Factory Built Hotels:

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

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Questions related to specific materials, methods, and services will be addressed at the conclusion of this presentation.

Course Description

- The benefits often cited for modular construction—including speed, reliability of workforce and quality control—are among the reasons one global hotel brand recently announced an initiative to increase the use of modular approaches for its U.S. hotels.
- In this presentation, an architect who has worked on several of these hotels, will explore the distinct aspects of modular hotel design, the reasons for using wood, and current trends in multi-family buildings and beyond.
- Discussion will emphasize opportunities to fully realize the benefits of modular construction by understanding of the unique design considerations and constraints, including manufacturing capabilities, trucking logistics, and third-party in-plant inspections.

Learning Objectives:

- Highlight the potential benefits associated with the use of modular construction in hotels and multi-family buildings.
- Discuss unique design considerations for modular projects including room layouts, spans, fire-resistance and acoustic performance.
- Review the construction process of modular hotels, including foundations, delivery logistics, worker safety, and building inspections.
- Explore the potential for the increased use of modular approaches in wood-frame construction.

Modular Experience:

- Marriott
- Hilton
- Hyatt
- Apartments
- Senior Housing
- Affordable Housing
- Retail

Presentation Outline:

- General Design Considerations
- The Details
- Permits and Inspections
- Case Study
- Benefits of Modular Construction
- Lessons Learned
- Other Modular Examples
- Questions

You have to ask yourself, is my project right for modular construction?

GENERAL DESIGN CONSIDERATIONS:

Maximum transportable width / height, per state

Double walls and floor / ceilings need to be accounted for

Utilities run to corridor walls

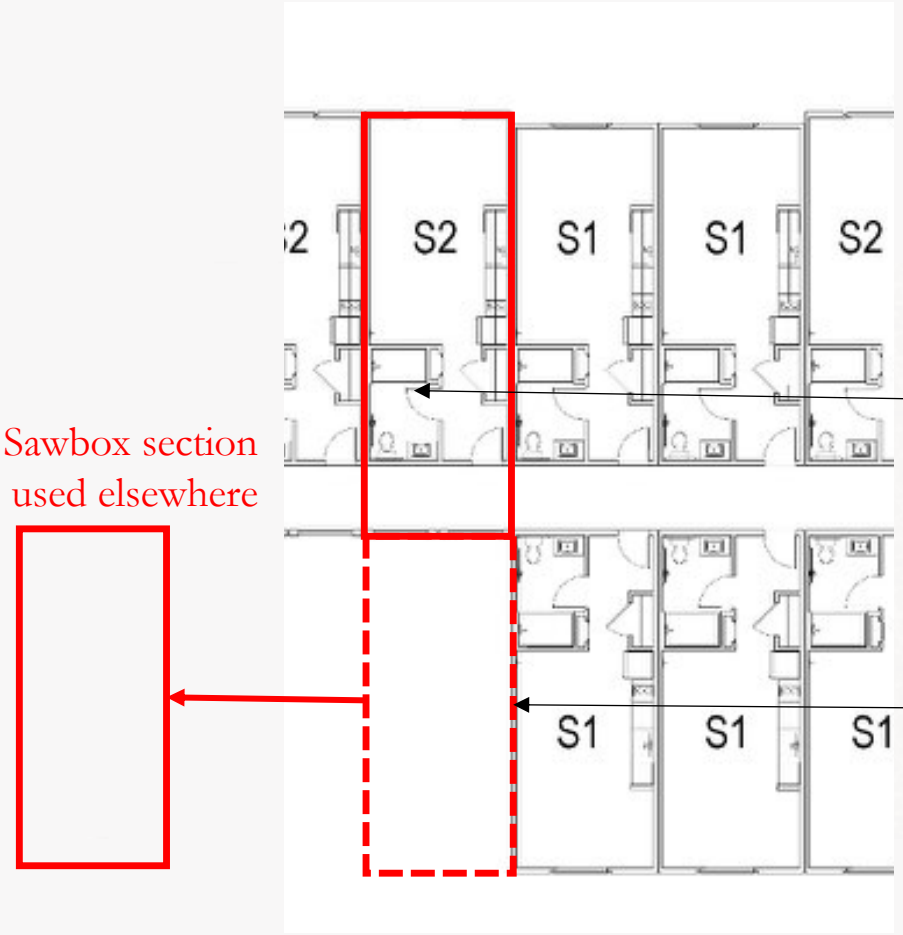
Demising walls need to align, and be continuous with site built spaces below, or you need beams

Variations in tolerances from stacking

Modules can cantilever over lower levels, understand the limits

Limits on openings between Modules

Design Parameters



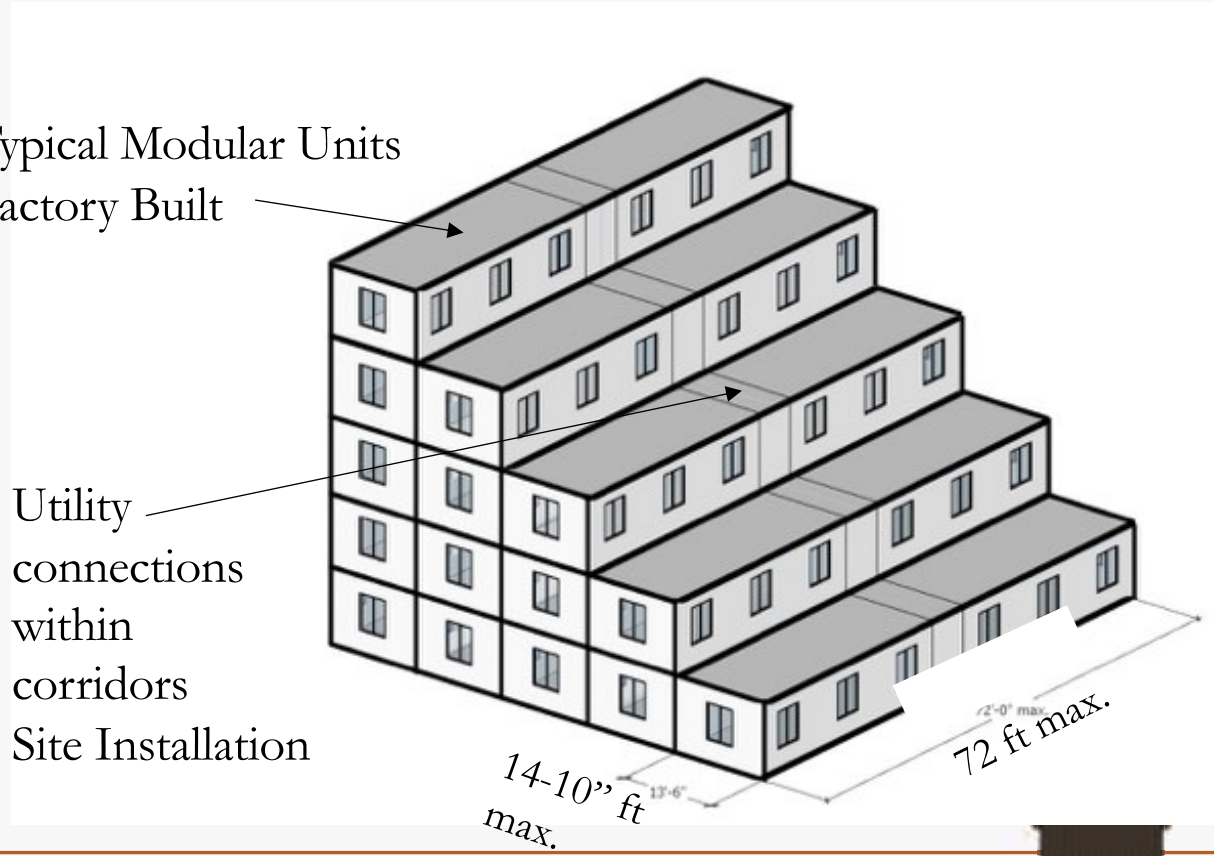
- Ideal sf per module 800sf to 1,000sf
- Height:
  - Overall module height: 12’-4”
  - Ceiling Assembly is typically 12”
  - Floor Assembly is typically 12”
- Length: Less than 72’-0”
- Width:
  - 11’-6” min.
  - 14’-10” max. recommended *
- Use Sawboxes for shorter modules

