



Mass Timber Construction Management:

Economics, Logistics & Risk Analysis

Presented by
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WoodWorks Regional Director



➤ Special Thanks: MassTimber@MSU

<https://www.canr.msu.edu/masstimber/>

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Questions related to specific materials, methods, and services will be addressed at the conclusion of this presentation.



Course Description

How do contractors answer the ever-growing demand from architects and ownership groups for mass timber buildings? The growth of this budding industry can be slowed by a lack of will and lack of know-how among seasoned construction professionals who know how to build, understand the onus of “architectural intent,” and must ultimately take on financial responsibility to deliver the dream of a new building system. This presentation will introduce mass timber products and building systems and then consider why some mass timber projects die at concept, what leads to the resistance, and how the development, architectural, engineering, and construction community can overcome assumptions to achieve success with mass timber projects of various scales and typologies. Particular emphasis will be given to preconstruction coordination, holistic approaches to costing and scheduling studies, project delivery methods, and how to achieve the highest level of cost efficiency.

Learning Objectives

1. Understand the preconstruction manager's role in material procurement and MEP coordination of code-compliant mass timber projects.
2. Highlight effective methods of early design-phase cost estimation that keeps mass timber options on the table.
3. Discuss potential construction schedule savings realized through the use of prefabricated mass timber elements.
4. Explore best practices for interaction between manufacturer, design team and preconstruction manager that can lead to cost efficiency and safety on site.

PRESENTATION OUTLINE

1. MASS TIMBER OVERVIEW

- Structural Solutions
- Connections
- Projects
- Products

2. CONSTRUCTION MANAGEMENT

- Risk Analysis (Risks & Solutions)
- Economics (What does it cost?)
- Logistics (Schedule & Coordination)

MASS TIMBER OVERVIEW



OVERVIEW | TIMBER METHODOLOGIES



Heavy Timber
Photo: Benjamin Benschneider



Mass Timber
Photo: John Stamets

Glue Laminated Timber (Glulam)
Beams & columns



Cross-Laminated Timber (CLT)
Solid sawn laminations



Cross-Laminated Timber (CLT)
SCL laminations



Photo: Freres Lumber



Photo: StructureCraft



Photo: LendLease



Photo: LEVER Architecture

Dowel-Laminated Timber (DLT)



Photo: StructureCraft

Nail-Laminated Timber (NLT)



Photo: Think Wood

Glue-Laminated Timber (GLT)
Plank orientation



Photo: StructureCraft



Photo: StructureCraft



Photo: Ema Peter



Photo: Manasc Isaac
Architects/Fast + Epp





Photo: Ema Peter

STRUCTURAL SOLUTIONS | POST, BEAM + PLATE



Photo: Seagate Structures



Photo: Lendlease



Photo: John Klein

STRUCTURAL SOLUTIONS | HYBRID LIGHT-FRAME + MASS TIMBER



FRAMING OPTIONS | HYBRID STEEL + MASS TIMBER



Photo: SOM

STRUCTURAL SOLUTIONS | HYBRID STEEL + MASS TIMBER

Wookworks Innovation Network (WIN)

MENU

W

N

WOODWORKS
INNOVATION
NETWORK

Sign in

City, State, ZIP ...

Building Systems

Building Type

Material Type


Sq Footage


Number of Stories

Construction Type

+


-






Salvagnini Industrial Showroom Expansion


Hybrid
1 Story
25,000 sq ft


 Hamilton, OH

The expanded Salvagnini customer resource campus features exposed CLT wall and roof systems, supported by glulam columns and an exterior finished concrete wall. The design tea...





