

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

EL142

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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

## Tacoma Municipal Code

### 2.02.140 Amendment to IBC Section 504.4 – Number of Stories – by amending subsection 504.4.1 WA State amendment to the IBC and by addition of a new Section 504.4.1.1 – Type B occupancies within R-1 and R-2 occupancies.

The following section amends Section 504.4.1 of the State Building Code amendments to IBC Section 504.4 – Number of Stories, by replacing 504.4.1 in its entirety, and by addition of a new Section 5.4.4.1.1.

#### 504.4.1 Stair Enclosure Pressurization Increase.

For Groups R-1 and R-2 in buildings of Type VA or IIIA construction, or I-1 Condition 2 Assisted living facilities licensed per chapter 388-78A WAC and residential treatment facilities as licensed by Washington state under chapter 246-337 WAC located in buildings of Type VA construction equipped throughout with an approved automatic sprinkler system in accordance with Section 903.3.1.1, the maximum number of stories permitted in Section 504.4 may be increased by one provided the interior exit stairways and ramps are pressurized in accordance with Sections 909.11 and 909.20. Legally required standby power shall be provided for buildings constructed in compliance with this section and be connected to stairway shaft pressurization equipment, elevators and lifts used for accessible means of egress, hoistway pressurization equipment (if provided) and other life safety equipment as determined by the authority having jurisdiction. For the purposes of this section, legally required standby power shall comply with most currently adopted NEC Section 701.12, options (A), (B), (C), (D), (E), (F), or (G) or subsequent revised section number(s).

#### 504.4.1.1 Type B Occupancies within R-1 and R-2 occupancies.

Provided the building meets the additional requirements in Section 504.4.1 as amended by the State Building Code, Type B occupancies that are considered accessory to and for the exclusive use of the R-1 and R-2 uses, including such uses as assembly areas, exercise rooms, or other amenity spaces with less than 50 occupants, may be permitted on all stories that the R-1 and R-2 uses are permitted. These spaces must also meet all the additional provisions as specified in the State Building Code amendment (WAC 51-50-0504) to IBC 504 – Building Height and Number of Stories.

(Ord. 28729 Ex. A; passed Jan. 26, 2021; Ord. 28590 Ex. A; passed Jun. 18, 2019; Repealed and reenacted by Ord. 28363 Ex. A; passed Jun. 14, 2016; Repealed and reenacted by Ord. 28155 Ex. A; passed Jun. 11, 2013; Repealed and reenacted by Ord. 27890 Ex. A; passed Jun. 15, 2010)

1. Five-stories per IBC 504.4
2. Seattle allows two-story podiums in 2003.
3. Seattle adopts six-stories of wood in May 2018.
4. Tacoma Followed in June 2019.
5. 1430Q completes: six-stories of wood in Sacramento via Alternate Means in 2020.

# Cost Benefits of Tall Light Framing

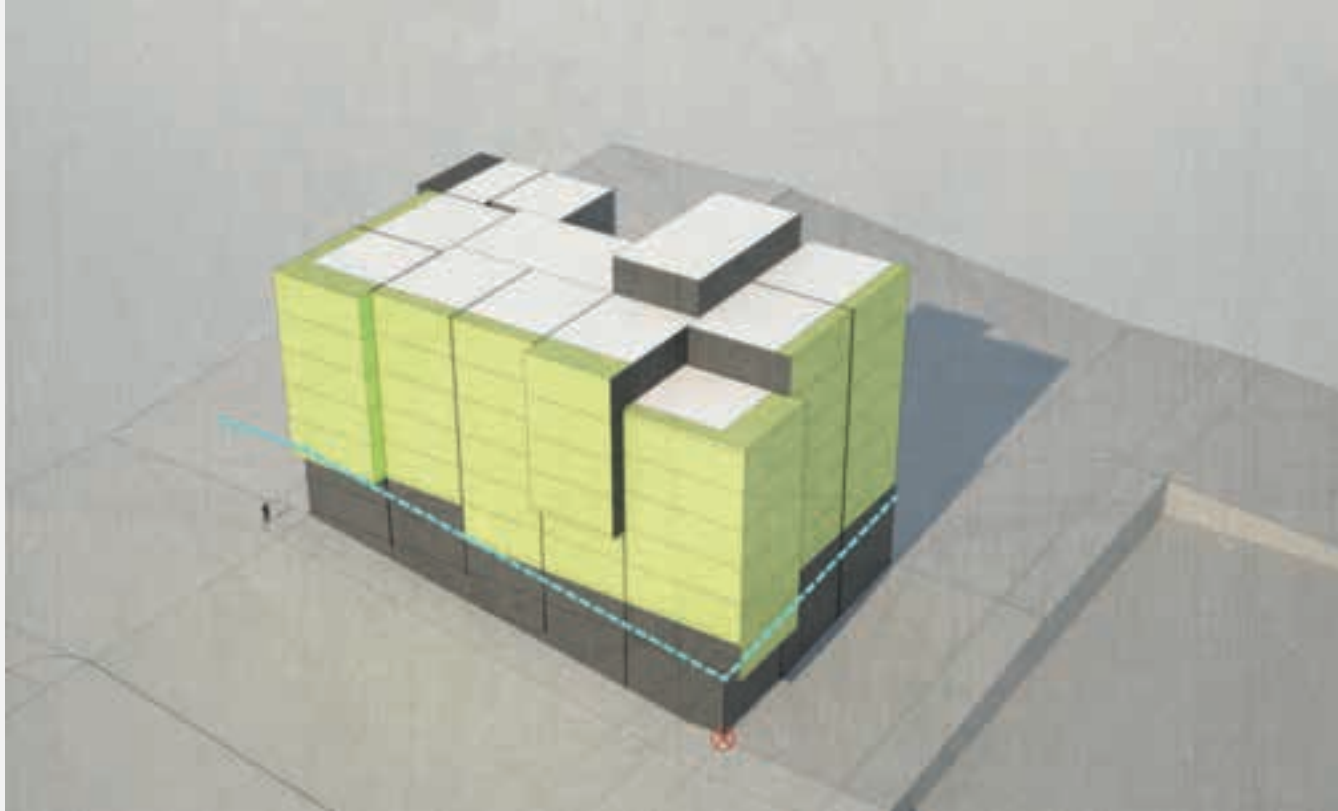
1. Analog is amongst the first projects in Washington to be permitted with 6 stories of Type IIIA.
2. The cost of one IIIA deck on Analog is \$32/SF vs. 1A at \$44/SF.
3. This amounts to a total of \$104k for the transitional deck on Analog and \$175k for Moraine.
4. The relative ease of routing MEP 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.

