



**WoodWorks™**  
WOOD PRODUCTS COUNCIL

# Making the Case & Keeping Costs in Check

February 2020 • Melissa Kroskey, AIA, SE • Technical Director, WoodWorks

# Mass Timber Cost & Design Optimization Checklists

## Overview

- Aid in design & cost optimization of mass timber projects
- Guiding discussions between:
  - Designers (architects & engineers)
  - Builders (general contractors, estimators, fabricators & installers)
  - Owners (developers & construction managers)

### Pre-Design Checklist:

- Design & Builder Team
- Cost Estimating Considerations
- Contractual Considerations
- Design Goals
- Contact WoodWorks

**Download Checklists at**

**[www.woodworks.org](http://www.woodworks.org)**

[www.woodworks.org/wp-content/uploads/wood\\_solution\\_paper-Mass-Timber-Design-Cost-Optimization-Checklists.pdf](http://www.woodworks.org/wp-content/uploads/wood_solution_paper-Mass-Timber-Design-Cost-Optimization-Checklists.pdf)

# Contractual Considerations

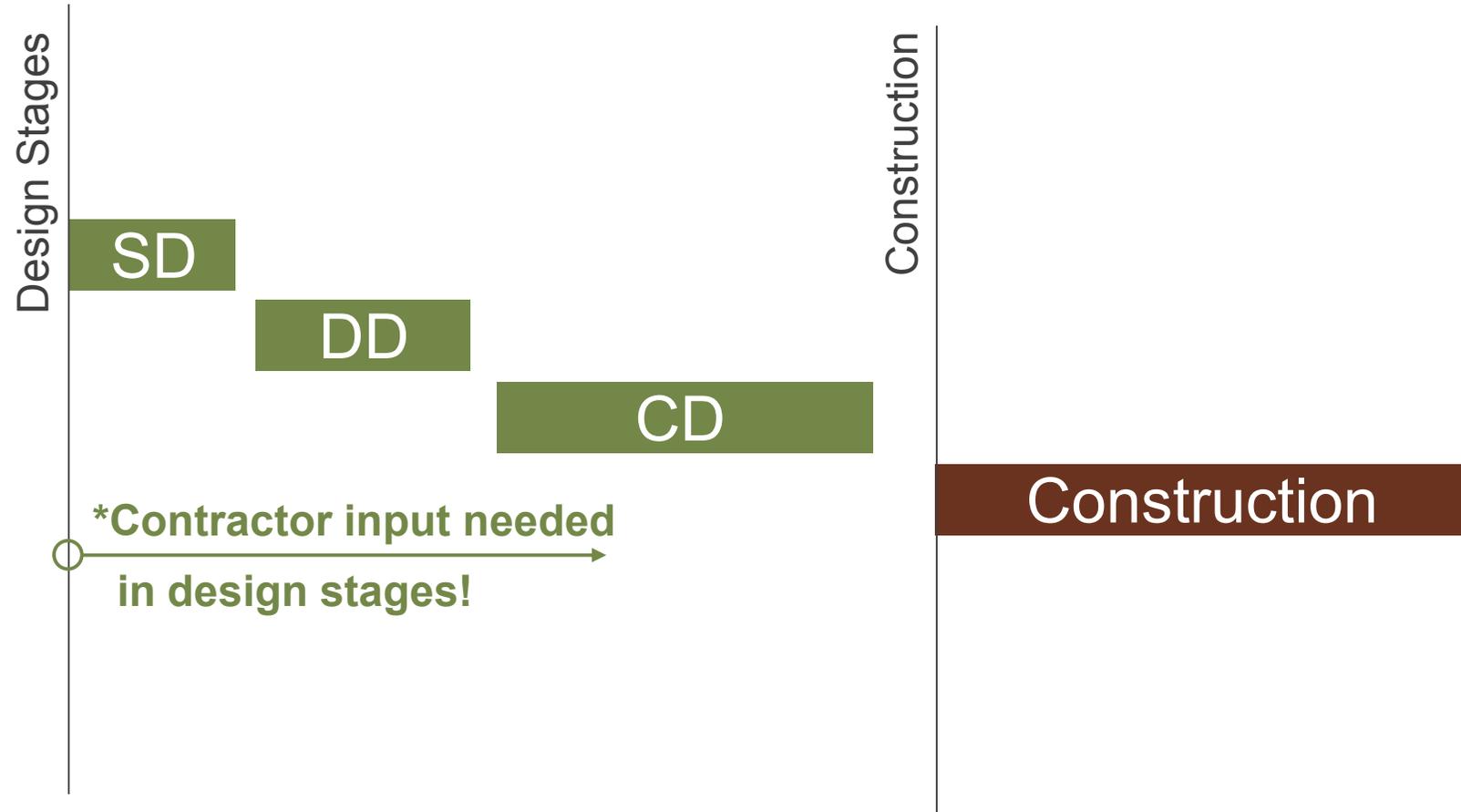
## Prefabricated Approach

Avoid:

- Design-bid-build

Consider:

- CM at risk
- Design-assist
- IPD
- Design-build



## Potential Benefits

Project Goal



Value Add



Fast construction

Aesthetic Value (Leasing velocity/ premiums)

Healthy Building / Biophilia

Lightweight structure

Labor shortage solution

- small crews
- entry level workers

Just-in-time delivery (ideal for dense urban sites)

Environmentally friendly (low carbon footprint)

Healthy forests/ wildfire resiliency & support rural economies

# Seattle Mass Timber Tower: Detailed Cost Comparison

## Fast Construction



- Textbook example done by industry experts
- Mass timber vs. PT conc
- Detailed cost, material takeoff & schedule comparisons

“The initial advantage of Mass Timber office projects in Seattle will come through the **leasing velocity** that developers will experience.”

