A Mass Timber Clinic: Introducing and Mastering Design Topics

Presented by
WoodWorks
April 12, 2022

Lake|Flato Architects (Design Architect), BOKA Powell (AOR), StructureCraft, Danysh & Associates, photo Erika Brown Edwards

MULTI-FAMILY/MIXED-USE | EDUCATION | OFFICE | RETAIL | INDUSTRIAL | CIVIC | INSTITUTIONAL

WOODWORKS
WOOD PRODUCTS COUNCIL

Designing a wood building?
Ask us anything.

FREE PROJECT SUPPORT / EDUCATION / RESOURCES

Nationwide support for the code-compliant design, engineering and construction of non-residential and multi-family wood buildings.

- Allowable Heights/Areas
- Construction Types
- Structural Detailing
- Wood-Framed & Hybrid Systems
- Fire/Acoustic Assemblies
- Lateral System Design
- Alternate Means of Compliance
- Energy-Efficient Detailing
- Building Systems & Technologies

Adidas North American Headquarters
LEVER Architecture, Studio O+A (interiors)
photo: Jeremy Bittermann

woodworks.org/project-assistance | help@woodworks.org

Funding Partners

SOFTWOOD LUMBER BOARD

FOREST SERVICE
US
DEPARTMENT OF AGRICULTURE

Forestry Innovation Investment

WOODWORKS WOOD PRODUCTS COUNCIL

2022 Board Partners

Boise Cascade

Georgia-Pacific

LP BUILDING SOLUTIONS

West Fraser

Weyerhaeuser

2022 Market Development Partners

binderholz

DR JOHNSON WOOD INNOVATIONS

www.frereslumber.com

Global IFS

HASSLACHER NORICA TIMBER From wood to wonders.

MERCER

ROSBORO BUILDING BETTER

SANSIN

SMARTLAM NORTH AMERICA

StructureCraft

VAAGEN TIMBERS

2022 Industry Advantage Partners

Eurotec

KALESNIKOFF TIMBER INSPIRES

RedBUILT

SIMPSON Strong-Tie

Design Professionals:
One-on-One Support & Assistance

PROJECT SUPPORT FIELD DIVISION

Senior Director
Field Division West

Heather Strong, PE

Janelle Leafblad, PE

David Hanley

Archie Landreman

Anthony Harvey, PE

Marc Rivard, PE, SE

Senior Director
Field Division East

Jason Reynolds, MBA, DBIA

Chelsea Drenick, SE

Mike Romanowski, SE

Momo Sun, PE, PEng

Jason Bahr, PE

Laura Cullen, EIT

John O'Donald II, PE

Mark Bartlett, PE

Jeff Peters, PE, CGC

Jessica Scarlett

Meet the **Help Desk**

Scott Breneman, PhD, PE, SE

Ashley Cagle, PE, SE

Karen Gesa, PE

Bruce Lindsey

Melissa Kroskey, AIA, SE

Terry Malone, PE, SE

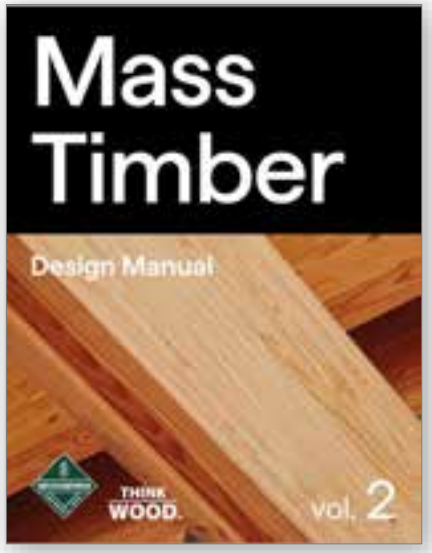
Ricky McLain, PE, SE

Need technical assistance on a project?

Email: **help@woodworks.org**

Expert Resources Create Wood Experts

Now at woodworks.org …



5

MANUALS, GUIDES & INVENTORIES

31

CASE STUDIES SHOWCASING U.S. PROJECTS

25

WOOD SOLUTION PAPERS

» **4**

DESIGN EXAMPLES

» **59**

EXPERT TIPS

» **111**

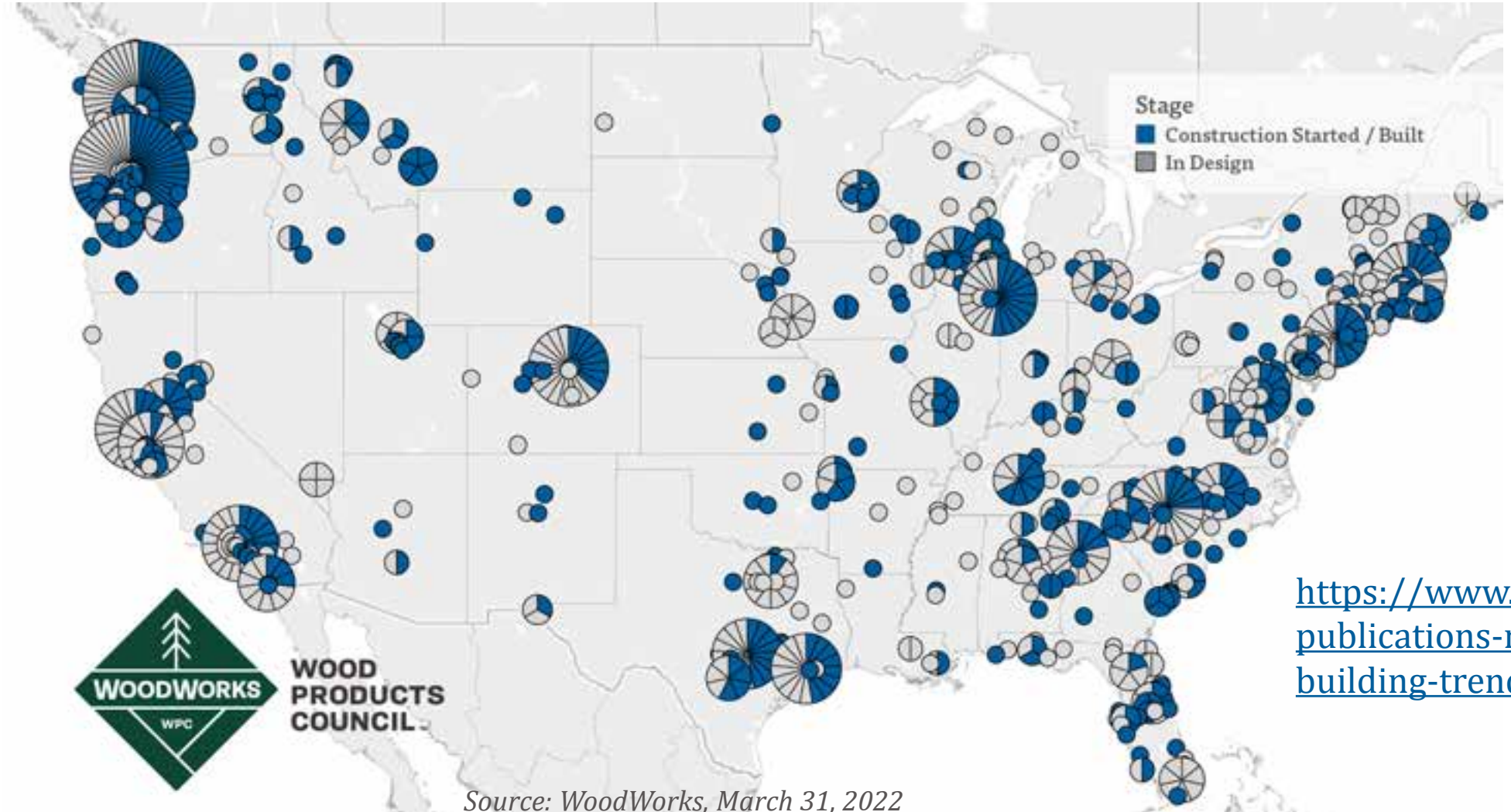
LIGHT-FRAME DETAILS

» **130**

MASS TIMBER DETAILS

Current State of Mass Timber Projects

As of March 2022, in the US, **1,384** multi-family, commercial, or institutional projects have been constructed with, or are in design with, mass timber.



WOODWORKS WPC WOOD PRODUCTS COUNCIL

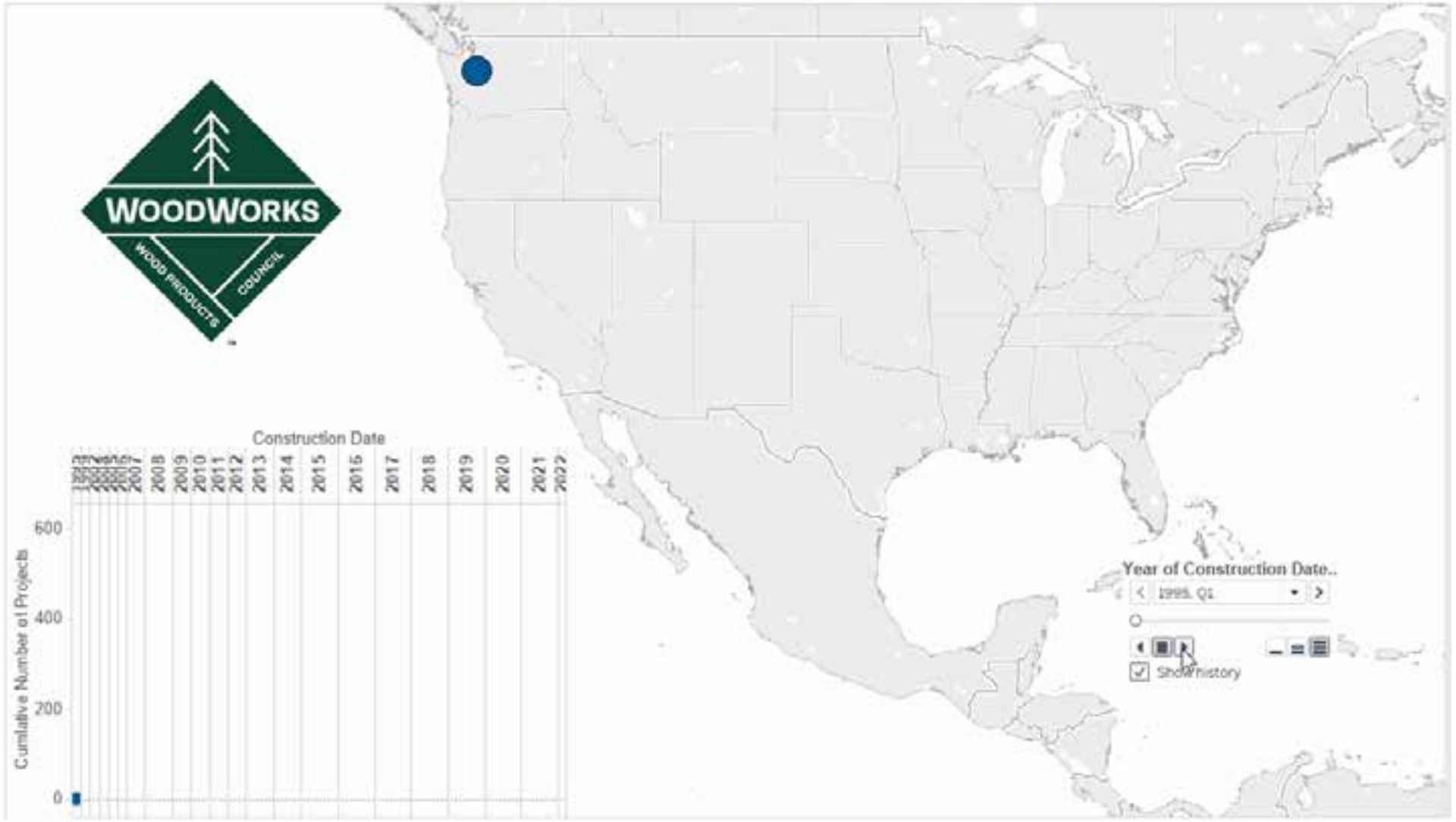
https://www.woodworks.org/publications-media/building-trends-mass-timber/

