# Is Wood-Frame Modular the Future of Multi-Family Construction?

## Structural Design:
## What's Different and What's the Same

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*Disclaimer: This presentation was developed by a third party and is not funded by WoodWorks or the Softwood Lumber Board.*

# Outline

1. Define what is volumetric modular construction
2. Discuss unique structural design considerations
3. Address the interface between site engineer and modular engineer
4. Clarify the delineation between Local and State jurisdictions, code review and inspections

# Project Examples

**Wood Modular** **Guerdon /** Pyatok

**Wood Modular** **Guerdon /** David Baker

**Wood Modular** **Champion /** Schematic Workshop

Wood Modular **Guerdon /** Lowney Architecture

**Steel Container** **CIMC /** HLW International

**Wood Modular** **ONE Build /** Hamilton Urban

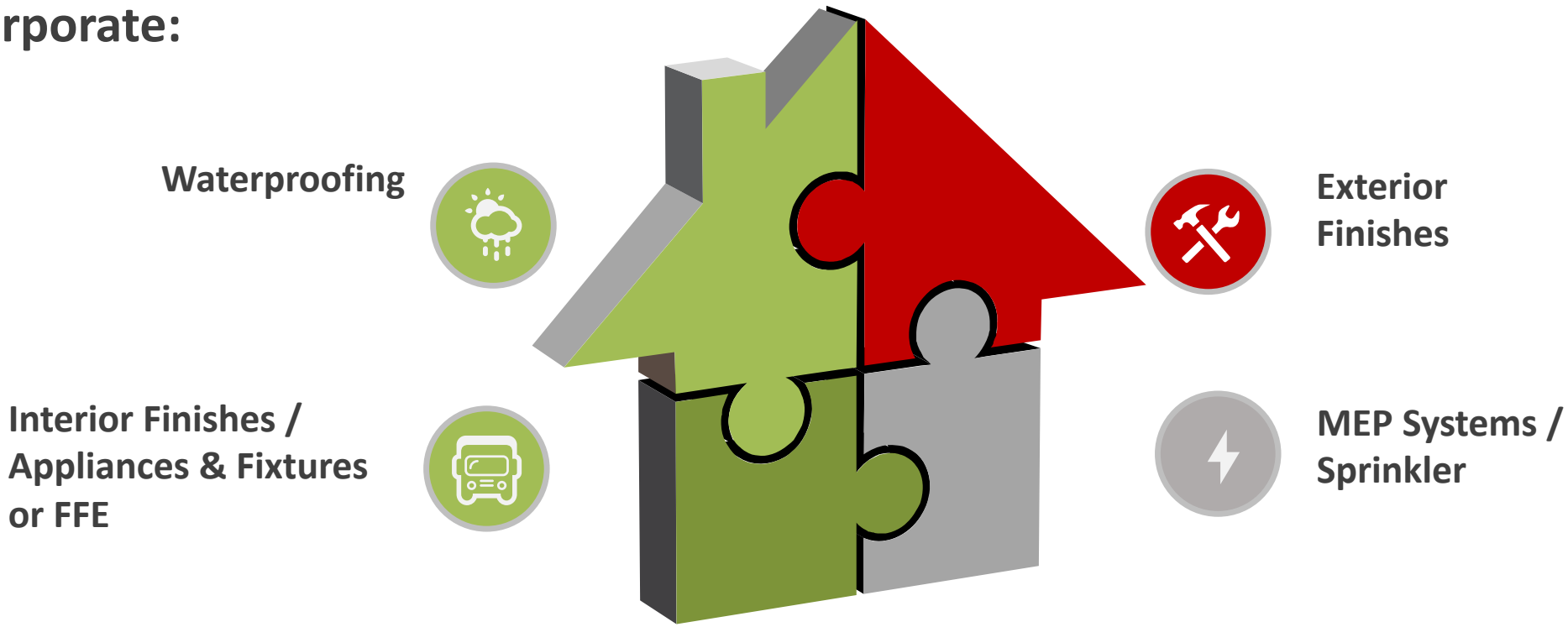
Wood Modular **Transform /** Driscoll Architects