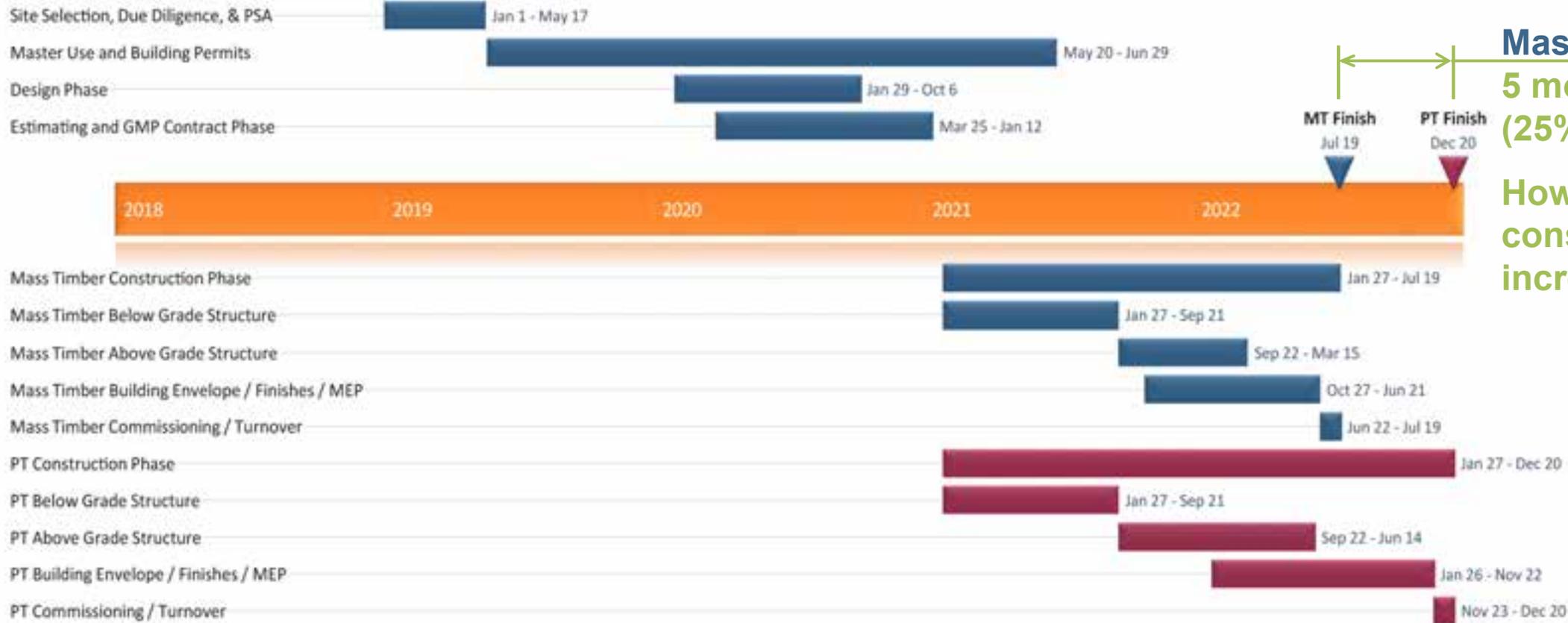
- Connor Mclain, Colliers<sup>1</sup>

**Download Case Study:**

<http://www.fastcpp.com/wp-content/uploads/181109-Seattle-Mass-Timber-Tower-Book.pdf>

# Seattle Mass Timber Tower Fast Construction

## Construction Schedule:



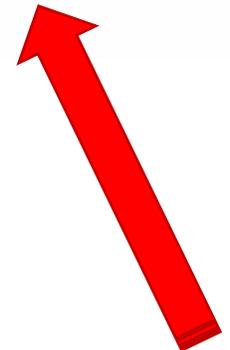
**Mass Timber**  
5 months  
(25%) faster

How can faster  
construction  
increase your ROI?

# Seattle Mass Timber Tower

Faster Construction + Higher Material Costs = Cost Competitive

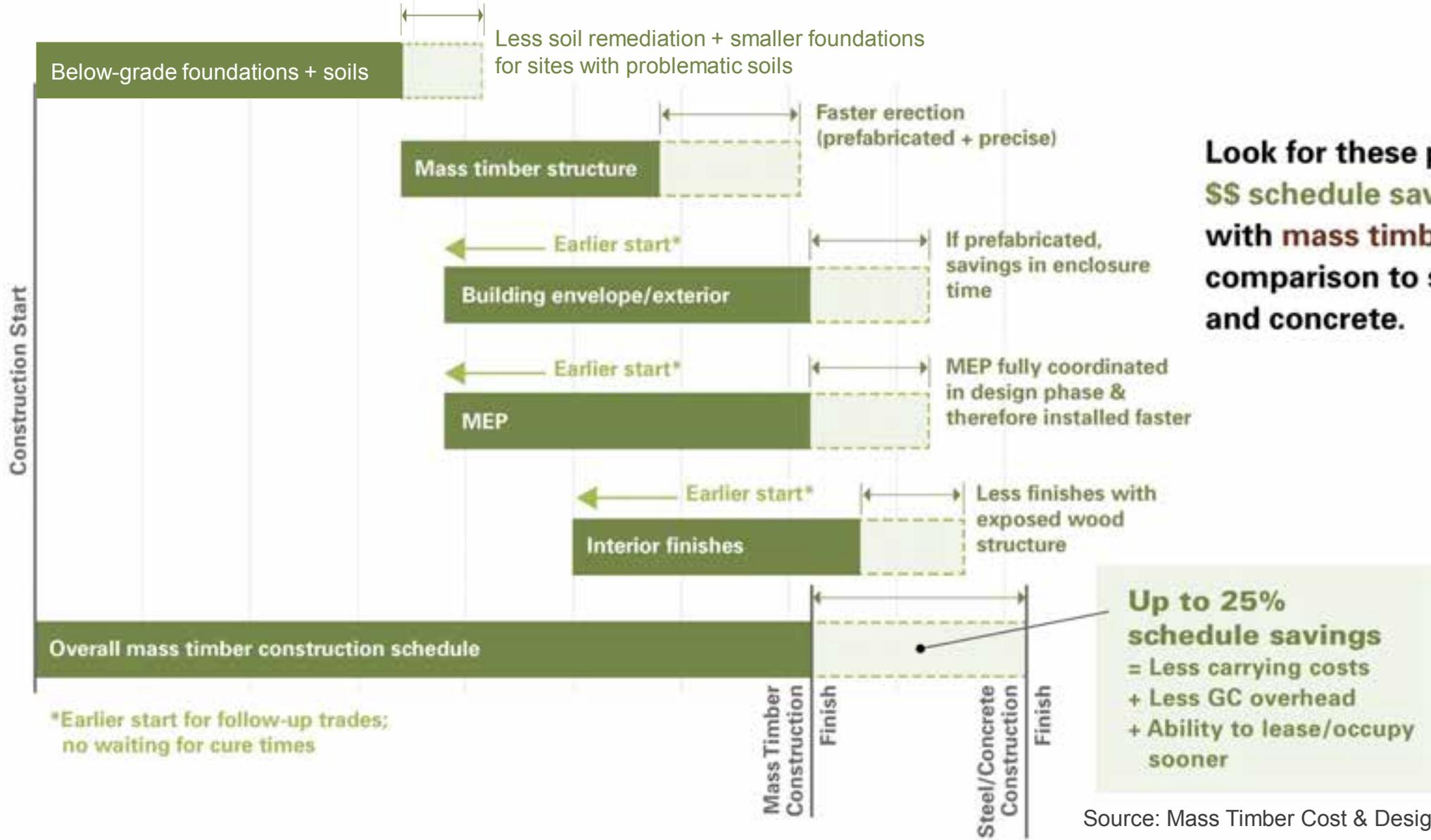
<b>System</b>	<b>Mass Timber Design</b>	<b>PT Concrete Design</b>	<b>Mass Timber Savings</b>
Direct Cost of Work	\$86,997,136	\$85,105,091	2.2%
Project Overhead	\$ 9,393,750	\$11,768,750	-20.2%
Add-Ons	\$ 8,387,345	\$ 8,429,368	-0.5%
<b>Total</b>	<b>\$104,778,231</b>	<b>\$105,303,209</b>	<b>-0.5%</b>



