WoodWorks™

Wood Products Council

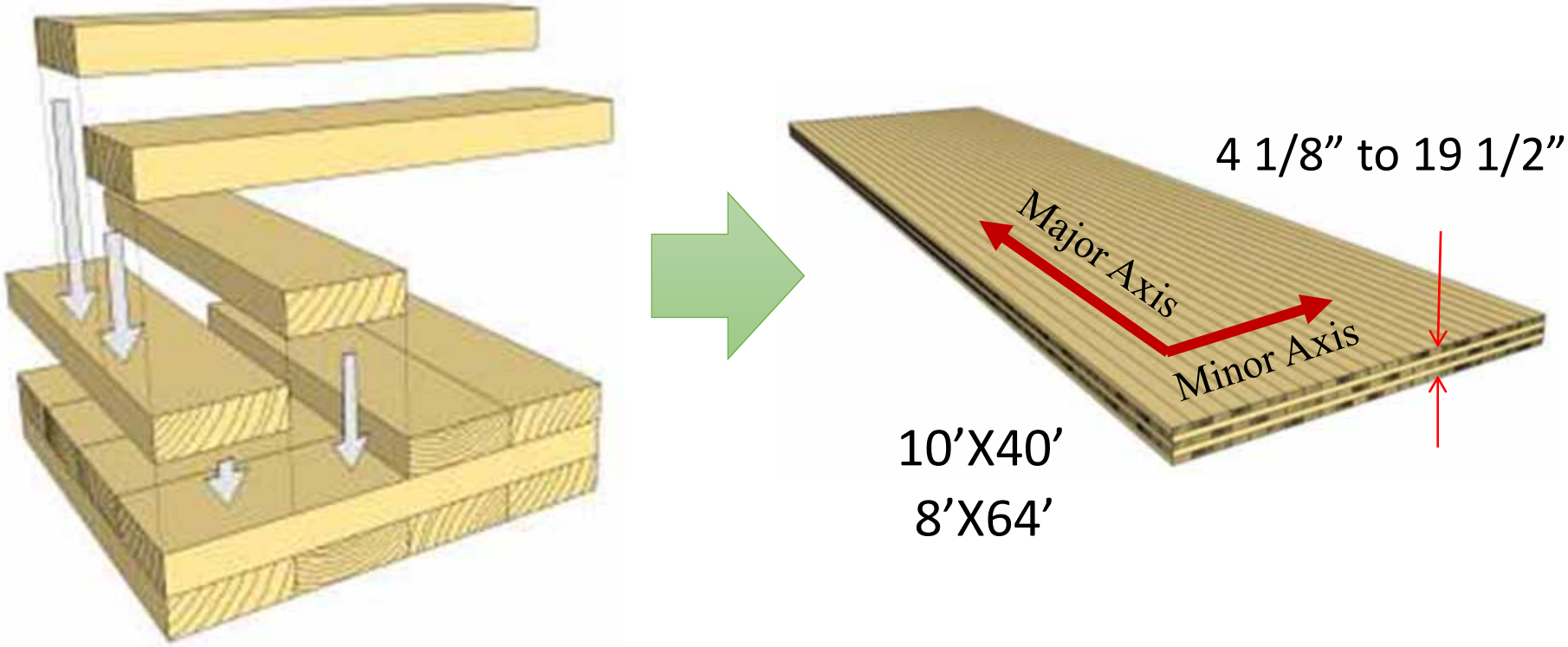
Providing Market Education and Design Resources for Wood Construction

Presented by Ethan Martin, PE
Northwest Regional Director
WoodWorks for Non-residential Construction

