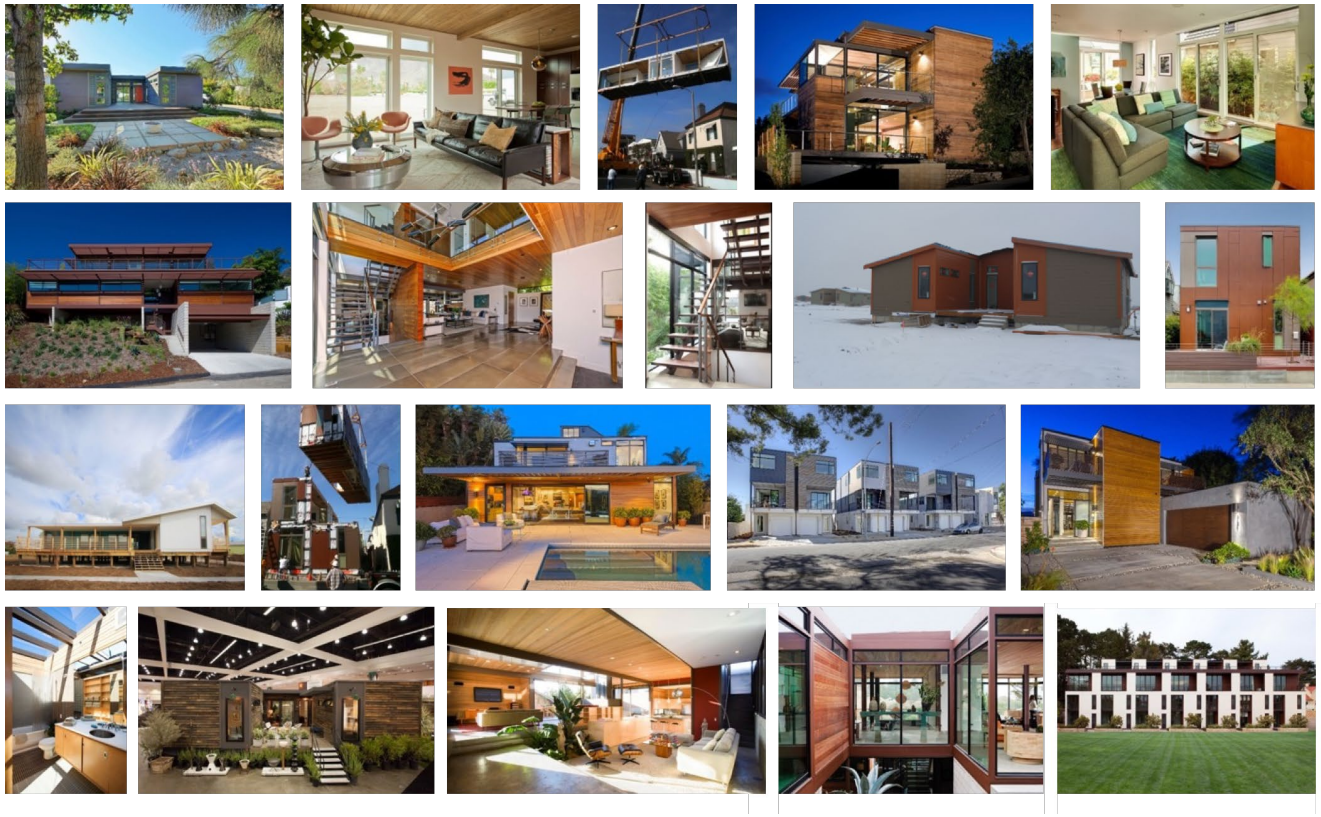
Plant Building System (PBS) Design Guidelines

plant PREFAB

Contents

5,250 sf single-family home designed by Ray Kappe, FAIA, 2 floors, 13 modules, panelized decks and trellises

Introduction



Plant Prefab was founded to make it easy and efficient to build custom, single-family and multi-family homes. Unlike most prefabricators who focus on standard homes they design, market, and sell, we're focused on empowering architects, designers, and developers, and providing your clients a more time- and cost-efficient way to build the homes you design for them. In addition to high-quality construction and great attention to detail, we focus on sustainable and healthy construction materials and processes.

We know design matters. We've worked with some of the industry's top architects and designers, including Ray Kappe, KieranTimberlake, Yves Béhar, M-Rad, Sagemodern, Toby Long, and Brooks + Scarpa, to name a few.

In California and most states, prefabricated homes can be built anywhere—i.e., they can't be excluded from a site because they are prefabricated—and banks cannot deny financing because they are factory built. (Note that cities and banks can and do exclude manufactured/mobile homes from many sites and financings.) There is no disclosure requirement on title for prefabricated homes, and resale, at least for projects we've done, appears to be the same.

The goal of this document is to provide you with an overview of our Plant Building System, basic design principles of using PBS, and how it expands upon the capabilities and experiences of traditional, site-based and prefabricated construction. It also provides helpful insights on how we achieve the fluidity of our system through a combination of design, communication, technology, and optimal user experience.

The guidelines are intended to be used as early in the design and planning process as possible, particularly before engineering is completed as engineering for prefab differs from that of site-based construction. Adhering to these guidelines will help create a successful prefabricated project at Plant, just as departures from them that are identified later in the process will take more time and resources to resolve. We are always available to answer questions and work with you, so please don't hesitate to reach out!

Plant Building System (PBS) Overview

Plant Building System (PBS) is a patented, component-based system for building custom, prefabricated homes even more efficiently and with greater design flexibility than other prefabricated building methods.

PBS is comprised of Plant Panels, a new, panelized construction system developed by Plant Prefab, as well as Plant Modules. Plant Modules are comprised of Plant Panels and can be constructed into full volumetric modules, or as core modules for specialized elements like kitchens, baths, mechanical areas, or combinations of them all.

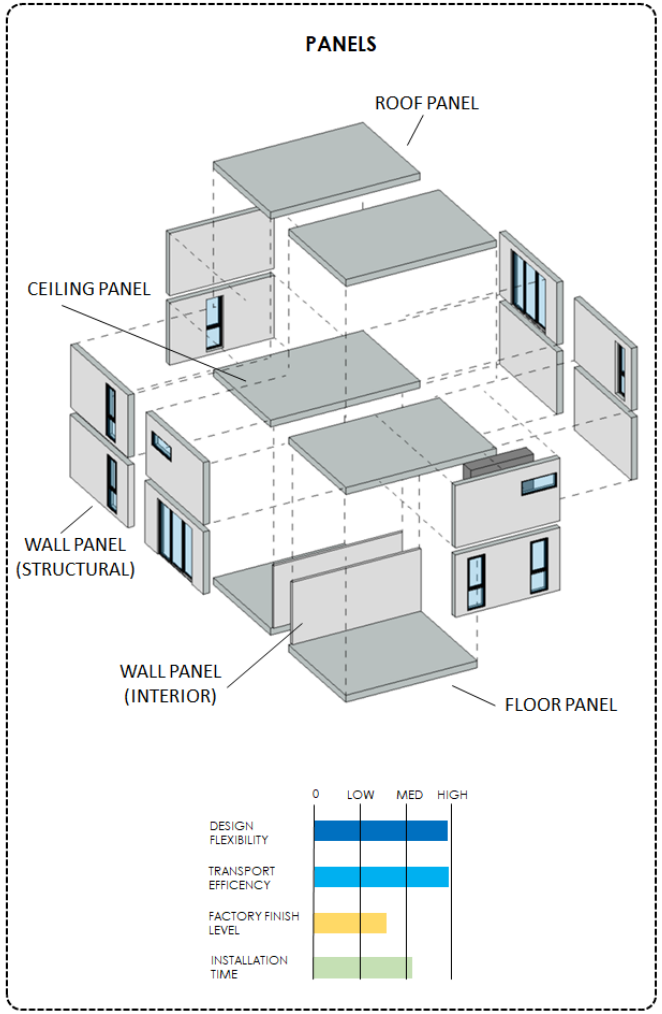
PBS also utilizes an advanced engineering system that translates designs into virtual building instructions faster, and far more precisely, than traditional, manual methods.

Unlike other wall panels such as SIPs, which only integrate framing and insulation, Plant Panels also include plumbing, electrical, and finish materials. By integrating both modular units and panels, PBS offers the following advantages over site-based and other individualized prefabricated systems:

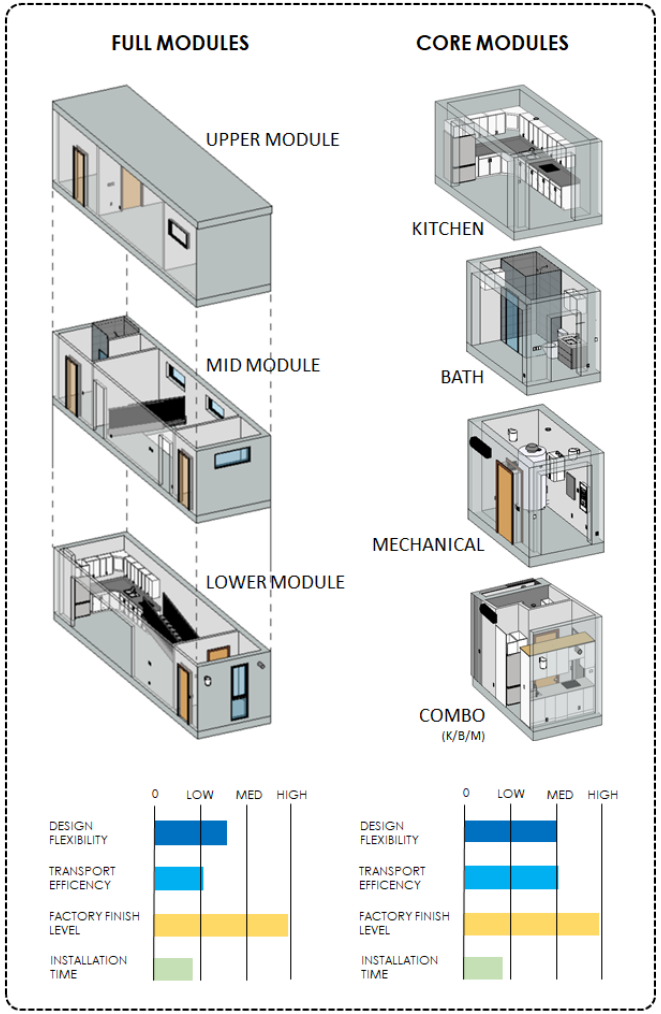
- **Empowers the design and construction of custom, high-quality, architectural homes** that are healthy, sustainable, and extremely durable
- **Increases creative flexibility** for architects to address diverse design needs, particularly for multi-family projects
- **Lowers costs and build time** for projects with more significant shipping and installation requirements
- **Increases access opportunities** for sites that may be challenging for the transportation and/or installation of larger modules

PBS is more than just components; it includes all the tools and engineering systems required to ensure the optimal process from design, to manufacture, installation, and completion. PBS can be used to design almost any residential building project under a variety of circumstances, from single-family and multi-family residential units to accessory dwelling units (ADUs) and remodels (room or floor additions).

