uncertified/illegal material be excluded from products, others allow a small amount of cross-contamination

Ask Your Suppliers:

Do you provide sustainably sourced wood certified by the FSC, PEFC or SFI forest management schemes?

Can you provide Chain-of-Custody certificates to confirm traceability of your products ?

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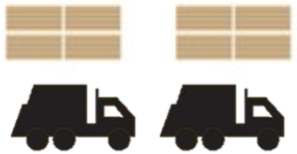
- **Adhesives** 
- Transportation to Site 

Adhesive Ingredients

Same functionality. Different chemical structure.

Urea-formaldehyde (UF)

Melamine Urea- formaldehyde (MUF)

Phenol Formaldehyde (PF)

Phenol Resorcinol Formaldehyde (PRF)

Polyurethane (PUR)

- Formaldehyde-based adhesives and volatile organic compounds negatively impact human health
- **Specify formaldehyde-free polyurethane (PUR) adhesive whenever viable**

Manufacturers & Adhesives

Manufacturers	Certif.	GreenGuard Gold	Ingredient Reporting	Adhesive Type	Location
Nordic Structures*	FSC	Yes	Yes	PUR	Chibougamau, QC, CA
Structurlam*	FSC & SFI	Yes	No	PUR	Okanagan Falls, BC
SmartLam*	FSC & SFI	TBD	TBD	PUR	Columbia Falls, MN
KLH*	FSC & PEFC	TBD	TBD	PUR	Teufenbach, Austria
International Beams*	FSC	No	No	PUR	Pohenegamook, QC, CA Tillsonburg, ON, CA Dothan, AL
Structure Fusion	FSC & SFI	No	No	N/A	Saint-Augustin-de-Desmaures, QC Canada Note: Only produces NLT
Katerra**	PEFC	No	No	PUR	Spokane, WA
Binderholz*	PEFC	No	No	PUR	Hallein & Unternberg, Austria
LignaCLT	TBD	TBD	TBD	TBD	Charlotte, NC
DR Johnson*	No	No	No	TBD	Riddle, OR

* Facility produces their own CLT slab. Others purchase CLT slabs from different locations.
** Katerra is set to open a CLT manufacturing facility in Spokane, WA which will be operational in 2019. Following 12 months of operation the company will commence with obtaining an EPD.

Source: Thornton Tomasetti, 2019

Principles of Procurement

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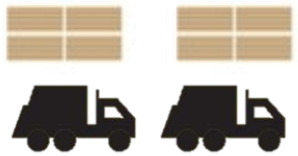
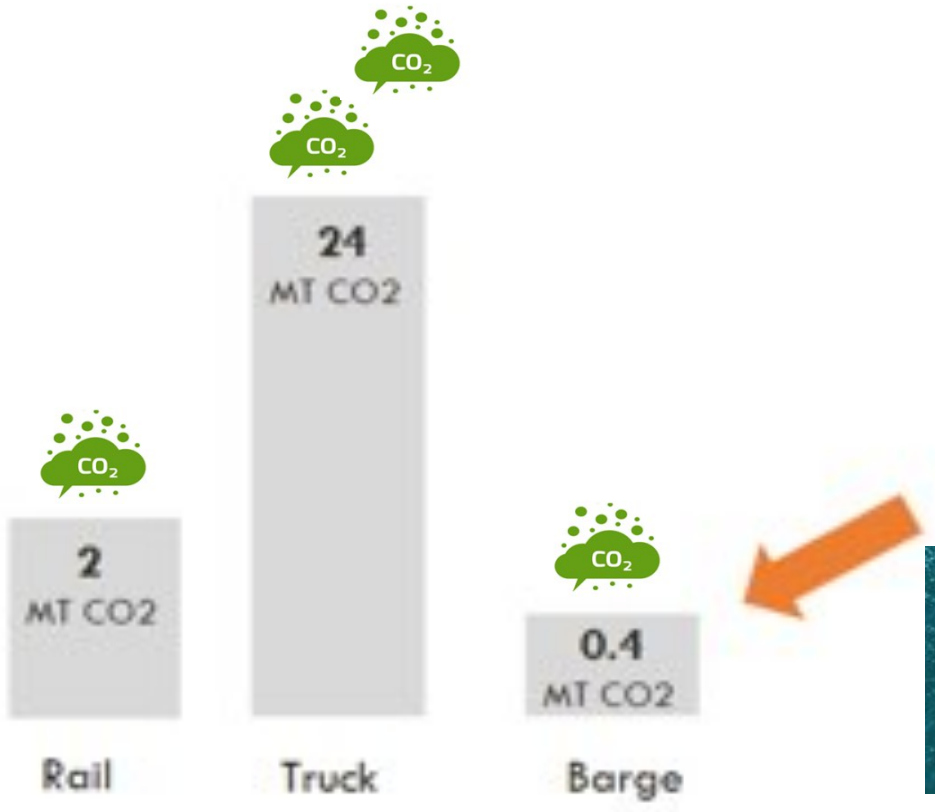
- **Transportation to Site** 

How is timber getting on-site?