Source: DLR Group | Fast + Epp | Swinerton Builders

# Compressing the Typical Schedule

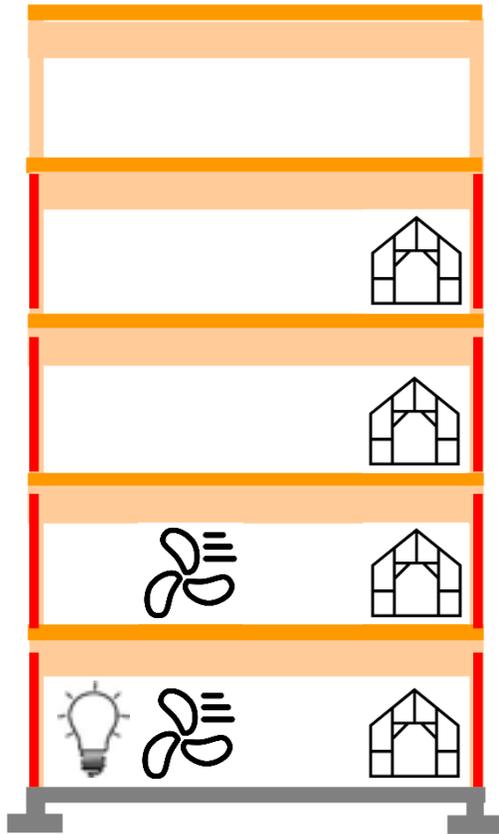
## Fast Construction



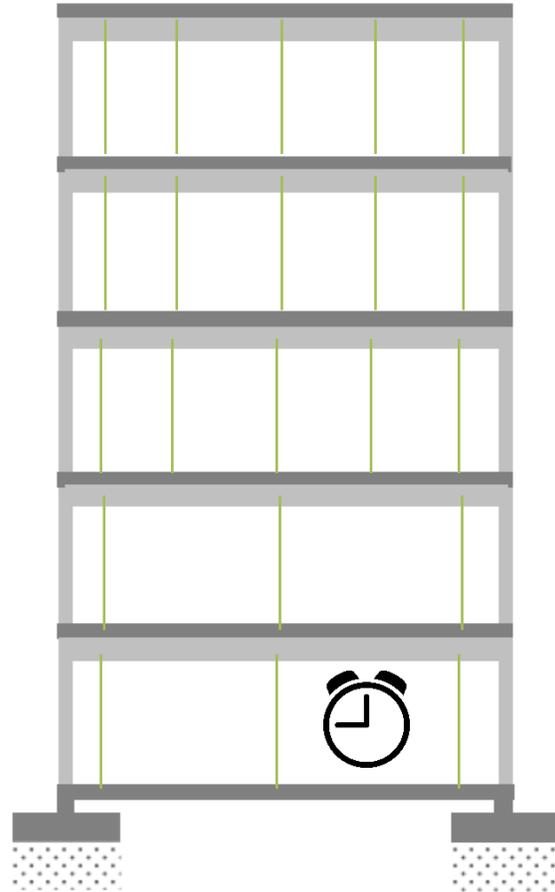
Look for these potential \$\$ schedule savings with mass timber in comparison to steel and concrete.

# Schedule Savings for Rough-In Trades

## Fast Construction



NO curing  
(mass timber)



Curing & maze of  
shores (concrete)



Photo: WoodWorks

# Schedule Examples

## Fast Construction

Example Timeframes for Mass Timber Projects

Project	Stories	Area	Type	Time to Erect the Mass Timber Structure	Overall Construction Schedule
First Tech Credit Union <i>(Swinerton<sup>8</sup>)</i>	5	150,000 sf	Office	12 weeks	14 months
Candlewood Suites at Redstone Arsenal <i>(Lendlease<sup>9</sup>)</i>	4	62,700 sf	Military hotel	16 weeks	12 months
Seattle Mass Timber Tower <i>(DLR Group hypothetical case study<sup>10</sup>)</i>	12	305,000 sf	Mixed-use office and hotel	24 weeks	18 months

# Candlewood Suites: Military Hotels

## Labor Shortage Solutions



Photos: Lendlease



### Redstone Arsenal:

- 37% faster overall<sup>2</sup>
- 40% fewer construction workers<sup>2</sup>
- Trained unemployed veterans

### Prefab Assemblies:

- Bathroom Pods
- Facades
- MEP Racks

Developer, Asset Manager, Design Builder: Lendlease  
Locations: Redstone Arsenal, Huntsville, Alabama

# ULI Report: The Business Case for Healthy Buildings

## Healthy Building/ Biophilia

### Global Wellness Real Estate Industry:

- \$134 billion industry in 2017
- 6.4% annual increase since 2015
- \$180 billion industry by 2022

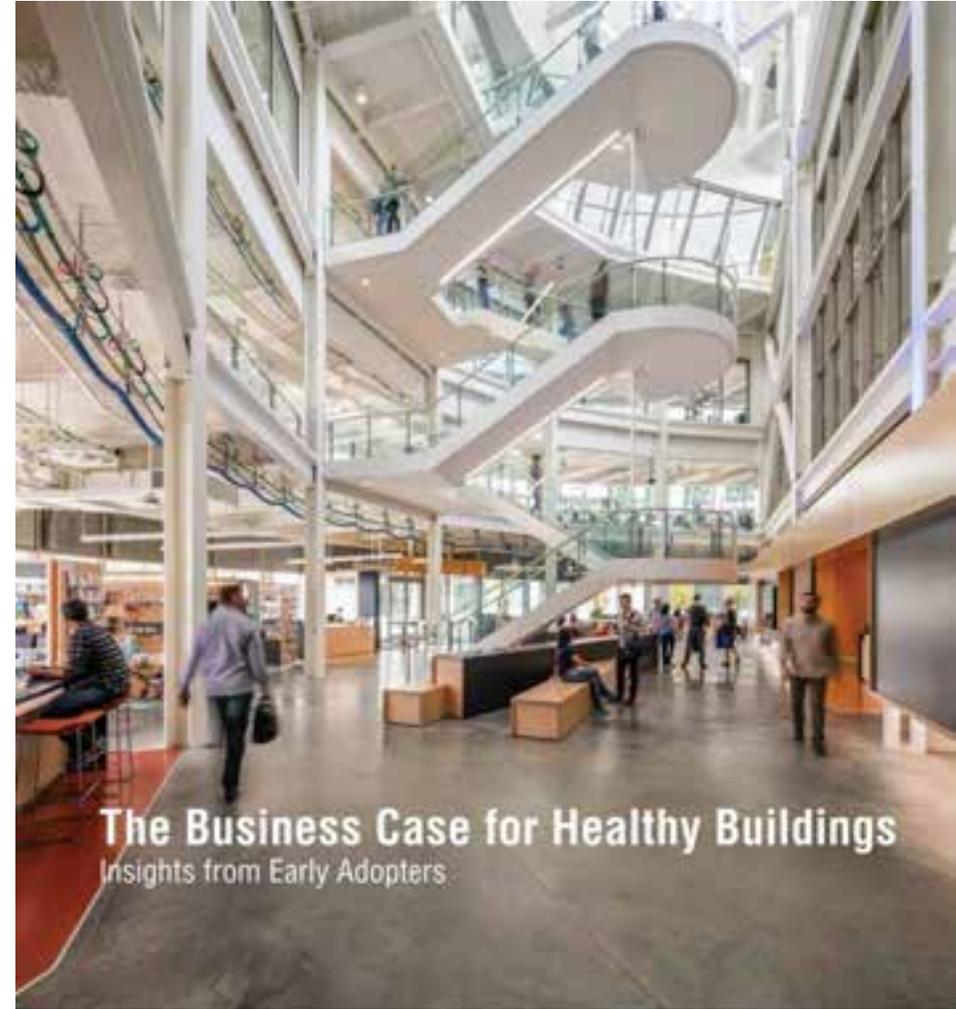
### Healthy Bldgs ROI (Survey of 200 Canadian Bldg Owners):

- 46% easier to lease
- 28% command premium rents
- 38% of those who reported value in healthy bldgs said they are worth 7% more than conventional ones