**Steel Container** **CIMC /** Panoramic Interests

# Volumetric Wood Modular

## OFF-SITE FACTORY BUILT CONSTRUCTION

- More efficient building delivery & higher quality
- Designed & inspected to meet current IBC codes
- Can incorporate:



# Modular Vs Conventional I

**TIME**

**Reduces on-site construction duration by shifting work to the factory**

**QUALITY CONTROL**

**Factory conditions & repetitive task workers can provide better quality of construction and finishes**

**COST**

**Savings in accelerated construction schedule, site labor reductions & faster speed to market**

# Modular Vs Conventional II


**COMMUNITY**

**Off-site construction shortens neighborhood impact**

**TEAM COORDINATION**

**Early collaboration between designers and trades ensures better coordination of final product**

**ENVIRONMENT**

**Produces less waste, LEED® credits awarded**

# Structural Design

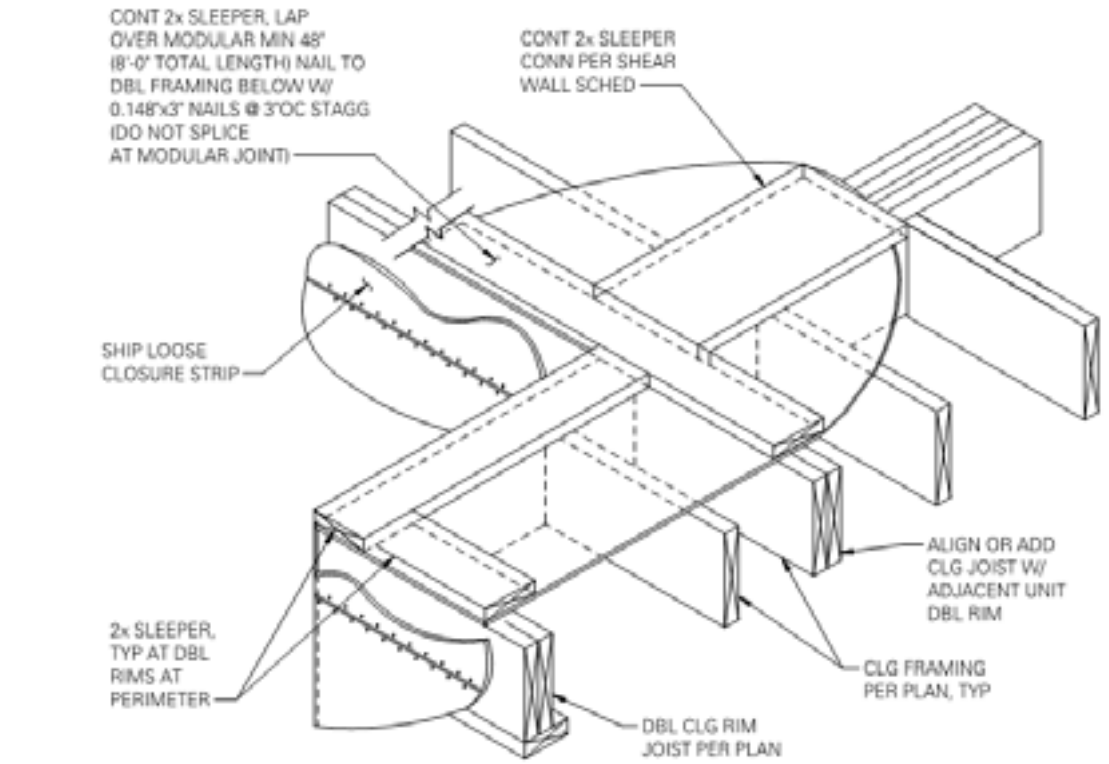
- **Same as site-built stick frame**
  - **Joists, beams, stud walls for gravity**
  - **Wood sheathed diaphragms and shear walls for lateral**
- **The difference is access and timing**
- **Design within building code to avoid alternate means and methods**

# Gravity Design

- **Double assembly**
- **Design for conservative repetition**
- **Continuous engineered lumber floor rim joists**
  - **Act as beams in the final condition**
  - **Provides stability during transport/install**