Modular Construction

Up to 4 stories: Type V Construction

5-stories: Type III Construction,

Modular on Podium, up to 7 stories and 85': Type I podium and Type III Modules



Site Installation Scope

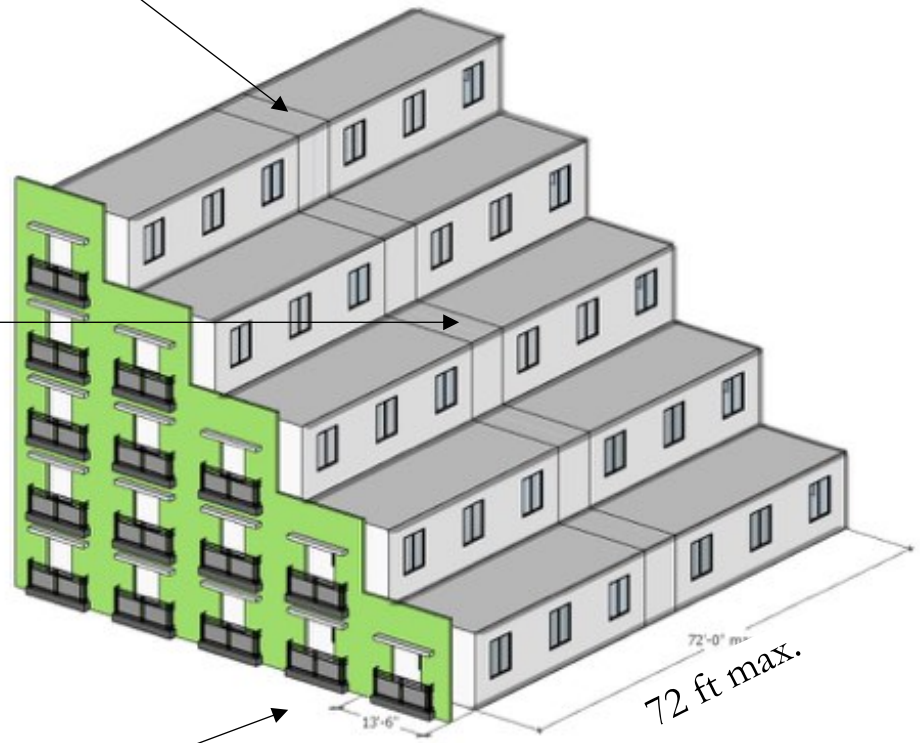
Typical Modular Units
Factory Built

Utility connections within corridors

Site Installation

Exterior Skin
Balconies
Awnings

Site Installation



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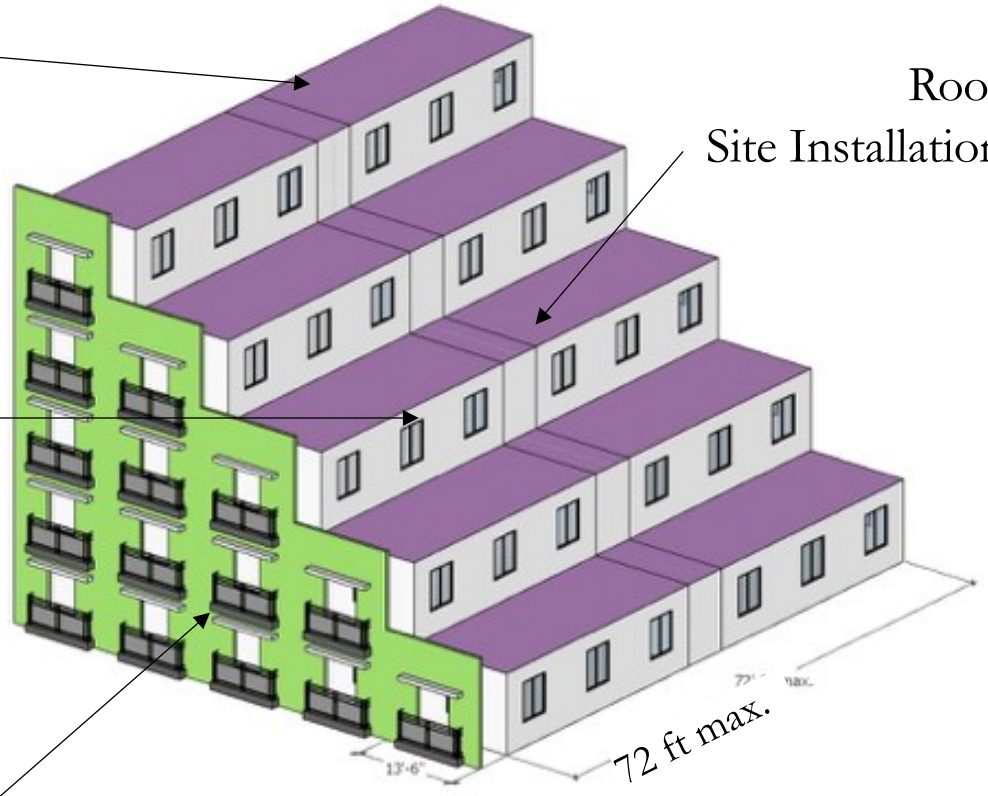
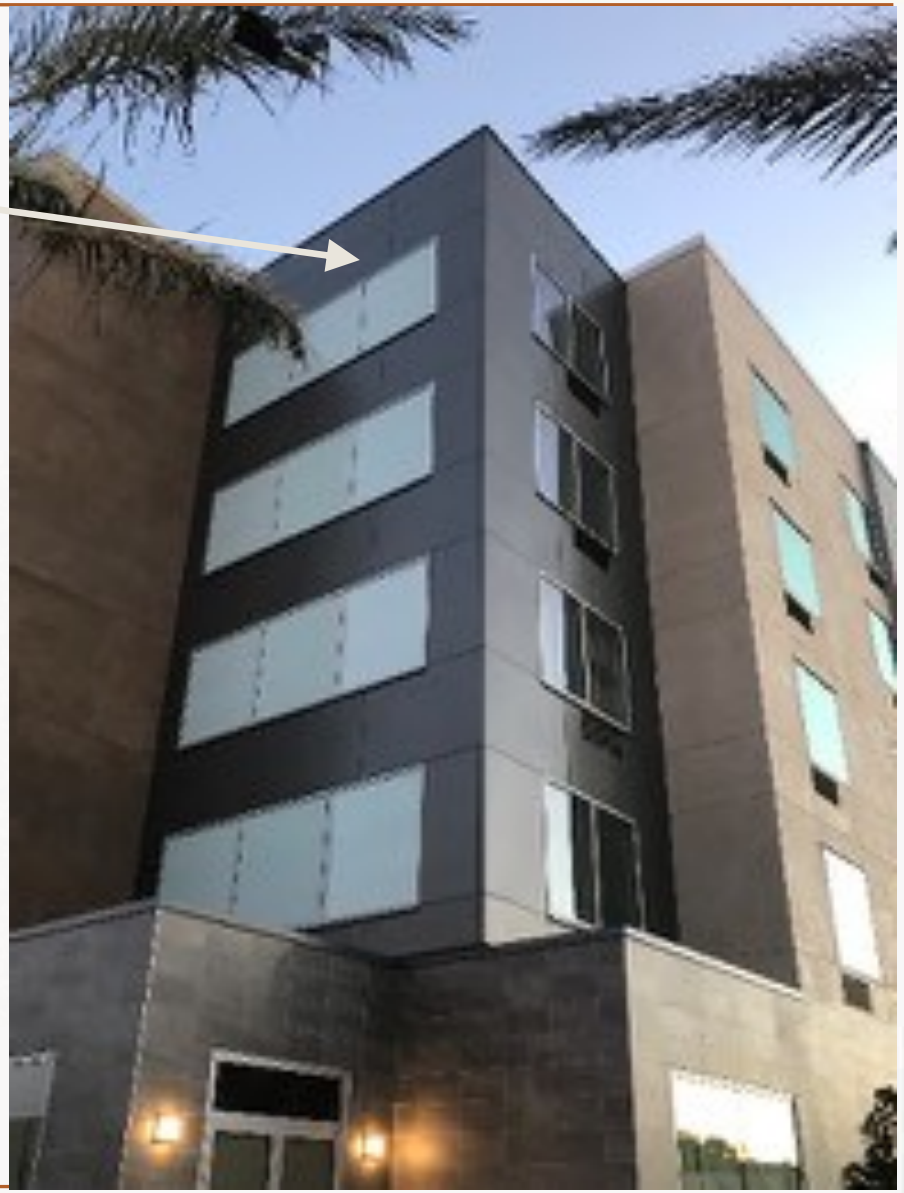
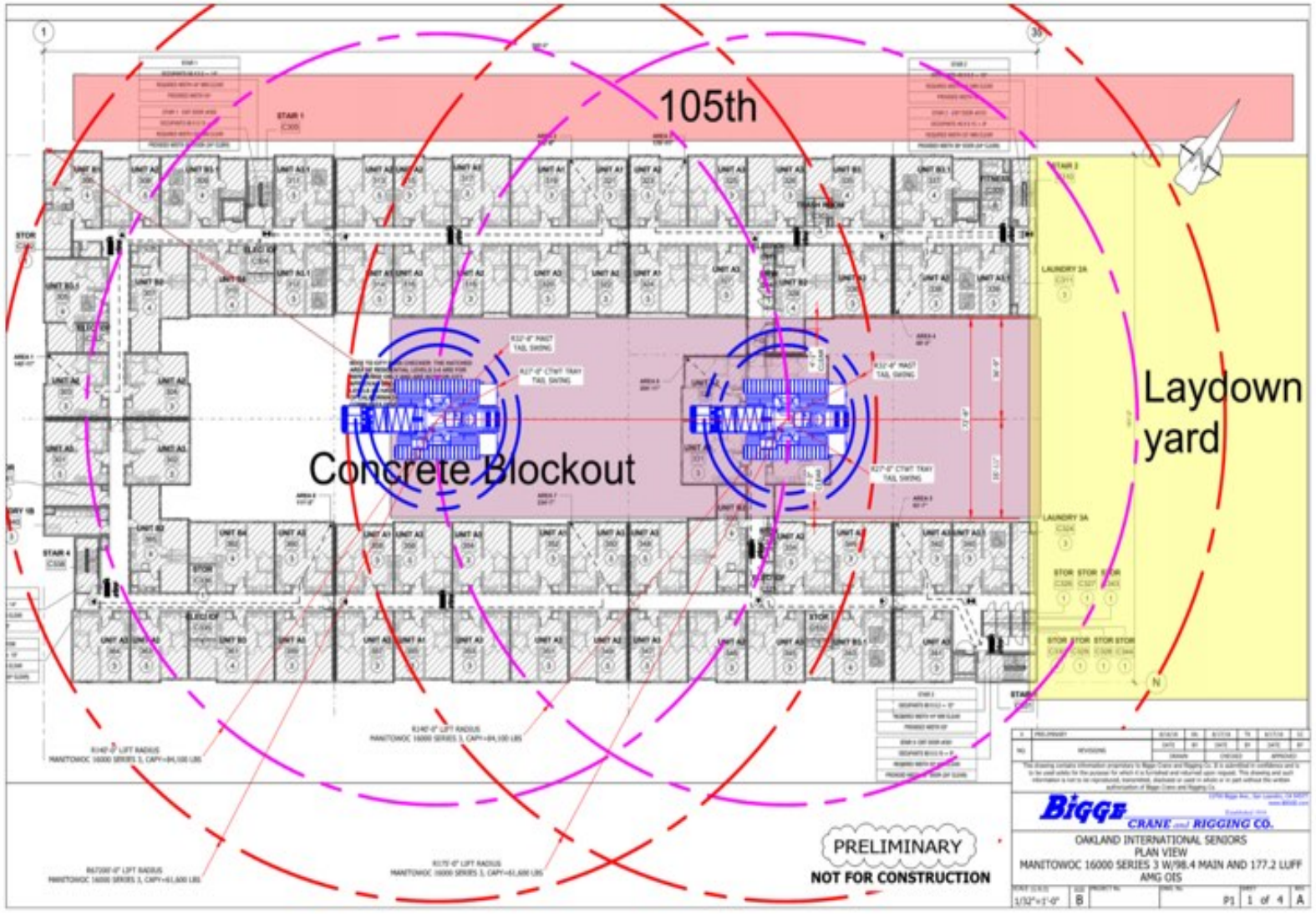