Echo Park Ewing Residence

 Los Angeles, CA



State of Massachusetts Public-Use Airport Buildings

 Beverly, MA



Now Care. Western Montana

<https://www.woodworksinnovationnetwork.org/>



Photo: Nordic Structures

PRECEDENT PROJECTS | UMASS AMHERST DESIGN BUILDING



Photo: ©Albert Vecerka/Esto



Photos: Baumberger Studio/PATH Architecture



Photo: Hines



Photo: Corey Gaffer courtesy Perkins + Will



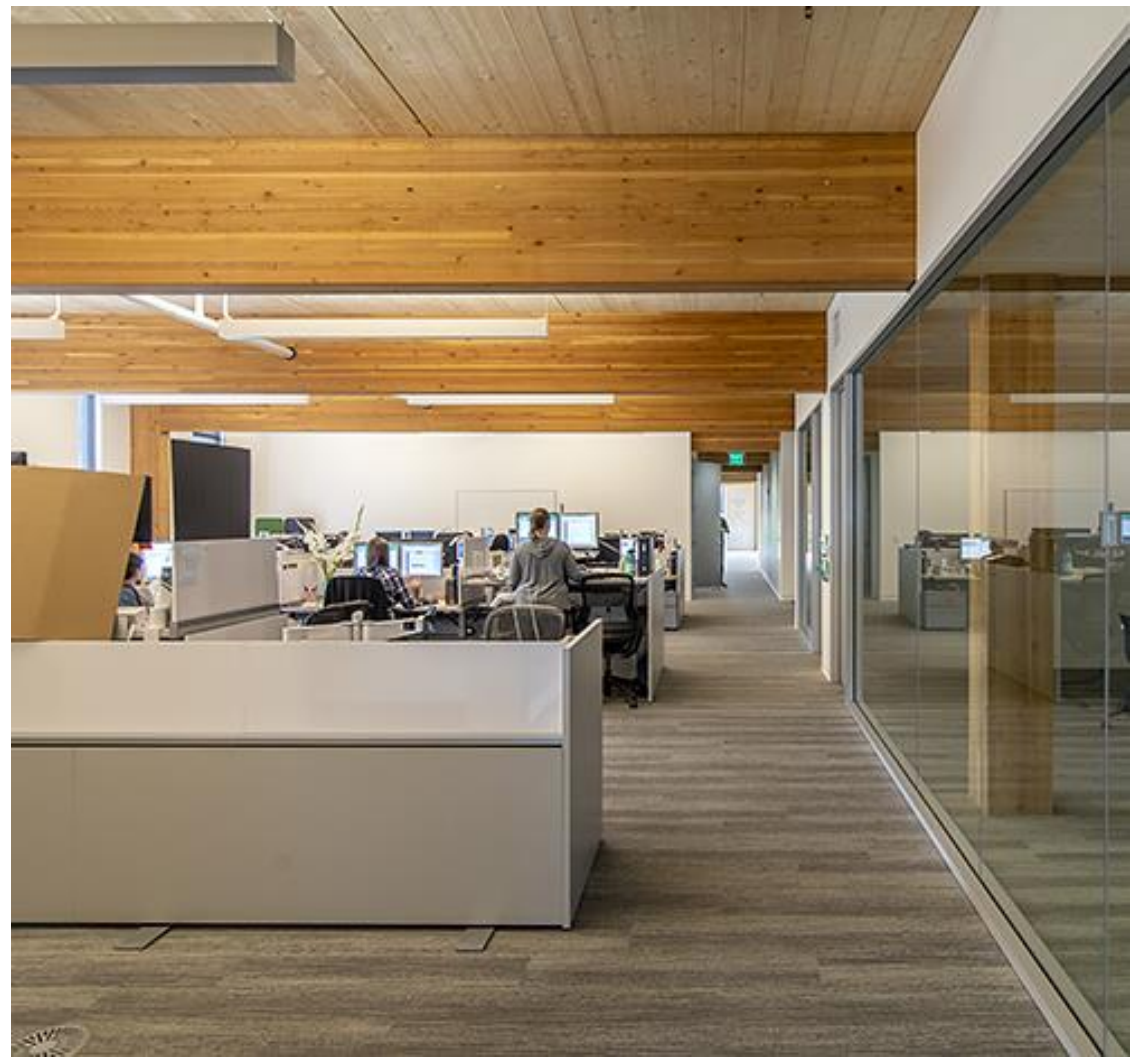
Photos: StructureCraft



Photo: Hartshorne Plunkard Architecture



Photos: Flank



Photos: Swinerton | DJC Oregon



Photos: Michael Elkan | Naturally Wood | UBC

MASS TIMBER PRODUCTS



MASS TIMBER IN THE CODE



Mass Timber in Low- to Mid-Rise: 1-6 Stories in Construction Types III, IV or V

IBC Table 503: Base Height



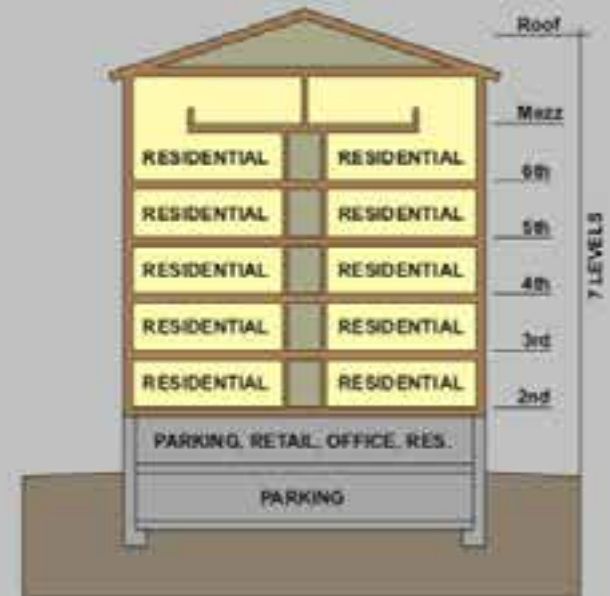
IBC Section 504: NFPA 13-Compliant Sprinkler System



IBC Section 505: Mezzanine



IBC Section 510.2: Podium



Tall Mass Timber: Up to 18 Stories in Construction Types IV-A, IV-B or IV-C



18 STORIES
BUILDING HEIGHT 270'
ALLOWABLE BUILDING AREA 972,000 SF
AVERAGE AREA PER STORY 54,000SF

TYPE IV-A



12 STORIES
BUILDING HEIGHT 180 FT
ALLOWABLE BUILDING AREA 648,000 SF
AVERAGE AREA PER STORY 54,000SF

TYPE IV-B



9 STORIES
BUILDING HEIGHT 85'
ALLOWABLE BUILDING AREA 405,000 SF
AVERAGE AREA PER STORY 45,000 SF

TYPE IV-C

IBC 2021



TYPE IV- HT

IBC 2015

BUSINESS OCCUPANCY [GROUP B]

*BUILDING FLOOR-TO-FLOOR HEIGHTS ARE SHOWN AT 12'-0" FOR ALL EXAMPLES FOR CLARITY IN COMPARISON BETWEEN 2015 TO 2021 IBC CODES.

MASS TIMBER CONSTRUCTION MANAGEMENT



**RISK
ANALYSIS**

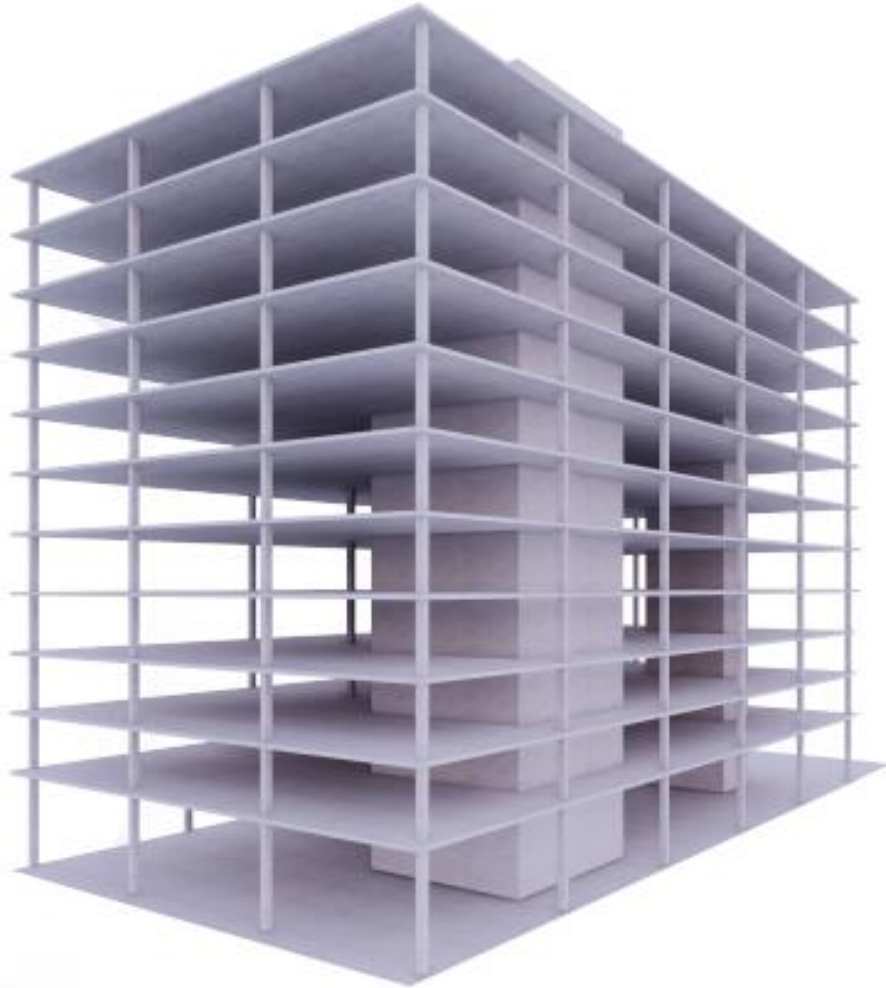
ECONOMICS

LOGISTICS

THREE KEY POINTS:

1. Mass timber is a custom building system, not a commodity.
2. Select the right partners for your project.
3. Assess projects holistically when estimating costs.

