a manual for project managers

MODULAR CONSTRUCTION

MULTIFAMILY RESIDENTIAL DEVELOPMENT TYPE III & TYPE V CONSTRUCTION

mercy HOUSING

ACKNOWLEDGMENTS

This Manual for Project Managers was created in response to questions that developers and members of the board of directors at Mercy Housing California had regarding modular construction. As one of the leading affordable housing developers and managers in the country, Mercy Housing is continually seeking ways to reduce the cost and time for the development of high-quality affordable housing. Based on peer research conducted by Mercy Housing and Proyecto, a real estate advisory and project management firm, a series of possible efficiencies were identified within the modular design and construction process that could be captured. These efficiencies could directly result in a shorter construction schedule, which could also, directly or indirectly, have cost savings impacts.

However, to capture these efficiencies, project managers must guide a process unique to modular design and construction. So, Proyecto led a series of discussions and investigations with Mercy Housing developers and a team of experts with experience in modular design and construction. The objective was to develop a tool for project managers that can be used as they approach new projects with the potential to benefit from the efficiencies provided by modular construction. This Manual is a result of that team work.

THE PROJECT TEAM

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I. MODULAR DEVELOPMENT:BACKGROUND

A. WHAT IS MODULAR CONSTRUCTION?

Modular design and construction is a method by which modules are built in a controlled factory environment (off-site) and delivered to the construction site as units. The modules are delivered to the construction site (on-site) where the foundation or podium has been completed. Once on-site, construction can occur more quickly and efficiently with eight to twelve modules being set each day, which translates to over 12,000 square feet of structure completed daily.

B. SOME GENERAL INFORMATION ABOUT MODULAR CONSTRUCTION:

- Modular units are fabricated off-site under controlled conditions and using materials which are ordered from the supplier and cut to exact dimensions.
- Consistent environmental conditions in the factory create safer and more productive construction work places.
- Quality assurance is easily monitored in controlled conditions, and inspections often occur throughout modular assembly line process.
- Because modules are prefabricated, on-site waste and site disturbance, including noise, are reduced.
- Modules include finished ceiling and floors, interior and exterior finishes, and mechanical, electrical, plumbing (MEP) within the units. Utility and MEP systems are ready to be connected vertically on-site within a multi-story building.
- Between 75% - 90% of the unit is typically completed off-site and delivered to the construction site ready to be set, which significantly minimizes on-site scope of work and time.
- Off-site fabricated modules are inspected in the factory, often by a state housing inspection agency. On-site construction work is inspected by the local jurisdiction. While modules are inspected in the factory, the completed structure meets local code requirements.

C. THE MAIN PLAYERS IN MODULAR DEVELOPMENT

1. Developer: the developer is responsible for assembling a design and construction team with experience in prefabrication and/or modular construction. From the start, the developer and the team must approach the project feasibility analysis, planning, and design with the intent to construct the project as a modular development. Once it has been determined that there are potential efficiencies in developing the project using modular construction, the developer is also responsible for coordinating and informing permitting agencies, as well as investors regarding the intent to develop the proposed project as a modular development.

2. Architect: the architect is responsible for analyzing the potential of the site to capitalize on the efficiencies of modular design and construction, and coordinating with the modular builder to ensure that the design of the project meets their fabrication parameters. In addition, the architect plays a significant role in coordinating inspections with state and/or local permitting and inspection agencies.

3. Construction Manager/ General

Contractor: the proposed general contractor often provides construction management services, who should have modular construction experience, prior to entering into a construction contract. The construction manager is responsible for advising the developer during the procurement process for the modular builder so that understandings regarding fabrication process, guarantees, site conditions, and on-site monitoring are addressed early in the development process. The construction manager is also crucial in advising on construction schedule and pricing, and in coordinating with the modular builder to reduce redundancies and clarify off-site versus on-site scopes of work with an objective of maximizing efficiencies of off-site fabrication and reducing on-site construction.

4. Modular Builder: the developer should seek the advice of the architect and construction manager to advise on the selection of the modular builder. Interests regarding financial, as well as production capacity and previous experience, are critical in evaluating and selecting the modular builder. During the predevelopment and design process, the modular builder is responsible for providing the project team with an understanding of their fabrication parameters, particularly regarding materials, dimensions, and production schedule. The modular builder works closely with the architect, particularly regarding engineering drawings and specifications, and the process for factory inspections and permits. The modular builder also works closely with the general contractor regarding the logistics for shipping, delivering, and storing the modules. It is strongly recommended that the modular builder also include in its pricing an on-site job supervisor with the general contractor to resolve issues that may arise during the assembly and installation process.

5. Investor/Lender: financial investors and lenders have a particular interest regarding risks prior to providing funding commitments to the project. For example, funders require demonstrable capacity of the modular builder and general contractor that may be evidenced through the ability for them to provide bonds and guarantees. In addition, funders are interested in the overall experience of the entire project team, and particularly in ways that the project team has significant experience in managing and completing complex projects.

6. Inspection/ Permitting Agencies: many government agencies that regulate residential construction are on a learning curve for managing the jurisdictional purviews for inspecting and permitting modular construction projects. Some government agencies structure their roles and responsibilities so that they are inspecting separate components of the overall construction –the modules, constructed off-site, are inspected in the factory by a state regulatory agency; on-site construction work is inspected by the local building department. However, team coordination of these jurisdictional concerns is critical from the beginning to address roles and liabilities; redundancies and/or miscommunication across review agencies could result in schedule delays and/or cost increases.

D. HOW THIS MANUAL IS ORGANIZED:

This Manual for Project Managers provides guidance throughout the development process when considering the use of modular design and construction. It begins with early site analysis and progresses through the various stages of project development. Even if the developer decides to pursue a standard site-built project in predevelopment, the process for modular design and construction helps to create a rational design and easier to construct building. The primary objective of the Manual is to outline and guide a development process for modular construction that maximizes efficiencies, primarily time savings that are inherent in modular design and construction.

