MASS TIMBER APPEAL

MASS TIMBER APPEAL

PRIMARY DRIVERS

CARBON REDUCTIONS

CONSTRUCTION SPEED & EFFICIENCY

CONSTRUCTION SITE CONSTRAINTS – URBAN INFILL

INNOVATION/AESTHETIC

STRUCTURAL PERFORMANCE – LIGHT WEIGHT

180,000 SF in 9.5 Weeks

MASS TIMBER APPEAL

REDUCED CONSTRUCTION TIME

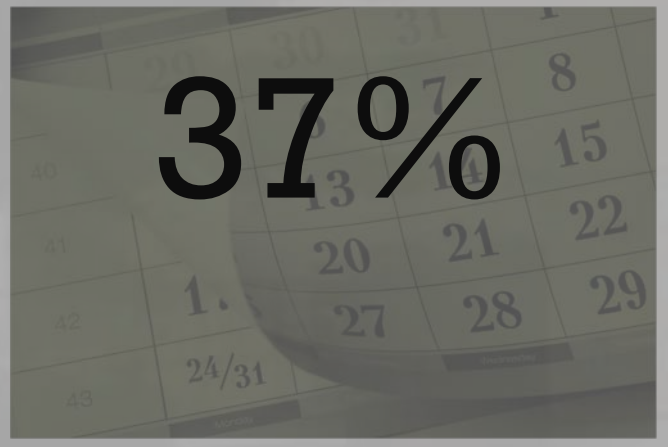
1 Floor = 3 Days

17 Floors Erected in 9.5 Weeks

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



Compared to typical construction

43%

MASS TIMBER APPEAL

MATERIAL MASS

75% LIGHTER WEIGHT THAN CONCRETE

MASS TIMBER APPEAL

PREFABRICATED AND PRECISE

MASS TIMBER ELEMENTS FABRICATED TO TIGHT TOLERANCES (1/16” IS COMMON)