Risk: Cost Analysis of Structure Only



$\$/\text{SF}$



$\$/\text{SF}$

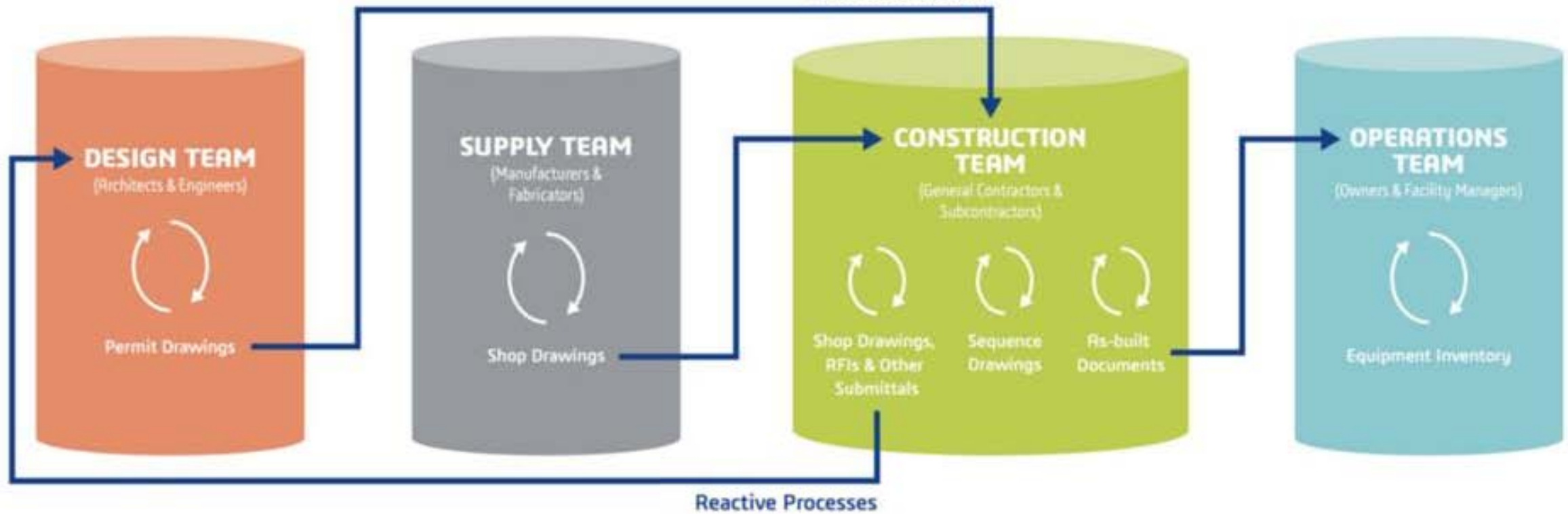
Risk Mitigation: Total Project Cost Analysis

CONSIDERATIONS:

- Ceiling Treatment
- Floor Topping
- HVAC System & Route
- Foundation Size
- Soil Improvements
- Exterior Skin Coordination
- Value of Time



Risk: Design-Bid-Build Procurement



Risk Mitigation: Trade Partner/Master Builder Approach



Procurement Strategy is Key to Success



Risk: Perception of a Commoditized Material



Risk Mitigation: Embrace the Prefab Advantage



Risk: Lack of Supply Chain Understanding

I don't have
any historic
cost data for
this structural
system.

Who makes
this stuff?
How do you
procure it?



