conference preview

MODULAR CONSTRUCTION BEST PRACTICES

When, where and why you should consider modular construction.

BY JACINDA COLLINS

TRADITIONAL CONSTRUCTION is a lot like baking cookies from scratch.

Both require numerous individual materials, time spent "mixing" them and finally assembling everything in one place. And after all the work is done, leftover materials must be cleaned up and stored or discarded.

Modular construction, on the other hand, is more akin to buying premixed, precut cookies from the refrigerated section at the supermarket. The ingredients are mixed prior to arriving on-site, using a precise, uniform amount of each material, and the process typically incurs less cost, time spent and waste/additional materials at the end of the process.

Bringing the discussion solely back to construction and away from baking (not easy to shift away from cookies, I understand), there are several questions whose answers can help you determine if modular construction is the right fit for your next project.

What is modular steel construction?

Modular steel construction is a broad term typically applied to the following three types of steel prefabrication. Projects can use a combination of these three methods for additional schedule and material benefits:

Kit-of-parts method. In this method, the same columns, beams, girders and connections are used throughout a majority of the project to speed both fabrication and erection of the steel. Think of this method as the "Erector Set" approach.

Panelization method. Panels are used for the floor, walls, roof and/or lateral systems and are assembled off-site, or on-site at ground level, then put into place. This approach is very similar to the way flat-pack furniture is assembled.

Modular (volumetric) method. Individual 3D modules—often in "building blocks" including framing and interior components provided by other trades—are assembled off-site, shipped to the site as completed modules and then erected on a module-by-module basis. This is essentially the same way manufactured housing is assembled on a residential lot.

Why Use Modular Construction?

The three biggest benefits to using modular construction are faster erection, improved quality and reduced waste.

Faster erection. A recent AISC-sponsored study (*Permanent Modular Construction—Practice, Process, Performance*, available at www.modular.org) determined that construction schedules can be reduced by an average of 39% when using modular construction versus traditional construction. Assembling volumes off-site in a controlled environment reduces the impact of typical site issues like inclement weather conditions, traffic patterns around the site or noise ordinances. Other trades such as MEP systems, fire protection, interior finishes or exterior finishes can be added to the modules in the off-site location to further accelerate the project schedule. When modules arrive on-site up to 95% complete, less work and fewer on-site trades are necessary to finish the project.

Improved quality. Off-site assembly also contributes to improved overall quality of the modules, as ironworkers and other trades are working at safe heights in a climate-controlled environment. This contributes to ease of installation and inspection of the assembled framing and other components contained in the module. With traditional construction, clashes between the various building systems are often only caught after

Modular construction is like precut cookie mix, ready to bake.

Jacinda Collins (collins@aisc.org) is AISC's New York structural steel specialist.

Brooklyn's modular B2 project (see "Building Blocks" in the June 2014 issue, available at **www.modernsteel.com**).

major completion milestones in the field, thus extending the project schedule and causing teams to make compromises in order to keep the project moving. With modular construction, inspecting a sample unit or individual module allows teams to fix clashes and make changes prior to major completion. Thus, when modules arrive on-site, the inspection process is accelerated and the quality of the put-in-place modules is enhanced.

Reduced waste. In a modular project, a majority of the design work is completed prior to ordering materials, which helps the steel fabricator and other trades work with just the right amount of materials, thus reducing site waste. Early, efficient ordering also helps the fabricator and other trades contribute their industry knowledge to help control procurement costs. This reduction in materials and on-site construction waste is particularly attractive to teams designing and building structures with green goals in mind.

Where can I use modular construction?

Project teams can take advantage of modular construction almost anywhere in the U.S., including high-seismic and high-wind locations. Modular construction can also be used for structures that are temporary or need be transported from one site to another, as well as for sites that have limited access and parking.

While project location is typically not a barrier to using modular construction, transporting the modules can be a factor. Road widths, weight restrictions, bridge heights, escort requirements and long distances between the off-site assembly location to the construction site can limit the use of modular construction for some projects. Therefore, it is important to research transportation needs between the assembly and project locations before considering the modular approach.

When do I start the schematic design of a modular project?

Ideally, project teams should not start schematic design until all project participants have contributed their general knowledge and expertise. The design-build approach of early participant engagement (especially the steel fabricator) is vital to addressing many items like transportation, module sizes, framing joints locations, module connection points, tolerances and interaction between the various trades involved with putting the modules together. Early discussion of such matters will help the architect design the building as efficiently as possible for project use, prefabrication and constructability.

Like traditional construction, late changes to the design increase the duration and overall cost of the project. Thus, project teams will want to minimize changes during the prefabrication phase by having most of the overall design complete prior to material purchase.

How do I design the steel frame for a module?

Modules are designed to be self-supporting for transportation between the prefabrication location and project site. For projects up to five stories, a lateral system generally can be created with the individual units. For projects five stories and taller, it is more common that a secondary lateral system will need to be evaluated and/or designed in combination with the modules or as a stand-alone system for the entire project. This secondary system can be erected on-site or panelized.

The AISC *Specification for Structural Steel Buildings* can be used to design the modules and the overall structure. And project teams should discuss steel fabrication and erection tolerances, as well as the tolerances required by other trades for their on-site and off-site work, to determine if the tolerances in the AISC *Code of Standard Practice* are acceptable. Again, early discussions with the fabricator, erector and other trades will facilitate such decisions prior to prefabricating the modules.

Who makes steel modules?

For modular projects where only the steel framing portion of the modules is created off-site, a structural steel fabricator will fabricate and assemble the framing. The steel fabricator will typically engage the steel erector for early project team discussions.

The Stack, a modular residential project in New York.

New York's Carmel Place, another modular residential project.

A volumetric module coming together, incorporating framing, fixtures and cladding.

There are also modular manufacturers who essentially create entire modules from top to bottom. In other words, they can fabricate the steel framing as well as install other trades/components into the modules. These manufacturers also typically erect the modules. As with any other trade, they should be engaged early in project team discussions.

What are some limitations of modular construction?

There are a number of potential obstacles to using modular construction. One is resistance to using "alternative" project delivery approaches like design-build or integrated project delivery, which are well suited to a modular project. And the traditional design-bid-build approach of waiting until one person completes a task before the other is brought on board does not create the best contract or communication vehicle for modular construction.

In addition, financing for modular construction varies from traditional construction. With traditional construction, trades are paid upon the sequenced completion of their task. With modular construction, the steel and other materials being placed in the module will need to be purchased earlier. This upfront payment schedule may not be ideal for some project financing methods, making traditional construction more ideal.

In addition, larger, specialized equipment is needed to erect the volumes, and limitations involving the availability and spacing of such equipment can make traditional construction more ideal. And as mentioned, transportation of volumes to a project site from the assembly location can also create a barrier to the use of modular construction.

To reap the benefits of modular construction, the team has to understand its challenges from the get-go. Understanding the process and following best practices will help your team deliver quality, quick-to-market modular projects. ■

This article is a preview of Session CA9 "Modular Construction Best Practices—When, Where and Why or Why Not" at NASCC: The Steel Conference, taking place March 22–24 in San Antonio. Learn more about the conference at www.aisc.org/nascc.

NYC Constructors/Banker

➤ Rockefeller University in Manhattan used large-scale modular construction for its new lab facility, barging in modules from an assembly site in New Jersey (see "Barging In" in the January issue, available at **www.modernsteel.com**).