# FEASIBILITY, BENEFITS AND CHALLENGES OF MODULAR CONSTRUCTION IN HIGH RISE DEVELOPMENT IN THE UNITED STATES: A DEVELOPER'S PERSPECTIVE

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Submitted to the Program in Real Estate Development in Conjunction with the Center for Real Estate in Partial Fulfillment of the Requirements for the Degree of Master of Science in Real Estate Development

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## ABSTRACT

Modular construction has long been utilized in the construction of residential and many other commercial product types as a means for potentially quicker construction delivery times. Over the past 5 years this construction technique has slowly been introduced into the high rise residential market throughout the world. The additional structural challenges of high rise construction make modular construction in this setting more challenging, but the high construction costs of high rise construction also make any savings in time and hard cost worth consideration. Based on case studies, interviews and financial simulations this thesis will address the design, engineering, sustainability, scheduling, legal and financial considerations a developer would likely consider in adopting modular construction in a high rise project in the United States.

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# I. Introduction

Development and operating margins in real estate have continued to diminish over the past 30 years as the industry has been more efficient. Market participants have utilized every advantage at their disposal and competition has squeezed out excess profit in the form of higher land and acquisition prices. (Cassidy, 2008) Substantial innovations have occurred in past 40-50 years in capital markets, financing, design, marketing, operations, construction delivery and materials.

However, relatively far few innovations have occurred in construction sequencing and process, as each project is built predominately in the same order: design, site work, foundations, structural, exterior, mechanical and finally interior finishes. Some innovations have occurred such as “fast tracking” a process by which only partial design work is required prior to starting site work and foundations. Since type of foundations (slab-on-grade vs. deep footings vs. piers) and construction (concrete vs. steel vs. wood) can typically be decided early on, work can commence well before the full project is designed. This allows final design and some construction work to occur simultaneously thus saving time and some costs related to construction loan interest carry. Similarly “up-down construction” improves schedule timing by allowing construction to simultaneously occur above and below grade. The process effectively allows below grade excavation and foundations to be poured while construction on above grade structural elements are also occurring, which is in stark contrast to the typical approach of construction starting below grade and ending at the top of the building.

Even these approaches are relatively new in the development industry and not widely adopted. But these and other substantial changes in construction practices maybe a final frontier in harvesting financial yields in development. To that end, modular construction appears poised to address financial, scheduling and other concerns in development. This technology may provide similar or better savings than the previously mentioned innovations.

The basic concept of modular construction substantially utilizes offsite construction and assembly in lieu for potentially more challenging onsite construction methods. Modular construction is essentially a construction method where individual modules or volumes are constructed offsite, stand alone, transported to the site and are then assembled together onsite to make up a larger structure. Permanent modular structures are intended to remain in one location for the duration of their useful life. Modular construction refers to volumetric or three-dimensional “volumes or rooms”, rather than prefabricated mechanical systems, kitchen/bathroom pods or wall assemblies. Modules are 60% to 90% completed off-site in a controlled factory environment, and transported and assembled at the final building site. This can comprise the entire building or equally likely non-core building components such as rooms, corridors, and common areas. The amount of offsite versus onsite construction can vary significantly depending on the project and scope. (Modular Building Institute, 2011)

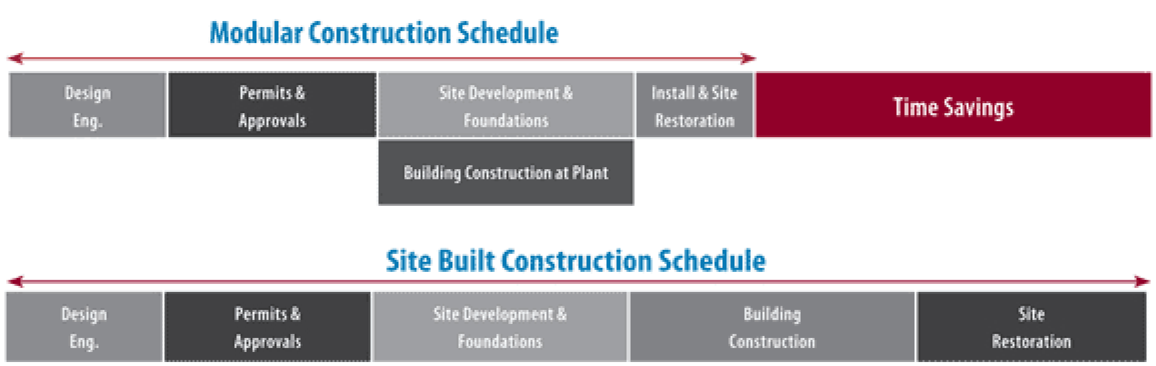


**Figure 1 Modular Schedule Advantage**

The benefits potential include higher financial return due to less construction interest carry and related time savings via a shortened construction schedule and potentially reduced hard cost from repeatable and higher efficiency construction methods, streamlined construction process, reduced material waste and higher construction quality.

This thesis will attempt to address the potential impact of high rise modular construction that could inure time and financial savings that would lend itself to a higher adoption rate throughout the US. The thesis will further address physical, design, legal, building code, scheduling and financing considerations that will impact the adoption of modular technology in high rise construction.

## II. Methodology

Although modular technology has been around for decades and established low rise examples have existed for over 20 years, the technology is relatively new in high rise construction and very limited examples exist that have been completed or are under construction. As such, large data set analysis is not currently possible and analysis must be limited to the few dozen projects available for review around the world. In light of this data set, the methodology of research primarily relies upon literature review, interviews, case studies and financial analysis based upon scenarios of available construction data.

The scope of the literature review was focused on the technical aspects of current modular systems and case studies of high rise modular projects from around the world. Interviews were conducted of adopters, manufacturers, contractors, industry representatives and lenders that would likely be involved in the development of a high rise modular project.

Based on the literature review and interviews, key measurement metrics will be tested in the financial models to evaluate project level data and modular advantages relative to standard onsite construction. The paper will address multiple considerations that must be considered in various property types while considering modular construction. As modular technology lends itself to more repeatable volumes, multifamily and hotel property types addressed more, but other property types are considered.

| I. Modular Utilization | Multifamily | Condo | Hotel | Build-to-Suit Office | Spec Office |
|---|---|---|---|---|---|
| A. MEP Connections | | | | | |
| B. Kitchen/Bath | | | | N/A | N/A |
| C. Interior Finishes | | | | | |
| D. Exterior Finishes | | | | | |
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| Opportunity | Neutral | Challenge |
|---|---|---|

**Table 1 Modular Considerations**

The following are key measurement metrics that were considered for measurement:

1. Percentage of Onsite vs. Offsite Construction via modular technology
    a. Level of Finishes

b. Economies of Scale and Project Size

2. Project Timing – parse time savings related to each element of modular construction
    a. Fast tracking vertical construction in factory, while site work continues
    b. Climate controlled environment & minimized weather related delays
    c. Assembly of pre-cut and manufactured parts versus field assembly
    d. Sequencing of trades is minimized by utilizing MEP integrated modules
    e. Reduced down time due to assembly line installation versus constant movement of trades to each installation site in a purely onsite project

3. Cost Savings – parse cost savings related to each element
    a. Reduced interest carry on construction loan resulting from reduced construction time
    b. Increased interest or contingency reserve to address lender underwriting concerns related to uncertainty. This maybe irrelevant as the lending community becomes more comfortable with modular.
    c. Materials cost of modules vs. standard onsite construction
    d. Reduced labor cost
        i. Due to cheaper labor markets of the manufacturer vs. onsite project city
        ii. Due to less skilled labor vs experienced trades
        iii. Due to non-union vs. union labor

    iv. Due to controlling many trades within one manufacturing company
    v. Due to increased job safety and lower insurance premiums

e. Storage costs –need to store raw materials on site versus carry cost of finished modules at manufacturer's facility
f. Reduced capital expenditures related to modules
g. Reduced contingency carry by forcing module manufacturers to buyout the contract.
h. Does project scale impact cost savings (300 vs. 3,000 units)
i. Can dedicated manufacturers owned by general contractor or developer ramp up and effectively achieve economies of scale that inure to the project versus separate modular manufacturer
j. Operating Costs
    i. Buildings cannot be partially occupied in most modular projects, due to the crane and setting functions that are necessary. This results in lost income due to partial occupancy.
    ii. Buildings can be occupied in entirety quicker due to modular construction. This yields quicker property income and quicker stabilization.  However, delivery of entire buildings without substantial pre-leasing occupancy translates to higher operating expenses.

## III. Brief History of Modular Construction

Among the earliest examples of prefabrication in during Britain's Great Exhibition of 1851, when the Crystal Palace was constructed in a few months and assembled using a series of prefabricated parts. The exhibit was also taken apart after the event and reassembled at another site. This is the precursor to modular or factory-based fabrication of buildings. In the 1900s the United States entered the market when the Sears Roebuck Company so prefabricated homes via mail order. The purchaser would receive a kit of parts that assembled onsite to build the home. But mass fabrication was first introduced in World War II when easy to assemble mass accommodation was required for soldiers. The Army utilized Quonset huts that could be easily assembled without skilled labor. This skill was later utilized by the Europeans and Japanese to quickly rebuild war devastated areas. In the 1960s and 1970s high rise concrete modular construction was introduced. The Hilton Palacio del Rio Hotel was among the first concrete high rise modular buildings in the world.  The project was across from the Texas World's Exposition of 1968, the 500-room hotel was designed, completed and occupied in an unprecedented period of 202 working days. The hotel's room modules were pre-cast from light-weight structural concrete. Before arriving on the construction site, each room was fully decorated, including color TV, AM/FM radios, beds, carpeting, and all FF&E.  The units are 32 feet 8 inches and 29 feet 8 inches long, 13 feet wide and 9 feet 6 inches high. They weigh 35 tons each and were manufactured at a plant located eight miles from the project site. All units were installed in 46 days. A production line consisting of two rows of eight room-size forms that produced eight complete units daily. The working crews were composed, as an average, of more than 100 men who completed a designated task 496 times, thus creating a true assembly line arrangement with inexpensive labor. The casting process was started by coating the permanent, hinged, outer forms with a forming release agent. Reinforcing steel for floors was added, and in 30 minutes, six and a half cubic yards of lightweight ready-mix concrete was poured to form a five-inch thick floor. When the concrete had set, it was hard finished and was allowed to cure for several hours. After that, crews placed steel reinforcing for the walls and ceilings, installed plumbing, electrical conduits and positioned block-outs for doors and other openings. In 30 minutes, fifteen and a half cubic yards of light weight ready-mix concrete for walls and ceilings were poured and vibrated into place.

Each module received a code number that keyed its position during the whole process, including date of erection and its exact placement in the building. Once on the site, a 350hp crane equipped with a special 36-foot diameter ring base and a 270-foot boom maneuvered them into place. So that they could literally be "flown" into place without turning or dangling in mid-air, a Sikorsky helicopter stabilizing tail section was attached to each room at job site. The tail, rotor, engine, magnetic compass and a set of automatic controls were fastened to a platform attached to the top of each unit. By giving the room a pre-determined magnetic heading and by feathering the vertical propeller, the operator atop the "flying" room controlled the direction of each unit as it was being hoisted to a precise location.

An average of 17 modules was placed each day. Because the module placement had to match the elevator shaft, each unit had to be set exactly on the unit underneath, at a precise elevation, with a maximum working tolerance of 3/4 inch to prevent creeping. Plumbing and wiring conduits were run up a 20-inch chase between modules for quick connections to individual rooms. In their final location, the reinforcing rods, extending from the lip at the corridor end of each room, were welded together. Forms were then placed under the interlacing rods and concrete poured to join the extensions in order to form the corridor's floor. Removable panels in the corridors were then added to close the 20-inch chase which provides access to the continuous vertical mechanical and electrical chaseways. (Modular Building Institute, 2007)

From this inefficient concrete module and elaborate, installation method arose the need to create more manageable modules with greater application. Some builders chose to utilize prefabricated subassemblies such as kitchen and bathroom only pods that were inserted onsite in the appropriate locations. This allowed for expensive areas to be developed in the factory and be attached in the field to reduce the need for trade coordination. Other builders chose to utilize wood frame and lightweight steel modules for low rise construction. The minimal loads in low rise construction allowed for greater flexibility in application. From these various methods, modern advances and the ability to solve structural concerns arose the modern day steel high rise modules that provide more flexibility in design and manufacturing.

Prefabrication and modular construction are processes that have been used in some capacity by generations of construction professionals. Over the past century, these processes have developed a stigma of cheapness and poor quality; however, through modern technology, that image has changed. Modular construction could be a key component that drives construction industry productivity. Prefabrication and modular building processes are not new activities in that 63% of the people that have been using it have been doing so for 5 years or more. 85% of all industry participants have been using these processes. Of those using it only 37% are using it at a high level in their course of work. The primary reason industry participants are not using it is that architects did not design it into their projects and architects cite owner resistance as the primary reason they do not design modular construction. (McGraw Hill Construction, 2011)

## IV. Modular Process

Modular construction techniques are analogous to assembly line car manufacturing and are readily observable on numerous videos on the internet and modular manufacturer websites. Typically, four stages make up a modular construction project. First, design development by the developer and plan approval by any regulating authorities; second, assembly of module components in a factory; third, transportation of modules to the project site; and fourth, erection of modular units to form the building.

Modular contractors manufacture buildings at off-site locations. They may also operate as general contractors on projects, coordinating the delivery, installation, site work and finish of the building or the modular contractor will be responsible for construction, delivery and installation of only the modules and an overall general contractor will be responsible for the entire project. Construction primarily occurs indoors away from harsh weather conditions preventing damage to building materials and allowing builders to work in comfortable conditions.

Unique to modular construction, while modules are being assembled in a factory, site work is occurring at the same time or in some cases prior to construction. This allows for much earlier building occupancy and contributes to a much shorter overall construction period, reducing labor, financing and supervision costs. Compared to traditional onsite construction, more coordination of design and engineering of the modules is required before construction of the modules can be completed; however, this requirement is also changing as the modular manufacturing industry is maturing and evolving to accommodate fast track construction techniques and the variety of delivery modern construction delivery methods. Everything from traditional general contracting to design-build-operate-transfer has been utilized in the modular industry. In fact many schools, hospitals and prisons are built with modular technology and an array of delivery methods. However, the off-site modular construction requires more coordination during the design/construction process and forces developers to make decisions earlier. For example in a steel frame, high rise project, it's possible to make decisions on foundations and some structural elements, but size and depths of the modules will dictate necessary structural supports. Similarly the exterior finishes, material specs and elevations need to be decided before modules can be fabricated. Even if the building exteriors will be built onsite the module volumes will be impacted by the elevations. Thus a traditional design-bid-build model is possible, but more challenging. It would be more appropriate to incorporate modular constrains into the projects at an earlier date to ensure the project time and cost savings are realized.

Through techniques that have been around for decades, prefabrication/modularization is seeing a renaissance as technologies, such as BIM, have enabled better assembly and precise design of modular components. Changes in design such as the emergence of environmentally sensitive design have also increased the opportunity for permanent modular buildings. (Modular Building Institute, 2011) Additionally in light of the long recession, more contractors are thinking of lean construction methods and looking for ways to build for less and thus the growth of prefabrication and modular construction. Although the trend for greater use of off-site construction has been growing slowly for years, the recession and new technologies could increase their use.

Permanent modular buildings may be Type III and V (wood frame, combustible) or Type I and II (steel, concrete, non-combustible) and can have as many stories as building codes allow. The focus in this thesis will be on the later as Type I and II modular construction has been limited and untested in many markets and Type V modular projects have been well documented, regardless of their relatively small market share.

## A. Factory

After the design is finalized with an architect, construction plans are sent to a factory where the majority of the building is erected. PMC uses prefabricated elements for as many building components as possible. Everything from walls and mechanical systems to painting and carpet can be completed on the assembly line. (Morton, 2011) Steel studs are usually cut to a standard length and shipped to a jobsite where they're cut to the needed size. Instead of wasting 2 feet of metal, the studs are created on the factory line to the exact length required. Modular building factories maintain a high level of quality control with inspections at each station, eliminating on-the-fly decisions or unexpected complications that can occur in the field. (Morton, 2011)

Factory construction of modular components varies greatly from static factory floors to conveyer belts to even robotic construction of modules. Toyota Motor Corporation known for its automobiles successfully transferred robotic assembly line manufacturing technology from the automobile sector to the construction industry. (Bock, 2007) As seen in Picture 1 Typical Assembly Line Modular Factory a typical modular factory works similar to other manufacturing facilities. Partially assembled modules are visible on the right and assembly stations are visible in the middle and left. The modules are moved from area to area on rollers.

**Picture 1 Typical Assembly Line Modular Factory**

In Picture 2 the structural steel frame and decking are already installed and each module is essentially a self-contained structural element that can withstand the rigors of transportation, crane lifting, setting and final structural assembly onsite.

**Picture 2 Typical Steel Frame Assembly**

In Picture 3 note how insulation can be readily applied in every corner, since the exterior in not finished and installers essentially have 360 degree access to the entire module. Although a wood frame module, the same principle applies to a steel frame module and the requisite fire proofing applications. This module can have exterior finishes applied at the factory or sent to the site with only framing and insulation.

**Picture 3 Insulation Prior to Exterior Finishes - Wood Frame Module**

## B. Transportation

Typically it is not feasible to ship modules extremely far due to road size/load restrictions. 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. 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 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.

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. Additionally, the ceiling height must also be considered, since most highway height restrictions are 13' 6" and with a 4' trailer height that leaves 9' 6" for the module. Typically this will yield a finished ceiling height of 9' of the module and thus high ceilings may not be possible in standard module construction. However the additional cost of the transportation must be carefully balanced with the additional square footage gained per trip and crane lift cost in a wider load. If there is a sufficient economy of scale the larger volume modules will actually reduce the total transportation cost even though the per trip cost is higher with the larger volume modules. (Carlo, 2007) The following Picture 11 is an example of a flatbed module transport. The single drop flatbed allows for taller modules to be transported.

**Picture 4 Flatbed Module Transport**

Modular manufacturers are located throughout North America, with larger "clusters" of manufacturers in Pennsylvania, Georgia, Texas, Indiana, California, and Alberta CN. Most manufacturers in North America are single location operations and can competitively transport units within a 500 mile radius of their plant. (Modular Building Institute, 2011) Shipping costs are billed separately on a per mile basis and these costs must be weighed against the savings in modular technology. Modular builders have begun utilizing both sea barge and helicopter delivery to islands or particularly remote locations, but this has not yet become widespread in the US. Despite the obvious difficulty inherent in such complicated transport it may often be a more cost effective alternative than utilizing a site built method in expensive labor markets or locations will poorly trained construction trades.

## C. Onsite

Once the modules are ready, they are shipped to the site and fastened together. Module installation includes matte line connections for MEP, exterior finishes and interior finishes, where applicable. The tolerances for such connections have decreased considerably of the past 50 years and can be as little as 1/32nd to 1/16th. The final construction stage includes completing exterior systems such as cladding and roofing components and internal spaces like lobbies, stairwells, and elevator shafts. (Morton, 2011)

**Picture 5 Lift of Steel Frame Module with Exterior Finishes**

In Picture 6 a steel module is being lifted into place by a crane operated and 2 site personnel are guiding the setting process. This module is temporarily sealed with waterproof material to withstand weather conditions during transport. Additionally, windows are already installed the exterior surface is ready for any finishing materials from masonry to siding to EIFS.

**Picture 6 Steel Module Being Set**

The crane is the most expensive part of the installation process with costs of $3500-4500 per day, not counting police details or road closures. Therefore, careful planning needs to be undertaken so the crane is never idle. 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. (Carlo, 2007) When selecting the type of crane it is also important to consider operational maneuverability of the crane and airspace of surrounding uses.

