

# Getting Down to Business: The Cost/Value Proposition of Timber Offices

Ricky McLain, PE, SE Senior Technical Director, WoodWorks



"The Wood Products Council" is a Registered Provider with The American Institute of Architects Continuing Education Systems (AIA/CES), Provider #G516.

Credit(s) earned on completion of this course will be reported to AIA CES for AIA members. Certificates of Completion for both AIA members and non-AIA members are available upon request. This course is registered with AIA CES for continuing professional education. As such, it does not include content that may be deemed or construed to be an approval or endorsement by the AIA of any material of construction or any method or manner of handling, using, distributing, or dealing in any material or product.

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



## **Course Description**

Great solutions often lie beyond convention. Consider that most offices in the U.S. could be built with a wood structure and yet this option goes largely unexplored. Many designers assume they're limited to concrete and steel for workplace environments—because that's the common default. In fact, wood construction can accommodate the space and performance needs of office occupancies while providing advantages such as speed, cost savings, and reduced environmental impact. This presentation will examine the value proposition for light-frame and heavy timber offices, with an emphasis on market data, code acceptance and opportunities, and built examples across the U.S.

# Learning Objectives

1. Review considerations for Class A and B offices.

2. Explore market opportunities for light-frame and heavy timber offices.

3. Evaluate the cost and value proposition of a Class A heavy timber office solution using successful built examples.

4. Assess the cost and value proposition of a Class B light-frame office solution using successful built examples.

# > OUTLINE

- Market Analysis
- Office Building Size
- Understanding Cost & Value
  - Class A Mass Timber Office Solution
  - Class B/C Light Frame Wood Office Solution

When asked why they didn't typically design offices in wood, Architects responded...

- "Does the building code even allow offices to be built in wood?"
- "Can wood accommodate the grid spacing needed for adaptable office floor plans?"
- "Is it possible to achieve high performance expectations ...affordably?"



# **Classifications of Office Space**



Class A

- New / Newly Renovated
- Prime / Central location
- On-site parking
- High Tech Building Systems (HVAC, elevators, utilities)
- High quality upkeep / maintenance
- Significant in size
- Contemporary Design



PROJECT: Federal Center South, Building 1202 – Seattle, WA ARCHITECT: ZGF Architects LLP ENGINEER: KPFF Consulting Engineers PHOTO CREDIT: Benjamin Benschneider

## **Ownership / Intended Tenant**



## Location and Scale



## David and Lucile Packard Foundation

- Location: Los Altos, CA
- 2 story, Type VB
- 49,000 sf
- Custom, Sub-Urban, Low-rise, Irregular Footprint





ARCHITECT: EHDD ENGINEER: Tipping Mar PHOTO CREDIT: Jeremy Bittermann, courtesy EHDD

## **The Radiator**

- Location: Portland, OR
- 5 story, Type IIIB
- 36,000 sf
- Speculative, Urban, Mid-rise, Regular Footprint



FLOORS 2-4 + TENANT IMPROVEMENT



ARCHITECT: PATH Architecture ENGINEER: Munzing Structural Engineering PHOTO CREDIT: Josh Partee & Caitlin Murray

# PREFACE: 2015 WoodWorks Market Analysis



# PREFACE: 2015 WoodWorks Market Analysis

Wood is under utilized in office construction:

- Nearly 75% of offices buildings are less than 50k sf in total building area
- More than 85% of office projects are 4 stories or less

Most Office Projects Could Be Wood Construction



# Heights and Areas

## Multi Story Business Occupancy (B)

Based on IBC 2012 Table 503 w/ allowable increases

| Height and Area<br>(With Allowable Increases)       | IIB  | IIIB | VA   | VB  |
|---|------|------|------|-----|
| Stories <sup>1</sup>                                | 4    | 4    | 4    | 3   |
| Height <sup>1</sup> (ft)                            | 75   | 75   | 70   | 60  |
| Max Story Area <sup>2</sup> (ft <sup>2</sup> )      | 69k  | 57k  | 54k  | 27k |
| Total Building Area <sup>3</sup> (ft <sup>2</sup> ) | 207k | 171k | 162k | 81k |



<sup>1</sup> Assumes NFPA 13 sprinklers throughout (IBC 504.2)
<sup>2</sup> Assumes NFPA 13 sprinklers throughout (IBC 506.3)
<sup>3</sup> Assumes 3 or more number of stories (IBC 506.4)

\*\*ASCE7 12.2-1 limits wood shear wall seismic systems to 65' in height in SDC D,E,F

