Mid-Rise and Beyond: Wood Construction in the Vibrant Urban Environment

Scott Breneman, PhD, PE, SE
Scott.Breneman@WoodWorks.org
Outline / Learning Objectives

• Learning Objective #1
  Evaluate the opportunities for wood frame structures in mid-rise projects.

• Learning Objective #2
  Understand how many creative wood-framed building layouts can be code compliant buildings while meeting the project goals and site limitations.

• Learning Objective #3
  Know the approximate residential unit densities achievable using different multi-family building configurations.

• Learning Objective #4
  Envision the opportunities for mass timber structures of 10 stories or more.
Global Population Boom

**Global Population**
9.0 billion by 2050
30% increase

**Urban Population**
5.3 billion
66% increase
Walk-up/ Tuck Under

Photos – Scott Breneman/WoodWorks
Wrap-Around

5 story yields 60-80 units/acre
Podium
4 over 1 Podium

- 60-80 units/acre

Inman Park Condos, Atlanta, GA
Architect: Brown Doane Architects, Inc.
Structural: Davis & Church, LLC
5 over 1 Podium

- 100-120 units/acre

Inman Park Condos, Atlanta, GA
Architect: Brown Doane Architects, Inc.
Structural: Davis & Church, LLC

AvalonBay Stadium, Anaheim, CA
Architect: Withee Malcom Architects
Structural: VanDorpe Chou Associates
5 over 1 Podium with Mezzanine

- 125-145 units/acre
Wood Mid-Rise Construction

How many stories can be wood framed in the IBC?

6 stories for Offices, 5 stories for Residential

Photo credit: Matt Todd & PB Architects
# IBC Building Size Limits

## Residential (R1, R2, and R4) Occupancies

<table>
<thead>
<tr>
<th>Construction Type Allowable Limit</th>
<th>IIIA</th>
<th>IIIB</th>
<th>VA</th>
<th>VB</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stories</td>
<td>4</td>
<td>4</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Height (ft)</td>
<td>65</td>
<td>55</td>
<td>50</td>
<td>40</td>
</tr>
<tr>
<td>Building Area/Story (ft²)</td>
<td>24k</td>
<td>16k</td>
<td>12k</td>
<td>7k</td>
</tr>
<tr>
<td>Total Building Area* (ft²)</td>
<td>72k</td>
<td>48k</td>
<td>36k</td>
<td>14k</td>
</tr>
</tbody>
</table>

* Assuming max stories built

**IBC 2012 Table 503 Tabular Values**
IBC Building Valuation Data

International Code Council, Feb 2014 Data
R-2 Occupancy

Primary Structural Wood Framing Allowed

$ per Square Foot

IBC Construction Type
### IBC Building Size Limits

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IBC 2012 Table 503 Tabular Values
IBC Building Size Limits

IIIA Tabular Height Limits

Increased Limits

With NFPA Sprinklers:
IBC gives an allowable Heights and Area Increase
# IBC Building Size Limits

## Residential (R1, R2, and R4) Occupancies

<table>
<thead>
<tr>
<th>Type IIIA Construction Allowable Limit</th>
<th>Table</th>
<th>NPFA 13</th>
<th>NPFA 13</th>
<th>Frontage ?</th>
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<tr>
<td>Stories</td>
<td>4</td>
<td>5</td>
<td>5</td>
<td>5</td>
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<tr>
<td>Height (ft)</td>
<td>65</td>
<td>85</td>
<td>85</td>
<td>85</td>
</tr>
<tr>
<td>Building Area/Story (ft^2)</td>
<td>24k</td>
<td>24k</td>
<td>72k</td>
<td>90k</td>
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<tr>
<td>Total Building Area* (ft^2)</td>
<td>72k</td>
<td>72k</td>
<td>216k</td>
<td>270k</td>
</tr>
</tbody>
</table>

#### IBC 2012 Section

- 503
- 504.2
- 506.3
- 506.2

* Assuming max stories built per IBC 506.4

? Maximum frontage increase possible
Spartan Village, UNC Greensboro, NC

“We assumed that wood framing would be a little less expensive, but actually found it gave us significant cost advantages. We saved $15 per square foot—which, for a 385,000-square-foot project, is a lot of savings”

