



UNITIZATION:

A Solution for Modern Demands on Construction and On-Site Project Teams

Modern construction deadlines are tight. On many projects, fabrication and construction of the building structure has commenced prior to the completion of the exterior façade design. Job sites, particularly in urban centers like New York, Boston, and Philadelphia, are more cramped than ever before, and extra space to lay out and stage materials prior to installation is at a premium. All trades are under pressure to top out the structure, begin the secondary supports for the envelope, get dried in, and commence interior fit out to ready for occupancy. As a result of these pressures, the industry has adapted to accommodate modern demands on construction and on-site teams. In many cases, the solution is unitization, a process of building assembly Metalwërks® wholly understands, has experienced in a wide range of complex situations, and can offer to their customers if the project follows some important guidelines.

What is unitization?

Commonly, materials for building facades, curtainwalls, or other structural features are delivered to the site and are then assembled and installed with the traditional “stick built” method. Unitization, on the other hand, eliminates some of these extra steps of on-site assembly. A unitized system is fabricated, assembled and glazed - if it is a curtain wall assembly - in a factory setting before arriving on the job site, fully prepared for attachment to the building. For this to happen, anchor clips are installed on the building structure to receive the pre-assembled units which will generally have pre-located receivers mounted to the facade units. These anchor clip/unit interfaces must be designed and fabricated from the appropriate materials and methods to accommodate building tolerances of the building structure, resist corrosion or degradation from the elements, align the units, and permanently affix the units to the building while allowing for drift, live loads, dead loads, and thermal expansion and contraction. In the past, unitized assembly has been well-suited to high-rise apartments, office buildings, or parking facilities, and has been used extensively for curtainwall applications.

Unitization can help decrease field labor costs since large assemblies and loose components are fabricated and assembled in the factory, and Metalwërks can work with you to determine when - and if - this is the most economically viable construction option. Additionally, by including multiple supports and building envelope components into the unitized assembly, coordination and mitigating the risks of tolerance accumulation across multiple disciplines can be better managed, and risky rigging conditions can be safer.

The unitization process can differ depending upon the design of the building and the materials from which it is made.

Three Stories of Design

Incorporating many units into one assembly: Horseshoe Casino and Hillman Cancer Center

The cornice feature in the Horseshoe Casino (Figure 1) was a particularly complex situation where unitization was key. In this design, the architect showed a series of sub-components including miscellaneous iron supports bolted to the cast-in-place concrete frame, studs, sheathing, and a waterproofing membrane on an overhanging feature that was 60' above finish grade.



Figure 1: Horseshoe Casino Parking Structure, Baltimore, MD

If all the construction workers responsible for all the different components had to individually rig and install their work while they were hanging out in space, and simultaneously try to maintain some semblance of a coordinated sizing and location tolerance, the job would have become unnecessarily complex. As a viable solution, Metalwërks pre-assembled all the internal supports and building components necessary to create a complete assembly with more exacting shop-controlled tolerances. This was then simply installed by a crew of three workers using a boom truck. (Figure 2)



Figure 2: Setting the pre-assembled cornice units onto engineered hook cleats.

With the Hillman Cancer Center project, (Figure 3) a similar set of conditions were created by the design of a complex overhanging cornice. Metalwërks took control of the entire feature by shop-assembling and integrating all of the internal supports necessary to create the shape and also to resist all of the structural loads. Loose attachment clips were provided to the installer, and each assembly was key-coded for its specific location in the cornice sequence.



Figure 3: Hillman Cancer Ctr - Pittsburgh, PA

Eclectic Design and the Building Envelope: Nemours Hospital and National Council at La Raza ("NCLR")

At the Alfred I. duPont Nemours Hospital for Children (Figure 4), Metalwërks developed the means and methods to provide multiple colors on a singular .125 aluminum panel assembly for unitization into the Oldcastle Curtainwall system. The visual effect is truly three dimensional given the 2D flat panel design which required panel seams to be virtually invisible. The design required multiple colors to be installed in the curtainwall system to appear like a pyramid, or present a prism effect when finished and glazed. Six separate colors were used in varying silver, grey, and blue tones to complement the blue/green tones of the glass panels and utilize similar geometry.