Sawbox Element

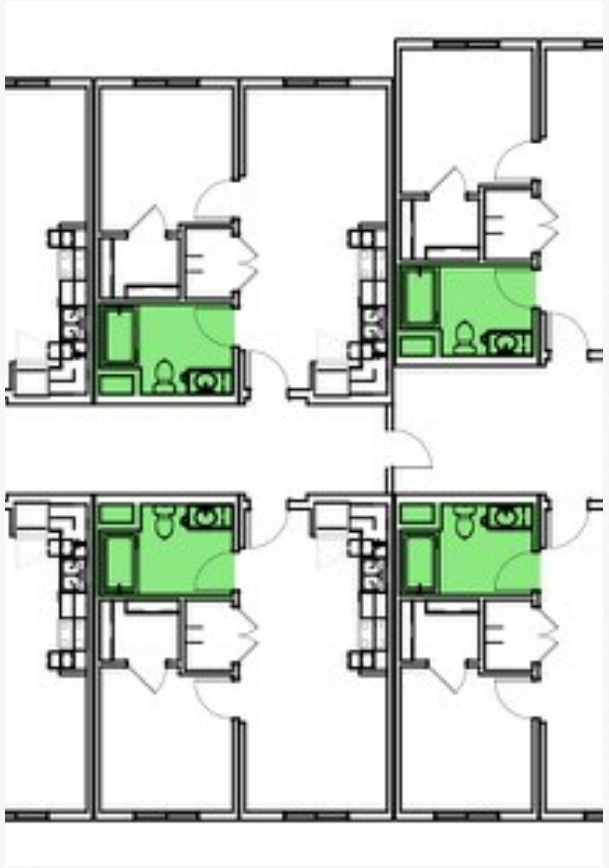
Roof
Site Installation





Crane location and laydown yard

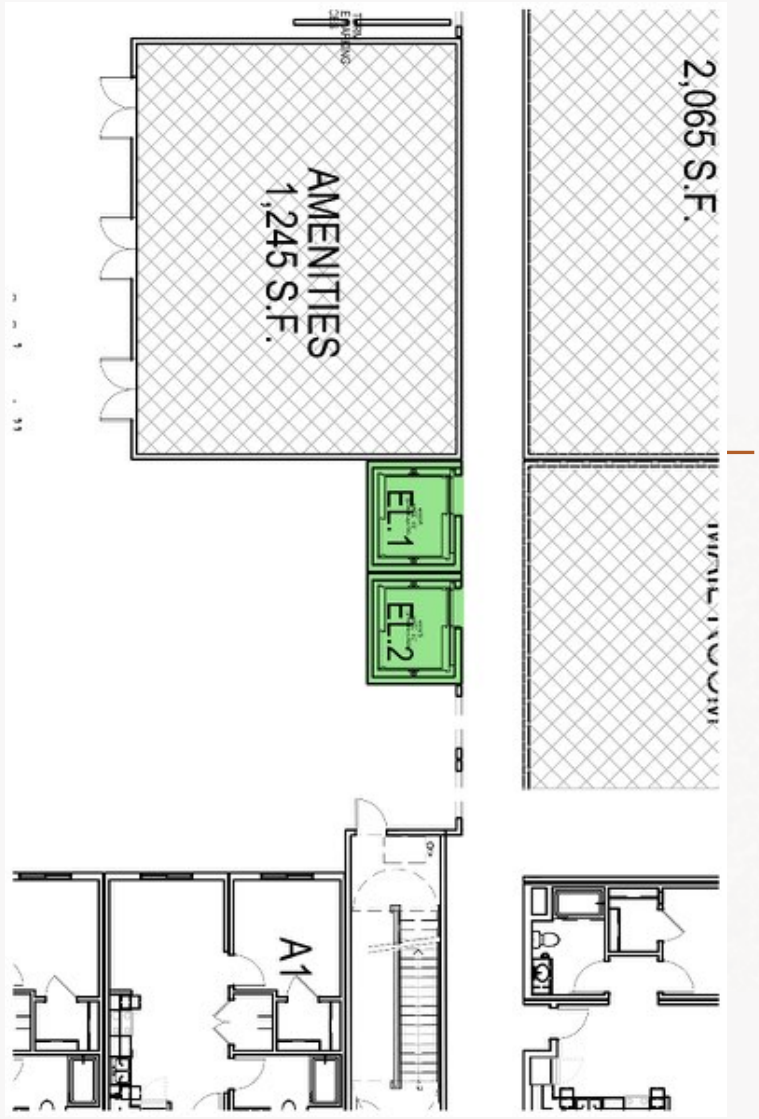
- Typically layout down space is required off site and should be arranged early in the process.
- Crane location during stacking has to be carefully coordinated with the structural engineer and will move to cover building footprint.
- If podium construction, must leave concrete block outs for crane locations.



Other modular components

Bathroom Pods

- Factory built bathroom pods.
- Standardized bathroom layouts.
- Width less than 7’-10” overall for shipping.
- Plumbing stacks are pre-installed in the void space between the pod and the corridor wall.

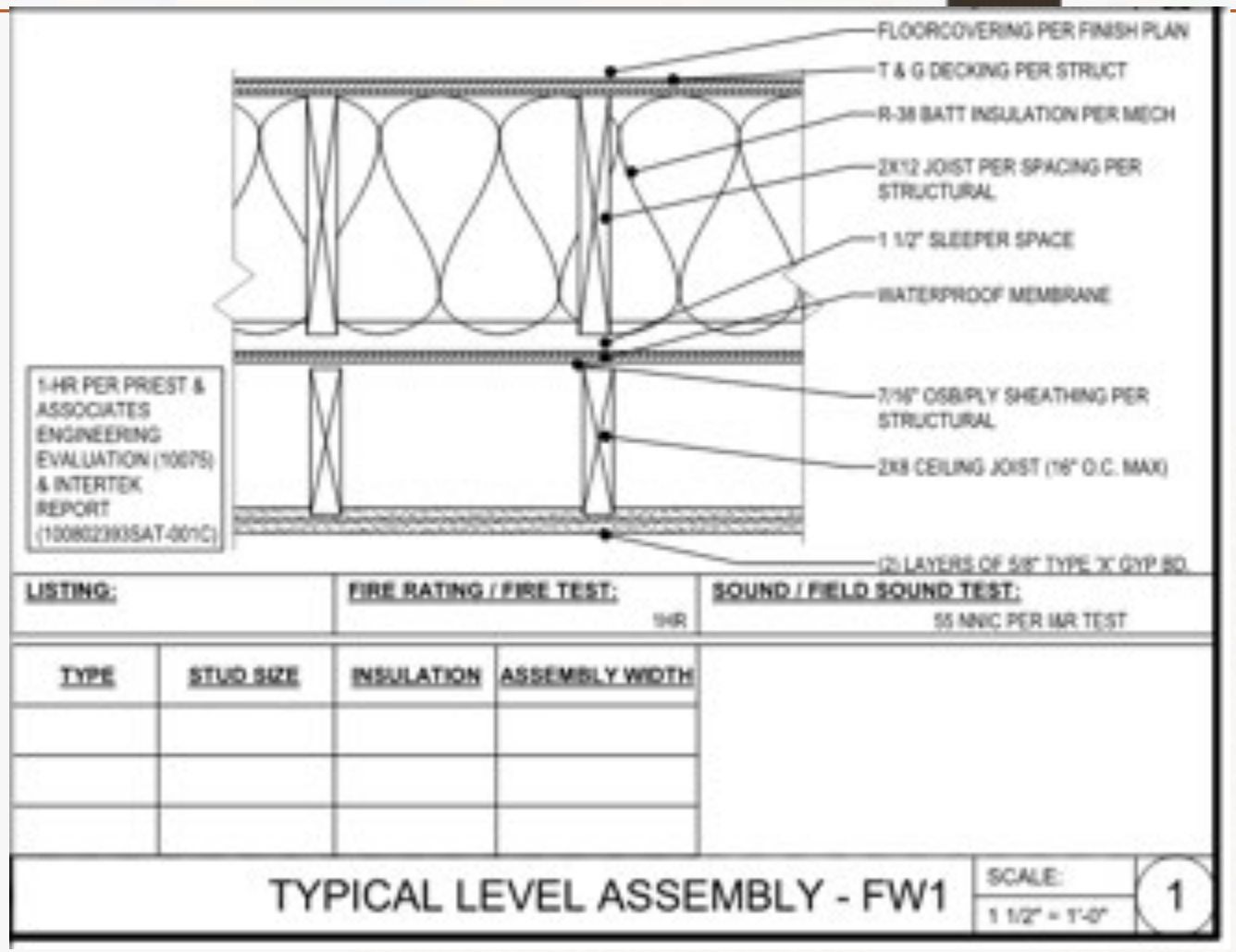


Modular elevators

- Modular Elevators are factory, built self contained assemblies. The fire-rated shaft contains the elevator cab, rails, and drive system. They are fully wired and ready for final hookup, testing and adjusting.
- The elevator and shaft assembly arrives on-site and is craned into place. With power connected, the elevator will be fully functional and ready for inspection in less than one week.
- Modular elevators replace temporary construction elevators

The Details!

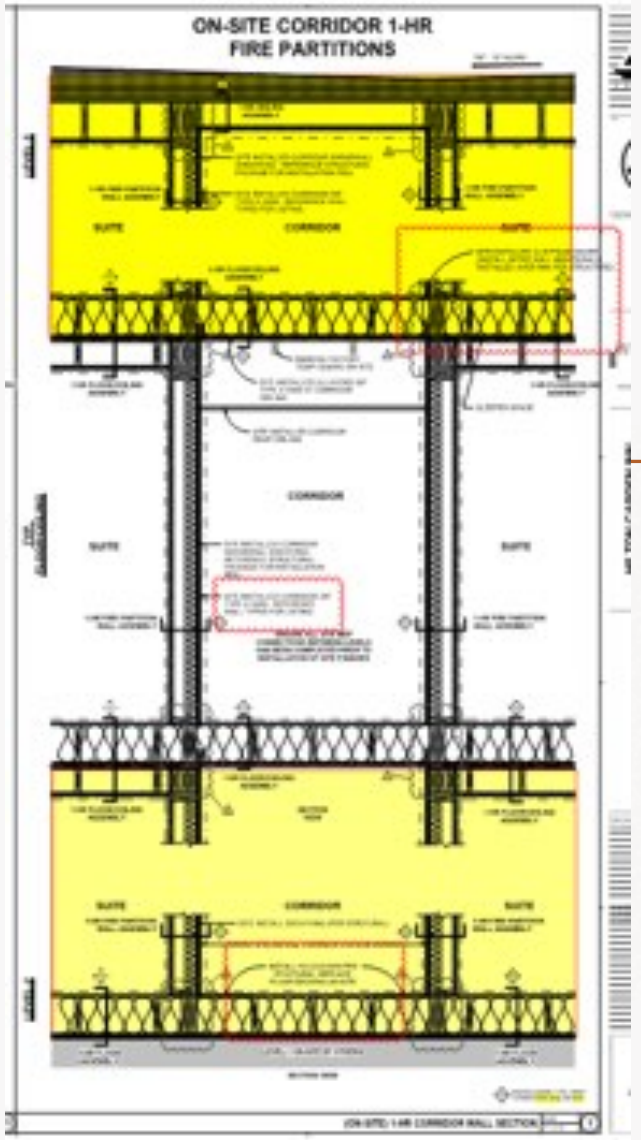
- Typical Sections
- Horizontal Fire Separations
- Vertical Fire Wall
- Shaft Walls
- Corridor Walls
- Exterior Walls

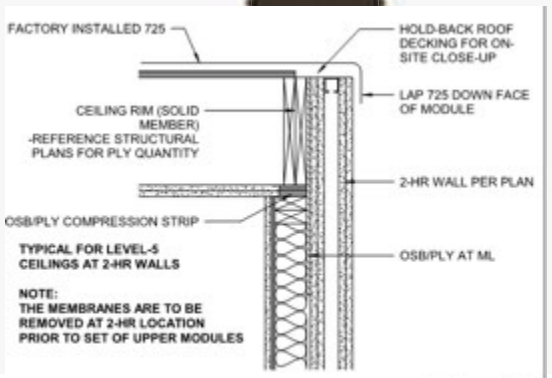


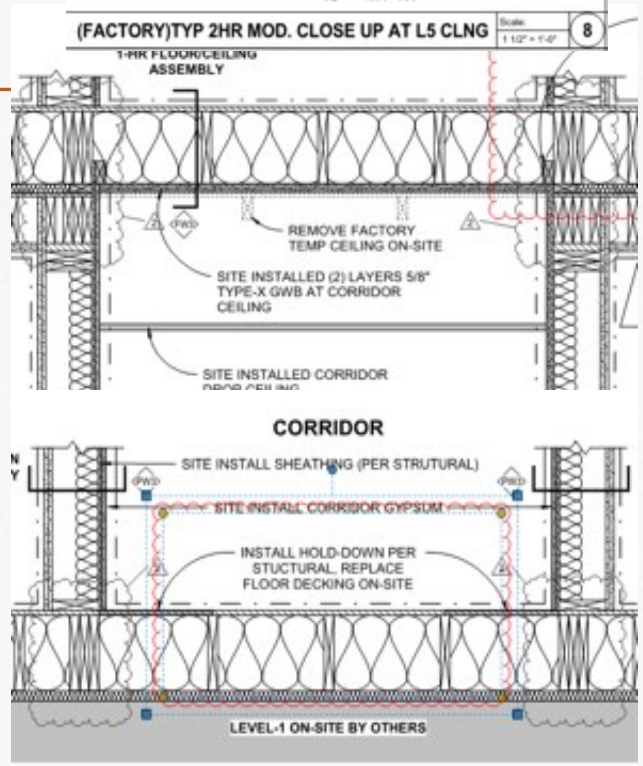
TYPICAL MODULE TO MODULE FLOOR CILING ASSEMBLY

Fire Ratings, and continuity among modular

- Typical floor ceiling assembly between modules
- Fire rating reports
- Acoustic testing reports
- Waterproofing for transport and installation to protect rooms from water damage







