State-of-Art Mass Timber Seismic Design and the 10 Story NHERI Mass Timber Shake Table Test

Introduced by:
Scott Breneman, Senior Technical Director, WoodWorks
Scott.Breneman@WoodWorks.org

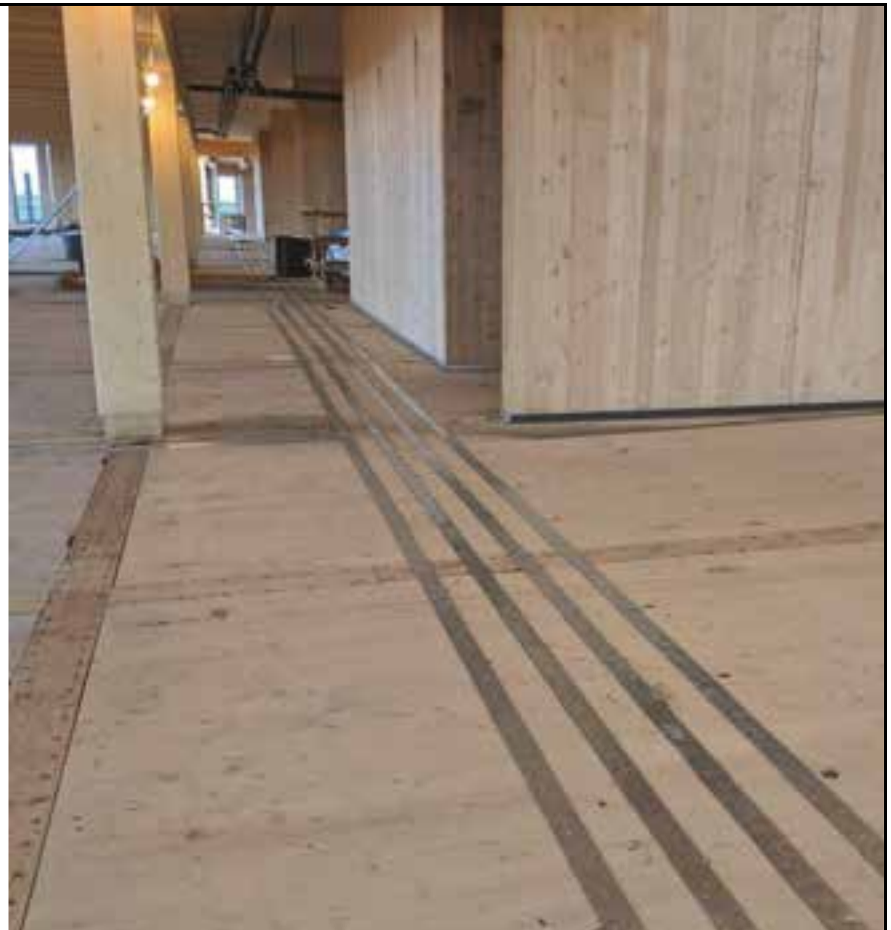

Photo credit: KPFF / Reid Zimmerman

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Today's Agenda

8:00 - 8:40 am: Welcome and Introduction to Mass Timber Lateral: Scott Breneman/WoodWorks

8:40 - 9:20 am: SDPWS 2021 - General Provisions and CLT Shear Wall Systems: Omar Amini/AWC

9:20 - 10:00 am: CLT Diaphragm Design Using SDPWS 2021: Eric McDonnell/Holmes

10:00 - 10:30 am: Break

10:30-11:10 am: Mass Timber Rocking Wall Systems and Design: Reid Zimmerman/KPFF

11:10-11:50 am: NHERI 10 Story Test Building Structure and Construction: Brooke Whitsell/Timberlab

11:50 – 12:00 pm: Conclusions and Site Visit Logistics: WoodWorks

Today's Agenda

12:00 – 3:30 pm | Site Visit to 10- Story NHERI Mass Timber Shake Table

On Return, bus will make a stop at San Diego Airport then Hilton San Diego Airport/Harbor Island.

Regional Directors: **One-on-One Project Support**

WOODWORKS
WPC

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Solutions Team


Scott Breneman, PhD, PE, SE


Ashley Cagle, PE, SE


Karen Gesa, PE


Erin Kinder, PE, SE, LEED AP


Melissa Kroskey, AIA, SE

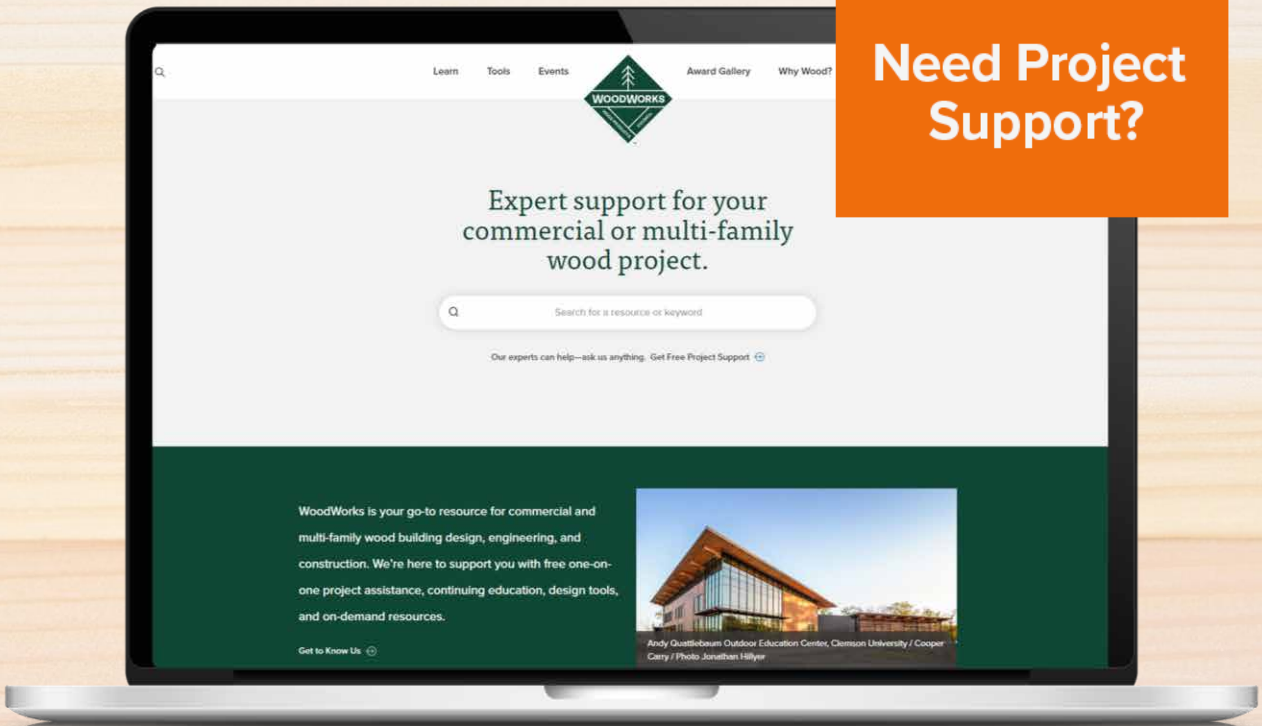

Bruce Lindsey


Terry Malone, PE, SE


Ricky McLain, PE, SE

WOODWORKS WPC

woodworks.org



Need Project Support?

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WOODWORKS WPC WOOD PRODUCTS COUNCIL

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

AIA Approved Continuing Education

Course Description

As the use of mass timber products in the built environment is growing rapidly, so has the interest in using all timber lateral systems for use in such buildings. Recent advances in design standardization such as in the 2021 edition of AWC's Special Design Provisions for Wind and Seismic Design have led to simpler approval of the defined CLT shear walls and CLT diaphragms covered. This workshop will present an overview of a full range of mass timber lateral systems in current use and under research and development. A detailed review of the SDPWS 2021 CLT shear wall system, now recognized with seismic design parameters in ASCE 7 2022, will be presented. Guidance will be provided on how to design CLT floor and roof systems as horizontal diaphragms with a discussion of different detailing strategies to create an efficient structural system. To go taller with mass timber shear wall systems, a recently developed mass timber rocking wall system design method will be presented. This mass timber working wall system is the vertical seismic system of the 10 story structure being tested at the NHERI outdoor shake table facility at University of California San Diego which will be visited in the afternoon of the workshop. Attend this workshop to learn about the latest advancements in mass timber seismic design and witness first hand innovations and research which will enable future tall all mass timber structures in high seismic regions.

Learning Objectives

1. Develop an understanding of structural design options for seismic design of mass timber buildings in the context of the International Building Code and California Building Code. and referenced standards.

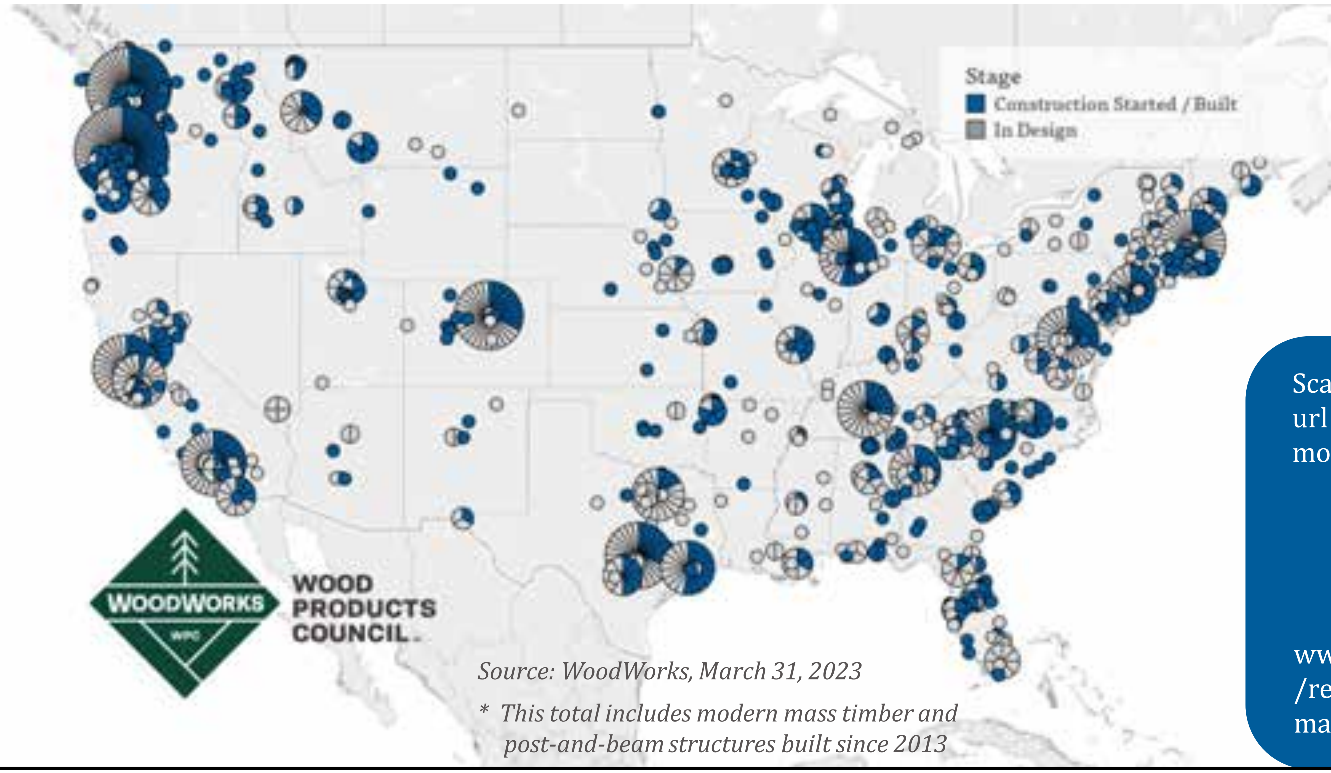
2. Learn from the research and standards team the intricacies of implementing the new SDPWS CLT Shear Wall system and the structural CLT diaphragms for wind and seismic applications

3. Summarize the mechanisms of the mass timber rocking wall system and the unique design attributes and characteristics.

4. See first-hand the components and design of the 10 story structure being tested at the NHREI 10 story shake table test at the UC San Diego outdoor test facility.

Current State of Mass Timber Projects

As of March 2023, in the US, **1,753** multi-family, commercial, or institutional projects have been constructed with, or are in design with, mass timber.