Photo: Swinerton

Risk Mitigation: Complementary Procurement

GC Hires
Turnkey Mass Timber
Subcontractor

GC Buys Material
GC Self-Performs Install
GC Coordinates

GC Buys Material
GC Subcontracts Labor
GC Coordinates

RISK SPECTRUM



Hiring Experience
Single Point of Responsibility



Hiring Experience
Single Point of Responsibility
Financial Security of strong GC



Potential Added Mark-Up



Prequal Capacity of Sub
Potential Added Mark-Up



Lack of familiarity with supply chain
Steep learning curve for coordination



Multiple layers of coordination
Prequal Capacity of Sub

Schedule Savings for Rough-In Trades

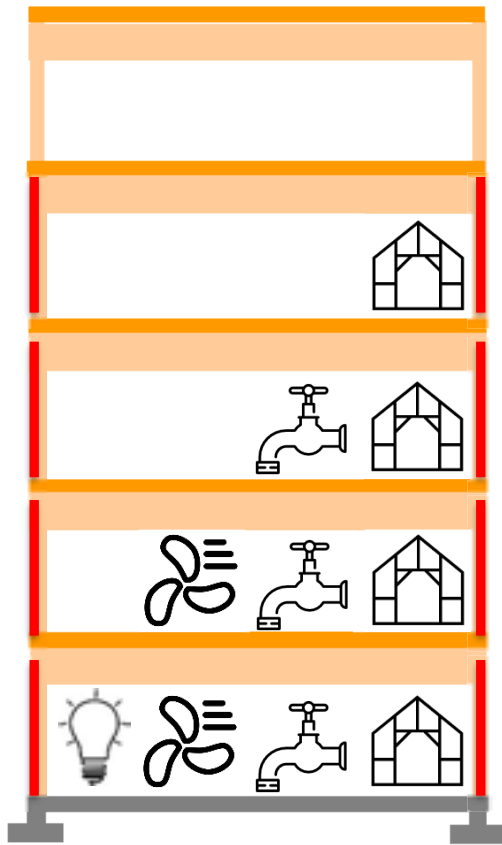


Image: Swinerton

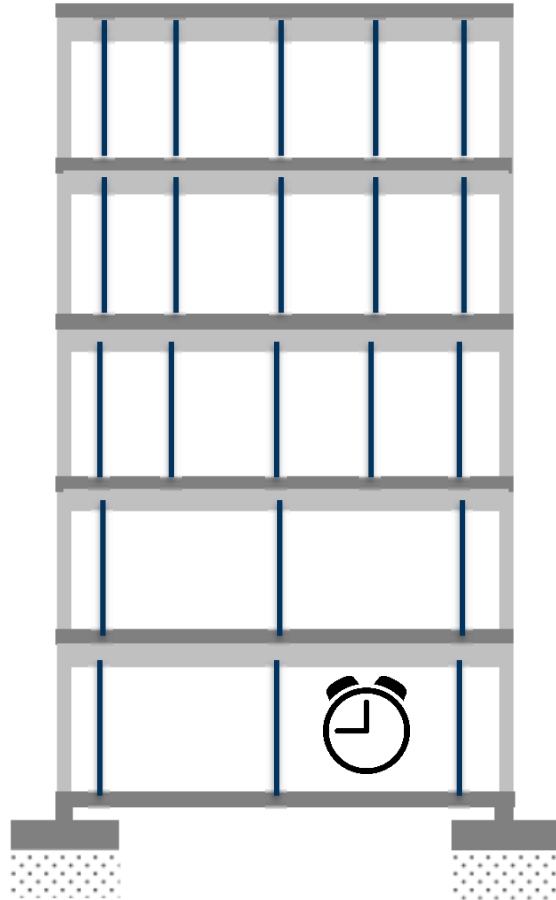
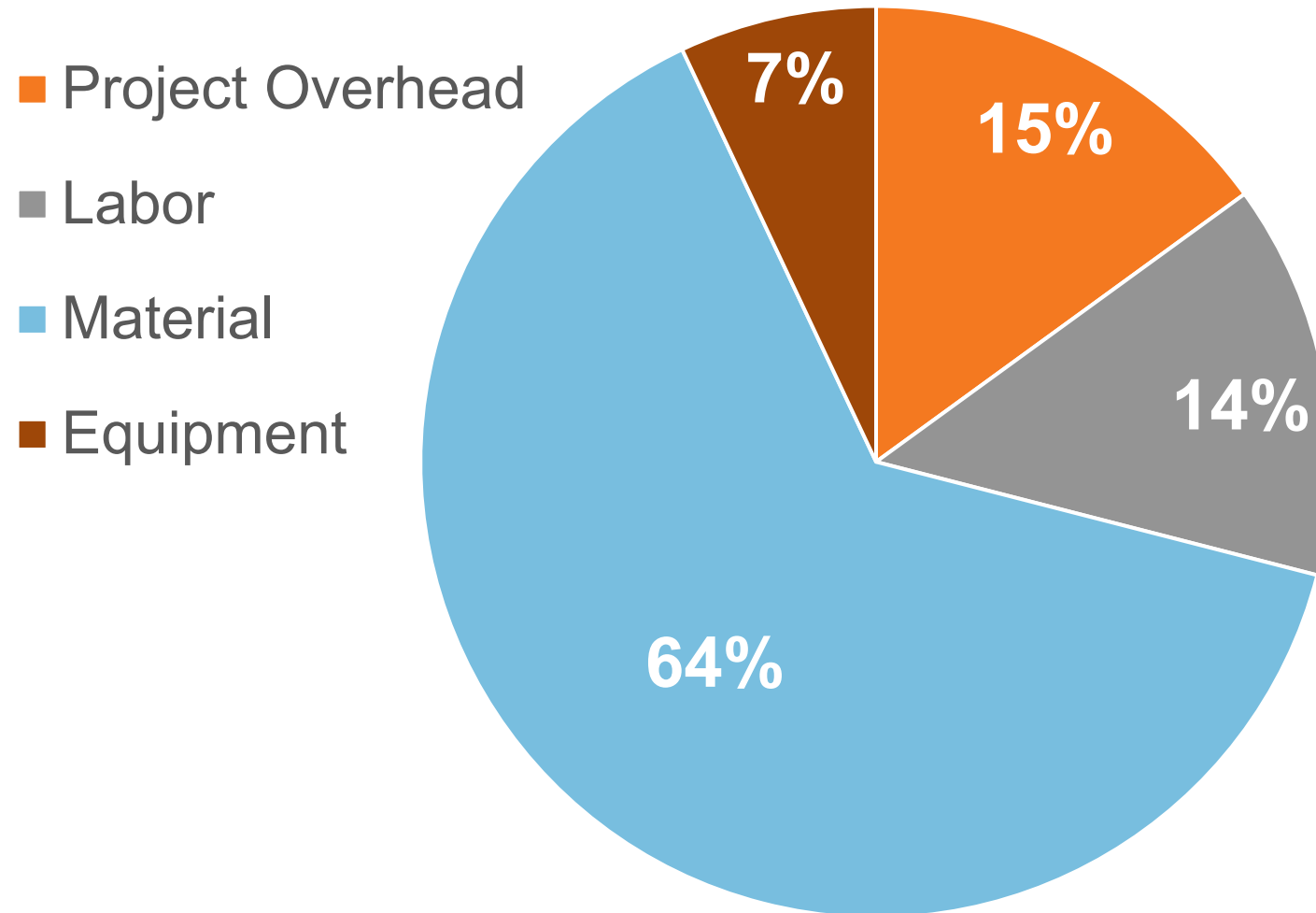
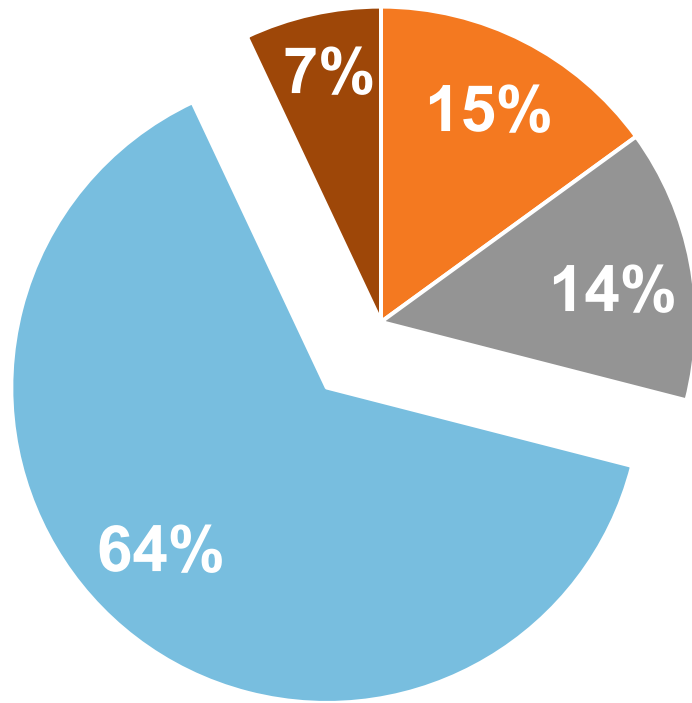