Source: WoodWorks, March 31, 2022

** This total includes modern mass timber and post-and-beam structures built since 2013*

Current State of Mass Timber Projects

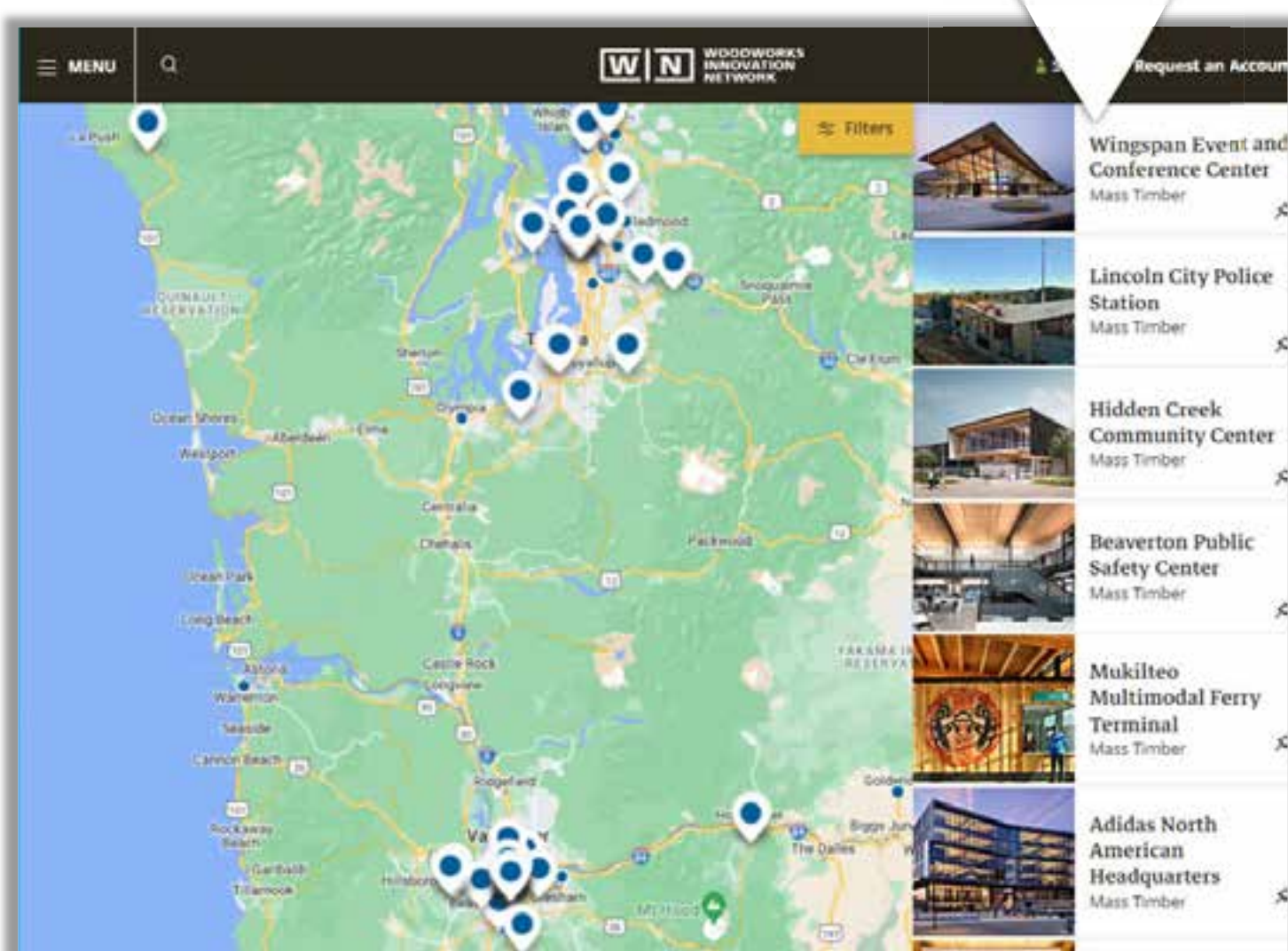
As of March 2022, in the US, **1,384** multi-family, commercial, or institutional projects have been constructed with, or are in design with, mass timber.



Find Mass Timber Projects

+ connect with the pros
who worked on them.

WOODWORKS
INNOVATION
NETWORK.ORG



RESOURCES & UPCOMING EVENTS

New WOOD SOLUTION PAPER

CLT Diaphragm Design for Wind and Seismic Resistance

Using SDPWS 2021 and ASCE 7-22

New CASE STUDIES

Adidas East Village Expansion

Innovative mass timber designs meet ambitious construction timeline

District Office

Developer chooses mass timber to differentiate speculative office project

Visit woodworks.org/publications-media

Common Challenges in Wood Lateral System Layouts | May 3

1.5 AIA/CES HSW LUs, 1.5 PDH credits, 0.15 ICC credits

Lateral Design for Mass Timber Structures: How to Do It, How It's Been Done | May 5

1.5 AIA/CES HSW LUs, 1.5 PDH credits, 0.15 ICC credits

Mass Timber Research Workshop | September 20-22

USDA Forest Products Research Lab – Madison, WI

Visit woodworks.org/events

Continuing Education Credits

- Participants will receive a certificate of completion via email within two weeks.
- AIA credits will be processed by WoodWorks

visit us at
booth 507

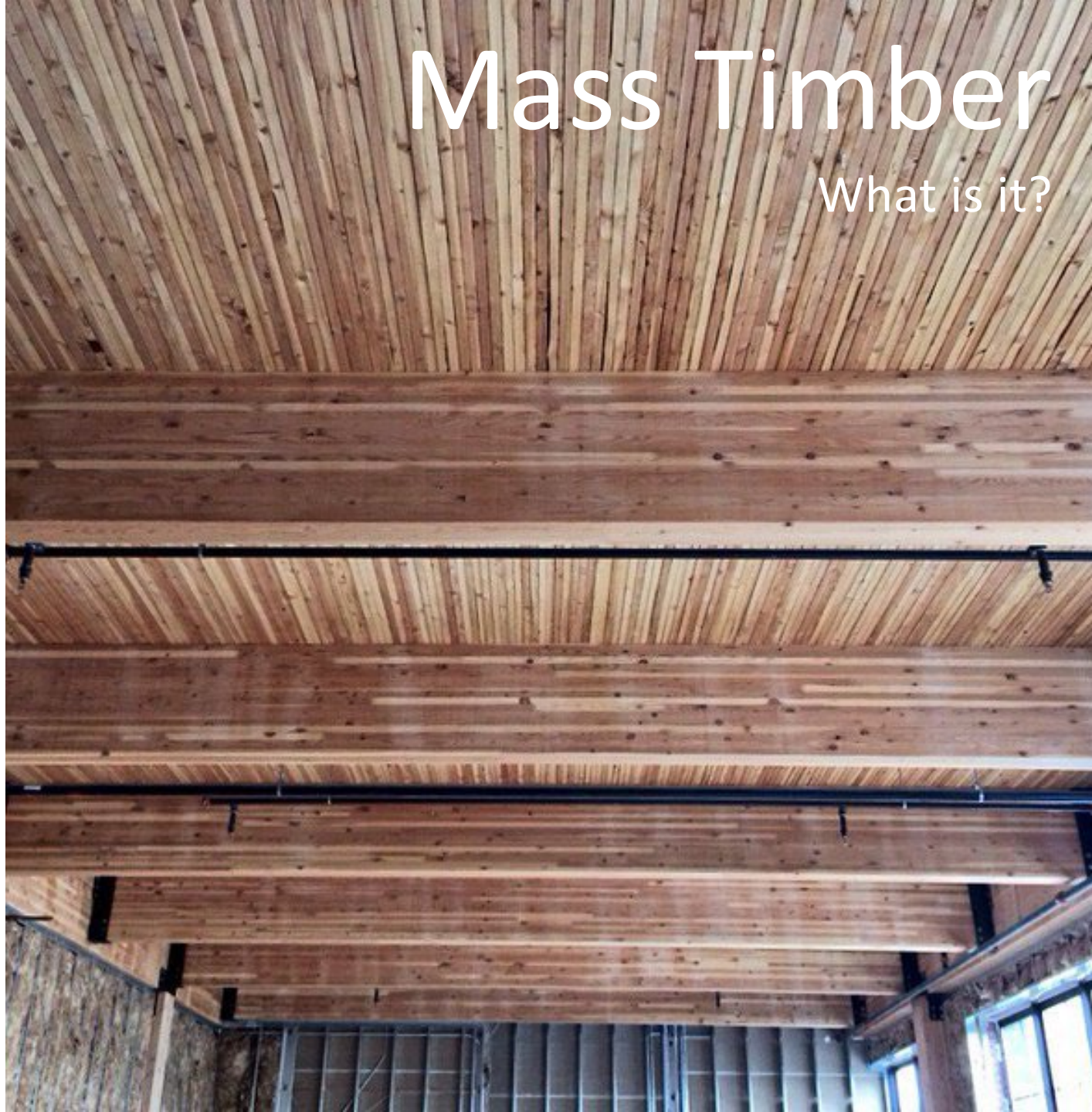
Questions? Ask us anything

Lake|Flato Architects (Design Architect), BOKA Powell (AOR), StructureCraft, Danysh & Associates, photo Erika Brown Edwards

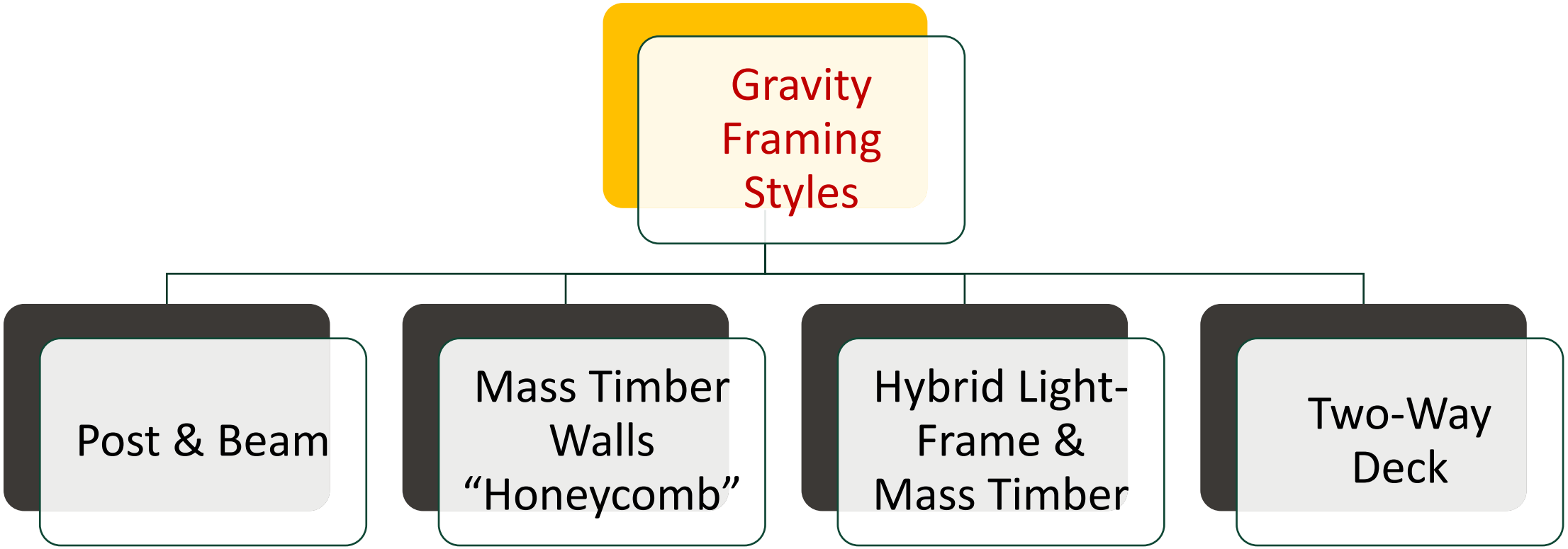
Mass Timber

What is it?