Source: WoodWorks, March 31, 2023

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

Scan this code or use the url to find the map and more details online.

www.woodworks.org /resources/mapping-mass-timber/

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Current State of Mass Timber Projects

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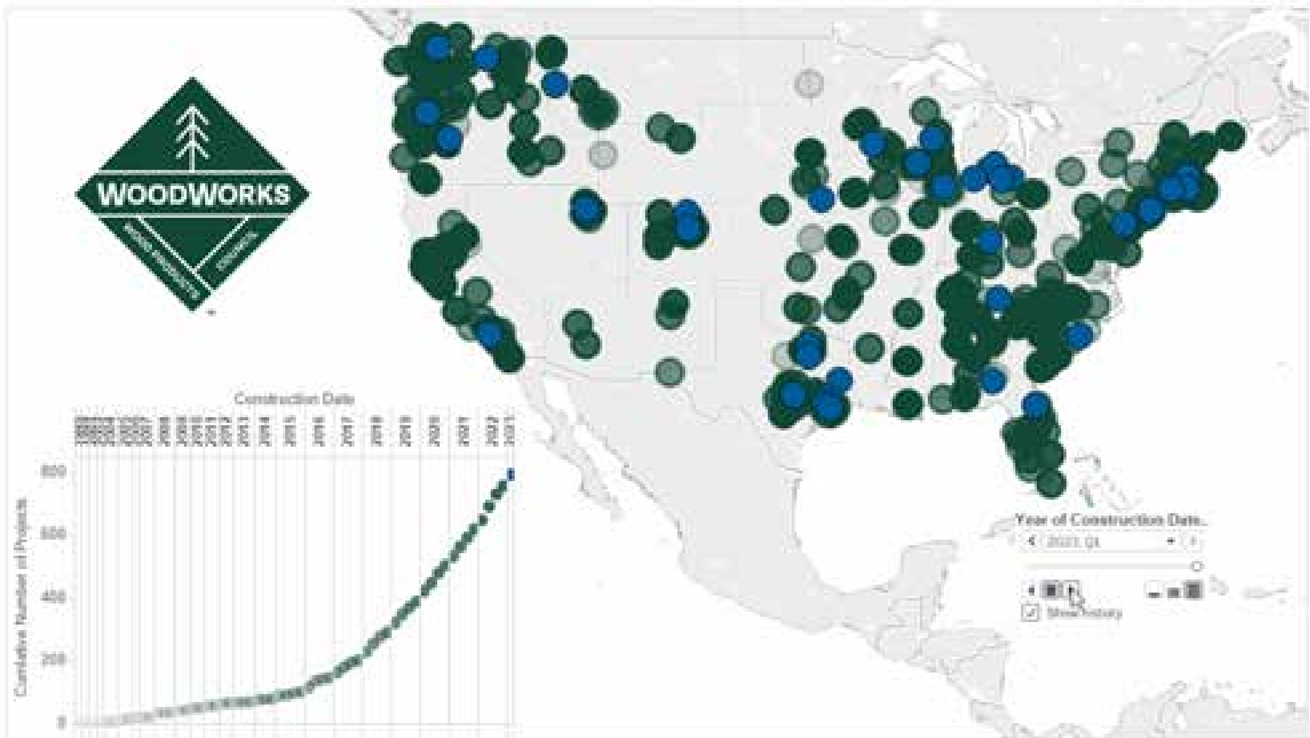

Glue Laminated Timber (Glulam)
Beams & columns

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

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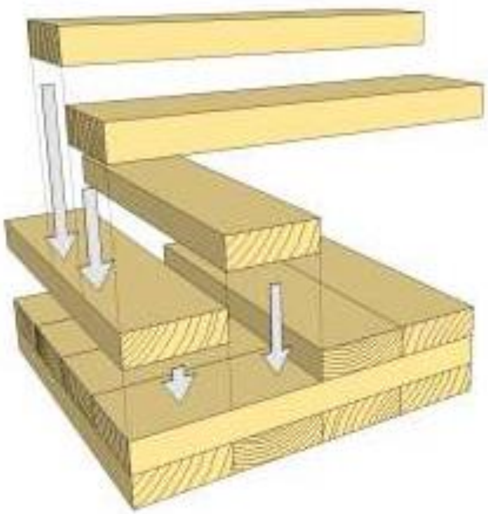
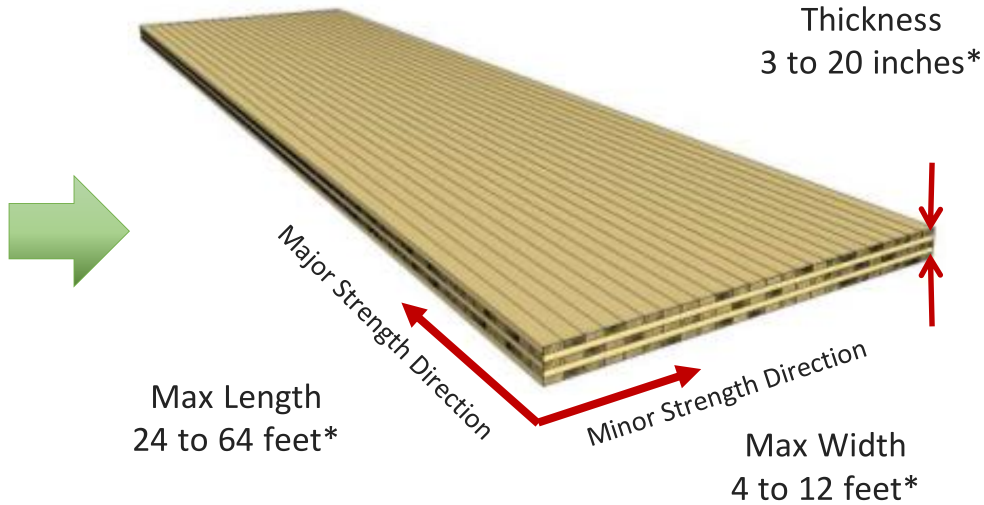
What is CLT?

3+ layers of laminations
Solid Sawn or Structural Composite Lumber Laminations
Cross-Laminated Layup
Glued with Structural Adhesives





*All dimensions are approximate.
Consult with manufacturers

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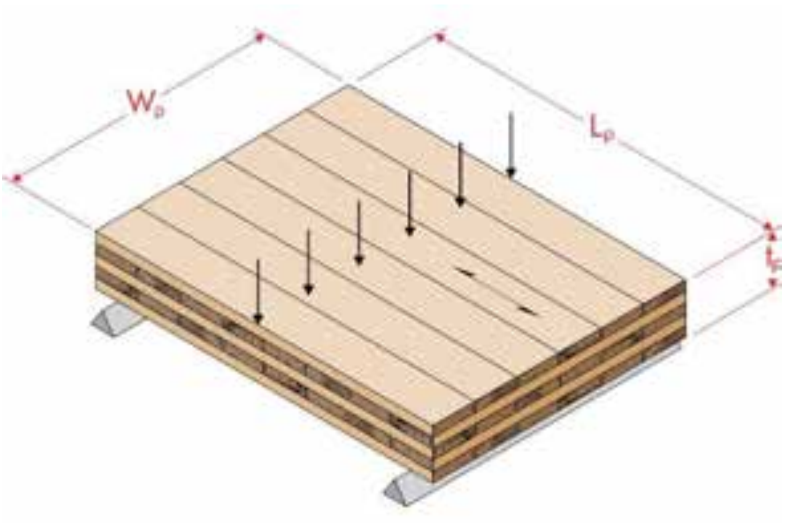
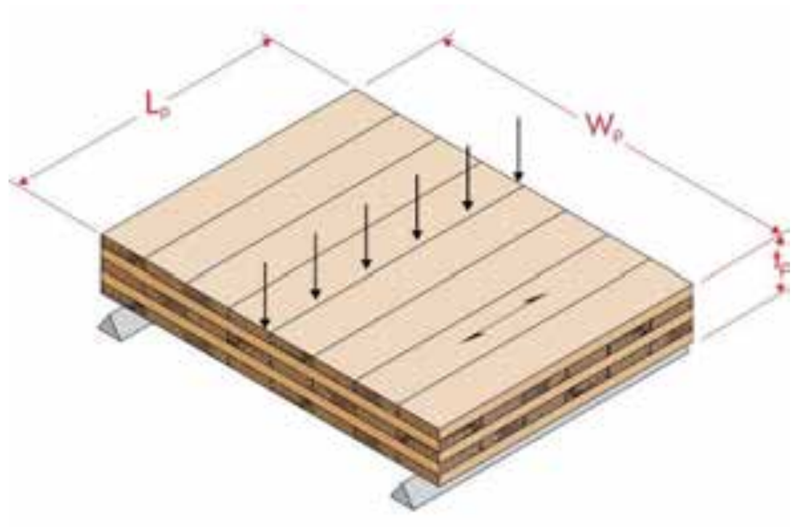
FLATWISE Panel Loading



Span in MAJOR Strength Direction
"Parallel" Direction
Use subscript '0' in Notation



Span in MINOR Strength Direction
"Perpendicular" Direction
Use subscript '90' in Notation

Reference & Source: ANSI/APA PRG 320

PRG 320 Defined Layups

CLT Grade (basic)

Layup

Panel Properties

TABLE A2

ASD REFERENCE DESIGN VALUES[a] FOR BASIC CLT GRADES AND LAYUPS (FOR USE IN THE U.S.)

CLT Grade	t_p (in.)	Lamination Thickness (in.) in CLT Layup =	⊥	=	⊥	=	⊥	=	Major Strength Direction $(F_bS)_{eff,f,0}$ (lbf-ft/ft of width)	$(EI)_{eff,f,0}$ (10^6 lbf-in.²/ft of width)	$(GA)_{eff,f,0}$ (10^6 lbf/ft of width)	$V_{s,0}$ (lbf/ft of width)	Minor Strength Direction $(F_bS)_{eff,f,90}$ (lbf-ft/ft of width)	$(EI)_{eff,f,90}$ (10^6 lbf-in.²/ft of width)	$(GA)_{eff,f,90}$ (10^6 lbf/ft of width)	$V_{s,90}$ (lbf/ft of width)
	4 1/8	1 3/8	1 3/8	1 3/8					4,525	115	0.46	1,490	160	3.1	0.61	495
E1	6 7/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8			10,400	440	0.92	2,480	1,370	81	1.2	1,490
	9 5/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	18,375	1,089	1.4	3,475	3,150	313	1.8	2,480
	4 1/8	1 3/8	1 3/8	1 3/8					3,825	102	0.53	1,980	165	3.6	0.56	660
E2	6 7/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8			8,825	389	1.1	3,300	1,440	95	1.1	1,980
	9 5/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	15,600	963	1.6	4,625	3,300	364	1.7	3,300
	4 1/8	1 3/8	1 3/8	1 3/8					2,800	81	0.35	1,160	110	2.3	0.44	385
E3	6 7/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8			6,400	311	0.69	1,930	955	61	0.87	1,160
	9 5/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	11,325	769	1.0	2,700	2,210	234	1.3	1,930
	4 1/8	1 3/8	1 3/8	1 3/8					4,525	115	0.50	1,820	140	3.4	0.62	605
E4	6 7/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8			10,400	440	1.0	3,025	1,230	88	1.2	1,820
	9 5/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	18,400	1,089	1.5	4,225	2,850	338	1.9	3,025
	4 1/8	1 3/8	1 3/8	1 3/8					3,825	101	0.46	1,650	160	3.1	0.55	550

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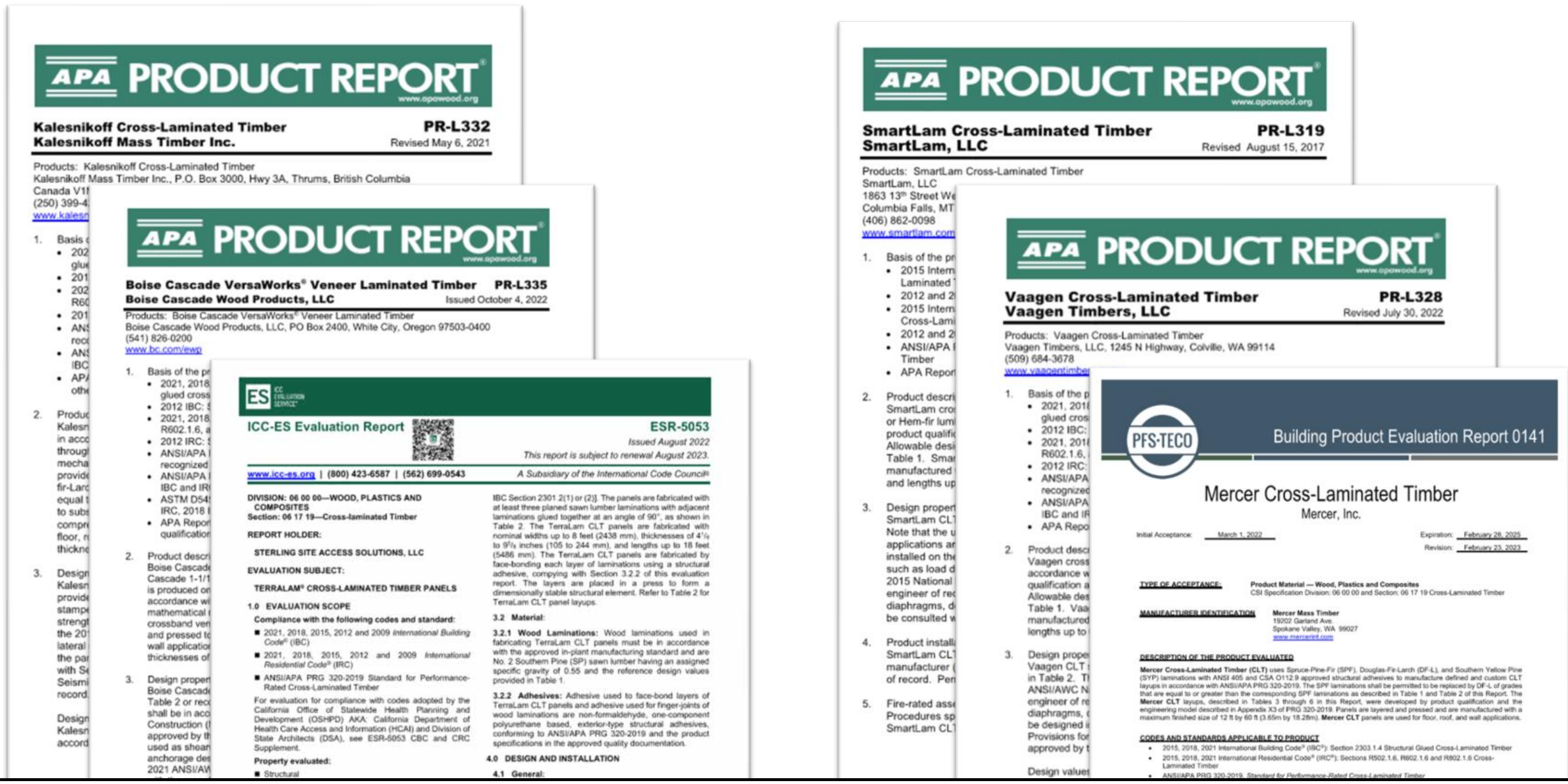
3rd Party Product Qualification of CLT



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CLT Product Reports

CLT Grade (basic or custom)

Layup

Panel Properties

APA Product Report® PR-L319
Revised August 15 , 2017

Table 1. Allowable Design Properties[a] for Lumber Laminations Used in SmartLam CLT (for Use in the U.S.)

