MICHIGAN GREEN BUILDING COLLABORATIVE

MiGBC + MASS TIMBER @MSU

WEBINAR

Mass Timber Webinar Series

Pioneering Mass Timber:

MSU's STEM Facility

IDS CELEBRATING 25 YEARS

GRANGER ADVANCE THE ART OF BUILDING

CHRISTMAN SINCE 1894

MiGBC
MICHIGAN GREEN BUILDING COLLABORATIVE
A USGBC COMMUNITY

https://migbc.org/events/

Future events

Lansing 2030 District
Incentives, Rebates, and Funding for Efficiency

Thursday, March 27th
10–11am
Via Zoom

Mass Timber Webinar Series
Kalamazoo Regional Educational Service Agency
In collaboration with MassTimber@MSU

Thursday, April 24th
10–11am
Via Zoom

Michigan Energy Summit

Thursday, May 8th
8:30am - 4:30pm
JW Marriott, Grand Rapids

Future events

Mass Timber Webinar Series

DNR Newberry

In collaboration with MassTimber@MSU

Thursday, June 26th
10–11am
Via Zoom

Mass Timber Webinar Series

Adelaide Pointe Condos

In collaboration with MassTimber@MSU

Thursday, July 24th
10–11am
Via Zoom

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Support real impact on your local community and join a network of like-minded individuals who are interested in all things building science.

Scan the QR code with your device to join today!

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Thank You to our Visionary Supporters

DTE

Consumers Energy
Count on Us®

EGLE
MICHIGAN DEPARTMENT OF ENVIRONMENT, GREAT LAKES, AND ENERGY

Agenda

MICHIGAN GREEN BUILDING COLLABORATIVE + MASS TIMBER @MSU WEBINAR

Sandra Lupien
Director
MassTimber@MSU
Moderator

George H. Berghorn, PhD, LEED AP, CGP
Assistant Professor, Construction Management
Research Director, MassTimber@MSU
Project History

Bill Bofysil
Project Director
Granger Construction
Construction Manager

Kevin Marshall
Associate/Senior Architect
Integrated Design Solutions
Architect

Andrew Riess, PE
Director of Pre-Construction and Mass Timber
Christman Constructors, Inc.
Installer

MASS TIMBER @MSU · IDS CELEBRATING 25 YEARS · CHRISTMAN SINCE 1894 · GRANGER ADVANCE THE ART OF BUILDING

MassTimber@MSU leverages research, education, outreach, communications, policy, and partnerships to advance sustainable mass timber construction and manufacture in Michigan, the Great Lakes region and beyond.

canr.msu.edu/masstimber/
#MIMassTimberMomentum

TYPES OF MASS TIMBER

Glue-laminated Timber (Glulam)

Cross-Laminated Timber (CLT)

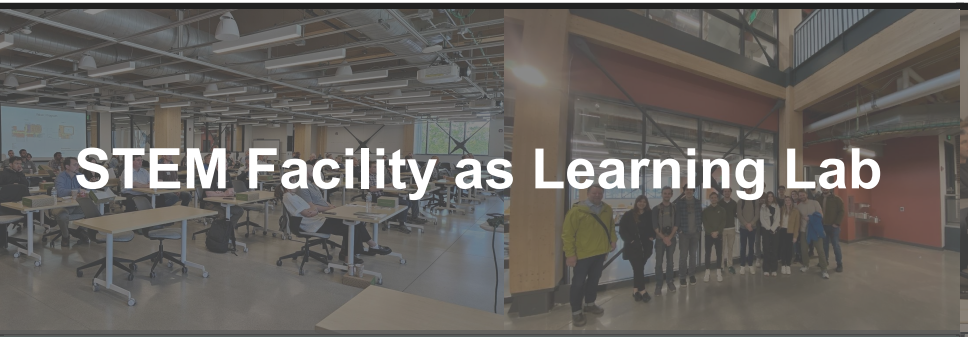
Mass Plywood Panels

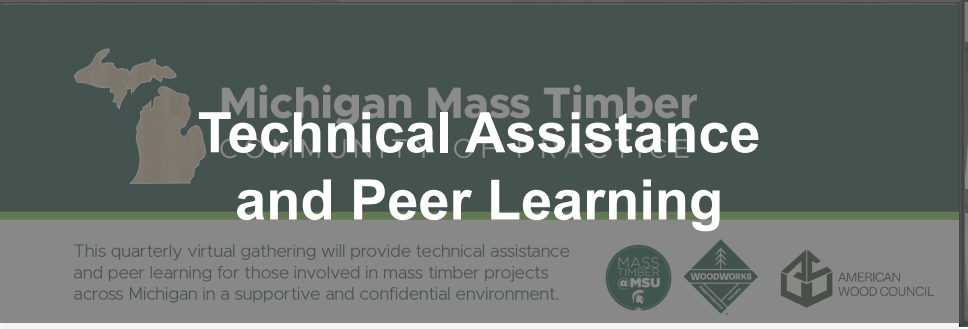
Nail-Laminated Timber

Dowel Laminated Timber

Laminated Veneer Lumber

Fostering a Mass Timber Ecosystem





Mass Timber Projects in Michigan:

~60 Complete or in the Pipeline

K-12 schools, Universities

Training Facilities, Community Centers, Government Buildings

Apartments & Condos
Affordable Housing
Single-Family Home

Hotel

Contact

Sandra Lupien

Director, MassTimber@MSU

Lupiensa@msu.edu

510-681-3171

Mobilizing education, science, outreach, and communication to advance mass timber construction and manufacture in Michigan and the surrounding region.