Fire Ratings, and continuity among modulars

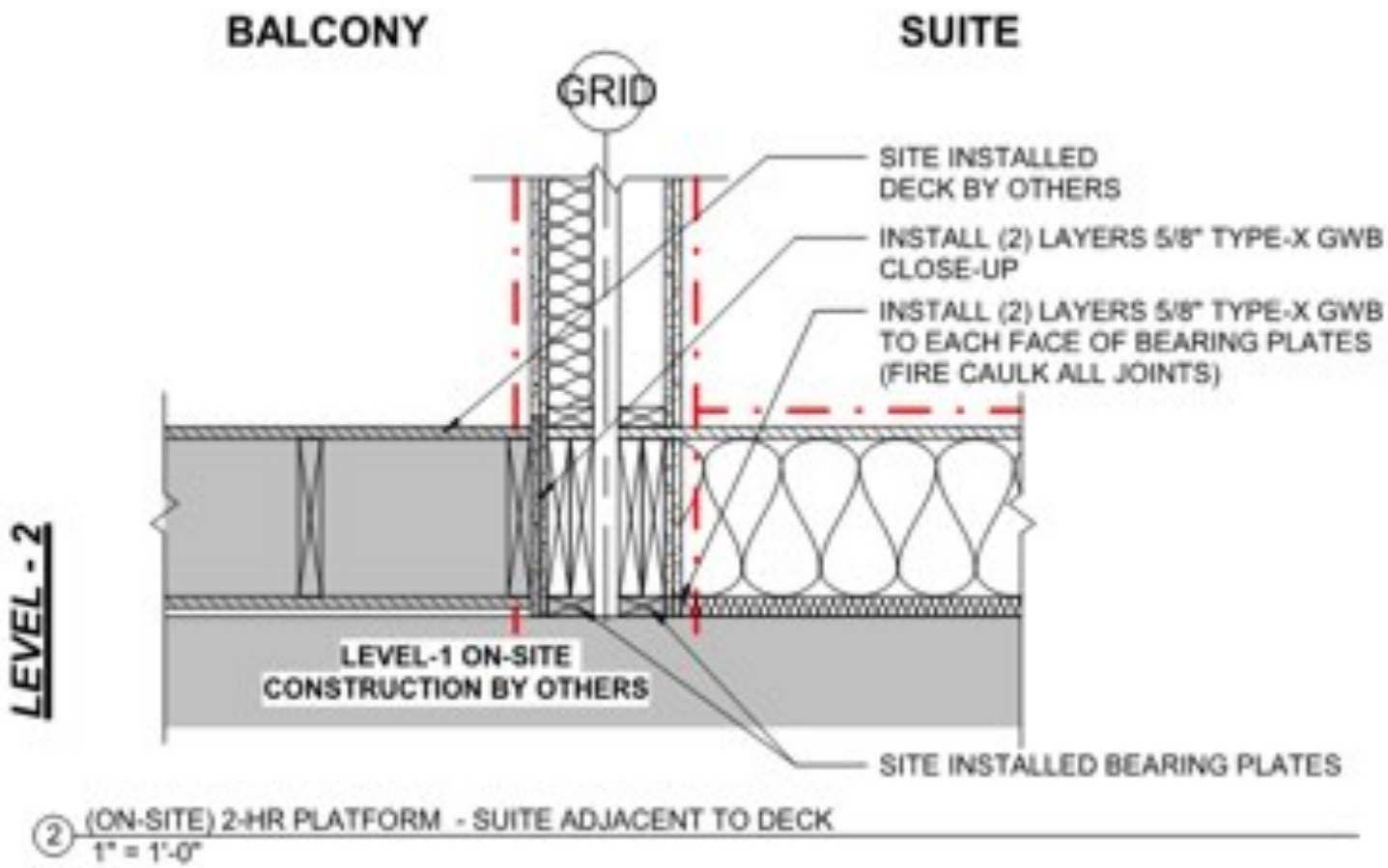
Interface between site and factory scope of work

Openings for hold down installation

Blocking for field installed ceilings

Remove factory installed ceilings

Remove Factory installed waterproof membrane



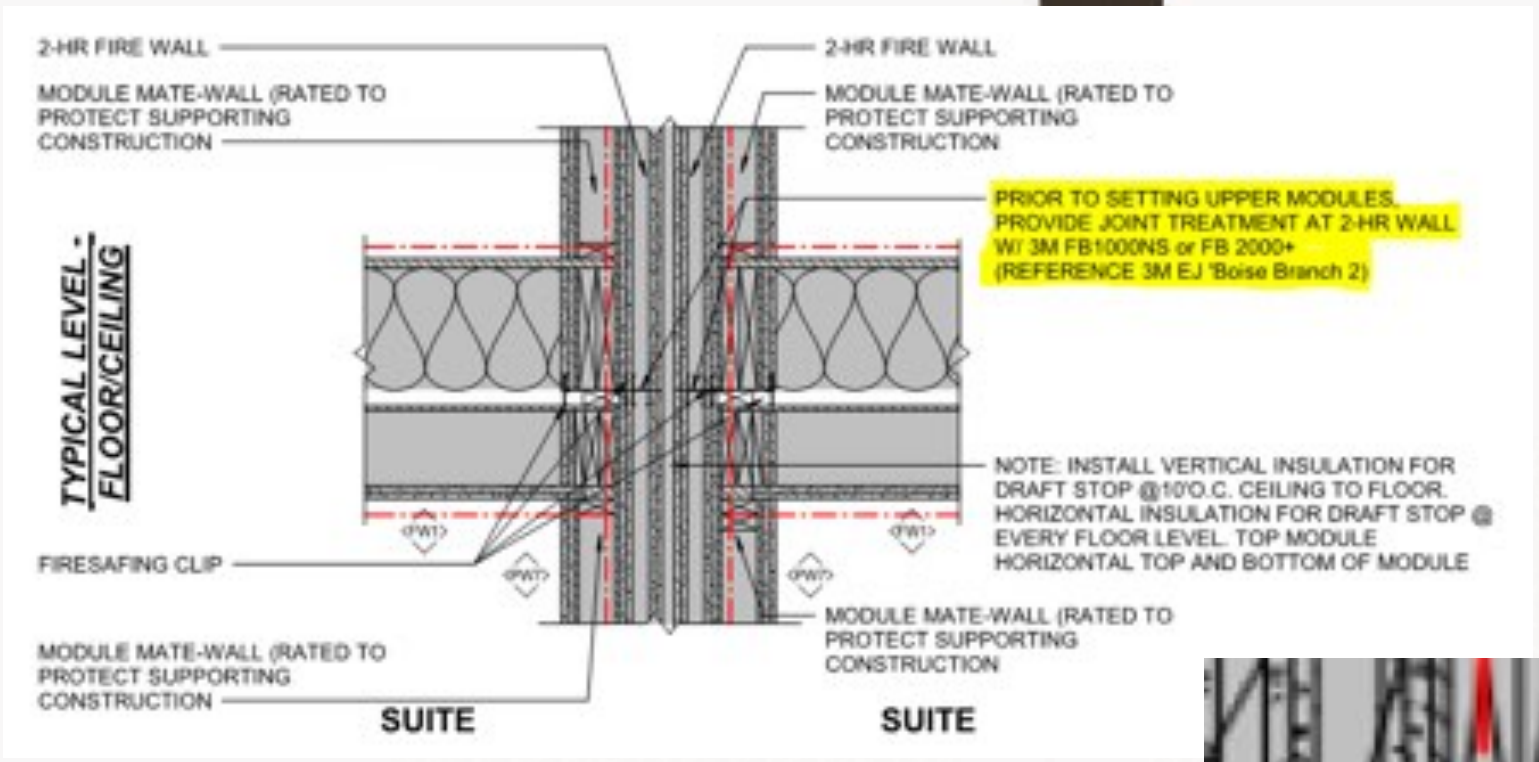
TYPICAL MODULE ON CONCRETE PODIUM CONNECTION AT EXTERIOR BALCONY

Fire Ratings, and continuity among modulars

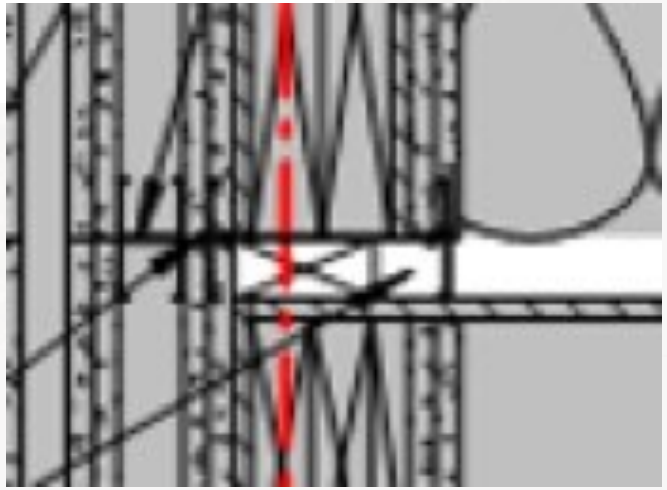
- Vertical Fire Walls
- Exterior 2 hour bearing walls
- Modular unit set on concrete podium
- Differentiate site work verse factory work
- Show site work required to make fire rating continuous.
- Fire rated caulk is your friend