PLANT PANELS

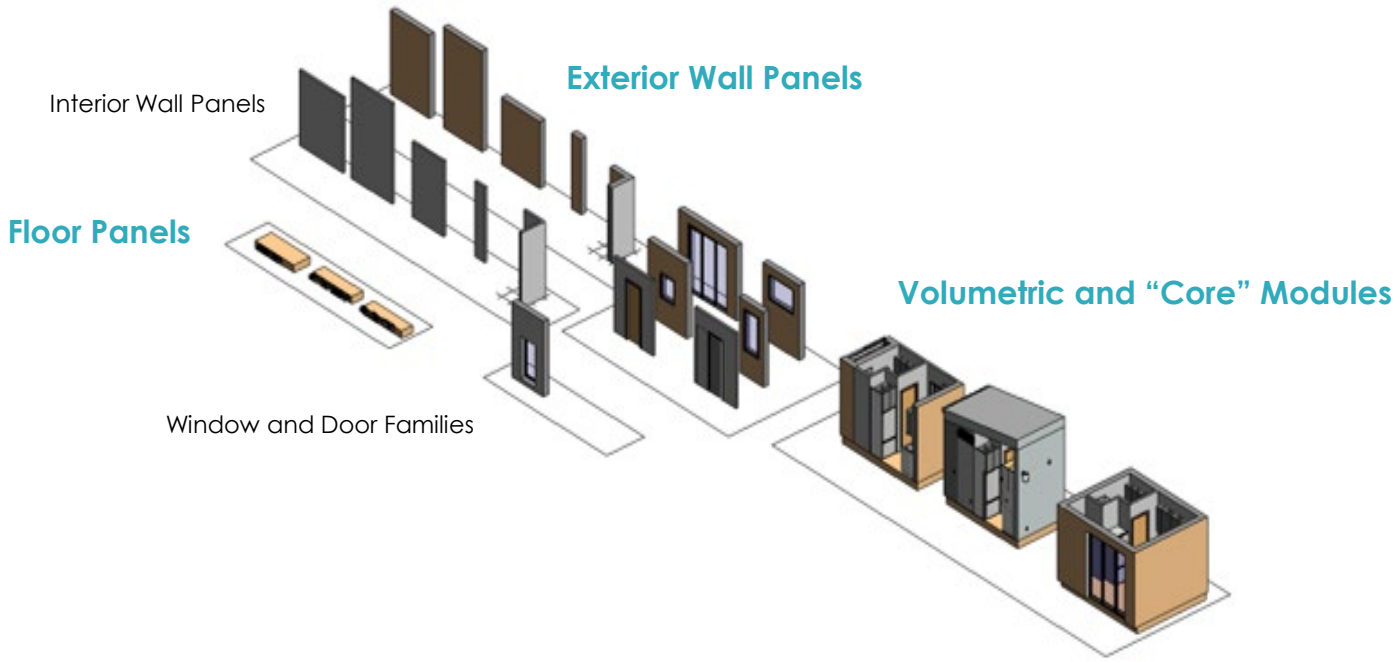


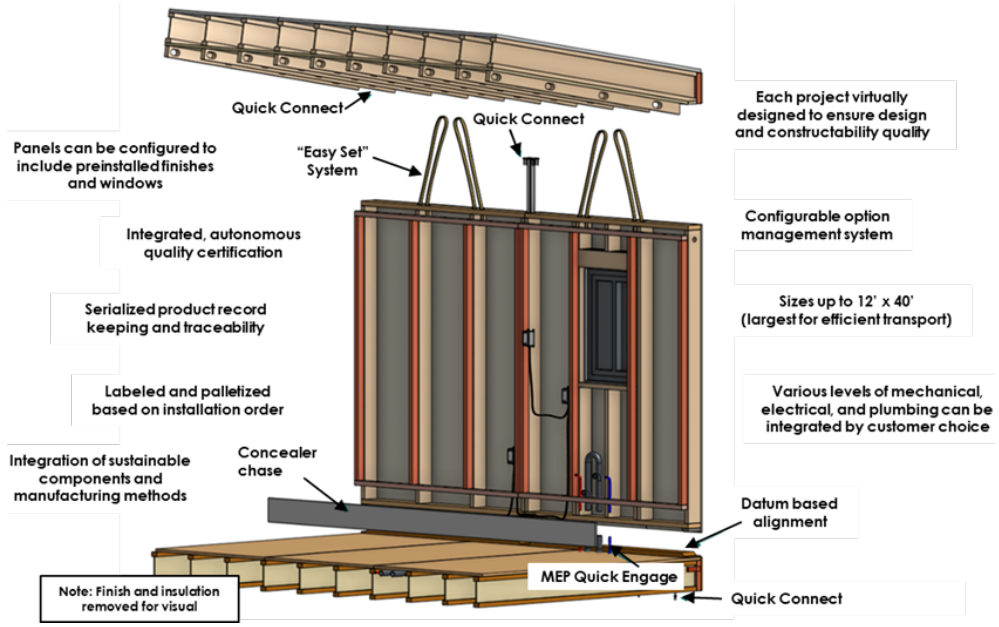
PLANT MODULES



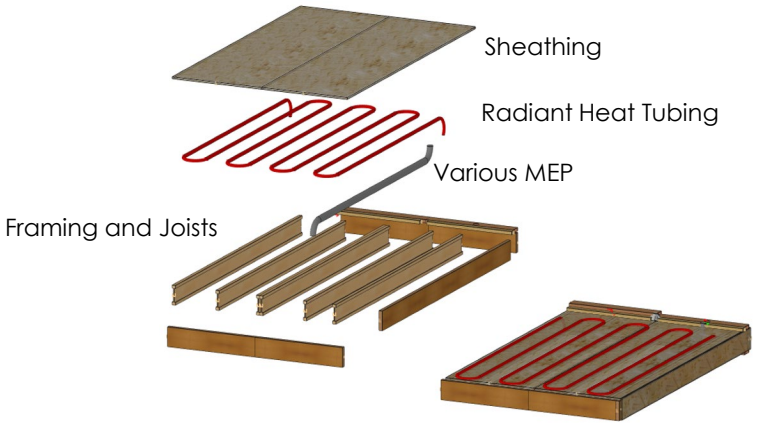
Note: Ceilings have been removed from Plant Modules for illustrative purposes only

PBS Components

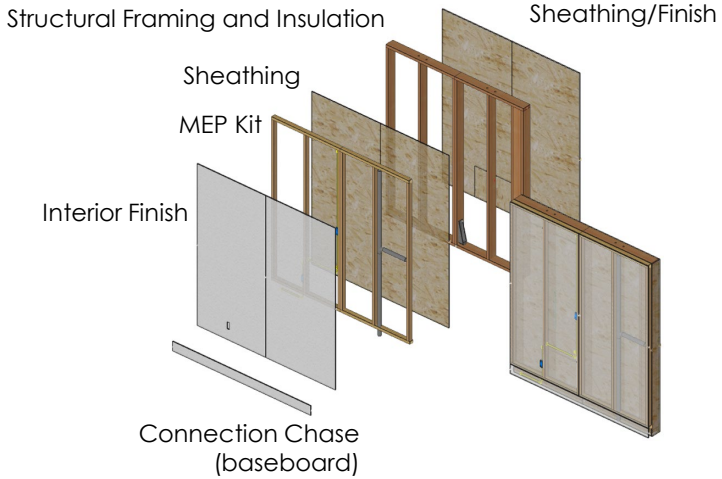




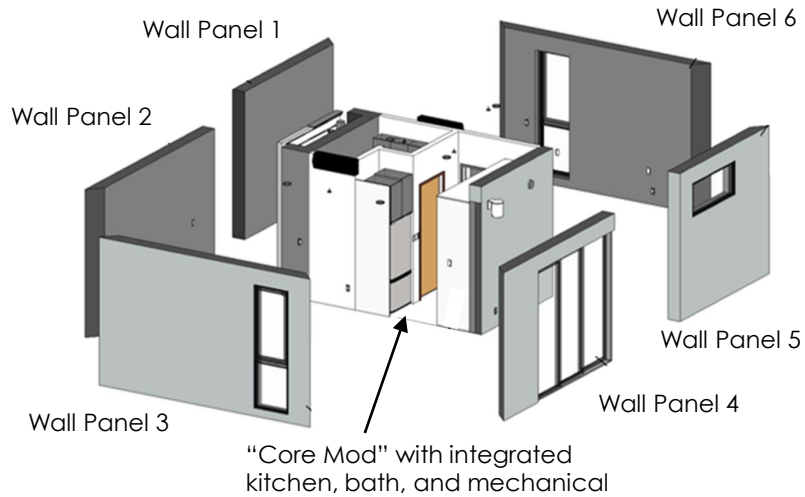
Floor Panel



Wall Panel



Core Module



PBS Benefits & Configuration Options

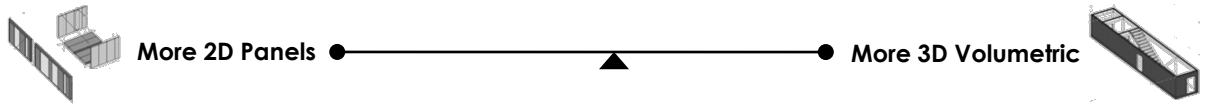
Plant's focus is solving custom design challenges for architects and their clients, so we developed PBS to offer much greater flexibility than traditional prefabrication systems.

PBS allows us to create an optimal construction solution based on your unique project's design, budget, site access issues (which impacts transportation and installation feasibility and costs), and customer experience. We work with you to determine the most efficient combination of building systems:

- *All volumetric modules:* Traditional, large, finished modules and/or "core" modules
- *All panelized components:* Panels that are assembled on-site
- *Hybrid:* A combination of both, based on best fit for the project

Clarifying the best approach occurs after a feasibility analysis has been completed (see page 9) and during the schematic design phase, when you have a sense for your design approach.

		Plant Panels	MORE / LESS < Combination >	Plant Modules
Design	**Design Flexibility**	Smaller components solve complex designs		Height and width requirements limits design flexibility
	Site Access	Build virtually anywhere		Requires site to be accessible for larger trucks and cranes
Transport	**Shipping Efficiency**	Palletized panels reduces truck count and size		Mods require special trailers, permits, and escorts (possible)
	Shipping Routes	No limitations		Must check routes for obstacles; extra costs for mods
Site	**Cranes Cost**	Uses smaller, less expensive cranes		Larger, more expensive cranes
	Install Time	More time to assemble multiple pieces		Less time to install mods
	Site Labor Costs	More labor to install panels, MEP connections, and stitching/finish		Less labor due to less joints and more finish work done in factory



Plant Prefab Process Overview

Bid & Feasibility

Design & Engineering

Precon Agreement

These are the detailed steps involved in working with you. Note that a number of these tasks can occur in parallel.

Project Bid
You'll share your client's project and we'll prepare a rough order of magnitude (ROM) bid that specifies anticipated costs, inclusions, and exclusions.
Time: 1 - 2 weeks

Site Feasibility
We'll evaluate your client's lot, and the route from our factory to the lot, to make sure it's feasible to deliver and install prefabricated components. In general, if a foundation can be engineered, we can install prefabricated components on it. However, impediments like overhanging trees and power lines, low bridges, narrow roads, severe curves, and steep slopes along the route will determine what we can build and deliver. We'll perform an initial analysis for free, using Google Maps. If no major impediments are found, we'll execute the full, detailed, paid analysis. This analysis is required in order to move forward.
Time: 1 - 3 weeks

Initial Design Review
You'll share your plans and we'll make sure they can be prefabricated at Plant. We'll give you a sense for what kind of changes may be required, if any, to make your design work with Plant Modules and/or Plant Panels.
Time: 1 - 2 weeks

Design
If you've already completed the design, we'll work with you on any changes that may be required to make it more efficient for prefabrication. Ideally, you connect with us before your plans have been engineered, as the requirements for offsite construction vary from those for site-built projects. If you're still developing the design, we'll help you optimize it for prefabrication and advise the most cost-effective, healthy, and sustainable options for finishes, fixtures, and other materials.
Time: 12 - 16 weeks

Engineering & Approvals
Engineering and approvals for prefabricated components are governed by state authorities. Engineering and permitting for the foundation and site work is governed by local authorities. The project general contractor (GC) will coordinate engineering and local permit submittal. Plant will submit to the state with the architect-prepared package. Plant can also support you or your GC as needed by recommending engineers who are experienced in prefabricated construction.
Time: Varies by jurisdiction

Pre-Construction
This is when you and/or your client will finalize finish specifications, and when we will work with you and/or your client to determine the scope of work between Plant and the site GC. We'll create production drawings using our state-of-the-art 3D virtual build process, and we'll finalize pricing for the production of your design. This is also when we'll submit the supplied, complete ASMEP drawing package for the prefabricated components to state authorities for approval.
Time: 8 - 16 weeks

Plant Prefab Process Overview, *continued*

Fabrication & Sitework

Installation to Move-In

Fabrication
Your client's project will be built in our indoor facility by our highly-skilled, full-time tradespeople, following precisely engineered plans. Our rigorous quality control program will ensure superior craftsmanship, and our environmental health and sustainability standards will minimize toxins and waste. This production will happen in parallel with site work, shaving months off the project timeline. And, all required inspections will be completed in our factory, so we'll be able to deliver your client's project with the walls sealed and finishes installed! You and your client will be invited to tour the project in production.
Time: 8 - 16 weeks

Site Work and Foundation
Plant does not perform site work, but we will collaborate with your client's site GC on the preparation of their lot and foundation. We will provide direction, answer questions, and work swiftly to resolve any issues, maintaining oversight and quality control of the entire process.
Time: 8 - 16 weeks

Delivery & Installation
Your client's GC or your client will secure installation resources, select a transportation company, and schedule delivery of the prefabricated components. Plant can introduce the GC to recommended transportation providers if needed. The transportation company will secure any necessary permits (for things like police escorts, road closures, or parking), and truck the components from Plant's factory to the job site.

Then for the fun part! Installation is when the prefabricated components that comprise the home are assembled on-site. A crane is typically used to lift the components off the truck and then lower them onto the prepared foundation, where they are bolted together. Depending on the size and complexity of the design, most projects are fully assembled in a matter of hours—not weeks or months. (Really.) It's a cool process to watch, and you're invited to spectate!
Time: 1 - 3 days (depending on size of the project and balance between Plant Modules and Plant Panels)

Finish Work
Once the building is assembled, your client's GC will connect the water, sewer, electric, and appliances, and apply the finishing touches (like exterior siding where the components were connected). Since most Plant modular projects ship 90% (or more) complete, with drywall, paint, millwork, tile work, and even the appliances already in place, on-site finish work is generally minimal. Landscaping is also typically done at this time.
Time: 6 - 16 weeks

Final Inspection
The local authority will perform the final inspection on the structural and utility connections, along with any other non-factory-produced site work, and issue the certificate of occupancy. The project is officially complete! Time to party like it's 1999!

Site Feasibility

Not all sites are eligible for traditional prefabricated construction, because not all sites are accessible for the trucks and cranes required to deliver and install traditional modules. PBS aims to solve this by facilitating the most optimal combination of larger, volumetric modules; smaller, core/wet modules; and panelized components.

To determine the most efficient combination of prefabricated components and their maximum dimensions, Plant must perform a comprehensive feasibility analysis before the design has begun. This analysis determines the following factors:

Truck Access

- What size trucks can access the project site?
- What height restrictions are determined by the path of travel from the factory to the job site?
- What are the road restrictions due to weight and size?
- Will pilot cars, police, and/or highway patrol escorts be required based on final design configuration?
- Are there road, bridge, or tunnel weight, height, or width limitations along the transportation route?
- Are there any significantly steep, narrow, or non-linear sections of any portion of the transportation route?
- Are there any other access issues?

Setting Equipment Size and Access

- What size and type of equipment will be required to install the Plant Modules or Plant Panels, based on their dimensions and weight?
- Will the required equipment fit on the street, and/or the lot? What type of permits are needed, with what timeline?
- Are there any road or site obstacles that may prevent the use of a crane, such as power lines or trees?
- If crane access is not possible, what other installation equipment can be utilized and designed for?

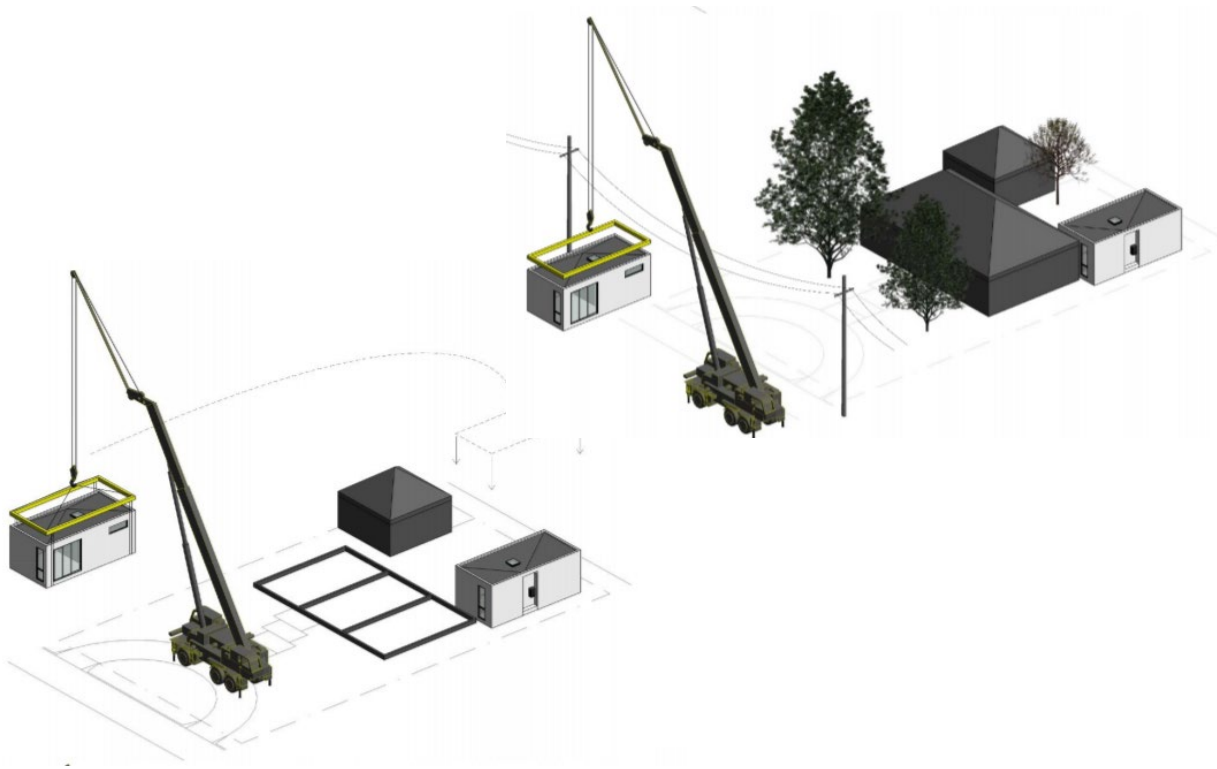
PBS Component Staging

- Is there space to stage modules and components prior to the day of installation?