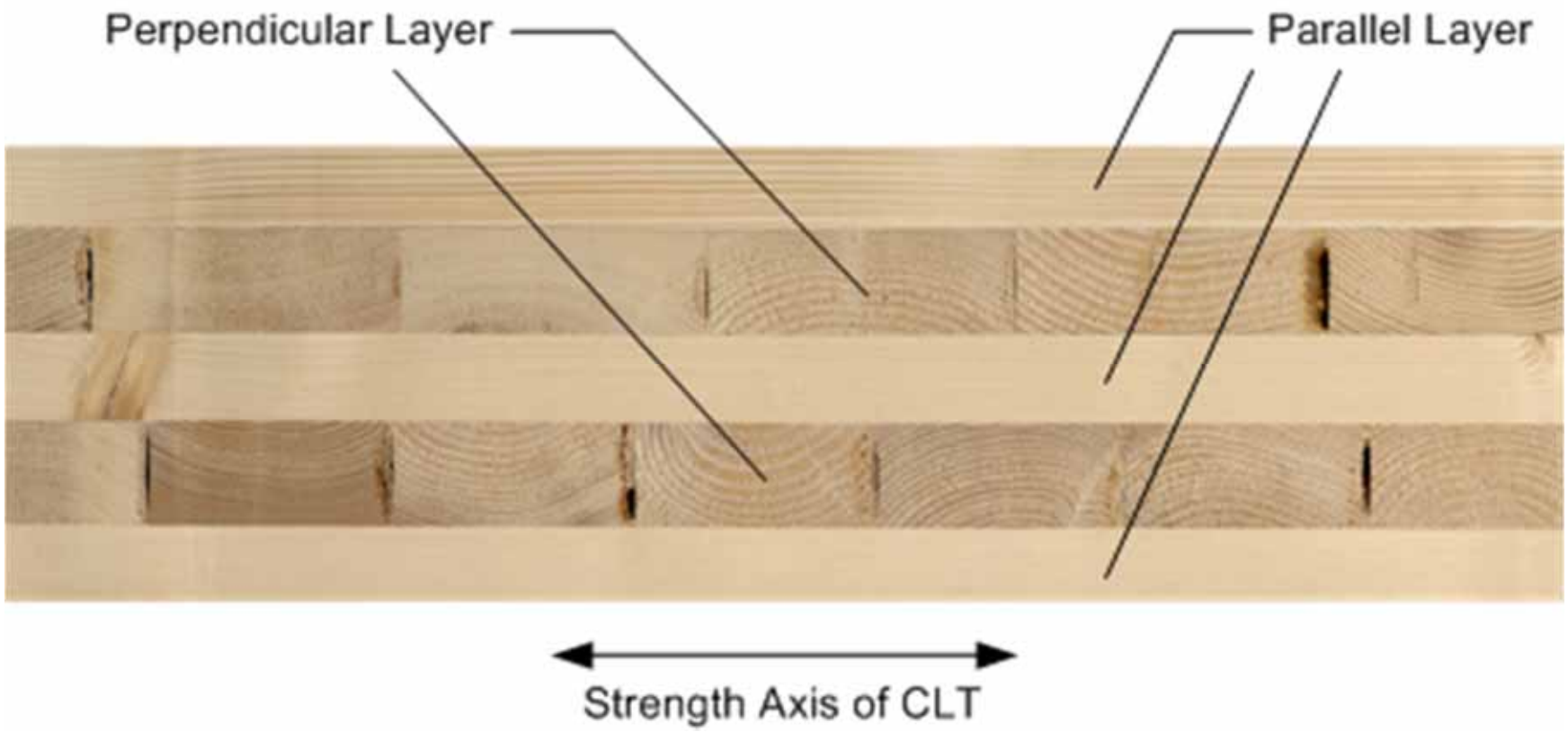
Funding Partners

What is Cross Laminated Timber (CLT)?

- Solid wood panel
- 3 layers min. of solid sawn lams
- 90 deg. cross-lams
- Similar to plywood sheathing



CLT Composition



Model Building Code Acceptance

2015 International Building Code

US CLT Handbook

1. Introduction
2. Manufacturing
3. Structural
4. Lateral
5. Connections
6. DOL and Creep
7. Vibration
8. Fire
9. Sound
10. Enclosure
11. Environmental
12. Lifting

Mass Timber Framing Options

Nail Laminated Timber (NLT)

Glue Laminated Timber (GLT)

Glulam Beams & Columns

Laminated Veneer Lumber (LVL)

Cross Laminated Timber (CLT)

Images Source: Structurecraft

Mass Timber Building Options

CLT Fabrication Press

Photo Credit: DR Johnson

What is the appeal of CLT?

