Progressive Wood Construction: The Evolution from Low-Rise to Tall Wood

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

Course Description

As a structural building material, wood has been a staple in the US for hundreds of years. However, recent decades have seen a dramatic change in the type and scale of wood projects. As codes have evolved due to recognition of the fire and life safety, structural, and resilient capabilities of wood-construction, new doors have opened that allow larger and taller wood buildings. Concurrently, advances in the technology behind the production of wood products and components have led to the introduction and increased use of off-site construction and mass timber. This opening plenary will take attendees through the progression of wood construction—from light-frame low-rise, to mid-rise, to mass timber and tall wood. With an emphasis on design topics and code provisions applicable to all of these building scales, this session will set the stage for the in-depth technical talks taking place throughout the day.

Learning Objectives

1. Evaluate the code opportunities for cost-effective wood-frame structures in residential mid-rise projects utilizing offsite construction techniques.

2. Understand the distinctive design opportunities in mid-rise commercial construction.

3. Review potential benefits associated with off-site wood construction including cost and schedule savings, worker safety and fire and life safety performance.

4. Discuss unique aspects of mass timber design and construction related to material procurement, on-site inspections, building official interaction, and installation techniques.

Outline

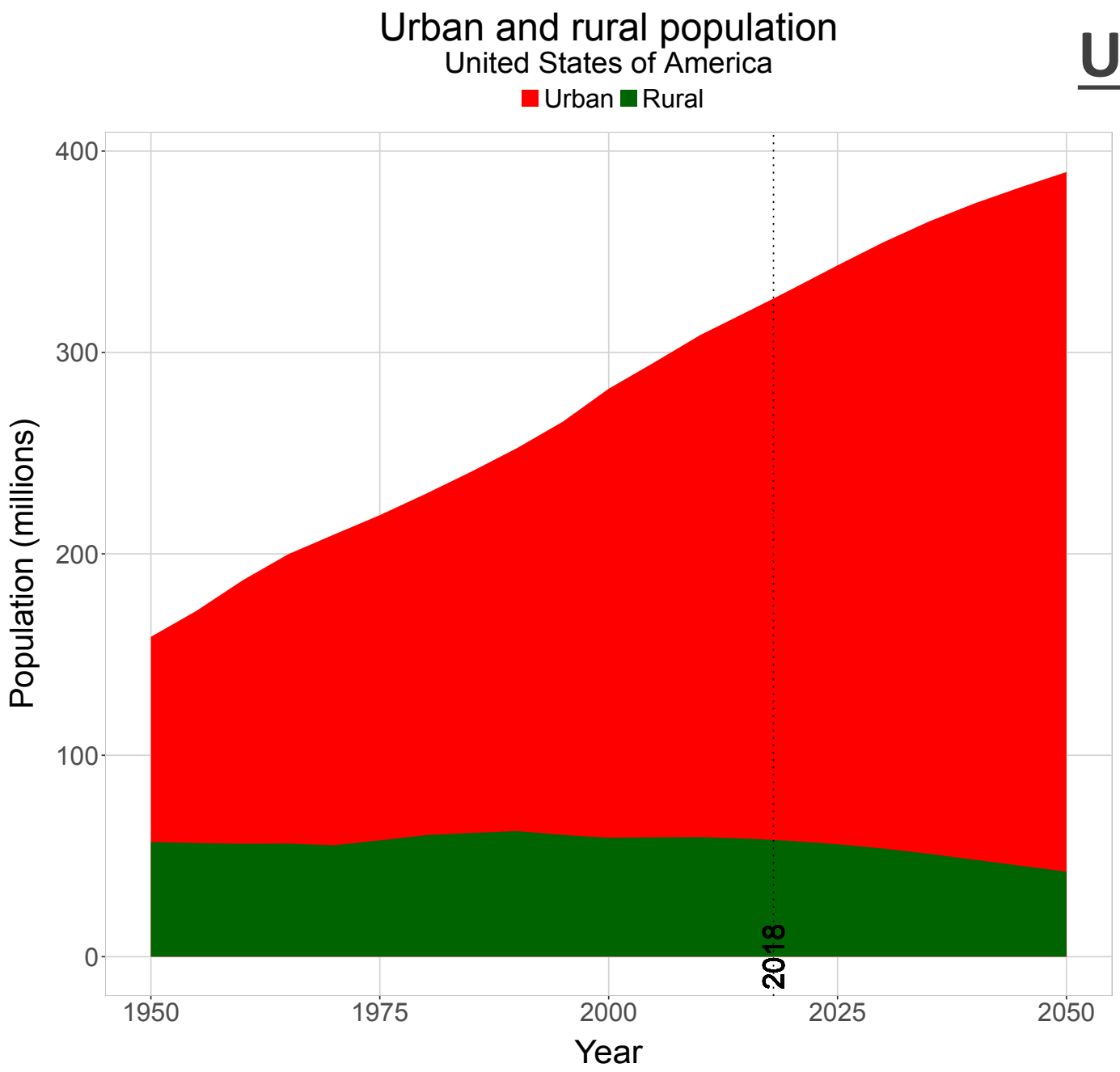
- Need for Wood Construction & Urban Densification
- Building Types/Configurations/Maximizing Height & Area
- Podium Provisions
- Energy Efficiency
- Off-Site Construction
- New Tall Wood Provisions

