PIECING TOGETHER MODULAR: UNDERSTANDING THE BENEFITS AND LIMITATIONS OF MODULAR CONSTRUCTION METHODS FOR MULTIFAMILY DEVELOPMENT

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in Partial Fulfillment of the Requirements for the Degree of

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ABSTRACT

The primary purpose of this thesis is to explain the benefits and limitations of modular construction as it pertains to primarily wood-frame, multifamily housing in the United States. This thesis attempts to educate the consumer/builder/developer about what the modular construction process entails from beginning to end. Long term demographic trends point to a steady and increasing need for housing production. Decreasing development yields and increasing construction costs and regulations are making it more difficult for the market to meet this need. It is the authors' goal that the knowledge contained in this thesis helps to introduce developers to the basic issues involved in this relatively underutilized but potentially beneficial process.

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I. Thesis Objectives

The population of the United States is expected to grow from approximately 300 million people today to just over 350 million people by 2025 (US Census interim projections) [1]. If the average household size were to remain constant at 2.59 people per household then the US would need around 19.3 million new homes to accommodate this growth. Factors such as: rising construction costs, escalating land costs, tightening government regulations on housing production, the increasingly low yields for development projects and a shrinking percentage of the American population entering the building trades exacerbate the production of housing required to meet this need.

This paper attempts to look at a (possible) way to efficiently and cost effectively boost multi-family housing production by taking advantage of the advances in manufacturing and transportation capabilities that several other sectors currently utilize. Modular construction is the most comprehensive production system of several which presently utilize factory assembly and manufacturing practices to produce housing. Its proponents claim that there are tremendous cost and time savings to utilizing this method. Despite this, only approximately 3-4% of all homes built annually in the US are built using modular, and of those, only 5% are for multifamily projects [2]. This thesis attempts to clarify this paradox and provide information to the development community about the potential benefits, limitations and applicability of modular construction for multi-family projects.

II. Methodology

The co-authors conducted much of this research from Massachusetts. Data and information were gathered from both literature and a variety of interviews with architects, modular manufacturers, developers, bankers and brokers. All interviews were conducted with parties familiar with modular construction as a result of a recent development project. Literature was assembled from various industry periodicals, books and the internet. Input and assumptions for financial analysis represent reasonable yet conservative generalizations about the impact of utilizing modular construction for a development project gathered from the body of research conducted.

III. The History, Definition and Evolution of Modular Construction Methods

mod·u·lar \'mä-jə-lər\ : (adjective-1798)
1 **:** made up of separate modules that can be rearranged, replaced, or interchanged easily 2 **:** constructed with standardized units or dimensions for flexibility and variety in use [3]

The use of pre-fabrication in the housing industry goes back over one-hundred years. It started gaining popularity early in the 20th century. Sears Roebuck Co. sold over 500,000 pre-fabricated homes through catalogs between 1908 and 1940. The first catalog was 68- pages long and offered 44 house designs, ranging in price from $695 - $4,115. Customers were asked to send in $1 after they had selected the design they wanted. They then received a bill of materials list and full blueprints via mail. When consumers placed the full order, the $1 was credited toward their purchase. Two boxcars would arrive at the nearest train depot containing 30,000 pieces of the home. A

75-page instruction book told homeowners how to put those 30,000 pieces together. The kit included 750 pounds of nails, 22 gallons of paint and varnish and 20,000 shingles for the roof and siding. Masonry and plaster were not included in the kit, but the materials list said that 1,100 cement blocks would probably be needed for the basement walls and foundation. As a result of The Great Depression vastly slowing the housing industry, Sears Roebuck soon discontinued this business.

Housing Demand at the end of World War II caused the modular market to truly explode and to greatly evolve. All of the soldiers returning to America were looking to buy a home and start a family. The demand for homes was greater than the marketplace could handle with the traditional “stick built” construction process. This shortage led builders to look for solutions to increase efficiency and lower the cost of new home construction. The modular building process answered both of these needs. There are still many modular homes occupied today that were built in the 1950s. These early modular homes were much simpler in design than today’s modular buildings.

In the last twenty years, sophistication of modular homebuilding methods has greatly increased with the advent of computer aided architectural modeling and the pioneering engineering process of assembling homes with overhead cranes that have a capacity to easily lift 100+ tons. This allows for larger modules to be constructed and shipped cross-country. The only size and design limitations for modular construction are the

practical size limits placed on each individual module due to the width and underpass clearances of the road from the factory to the building site.

To clarify what is meant by modular construction, it is important to provide definitions for some commonly interchanged terminology:

Site-Built homes are constructed from individual pieces of wood, concrete or steel that are delivered from suppliers, cut or poured to size on site and assembled.

Pre-cut homes are assembled out of the same basic components as site-built except that the correct pieces are pre-selected and cut or formed to size at a factory and then shipped to the site for assembly (similar to the Sears Roebuck kits).

Panelized homes are constructed out of factory built wall panels that are typically 8-9 feet tall and 4-40 feet wide. Some panelized systems include plumbing, wiring and insulation already installed (closed-panel systems) while others only include framing and the exterior sheathing (open-panel systems). The panels are shipped from the factory to the site and assembled into a home by use of a crane that sets them onto the foundation.

Manufactured homes, known as mobile homes in the past are similar to Modular homes in that they are both composed of boxes built in a factory. The two are often confused but the main differences between them are portability and regulatory compliance. Manufactured homes are constructed according to HUD federal codes and are required to be built on a non-removable steel chassis so that they can be easily and

safely transported. Also, most state building codes, local zoning codes and subdivision covenants severely restrict the use of manufactured homes in most areas.

Modular homes (like site-built, pre-cut and panelized) are built in compliance with stricter state and local building codes and are intended to be built in a factory, permanently set in place on a foundation at a home-site and never relocated for the building's useful life . For the purposes of this paper, only modular homes will be discussed unless otherwise stated.

IV. The Modular Manufacturing Process

The National Association of Home Builder's Modular Building System's Council defines a building system as:

> A highly engineered method of producing buildings or building components in an efficient and cost effective manner. The use of building systems is common in many different types of residential, multifamily and commercial constructions. A modular home is the culmination of a type of building system. Modular homes are constructed in segments (called "modules") in a climate-controlled factory by craftsman using precise machinery and methods. When these modules come together on a building site and the final finishing touches are completed by a local builder and their subcontractors, those modules become a home. [4]

Such a system tries to integrate technology with craftsmanship in order to efficiently produce a solidly built product in a climate controlled factory, as opposed to on-site, with

the goal of delivering a finished or quasi-finished product (depending on the client's specifications) faster that the consumer can readily enjoy.

1) The Factory

Modular manufacturers vary in their production capabilities, technologies and assembly methods. They range from true automated moving production lines that shift the modules thru several different stations where specialized crews perform specific tasks, to static production lines where various crews come to the module and perform their respective tasks. As Co-Founder of RCM Modular, Gilbert Trudeau, mentioned:

> Moving production lines are better because it allows each station to become more specialized and faster. You don't have to move, your tools don't have to move and you know that you have a fixed period of time to do your task before it moves to the next station. You also know that if you make a mistake it will be noticed at the next station. Static lines feel a lot like building on a site to me.[5]

Regardless of production line type, the steps involved are very similar. Today most modular manufacturers employ wood frame construction as opposed to steel or concrete. The very beginning step for most manufacturers in the building phase within the factory is the lumber check. Lumber must be moisture checked, and pre cut for the floor and ceiling joists. This is an integral step that manufacturers tout as evidence of superior product quality.

Epoch Homes Factory Pembroke, NH

It is done to ensure that the structure does not experience shrinkage or warping since lumber that is too dry can become twisted and brittle; if it is too wet it warps. Thus by monitoring this via meter reading, manufacturers can refuse wood that doesn't fit within moisture and grade parameters. Some companies go a step further and use kiln dried lumber that is stored in heated warehouses.

Once the lumber is checked, approved and cut, the floor platforms are built on raised steel jigs to ensure they are plumb and level.

Epoch Homes Factory Pembroke, NH

While elevated on these risers, any rough plumbing or required duct work is laid out. Some manufacturers utilize 2x10 beams for cross-bridging to increase floor strength. After the decking comes the sub-floors and walls while the module is set on the floor or the production line.

Epoch Homes Factory Pembroke, NH

Once these elements are set, the roof trusses go on and there is further framing, piping, electrical and data wiring and sheet rocking (usually 5/8”). The sheetrock application is different from a site built structure in that it is applied prior to the exterior being enclosed. This is possible because carpenters do not have to worry about protecting the inside from the elements. What this allows for is a wall fully insulated from the inside out. With traditional home-building methods, the corners of the structure rarely get insulation as they are sealed from the outside prior to the sheetrock installation and are largely inaccessible.

Epoch Homes Factory Pembroke, NH

In design, manufacturers leave a small space between what will become marriage walls (walls where two modules are joined) to allow for a margin of error that will be backfilled with foam when set. Next, several finish components are performed including kitchens, baths, lighting, ducting, windows and occasionally flooring and exterior siding. Doors and windows are assembled with foam around the edges and good quality flashing, weather-stripping and chafing strips, ensuring proper insulation. Once built, the modules must be tested and most manufacturers do this on site. These tests include airtight testing, plumbing inspections (running the bathtubs/Jacuzzi's etc…to ensure piping is leak free), and tests on radiant heat and any other specialized systems in place that are specified.

Epoch Homes Factory Pembroke, NH

After this step, the interior walls of the modules are typically primed and the modules are prepared for transportation.

Epoch Homes Factory Pembroke, NH

Most times sheetrock is cut with extra slack to prevent cracking where walls meet door openings or hallways (as seen in the photo below) then once on site, the excess is trimmed away.

Epoch Homes Factory Pembroke, NH

When combining modular with panelized or site-built construction (to achieve a wide span or a cathedral ceiling) temporary walls or framing is built in to add extra structural support and arched plywood is applied to the tops of the modules where the heavy plastic will be placed to create a bowed frame that rain or snow will readily run off.

Epoch Homes Factory Pembroke, NH

Floors are covered, doors are locked and a plastic wrap covers the sides. Roofs are always covered with a thicker, heavier plastic material.

Epoch Homes Factory Pembroke, NH

It is common for manufacturers to utilize their additional interior or exterior storage capacity in the event that customers are not ready to receive their product or a manufacturer feels it more efficient to stage delivery only when a certain inventory builds up. For example, Epoch Homes, a company with two production lines, has 5+ acres of storage which experience varying levels of occupancy based on delivery schedules. Modules being stored outside, although shrink wrapped, are routinely checked for any potential leaks or cracks in the wrapping as anything from severe weather conditions to birds can potentially impact the integrity of the protective wrapping and allow water to damage the interior and create the potential for mold. Once the time is right, the modules can be lifted onto flatbed trucks for delivery to their destination.

Epoch Homes Factory Pembroke, NH

The modules are carefully secured to the truck at the factory to protect against the rigors of the transportation process, which has been compared by multiple parties to "earthquake-like conditions". There are a few horror stories involving modules slipping of trucks during transit or being involved in accidents, but these sort of occurrences appear to be infrequent. An interesting testament to the structural integrity of the modules came from a story about a single family home module that fell off a truck and rolled over multiple times. The module was found to be in solid structural condition except for damage to some interior fixtures. The customer requested that it be used in their home as they felt content with the structural integrity and therefore thought it would be wasteful to destroy it.

2) Transportation

Typically it is not feasible to ship modules extremely far due to road size/load restrictions. The average manufacturer typically quotes 250-400 miles as the maximum distance that it is desirable to transport modules. Some companies, like Epoch Homes in New Hampshire, are looking into how to efficiently transport beyond this distance, in special circumstances such as aiding in the reconstruction of New Orleans, but this is atypical. Modular appears to have pushed some fairly interesting boundaries in terms of alternate transport by utilizing both sea barge and helicopter delivery to islands or particularly remote locations. Despite the obvious difficulty inherent in such complicated transport it may often be a more cost effective alternative than utilizing a site built method. "Think of what it costs to pay a factory worker in Canada versus paying and putting up an army of electricians on Nantucket". [5]

Exotic transport aside, most modular deliveries are made over the highway and governed by a somewhat complicated web of inter-national and inter-state regulations. It is not rare for a transporter to have to deal with three or more different government agencies to get through a single state. Opinions vary on the complexity of the approval process. One modular manufacturer very experienced in transporting the modules claimed, "The rules are very complicated and constantly changing and these are both transportation and tax rules" [6]. A second developer that handled the contracting of the transportation themselves for the first time called it "not really that difficult, it's paperwork, coordination and government officials and I'm used to dealing with all of that" [7].

Modular manufacturers are increasingly responding to developer's desire to be provided with more seamless service and are handling the transportation component of the process. That being said, this doesn't eliminate a developer's need to understand the transportation limitations. Several issues remain that one needs to be aware of such as: potential time delays due to delayed transportation permits for oversized loads, potential delays due to customs issues along the Canadian border which were "horrible after 9/11 but they're easing up now" [5] and most importantly, dimensional restrictions on modules being transported. Rules regarding dimensional limitations vary from state to state, so prior to selecting a modular manufacturer one would want to understand the route a manufacturer must travel and contact the applicable states' United States Department of Transportation – Federal Highway Administration representative.