@MassTimberatMSU

canr.msu.edu/masstimber/

George H. Berghorn, PhD, LEED AP, CGP
Assistant Professor
Research Director, MassTimber@MSU
Michigan State University

- Summer 2016 – Madison, WI
- February 2017 – Meet with the Executive VP
- Spring 2017 – Summer 2018 – “The Long and Winding Road”
- August 2018 – Groundbreaking
- Summer 2021 - Opening

The Case Back Then

- Innovation: First-of-its-Type
- Campus as a Learning Laboratory
- Public Funding

The Case Now

- Innovation on Display – National Recognition
- Building as a Teaching Tool
- Outreach and Engagement Tool: 3,500+ tour participants + technical assistance
- Conversation Changer

INTEGRATED design SOLUTIONS
architecture engineering interiors & technology

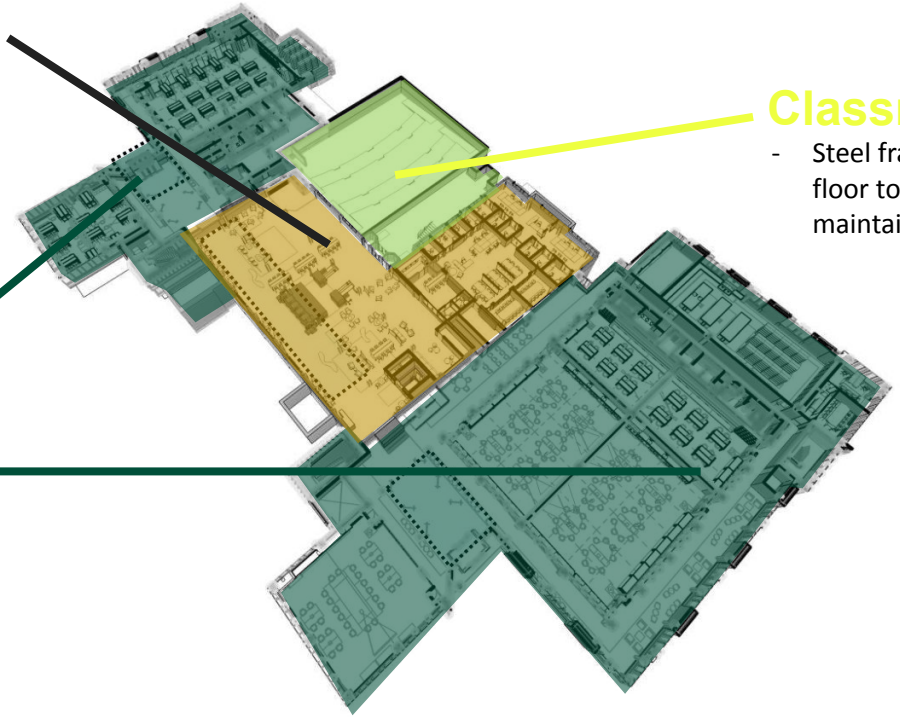
Kevin Marshall

AIA, LEED AP BD+C

Lead Project Architect

Shaw Lane Powerplant

- Existing Steel Building Frame
- Existing concrete Floors
- New Floors constructed of CLT to connect with STEM wings



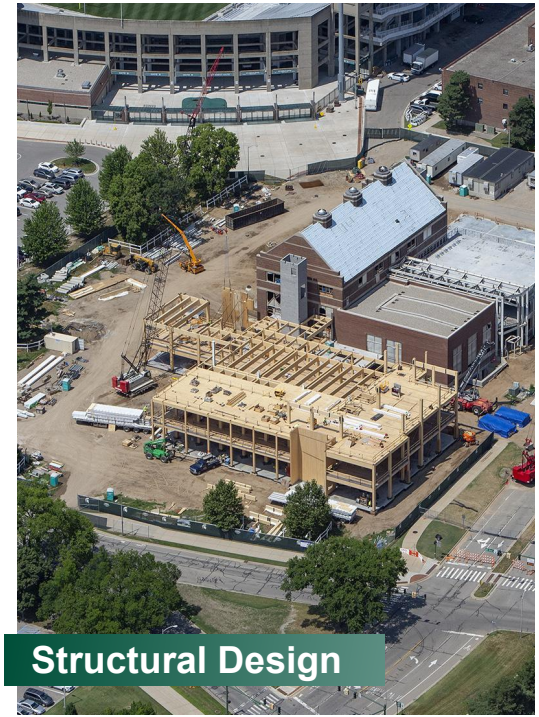
Classroom Addition

- Steel frame and composite concrete floor to increase spans while maintaining ceiling heights

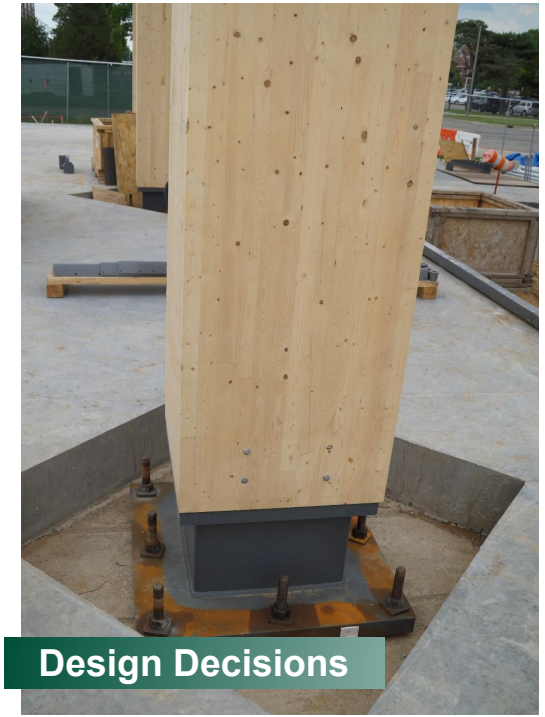
STEM Wings

- Exposed Glu-Lam columns and beams to highlight wood construction and yet be less industrial than Power Plant
- Floors constructed of CLT with polished concrete topping as walking surface

Mass Timber Considerations



Structural Design



Design Decisions

Mass Timber Considerations: Structural Design

Construction Type

Fire Resistance/Panel Thickness

Vibration Analysis

Right Sizing Timber

Mass Timber Considerations: Structural Design

Construction Type

Construction Type: IIIB

First Floor Areas:

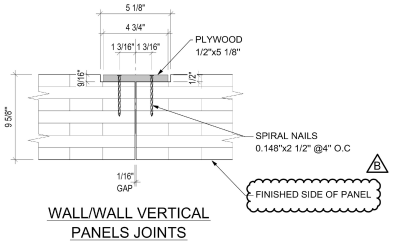
North STEM: 12,488 sf
Power Plant: 19,929 sf
South STEM: 24,103 sf

TABLE 506.2
ALLOWABLE AREA FACTOR (A_t = NS, S1, S13R, S13D or SM, as applicable) IN SQUARE FEET[a, b]

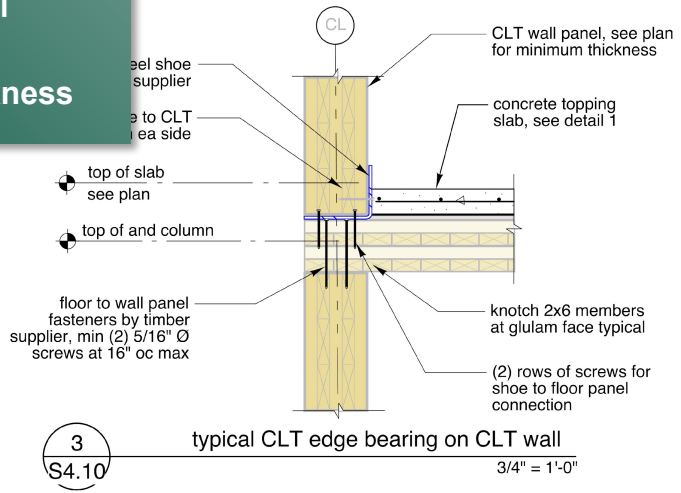
OCCUPANCY CLASSIFICATION	SEE FOOTNOTES	TYPE OF CONSTRUCTION											
		Type I		Type II		Type III		Type IV				Type V	
		A	B	A	B	A	B	A	B	C	HT	A	B
A-1	NS	UL	UL	15,500	8,500	14,000	8,500	45,000	30,000	18,750	15,000	11,500	5,500
	S1	UL	UL	62,000	34,000	56,000	34,000	180,000	120,000	75,000	60,000	46,000	22,000
	SM	UL	UL	46,500	25,500	42,000	25,500	135,000	90,000	56,250	45,000	34,500	16,500
A-2	NS	UL	UL	15,500	9,500	14,000	9,500	45,000	30,000	18,750	15,000	11,500	6,000
	S1	UL	UL	62,000	38,000	56,000	38,000	180,000	120,000	75,000	60,000	46,000	24,000
	SM	UL	UL	46,500	28,500	42,000	28,500	135,000	90,000	56,250	45,000	34,500	18,000
A-3	NS	UL	UL	15,500	9,500	14,000	9,500	45,000	30,000	18,750	15,000	11,500	6,000
	S1	UL	UL	62,000	38,000	56,000	38,000	180,000	120,000	75,000	60,000	46,000	24,000
	SM	UL	UL	46,500	28,500	42,000	28,500	135,000	90,000	56,250	45,000	34,500	18,000
A-4	NS	UL	UL	15,500	9,500	14,000	9,500	45,000	30,000	18,750	15,000	11,500	6,000
	S1	UL	UL	62,000	38,000	56,000	38,000	180,000	120,000	75,000	60,000	46,000	24,000
	SM	UL	UL	46,500	28,500	42,000	28,500	135,000	90,000	56,250	45,000	34,500	18,000
A-5	NS	UL	UL	UL	UL	UL	UL	UL	UL	UL	UL	UL	UL
	S1												
	SM												
B	NS	UL	UL	37,500	23,000	28,500	19,000	108,000	72,000	45,000	36,000	18,000	9,000
	S1	UL	UL	150,000	92,000	114,000	76,000	432,000	288,000	180,000	144,000	72,000	36,000
	SM	UL	UL	112,500	69,000	85,500	57,000	324,000	216,000	135,000	108,000	54,000	27,000

Mass Timber Considerations: Structural Design

Fire Resistance/Panel Thickness

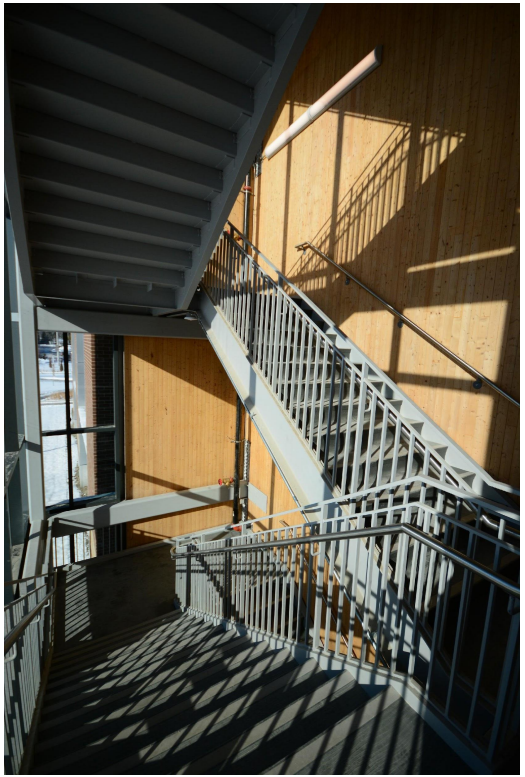


WALL/WALL VERTICAL PANELS JOINTS



3 S4.10 typical CLT edge bearing on CLT wall

3/4" = 1'-0"