### Millennials:

- 78% say workplace quality is important
- 69% would trade other benefits for good workplace

**“Health and wellness-focused environments...can help reduce company operating costs and increase revenues and profits.”**



**The Business Case for Healthy Buildings**  
Insights from Early Adopters

# Employee Retention

## Healthy Building/ Biophilia

Cost of losing an employee  
(assume: \$33/ hr):

\$ 1,000 termination  
\$ 9,000 replacement  
\$15,875 lost productivity  
**\$25,875 total**

Sources by Terrapin Bright Green:

- *Economics of Biophilia*, 2012
- *14 Patterns of Biophilic Design*, 2014  
(includes list of testing citations)



# Leading Office Developer Embraces Mass Timber

T3 = Timber, Transit & Technology



Photos: Ema Peter; MGA



## IV (HT)

- 6 stories wood over podium
- 220,000 sf
- *Finance & Commerce* reports:
  - **\$25 to 50 million** project cost<sup>3</sup> (2016 completion)
  - **\$87 million** purchase price (May 2018 sold to LaSalle)<sup>4</sup>

Location: Minneapolis, MN

Architect: Michael Green Architecture, DLR Group

Structural Engineer: Magnusson Klemencic Associates

Mass Timber Engineer: StructureCraft

# Leading Office Developer Embraces Mass Timber

## T3 Minneapolis



Photo: WoodWorks

Location: Minneapolis, MN  
Architect: MGA | Michael Green Architecture, DLR Group  
Structural Engineer: Magnusson Klemencic Associates  
Mass Timber Engineer: StructureCraft

### IV (HT)

- 20' x 25' grid
- 2x8 NLT spanning 20 ft
- MEP mains routed around core w/ a shorter bay spacing & shallower beam
- Timber erection:
  - 2.5 months total
  - 9 days per 30,000-sf floor
- **Foundation \$ savings:**
  - 30% lighter than steel
  - 60% lighter than conc<sup>5</sup>

# Tenant Build Outs – Potentially Lower Costs Starting with Aesthetic Value of Structure





# 55 Southbank: Add Vertical Density over Existing Bldgs

## Lightweight



10-story  
CLT addition

Location: Melbourne, Australia  
Architect: Bates Smart  
Engineer: Vistek

- Existing building constructed to accommodate future 6-story concrete addition
- Owner wanted 220 key hotel addition:  
**6-stories conc = no deal**  
**10-stories wood = deal<sup>6</sup>**
- Research shows  $\frac{1}{4}$  of urban buildings in the world are strong enough to carry additional floors of wood<sup>7</sup>
- Low embodied carbon footprint

# Fully Prefabricated: North America's First DLT Office

111 East Grand



Image: Neumann Monson Architects courtesy of Ryan Companies

## IIIB

- 4 Story
- 64,000 sf
- First DLT office in the US
- 1<sup>st</sup> spec office in Des Moines in over a decade<sup>8</sup>
- Superstructure all prefabricated for fast erection.
- Lateral system – precast concrete walls & core

Location: Des Moines, IA  
Architect: Neumann Monson  
Structural Engineer: Raker Rhodes  
Mass Timber Engineer: StructureCraft

# Fully Prefabricated: North America's First DLT Office

111 East Grand



## III B

- 20' x 25' grid
- 2x8 DLT spanning 20 ft
- 40' x 6'-4" DLT panels
- Glulam beams & cols

**Just-in-time delivery**  
ideal for tight sites and urban  
locations

Location: Des Moines, IA  
Architect: Neumann Monson  
Structural Engineer: Raker Rhodes  
Mass Timber Engineer: StructureCraft

# Wood Products

Increase Forest Value & Support Rural Economies



Source:

American Wood Council, Wood Products Industry at a Glance  
California 2018

# Carbon Storage: Wood = 50% Carbon (dry weight) Environmentally Friendly



Image: Kaiser + Path



Image: Lever Architecture



**Millennials**  
50% of US workforce!

Attract talent w/ craft  
coffee & exposed  
timber offices



Microsoft Campus

Image: Microsoft | WRNS Studio



Sidewalk Labs, Toronto

Image: Picture Plane  
for Heatherwick Studio for Sidewalk Labs



Google HQ, UK

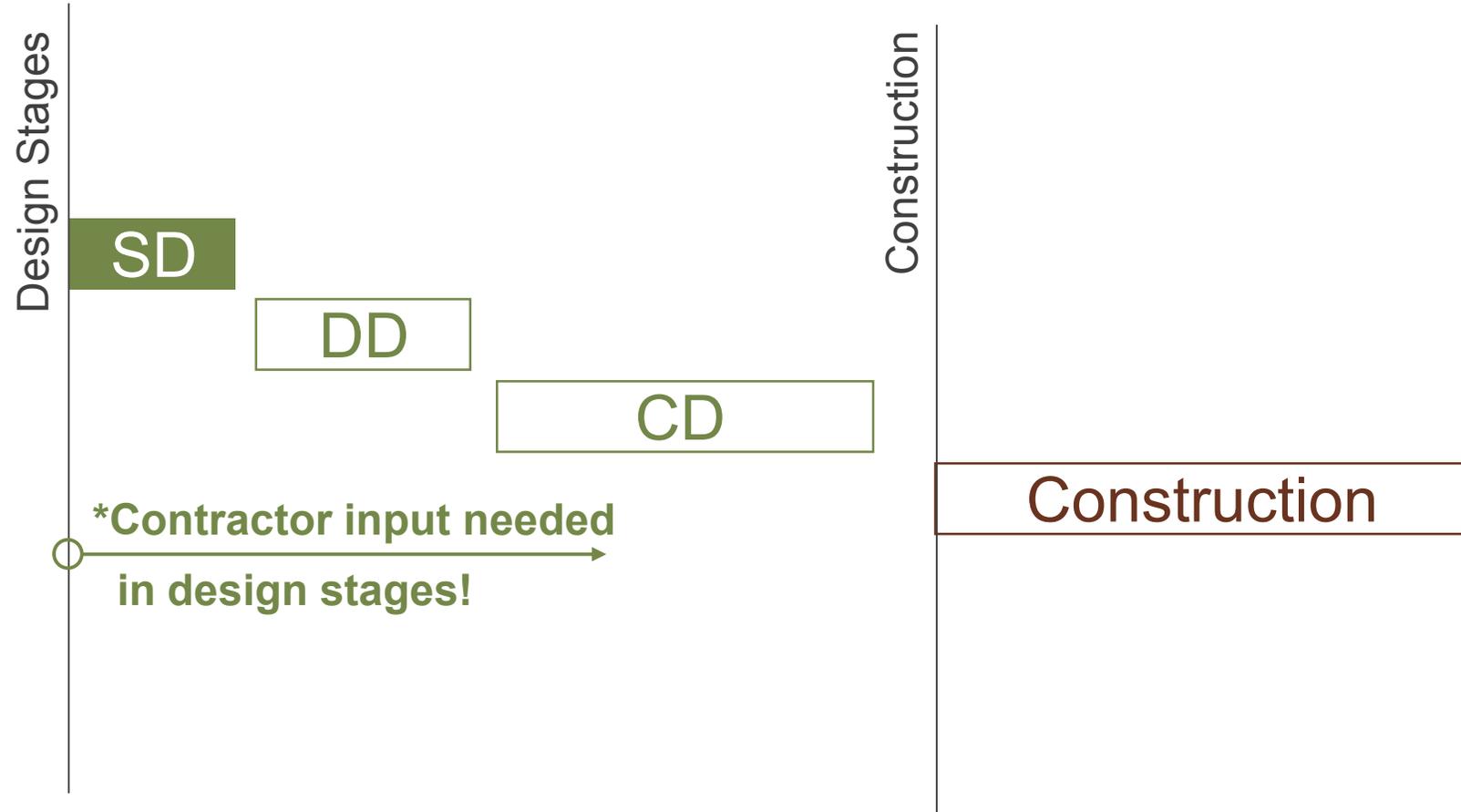
Image: Google | Lendlease  
HayesDavidson for BIG & Heatherwick Studios

# Schematic Design (SD) Phase

## Prefabricated Mass Timber

- Structural & MEP require more detailed input from engineers and builders
- Estimating: Not enough data for unit cost method; more detailed approaches req'd

Publicly-funded projects to be competitively bid, make the “go/no go” decision on mass timber by end of SD.