**Picture 7 Typical Set**

## V. Modular Construction Industry

US commercial construction market was $201 billion in 2010 and only $2 billion accounted for modular construction or 1%, but the industry has been growing at 20-25% annually over the past few years. (Modular Building Institute, 2011) International market for modular construction is larger than the US, but even well accepted markets only have 2-3% market share. The UK is an example of a well-accepted market that had approximately a 2% share since 2005. (AMA Research, 2007) However, wide adopt of this technology with its potential advantages in schedule and cost could be a partial answer to building housing for over 2 billion people in China & India over the next 20-30 years. Customers served by modular construction include federal, state, provincial, and local governments, school boards, corporations, non-profit organizations, retail establishments, healthcare providers. Other uses include medical facilities, airport facilities, military installations, restaurants, churches, and remote telecommunications stations. These uses reflect the highly repeatable and componentized nature of modular construction that lends itself well to repeatable assembly line construction.

Larger facilities employ between 140-150 workers during their peak production, while smaller plants employ between 60-70. The typical modular manufacturer produced about 158,000 square feet in 2010, producing an average of 232 "modules." This production is about 7% less than reported in 2009, which reflects the challenging economic climate. Each module is roughly 600-700 square feet, commonly 12 feet wide by 50+ feet in length. Transportation regulations are commonly the limiting factor in module size. Depending on the level of customization required by the owner and architect, most modules leave the factory 60-90% complete, with wiring, plumbing, structural, and mechanical systems inspected and approved before arriving at the site. (Modular Building Institute, 2011)

Many including the National Research Council of the US National Academies believe greater use of the modular construction techniques could greatly improve both the efficiency and competitiveness of the US construction industry. This need is further exacerbated by the lack of skilled onsite construction workers and the need for construction companies to be leaner to be more competitive. (McGraw Hill Construction, 2011)

However, capacity and access issues continue to exist in the modular industry. The historical availability skilled trade labor and product demand hav

## VI. Design Considerations

The decision to use modular construction must be made from the onset of design; however there are a few examples of conventional site built designed projects being later converted to modular construction. The advantages of modular also wane considerably if your intended building doesn't have repeating spaces. The prefabrication of entire rooms lies at the heart of modular construction, so a building with open expanses is not the best candidate. For example, an office building shell designed with unfinished interiors and intended for multiple tenants who would finish out their own individual space would not be a good option; however a build-to-suit office building could be viable. (Morton, 2011) In addition finish customization, as required in most condominium projects, can be possible and will yield very similar costs as traditional site built customization. Challenges that arise from customization deal with very limited opportunity to change structural and demising elements of the modules and unit plans. The advantages of modularity and assembly line production are limited by the lack of multiple master tradespeople at the factory to make changes like swapping the location of a bedroom and bathroom. In a site build project it may be possible to make such changes in the field and modify MEP connections to accommodate a buyer's needs, but such changes are more challenging in a factory. If such market demands are necessary, it may be more appropriate to provide a cold, dark shell module with exterior finishes and allow onsite construction to complete the finishes. This example highlight the fact that modular construction is not a binary condition in that many projects use both onsite and offsite construction on projects. The question is more about how much offsite construction is appropriate for a particular project.

Modular construction is not necessarily a barrier to creativity. The architects for the Victoria Hall Wolverhampton project readily admit that the challenges of converting a traditional building to a modular building arises from planning issues, which require structural changes to the design. However, none of those changes critically impacted the overall aesthetic of the buildings. (Modular Building Institute, 2010) Modular rooms or pairs of rooms or room/corridor modules can be used to create a variety of unit layouts. These layouts can be put together to make most desired unit mixes and ultimately any combination of exterior elevations. As seen in Picture 8, the exterior elevation of The Modules project, a 5-story wood frame apartment project that is geared towards students at Temple University in Philadelphia, PA, allows for the use of multiple materials and has exterior expressions well beyond a flat plane.  Similarly, in Picture 9 the town center project in Beaver Creek, OH exhibits architecturally variety in this modular project with varying roof lines, window openings and exterior materials.


**Picture 8 - The Modules - Philadelphia, PA**

**Picture 9 Exterior Elevation - Beaver Creek, OH**

The nature of high-rise buildings is such that the modules are clustered around a core or stabilizing system. The particular features of the chosen modular system have to be well understood by the design team at an early stage so that the detailed design conforms to the limits of the particular system, particularly the structural integrity of the design. The Modules typical floor plan, shown in Picture 10, provides a slightly more varied floor plan with a "finger-like" structure emanating from the central spine. Even with this configuration all non-core elements were constructed modularly.

**Picture 10 - The Modules - Floor Plan**

The design of high-rise modular buildings is strongly influenced by structural, fire and services requirements. From a building layout viewpoint, two generic floor plans may be considered for the spatial relationship of the modules around a stabilizing concrete core:

- A generally square configuration where the corridor surrounds the central core on all sides and units are access off the corridor or a traditionally single loaded, central corridor.

- A generally rectilinear configuration where the corridor extends in opposite directions from the core and units are access on either side of the corridor or a traditionally double-loaded corridor.

The addition of external balconies, cantilevers or other architectural features can be used to create a layer of architectural interest, while still maintaining structural integrity. Balconies can be attached at the corner posts of the modules or the loads can be directly transferred to the ground. Integrated balconies within the modules may be provided by bringing the balcony end wall within the configuration of the module. However, curvilinear forms, multiple exterior materials, and new window-wall systems add additional layers of complexity. It is important to understand how cost and time advantages to modular construction might erode with more complicated architecture or completely eliminate the option to utilize modular technology.

Many Class A residential towers are utilizing unique designs and complex architectural forms to achieve higher yields and attract wealthier clients. These projects will only be more complex as appetites and tastes of prospective residents grow. Thus modular construction must be able to accommodate high end finishes, material sourcing from all over the world, and unique floor plan layouts. The optimum use of modular construction can achieved by designing the MEP intensive residential units and hence more expensive parts of the building in modular form and the more open plan space as part of a regular structural frame in steel or concrete. This requires consideration of design and the construction process from the outset. However, even open space or unique common areas that are not highly repeatable modules are being manufactured with this technology, as is the case in the Atlantic Yard project.

Additionally construction quality of modular buildings is typically more desirable than traditional onsite construction. This is especially true of modern modular construction. Current modular construction simultaneously constructs a building’s floors, walls, ceilings, rafters, and roofs. During site-built construction, walls cannot be set until floors are in position, and ceilings and rafters cannot be added until walls are erected. On the other hand, with modern modular methods of construction, walls, floors, ceilings, and rafters are all built and then brought together in the same factory to form a building. Additionally most modular buildings are built from the inside-out with exteriors being attached last. Two layers of plasterboard or gypsum board are then attached to the internal face of the wall by screws at not more than 1' apart. Cement particle board (CPB) or oriented strand board (OSB) are often attached to the exterior of the walls of the modules. In production, boards may be fixed via air driven nails or screws enhanced by glued joints. These boards restrain the C sections against buckling. This process provides numerous construction advantages that are not physically possible in standard construction. (Lawson R. M., 2011)

1) Tighter Building Envelope –screws are used to connect modules, ceilings to floors and walls to walls instead of nails. This advantage may have substantially decreased as most high-quality projects no longer use nails; however, the tolerances of the connections between the walls, ceiling and floor are still minimized in modular.
2) Better Insulation - constructing building envelope last allows even small interior cavities to be accessible and well insulated
3) Moisture Control – minimizing environmental factors during construction allows wood and other natural materials to behave at normal tolerances and reduce settling in the field

In spite of these advantages the modular industry in the United States suffers from an image and perception problem related to its foundations in manufactured housing the poor quality associated with it from 1950s. However, modular condominium projects do not appear to suffer from a discount to market and in fact may have a slight benefit amongst well informed purchasers.

## VII. Structural Considerations

There are two basic types of modular construction that are applicable to high rise applications and affect the building forms that can be designed:

1. Load-bearing steel modules in which loads are transferred through the side walls of the modules

2. Corner supported steel modules in which loads are transferred via edge beams to corner posts

**Picture 11 Corner Post Steel Module**

In the first type of modular system, the compression resistance of the walls, which generally comprise light steel C sections at 1-2' spacing, is the controlling factor in design. The double layer construction of the modular walls and floor /ceiling combination due to each module having its own party walls/floor/ceiling, enhances the acoustic insulation and fire resistance of the construction system. In the second type of modular system, the compression resistance of the corner posts is the controlling factor and for this reason, Square Hollow Sections (SHS) are often used for their high buckling resistance.

Resistance to horizontal forces, such as wind loads and other actions, become increasingly important with the height of the building. The strategies employed to ensure adequate stability of modular assemblies, as a function of the building height, are:

- Diaphragm action of boards or bracing within the walls of the modules – suitable for 4 to 6 story buildings
- Separate braced structure using hot rolled steel members located in the lifts and stair area or in the end gables – suitable for 6 to10 stories
- Reinforced concrete or steel core – suitable for taller buildings
- Lateral bracing elements integrated into the building core to care load to the core and structural columns near the perimeter of the building

Modules are tied at their corners so that structurally they act together to transfer wind loads and to provide for alternative load paths in the event of one module being severely damaged. For taller buildings, questions of compression resistance and overall stability require a deeper understanding of the behavior of the light steel C sections in load-bearing walls and of the robust performance of the inter-connection between the modules.

For modules with load-bearing walls, the side walls of the modules should align vertically through the building, although openings of up to 8' width can be created in the side walls, depending on the loading. For modules with corner posts, the walls are non-load-bearing, but the corner posts must align and be connected throughout the building height. Additional intermediate posts may be required in long modules, so that the edge beams which span between the posts are not excessively deep.

The structural behavior of an assembly of modules is complex because of the influence of the tolerances in the installation procedure, the multiple inter-connections between the modules, and the way in which forces are transferred to the stabilizing elements, such as vertical bracing or core walls.

In most building codes utilized in the US, 2 hour fire rating and sprinklers are required for Type II (high rise) residential buildings. The fire resistance of modular construction derives from four important aspects of performance.

- The stability of the light steel walls is a function of the load applied to the walls and the fire protection of the internal face of the walls of the module.
- The load capacity of the module floor is influenced by the thermal shielding effect of the ceiling of the module beneath.
- The elimination of fire spread by fire barriers placed between the modules (to prevent smoke or fire spread in the cavity between the modules)
- The limiting of heat transfer through the double leaf wall and floor-ceiling construction of the modules.

Generally, the internal face of the walls and ceiling of the module are provided with two 0.6" plasterboard layers (at least one layer being fire resistant plasterboard using vermiculite and glass fiber). Mineral wool is placed between the C-sections (also required for acoustic purposes). The floor and ceiling in combination and the load-bearing light steel walls can achieve 2 hour fire resistance, depending on the type of sheathing board used on the outside of the modules. The double layer walls and floor-ceiling of the modules also provides excellent resistance to airborne and impact sound particularly when supplemented by external sheathing board. Additional sound reductions and floor stiffness to minimize vibrations can be achieved by a thin concrete floor either placed on the light steel floor or as a composite slab spanning between the walls or edge beams.

Modules in tall buildings can be clustered around a core, or alternatively, they can be connected to a braced corridor, which transfers wind loading to the core. The design of the load-bearing walls or corner posts should take into account the effects of eccentricities due to manufacturing and installation tolerances. The various case studies of modular buildings show the different floor plan that can be created depending on the type of modular system. Modules with corner posts provide more flexibility in room layouts but are more costly in manufacture than the wholly light steel load–bearing systems. (Lawson R. M., 2011)

## VIII. MEP Considerations

Mechanical, electrical and plumbing considerations must be addressed early and consistently throughout the design and construction process. Installing MEP in the modules provides advantages beyond simply installing conduits in the module and installing MEP onsite. Additionally, multiple mechanical systems can be installed included individual and central plants. With central systems the plant is typically an onsite item and only the ducting and distribution system is installed in the module with module-to-core connections made on site. Any number of distribution systems including single duct, double duct, VAV, plenums and raised floor systems are possible. Even more advanced systems with floor by floor controlled air handler units or sustainable technologies such as chilled beams could be implemented, but have not been utilized in most projects. Similarly individual fan coil and heat pump units have been successfully utilized, but no studies have determined optimum mechanical systems for modular construction. However, highly sustainable systems have been utilized in institutional modular projects such as schools and barracks. These have included higher efficiency HVAC systems, reduced solar gain windows, and water reclamation systems.

Similarly, electrical and plumbing systems can be configured to almost any specifications. Although the capability and the physical possibility of these systems are viable, most projects have not utilized cutting edge MEP systems. However, since the modules are typically more setup for distribution of MEP and the generation and central systems are in the building core, MEP will not typically drive or limit the viability of modular construction.

## IX. Sustainability Considerations

Architectural, engineering and construction choices are the decisions that comprise how a project is designed and constructed. Material selection, construction techniques, building systems selection, installation and controls and most other decisions that pertain to building envelope, mechanical, electrical and plumbing systems and space conditioning are in this category. Modular building offers significant opportunities for environmental stewardship, economic opportunity, LEED certification and market penetration in this area. Material handling, optimal construction conditions and environmental control during construction all can contribute to attaining LEED credits. It is extremely challenging to identify specific LEED criteria or points that favor modular construction, since each project will be different and the extent of modular construction and other decisions will change the certification level. However, what is clear is that the market desire for LEED approved and sustainable buildings will only benefit the further adoption of modular construction. (Kobet, 2009)

Modular construction provides several opportunities to improve the sustainability of the project during the construction process and maintain superior operating performance within the completed building.

- Construction waste is substantially reduced from 10 to 15% in a traditional building site to less than 5% in a factory environment. It is estimated that modular construction can achieve the highest level of waste reduction relative to both traditional construction and any other modern construction techniques, such as panelized or pre-fabricated pods. (AMA Research, 2007) The majority of waste in traditional construction projects is generated from the concreting process and the related wet trades, which constitutes over 80% of construction waste. Concrete waste is generated mainly from both the direct work, steel from the cutting of reinforcement bars, surplus or spilled concrete, etc. Rework, the need to replace, remove or extend work previously considered completed also results in construction waste. One way of reducing construction waste is by precasting or creating repeatable forms in the factory. (Baldwin, 2009)
- With steel modular units, the wall and roof frames are typically constructed using the stud and track method of connection, whereby sections are joined together using self-drill/tap fasteners, bolts and rivets. Consequently, at the end of life, these should be easy to disassemble. The floor and ceiling joists have service conduits in the form of holes that allow for the running of cables and pipework, which are easily removed. With the façade and roof covering elements, the façade panels and insulation boards are all connected using a system of brackets, rails and self-drill/tap fasteners. As no mortar, is used, disassembly of these components should be straightforward. The steel components are all highly recyclable and are metal facade materials such as aluminum, and zinc and also brick slips, timber and slates. (AMA Research, 2007)

- Acoustic and insulation benefits of a modular building are largely due to additional materials used in the construction. Several manufacturers estimate that anywhere from 10-25% more structural 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. The net usage of total building materials in a modular project is only slightly less than that utilized by a conventional onsite project, but more materials are used to the benefit of the building than wasted and result in landfill.
- The number of visits to site by delivery vehicles is reduced by up to 70%. The bulk of the transport activity is moved to the factory where each delivery provides more material in bulk than is usually delivered to a construction site.
- Noise and disruption are reduced on site, further diminished by the 30 to 50% reduction in the construction period, which means that neighboring buildings are not affected as much during a traditional building process.
- The air-tightness and the thermal performance of the building fabric can be much higher than is usually achieved on site due to the tighter tolerances of joints that can be achieved in a factory environment which reduces the need for higher utility expenditure.
- The efficient use of lightweight materials and the reduced waste means that embodied energy of the construction materials is also reduced.
- Safety on site and in the factory is greatly improved and it is estimated that reportable accidents are reduced by over 80% relative to site intensive construction. The modules can be installed with pre-attached protective barriers or in some cases, a protective 'cage' is provided as part of the lifting system. (Lawson R. M., 2011)
- Theft is also greatly reduced as most finishes and expensive exterior elements are set in the factory and tied to the module.

## X. Legal Considerations

Modular manufacturers and early adopters of this technology do not consider there to be any limitations in this technology due to the building codes used in the US. Most states require that the modular manufacturers have an approved quality-assurance program and that it be monitored by an accredited, third-party agency. These third-party agencies make inspections on both the modular builder's plant and the building under construction. Where a third-party agency is not a local requirement, building department officials and/or certifying engineers typically assume the same inspection role. (Hardiman, Dispelling the Myths of Modular Construction, 2008) Any building code issues can be effectively addressed in the design process and the building code itself prescribes design guidelines and tolerances, not construction techniques.

Additionally, the modular process presents both opportunities and challenging for the developer during the entitlement process. The construction advantages specifically the reduced environmental impact, traffic, noise and construction time will likely engender substantial support amongst the community and adjoining neighbors, all else equal. Additionally, the reduced construction timeline will yield quicker property tax revenue streams and quicker development fees. There is also speculation that more affordable construction techniques could yield lower rents and sale prices as derivative advantage to the community. (Kastenbaum, 2011) However, the likely reduction in construction jobs in a modular project versus traditional project will likely draw criticism with labor supporters particular unions. An argument can be made that adopt of modular construction will lead to further US manufacturing jobs, minimize offshoring and supporting a renewed construction industry that could become a global leader and exporter of modular technology.

Unico Properties, a developer based in Seattle tested this strategy and utilized the benefits of modular construction to gain not only city approvals, but also gain public support for an environmentally friendly project. The company commission two modular units of 480 and 675 sq. ft. with complete finishes. The projects were well received by the building inspector who reviewed the entire manufacturing process. (Cassidy, 2008)

## XI. Schedule Considerations

One of the greatest benefits is the ability to dramatically reduce the time needed for construction. Factory efficiencies allow building components to be completed quickly and without weather delays. The factory has all of the key players onsite to handle multiple building requirements and multiple subcontractors are not always required. This makes modular construction suitable for owners who need buildings quickly, properties with hard dates for occupancy, and areas where seasonal weather restricts or even halts construction. (Morton, 2011) Additionally, modular construction allows horizontal construction on the factory floor rather than vertical construction in high rise buildings onsite, thus saving additional time for all trades to move throughout the building.

Although modular construction that integrates MEP into the module allows the manufacturer to employ multiple trades and provide near finished modules to the site, both the manufacturer and onsite contractor must coordinate schedules and module installation. Delays and lack of schedule coordinate either onsite or in the factory could mitigate much of the time and cost savings. Additionally the access to cranes and the timely arrival of modules to efficiently utilize the crane is important in maintaining the schedule. An idle crane or too many modules onsite could change the financial dynamics of the project.

Typically the modular manufacturer is responsible for delivery and assembly of the modules. MEP connections can be the responsibility of the general contractor or the modular manufacturer depending the project scope. It is important to know the liability of the manufacturer during and after installation of the module. These schedule coordinates are further complicated by the inability of the general contractor to control the manufacturer, but some projects have resolved this conflict by requiring the general contractor to subcontract the manufacturer and thus eliminating any conflicts of interest and keeping complete control at the general contractor level.

Additionally, in standard residential construction it is important to maintain a predictable, moderate and steady stream of unit deliveries through the construction process. Most major markets that can financial support high rise construction can absorb 25-40 residential rental units per month per project under typical market conditions. This delivery equates to delivering certificates of occupancy for 1-2 floors per month. It is important to consider the cost of delivering 100 units per month versus the lease up cost of 100 vacant units over 2-4 months. Smoothing unit delivery will be important to many developers. To that end modular construction can deliver entire buildings in weeks, as opposed to months, so most developers who utilize modular technology choose not to occupy any part of the building until construction is complete. This will result in a loss of a few weeks of potential leasing or occupancy, but could be offset by a few additional months of time savings when the project is completed with no construction activity on site and much easier opportunity to solicit potential property income. These competing costs and advantages will be further discussed in the financial analysis, but will vary for each project.