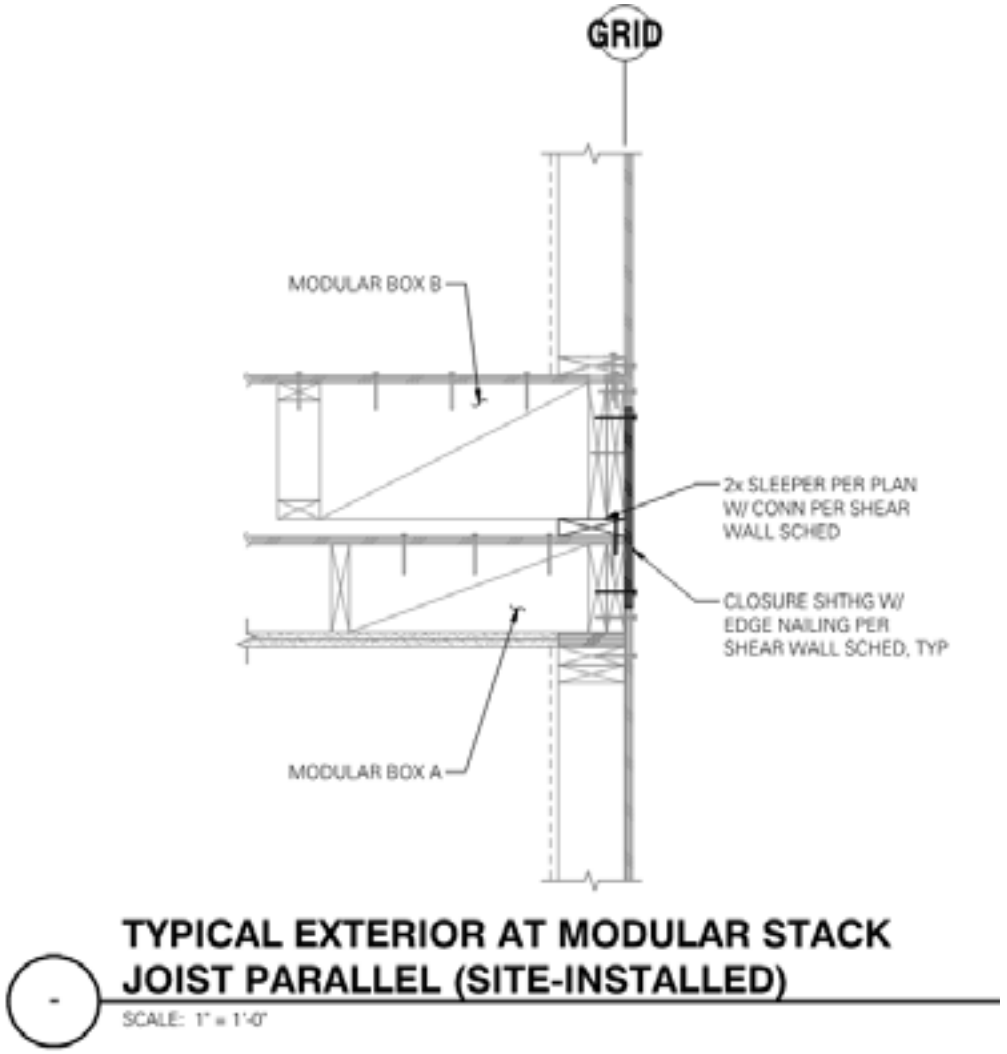
# Lateral Design I

- Similar to site-built stick frame
  - More focus on access
- Continuous diaphragm at ceiling sheathing
- Chords and collectors
  - Factory aligned framing
  - 2x sleepers and metal straps



# Lateral Design II

- Corridor left unfinished
- “Belly bands” or “stitch sheathing”
- Hold downs where accessible
- Coordination with crane set sequence
  - Shear Connections
  - Hold downs