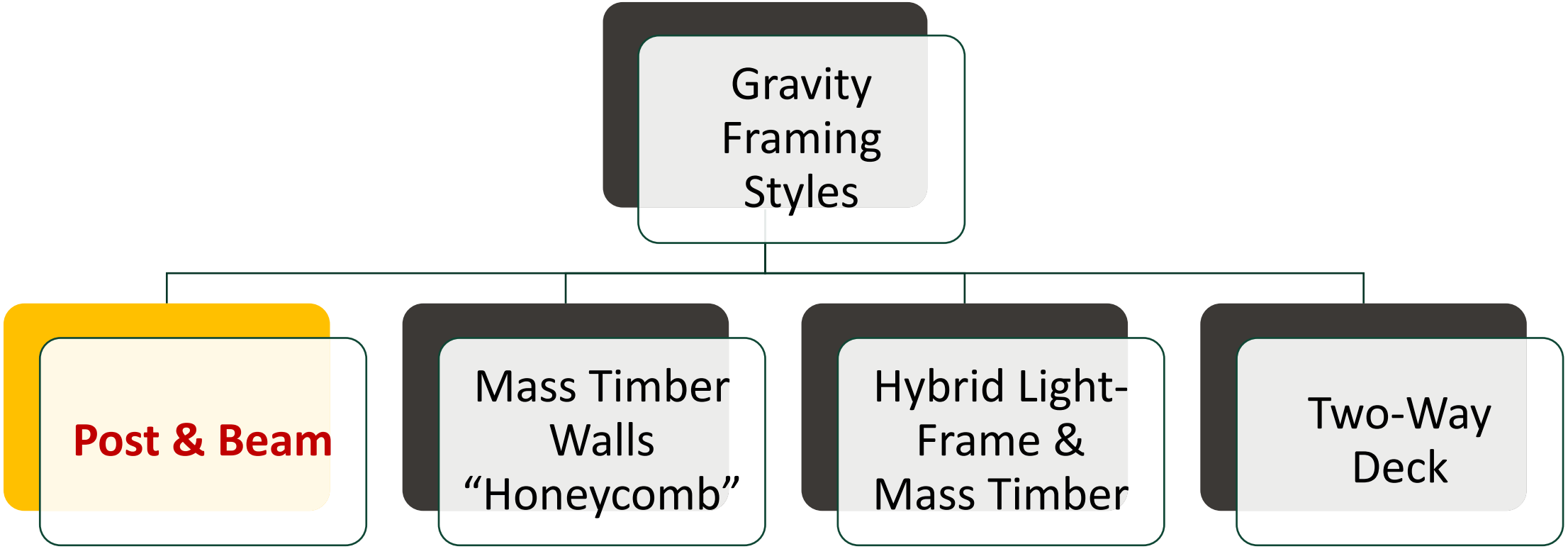
Mass timber is a category of framing styles often using small wood members formed into large panelized solid wood construction including CLT, NLT or glulam panels for floor, roof and wall framing



Mass Timber Framing Systems



Mass Timber Framing Systems



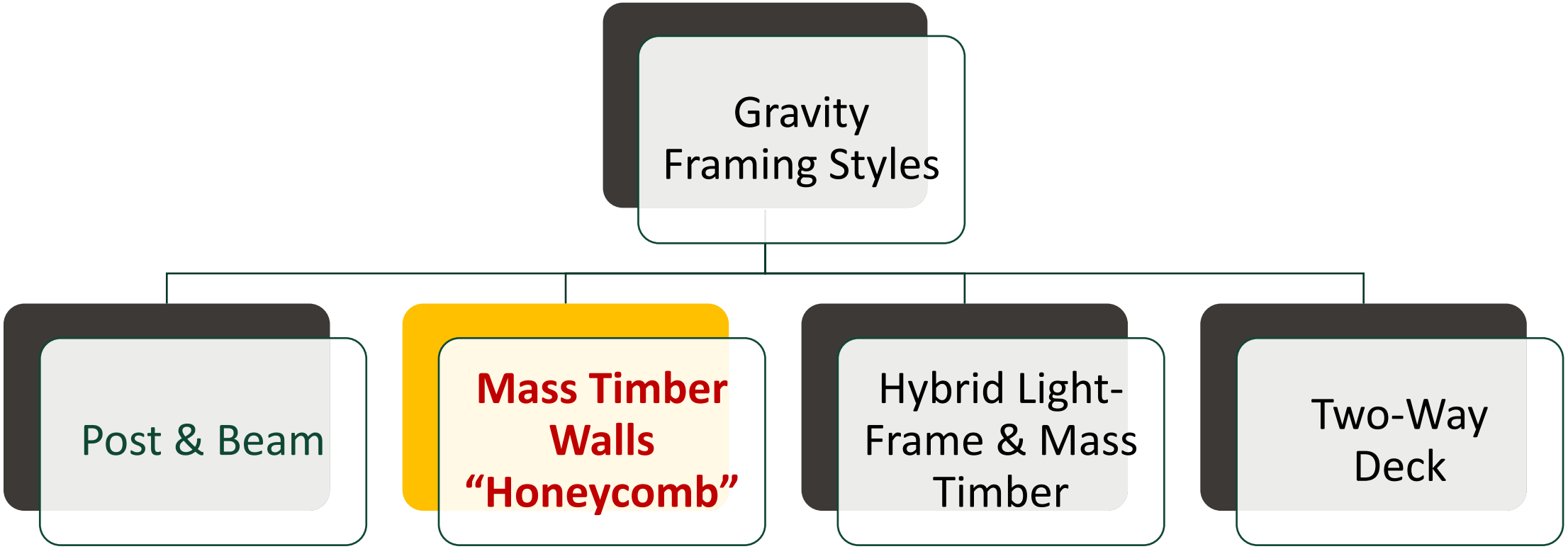
Bullitt Center

Seattle, WA

2x4 NLT roof deck
2x6 NLT floor deck
Floor assembly top to bottom:
3” concrete topping, acoustical mat, WSP, 2x6 NLT

Photo Credit: John Stamets

Mass Timber Framing Systems



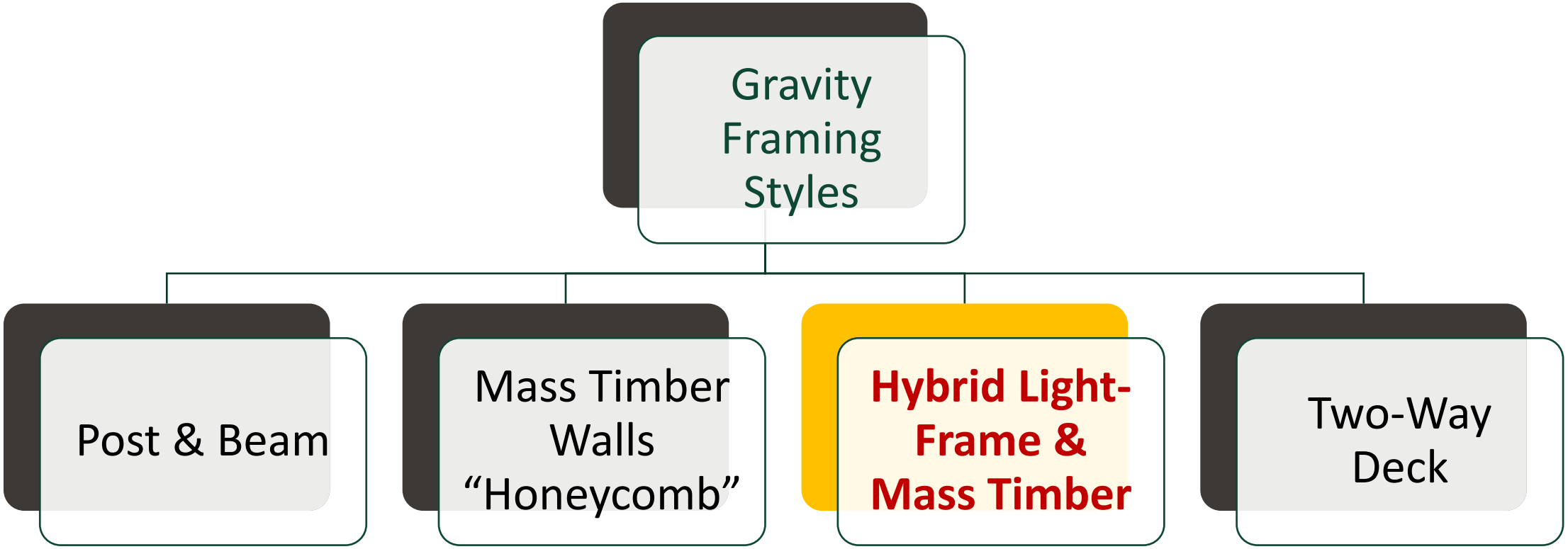
Candlewood Suites

Redstone Arsenal, AL

- 62,600 SF, 4 story hotel, 92 private rooms
- CLT utilized for walls, roof panels, and floor panels

Image Credit: Lend Lease

Mass Timber Framing Systems



Canyons

Portland, OR

Credit: Jeremy Bittermann & Kaiser + Path

Mass Timber and Steel Framing

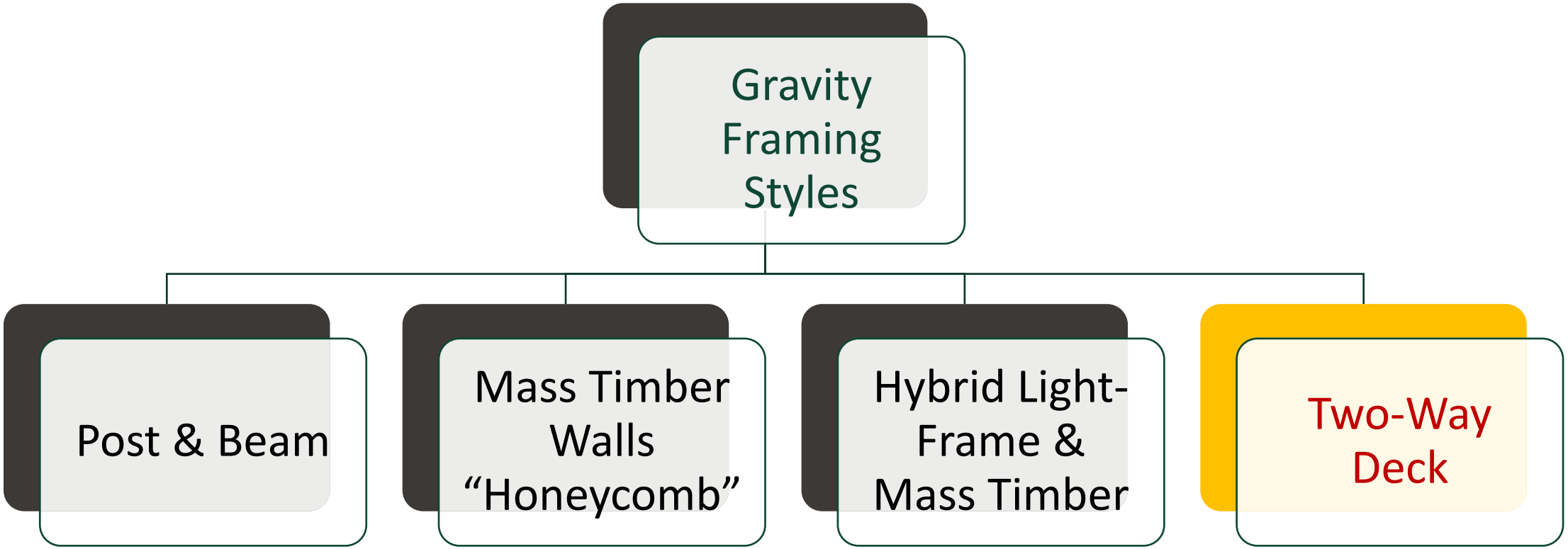
Barracuda Condos
Madison WI

Photo Credit: WoodWorks

Public Library
Brentwood CA

Photo Credit: Holmes Structures

Mass Timber Framing Systems



5 ply CLT panels, 2-way span
~9’x13’ grid of columns

Brock Commons

Vancouver, BC

Images: Acton Ostry Architects

What's in a mass timber building? Products used

Photo: Structurlam

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

Nail-Laminated Timber (NLT)

Photo: Think Wood

Dowel-Laminated Timber (DLT)

Photo: StructureCraft

Glue-Laminated Timber (GLT)

Plank orientation

Photo: StructureCraft

Photo: Ema Peter

Photo: StructureCraft

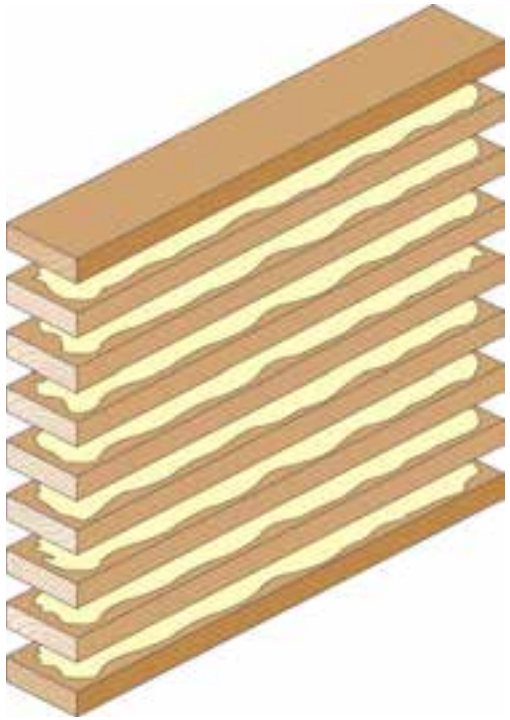
Photo: Marlasc Isaac Architects/Fast + Epp

MASS TIMBER PRODUCTS

GLULAM

GLULAM = A STRUCTURAL COMPOSITE OF LUMBER AND ADHESIVES

- RECOGNIZED IN IBC 2303.1.3 USING ANSI/AITC A 190.1 AND ASTM D 3737
- CAN BE USED FOR FLOOR, ROOF PURLINS, BEAMS, ARCHES, COLUMNS



MASS TIMBER PRODUCTS

GLULAM

GLULAM SPECS:

TYPICAL WIDTHS:

3-1/8”, 3-1/2”, 5-1/8”, 5-1/2”, 6-3/4”, 8-3/4”, 10-3/4”, 12-1/4”

TYPICAL DEPTHS:

INCREMENTS PER # OF LAMS FROM 6” TO 60”+
WESTERN SPECIES LAMS ARE TYPICALLY 1-1/2” THICK
SOUTHERN PINE LAMS ARE TYPICALLY 1-3/8” THICK

TYPICAL SPECIES:

DOUGLAS-FIR, SOUTHERN PINE, SPRUCE
ALSO AVAILABLE IN CEDAR & OTHERS

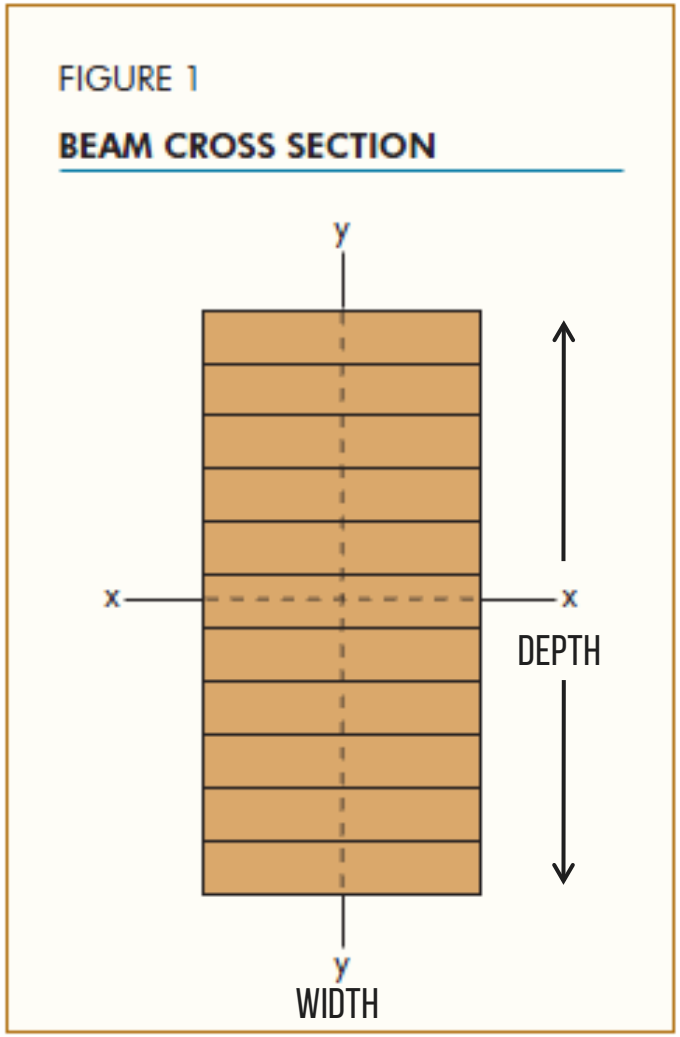


IMAGE: APA GLULAM PRODUCT GUIDE

MASS TIMBER PRODUCTS

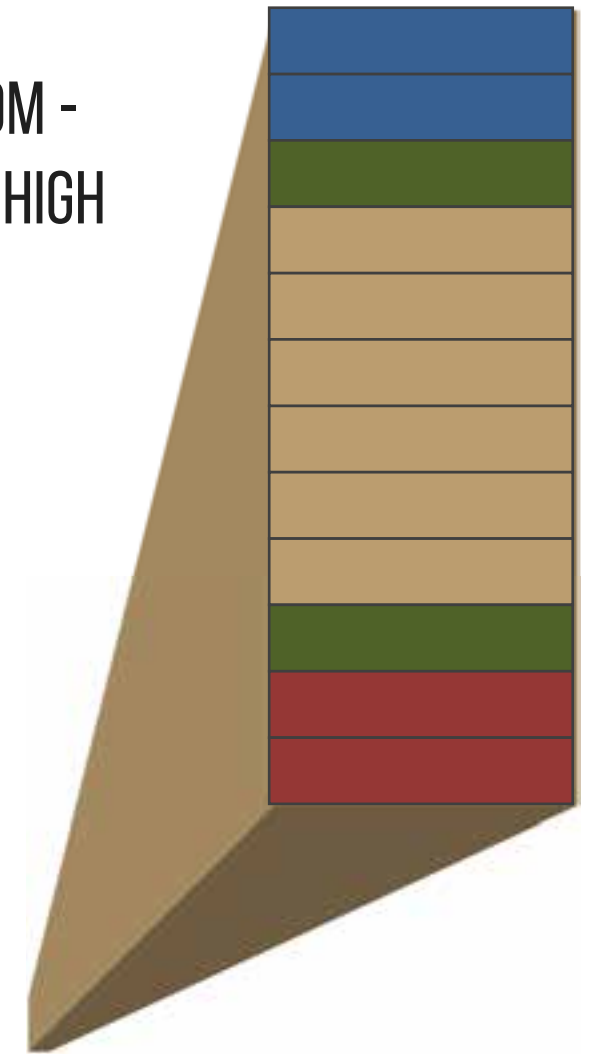
GLULAM

GLULAM LAYUP:

VARY STRENGTH OF LAMINATIONS

- HIGHER STRENGTH LAMS AT TOP AND BOTTOM - TENSION AND COMPRESSION STRESSES ARE HIGH
- LOWER STRENGTH LAMS IN CENTER PLIES

IMAGE: APA



HIGH STRENGTH OUTER COMPRESSION LAMS

MEDIUM GRADE INNER COMPRESSION LAM

LOWER GRADE INNER LAMS

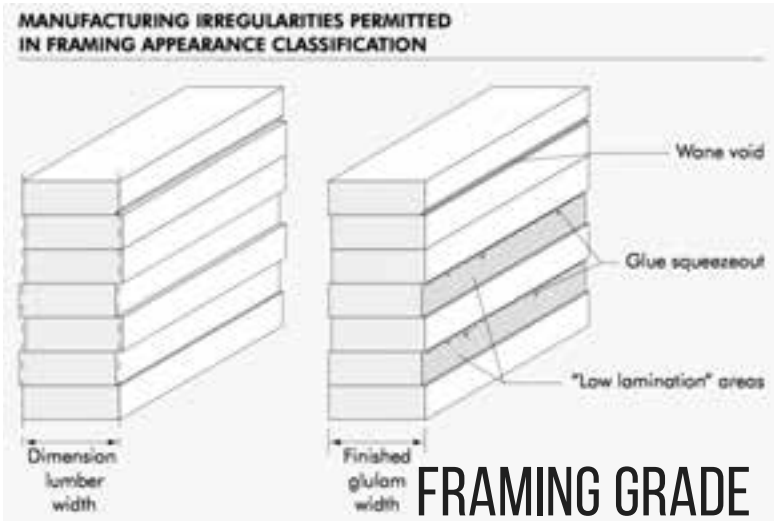
MEDIUM GRADE INNER COMPRESSION LAM

HIGH STRENGTH OUTER TENSION LAMS

PHOTO: EMA PETER PHOTOGRAPHY

MASS TIMBER PRODUCTS

GLULAM



FRAMING GRADE

GLULAM APPEARANCE GRADES


INDUSTRIAL GRADE


ARCHITECTURAL GRADE


PREMIUM GRADE

IMAGES: AMERICAN LAMINATORS

MASS TIMBER PRODUCTS

GLULAM

PHOTO CREDIT: ANTHONY FOREST PRODUCTS

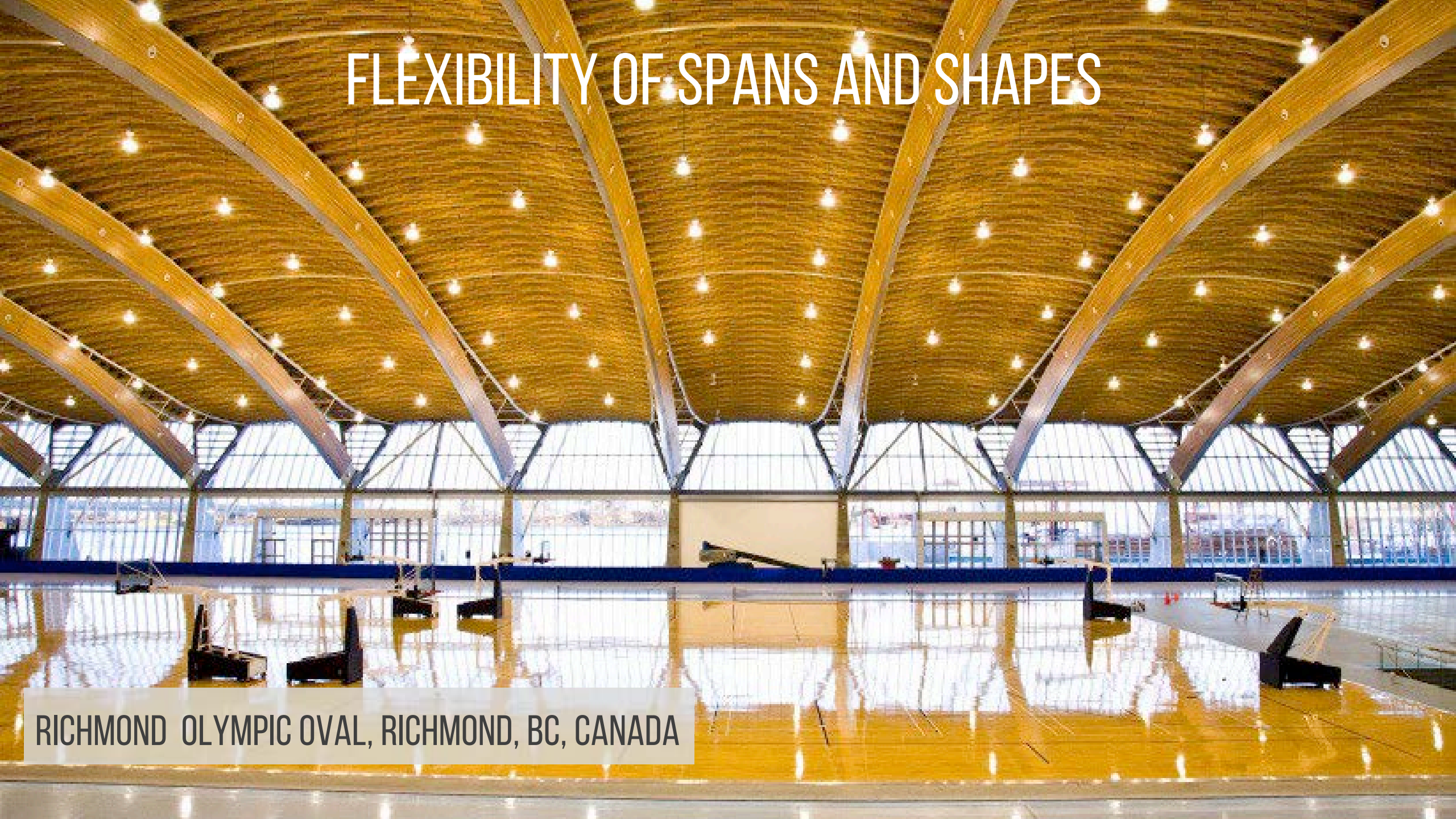
GLULAM SPECS:

PT READILY AVAILABLE
FRT MAY BE AVAILABLE, VARIES BY MANUFACTURER & TREATER

CAN BE CAMBERED, CURVED & TAPERED

DIFFERENT APPEARANCE GRADES AVAILABLE

FLEXIBILITY OF SPANS AND SHAPES



RICHMOND OLYMPIC OVAL, RICHMOND, BC, CANADA

THE CATHEDRAL OF CHRIST THE LIGHT

OAKLAND, CA

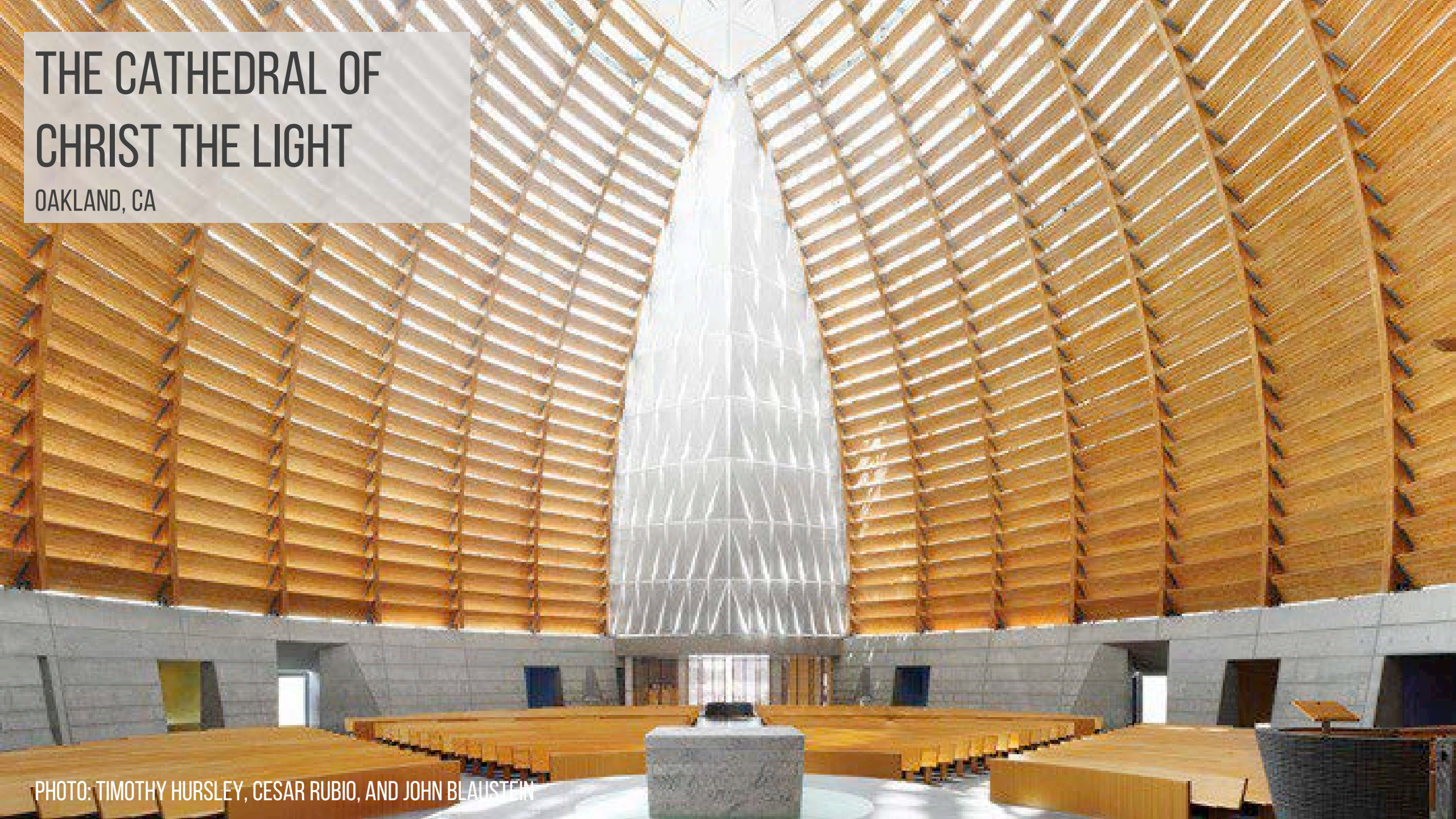


PHOTO: TIMOTHY HURSLEY, CESAR RUBIO, AND JOHN BLAUSTEIN

MASS TIMBER PRODUCTS

CROSS-LAMINATED TIMBER (CLT)

MASS TIMBER PRODUCTS

CROSS-LAMINATED TIMBER (CLT)

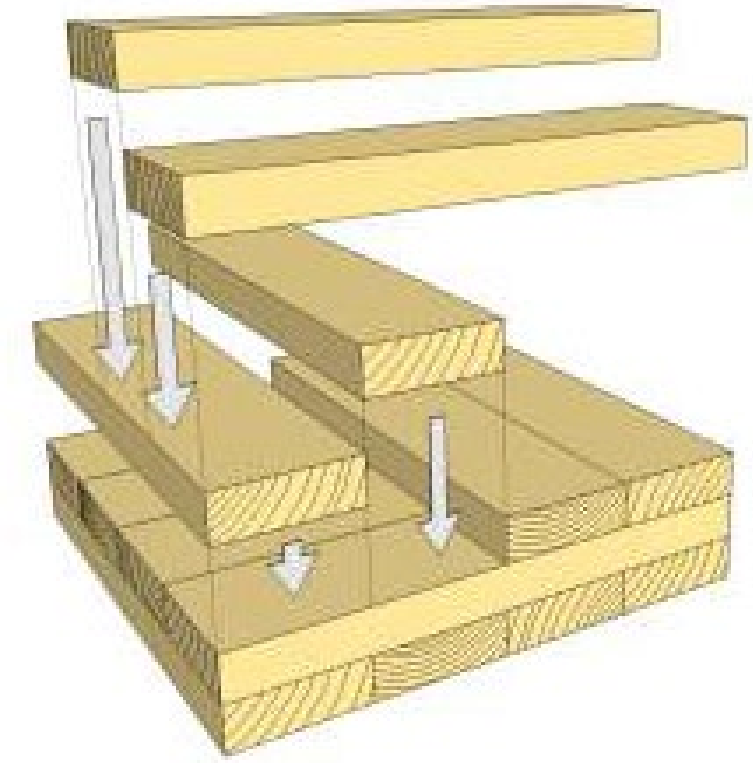
WHAT IS CLT?

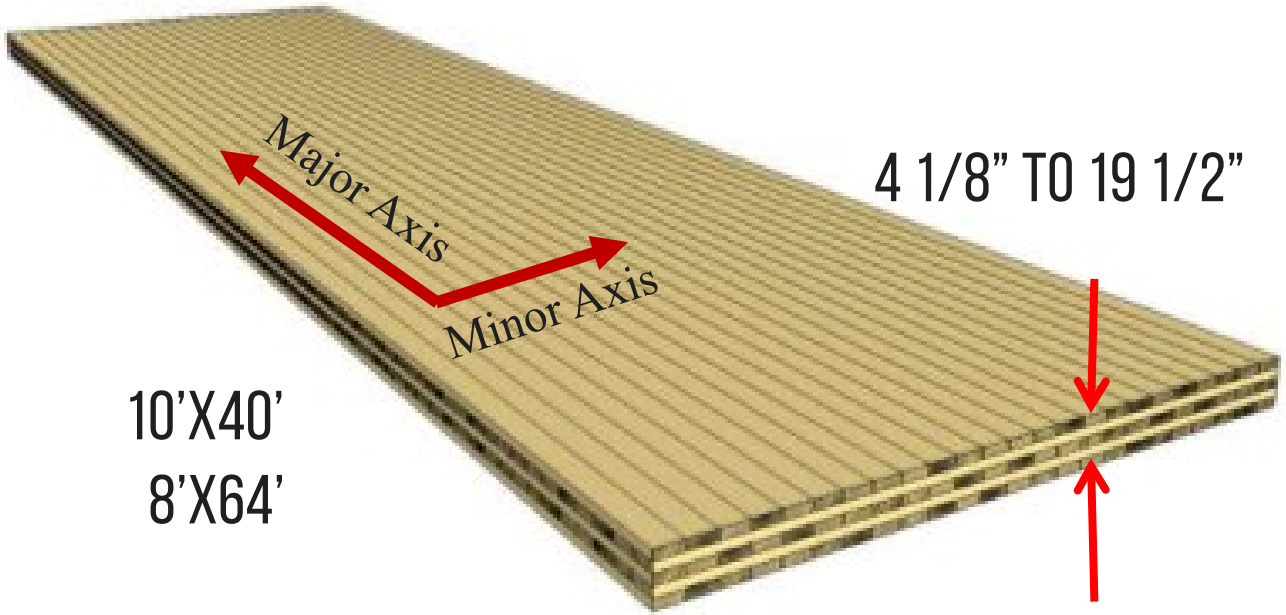
SOLID WOOD PANEL

3 LAYERS MIN. OF SOLID SAWN LAMS

90 DEG. CROSS-LAMS

SIMILAR TO PLYWOOD SHEATHING





MASS TIMBER PRODUCTS

CROSS-LAMINATED TIMBER (CLT)

COMMON CLT LAYUPS

3-PLY 3-LAYER

5-PLY 5-LAYER

7-PLY 7-LAYER

9-PLY 9-LAYER

7-PLY 5-LAYER

9-PLY 7-LAYER

MASS TIMBER PRODUCTS

CROSS-LAMINATED TIMBER (CLT)

PHOTO CREDIT: DR JOHNSON

MASS TIMBER PRODUCTS

CLT PANEL FABRICATION

CROSS-LAMINATED TIMBER (CLT)

MASS TIMBER PRODUCTS

CROSS-LAMINATED TIMBER (CLT)

CLT PREFABRICATION

- FINISHED PANELS ARE PLANED, SANDED, CUT TO SIZE. THEN OPENINGS ARE CUT WITH PRECISE CNC ROUTERS.
- THIRD PARTY INSPECTION AT FACTORY
- CUSTOM ENGINEERED FOR MATERIAL EFFICIENCY
- CUSTOM DESIGNED FOR PROJECT
- EACH PANEL NUMBERED, DELIVERED & INSTALLED IN PREDETERMINED SEQUENCE

ALBINA YARD

PORTLAND, OR

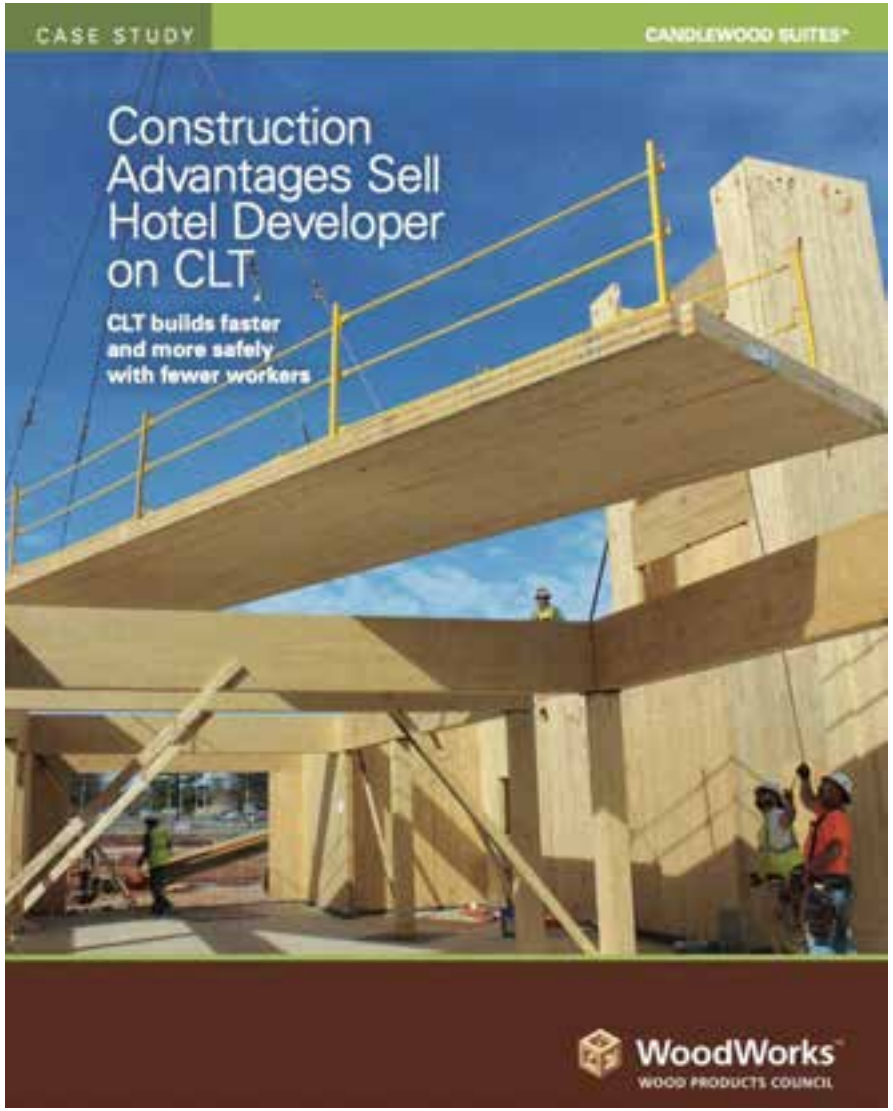
4 STORIES
16,000 SF
GREEN ROOF

ARCHITECT: LEVER ARCHITECTURE
IMAGE CREDIT: LEVER ARCHITECTURE

CANDLEWOOD SUITES

REDSTONE ARSENAL, AL

IMAGE CREDIT: LEND LEASE & SCHAEFER



- 62,600 SF, 4 STORY HOTEL, 92 PRIVATE ROOMS
- CLT UTILIZED FOR WALLS, ROOF PANELS, AND FLOOR PANELS
- 1,557 CLT PANELS; TYPICAL FLOOR PANEL IS 8’X50’ & WEIGHS 8,000 LBS
- COMPLETED LATE 2015

PAL Portfolio	Typical New PAL Hotel (Actual*)	Redstone Arsenal (Actual)	Difference
Gross square feet (sf)	54,891	62,688	+14%
Average # of employees	18 (peak 26)	10 (peak 11)	-43%
Structural duration (days)	123	78	-37%
Structural person hours	14,735	8,203	-44%
Structural production rate/day	460 sf	803 sf	+75%
Overall schedule	15 months	12 months	-20%