GLOBAL POPULATION BOOM

Global Population
7.6 billion now
9.8 billion by 2050
30% increase

Source: United Nations Department of Economic and Social Affairs

US URBAN POPULATION BOOM

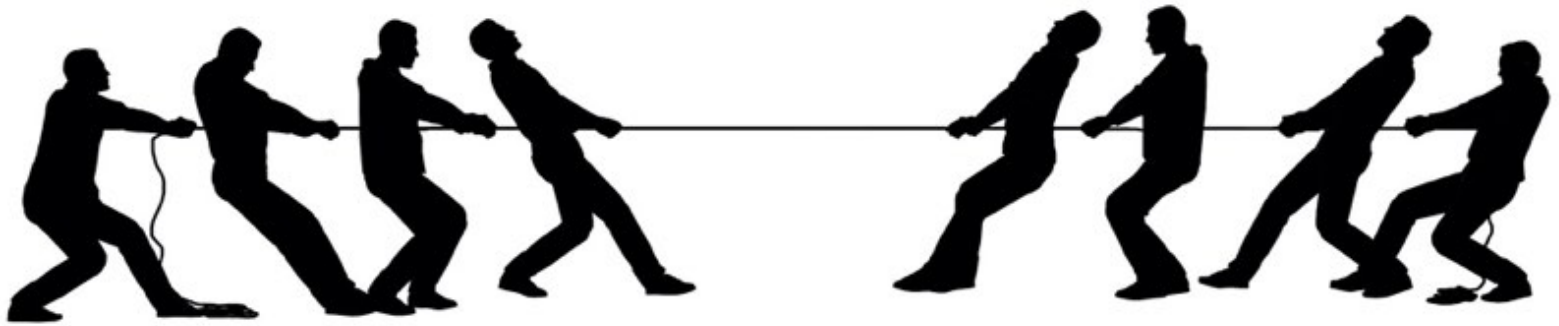


	URBAN	RURAL
2019	271.4 M	57.7 M
2030	301 M	53.7 M
2050	347.3 M	42.2 M

Construction Traffic & Noise
Material Stockpiles
Labor Costs
Labor Availability
Weather Risks

Resiliency
Sustainability
Fire & Life Safety

Need for Sustainable Multi-Family & Mixed Use Structures



Economically Meet
Urban Housing Needs

Increase
Environmental
Responsibility

These 2 items don’t need to be in opposition-
Wood framing helps them work together!

Just Scratching the Surface

Type V Construction

Type V-B Height and Area Limits

V-B

Occupancy	# of Stories	Height (ft)	Area per Story (SF)	Building Area (SF)
A-2	2 / 1	60 / 40	6,000 / 24,000	12,000 / 24,000
B	3	60	27,000	81,000 SF
M	2	60	27,000	54,000 SF
R-2	3 / 2	60 / 40	7,000 / 21,000	14,000 / 42,000

Stories/Heights/Areas include allowable increases for NFPA 13 sprinklers, but exclude potential frontage increase. Where 2 values are shown, first number indicates sprinkler increase for height/stories (no area increase); second number indicates sprinkler increase for area (no height/stories increase).

No fire resistance ratings required

1-story retail and restaurants

2 to 3-story residential/office

Type V-A Height and Area Limits

V-A

3 to 4-story residential/office

Occupancy	# of Stories	Height (ft)	Area per Story (SF)	Building Area (SF)
A-2	3 / 2	70 / 50	11,500 / 34,500	23,000 / 69,000
B	4	70	54,000	162,000
M	4	70	42,000	126,000
R-2	4	70 / 60	12,000 / 36,000	24,000 / 72,000

Stories/Heights/Areas include allowable increases for NFPA 13 sprinklers, but exclude potential frontage increase. Where 2 values are shown, first number indicates sprinkler increase for height/stories (no area increase); second number indicates sprinkler increase for area (no height/stories increase).

