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

Presented by Marc Rivard, SE – WoodWorks Regional Director

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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

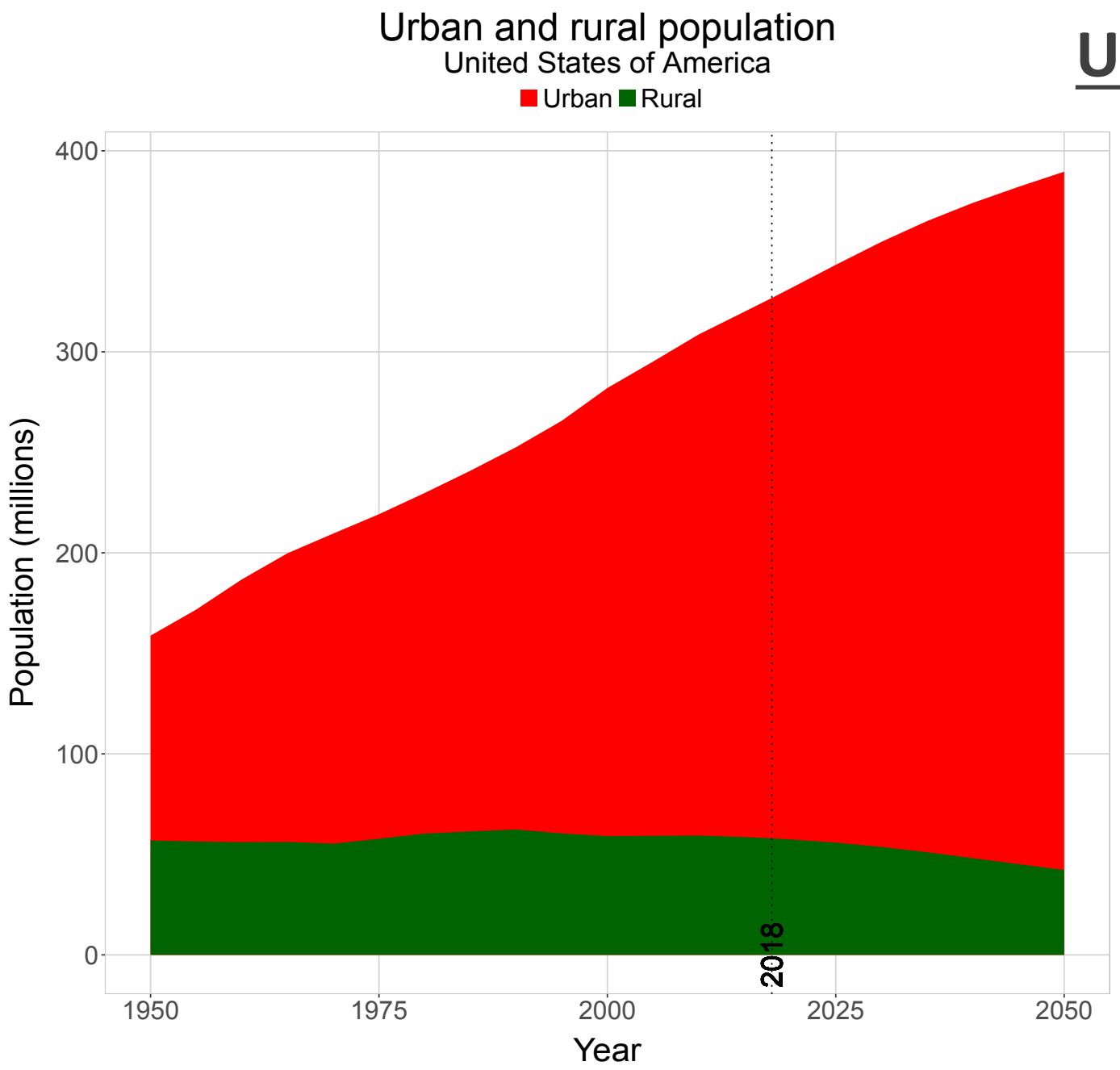
- Need for Wood Construction & Urban Densification
- Building Types/Configurations/Maximizing Height & Area
- Podium Provisions
- Energy Efficiency
- Off-Site Construction
- New Tall Wood Provisions