COMPUTER NUMERICALLY CONTROLLED (CNC) CONNECTIONS

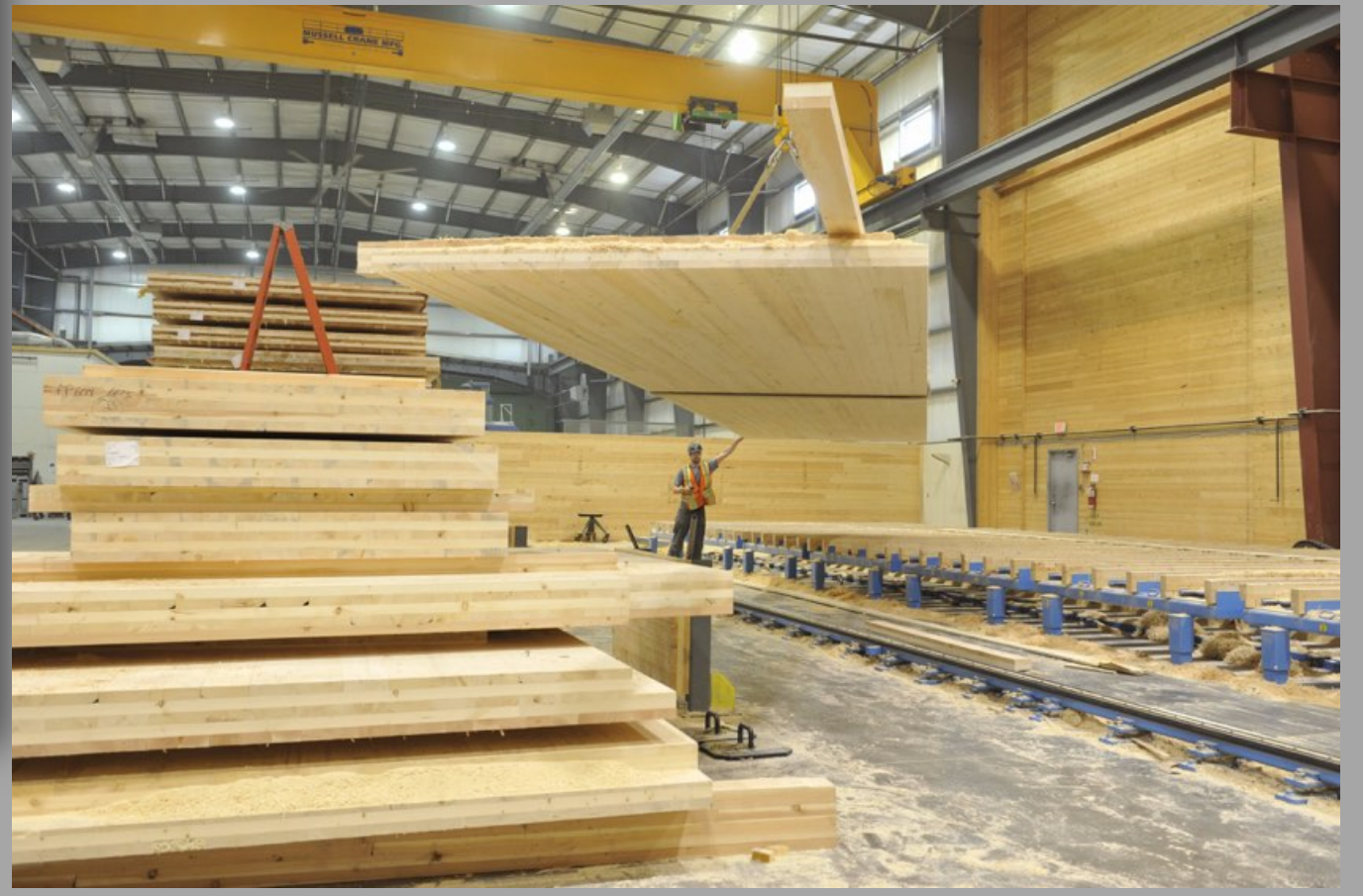


PHOTO CREDIT: NATURALLY WOOD

CLT STRUCTURAL DESIGN

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

MASS TIMBER APPEAL

MINIMAL WASTE

MASS TIMBER APPEAL

ENERGY EFFICIENT

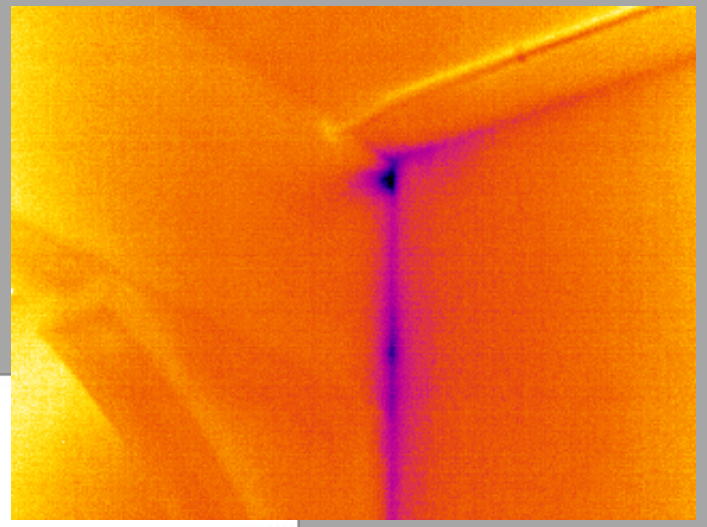


Table 2

Thermal resistance of typical softwood at various thicknesses and 12% moisture content

Thickness	1 in. (25 mm)	4 in. (100 mm)	6 in. (150 mm)	8 in. (200 mm)
R-value ($h \cdot ft.^2 \cdot °F \cdot Btu^{-1}$)	1.25	5.00	7.50	10.00
RSI ($m^2 \cdot K \cdot W^{-1}$)	0.22	0.88	1.30	1.80

CLT HAS AN R-VALUE OF APPROXIMATELY 1.25 PER INCH OF THICKNESS.

SOURCE: US CLT HANDBOOK

CARBON BENEFITS

Frank Rosenstein, courtesy Plum Creek

Volume of wood products used:
2,052 cubic meters (72,467 cubic feet)

U.S. and Canadian forests grow this much wood in:
6 minutes

Carbon stored in the wood:
1,826 metric tons of CO_2

Avoided greenhouse gas emissions:
706 metric tons of CO_2

TOTAL POTENTIAL CARBON BENEFIT:
2,532 metric tons of CO_2

EQUIVALENT TO:

535 cars off the road for a year

Energy to operate 267 homes for a year

Source: US EPA

MASS TIMBER APPEAL

REDUCED EMBODIED CARBON

Volume of wood products used:
818,736 board feet (equivalent)

U.S. and Canadian forests grow this much wood in:
4 minutes

Carbon stored in the wood:
1,014 metric tons of CO_2

Avoided greenhouse gas emissions:
2,155 metric tons of CO_2

TOTAL POTENTIAL CARBON BENEFIT:
3,169 metric tons of CO_2

EQUIVALENT TO:

605 cars off the road for a year

Energy to operate a home for 269 years

Source: US EPA

...FROM ONE SCHOOL

Estimated by the Wood Carbon Calculator for Buildings, based on research by Sarthre, R. and J. O'Connor, 2010, A Synthesis of Research on Wood Products and Greenhouse Gas Impacts, FPInnovations. Note: CO_2 on this chart refers to CO_2 equivalent.

Carbon Stored

The mass of carbon stored in wood products was calculated based upon the assumption that the amount of carbon contained in wood fiber was 50% by dry weight (Sathre O'Connor 2010). After the mass of carbon in the wood products was determined, the carbon was converted to CO_2 based on molecular weight ratio. The final value provided in the carbon calculator is an estimate of the mass of carbon dioxide removed from the atmosphere during the growth of the tree and stored as carbon in the chemical structure of the wood building products.

The following is a general equation for the mass of CO_2 equivalents contained within wood fiber:

$$m_{CO_2} = \left(\frac{M_{CO_2}}{M_C}\right) \times m_{wood} \times 0.5$$

Where:

m_{CO_2}	=	Mass of CO_2 equivalents (kg)
M_{CO_2}	=	Molecular mass of CO_2 (44 g/mol)
M_c	=	Molecular mass of carbon (12 g/mol)
m_{wood}	=	Mass of oven-dry wood (kg)

Source: WoodWorks Carbon Calculator

The general equation for the mass of GHG emissions avoided is as follows:

$$GHG = m_{wood} \times D_f$$

Where:

GHG	=	Greenhouse gas avoided (kg CO_2 equivalents)
m_{wood}	=	Mass of dry wood (kg)
D_f	=	Displacement factor (kg CO_2 equivalents/kg oven-dry wood)

Mass Timber Df = 0.71

Source: WoodWorks Carbon Calculator

UMASS DESIGN BUILDING

AMHERST, MA

IMAGE CREDIT: ALEX SCHREYER

UMASS DESIGN BUILDING

AMHERST, MA

4 STORY, 87,500 SF FACILITY WITH: CLASSROOMS, LOUNGES, MEETING ROOMS, MATERIALS-TESTING LAB, GREEN-BUILDING LAB, WOOD SHOP, DIGITAL FABRICATION LAB, CAFE, EXHIBIT SPACE, AND LIBRARY