# Mechanical Electrical Plumbing

**FACTORY INSTALLED MEP ROUTES**

**Corridor** left unfinished for access

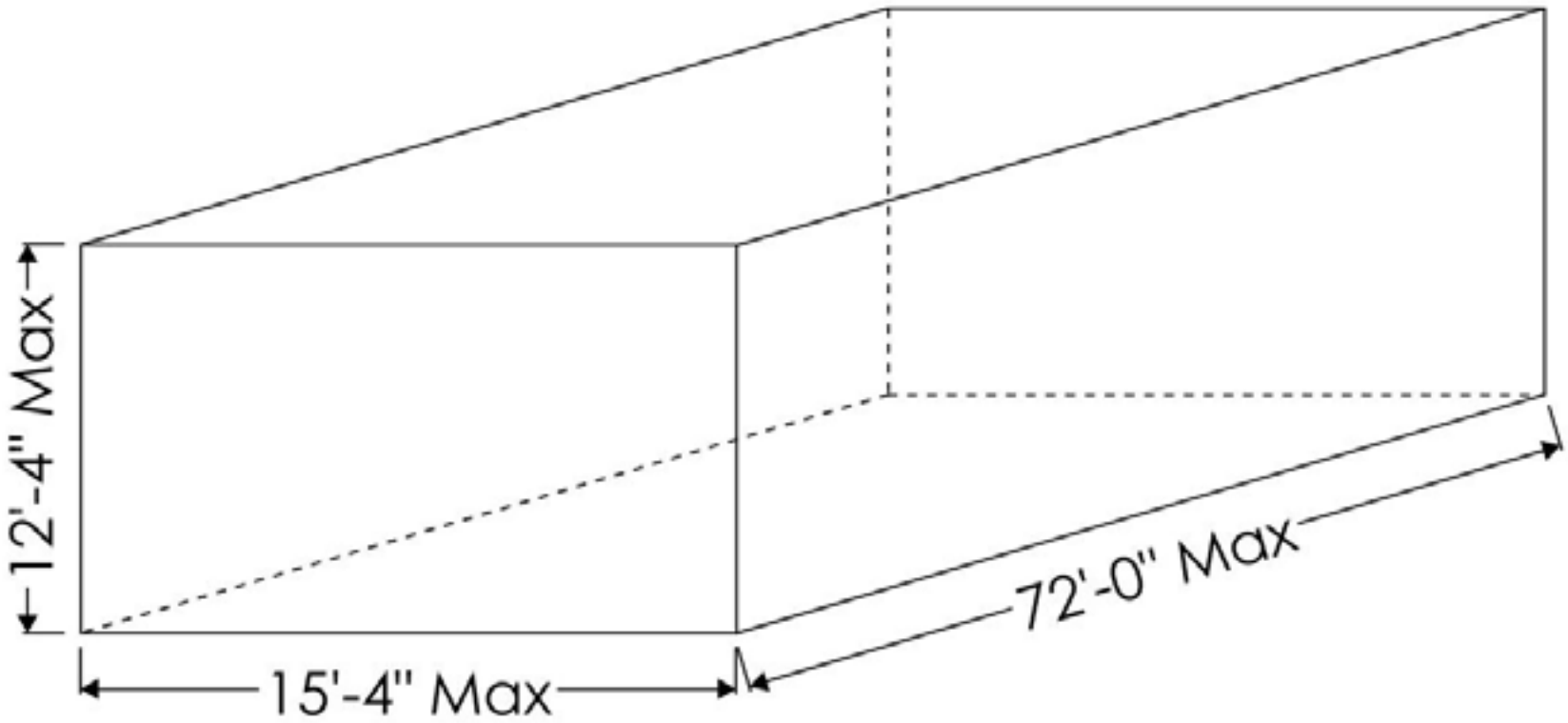
**KITCHENS & BATHROOMS**

**Located adjacent** to corridor

**SITE CONNECTIONS**

**Hookups** made in corridor

# Modular Shipping