# 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

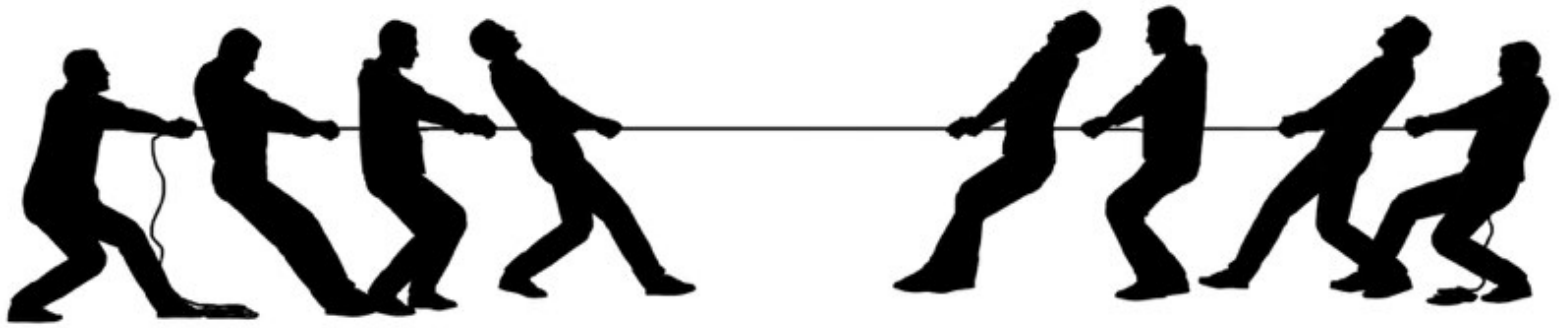



| | URBAN | RURAL |
|---|---|---|
| 2019 | 271.4 M | 57.7 M |
| 2030 | 301 M | 53.7 M |
| 2050 | 347.3 M | 42.2 M |

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 | Area per Story | Building Area |
|---|---|---|---|---|
| A-2 | 2 | 60 ft | 18,000 SF | 36,000 SF |
| B | 3 | 60 ft | 27,000 SF | 81,000 SF |
| M | 2 | 60 ft | 27,000 SF | 54,000 SF |
| R-2 | 3 | 60 ft | 21,000 SF | 63,000 SF |

Stories/Heights/Areas include allowable increases for sprinklers, but exclude potential frontage increase

**1-story retail and restaurants**

**2 to 3-story residential/office**

**No fire resistance ratings required**

# Type V-A Height and Area Limits

V-A

| Occupancy | # of Stories | Height | Area per Story | Building Area |
|---|---|---|---|---|
| A-2 | 3 | 70 ft | 34,500 SF | 103,500 SF |
| B | 4 | 70 ft | 54,000 SF | 162,000 SF |
| M | 4 | 70 ft | 42,000 SF | 126,000 SF |
| R-2 | 4 | 70 ft | 36,000 SF | 108,000 SF |

Stories/Heights/Areas include allowable increases for sprinklers, but exclude potential frontage increase

## 3 to 4-story residential/office

## 1-hour fire resistance rating required for most building elements

# Type V Buildings

Multi-family

Restaurants


Retail

Office

# Common Ground High School

New Haven, CT

Photo Credit: David Sundberg and Gray Organschi Architecture

# Common Ground High School

New Haven, CT

Photo Credit: David Sundberg and Gray Organschi Architecture

# Patrons Oxford Insurance

Portland, ME

Photo Credit: Robert Benson

# 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

Credit: Lever Architecture

| Occupancy | # of Stories | Height | Area per Story | Building Area |
|---|---|---|---|---|
| A-2 | 3 | 75 ft | 28,500 SF | 85,500 SF |
| B | 4 | 75 ft | 57,000 SF | 171,000 SF |
| M | 3 | 75 ft | 37,500 SF | 112,500 SF |
| R-2 | 5 | 75 ft | 48,000 SF | 144,000 SF |

**Stories/Heights/Areas include allowable increases for sprinklers, but exclude potential frontage increase**

## 4-story office / 5-story residential

## 2-hour fire resistance rating required for exterior bearing walls only (non combustible or FRT construction)

# Type III-A Height and Area Limits

III-A

Credit: Christian Columbres

| Occupancy | # of Stories | Height | Area per Story | Building Area |
|---|---|---|---|---|
| A-2 | 4 | 85 ft | 42,000 SF | 126,000 SF |
| B | 6 | 85 ft | 85,500 SF | 256,500 SF |
| M | 5 | 85 ft | 55,500 SF | 166,500 SF |
| R-2 | 5 | 85 ft | 72,000 SF | 216,000 SF |

