Evaluating the Cost, Carbon, and Energy Impacts of Different Structural Systems

November 4, 2021

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Disclaimer: This presentation was developed by a third party and is not funded by WoodWorks or the Softwood Lumber Board.
Evaluating the Cost, Carbon, and Energy Impacts of Different Structural Systems

OUTLINE

1. Introduction to Platte Fifteen
2. Basics of embodied carbon
4. Comparative LCAs: Platte Fifteen in Timber, Steel, and Concrete
5. Comparative costs
6. Conclusions
Office / Retail
Type III-B over IA Construction
2 floors concrete below grade
1 floor concrete above grade
3 floors + roof in mass timber
Concrete cores

30’ x 30’ grid
PLATTE 15 UNDER CONSTRUCTION

Office / Retail
Type III-B Construction
30’ x 30’ grid
PLATTE 15 UNDER CONSTRUCTION

Office / Retail
Type III-B Construction
30’ x 30’ grid
PLATTE 15 UNDER CONSTRUCTION

50+ ft panels
span five 10 ft bays
PLATTE 15 UNDER CONSTRUCTION
2,000 sf / day
with 6-8 laborers
PLATTE FIFTEEN
Meanwhile, embodied carbon starts getting attention...

Understanding Carbon

Embodied Carbon
Manufacture, transport and installation of construction materials

Operational Carbon
Building energy consumption

Source image: Carbon Leadership Forum
Image by Skanska
Initial embodied carbon of buildings with respect to operational energy over 50 years varies with building type:

- Office 50%
- Residential 62%
- Warehouse 66%
Construction Industry = 39% +

28% Building Operations

11% Building Materials & Construction (Core and Shell)

23% Concrete (11%)
Steel (10%)
Aluminum (2%)

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Data Sources: Global ABC Global Status Report 2018, EIA
THE SE 2050 CHALLENGE

Source: SE 2050 Commitment Initiative Brief by the Carbon Leadership Forum and the SEI Sustainability Committee
Current embodied carbon policy in the U.S.

Source: Carbon Leadership Forum
LIFE CYCLE ASSESSMENT (LCA)

TRACKS ENVIRONMENTAL IMPACTS FROM ALL THE STAGES OF A PRODUCT OR PROCESS,

INCLUDING:

- EXTRACTION
- MANUFACTURING
- CONSTRUCTION
- SERVICE
- END OF LIFE
  - RECYCLE
  - REUSE
  - DISPOSAL

AND EXPRESSES IT AS “GLOBAL WARMING POTENTIAL” OR GWP
• GWP = GLOBAL WARMING POTENTIAL (kgCO₂eq)

• UNDERSTAND AND IDENTIFY HOT SPOTS
• UNDERSTAND THE IMPACT OF OUR MODIFICATIONS AND INNOVATIONS
• VALIDATE DECISIONS AND INVESTMENTS

MEASURING EMBODIED CARBON
Platte Fifteen Life Cycle Assessment

Authors
KL&A Engineers and Builders
Adolfson & Peterson
### LIFE CYCLE ASSESSMENT SCOPE

#### CRADLE TO GATE

#### CRADLE TO GRAVE

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**Life Cycle Stages & Study Scope**

<table>
<thead>
<tr>
<th>Product</th>
<th>Construction</th>
<th>Use</th>
<th>End-of-Life</th>
<th>Module D</th>
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*Figure 3. Life Cycle Stages as defined by EN 15978. Processes included in Tally modeling scope are shown in bold. Italics indicate optional processes.*
BIOGENIC CARBON

CRADLE TO GATE

CRADLE TO GRAVE

Dynamic LCA Comparison

STAGE A (NEGATIVE)

STAGE D END OF LIFE

NET POSTIVE GWP IMPACT

2020

2080?
Percent Mass to Percent GWP Per Material Above Podium Slab

- **Mass Timber**
- **Steel**
- **Concrete**

- **Wood**
- **Metals**
- **Concrete**
Tally Mix Assumptions for Wood:
- 65.5% landfill
- 17.5% incineration
- 17.5% recycle
LONG LIFE, LOOSE FIT, EASY CARE
WHAT ABOUT COST?
MATERIAL COST (STRUCTURE AND VERTICAL ENCLOSURE)

Cost Premium Over Steel (%)

- Steel: Lowest = Baseline
- Concrete: Middle
- Mass Timber: Highest

Raw Material Installed
- Concrete System: 3.27%
- Mass Timber System: 8.37%
Steel: + 2 months
Concrete: + 3.5 months
Mass Timber: Baseline time

Cost Premium Over Steel (%)

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<thead>
<tr>
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<th>Concrete System</th>
<th>Mass Timber System</th>
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<tr>
<td>Raw Material Installed</td>
<td>3.27</td>
<td>8.37</td>
</tr>
<tr>
<td>Structure Construction</td>
<td>3.9</td>
<td>4.89</td>
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</tbody>
</table>
TOTAL BUILDING COST

Cost Premium Over Steel (%)

- **Concrete System**: Raw Material Installed: 3.27, Structure Construction: 3.9, Whole Building Construction: 1.55
- **Mass Timber System**: Raw Material Installed: 8.37, Structure Construction: 4.89, Whole Building Construction: 1.95

Steel: + 2 mos
Concrete: + 3.5 mos
Mass Timber: Baseline time
"The Gap" in this study is less than 2% of building cost
WHY MASS TIMBER

UNDER CONSTRUCTION, MASS TIMBER...

- IS FAST
- REQUIRES LIMITED LABOR
- IS QUIET
- HAS LITTLE WASTE
- REDUCES CONSTRUCTION TRAFFIC
WHY MASS TIMBER

IN THE FINISHED BUILDING, MASS TIMBER...

• LOOKS GREAT!

• CREATES A HEALTHY ENVIRONMENT (BIOPHILIA)

• GENERATES HIGH LEASE RATES AND HIGH LEASING VELOCITY
WHY MASS TIMBER

MASS TIMBER IS SUSTAINABLE

• RENEWABLE

• REUSABLE, EASE OF DECONSTRUCTION

• SUPPORTS FOREST HEALTH

• SUPPORTS RURAL ECONOMIES

• SEQUESTERS CARBON / LOW EMBODIED CARBON (50% CARBON BY DRY WEIGHT)
THANK YOU
QUESTIONS?

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