Photo: WoodWorks

Anatomy of a Turnkey Mass Timber Package



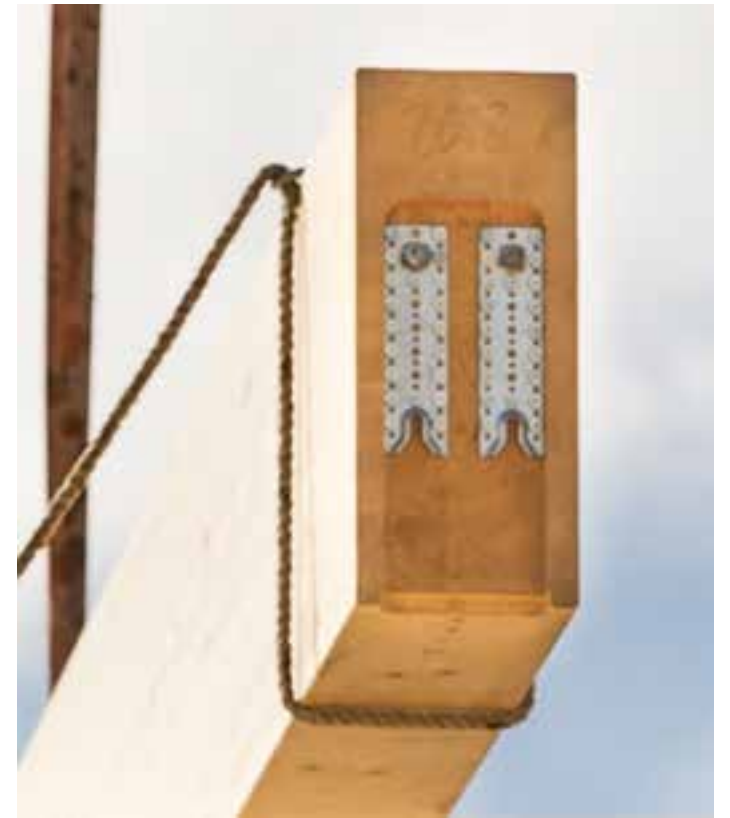
Material (Direct Cost)



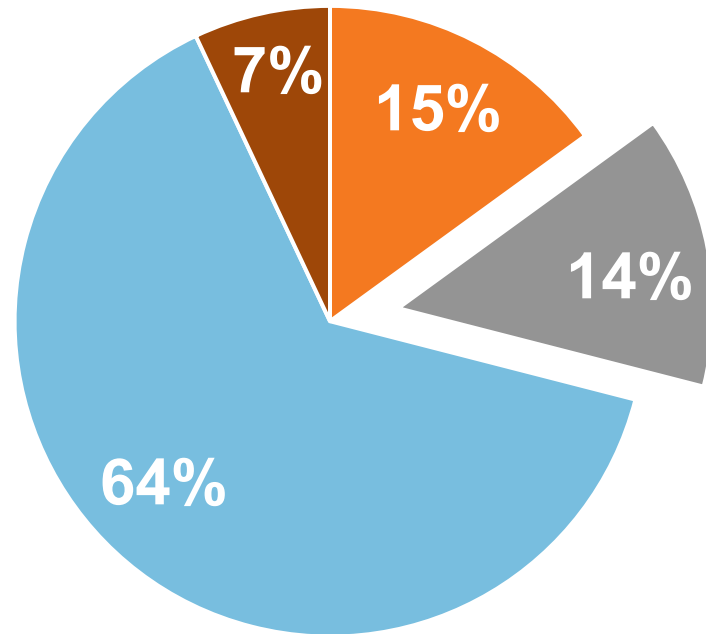
Turnkey Mass Timber Package



or



Labor (Direct Cost)

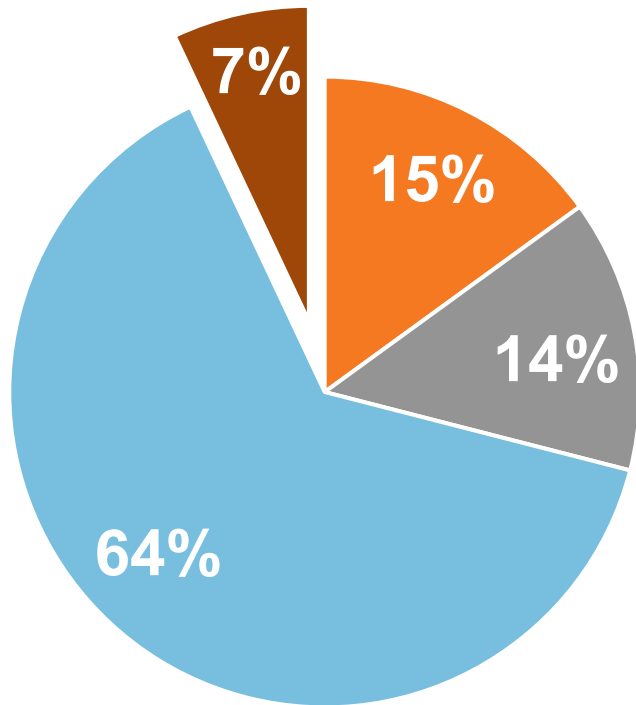


Turnkey Mass Timber Package



Photo: Swinerton

Equipment (Direct Cost)



Turnkey Mass Timber Package

Source: Swinerton

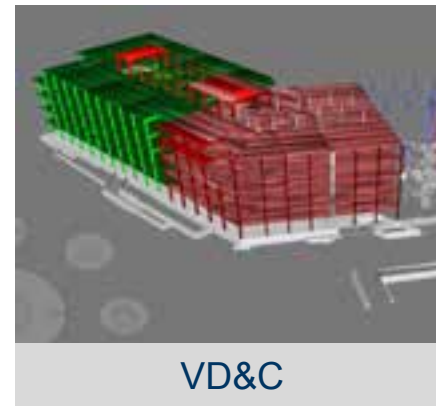
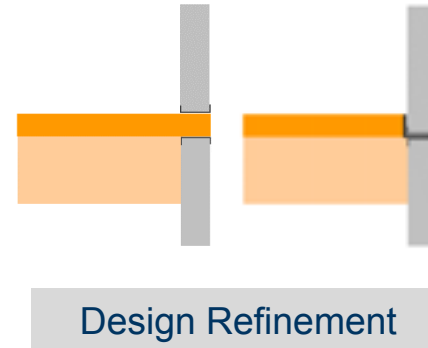
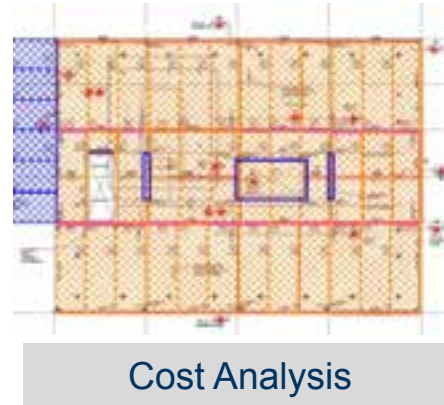
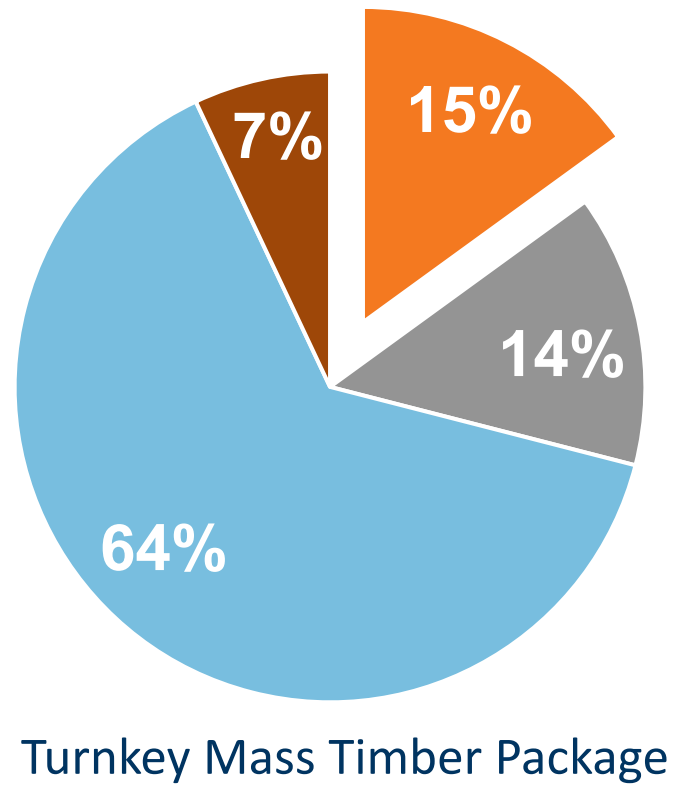