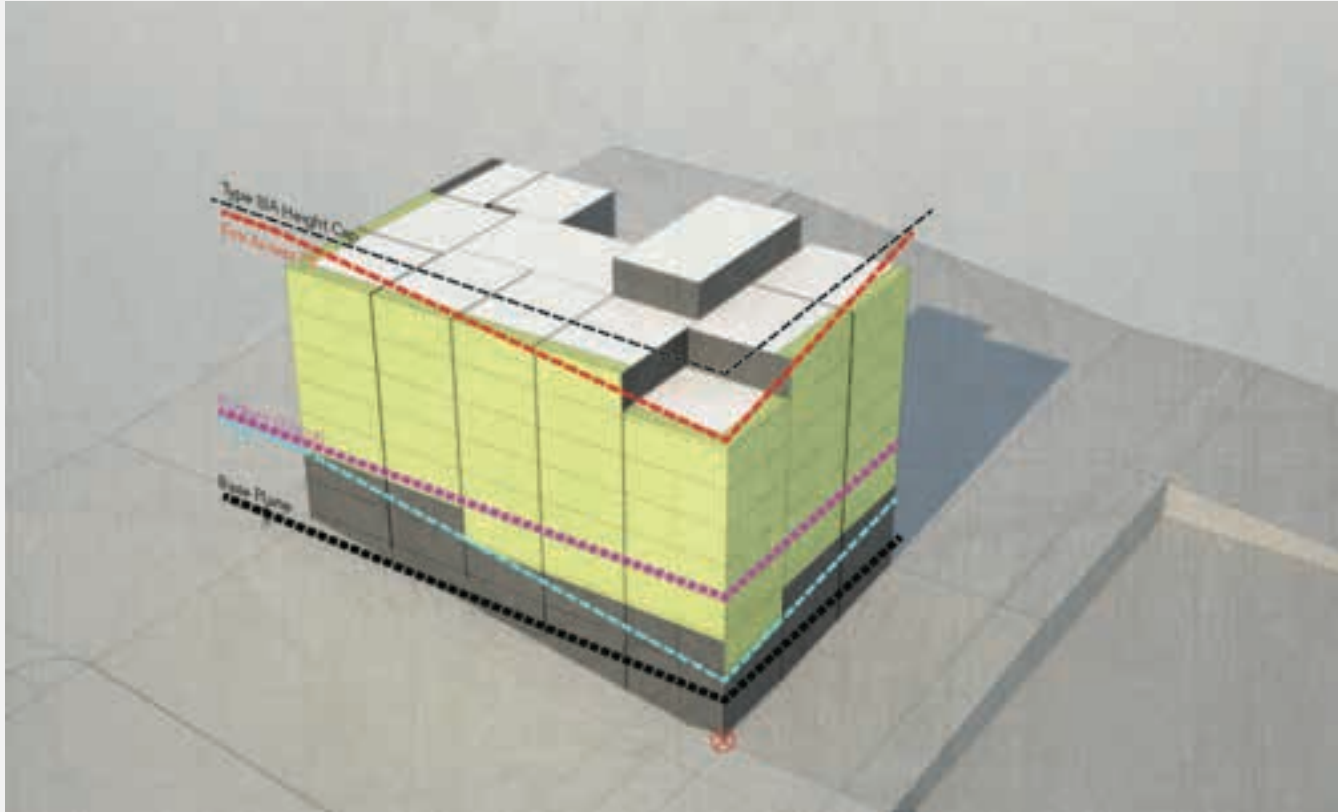
# Analog – Massing Strategy



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



# Analog – Massing Strategy



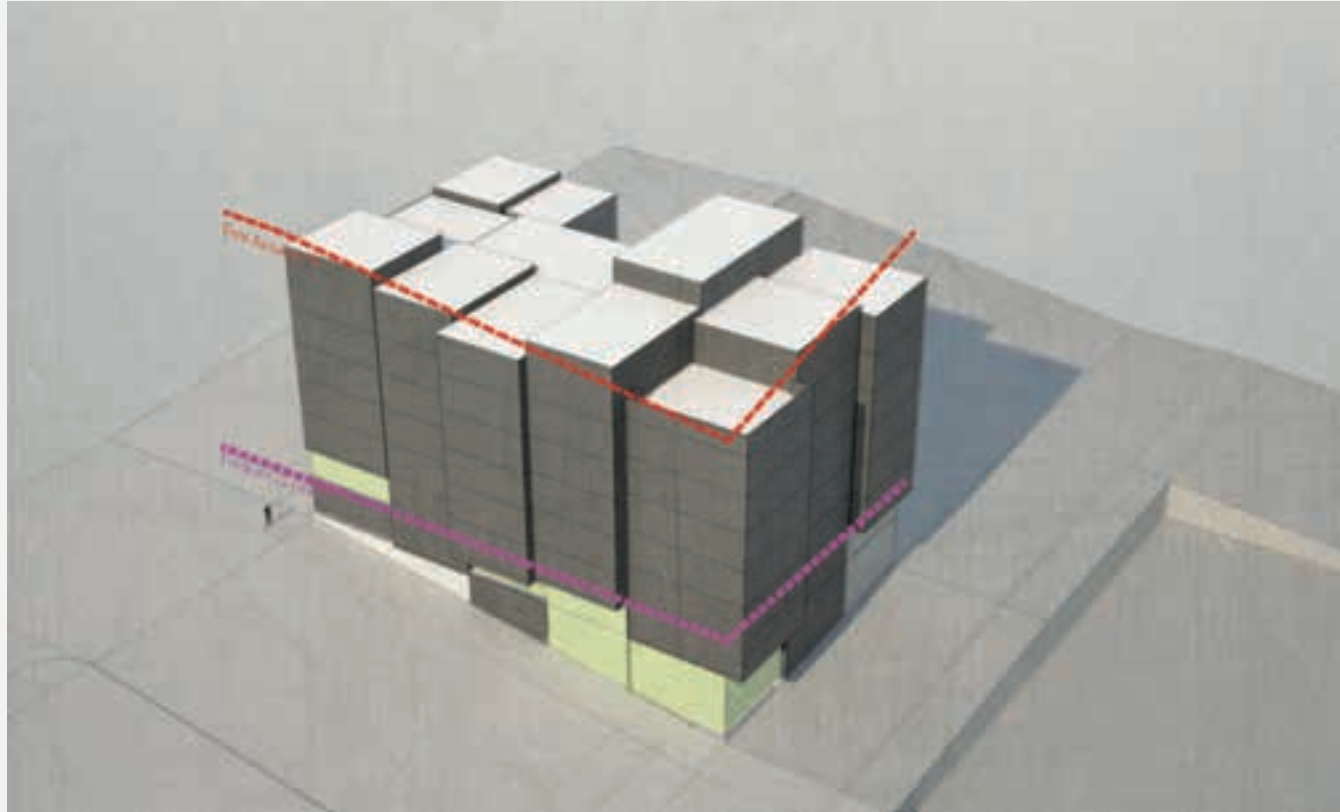
1. 85' Maximum for Type III-A Height Per WSBC 504.3.
2. Three-Story Podium + Basement Per 510.2.
3. All Encroachments Off Concrete Decks.
4. Fire Marshall Definition of High-Rise Taken from Lowest Access Point.

