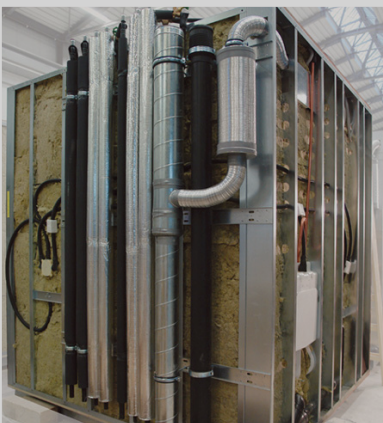
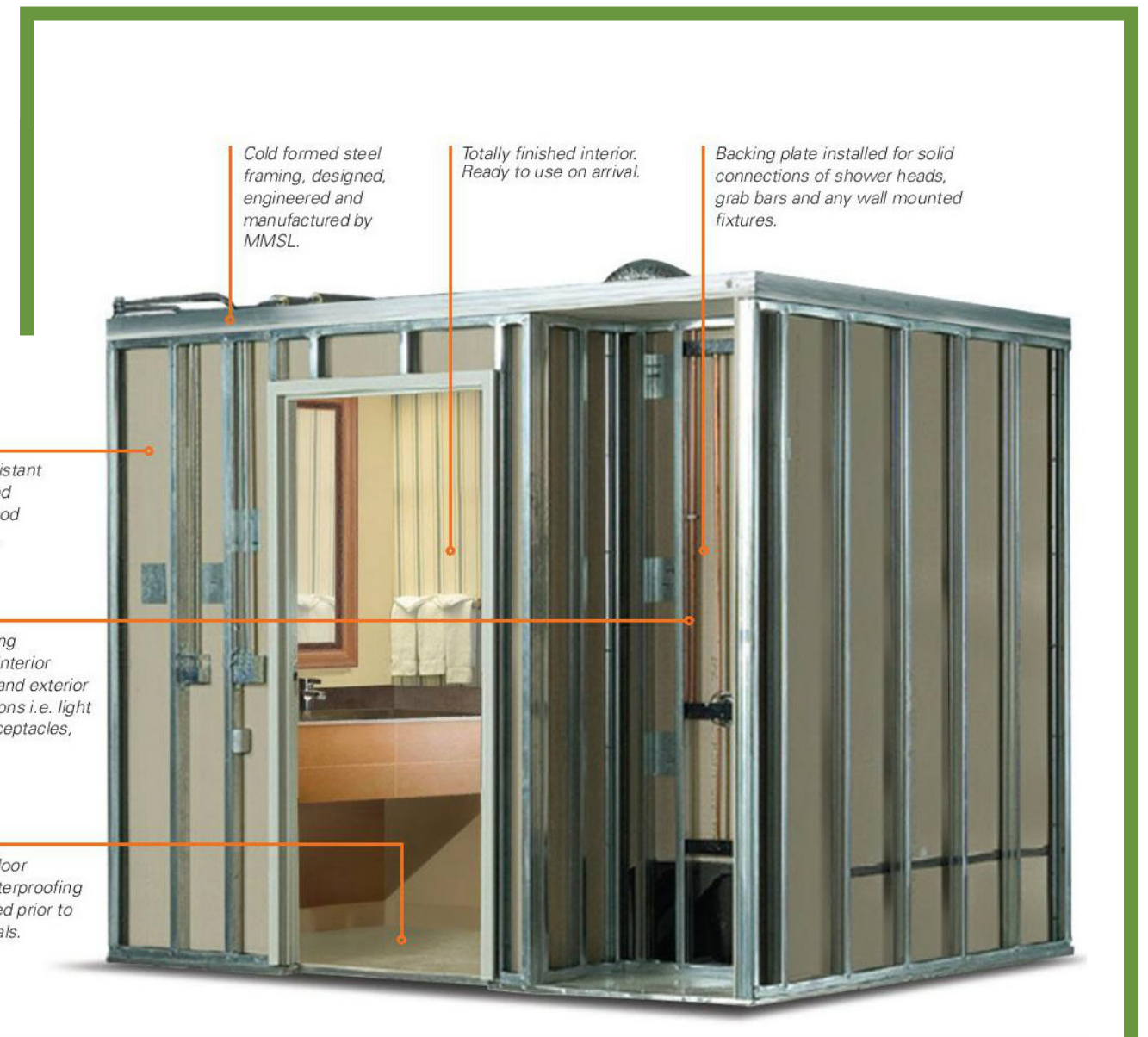




SAVING TIME WITH MODULAR BATHROOM PODS



Bathroom Pods AT A GLANCE



Bathroom pods contribute to a cleaner and safer work environment, help reduce labor, materials, waste, and costs, and increase speed to occupancy.

