THE ULTIMATE GUIDE TO

Modular Construction

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Introduction

Constructing a new building is not easy. In fact, it's difficult, expensive, time consuming and stressful. So much so that even seasoned developers find the process daunting.

Historically, a major contributor to the limited construction productivity growth in the U.S. is a lack of improvement in technological capabilities and innovation, production methods and scale.

But that's all changing – and modular construction is one method that has the potential to increase productivity by accelerating construction time and reducing construction costs.

Modular construction is an innovative, sustainable construction delivery method utilizing offsite, lean manufacturing techniques to prefabricate whole building solutions in deliverable module sections. This process permits constructing a building under controlled conditions in a factory, using the same materials and designed to the same building codes and standards as conventionally constructed buildings, but in about half the time.

The process of modular construction is quite different than conventional on-site construction. As a result, owners, architects and builders are sometimes confused by the process.

This guide is intended to help you sort through the confusion, give you an in-depth understanding of the modular construction process, its benefits and challenges, and help you determine if modular construction is right for you.
CHAPTER 1

Modular Construction Defined

In order to better understand the technical aspects of modular construction, we must first understand what it means and how it relates to other methods of construction.

**Stick/Site built** refers to conventional on-site frame construction methods. Buildings are constructed from pieces of wood, concrete, or steel that are delivered to a project site, measured and cut, and then assembled on-site.

**Panelized buildings** are constructed out of wall panels that are manufactured off-site in a factory. Panelized systems may be “open panel” or “closed panel.” Open panel systems include framing and exterior sheathing, while closed panel systems include plumbing, insulation and electric wiring within the panels. Under both systems, the panels are shipped to the site and assembled by use of a crane to set the panels onto a foundation or platform.

**Modular construction** uses an inside-out approach to building. Modular frames are constructed as volumetric boxes, and then finished from the inside-out generally starting with framing, followed by interior surfaces, electrical, plumbing, mechanical, insulation, exterior sheathing, and cladding. This differs from the traditional on-site construction method of outside-in.
CHAPTER 2

History of Modular Construction

The Crystal Palace

Modular construction is not a new concept. The Crystal Palace, which was built for Britain’s Great Exhibition of 1851, is one of the most famous examples of early modular construction. It was designed in less than two weeks, the building used light and inexpensive materials, including iron, wood and glass, and was constructed in only a few months!

After the exhibition, the Palace was even taken apart, piece by piece, and moved to another location.

The first documented prefabricated home was built in the 1830s. John Manning, a London carpenter, wanted to construct a home for his son who was moving from England to Australia, but did not know what materials and supplies his son would find there. Manning built a prefabricated house, which became known as the “Manning Cottage” in pieces so that it could be stored, shipped, and then assembled upon arrival halfway around the world.

This modular technique made its way to the US by the 1840s, when prefabricated buildings helped meet the housing needs of prospectors during the California Gold Rush. By the 1900s, a Chicago builder named Augustine Taylor had devised the balloon-frame method, which allowed walls to be built off site and then transported on-site for speedy assembly.

Catalog Houses

Between 1908 and 1940 Sears Roebuck and Co. sold over 500,000 prefabricated homes through the Sears catalogue that were delivered to customers as mail-order homes using pre-scheduled procedures based on modern mass production.

At the time, these “Catalog Houses” cost less than two-thirds of a conventionally built home, and many of these homes still exist throughout U.S. This demand for prefabricated structures continued into World War II due to the need for mass accommodation for military personnel. To meet this need, “Quonset Huts” (or “Nissen Huts” as they became known as in the U.K.) were introduced. These prefabricated structures – made from corrugated steel – were used across the world for domestic, military, and institutional uses.

Following the end of the World War II, as soldiers were returning, the U.S. experienced a severe housing shortage. As a result of this unprecedented
demand for housing, builders began searching for solutions to increase efficiency and lower the cost of construction.

