



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

www.woodworks.org/wp-content/uploads/wood_solution_paper-Mass-Timber-Design-Cost-Optimization-Checklists.pdf

Contractual Considerations

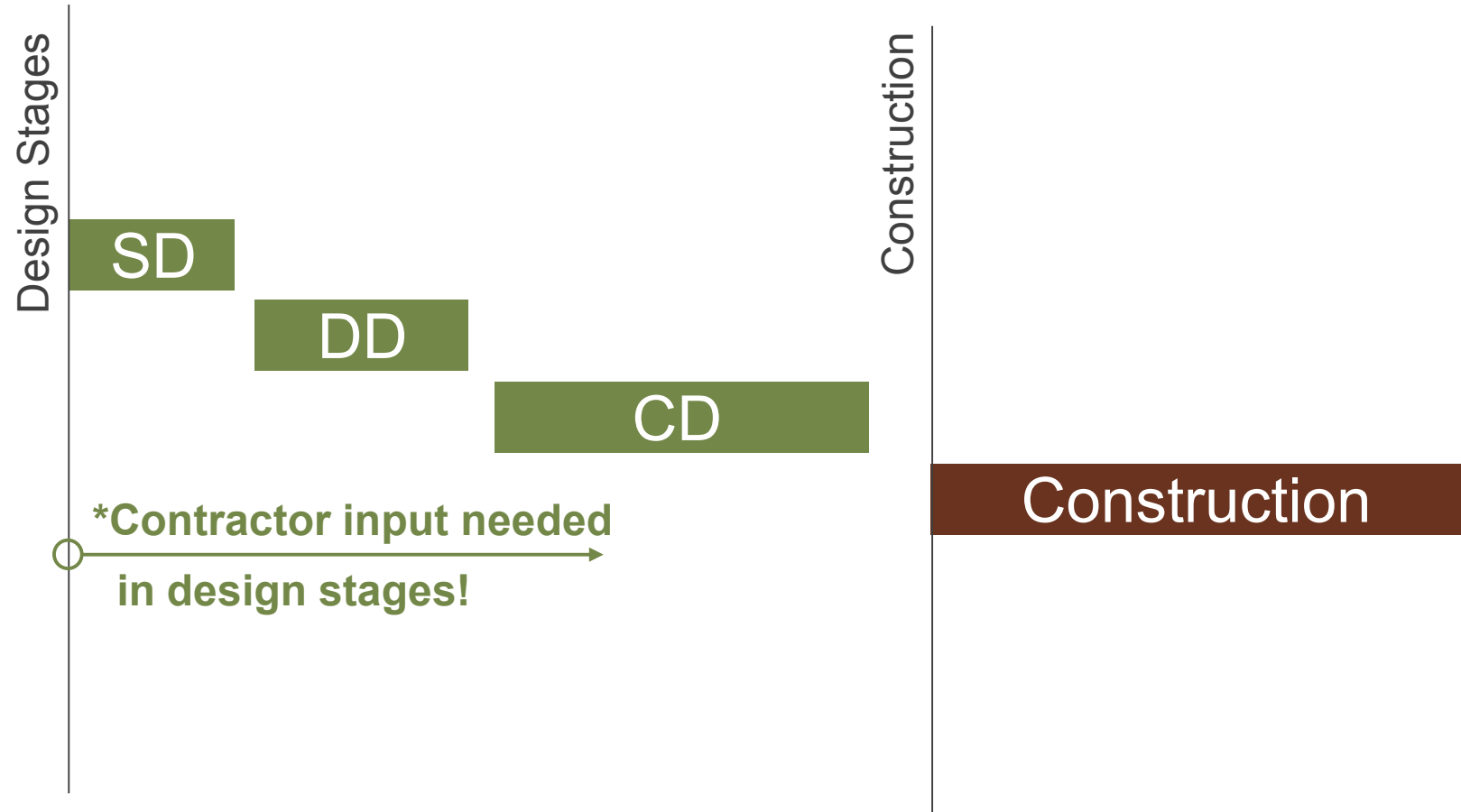
Prefabricated Approach

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 <ul style="list-style-type: none">• 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 McInnis, Colliers¹