# 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



1. Redesign to Keep All Encroachments Off Concrete Decks.

# 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

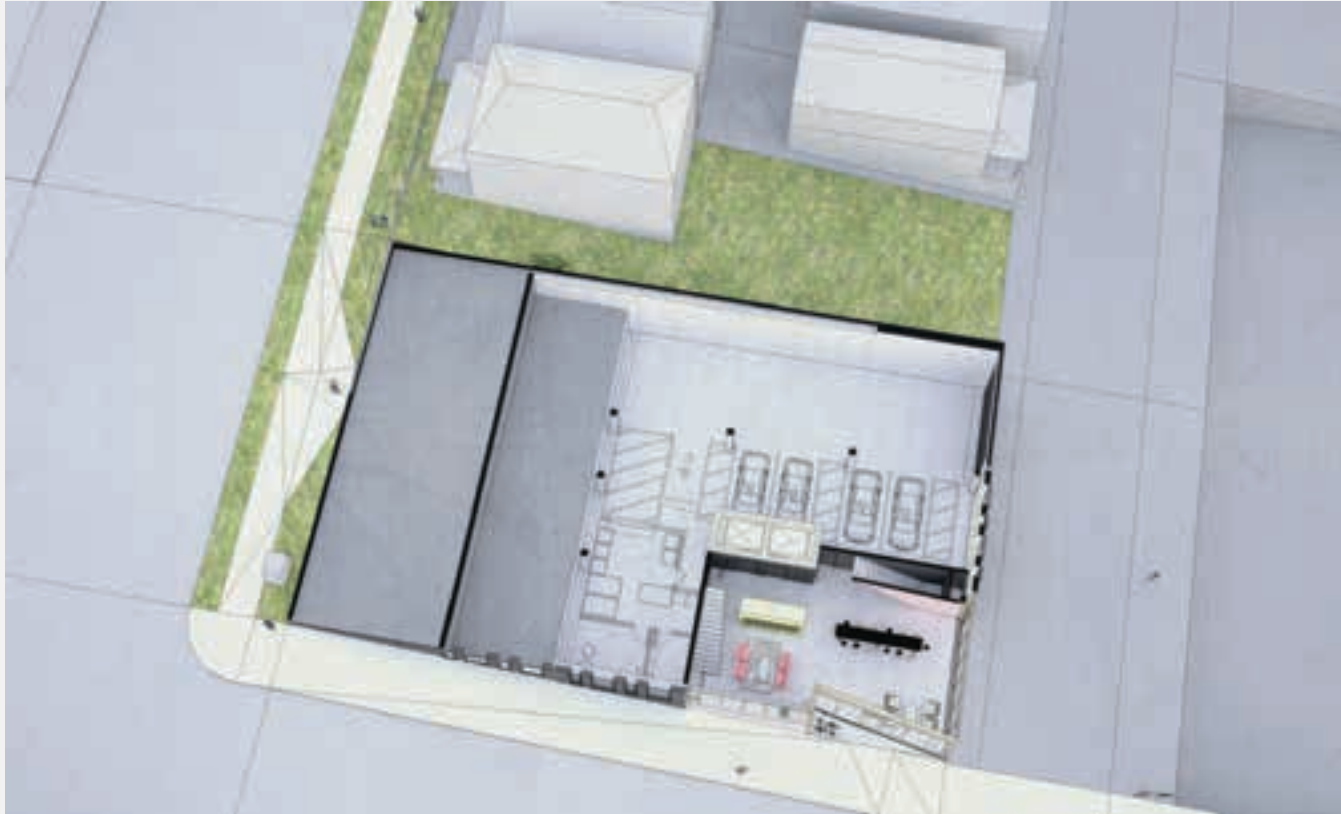


# Analog – Floor Plans – Level 1



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



# Analog – Construction Photos



1. High Count Stud Packs at the Lower Floors. Suggest Pulling All Plumbing Out of Demising Walls.
2. Keep an Eye on Any Walls with Double Shear. Provide Staggered Studs for Acoustic Separation.



# Analog – Construction Photos



1. High Packs Around Tie Downs Emphasize Stacking Requirement.
2. Keep Corridor to Exterior Wall Depth Below 30' to Try to Keep Shear Off Exterior Walls.