Sustainability	• Reduced Embodied Carbon • Minimal waste production • Highly Energy Efficient
Performance	• Disaster Resilient • Good Fire Resistance • High performing Acoustics • Structural Flexibility
Construction Efficiency	• ~75% lighter than concrete • Reduced construction time • Pre-fabricated and Precise

Minimal Waste

Structural Flexibility

Reduced Construction Time

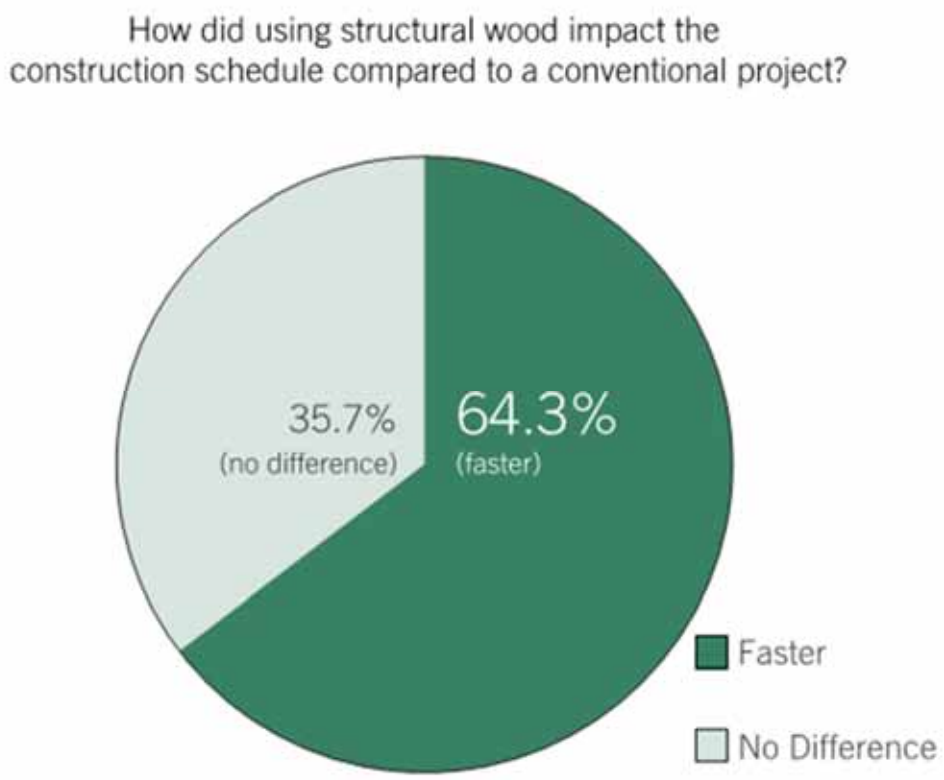
Murray Grove, London UK

- 8 stories of CLT over 1 story concrete podium
- 8 stories built in 27 days (~1/2 the time of precast concrete)