**Once again, builders turned to prefabrication.** Postwar Europe and Japan had massive rebuilding needs and similarly turned to prefabrication and off-site construction to replace the loss of housing.

### Smart Design for the Masses

Inspired by the Industrial Revolution, architects have long seen Modular Construction as a way to deliver "smart design to the masses". Highly respected architects like Walter Gropius, Buckminster Fuller and Frank Lloyd Wright envisioned the technology and efficiency of assembly line manufacturing as a way to apply mass production to build housing for the masses.

In 1927 Buckminster Fuller designed the "Dymaxion House" which, though never built, was to be shipped in pieces and then assembled on site.

### Modularization Today

Since then, countries around the world have been using prefabricated and modular construction for decades. In fact, 84% of all detached houses built in Sweden are prefabricated. This compares with 5% in the US; 9% in Germany and 20% in the Netherlands, and 28% in Japan.

### The U.S. Modular Construction Industry

Since WWII, the U.S. has seen significant technological innovations giving rise to the U.S. modular construction industry. Advances in software, automation, and Building Information Modeling (BIM) as well as new processes and materials have made it possible to prefabricate and deliver more sophisticated and complex buildings than was previously possible.

As demand began exceeding the supply of existing structures, commercial applications of modular construction began to emerge in the 1970’s, with significant advances through the 2000’s enabling the prefabrication and modularization of hotels, apartment buildings, offices, hospitals and schools.

In the United States the acceptance of prefabrication and modularization is growing, with 49% of healthcare facilities, 42% of college buildings and dorms, and 42% of manufacturing buildings using some form of prefabrication or Modular Construction.
CHAPTER 3

The Time for Modular is Right Now

While offsite Modular Construction has been around for decades, it is now emerging as a critical method for delivering projects faster, safer and cheaper in today’s labor-constrained environment. Today’s construction projects are growing larger and increasingly complex, with many projects facing chronic cost overruns and schedule delays. The construction efficiency crisis has grown so bad that engineering and construction companies have simply come to accept that nothing ever gets built on time or on budget.

Everything but buildings are made in a factory.

Imagine if your suit were made the way we build buildings – outdoors in the rain and snow and mud, upon a scaffold 9-stories in the air, with a different tradesman needed to sew the lining, another for cutting the lapel, and a third for sewing the buttons. And if the lapel subcontractor couldn’t make it to the job site when scheduled, then he throws the entire suit project off schedule 3 weeks or more. And at the end of the process, you get a lower quality product that took longer to produce for considerably more money.

That would be unacceptable – yet that’s exactly how conventional on-site construction works in America today.

Global consulting firm McKinsey perhaps best articulated this dysfunction in a 2017 report, which stated:

“Construction is among the most fragmented industries in the world, the contracting structures governing projects are rife with mismatched risk allocation, and owners and buyers, who are often inexperienced, must navigate a challenging and opaque marketplace. The results are operational failures within firms, including an inefficient design with limited standardization; insufficient time spent on planning and implementing the latest thinking on project management and execution; and a low-skilled workforce.”

The report continues on to declare that the construction industry is “ripe for disruption.”

These conditions, combined with a critical shortage of skilled construction labor, have forced owners and developers to re-examine the status quo. As McKinsey put it:

“There is a need to move away from the hostile contracting environment that characterizes many construction projects to a system focused on collaboration and problem solving... The biggest impact on productivity would come from moving toward thinking about construction as a production system, where possible encouraging off-site manufacture, minimizing on-site construction through the extensive use of pre-cast technology, assembling panels in factories and then finishing units onsite.”


As a result of technological advancements over the past 20 years, modern materials and sophisticated manufacturing processes, modular construction can achieve significant gains in productivity not possible before.

Recently, a committee of experts appointed by the National Research Council identified “greater use of prefabrication/modularization as a key breakthrough opportunity that could significantly improve the efficiency and competitiveness of the U.S. construction industry going forward.”