Site Grading

- Will site grading adjustments be required for prefabricated components and crane/setting equipment staging?

The ability to solve for most site constraints is a significant advantage of PBS. It's also why defining the constraints early in the process is so critical, so they may be taken into consideration from the earliest phase of design. Plant performs initial assessments for free; simply send us your site address. If the site is determined to be a potential candidate for prefabricated construction, Plant will then complete the full feasibility analysis described above for a small fee.



Modular Housing Approvals

As the architect/designer, you will be responsible for ensuring that your project complies with all applicable local zoning laws, regulations, and restrictions. The state approval agency who reviews the drawings (detailed below) will only review fire and life/safety building codes as they apply to the California (or other applicable state) Building Standards Code, not local zoning or specific fire codes.

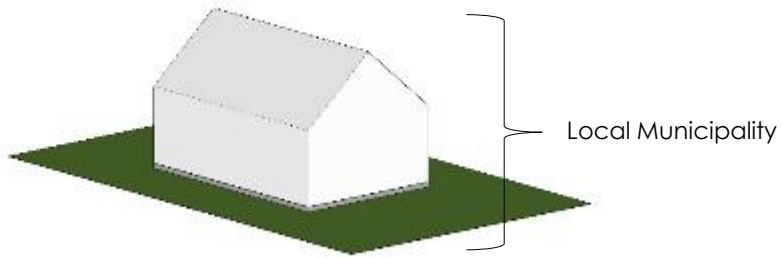
You as the architect/designer are responsible for ensuring the modular home meets all local zoning requirements, including review by applicable specialty agencies (e.g., Coastal Commission, Design Review). There is a bifurcated process for the building permit; the Local Enforcement Agency (LEA) is responsible for reviewing the construction set for the site work and completing their usual inspections, while the state's Housing and Community Development (HCD) is responsible for the modules and factory inspections. Modules inspected at the factory are delivered to the job site with walls sealed and local municipalities have no authority to inspection behind the walls.

Factory-Built Housing (FBH) units are designed to the California Building Standards Code: Parts 2, 2.5, 3, 4, 5, 6, and 11 of Title 24, California Code of Regulations. A Design Approval Agency (DAA) approved by HCD reviews and approves FBH plans. FBH rules and regulations vary by state, and there are thirteen designated DAAs in the state of California. Plant submits the drawing package to the DAA on behalf of the architect.

The LEA may have unique requirements in addition to the state requirements, such as snow load, wind pressure, fire zone, building setbacks and heights, site development, and property line requirements.

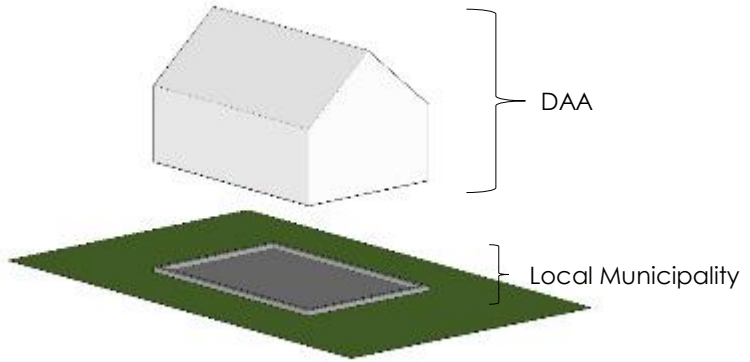
The HCD regularly updates a handbook that delineates what qualifies as FBH, the governing bodies responsible for oversight, and what local jurisdictions can and cannot do. The full handbook may be found here.

Traditional Project



The local jurisdiction permits all facets of the project: setbacks, building extents, zoning, home, foundation, and additional structures.

Modular Project



The state DAA permits all factory-built portions of the project, while the local jurisdiction permits all sitework.

Transportation & Shipping Limits

PBS allows much greater flexibility in transportation than traditional, all-volumetric, prefabricated construction. We work with you to clarify your design into the most optimal combination of modules and panels, ensuring maximum efficiency in transportation and other logistical constraints.

The following factors are taken into consideration when determining module and panel dimensions, which occurs during the comprehensive feasibility study described on page 9.

PBS Component Height and Length

Panels are typically shipped on a standard trailer and can be stacked vertically or horizontally. Modules are typically shipped on a double-drop trailer. However, there are three main trailer types (identified below) that can be used, and this determines the maximum sizes of PBS components.

The maximum total shipping height (including trailer) that will fit under most bridges and overpasses is 15'-6". Measured from the bottom of the floor structure to the top of the roof and/or parapet structure, the maximum single module height is 13'-4" for a double-drop trailer. Taller modules may be transported on a case-by-case basis, dependent upon route and site, but additional costs will be incurred for permits and assistance vehicles like police escorts and pilot cars.

PBS Component Width

Module widths are determined by site and access conditions. However, notwithstanding these conditions, the California Department of Transportation (Caltrans) limits shipping width to 16', measured from the finished, outside face. Wider modules can be shipped, at additional cost, and with specific limitations set by Caltrans. Caltrans also determines when a pilot car is required (generally 14' or wider), and when a California Highway Patrol (CHP) escort is required. Specific California travel route limits can be found here. For ease of transport and installation, the optimal size for modules is 12'-14' wide x 36'-40' long.

Double-drop, lowboy, or modular trailer
Mod height up to 13'4"

Single-drop trailer
Mod height up to 10'6"

Standard trailer
Mod height up to 8'

Plant Modules — **Plant Panels**

Transport Cost

Basic Design Principles of Plant Modules: Full-Size Mods

This section applies to projects in which the bulk (or entirety) of the project is constructed as full-size, volumetric Plant Modules.

The most successful projects are designed so that the majority of the construction is completed at Plant. This includes all finishes, fixtures, equipment, and appliances. Both Plant Modules and Plant Panels can ship with finishes installed (e.g., finished plumbing and electrical fixtures, millwork, and tiling), and Plant Modules even ship with appliances in place, keeping on-site finish work to an absolute minimum.

Structural Elements

The overall design will be engineered by a licensed structural engineer familiar with modular and panelized construction. Prefabricated construction has limitations that differ from site construction. Each module is designed for transportation and installation limits and then engineered to be tied together as one permanent structure. Typical, overall floor thickness is roughly 12", including sheathing. Typical floor framing is 11 7/8" TJI to allow for utility runs. The perimeter of each floor or floor panel is created with double rim joists. For design purposes, roof construction for one-story homes is the same as the floor framing, with allowances for drainage, slope, shape, parapets, etc. For multi-story homes, allow 10" for framing.

Exterior walls are typically 2x6, and interior, non-load-bearing walls 2x4. Plumbing walls that are located along an exterior wall require a 2x4 plumbing chase wall to allow for vents and waste lines to bypass the double rim joists. Rough plumbing drops straight down into the crawl space, while vents need to go to the roof or side wall or through multiple stories above to the roof. Side-by-side modules typically require double walls along the length. It's best to design for this "worst-case scenario" until it is determined that all shear requirements can be met in other ways such that a wall can be removed.

Two lateral resistance systems are used at a separation of 90 degrees to avoid structural code penalties. Moment frames are used in the short or long direction when there are no shear walls present within the module. At least one shear wall per building length is required at the exterior, and one shear wall per building length is required at the seam between modules.

Transportation Parameters

Since modules and panels need to be transported from Plant to the job site, it's important to understand some of the parameters that ultimately impact module dimensions and cost (see page 11).

Double-Height Spaces

Modules can be shipped without framing cut-outs and stacked to create double-height spaces. Panel configurations can also be used to accommodate this need.

Oversize Modules

Roof overhangs that extend beyond the module can be accommodated in a few ways. A common way is to hinge the portion that is over width back on top of the roof for transport. Upon installation, the hinged portion is rotated back to the overhang position and then roofing is completed on-site. Another option is to use separate panels to create large roof overhangs, decks, or trellises. Such panels would be engineered to be connected to the adjacent module (and any foundation work) on-site.

Basic Design Principles of Plant Modules: Core Mods

This section applies to hybrid design approaches, in which Plant Panels and Plant Modules are combined.

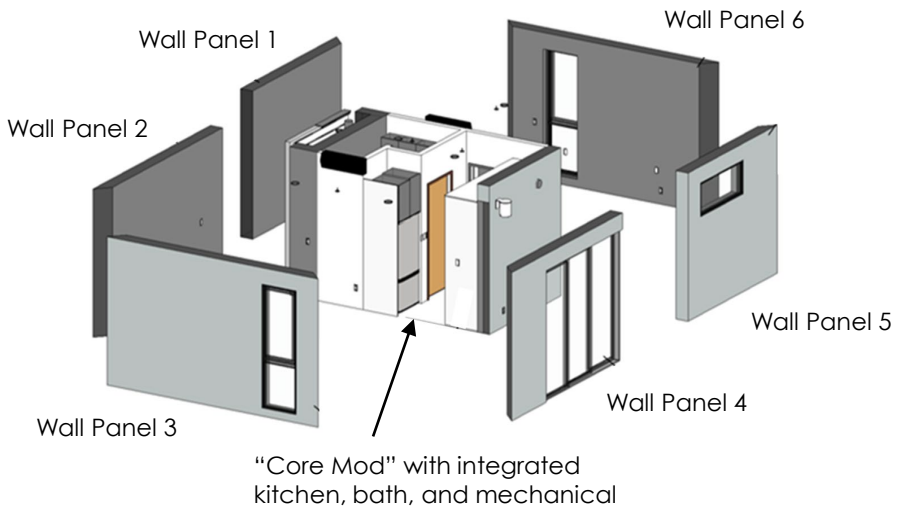
Design of Bathrooms, Kitchens, and Mechanical Areas

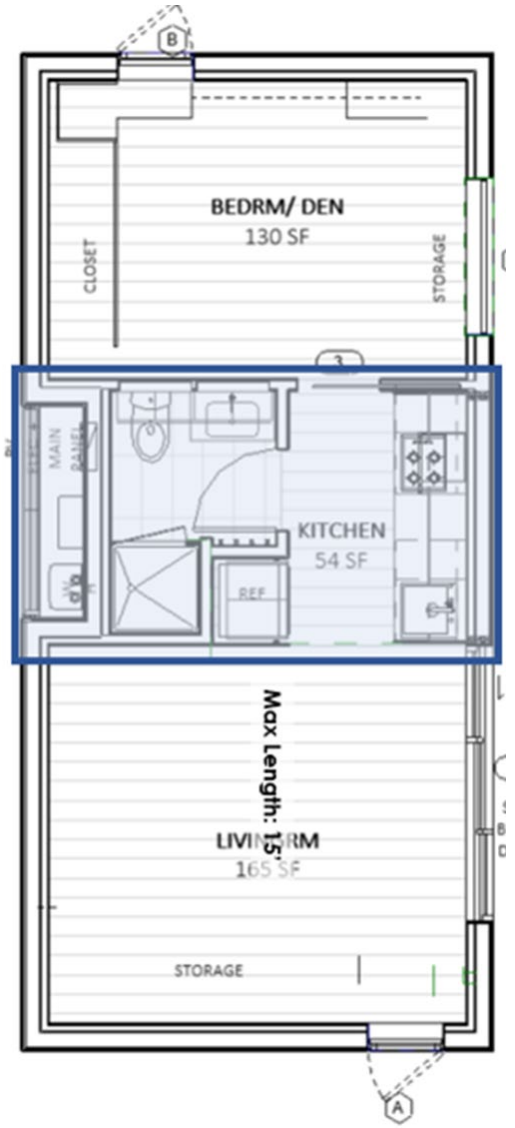
Although not a requirement, a good practice is to design bathrooms, kitchens, and/or mechanical rooms to be included entirely within one module, when possible. We refer to such modules as "core mods." This maximizes efficiency in construction and installation, thus typically reducing project cost.

Core mods are volumetric, complete with ceiling, floor, and all four walls. This allows all finishes, fixtures, and equipment to be installed and tested before leaving the factory. Projects may have one or more core mods, and each will be dimensioned for optimal project scope.

Note: With good design planning, kitchens and bathrooms can also span across more than one Plant Module if there is a natural break point in the design at the mateline.

Plant Core Module





Basic Design Principles of Plant Panels

Walls

Wall Panels

- Wall panels are fully structural and may include interior and exterior finishes.
- Wall panels may also include electrical receptacles and switches.
- Wall panels can be a maximum of 12 ft tall and a maximum of 40 ft long. Where spans greater than 40 ft are required, Plant will analyze the design to split the wall into two panels.
- To minimize material waste, wall spans should vary within 2 ft increments.

Wall Finish

- Wall panels may include interior finish such as drywall or paneling. Wall panels may also include exterior finish of various types.
- In order to be pre-installed on the panels, exterior finish should consist of either vertical siding or panel siding.

Floors

Floor Panels

- Floors outside of core mods are built as panels.
- Floor panels are fully structural and may include finishes.
- Floor panels are typically 8 ft wide and less than 40 ft long. Plant will analyze the design to split the floor system into appropriate panels.

Floor Finish

- Floor panels cannot be finished with continuous sheet goods (such as linoleum) in the factory. Final floor finish is normally finished on-site.
- Flooring in core mods is an exception to this rule, since core mods ship complete. Core mods can thus include any flooring finish (including tile and linoleum).