1-hour fire resistance rating required for most building elements

Type V Buildings

Multi-family

Restaurants

Retail

Office

4 stories of Type V over Podium

Drs Jullian and Raye Richardson Apts. San Francisco, CA

David Baker Architect, Photo Credits: Bruce Damonte

Plumas County Biomass Boiler

Quincy, CA

- 2,000 SF
- 1st Full CLT Structure in California
- Completed 2018

Photo Credit: Holmes Structures/Sierra Institute for Community & Environment

Let’s Go a Little Bigger

Type III Construction

Type III Buildings

Multi-family

K-12/Higher Ed

Hospitality

Office

Type III-B Height and Area Limits

III-B

4-story office /
5-story residential

Credit: Lever Architecture

Occupancy	# of Stories	Height (ft)	Area per Story (SF)	Building Area (SF)
A-2	3 / 2	75 / 55	9,500 / 28,500	19,000 / 57,000
B	4	75	57,000	171,000
M	3	75	37,500	112,500
R-2	5 / 4	75 / 55	16,000 / 48,000	32,000 / 96,000

Stories/Heights/Areas include allowable increases for NFPA 13 sprinklers, but exclude potential frontage increase. Where 2 values are shown, first number indicates sprinkler increase for height/stories (no area increase); second number indicates sprinkler increase for area (no height/stories increase).

2-hour fire resistance rating required for exterior bearing walls only (FRTW or NC)

Type III-A Height and Area Limits

III-A

5-story residential / 6-story office

Credit: Christian Columbres

Occupancy	# of Stories	Height (ft)	Area per Story (SF)	Building Area (SF)
A-2	4 / 3	85 / 65	14,000 / 42,000	28,000 / 84,000
B	6	85	85,500	256,500
M	5	85	55,500	166,500
R-2	5 / 4	85 / 65	24,000 / 72,000	48,000 / 144,000

Stories/Heights/Areas include allowable increases for NFPA 13 sprinklers, but exclude potential frontage increase. Where 2 values are shown, first number indicates sprinkler increase for height/stories (no area increase); second number indicates sprinkler increase for area (no height/stories increase).

2-hour rating for exterior bearing walls

1-hour rating for other building elements

5 Stories of Type III

AvalonBay Stadium, Anaheim, CA
Architect: Withee Malcom Architects
Structural: VanDorpe Chou Associates