And according to a recent study by Fails Management Institute (FMI), “Two-thirds of engineering and owner organizations acknowledge that today’s offsite construction environment is much different than it was just three years ago—a shift that’s due mainly to labor shortages and increasing cost and schedule pressures. And while change is happening in pockets across the country—in different market sectors and across a range of project types and sizes—there is no doubt that an underlying transformation is happening and gaining momentum each day.”

Because the construction industry is facing such growing inefficiencies, many believe the time for widespread adoption of modular building techniques is right now.
The Benefits of Modular Construction

Modular construction seeks to effect significant efficiencies in the construction process that should result in significant cost savings, as well as a significantly reduced project completion schedule.

The National Institute of Standards and Technology (NIST) Study on “Advancing The Competitiveness And Productivity Of The U.S. Construction Industry” concluded that “greater use and deployment of [prefabrication] techniques (if used appropriately) can result in shorter schedules, lower project costs, more efficient use of labor, improved quality, and more efficient use of materials.

TIME SAVINGS

The greatest benefit of modularization is in time saved during construction. Modular construction reduces construction time by as much as 50%, which translates to an average of a 9-month construction period as compared to an 18-month construction period, according to the Modular Building Institute (MBI). This is because the modular units can be constructed in the factory all while on-site preparation and construction of the foundation occurs.

COST SAVINGS

Modular construction can save 20% or more compared to the cost of conventional on-site construction. The most significant cost savings result from reduced reliance on expensive on-site labor.

A shorter project schedule, itself, further enhances cost savings. The shorter the construction period, the less construction period carrying costs, such as real estate taxes, insurance, interest and other construction period carrying costs typically referred to as “soft costs”, and the sooner the building can start generating revenue.

Think of a hotel. Let’s say that a particular hotel would take 18 months to construct through conventional methods. If you could cut that in half, to just nine months, then the owner will save months nine months worth of interest on the construction loan, nine months worth of premiums on builder’s risk insurance, nine months worth of real estate taxes, and nine months worth of any other similar construction period expenses.

And if the hotel is opened nine months earlier, that means it can start generating revenue nine months sooner. Together, this could add up to millions of dollars saved – just by choosing the right construction method.

And let us not forget real estate taxes and construction period insurance. On a typical $20 million project one can expect to save $250,000 or more on property taxes and insurance by using modular construction.
Developers also save in interest paid on construction loans and other financing. Construction loans typically account for up to 80% of total project costs and account for a 20-24 month construction duration (including a six month cushion on either side). Using modular construction, the development timeline is cut in half, reducing the interest carry on the construction loan in half. If a $20 million project borrows $16 million in construction financing at 7% interest, this could amount to more than a $1.1 million cost savings.

2 COST COMPARISON TO CONVENTIONAL CONSTRUCTION

Deluxe Modular uses the following Cost Comparison Matrix to help Owners visualize the savings and where they come from. The following is a sample on a 100,000 sq. ft. project in the North East region of the U.S.

<table>
<thead>
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<th>Cost Comparison Matrix - Hard Costs and Other Revenues</th>
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<td>Construction Period Interest</td>
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<td>Builder’s Risk</td>
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<tr>
<td>Total Insurance Costs</td>
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<tr>
<td>Total Revenues from early operations</td>
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<tr>
<td>Construction Period interest</td>
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<tr>
<td>R.E. Taxes</td>
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<tr>
<td>TOTALS</td>
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<td>OVERALL SAVINGS</td>
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<tr>
<td>SAVINGS PER SQ FT</td>
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<tr>
<td>SAVINGS AS % OF PROJECT</td>
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</table>

3 THE IMPACT OF LABOR ON CONSTRUCTION

Over the past 50 years, productivity in construction has fallen significantly with a loss of 19%, while all other non-farm production has increased by 153% during the exact same period.

More than 1.5 million construction workers left the industry as a result of the “Great Recession” with less than half of them have returned to the workforce. And as older construction workers retire fewer new entrants take their place.