Figure 4: Al DuPont de Nemours Children's Hospital - Unitized Curtain wall with 3D alum plate spandrel infills.

The National Council of La Raza is the largest national Hispanic civil rights and advocacy organization in the U.S. The original 1960's era building in which the organization was housed was badly in need of a facade replacement to update its appearance and extend the life of the building and its value as a leased space. Metalwërks collaborated with the design architect to create a custom scalloped Sculpted™ 3D facade assembly (Figures 5 & 6) which could cover the old spandrel areas between the strip windows at slab edge conditions while leaving the glazed ribbon windows undisturbed. The new assemblies needed to be self-supporting, so they were pre-assembled at



Figure 5: National Council at LaRaza - Washington, DC - Facade replacement- street view

the Metalwërks facilities to enable more efficient on-site installation. Interestingly, urban logistics played a key role in this unitization decision: Access from over an existing plaza with finished landscaping made it an imperative to hoist the units from the flat bed parked in the street. They were then hung in place from a crane located across the street.



Figure 6: Curved SS Spandrel assemblies and mullion covers

Unitization with Curtainwall and Metal Panel: PNC Bank

As part of the PNC Bank project, (Figures 7 & 8) unitized spandrel and wall panel assemblies were mated with unitized curtain wall assemblies supplied to the exterior curtain wall subcontractor. The project featured a 650,000 sf, six-story building with a curtainwall and metal panel clad exterior which used 85,000 sf of Omniplate™ 1500 .125 alum spandrel panels. A custom-glazed extrusion system was deployed, which allowed unitization of the curtain wall. Custom mating extrusions were co-developed with the curtain wall supplier to permit a uniform stacking method of glazed units and metal panel units from bottom to top.

Unitization in action

Metalwërks understands that unitization, or shop assembly of multiple parts into one assembly, can be ideal for situations such as:

- Aggressive contract schedules which may require accelerated construction sequences.
- If the site is heavily constrained and limited laydown area is available to sort and lay out materials for installation.
- If there is hoisting equipment available, or the site is conducive to moving assemblies from the back of a flatbed or an on-site storage area and placing directly into place.
- Cases where the geometry of the assembly is sufficiently repetitive to justify the logistical investments in engineering, off-site assembly, and shipping. Such units are typically more expensive to ship, and the time and site installation labor savings needs to more than offset those upfront investments.