5 over Podium

Pierce Reed Multi-Family,
San Jose, CA

ICE Block I

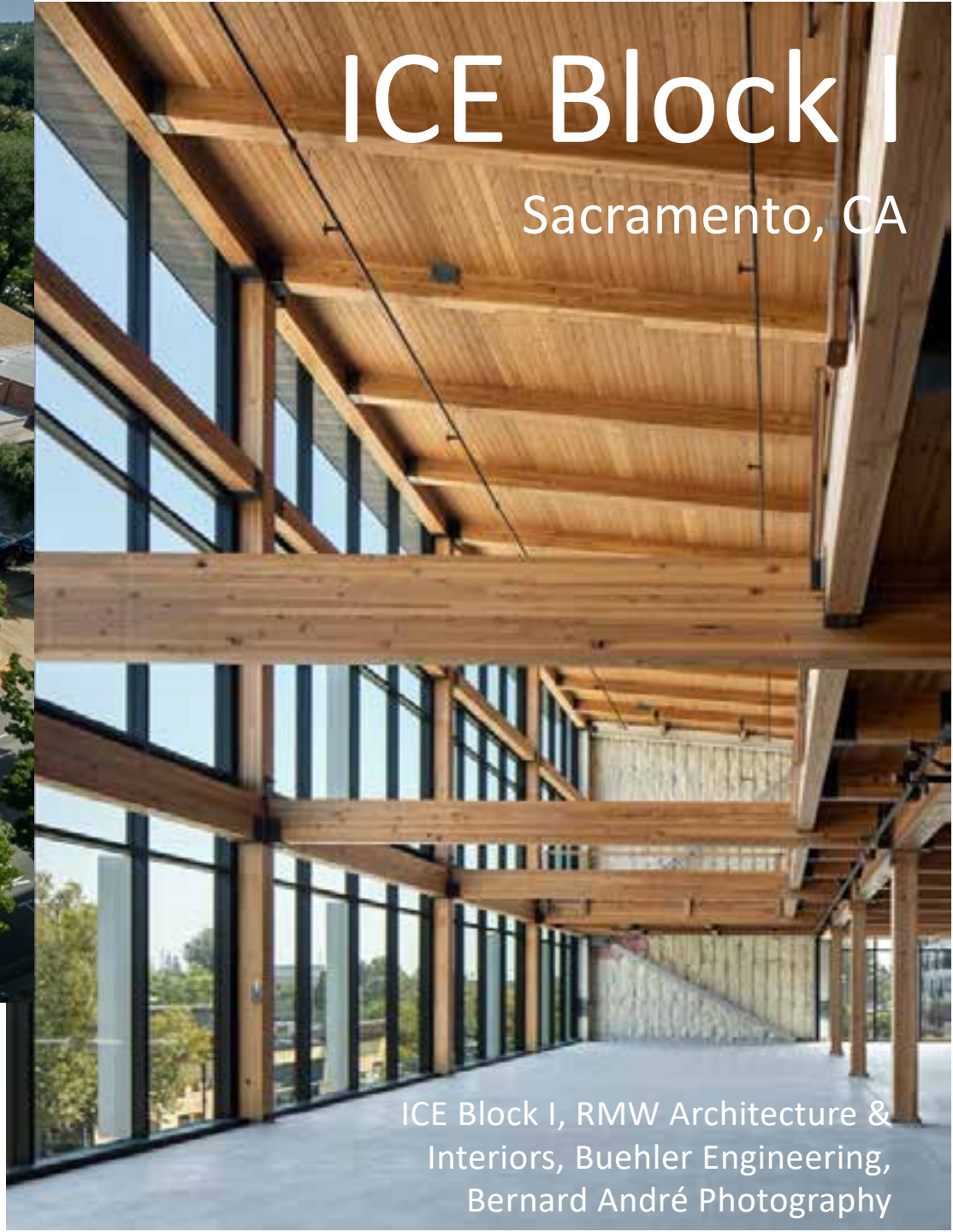
Sacramento, CA

ICE Block I, RMW Architecture & Interiors, Buehler Engineering, Bernard André Photography

ICE Block I

Sacramento, CA

Photo Credit: RMW Architecture



ICE Block I, RMW Architecture & Interiors, Buehler Engineering, Bernard André Photography

135,000 SF of Retail and Restaurant Space

Glulam Frame, 3x T&G Decking

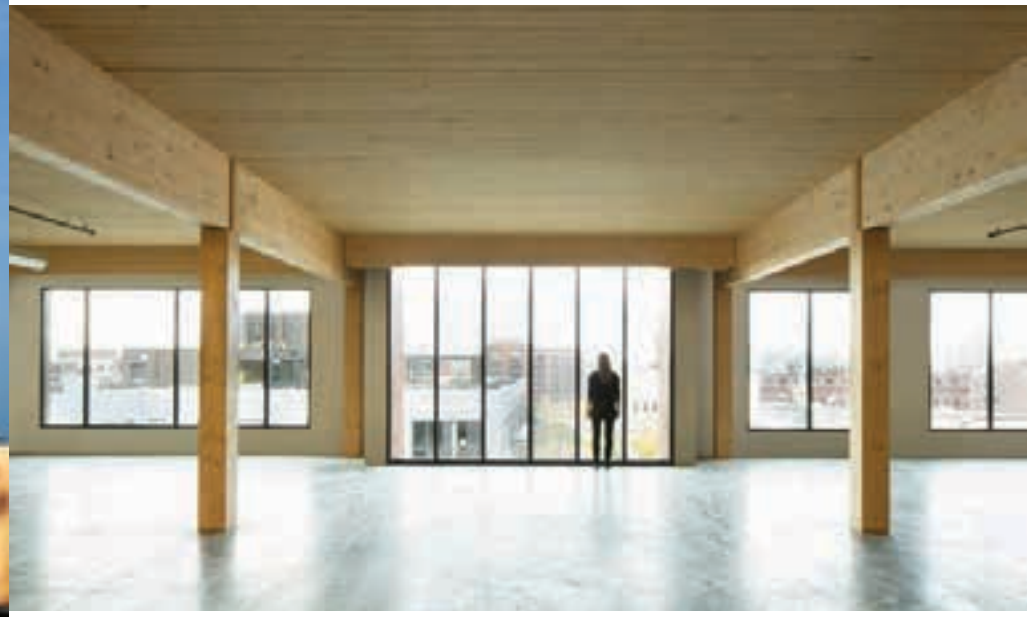
Any Bigger?