Parameters

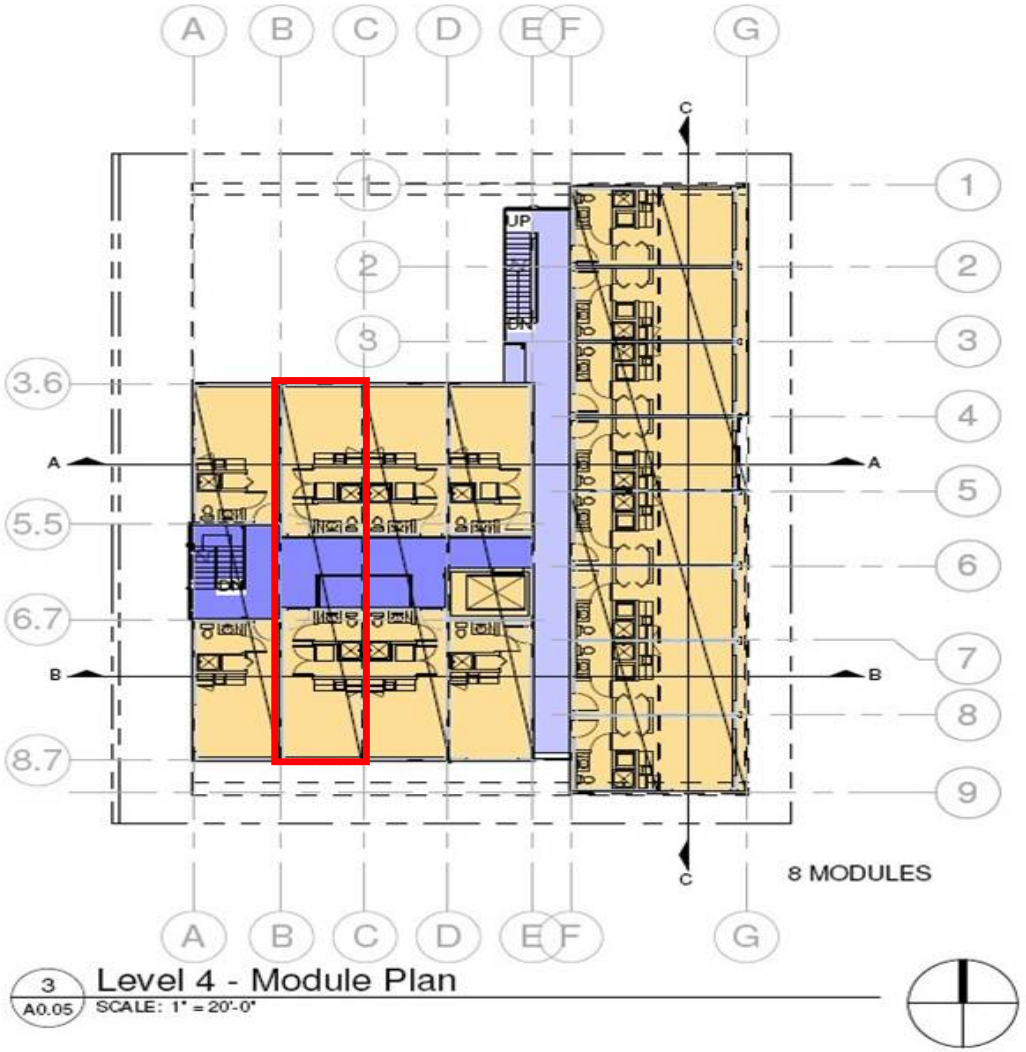


# Layout Configuration I

**BARBELL CONFIGURATION –**

**MOST EFFICIENT**

- **Units must align across the corridor**
- **Provides workforce access during construction**
- **Openings can be provided between modules (pass throughs)**