Fire Ratings, and continuity among modulars

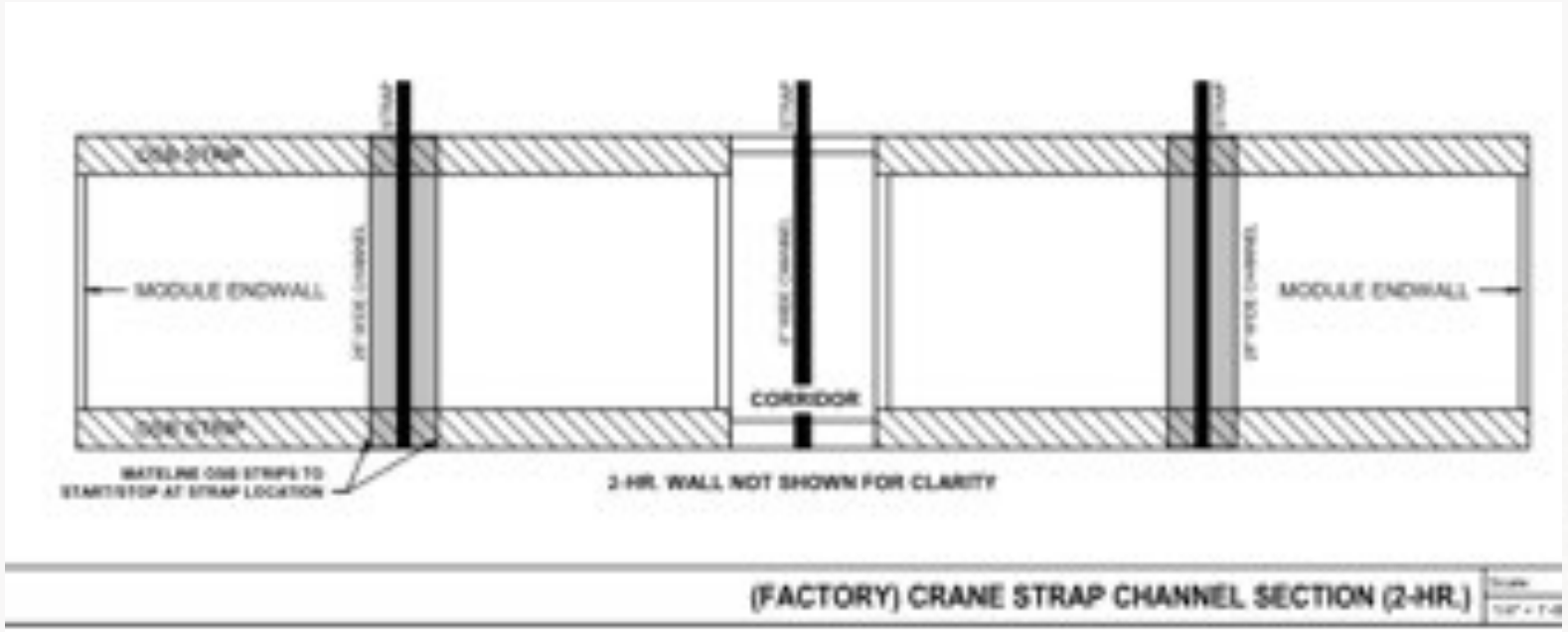
Vertical Fire Walls
Horizontal Fire Separations
Shaft Walls
Corridor Walls
Exterior Walls



TYPICAL MODULE ON MODULE CONNECTION AT 2 HOUR FIRE WALL



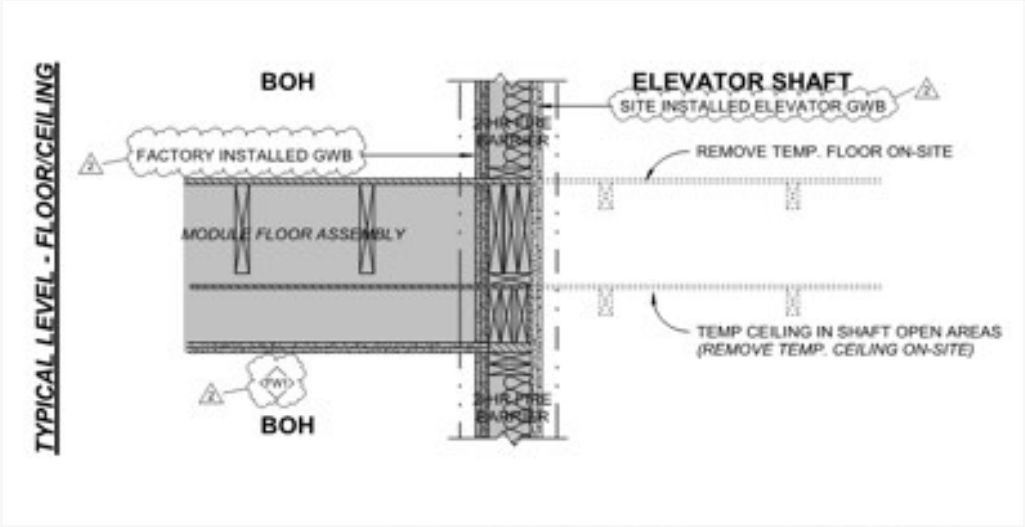
Fire Ratings, and continuity among modulars

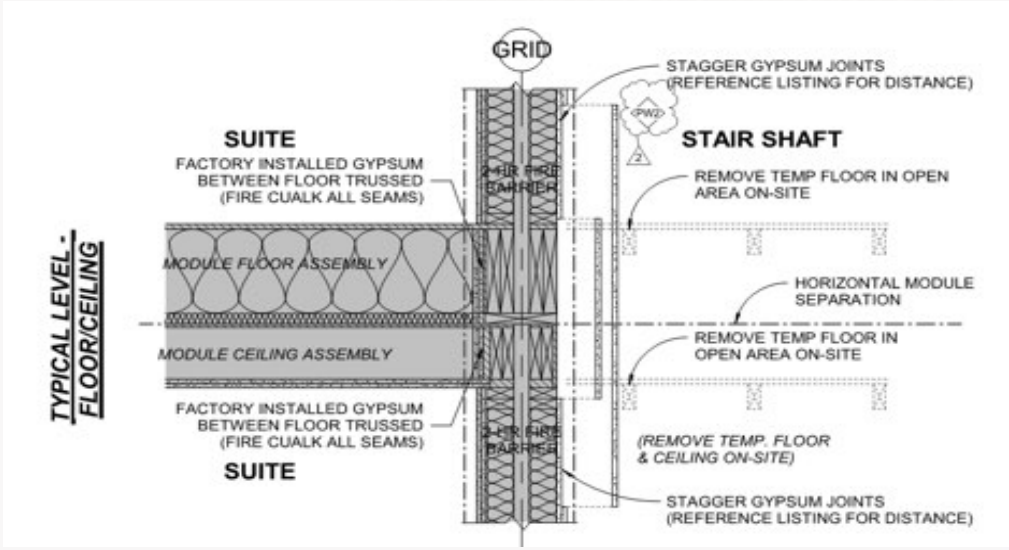


2 hour fire walls

Special consideration for crane straps at factory built 2 hour walls

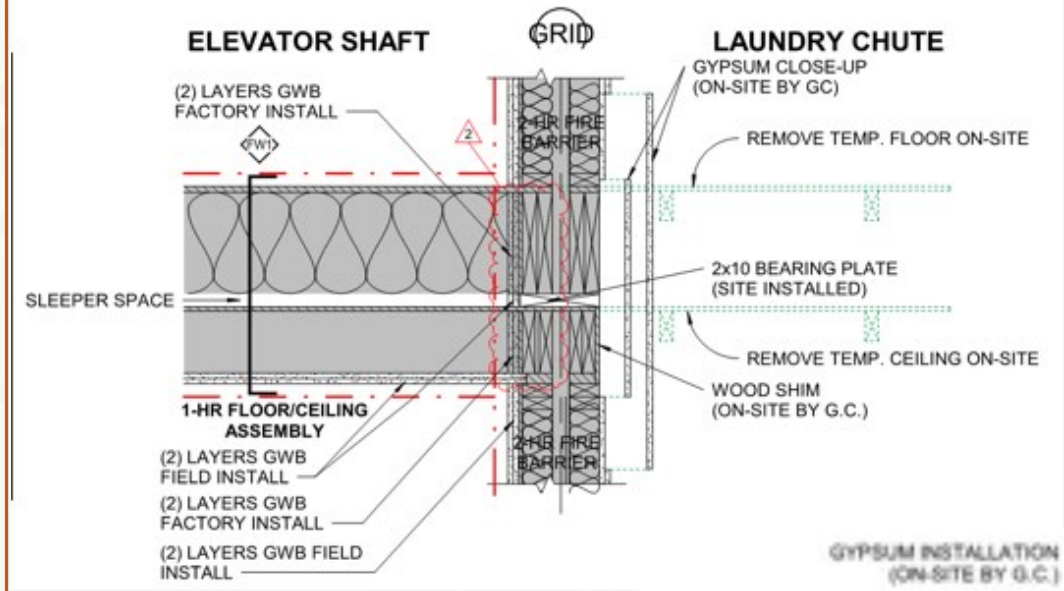
Consider impact of 2 hour walls, and shear walls on room layouts. Total width of module is set by transportation standards, so extra width may come out of guest room interiors.