A general rule of thumb to understand the most basic size limitations is that the maximum width allowed anywhere is 16 feet, the maximum height is 13'6" including trailer and the maximum length feasible for transport is around 60-65 feet long. Within these limitations there are varying levels of state specific regulations and added expense mostly relating to width. Modules less than twelve feet wide are mostly allowed to travel with no restrictions. When the size increases to between twelve and fifteen feet wide there is an accompanying increase in the restrictions and often a requirement for police escort. Once a module reaches the fifteen to sixteen foot width it is almost universally declared a wide-load that requires police escorts and can often be required to travel overnight as to not impede local traffic. As architect Robert Koch explains:

> Transportation used to be a huge issue but the government understands that nothing is consumed where it is built anymore and the construction industry as a whole, not just the modular industry, has been pushing the limitations of what can be transported over the roads. More and more components are becoming panelized or pre-fabricated and single components can at times be as wide and heavier than an entire module. [8]

3) The Set

It is the developer's responsibility to have the foundation ready and the tie-ins for electric, plumbing, and sewer in place so that the modules can be connected to the necessary infrastructure.

Sample Site, Westwood, MA

Such infrastructure work occurs, weather permitting, concurrently with the manufacturing process so that essentially, once the foundation is set one can ship the modules, connect them and obtain occupancy permits. The modules arrive built with walls, floors, trusses, ceilings, wiring and interior fixtures to the extent the developer wants them.

Sample Site, Westwood, MA

Once on site, the modules are stacked by a crane (usually between an 80 to a 160 ton crane depending on the size of the modules and the distance from the crane that it must travel) at an average pace of approximately four to six modules per crane per day.

Sample Site, Westwood, MA

The modules are bolted together along both the floor and the ceiling joists and the marriage walls are connected with a series of steel fasteners and strapping. They are quickly weather proofed by sealing them with building wrap that blocks moisture and pollutants yet allows the structure to breathe and water vapor to escape. Care needs to be taken to monitor weather conditions around the scheduling of the set. While tarps may be used to protect the unwrapped modules from rain or snow during a set if necessary, this is a less than perfect solution and it is better to schedule around inclement weather if possible. Once set and connected, the structure is then ready for

subcontractors to begin the process of performing the interior and exterior finishes and all required utility connections.

Sample Site, Westwood, MA

The “buttoning-up” process can take anywhere from one to two months to complete depending on the size of the project. Modular construction typically delivers a product that is between 70-80% complete, and there is still a lot of interdisciplinary, complicated on-site work that needs to be finished by the developer’s on-site work crew. As with the transportation integration, more manufacturers are handling the craning and module connection component of the set in-house but still not the utility connection work.

4) Inspection and Quality Control

One primary difference between site-built and modular methods is inspections. With modular, throughout the manufacturing and installation process, there are multiple parties monitoring the process. While a large multifamily project still requires local architects and engineers to submit stamped permit drawings in their particular state, the physical inspection of the modules as they are built are not handled by local building inspectors but independent third party inspection companies who are licensed to review the work as it is being performed in the factory to ensure code compliance. As each module is inspected and approved it receives a seal certifying that everything within the module conforms to the plan and the building code. Local building inspectors are only "supposed" to review the additional work that occurs once the module is set such as utility connections and the buttoning up and connections of modules. This is occasionally tested however, by local inspectors who overreach their authority. The third party inspection process applies in most jurisdictions but one must locally verify the applicability

Additionally, the design process involves both a factory architect and an architect employed by the developer and licensed in the state where the development is to occur. This dual design/review process can often eliminate any future change orders or surprises in the field. "The duplication of design review means that you end up getting a product that in the end is much closer to what the drawings actually say it's going to be. Is it 100%? Absolutely not, but it's a lot closer to 100% than site-built." [9]

Quality control is not just code compliance, however, and quality assurance employees and shop foremen inspect the modules throughout the construction process. A major difference between the site-built and the modular process is proximity of quality control personnel to the work being inspected. Modular experienced Architect, Bruce Fairty mentions:

> On a typical site, the foreman could be down on the ground and the work is happening on the third floor so the guy knows if he makes a mistake nobody is going to catch it for days, maybe weeks and by then who knows who made it. Modular is different. The foreman is right there on the floor with the modules, inspecting the process and if a mistake slips by, the guy at the next station will catch it two hours later instead of two weeks. [7]

Quality controls are still subject to human error. Since the factory building method is a fast moving process, many industry insiders recommend the practice of having the manufacturer make two or three modules and then sending the local architect and general contractor to the factory to inspect so that any issues, specifically those pertaining to MEP systems, can be cleared up early on. Some common infractions that do arise either during manufacturing, or once on-site, are minor issues: foil insulation is facing the wrong way inside an interior wall, hairline cracks in the plaster, sixty foot long modules may be slightly off in length. These issues are either fixed at the factory or on site depending on the most efficient way to address what is being repaired. Dick Krant, CEO of Customized Structures stated, “If you want to deliver quality, you have got to sweat every detail up front. You are only as good as your preparation”.

V. Design and Dimensional Considerations

1) Design Parameters

The modular industry has benefited greatly from advances in engineering and computer software. Design(s) and customization that was once very difficult to accomplish has become much easier. Hinged roofing systems allow for manufacturers to construct roofs with a pitch of up to 12/12 that are still transportable with prevailing height limitations. CAD allows for the quick manipulation of complex documents into manufacturer's shop drawings ready to be priced and built. A combination of modular and either panelized or site-built construction processes allow a developer to build almost any structure.

The real design limitations come from transportation regulations and from the structural nature of a modular box. The 16 foot width limitation makes it more difficult to create rooms with wide open spaces. The only real way to accomplish this is to combine two modules and open the walls between the two. It is "easy to have an open span of 11 feet in a bearing wall of a module with no additional support required. If you add additional structural support you can get up to a 16 foot opening" [10]. Height limitations of around 13'6" including trailer, limit finished ceiling height to approximately nine feet. A 9'6" ceiling height is accomplished regularly with the use of a tray ceiling but this is the absolute maximum. Similar to site-built construction, the higher a ceiling is, the more expensive the building becomes to construct.

Both width and height design decisions become market driven. There is an incremental cost increase to expanding the width of a module being used for the construction of a townhouse from 13 to 16 feet, both in construction costs and because the unit will require transportation permits, off hours shipment and a police escort which can double the transport costs. However, if a 13 foot wide townhouse is not a marketable width in a given market, those extra costs are unavoidable. Some (luxury) developers may also deem the finished ceiling limitation not palatable within their market niche.

When designing a large complex with multiple units, additional design complexities factor in. Gilbert Trudeau adds:

> It's ideal to minimize the number of boxes you must build. The most cost efficient box is the largest you can transport with the most amount of interior finishes so you would design and order fewer larger modules rather than more smaller ones. There is less cost incurred and you get more square footage per truckload. Where a 14' wide module may be $2000 to transport, an oversize 16' might be $3500 but you would have more square footage for the extra cost plus the crane would only have to move one box and you would only have to connect one box instead of many. [5]

Underground parking also drives width considerations. When lining up a multistory modular building, it is ideal to have bearing walls line up under one another throughout the floors. When parking is introduced this necessitates designing a collection of units

that will roughly align with the width of multiple parking spaces (some multiple of 8 to 9 feet). If this can't be efficiently designed, a transfer slab (or beams) must be added, which is not only expensive but increases the risk of moisture and mold.

It is often recommended , if not required, to have a local architect and engineer do a full set of drawings including architectural, mechanical, electrical, plumbing, sprinkler, and perhaps full structural plans for any multifamily structure over a certain size- "except for maybe the framing plans beyond the first floor" [10] so that a development can be permitted. However this is not the primary reason that it is recommended. Modular construction is no different that any other method in that a series of value engineering decisions must be made throughout the process. A developer not familiar with both design and construction could make some costly errors if he/she is to rely solely on the modular manufacturer's in house architecture and engineering personnel. The manufacturer's designers, while extremely knowledgeable about designing modules that can be efficiently built, will not be as familiar with the potential marketing and local code ramifications of certain modular specific value engineering decisions.

2) Level of Finish

Given the fact that the construction industry operates within a market environment, pricing levels are greatly influenced by specific location and demand factors. One should price compare and bid out costs for several finish components as there are as cost savings to be had, based on current market conditions, if things are done in the

field versus in the modular factory and vice versa. However, there are some components that one might commonly want to consider site-building:

Flooring: The module only arrives 70-80% done and then experiences 1 to 2 months of active construction making the probability for damaging a floor high.

Siding: Most manufacturers can perform a variety of siding installations ranging from vinyl to clapboard to even brick. However, there is a strong possibility that siding may be damaged during the set and require patch work which may not effectively match the original. An even larger probability is that the modules in a multi-story building will not line up perfectly along the vertical plane. It is easy to install shims where needed prior to the field application of siding. It is much more difficult to try to patch and match siding that is not lining up correctly.

Pitched Roofs: Advances in hinged roofs allow for fairly steep pitched roofs to be built in a factory, but it is still a relatively bulky and low value item to ship. The cost to site-build and then hoist into place once the modules are set may often be cheaper than transporting roofs built in a factory.

VI. Physical Considerations

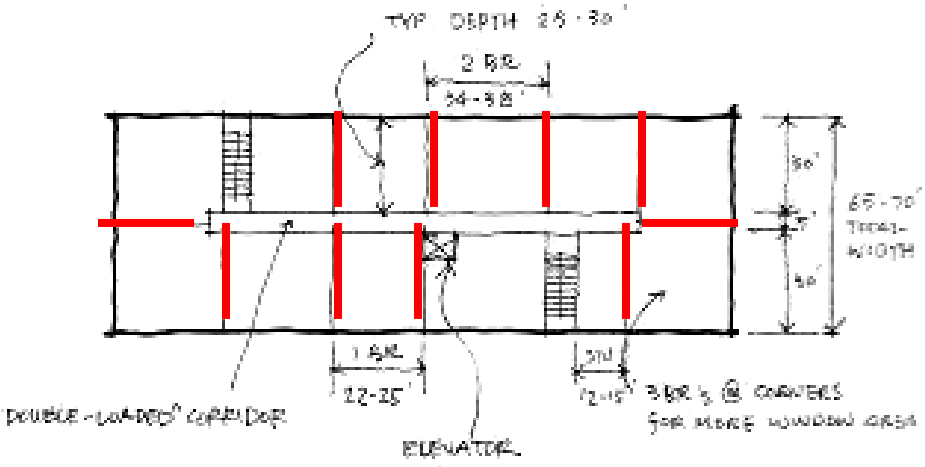
1) MEP Systems

Far and away the most complicated components of multifamily modular are integrating the factory vs. site built components of building MEP systems. The majority of issues are not complex engineering, however, but communication-related. These arise out of mostly unfamiliarity and inexperience of both; the manufacturers being unable to think beyond the modules to the overall integrated structure that the modules will become and, from the electricians and plumbers who do not fully understand (or don't like) what exactly they will be delivered that requires connection. "Modular manufacturers whose bread and butter is the single family home are used to a simpler process of handing off problems and finish spec work to a builder. That works fine on a single family home because it isn't that complicated. On a large project though, the plumber and the electrician don't like it because a lot of the times it isn't done the way they would've done it but they are stuck with it". Communication, both verbal and written, is imperative to ensure that all parties understand their responsibilities. Whether it is by color-coded plans, round table discussions and working sessions, or training sessions (or a combination of these), a team effort is required to avoid major mishaps and the risk of cost escalation.

2) The 1.202% Effect

A modular structure has a certain inherent strength superiority to a traditional site-built home due to the fact that each module is a self-supporting and independent structure.

When two modules are joined together to create two separate units (like in the double loaded corridor floor plan shown below) the adjoining walls are double thick walls as each unit has a finished four to six inch perimeter wall. This independent structure helps in soundproofing and structural strength, but also adds redundant materials and dimension to the building. While this is a non-issue in a suburban setting or on a site with ample room for setbacks, it can make a difference when developing a building that is pushing the limits of a site's setbacks.



Given the plan above, a 10,400 square foot traditional double loaded corridor floorplate with twelve units, a width of 65 feet and a length of 160 feet, there are ten redundant demising walls (marked red) between units. Each of these walls is approximately thirty feet long and between four to six inches thick (using an average of five inches for the purposes of this analysis). This equals a total of 125 square feet of redundant interior floor area per floor. Assuming a four-story condo development, where interior floor areas are certified by the architect drafting plans for the condo documents, this represents a 1.2% loss in actual saleable square footage. At a sale price of $300/sf this

is a loss in sales revenue due to duplication of thickness of $150,000. One could clearly make the argument that very few sites are this tight or that square footage sales prices are not so inelastic that they would remain flat due to a five inch width difference but those are issues to be considered by the developer on a case by case basis.

In a publication from the Federal Emergency Management Agency (FEMA), commenting on Hurricane Andrew, the following observation was made about the structural benefit of this redundancy:

> Overall, relatively minimal structural damage was noted in modular housing developments. The module-to-module combination of units appears to have provided an inherently rigid system that performed much better than conventional residential framing. This was evident in both the transverse and longitudinal directions of the modular buildings". This is a remarkable observation since hurricane winds from the Category Five storm were recorded up to 175 miles per hour. It is impossible however, to put a monetary benefit for a developer on this advantage as structural integrity in excess of code requirements does not appear to be a category that the marketplace significantly values.[11]

VII. Site Considerations

1) The Site

When making the decision to implement a modular building system there are a number of considerations that one must address, amongst them is how to work with a particular site. Modular is certainly a convenient answer to building in challenging weather climates but several other location specific issues must be considered including: building in tight or urban locations, in remote locations, in neighborhoods where you must compress the on-site construction timeline such as a college or adjacent to a particularly challenging neighbor.

To determine if any of these situations may affect the potential for modular, one must work with the manufacturer and transportation vendor early. On a tight urban site for a large project, one needs to determine where the modules can be set down upon arrival prior to being set. If the site is too small to marshal modules for stacking on-site, can an adjacent site ("no further than 5-10 miles" [5]) be utilized to store modules up so that you may build an inventory and minimize the number of days that you must rent a crane.