## XII. Financial Considerations

Modular construction takes most of the production away from the construction site, and essentially the slow unproductive site activities are replaced by more efficient faster factory processes. However, the infrastructure for factory production requires greater investment in fixed manufacturing facilities, and repeatability of output to achieve economy of scale in production.

An economic model for modular construction must take into account the following factors:

- Production volume (economy of scale).
- Proportion of on-site construction (in relation to the total build cost)
- Transport and installation costs
- Benefits in speed of installation versus limited change order opportunities
- Savings in site infrastructure and construction management

Materials use and wastage are reduced and productivity is increased, but conversely, the fixed costs of the manufacturing facility can be as high as 20% of the total built cost. Even in a highly modular project, a significant proportion of additional work is done on-site. Limited data is available on multifamily modular construction, but some guidance can be provided may be taken from a UK government report on modular home construction. This report estimates that the proportion of on-site work is approximately 30% of cost for a fully modular building, and can be broken down into foundations (4%), general services (7%), exterior finishes (13%) and interior finishes(6%). However, in many modular projects, the proportion of on-site work can be as high as 55%, as was the case in the Victoria Hall Wolverhampton case study. Modular construction also saves on commissioning and change order costs that can be as high as 2% in traditional construction. (Lawson R. M., 2011)

The previously verified financial benefits of improved construction timing are:

- Reduced interest carry charges
- Earlier inception of rental income.

The tangible benefits due to reduced interest carry can be 2 to 3% over the shorter building cycle. The UK report estimates that the total financial savings when using modular construction are as high as 5.5%. However, the scalability of single family homes is limited and commensurately so are the savings. (Lawson R. M., 2011) Additionally, all trades and consultants on the project are also likely to be in support of modular construction if the reduce project time also equates to a quicker release of fees upon project completion. This will also lead to a reduced carry cost on general conditions for the overall project and reduced opportunity for cost overruns due to weather related delays.

Perhaps more important than any quantifiable difference between modular and traditional construction costs is the value in an accelerated construction schedule relative to market changes. With a quicker delivery time the developer reduces the risk of market changes and can more efficiently meet just in time market demand. This is more applicable in low rise garden and detached home construction, but the general principle applies to high rise projects also.

### A. Financing

The current equity and debt communities are making themselves aware of modular construction and are beginning to explore the opportunity, but they are in the early stages of their learning curve. Of the lenders that were interviewed, none believe there is an inherent challenge to modular construction that would like the sources of funding, but all continue to explore ways of mitigating risk in this new technology and industry. Lenders will provide terms based on the quality of the sponsor and project, but may not substantially change financial underwriting terms if modular construction is utilized. However, they may consider additional contingencies and projections in the form of reserves and guarantees until they are more comfortable with the technology. In particular, the lenders are concerned about completion guarantees if a modular manufacturer becomes financially troubled. With only 3-4 companies capable of high rise modular construction, the lending community is concerned about project completion if the manufacturer is insolvent. Some solutions maybe building a contingency fund, that can be drawn down as the project nears completion, to address any potential disruptions in the factory and need to change fabricators. Additionally, a lender may require additional interest reserves or other considerations to satisfy their uncertainty from the sponsor and a Letter of Credit or other credit enhancements form the modular manufacturer. These requirements will likely atrophy as modular becomes more accepted within the lending community. This is decidedly a first mover disadvantage.

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. Its possible to find a solution to this problem by splitting payments up or holding a sufficient retainage to ensure the set goes smoothly.

## B. Labor Markets

International Trade – Firms specializing in modular construction have not gained hold in the US as only 1% of all commercial construction employs this method. Other markets around the world have been early adopters of this technology, but their adoption rate is only 2-3% of their construction activity. Industry experts believe this technology will grow 20-25% annually. (Modular Building Institute, 2011) However, certain countries and industries have been more apt to adopt this technology and have long seeded histories with similar technology. In particular Scandinavian countries with their long history of ship building have employed similar modular designs and fabrication techniques, which companies such as IKEA and Skanska have applied to real estate. If other countries have incubators and/or government support to foster this technology it's possible that the majority of modular construction could be built overseas and significantly dislocate the construction industry. Currently the Broad Group in China has been a leading adopter of this technology and has pushed the limits of construction by building a 30 story hotel in 15 days and announcing plans to building the world's tallest building in a mere 90 days.

Project labor is typically local and supports local economies. A strong modular construction industry could substantially limit the need for local construction labor and allow for centralization for the labor force. This will have substantial impact on local economies and wages. Unions in particular will be reticent to allow local jobs to be shifted away. Manufacturers must address the likelihood that developers will need to support union labor to secure entitlements and zoning approvals. As such, manufacturers may need to consider hiring union labor as a mechanism to support developer's interests and thus increase their operating costs. As noted in the Atlantic Yards project, there is even a steep difference in wages between onsite construction union workers and manufacturing union workers. The going rate for a union carpenter in NYC is $85 versus $35 for a factory union worker. (Bagli, 2011)

## C. Pricing

Based on the guidance provided by various developers, modular manufacturers, contractors, lenders and others a financial model was developed to parse the various changes between traditional site built construction and modular construction. A single development example will be utilized to compare the differences between the approaches. Based on confidential underwriting, budget and schedule information provided by an institutional developer on a 20 story Class A+ high rise building in a major east coast MSA the project costs will be analyzed. The project has 397 units and is based on a completed project. Some elements of the project have been altered to maintain confidentiality, but the changes are not material to this analysis. All rents, returns and costs are considered market rate, but will not be altered between the scenarios, unless it merits consideration. Each item listed in the following section was modified individually to determine its sole impact and ultimately all variables between the two models were altered to provide a comparison between onsite and modular construction. Lastly, sensitivity analysis of key metrics will be presented to provide ranges of values.

Baseline Assumptions:

- 397 Multifamily units with 13% affordable units
- Timing
    - Land acquisition July 1, 2012
    - Construction Start – April 2014
- Income/Expense Growth constant at 2%
- Land Price - $50,000 per unit or $19,837,5000
- Development Fee – 3.0%
- Construction
    - Guaranteed Maximum Price contract will be executed immediately prior to construction start. There are multiple options on the type of contract

that could be utilized, but these yield operation and risk mitigation opportunities; however, these will not be considered in this analysis

  - Sponsor will maintain a contingency and inflation factor for current underwriting purposes, since the current hard cost budget is based on an estimate and not an actual GMP.
- Construction Loan – based on strong sponsorship
  - 70% LTC
  - 3.5% Interest Rate
  - Recourse considerations do not impact this analysis
  - Construction loan is in place until disposition.
- Sponsorship
  - Institutional sponsorship with 100% funding from sponsor. This method is utilized to simplify the understanding of the modular impact. Use of capital partners should only magnify the impacts.
  - Discount Rate – 8.0% - Most sponsors are requiring minimum 7.0% current yields on core development opportunities
- Disposition
  - Asset sale 6 months after stabilization, while allows for property marketing and closing period.
  - 5.25% - reversion cap rate. Kept constant throughout analysis
  - 0.40% - transaction costs. Given the size of the asset lower cost is market.
- Modular Construction
  - Utilize modular construction for all residential units, structural, MEP, 85% interior finishes and 85% exterior finishes.
  - Not utilize modular construction for building core, including central plants, elevators, stairs and common areas.

- Measurement
  - Project Level – All returns are considered only at the project level, since no partnership structures were considered.
  - Monthly NPV – to accurately measure the opportunity cost of the baseline return required and additional wealth creation between approaches

- Monthly IRR –secondary measure will allow industry practitioners more familiar return metrics. Monthly was utilized since the development timeline is substantially shorter than most stabilized project holds and one month changes cannot be accurately reflected in annual returns.

Variables Considered

1. Percentage of building using modular technology – if there are advantages to modular construction the savings are substantially magnified with a greater level of modular utilization. A base high rise building would need to at minimum use structural and MEP in the adoption of modular construction. Additionally, most would strongly recommend completing a high level of interior finishes within the module and only external finish work would be an optional element. Alternatively it is also possible to achieve savings with a relatively low level of interior/exterior finish work if the project supports a very high number of modules. For example, a 150 unit high rise modular building with all possible interior/exterior finishes could yield a similar per unit savings as a 400 unit building with almost no finish work. However, a 400 unit building with a high level of modular adoption would achieve substantial savings since both the size of the project and level of modular adopt is high. It is extremely difficult to apply a simple formula for how much savings could be achieved with either more units or more modular adoption. (Manufacturer, 2012)

   Based on multiple interviews with manufacturers, it is very challenging to manipulate this variable and achieve definable quantitative results. Each project is unique and bidding construction costs on multiple hypothetical scenarios can lead to gross over simplifications. As such we have chosen to utilize an appropriately higher level of offsite construction in this model. But recognize the advantages of both economies of scale and higher modular adoption.

2. Project Timing – modular construction offers timing savings on multiple fronts, but each element produces different results. Each time savings element was modeled by minimizing only the construction time and changing no other variable. The financial savings typically will flow from reduced interest carry and quicker completion. Since most modular buildings cannot be occupied until construction is complete, initial occupancy will not change based on time savings and thus the benefits of quicker construction is offset by higher operating expenses as lease up cannot be started until after project completion, which is an effective loss of 6-8 months of construction period lease up. In this section we have chosen to only address the temporal savings and will address material and labor savings in other sections.
    a. Fast Tracking - The overall advantage results from fast tracking module construction while site work is occurring. However, not all of this fast tracking savings can be attributed to modular technology. There are other fast tracking methods such as "up-down" construction that also yield time savings. A project of this scope with 3.5 floors of underground parking could yield 4-6 month savings by fast tracking alone. Thus these savings could be attributed to any fast track system and is not unique to modular construction.
    b. Climate Controlled Construction – There can be numerous delays related to the weather on a site built project. These can cause the site be shut down, certain trades to stop their work or cause delivery delays. Although these delays can exist most projects are able to compensate by forces subcontractors to work more aggressive hours to get back on schedule. Some of these potential delays are also built into schedules. In factory construction there are never any weather related delays and schedules also reflect that time savings. These savings could be magnified in jobsites that have extreme weather

conditions, such as inclement coast areas or very hot climates. Given this project scope offsite construction will result in at most 1 month of savings.

c. Assembly of pre-cut and manufactured parts versus field assembly – The opportunity to install a kit of parts, as opposed to field measurement and installation does save time by taking some of the guesswork out for the installers, minimizing errors and re-construction. These savings at the factory will also yield 1 month in savings, but also minimize risk by reducing opportunity for critical errors that impact multiple trades and material sourcing.
d. Sequencing of trades is minimized by utilizing MEP integrated modules – Factory construction allows modules to roll from one trade's station to the next and thus eliminates the need for any trade to wait for the previous trade to complete their work in the building and minimizes downtime. However, if a bottleneck occurs in the assembly line this can eliminate those savings. This can be a savings of 1-2 months.
e. Reduced down time due to assembly line installation versus constant movement of trades to each installation site in a purely onsite project – This is the second component of downtime, especially on a high rise project. Factory construction eliminates the need for every worker to go up the elevator to their construction area and then move to the next area. This is a task that is repeated multiple times a day by every worker on every business day. Each minute or hour that is spent getting to/from an area also eliminates opportunity for actually completing a task. Of the time savings this is the single largest component and could be a 3-4 month savings.

Total time savings of modular utilization can yield between 10-12 months on a project of this nature. The time savings estimated is a conservative estimate based on discussion with developers and manufacturers utilizing this technology; however, it is possible the time savings could be up to 14 months given optimum crane, setting and factory conditions. An 11 month time savings result in $309,000 in NPV value and 108 bps in IRR value. The increase in NPV and IRR results from reducing the project timing by almost 1 year or 20%, but the lease up period is lengthened and thus only reduces the time to stabilization by 4 months. The effective project time savings is thus only 4 months. The project cost increases by $790,000. The cost increase is due almost exclusively to a $2,144,000 operating deficit increase during the lease up period. This is mostly offset by $847,000 in interest carry savings and another $333,000 in capitalized expense savings during construction and $211,000 reduced builder's risk premium due to a shorter construction period. The far more dramatic savings would result if both the construction period and 1st unit occupancy could be reduced by 11 months.

3. Hard Cost and Other Project Costs – Beyond time savings there are other financial impacts related to modular construction. These variables are addressed individually prior to any modification for time savings.
    a. Increased interest or contingency reserve to address lender underwriting concerns related to modular uncertainty. This maybe irrelevant as the lending community becomes more comfortable with modular; however, in this model this was addressed by assuming an increase in builder's risk insurance by almost 50% and increase financing costs from 4.05% to 4.55% to loan cost. This resulted in a -33% IRR and -$729,000 NPV loss.
    b. Materials cost of modules vs. standard onsite construction – Based on costing estimates of the economics of scale that could be achieve on a project of this magnitude its anticipated that concrete, steel, exterior cladding and finish work could yield 2% in materials cost savings and

thus provide $2,589,000 in hard cost savings, but this would likely be offset by at least a $250,000 increase in soft cost, as additional design and consulting services might be necessary in a modular project for a first-time adopter.

c. Reduced labor cost – Beyond material savings more savings are attributable to labor savings due to 1) the cheaper manufacturing wage rate, 2) increased labor efficiency of off-site construction, 3) non-union offsite labor (not all manufacturers have this savings), 4) cheaper overall labor markets for manufacturers and 5) improved job safety. This yields an additional $3,900,000 in hard cost savings.

d. Storage costs – The need to store raw materials on site versus carry cost of finished modules at manufacturer's facility. Given the substantial variability of material procurement and contract buyouts it was very challenging to estimate these costs. Payment terms for both offsite and onsite subcontractors will vary greatly from project to project and it is likely that costs are more related to risk management and have less financial impact, given the size of the project.

e. Reduced capital expenditures related to modules. Developers and lenders did not believe there was a material advantage to modular construction in being able to reduce capital reserves or repairs/maintenance for the project. Although there are likely operational and long-term capital benefits the technology does not have enough history or data to support lower reserves and lenders would likely not allow any change in that expense.

f. Reduced contingency carry by forcing module manufacturers to buyout the contract. Although this is also a risk mitigation item there is an opportunity for a developer to substantially reduce their pricing exposure, since most modular manufacturers procure their materials at the outset of fabrication. Thus nearly all trades can be bought out early in the process. Thus a conservative developer could reduce their contingency from 4% to 2.5% as construction documents are near completion.

g. Does project scale impact cost savings (300 vs. 3,000 units) – This was partially addressed in Item 1, but there is strong support from the modular manufacturing industry to support 10-20% cost savings as projects sizes approach 2,000+. There is evidence to suggest such savings based on stick-built modular projects for government entities, but there is no large scale high rise modular project for comparison. The Atlantic Yards project claims to have 20% cost savings, but it is unclear how these savings are achieved and this is merely an ex-ante claim.

h. Can dedicated manufacturers owned by general contractor or developer ramp up and effectively achieve economies of scale that inure to the project versus separate modular manufacturer. Given the relative youth of the modern modular industry, it is difficult to determine any advantage that may arise from supply chain management of integrating the manufacturer with either the general contractor or the developer. However, some contractors believe there maybe an opportunity to acquire modular companies if the demand for modular construction grows.

The resulting savings from hard cost and related items yields approximately $5,351,000 in NPV value and 212 bps in IRR. The value creation mostly results from project savings of $7,479,000 or 4.75% which is almost entirely from hard cost savings. In total all changes result in $5,879,000 in NPV value creation and an increase in 348 bps IRR monthly return. The project cost has also similarly decreased by $6,809,000 or 4.33% in savings.

| RETURNS | Site Built | Modular | Change |
|---|---|---|---|
| Monthly IRR | 18.98% | 22.46% | 3.48% |
| Annual IRR | 20.44% | 22.00% | 1.56% |
| NPV | $24,943,475 | $30,822,437 | $5,878,963 |

| CONSTRUCTION COSTS | Site Built | Modular | Change |
|---|---|---|---|
| Land | $20,237,019 | $20,237,019 | $0 |
| Soft Cost | $16,072,334 | $16,680,350 | $608,016 |
| Hard Cost | $112,049,145 | $104,042,334 | -$8,006,812 |
| Internal Capitalization | $4,584,122 | $4,385,804 | -$198,318 |
| Capitalized Property Taxes | $1,360,987 | $1,031,793 | -$329,194 |
| Capitalized Utilities Expenses | $40,674 | $21,194 | -$19,480 |
| Capitalized Marketing Expenses | $22,913 | $17,630 | -$5,282 |
| Const. Loan Interest | $2,683,440 | $1,795,306 | -$888,134 |
| Land Loan Financing Costs | $0 | $0 | $0 |
| Land Loan Interest | $0 | $0 | $0 |
| Operating Deficits | $337,562 | $2,367,841 | $2,030,279 |
| Total Project Cost | $157,388,196 | $150,579,270 | -$6,808,926 |
| | | | -4.33% |

**Table 2 Summary Comparison**

## XIII. Case Studies

Examples of high rise modular construction is available from as far back as the 1960s. Habitat 67 in Montreal and Nakagin Capsule Tower in Tokyo are two examples of concrete modular structures that were considered architectural curiosities at the time, but received praise for their innovation. However, each module was mostly self-contained and much smaller in size than modern living needs. Habitat 67 was conceived for affordable housing and the concrete modules were fabricated onsite and reached 12 stories. Nakagin Capsule is a mixed use residential tower completed in 1972 that reached 13 stories. The modules were relatively small and the target audience was bachelors, who typically had smaller space requirements. The modules were fabricated offsite with utilities already installed. Given the smaller spans of concrete modules and the weight of these modules they are not generally viable options in modern high rise construction.

Data available in each case study varies greatly based on access to participants, available records and the timeline of the projection.

### A. Paragon, Brentford, West London, UK

Developer: Berkeley Homes

Modular Company: Caledonion. Operating from a 42 acre site near Newark in Nottinghamshire the Caledonian facility comprises 4 separate factories, each producing modular units, enabling 4 independent projects to be processed at any one time. Each factory is approximately 120,000 sq. ft. and has a combined capacity to produce 8,600 sq. ft. of modules per day.

Contractor: Caledonion. Operated as the modular manufacturer and general contractor.

Architect: Carey Jones

Key Dates: 22 months to completion

Financials: £26,000,000 (Pounds – UK) Hard Cost

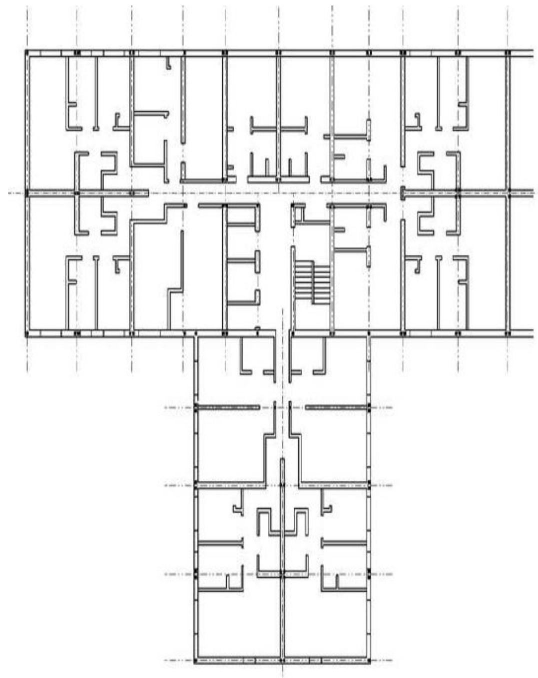
Height: 17 stories

Berkeley First and Thames Valley University partnered through a Nominations Agreement to develop 839 bed dormitory for students attending the university. In addition to this the project also includes 221 unit worker and shared ownership homes and 129,000 sq. ft. of academic facilities for the university. This inner city project for Berkeley First, a division of Berkeley Homes, incorporates a mix of student, key worker and affordable one and two bedroom condominium units. The 5 housing blocks, incorporate 1060 accommodation units, and range from 4 stories to 8, to 11 and culminate at 18 stories. At the time the project was the tallest modular building in the world. The project was awarded Major Housing Project of the Year (UK) 2007.