- Carbon impact of wood is heavily dependent on type of haulage and vehicles used for delivery
- Consider the carbon cost of transporting timber versus what is locally available



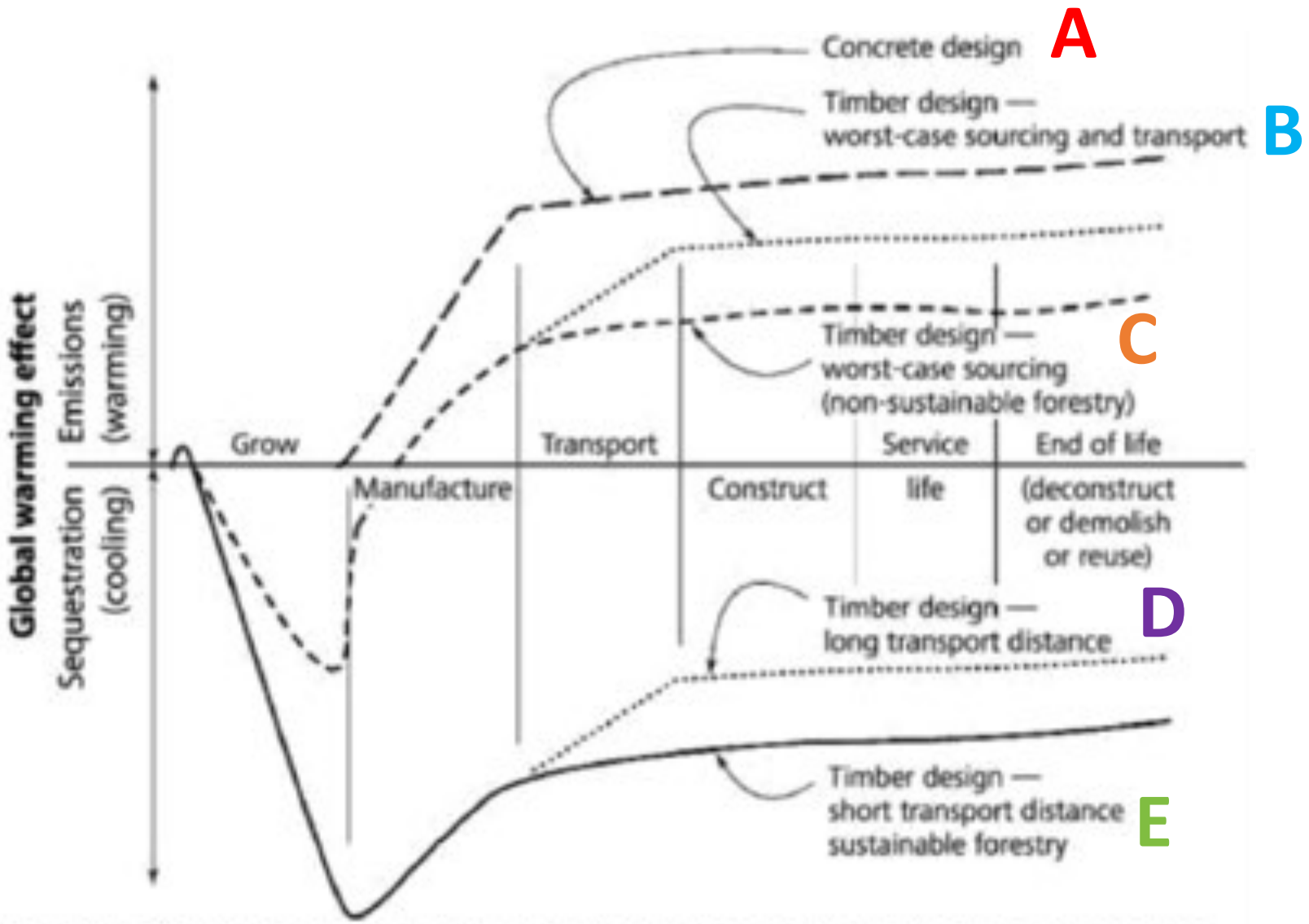


Fig. 4.5: *Comparison of carbon emissions between timber design and concrete design over life cycle of structural materials in 12-story tower, when wood is not sourced from sustainably managed forests.*
Credit: Arup / Bruce King

Is it sustainable?

Be conscious of the key elements which distinguish sustainable practices

Embodied Carbon

- Evaluate a timber (or hybrid) option alongside to traditional steel or concrete design to reduce carbon impacts

Timber Sourcing

- Ensure sustainable forestry certification for wood through FSC, PEFC or SFI management schemes & verify traceability with Chain-of-Custody

Adhesives

- Opt for formaldehyde-free adhesives to decrease negative health impacts and improve recyclability

Transportation to Site

- Is there a local supply option? If not, which suppliers can provide the most effective certified option?

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General Contractor's Perspective

Personal:

Live in Maine

On the Maine Mass Timber Advisory Council at UMaine

Have (3) Chain Saws – Stihl is my fav.

Drive a full size SUV

Like Land Rover Defenders

Have a 2010 boat with a 135HP Mercury Optimax 2-stroke

Career:

18 years at Consigli Construction - Construction Manager Self Performing Contractor

1 year at Revit Technology – (prior to Autodesk acquisition)

7 years Structural Engineer for in Massachusetts

- **70% steel and concrete design**
- **25% restoration & Building Envelope Consulting**
- **5% wood / glulam, stick frame design**

Not Me

Not a Timber Industry Lobbyist

No longer actively practicing Structural Engineering

Huge Advocate for 3D modeling / Off Site Construction

Realist / Pessimist / Advocate for the right system for the project

Advocate for Preconstruction Services being implemented to drive efficiency into Construction and Manufacturing buildings

Passionate about concept of attracting a Mass Timber (CLT & Glulam manufacturer) to New England (Specifically advocating for Maine)

General Contractor’s Perspective

Understand the benefits and potential uses

- Rationale for the benefits

Discuss Challenges with Mass Timber and what makes it a success on a project

- Examples

Compare the environmental impact

- Hmmm

Definition of Mass Timber – Industry Term

Mass Timber: Not Yet a Codified Term

Generally Covers elements also termed “Heavy Timber”

GLULAM

CROSS-LAMINATED TIMBER (CLT)

Photos: APA

NAIL-LAMINATED TIMBER (NLT)

Photo: Think Wood

Benefits and Potential Uses

What has been Historical Sustainable Choice for Building Structural Systems?