Type IV Construction

Type IV Buildings

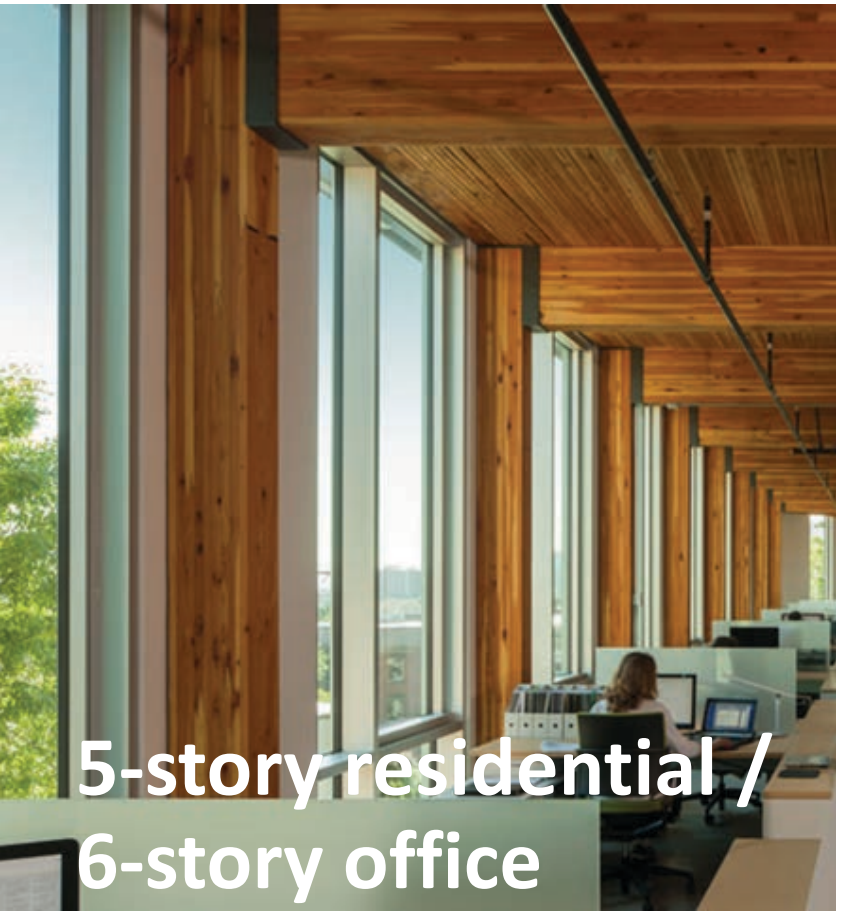
Higher Education

Office



Type IV-HT Height and Area Limits

IV-HT



Credit: John Staments

Occupancy	# of Stories	Height (ft)	Area per Story (SF)	Building Area (SF)
A-2	4 / 3	85 / 65	15,000 / 45,000	30,000 / 90,000
B	6	85 / 65	108,000	324,000
M	5	85 / 65	61,500	184,500
R-2	5 / 4	85 / 65	20,500 / 61,500	41,000 / 123,000

Stories/Heights/Areas include allowable increases for NFPA 13 sprinklers, but exclude potential frontage increase. Where 2 values are shown, first number indicates sprinkler increase for height/stories (no area increase); second number indicates sprinkler increase for area (no height/stories increase).

