Light-frame Wood Innovation: Six-over-Two Podium Construction

EL142
June 23, 2022; 3:00-4:00pm
1.00 LU/HSW/GBCI/RIBA

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Acknowledgements/Credits

Paul Del Vecchio – President, Ethos Development
Speakers List

• Alex Davis – Project Engineer, PCS Structural Solutions
• Adam Hostetler, Design Director, Works Progress Architecture
Course Description

Light wood frame over podium has become a ubiquitous style of construction for multifamily projects. The four or five stories of wood frame housing provide construction cost advantages while the one, two, or three stories of podium increase site density.

While limits within the International Building Code (IBC) have capped this style of construction at five stories of wood framing, the Washington State Building Code has amended IBC limits to allow six stories of Type IIIA, wood frame, multifamily housing when additional safety and design criteria are met.

In this presentation, the design team of two such projects will share the benefits, challenges, and financial impacts they saw throughout their development, design, and construction.
Course / Learning Objectives

1. Discuss the Washington State code amendments that permit six stories of type IIIA, wood frame multifamily construction.
2. Examine the structural design considerations associated with a six-over-two building.
3. Review the financial benefits realized with increased site density of six-over-two projects.
4. Explore how these six-over-two Tacoma projects meet fire life safety objectives.
The Projects

1. Analog
   1351 Fawcett Ave
   Tacoma WA, 98402

2. Moraine
   1402 Tacoma Ave
   Tacoma WA, 98402

Base Zone:
Downtown Residential District (DR)
The Projects

1. Analog
   1351 Fawcett Ave
   Tacoma WA, 98402

2. Moraine
   1402 Tacoma Ave
   Tacoma WA, 98402
Context for Six-Stories of Light Framing

1. Five-stories per IBC 504.4
Cost Benefits of Tall Light Framing

1. Analog is amongst the first projects in Washington to be permitted with 6 stories of Type IIIA.
2. The cost of one IIIA deck on Analog is $32/SF vs. 1A at $44/SF.
3. This amounts to a total of $104k for the transitional deck on Analog and $175k for Moraine.
4. The relative ease of routing MEP chases in wood vs concrete is relevant.
5. This is primarily a cost-based choice as there is no degradation in value or resident experience.
Analog – Project Overview

1. 120’ x 75.5’ Site
2. 17.2’ E-W Elevation Change
3. 4.1’ N-S Elevation Change
4. 115 Units
5. Mix of Micros, Studios, 1-Beds, 2-Beds, and 3-Beds
6. 6-Stories of III-A Over 2-Story I-A Podium and a Basement.
Analog – Massing Strategy

1. Started by Assuming Three-Story Podium + Basement per WSBC 510.2.
2. All Encroachments Off Concrete Decks.
Analog – Massing Strategy

1. 85’ Maximum for Type III-A Height Per WSBC 504.3.
2. Three-Story Podium + Basement Per 510.2.
3. All Encroachments Off Concrete Decks.
4. Fire Marshall Definition of High-Rise Taken from Lowest Access Point.
Analog – Massing Strategy

1. Applying TMC 2.02.140 Drops to Two-Story Podium and a Basement
2. All Encroachments Off Concrete Decks.
3. Fire Marshall Definition of High-Rise Taken from Lowest Access Point.
Analog – Massing Strategy

1. Redesign to Keep All Encroachments Off Concrete Decks.
Analog – Massing Strategy

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Analog – Massing Strategy

1. Redesign to Keep All Encroachments Off Concrete Decks.
Analog – Floor Plans – Level 8

1. All Walls Stack Down to the Transfer Slab.
2. Façade Articulations Fall Along Wall Stacks
Analog – Floor Plans – Typical

1. All Walls Stack Down to the Transfer Slab.
2. Façade Articulations Fall Along Wall Stacks
Analog – Floor Plans – Level 2

1. Upper Exit Discharge Level
1. Storage Area Due to Height Change Across Site Not Quite being Enough for Two Full Stories.