Millennials excited to become electricians, plumbers, and carpenters are growing fewer and farther between. Until more high school graduates and young adults entering the workforce start choosing the construction trades, the industry will continue to experience severe labor
QUALITY CONTROL

Because modular construction occurs in a factory, there is improved supervision, access to tools, and on-time material deliveries.

Moreover, most modular manufacturers contract with third party inspection agencies such as NTA or RADCO who not only conduct state inspections but also conduct quality control checks in the factory before the modules are transported to the construction site.

SITE IMPACT

Another important advantage of modular construction is the reduction of negative impacts to a job site and its surrounding neighborhood. Because more than 80% of the building is constructed off-site in a factory, fewer workers are needed on the job-site for a shorter time. Therefore, modular construction sites are quieter, experience much less traffic (of workers and material deliveries), are significantly less chaotic, have limited need for heavy equipment on-site and cause considerably less impact to the surrounding community. This translates into a massive reduction in time neighbors spend being exposed to the nuisance of a construction site.

ENVIRONMENTAL SUSTAINABILITY

Conventional construction sites are notorious for the enormous material waste they generate. The construction industry is the world’s single largest consumer of natural resources and materials, with construction and demolition producing 40% of all solid waste, much of it going into landfills.

Consider the way in which buildings are typically constructed and it should come as no surprise that so many materials are wasted. Imagine a typical construction worker – up on a scaffold, nine stories in the air, on a rainy, windy day, who he needs an 8-foot stud. Instead of going all the way down to the ground, hunting for the right one in the mud and going all the way back up, he sees a 12-foot stud, likely brought there by another construction worker for later use. So our typical construction worker simply grabs that near-by 12-foot stud, saws four feet off of it, and throws the “waste” into a dumpster.

When building in a controlled environment, however, there are fewer opportunities to waste materials unnecessarily and more opportunities to recycle and reuse discarded materials. Because modular buildings are designed using BIM technology, each component is precision cut, significantly reducing the likelihood of waste resulting from inaccurate measurement.

MATERIAL USE AND STANDARDIZATION

Larger modular manufacturers are able to negotiate lower pricing due to volume and standardization. Many modular manufacturers handle all of their own design work giving them the ability of standardizing systems, components and assemblies, and specifying their standards for fabrication – always using the same systems, components, screws, bolts, fastening modalities and the like. In this way they are able to negotiate better pricing and have the ability to drive down the cost of the building.

By contrast, a site-built contractor is at the mercy of third party architects, structural and MEP engineers who specify everything from mechanical and structural systems, down to what type of bolts are used, and is, therefore, less able to negotiate pricing discounts for volume.

Moreover, to justify their design fees, architects and engineers approach each building as “unique” or “bespoke”, designing elements that significantly increase the price of materials and require a significant, time-consuming learning curve on construction process.
EFFICIENCY WITHOUT SACRIFICING DESIGN

High quality modular manufacturers maintain their own design staffs with in-house architects and engineers who specialize in modular construction. Early modular buildings from the 70’s through the 90’s were usually designed to be functional and cheap, and suffered from a lack of great architecture.

That is no longer true.

Sophisticated modular manufacturers have made great design and aesthetics an important component of their business strategy. Some manufacturers have gone so far as to hire top-notch architects from world famous so-called “star-chitect” firms, and have made enormous advances in modular design.

Today, modular buildings can be designed to meet the exacting standards of even the most demanding clients.
The Four Most Important Considerations in Modular Construction

There are four areas of consideration, each with its own set of questions, which may significantly impact the success of any modular construction project, where making the correct decision at the right time will reduce risk and enhance success.

1. THE PRE-CONSTRUCTION DESIGN PROCESS
   - Who should design the building?
   - What type of design agreement should be used?
   - What is the designer’s scope of work?
   - When should they be brought on board and who should they be coordinating with?

2. THE STRUCTURAL SYSTEM
   - What is the right structural system to use for this modular building?
   - Is it going to be panelized or modularized?
   - Should it be built of wood or steel, and why?