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MASS TIMBER @MSU

Mass Timber Considerations: Design Decisions

Beam Connections

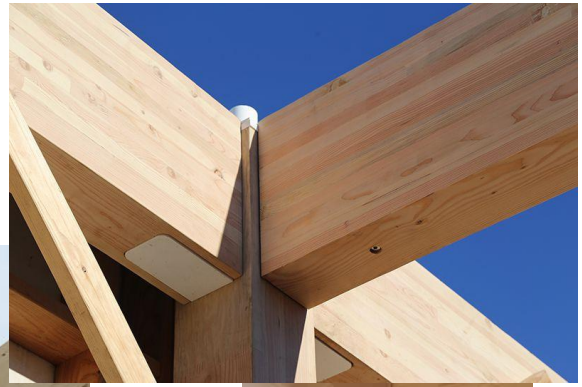
Column Design

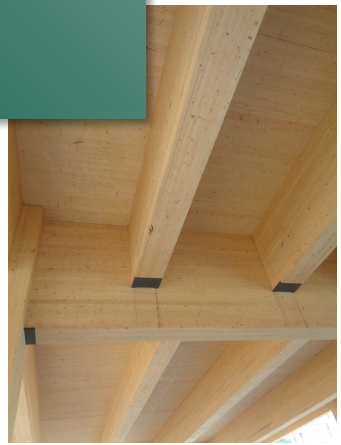
Lateral System

Transitions

Mass Timber Considerations: Design Decisions

Beam Connections



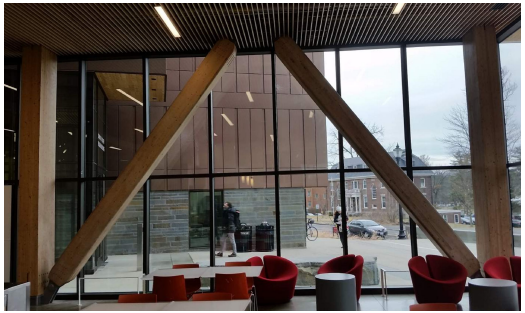


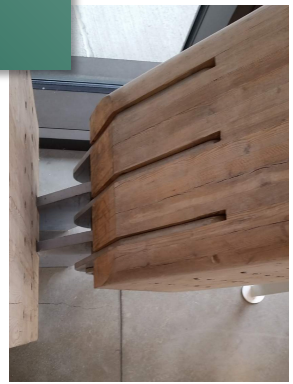
Mass Timber Considerations: Design Decisions

Column Design

Mass Timber Considerations: Design Decisions

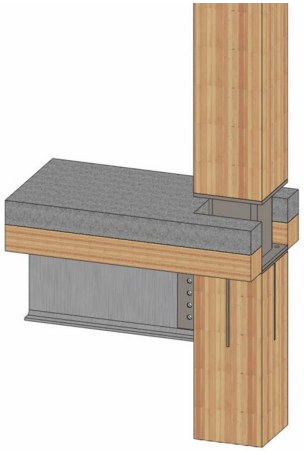
Lateral System

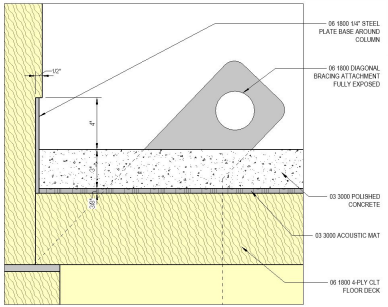




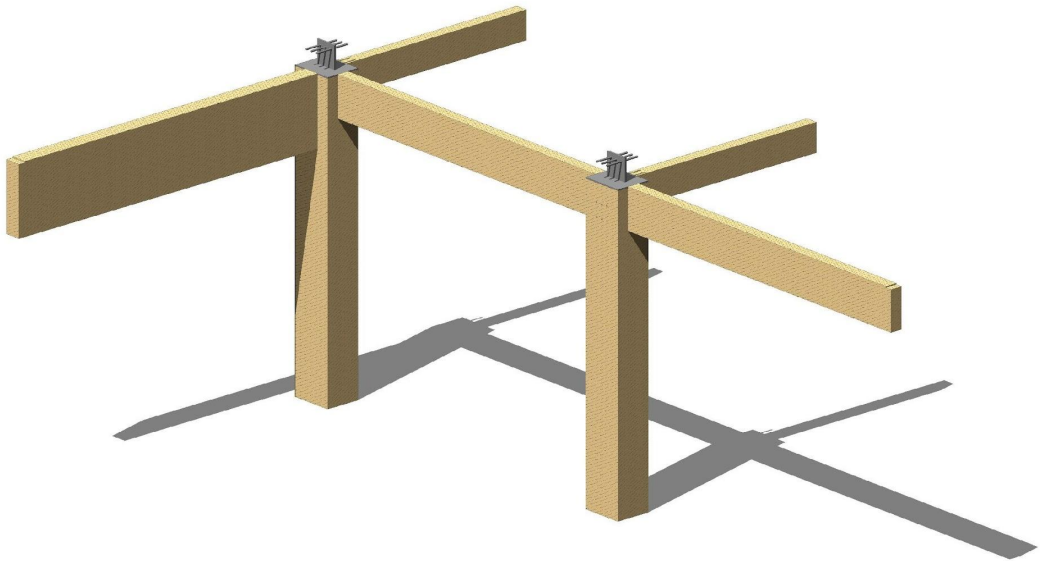
Mass Timber Considerations: Design Decisions