# Heights and Areas

## Multi Story Business Occupancy (B)

Based on IBC 2012 Table 503 w/ allowable increases

| <b>Construction Type</b>                            | IIA    | IIIA   | IV   |
|---|--------|--------|------|
| Stories <sup>1</sup>                                | 6      | 6      | 6    |
| Height <sup>1</sup> (ft)                            | 85     | 85     | 85   |
| Story Area <sup>2</sup> (ft <sup>2</sup> )          | 112.5k | 85.5k  | 108k |
| Total Building Area <sup>3</sup> (ft <sup>2</sup> ) | 337.5k | 256.5k | 324k |

<sup>1</sup> Assumes NFPA 13 sprinklers throughout (IBC 504.2)
 <sup>2</sup> Assumes NFPA 13 sprinklers throughout (IBC 506.3)
 <sup>3</sup> Assumes 3 or more number of stories (IBC 506.4)



\*\*ASCE7 12.2-1 limits wood shear wall seismic systems to 65' in height in SDC D,E,F



"Is it possible to achieve the high performance expectations ... affordably?"

# 2016 Office Construction Outlook – AGC of America

## Key points in Office Construction:

- Employment sets records each month but office space per employee keeps shrinking
- Growth is mainly in cities and renovations, not suburban office parks
- Largely privately funded



Source: AGC of America, Constriction Spending, Labor & Materials Outlook, Jan. 2016, Census Bureau construction spending reports

# Office Construction Costs – ICC Building Valuation



(B) Business Occupancy

"...where wood frame construction is allowed, depending on location and occupancy, this would help to keep costs lower. In areas that are restricted to nonflammable construction, price per square foot will go up." -EV Studio Article (full service Design firm)

Source: ICC Building Valuation Data, Feb 2018

http://evstudio.com/construction-cost-per-square-foot-for-office-buildings/construction-cost-office-building-2-to-4-stories-2/

# 1-4 Story Office Construction Costs – Built National Average

## **1-4 Story Offices in US:**

- wood offices are 20-30% less expensive per square foot than non-wood office
- average square foot per project for a wood office was 18-80% smaller than a non-wood office



Data Source: Dodge Analytics Data

# 2-4 Story RSMeans Cost Estimates – Estimated National Average

#### OFFICE & WAREHOUSE SQUARE FOOT COST ESTIMATES

The following estimate assumes face brick with concrete block back-up / wood joists, using 2013 RSMeans data.

| National Cost Estimate (Union Labor)   | % of Total | Cost Per SF |
|--|------------|-------------|
| Construction Total                     |            | \$\$134.78  |
| Contractor Fees (GC, Overhead, Profit) | 25%        | \$\$33.69   |
| Architectural Fees                     | 6%         | \$\$8.09    |
| Total Building Cost                    |            | \$\$176.56  |

#### OFFICE, 2-4 STORY SQUARE FOOT COST ASSUMING BRICK VENEER / WOOD FRAME

| Cost Estimate (Union Labor)            | % of Total | Cost Per SF |  |
|--|------------|-------------|--|
| Total                                  |            | \$\$119.40  |  |
| Contractor Fees (GC, Overhead, Profit) | 25%        | \$\$29.85   |  |
| Architectural Fees                     | 7%         | \$\$10.45   |  |
| Total Building Cost                    |            | \$\$159.70  |  |

Source: RS Means Cost per Square Foot Models

## Regional Variation of Construction Cost– Built Projects 2013-2015



Data source: Dodge Analytics Data

## **The Value Proposition**

VALUF

LITITIC MARTINE

# The Value Proposition

# Structure Cost Holistic View of Construction Cost Schedule Savings Increased Lease Rates Sustainability

PHOTO: EMA PETER PHOTOGRAPHY

# Heavy/Mass Timber provides great solutions for: I Market Distinction I Larger Scale I Open Layout

Marcus Kauffman, ODF

**MASS TIMBER IS A CATEGORY OF FRAMING STYLES OFTEN USING SMALL WOOD MEMBERS FORMED INTO LARGE PANELIZED SOLID WOOD CONSTRUCTION INCLUDING CLT, NLT OR GLULAM PANELS FOR FLOOR**, **ROOF AND WALL FRAMING** 



# **BUILDING FRAME SYSTEMS**









## **GLULAM BEAMS & COLUMNS**



# **MASS TIMBER PRODUCTS**



CROSS LAMINATED TIMBER (CLT) WALLS





# **MASS TIMBER PRODUCTS**

## **HORIZONTAL FRAMING**

## **GLUE-LAMINATED TIMBER (GLT)**



## **CROSS-LAMINATED TIMBER (CLT)**



NAIL-LAMINATED TIMBER (NLT)