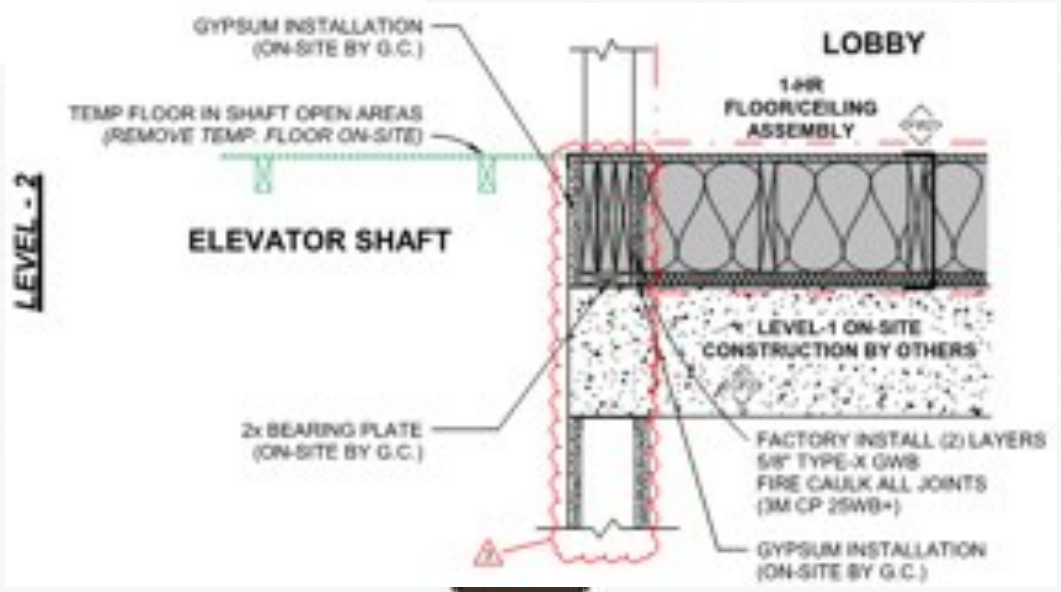




Fire Ratings, and continuity among modulars

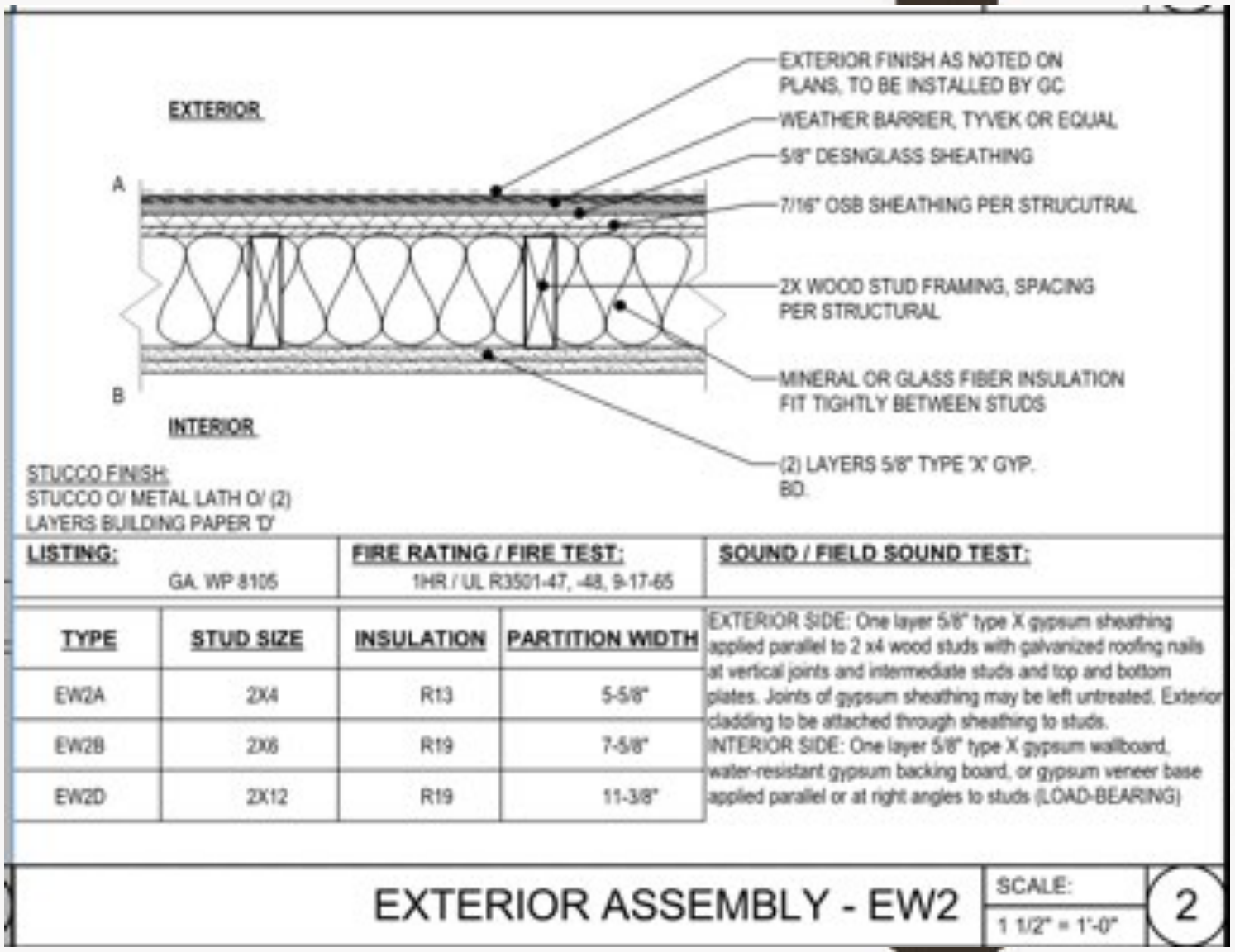
- Shafts
- Rated Elevator Shafts
- Rated Stair Shafts
- Stairs are shipped with Modules and built in factory but installed in the field.
- Temporary floors and ceiling removed
- Site work verse factory work to achieve ratings





Fire Ratings, and continuity among modulars

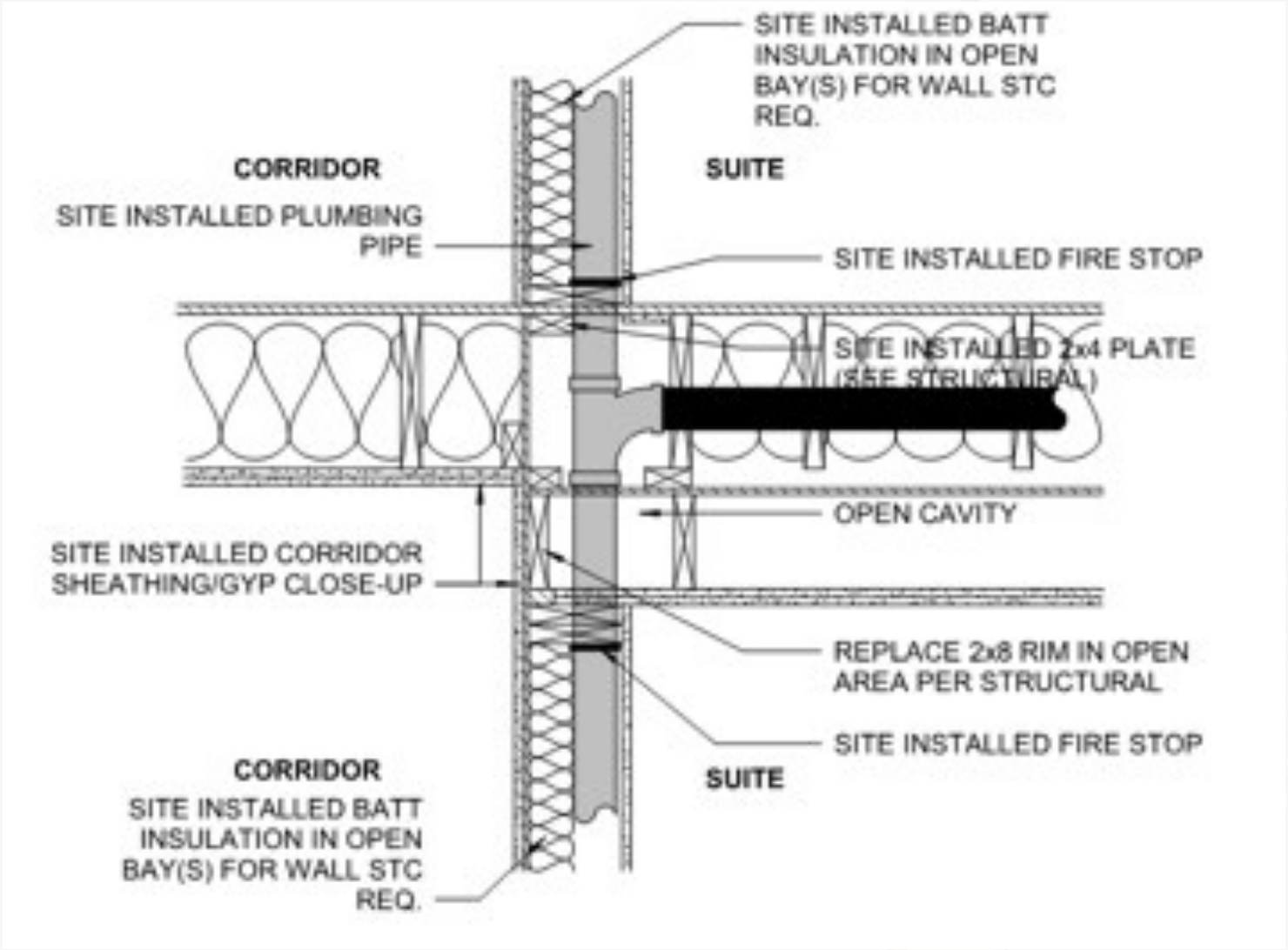
- Shafts
- Rated Laundry Shafts
- Rated Elevator Shafts that bypass the concrete podium



Fire Ratings, and continuity among modulars

- Exterior Walls
- Factory provides exterior wall with Tyvek wrap
- Pop outs and features
- Blocking and power for signs, lights and architectural features
- ID 2 hour wall locations for type 3 construction
- Waterproofing and flashing at windows, PTACS, etc.

Fire Ratings, and continuity among modulars



- Plumbing connections and shaft close up in field
- Through penetration ratings and fire stops
- Site installed insulation and corridor walls.
- Site installed furring to ensure straight walls.

Guestroom Units – ADA, Fire Rating –The accessibility and fire ratings in the guest rooms were reviewed as part of NTA's review.
Corridor – ADA – Exiting – The corridor accessibility and exiting would mostly fall under the city's review. Our review of this was limited to verify that the guestrooms fell within the exiting limits in chapter 10 and that the guestroom entries meet the accessibility requirements. The only other portion we would review are the stair configurations and landings that are part of the factory-built portion of the building. Some things that would be part of the city review would be exit signs, the portions of the stair not constructed at the factory (such as the first story, handrails, etc), emergency lighting, the elevator, etc.
Corridor Walls – Fire Rating –The corridor fire rating was reviewed as part of our review.
Corridor walls – Penetrations –The penetrations of the rated construction in the corridor walls were reviewed for any items that are part of the factory construction.
2Hr rated shafts, Plumbing chases –The shafts and chases that are part of the factory-built portion were reviewed by NTA. There are portions that will need to be inspected at the local level, such as the continuity between floors and finishing the shaft on the open side after the connections are made.
Guestroom & Corridors window Glazing, T-24 review –The window glazing was reviewed by NTA. The T-24 was partially reviewed, mostly to verify that the factory-built portions meet what is in the T-24 report (such as window specs and insulation). The city should review the T-24 for compliance.
Structural connections, hold downs, straps –The structural connections were reviewed by NTA for the factory-built portions. The city will need to inspect the connections
And connections not part of the factory-built portion will need revi
connection to the foundation.
Insulation – T-24 – See my response to the window glazing above.
MEP – Overall Design – Our review was limited to what was installe
not review any portions of these once they exit the guestrooms int
guest rooms would be under the city's review.
Fire Alarm – The scope of NTA's review was limited to the locations
guestrooms and any junction boxes on the corridor walls. Most of
under the city's review.
Fire Sprinkler – Full Project design or Only Guestroom piping, Spri
the guestroom piping and sprinklers. All other portions would be p

Approved: State of CA
Certified Design Approval Agency - NTA, Inc. 920268
Approved: Factory Built Housing

NTA Plan Approval # GRD040517-8
Approval Date: 6/23/2017
Expiration Date: 6/23/2020

RE: NTA – California Inspection Process - GRD0706

Dear Chaukkar:

NTA is an approved Quality Assurance Agency as described
Code Title 25, Subchapter 2. All NTA Inspectors utilized on this project are approved Quality Assurance Inspectors in good standing under the same Subchapter. Richard Leonard # IF 1271776; Pete Gingrich # IF 1500786 and Josh Mattos # 1271015. All MEP, structural and Sprinkler Systems were inspected under 100% surveillance for this project in accordance with California FBH requirements.

All NTA Licensed California FBH inspectors are also required to complete training under NTA procedures and Inspection Methods (IM). I have attached NTA IM 042 California Factory Built Housing Design Approval and Inspection (DAA and QAA) for Building Components and Building Structures to clarify process under NTA's Quality Assurance Program.

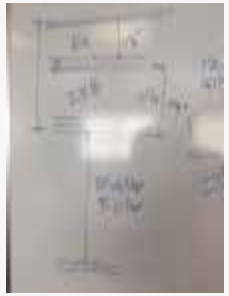
I have also provided some additional information with regards to Design Review as requested by the city of San Jose, CA.