Transitions





Typical Erection Sequence



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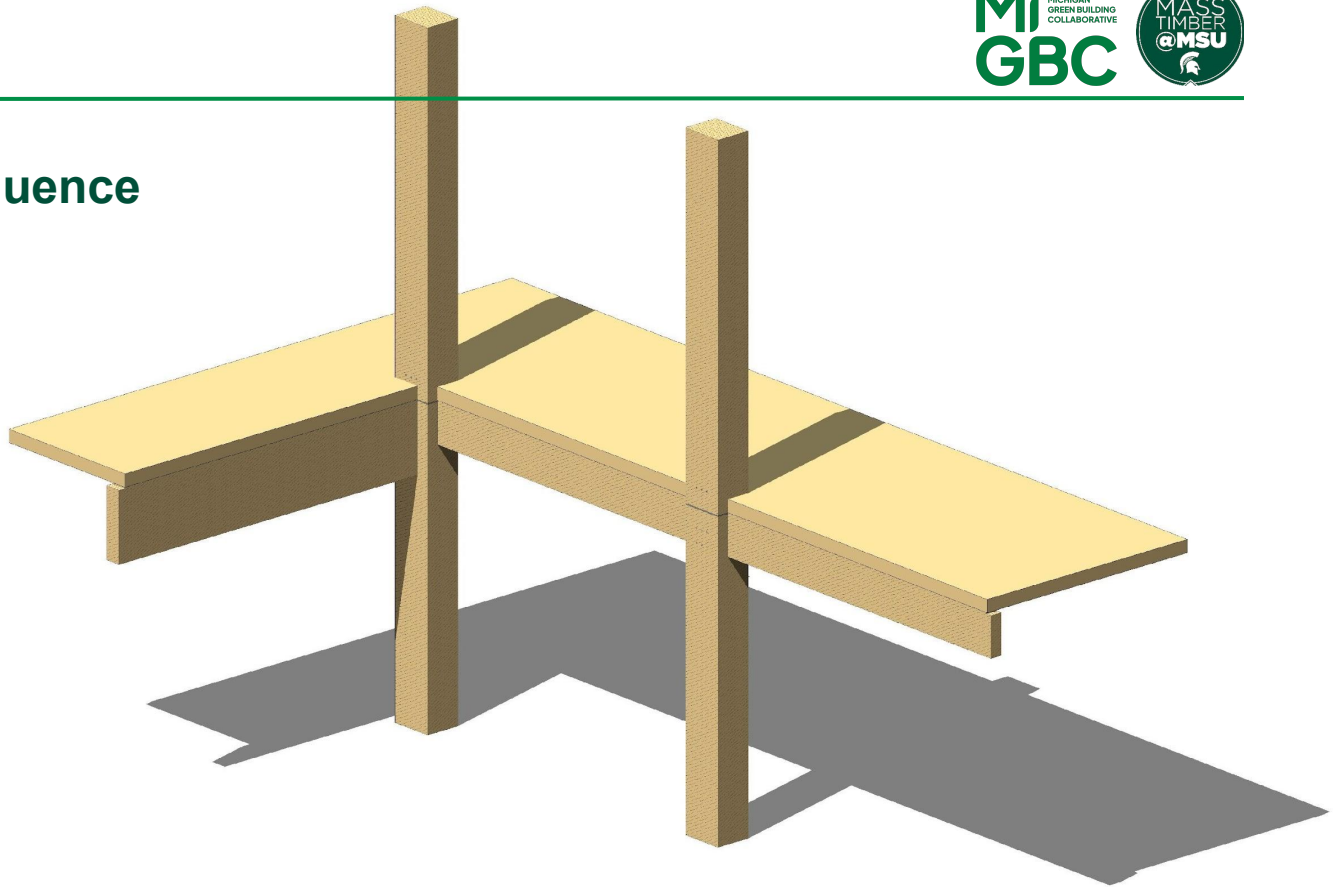

Typical Erection Sequence

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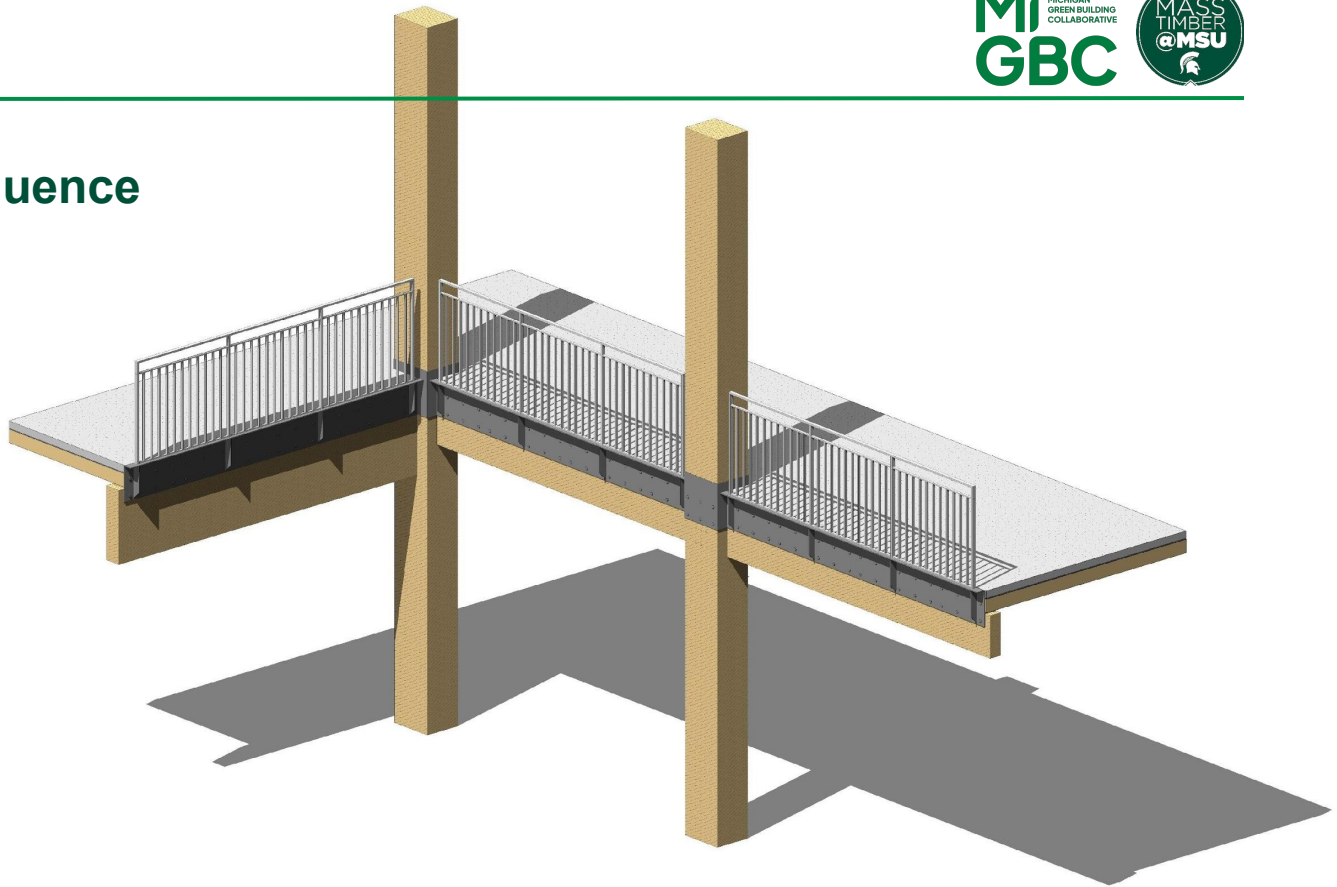