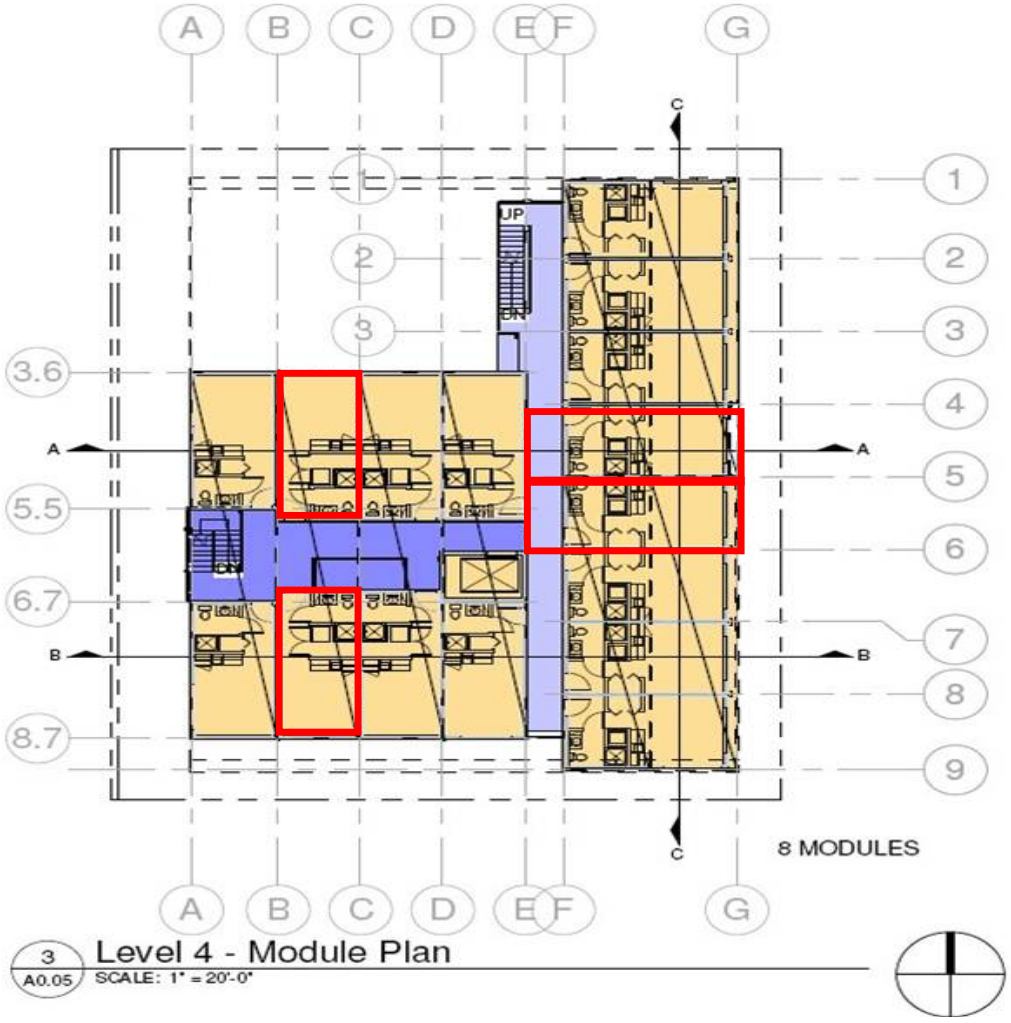


# Layout Configuration II

**SAW BOX CONFIGURATION –**

**LESS EFFICIENT**

- **Units do not have to align across corridor**
- **Still include corridor**
- **Typically used at building turns**
- **Solve limited crane maneuverability**
- **Openings can be provided between modules (pass throughs)**