Because modular design and construction for multi-family residential development is somewhat nascent, the potential for hard and soft cost savings continues to evolve. Project managers are encouraged to review development pro formas to identify potential reductions in line item costs corresponding to a reduced development schedule. Also, reviewing professional and construction contract fees related to scopes of work and reduction of time or scope may help to find additional cost savings.

!. General Manual Outline

I. Modular Development: Background

II. Development & Site Planning

III. Project Set-up

IV. Modular Layout: Building Plans

V. Efficiencies: Construction Scope of Work

VI. Tracking Costs: Budget & Schedule

VII. Financing Modular Construction

VIII. Appendix B: Site Plans for Site-Built & Modular Construction

II. DEVELOPMENT & SITE PLANNING

While most development sites can be constructed using modular construction, achieving cost and time efficiencies that modular construction can bring begins with identifying sites with a few key criteria. It is important to plan ahead to address various site parameters and constraints of modular design and construction, and include them in the project management schedule and tasks, as well as in project cost assumptions in the development pro forma.

A. SITE SELECTION & LOCATION

1. Access. Sites with access to major transportation networks increase the ability for module deliveries without significant traffic disruption and transportation logistical challenges. Sites with good transportation access help ensure the flow of the modules to the site based on a projected delivery schedule.

2. Site Height and Width. Sites with the capacity to have a crane on-site to set modules reduces the need for coordination with the department of transportation to occupy on-street area during the module delivery and set period. It is important to check for utility and electric lines that may hinder crane activity. Otherwise, measures for relocating the lines may be necessary before modular units can be delivered and/or set.

3. Storage. As units are delivered from the modular fabricator, development sites with a nearby location to store modular units for delivery to the site each day is optimal. Units can be stored off-site then delivered to the site each day for staging and setting. A storage location may need to be leased for the duration of the staging and setting period. The general contractor will include this cost in their total fee.

4. Staging. Sites with adjacent vacant land provide an opportunity to stage modular units that will be set each day, or a few days in advance, to ensure the flow for setting the modular units according to schedule.

5. Setting. Modules are usually delivered in increments of 10-12 per day, and approximately 8-10 are set each day. For example, 24 days of module set time is standard for a typical urban and suburban site. By contrast, for a site-built project, construction schedules for this level of completely dry-walled units would be anywhere between 6 and 8 months.

B. SITE PLANNING & PERMITTING

1. Site Planning. Rectangular sites are optimal for the design of a building using modular units. Because of the regularity of the module shape and dimension parameters, modules can be easily placed and stacked to create a rectangular building. Designs using modular construction parameters on an irregular site might need to consider on-site constructed building elements. While not a major impediment in the design and construction process, on-site constructed elements should be identified early in the design process, Schematic Design, to ensure that correct construction pricing and coordination, and design scope responsibilities, are considered in budget and other project management critical path assumptions. Similarly, fully built walls of modular units, when connected, increase the total floor area of building plans. Therefore, setbacks and height limitations should be considered when developing initial site plan,

building massing, and development capacity studies.

2. Construction Types. Currently, most modular fabricators are producing modular units for Type III and Type V wood frame construction. Many construction projects are built above parking garage podiums, or at-grade and wrap around parking garages. Of course, others are constructed at-grade with adjacent parking areas.

3. Building Height and Width.
Type III and Type V construction typically means a building height of 5-stories, or approximately 50-feet. Type III allows for an 85’-0” building height. However, it is important to research actual height measurement parameters in local land use ordinances. Modular units have finished ceilings and floors that are stacked and can add up to an additional five feet more than a standard on-site constructed building. As such, a variance may be needed to accommodate the additional height that stacking modular units would create.

4. Parameters for Site/Building Layout.
See Diagram in Appendix A

5. State and Municipal Plan Reviews.
Both state and municipal building and permitting agencies review construction documents for modular developments. The State agency reviews construction documents for the modular units and performs on-site

inspections at the modular fabricator facilities to ensure compliance with residential applicable construction codes and regulations. Based upon a successful inspection, a certification of building approval is applied to the individual modular units. The Municipal agency reviews construction documents regarding building code and regulation compliance for the on-site constructed elements of the building, OSHA regulations, and other construction requirements apart from parameters of the modular unit design and construction, which is regulated by the State. Both agencies typically receive a complete set of construction documents. Fees for the State review and inspection of the modular units are typically included in the modular fabricator's fees. Fees for Municipal agency review and inspections are paid by the developer, and even though they are not responsible for reviewing the entire building, fees are not discounted and are typically calculated based on total construction costs. The project manager, architect of record, and modular fabricator engineer, should coordinate a meeting with both permitting agencies before completing the Schematic Design process. At this meeting, the project manager and agencies should confirm and clarify documentation and coordination between the agencies that may be requested or required, and should discuss module inspections on-site due to limitations of testing at modular factory.

IT SHOULD BE NOTED

The architect of record should have the primary authority for managing the design and permitting process and coordinating with the fabricator's engineer. It is recommended that the fabricator serves an advisory role to ensure the architect understands the assembly and fabrication details, dimensions, and other key parameters of modular fabrication, delivery, and construction. The modular fabricator is responsible for completing the permit application in coordination with the architect of record and project consultant team.

III. PROJECT SET-UP

For a project manager who is about to undertake a modular development, the most important distinguishing factor to consider is that most design and construction specification decisions are made upfront, and basically determined by the completion of the Schematic Design phase. This will allow the project manager to manage potential budget and scope more effectively with the project team. As such, scopes of work for the design team and the construction manager/ cost estimator, including the modular fabricator engineer, are front-loaded to help the developer address the various design and construction considerations that will have an impact on the financing and scheduling feasibility analysis. Even if the developer determines not to construct the building using modular units, the parameters that modular design establishes, creates a rational and easier to construct standard on-site Type III or Type V building.