3. THE MODULAR MANUFACTURER
   - Who should build the building?
   - What attributes are needed and how should one go about selecting the right manufacture?

4. THE TYPE OF CONSTRUCTION CONTRACT
   - What is the appropriate construction contract type for this project?
   - Should the building be built as a turnkey project by the modular manufacturer or should there be a third-party contractor brought in to undertake on-site construction?
1. The Pre-Construction Design Process

To realize the benefits of modular construction, developers should make the decision on whether to use modular construction early in the process, and most certainly before any construction plans are drawn. All too often a developer commences a project the conventional route and retains the team of design professionals to commence designing a building without giving much thought as to whether the building will be built modularly off-site or conventionally on-site.

The idea that it is simple to change methods later on without complications is not correct. That is because the way conventional buildings are designed to be built – from the outside-in – requires an entirely different type of design modality than the way modular buildings are built – from the inside-out.

Unlike when using stick built construction, developers cannot change small details of the project throughout the construction phase. To realize the benefits of modular, developers and designers must plan to use modular construction from the outset and commit to a building design earlier than in conventional construction.

Unfortunately, it is usually late in the process, often not until spending three to six months or longer designing traditional plans, that developers realize that those plans are incompatible with modularization. That’s because the foundation and platform or plinth on which the modular units will be assembled needs to be designed to accept the structural point loads of the modular units. Therefore designing the footings and foundations before knowing which modular structural system will be used, will most likely render the plans useless.
2. The Structural System

Because it is important to design the building as a modular building from the start, one must determine which structural system is to be used before they start the drawings.

**PANELIZATION OR MODULARIZATION**

When deciding on structural systems, the first question to ask is: Is it going to be panelized or modularized?

Prefab, or “Prefab” for short, is a broad category that refers to a construction process where some building elements are built off-site and when completed, shipped to a construction site for installation on that site.

There are many subcategories of construction grouped together under the “Prefab” banner. Each refers to varying degrees of prefabricating or assembling building components at off-site locations, while site-work to accept those components is simultaneous underway.

Two of the most common subcategories of prefabrication are panelization and modularization.

**Panelization**

- Panelization is a construction method where the structural components of a building, such as walls, roofs and floor systems are constructed off-site in a factory and delivered to the job site to be incorporated into the building, and finished conventionally on-site. Generally the panels are structural, and have very little infrastructure or other components built into them.

- The panels are generally “bare” meaning that they will include the structural members pre-built so that a wall or floor can come off a truck and be placed into the building. Once in place, these panels need to be connected or fastened to other structural components in the field, and generally finished in a conventional way. Wall finishes, plumbing fixtures, electric and other infrastructure are usually not pre-installed, and need to be installed, connected and finished in the field. Panelized buildings therefore require a considerable amount of on-site work, but less work than if it were all stick-built in the field. This system works best for buildings that require wide open spaces and high ceilings.

**Modularization**

- Modularization is a construction method where an entire unit of a building is constructed off-site, rather than smaller, structural components as with panelization. Modular units require the least amount of on-site construction time, as all plumbing, electrical, and even design finishes have typically already been installed in the facility. This leaves only the task of assembling the modular units together to form a completed building.

- Modular buildings are very versatile and can be designed and built to serve virtually any function. They are particularly well suited, though, for buildings such as hotels, apartments, student housing, and any other types that typically consist of many repetitive units serving similar functions.

With this type of modular construction, you can complete an apartment or hotel room in the factory, and ship it to the job site complete with bed bolted to the floor, towels and soap in the bathroom. In this way, no one needs to “fit-out”, clean or prepare any hotel room for occupancy. The only “unfinished” areas left to complete on-site are the hallways, where all inter-module connections can be made in the field. With modularization, the hotel owners can significantly reduce the time before they are able to open the doors and get the cash registers ringing, all while getting there at a lower cost than conventional construction.
As modular buildings spend more time in off-site facilities during the construction process, the conditions are under even greater control for a larger portion of the entire process, which results in the greatest efficiency and quality of any of the prefabrication techniques for large-scale commercial construction.