# Mass Timber Cost & Design Optimization Checklists

## Schematic Design

### SD Design Optimization Checklist:

- Material Optimization/ Grids
- System Coordination
  - Structural
  - Acoustics/ Vibration
  - Fire Resistance
- Finish Quality

### SD Cost Optimization Checklist:

- Schedule Savings = Cost Savings
- Aesthetic Value
- Less Weight = Cost Savings
- Fabrication
- Shipping/ Trucking
- Installation & Labor

# Design Phases

## Schematic Design (SD)

- Select lateral system in SD!!
  - Compatibility w/ fast speed of mass timber
- Responsibility
  - design engineer
  - fabrication
- Installation
  - GC self install?
  - Subcontractor?



# Largest Mass Timber Building in the US: Southeast (not PNW)

## T3 West Midtown, Atlanta



Photo: StructureCraft

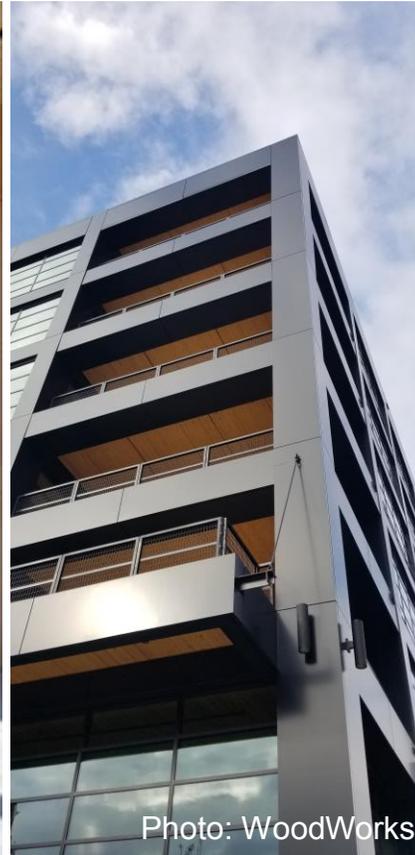


Photo: WoodWorks

### IV (HT)

- 6 stories Type IV over podium
- 205,000 sf
- DLT floors, glulam frame

Location: Atlanta, GA

Architect: Hartshorne Plunkard Architects + DLR Group

Structural Engineer: Magnusson Klemencic Associates

Mass Timber Engineer: StructureCraft

# Largest Mass Timber Building in the US: Southeast (not PNW)

## T3 West Midtown, Atlanta



Photos: WoodWorks



Stair Shaft

### IV (HT)

- T3 Atlanta replaces concrete with steel braced-frame lateral system to keep up with **fast speed of mass timber erection**
- Timber exposed in stair shaft

Location: Atlanta, GA

Architect: Hartshorne Plunkard Architects + DLR Group

Structural Engineer: Magnusson Klemencic Associates

Mass Timber Engineer: StructureCraft



T3 Atlanta | Photos: WoodWorks

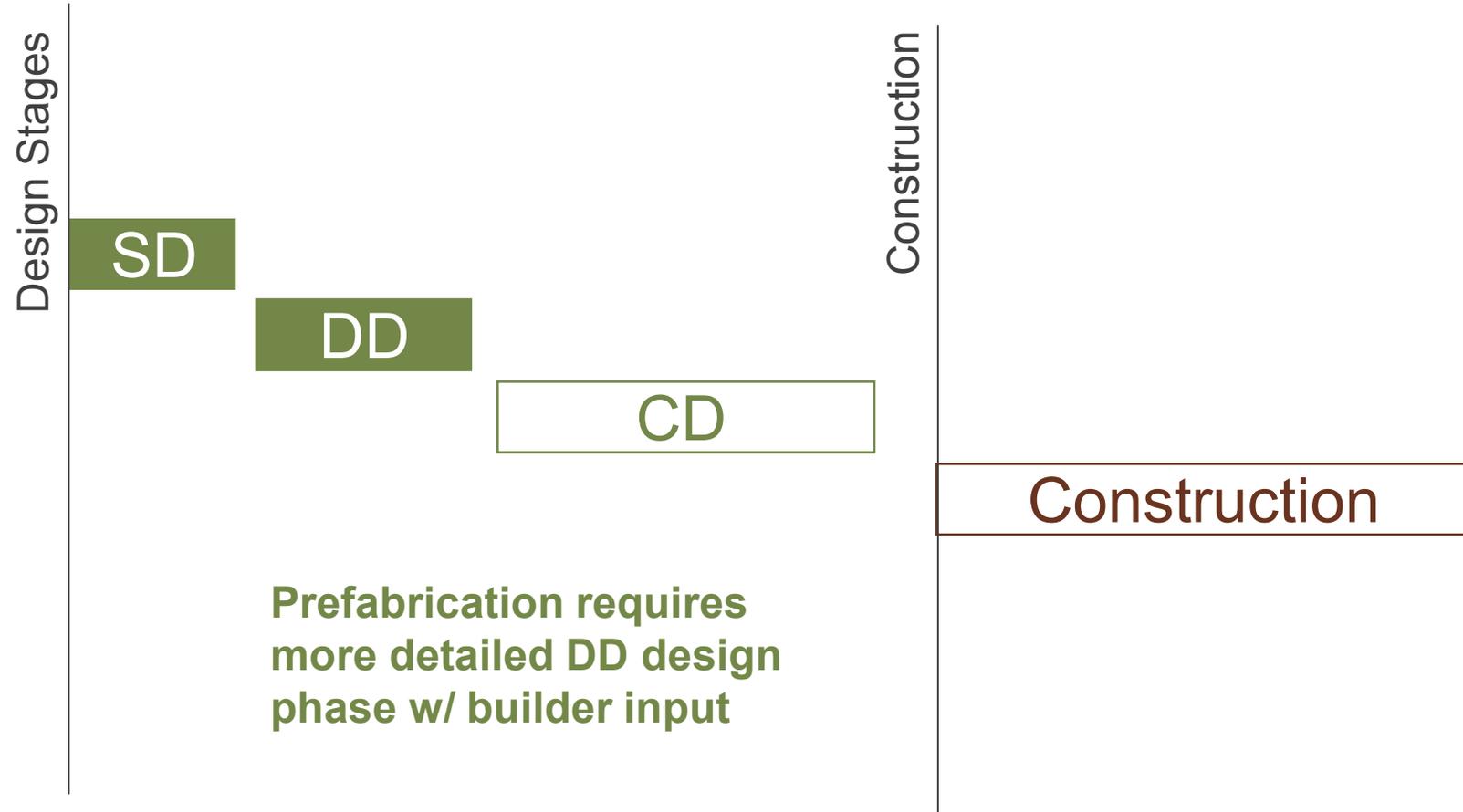


# Design Development (DD) Phase

## Prefabricated Mass Timber

- Structural & MEP require more detailed designs from engineers and builders
- More Key Details need to be developed

