

Pre-Assembly Perks:

Discover Why Modularization Works

What happens if you need to build a factory in Louisiana but skilled labor is in short supply? Wait, that's not an "if"... that's a reality.

So, what can you do?

Using pre-assembly building practices is one answer to the skilled workforce shortage. And, as Wayne A. Crew, Executive Director of the Construction Industry Institute (CII) explains, it's an answer that is becoming more well-known across the country. "Modular has always been used in the oil and gas industries in the U.S.," says Crew. "However, now more than ever there are certain benefits and drivers in place that are increasing its use in other industrial sectors, too. These include a lack of skilled labor, scheduling pressure, safety concerns, environmental/ regulatory constraints, unique site attributes and cost saving opportunities."

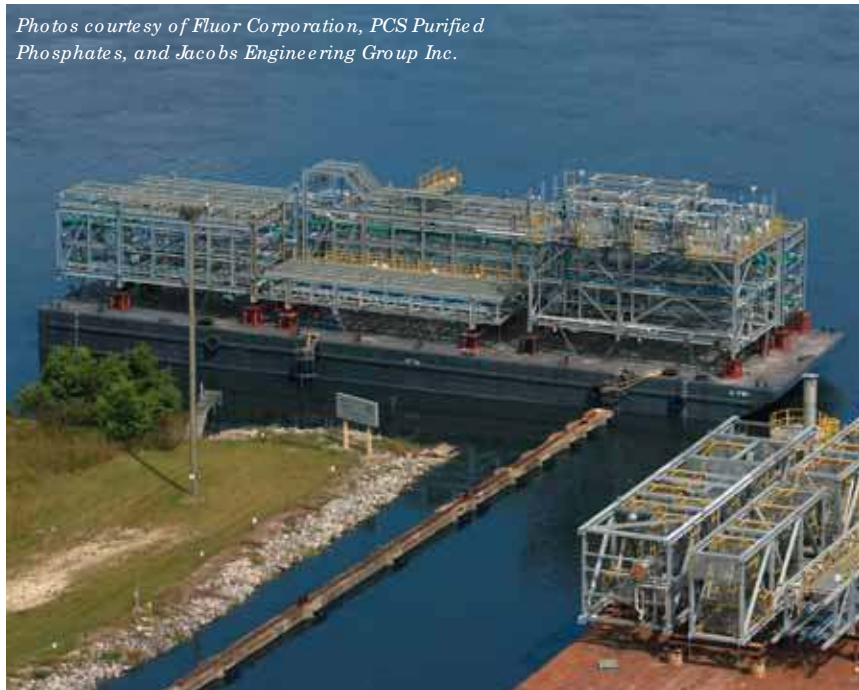
Crew says that the use of pre-assembly has definitely increased in the past 10 to 15 years, especially with new technologies such as building information modeling (BIM), and Internet design capabilities. In fact, CII has developed their own online design tool which allows owners to assess how beneficial the use of pre-assembly would be on their own projects. Owners are asked to input information such as equipment size and weights, layout drawings, and logistics/ transportation planning costs, which can help them to understand potential issues, as well as estimate timelines.

"The tool makes it easier for project coordinators to understand all the issues when using pre-assembly, ahead of time," says Crew. "The program looks at all the different factors for each individual project and can give some guidance as to what direction a project should go. It doesn't

have all the answers but it does help users make a rational, well-informed decision."

This is especially helpful because, as Crew puts it, "The world lives in a stick-built paradigm where decisions can be made and changed well into the project." He cautions though that when using pre-assembly, up-front planning and solid decision-making is essential for its success. "If owners are delaying decisions until last minute or changing their minds, pre-assembly won't be successful. There is definitely an increased requirement for front-end decision making and decreased flexibility for design changes later in the project."

Sean Boney, Global Director of Construction Services for Fluor Corporation says there are many reasons why pre-assembly is a good choice for owners. For Fluor in particular, a company which has designed, fabricated and installed



Photos courtesy of Fluor Corporation, PCS Purified Phosphates, and Jacobs Engineering Group Inc.

Pre-assembly approach	Conventional stick-built
Dependent on engineering completing entire modules and preassemblies.	Engineering driven by completing entire project; it doesn't need to obey the rules of gravity.
Modular operations only dependent on: <ul style="list-style-type: none"> • Fabrication yard and preassembly area mobilization • Material availability 	Constrained by the normal sequence of site preparations, underground and foundation works, equipment installation, and so on.
Modularization execution means: <ul style="list-style-type: none"> • Working with building blocks • Working in vertical commodity slices within the building block 	Stick-built execution allows: <ul style="list-style-type: none"> • Larger work areas/ fronts • Working horizontally
Requires early (partial) material releases and deliveries. Late materials can shut down the assembly line.	Allows for "working around" by scheduling trades people to areas with material availability.
Inflexible fabrication yard schedules and sequencing can slow down operations.	There is some schedule flexibility which allows for the ability to move work fronts to accommodate late materials.

Information courtesy of Sean Rooney's presentation at the CURT Pre-assembly and Modularization workshop in Boston, September 2007.

hundreds of modularized projects since the 1970s, Boney says, "The decision to modularize has been influenced by resource availability, climate, site access, quality control, local labor costs, scheduling and other execution factors. Many projects today are impacted by scarce labor resources and escalating labor and material costs, so the modular approach option is frequently considered as an alternative to traditional stick-built approaches."

In the past five years alone, Fluor has executed over 30 projects using a modular construction approach. "And we are seeing an increasing demand for modular construction for many of our projects that are now in the early planning phases," says Boney.