The following sections focus on "obtaining efficiencies", and ultimately cost savings, by understanding some basic parameters of the modular system that will affect the building and unit layout.

IV. MODULAR LAYOUT: BUILDING PLANS

A fundamental premise in modular building is – "start with the assumption that the project will be designed and constructed as a modular building." Using this as the fundamental approach will create a rationally designed building, which will be easier to construct if the developer chooses to pursue to a site-built project. Modules can be used when constructing over podiums, wrapping around a parking garage or courtyard, and building at-grade. To capture efficiencies leading to time and cost reductions, there are a few rules of thumb to follow with the architect and engineering team in laying out building plans and massing.

A. EFFICIENT MODULE DIMENSIONS

Rule 1: Maximize the dimensions of the modules to reduce the number of trucks used in transportation and number of units to set. However, maximizing module dimensions must be weighed against the need to saw-box those modules on-site, thereby increasing the site built work, time, and costs, while reducing the efficiency of modular construction.

Rule 2: Reduce on-site work by designing a building plan that easily stacks modules and minimizes on-site installations.

Rule 3: Design unit plan dimensions within the parameters of maximizing the module dimensions. For example, modules can be up to 72 feet long, which means that a module could accommodate a 6-foot hallway with units with a depth of 30-feet on both sides of the hallway for a total module unit length of 66-feet. An additional 2-feet should be considered, for a total of 68-feet, to accommodate vertical chases for MEP lines in the hallways. While the modules can be up to 72 feet long, unit depths over 30 feet tend to get poorer lighting toward the interior of the unit. The optimal width of the module is approximately 14'-6" within which typical apartment rooms sizes can be accommodated. While a module's dimension can be as wide as 15'-9", the ideal dimension is less, and the most inefficient module width would be below 12'-6".

Rule 4: Orient modules to minimize the number of modules to transport or saw-box on-site. Two modular orientations are:

- Modules with Hallway are the most efficient because it minimizes on-site work and maximizes the module depth.
- Modules Parallel to Hallway can produce building plans to reduce the number of modules. However, on-site work increases because hallways and stairwells need to be built, and create challenges connecting hallways built on site to modules as they are being set. In addition, building layouts that maximize module dimensions may be more challenging and create the need for saw-boxing on-site. Reduce the need for saw-boxing.

SAW BOX

Typical cross-corridor modules are built in the factory with dimensions at approximately 16' x 32" on either side of a 5' to 6' corridor. The cross-corridor "boxes" arrive at the site as a complete module or may be sawed in half at the construction site to create two separate boxes. While there are efficiencies in factory building and shipping these two boxes as a single module, saw-boxing creates additional on-site construction scope, which reduces the overall efficiencies in modular construction.

Rule 5: Maximize modular building elements to minimize on-site work. For example, stairwells and corridors can be constructed as modules. Building modular stairwells and hallways mitigates the need for scaffolding and other ingress/egress or life safety requirements, such as OSHA regulations during construction, as hallways and stairwells are built, and modules are stacked and set, floor-by-floor.

Rule 6: Consider the trade-offs, as well as building height impacts, of building a usable podium space, or unusable crawl space, upon which the modules are set, and through which modular infrastructure systems are run.

Rule 7: While considering transportation height limits, include the roof if possible, which keeps the top units weatherproof during installation reduces the mount of on-site roofing and insulation scope of work.

V. EFFICIENCIES: DESIGN SCOPE OF WORK

It may helpful to think of design services in terms of the Architect of Record (AoR) providing the full range of architecture and engineering services, and the modular fabricator providing engineering design advisory services. The modular fabricator, engineer/architect, and the AoR should coordinate at the commencement of the first design phase, Concept or Schematic Design, to ensure that the parameters of the module dimensions, scope, shipping constraints, and other considerations which maximize, or reduce modular design and construction efficiencies are understood.

To facilitate effective coordination between the AoR and the fabricator architect/engineer, reduce or prevent scope redundancies, and ensure that the design is maximizing the modular efficiencies, there are a few rules of thumb to follow with the architect and engineering team in scoping design services.

Rule 1: Select an architecture firm with experience in modular design and construction. Until the design industry has a larger pool of experienced firms, architects with experience in modular construction can be challenging to find. An alternative may be to identify firms that have staff architects or engineers with experience in modular design and construction. This strategy is highly advised for a developer’s first modular project, as the design team will bring the do’s and don’ts, and design and construction oversight experience, to reduce potential risks.

Rule 2: Include the development of the permit set of documents for both the municipal, as well as the state building departments in the AoR scope of work. The state building department reviews permit documents and factory inspect the modules, i.e. the building elements that are fabricated off-site, in the factory. The municipal building department reviews permit documents and inspects on-site construction. A complete permit set of documents should be submitted to both building departments, even though each department is only responsible for reviewing, permitting, and inspecting either the site-built or factory-built construction elements.

Rule 3: Prepare to identify finishes and specifications in early design phases so that the modular unit fabricator and cost estimator can more easily advise on potential cost and time savings and provide more accurate cost estimates. Also, consider the possibility of standardizing finishes and specifications when working with a few modular unit fabricators so that costs and time for developing specification packages are reduced.

Rule 4: Anticipate an increase in the AoR fees (approximately 20%) to cover the additional dual role of coordinating with the modular unit fabricator, as well as submitting two separate permit set of documents to state and municipal building departments. While this is an unfortunate potential cost increase in architecture fees, centralizing and working with an experienced architecture firm will reduce risk during the modular design and construction process. Also, it should be noted that this fee would have otherwise been paid to fabricator's engineer for design services, and is now going to the AoR to centralize responsibilities, which also increases scope of work efficiencies and makes it easier to manage the project team.