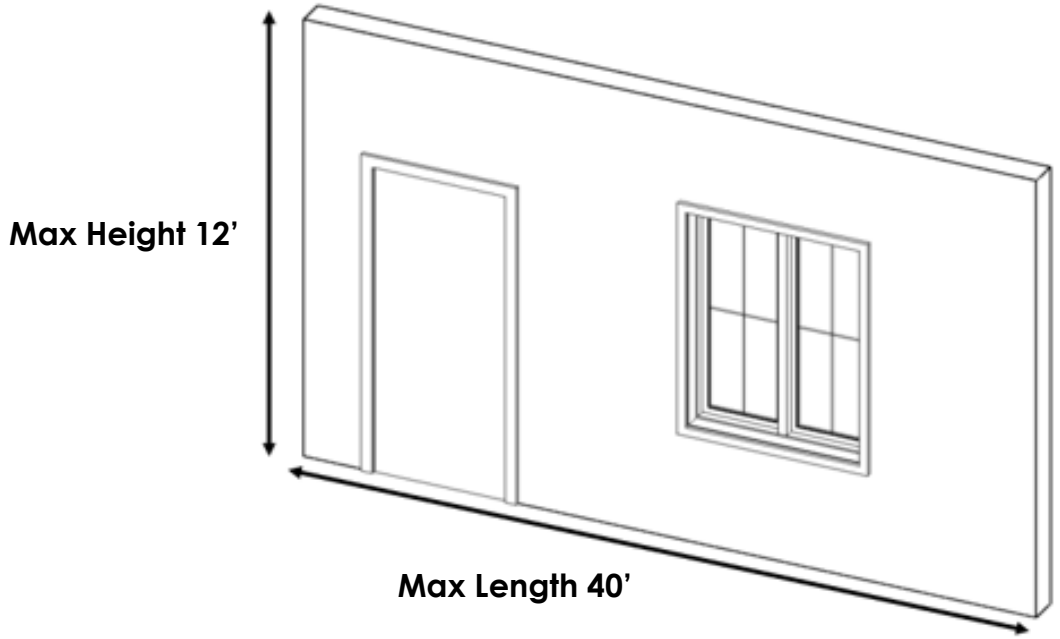
Roof

Roof Panels

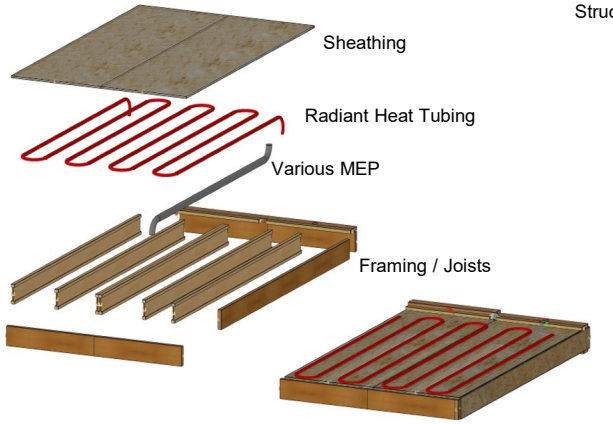
- Roofs outside of core mods are built as panels.
- These panels are fully structural and typically 8 ft wide and less than 36 ft long. Plant will analyze the design to split the roof system into appropriate panels widths.

Roof Finish

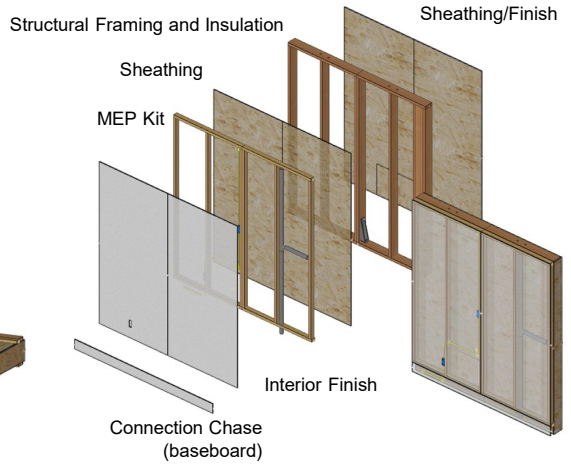
- Insulation and framing are completed in the factory.
- Exterior roof materials will be installed on-site in order to meet manufacturer's warranty and waterproofing requirements.



Floor Panel



Wall Panel



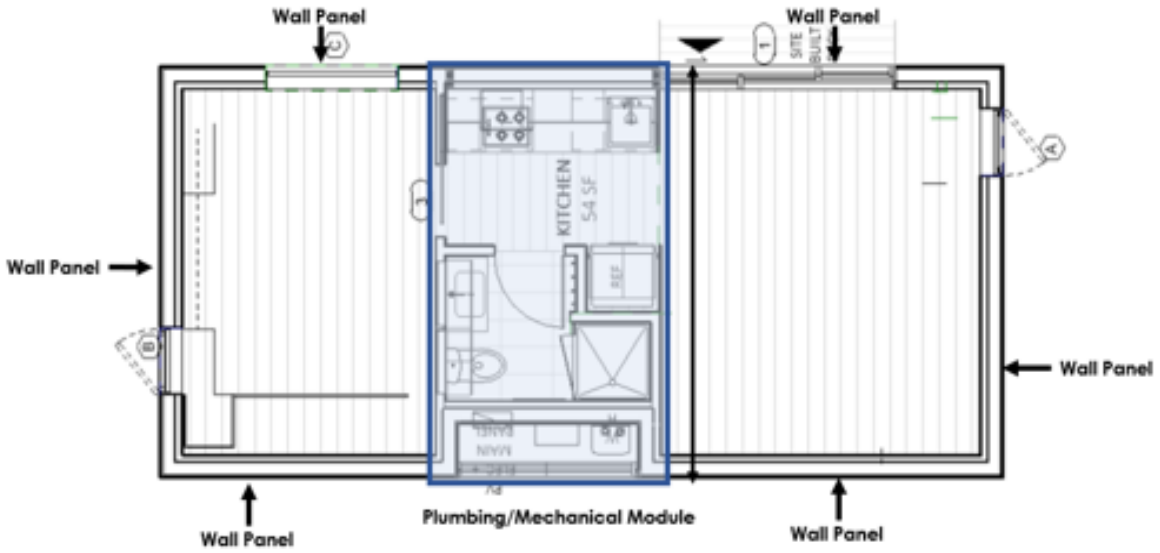
Basic Design Principles of Plant Panels, *continued*

Ceiling Panels

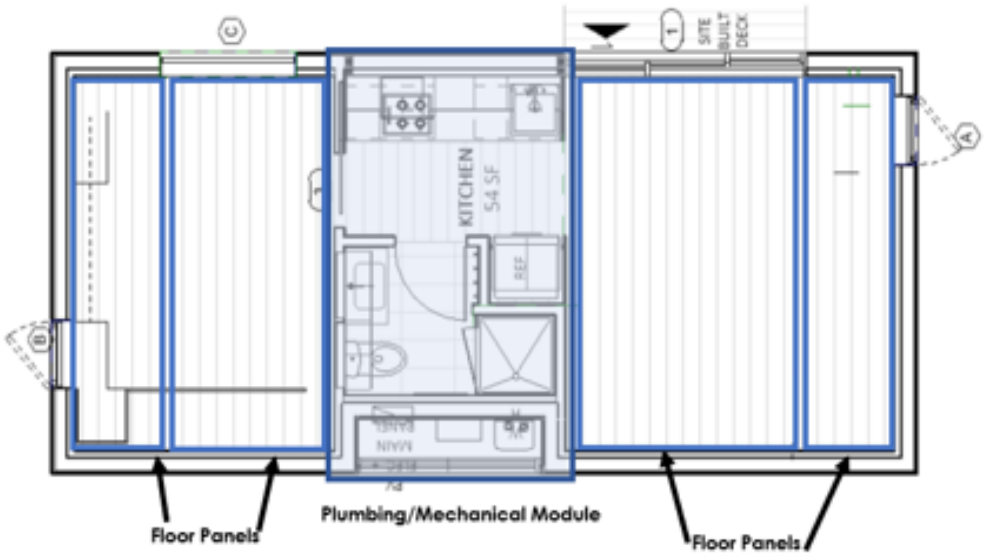
- Ceilings outside of core mods are built as panels.
- These panels are not structural and typically 8 ft wide and less than 36 ft long. Plant will analyze the design to split the roof or ceiling system into appropriate panels widths.
- Finish materials are completed in the factory and may include drywall or paneling. If paneling is used, attention should be given to material widths, as finishes are uniquely applied to each panel.
- Joints can be left expressed, as a part of the interior design, or stitched and finished on-site following installation (see examples on pages 27 and 30).

Windows and Doors

- Windows and doors may be included in wall panels.
- Floor-to-ceiling glass cannot be accommodated in a wall panel. Panels must contain framing as necessary to secure glazing.
- However, based on the overall building design, floor-to-ceiling glass may be accommodated by taking into consideration the roof and/or floor assembly, and/or the entire wall.



In addition to the wall and floor panels shown here, the roof will also be panelized.



LivingHome 10

This illustration shows the LivingHome 10 floor plan if it were to be constructed as one Plant Core Module (containing the kitchen, bath, and mechanical) with the rest (other walls, floor, and roof) as Plant Panels.

Utilizing PBS, this same floor plan could be constructed entirely as Plant Panels and shipped as a complete kit, or built as a single, fully-finished Plant Module.

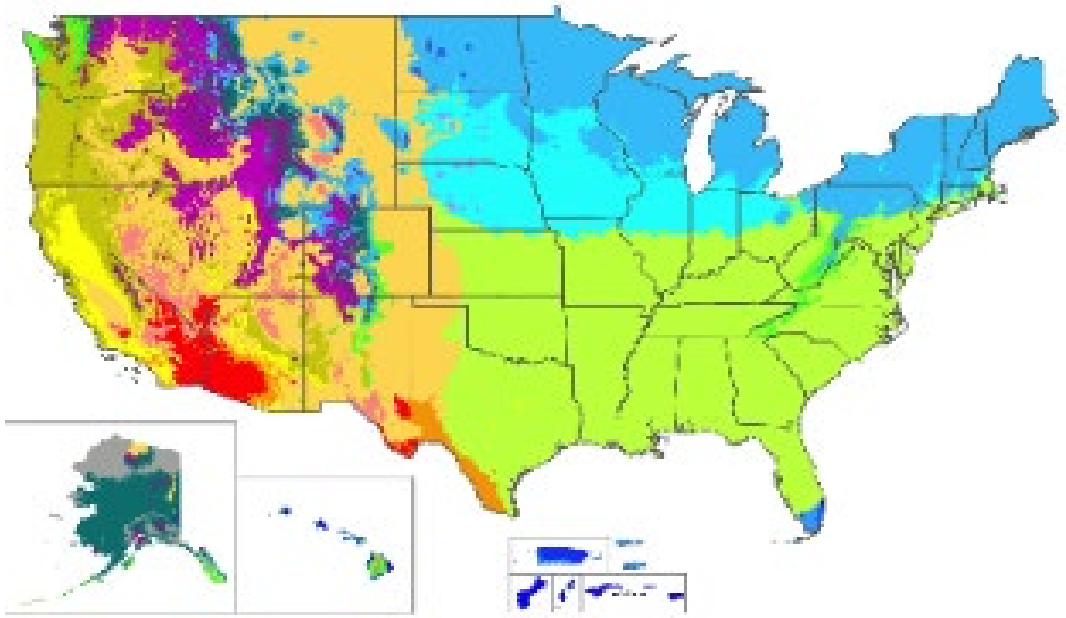
Plant Panel Design for Performance

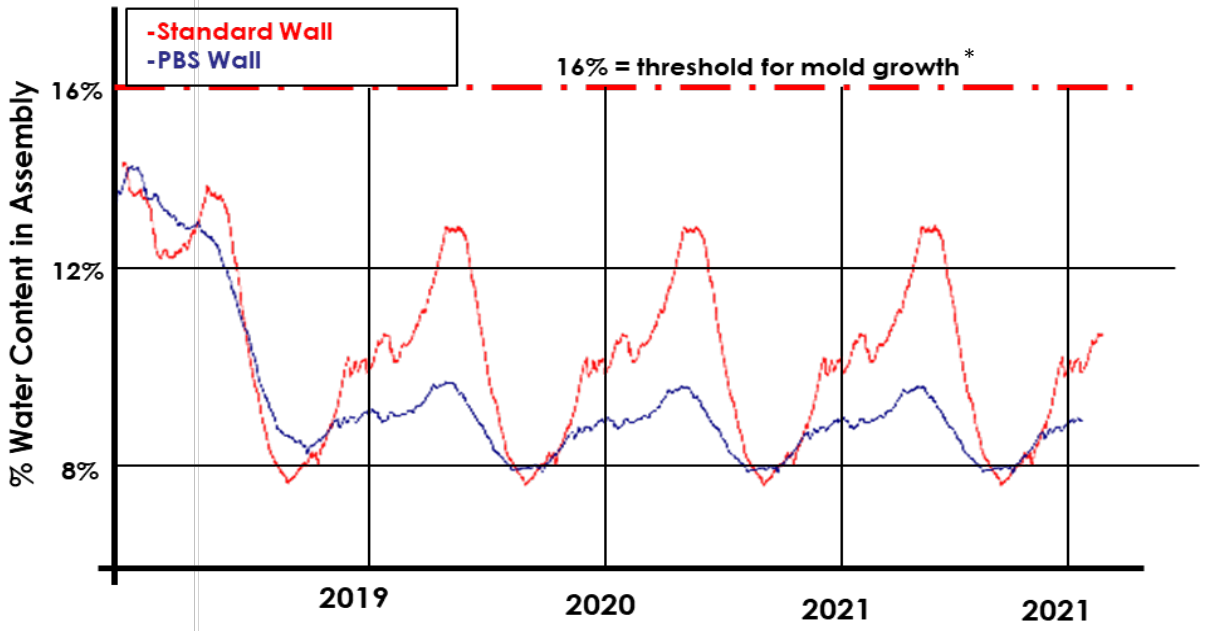
Engineered for Regional Performance

PBS component design is configurable by climate/region for optimal thermal performance and increased durability.