ACKNOWLEDGEMENTS

THANK YOU, CONTRIBUTORS

INTELLIGENT OFFSITE
Intelligentoffsite.com



PIVOTEK
PIVOTek.net



EASY BUILDING SOLUTIONS
Easybuildingsolutions.com



PUDA INDUSTRIAL CO.
Puda.com.tw



BLOX MODULAR
Bloxbuilt.com



COPYRIGHT © 2017

No portion of this document may be reproduced or altered without the written permission of the Modular Building Institute.

Prepared by:
Modular Building Institute Staff



CONTENTS

Introduction	9
Are Bathroom Pods Right for Your Project?	11
Benefits to Choosing Pods	13
Bathroom Pod Costs	15
Installation	17
Who Benefits from Bathroom Pods?	19
Case Studies	20
References	29

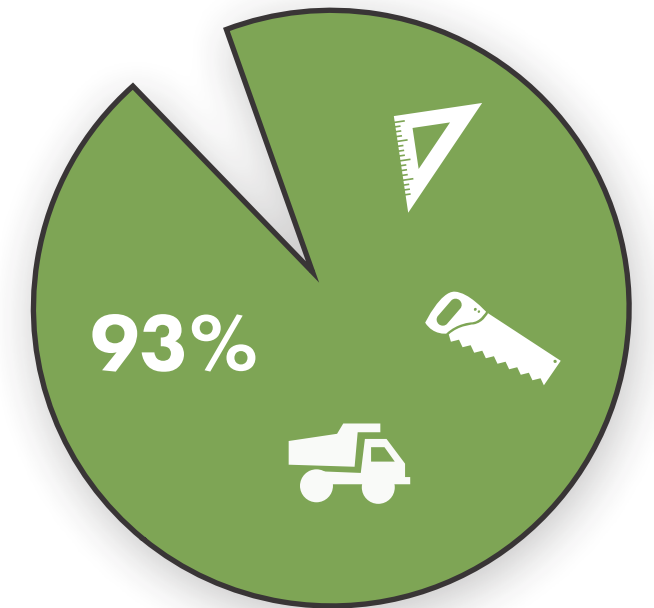
INTRODUCTION

Consider all the things surrounding you in this moment that are made in a factory setting. The computer you may be reading this on, the car you drive in everyday, the desk that you work from, whether at work or home, all of these items were manufactured in a factory. Now imagine if all these products that make your life easier were created outside in the rain, heat, and snow. Would you expect a high-quality product? Would you pay a tenth of the price for these products if you were told they were made out in the rain? Probably not. For a fine-tuned, high-quality product you would expect it to be created in a climate-controlled environment with little to no distractions.

Offsite construction, such as bathroom pods, is completed in a factory, it capitalizes on the ability to move product in controlled manufacturing conditions, and on tight inventory control and project schedules. It is inherently waste conscious and can have minimum site impact if delivered carefully and strategically with respect to site constraints.

Examples in which offsite construction can be incorporated into site construction include projects with tight deadlines, those built in secure environments, those where weather may impede construction, and those needing repetitive interior structures.

This white paper focuses on the interspersion of bathroom pods into traditional construction methods. We will discuss how to know if bathroom pods are ideal for your project, the benefits of bathroom pods, and provide case study examples of successful bathroom pod implementations.



93% of respondents in the architect, engineer, contractor, and owner fields said they had implemented some form of offsite construction in the past 12 months. (Source NIBS Survey)

Paul Teicholz, at the Center for Integrated Facility Engineering (CIFE) at Stanford University said “Contractors have made greater use of offsite components which take advantage of factory conditions and specialized equipment. Clearly this has allowed for higher quality and lower cost production of components, as compared to on-site work. Although the cost of these components is included in our construction cost data, the labor is not. This tends to make on-site construction appear better than it actually is.”