Publicly-funded projects to be competitively bid, early bid the mass timber supplier at end of DD or by 50% CD at latest



# Mass Timber Cost & Design Optimization Checklists

## Design Development

### DD Design Optimization Checklist:

- ✓ Material Optimization/ Grids
- ✓ Hybrid Considerations
- ✓ System Coordination
- ✓ Fire Resistance
- ✓ MEP Systems
- ✓ Finish Quality
- ✓ Key Details

### DD Cost Optimization Checklist:

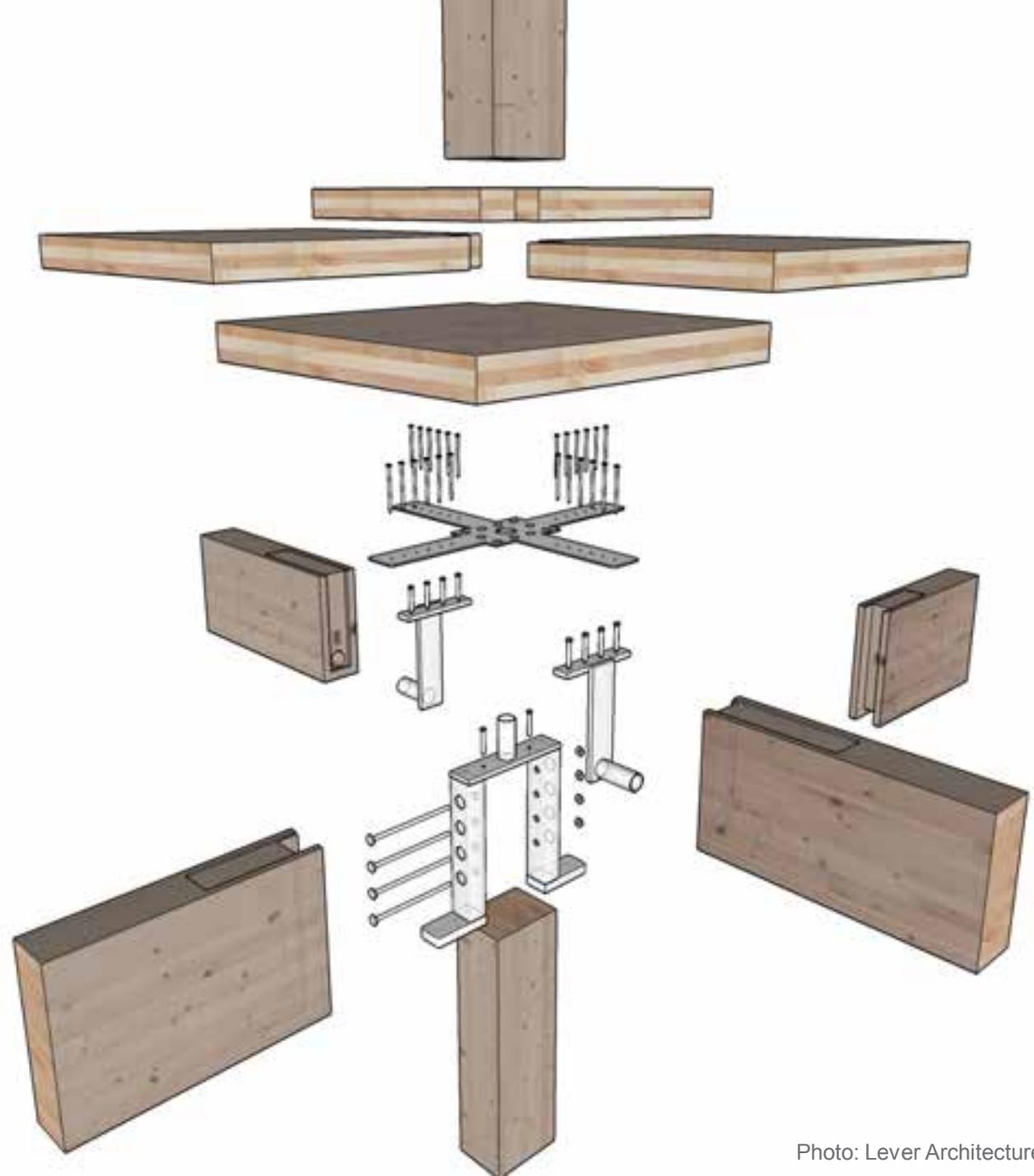
- ✓ Less Weight = Cost Savings
- ✓ Schedule Savings = Cost Savings
- ✓ Cost & Value
- ✓ Fabrication
- ✓ Installation & Labor
- ✓ Protection

# Digital Fabrication

## Design Development (DD)

- Prefabricated panels
- Coordinate all MEP & fire protection penetrations
- Tolerances for wood tighter than steel, conc, & other materials
- Structural connections
- Schedule steel shops so they don't delay mass timber fabrication
- Plan now to reduce on-site labor





# Austin's 1<sup>st</sup> CLT Office: Built to Attract Millennial Talent

901 E 6<sup>th</sup> Street



Photo: Structurlam



## IIIA

- 5 Story
- 129,000 sf
- CLT & steel frame **hybrid**
- 14-ft Floor to ceiling heights w/ 9' windows
- “Leasing broker feedback... **CLT helped generate interest**, assisted in **faster leasing** and helped support **higher lease rates**.”<sup>9</sup>

Location: Austin, TX

Architect: Thoughtbarn / Delineate Studio

Engineer: LEAP! Structures

# Moisture Management

## Keep Wood Dry & Schedule on Track

- Just-in-time delivery, no storage - wood installed directly from trucks
  - Protect connections/ connectors
  - Moisture management plan
-  Reuse panel wraps for covering wood end grains & connections

**Construction Phase Moisture Management,  
Section 7.6 NLT Guide (Good Tips for all MT)**

**Download:**

<https://www.thinkwood.com/products-and-systems/mass-timber/nltguide>

<https://info.thinkwood.com/nlt-design-and-construction-guide-u.s.-version-think-wood-0>

PROTECTION LEVEL



# Moisture Management

## Keep Wood Dry & Schedule on Track

- Mass timber & light frame
- Design & Construction Moisture Mgmt Checklists in Appendix I & II
- Categorizes material
  - by wetting & drying potential
  - for on-site protection strategies

Moisture Management Guide

**Download:**

[https://www.bchousing.org/publications/  
Wood-Construction-Moisture-  
Management-Guide.pdf](https://www.bchousing.org/publications/Wood-Construction-Moisture-Management-Guide.pdf)

<https://www.bchousing.org/publications/Wood-Construction-Moisture-Management-Guide.pdf>



# Finish Quality: Exposed Structure

## Protect the Investment

- Industrial grade appearance, save \$
- Surface coatings
- Temporary Protection
  - Moisture
  - Construction trades