**WOOD OR STEEL**

Once an owner has determined whether to use pannelization or modularization, the next most important decision necessary is to finalize the structural framing system. Structural framing systems can be designed to satisfy building code requirements using structural steel, concrete and wood. Both panelization and modularization can be accomplished with either material.

Which material is chosen for a building’s structural framing system impacts the resilience of the structure by reducing the cost of the risk associated with structure’s ability to absorb and recover from the stress of an extreme event.

When assessing the resilience of a material the primary attributes of the material must be evaluated. For structural framing materials like structural steel, concrete or wood these would include durability, strength, elasticity, combustibility and resistance to decomposition.

Durability is the ability of the material to withstand outside forces in a manner which results in minimal wear, fatigue or damage. Of the major building materials wood was ranked last in durability in a survey of 910 design and construction professionals conducted by FMI. Both concrete and steel were rated highly with steel’s durability considered its leading benefit.

According to that study, wood has certain limitations not shared by steel or concrete. Because wood can burn, it can not be used for any structure that must be "non-combustible." Typically that limits wood’s use to buildings that are less than five stories. Wood cannot be used for buildings of public assembly, hospitals and many other classifications of buildings. Moreover, while wood is cheaper than steel, wood warps, rots, deteriorates and releases gases into the environment.

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<thead>
<tr>
<th></th>
<th>Compressive Strength</th>
<th>Tensile Strength</th>
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<td></td>
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<td>Hardwoods</td>
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<td>Sofwoods</td>
<td>5 – 8 ksi</td>
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<tr>
<td>Concrete</td>
<td>5 ksi (High Strength 15 ksi)</td>
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<tr>
<td>Structural Steel</td>
<td>50 ksi (as high as 70 ksi)</td>
<td>50 ksi (as high as 70 ksi)</td>
</tr>
</tbody>
</table>

Like wood, concrete also has its limitations. Concrete is heavy, which makes it difficult to transport, and requires proper curing time before additional construction or weight can be placed on it. This typically slows down a construction process. It also requires steel reinforcements either in columns and/or beams, as well as through steel rebar cut and bent into proper shape and installed within the cavity where the concrete will be poured.

For these reasons, steel is considered the superior choice for high-quality, modular structures.
TYPES OF STEEL

When it comes to steel, there are two framing system choices – structural steel, commonly known as “black iron”, or light-gauge stud framing, made of cold rolled steel. The primary difference between the two structural systems is the height of the structures they can support.

Light gauge steel framing is effectively a noncombustible steel substitute for traditional wood stud framing, which can generally be used for buildings as tall as eight stories, but not taller. To go above eight stories, one would need to use structural steel or black iron.

Of the materials used for structural framing systems, structural steel has the greatest level of resilience relative to extreme events. This is verified by significantly lower Builder’s Risk and All Risk premiums for structural steel framing systems compared to concrete or wood. The reasons for these lower rates and the greater resilience of buildings built with structural steel is structural steel’s inherent durability, strength, elasticity, non-combustibility, and resistance to decomposition.
3. The Modular Manufacturer

The next most important decision one needs to make early in the process is which modular manufacturer to select. Like everything else in life, not all modular manufacturers are the same. Today there are less than 100 modular manufacturers in the United States, with roughly 90% of them only building with wood. These modular manufacturers focus primarily on the single-family modular home market, and sell to a network of dealers/contractors who transact with the public and handle all of the land-use and on-site construction work, purchase the modular units from the modular manufacturer, and generally also handle all of the assembly, inter-module connections and finishes.

Some wood modular manufacturers have recently sought to enter the commercial construction market by offering developers the opportunity to use their wood products for non-combustible buildings of up to five stories. These modular manufacturers generally do not have in-house design teams, mostly operate out of smaller, less automated facilities, and view themselves as a subcontractor to a contractor, who is was always needed in order to provide the on-site construction services.