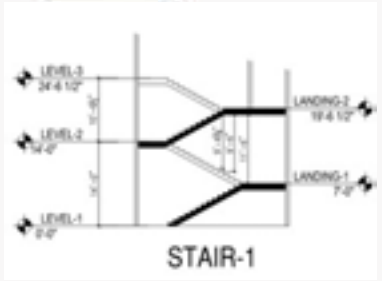
Permits and inspections required

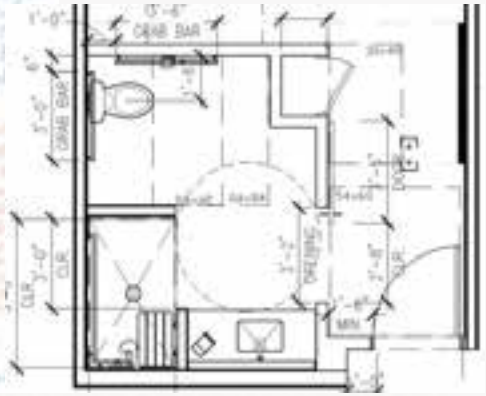
- Confirm city requirements
- Confirm state requirements
- Submit site scope to local jurisdiction for permits
- Submit Factory scope to state for permits
- Attach the approved state permit set as a reference for the local permit set
- Review inspection process with local jurisdiction
- On Site verse in factory

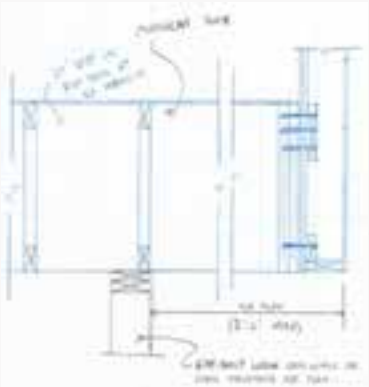
Case Study

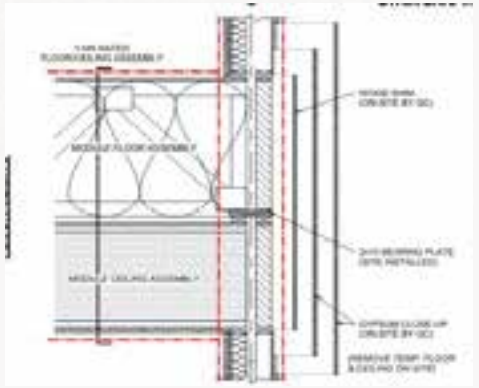
- **Hawthorne, California**
- Marriott Dual Brand Hotel
- Courtyard Hotel and Town Place Suites Hotel
- 354 keys total
- 2 lobbies
- Shared kitchen, laundry, fitness, pool, exiting
- 3rd party retail space
- Multiple room types including King, QQ, 1 Bedroom suites, Extended stay, conventional and ADA versions.

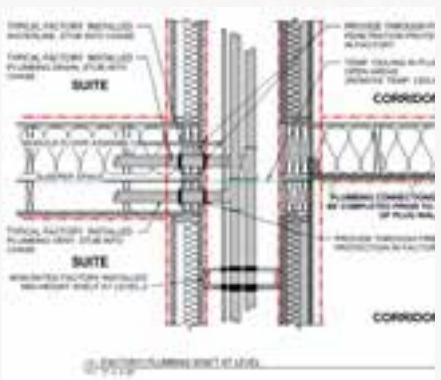




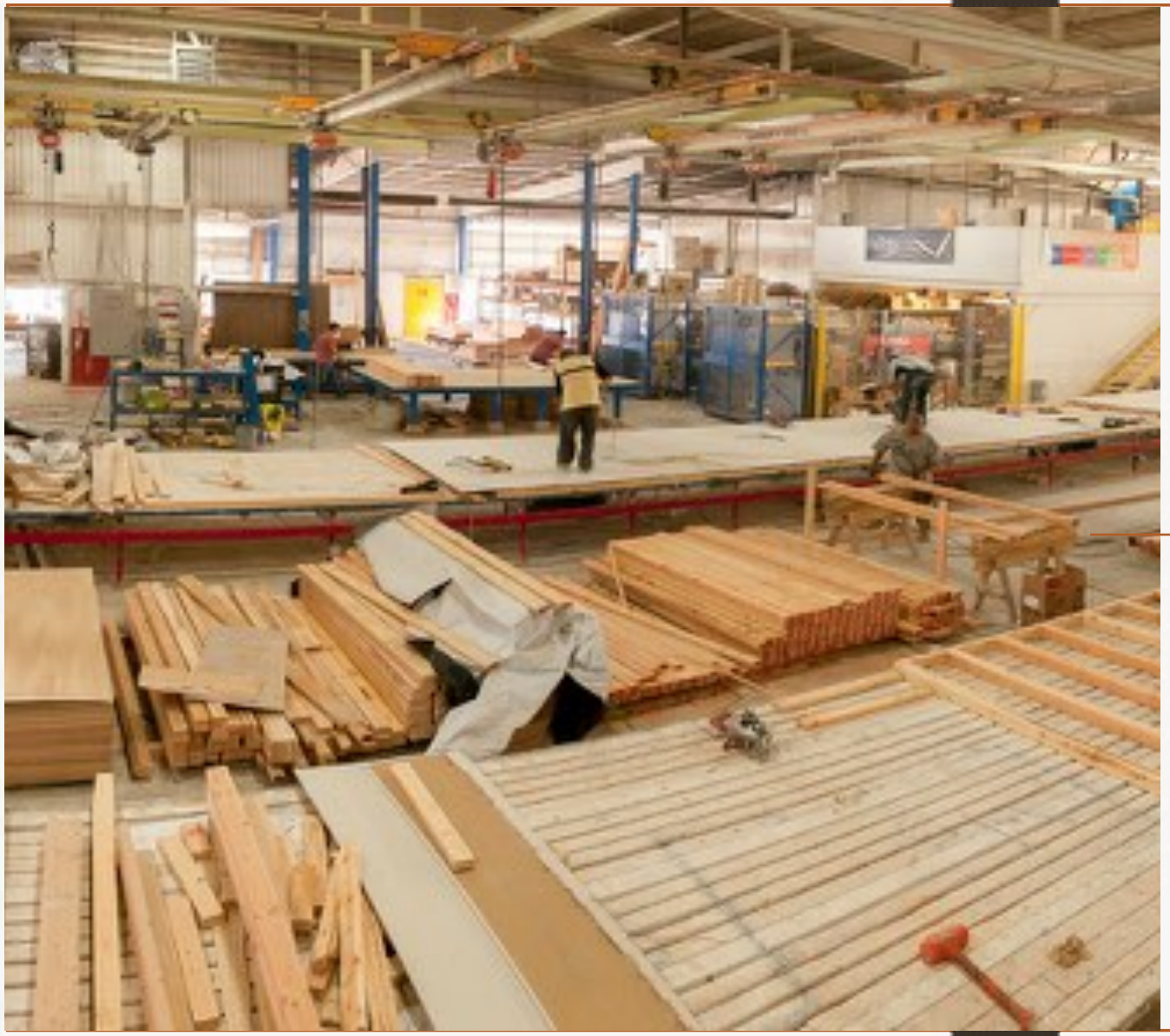








Working together to define scope and achieve the design vision efficiently in the factory



Work begins at the factory . . .

Walls and roof / ceiling

Roof deck

Underfloor utilities

Electric

Roofing and Parapets

Foam and tie backs

Windows and building wrap

- Building wrap
- Flashing at windows
- Flashing at louvers / HVAC units

Interiors

Happens concurrent with site work, much earlier than a conventional project

When the General contractor is pouring foundations, The factory is installing lighting, tile, carpet, showers, hardware, wall covering, furniture and art work!

In the field, the project starts like a conventional project . . .

Demolition

Grading and excavation

- Can have a crawl space under modules for access to utilities.
- 3’ deep at center, 18” deep at exterior walls.
- Air must circulate through and be vented.
- Need access hatch to crawl space
- Need to detail adjacent sidewalks and planters appropriately

Foundations, stem walls and Below grade utilities for the modules

Foundations and anchor bolts for major steel

Steel is set over lobby

- Note the double columns and beams due deflection limits and inability to camber
- Clear span lobby with minimal columns
- Modules don't handle camber very well
- Upper level fitness room required steel framing at level 2 as well. Beam slid into beam pocket after modules were set

But instead of starting framing on level 2, the five floors of guest rooms have already been built and are sitting nearby, ready to be stacked on the foundations

Stacking begins

And the building grows quickly


PROSET

Work starts in the corridors.

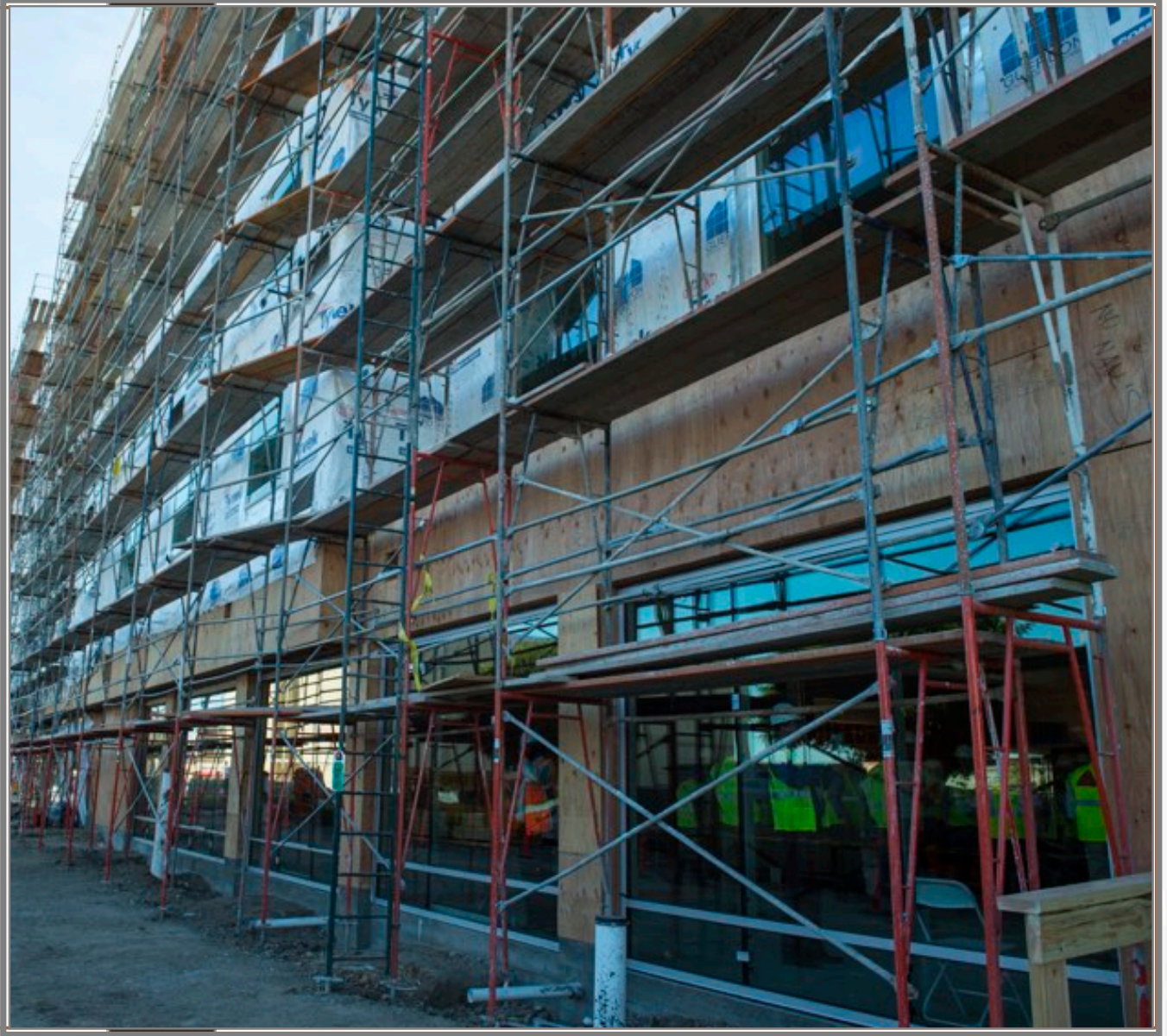
Tie rods to anchor the stacked buildings to the foundations.

