by Amanda Gibney Weko and Joseph DeAngelis, AIA, LEED AP

DEVIL'S DETAIL

STICK-BUILT VS. UNITIZED

As previous editions of the Devil's Details have explained, continuity in the design process – from inception to construction – and collaboration among all parties allows for the combination of unique knowledge and experience. As design details are developed by the architect and vetted by the construction team, early fabrication and testing can verify compliance with project requirements and owner objectives. Delivery method can be a critical factor in project success, impacting schedule and budget. Early discussions about a building's glazing system should assess whether stick-built or unitized glazing will be more appropriate to meet design intent and project goals. But what's the difference?

UNDERSTANDING STICK-BUILT

Stick-built glazing systems generally ship to the job site as individual parts and pieces that are constructed in place by the glazing contractor team. The component parts can be purchased from glazing manufacturers in standard lengths; glaziers will then cut, assemble, and seal the system in the field. The parts may also be delivered to the site as "knocked-down" components that are already machined and cut to the proper size for assembly and sealing in the field.

In stick-built aluminum curtain wall framing, for example, vertical mullions typically extend past two floors. Splices between mullions permit vertical movement while offering lateral resistance. In the Glass Magazine article, "Curtain Wall Fundamentals," author Joe Schiavone presents a detailed overview of stick-built vs. unitized glazing and important factors to consider during design development.

Typically, a stick-built frame assembly requires the use of either shear blocks to connect vertical and horizontal framing members or screw-spline construction. Shear blocks are short framing members that transfer shear force into or out of the system. Screw-spline construction feeds fasteners through holes in interlocking vertical stacking mullions and into extruded grooves or raceways in the adjoining horizontal mullion. Screw-spline construction can help reduce the amount of components required for field assembly.

Stick-built systems are always field glazed, since the glass is shipped separately to the site and installed after the frames have been assembled and installed. Field glazing typically requires some amount of sealant application (e.g. "wet" glazing).

Above top: stick-built curtain wall on the Independence Blue Cross Building (image courtesy Paul Rabinowitz Glass Co., Inc.); above bottom: installation of unitized curtain wall on Nemours Alfred I. DuPont Hospital for Children (image courtesy R.A. Kennedy & Sons, Inc.)

Stick-built curtain wall construction generally offers shorter lead times to obtain materials and lower required material volumes, which may translate to financial savings. However, the method requires space on site to store materials and installation takes longer to complete.

SITE CONSTRAINTS

Limited construction site space or access may deter the use of stick-built glazing. The sequencing of different building trades, equipment and material staging, or vehicle access may restrict construction sites. The site's topography or location – such as tight, urban environments – may also inhibit productive movement in and around the building. In cases where there is little "lay down" space to store materials, or where an aggressive project schedule requires that the structure be enclosed quickly, a pre-fabricated approach to glazing might be more appropriate than stick-built construction.

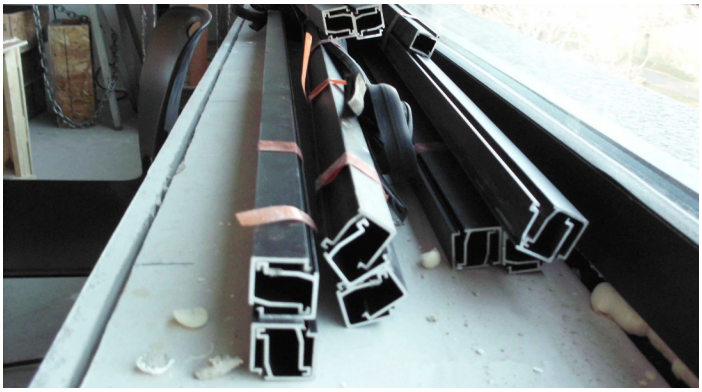
Exterior wall assemblies – including framing and glass – can be designed as pre-fabricated, non-load-bearing components that hang off the building structure or floor slabs. Shop-assembled, pre-fabricated systems are known as unitized.