Franklin Elementary School, Franklin, WV

- 45,200 ft^2 2 story elementary school
- 8 weeks to construct

Speed of Construction



Source: Survey of International Tall Wood Buildings, 2014

Speed of Construciton - Time is Money

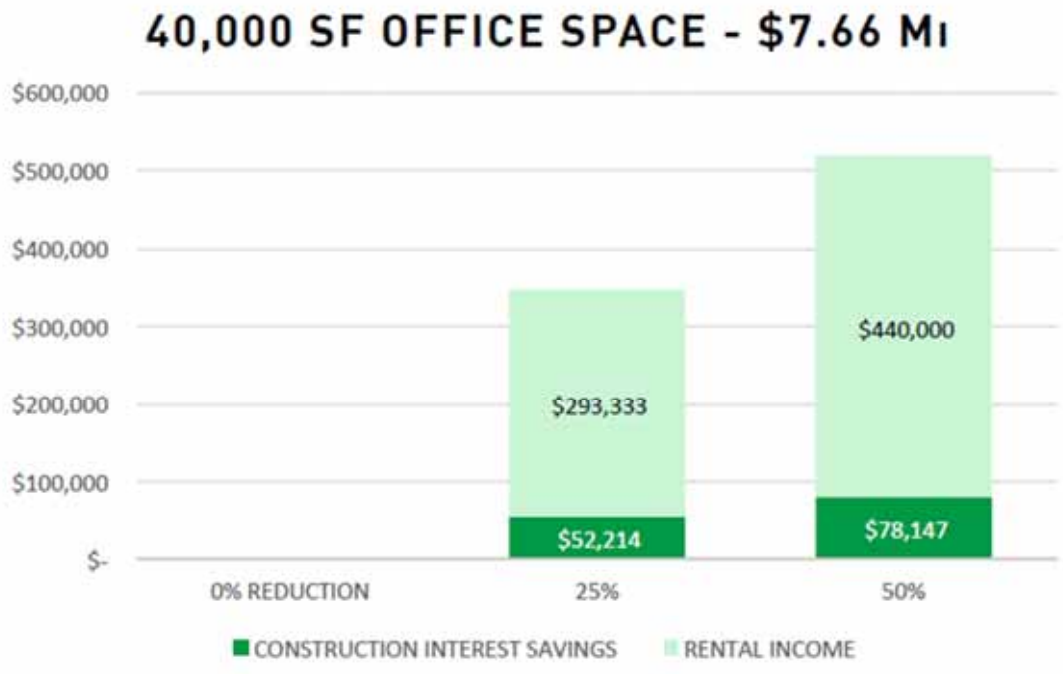
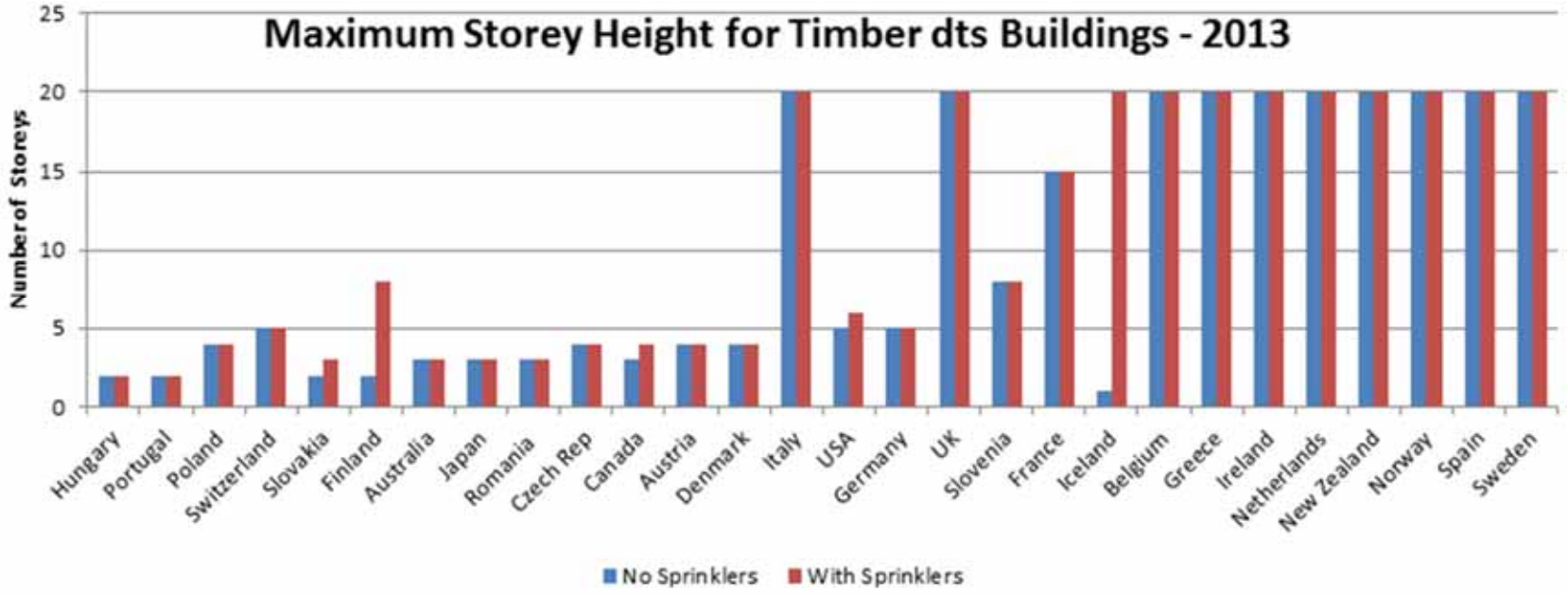