Photo: Christian Columbres

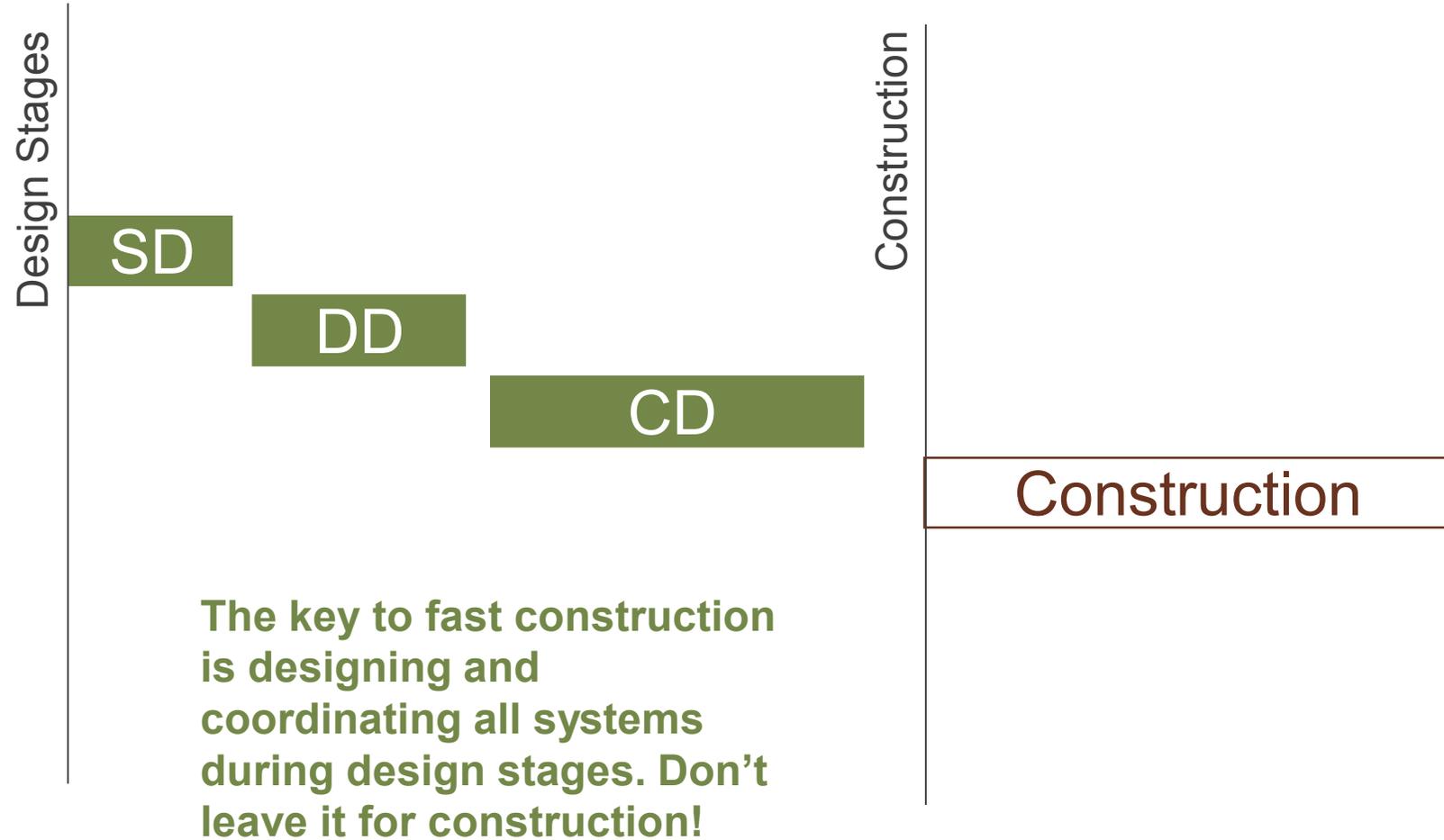


The Hudson | Vancouver, WA | Mackenzie | Turner Construction

# Construction Document (CD) Phase

## Prefabricated Mass Timber

- Everything is in 3D Model: Structural, MEP, & Fire Protection
- Pay extra attention to material systems interaction: timber to concrete to steel including tolerances, timing of shop drawings & responsibility



# Mass Timber Provides Market Differentiation in San Antonio

## The Soto



Image: Lake Flato/ BOKAPowell

### IIIA

- 5 Stories wood over podium
- 150,000 sf
- 20' x 30' typical grid  
20'x15' at perimeter
- DLT panels, glulam frame
- Raised floor w/ underfloor air distribution

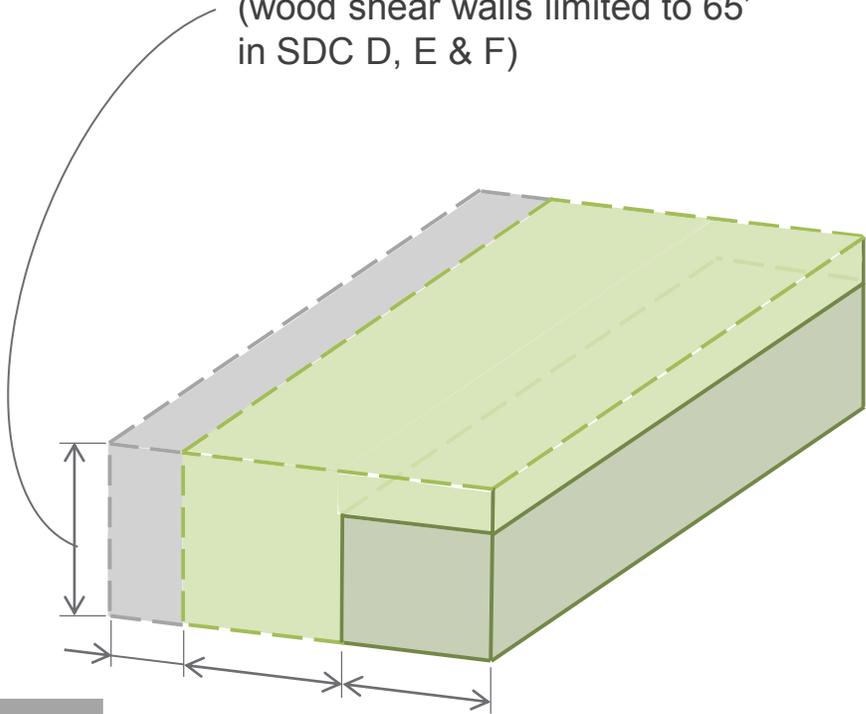
Location: San Antonio, TX  
Architect: Lake Flato / BOKAPowell  
Structural Engineer: Danysh & Associates  
Mass Timber Engineer: StructureCraft

# You Don't Have to Start Tall! Wood Allows for Sizeable Buildings

Heights & Areas: 2015 IBC up to 6 Stories (Not incl. new tall wood provisions)

3-4 Stories, 60-75 ft Tall

(wood shear walls limited to 65' in SDC D, E & F)