Consideration also has to be given to whether a property/street/neighborhood is large enough to allow for a flatbed truck's turning radii. If one's site or travel route poses limitations, some manufacturers drive the route and inspect the site to understand how transportation and installation will work and how they must modify the product or plan accordingly.

A very valuable site specific benefit has nothing to do dimensions and logistics but the abutters and the neighborhood. Colleges specifically loath portions of their campus becoming construction sites for liability, noise pollution and marketing purposes. These reasons, coupled with the need for fall student occupancy, have motivated a number of colleges to turn to modular construction. Student housing is built year round in a factory miles away, and once students leave for the summer it is shipped to the college and set, ready to be occupied once students return. Similar benefits can be experienced when building near a hospital, playground, politically charged or influential neighborhood, or in a location with high crime/theft.

2) On Site Assemblage

Regardless of whether the developer or the manufacturer coordinates the crane, it is the most expensive part of the set process with costs of $2500-3500 per day, not counting police details or road closures. Therefore, careful planning needs to be undertaken so that the crane is never idle.

Sample Site, Westwood, MA

Since cranes are classified by tonnage the larger the crane the more operational flexibility one has, especially on challenging small sites where one might be forced to place the crane in a less than ideal position for efficiency which can negatively impact the number of sets per day.

VIII. Vendor Selection

Production capabilities, quality controls, familiarity with multi-family product type, and degree of factory and operating sophistication can vary widely among modular manufacturers. Production capacities range from 100 single family homes per year at a typical smaller manufacturer to 12,000 square feet per week (75% commercial/ multifamily buildings) at a larger manufacturer like RCM in Canada.

The selection process can be more difficult with modular than it is when selecting a traditional site-builder in many markets. One can easily visit a project completed by a traditional stick-builder in most markets to get a sense of quality and competence. The lack of multifamily market penetration for modular makes it harder to find a comparable built project that would establish a comfort level. This is evolving, however, and with an increasing market share and the prevalence of web based virtual tours of developments, this should be much less of an issue in the years to come.

Some other factors to consider are; checking if the manufacturer use 2x6's for exterior walls, if the lumber used is structural versus dimensional, how the floor joists are laid out for access of MEP, the integrity of installed drywall, the application of moldings around doorways, seamless connections of modules, the quality of staircases, kitchens and bathrooms. These components vary from company to company so it is important to see the way each builds their product. It is important to consider all the above factors so that one ends up matching the capability of the manufacturer with the need of the project.

IX. Marketing Considerations

Since the inception of modular building there has been a stigma associated with it being poor quality, not architecturally pleasing, sterile, not durable, low ceilings, too small and generally poorly laid out. This still exists today but to a much lesser extent. Consumers are becoming more knowledgeable about the potential benefits and advantages modular offers. Prior work speaks for itself and most people often cannot tell the

difference. The notion that sale value (or re-sale value) is negatively impacted due to the fact that a home was modular appears unfounded based on the research performed. In conducting case studies, no evidence of the use of modular construction impacting the sale price has been found. One broker, John Schwagerl of RCG in Somerville says that if faced with another mandate to sell a modular project, he would not try to downplay the fact that it was modular but rather emphasize the superior construction and benefits of modular construction and use this as a chief marketing point [12]. Another conversation with broker Scott Macdonald of The Thomson Companies of Danvers, who is marketing a 60 unit luxury condominium deal in Revere, MA, says he does not see any evidence of a stigma effect and that he in fact takes time to explain to his clients the construction superiority of modular.

Belle Isle, Revere, MA

However, Macdonald did comment that some of the developers he works with are still reluctant to use modular on a luxury condominium product as they fear the stigma may still be there for buyers in this price range [13] . Feedback from several other members of the brokerage community carried similar tones: they have seen no evidence of a marketing stigma for modular developments they have worked on, even at the high-end of the market, but have encountered or at least heard of a one or more stories of a developer who decided to not go modular based on marketability fears. This is clearly a market specific decision that should be made by the developer in conjunction with feedback from the local brokerage community.

X. The Green Advantage (?)

Utilizing a modular building system has several environmental benefits. There is more precise purchasing planning and cutting of materials which leads to less waste. Often, any piece of wood longer than twelve inches is utilized for blocking in a factory setting and some factories even burn the smaller pieces of wood to fuel heating systems in the winter. When building in an environmentally sensitive landscape, modular construction does not disturb the site for as long as site-built would. Due to the superior insulation ratings typically achieved by modular, there is greater energy efficiency which is cost beneficial for the owner. Architect Jai Khalsa, in one of his projects explained:

> A project we performed in Westport, Massachusetts that was a 55 and older development had tremendous energy reduction. A lot of the tenants ended up being older individuals who often like to use a little more heat in

> the winter, but due to both energy efficient systems and largely the superior R-rating of the structure, the largest heating bill was about $1700/month for a 32 unit bldg. [10]

Process logistics also offer environmentally superior benefits such as shortened production times leading to less energy being required to build a building, automobile trips by subcontractors and suppliers to a job site that may be for example 30-50 miles away are reduced and/or replaced by more direct and fewer trips by factory workers and suppliers delivering in bulk to a manufacturing facility. Most modular manufacturing plants are concentrated in places like Quebec, Montreal, Pennsylvania, New Hampshire and Maine, and often have an employee base that lives nearby.

Finally, the climate controlled environment of modular construction allows for less moisture to penetrate the structure, avoiding the potential for mold that can easily occur when homes are site-built.

All of these are solid, environmentally-friendly arguments in favor of modular construction. However, it is important to remember that the structural benefits of a modular built home are largely due to additional materials used in the construction. Several manufacturers estimate that anywhere from 10-25% more materials are used in a modular home. So, while fewer natural resources are “wasted” during the modular construction process, more are being consumed to create the same square footage of livable area.

Modular, just like site-built, can be as green as one would like to make it. Some projects researched had wall insulations with 15+ R values and roof insulations with 25+ R values, ground-source heat pumps for cooling and heating, innovative air filtration and vapor barriers, low U value window glazing, mastic for ducting versus taping, etc. The key issue is ensuring that the manufacturer's staff is trained on how to properly install green products, as they can be both costly to purchase and install, and difficult to repair.

XI. Financial Considerations

There are some specific financial considerations and impacts to consider prior to proceeding with a modular development. These financial impacts will vary by region, developer and the economic climate for both the debt and property markets, and should be evaluated and understood clearly before selecting between site-built and modular.

1) Financing

There does not appear to be any difference in origination fees and interest rates associated with financing a modular project. However, potential complications may arise with regard to appraisal and payment terms. If a bank's appraiser is trying to use comparable sales of only modular projects to determine a finished value for the project, it may be difficult obtaining a sufficient number of comparables. This can cause the valuation that the bank will be basing its underwriting on to be skewed unfavorably. Make sure that the lender and the manufacturer (and contracts with each) are in agreement about the timing of disbursements. Issues may arise when a manufacturer

wants payment upon delivery but prior to the modules being set but the lender or the developer resists. A manufacturer typically would want payment at this time to avoid the conversion from personal property to real property that occurs as soon as the module is set as this can add a significant amount of additional legal complications to a manufacturer's recourse if there are payment disputes. A lender typically wants the module set first so that their disbursement to the developer goes towards real property that they could perfect a lien on.

Developers should seek lenders familiar with the modular construction method as they can often find a solution to this problem by splitting payments up or holding a sufficient retainage to ensure the set goes smoothly. An example of a recent payment schedule successfully utilized for a 40 unit commercial building entailed: a deposit and a plan fee of $20,000-50,000 to draft construction documents, a 10% deposit to commence construction and order all materials, 80% upon delivery to the site and then installments of 10% per unit completed once the module is set minus a traditional retainage amount for punch-list items. "We're like any creditor, the terms all depend on the balance sheet of the customer and the level of unique finish components that we have to supply".[14]

2) Materials Cost Control

Further cost control can come from the fact that manufacturers buy material in bulk and often in advance or immediately upon contract execution. This can serve as a hedge against material cost escalations. Recent price escalations have made traditional site-builders much more conscious of the need to improve their purchasing policies, so this

sophistication gap may be narrowing. Also, economies of scale are enjoyed by suppliers that can, with modular, ship a large, steady volume of goods to the same clients at the same location with the same payment plan. This repeat business creates a more solid working relationship (opposed to site-builders ordering smaller shipments of one-off supplies) placing modular manufacturers, "first in line" for the latest goods and best quality products. This supply-side economy of scale can also create price benefits for manufacturers, especially in times of high fuel and transportation costs. Finally, theft can be reduced as the modules typically come fit out with fixtures and are set within a day or two and immediately secured.

3) Unique Labor Environments

The most clear advantage that modular manufacturing has over site-built in many markets is labor cost savings. Factories tend to be located in tertiary markets where labor costs are low and there is an ample supply of workers. Many manufacturers have begun recruiting and training people with no construction background versus trades-people who previously worked in site-built construction, as they find the culture of a construction worker vastly different than the culture of a good manufacturing employee. The result is an employee who can fairly quickly be trained to perform a specific, repetitive task very well, very quickly and at a wage of $15-$25/hour versus the $30+ that skilled construction labor typically demands. This difference is intensified in locations with high labor costs and a unionized workforce. The reality of entitlements may make it difficult to utilize modular for some projects that are either located in strong union labor markets like Boston or New York City or are in part financed with union

pension fund money. However, affordable housing developments and other state or federally funded projects that trigger Davis-Bacon requirements for prevailing wages are perfect candidates for modular construction, as 70-80% of the work is shifted off-site to an exceptionally lower labor cost environment when compared to current prevailing wages in most markets. It is important to note that Davis-Bacon requirements only apply to on-site wage rates. Thus, one could have a modular product built in a factory at local wages and only be required to pay prevailing wages for set and "button-up" work that occurs on-site.

4) Pricing and Change Orders

Several of the case studies presented in this paper will emphasize the additional planning and preparation required to build a modular product. The condensed time period of construction does not allow one to utilize the all too familiar strategy utilized in site building of obtaining a loose bid with several allowances, commencing construction and then figuring it out. Materials must be specified and complete drawings approved before a single piece of wood can be cut. This additional work appears to have the benefit of reducing change orders and cost overruns. “We will bid a project sometimes, even a project that is ideally suited to our capabilities, and give a higher price than the site-builder. The difference is my price is fixed and in the end, after all of the change orders you have on a regular project, I would be less expensive.” [9] While this is the opinion of one manufacturer, architects interviewed during the research process agreed with the benefits that modular planning requirements have on establishing a fixed price and leaving little wiggle room for “extras” to occur.

5) Financial Impact

The bottom line impact of utilizing modular construction is greatly affected by specifics relating to material cost control, financing and labor environments. However, if a developer is going to use modular construction and implement debt financing, there appears to be both a significant benefit to the shortened construction timeframe, and some potential risk.

The primary financial benefit that most developers look for in modular are hard cost savings. This appears to be a locationally and market specific benefit. However, soft cost savings for a well conceived project with predictable market demand can be very significant regardless of location.

Assume a traditional multiple building, multi-family project that finances close to 100% of the hard costs on an interest-only basis over a 9-12 month period. A typical average outstanding loan balance would be 60%, with rental income beginning around month eight or nine that helps supports interest payments. Interest on the loan balance would compound for the entire construction period and until the project is either refinanced or sold.

For a similar modular project, the first phases of the development are typically fully complete and ready to be occupied by month four. Thus, provided there is a market for the units, you are able to earn rental or sales income for a portion of the development in less than half the time. This can offset a much more significant portion of the required

construction draws and lower the average outstanding loan balance. Assuming a project completion date anywhere from a third to one-half faster, interest payments are reduced by the effects of both a shorter loan period and a smaller loan amount. Fees on the loan may also be smaller as they would be based on a lower projected loan amount, however this is dependant upon a lender fully buying into the projected time savings as this occurs ex-ante. Additional soft cost savings relating to the shortened time span can include lower builders risk insurance and lower general conditions

The key caveat mentioned above that can either magnify or eliminate the soft cost savings is velocity of market absorption. The speed of modular construction often provides a significant benefit in that it allows a developer to significantly shorten the time period for construction. This can help mitigate and/or eliminate uncertainty about what future market conditions will be when the product is delivered by delivering the completed inventory more quickly. Similarly, if the development is a typical for-sale product that requires buyers to put up a modest deposit and then close upon construction completion, it is reasonable to assume that a buyer will be less likely to change their mind if the construction only takes four months instead of nine.

A possible risk that could arise with the speed of development comes when a project meets tremendous difficulty in marketing or market conditions abruptly change. With modular, it can be too late to halt production because the entire project may be complete before it is possible to truly gauge the market response. This would cause a developer of a modular project to have expended the entire budget and incur interest

and carrying costs for the entire project. A site-built project encountering the same problem at the same time may only be one-half complete before recognizing the issue and halting additional phases and would therefore have both lower carrying costs and a smaller construction loan to service. A more reserved approach when contemplating modular construction in an uncertain market is to either build to pre-sales or in manageable phases. If the product is well received, one would open the construction spigot, if not, they would either damper down or close it fast.

Four detailed project pro-formas are included in the appendices that offer a comparison of the bottom line impact of modular versus site-built for both a for-rent and for sale development.

VIII. Case Studies

1) CAMBRIDGE COHOUSING – 175 RICHDALE AVENUE, CAMBRIDGE, MA

Developer: Oaktree Green

Modular Company: Epoch Homes

Architect: Bruce Hampton Architects

Contractor: CB Construction Company

Cambridge Cohousing is a 41 unit infill residential project located on a 1.5 acre site in Cambridge, Massachusetts. The project consists of a mix of 1,2 & 3 bedroom flats and large 3-story townhouses all over an underground parking deck. Cambridge Cohousing was the vision of Oaktree Green, a Massachusetts based development and design/build firm founded originally as Unihab in 1969 as a developer specializing in factory-produced, urban, multifamily housing with a vision of maximizing quality and value by emphasizing good design. In the early 1990's, the company re-organized as a partnership committed to sustainable design and development named Oaktree Green.