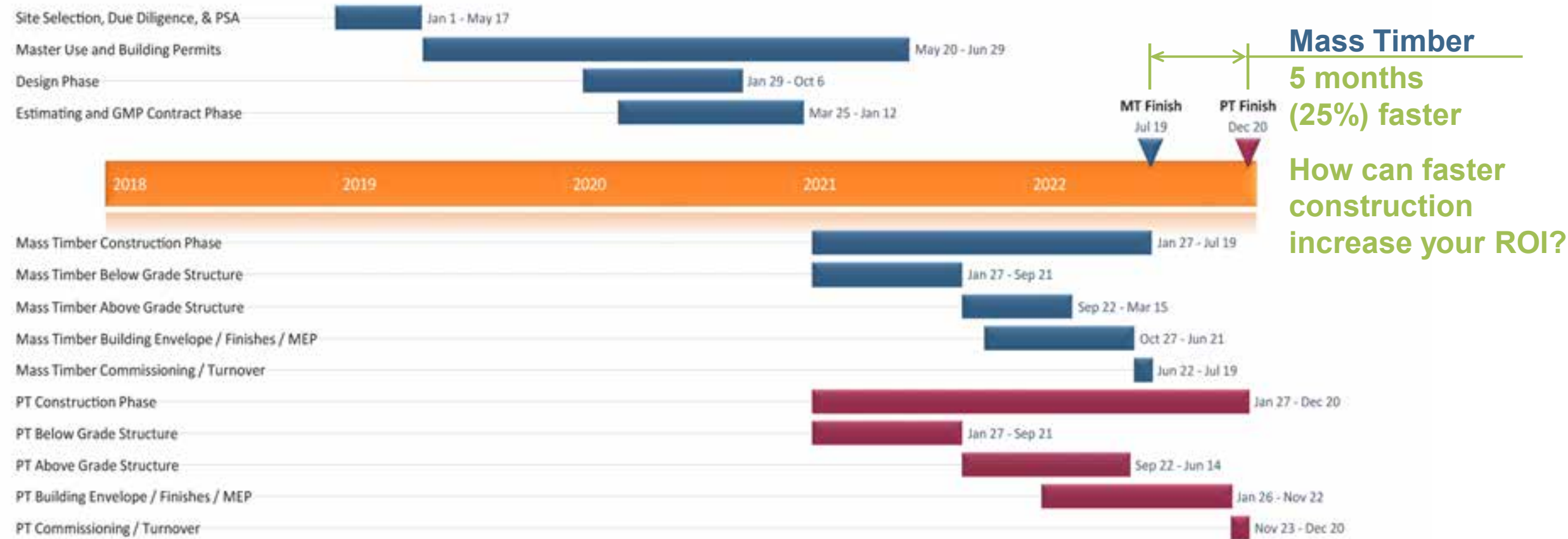
Download Case Study:

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

Seattle Mass Timber Tower

Fast Construction

Construction Schedule:



Seattle Mass Timber Tower

Faster Construction + Higher Material Costs = Cost Competitive

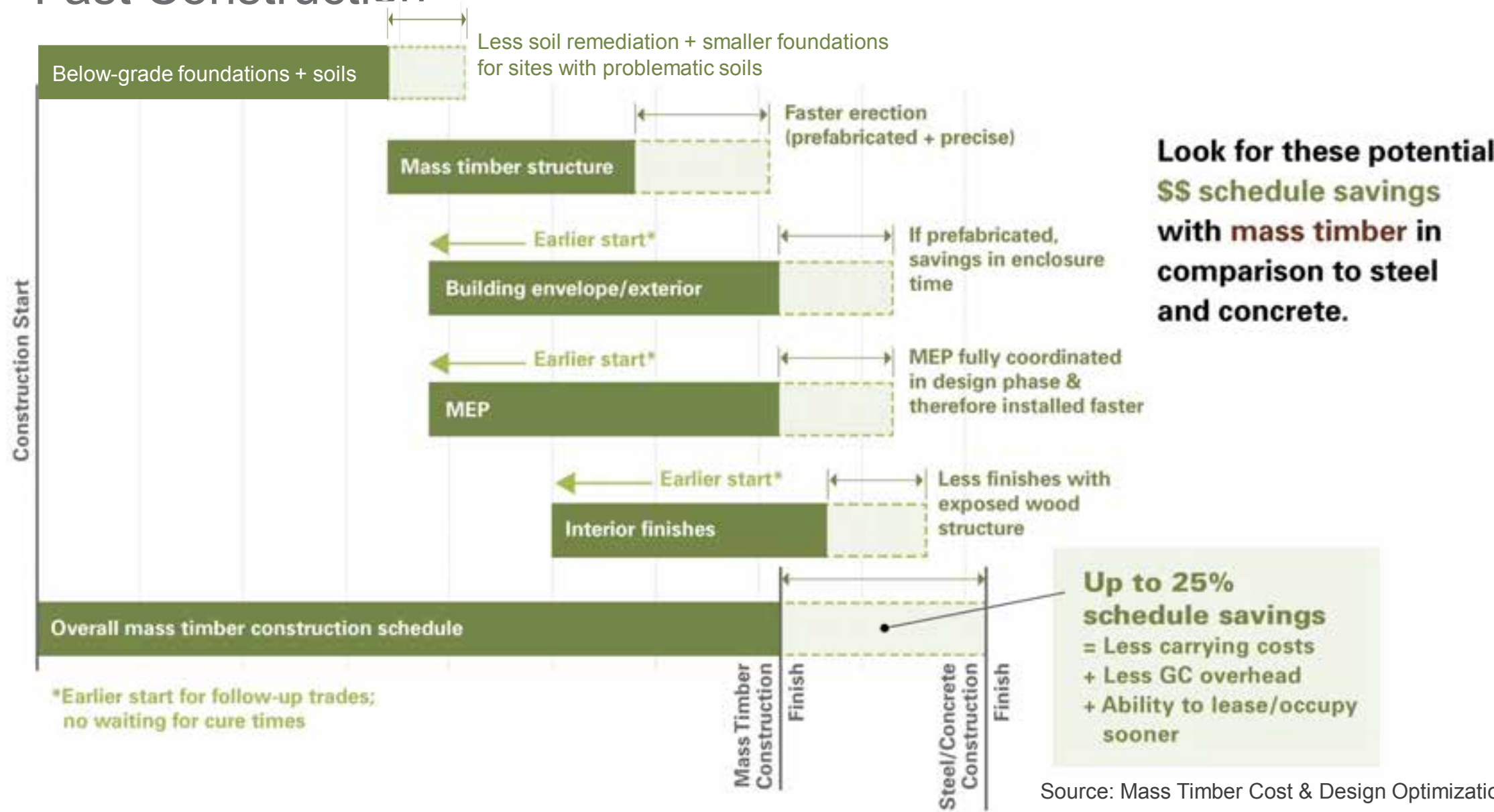
System	Mass Timber Design	PT Concrete Design	Mass Timber Savings
Direct Cost of Work	\$86,997,136	\$85,105,091	2.2%
Project Overhead	\$ 9,393,750	\$11,768,750	-20.2%
Add-Ons	\$ 8,387,345	\$ 8,429,368	-0.5%
Total	\$104,778,231	\$105,303,209	-0.5%



