BUILDING FOR A SUSTAINABLE FUTURE

February 26, 2020
University of Washington Tacoma
PRACTICAL CONSIDERATIONS

BUILDING FOR A SUSTAINABLE FUTURE

February 26, 2020 | University of Washington Tacoma
WASHINGTON STATE CODE CHANGE PROPOSALS

- Advocated in support of ESB 5450
- Required SBCC to take action on mass timber building codes
- Overwhelming, bipartisan support (91-6 in the House)
- Submitted statewide code change proposal based directly from ICC TWB Committee Work
- State Building Code Council Process
WASHINGTON STATE CODE CHANGE PROPOSALS

- **Outcome:**
  - Tall wood provisions adopted for 2015 WA State Building Code (effective July 1, 2019)
  - Pre-adopts 2021 IBC provisions approved by ICC
  - SBCC interpretations necessary to incorporate IBC changes made in 2019

---

**Washington state to allow mid and high-rise mass-timber buildings**

State is first in the nation to alter building codes in support of a new generation of engineered wooden building materials with exciting properties of strength, durability and beauty. With mass timber, architects and builders acquire a new material to create with and rural areas gain the prospect of new high-skilled, high-paid jobs.
Mass Timber in Low- to Mid-Rise: 1-6 Stories in Construction Types III, IV or V

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

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

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

6 STORIES MAXIMUM
85'-6" MAXIMUM BUILDING HEIGHT
324,000 SF MAXIMUM AREA

TYPE IV-A
TYPE IV-B
TYPE IV-C

IBC 2021

CREDIT: SUSAN JONES, ATELIERJONES

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.

BUILDING FOR A
SUSTAINABLE FUTURE

FORT&ERRA
Overall Project Cost Analysis: 12 Story Type IV-B

<table>
<thead>
<tr>
<th></th>
<th>MASS TIMBER</th>
<th>PT CONCRETE</th>
<th>MASS TIMBER SAVINGS VS. PT CONCRETE (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>DIRECT COST OF WORK</td>
<td>86,997,136</td>
<td>85,105,091</td>
<td>2.2%</td>
</tr>
<tr>
<td>PROJECT OVERHEAD</td>
<td>9,393,750</td>
<td>11,768,750</td>
<td>-20.2%</td>
</tr>
<tr>
<td>ADD-ONS</td>
<td>8,387,345</td>
<td>8,429,368</td>
<td>-0.5%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>104,778,231</strong></td>
<td><strong>105,303,209</strong></td>
<td><strong>-0.5%</strong></td>
</tr>
</tbody>
</table>

* Includes 2 layers of gyp on 80% of interior surfaces

Source: Swinerton
BUILDING FOR A SUSTAINABLE FUTURE

February 26, 2020
University of Washington Tacoma
BUILDING NATURE

ARCHITECTURE SHAPES THE RELATIONSHIPS BETWEEN PEOPLE AND THE NATURAL ENVIRONMENT. BECAUSE OF THIS, WE NEED TO ENSURE THAT WHAT WE DO IS BEST FOR BOTH. DESIGN THAT WORKS IN TANDEM WITH NATURE REMINDS US THAT WE CAN DO THE SAME.
1ST BUILT DLT BUILDING IN SEATTLE
BUILDING FOR A SUSTAINABLE FUTURE

February 26, 2020
University of Washington Tacoma
ALL TYPES OF MASS TIMBER

BUILDING FOR A SUSTAINABLE FUTURE
CURRENT STATE OF MASS TIMBER PROJECTS
As of July 2019, 599 multi-family, commercial, or institutional projects have been constructed out of mass timber across the U.S., or they’re currently in design.