IMAGE: ALEX SCHREYER

UMASS DESIGN BUILDING

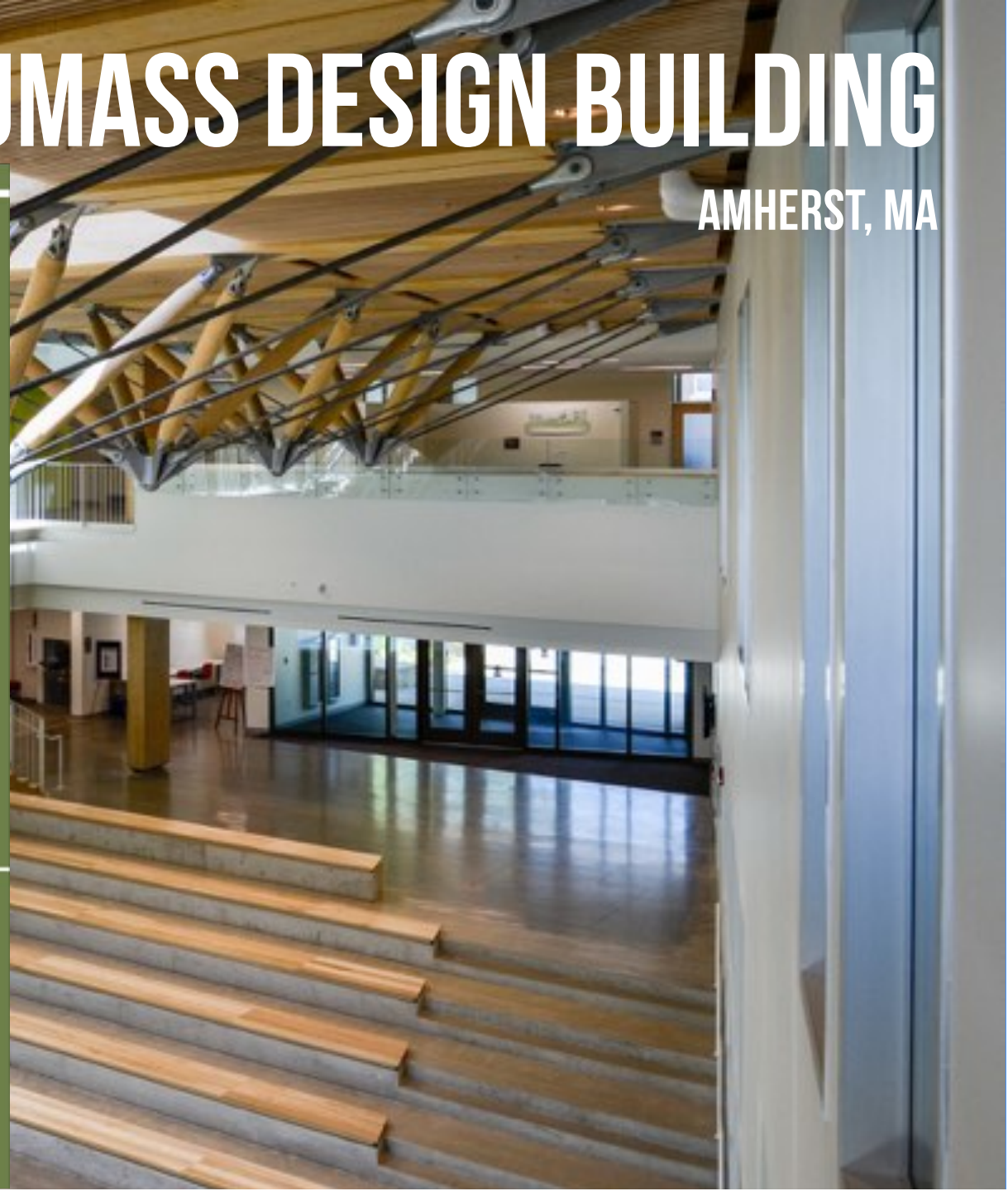
AMHERST, MA

COMPLETED SPRING 2017

PHOTO CREDIT: ALEX SCHREYER

UMASS DESIGN BUILDING