- Don’t Build New – Renovate/Restore
- Build New: Recycled Steel

When was the last new Structural System available to engineers (that is not a proprietary / licensed / single source product)?

- Girderslab/D-beam/Bubbleslab/Others?

What was the last building structure that you were able to grow?

- Did it Exceed 5 Stories?

What Entire Structural System Forces a Manufacturing Mindset?

- That is as good as modeled Structural Steel in Tekla/SDS or other steel detailing software?

Mass Timber – Potential Uses

IV-A

18 Stories
270'
TYPE IV-A

IV-B

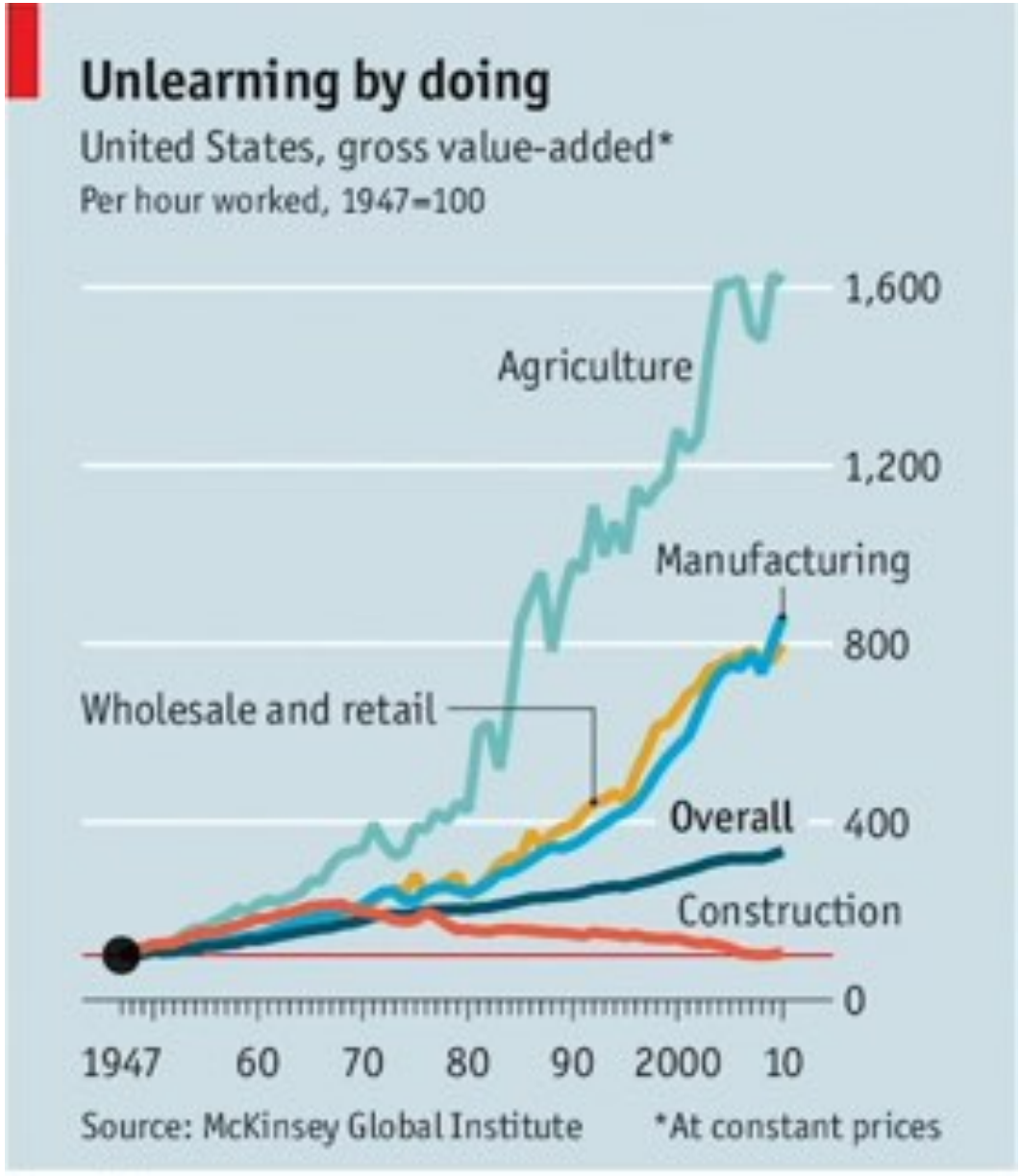
12 Stories
180'
TYPE IV-B

IV-C

9 Stories
85'
TYPE IV-C

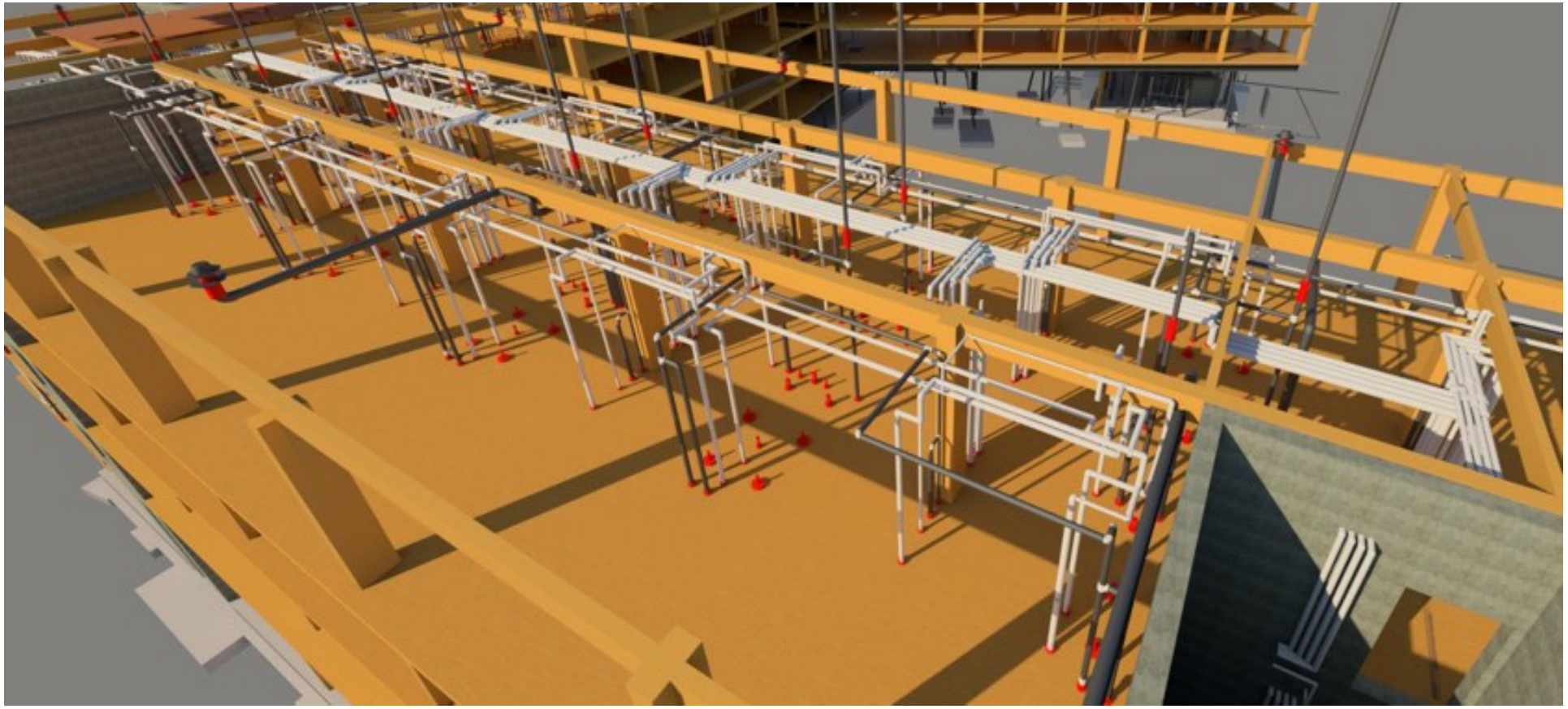
Construction Industry Productivity

Please start Designing to allow Contractors to adopt a Manufacturing Mindset



Mass Timber – Drives a Manufacturing Mindset

Forces Planning



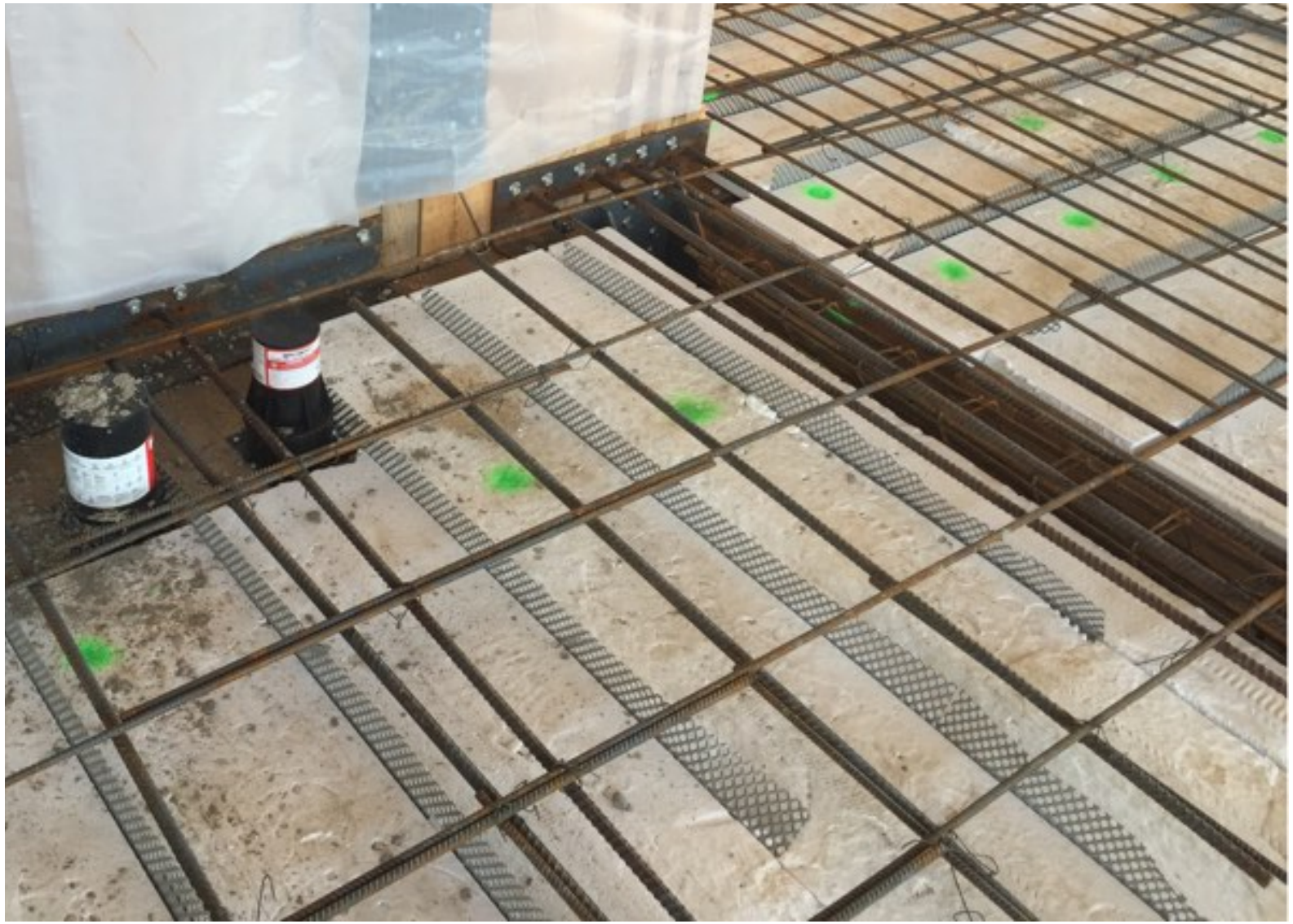
Mass Timber – Manufacturing forces planning earlier