Source: DLR Group | Fast + Epp | Swinerton Builders

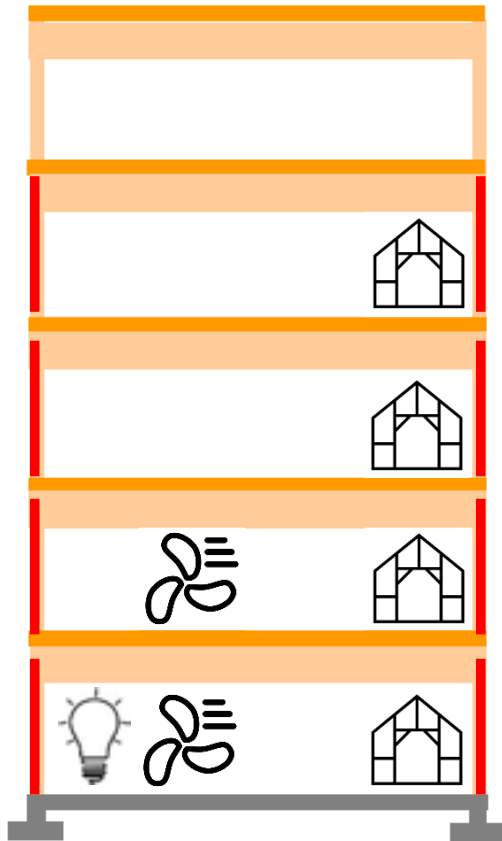
Compressing the Typical Schedule

Fast Construction

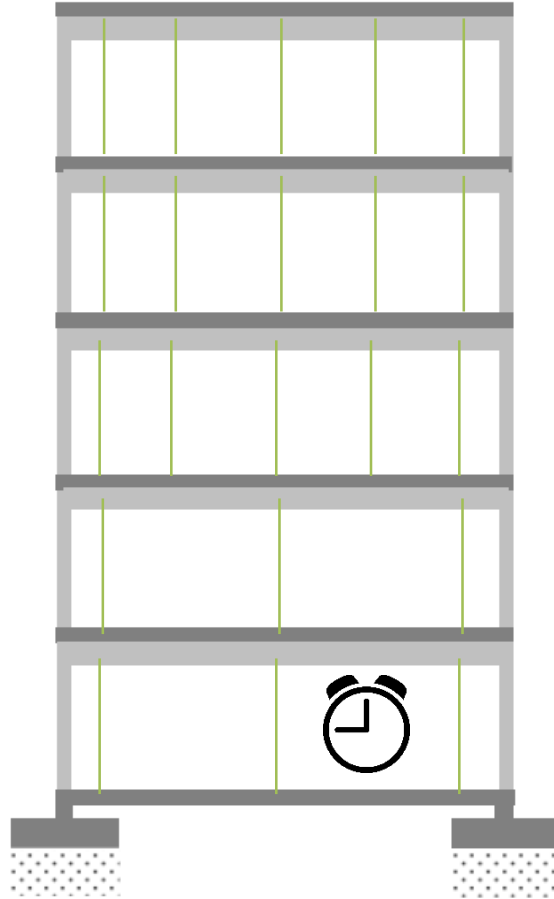


Schedule Savings for Rough-In Trades

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>(Swinerton⁸)</i>	5	150,000 sf	Office	12 weeks	14 months
Candlewood Suites at Redstone Arsenal <i>(Lendlease⁹)</i>	4	62,700 sf	Military hotel	16 weeks	12 months
Seattle Mass Timber Tower <i>(DLR Group hypothetical case study¹⁰)</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 overall²
- 40% fewer construction workers²
- 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.”