AMHERST, MA



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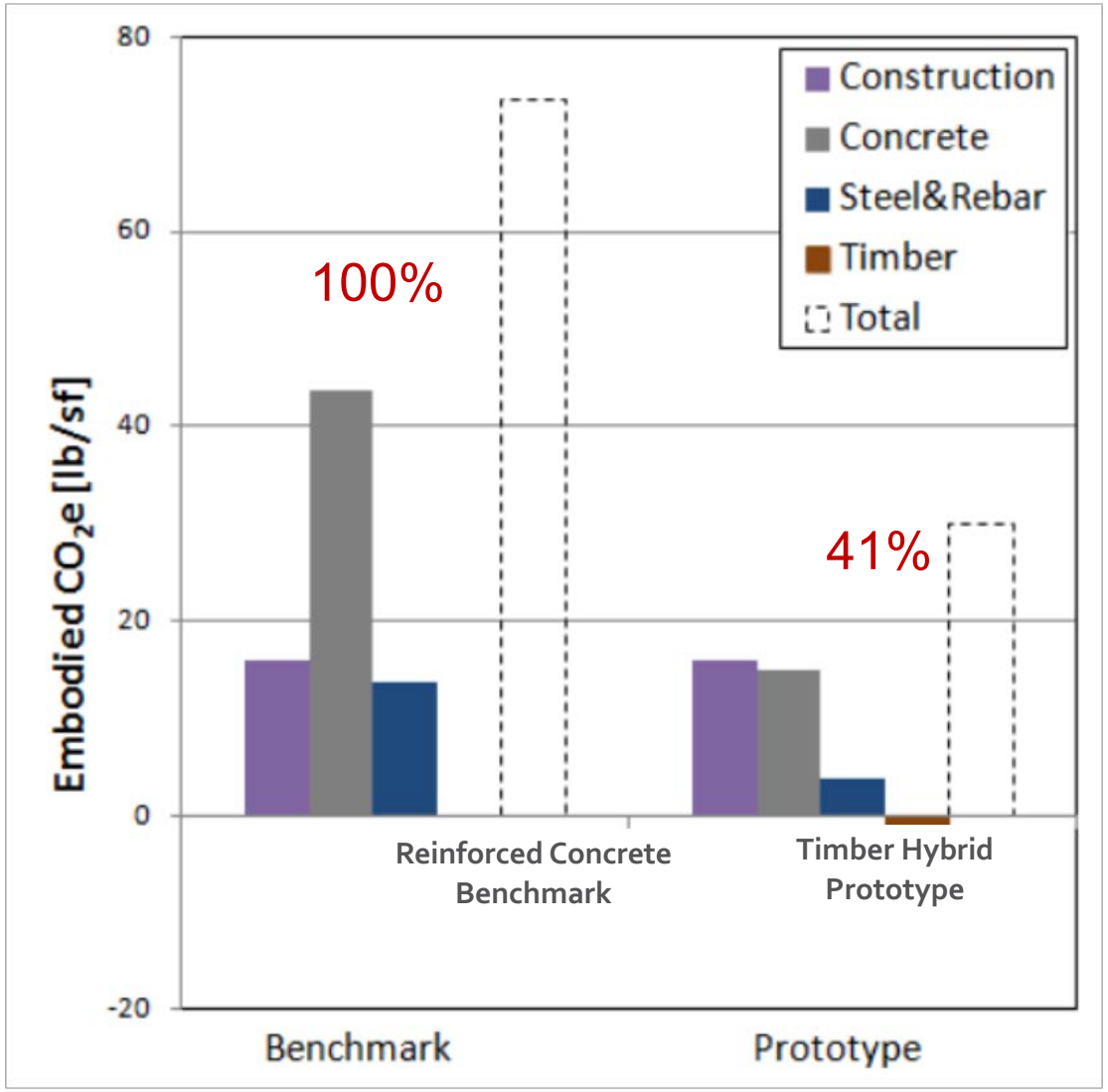
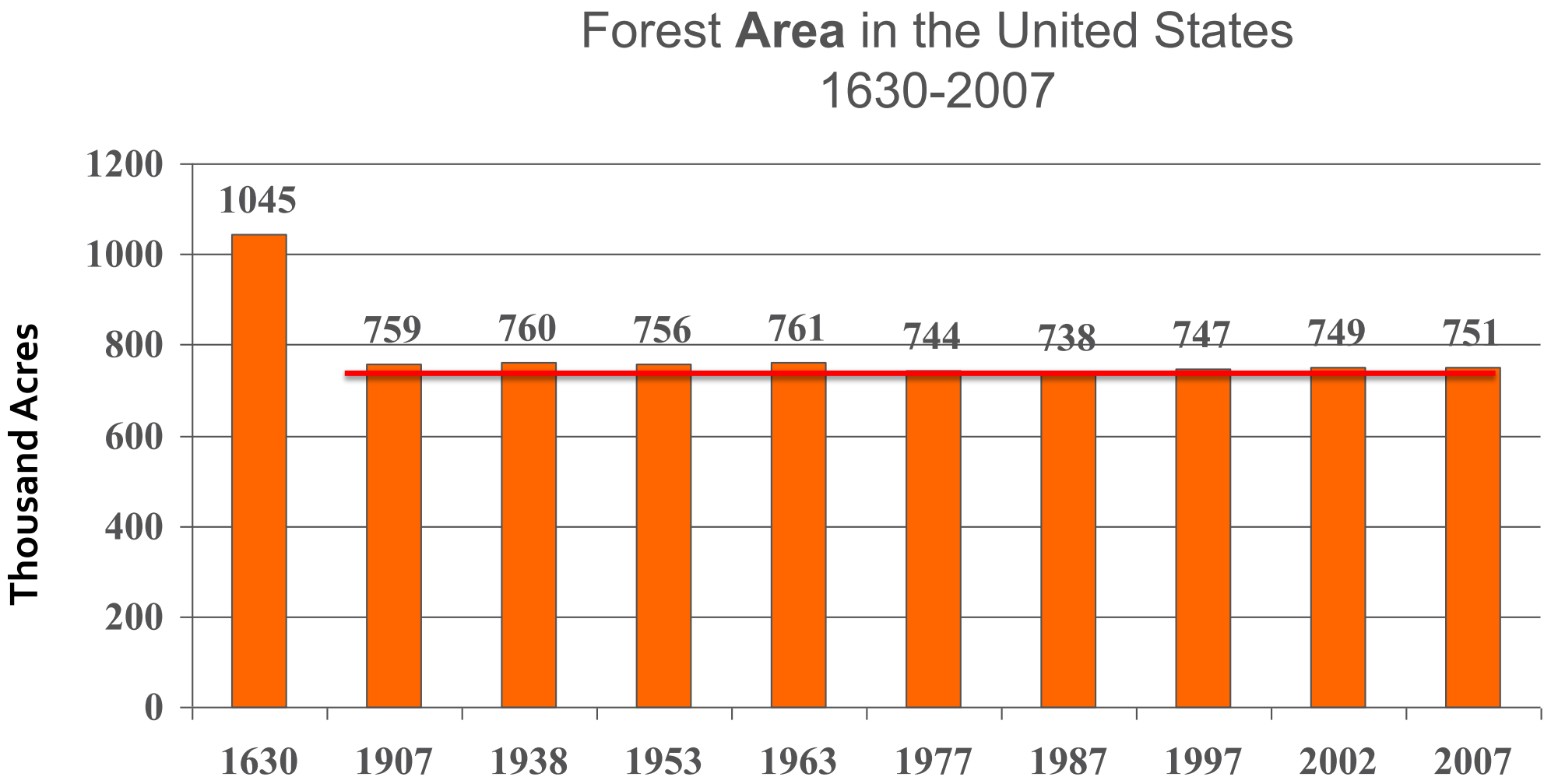
Dramatic Potential for Change