# Moraine – Project Overview



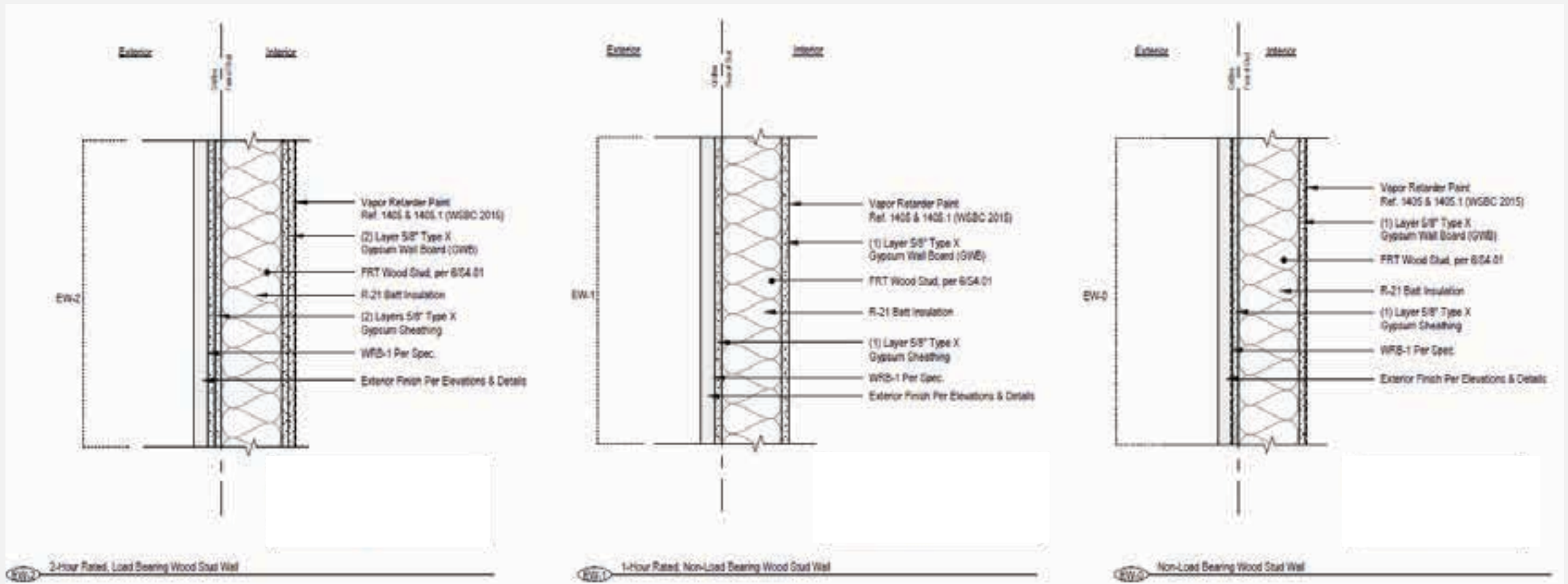
1. 130' x 137.5' Site
2. 19.5' E-W Elevation Change
3. 1.0' N-S Elevation Change
4. 171 Units
5. Mix of Micros, Studios, 1-Beds, 2-Beds, and 3-Beds
6. 6-Stories of III-A Over 2-Story I-A Podium and a Basement.

# Moraine – Lessons Learned from Analog



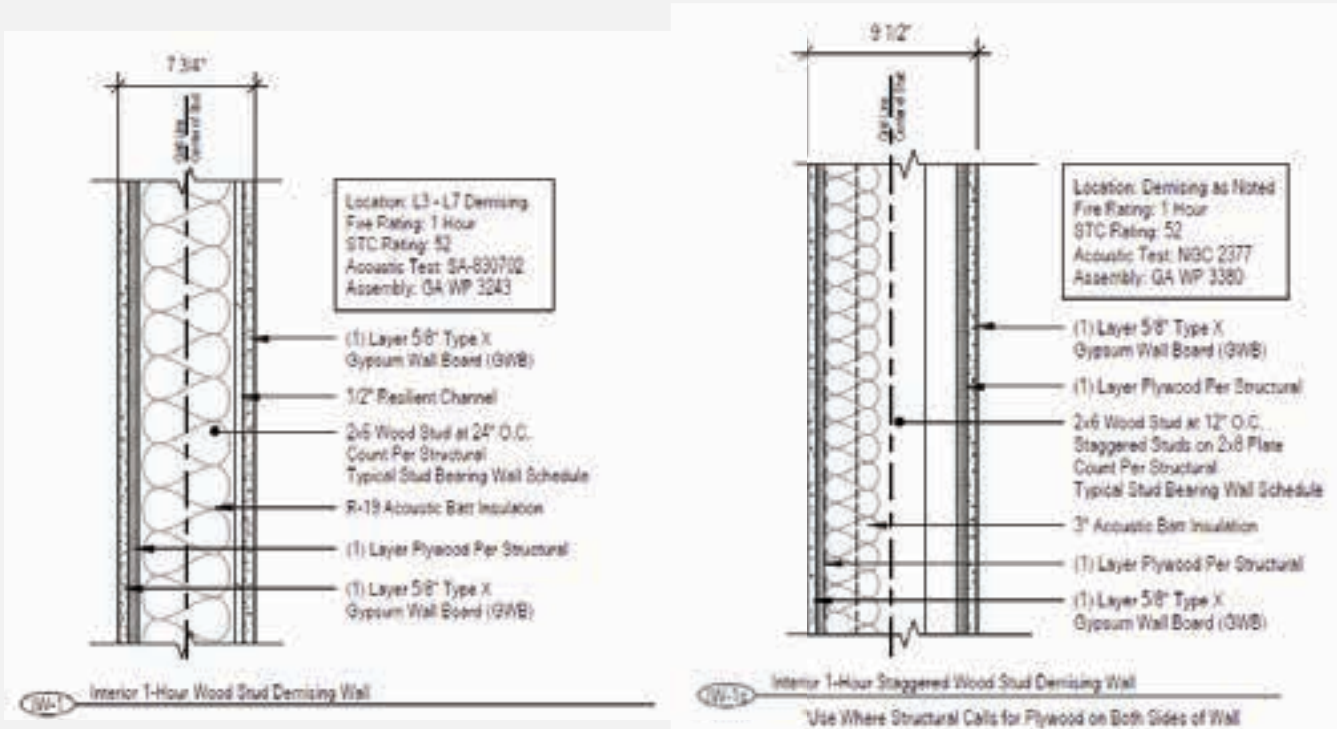
1. Utilized Fire Access Height Early in the Design Process.
2. The Six-Story Wood Structure Has More Capacity to Push and Pull Than Utilized in Analog.
3. Removing Blocks from the Interior Creates a More Impactful Massing While Still Stacking Bearing Walls.