2-hour rating for exterior bearing walls

Interior elements must qualify as HT

The Cathedral of Christ The Light, Oakland, CA

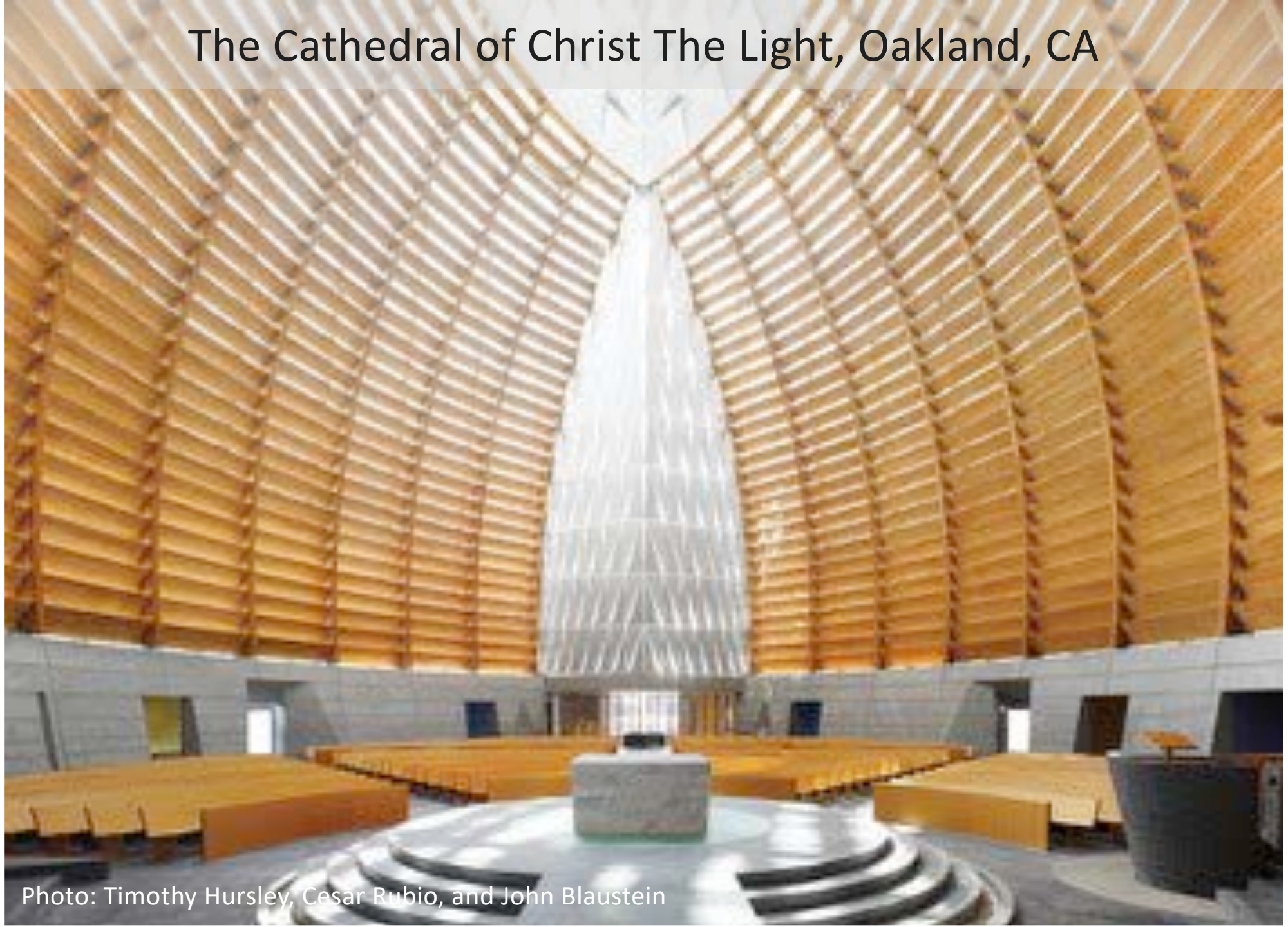


Photo: Timothy Hursley, Cesar Rubio, and John Blaustein

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

Let’s Push It To The Limit

Podiums

Podium Limits

Credit: Matt Todd & PB Architects

IBC	# of Podium Levels	Podium Occupancy
2009	1	S-2 Parking
2012	1	A, B, M, R or S-2 Parking
2015	Multi-story	A, B, M, R or S-2 Parking
2018	Multi-story	A, B, M, R or S-2 Parking

3-hour building separation

Pushed light-framed wood to the limits of code allowed heights

5 over 1 Podium with Mezzanine

120 Union, San Diego, CA
Togawa Smith Martin

Leveraging Thermal Benefits

Wood’s Advantages for Energy Efficiency

Energy Efficiency

Techniques such as Passive House can be paired with Wood's inherent thermal benefits to gain greater savings

- Minimize Thermal Bridging
- Continuous air barrier
- High performance glazing
- Balanced air intake & heat recovery mechanical systems