Source: Timber Tower Research Project, Skidmore, Owings and Merrill, May 2013

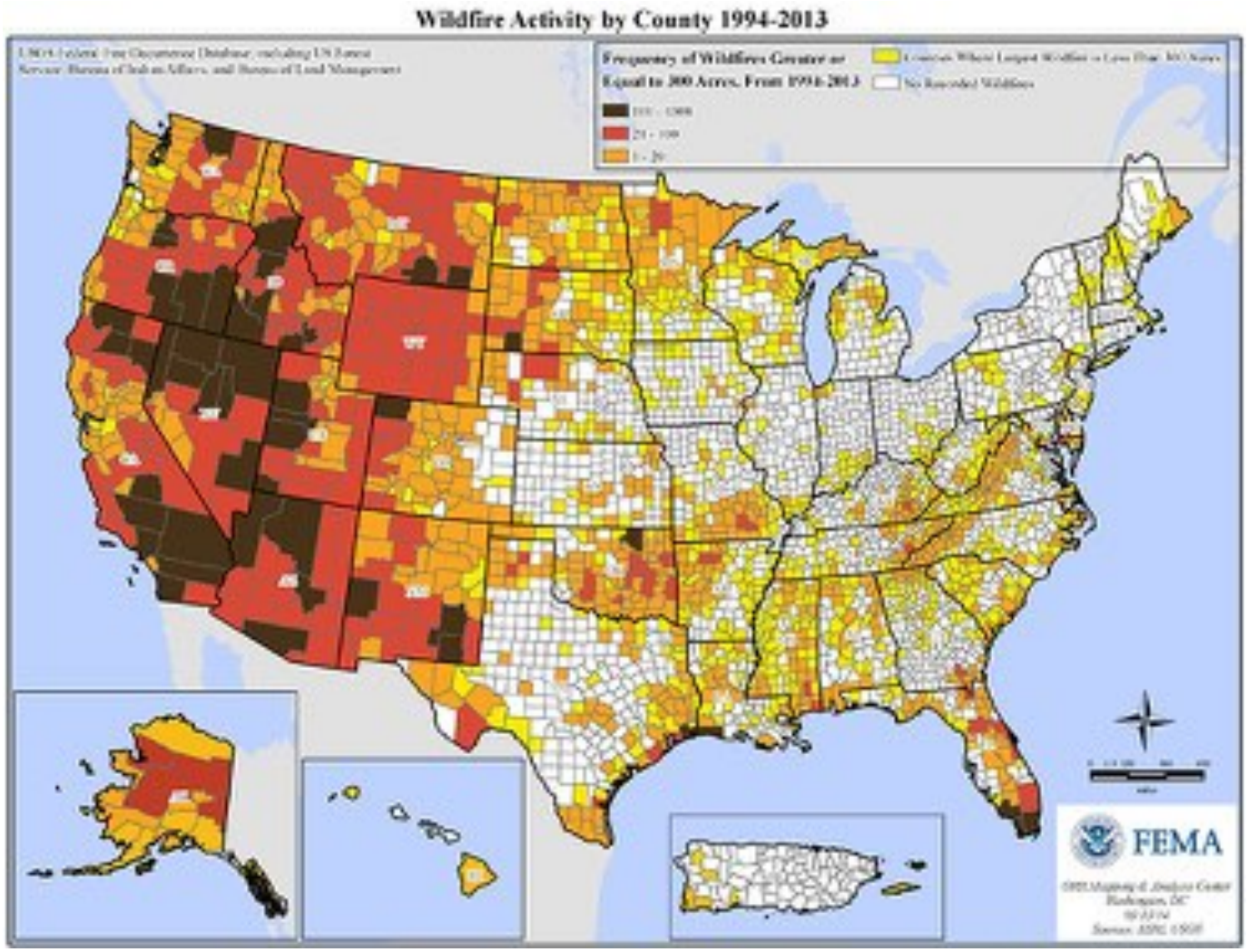
Sustainable Forestry Carbon Cycle

U.S. Forest Land



Source: USDA-Forest Service, General Technical Report WO-78. (2009).

HAZARDOUS FUELS TODAY



Western U.S. Wild Fire Epidemic

- Fire readiness and suppression has gone from 20% of the FS budget in 2001 to 52% in 2015.
- It is not uncommon to spend $1 million per hour fighting fires.

Source: US Forest Service – http://www.fs.fed.us/about-agency/budget-performance/cost-fire-operations

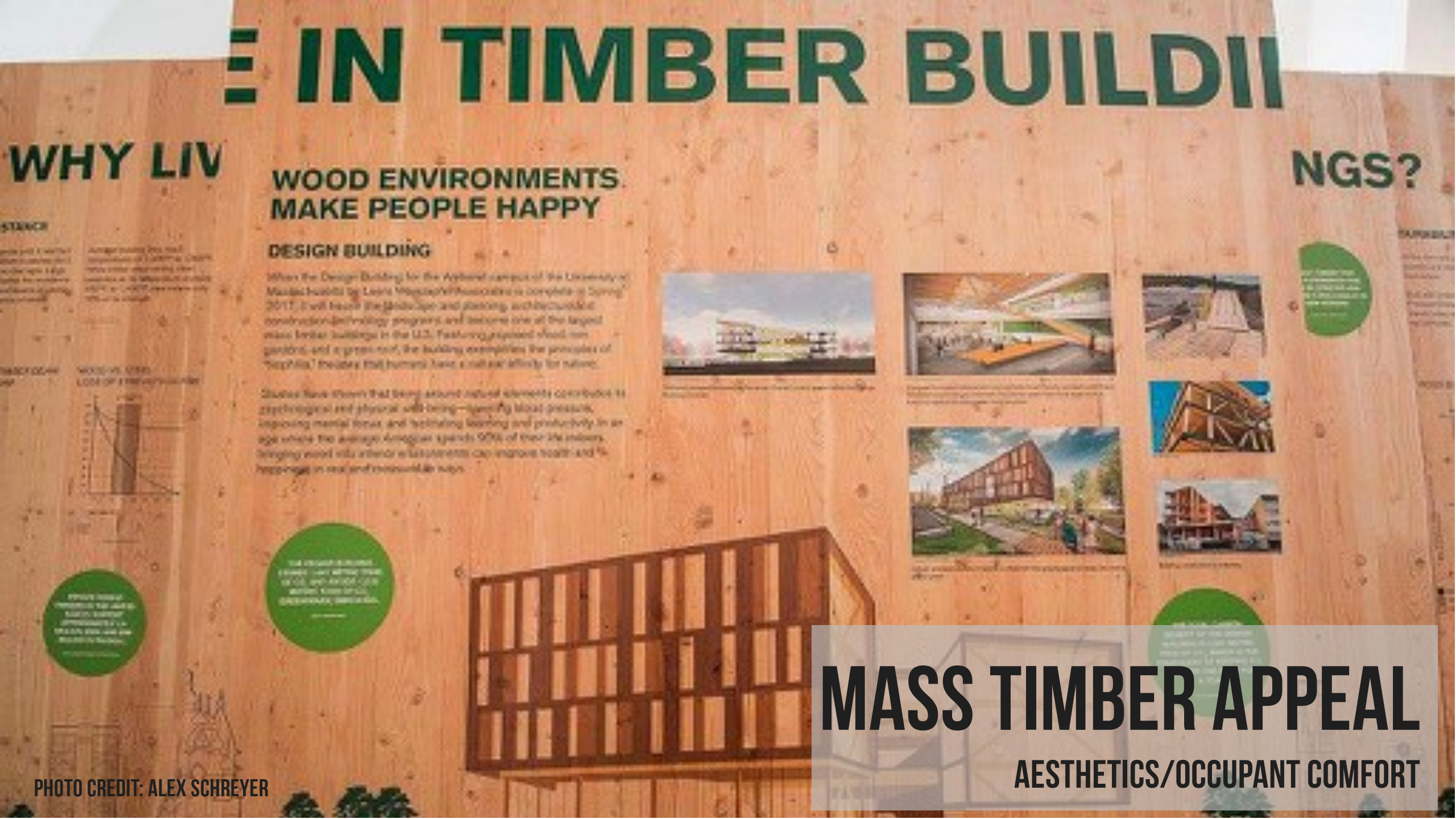
LANDSCAPE RESTORATION IMPACT POTENTIAL

Wood Use Paradox

- Increasing the use of products from healthy managed forests helps keep forest land forested
- Finding high value uses for low value wood – mass timber and CLT
- Renewable – sustainable resource