STRUCTURAL IMPACTS

Maximum Seismic Load Increase for IBC 2018/ASCE 7-16

Shorter Buildings

- Seattle
- Portland
- San Francisco
- Los Angeles
- Irvine
- San Diego
- Anchorage
- Denver
- Bozeman
- Kalispell

Seismic Load Increase

Site Class D Increase
Site Class C Increase
STRUCTURAL IMPACTS

![Bar chart showing seismic load increase for different cities.](chart.png)
STRUCTURAL IMPACTS

FORCE = MASS \times ACCELERATION
<table>
<thead>
<tr>
<th>ELEMENT</th>
<th>TOTAL</th>
<th>COSTS/SF</th>
</tr>
</thead>
<tbody>
<tr>
<td>FOUNDATION</td>
<td>$1,816,642.73</td>
<td>$11.08</td>
</tr>
<tr>
<td>SUBSTRUCTURE</td>
<td>$467,984.84</td>
<td>$2.85</td>
</tr>
<tr>
<td>SUPERSTRUCTURE</td>
<td>$9,267,893.94</td>
<td>$56.53</td>
</tr>
<tr>
<td>EXTERIOR CLOSURE</td>
<td>$9,924,326.47</td>
<td>$60.53</td>
</tr>
<tr>
<td>ROOFING &amp; SHEET METAL</td>
<td>$1,547,376.00</td>
<td>$9.44</td>
</tr>
<tr>
<td>INTERIOR CONSTRUCTION</td>
<td>$2,554,299.69</td>
<td>$15.58</td>
</tr>
<tr>
<td>CONVEYING SYSTEMS</td>
<td>$1,337,723.00</td>
<td>$8.16</td>
</tr>
<tr>
<td>MECHANICAL</td>
<td>$4,866,740.00</td>
<td>$29.68</td>
</tr>
<tr>
<td>ELECTRICAL</td>
<td>$3,667,835.00</td>
<td>$22.37</td>
</tr>
<tr>
<td>EQUIPMENT</td>
<td>$25,000.00</td>
<td>$0.15</td>
</tr>
<tr>
<td>FURNISHINGS</td>
<td>EXCLUDED</td>
<td>$0.00</td>
</tr>
<tr>
<td>SITWORK</td>
<td>$3,834,451.37</td>
<td>$23.39</td>
</tr>
<tr>
<td>GENERAL REQUIREMENTS</td>
<td>$3,283,643.88</td>
<td>$20.03</td>
</tr>
<tr>
<td>STREET USE FEE ALLOWANCE</td>
<td>$441,475.00</td>
<td>$2.69</td>
</tr>
<tr>
<td><strong>SUBTOTAL:</strong></td>
<td><strong>$43,035,391.91</strong></td>
<td><strong>$262.49</strong></td>
</tr>
</tbody>
</table>
MASS TIMBER COST VARIABLES

- Systems costs primarily affected in Mass Timber cost estimate

<table>
<thead>
<tr>
<th></th>
<th>Column2</th>
<th>Column3</th>
<th>Column4</th>
</tr>
</thead>
<tbody>
<tr>
<td>SUPERSTRUCTURE</td>
<td>$9,267,893.94</td>
<td>$56.53</td>
<td></td>
</tr>
<tr>
<td>EXTERIOR CLOSURE</td>
<td>$9,924,326.47</td>
<td>$60.53</td>
<td></td>
</tr>
<tr>
<td>INTERIOR CONSTRUCTION</td>
<td>$2,554,299.69</td>
<td>$15.58</td>
<td></td>
</tr>
<tr>
<td>GENERAL REQUIREMENTS</td>
<td>$3,283,643.88</td>
<td>$20.03</td>
<td></td>
</tr>
</tbody>
</table>
• Includes – building primary structure
  – Columns
  – Beams
  – Decks or floors

• Comparison of options
  – Cast in Place Concrete
  – Structural Steel
  – Mass Timber –
    • Over 6 floors req’s ‘hybrid lateral system’ shear walls and cores
    • most like structural steel
Includes – Exterior wall systems, glazing and doors
Mass timber is compatible with multiple conventional systems, should not be a cost premium.
Exposed elements to enhance mass timber experience
Consideration should be given to construction sequence and waterproofing construction
• Includes all interior construction build-out
• Maximize mass timber exposure to minimize cost
• Fire protection wrap is an added cost
• Floor system can provide temp weather protection during construction
HIGHRISE MASS TIMBER CONSIDERATIONS

• Virtual design and construction model integration required
• Sourcing – has been limited, now +/- 5 regional suppliers
• Custom lamella widths and variable species to minimize mass and cost
• Downtown congested sites require ‘just in time delivery’ & maximizing offsite prefabrication/staging
• Fire protection during construction
  – Temporary standpipe risers
  – 1 layer GWB wrap every 4 floors
• Weather protection is a factor