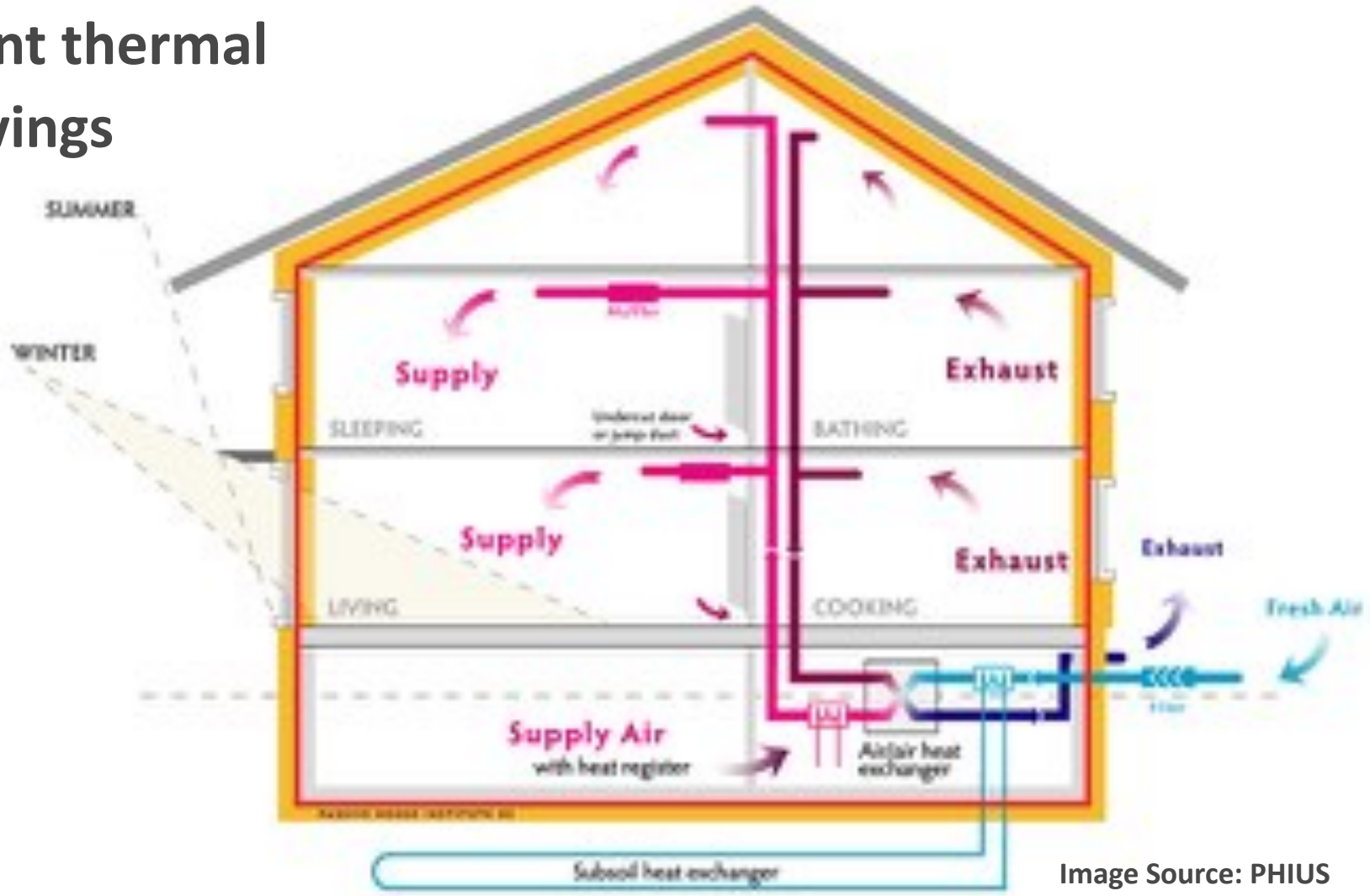
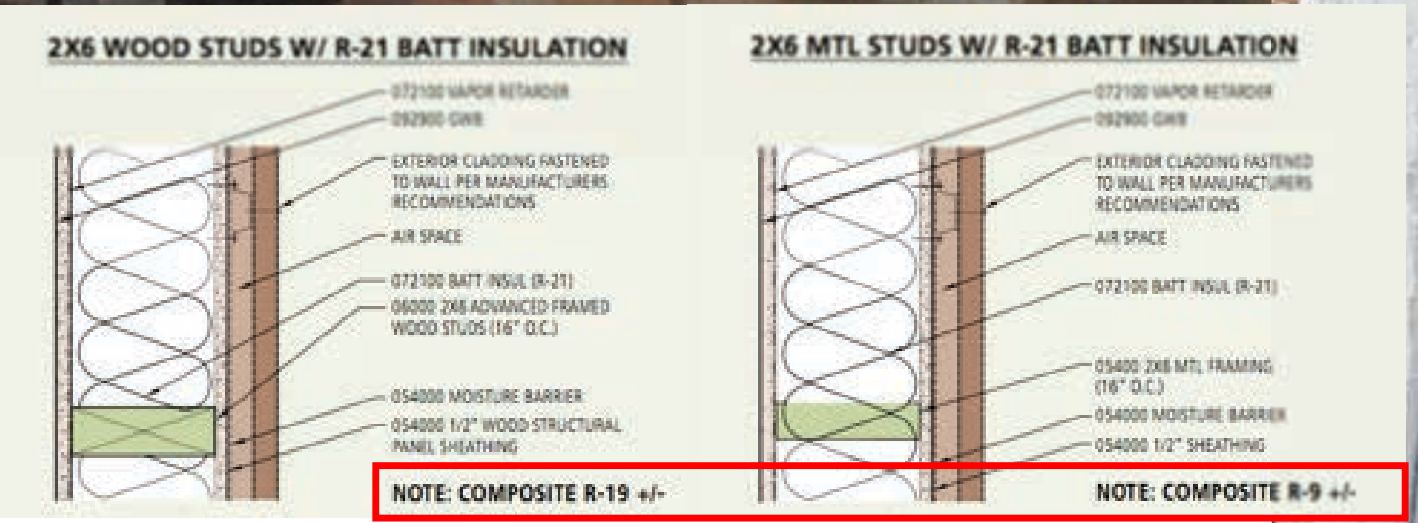