# Moraine – Exterior Wall Types





# Moraine – Interior Wall Types



MARK	WALL SHEATHING	SIDES WITH SHEATHING	SHEATHING NAILS NOTE 2	EDGE NAILING ON CENTER	EDGE FRAMING NOTE 5	FIELD NAILING ON CENTER	BOTTOM PLATE NOTE 6	BOTTOM PLATE CONNECTION	5/8" ANCHOR BOLT SPACING (EMBED 1" MINIMUM)
(A)	15/32"	(1)	12d	6"	2x	12"	2x	(2) 16d @ 8" O.C.	48" O.C.
(B)	15/32"	(1)	12d	4"	3x	12"	2x	1/4x6 SDS @ 6" O.C.	32" O.C.
(C)	15/32"	(1)	12d	3"	2x	12"	2x	1/4x6 SDS @ 6" O.C.	32" O.C.
(D)	15/32"	(1)	12d	2"	3x	12"	3x	(2) 1/4x6 SDS @ 16" O.C.	16" O.C.
(E)	15/32"	(2)	12d	6"	2x	12"	2x	(2) 1/4x6 SDS @ 12" O.C.	16" O.C.
(F)	15/32"	(2)	12d	4"	3x	12"	3x	(2) 1/4x6 SDS @ 8" O.C.	16" O.C.
(G)	15/32"	(2)	12d	3"	3x	12"	3x	(2) 1/4x6 SDS @ 6" O.C.	16" O.C.
(H)	15/32"	(2)	12d	2"	3x	12"	3x	(2) 1/4x6 SDS @ 6" O.C.	16" O.C.
(I)	DIAPHRAGM	(2)	12d	4"	2x	6"	2x	(2) 16d @ 8" O.C.	-

MARK	STUD SIZE AND SPACING	NUMBER STUDS REQUIRED AT MEMBER ENDING
1	2x6 @ 16" O.C.	(1)
2	(2) 2x6 @ 16" O.C.	(2)
3	(3) 2x6 @ 16" O.C.	(3)
4	2x4 @ 16" O.C.	(1)
5	(2) 2x4 @ 16" O.C.	(2)
6	(3) 2x4 @ 16" O.C.	(3)

**NOTES:**

1. (A) INDICATES SPECIAL STRUCTURAL WALL MARK. ALL WALLS SHOWN ON STRUCTURAL DRAWINGS ARE 2x6 @ 16" ON CENTER UNLESS DESIGNATED SPECIAL. STUD SHALL MATCH FRAMING MEMBER LAYOUT ABOVE WHERE APPLICABLE. ALL WALLS SHALL HAVE 15/32" WOOD SHEATHING AND BE NAILED WITH 12d AT 6" CENTER AT EDGES AND 12" ON CENTER IN FIELD UNLESS DESIGNATED SPECIAL.

2. ALL EXTERIOR WALLS AND ALL DESIGNATED SHEAR WALLS SHALL BE BLOCKED EDGES. EDGE NAILING APPLIES TO ALL TOP AND BOTTOM PLATES. VERTICAL JOINTS SHALL BE STAGGERED.

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 an Eye Toward Minimizing Exterior Bearing Walls.

1-hr Floor (601)  
1-hr Roof (601)  
2-hr Wall (601)  
3-hr (510.2)

2. Walls and the Doors within Them Need to Stack.
3. The AHJ Did Not Accept Asymmetric Assemblies on This Project

# Moraine – Floor Plans - Basement



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.