CLT Grade	Major Strength Direction						Minor Strength Direction					
	$F_{b,0}$ (psi)	E_0 (10^6 psi)	$F_{t,0}$ (psi)	$F_{c,0}$ (psi)	$F_{v,0}$ (psi)	$F_{s,0}$ (psi)	$F_{b,90}$ (psi)	E_{90} (10^6 psi)	$F_{t,90}$ (psi)	$F_{c,90}$ (psi)	$F_{v,90}$ (psi)	$F_{s,90}$ (psi)
SL-V4	775	1.1	350	1,000	135	45	775	1.1	350	1,000	135	45

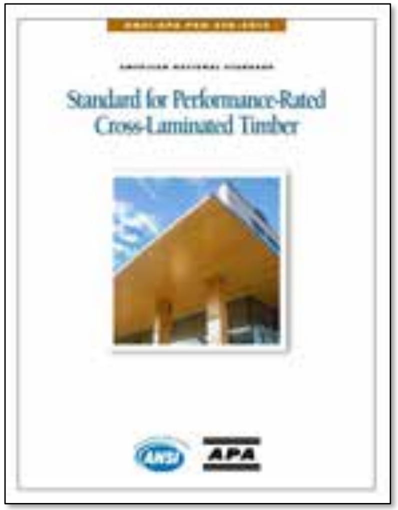
For SI: 1 psi = 0.006895 MPa

[a] Tabulated values are allowable design values and not permitted to be increased for the lumber flat use or size factor in accordance with the NDS. The design values shall be used in conjunction with the section properties provided by the CLT manufacturer based on the actual layup used in manufacturing the CLT panel (see Tables 2 and 3).

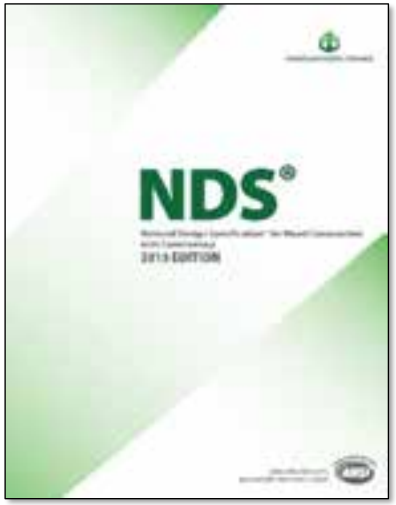
Table 2. Allowable Design Capacities[a] for SmartLam Balanced CLT (for Use in the U.S.)

CLT Grade	Layup #	Thick-ness (in.)	Lamination Thickness (in.) in CLT Layup									Major Strength Direction				Minor Strength Direction			
			=	⊥	=	⊥	=	⊥	=	⊥	=	$F_bS_{eff,0}$ (lbf-ft/ft)	$EI_{eff,0}$ (10^6 lbf-in.^{2}/ft)	$GA_{eff,0}$ (10^6 lbf/ft)	$V_{s,0}$ (lbf/ft)	$F_bS_{eff,90}$ (lbf-ft/ft)	$EI_{eff,90}$ (10^6 lbf-in.^{2}/ft)	$GA_{eff,90}$ (10^6 lbf/ft)	$V_{s,90}$ (lbf/ft)
SL-V4[b]	3-alt	4 1/8	1 3/8	1 3/8	1 3/8							1,800	74	0.41	1,430	245	2.9	0.41	495
	4-maxx	5 1/2	1 3/8	1 3/8 x 2	1 3/8							2,925	161	0.49	1,740	975	23	0.85	990
	5-alt	6 7/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8					4,150	286	0.83	1,980	2,120	74	0.83	1,430
	5-maxx	6 7/8	1 3/8 x 2	1 3/8	1 3/8 x 2							5,150	355	1.4	2,460	245	2.9	0.86	495
	6-maxx	8 1/4	1 3/8 x 2	1 3/8 x 2	1 3/8 x 2							7,200	596	1.2	2,875	975	23	1.3	990
	7-alt	9 5/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8			7,325	707	1.2	2,500	4,825	283	1.2	1,960
	[illegible]	[illegible]	1 3/8 [illegible]	[illegible]	[illegible]	[illegible]	1 3/8 [illegible]					[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

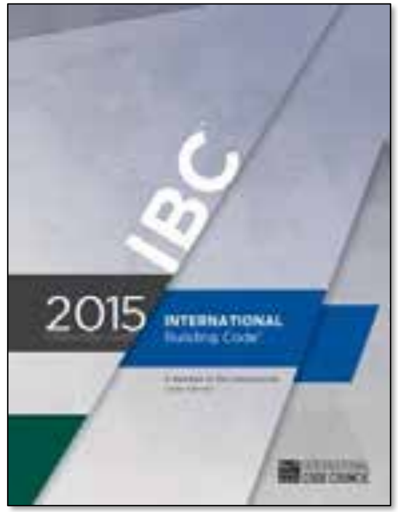
CLT in the U.S. Building Code - IBC 2015



ANSI/APA PRG 320 2011



AWC NDS 2015

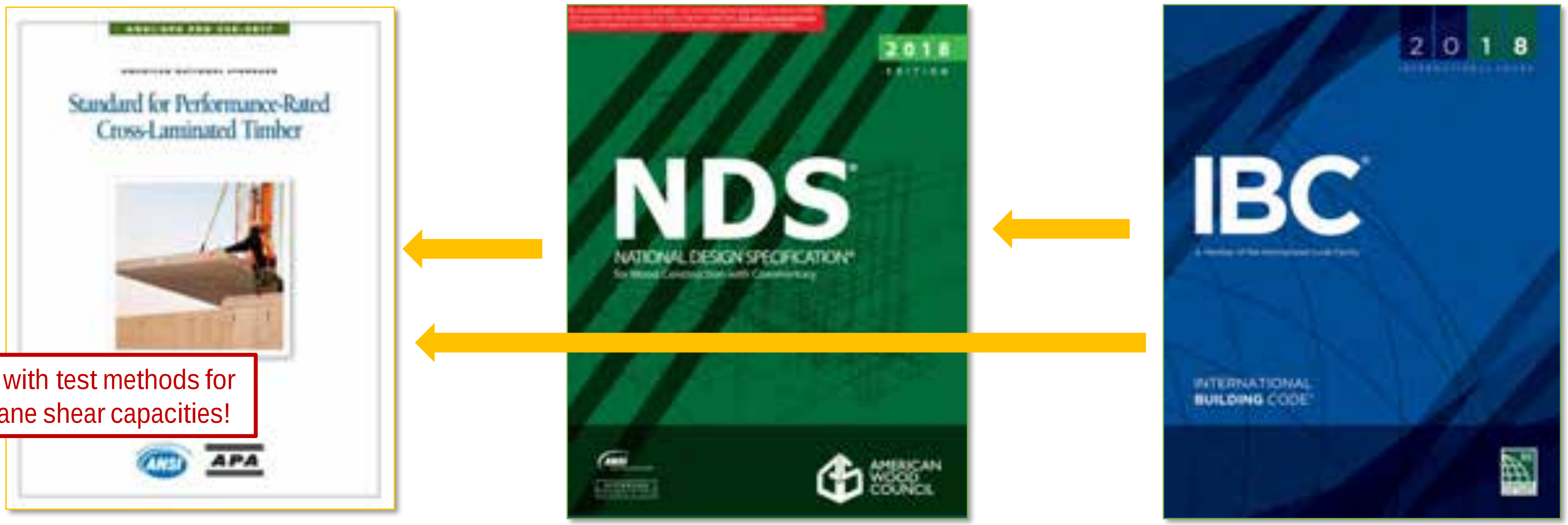


2015 International Building Code

CLT Recognized in the Model Building Code!*

(*for gravity systems with existing Construction Types)

CLT in the U.S. Building Code – IBC 2018



Now with test methods for in-plane shear capacities!

ANSI/APA PRG 320 2017

AWC NDS 2018

2018 International Building Code

General improvements

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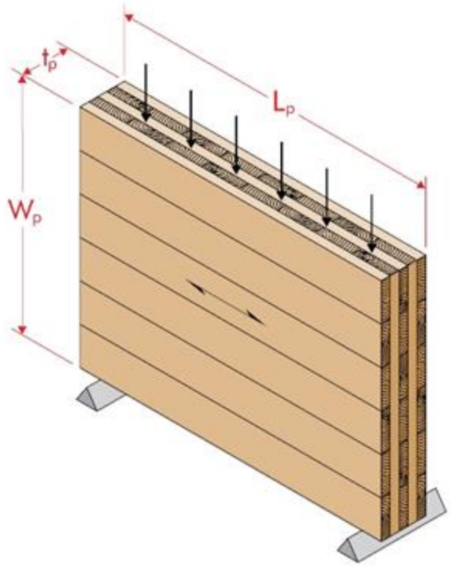
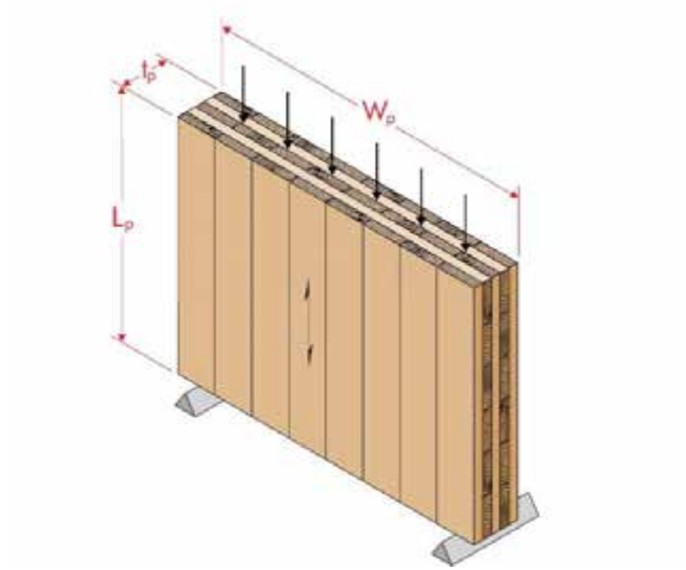
EDGEWISE Panel Loading



Span in MAJOR Strength Direction



Span in MINOR Strength Direction

Reference & Source: ANSI/APA PRG 320-2017

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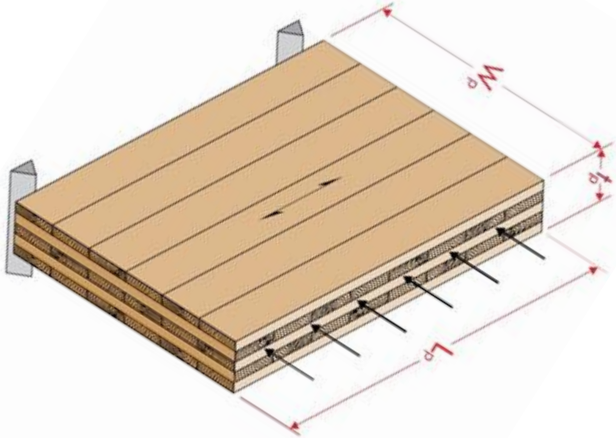
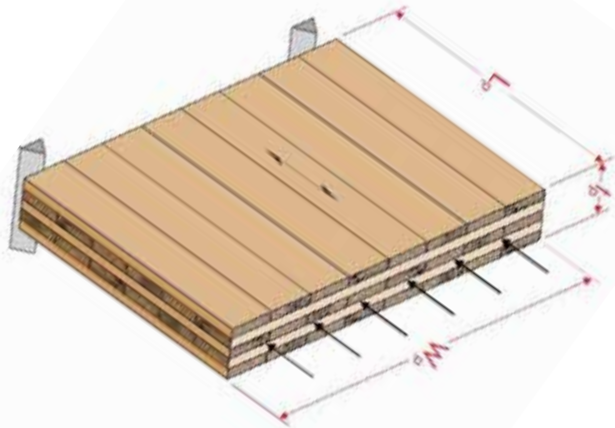
EDGEWISE Panel Loading