**Stories/Heights/Areas include allowable increases for sprinklers, but exclude potential frontage increase**

**5-story residential / 6-story office**

**2-hour rating for exterior bearing walls**

**1-hour rating for other building elements**

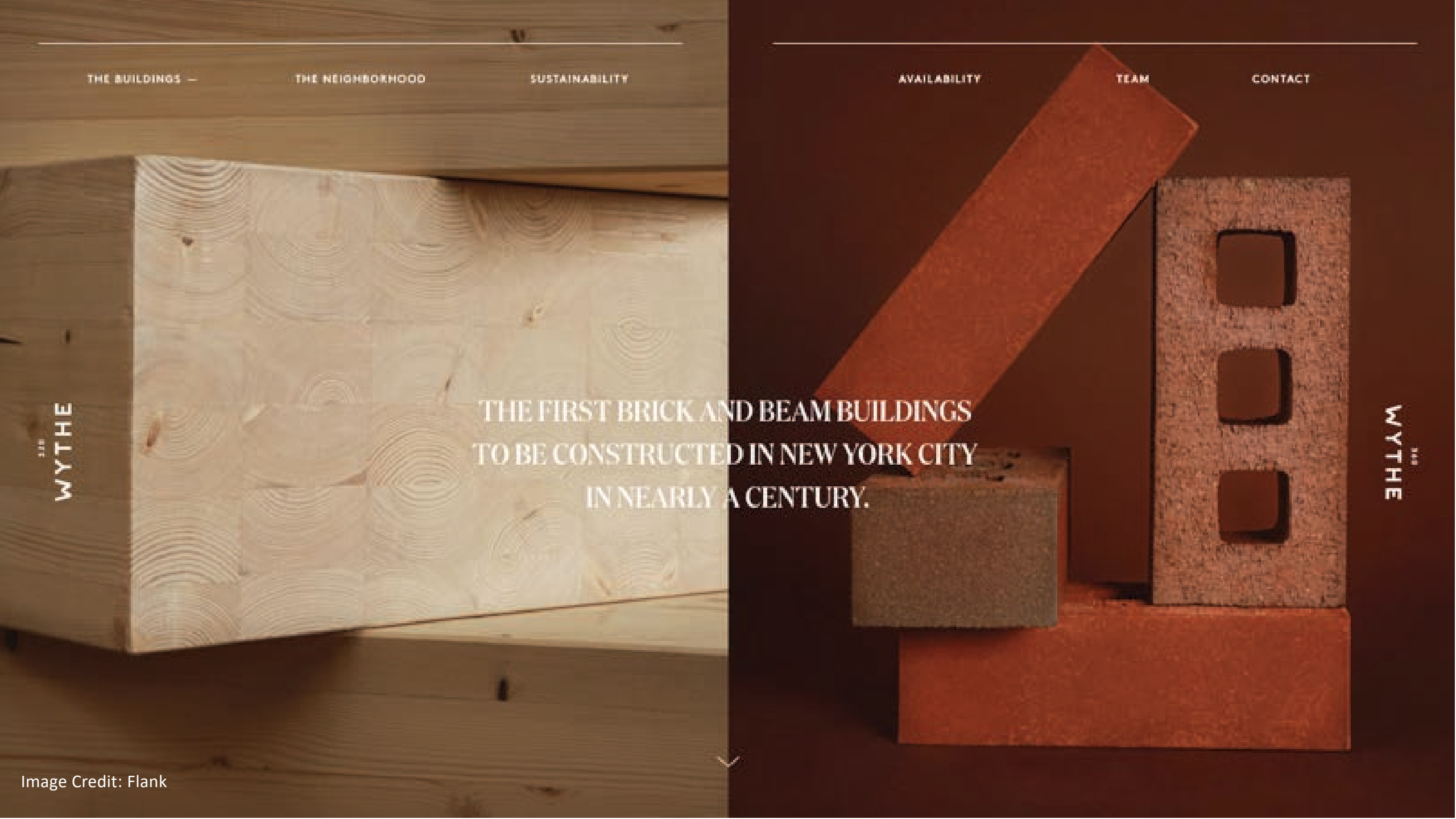
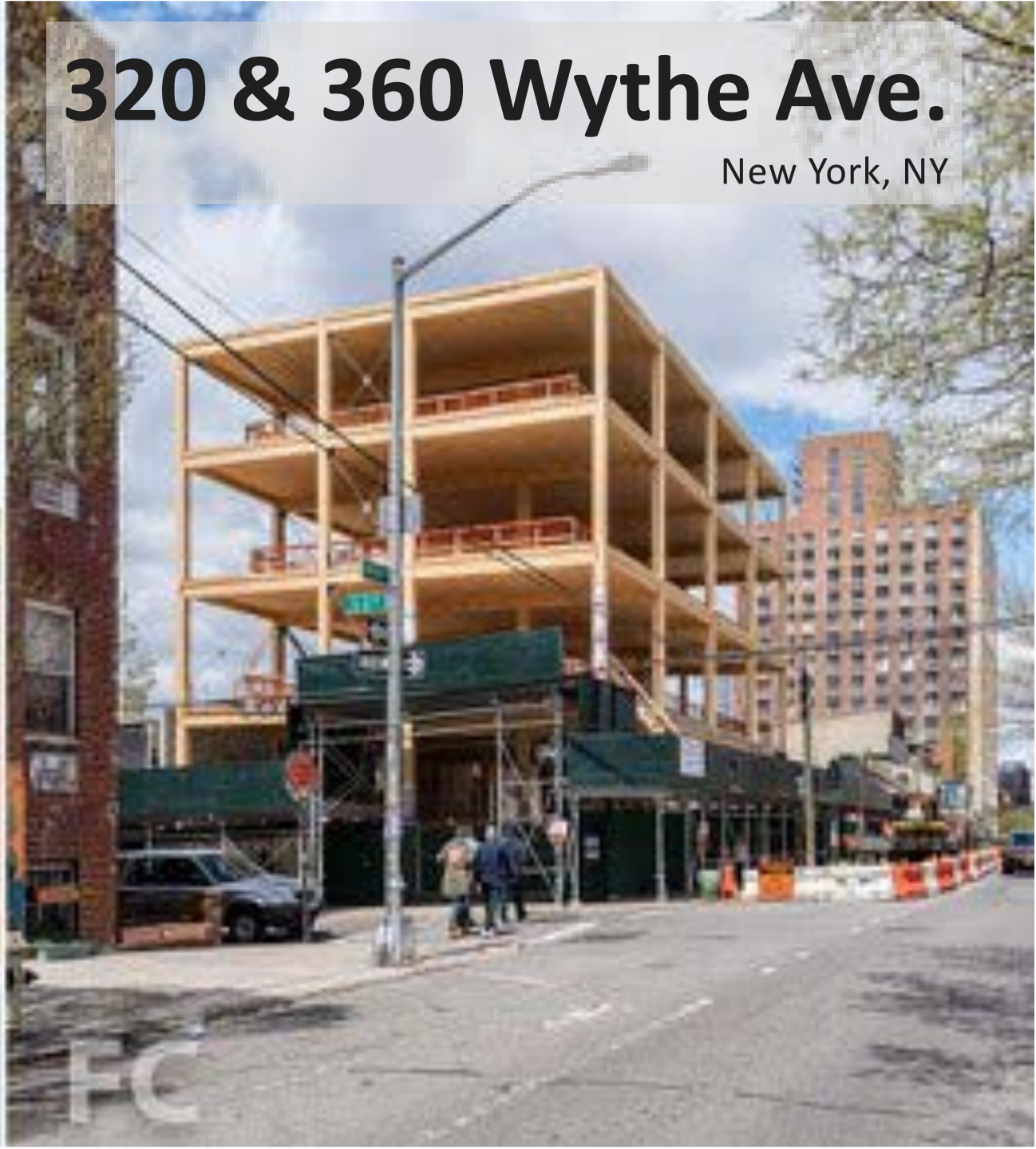