Two of the firm's partners Arthur Klipfel and Gwendolyn Noyes were a part of the Cambridge Consortium, a community based group that spent several years in the mid 1990's looking to do a green cohousing project in Cambridge. Entitlements moved quickly as the community was very supportive of both the co-housing concept and of the mission of building an environmentally responsible project.

"Green" development was in its infancy in the mid 1990's, there were no LEED certifications or US Green Building Council. Many of the concepts being considered for implementation on the project would have significant cost premiums as the materials were difficult to come by and vendors were not well trained to install or service them. Oaktree knew they would have to find a way to create some cost savings as the Cambridge Consortium, who intended on occupying the co-housing development, was a cost conscious group. Partners Klipfel and Noyes had some prior experience in working with modular construction as Arthur still holds a patent for a modular building system typology that he created in the late 60's and the two have been in business together for over thirty years. This experience was somewhat dated however as it had been years since they had done any modular development. They felt that modular was a way to potentially obtain some significant cost savings to counter any potential premiums for the green components of the development.

Oaktree interviewed and selected New Hampshire based modular home builder Epoch Homes. Epoch Homes was founded in 1983 and until that time was primarily a high-end single family home builder. Epoch Homes was very interested in the potential for

handling larger scale projects, where economies of scale for production could potentially be magnified, and in the green component of the project as it seemed to be a natural fit for the modular process. The company produced around 150-200 homes per year at the time but had never tackled a project of this scale.

The total hard costs were $6.6 Million dollars or approximately $100/sf for 122 modular pods and a construction timetable appeared to eliminate around 3-4 months from the timetable of a site-built project.

Implementation:

Production of the modules and site work commenced immediately and the first shipment of boxes arrived within two months. Complications began shortly thereafter. The first issue that arose was permit related and Project Architect, Bruce Hampton explains, “the city was very cooperative but some inspectors had to be educated on the scope of what they were really signing off on and the legal limitations of their on site review.” [15] Next came the single largest modular specific issue of the project, the on-site connection work, “One of the biggest issues was marrying the boxes and the on-site utilities together. The local plumbers and electricians etc… had their licenses on the line for a lot of work that they weren’t performing or weren’t sure if they were supposed to perform and they charged us a premium for this work. That premium began to quickly eat up some of the savings we had projected on paper.” [16] As a result of this and other projects, the modular builder has implemented a requirement for all customers and

builders who wish to utilize the Epoch Homes product to attend a mandatory training program of approximately one week initially, with follow ups as advances or changes in production methods are implemented. "Educated partners of Epoch Homes should have no vendor complication issues as they are trained start to finish on our process. If you don't know what you're doing you can get into trouble and I think that's what happened in Cambridge".[6] This issue can be handled either through education, both of your developer/contractor partner or through increased market awareness and market share.

"Also, until recently, modular has been a suburban development tool, single family homes and such. An urban setting was new for modular. Stacking the units as they arrived became an issue and we had to rebuild some of the units that were not yet installed and fully enclosed when we had a storm." [16] This runs counter to the primary quality argument made by the modular industry, specifically those doing business in inclement climates, of offering a product that is protected from the elements as opposed to traditional site-building that is subject to rain and snow. Typical installation procedures should protect against this as the shrink wrap, while sturdy, is not impervious and needs to be inspected for leaks and pitched in a way that does not allow water to pool on top if it is to remain unset for any period of time.

The main complication arose however not as part of the modular process but in the form of growing pains for Epoch Homes. Their production capabilities were not able to keep up with the projected timeline and significant delays occurred. "Time is the real savings

with modular if it works but the schedule got derailed because of the size of this job and it almost broke them ". [6]

Results:

Despite delays, the project sold out shortly after opening with reasonable success. Marketing was not an issue and the developer was able to overcome any initial skepticism and stigma of modular by communicating with the occupants. "We pitched it as superior quality…I mean in any controlled situation you should have better quality and less waste and it worked". The product has proven to be about average in quality and durability as the developer has had to address some minor cracks and one occupant in particular complained of two months of loud pops in her wall. There has actually been more issues with some of the green components utilized (water source heat pumps all failed within 1-2 years) as they were more cutting edge and untested at the time.

Several changes at both the development firm and the manufacturer have occurred since then as both have learned valuable lessons. The manufacturer's training program and commitment to work only with builders and developers who are willing to educate themselves on the Epoch Homes system seems to be a real positive step towards eliminating both unrealistic scheduling and subcontractor complications. While Oaktree later recommended Epoch Homes to a relative to build a custom home, they have yet to do another modular project and are instead focusing on traditional stick and steel built in

their for-sale projects. "Customization is an issue and to sell a condo, if you need to make on site, on the fly changes, modular can be more expensive". [16] However, the main issue germane to the modular process that Oaktree would like to see is more of a full service/holistic, turnkey approach from modular companies so that they or their vendors handle every component of the construction except the foundation. "Canadians are doing more but you really need one vendor to do the whole thing to avoid the complications".[16] From an architectural standpoint it was felt that "the delays caused the project to not experience any time savings over site-built but there were still hard cost savings of probably 10% if I think about comparable site-built costs at the time, I think we all forget that because there was a lot of pain and suffering to get there." [15] As for post project experiences with modular, the Project Architect has had more success, he mentioned:

> a lot of little things fell through the cracks on that job, AC piping, fire alarms…all of the things that were multi-disciplinary systems that modular doesn't have to do a lot of in their single family homes. Since then, we sit everybody down, go thru the project and say 'who's got this, who's got that' rather than letting people try to figure out on their own where their responsibilities begin and end, when you do that it goes much more smoothly. [15]

LESSONS LEARNED:

1) Understand the realistic production capacity and backlog of the manufacturer to establish a realistic timeframe for production and delivery of modular elements.
2) Promote clear communication between manufacturer and local trades or, if possible, select a manufacturer that self performs installation and utility connections.
3) Monitor quality control early and at all levels of production, including transport and set phases.

2) CAHILL PARK – 200 BUSH STREET, SAN JOSE, CA

Developer: Castle Group California

Modular Company: Guerdon Homes

Architect: Studio X

Contractor: Castle Group

Cahill Park is a 160 unit, for-sale townhouse development located in the historic midtown district of San Jose California. The development is comprised entirely of three-

story, four bedroom townhouses on top of individual attached garages. Cahill Park was the vision of San Mateo based Castle Group California, a development firm founded in 1993 to bring innovation to the Bay Area housing industry. A key factor which eventually led the Castle Group to utilize modular construction was the belief of founder Chris Kober that the average quality of homes built today is actually less than ones built 50 years ago. It is his belief that while automobile makers and the computer industry have made steady gains in quality and production that the housing industry has lagged.

The Castle Group's first attempt at improving the process and standardizing construction was a 54 unit development called Sutton Place. They utilized a poured-in-place concrete chassis to frame the structure but found that the irregularities that developed when the concrete settled were not worth any minor gains in process efficiency. After significant research into the process, they decided that modular could get them the quality and efficiency improvements they desired with the added benefit of being able to more quickly respond to market demands due to shorter construction cycles, "turning the spigot on or off as market demand dictates" states Kober. [17] The site was an ideal development opportunity in a rapidly transforming neighborhood on the west side of Midtown San Jose but it held no particular site or access issues that made it a candidate for modular, the decision was purely a quality and economic driven one.

Implementation:

Once the site was under control, the Castle Group knew they would be utilizing modular and designed the building accordingly. Three manufacturers were contacted and sent schematic plans. All three sent bids with indicative pricing. They selected Idaho based Guerdon Homes who not only offered competitive pricing but appeared to have sufficient capacity to handle the project and good quality controls in place. "Cost savings on the hard cost component were around $35/sf but San Jose is an expensive place to build, we might not have had any hard cost savings at the time if we were building in Sacramento" according to Bruce Fairty of Castle Group California.

As this was the developer's first foray into modular they did several things to simplify the process and value engineer the buildings. First, all units were comprised of four bedrooms and within those only three different floor plans were offered. They felt as though this would best take advantage of economies of scale. Second, the majority of the buildings utilize flat roofs, this "eases the transportation component which we were handling directly". A third interesting decision was to build all units at approximately 15' wide by 37' long and 11' tall. "On our route, you can ship 12' wide completely unrestricted, when you go to 12.1-15' you get a certain level of restrictions but once you go to between 15-16' it becomes much more restrictive and that extra foot isn't worth it". The fourth modular specific decision was to utilize a time and materials work process for the on-site utilities connection work on the first several townhouses. "Our on-site work bids were coming in over budget, it's difficult to get competitive sub-pricing, especially in

a market where modular is fairly new, so we went T&M until the subs really understood what they were being delivered and what they had to do, then we got better fixed pricing for the rest of the project". Finally, the condos were selling in the $500-600k range. When marketing to customers at that higher end of the pricing spectrum there can be significant demands for customization, something that due to the rapid speed of production, modular isn't very well designed to handle. To compensate the developer "moved way up the curve on the base bldg package" giving the customers many items that might be considered upgrades in competitive developments. The only items that were left to customization were flooring and appliances.

The largest unforeseen complication was the construction financing. The local lending community did not have a familiarity and comfort level with the production process and market performance of modular multifamily housing. "At the time, there were only two other significant modular projects on the west coast, one in Sacramento and one in Portland, Oregon and both went horribly because of production issues". As a result, the lender restricted the size of any one phase to 51 units. Each phase was ordered, built, delivered and finished on site within 3-3.5 months. However, the units were selling out as quickly as they were delivered. "We could've done even better financially if they would've released the funds more quickly. As it stood we couldn't keep up with the velocity of demand". The delay didn't end up hurting the project significantly as the project finished and sold out by early 2005. Were a delay like that to happen a year later, pushing unit delivery into the beginning of a down market, the impact could have been disastrous.

Results:

Cahill Park has been the poster child project for modular construction on the West Coast. It proved to be a financial success and a good test case for the developer. "We sold out as fast as we built them and didn't have to give a dime worth of discounts to address any market stigma, which actually was surprising but our quality was great, we had very few repairs or issues with quality, much fewer than normal". Consequently, the Castle Group currently has close to 1,000 residential units in various stages of permitting and planning and will utilize modular construction on every project going forward. They are seriously contemplating forming a partnership with the manufacturer for the project, Idaho-based Guerdon Homes, so that they can be even more integrated into the production process.

While throughout research for this project we have heard repeatedly that transportation regulation is one of the major difficulties inherent in the modular process. This proved to be straightforward for Castle, who handled the transportation and craning components themselves. One issue that they feel they can address going forward are the financing complications that West Coast banks may have in issuing construction loans for more large scale modular projects. They intend to look at privately financing the construction costs so that they can fully take advantage of the market responsiveness that comes with the speed of the modular process. They feel that there will be significant interest from funding sources as there is much less variability in the

construction pricing with modular and a much higher probability that you will close on pre-sales as a buyer placing a deposit for a home they will be closing on in 3 months is less likely to change their mind than if the home was to be built traditionally and take 9-12 months.

While pleased with and committed to the modular process, the developer admits it is not ideal for every developer, as Castle Group California's Fairty mentions:

> You really have to re-invent yourself if you go modular as there are 1,000 new details. You have to run the job with the mindset of a producer/manufacturer, not a deal junkie type developer with limited construction knowledge who finds the site, permits it, signs a construction contract and disappears for three months. You have to know more about construction than you would in a regular project and you have to pay a lot more attention throughout the process or you are going to get hurt".[7]

The developer also acknowledges that it can make the entitlement process more difficult in areas that have a strong unionized labor force that typically opposes the use of modular construction and exerts influence on local politicians to not support projects that don't utilize local labor.

Two positive aspects of modular construction that they feel will assist them in battling this resistance are the need for quality affordable housing and the growing demand for environmentally friendly construction. According to Kober and Fairty:

It's really a better value. In a traditionally built home, to install a counter the subcontractor has to go to the site, measure several times and make multiple cuts in addition to having a schedule that is subject to everyone else's timelines. All of that creates tremendous cost, none of which has a sense of worth to the consumer but ultimately the consumer has to pay for it.[18]

It's much greener, you're using less power because you are condensing the construction period, less gas because you aren't having subs travel to a worksite every day for nine months and less construction waste, you go down from around 5% on site to probably 2% in a factory. Soon only LEED certifiable projects will be built in California and with the modular process you are much closer. We'll probably go LEED Bronze on our next development and we can get there cost effectively with modular. [7]

LESSONS LEARNED:

1) Modular construction can have tremendous costs savings in high cost of labor/strong union markets but will experience additional difficulties when permitting in such markets. Pitch the green/affordable component of the project to counter this.
2) Significant construction knowledge is a must to compensate for subcontractor and process issues.

3) Financing can be an issue if the local lending community is unfamiliar or uncomfortable with the process. Prepare to spend more time here.
4) Large scale projects can potentially offer more savings, as they offer greater opportunity to perfect the manufacturing and connection process.

3) BROOKSIDE MEADOWS – 10100 BROOKSIDE ROAD, PLEASANT VALLEY, NY

Developer: Kirchoff Companies

Modular Company: RCM Modular

Architect: Fugleberg Koch Architects

Contractor: Kirchoff Construction

Brookside Meadows is a 270 unit rental community located just north of Poughkeepsie, New York in Pleasant Valley, a relatively rural suburb in upstate New York. The development was conceived and built by the Kirchoff Companies, a large & multi-faceted construction and development company based in Pleasant Valley. Brookside is comprised of a mix of 1 and 2 bedroom flats and 2 and 3 bedroom townhouses and utilizes eight different floorplans. It was intended to serve a slightly higher segment of the market that was not being serviced with the then-existing older stock of apartment housing in the area.