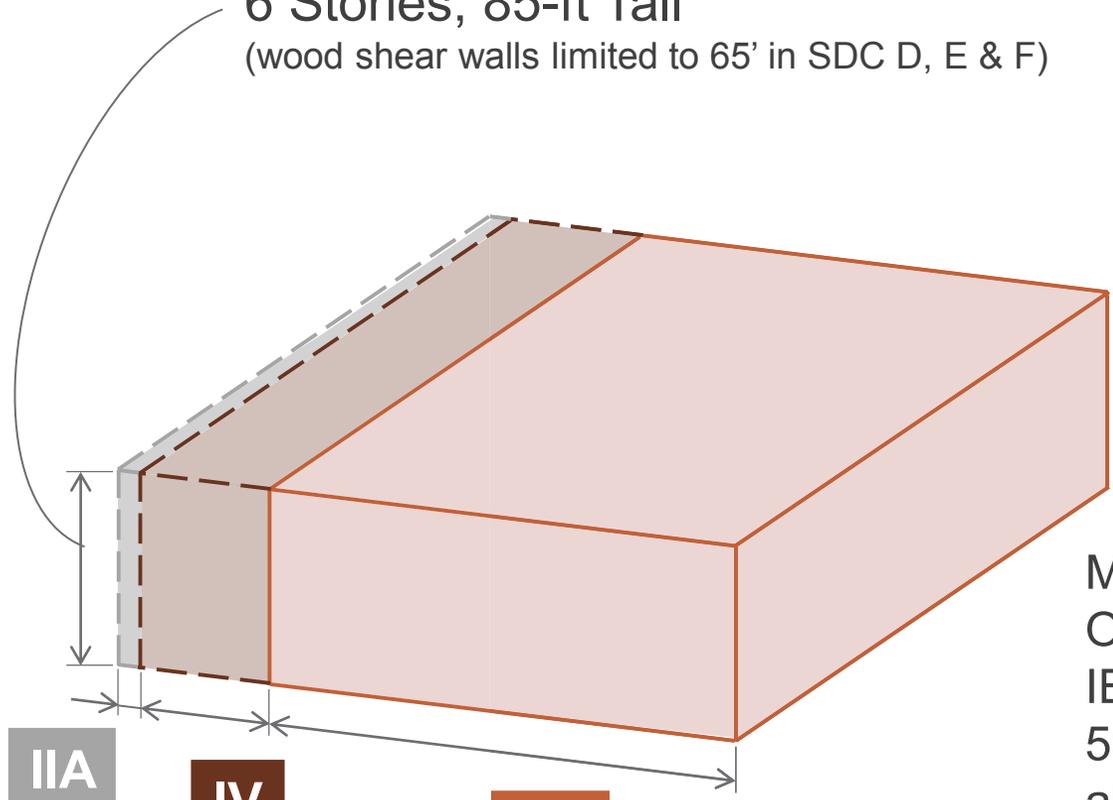
**IIB**  
24% more

**IIIB**  
**VA**  
162,000 sf

**VB**  
81,000 sf

6 Stories, 85-ft Tall

(wood shear walls limited to 65' in SDC D, E & F)



**IIA**  
4% more

**IV**  
324,000 sf

**IIIA**  
256,000 sf

Multi-story Business  
Occupancy (B)  
IBC 2015/ 2018 Tables  
504.3, 504.4, 506.2 w/  
allowable increases

Assumptions:

- <sup>1</sup> NFPA 13 sprinkler increase (IBC 504.2)
- <sup>2</sup> NFPA 13 sprinkler increase (IBC 506.3)
- <sup>3</sup> Stories 3 or more (IBC 506.4)

# Heavy Timber Revolution: California's Hip New Commercial Block ICE Block I



Location: Sacramento, CA  
Architect: RMW Architecture & Interiors  
Engineer: Buehler Engineering

## III B

- 3 Story heavy timber over podium
- 87,460 sf
- Traditional heavy timber
- Aesthetic value is same for heavy & mass timber
- **Consider traditional timber approaches! Innovative mass timber is not the only option.**

# Heavy Timber Revolution: California's Hip New Commercial Block ICE Block I



Photo: Bernard Andre

Location: Sacramento, CA  
Architect: RMW Architecture & Interiors  
Engineer: Buehler Engineering

## III B

- 20' x 24' grid
- 3x T&G decking
- Beam depths minimized cantilevered beams over columns w/ offset connection
- Exposed connectors

“The **building sold itself** because of its unique character. There really was no true competition in the market. **A lot of the credit goes to the fact that it is a timber building.**”

– Mike Heller, Heller Pacific



Office

Wythe Ave Buildings, NY | Flank Architecture + Development



Hospitality

Lark Hotel, Bozeman | Thinktank Design | Photo: Dan Armstrong



Multi-family

Carbon 12, Portland | Path Architecture | Photo: Andrew Pogue



Industrial

StructureCraft Plant, Abbotsford, BC

# Reduce Risk

## Optimize Costs

- For the entire project team, not just builders
- Lots of reference documents

## Mass Timber Cost and Design Optimization Checklists

WoodWorks has developed the following checklists to assist in the design and cost optimization of mass timber projects.

The *design optimization* checklists are intended for building designers (architects and engineers), but many of the topics should also be discussed with the fabricators and builders. The *cost optimization* checklists will help guide coordination between designers and builders (general contractors, construction managers, estimators, fabricators, installers, etc.) as they are estimating and making cost-related decisions on a mass timber project.

Most resources listed in this paper can be found on the WoodWorks website. Please see the end notes for URLs.

**First Tech Federal Credit Union** -  
Windsor, CO  
ARCHITECT  
Hickel  
STRUCTURE  
Essner Gorman & Associates  
Equilibrium Consulting  
CONTRACTOR  
Zimmerman



**Download Checklists at**  
[www.woodworks.org](http://www.woodworks.org)

[www.woodworks.org/wp-content/uploads/wood\\_solution\\_paper-Mass-Timber-Design-Cost-Optimization-Checklists.pdf](http://www.woodworks.org/wp-content/uploads/wood_solution_paper-Mass-Timber-Design-Cost-Optimization-Checklists.pdf)

# ULI Article: Mass Timber's Expanding Presence in the Commercial Building Industry

**URBANLAND**

INDUSTRY SECTORS | CAPITAL MARKETS | DEVELOPMENT | INSIDE ULI | SUSTAINABILITY | TRENDS | ULI MEETING RECAPS | ASIA PACIFIC

Urban Land > Market Trends > Mass Timber's Expanding Presence in the Commercial Building Industry

<https://urbanland.uli.org/sustainability/mass-timbers-expanding-presence-in-the-commercial-building-industry/>

## Mass Timber's Expanding Presence in the Commercial Building Industry

By Beth Mattison-Teig  
January 23, 2020

Text Size: **A A A**  
[Print](#) [Email](#) [Share](#) [Facebook](#) [LinkedIn](#) [Twitter](#)



The four-story, 110,000-square-foot (10,000 sq m) ICE Block project in Sacramento was one of the first contemporary, timber-framed mid-rise structures in Northern California. (Miller Pacific/RMW architecture & interiors/Bernard Andre)

Developers around the world who were first movers on buildings that use mass timber for both structural and design elements are seeing a growing wave of projects lining up before them. The regulatory environment is adapting while the business model for use of mass timber is expanding across property types.



A 9-story LendLease coworking space in Brisbane at 25 King Street



An exterior image of Carbon 12 in Portland, Oregon.

# Questions?

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# Sources & Works Cited

1. Tall With Timber: A Seattle Mass Timber Tower Case Study by DLR Group: [www.fastep.com/wp-content/uploads/181109-Seattle-Mass-Timber-Tower-Book.pdf](http://www.fastep.com/wp-content/uploads/181109-Seattle-Mass-Timber-Tower-Book.pdf)
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