V. EFFICIENCIES: CONSTRUCTION SCOPE OF WORK

There seems to be an assumption from various development team members, including project managers, financiers, and designers, that the developer contracts directly with the modular unit fabricator. However, as the modular design and construction method is different from a site built method, the perspective on what gets procured and delivered in construction differs, as well. The developer should think of the module, the unit, as an element that is purchased and delivered to the site for installation by the general contractor, and is overseen by a site supervisor representing the modular fabricator to address issues during modular unit delivery and setting that may arise at the site.

The module can be considered similar to the way a cabinet is constructed in a factory, delivered to the site, and ready to be installed. As such, similar risks in production, transportation, availability, quality, etc. are a concern, and, like a cabinet, it is the general contractor that contracts for the purchase, delivery, and installation of the cabinet. However, if something goes wrong with a cabinet, the budget and schedule impacts may not be as devastating as a modular unit. Therefore, the coordination between the architect, fabricator, and general contractor (GC) is critical from the very beginning of the design process.

The GC should recommend potential modular unit fabricators and work closely with the developer in identifying the qualified fabricator with capacity. Because the fabricator is critical to the design of the project, they should be identified early so that the fabricator's design engineer informs the design of the building at the initial Concept and Schematic Design phase.

Finally, a key factor in modular construction and achieving more exact pricing, scheduling, and efficiencies is agreeing on building plans and unit finishes during the schematic design phase. Agreeing upfront on these core design elements provides opportunities to focus on modular design methods that will reduce construction time and potentially costs, particularly related to coordinating on-site construction and off-site fabrication.

To reduce risks and ensure effective coordination in the design and construction of a modular construction project, there are a few rules of thumb to follow when procuring and managing the design and construction team.

A. PLANNING & CONCEPT DESIGN PHASE

Rule 1: Discuss the design and construction intent of the project with an architect experienced in modular design, and clearly communicate the intent to design the building using standard modular dimensions.

Rule 2: If possible, work with a construction manager/cost estimator experienced in modular construction, and who has relationships with modular fabricators, to get initial pricing for feasibility analysis.

Rule 3: Discuss site challenges that might reduce efficiencies of modular construction with the architect and general contractor, particularly regarding irregularly shaped sites, hindrances to staging and deliveries, and obstructions for cranes and setting, and determine if the site is appropriate for modular construction.

B. SCHEMATIC DESIGN PHASE

Rule 1: If possible, procure the experienced construction contractor during the schematic design phase to work with the architect and the modular fabricator, and coordinate efforts to maximize efficiency in the design to reduce construction costs.

Rule 2: To obtain more exact pricing, begin working with a qualified modular fabricator with financial and scheduling capacity during the schematic design phase.

Rule 3: Obtain agreement and approval of general building plans, height, massing, set-backs, etc. as soon as possible.

Rule 4: Work with architect and modular fabricator to select interior unit finishes. In addition, modular fabricators typically have preferred vendors and suppliers that might bring additional savings.

Rule 5: Develop and agree on a fabrication and construction schedule prior to proceeding to the design development phase.

Rule 6: Obtain pricing from the construction contractor with an itemized breakdown from the fabricator, refine design to maximize efficiencies and reduce costs, and agree on a preliminary construction budget prior to proceeding to the design development phase.

A NOTE ON DESIGN KICK-OFF

Ensure that the AoR has all the modular design parameters at the Design Kick-off Meeting. Modular design parameters (dimensions, sheer wall location, mechanical system layouts, structural elements, fenestration requirements, podium attachments, modular MEP connections and locations), assemblies (assemblies that are modular specific, fire rated, acoustic assemblies), and schedules should be discussed and agreed upon at the Design Kick-Off Meeting.

C. DESIGN DEVELOPMENT PHASE

Rule 1: Direct architect to coordinate with the general contractor regarding MEP, crawl spaces, access, vertical rise space, etc. that will be constructed on-site (vertical runs) and those that will be part of modular unit fabrication off-site (horizontal runs).

Rule 2: Finalize and agree on finishes and specifications - interior finishes, structural elements, mechanical, electrical, plumbing, fixtures, etc. so that modular unit is ready for vertical connections from floor to floor.

Rule 3: Obtain, refine, and agree on final pricing for modular units and the fabrication/construction schedule.

D. CONSTRUCTION DOCUMENTS PHASE

Rule 1: Direct architect to coordinate permit set construction drawings with modular fabricator, including submittal packages and, applications, approvals, inspections. Anticipate submitting complete packages to both local and state permitting agencies.

Rule 2: The modular fabricator contract is signed when the permit drawings are issued to governmental permitting agencies, which is approximately 120-days prior to plant modular fabrication.

Rule 3: Direct architect to clearly indicate what is on-site built versus off-site fabricated, identify related construction trades, and the logistical coordination for delivering, setting, and connecting.

Rule 4: Direct general contractor to coordinate all logistical specifications with modular fabricator, including transportation, delivery, staging, scheduling, and other related logistics particularly related to roles and responsibilities as the modular unit transitions for fabricator to general contractor.

Rule 5: Identify fabrication queue date and completion dates with modular fabricator, and include architect and general contractor. Ensure that fabrication and delivery dates are scheduled to coincide site preparation work completion, and readiness for delivery and setting.

E. FABRICATION

Rule 1: Establish regular conference project management calls with architect, modular fabricator, and general contractor at the start of modular unit fabrication.