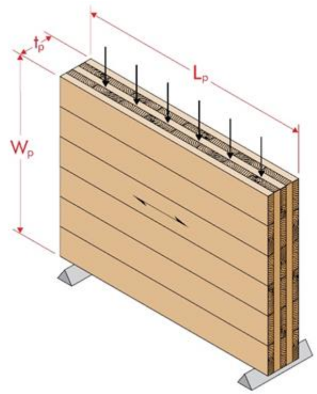
Span in MAJOR Strength Direction



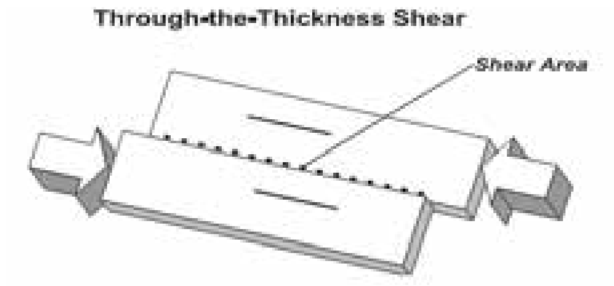
Span in MINOR Strength Direction

Reference & Source: ANSI/APA PRG 320-2017

Shear Force Terminology & Jargon



Source: ANSI/APA PRG 320-2017



Source: NDS 2015 Manual

Through-the-Thickness Shear
In-plane Shear Forces
EDGEWISE Shear in PRG 320-2017

NDS 2015: $F_v(t_v)$
PRG 320-2017: $F_{v,e,0}\, t_p$ & $F_{v,e,90}\, t_p$

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CLT in In-Plane (Edgewise) Strength

TABLE 3—REFERENCE DESIGN VALUES FOR IN-PLANE SHEAR OF THE STRUCTURLAM CROSSLAM® CLT PANELS[1]

CLT LAYUP[2]	CLT PANEL THICKNESS DESIGNATION	FACE LAMINATION ORIENTATION[3] (psi) ∥[4]	FACE LAMINATION ORIENTATION[3] (psi) ⊥[4]	FACE LAMINATION ORIENTATION[3] (lbf/ft of width) ∥[4]	FACE LAMINATION ORIENTATION[3] (lbf/ft of width) ⊥[4]
V2M1	99 V	175[3]	235[3]	8,200[3]	11,000[3]
	169 V	175[3]	235[3]	14,000[3]	18,800[3]
	239 V	175[3]	235[3]	19,800[3]	26,600[3]
	309 V	175[3]	235[3]	25,600[3]	34,300[3]
V2M1.1	105V	195	290	9,700	14,400
	175V	270	290[3]	22,400	24,000[3]
	245V	270[3]	290[3]	31,300[3]	33,600[3]
	315V	270[3]	290[3]	40,200[3]	43,200[3]

Source: ICC-ES/APA Joint Evaluation Report *ESR 3631*

Reference Design Values for Nordic X-Lam Listed in Table 1 (For Use in

			Major Strength Direction $F_{v,e,0}$[a] (psi)	Major Strength Direction $G_{e,0} t_p$[d] (10^6 lbf/ft)	Minor Strength Direction $F_{v,e,90}$[a] (psi)	Minor Strength Direction $G_{e,90} t_p$[d] (10^6 lbf/ft)
			155[b]	1.36	190[b]	1.36
			155	1.52	190[b]	1.52
			155	1.79	190	1.79
			185[c]	2.23	215[c]	2.23
E1	140-4s	5 1/2	145	2.39	190[b]	2.39
	143-5s	5 5/8	185[c]	2.44	215[c]	2.44
	175-5s	6 7/8	185	2.99	215	2.99
	197-7s	7 3/4	155[b]	3.37	215[c]	3.37
	213-7l	8 3/8	185[c]	3.64	215[c]	3.64
	220-7s	8 5/8	185[c]	3.75	215[c]	3.75
	244-7s	9 5/8	185[c]	4.18	215[c]	4.18
	244-7l	9 5/8	185[c]	4.18	215[c]	4.18
	267-9l	10 1/2	155[b]	4.56	215[c]	4.56
	314-9l	12 3/8	185[c]	5.38	215[c]	5.38

Source: *APA Product Report PR-L306*

145 to 290 PSI Edgewise Shear Capacity
= 1.7 to 3.5 kips/ft (ASD)
per inch of thickness!

Consult with the Manufacturers for Values

Multiply by ***Cd = 1.6***
for short term ASD strength

CLT Panels can have > 9 kips / ft in-plane shear capacity


Mass Timber Design
Lateral framing systems
Light-frame wood shearwalls
Photo Credit: WoodWorks

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Mass Timber Design
Lateral framing systems
Central Core – concrete shearwalls
Photo Credit: Structurecraft

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Mass Timber Design
Lateral framing systems
Steel moment frame
Photo Credit: WoodWorks

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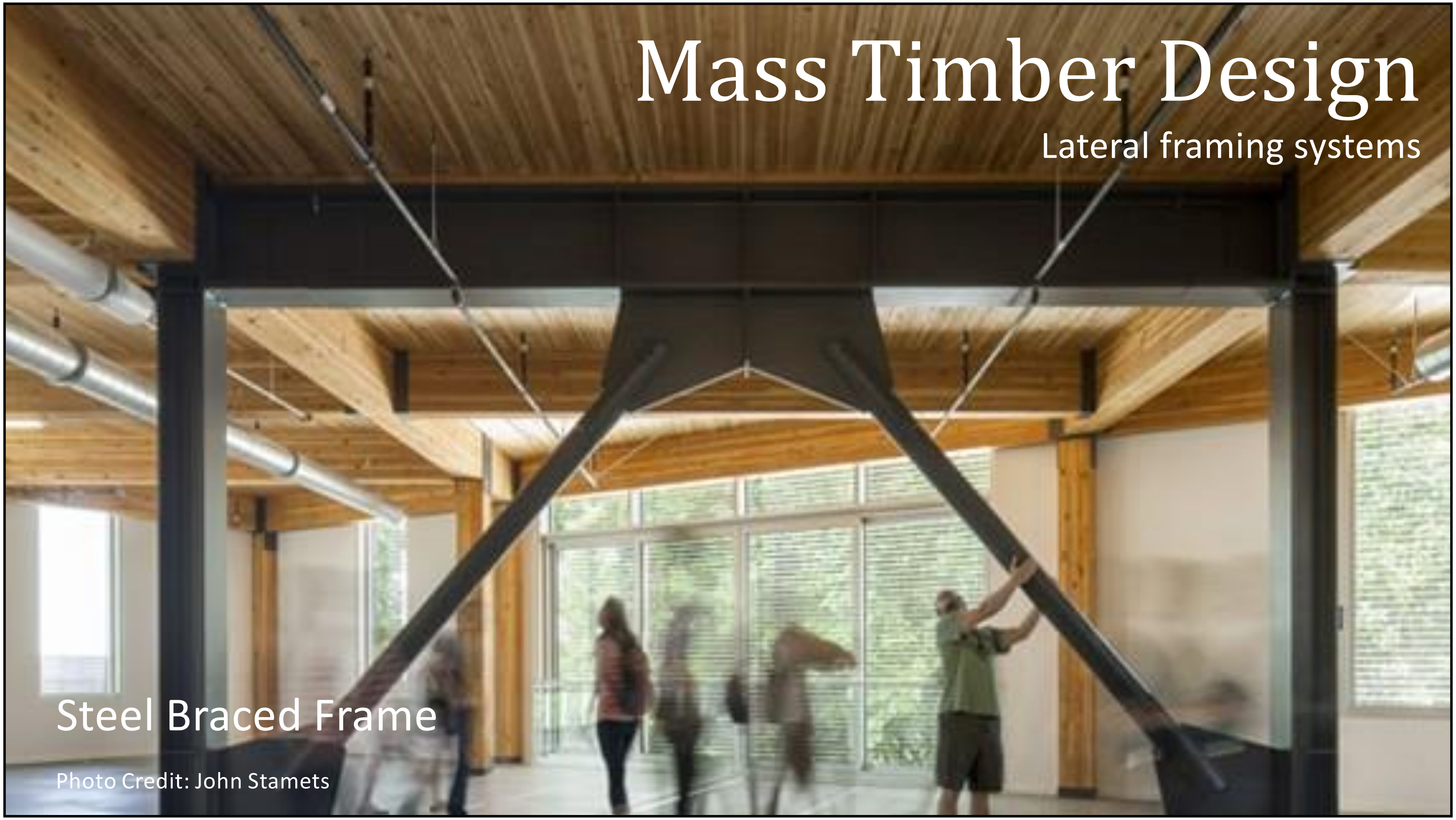
Mass Timber Design
Lateral framing systems
Steel Braced Frame
Photo Credit: John Stamets

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Mass Timber Design
Lateral framing systems
CLT Shearwalls
Photo Credit: Alex Schreyer

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What R Value Can I use?

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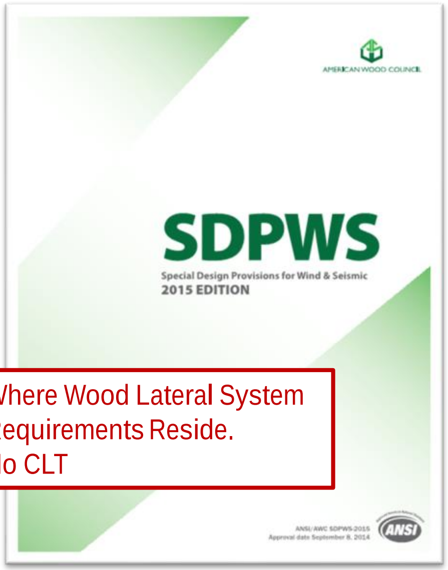
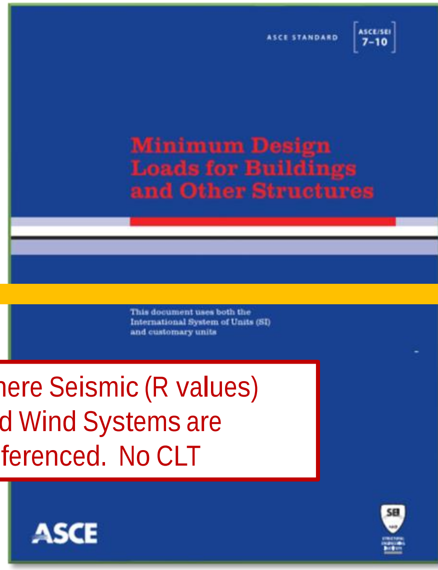
CLT in the U.S. Building Code – IBC 2018 (Lateral)



Where Wood Lateral System Requirements Reside.
No CLT

AWC SDPWS 2015



Where Seismic (R values) and Wind Systems are Referenced. No CLT

ASCE/SEI 7-16

2018 International Building Code
(2019 California Building Code)

No explicitly recognized requirements for CLT Lateral Systems in 2018 IBC

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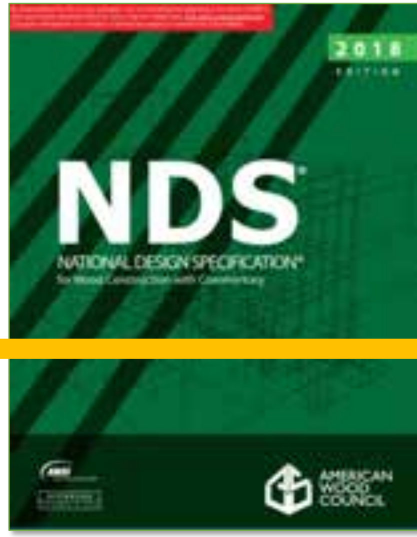
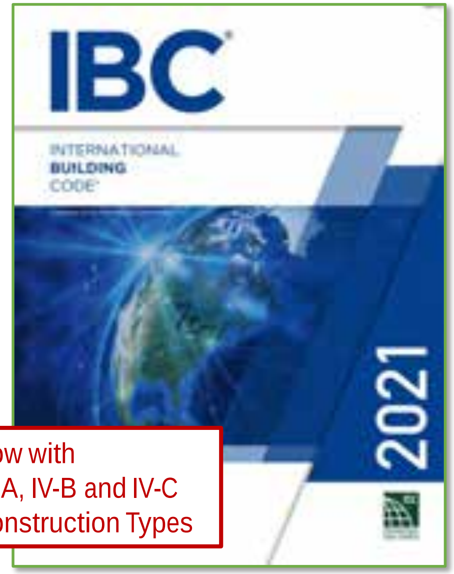
CLT in the U.S. Building Code – IBC 2021

With new and improved adhesive qualification tests

ANSI/APA PRG 320 2019



AWC NDS 2018



Now with
IV-A, IV-B and IV-C
Construction Types

2021 International Building Code
(2022 California Building Code)

New Type IV Mass Timber Construction up to 18 Stories!