The other 10% are the modular manufacturers in the U.S. that are able to use steel. Of those, only a handful have the experience, capacity capability of producing high-quality black iron-based structural steel for modular buildings. Deluxe Modular is one of them.

Therefore, an important question to ask when considering a potential manufacturer is: Can this modular manufacturer produce the structural framing system the developer/owner wishes to use for this building?

In comparing and contrasting the ultimate universe of possible manufacturers, one needs to consider the following:

- The location of the factory and its ability to deliver to the job-site
- The experience of the modular manufacturer
- The capacity of the modular manufacturer
- The bonding capacity of the modular manufacturer
- The design staff of the modular manufacturer
- The modular manufacturer’s ability to handle the entire pre-construction process, including design
- The modular manufacturer’s ability to handle the on-site construction
- The types of projects they have successfully completed
- If you can work with their team in a cooperative manner
4. The Type of Construction Contract

Finally, after selecting the modular manufacturer, one needs to consider how to manage the pre-construction and construction processes. This usually boils down to determining who will design the building, who will permit the building, who will construct the building and what modes of contracts will be used.

One must determine whether they are seeking a single turnkey approach to the building – where one company handles all aspects of construction, including both the on-site work as well as the off-site work, or whether to use two separate teams – one to build the on-site work and the other to manufacture the module units.

Some owner/developers want a single source responsible for everything, from design through permitting, construction and completion. Some have already brought on a contractor and wish for them to handle the on-site work, and will seek a separate manufacturer to handle the modular units.

DESIGN-BUILD

Design–build is a project delivery system used in the construction industry. It is a method to deliver a project in which the design and construction services are contracted by a single entity known as the design–builder or design–build contractor.

This would entail all of the design work, on-site work, modular production and off-site work, all being handled by a single company. Finding a modular manufacturer, like Deluxe, that has the expertise, experience and staff – including design professionals, on-site construction capability and off-site modular construction – all in one place, with responsibility in the hands of one team – will usually save a developer/owner much aggravation and frustration, as well as enhance efficiency and complete the project on-time and within budget. Which is becoming a more and more elusive goal.
CHAPTER 6

Challenges in Modular Construction

Modular construction is a revolutionary process that can save significant time and money. There are, however, certain characteristics of the method that developers should be aware of before selecting this option.

CAPITALIZATION

Factory manufactured buildings require large upfront capital investment to procure materials in advance of manufacturing and to deliver modules on schedule. This is a challenge not only for the manufacturer but for the developer, as well. The issue of who should provide the upfront capital can create complications when different parties have different, sometimes conflicting, motivations and constraints.

Modular manufacturers ask for as much as 50% of the total project cost upfront to finance procurement and production, and most developers consider this as too high. Moreover many conventional construction lenders will not release construction draws until the modules arrive on-site. As a result the up-front capital investment generally has to be funded by the developer or his/her equity investors. Developers and general contractors generally are willing to front a small deposit of 10-25% of the project cost, and view the manufacturer as responsible for financing procurement and production.

By contrast, modular manufacturers correctly point out that production begins as much as six months before the first module is delivered on site and material procurement should start 6-9 weeks before module production begins. This puts the burden to purchase and pay for materials several weeks before the modules start production and then pay for labor throughout the months it takes to produce the modules unfairly on the modular manufacturer.

The challenge of upfront capitalization is perhaps the largest barrier for the widespread adoption of modular construction. Developers should be prepared to put down a deposit of 10-25% of the manufacturing contract as early as 6 months in advance of the production of modules. Although this presents a risk to the developer, there are ways to protect against that risk by transferring title to the materials procured to the developer, and to title the modules to the developer when still at the factory.

Banks generally raise two concerns: first, they want the ability to identify collateral in a manufacturing facility where the same materials could be used for multiple projects. One possible solution would be for the modular manufacturers to establish itemized and traceable inventory logs to establish which material was procured for which project. Second, banks are concerned that if the modular manufacturer goes out of business that the building will not be completed.