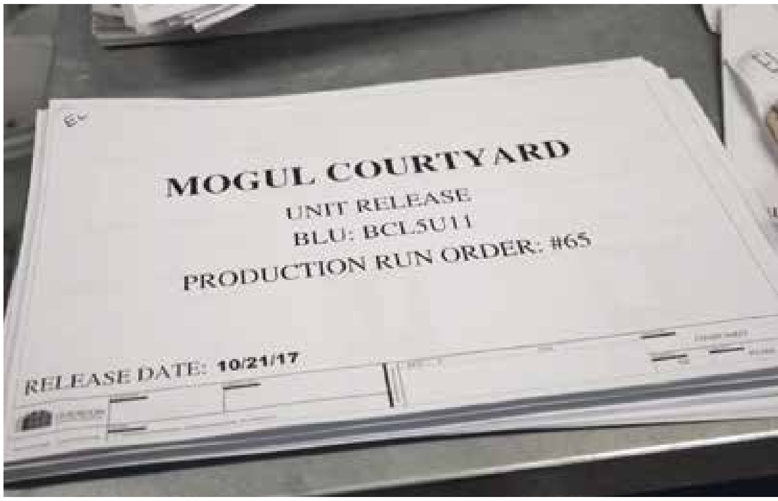
A NOTE ON "DESIGN FREEZE"

In order to maintain efficiencies, the project manager should plan to upload many of the design decisions and approving specifications early in the design process. Once these decisions have been made, to maintain efficiencies, a Design Freeze occurs after which changes have a cost increase impact on the schedule and budget. Shop drawings and procurement start once the State permitting agency has issued the modular permit. Construction drawings are issued to the State permitting agency at approximately 80% completion of Construction Documents design phase. At the point in the modular purchasing and fabrication, a change would be considered similar to any change order during the construction phase. The modular fabricator contract is signed when the permit drawings are issued to governmental permitting agencies, which is approximately 120-days prior to plant modular fabrication. The final Design Freeze moment is at approximately 20% completion of Construction Documents design phase.

Rule 2: Confirm with general contractor and modular fabricator that the scope of services include on-site supervision from the modular fabricator.

Rule 3: Direct general contractor and modular fabricator to coordinate permits and logistics related to delivery, staging, and setting.

Rule 4: Confirm the queue date (when the modules will enter the assembly line) with the modular fabricator and the project team at least 4-6 months in advance of the fabrication queue date, as projected in the development schedule.Note that it is better to have modules fabricated and stored if closing and construction start is delayed. Coordinate with module fabricator to determine if they have room to store modules before shipping to maintain the project in the fabricator's queue. Rescheduling modular production can make it challenging to get in the fabricator's queue at the time the project will need them.



VI. TRACKING COSTS: BUDGET & SCHEDULE

At the time of writing the project management manual, multi-family residential modular design and construction is nascent. There are very few experienced architecture firms general contractors, or modular fabricators with a deep track records of completed modular design and construction projects that have achieved significant cost reductions. In fact, the study undertaken as part of developing this manual compared two development proposals in locations that met the basic criteria for using modular construction parameters and maximizing efficiencies. However, the hard cost pricing was not significantly reduced.

To illustrate these findings, site planning feasibility studies were undertaken at two sites – one in West Sacramento and the other at Treasure Island in San Francisco. The West Sacramento site was a perfect rectangle with two street frontages, which created excellent conditions for maximizing the efficiencies of modular construction. Efficiencies could be obtained with a compact building footprint. However, while there was recent three and four story residential development along the mixed-use corridor, the site was surrounded by low-density development. As such, a low-rise, spread out, narrow building with many single loaded corridors was studied, which did not capitalize on the efficiencies of modular construction. The Treasure Island site provided the opportunity for higher density with double loaded corridors, and for maximizing the allowable building height and mass. However, one edge of the site was angled. Since modular units are rectangular volumes, the modular building layout was stepped to address the angle. If site-built, the building plan could be easily angled to maximize the development capacity at that edge of the site. (See Appendix A – Two Site Planning Feasibility Studies).

A lack of cost savings may also be attributed to some inefficiency in pricing. For example, without a lot of precedent projects to analyze, it is challenging to confirm a scope of work and time reduction for the on-site construction trades, which are assumed to be reduced since the units arrive finished. Also, the general contractor includes fees and insurance, as well as contingencies, in the total hard cost pricing, which includes the modular unit. Similarly, the modular fabricator is including fees, contingency, and insurance on modular units. It should be noted that the general contractor assumes responsibilities for the modules once the modules leave the fabricator's plant, and is responsible for the modules during the transportation, delivery, and setting. The project manager should discuss what is included in the total fees, general conditions, and insurance with the general contractor and modular fabricator to ensure that there are no redundancies.

As previously indicated, the design scope of services may increase due to the AoR's increased responsibilities coordinating with the modular fabricator's engineer in addition to submitting and coordinating two sets of permit application packages. A resulting 20% increase in design phases should be anticipated. However, this increase may also be mitigated as architecture firms gain more experience in identifying efficiencies in the design and permit process, as well as government permitting agencies increasing confidence in the ability of their partner's agency to effectively issue permits, and inspect within their review purview, i.e. state agency reviews modular unit documents and performs inspection of modular units at fabricator's plant, and the local agency reviews on-site construction documents and performs on-site inspections.

Despite these cost implications, and as the industry continues to evolve, it is still predicted that modular construction reduces the construction schedule by approximately 15% - 20%. A reduced construction schedule has a direct impact on other development costs, such as Construction General Conditions, Construction Management, Construction Loan Interest. The project manager should review. The project manager should review the project budget to identify any other line items that are keyed to construction schedule commencement and completion.

Furthermore, until there is a strong portfolio of completed modular construction projects, it is advisable for project managers to track two development pro formas: (1) Site Built Project; and (2) Modular Construction Project to continually identify items in the development and construction process where efficiencies toward achieving cost reductions can be achieved.

Concept plans between site-built versus modular construction for two projects are in Appendix B. As previously noted, hard cost savings are minimal for these two projects, and not a 10%-15% reduction in total development costs that many in the modular construction industry are claiming. The current recommendation is to underwrite the projects with Site Built cost estimates, and track savings that may be identified as the project proceeds using the design and construction parameters for a Modular Construction Project.