Figure 26

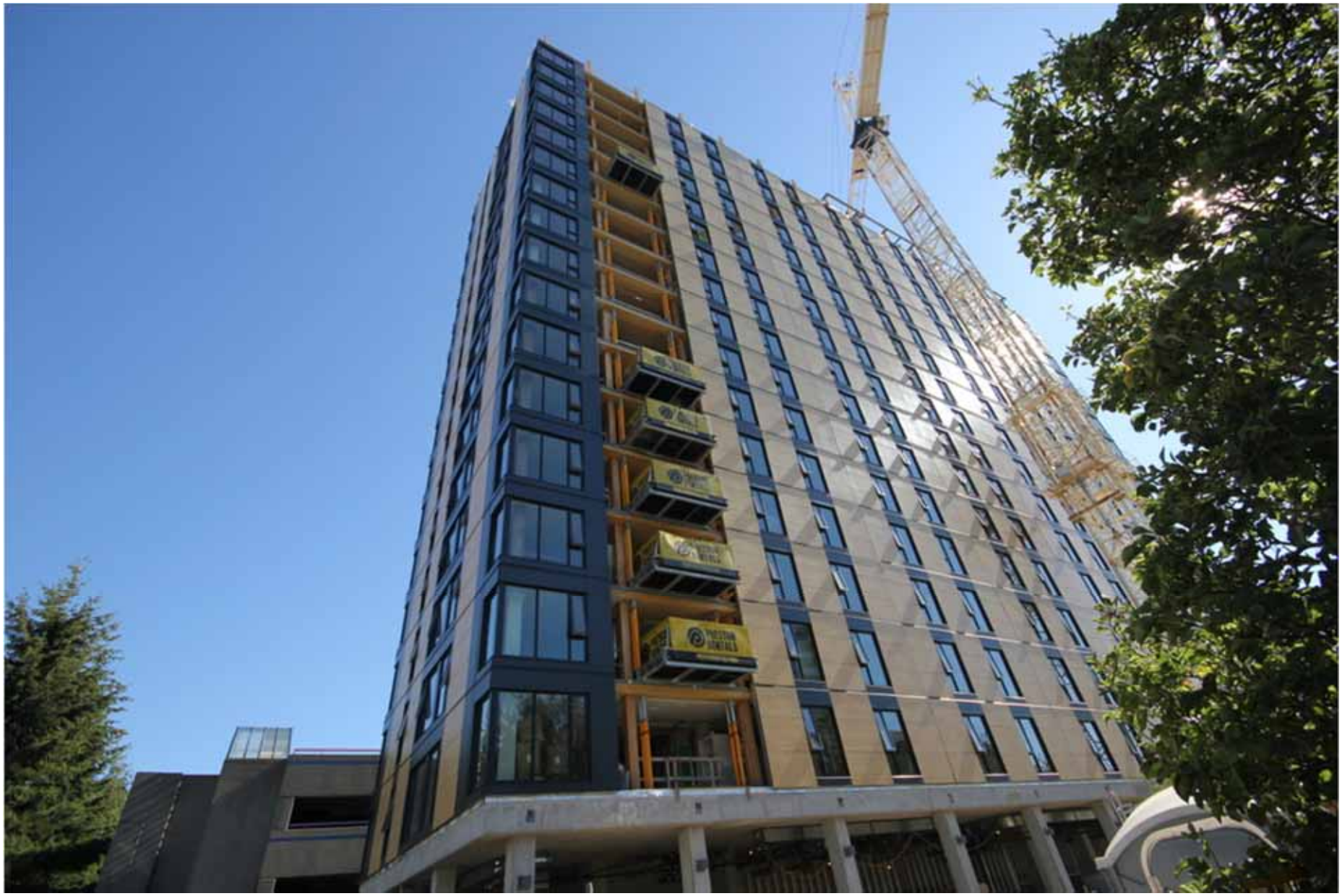
Pro-Formas include a cost reduction in terms of a 25% and 50% faster build time. The lease rate information assumes a 100% building occupancy to reflect the possible savings.