Figure 7: PNC Bank First Side Center

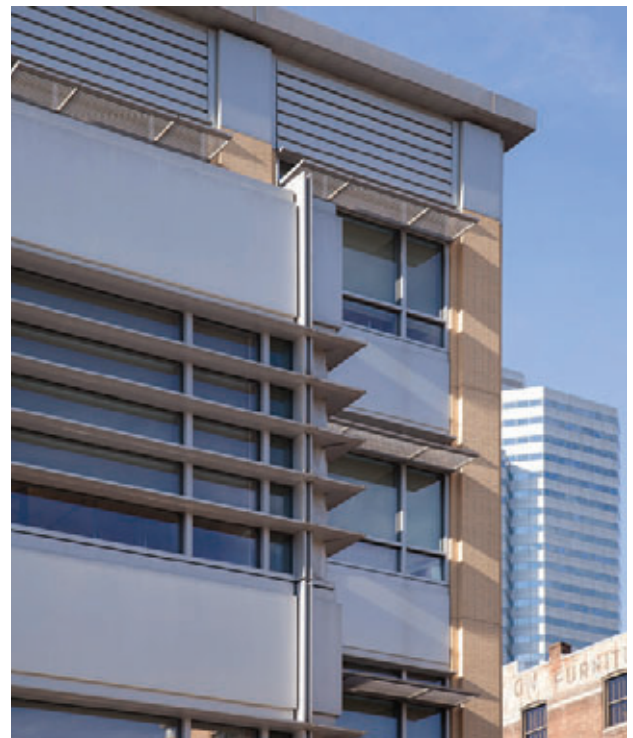


Figure 8: PNC Bank Ops Center - Alum plate spandrels

- If a pre-assembled unit consists of more than just a couple of panels. These items should be large or complex enough make shop assembly more financially efficient than costs involved with on-site assembly and equipment.
- Conditions which require complex rigging to field assemble: Unitization is a safer method than on-site assembly.
- Designs with repetitive unit sizes and shapes that are more conducive to off-site assembly. Designs with numerous custom sizes, shapes, and modules generally require too many planning and setup hours to justify the longer upfront lead times required to execute a unitized assembly method.

Case Studies: Where Unitization was the Best Option

Site conditions differ, sometimes in an extreme manner from one project to the next. Because of major challenges on the following case studies where complex situations called for unitization, Metalwërks was able to coordinate with everyone involved in each project to ensure safe delivery and installation of pre-assembled building elements, further demonstrating how the Metalwërks team can and will collaborate to determine the best possible methods for assembly.

1. The design is so variable or irregularly shaped that alignment on site would be difficult if not impossible. Metalwërks experienced this with the National Council at La Raza project and their work on the South Boston Waterfront Transportation Center Parking Garage (Figures 9 & 10).



Figure 9: South Boston Waterfront Transportation Center Parking Garage



Figure 10: South Boston Waterfront Transportation Center Parking Garage

2. When safety is an issue: Large projections or rigging concerns lend themselves to off-site assembly to prevent unsafe or inaccessible areas from posing a safety risk. The Horseshoe Casino and the project at 90 K St in Washington, DC (Figures 11-14)

both presented this scenario. Here, the roof-mounted canopy features posed a rigging risk due to overhang conditions.



Figure 11: 90 K St NW - Washington, DC



Figure 12: Lifting the unit



Figure 13: In place unit



Figure 14: No he's not using his teeth. Even we can't make it that easy.

A similar issue arose at the University of Science and Technology, Philadelphia, PA (Figures 15-18). Due to the severe roof pitch, the decision was made to avoid multiple trades working over the sloped roof and to pre-assemble studs, sheathing, AVB, and panels at Metalwërks' Elkton Facility.



Figure 15: Custom hinged rigging enables units to be shipped flat



Figure 16: Units hinge together and are bolted prior to hoisting - Clamshell method used to avoid low overhead trolley lines.



Figure 17: Hoisting the units into place



Figure 18: Final placement onto the preset curbs

3. Coordination of the envelope: Multiple trades' accumulated tolerances can often disrupt architectural integrity. By including supports, AVB, and architectural cladding into one assembly, tolerances can be better managed in a factory setting:

For example, the 1800 N Moore project in Arlington, VA (Figures 19-21): Unitized sunshade features incorporated all the miscellaneous supports to bolt the units on to the primary structure and to create the airfoil shape for the skins. This was a tight urban site and the customer wanted as much off-site production of this item as possible. By incorporating the internal supports with the assembly, tolerance accumulations were minimized.



Figure 19



Figure 20

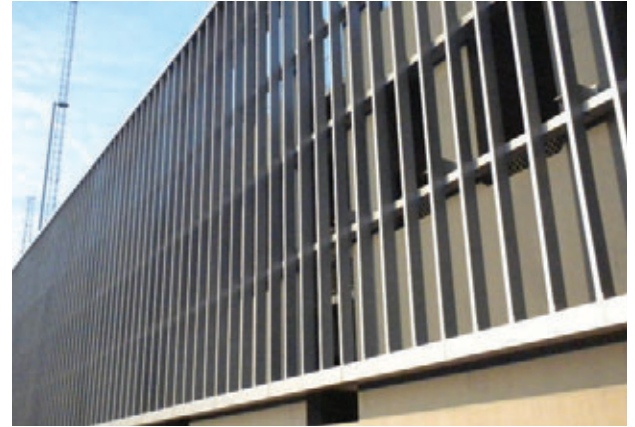


Figure 23: Kaiser Permanente Health at Washington Hospital, Washington, DC



Figure 21: Shop assemblies awaiting truck loading for site delivery to 1812 North Moore in Arlington, VA



Figure 24: Kaiser Permanente Health at Washington Hospital, Washington, DC

4. Efficiency: Pre-assembled components can be more efficiently installed to create a competitive advantage, streamlining the overall construction process. For example, custom CNC crafted internal supports can avoid the assembly of multiple elements.