Read on to discover more about bathroom pods and how they can help complete your project on time and on schedule.

ARE BATHROOM PODS RIGHT FOR YOUR PROJECT?

On construction projects, many elements are repetitive with consistent quality and finishes are highly sought after for a successful project.

Bathrooms built in a factory setting will offer you fewer defects. This offsite construction method also allows the bathroom pod manufacturer the ability to research and implement aesthetic and functional innovations to better improve the quality of the bathroom pod.

Using bathroom pods lowers construction costs by reducing construction time, improving quality, and eliminating the bathroom defects list. With traditional building, a multitude of trades need to be organized to realize the bathroom design. This requires a high degree of supervision and management on site to ensure correct sequencing and quality of work from plumbers, electricians, tilers, floor layers, sealant applicators, decorators, glaziers, carpenters, and other specialists.

Bathroom pods do away with most of these issues and although the capital cost may not be less than site-constructed bathrooms, savings from waste and improved quality result in less snagging and better performance in use. More significantly, reduced construction times mean earlier income streams from the project.



MARKETS SERVED

Hospitality
Student Housing
Healthcare
Multi-Family

As with any innovation, there are specific situations that highlight the efficiency of a particular solution over others. Because of their small size and numerous necessary trades, bathrooms are a natural way for a contractor, builder or developer to dip a toe into the water of modular or in-factory construction.

Through palletizing mechanical equipment (bringing complex mechanical equipment into a building permanently mounted on a skid), most builders are already using in-factory construction efficiencies in lower profile areas of the building, without ever realizing how revolutionary this is. Here are some indicators to look for when considering the use of bathroom pods as part of your building process:

REPEATABLE COMPONENTS: Buildings such as hospitals, hotels, and housing are ideal for the use of prefabricated building components, such as bathrooms, kitchen, and headwalls.

SIZE: Bathroom pods must be trailered to the job site, therefore, size is an important consideration

STACKING: Repeatable components that are located in a stacked configuration increases efficiency of installation and connection to mechanical, electrical, and plumbing systems.

CLEARANCE: Large repeatable components must be delivered to the jobsite, raised to the final floor, moved across the floor into final position, and lowered into place without interference. The route these components take is an important consideration.



BENEFITS TO CHOOSING PODS

Choosing to use bathroom pods can lead to real benefits realized in purchasing, design, production, quality control, and shortened completion times.

PURCHASING: With a focus on similar bathrooms, i.e., hospitality, student housing, senior living, or multi-family the bathroom pod manufacturing purchasing agent has the opportunity to purchase in bulk or even custom manufacture components that fit their specialty. This is especially valuable to prototype or repetitive clients who wish to work through the details of their bathrooms only once and not with every general contractor, sub contractor and supplier in every location. Therefore, time, cost, and frustration is saved for the client.

DESIGN: Building with a bathroom pod requires specific changes to the framing, dimensions of the bathroom and building and (very importantly) to the inspection process. With multiple iterations of a bathroom pod, these initial expenses will be minimized. With enough units, a sample bathroom pod can be pre-produced for client comments and acceptance before ordering is completed.

It is very difficult to successfully implement a bathroom pod program if the idea is not part of the initial design. In order to be lifted and moved around, the bathroom pod requires its own self-supporting framing that frequently needs to be set into a different type of framing system. If not part of the initial designs, this requires unwanted changes to interior spaces or other difficulties.

QUALITY CONTROL: The best cars are made in a controlled factory environment, not in the dealership's parking lot. As construction managers and architects become more comfortable with prefabrication and its areas of application, bathroom pods will become more effective at delivering higher quality and more profitable outcomes than traditional on-site builds. Quality that is derived from best practices in manufacturing, all in a controlled factory environment, not a temporary facility, where repeatable functions can be monitored and scrutinized for the utmost consistency.



SHORTENED COMPLETION TIME: This is the big differentiator where finishing the bathrooms is traditionally on the critical path for completion. An 80-room hotel fits this where a 100,000-square foot warehouse with a single bathroom may not. The bathroom pod manufacturer will be producing and finishing a bathroom while the dirt is still being moved on-site. With properly routed and bundled utilities, the units can be very quickly connected into the larger building with a lower level of skill required.