Image Credit: Flank

# 320 & 360 Wythe Ave.

New York, NY

Image Credit: Field Condition/Flank



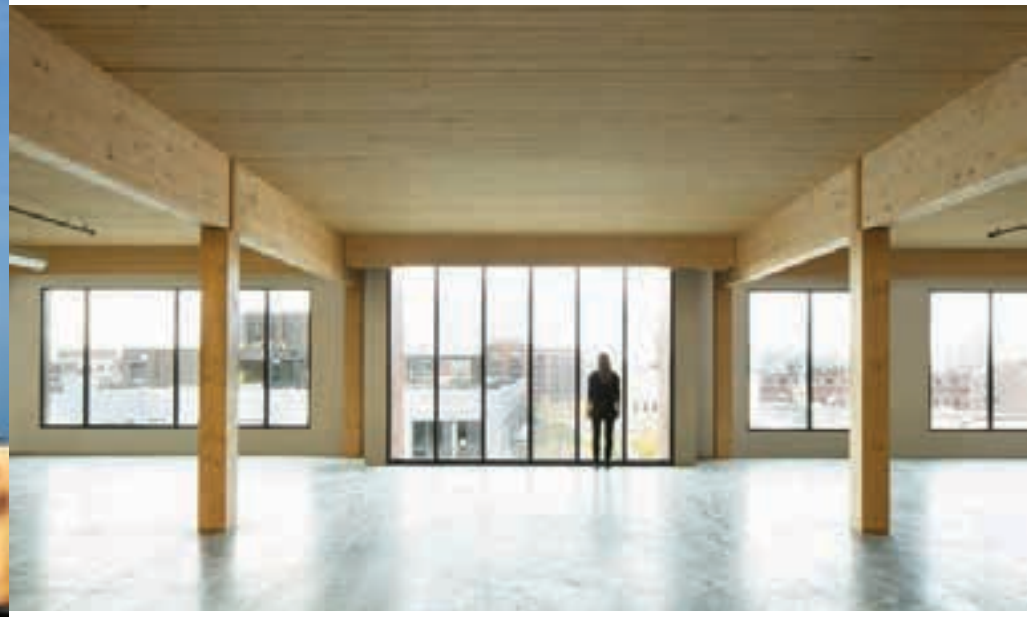
# Any Bigger?