IMPACT ON RURAL ECONOMIES

Credit: U.S. Softwood Lumber Board, infographic, *Changing how America Builds*, 2017



MASS TIMBER APPEAL

AESTHETICS/OCCUPANT COMFORT

PHOTO CREDIT: ALEX SCHREYER

MASS TIMBER APPEAL

DISASTER RESILIENT

USFPL WOOD TORNADO SHELTER

MASS TIMBER APPEAL

DISASTER RESILIENT

LIVE BLAST PERFORMANCE OF MASS TIMBER

MASS TIMBER CONSTRUCTION

THE FUTURE'S LOOKING UP

PHOTO CREDIT: ALEX SCHREYER

TALL WOOD IN NORTH AMERICA CIRCA 1906

9 STORIES

THE LANDING, VANCOUVER

BUTLER SQUARE, MINNEAPOLIS

GLOBAL TALL WOOD CIRCA 2015

7-14 STORIES

GLOBAL TALL WOOD CIRCA 2019

18-24 STORIES

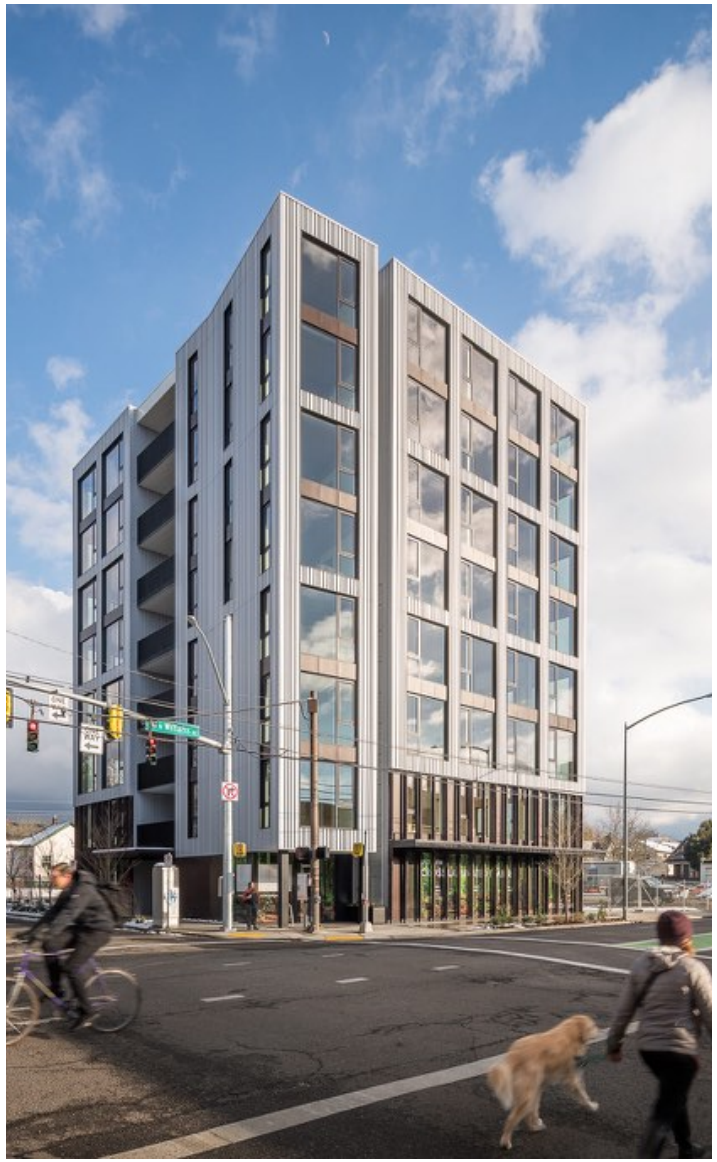

Photo: Moelven Limtre

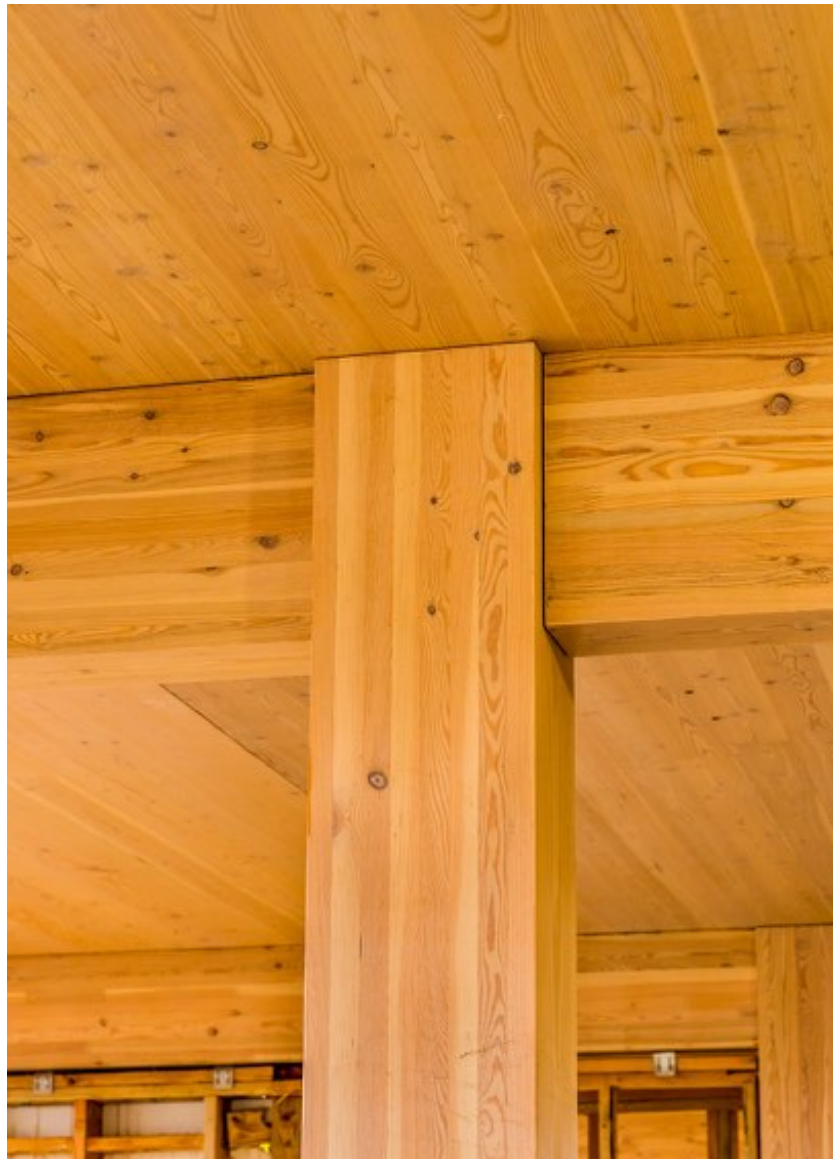

Photo: naturally:wood


Photo: Rudiger Lainer + Partner

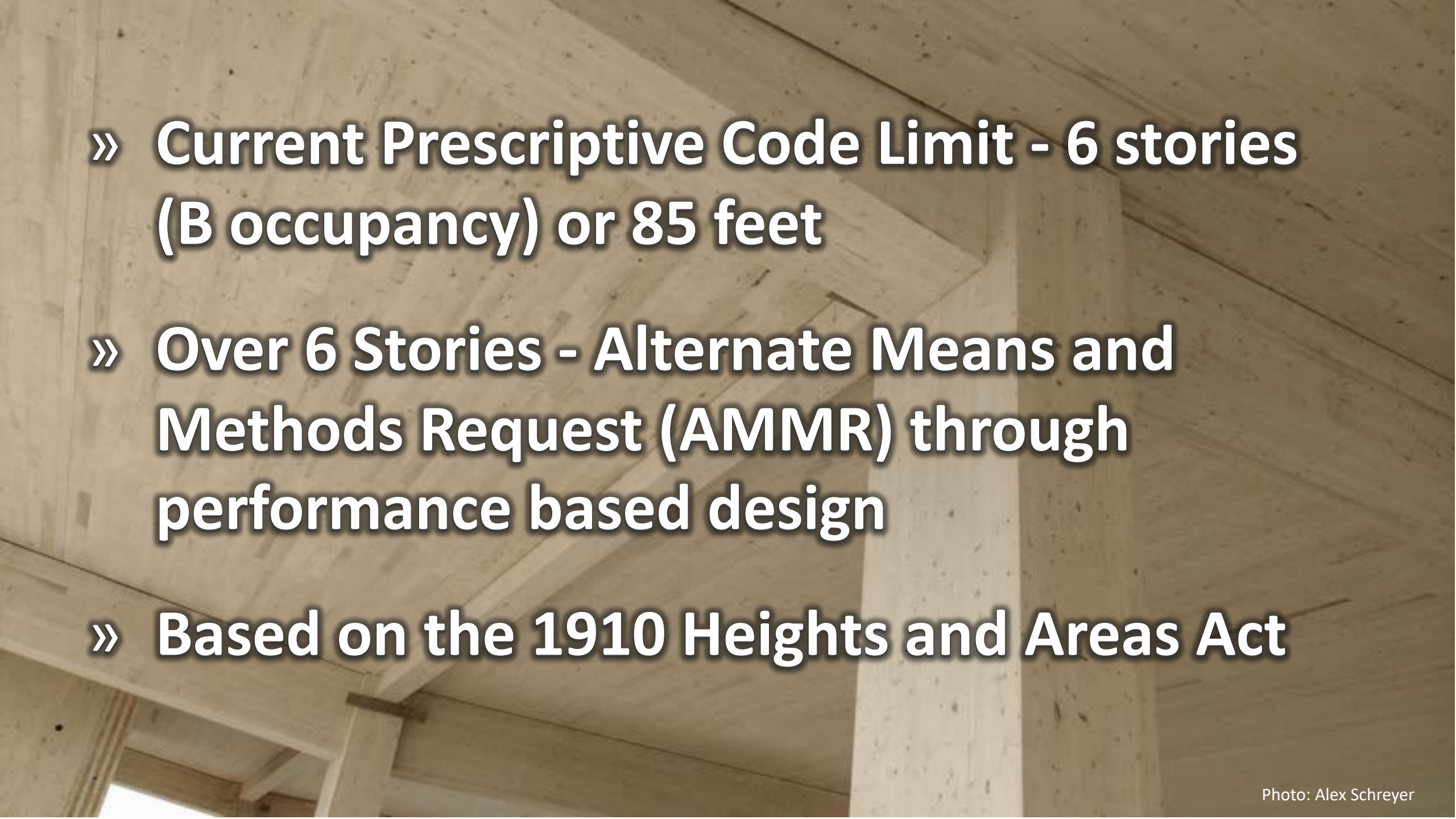
TALL WOOD IN THE US CIRCA 2019

8 STORIES





Photos: Baumberger Studio/PATH Architecture/Marcus Kauffman | Architect: PATH Architecture



- Current Prescriptive Code Limit - 6 stories (B occupancy) or 85 feet
- Over 6 Stories - Alternate Means and Methods Request (AMMR) through performance based design
- Based on the 1910 Heights and Areas Act