* PAL New Build Hotel Historical Average
Source: Lendlease

43%

Savings on this CLT project compared to typical light gauge steel construction

Candlewood Suites at Redstone Arsenal, AL
4 Stories, 62k SF

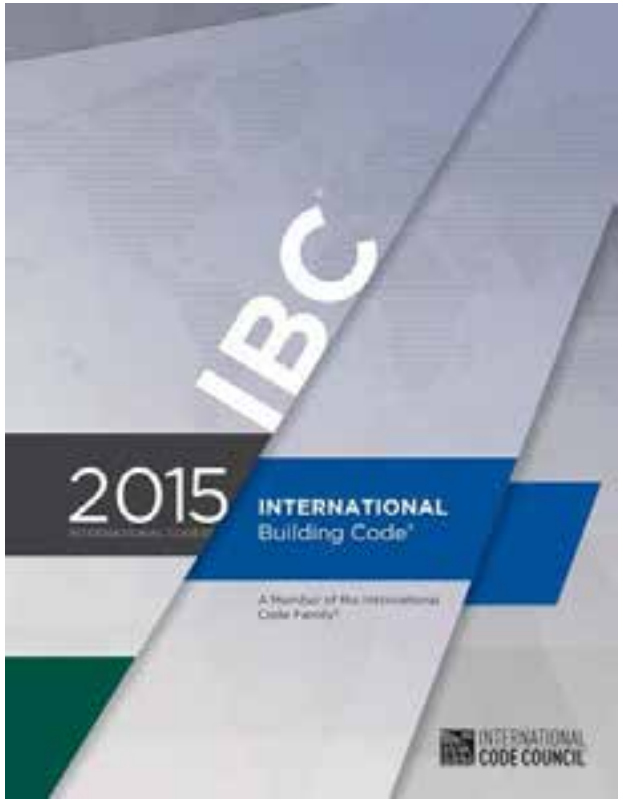
Image: Lendlease | Source: Lendlease[2]

MASS TIMBER PRODUCTS

CROSS-LAMINATED TIMBER (CLT)

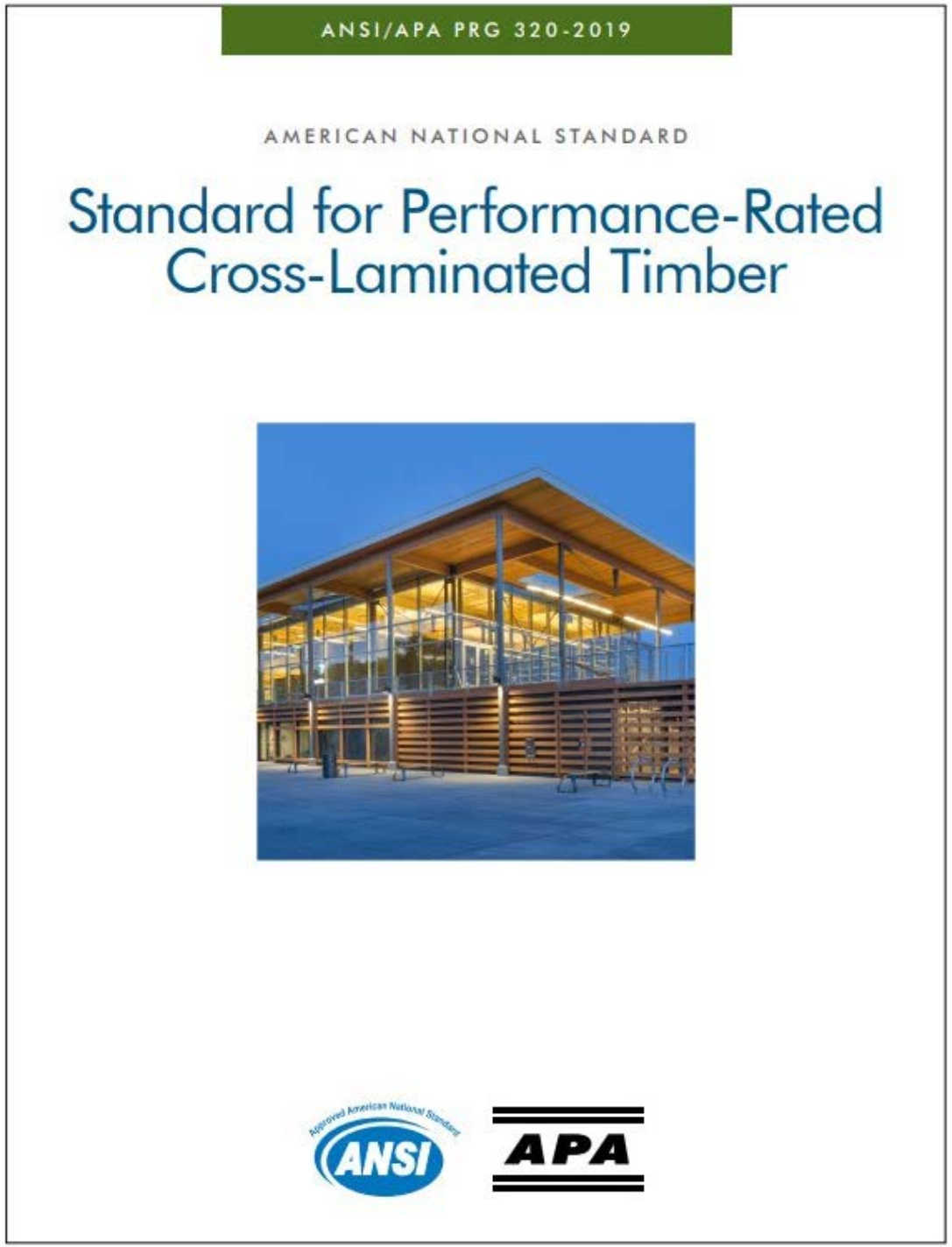
IN 2015 IBC, CLT IS NOW DEFINED IN CHAPTER 2 DEFINITIONS:

[BS] CROSS-LAMINATED TIMBER. A prefabricated engineered wood product consisting of not less than three layers of solid-sawn lumber or *structural composite lumber* where the adjacent layers are cross oriented and bonded with structural adhesive to form a solid wood element.



AND IS REFERENCED IN CHAPTER 23:

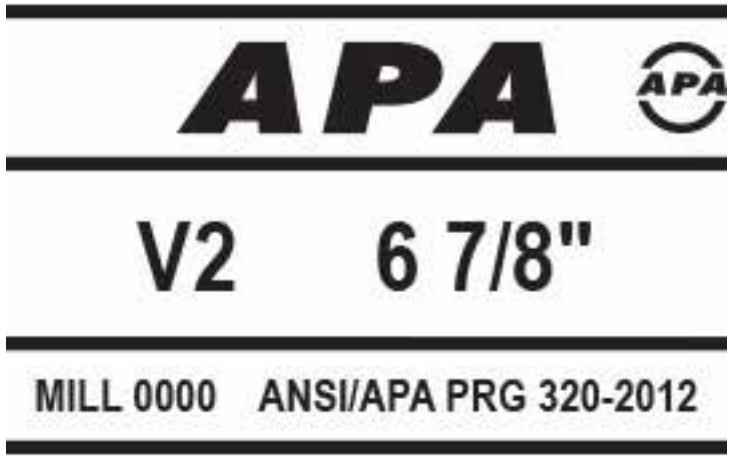
2303.1.4 Structural glued cross-laminated timber. Cross-laminated timbers shall be manufactured and identified in accordance with ANSI/APA PRG 320.



MASS TIMBER PRODUCTS

CROSS-LAMINATED TIMBER (CLT)

CLT PRODUCT STANDARD



ANSI / APA PRG 320 STANDARD FOR PERFORMANCE RATED CROSS-LAMINATED TIMBER

MASS TIMBER PRODUCTS

CLT PRODUCT REPORTS

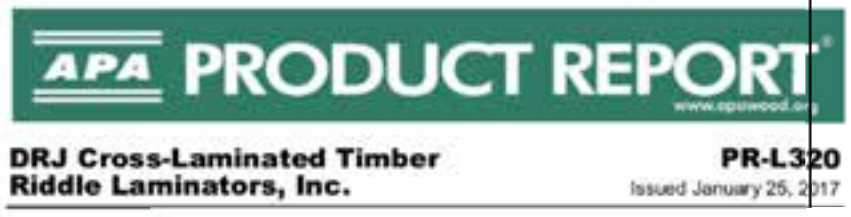
CROSS-LAMINATED TIMBER (CLT)

APA PRODUCT REPORT
www.apawood.org

SmartLam Cross-Laminated Timber **PR-L319**
SmartLam, LLC Issued August 15, 2016

Products: Sm
SmartLam, LL
1863 13th Stre
Columbia Falls
(406) 862-009
www.smartlam

1. Basis of
   - 2015
   - 2012
   - 2015
   - 2012
   - ANSI/
   - APA
2. Product
3. Design p
4. Product

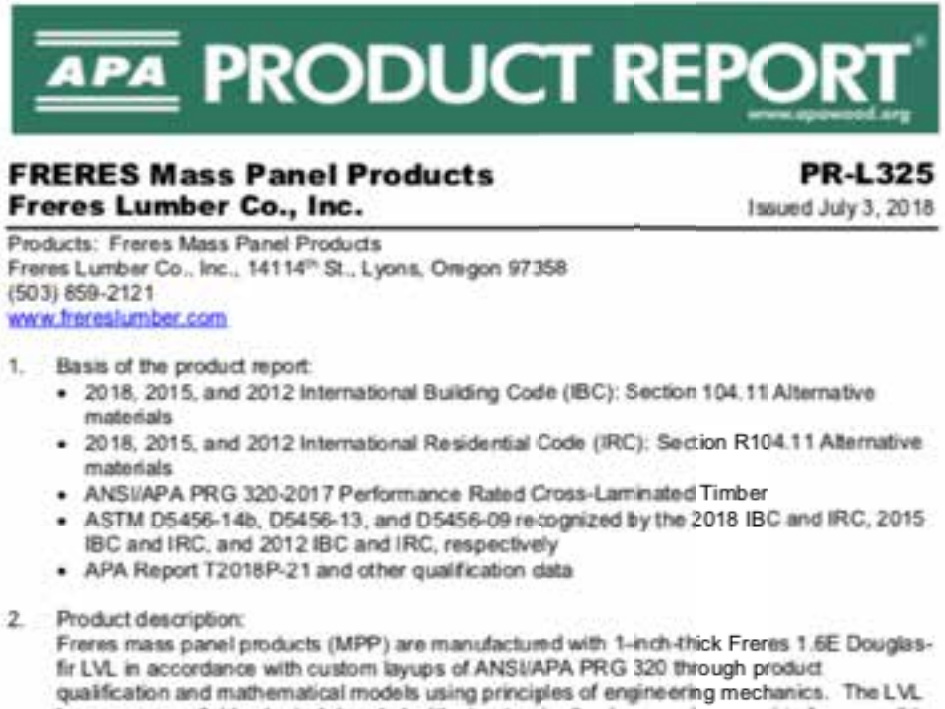


APA PRODUCT REPORT
www.apawood.org

DRJ Cross-Laminated Timber **PR-L320**
Riddle Laminators, Inc. Issued January 25, 2017

Products: DRJ
Riddle Laminato
1991 Pruner Ro
P.O. Box 66
Riddle, OR 9746
(541) 874-8267
www.drjlumber.c

1. Basis of the
   - 2015 Int
   - 2012 an
   - 2015 Int
   - 2012 an
   - ANSI/AF
   - APA Re
2. Product de
3. Design pro



APA PRODUCT REPORT
www.apawood.org

FRERES Mass Panel Products **PR-L325**
Freres Lumber Co., Inc. Issued July 3, 2018

Products: Freres Mass Panel Products
Freres Lumber Co., Inc., 14114th St., Lyons, Oregon 97358
(503) 859-2121
www.frereslumber.com

1. Basis of the product report:
   - 2018, 2015, and 2012 International Building Code (IBC): Section 104.11 Alternative materials
   - 2018, 2015, and 2012 International Residential Code (IRC): Section R104.11 Alternative materials
   - ANSI/APA PRG 320-2017 Performance Rated Cross-Laminated Timber
   - ASTM D5456-14b, D5456-13, and D5456-09 recognized by the 2018 IBC and IRC, 2015 IBC and IRC, and 2012 IBC and IRC, respectively
   - APA Report T2018P-21 and other qualification data
2. Product description:
   Freres mass panel products (MPP) are manufactured with 1-inch-thick Freres 1.6E Douglas-fir LVL in accordance with custom layups of ANSI/APA PRG 320 through product qualification and mathematical models using principles of engineering mechanics. The LVL

AUTHORIZATION TO MARK

In recognition of its compliance with PFS TECO's policies, the manufacturer listed below is authorized to mark their product(s) with the following certification mark.