Source: Solid Wood Construction: Process Practice Performance, Smith, Griffin Rice, 2015

Building Height Limits in Timber



Source: Arup



Brock Commons
Vancouver, BC

STARTED JULY 2015
DALSTON LANE
LONDON, UK

ARCHITECT: Waugh Thistleton Architects
ENGINEER: Romboll UK Limited

SEATTLE, WA

PORTLAND, OR

VANCOUVER, WA

PORTLAND, OR

PORTLAND, OR

PORTLAND, OR

PORTLAND, OR

MINNEAPOLIS, MN

UNDER CONSTRUCTION
T3 OFFICE
MINNEAPOLIS, MN

Architect: Michael Green
Images: StructureCraft, MGA

2015
REDSTONE ARSENAL CANDLEWOOD SUITES HOTEL
HUNSTVILLE, AL

Design/Build: LendLease
Images: LendLease

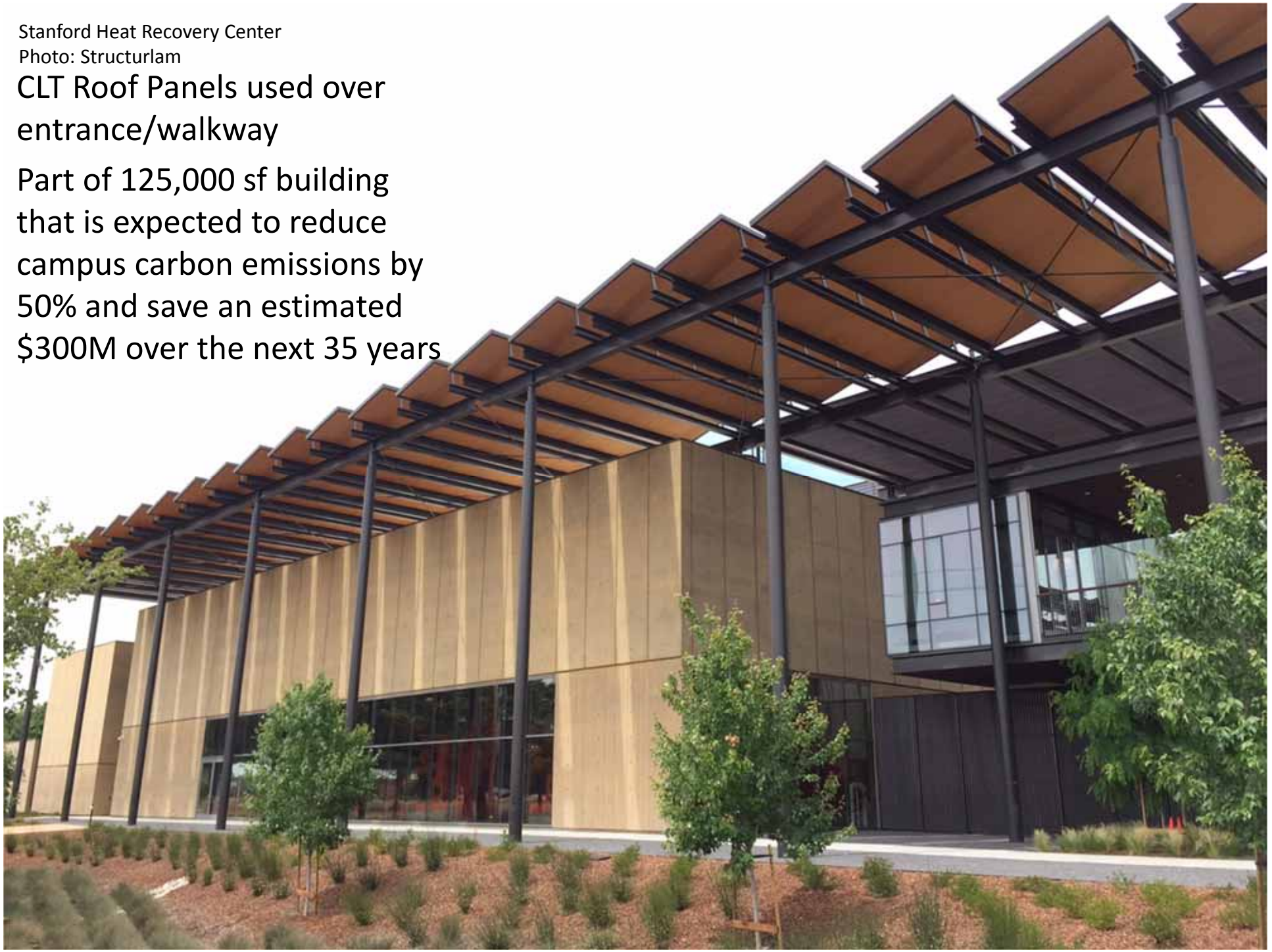
Cooley Landing Education Center

East Palo Alto, CA

Stanford Heat Recovery Center
Photo: Structurlam

CLT Roof Panels used over entrance/walkway

Part of 125,000 sf building that is expected to reduce campus carbon emissions by 50% and save an estimated $300M over the next 35 years