## 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 | Area per Story | Building Area |
|---|---|---|---|---|
| A-2 | 4 | 85 ft | 45,000 SF | 135,000 SF |
| B | 6 | 85 ft | 108,000 SF | 324,000 SF |
| M | 5 | 85 ft | 61,500 SF | 184,500 SF |
| R-2 | 5 | 85 ft | 61,500 SF | 184,500 SF |

**Stories/Heights/Areas include allowable increases for sprinklers, but exclude potential frontage increase**

**5-story residential / 6-story office**

**2-hour rating for exterior bearing walls**

**Interior elements must qualify as Heavy Timber**

# John W. Olver Design Building

University of Massachusetts, Amherst, MA

Image Credit: Alex Schreyer

# John W. Olver Design Building

University of Massachusetts, Amherst, MA

Photo Credit: Alex Schreyer

# 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**

# Marselle Condos, Seattle, WA


6 stories for Offices, 5 stories for Residential
+ Mezzanine + Multi-Story Podium

# 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

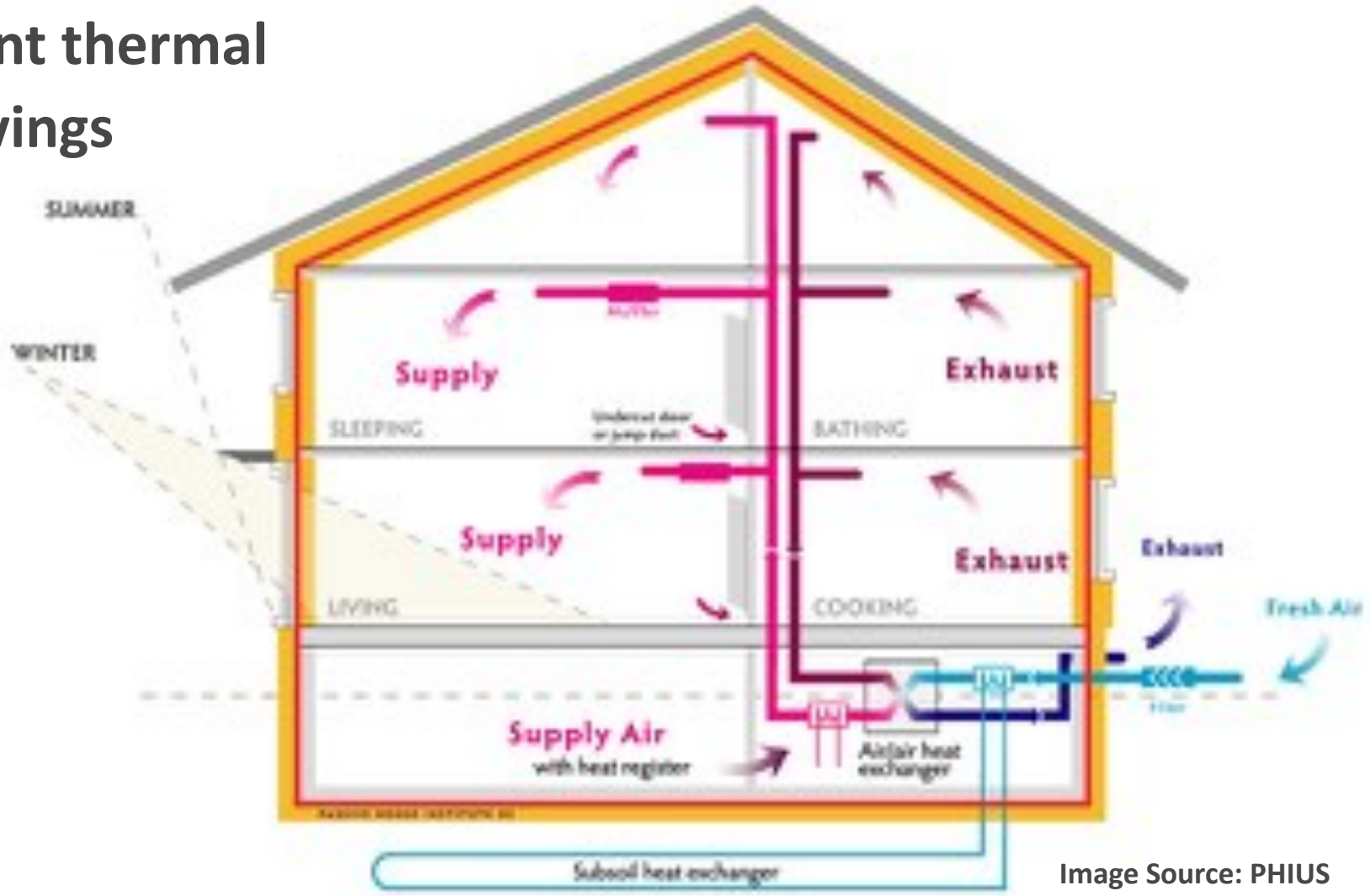



Image Source: PHIUS

# Energy Efficiency

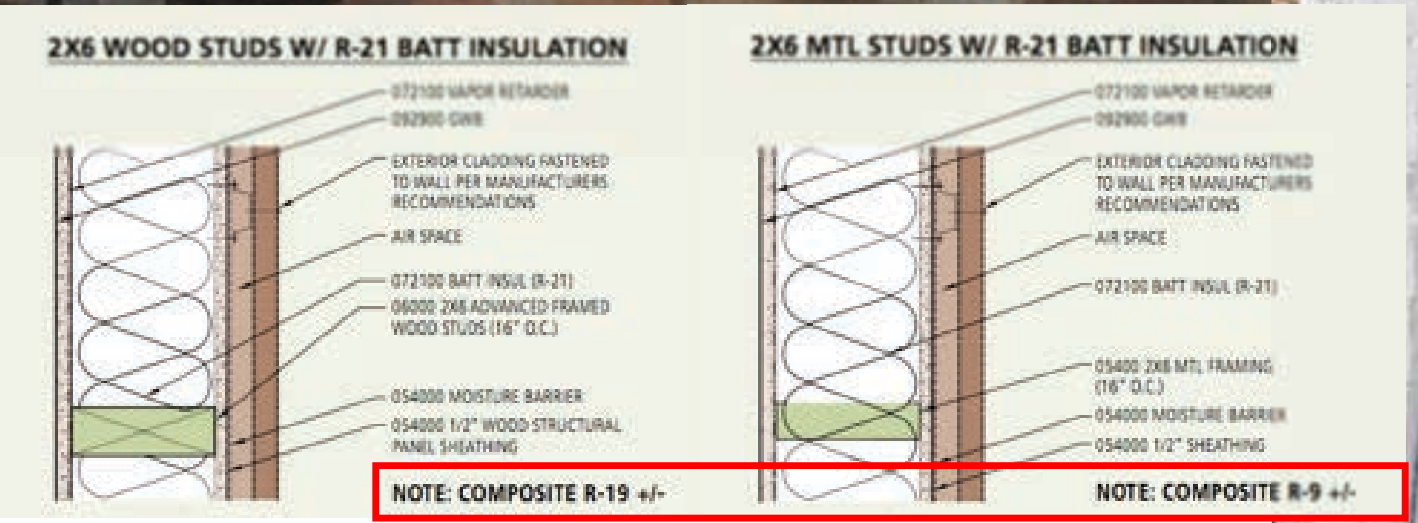
- Energy codes continue to evolve, requiring enhanced levels of energy efficiency
- Recognition of wood's superior thermal properties