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Pioneering Mass Timber: MSU STEM Facility

INTEGRATED DESIGN SOLUTIONS

Entering STEM from Southwest


EXIT
EXIT
EXIT


3
2
PITCHFORK

INTRODUCTION

GRANGER

ADVANCE THE ART OF BUILDING

Bill Bofysil

Project Director

DISCOVERY

MICHIGAN STATE UNIVERSITY

STEM Teaching & Learning Facility

Mass Timber Structural Study Summary
February 20, 2018 v.1

BACKGROUND

MSU desired to explore the use of mass timber materials for the STEM Teaching & Learning facility. The STEM project team (MSU IPF, MSU FPSM, IDS, Granger) engaged a variety of subject matter experts in three workshops from December 2017 through February 2018. The project team evaluated the differences between a structural steel solution, a mass timber solution, or some combination of both. Factors considered and discussed covered a wide range of topics including: first & life cycle cost, construction schedule, building systems coordination, code compliance, sustainability, aesthetics, adaptability of design, trade availability, demonstration of innovation, relation to MSU pedagogy, local economic impact, systems reliability, pests, and other. Some topics were explored in detail, others were discussed in a Q & A-style forum between the project team and subject matter experts.

STUDY TEAM

STEM Project Team

MSU IPF	Ken Gottschalk, Jeff Kasdorf
MSU FPSM	Nestor DeOcampo
IDS Design	Jeff Johnson, Christa Azar, Kevin Marshall
Ellenzweig	Peter Herman
Granger	Tim VanAntwerp, Matt Bort, John Bort, Ian Clutten
SDI (structural engineer)	Paul Dannels

Subject Matter Experts

Structural steel trade	Sean Sage – Kirby Steel
Mass timber supplier	Crawford Dewar – Guardian Industries
Mass Timber industry	Archie Landreman – Woodworks

Additional Planning Partners

MSU IPF	Shawn Kelly, Brandon Baswell
	Dean Geisenhauer, Eric Doolittle

PROCESS SUMMARY

Workshop #1 – December 15, 2017

Objectives: Develop and co-draft (with SME's) a preliminary Choosing by Advantages (CBA) worksheet evaluating preliminary advantages of either steel and mass timber solutions or some combination of both.

Attendees: MSU IPF, FPSM, IDS, SDI, Granger, Kirby, Guardian

Conclusions: Little to no difference in most factors considered. Some differences exist with anticipated construction schedule (mass timber should take less time to erect), availability of local, qualified trade partners (more local steel partners), demonstrating innovation (mass timber is perceived to be more innovative), and supporting MSU pedagogy (some partnerships exist with mass timber industry and MSU College of Agriculture).

Follow Ups: Engage additional MSU planning partners. Complete more in-depth technical review.

Workshop #2 – February 7, 2018

Objectives: Introduce mass timber systems to MSU IPF planning partners to identify early concerns and answer preliminary questions.

Attendees: MSU IPF, IPF Planning Partners listed above, FPSM, IDS, Ellenzweig, SDI, Granger, Guardian, Woodworks

Conclusions: In addition to the project team and invited subject matter experts, four IPF planning partners attended. No significant technical concerns were identified, however, the possible requirement for humidity control needed further research. The question remained whether MSU would consider trying try a new/unfamiliar system for an entire structure, or begin with a smaller element or building component.

Follow Ups: Research humidity control question. MSU IPF continuing to discuss internally. Complete more in-depth structural technical review.

Workshop #3 – February 13, 2018

Objectives: Structural engineers to conduct a technical discussion and initial review of mass timber design, members, connections, etc. to identify any technical or engineering concerns.

Attendees: MSU IPF, IDS, Ellenzweig, SDI, Granger, Guardian, Guardian's structural consultant

Conclusions: No technical or engineering concern was identified which would preclude the use of mass timber. A mass timber system was conceptualized as a mass timber frame, cross laminated (CLT) floor and roof deck, 3" concrete topping slab, pipe x-bracing, steel stairs, and a steel frame penthouse. No "special" humidity control is required just for mass timber.

Follow Ups: Further investigate steel framing required for curtainwall and envelope systems. Further investigate use of mass timber or steel at Penthouses.

IDS ELLENZWEIG GRANGER

MSU STEM – sample rendering with mass timber.

U-Mass Amherst John D. Olver Design School. Completed January 2017.