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 cost³ (2016 completion)
 - **\$87 million** purchase price (May 2018 sold to LaSalle)⁴

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 conc⁵

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





55 Southbank: Add Vertical Density over Existing Bldgs

Lightweight



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 = deal⁶
- Research shows $\frac{1}{4}$ of urban buildings in the world are strong enough to carry additional floors of wood⁷
- 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
- 1st spec office in Des Moines in over a decade⁸
- 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



IIIB

- 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

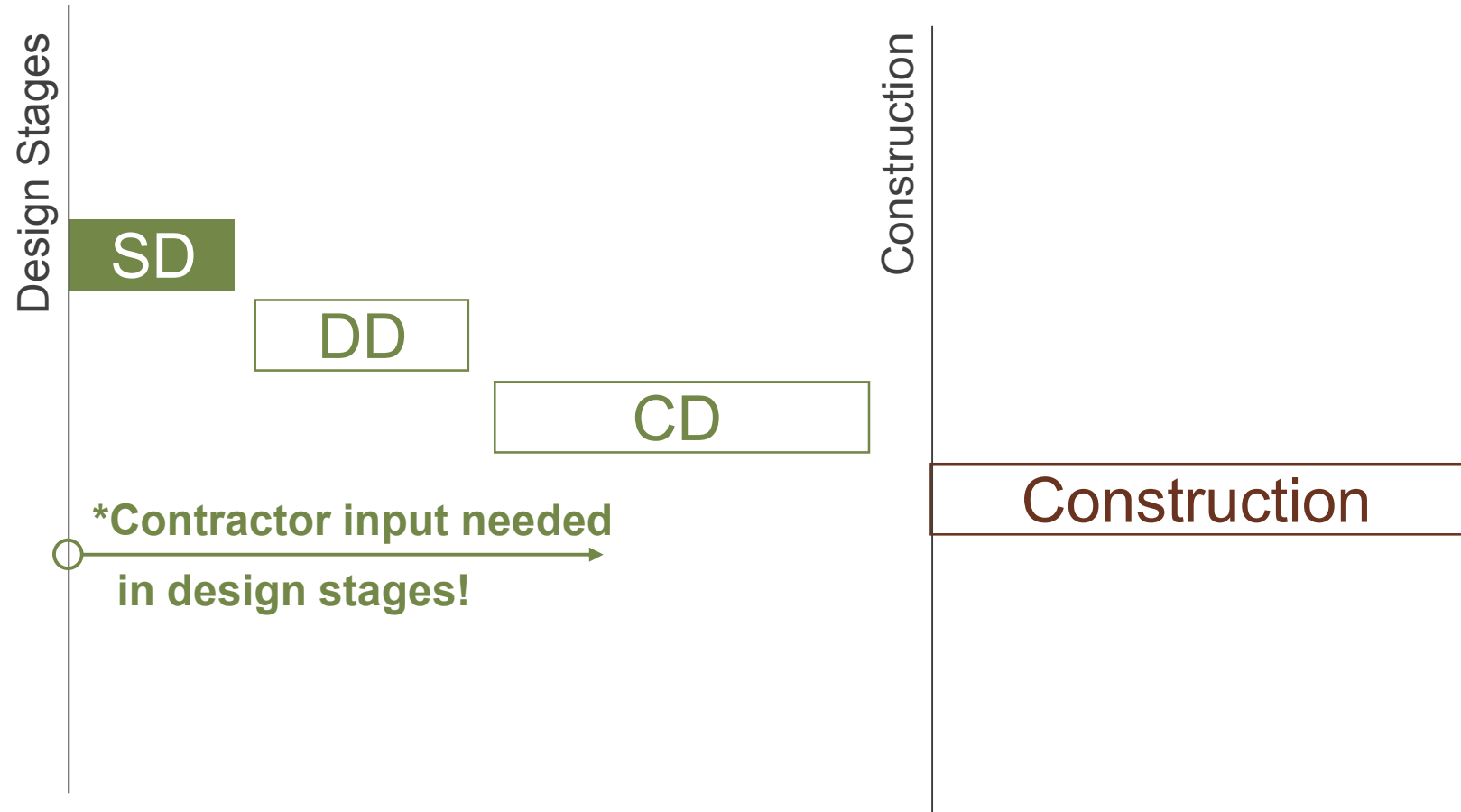
Image: Google | Lendlease
HayesDavidson for BIG & Heatherwick Studios