TONGUE & GROOVE DECKING (T&G)

## **TIMBER CONCRETE COMPOSITE**

#### **STRUCTURAL COMPOSITE LUMBER**



IMAGE SOURCE: STRUCTURECRAFT

# **RADIATOR BUILDING**

PORTLAND, OR

#### PHOTO CREDIT: JOSH PARTEE

# **RADIATOR BUILDING**

## PORTLAND, OR





BUILDING INFO: OFFICE BUILDING 5 STORIES 36,000 SF COMPLETED 2015

# ONE NORTH

PORTLAND, OR

 RENTAL RATES SURPASS DOWNTOWN (BUT IT'S NOT IN DOWNTOWN)
 THIS PROJECT IS DEFINING A NEW CLASS A OFFICE SPACE (IT'S NOT IN AN AREA THAT USUALLY HAS CLASS A OFFICES)

**PHOTO CREDIT: JOSH PARTEE** 

# **CLAY CREATIVE**

PORTLAND, OR

IMAGE CREDIT: CHRISTIAN COLUMBRES

# GETTING \$7/SF MORE (ANNUAL BASIS) THAN SIMILAR (NON-TIMBER) OFFICE BUILDINGS IN THE AREA

# CLAY CREATIVE



## 5 STORIES MOSTLY OFFICE, SOME RETAIL AND AMENITY 72,000 SF

# CLAY CREATIVE Portland, or

~8' FINISHED FLOOR TO BOTTOM OF BEAM **25'X30' AT PERIMETER 30'X30' BAYS AT CENTER 1.5" GYPSUM, WSP, 2X6 NLT FLOOR PANELS RAISED FLOOR SYSTEM FOR MECHANICAL, DATA AND ACOUSTICS EXTERIOR STEEL MOMENT FRAME KEEPS CORE AREA MORE VERSATILE** 



- 5 STORIES OF TYPE IIIA OVER 1 STORY OF TYPE IA
- NET COST: ~\$300-\$350/SF OF RENTABLE SPACE
- RECEIVED A \$300K TRANSIT ORIENTED DEVELOPMENT GRANT
- ~12 MONTH CONSTRUCTION DURATION

# CLAY CREATIVE Portland, or





## 3 STORIES 45,000 SF Type va construction

DEVELOPER: KILLIAN PACIFIC AND MACKENZIE Photo credit: Christian Columbres

# HUDSON BUILDING





# HUDSON BUILDING

VANCOUVER, WA

- 25'X25' GRID
- 15'-18' FLOOR TO FLOOR HEIGHTS
   COMPOSITE FLOOR: 2X4 AND 2X6 NLT FLOOR PANELS WITH 3 ½" REINFORCED CONCRETE TOPPING
- ALL MEP EXPOSED



# **ALBINA YARD**



4 STORIES 16,000 SF Green Roof



- 20'X20' GRID, 12' FLOOR TO FLOOR
- 3-PLY CLT FLOOR PANELS WITH ELECTRICAL CONDUIT POURED INTO 1" LIGHT WEIGH GYPSUM TOPPING
- WOOD SHEARWALL CORE WITH OPEN FRONT DESIGN For glazing wall





## CLT PANELS FOR AN ENTIRE FLOOR Installed in 3.5 hours



ARCHITECT: Miller Hull Partnership ENGINEER: PAE Consulting Engineers PHOTO CREDIT: John Stamets, Nic Lehoux



## **Bullitt Center**

- Location: Seattle, WA.
- Type IV construction
- 4 stories of wood over a 2 story concrete podium
- 52,000 sf



## Nail Laminated Timber Floor & Roof Decks



Nail Laminated Timber Decks Provide: Maximized Spans, Reduced Number of Columns, More Open Space Flexibility, Minimized Structure Depth

## **Bullitt Center (Cont.)**

- Construction cost \$18.5 M, \$355/sf
- Net Zero Building
- Goal- 250 year life expectancy
- First Living Building Challenge Certified Office Building
- 80% Energy reductions
- PV array provides energy for building

**ARCHITECT: Miller Hull Partnership ENGINEER: PAE Consulting Engineers** PHOTO CREDIT: John Stamets, Nic Lehoux





Volume of wood used: 24,526 cubic feet

| _ |   |   | _ |   |
|---|---|---|---|---|
|   |   |   |   | - |
|   |   |   |   |   |
|   |   |   |   |   |
|   |   |   | _ |   |
|   |   |   |   |   |
|   |   | _ |   |   |
|   | - |   |   |   |
|   |   |   |   |   |
|   |   | - |   |   |