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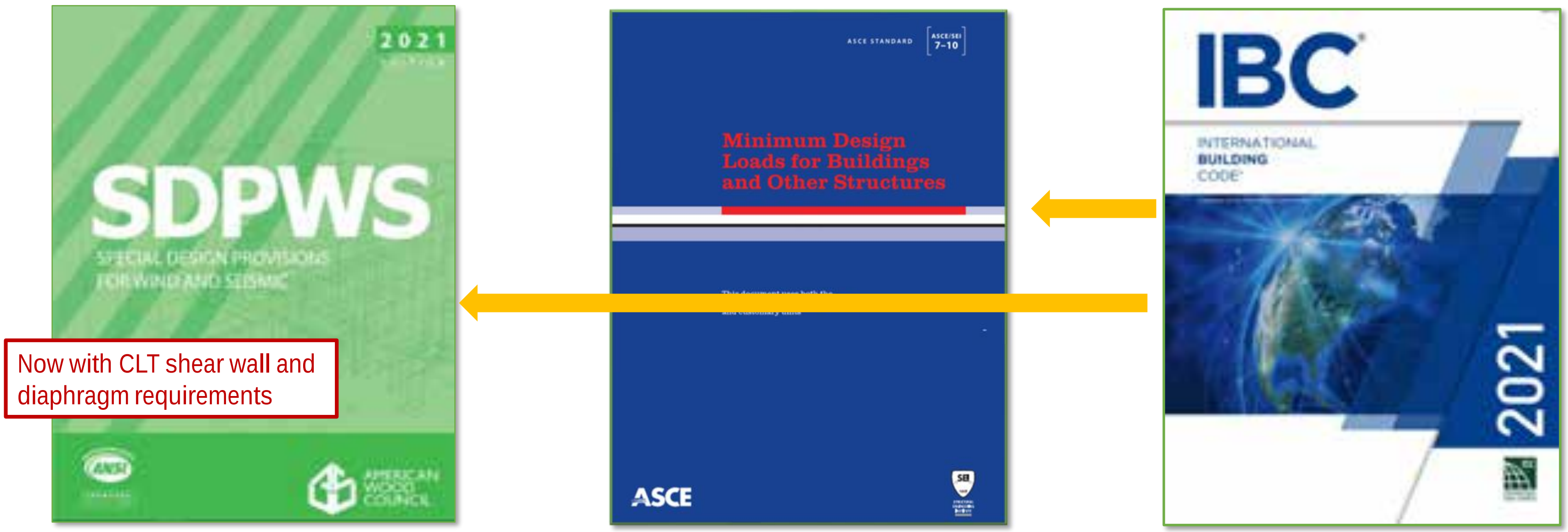
CLT in the U.S. Building Code – IBC 2021 (Lateral)



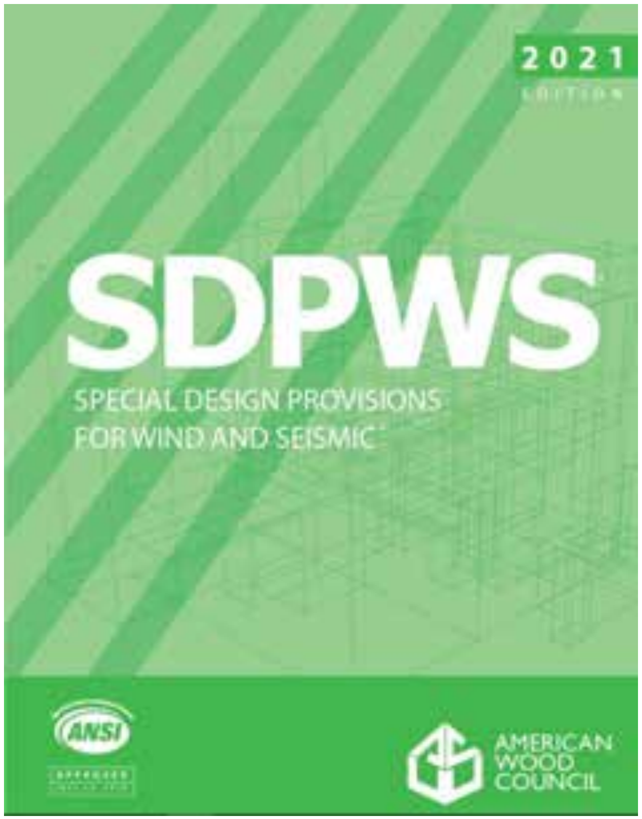
AWC SDPWS 2021

ASCE/SEI 7-16

2021 International Building Code
(2022 California Building Code)

New Requirements for CLT Lateral Systems in SDPWS 2021!
Referenced from IBC 2021

2021 Special Design Provisions for Wind and Seismic



Top Changes Relevant to CLT Lateral Systems:

- New unified nominal shear capacity
- New CLT Shear Wall requirements
- New CLT Diaphragm requirements

View for free at awc.org

<u>PowerPoint IS NOT the CODE!</u>

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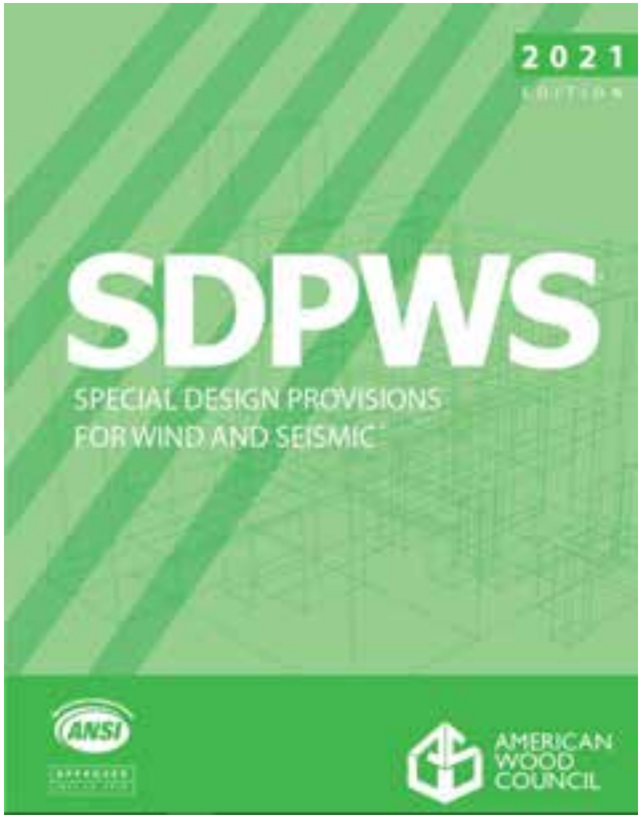
2021 Special Design Provisions for Wind and Seismic



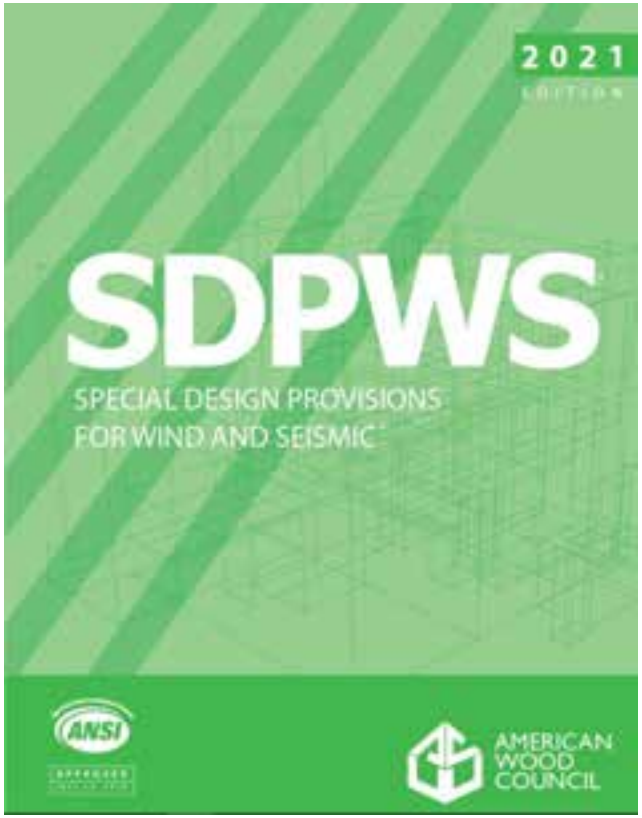
Top Changes Relevant to CLT Lateral Systems:

- **New unified nominal shear capacity**
- New CLT Shear Wall requirements
- New CLT Diaphragm requirements

View for free at awc.org

PowerPoint IS NOT the CODE!

2021 SDPWS – Unified Nominal Shear Capacity



For sheathed wood frame shear walls and diaphragms, SDPWS 2015 has two nominal shear capacities

v_s Nominal shear capacity for seismic loads

v_w Nominal shear capacity for wind loads

SDPWS 2021 has one nominal shear capacity for both wind and seismic (for all systems such as WSP and CLT)

v_n Nominal shear capacity

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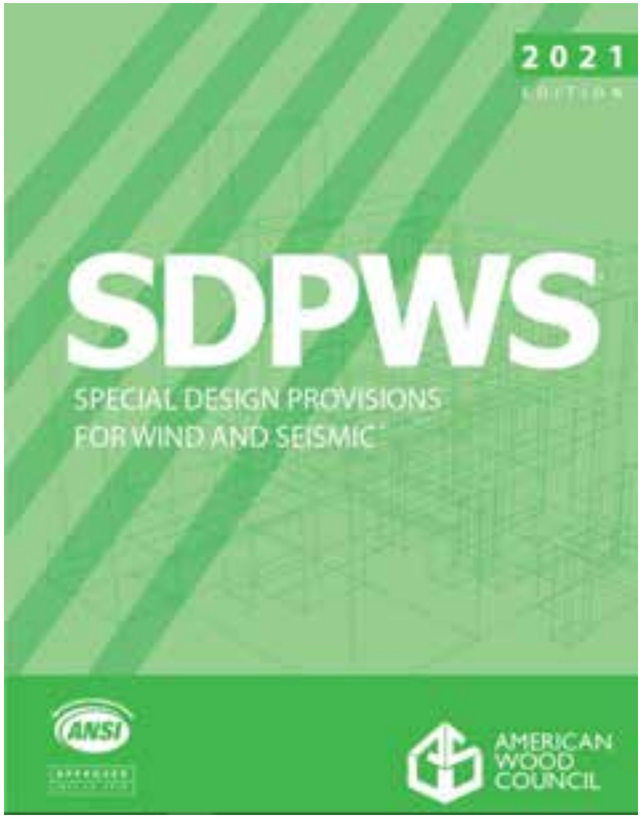
2021 SDPWS – Unified Nominal Shear Capacity



To calculate the ASD or LRFD shear capacity, SDPWS 2021 has different reduction factors for wind and seismic

	Design shear capacity	
	ASD	LRFD
Wind	$v_n/2.0$	$0.8\ v_n$
Seismic	$v_n/2.8$	$0.5\ v_n$

SDPWS 2021 Section 4.1.4

What R Value Can I use?

43

R = 3?

or 4 or 1.5?

or 2 or 6?