SUMMARY CBA MATRIX

Factor	Steel	Mass Timber	Advantage
Construction Schedule	3-4 months design & fab 16-18 weeks install	3-4 months design & fab 6-8 weeks install	Mass timber is expected to take less time to install
Code Compliance / AHJ	Type 2 construction. 2HR separation to Power Plant. Special inspections known.	Type 3 construction. 3HR separation to Power Plant. Special inspections less known.	Steel has small beneficial difference in code compliance / AHJ approval.
Sustainability	Calculated recycled value 75% Regional materials > 50%	Perception that wood products are more sustainable	Very small difference in sustainable attributes
Aesthetics	Steel could be exposed or concealed. Painted acoustical metal deck.	Mass timber could be exposed or concealed. Exposed, sealed CLT wood deck.	Neutral (subjective).
Structure & Building Systems Coordination	6 ¾" total floor section anticipated, 27" deep beams expected	10 ½" total floor slab anticipated, beams are deeper than 27"	Steel has small beneficial difference in systems coordination
Trade Availability	Michigan-based qualified firms with trained workforce	National fabricators expected, rely primarily on local labor to install.	Steel has some beneficial difference in availability of available trades
Innovation	Unique design possible. Steel is commonly used material.	No known mass timber structures currently exist on MSU campus.	Mass timber has some beneficial difference in demonstrating innovation.
MSU Pedagogy	Teaching moments/internships for MSU students	Partnerships exist with the College of Agriculture and industry	Mass timber has some beneficial difference in support of MSU pedagogy
Local economic impact	Fabricators and installers are expected to be Michigan owned. Steel materials regional, but not expected to come from Michigan.	Wood materials could be sourced from Michigan. Majority of installers expected to be Michigan residents. Fabricators likely to be non-Michigan based.	Neutral (detailed economic impact was not completed).
Reliability	Materials are familiar to the project team.	Materials are unfamiliar to the project team. Shrinkages is not a concern on a building of this size.	Neutral

INITIAL CONCLUSIONS

FIRST COST: First Cost is anticipated to be neutral between steel or mass timber ($4.3 - $4.75million, construction cost).

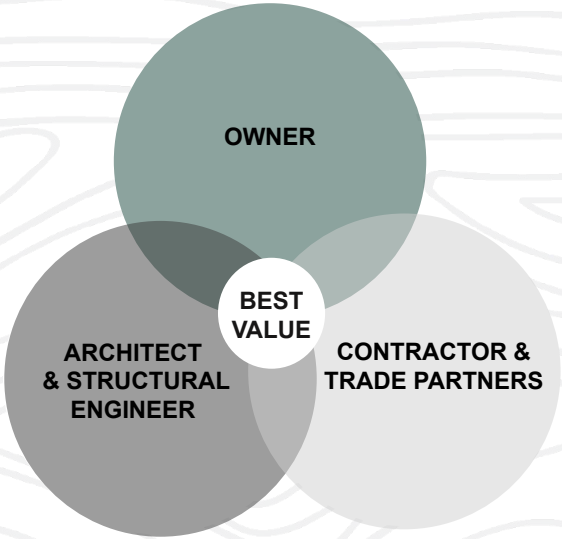
LIFE CYCLE COST: Life cycle / maintenance costs are anticipated to be negligible for either steel or mass timber.

TECHNICAL: No technical or operational reason has yet been identified which precludes the use of either steel or mass timber for the entire STEM structure or an element within.

ADDITIONAL LEARNING:

- Engage additional mass timber partner to validate conceptual estimate (*mass timber budget based on estimate of early scheme, and trade SME anticipates current design to be cost neutral to steel*).
- Make site visit to completed project in Amherst, MS or Minneapolis, MN.

PROJECT DELIVERY



PROGRAMMING
- Mass Timber Option
- Site Feasibility
- Identify Project Team

SCHEMATIC DESIGN
- Owner Mass Timber Project Goals
- Construction Type
- Timber Optimization
- Connection Design

TIMBER PARTNER

DESIGN DEVELOPMENT
- Wood Sourcing Requirements
- European v North American
- Manufacturer Timber ‘Right Sizing’
- Delegated Design Analysis

CONSTRUCTION DOCUMENTS
- Shop Drawings
- BIM Coordination – Sequencing of Erection
- Transit / Storage and Handling
- Moisture Mitigation Plan

SOURCING

DowelLam
(Manufacturer)
Abbotsford, BC

Element5 | HASSLACHER Group
(CLT, GLT, Glulam, fabricator)
St.Thomas, ON

Freres Engineered Wood
(CLT, LVL beams/columns, fabricator)
Lyons, OR

Kalesnikoff
(CLT, GLT, Glulam, fabricator)
Castlegar, BC

Mercer
(CLT, GLT, Glulam, fabricator)
Conway, AR; Okanagan Falls, BC; Spokane, WA