OVERHEAD SAVINGS: Building bathrooms on-site requires the general contractor to coordinate 5 specialty trades, each of which is dependent upon the other to do their jobs. You also have the “it was not me” scenario when it comes to damage. Eliminating all this time and effort helps site supervisors become much more effective at managing the construction process. Bathroom pods also reduce the amount of site waste, electricity, material handling equipment, and other resources that must be used to support the site. Using bathroom pods can also cut pre-opening room cleaning.

WORK AROUND LABOR SHORTAGE: Is there enough cost effective trained labor available? Naturally, bathroom pods have their biggest impact in areas with high labor costs and a shortage of skilled tradesmen. That would be remote sites and urban areas.

Factory operations are up to 250% more efficient than the same activity carried out on-site.

Skilled labor and construction shortage is a problem that is not going away. For example, the 2015 Worker Shortage Survey Analysis by the Associated General Contractors of America found that 73% of survey respondents said carpenters were in short supply and 60% said electricians. Not only does this make it extremely difficult to find reliable on-site workers, but it also impacts the cost of employing these skilled laborers.

SUSTAINABILITY: Factory manufacturing is inherently less wasteful than traditional forms of construction and thus more sustainable. Factory waste material is typically less than 1.5% compared with 7%+ on a traditional construction site and recycling of waste is more reliably controlled in a factory environment than it is on-site.

Recent reporting from the Waste & Resources Action Program (WRAP) shows that a 90-percent waste reduction can be achieved by increasing the use of offsite construction.



BATHROOM POD COSTS COMPARED TO SITE-BUILT

There is no such thing as a standard bathroom pod; what you specify is what you get. Bathroom pods will cost about the same as site-built bathrooms on a direct cost basis. This alone is a significant value because bathroom pods are built to a much higher level of quality than can be achieved in site built construction. For example, pod manufacturers do tanking on their walls and floors as a standard, very little consideration is given to that method in traditional construction.

When you compare the cost of bathroom pods to site-built construction, it is important to make sure that you get an accurate estimate of what site-built bathrooms actually cost. There are some key factors to consider when calculating costs.

COMPARE LIKE FOR LIKE

A hurdle with many potential bathroom pod users is the failure to include all materials when estimating the cost of site building a bathroom. Bathroom pod manufacturers will provide a detailed list of all materials included in a bathroom in their estimate. Compare the manufacturers detailed estimate to ensure that all the right materials were included for the site-built estimate.

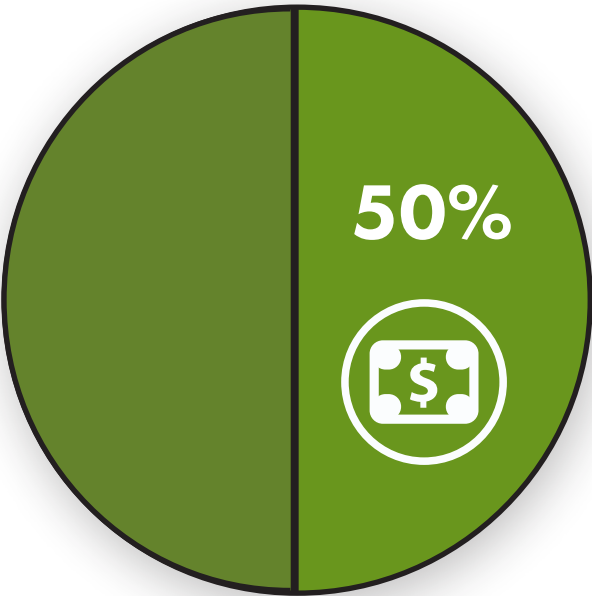
INCLUDE INSTALLATION COSTS

Ensure that the site built cost estimate includes the costs of installation. For example, a granite vanity cost must include the cost of freight, blocking, handling, and installation, as well as the cost of templating, which happens on most traditional builds, not just the cost for the purchased granite itself. The pod manufacturer helps you calculate this cost by providing an estimate for the installed cost of each component.

BEST PRACTICES

The best approach when getting estimates is to make an informed decision before going out to bid. You will be able to incorporate the bathroom pods specifications in to the bid documents and evaluate the cost per room, as you would with site-built construction. This straightforward proposition only requires a correct scope of work for the major trades involved in the connection of the bathroom.