Shafts are left open so the GC can do his work.

And the site contractor follows behind with his scaffolding to start exterior finishes

Exterior finishes

- Plaster
- Ceramic Tile
- Metal panels and sheet metal trim
- Window wall system
- Exterior canopies
- Exterior signage
- Architectural lighting



Lobby work begins under stacked units

- Steel beams sit under all module mate lines
- Separate support is installed to support ducting, soffits, and ceilings
- Fire ratings must be maintained at steel to wood conditions

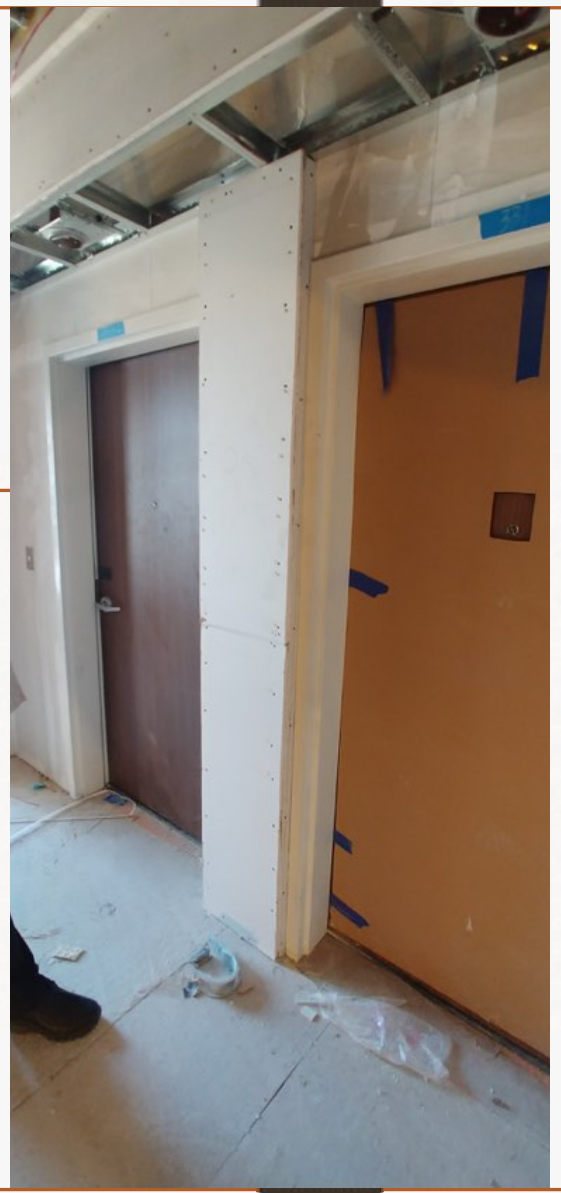
2 hour wall built in factory

Guest room utilities stubbed to corridor for Site team to connect

Corridor arrives unfinished and is completed in field

Corridor Alignment

- Modules don't align perfectly during setting.
- GC to install main utility runs
- GC to install connections to modules
- GC to finish shaft faces
- GC to install corridor finishes and ceiing



The finished Product!

Shared pool area

Courtyard Lobby

Courtyard Lobby and Bistro

Townplace
Suites
Lobby

Townplace Suites Lobby

Field work includes:

- Utilities
- Ceiling
- Lights
- Door Frames
- Carpet
- Furring
- Gypsum Board
- Final Rated Wall at Shafts
- Wall Covering
- Signage
- Trim

Marriott Courtyard guestroom

TownePlace Suites guest room

Benefits of Modular Construction

- Quality Control in the Factory
- Speed of construction / speed to market – site work and lower levels are constructed simultaneously, with upper levels, not sequentially
- Budget Certainty – costs are known and agreed to up front.
- Reduced risk – weather, labor shortages, safe working conditions, reduced on site labor,
- Reduced construction impact on neighbors and adjacent residents.
- Reduces on site labor, helps with prevailing wage projects
- It's a smart approach to construction.

Lessons learned

Architectural:

There is a tolerance to stacking modules. for this. Pay close attention to mate lines and tolerances for stacking. Things won't align perfectly.

Review clearly with the agency and inspection team so they understand modular, and what is in their scope.

Engage all consultants early. vertical construction starts early in the factory and information is needed immediately.

Use same architect and engineers for site built portion and factory portion of work, for state permit sets and local permit sets.

Vet any unusual or non standard modular components early with the factory Factories are better suited to standard elements

Visit the factory for punch walks and “field visits” early and often. Identify any deviations early, so it only has to be fixed a few times and not 354 times.

The devil is in the details.

Build the ADA units in the first production run, as they need to be inspected in the factory early to catch any non conformance issues. ADA often has no tolerance for deviations in dimensions.

Confirm the factory follows UL listing for fire and acoustic ratings for all wall types to avoid revisions from plan check or field inspectors.

Revit is the preferred software to assist the factory in their shop drawings.

Demising walls must stack through the building levels

General Contractor:

Coordinate closely between the field GC and the factory, ensure all scope is covered by one of them

The stacking sequence has to be determined early with GC, Factory and Structural input, or it affects the structural engineering

Line up a staging yard early for the modules to sit, if there is no room to store them on site.

Ensure the building is watertight at all times. The rooms are finished and susceptible to damage right away

Shop drawings are needed early, including sprinklers, elevator drawings, façade maintenance, mechanical, etc.

Owner

Order FF & E early, so it is in time for model room review and can be shipped with room modules.

Ensure the owner, brand and operator sign off on the design before factory production starts. Changes after this point are expensive and hard to implement.

Engage the Interior Designer early. Interior coordination with the factory must start early and be comprehensive.

Ensure financing is on board with the modular approach and familiar with the schedule.

Modular Construction

Prototype Modular Project

International Station Modular Senior Affordable Housing

Under Construction

484 du | 3.9 ac | 124.1 du/ac

Prototype Modular Project

El Cerrito Modular Affordable Housing

633 du I 3.9 ac I 162.3 du/ac

Prototype Modular Project

El Cerrito Modular Affordable Housing

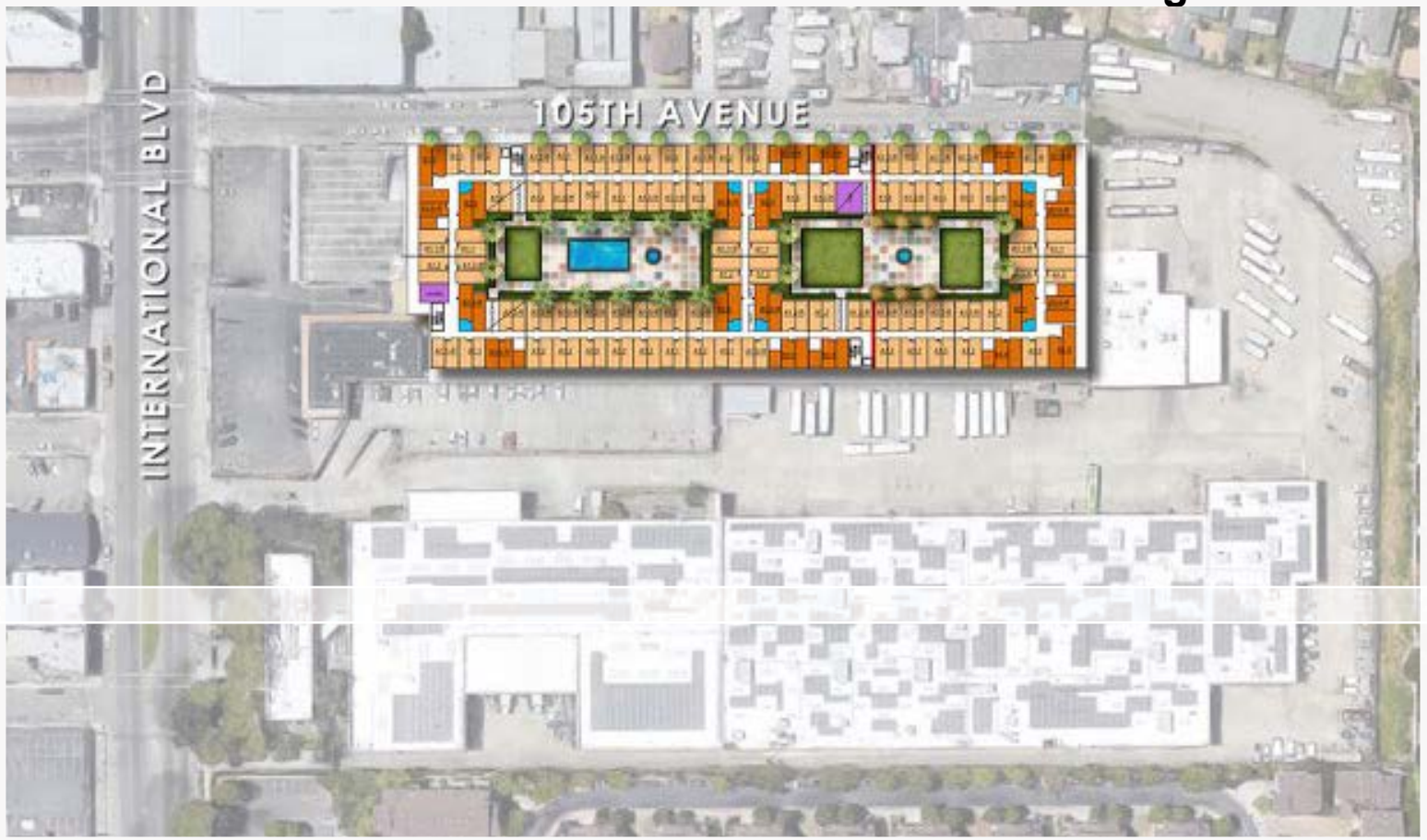
633 du | 3.9 ac | 162.3 du/ac

Prototype Modular Project

Hilton Garden Inn, San Jose, CA

Prototype Modular Project

International Station Modular Senior Affordable Housing



484 du | 3.9 ac | 124.1 du/ac

Under Construction

Prototype Modular Project

Hilton Tru Hotel, Inglewood, CA

- 130 key Hilton Hotel
- Concrete podium for lobby, and parking levels
- Roof top deck for guests

Prototype Modular Project

Mixed Use Modular Charter School Project

204 du | 2.4 ac | 85.1 du/ac

This Concludes The American Institute of Architects Continuing Education Systems Course

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Thank you!

Questions
and
Discussion