# Moraine – Floor Plans – Level 1



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# 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





# Moraine – Construction Photos



# 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.

STRENGTH DESIGN FACTORS	SOUTHERN PINE	DOUGLAS FIR	SPRUCE-PINE-FIR	OTHER SPECIES
Modulus of Rupture (MOR)	0.82	1.00	0.95	0.82
Modulus of Elasticity (MOE)	0.87	1.00	0.94	0.87
Work to Maximum Load (WML)	0.72	0.93	0.90	0.72
Ultimate Tensile Strength (UTS)	0.99	1.00	0.98	0.98
Maximum Compressive Strength (MCS)	0.96	0.96	1.00	0.96
Ultimate Shear Strength (USS)	0.95	1.00	0.99	0.95
Fasteners/Connectors	0.90	0.90	0.90	0.90

Source: ICC-ESR 4244

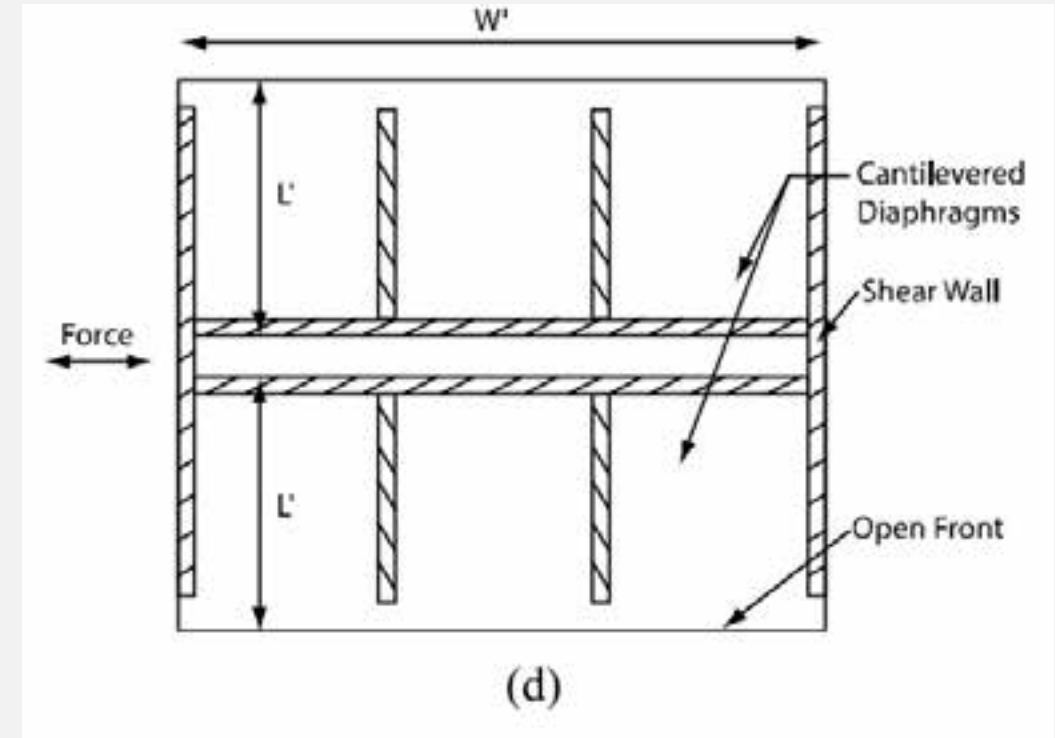
# Gravity System – Type IIIA Impacts

- 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.