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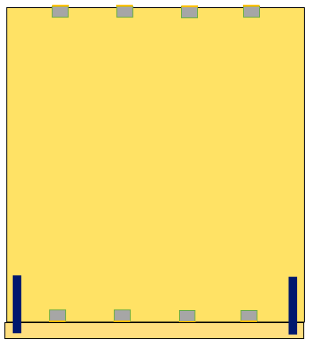
R Values for CLT Shear Walls in SDPWS 2021

(other)
CLT Shear Walls
not meeting Appendix B

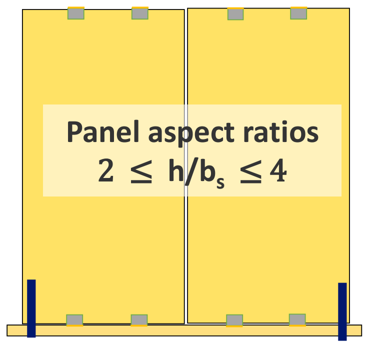
Platform Framed
CLT Shear Walls
meeting SDPWS 2021 Appendix B



R = 1.5

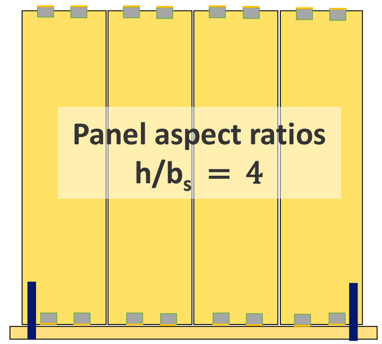
C_d = 1.5 Ω_o = 2.5

In SDPWS 2021 4.6.3



R = 3.0*

C_d = 3.0 Ω_o = 3.0



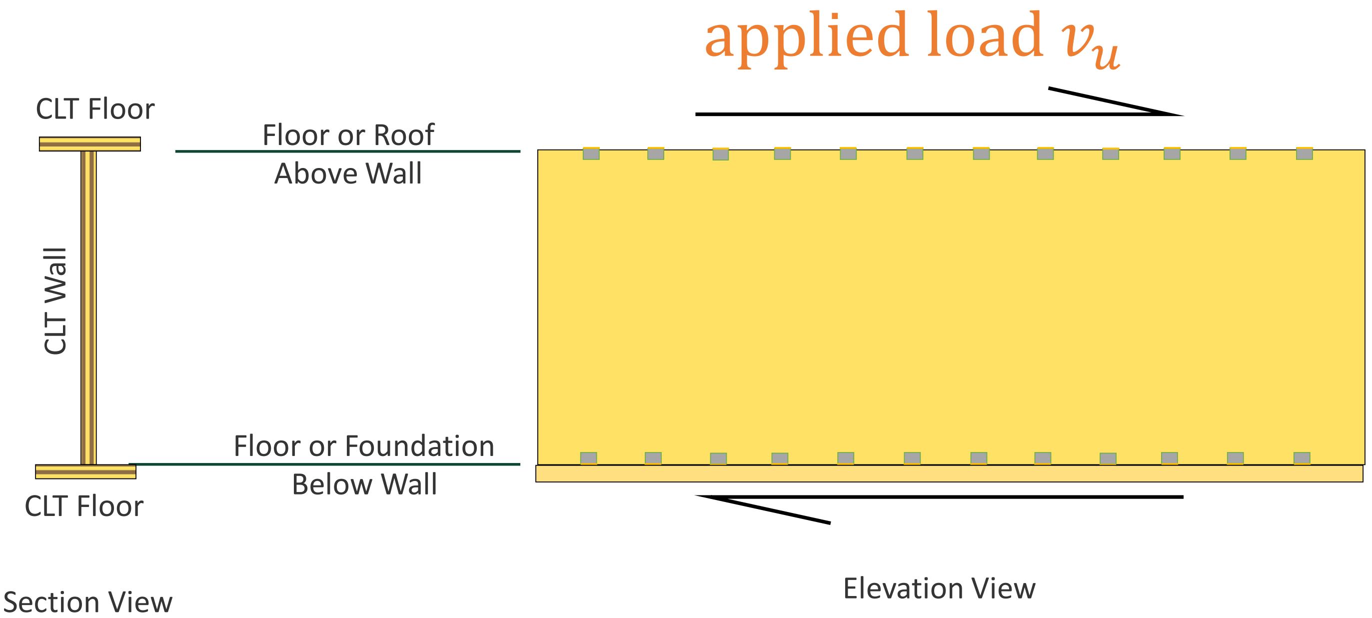
R = 4.0*

C_d = 4.0 Ω_o = 3.0

* ASCE 7-22

CLT Shear Walls in SDPWS 2021

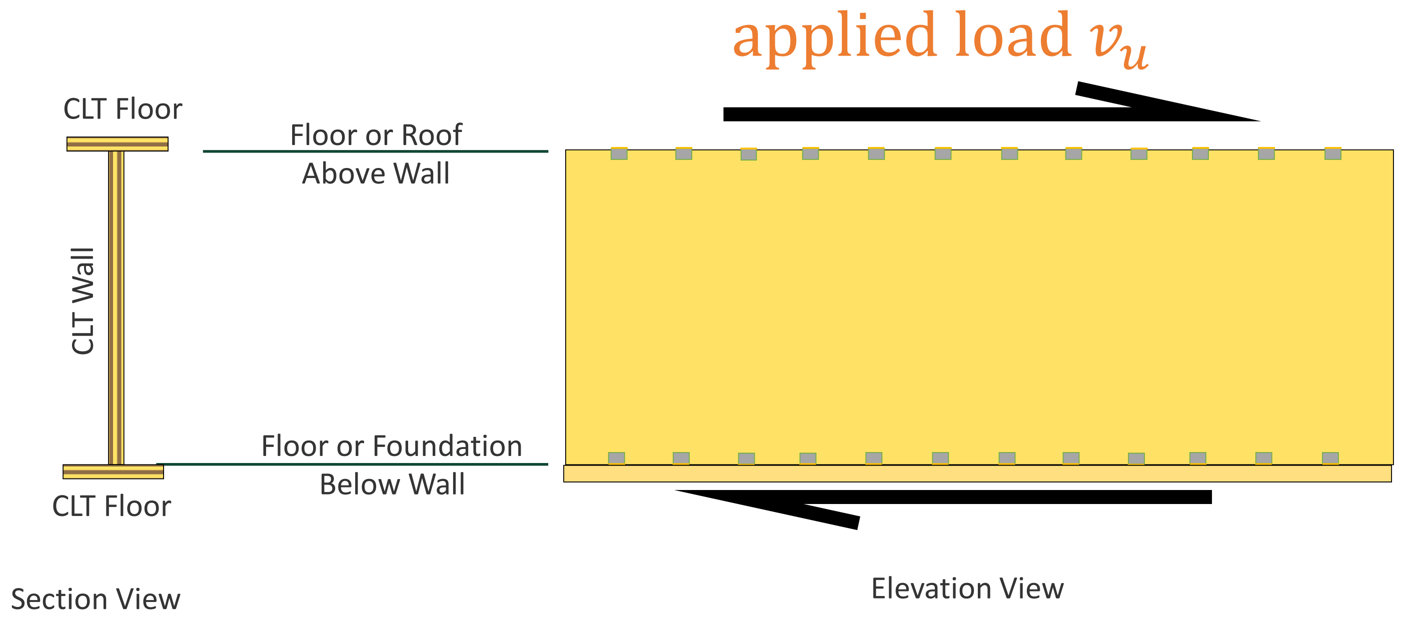
Platform Framed CLT Construction



SDPWS 2021 Section 4.1.4

CLT Shear Walls in SDPWS 2021

Platform Framed CLT Construction



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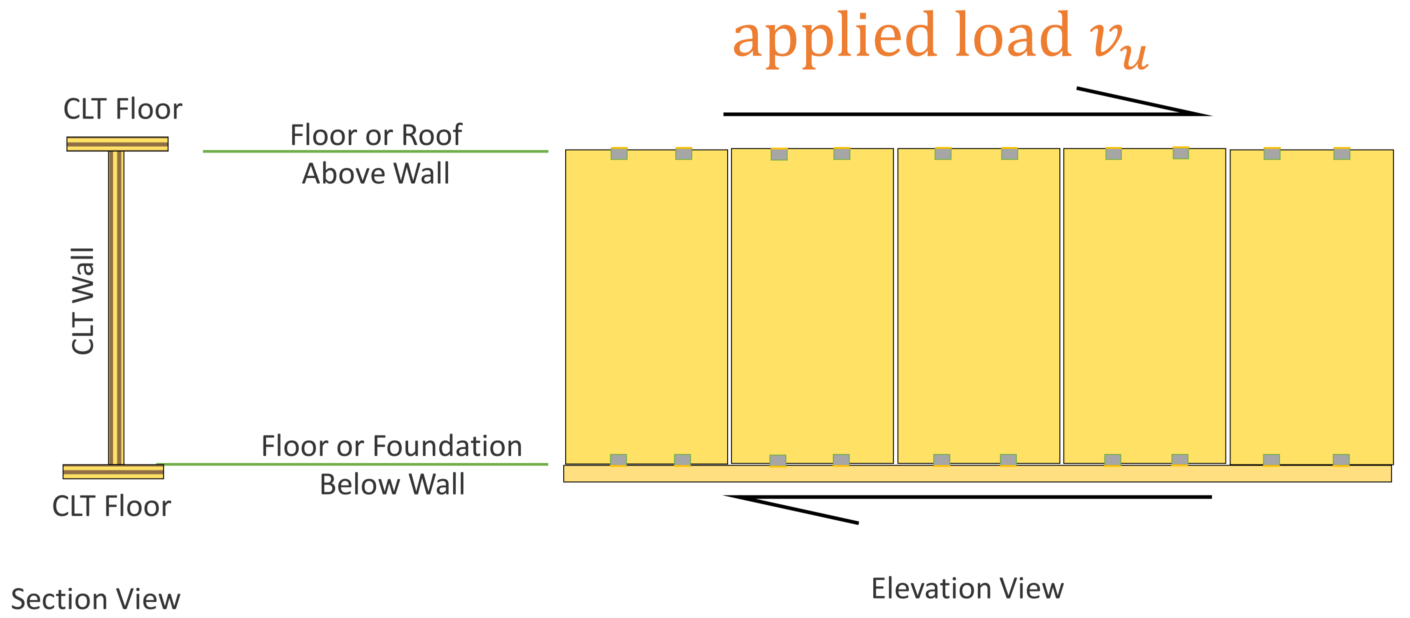
CLT Shear Walls in SDPWS 2021

Platform Framed CLT Construction



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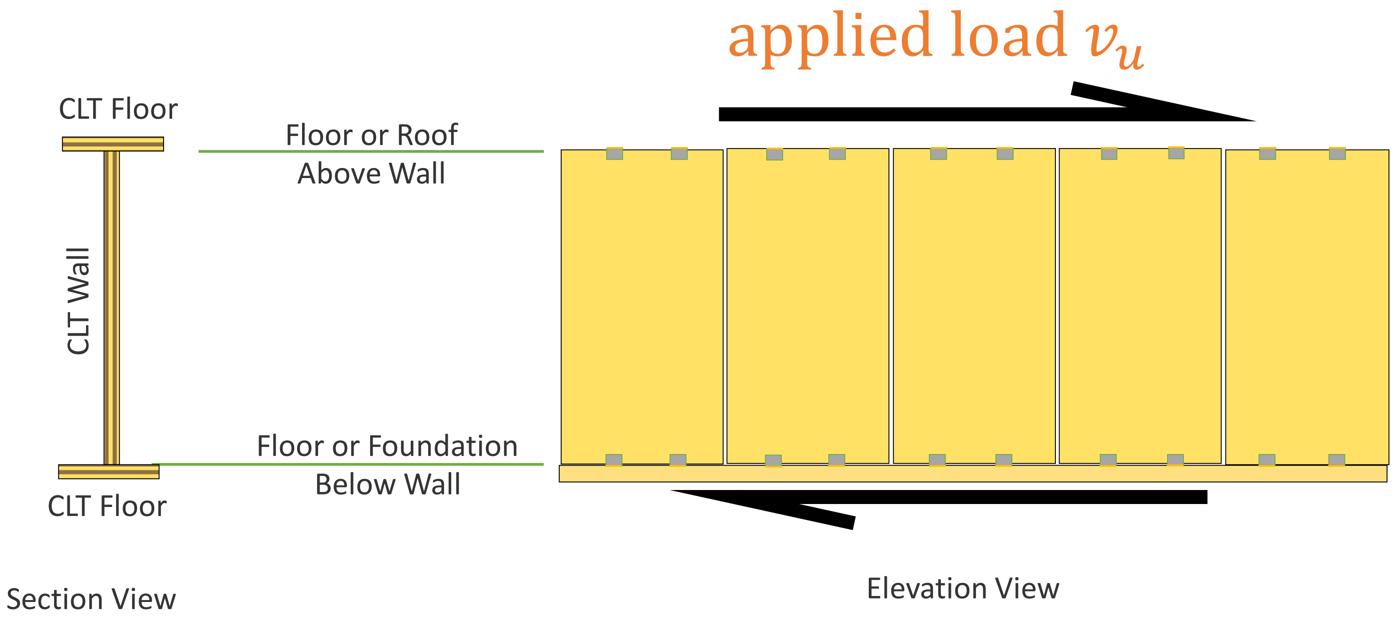
CLT Shear Walls in SDPWS 2021