2. Beginning to Stepped Foundations
Analog – Floor Plans – Basement

1. Lower Exit Discharge Level.
2. Main Building Entry Lobby.
3. Tacoma Requires an Accessible Stall for Any Type A Unit, Regardless of How Much Parking is Being Provided.
Special Six-Story Wood Requirements

1. Provide Stair Enclosure Pressurization.
2. Opportunity to Remove Smoke Doors on the Elevator Shaft by Tying into the Same System.
Special Six-Story Wood Requirements

1. Bearing Walls are Located Like Any Other Type III Building. Minimize Exterior Bearing Walls
2. Rating Req. Per Table 601
   - 1-hr Wall
   - 2-hr Wall
3. Walls and the Doors in Them Need to Stack
4. The AHJ Did Not Accept Asymmetric Assemblies on This Project
Analog – Construction Photos

2. Keep an Eye on Any Walls with Double Shear. Provide Staggered Studs for Acoustic Separation.
Analog – Construction Photos


2. Keep Corridor to Exterior Wall Depth Below 30’ to Try to Keep Shear Off Exterior Walls.
Moraine – Project Overview

1. 130’ x 137.5’ Site
2. 19.5’ E-W Elevation Change
3. 1.0’ N-S Elevation Change
4. 171 Units
5. Mix of Micros, Studios, 1-Beds, 2-Beds, and 3-Beds
6. 6-Stories of III-A Over 2-Story I-A Podium and a Basement.
Moraine – Lessons Learned from Analog

Moraine – Exterior Wall Types

1. Set Exterior Wall Types Early and Design with Them in Mind.
Moraine – Interior Wall Types

1. Double Sided Shear is Common on Lower Floors, which Change Acoustic Performance and Makes Trade Work Difficult

2. Multi-Stud Pack is Common
Moraine – Building Section

1. Bearing Walls Are Located Like Any Other Type III Building, with and Eye Toward Minimizing Exterior Bearing Walls.

2. Walls and the Doors within Them Need to Stack.

3. The AHJ Did Not Accept Asymmetric Assemblies on This Project
1. Carrying Shear Down Through the Podium Proved Most Difficult Part with This Program.

2. Tacoma Requires an Accessible Stall for Any Type A Unit, Regardless of How Much Parking is Being Provided.
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2. Tacoma Requires an Accessible Stall for Any Type A Unit, Regardless of How Much Parking is Being Provided.
Moraine – Floor Plans – Level 5

1. Once into the Wood, the Logics are Very Similar to Analog.
2. Per Table 601
   - 1-hr Wall
   - 2-hr Wall
3. Walls and the Doors within Them Need to Stack.
4. Provide Stair Pressurization.
Moraine – Floor Plans – Level 8

1. Once into the Wood, the Logics are Very Similar to Analog.
2. Per Table 601
   - 1-hr Wall
   - 2-hr Wall
3. Walls and the Doors within Them Need to Stack.
4. Provide Stair Pressurization.
Moraine – Main Entrance
Moraine – Main Lobby
Moraine – East Deck
Moraine – North Lounge
Moraine – South Lounge
Moraine – Construction Photos
Moraine – Construction Photos

Update
Replace with Moraine Photos When Available

Update
Replace with Moraine Photos When Available
Gravity System – Type IIIA Impacts

- All exterior type IIIA wood walls are required to be constructed of fire retardant treated (FRT) lumber. Reference design values for these members are reduced per manufacturer adjustment factors. IBC Table 721.1(2), note m provides some capacity reduction guidance as well.

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<th>STRENGTH DESIGN FACTORS</th>
<th>SOUTHERN PINE</th>
<th>DOUGLAS FIR</th>
<th>SPRUCE-PINE-FIR</th>
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Source: ICC-ESR 4244
Gravity System – Type IIIA Impacts

- Joist bearing at the exterior walls was limited by framing joists parallel to the exterior walls where possible. This reduced the amount of 2-hr rated walls.

- Loads from added story result in additional studs and closer spacing especially at 2x4 walls. Compression perpendicular to grain and crushing of plates important considerations for design.
Lateral System – Type IIIA Impacts

- To reduce 2 hour rated exterior walls, any exterior shear walls were eliminated. This created an open-front cantilevered diaphragm condition.
- An enveloped solution of rigid & flexible analysis was performed to meet the requirements listed in SDPWS Section 4.2.5.2.

Source: AWC 2021 Special Design Provisions for Wind and Seismic
Lateral System – Type IIIA Impacts

- With the additional story comes increased deflections and higher overturning/shear demands for shear walls. Solutions involved using more stringent holdown deflection allowances and increasing double sided walls to provide additional stiffness and capacity.

- Holdown forces should be included in localized podium slab anchorage & global slab design when over 30 kips.
Lateral System – Type IIIA Impacts

- Ensure continuous rod holdowns have shrinkage compensating take up devices capable of accommodating additional shrinkage from added story.
- Stacking of vertical and lateral elements key to avoiding continuous steel elements and prevent localized shrinkage issues.
Contact Information

Alex Davis – adavis@pcs-structural.com
Adam Hostetler - adam@worksarchitecture.net
Thank you!