U.S. and Canadian forests grow this much wood in: 2 minutes



Carbon stored in the wood: 545 metric tons of CO<sub>2</sub>



Avoided greenhouse gas emissions: 1,158 metric tons of CO<sub>2</sub>



TOTAL POTENTIAL CARBON BENEFIT: 1,703 metric tons of CO2

#### EQUIVALENT TO:



#### 325 cars off the road for a year



#### Energy to operate a home for 145 years

Estimated by the Wood Carbon Calculator for Buildings, based on research by Sarthye, R. and J. O'Connor, 2010, A Synthesis of Research on Wood Products and Greenhouse Gas Impacts, FPInnovations. Note: CO<sub>2</sub> on this chart refers to CO<sub>2</sub> equivalent.

## Additional Value of a Heavy Timber Structure



# Light frame wood provides great solutions for: ✓ Low-rise (1-4 stories) ✓ Custom

Irregular in footprint

#### **Bonner General Health**

- Location: Sandpoint, ID
- Complete: 2015
- 3 stories, 50,000 sf
- 32' floor spans
- 28" deep I-joists w/ topping
- Originally to be steel
- Poor soils needed lighter structure
- Wood framing brought project in budget







ARCHITECT: John Eixenberger PHOTO CREDIT: RedBuilt



-Construction Manager Jim Williamson

PROJECT: Bonner General Health Office ARCHITECT: John Eixenberger PHOTO CREDIT: RedBuilt





## **575 Stonecutters Way Office Building**

- Location: Montpelier, VT
- Completed: Fall 2012
- 2 stories, Type VB, 20,000 sf
- Prefabricated walls
- High R-value walls and roof

ARCHITECT: Connor Contracting PHOTO CREDIT: Connor Contracting





# Panelized Walls Speeded Construction

In order to deal with many variables associated with winter construction in New England, the general contractor and design team decided to utilize prefabricated wall panels.

## William Clyburn Center for Primary Care

- Location: Aiken, SC
- Completed: Nov, 2014
- 2 stories, Type VB, 26,600 sf
- Wood bearing walls with I-joists
- Total Construction Cost: \$4M
- Approx. \$150/sf

ARCHITECT: Hughes, Beattie, O'Neal, Law & Associates ENGINEER: J.E. Stewart Engineering, Inc. PHOTO CREDIT: Hughes, Beattie, O'Neal, Law & Associates ADULT

DENT

MEDICINE



- Location: Basalt, CO
- Type VB, 2 stories
- 15,600 sf
- Goal- 100 year design life



ARCHITECT: ZGF Architects ENGINEER: KPFF Consulting Engineers PHOTO CREDIT: Tim Griffith

## Rocky Mountain Institute Innovation Center (Cont.)

- SIP panel exterior walls and roof
- Targeting net zero energy
- Cross-laminated timber used for floor structure utilizes beetle-kill lumber from British Columbia.
- Use of CLT allowed structure depth to be minimized, allowing natural daylight to penetrate further into building

ARCHITECT: ZGF Architects ENGINEER: KPFF Consulting Engineers PHOTO CREDIT: Structurlam, RMI, Aspen Times







#### WOOD BUILDING ROOF FRAMING PLAN





SCALE: & - 1'-0"

## Cost Comparison: 22'x30' Grid



Source: ESQ Consultants, RSMeans 2016 Q2

# Cost Comparison: 22'x30' Grid

#### **Cost Savings by System:**

- Average overall savings of 40% on structure
- Structure makes up 15-30% of overall building cost
- Largest Cost Savings in the Roof
- Included were all secondary assembly items that differed between a steel and roof structural system



# Architects largely agree that timber construction offers:

- Cost Effectiveness
- Large Labor Pool
- Readily Available Material
- Speed of Erection
- Low Carbon Footprint

But what is often missed is..... It can be done more often than you thought!



## **Questions?**

This concludes The American Institute of Architects Continuing Education Systems Course

Ricky McLain, PE, SE Senior Technical Director - WoodWorks (802)498-3310 Ricky.mclain@woodworks.org

## **Copyright Materials**

This presentation is protected by US and International Copyright laws. Reproduction, distribution, display and use of the presentation without written permission of the speaker is prohibited.

© The Wood Products Council 2018