Platform Framed CLT Construction



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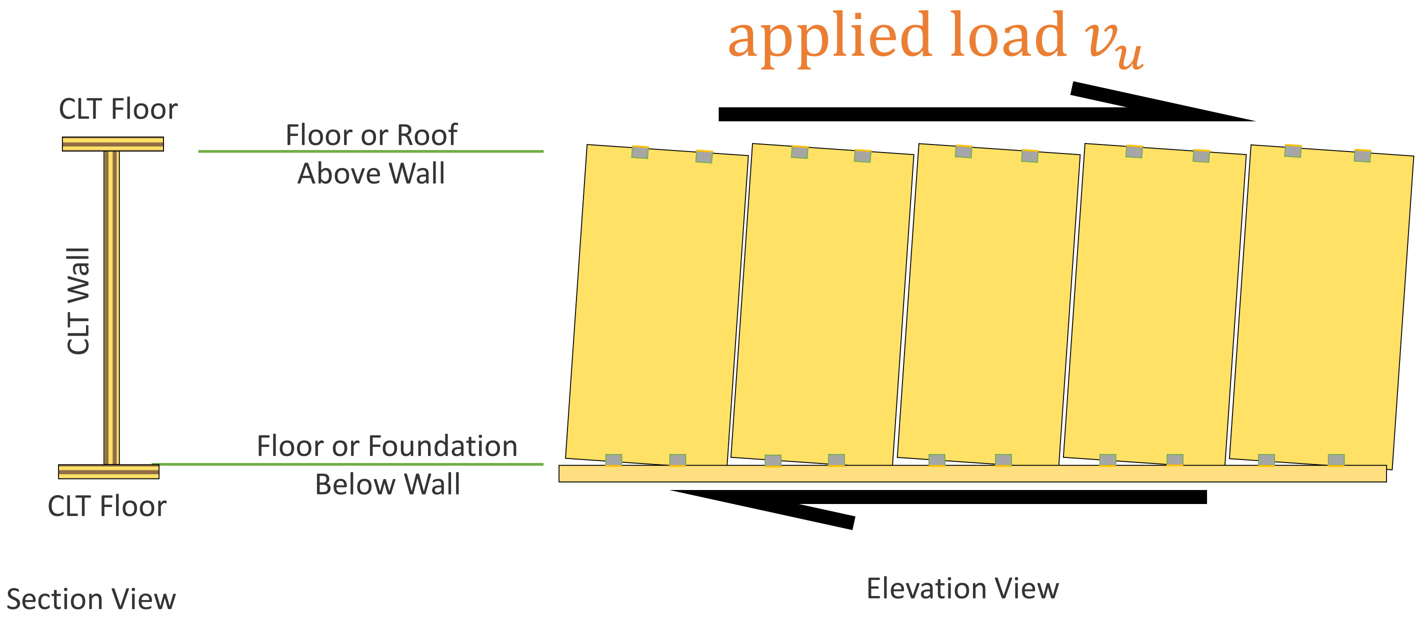
CLT Shear Walls in SDPWS 2021

Platform Framed CLT Construction



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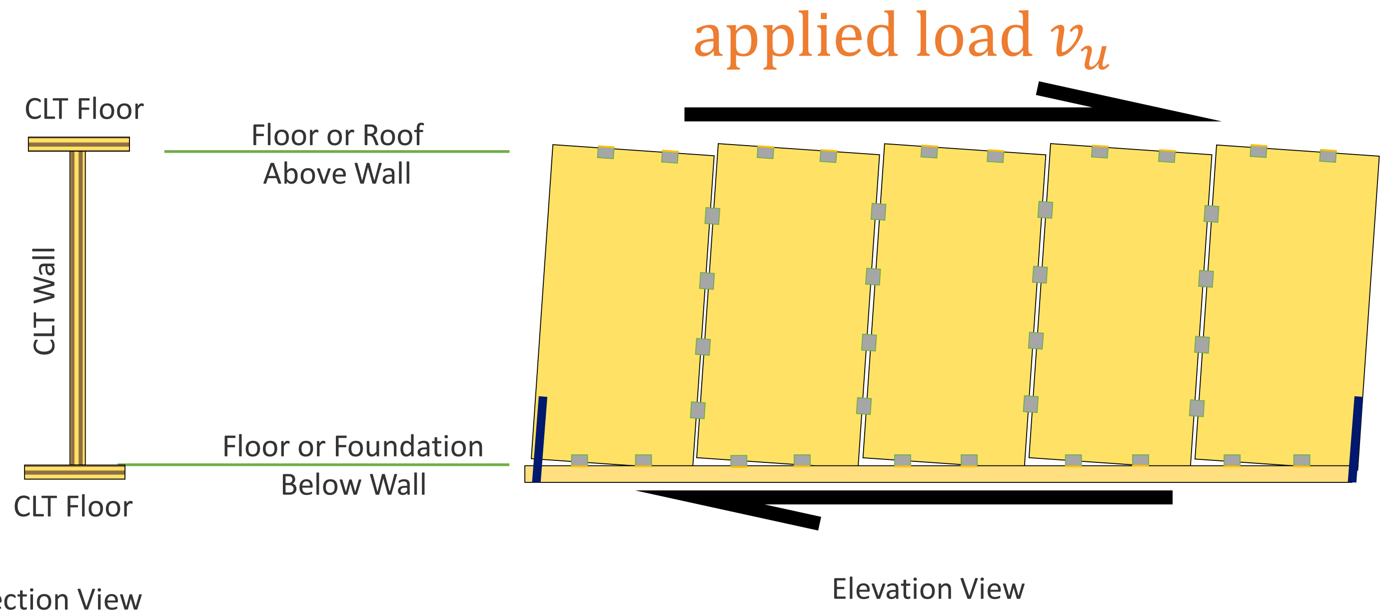
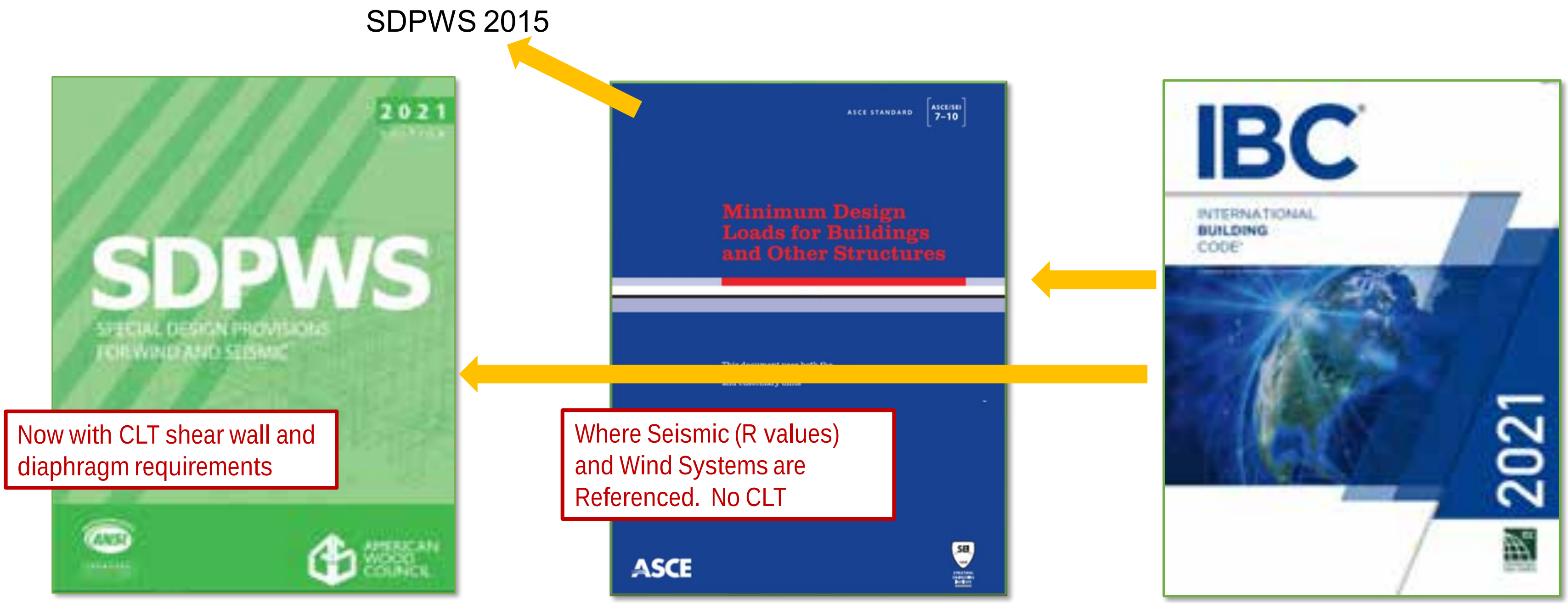
CLT Shear Walls in SDPWS 2021

Platform Framed CLT Construction



CLT in the U.S. Building Code – Lateral in IBC 2021



AWC SDPWS 2021

ASCE/SEI 7-16

2021 International Building Code
(2022 California Building Code)

New Requirements for CLT Lateral Systems!

(but R values for CLT Shear Walls not in ASCE 7-16)

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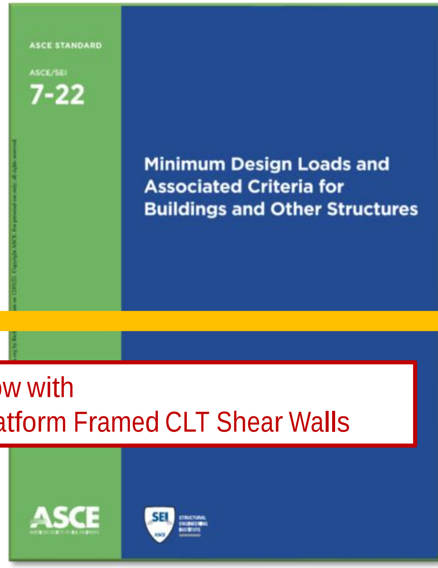
CLT in the U.S. Building Code – Lateral in the IBC 2024?

Now with CLT shear wall and diaphragm requirements

AWC SDPWS 2021



Now with
Platform Framed CLT Shear Walls

ASCE/SEI 7-22

2024 IBC
(in process)

Future Full Recognition of CLT Lateral Systems

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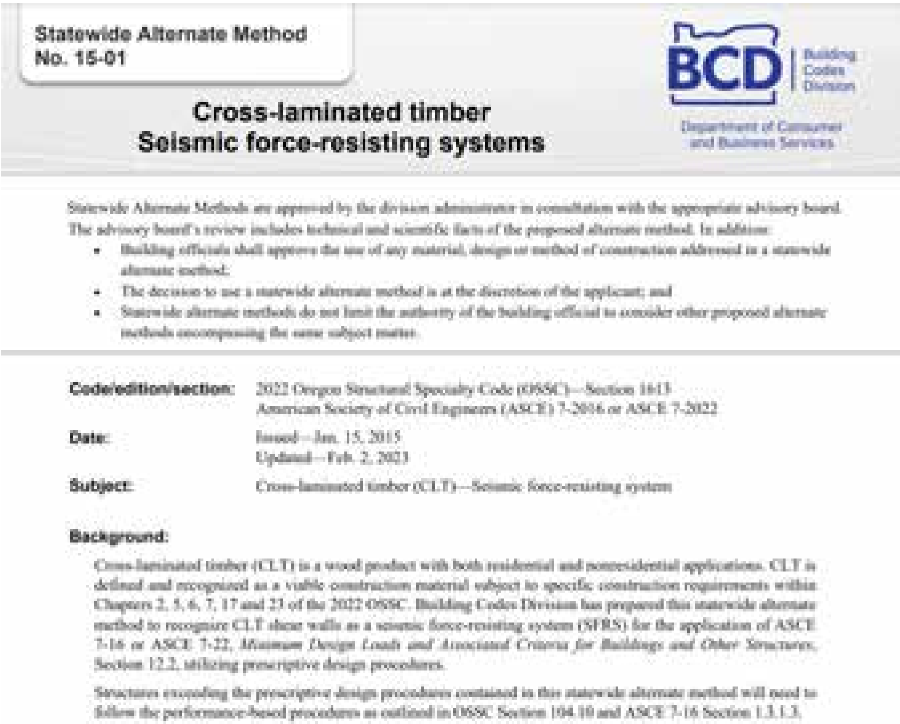
CLT Shear Walls of Oregon Statewide Alternative Method

www.oregon.gov/bcd/codes-stand/Documents/sam-15-01-crosslaminatedtimber.pdf
Or search for "Oregon CLT SAM 15-01"



Statewide Alternate Method
No. 15-01

BCD | Building Codes Division
Department of Consumer and Business Services

Cross-laminated timber
Seismic force-resisting systems

Statewide Alternate Methods are approved by the division administrator in consultation with the appropriate advisory board. The advisory board's review includes technical and scientific facts of the proposed alternate method. In addition:

- Building officials shall approve the use of any material, design or method of construction addressed in a statewide alternate method;
- The decision to use a statewide alternate method is at the discretion of the applicant; and
- Statewide alternate methods do not limit the authority of the building official to consider other proposed alternate methods encompassing the same subject matter.

Code/edition/section:	2022 Oregon Structural Specialty Code (OSSC)—Section 1613 American Society of Civil Engineers (ASCE) 7-2016 or ASCE 7-2022
Date:	Issued—Jan. 15, 2015 Updated—Feb. 2, 2023
Subject:	Cross-laminated timber (CLT)—Seismic force-resisting system

Background:

Cross-laminated timber (CLT) is a wood product with both residential and nonresidential applications. CLT is defined and recognized as a viable construction material subject to specific construction requirements within Chapters 2, 5, 6, 7, 17 and 23 of the 2022 OSSC. Building Codes Division has prepared this statewide alternate method to recognize CLT shear walls as a seismic force-resisting system (SFRS) for the application of ASCE 7-16 or ASCE 7-22, *Minimum Design Loads and Associated Criteria for Buildings and Other Structures*, Section 12.2, utilizing prescriptive design procedures.

Structures exceeding the prescriptive design procedures contained in this statewide alternate method will need to follow the performance-based procedures as outlined in OSSC Section 104.10 and ASCE 7-16 Section 1.3.1.3.

Two Alternatives in the SAM

#1: CLT Shear walls per ASCE 7-22 and SDPWS 2021 as these are not yet adopted by Oregon

#2: SAM Specific CLT Shear wall design criteria: Moderately ductile CLT Shear Walls with at least one of global yield modes listed in SAM

R = 2.0!