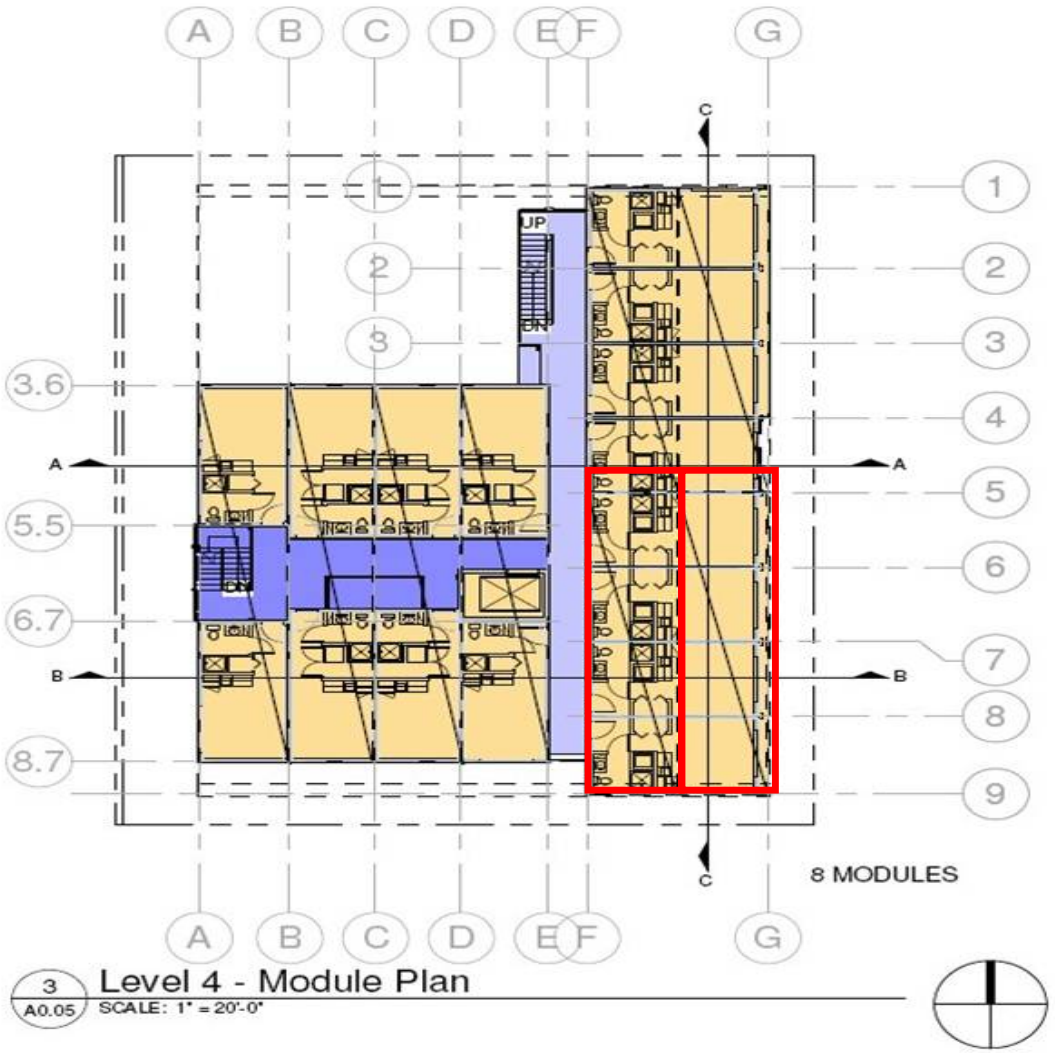


# Layout Configuration III

**CROSS CUT CONFIGURATION –**

**LEAST EFFICIENT**

- Reduce total number of modules
- Most finish work on-site
- Site installed corridors
- No natural vibration breaks
- Requires more extensive MEP coordination



# Design for Delivery

## TRANSPORTATION

- 72’ Module on 60’ truck bed
- Means and methods

## INSTALLATION

- Continuous floor rims
- Irregular shape
- Lift from the bottom

# Urban Site Challenges

- **Crane access and swing**
- **Temporary mod storage**
- **Space for Staging**
- **Transportation logistics**
- **Zoning height and site width considerations due to double framing assembly**

# Permitting Approach – Dual Jurisdictions

## STATE JURISDICTION

- Code Review: Modular Portions
  - Built/installed in factory
  - On-site connections (load path)
  - Components connected to the modular structure
- Inspections: Modular Portions
  - Built/Installed in Factory
  - Third party in the factory

## LOCAL JURISDICTION

- Code Review: Site-Built Portions
  - Fully site-built (e.g. foundations, concrete podium, etc)
- Inspections: Site-Built and Site-installed Modular Portions
  - Modular portions inspected based on State approved drawings
  - Local AHJ or third party