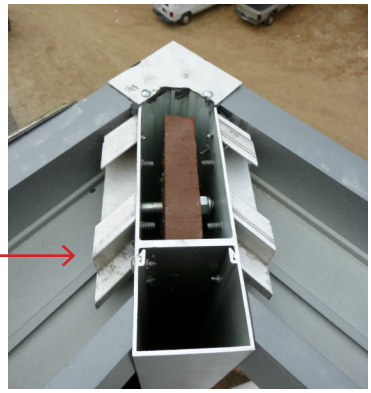
UNDERSTANDING UNITIZED

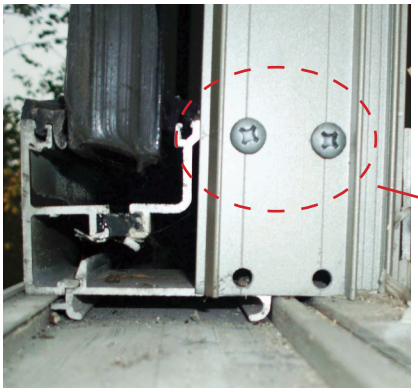
Unitized glazing refers to shop-fabricated and glazed assemblies that have been developed to meet rigorous performance requirements. Numerous manufacturers offer products providing different performance criteria and aesthetic features. Most unitized curtain walls begin as pressure-equalized rain screen systems, although unitized systems in general are often highly customizable.

Unitized systems offer increased quality control and tight tolerances, since all parts are shop-fabricated in a climate-controlled, interior environment. Shop fabrication allows each panel to be inspected and tested at the facility to ensure the product meets the specified performance requirements. Unitized assemblies are generally fabricated in large panels, transported to the project site, and installed quickly. Installation of unitized systems often takes just one-third the time of stick-built because there is no on-site glazing.

The process can be accelerated because the unitized panels are fabricated in the factory while the building structure is built. When the unitized panels arrive on site, they are hoisted by crane into position, enclosing the building quickly and effectively. The approach also requires less space on site for layout because the panels are ready to install when they arrive. In many cases, there is little or no need for exterior access to unitized panels during construction as cranes are primarily used to set them into place.

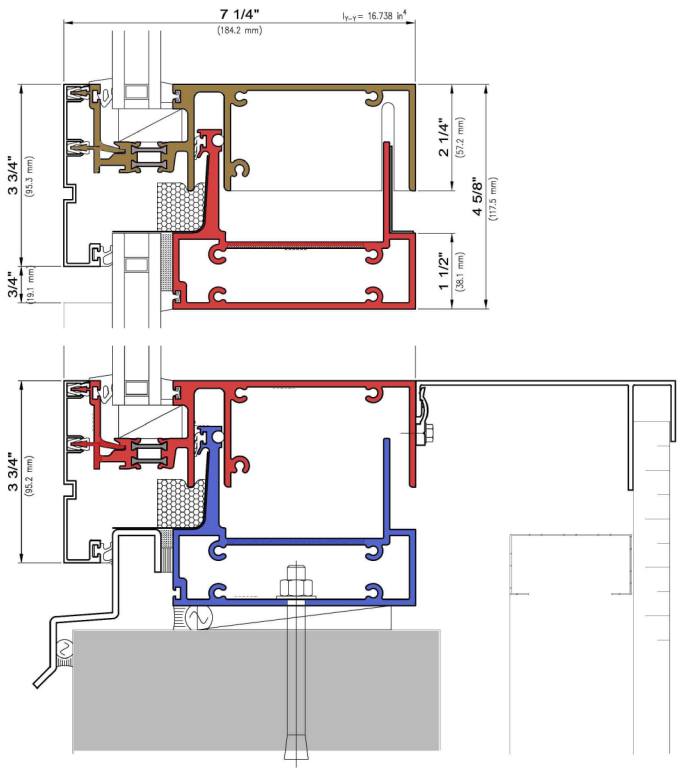






From top: Stock aluminum glazing stops for stick-built construction; shear blocks provide robust connection between vertical and horizontal framing; screw spline provides a direct connection between vertical and horizontal elements; unitized panels factory-crated and ready for installation

Below: unitized curtain wall detail: unit A (red) is inserted into the sill section (blue) and unit B (brown) is inserted into head section of unit A



UNITIZED DETAILS

Unitized curtain walls are typically designed with internal gaskets to control water and air infiltration into the building. The limited use of exterior sealants translates to less maintenance over the service life of the system.

Unitized systems can be economically friendly, shifting labor expense from field to factory. Unitized can offer performance benefits where seismic resistance, wind loads, or water penetration protection are important considerations.

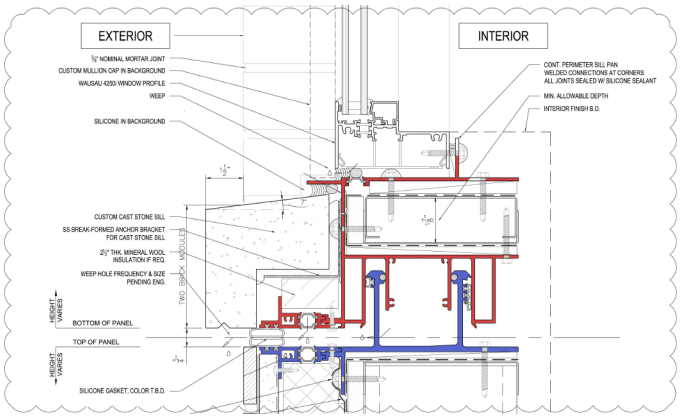
Mullion dimensions in a unitized system may also be larger than a stick-built system because of their pre-fabricated assembly.