Raymond Hunt
– EDC Development Management

Lord, Aeck & Sargent Architecture
TFF Architects & Planners
Drs Jullian and Raye Richardson Apts.
San Francisco, CA

David Baker Architect, Photo Credits: Bruce Damonte
See Special Provisions for Podiums in IBC 2012 510.2
Increases allowable stories... not allowable building height
**Evolution of IBC Mixed-Use Podium**

<table>
<thead>
<tr>
<th>IBC</th>
<th>2006</th>
<th>2009</th>
<th>2012</th>
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</thead>
<tbody>
<tr>
<td>Section</td>
<td>509.2</td>
<td>509.2</td>
<td>510.2</td>
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<tr>
<td>Upper Occupancy</td>
<td>A, B, M, R or S</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lower Occupancy</td>
<td>S-2 Parking</td>
<td>A, B, M, R or S-2 Parking</td>
<td></td>
</tr>
<tr>
<td>Podium Height</td>
<td>1 Story</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**IBC Provisions for Mixed-Use podium have been evolving.**
Emory Point, Atlanta, GA

3 buildings complete in 2012

- Luxury Apartments, retail, restaurants
- (2) 4 stories of wood over 1 story concrete podium
- (1) 5 story Type III wood frame over slab on grade

Architects: Cooper Carry & The Preston Partnership
Photo: Gables Residential
Emory Point, Atlanta, GA

Architects: Cooper Carry & The Preston Partnership

Photo: Aerial Photography Inc.
Galt Place Apartments, Galt, CA

Mixed Use Residential
Over Retail and Parking

Applied Architecture, Inc.
Michael Malinowski
Stella Apartments, Marina Del Ray, CA

Architect: Design ARC. Los Angeles, CA
Photos: Lawrence Anderson,
www.lawrenceanderson.net
Stella Apartments, Marina Del Ray, CA

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Photos: Lawrence Anderson,
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Stella Apartments, Marina Del Ray, CA

Architect: Design ARC. Los Angeles, CA
Photos: GLJ Partners
Stella Apartments, Marina Del Ray, CA

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www.lawrenceanderson.net
Marselle Condos, Seattle, WA

Photo credit: Matt Todd & PB Architects
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**Evolution of IBC Mixed-Use Podium**

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<tbody>
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<td><strong>Section</strong></td>
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<tr>
<td><strong>Upper</strong></td>
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<tr>
<td><strong>Occupancy</strong></td>
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<td><strong>A, B, M, R or S</strong></td>
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<tr>
<td><strong>Lower</strong></td>
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<tr>
<td><strong>Occupancy</strong></td>
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<td></td>
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<td><strong>A, B, M, R or S-2 Parking</strong></td>
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<td><strong>1 Story</strong></td>
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<td><strong>Type IA</strong></td>
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**IBC Provisions for Mixed-Use podium have been evolving.**
Bullitt Center, Seattle, WA

Photos © Nick Lehoux for the Bullitt Center
Bullitt Center, Seattle, WA

Renderings: Miller Hull Partnership

Architect: Miller Hull Partnership
Living Building Challenge Building
Completed 2013
Beyond Mid-Rise?

Modern Tall Wood Buildings
Stadhaus at Murray Grove, London

Waugh Thistleton Architects
9 Story
97 Ft Tall Residential
Completed 2009

Photo credit: Waugh Thistleton Architects
### Stadhaus at Murray Grove, London

**Reduced Embodied Carbon**

<table>
<thead>
<tr>
<th>Volume of wood used</th>
<th>950 m³</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon sequestered and stored (CO₂e)</td>
<td>760 metric tons</td>
</tr>
<tr>
<td>Avoided greenhouse gases (CO₂e)</td>
<td>320 metric tons</td>
</tr>
<tr>
<td>Total potential carbon benefit (CO₂e)</td>
<td>1,080 metric tons</td>
</tr>
</tbody>
</table>