Photo: Swinerton



Photo: Alex Schreyer

Project Overhead



Photos: Swinerton

Value Analysis

$$Value = \frac{\uparrow Function + \uparrow Aesthetics}{\downarrow Cost}$$



Photo: RMW Architecture & Interiors

Value Analysis

$$\text{Value Engineering} = \frac{\downarrow \text{Function} + \downarrow \text{Aesthetics}}{\downarrow \text{Cost}}$$

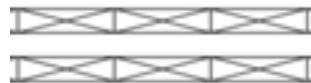


Cost: Construction Type

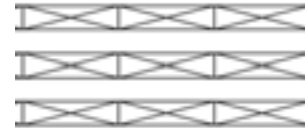
TABLE 601
Fire Resistance Rating Requirements for Building Elements (Hours)

Building Element	I-A	I-B	III-A	III-B	IV-A	IV-B	IV-C	IV-HT	V-A	V-B
Primary Structural Frame	3*	2*	1	0	3*	2	2	HT	1	0
Ext. Bearing Walls	3*	2*	2	2	3*	2	2	2	1	0
Int. Bearing Walls	3*	2*	1	0	3*	2	2	1/HT	1	0
Floor Construction	2	2*	1	0	2	2	2	HT	1	0
Roof Construction	1.5*	1*	1	0	1.5	1	1	HT	1	0
Exposed Mass Timber Elements					None	20-40%	Most	All		

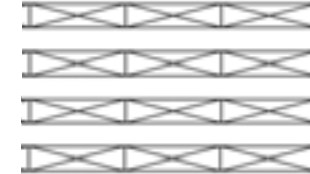
Baseline
0hr & HT



+\$10/SF
1hr & maybe 2hr



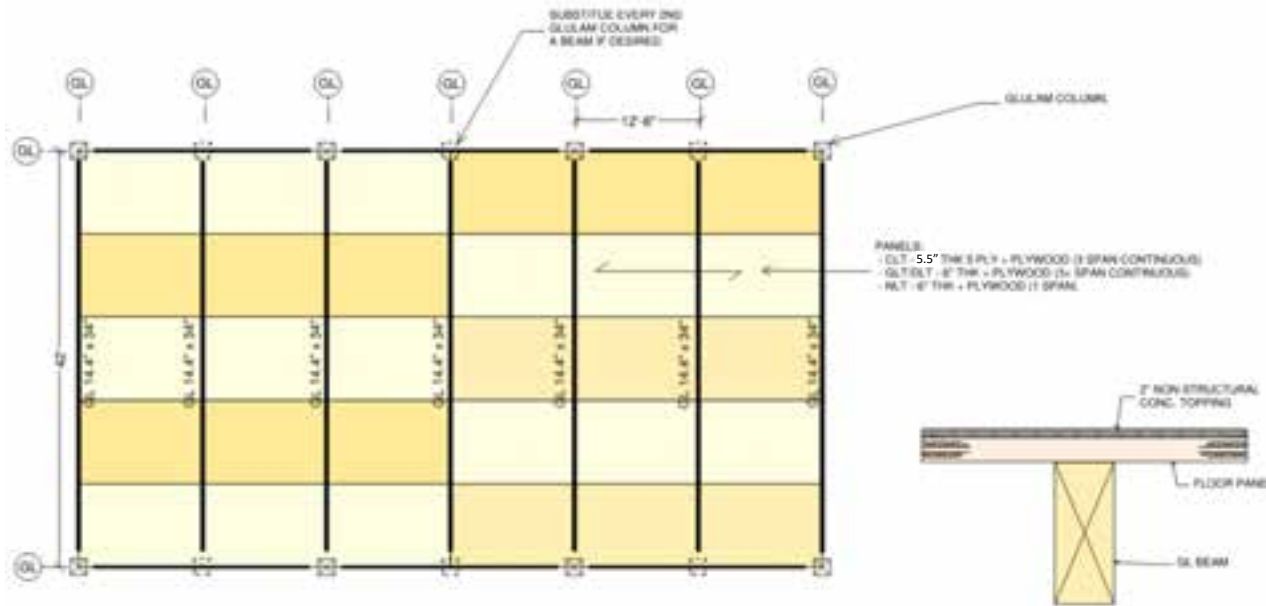
+\$12-15/SF
2hr FRR



Cost Source: Swinerton

*These values can be reduced based on certain conditions in IBC 403.2.1, which do not apply to Type IV buildings.