TABLE C402.1.3
OPAQUE THERMAL ENVELOPE INSULATION COMPONENT MINIMUM REQUIREMENTS, R-VALUE METHOD[a]

| CLIMATE ZONE | 1 | | 2 | | 3 | | 4 EXCEPT MARINE | | 5 AND MARINE 4 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | All other | Group R | All other | Group R | All other | Group R | All other | Group R | All other | Group R | All other |
| | Walls, above grade | | | | | | | | | | |
| Mass | R-5.7ci[f] | R-5.7ci[f] | R-5.7ci[f] | R-7.6ci | R-7.6ci | R-9.5ci | R-9.5ci | R-11.4ci | R-11.4ci | R-13.3ci | R-13.3ci |
| Metal building | R-13 + R-6.5ci | R-13 + R-6.5ci | R13 + R-6.5ci | R-13 + R-13ci | R-13 + R-6.5ci | R-13 + R-13ci | R-13 + R-13ci | R-13 + R-13ci | R-13 + R-13ci | R-13 + R-13ci | R-13 + R-13ci |
| Metal framed | R-13 + R-5ci | R-13 + R-5ci | R-13 + R-5ci | R-13 + R-7.5ci | R-13 + R-7.5ci | R-13 + R-7.5ci | R-13 + R-7.5ci | R-13 + R-7.5ci | R-13 + R-7.5ci | R-13 + R-7.5ci | R-13 + R-7.5ci |
| Wood framed and other | R-13 + R-3.8ci or R-20 | R-13 + R-3.8ci or R-20 | R-13 + R-3.8ci or R-20 | R-13 + R-3.8ci or R-20 | R-13 + R-3.8ci or R-20 | R-13 + R-3.8ci or R-20 | R-13 + R-3.8ci or R-20 | R-13 + R-3.8ci or R-20 | R-13 + R-3.8ci or R-20 | R-13 + R-7.5ci or R-20 + R-3.8ci | R-13 + R-7.5ci o R-20 + R-3.8ci |