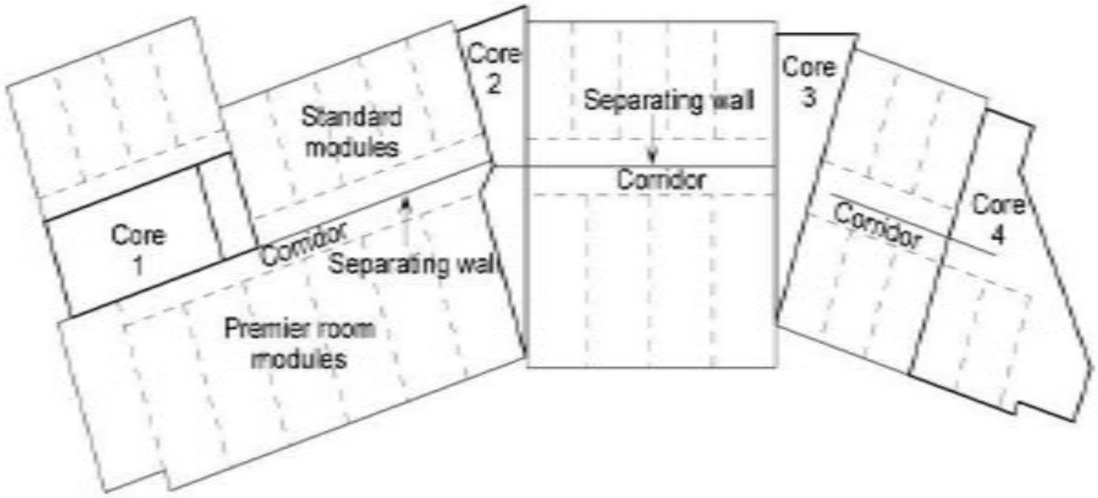
From on site construction start, the entire development took 22 months to complete –12 months less than what would have been required for traditional construction. The benefits of early occupation and revenue generation produced financial benefits to the developer and university.

The modular component is built over a concrete podium which provides below grade parking and slip formed or poured-in-place concrete core included elements such as the stairs and elevator shafts. All of the accommodation spaces are fully modular, with rooms completed with finished windows, doors, finishes, fixtures and M&E fit out – final M&E connections, FF&E and carpeting were the only trades required on site to complete the construction.

The buildings from 11 to 17 stories were constructed using modules with load-bearing corner posts. The floor plan of the L shaped building is shown in Fig. 1. The modules were also manufactured with integrated corridors in which half of the corridor was included in each module. The corner columns were therefore in-board of the ends of the modules and the projection of the floor into the corridor was achieved by the stiff edge beams of the modules. In the corridor arrangement, horizontal loads are transferred via in-plane bracing in the corridors and are again connected to the core. The distance of the outer module from the core was limited by the shear force that could be transferred via the corridor or by the travel distance for life safety. This phase of the project consisted of a total of 827 modules in the form of 600 student rooms, 114 studios , 44 one- bedroom and 63 two-bedroom key worker apartments. The 17 storey building consists of 413 modules. Modules are 9 ft to 13.5 ft wide, which is the maximum for highway transport in the UK. The edge beams were 8 in x 3.5 in Parallel Flange Channels (PFC) at floor level and 5.5 in x 2.7 in PFC at ceiling level in order to design the modules with partially open-sides of up to 20 ft span. The one or two bedroom apartments were constructed using 2 or 3 modules, each 375 to 590 sq. ft. The plan view shows the many variations in room layouts that were possible using corner supported modules. (Lawson R. M., 2011)



## B. Phoenix Court, Bristol, UK




Developer: Carillion

Modular Company: Unite Modular Solutions. Employs around 130 dedicated personnel including designers, technicians, surveyors and specialist manufacturing staff. UMS has designed, manufactured and installed some 17,000 fully fitted volumetric modules since 2002. UMS operates out of a 16-acre, 185,000 sq. ft. manufacturing. With a maximum capacity of approximately 10,000 units per year, typically a fully-fitted module currently comes off the end of the manufacturing line every 55 minutes.

Contractor:

Architect: Stride Treglown

Key Dates:

Financials: £22,000,000 (Pounds – UK) Hard Cost

Height: 11 stories

Fitted out to a higher end finishes, Phoenix Court offers a range of rooms to students in Bristol in 2-6 bedroom configurations as well as studios. The project incorporated an onsite laundry, bike storage, a common room and in-room internet access. Phoenix Court is the highest self-supporting modular building in Europe and the first of its kind to incorporate fully cold rolled steel modules in an 11 story building. A vertical heat recovery system was fitted in all studios and smaller units. Studios and most units were delivered to site with full FF&E, kitchens and white goods. Difficult transportation logistics were successfully dealt with since the site was at the end of the M32, a very busy highway in central Bristol.

As is the case in the Phoenix, modular construction may be combined with steel or concrete frames to extend the flexibility in space planning in applications where the dimensional constraints of modular systems would otherwise be too restrictive. An adaptation of modular technology is to design a 'podium' or platform structure on which the modules are placed. In this way, open space can be provided for retail or commercial use or below ground car parking. Support beams should align with the walls of the modules and columns are typically arranged on a 20 to 26 ft grid. A column grid of 24 ft was considered optimum for parking in the UK at ground floor or basement levels as it provides for 3 parking spaces. The 12 story dormitory and commercial building in Bristol in the west of England in which 6 to 10 stories of modules sit on a 2 story steel framed podium. The 400 bedroom modules are a 9ft external width, and approximately 100 modules are combined in pairs to form larger studios consisting of 2 rooms. The kitchen modules are 12 ft external width. Stability is provided by four braced steel cores, into which some modules are placed. The floor plan form is illustrated in Fig. 2. A double corridor is provided so that a cluster of 5 rooms forms one compartment for life safety purposes. Stability is provided by the braced steel cores and the maximum number of 5 modules is placed between the cores in order to limit the forces in the connections to the core. The building used a lightweight cladding system consisting of a 'rain screen' in which the self weight of the cladding is supported by the modules. The air- and weather-tight layers and the majority of insulation are provided within the module as delivered. (Lawson R. M., 2011)

## C. Victoria Hall, Wembley, UK

Developer: Clovis Propco/Victoria Hall

Modular Company: Futureform Building Systems

Contractor: Mace

Architect: O'Connell East Architects

Key Dates: Completed in 2011

Financials: £23,500,000 (Pounds – UK) Hard Cost

Height: 19 stories

Split into three wings around a central spiral-shaped tower, the 19-story development offers views towards Wembley Stadium and close proximity to Wembley Park Tube station. Mace is the main contractor on the project and has utilized modular construction techniques to deliver an accelerated completion schedule.

The building contains 435 student rooms and features buildings at different heights to respond to neighboring lower residential and commercial buildings and nearby amenities. Two of the wings are designed to be partially clad in blue cladding panels complementing the main cladding in silver. Biomass boilers are incorporated within a central plant room. Features include a double-height entrance, a launderette, management offices and extensive bicycle parking. Two landscaped amenity areas—one for gatherings and one for a quiet garden—provide ample space for residents to enjoy the outdoors.

This important project, for Victoria Hall, is a student residence consisting of a concrete core and circular concrete floor plan with north, east and west facing modular wings radiating from it. The west wing consists of 17 stories of modules, whilst the north and east wings consist of four and seven stories of modules respectively, on a single story concrete podium.

This project also is a first in terms of the size of the modules that are manufactured and installed, which are 52' long × up to 12.5' wide. With this size its possible to achieve two rooms and a twin corridor can be introduced into the modular concept, which minimizes on-site work. The services can be connected along the corridors and the modules are delivered with additional finishes to allow the corridors to be finished after installation. The walls of the module consist of C section steel frames and top hat sections that created a rigid form, which enable larger modules to be manufactured and installed. A typical module weighs up to 12 tons. Lifting was done by a 200 ton mobile crane. Construction tolerances were extremely tight. A maximum deviation of 5 mm to the adjoining module was achieved in manufacturing and the module positions were reset out on each floor to ensure verticality. The modules were tied at their corners into the concrete core which provided overall stability. In-plane wind loads were transferred through the connections between the modules. (Steel Construction Institute, 2011)

The lightweight cladding is a rain screen system using Alucabond supported on horizontal rails attached to the modules. The modules are fully insulated and weather-tight, and achieve a thermal U value of 0.21. In terms of time taken to build, this approach saves in excess of six months when compared to site-intensive construction.

From a sustainability point of view, it is estimated that on-site waste was reduced by 90% and the deliveries of materials to site was reduced by over 70%. The number of site operatives and their facilities were also dramatically reduced, with modules were installed by a six man team over a four month period. (Lawson R. M., 2011)

Production of the modules at Futureform's Wellingborough plant commenced in August 2010. The construction of the cores and podium had started in July and the modules were installed on site over a 15 week period from the end of September 2010. In this way, the construction of the cores and installation of the modules could be carried out in parallel. Each wing consisted of 10 modules per floor, which enables 3-4 floors to be installed per week. The project was completed in September 2011, which leads to a saving of 6 months relative to site-intensive construction.

### D. Victoria Hall, Wolverhampton, UK

| | |
|---|---|
| Developer: | Clovis Propco/Victoria Hall |
| Modular Company: | Vision Modular Systems |
| Contractor: | Fleming Developments |
| Architect: | O'Connell East Architects |
| Key Dates: | 27 week modular construction time. |
| Financials: | $34,000,000 Hard Cost |
| Height: | 25 stories |

The construction team for the 25 story modular construction project in Wolverhampton in the midlands of England provided extensive data on the construction process. It consists of 3 blocks of 8 to 25 stories and in total the project consists of 824 modules. The tallest building is Block A. The total floor area in these three buildings is 223,000 ft2 including a podium level. The floor area of the modules represents 79% of the total floor area. The average module size was 226 ft2 but the maximum size was 398ft2. The project started on site in July 2008 and was handed over to the client in August 2009 (a total of 59 weeks). Installation of the modules started in October 2008 after completion of the podium slab, and construction of the concrete core to Block A was carried out in parallel with the module installation on Blocks C and B. Importantly, the use of off-site technologies meant that the site activities and storage of materials are much less than in traditional construction, which was crucial to the planning of this project. The tallest building, Block A, has various set back levels using cantilevered modules to reduce its apparent size. Lightweight cladding was used on all buildings and comprises a mixture of insulated and composite panels, which are attached directly to the external face of the modules. The total area of exterior cladding was 112,300 ft2 for the 3 blocks.

The modules were fabricated in Cork, Ireland and were sent via ship to the site. (Kalette, 2009) The module weights varied from 10 to 25 Tons depending on their floor size and the module self weight was approximately 120 pounds/ ft2 floor area. The modules in the first Block C were installed by mobile cane, whereas the modules in Blocks A and C were installed by the tower crane that was supported by the concrete core. The installation period for the 824 modules was 32 weeks and the installation team was a total of 8 workers plus 2 site managers. The average installation rate was 7 modules per day although the rate was as high as 15 per day. This corresponds to 14.5 man-hours per module in installation. The overall construction team for the non-modular components varied over the 59 week project from 40 to 110 with 3 to 4 site managers. It was estimated that the reduction in construction period relative to site-intensive concrete construction was over 50 weeks (or a saving of 45% in construction period).

It was estimated by the modular supplier that the manufacture and in –house management effort was equivalent to a productivity of 0.7 man -hours per square foot module floor area for a 225 ft2 module floor size This does not take into account the design input of the architect and external consultants, which would probably add about 20% to this total effort.

For modules at the higher levels, approximately 14% of the module weight is in the steel components and 56% in its concrete floor slab. At the lower levels of the high-rise block, the steel weight increased to 19% of the module weight. The steel usage varied from 14 to 24 pounds/ ft2, which is higher than the 10 to 12 pounds/ ft2 generally used in medium-rise modular systems. This is because of the use of concrete floors in this type of modular system.

The estimated breakdown of man effort with respect to the completed building was; 36% in manufacturing, 9% in transportation and installation, and 55% in construction of the rest of the building. The total effort in manufacturing and constructing the building was approximately 1.5 man-hours per ft2, which represents an estimated productivity increase of about 80% relative to site-intensive construction.

Site deliveries were monitored over the construction period. During installation of the modules, approximately 6 major deliveries per day were made, in addition to the 6 to 12 modules delivered on average. The concrete core progressed at a rate of one story every 3 days.

Waste was removed from site at a rate of only 2 skids of 210 cubic ft per week during the module installation period and 6 skips per week in the later stages of construction, equivalent to approximately, 3 Tons of general waste, including waste and packaging. This is equivalent to about 1.8 pounds per ft2. The manufacturing waste was equivalent to 5.1 pounds/ ft2 of the module area, of which, 43% of this waste was recycled. For the proportion of module floor area to total area of 79%, this is equivalent to about 5% of the weight of the overall construction. This may be compared to a construction industry average of 10 to 13% wastage of materials, with little waste being recycled. It follows that modular construction reduces landfill by a factor of at least 70%. (Lawson R. M., 2011)

## E. Atlantic Yards, Brooklyn, NY

| | |
|---|---|
| Developer: | Forest City Ratner |
| Modular Company: | Xsite Modular |
| Engineer: | Ove Arup & Partners |
| Architect: | SHoP |
| Key Dates: | Groundbreaking Q3/4 2012 |
| Financials: | Hard Cost 20% cheaper traditional construction |
| Height: | 32 stories |

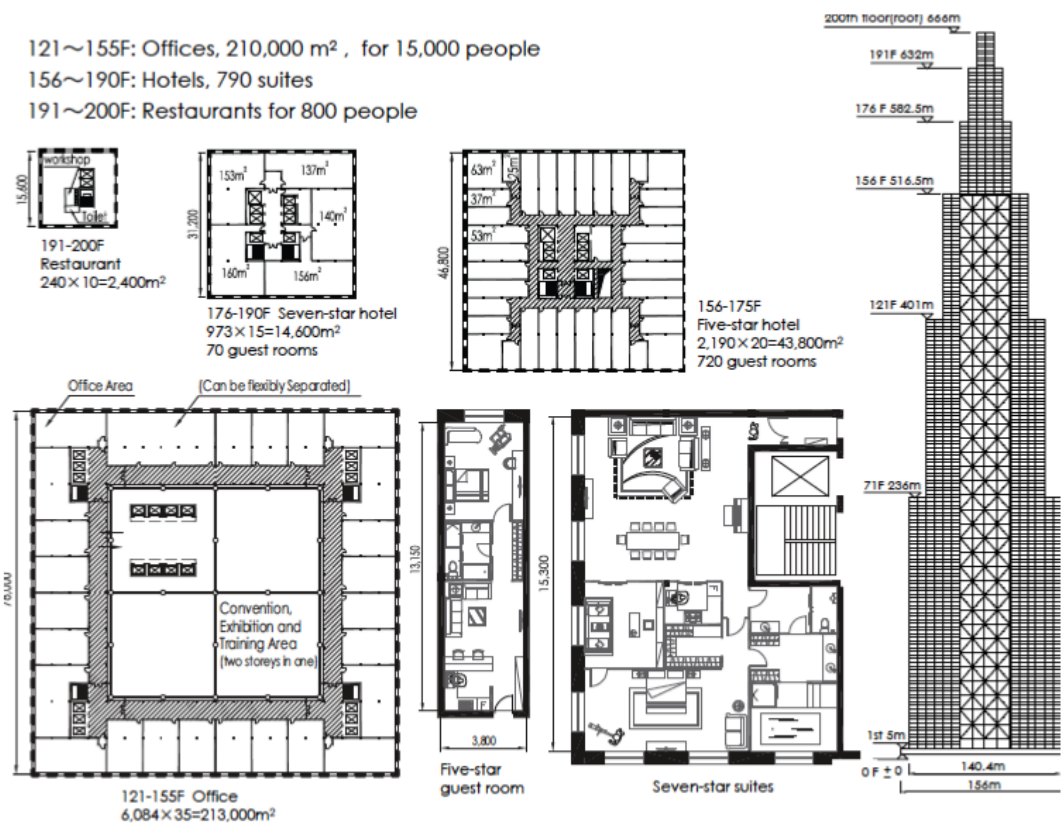
The $4.9 billion Atlantic Yards project is the redevelopment of 22 acres in downtown Brooklyn by Forest City Ratner Companies that will include approximately 6 million square feet of residential space (6,430 units of affordable and market-rate housing), a state of the art sports and entertainment arena, the Barclays Center, 247,000 square feet of retail use, approximately 336,000 square feet of office space and 8 acres of publicly accessible open space. All 6,430 residential units are scheduled to be constructed utilizing modular manufacturing, which make it the tallest and largest modular project in the world. The project also includes major transportation improvements, including a new storage and maintenance facility for the LIRR and a new subway entrance to the Atlantic Terminal Transit Hub, the third largest hub in the City. The project's Master Plan was designed by renowned architect Frank Gehry. The first residential building is B2 and comprised 363 units in a 32 story tower and will utilize approximately 930 modules. (New York City Housing Development Corporation, 2012) The project has been delayed due to economic market conditions and local politics; however, Forest City must begin construction by May 2013 or pay $5 million in penalties for every year the project is behind schedule. (Bagli, 2011)

The modules would be constructed with most interior finishes, mechanical electrical and exterior finishes completed at the factory. The current module design utilizes corner post steel construction with lateral bracing. Kitchen and bathroom subassemblies are then attached to the steel superstructure. Then MEP and interior/exterior finishes are attached to the module prior to onsite delivery. Although the building utilizes central cores the height of the building dictated additional use of steel bracing that allow the modules to attach and transfer loads downwards without directly attaching to the central core. More detailed information on the project is not available due to Forest City's desire to maintain proprietary data in house.

The modular manufacturing would be produced by union labor in New York City and was pitched to unions and the community as a way to expand manufacturing export opportunities from NYC. Modular was also touted as having the potential to introduce union labor into affordable housing development at scale for the first time in New York City.

Modular buildings built in NYC must meet the NYC Building Code as well as all fire and life safety codes. The construction is non-combustible and is subject to the same requirements and provisions as conventional construction. Manufacturing is six times safer than on-site construction. (HAPREST Research Project, 2004). Conventional on-site workers are also safer as they are primarily working within finished, enclosed portions of the building away from the typical risks of an open construction site. When building a modular project compared to an equivalently traditionally built project there is reduced energy consumption of up to 67% (ARUP Research & Development). It is further anticipated that modular construction could save 20% of construction cost and at least 60% of the total construction would be done in the factory. (Kastenbaum, 2011) The financial and schedule savings are higher at Atlantic Yards due to the vast economies of scale of the 6,430 units.

## F. Sky City, Changsa, China



| | |
|---|---|
| Developer: | Broad Group |
| Modular Company: | Broad Sustainable Building (related to Developer) |
| Architect: | Unknown |
| Key Dates: | Groundbreaking November 2012 |
| Financials: | $628 Million in Hard Cost |
| Height: | 220 stories |

The Broad Group has announced plans to erect the world's tallest building in 90 days. The building will surpass the Burg Khalifa in height which took 5 years to complete and was $1.5 billion to construct. Its 220 stories will provide a total of 1 million square meters of usable space, linked by 104 elevators. 95 percent of Sky City will be completed in the factory before breaking ground on the site. The 220 story building also aims to be as sustainable as possible by using quadruple glazing and 15 centimeter-thick exterior walls for thermal insulation. It is also expected to use a fifth of the energy that a regular building requires due to BSB's unique construction methods, and will serve as a city unto itself by housing over 100,000 people. It will feature the world's tallest hotel, "The J Hotel" and be linked by 104 elevators.