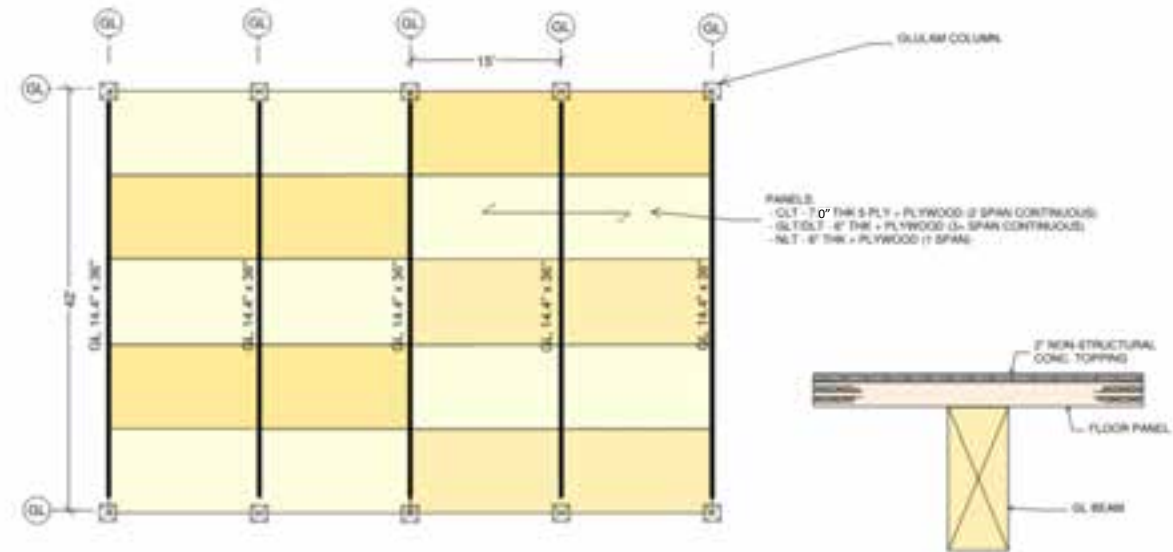
Cost: Structural System & Grid



Baseline

12'-6" Glulam Spacing

5.5" CLT



\$ +5%

15' Glulam Spacing

7" CLT

Value: Perimeter Glazing



Photos: Mark Bitterman



Tolerances: Interface with Other Structural Materials



Photos: Swinerton

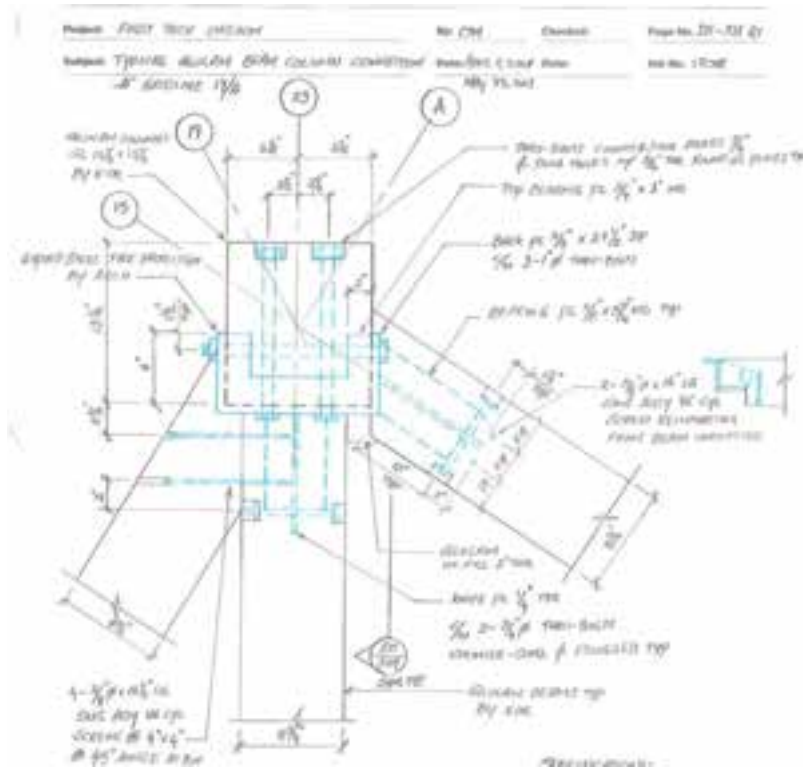
SCHEDULE



What are the schedule drivers on a mass timber project?



Schedule Impacts: Translating 2D to 3D



Schedule Impacts: Hybrid Structures



Photos: Swinerton

Is there a schedule savings with a mass timber structure compared to other structural systems?



Seattle Mass Timber Tower: Detailed Cost Comparison

Fast Construction



- Textbook example done by industry experts
- Mass timber vs. PT concrete
- 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, Colliers¹

Download Case Study:

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

Overall Project Cost Analysis: 12 Story Type IV-B

	MASS TIMBER	PT CONCRETE	* MASS TIMBER SAVINGS VS. PT CONCRETE (%)
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%
<i>Total</i>	<i>104,778,231</i>	<i>105,303,209</i>	<i>-0.5%</i>