The development utilized both modular and site-built construction techniques. This unique set-up was a function of a variety of factors: first, modular construction was utilized for the majority of units to reduce costs, as Project Developer, Joseph Kirchoff explains, “Apartment development is tricky nowadays, you need some catch, some way to cut costs or you’re not going to make any money”,[19] second, modular construction was utilized to address the dearth of a significant workforce in this fairly rural area that could quickly and efficiently handle such a large project, and finally, traditional site-built construction was used for building the townhouses as a way to both keep the developer’s in-house carpentry and construction teams actively involved and as insurance against any possible missteps by the modular manufacturer. “I didn’t want to put all my eggs in one basket on a project this size,”

Implementation:

The project experienced a somewhat inauspicious start for a couple of reasons. First, the permitting authority in New York, which has a reputation for being relatively slow, took a significant period of time in approving the plans for the structure. Because the developer does a large amount of construction in New York every year (close to $100M), it was aware of the permitting authority’s reputation and decided to run municipal approvals concurrent with the building structure approval process. This could have been quite costly were they to fail to obtain municipal approvals and yet still have spent a significant amount of money to draft construction drawings. Regardless, they felt confident about the municipal approvals and determined it was a relatively low risk

gamble. Also, the developer switched from an American based manufacturer to a Canadian based manufacturer fairly late in the pre-construction process. As this was the first project that he built utilizing modular, he continued to research various companies throughout the process and came to a relatively late decision that the Canadian firm had superior volume capabilities and quality controls in place. This decision also had cost benefits as, thanks to NAFTA, there is no tax on the materials used to build the modules that are shipped to the US and factory labor costs are lower in Canada "around 25 percent cheaper, it's $15/hr versus about $20 in the US".[19] Issues continued through the construction period as this case proved not significantly different than others. There were on-site issues with the utility connections. Developer Kirchoff said:

> Look, we own a plumbing contractor, an electrical contractor and a site-work company as subsidiaries and we still had a tremendous learning curve to deal with. It took us several buildings to get the connections down but we allowed the guys to have a lot of communication with the manufacturer throughout the process and eventually we got it down…but it was a real group effort".[19]

The developer also made sure to itemize pricing on several finish components and decided that it was more cost effective to handle the exterior finish work on-site. The plans called for porches and architectural overhangs to be performed on site. As this work was being performed by the same carpenters who handled the siding, the pricing proved to be slightly superior and they were also able to ensure one source of

responsibility for all exterior finishes, thus avoiding any potential blame-games regarding damages to exterior finishes that could arise from using multiple sources. Another seemingly significant decision driver for going modular on the project was the market. Pleasant Valley was a relatively new and unproven market for higher end rental product. "In an untested market, where your velocity of absorption is uncertain you can damper down or open up the production flood gates without the same heartache and delays that you would experience in a site-built project." . [8]

Results:

Brookside Meadows proved to be a financial success and is almost fully leased at present. Kirchoff mentioned that:

> "We saved about 5-6% on our total project costs by going modular. But it wasn't really in hard costs, it was in a lot of areas that you wouldn't think of at first; shorter construction periods meant lower general conditions, less builder's risk insurance, a smaller construction loan that gets paid off faster which gets you less interest and lower fees. It was a lot of work, a lot harder than if we just did it the old way but in the apartment business a 6% savings is the difference between making money or not. [19]

Although the project encountered relatively minor setbacks, the owner made an interesting decision as a hedge against any major issues - he drafted two sets of construction documents, one for modular and one for site-built. This served a dual

purpose; first, if they were to encounter any significant delays with modular production or deliveries, they would be able to proceed with construction by ramping up the on-site staffing and proceed with stick-building. Second, should any issues arise with the manufacturer, they wouldn't be at his mercy as he was aware that they had the capabilities to do it themselves, on-site with their ready-to-go set of plans for site-built, "that helped keep everybody honest" [19]. While this may appear to be a duplication of A&E costs, the owner selected an architectural firm that was extremely experienced in modular construction; Florida based Fugleberg & Koch, who were able to design the structure in a way that could be efficiently built either on-site or in a factory. Thus the changes required to produce the second set of plans were relatively minor. Kirchoff mentioned, "We could've gone with a less expensive local architect but we felt it was worth it to use someone who has a significant amount of experience with modular… so you pay a little extra by the hour maybe but in the end you save money." [19]

One potentially costly decision of using a Canadian manufacturer did not end up making a material impact but in a smaller project with more site constraints it easily could have. The modular shipments were fairly regularly held up at the border for significant periods of time. This didn't end up impacting the development as they had plenty of room to stack incoming modules on-site to always keep an inventory of work progressing. If this had been a smaller project on an urban site that utilized more of a just-in-time delivery schedule, these delays would have shut progress down. Similarly, if they had pushed the dimensional limitations of width, thus requiring police escorts and other specialized delivery-related work (removal of low street-lights, scheduled road closures and police

details) those costs would have potentially doubled. When delivering off-hours there is very little wiggle room in the timing within which deliveries can occur and one would have to pay those expenses for multiple days if the delays pushed delivery outside of those parameters.

In contrast to the previous West coast case study, financing was not an issue for this particular development as New York, and the northeast region in general, is relatively familiar with modular methods. The developer also was particularly well financed and used a bank that he had a significant prior relationship with. Such impressive success stories aside, Architect Koch said:

> It will be awhile before the multifamily industry adopts this en masse but within the next ten years you will se a whole lot more of it, especially along the coasts where labor costs are high. The main limitation is the brain damage of doing it the first time in a fast moving business. When you find a site you can't take the time to slow down and educate yourself on something brand new if you want to be competitive. This was a unique situation with a very well financed developer who was very knowledgeable about construction and curious enough about the savings to really dig in and study it enough to get a comfort level."[8]

Going forward, Kirchoff has said that if the opportunity arises he will use modular construction again but that he isn't specifically looking for deals where he can. "If it's

the right opportunity, I will most certainly do it again and it should be easier this time…should be." [19]

LESSONS LEARNED:

1) Use an architect familiar with modular construction. Do not use a regular architect and expect the manufacturer's in-house architect to make the required changes. There needs to be an educated back and forth or you will run into issues.
2) Connection issues will occur regardless of construction sophistication. Attempt to phase accordingly so that factory adjustments and communication can occur.
3) Itemize finish component pricing as some aspects can be handled on-site for less and with a single source of responsibility.
4) Understand transportation issues and attempt to plan accordingly.

XIII. Conclusion

This thesis aims to provide a broad range of the knowledge gleaned throughout the research process about potential benefits, limitations and considerations for a developer contemplating “going modular”. The overarching message is that every project and every market has a unique set of characteristics that will influence the decision process. Much of the research performed showed that modular construction has some very interesting potential advantages over the traditional site-built process that make exploring the possibility of utilizing it a worthwhile exercise on a case by case basis.

1) Physical Product

Issues affecting the visual appeal of a modular building are becoming less restrictive. This is partially due to advances in technology, loosening transportation regulations and a movement towards less parochial building codes. However these are not the main reasons. Both architects and manufacturers are becoming more adept at designing and delivering good product around the transportation and structural limitations of modular. It is often difficult to even discern the difference between a current modular built and a site-built multifamily project. The structural benefits offered include better insulation ratings, superior soundproofing due to independent demising walls, a lower probability for mold/moisture issues and superior structural integrity. The primary issues that still remain revolve around the height and width limitations that make delivering a very expansive room or high ceiling difficult and expensive. For most multifamily projects, these issues will not limit or eliminate the applicability of modular.

Site specific limitations and complications may dramatically alter the dimensional specifications of the module that can be delivered cost effectively. Low overhead power-lines, narrow streets and small sites in densely developed neighborhoods may add complexity and restrictions to your design and construction that need to be considered up-front. Also, the desired level of finishes that the developer would want the manufacturer to perform should be contemplated as with the existing technology and process, both flooring and siding should probably be performed in the field.

2) Process Considerations

There is not a better reminder of the increased complexity of modular construction than to repeat the reference comparing it to a "D-Day invasion." The process involves coordinating manufacturers, general contractors, subcontractors and building inspectors to accomplish in a few days what takes weeks and months to do in a site-built scenario. Preparation, communication and planning all become more challenging and must be more precise. A way to help simplify this process and eliminate some complexity is to seek a team, from fire-alarm installers to financing sources, familiar with modular from prior developments. Accept that the process will be more complicated, at least the first time around, and plan accordingly. Foster constant communication between the factory and the various on-site trades and clearly document where each parties responsibilities begin and end. The more time invested up front by the entire project team will have a direct impact on the end result

It is more difficult to make changes to a completed module once installed than it is to an in-process site-built building. To address this complication, have a few modules built and then inspected by representatives from the on-site team to ensure that both the finished product is what it should be and that the on-site team understands what exactly is being delivered to them.

A note of caution; understand the entitlement environment that the development is to occur in and be realistic about the potential impact on entitlements that can arise in some markets without the support of organized labor unions. Finally, involve the manufacturer early in the process as certain design elements that become part of a set of permitted drawings may handicap the potential applicability and effectiveness of going the modular route.

3) Market Issues

The issue of stigma needs to be considered carefully for any development and a good understanding of local opinions towards modular within the target market and demographic is imperative. Despite the fact that none of the case studies found this to be an issue, remember the adage “all real estate is local” and recognize that results and opinions can vary by state, city and even neighborhood. As more emphasis is placed on environmentally conscious development, the developer can emphasize certain product and process benefits to modular construction that can help overcome any perceived stigma and may actually help increase demand with the “green” consumer.

4) Financial Implications

Modular construction has both potential financial benefits and risks. In average to strong markets, the shorter construction period can greatly reduce construction loan interest, overall soft costs and help to generate revenue sooner. The shorter time period also eliminates some market risk as the market is typically less likely to change as significantly in four months than it is in nine months. Hard cost savings due to labor costs, tax savings on Canadian goods, economies of scale etc…seem to vary greatly depending on local conditions. One potential benefit however, is that the greater level of detail required to commence modular construction should eliminate cost overruns due to inaccurate allowance allocations and material cost spikes.

Conversely, the speed of modular construction can lead to issues when market conditions do rapidly change or if a project is ill conceived and selling/leasing slowly. It is much more difficult to gauge the market reception for a development in four months than it is in nine months and while it is easy to “turn the production spigot off”, this only helps when a project is phased, or built from pre-sales.

5) Summary

In summation, modular construction adds complexity and unfamiliarity to the typical development process. It should not be undertaken by those looking to eliminate or reduce construction management responsibilities as this would almost certainly be a costly error. Rather, it is a potentially effective process that a detail oriented multifamily

developer looking to reduce costs and/or standardize and improve quality across a development should explore.

XIV. Looking Ahead. Where is the Industry Headed?

Modular construction has experienced significant advances in market share, technology and capability. '[Now a $5 billion dollar per year industry; modular construction has expanded into multiple product types beyond residential including industrial, office, hotel, retail and institutional.' [20] While primarily utilized in the inclement climate of the northeast, where it has experienced a 57% growth in market share in the past six years, the geographic range of modular housing is expanding.[21] Some interesting issues to watch pertaining to the future of modular are as follows:

Steel frame: To tackle larger projects, manufacturers are expanding their focus to include steel frame construction. This does not dramatically alter the modular process per se but it has a much smaller market penetration than wood frame. Most manufacturers felt that the real opportunity for steel frame was in the mid-rise, 9-16 story urban buildings. A significant amount of this is already occurring in Asia and selectively throughout Europe but look for an increased focus from domestic manufacturers in the next ten years.

Foreign Invasion: Several large multinational firms such as Verbus and Ikea (through a partnership with Skanska) are looking to enter the US modular market. Despite the

additional transportation issues to manage, it is felt that they can capitalize on their competitive and operational advantages and be cost competitive. Look for heavy lobbying from the international manufacturers to address the current code compliance restrictions that would prevent this today.

Hybrid Processes: More manufacturers are beginning to add panelized and pre-fabricated components to their manufacturing capabilities. Bringing this operational capacity in-house should help eliminate some of the dimensional restrictions that modular manufacturers currently face and allow them to cater to an expanded customer base.

One-Stop Shopping: Manufacturer Roger Lyons, of Penn Lyon, calls the largest obstruction to modular expansion into the multifamily industry the "distribution problem".[14] This refers to the lack of a turnkey construction services. Several large manufacturers are taking the first steps towards handling the entire construction process from site-work to module building, transportation and utility connections either completely with in-house personnel or by general contracting with preferred subs. Look for significant growing pains as this process evolves. Should it be successful, a large portion of the process difficulty will be eliminated and market penetration should increase.

***Technological Advances*:** With the increasing user friendly advances of CAD, many manufacturers are allowing more and more design process interaction with clients. Hi-

tech tools such as the Weinmann WBZ 120 beam processing station (an automated high-tech saw that cuts to 1/16th of an inch) will continue the trend towards automating production lines.

Labor: There is a general concern in the building industry about the declining pace of people entering the building trades. This bodes well for modular manufacturers, as in a factory setting work gets done faster and more efficiently in a cleaner, safer and more appealing environment for employees.

Environmental: The Modular industry is working closely with representatives from Energy Star to create an Energy Star certification tailored specifically to modular construction. As LEED expands its reach into the single and multi-family home sector, modular appears poised to make a much easier transition than traditional production homebuilders.