Many financial institutions are beginning to understand this dilemma, and the more progressive ones are reconfiguring the model of construction financing to allow for release of substantial funding (sometimes 50% of the overall modular production budget) during the predevelopment material procurement and production phase, and have worked with manufacturers to establish methods to guaranty completion of construction.
EARLY COMMITMENT TO DESIGN

In traditional, on-site construction, developers and architects are able to make changes to the design and construction of the project down to the last possible minute. Modular manufacturing requires all parties to commit to a design before the modules are produced in the factory. If changes are made to the design after production has commenced modules may have to run back through the line to be reworked, which increases the time on the line, reduces efficiency, and increases costs. It is therefore important to lock-in on a design up-front, and once committed, not make changes.

While this early commitment might be a challenge for some, it is one of the key reasons why modular construction is capable of such robust savings.

PERMITTING AND INSPECTION

In many states there is a state engineering permitting agency that certifies code compliance of modular construction. The state permitting and inspection process is in addition to local jurisdictional inspections and code compliance review with respect to on-site work.

This dual process can sometimes cause confusion. If the modular manufacturer undertakes a project on a “Design-Build” basis, the manufacturer takes on all design services, except for civil engineering and surveying, and will apply for the permits and inspections both state and local.

However, when the owner/developer uses their outside design professionals to design the building (whether before or after the decision to go modular has been made), it generally becomes a matter of negotiation as to who’s design professionals are responsible for what services. In such cases, it is not unusual for the owner/developer to design all on-site construction and file for local building permits for both the on-site work and off-site work, while the module manufacturer is responsible for obtaining state permits for the modules themselves.

ADDITIONAL MATERIAL

Modular units generally require between 8% and 10% more materials than traditional construction to ensure their structural strength.

CRANES AND CONSTRAINTS

Once they arrive on the site, the modules must be lifted and stacked onto the foundation or platform built to accept them. This typically requires the use of a crane. These cranes can weigh in between 80 and 160 tons, depending on the size of the modules they’re lifting and the distance from the base of the crane that the modules must travel. With a price tag of $10,000 per day or more, these industrial cranes can be one of the largest expenses associated with modular construction.

Another important consideration is the ability to store modules on site while they wait to be hoisted and assembled. Generally, an experienced rigger can lift and place 4 – 10 modules per day. An ideal project site would have storage capacity for 50 modules within the crane’s distance of the project. This estimate does not factor in space needed for mobilization, positioning, loading, unloading, and hoisting the modules into place.
Conclusion

For many, building a new building – from the ground up – one that reflects their organization’s goals, desires, and needs is truly exciting. We don’t often get a chance to watch as our ideas go from concept to drawings to reality – and when complete, we can delight in our achievement.

But the process of getting there can be a challenge.

Identifying new, tech-driven and efficient construction options, such as modular construction can help simplify the process.

Understanding the modular construction process and its benefits, bringing on the design team as early as possible, identifying the right modular manufacturer and determining if one company or multiple companies will be involved in the construction process, and through what type of contractual arrangement, will undoubtedly have major impact on the successful outcome of any project.

ABOUT DELUXE MODULAR

For over 50 years, our goal has been to streamline the building process and make it stress-free for our clients. Our company motto is “Construction Simplified,” and for us, it is not just words – it’s our mission. Deluxe challenges the conventional wisdom that there is only one way to build a building. We constantly re-examine each component of the construction process and ask ourselves, “Is there a different, better, more efficient and less wasteful way to accomplish better results?”

Then we put our outstanding team of professionals to the task of re-imagining innovative ways to remove friction from the process, create efficiencies, and deliver your dream building on-time and within budget. It is with this philosophy that we created the Deluxe Modular process, to get your new building designed, built, and completed with the greatest efficiency and the least stress.

Contact us today to find out how our innovative, one-stop, state-of-the-art, modular construction process can save you 50% of the time and 20% of the cost on your next large-scale, commercial building project.