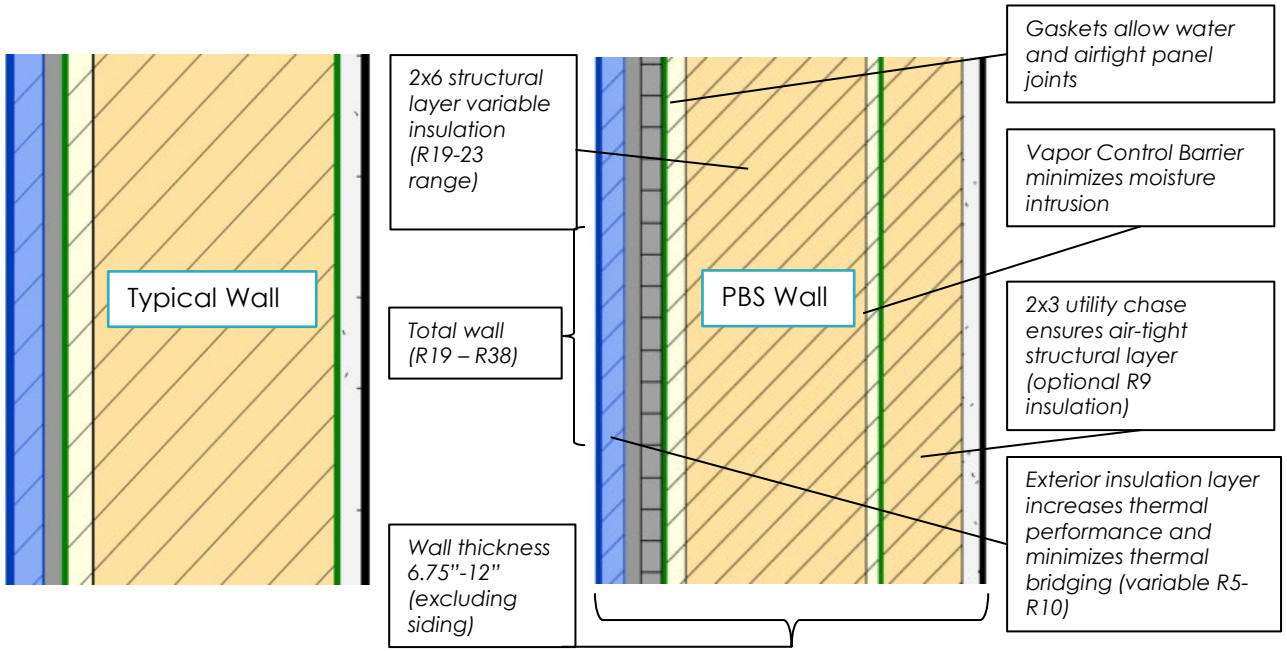
The overall design is regionally code-driven by air, water, and heat transfer analysis, coupled with local structural and seismic requirements.

This allows for optimal cost vs. performance profile for the project location. This customizability is a powerful feature of PBS.





We build variable wall geometries by geography and client needs



*Collected using WUFI® building performance software assuming common wall construction in CA marine climate

Case Studies

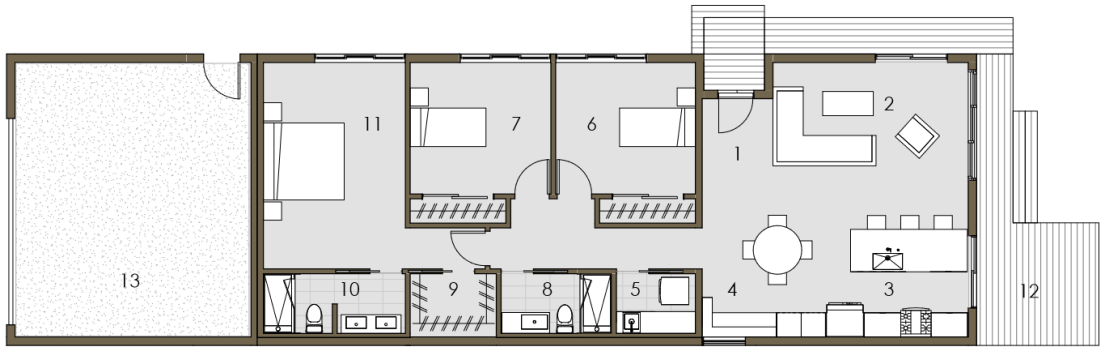
Case Study #1: All Plant Modules

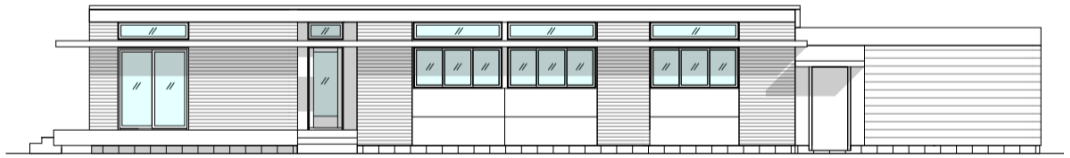
Pilarcitos Lake, CA
LivingHome 8
Designed by Plant Design Studio

- 1286 sf single-family home
- 3 beds, 2 baths
- Includes green roof, rainwater collection system, and super-efficient mini-split heating and cooling
- Built as two finished Plant Modules (living area) and Plant Panels (garage)
- Modules set and installed in ½ day

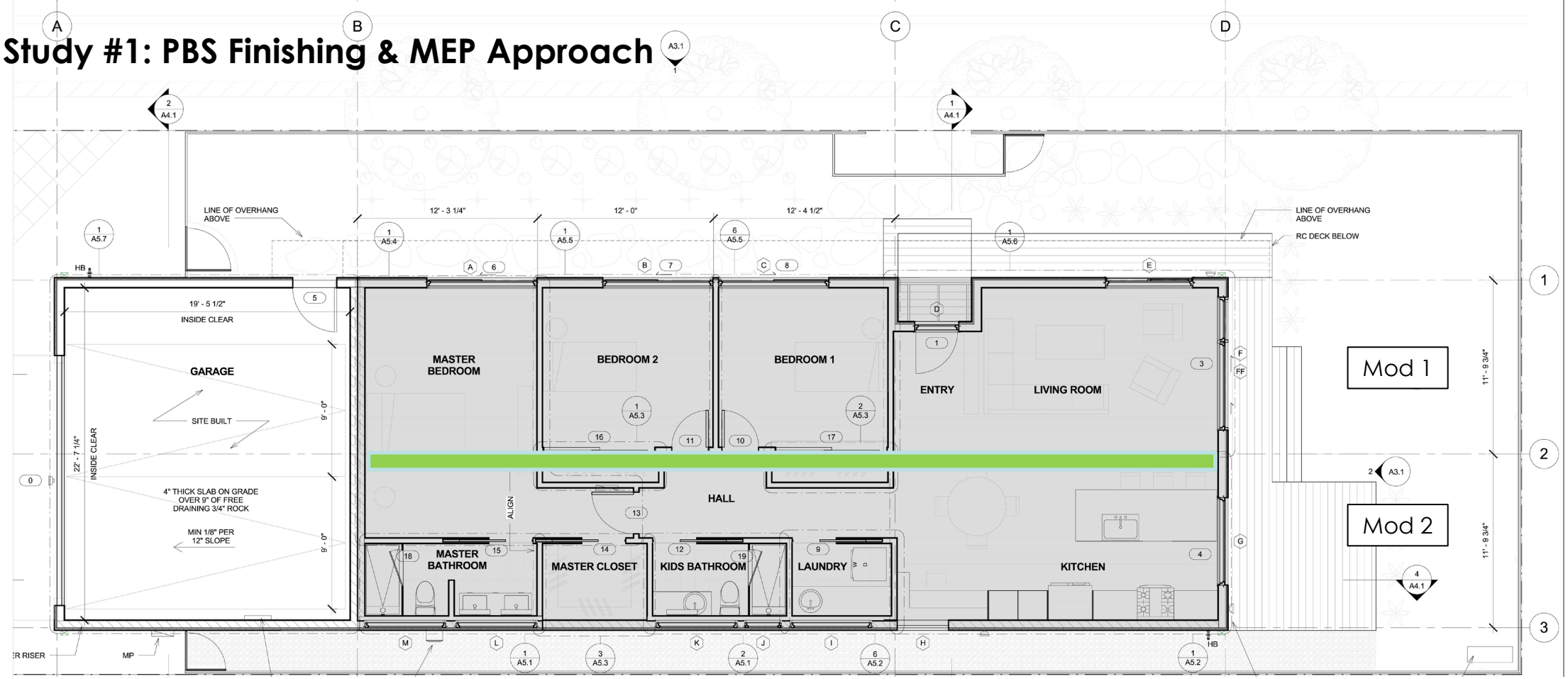
Classic modernist design elements like long, clean lines, spaces that bring the outdoors in, and a sense of openness in common areas is combined with functional amenities for real life. The open-plan living and dining area is anchored by a large, eat-in kitchen, which incorporates a built-in desk. A kitchen island with sink is perfect for entertaining, and glass doors open onto a sizeable deck for dining al fresco.

A hallway off the kitchen marks the passage into private living spaces, which include a laundry room, two bedrooms, and a full bathroom. At the end of the hall, a spacious master suite features a walk-in closet and master bath with double vanity. The adjacent garage provides more room for storage as well as a green roof for additional insulation and air purification.





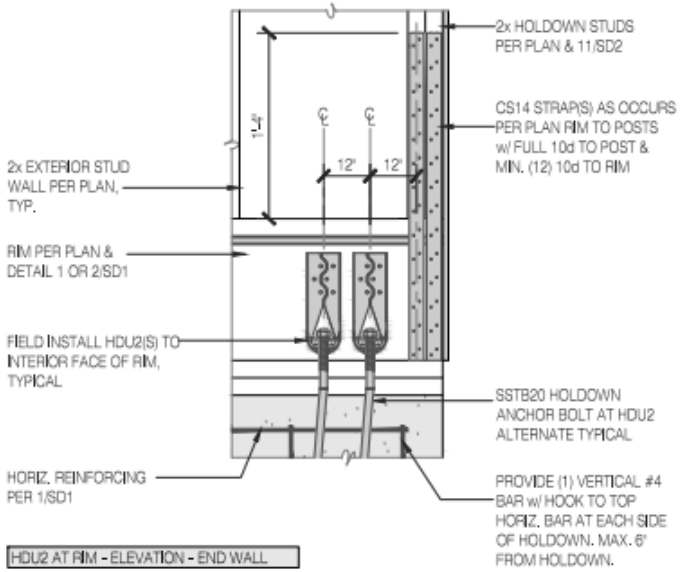
Case Study #1: PBS Finishing & MEP Approach

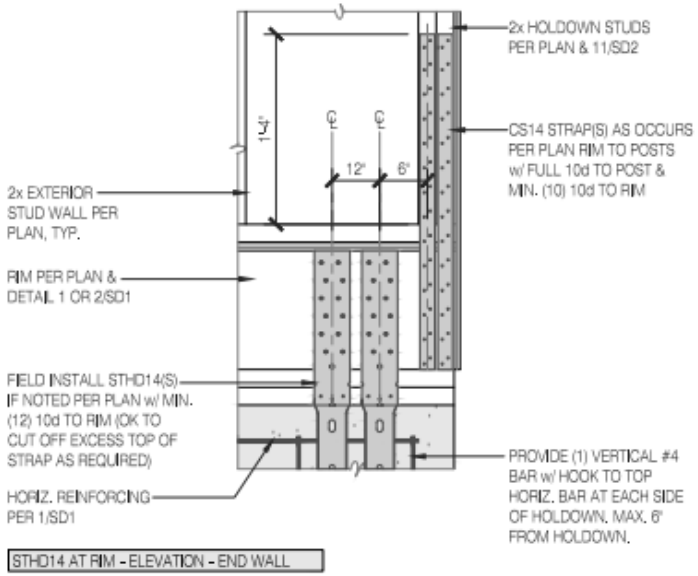


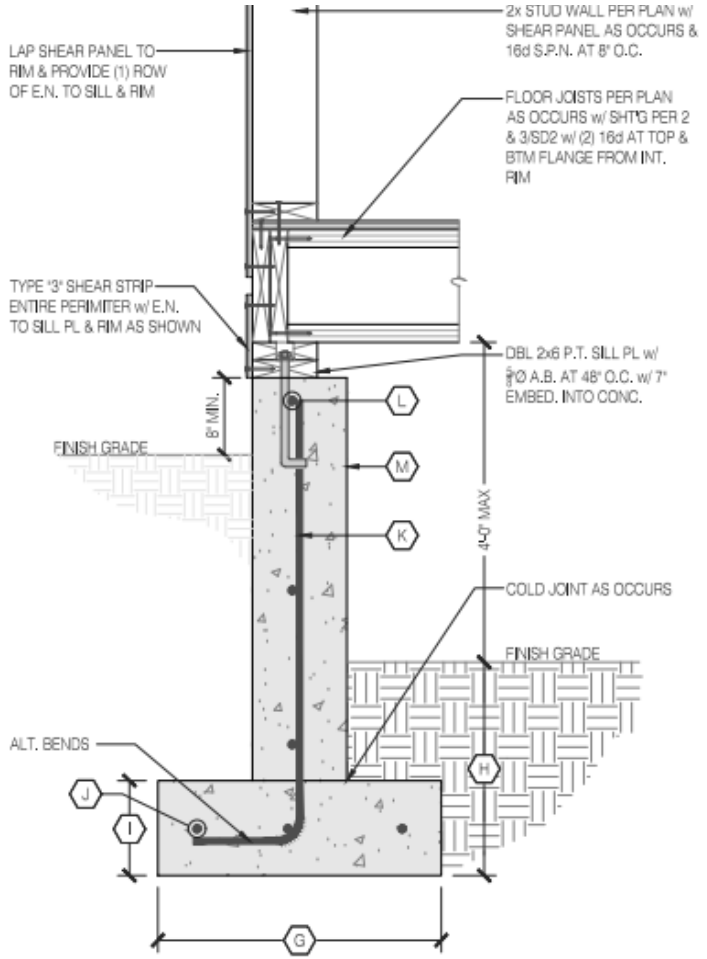
On-Site Finishes Installation

- Foundation, utilities, and garage slab are constructed while Plant Modules and Plant Panels are built in the factory.
- Flooring and drywall ceiling is installed in factory and left off at mate lines (green on plan) to allow for electrical, structural, mechanical, and sprinkler crossovers. One foot of drywall is left off each module.
- Six inches of drywall is left off (vertically) at mate line connections for on-site connection (blue on plan).
- Closet doors are installed in factory as well to minimize on-site finish work.
- Garage panels are installed the same day as the modules.
- Lowered ceiling in bathrooms allows for slim duct to blow across the top of closets into each bedroom. There are no ducted mod-to-mod crossovers.
- All plumbing is in Module 2 to minimize on-site connections.
- Rough plumbing is tested in the factory, then disconnected.
- A 2x4 plumbing wall (red on plan) is installed to ensure that vents and waste can bypass the double rim joists in both the roof and floor cavities.