Bathroom pods are more consistent in quality and finish, are an integral part of faster ROIs, shorter financing terms, and greater overall production bandwidth that is becoming more of a standard for good reason. You don’t order your PTACs in parts to be put together, and a complex small space like a bathroom is, for all practical matters, highly comparable.



50% of respondents said cost-effectiveness was an actual benefit of offsite construction. (Source NIBS Survey)

HOW BATHROOM PODS GET INSTALLED

The use of bathroom pods greatly reduces the amount of work on-site. It also reduces the amount of on-site coordination typically required for multiple trades to work in one area. The U.S. construction industry is under even more pressure to build more quickly and reduce costs even as materials climb and skilled labor is harder to find. Innovative solutions such as bathroom pods provide an opportunity to escalate the pace of change needed to overcome industry challenges.

There are more than 250,000 pods manufactured globally each year.

INSTALLATION PROCESS

While bathroom pod manufacturers have custom and proprietary designs, the general installation of bathroom pods into a project site occur in the same fashion.

Bathroom pod installation can be performed in many ways, but all methods are straightforward, repeatable, and can be performed by a contractor chosen by the construction manager. The process can even loosely be compared to hooking up a major appliance.

INSPECTION

During the design process, bathroom pod manufacturers will review shop drawings and submittals with local inspectors to ensure all needs are being met. Delivery and installation logistics are usually discussed during this review process to develop an inspection strategy at each stage of the bathroom pod's development.

DELIVERY

Delivery of the bathroom pods will be carefully planned around the project schedule. They will arrive and be set in the building structure before the exterior facade goes up. Pods can be shipped on open-air or enclosed trucks. Site restrictions and the size of the bathroom pods will determine the mode of transportation.





QUALITY ASSURANCE/ QUALITY CONTROL

A final on-site inspection will take place after the bathroom pod is installed and connected to all building systems. Upon the final inspection, the bathroom pod manufacturer will usually work with the client to ensure all needs were met.



Bathroom pod delivery can occur all at once or in phases floor-by-floor or section-by-section.

Upon delivery to the project site, bathroom pods can be offloaded with cranes and hoisted into the building structure for complete installation. Many bathroom pod manufacturers provide any specialized equipment required for staging the pod for installation. Bathroom pods generally come wrapped and protected from outside elements. This wrapping allows the pods to remain in pre-determined areas without interference with framing and other construction activities.

FINAL CONNECTIONS

Mechanics and partition walls are installed before the bathroom pods are slid into place.

The bathroom pod can have simple final connections through waste, mechanical, water, and electrical.



WHO BENEFITS FROM BATHROOM PODS?



DEVELOPERS

With a compressed project timeline, developers will benefit from a quicker time to market. Bathroom pods eliminate the complexity of delegating to multiple trades and ensure a high quality product. The higher return on investment makes the addition of bathroom pods a sound investment.



CONTRACTORS

Bringing together all required trades in a controlled factory environment lessens the need for delays and reworking that would typically occur on-site. The factory setting allows for required construction building codes to be strictly followed.



INSPECTORS

Bathroom pods will be built to meet the local codes required and leave the factory compliant and ready to pass the final on-site inspection. Pods arrive on-site with open walls to allow for easy access for site electrical, mechanical, and plumbing component inspections.



DOING MORE WITH LESS

PIVOTek worked with Lend Lease to create 95 fully finished prefabricated bathroom pods. Lend Lease planned a new 62,000 square-foot, 4-story, 95 room Candlewood Suites for transient soldiers and their families at Redstone Arsenal, Alabama. They brought the idea of bathroom pods on board fairly early in the process while identifying ways to save time and money on the project.

“Doing more with less is the underlying mantra of the construction industry,” said Bill Tobin, Master Superintendent and Vice President of Project Management & Construction for Lend Lease. “This is particularly challenging during a time when developers are asked to build stronger, more sustainable buildings when traditional building materials and labor are more expensive and there is a shortage of construction specialists.”

The combination of sustainable and pre-fabricated materials improved worker safety, reduced construction time, saved 1,450 tons of carbon, and dramatically eliminated on-site waste.