Photo: Alex Schreyer

TYPE III CONSTRUCTION, RESIDENTIAL OCCUPANCY: 5 STORIES

Photo: Leers Weinzapfel Associates

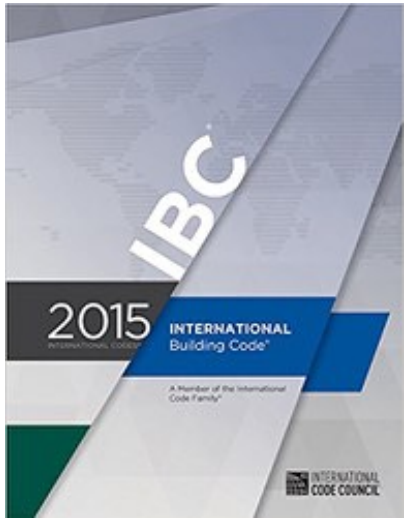
LIGHT-FRAME WOOD
MASS TIMBER

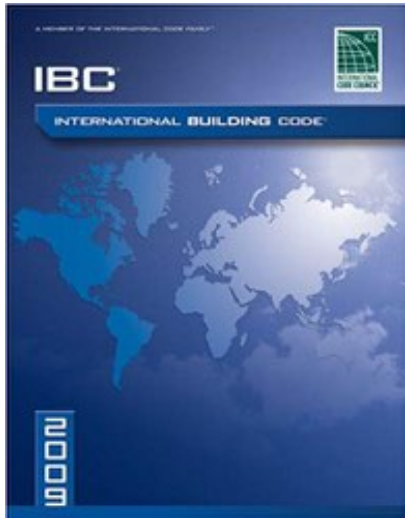
U.S. BUILDING CODE STATUS

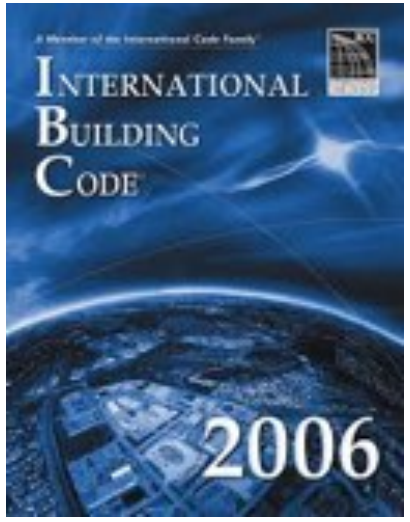
Photo: Ema Peter

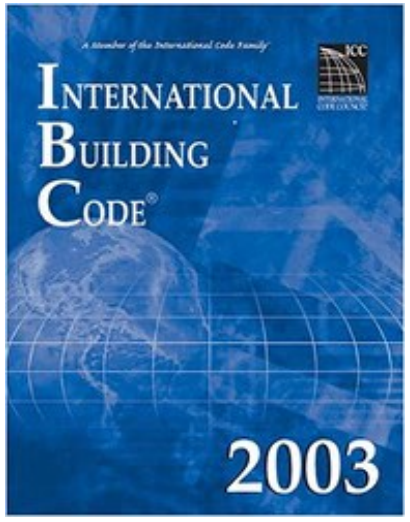
ICC INTERNATIONAL CODE COUNCIL®

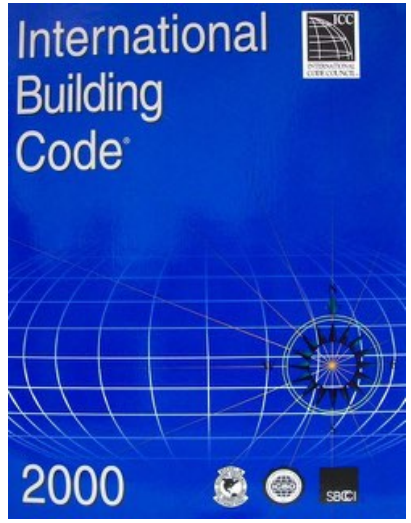
3 YEAR CODE CYCLE











U.S. TALL WOOD
DEVELOPMENT AND CHANGES

In December 2015, the ICC Board established the ICC Ad Hoc Committee on Tall Wood Buildings. Objectives:

1. Explore the building science of tall wood buildings
2. Investigate the feasibility, and
3. Take action on developing code changes for tall wood buildings.

Photo: LendLease

Photo: LendLease

Photo: LendLease

Photo: LendLease

Photo: LendLease

TALL WOOD APPROVED!

Unofficial results posted Dec 19, 2018

Final votes ratified Jan 31, 2019

AWC: Tall Mass Timber code changes get final approval

Dec 19, 2018

LEESBURG, VA. – The International Code Council (ICC) has released the unofficial voting results on code change proposals considered in 2018, including passage of the entire package of 14 tall mass timber code change proposals. The proposals create three new types of construction (Types IV-A, IV-B and IV-C), which set fire safety requirements, and allowable heights, areas and number of stories for tall mass timber buildings. Official results are expected to be announced during the first quarter of 2019. The new provisions will be included in the 2021 *International Building Code* (IBC).

"Mass timber has been capturing the imagination of architects and developers, and the ICC result means they can now turn sketches into reality. ICC's rigorous study, testing and voting process now

2021 IBC Introduces 3 new tall wood construction types:

IV-A, IV-B, IV-C

Previous type IV renamed type IV-HT

BUILDING ELEMENT	TYPE I		TYPE II		TYPE III		TYPE IV				TYPE V	
	A	B	A	B	A	B	A	B	C	HT	A	B

New Building Types

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

TYPE IV-A

12 STORIES
BUILDING HEIGHT 180 FT
ALLOWABLE BUILDING AREA 648,000 SF
AVERAGE AREA PER STORY 54,000SF

TYPE IV-B

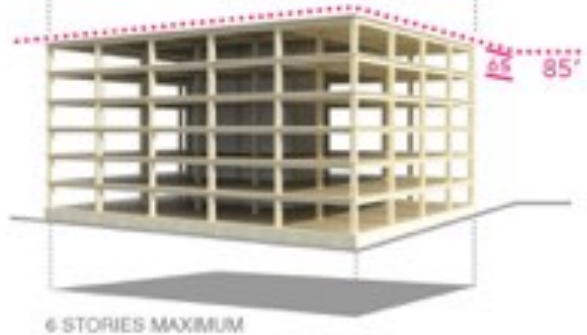
9 STORIES
BUILDING HEIGHT 85'
ALLOWABLE BUILDING AREA 405,000 SF
AVERAGE AREA PER STORY 45,000 SF

TYPE IV-C

IBC 2021

324,000 SF
ALLOWABLE BUILDING AREA

54,000 SF
AVERAGE AREA PER STORY



6 STORIES MAXIMUM
85'-0" MAXIMUM BUILDING HEIGHT
324,00 SF MAXIMUM AREA

TYPE IV- HT

IBC 2015

BUSINESS OCCUPANCY [GROUP B]

*BUILDING FLOOR-TO-FLOOR HEIGHTS ARE SHOWN AT 12'-0" FOR ALL EXAMPLES FOR CLARITY IN COMPARISON BETWEEN 2015 TO 2021 IBC CODES.

Credit: Susan Jones, atelierjones

Questions?

This concludes The American Institute of Architects Continuing Education Systems Course

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