Education: A recurring theme found throughout the research was the need for modular specific education and training. The industry has begun to address this. From institutions such as the Factory Built Housing Center at the Pennsylvania College of Technology to a growth in company sponsored orientation and education programs for new clients, there is a concerted effort to build awareness. This should help to not only eliminate the issues that can arise when inexperienced developers, builders and subcontractors attempt modular for the first time, but should also serve to elevate the status of the modular construction industry.

Appendix

Quantitative Analysis

To better quantify the true impact of going modular, we will apply some of the commonly repeated anecdotal evidence and real world results of this decision to two different scenarios and measure both the project level and equity level IRRs of both a traditionally constructed project and a modular project.

Base Assumptions

There is little doubt left that a modular built structure is typically constructed and installed in less time than a traditionally built structure once the construction process proceeds. However, varying accounts in research has left a margin of doubt to the fact that it significantly shrinks the entire project time. It appears that in several cases that the level of detail required to begin building modular could be greater and thus potentially more time consuming. "A developer sticking to the traditional method of construction has a very familiar waltz to perform. All the players, lawyers, architects, contractors, know it and it proceeds along at a well known pace and rhythm. If you go modular, all of that familiarity of process goes away and you have to prepare as if you are doing a D-day invasion" [7].

In addition to the potential for additional pre-construction planning required for modular, if you are operating in an environment with strong unions, the approval process could take longer. For the purposes of this analysis it is assumed that no time savings can be

achieved on the pre-construction phase, but the actual construction phase is reduced by one third, which appears to be an even handed approach based on the cases studied.

Certain projects studied experienced significant hard cost savings approaching 10-15%. However, savings like that do not appear to be the norm and will likely only be realized in the following scenario: 1) The project is located in a high labor cost (and possibly unionized) environment such as New York, downtown Boston, Chicago, Washington D.C., San Francisco and Los Angeles; 2) The project is allowed to undergo significant modular specific value engineering early in the process. A much more typical hard cost savings across the projects studied is approximately 5%. That being said, no hard or soft cost savings will be factored into the analysis as they are project specific.

Phasing specifics, their resulting impact on financing requirements and the resultant project financial performance also behave quite differently in a modular project. Area specific financing difficulties arising largely from local market unfamiliarity with the modular process, such as those described in the Cahill Park development can certainly dampen the positive effects of the financial benefits of modular. However, absent this regional complication, we will assume a typical arrangement of 20% up front and the balance due as delivered and set, which should occur in the same month, which is typically 1.5-3 months later (dependant upon the availability of the finish materials and the capacity of the manufacturer).

Phasing is more flexible with modular than with site-built. For a typical garden style development of approximately 150 units spaced over six buildings, you may have all six buildings under construction in varying stages of completion for approximately nine months start to finish for each building. This is required to be able to have a rolling delivery of units to meet market demand. A modular project will have significantly less work in progress at any given point, typically two buildings being set at a time in various stages of completion and one under construction in the factory. Each building can be built and delivered in approximately two to three months thus creating a revenue stream which helps pay down and/or eliminates the need for a larger construction loan.

Scenario 1:

The project will be a six building, 150 unit, townhouse style, for-rent development. Units will average 1,000 square feet each. It is assumed the developer owns the land slated for development but has to handle entitlements, construction, lease-up and disposition upon completion. A rolling delivery of units will be used, based on a three month construction period for each modular building with each building being released for construction every month. The traditional built site will also be a rolling delivery with every building taking approximately nine months and coming on line one month after the previous one. Financing will be a 70% LTC at 7.5%. Entitlement time and planning for the project will be 9 months. Rental rate psf will be assumed to be identical for each project at $2.00/sf/mo. Operating expenses will be identical at $6,000/unit/year despite some anecdotal evidence of lower utility costs for heating modular buildings in colder climates. Hard costs will be assumed to be $150/sf. Soft costs excluding financing will

be $50/sf in each scenario however we will add in three weeks of modular specific training for three members of the developer's team billed at $300/hr on the front end. Soft costs will be incurred 15% upon permitting inception and the remainder spread evenly over the duration of the project. Hard costs will be assumed to be billed 20% up front in both scenarios as each building is released for construction and then distributed evenly every month for the total project duration for the traditional scenario and paid as the units are delivered for the modular scenario. The land will be valued at $4.5 million. Lease-up will be assumed to be 40% upon delivery of a building and 10% every month thereafter per building. Reversion cap rate will be assumed the same at 6.5% for each complex.

Scenario 2:

Similar assumptions to scenario one except this will be a for sale project. Hard costs will be increased by 10% for higher finishes in a for sale project and units will be pre-sold at a rate of four units per month beginning at project entitlements and closed on once completed. Once completed buildings appear on-site the pace of sales increases to six units per month. Sale prices are assumed to be $300/sf.

QUANTITATIVE ANALYSIS MODULAR vs. SITE BUILT INPUTS

Development Costs Summary	**Traditional Rent**		**Modular Rent**		**Traditional 4 Sale**		**Modular 4 Sale**	
Item	$/SF	Amount	$/SF	Amount	$/SF	Amount	$/SF	Amount
Land	30	4,500,000	30	4,500,000	30	4,500,000	30	4,500,000
Hard Cost	150	22,500,000	150.0	22,500,000	165	24,750,000	165	24,750,000
Soft Cost	50	7,500,000	50.7	7,608,000	50	7,500,000	51	7,608,000
Const. Loan Interest	16	2,327,644	16	1,546,463	16	2,327,644	10	1,546,463
TDC	**245.52**	**36,827,644**	241	36,154,463	**260.52**	**39,077,644**	256	38,404,463
Const. Loan Interest Rate	7.50%				7.50%			
Constr Loan Fee	1.00%							

Project Specifications						
GSF	150,000					
	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Apartment Rent PSF/mo	$ 2.00	2.06	2.12	2.19	2.25	2.32
Apartment Rent PSF Growth	3.00%					
Condo Sales PSF-Sc2	$ 300.00	$ 309.00	$ 318.27	$ 327.82		
Condo Sales PSF- Sc3	$ 300.00	$ 309.00	$ 293.55	$ 293.55		
Exit cap rate	6.50%	Year 2	Year 3	Year 4	Year 5	Year 6
Expenses ($/Unit/mo)	$ 500	$ 515.00	$ 530.45	$ 546.36	$ 562.75	$ 579.64
Expenses Growth	3.00%					
# of units	150.00					
Avg Unit Size	1,000.00					
Vacancy & Bad Debt	4.00%					
Sales Fee	1.50%					
Modular HC Adjustment	100%					

SCENARIO 1 SCHEDULE COMPARISON

Traditional Schedule	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Units Released	0	0	0	0	0	0	0	0	0	25	25	25	25	25	25	0	0	0
Cummulative Released	0	0	0	0	0	0	0	0	0	25	50	75	100	125	150	150	150	150
Units Delivered	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cummulative Delivered	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Units Leased in Mo.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cummulative Leased	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Modular Schedule	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Units Released	0	0	0	0	0	0	0	0	0	25	25	25	25	25	25	0	0	0
Cummulative Released	0	0	0	0	0	0	0	0	0	25	50	75	100	125	150	150	150	150
Units Delivered in Mo	0	0	0	0	0	0	0	0	0	0	0	0	25	25	25	25	25	25
Cummulative Delivered	0	0	0	0	0	0	0	0	0	0	0	0	25	50	75	100	125	150
Units Leased in Mo	0	0	0	0	0	0	0	0	0	0	0	0	10	12.5	15	17.5	20	22.5
Cummulative Leased	0	0	0	0	0	0	0	0	0	0	0	0	10	22.5	37.5	55	75	97.5

SCENARIO 1 SCHEDULE COMPARISON (continued)

Traditional Schedule	19	20	21	22	23	24	25	26	27	28	29	30
Units Released	0	0	0	0	0	0	0		0	0	0	0
Cummulative Released	150	150	150	150	150	150	150	150	150	150	150	150
Units Delivered	25	25	25	25	25	25	0	0	0	0	0	0
Cummulative Delivered	25	50	75	100	125	150	150	150	150	150	150	150
Units Leased in Mo.	10	12.5	15	17.5	20	22.5	15	12.5	10	7.5	5	2.5
Cummulative Leased	10	22.5	37.5	55	75	97.5	112.5	125	135	142.5	147.5	150

Modular Schedule	19	20	21	22	23	24	25	26
Units Released	0	0	0	0	0	0	0	0
Cummulative Released	150	150	150	150	150	150	150	150
Units Delivered in Mo	0	0	0	0	0	0	0	0
Cummulative Delivered	150	150	150	150	150	150	150	150
Units Leased in Mo	15	12.5	10	7.5	5	2.5	0	0
Cummulative Leased	112.5	125	135	142.5	147.5	150	150	150

SCENARIO 1 CASH FLOW

Scenario 1 - Traditional

	Acq.	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*
Land	4,500,000													
Hard Costs											4,500,000	1,285,714	1,285,714	1,285,714
Soft Costs		1,125,000	219,828	219,828	219,828	219,828	219,828	219,828	219,828	219,828	219,828	219,828	219,828	219,828
Land Option														
Total	(4,500,000)	(1,125,000)	(219,828)	(219,828)	(219,828)	(219,828)	(219,828)	(219,828)	(219,828)	(219,828)	(4,719,828)	(1,505,542)	(1,505,542)	(1,505,542)
Cumulative Total	(4,500,000)	(5,625,000)	(5,844,828)	(6,064,655)	(6,284,483)	(6,504,310)	(6,724,138)	(6,943,966)	(7,163,793)	(7,383,621)	(12,103,448)	(13,608,990)	(15,114,532)	(16,620,074)
Operating Budget														
Rental Income		0	0	0	0	0	0	0	0	0	0	0	0	0
Less Vacancy& Bad Debt		0	0	0	0	0	0	0	0	0	0	0	0	0
Less Expenses		0	0	0	0	0	0	0	0	0	0	0	0	0
NOI		0	0	0	0	0	0	0	0	0	0	0	0	0
Reversion														
Sale Costs														
Construction Loan Fee (1 pt.)											(255,628)			
Construction Loan Beg. Baln	0	0	0	0	0	0	0	0	0	0	0	4,719,828	6,254,868	7,799,503
Construction Loan Proceeds	0	0	0	0	0	0	0	0	0	0	4,719,828	1,505,542	1,505,542	1,505,542
Construction Loan Int.	0	0	0	0	0	0	0	0	0	0	0	29,499	39,093	48,747
Construction Loan Repayment	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Construction Loan End Balance	0	0	0	0	0	0	0	0	0	0	4,719,828	6,254,868	7,799,503	9,353,792
Net Cash Flows (equity as financed)	*(4,500,000)*	*(1,125,000)*	*(219,828)*	*(219,828)*	*(219,828)*	*(219,828)*	*(219,828)*	*(219,828)*	*(219,828)*	*(219,828)*	*(255,628)*	*0*	*0*	*0*
Unlevered Cash Flows	(4,500,000)	(1,125,000)	(219,828)	(219,828)	(219,828)	(219,828)	(219,828)	(219,828)	(219,828)	(219,828)	(4,719,828)	(1,505,542)	(1,505,542)	(1,505,542)

Unlevered IRR	**20.70%**
Equity Level IRR	**35.10%**
Residual Cap Rate	6.50%
Const. Loan % Draw	100.00%
Const. Loan Int.	7.50%

Project Cost	
Land	4,500,000
Hard Costs	22,500,000
Soft Costs	7,500,000
Const. Int	2,327,644
Total	36,827,644
TDC/SF	**245.52**

SCENARIO 1 CASH FLOW (continued)

Scenario 1 - Traditional

	14	*15*	*16*	*17*	*18*	*19*	*20*	*21*	*22*	*23*	*24*	*25*	*26*
Land													
Hard Costs	1,285,714	1,285,714	1,285,714	1,285,714	1,285,714	1,285,714	1,285,714	1,285,714	1,285,714	1,285,714	1,285,714		
Soft Costs	219,828	219,828	219,828	219,828	219,828	219,828	219,828	219,828	219,828	219,828	219,828	219,828	219,828
Land Option													
Total	(1,505,542)	(1,505,542)	(1,505,542)	(1,505,542)	(1,505,542)	(1,505,542)	(1,505,542)	(1,505,542)	(1,505,542)	(1,505,542)	(1,505,542)	(219,828)	(219,828)
Cumulative Total	(18,125,616)	(19,631,158)	(21,136,700)	(22,642,241)	(24,147,783)	(25,653,325)	(27,158,867)	(28,664,409)	(30,169,951)	(31,675,493)	(33,181,034)	(33,400,862)	(33,620,690)
Operating Budget													
Rental Income	0	0	0	0	0	20,600	46,350	77,250	113,300	154,500	200,850	238,703	265,225
Less Vacancy& Bad Debt	0	0	0	0	0	(824)	(1,854)	(3,090)	(4,532)	(6,180)	(8,034)	(9,548)	(10,609)
Less Expenses	0	0	0	0	0	(12,875)	(25,750)	(38,625)	(51,500)	(64,375)	(77,250)	(79,568)	(79,568)
NOI	0	0	0	0	0	7,725	20,600	38,625	61,800	90,125	123,600	159,135	185,658
Reversion													
Sale Costs													
Construction Loan Fee (1 pt.)													
Construction Loan Beg. Baln	9,353,792	10,917,795	12,491,573	14,075,187	15,668,699	17,272,170	18,877,938	20,480,867	22,075,790	23,657,505	25,220,781	26,760,353	26,988,298
Construction Loan Proceeds	1,505,542	1,505,542	1,505,542	1,505,542	1,505,542	1,497,817	1,484,942	1,466,917	1,443,742	1,415,417	1,381,942	60,693	34,170
Construction Loan Int.	58,461	68,236	78,072	87,970	97,929	107,951	117,987	128,005	137,974	147,859	157,630	167,252	168,677
Construction Loan Repayment	0	0	0	0	0	0	0	0	0	0	0	0	0
Construction Loan End Balance	10,917,795	12,491,573	14,075,187	15,668,699	17,272,170	18,877,938	20,480,867	22,075,790	23,657,505	25,220,781	26,760,353	26,988,298	27,191,145
Net Cash Flows (equity as financed)	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Unlevered Cash Flows	(1,505,542)	(1,505,542)	(1,505,542)	(1,505,542)	(1,505,542)	(1,497,817)	(1,484,942)	(1,466,917)	(1,443,742)	(1,415,417)	(1,381,942)	(60,693)	(34,170)