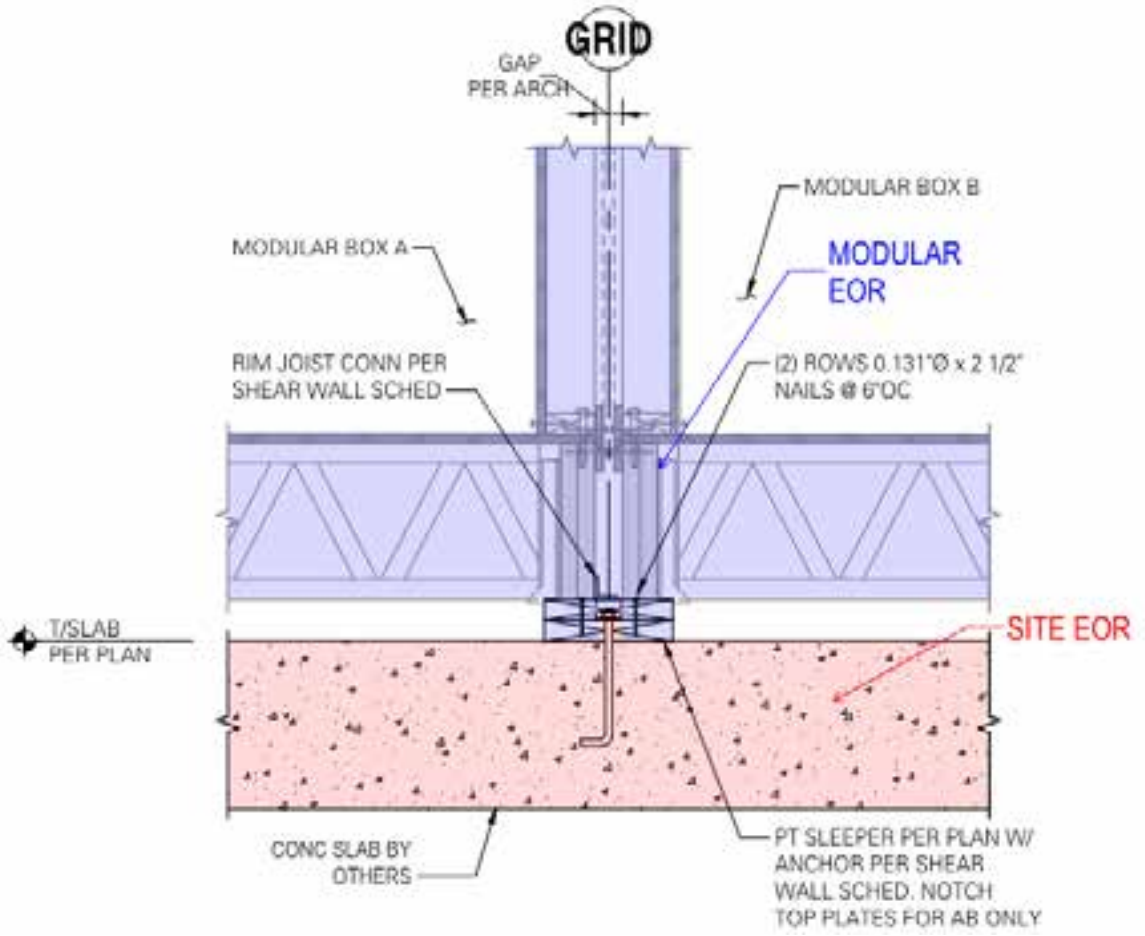
# Modular Engineer of Record

## SITE EOR RESPONSIBILITIES

- Supporting structure
- Simple scope delineation
- Local Permit

## MODULAR EOR RESPONSIBILITIES

- Factory-built portion
- Provide building loads to Site EOR
- State Permit



# California Specific Permitting

- **California State Jurisdiction**
  - **California Department of Housing and Community Development (HCD)**
  - **Maintains a handbook to educate local AHJs, builders and general public**
    - **HCD FBH 314**
- **Recommended pre-app meeting with local jurisdiction**
- **Resume of work (highly recommended)**

***HCD = California Department of Housing and Community Development
***LAHJ = Local Authority Having Jurisdiction
***FD = Fire Department

| Discipline/Description | Plan Review | | | Inspections | | | Comments |
|---|---|---|---|---|---|---|---|
| | HCD | LAHJ | FD | HCD | LAHJ | FD | |
| **Structural** | | | | | | | |
| Podium Slab | | X | | | X | | Including embedded elements that modular units will attach to (embeds, anchors, etc) |
| All construciton below poduim slab | | X | | | X | | |
| Factory-Built (FB) Portions (Modules) | X | | | X | | | |
| Interconnections between modules | X | | | | X | | Including hold downs and their connections to the embedded podium elements |
| Site-built elements in the FB Portion | x | | | | x | | e.g. partial corridor framing, parapets and parapet braces, misc framing where indicated |
| Site-installed wood shear wall components | x | | | | x | | e.g. corridor sheathing, ATS rods and hardware, where indicated |

# QUESTIONS?

This concludes The American Institute of Architects Continuing Education Systems Course

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