Sauter Timber
(Fabricator)
Rockwood, TN; Estacada, OR

SmartLam
(CLT, GLT, Glulam, fabricator)
Dothan, AL; Columbia Falls, MT

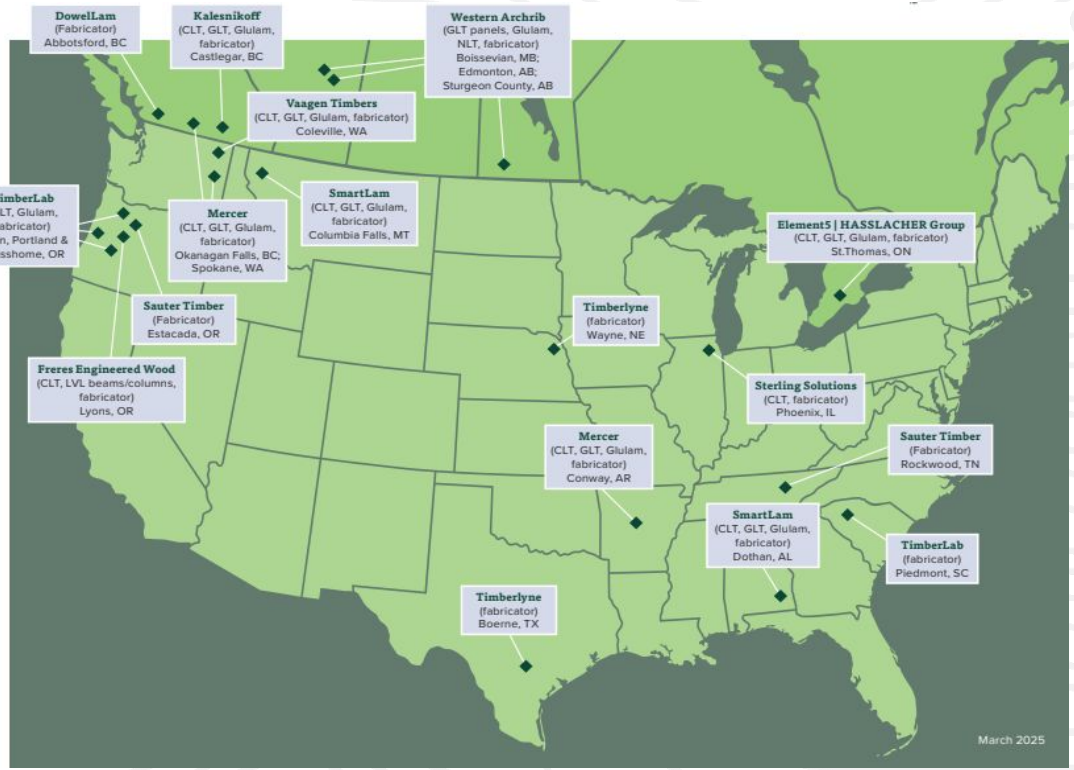
Sterling Solutions
(CLT, fabricator)
Phoenix, IL

TimberLab
(GLT, Glulam, fabricator)
Drain, Portland & Swisshome, OR; Piedmont, SC

Timberlyne
(fabricator)
Wayne, NE; Boerne, TX

Vaagen Timbers
(CLT, GLT, Glulam, fabricator)
Coleville, WA

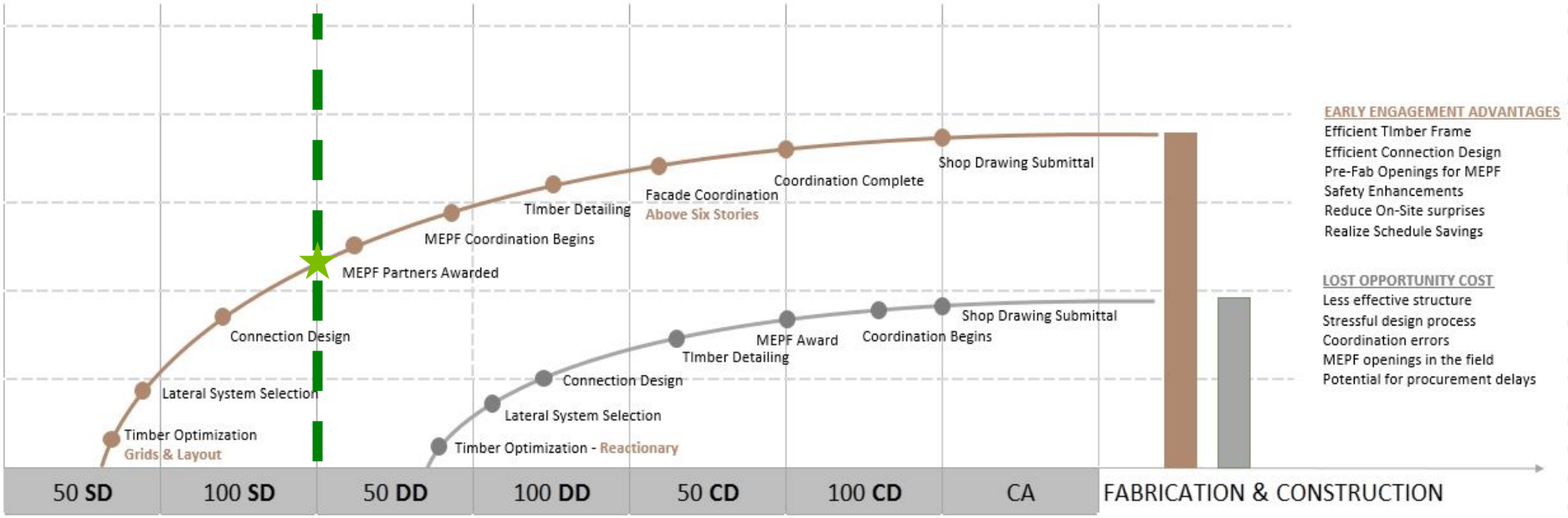
Western Archrib
(GLT panels, Glulam, NLT, fabricator)
Boissevian, MB; Edmonton, AB; Sturgeon County, AB



EUROPEAN SUPPLIERS

- Binderholz (Austria)
- Hasslacher Norica Timber (Austria)
- KLH (Austria)
- Wiehag Timber Construction (Austria)

COLLABORATION



LESSONS LEARNED

MASS TIMBER CHALLENGES

- Longer preconstruction process
- Non-traditional procurement
- National/international availability
- Tolerances
- Protecting finished installed work
- Education

MASS TIMBER ADVANTAGES

- Total team collaboration – IPD/ Design-Assist
- Prefabrication
- Smaller crew sizes
- Minimal laydown area is required
- Quicker installation
- Releases interfacing trades sooner
- Biophilic design

Andrew G. Riess, P.E.
Director of Pre-Construction and Mass Timber

CHRISTMAN
BUILDING SINCE 1894

A Change in Construction

CHRISTMAN
BUILDING SINCE 1894

How is it Done?

CHRISTMAN
BUILDING SINCE 1894

Project Planning

Dealing with the Structure

Thank You!

Sandra Lupien
Director
MassTimber@MSU
Moderator

George H. Berghorn, PhD, LEED AP, CGP
Assistant Professor, Construction Management
Research Director, MassTimber@MSU
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