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

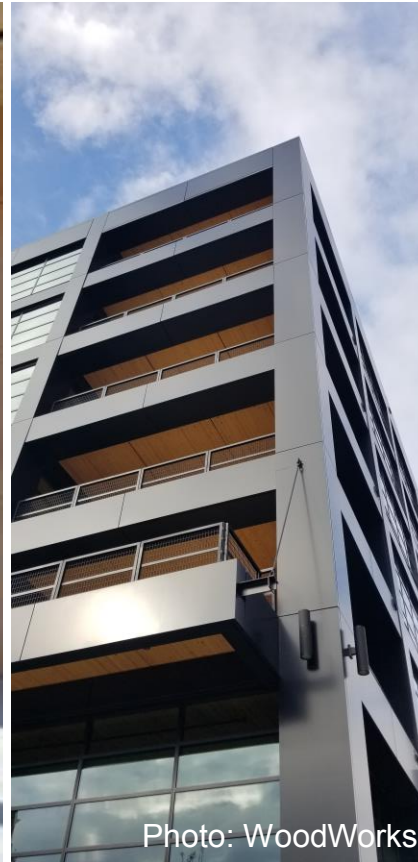


Photo: WoodWorks

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

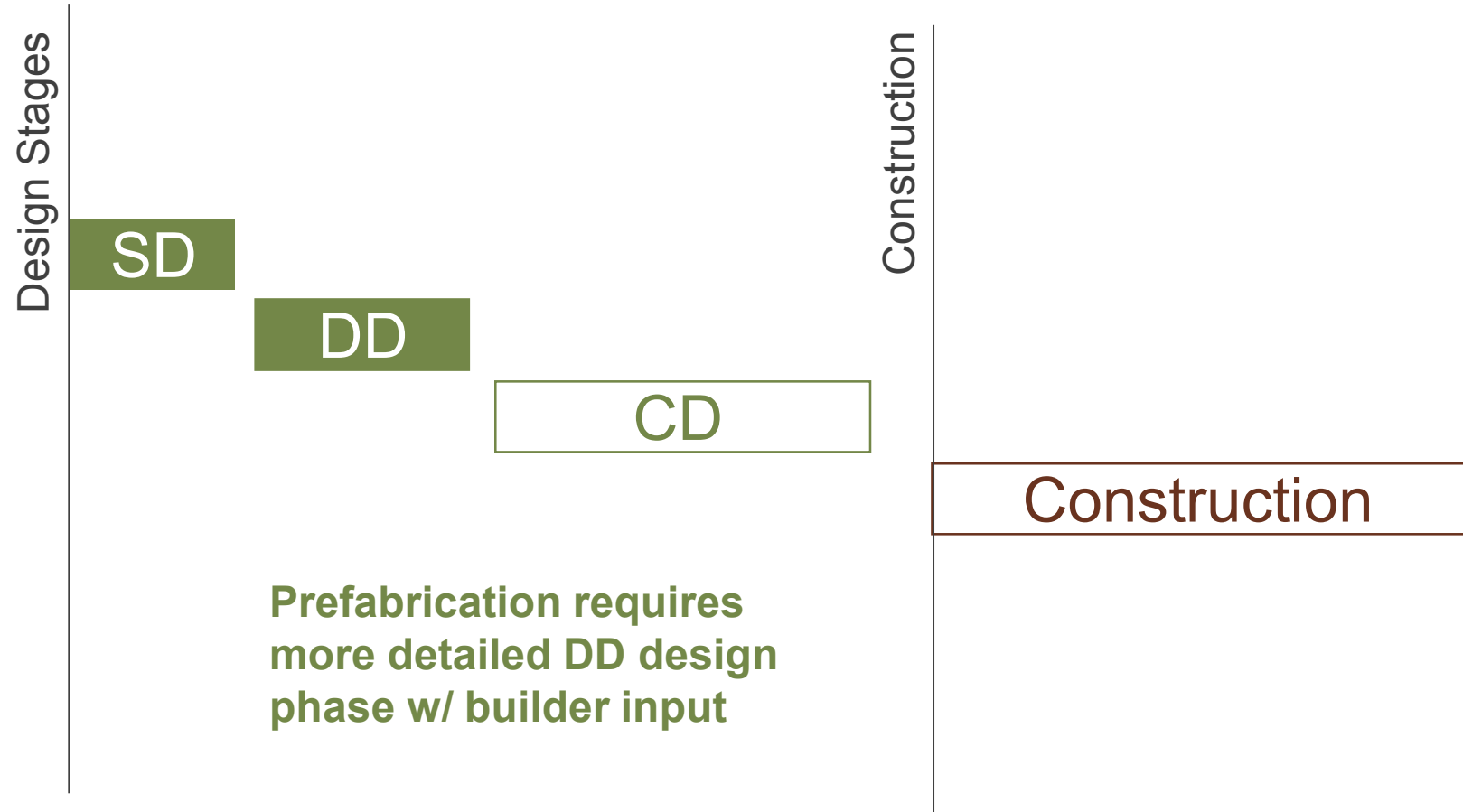


Design Development (DD) Phase

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:

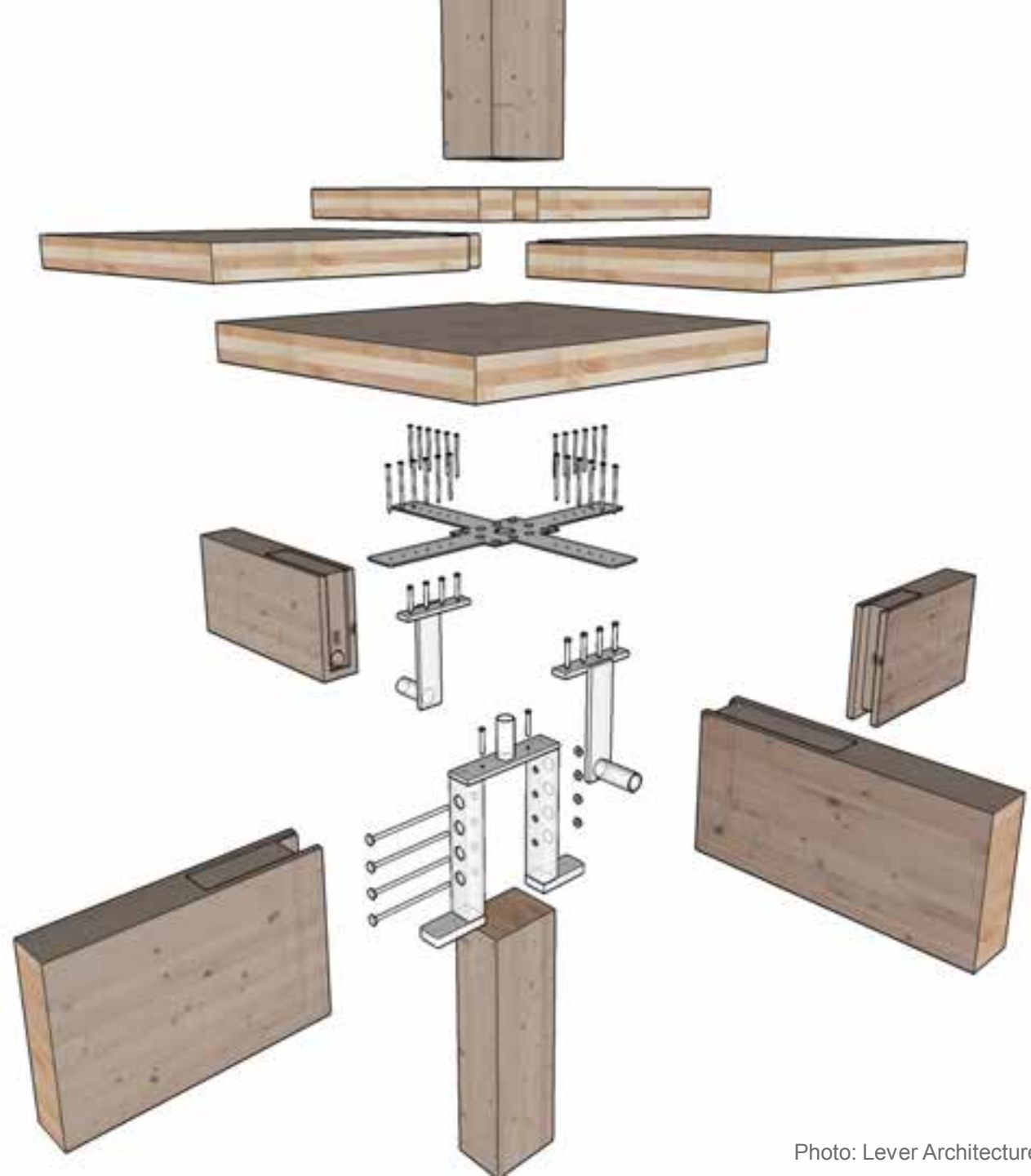
- ✓ Less Weight = Cost Savings
- ✓ Schedule Savings = Cost Savings
- ✓ Cost & Value
- ✓ Fabrication
- ✓ Installation & Labor
- ✓ Protection

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 1st CLT Office: Built to Attract Millennial Talent