Unitized has quickly become a preferred approach to glazing due to time and cost savings, quality control, and high performance. However, designers must be cognizant of details to ensure the unitized system works in tandem with the rest of the building envelope. Glass Magazine presents a good overview in "Unitized Curtain Walls and Their Limitations," by Michael J. Louis, PE. The article illustrates curtain wall-to-structure alignment conditions and details, incorporation of end wall dams where unitized curtain wall terminates against other wall systems, and thermal bridging.

PANELIZED SYSTEMS

Pre-fabricated glazing assemblies can be incorporated into pre-fabricated exterior wall assemblies that utilize other cladding materials. Similar to unitized assemblies, panelized walls are designed as non-load-bearing components that hang off the structure. As with unitized glazing, panelized assemblies are fabricated in a controlled factory environment for strict quality control where they undergo a highly engineered construction sequence. The fabrication process allows the panels to be inspected and tested early in the overall construction process and if needed, modifications can be made before the panels leave the plant.

The completed panels can be transported in large lengths of up to 60 feet. The panels are typically staged in specific order for erection, and then hoisted into place by crane.



Above and left: Panelized wall detail: unit A (red) is inserted into the sill section (blue); pre-fabricated glazing assembly incorporated into a panelized exterior wall assembly; exterior wall panel staged at the site for erection

The industry accepted procedure for establishing the loads each part of a building envelope must withstand is established by the American Society of Civil Engineer's Minimum Design Loads for Buildings and Other Structures (ASCE 7). ASCE 7 provides applicable wind speeds specific to the project's geographic location. Loads on the windward side of a building are positive, accounting for forces acting against the windows, walls, and doors. Wind loads on the leeward side of a building are negative, creating a vacuum as wind blows past the building. The highest absolute value of either of these forces form the basis for the cladding and glazing performance criteria.

DECISION-MAKING EXPERTISE

The design and construction team has a myriad of conditions to factor into the curtain wall decision-making process, from aesthetic and performance criteria to speed and efficiency of installation. As construction schedules continue to shrink, challenges often get larger.

The development and proliferation of unitized glazing systems and panelized exterior wall systems address many of the demands presented by schedule and site constraints. Due to the complexity and customization in these systems, a team will benefit from the early involvement of a glazing contractor. A glazier's understanding of the practical benefits of different systems can provide the construction team with information to achieve the project's design and performance objectives while considering all of related requirements and constraints. A glazing contractor can help effectively evaluate delivery methods through understanding of both the limitations and benefits of unitized vs. stick-built construction and the nuance of different unitized or panelized systems.

Evaluating and overcoming the obstacles that affect workmanship helps avoid limitations due to project location, weather, site access, site conditions, and the necessity of field labor. A glazing contractor's participation and expertise early in the design process can ensure the chosen system performs properly and the team achieves project success.

ADDITIONAL RESOURCES

Whole Building Design Guide, a program of the National Institute of Building Sciences, offers a detailed description of stick-built and unitized curtain walls, including system types, thermal performance characteristics, acoustic and aesthetic features, and health and safety considerations. (https://www.wbdg.org/systems-specifications/building-envelope-design-guide/fenestration-systems/curtain-walls)

Curtain Wall Fundamentals, Glass Magazine: http://glassmagazine.com/article/commercial/curtain-wall-fundamentals-1413202

Unitized Curtain Walls and Their Limitations, Glass Magazine: http://glassmagazine.com/article/commercial/unitized-curtain-walls-and-their-limitations-1513403

Designing, Specifying, and Testing Windows for Water Penetration Resistance: The Effects of Changes in the AAMA 502 Test Standard, Robért Hinojosa

American Society of Civil Engineer's Minimum Design Loads for Buildings and Other Structures (ASCE 7): https://law.resource.org/pub/us/cfr/ibr/003/asce.7.2002.pdf

About the Devil's Details

The AGI educational series illustrates and describes common glazing challenges as a means to communicate best practices for the design and construction industry, not as a sole source for design guidance. AGI recommends design professionals consult with an AGI contractor regarding specific project challenges. AGI contractor profiles may be accessed at www.theagi.org. To share a devilish detail of your own, contact info@theagi.org.