Case Study #1: Typical Foundation & Connection Details







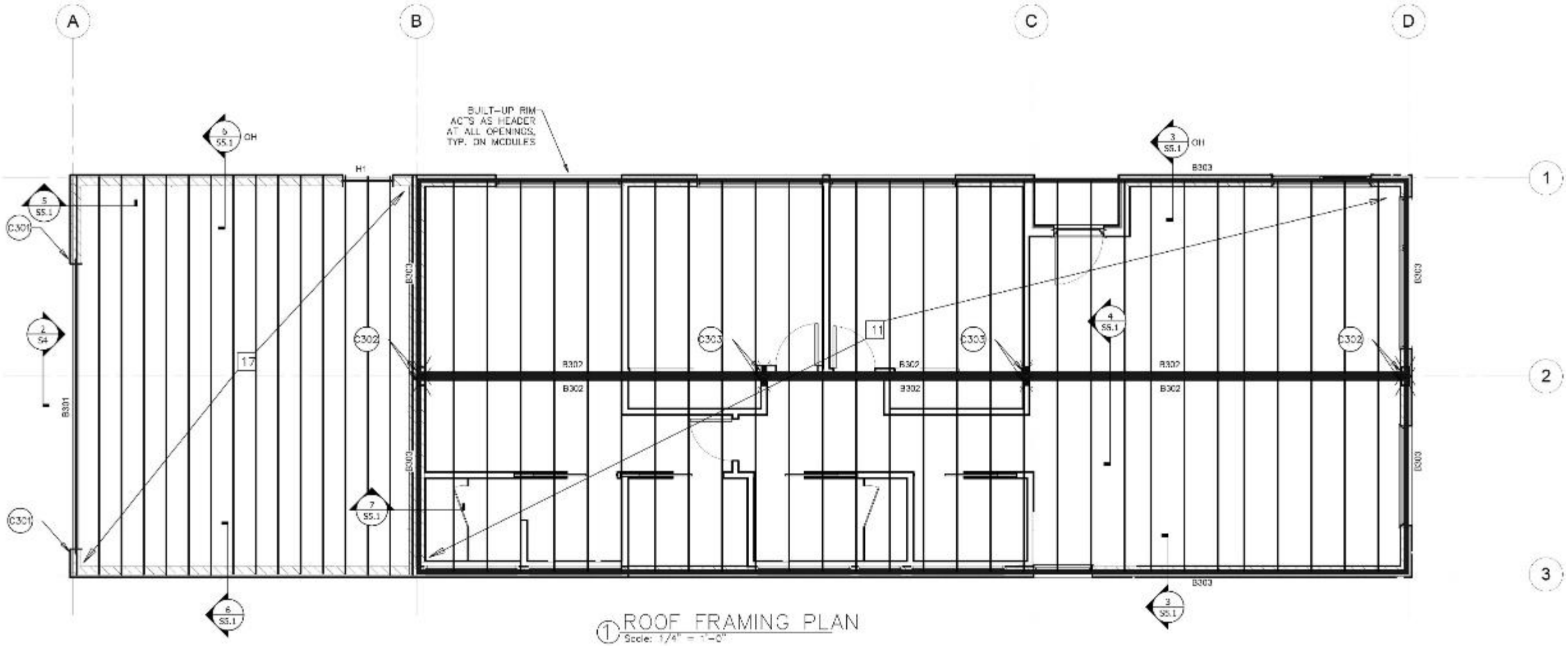
Above details show two different types of holdown conditions.

1. Posts for holdowns are installed in the foundation; the actual HDUs are packaged and shipped inside with the modules and installed in the floor framing.

2. STHD14 straps are embedded in the foundation and bent back prior to module set, then bent back in place and field installed.

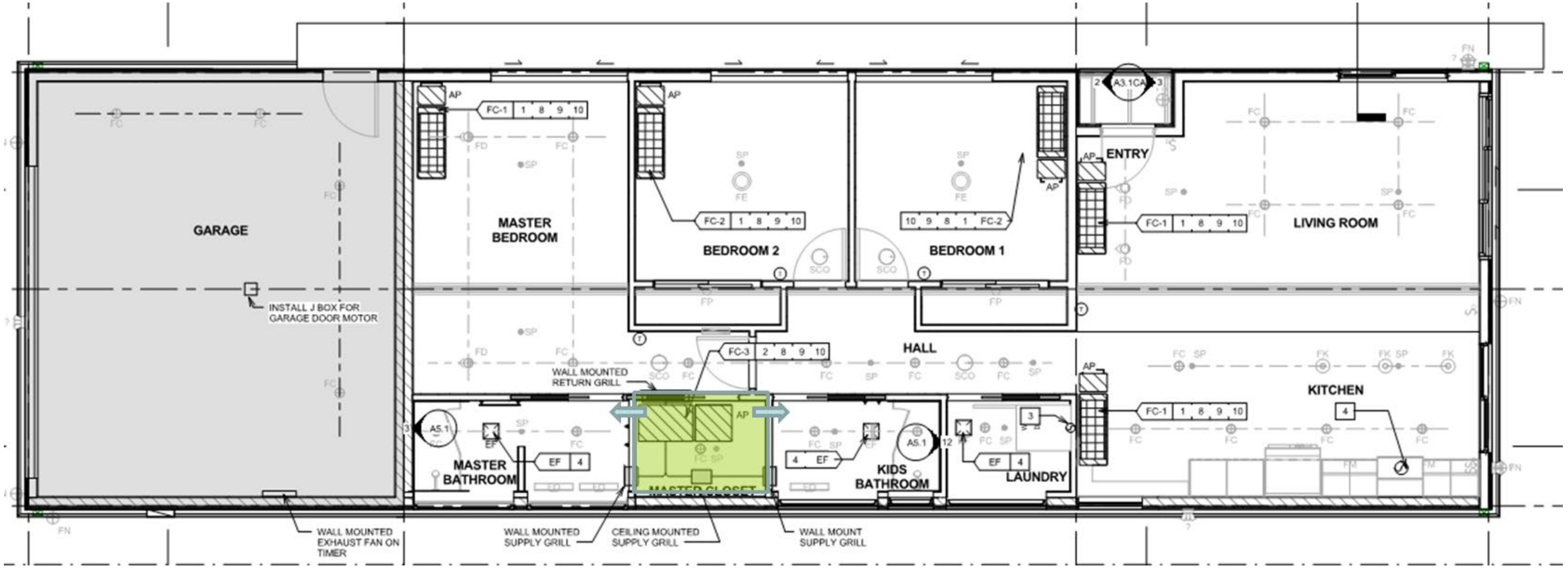
3. An OSB shear strip ties the module to the foundation at the sill plate.

Case Study #1: Roof Framing Plan



There is a drop beam at gridline 2, designed to continue the full length of the module to accommodate an open area between gridlines C and D, along gridline 1.

Case Study #1: Mechanical Design



Mechanical and sprinkler crossovers are located in the same bay to minimize areas that must be closed on-site. In this example, ceiling cassettes in each bedroom are located adjacent to the interior wall for condensate and line sets to be installed. They drop into the crawl space for connection to the condensing unit.

Master closet (yellow on plan) has a dropped ceiling to allow for slim duct to service bathrooms.

Case Study #1: On-site Exterior Finishing

Most of the exterior siding is installed in the factory, except for the roof overhang, any vertical component connection lines, and the fascia at the foundation wall.

- The vertical module line on the short end of the mods is sided after the structural connections are made and insulation is installed.
- The roof overhang is installed as a Plant Panel after the other component installation. Siding material is therefore left off that area to allow for flashing.
- The garage is completed using Plant Panels and TPO roof patch.
- All gutters and downspouts are also installed following the set.

Case Study #1: Installation Day

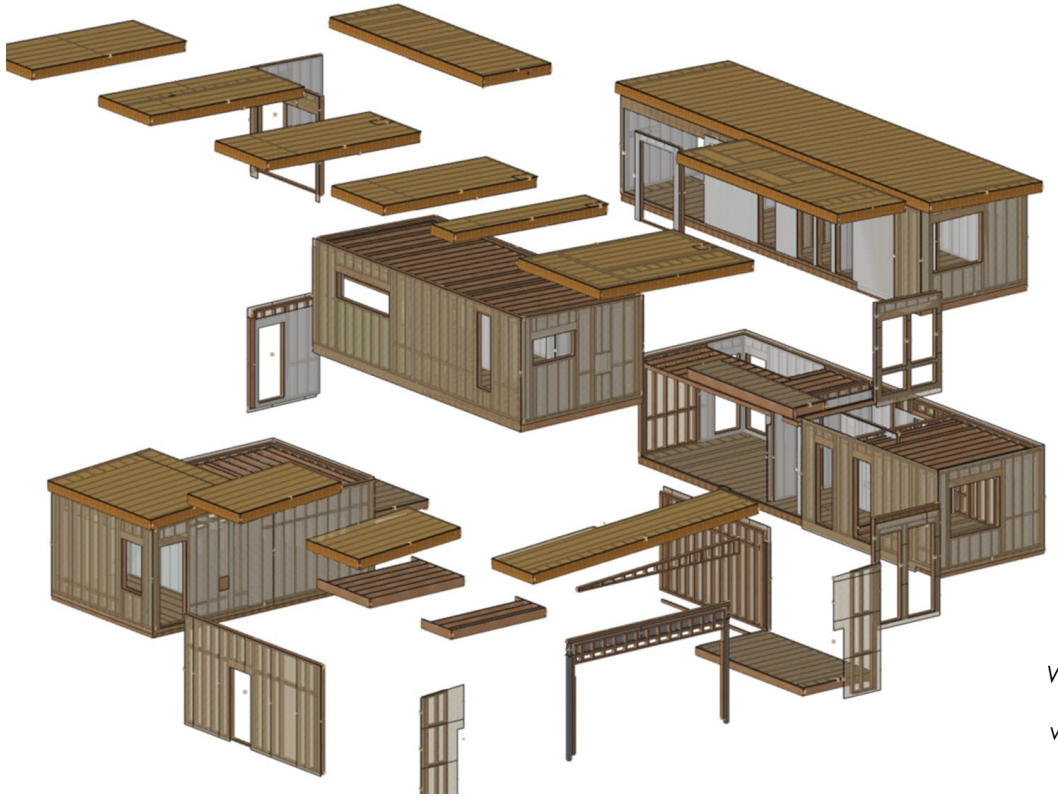
As is always the case with Plant projects, PBS components are constructed in our factory while the foundation and utility connections are completed by a general contractor at the job site. On installation day (pictured), a crane or other specified setting equipment is used to lift and set the components in place. The components are then secured to the foundation and one another, and utility connections are then completed by the site general contractor.

This project was set in roughly 4 hours.

Case Study #2: Plant Modules & Plant Panels

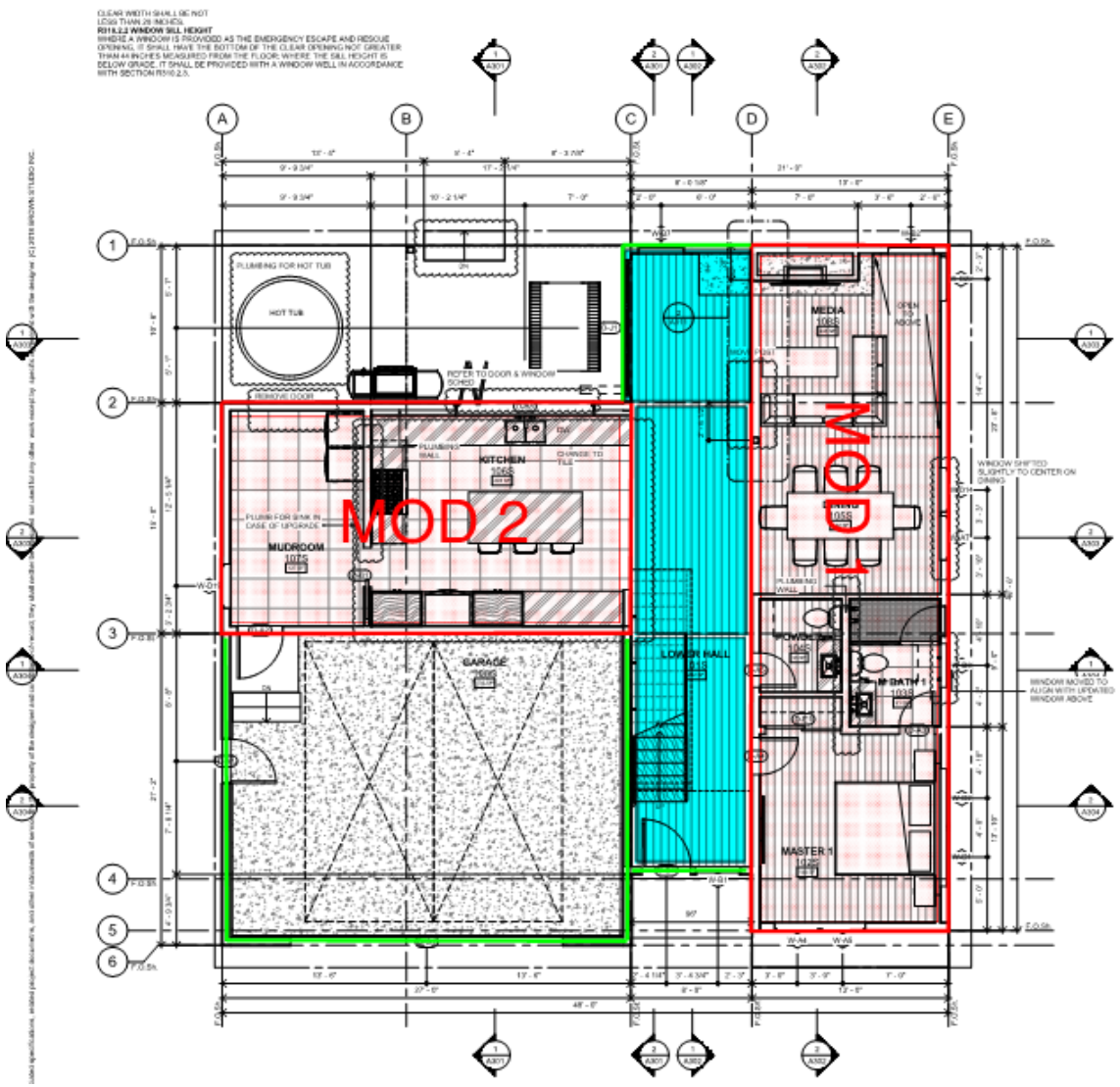
The Palisades at Squaw Valley
Custom home
Designed by The Brown Studio

- 2630 sf single-family home with 600 sf garage
- 4 beds, 3.5 baths
- Built as four finished Plant Modules (majority of living area) and 35 Plant Panels (garage, roof overhangs, and hallway areas between modules; indicated by red arrows on photo)
- Components set and installed in 15 hours
- *25 additional variants to be produced over 2020 and 2021*



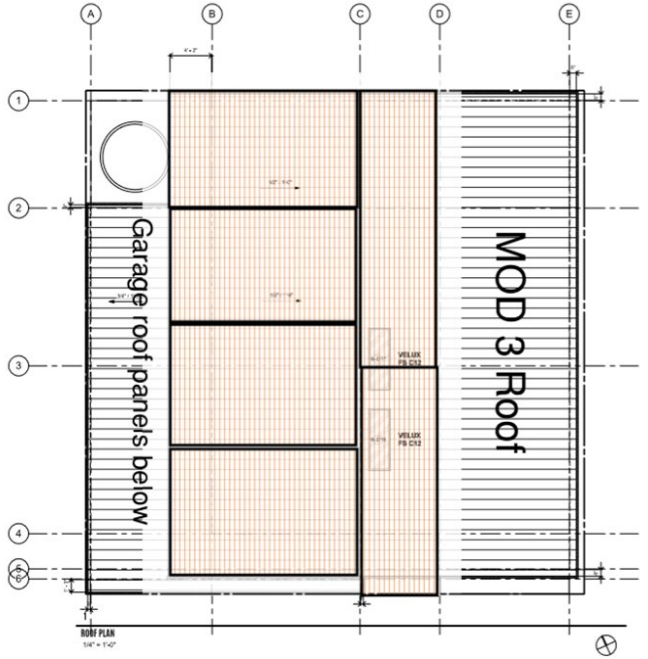
"We had a firm deadline and tight budget tied to the grand opening on January 3. We considered several partners, but ultimately concluded that we could only do this with Plant, because of their building and engineering technology.
—Developer