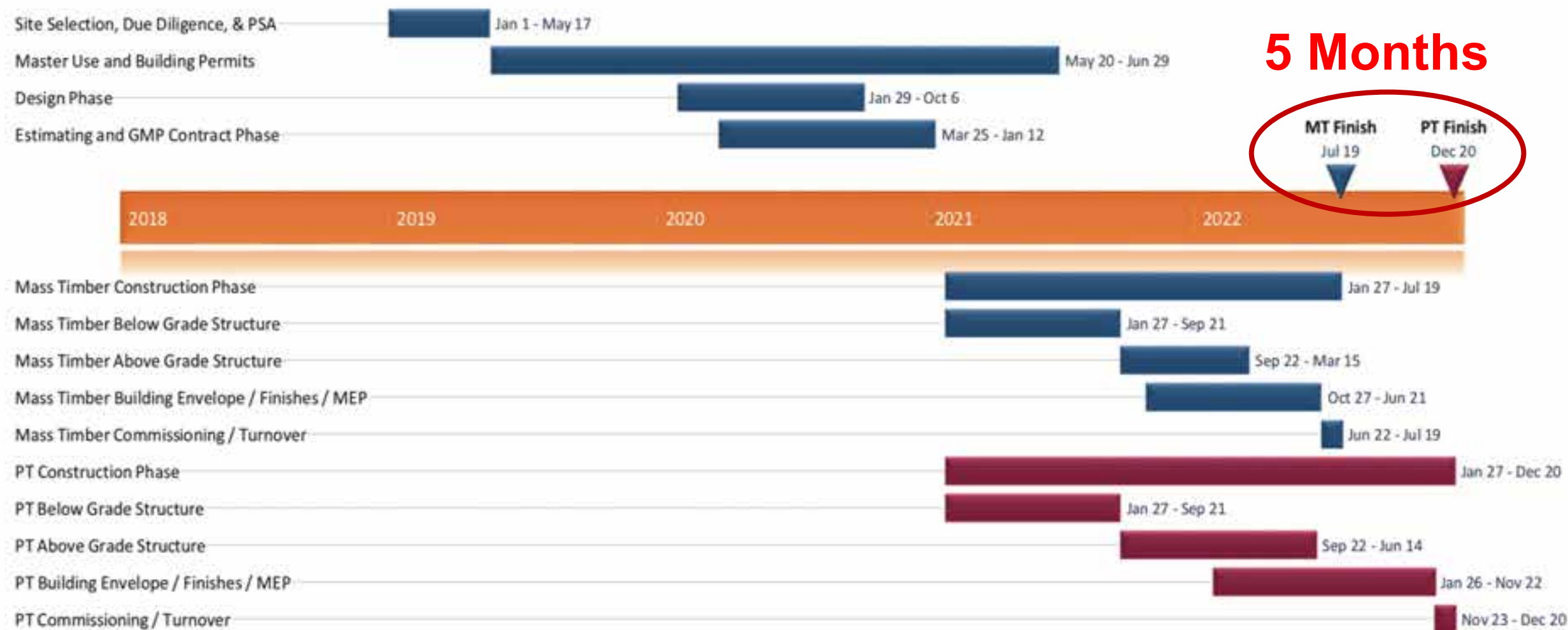
Source: Swinerton

** Includes 2 layers of gyp on 80% of interior surfaces*



Credit: DLR Group | Fast + Epp | Swinerton

Overall Project Schedule Analysis: 12 Story Type IV-B



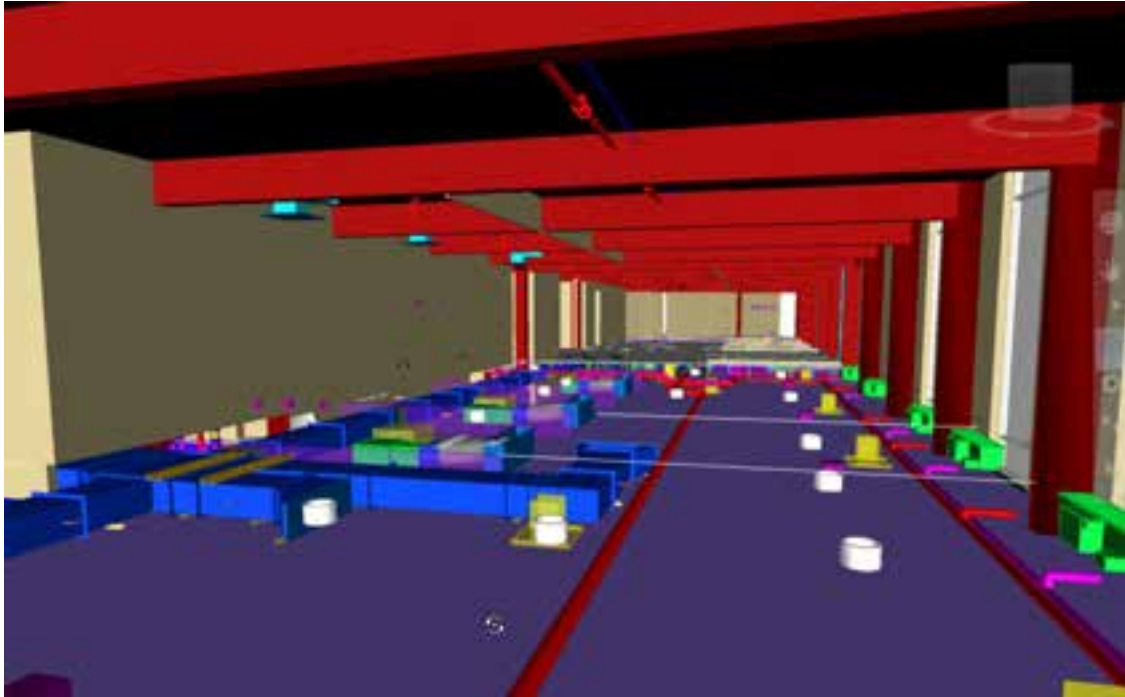
Early Move-In for Rough-In Trades.



Photos: Swinerton



Embracing BIM for Fabrication



Photos: Swinerton

Holistic Schedule Analysis

Shorter Schedule = Lower General Conditions Costs





MASS TIMBER | TRAINING THE WORKFORCE

MASS TIMBER CONSTRUCTION MANAGEMENT RESOURCES

In Progress/Development



MASS TIMBER
CONSTRUCTION
MANUAL



INSTALLER TRAINING



VIRTUAL OR IN-PERSON
WORKSHOPS

Stay up to date with training for construction managers, GC's, and installers at our website:

<https://www.woodworks.org/mass-timber-construction-management-program/>

In Planning



ENGAGE WITH
GENERAL
CONTRACTORS



COMMUNITY COLLEGES



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Construction Management Program



MASS TIMBER
CONSTRUCTION
MANUAL



8- & 16-HOUR
INSTALLER TRAINING
PACKAGE TRAINING
CENTERS



COMMUNITY COLLEGE
AND UNIVERSITY
PROGRAMS



VIRTUAL AND/OR IN-
PERSON WORKSHOPS

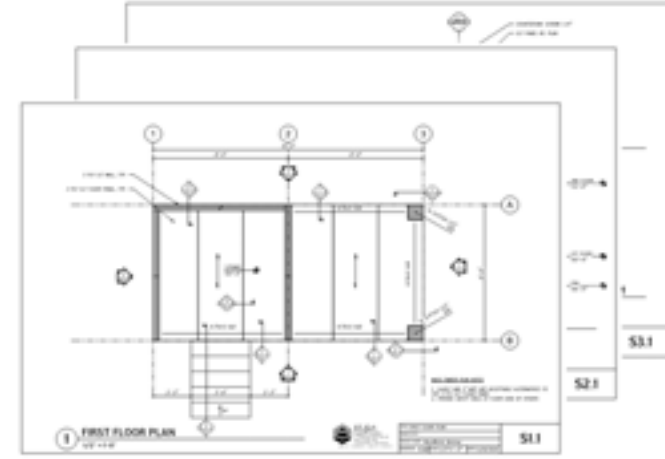


Photo Credit: WoodWorks



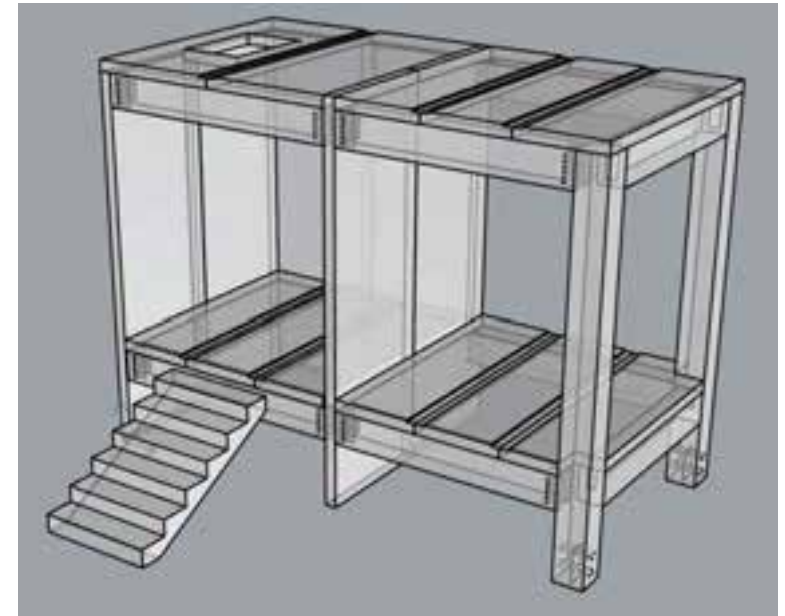
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PROJECT TOURS



ENGAGE WITH
GENERAL
CONTRACTORS ACROSS
THE US



New for GCs and installers: U.S. Mass Timber Construction Manual



PHOTO: MARCUS KAUFFMAN

U.S.
Mass Timber
Construction
Manual



Download free at
woodworks.org

Reduce Risk

Optimize Costs

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

Download Checklists at
www.woodworks.org

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

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.

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Expert Design & Associates
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This concludes The American
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