Mass Timber – Manufacturing Opportunities

Mass Timber – Manufacturing Opportunities

Mass Timber – Potential for Innovation

Composite Concrete Topping?



How to Fail Fast with Mass Timber

Engaging a Design Team that has not completed a similar project in Mass Timber

Considering Mass Timber after hiring Architect and Engineers

Asking Designer to switch out preliminary design with Mass Timber

Engaging a Contractor that has not completed a Mass Timber Project

Asking a Contractor with Experience in Mass Timber that doesn't have a person on the team with Experience with Mass Timber

Where Mass Timber May be a Solution

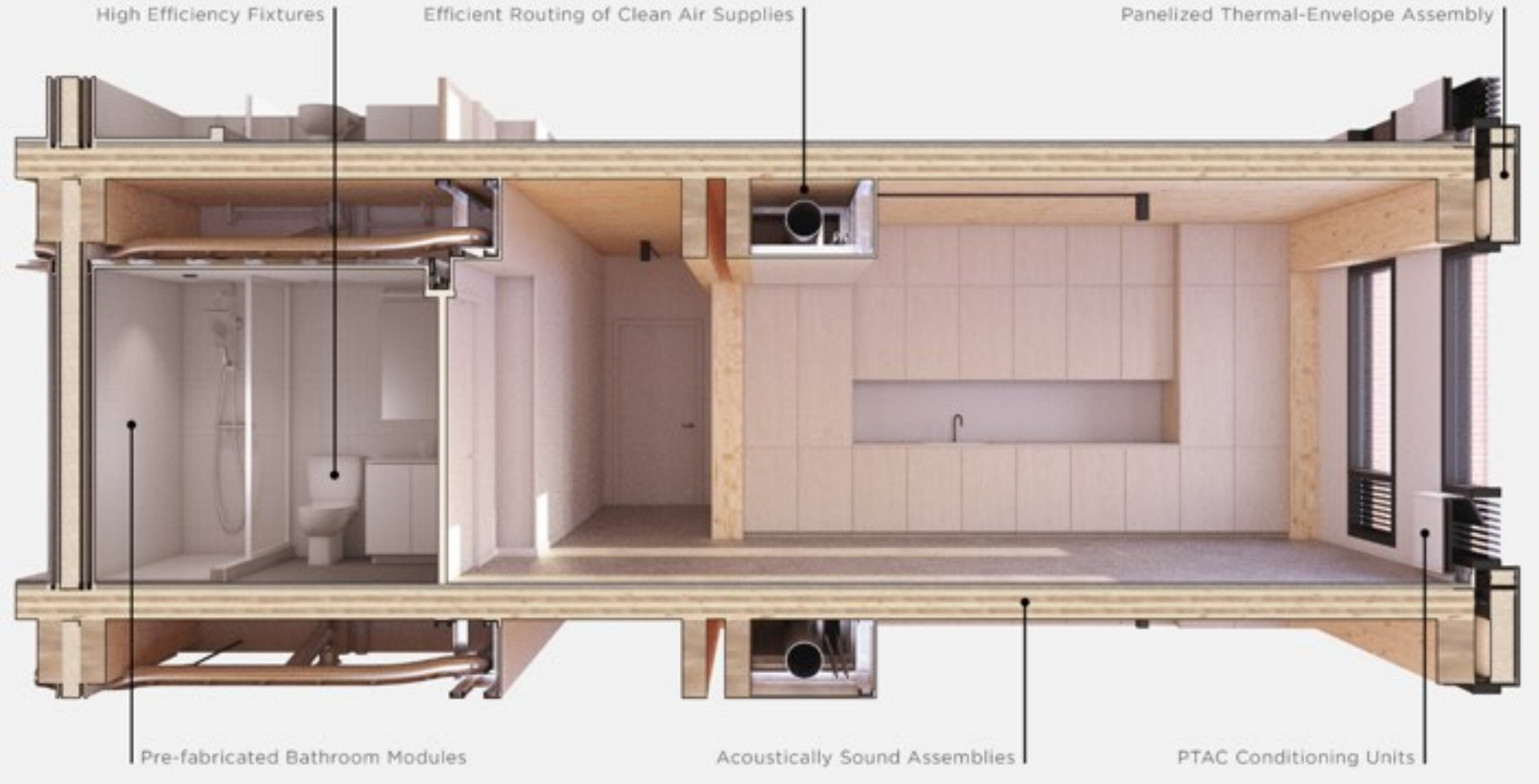
- Client has Sustainability Goals for the Project
  - Carbon is a factor in material choices (or value is assigned)
- Choice of Structure is part of first Design Options
- Structure can accommodate a smaller column grid pattern
- Structure can accommodate spans of 15 to 20 feet of floor plate
- Structure can accommodate a bearing wall design
- Client allows early procurement of Subcontractors / Vendors
- Soil Conditions allow for lighter building to receive advantage
- Exposed Structure is of importance
- Structure is 6 stories or greater
- Exposed Utilities are accepted
- Solid Wall Elements can do more than one job
  - Support Vertical Loads
  - Can be the Lateral Force Resisting System
  - Can be the finished interior surface
  - Can be the building envelope and installed during erection