PFS

Manufactur
PFS TECO
Product:
Product De

ES ICC EVALUATION SERVICE

ICC-ES Evaluation Report **ESR-4081**
Issued June 2020

(800) 423-6
-WOOD, PLA
Cross-laminat
USYSTEME G
ECT:
BBS
COPE
he following c
and 2009 Inte
12 and 2009
ith codes ad
uilding and
d LARC Suppl
he following s
-320-2019 Sta
inated Timber
t:
S is a cross-
mponents in fl
(IBC) and in
or decks only

APA PRODUCT REPORT
www.apawood.org

Vaagen Cross-Laminated Timber **PR-L328**
Vaagen Timbers, LLC Revised April 1, 2022

Products: Vaagen Cros
Vaagen Timbers, LLC, 1
(509) 684-3678
www.vaagentimbers.com

1. Basis of the produc
   - 2021, 2018, and
   glued cross-lam
   - 2012 IBC: Sect
   - 2021, 2018, and
   R602.1.6, and F
   - 2012 IRC: Secti
   - ANSI/APA PRG
   recognized in th
   - ANSI/APA PRG
   IBC and IRC, 20
   - APA Reports T2
2. Product description
   Vaagen cross-lami
   accordance with cu
   qualification and/or
   Allowable design p
   Table 1. Vaagen C

APA PRODUCT REPORT
www.apawood.org

Kalesnikoff Cross-Laminated Timber **PR-L332**
Kalesnikoff Mass Timber Inc. Revised March 28, 2022

Products: Kalesnikoff Cross-Laminated Timber
Kalesnikoff Mass Timber Inc., P.O. Box 3000, Hwy 3A, Thrums, British Columbia
Canada V1N 3L8
(250) 399-4211
www.kalesnikoff.com

1. Basis of the product report:
   - 2021, 2018, and 2015 International Building Code (IBC): Section 2303.1.4 Structural glued cross-laminated timber
   - 2012 IBC: Section 104.11 Alternative materials
   - 2021, 2018, and 2015 International Residential Code (IRC): Sections R502.1.6, R602.1.6, and R802.1.6 Cross-laminated timber
   - 2012 IRC: Section R104.11 Alternative materials
   - ANSI/APA PRG 320-2019 Standard for Performance-Rated Cross-Laminated Timber, recognized in the 2021 IBC and IRC

MASS TIMBER PRODUCTS

CLT WITH STRUCTURAL COMPOSITE LUMBER (SCL) LAMINATIONS

THICKNESSES IN 1” INCREMENTS
STRUCTURAL PROPERTIES IN APA
PRODUCT REPORT PR-L325

MASS TIMBER PRODUCTS

MASS PLYWOOD PANELS (MPP)

Table 1. ASD Reference Design Values[a,b,c] for Freres MPP (For Use in the U.S.)

MPP Layup	Layup ID	Thickness, t_p (in.)	Major Strength Direction				Minor Strength Direction			
			$(F_bS)_{eff,f,0}$ (lbf-ft/ft)	$(EI)_{eff,f,0}$ (10^6 lbf-in.^{2}/ft)	$(GA)_{eff,f,0}$ (10^6 lbf/ft)	$V_{s,0}$ (lbf/ft)	$(F_bS)_{eff,f,90}$ (lbf-ft/ft)	$(EI)_{eff,f,90}$ (10^6 lbf-in.^{2}/ft)	$(GA)_{eff,f,90}$ (10^6 lbf/ft)	$V_{s,90}$ (lbf/ft)
F16	F16-2	2	1,110	16	0.82	2,190	210	2.8	0.17	695
	F16-3	3	1,870	51	1.23	2,190	355	9.0	0.26	695
	F16-4	4	3,325	122	1.64	2,925	630	21	0.34	930
	F16-5	5	5,200	238	2.05	3,650	985	42	0.43	1,160
	F16-6	6	7,500	410	2.46	4,375	1,420	72	0.69	1,390
	F16-7	7	10,200	652	2.66	5,100	1,930	114	0.81	1,630
	F16-8	8	13,325	973	3.04	5,825	2,525	170	0.91	1,860
	F16-9	9	16,850	1,385	3.42	6,575	3,200	242	1.04	2,090
	F16-10	10	20,825	1,900	3.80	7,300	3,950	333	1.15	2,320
	F16-11	11	25,175	2,529	4.18	8,025	4,775	443	1.27	2,550
	F16-12	12	29,975	3,283	4.56	8,750	5,675	575	1.38	2,775

For SI: 1 in. = 25.4 mm; 1 ft = 304.8 mm; 1 lbf = 4.448N

(a) Tabulated values are allowable design values.

(b) Tabulated values are limited to MPP manufactured with 1-inch-thick Freres 1.6E Douglas-fir LVL.

(c) Deflection under a specified uniformly distributed load, w, acting perpendicular to the face of a single deflections due to moment and shear effects using the effective bending stiffness, $(EI)_{eff}$, and the eff follows:

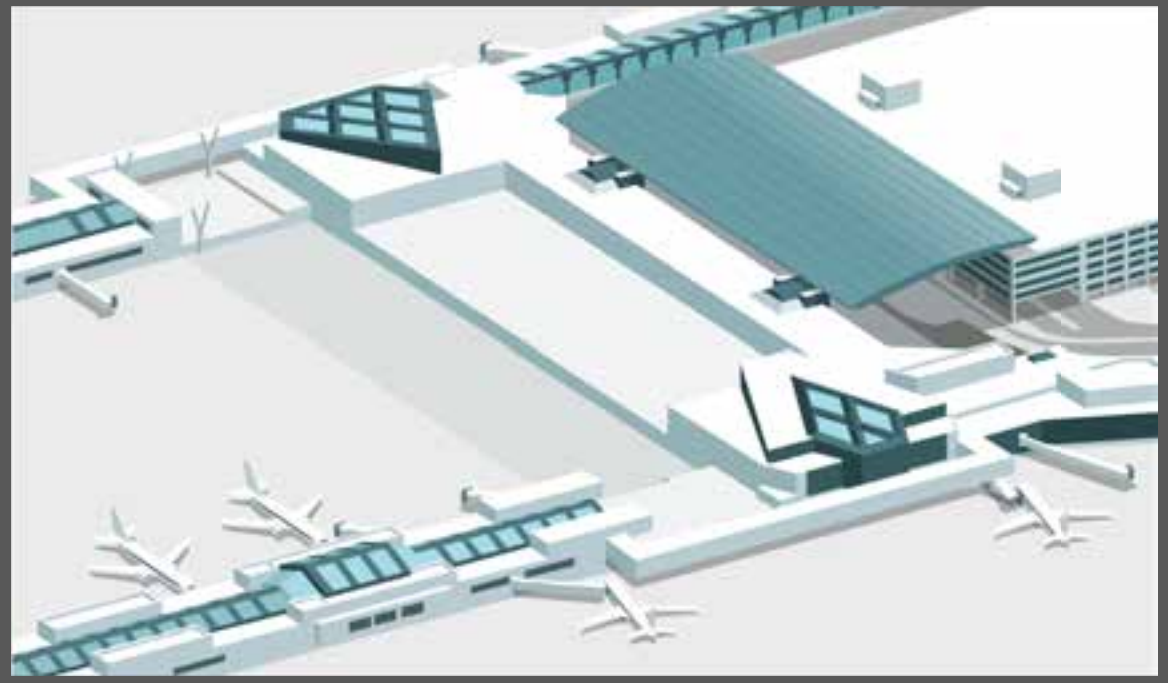
$$\delta = \frac{22.5wL^4}{(EI)_{eff}} + \frac{3wL^2}{2(GA)_{eff}}$$

where: δ = Estimated deflection, inches; w = uniform load, plf;
L = span, feet; $(EI)_{eff}$ = tabulated effective bending stiffness, 10^6
$(GA)_{eff}$ = tabulated effective in-plane (planar) shear rigidity, 10^6 lbf/ft

MPP

PORTLAND INTERNATIONAL AIRPORT – MAIN TERMINAL

PORTLAND, OR



GIF courtesy of PDXNext.com, Port of Portland

Photo: WoodWorks

NAIL LAMINATED TIMBER

PHOTO CREDIT: STRUCTURECRAFT BUILDERS

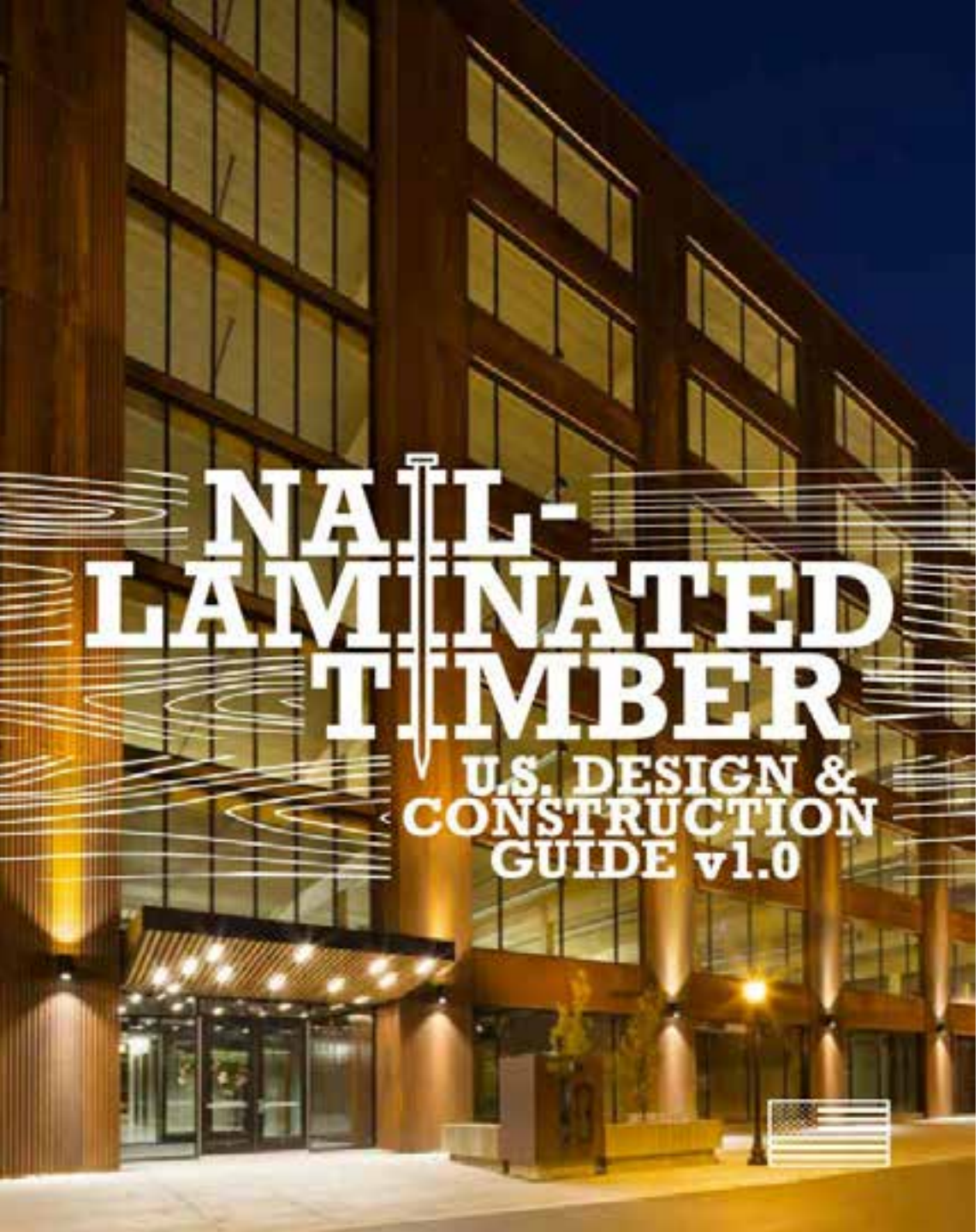
MASS TIMBER PRODUCTS

NAIL-LAMINATED TIMBER (NLT) PANELS

What is it?

Nail-laminated timber (NLT) is mechanically laminated to create a solid timber panel. NLT is created by placing dimension lumber (nominal 2x, 3x, or 4x thickness and 4 in. to 12 in. width) on edge and fastening the individual laminations together with nails.