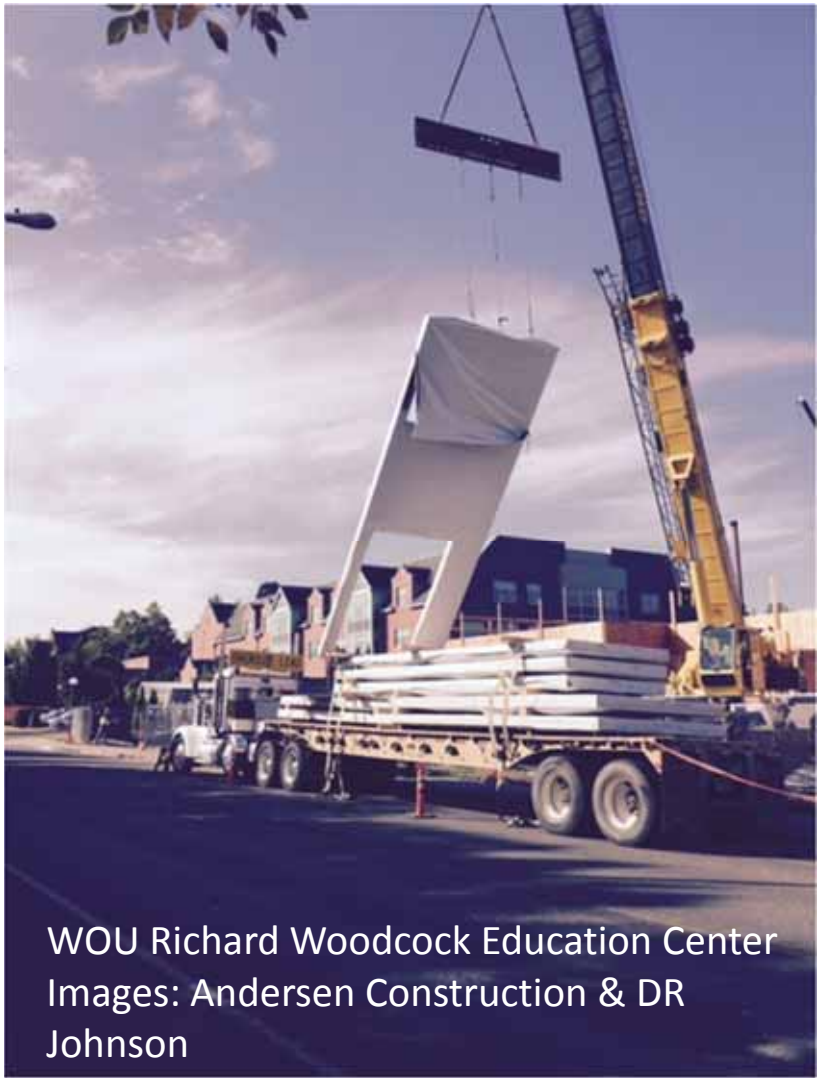
Chicago Horizon Pavilion
Chicago, IL

56’ square kiosk

2 Layers of 3-ply, 4-1/8” CLT roof panels in opposite directions, each panel 8’ x 56’, creating 2 way spanning plate

Chicago Horizon Pavilion
Photos: Tom Harris

Project is currently under construction, anticipated completion fall 2016



WOU Richard Woodcock Education Center
Images: Andersen Construction & DR Johnson

Benefits of CLT Shaft Walls:

- 23 CLT Panels used to form two stairwells
- Each Panel was 5-ply, 6-7/8" thick, 7.5' x 24'
- Each panel weighed 3,330 lbs which is about 20,000 lbs less than a concrete panel of the same size

Source: Andersen Construction

WOU Richard Woodcock Education Center
Image: DR Johnson

Oregon Zoo Elephant Lands
Portland, OR

2,000 sf visitor center

CLT utilized for roof panels

Use of CLT allowed elimination of 20 percent of the steel beams originally needed to support the standard wood decking

1st Oregon CLT project

Oregon Zoo Elephant Lands
Top Photo: Oregon Zoo
Bottom Photo: Oregon Live

Oregon Zoo Elephant Lands
Photos: SRG Partnership, Equilibrium Engineers, Oregon Zoo

International Community Health Services
Shoreline Clinic
Shoreline, WA

Photo Credit: Andrew Pogue Photography

CLT utilized for roof panels with large expressed overhangs

Completed Fall 2014

ICHS Shoreline Clinic
Photos: ICHS

Sauter Timber Production Facility
Rockwood, TN

9,000 sf Industrial production facility

CLT roof and wall panels, glulam beam & column frame

23’ tall walls

$55/sf installed structure cost

2015 Wood Design Award Winner

Sauter Timber Production Facility