Example of a number of Advantages

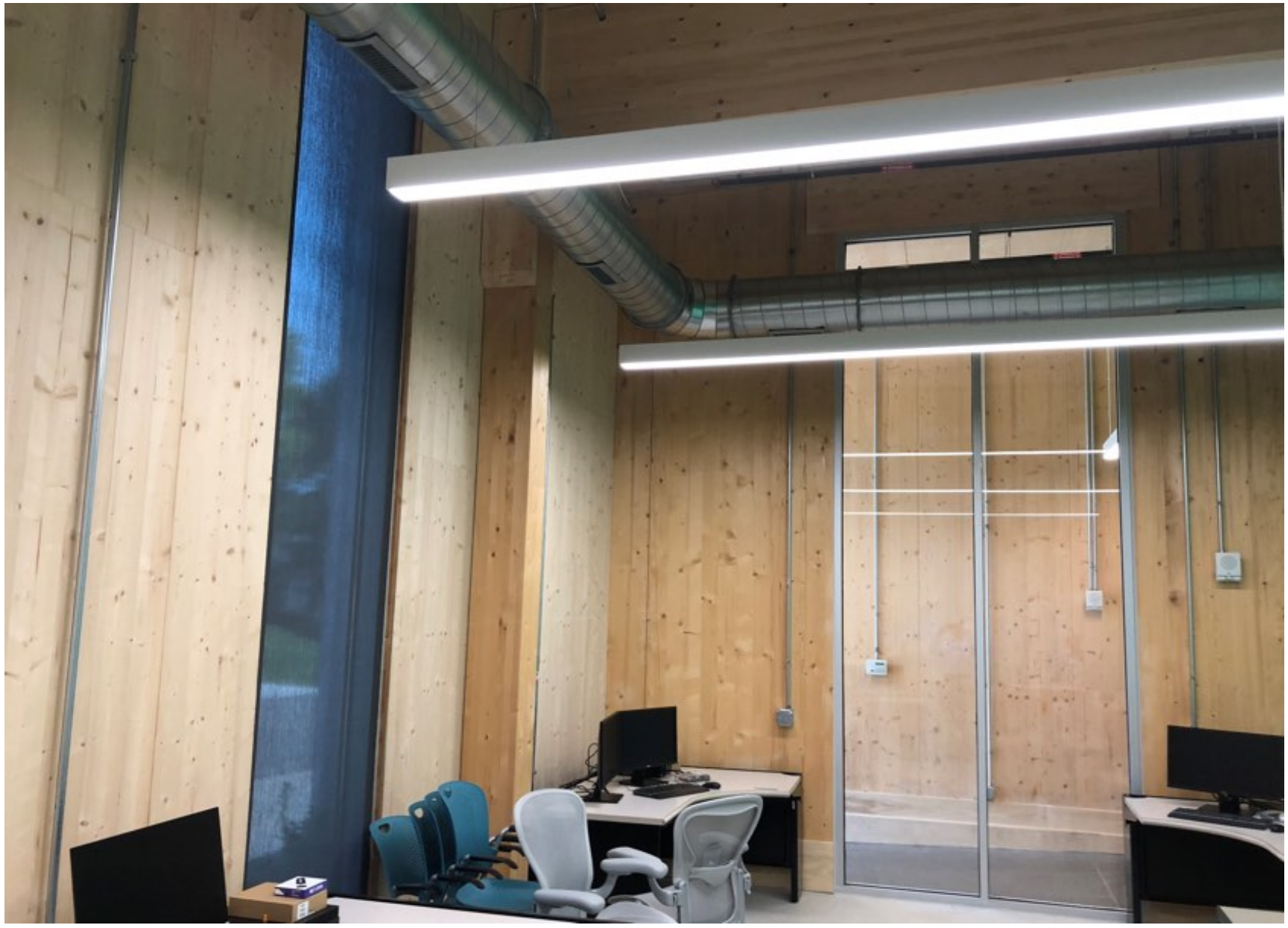
*Credit – Generate Technologies, Consigli, Buro Happold