SCENARIO 1 CASH FLOW (continued)

Scenario 1 - Traditional

	27	*28*	*29*	*30*
Land				
Hard Costs				
Soft Costs	219,828	219,828	219,828	219,828
Land Option				
Total	(219,828)	(219,828)	(219,828)	(219,828)
Cumulative Total	(33,840,517)	(34,060,345)	(34,280,172)	(34,500,000)
Operating Budget				
Rental Income	286,443	302,357	312,966	318,270
Less Vacancy& Bad Debt	(11,458)	(12,094)	(12,519)	(12,731)
Less Expenses	(79,568)	(79,568)	(79,568)	(79,568)
NOI	206,876	222,789	233,398	238,703
Reversion				44,068,154
Sale Costs				(661,022)
Construction Loan Fee (1 pt.)				
Construction Loan Beg. Baln	27,191,145	27,374,042	27,542,168	27,700,736
Construction Loan Proceeds	12,952	0	0	0
Construction Loan Int.	169,945	171,088	172,139	173,130
Construction Loan Repayment	0	(2,961)	(13,570)	(27,873,866)
Construction Loan End Balance	27,374,042	27,542,168	27,700,736	0
Net Cash Flows (equity as financed)	*0*	*0*	*0*	*15,552,141*
Unlevered Cash Flows	(12,952)	2,961	13,570	43,426,006

SCENARIO 1 CASH FLOW (continued)

Scenario 1 - Modular

	Acq.	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*
Land	4,500,000												
Hard Costs											4,500,000	0	0
Soft Costs		1,141,200	281,165	281,165	281,165	281,165	281,165	281,165	281,165	281,165	281,165	281,165	281,165
Land Option													
Total	(4,500,000)	(1,141,200)	(281,165)	(281,165)	(281,165)	(281,165)	(281,165)	(281,165)	(281,165)	(281,165)	(4,781,165)	(281,165)	(281,165)
Cumulative Total	(4,500,000)	(5,641,200)	(5,922,365)	(6,203,530)	(6,484,696)	(6,765,861)	(7,047,026)	(7,328,191)	(7,609,357)	(7,890,522)	(12,671,687)	(12,952,852)	(13,234,017)
Operating Budget													
Rental Income		0	0	0	0	0	0	0	0	0	0	0	0
Less Vacancy& Bad Debt		0	0	0	0	0	0	0	0	0	0	0	0
Less Expenses		0	0	0	0	0	0	0	0	0	0	0	0
NOI		0	0	0	0	0	0	0	0	0	0	0	0
Reversion													
Sale Costs													
Construction Loan Fee (1pt)											(251,153)		
Construction Loan Beg. Baln	0	0	0	0	0	0	0	0	0	0	0	4,781,165	5,092,213
Construction Loan Proceeds	0	0	0	0	0	0	0	0	0	0	4,781,165	281,165	281,165
Construction Loan Int.	0	0	0	0	0	0	0	0	0	0	0	29,882	31,826
Construction Loan Repayment	0	0	0	0	0	0	0	0	0	0	0	0	0
Construction Loan End Balance	0	0	0	0	0	0	0	0	0	0	4,781,165	5,092,213	5,405,204
Net Cash Flows (equity as financed)	*(4,500,000)*	*(1,141,200)*	*(281,165)*	*(281,165)*	*(281,165)*	*(281,165)*	*(281,165)*	*(281,165)*	*(281,165)*	*(281,165)*	*(251,153)*	*0*	*0*
Unlevered Cash Flows	(4,500,000)	(1,141,200)	(281,165)	(281,165)	(281,165)	(281,165)	(281,165)	(281,165)	(281,165)	(281,165)	(4,781,165)	(281,165)	(281,165)

Unlevered IRR	**28.61%**
Equity Level IRR	**47.50%**
Residual Cap Rate	6.50%
Const. Loan % Draw	100.00%
Const. Loan Int.	7.50%

Project Cost	
Land	4,500,000
Hard Costs	22,500,000
Soft Costs	7,608,000
Const. Int	1,546,463
Total	36,154,463
TDC/SF	**241.03**

SCENARIO 1 CASH FLOW (continued)

Scenario 1 - Modular

	13	*14*	*15*	*16*	*17*	*18*	*19*	*20*	*21*	*22*	*23*	*24*
Land												
Hard Costs	3,000,000	3,000,000	3,000,000	3,000,000	3,000,000	3,000,000	0	0	0	0	0	0
Soft Costs	281,165	281,165	281,165	281,165	281,165	281,165	281,165	281,165	281,165	281,165	281,165	281,165
Land Option												
Total	(3,281,165)	(3,281,165)	(3,281,165)	(3,281,165)	(3,281,165)	(3,281,165)	(281,165)	(281,165)	(281,165)	(281,165)	(281,165)	(281,165)
Cumulative Total	(16,515,183)	(19,796,348)	(23,077,513)	(26,358,678)	(29,639,843)	(32,921,009)	(33,202,174)	(33,483,339)	(33,764,504)	(34,045,670)	(34,326,835)	(34,608,000)
Operating Budget												
Rental Income	20,600	46,350	77,250	113,300	154,500	200,850	231,750	257,500	278,100	293,550	303,850	309,000
Less Vacancy& Bad Debt	(824)	(1,854)	(3,090)	(4,532)	(6,180)	(8,034)	(9,270)	(10,300)	(11,124)	(11,742)	(12,154)	(12,360)
Less Expenses	(12,875)	(25,750)	(38,625)	(51,500)	(64,375)	(77,250)	(77,250)	(77,250)	(77,250)	(77,250)	(77,250)	(77,250)
NOI	7,725	20,600	38,625	61,800	90,125	123,600	154,500	180,250	200,850	216,300	226,600	231,750
Reversion												44,068,154
Sale Costs												(661,022)
Construction Loan Fee (1pt)												
Construction Loan Beg. Baln	5,405,204	8,712,427	12,027,445	15,345,157	18,660,429	21,968,097	25,262,963	25,547,522	25,808,109	26,049,725	26,277,401	26,496,200
Construction Loan Proceeds	3,273,440	3,260,565	3,242,540	3,219,365	3,191,040	3,157,565	126,665	100,915	80,315	64,865	54,565	0
Construction Loan Int.	33,783	54,453	75,172	95,907	116,628	137,301	157,894	159,672	161,301	162,811	164,234	165,601
Construction Loan Repayment	0	0	0	0	0	0	0	0	0	0	0	(26,661,801)
Construction Loan End Balance	8,712,427	12,027,445	15,345,157	18,660,429	21,968,097	25,262,963	25,547,522	25,808,109	26,049,725	26,277,401	26,496,200	0
Net Cash Flows (equity as financed)	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*16,695,915*
Unlevered Cash Flows	(3,273,440)	(3,260,565)	(3,242,540)	(3,219,365)	(3,191,040)	(3,157,565)	(126,665)	(100,915)	(80,315)	(64,865)	(54,565)	43,357,716

SCENARIO 2 SCHEDULE COMPARISON

Traditional Schedule	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Units Released	0	0	0	0	0	0	0	0	0	25	25	25	25	25	25	0	0	0	0	0	0
Cummulative Released	0	0	0	0	0	0	0	0	0	25	50	75	100	125	150	150	150	150	150	150	150
Units Delivered	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25	25	25
Cummulative Delivered	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25	50	75
Units Reserved	0	0	0	0	0	0	0	0	0	4	4	4	4	4	4	4	4	4	6	6	6
Cummulative Reserved	0	0	0	0	0	0	0	0	0	4	8	12	16	20	24	28	32	36	42	48	54
Units Sold in Mo	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25	23	6
Cummulative Sold	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25	48	54

Modular Schedule	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Units Released	0	0	0	0	0	0	0	0	0	25	25	0	0	25	25	0	0	25	25	0	0
Cummulative Released	0	0	0	0	0	0	0	0	0	25	50	50	50	75	100	100	100	125	150	150	150
Units Delivered in Mo	0	0	0	0	0	0	0	0	0	0	0	0	25	25	0	0	25	25	0	0	25
Cummulative Delivered	0	0	0	0	0	0	0	0	0	0	0	0	25	50	50	50	75	100	100	100	125
Units Reserved	0	0	0	0	0	0	0	0	0	4	4	4	6	6	6	6	6	6	6	6	6
Cummulative Reserved	0	0	0	0	0	0	0	0	0	4	8	12	18	24	30	36	42	48	54	60	66
Units Sold in Mo	0	0	0	0	0	0	0	0	0	0	0	0	18	6	6	6	6	6	6	6	6
Cummulative Sold	0	0	0	0	0	0	0	0	0	0	0	0	18	24	30	36	42	48	54	60	66

SCENARIO 2 SCHEDULE COMPARISON (continued)

Traditional Schedule	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
Units Released	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0
Cummulative Released	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150
Units Delivered	25	25	25	0	0	0	0	0	0	0	0	0	0	0	0	0
Cummulative Delivered	100	125	150	150	150	150	150	150	150	150	150	150	150	150	150	150
Units Reserved	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
Cummulative Reserved	60	66	72	78	84	90	96	102	108	114	120	126	132	138	144	150
Units Sold in Mo	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
Cummulative Sold	60	66	72	78	84	90	96	102	108	114	120	126	132	138	144	150

Modular Schedule	22	23	24	25	26	27	28	29	30	31	32	33	34	35
Units Released	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cummulative Released	150	150	150	150	150	150	150	150	150	150	150	150	150	150
Units Delivered in Mo	25	0	0	0	0	0	0	0	0	0	0	0	0	0
Cummulative Delivered	150	150	150	150	150	150	150	150	150	150	150	150	150	150
Units Reserved	6	6	6	6	6	6	6	6	6	6	6	6	6	6
Cummulative Reserved	72	78	84	90	96	102	108	114	120	126	132	138	144	150
Units Sold in Mo	6	6	6	6	6	6	6	6	6	6	6	6	6	6
Cummulative Sold	72	78	84	90	96	102	108	114	120	126	132	138	144	150

SCENARIO 2 CASH FLOW

Scenario 2 - Traditional

	Acq.	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*
Land	4,500,000												
Hard Costs											4,950,000	1,414,286	1,414,286
Soft Costs		1,125,000	219,828	219,828	219,828	219,828	219,828	219,828	219,828	219,828	219,828	219,828	219,828
Land Option													
Total	(4,500,000)	(1,125,000)	(219,828)	(219,828)	(219,828)	(219,828)	(219,828)	(219,828)	(219,828)	(219,828)	(5,169,828)	(1,634,113)	(1,634,113)
Cumulative Total	(4,500,000)	(5,625,000)	(5,844,828)	(6,064,655)	(6,284,483)	(6,504,310)	(6,724,138)	(6,943,966)	(7,163,793)	(7,383,621)	(12,553,448)	(14,187,562)	(15,821,675)
Operating Budget													
Rental Income		0	0	0	0	0	0	0	0	0	0	0	0
Less Vacancy& Bad Debt		0	0	0	0	0	0	0	0	0	0	0	0
Less Expenses		0	0	0	0	0	0	0	0	0	0	0	0
NOI		0	0	0	0	0	0	0	0	0	0	0	0
Unit Sales		0	0	0	0	0	0	0	0	0	0	0	0
Sale Costs		0	0	0	0	0	0	0	0	0	0	0	0
Construction Loan Fee (1 pt.)											(182,427)		
Construction Loan Beg. Baln	0	0	0	0	0	0	0	0	0	0	0	5,169,828	6,836,252
Construction Loan Proceeds	0	0	0	0	0	0	0	0	0	0	5,169,828	1,634,113	1,634,113
Construction Loan Int.	0	0	0	0	0	0	0	0	0	0	0	32,311	42,727
Construction Loan Repayment	0	0	0	0	0	0	0	0	0	0	0	0	0
Construction Loan End Balance	0	0	0	0	0	0	0	0	0	0	5,169,828	6,836,252	8,513,092
Net Cash Flows (equity as financed)	*(4,500,000)*	*(1,125,000)*	*(219,828)*	*(219,828)*	*(219,828)*	*(219,828)*	*(219,828)*	*(219,828)*	*(219,828)*	*(219,828)*	*(182,427)*	*0*	*0*
Unlevered Cash Flows	(4,500,000)	(1,125,000)	(219,828)	(219,828)	(219,828)	(219,828)	(219,828)	(219,828)	(219,828)	(219,828)	(5,169,828)	(1,634,113)	(1,634,113)

Unlevered IRR	**19.73%**
Equity Level IRR	**25.75%**
Sales Costs	5.00%
Const. Loan % Draw	100.00%
Const. Loan Int.	7.50%

Project Cost	
Land	4,500,000
Hard Costs	24,750,000
Soft Costs	7,500,000
Const. Int	1,112,107
Total	37,862,107
TDC/SF	**252.41**

SCENARIO 2 CASH FLOW (continued)