VII. FINANCING MODULAR CONSTRUCTION

Many financial lenders and investors are tracking the potential for modular construction to reduce overall development costs. However, many funders consider multi-family residential modular construction as an industry with some uncertainties, and are evaluating risk concerns and reviewing development cost and time assumptions to ensure that developers are not over projecting savings.

One significant example of risk is the reliance on a single modular fabricator to fabricate and deliver high-quality modules on time and within the terms specified in the Letter of Intent and the final Production Contract. As such, the lender is underwriting according to the financial and production capacity of the modular fabricator, as well as the general contractor, and the developer's track record. Evaluating the overall capacity of a modular fabricator is still somewhat new for most financial institutions, making it critical for the developer to anticipate much coordination with the funders to ensure that the entire project team meets the underwriting requirements of the lenders and investors.

Project managers should anticipate some distinct funding requirements, and extended underwriting review periods that financial institutions will have for modular construction projects. In addition, the developer should anticipate earlier outlays of equity as part of the modular fabrication process. Lenders will most likely require more robust guarantee package, and that the modular fabricator post of Letter of Credit. As such, the project manager should set-up the project team, as well as the schedule and development cash flow assumptions, that consider the following:

- The AoR, GC, and modular fabricator have prior experience in successfully completing a modular development. Furthermore, the financiers want to see that the experienced team commenced the project as a modular development and coordinated since the Concept Design phase. The project manager should be able to provide detailed project management worksheets showing schedule and scopes of work for each member of the team.

- The modular fabricator is well capitalized and has the financial capacity to provide insurance, bond, and a form of guarantee, or letter of credit. Fabricators may not be able to provide the necessary form of guarantee at all times. So, it is critical to identify as early as possible the timing for fabrication and when the fabricator will need to provide the guarantee in the development schedule.

- The general contractor is similarly well capitalized and has the financial capacity to provide insurance and form of guarantee.

- The roles and responsibilities between general contractor and modular fabricator are clear, particularly regarding risk positions as modular units transition from fabricator to general contractor, and adequate insurance pursuant to the said risks. The financiers want detail regarding the level of protection from weather or vandalism during delivery and storage.

- It is assumed that the developer owns the work in process, i.e. during fabrication. The financier will require the developer have adequate insurance coverage.

- The supervision and monitoring of modular unit delivery, staging, and setting by modular fabricator and coordination with general contractor is specified.

- The financial partners and developer agree on source, schedule and amount of funding disbursements, particularly for risks associated with early payments for securing a place in the fabrication queue and disbursements during fabrication. Below is an example payment schedule paid to the module fabricator, followed by a sample schedule and a chart illustrating percentage amounts paid at benchmark points in the modular construction process with the fabricator.

MODULE PAYMENT SCHEDULE

The Module Payment Schedule shows the benchmarks when payments are due to the modular fabricator during the development process.

Engineering Services: 100% of fee for services paid at signing of a Letter of Intent (LOI)

The following percentages are based on the total cost of modular fabrication:

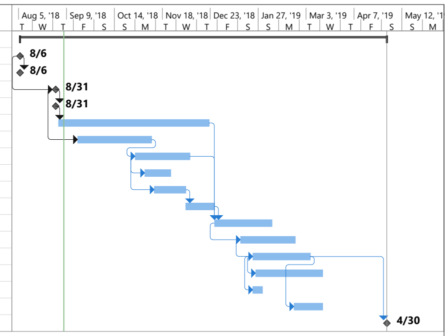
Production Capacity Deposit:	5% paid at signing of LOI
Long Lead Time Materials:	10% paid approximately 5 mos before fabrication
Contract Deposit:	10% paid approximately 4 mos before fabrication
Fabrication Commencement:	30% due weekly during fabrication
Production Off-Line:	25% due weekly for units off production line
Ready to Ship:	15% due weekly for units ready to transport
Delivery:	5% due weekly for units delivered

Contract amount includes insurance, contingency, and site supervision fees.

Pre-Construction/ Fabrication Schedule

The Pre-Construction / Fabrication Schedule illustrates a typical construction critical path scenario and the coordination efforts leading up to, and including, the fabrication of the modular units, particularly between the general contractor and modular fabricator, and managed by the developer.

ID		Task Mode	Task Name	Duration	Start	Finish	Predecessors
1			**Modular**	**192 days**	**8/6/18**	**4/30/19**	
2			Letter of Intent / Production Capacity Deposit (5%)	0 days	8/6/18	8/6/18	
3			Engineering Deposit	0 days	8/6/18	8/6/18	2
4			Contract Execution	0 days	8/31/18	8/31/18	2SS+20 days
5			Early Design Decisions Complete	0 days	8/31/18	8/31/18	4
6			Submittals / Procurement Release (20%)	80 days	9/3/18	12/21/18	5
7			State Submittals	40 days	9/17/18	11/9/18	4SS+10 days
8			Client Approval Drawings	30 days	10/29/18	12/7/18	7FS-10 days
9			Coordination w/ Site Trades	15 days	11/5/18	11/23/18	8SS+5 days
10			Prototype Online / Review	17 days	11/12/18	12/4/18	8SS+10 days
11			Incorporate Client Comments - Proto Review	15 days	12/5/18	12/25/18	10
12			Production Online (Duration Varies on Mod Count) - (30%)	30 days	12/26/18	2/5/19	8,6,11
13			Production Offline (Duration Varies on Mod Count) - (35%)	30 days	1/14/19	2/22/19	12SS+13 days
14			Delivery Commence (5%)	30 days	1/23/19	3/5/19	13SS+7 days
15			Staging Units / Storage Lot (Duration Varies on Mod Count)	35 days	1/25/19	3/14/19	14SS+2 days
16			Approval for Street Closures, Traffic Control Plans	5 days	1/23/19	1/29/19	14SS
17			Crane Set (Duration and Start Date Varies based on Mod Count)	15 days	2/22/19	3/14/19	14FS-8 days
18			Modular Retention Release	0 days	4/30/19	4/30/19	14FS+40 days