Photos: Andreas Sauter, Tim Clay Photography

Glulam Moment Frame Provides Facility's Lateral Resistance

Redstone Arsenal Hotel
Huntsville, AL

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

Redstone Arsenal Hotel
Photos: Lend Lease & Schaefer

Franklin Elementary School
Franklin, WV

Photo Credit: Pam Wean, MSES Architects

45,200 sf, 2 story school

CLT utilized for walls, roof panels, and floor panels

CLT chosen for its construction schedule benefits

Completed January 2015

Photo Credit: Pam Wean, MSES Architects

Brelsford WSU Visitor Center
Pullman, WA

4,277 sf, 1 story visitor center

CLT utilized for roof panels with large, expressed overhangs

Completed Late 2013

Brelsford WSU Visitor Center
Photos: WSU & Benjamin Benschneider

CLT Benefits: Structure Mass, Thickness & Construction Speed

4” CLT roof panels were 6 times lighter and 1/3 thinner than concrete roof panels. Installed faster as no cure time is required

Brelsford WSU Visitor Center Photos: WSU & Benjamin Benschneider

Carbon 12 – Portland, OR

8-stories

Tall Wood Winner – Portland, OR

Framework: An Urban + Rural Ecology

- **Location**: Pearl District, Portland, OR
- **Height:** 130’ / 12 stories
- **Total Building Area:** 90,000 square feet
- **Building Uses:** Ground floor retail; 5 office floors; 5 apartment floors; rooftop amenity
- **Materials:** Cross laminated timber floors and lateral force resisting system; glued laminated beams and columns

OWNER: Beneficial State Bancorp
ARCHITECT: LEVER Architecture
ENGINEERS: Arup, KPFF Consulting Engineers and PAE Consulting Engineers

Questions?

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