Case Study #2: Plant Modules & Plant Panels



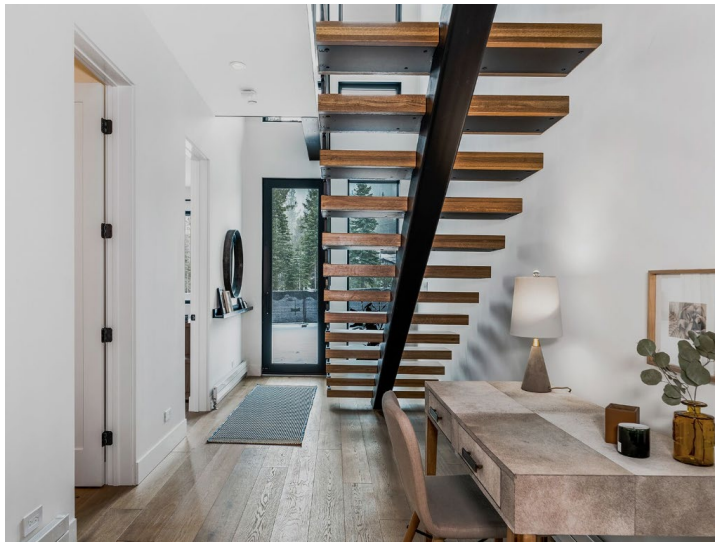
The first floor consists of 2 mods (red), 7 wall panels (green), and 3 floor panels (blue)

The second floor consists of 2 mods (red), 3 wall panels (green), 2 floor panels (blue), and 4 roof panels (orange) for a portion of the roof



The rest of the roof consists of 6 roof panels (orange)

Case Study #2: Interior Finishing






The hallway area (stairs photo) was constructed as Plant Panels, while the adjacent areas were constructed as finished Plant Modules. Joints between mods and panels can either be "stitched" (finished) for a seamless flow or "celebrated" (exposed) as an intentional design element. In this project, the joints and intersections were stitched together to create a seamless aesthetic.

Case Study #2: Installation Day

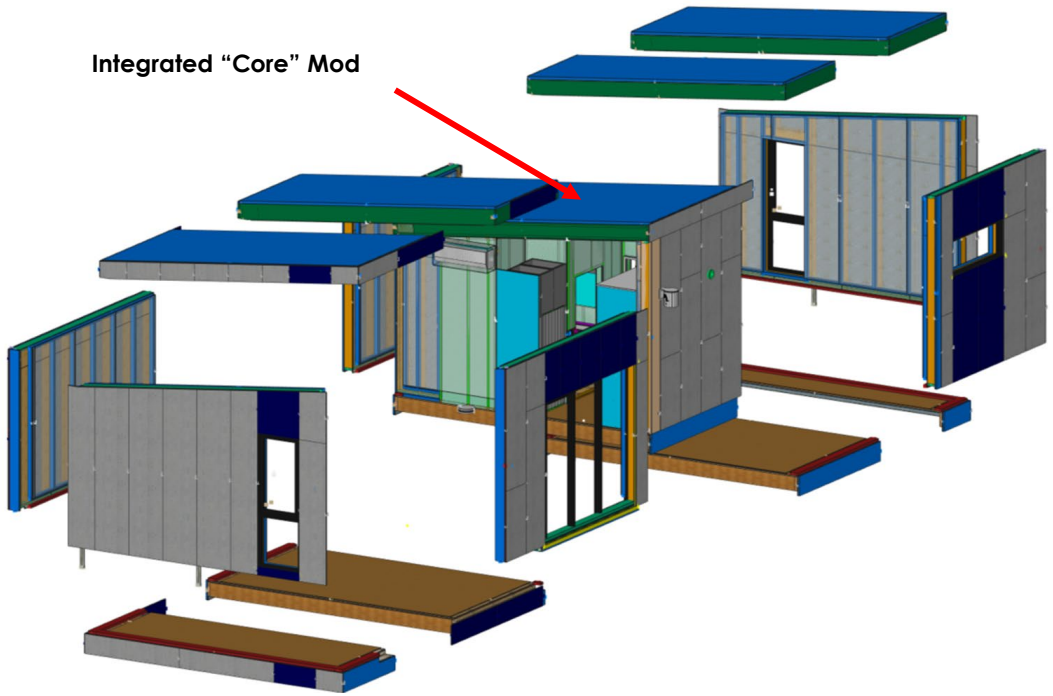
As is always the case with Plant projects, PBS components are constructed in our factory while the foundation and utility connections are completed by a general contractor at the job site. On installation day (pictured), a crane or other specified setting equipment is used to lift and set the components in place. The components are then secured to the foundation and one another, and utility connections are then completed by the site general contractor.

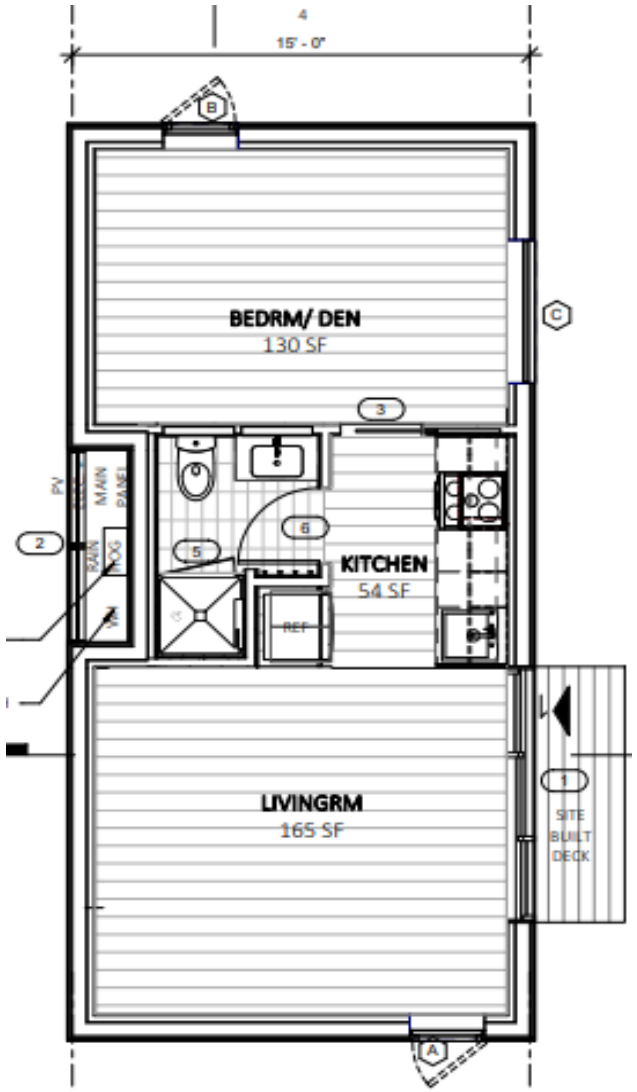
All components of this project (4 large modules and 35 panels) were set in roughly 15 working hours.

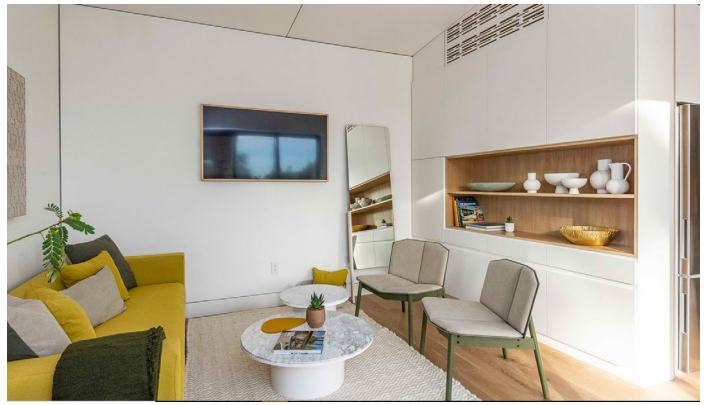
Case Study #3: Plant Core Module & Plant Panels

Palm Springs, CA
LivingHome 10
Designed by Plant Design Studio

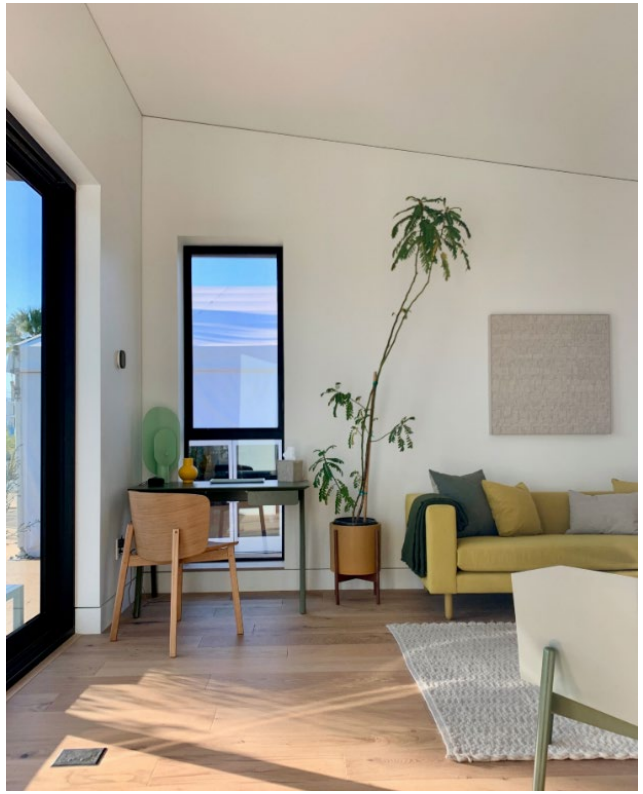
- 496 sf accessory dwelling unit show home
- 1 bed, 1 bath
- Built as one Plant Core Module (fully finished kitchen, bath, and mechanical area) and 14 Plant Panels (floor, ceiling/roof and wall panels, fully finished including glazing and electrical)

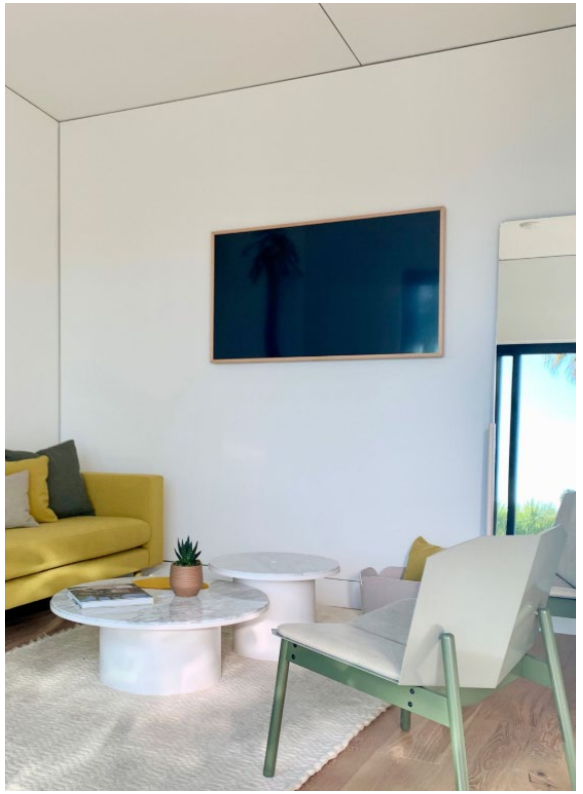
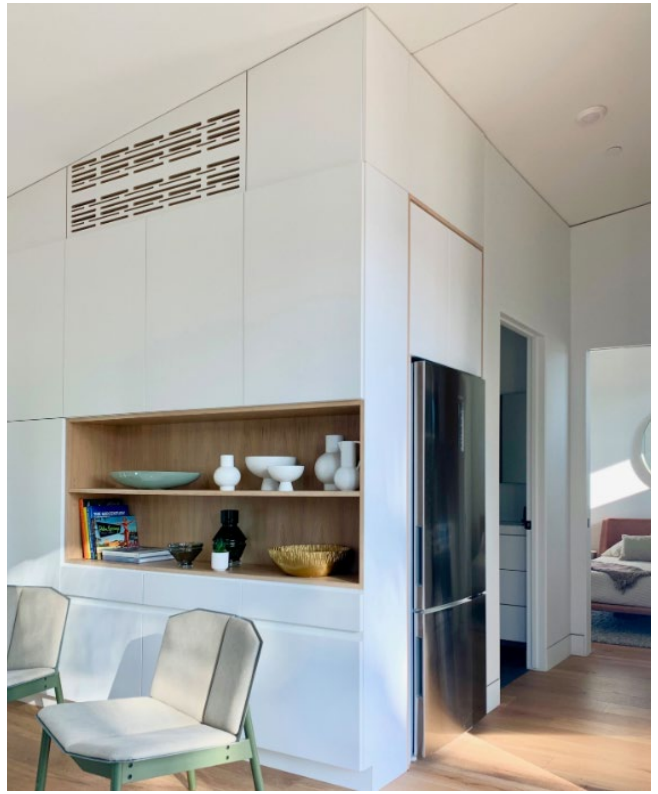






Case Study #3: Interior Finishing

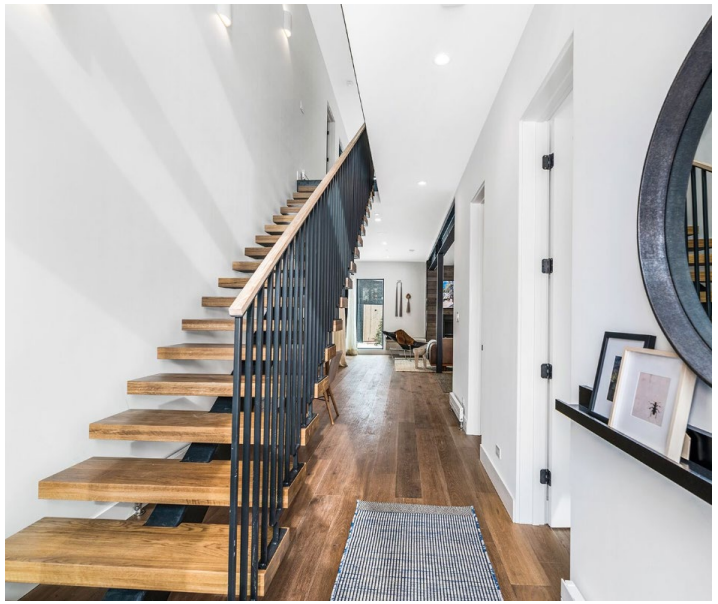


As referenced on page 27, joints can either be “stitched” (finished) for a seamless flow or “celebrated” (exposed) as an intentional design element. In this project, the joints and intersections were left exposed as a part of the modern aesthetic.