Cross Section of Timber Option

*Credit – Generate Technologies, Consigli, Buro Happold



Win: Client Accepts Exposed Utilities



Structural Option Pricing Comparison

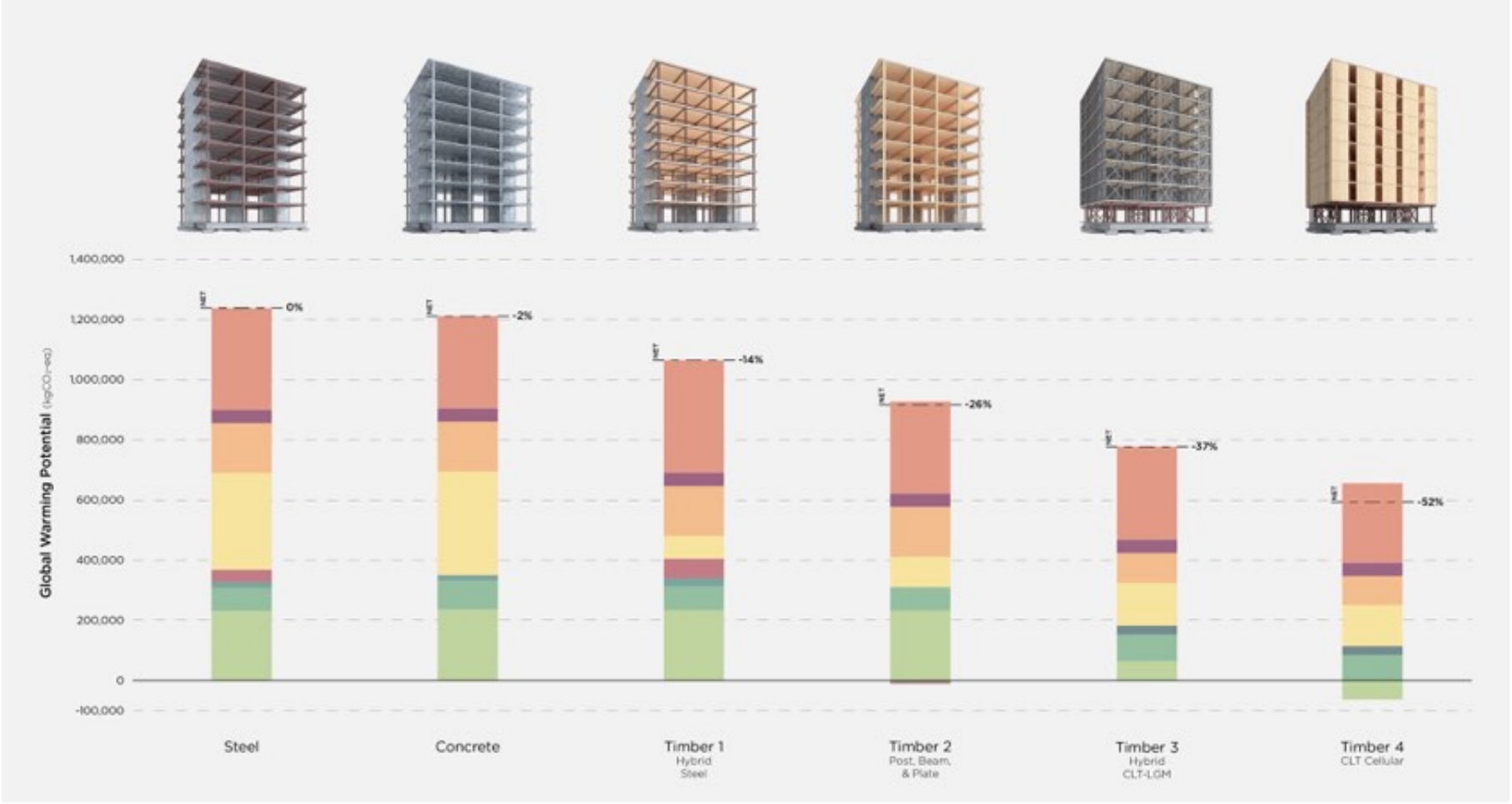
*Credit – Generate Technologies, Consigli, Buro Happold

CONSTRUCTION COST (PER TRADE)

Construction costs shown in graph illustrates structural and other variable costs that change in scope, schedule or sequence across the structural options. Costs not included are soft costs, finishes, MEP systems and envelope systems that are constant across all options. The schedule duration indicated is from completion of subgrade prep through completion of Air Vapor Barrier and roof membrane.

Global Warming Comparison

*Credit – Generate Technologies, Consigli, Buro Happold



GLOBAL WARMING POTENTIAL (PER BUILDING ASSEMBLY)

This graph illustrates the GWP broken down by building assembly. The Steel, Concrete and Hybrid Steel design options show a GWP burden for columns and beams due to their steel and concrete members. In the Post, Beam, & Plate option, columns and beams appear as a small negative, which in this study equates to positive impact and lower net GWP. The impact of timber is most evident in the CLT Cellular option, where the CLT of the structural walls also reduces the overall impact of the structural system. It is also evident that the timber options generally require more interior fit-out, in order to achieve equivalent acoustic and fire performance. Furthermore, the Hybrid CLT/LGM and CLT Cellular options indicate savings in the exterior enclosure as their structural systems are also part of their enclosure systems.

Environmental Impact

General Contractor's Perspective

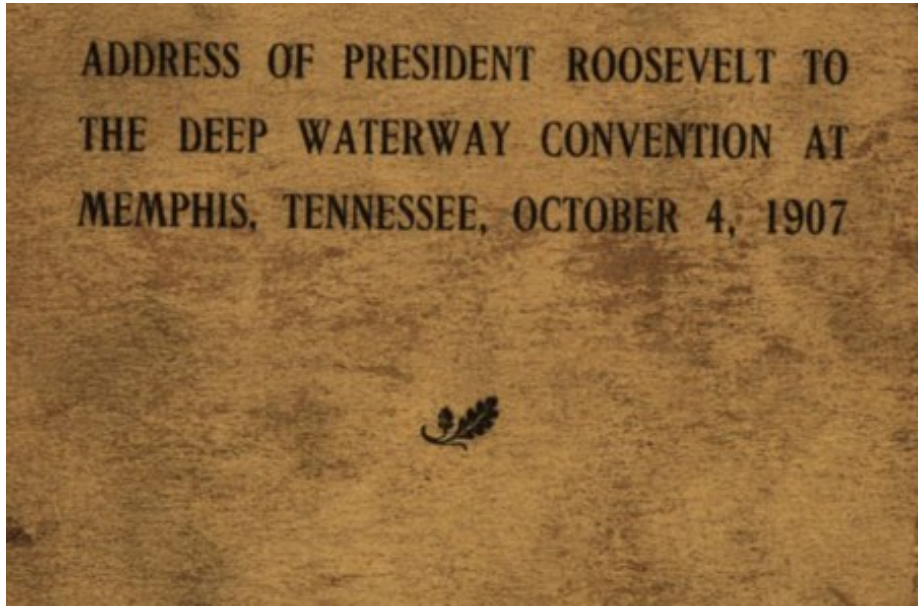
- Hmmm
- Remember who I am not:
- Remember who I am:

General Contractor's Perspective

First a Quote

We are consuming our forests three times faster than they are being reproduced. Some of the richest timber lands of this continent have already been destroyed, and not replaced, and other vast areas are on the verge of destruction.

Who said it? And When?

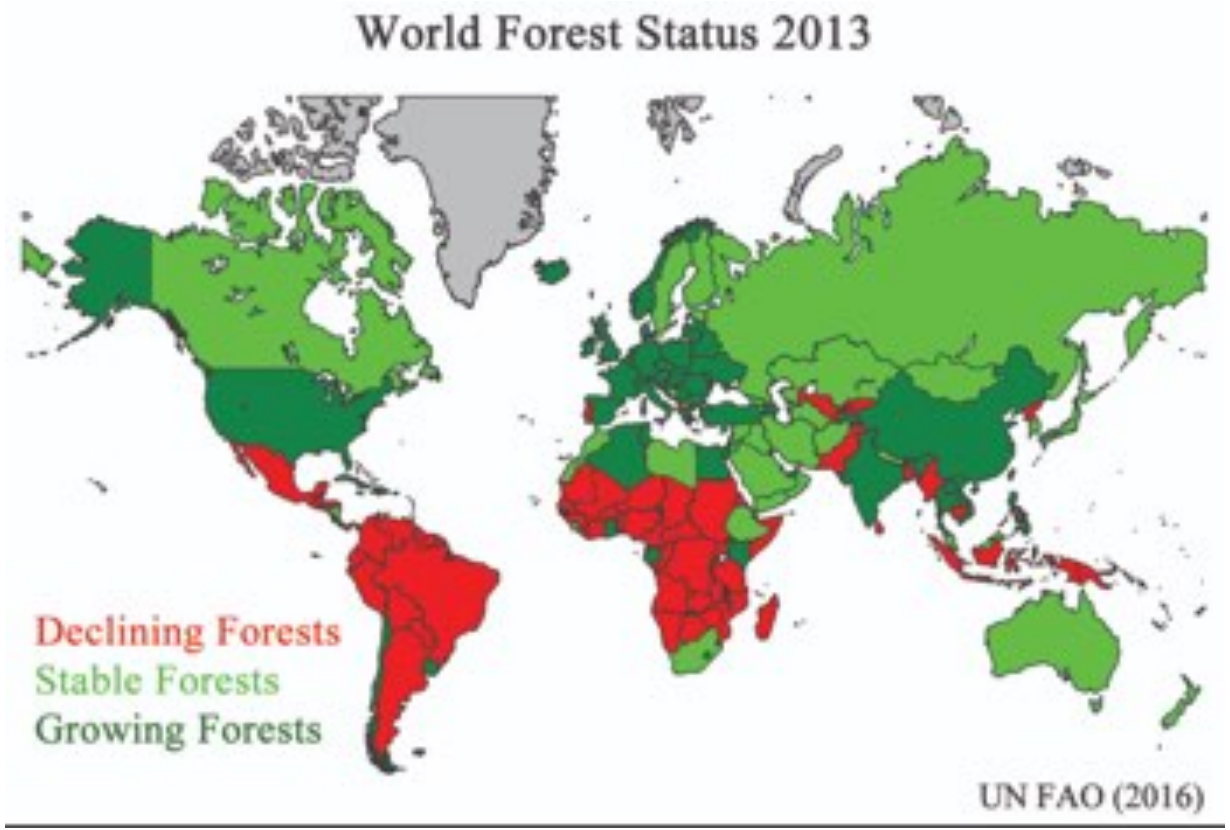


without supervision of any kind. We are

consuming our forests three times faster than they are being reproduced. Some of the richest timber lands of this continent have already been destroyed, and not replaced, and other vast areas are on the verge of destruction. Yet forests, unlike mines, can be so handled as to yield the best results of use, without exhaustion, just like grain fields.

Environmental Opinion

- Timber will Re-grow
- We MUST maintain our Working Forests – without a market for lumber -- they will be developed to their highest and best use



Questions to ask Construction Manager

- How to Price Mass Timber Systems at Concept Level
- How to hold Pricing after Concept Level
- How to Procure Mass Timber Manufacturer / Fabricator at DD
- How to Procure a Structural of CLT, Glulam, Steel and Concrete
  (Noting that structure may mix all materials)
- How to Coordinate MEPs with Timber Structure
- How to Mitigate Fire Risk during Construction
- Can discuss the Tall Wood Requirements for Construction phase fire management
- How to include a schedule advantage in early pricing studies
- How to protect the material after it is erected
- How to price sound attenuation measures
- How to manage the Delivery and Site Logistics of receiving Timber
  - From US based Vendor
  - From EU based Vendor

Planning Mass Timber – PROTECTION – Water Staining

Planning Mass Timber – PROTECTION

Planning Mass Timber – COORDINATION

Planning Mass Timber – Protection / Receiving

QUESTIONS?

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