Image: Think Wood



MASS TIMBER PRODUCTS

NAIL-LAMINATED TIMBER (NLT) PANELS

CONTENT INCLUDES:

- ARCHITECTURE
- FIRE
- STRUCTURE
- ENCLOSURE
- SUPPLY AND FABRICATION
- CONSTRUCTION AND INSTALLATION
- ERECTION ENGINEERING

FREE DOWNLOAD AT

WWW.THINKWOOD.COM/NLTGUIDE

MASS TIMBER PRODUCTS

NAIL-LAMINATED TIMBER (NLT) PANELS

NLT PANELS CAN BE BUILT ON-SITE/IN-PLACE OR PRE-FABRICATED OFFSITE


PHOTO CREDIT: JOHN STAMETS


PHOTO CREDIT: STRUCTURECRAFT BUILDERS

NLT DIAPHRAGM DESIGN:

LACK OF TESTED, PUBLISHED DIAPHRAGM VALUES FOR BARE NLT LEAD MANY ENGINEERS TO COVERING WITH WOOD STRUCTURAL PANELS. DESIGN AS A BLOCKED, SHEATHED DIAPHRAGM. USE SDPWS TABLE 4.2A/4.2B

MASS TIMBER PRODUCTS

NAIL-LAMINATED TIMBER (NLT) PANELS

PHOTO CREDIT: STRUCTURECRAFT BUILDERS

MASS TIMBER PRODUCTS

NAIL-LAMINATED TIMBER (NLT) PANELS

NLT SHRINKAGE/EXPANSION DESIGN:

RULE OF THUMB: LEAVE ONE PLY OUT PER 8’-10’ WIDE PANEL

MASS TIMBER PRODUCTS

NAIL-LAMINATED TIMBER (NLT) PANELS

PHOTO CREDIT: STRUCTURECRAFT BUILDERS

FLUTED PANEL OPTIONS
VARY LAMINATION DEPTHS

MASS TIMBER PRODUCTS

NAIL-LAMINATED TIMBER (NLT) PANELS

PHOTO CREDIT: STRUCTURECRAFT BUILDERS

PRE-FABRICATED PANELS
OFTEN PRE-SHEATHED

ONCE INSTALLED, ADD
STITCHING STRIPS, TAPE
JOINT IF APPLICABLE

T3 MINNEAPOLIS

MINNEAPOLIS, MN

Photo Credit: Blaine Brownell

T3 MINNEAPOLIS

MINNEAPOLIS, MN

Type IV Construction
7 stories (6 Timber on 1 Concrete)
234,000 sf
2x8 NLT Floor Panels w/3” Concrete Topping
Glulam Beam and Column Frame
20’x25’ Grid

Image Credit: StructureCraft Builders

T3 MINNEAPOLIS

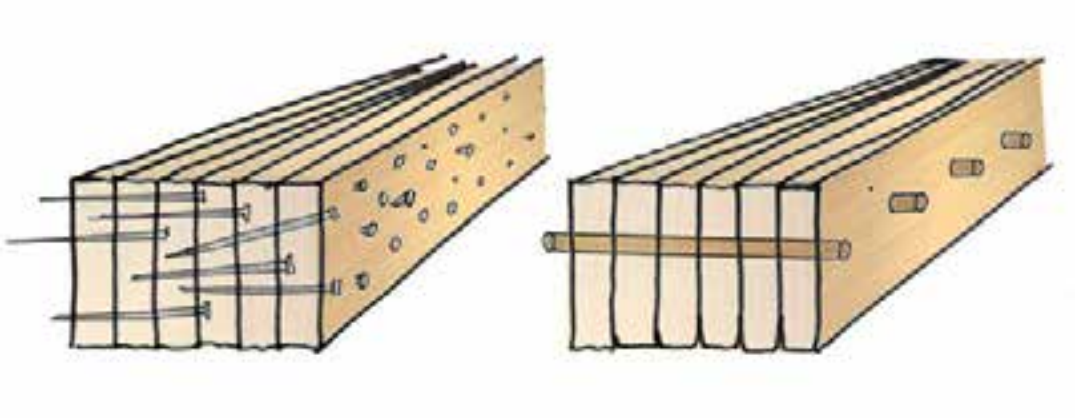
MINNEAPOLIS, MN

IMAGE CREDIT: EMA PETER

MASS TIMBER PRODUCTS

DOWEL-LAMINATED TIMBER (DLT)

PHOTO CREDIT: STRUCTURECRAFT BUILDERS

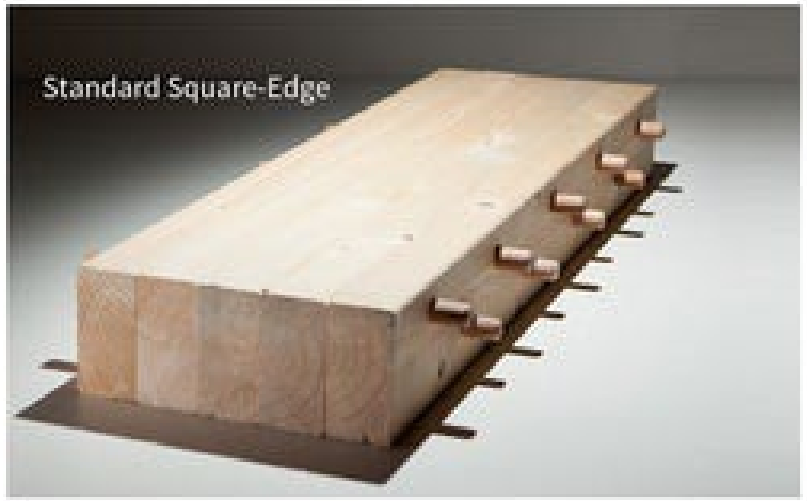


DLT:

- SIMILAR TO NLT – NAILS CONNECTING LAMS REPLACED WITH HARDWOOD DOWELS
- COMMON IN EUROPE – OFTEN REFERRED TO AS BRETTSTAPEL
- NOT CURRENTLY RECOGNIZED AS PRESCRIPTIVELY PERMITTED MATERIAL IN IBC
- TIMBER FRAMERS GUILD – RESOURCES ON DOWEL DESIGN

PHOTO CREDIT: STRUCTURECRAFT BUILDERS

VARIOUS PROFILE OPTIONS



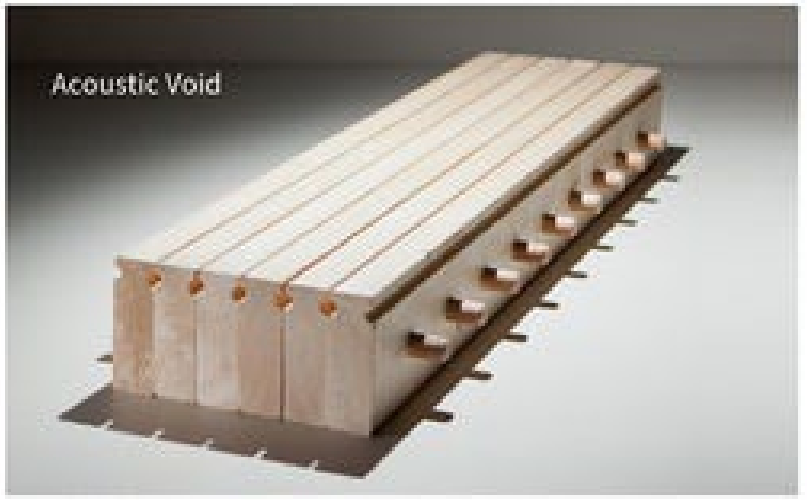


PHOTO CREDIT: STRUCTURECRAFT BUILDERS

111 EAST GRAND

DES MOINES, IA

CREDIT: NUEMANN MONSON ARCHITECTS
COURTESY: RYAN COMPANIES

CREDIT: STRUCTURECRAFT BUILDERS

4 STORY, 66,800 SF SPEC OFFICE BUILDING
DLT PANELS, GLULAM FRAME

MASS TIMBER PRODUCTS

GLUE-LAMINATED TIMBER (GLT) PANELS

PHOTO CREDIT: STRUCTURE FUSION

PHOTO CREDIT: UNALAM

MASS TIMBER PRODUCTS

GLUE-LAMINATED TIMBER (GLT) PANELS

IMAGE SOURCE: MANASC ISAAC ARCHITECTS/FAST + EPP

GLULAM DECKING:

- SIMILAR TO DEEP GLULAM BEAMS LAID ON THEIR SIDE
- SAME CODE REFERENCES AND MANUFACTURING STANDARDS AS GLULAM BEAMS AND COLUMNS
- BE CAREFUL OF DESIGN STRESSES AND LAYUPS USED – SPEC UNIFORM LAYUP (ALL LAMS SAME SPECIES & GRADE)

IMAGE SOURCE: STRUCTURECRAFT BUILDERS

MASS TIMBER PRODUCTS

GLUE-LAMINATED TIMBER (GLT) PANELS

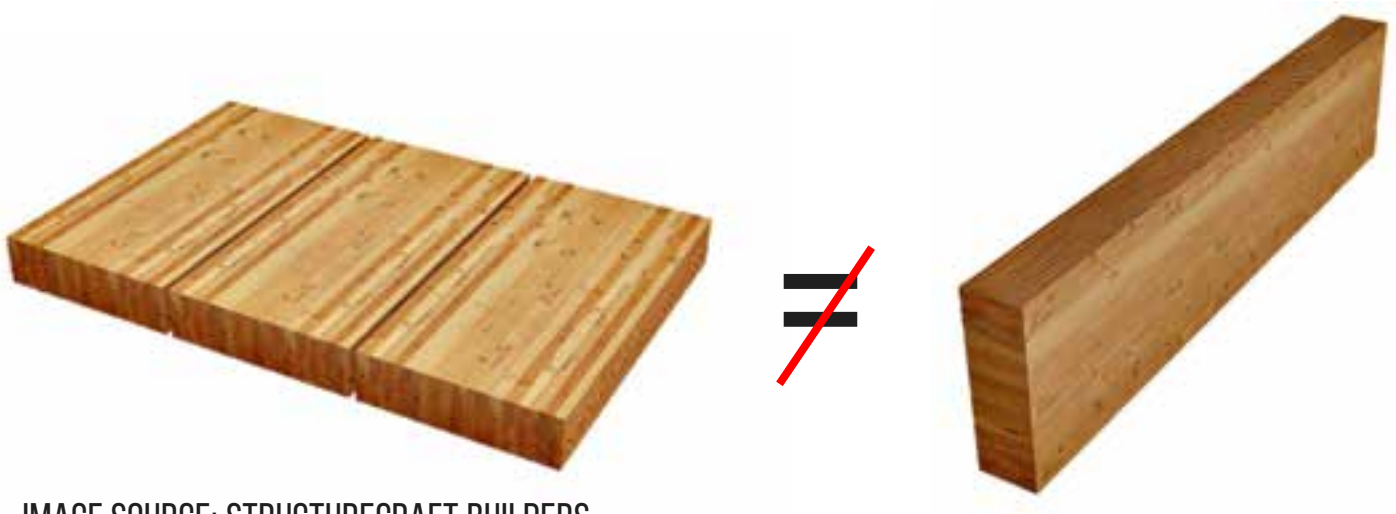


IMAGE SOURCE: STRUCTURECRAFT BUILDERS

Use with Table 5A Adjustment Factors

ecies / Core	Bending About X-X Axis (Loaded Perpendicular to Wide Faces of Laminations)							Bending About Y-Y Axis (Loaded Parallel to Wide Faces of Laminations)				
	Bending		Compression Perpendicular to Grain		Shear Parallel to Grain	Modulus of Elasticity		Bending	Compression Perpendicular to Grain	Shear Parallel to Grain	Modulus of Elasticity	
	Bottom of Beam Stressed in Tension (Positive Bending)	Top of Beam Stressed in Tension (Negative Bending)	Tension Face	Compression Face		For Deflection Calculations	For Stability Calculations				For Deflection Calculations	For Stability Calculations
	F_{bx}^{+} (psi)	F_{bx}^{-} (psi)	$F_{c\perp x}$ (psi)		$F_{vx}^{(2)}$ (psi)	E_x (10^6 psi)	$E_{x\,min}$ (10^6 psi)	F_{by} (psi)	$F_{c\perp y}$ (psi)	$F_{vy}^{(2)(3)}$ (psi)	E_y (10^6 psi)	$E_{y\,min}$ (10^6 psi)
	2400	**1450**	**650**		**265**	**1.8**	**0.95**	**1450**	**560**	**230**	**1.6**	**0.85**
F/DF	2400	1850	650	650	265	1.8	0.95	1450	560	230	1.6	0.85
F/DF	2400	2400	650	650	265	1.8	0.95	1550	560	230	1.6	0.85
F/DF	2400	1450	650	650	265	1.8	0.95	1400	560	230	1.7	0.90
F/DF	2400	2400	650	650	265	1.8	0.95	1750	560	230	1.7	0.90
F/DF	2400	2400	650	650	265	1.8	0.95	1550	560	230	1.7	0.90
P/SP	2400	2000	740	740	300	1.8	0.95	1700	650	260	1.6	0.85

NDS SUPPLEMENT LISTS DIFFERENT DESIGN VALUES FOR BENDING.

LAYUP COMBINATIONS TYPICALLY OPTIMIZED FOR BEAM APPLICATIONS.

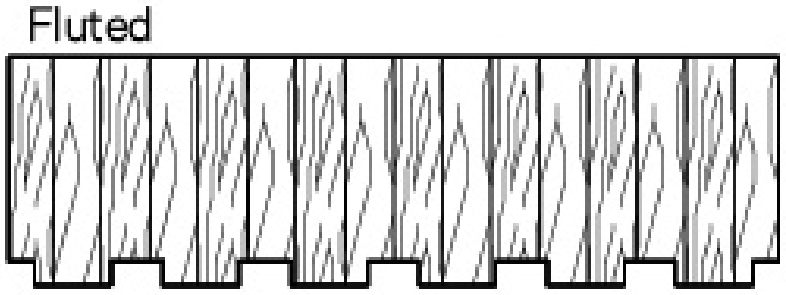
LAYUP COMBINATIONS AREN'T EFFECTIVE IN GLT DECKING APPLICATIONS

MASS TIMBER PRODUCTS

GLUE-LAMINATED TIMBER (GLT)

SAME SHRINKAGE AND DIAPHRAGM CONSIDERATIONS AS NLT:

- GAP PANELS TO ALLOW MOVEMENT
- COVER WITH WOOD STRUCTURAL PANEL FOR DIAPHRAGM
- AVAILABLE IN VARIETY OF LAMINATION OPTIONS



Find Mass Timber Projects

+ connect with the pros
who worked on them.

WOODWORKS
INNOVATION
NETWORK.ORG