## XIV. Conclusions

The modern modular industry has made great strides in improving its product and providing benefits that are appealing to owners. The industry continues to evolve and 5 years ago would never have imagined the possibility of a project the scope of Atlantic Yards or Sky City. These opportunities and recent successes have required all developers to at least consider modular technology for their projects. Additionally, the push for sustainable development and financial alternatives in a challenging global recession has created macro-level demand drivers that could increase the adoption rate for offsite construction. The 5-10% savings of modular is very desirable in a market where 1-2% savings is the difference between profit/loss and moving forward versus failure.

However, modular construction has its share of challenges. First, the perception of modular construction in real estate circles and among the general public is very poor. The word conjures memories of trailer parkers and low-income housing. Even among most sophisticated real estate parties modular is thought of as a solution to low-income housing, but mutually exclusive with high design. Most projects adopted this technology due to budget constraints, not product constraints. Even though this is far from the truth and design choices are not materially constrained by modular there is great reluctance among developers, architects and contractors to adopt this technology in high rise construction. Additionally, there is limited capacity in the modular industry to meet any meaningful increase in demand. Primarily only 3-4 large scale manufacturers can meet high rise demand and they are located on the Mid-Atlantic and Northeastern United States. Their location and transportation access limits their service area to the East Coast and parts of the Midwest. It is likely more facilities would be built if the demand increases, but the lack of current capacity itself could prevent any thought of utilizing modular. Additionally, there is limited product in the US and throughout the world that points to successful high rise modular construction. It is likely both these challenges to the modular industry will be less prominent over the next 10 years.

It is clear that there are numerous project benefits to modular construction, but the most prevalent are time savings, cost savings and more sustainable construction. As seen in Table 3, 41% of adopters of modular construction saw at least a 6% decrease in project cost. The same study found that respondents achieved significant savings in their project time. (McGraw Hill Construction, 2011) Similar results are noted in sustainability as material waste is reduced by 5-15%; however, this waste is offset by a similar increase in materials used, since each module as structural redundancies.

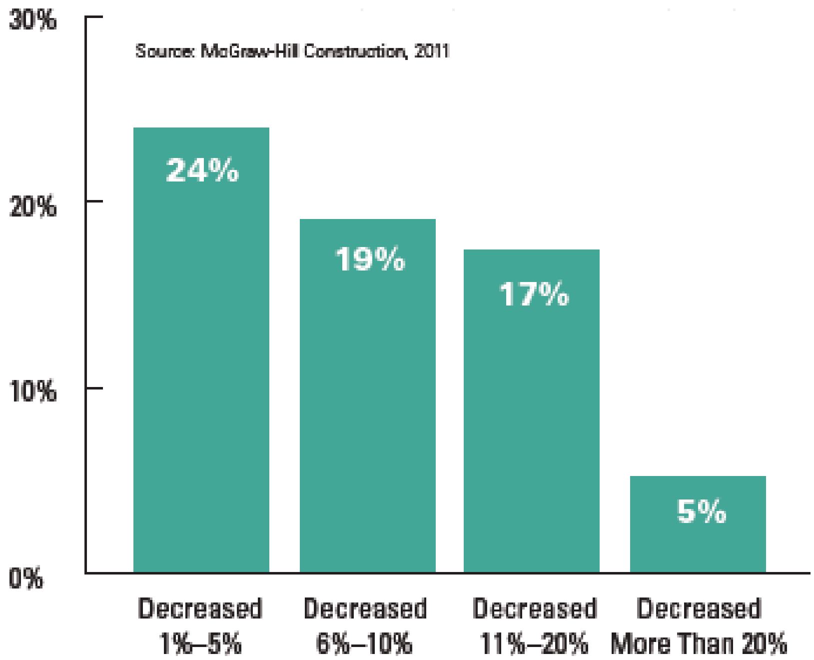



**Table 3 Cost Savings Utilizing Modular Construction**

When considering modular high rise construction it's important to consider the product type and how each volume of space can be fabricated. The most advantageous product types are hotels, apartments and condominiums and the least beneficial product type is speculative office, where interior fit out must be done after base building completion. As noted in Table 4, spec office limited opportunities for factory construction, especially interior finishes. It is also important to note that a building need not be all modular or all site built. Most modular projects utilize a combination, but the mix of these two methods is important to the time and financial savings. Through the early conceptual design process it's possible to quickly determine what elements of the building can or should be modular and which should be site built.

| | Multifamily | Condo | Hotel | Build-to-Suit Office | Spec Office |
|---|---|---|---|---|---|
| I. Modular Utilization | | | | | |
| A. MEP Connections | Opportunity | Opportunity | Opportunity | Opportunity | Opportunity |
| B. Kitchen/Bath | Opportunity | Neutral | Opportunity | N/A | N/A |
| C. Interior Finishes | Opportunity | Opportunity | Opportunity | Opportunity | Challenge |
| D. Exterior Finishes | Opportunity | Opportunity | Opportunity | Opportunity | Opportunity |
| E. Hallways | Opportunity | Opportunity | Opportunity | Opportunity | Challenge |
| F. Core | Neutral | Neutral | Neutral | Neutral | Neutral |
| G. Common Areas | Neutral | Neutral | Neutral | Neutral | Neutral |
| II. Modular Considerations | | | | | |
| A. Design | Neutral | Neutral | Neutral | Neutral | Neutral |
| B. Delivery Method | Neutral | Neutral | Neutral | Neutral | Neutral |
| C. Transportation | Neutral | Neutral | Neutral | Neutral | Neutral |
| D. Environmental | Opportunity | Opportunity | Opportunity | Opportunity | Opportunity |
| E. Scheduling | Opportunity | Opportunity | Opportunity | Opportunity | Neutral |
| F. Hard Cost Savings | Opportunity | Neutral | Opportunity | Opportunity | Challenge |
| G. Entitlements | Neutral | Neutral | Neutral | Neutral | Neutral |

| Opportunity | Neutral | Challenge |
|---|---|---|

**Table 4 Summary Findings**

Once a design determination has illustrated the appropriate modular elements of the project, the project team should continue to involve the modular manufacturer in the design phase to ensure there are no design or engineering barriers to fabrication. This need further dovetails with choosing an appropriate contract delivery method. Although any method from traditional general contracting to design-build or turnkey can be utilized it is critical that a modular manufacturer be consulted throughout the design process to avoid unnecessary redesign to accommodate modular fabrication.

A modular manufacturer should also be selected based on similar criteria as a contractor, but some additional items must be consider such as transportation cost, delivery route, capacity and financial health. Transportation considerations impact the cost and timing of module deliveries. Typically a factory within 400-600 miles can offer reasonable transportation costs, but escort and night/day delivery restrictions should also be considered. Lastly, given an owner's and lender's concern about completion guarantees the financial health of the manufacturer must be closely assessed to ensure they can deliver. This is especially important since there maybe no other manufacturer that is within delivery range of the project site or has the capacity to create the number of modules.

The lack of depth of the higher capacity modular manufacturers requires developers to be especially vigilant in risk mitigation when engaging a manufacturer. This is especially true for lenders who may require manufacturers to provide enhanced credit to ensure completion. Similarly, owners will have to address payment and procurement concerns of the manufacturers as they typically secure most of their materials at the outset of the project, but cannot deliver finished product until nearly all modules are complete. This lag creates materials carry that may need to be financed or priced into the manufacturing contract.

The most important consideration is scheduling and project timing. As seen the financial model some of the project time savings can erode if they do not resolve the financial needs of the project. For example, a high rise apartment building typically benefits from stagger unit delivery that results to a slow ramp up in operating expenses and a stead lease up. In a modular project the operation of cranes, matte line connections and tying modules to the building core typically limit the opportunity for lease up until all modules are set and installed. Given the high level of finishes in many modular projects there is limited onsite construction after module setting, especially if the exteriors are also finished in the factory. With these parameters, as in the financial model, a project may delivery 150 units per month that requires near full operating expense but only 20-30 of those units maybe leased per month and thus generating revenue. As noted in the model this condition greatly increases the operating deficit of the project during construction and today's low interest rate environment may have a greater impact than the reduced interest carry. Despite this operational challenge there is still a small, but meaningful financial benefit from schedule savings. On the other hand, hotels, build-to-suit offices and condos, which can have 30-100% pre-sales, can have near 100% economical use of the building immediately following construction completion. Thus these property types will suffer from almost no increased operating deficit due to modular construction and will have all of the reduced interest carry yield bottom line savings.

Financial savings are more pronounced and appropriate when considering materials, labor and schedule as a collective pricing metric. Although there is some meaningful material cost savings due to pre-cut and bulk order materials, the far greater savings results from the reduced labor time and wages in offsite construction. In combination all of these savings can produce 5-10% total project savings. With larger projects and more amenable property types the saving will be on the higher end of the range.

Without question there are material benefits to modular construction, but any developer should carefully study the opportunities and challenges prior to adoption. At this point in time, this technology has not matured enough for an owner to effectively outsource complete oversight and quality control. Given the financial and schedule benefits, a developer would be wise to consider this technology based on their product type and location relative to manufacturing facilities. The developer should engage a modular company early in the design process, but not allow the manufacturer to drive the design process. Further it's important to understand the differences between a traditional contractor and a manufacturer, as both debt and equity partners will require more assurances, financial considerations and explanations before allowing its use. However, if a developer has successfully navigated this path there are clear financial benefits to offsite modular construction.

# Appendix

## 1) Traditional Site Built Underwriting

**Cash Flow Summary - Fiscal Year**

| Year 1 Starts: Jul-12<br>Year 1 includes pre COE costs | | Totals | 2012<br>Year 1 | 2013<br>Year 2 | 2014<br>Year 3 | 2015<br>Year 4 | 2016<br>Year 5 | 2017<br>Year 6 | 2018<br>Year 7 | 2019<br>Year 8 | 2020<br>Year 9 | 2021<br>Year 10 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **DELIVERS & LEASING** | | | | | | | | | | | | |
| Units Delivered | | 396.75 | 0 | 0 | 0 | 147 | 249.75 | 0 | 0 | 0 | 0 | 0 |
| Cumm | | | 0 | 0 | 0 | 147 | 396.75 | 396.75 | 396.75 | 396.75 | 396.75 | 396.75 |
| Units Leased | | 378 | 0 | 0 | 0 | 75 | 300 | 3 | 0 | 0 | 0 | 0 |
| Cumm | | | 0 | 0 | 0 | 75 | 375 | 378 | 378 | 378 | 378 | 378 |
| **NET OPERATING INCOME** | | | | | | | | | | | | |
| Total Effective Revenue | | $17,538,276 | $0 | $0 | $0 | $443,942 | $8,517,886 | $8,576,447 | $0 | $0 | $0 | $0 |
| Commercial Revenue | | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| Less Net Expenses | | ($6,079,124) | $0 | $0 | $0 | ($525,799) | ($3,370,406) | ($2,182,918) | $0 | $0 | $0 | $0 |
| Less Ground Lease Expense | | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| **Net Operating Income** | | **$11,459,152** | **$0** | **$0** | **$0** | **($81,857)** | **$5,147,480** | **$6,393,529** | **$0** | **$0** | **$0** | **$0** |
| Less Reserves | | ($457,406) | $0 | $0 | $0 | ($18,375) | ($265,453) | ($173,578) | $0 | $0 | $0 | $0 |
| Less Loan Payments | | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| **Cash Flow** | | **$11,001,746** | **$0** | **$0** | **$0** | **($100,232)** | **$4,882,027** | **$6,219,951** | **$0** | **$0** | **$0** | **$0** |
| **CAPITAL COST** | | | | | | | | | | | | |
| Land Cost | | $20,237,019 | $20,237,019 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| Soft Cost | | $22,418,592 | $8,049,251 | $6,875,335 | $3,379,361 | $3,422,715 | $691,930 | $0 | $0 | $0 | $0 | $0 |
| Hard Cost | | $112,049,145 | $0 | $1,977,338 | $42,759,931 | $45,149,214 | $22,162,662 | $0 | $0 | $0 | $0 | $0 |
| Finance Cost | | $2,683,440 | $0 | $0 | $421,236 | $1,917,593 | $344,612 | $0 | $0 | $0 | $0 | $0 |
| **Total Capital Cost** | | **$157,388,196** | **$28,286,270** | **$8,852,673** | **$46,560,527** | **$50,489,522** | **$23,199,204** | **$0** | **$0** | **$0** | **$0** | **$0** |
| **FUNDING** | Max Funded | | | | | | | | | | | |
| Investor Equity | $47,216,459 | $47,216,459 | $28,286,270 | $8,852,673 | $10,077,516 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| Sponsor Equity | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| Construction Loan | $110,171,737 | $110,171,737 | $0 | $0 | $36,483,011 | $50,489,522 | $23,199,204 | ($110,171,737) | $0 | $0 | $0 | $0 |
| Permanent Loan | | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| **DISPOSITION** | | | | | | | | | | | | |
| Disposition | | $212,099,842 | $0 | $0 | $0 | $0 | $0 | $212,099,842 | $0 | $0 | $0 | $0 |
| Project Cash Flow | **Monthly IRR** | **18.98%** | ($28,286,270) | ($8,852,673) | ($10,077,516) | $0 | $1,673,670 | $105,898,716 | $0 | $0 | $0 | $0 |
| | **Annual IRR** | **20.44%** | | | | | | | | | | |
| | **NPV** | **$24,943,475** | | | | | | | | | | |

# Proforma

## Standard HR

## Washington

Date Prepared
07.01.12

| | Land Close | Construction Start | First Unit Delivered | Construction Completion | Stabilized | Disposition |
|---|---|---|---|---|---|---|
| Date | Jul-12 | Apr-14 | Apr-16 | Dec-16 | Jul-17 | Jan-18 |

Current revenues are for Jul-12 growing 2.08% per annum for 60 months to a stabilized rate

| Type | Unit | Size (SF) | Number | Mix | Rent/Month | Rent/SF | Current | Stabilized | 12 Mo. Forward Looking Yield |
|---|---|---|---|---|---|---|---|---|---|
| **Market Rate** | | | | | | | | | |
| S1 | 1-1 | 522 | 90 | 22.7% | $1,900 | $3.64 | $2,052,000 | 2,265,574 | 2,331,993 |
| A1 | 1-1 | 690 | 50 | 12.6% | 2,100 | 3.04 | 1,260,000 | 1,391,142 | 1,431,925 |
| A3 | 1-1 Den | 850 | 50 | 12.6% | 2,550 | 3.00 | 1,530,000 | 1,689,244 | 1,738,766 |
| B1 | 2-2 | 1,150 | 130 | 32.8% | 3,250 | 2.83 | 5,070,000 | 5,597,690 | 5,761,795 |
| C1 | 3-2.5 | 1,511 | 25 | 6.3% | 4,050 | 2.68 | 1,215,000 | 1,341,458 | 1,380,785 |
| **Subtotals** | | **311,255** | **345** | **87.0%** | **$927,250** | **$2.98** | **$11,127,000** | **$12,285,107** | **$12,645,264** |
| **Averages** | | **902** | | | **$2,688** | **$2.98** | | **$3.29** | **$3.39** |
| **BMR** | | | | | | | | | |
| S1 | 1-1 | 522 | 14 | 3.4% | 966 | 1.85 | 156,443 | 172,505 | 177,562 |
| A1 | 1-1 | 690 | 8 | 1.9% | 1,277 | 1.85 | 114,885 | 126,680 | 130,394 |
| A3 | 1-1 Den | 850 | 8 | 1.9% | 1,445 | 1.70 | 130,050 | 143,402 | 147,606 |
| B1 | 2-2 | 1,150 | 20 | 4.9% | 1,898 | 1.65 | 444,015 | 489,601 | 503,954 |
| C1 | 3-2.5 | 1,511 | 4 | 0.9% | 2,493 | 1.65 | 112,192 | 123,710 | 127,337 |
| **Subtotals** | | **46,688** | **52** | **13.0%** | **$79,799** | **$1.71** | **$957,585** | **$1,055,898** | **$1,086,854** |
| **Averages** | | **902** | | | **$1,542** | **$1.71** | | **$1.88** | **$1.94** |
| | **Less: Concessions** | | | | | | $0 | $0 | $0 |
| **Totals** | | **357,943** | **397** | **100.0%** | **$1,007,049** | | **$12,084,585** | **$13,341,005** | **$13,732,118** |
| **Averages** | | **902** | | | **$2,538** | **$2.81** | | $3.11 | $3.20 |

| Other Income | Number | % of Units | Rent/Month | Current | Stabilized | 12 Mo. Forward Looking Yield |
|---|---|---|---|---|---|---|
| Garage Parking | 400 | 100.82% | $200.00 | $960,000 | 1,058,561 | 1,089,594 |
| Floor Premiums | 345 | 86.96% | 55.00 | 227,700 | 251,077 | 258,438 |
| Amenity Fee | 161 | 40.58% | 50.00 | 96,600 | 106,518 | 109,640 |
| View Premiums | 300 | 75.61% | 50.00 | 180,000 | 198,480 | 204,299 |
| Storage | 100 | 25.20% | 50.00 | 60,000 | 66,160 | 68,100 |
| Penthouse Premiums | 78 | 19.66% | 200.00 | 187,200 | 206,419 | 212,471 |
| Other Income | 345 | 86.96% | 48.00 | 198,720 | 219,122 | 225,546 |
| **Total Other Income** | | | | **$1,910,220** | **$2,106,338** | **$2,168,088** |
| **Gross Potential Revenue** | | | | **$13,994,805** | **$15,447,343** | **$15,900,206** |
| **Less: Vacancy @** | 4.60% | | | ($644,293) | ($711,165) | ($732,014) |
| **Less: Loss to Lease** | | | | $0 | ($83,380) | ($92,157) |
| | Number | % of Units | Avg. Rent/Mo. | | | |
| **Less: Rent Losses** | 0 | 0.00% | $0 | $0 | $0 | $0 |
| | SF | NNN Rent/SF | Vacancy | | | |
| **Plus Retail Income** | 0 | $2.92 | 0.00% | $0 | $0 | $0 |
| **Effective Revenue** | | | | **$13,350,512** | **$14,652,798** | **$15,076,035** |

Current Expenses are for Jul-12 growing 2.06% per annum for 60 mo. to stabilized

| Expenses | | Per Unit | Current | Stabilized | 12 Mo. Forward Looking Yield |
|---|---|---|---|---|---|
| Personnel | | ($1,900) | ($753,825) | ($832,284) | ($856,683) |
| Contract Services | | ($300) | ($119,025) | ($131,413) | ($135,266) |
| Utilities | | ($600) | ($238,050) | ($262,826) | ($270,532) |
| Make-Ready | | ($600) | ($238,050) | ($262,826) | ($270,532) |
| Maintenance | | ($650) | ($257,888) | ($284,729) | ($293,076) |
| Marketing | | ($250) | ($99,188) | ($109,511) | ($112,722) |
| Administrative | | ($200) | ($79,350) | ($87,609) | ($90,177) |
| Management Fee | 2.62% | ($882) | ($350,000) | ($383,748) | ($394,832) |
| Insurance | | ($220) | ($87,285) | ($96,370) | ($99,195) |
| Property Taxes | | ($2,905) | ($1,152,578) | ($1,272,539) | ($1,309,846) |
| **Total Expenses** | | **($8,507)** | **($3,375,238)** | **($3,723,855)** | **($3,832,859)** |
| **Ground Lease** | | $0 | $0 | $0 | $0 |
| **Net Operating Income** | | **$25,142** | **$9,975,275** | **$10,928,943** | **$11,243,176** |
| **Average Annual NOI Growth Rate from Current** | | | | 1.84% | 2.01% |
| **Reserves** | | ($750) | ($297,563) | ($297,563) | ($297,563) |
| **Permanent Loan Payment** | | $0 | $0 | $0 | $0 |
| **Cash Flow** | | $24,392 | $9,677,712 | $10,631,381 | $10,945,614 |
| **Total Project Cost** | | | **$152,623,203** | **$157,388,196** | **$157,388,196** |
| **INVESTMENT YIELD (Make-Ready Expensed)** | | | **6.54%** | **6.94%** | **7.14%** |
| **AFTER RESERVES YIELD** | | | 6.34% | 6.75% | 6.95% |