- **Carbon savings from the choice of wood in this one building are equivalent to:**
  - 1,615 passenger vehicles off the road for a year
  - Enough energy to operate a home for 803 years

Waugh Thistleton Architects
Forté
Melbourne, Australia
10 stories
105.5 ft
Developer: Lend Lease
Completed 2012
Via Cenni, Milan

4 9 Story residential buildings
92 ft tall

Architect: Rossiprodi Associati SpA
Completed 2013

Photo credit: Promo Legno, Gaia Cambiaggi
Wood Innovation Design Center
Prince George, British Columbia

8 Levels*
97 feet tall

*6 stories
+Mezzanine +Mech. Penthouse

Under Construction
Completion Fall 2014

Architect: Michael Green Architecture
Structural Engineer: Equilibrium Consulting
Contractor: PCL Constructors Westcoast
Wood Innovation Design Center
Prince George, British Columbia

- University of Northern British Columbia
- All Timber Structure
- CLT Floors and Core Walls
- Glulam Columns
Available at
ReThinkWood.com
Available at Mahlum.com

INTRODUCTION

CROSS LAMINATED TIMBER
This study explores the use of Cross Laminated Timber (CLT) in a 10-story residential building as an alternative building method to concrete and steel construction. The study is not meant to be exhaustive, rather a preliminary investigation to test the economic viability of utilizing this new material to increase density, walkability and sustainable responsiveness in our built environment.
Treet, Bergen Norway

Under Construction

14 Stories
147 feet tall

Architect: Artec
Structural Engineer: Swenko
Renderings: 3Seksti/Artec/Sweco
An Enabling Technology is “Mass Timber”
For more information

www.masstimber.com
Beyond Mid-Rise?

Historic Tall Wood Buildings in North America
Butler Brothers Building, Minneapolis MN

Built 1906  500,000 s.f.
Butler Square today...

Renovated 1974
9 Stories, 500,000 sf
The Landing

- Built 1905
- 7/9 stories (~98 ft)
- over 175,000 sf
- Vancouver
425 King St
• Built in 1910
• 7 Stories
• Toronto

312 Adelaide
• Built in 1895
• 8 Stories
• Toronto
Beyond Mid-Rise?

Wood High-Rise
Research and Studies
20, 30, or 40 Stories?
Life Cycle Tower System

Life Cycle Tower by Cree Gmbh
Architect: Herman Kaufmann
Engineering: Arup

Designed for up to 30 Stories
LifeCycle Tower

Up to 30 Stories
LCT One

OFFICE BUILDING
LCT ONE
Dornbirn, Austria

Height: 8 stories
FA: app. 17,000 ft²

Completed Sept 2012
88.5 ft tall
SOM Timber Tower

Timber Tower Research Project
Skidmore, Owings, & Merrill LLP
Redesign of Existing 42 Story Building

Credits: Skidmore, Owings, & Merrill
SOM Timber Tower

Concrete Jointed Timber Frame
SOM Timber Tower

Embodied Carbon

Standard Materials

Sustainable Materials

100%

41%

77%

20%
In Review
Common environmental concerns about specifying wood:

1. Is North America running out of Forests?

2. Does specifying wood products contribute to deforestation?

3. Is wood is a renewable resource?
State of our Forests

Forest Area in the United States 1630-2007

State of our Forests

Forest Area in the United States 1630-2007

Forest area has been stable for over 100 years!

State of our Forests

US Timber Volume on Timber Land

State of our Forests

US Timber Volume on Timber Land

Volume of Trees has been growing for over 50 years!

US Forest Lands

Forest Land Ownership

This map displays the basic vegetation (forest vs. non-forest) of the contiguous United States as well as ownership (private vs. public). The lands displayed as “public” include federal and State lands but do not generally include lands owned by local governments and municipalities.
Questions?

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530-723-6230
Scott.Breneman@woodworks.org

Wood Project Assistance
help@woodworks.org

WoodWorks Website
www.woodwork.org
WoodWorks Support

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- Educational Literature
- Monthly Webinars
- Recorded Presentations
- CEUs Available
- Educational schedule – WSF, workshops and lunch seminars