Photo courtesy of PIVOTek

43%

Fewer people used to build the superstructure

44%

Fewer total man hours

37%

Less time & delivered four months ahead of the schedule

STYLISH BOUTIQUE HOTEL

PUDA Tiger’s Gate of Andaz hotel is at the heart of the vast and ever-pulsating urban flux in the center of Tokyo. Andaz Tokyo Toranomon Hills, located in the second-tallest highrise in this dynamic capital, is Tokyo’s first boutique hotel.

Bathroom pods have been a solid market in Japan for more than 40 years. Over 80% of construction projects have used prefabricated bathroom in Japan. Flat pack systems are for the main market and suitable for the highrise buildings, especially under strict job site accessibility. During construction, all site’s restriction are followed by loading weight, packing size, installation timing.

80%

of construction projects in Japan use bathroom pods



Photos courtesy of PUDA Industrial

CUSTOMIZATION IN HEALTHCARE

The Christ Hospital Joint and Spine Center is unique in that it was successfully completed despite the generally held expectation that finishes and tolerances present in this project are not normally achievable in traditional bathroom pod projects. The Christ Hospital Joint and Spine Center called for the highest quality in custom finishes, applied across three different configurations all of which needed to account for a zero-height transition from room to bathroom. This adaptability is, ultimately, what made this project a reality for the owner and construction management partner. All parties agreed that pods were the right solution, but it was PIVOTek’s innovation around the no-threshold slab issue that made this project a reality. So much so that The Christ Hospital Group added 30 additional pods to their original order, for a total of 90 pods for this particular project.

TECHNICAL INNOVATIONS

Hospital grade bathroom pods are the most difficult prefabricated pods to design, produce and install, even more so for specialty hospital facilities such as The Christ Hospital Joint and Spine Center. For example, accommodations must be made for nurse call, medical gas, and fire protection, all of which must be coordinated into pod design to provide conduits, raceways and other needed spaces for the specialty systems. The most crucial of specialty needs is the need for a no-threshold barrier for wheelchairs and rolling IV trees. In this case, PIVOTek had to account for three inches that were removed from the slab sub-floor. To do this, PIVOTek had to find a solution that removed this floor height while maintaining density and performance. This came in the placement of a one-inch steel plate that was added to the bottom of the pod. This adaptability and design innovation are hallmarks of PIVOTek’s customized approach when taking on individual projects.

COST EFFECTIVENESS

Using bathroom pods presents inherent cost savings at every phase of the construction process. There is scalability in the planning process, certainty of delivery for the project timeline, there is streamlining of labor hours through seamless installation and ultimately, there is substantial reduction in on-site waste. PIVOTek delivered on all of these, but what sets this project apart from even the usual cost effectiveness is the value delivered within each pod. The pods allowed for bariatric lifts to be built into the bathroom configuration, as well as, incorporated waste vent stacks. They planned for patient-focused features such as a recessed area for flat screen TVs and, to assist in their actual care, fully equipped nursing station connections. These features, in addition to a “partnership-first” focus, created an environment where the client increased their initial pod order by 50% after seeing the prototype pod that would be used in their facility.



Photo courtesy of PIVOTek

22 DAYS
for installation

BUILDING BETTER WITH BATHROOM PODS

For the Women’s Hospital of Texas, the initial focus of BLOX was on patient rooms. They are manufactured in four parts: headwall, footwall, sinkwall and bathroom. Patient rooms are the low hanging fruit and have the greatest immediate impact on the critical construction path. A typical hospital patient room toilet contains 800 components installed (in the field) by a dozen trades over a three-month span. Imagine replacing that complexity with a single component, installed by a single trade in a day. Now imagine the benefit of doing that a hundred times on a project, on a hundred projects. BLOX manufactured and installed 9 bathrooms, 4 sinkwalls, 5 footwalls, and 9 headwalls. This project was the first that used BLOX modular components developed specifically to this owner’s design standards. The pilot project and successful implementation served as a launching pad for future projects. The bathroom units were 55 square feet and measured approximately 7’-7”x 7’-10’.