901 E 6th 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**."9


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>



Remove Snow ASAP

Photo: Lendlease



Panels protected until needed

Photo: Alex Schreyer

Finish Quality: Exposed Structure

Protect the Investment

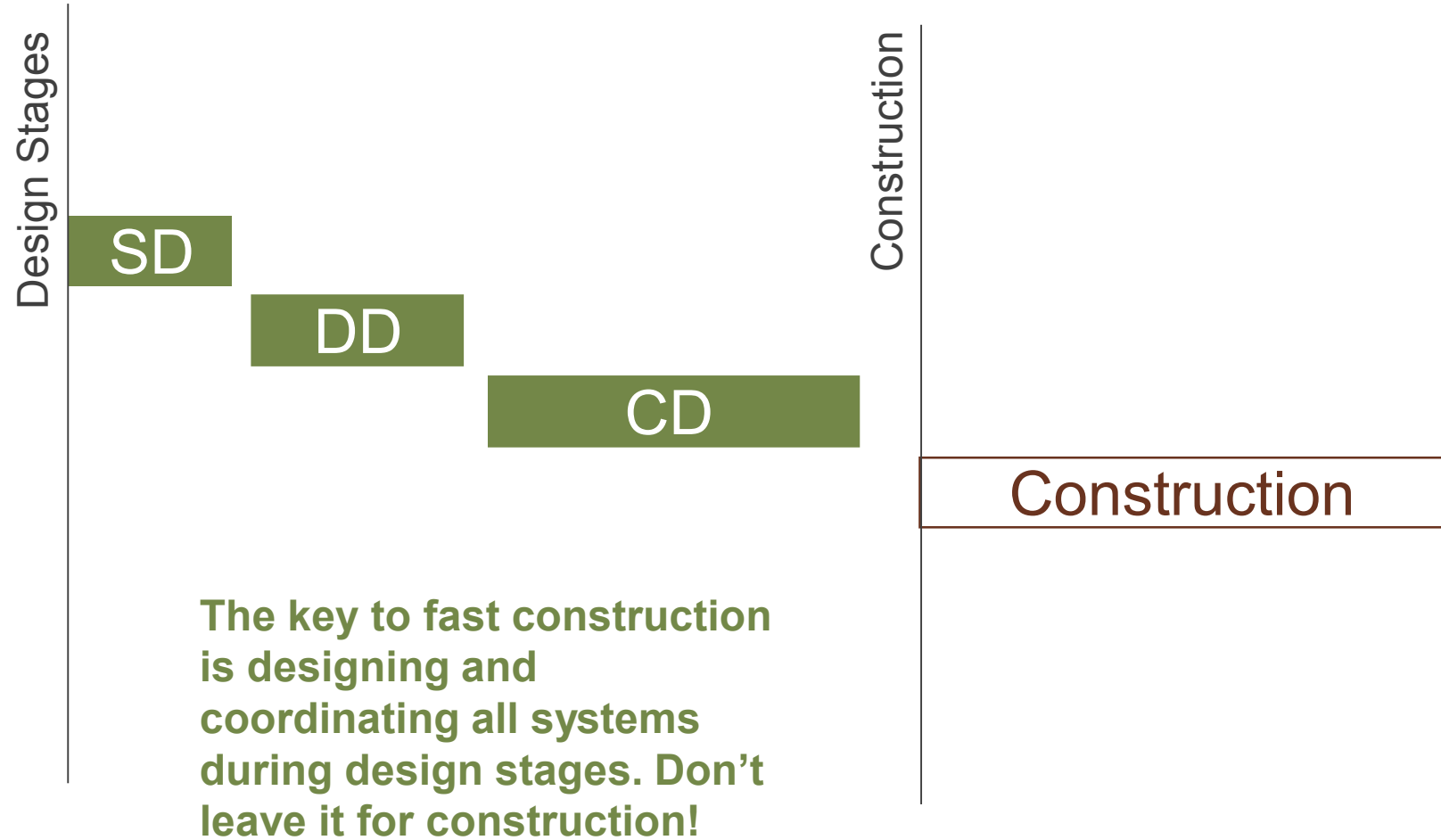
- Industrial grade appearance, save \$
- Surface coatings
- Temporary Protection
 - Moisture
 - Construction trades



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

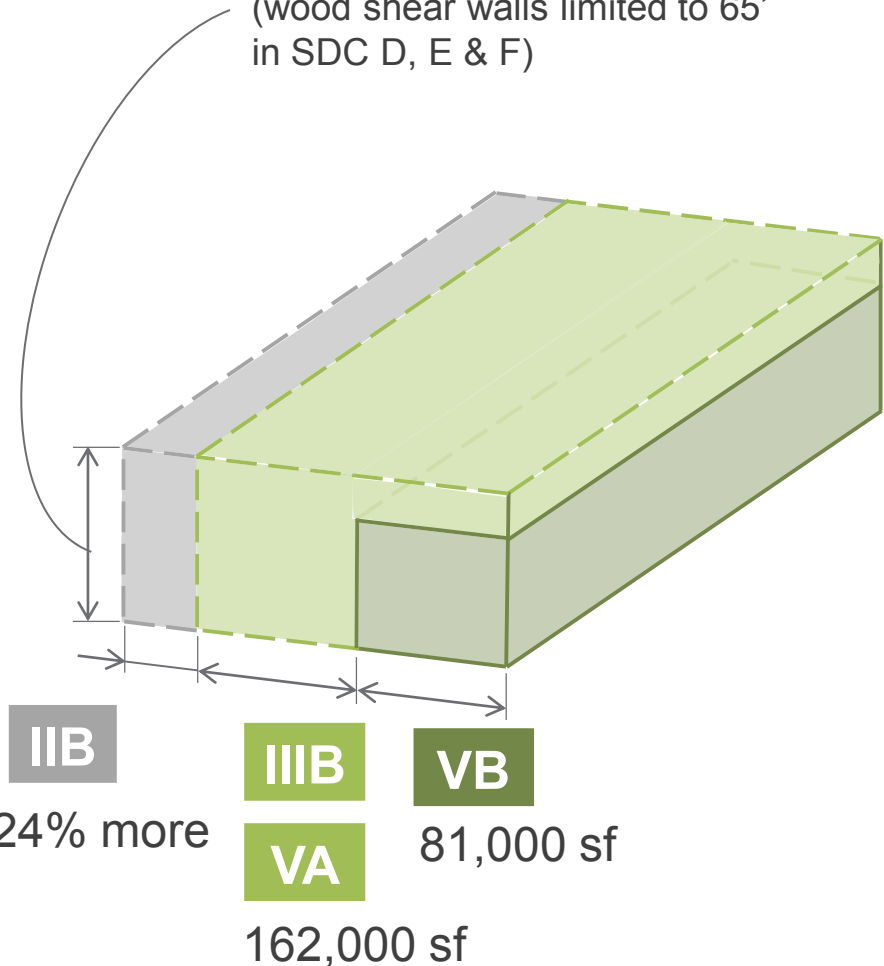
- 5 Stories wood over podium
- 150,000 sf
- 20' x 30' typical grid
20'x15' at perimeter
- DLT panels, glulam frame
- Raised floor w/ underfloor air distribution