Image Source: PHIUS

- Finding value in utilizing wood in ”non-wood” levels
- Wood framing within Podium Levels



Source: Mahlum Architects

How is Design Shifting?

Off-Site Construction

Off-Site Construction

Varying Degrees of Automated Equipment

Panelized Construction

Image: Blueprint Robotics

Prefabricated Construction

Image: Ecocor

33% Schedule Savings

Woodlands at Harvest Hill, Lebanon, NH
4 Stories, 167k SF

Image: Trumbull-Nelson Construction Company
Source: Wallace Building Products[3]

MODULAR CONSTRUCTION

Modular Construction

Image: Guerdon Modular

Modular Construction

Image: Guerdon Modular

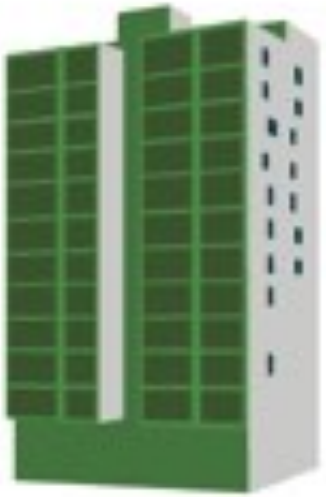
What’s Happening Across The Globe?

Tall Wood

International Tall Wood Projects

Murray Grove
London, United Kingdom
8 Stories
2009

Forté
Melbourne, Australia
10 Stories
2012



TREET
Bergen, Norway
14 Stories
2015

Brock Commons
Vancouver, Canada
18 Stories
2017

Source: ThinkWood

What Will The Future Bring?

Tall Wood in the US

IBC 2021

Type IV-C

Credit: Susan Jones, atelierjones

Photos: Baumberger Studio/PATH Architecture/Marcus Kauffman

Type IV-C Height and Area Limits

IV-C

Occupancy	# of Stories	Height	Area per Story	Building Area
A-2	6	85 ft	56,250 SF	168,750 SF
B	9	85 ft	135,000 SF	405,000 SF
M	6	85 ft	76,875 SF	230,625 SF
R-2	8	85 ft	76,875 SF	230,625 SF

Areas exclude potential frontage increase

In most cases, Type IV-C height allowances = Type IV-HT height allowances, but add'l stories permitted due to enhanced FRR

Type IV-C area = 1.25 * Type IV-HT area

Credit: Susan Jones, atelierjones

Type IV-B

Credit: Susan Jones, atelierjones

Credit: LEVER Architecture

Type IV-B Height and Area Limits

IV-B

Credit: Susan Jones, atelierjones

Occupancy	# of Stories	Height	Area per Story	Building Area
A-2	12	180 ft	90,000 SF	270,000 SF
B	12	180 ft	216,000 SF	648,000 SF
M	8	180 ft	123,000 SF	369,000 SF
R-2	12	180 ft	123,000 SF	369,000 SF

Areas exclude potential frontage increase

In most cases, Type IV-B height & story allowances = Type I-B height & story allowances

Type IV-B area = 2 * Type IV-HT area

Type IV-A

Credit: Susan Jones, atelierjones

Photos: Structurlam, naturally:wood, Fast + Epp

Type IV-A Height and Area Limits

Credit: Susan Jones, atelierjones

Occupancy	# of Stories	Height	Area per Story	Building Area
A-2	18	270 ft	135,000 SF	405,000 SF
B	18	270 ft	324,000 SF	972,000 SF
M	12	270 ft	184,500 SF	553,500 SF
R-2	18	270 ft	184,500 SF	553,500 SF

Areas exclude potential frontage increase

In most cases, Type IV-A height & story allowances = 1.5 * Type I-B height & story allowances

Type IV-A area = 3 * Type IV-HT area

QUESTIONS?

This concludes The American Institute of Architects Continuing Education Systems Course

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WoodWorks – The Wood Product Council

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