M5, Vancouver and Terraine, San Jose: Lessons Learned from Conception to Construction

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WHY HYBRID?
LESSONS FROM CONCEPTION TO CONSTRUCTION

MAY 24, 2022
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WHY HYBRID?

HYBRID TYPES

• GRAVITY SYSTEMS
• LATERAL SYSTEMS
• GRAVITY & LATERAL SYSTEMS
WHY HYBRID?

DRIVERS FOR HYBRID

- PROGRAMMING & FUNCTIONALITY
- ARCHITECTURAL DESIGN
- CODE LIMITATIONS
- INSURANCE OR “PERFORMANCE”
- COST?
- OTHERS?

BROCK COMMONS

UBC PUBLIC AFFAIRS

CHINATOWN #7

HKS ARCHITECTS

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WHY HYBRID? GETTING TALLER WITH TIMBER

**Type IV-A**
- 16 Stories
- Building Height: 270 ft
- Allowable Building Area: 972,000 sf
- Average Area per Story: 54,000 sf

**Type IV-B**
- 12 Stories
- Building Height: 180 ft
- Allowable Building Area: 648,000 sf
- Average Area per Story: 54,000 sf

**Type IV-C**
- 8 Stories
- Building Height: 85 ft
- Allowable Building Area: 490,000 sf
- Average Area per Story: 40,000 sf
MAIN ALLEY PROTOTYPE MASS TIMBER TOWER WITH HPA ARCHITECTS (VANCOUVER, BC)
WHY HYBRID? SYSTEMS CONSIDERED

POINT-SUPPORTED CLT SYSTEM

- PANEL-ONLY SYSTEM SPANNING TO TIMBER OR STEEL
- GRID IS LIMITED (10’x12” MAX)
- THICKER PANEL REQUIRED
- HOTEL/DORMITORY APPLICATIONS

POST, BEAM AND PANEL SYSTEM

- PANELS SPANNING TO BEAMS AND POSTS
- MORE GRID FLEXIBILITY
- RESIDENTIAL AND OFFICE APPLICATIONS
## COST PER FLOOR

<table>
<thead>
<tr>
<th></th>
<th>TIMBER POST + PANEL</th>
<th>TIMBER POST, BEAM PANEL</th>
<th>HYBRID POST, BEAM, PANEL</th>
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</thead>
<tbody>
<tr>
<td>CLT Area (m² per floor)</td>
<td>495</td>
<td>495</td>
<td></td>
</tr>
<tr>
<td>CLT Volume (m³ per floor)</td>
<td>99</td>
<td>109</td>
<td>99</td>
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<td>Glulam Column Volume (m³ per floor)</td>
<td>15</td>
<td>8</td>
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<td>Glulam Beam Volume (m³ per floor)</td>
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<tr>
<td>Steel Column (kg per floor)</td>
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<td>Steel Beam (kg per floor)</td>
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<td>Timber</td>
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<td>Steel</td>
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<td>102321</td>
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<td><strong>Total</strong></td>
<td><strong>$ 195,900.00</strong></td>
<td><strong>$ 211,900.00</strong></td>
<td><strong>$ 260,721.00</strong></td>
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</tbody>
</table>

* Assumes a unit rate of 9 CAD/kg Steel, 1600 CAD/m³ CLT supply & 2500 CAD/m³ Glulam Supply
** Costs do not include install, but installation costs should be similar
WHY HYBRID? STRUCTURAL PLAN
WHY HYBRID? FUNCTIONAL REQUIREMENTS
WHY HYBRID? LATERAL SYSTEM

- REQUIRED STIFFNESS
- FIRE-RATING REQUIREMENTS
- MEMBER SIZING AND COSTING
- ARCHITECTURAL PROGRAM CONSTRAINTS
- CONSTRUCTION SEQUENCING
WHY HYBRID? MIXING AND MATCHING MATERIALS
TERRAINE WITH STUDIO GANG (SAN JOSE, CA)
WHY HYBRID? EXPLORING THE ALTERNATIVES

Mass Timber
Post + Beam + Panel

Timber-Steel Hybrid
Steel Column/Beam + CLT Panel

All Concrete
Columns, Post-tensioned Slabs
WHY HYBRID? EMBODIED CARBON BENEFITS

16,000,000 kg CO₂e sequestered
65% Avoided & Offset by
22% Emissions Avoided

14,000,000 kg CO₂e sequestered
50% Avoided & Offset by
18% Emissions Avoided

34,000,000 kg CO₂e
Emissions

36,000,000 kg CO₂e
Emissions
WHY HYBRID? OVERCOMING MASSING CHALLENGES
WHY HYBRID? OVERCOMING MASSING CHALLENGES

CANTILEVERING IN MASS TIMBER
WHY HYBRID? OVERCOMING MASSING CHALLENGES
CANTILEVERING IN MASS TIMBER
WHY HYBRID? COLUMN SIZING AND DIFFERENTIAL SHRINKAGE
CHINATOWN #7

HYBRID GRAVITY
• P1-L2, RC SLABS + COLUMNS
• L2-ROOF, CLT SLABS + STEEL FRAME

HYBRID LATERAL
• P1-L2, RC SHEARWALLS + RC DIAPHRAGMS
• L2-ROOF, STEEL SCBFS + RC DIAPHRAGMS
WHY HYBRID?

HYBRID GRAVITY
• PODIUM (3HR SEPARATION, 1A OVER IIIB)
• BELOW GRADE PARKING & EXISTING COLUMN GRIDS
• BALCONY DESIGN INTENT
• EXTERIOR CONNECTOR DESIGN INTENT
• STAIR/ELEVATOR CORE DESIGN INTENT

HYBRID LATERAL
• CODE LIMITATIONS (SEISMICITY)
• DESIGN INTENT

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WHY HYBRID?

CITY REVIEWS/APPROVALS

• FIRST CLT PROJECT IN CITY OF LA (COLA)
• CITY OF LA, “FLEXIBLE” DIAPHRAGM FOR CLT
• FINAL DESIGN EMPLOYED ACOUSTIC CONCRETE TOPPING AS RC DIAPHRAGM
• FIRST IS NOT ALWAYS BEST
• HAVE ALTERNATE DESIGN STRATEGIES IN PLACE AND/OR CONSIDER AM&M APPROVAL PATH w/ PEER REVIEW
WHY HYBRID?

CHALLENGES & DRAWBACKS

• MORE MATERIALS = MORE TRADES = GREATER POTENTIAL FOR SCOPE GAPS
• DIRECT CONVERSATIONS WITH GC TO UNDERSTAND WHO IS DOING WHAT, SIMPLE SCOPES CAN BE AN OVERSIGHT
WHY HYBRID?

CHALLENGES & DRAWBACKS

• MORE MATERIALS = MORE Trades = GREATER POTENTIAL FOR SEQUENCING & CONSTRUCTABILITY CHALLENGES
• GC AND SUBS MUST COORDINATE DETAILS AND SEQUENCING
WHY HYBRID?

THANK YOU