Image Source: 2015 IECC

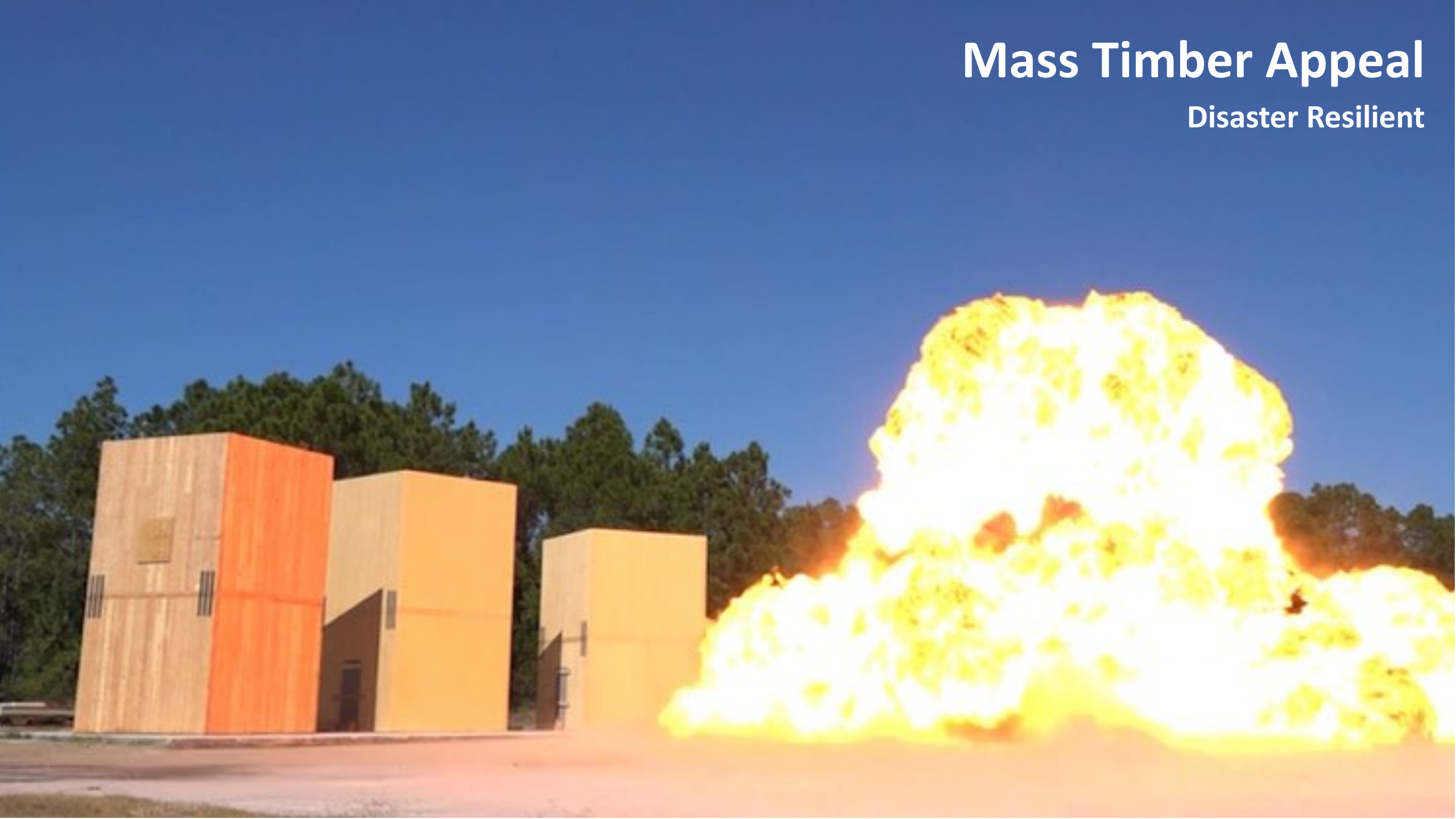
- Finding value in utilizing wood in ”non-wood” levels
- Wood framing within Podium Levels




Source: Mahlum Architects

# Mass Timber Appeal

## Disaster Resilient



# 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

Image: Guerdon Modular

# Modular Construction

Image: Guerdon Modular

# Modular Construction

Image: Guerdon Modular

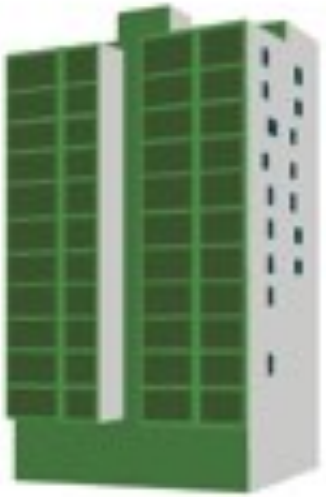
# What’s Happening Across The Globe?