$C_d = 2.0 \quad \Omega_o = 2.5$

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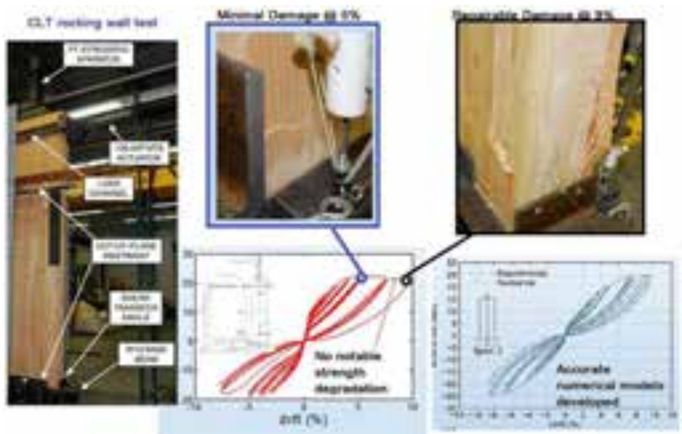
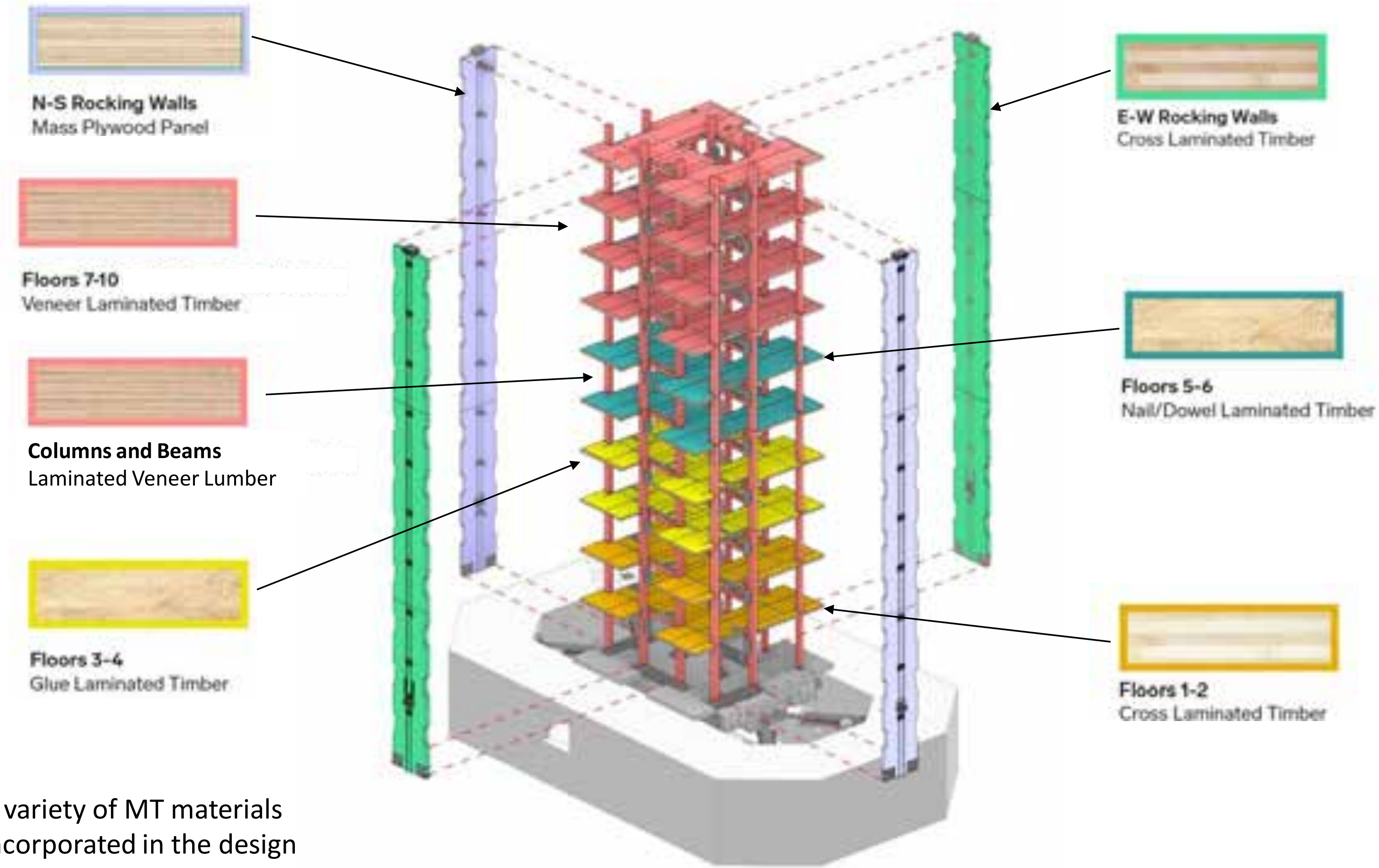
Mass Timber Post Tension Rocking Shear Wall Tests



Source: S. PEI et al. http://nheritallwood.mines.edu/



A variety of MT materials incorporated in the design

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Acknowledgement

University

Industry partner

Construction/Design partner

Non-Prof Sponsor

The structural system scope of this project is sponsored by NSF Grants No. 1635227, 1634628, 1634204. The nonstructural component scope of this project is sponsored by NSF Grant No. CMMI-1635363 and USFS Grant No. 19-DG-11046000-16. The use and operation of NHERI shake table facility is supported by NSF through CMMI-2227407. The test program also received great technical, financial, and material donation support from industry leaders both with the U.S. and internationally.

11 tall wood projects already under construction or built.

TALL WOOD

WOODWORKS WOOD PRODUCTS COUNCIL

= 20 in-design tall wood projects

= tall wood project in construction or completed

Carbon 12
Portland, OR
8 stories mass timber

Heartwood
Seattle, WA
8 stories mass timber

Minnesota Places
Portland, OR
8 stories – 7 mass timber

TimberView
Portland, OR
8 stories mass timber

1510 Webster
Oakland, CA
18 stories – 16 mass timber

Ascent
Milwaukee, WI
25 stories – 19 mass timber

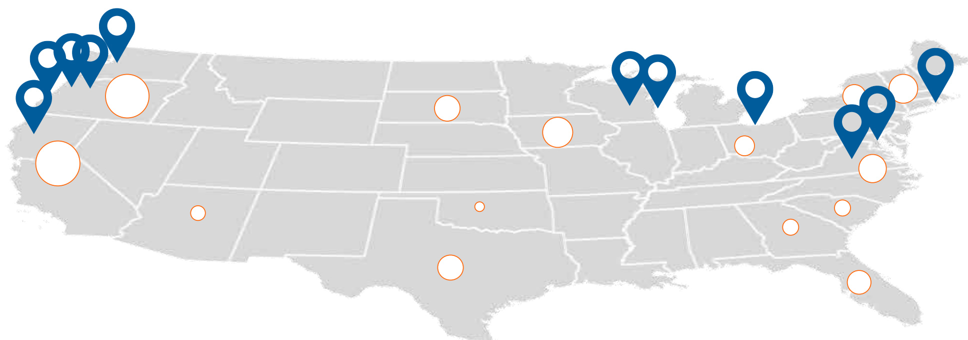
Bakers Place
Madison, WI
15 stories – 12 mass timber

INTRO
Cleveland, OH
9 stories – 8 mass timber

11 E Lenox
Boston, MA
7 stories mass timber

80 M Street
Washington DC
10 stories – 3-story mass timber vertical addition

Apex Plaza
Charlottesville, VA
8 stories – 6 mass timber




APEX PLAZA
CHARLOTTESVILLE, VA
8 STORIES
6 TIMBER OVER 2 PODIUM, 100 FT
Monticello Av
Gleason St
PRIMARILY OFFICE SPACE
Photo: William McDonough + Partners | Architect: William McDonough + Partners

61


Photos: Baumberger Studio/PATH Architecture

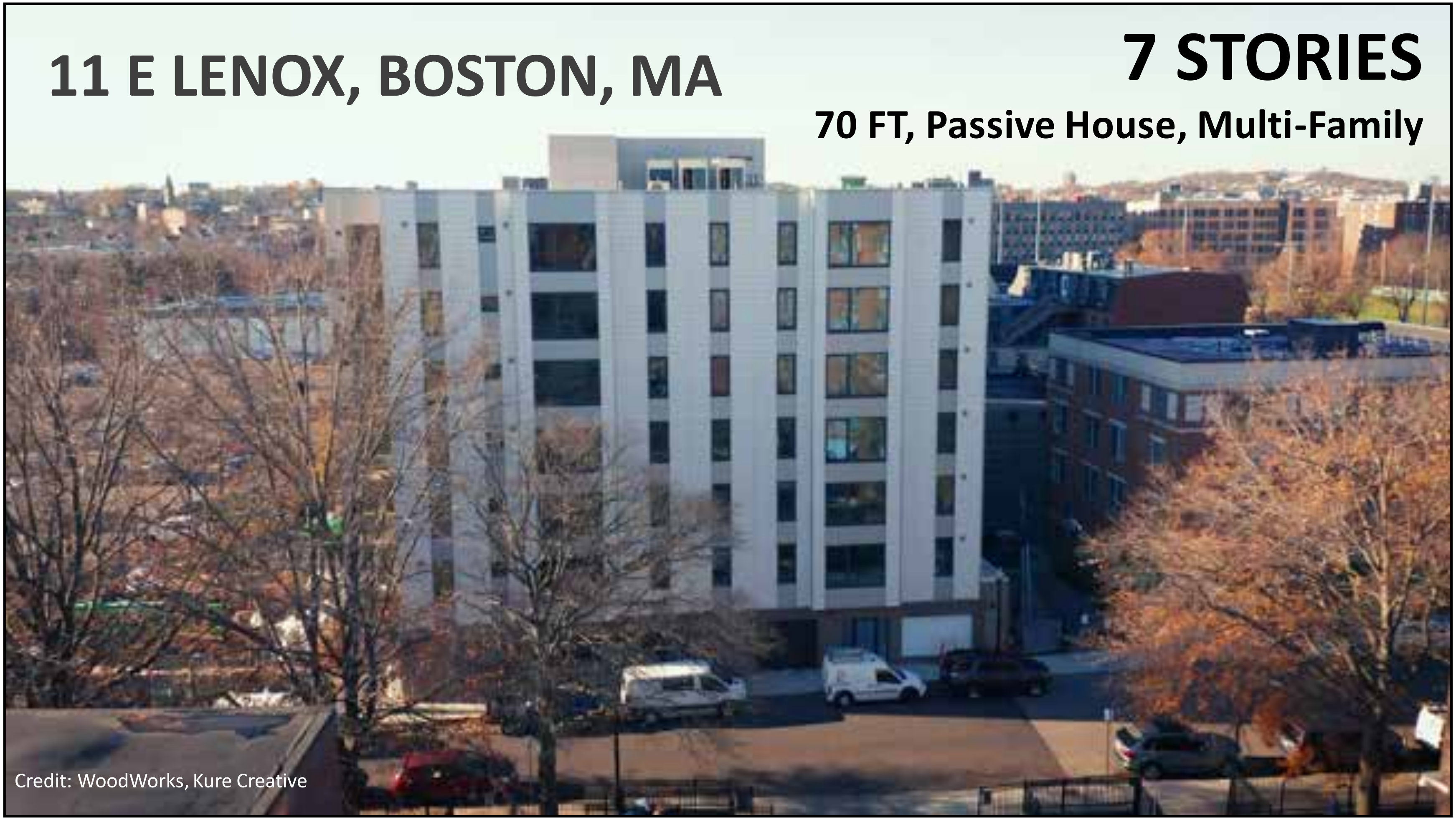
PRECEDENT PROJECTS | CARBON 12 | PORTLAND, OR

62

11 E LENOX, BOSTON, MA

7 STORIES

70 FT, Passive House, Multi-Family



Credit: WoodWorks, Kure Creative

63

ASCENT, MILWAUKEE

25 STORIES

19 TIMBER OVER 6 PODIUM, 284 FT

Tallest Mass Timber Building in the World

Photo: CD Smith Construction |
Architect: Korb & Associates Architects

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❯ QUESTIONS?

Scott Breneman

WoodWorks – Wood Products Council

Scott.Breneman@gmail.com

Today's Agenda

8:00 - 8:40 am: Welcome and Introduction to Mass Timber Lateral: Scott Breneman/WoodWorks

8:40 - 9:20 am: SDPWS 2021 - General Provisions and CLT Shear Wall Systems: Omar Amini/AWC

9:20 - 10:00 am: CLT Diaphragm Design Using SDPWS 2021: Eric McDonnell/Holmes

10:00 - 10:30 am: Break

10:30-11:10 am: Mass Timber Rocking Wall Systems and Design: Reid Zimmerman/KPFF

11:10-11:50 am: NHERI 10 Story Test Building Structure and Construction: Brooke Whitsell/Timberlab

11:50 – 12:00 pm: Conclusions and Site Visit Logistics: WoodWorks