At the Kaiser Permanente project in South Baltimore, MD (Figures 22-24), it was determined that the wall grille units were sufficiently repetitive, and site access for hoisting was excellent. Parking structures are often good candidates for unitization.

Another parking structure, Democracy Tower in Reston, VA (Figures 25 & 26) had similarly repetitive panels, making off-site assembly more efficient for installation. This crew hung 20 units a day with seven panels on each assembly.



Figure 22: Kaiser Permanente Health at Washington Hospital, Washington, DC



Figure 25: Democracy Tower, Reston, VA



Figure 26: Democracy Tower, Reston, VA

Many small, custom-shaped panels were pre-assembled into larger assemblies so the installation costs and tolerance accumulation could be better managed. This installation was reduced from hundreds of small shaped panels into dozens of manageably sized assemblies. Headers, cornice projections, spandrels, and pilasters were all preassembled in the shop after finishing.

Unitization with Metalwërks

The Metalwërks team are adept at working with all those involved with a project to determine when to unitize certain internal support elements. Naturally, there are nuances to every project and schedule, and to ensure unitization is ideal, these considerations should also be factored into the final decision. It must be noted, however, that not every project is a good candidate for full pre-assembly:

- Cost estimation: Will the units be fully assembled in one factory, or will they be fabricated elsewhere and returned to their origins before moving to the site? Will the cost savings justify the necessary increased investment to justify the opportunity costs?
- Examine all elements to a unit, especially specialty pieces: Coordinating a variety of subcomponents to arrive at the right assembly location at the right time involves increased project logistics and will take more time that must be justified by the value of the work. Some of the questions to be addressed are:
 - Does this particular component need to be a part of the assembly or can it be shipped loose and field installed? Sometimes a hybrid of unitized and field assembled is a rational approach.
 - Does pre-assembly save enough field installation time to justify the increased opportunity costs? These projects occupy a greater amount of design, engineering, project management, and rehandling and must be worthwhile to all stakeholders.
 - Does the unitized assembly create a composite strength that improves the efficiency of the original design or does it add internal components that render unitization less efficient?

- Ensure full understanding of what constitutes an "assembly": Always check assumptions about pre-assembly generally or the extent of what should be a part of an assembly, and make sure there are adequate reasons to unitize. Some good questions to ask can be, "Is there adequate opportunity to eliminate coordination with multiple trades?", and "Is there sufficient space for installation?"
- Mockups are key: Include time and materials in the budget for a full-length/size mock-up of custom parts to vet the assembly design and work out assembly bugs - even if not required on the project.
- Design Assist: A team approach is ideal earlier in this process with regularly scheduled meetings so that any problems can be identified in the early stages. This way, the stakeholders - each member with his or her specialized expertise - can work together to determine whether a unitized system will be best for the project budget, projected schedule, and overall design.

Metalwërks possess a deep and extensive background on installed projects and are skilled in communicating and collaborating with building teams across the country. Our experienced sales engineers can help you determine whether unitization makes sense and advise the right amount of off-site assembly for your project. We have an extensive list of "lessons learned" for the "Dos and Don'ts" of unitized assemblies. Our clients can learn from our past successes and mistakes without expending valuable capital and risks in the learning curve.

With their knowledge and experience of Design Assist, Metalwërks understands the design process and the importance of working in concert with the architect and building team from the very early stages of a project. When unitization is ideal for a certain project's needs, Metalwërks will be there every step of the way to minimize disruption, adhere to budget, and ensure that your Metalwërks systems are installed perfectly.