He explains that the decision regarding modular feasibility and the extent to

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Modular makes sense for commercial projects, too

While pre-assembly has been used in the industrial sector for decades, it is relatively new to the commercial construction industry. Laurie Robert, Vice President of Sales and Marketing for Modular Building Specialists, a company which offers modular solutions to clients through the United States and Canada, says, "The modular building industry has gained substantial ground during the past decade or so, with the continued development of more sophisticated designs and applications. The continued growth of our industry and its capabilities, the diversity in builders and locations, and the overall advancement in design and construction technology gives owners, architects and contractors the ability to explore a construction option that can help them execute a better project."

Steve Sickman, Director of Marketing for Ramtech Building Systems—a modular builder that has been providing solutions to educational institutions, healthcare providers, Fortune 500 companies and government agencies for 25 years, says it's time to look at the facts. He explains, "Modular construction is faster, often cutting timelines in half because the manufacturing of the building and the site preparation takes place concurrently, it is often less expensive because a shorter overall construction timeframe substantially reduces on-site costs, and many metropolitan areas have high prevailing wage rates, resulting in higher costs when all of the work is done on-site."

Even with so many positive attributes, there still remains some myths about modular construction. Paul Lewandowski, Director of Sales for Modular Building Specialists says that while some still think modules are nothing more than big boxes, that is simply not true. "The industry has come a long way and most any type of application in commercial construction, from a 2,000 square foot convenience store to a 60,000 square foot or larger school, hospital or office building, is possible. Obviously large voluminous spaces with wide-open floor plans can be more difficult to design structurally, but you would be surprised what is possible. Modular doesn't just mean boxes anymore."

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which it is used should be made very early in the project concept/ strategy phase. “Executing a modular project (versus a conventional stick-built project) tangibly effects all of the major aspects of project delivery including, cash flow, preliminary and detailed design, procurement, construction and start-up. For example, decisions will need to be made much earlier in the project lifecycle, and project leadership at the shop is really vital in order to ensure that all the project objectives are met.”

Pre-assembly case file

Paul Hochi, Manager of Project Development for Jacobs Engineering Group Inc.—one of the world’s largest and most diverse providers of professional technical services—agrees that pre-assembly is an option that owners should explore. Hochi should know. He has been involved in numerous pre-assembly driven projects, with positive results.

He points to benefits such as, “Schedule acceleration from doing more work in parallel (shop and field), mitigation of craft labor shortages, and addressing site construction challenges (such as long permitting times, hazardous environments or construction near operating units).”

Advantages such as these, notes Hochi, have increased the profile of pre-assembly. He explains that, “Several years ago, we used to see pockets of labor shortages in the U.S. Today, however, labor shortages are much more widespread because older craft workers are retiring and are not being replaced with a similar number of younger people, and the ‘hurricane effect’ from Rita and Katrina is taking labor away from constructing industrial projects to focus on hurricane rebuilding efforts. Most industries use modularization or pre-assembly in some form. But now, if they haven’t been using modular, they’re starting to look at it.”

One project Jacobs was involved with is the construction of two purified phosphoric acid plants in Aurora, N.C.

Both were built with significant modular content in Jacobs’ modular fabrication shop in Charleston, SC. Hochi says that market opportunity required the plant for PCS Purified Phosphates be operational in 18-months and a conventional stick-built schedule would have taken 24. Additionally, the site was remote with limited craft availability and a large amount of the construction was going to be done at high-elevations (up to 140 feet high).

The solution that made sense to both PCS and Jacobs was pre-assembly. There were 32 modular units (15 by 15 by 60 feet, on average) barge-transported to the site in 3 separate shipments. Modularization supplemented the local craft labor force by executing 175,000 hours in a shop environment. Shaving six months off any construction schedule is no easy feat. This one however, was finished on-time with four months saved as a result of modularization, and two months saved as a result of integrated delivery.

These savings are impressive, as there was minimized disruption to the adjacent manufacturing.

As PCS Project Manager Dennis Grieve explains, “The turnkey approach, utilizing the three facets of engineering, modular construction, and field construction was probably the only way that we could have a plant that was operational on time, of very high quality, and one that we could start up with minimal difficulties.”

Hochi cautions that, “To be optimally effective, modularization needs to be looked at upfront, preferably during the pre-conceptual or early conceptual design phase. Also, the sequence of engineering, procurement and construction is different on a modular project. A higher number of activities occur in the front-end of the project because equipment and other components are procured earlier than they would be in traditional construction.”

As the workforce shortage continues to bring modularization to the forefront, it is easy to see why companies are

Deciphering the lingo

Wayne A. Crew, Executive Director of the Construction Industry Institute (CII), says that while modular has been around for a long time in the oil and gas industries, it now seems to be gaining more and more recognition in other sectors. In order to make sense of the different terminology, CII developed PPMOF: Prefabrication, Pre-assembly, Modularization, and Off-Site Fabrication.

Pre-fabrication: This is a manufacturing process, generally taking place at a specialized facility, in which various materials are joined to form a component part of a final installation. Pre-fabrication is a common practice on most industrial projects today.

Pre-assembly: This is a process by which various materials, prefabricated components, and/or equipment, are joined together by different crafts at a remote location for subsequent installation as a sub-unit. It is generally focused on a system. Pre-assembly also is a common practice on most industrial projects today.

Modularization: A module is a major section of a plant resulting from a series of remote assembly operations and may include portions of many systems. It is usually the largest transportable unit or component of a facility.

Off-Site fabrication: The practice of preassembly or fabrication of components both off the site and on site at a location other than the final point of installation.

jumping on the bandwagon. Pre-assembly perks such as reduced construction time, decreased costs and increased safety have all contributed to this method’s popularity, and while many companies have used this construction method for decades, others are quickly realizing the full spectrum of benefits. ●