GENERAL CONTRACTOR'S GUIDE TO PREFABRICATION

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This guide is designed to provide general contractors with the information needed to help them make more informed decisions on the use of Prefabricated Cold Formed Metal Stud Wall and Floor System technology. Please feel free to contact Klover directly for project specific guidance or to schedule a continuing education program.

1. What is Prefabrication?

The National Institute of Building Sciences defines Prefabrication as the "Planning, design, fabrication and assembly of building elements at a location other than their final installed location to support the rapid and efficient construction of a permanent structure". It is also referred to as offsite construction, industrialized construction, modern methods of construction or design for manufacture and assembly.

Prefabrication is unique in that it helps solve the traditional construction paradigm of time vs. money vs. quality vs. scope. Time is reduced due to the ability of prefabrication to allow concurrent construction activities. For example, wall assemblies can be fabricated while concrete footings are being poured. Money is typically saved due to productivity gains from fabricating in a controlled environment vs. in the field. Quality is improved due to factory precise fabrication and oversight. Scope can be expanded while minimizing overall cost impacts because of the improvements made with time, money, and quality.

2. What size and type of projects are best suited for Prefabrication?

In general, almost all projects are candidates for prefabrication to some degree. Factors to consider include project delivery method, size, location, time of year, schedule, budget, client preferences and labor requirements (Union/Open Shop/Prevailing Wage).

Facilities with repetitive walls make ideal prefabrication projects using cold formed metal framing. Examples include hospitals, healthcare facilities, hotels, dormitories, condominiums, mixed use, apartments, office buildings/towers and casinos. Projects with compressed schedules, site restrictions, limitations on work schedules/hours can be ideally suited to prefabrication.

One of the main aesthetic advantages of wall prefabrication is that although it is most cost effective with repetitive designs (wall sections with similar widths, heights and framed opening locations), there is *virtually no limit* regarding façade choices. ACM/MCM, brick, stone veneer, metal, ceramic tile and insulated metal panels are all easily adapted to prefabricated walls due to the cold formed metal stud framing used for these systems. Figure 1 is an excellent example of various façade systems used with prefabricated wall assemblies.

Figure 1

3. <u>What are the Project Delivery implications when using Prefabrication?</u>

Prefabrication is possible with all delivery methods, but those that allow earlier coordination between the parties are the best candidates. Design/Build, Design/Negotiate/Build, Integrated Project Delivery, Construction Management (fast track) and Owner/Build are all excellent choices for prefabrication. The contractor, architect, engineer and fabricator all need to be communicating early and often for the benefits of prefabrication to be fully realized. This is because prefabrication requires *earlier engineering and design decisions* to improve the project schedule and sequencing. The best way to think of it is that certain decisions need to be made earlier in the project so that *concurrent activities* can happen. For example, the walls can be fabricated while the foundation is being poured, not afterward like traditional construction. Due to the change's prefabrication has on individual trades regarding scope, the decision to use this process is best made *prior to finalizing construction documents* and before the bidding process. Prefabrication works well with both public and private sector projects.

Prefabrication can also work with Design/Bid/Build projects but is less common. This process is referred to as "conversion". Challenges include scopes that change after the project bids, which in turn affect scheduling, material procurement, trade coordination, budgets/credits etc. Examples of scope change might include materials and labor for structural steel supports, floor decking closures, pour stops, brick shelves, bracing etc. Flexibility and cooperation between the general contractor, subcontractor and material suppliers are necessary to minimize disruption due to post-bid scope changes. Specifically, the ability to fabricate wall and floor assemblies earlier in the process while foundation work is being done is lost when the project is *converted after bidding*. *However, some projects still find enough efficiencies with conversion to overcome these initial challenges.*

In most instances, the previously mentioned project delivery methods will dictate that the general contractor or owner makes the final decision on who is the prefabricator due to the means and methods nature of this process. However, the architect should have considerable say in the selection process because of the delegated design and design assist support that *must be provided by the prefabricator.* Forming solid working relationships with prefabricators in your area *before* you need them is always good policy.

Prefabricators need to qualify and understand many of the same issues that general contractors do when evaluating an opportunity. Reach out to them early in the process for assistance, and to gauge their level of interest in the project as well as their capabilities. Companies who can provide prefabrication, installation and traditional carpentry services are usually preferred due to their ability to provide a single source solution.

4. What impacts does Prefabrication have on project schedule?

One of the single biggest benefits to prefabrication is *schedule compression*. Critical items such as wall design and engineering are *moved up earlier in design development* to allow multiple activities to progress at the same time. The structural engineer of record will be actively coordinating with the prefabricator's specialty structural engineer to finalize the design of load and non-load bearing prefabricated wall and partition assemblies along with floor and roof components. This work is completed far in advance of site work. This allows buildings to be constructed very rapidly after footings and ground floor slabs are constructed.

The biggest differences from a design viewpoint involve the use of significant amounts of delegated design and design assist supplied by the prefabricator. They will need to work closely with the project architect for cladding attachment details and air/water/vapor/thermal control layers. Prefabricators and their specialty structural engineers will need to work closely with the structural engineer of record for panel attachments, shear walls, structural vs. non-structural wall/partitions and floor deflection accommodations.

5. How does Prefabrication reduce contractor risk?

The key area of risk management in construction occurs at the jobsite. Prefabrication helps mitigate these risks by removing and reducing many of these tasks to offsite locations that are less chaotic and more controllable than at the construction site. By reducing the amount of activity performed onsite and shifting it to offsite fabrication facilities there is less congestion, equipment, and material movement. Due to the just-in-time delivery of wall, floor and/or roof sections, there is better security against theft and damage because there are fewer stored materials onsite. Sites which have limited laydown areas and/or restrictive work hours benefit greatly from prefabrication for these same reasons.