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

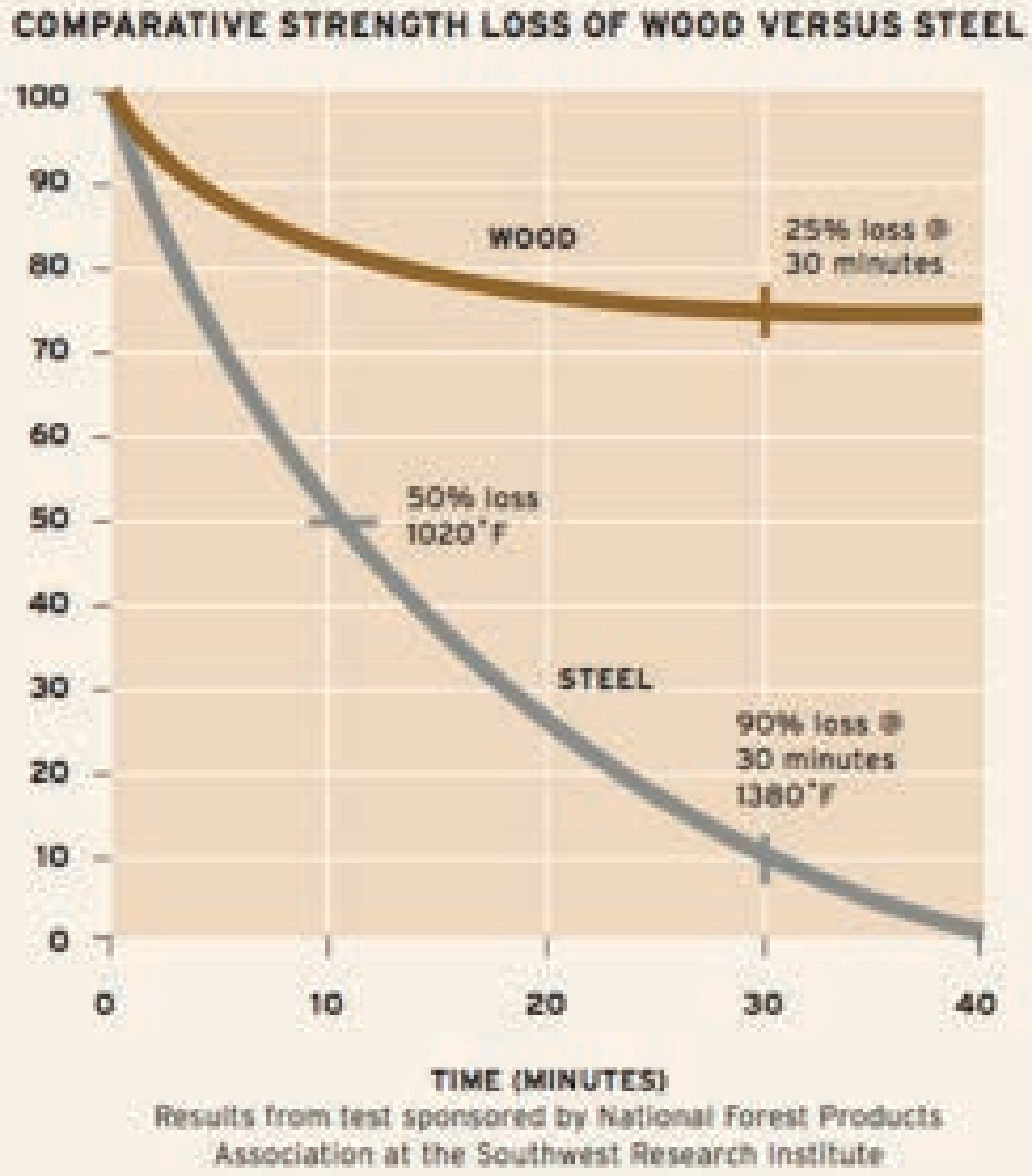
Source: ThinkWood

# What Will The Future Bring?

Tall Wood in the US

IBC 2021

# Mass Timber Fire Resistance




Source: AITC

# Butler Brothers Building

Minneapolis, MN


# Portland International Jetport, Portland, ME

Architect : Gensler
Structural Engineer: Oest Associates
Timber Engineer:  DeStefano & Chamberlain

Photos Credit: DeStafano & Chamberlain, Inc.

# Portland International Jetport

- Location: Portland, ME
- LEED Gold
- Completed 2012

Design Team: Gensler, Oest Associates
Photo Credit: DeStafano & Chamberlain, Inc, Robert Benson Photography

## NEW CONSTRUCTION TYPES IN 2021 IBC

**Type IV-A** – Maximum 18 stories, with gypsum wallboard on all mass timber.

**Type IV-B** – Maximum 12 stories, limited-area of exposed mass timber walls and ceilings allowed.

**Type IV-C** – Maximum 9 stories, all exposed mass timber designed for a 2-hour fire resistance.

Credit: American Wood Council

# 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

# Modern Tall Wood-Carbon 12

## Portland, OR, 8 stories, 32,000 sf

Photos:
Baumberger Studio/PATH Architecture/Marcus Kauffman

# 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

18 STORIES
BUILDING HEIGHT 270'
ALLOWABLE BUILDING AREA 972,000 SF
AVERAGE AREA PER STORY 54,000SF

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**

# Brock Commons

**Vancouver, BC**

**17 Stories of Timber**
**Installation**
**Started June 6, 2016**
**Finished August 10, 2016**

# 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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