## Reversion Analysis

| | | | | | | Reversion Date |
|---|---|---|---|---|---|---|
| | | | | | | Jan-01-18 |
| Unit Type | Bed/Bath | Number | Size (SF) | Reversion Rent/Month | Rent/SF | 12 months following Reversion |
| 1 | S1 | 90 | 522 | $2,139 | $4.10 | $2,309,870 |
| 2 | A1 | 50 | 690 | 2,364 | 3.43 | 1,418,341 |
| 3 | A3 | 50 | 850 | 2,870 | 3.38 | 1,722,272 |
| 4 | B1 | 130 | 1,150 | 3,658 | 3.18 | 5,707,135 |
| 5 | C1 | 25 | 1,511 | 4,559 | 3.02 | 1,367,686 |
| **Total Market Revenue** | | **345** | | | | **$12,525,304** |
| **Averages** | | | **902** | **$3,025** | **$3.35** | |

| | | | | | | |
|---|---|---|---|---|---|---|
| 1 | S1 | 14 | 522 | $12,631 | $24.20 | $2,046,294 |
| 2 | A1 | 8 | 690 | 16,697 | 24.20 | 1,502,707 |
| 3 | A3 | 8 | 850 | 18,901 | 22.24 | 1,701,066 |
| 4 | B1 | 20 | 1,150 | 24,819 | 21.58 | 5,807,758 |
| 5 | C1 | 4 | 1,511 | 32,611 | 21.58 | 1,467,479 |
| **Total BMR Revenue** | | **51.75** | | | | **$1,077,923** |
| **Averages** | | | **902** | **$1,736** | **$1.92** | |

| | | | |
|---|---|---|---|
| Total Rental Revenue | | | $13,603,227 |
| Total Other Income | | | 2,150,273 |
| Concessions | | | - |
| **Gross Potential Rent** | | | **15,753,500** |
| Less: Vacancy | | 5.00% | (787,675) |
| Loss to Lease | | | (88,087) |
| Bad Debt | | 0.00% | - |
| Non Revenue Units | | | - |
| Retail Income | | | - |
| Office Income | | | - |
| **Effective Revenue** | *Monthly Collections* | $1,239,812 | **$14,877,738** |

| Operating Expenses | | Per Unit | Reversion |
|---|---|---|---|
| Personnel | | $2,142 | $849,644 |
| Contract Services | | 338 | 134,154 |
| Utilities | | 676 | 268,309 |
| Make-Ready | | 676 | 268,309 |
| Maintenance | | 733 | 290,668 |
| Marketing | | 282 | 111,795 |
| Administrative | | 225 | 89,436 |
| Management Fee | 2.63% | 987 | 391,674 |
| Insurance | | 248 | 98,380 |
| Property Taxes | | $3,013 | 1,195,408 |
| **Total Operating Expenses** | | **$9,320** | **$3,697,777** |

| | | | | |
|---|---|---|---|---|
| **Net Operating Income** | | | | **$11,179,962** |
| | | | **Cap Rate** | **5.25%** |
| | | **Per S.F.** | **Per Unit** | **Total** |
| Sales Price | | $594.93 | $536,740 | $212,951,648 |
| Sales Cost @ | 0.40% | (2.38) | (2,147) | (851,807) |
| Investment Basis | | (439.70) | (396,694) | (157,388,196) |
| **Net Gain / (Loss)** | | **$152.85** | **$137,900** | **$54,711,646** |

**Reversion Tax Worksheet**

| | Total | Per Unit |
|---|---|---|
| Sales Price | $212,951,648 | $536,740 |
| % Assessed | 69.00% | |
| Assessed Value | 146,936,637 | 370,351 |
| Millage | 0.00850 | |
| Millage annual growth | 0.00% | |
| Property Tax | 1,248,961 | 3,148 |
| Discount | 0.00% | |
| Actual Property Tax Paid | 1,248,961 | 3,148 |
| Fire and Rescue | - | - |
| Personal Property | - | - |
| Other Assessments | - | - |
| **Total Property Taxes** | **$1,248,961** | **$3,148** |

**Reversion vs. Stabilized Assumptions (per unit)**

| | Stabilized | Reversion | Variance |
|---|---|---|---|
| Gross Revenue | $38,935 | $39,928 | $994 |
| Total Rent Loss | (2,003) | (2,429) | (427) |
| Make Ready | 662 | 676 | (14) |
| Insurance | 243 | 248 | (5) |
| Management Fees | 967 | 987 | (20) |
| Property Taxes | 3,207 | 3,148 | 59 |
| **Total NOI** | **$27,546** | **$28,179** | **$633** |

**Return Summary**

| | | | |
|---|---|---|---|
| Levered Quarterly IRR: | 18.81% | Equity Multiple: | 2.28 |
| Levered Monthly IRR: | 18.98% | | |

**Standard HR**

Date Prepared 07.01.12

No. of Units: 396.75

| | COE | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Month** | **Jul-12** | **Aug-12** | **Sep-12** | **Oct-12** | **Nov-12** | **Dec-12** | **Jan-13** | **Feb-13** | **Mar-13** | **Apr-13** | **May-13** | **Jun-13** | **Jul-13** | **Aug-13** | **Sep-13** | **Oct-13** | **Nov-13** | **Dec-13** | **Jan-14** |
| COE Month # | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
| Const Month # | -21 | -20 | -19 | -18 | -17 | -16 | -15 | -14 | -13 | -12 | -11 | -10 | -9 | -8 | -7 | -6 | -5 | -4 | -3 |
| Last & Occupancy Stabilization | | | | | | | | | | | | | | | | | | | |
| **Soft Cost Draw** | | | | | | | | | | | | | | | | | | | |
| Proforma Draw | 3.6% | 3.6% | 3.6% | 3.6% | 3.6% | 3.6% | 3.6% | 3.6% | 3.6% | 3.6% | 3.6% | 3.6% | 3.6% | 3.6% | 3.6% | 3.6% | 3.6% | 3.6% | 3.6% |
| Reallocation | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| Override | | | | | | | | | | | | | | | | | | | |
| Utilized | 3.6% | 3.6% | 3.6% | 3.6% | 3.6% | 3.6% | 3.6% | 3.6% | 3.6% | 3.6% | 3.6% | 3.6% | 3.6% | 3.6% | 3.6% | 3.6% | 3.6% | 3.6% | 3.6% |
| Cummulative | 3.6% | 7.1% | 10.7% | 14.3% | 17.9% | 21.4% | 25.0% | 28.6% | 32.1% | 35.7% | 39.3% | 42.9% | 46.4% | 50.0% | 53.6% | 57.1% | 60.7% | 64.3% | 67.9% |
| **Hard Cost Draw** | | | | | | | | | | | | | | | | | | | |
| Proforma Draw | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| Reallocation | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| Override | | | | | | | | | | | | | | | | | | | |
| Utilized | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| Cummulative | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| **Units Delivered** | | | | | | | | | | | | | | | | | | | |
| Proforma Delivery | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Override | | | | | | | | | | | | | | | | | | | |
| Utilized | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Cummulative | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Percent of Total | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| **Units Leased** | | | | | | | | | | | | | | | | | | | |
| Available For Lease | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Proforma Leased | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Override | | | | | | | | | | | | | | | | | | | |
| Utilized | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Cummulative | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Percent of Total | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |

|  |  |  | Const Start |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Month** | **Feb-14** | **Mar-14** | **Apr-14** | **May-14** | **Jun-14** | **Jul-14** | **Aug-14** | **Sep-14** | **Oct-14** | **Nov-14** | **Dec-14** | **Jan-15** | **Feb-15** | **Mar-15** | **Apr-15** | **May-15** | **Jun-15** | **Jul-15** | **Aug-15** |
| COE Month # | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 |
| Const Month # | -2 | -1 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 |
| Last & Occupancy |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Stabilization |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **Soft Cost Draw** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Proforma Draw | 3.6% | 3.6% | 1.0% | 1.0% | 1.0% | 1.0% | 1.0% | 1.0% | 1.0% | 1.0% | 1.0% | 1.0% | 1.0% | 1.0% | 1.0% | 1.0% | 1.0% | 1.0% | 1.0% |
| Reallocation | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| Override |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Utilized | 3.6% | 3.6% | 1.0% | 1.0% | 1.0% | 1.0% | 1.0% | 1.0% | 1.0% | 1.0% | 1.0% | 1.0% | 1.0% | 1.0% | 1.0% | 1.0% | 1.0% | 1.0% | 1.0% |
| Cummulative | 71.4% | 75.0% | 76.0% | 77.1% | 78.1% | 79.2% | 80.2% | 81.3% | 82.3% | 83.3% | 84.4% | 85.4% | 86.5% | 87.5% | 88.5% | 89.6% | 90.6% | 91.7% | 92.7% |
| **Hard Cost Draw** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Proforma Draw | 0.0% | 0.0% | 0.0% | 0.6% | 1.2% | 1.8% | 2.6% | 3.5% | 3.4% | 3.4% | 3.4% | 3.4% | 3.4% | 3.4% | 3.4% | 3.4% | 3.4% | 3.4% | 3.4% |
| Reallocation | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| Override |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Utilized | 0.0% | 0.0% | 0.0% | 0.6% | 1.2% | 1.8% | 2.6% | 3.5% | 3.4% | 3.4% | 3.4% | 3.4% | 3.4% | 3.4% | 3.4% | 3.4% | 3.4% | 3.4% | 3.4% |
| Cummulative | 0.0% | 0.0% | 0.0% | 0.6% | 1.8% | 3.5% | 6.2% | 9.7% | 13.1% | 16.4% | 19.8% | 23.1% | 26.5% | 29.9% | 33.2% | 36.6% | 39.9% | 43.3% | 46.6% |
| **Units Delivered** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Proforma Delivery | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Override |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Utilized | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Cummulative | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Percent of Total | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| **Units Leased** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Available For Lease | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Proforma Leased | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Override |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Utilized | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Cummulative | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Percent of Total | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |

| | | | | | | | | First Units | | | | | | | | Last Units | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Month** | **Sep-15** | **Oct-15** | **Nov-15** | **Dec-15** | **Jan-16** | **Feb-16** | **Mar-16** | **Apr-16** | **May-16** | **Jun-16** | **Jul-16** | **Aug-16** | **Sep-16** | **Oct-16** | **Nov-16** | **Dec-16** | **Jan-17** | **Feb-17** | **Mar-17** |
| COE Month # | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 |
| Const Month # | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 |
| Last & Occupancy | | | | | | | | | | | | | | | | 1 | | | |
| Stabilization | | | | | | | | | | | | | | | | | | | |
| **Soft Cost Draw** | | | | | | | | | | | | | | | | | | | |
| Proforma Draw | 1.0% | 1.0% | 1.0% | 1.0% | 1.0% | 1.0% | 1.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| Reallocation | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| Override | | | | | | | | | | | | | | | | | | | |
| Utilized | 1.0% | 1.0% | 1.0% | 1.0% | 1.0% | 1.0% | 1.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| Cummulative | 93.7% | 94.8% | 95.8% | 96.9% | 97.9% | 99.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% |
| **Hard Cost Draw** | | | | | | | | | | | | | | | | | | | |
| Proforma Draw | 3.4% | 3.4% | 3.4% | 3.4% | 3.4% | 3.4% | 3.4% | 3.4% | 3.4% | 3.4% | 3.4% | 3.4% | 3.4% | 3.5% | 2.6% | 1.8% | 1.2% | 0.6% | 0.0% |
| Reallocation | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| Override | | | | | | | | | | | | | | | | | | | |
| Utilized | 3.4% | 3.4% | 3.4% | 3.4% | 3.4% | 3.4% | 3.4% | 3.4% | 3.4% | 3.4% | 3.4% | 3.4% | 3.4% | 3.5% | 2.6% | 1.8% | 1.2% | 0.6% | 0.0% |
| Cummulative | 50.0% | 53.4% | 56.7% | 60.1% | 63.4% | 66.8% | 70.1% | 73.5% | 76.9% | 80.2% | 83.6% | 86.9% | 90.3% | 93.8% | 96.5% | 98.2% | 99.4% | 100.0% | 100.0% |
| | | | | | | | | | | | | | | | | | | | |
| **Units Delivered** | | | | | | | | | | | | | | | | | | | |
| Proforma Delivery | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 49 | 49 | 49 | 49 | 49 | 49 | 49 | 49 | 4.75 | 0 | 0 | 0 |
| Override | | | | | | | | | | | | | | | | | | | |
| Utilized | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 49 | 49 | 49 | 49 | 49 | 49 | 49 | 49 | 4.75 | 0 | 0 | 0 |
| Cummulative | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 49 | 98 | 147 | 196 | 245 | 294 | 343 | 392 | 396.75 | 396.75 | 396.75 | 396.75 |
| Percent of Total | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 12% | 25% | 37% | 49% | 62% | 74% | 86% | 99% | 100% | 100% | 100% | 100% |
| **Units Leased** | | | | | | | | | | | | | | | | | | | |
| Available For Lease | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 49 | 73 | 97 | 121 | 145 | 169 | 193 | 217 | 196.75 | 179.75 | 154.75 | 129.75 |
| Proforma Leased | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 |
| Override | | | | | | | | | | | | | | | | | | | |
| Utilized | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 |
| Cummulative | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 25 | 50 | 75 | 100 | 125 | 150 | 175 | 200 | 225 | 250 | 275 | 300 |
| Percent of Total | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 6% | 13% | 19% | 25% | 32% | 38% | 44% | 50% | 57% | 63% | 69% | 76% |

| | | | | Stabilization | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Month** | **Apr-17** | **May-17** | **Jun-17** | **Jul-17** | **Aug-17** | **Sep-17** | **Oct-17** | **Nov-17** | **Dec-17** | **Jan-18** | **Feb-18** | **Mar-18** | **Apr-18** | **May-18** | **Jun-18** | **Jul-18** | **Aug-18** | **Sep-18** | **Oct-18** |
| COE Month # | 57 | 58 | 59 | 60 | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 71 | 72 | 73 | 74 | 75 |
| Const Month # | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 |
| Last & Occupancy | | | | 2 | | | | | | | | | | | | | | | |
| Stabilization | | | | 3 | | | | | | | | | | | | | | | |
| **Soft Cost Draw** | | | | | | | | | | | | | | | | | | | |
| Proforma Draw | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| Reallocation | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| Override | | | | | | | | | | | | | | | | | | | |
| Utilized | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| Cummulative | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% |
| **Hard Cost Draw** | | | | | | | | | | | | | | | | | | | |
| Proforma Draw | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| Reallocation | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| Override | | | | | | | | | | | | | | | | | | | |
| Utilized | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| Cummulative | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% |
| | | | | | | | | | | | | | | | | | | | |
| **Units Delivered** | | | | | | | | | | | | | | | | | | | |
| Proforma Delivery | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Override | | | | | | | | | | | | | | | | | | | |
| Utilized | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Cummulative | 396.75 | 396.75 | 396.75 | 396.75 | 396.75 | 396.75 | 396.75 | 396.75 | 396.75 | 396.75 | 396.75 | 396.75 | 396.75 | 396.75 | 396.75 | 396.75 | 396.75 | 396.75 | 396.75 |
| Percent of Total | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% |
| **Units Leased** | | | | | | | | | | | | | | | | | | | |
| Available For Lease | 104.75 | 79.75 | 54.75 | 29.75 | 26.75 | 26.75 | 26.75 | 26.75 | 26.75 | 26.75 | 26.75 | 26.75 | 26.75 | 26.75 | 26.75 | 26.75 | 26.75 | 26.75 | 26.75 |
| Proforma Leased | 25 | 25 | 25 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Override | | | | | | | | | | | | | | | | | | | |
| Utilized | 25 | 25 | 25 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Cummulative | 325 | 350 | 375 | 378 | 378 | 378 | 378 | 378 | 378 | 378 | 378 | 378 | 378 | 378 | 378 | 378 | 378 | 378 | 378 |
| Percent of Total | 82% | 88% | 95% | 95% | 95% | 95% | 95% | 95% | 95% | 95% | 95% | 95% | 95% | 95% | 95% | 95% | 95% | 95% | 95% |

## Capital Budget

397 Apt. Net Square Footage: 357,943

| Budget Category | Per Unit | Per Net SF: | Total |
|---|---|---|---|
| **Land Costs** | | | |
| Purchase Price (includes Earnest Money Deposits) | $50,000 | $55.42 | $19,837,500 |
| Commissions | - | - | - |
| Closing Costs / Escrow Fees | 762 | 0.85 | 302,519 |
| Title Insurance | 55 | 0.06 | 22,000 |
| Capitalized Property Taxes | 3,430 | 3.80 | 1,360,987 |
| **Total Land Costs** | **$54,437** | **$60.34** | **$21,598,006** |
| **Soft Costs** | | | |
| **Legal:** | | | |
| General | $756 | $0.84 | $300,000 |
| Zoning | 126 | 0.14 | 50,000 |
| **Subtotal Legal** | **$882** | **$0.98** | **$350,000** |
| | | | |
| **Design Costs:** | | | |
| AIA Inspections | $978 | $1.08 | $388,000 |
| Consultants | 630 | 0.70 | 250,000 |
| Architect Fees | 5,293 | 5.87 | 2,100,000 |
| Architectural Reimbursables | 378 | 0.42 | 150,000 |
| As-built Survey | 63 | 0.07 | 25,000 |
| Blueprints & Photos | 252 | 0.28 | 100,000 |
| Civil Engineering | 605 | 0.67 | 240,000 |
| Construction Closeout Audit | 76 | 0.08 | 30,000 |
| Construction Inspections | 378 | 0.42 | 150,000 |
| Electrical Engineering | 277 | 0.31 | 110,000 |
| Interior Design Fees | 807 | 0.89 | 320,000 |
| Landscape Architecture | 567 | 0.63 | 225,000 |
| Materials Testing | 1,260 | 1.40 | 500,000 |
| Mechanical Engineering | 391 | 0.43 | 155,000 |
| Miscellaneous Design Costs | 504 | 0.56 | 200,000 |
| Phase I Environmental Report | 25 | 0.03 | 10,000 |
| Phase II Environmental Report | 151 | 0.17 | 60,000 |
| Pre-Development Costs | 252 | 0.28 | 100,000 |
| Soils Engineering | 466 | 0.52 | 185,000 |
| Structural Engineering | 857 | 0.95 | 340,000 |
| Survey | 63 | 0.07 | 25,000 |
| Traffic Report | 3 | 0.00 | 1,000 |
| Permit Expeditor | 378 | 0.42 | 150,000 |
| **Subtotal Design Costs** | **$14,654** | **$16.24** | **$5,814,000** |
| | | | |
| **Marketing Costs:** | | | |
| Advertising & Promotion | $630 | $0.70 | $250,000 |
| Clubhouse | 2,520 | 2.79 | 1,000,000 |
| Fitness FF&E | 756 | 0.84 | 300,000 |
| Graphic Design & Promotion | 441 | 0.49 | 175,000 |
| Maintenance FF&E | 227 | 0.25 | 90,000 |
| Marketing Signage | 252 | 0.28 | 100,000 |
| Miscellaneous Marketing | 126 | 0.14 | 50,000 |
| Model FF&E | 315 | 0.35 | 125,000 |
| Office FF&E | 189 | 0.21 | 75,000 |
| Pool & Site Furniture | 378 | 0.42 | 150,000 |
| Postage & Overnight Delivery | 25 | 0.03 | 10,000 |
| Pre-leasing Trailer | 126 | 0.14 | 50,000 |
| **Subtotal Marketing Costs** | **$5,986** | **$6.64** | **$2,375,000** |
| | | | |
| **Permits & Fees:** | | | |
| Plan Check Fees | $126 | $0.14 | $50,000 |
| Building Permits & Inspections | 983 | 1.09 | 390,000 |
| Water Fees | 189 | 0.21 | 75,000 |
| Sewer Fees | 567 | 0.63 | 225,000 |
| Electrical Fees | 945 | 1.05 | 375,000 |
| Traffic Fees | - | - | - |
| Village / City Impact Fees | 2,268 | 2.51 | 900,000 |
| School Fees | - | - | - |
| Total Other Impact Fees | - | - | - |
| **Subtotal Permits & Fees** | **$5,079** | **$5.63** | **$2,015,000** |
| | | | |
| Construction Financing Costs | 6,764 | 7.50 | 2,683,440 |
| Financing Fees & Closing Costs | 11,249 | 12.47 | 4,462,934 |
| Land Loan Financing Costs | - | - | - |
| Land Loan Financing Fees & Closing Costs | - | - | - |
| Development Fee | 11,554 | 12.81 | 4,584,122 |
| Property Operating Costs | 160 | 0.18 | 63,587 |
| Operating Deficits | 851 | 0.94 | 337,562 |
| Soft Cost Contingency | 2,660 | 2.95 | 1,055,400 |
| **Total Soft Costs** | **$59,839** | **$66.33** | **$23,741,045** |
| **Hard Costs** | | | |
| Hard Costs General Contractor | $258,500 | $286.53 | $102,560,000 |
| Inflation Factor | 11,548 | 12.80 | 4,581,724 |
| Hard Costs Contingency | 10,802 | 11.97 | 4,285,669 |
| Builder's Risk Insurance | 1,567 | 1.74 | 621,752 |
| Hard Costs Other | - | - | - |
| **Total Hard Costs** | **$282,418** | **$313.04** | **$112,049,145** |
| | | | |
| **Total Project Cost** | **$396,694** | **$439.70** | **$157,388,196** |