Project: ModularScheduler1
Date: 9/7/18

Task	Project Summary	Manual Task	Start-only	Deadline
Split	Inactive Task	Duration-only	Finish-only	Progress
Milestone	Inactive Milestone	Manual Summary Rollup	External Tasks	Manual Progress
Summary	Inactive Summary	Manual Summary	External Milestone	

Fabricator Payment Fund Draws

The Fabricator Payment Fund Draws is an example of the draw amounts for payments to the fabricator and what is included in the overall contract price. It illustrates the need for funding sources to make early deposits to secure a position in the fabricator's assembly queue, as well as payments due as modules are delivered.

Figures & Amounts for Demonstrative Purposes Only

Cash Flow Assumptions

On-Site Installation Value		
Engineering Services		$ 165,000
Project Specific Insurance Policy Premium	(estimated)	$ 80,000
Contract Value		$ 10,000,000
Total Amount		**$ 10,245,000**

Total Modules	75

Proposed Payment Terms		%	Terms	
Engineering Services	$ 165,000	100%	Due at Letter of Intent ("LOI") execution. See below for balance due dates.	Paid directly to Guerdon
Project Specific Insurance Policy Premium	$ 80,000	100%	Due at Supply Agreement Execution	

Remaining Contract Value		%	Terms	
Production Capacity Deposit	$ 500,000	5.00%	Due at LOI Execution	Paid directly to Guerdon
Long Lead Time Materials	$ 1,000,000	10.00%	Due 20 weeks before Production	
Contract Deposit	$ 1,000,000	10.00%	Due 120 days prior to Production Commencement.	
Production Commencement	$ 3,000,000	30.00%	Due weekly for units commenced	These amounts are paid to Escrow
Production Offline	$ 2,500,000	25.00%	Due weekly for units exited production line	
Ready to Ship	$ 1,500,000	15.00%	Due weekly for units ready to ship	
Delivery	$ 500,000	5.00%	Due weekly for units delivered	
Total		**100.0%**		

Developer Payments						Guerdon Payments Received									Unit Totals				
Week Beginning	Payments from Developer to GE	Payments from Developer to Escrow	Cuml. Payment	Balance in Escrow	% Paid	Engineering Services / Insurance Premium	Contract Dep. Prod Cap Dep.	Production Commencement	Units Offline	Units Ready to Ship	Delivery	Comments	Weekly Received	Cuml. Received	Online	Offline	Ready to Ship	Delivery	Set
9/10/2018	665,000		665,000	-	6%	165,000	500,000	-	-		-	LOI / Engineering	665,000	665,000					
9/17/2018	-		665,000	-	6%			-	-		-		-	665,000					
9/24/2018	-		665,000	-	6%			-	-		-		-	665,000					
10/1/2018	-		665,000	-	6%			-	-		-		-	665,000					
10/8/2018	-		665,000	-	6%			-	-		-		-	665,000					
10/15/2018	-		665,000	-	6%			-	-		-		-	665,000					
10/22/2018	-		665,000	-	6%			-	-		-		-	665,000					
10/29/2018	-		665,000	-	6%			-	-		-		-	665,000					
11/5/2018	-		665,000	-	6%			-	-		-		-	665,000					
11/12/2018	-		665,000	-	6%			-	-	-	-		-	665,000					
11/19/2018	-		665,000	-	6%			-	-	-	-		-	665,000					
11/26/2018	-		665,000	-	6%			-	-	-	-		-	665,000					
12/3/2018	-		665,000	-	6%			-	-	-	-		-	665,000					
12/10/2018	-		665,000	-	6%			-	-	-	-		-	665,000					
12/17/2018	-		665,000	-	6%			-	-	-	-		-	665,000					
12/24/2018	-		665,000	-	6%			-	-	-	-		-	665,000					
12/31/2018	-		665,000	-	6%			-	-	-	-		-	665,000					
1/7/2019	-		665,000	-	6%			-	-	-	-		-	665,000					
1/14/2019	1,000,000		1,665,000	-	16%		1,000,000	-	-	-	-	Long Leads	1,000,000	1,665,000					
1/21/2019	-		1,665,000	-	16%			-	-	-	-		-	1,665,000					
1/28/2019	-		1,665,000	-	16%			-	-	-	-		-	1,665,000					
2/4/2019	1,080,000		2,745,000	-	27%	80,000	1,000,000	-	-	-	-	Long Leads / Premium Insurance	1,080,000	2,745,000					
2/11/2019	-		2,745,000	-	27%			-	-	-	-		-	2,745,000					
2/18/2019	-		2,745,000	-	27%			-	-	-	-		-	2,745,000					
2/25/2019	-		2,745,000	-	27%			-	-	-	-		-	2,745,000					