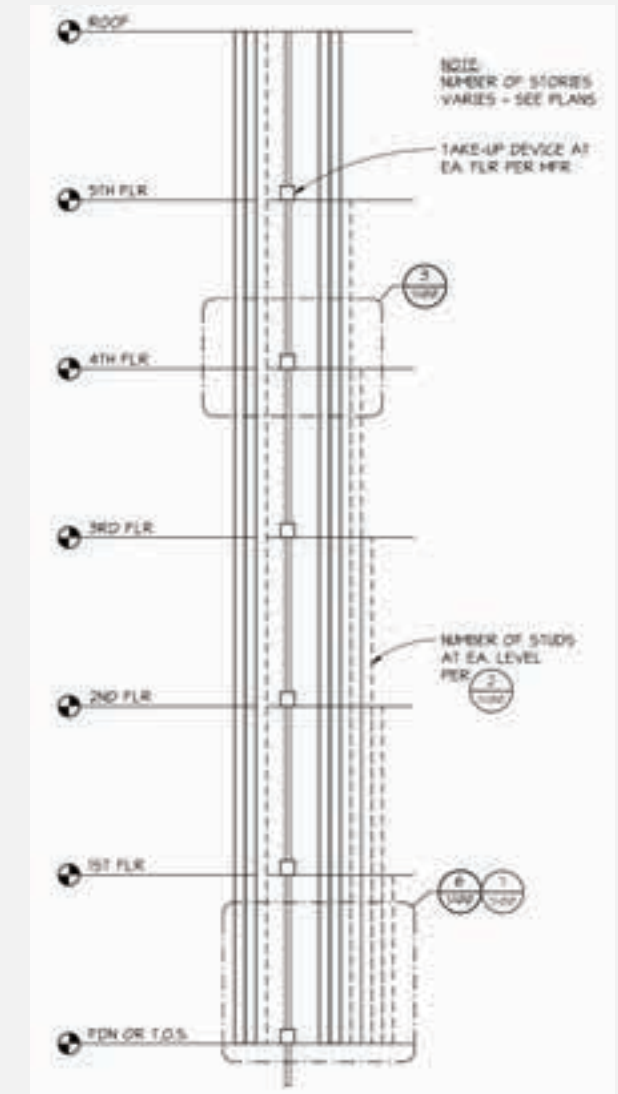


Source: AWC 2021 Special Design Provisions for Wind and Seismic

# 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.

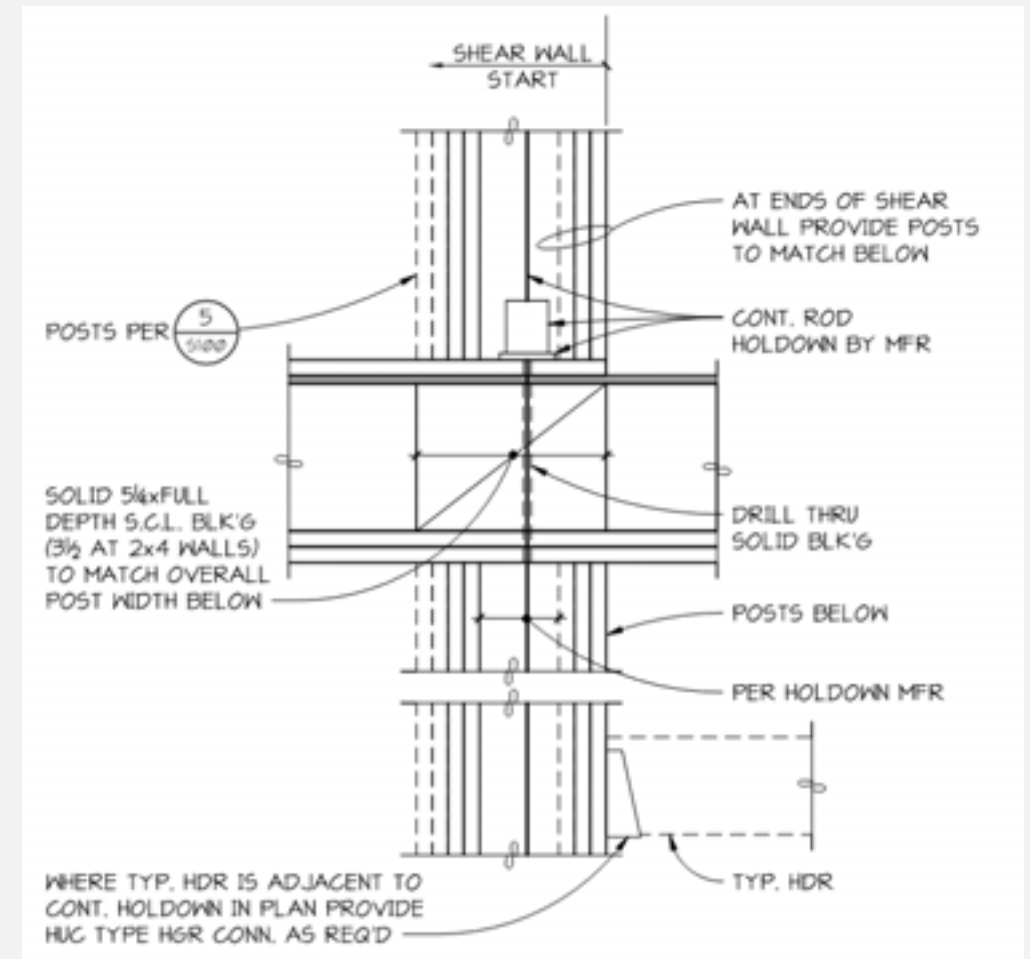
LEVEL	ROD DIAMETER AND GRADE	TENSION	STRETCH	NUMBER OF ADDITIONAL STUDS	
				2x4	2x6
6	-	-	-	-	-
5	-	-	-	-	-
4	-	-	-	-	-
3	-	-	-	-	-
2	-	-	-	-	-
1	-	-	-	-	-





# 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](mailto:adavis@pcs-structural.com)

Adam Hostetler - [adam@worksarchitecture.net](mailto:adam@worksarchitecture.net)

# Thank you!