Case Study #4: Multi-Story Homes

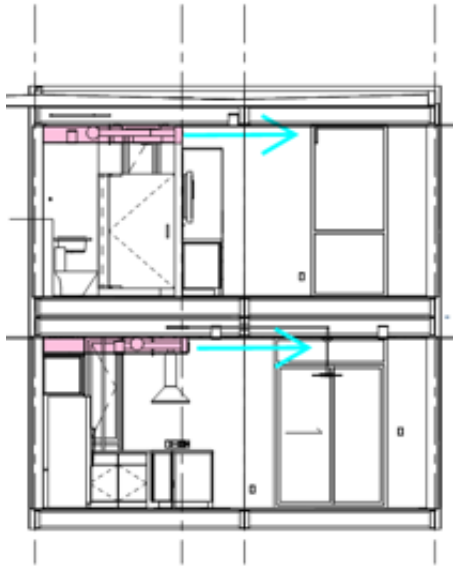
PBS facilitates efficient construction of multi-story homes. Staircases can be designed to be constructed in the factory and integrated into a Plant Module, or installed on-site as a separate PBS component.

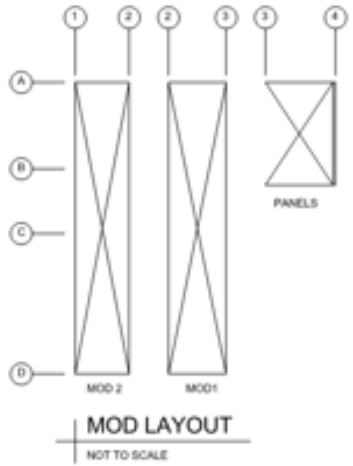


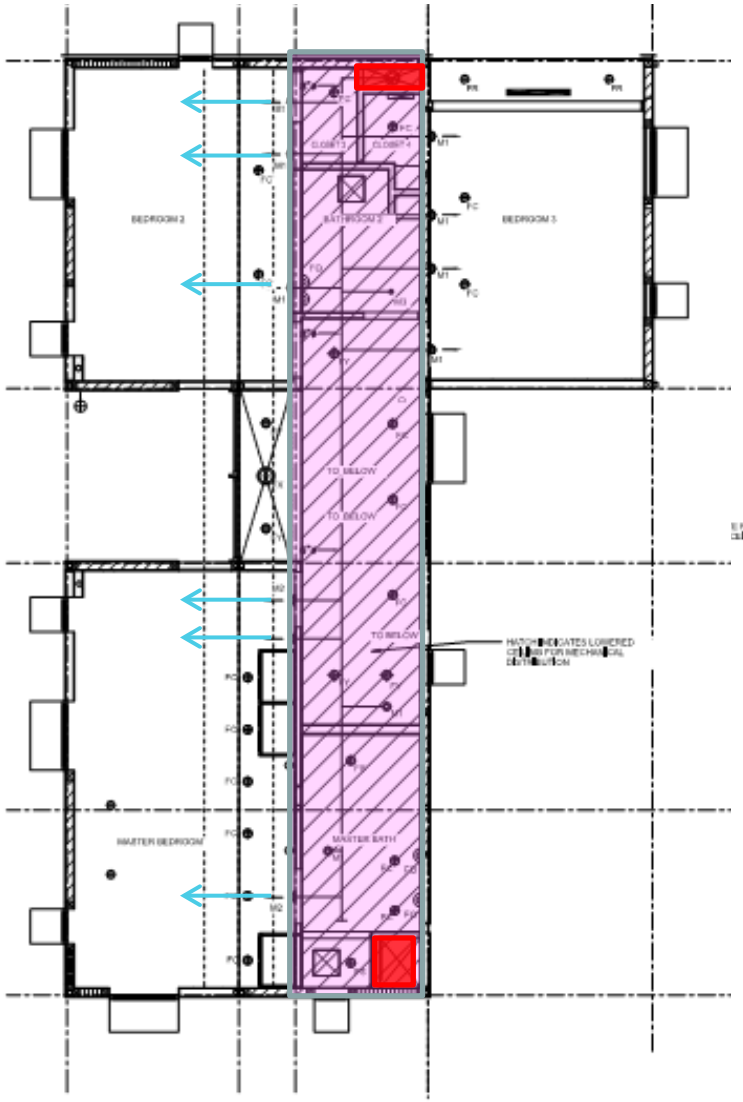
Case Study #4: Mechanical Design, Multi-Story Homes

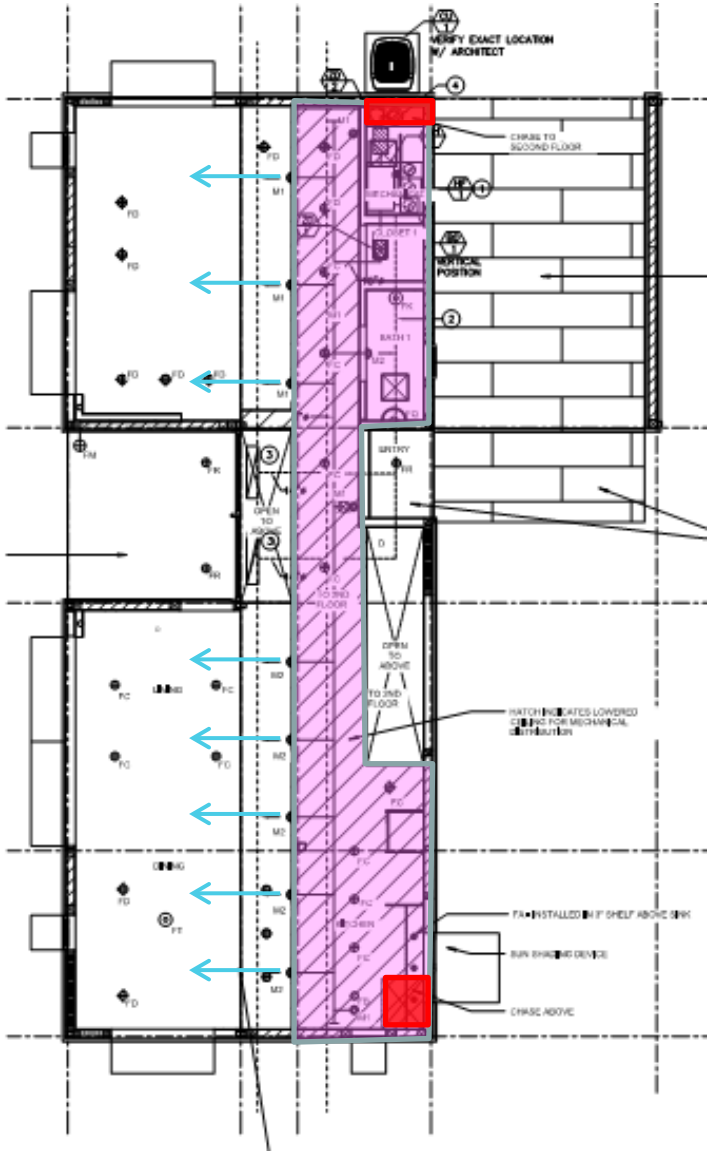
Mechanical design in this home is achieved with a mechanical/plumbing core. Dropped soffits are installed in Module 1 on both levels. The main trunk line of the high-velocity air system and supplemental 3" lines are installed within this soffit (pink on plan). Supply ducts blow air across from one module to service the rooms in the adjacent module.

Plumbing is also limited to Module 1. A vertical chase allows for sprinkler, plumbing (supply, vent, and drain), and duct work to travel between floors (red on plan).







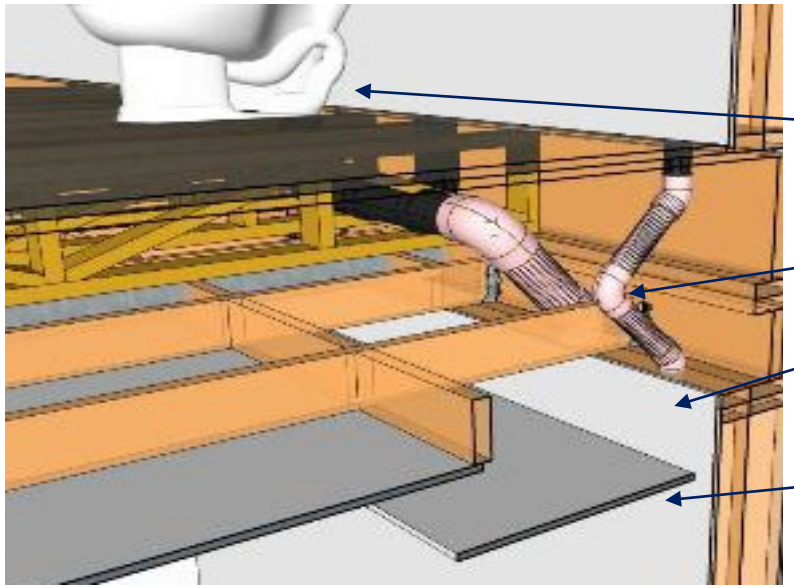


Case Study #4: Mod-to-Mod MEP Connections

Interior Vertical Plumbing Wall Detail

The bathroom is stacked on top of the living space with no plumbing. A chase wall is still needed in order to bypass the double rim joists along the exterior of the module. Detail also shows the parts that must be installed on-site by the local general contractor.

Drywall on the ceiling is left off in order to carry the plumbing from the floor above to the site utility.



Waste and vent (behind drywall) from module above

Site plumber connects upper mod to lower

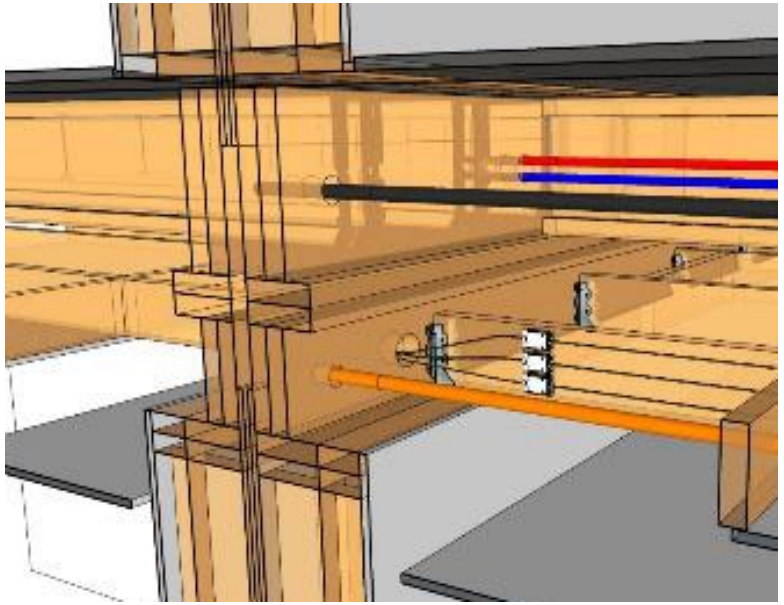
Waste and vent (behind drywall) installed in module below

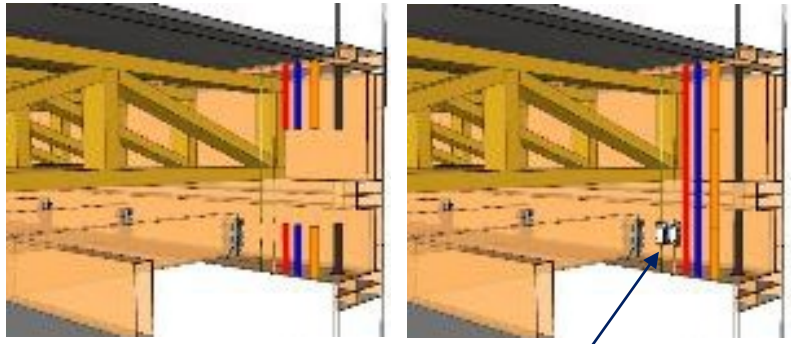
Drywall is left off to make plumbing connections

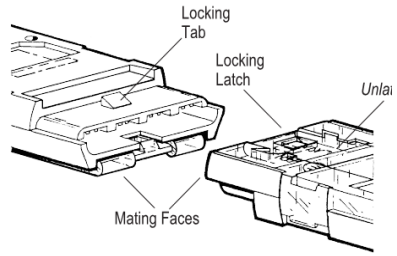
Interior Horizontal Plumbing and Electrical Connection Detail

Drywall is left off the lower module to allow for electrical quick connect, sprinkler, gas line, and water supply. Best design practice allows for horizontal chases to minimize the amount of drywall that must be left off and on-site connections that must be made.

Plant will advise on best practices for prefabricated design, but the architect/designer is ultimately responsible for incorporating these chases into the final architectural design.







Detail of electrical quick connect

Case Study #5: Overwidth Projects

The client for this LivingHome 6 wanted roof overhangs, which would have made the modules too wide for shipping. The overhangs were accomplished by integrating specialized panels that flipped up for shipping and were then set in place and attached on-site.

In the factory, the roof is constructed with overhang and then flipped onto main roof for shipping.

Post-installation, modules are attached to the foundation and the roof is flipped into position.

Modules are wrapped before departing the factory. On installation day (above), the hinged roof is visible beneath the plastic wrap, flipped onto the main roof along the exterior walls.

The Next Step

We would love to work with you to give you and/or your clients a proven, reliable, time- and cost-effective way to build an extremely high-quality home, based on your custom design.

If you'd like to learn more, we're happy to meet with your team at your office or ours for a presentation on prefabricated construction using the PBS system. We also offer guided tours of our factory in Rialto, CA and our show home in Santa Monica, CA. The home was designed by Ray Kappe, FAIA, and was the first home in the world to achieve LEED for Homes Platinum certification.

If you have a specific project you'd like to assess for prefab, send us your plans (ideally at a schematic level, but can be further along) and we'll conduct a complimentary review.

More generally, prior to production we're available to serve:

- As a consultant, to optimize your drawing set for prefabricated construction and coordinate with your SMEP consultants;
- As an executive architect, to complete the drawing set and state approval package based on your schematic design and specifications;
- Any combination of the above.

Thank you for your interest in Plant Prefab. To learn more, please visit plantprefab.com. To contact us, please email info@plantprefab.com or submit a project inquiry through our website.