| Hard Cost GMP Budget<br>TRADE ITEM | GMP |
|---|---|
| Concrete | $6,010,000 |
| Masonry | $2,960,000 |
| Structural Steel, Joists and Metal Deck | $10,680,000 |
| Miscellaneous Metals | $1,060,000 |
| Finish Carpentry and Millwork, Cabinets & Countertops | $4,580,000 |
| Waterproofing | $2,000,000 |
| Spray-on Fireproofing | $660,000 |
| Roofing | $1,430,000 |
| Sheet Metal and Flashings | $300,000 |
| Exterior Metal Siding | $4,050,000 |
| Doors, Frames and Hardware | $1,920,000 |
| Windows and Entry Systems | $4,350,000 |
| Rough Carpenty, Drywall, Sheathing and LGMF | $11,550,000 |
| Ceramic Tile and Stone | $1,650,000 |
| Wood Flooring | $2,460,000 |
| Resilient Flooring & Carpet | $1,760,000 |
| Paint & Decorating | $2,280,000 |
| Specialties | $720,000 |
| Appliances | $1,710,000 |
| Blinds & Shades | $170,000 |
| Elevators and Conveying Systems | $1,500,000 |
| Plumbing | $6,000,000 |
| HVAC | $9,490,000 |
| Fire Protection | $2,080,000 |
| Electrical/Telecommunication Systems | $8,400,000 |
| Security/Intercom Systems (Allowance #1) | $300,000 |
| Earthwork, Site Utilities and Sidewalks | $2,800,000 |
| Lawns & Plantings | $1,800,000 |
| **Total Building and Sitework Improvements** | **$94,670,000** |
| General Conditions | $3,280,000 |
| General Requirements | $1,910,000 |
| Contractor Fee | $1,830,000 |
| **Subtotal** | **$101,690,000** |
| Performance and Payment Bond | $870,000 |
| **Totals** | **$102,560,000** |

## PROPERTY TAX - INCOME CAPITALIZATION
### Standard HR
### At Stabilization - 2012

| | |
|---|---|
| # of Units | 397 |
| Expense Ratio | 26.7% |
| Capitalization Rate | 6.250% |
| Tax Rate | 0.850% |
| Misc. Income | $855,750 |
| Vacancy & Credit Loss | 5.0% |

| Assessor's Calculation | Annual | Per Unit |
|---|---|---|
| Potential Gross Income | $12,084,585 | $30,459 |
| Less: Vacancy & Credit Loss (5%) | (604,229) | (1,523) |
| Effectiv e Gross Income | $11,480,356 | $28,936 |
| Less: Operating Expenses (26.65%) | ($3,059,515) | ($7,711) |
| Plus: Misc. Income | 855,750 | 2,157 |
| NOI Before Taxes | $9,276,591 | $23,381 |
| Cap Rate | 6.250% | |
| Tax Rate | 0.850% | |
| Loaded Cap Rate | 7.100% | |
| Income Value | $130,656,212 | $329,316 |
| Real Estate Taxes | $1,110,578 | $2,799 |
| Personal Property Tax | 0 | 0 |
| Local District Tax | 42,000 | 106 |
| Other | 0 | 0 |
| **Total Real Estate Taxes** | **$1,152,578** | **$2,905** |

## Cash Flow Summary - Fiscal Year

| Year 1 Starts: Jul-12<br>Year 1 includes pre COE costs | Max Funded | Totals | 2012<br>Year 1 | 2013<br>Year 2 | 2014<br>Year 3 | 2015<br>Year 4 | 2016<br>Year 5 | 2017<br>Year 6 | 2018<br>Year 7 |
|---|---|---|---|---|---|---|---|---|---|
| **DELIVERS & LEASING** | | | | | | | | | |
| Units Delivered | | 396.75 | 0 | 0 | 0 | 396.75 | 0 | 0 | 0 |
| Cumm | | | 0 | 0 | 0 | 396.75 | 396.75 | 396.75 | 396.75 |
| Units Leased | | 378 | 0 | 0 | 0 | 200 | 178 | 0 | 0 |
| Cumm | | | 0 | 0 | 0 | 200 | 378 | 378 | 378 |
| **NET OPERATING INCOME** | | | | | | | | | |
| Total Effective Revenue | | $17,394,161 | $0 | $0 | $0 | $2,649,203 | $12,303,828 | $2,441,129 | $0 |
| Commercial Revenue | | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| Less Net Expenses | | ($6,985,793) | $0 | $0 | $0 | ($2,623,405) | ($3,741,247) | ($621,141) | $0 |
| Less Ground Lease Expense | | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| **Net Operating Income** | | **$10,408,368** | **$0** | **$0** | **$0** | **$25,799** | **$8,562,581** | **$1,819,988** | **$0** |
| Less Reserves | | ($533,063) | $0 | $0 | $0 | ($185,906) | ($297,563) | ($49,594) | $0 |
| Less Loan Payments | | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| **Cash Flow** | | **$9,875,305** | **$0** | **$0** | **$0** | **($160,108)** | **$8,265,019** | **$1,770,394** | **$0** |
| **CAPITAL COST** | | | | | | | | | |
| Land Cost | | $20,237,019 | $20,237,019 | $0 | $0 | $0 | $0 | $0 | $0 |
| Soft Cost | | $24,504,612 | $8,462,341 | $7,382,499 | $4,228,094 | $4,431,679 | $0 | $0 | $0 |
| Hard Cost | | $104,042,334 | $0 | $2,714,148 | $63,573,693 | $37,754,492 | $0 | $0 | $0 |
| Finance Cost | | $1,795,306 | $0 | $0 | $828,634 | $966,672 | $0 | $0 | $0 |
| **Total Capital Cost** | | **$150,579,270** | **$28,699,360** | **$10,096,647** | **$68,630,421** | **$43,152,843** | **$0** | **$0** | **$0** |
| **FUNDING** | Max Funded | | | | | | | | |
| Investor Equity | $45,173,781 | $45,173,781 | $28,699,360 | $10,096,647 | $6,377,775 | $0 | $0 | $0 | $0 |
| Sponsor Equity | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| Construction Loan | $105,405,489 | $105,405,490 | $0 | $0 | $62,252,646 | $43,152,843 | $0 | ($105,405,489) | $0 |
| Permanent Loan | | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| **DISPOSITION** | | | | | | | | | |
| Disposition | | $210,170,633 | $0 | $0 | $0 | $0 | $0 | $210,170,633 | $0 |
| Project Cash Flow | **Monthly IRR** | **22.46%** | ($28,699,360) | ($10,096,647) | ($6,377,775) | $0 | $4,575,827 | $105,920,673 | $0 |
| | **Annual IRR** | **22.00%** | | | | | | | |
| | **NPV** | **$30,822,437** | | | | | | | |

## Proforma

No. of Units: 397 — Scenario: Modular High Rise

| | Land Close | Construction Start | First Unit Delivered | Construction Completion | Stabilized | Disposition |
|---|---|---|---|---|---|---|
| Date | Jul-12 | Apr-14 | Nov-15 | Jan-16 | Feb-17 | Aug-17 |

Current revenues are for Jul-12 growing 2.07% per annum for 55 months to a stabilized rate

| Type | Unit | Size (SF) | Number | Mix | Rent/Month | Rent/SF | Current | Stabilized | 12 Mo. Forward Looking Yield |
|---|---|---|---|---|---|---|---|---|---|
| **Market Rate** | | | | | | | | | |
| S1 | 1-1 | 522 | 90 | 22.7% | $1,900 | $3.64 | $2,052,000 | 2,246,957 | 2,312,830 |
| A1 | 1-1 | 690 | 50 | 12.6% | 2,100 | 3.04 | 1,260,000 | 1,379,711 | 1,420,159 |
| A3 | 1-1 Den | 850 | 50 | 12.6% | 2,550 | 3.00 | 1,530,000 | 1,675,363 | 1,724,479 |
| B1 | 2-2 | 1,150 | 130 | 32.8% | 3,250 | 2.83 | 5,070,000 | 5,551,693 | 5,714,449 |
| C1 | 3-2.5 | 1,511 | 25 | 6.3% | 4,050 | 2.68 | 1,215,000 | 1,330,435 | 1,369,439 |
| **Subtotals** | | **311,255** | **345** | **87.0%** | **$927,250** | **$2.98** | **$11,127,000** | **$12,184,159** | **$12,541,356** |
| **Averages** | | **902** | | | **$2,688** | **$2.98** | | **$3.26** | **$3.36** |
| **BMR** | | | | | | | | | |
| S1 | 1-1 | 522 | 14 | 3.4% | 966 | 1.85 | 156,443 | 171,088 | 176,103 |
| A1 | 1-1 | 690 | 8 | 1.9% | 1,277 | 1.85 | 114,885 | 125,639 | 129,322 |
| A3 | 1-1 Den | 850 | 8 | 1.9% | 1,445 | 1.70 | 130,050 | 142,224 | 146,393 |
| B1 | 2-2 | 1,150 | 20 | 4.9% | 1,898 | 1.65 | 444,015 | 485,578 | 499,813 |
| C1 | 3-2.5 | 1,511 | 4 | 0.9% | 2,493 | 1.65 | 112,192 | 122,694 | 126,291 |
| **Subtotals** | | **46,688** | **52** | **13.0%** | **$79,799** | **$1.71** | **$957,585** | **$1,047,222** | **$1,077,923** |
| **Averages** | | **902** | | | **$1,542** | **$1.71** | | **$1.87** | **$1.92** |
| | **Less: Concessions** | | | | | | $0 | $0 | $0 |
| **Totals** | | **357,943** | **397** | **100.0%** | **$1,007,049** | | **$12,084,585** | **$13,231,380** | **$13,619,279** |
| **Averages** | | **902** | | | **$2,538** | **$2.81** | | $3.08 | $3.17 |

| Other Income | Number | % of Units | Rent/Month | Current | Stabilized | 12 Mo. Forward Looking Yield |
|---|---|---|---|---|---|---|
| Garage Parking | 400 | 100.82% | $200.00 | $960,000 | 1,049,863 | 1,080,641 |
| Floor Premiums | 345 | 86.96% | 55.00 | 227,700 | 249,014 | 256,315 |
| Amenity Fee | 161 | 40.58% | 50.00 | 96,600 | 105,642 | 108,739 |
| View Premiums | 300 | 75.61% | 50.00 | 180,000 | 196,849 | 202,620 |
| Storage | 100 | 25.20% | 50.00 | 60,000 | 65,616 | 67,540 |
| Penthouse Premiums | 78 | 19.66% | 200.00 | 187,200 | 204,723 | 210,725 |
| Other Income | 345 | 86.96% | 48.00 | 198,720 | 217,322 | 223,693 |
| **Total Other Income** | | | | **$1,910,220** | **$2,089,030** | **$2,150,273** |
| **Gross Potential Revenue** | | | | **$13,994,805** | **$15,320,410** | **$15,769,552** |
| **Less: Vacancy @** | 4.60% | | | ($644,293) | ($705,321) | ($725,998) |
| **Less: Loss to Lease** | | | | $0 | ($82,695) | ($91,400) |
| | Number | % of Units | Avg. Rent/Mo. | | | |
| **Less: Rent Losses** | 0 | 0.00% | $0 | $0 | $0 | $0 |
| | SF | NNN Rent/SF | Vacancy | | | |
| **Plus Retail Income** | 0 | $2.92 | 0.00% | $0 | $0 | $0 |
| **Effective Revenue** | | | | **$13,350,512** | **$14,532,394** | **$14,952,153** |

Current Expenses are for Jul-12 growing 2.05% per annum for 55 mo. to stabilized

| Expenses | | Per Unit | Current | Stabilized | 12 Mo. Forward Looking Yield |
|---|---|---|---|---|---|
| Personnel | | ($1,900) | ($753,825) | ($825,445) | ($849,644) |
| Contract Services | | ($300) | ($119,025) | ($130,333) | ($134,154) |
| Utilities | | ($600) | ($238,050) | ($260,667) | ($268,309) |
| Make-Ready | | ($600) | ($238,050) | ($260,667) | ($268,309) |
| Maintenance | | ($650) | ($257,888) | ($282,389) | ($290,668) |
| Marketing | | ($250) | ($99,188) | ($108,611) | ($111,795) |
| Administrative | | ($200) | ($79,350) | ($86,889) | ($89,436) |
| Management Fee | 2.62% | ($882) | ($350,000) | ($380,594) | ($391,588) |
| Insurance | | ($220) | ($87,285) | ($95,578) | ($98,380) |
| Property Taxes | | ($2,905) | ($1,152,578) | ($1,262,082) | ($1,299,082) |
| **Total Expenses** | | **($8,507)** | **($3,375,238)** | **($3,693,255)** | **($3,801,364)** |
| **Ground Lease** | | $0 | $0 | $0 | $0 |
| **Net Operating Income** | | **$25,142** | **$9,975,275** | **$10,839,139** | **$11,150,789** |
| **Average Annual NOI Growth Rate from Current** | | | | **1.83%** | **2.02%** |
| **Reserves** | | ($750) | ($297,563) | ($297,563) | ($297,563) |
| **Permanent Loan Payment** | | $0 | $0 | $0 | $0 |
| **Cash Flow** | | $24,392 | $9,677,712 | $10,541,576 | $10,853,227 |
| **Total Project Cost** | | | **$146,154,472** | **$150,579,270** | **$150,579,270** |
| **INVESTMENT YIELD (Make-Ready Expensed)** | | | **6.83%** | **7.20%** | **7.41%** |
| **AFTER RESERVES YIELD** | | | 6.62% | 7.00% | 7.21% |

Reversion Analysis
Version: Modular High Rise

| Unit Type | Bed/Bath | Number | Size (SF) | Reversion Rent/Month | Rent/SF | Reversion Date Aug-01-17 12 months following Reversion |
|---|---|---|---|---|---|---|
| Market Rate | | | | | | |
| 1 | S1 | 90 | 522 | $2,121 | $4.06 | $2,290,890 |
| 2 | A1 | 50 | 690 | 2,344 | 3.40 | 1,406,687 |
| 3 | A3 | 50 | 850 | 2,847 | 3.35 | 1,708,119 |
| 4 | B1 | 130 | 1,150 | 3,628 | 3.16 | 5,660,239 |
| 5 | C1 | 25 | 1,511 | 4,521 | 2.99 | 1,356,448 |
| **Total Market Revenue** | | **345** | | | | **$12,422,382** |
| **Averages** | | | **902** | **$3,001** | **$3.33** | |
| BMR | | | | | | |
| 1 | S1 | 14 | 522 | $12,528 | $24.00 | $2,029,480 |
| 2 | A1 | 8 | 690 | 16,560 | 24.00 | 1,490,359 |
| 3 | A3 | 8 | 850 | 18,745 | 22.05 | 1,687,088 |
| 4 | B1 | 20 | 1,150 | 24,616 | 21.40 | 5,760,035 |
| 5 | C1 | 4 | 1,511 | 32,343 | 21.40 | 1,455,420 |
| **Total BMR Revenue** | | **51.75** | | | | **$1,069,065** |
| **Averages** | | | **902** | **$1,722** | **$1.91** | |

| | | | |
|---|---|---|---|
| Total Rental Revenue | | | **$13,491,447** |
| Total Other Income | | | 2,132,604 |
| Concessions | | | - |
| **Gross Potential Rent** | | | **15,624,051** |
| Less: Vacancy | | 5.00% | (781,203) |
| Loss to Lease | | | (87,363) |
| Bad Debt | | 0.00% | - |
| Non Revenue Units | | | - |
| Retail Income | | | - |
| Office Income | | | - |
| **Effective Revenue** | *Monthly Collections* | $1,229,624 | **$14,755,485** |

| Operating Expenses | | Per Unit | Reversion |
|---|---|---|---|
| Personnel | | $2,124 | $842,662 |
| Contract Services | | 335 | 133,052 |
| Utilities | | 671 | 266,104 |
| Make-Ready | | 671 | 266,104 |
| Maintenance | | 727 | 288,279 |
| Marketing | | 279 | 110,877 |
| Administrative | | 224 | 88,701 |
| Management Fee | 2.63% | 979 | 388,456 |
| Insurance | | 246 | 97,571 |
| Property Taxes | | $3,013 | 1,195,408 |
| **Total Operating Expenses** | | **$9,268** | **$3,677,214** |

| | | | | |
|---|---|---|---|---|
| **Net Operating Income** | | | | **$11,078,271** |
| | | | **Cap Rate** | **5.25%** |
| | | **Per S.F.** | **Per Unit** | **Total** |
| Sales Price | | $589.52 | $531,858 | $211,014,691 |
| Sales Cost @ | 0.40% | (2.36) | (2,127) | (844,059) |
| Investment Basis | | (420.68) | (379,532) | (150,579,270) |
| **Net Gain / (Loss)** | | **$166.48** | **$150,199** | **$59,591,362** |

**Reversion Tax Worksheet**

| | Total | Per Unit |
|---|---|---|
| Sales Price | $211,014,691 | $531,858 |
| % Assessed | 69.00% | |
| Assessed Value | 145,600,137 | 366,982 |
| Millage | 0.00850 | |
| Millage annual growth | 0.00% | |
| Property Tax | 1,237,601 | 3,119 |
| Discount | 0.00% | |
| Actual Property Tax Paid | 1,237,601 | 3,119 |
| Fire and Rescue | - | - |
| Personal Property | - | - |
| Other Assessments | - | - |
| **Total Property Taxes** | **$1,237,601** | **$3,119** |