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

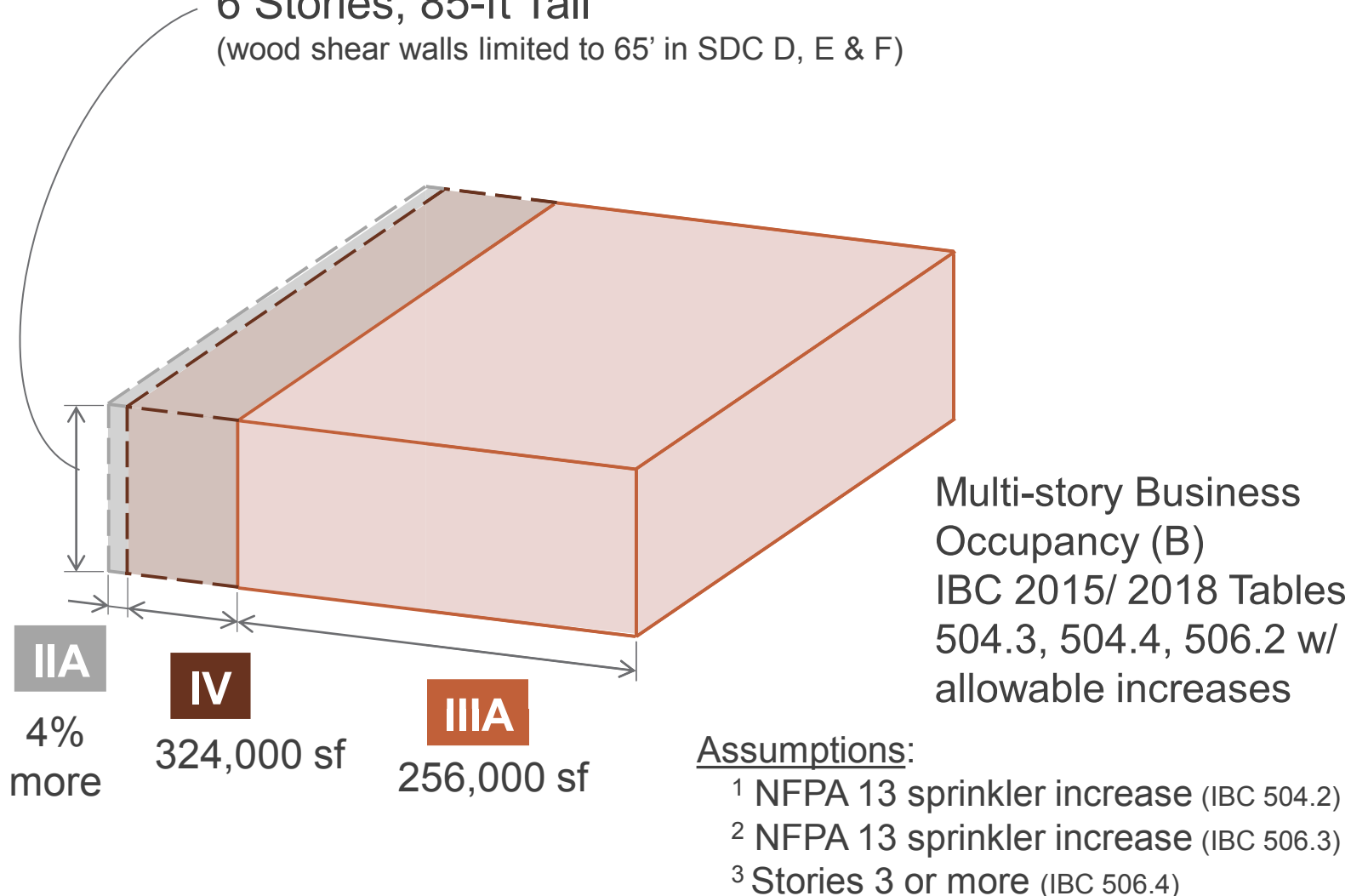
You Don't Have to Start Tall! Wood Allows for Sizeable Buildings

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)



6 Stories, 85-ft Tall
(wood shear walls limited to 65' in SDC D, E & F)



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

IIIB

- 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

IIIB

- 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 -
Indianapolis, IN
ARCHITECT
Hickok
ENGINEERING
Expert Design & Associates
Equilibrium Consulting
CONTRACTOR
Quinn



Download Checklists at
www.woodworks.org

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

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



Urban Land > Market Trends > Mass Timber's 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

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The four-story, 110,000-square-foot (10,000 sq m) ICE Block I project in Sacramento was one of the first contemporary, timber-framed mid-rise structures in Northern California. (Heller 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

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2. WoodWorks Case Study – *Mass Timber Cost & Design Optimization*: www.woodworks.org/wp-content/uploads/wood_solution_paper-Mass-Timber-Design-Cost-Optimization-Checklists.pdf
3. *Finance & Commerce* - Top Projects of 2016: T3: <https://finance-commerce.com/2017/07/top-projects-of-2016-series-t3/>
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8. *Des Moines Register* - This new East Village building is the first of its kind in the United States: <https://www.desmoinesregister.com/story/money/business/development/2019/05/09/des-moines-iowa-ia-development-east-village-111-east-grand-office-building-mass-timber-eco-friendly/1154222001/>
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