TECHNICAL INNOVATIONS

BLOX modules are four dimensional and smart. The process includes embedding scoping documents, regulatory submissions, shop drawings, installation sequencing, tolerances, construction templates, connection details, quality control manuals, warranties and maintenance manuals in a toolset. Everything a project needs, all in one spot. The modules are constructed by skilled labors as part of a lean manufacturing process. The assembly line has a constant feedback loop that results in outstanding quality, far superior to what is constructed in the field. Once the modules are complete, they are shipped to the jobsite, flown into the building, and installed by an experienced installation crew. Advance offsite modular construction and the speed of installation results in a finished product that is months ahead of traditional construction methods. By taking some of the most complex components off of the jobsite, it reduces the complexity of the site to allow for better organization of the remaining material and workers.

COST EFFECTIVENESS

BLOX has proven that it can cut 3 months off of a 100 bed hospital construction project, with no increase in costs. The average revenue per bed for these facilities is \$3,000 per day. A 100 bed facility generates \$300,000 in revenue per day, or \$9 million a month. By implementing modular components and opening 3 months sooner, the hospital earned an additional \$27 million in revenue. Modular innovation is creating real value for clients and driving an outstanding return on investment.



Photos courtesy of BLOX

\$27M

Additional revenue earned by the hospital due to the use of bathroom pods and the ability to open 3 months ahead of schedule

104

Bathroom pods produced

HEALTHCARE CASE STUDIES

DESTINATION HEALTHCARE FOR THE WORLD

The Health City Cayman Islands hospital is unique in that it provides world-class, destination healthcare for local and international patrons. The first phase of construction consisted of a 140 bed cardiac wing. PIVOTek provided the 56 bathrooms for patient rooms, integrating every component from building structure to finishes. Bathroom pods were constructed in accordance with all International and Cayman Island codes using materials readily available in the U.S. and Cayman Islands. The combination of quality products and proprietary unit assemblies allowed PIVOTek to manufacture and assemble resilient bathroom units that can withstand the multiple exchanges of overseas shipping. There were two configurations: standard and ADA compliant. PIVOTek performed in a design assist role. The plumbing stacks and vents were designed by PIVOTek, which provided the complete above slab plumbing design. PIVOTek worked to select vendors and products that would provide the aesthetic appeal and quality needed.

TECHNICAL INNOVATIONS

The special nature of shipping bathroom pods to another country generated the need to create a product that was exceptionally durable, handling weather elements over a long period of time and many modes of transportation. Materials included an epoxy coated aluminum subfloor, G90 steel welded wall panels, and stainless steel fasteners, which were used to withstand the corrosive salt-water air. To aid in energy savings and water runoff control, a greywater pipe system was utilized throughout. The shortage of skilled labor available in the Cayman Islands provided opportunities for coordination between the bathroom units and other site built work. PIVOTek trained the local workers on custom jigs, which assisted in positioning the bathroom pods, plumbing sleeves, and penetrations. The simplified layout process that was implemented improved the underground plumbing schedule. PIVOTek trained local contractors on how to set the units in 3 days, which freed up much needed work for a starved labor market.

COST EFFECTIVENESS

Cost effectiveness was extremely important due to the goal set forth by the client. Historically, prefabrication is most cost effective when there are a large number of units. This allows for greater distribution of engineering costs as well as time to develop a steady production level on a project. PIVOTek adapted a process to manufacture a lower number of units (56) while maintaining the efficiencies not typically seen in smaller batches. This process of bringing a manufactured item to a high production level very quickly requires involving the team in engineering and production meetings so they understand the intent. PIVOTek also developed simpler versions of complex templates and jiggig, which eliminated longer setup and change over time.



60
Days of design

35
Days in the factory

14
Days of installation



Photos courtesy of PIVOTek

REFERENCES

Report of the Results of the 2014 Offsite Construction Industry Survey.
National Institute of Building Sciences - Offsite Construction Council. 2014.

An Insiders Guide On How to Evaluate The Use of Bathroom Pods.
Intelligent Offsite. 2015.

Prefabrication is Helping Construction Managers Achieve More With Less.
PIVOTek. 2016.

PIVOTek Bathroom Pods and Cross Laminated Timber (CLT) Help Lend Lease
Make A Difference (A Really Big One). PIVOTek. 2015

Springer, Philip. A Chip Off the Old Block.
Easy Building Solutions LLC. 2016.

Meyers, Mark. How Modular Construction is Keeping Waste Out of U.S.
Landfills. Triple Pundit. <http://www.triplepundit.com/2016/02/modular-construction-keeping-waste-u-s-landfills/>