**Reversion vs. Stabilized Assumptions (per unit)**

| | Stabilized | Reversion | Variance |
|---|---|---|---|
| Gross Revenue | $38,615 | $39,600 | $986 |
| Total Rent Loss | (1,986) | (2,409) | (423) |
| Make Ready | 657 | 671 | (14) |
| Insurance | 241 | 246 | (5) |
| Management Fees | 959 | 979 | (20) |
| Property Taxes | 3,181 | 3,119 | 62 |
| **Total NOI** | **$27,320** | **$27,923** | **$603** |

**Return Summary**

| | | | |
|---|---|---|---|
| Levered Quarterly IRR: | 22.73% | Equity Multiple: | 2.45 |
| Levered Monthly IRR: | 22.46% | | |

**Modular HR**

Date Prepared 07.01.12

No. of Units: 396.75

| | COE | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Month** | **Jul-12** | **Aug-12** | **Sep-12** | **Oct-12** | **Nov-12** | **Dec-12** | **Jan-13** | **Feb-13** | **Mar-13** | **Apr-13** | **May-13** | **Jun-13** | **Jul-13** | **Aug-13** | **Sep-13** | **Oct-13** | **Nov-13** | **Dec-13** | **Jan-14** |
| COE Month # | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
| Const Month # | -21 | -20 | -19 | -18 | -17 | -16 | -15 | -14 | -13 | -12 | -11 | -10 | -9 | -8 | -7 | -6 | -5 | -4 | -3 |
| Last & Occupancy | | | | | | | | | | | | | | | | | | | |
| Stabilization | | | | | | | | | | | | | | | | | | | |
| **Soft Cost Draw** | | | | | | | | | | | | | | | | | | | |
| Proforma Draw | 3.6% | 3.6% | 3.6% | 3.6% | 3.6% | 3.6% | 3.6% | 3.6% | 3.6% | 3.6% | 3.6% | 3.6% | 3.6% | 3.6% | 3.6% | 3.6% | 3.6% | 3.6% | 3.6% |
| Reallocation | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| Override | | | | | | | | | | | | | | | | | | | |
| Utilized | 3.6% | 3.6% | 3.6% | 3.6% | 3.6% | 3.6% | 3.6% | 3.6% | 3.6% | 3.6% | 3.6% | 3.6% | 3.6% | 3.6% | 3.6% | 3.6% | 3.6% | 3.6% | 3.6% |
| Cummulative | 3.6% | 7.1% | 10.7% | 14.3% | 17.9% | 21.4% | 25.0% | 28.6% | 32.1% | 35.7% | 39.3% | 42.9% | 46.4% | 50.0% | 53.6% | 57.1% | 60.7% | 64.3% | 67.9% |
| **Hard Cost Draw** | | | | | | | | | | | | | | | | | | | |
| Proforma Draw | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| Reallocation | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| Override | | | | | | | | | | | | | | | | | | | |
| Utilized | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| Cummulative | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| **Units Delivered** | | | | | | | | | | | | | | | | | | | |
| Proforma Delivery | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Override | | | | | | | | | | | | | | | | | | | |
| Utilized | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Cummulative | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Percent of Total | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| **Units Leased** | | | | | | | | | | | | | | | | | | | |
| Available For Lease | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Proforma Leased | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Override | | | | | | | | | | | | | | | | | | | |
| Utilized | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Cummulative | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Percent of Total | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |

| | | | Const Start | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Month** | **Feb-14** | **Mar-14** | **Apr-14** | **May-14** | **Jun-14** | **Jul-14** | **Aug-14** | **Sep-14** | **Oct-14** | **Nov-14** | **Dec-14** | **Jan-15** | **Feb-15** | **Mar-15** | **Apr-15** | **May-15** | **Jun-15** | **Jul-15** | **Aug-15** |
| COE Month # | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 |
| Const Month # | -2 | -1 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 |
| Last & Occupancy | | | | | | | | | | | | | | | | | | | |
| Stabilization | | | | | | | | | | | | | | | | | | | |
| **Soft Cost Draw** | | | | | | | | | | | | | | | | | | | |
| Proforma Draw | 3.6% | 3.6% | 1.3% | 1.3% | 1.3% | 1.3% | 1.3% | 1.3% | 1.3% | 1.3% | 1.3% | 1.3% | 1.3% | 1.3% | 1.3% | 1.3% | 1.3% | 1.3% | 1.3% |
| Reallocation | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| Override | | | | | | | | | | | | | | | | | | | |
| Utilized | 3.6% | 3.6% | 1.3% | 1.3% | 1.3% | 1.3% | 1.3% | 1.3% | 1.3% | 1.3% | 1.3% | 1.3% | 1.3% | 1.3% | 1.3% | 1.3% | 1.3% | 1.3% | 1.3% |
| Cummulative | 71.4% | 75.0% | 76.3% | 77.6% | 78.9% | 80.3% | 81.6% | 82.9% | 84.2% | 85.5% | 86.8% | 88.2% | 89.5% | 90.8% | 92.1% | 93.4% | 94.7% | 96.1% | 97.4% |
| **Hard Cost Draw** | | | | | | | | | | | | | | | | | | | |
| Proforma Draw | 0.0% | 0.0% | 0.0% | 0.9% | 1.7% | 2.6% | 3.9% | 5.2% | 5.5% | 5.5% | 5.5% | 5.5% | 5.5% | 5.5% | 5.5% | 5.5% | 5.5% | 5.5% | 5.5% |
| Reallocation | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| Override | | | | | | | | | | | | | | | | | | | |
| Utilized | 0.0% | 0.0% | 0.0% | 0.9% | 1.7% | 2.6% | 3.9% | 5.2% | 5.5% | 5.5% | 5.5% | 5.5% | 5.5% | 5.5% | 5.5% | 5.5% | 5.5% | 5.5% | 5.5% |
| Cummulative | 0.0% | 0.0% | 0.0% | 0.9% | 2.6% | 5.2% | 9.1% | 14.3% | 19.8% | 25.3% | 30.8% | 36.3% | 41.8% | 47.3% | 52.7% | 58.2% | 63.7% | 69.2% | 74.7% |

| | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Units Delivered** | | | | | | | | | | | | | | | | | | | |
| Proforma Delivery | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Override | | | | | | | | | | | | | | | | | | | |
| Utilized | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Cummulative | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Percent of Total | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| **Units Leased** | | | | | | | | | | | | | | | | | | | |
| Available For Lease | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Proforma Leased | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Override | | | | | | | | | | | | | | | | | | | |
| Utilized | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Cummulative | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Percent of Total | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |

| | | | First Units | | Last Units | | | | | | | | | | | | | Stabilization | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Month** | **Sep-15** | **Oct-15** | **Nov-15** | **Dec-15** | **Jan-16** | **Feb-16** | **Mar-16** | **Apr-16** | **May-16** | **Jun-16** | **Jul-16** | **Aug-16** | **Sep-16** | **Oct-16** | **Nov-16** | **Dec-16** | **Jan-17** | **Feb-17** | **Mar-17** |
| COE Month # | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 |
| Const Month # | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 |
| Last & Occupancy | | | | | 1 | | | | | | | | | | | | | 2 | |
| Stabilization | | | | | | | | | | | | | | | | | | 3 | |
| **Soft Cost Draw** | | | | | | | | | | | | | | | | | | | |
| Proforma Draw | 1.3% | 1.3% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| Reallocation | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| Override | | | | | | | | | | | | | | | | | | | |
| Utilized | 1.3% | 1.3% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| Cummulative | 98.7% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% |
| **Hard Cost Draw** | | | | | | | | | | | | | | | | | | | |
| Proforma Draw | 5.5% | 5.5% | 5.2% | 3.9% | 2.6% | 1.7% | 0.9% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| Reallocation | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| Override | | | | | | | | | | | | | | | | | | | |
| Utilized | 5.5% | 5.5% | 5.2% | 3.9% | 2.6% | 1.7% | 0.9% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| Cummulative | 80.2% | 85.7% | 90.9% | 94.8% | 97.4% | 99.1% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% |
| **Units Delivered** | | | | | | | | | | | | | | | | | | | |
| Proforma Delivery | 0 | 0 | 198 | 198 | 0.75 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Override | | | | | | | | | | | | | | | | | | | |
| Utilized | 0 | 0 | 198 | 198 | 0.75 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Cummulative | 0 | 0 | 198 | 396 | 396.75 | 396.75 | 396.75 | 396.75 | 396.75 | 396.75 | 396.75 | 396.75 | 396.75 | 396.75 | 396.75 | 396.75 | 396.75 | 396.75 | 396.75 |
| Percent of Total | 0% | 0% | 50% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% |
| **Units Leased** | | | | | | | | | | | | | | | | | | | |
| Available For Lease | 0 | 0 | 198 | 371 | 346.75 | 321.75 | 296.75 | 271.75 | 246.75 | 221.75 | 196.75 | 179.75 | 154.75 | 129.75 | 104.75 | 79.75 | 54.75 | 29.75 | 26.75 |
| Proforma Leased | 0 | 0 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 3 | 0 |
| Override | | | | | | | | | | | | | | | | | | | |
| Utilized | 0 | 0 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 3 | 0 |
| Cummulative | 0 | 0 | 25 | 50 | 75 | 100 | 125 | 150 | 175 | 200 | 225 | 250 | 275 | 300 | 325 | 350 | 375 | 378 | 378 |
| Percent of Total | 0% | 0% | 6% | 13% | 19% | 25% | 32% | 38% | 44% | 50% | 57% | 63% | 69% | 76% | 82% | 88% | 95% | 95% | 95% |

## Capital Budget

No. of Units: 397 Apt. Net Square Footage: 357,943

| Account # | | Budget Category | Per Unit | Per Net SF: | Total |
|---|---|---|---|---|---|
| | | **Land Costs** | | | |
| LAND | PPRCE | Purchase Price (includes Earnest Money Deposits) | $50,000 | $55.42 | $19,837,500 |
| LAND | COMMI | Commissions | - | - | - |
| LAND | CLOSE | Closing Costs / Escrow Fees | 762 | 0.85 | 302,519 |
| LAND | TITLE | Title Insurance | 55 | 0.06 | 22,000 |
| LAND | PRTAX | Capitalized Property Taxes | 2,601 | 2.88 | 1,031,793 |
| | | **Total Land Costs** | **$53,608** | **$59.42** | **$21,268,812** |
| | | **Soft Costs** | | | |
| | | **Legal:** | | | |
| LEGAL | LEGAL | General | $756 | $0.84 | $300,000 |
| LEGAL | ZONE | Zoning | 126 | 0.14 | 50,000 |
| | | **Subtotal Legal** | **$882** | **$0.98** | **$350,000** |
| | | | | | |
| | | **Design Costs:** | | | |
| DESGN | CONIN | AIA Inspections | $978 | $1.08 | $388,000 |
| DESGN | APRSL | Consultants | 1,260 | 1.40 | 500,000 |
| DESGN | ARCHT | Architect Fees | 5,293 | 5.87 | 2,100,000 |
| DESGN | ARCHT | Architectural Reimbursables | 378 | 0.42 | 150,000 |
| DESGN | SURVY | As-built Survey | 63 | 0.07 | 25,000 |
| DESGN | BLUEP | Blueprints & Photos | 252 | 0.28 | 100,000 |
| DESGN | CIVIL | Civil Engineering | 605 | 0.67 | 240,000 |
| DESGN | CONIN | Construction Closeout Audit | 76 | 0.08 | 30,000 |
| DESGN | CONIN | Construction Inspections | 378 | 0.42 | 150,000 |
| DESGN | ELECG | Electrical Engineering | 277 | 0.31 | 110,000 |
| DESGN | INTDS | Interior Design Fees | 807 | 0.89 | 320,000 |
| DESGN | LARCH | Landscape Architecture | 567 | 0.63 | 225,000 |
| DESGN | MTEST | Materials Testing | 1,260 | 1.40 | 500,000 |
| DESGN | MECHN | Mechanical Engineering | 391 | 0.43 | 155,000 |
| DESGN | DESGN | Miscellaneous Design Costs | 504 | 0.56 | 200,000 |
| DESGN | ENVIR | Phase I Environmental Report | 25 | 0.03 | 10,000 |
| DESGN | ENVIR | Phase II Environmental Report | 151 | 0.17 | 60,000 |
| DESGN | DESGN | Pre-Development Costs | 252 | 0.28 | 100,000 |
| DESGN | SOILS | Soils Engineering | 466 | 0.52 | 185,000 |
| DESGN | STRUT | Structural Engineering | 857 | 0.95 | 340,000 |
| DESGN | SURVY | Survey | 63 | 0.07 | 25,000 |
| DESGN | TRFIC | Traffic Report | 3 | 0.00 | 1,000 |
| DESGN | ZCNSL | Permit Expeditor | 378 | 0.42 | 150,000 |
| | | **Subtotal Design Costs** | **$15,284** | **$16.94** | **$6,064,000** |
| | | | | | |
| | | **Marketing Costs:** | | | |
| MKFFE | ADVRT | Advertising & Promotion | $630 | $0.70 | $250,000 |
| MKFFE | CLUBH | Clubhouse | 2,520 | 2.79 | 1,000,000 |
| MKFFE | FITNS | Fitness FF&E | 756 | 0.84 | 300,000 |
| MKFFE | BROCH | Graphic Design & Promotion | 441 | 0.49 | 175,000 |
| MRKTG | MAINT | Maintenance FF&E | 227 | 0.25 | 90,000 |
| MRKTG | SIGNG | Marketing Signage | 252 | 0.28 | 100,000 |
| MKFFE | MRKTG | Miscellaneous Marketing | 126 | 0.14 | 50,000 |
| MKFFE | 1BR/2BR | Model FF&E | 315 | 0.35 | 125,000 |
| MRKTG | OFFIC | Office FF&E | 189 | 0.21 | 75,000 |
| MRKTG | POOLF | Pool & Site Furniture | 378 | 0.42 | 150,000 |
| MRKTG | POSTG | Postage & Overnight Delivery | 25 | 0.03 | 10,000 |
| MRKTG | LSTRL | Pre-leasing Trailer | 126 | 0.14 | 50,000 |
| | | **Subtotal Marketing Costs** | **$5,986** | **$6.64** | **$2,375,000** |
| | | | | | |
| | | **Permits & Fees:** | | | |
| PFEES | PLNCK | Plan Check Fees | $126 | $0.14 | $50,000 |
| PFEES | BLDPE | Building Permits & Inspections | 983 | 1.09 | 390,000 |
| PFEES | WATER | Water Fees | 189 | 0.21 | 75,000 |
| PFEES | SEWER | Sewer Fees | 567 | 0.63 | 225,000 |
| PFEES | ELECG | Electrical Fees | 945 | 1.05 | 375,000 |
| PFEES | TRFCF | Traffic Fees | - | - | - |
| PFEES | IMPAC | Village / City Impact Fees | 2,268 | 2.51 | 900,000 |
| PFEES | SCHOL | School Fees | - | - | - |
| PFEES | PFEES | Total Other Impact Fees | - | - | - |
| | | **Subtotal Permits & Fees** | **$5,079** | **$5.63** | **$2,015,000** |
| | | | | | |
| UNCON | CBLIN | Construction Financing Costs | 4,525 | 5.02 | 1,795,306 |
| UNCON | LFEES | Financing Fees & Closing Costs | 12,088 | 13.40 | 4,795,950 |
| | | Land Loan Financing Costs | - | - | - |
| | | Land Loan Financing Fees & Closing Costs | - | - | - |
| UNCON | OVERH | Development Fee | 11,054 | 12.25 | 4,385,804 |
| LEASEUP | LEASUP | Property Operating Costs | 98 | 0.11 | 38,824 |
| | | Operating Deficits | 5,968 | 6.62 | 2,367,841 |
| SCONT | SCONT | Soft Cost Contingency | 2,723 | 3.02 | 1,080,400 |
| | | **Total Soft Costs** | **$63,688** | **$70.59** | **$25,268,125** |
| | | **Hard Costs** | | | |
| HARD | GENRL | Hard Costs General Contractor | $243,558 | $269.96 | $96,631,500 |
| HARD | GENRL | Inflation Factor | 10,881 | 12.06 | 4,316,877 |
| HARD | HCONT | Hard Costs Contingency | 6,361 | 7.05 | 2,523,709 |
| HARD | BRINS | Builder's Risk Insurance | 1,437 | 1.59 | 570,247 |
| HARD | HARD | Hard Costs Other | - | - | - |
| | | **Total Hard Costs** | **$262,237** | **$290.67** | **$104,042,334** |
| | | | | | |
| | | **Total Project Cost** | **$379,532** | **$420.68** | **$150,579,270** |

| Hard Cost GMP Budget<br>TRADE ITEM | GMP |
|---|---|
| Concrete | $5,409,000 |
| Masonry | $2,812,000 |
| Structural Steel, Joists and Metal Deck | $9,612,000 |
| Miscellaneous Metals | $1,060,000 |
| Finish Carpentry and Millwork, Cabinets & Countertops | $4,351,000 |
| Waterproofing | $2,000,000 |
| Spray-on Fireproofing | $660,000 |
| Roofing | $1,430,000 |
| Sheet Metal and Flashings | $300,000 |
| Exterior Metal Siding | $3,847,500 |
| Doors, Frames and Hardware | $1,824,000 |
| Windows and Entry Systems | $4,132,500 |
| Rough Carpenty, Drywall, Sheathing and LGMF | $10,395,000 |
| Ceramic Tile and Stone | $1,485,000 |
| Wood Flooring | $2,214,000 |
| Resilient Flooring & Carpet | $1,672,000 |
| Paint & Decorating | $2,166,000 |
| Specialties | $720,000 |
| Appliances | $1,710,000 |
| Blinds & Shades | $170,000 |
| Elevators and Conveying Systems | $1,500,000 |
| Plumbing | $5,400,000 |
| HVAC | $9,015,500 |
| Fire Protection | $1,976,000 |
| Electrical/Telecommunication Systems | $7,980,000 |
| Security/Intercom Systems (Allowance #1) | $300,000 |
| Earthwork, Site Utilities and Sidewalks | $2,800,000 |
| Lawns & Plantings | $1,800,000 |
| **Total Building and Sitework Improvements** | **$88,741,500** |
| General Conditions | $3,280,000 |
| General Requirements | $1,910,000 |
| Contractor Fee | $1,830,000 |
| **Subtotal** | **$95,761,500** |
| Performance and Payment Bond | $870,000 |
| **Totals** | **$96,631,500** |

## PROPERTY TAX - INCOME CAPITALIZATION
### Modular HR
### At Stabilization - 2012

| | |
|---|---|
| # of Units | 397 |
| Expense Ratio | 26.7% |
| Capitalization Rate | 6.250% |
| Tax Rate | 0.850% |
| Misc. Income | $855,750 |
| Vacancy & Credit Loss | 5.0% |

| **Assessor's Calculation** | **Annual** | **Per Unit** |
|---|---|---|
| Potential Gross Income | $12,084,585 | $30,459 |
| Less: Vacancy & Credit Loss (5%) | (604,229) | (1,523) |
| Effectiv e Gross Income | $11,480,356 | $28,936 |
| Less: Operating Expenses (26.65%) | ($3,059,515) | ($7,711) |
| Plus: Misc. Income | 855,750 | 2,157 |
| NOI Before Taxes | $9,276,591 | $23,381 |
| Cap Rate | 6.250% | |
| Tax Rate | 0.850% | |
| Loaded Cap Rate | 7.100% | |
| Income Value | $130,656,212 | $329,316 |
| Real Estate Taxes | $1,110,578 | $2,799 |
| Personal Property Tax | 0 | 0 |
| Local District Tax | 42,000 | 106 |
| Other | 0 | 0 |
| **Total Real Estate Taxes** | **$1,152,578** | **$2,905** |

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