Scenario 2 - Traditional

	14	*15*	*16*	*17*	*18*	*19*	*20*	*21*	*22*	*23*	*24*	*25*	*26*
Land													
Hard Costs	1,414,286	1,414,286	1,414,286	1,414,286	1,414,286	1,414,286	1,414,286	1,414,286	1,414,286	1,414,286	1,414,286		
Soft Costs	219,828	219,828	219,828	219,828	219,828	219,828	219,828	219,828	219,828	219,828	219,828	219,828	219,828
Land Option													
Total	(1,634,113)	(1,634,113)	(1,634,113)	(1,634,113)	(1,634,113)	(1,634,113)	(1,634,113)	(1,634,113)	(1,634,113)	(1,634,113)	(1,634,113)	(219,828)	(219,828)
Cumulative Total	(19,089,901)	(20,724,015)	(22,358,128)	(23,992,241)	(25,626,355)	(27,260,468)	(28,894,581)	(30,528,695)	(32,162,808)	(33,796,921)	(35,431,034)	(35,650,862)	(35,870,690)
Operating Budget													
Rental Income	0	0	0	0	0	0	0	0	0	0	0	0	0
Less Vacancy& Bad Debt	0	0	0	0	0	0	0	0	0	0	0	0	0
Less Expenses	0	0	0	0	0	0	(1,030)	(10,815)	(20,600)	(30,385)	(40,170)	(38,192)	(35,010)
NOI	0	0	0	0	0	0	(1,030)	(10,815)	(20,600)	(30,385)	(40,170)	(38,192)	(35,010)
Unit Sales	0	0	0	0	0	7,725,000	7,107,000	1,854,000	1,854,000	1,854,000	1,854,000	1,909,620	1,909,620
Sale Costs	0	0	0	0	0	(386,250)	(355,350)	(92,700)	(92,700)	(92,700)	(92,700)	(95,481)	(95,481)
Construction Loan Fee (1 pt.)													
Construction Loan Beg. Baln	10,200,412	11,898,278	13,606,756	15,325,911	17,055,811	18,796,524	13,209,365	8,175,417	8,110,142	8,054,243	8,007,781	7,970,813	6,464,511
Construction Loan Proceeds	1,634,113	1,634,113	1,634,113	1,634,113	1,634,113	0	0	0	0	0	0	0	0
Construction Loan Int.	63,753	74,364	85,042	95,787	106,599	117,478	82,559	51,096	50,688	50,339	50,049	49,818	40,403
Construction Loan Repayment	0	0	0	0	0	(5,704,637)	(5,116,507)	(116,372)	(106,587)	(96,802)	(87,017)	(1,556,119)	(1,559,302)
Construction Loan End Balance	11,898,278	13,606,756	15,325,911	17,055,811	18,796,524	13,209,365	8,175,417	8,110,142	8,054,243	8,007,781	7,970,813	6,464,511	4,945,613
Net Cash Flows (equity as financed)	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*(0)*	*(0)*
Unlevered Cash Flows	(1,634,113)	(1,634,113)	(1,634,113)	(1,634,113)	(1,634,113)	5,704,637	5,116,507	116,372	106,587	96,802	87,017	1,556,119	1,559,302

SCENARIO 2 CASH FLOW (continued)

Scenario 2 - Traditional

	27	*28*	*29*	*30*	*31*	*32*	*33*	*34*	*35*	*36*	*37*
Land											
Hard Costs											
Soft Costs	219,828	219,828	219,828	219,828	0	0	0	0	0	0	0
Land Option											
Total	(219,828)	(219,828)	(219,828)	(219,828)	0	0	0	0	0	0	0
Cumulative Total	(36,090,517)	(36,310,345)	(36,530,172)	(36,750,000)	(36,750,000)	(36,750,000)	(36,750,000)	(36,750,000)	(36,750,000)	(36,750,000)	(36,750,000)
Operating Budget											
Rental Income	0	0	0	0	0	0	0	0	0	0	0
Less Vacancy& Bad Debt	0	0	0	0	0	0	0	0	0	0	0
Less Expenses	(31,827)	(28,644)	(25,462)	(22,279)	(19,096)	(15,914)	(12,731)	(9,548)	(6,365)	(3,183)	0
NOI	(31,827)	(28,644)	(25,462)	(22,279)	(19,096)	(15,914)	(12,731)	(9,548)	(6,365)	(3,183)	0
Unit Sales	1,909,620	1,909,620	1,909,620	1,909,620	1,909,620	1,909,620	1,909,620	1,909,620	1,909,620	1,909,620	1,966,909
Sale Costs	(95,481)	(95,481)	(95,481)	(95,481)	(95,481)	(95,481)	(95,481)	(95,481)	(95,481)	(95,481)	(98,345)
Construction Loan Fee (1 pt.)											
Construction Loan Beg. Baln	4,945,613	3,414,038	1,869,709	312,545	0	0	0	0	0	0	0
Construction Loan Proceeds	0	0	0	0	0	0	0	0	0	0	0
Construction Loan Int.	30,910	21,338	11,686	1,953	0	0	0	0	0	0	0
Construction Loan Repayment	(1,562,484)	(1,565,667)	(1,568,850)	(314,498)	0	0	0	0	0	0	0
Construction Loan End Balance	3,414,038	1,869,709	312,545	0	0	0	0	0	0	0	0
Net Cash Flows (equity as financed)	*0*	*0*	*0*	*1,257,534*	*1,795,043*	*1,798,226*	*1,801,408*	*1,804,591*	*1,807,774*	*1,810,956*	*1,868,563*
Unlevered Cash Flows	1,562,484	1,565,667	1,568,850	1,572,033	1,795,043	1,798,226	1,801,408	1,804,591	1,807,774	1,810,956	1,868,563

SCENARIO 2 CASH FLOW (continued)

Scenario 2 - Modular

	Acq.	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*
Land	4,500,000												
Hard Costs											4,950,000	0	0
Soft Costs		1,141,200	281,165	281,165	281,165	281,165	281,165	281,165	281,165	281,165	281,165	281,165	281,165
Land Option													
Total	(4,500,000)	(1,141,200)	(281,165)	(281,165)	(281,165)	(281,165)	(281,165)	(281,165)	(281,165)	(281,165)	(5,231,165)	(281,165)	(281,165)
Cumulative Total	(4,500,000)	(5,641,200)	(5,922,365)	(6,203,530)	(6,484,696)	(6,765,861)	(7,047,026)	(7,328,191)	(7,609,357)	(7,890,522)	(13,121,687)	(13,402,852)	(13,684,017)
Operating Budget													
Rental Income		0	0	0	0	0	0	0	0	0	0	0	0
Less Vacancy& Bad Debt		0	0	0	0	0	0	0	0	0	0	0	0
Less Expenses		0	0	0	0	0	0	0	0	0	0	0	0
NOI		0	0	0	0	0	0	0	0	0	0	0	0
Unit Sales		0	0	0	0	0	0	0	0	0	0	0	0
Sale Costs		0	0	0	0	0	0	0	0	0	0	0	0
Construction Loan Fee (1 pt.)											(150,205)		
Construction Loan Beg. Baln	0	0	0	0	0	0	0	0	0	0	0	5,231,165	5,545,025
Construction Loan Proceeds	0	0	0	0	0	0	0	0	0	0	5,231,165	281,165	281,165
Construction Loan Int.	0	0	0	0	0	0	0	0	0	0	0	32,695	34,656
Construction Loan Repayment	0	0	0	0	0	0	0	0	0	0	0	0	0
Construction Loan End Balance	0	0	0	0	0	0	0	0	0	0	5,231,165	5,545,025	5,860,847
Net Cash Flows (equity as financed)	*(4,500,000)*	*(1,141,200)*	*(281,165)*	*(281,165)*	*(281,165)*	*(281,165)*	*(281,165)*	*(281,165)*	*(281,165)*	*(281,165)*	*(150,205)*	*0*	*0*
Unlevered Cash Flows	(4,500,000)	(1,141,200)	(281,165)	(281,165)	(281,165)	(281,165)	(281,165)	(281,165)	(281,165)	(281,165)	(5,231,165)	(281,165)	(281,165)

Unlevered IRR		**23.81%**
Equity Level IRR		**27.60%**
Sales Costs		5.00%
Const. Loan % Draw		100.00%
Const. Loan Int.		7.50%

Project Cost	
Land	4,500,000
Hard Costs	24,750,000
Soft Costs	7,608,000
Const. Int	539,935
Total	37,397,935
TDC/SF	**249.32**

SCENARIO 2 CASH FLOW (continued)

Scenario 2 - Modular

	13	*14*	*15*	*16*	*17*	*18*	*19*	*20*	*21*	*22*	*23*	*24*
Land												
Hard Costs	3,300,000	3,300,000	0	0	3,300,000	3,300,000	0	0	3,300,000	3,300,000		
Soft Costs	281,165	281,165	281,165	281,165	281,165	281,165	281,165	281,165	281,165	281,165	281,165	281,165
Land Option												
Total	(3,581,165)	(3,581,165)	(281,165)	(281,165)	(3,581,165)	(3,581,165)	(281,165)	(281,165)	(3,581,165)	(3,581,165)	(281,165)	(281,165)
Cumulative Total	(17,265,183)	(20,846,348)	(21,127,513)	(21,408,678)	(24,989,843)	(28,571,009)	(28,852,174)	(29,133,339)	(32,714,504)	(36,295,670)	(36,576,835)	(36,858,000)
Operating Budget												
Rental Income	0	0	0	0	0	0	0	0	0	0	0	0
Less Vacancy& Bad Debt	0	0	0	0	0	0	0	0	0	0	0	0
Less Expenses	(3,605)	(13,390)	(10,300)	(7,210)	(16,995)	(26,780)	(23,690)	(20,600)	(30,385)	(40,170)	(37,080)	(33,990)
NOI	(3,605)	(13,390)	(10,300)	(7,210)	(16,995)	(26,780)	(23,690)	(20,600)	(30,385)	(40,170)	(37,080)	(33,990)
Unit Sales	5,562,000	1,854,000	1,854,000	1,854,000	1,854,000	1,854,000	1,854,000	1,854,000	1,854,000	1,854,000	1,854,000	1,854,000
Sale Costs	(278,100)	(92,700)	(92,700)	(92,700)	(92,700)	(92,700)	(92,700)	(92,700)	(92,700)	(92,700)	(92,700)	(92,700)
Construction Loan Fee (1 pt.)												
Construction Loan Beg. Baln	5,860,847	4,198,347	6,057,842	4,625,869	3,181,856	5,038,603	6,916,739	5,503,524	4,078,386	5,954,126	7,851,375	6,457,391
Construction Loan Proceeds	0	1,833,255	0	0	1,836,860	1,846,645	0	0	1,850,250	1,860,035	0	0
Construction Loan Int.	36,630	26,240	37,862	28,912	19,887	31,491	43,230	34,397	25,490	37,213	49,071	40,359
Construction Loan Repayment	(1,699,130)	0	(1,469,835)	(1,472,925)	0	0	(1,456,445)	(1,459,535)	0	0	(1,443,055)	(1,446,145)
Construction Loan End Balance	4,198,347	6,057,842	4,625,869	3,181,856	5,038,603	6,916,739	5,503,524	4,078,386	5,954,126	7,851,375	6,457,391	5,051,605
Net Cash Flows (equity as financed)	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Unlevered Cash Flows	1,699,130	(1,833,255)	1,469,835	1,472,925	(1,836,860)	(1,846,645)	1,456,445	1,459,535	(1,850,250)	(1,860,035)	1,443,055	1,446,145

SCENARIO 2 CASH FLOW (continued)

Scenario 2 - Modular

	25	*26*	*27*	*28*	*29*	*30*	*31*	*32*	*33*	*34*	*35*
Land											
Hard Costs											
Soft Costs	0	0	0	0	0	0	0	0	0	0	0
Land Option											
Total	0	0	0	0	0	0	0	0	0	0	0
Cumulative Total	(36,858,000)	(36,858,000)	(36,858,000)	(36,858,000)	(36,858,000)	(36,858,000)	(36,858,000)	(36,858,000)	(36,858,000)	(36,858,000)	(36,858,000)
Operating Budget											
Rental Income	0	0	0	0	0	0	0	0	0	0	0
Less Vacancy& Bad Debt	0	0	0	0	0	0	0	0	0	0	0
Less Expenses	(31,827)	(28,644)	(25,462)	(22,279)	(19,096)	(15,914)	(12,731)	(9,548)	(6,365)	(3,183)	0
NOI	(31,827)	(28,644)	(25,462)	(22,279)	(19,096)	(15,914)	(12,731)	(9,548)	(6,365)	(3,183)	0
Unit Sales	1,909,620	1,909,620	1,909,620	1,909,620	1,909,620	1,909,620	1,909,620	1,909,620	1,909,620	1,909,620	1,909,620
Sale Costs	(95,481)	(95,481)	(95,481)	(95,481)	(95,481)	(95,481)	(95,481)	(95,481)	(95,481)	(95,481)	(95,481)
Construction Loan Fee (1 pt.)											
Construction Loan Beg. Baln	5,051,605	3,300,866	1,536,001	0	0	0	0	0	0	0	0
Construction Loan Proceeds	0	0	0	0	0	0	0	0	0	0	0
Construction Loan Int.	31,573	20,630	9,600	0	0	0	0	0	0	0	0
Construction Loan Repayment	(1,782,312)	(1,785,495)	(1,545,601)	0	0	0	0	0	0	0	0
Construction Loan End Balance	3,300,866	1,536,001	0	0	0	0	0	0	0	0	0
Net Cash Flows (equity as financed)	*0*	*0*	*243,076*	*1,791,860*	*1,795,043*	*1,798,226*	*1,801,408*	*1,804,591*	*1,807,774*	*1,810,956*	*1,814,139*
Unlevered Cash Flows	1,782,312	1,785,495	1,788,677	1,791,860	1,795,043	1,798,226	1,801,408	1,804,591	1,807,774	1,810,956	1,814,139

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