Developer Payments						Guerdon Payments Received									Unit Totals				
Week Beginning	Payments from Developer to GE	Payments from Developer to Escrow	Cuml. Payment	Balance in Escrow	% Paid	Engineering Services / Insurance Premium	Contract Dep. Prod Cap Dep.	Production Commencement	Units Offline	Units Ready to Ship	Delivery	Comments	Weekly Received	Cuml. Received	Online	Offline	Ready to Ship	Delivery	Set
3/4/2019	-		2,745,000	-	27%			-	-	-	-		-	2,745,000					
3/11/2019	-		2,745,000	-	27%			-	-	-	-		-	2,745,000					
3/18/2019	-		2,745,000	-	27%			-	-	-	-		-	2,745,000					
3/25/2019	-		2,745,000	-	27%			-	-	-	-		-	2,745,000					
4/1/2019	-		2,745,000	-	27%			-	-	-	-		-	2,745,000					
4/8/2019	-	7,500,000	10,245,000	7,500,000	100%			-	-	-	-	Escrow Deposit / Proto	-	2,745,000	1				
4/15/2019	-		10,245,000	7,460,000	100%			40,000	-	-	-		40,000	2,785,000					
4/22/2019	-		10,245,000	7,460,000	100%			-	-	-	-		-	2,785,000		1			
4/29/2019	-		10,245,000	7,426,667	100%			-	33,333	-	-		33,333	2,818,333					
5/6/2019	-		10,245,000	7,426,667	100%			-	-	-	-		-	2,818,333					
5/13/2019	-		10,245,000	7,426,667	100%			-	-	-	-		-	2,818,333					
5/20/2019	-		10,245,000	7,426,667	100%			-	-	-	-		-	2,818,333					
5/27/2019	-		10,245,000	7,426,667	100%			-	-	-	-		-	2,818,333					
6/3/2019	-		10,245,000	7,426,667	100%			-	-	-	-	Production Commencement	-	2,818,333	15				
6/10/2019	-		10,245,000	6,826,667	100%			600,000	-	-	-		600,000	3,418,333	15				
6/17/2019	-		10,245,000	6,226,667	100%			600,000	-	-	-		600,000	4,018,333	15	15			
6/24/2019	-		10,245,000	5,126,667	100%			600,000	500,000	-	-		1,100,000	5,118,333	15	15			
7/1/2019	-		10,245,000	4,026,667	100%			600,000	500,000	-	-		1,100,000	6,218,333	14	15	16		
7/8/2019	-		10,245,000	2,646,667	100%			560,000	500,000	320,000	-		1,380,000	7,598,333		15	15	16	
7/15/2019	-		10,245,000	1,740,000	100%			-	500,000	300,000	106,667		906,667	8,505,000		14	15	15	
7/22/2019	-		10,245,000	873,333	100%			-	466,667	300,000	100,000		866,667	9,371,667			15	15	
7/29/2019	-		10,245,000	473,333	100%			-	-	300,000	100,000		400,000	9,771,667			14	15	25
8/5/2019	-		10,245,000	93,333	100%			-	-	280,000	100,000		380,000	10,151,667				14	25
8/12/2019	-		10,245,000	-	100%			-	-	-	93,333		93,333	10,245,000					25
8/19/2019	-		10,245,000	-	100%			-	-	-	-		-	10,245,000					
8/26/2019	-		10,245,000	-	100%			-	-	-	-		-	10,245,000					
9/2/2019	-		10,245,000	-	100%			-	-	-	-		-	10,245,000					
9/9/2019	-		10,245,000	-	100%			-	-	-	-		-	10,245,000					
9/16/2019	-		10,245,000	-	100%			-	-	-	-		-	10,245,000					
9/23/2019	-		10,245,000	-	100%			-	-	-	-		-	10,245,000					
Totals	**2,745,000**	**7,500,000**	**10,245,000**			**245,000**	**2,500,000**	**3,000,000**	**2,500,000**	**1,500,000**	**500,000**		**10,245,000**		**75**	**75**	**75**	**75**	**75**

APPENDIX A

TWO SITE PLANNING FEASIBILITY STUDIES

A. INTRODUCTION

The following two sites were tested as potentials for modular development. At each site, two module layouts were explored. The perpendicular layout was more efficient, as it included the corridor with a unit module on each site. The parallel layout was explored to see if there was more flexibility in unit size and plan. However, the corridor had to be constructed on-site, which added costs and more complex on-site module assembly and construction logistics.

B. WEST SACRAMENTO SITE

The West Sacramento site was a perfect rectangle with two street frontages, which created excellent conditions for maximizing the efficiencies of modular construction. Efficiencies could be obtained with a compact building footprint. However, while there was recent three and four story residential development along the mixed-use corridor, the site was surrounded by low-density development. As such, a low-rise, spread out, narrow building with many single loaded corridors was studied, which did not capitalize on the efficiencies of modular construction.

B. TREASURE ISLAND, SAN FRANCISCO SITE

The Treasure Island site provided the opportunity for higher density with double loaded corridors, and for maximizing the allowable building height and mass. However, one edge of the site was angled. Since modular units are rectangular volumes, the modular building layout was stepped to address the angle. If site-built, the building plan could be easily angled to maximize the development capacity at that edge of the site.

APPENDIX B

SITE PLANS FOR MODU-LAR CONSTRUCTION

PARAMETERS FOR THREE TYPES OF SITES

Achieving efficiencies of factory built unit modules, and the potential for time and cost savings, is primarily dependent on a regularly shaped rectangular site, site dimensions, and the allowable site density. Site shape, density, and dimensions that allow for cross-corridor module layouts that maximize the use of double loaded corridors, increase the inherent efficiencies of factory built modules, and reduce the need for on-site construction work.

Lowney Architecture developed quick and easy to use graphic layouts for three different sites. The graphic layouts can be used to analyze sites to determine the site's potential to maximize the efficiencies inherent in modular design and construction.

TYPE A – Infill Lot (two bookend street frontages)

- Lots width a minimum of 75' site
- 30' length unit module + 5' corridor + 30' unit + 5' set-back on either side

TYPE B – Corner Lot (two street frontages at corners)

- Corner lot allow for larger unit modules at the building corner
- Dimensions (185'-200' lot width) become more important because of an additional corridor and courtyard area (40' courtyard width assumption)

TYPE C – Full Block Lot (three street frontages at two corners)

- Multiple corner lots allow for additional area for larger unit modules at the corners
- Dimensions (200'-250' lot width) become more important because of an additional corridor and courtyard area (40' courtyard width assumption)