One of the most common complaints in the construction industry is the difficulty in getting enough skilled labor. Prefabrication minimizes this issue due to the advanced fabrication methods available in a factory. Improved working conditions, productivity, computer controlled manufacturing equipment, assembly jigs and easier to manage quality control programs all help reduce issues associated with the shortage of skilled labor.

Safety is another risk factor prefabrication helps solve. Having less worker hours on-site limits liability. In terms of insurance, this is a big win for contractor-controlled insurance programs (CCIPs) because the work hours performed *offsite don't get counted against the program*. Less work hours onsite means less accidents and injuries and lower premiums. The same applies for projects using owner controlled insurance programs (OCIPs).

6. What are the cost implications of Prefabrication?

When speaking about cost the conversation often revolves around square foot or initial cost. However, the cost benefit of prefabrication is a much larger subject and has many components. Not only does prefabrication often lead to lower initial costs, but also reduces financing costs, general conditions, opportunity costs, environmental costs and most importantly to Owners, speed to revenue. Compressing the construction schedule and utilizing offsite fabrication help improve *cost certainty* and reduce the risk of cost overruns.

7. What types of Prefabricated assemblies are typically available?

Cold formed light gauge metal framing is typically used for prefabricated wall assemblies. Walls are panelized (unitized) and come in several configurations. Curtainwall panels bypass slab edges and are designed to support cladding systems and windows only. The panels are attached using slip connections to slab edges to allow for floor deflection. They are suitable for non-load bearing applications and are used for mid to high rise construction. These same panels can also come with air, water, vapor and thermal layers installed from the factory (Figure 2). Many are also available with façade systems pre-installed, such as ACM, single skin metal, synthetic stucco, thin brick, insulated metal panels and ceramic tiles.

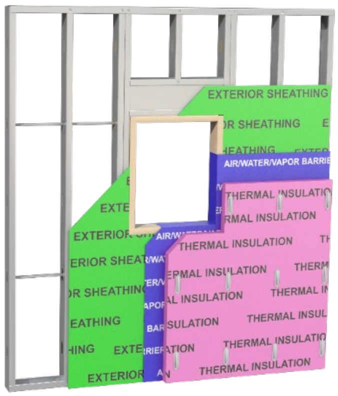

Figure 2

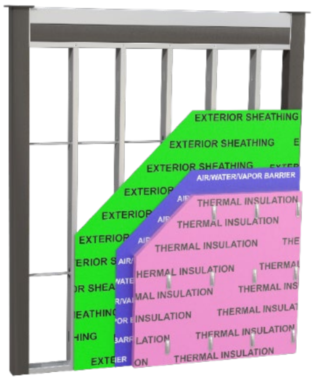

Figure 3

Figure 4

Load bearing panels (Figure 3) provide support for the floor systems above, and often incorporate hollow steel sections (i.e. tube steel) into cold formed light gauge panels. They are generally limited in use to approximately a dozen stories. Load bearing panels are also readily available with air, water, vapor and thermal control layers, and many have the option of factory installed façade systems similar to curtainwall panels. They may also be used for shear walls (Figure 4).

Composite floor systems are commonly used with load bearing wall panels. Figure 5 shows concrete bonded to metal decking laid over structural open web joists. This system provides excellent spanning capabilities with light weight. Figure 6 shows deeply profiled metal decking with wire mesh and concrete, providing the thinnest possible floor system for many span conditions.

Figure 5

Figure 6

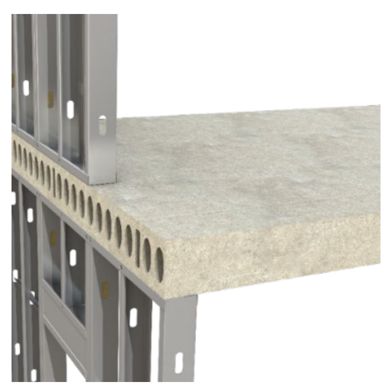

Figure 7

Note the use of a hollow structural section (HSS) otherwise known as a steel tube at the top of these wall assemblies. They distribute the load from the joists and deck panels evenly along the wall so there is no need to line them up with the studs below.

Figure 7 shows hollow core planks that are pre-cast (factory built) and install quickly. Due to their flat configuration, they usually do not require the use of a load distribution beam when supported by cold formed light gauge walls. Planks provide good spanning capabilities with a slim profile, and the voids are sometimes used for electrical or mechanical runs. All three of these floor systems when used with prefabricated metal walls provide a *non-combustible* assembly.

Prefabricated roof trusses comprised of light gauge metal framing are sometimes used in lieu of more traditional systems such as bar joists and decking. These systems are also fully compatible with prefabricated wall assemblies.

8. What are the environmental benefits of Prefabrication?

Prefabrication has many environmental benefits due to a far lower scrap rate than site-built assemblies, use of recycled steel components, extensive recycling of scrap materials and economical freight from manufacturing plants to jobsites due to the flat configuration of most wall assemblies. Standard 48' long flatbed trailers regularly accommodate 5,000 sf or more of wall panels per load. In addition, some prefabrication factories are powered by green energy, further reducing their environmental footprint. Industry Environmental Product Declarations are available through the Steel Framing Industry Association.

9. Where can I get more information about Prefabricated Cold Formed Metal Solutions?

- *SFIA (Steel Framing Industry Association):* https://sfia.memberclicks.net

  SFIA STEEL FRAMING INDUSTRY ASSOCIATION

- *Cold-Formed Steel Framing Resource Center for Building Professionals:* https://www.buildsteel.org

  BuildSteel

- *Steel Framing Alliance:* www.steelframingalliance.com

  Steel Framing Alliance™ Steel. The Better Builder.

- *Klover Inc. & Contracting:* www.kloverinc.com

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